

CHEROKEE SIX

Service Manual

PA-32-260 PA-32-300 PA-32R-300

CARD 1 OF 3

PIPER AIRCRAFT CORPORATION

753 690

AEROFICHE EXPLANATION AND REVISION STATUS

The Service Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aviation Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Service Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual Table of Contents is for all fiche in this set.
2. A complete list of Illustrations is given and follows the Table of Contents.
3. A complete list of Tables is given for all fiche in this set and follows the list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:
   Revised text and illustrations are indicated by a black 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.
6. Revisions to this Service Manual 753 690 issued May 1, 1965 are as follows:

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PR770729	July 29, 1977	1, 2 & 3
PR780918	September 18, 1978	1, 2 & 3
PR791204	December 4, 1979	1, 2 & 3
PR801215	December 15, 1980	1, 2 & 3
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* INTERIM CHANGE

Revisions appear in Table III-I and Table III-II of card 1. There are no other changes included in this maintenance manual. Please discard your current card 1 and replace it with this revised one. DO NOT DISCARD CARDS 2 or 3.

The date on Aerofiche cards should not be earlier than the date noted for the respective card effectivity. Consult the latest card in this series for current Aerofiche card effectivity.

TABLE OF CONTENTS

SECTION	AEROFICHE CARD NO. 1	GRID NO.
I	INTRODUCTION	1A13
II	HANDLING AND SERVICING	1A17
III	INSPECTION	1D10
IV	STRUCTURES	1E14
V	SURFACE CONTROLS	1G11
VA	HYDRAULIC SYSTEM (PA-32R-300)	1I22
	AEROFICHE CARD NO. 2	
VI	LANDING GEAR AND BRAKE SYSTEM (PA-32-260/300)	2A8
VIA	LANDING GEAR AND BRAKE SYSTEM (PA-32R-300)	2C5
VII	POWER PLANT (PA-32-260)	2E14
VIIA	POWER PLANT (PA-32-300 & 32R-300)	2G4
VIII	FUEL SYSTEM	2I19
IX	INSTRUMENTS	2J14
	AEROFICHE CARD NO. 3	
X	ELECTRICAL SYSTEM	3A8
XI	ELECTRONICS	3F7
XII	HEATING AND VENTILATING	3F21
XIII	ACCESSORIES AND UTILITIES	3G8

LIST OF ILLUSTRATIONS

Figure		Aerofiche Grid No.
2-1.	Three-View of PA-32, Serial Nos. 32-1 to 32-7140086	1A20
2-1a.	Three-View of PA-32, Serial Nos. 32-7200001 to 32-7840222	1A21
2-1b.	Three-View of PA-32-300, Serial Nos. 32-794001 and up	1A22
2-1c.	Three-View of PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068	1A23
2-2.	Station Reference Lines (PA-32-260 and 300)	1B5
2-2a.	Station Reference Lines (PA-32R-300)	1B6
2-3.	Access Plates and Panels	1B8
2-4.	Jacking Arrangement	1B13
2-5.	Weighing the Airplane	1B14
2-6.	Leveling Longitudinally	1B15
2-7.	Leveling Laterally	1B15
2-8.	Lubrication Chart (Landing Gear, Main) PA-32-260 and 300	1C13
2-9.	Lubrication Chart (Landing Gear, Main) PA-32R-300	1C14
2-10.	Lubrication Chart (Landing Gear, Nose) PA-32-260 and 300	1C15
2-11.	Lubrication Chart (Landing Gear, Nose) PA-32R-300	1C16
2-12.	Lubrication Chart (Control System)	1C17
2-13.	Lubrication Chart (Control System) (cont)	1C18
2-14.	Lubrication Chart (Control System) (cont)	1C19
2-15.	Lubrication Chart (Air Conditioning Condenser)	1C20
2-16.	Lubrication Chart (Cabin Door, Baggage Door and Seat)	1C21
2-17.	Lubrication Chart (Power Plant, Propeller and Control Pivot Points)	1C22
2-18.	Lubrication Chart (Back-Up Extender and Fuel Selector)	1C23
2-19.	Torque Wrench Formula	1D2
2-20.	Cherrylock Rivet Removal	1D3
2-21.	Identification of Aircraft Lines	1D4
3-1.	Typical Muffler Fatigue Areas	1D13
3-2.	Exhaust System Inspection Points	1D14
3-3.	Flap Control Cable Attachment Bolt Inspection	1D16
3-4.	Inspection of Main Landing Gear Torque Links	1D17
3-5.	Inspection of Seat Belt Attachment Hardware	1D18
4-1.	Wing Installation (PA-32-260 and PA-32-300, Serial Nos. 32-40000 to 32-7840222 inclusive)	1E17
4-1a.	Empennage Group Installation	1E19
4-1b.	Wing Installation (PA-32R-300 and PA-32-300, Serial Nos. 32-7940001 and up)	1E21
4-1c.	Landing Light Assembly	1E23
4-2.	Rear Door Window Replacement	1F3
4-3.	Skin Material and Thickness (PA-32-260 and PA-32-300, Serial Nos. 32-40000 to 32-7840222 inclusive)	1F5
4-3a.	Skin Material and Thickness (PA-32R-300 and PA-32-300, Serial Nos. 32-7940001 and up)	1F7
4-4.	Surface Scratches, Abrasions or Ground-In Dirt	1F9
4-4a.	Deep Scratches, Shallow Nicks and Small Holes	1F10
4-5.	Mixing of Epoxy Patching Compound	1F10
4-6.	Welding Repair Method	1F12

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
4-7.	Repairing of Cracks	1F12
4-8.	Various Repairs	1F13
4-9.	Repair of Stress Lines	1F14
4-10.	Repair of Impacted Damage	1F15
4-11.	Wing Rib Modification	1F20
4-12.	Balance Weight Assembly Installation	1F20
4-13.	Flap Modification	1F21
4-14.	Additional Drain Holes in Stabilator	1F22
4-15.	Control Surface Balance Tool	1G1
4-16.	Stabilator Balance	1G2
4-17.	Aileron Balance	1G3
4-18.	Seat Back Lock	1G5
4-19.	Door Snubber Installation	1G7
5-1.	Control Column Assembly (PA-32-260 and 300)	1G18
5-1a.	Control Column Assembly (PA-32R-300)	1G20
5-1b.	Correct Method of Installing Rod End Bearings	1G21
5-2.	Aileron Controls (Typical)	1G24
5-3.	Bellcrank Rigging Tool	1H4
5-4.	Aileron Rigging Tool	1H4
5-5.	Stabilator Controls	1H8
5-6.	Stabilator Rigging Tool	1H9
5-7.	Methods of Securing Trim Cables	1H11
5-8.	Stabilator Trim Controls	1H12
5-9.	Rudder and Steering Pedal Assembly (Typical)	1H18
5-10.	Rudder Controls	1H22
5-11.	Rudder Rigging Tool	1H23
5-12.	Clamping Rudder Pedals	1H23
5-13.	Rudder and Stabilator Travel Adjustment	1H24
5-14.	Rudder Trim Control	1I2
5-15.	Flap Controls	1I4
5-16.	Flap Step Adjustment	1I7
5-17.	Flap Rigging Tool	1I7
5-18.	Fabricated Aileron Bellcrank Rigging Tool	1I9
5-19.	Fabricated Aileron and Flap Rigging Tool	1I10
5-20.	Fabricated Stabilator Rigging Tool	1I11
5-21.	Fabricated Rudder Rigging Tool	1I12
5A-1.	Schematic Diagram of Hydraulic System	1J1
5A-2.	Hydraulic System Installation	1J2
5A-3.	Hydraulic Pump/Reservoir, Exploded View	1J8
5A-4.	Test and Adjustment of Hydraulic Pump	1J9
5A-5.	Checking Aligning Brackets of Gear Back-Up Extender Actuator	1J12
5A-6.	Gear Back-Up Extender Actuator	1J13
5A-7.	Nose Gear Actuating Cylinder	1J19
5A-8.	End Gland Locking Device (Main Gear)	1J20
5A-9.	Main Gear Actuating Cylinder	1J20
5A-10.	Gear Back-Up Extender Actuator Aligning Tool	1K11
6-1.	Nose Gear Oleo Strut Assembly	2A12

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
6-2.	Nose Gear Installation	2A16
6-3.	Clamping Rudder Pedals in Neutral Position	2A18
6-4.	Rudder Pedals at Neutral Angle	2A18
6-5.	Main Gear Oleo Strut Assembly, Cylinder Housing 65319	2A22
6-6.	Main Gear Oleo Strut Assembly, Cylinder Housing 65441	2A23
6-7.	Main Gear Installation	2B1
6-8.	Nose Wheel Assembly	2B4
6-9.	Main Wheel Assembly	2B6
6-9a.	Removal and Installation of Anchor Bolts	2B8
6-10.	Wheel Brake Assembly	2B10
6-11.	Brake System Installation	2B12
6-12.	Brake Master Cylinder (Hand/Parking Brake)	2B13
6-13.	Toe Brake Installation	2B15
6-14.	Brake Cylinder 10-20 (Toe Brake)	2B17
6-15.	Brake Cylinder 10-27 (Toe Brake)	2B17
6-15a.	Brake Cylinder 10-30 (Toe Brake)	2B18
6-15b.	Brake Cylinder 17000 (Toe Brake)	2B18
6-16.	Bleeding Brake (Gravity)	2B20
6-17.	Bleeding Brake (Pressure)	2B20
6A-1.	Nose Gear Oleo Strut Assembly	2C12
6A-2.	Nose Gear Installation	2C14
6A-2a.	Nose Gear Service Tolerances	2C15
6A-2b.	Main Gear Service Tolerances	2C19
6A-2c.	Adjustment of Eccentric Bushing	2C24
6A-3.	Nose Gear Adjustment	2D1
6A-4.	Clamping Rudder Pedals in Neutral Position	2D3
6A-5.	Rudder Pedals at Neutral Angle	2D3
6A-6.	Nose Gear Doors	2D4
6A-7.	Main Gear Oleo Strut Assembly	2D7
6A-8.	Main Gear Installation	2D13
6A-9.	Aligning Main Gear	2D19
6A-10.	Adjustment of Nose Gear Down Limit Switch	2D22
6A-11.	Adjustment of Main Gear Down Limit Switch	2D22
6A-12.	Throttle Warning Switches	2D24
6A-13.	Nose Wheel Assembly	2E2
7-1.	Propeller System Installation (Constant Speed)	2E18
7-2.	Typical Nicks and Removal Method	2E18
7-2a.	Propeller Installation	2E19
7-3.	Propeller Governor	2E21
7-4.	Engine Installation	2E23
7-4a.	Adjustment of Engine Controls	2F3
7-5.	Carburetor	2F4
7-6.	Magneto Inspection	2F8
7-7.	Impulse Coupling	2F9
7-8.	Magneto Timing Marks	2F10
7-9.	Timing Pointer	2F10
7-10.	Timing Kit Installed	2F11
7-11.	Breaker Compartment with Cast Timing Marks	2F11

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
7-12.	Removing Spark Plug Frozen to Busing	2F16
7A-1.	Propeller Installation	2G7
7A-2.	Typical Nicks and Removal Method	2G8
7A-3.	Propeller Governor	2G11
7A-4.	Engine Installation	2G14
7A-4a.	Adjustment of Engine Control	2G16
7A-5.	Schematic Diagram of RSA Fuel Injection System	2G19
7A-6.	Fuel Injector	2G20
7A-7.	Fuel-Air Bleed Nozzle	2G22
7A-8.	Contact Points	2G23
7A-9.	Rotor Holding Tool Installed	2H1
7A-10.	Timing Kit Installed	2H1
7A-11.	Aligning Timing Marks	2H2
7A-12.	Checking Flyweight Clearance of Impulse Coupling	2H3
7A-13.	Engine Timing Marks	2H4
7A-14.	Magneto Timing Marks	2H5
7A-15.	Removing Spring From Lead Assembly	2H7
7A-16.	Assembly Tool	2H7
7A-17.	Using Assembly Tool	2H8
7A-18.	Measuring Lead Assembly Length	2H8
7A-19.	Cutting Metallic Braid From End of Lead	2H9
7A-20.	Unbraiding Metallic Shielding	2H9
7A-21.	Forming Shielding Around Ferrule	2H10
7A-22.	Ferrule Seating Tool	2H10
7A-23.	Needle	2H10
7A-24.	Measuring Wire From Top of Ferrule	2H11
7A-25.	Installing Grommet Over Lead Assemblies	2H11
7A-26.	Lead Assembly Installed in Grommet	2H11
7A-27.	Wire Doubled Over for Installation of Eyelet	2H11
7A-28.	Height of Spring in Distributor Block Tower	2H13
7A-29.	Timing Light Connected to Magneto	2H15
7A-30.	Timing Marks on Magneto Rotor	2H16
7A-31.	Painted Tooth Centered in Timing Window	2H17
7A-32.	Timing Mark on Rotor Aligned with Pointer	2H17
7A-33.	Timing Light Connected to Magneto and Breakers	2H18
7A-34.	Cam End View of Magneto	2H20
7A-35.	Removing Impulse Coupling	2H21
7A-36.	Checking Flyweight to Stop Pin Clearance	2H21
7A-37.	Stop Pin Installation Dimension	2H22
7A-38.	Checking Flyweight Axial Wear with Drill Shank	2H23
7A-39.	Checking Flyweight Radial Wear With Gauge	2H23
7A-40.	Points of Coupling Body Wear	2H24
7A-41.	Acceptable and Deformed Coupling Springs	2H24
7A-42.	Checking Impulse Coupling for Magnetization	211
7A-43.	Orientation of Spring in Coupling Body	211
7A-44.	Lifting Inner End of Spring	212

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
7A-45.	Checking Harness Lead Continuity	2I3
7A-46.	Checking Harness Lead Insulation Resistance	2I3
7A-47.	Modified Pliers	2I4
7A-48.	Ferrule Positioned Under Braid	2I4
7A-49.	Position of 11-8627 Kit and Contact Spring at Start of Installation	2I5
7A-50.	Position of 11-8627 Kit and Contact Spring after Installation	2I5
7A-51.	Lubricating Sleeve	2I5
7A-52.	Lubricating Ferrule Shoulder	2I5
7A-53.	Removing Spark Plub Frozen to Bushing	2I8
8-1.	Fuel System (PA-32-260)	2I21
8-2.	Fuel System (PA-32-300)	2I22
8-3.	Fuel System (PA-32-300, Serial Nos. 32-7940001 and up; PA-32R-300 All)	2I23
8-4.	Fuel Gauge (PA-32R-300)	2J4
8-5.	Fuel Selector and Filter	2J5
8-6.	Fuel Filter	2J6
8-7.	Pulsate (Plunger) Fuel Pump	2J9
9-1.	Instrument Panel (PA-32-260,Serial Nos. 32-1 to 32-1110 incl., and PA-32-300, Serial Nos. 32-40000 to 32-40565 incl.)	2J24
9-2.	Instrument Panel (PA-32-260, Serial Nos. 32-1111 to 32-1320)	2K1
9-3.	Instrument Panel (PA-32-300, Serial Nos. 32-40566 to 32-41018)	2K2
9-4.	Instrument Panel (PA-32-260, Serial Nos. 32-7100001 to 32-7200055)	2K3
9-4a.	Instrument Panel (PA-32-260, Serial Nos. 32-7300001 to 32-7400061)	2K4
9-4b.	Instrument Panel (PA-32-300, Serial Nos. 32-7140001 to 32-7240147)	2K5
9-4c.	Instrument Panel (PA-32-300, Serial Nos. 32-7340001 to 32-7440182)	2K6
9-4d.	Instrument Panel (PA-32-260, Serial Nos. 32-7500001 and up)	2K7
9-4e.	Instrument Panel (PA-32-300, Serial Nos. 32-7540001 and up)	2K8
9-4f.	Instrument Panel (PA-32R-300, Serial Nos. 32R-7680001 and up)	2K9
9-5.	Instrument Air System Installation	2K12
10-1a.	Alternator and Starter System (PA-32-260, Serial Nos. 32-1 to 32-855 inclusive)	3A15
10-1b.	Alternator and Starter System (PA-32-260, Serial Nos. 32-856 and up, PA-32-300, Serial Nos. 32-40000 to 32-40566)	3A16
10-1c.	Alternator and Starter System (PA-32-260, Serial Nos. 32-1112 to 32-7400061 incl., and PA-32-300, Serial Nos. 32-40567 to 32-7440182 incl.)	3A17
10-2a	Alternator and Starter System (PA-32-260, Serial Nos. 32-7500001 to 32-7600033 incl., and PA-32-300, Serial Nos. 32-7540001 to 32-7640142 incl., and PA-32R-300, Serial Nos. 32R-7680001 to 32R-7680538 incl.)	3A18
10-2b.	Alternator and Starter System (PA-32-260, Serial Nos. 32-7700001 to 32-7800008 incl., PA-32-300, Serial Nos. 32-7740001 and up, and PA-32R-300, Serial Nos. 32R-7780001 to 32R-7880068)	3A19

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
10-3.	Lamp-Bank Load	3A22
10-4.	Checking Field Current	3A22
10-5.	Testing Field Circuit	3A23
10-6.	Testing Rectifiers (Positive)	3A24
10-7.	Testing Rectifiers (Negative)	3B1
10-8.	C-3928 Fixtures and Adapters	3B2
10-9.	Removing Rectifiers	3B2
10-10.	Installing Rectifiers	3B3
10-11.	Soldering Rectifier Lead	3B4
10-12.	Testing Stator Coils	3B5
10-13.	Removing End Bearing	3B7
10-14.	Installing End Bearing	3B7
10-15.	Removing Drive Pulley	3B8
10-16.	Removing Drive End Bearing	3B8
10-17.	Removing Slip Ring	3B9
10-18.	Aligning Slip Ring	3B9
10-19.	Installing Slip Ring	3B10
10-20.	Installing Retainer	3B10
10-21.	Solder Points	3B11
10-22.	Installing Driver End Shield and Bearing (Typical)	3B12
10-23.	Installing Pulley	3B12
10-24.	Meter Connections for Alternator Performance Test	3B15
10-24a.	Exploded View of Alternator	3B18
10-24b.	Removal of Slip Ring End Bearing	3B19
10-24c.	Removal of Rectifier	3B19
10-24d.	Removal of Drive End Head	3B20
10-24e.	Removal of End Head Bearing	3B20
10-24f.	Testing Rotor for Ground	3B21
10-24g.	Testing Rotor for Shorts	3B21
10-24h.	Installation of Bearing	3B22
10-24i.	Installation of Rectifier	3B22
10-24j.	Terminal Assembly	3B23
10-24k.	Slip Ring End Bearing Assembly	3B24
10-24l.	Testing Alternator	3B24
10-24m.	Brush Installation	3C1
10-24n.	Internal Wiring Schematic	3C1
10-25.	No-Load Test	3C6
10-26.	Resistance Test	3C7
10-27.	Exploded View of Gear Reduction Starting Motor	3C11
10-28.	Turing Starter Motor Commutator	3C14
10-29.	Testing Motor Armature for Shorts	3C14
10-30.	Testing Fields for Grounds	3C14
10-31.	No-Load Test Hook-Up	3C15
10-32.	Stall-Torque Hook-Up	3C16
10-32a.	Ignition Switch	3C24

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
10-32b.	Terminal Block	3D16
	NOTE: (Figures 10-33 thru 10-76. See Table X-1)	3A12-3A13
11-1.	Two Year, Magnesium Battery Connections	3F9
11-2.	ELT Schematic (NARCO)	3F10
11-3.	ELT Portable Folding Antenna (NARCO)	3F11
11-4.	ELT Using Fixed Aircraft Antenna (NARCO)	3F11
11-5.	Communications Components ELT Schematic	3F16
12-1.	Cabin Heater, Defroster and Fresh Air System	3F23
12-2.	Cabin Heater and Defroster Fresh Air System, Serial Nos. 32-7100001 to 32-7340191	3F24
12-3.	Cabin Heater and Defroster Fresh Air System, Serial Nos. 32-7400001 and up	3G1
12-4.	Cabin Heater and Defroster Fresh Air System, PA-32R-300 only	3G2
13-1.	Air Conditioning System Installation	3G11
13-2.	Service Valves	3G16
13-3.	Test Gauge and Manifold Set	3G17
13-4.	Manifold Set Operation	3G18
13-5.	Leak Test Hook-Up	3G19
13-6.	Evacuation Hook-Up	3G21
13-7.	Charging Stand	3G23
13-8.	Charging Hook-Up	3H1
13-9.	Compressor and Fabricated Oil Dipstick	3H5
13-10.	Compressor and Alternator Belt Installation	3H7
13-11.	Magnetic Clutch	3H11
13-12.	Condensor Air Scoop Installation	3H15
13-13.	Expansion Valve	3H16
13-14.	Components Installation	3H17
13-15.	Control Head - Diode Mounting Board, Diode Location and Number, Serial Nos. 32-7240056 to 32-7340042	3H19
13-16.	Air Conditioning Wiring Schematic, Serial Nos. 32-7240056 to 32-7340042	3H20
13-17.	Air Conditioning Wiring Schematic, Serial Nos. 32-7340043 and up	3H21
13-18.	Air Conditioning Wiring Schematic (32R-300)	3H22

LIST OF TABLES

Table		Aerofiche Grid No.
II-I.	Leading Particulars and Principal Dimensions	1A24
II-II.	Recommended Nut Torques	1B10
II-III.	Recommended Lubricating Oils	1C8
II-IV.	Visible Strut Extension	1C8
II-V.	Decimal Conversion Chart	1C9
II-VI.	Special Lubrication Instruction	1C10
II-VIA.	Hose Clamp Tightening, (Initial Installation)	1C10
II-VII.	List of Consumable Materials	1C11
II-VIII.	Flare Fitting Torques	1C24
II-IX.	Maximum Distance Between Supports for Fluid Tubing	1D1
II-X.	Thread Lubricants	1D1
II-XI.	Conversion Tables	1D5
III-I.	Inspection Report (PA-32-260 and 300)	1D19
III-II.	Inspection Report (PA-32R-300)	1E5
IV-I.	List of Materials (Thermoplastic Repair)	1F6
IV-II.	Balance Specifications	1F24
V-I.	Control Surface Travel and Cable Tension	1G14
V-II.	Cable Tension Vs. Ambient Temperature	1G15
V-III.	Troubleshooting Chart (Surface Controls)	1H3
VA-I.	Leading Particulars, Hydraulic System	1J10
VA-II.	Characteristics, Hydraulic Pump Motor	1J10
VA-III.	Hydraulic System Troubleshooting	1J24
VI-I.	Landing Gear Troubleshooting	2B24
VIA-I.	Nose Gear Service Troubleshooting	2C16
VIA-II.	Main Gear Service Tolerance	2C20
VIA-III.	Toe-In - Toe-Out Correction Chart	2D18
VIA-IV.	Troubleshooting Chart (Landing Gear)	2E4
VII-I.	Propeller Specifications	2E20
VII-II.	Engine Troublshooting Chart	2F19
VIIA-I.	Propeller Specifications	2G9
VIIA-II.	Coupling Torques	2I7
VIIA-III.	Engine Troubleshooting Chart	2I11
VIII-I.	Sender/Fuel Quantity Gauge Tolerances (PA-32-260 and 300)	2J3
VIII-II.	Sender Fuel Quantity Gauge Tolerance (PA-32R-300 and 32-300 above S/N 32-7940001)	2J5
VIII-III.	Troubleshooting Chart (Fuel System)	2J10
IX-I.	Vacuum System	2J20
IX-II.	Directional Gyro Indicator	2K14
IX-III.	Gyro Horizon Indicator	2K15
IX-IV.	Rate of Climb Indicator	2K16
IX-V.	Altimeter	2K18
IX-VI.	Airspeed Tubes and Indicator	2K20
IX-VII.	Magnetic Compass	2K22
IX-VIII.	Manifold Pressure Indicator	2K23
IX-IX.	Tachometer	2K24
IX-X.	Engine Oil Pressure Gauge	2L1
IX-XI.	Fuel Pressure Gauge	2L2

LIST OF TABLES

Table		Aerofiche Grid No.
IX-XII.	Turn and Bank Indicator	2L3
IX-XIII.	Fuel Quantity Indicators	2L4
IX-XIV.	Oil Temperature Indicators	2L5
IX-XV.	Exhaust Gas Temperature Gauge (Alcor)	2L9
IX-XVI.	Cylinder Head Temperature Gauge	2L10
IXXVII.	Fuel Flow Gauge	2L11
X-I.	Electrical System Schematics	3A11
X-II.	Electrical System Components Loads	3C20
X-III.	Electrical System Troubleshooting	3D1
X-IIIA.	Electrical Symbols	3D17
X-IV.	Electrical Wire Coding	3D18
XII-I.	Blower System Wire Color Codes	3G5
XIII-I.	Temperature Pressure Chart	3G13
XIII-II.	Aluminum Tubing Torque	3G15
XIII-III.	Compressor Oil Charge	3H4
XIII-IV.	Troubleshooting Chart (Air Conditioner)	3H24

SECTION I

INTRODUCTION

		Aerofiche Grid No.
1-1.	General	1A14
1-2.	Scope of Manual	1A14
1-3.	Description	1A14
1-4.	Wing	1A14
1-5.	Empennage	1A14
1-6.	Fuselage	1A14
1-7.	Landing Gear (PA-32-260 and PA-32-300)	1A14
1-8.	Landing Gear (PA-32R-300)	1A15
1-9.	Hydraulic System (PA-32R-300)	1A15
1-10.	Brake System	1A15
1-11.	Engines and Propeller	1A15
1-12.	Fuel System (PA-32-260 and PA-32-300)	1A15
1-13.	Fuel System (PA-32-300, S/N 32-7940001 and up, and PA 32R-300)	1A15
1-14.	Flight Controls	1A16
1-15.	Radio	1A16
1-16.	Cabin Heater, Defroster, and Fresh Air System	1A16
1-17.	Instrument and Autopilot System	1A16

SECTION I

INTRODUCTION

1-1. GENERAL. This manual contains service and maintenance instructions for the Piper PA-32 and PA-32R Cherokee Six, designed and manufactured as a versatile airplane in the personal and business aviation field, by the Piper Aircraft Corporation, Vero Beach, Florida.

1-2. SCOPE OF MANUAL. Sections II and III comprise the service part of this manual, whereas Sections IV through XI comprise the maintenance instructions. The service instructions include ground handling, servicing and inspection. The maintenance instructions for each system include troubleshooting, removal and installation of components, and corrective maintenance and testing; each major system of the airplane is covered in a separate section. Only qualified personnel should perform the operations described in this manual.

The description of the airplane included in this section is limited to general information. Section II gives leading particulars and principal dimensions, while each major system is described in its appropriate section of the manual. For a more detailed description of the airplane, refer to the Owner's Handbook.

1-3. DESCRIPTION. The Cherokee Six is a six place (seventh seat optional), single-engine, low-wing monoplane of all-metal construction. The following paragraphs provide descriptions of the major components and systems.

1-4. WING. The laminar flow wing is of all-metal stressed skin, full cantilever, low-wing design, consisting of two wing panels bolted to a spar box assembly in the fuselage. The wing tips are removable. The ailerons are cable and push rod controlled and are dynamically balanced. The trailing edge wing flaps are manually operated.

1-5. EMPENNAGE. The empennage consists of the fin, stabilator, and stabilator trim tabs. The stabilator is dynamically balanced.

1-6. FUSELAGE. The fuselage consists of three basic units: The engine section, the cabin section, and the sheet-metal tail cone.

1-7. LANDING GEAR (PA-32-260 and PA-32-300). The tricycle landing gear is of the fixed type, consisting of a nose wheel and two main wheels.

1-8. LANDING GEAR (PA-32R-300). The tricycle landing gear is a hydraulically operated, fully retractable unit consisting of shock absorbing air-oil type oleo struts.

1-9. HYDRAULIC SYSTEM (PA-32R-300). The hydraulic system incorporates an electrically driven pump which is controlled by a switch on the instrument panel which in turn operates the retraction and extension of the landing gear.

1-10. BRAKE SYSTEM. The brake system is operated hydraulically by toe brakes located on the rudder pedals or by a hand lever connected to a single brake cylinder below and behind the left center of the instrument panel.

1-11. ENGINES AND PROPELLER.

Model	Engine	Propeller	H.P.	Octane
PA-32-260	O-540-E4B5	F.P. - 1P235PFA8266 C.S. - HC-C2YK-1A 8477-2	260	100/130
PA-32-300 For S/Ns 32-7940001 and up	IO-540-K1A5 IO-540-K1G5D	C.S. - HC-C2YK-1/8475D-4 C.S. - HC-C2YK-1 ( ) F/F8475D-4	300	100/130
PA-32R-300	IO-540-K1A5D	C.S. - HC-C2YK-1/8475D-4	300	100/130

1-12. FUEL SYSTEM (PA-32-260 and PA-32-300). The fuel system consists of two aluminum fuel tanks in the wings plus an auxiliary tank in each wing tip, giving a total capacity of 84 U.S. gallons with 83.5 gallons usable. Incorporated in the system is a combination selector valve-fuel filter, electric auxiliary fuel pump(s) and an engine driven pump.

1-13. FUEL SYSTEM (PA-32-300 S/N 32-7940001 and up, and PA-32R-300). The fuel system consists of two interconnected aluminum fuel tanks in each wing, giving a total capacity of 98 U.S. gallons with 94 gallons usable. Incorporated in the system is a three position fuel valve (off-left-right), gascolator and electric emergency fuel pump.

1-14. FLIGHT CONTROLS. The flight controls are conventional equipment, consisting of a control wheel which operates the ailerons and stabilator, and pedals which operate the rudder. Duplicate controls are provided for the copilot.

1-15. RADIO. Provisions are provided for the installations of microphone and headset jacks, loudspeaker, and panel space for radios.

1-16. CABIN HEATER, DEFROSTER, AND FRESH AIR SYSTEM. Heat for the cabin interior and defroster system is provided by a heater muff attached to the exhaust system. Controls for these systems are located on the lower right side of the instrument panel. There are six heater outlets, one for each seat. Fresh air inlets are located in the leading edge of the wing at the intersection of the tapered and straight sections. Two large adjustable outlets are located on each side of the cabin, one forward and one aft of the front seats near the floor. In addition, an air scoop is located on top of the fuselage or in the leading edge of the fin on newer models which directs air to individually adjustable, overhead outlets above each seat.

1-17. INSTRUMENT AND AUTOPILOT SYSTEM. Provisions for instrument installation include panels for engine instruments and advanced instruments, as well as for an Autopilot system.

SECTION II

HANDLING AND SERVICING

Paragraph		Aerofiche Grid No.
2-1.	Introduction	1A19
2-2.	Dimensions	1A19
2-3.	Station Reference Lines	1A19
2-4.	Weight and Balance Data	1A19
2-5.	Access and Inspection Provisions	1B7
2-6.	Tools and Test Equipment	1B7
2-7.	Torque Requirements	1B7
2-8.	Step, Handhold and Walkways	1B7
2-9.	Ground Handling	1B13
2-10.	General	1B13
2-11.	Jacking	1B13
2-12.	Weighing	1B14
2-13.	Leveling	1B15
2-14.	Mooring	1B15
2-15.	Locking Airplane	1B16
2-16.	Parking	1B16
2-17.	Towing	1B17
2-18.	Taxiing	1B17
2-19.	External Power Receptacle	1B17
2-20.	Operation of External Power Receptacle	1B17
2-21.	Servicing	1B18
2-22.	General	1B18
2-23.	Fuel System	1B18
2-24.	Servicing Fuel System	1B18
2-25.	Filling Fuel Tanks	1B18
2-26.	Draining Moisture from Fuel System	1B19
2-27.	Draining Fuel System	1B19
2-27a.	Anti-Icing Fuel Additive	1B20
2-28.	Brake System	1B20
2-29.	Servicing Brake System	1B20
2-30.	Filling Brake Cylinder Reservoir	1B20
2-31.	Draining Brake System	1B20
2-32.	Hydraulic System (PA-32R-300)	1B21
2-32a.	Servicing Hydraulic System	1B21
2-32b.	Servicing Hydraulic Pump/Reservoir	1B21

		Aerofiche Grid No.
2-33.	Landing Gear System	1B21
2-33a.	Servicing Landing Gear	1B21
2-34.	Oleo Struts	1B21
2-34a.	Servicing Oleo Struts	1B21
2-35.	Filling Nose Gear Oleo Strut (PA-32-260 and 300)	1B22
2-35a.	Filling Main Gear Oleo Strut (PA-32-260 and 300)	1B23
2-35b.	Filling Oleo Struts (PA-32R)	1B24
2-36.	Inflating Oleo Struts	1C1
2-37.	Tires	1C2
2-38.	Servicing Tires	1C2
2-39.	Battery	1C2
2-40.	Servicing Battery	1C2
2-41.	Cleaning	1C2
2-42.	Cleaning Engine Compartment	1C2
2-43.	Cleaning Landing Gear	1C3
2-44.	Cleaning Exterior Surfaces	1C3
2-45.	Cleaning Windshield and Windows	1C3
2-46.	Cleaning Headliner, Side Panels and Seats	1C4
2-47.	Cleaning Carpets	1C4
2-48.	Oil System (Engine)	1C5
2-49.	Servicing Oil System	1C5
2-50	Filling Oil Sump	1C5
2-51.	Draining Oil Sump	1C5
2-52.	Oil Screen (Suction)	1C5
2-53.	Oil Screen (Pressure)	1C5
2-54.	Oil Filter (Full Flow)	1C6
2-55.	Recommendations For Changing Oil	1C6
2-56.	Lubrication	1C6
2-57.	Lubrication Instructions	1C6
2-58.	Application of Oil	1C7
2-59.	Application of Grease	1C7
2-60.	Lubrication Charts	1C7
2-61.	Torque Requirements	1C24
2-62.	Torque Wrenches	1D2
2-63.	Cherrylock Rivets, Removal	1D3

SECTION II

HANDLING AND SERVICING

2-1. INTRODUCTION. This section contains routine handling and servicing procedures 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 routine procedures as outlined in this section, refer to the appropriate section for that component.

2-2. DIMENSIONS. The principal airplane dimensions are shown in Figures 2-1, 2-1a or 2-1b 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, wing station or buttock line (BL), and water line (WL) designations is frequently employed in this manual. (Refer to Figure 2-2 or Figure 2-2a.) 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. Station 0 of the fuselage is 78.4 inches ahead of the wing leading edge or 33.4 inches ahead of the firewall; station 0 (BL) of the wing and stabilator is the centerline of the airplane; and station 0 (WL) of the vertical stabilizer and rudder is 20.5 inches below the cabin floor as measured at the rear wing spar with the airplane level. The reference datum line is located 78.4 inches ahead of the wing leading edge at the intersection of the straight and tapered section.

2-4. WEIGHT AND BALANCE DATA. When figuring various weight and balance computations, the empty, static and gross weight, and center of gravity of the airplane may be found in the Weight and Balance Form of the Airplane Flight Manual.

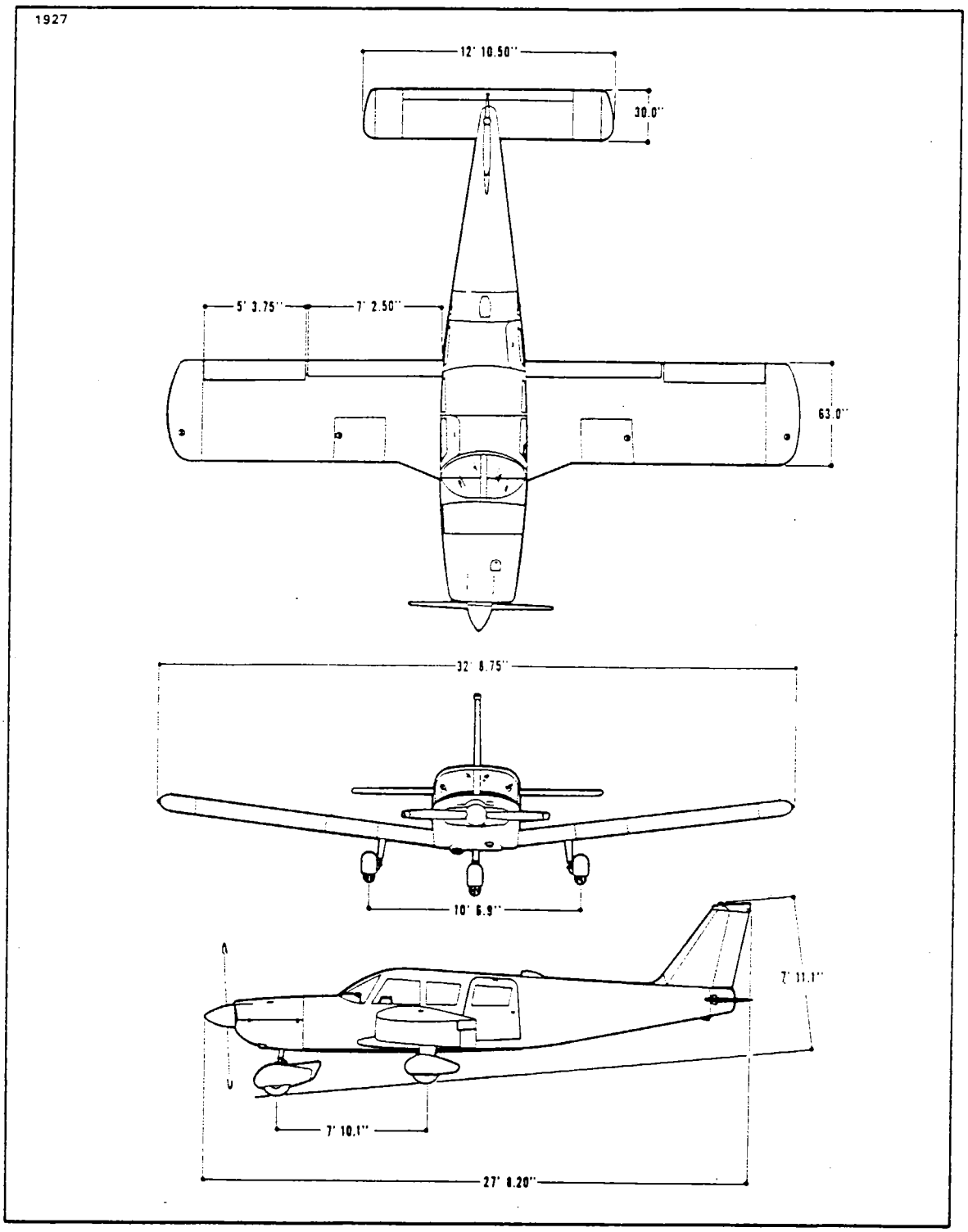


Figure 2-1. Three View of PA-32, Serial Nos. 32-1 to 32-7140086

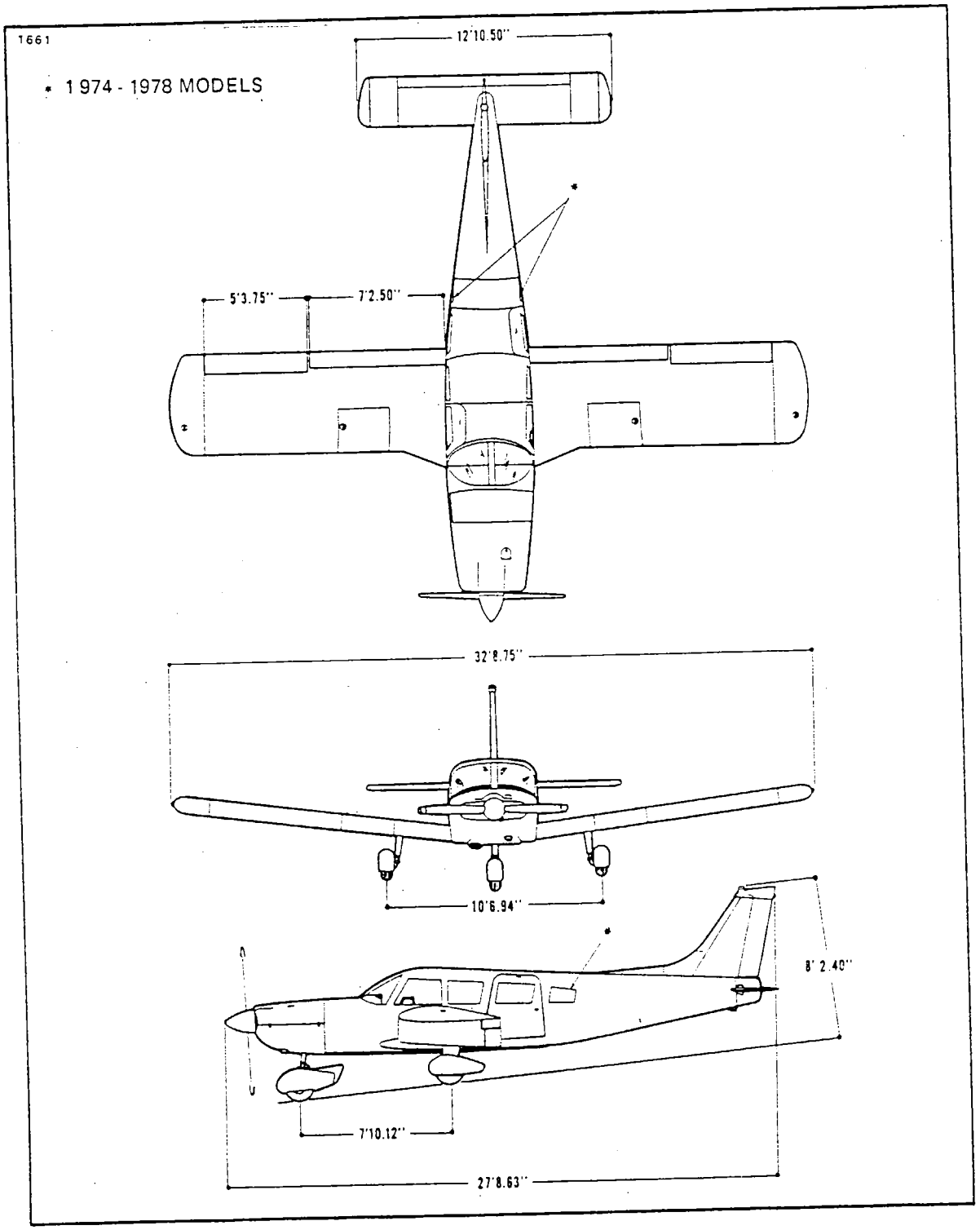


Figure 2-1a. Three-View of PA-32, Serial Nos. 32-7200001 to 32-7840222

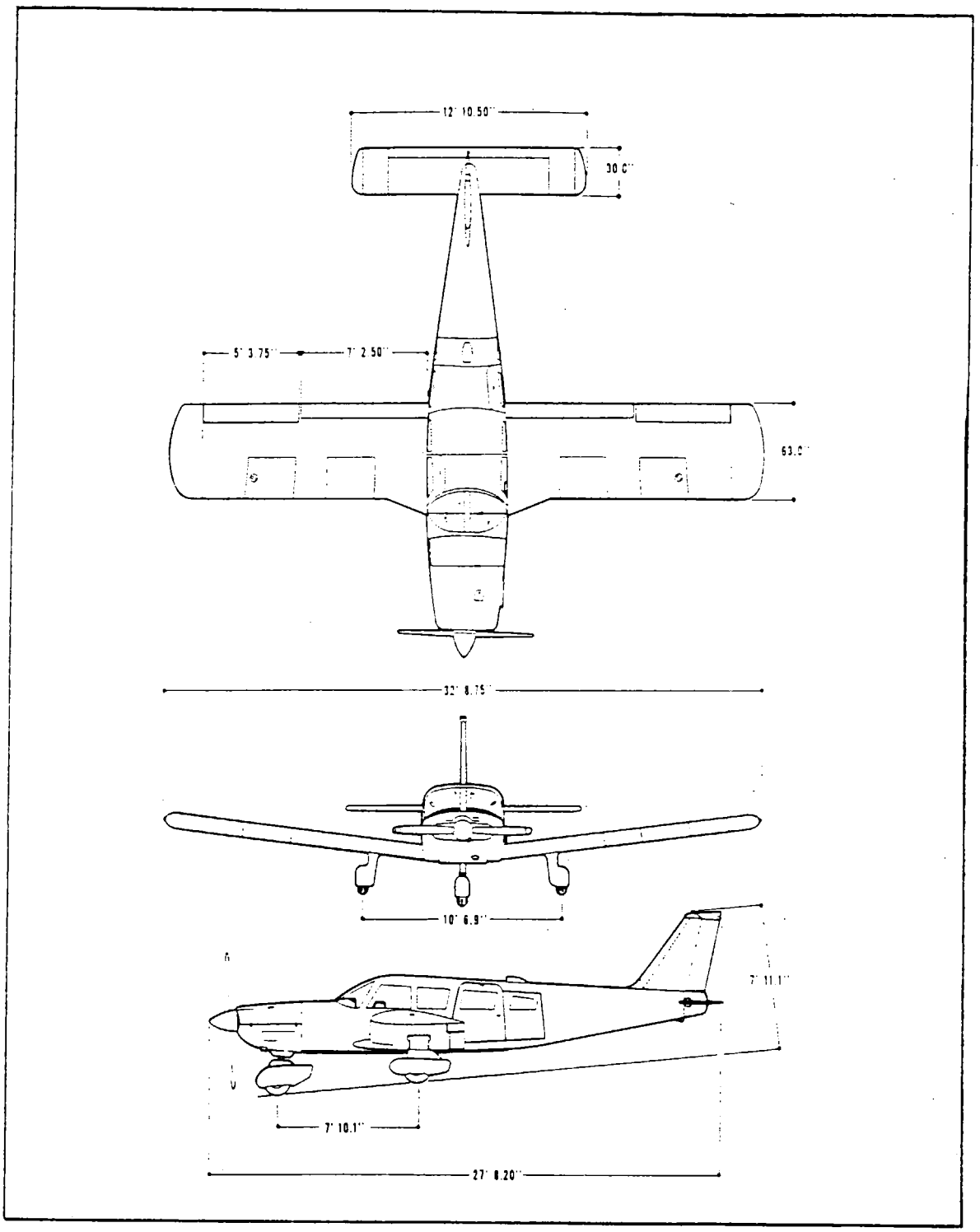


Figure 2-1b. Three-View of PA-32-300, Serial Nos. 32-7940001 and up

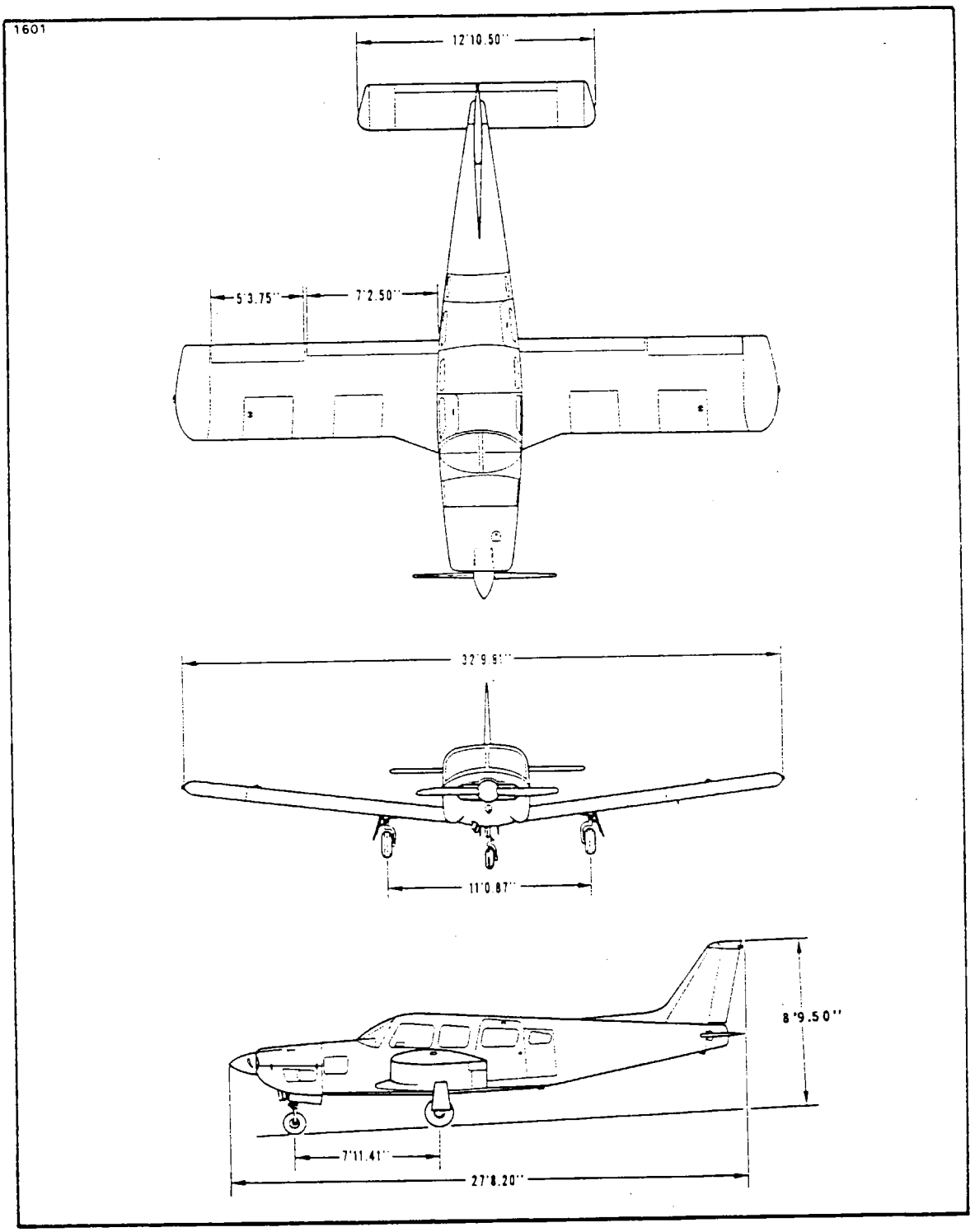


Figure 2-1c. Three View of PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-32-260
ENGINE	
Manufacturer	Avco Lycoming
Model	O-540-E4B5
Rated Horsepower and Speed	260 hp @ 2700 rpm
Oil Sump Capacity	12 U.S. quarts
Fuel, Aviation Grade (Minimum and Specified Octane)	100/130 (See Note 8)
Carburetor, Marvel-Schebler	MA-4-5
Fuel Injector, Bendix	
Magnetos, Scintilla:	
Left	S6LN-21
Right	S6LN-204
Magneto Timing	25 degrees BTC
Magneto Point Clearance	0.015 ± 0.006 in.
Spark Plugs (shielded):	See Note 2
Spark Plug Gap Setting	.017 to .021 in. (2)
Firing Order	1-4-5-2-3-6
Starter:	
Delco-Remy, 12-volt	1109657
Prestolite, 12-volt	MZ4206
Alternator, Chrysler, 12-volt, 60 amp:	2642197
Voltage Regulator, WICO	X16300B
Overvoltage Relay, WICO	X16799B
Alternator, Prestolite, 60 amp:	
Voltage Regulator, WICO	
Fuel Pump Drive	Plunger
PROPELLER	
Fixed Pitch	
Manufacturer	McCauley
Model	1P235/PFA8266
Diameter	82.0 in.
Diameter, Minimum	80.5 in.
Blade Pitch in inches at the 75% Radius Station (4)	60 thru 66

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-32-300	PA-32R-300
ENGINE		
Manufacturer	Avco Lycoming	Avco Lycoming
Model	IO-540-K1A5 IO-540-K1G5D	IO-540-K1A5D
Rated Horsepower and Speed	300 hp @ 2700 rpm	300 hp @ 2700 rpm
Oil Sump Capacity	12 U.S. quarts	12 U.S. quarts
Fuel, Aviation Grade (Minimum and Specified Octane)	100/130 (Refer to Note 8)	100/130 (Refer to Note 8)
Carburetor, Marvel-Schebler		
Fuel Injector, Bendix	RSA-10ED1	RSA-10ED1
Magnetos, Scintilla:		
Left	S6LN-1227	D6LN-2031 (Dual Mag with impulse coupling)
Right	S6LN-1209	
Magneto Timing	20 degrees BTC	20 degrees BTC
Magneto Point Clearance	0.016 in.	0.016 in.
Spark Plugs (shielded):	See Note 2	See Note 2
Spark Plug Gap Setting	.017 to .021[3]	.017 to .021 in.[3]
Firing Order	1-4-5-2-3-6	1-4-5-2-3-6
Starter:		
Delco-Remy, 12-volt	—	—
Prestolite, 12-volt	MZ4206	MZ4206
Alternator, Chrysler, 12-volt, 60 amp:	2642197	2642997
Voltage Regulator, WICO	X16300B	X16300B
Overvoltage Relay, WICO	ALY-6409[3]	ALY-6409[3]
Alternator, Prestolite, 60 amp:	X16300B	
Voltage Regulator, WICO	Plunger	Plunger
Fuel Pump Drive		
PROPELLER		
Fixed Pitch	—	—
Manufacturer	—	—
Diameter	—	—
Diameter, Minimum	—	—
Blade Pitch in inches at the 75% Radius Station[4]	—	—

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

MODEL	PA-32-260
PROPELLER (cont.)	
Constant Speed	
Manufacturer	Hartzell (Two Blades)
Hub, Model } See Table VII-I and VIIA-I	
Blade, Model } See Table VII-I and VIIA-I	
Diameter	82.0 in.
Diameter, Minimum	80.5 in.
Blade Angle, Low Pitch (4)	12° ± 0.2°
Blade Angle, High Pitch (4)	32° ± 2.0°
Governor Control	Hartzell
Governor Model	F-4-4A
FUEL SYSTEM	
Inboard (Main) Fuel Tanks:	Two
Capacity	25 U.S. gallons (each)
Unusable Fuel	.125 U.S. gallons (each)
Outboard (Tip) Fuel Tanks:	Two
Capacity (each)	17 U.S. gallons
Unusable Fuel (each)	.125 U.S. gallons
Total Capacity	84 U.S. gallons
Total Unusable Fuel	.5 U.S. gallons
Electric Fuel Pump	Bendix Part No. 480543
LANDING GEAR	
Type	Fixed
Shock Strut Type	Combination Air and Oil
Fluid Required (Struts and Brakes)	MIL-H-5606
Strut Extension (exposure under static load):	
Nose	See Table II-IV. Visible Strut Extension
Main	10 ft., 6.9 in.
Tread (width from each tire center)	

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

MODEL	PA-32-300	PA-32R-300
PROPELLER (cont.)		
Constant Speed		
Manufacturer	Hartzell (Two Blades)	Hartzell (Two Blades)
Hub, Model	See Table VII-I and VIIA-I	
Blade, Model	See Table VII-I and VIIA-I	
Diameter	80.0 in.	80.0 in.
Diameter, Minimum	78.5 in.	78.5 in.
Blade Angle, Low Pitch[4]	13.5° ± 0.2°	13.5° ± 0.2°
Blade Angle, High Pitch[4]	34.0° ± 1.0°	34.0° ± 1.0°
Governor Control	Hartzell	Hartzell
Governor Model	F-4-4A F-4-11[1]	F-4-11B
FUEL SYSTEM		
Inboard (Main) Fuel Tanks:	Two	4 (2 interconnected, each wing)[1]
Capacity	25 U.S. gallons (each)	49 U.S. gallons (each)[1]
Unusable Fuel	.125 U.S. gallons (each)	2 U.S. gallons (each)[1]
Outboard (Tip) Fuel Tanks:	Two	—
Capacity (each)	17 U.S. gallons	—
Unusable Fuel (each)	.125 U.S. gallons	—
Total Capacity	84 U.S. gallons	98 U.S. gallons[1]
Total Usuable Fuel	.5 U.S. gallons	4 U.S. gallons[1]
Electric Fuel Pump	Airborne 1B5-6	Airborne 1B5-6[1]
LANDING GEAR		
Type	Fixed	Hydraulically Retractable
Shock Strut Type	Combination Air and Oil	Combination Air and Oil
Fluid Required (Struts and Brakes)	MIL-H-5606	MIL-H-5605
Strut Extension (exposure under static load):		
Nose	3.50 ± .50 in.	2.75 in.
Main	4.50 ± .25 in.	4.0 in.
Tread (width from each tire center)	10 ft., 6.9 in.	11 ft., .87 in.

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

LANDING GEAR (cont.)	
Wheel Base	7 ft., 10.12 in. 7 ft., 8 in. (1)
Nose Wheel Travel	30° left & right, 22.5° ± 2° left & right (5)
Turning Distance (Min)	59 ft., 10.8 in., 75 ft., 6 in. (5)
Wheel, Nose	Cleveland 38501, Cleveland 40-77 (5)
Wheel, Main	Cleveland 40-90A or 40-120 (7)
Brake Type	Cleveland 30-65 or 30-83 (7) 500 x 5
Tire, Nose	6:00 x 6, 4 or 6 ply rating, 5:00 x 5, 6 ply rating
Tire, Main	6:00 x 6, 6 ply rating, 8 ply rating (5) (6)
Tire Pressure, Nose	28-30 psi, 35 psi (1) (5)
Tire Pressure, Main	35-40 psi, 38 psi (5)
CONTROL SURFACE TRAVELS	REFER TO TABLE V-I, SECTION V
CABLE TENSIONS	REFER TO TABLE V-I, SECTION V

NOTE 1: ALSO APPLIES WHERE NOTED TO 32-300 WITH SERIAL NUMBERS 32-7940001 AND UP.
NOTE 2: REFER TO THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTION NO. 1042.
NOTE 3: USED ON AIRPLANES WITH AIR CONDITIONING ONLY.
NOTE 4: BLADE ANGLE AT 30 IN. RADIUS.
NOTE 5: PA-32R-300 MODEL ONLY.
NOTE 6: SERIAL NOS. 32-7200001 AND UP FOR PA-32-260 AND 32-7240001 AND UP FOR PA-32-300 MODELS.
NOTE 7: PA-32R-300 MODEL WITH HEAVY DUTY BRAKES, WHEELS AND B.F. GOODRICH NYLON - TYIII OR 30805 McCREARY AIR HAWK - TYIII TIRES.
NOTE 8: REFER TO THE LATEST REVISION OF AVCO-LYCOMING S.I. 1070.

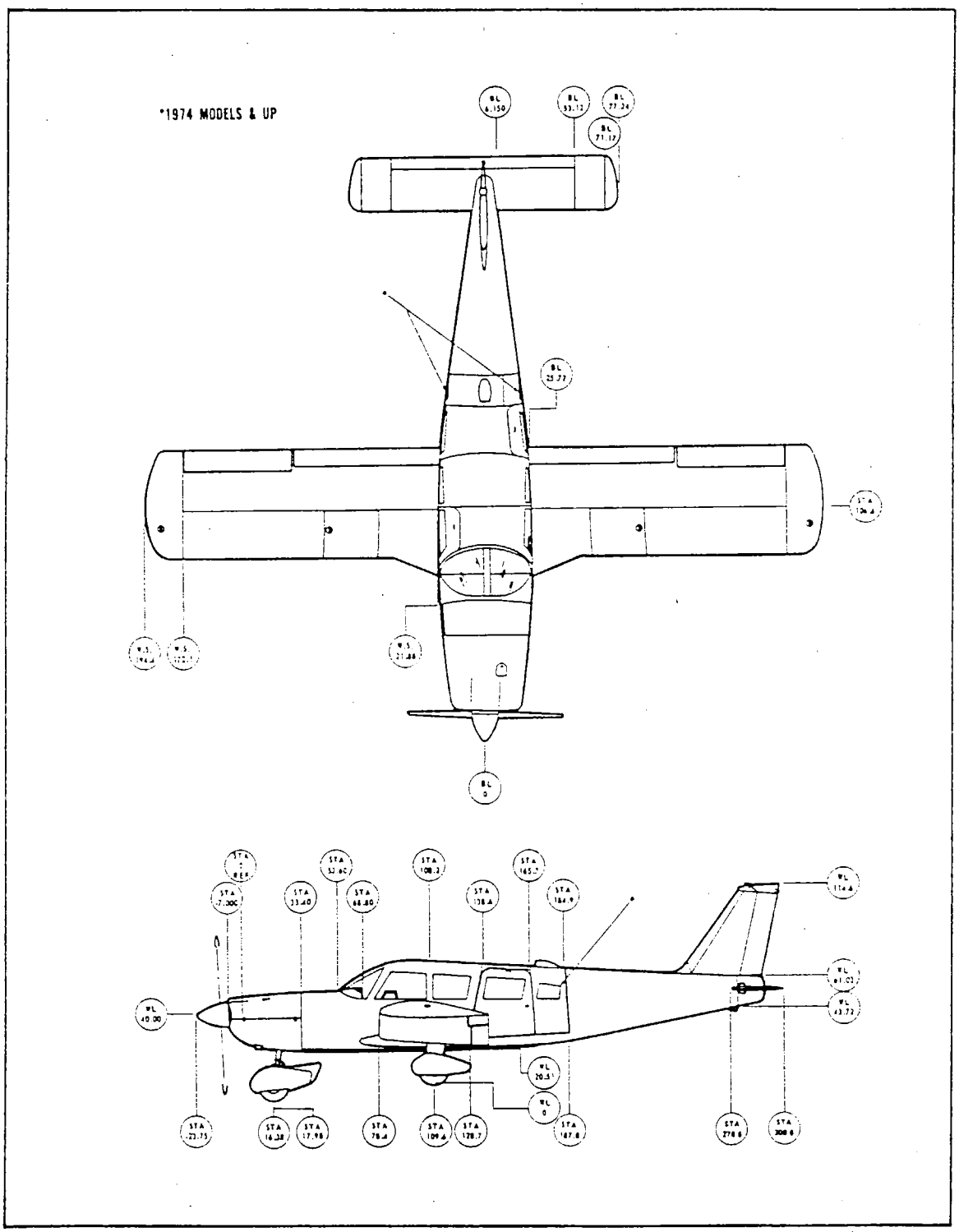


Figure 2-2. Station Reference Lines (PA-32-260 and 300)

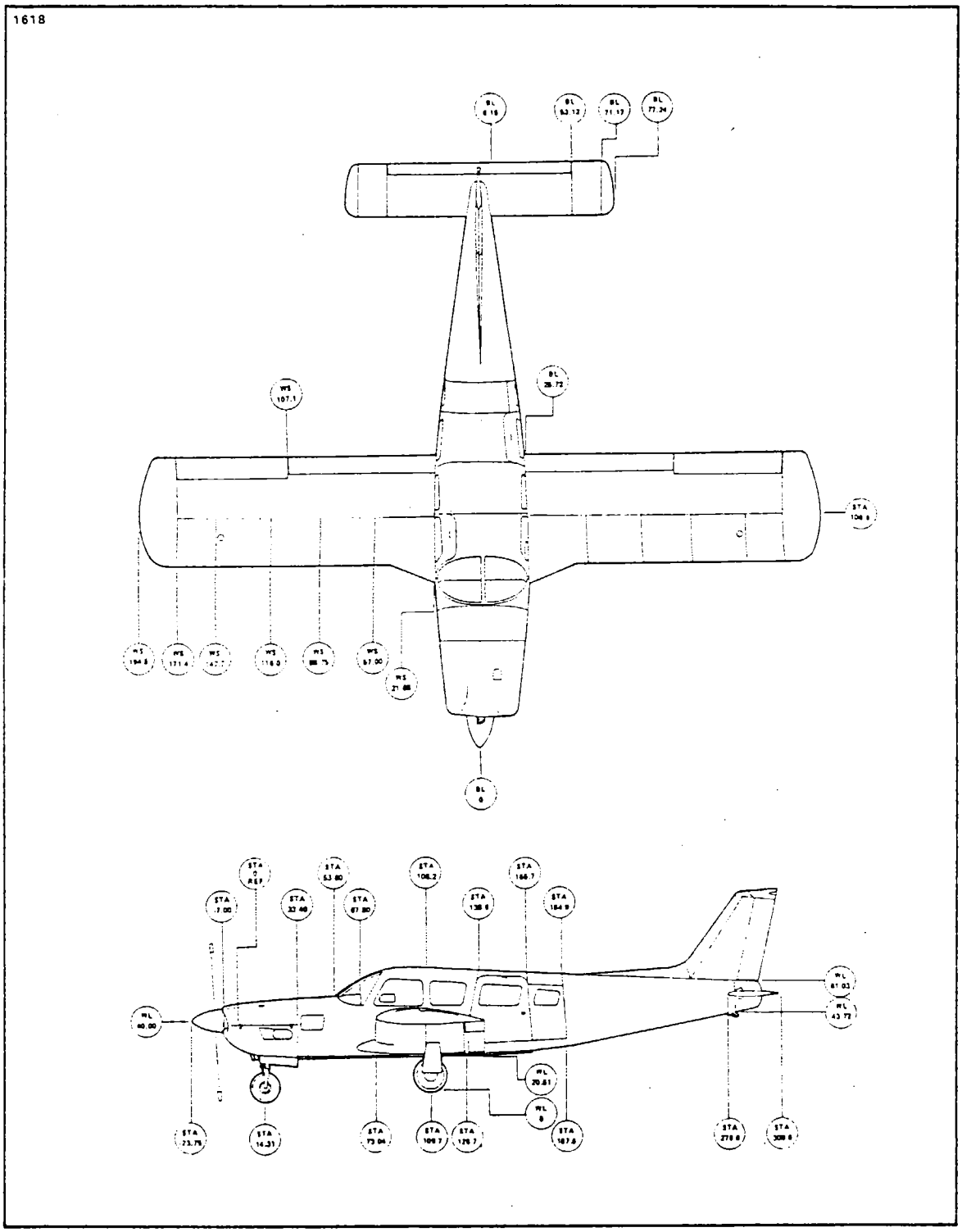


Figure 2-2a. Station Reference Lines (PA-32R-300)

2-5. ACCESS AND INSPECTION PROVISIONS. The access and inspection provisions for the airplane are shown in Figure 2-3. The component to be serviced or inspected through each opening is identified in the 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 attachment screws.

CAUTION

Before entering the aft section of the fuselage, be sure the airplane is supported at the tail skid.

2-6. 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 back of the section that pertains to a particular component or are listed in the back of the PA-32 Parts Catalog.

2-7. TORQUE REQUIREMENTS. The torque values given in Table II-II are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torqueing is required, unless otherwise noted in sections where other values are stipulated. Engine torque values are found in the latest revision of Avco-Lycoming SSP 2070-3, and propeller torque values are found in Section VII or VIIA of this manual.

2-8. STEP, HANDHOLD, AND WALKWAYS. A fixed handhold is located on the right side of the fuselage, above and aft of the center seat window. The walkway is made up of a non-skid compound applied to the wing surface.

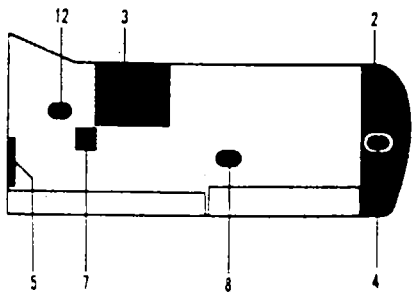
CAUTION

Walk on the walkways only to avoid damage to the wings.

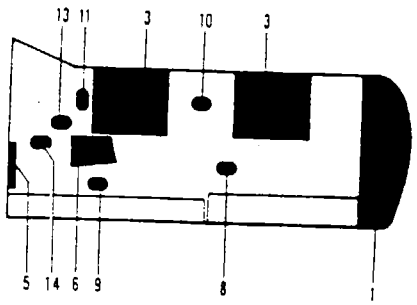
817

UPPER WING SURFACE

32-260 & 300

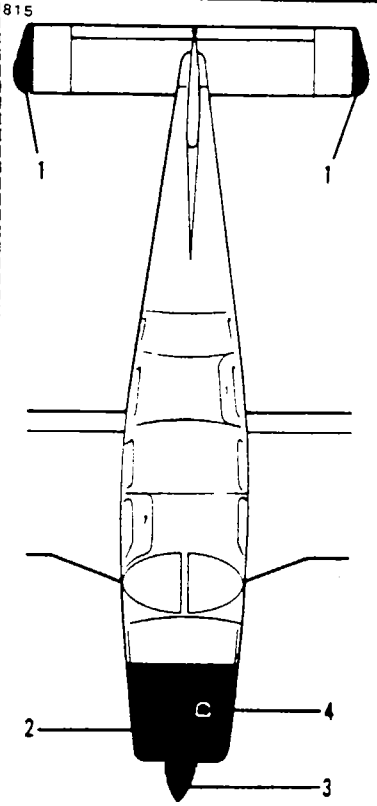


32-300 S/N 32-7940009 AND UP
AND
32R-300
*32-300 S/N 32-7940001 AND UP



1. WING TIP
2. TIP FUEL TANK
3. MAIN FUEL TANK
4. COVER, TIP TANK
5. FAIRING, FLAP TORQUE TUBE & AILERON CABLES
6. DOOR, MAIN GEAR
7. COVER, GEAR ACCESS
8. COVER, AILERON BELLCRANK ACCESS
9. COVER, GEAR ATTACHMENT FITTING
10. COVER, FUEL FITTING
11. COVER, FUEL & BRAKE FITTINGS AND GEAR ATTACHMENT FITTING
12. COVER, BRAKE FITTING
13. COVER, FUEL FITTING
14. COVER, FUEL LINE ACCESS*

815

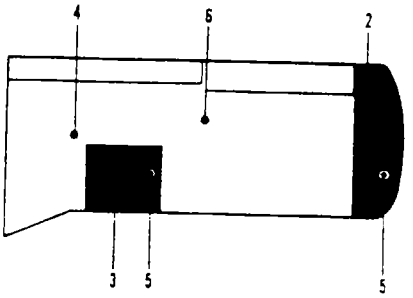


1. TIP, STABILATOR
2. COWL, ENGINE ACCESS
3. SPINNER, PROPELLER
4. DOOR, OIL FILLER

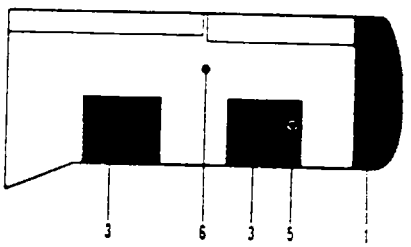
817

LOWER WING SURFACES

32-260 & 300



32-300 S/N 32-79400009 AND UP
AND
32R-300



1. WING TIP
2. TIP FUEL TANK
3. MAIN FUEL TANK
4. PLUG, MAIN GEAR SERVICE
5. CAP, FUEL TANK
6. PLUG, AILERON BELLCRANK ACCESS

Figure 2-3. Access Plates and Panels

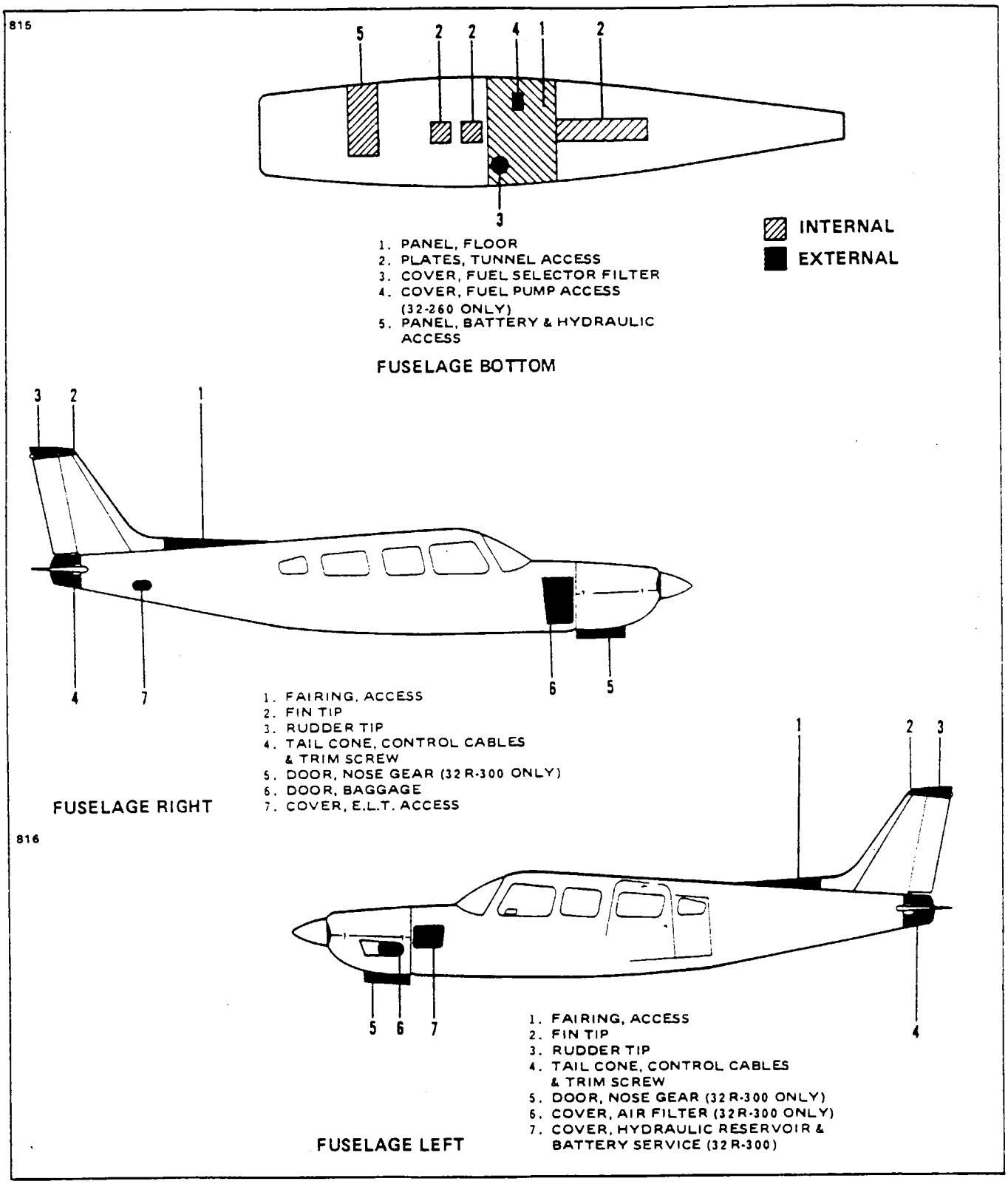


Figure 2-3. Access Plates and Panels (cont.)

TABLE II-II. RECOMMENDED NUT TORQUES

TORQUES: The importance of correct application cannot be overemphasized. Undertorque can result in unnecessary wear of nuts and bolts as well as the parts they are holding together. When insufficient pressures are applied, uneven loads will be transmitted throughout the assembly which may result in excessive wear or premature failure due to fatigue. Overtorque can be equally damaging because of failure of a bolt or nut from overstressing the thread areas. The following procedures should be followed to assure that the correct torque is applied:

1. Torque (self-locking fasteners) — Add the friction torque from Chart A for sizes 8 through 7/16 to the recommended torque from Chart B to get the final torque. This would be the actual reading on the torque wrench.
2. Torque (castellated and non-self-locking nuts) — Use only the torque given in Chart B. Unless otherwise specified, when castellated nuts are used with a cotter pin on moving joints, do not torque the nut. Turn the nut onto the bolt until proper grip is established and alignment with the cotter pin hole is achieved. Then install the cotter pin.

GENERAL REQUIREMENTS:

1. Calibrate the torque wrench periodically to assure accuracy; recheck frequently.
2. Ascertain that the bolt and nut threads are clean and dry (unless otherwise specified by the manufacturer). If the bolt or nut is specified to be lubricated prior to tightening, the torque range should be reduced 50 percent.
3. Use a bolt length long enough to prevent bearing loads on the threads. The complete chamfer or end radius of the bolt or screw must extend through the nut.
4. Unique torques specified in the text of this manual supersede the torques given in Charts A and B.
5. Refer to the latest revision of Lycoming SSP 1776 for torques on parts used on Lycoming engines.
6. A maximum of two AN960 washers may be added under the bolt heads or nuts to correct for variations in material thickness within the tolerances permitted.
7. Limitations of the use of self-locking nuts, bolts and screws including fasteners with non-metallic inserts are as follows:
   A. Fasteners incorporating self-locking devices shall not be reused if they can be run up using only fingers. 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.
   B. Bolts 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 bolts are free from burrs around the cotter pin hole.
   C. Do not use self-locking nuts at joints which subject either the nut or the bolt to rotation.
   D. Never tap or rethread self-locking fasteners. Do not use nuts, bolts or screws with damaged threads or rough ends.

TABLE II-II. RECOMMENDED NUT TORQUES (cont.)

TABLE A

BOLT SIZE	FRICTION DRAG TORQUE (IN LBS.)
8*	15
10	18
1/4	30
5/16	60
3/8	80
7/16	100

*APPLICABLE TO COARSE THREADS ONLY

TABLE B

	BOLTS Steel Tension	
	AN 3 thru AN 20 AN 42 thru AN 49 AN 73 thru AN 81 AN 173 thru AN 186 MS 20033 thru MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039	
	NUTS	
	Steel Tension	Steel Shear
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364

COARSE THREAD SERIES

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

PPS 20016E

TABLE II-II. RECOMMENDED NUT TORQUES (inch pounds) (cont.)

FINE THREAD SERIES												
	BOLTS Steel Tension				BOLTS Steel Tension				BOLTS Aluminum			
	AN 3 thru AN 20 AN 42 thru AN 49 AN 73 thru AN 81 AN 173 thru AN 186 MS 20033 thru MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039				MS 20004 thru MS 20024 NAS 144 thru NAS 158 NAS 333 thru NAS 340 NAS 583 thru NAS 590 NAS 624 thru NAS 644 NAS 1303 thru NAS 1320 NAS 172 NAS 174 NAS 517		Steel shear bolt NAS 464		AN 3DD thru AN 20DD AN 173DD thru AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD			
	NUTS				NUTS				NUTS			
	Steel Tension		Steel Shear		Steel Tension		Steel Shear		Alum. Tension		Alum. Shear	
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679		AN 320 AN 364 NAS 1022 MS 17826 MS 20364		AN 310 AN 315 AN 363 AN 365 MS 17825 MS 20365 MS 21045 NAS 1021 NAS 679 NAS 1291		AN 320 AN 364 NAS 1022 MS 17826 MS 20364		AN 365D AN 310D NAS 1021D		AN 320D AN 364D NAS 1022D	
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

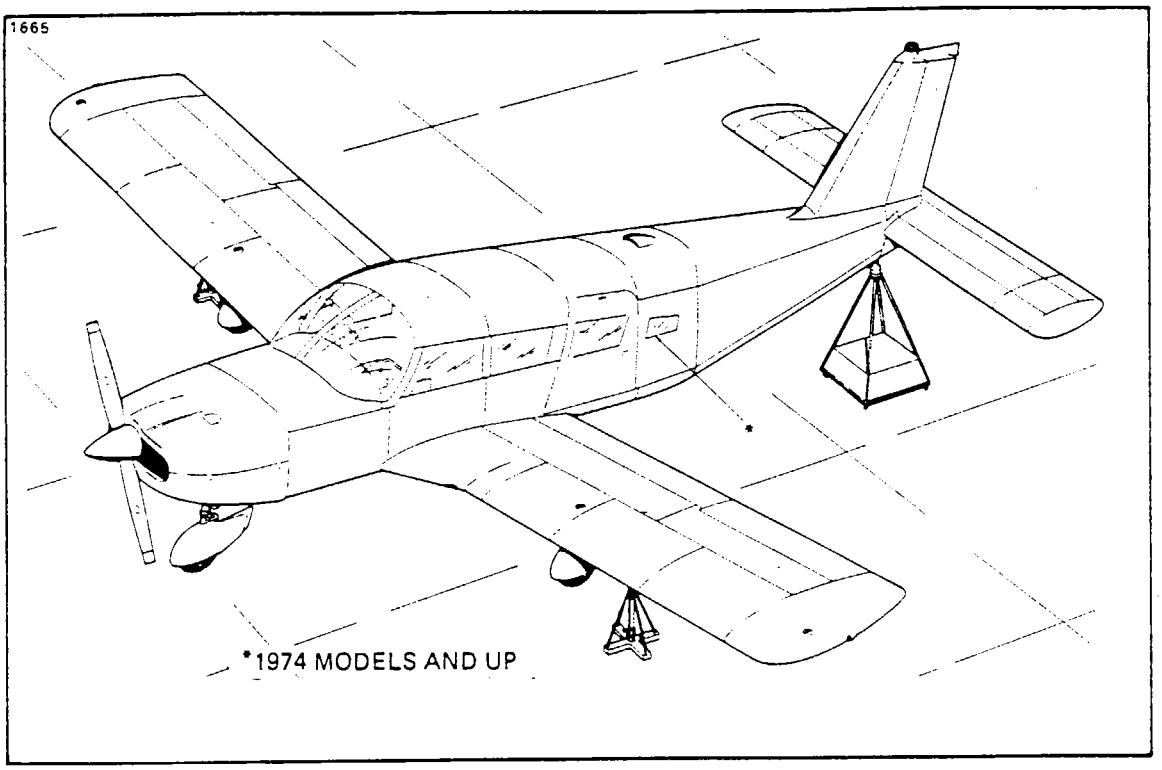


Figure 2-4. Jacking Arrangement

2-9. GROUND HANDLING.

2-10. GENERAL. Ground handling covers essential information governing the handling of the airplane while on the ground. This includes jacking, weighing, leveling, mooring, parking, towing and taxiing. When the airplane is handled in the manner described in the following paragraphs, possible damage to the airplane and its equipment will be minimized.

2-11. JACKING. Jack the airplane to service the landing gear and as specified to perform other service operations. Proceed as follows:

a. Place the jacks under jack pads on the front wing spar. (Refer to Figure 2-4.)

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

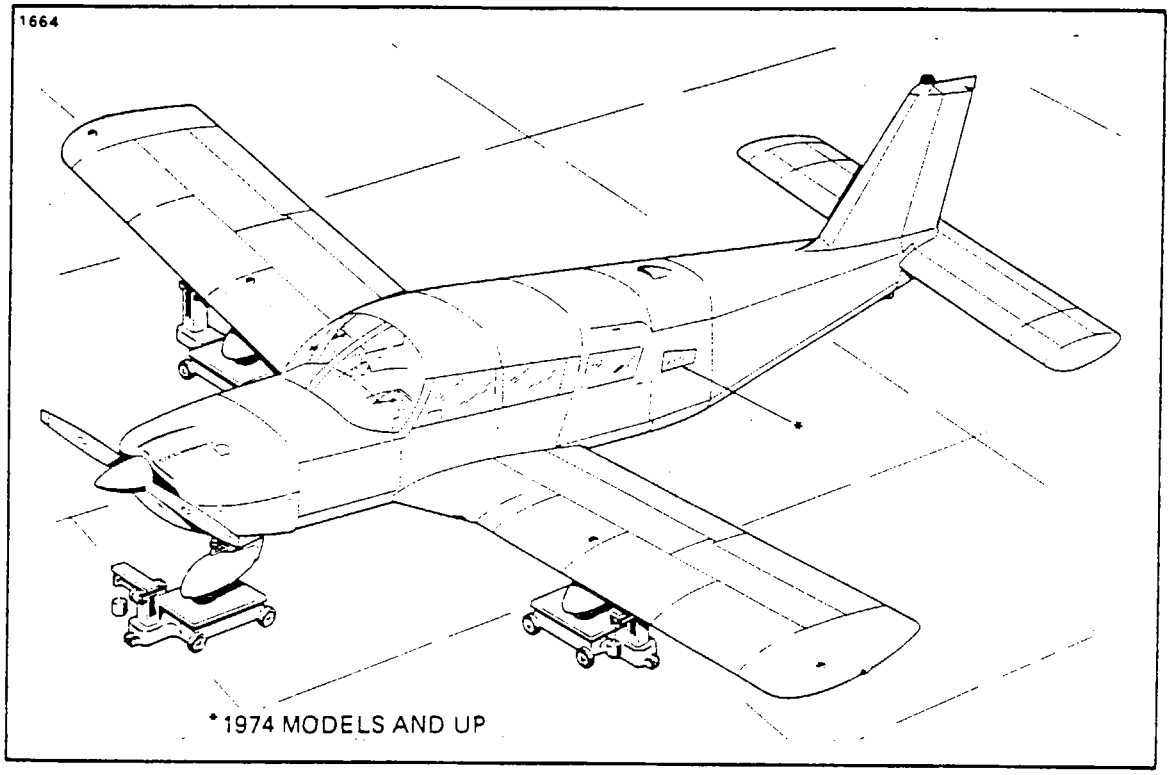


Figure 2-5. Weighing the Airplane

CAUTION

Be sure to apply sufficient tail support ballast; otherwise the airplane will tip forward.

c. Raise the jacks until all three wheels are clear of the surface.

2-12. WEIGHING. (Refer to Figure 2-5.) For weighing purposes, place the airplane on scales as follows:

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

b. Secure the scales from rolling forward and tow the airplane up onto the scales. (Refer to Towing, Paragraph 2-17.)

c. Remove the ramp 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 2-13.

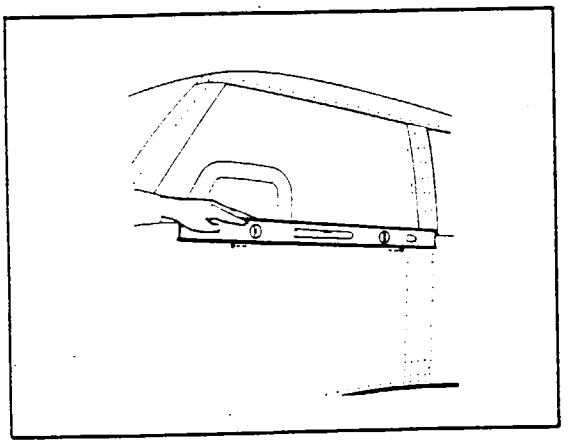


Figure 2-6. Leveling Longitudinally

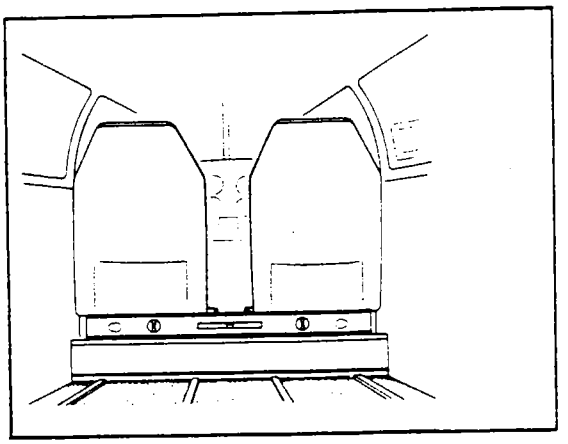


Figure 2-7. Leveling Laterally

2-13. 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 purposes of weighing or rigging, the following procedures may be used:

a. To longitudinally level the airplane, partially withdraw the two leveling screws located immediately below the left front side window. (Refer to Figure 2-6.) Place a spirit level on these screw heads and deflate the nose wheel tire or adjust the jacks until the bubble of the level is centered.

b. To laterally level the airplane, place a spirit level across the baggage compartment floor along the rear bulkhead (Refer to Figure 2-7.) and deflate the tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

2-14. 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. Secure the aileron and stabilator controls using the front seat belt or control surface blocks.

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 on the landing gear forks and securing the rudder.

e. Install pitot tube cover if available.

2-15. LOCKING AIRPLANE. The right cabin door is provided with an outside key lock. The cabin door lock and forward baggage compartment door lock have separate keys.

2-16. PARKING. When parking the airplane, ensure 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 2-14.

a. Park the airplane headed into the wind, if possible.

b. Set the parking brake by pulling back the brake lever and depressing the knob attached to the left side of the handle. Then release the handle. To release the parking brakes, pull back on the brake lever to disengage the catch mechanism. Then allow the handle to swing forward.

NOTE

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

c. The aileron and stabilator controls may be secured using the front seat belt.

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.

2-17. TOWING. The airplane may be moved by using the nose wheel steering bar that is stowed below the forward ledge of the rear baggage compartment, or by using power equipment that will not damage or cause excess strain to the nose gear steering assembly. On PA-32-260 and PA-32-300 airplane towing lugs are incorporated as part of the nose gear fork. On PA-32R-300 models, the stem on the towing bar is inserted in the hollow of the nose wheel axle at its right side.

CAUTION

When towing with power equipment, do not turn the nose gear in either direction beyond its steering radius limits as this will result in damage to the nose gear and steering mechanism. 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. Do not tow airplane with controls or control surfaces secured.

In the event towing lines are necessary, lines (rope) should be attached to both main gear struts as high up on the tubes as possible. Lines should be long enough to clear the nose and/or tail by not less than 15 feet, and a qualified person should ride in the pilot's seat to maintain control by use of the brakes.

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, avoid 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 receptacle is located on the left side of the nose section, just aft of the engine cowling. When used for engine starting or operation of the airplanes' other equipment, proceed as follows:

a. Set MASTER SWITCH to OFF.

b. Ensure that the RED lead of PEP (Piper External Power) kit jumper cable is connected to the POSITIVE (+) terminal of an external 12-volt battery or a power cart and that the BLACK lead is connected to the NEGATIVE (-) terminal.

NOTE

If using an external battery and the airplane's battery is low or depleted, disconnect the airplane battery at the negative terminal to prevent excessive loading of the external battery.

c. Insert the plug of the jumper cable into the receptacle.
d. Set MASTER SWITCH to ON and proceed with NORMAL engine starting.
e. After starting engine, set the MASTER SWITCH to OFF and remove the jumper cable plug from the receptacle.
f. Set the MASTER SWITCH to ON and check the alternator ammeter for an indication of output.

WARNING

Do not attempt flight without an indication of alternator output.

NOTE

If the aircraft battery is weak, charging current will be high. Do not take off until charging current falls below 20 amperes. Do not take off with a completely discharged battery as three-volts are needed to excite the alternator.

2-21. SERVICING.

2-22. GENERAL. Servicing the airplane includes the replenishment of fuel, oil, hydraulic fluid, tire pressures, lubrication requirements and other items required to completely service the airplane.

2-23. FUEL SYSTEM.

2-24. SERVICING FUEL SYSTEM. At intervals of 50 hours or 90 days, whichever comes first, clean the screens and bowl in the fuel filter unit of the fuel selector, and in the fuel pump(s) of the PA-32-260. Remove and clean the filters in accordance with the instructions outlined in Section VIII. Additional service information may also be found in Section VIII. Inspection intervals of the various fuel system components may be found in Section III.

2-25. FILLING FUEL TANKS. The fuel tanks of each wing are filled through filler necks. A filler neck is provided for main and tip tanks on PA-32-260 and 300. The filler neck on PA-32-300 (S/N 32-7840009 and up) and PA-32R-300 services both inboard and outboard tanks. On PA-32-260 and 300 each wing tank holds a capacity of 25 U.S. gallons while each tip tank holds a capacity of 17 U.S. gallons. On PA-32R-300 each wing with interconnecting tanks has a capacity of 49 U.S. gallons.

a. Observe all required safety precautions for handling gasoline.
b. Fill the tanks with fuel as specified on the placard adjacent to the filler neck or as indicated in Table II-I.

2-26. DRAINING MOISTURE FROM FUEL SYSTEM. The fuel system should be drained daily prior to first flight and after refueling to avoid the accumulation of water or sediment. Each fuel tank is equipped with an individual quick drain located at the lower inboard rear corner of the tank. The fuel strainer and a system quick drain valve are located in the fuselage at the lowest point of the fuel system. It is important that the fuel system be drained in the following manner:

a. Drain each tank through its individual quick drain located at the lower inboard rear corner of the tank, making sure that enough fuel has been drained to ensure that all water and sediment is removed.

b. Place a container under the fuel sump drain outlet, which is located under the fuselage.

c. Drain the fuel strainer by pressing down on the lever located on the right-hand side of the cabin below the forward edge of the center seat. The fuel selector must be positioned in the following sequence: off position, left tip, left main, right main, and right tip for PA-32-260 and 300, and off position, left main and right main for PA-32R-300 and PA-32-300 (S/N 32-7940001 and up) while draining the strainer to ensure that the fuel lines between each tank outlet and fuel strainer are drained as well as the strainer. When the fuel tanks are full, it will take approximately 11 seconds to drain all the fuel in one of the lines between a tip tank (PA-32-260 and 300 models only) and the fuel strainer and approximately six seconds to drain all the fuel in one of the lines from a main tank to the fuel strainer. When the fuel tanks are less than full, it will take a few seconds longer.

d. Examine the contents of the container placed under the fuel sump drain outlet for water and sediment and dispose of the contents.

CAUTION

When draining any amount of fuel, care should be taken to ensure that no fire hazard exists before starting engine.

NOTE

After using the underseat quick drain, it should be checked from outside to make sure it has closed completely and is not leaking.

2-27. DRAINING FUEL SYSTEM. Fuel may be drained from the system by opening the valve at the inboard end of each fuel tank. Push up on the arms of the drain valve and turn counterclockwise to hold the drain in the open position. The flush type drain valve requires the drain cup pin to hold valve open. The remaining fuel in the system may be drained through the filter bowl. Any individual tank on a PA-32-260 and 300 or tank set on PA-32R-300 and those PA-32-300 with S/N 32-7940001 and up, may be drained by closing the selector valve and then draining as desired.

2-27A. ANTI-ICING FUEL ADDITIVE. The aircraft may be operated with an anti-icing fuel additive meeting the specification MIL-L-27686 added to the fuel providing that the following specifications and cautions are adhered to:

a. The additive must be uniformly blended with the fuel while refueling.
b. It must not exceed .15% by volume of the refueled quantity.
c. To insure its effectiveness, it should be blended at not less than .10% by volume. (One and one-half liquid ozs. per ten gallons of fuel would fall within this range.)
d. A blender supplied by the additive manufacturer should be used.
e. Except for the information contained in this section, the manufacturer's mixing or blending instructions should be carefully followed.

CAUTIONS

Assure that the additive is directed into the flowing fuel stream. The additive flow should start after and stop before the fuel flow. Do not permit the concentrated additive to come into contact with painted surfaces or the interior surfaces of the fuel tanks.

Some fuels have anti-icing additives pre-blended in the fuel at the refinery so no further blending should be performed.

Fuel additives cannot be used as a substitute for preflight draining of the fuel system drains.

2-28. BRAKE SYSTEM.

2-29. 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 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 2-30. When found necessary to accomplish repairs to any of the brake system components, or to bleed the system, these instructions may be found in Section VI.

2-30. 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 on the left side of the firewall in the engine compartment, should be checked at every 50-hour inspection and replenished as necessary. No adjustment of the brakes is necessary, though they should be checked periodically per instructions given in Section VI.

2-31. 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 hand brake lever and the desired brake pedal until fluid ceases to flow. To drain the wheel brake unit, disconnect the line at the bottom of the unit and allow fluid to flow into a suitable container. To clean the brake system, flush with denatured alcohol.

2-32. HYDRAULIC SYSTEM (PA-32R).

2-32a. SERVICING HYDRAULIC SYSTEM. The general condition of the hydraulic pump and landing gear actuating cylinders should be checked. Ensure that there are no leaks and that the line fittings are tight. The cylinder rods are to be free of all dirt and grit. To clean the rods use an oil soaked rag and carefully wipe them. All the hydraulic lines should also be checked for leaks, kinks, and corrosion. Check the tightness of the attachment fittings.

The gear back up extender actuator assembly is located beneath the floorboard of center seats and should be checked to determine that it is operating properly. The diaphragm shaft may be operated by hand to make sure that it is free to fluctuate and that the actuating arm and its components are operating freely. Check the pressure housing assembly for cracks, breaks, or fatigue. Check to ensure that the hydraulic valve and fittings are free of leaks.

Repair and check procedures for the hydraulic pump, cylinders and various components may be found in Section VA of this manual.

2-32b. SERVICING HYDRAULIC PUMP/RESERVOIR. The fluid level of the reservoir of the combination pump and reservoir should be checked every 50 hours by viewing the fluid through the filler plug hole in the hydraulic pump. Access to the pump is through the panel at the left side of forward baggage compartment.

To check fluid level, remove the filler plug located on the forward side of the pump and ascertain that fluid is visible up to the bottom of the filler plug hole. Should fluid be below the hole, add fluid, MIL-H-5606A, through the filler hole until full. Reinstall the filler plug and tighten.

NOTE

A small vent hole is located under the vent screw head. Retain 1/64 inch clearance between the screw head and the small vent hole.

2-33. LANDING GEAR SYSTEM.

2-33a. SERVICING LANDING GEAR. The landing gear consists of tires, brakes, oleo strut assemblies and on some models wheel fairings. These should be inspected for proper gear extension, scored piston tubes, possible hydraulic fluid leakage, security and condition of all connection points and the fiberglass fairings for cracks. Check the brake linings for wear and frayed edges, and brake discs for scoring. Replace if found necessary. In addition, the PA-32R should be checked for proper adjustment of downlock hooks, looseness of drag links and side brace links. Minor servicing is described in the following paragraphs, and for detailed service and overhaul instructions. (Refer to Section VI or VIA.)

2-34. OLEO STRUTS.

2-34A. SERVICING OLEO STRUTS. The air-oil type oleo strut should be maintained at proper strut tube exposures for best oleo action. The nose gear strut must have approximately 3.50 ± .50 inches on PA 32-260; 3.25 ± .25 inches on PA 32-300; or 2.75 inches on PA 32-R. The main gear strut requires approximately 4.50 ± .25 inches on PA 32-260; 4.50 ± .50 inches on PA 32-300; or 4.00 inches on PA 32R. Refer to Table II-IV.

CAUTION

Do not exceed these tube exposures.

These measurements are taken with the airplane sitting on level surface under normal static load. (Empty weight of airplane plus full fuel and oil.) If the strut has less tube exposure than prescribed, determine whether it needs air or oil by rocking the airplane. If the oleo strut oscillated 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 2-36.

NOTE

Valves should be installed with a torque of 45 ft. lbs. The valve caps with bare threads should also be torqued to 45 ft. lbs. while caps with phosphate coating torqued to 22.5 ft. lbs.

If the oleo 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 Paragraphs 2-34, 2-35 or 2-35a. For repair procedures of the landing gear and/or oleo struts, refer to Section VI or VIA.

WARNING

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

CAUTION

Dirt and foreign particles form around the filler plugs of the landing gear struts, therefore, before attempting to remove these plugs, the tops of the struts should be cleaned with compressed air and/or with a dry solvent.

2-35. FILLING NOSE GEAR OLEO STRUT (PA-32-260 and 300). To fill the nose gear oleo strut with hydraulic fluid (MIL-H-5606A), whether it be only the addition of a small amount or if the unit has been completely emptied and will require a large amount, it should be filled as follows:

a. Raise the airplane on jacks until the nose wheel is completely clear of the ground. (Refer to Jacking, Paragraph 2-11.)

b. Place a pan under the gear to catch spillage.

c. If not previously accomplished, remove the engine cowl, and relieve air from the strut housing chamber by removing the cap from the air valve and depressing the valve core.

d. There are two methods by which the strut chamber may be filled and these are as follows:

First Method:

1. Remove the valve core from the filler plug at the top of the strut housing. Allow the plug to remain installed.

2. Attach one end of a clear plastic hose to the valve stem of the filler plug and submerge the other end in a container of hydraulic fluid. Ascertain that the end of the hose on the valve stem is tight and the fluid container is approximately equal in height to the top of the strut housing.

3. Fully compress and extend the strut thus drawing fluid from the fluid container and expelling air from the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.

4. When air bubbles cease to flow through the hose, compress the strut fully and remove the hose from the valve stem.

5. With the strut compressed, remove the filler plug to determine that the fluid level is visible up to the bottom of the filler plug hole.

6. Reinstall the core in the filler plug and apply thread lubricant (Parker 6PB) to the threads of the filler plug and install the plug in the top of the strut housing. Torque the plug to 45 foot-pounds.

Second Method:

1. Remove the filler plug from the top of the strut housing.
2. Raise the strut piston until it is fully compressed.
3. Pour fluid from a clean container through the filler opening until it reaches the bottom of the filler plug hole.
4. Install the filler plug finger tight, and extend and compress the strut two or three times to remove any air that may be trapped in the housing.
5. Remove the filler plug, raise the strut to full compression and fill with fluid if needed.
6. Apply thread lubricant (Parker 6PB) to the threads of the filler plug. Reinstall the filler plug and torque to 45 foot-pounds.

e. Clean off overflow of fluid and inflate the strut as described in Paragraph 2-36.

f. Check that fluid is not leaking around the strut piston at the bottom of the housing.

2-35a. FILLING MAIN GEAR OLEO STRUT (PA-32-260 and 300). To fill with fluid, a main gear oleo strut that is partly full or that has been completely emptied, proceed as follows:

a. Raise the airplane on jacks until the landing gear torque link assembly has almost reached its full travel. (Refer to Jacking, Paragraph 2-11.)

b. Place a pan under the gear to catch spillage.

c. If not previously accomplished, remove the cap on top of the wing to gain access to the top of the strut housing, and relieve air from the strut housing chamber by removing the cap from the air valve and depressing the valve core.

d. Remove any one of the three torque link bolts, and again raise the airplane until a minimum of ten inches (do not exceed twelve inches of tube exposure) of strut tube is exposed with the wheel remaining on the ground. With this amount of tube exposed, it will allow fluid to flow from the middle chamber to the bottom chamber of the strut housing insuring that the bottom chamber is filled with fluid.

NOTE

With the torque links disconnected, the piston tube is free to slide from the strut housing.

e. Fill the main gear housing by one of two methods which are as follows:

First Method:

1. Remove the valve core from the filler plug at the top of the strut housing. Allow the plug to remain installed.

2. Attach one end of a clear plastic hose to the valve stem of the filler plug and submerge the other end in a container of hydraulic fluid.

3. Fully compress and extend (ten +2 -0 inches of strut tube exposed) the strut thus drawing fluid from the fluid container and expelling air from strut chambers. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chambers. The strut must be extended the full ten inches to allow fluid to enter the bottom chamber of strut housing.

4. When air bubbles cease to flow through the hose, compress the strut fully and remove the hose from the valve stem.

5. With the strut fully compressed, remove the filler plug to determine that the fluid level is visible up to the bottom of the filler plug hole.

6. Reinstall the core in the filler plug and apply thread lubricant (Parker 6PB) to the threads of the filler plug and install the plug in the top of the strut housing. Torque the plug to 45 foot-pounds.

Second Method:

1. Remove the filler plug from the top of the strut housing.

2. Raise the strut to full compression.

3. Pour fluid from a clean container through the filler opening until it is visible at the top of the strut chamber. If the housing has been completely emptied or nearly so, allow sufficient time for the fluid to drain through the orifice from the upper chamber into the middle chamber.

4. Lower the gear until the wheel touches the ground (ten +2 -0 inches of strut exposure) and then fully compress and extend the strut three or four times to remove any air that may be trapped and to allow fluid to enter the bottom chamber of the housing.

5. Raise the strut to full compression and if needed, fill with fluid to the bottom of the filler plug.

6. Apply thread lubricant (Parker 6PB) to the threads of the filler plug. Reinstall the filler plug and torque to 45 foot-pounds.

e. Replace the torque link bolt. Tighten bolt only tight enough to allow no side play in the connection.

g. With the airplane raised, retract and extend the gear strut several times to ascertain that the strut actuates freely. The weight of the gear fork and wheel should extend the strut.

h. Clean off overflow of fluid and inflate the strut as described in Paragraph 2-36.

i. Check that fluid is not leaking around the strut piston at the bottom of the housing.

2-35b. FILLING OLEO STRUTS (PA-32R). To fill the nose or main gear oleo strut with fluid (MIL-H-5606A)., whether it be the addition of a small or large amount, proceed as follows:

a. Raise the airplane on jacks. (Refer to Paragraph 2-11.)

b. Place a pan under the gear to catch spillage.

c. At the filler plug, relieve air pressure from the strut housing chamber by removing the cap from the air valve and depressing the valve core.

d. There are two methods by which the strut chamber may be filled and these are as follows:

Method 1:

1. Remove the valve core from the filler plug at the top of the nose gear strut housing or at the top inboard side of the main gear housing. Allow the filler plug to remain installed.

2. Attach one end of a clean plastic hose to the valve stem of the filler plug and submerge the other end in a container of hydraulic fluid.

NOTE

An air-tight connection is necessary between the plastic tube and the 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.

3. Fully compress and extend the strut thus drawing fluid from the fluid container and expelling air from the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.

4. When air bubbles cease to flow through the hose, compress the strut fully and remove the hose from the valve stem.

5. With the strut compressed, remove the filler plug to determine that the fluid level is visible up to the bottom of the filler plug hole.

6. Reinstall the core in the filler plug and apply thread lubricant (Parker 6PB) to the threads of the filler plug and install the plug in the top of the strut housing. Torque the plug to 45 foot-pounds.

Method 2:

1. Remove the filler plug from the top of the nose gear strut housing or at the top inboard side of the main gear housing.

2. Raise the strut piston tube until it is fully compressed.

3. Pour fluid from a clean container through the filler opening until it reaches the bottom of the filler plug hole. (Air pressure type oil container may be helpful.)

4. Install the filler plug finger tight and extend and compress the strut two or three times to remove air from the housing.

5. Remove the filler plug, raise the strut to full compression and fill with fluid if needed.

6. Apply thread lubricant (Parker 6PB) to the threads of the filler plug. Reinstall the filler plug and torque to 45 foot-pounds.

e. With the airplane still on jacks, compress and extend the gear strut several times to ascertain that the strut actuates freely. The weight of the gear fork and wheel should extend the strut.

f. Clean off overflow of fluid and inflate the strut as described in Paragraph 2-36.

g. Check that fluid is not leaking around the strut piston at the bottom of the housing.

2-36. INFLATING OLEO STRUTS. After making certain that an oleo strut has sufficient fluid, attach a strut pump to the air valve and inflate the oleo strut. The strut should be inflated until the correct inches of piston is exposed with normal static load (empty weight of airplane plus full fuel and oil) on the gears. (Refer to Paragraph 2-33.) Rock the airplane several times to ascertain that the gear settles back to the correct strut position. (If a strut pump is not available, raise the airplane and use line pressure from a high pressure air system to inflate the strut. Lower the airplane and while rocking it, let air from the valve to bring the strut down to the proper extension.) Before capping the valve, check for valve core leakage.

2-37. TIRES

2-38. 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. Also ascertain that the tires, tubes, and wheels are properly balanced when installed. Align the index mark on the tire with the index mark on the tube.

2-39. BATTERY.

2-40. SERVICING BATTERY. Servicing of the battery, which is located under the floor panel of the forward baggage compartment, involves adding distilled water to maintain electrolyte even with the horizontal baffles, checking cable connections, and checking for any spilled electrolyte that would lead to corrosion. A check for proper fluid level and presence of corrosion should be conducted at intervals of 50 hours or 30 days, whichever comes first. When corrosion is found, at each 100 hour inspection or every 90 days, the battery should be removed from the box, and the battery and box should be cleaned. Removal, cleaning and charging instructions may be found in Section X of this manual.

2-41. CLEANING.

2-42. 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 pan under the engine to catch waste.

b. With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser, as desired. Brushing after spraying may be necessary to remove heavy grease and dirt deposits.

CAUTION

Do not spray solvent into the alternator, starter, air intake, and alternate air inlets.

c. Allow the solvent to remain on the engine from five 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 filter and magnetos.

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

2-43. CLEANING LANDING GEAR. Before cleaning the landing gear, place a plastic cover or similar material over the wheel and brake assembly.

a. Place a pan under the gear to catch waste.

b. Spray or brush the gear area with solvent or a mixture of solvent and degreaser, as desired. Brushing may be necessary in areas where heavy grease and dirt deposits have collected.

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

d. Remove the cover from the wheel and remove the catch pan.

e. Lubricate the gear per Lubrication Chart.

2-44. 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.

2-45. CLEANING WINDSHIELD AND WINDOWS.

a. Remove dirt, mud, etc., from exterior surfaces 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-VII Consumable Materials, for Specifications and Manufacturer's address.)

2-46. 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.

CAUTION

Solvent cleaners require adequate ventilation.

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

2-47. CLEANING CARPETS. Use a small whisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid. Floor carpets may be removed and cleaned like any household carpet.

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2-48. OIL SYSTEM. (ENGINE.)

2-49. SERVICING OIL SYSTEM. The engine oil level should be checked before each flight and changed after 50 hours of engine operation. During oil change, the oil suction screen(s) should be removed and cleaned, and when installed, the oil filter cartridge replaced. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters provided the element is replaced each 50 hours of operation. The engine manufacturer does not recommend oils by brand names. Use a quality brand Aviation Grade Oil of the proper season viscosity. For information on the use of ashless dispersant oil, refer to Paragraph 2-55 and/or the latest revision of Lycoming Service Instruction Letter 1014.

CAUTION

Do not introduce any trade additive to the basic lubricant.

2-50. FILLING OIL SUMP. The oil sump should normally be filled with oil to the mark on the engine dipstick. The quantity of oil required for the engines may be found in Table II-I. The specified grade of oil may be found in Table II-III, the Lubrication Chart, or on the right cowl panel or each engine oil filler access door. To service the engine with oil, open the quick release access door on top of the cowl and remove the oil filler cap with dipstick.

2-51. DRAINING OIL SUMP. To drain the oil sump, provide a suitable container with a minimum capacity of that required to fill the sump. Remove the engine cowl and open the oil drain valve located on the 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 ensure complete draining of the old oil.

2-52. OIL SCREENS. (SUCTION.) The oil suction screen is located on the bottom aft end of the engine sump, installed horizontally. To remove, cut the safety wire and remove the hex head plug. The screen 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. After cleaning and inspection, place the screen inside the recess in the hex head plug to eliminate possible damage to the screen. Insert the screen into the housing and when certain that the screen is properly seated, tighten and safety the plug with MS-20995-C41 safety wire.

2-53. OIL SCREEN. (PRESSURE.) The oil 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. When reinstalling the screen, it is recommended that a new gasket be used. Ascertain that the screen fits flush with the base surface of the screen housing. Position housing on mounting pad and install attachment bolts. Torque bolts within 50 to 70 inch pounds.

2-54. OIL FILTER (FULL FLOW).

a. The oil filter element should be replaced after each 50 hours of engine operation; 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.

b. Before discarding the filter element, 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 element 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.

c. After the element has been replaced, tighten the attaching bolt within 20 to 25 foot-pounds of torque. Lockwire 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.

2-55. RECOMMENDATIONS FOR CHANGING OIL. (Refer to the 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 ashless dispersant oil should be made with a degree of caution, since the cleaning action of some ashless dispersant 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 ashless dispersant oil should be deferred until after the engine is overhauled.

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

1. Do not add ashless dispersant oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with ashless dispersant 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 and change oil every ten hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

2-56. LUBRICATION

2-57. 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, as detailed in the following paragraphs, together with the observance of cleanliness, will insure the maximum efficiency and utmost service of all moving parts. Lubrication instruction regarding the locations, time intervals, and type of lubricants used may be found in the Lubrication Chart. To insure the best possible results from the application of lubricants, the following precautions should be observed:

a. Use recommended lubricants. Where general purpose lubricating oil is specified, but unavailable, clean engine oil may be used as a satisfactory substitute.

b. Check the components to be lubricated for evidence of excessive wear and replace them as necessary.

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

NOTE

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

2-58. APPLICATION OF OIL. Whenever specific instructions for lubrication of mechanisms requiring lubrication are not available, observe the following precautions:

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

b. Since the control cables are sufficiently coated by the manufacturer, additional protection for the prevention of corrosion is unnecessary.

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.

CAUTION

Be careful not to add too much oil, because the excess will be thrown off during operation and will cause pitting and burning of the magneto points.

2-59. APPLICATION OF GREASE. Care must be taken when lubricating bearings and bearing surfaces with a grease gun, to insure that gun is filled with new, clean grease of the grade specified for the particular application before applying lubricant to the grease fittings.

a. Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe of any excess.

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

c. Use extra care when greasing the constant speed propeller hub to avoid blowing the clamp gaskets. Remove one grease fitting and apply grease to the other fitting until fresh grease appears at the hole of the removed fitting.

2-60. LUBRICATION CHARTS. The lubrication charts consists of individual illustrations for the various aircraft systems, and each component to be lubricated is indicated by a number, the type of lubricant and the frequency of application. Special instructions are listed at the beginning of the lubrication charts and with the applicable component illustration.

TABLE II-III. RECOMMENDED LUBRICATING OILS

Average Ambient Air Temperature	MIL-L-6082 Spec. Mineral Grades	MIL-L-22851 Spec. Ashless Dispersant Grades
All Temperature	- - -	SAE 15W50 or SAE 20W50
Above 80°F	SAE 60	SAE 60
Above 60°F	SAE 50	SAE 40 or SAE 50
30°F to 90°F	SAE 40	SAE 40
0°F to 70°F	SAE 30	SAE 30, SAE 40 or SAE 20W40
0°F to 90°F	- - -	SAE 20W50 or SAE 15W50
Below 10°F	SAE 20	SAE 30 or SAE 20W30
Refer to the latest revision of Avco-Lycoming Service Instructions No. 1014 for additional information.		

AVCO-LYC. S.I. 1014J

TABLE II-IV. VISIBLE STRUT EXTENSION

Model	Piston Tube Exposure
NOSE GEAR	
PA-32-260	3.50 ± .50 inches
PA-32-300	3.25 ± .25 inches
PA-32R	2.75 inches
MAIN GEAR	
PA-32-260	4.50 ± .25 inches
PA-32-300	4.50 ± .50 inches
PA-32R	4.00 inches

CAUTION
Do not exceed these tube exposures.

TABLE II-V. DECIMAL CONVERSION CHART

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV.
				1/64	.016	.02	.397
			1/32		.031	.03	.794
				3/64	.047	.05	1.191
		1/16			.062	.06	1.587
				5/64	.078	.08	1.984
			3/32		.094	.09	2.381
				7/64	.109	.11	2.778
	1/8				.125	.12	3.175
				9/64	.141	.14	3.572
			5/32		.156	.16	3.969
				11/64	.172	.17	4.366
		3/16			.188	.19	4.762
				13/64	.203	.20	5.159
			7/32		.219	.22	5.556
				15/64	.234	.23	5.593
1/4					.250	.25	6.350
				17/64	.266	.27	6.747
			9/32		.281	.28	7.144
				19/64	.297	.30	7.540
		5/16			.312	.31	7.937
				21/64	.328	.33	8.334
			11/32		.344	.34	8.731
				23/64	.359	.36	9.128
	3/8				.375	.38	9.525
				25/64	.391	.39	9.922
			13/32		.406	.41	10.319
				27/64	.422	.42	10.716
		7/16			.438	.44	11.112
				29/64	.453	.45	11.509
			15/32		.469	.47	11.906
				31/64	.484	.48	12.303
					.500	.50	12.700

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M EQUIV.
				33/64	.516	.52	13.097
			17/32		.531	.53	13.494
				35/64	.547	.55	13.891
		9/16			.562	.56	14.288
				37/64	.578	.58	14.684
			19/32		.594	.59	15.081
				39/64	.609	.61	15.478
	5/8				.625	.62	15.875
				41/64	.641	.64	16.272
			21/32		.656	.66	16.669
				43/64	.672	.67	17.065
		11/16			.688	.69	17.462
				45/64	.703	.70	17.859
			23/32		.719	.72	18.256
				47/64	.734	.73	18.653
3/4					.750	.75	19.050
				49/64	.766	.77	19.447
			25/32		.781	.78	19.844
				51/64	.797	.80	20.241
		13/16			.812	.81	20.637
				53/54	.828	.83	21.034
			27/32		.844	.84	21.431
				55/64	.859	.86	21.828
	7/8				.875	.88	22.225
				57/64	.891	.89	22.622
			29/32		.906	.91	23.019
				59/64	.922	.92	23.416
		15/16			.938	.94	23.812
				61/64	.953	.95	24.209
			31/32		.969	.97	24.606
				63/64	.984	.98	25.003
					1.000	1.00	25.400

TABLE II-VI. SPECIAL LUBRICATION INSTRUCTIONS

1. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE LUBRICATING.
2. LUBRICATION POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.

NOTE

1. SEE THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF ASHLESS DISPERSANT OIL.

CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVERLUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.
4. DO NOT LUBRICATE CABLES; THIS CAUSES SLIPPAGE.

TABLE II-VIA. HOSE CLAMP TIGHTENING. (INITIAL INSTALLATION)

Types of hose	Types of clamps	
	Worm screw type	All other types
Self sealing	Finger-tight-plus 2 complete turns	Finger-tight-plus 2 1/2 complete turns
All other hose	Finger-tight-plus 1 1/4 complete turns	Finger-tight-plus 2 complete turns
If clamps do not seal at specified tightening, examine hose connection and replace parts as necessary.		

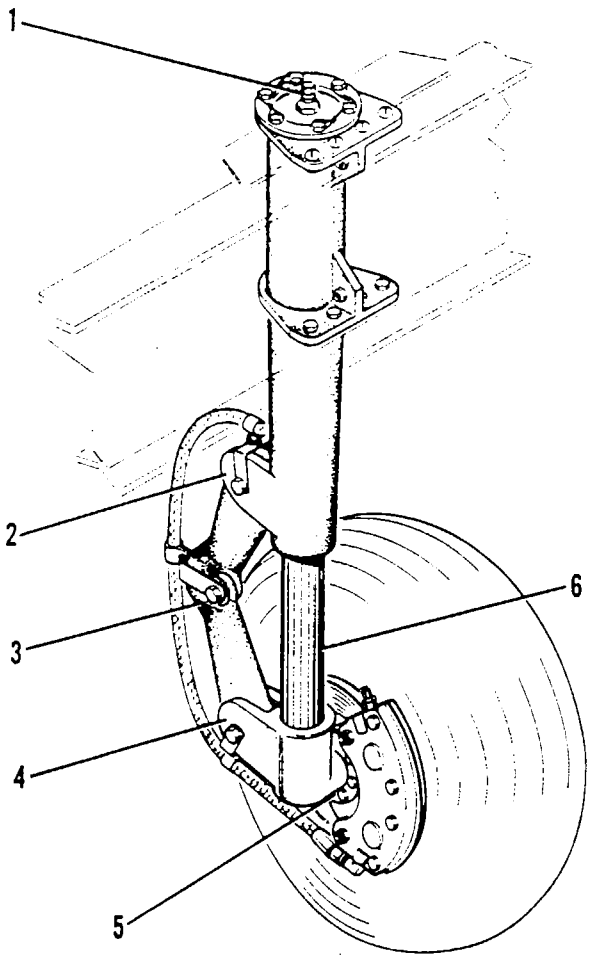
TABLE II-VII. LIST OF CONSUMABLE MATERIALS

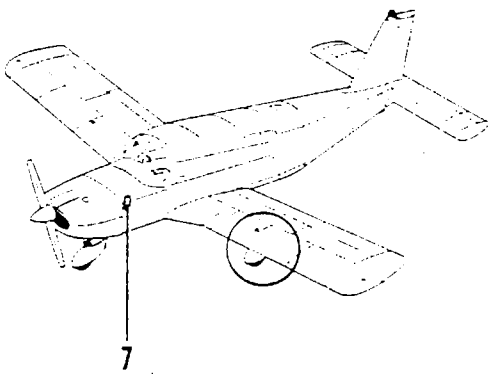
MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Lubricating Oil, General Purpose, Low Temperature	MIL-L-7870		
Oil, Engine (Piston) Mineral Grade Ashless Dispersant Grades	MIL-L-6082 MIL-L-22851		
Hydraulic Fluid	MIL-H-5606A		
Grease, Aircraft and Instrument Gear and Actuator Screw	MIL-G-23827	Texaco Marfak All Purpose Grease	Texaco Inc. 2000 West Chester Ave. White Plains, N.Y. 10650
		Mobil Grease 77 (or Mobilux EP2)	Mobil Oil Corporation 150 E. 42nd St. New York, N.Y. 10017
		Shell Alvania EP Grease 2	Shell Oil Company One Shell Plaza Houston, TX 77002
O-Ring Lubricant Grease, High and Low Temperature, Waterproof		Parker Aero Lubriplate or Aeroshell #7	Parker Seal Co. Fiske Bros. Refining Co. Shell Oil Company 50 West 50th Street New York, N.Y.
Fluorocarbon Release Agent Dry Lubricant	MIL-L-60326	MS-122	Miller-Stephenson
Grease, Lubrication, General Purpose, Aircraft	MIL-G-7711		
Silicone Compound	MIL-C-21567		
Grease, Wide Temperature Range	MIL-G-81322	Mobil Grease 28 Royco 22-S Aeroshell Grease 22	

TABLE II-VII. LIST OF CONSUMABLE MATERIALS (cont.)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Rain Repellent		Repcon FSCM 50159	UNELKO Corporation 727 E. 110th Street Chicago, Illinois 60628
Tape, Teflon	Teflon — .003 x .50 wide -1		Minnesota Mining & Manufacturing Co. 3M Center St. Paul, Minnesota 55144
			Shamban W.S. & Co. 1857 Centinela Ave. Santa Monica, CA 90404
	Teflon — .003 x .25 wide -2		Johnson & Johnson Inc. Permacel Division 501 George St. New Brunswick, N.J. 08903
Adhesive		Carboline F-1	Carboline Co. 328 Hanley Ind. Ct. St. Louis, MO 63144
		Scotch Grip 2210	3M Co. Adhesive Coatings and Sealers Div. 3M Center St. Paul, Minn. 55101
		Proco Adhesive 6205-1	Protective Coating Inc. 807 N. Fremont Ave. Tampa, Fla.
Cleaner		Prep-Sol No. 39195	DuPont 1007 Market St. Wilmington, Del. 19898

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606A	AS REQUIRED
2. UPPER TORQUE LINK BEARING	MIL-G-23827	100 HRS
3. TORQUE LINK BUSHING	MIL-L-7870	100 HRS
4. TORQUE LINK CONNECTING BUSHING	MIL-G-23827	100 HRS
5. MAIN WHEEL BEARING	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
7. BRAKE RESERVOIR	MIL-H-5606A	100 HRS



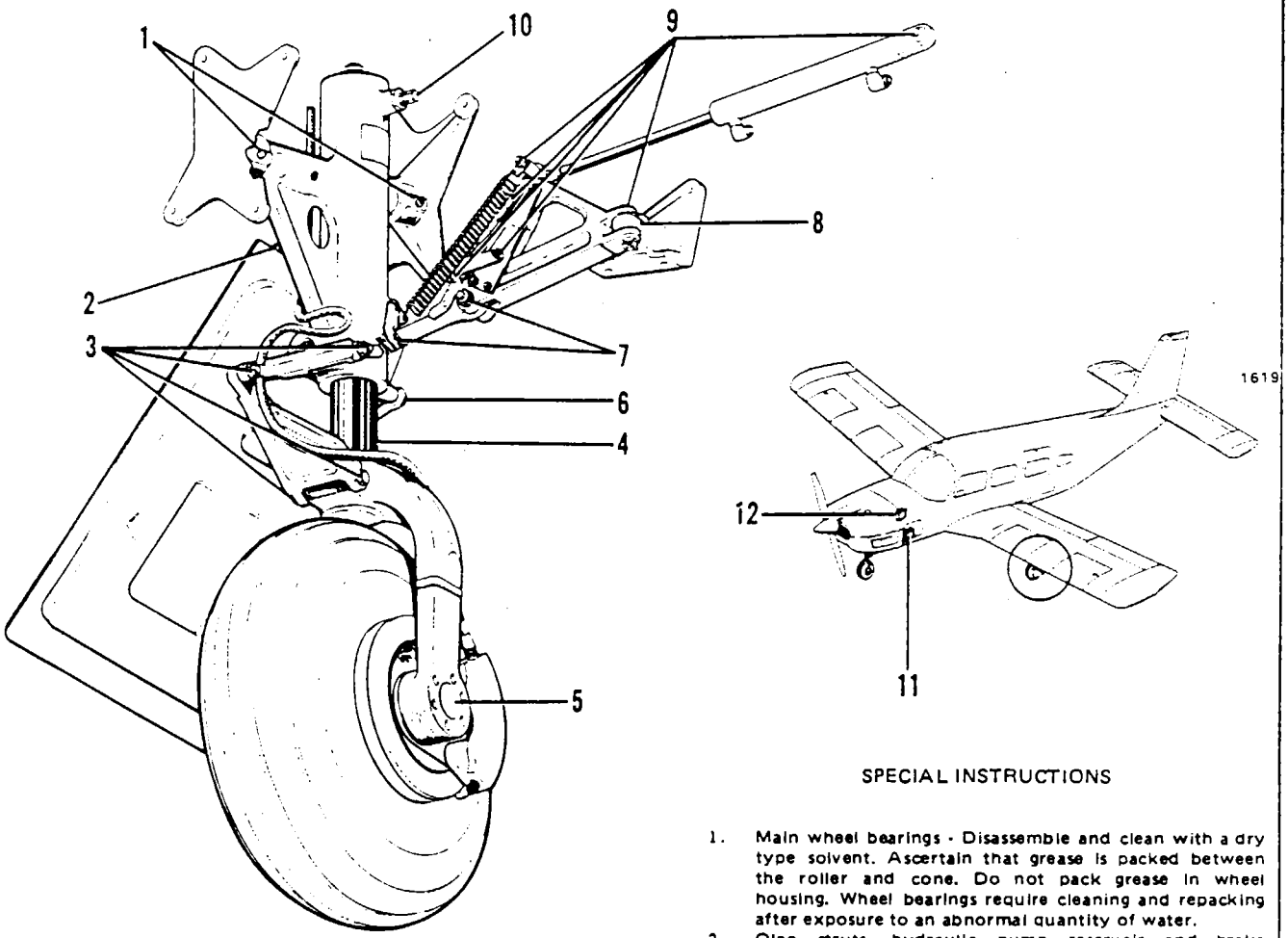


SPECIAL INSTRUCTIONS

1. Main wheel bearings - Disassemble and clean with a dry type 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 an abnormal quantity of water.
2. Oleo struts and brake reservoir - Fill per instructions on unit or container or refer to service manual.

Figure 2-8. Lubrication Chart (Landing Gear, Main) PA-32-260 and 300

COMPONENT	LUBRICANT	FREQUENCY
1. MAIN GEAR PIVOT POINTS	MIL-G-23827	100 HRS
2. MAIN GEAR DOOR HINGE	MIL-L-7870	100 HRS
3. MAIN GEAR TORQUE LINKS	MIL-L-7870	100 HRS
4. EXPOSED OLEO STRUT MAIN	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
5. MAIN GEAR WHEEL BEARINGS	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. MAIN GEAR DOOR CONTROL ROD ENDS	MIL-L-7870	100 HRS
7. MAIN GEAR SIDE BRACE LINK ASSEMBLY	MIL-G-23827	100 HRS
8. UPPER SIDE BRACE SWIVEL FITTING	MIL-G-23827	100 HRS
9. MAIN GEAR DOWNLOCK ASSEMBLY RETRACTION FITTING AND CYLINDER ATTACHMENT POINTS	MIL-L-7870	100 HRS
10. OLEO STRUT FILLER POINT (MAIN GEAR)	MIL-H-5606A	AS REQUIRED
11. HYDRAULIC PUMP RESERVOIR	MIL-H-5606A	100 HRS
12. BRAKE RESERVOIR	MIL-H-5606A	100 HRS

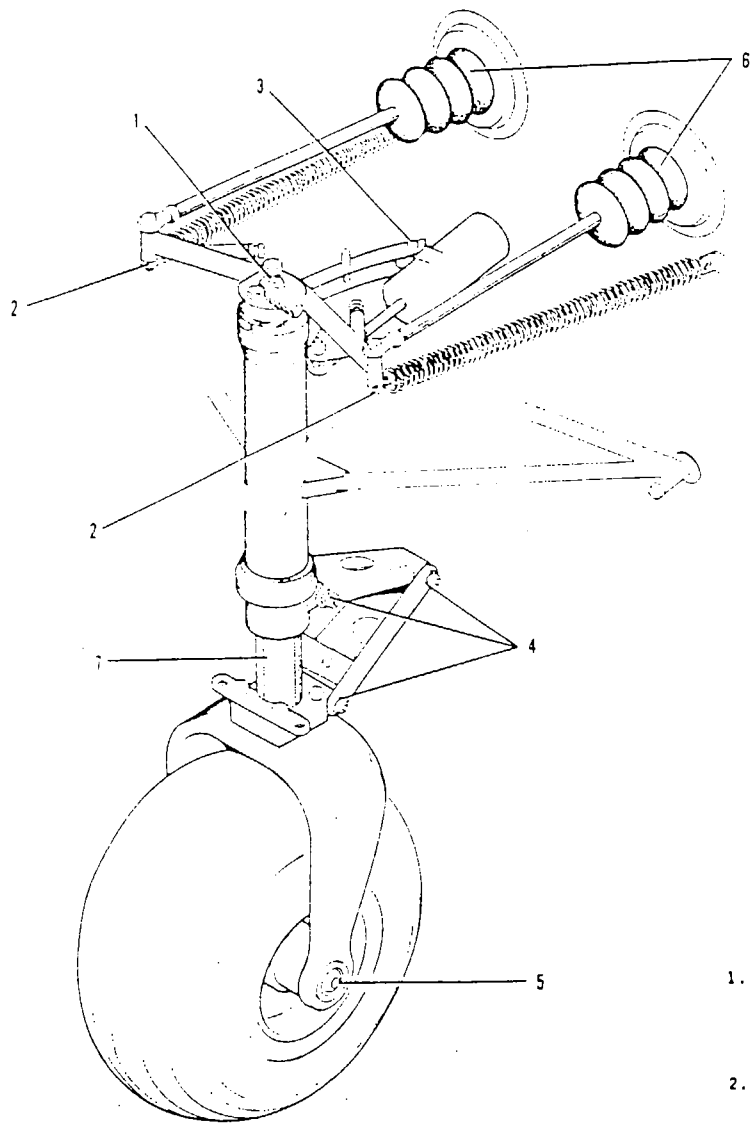


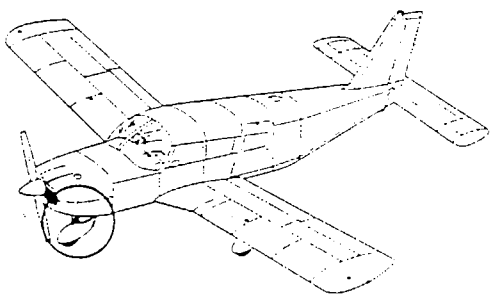
SPECIAL INSTRUCTIONS

1. Main wheel bearings - Disassemble and clean with a dry type 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 an abnormal quantity of water.
2. Oleo struts, hydraulic pump reservoir and brake reservoir - Fill per instructions on unit or container or refer to service manual.

Figure 2-9. Lubrication Chart (Landing Gear, Main) PA-32R-300

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606A	AS REQUIRED
2. STEERING BELLCRANK PIVOT POINT	MIL-L-7870	100 HRS
3. SHIMMY DAMPENER PIVOT POINT	MIL-L-7870	100 HRS
4. TORQUE LINK ASSEMBLY	MIL-L-7870	100 HRS
5. NOSE WHEEL BEARING	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBILUX EP #2 OR SHELL ALVANIA EP GREASE)	100 HRS
6. NOSE GEAR STEERING ROD END BEARINGS	MIL-L-7870	100 HRS
7. EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS



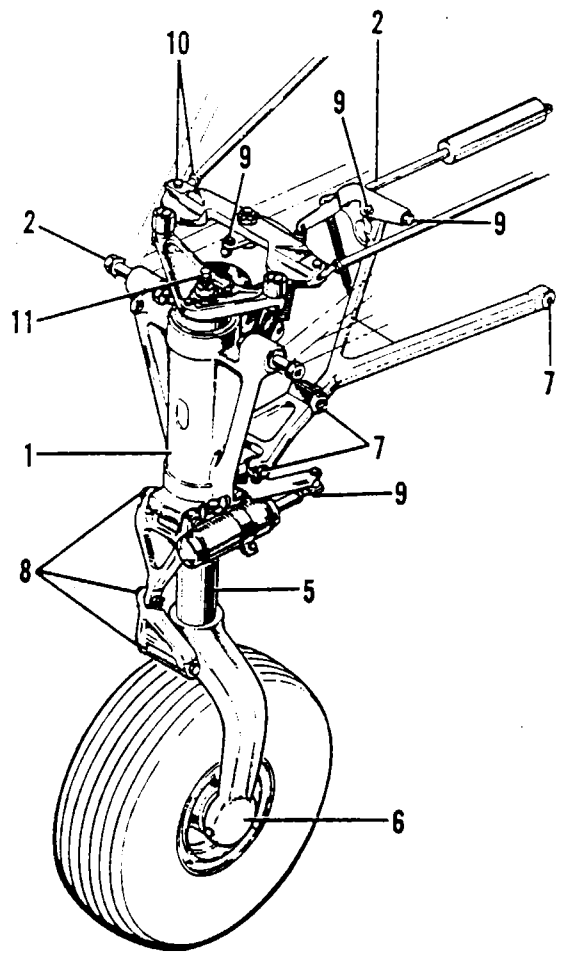


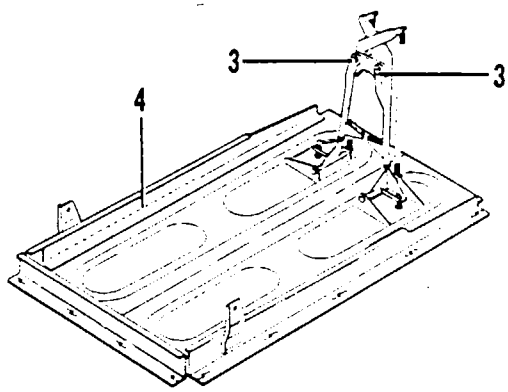
SPECIAL INSTRUCTIONS

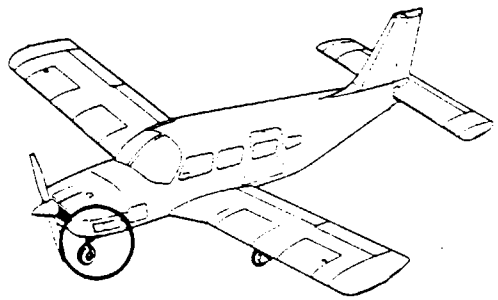
1. Nose wheel bearings - Disassemble and clean with a dry type solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to an abnormal quanity of water.
2. Oleo struts - Fill per instructions on unit or refer to service manual.

Figure 2-10. Lubrication Chart (Landing Gear, Nose) PA-32-260 and 300

COMPONENT	LUBRICANT	FREQUENCY
1. NOSE GEAR STRUT HOUSING GREASE FITTING	MIL-G-23827	100 HRS
2. NOSE GEAR PIVOT POINT AND HYDRAULIC CYLINDER ROD END	MIL-L-7870	100 HRS
3. NOSE GEAR DOOR RETRACTION MECHANISM	MIL-L-7870	100 HRS
4. NOSE GEAR DOOR HINGES	MIL-L-7870	100 HRS
5. EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
6. NOSE WHEEL BEARINGS	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
7. NOSE GEAR DRAG LINK ASSEMBLIES	MIL-L-7870	100 HRS
8. NOSE GEAR TORQUE LINK ASSEMBLY AND STRUT HOUSING	MIL-G-23827	100 HRS
9. DOWNLOCK HOOK, TENSION SPRING ARMS, SHIMMY DAMPENER AND ALIGNING ROLLER PIVOT POINTS	MIL-L-7870	100 HRS
10. STEERING BELLCRANK PIVOT POINTS AND ROD ENDS	MIL-L-7870	100 HRS
11. NOSE GEAR OLEO STRUT FILLER POINT	MIL-H-5606A	AS REQUIRED







SPECIAL INSTRUCTIONS

1. Nose wheel bearings - Disassemble and clean with a dry type 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 an abnormal quantity of water.
2. Oleo struts - Fill per instructions on unit or refer to service manual.

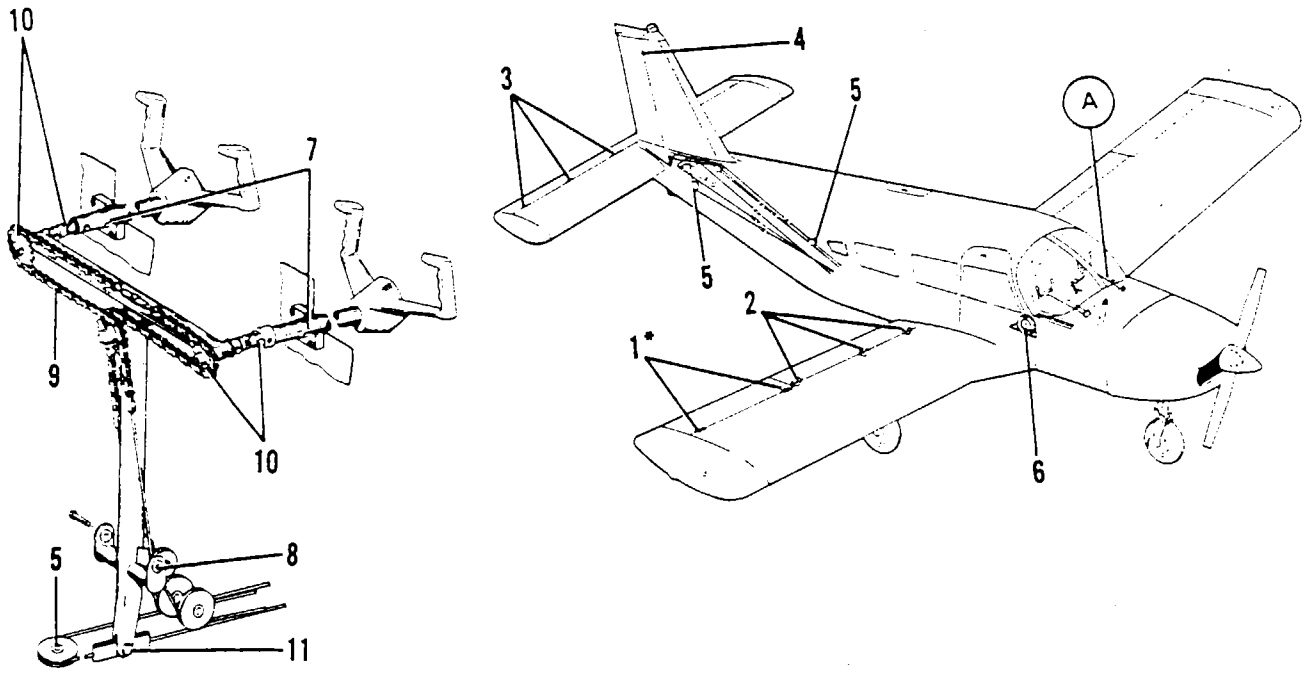
Figure 2-11. Lubrication Chart (Landing Gear, Nose) PA-32R-300

— CAUTION —

Do not lubricate control wheel shaft or bushing. Clean only using alcohol or other suitable solvent.

COMPONENT	LUBRICANT	FREQUENCY
1. AILERON HINGE PINS	MIL-L-7870*	100 HRS
2. FLAP HINGE BEARINGS	MIL-L-7870	100 HRS
3. STABILATOR HINGE PINS	MIL-L-7870	100 HRS
4. RUDDER HINGE BEARINGS	MIL-L-7870	100 HRS
5. CONTROL CABLE PULLEYS	MIL-L-7870	100 HRS
6. TRIM CONTROL WHEEL	MIL-L-7870 OR AEROSHELL #7	100 HRS
7. O-RING, CONTROL SHAFT BUSHING	PARKER O-RING LUBRICANT	AS REQUIRED
8. TEE BAR PIVOT POINT	MIL-L-7870	100 HRS
9. CONTROL COLUMN CHAIN	MIL-L-7870	500 HRS
10. CONTROL COLUMN FLEX. JOINTS AND SPROCKET	MIL-L-7870	100 HRS
11. STABILATOR CONTROL	MIL-L-7870	100 HRS

1776

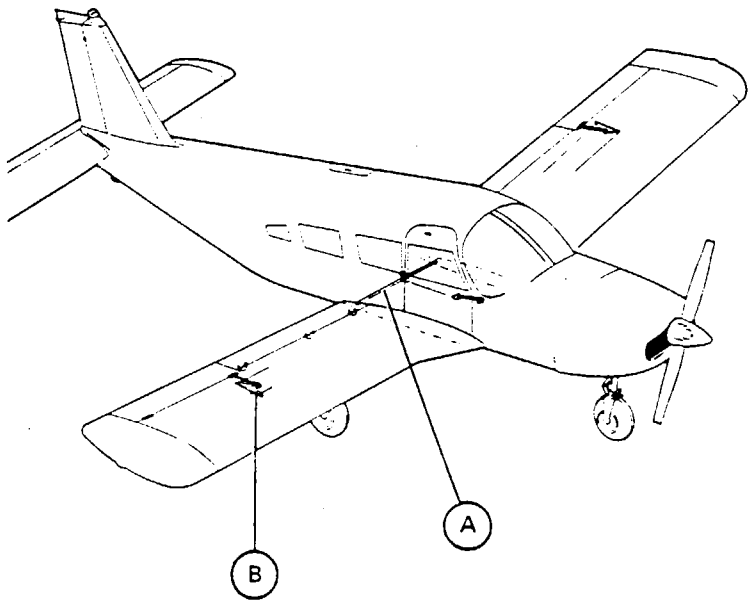


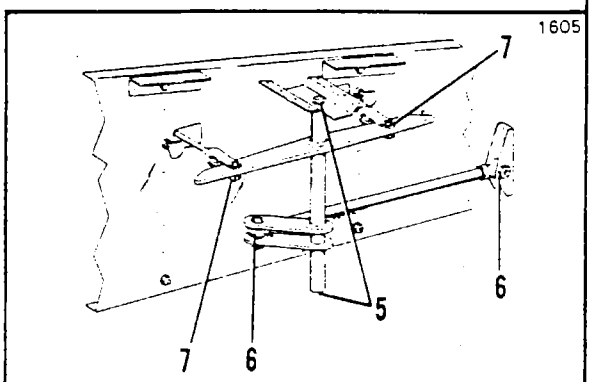
SPECIAL INSTRUCTIONS

* Aileron hinges with teflon sleeves should not be lubricated. Aileron hinges without teflon sleeves should first be cleaned with a dry type solvent then lubricated with MIL-L-7870.

Figure 2-12. Lubrication Chart (Control System)

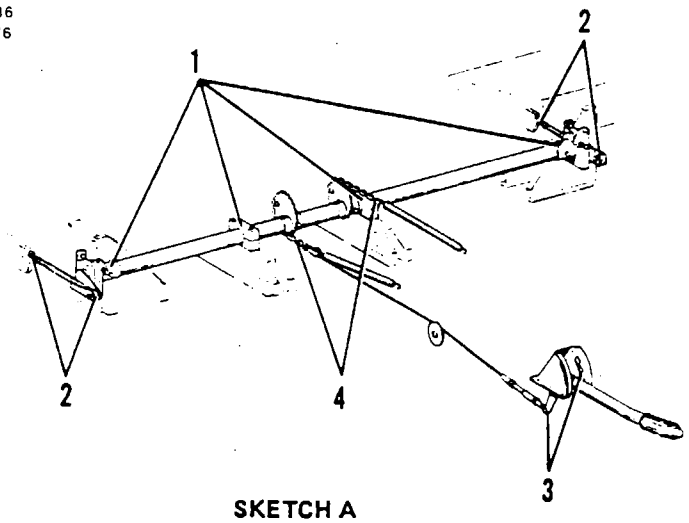
COMPONENT	LUBRICANT	FREQUENCY
1. FLAP TORQUE TUBE BEARING BLOCKS	MIL-L-7870	100 HRS
2. FLAP CONTROL ROD END BEARINGS	MIL-L-7870	100 HRS
3. FLAP HANDLE PIVOT POINT, LOCK MECHANISM AND TURNBUCKLE END	MIL-L-7870	100 HRS
4. FLAP RETURN AND TENSION CHAINS	MIL-L-7870	500 HRS
5. AILERON BELLCRANK PIVOT POINTS	MIL-L-7870	100 HRS
6. AILERON CONTROL ROD END BEARINGS	MIL-L-7870	100 HRS
7. AILERON BELLCRANK CABLE ENDS	MIL-L-7870	100 HRS



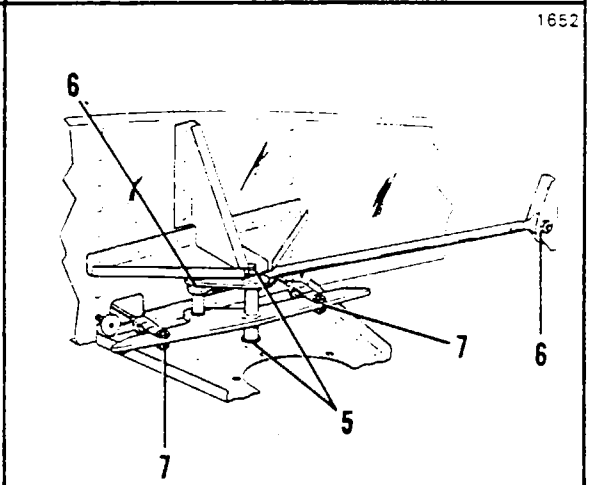


PA-32R-300
SKETCH B

C336
1876



SKETCH A



PA-32-260 & 300
SKETCH B

Figure 2-13. Lubrication Chart (Control System) (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
2. TOE BRAKE CYLINDER ATTACHMENTS	MIL-L-7870 OR AEROSHELL #7	100 HRS
3. RUDDER TUBE CONNECTIONS	MIL-L-7870	100 HRS
4. BRAKE ROD ENDS	MIL-L-7870	100 HRS
5. RUDDER ARM CABLE ENDS	MIL-L-7870	100 HRS
6. STABILATOR TRIM SCREW	AERO LUBRIPLATE, FISKE BROS. REFINING CO. (OR AEROSHELL #7) OR MAG-1	100 HRS.
7. STABILATOR SCREW/TAB LINKS	MIL-L-7870	100 HRS
8. STABILATOR HINGE POINTS	MIL-L-7870	100 HRS
9. RUDDER TRIM ASSEMBLY	MIL-L-7870 (OR AEROSHELL #7)	100 HRS

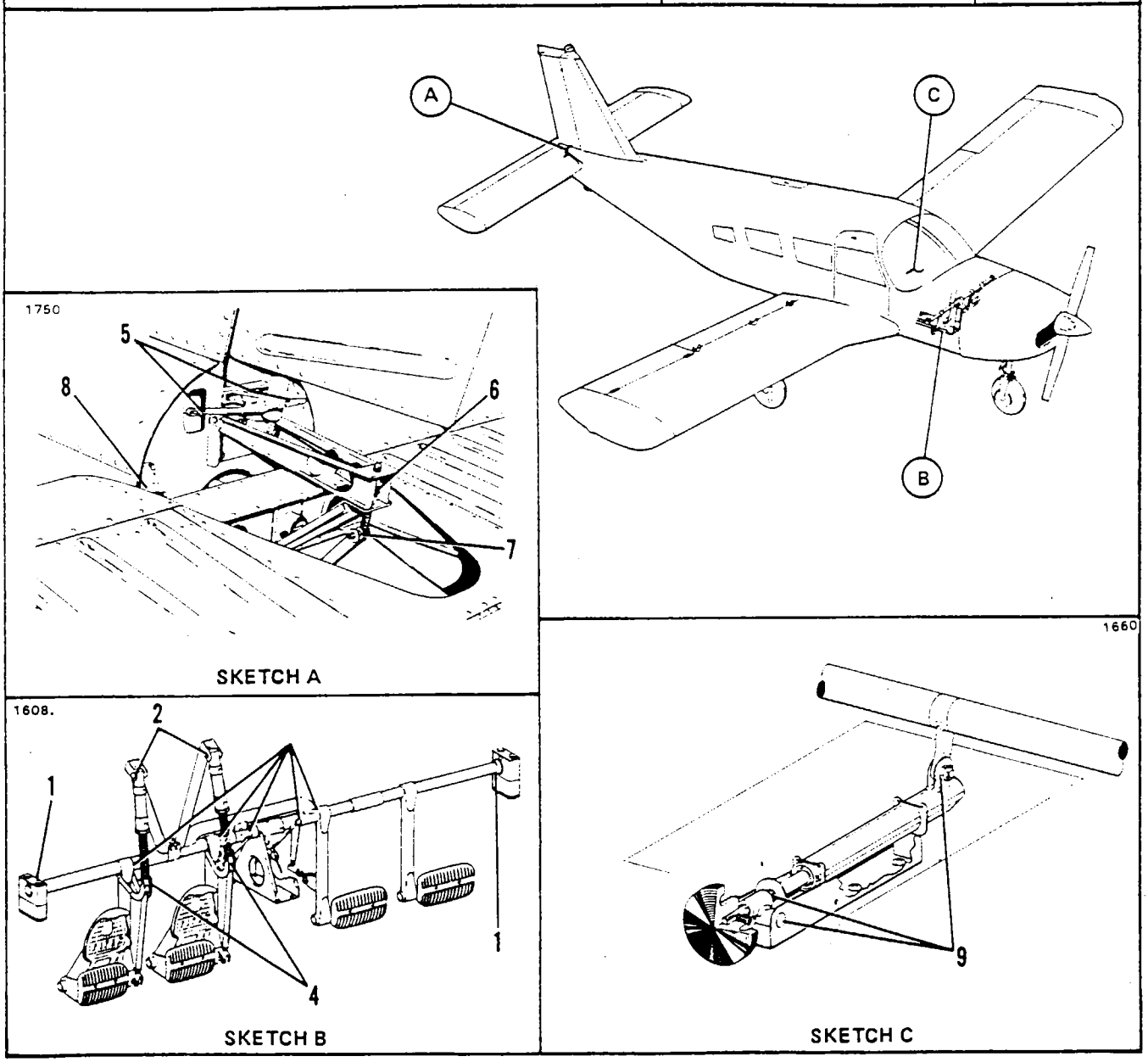
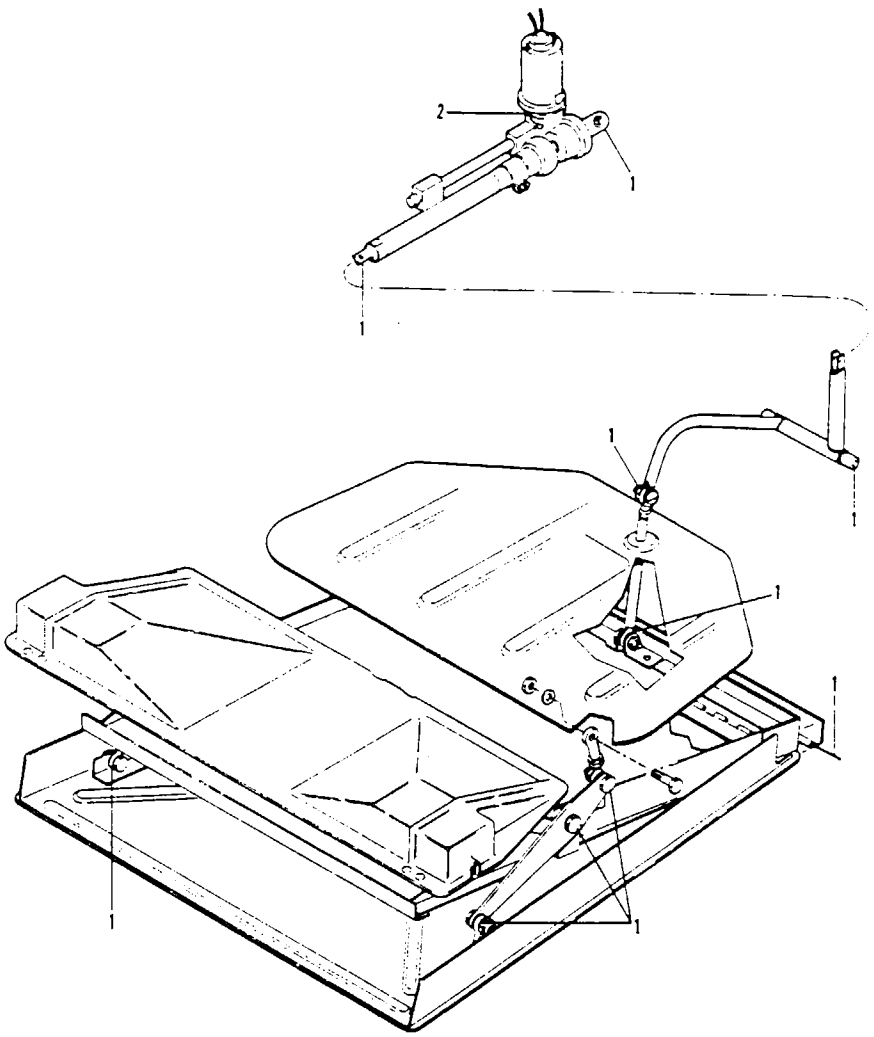


Figure 2-14. Lubrication Chart (Control System) (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. CONDENSER HINGE AND ACTUATORS	MIL-L-7870	100 HRS
2. CONDENSER DOOR ACTUATING TRANSMISSION	MIL-G-23827	500 HRS

1621

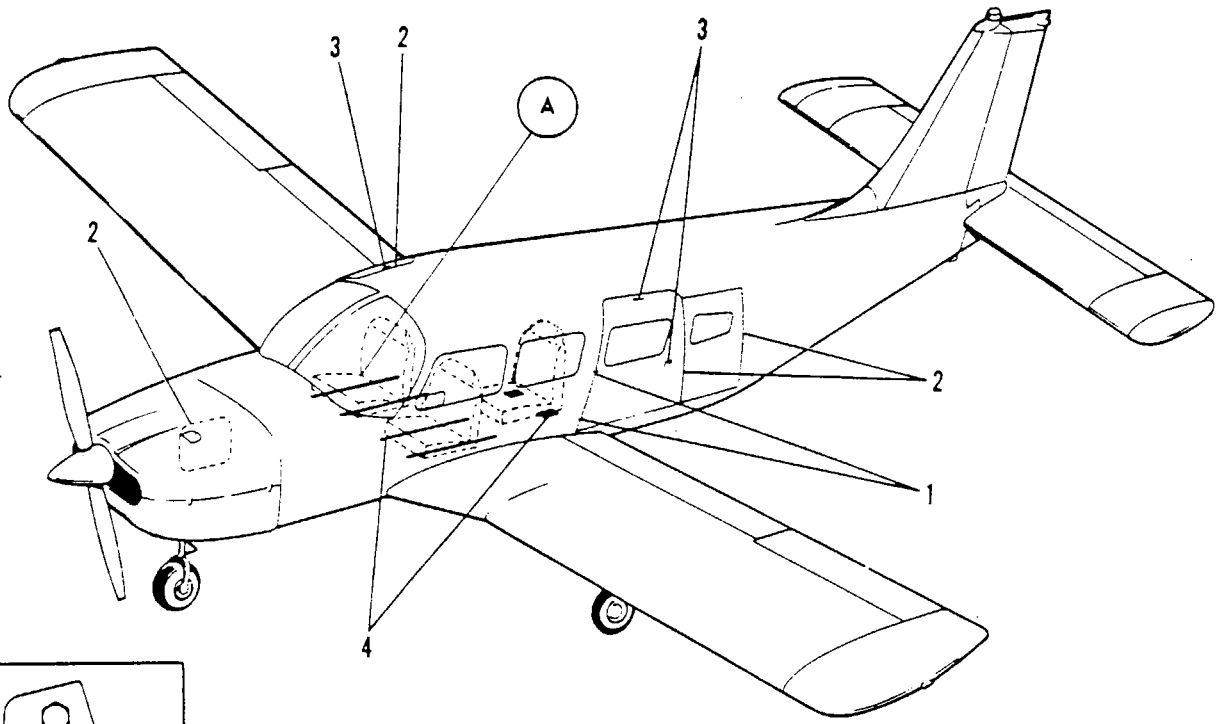


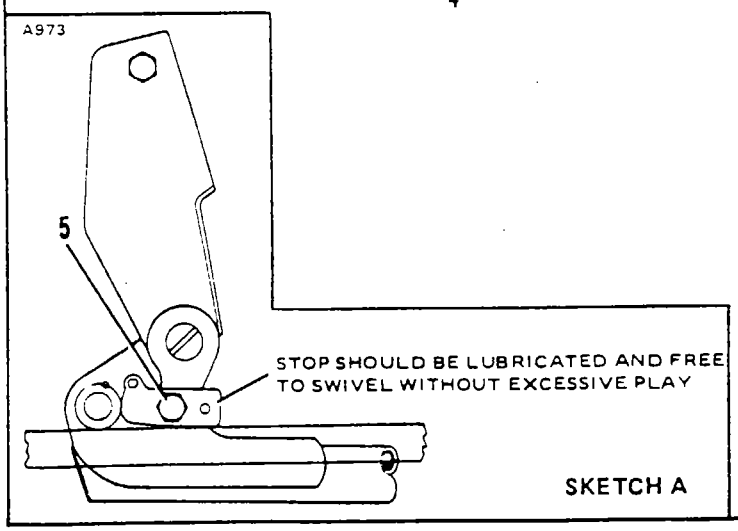
SPECIAL INSTRUCTIONS

Transmission to be 1/2 full of grease. Apply grease during assembly and lubricate transmission ball nut and screw with MIL-G-23827 grease.

Figure 2-15. Lubrication Chart (Air Conditioning Condenser)

COMPONENT	LUBRICANT	FREQUENCY
1. DOOR HINGES	MIL-L-7870	100 HRS
2. DOOR SEALS	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	50 HRS
3. DOOR LATCH MECHANISMS	MIL-L-7870 OR AEROSHELL #7	500 HRS
4. SEAT TRACK ROLLERS, STOP PINS AND REAR SEAT LEG RETAINER (CLIP AND CAM)	AERO LUBRIPLATE, FISKE BROS. REFINING CO (OR AEROSHELL #7 OR MAG-1)	100 HRS
5. SEAT LATCH STOP PIVOT POINT (COPILOT)	MIL-L-7870 OR AEROSHELL #7	100 HRS



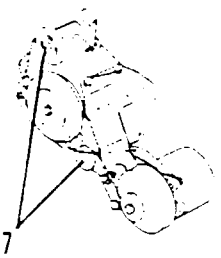


SPECIAL INSTRUCTIONS

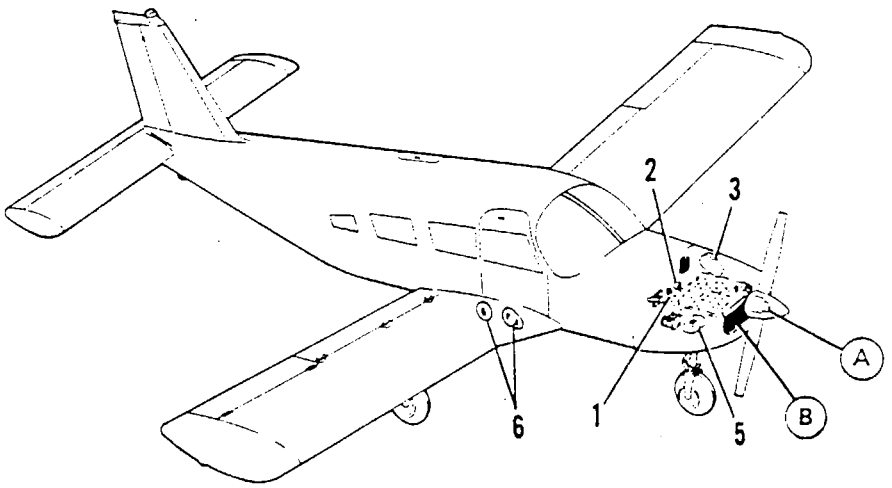
Apply fluorocarbon dry lubricant to door seals at least once a month to prevent the seal from sticking, and improve sealing characteristics.

Figure 2-16. Lubrication Chart (Cabin Door, Baggage Door & Seat)

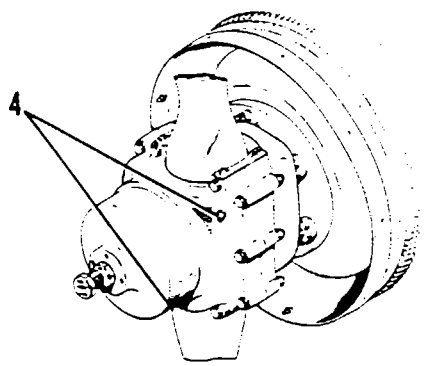
COMPONENT	LUBRICANT	FREQUENCY
1. ENGINE SUMP	MIL-L-6082 LUBRICATING OIL MINERAL GRADES. MIL-L-22851 LUBRICATING OIL ASHLESS DISPERSANT GRADES.	50 HRS
2. CARTRIDGE TYPE OIL FILTERS		50 HRS
3. AIR FILTERS		50 HRS
4. PROPELLER ASSEMBLY	MIL-G-23827	100 HRS
5. ENGINE CONTROL AND ENVIRONMENTAL CONTROL PIVOT POINTS	MIL-L-7870	100 HRS
6. FRESH AIR VENT SHAFTS	MIL-G-7711	500 HRS
7. ALTERNATOR AND COMPRESSOR IDLER PULLEY BEARINGS	MIL-G-81322	100 HRS



SKETCH B



1740



SKETCH A

SPECIAL INSTRUCTIONS

1. AIR FILTER - TO CLEAN FILTER, TAP GENTLY TO REMOVE DIRT PARTICLES. DO NOT BLOW OUT WITH COMPRESSED AIR OR USE OIL. REPLACE FILTER IF PUNCTURED OR DAMAGED.
2. INTERVALS BETWEEN OIL CHANGES CAN BE INCREASED AS MUCH AS 100% ON ENGINES EQUIPPED WITH FULL FLOW (CARTRIDGE TYPE) OIL FILTERS - PROVIDED THE ELEMENT IS REPLACED EACH 50 HOURS OF OPERATION.
3. PROPELLER - REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.

NOTE

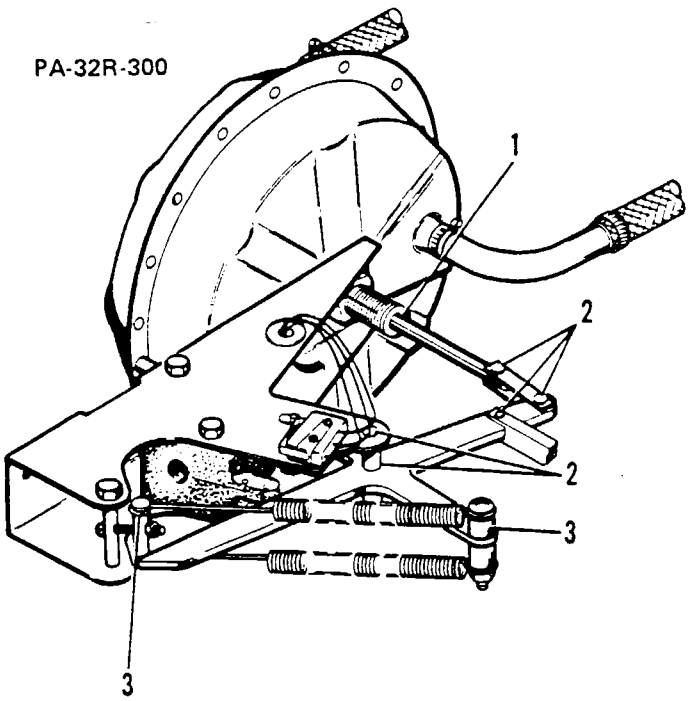
SEE THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF ASHLESS DISPERSANT OIL.

Figure 2-17. Lubrication Chart (Power Plant, Propeller & Control Pivot Points)

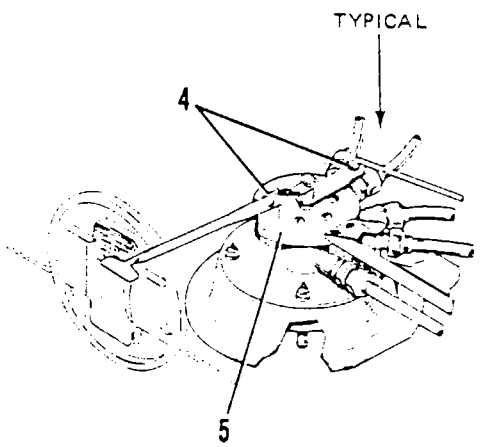
COMPONENT	LUBRICANT	FREQUENCY
1. DIAPHRAGM SHAFT AND BUSHING	MIL-L-7870 ABOVE 20 F MIL-C-21567 BELOW 20 F	100 HRS
2. BACK-UP EXTENDER LINKS AND CONTROL ARM PIVOT POINTS	MIL-L-7870	100 HRS
3. BACK-UP EXTENDER SPRING ATTACHMENT POINTS	MIL-L-7870	100 HRS
4. FUEL SELECTOR LINKAGE	MIL-L-7870	100 HRS
5. FUEL SELECTOR VALVE COVER PLATE	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS

801

PA-32R-300



1673



SPECIAL INSTRUCTIONS

1. Diaphragm shaft and bushing - soft film silicone compound (MIL-C-21567) is recommended for use when operating at temperatures below 20°F.
2. Fuel selector valve - lubricate area where detent ball moves across cover plate (on external detent valves only).

Figure 2-18. Lubrication Chart (Back-up Extender & Fuel Selector)

2-61. TORQUE REQUIREMENTS. The torque values given in Table II-VIII are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless otherwise noted in sections where other values are stipulated. Engine torque values are found in the latest revision Lycoming SSP-1776 and propeller torque values are found in Section VIII or VIIIA of this manual. Table II-VIII lists the torque values for flared fittings of various sizes and material.

CAUTION

Do not overtorque fittings.

NOTE

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Table II-VIII.

TABLE II-VIII. FLARE FITTING TORQUES

TORQUE - INCH-POUND						
TUBING OD INCHES	ALUMINUM - ALLOY TUBING FLARE - AND 10061 OR AND 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	700	1150
1-1/4	600	900				
1-1/2	600	900				
1-3/4						
2						

TABLE II-IX. MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

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

TABLE II-X. THREAD LUBRICANTS

TYPE OF LINE	TYPE OF LUBRICANT
Brakes	MIL-H-5606
Freon	TT-A-580 or MIL-T-5544, Anti-Seize Compound
Fuel	MIL-T-5544, Anti-Seize, Graphite Petrolatum
Landing Gear (Air Valve)	6PB Parker
Oil	MIL-G-6032, Lubricating Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)

— NOTE —

Lubricate engine fittings only with the fluid contained in the particular lines.

2-62. TORQUE WRENCHES.

Torque wrenches should be checked daily and calibrated by means of weights and a measured lever arm to make sure that inaccuracies are not present. Checking one torque wrench against another is not sufficient and is not recommended. Some wrenches are quite sensitive as 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 2-19.)

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).

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

EXAMPLE

A bolt requires 30 foot-pounds and a 3 inch adapter (one-quarter to a foot or .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.

$$C = \frac{1 \times 30}{1 + .25} \text{ or } C = \frac{30}{1.25} = 24 \text{ ft.-lbs.}$$

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.

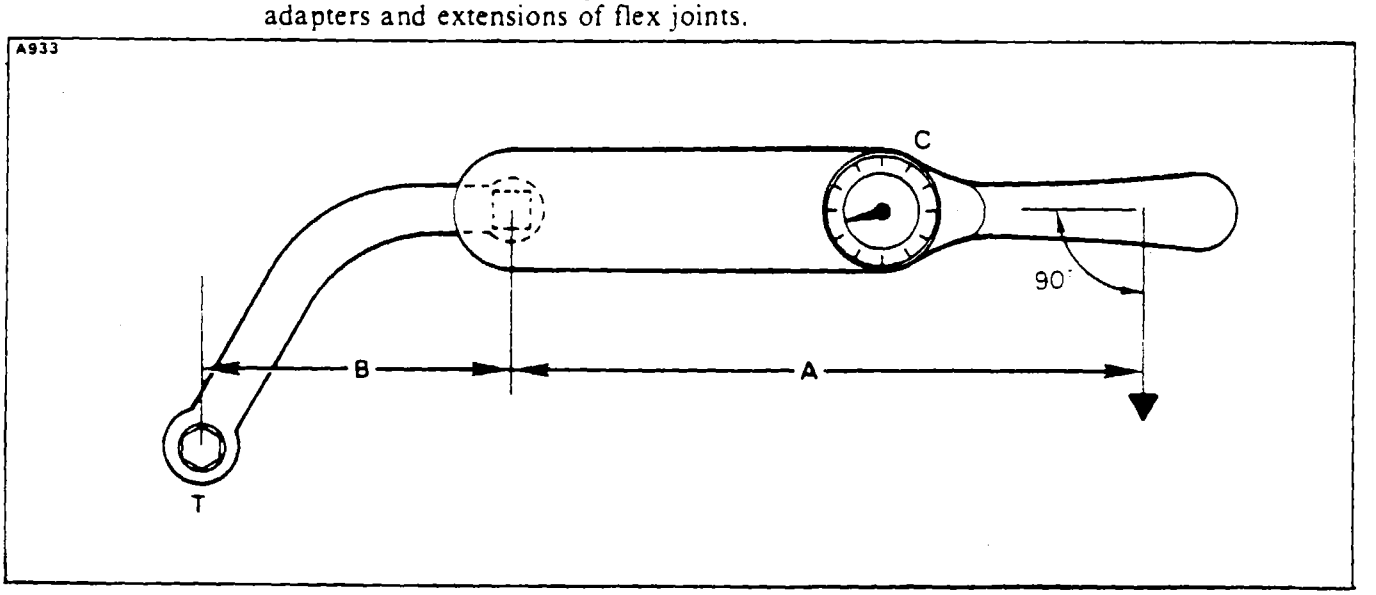


Figure 2-19. Torque Wrench Formula

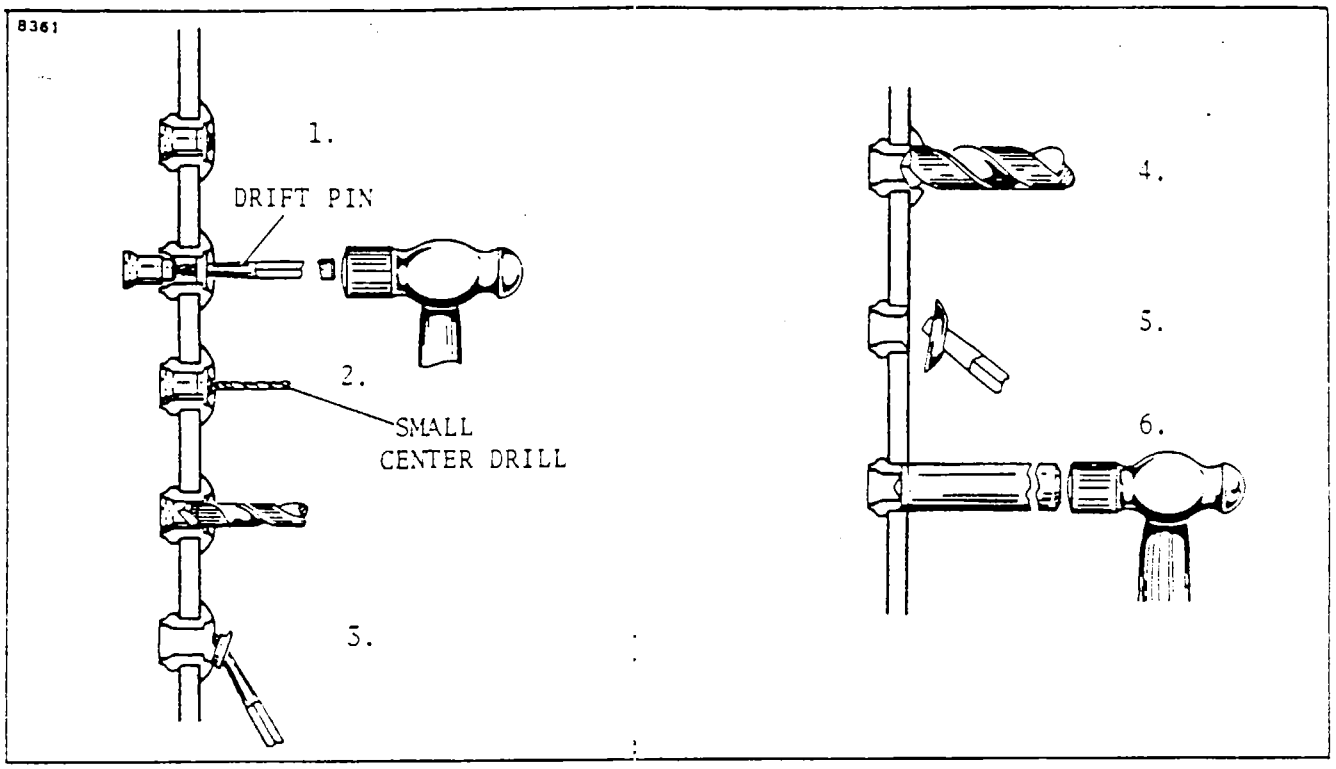


Figure 2-20. Cherrylock Rivet Removal

2-63. CHERRYLOCK RIVETS, REMOVAL. (Refer to Figure 2-20.)

a. File head flat.
b. Centerpunch rivet head.
c. 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.

d. In thin material, use a small center drill to provide a guide for a larger drill on top of the rivet stem and the tapered position of the stem be drilled away to destroy the lock.
e. Remove the remainder of the locking collar out of the rivet head by prying it loose with the drift pin. (See View 3.)
f. Drill nearly through the head of the rivet, using a drill the same size as the rivet shank. (See View 4.)
g. Pry off the rivet head using the drift pin. (See View 5.)
h. Drive out the remaining shank with a pin having the same diameter as the rivet shank. (See View 6.)

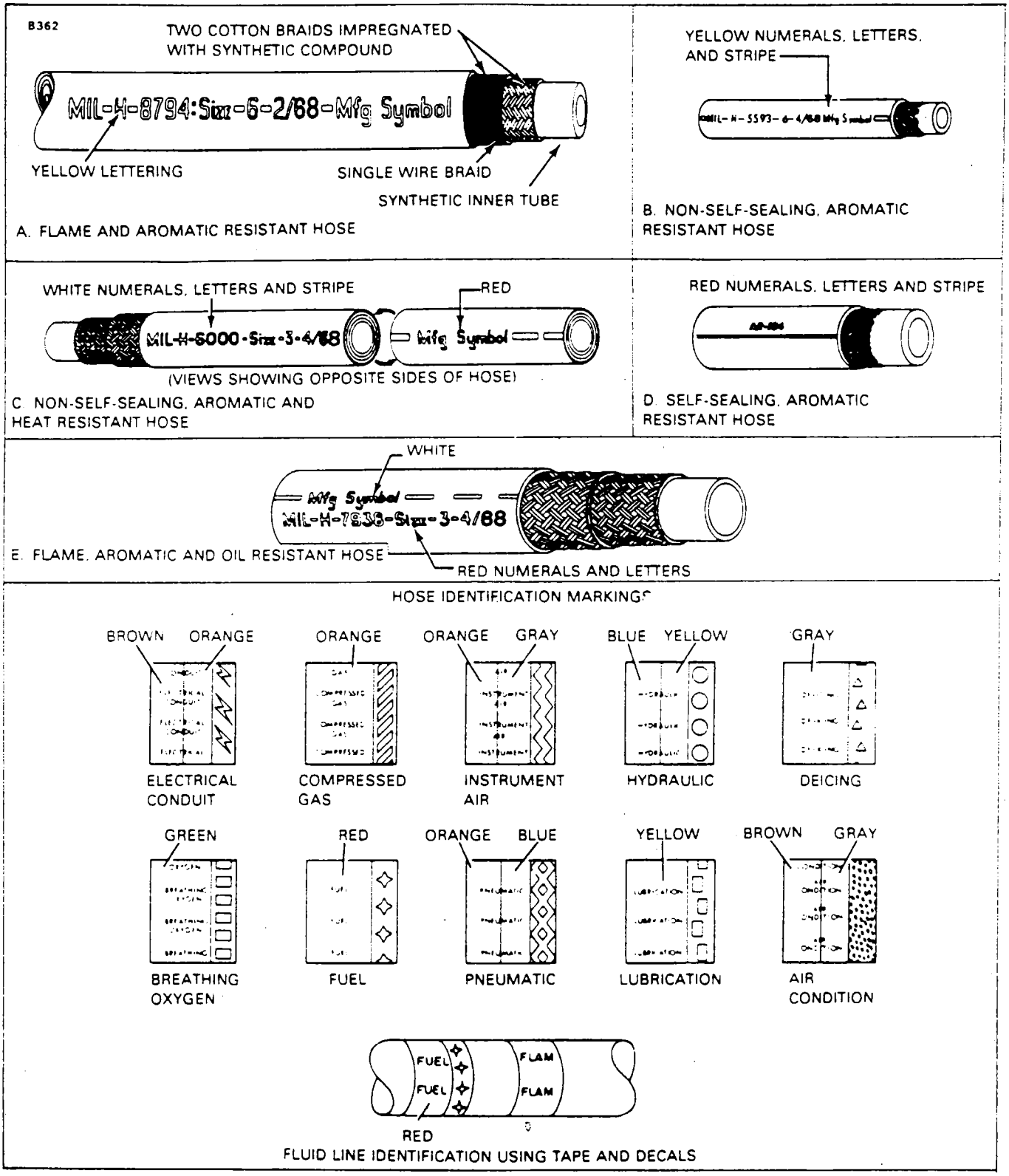


Figure 2-21. Identification of Aircraft Lines

TABLE II-XI. CONVERSION TABLES

1. These charts contain the various conversion data that may be useful when figuring capacities, length, 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.

   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 (1.5 inches is 38.10 millimeters).

4. Procedure for converting Fahrenheit (°F) and Celsius (°C) (Centigrade) temperature.

   A. Read number in middle column, if in degrees Celsius (°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-XI. 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
27.76	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-XI. CONVERSION TABLES (cont.)

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
					MILLIMETER					
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	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	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	0.1447	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	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
					MILLIMETER					
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	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
					MILLIMETER					
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.285
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	5.558	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

TABLE II-XI. CONVERSION TABLES (cont.)

INCHES TO MILLIMETER

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
					MILLIMETER					
0.		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.25
7.	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

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TABLE II-XI. 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. JOULES	2.540 .08333 0.000948 0.7376	CM. FT. FT. FT.-LB.

MULTIPLY	BY	TO OBTAIN
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

SECTION III

INSPECTION

		Aerofiche Grid No.
3-1.	Introduction	1D11
3-2.	Recommended Lubricants	1D11
3-3.	Inspection Periods	1D11
3-4.	Inspection Requirements	1D11
3-5.	Preflight	1D11
3-6.	Overlimits Inspection	1D12
3-7.	Special Inspection	1D12
3-8.	Programmed Maintenance	1D12
3-9.	Inspection of Exhaust System	1D12
3-10.	Inspection of Flap Control Cable Attachment Bolt	1D16
3-11.	Inspection of Induction Air Inlet Duct and Alternate Heat Duct	1D17
3-12.	Inspection of Main Landing Gear Torque Links (PA-32-260 & 300)	1D17
3-13.	Inspection of Seat Belt Attachment Hardware	1D18
Inspection Report PA-32-260 and PA-32-300		1D19
Inspection Report PA-32R-300		1E5

Revised: 12/15/80

SECTION III

INSPECTION

3-1. INTRODUCTION. This section provides instructions for conducting inspections. These inspections are described in Paragraphs 3-4 and 3-5. Repair or replacement instructions for those components found to be unserviceable at inspection may be found in the section covering the applicable aircraft system.

CAUTION

When working on engines, ground the magneto primary circuit before performing any operation.

3-2. RECOMMENDED LUBRICANTS. Refer to Recommended Lubricants, Section II for Lubrication Servicing Instructions.

3-3. INSPECTION PERIODS.

3-4. INSPECTION REQUIREMENTS. The required inspection procedures are listed in Table III-I for PA-32-260 and 300 and in Table III-II for PA-32R-300. The inspection procedure is broken down into major groups which are Propeller, Engine, Cabin, Fuselage and Empennage, Wing, Landing Gear, Float Group (PA-32S only), Operational Inspection and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into four columns indicating the required inspection intervals of 50 hours, 100 hours, 500 hours and 1000 hours. Each inspection or operation is required at each of the inspection intervals as indicated by a circle (O). If an item is not entirely accessible or must be removed, refer to the applicable section of this manual for instructions on how to gain access to remove the item. When performing inspections, use inspection forms furnished by the Piper Factory Service Department, available through Piper Dealers or Distributors.

NOTE

In addition to inspection intervals required in Table III-I or III-II, a preflight check must be performed as described in Paragraph 3-5.

3-5. PREFLIGHT CHECK. The airplane must be given a thorough preflight and walk-around check. The pilot and/or mechanic must include the preflight check as a normal procedure necessary for the safe operation of the aircraft. Refer to the Pilot's Operating Manual for a listing of items that must be checked.

3-6. OVERLIMITS INSPECTION. If the airplane has been operated so that any of its components have exceeded their maximum operational limits, check with the appropriate manufacturer.

3-7. SPECIAL INSPECTIONS. The special inspections given in the following paragraphs, supplement the scheduled inspections as outlined in the Inspection Report, Tables III-I, and III-II to include inspection of items which are required to be examined at intervals not compatible with airframe operating time or airframe inspection intervals. Typical of this type are:

a. Inspection is required because of special conditions or incidents that arise, and because of these conditions or incidents, an immediate inspection would be required to insure further safe flight.

b. Inspection of airframe or components on a calendar basis. This type of inspection could often be accomplished during the nearest scheduled inspection.

c. Specific definitive inspection on engines based strictly upon engine operating time.

d. Those inspections not completely covered in other sections of this manual, but outlined in the Inspection Report and must be explained in more detail to give a clearer and complete inspection.

3-8. PROGRAMMED MAINTENANCE. The programmed maintenance was designed to permit the utilization of the aircraft, by scheduling inspections through the use of a planned inspection schedule. Programmed maintenance schedules are available from Service Sales Part No. 761 497 for PA-32-260 and 300; or Part No. 761 500 for PA-28R and PA-32R.

3-9. INSPECTION OF EXHAUST SYSTEM. (Refer to Figure 3-1 and 3-2.) A very thorough inspection of the entire exhaust system, including heat exchange shroud, muffler, muffler baffles, stacks and all exhaust connections must be accomplished at each 100 hour inspection. The possibility of exhaust system failure increases with use. It is recommended that the system be checked even more carefully as the number of hours increase; for example an inspection at the 700 hour period would be more critical than one in the 100 hour period. The system should also be checked carefully before winter operation when the cabin heat will be in use.

NOTE

It is recommended that all PA-32 airplanes be fitted with a new muffler at or near 1000 hours of muffler operation.

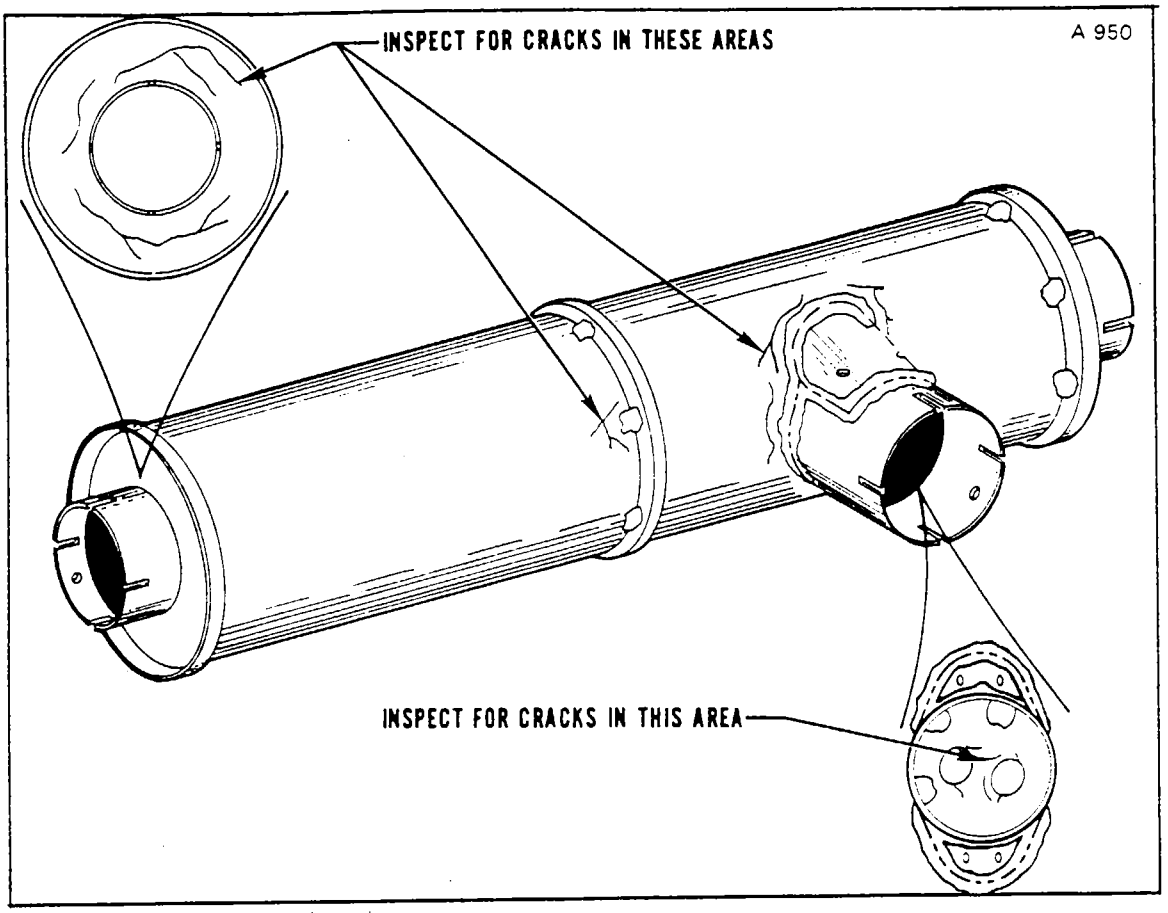


Figure 3-1. Typical Muffler Fatigue Areas

Removal of the tail pipe and stacks is required for inspection of the muffler baffle. Remove or loosen all exhaust shields, carburetor and cabin heat muffs, shrouds, heat blankets, etc., as required to permit inspection of the complete system. Perform the necessary cleaning operations and inspect all external surfaces for dents, cracks and missing parts. Pay particular attention to welds, clamps, supports and support attachment lugs, slip joints, stack flanges and gaskets. Inspect internal baffle or diffusers. Any cracks, warpage or severe oxidation are cause for replacement of the muffler.

If any component is inaccessible for a thorough visual inspection, accomplish one of the following:

a. Accomplish a submerged pressure check of the muffler and exhaust stack at 2 psi air pressure.

b. Conduct a ground test using a carbon monoxide indicator by heading the airplane into the wind, warming the engine on the ground, advancing the throttle to full static RPM with cabin heat valves open, and taking readings of the heated airstream inside the cabin at each outlet (including rear seat heat outlet, if installed). Appropriate sampling procedures applicable to the particular indicator must be followed. If carbon monoxide concentration exceeds .005 percent or if a dangerous reading is obtained on an indicator not calibrated in percentages, the muffler must be replaced.

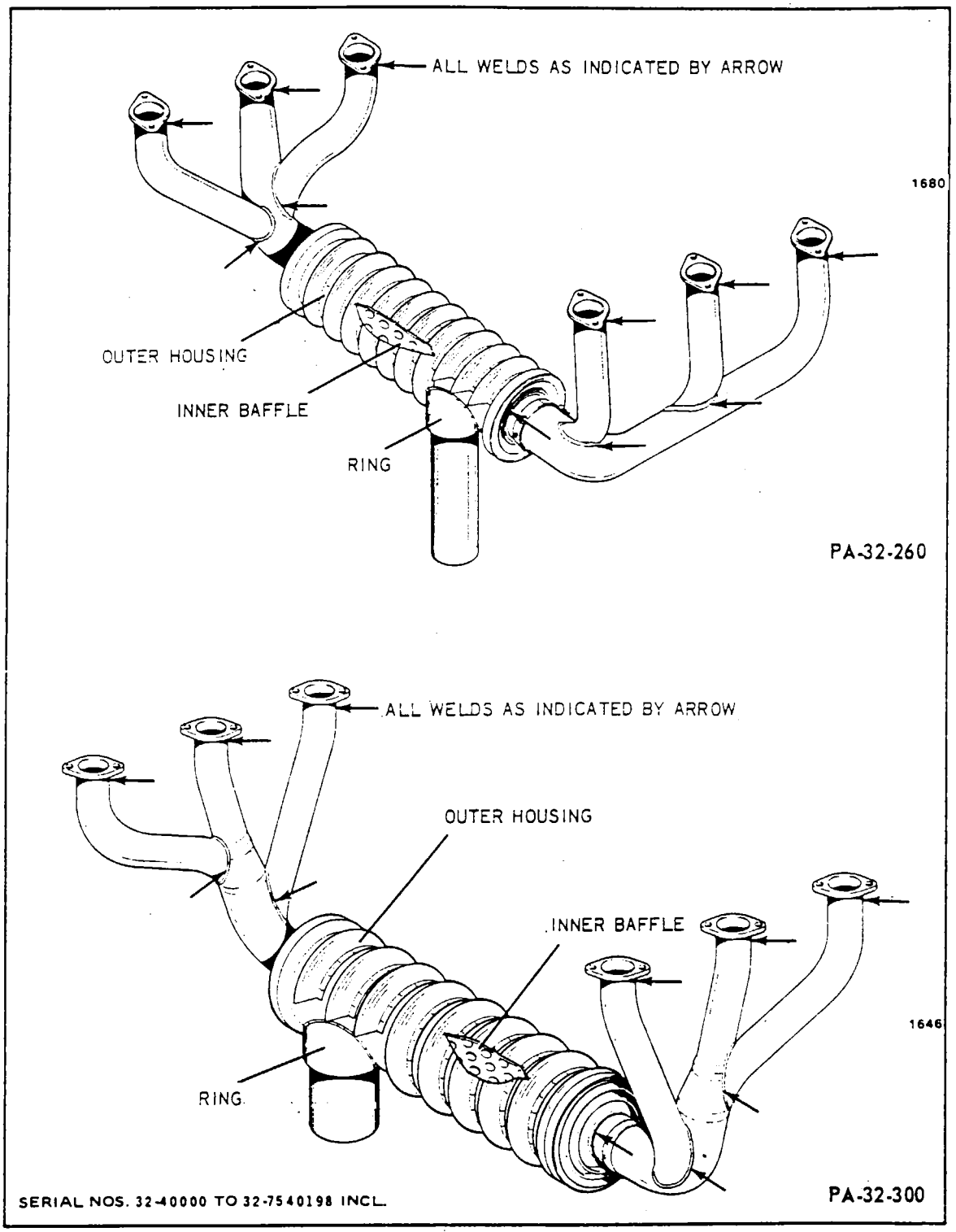


Figure 3-2. Exhaust System Inspection Points

INSPECTION
Revised: 6/18/76

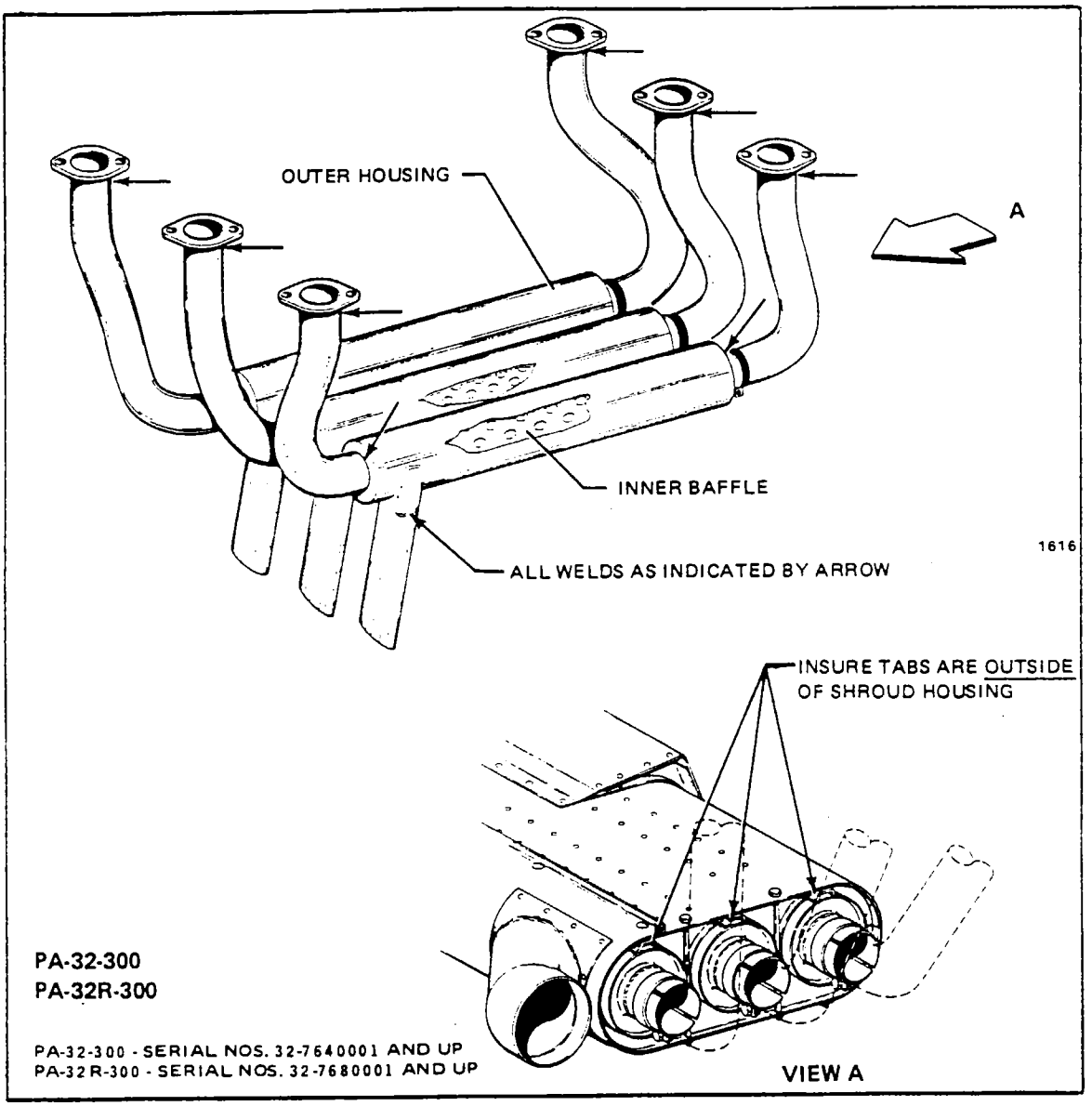


Figure 3-2. Exhaust System Inspection Points (cont.)

c. As specified in the latest revision of Piper Service Bulletin No. 520, for PA-32-300 and PA-32R-300 aircraft, insure the proper installation of the shroud on the muffler upon reassembly. Mislocation of the shroud could result in shifting of the shroud with a resulting reduction of cabin heat and possible inability of the nose landing gear on the PA-32R-300 to fully extend to its down lock position.

Revised: 12/15/80

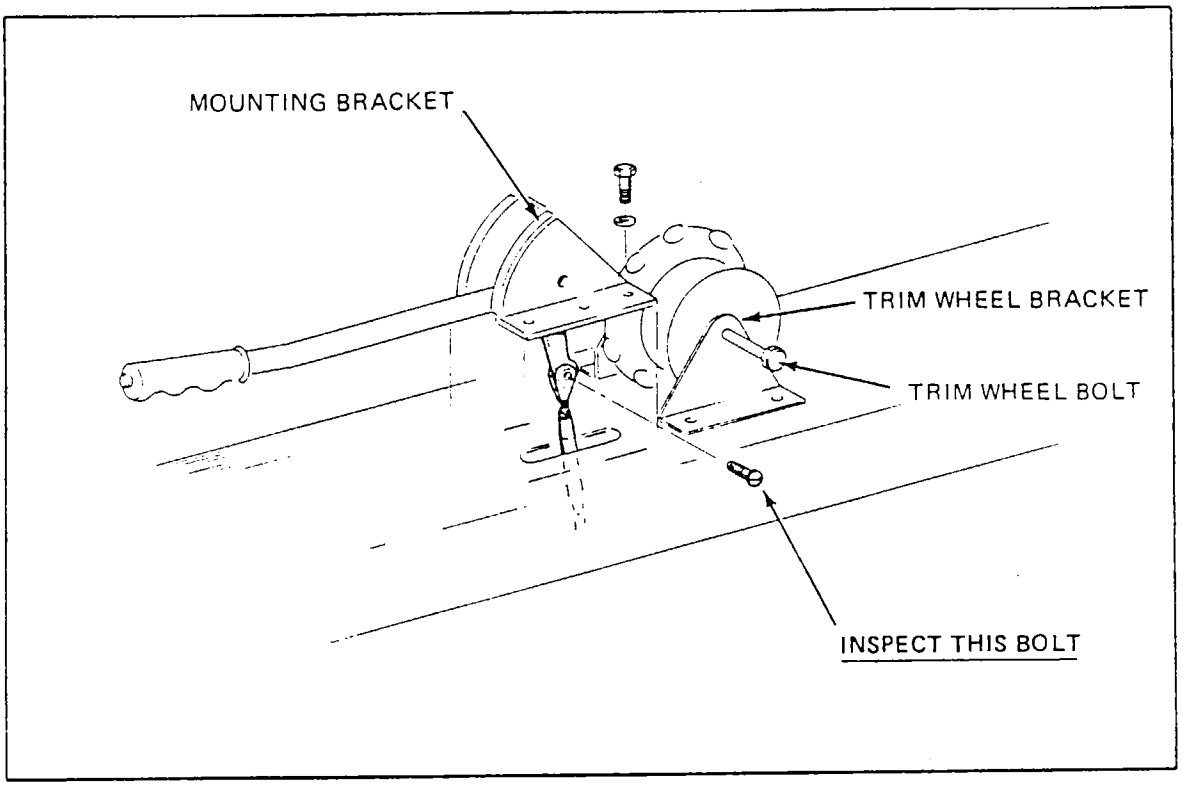


Figure 3-3. Flap Control Cable Attachment Bolt Inspection.

3-10. INSPECTION OF FLAP CONTROL CABLE ATTACHMENT BOLT. (Refer to Figure 3-3.)

a. This inspection should be accomplished at the next 100 hours or annual inspection and repeated at each 500 hours thereafter.

b. The inspection is required to detect any possible wear and replacement of attachment bolt, should evidence of wear be detected.

c. Remove the royalite flap or flap/trim cover.

d. On aircraft having the flap handle only, proceed as follows:

1. Remove flap handle mounting bracket attachment bolts.

2. Raise flap handle and bracket assembly to gain access to the control cable attachment bolt.

e. On aircraft having the flap handle and trim wheel mounted together, proceed as follows:

1. Loosen the trim wheel attachment bolt.

2. Remove the trim wheel bracket attachment bolts and remove bracket from top of tunnel.

3. Remove flap handle mounting bracket attachment bolts and raise handle and bracket assembly to gain access to control cable attachment bolt.

f. Remove and inspect cable attachment bolt for possible wear. Should wear be detected, replace bolt with new AN23-11 clevis bolt.

g. Reinstall all parts that were removed.

INSPECTION
Revised: 6/18/76

3-11. INSPECTION OF INDUCTION AIR INLET DUCT AND ALTERNATE HEAT DUCT.

This inspection should be accomplished at the next 25 hours of operation and at each subsequent 100 hours of operation thereafter. This inspection is a visual inspection of the external surface of the subject ducts and does not require duct removal and replacement to accomplish the inspection. Inspect the ducts for evidence of deterioration as follows:

a. Inspect the external surface of the ducts for loose or broken strings.
b. Inspect the ducts for loose or displaced supporting wire.
c. Inspect the ducts for signs of wear or perforation.

Should any of the above conditions exist, remove and replace the affected duct or ducts prior to the next flight. Refer to PA-32 Cherokee Parts Catalog for replacement part numbers.

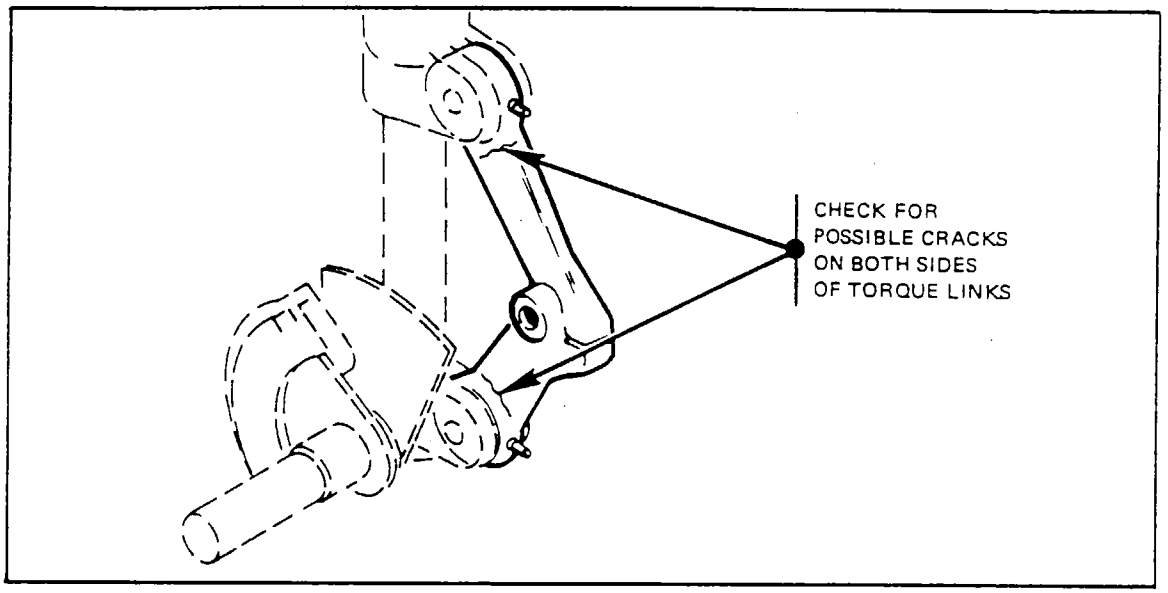


Figure 3-4. Inspection of Main Landing Gear Torque Links

3-12. INSPECTION OF MAIN LANDING GEAR TORQUE LINKS. (PA-32-260 & 300)

This inspection should be accomplished within the next 100 hours and at intervals not to exceed 500 hours of operation from previous inspection.

The main landing gear torque links should be inspected for possible cracks which may appear on the areas referenced in Figure 3-4. These cracks may form just behind the large boss which attaches to the strut or to the wheel, and in the center of the link progressing toward the edge. The following steps should be used to make this inspection:

a. Remove paint from the area to be inspected, using acetone, MEK, or any suitable commercial paint remover which does not contain wax.
b. Allow the cleaned part to dry thoroughly.
c. If cracks do not readily appear, inspect by one of the following methods:
   1. 10X magnifying glass.
   2. Dye check or other penetrant inspection.
d. Should cracks be detected, replace defective torque links prior to further flight.
e. If no cracks appear, make proper log book entry and return aircraft to service.

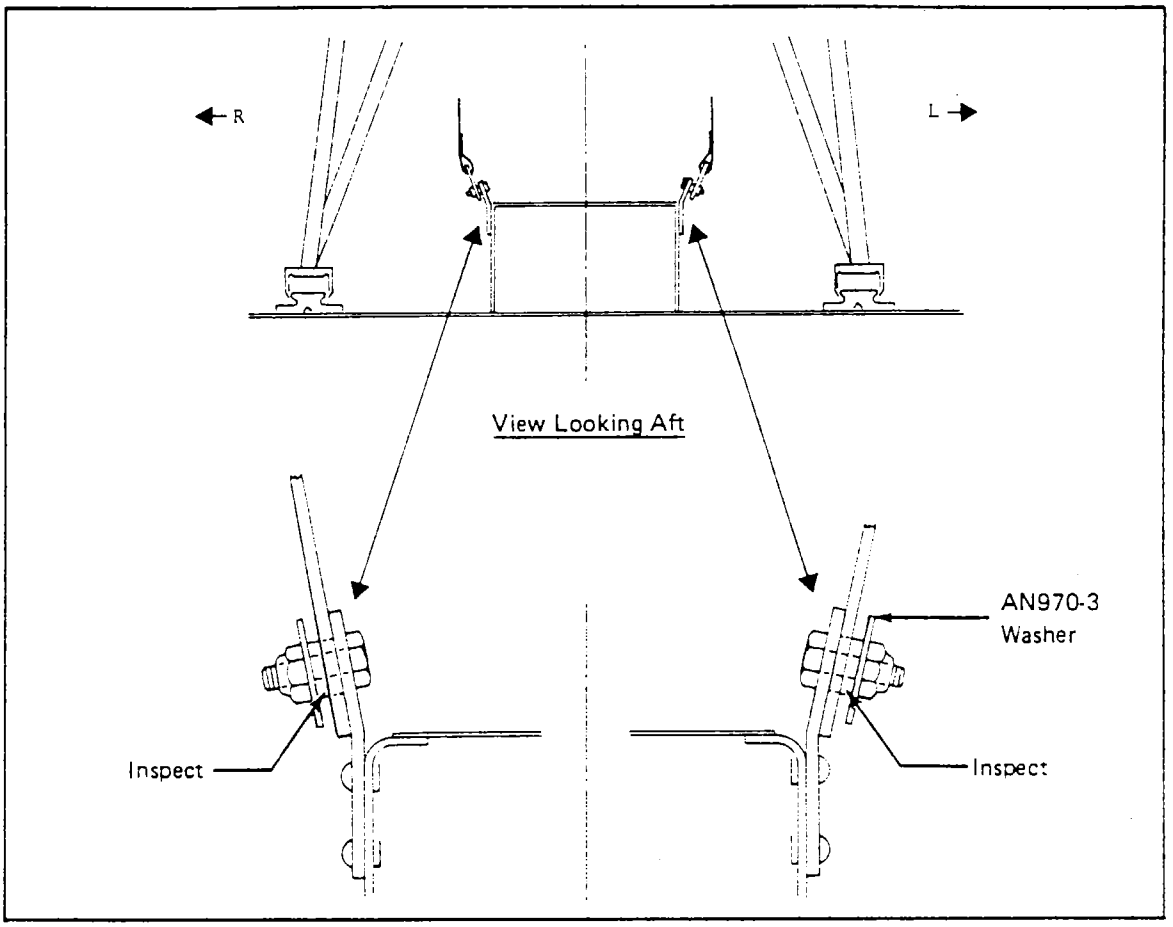


Figure 3-5. Inspection of Seat Belt Attachment Hardware

3-13. INSPECTION OF SEAT BELT ATTACHMENT HARDWARE. (Refer to Figure 3-5.) Only shoulder harness equipped aircraft with serial numbers 32-7100038 and below for the PA-32-260 and 32-7140086 and below for the PA-32-300 and PA-32S-300 will have to be inspected. Check the forward inboard seat belt attachment bushing. If the bushing O.D. is 5/16 inch, no further action is required. If the bushing O.D. is 3/8 inch, Kit 760 515V must be installed. After the inspection the aircraft will comply with the latest revision of Piper Service Bulletin 329 and A.D. 71-9-5.

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300)

NOTE

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
A. PROPELLER GROUP				
1. Inspect spinner and back plate for cracks	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. Inspect complete propeller and spinner assembly for security, chafing, cracks deterioration, wear and correct installation		O	O	O
5. Lubricate propeller per lubrication chart in Section II		O	O	O
6. Inspect spinner mounting brackets for cracks		O	O	O
7. Inspect propeller mounting bolts (Check torque if safety is broken)		O	O	O
8. Inspect hub parts for cracks and corrosion		O	O	O
9. Rotate blades of constant speed propeller and check for tightness in hub pilot tube (Refer to Section VII)		O	O	O
10. Remove constant speed propeller; remove sludge from propeller and crankshaft			O	O
11. Overhaul propeller (per the latest revision of Hartzell Service Letter No. 61)				
B. ENGINE GROUP				
NOTE: Read Notes 5 and 23 prior to completing this inspection group. CAUTION: Ground Magneto Primary Circuit before working on engine.				
1. Remove and inspect engine cowling for damage (See Note 20)	O	O	O	O
2. Clean and inspect cowling for and cracks, distortion and loose or missing fasteners (Refer to the latest revision of Piper Service Letter No. 796)	O	O	O	O
3. Drain oil sump (See Note 6)	O	O	O	O
4. Clean suction oil strainer at oil change (Inspect strainer for foreign particles)	O	O	O	O
5. Clean pressure oil strainer or change full flow oil filter element (cartridge type). Inspect strainer or element for foreign particles	O	O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont.)				
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 (See Note 8)	O	O	O	O
8. Clean and inspect oil radiator cooling fins		O	O	O
9. Remove and flush oil radiator			O	O
10. Fill engine with oil per information on cowl or Service Manual	O	O	O	O
11. Clean engine		O	O	O
CAUTION: Do not contaminate the vacuum pump with cleaning fluid. (Ref: The latest revision of Lycoming Service Letter No. 1221.)				
12. Inspect condition of spark plugs (Clean and adjust gap as required, adjust per the latest revision of Lycoming Service Instruction No. 1042) (See Note 15)		O	O	O
NOTE: If fouling of spark plugs has been 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 (Ref: AC 43.13-1A)		O	O	O
15. Inspect cylinders for cracked or broken fins		O	O	O
16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket, torque cover screws 50 inch-pounds (See Note 12)	O	O	O	O
NOTE: Lycoming requires a Valve Inspection be made after every 400 hours of operation (See Note 11)				
17. Inspect ignition harness and insulators for security of mounting, tight connections, high tension leakage and continuity	O	O	O	O
18. Check magneto points for proper clearance (Maintain clearance at .018 ± .006, for -20 and -200 series/.016 for -1200 series)		O	O	O
19. Inspect magnetos for oil seal leakage		O	O	O
20. Inspect breaker felts for proper lubrication		O	O	O
21. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs		O	O	O
22. Check magento to engine timing		O	O	O
23. Inspect ignition switch operation (Refer to the latest revision of Piper Service Letter No. 758)				
24. Overhaul or replace magentos (See Note 7)				O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont.)				
25. Inspect air induction system for leaks, security and damage; repair or replace as required	O	O	O	O
26. Remove air filter and tap gently to remove dirt particles (Replace as required)	O	O	O	O
27. Drain carburetor 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
28. Inspect condition and operation of carburetor or injector alternate air door and box (Refer to the latest revision of Piper Service Bulletin No. 524 and see Note 13)		O	O	O
29. Inspect primer lines for leaks and security of mounting	O	O	O	O
30. Inspect intake seals for leaks and clamps for tightness		O	O	O
31. Inspect all induction air and alternate heat ducts (Refer to the latest revision of Piper Service Bulletin No. 356)	O	O	O	O
32. Inspect condition of flexible fuel lines		O	O	O
33. Replace flexible fuel lines		O	O	O
34. Inspect fuel system for leaks		O	O	O
35. Inspect vent lines for evidence of fuel or oil leakage; if present, inspect fuel pump (See Note 16)	O	O	O	O
36. Inspect fuel pumps for operation (engine driven and electric)	O	O	O	O
37. Overhaul or replace fuel pumps (engine driven) (See Note 7)				O
38. Inspect operation of vacuum pump and security of lines		O	O	O
39. Overhaul or replace vacuum pump (See Note 7)				O
40. Inspect throttle, alternate air, mixture and propeller governor controls for security, proper travel and operating condition (Refer to the latest revision of Piper Service Bulletins Nos. 448 and 537, and Piper Service Letter No. 747)		O	O	O
41. Inspect exhaust stacks, connections and gaskets (Refer to Section III) Replace gaskets as required	O	O	O	O
42. Inspect muffler, heat exchanger and baffles (Refer to Section III) (Refer to the latest revision of Piper Service Bulletin No. 520)		O	O	O
43. Inspect breather tube for obstructions and security		O	O	O
44. Inspect crankcase for security of seam bolts		O	O	O
45. Inspect engine mounts for cracks and loose mountings		O	O	O
46. Inspect engine baffles for damage and security of attachments	O	O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont.)				
47. Inspect rubber engine mount bushings for deterioration (Replace as required)		O	O	O
48. Inspect condition of fire wall seals		O	O	O
49. Inspect condition and tension of alternator drive belt		O	O	O
50. Lubricate alternator idler pulley (if installed); remove front grease seal and add grease (Refer to lubrication chart in Service Manual, Section II)		O	O	O
51. Inspect condition of alternator and starter		O	O	O
52. Inspect security of alternator mounting		O	O	O
53. Inspect engine mounted accessories, such as pumps, temperature and pressure sensing units for security of mounting and tight connections		O	O	O
54. Check fluid in brake reservoir (Fill as required)	O	O	O	O
55. Install and lubricate all power plant controls		O	O	O
56. Check air conditioning compressor oil level (See Note 9)				
57. Inspect condition of compressor drive belt and tension (See Section XIII)		O	O	O
58. Inspect compressor clutch security and wiring (See Note 10)		O	O	O
59. Inspect security of compressor mounting		O	O	O
60. Overhaul or replace propeller governor*				O
61. Complete overhaul of engine or replace with factory rebuilt unit (See Note 7)				
62. Reinstall engine cowling	O	O	O	O
C. CABIN GROUP				
1. Inspect cabin entrance doors and windows for damage, operation and security (See Note 21)		O	O	O
2. Inspect upholstery for tears		O	O	O
3. Inspect seats, seat belts, security brackets and bolts		O	O	O
4. Inspect trim operation (See Note 18)		O	O	O
5. Inspect operation of rudder pedals		O	O	O
6. Inspect parking brake and brake handle for operation and cylinder leaks		O	O	O
7. Inspect condition of control wheels, column, pulleys and cables		O	O	O
8. Inspect flap control cable attachment bolt (Refer to the latest revision of Piper Service Bulletin No. 597)			O	O

* (Refer to latest revision of Hartzell S/L No. 61)

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
C. CABIN GROUP (cont.)				
9. Check operation of landing, navigation, cabin and instrument lights	O	O	O	O
10. Inspect condition of instruments, lines and attachments		O	O	O
11. Inspect gyro operated instruments and electric turn and bank (Overhaul or replace as required)		O	O	O
12. Replace filters on gyro horizon and directional gyro or replace central air filter			O	O
13. Clean or replace vacuum regulator filter		O	O	O
14. Inspect altimeter (Calibrate altimeter system in accordance with FAR 91.170, if appropriate)		O	O	O
15. Inspect operation of fuel selector valve (See Note 19)		O	O	O
16. Inspect operation of fuel drain	O	O	O	O
17. Inspect condition of heater controls and ducts		O	O	O
18. Inspect condition and operation of air vents		O	O	O
19. Inspect condition of air conditioning ducts		O	O	O
20. Remove and clean air conditioning evaporator filter		O	O	O
D. FUSELAGE AND EMPENNAGE GROUP				
1. Remove inspection plates and panels		O	O	O
2. Inspect baggage door(s) latches and hinges for operation and security		O	O	O
3. Inspect battery, box and cables (Inspect at least every 30 days. Flush box as required and fill battery per instructions on box)	O	O	O	O
4. Inspect security of electronic installations		O	O	O
5. Inspect bulkheads and stringers for damage		O	O	O
6. Inspect antenna mounts and electric wiring for damaged insulation and security		O	O	O
7. Inspect air conditioning system for freon leaks		O	O	O
8. Inspect freon level in sight gauge of receiver-dehydrator (Refer to Section XIII)	O	O	O	O
9. Inspect air conditioner condenser air scoop rigging	O	O	O	O
10. Inspect fuel lines, valves and gauges for damages and operation		O	O	O
11. Clean screens in fuel pumps (PA-32-260 only)		O	O	O
12. Remove, drain, and clean fuel strainer bowl and screen located in bottom of fuel selector (Drain and clean at least every 90 days)	O	O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
D. FUSELAGE AND EMPENNAGE GROUP (cont)				
13. Inspect security of all lines		O	O	O
14. Inspect vertical fin and rudder surfaces for damage		O	O	O
15. Inspect rudder hinges, horn and attachments for damage and operation		O	O	O
16. Inspect rudder control stops to insure stop has not loosened and locknut is tight		O	O	O
17. Inspect vertical fin attachments		O	O	O
18. Inspect rudder hinge bolts for excess wear (Replace as required)		O	O	O
19. Inspect stabilator surfaces for damage		O	O	O
20. Inspect stabilator, tab hinges, horn and attachments for damage and operation		O	O	O
21. Inspect stabilator control stops to insure stop has not loosened and locknut is tight		O	O	O
22. Inspect security of stabilator attachments **(see latest Piper Service Bulletin 856)**		O	O	O
23. Inspect stabilator and tab hinge bolts and bearings for excessive wear (Replace as required)		O	O	O
24. Inspect stabilator trim mechanism installation		O	O	O
25. Inspect aileron, rudder, stabilator, stabilator trim cables, turnbuckles, guides and pulleys for safety, damage and operation		O	O	O
26. Check all cable tensions (use tensiometer) (See Note 14)		O	O	O
27. Clean and lubricate stabilator trim drum screw		O	O	O
28. Clean and lubricate all exterior needle bearings		O	O	O
29. Lubricate per lubrication chart (Refer to Section II)		O	O	O
30. Inspect rotating beacon for security and operation		O	O	O
31. Inspect security of Autopilot bridle cable clamps (Refer to latest revision of Piper Service Letter No. 695)		O	O	O
32. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
33. Inspect emergency locator transmitter battery for replacement date or time per service manual (Refer to latest revision of Piper S/L 820)		O	O	O
34. Reinstall inspection plates and panels		O	O	O
E. WING GROUP				
1. Remove inspection plates and fairings		O	O	O
2. Inspect surfaces and tips for damage, loose rivets and condition of walkway		O	O	O
3. Inspect security of aileron hinges and attachments		O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
E. WING GROUP (cont.)				
4. Inspect aileron control stops to insure stop has not loosened and locknut is tight		O	O	O
5. Inspect aileron cables, pulleys and bellcranks for damage and operation		O	O	O
6. Inspect flaps and attachments for damage and operation		O	O	O
7. Inspect condition of bolts used with hinges (Replace as required)				O
8. Lubricate per lubrication chart (Refer to Section II)		O	O	O
9. Inspect condition of wing attachment bolts and brackets		O	O	O
10. Inspect fuel quantity sender per latest Piper Service Letter No. 884		O	O	
11. Inspect fuel tanks and lines for leaks, water and contamination (See Notes 17 and 19)		O	O	O
12. Fuel tanks marked for capacity		O	O	O
13. Fuel tanks marked for minimum octane rating		O	O	O
14. Inspect fuel tank vents (See Notes 16 and 19)		O	O	O
15. Inspect all control cables, air ducts, electrical leads, lines and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
16. Reinstall inspection plates and fairings		O	O	O
F. LANDING GEAR GROUP				
1. Inspect oleo struts for proper extension (Check for proper fluid level as required)	O	O	O	O
2. Inspect nose gear steering and travel (Refer to the latest revision of Piper Service Letter No. 708)		O	O	O
3. Check wheel alignment		O	O	O
4. Put airplane on jacks		O	O	O
5. Inspect tires for cuts, uneven or excessive wear and slippage		O	O	O
6. Remove wheels, clean, check and repack bearings		O	O	O
7. Inspect wheels for cracks, corrosion and broken bolts		O	O	O
8. Check tire pressure	O	O	O	O
9. Inspect brake lining and disc for wear (Refer to Section VI, Para. 31)		O	O	O
10. Inspect brake backing plates for cracks		O	O	O
11. Inspect condition and security of brake lines		O	O	O
12. Inspect shimmy dampener operation		O	O	O
13. Inspect gear forks for damage		O	O	O
14. Inspect oleo struts for fluid leaks and scoring		O	O	O
15. Inspect gear struts, attachments, torque links and bolts for condition and security (See Note 21)		O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
F. LANDING GEAR GROUP (cont.)				
16. Lubricate per lubrication chart (Refer to Section II)		O	O	O
17. Inspect all hydraulic lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
18. Remove airplane from jacks		O	O	O
G. FLOAT GROUP				
1. Inspect float attachment fittings for corrosion and security		O	O	O
2. Inspect floats for damage		O	O	O
3. Inspect pulleys and cables for corrosion and security		O	O	O
H. OPERATIONAL INSPECTION				
1. Check fuel pump and fuel tank selector (Refer to the latest revision of Piper Service Bulletin No. 519)	O	O	O	O
2. Check fuel quantity and pressure or flow gauge	O	O	O	O
3. Check oil pressure and temperature	O	O	O	O
4. Check alternator output	O	O	O	O
5. Check manifold pressure	O	O	O	O
6. Check alternate air	O	O	O	O
7. Check parking brake	O	O	O	O
8. Check vacuum gauge	O	O	O	O
9. Check gyros for noise and roughness	O	O	O	O
10. Check cabin heater operation	O	O	O	O
11. Check magneto switch operation (Refer to the latest revision of Piper Service Letter No. 758)	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 constant speed propeller action	O	O	O	O
16. Check engine idle	O	O	O	O
17. Check electronic equipment operation	O	O	O	O
18. Check operation of AutoPilot, including automatic Pitch Trim and Manual Electric Trim (See Note 22)	O	O	O	O
19. Check air conditioner compressor clutch operation	O	O	O	O
20. Check air conditioner condenser scoop operation	O	O	O	O

TABLE III-I. INSPECTION REPORT (PA-32-260 and 300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
I. GENERAL				
1. Aircraft conforms to FAA Specifications	O	O	O	O
2. All the latest FAA Airworthiness Directives complied with	O	O	O	O
3. All the latest Manufacturers Service Letters and Bulletins complied with	O	O	O	O
4. Check for proper Flight Manual	O	O	O	O
5. Aircraft papers in proper order	O	O	O	O

NOTES:

1. Refer to the last card of the Piper Parts Price List - Aerofiche, for a check list of current revision dates to Piper Inspection Reports and Manuals.
2. All inspections or operations are required at each of the inspection intervals as indicated by a (O). Both the annual and 100-hour inspections are complete inspections of the airplane, identical in scope, while both the **500 and 1000**-hour inspections are extensions of the annual or 100-hour inspection, which require a more detailed examination of the airplane, and overhaul or replacement of some major components. Inspections must be accomplished by persons authorized by the FAA.
3. Piper service bulletins are of special importance and Piper considers compliance mandatory.
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. 60297-10) for this airplane, dated November 1973. Any changes issued to the engine manufacturer's operator's manual after this date shall supersede or supplement the inspections outlined in this report.
6. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters, provided the element is replaced each 50 hours of operation.
7. Replace or overhaul as required or at engine overhaul. (For engine overhaul, refer to latest Lycoming Service Instructions No. 1009.)
8. Replace flexible oil lines as required but no later than 1000 hours.
9. The compressor oil level should not be checked unless a freon leak has occurred which requires an addition of freon to the system.
10. Clean any traces of oil from the clutch surface.
11. 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 keeper, springs and spring seats. If any indications are found, the cylinder and all of its components should 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 Lycoming Service Table of Limits No. SSP1776.
12. 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 its cause must be determined and corrected before the aircraft 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 awhile. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.
13. Check carburetor throttle body attaching screws for tightness; the correct torque for these screws is 40 to 50 inch-pounds. Refer to the latest revision of Piper Service Bulletin No. 524.
14. Maintain cable tensions as specified in Section V of this manual.
15. When using alternate fuels, refer to the latest revision of Lycoming Service Letter No. L185 for additional information and recommended service procedures.
16. Replace fuel tank vent line flexible connections as required, but no later than 1000 hours of service.
17. Replace flexible fuel tank supply hose at time of engine overhaul.
18. If airplane has electric trim, refer to the latest revision of Piper Service Bulletin No. 556.
19. Refer to and comply with the latest revision of Piper Service Bulletin No. 571.
20. Refer to the latest revision of Piper Service Bulletin No. 580.
21. Refer to latest revision of Piper S/L 620, 621, 749, and 842.
22. Refer to Flight Manual Supplement for preflight and flight check, for intended function in all modes.
23. Refer to Lycoming Service Bulletin 469.

TABLE III-II. INSPECTION REPORT (PA-32R-300)

NOTE

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
A. PROPELLER GROUP				
1. Inspect spinner and back plate	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	O
5. Inspect spinner mounting brackets		O	O	O
6. Inspect propeller mounting bolts and safety (Check torque if safety is broken)		O	O	O
7. Inspect hub parts for cracks and corrosion		O	O	O
8. Rotate blades of constant speed propeller and check for tightness in hub pilot tube		O	O	O
9. Remove constant speed propeller; remove sludge from propeller and crankshaft			O	O
10. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear, and correct installation		O	O	O
11. Overhaul propeller (Refer to the latest revision of Hartzell S/L 61.)				
B. ENGINE GROUP				
NOTE: Read Notes 5 and 21 prior to completing this inspection group. CAUTION: Ground Magneto Primary Circuit before working on engine.				
1. Remove engine cowl and inspect for 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 6)	O	O	O	O
4. Clean suction oil strainer at oil change (Inspect strainer for foreign particles)	O	O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
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 fitting for leaks, security, chafing, dents and cracks (See Note 8)	O	O	O	O
8. Clean and check oil radiator cooling fins (See Note 18)		O	O	O
9. Remove and flush oil radiator			O	O
10. Fill engine with oil per information in lubrication chart	O	O	O	O
11. Clean engine		O	O	O
CAUTION: Do not contaminate the vacuum pump with cleaning fluid. (Ref: The latest revision of Lycoming Service Letter No. 1221.)				
12. Inspect condition of spark plugs (Clean and adjust gap as required, adjust per the latest revision of Lycoming Service Instruction No. 1042.)		O	O	O
NOTE: If fouling of spark plugs has been 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 (Ref: AC43.13-1A)		O	O	O
15. Inspect cylinders for cracked or broken fins		O	O	O
16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds (See Note 12)	O	O	O	O
NOTE: Lycoming requires a Valve Inspection be made after every 400 hours of operation. (See Note 11)				
17. Inspect ignition harness and insulators (high tension leakage and continuity)		O	O	O
18. Check magneto points for proper clearance (Maintain clearance at 0.016)		O	O	O
19. Inspect magento for oil leakage		O	O	O
20. Inspect breaker felts for proper lubrication		O	O	O
21. Inspect distributor block for cracks, burned areas or corrosion and height of contact springs			O	O
22. Inspect magnetos to engine timing		O	O	O
23. Inspect ignition switch operation (See the latest revision of Piper Service Letter No. 758)	O	O	O	O
24. Overhaul or replace magnetos (See Note 7)				O
25. Remove air filter and tap gently to remove dirt particles (Replace as required)	O	O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont.)				
26. Inspect air induction system for leaks, security and damage. Repair or replace as required (See Note 19)	O	O	O	O
27. Clean fuel injector inlet line screen (Clean injector nozzles as required) (Clean with acetone only)	O	O	O	O
28. Inspect condition of injector alternate air door and box (Refer to the latest revision of Piper Service Bulletin No. 524 and see Note 13)	O	O	O	O
29. Inspect intake seals for leaks and clamps for tightness	O	O	O	O
30. Inspect all air inlet duct hoses (Replace as required)	O	O	O	O
31. Inspect condition of flexible fuel lines		O	O	O
32. Replace flexible fuel lines (See Note 7)				O
33. Inspect fuel system for leaks		O	O	O
34. Inspect fuel pumps for operation (engine driven and electric)		O	O	O
35. Overhaul or replace fuel pumps (engine driven and electric) (See Note 7)				O
36. Inspect vacuum pump and lines		O	O	O
37. Overhaul or replace vacuum pump (See Note 7)				O
38. Inspect throttle, alternate air, mixture and propeller governor controls for security, travel and operating condition (Refer to the latest revision of Piper Service Bulletin No. 537)		O	O	O
39. Inspect exhaust stacks, connections and gaskets (Refer to Section III) (Replace gaskets as required)		O	O	O
40. Inspect muffler, heat exchange and baffles (Refer to Section III) (Refer to the latest revision of Piper Service Bulletin No. 520)		O	O	O
41. Inspect breather tube for obstructions and security		O	O	O
42. Inspect crankcase for cracks, leaks and security of seam bolts		O	O	O
43. Inspect engine mounts for cracks and loose mountings (Refer to the latest revision of Piper Service Letter No. 799)		O	O	O
44. Inspect all engine baffles		O	O	O
45. Inspect rubber engine mount bushings for deterioration (Replace as required)		O	O	O
46. Inspect fire wall seals		O	O	O
47. Inspect condition and tension of alternator drive belt (Refer to Section X or Section XIII if air conditioning is installed)		O	O	O
48. Lubricate alternator idler pulley (if installed); remove grease seal and add grease (Refer to lubrication chart in Service Manual, Section II)		O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont.)				
49. Inspect condition of alternator and starter		O	O	O
50. Inspect security of alternator mounting		O	O	O
51. Check air conditioning compressor oil level (See Note 9)				
52. Inspect condition of compressor belt and tension (See Section XIII)		O	O	O
53. Inspect compressor clutch security and wiring (See Note 10)		O	O	O
54. Inspect security of compressor mounting		O	O	O
55. Inspect fluid in brakes reservoir (Fill as required)	O	O	O	O
56. Inspect and lubricate all controls (Refer to Section II) (Refer to latest revision of Piper Service Bulletin No. 538)		O	O	O
57. Overhaul or replace propeller governor (Refer to the latest revision of Hartzell S/L No. 61.)				
58. Complete overhaul of engine or replace with factory rebuilt (See Note 7)				
59. Reinstall engine cowl	O	O	O	O
C. CABIN GROUP				
1. Inspect cabin entrance doors and windows for damage, operation and security		O	O	O
2. Inspect upholstery for tears		O	O	O
3. Inspect seats, seat belts, security brackets and bolts		O	O	O
4. Inspect trim operation		O	O	O
5. Inspect rudder pedals		O	O	O
6. Inspect parking brake and brake handle for operation and cylinder leaks		O	O	O
7. Inspect control wheels, column, pulleys and cables		O	O	O
8. Inspect flap control cable attachment bolt			O	O
9. Check landing, navigation, strobe, cabin and instrument lights	O	O	O	O
10. Inspect instruments, lines and attachments		O	O	O
11. Inspect gyro operated instruments and electric turn and bank (Overhaul or replace as required)		O	O	O
12. Replace filters on gyro horizon and directional gyro or replace central air filter			O	O
13. Clean or replace vacuum regulator filter		O	O	O
14. Inspect altimeter (Calibrate altimeter system in accordance with FAR 91.170, if appropriate)		O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
C. CABIN GROUP (cont.)				
15. Check operation of fuel selector valve		O	O	O
16. Inspect condition of heater controls and ducts		O	O	O
17. Inspect condition and operation of air vents		O	O	O
18. Inspect condition of air conditioning ducts		O	O	O
19. Remove and clean air conditioning evaporator filter		O	O	O
D. FUSELAGE AND EMPENNAGE GROUP				
1. Remove inspection plates and panels		O	O	O
2. Inspect baggage doors latch and hinges for operation and security		O	O	O
3. Inspect battery, box and cables (Check at least every 30 days. Flush box as required and fill battery per instructions in Section II)	O	O	O	O
4. Inspect electronic installations		O	O	O
5. Inspect bulkheads and stringers for damage		O	O	O
6. Inspect antenna mounts and electric wiring		O	O	O
7. Check hydraulic pump fluid level (Fill as required)	O	O	O	O
8. Inspect hydraulic pump lines for damage and leaks		O	O	O
9. Inspect for obstructions and contamination in inlet of backup landing gear extender actuator inlet head	O	O	O	O
10. Inspect air conditioning system for freon leaks		O	O	O
11. Check freon level in sight gauge of receiver-dehydrator (Refer to Section XIII)	O	O	O	O
12. Inspect air conditioner condenser air scoop rigging	O	O	O	O
13. Inspect fuel lines, valves, and gauges for damage and operation		O	O	O
14. Remove, drain, and clean fuel strainer bowl and screen (Drain and clean at least every 90 days)	O	O	O	O
15. Inspect security of all lines		O	O	O
16. Inspect vertical fin and rudder surfaces for damage		O	O	O
17. Inspect rudder hinges, horn and attachments for damage and operation		O	O	O
18. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O	O	O
19. Inspect vertical fin attachments		O	O	O
20. Inspect rudder hinge bolts for excess wear (Replace as required)		O	O	O
21. Inspect stabilator surfaces for damage		O	O	O
22. Inspect stabilator, tab hinges, horn and attachments for damage and operation		O	O	O
23. Inspect stabilator attachments **(see latest Piper Service Bulletin 856)**		O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
D. FUSELAGE AND EMPENNAGE GROUP (cont.)				
24. Inspect stabilator and tab hinge bolts and bearings for excess wear (Replace as required)		O	O	O
25. Inspect stabilator trim mechanism		O	O	O
26. Inspect stabilator control stop to insure stop has not loosened and locknut is tight		O	O	O
27. Check all cable tensions (use tensiometer (See Note 17)		O	O	O
28. Check all control surface travel (Refer to Service Manual, Section V)		O	O	O
29. Inspect aileron, rudder, stabilator, stabilator trim cables, turnbuckles, guides and pulleys for safety, damage and operation		O	O	O
30. Clean and lubricate stabilator trim drum screw			O	O
31. Clean and lubricate all exterior needle bearings				O
32. Lubricate per lubrication chart (Refer to Section II)	O	O	O	O
33. Inspect anti-collision light for security and operation		O	O	O
34. Inspect security of Autopilot bridle cable clamps		O	O	O
35. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
36. Inspect emergency locator transmitter battery for replacement date or time per service manual (Refer to the latest revision of Piper S/L 820)		O	O	O
37. Reinstall inspection plates and panels		O	O	O
38. Inspect emergency locator transmitter for replacement date and transmitter for operation per Service Manual		O	O	O
E. WING GROUP				
1. Remove inspection plates and fairings		O	O	O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway		O	O	O
3. Inspect aileron hinges and attachments		O	O	O
4. Inspect aileron control stops to insure stops have not loosened and locknuts are tight		O	O	O
5. Inspect aileron cables, pulleys and bellcranks for damage and operation (See the latest revision of Piper Service Letter No. 768)		O	O	O
6. Inspect flaps and attachments for damage and operation		O	O	O
7. Inspect condition of bolts used with hinges (Replace as required)				O
8. Lubricate per lubrication chart (Refer to Section II)	O	O	O	O
9. Inspect wing attachment bolts and brackets		O	O	O
10. Inspect fuel tanks and lines for leaks, water and contamination (See Note 15)		O	O	O
11. Fuel tanks marked for capacity		O	O	O
12. Fuel tanks marked for minimum octane rating		O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
E. WING GROUP (cont.)				
12. Inspect fuel cell vents (See Note 16)		O	O	O
13. Inspect all control cables, air ducts, electrical leads lines and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O	O	O
14. Reinstall inspection plates and fairings		O	O	O
F. LANDING GEAR GROUP				
1. Inspect oleo struts for proper extension (N-2.60 in./M-4.0 in.) (Check fluid level as required)	O	O	O	O
2. Inspect nose gear steering control and travel		O	O	O
3. Inspect wheels for alignment		O	O	O
4. Put airplane on jacks		O	O	O
5. Inspect tires for cuts, uneven or excessive wear and slippage		O	O	O
6. Remove wheels, clean, check and repack bearings		O	O	O
7. Inspect wheels for cracks, corrosion and broken bolts		O	O	O
8. Check tire pressure (N-35 PSI/M-38 PSI)		O	O	O
9. Inspect brake lining and disc for wear		O	O	O
10. Inspect brake backing plates for cracks		O	O	O
11. Inspect condition of brake and hydraulic lines		O	O	O
12. Inspect shimmy dampener operation		O	O	O
13. Inspect gear forks for damage		O	O	O
14. Inspect oleo struts for fluid leaks and scoring		O	O	O
15. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security		O	O	O
16. Inspect downlock for operation and adjustment		O	O	O
17. Inspect torque link bolts and bushings (Rebush as required)			O	O
18. Inspect drag and side brace link bolts (Replace as required)				O
19. Inspect gear doors and attachments		O	O	O
20. Inspect warning horn and light for operation		O	O	O
21. Retract gear - inspect operation		O	O	O
22. Retract gear - check doors for clearance and operation		O	O	O
23. Inspect anti-retraction system		O	O	O
24. Inspect actuating cylinders for leaks and security		O	O	O
25. Inspect all hydraulic lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation (Refer to the latest revision of Piper Service Letters Nos. 808 and 810)		O	O	O

TABLE III-II. INSPECTION REPORT (PA-32R-300) (cont.)

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
F. LANDING GEAR GROUP (cont.)				
26. Inspect position indicator switch and electrical leads for security		O	O	O
27. Lubricate per lubrication chart (Refer to Section II)	O	O	O	O
28. Remove airplane from jacks		O	O	O
G. OPERATIONAL INSPECTION				
1. Check fuel pump and fuel tank selector (Refer to the latest revision of Piper Service Bulletin No. 519A)	O	O	O	O
2. Check fuel quantity, pressure and flow readings	O	O	O	O
3. Check oil pressure and temperature	O	O	O	O
4. Check alternator output	O	O	O	O
5. Check manifold pressure	O	O	O	O
6. Check alternate air	O	O	O	O
7. Check parking brake	O	O	O	O
8. Check vacuum gauge	O	O	O	O
9. Check gyros for noise and roughness	O	O	O	O
10. Check cabin heater operation	O	O	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	O	O
18. Check operation of AutoPilot, including Automatic Pitch Trim, and Manual Electric Trim (See Note 20)	O	O	O	O
19. Check emergency locator transmitter for operation per Service Manual		O	O	O
20. Check air conditioner compressor clutch operation	O	O	O	O
21. Check air conditioner condenser scoop operation	O	O	O	O
22. Check (Fly Aircraft) Landing Gear System (See Note 14)		O	O	O
H. GENERAL				
1. Aircraft conforms to FAA Specification	O	O	O	O
2. All the latest FAA Airworthiness Directives complied with	O	O	O	O
3. All the latest Manufacturers Service Bulletins and Letters complied with	O	O	O	O
4. Check for proper Flight Manual	O	O	O	O
5. Aircraft papers in proper order	O	O	O	O

NOTES:

1. Refer to the last card of the Piper Parts Price List - Aerofiche, for a check list of current revision dates to Piper Inspection Reports and Manuals.
2. All inspections or operations are required at each of the inspection intervals as indicated by a (O). Both the annual and 100-hour inspections are complete inspections of the airplane, identical in scope, while both the **500 and 1000**-hour inspections are extensions of the annual or 100-hour inspection, which require a more detailed examination of the airplane, and overhaul or replacement of some major components. Inspections must be accomplished by persons authorized by the FAA.
3. Piper service bulletins are of special importance and Piper considers compliance mandatory.
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. 60297-10) for this airplane, dated November 1973. Any changes issued to the engine manufacturer's operator's manual after this date shall supersede or supplement the inspections outlined in this report.
6. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters, provided the element is replaced each 50 hours of operation.
7. Replace or overhaul as required or at engine overhaul. (For engine overhaul, refer to latest Lycoming Service Instructions No. 1009.)
8. Replace flexible oil lines as required but no later than 1000 hours.
9. The compressor oil level should not be checked unless a freon leak has occurred which requires an addition of freon to the system.
10. Clean any traces of oil from the clutch surface.
11. 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 keeper, springs and spring seats. If any indications are found, the cylinder and all of its components should 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 Lycoming Service Table of Limits No. SSP1776.
12. 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 its cause must be determined and corrected before the aircraft 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 awhile. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.
13. Check throttle body attaching screws for tightness; the correct torque for these screws 40 to 50 inch-pounds.
14. Fly aircraft to check landing gear system in accordance with instructions given in PA-32 Service Manual, Section VA, Paragraph 5A-14a.
15. Replace flexible fuel supply hose and interconnect hose couplings at time of engine overhaul.
16. Replace fuel tank vent line flexible connections as required, but no later than 1000 hours of service.
17. Maintain cable tensions as specified in section V of this manual.
18. Inspect engine oil coolers in accordance with latest revision of Piper Service Bulletin No. 586.
19. Check clamp connecting induction elbow to injector is torqued 40-50 in.-lbs.
20. Refer to Flight Manual Supplement for preflight and flight check, for intended function in all modes.
21. Refer to Lycoming Service Bulletin 469.

STRUCTURE

SECTION IV

4-1.	Description	1E15
4-2.	Removal and Replacement	1E15
4-3.	Removal and Replacement of Wing Assembly	1E15
4-4.	Removal and Replacement of Wing Tip	1E15
4-5.	Removal and Replacement of Wing Flaps	1E16
4-6.	Removal and Replacement of Aileron	1E16
4-7.	Removal and Replacement of Wing	1E16
4-8.	Removal and Replacement of Landing Light	1E23
4-9.	Removal and Replacement of Rudder	1E23
4-10.	Removal and Installation of Stabilator	1E24
4-11.	Removal and Installation of Fin	1E24
4-12.	Removal and Installation of Door Lock Assembly	1E24
4-13.	Removal of Windshield	1F1
4-14.	Installation of Windshield	1F1
4-15.	Removal of Windows (Side)	1F1
4-16.	Installation of Windows (Side)	1F2
4-17.	Removal of Rear Door Window	1F2
4-18.	Installation of Rear Door Window	1F2
4-19.	Structural Repairs	1F6
4-19a.	General Thermoplastic Repairs	1F9
4-20.	Fiberglass Repairs	1F15
4-21.	Fiberglass Touch-up and Surface Repairs	1F15
4-22.	Fiberglass Fracture and Patch Repairs	1F16
4-23.	Safety Walk Repair	1F18
4-24.	Surface Preparation	1F18
4-25.	Product Listing for Liquid Safety Walk Compound	1F18
4-26.	Application of Liquid Safety Walk Compound	1F18
4-27.	Aileron Balance Weight Modification	1F19
4-28.	Flap Inspection and Modification	1F19
4-29.	Stabilator Drain Holes	1F19
4-30.	Control Surface Balancing	1F23
4-31.	Checking Control Surface Balance	1F23
4-32.	Checking Control Surface Free Play	1F23
4-33.	Balancing Equipment	1F24
4-34.	Balancing Stabilator	1G2
4-35.	Balancing Ailerons	1G3
4-36.	Balancing Rudder	1G4
4-37.	Rigging Instructions - Seat Back Lock and Release	1G5
4-38.	Removal and Installation of Door Seal Snubbers	1G6

SECTION IV

STRUCTURE

4-1. DESCRIPTION. This section explains the removal and installation procedures for the structural surfaces of the airplane. For the removal, installation and rigging and adjustment procedures of the controlling components of the various structural surfaces, refer to Section V.

NOTE

When torquing structural assemblies, standard torque values are to be used as found in Table II-II of this manual or FAA Advisory Circular 43.13-1A, unless otherwise stated in this section.

4-2. REMOVAL AND REPLACEMENT.

4-3. REMOVAL AND REPLACEMENT OF WING ASSEMBLY.

NOTE

The major subassemblies of the wing may be removed individually or the wing may be removed as a unit. To remove a wing, a fuselage supporting cradle is required.

4-4. REMOVAL AND REPLACEMENT OF WING TIP.

a. Incorporated in each PA-32-260 and 300 with a serial number up to but not including 32-7940001, wing tip is a 17 gallon auxiliary fuel tank. Given below are the steps necessary for removal of the wing tip:

1. Drain fuel from the tank to be removed.
2. Remove the access cover from the bottom of the wing tip.
3. By working through the access, disconnect the fuel line, fuel quantity transmitting wire, the position light wire, strobe light wire, and two bolts which hold tank to wing tip.
4. Remove the screws from around the wing tip and remove the tip assembly.
5. After the wing tip is installed and all connections are secure, fill the tank and check for leaks.
6. Refer to Section VIII for information on repairing of fiberglass tanks.

b. The PA-32R-300 and 32-300 with S/N 32-7940001 and up, wing tips are removed using the following steps.

1. Remove the screws from around the wing tip.
2. Pull the tip away from the wing assembly far enough to gain access for removal of electrical connections for strobe and position lights.
3. Remove the tip from the wing.

c. Replacement of wing tip is reverse of removal instructions.

4-5. REMOVAL AND REPLACEMENT OF WING FLAPS.

a. Remove the access plate at the wing butt rib.
b. Disconnect the flap push rod.
c. Remove the three hinge bolts.
d. Pull the flap straight back off the wing.
e. Install the flap in reverse of removal instructions.

4-6. REMOVAL AND REPLACEMENT OF AILERON.

a. Disconnect the aileron push rod at the inboard end of the aileron.
b. Remove the eight bolts which hold the aileron to the wing assembly.
c. Remove the aileron by lowering the inboard end first, then swing forward so the balance assembly will clear the outboard portion of the wing.
d. Install the aileron in reverse of removal instructions.

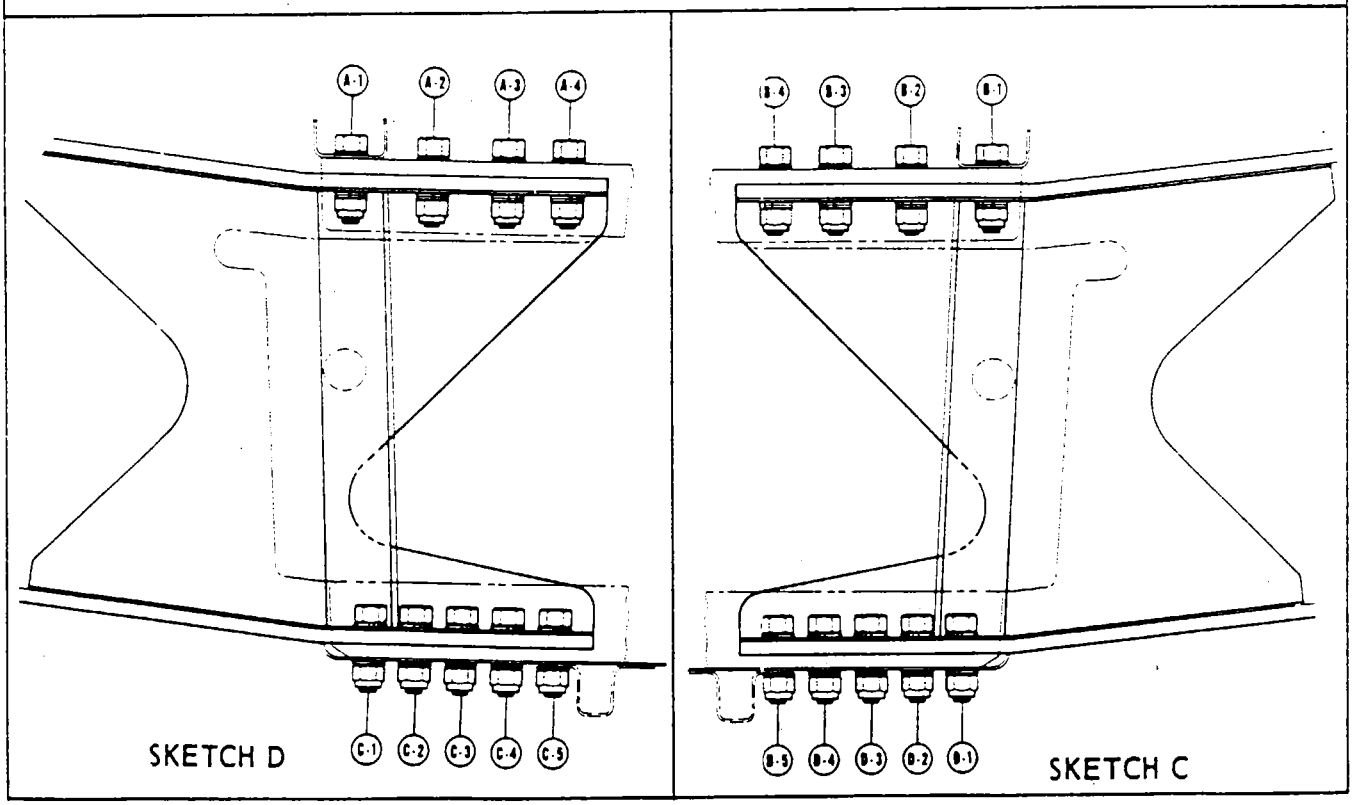
4-7. REMOVAL AND REPLACEMENT OF WING.

a. Remove wing root fairings and all wing inspection panels.
b. Drain gas from the desired wing. (Refer to Draining Fuel System, Section II.)
c. Drain brake lines and reservoir. (Refer to Draining Brake System, Section II.)
d. Remove seats, floor panels and side panels as required.
e. Set the airplane on jacks. (Refer to Jacking, Section II.)
f. Disconnect aileron balance cables at aileron bellcranks and aileron control cables at center of fuselage.
g. Disconnect the fuel lines at the wing butt.
h. Disconnect the airspeed lines.
i. Disconnect brake line and electrical wiring.
j. On PA-32R-300 disconnect landing gear retraction hydraulic lines.
k. Arrange a suitable fuselage support cradle and remove the wing jacks.
l. Remove the eighteen spar bolts and the bolts on the front and rear spar.
m. Remove the wing.
n. Reinstall wing in reverse of removal instructions. (Torque bolt heads on upper spar cap and nuts on lower spar cap from 360 to 390 inch-pounds.)

BOLT LEGEND

POSITION	BOLT	NUT	WASHER			
			UNDER HEAD	UNDER NUT	UNDER HEAD	UNDER NUT
C-1	AN176-13A	MS20365-624	AN960-616-1		1-96352-3	
C-2	1	1		2	1	
C-3	1	1		2	1	
C-4	1	1		2	1	
C-5	1	1		1	1	
D-1	1	1		1	1	
D-2	1	1		2	1	
D-3	1	1		2	1	
D-4	1	1		2	1	
D-5	1	1		1	1	
A-1	1	1	1	1		1
A-2	AN176-12A	1	1	1		1
A-3	1	1	1	1		1
A-4	1	1	1	1		1
B-1	AN176-14A	1	1	2		
B-2	AN176-13A	1	1	2		
B-3	1	1	1	2		
B-4	1	1	1	2		

TORQUE BOLT HEADS ON UPPER SPAR CAP AND NUTS ON LOWER SPAR CAP 360-390 INCH-POUNDS.



68100

Figure 4-1. Wing Installation (PA-32-260 and PA-32-300, Serial Nos. 32-40000 to 32-7840222 inclusive.)

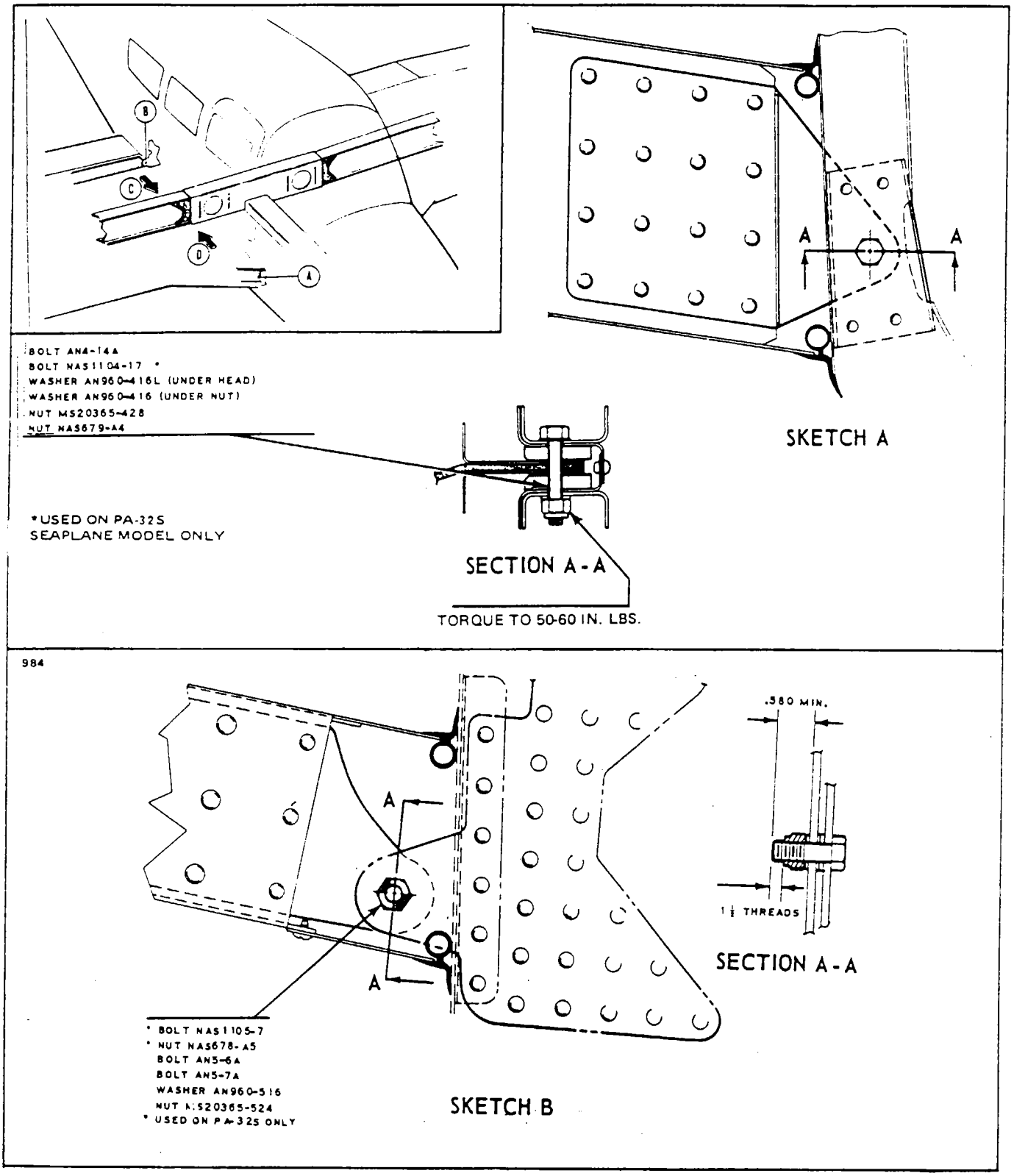


Figure 4-1. Wing Installation (PA-32-260 and PA-32-300, Serial Nos. 32-40000 to 32-7840222, inclusive.) (cont.)

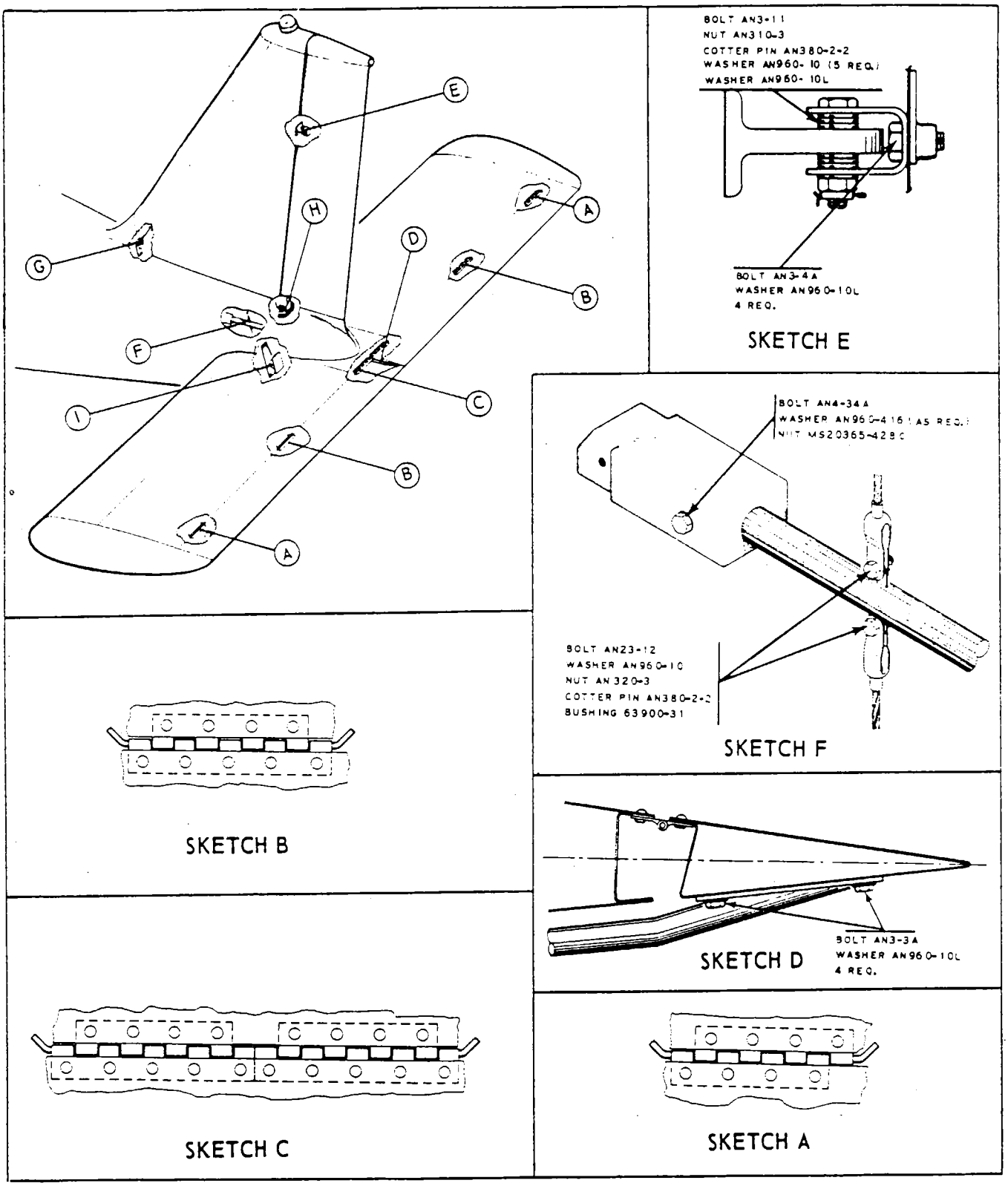


Figure 4-1a. Empennage Group Installation

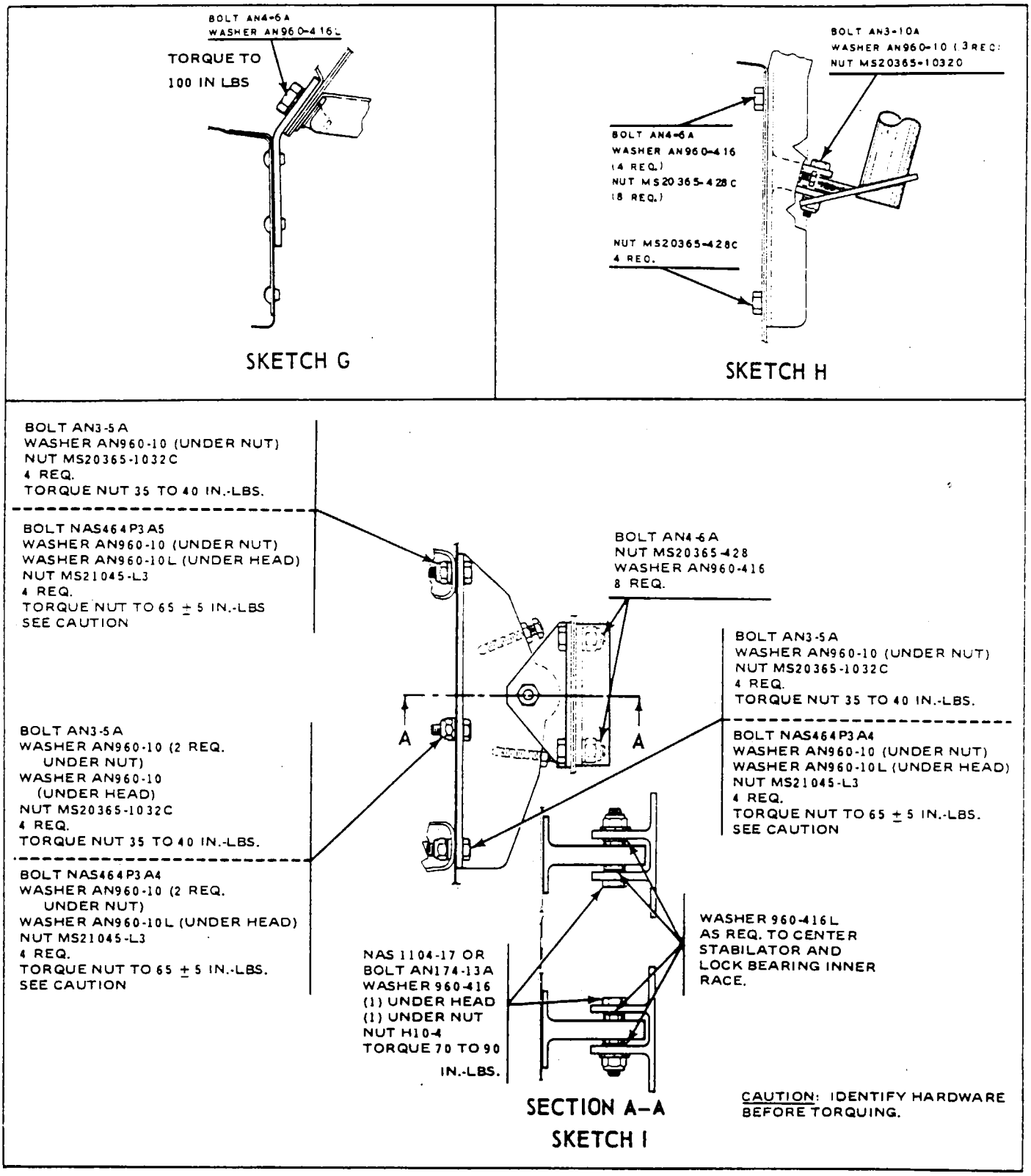


Figure 4-1A. Empennage Group Installation (cont.)

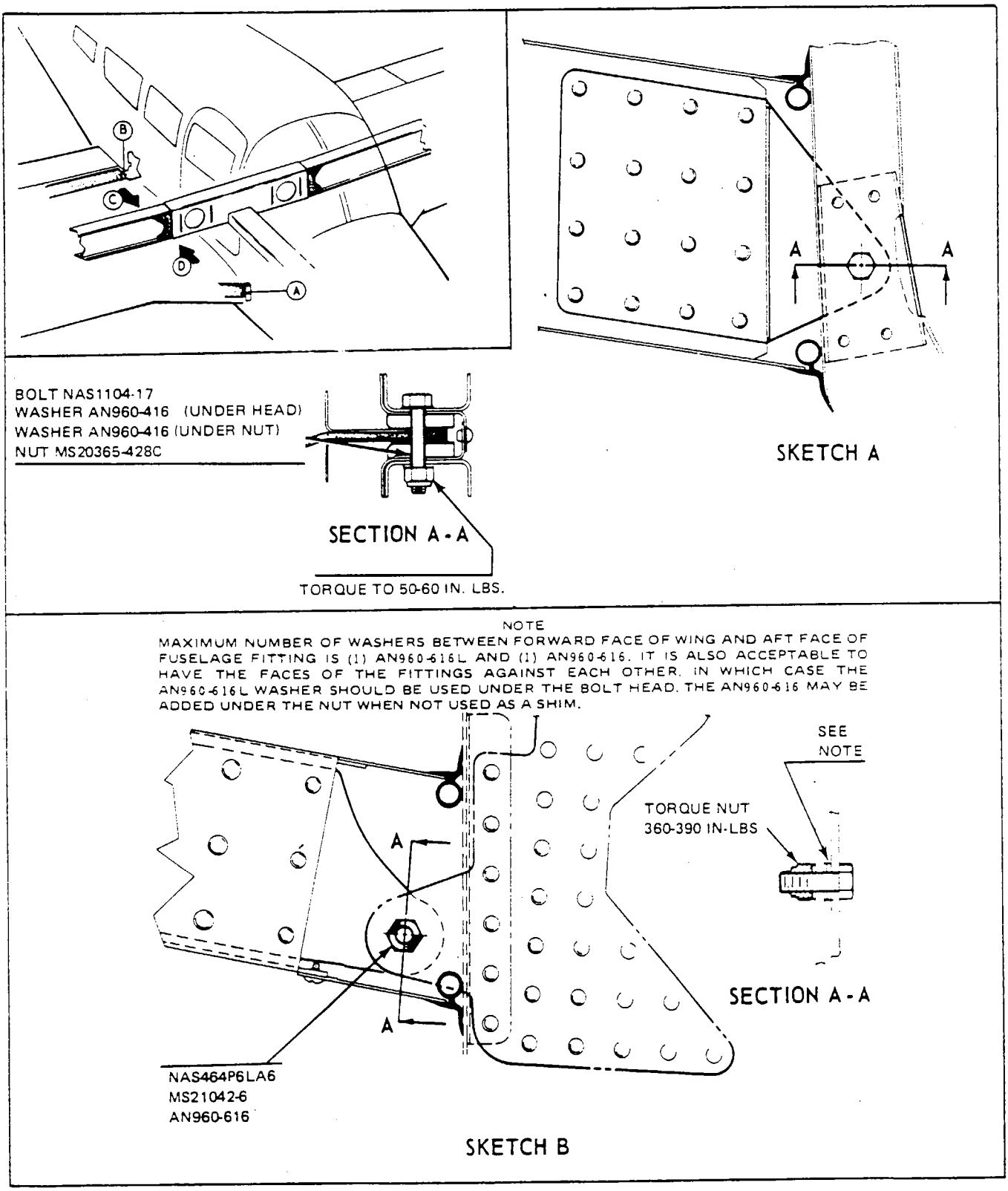


Figure 4-1B. Wing Installation (PA-32R-300 and PA-32-300 S/N 327940001 and up)

BOLT LEGEND				
POSITION	BOLT	NUT	WASHER UNDER HEAD	WASHER UNDER NUT
A-1	AN176-15A	MS20365-624C	(1) AN960-616	(2) AN960-616
A-2	AN176-15A	MS20365-624C	(1) AN960-616	(3) AN960-616
A-3	AN176-15A	MS20365-624C	(1) AN960-616	(3) AN960-616
A-4	AN176-15A	MS20365-624C	(1) AN960-616	(3) AN960-616
B-1	AN176-14A	MS20365-624C	(1) AN960-616	(1) AN960-616
B-2	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-3	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-4	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
C-1	AN176-14A	MS20365-624C	(1) 96352-3	(1) AN960-616
C-2	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-3	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-4	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-5	AN176-14A	MS20365-624C	(1) 96352-3	(1) 96352-3
D-1	AN176-14A	MS20365-624C	(1) 96352-3	(1) AN960-616
D-2	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-3	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-4	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-5	AN176-14A	MS20365-624C	(1) 96352-3	(1) 96352-3

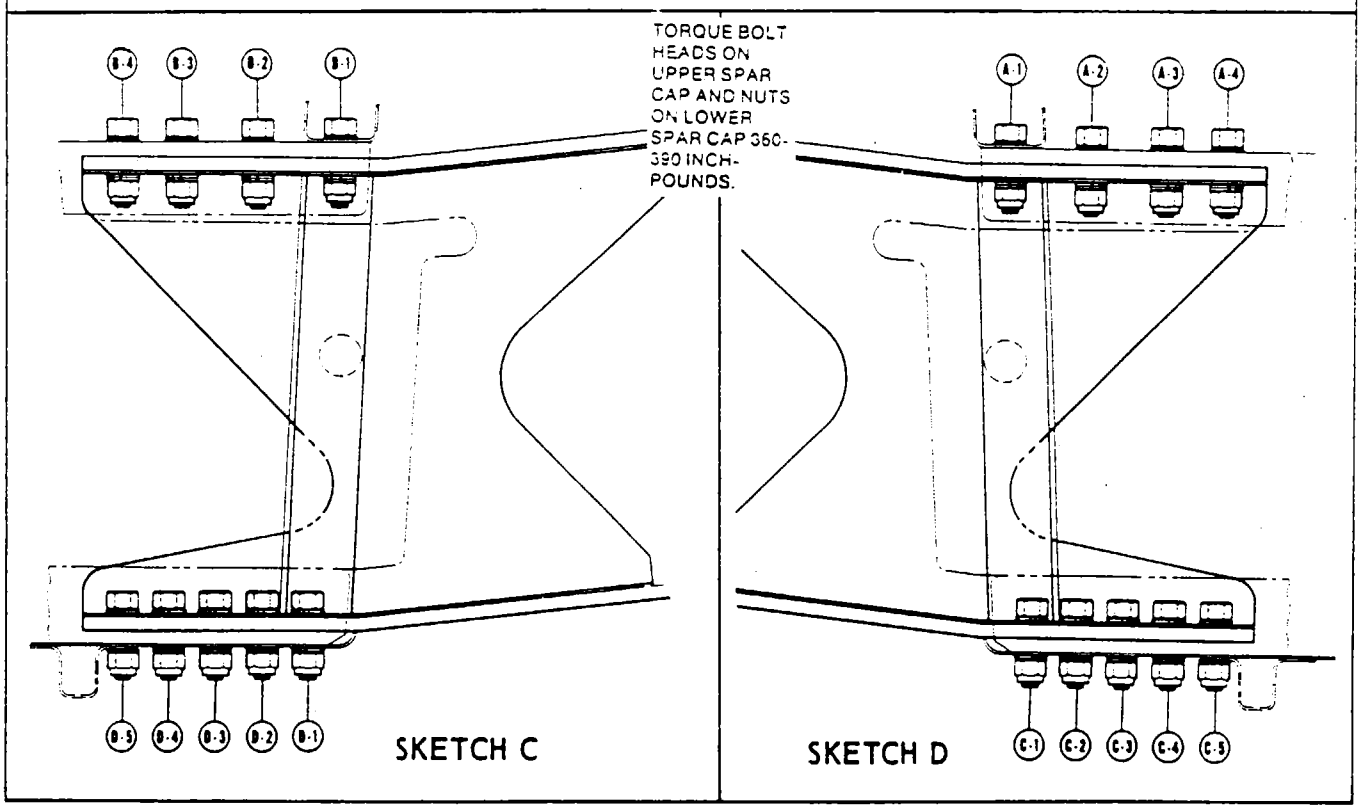


Figure 4-1B. Wing Installation (PA-32R-300 and PA-32-300 S/N 327940001 and up) (cont.)

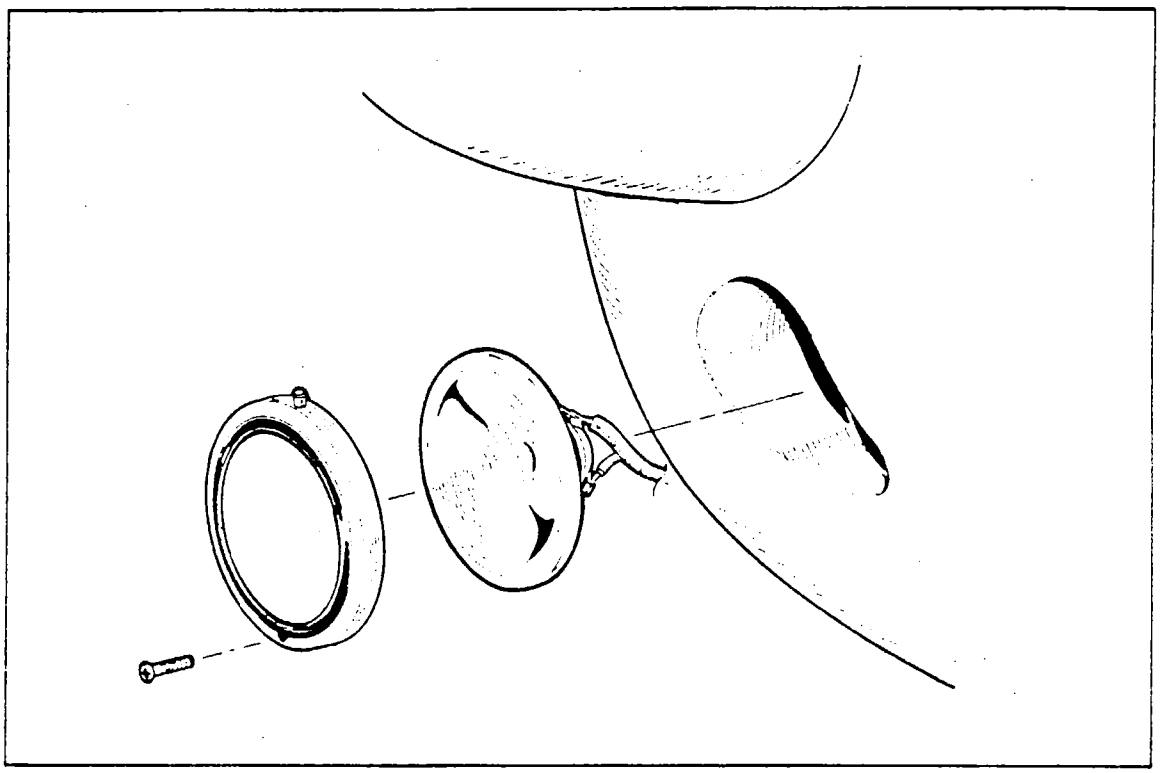


Figure 4-1c. Landing Light Assembly

4-8. REMOVAL AND REPLACEMENT OF LANDING LIGHT.

a. Remove the landing light assembly by removing the retainer screw and pulling forward.

b. Disconnect the wires from the light assembly and remove.

4-9. REMOVAL AND REPLACEMENT OF RUDDER.

a. Remove the tail cone fairing.

b. Disconnect the two control cables from the rudder horn.

c. Disconnect the rudder from the lower rudder hinge bracket.

d. Remove the one remaining hinge bolt, disconnect the tail light electrical wire and remove the rudder.

e. Install the rudder in reverse of removal, check all bolts and pins for safety.

4-10. REMOVAL AND INSTALLATION OF STABILATOR.

The complete stabilator assembly can be removed by following the procedure given below:

a. Remove the tail cone assembly.

b. Relieve the tension on the trim cable and remove the trunnion assembly.

c. From inside the fuselage disconnect the two stabilator control cables from the stabilator balance arm assembly.

d. Remove the two hinge bolts at the pivot points and remove the stabilator as a complete assembly.

e. Reinstall the stabilator in reverse of removal instructions. Tension trim cable and stabilator control cables to specifications given in Table V-I, Section V.

NOTE

Check the surface for proper travel and all turnbuckles, pins, etc. for safety.

4-11. REMOVAL AND INSTALLATION OF FIN.

a. Remove the tail cone fairing and fairing at the forward edge of the fin.

b. Remove the rudder. (Refer to Paragraph 4-9.)

c. Disconnect the antenna wire from the antenna assembly, attach a fish line to the antenna cable before removing it from the fin.

d. Separate the stabilator trim cable at turnbuckle, and remove the cable from the trim mechanism.

e. Remove the one bolt at the leading edge of the fin.

f. Remove the two bolts which secure the trim mechanism to the fin spar. Remove the four bolts which secure the fin spar to the aft bulkhead. Remove the fin.

g. Install the fin in reverse of removal instruction using Figure 4-1a as reference for proper hardware and torques. Check all bolts for safety.

NOTE

Modifications to the fuselage are permissible if they do not involve alterations to the primary structure. It is recommended that the manufacturer be contacted for information regarding specific alterations proposed.

4-12. REMOVAL AND INSTALLATION OF DOOR LOCK ASSEMBLY.

a. Remove door latch assembly by removing door trim upholstery and removing screws attaching latch plate and latch assembly to door.

b. Disconnect latch pull rod from inside door handle.

c. Remove complete latch assembly.

d. Install the door latch in reverse of the removal instructions.

4-13. REMOVAL OF WINDSHIELD.

a. Remove the collar molding from around the bottom of the windshield by removing attaching screws.

b. Remove the trim strip from between the windshield halves by removing attaching screws.

c. Remove the windshield by raising the lower portion of the windshield and pulling forward.

NOTE

A damaged windshield should be saved since it can be used as a pattern for drilling holes in a new windshield.

d. Clean old tape and sealer from the windshield retainer channels and strips.

4-14. INSTALLATION OF WINDSHIELD.

a. Ascertain that the new windshield outside contours are that of the old windshield. It may be necessary to cut or grind the new windshield.

b. Apply black vinyl plastic tape around the outer edges of the entire windshield.

c. Apply a strip of vinyl foam tape (1/8 x 1" wide - type 1 P.U.C. per PMS-K0003) over the plastic tape completely around the top and outboard edges of the windshield.

d. Apply white PRC 5000 sealing compound (Product Research Corporation) in the upper and outboard windshield.

e. Slide the windshield aft and up into place. Use caution not to dislocate the tape around the edges of the windshield. Allow clearance between the two sections of the windshield, at the divider post, for expansion.

f. Lay sealant at the bottom and center (inboard) of the windshield, in the hollow between the outside edge and channel.

g. Lay a small amount of sealant under the center trim strip, install and secure.

h. Lay black vinyl tape on the underside of the collar molding, install and secure.

i. Seal with sealant any areas around windshield that may allow water to penetrate past windshield.

j. Remove excess exposed sealer or tape.

4-15. REMOVAL OF WINDOWS (Side).

a. Remove the retainer molding from around the window by removing attachment screws. At the forward end of both the right and left window that is adjacent to the second row of seats, the window retainer is riveted in place and need not be removed.

b. Remove the window from the frame.

c. Remove excess tape and sealer from the window frame.

4-16. INSTALLATION OF WINDOWS (Side)

a. Cut or grind the new window to the same dimension as the window removed.

b. Apply a strip of vinyl foam tape (1/8 x 1" wide - type 1 P.V.C. per PMS-K0003) completely around the edge of the window.

c. Apply white PRC#5000 sealing compound (Product Research Corporation) completely around the outer surface of the window at all attachment flanges.

d. Install the window in the frame and install retainer molding; secure with screw.

e. Remove excess exposed sealer and tape.

4-17. REMOVAL OF REAR DOOR WINDOW. (Refer to Figure 4-2.)

NOTE

When removing the rear door window for the first time, proceed with instructions contained in paragraph 4-17a thru 4-17d. When removing the window indoors with previously installed 68020-03 retainer, proceed with instructions contained in paragraph 4-17a and 4-17e thru 4-17h.

a. Remove rear door and place on a protective surface to prevent scratching the painted surface. The door should be supported in such a manner so it will not rock back and forth as the window is being replaced.

b. Measure in .45-inch from the edge of the window frame and scribe a line around the inner panel assembly. (Refer to Line "A", Figure 4-2.)

c. Insert router into jaws of drill chuck. Install guide on router. The router should protrude from the rounded end of the guide by no more than .19-inch. Adjust router in drill check as necessary to obtain this dimension.

d. Energize drill and using any convenient point along the perimeter of Line "A", rout the .45-inch wide metal strip and window as shown in Sketch A. The remaining seam should be sharp and clean.

e. Measure in .44-inch from the inner edge of retainer P/N 68020-03. Scribe a line around its perimeter. (Refer to Line "B", Figure 4-2.)

f. Insert router into jaws of drill chuck. Install guide on router. The router should protrude from the rounded end of the guide by no more than .25-inch. Adjust router in drill chuck as necessary to obtain this dimension.

g. Energize drill and using any convenient point along the perimeter of Line "B", route the .44-inch wide portion of retainer P/N 68020-03 and window as shown in Sketch B. Continue routing until the original trim line is reached.

h. Locate the seam between the top of the inner panel assembly and the retainer. Using a sharp chisel and tapping it lightly with a mallet, remove remainder of retainer 68020-03 from the door. Smooth off any surface roughness that may remain.

4-18. INSTALLATION OF REAR DOOR WINDOW. (Refer to Figure 4-2.)

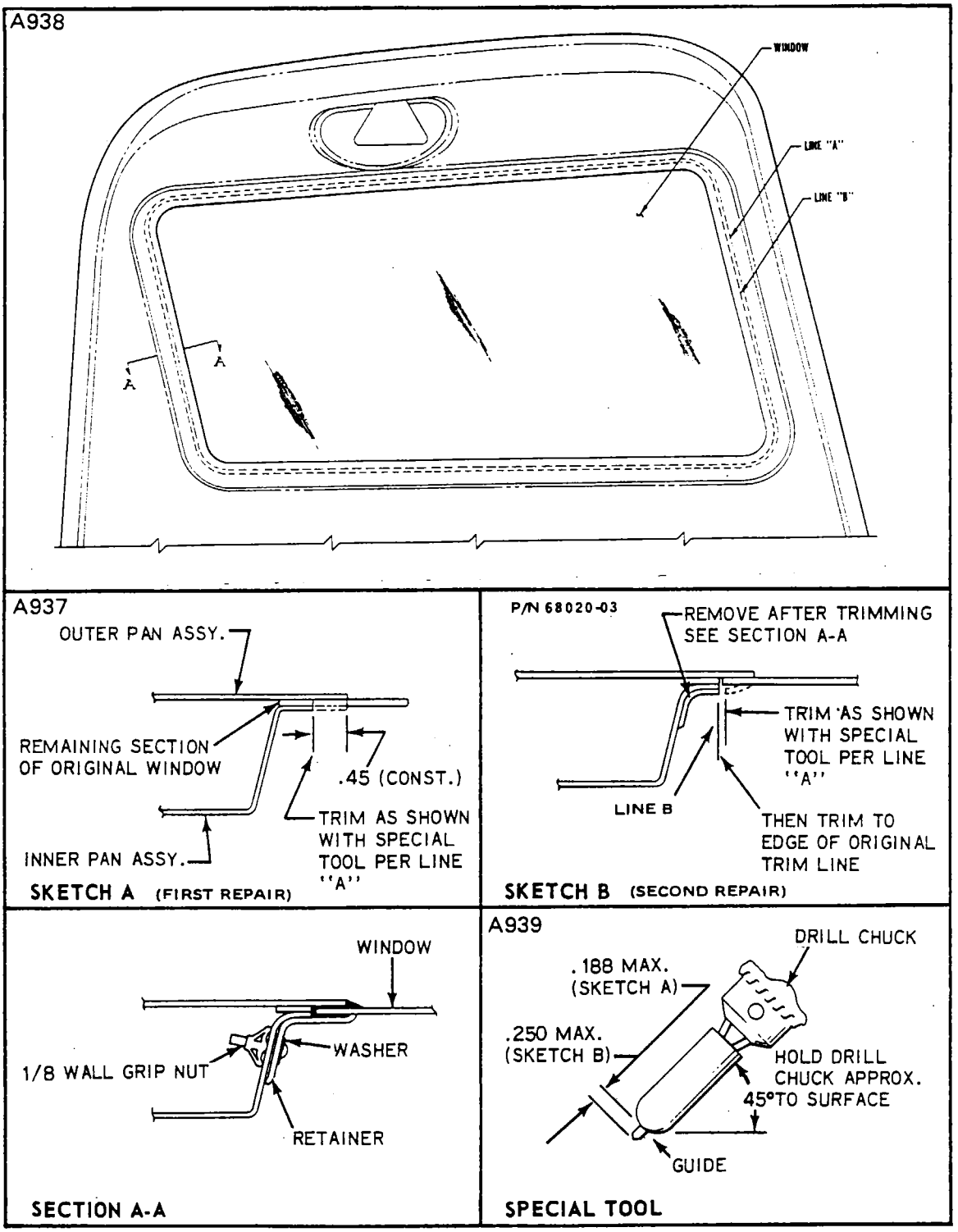


Figure 4-2. Rear Door Window Replacement

NOTE

Repair Kit, part number 757 023, contains all materials necessary to replace the rear door window and is available through Piper Aircraft Dealers or Distributors.

a. Temporarily position new retainer. Using a 1/8-inch drill, drill 16 holes around the inner panel assembly using the holes in the retainer as pilot holes. Remove retainer and redrill all 16 holes using a 5/16-inch drill.

b. Temporarily position new window in its recess to determine that sufficient material has been removed and that it fits properly.

c. Stand the window on edge on a protective surface. Peel the protective masking away from the edge far enough to permit the application of the sealing tape. The tape should be applied in such a manner that the approximate center of the tape will contact the edge of the window.

d. Carefully press tape to contact both sides of the window simultaneously. The tape should be evenly divided on both sides of window. Cut and trim tape as necessary.

e. Position window in its recess in the door. Gently press outer edges of the window so that tape will contact the inner surface of the outer panel assembly.

f. Insert 16 wall grip nuts (with screws installed) through holes previously drilled in the inner panel assembly. Turn screws in clockwise rotation thus activating the locking feature of the nut. Continue in this direction until the nut is drawn up tight. Avoid excess torque to prevent stripping threads. Remove screws.

g. Place new retainer into position and secure with 16 screws and washers (AN960-6).

h. Carefully invert the door. Apply a bead of PRC-5000 sealant to the outer perimeter of the window. Allow sealant to dry before reinstalling door.

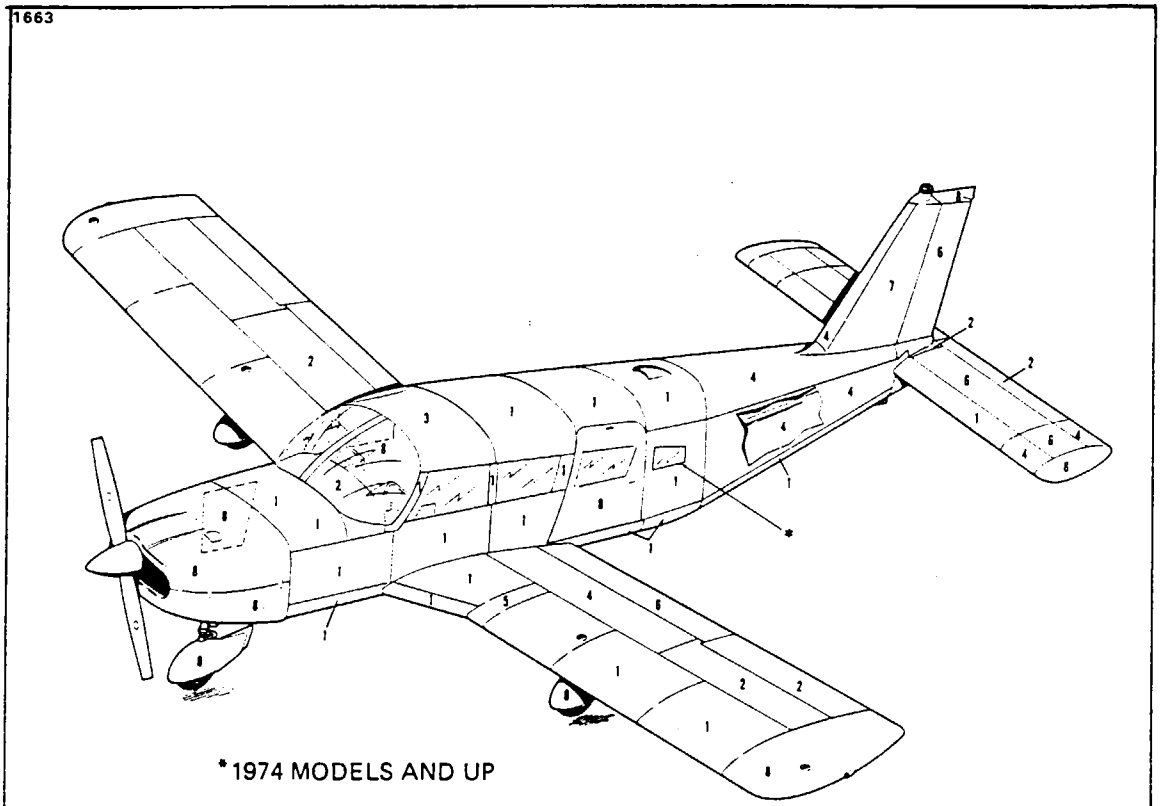
NOTE

Inspect to determine that all original bond lines between outer panel and window, and window and inner panel are tight. Fresh breaks in bond lines can be sealed using one of the following:

1. Eastman 910
2. Aron Alpha Vigor Tool Co., NYC., N.Y.

Older breaks in bond lines should be sealed using one of the following adhesives:

1. Scotchweld 2216 B/A Liquid epoxy, MMM Co., St. Paul, Minn.
2. Chemlock 304 Hughson Chemical Co., Erie, Pa.
3. Reisweld 7006 H.B. Fuller Co., St. Paul, Minn.
4. Locktite 2508† Locktite Corp, Newington, Conn.
   †Packaged in 1-oz cups for ready mix under P/N 53-83.



No.	Material	Thickness	No.	Material	Thickness
1	2024-T3	0.032	5	2024-T3	0.051
2	2024-T3	0.020	6	2024-T3	0.016
3	2024-T3	0.040	7	2024-O*	0.020
4	2024-T3	0.025	8	Fiberglas	

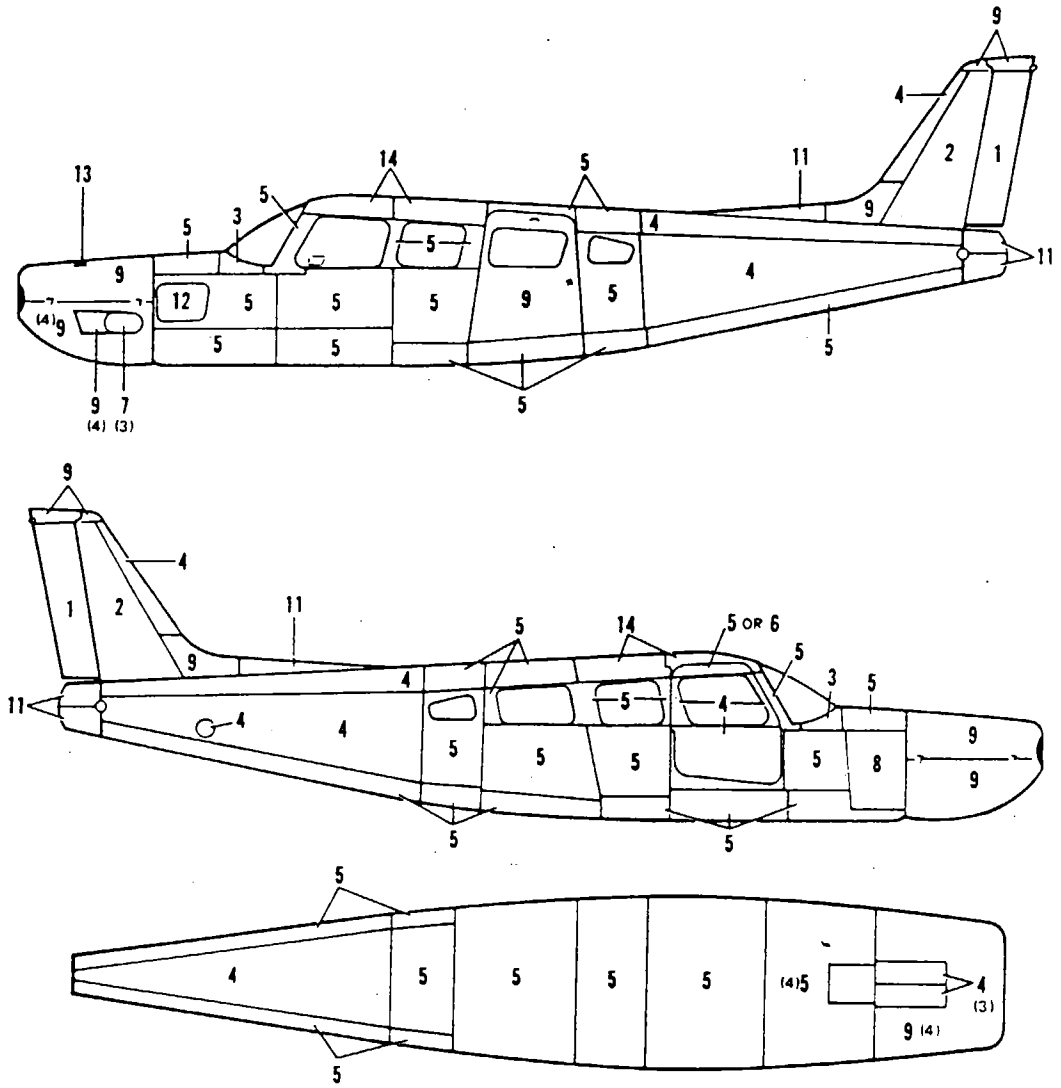
*Heat treat to 2024-T4

Figure 4-3. Skin Material and Thickness (PA-32-260 and PA-32-300, Serial Nos. 32-40000 to 32-7840222 inclusive.)

4-19. STRUCTURAL REPAIRS. Structural repair methods used may be made in accordance with the regulations set forth in FAA Advisory Circular 43.13-1A. To assist in making repairs, Figure 4-3 for PA-32-260 and 300 or Figure 4-3a for PA-32R-300 identifies the type and thickness of skin structure used. Never make a skin replacement or patch from a material thinner than the original skin. Original material and thickness is recommended and must result in a surface which is as strong as, or stronger than, the original skin. However, flexibility must be retained so that the surrounding areas will not receive extra stress.

TABLE IV-I. LIST OF MATERIALS (THERMOPLASTIC REPAIR)

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type - DuPont #7 Ram Chemical #69 x 1 Mirror Glaze #1	DuPont Company Wilmington, Del. 19898 Ram Chemicals Gardena, Cal. 90248 Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethylketone Methylene Chloride Acetone	Obtain From Local Suppliers
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400°F	Local Suppliers



NUMBER	MATERIAL	THICKNESS
1	2024-T3	.016
2	2024-0 (1)	.020
3	2024-T3	.020
4	2024-T3	.025
5	2024-T3	.032
6	2024-T3	.040
7	2024-T3	.051
8	2024-0 (2)	.032
9	FIBERGLASS	
10	2024-T3 (2)	.020
11	THERMOPLASTIC OR FIBERGLASS	
12	2024-T3 (2)	.040
13	5052-H34	.040
14	2024-T3 (2)	.032

NOTE: LEFT WING SHOWN, RIGHT WING OPPOSITE.

1. HEAT TREAT TO 2024-T42 AFTER FORMING.
2. HEAT TREAT TO 2024-T3 AFTER FORMING.
3. ONLY PERTAINS TO 32R-300.
4. ELIMINATING GEAR DOORS, RETRACTING PANELS OR OTHER PANELS NOTED FOR 32R-300, THE MATERIAL NOTED DEALS WITH THE ENTIRE PANEL DESIGNATED.

Figure 4-3A. Skin Material and Thickness
(PA-32R-300 and 32-300 S/N 32-7940001 and up)

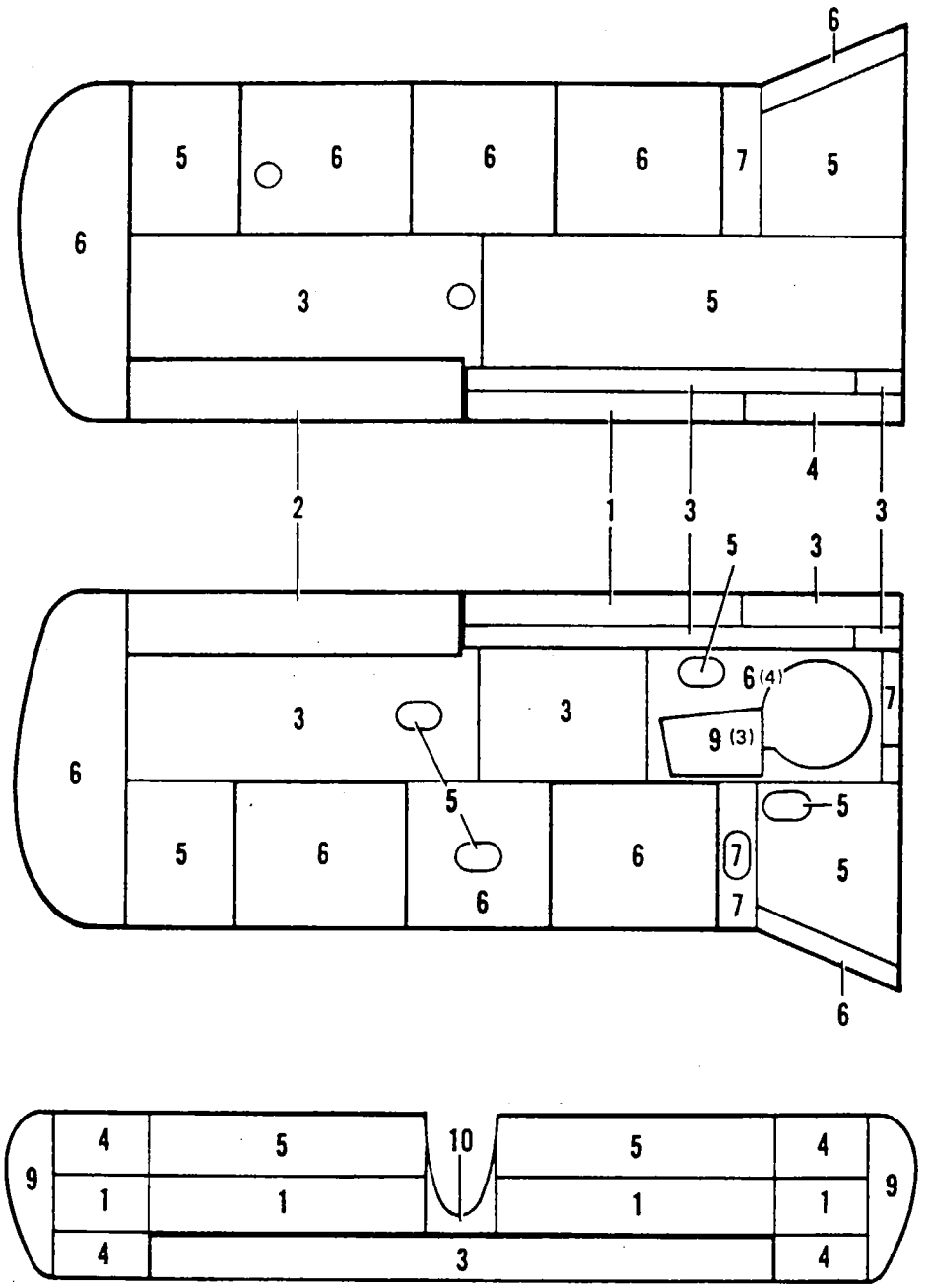


Figure 4-3A. Skin Material and Thickness
(PA-32R-300 and 32-300 S/N 32-794001 and up) (cont.)

Added: 7/28/75

STRUCTURE

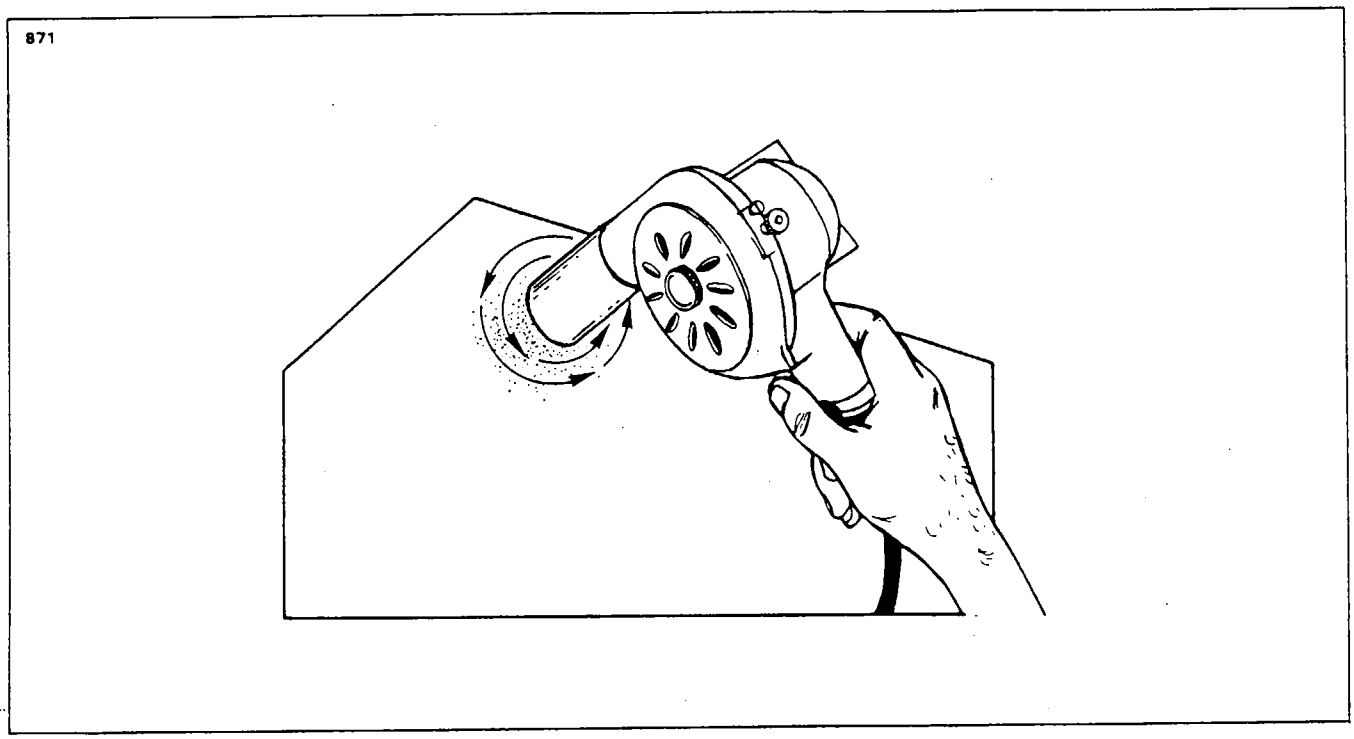


Figure 4-4. Surface Scratches, Abrasions or Ground-in-Dirt

4-19a. GENERAL THERMOPLASTIC REPAIRS. The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane except for wheel and strut fairing. 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.

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 Naphtha will generally insure a good bond between epoxy compounds and thermoplastic.

b. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 4-4.)

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 4-4a.)

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.

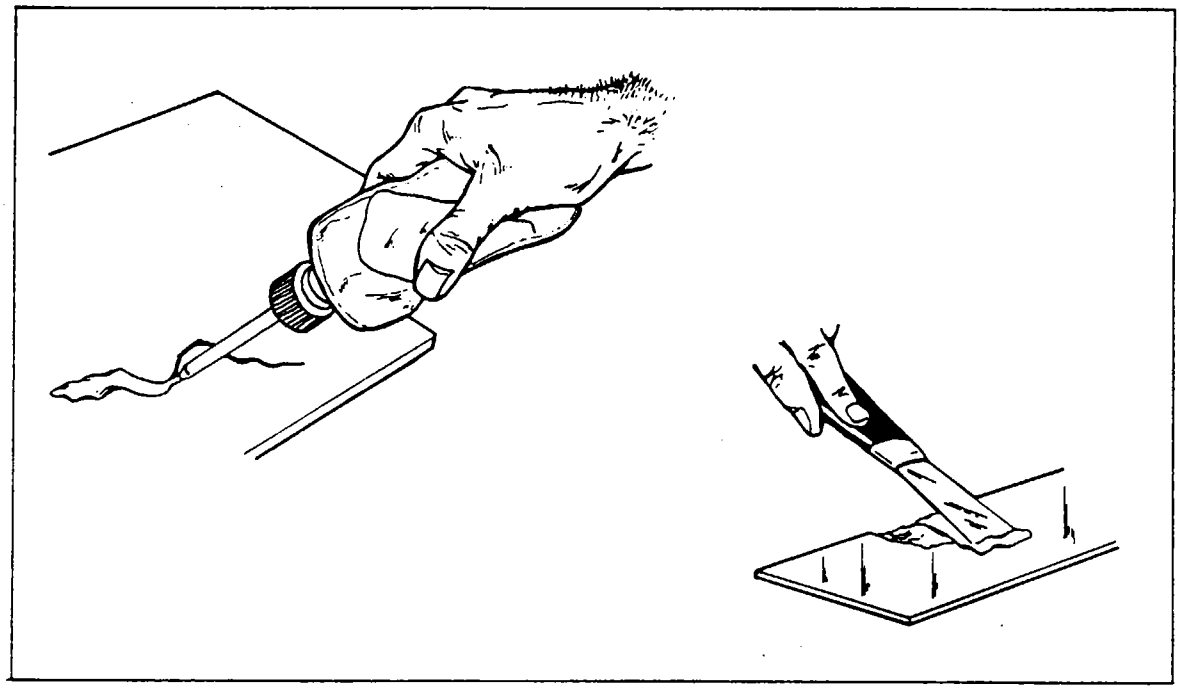


Figure 4-4a.Deep Scratches, Shallow Nicks and Small Holes

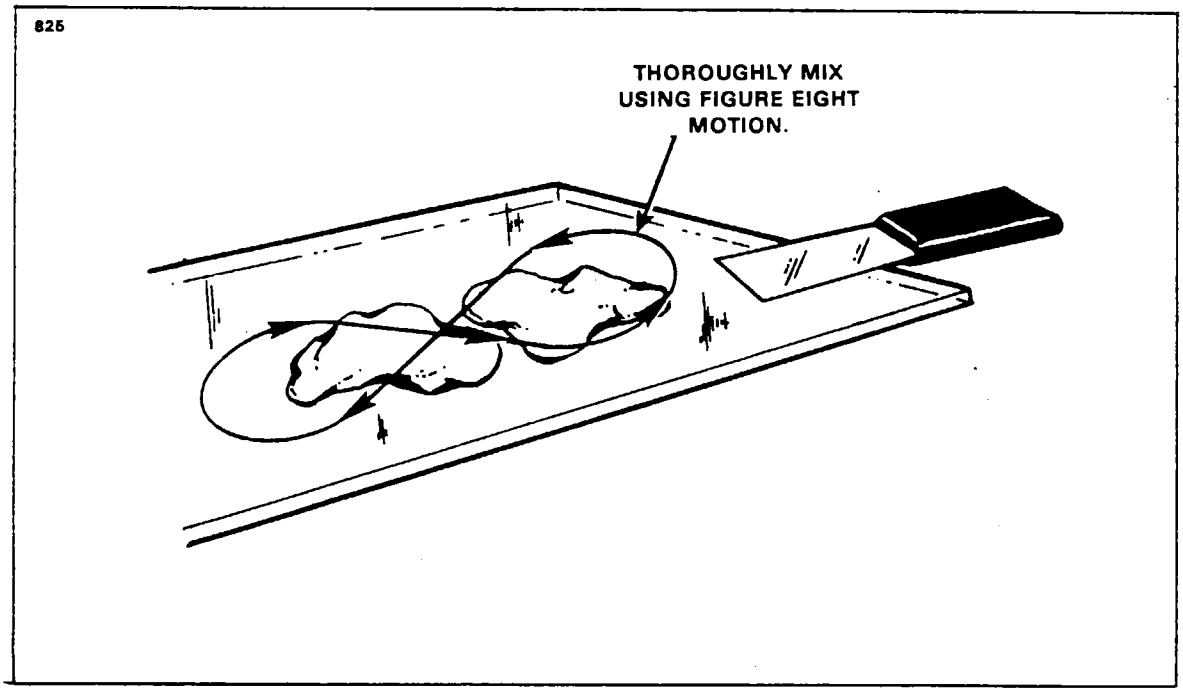


Figure 4-5. Mixing of Epoxy Patching Compound

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.

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 Naphtha prior to applying the compound. (Refer to Figure 4-5.)

7. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

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 4-6.)

11. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

d. Cracks: (Refer to Figure 4-7.)

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 4-8.)

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 as required.

f. Stress Lines: (Refer to Figure 4-9.)

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 4-10.)

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.

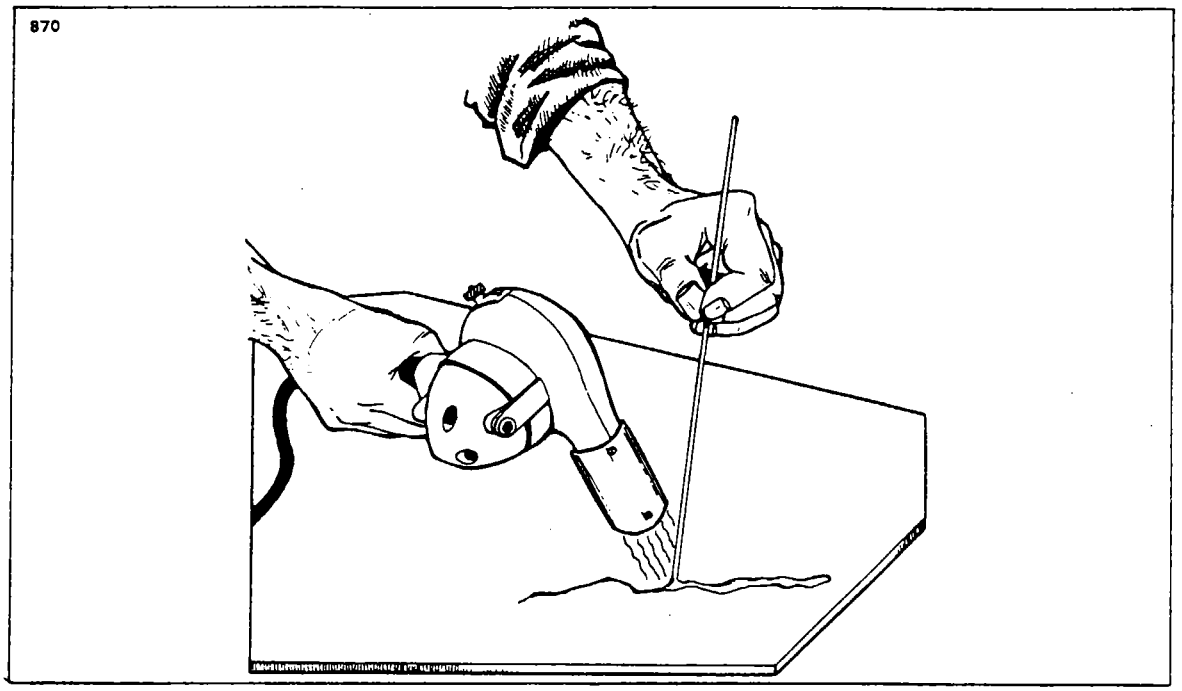


Figure 4-6. Welding Repair Method

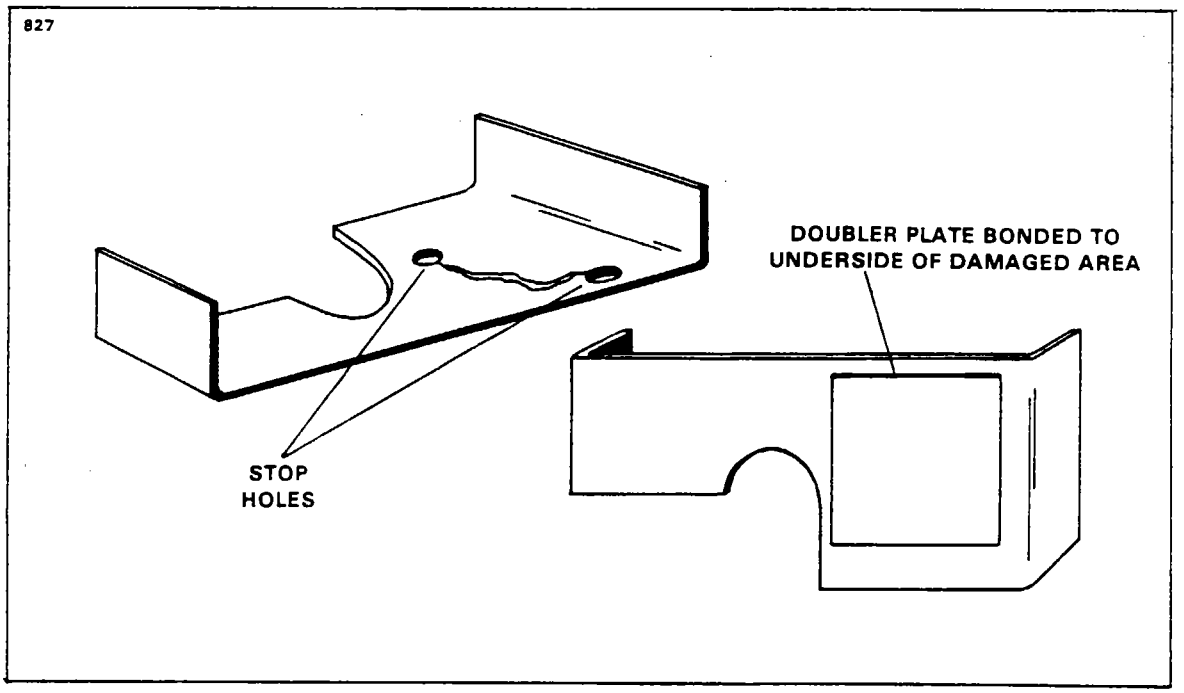


Figure 4-7. Repairing of Cracks

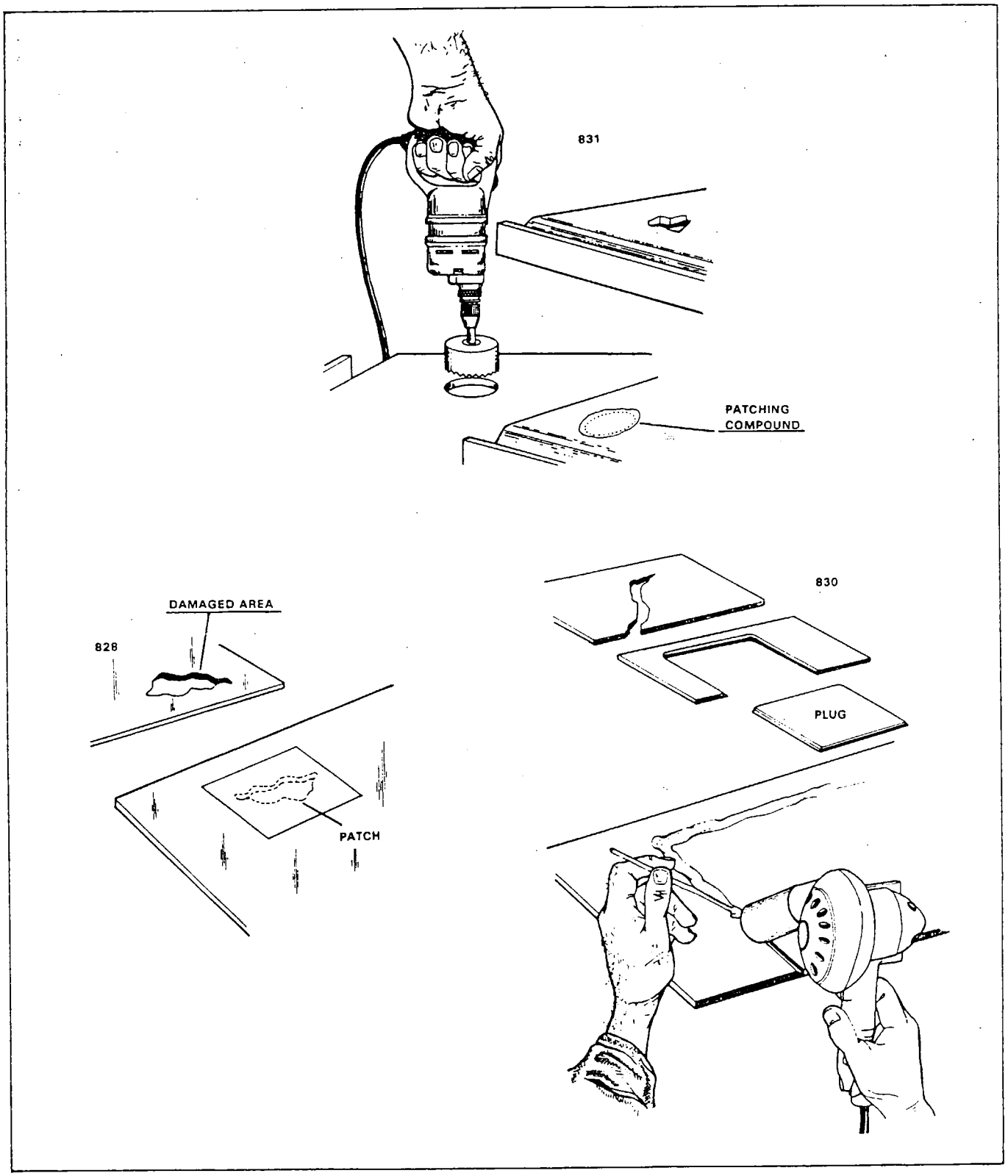


Figure 4-8. Various Repairs

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 with 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.

4. Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas whick incur high stress, flexing or impact. Such coating may crack, thus creating a weak area.

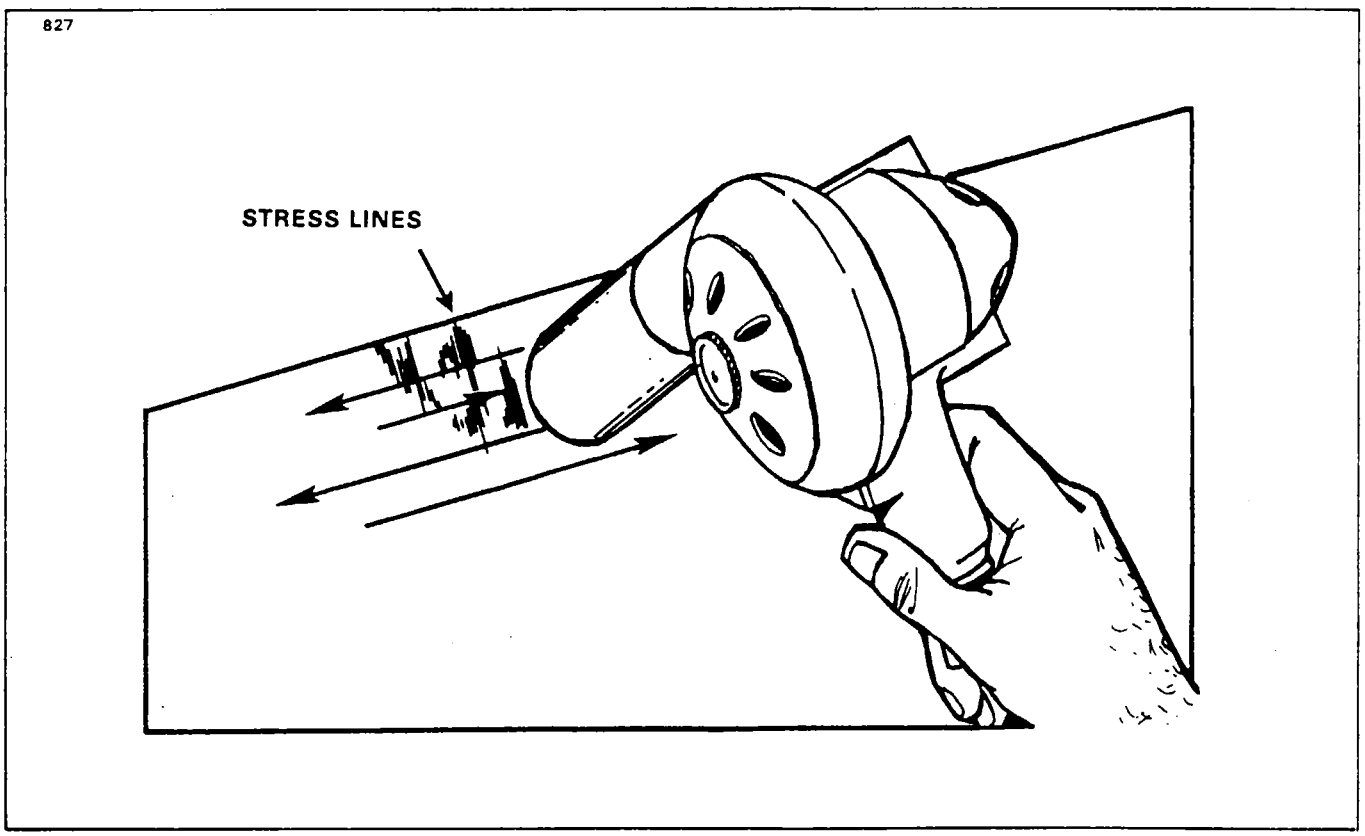


Figure 4-9. Repair of Stress Lines

4-20. FIBERGLASS REPAIRS. The repair procedure in this manual will describe the methods for the repair of fiberglass reinforced structures. Paragraph 4-21 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 4-22 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 Distributors.

NOTE

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

4-21. FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.

a. Remove wax, oil and dirt from around the damaged area with acetone, Methyl-ethylketone or equivalent and remove paint to gel coat.

b. The damaged area may be scaped 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 instruction, 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.

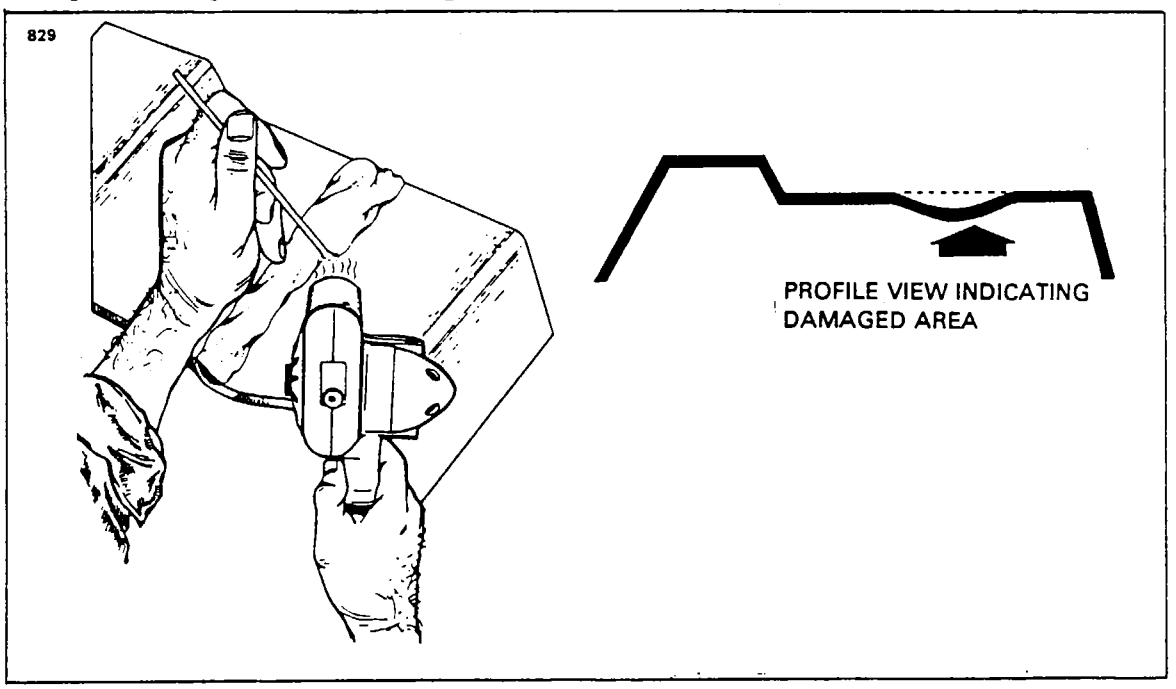


Figure 4-10. Repair of Impacted Damage

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 waxed paper over the repair to cut off air and start the cure of gel mixture.

f. Allow the gel 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 sand paper. 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 finger tips, 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 or two hours or overnight, for complete cure.

l. After repair has cured for 24 hours, sand patched area, using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

4-22. 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.

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.

4-23. SAFETY WALK REPAIR.

4-24. 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.

4-25. PRODUCT LISTING FOR LIQUID SAFETY WALK COMPOUND.

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 Part No. 179872.)

4-26. 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 bristle 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.

4-27. AILERON BALANCE WEIGHT MODIFICATION. (PA-32-260, Serial Nos. 32-1 to 32-1118 incl; PA-32-300 -300S, Serial Nos. 32-40000 to 32-40619 incl.) To facilitate the use of new aileron balance weight assembly (P/N 66766-00) on above stated airplanes, it will be necessary to modify the balance weight cutout in the wing rib. (Refer to Figure 4-11.) The hole pattern in the new balance weight bracket is the same as the old bracket with the exception of two holes. When replacing the old bracket with the new one, it is permissible to use the new bracket as a hole template to drill the two new holes at their proper location. To install the balance weight assembly, the following procedure may be used:

a. Remove the aileron per paragraph 4-6.

b. Remove the old balance weight by drilling out the rivets from around the perimeter of the bracket.

c. Modify the wing end rib balance arm hole as shown in Figure 4-11.

d. Using the new bracket as a template, drill the two new holes in the rib. (Refer to Figure 4-12.)

e. Place six cherry lock rivets, CR22494-2, in the holes within the bracket and set the rivets.

f. Replace the six rivets around the perimeter of the bracket with MS20470 AD3-3, and set.

g. Prior to installation, paint metal parts where necessary.

h. Install the aileron per paragraph 4-6.

4-28. FLAP INSPECTION AND MODIFICATION. (Refer to Figure 4-13.) Inspect the aft flap attaching point for security. If it is found secure, no modification is required. If the clevis bolt appears to be working loose from the anchor nut, the attachment point should be modified in accordance with the following instructions.

a. Remove the clevis bolt and related parts from the inboard flap hinge attaching point.

b. The skin on the flap must be modified in accordance with Figure 4-13.

c. Remove the existing anchor nuts from the inboard flap hinge.

d. Install a new clevis bolt and related parts and secure with castellated nuts and cotter pins.

4-29. STABILATOR DRAIN HOLES. In order to prevent the accumulation of water or ice in the stabilator when the aircraft is parked, it is recommended that drain holes be added in accordance with Figure 4-14.

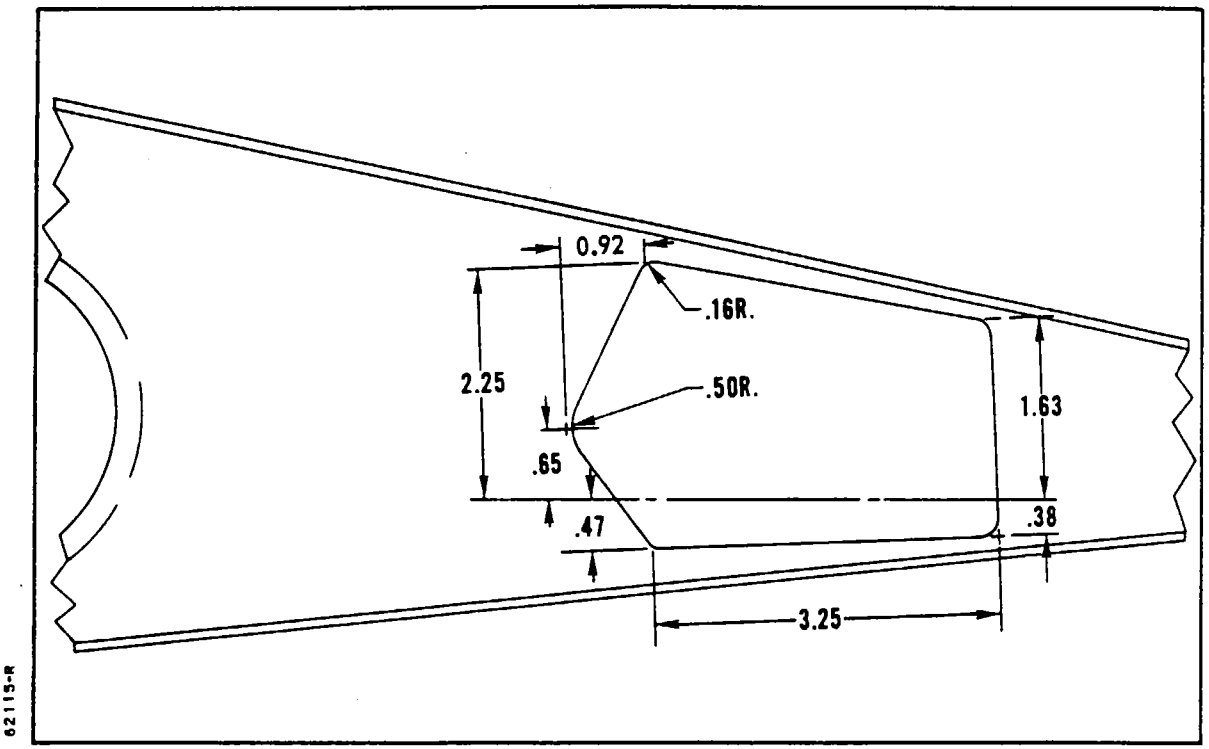


Figure 4-11. Wing Rib Modification

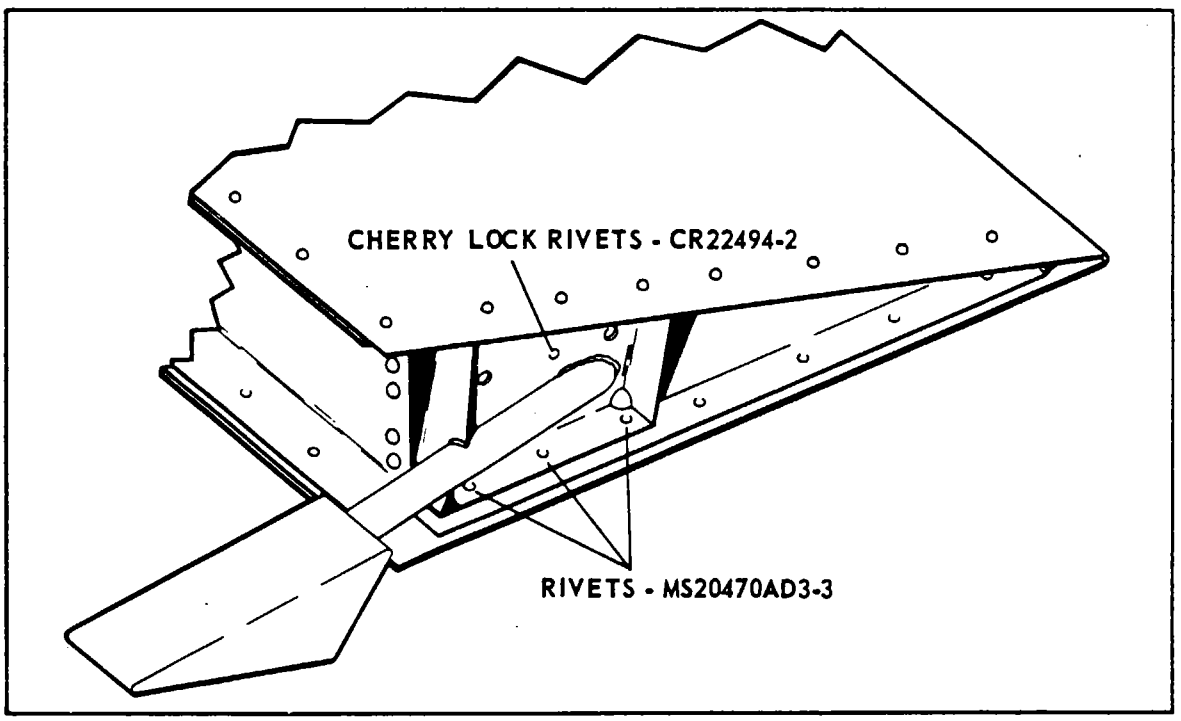


Figure 4-12. Balance Weight Assembly Installation

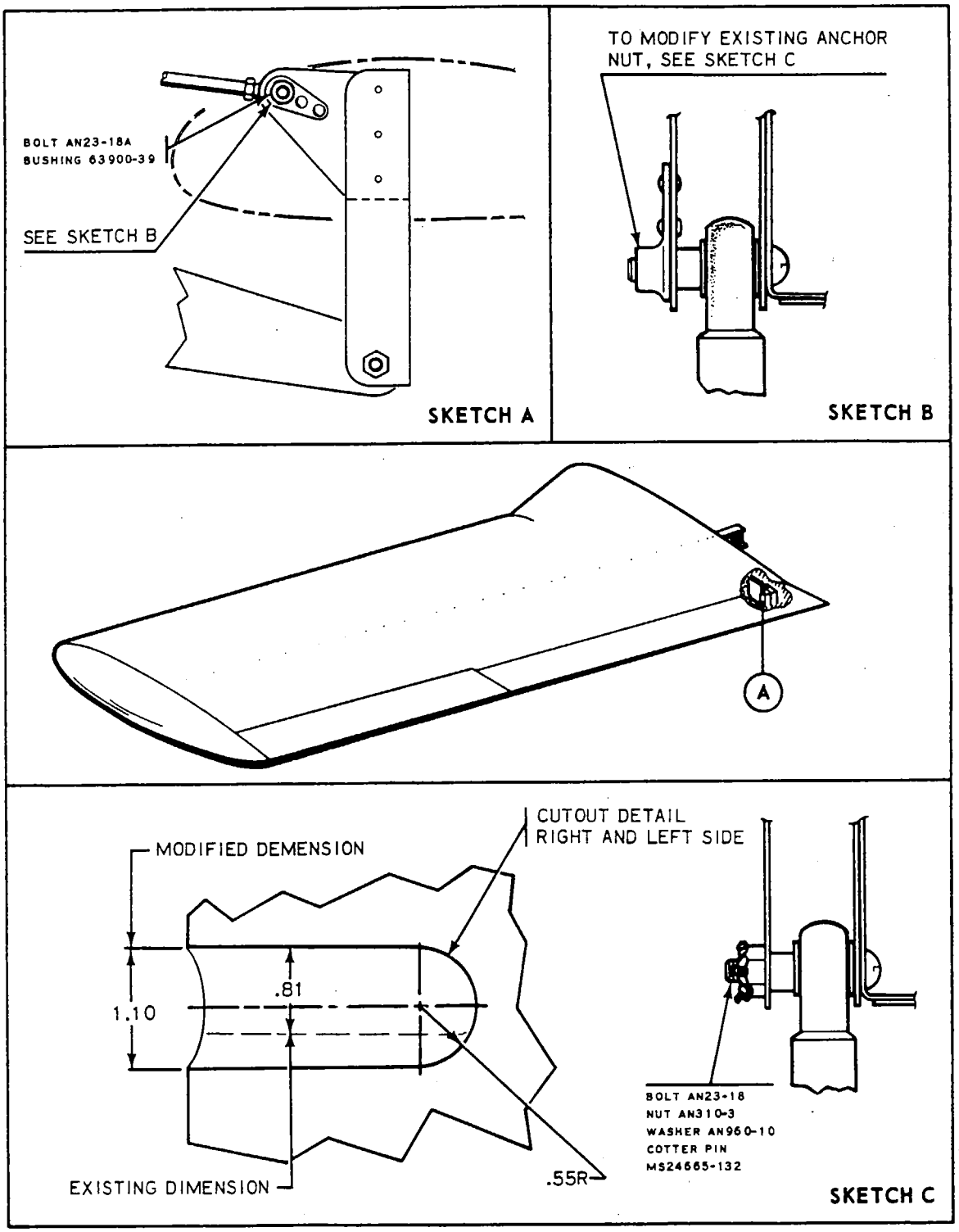


Figure 4-13. Flap Modification

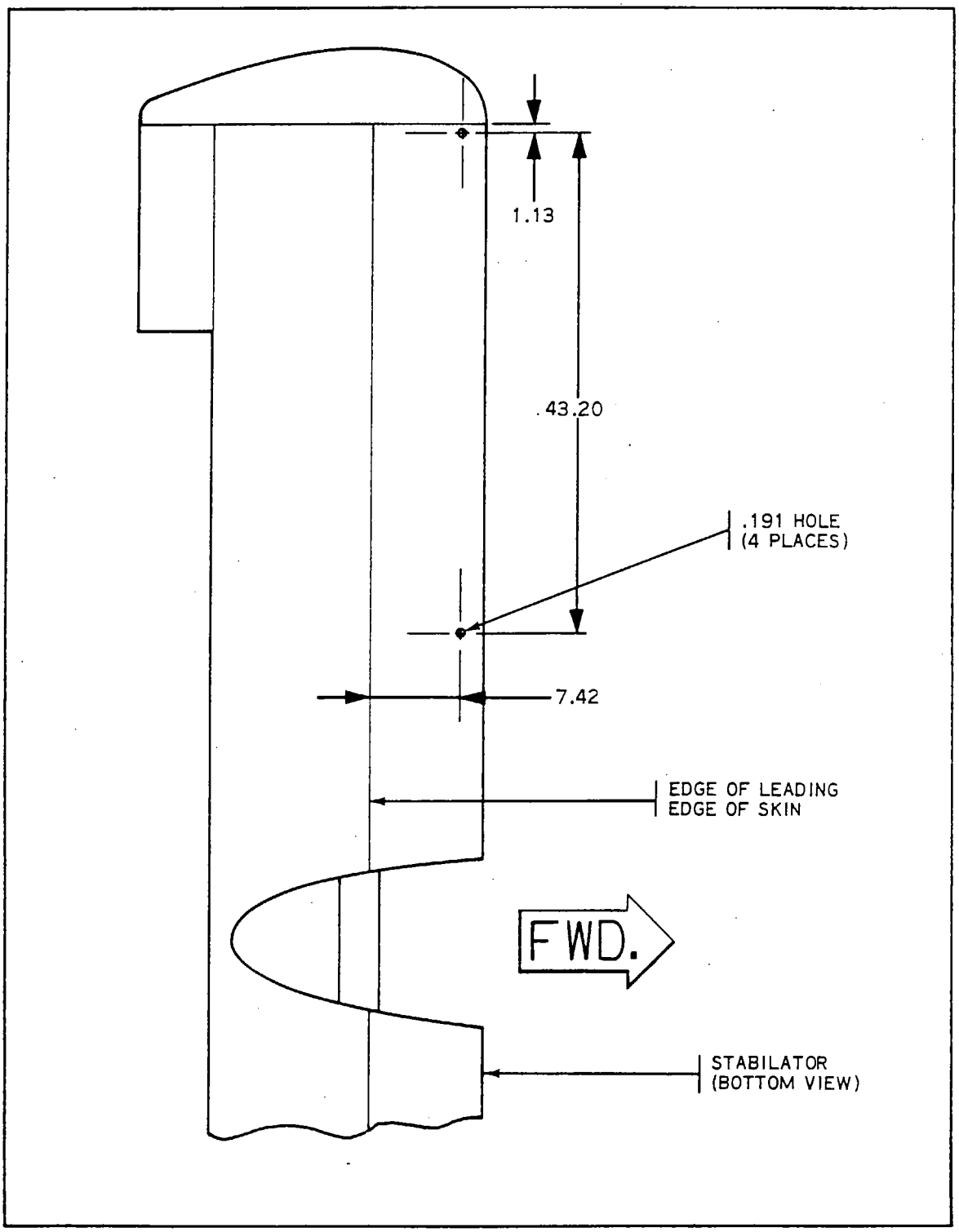


Figure 4-14 Additional Drain Holes in Stabilator.

4-30. CONTROL SURFACE BALANCING.

4-31. CHECKING CONTROL SURFACE BALANCE. The movable control surfaces have been statically balanced at the time of installation at the factory and normally should not require rebalancing. Where possible the control surfaces were set with the balance weight on the heavy side of the limits, to permit limited repair or paint touch-up without adjusting the balance weight. It should be noted however, that spare control surfaces are delivered unpainted and the static balance will not necessarily fall within the limits provided, this is more pronounced on the stabilators and rudders. The completed control surface including paint should be within the limits given in Table IV-II. If the surface is not to be painted, the balance weight will probably require adjustment. All replacement control surfaces or surfaces that have been repainted or repaired should be rebalanced according to the procedures given in paragraphs 4-33 thru 4-35. The static balance of the surfaces must be as specified in Table IV-II.

Before balancing any control surface, it must be complete including tip, trim/servo tabs as applicable and tab actuating arms or push rods with bearings as applicable, and all optional equipment which is mounted on or in the control surface when it is flown, including paint, position lights and wiring, static wicks, scuff boots, etc.

If optional equipment is added or removed after balancing the control surface must be rebalanced. During balancing, trim/servo tabs must be maintained in their neutral positions.

4-32. CHECKING CONTROL SURFACES FREE PLAY. The following checks are recommended before balancing to ascertain the amount of "free play" in the stabilator, stabilator trim tab and aileron:

a. Stabilator: Check the stabilator for any "free play" at its attachment points by grasping each half near the tip and gently trying to move it up and down, fore and aft, and in and out. No play is allowed.

b. Stabilator Trim Tab: Set the stabilator trim tab in neutral position. This neutral position is determined with the airplane properly rigged per instructions given in Section V of this Service Manual and the trim indicator at its neutral position. Obtain a straightedge long enough to extend from the ground up to a few inches above the trim tab trailing edge. Place the straightedge next to the trim tab inboard (center) trailing edge; secure the stabilator in neutral and grasping the tab, gently move it up and down, mark the limit of tab free play on the straightedge. The overall travel (free play) must not exceed 0.15 of an inch. The use of a dial indicator and fixed stand is recommended.

c. Aileron: Set the aileron in its neutral position and secure. Obtain a straightedge long enough to extend from the ground up to a few inches above the aileron trailing edge. Place the straightedge next to the aileron trailing edge and gently move the aileron up and down, mark the limit of travel (free play) on the straightedge. The overall travel (free play) must not exceed 0.24 of an inch. Should free play exceed the limit stated make necessary repairs as required to eliminate excessive free play. Grasp the aileron and move it spanwise (inboard/Outboard) to insure maximum end play of .035 is not exceeded.

4-33. BALANCING EQUIPMENT. (Refer to Figure 4-15.) The balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the centerline of the control surface hinge pin. A suggested tool configuration is shown in Figure 4-15. Other tool configurations may be used, provided accuracy is maintained and recalibration capability is provided.

TABLE IV-II. BALANCE SPECIFICATIONS
Maximum Limits - Flight Conditions

SURFACE	STATIC BALANCE LIMITS (IN.-LBS.) LEADING EDGE HEAVY		TRAILING EDGE HEAVY
Stabilators	+5	to	-40
	0	to	-40 (1)
Ailerons	+2	to	-20
Rudders	0	to	-16 (3)
	0	to	-13 (2)
	0	to	-11 (1)

(1) PA-32R-300 only
(2) 1974 Models and up
(3) PA-32-260 and 300 up to 1974 models

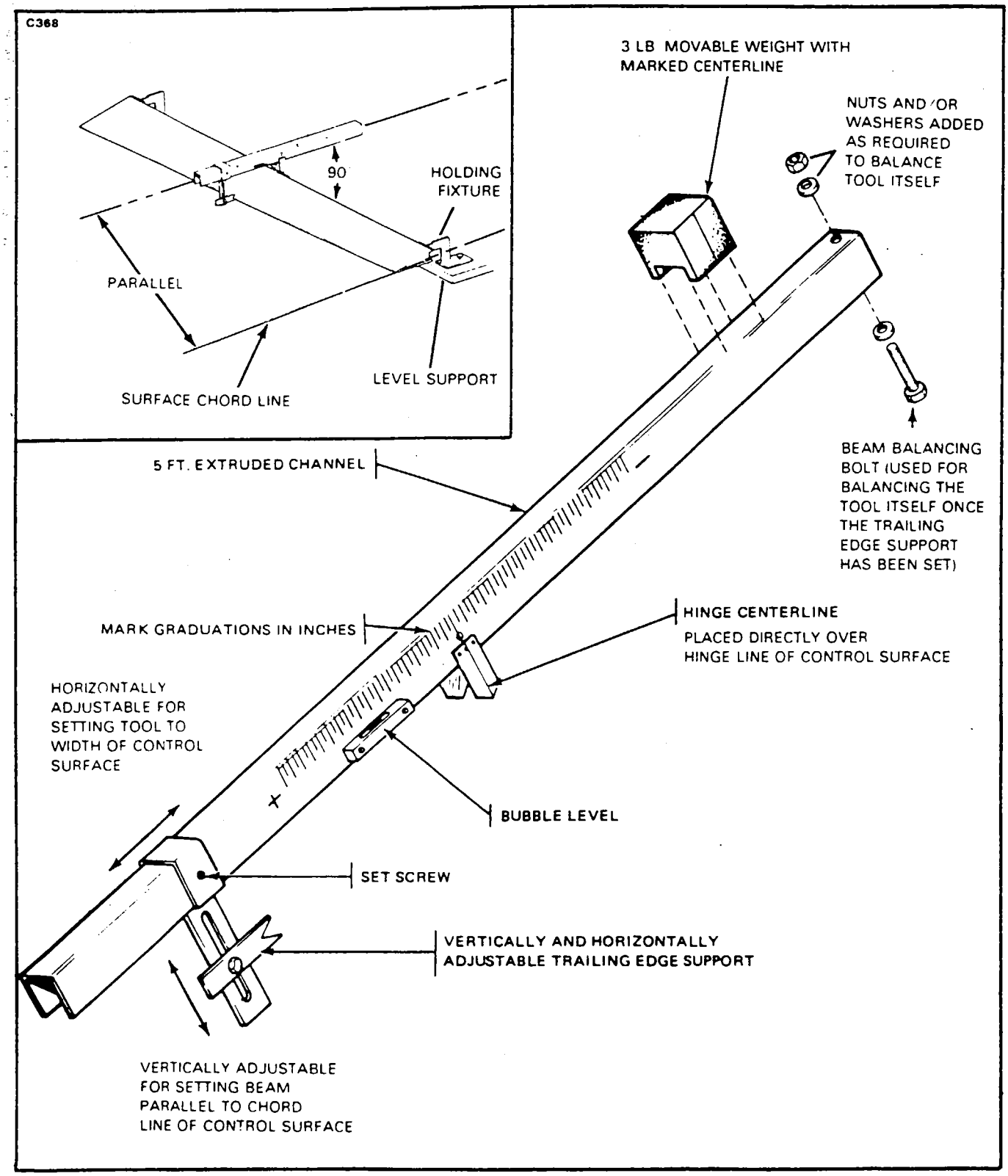


Figure 4-15. Control Surface Balance Tool

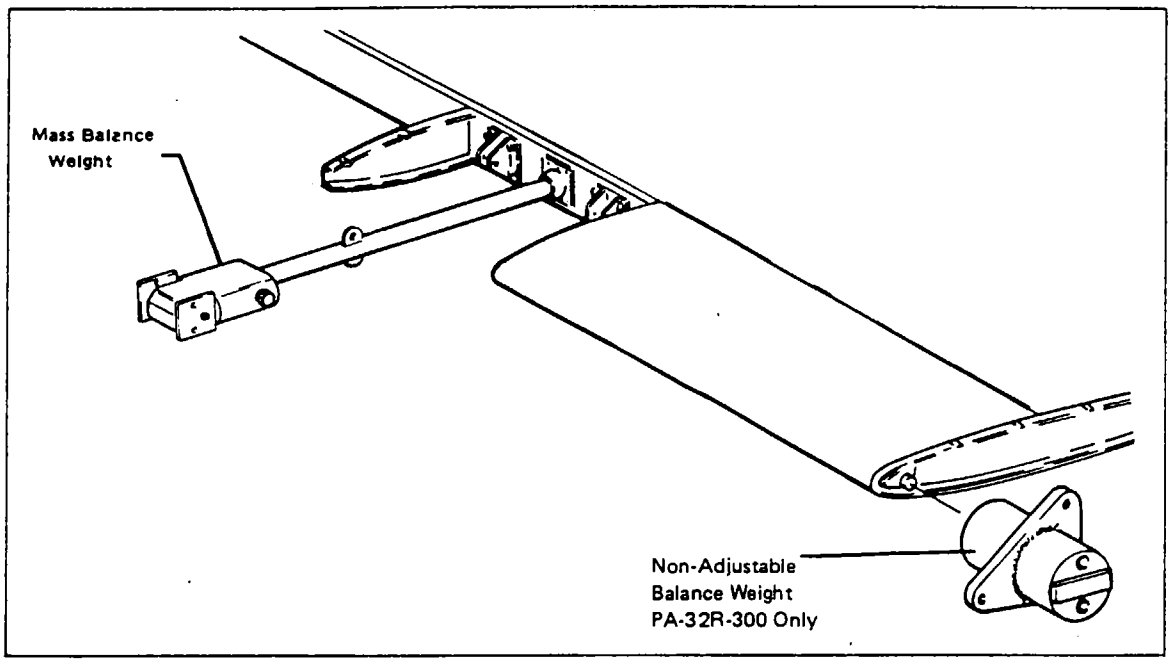


Figure 4-16 Stabilator Balance

4-34. BALANCING STABILATOR. (Refer to Figure4-16)

Prior to balancing the stabilator, tape the trim tab in the neutral position with a small piece of tape. For balancing, the stabilator assembly must be complete, including the trim tabs, the tab push rod and end bearing, stabilator tips and all attaching screws. Place the complete assembly on the knife edge supports in a draft free area and insure unrestricted movement. Position the platform scale and spindle approximately midway between the hinge points and on the stabilator rear spar. The spindle should not be in contact with any part of the trim tab. Place the protractor on the balance weight arm and adjust the height of the screw jack as required to position the arm in the level position or 0.0° ± .5° with the horizontal. Remove the protractor and record the scale reading. Measure the horizontal distance between the hinge line and the screw jack point of contact, "D" inches. Determine the weight of the screw jack and subtract this weight from the above scale reading to obtain the weight "W" of the stabilator. Multiply the weight "W" times the distance "D" to obtain the static balance in inch-pounds. This value shall be within the limits given in Table IV-II. If the static balance of the stabilator is not within the limits shown, proceed as follows:

a. Heavy: Remove weight from the mass balance weight until the static balance is within limits.

b. Light: Add weights to the mass balance weight until the static balance is within limits. (Refer to Parts Catalog for balance weight part number.)

If the stabilator is overbalanced (nose heavy) as may be possible on an unpainted stabilator, place the scale and screw jack under the balance weight and proceed as above.

NOTE

On PA-32R-300 do not attempt to adjust the stabilator tip balance weight.

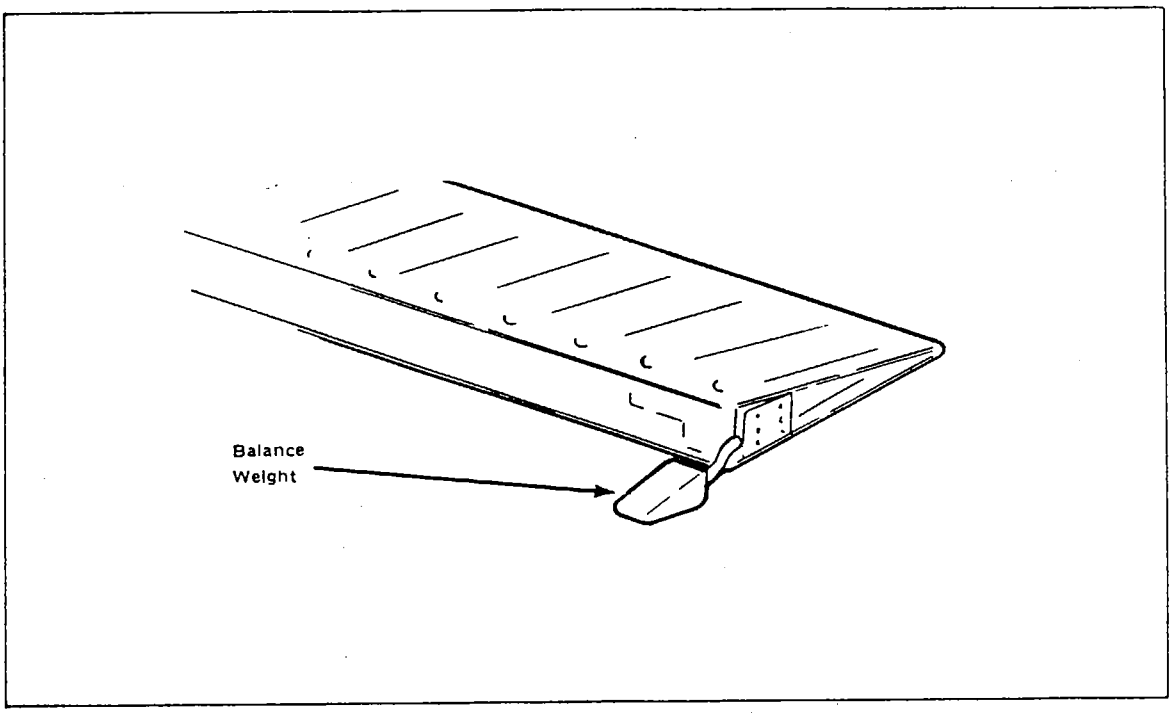


Figure 4-17. Aileron Balance

4-35. BALANCING AILERONS. (Refer to Figure 4-17.)

With the hinge pins in place, position the aileron on the knife edge supports in a draft free area and in a manner to allow unrestricted movement on the hinge pins. Position the scale and screw jack approximately midway between the hinge points and as near the trailing edge as practical. Place the protractor on the upper surface of the control and adjust the height of the screw jack as required to obtain an angle of 12.10° ± .5° between the upper surface of the aileron and the horizontal. Remove the protractor and record the scale reading. Measure the horizontal distance between the centerline of hinge and point of contact of the screw jack, "D" inches. Determine the weight of the screw jack and subtract this weight from the above scale reading to obtain the weight, "W" of the aileron. Multiply the weight "W" times distance "D" to obtain the static balance in inch-pounds. If the static balance of the ailerons is not within the limits shown in Table IV-II, proceed as follows:

a. Nose Heavy: This condition is highly improbable - recheck measurements and calculations.

b. Nose Light: In this case the mass balance weight is too light, or the aileron is too heavy. If the aileron is too heavy because of painting over old paint, it will be necessary to strip all paint from the aileron and, start over. If the aileron is too heavy resulting from repair to the skin or ribs, it then becomes necessary to remove the repair and replace all damaged parts. Normally, on the ailerons, 2 to 3 inch-pounds will be available to permit repainting (1.00 inch-pound average) repairs, addition of static wicks, etc., however to be certain, check the balance.

4-36. BALANCING RUDDER. (Refer to Figure 4-15) Prior to balancing the rudder, be sure that the assembly is complete, including the tip assembly, position light and wiring, and all attaching screws.

Place the complete assembly on the knife edge supports in a horizontal position and check the freedom of movement. Place a platform scale and screw jack midway between the hinge points and as far aft as possible. Place the protractor on the top surface of the rudder perpendicular to the hinge line and adjust the height of the screw jack as required to position the upper surface at an angle of 8.10±.5 . Remove the protractor and record the scale reading. Measure the horizontal distance between the hinge line and the screw jack contact point "D" in inches. Determine the weight of the screw jack and subtract the weight from the above scale reading to obtain the weight "W" of the rudder. Multiply the weight "W" of the rudder times the distance "D" to obtain the static balance in inch-pounds. This value shall be within the limits given in Table IV-II. If the static balance of the rudder is not within the limits shown, use the following procedures:

a. Nose Heavy: This condition is highly improbable; recheck measurements and calculations.

b. Nose Light: In this case, the mass balance weight is too light, or the rudder too heavy. If the rudder is too heavy because of painting, it will be necessary to strip the paint and start over. If the rudder is too heavy as a result of repairs, the repair must be removed and the damaged parts replaced.

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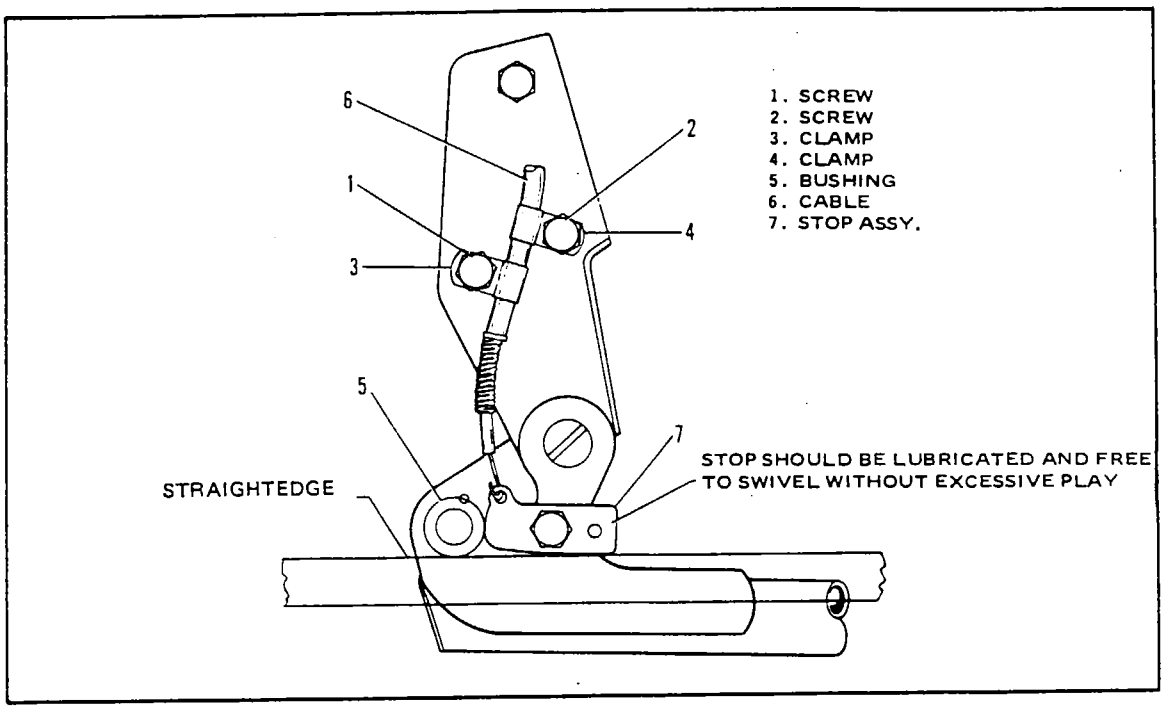


Figure 4-18. Seat Back Lock

4-37. RIGGING INSTRUCTIONS - SEAT BACK LOCK AND RELEASE. (Refer to Figure 4-18.)

a. Loosen screws (1 and 2) and ascertain that clamps (3 and 4) are in a relaxed condition. (Push-pull cable (6) is able to move within the clamps.)

b. Place a straightedge along the lower surface of bushing (5) of the seat back release.

c. Adjust the push-pull cable (6) by raising or lowering it until the lower surface of the stop assembly (7) is parallel to the straightedge.

d. Secure the push-pull cable in this position by tightening screws (1 and 2) on clamps (3 and 4). The stop assembly (7) should be lubricated and free to swivel without excessive play.

e. Push on the seat back with the stop assembly (7) in an engaged position to check engagement. Rotate the seat back release handle and check for disengagement of seat back.

4-38. REMOVAL AND INSTALLATION OF DOOR SEAL SNUBBERS. (Refer to Figure 4-19.)

a. If the existing door seal is torn or has deteriorated it should be replaced. If rebonding is required use:
   1. 3M EC 1300L (preferred)
   2. Proco Adhesive (6205-1)
   3. Scotch Grip 2210
b. Remove windlace retainers. Expose the door jamb by rolling back and taping the windlace.
c. Disconnect the door-holder attached to the lower door jamb and remove scuff plate.
d. Remove the striker plate. (Refer to Figure 4-19, Section A-A.)
e. Remove the snubber as follows:
   1. Apply mineral spirits to the snubber to loosen the adhesive.
   2. Using a plastic scraper (or other appropriate instrument), scrape off the snubber while applying mineral spirits as necessary.
   3. With the snubber removed, use a clean cloth and mineral spirits to remove excess adhesive.
f. Installation of the door seal snubber is as follows:
   1. If the door jamb paint is flaking or is excessively scuffed, rub down with wet and dry emery cloth. Clean the surface with Prep-Sol or equivalent cleaner which will not leave an oily residue.

NOTE

The normal "tack time" for 3M EC 1300L is 30 to 45 minutes at 75°F. However, adhesive which has "set" may be reactivated by a clean rag moistened with Toluol or Methylethylketone.

   2. To effect a clean installation it is recommended that the door jamb is masked off with tape as shown in Figure 4-19, View D.
   3. Apply adhesive to the door jamb with a small brush on the area indicated in Figure 4-19, View D.
   4. Apply adhesive to the inside surface of the snubber.
   5. Position the snubber with the protruding leg facing outboard beginning at the lower center (+2 inches) of the door jamb. Work progressively around the door jamb applying a pressure to the snubber to remove any trapped air and to ensure the edges are effectively bonded to the jamb.

NOTE

Do not stretch the rubber, especially in the corner areas, as this can cause cracks.

   6. It takes approximately one day for the bond to cure. It is recommended that the door be kept open as long as possible during this time to effect maximum curing.
   7. Remove masking tape if used, and clean off excessive adhesive using a clean cloth and mineral spirits or Toluol.
   8. Install the striker plate.
   9. Reposition the windlace and secure with retainers previously removed.
   10. Install the scuff plate and door holder previously removed.
   11. Adjust the door latch to compensate for the snubber, ensuring a good door to fuselage contour fit with no increase in latching effort.
   12. After installation, the door latches must be adjusted to compensate for the snubbers, ensuring a good fuselage contour fit and no increase in latching effort. (Refer to latest revision of Piper Service Spares Letter #365.)
   13. After all adjustments and curing have been accomplished, coat the snubber with silicone - wipe off any excess.

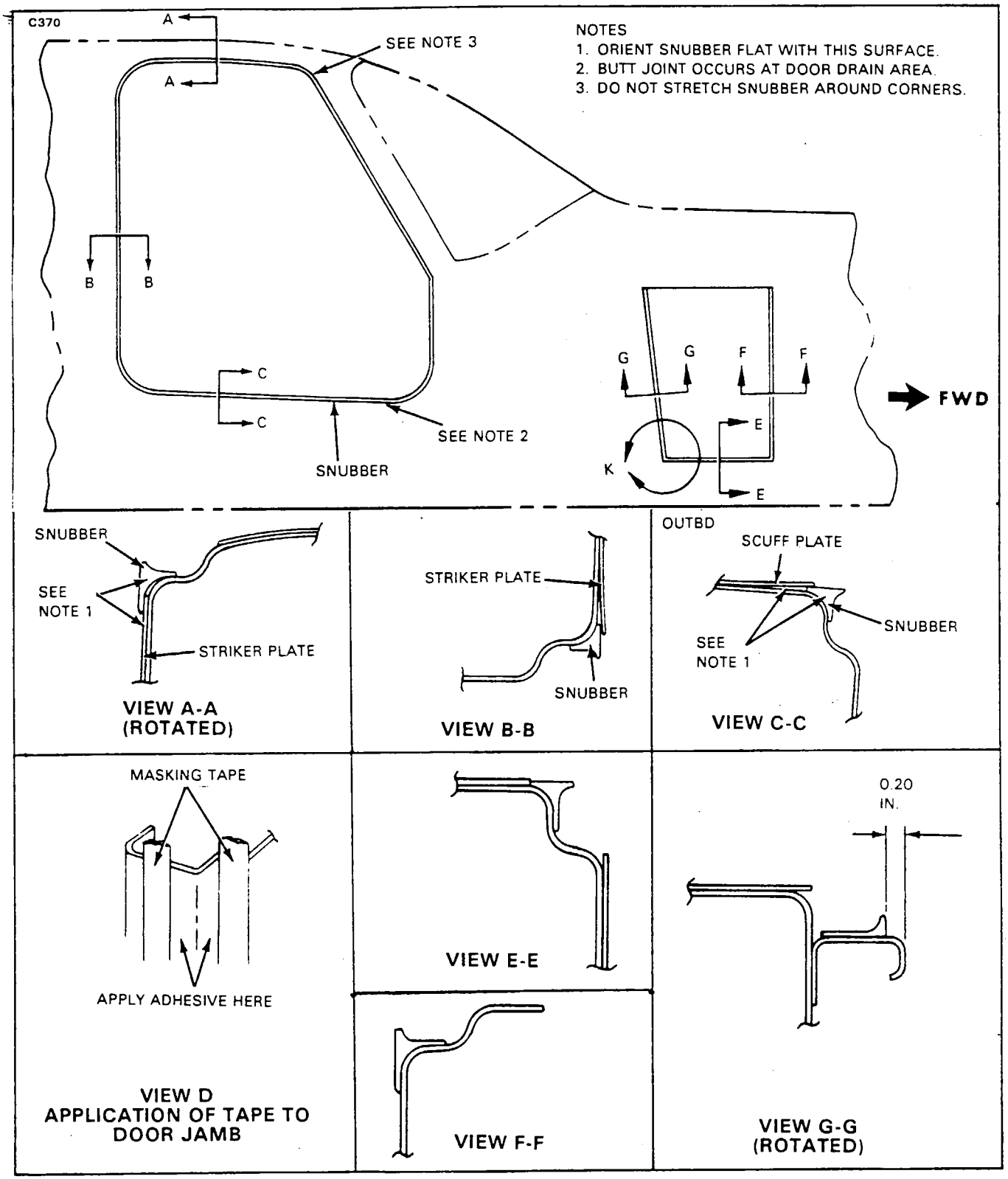


Figure 4-19. Snubber Installation

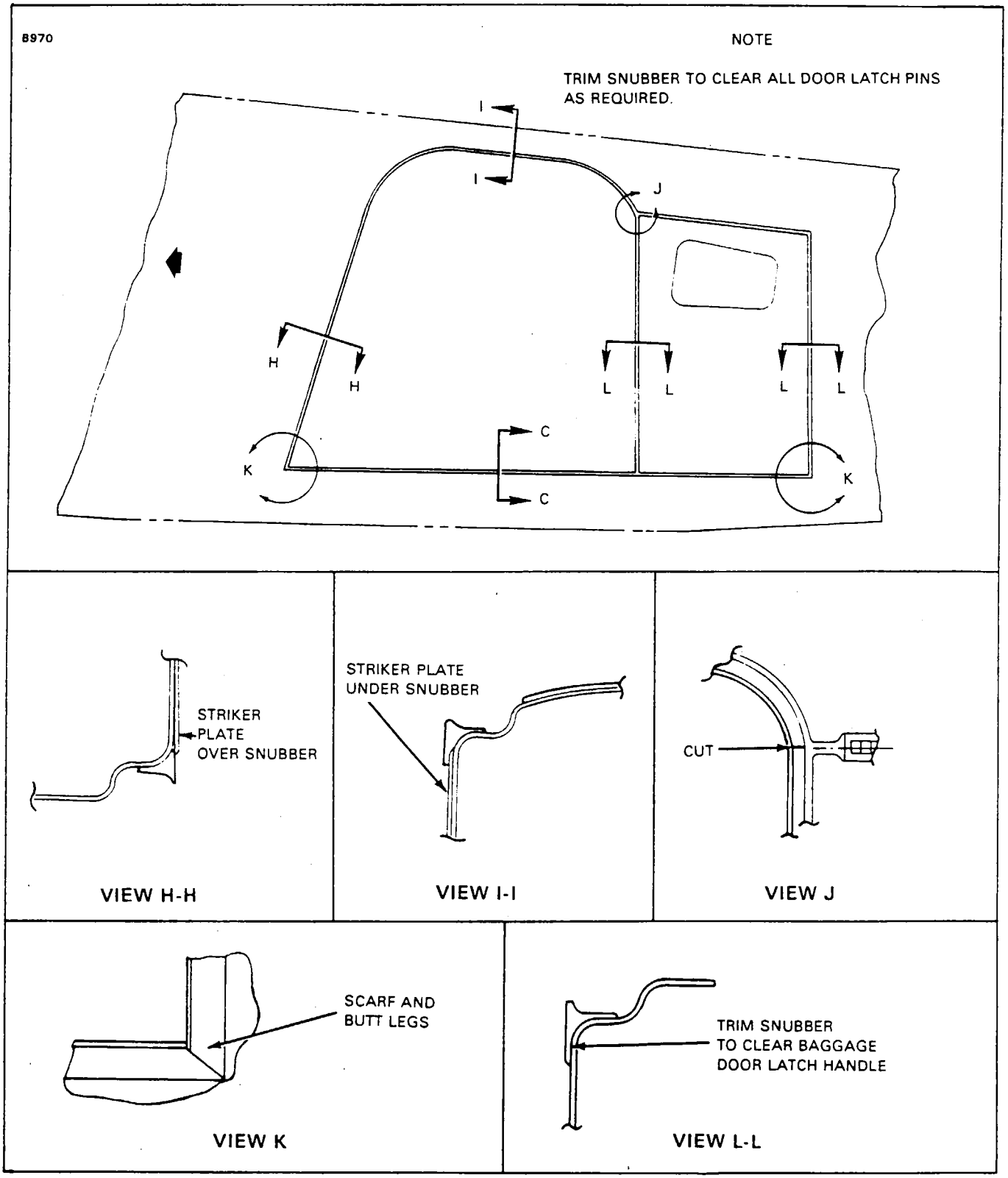


Figure 4-19. Snubber Installation (cont.)

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SECTION V

SURFACE CONTROLS

		Aerofiche Grid No.
5-1.	Introduction	1G13
5-2.	Description	1G13
5-3.	Control Column Assembly	1G16
5-4.	Removal of Control Column Assembly (PA-32-260 and 300)	1G16
5-5.	Installation of Control Column Assembly (PA-32-260 and 300)	1G17
5-5a.	Removal of Control Column Assembly (PA-32R-300)	1G19
5-5b.	Installation of Control Column Assembly (PA-32R-300)	1G22
5-6.	Aileron Controls	1G23
5-7.	Removal of Aileron Control Cables	1G23
5-8.	Installation of Aileron Control Cables	1H1
5-9.	Removal of Aileron Bellcrank Assembly	1H3
5-10.	Installation of Aileron Bellcrank Assembly	1H3
5-11.	Rigging and Adjustment of Aileron Controls	1H3
5-12.	Stabilator Controls	1H6
5-13.	Removal of Stabilator Control Cables	1H6
5-14.	Installation of Stabilator Control Cables	1H7
5-15.	Rigging and Adjustment of Stabilator Controls	1H9
5-16.	Stabilator Trim Controls	1H10
5-17.	Removal of Stabilator Trim Assembly (Forward)	1H10
5-18.	Installation of Stabilator Trim Assembly (Forward)	1H13
5-19.	Removal of Stabilator Trim Controls (Aft)	1H14
5-20.	Installation of Stabilator Trim Controls (Aft)	1H15
5-21.	Rigging and Adjustment of Stabilator Trim	1H16
5-22.	Rudder and Steering Pedal Assembly	1H17
5-23.	Removal of Rudder and Steering Pedal Assembly	1H17
5-24.	Installation of Rudder and Steering Pedal Assembly	1H19
5-25.	Rudder Controls	1H20
5-26.	Removal of Rudder Control Cables	1H20
5-27.	Installation of Rudder Control Cables	1H21
5-28.	Rigging and Adjustment of Rudder Controls	1H23
5-29.	Rudder Trim Controls	111
5-30.	Removal of Rudder Trim Controls	111
5-31.	Installation of Rudder Trim Controls	111
5-32.	Rigging and Adjustment of Rudder Trim Controls	113

Revised: 12/4/79

Aerofiche Grid No.

5-33. Wing Flap Controls 113
5-34. Removal of Wing Flap Controls. 113
5-35. Installation of Wing Flap Controls. 115
5-36. Rigging and Adjustment of Wing Flaps 116

Revised: 12/4/79

SECTION V

SURFACE CONTROLS

5-1. INTRODUCTION. This section explains 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 paragraph since each paragraph describes the individual removal and installation of the various assemblies. The following tips may be helpful in the removal and installation of the various assemblies:

a. It is recommended, though not always necessary, to level and place the airplane on jacks during rigging and adjustment, especially when using a bubble protractor or level.

b. Remove the turnbuckle barrels from cable ends before withdrawing the cable through the structures.

c. Tie a cord to the cable end before drawing cable through structures to facilitate reinstallation of cable.

d. When turnbuckles have been set to correct tension, no more than three threads should be exposed from either end of the turnbuckle barrel.

e. When push rods or rod ends are provided with an inspection hole, the screw shall be screwed in sufficiently far to pass the hole. This can be determined visually or by feel, inserting a piece of wire into the inspection hole. Where no inspection hole is provided, there shall be a minimum of 3/8 inch thread engagement.

f. When installing rod end jam nuts, refer to Figure 5-1b for proper installation method.

5-2. DESCRIPTION. The Cherokee Six is controlled in flight by the use of three standard primary control surfaces, consisting of ailerons, stabilator and rudder. Operation of these controls is through the movement of the control column-tee bar assembly and rudder pedals. On the forward end of each control column is a sprocket assembly. A chain is wrapped around the sprockets to connect the right and left controls and then back to idler sprockets on the column's tee bar, which in turn connect to the aileron primary control cables. The cables operate the aileron bellcrank and push-pull rods. The stabilator is controlled by a cable connected to the bottom of the tee bar assembly and at the balance arm of the stabilator. Cables also connect the rudder pedals with the rudder horn.

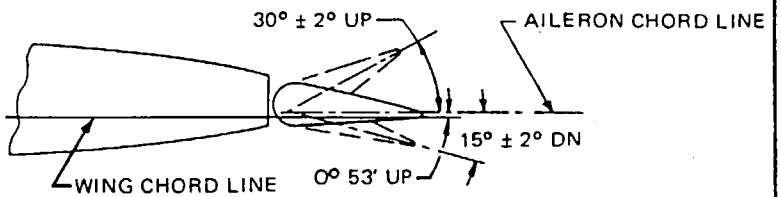
Provisions for directional and longitudinal trim control is provided by an adjustable trim mechanism for the stabilator and rudder. The stabilator trim is controlled by a wheel and drum mounted on the floor tunnel between the front seats. Cables routed aft from the drum to the tail cone operate a screw assembly which in turn moves the stabilator trim tab. The rudder trim is controlled by a knob and screw assembly attached to the rudder pedal assembly.

TABLE V-I. CONTROL SURFACE TRAVEL AND CABLE TENSION

Aileron

NOTES

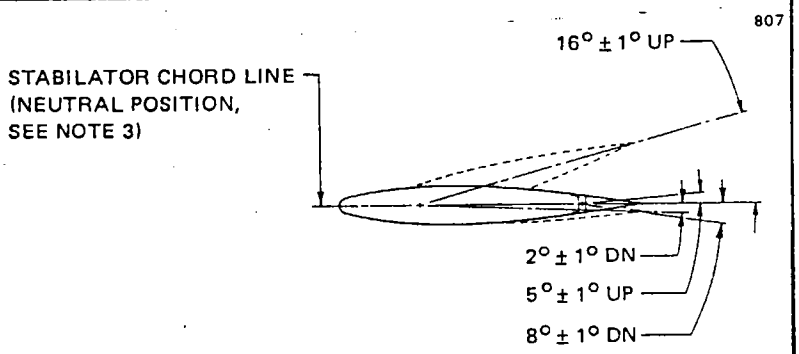
1. Maximum free play for aileron is 0.24 of an inch, measured at trailing edge.
2. Refer to Section IV, Paragraph 4-32.
3. Maximum end play (Inboard/Outboard must not exceed .035 of an inch.



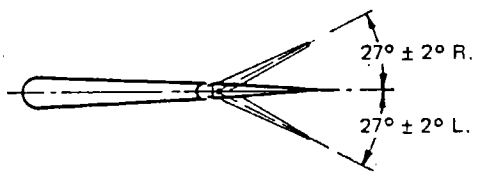
Stabilator
Stabilator Trim Tab

NOTES

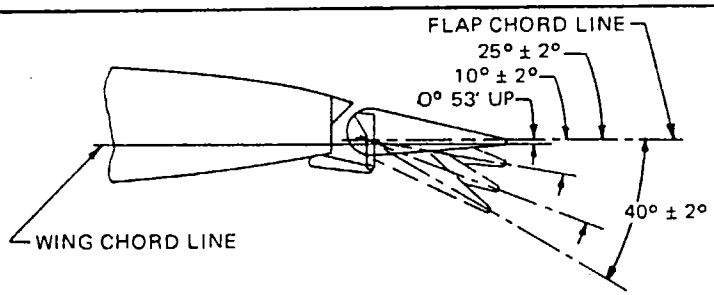
1. Maximum free play for control surface tab is 0.15 of an inch measured at tab trailing edge.
2. Refer to Section IV, Paragraph 4-32.
3. Neutral position of stabilator is with the stabilator chord line parallel with the leveling holes noted in Figure 2-6.



Rudder



Flap



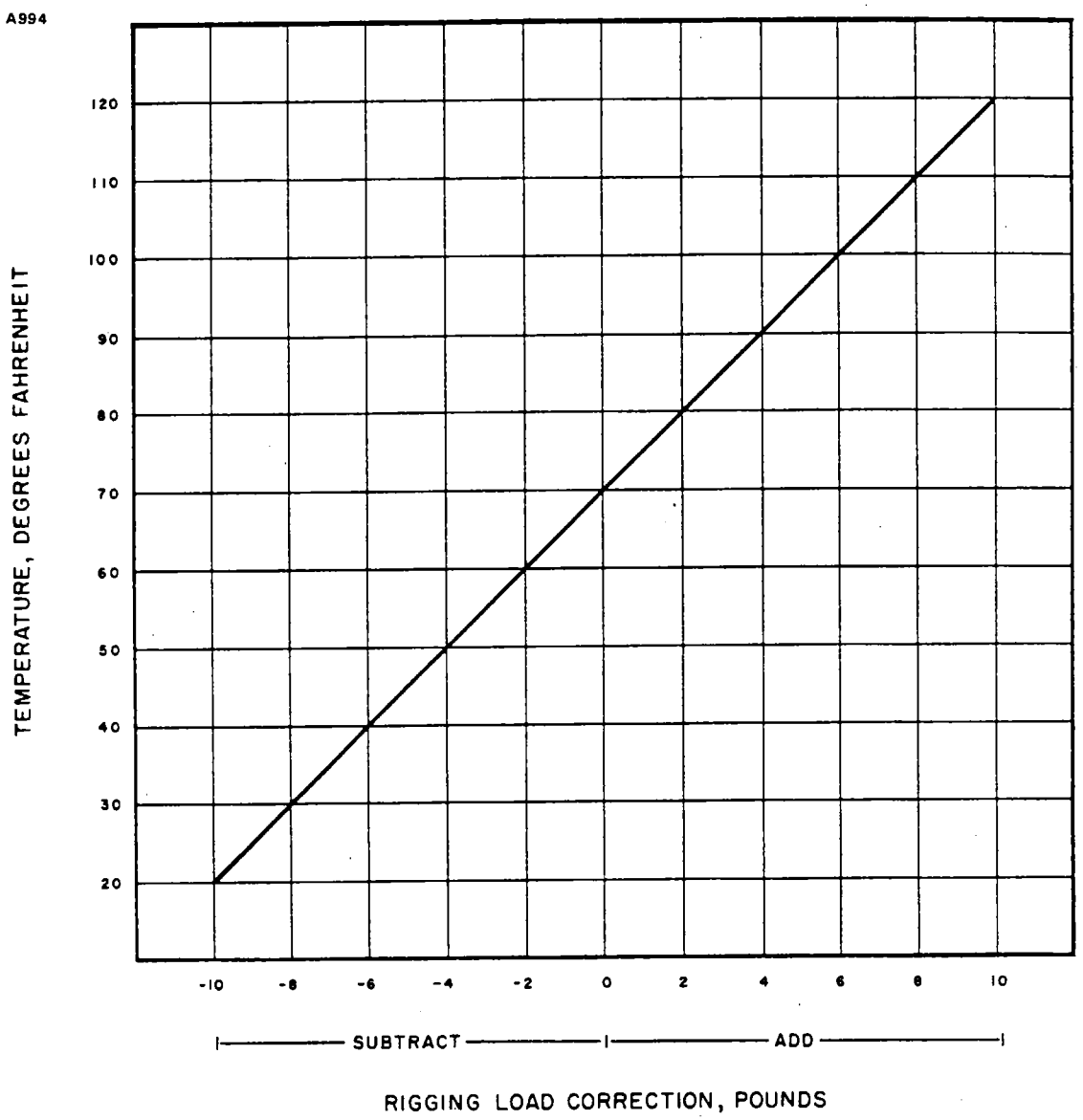
Rudder Pedal

Rudder Pedal Neutral Position
Aft of Vertical 11°, 14° +3° -1° on 1974 Models and up

Cable Tensions

Aileron	40 lbs ± 5 lbs	NOTE
Flap	10 lbs ± 1 lb	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.
Stabilator	40 lbs ± 5 lbs	
Stabilator Trim Tab	14 lbs ± 1 lb	
Rudder	85 lbs ± 5 lbs	
Rudder	65 lbs ± 5 lbs	PA-32R-300 ONLY

TABLE V-II. CABLE TENSION VS. AMBIENT TEMPERATURE



The wing flap system consists of an operating handle, a cable routed from the handle to a torque tube and push-pull rods. Through the push-pull rods and torque tube, the flaps are interconnecting and can be positioned in three locations of 10, 25 and 40 degrees.

5-3. CONTROL COLUMN ASSEMBLY.

5-4. REMOVAL OF CONTROL COLUMN ASSEMBLY (PA-32-260 and 300). (Refer to Figure 5-1.)

a. To remove either control wheel (1) with tube (2), the following procedure may be used:

1. Separate the control wheel tube (2) from the flexible joint (4) that is located on either side of the tee bar assembly (5) by removing the nut, washer and bolt (3). Pull the tube from the flexible joint.
2. If removing the left control tube, slide the stop (6) from the tube.
3. Should wires for the various AutoPilot systems be installed in the control tube, disconnect them at the quick disconnect terminals behind the instrument panel. Draw the wires back into the tube and back out through the forward end of the tube.
4. Remove the control wheel assembly from the instrument panel.

b. The tee bar (5) with assembled parts may be removed from the airplane by the following procedure:

1. Remove the access panel to the aft section of the fuselage.
2. Relieve cable tension from the stabilator control cables (11) at one of the stabilator cable turnbuckles in the aft section of the fuselage.
3. Relieve tension from the aileron control cables (12) and chains (7 and 8) at the turnbuckle (9) that connects the chains at the top of the tee bar (5).
4. Disconnect the control chains from the control cables where the chains and cables join by removing the cotter pins, nuts, bolts and bushings.
5. If the control wheel assemblies have not been previously disconnected from the tee bar assembly, separate the control wheel tubes (2) at the flexible joints (4) by removing the nuts, washers and bolts (3).
6. Remove the fuel selector panel cover by removing the rudder trim knob and the cover attachment screws.
7. Remove the lower selector cover and disconnect the fuel selector control lever from the selector torque tube by removing the attachment pin located at the bottom of the lever.
8. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.
9. Remove the two aileron control cable pulleys (13) attached to the lower section of the tee bar by removing the pulley attachment bolt (14).

10. Disconnect the stabilator control cables (11) from the lower end of the tee bar assembly.

11. Disconnect the necessary control cables, such as the propeller pitch control, mixture control, etc., that will allow the tee bar assembly to be removed.

12. Remove the tee bar assembly by removing the attachment bolts (15) with washers and nuts which are through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

5-5. INSTALLATION OF CONTROL COLUMN ASSEMBLY (PA-32-260 and 300). (Refer to Figure 5-1.)

a. The tee bar assembly may be installed in the airplane by the following procedure:

1. Swing the tee bar assembly into place from the right side of the cabin and secure with attachment bolts (15), washers and nuts inserted in through each side of the floor tunnel.

2. Connect the stabilator control cables (11) to the lower end of the tee bar with bolt, washer, nut and cotter pin (16). Allow the cable ends free to rotate.

3. Place the aileron control cables (12) around the pulleys (13) that attach to the lower section of the tee bar (5), position pulleys and secure with bolt, washers and nut (14).

4. Install the control wheel per step b.

5. Place the control wheels in neutral (centered) position and install the aileron control chains (7 and 8) on the control wheel sprockets (17 and 18) and idler cross-over sprockets (19 and 21). The turnbuckle (9) must be centered between the two control wheel sprockets.

6. Loosen the connecting bolts (22) of the idler sprockets (19 and 21) to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.

7. Connect the aileron control cables (12) to the ends of the chains (7 and 8) with bolts, bushings, nuts and cotter pins (10).

8. Adjust the chain turnbuckle (9) between the two control wheel sprockets to allow the control wheels to be neutral and obtain proper cable tension as given in Table V-I. It may be necessary in order to have both control wheels neutral to set the chain turnbuckle to neutralize the wheels and then set cable tension with the turnbuckles located under the floor panel aft of the main spar as instructed in paragraph 5-11. Before safetying the turnbuckle, check that when the ailerons are neutral, the control wheels will be neutral and the chain turnbuckle centered. Also the aileron bellcranks should contact their stops before the control wheel hits its stop. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.

9. Set stabilator cable tension with the turnbuckle in the aft section of the fuselage and instructions given in paragraph 5-15. Check safety of all turnbuckles upon completion of adjustments.

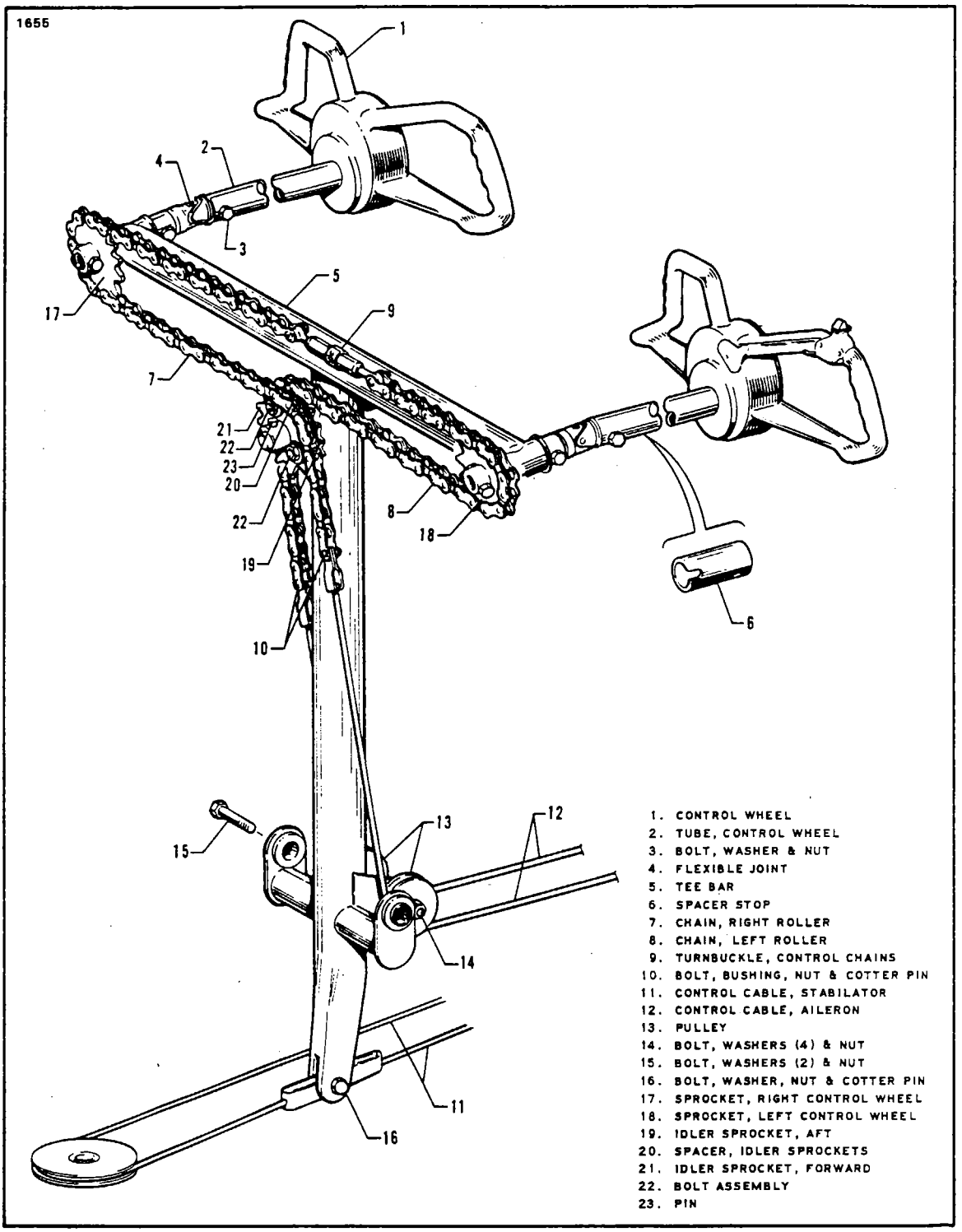


Figure 5-1. Control Column Assembly (PA-32-260 and 300)

10. Tighten the connecting bolts (22) of the idler sprockets (19 and 21).

11. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

12. Install the fuel selector lever on the selector torque tube and secure with clevis pin and safety with cotter pin.

13. Install the fuel selector covers and the rudder trim control knob.

b. Either control wheel assembly may be installed by the following procedure:

1. Insert the control wheel tube through the instrument panel.

2. Should wires for the various Autopilot systems need to be installed in the control tube, route them through the hole in the forward side of the tube and out of the small hole in the forward side. Position the rubber grommet in the hole in the side of the tube.

3. On the left control tube install the stop (6).

4. Connect the control wheel tube (2) to the flexible joint (4) of the tee bar assembly. If the control cables and/or chains have not been removed or loosened, place the ailerons in neutral and install the control tube on the flexible joint to allow the control wheel to be neutral. Install bolt, washer and nut (3) and tighten.

5-5a. REMOVAL OF CONTROL COLUMN ASSEMBLY (PA-32R-300). (Refer to Figure 5-1a.)

a. To remove either control wheel (5) with tube (4), the following procedure may be used:

1. Separate the control wheel tube (4) from the flexible joint (2) that is located on either side of the tee bar assembly (7) by removing the nut, washer and bolt (3). Pull the tube from the flexible joint.

2. If removing the left control tube, slide the stop (12) from the tube.

3. Should wires for the various Autopilot systems be installed in the control tube, disconnect them at the quick disconnect terminals behind the instrument panel. Draw the wires back into the tube and back out through the forward end of the tube.

4. Remove the control wheel assembly from the instrument panel.

b. The tee bar (7) with assembled parts may be removed from the airplane by the following procedure:

1. Remove the access panel to the aft section of the fuselage.

2. Relieve cable tension from the stabilator control cables (23) at one of the stabilator cable turnbuckles in the aft section of the fuselage.

3. Relieve tension from the aileron control cables (22) and chains (14 and 16) at the turnbuckle (6) that connects the chains at the top of the tee bar (7).

4. Disconnect the control chains from the control cables where the chains and cables join by removing the cotter pins, nuts, bolts and bushings.

5. If the control wheel assemblies have not been previously disconnected from the tee bar assembly, separate the control wheel tubes (4) at the flexible joints (2) by removing the nuts, washers and bolts (3).

6. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.

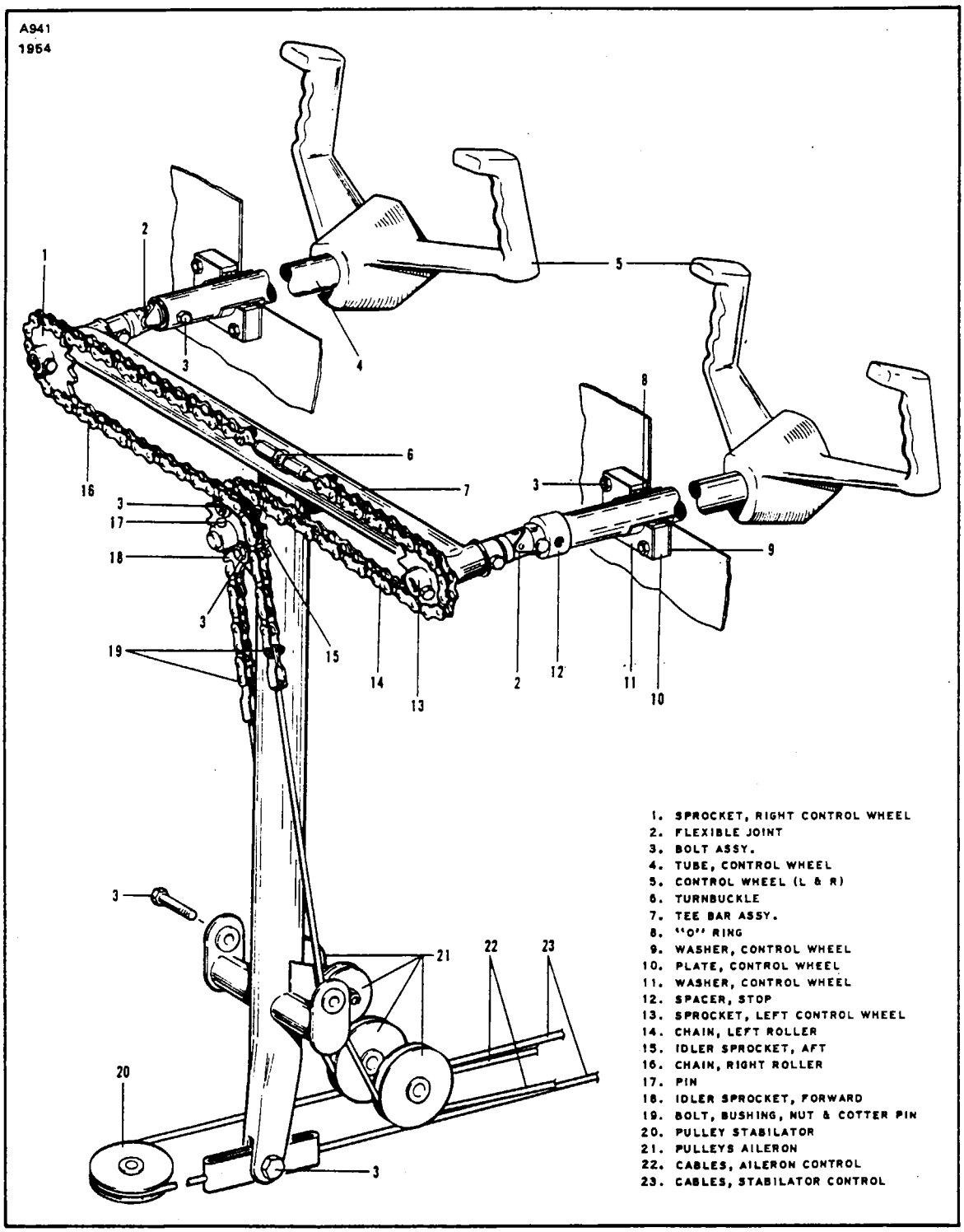


Figure 5-1a. Control Column Assembly (PA-32R-300)

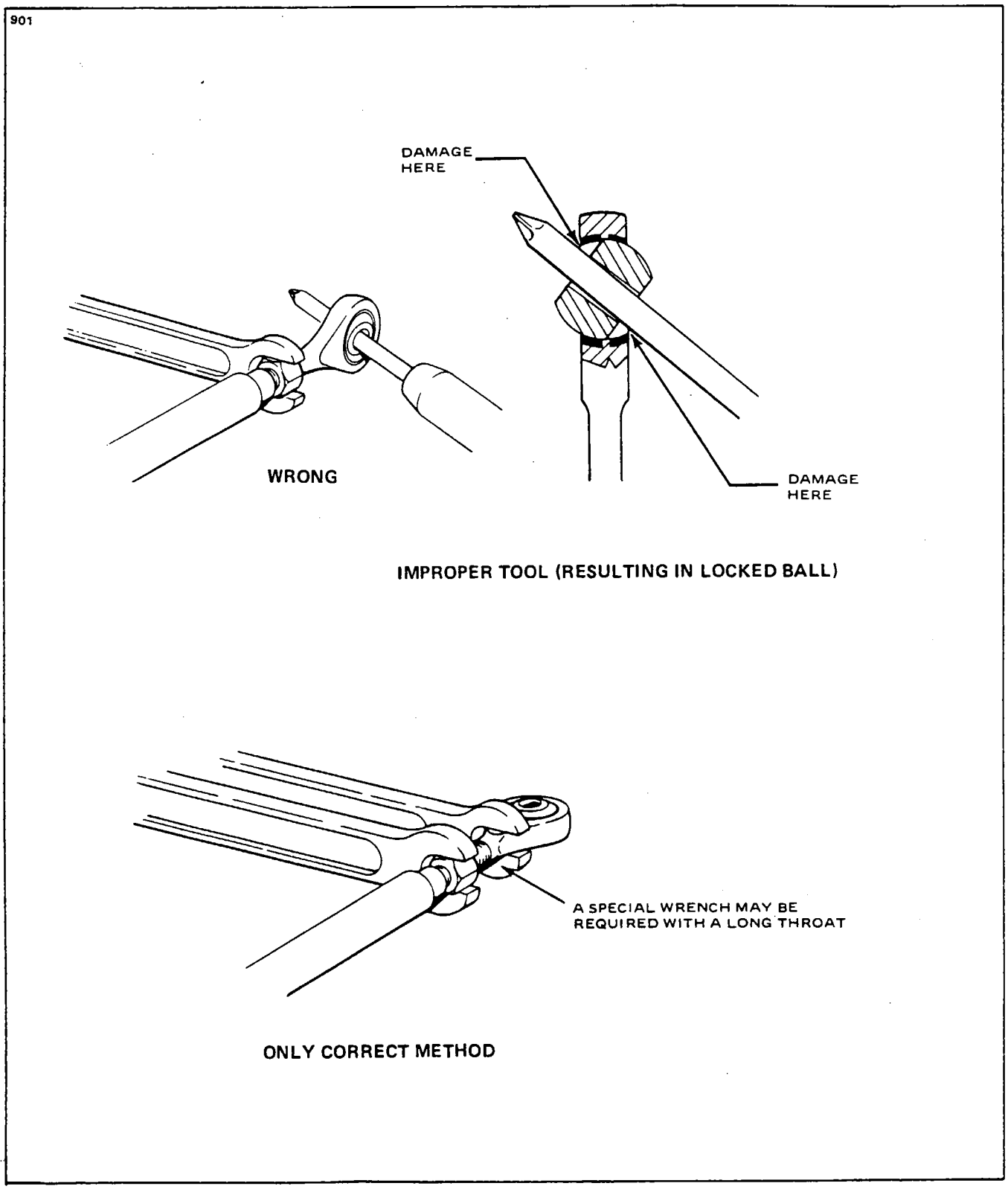


Figure 5-1b. Correct Method of Installing Rod End Bearings

7. Remove the two aileron control cable pulleys (21) attached to the lower section of the tee bar by removing the pulley attachment bolt (8).

8. Disconnect the stabilator control cables (23) from the lower end of the tee bar assembly.

9. Disconnect the necessary control cables, such as the propeller pitch control, mixture control, etc., that will allow the tee bar assembly to be removed.

10. Remove the tee bar assembly by removing the attachment bolts (3) with washers and nuts which are through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

5-5b. INSTALLATION OF CONTROL COLUMN ASSEMBLY (PA-32R-300). (Refer to Figure 5-1a.)

a. The tee bar assembly may be installed in the airplane by the following procedure:

1. Swing the tee bar assembly into place from the right side of the cabin and secure with attachment bolts (3), washers and nuts inserted in through each side of the floor tunnel.

2. Connect the stabilator control cables (23) to the lower end of the tee bar with bolt (3), washer, nut and cotter pin. Allow the cable ends free to rotate.

3. Place the aileron control cables (22) around the pulleys (21) that attach to the lower section of the tee bar (7); position pulleys and secure with bolt, washers and nut.

4. Install the control wheel per Step b.

5. Place the control wheels in neutral (centered) position and install the aileron control chains (14 and 16) on the control wheel sprockets (1 and 13) and idler cross-over sprockets (15 and 18). The turnbuckle (6) must be centered between the two control wheel sprockets.

6. Loosen the connecting bolts (3) of the idler sprockets (15 and 18) to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.

7. Connect the aileron control cables (22) to the ends of the chains (14 and 16) with bolts, bushings, nuts and cotter pins (19).

8. Adjust the chain turnbuckle (6) between the two control wheel sprockets to allow the control wheels to be neutral and obtain proper cable tension as given in Table V-I. It may be necessary in order to have both control wheels neutral to set the chain turnbuckle to neutralize the wheels and then set cable tension with the turnbuckles located under the floor panel aft of the main spar as instructed in Paragraph 5-11. Before safetying the turnbuckle, check that when the ailerons are neutral, the control wheels will be neutral and the chain turnbuckle centered. Also the aileron bellcranks should contact their stops before the control wheel hits its stop. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.

9. Set stabilator cable tension with the turnbuckle in the aft section of the fuselage and instruction given in paragraph 5-15. Check safety of all turnbuckles upon completion of adjustments.

10. Tighten the connecting bolts (3) of the idler sprockets (15 and 18).

11. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

b. Either control wheel assembly may be installed by the following procedure:

1. Insert the control wheel tube through the instrument panel.

2. Should wires for the various Autopilot systems need to be installed in the control tube, route them through the hole in the forward side of the tube and out of the small hole in the side. Position the rubber grommet in the hole in the side of the tube.

3. On the left control tube, install the stop (12).

4. Connect the control wheel tube (4) to the flexible joint (2) of the tee bar assembly. If the control cables and/or chains have not been removed or loosened, place the ailerons in neutral and install the control tube on the flexible joint to allow the control wheel to be neutral. Install bolt, washer and nut (3). Then tighten.

5-6. AILERON CONTROLS.

5-7. REMOVAL OF AILERON CONTROL CABLES. (Refer to Figure 5-2.)

a. For the removal of any of the control cables in the fuselage or wings, first remove the floor panel that is located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from airplane.

b. To remove either the right or left primary control cables (14 and 15) that are located in the fuselage, the following procedure may be used:

1. Remove the fuel selector panel cover by removing the rudder trim knob and the cover attachment screws.

2. Remove the lower selector cover and disconnect the fuel selector control lever from the selector torque tube by removing the attachment pin located at the bottom of the lever.

3. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.

4. Remove the forward heat duct from one side of the floor tunnel (preferably from the side from which the cable is to be removed) by removing the trim control wheel cover, the heater baffles from the side of the duct, the floor carpet and the duct attachment screws.

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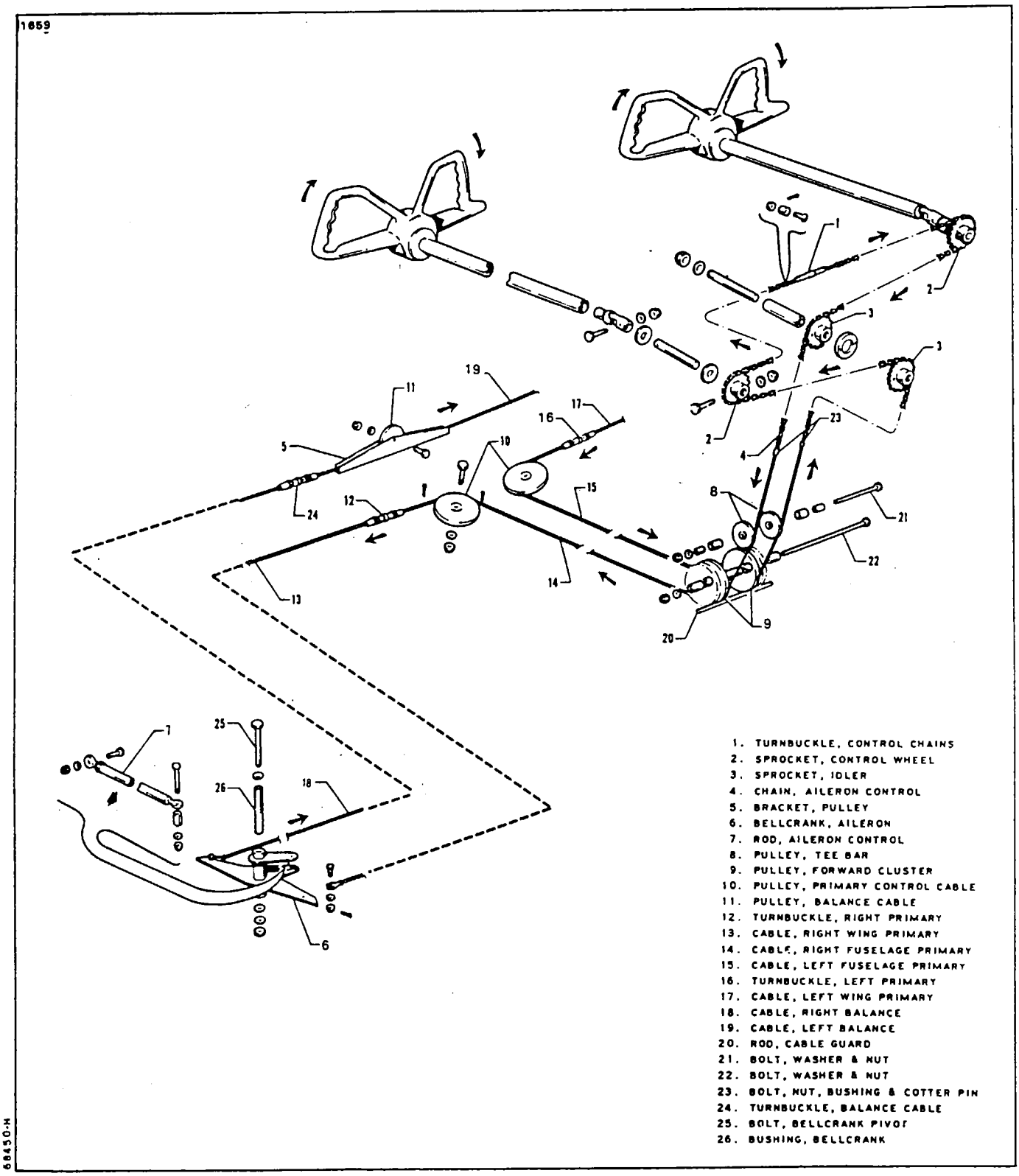


Figure 5-2. Aileron Controls (Typical)

5. Separate the primary control cable (14 or 15) at the turnbuckle (12 or 16) located in the floor opening aft of the main spar.

6. Remove the cable pulleys (8) attached to the lower section of the control column tee bar assembly by removing the pulley attachment bolt (21).

7. Move the cable guard (20) located under the pulley cluster (9) below the fuel selector by removing the cotter pin from the exposed end of the guard and sliding it to the left or right as required.

8. Remove the cotter pins used as cable guards at the pulley (10) in the forward area of the floor opening aft of the main spar.

9. Disconnect the cable (14 or 15) from the control chain (4) at the control column tee bar assembly by removing the cotter pin, nut, bolt and bushing (23) that connect the two together. Secure the chains in some manner to prevent them from unwrapping from around the sprockets.

10. Draw the cable back through the floor tunnel.

c. The primary control cable (13 or 17) in either wing may be removed by the following procedure:

1. Remove the access plate to the aileron bellcrank (6) located on the underside of the wing forward of the inboard end of the aileron.

2. If not previously disconnected, separate the cable at the turnbuckle (12 or 16) located in the floor opening aft of the main spar.

3. Disconnect the cable from the forward end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.

4. Draw the cable from the wing.

d. Either balance cable (18 or 19) may be removed by the following procedure:

1. Separate the balance cable at the turnbuckle (24) in the right side of the floor opening aft of the main spar.

2. If the left balance cable is to be removed, remove the cotter pin used as a cable guard at the pulley (11) in the center of the floor opening.

3. Remove the access plate to the aileron bellcrank (6) located on the underside of the wing forward of the inboard end of the aileron.

4. Disconnect the cable from the aft end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.

5. Draw the cable from the wing.

5-8. INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figure 5-2.)

a. The installation of either the right or left primary control cable (14 or 15) that is located in the fuselage may be accomplished as follows:

1. Draw the cable through the fuselage floor tunnel.

2. Connect the cable to the end of the control chain (4) and secure using bushing, bolt, nut and cotter pin (23).

3. Place the cable around the pulley (9) that is located in the tunnel, below

the fuel selector. Install cable guard (20) and secure with cotter pin.

4. Position cables and install the cable pulleys (8) that attach to the lower section of the tee bar assembly. Secure with bolt, washer and nut (21).

5. Place the cable around the pulley (10) that is located in the floor opening just aft of the main spar and install cotter pin cable guards.

6. If the primary control cable in the wing is installed, connect the control cable ends at the turnbuckle (12 or 16) located in the floor opening aft of the main spar.

7. Check rigging and adjustment per paragraph 5-11.

8. Position the heat duct and secure with screws.

9. Install the tunnel plate aft of tee bar assembly and secure with screws.

10. Put the floor carpet in place and secure.

11. Place the fuel selector lever on the selector torque tube and secure with pin and cotter pin.

12. Install the lower and upper selector covers and secure with screws.

b. The primary control cable (13 or 17) in either wing may be installed by the following procedure:

1. Draw the control cable into the wing.

2. Connect the cable to the forward end of the aileron bellcrank (6) using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.

3. If the primary control cable in the fuselage is installed, connect the ends at the turnbuckle (12 or 16) located in the floor opening aft of the main spar.

4. Check rigging and adjustment per paragraph 5-11.

5. Install the access plate on the underside of the wing.

c. Either balance cable (18 or 19) may be installed by the following procedure:

1. Draw the cable into the wing.

2. Connect the cable to the aft end of the aileron bellcrank (6) using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.

3. Connect the balance cable ends at the turnbuckle (24) in the floor opening aft of the main spar.

4. If the left cable was removed, install the cotter pin cable guard at the pulley (10) located in the center of the floor opening.

5. Check rigging and adjustment per paragraph 5-11.

6. Install the access plate on the underside of the wing.

7. Install the floor panel, seat belt attachments and seats.

5-9. REMOVAL OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 5-2.)

a. Remove the floor panel located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the floor panel. Lift the panel and remove from the airplane.

b. Remove the access plate to the aileron bellcrank (6) located on the underside of the wing, forward of the inboard end of the aileron.

c. Relieve tension from the aileron control cables by loosening the balance cable turnbuckle (24) located in the floor opening aft of the main spar.

d. Disconnect the primary (13 or 17) and balance (18 or 19) control cables from the bellcrank assembly by removing cotter pins, nuts, washers and bolts.

e. Disconnect the aileron control rod (7) at the aft or forward end, as desired.

f. Remove the nut, pivot bolt (25) and washers that secure the bellcrank. The nut is visible from the underside of the wing.

g. Remove the bellcrank from within the wing.

5-10. INSTALLATION OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 5-2.)

a. Ascertain that the bellcrank pivot bushing (26) is lubricated and install in the torque tube portion of the bellcrank (6).

b. Place the bellcrank in position in the wing with a washer located between each end of the torque tube and the mounting brackets.

c. Install the bellcrank pivot bolt (25) with the head up. Install a washer and nut on the bolt and torque nut 20 to 25 inch pounds. Check that the bellcrank rotates freely with little up-down play.

d. Install and adjust control rod (7) and check aileron travel per paragraph 5-11.

e. Connect the ends of the primary (13 or 17) and balance (18 or 19) control cables to the bellcrank using bolts, washers, nuts and cotter pins. Allow the cable ends to rotate freely on the bellcrank.

f. Tighten the control cables at the balance cable turnbuckle (24) in the floor opening aft of the main spar. Check cable tension per paragraph 5-11.

g. Install the access plate on the underside of the wing, the floor panel aft of the main spar, seat belt attachments and seats.

5-11. RIGGING AND ADJUSTMENT OF AILERON CONTROLS.

a. To check and adjust the rigging of the aileron controls, first set the right and left aileron bellcranks at neutral position. (Ascertain that the control chains have been rigged per paragraph 5-5.) This may be accomplished by the following procedure:

1. Remove the access plate to each aileron bellcrank located on the under-

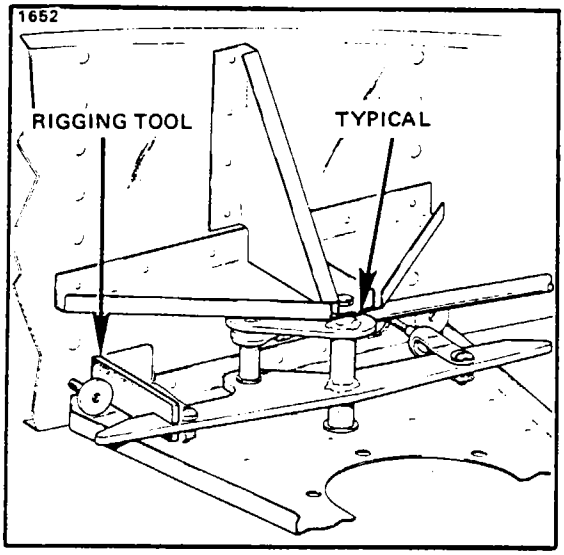


Figure 5-3. Bellcrank Rigging Tool

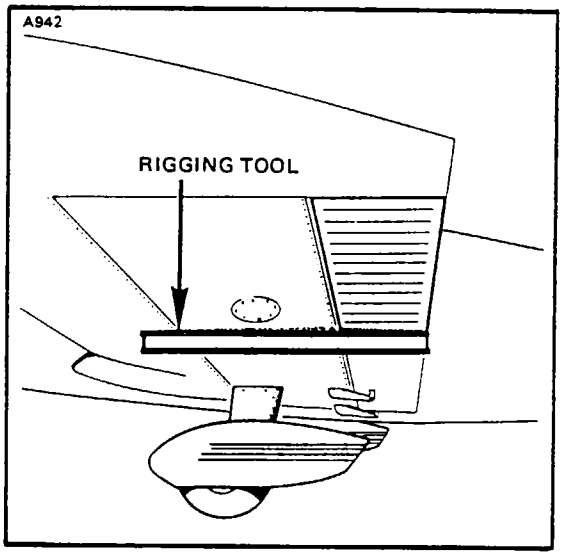


Figure 5-4. Aileron Rigging Tool

side of the wing, forward of the inboard end of the aileron by removing the plate attachment screws.

2. Affix a bellcrank rigging tool, as shown in Figure 5-3 between the forward arm of each bellcrank and the adjacent rib. The slotted end of the tool fits on the arm forward of and adjacent to the primary control cable end. The other end of the tool is positioned so that the side of the tool contacts the aft side of the bellcrank stop. The bellcrank must be moved to allow a snug fit of the tool between the bellcrank arm and rib. To do so, it may be necessary to loosen a primary control cable or the balance cable. (This tool may be fabricated from dimensions given in Figure 5-18.) Neutral position of the bellcrank may also be found by locating the center of the balance cable attachment bolt or the hole in the aft arm of the bellcrank three inches from the face of the adjacent rib.

b. With each bellcrank set at neutral, the ailerons may be checked and adjusted for neutral as follows:

1. Ascertain that the bellcrank rigging tool fits snug between the bellcrank and the rib.

2. Place an aileron rigging tool as shown in Figure 5-4 against the underside of the wing and aileron as close as possible to the inboard end of the aileron without contacting any rivets. The tool must be positioned parallel with the wing ribs with the aft end of the tool even with the trailing edge of the aileron. (This tool may be fabricated from dimensions given in Figure 5-19.)

3. With the aileron control rod connected between the bellcrank and aileron, check that the surface of the wing contacts the tool at its forward surface and at the spacer, and the trailing edge of the aileron contacts the aft end of the tool. The aileron is neutral at this position.

4. Should the three points not contact, loosen the jam nut at the aft end of the control rod and rotate the rod until the three points contact. Apply a slight up pressure against the trailing edge of the aileron while making this adjustment. After adjustment retighten the jam nut. The ailerons may be allowed to "droop" by approximately 1/8 of an inch at this point.

c. Adjust primary and balance cable tension as given in Table V-I, by the following procedure:

1. Remove the floor panel that is located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel.

2. Loosen the connecting bolts of the idler cross-over sprockets at the control tee bar to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.

3. Ascertain that both bellcranks are at neutral position.

4. Adjust the turnbuckles, located in the floor opening aft of the main spar, of the primary and balance cables to proper cable tension and maintain neutral-center position of the control wheels. To obtain neutral position of both control wheels, it may also be necessary to adjust the roller chain turnbuckle located between the control wheel sprockets. During adjustment obtain a little more tension on the primary control cables to hold the bellcranks in neutral against the rigging tools, finishing with even tension on all cables.

5. Tighten the bolts to secure the idler cross-over sprockets.

6. Remove the aileron bellcrank rigging tool from each wing.

d. Check the ailerons for correct travel from neutral per dimensions given in Table V-I, by the following procedure:

1. Center the bubble of a protractor over the surface of an aileron at neutral position and note the reading.

2. Move the aileron full up and down, and check the degree of travel for each direction. The degree of travel on the protractor is determined by taking the difference between the protractor reading at neutral and up, and neutral and down. The bubble must be centered at each reading.

3. Should the travel not be correct, the travel may be set by rotating the bellcrank stops in or out. Stops are located in the wing attached to the rib that is adjacent to the aileron bellcrank.

4. Repeat this procedure for the other aileron.

e. Check the bellcrank stops to assure that the bellcrank contact is made simultaneously, but still have cushion before contacting the control wheel stops. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.

f. Check control operation, and bolts and turnbuckles for safety.

g. Install access plates and panels.

h. Should an out-of-trim condition persist despite all the rigging corrections that can be made, there is a possibility that the trailing edge of the aileron has been used to move the aircraft forward. This can result in a slight bulging of the aileron contour at the trailing edge which will cause an out-of-rig condition that is very difficult to correct.

5-12. STABILATOR CONTROLS.

5-13. REMOVAL OF STABILATOR CONTROL CABLES. (Refer to Figure 5-5.)

a. To remove either the forward or aft stabilator cables, first remove the access panel to the aft section of the fuselage.

b. Disconnect the desired control cable at the turnbuckle (16) in the aft section of the fuselage.

c. Either forward stabilator cable (2 or 3) may be removed by the following procedure:

1. Remove the floor tunnel cover in the aft area of the cabin by removing the trim plate, the carpet over the tunnel and the cover attachment screws.

2. Remove the cable guard plate (11) from the underside of the pulley cluster (19) in the aft area of the tunnel opening by removing the guard attachment screws.

3. Remove the floor panel located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from airplane.

4. Within the floor opening, remove the cable rub blocks (10) that are attached to the spar housing by removing the block attachment screws. Also remove the cotter pin cable guard at the pulley cluster (6) in the aft area of the opening.

5. Remove the fuel selector panel cover by removing the rudder trim knob and the cover attachment screws.

6. Remove the lower selector cover and disconnect the fuel selector control lever from the selector torque tube by removing the attachment pin located at the bottom of the lever.

7. Remove the tunnel plate just aft of the tee bar by removing enough carpet from the tunnel to allow the plate attachment screws and plate to be removed.

8. If the right (upper) stabilator control cable (2) is to be removed, remove the cotter pin cable guards at the pulley (14) located in the forward area of the tunnel.

9. Disconnect the cables (2 and 3) from the lower end of the tee bar by removing cotter pin, nut, washer and bolt (15).

10. Draw the cable aft through the floor tunnel.

d. Either aft stabilator control cable (4 or 5) may be removed by the following procedure:

1. Disconnect the cable end at the balance arm (18) of the stabilator by removing the cotter pin, nut, washer and bolt (8).

2. Remove the cotter pin cable guard at the pulley (7) located either above or below the balance arm.

3. Remove the cable from the airplane.

5-14. INSTALLATION OF STABILATOR CONTROL CABLES. (Refer to Figure 5-5.)

a. The forward stabilator cables (2 and 3) may be installed by the following procedure:

1. Draw the control cable through the floor tunnel. Ascertain that the right (upper) cable (2) is routed around the pulley (14) that is in the forward area of the forward floor tunnel.

2. Connect the cables (2 and 3) to the lower end of the control column tee bar (1) with bolt, washer, nut and cotter pin (15). Allow the cable to be free to rotate.

3. If the aft control cable (4 or 5) is not installed, install per step b.

4. Connect the control cable to the aft cable at the turnbuckle (16) in the aft section of the fuselage.

5. For the right control cable (2), install the cotter pin cable guard at the pulley (14) in the forward area of the tunnel.

6. Within the forward area of the floor opening aft of the main spar, install the cable rub blocks (10) to the spar housing and secure with screws.

7. In the aft area of the floor opening, install the cotter pin cable guard at the pulley cluster (6).

8. Install the cable guard (11) under the pulley cluster (19) located in the aft area of the aft floor tunnel and secure with screws.

9. Set cable tension and check rigging and adjustment per paragraph 5-15.

10. Install the tunnel plate directly aft of the tee bar assembly and secure with screws.

11. Put the floor carpet in place and secure.

12. Place the fuel selector lever on the selector torque tube and secure with pin and safety with cotter pin.

13. Install the lower and upper selector covers and secure with screws.

14. Install the floor panel aft of the main spar and secure with screws. Install the seat belt attachments and seats.

15. Install the cover and carpet of the aft floor tunnel.

b. Either aft stabilator control cable (4 and 5) may be installed by the following procedure:

1. Route the cable (4 or 5) around its pulley (7) located either over or under the balance arm (18) of the stabilator.

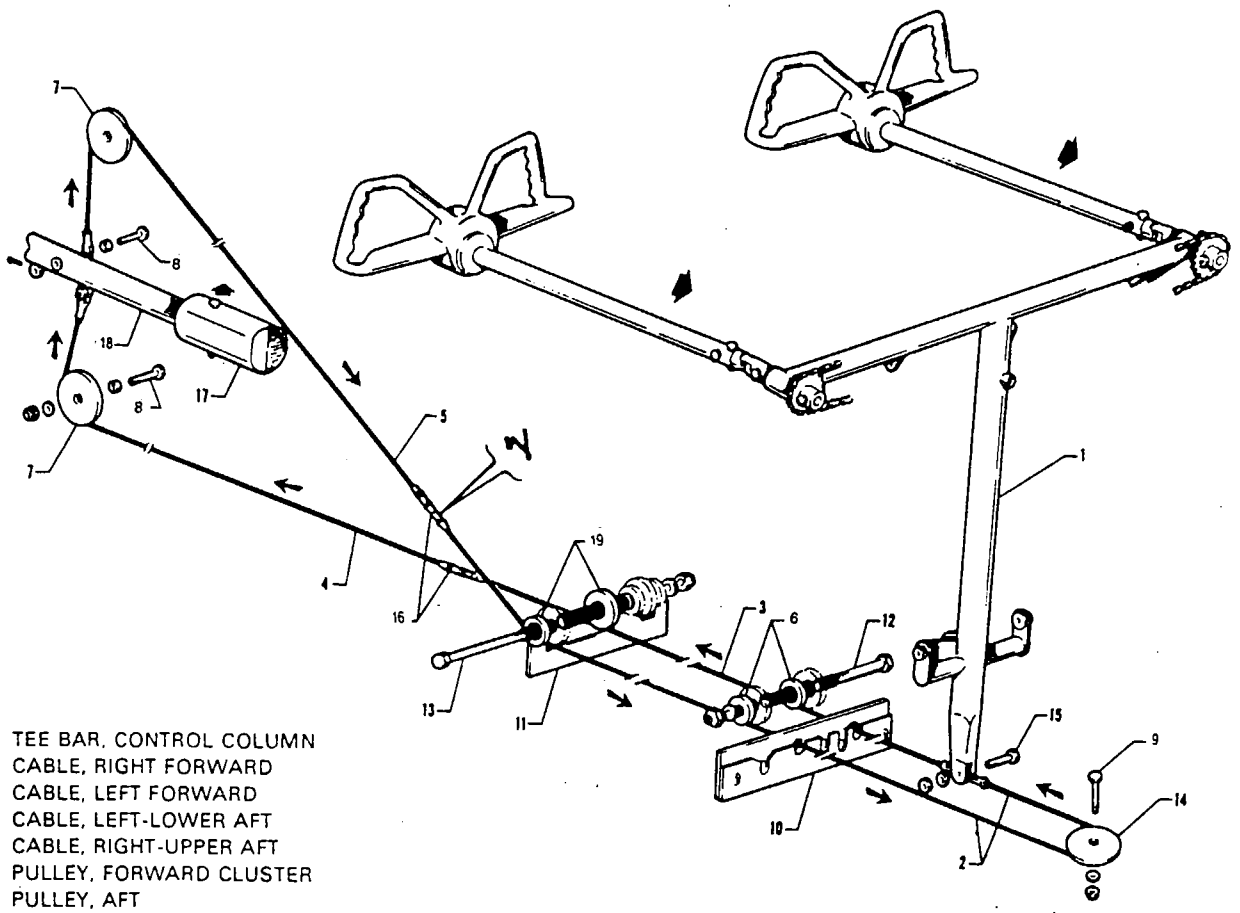
2. Connect the cable to the stabilator balance arm and secure with bolt, washer, nut and cotter pin (8). (Insure bushing is installed with bolt.)

3. Connect the cable to the forward cable at the turnbuckle (16) in the aft section of the fuselage. The upper aft cable (5) connects to the right forward cable (2) and the lower cable (4) to the left cable (3).

4. Install the cotter pin cable guard at the pulley (7) where required.

5. Set cable tension and check rigging and adjustment per paragraph 5-15.

c. Install the access panels to the aft section of the fuselage.



1. TEE BAR, CONTROL COLUMN
2. CABLE, RIGHT FORWARD
3. CABLE, LEFT FORWARD
4. CABLE, LEFT-LOWER AFT
5. CABLE, RIGHT-UPPER AFT
6. PULLEY, FORWARD CLUSTER
7. PULLEY, AFT
8. BOLT, WASHER, NUT & COTTER PIN
9. BOLT, WASHER & NUT
10. BLOCK, CABLE RUB
11. GUARD, CABLE
12. BOLT, WASHER (7) & NUT
13. BOLT, WASHER (11) & NUT
14. PULLEY, FORWARD
15. BOLT, WASHER, NUT & COTTER PIN
16. TURNBUCKLE
17. WEIGHT, BALANCE ARM
18. BALANCE ARM, STABILATOR
19. PULLEYS

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Figure 5-5. Stabilator Controls

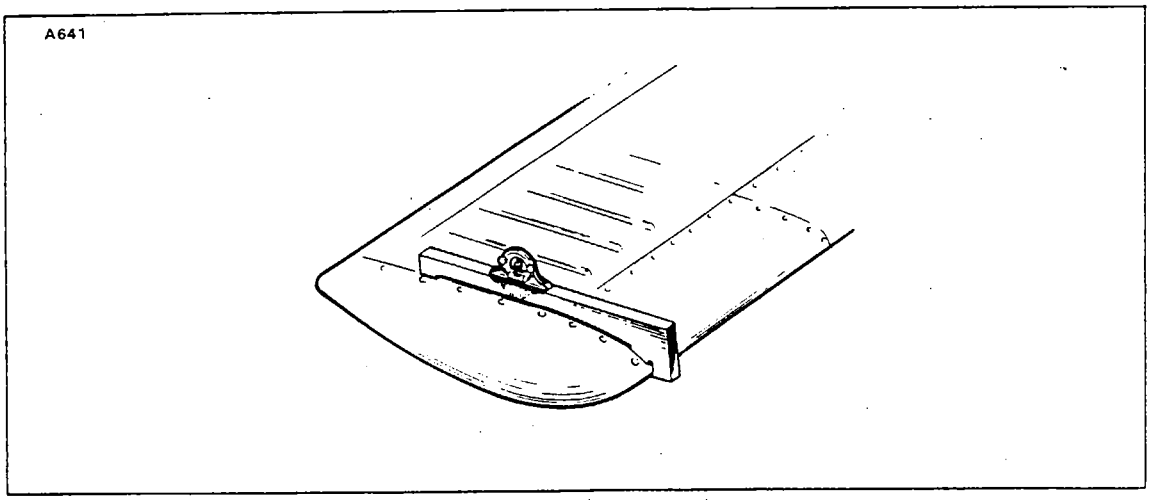


Figure 5-6. Stabilator Rigging Tool

5-15. RIGGING AND ADJUSTMENT OF STABILATOR CONTROLS.

a. To check and set the correct degree of stabilator travel, the following procedure may be used:

1. Level the airplane. (Refer to Leveling, Section II.)
2. Place the stabilator in neutral position. Neutral position is obtained when a level placed on stabilator rigging tool (Figure 5-6) indicates that stabilator is parallel with leveling holes noted in Figure 2-6.
3. Check the stabilator travel by placing a rigging tool on the upper surface of the stabilator as shown in Figure 5-6. (This tool may be fabricated from dimensions given in Figure 5-20.)
4. Set on a bubble protractor the number of degree up travel as given in Table V-I and place it on the rigging tool. Raise the trailing edge of the stabilator and determine that when the stabilator contacts its stops, the bubble of the protractor is centered.

NOTE

The stabilator should contact both of its stops before the control wheel contacts its stop.

5. Set on the protractor the number of degrees down travel as given in Table V-I and again place it on the rigging tool. Lower the trailing edge of the stabilator and determine that when it contacts its stops, the bubble of the protractor is centered.
6. Should the stabilator travel be incorrect in either the up or down position, remove the tail cone by removing the attachment screws and with the use of the rigging tool and bubble protractor turn the stops located at each stabilator hinge in or out (refer to Figure 5-13) to obtain the correct degree of travel.
7. Ascertain that the locknuts of the stop screws are secure and then reinstall the tail cone.

b. To check and set stabilator control cable tension, the following procedure may be used:

1. Ascertain that the stabilator travel is correct.
2. Remove the access panel to the aft section of the fuselage.
3. Secure the control column in the near forward position. Allow one-quarter inch between the column and the stop bumper.

4. Check each control cable for the correct tension as given in Table V-I.

5. Should tension be incorrect, loosen the turnbuckle of the lower cable in the aft section of the fuselage and adjust the turnbuckle of the upper cable to obtain correct tension. Cable tension should be obtained with control wheel at the one-quarter inch dimension from the stop and the stabilator contacting its stop.

6. Check safety of all turnbuckles and bolts.

7. With the tension of the upper cable correct and the control wheel still forward, adjust the turnbuckle of the lower cable to obtain correct tension.

8. Check the full travel of the control wheel with relation to the full travel of the stabilator to determine that the stabilator contacts its stops before the control wheel contacts its stops. With the control wheel in the fore and aft positions, the travel distance from the point where the stabilator contacts its stops and the control wheel contacts its stops should be approximately equal. Readjust turnbuckles if incorrect.

9. Reinstall access panels.

5-16. STABILATOR TRIM CONTROLS.

5-17. REMOVAL OF STABILATOR TRIM ASSEMBLY (FORWARD). (Refer to Figure 5-8.)

a. To remove the trim control wheel assembly and/or the trim control cables, first remove the panel to the aft section of the airplane.

b. If the aft trim cable (12) is not to be removed, block the cables at the pulleys (13) in the upper aft section of the fuselage to prevent them from unwrapping from the trim drum. (Refer to Figure 5-7.)

c. Loosen the cables if the trim control wheel (1) is to be removed or disconnect if the cables are also to be removed. Do this at the trim cable turnbuckles (10 and 11) in the aft section of the fuselage.

d. The control wheel (1) with drum (3) may be removed by the following procedure:

1. Remove the control wheel cover by removing the cover attaching screws.

2. The wheel assembly may be removed from its mounting brackets (4) by removing nut, washer and bolt (8) that secures the wheel between the brackets. Draw the wheel from the brackets. Use caution not to damage trim indicator wire (2).

3. Unwrap the left cable (9) from the drum.

4. The wheel and drum are joined by a push fit, separate these two items with their center bushing and unwrap the right cable (8).

5. Tie the cables forward to prevent them from slipping back into the floor

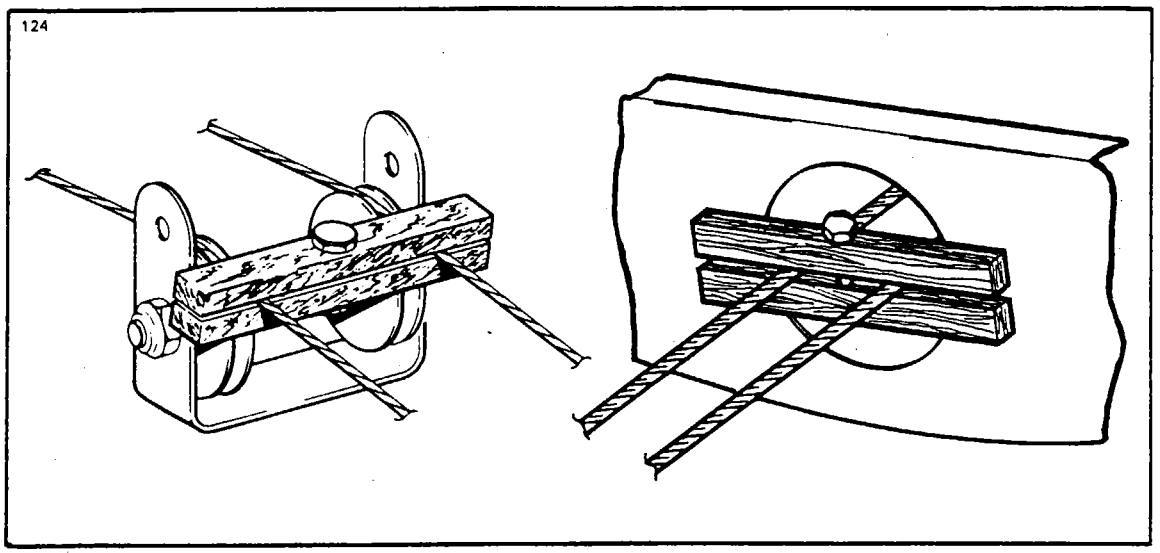


Figure 5-7. Methods of Securing Trim Cables

tunnel.

e. The trim control cables (8 and 9) may be removed by the following procedure:

1. Remove the center seats, and the pilot and rear seats if desired.
2. Remove the seat belts attached to the forward floor tunnel by removing attachment nuts, washers and bolts.
3. Remove the heater deflectors from each side of the aft end of the forward floor tunnel by sliding the deflector sideways and releasing the retainer spring.
4. Unfasten the carpet from the aft portion of the forward floor tunnel and lay it forward.
5. Remove the tunnel cover located between the trim control wheel and the spar cover by removing attachment screws.
6. Remove the cable pulleys (6) located in the forward tunnel by removing the cotter pin, washer and clevis pin (5).
7. Remove the floor panel aft of the main spar by removing the panel attachment screws and seat belt attachments. Lift the panel and remove from airplane.
8. Remove the cable rub blocks (39) located in the floor opening on the aft side of the main spar by removing the block attachment screws.
9. Remove the trim plate located on top of the forward end of the aft floor tunnel.
10. Remove the carpet from the aft floor tunnel.
11. Remove the cover plate from the top of the aft floor tunnel by removing attachment screws.

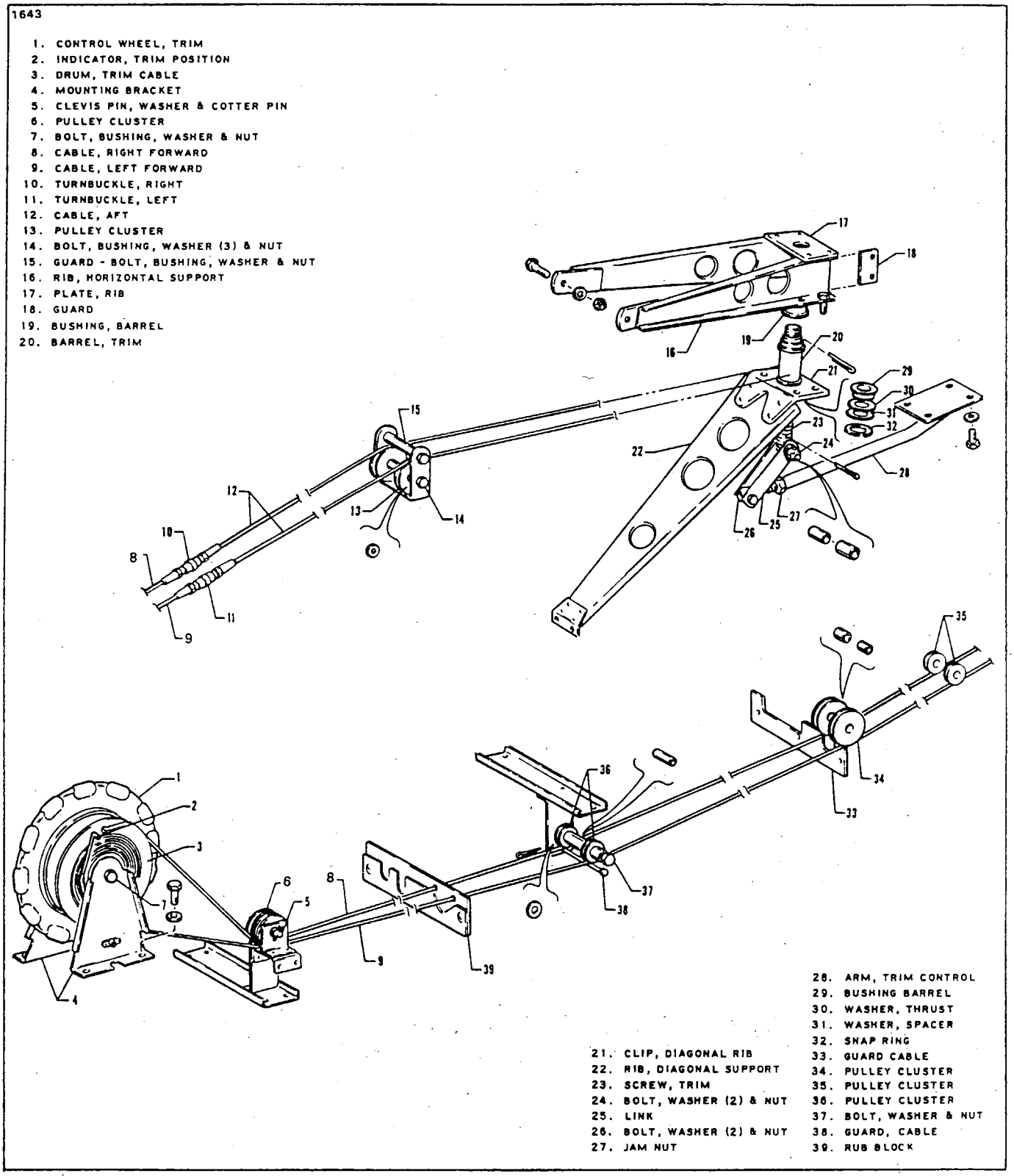


Figure 5-8. Stabilator Trim Controls

12. Remove the cable guard (38) from the underside of the trim cable pulleys (36) located in the forward area of the aft floor tunnel by removing the cotter pin and withdrawing the roll pin.

13. Remove the cable guard plate (33) from the underside of the pulley cluster (34) located in the aft area of the floor tunnel by removing the plate attachment screws.

14. Remove the cable guard from the cable pulleys (35) in the aft lower section of the fuselage forward of the cable turnbuckles (10 and 11).

15. With the cables disconnected from the trim control wheel, draw the cable(s) through the floor tunnel.

5-18. INSTALLATION OF STABILATOR TRIM ASSEMBLY (FORWARD). (Refer to Figure 5-8.)

a. The trim control wheel (1) with drum (3) may be installed by the following procedure:

1. Wrap the right trim cable (8) on the trim drum by inserting the swaged ball of the cable in the slot provided in the side (right side) of the drum that mates with the control wheel, and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.

2. Attach the control wheel (1) to the cable drum (3) by aligning the long lug of the drum with the long slot of the wheel and pushing the two pieces together.

3. Wrap the left trim cable (9) on the drum by inserting the swaged ball of the cable in the slot provided in the flanged side (left side) of the drum and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.

4. Lubricate and install the bushing in the control wheel and drum.

5. Align the control cables and position the control wheel assembly between its mounting brackets (4). Ascertain that the end of the trim indicator wire (2) is positioned in the spiraled slot of the drum (3) with no bind on the end. Install the retainer bolt (8) from the left side and install washer and nut. AN960-616L washers may be added as necessary between the mounting bracket and the trim control wheel to eliminate end play.

6. Install the cover over the control wheel and secure with screws, unless the control cables have yet to be installed.

b. The trim control cables (8 and 9) may be installed by the following procedure:

1. Draw the cable(s) through the floor tunnel.

2. Wrap the cable drum (3) and install the trim control wheel as given in step a.

3. Position the cable pulleys (6) on their mounting bracket and install the clevis pin, washer and cotter pin (5).

4. Connect the cable (8 or 9) to the aft cable (12) at the turnbuckle (10 or 11) in the aft section of the fuselage. Install aft cable (12) if not installed.

5. Install the cable guard at the cable pulleys (35) in the aft lower section of the fuselage forward of the cable turnbuckles.

6. Install the cable guard plate (33) at the underside of the pulley cluster (34) located in the aft area of the aft floor tunnel and secure with screws.

7. Install the roll pin type cable guard (38) at the underside of the pulleys (36) located in the forward area of the aft floor tunnel and secure it with a cotter pin.

8. Install the cable rub blocks (39) located on the aft side of the main spar housing and secure with screws.

9. Remove the blocks that secure the aft trim cable and check that the cables are seated on their pulleys.

10. Set cable tension and check rigging and adjustment per paragraph 5-21. Check safety of all turnbuckles.

11. Install the tunnel cover on the forward tunnel and secure with screws.

12. Install the carpet over the floor tunnel.

13. Install the heat deflectors on each side of the floor tunnel.

14. Install the cover over the trim control wheel and secure with screws and special washers.

15. Install the seat belts removed from the top of the floor tunnel and secure with bolt, washer and nut.

16. Install the floor panel and seat belt attachments aft of the main spar, and secure panel with screws.

17. Install the aft floor tunnel and secure with screws.

18. Install the carpet over the aft floor tunnel.

19. Install the trim plate on top of the forward end of the aft floor tunnel.

c. Install the panel to the aft section of the airplane and the seats.

5-19. REMOVAL OF STABILATOR TRIM CONTROLS (AFT). (Refer to Figure 5-8.)

a. Remove the access panel to the aft section of the fuselage.

b. Block the trim cables at the first set of pulleys (35) forward of the cable turnbuckles (10 and 11) in the aft section of the fuselage by a method shown in Figure 5-7.

c. Disconnect the cable (12) at the turnbuckles (10 and 11) in the aft section of the fuselage.

d. Remove the tail cone by removing its attachment screws.

e. Disconnect the link (25) between the trim screw (23) and the trim control arm (28) by removing the nut, washer and bolt (24) that connects the link to the screw.

f. Remove the cotter pin from the top of the screw (23), and turn the screw down and out of the barrel (20).

g. Remove the snap ring (32), washer (31) and thrust washer (30) from the bottom of the barrel.

h. Disconnect the diagonal rib (22) from the horizontal rib (16) that supports the trim assembly by removing the four attachment nuts, washers and bolts.

i. Draw the trim cable (12) from the fuselage.

5-20. INSTALLATION OF STABILATOR TRIM CONTROLS (AFT). (Refer to Figure 5-8.)

a. Wrap the trim barrel (20) by first laying the center (as measured equally from each end to the center of the cable) of the trim cable (12) in the slot of the barrel. Bring the upper cable through the diagonal slot in the flange at the upper end of the barrel and wrap down in a counter-clockwise direction. Bring the lower cable through the diagonal slot in the lower end of the barrel and wrap up in a clockwise direction. Wrap the cable as evenly as possible to obtain 23 wraps on the barrel as viewed from the side opposite the slot and with the cables extending out from the slotted side.

b. Block both cables by clamping them between two pieces of wood laid next to the wraps to prevent them from unwrapping.

c. Ascertain that the barrel bushings (19 and 29) are installed in the rib plate (17) and clip (21).

d. Lubricate the bushings and install the trim barrel (20) in the bushings between the two support ribs. Attach the bottom diagonal rib (22) to horizontal rib (16) and secure with bolt, washers and nuts.

e. Install the thrust washer (30), washer (31) and snap ring (32) on the lower end of the barrel.

f. Install the trim screw (23) in the barrel (20) and secure each end with a cotter pin through the screw.

g. Route the cables into the fuselage and attach the ends to the forward trim cables (8 and 9).

h. Remove the blocks that are holding the forward cables tight and aft cables at the barrel.

i. Set cable tension and check rigging and adjustment per paragraph 5-21. Check safety of all turnbuckles.

j. Install the tail cone and secure with screws.

k. Install the access panel to the aft section of the fuselage.

5-21. RIGGING AND ADJUSTMENT OF STABILATOR TRIM. (Refer to Figure 5-8.)

a. Level the airplane. (Refer to Leveling, Section II.)

b. Check for proper stabilator trim cable tension as given in Table V-I. If cables were disconnected, rotate control wheel several times to allow the cables to seat and recheck tension.

c. Secure the stabilator in neutral position. To find neutral, place a rigging tool on the upper surface of the stabilator as shown in Figure 5-6. Zero a bubble protractor, set it on the rigging tool and tilt the stabilator until the bubble is centered.

d. With the stabilator centered, turn the trim wheel (1) until the aft end of the turnbuckle (10) of the right trim cable (8) is approximately two inches forward of the double pulleys (13) at the top of the rear bulkhead at station 259.0.

e. Check that the trim screw (23) is turned down until the cotter pin stop in the top of the screw is contacting the plate (17) on the horizontal support rib (16) of the trim assembly. If the stop is not contacting the plate, and the links (25) between the screw (23) and the trim control arm (28) are not disconnected, disconnect the two by removing the nut, washers and bolt (24). With the turnbuckle still at the two inch dimension from the pulley, turn the screw down until the pin contacts the plate.

f. Check the rod end (26) on the tab actuating arm (28) for approximately six threads forward of the jam nut (27).

g. Connect the links to the trim screw and secure with bolt, washers and nut.

h. Turn the trim control wheel until the trim tab streamlines with the neutral stabilator.

i. Check the bubble of the protractor over the neutral tab and then check tab travels as given in Table V-I. The degree of travel on the protractor is determined by taking the difference between the protractor reading at neutral and up, and neutral and down. The bubble must be centered at each reading with the airplane level.

j. To obtain correct travels, if incorrect, adjust by disconnecting the links (25) at the actuating arm rod end (26) and turning the end in or out as required. Reconnect links to rod end.

k. Secure the jam nut (27) on the actuating arm rod end.

l. Turn the trim wheel to full travel and check for turnbuckle clearance and location of tab indicator.

5-22. RUDDER AND STEERING PEDAL ASSEMBLY.

5-23. REMOVAL OF RUDDER AND STEERING PEDAL ASSEMBLY. (Refer to Figure 5-9.)

a. Remove the access panel to the aft section of the fuselage.

b. Relieve rudder and stabilator cable tension by loosening one of the rudder and stabilator cable turnbuckles in the aft section of the fuselage.

c. Remove the fuel selector panel cover by removing the rudder trim knob and the cover attachment screws.

d. Remove the lower selector cover and disconnect the fuel selector control lever from the selector torque tube by removing the attachment pin located at the bottom of the lever.

e. Remove the tunnel plate just aft of the tee bar by laying back enough tunnel carpet to remove the plate attachment screws.

f. Disconnect the stabilator control cable from the lower end of the tee bar assembly.

g. Remove the tee bar attachment bolts with their washers and nuts which are through each side of the floor tunnel. Pull the lower end of the tee bar aft.

h. Disconnect the control cable (19) ends from the arms on the torque tube (3) by removing the cotter pins, washers, nuts and bolts (20).

i. Disconnect the rudder trim from the torque tube assembly by removing the cotter pin, washers and bolt that connects the arm to the trim.

j. Disconnect the steering rods (21) at the rudder pedals (32 and 33) by removing nuts and bolts (24).

k. Disconnect the brake cylinders (12) at the lower end of each cylinder rod (11) by removing the cotter pins, washers, nuts and bolts (20).

l. Disconnect the vee brace(s) (29) (two braces are used with right hand brakes) from the torque tube by removing nuts, washers and bolts (27) that secure the strap bracket (28) to the vee brace.

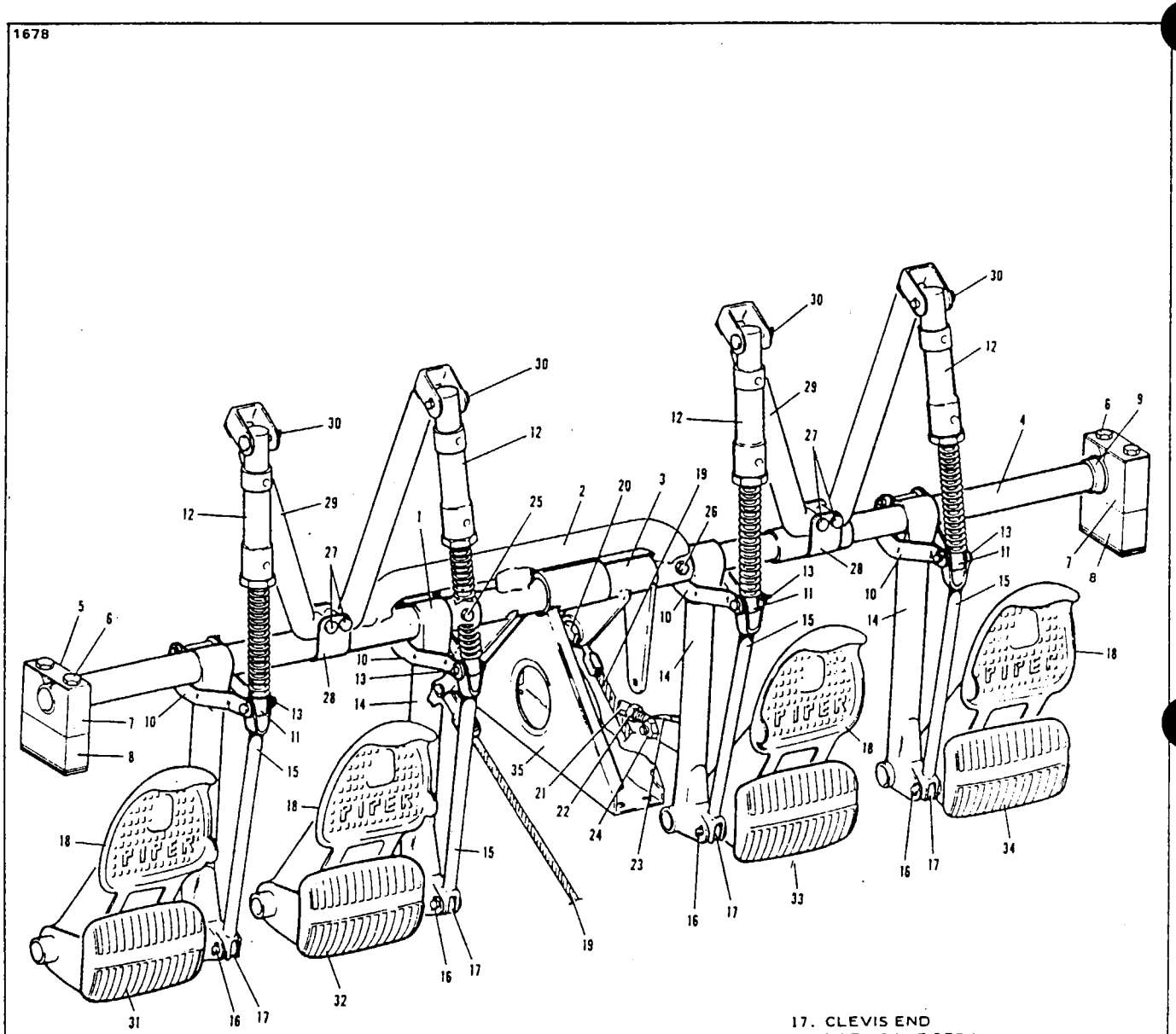
m. If an AutoPilot amplifier is installed over the torque tube at the right side of the fuselage, disconnect the electrical plug and release the two fasteners that secure it to its mounting bracket.

n. Disconnect the torque tube support bracket (35) where it attaches to the floor tunnel by removing its attachment bolts.

o. Remove the two bolts (25 and 26) that extend through the torque tube and are located at the center of the tube assembly over the floor tunnel. Compress the tubes.

p. Disconnect the torque tube support blocks (7 and 8) from their support brackets on each side of the fuselage by removing the attachment nuts, washers and bolts (6).

q. Remove the trim side panels, if desired.



1. TUBE, L. OUTER
2. TUBE, L. CENTER
3. TUBE, R. CENTER
4. TUBE, R. OUTER
5. PLATE
6. BOLT & NUT
7. SUPPORT BLOCK, UPPER
8. SUPPORT BLOCK, LOWER
9. WASHER, SPACER
10. ARM, IDLER
11. ROD, BRAKE CYLINDER
12. BRAKE CYLINDER
13. CLEVIS PIN & COTTER PIN
14. TUBE, RUDDER CONTROL
15. CLEVIS ROD
16. CLEVIS PIN & COTTER PIN
17. CLEVIS END
18. TOE BRAKE PEDAL
19. CONTROL CABLE, RUDDER
20. BOLT, WASHER, NUT & COTTER PIN
21. BUNGEE, NOSE WHEEL STEERING
22. JAM NUT
23. ROD END, BUNGEE
24. BOLT & NUT
25. BOLT, WASHER & NUT
26. BOLT, WASHER & NUT
27. BOLT, WASHER & NUT
28. BRACKET
29. VEE BRACE
30. CLEVIS PIN & COTTER PIN
31. RUDDER PEDAL, L. OUTER
32. RUDDER PEDAL, L. INNER
33. RUDDER PEDAL, R. INNER
34. RUDDER PEDAL, R. OUTER
35. BRACKET, TUBE SUPPORT

Figure 5-9. Rudder and Steering Pedal Assembly (Typical)

r. Remove the assembly from the airplane. Note the spacer washer (9) on each end and between the support blocks.

5-24. INSTALLATION OF RUDDER AND STEERING PEDAL ASSEMBLY. (Refer to Figure 5-9.)

a. Assemble the torque tube assembly (1, 2, 3 and 4) as shown in Figure 5-9. Do not at this time install the two bolts (25 and 26) through the center of the tube assembly.

b. Place the upper support blocks (7) on the ends of the torque tube assembly. Note that a washer (9) is required on each end of the tube.

c. Position the support blocks (7 and 8) on their mounting brackets at each side of the fuselage and secure with bolts, washers and nuts. Note that a bushing is required in the bolt holes of the upper support block, and a plate on top of the upper block, between the upper and lower blocks and under the block mounting bracket.

d. Align the bolt holes in the center area of the torque tube assembly, install bolts, washers and nuts (25 and 26) and tighten.

e. Position the torque tube support bracket (35) on the floor tunnel and secure with bolts.

f. Position the vee brace(s) (29) on the torque tube, install the strap bracket (28) around the torque tube and brace, and secure with bolts, washers and nuts (27).

g. Check that the rod end (18) on the clevis rod (15) is adjusted to give a dimension of 7.94 inches between hole centers.

h. Connect the ends of the brake cylinder rods (11) and clevis rods (15) to the idler arms (10) and secure with clevis and cotter pins (13).

i. Connect the steering rods (21) to the rudder pedals (32 and 33) and secure with bolts and nuts (24). Check steering rod adjustment per Alignment of Nose Gear, Section VI.

j. Connect the rudder trim to the arm of the torque tube and secure with bolt, washer, nut and cotter pin. A thin washer is installed under the nut which is tightened only finger tight.

k. Connect the ends of the rudder control cables (19) to the arms provided on the torque tube and secure with bolts, washers, nuts and cotter pins (20). Allow the ends free to rotate.

l. Swing the tee bar into place and secure with attachment bolts, washers and nuts (15) with the bolts inserted in through each side of the floor tunnel.

m. Connect the stabilator control cables (11) to the lower end of the tee bar with bolt, washer and nut (16), and secure with cotter pin. Allow the cable ends free to rotate.

n. Set rudder cable tension and check rigging and adjustment per paragraph 5-32.

o. Set stabilator cable tension and check rigging and adjustment per paragraph 5-15.

p. Check aileron cable tension.

q. Check safety of bolt and turnbuckles.

r. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.

s. Install the fuel selector lever on the selector torque tube, secure with clevis pin and safety with cotter pin.

t. Install the fuel selector covers and the rudder trim control knob.

u. Install the access to the aft section of the fuselage.

5-25. RUDDER CONTROLS.

5-26. REMOVAL OF RUDDER CONTROL CABLES. (Refer to Figure 5-10.)

a. To remove either the forward (13 and 14) or aft (17 and 18) rudder cables, first remove the access panel to the aft section of the fuselage.

b. Disconnect the desired cable at the turnbuckle (15 or 16) in the aft section of the fuselage.

c. Either forward rudder cable (13 or 14) may be removed by the following procedure:

1. Remove the tunnel cover in the aft area of the cabin by removing the carpet over the tunnel and the cover attachment screws.

2. Remove the cable guard plate (10) from the underside of the pulley cluster (12) that is located in the aft area of the floor tunnel, by removing the guard attachment screws.

3. Remove the floor panel located directly aft of the main spar by removing the center seats, seat belt attachments and the screws securing the floor panel. Lift the panel and remove from airplane.

4. From within the area of the floor opening, remove the cable rub blocks (6) that are attached to the spar housing by removing the block attachment screws. Also remove the cable guard pin (9) at the pulley (8) cluster in the aft area of the opening by removing a cotter pin from one end of the guard.

5. Remove the fuel selector panel cover by removing the rudder trim knob and the cover attachment screws.

6. Remove the lower selector cover, and the fuel selector control lever by removing the attachment pin, at the bottom of the lever, that holds the lever on the selector torque tube.

7. Remove the tunnel plate just aft of the tee bar by removing enough carpet from the tunnel to allow the plate attachment screws and the plate to be removed.

8. Remove the forward heat duct from one side of the floor tunnel. (Preferably from the side from which the control cable is to be removed.)

9. Move the cable guard (4) located under the pulley cluster (5) and below the fuel selector by removing the cotter pin from the exposed end and sliding it to the left or right as required.

10. Disconnect the end of the cable from the arm on the rudder pedal torque tube by removing the cotter pin, nut, washer and bolt (2).

11. Draw the cable from the floor tunnel.

d. The aft rudder control cables (17 and 18) may be removed by the following procedure:

1. Remove the tail cone by removing its attachment screws.

2. Disconnect the cable from the rudder horn (20) by removing cotter pin, nut, washer and bolt (19).

3. Draw the cable through the fuselage.

5-27. INSTALLATION OF RUDDER CONTROL CABLES. (Refer to Figure 5-10.)

a. The forward rudder control cables (13 and 14) may be installed by the following procedure:

1. Draw the control cable through the floor tunnel.

2. Connect the end of the cable to the arm on the rudder pedal torque tube (1) by installing bolt, washer, nut and cotter pin (2). Allow the cable end free to rotate.

3. Connect the cable (13 or 14) to the aft control cable (17 or 18) at the turnbuckle (15 or 16) in the aft section of the fuselage. If the aft control cables are not installed, install at this time per step b. Ascertain that each cable is in the groove of its pulley.

4. Move the cable guard (4) that is located in the forward tunnel, under the pulley cluster (5) and below the fuel selector into position, and secure with cotter pin.

5. Within the area of the floor opening aft of the main spar, install the cable guard blocks (6) onto the spar housing and secure with screws, and the cable guard pin (9) at the pulley cluster (8) in the aft area of the opening by sliding it into position and fastening it with a cotter pin.

6. Install the cable guard plate (10) under the pulley cluster (12) located in the aft area of the aft floor tunnel and secure with screws.

7. Set cable tension and check rigging and adjustment per paragraph 5-28.

8. Install the heat duct and secure with screws.

9. Install the forward tunnel plate aft of the tee bar and secure with screws.

10. Put the floor carpet in place and secure.

11. Place the fuel selector lever on the selector torque tube and secure with pin and cotter pin.

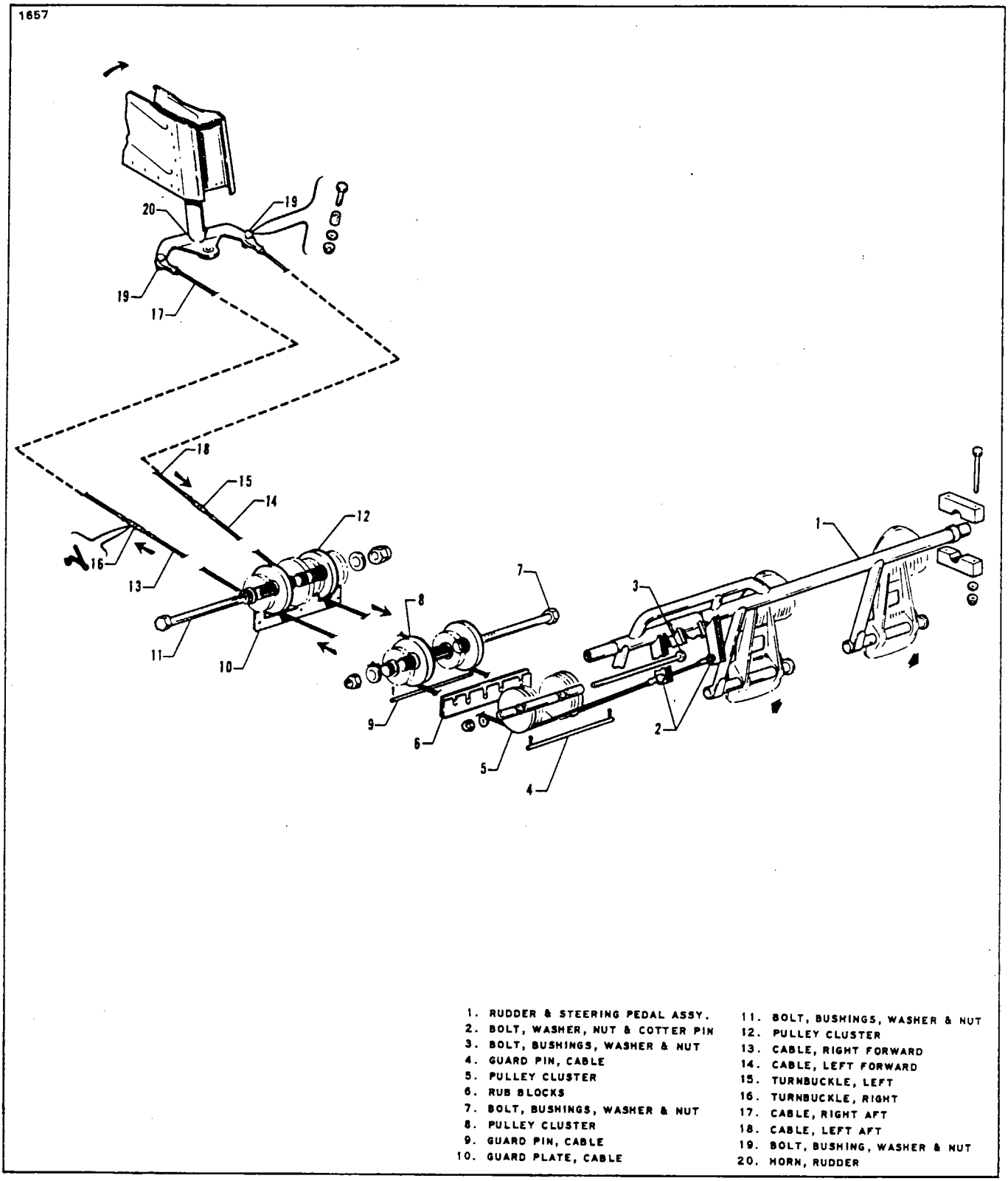


Figure 5-10. Rudder Controls

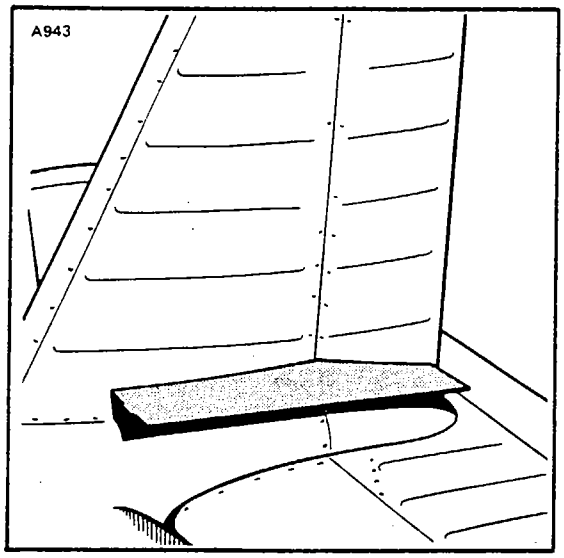


Figure 5-11. Rudder Rigging Tool

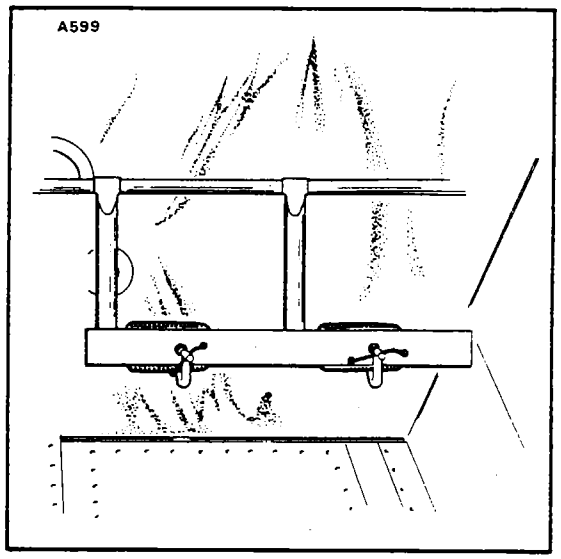


Figure 5-12. Clamping Rudder Pedals

12. Install the lower and upper selector covers and secure with screws.

13. Install the floor panel and seat belt attachment aft of the main spar securing the panel with screws, and install the seats.

14. Install the cover and carpet of the aft floor tunnel.

b. The aft rudder control cables (17 and 18) may be installed by the following procedure:

1. Position the control cable in the fuselage.

2. Connect the end of the cable to the rudder horn (20) with bolt, washer, nut and cotter pin (19). Allow the cable end free to rotate.

3. Connect the other cable end to forward control cable (13 or 14) at the turnbuckle (15 or 16) in the aft section of the fuselage.

4. Set cable tension and check rigging and adjustment per paragraph 5-28.

5. Install tail cone and secure with screws.

c. Install the access panel to the aft section of the fuselage.

5-28. RIGGING AND ADJUSTMENT OF RUDDER CONTROLS.

a. To check and set the correct degree of rudder travel, the following procedure may be used:

1. Check the rudder travel by swinging the rudder until it contacts its stop. If the control cables are connected, use the rudder pedals to swing the rudder.

2. With the rudder against its stop, place a rigging tool against the side of the rudder and vertical stabilizer as shown in Figure 5-11. (Ascertain that the tool is not contacting any rivets.) If no gap exists between the rigging tool and the surface of the rudder and vertical stabilizer, the rudder stop for one di-

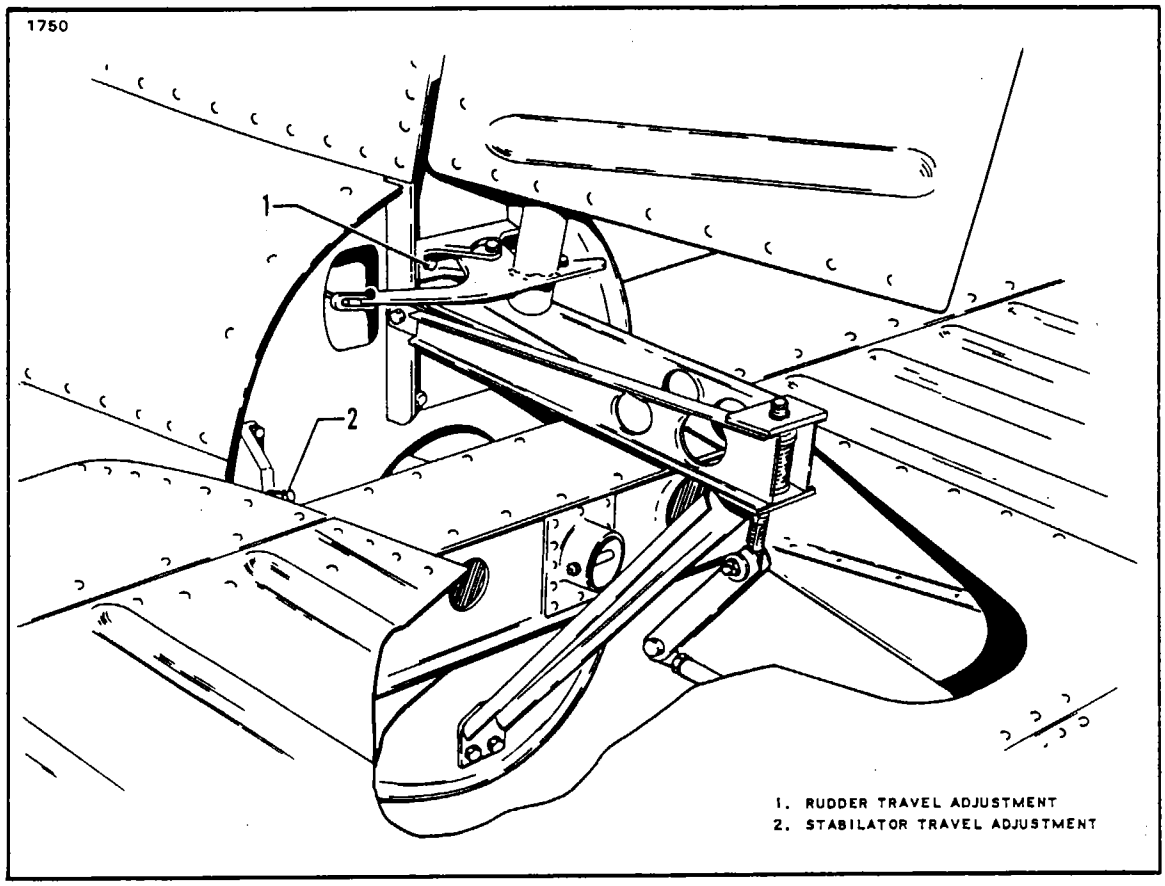


Figure 5-13. Rudder and Stabilator Travel Adjustments

rection of travel is correct as required in Table V-I. (This tool may be fabricated from dimensions given in Figure 5-21.)

3. Swing the rudder in the other direction and check travel as directed in step 2.

4. Should the rudder travel be incorrect showing a gap between the tool and any part of the control surfaces, the tail cone should be removed and the stops reset to obtain correct rudder travel. (Refer to Figure 5-13.)

b. To set cable tension and alignment of the rudder, the following procedure may be used:

1. Remove the access panel to the aft section of the fuselage.

2. Ascertain that the nose gear steering has been aligned and rudder pedals set fore and aft according to Alignment of Nose Landing Gear, Section VI.

3. Clamp the rudder pedals to align in a lateral position as shown in Figure 5-12.

4. Adjust the turnbuckles in the aft section of the fuselage to obtain proper cable tension as given in Table V-I and to allow the rudder to align at neutral

position. Neutral position can be determined by standing behind the airplane and sighting the rudder with the vertical stabilizer or the center of the trim screw.

5. Check safety of turnbuckles.

c. Check that when the rudder contacts its stops, the clearance between the nose wheel stops and the nose wheel horn is between .06 and .12 of an inch. A more accurate check can be made with weight off of the nose wheel. Adjust the stops according to Alignment of Nose Landing Gear, Section VI.

d. Install the tail cone and the access panel to the aft section of the fuselage.

5-29. RUDDER TRIM CONTROLS. (Refer to Figure 5-14.)

5-30. REMOVAL OF RUDDER TRIM CONTROLS.

a. Remove the cover (1) from over the trim control assembly by removing attachment screws.

b. Remove the fuel selector panel cover by removing the rudder trim (2) and the cover attachment screws.

c. Rotate the trim knob (2) to the extreme left (counterclockwise) trim position.

d. Disconnect the housing lug from the arm on the rudder pedal torque tube by removing cotter pin, nut, washer and bolt (7).

e. Remove the threaded bushing (4) from the aft end of the mounting channel (8) by removing cotter pin and clevis pin (5). Some mounting channels have two holes in the aft end, note from which hole the clevis pin was removed.

f. The mounting channel (8) may be removed by removing the channel attachment screws at the inside of the channel. The middle and aft screws (9) need only be turned out while the forward screw (10) is secured by a nut on the side of the floor tunnel. To remove the forward screw, lift the floor carpet on the right side of the tunnel adjacent to the channel and remove the access plate on the side of the tunnel. Secure the nut and turn out the screw.

5-31. INSTALLATION OF RUDDER TRIM CONTROLS. (Refer to Figure 5-14.)

a. Install the trim control mounting channel (8) on the upper side of the floor tunnel. A spacer plate (14) is installed between the channel and the tunnel. Install the middle and aft attachment screws (9). These screws are secured with anchor nuts. The forward screw (10) though is secured with a nut that must be held from within the channel.

b. Install the access plate on the side of the tunnel and secure carpet in place.

c. Before attaching the assembly to the mounting channel, ascertain that the clips (11) are installed so the safety wire (2) will be on top. Also that the threaded

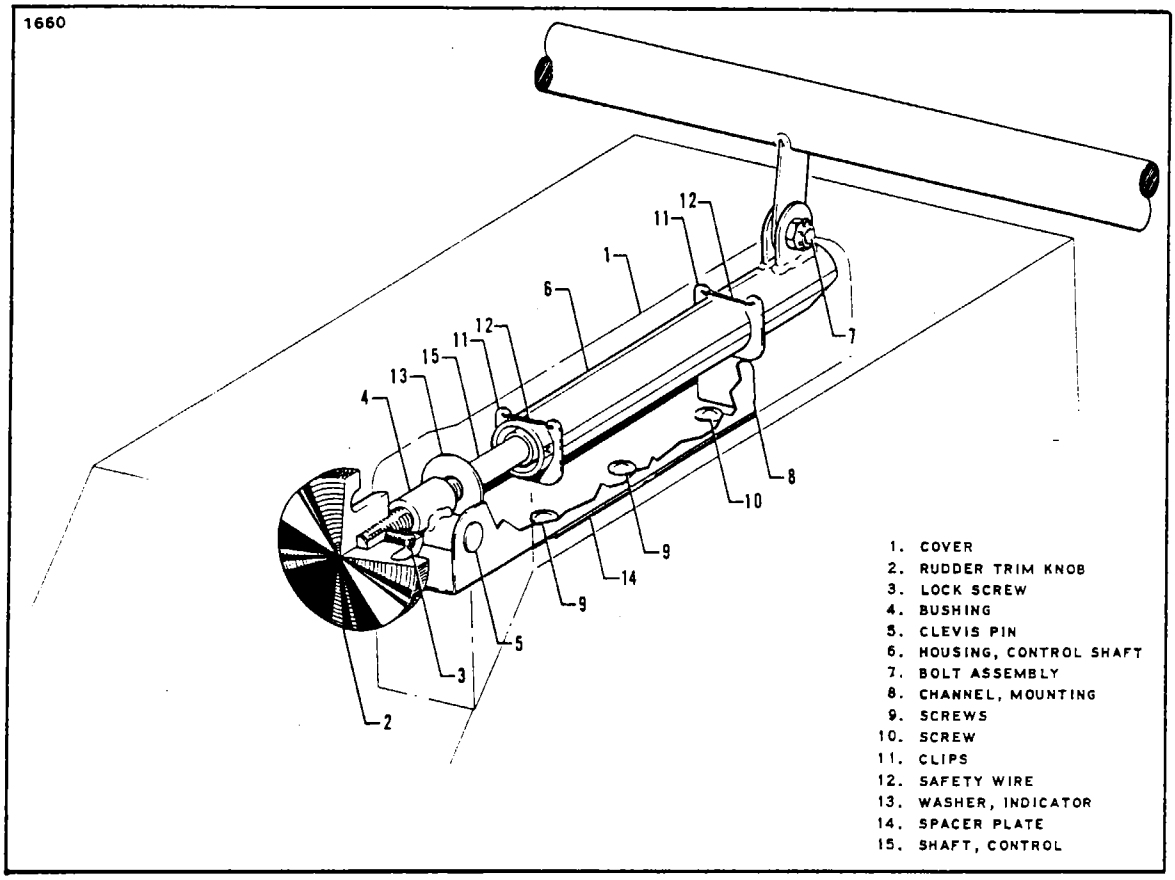


Figure 5-14. Rudder Trim Control

bushing (4) is installed on the assembly shaft (15) with the welded attachment bushing forward or toward the housing.

d. Attach the housing lug to the arm provided on the rudder pedal torque tube and secure with bolt, washer and nut (7). Tighten the nut only finger tight and safety with cotter pin.

e. Clamp the rudder pedals in neutral and position the threaded bushing (4) in the mounting channel (8). Turn the control shaft (15) until the holes in the bushing and channel align and then install the clevis pin and cotter pin (5). Should two thru holes be located in the aft end of the mounting channel, the pin must be installed through the hole that will give equal travel and hit rudder stops before bottoming out of the trim assembly.

f. With the rudder pedals neutral and no pressure fore or aft on the clevis pin, install the assembly cover (1) so that the indicator washer (13) and the neutral mark on the cover align.

g. Install the fuel selector cover, secure with screws, and the trim control knob.

5-32. RIGGING AND ADJUSTMENT OF RUDDER TRIM CONTROLS. No adjustments are necessary other than those required during installation of the assembly in the airplane as given in paragraph 5-31.

5-33. WING FLAP CONTROLS.

5-34. REMOVAL OF WING FLAP CONTROLS. (Refer to Figure 5-15.)

a. The flap torque tube assembly may be removed by the following procedure:

1. Remove the access plate located between the underside of the aft section of each wing and the fuselage by removing attaching screws.

2. Remove the floor panel located aft of the main spar by removing the center seats, seat belt attachments and the screws securing the panel. Lift the panel and remove from airplane.

3. Disconnect the left and right flap control tubes (rods)(4) at the flaps by removing the nuts, washers and bolts (2) or at the torque tube cranks (arms)(11) by removing the bolts and washers (12) from the inner side of each crank. It will be necessary to remove bolt (12) through a hole in the side skin of the fuselage located over the torque tube with the flap handle moved to its 40 degree position.

4. With the flap handle (29), fully extend the flaps and disconnect the flap tension spring (22) at the spar or the aft end of the control cable (23) as desired.

5. Grasp the flap handle, release the plunger (35) and allow the flap to return to the retracted position. Use caution as forward pressure will be on the handle with the tension spring (22) disconnected.

6. Disconnect the flap return spring (34) at the spar or return chain (32) as desired.

7. Disconnect the control cable from the chain (20) by removing cotter pin, nut, and clevis bolt (21).

8. Remove the tube support blocks (16 and 33) by removing the block attachment bolts (15).

9. Remove the nuts, washers and bolts (10) securing the right and left cranks (11) and stop fittings (13) on the torque tube.

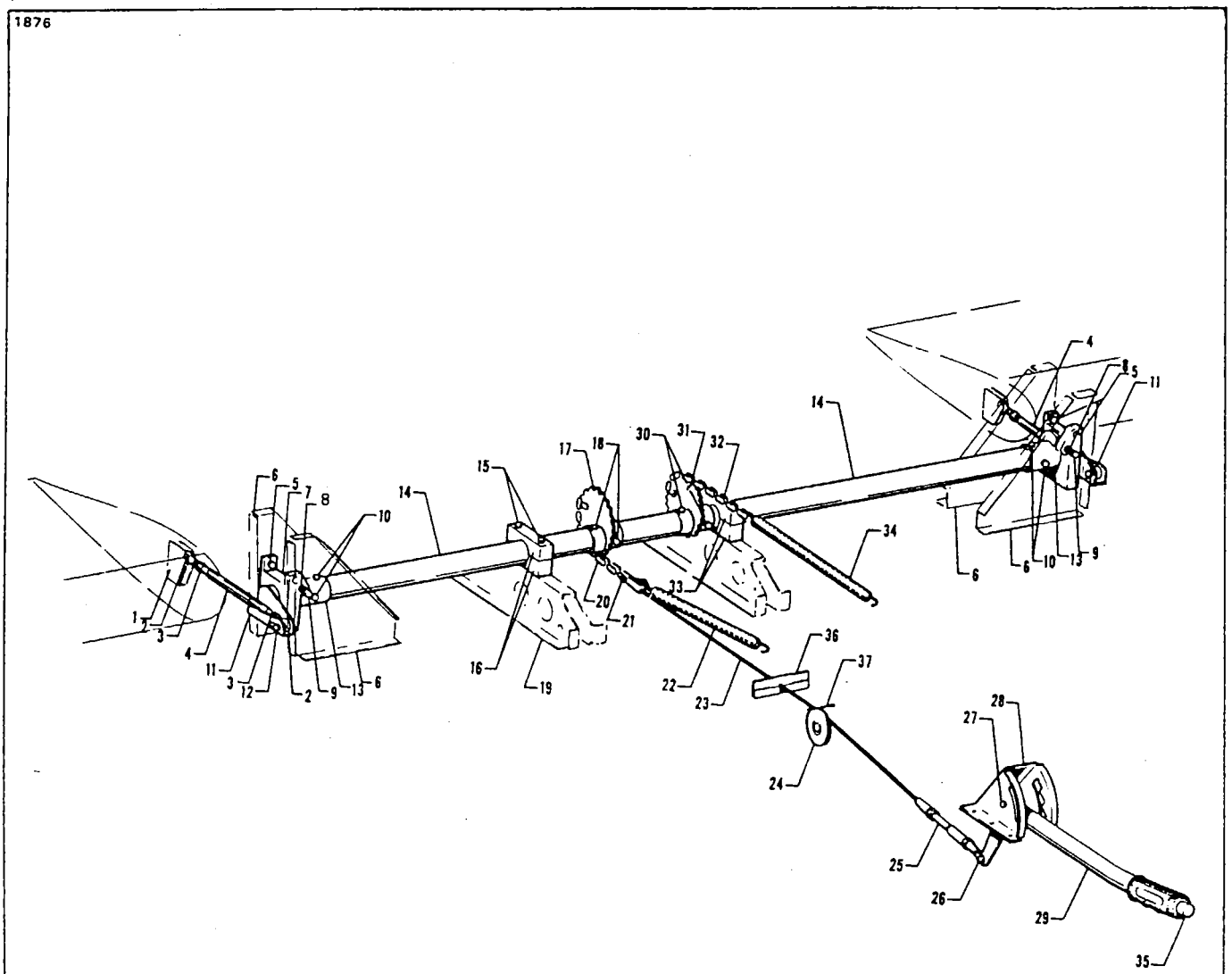
10. From between each wing and the fuselage, remove the cranks (11) from the torque tube.

11. Disconnect one bearing block (7) from its mounting brackets (6) by removing nuts, washers and bolts (5).

12. Slide the tube from the bearing block still attached to its brackets, raise the end and lift it from the floor opening.

b. The flap control cable (23) may be removed by the following procedure:

1. If the center seats and floor panel have not been removed, remove the seats and the screws securing the floor panel.



1. BRACKET, ROD ATTACHMENT
2. BOLT, WASHER & NUT
3. JAM NUT
4. ROD, FLAP CONTROL
5. BOLT, BEARING BLOCK ATTACHMENT
6. BRACKET, BEARING BLOCK
7. BLOCK, BEARING
8. NUT, LOCK
9. SCREW, FLAP ADJUSTMENT
10. BOLT, WASHER & NUT
11. CRANK (ARM), TORQUE TUBE
12. BOLT, WASHER & BUSHING
13. FITTING, TORQUE TUBE STOP
14. TUBE, TORQUE
15. BOLT, WASHER & NUT
16. BLOCK, BEARING
17. SPROCKET, TENSION SPRING
18. BOLT, WASHER & NUT
19. BRACKET, BEARING BLOCK
20. CHAIN, TENSION SPRING
21. CLEVIS BOLT, BUSHING NUT & COTTER PIN
22. SPRING, TENSION
23. CABLE, FLAP CONTROL
24. PULLEY
25. TURNBUCKLE
26. CLEVIS BOLT, NUT & COTTER PIN
27. BOLT, BUSHING, WASHER & NUT
28. BRACKET, FLAP HANDLE
29. HANDLE, FLAP
30. BOLT, WASHER & NUT
31. SPROCKET, RETURN SPRING
32. CHAIN, RETURN SPRING
33. BLOCK, BEARING
34. SPRING, RETURN
35. BUTTON, FLAP RELEASE
36. RUB BLOCK
37. SAFETY COTTER PIN

Figure 5-15. Flap Controls

2. Disconnect the flap tension spring (22) from the cable (23) if not previously disconnected, by extending the flaps to relieve spring tension.

3. Retract the flap. Use caution as forward pressure will be on the handle with the spring disconnected.

4. Disconnect the cable from the chain (20) by removing cotter pin, nut, clevis pin and bushing (21).

5. Remove the flap handle bracket and trim control wheel cover.

6. Remove the aft heat deflectors on each forward floor tunnel by sliding far enough to release the spring fasteners.

7. Lift the aft section of the tunnel carpet far enough to remove the screws securing the tunnel cover that is between the flap handle and the spar cover. Remove the cover.

8. Remove the cotter pin cable guard from the flap cable pulley (24) located inside the floor tunnel just ahead of the spar housing.

9. Remove the cable rub blocks (36) located in the floor opening on the aft side of the spar housing by removing the attachment screws.

10. Disconnect the cable turnbuckle (25) at the flap handle by removing cotter pin, nut and bolt (26). Check bolt (26) per information in Section III of this manual.

c. Remove the flap handle (29) and bracket (28) by disconnecting the cable turnbuckle from the handle and removing the bolts securing the bracket to the floor tunnel.

5-35. INSTALLATION OF WING FLAP CONTROLS. (Refer to Figure 5-15.)

a. The flap torque tube assembly may be installed by the following procedure:

1. Install the chain sprockets (17 and 31) with chains (20 and 32) on the torque tube (14) and secure with bolts, washers and nuts (18 and 30).

2. Slide the tube stop fittings (13) on their respective ends of the torque tube.

3. Ascertain that one bearing block fitting (7) is installed between its attachment brackets (6).

4. Slide the other bearing block over its respective end of the torque tube.

5. Position the torque tube by placing the end with the bearing block on it between the mounting bracket and sliding the other end into the previously attached bearing block.

6. Position the remaining bearing block and secure with bolts, washers and nuts (5).

7. Push the torque tube cranks (arms) (11) on each end of the torque tube and slide the stop fitting (13) in place. Align the bolt hole of the crank and stop fitting with the holes in the torque tube, and install bolts. The holes in the stop fitting are elongated to allow the stop fitting to be pushed against the bearing blocks (7) thus allowing no side play of the assembly. Tighten the bolt assemblies (10) on the stop fittings.

8. Install the tube support blocks (16 and 33) on their support brackets (19) and secure with bolts (15).

9. Connect the flap return spring (34) to the return chain (32) and/or at the spar housing.

10. Connect the control cable end to the tension chain (20) and secure with bushing, clevis bolt, nut and cotter pin.

11. Pull the flap handle full back and connect the tension spring (22). Release the flap handle to the forward position.

12. Connect the flap control tube (4) to the flap and/or torque tube crank (11) and secure. The bolt (12) and bushing that connects the control tube to the crank is installed through a hole in the side of the fuselage located over the torque tube.

b. To install the flap handle (29) with bracket (28), place the assembly on the floor tunnel and secure with bolts.

c. The flap control cable (23) may be installed by the following procedure:

1. Attach the cable (23) and turnbuckle (25) to the flap handle arm and secure with a new clevis bolt, nut and cotter pin (26). Ascertain that the turnbuckle end is free to rotate on the arm.

2. Route the cable through the tunnel and spar housing.

3. Install the cable rub blocks (36) on the aft side of the spar housing and secure with screws.

4. Install cotter pin cable guard over pulley (24) located just ahead of the spar housing in the forward floor tunnel.

5. Attach the cable end to the tension chain (20) and secure with bushing, clevis bolt, nut and cotter pin. If the chain is not installed because of the torque tube assembly being removed, install the assembly as given in step c.

6. Pull the flap handle (29) full back and connect the tension spring (22) to the cable end.

e. Install the tunnel cover and secure with screws. Also the tunnel carpet, heat deflectors, and bracket cover.

f. Install the floor panel and seat belt attachments. Secure with screws and install seats.

5-36. RIGGING AND ADJUSTMENT OF WING FLAPS.

a. Place the flap handle in the full forward position.

b. If not previously removed, remove the floor panel just aft of the main spar.

c. To adjust the flap up stop and step lock, loosen the jam nut of the right torque tube stop screw, located in the floor opening along the outer end of the flap torque tube, and turn the stop screw to obtain approximately .60 of an inch between the stop fitting and the bearing block as measured along the top side of the screw. (Refer to Figure 5-16.) It may be necessary to loosen the adjustment screw of the left stop.

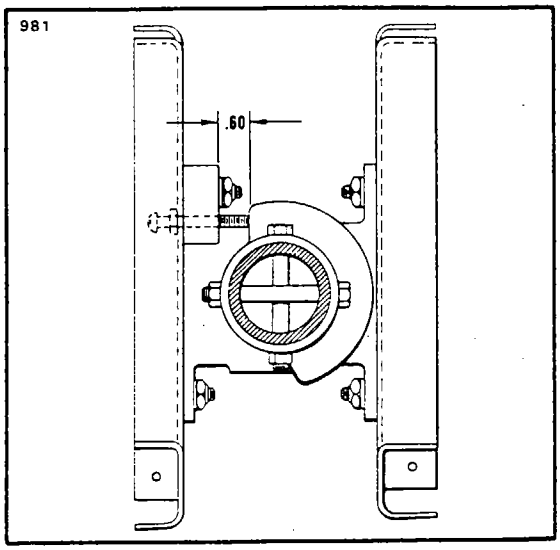


Figure 5-16. Flap Step Adjustment

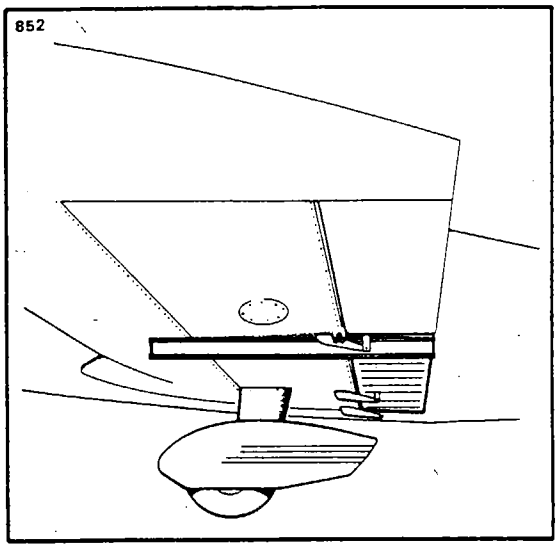


Figure 5-17. Flap Rigging Tool

d. Place a .125 spacer between the stop fitting and the end of the screw. Determine that when pressure is applied down on the flap, it will remain in the up-lock position. If it extends, turn the adjustment screw out a few threads at a time until the flap remains in the up-lock position with the spacer inserted. Tighten the jam nut.

e. Rotate the left stop adjustment screw until it contacts the stop fitting. Tighten the jam nut.

f. Set the flap control cable tension (handle next to floor, 0 degrees) as given in Table V-I at the turnbuckle that is attached to the lower end of the flap handle in the floor tunnel. To do this and if not previously removed, remove the flap handle cover and enough tunnel carpet to remove the tunnel cover just aft of the handle. Adjust and resafety the turnbuckle.

NOTE

Do not rotate the torque tube while retensioning the cable or tighten tight enough to allow tube to be pulled away from its stops.

g. To check up-neutral position of the flaps, place a flap rigging tool as shown in Figure 5-17 against the underside of the wing and flap as close as possible to the outboard end of the flap without contacting any rivets. The tool must be positioned parallel with the wing ribs with the aft end of the tool even with the trailing edge of the flap. (This tool may be fabricated from dimensions given in Fig-

ure 5-19.)

h. With the flap control rod connected between the torque tube crank arm and the flap, check that the surface of the wing contacts the tool at its forward surface and at the spacer, and the aft end of the flap contacts the aft end of the tool. The flap is neutral at this position.

i. Should the three points not contact, loosen the jam nuts on each end of the control rod and rotate the rod until the three points contact. Apply a slight up pressure against the trailing edge of the flap while making this adjustment. After adjustment, retighten the jam nuts.

j. Check and adjust the other flap in a like manner.

NOTE

In the event of wing heaviness during flight, the flap on the side of the heavy wing can be adjusted down from neutral to remedy this condition by lengthening the control rod. Check the inspection hole in each rod end to ascertain that there are sufficient threads remaining and a wire cannot be inserted through these holes. Do not raise the flap of the other wing above neutral.

k. Check the flap for full down travel to the degrees required in Table V-I. Should the travel not be as that required, readjust the torque tube stop screw in or out as required. After readjusting the screw, it will be necessary to review steps d thru j.

l. Check operation of the flap and flap handle ratchet mechanism.

m. Install access plates and panels.

NOTE

Check aft flap attachment per Section IV, paragraph 4-28. Figure 4-13.

MATERIAL:
.125 X 3.531 X 1.0 ALUM. PLATE

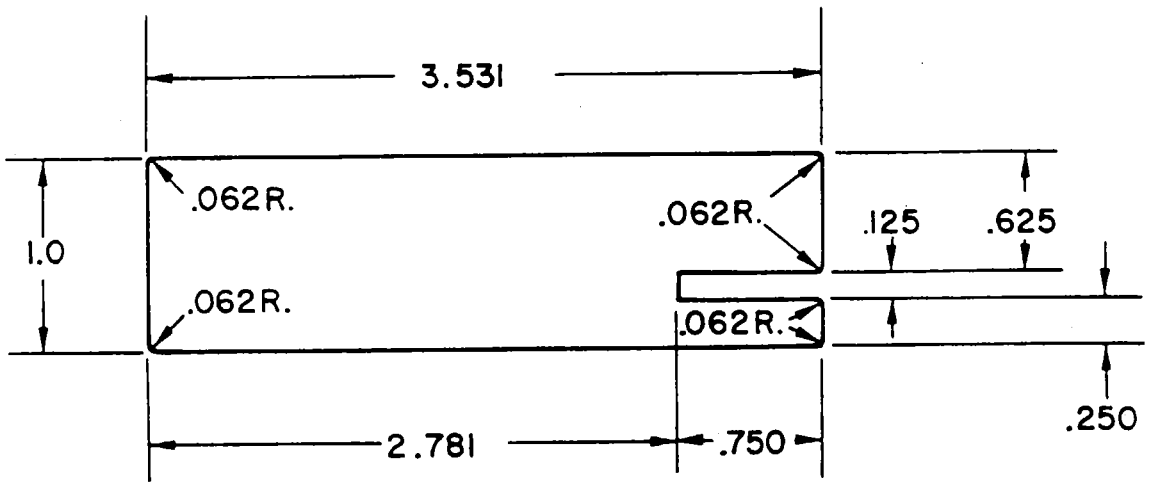
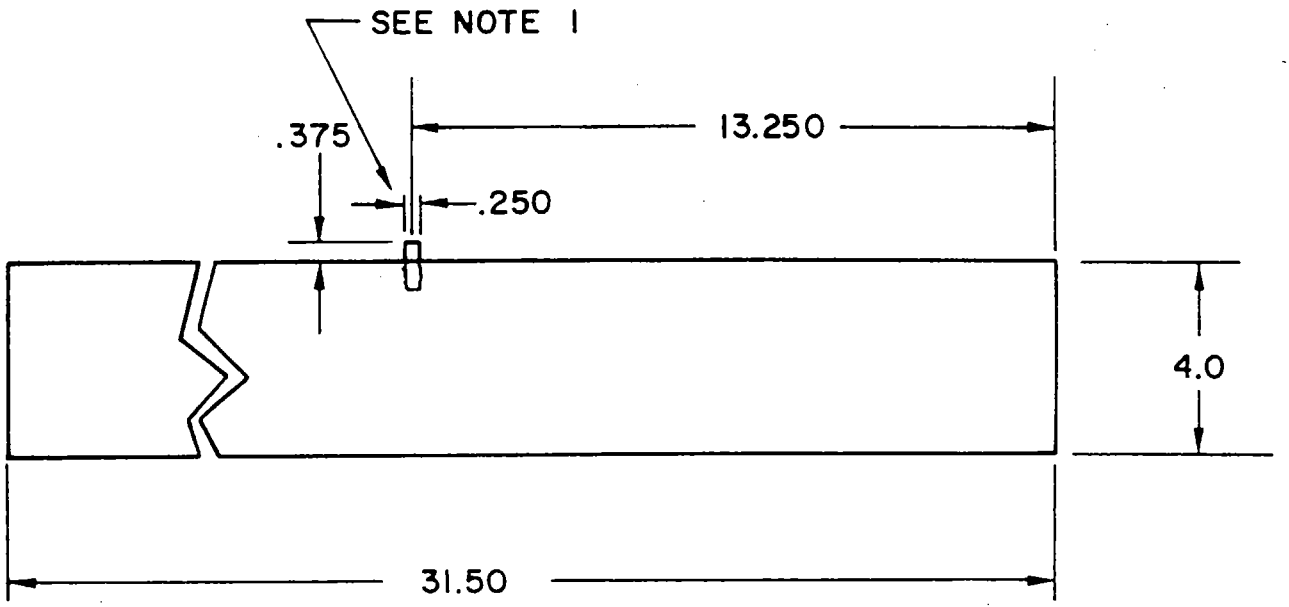


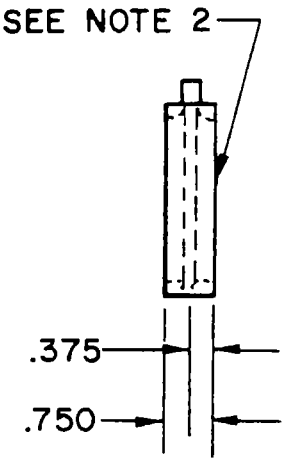
Figure 5-18. Fabricated Aileron Bellcrank Rigging Tool

A115

NOTE:

1. DRILL AND TAP TO 1/4-28NF. BOLT AND FILE TO REQUIRED LENGTH.
2. SPAR STOCK MAY BE USED IN PLACE OF ALUM. BAR STOCK.





MATERIAL:
.750 X 31.50 X 4.00 ALUM. BAR

Figure 5-19. Fabricated Aileron and Flap Rigging Tool

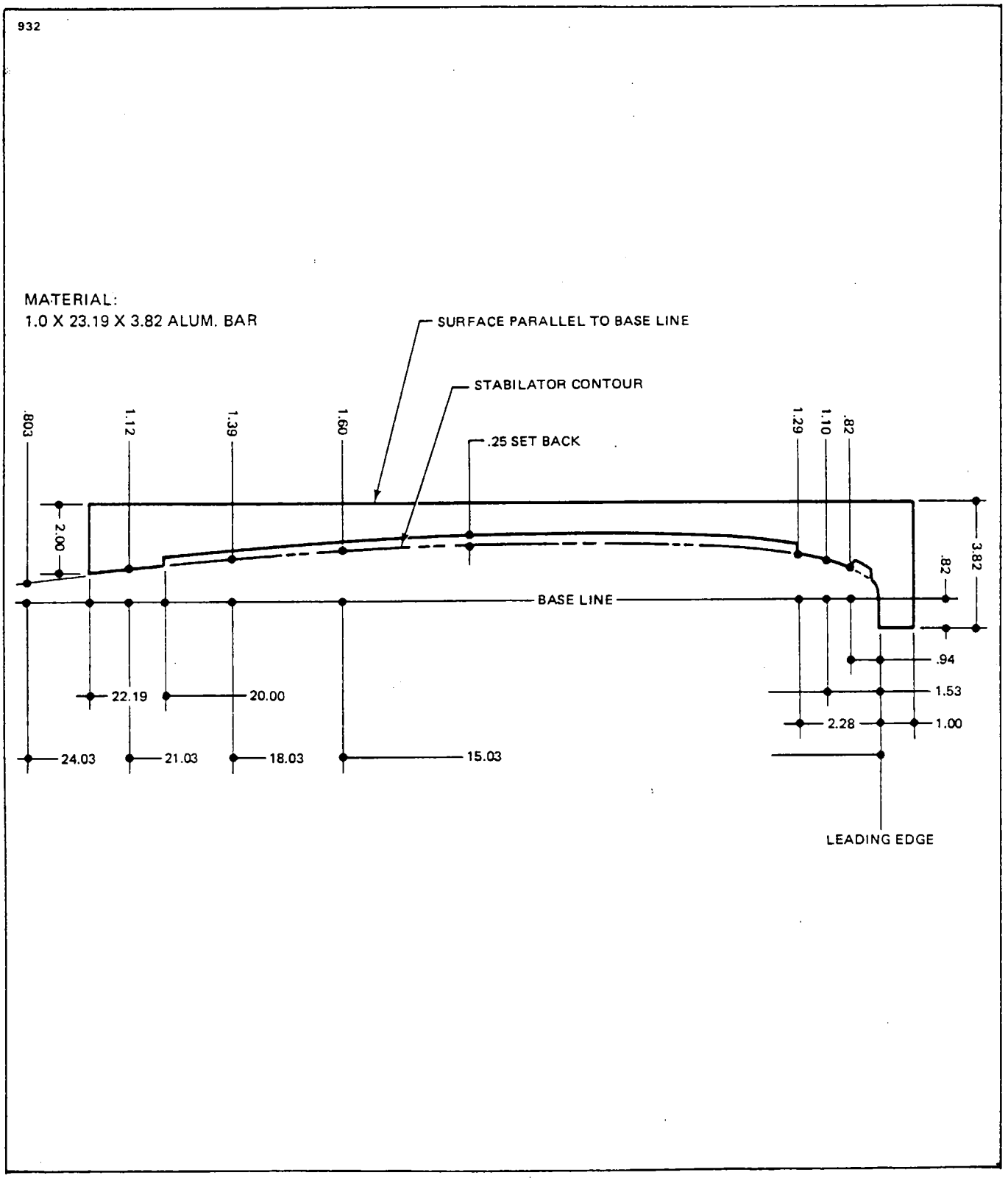


Figure 5-20. Fabricated Stabilator Rigging Tool

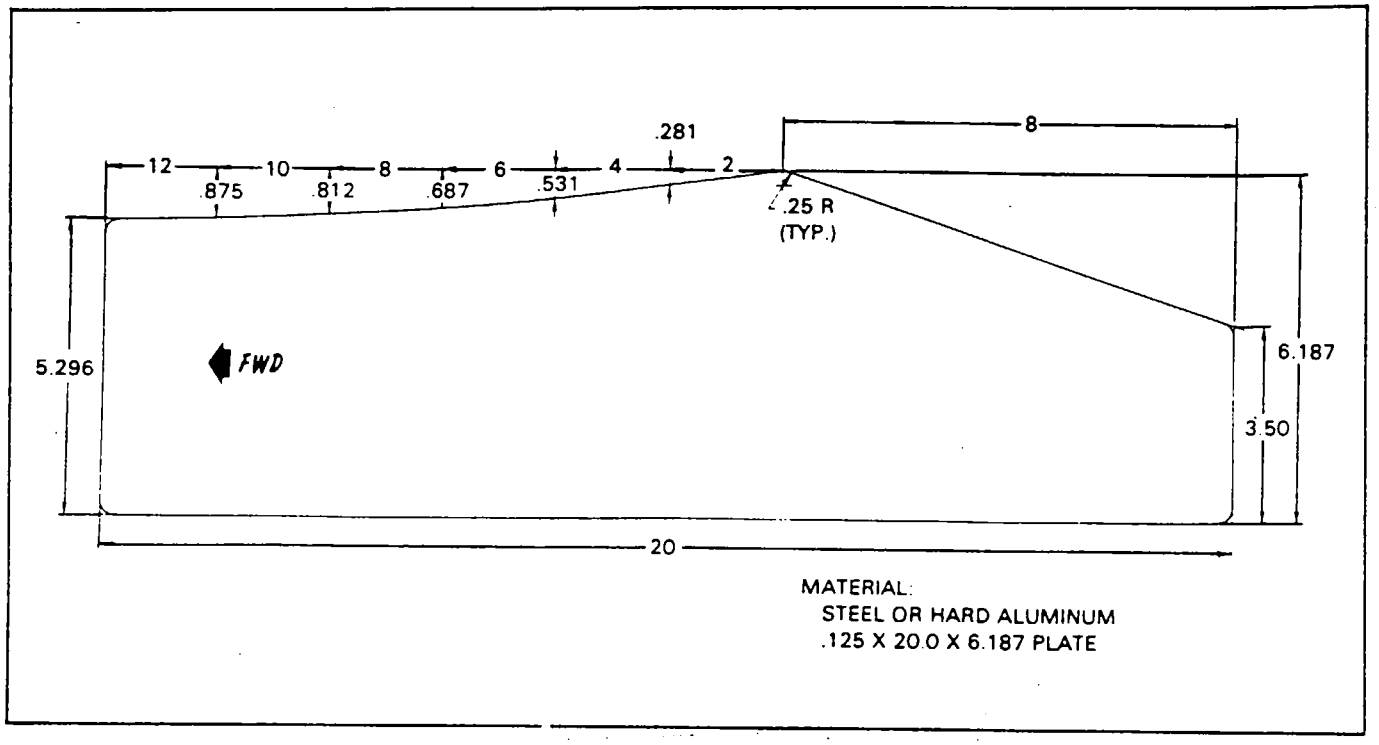


Figure 5-21. Fabricated Rudder Rigging Tool

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS)

Trouble	Cause	Remedy
	AILERON CONTROL SYSTEM	
Lost motion between control wheel and aileron.	Cable tension too low.	Adjust cable tension. (Refer to paragraph 5-11.)
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
Resistance to control wheel rotation.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension. (Refer to paragraph 5-11.)
	Control column horizontal chain improperly adjusted.	Adjust chain tension. (Refer to paragraph 5-5 or 5-5B.)
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Bent aileron and/or hinge.	Repair or replace aileron and/or hinge.
	Cables crossed or routed incorrectly.	Check routing of control cables.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
AILERON CONTROL SYSTEM (cont.)		
Control wheels not synchronized.	Incorrect control column rigging.	Rig in accordance with paragraph 5-5 or 5-5B.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rig in accordance with paragraph 5-11.
Incorrect aileron travel.	Aileron control rods not adjusted properly. Aileron bellcrank stops not adjusted properly.	Adjust in accordance with paragraph 5-11. Adjust in accordance with paragraph 5-11.
Correct aileron travel cannot be obtained by adjusting bellcrank stops.	Incorrect rigging of aileron cables, control wheel and control rod.	Rig in accordance with paragraph 5-11.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rig in accordance with paragraph 5-11.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
	STABILATOR CONTROL SYSTEM	
Lost motion between control wheel and stabilator.	Cable tension too low.	Adjust cable tension per paragraph 5-15.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly.
Resistance to stabilator control movement.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension per paragraph 5-15.
	Binding control column.	Adjust and lubricate per paragraph 5-5 or 5-5B.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Bent stabilator hinge.	Repair or replace stabilator hinge.
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws per paragraph 5-15.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
STABILATOR CONTROL SYSTEM (cont.)		
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Rig cables in accordance with paragraph 5-15.
STABILATOR TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust in accordance with paragraph 5-21.
	Cables not in place on pulleys.	Install cables according to paragraphs 5-18 and 5-20.
	Broken pulley.	Replace pulley.
	Linkage loose or worn.	Check linkage and tighten or replace.
Trim control wheel moves with excessive resistance.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust in accordance with paragraph 5-21.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Refer to paragraphs 5-18 and 5-20.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.
	Cables crossed or routed incorrectly.	Check routing of control cables.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
	STABILATOR TRIM CONTROL SYSTEM (cont.)	
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging per paragraph 5-21.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging per paragraph 5-21.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Adjust in accordance with paragraph 5-21.
	RUDDER CONTROL SYSTEM	
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension per paragraph 5-28.
	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 paragraph 5-28.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
	RUDDER CONTROL SYSTEM (cont.)	
Excessive resistance to rudder pedal movement. (cont.)	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged.	Rig in accordance with paragraph 5-28.
Incorrect rudder travel.	Rudder bellcrank stop incorrectly adjusted.	Rig in accordance with paragraph 5-28.
	Nose wheel contacts stops before rudder.	Rig in accordance with paragraph 5-28.
	RUDDER TRIM CONTROL SYSTEM	
Trim control knob moves with excessive resistance.	System not lubricated properly.	Lubricate system.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
	FLAP CONTROL SYSTEM	
Flaps fail to extend or retract.	Control cable broken or disconnected.	Replace or reconnect control cable. (Refer to paragraph 5-35.)
Flaps not synchronized or fail to move evenly when retracted.	Incorrect rigging of system.	Adjust flaps per instructions in paragraph 5-36.

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SECTION VA

HYDRAULIC SYSTEM (PA-32R-300)

		Aerofiche Grid No.
5A-1.	Introduction	1I23
5A-2.	Description	1I23
5A-3.	Troubleshooting	1J3
5A-4.	Hydraulic Pump	1J3
5A-5.	Removal of Hydraulic Pump	1J3
5A-6.	Disassembly of Hydraulic Pump	1J4
5A-7.	Cleaning, Inspection and Repair of Hydraulic Pump	1J4
5A-8.	Assembly of Hydraulic Pump	1J5
5A-9.	Test and Adjustment of Hydraulic Pump	1J6
5A-10.	Installation of Hydraulic Pump	1J11
5A-11.	Gear Back-Up Extender Actuator Assembly	1J11
5A-12.	Removal of Gear Back-Up Extender Actuator Assembly	1J11
5A-13.	Installation of Gear Back-Up Extender Actuator Assembly	1J12
5A-14.	Check and Adjustment of Gear Back-Up Extender Actuator	1J14
5A-14a.	Operational Check of Retractable Landing Gear System	1J16
5A-15.	Nose Gear Actuating Cylinder	1J17
5A-16.	Removal of Nose Gear Actuating Cylinder	1J17
5A-17.	Disassembly of Nose Gear Actuating Cylinder	1J18
5A-18.	Cleaning, Inspection and Repair of Nose Gear Actuating Cylinder	1J18
5A-19.	Assembly of Nose Gear Actuating Cylinder	1J18
5A-20.	Installation of Nose Gear Actuating Cylinder	1J21
5A-21.	Main Gear Actuating Cylinder	1J21
5A-22.	Removal of Main Gear Actuating Cylinder	1J21
5A-23.	Disassembly of Main Gear Actuating Cylinder	1J21
5A-24.	Cleaning, Inspection and Repair of Main Gear Actuating Cylinder	1J22
5A-25.	Assembly of Main Gear Actuating Cylinder	1J22
5A-26.	Installation of Main Gear Actuating Cylinder	1J22
5A-27.	Hydraulic Lines	1J22
5A-28.	Removal and Installation of Hydraulic Lines	1J22
5A-29.	Testing Hydraulic System	1J23
5A-30.	Servicing Hydraulic Pump/Reservoir	1J23

SECTION VA

HYDRAULIC SYSTEM
PA-32R-300

5A-1. INTRODUCTION. The PA-32R-300 hydraulic system components covered in this section consist of the combination hydraulic pump and reservoir, gear back-up extender actuator assembly, actuating cylinders and hydraulic lines. The brake system, although hydraulically operated, is not included in this section as it has its own hydraulic system independent of the gear retraction system. The brake system along with the landing gear and components is covered in Section VIA.

This section provides instructions for remedying difficulties which may arise in the operation of the hydraulic system. The instructions are organized so that the mechanic can refer to: Description of the System, for a basic understanding of the system; Troubleshooting, for a methodical approach in locating difficulty; Corrective Maintenance, for the removal, repair and installation of components; and Adjustments and Checks, for the operation of the repaired system.

CAUTION

Prior to starting any investigation of the hydraulic system, place the airplane on jacks. (Refer to Jacking, Section II.)

5A-2. DESCRIPTION. Hydraulic fluid to the landing gear actuating cylinders is supplied by an electrically powered reversible pump located below the raised floor in the forward baggage compartment at station 45. A reservoir is also an integral part of the pump. The pump is controlled by a selector switch on the instrument panel to the left of the control quadrant. As the switch is placed in either the up or down position, the pump directs fluid through the particular pressure line to each individual actuating cylinder. As fluid pressure increases at one side of a cylinder piston, fluid at the other side is directed back through the other line to the pump. Both lines serve either as pressure or return passages depending on the rotation of the pump to retract or extend the gear.

A pressure switch is installed on a cross fitting connected to the pump mount assembly. During retraction the pressure switch is the primary means to shut down the pump. This switch opens the electrical circuit to the pump solenoid when the gear fully retracts and the pressure in the system increases. The switch will continue to hold the circuit open until pressure in the system drops when at that time the pump will again operate to build up pressure as long as the gear selector handle is in the up position. The down position of the selector does not affect the pressure switch. (For Specific Pressures refer to Table VA-I.)

The hydraulic pump is a gear type unit driven by a 12 to 14 volt reversible motor designed to operate in a pressure range as given in Table VA-I. A relief valve is incorporated in the pump, which when open allows fluid to flow into the reservoir. Also incorporated in the system on earlier models is a primary thermal relief valve which prevents excessive buildup of pressure in the hydraulic system due to expansion. Other valves in the pump, channel fluid to the proper outlet during retraction or extension of gear. A shuttle valve located in the base of the pump allows fluid displaced by the cylinder pistons to return to the reservoir without back pressure. (For specific pressures refer to Table VA-I.)

Also in the system is a by-pass or free-fall valve that allows the gear to drop should a malfunction in the pump system occur. To prevent the gear from extending too fast, there is a special restrictor nipple on the main gear retraction line. The valve is controlled manually or by a gear back-up extension device that is operated by a pressure sensing device which lowers the gear regardless of gear selector handle position, depending upon airspeed and engine power (propeller slipstream). Gear extension occurs even if the selector is in the up position, at airspeeds below approximately 118 MPH with engine power off. The device also prevents the gear from retracting at airspeeds below approximately 93 MPH at sea level with full power, though the selector switch may be in the up position. This speed increases with reduced power and/or increased altitude. The sensing device operation is controlled by a differential air pressure across a flexible diaphragm which is mechanically linked to the hydraulic valve and an electrical switch which actuates the pump motor. A high pressure and static air source for actuating the diaphragm is provided in a mast mounted on the left side of the fuselage above the wing. Manual override of the device is provided by an emergency gear lever located between the front seats to the right of the flap handle.

The emergency gear lever, used for emergency extension of the gear, manually releases hydraulic pressure to permit the gear to free-fall with spring assistance on the nose gear. The lever must be held in the downward position for emergency extension. This same lever, when held in the raised position, can be used to override the system, and gear position is controlled by the selector switch regardless of airspeed/power combinations. The lever must also be held in the raised position when hydraulic system operational checks are being conducted. An override latch allows the emergency extension lever to be retained in the up override position. The latch is disengaged by pulling up on the extension lever. The lever includes a centering device to return the handle to neutral, when not latched in override. An auto extension off light is mounted below the gear selector switch, and flashes to indicate whenever the latch is in use. The auto extension off light is controlled by a switch and flasher mounted under the flap handle cover.

For a description of the landing gear and electrical switches, refer to Section VIA, Landing Gear and Brake System.

SEE CAUTION NOTE ON GRID 1J3

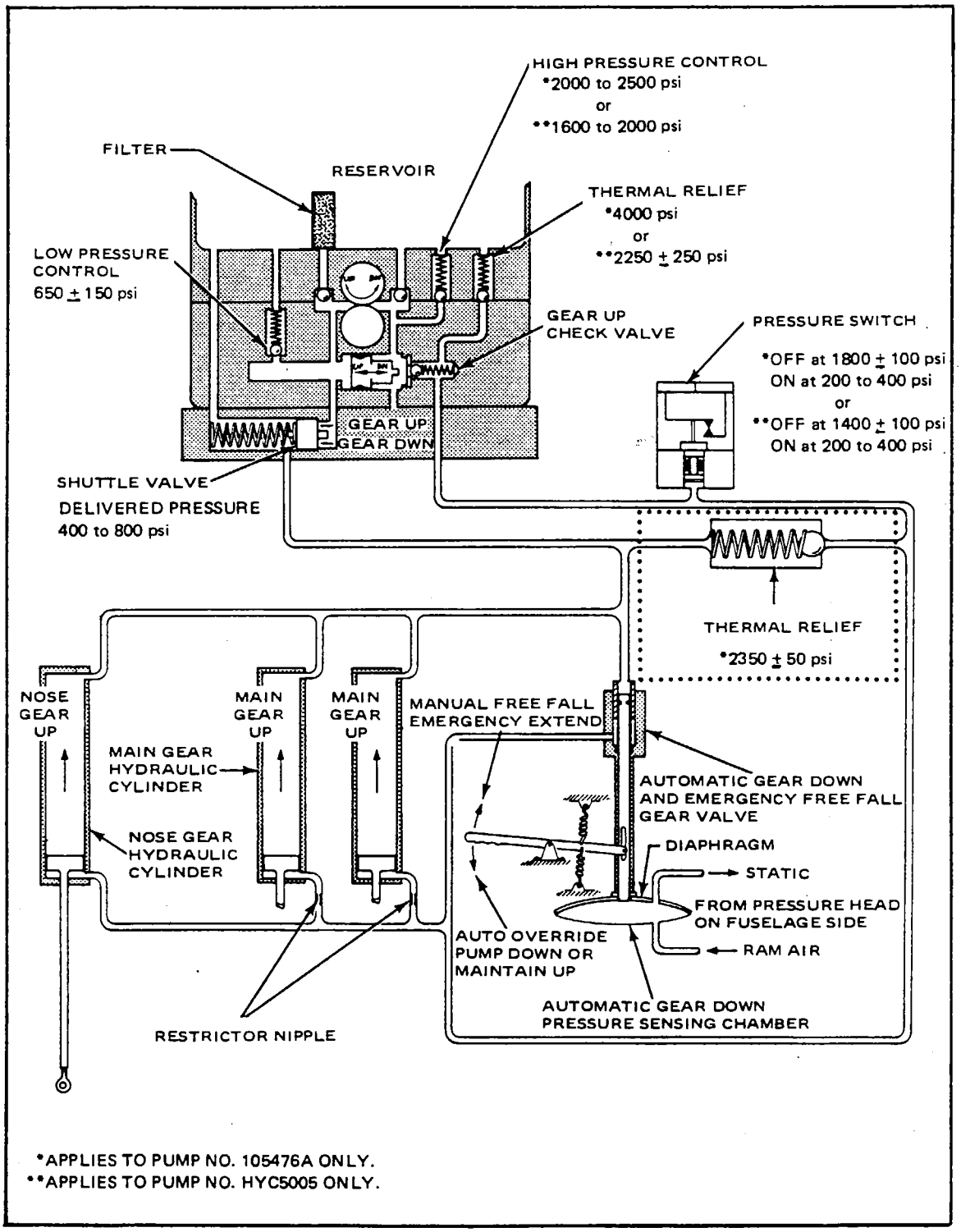
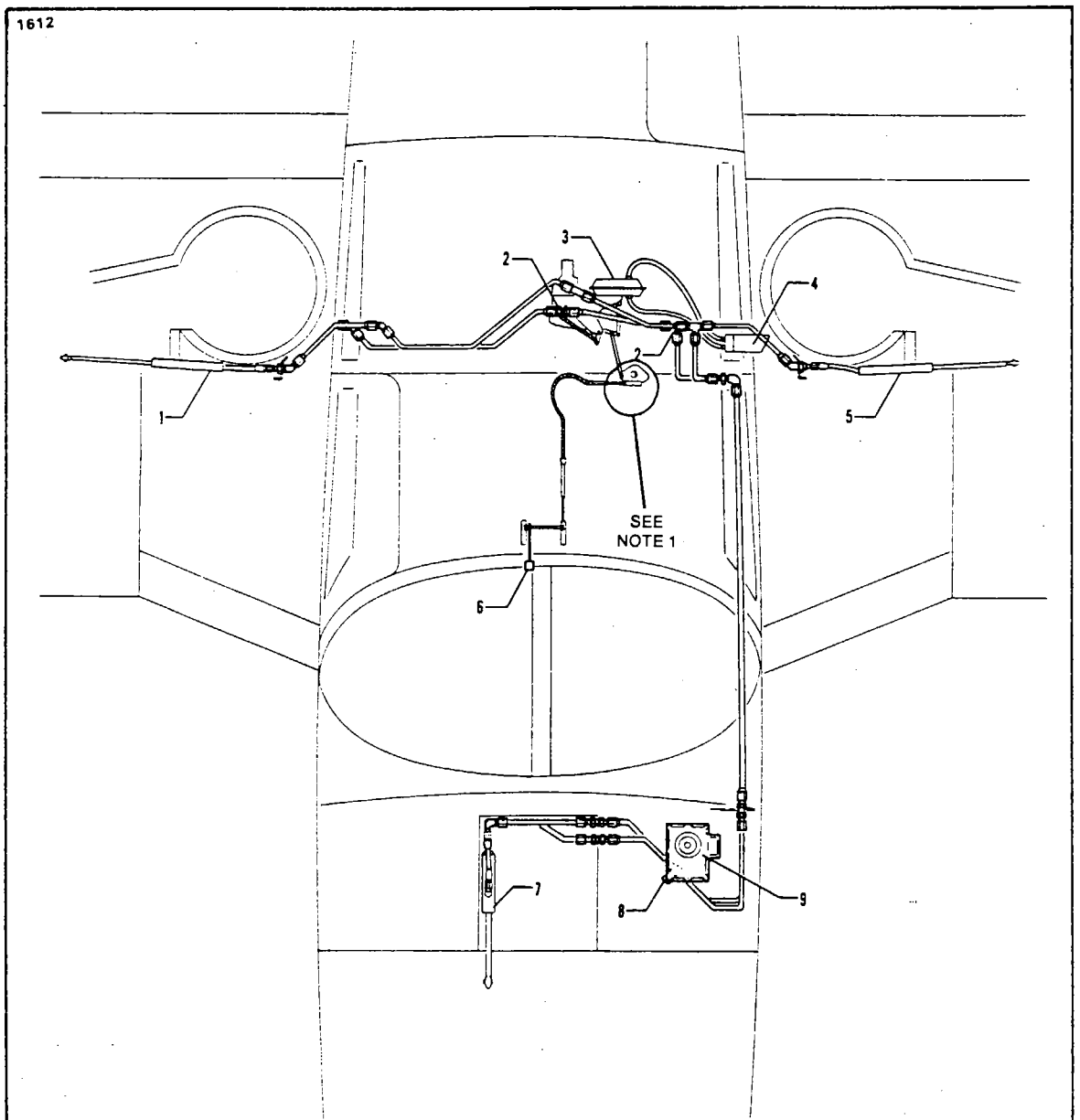


Figure 5A-1. Schematic Diagram of Hydraulic System



NOTES
1. ADJUST CONNECTOR ON END OF CONTROL CABLE TO OBTAIN .65 IN. MAX DIMENSION SHOWN IN FIG. 5A-6 DETAIL B.
2. A SPECIAL RESTRICTOR NIPPLE (2) IS INSTALLED ON THE MAIN GEAR RETRACTION LINE. DO NOT MISTAKE THIS FOR A STANDARD AN NIPPLE.

1. ACTUATING CYLINDER, RIGHT
2. NIPPLE, RESTRICTOR (SEE NOTE)
3. GEAR BACK-UP EXTENDER ACTUATOR
4. BACK-UP EXTENDER MAST
5. ACTUATING CYLINDER, LEFT
6. LEVER EMERGENCY EXTENDER
7. ACTUATING CYLINDER, NOSE
8. PRESSURE SWITCH
9. PUMP/RESERVOIR

Figure 5A-2. Hydraulic System Installation

CAUTION

Prior to starting any investigation of the hydraulic system, place the airplane on jacks. With the airplane on jacks, pull the emergency extension lever up and latch in override position thus preventing the buildup of unnecessary pressure on the actuating cylinders and connecting hydraulic lines when the gear is raised or lowered manually. Failure to comply with these instructions could result in the buildup of sufficient pressure to unlock the downlock mechanism allowing the gear to collapse when the wing jacks are removed. Prior to removing the airplane from jacks, push the emergency extension lever down, turn on the master switch and select gear down, observe that all three green lights indicating the landing gear is down and locked are energized. Turn master switch off.

5A-3. TROUBLESHOOTING. Malfunctions in the hydraulic system will result in failure of the landing gear to operate properly. When trouble develops, jack up the airplane (refer to Jacking, Section II) and then proceed to determine the extent of the trouble. Generally, hydraulic system troubles fall into two types, troubles involving the hydraulic supplying system and troubles in the landing gear hydraulic system. Table VA-III 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 using Figures 5A-1 or 5A-2. 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 and, in turn, by process of elimination, isolate the troubles.

NOTE

If it is found that the hydraulic pump is at fault and requires disassembly, it is recommended that it be overhauled by an accredited overhaul facility. Pressure checks with adjustments may be accomplished in accordance with instructions given in Paragraphs 5A-6 thru 5A-9.

5A-4. HYDRAULIC PUMP.

5A-5. REMOVAL OF HYDRAULIC PUMP. The hydraulic pump with reservoir incorporated is located in the nose section of the fuselage. Access to the pump is through the access panel in the nose baggage compartment.

a. Disconnect the pump electrical leads from the pump solenoid relays and the ground wire from the battery shelf.

b. Disconnect the hydraulic lines from the pump. Cap the line ends to prevent contamination.

c. Remove pump by removing pump attaching bolts.

5A-6. DISASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 5A-3.) After the hydraulic pump has been removed from the airplane, cap or plug all ports, and clean exterior of pump using a dry cleaning solvent to remove accumulated dirt and dust. The three major components of the pump assembly are the pump base, pump motor, and valve and gear case. These three major components should be disassembled as follows:

a. Pump Base: Remove pump base (16) from valve and gear case by:

1. Cutting safety wire and removing bolts (17) with washers securing pump base to pump and gear case.

2. The check valve within the pump base should be removed for cleaning purposes only. To remove valve, cut safety wire and remove bolt, spring and steel ball. Replace O-ring at reassembly.

b. Pump Motor: The pump motor may be removed from the pump and disassembled as follows:

1. Remove thru bolts (4) from head (1) of motor. Using a knife cut the seal coating between the motor head and case.

2. Lift the head up from the case approximately .50 of an inch, this will allow inspection of brushes (3) without the brushes unseating from the commutator. (Refer to Paragraph 5A-7 for brush inspection.) The brush leads are secured to the head assembly.

3. Raise the head assembly (1) off the armature (8) and note the small thrust ball (7) located between the end of the armature (8) and motor head. Do not misplace this bearing.

4. Draw the armature from the motor frame (9). Note the number of thrust washers (11) mounted on the drive end of the armature shaft.

5. Remove the motor frame from the pump reservoir (13).

c. Valve and Gear Case: Remove valve and gear case (15) from reservoir (13) as follows:

1. Remove eight screws from flange of body and separate the two assemblies (18).

2. Pump gears and valves should be removed for cleaning purposes only. To remove cap securing gears, remove attaching bolts. The two valve springs should be positively identified with their cavities; otherwise, it will be necessary to readjust each valve for proper operating pressure.

5A-7. CLEANING, INSPECTION AND REPAIRS OF HYDRAULIC PUMP.

NOTE

Repair facilities must be clean to prevent contamination of pump components. Proper and careful handling should be exercised to prevent damaging pump components.

a. Discard all O-rings.

b. Remove caps or plugs and clean all components with a dry type cleaning solvent and dry thoroughly.

c. Inspect pump components for scatches, scores, chips, cracks and wear.

d. Inspect motor for worn brushes (minimum of .218 brush remains between the braided wire and commutator end), excess wear and excess bearing wear.

e. Repairs are limited to brush replacement as follows:

1. One brush holder has the winding wire attached. Locate this wire and remove by using a soldering gun.

2. The head assembly can now be removed and worked on for ease of brush replacement if required.

3. Remove brush wire and brush from by-metal heat protector.

4. Solder new brush wires to head assembly and by-metal heat protector, and wire from winding to one brush holder.

5. Install brush springs and brushes into brush holders and secure in place (temporary) with a piece of string looped around the brush and holder and tied in a knot.

NOTE

Insure that the braided wire is in the holder slot for proper brush movement.

6. Install the head assembly with new brushes to the frame and commutator in accordance with instructions given in Paragraph 5A-8, Step a.

5A-8. ASSEMBLY OF HYDRAULIC PUMP. (Refer to Figure 5A-3.)

a. The pump motor may be assembled and installed on the reservoir as follows:

1. Position motor frame (9) on reservoir (13). Note aligning marks on frame and reservoir.

2. Place thrust washers (11), of the same amount removed, on the drive end of the armature (8).

3. Lubricate the entire length of the armature shaft, on the drive end, with light grease to prevent O-ring seal from damage. Insert end of shaft in reservoir.

4. Saturate felt oiling pad around commutator end bearing with SAE 20 oil. Allow excess oil to drain off before assembling motor.

5. Insert thrust ball (7) in bearing of motor head (1). To hold ball in position, place a small amount of grease inside the bearing.

6. Place head assembly on frame and allow brushes to extend over commutator. Remove the string securing the brushes in the holders. Push head assembly on frame and insure proper indexing of head and frame assemblies. Secure in place with thru bolts (4).

7. Check freedom of rotation and end play (thrust) of the armature within the assembly. A minimum of .005 inch end play is permissible. Adjust to this tolerance if necessary by adding or removing thrust washers (11) on drive end of armature shaft.

b. Assemble valve and gear case (15) to the reservoir (13) as follows:

1. If removed, place pump gears in valve and gear case and install cover. Install cover attaching bolts and secure.

2. Lubricate reservoir seal ring (14) with hydraulic fluid (MIL-H-5606A) and place in recess provided in case (15).

3. Position reservoir (13) on valve and gear case (15). Care should be taken when aligning the armature shaft with the pump gear. Do not run the motor to accomplish this.

4. Ascertain the seal ring is properly positioned and install and tighten screws. With the motor electrically connected to a 14-volt power supply, and with an ammeter in the circuit, the current drawn should not exceed 12 amperes.

c. Attach the pump base to the pump as follows:

1. With pump inverted, lubricate O-ring seals and install them in recesses provided in the valve and gear case (15).

2. Install attaching bolts with washers and torque to 70 inch-pounds.

3. Safety attaching bolts with MS20995-C32 wire.

d. Conduct motor operational check not to exceed 10 seconds running time.

5A-9. TEST AND ADJUSTMENT OF HYDRAULIC PUMP. (Refer to Figure 5A-4.)

a. Test Equipment:

1. Hydraulic pump and mounting base.
2. Pressure gauge (0-1000 psi).
3. Pressure gauge (0-3000 psi).
4. Hoses with fittings to connect base and gauges.
5. Power supply (14 VDC).
6. Ammeter (0 to 100 amps).
7. Fuse or circuit protector (100 amps).

b. Test and Adjustment:

NOTE

Test gauges or gauges of known accuracy should be used when performing the following tests.

1. Connect the 0 to 1000 psi gauge to the low pressure port of the pump base.
2. Connect the 0 to 3000 psi gauge to the high pressure port of the pump base.
3. Connect black lead of pump motor to the negative terminal of the DC power supply.
4. Remove the filler plug located on the forward side of the pump and ascertain that fluid is visible up to the bottom of the filler plug hole. Should fluid be below the hole, add fluid, MIL-H-5606A, through the filler hole until full. Reinstall the filler plug and tighten.

NOTE

A small vent hole is located under the vent screw head. Retain 1/64 inch clearance between the screw head and the small vent hole.

5. Bleed air from the attached lines. (Lines may be bled by alternately connecting blue lead and green lead to the positive terminal of the power supply until all air is exhausted.)
6. Connect blue lead to positive terminal of power supply. Pump should operate and the high pressure gauge should indicate a specific pressure, as given in Table VA-I. (Should the gauge indicate a pressure below or over the given pressure, adjust valve "A," Figure 5A-3 accordingly to obtain the desired reading.)

NOTE

When increasing pressure, the pump running time must not exceed 12 seconds. There should be no external leakage while performing Steps 5 thru 8.

7. Disconnect blue lead. The high pressure reading should not drop more than 300 psi in five minutes. High pressure may not be selected again for five minutes.
8. Connect green lead to positive terminal of power supply. Pump should operate in reverse, dropping reading on high pressure gauge to zero. The low pressure gauge should indicate 500 to 800 psi. (Should the gauge indicate a pressure below 500 psi or over 800 psi, adjust valve "B," Figure 5A-3, accordingly to obtain desired reading.) Disconnect green lead. Both pressure gauges should indicate zero psi.
9. Should it be necessary to check the pump motor, first connect the ammeter in the electrical circuit with the positive terminal of the meter to the black lead and negative terminal of the meter to the negative terminal of the DC power supply.

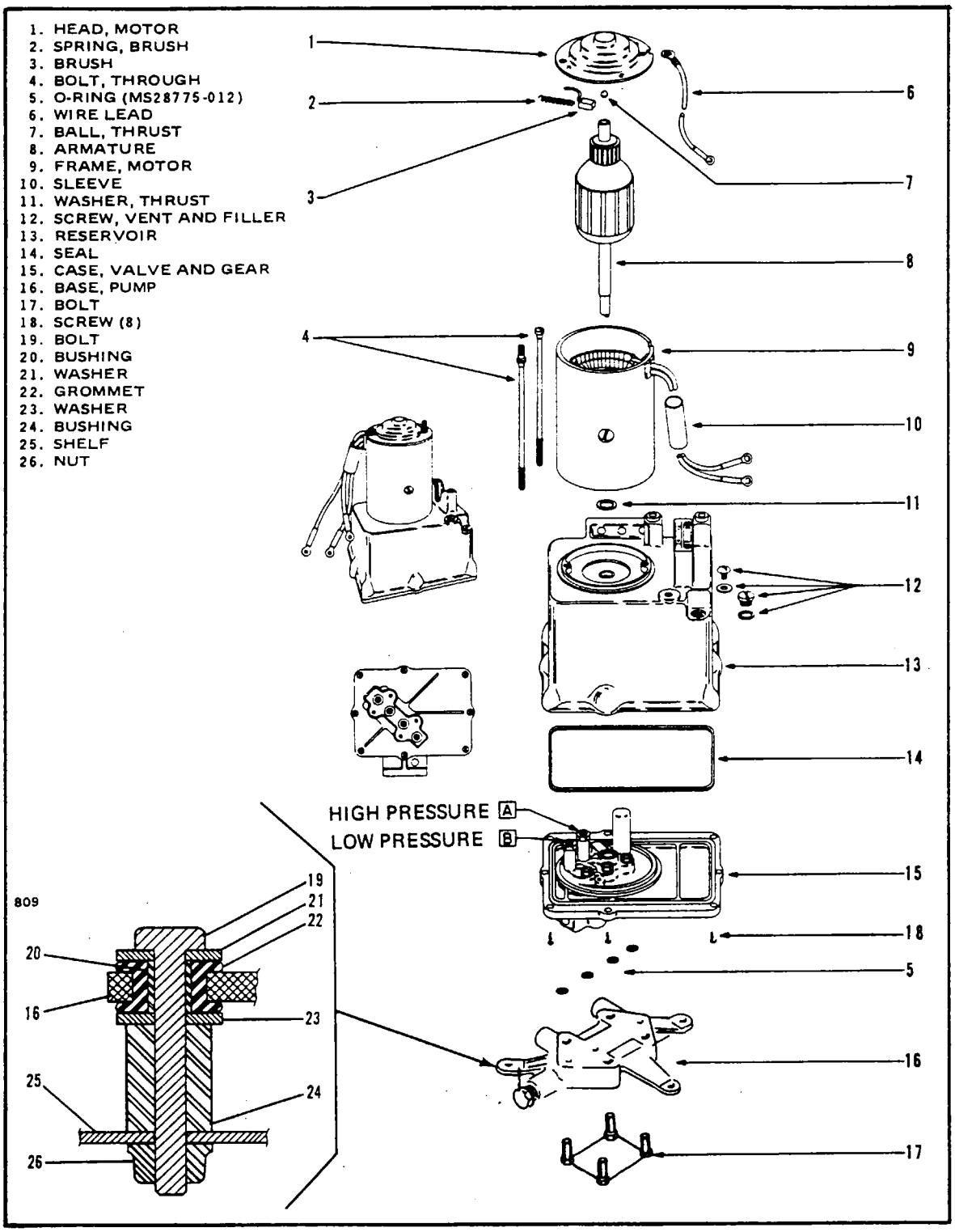


Figure 5A-3. Hydraulic Pump/Reservoir, Exploded View

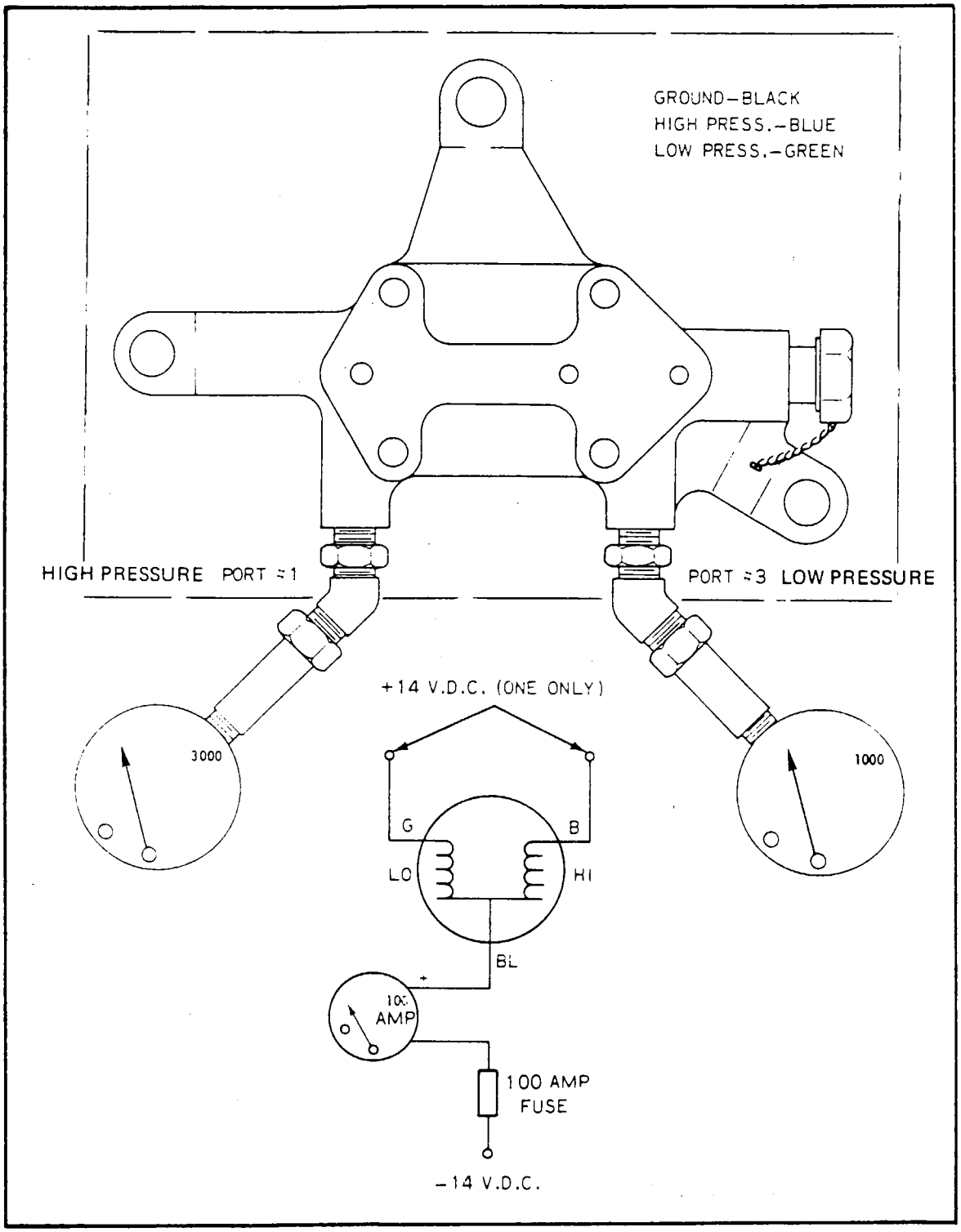


Figure 5A-4. Test and Adjustments of Hydraulic Pump

TABLE VA-I. LEADING PARTICULARS, HYDRAULIC SYSTEM

HYDRAULIC PUMP	IO5476A	HYC5005
Hydraulic Pump		
High Pressure	2000 to 2500 psi	2000 to 2500 psi
Low Pressure	650 ± 150 psi	650 ± 150 psi
Flow Rate @ 1000 psi	45 cu. in. per min.	45 cu. in. per min.
High Pressure Control	2000 to 2500 psi	1600 to 2000 psi
Hydraulic Fluid	MIL-H-5606A	MIL-H-5606A
Relief Valve	4000 psi	2250 ± 250 psi
Shuttle Valve Delivered Pressure	400 to 800 psi	400 to 800 psi
System Thermal Relief (AN6245-AB4)	2350 ± 50 psi	
Pressure Switch		
Open (OFF) Pressure	1800 ± 100 psi	1400 ± 100 psi
Close (ON) Pressure	Pressure decreasing 200 to 400 psi	Pressure decreasing 200 to 400 psi

TABLE VA-II. CHARACTERISTICS, HYDRAULIC PUMP MOTOR

Electrical Characteristics:	
Voltage	14 V.D.C.
Rotation	Reversible
Polarity	Negative ground
Operating Current	75 amps, max. at 14-volts (both rotations)
Operating Time	12 seconds max. with a current load of 75 amperes at 77° F
Overload Protection	Thermal circuit breaker
Automatic Reset Time	12 seconds, max.
Location, Automatic Reset	Commutator end head of motor
Mechanical Characteristics:	
Bearings	Absorbent bronze (Drive end bearing in upper pump and valve assembly casting) Steel ball (Thrust, between commutator end head and end of armature shaft)
End Play, Armature	.005 inch, min. (Adjust by selection of thrust washers on drive end of armature shaft)

10. Connect the blue lead from the pump motor to the positive terminal of the power supply. With a high pressure indication on the pressure gauge, the ammeter should read 75 amperes maximum. Disconnect the blue lead.

11. Connect the green lead from the pump motor to the positive terminal of the power supply. With low pressure indication within the 500 to 800 psi range, the ammeter should read between 15 to 35 amperes.

NOTE

In the event any of the various tests do not perform satisfactorily, the pump assembly should be replaced.

12. Disconnect the green lead from the power supply and permit the pressure to drop before disconnecting the hydraulic lines.

5A-10. INSTALLATION OF HYDRAULIC PUMP. (Refer to Figure 5A-3.)

a. Insert grommet (22) in pump base mounting hole.

b. Insert bushing (20) in grommet (22).

c. Place washer (21) over bolt (19) and insert bolt through grommet (22) and bushing (20) and pump base (16).

d. Place washer (23) and bushing (24) over bolt (19) and secure to mounting shelf (25).

e. Connect hydraulic lines to pump.

f. Connect pump electrical leads. Blue wire to outboard (lower) solenoid, green wire in inboard (upper) solenoid, and black wire to ground on battery shelf.

g. Check fluid level in pump. Refer to Section II for filling instructions.

h. With airplane on jacks, operate pump to purge hydraulic system of air, and check for leaks. After operation, recheck fluid level.

5A-11. GEAR BACK-UP EXTENDER ACTUATOR ASSEMBLY.

5A-12. REMOVAL OF GEAR BACK-UP EXTENDER ACTUATOR ASSEMBLY. (Refer to Figure 5A-6.) The back-up extender actuator is located under the center seat floorboard. To reach the actuator, remove the center seats and floorboard.

a. Disconnect the actuator electrical leads at the quick disconnect terminals.

b. Disconnect the manual override control rod (30) at the actuator control arm (19) by removing cotter pin, washers, and clevis pin (1).

c. Disconnect the pressure (13) and static (11) hoses from the elbows (12) of the diaphragm housing (10) by releasing clamps and sliding the hoses from their elbows. The hoses should be tagged for ease of reassembly.

d. Place a shop cloth under the actuator hydraulic valve (25) to absorb fluid, and then disconnect the hydraulic tubes (26, 39, 40 and 41) from cross (38) and tee (46). Cover open tubes and fittings to prevent contamination.

e. Remove the hardware that secure the actuator base to the mounting brackets. There are two mounting bolts at the inboard side of the base and one mounting screw at the outboard side of the diaphragm housing. Remove the actuator from the mounting brackets.

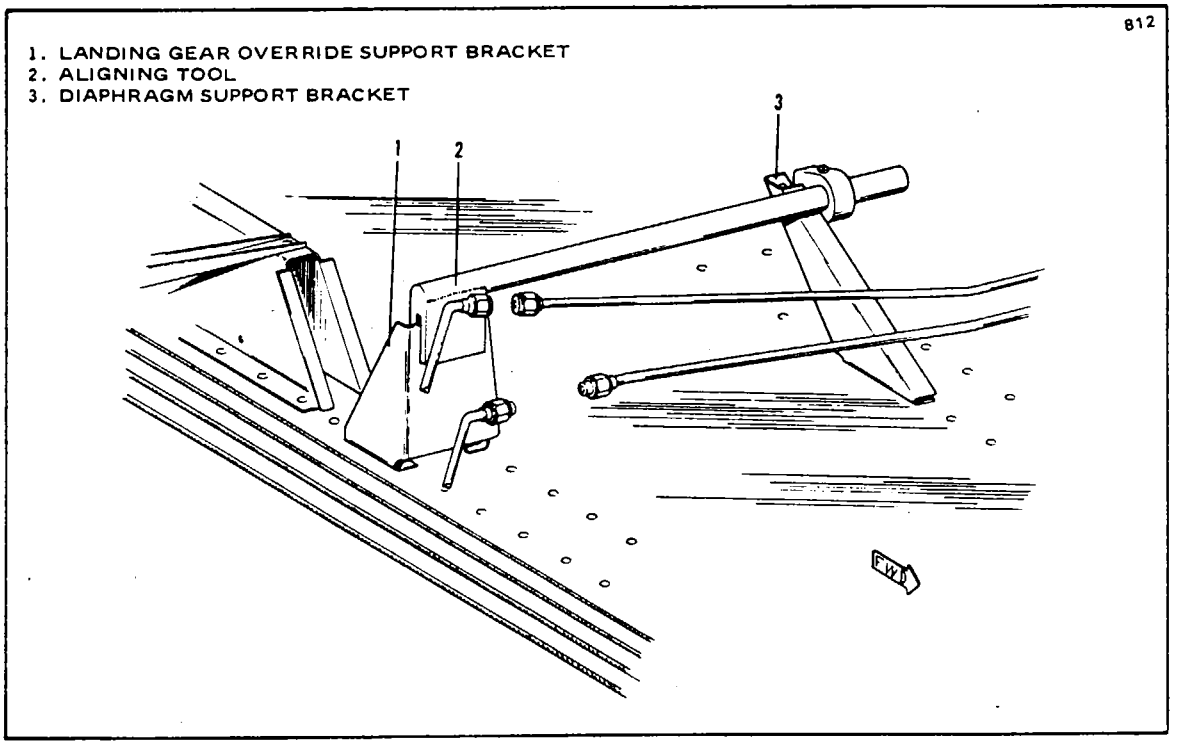


Figure 5A-5. Checking Aligning Brackets of Gear Back-Up Extender Actuator

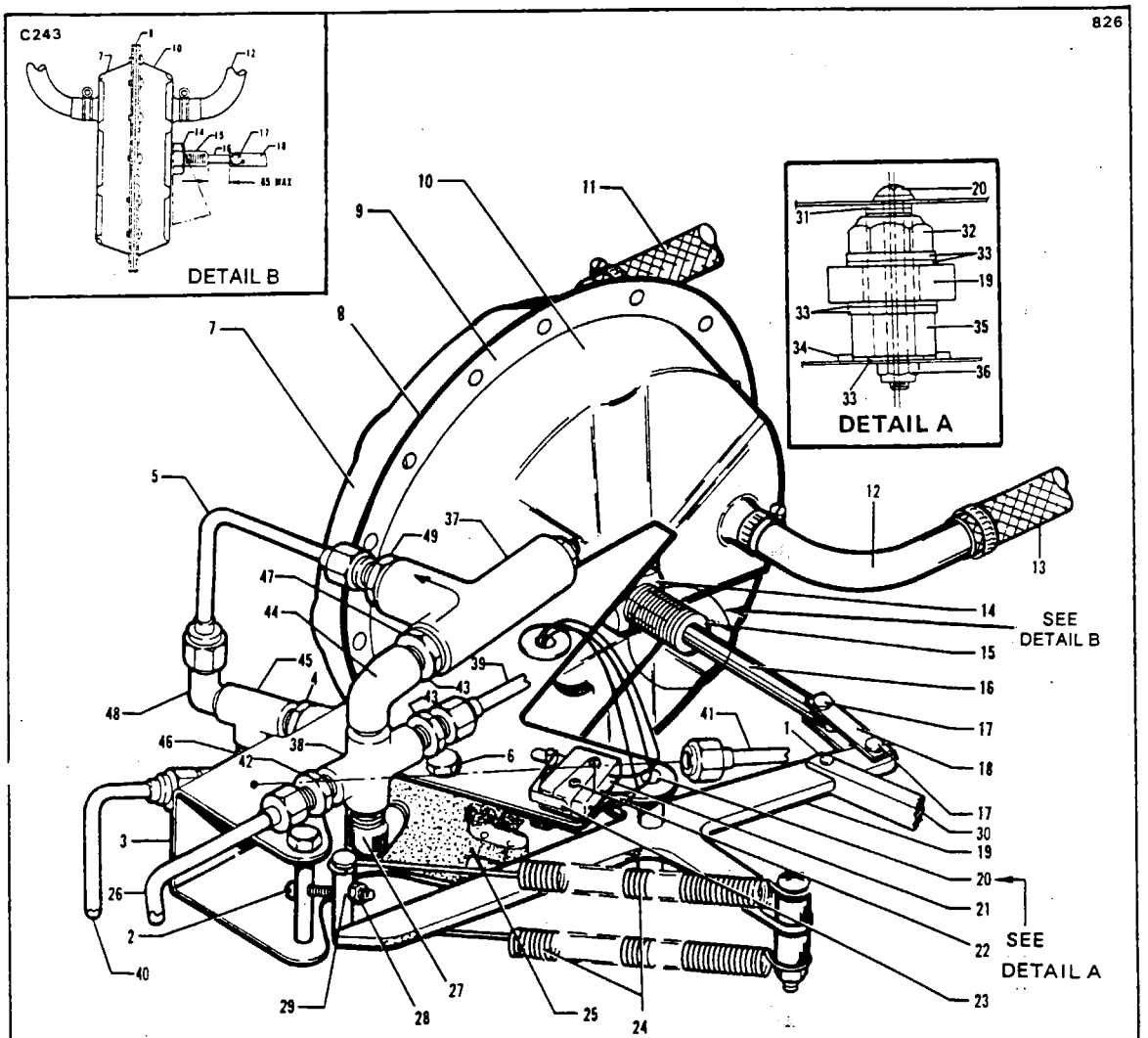
5A-13. INSTALLATION OF GEAR BACK-UP EXTENDER ACTUATOR ASSEMBLY. (Refer to Figure 5A-6.)

a. Position the gear back-up extender actuator against its mounting brackets and install attaching hardware. Do not tighten nuts.

NOTE

With the base attached and before installing the attaching screw through the ring of the diaphragm housing, insure that the attaching holes in the housing and mounting bracket align without using force. Should they misalign, it may be necessary to reform the main fuselage mounting bracket.

To reform the main fuselage mounting bracket, an aligning tool may be used. (Refer to Figure 5A-5.) This tool may be fabricated from dimensions given in Figure 5A-10. When proper alignment has been accomplished, tighten the attaching hardware.



1. CLEVIS PIN
2. SCREW, ADJUSTMENT
3. BASE
4. NIPPLE
5. TUBE
6. BOLT & NUT
7. HOUSING ASSEMBLY, STATIC
8. SEAL
9. RING, HOUSING
10. HOUSING ASSEMBLY, PRESSURE
11. HOSE, STATIC
12. ELBOW
13. HOSE PRESSURE
14. NUT
15. BUSHING, TEFLON
16. SHAFT, DIAPHRAGM
17. CLEVIS PIN
18. LINK
19. ARM, ACTUATING
20. SCREW
21. SWITCH, PUMP
22. SCREW & NUT
23. ACTUATOR, SWITCH
24. SPRINGS
25. VALVE, HYDRAULIC
26. TUBE
27. ELBOW
28. JAM NUT
29. ANCHOR
30. PUSH ROD
31. SPACER
32. ADJUSTMENT NUT
33. WASHER
34. CAM
35. ECCENTRIC BOLT
36. NUT
37. VALVE, THERMAL RELIEF
38. CROSS
39. TUBE
40. TUBE
41. TUBE
42. NIPPLE
43. NIPPLE
44. ELBOW
45. TEE
46. TEE
47. NIPPLE
48. ELBOW
49. UNION

Figure 5A-6. Gear Back-Up Extender Actuator

b. Connect the manual control push rod (30) to the actuator control arm (19) using clevis pin (1). Place a washer over end of clevis pin and secure with cotter pin.

c. Move the actuator on its mounting brackets to allow the manual control push rod to have maximum clearance from the left stabilator cable and center in the fairlead on the aft face of the main spar box. Check system for sufficient travel and freedom of movement of controls. Tighten actuator attaching hardware.

NOTE

Care should be used when attaching the forward hose (13) to the diaphragm assembly (10) so that no strain is placed on the teflon bushing (15) and diaphragm shaft (16), thus causing friction in movement.

d. Connect hydraulic tubes (26, 39, 40 and 41) to cross (38) and tee (46).

e. Connect the pressure (13) and static (11) hoses to the elbows (12) of the diaphragm housing (10). Secure hoses with clamps.

f. Connect the actuator electrical leads terminal to their mating terminals and insulate. Refer to the electrical schematic for hookup.

g. Check the actuator adjustments as given in Paragraph 5A-14.

h. Check to insure that maximum distance between end of link (18) and teflon bushing (15) does not exceed .65 inch. Override must be engaged for this check. Make any adjustments at the control cable assembly connector located at the spar box linkage. (Refer to Figures 5A-6, detail B, and 5A-2, Note 1.)

i. Install floorboard and center seats.

5A-14. CHECK AND ADJUSTMENT OF GEAR BACK-UP EXTENDER ACTUATOR. (Refer to Figure 5A-6.)

a. If diaphragm failure is suspected note the following:

1. If the landing gear retracts or extends at too high an airspeed or will not retract at all unless the back-up extender is placed in the override position, then the diaphragm is possibly defective.

2. If it is determined that the diaphragm is defective, then remove the Back-Up Extender per instructions given in Paragraph 5A-12 and install, Piper Kit No. 761 138V, Back-Up Gear Extender Diaphragm Replacement. Instructions for installing the diaphragm are included in the kit.

3. Following completion of Replacement Kit, reinstall the extender unit in the aircraft and functionally test and adjust as outlined below and in Paragraph 5A-14a.

b. Adjustment of the gear back-up extender actuator is preset to allow the hydraulic valve (25) of the actuator to open when the airspeed is reduced below 118 MPH (103 Kts) with the engine power OFF. This adjustment is accomplished by setting the tension of spring (24) on the actuator with adjustment screw (2) as follows:

NOTE

The airspeed at which the hydraulic valve of the actuator opens was preset at the factory under ideal conditions. There could be some variations at different altitudes and atmosphere conditions.

CAUTION

The micro switch (21) and eccentric bolt (35) must not be adjusted. These components are set at the factory under specific conditions, with the use of special set-up equipment.

NOTE

This adjustment will require two persons, a qualified pilot and a mechanic to set the actuator adjustment screw (2).

1. Remove the center seats and floorboard.
2. The pivot screw (20) should be torqued 8 to 10 inch-pounds.
3. Loosen the jam nut (28) of the adjustment screw (2).
4. Ascertain that the electrical switch (21) will actuate with the use of the emergency gear extension lever.
5. Fly the airplane (refer to Owner's Handbook). Should the spring tension be out of adjustment very much, it may be necessary to assist gear retraction with the use of the emergency gear extension lever moved to the up override position.
6. Loosen the adjustment screw (2) by turning counterclockwise until spring (24) tension is free.

WARNING

While making adjustments, do not lay tools in area exposed by the removal of floorboard. This may interfere with airplane controls.

7. With the airplane at a safe altitude, slow the airplane to a glide of 125 MPH (109 Kts) with the gear selector handle up and the throttle reduced to power OFF. (Gear unsafe light and horn will indicate when power is reduced.) At 125 MPH (109 Kts), slow the airplane at a rate of one (1) MPH per second until 118 MPH (103 Kts) is obtained, hold the airplane at this speed.

NOTE

Adjustment of the nut (32) may be necessary to increase or decrease the spread between the gear up and gear down actuation speeds. To expand the spread between these speeds, loosen the nut. Tighten the nut to bring the airspeeds closer together. Whenever the nut is adjusted, it may be necessary to readjust the tension on the springs (24) and to repeat the nut adjustment procedure. CAUTION should be observed so as not to disturb the position of eccentric bolt (35) in relation to the rest of the unit.

8. With the glide established, turn the adjustment screw (2) clockwise until the gear drops. (First indication of gear dropping will be that the gear unsafe light comes ON.)

9. Climb again to a safe altitude and check that the gear drops at the correct airspeed.

10. Land the airplane and tighten the adjustment screw jam nut (28).

c. To check adjustment of electrical switch, the following procedure may be used:

1. Place the airplane on jacks. (Refer to Jacking, Section II.)

2. Move the mixture control back to idle cut-off and the throttle to full forward to prevent gear warning horn from sounding during adjustment.

3. Ascertain that the actuator tension springs are properly adjusted according to Step a.

4. Retract the landing gear hydro-electrically by turning the master switch ON, raising the emergency gear extension lever and moving the gear selector switch to the up position. The emergency gear extension lever must be retained in the up position to keep the gear up.

5. Check for proper switch operation by the following procedure:

(a) Turn master switch ON and move gear selector switch to the up position. Pump should not operate.

(b) Move the emergency gear extension lever to the up override position. Pump should operate and gear should retract.

(c) With selector lever up, slowly lower emergency gear extension lever to allow gear to drop to down position. The pump should not operate at any time during extension.

(d) Turn master switch OFF.

6. Check gear operation in the normal manner with the use of the gear selector switch. The emergency extension lever must be held in the up override position.

7. Ascertain that gear is down and locked and remove airplane from jacks. Then flight check the retractable landing gear system. (Refer to Paragraph 5A-14a.)

5A-14a. OPERATIONAL CHECK OF RETRACTABLE LANDING GEAR SYSTEM.

a. Maximum Gear Extend: Place the gear selector in the down position at 150 MPH (130 Kts). In approximately 5 to 10 seconds the three green gear lights should be on indicating that the gear is down and locked.

b. Minimum Gear Retract: Allow approximately 8 seconds for the pressure in the hydraulic system to normalize between gear extension and retraction. Place the selector switch in the UP position at 125 MPH (109 Kts). In approximately 5 to 10 seconds all the gear indicating lights should be out, indicating that the gear is fully retracted.

c. Override Gear Down and Up:

1. Down: Establish a normal glide at approximately 130 MPH (113 Kts), with power at idle. Slowly move the override lever down, while observing the ammeter to confirm that the hydraulic pump does not start. The gear should go down and lock. Move the gear selector switch down. Release the override lever. The gear should remain down.

2. Up: Set maximum climb power. Maintain approximately 80 MPH (70 Kts) for approximately 15 seconds. Move the gear selector switch to the up position. The gear should not retract. Pull the override lever up. The gear should retract. Allow the airspeed to increase to at least 130 MPH (113 Kts). Release the override lever and the gear should remain up.

d. Gear "Back-Up" Down and Up:

1. Gear Down: Set power at idle. Glide the aircraft at 130 MPH (113 Kts). Decrease the airspeed at the rate of 1 MPH (1 Kt) per second. The gear should start down between 113 and 123 MPH (98 to 108 Kts). Place the gear selector switch down, after the gear is down and locked.

2. Gear Up: Set maximum climb power. Maintain approximately 80 MPH (70 Kts) for approximately 15 seconds. Move the gear selector up. The gear should stay down and locked. Increase the airspeed at the rate of 1 MPH (1 KT) per second. The gear should begin to retract between 88 and 98 MPH (76 and 85 Kts) at zero density altitude. The speed at which the gear starts up will increase 1.5 MPH (1.3 Kts) for each 1000 feet increase of density altitude.

3. Manual Override Up Latch: With the gear up, the aircraft in normal flight configuration, select up on the gear override lever. Engage the up latch. The amber up latch warning light, below the gear selector switch, should be flashing. Gradually slow the aircraft below the auto gear extend speed and observe that the gear stays fully retracted. Disengage the up latch. The flashing amber warning light should go out.

e. Gear Indicator Lights:

1. The green lights indicate when the corresponding gear is in the down and locked position. Turn landing light switch on and off-observe ammeter for indication.

2. The red gear warning light will indicate an unsafe condition. It will indicate when the gear is in an intermediate position neither fully up nor down. In conjunction with the gear warning horn, it will indicate when the throttle setting is less than 14 ± 2 inches of manifold pressure while the gear is not down and locked. It will also indicate when the gear is down and locked while the selector switch is in the UP position, except at full throttle.

f. The Gear Warning Horn: It will sound in conjunction with red gear unsafe light per the conditions noted above.

g. Micro Switch Check:

1. The forward throttle micro switch is checked by moving the throttle full forward while the gear is down and the gear selector switch is in the up position. The horn should stop sounding and the red light should go out. Retard the throttle slightly and the horn and light should come on.

2. The aft throttle micro switch setting is checked as follows: With the gear up, reduce the throttle at a normal rate. The gear warning horn and the red light should come on at 14 inches of manifold pressure ± 2".

5A-15. NOSE GEAR ACTUATING CYLINDER.

5A-16. REMOVAL OF NOSE GEAR ACTUATING CYLINDER.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.

c. Disconnect the cylinder operating rod end, this will require manually unlocking the nose gear to allow clearance from the engine mount for removal of attachment bolt.

CAUTION

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occur to the downlock if not disengaged fully.

d. Disconnect the aft end of cylinder from its attachment fitting and remove the cylinder from the wheel well.

5A-17. DISASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (Refer to Figure 5A-7.)

a. With the cylinder removed from the airplane, remove the fitting from the piston rod (6) end of the cylinder (7). Mark the position of the fitting to facilitate reinstallation.

b. On Syncro Devices nose gear actuating cylinders remove the snap ring (1) from the annular slot in the end of the housing. On Gar-Kenyon nose gear actuating cylinder remove saftey wire (9) and unscrew the end gland (2).

c. On Syncro Devices assemblies pull the piston (6) with end gland (2) from the cylinder housing. On Gar-Kenyon assemblies remove piston (6) after unscrewing end gland (2).

5A-18. CLEANING, INSPECTION, AND REPAIR OF NOSE GEAR ACTUATING CYLINDER.

a. Clean the cylinder parts with a suitable dry type solvent and dry thoroughly.

b. Inspect the cylinder assembly for the following:

1. Interior walls of the cylinder and exterior surfaces of the piston for scratches, burrs, corrosion, etc.

2. Threaded areas for damage.

3. Rod end fitting and swivel fitting of cylinder for wear and corrosion.

c. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc. and replacing parts.

5A-19. ASSEMBLY OF NOSE GEAR ACTUATING CYLINDER. (Refer to Figure 5A-7.)

a. Install "O" ring (5) on the exterior of the end gland (2).

b. Install "O" ring (4) in the interior of the end gland. The Syncro Devices assemblies also includes a ring back-up (3) with the "O" ring (4).

c. Install "O" ring (8) on the body of the piston assembly.

d. Lubricate the areas around the "O" rings with hydraulic fluid, slide the end gland on the piston rod and the piston into the cylinder housing (7).

e. Secure the end gland in the cylinder by installing the snap ring (1) in the annular slot in the Syncro Devices cylinder. The end gland on the Gar-Kenyon cylinder is secured by threading gland into cylinder body (7) and securing with safety wire (9).

f. Install restrictor fitting in the piston rod end of the cylinder.

g. Check smoothness of operation of the piston.

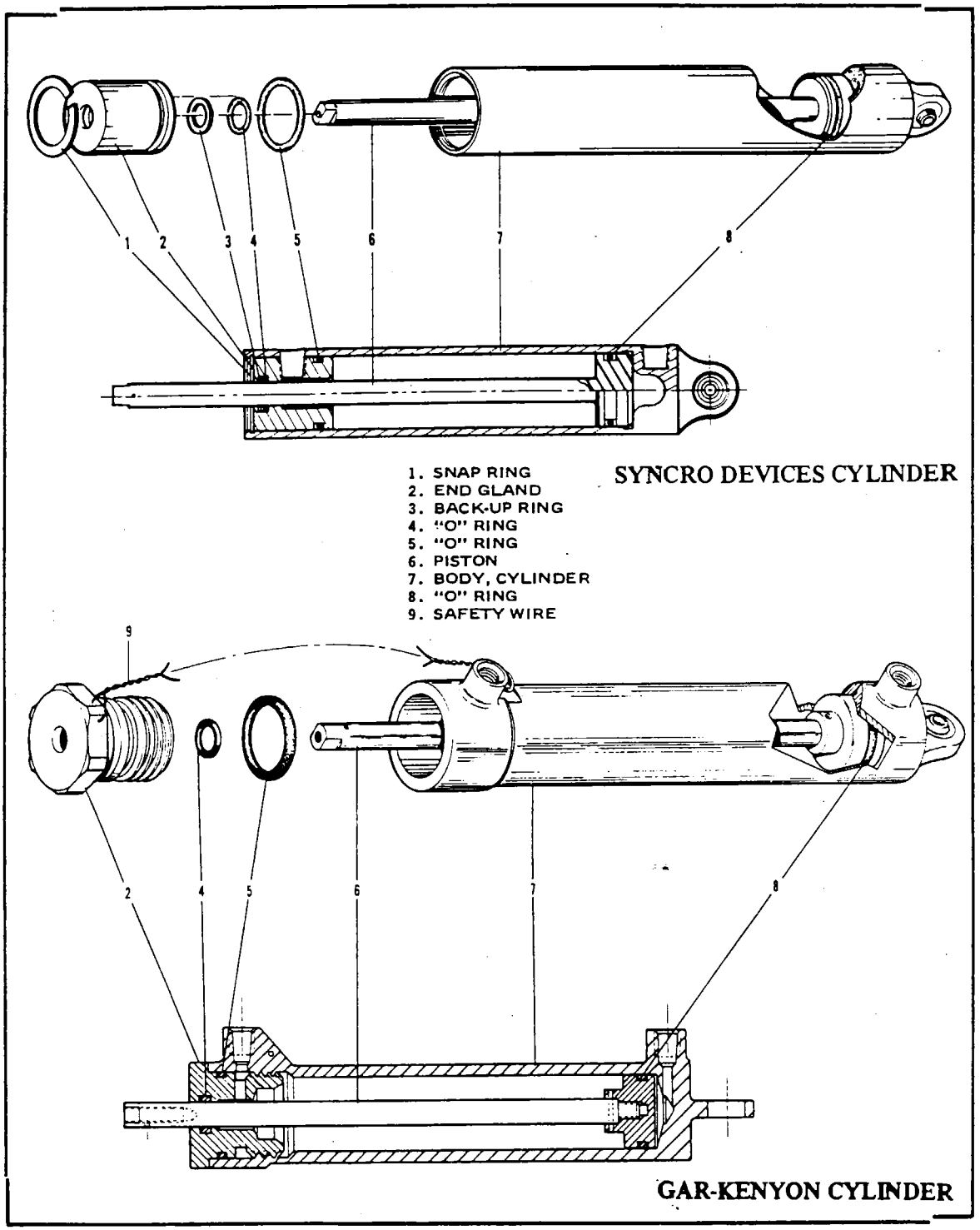


Figure 5A-7. Nose Gear Actuating Cylinder

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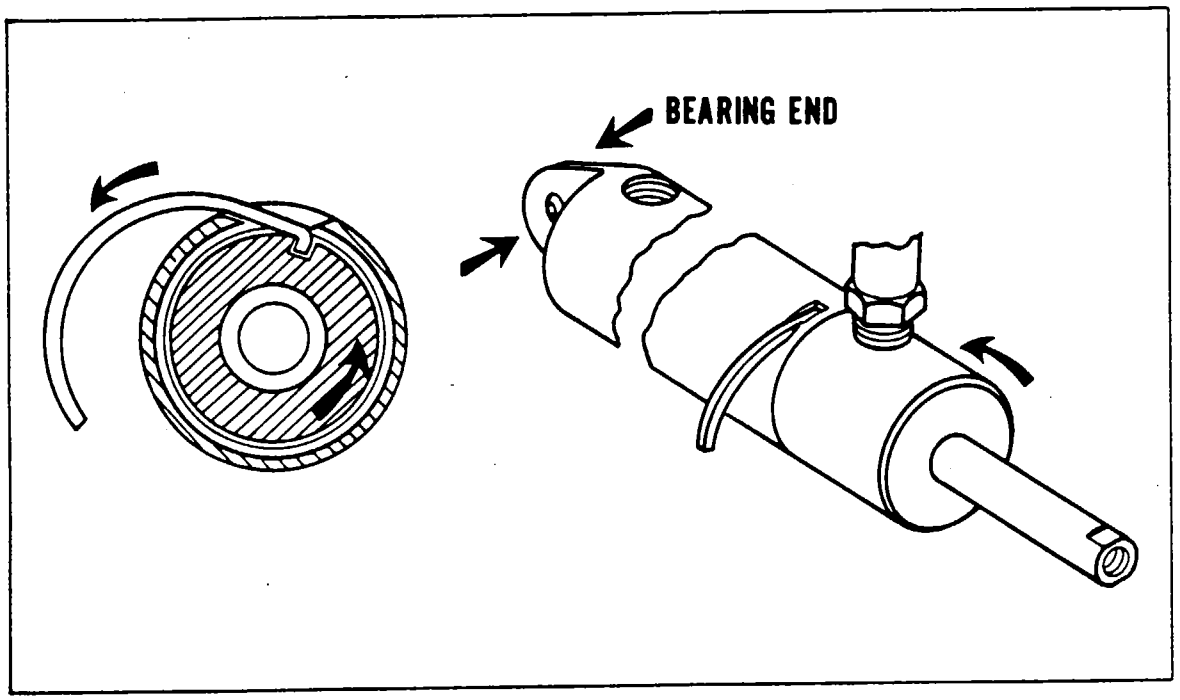


Figure 5A-8. End Gland Locking Device (Main Gear)

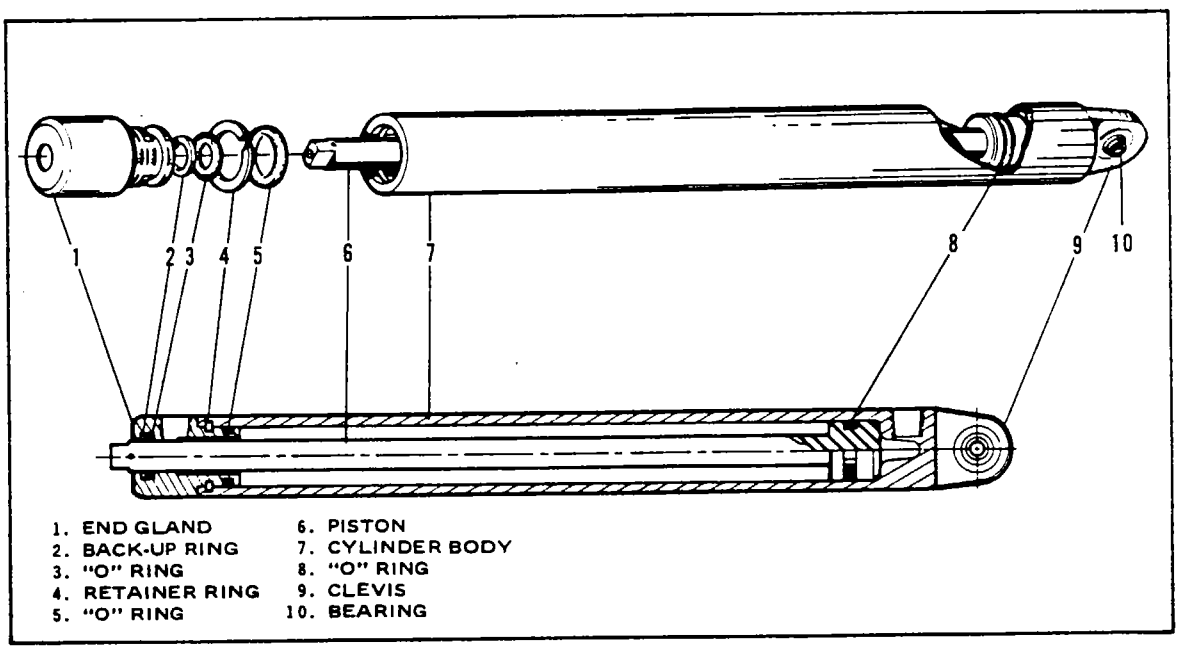


Figure 5A-9. Main Gear Actuating Cylinder

5A-20. INSTALLATION OF NOSE GEAR ACTUATING CYLINDER.

a. Attach the cylinder to its attachment fitting using bolt and nut.

b. Attach the operating rod end to the downlock, this will require manually unlocking the nose gear to allow clearance from the engine mount to install attaching bolt. (Refer to Caution Note Paragraph 5A-16).

c. Connect the hydraulic lines to the cylinder fittings.

d. Check the adjustment of the cylinder rod end. (Refer to Adjustment of Nose Landing Gear, Section VIA.)

e. Operate pump to purge system of air and check fluid level in reservoir.

f. Remove the airplane from jacks.

5A-21. MAIN GEAR ACTUATING CYLINDER.

5A-22. REMOVAL OF MAIN GEAR ACTUATING CYLINDER.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.

c. Disconnect the gear downlock spring from the swivel fitting at the upper end of the spring.

d. Remove the downlock spring swivel fitting and disconnect the cylinder operating rod end from the upper side brace retraction fitting by removing the attaching nut, washer and bolt.

e. Disconnect the cylinder from its attachment by removing nut and bolt.

f. Remove the cylinder from the wheel well.

5A-23. DISASSEMBLY OF MAIN GEAR ACTUATING CYLINDER. (Refer to Figure 5A-9.)

a. With the cylinder removed from the airplane, push the piston rod (6) (by hand) toward the clevis (9) to remove oil from the unit.

b. Put clevis (9) only in a soft jaw vise and clamp against the clevis bearing (10).

c. If no pipe fitting is installed in the port of the end gland (1), install a fitting (1/8 - 27) into the port. This fitting need not be tight as it will be used for leverage only.

d. Rotate the gland counterclockwise (with use of fitting) until the end of the gland lock ring (4) shows in the slot in the cylinder body (7). Reverse rotation of the gland (clockwise direction) to allow the lock ring to move out of the slot. (Refer to Figure 5A-8.) (It may be necessary to give the ring an assist to start out of the slot. If so, insert a strong wire pick or other available tool in the slot to lift up the end of the ring and then rotate gland.)

e. Pull the piston (6) and end gland from the cylinder.

f. Remove O-rings as desired.

5A-24. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR ACTUATING CYLINDER.

a. Clean the cylinder parts with a suitable dry type solvent and dry thoroughly.

b. Inspect the cylinder assembly for the following:

1. Interior walls of cylinder and exterior surfaces of piston for scratches, burrs, corrosion, etc.

2. Threaded areas for damage.

3. End fitting retainer slot for excess wear.

4. Rod end fitting and swivel fitting of cylinder for wear and corrosion.

c. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and replacing components. (Refer to Parts Catalog for replacement part numbers.)

5A-25. ASSEMBLY OF MAIN GEAR ACTUATING CYLINDER. (Refer to Figure 5A-9.)

a. Install O-ring (5) on the exterior of the end gland (1).

b. Install O-ring (3) and back-up ring (2) in the interior of the end gland.

c. Install O-ring (8) on the body of the piston assembly.

d. Lubricate the areas around the O-rings with hydraulic fluid, park-o-lube or vaseline; slide the end gland on the piston rod and the piston into the cylinder housing (7).

e. Insert the hook end of a new lock ring (4) (P/N 755 997) in the slot in the cylinder body (7) and slot in the end gland (1). Rotate gland counterclockwise to completely wrap lock ring into assembly.

f. Align port in end gland and cylinder body.

g. Check smoothness of operation of piston and static pressure test unit to check for possible cut O-rings.

5A-26. INSTALLATION OF MAIN GEAR ACTUATING CYLINDER.

a. Attach the cylinder to its attachment fitting in the wheel well using bolt and nut.

b. Attach the operating rod end and downlock spring swivel fitting to the upper side brace retraction fitting by using bolt, washer and nut. Ascertain swivel fitting is free to rotate.

c. Connect the downlock spring to the swivel fitting.

d. Check the adjustment of the cylinder rod end. (Refer to Adjustment of Main Landing Gear, Section VIA.)

e. Operate pump to purge system of air and check fluid level in reservoir.

f. Remove the airplane from jacks.

5A-27. HYDRAULIC LINES.

5A-28. REMOVAL AND INSTALLATION OF HYDRAULIC LINES. Remove a damaged hydraulic line by disconnecting the fitting at each end and by disconnecting where secured by brackets. Refer to Figure 5A-2 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. Operate the pump to purge the system of air and check fluid level in reservoir.

5A-29. TESTING HYDRAULIC SYSTEM. The hydraulic system should be tested to determine that it functions properly after performing any service or repairs. It is suggested that the airplane be connected to an outside power source in order to conserve the battery. (Refer to External Power Receptacle, Section II.)

CAUTION

Turn master switch OFF before inserting or removing external power supply plug.

a. Place airplane on jacks. (Refer to Jacking, Section II.)

b. With gear down, master switch ON, and circuit breaker closed, place landing gear selector switch in the UP position. The pump should immediately start operating and the gear retract. The red gear unsafe light on the instrument panel should light up until the gear is fully retracted. The hydraulic pump should stop operating after full gear retraction.

c. Place gear selector switch in DOWN position. The gear should extend and lock in position. Gear down lights on the instrument panel will light up when all three gears are locked in position. Inspect hydraulic system for leakage of hydraulic fluid.

d. Recycle the landing gear to determine that it functions properly.

CAUTION

Prior to removing the airplane from jacks, turn master switch on and determine that all three green lights are energized. This will indicate the landing gear is down and locked.

e. To check operation of gear back-up extender actuator, refer to Paragraph 5A-14 for Check and Adjustment Procedures.

5A-30. SERVICING HYDRAULIC PUMP/RESERVOIR. The fluid level of the reservoir of the combination pump and reservoir should be checked every 50 hours by viewing the fluid through the filler plug hole in the hydraulic pump. Access to the pump is through the panel at the left side of forward baggage compartment.

To check fluid level, remove the filler plug located on the forward side of the pump and ascertain that fluid is visible up to the bottom of the filler plug hole. Should fluid be below the hole, loosen the vent screw and add fluid, MIL-H-5606A, through the filler hole until full. Reinstall the filler plug and tighten the vent screw.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Landing gear retraction system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wiring.
	Landing gear selector circuit wires broken.	Check wiring.
	Safety (squat) switch out of adjustment.	Readjust switch. (Refer to Adjustment of Safety Switch, Section VIA.)
	Squat switch inoperative.	Replace switch.
	Pressure switch inoperative.	Replace switch.
	Pump retraction solenoid inoperative (inboard solenoid).	Replace solenoid.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
NOTE If the retracting solenoid of the pump can be heard to actuate when operating the gear selector switch, it may be assumed that the gear control circuit is operating properly and the actuator circuit should be further checked.		
Landing gear retraction system fails to operate. (cont.)	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
	Hydraulic pump ground incomplete.	Check ground.
	Hydraulic pump inoperative.	Replace or overhaul pump.
	Auxiliary extender switch inoperative.	Replace unit.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Battery low or dead.	Check condition of battery.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear retraction system fails to operate. (cont.)	Pressure head air passage obstructed. *	Clear obstruction.
	Pressure head hose off. *	Reconnect hose.
	Split or hole in diaphragm of auxiliary extender. *	Refer to latest revision of Piper Service Letter No. 810.
	* Can be checked by using override.	
Landing gear extension system fails to operate.	Landing gear actuator circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Landing gear actuator circuit wires broken.	Check wiring.
	Landing gear selector circuit wires broken.	Check wiring.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear extension system fails to operate. (cont.)	Pump extension solenoid inoperative (outboard solenoid).	Replace solenoid.
NOTE If the extension solenoid of the pump can be heard to actuate when operating the gear selector switch, it may be assumed that the gear control circuit is operating properly and the actuator circuit should be further checked.		
	Gear selector switch ground incomplete.	Check ground.
	Gear selector switch inoperative.	Replace switch.
	Hydraulic pump ground incomplete.	Check ground.
	Hydraulic pump inoperative.	Replace or overhaul pump.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Low or dead battery.	Check condition of battery.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear retraction extremely slow.	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
	Restriction in hydraulic lines.	Isolate and check hydraulic lines.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear retraction.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Pressure switch out of adjustment.	Remove and readjust or replace switch.
	Mechanical restriction or obstruction in hydraulic system to allow pressure to build up and shut off pump before gear has retracted.	Place airplane on jacks and run retraction check. Isolate and determine cause.
	Shuttle valve sticking in pump base.	Check cause.
Pump stops during gear extension.	Landing gear actuator circuit breaker opens.	Reset circuit breaker and determine cause for overload.
	Landing gear selector circuit breaker opens.	Reset circuit breaker and determine cause for overload.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted.	Pressure switch inoperative.	Replace switch.
	Pressure switch out of adjustment.	Replace switch.
	Pump retraction solenoid sticking (inboard solenoid).	Replace solenoid.
	Internal leakage of system.	Check back-up extension unit valve for internal leakage.
		Check gear actuating cylinders for internal leakage.
		Check for internal damage to hydraulic pump.
	External leakage of system.	Check back-up extension unit valve for external leakage.
		Check gear actuating cylinders for external leakage.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Pump fails to shut off though gear has fully retracted. (cont.)	External leakage of system.(cont.)	Check for broken or damaged hydraulic lines or hoses.
	Pump relief valve out of adjustment.	Replace pump.
Pump fails to shut off though the gear has fully extended.	Pump extension solenoid sticking (outboard solenoid).	Replace solenoid.
	Nose gear down limit switch actuator out of adjustment.	Adjust switch actuator. (Refer to Adjustment of Nose Gear Down Limit Switch, Section VIA.)
	Nose gear down limit switch failed.	Replace switch.
	Main gear down limit switch out of adjustment.	Adjust switch. (Refer to Adjustment of Main Gear Down Limit Switch, Section VIA.)
	Main gear down limit switch failed.	Replace switch.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
NOTE The out of adjustment or failed switch may be determined by noting which down light is not lit.		
Pump running intermittently after gear has retracted.	Leakage of high pressure check valve. Internal leakage of system. External leakage of system.	Remove pump and replace check valve. Check auxiliary retraction unit valve for internal leakage. Check gear actuating cylinders for internal leakage. Check back-up extension unit valve for external leakage. Check gear actuating cylinders for external leakage. Check for broken or damaged hydraulic lines.
Gear stops part way up, but pump continues to run.	Pump high pressure relief valve out of adjustment.	Replace pump.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Gear stops part way up, but pump continues to run. (cont.)	Internal leakage of system.	Check back-up extension unit valve for internal leakage. Check gear actuating cylinders for internal leakage. Check for broken or damaged hydraulic lines.
	Hydraulic fluid in reservoir below operating level.	Fill reservoir with hydraulic fluid.
All gears fail to free fall.	Back-up extension unit valve fails to open.	Check unit and valve and replace.
Gear free falls at air speeds above that required.	Back-up extender unit hydraulic valve fails to close.	Check extender unit spring adjustment. Check hydraulic valve for sticking open. Check extender unit diaphragm for damage. Check for restriction in air pressure and static lines.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear fails to operate at required speeds. (Gear up at 93 mph, gear down at 118 mph.)	Friction or tight connection at any of the attachment points (pivot points) of the override control components.	Clean, free and lubricate all pivot points.
	Binding of diaphragm shaft caused by build up of sand or dirt.	Clean all moving parts.
Landing gear will not retract after selecting up at an airspeed above actuator speed. (Also, upon trying to override it is found that only with a steady pressure can the override be activated. After gear does retract and the override lever (manual extruder) is relaxed (approximately 11 to 15 seconds) the gear will fall free.	Restriction in pressure head of gear back-up extender actuator.	Disconnect hoses at back-up extender and clean out hoses and head.

TABLE VA-III. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
With gear selector down and three green lights on, gear unsafe light comes on or intermittently on.	Shorted gear up solenoid.	Replace solenoid.
With gear selector down and three green lights on, pump motor circuit breaker opens.	Shorted gear up solenoid.	Replace solenoid.
With gear unsafe light on, pump operates on and off.	Shorted gear down solenoid.	Replace solenoid.
With gear unsafe light on, pump motor circuit breaker opens.	Shorted gear down solenoid.	Replace solenoid.
With override lever up, auto extension off light fails to operate.	Auto extension off switch actuator out of adjustment.	Adjust switch. (Refer to Section VA, Paragraph 5A-2 for switch location) by moving mounting bracket at attachment slot. Adjust switch until actuator is closed when emergency gear handle is in override position and open when handle is in neutral.
	Auto extension off switch failed.	Replace switch.
	Auto extension off flasher failed.	Replace flasher.

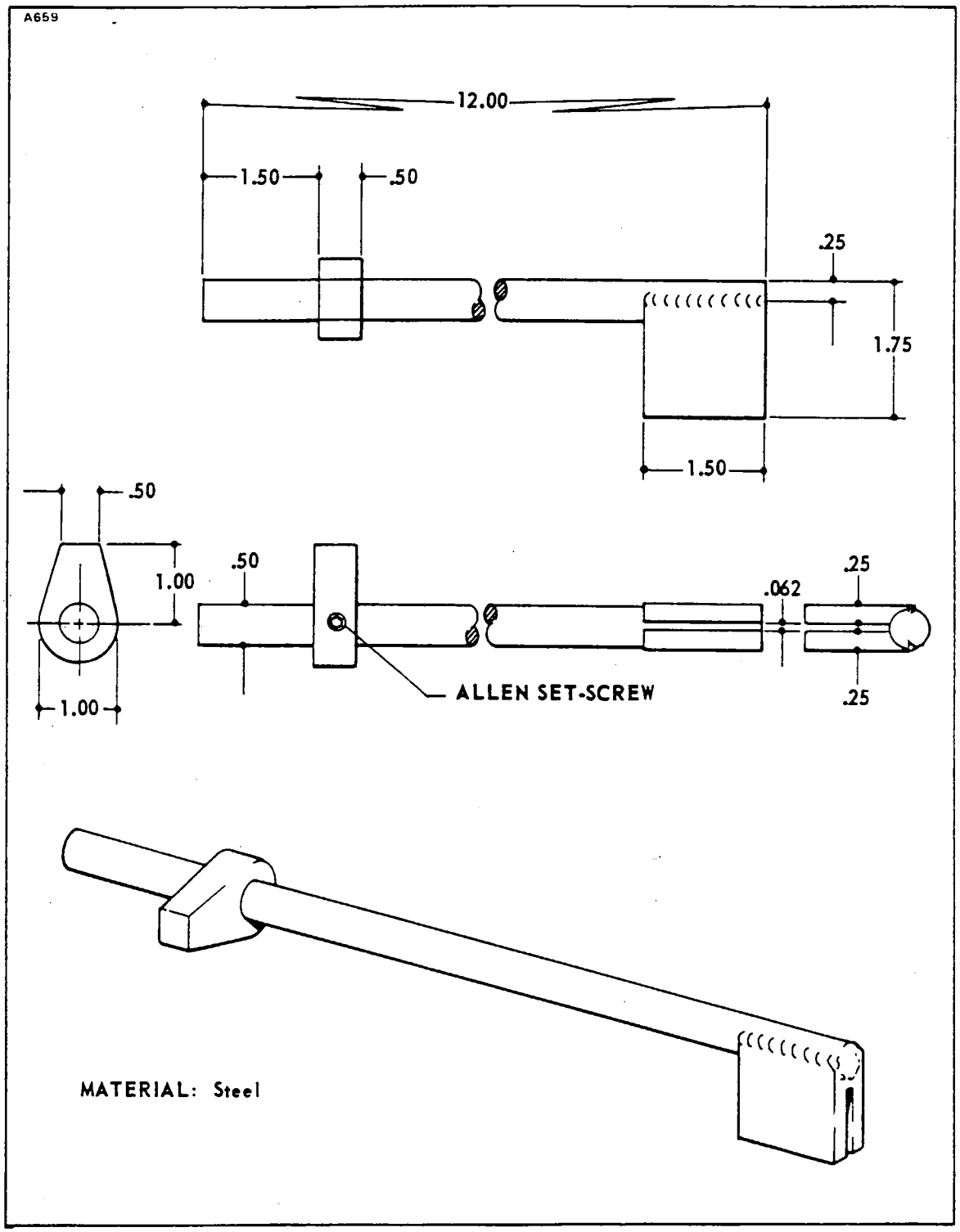


Figure 5A-10. Gear Back-Up Extender Actuator Aligning Tool

GRIDS 1K12 THRU 1L24 INTENTIONALLY LEFT BLANK



CHEROKEE SIX

Service Manual

PA-32-260 PA-32-300 PA-32R-300

CARD 2 OF 3

PIPER AIRCRAFT CORPORATION

Published by
PUBLICATIONS DEPARTMENT
Piper Aircraft Corporation

753 690

2A1

AEROFICHE EXPLANATION AND REVISION STATUS

The Service Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aviation Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Service Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual Table of Contents is for all fiche in this set.
2. A complete list of Illustrations is given and follows the Table of Contents.
3. A complete list of Tables is given for all fiche in this set and follows the list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:
   Revised text and illustrations are indicated by a black 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.
6. Revisions to this Service Manual 753 690 issued May 1, 1965 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
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PR760618	June 18, 1976	—
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PR780918	September 18, 1978	1, 2 & 3
PR791204	December 4, 1979	1, 2 & 3
PR801215	December 15, 1980	1, 2 & 3
PR810803	August 3, 1981	1, 2 & 3
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IR860430	April 30, 1986	1
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IR870506*	July 12, 1987	1

This publication contains material revised as of November 4, 1983 (with three interim revisions effective April 30, 1986, July 30, 1986, and May 6, 1987).

* INTERIM CHANGE

Revisions appear in Table III-I and Table III-II of card 1. There are no other changes included in this maintenance manual. Please discard your current card 1 and replace it with this revised one. DO NOT DISCARD CARDS 2 or 3.

The date on Aerofiche cards should not be earlier than the date noted for the respective card effectivity. Consult the latest card in this series for current Aerofiche card effectivity.

TABLE OF CONTENTS

SECTION	AEROFICHE CARD NO. 1	GRID NO.
I	INTRODUCTION	1A13
II	HANDLING AND SERVICING	1A17
III	INSPECTION	1D10
IV	STRUCTURES	1E14
V	SURFACE CONTROLS	1G11
VA	HYDRAULIC SYSTEM (PA-32R-300)	1I22
	AEROFICHE CARD NO. 2	
VI	LANDING GEAR AND BRAKE SYSTEM (PA-32-260/300)	2A8
VIA	LANDING GEAR AND BRAKE SYSTEM (PA-32R-300)	2C5
VII	POWER PLANT (PA-32-260)	2E14
VIIA	POWER PLANT (PA-32-300 & 32R-300)	2G4
VIII	FUEL SYSTEM	2I19
IX	INSTRUMENTS	2J14
	AEROFICHE CARD NO. 3	
X	ELECTRICAL SYSTEM	3A8
XI	ELECTRONICS	3F7
XII	HEATING AND VENTILATING	3F21
XIII	ACCESSORIES AND UTILITIES	3G8

LIST OF ILLUSTRATIONS

Figure		Aerofiche Grid No.
6-1.	Nose Gear Oleo Strut Assembly	2A12
6-2.	Nose Gear Installation	2A16
6-3.	Clamping Rudder Pedals in Neutral Position	2A18
6-4.	Rudder Pedals at Neutral Angle	2A18
6-5.	Main Gear Oleo Strut Assembly, Cylinder Housing 65319	2A22
6-6.	Main Gear Oleo Strut Assembly, Cylinder Housing 65441	2A23
6-7.	Main Gear Installation	2B1
6-8.	Nose Wheel Assembly	2B4
6-9.	Main Wheel Assembly	2B6
6-9a.	Removal and Installation of Anchor Bolts	2B8
6-10.	Wheel Brake Assembly	2B10
6-11.	Brake System Installation	2B12
6-12.	Brake Master Cylinder (Hand/Parking Brake)	2B13
6-13.	Toe Brake Installation	2B15
6-14.	Brake Cylinder 10-20 (Toe Brake)	2B17
6-15.	Brake Cylinder 10-27 (Toe Brake)	2B17
6-15a.	Brake Cylinder 10-30 (Toe Brake)	2B18
6-15b.	Brake Cylinder 17000 (Toe Brake)	2B18
6-16.	Bleeding Brake (Gravity)	2B20
6-17.	Bleeding Brake (Pressure)	2B20
6A-1.	Nose Gear Oleo Strut Assembly	2C12
6A-2.	Nose Gear Installation	2C14
6A-2a.	Nose Gear Service Tolerances	2C15
6A-2b.	Main Gear Service Tolerances	2C19
6A-2c.	Adjustment of Eccentric Bushing	2C24
6A-3.	Nose Gear Adjustment	2D1
6A-4.	Clamping Rudder Pedals in Neutral Position	2D3
6A-5.	Rudder Pedals at Neutral Angle	2D3
6A-6.	Nose Gear Doors	2D4
6A-7.	Main Gear Oleo Strut Assembly	2D7
6A-8.	Main Gear Installation	2D13
6A-9.	Aligning Main Gear	2D19
6A-10.	Adjustment of Nose Gear Down Limit Switch	2D22
6A-11.	Adjustment of Main Gear Down Limit Switch	2D22
6A-12.	Throttle Warning Switches	2D24
6A-13.	Nose Wheel Assembly	2E2
7-1.	Propeller System Installation (Constant Speed)	2E18
7-2.	Typical Nicks and Removal Method	2E18
7-2a.	Propeller Installation	2E19
7-3.	Propeller Governor	2E21
7-4.	Engine Installation	2E23
7-4a.	Adjustment of Engine Controls	2F3
7-5.	Carburetor	2F4
7-6.	Magneto Inspection	2F8
7-7.	Impulse Coupling	2F9
7-8.	Magneto Timing Marks	2F10
7-9.	Timing Pointer	2F10
7-10.	Timing Kit Installed	2F11
7-11.	Breaker Compartment with Cast Timing Marks	2F11

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
7-12.	Removing Spark Plug Frozen to Busing	2F16
7A-1.	Propeller Installation	2G7
7A-2.	Typical Nicks and Removal Method	2G8
7A-3.	Propeller Governor	2G11
7A-4.	Engine Installation	2G14
7A-4a.	Adjustment of Engine Control	2G16
7A-5.	Schematic Diagram of RSA Fuel Injection System	2G19
7A-6.	Fuel Injector	2G20
7A-7.	Fuel-Air Bleed Nozzle	2G22
7A-8.	Contact Points	2G23
7A-9.	Rotor Holding Tool Installed	2H1
7A-10.	Timing Kit Installed	2H1
7A-11.	Aligning Timing Marks	2H2
7A-12.	Checking Flyweight Clearance of Impulse Coupling	2H3
7A-13.	Engine Timing Marks	2H4
7A-14.	Magneto Timing Marks	2H5
7A-15.	Removing Spring From Lead Assembly	2H7
7A-16.	Assembly Tool	2H7
7A-17.	Using Assembly Tool	2H8
7A-18.	Measuring Lead Assembly Length	2H8
7A-19.	Cutting Metallic Braid From End of Lead	2H9
7A-20.	Unbraiding Metallic Shielding	2H9
7A-21.	Forming Shielding Around Ferrule	2H10
7A-22.	Ferrule Seating Tool	2H10
7A-23.	Needle	2H10
7A-24.	Measuring Wire From Top of Ferrule	2H11
7A-25.	Installing Grommet Over Lead Assemblies	2H11
7A-26.	Lead Assembly Installed in Grommet	2H11
7A-27.	Wire Doubled Over for Installation of Eyelet	2H11
7A-28.	Height of Spring in Distributor Block Tower	2H13
7A-29.	Timing Light Connected to Magneto	2H15
7A-30.	Timing Marks on Magneto Rotor	2H16
7A-31.	Painted Tooth Centered in Timing Window	2H17
7A-32.	Timing Mark on Rotor Aligned with Pointer	2H17
7A-33.	Timing Light Connected to Magneto and Breakers	2H18
7A-34.	Cam End View of Magneto	2H20
7A-35.	Removing Impulse Coupling	2H21
7A-36.	Checking Flyweight to Stop Pin Clearance	2H21
7A-37.	Stop Pin Installation Dimension	2H22
7A-38.	Checking Flyweight Axial Wear with Drill Shank	2H23
7A-39.	Checking Flyweight Radial Wear With Gauge	2H23
7A-40.	Points of Coupling Body Wear	2H24
7A-41.	Acceptable and Deformed Coupling Springs	2H24
7A-42.	Checking Impulse Coupling for Magnetization	211
7A-43.	Orientation of Spring in Coupling Body	211
7A-44.	Lifting Inner End of Spring	212

LIST OF ILLUSTRATIONS (cont)

7A-45.	Checking Harness Lead Continuity	213
7A-46.	Checking Harness Lead Insulation Resistance	213
7A-47.	Modified Pliers	214
7A-48.	Ferrule Positioned Under Braid	214
7A-49.	Position of 11-8627 Kit and Contact Spring at Start of Installation	215
7A-50.	Position of 11-8627 Kit and Contact Spring after Installation	215
7A-51.	Lubricating Sleeve	215
7A-52.	Lubricating Ferrule Shoulder	215
7A-53.	Removing Spark Plug Frozen to Bushing	218
8-1.	Fuel System (PA-32-260)	2121
8-2.	Fuel System (PA-32-300)	2122
8-3.	Fuel System (PA-32-300, Serial Nos. 32-7940001 and up; PA-32R-300 All)	2123
8-4.	Fuel Gauge (PA-32R-300)	2J4
8-5.	Fuel Selector and Filter	2J5
8-6.	Fuel Filter	2J6
8-7.	Pulsate (Plunger) Fuel Pump	2J9
9-1.	Instrument Panel, (PA-32-260, Serial Nos. 32-1 to 32-1110 inclusive and PA-32-300, Serial Nos. 32-40000 to 32-40565 inclusive	2J24
9-2.	Instrument Panel, PA-32-260, Serial Nos. 32-1111 to 32-1320	2K1
9-3.	Instrument Panel, PA-32-300, Serial Nos. 32-40566 to 32-41018	2K2
9-4.	Instrument Panel, PA-32-260, Serial Nos. 32-7100001 to 32-7200055	2K3
9-4a.	Instrument Panel, PA-32-260, Serial Nos. 32-7300001 to 32-7400061	2K4
9-4b.	Instrument Panel, PA-32-300, Serial Nos. 32-7140001 to 32-7240147	2K5
9-4c.	Instrument Panel, PA-32-300, Serial Nos. 32-7340001 to 32-7440182	2K6
9-4d.	Instrument Panel, PA-32-260, Serial Nos. 32-7500001 and up	2K7
9-4e.	Instrument Panel, PA-32-300, Serial Nos. 32-7540001 and up	2K8
9-4f.	Instrument Panel, PA-32R-300, Serial Nos. 32R-7680001 and up	2K9
9-5.	Instrument Air System Installation	2K12

LIST OF TABLES

Table		Aerofiche Grid No.
VI-I.	Landing Gear Troubleshooting	2B24
VIA-I.	Nose Gear Service Troubleshooting	2C16
VIA-II.	Main Gear Service Tolerance	2C20
VIA-III.	Toe-In - Toe-Out Correction Chart	2D18
VIA-IV.	Troubleshooting Chart (Landing Gear)	2E4
VII-I.	Propeller Specifications	2E20
VII-II.	Engine Troublshooting Chart	2F19
VIIA-I.	Propeller Specifications	2G9
VIIA-II.	Coupling Torques	2I7
VIIA-III.	Engine Troubleshooting Chart	2I11
VIII-I.	Sender/Fuel Quantity Gauge Tolerances (PA-32-260 and 300)	2J3
VIII-II.	Sender/Fuel Quantity Gauge Tolerance (PA-32R-300 and 32-300 above S/N 32-7940001)	2J5
VIII-III.	Troubleshooting Chart (Fuel System)	2J10
IX-I.	Vacuum System	2J20
IX-II.	Directional Gyro Indicator	2K14
IX-III.	Gyro Horizon Indicator	2K15
IX-IV.	Rate of Climb Indicator	2K16
IX-V.	Altimeter	2K18
IX-VI.	Airspeed Tubes and Indicator	2K20
IX-VII.	Magnetic Compass	2K22
IX-VIII.	Manifold Pressure Indicator	2K23
IX-IX.	Tachometer	2K24
IX-X.	Engine Oil Pressure Gauge	2L1
IX-XI.	Fuel Pressure Gauge	2L2
IX-XII.	Turn and Bank Indicator	2L3
IX-XIII.	Fuel Quantity Indicators	2L4
IX-XIV.	Oil Temperature Indicators	2L5
IX-XV.	Exhaust Gas Temperature Gauge (Alcor)	2L9
IX-XVI.	Cylinder Head Temperature Gauge	2L10
IXXVII.	Fuel Flow Gauge	2L11

SECTION VI
LANDING GEAR AND BRAKE SYSTEM
(PA-32-260 and 300)

Paragraph		Aerofiche Grid No.
6-1.	Introduction	2A10
6-2.	Description	2A10
6-3.	Troubleshooting	2A10
6-4.	Landing Gear System	2A11
6-5.	Nose Landing Gear	2A11
6-6.	Disassembly of Nose Gear Oleo	2A11
6-7.	Cleaning, Inspection and Repair of Nose Gear Oleo	2A13
6-8.	Assembly of Nose Gear Oleo	2A14
6-9.	Removal of Nose Landing Gear	2A15
6-10.	Cleaning, Inspection and Repair of Nose Landing Gear	2A15
6-11.	Installation of Nose Landing Gear	2A15
6-12.	Alignment of Nose Gear	2A17
6-13.	Main Landing Gear	2A19
6-14.	Disassembly of Main Gear Oleo	2A19
6-15.	Cleaning, Inspection and Repair of Main Gear Oleo	2A20
6-16.	Assembly of Main Gear Oleo	2A20
6-17.	Removal of Main Landing Gear	2A24
6-18.	Cleaning, Inspection and Repair of Main Landing Gear	2A24
6-19.	Installation of Main Landing Gear	2B2
6-20.	Wheels	2B2
6-21.	Removal and Disassembly of Nose Wheel	2B2
6-22.	Inspection of Nose Wheel Assembly	2B2
6-23.	Assembly and Installation of Nose Wheel	2B3
6-24.	Removal and Disassembly of Main Wheel	2B3
6-25.	Inspection of Main Wheel Assembly	2B3

	6-26.	Assembly and Installation of Main Wheel	2B5
	6-26a.	Repair of Nose and Main Wheel Assemblies	2B6
6-27.	Brake System		2B7
6-28.	Wheel Brake Assembly		2B7
	6-29.	Brake Adjustment and Lining Tolerance	2B7
	6-30.	Removal and Disassembly of Wheel Brake Assembly	2B7
	6-31.	Cleaning, Inspection and Repair of Wheel Brake Assembly	2B9
	6-32.	Assembly and Installation of Wheel Brake Assembly	2B11
6-33.	Brake Master Cylinder (Hand Parking Brake)		2B11
	6-34.	Removal of Brake Master Cylinder	2B11
	6-35.	Disassembly of Brake Master Cylinder	2B13
	6-36.	Cleaning, Inspection and Repair of Brake Master Cylinder	2B13
	6-37.	Assembly of Brake Master Cylinder	2B14
	6-38.	Installation of Brake Master Cylinder	2B14
6-39.	Brake Cylinder (Toe Brake)		2B16
	6-40.	Removal of Brake Cylinder	2B16
	6-41.	Disassembly of Brake Cylinder	2B16
	6-42.	Cleaning, Inspection and Repair of Brake Cylinder	2B17
	6-43.	Assembly of Brake Cylinder	2B19
	6-44.	Installation of Brake Cylinder	2B21
6-45.	Bleeding Brakes		2B21
	6-46.	Brake Bleeding Procedure (Gravity)	2B21
	6-47.	Brake Bleeding Procedure (Pressure)	2B21
	6-48.	Brake System Leak Check	2B22
	6-49.	Bleeding of Brakes After a Unit Has Been Changed	2B22

Revised: 12/4/79

SECTION VI

LANDING GEAR AND BRAKE SYSTEM

6-1. INTRODUCTION. In this section are instructions for the removal, disassembly, inspection, overhaul and installation of the various landing gear and brake system components used on PA-32 series airplanes. Also included are instructions for the alignment of the nose gear and the repair and service of the brake system.

6-2. DESCRIPTION. The landing gear incorporated on the PA-32 is a fixed, tricycle type, fitted with three 600 x 6 wheels. The landing gear struts are of the air-oil type. The nose gear, steerable through a 60 degree arc, enables a 30 degree turn in each direction. To aid in nose wheel and rudder centering and to provide rudder trim is a spring device attached to the rudder pedal torque tube assembly. A shimmy dampener is also incorporated in the nose wheel steering mechanism.

The two main wheels are equipped with a single disc hydraulic brake assembly which is actuated by a hand lever connected to a cylinder located below and behind the center of the instrument panel, or by individual cylinders attached to each rudder pedal. The hand lever also doubles as a parking brake and may be operated by pulling back on the handle and pushing in on the button at the side of the handle. To disengage the parking brake, pull back on the handle. A brake fluid reservoir is installed on the left forward face of the engine firewall.

6-3. TROUBLESHOOTING. Troubles peculiar to the landing gear are listed in Table VI-I, at the back of this section, along with their probable causes and suggested remedies. When troubleshooting the landing gear system, it may be found that it is necessary to place the airplane on jacks. If so, refer to Jacking, Section II.

6-4. LANDING GEAR SYSTEM.

6-5. NOSE LANDING GEAR.

6-6. DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 6-1.) The nose gear oleo strut assembly may be removed and disassembled from the strut housing with the gear removed from or installed on the airplane.

a. Remove the lower engine cowling by the following procedure:

1. Release the cowl fasteners, two on each side and remove the top cowl.

2. Disconnect the electrical lead to the landing light at the quick disconnect at the inside of the bottom cowl.

3. Remove the bottom cowl attaching screws from around its aft end and remove cowl.

b. Place airplane on jacks. (Refer to Jacking, Section II.)

c. Place a drip pan under the nose gear to catch spillage.

d. To remove air from the strut, depress the air valve core pin found at the top of the strut assembly. After the pressure in the strut chamber has diminished, remove the valve core pin, and attach a small hose to the air valve, and drain the fluid by slowly compressing the piston tube. If it is desirable to extract more fluid from the strut chamber, remove the filler plug, insert the siphon hose and drain fluid from the upper area of the housing.

e. To remove the strut assembly from the strut housing (4), cut the safety wire at the top of the housing that secures the steering horn attaching bolt to the tube retainer nut. Then remove the steering horn attaching bolt and the flat head pin, thus relieving the steering horn from the top of the strut housing.

f. Loosen the strut assembly retainer nut (1) that secures the strut assembly in the strut housing. At the same time, slide the strut assembly out through the bottom of the strut housing. Remove the nut (1) and washer (2) from the top of the strut housing after the assembly is removed.

NOTE

The strut assembly may fit tight inside of the housing. It may be necessary to tap the top of the fork with a plastic mallet.

g. If desired, remove the top and bottom bearing (3 and 5) from the strut housing. The bearings are compressed slightly into place, and light tapping may be needed to free them.

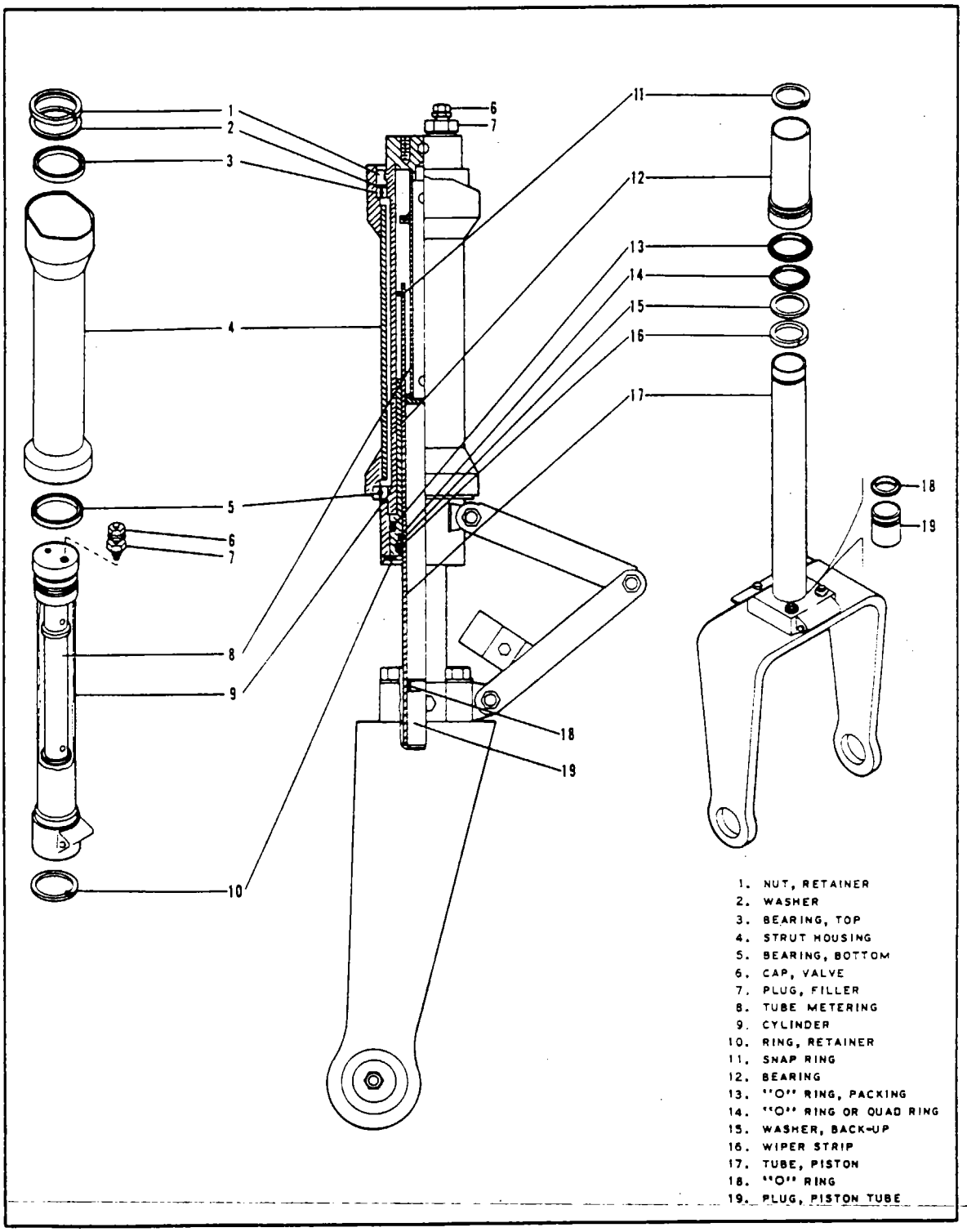


Figure 6-1. Nose Gear Oleo Strut Assembly

h. To remove the piston tube and fork assembly (17) from the cylinder (9), proceed as follows:

1. Separate the upper and lower torque links by removing the connecting nut, washer and bolt.

2. Compress the piston tube and fork assembly slightly and remove the retainer ring (10) from the annular slot in the bottom of the cylinder tube. Then remove piston tube and fork assembly by sliding out from the bottom of the cylinder tube.

i. To remove the bearing assembly from the piston tube, release the snap ring (11) from the top of the piston tube and slide bearing assembly off the end.

1. If desired, carefully remove the wiper strip (16), back-up washer (15) and quad ring or "O" ring (14) from the inside of the bearing sleeve, and also the "O" ring gasket (13) from the outside of the bearing sleeve.

j. To remove the piston tube plug (19) with "O" ring (18) located in the lower end of the tube, the following procedure may be used:

1. Remove the nose wheel from the fork as described in paragraph 6-21.

2. Loosen and remove the bolt, washer and nut that extends through the piston tube and block assembly.

3. Push the plug through the top of the piston tube by use of a rod inserted through the bottom of the tube.

6-7. 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 component for the following:

1. Cylinder tube assembly for corrosion, scratches, nicks and excessive wear.

2. Lock rings for cracks, burrs, wear.

3. Fork assembly for corrosion, scratches, nicks, and misalignment.

4. Link assembly for elongated holes, cracks, corrosion, scratches, nicks and straightness.

5. General condition of air valve.

c. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

6-8. ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 6-1.)

a. Ascertain that all parts are cleaned and inspected.

b. To install the piston tube plug, proceed as follows:

1. Lubricate the tube plug (19) and "O" ring (18) with hydraulic fluid (MIL-H-5606) and install the "O" ring on the plug.

2. Lubricate the inside wall of the piston tube, and insert the plug into the top of the tube, pushing it to the fork end.

3. Align the bolt holes of the fork, tube and plug; install the bolt, washer and nut.

c. Carefully install in the bearing sleeve the quad ring (14), back-up washer (15) and the wiper strip (16). Slide the "O" ring (13) in place on the outside of the sleeve.

d. Lubricate the bearing assembly and carefully install it on the piston tube (17).

e. Position the snap ring (11) on the upper end of the piston tube.

f. Insert the piston tube with bearing assembly in the cylinder tube (9). Secure it with the retainer ring (10) in the annular slot at the bottom of the tube.

g. Connect the torque links on the tube and fork securing them with a bolt, washer and nut. Tighten the nuts only tight enough to retard side play, but still allowing the links to rotate freely.

h. Ascertain that the upper and lower bearings (3 and 5) are installed in the strut housing. Bearings are a press-fit with the grooves in the inner and outer races in the up position.

i. Position washer (2) and strut assembly retainer nut (1) on top of the strut housing. Insert the strut assembly up through the washer until it contacts the nut. Tighten the nut to a snug fit.

j. To install the steering horn assembly, insert the flat head pin through the side of the horn and top of the strut assembly. When it protrudes through the other side of the steering horn, install the washer and secure with a cotter pin.

k. Install the steering horn attaching bolt through the top of the horn into the strut assembly. Do not tighten bolt at this time. If a space appears between the steering horn plate and the top of the strut assembly, it will then be necessary to install spacer washer(s), (AN960-416L), between the horn and strut. Then tighten the bolt and safety the bolt to the strut assembly retainer nut (1) with MS20995C40 wire.

l. 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.

m. Service the oleo strut with fluid and air. (Refer to Oleo Struts, Section II.)

n. Check the gear for alignment. (Refer to Alignment of Nose Landing Gear, paragraph 6-12.)

6-9. REMOVAL OF NOSE LANDING GEAR.

a. Remove the engine cowling by the following procedure:

1. Release the fasteners; two on each side and two at the top of the cowl.

2. Lift the aft end of the top cowl, and then slide it forward to release the two stud type front fasteners. Remove the top cowl.

3. Disconnect the electrical lead to the landing light at the quick disconnect at the right inside of the bottom cowl.

4. Remove the bottom cowl attaching screws from around its aft end and remove the cowl.

b. Remove the propeller. (Refer to Removal of Propeller, Section VII or VIIA.)

c. Place the aircraft on jacks. (Refer to Jacking, Section II.)

d. Remove the engine. (Refer to Removal of Engine, Section VII or VIIA.)

e. Disconnect the two steering rods and boots (3 and 4) (on 1974 models and up, disconnect the bungee assemblies (25) at the nose gear horn assembly by removing the cotter pins, nuts, washers and bolts.

f. Disconnect the oil lines, vacuum lines, fuel lines, hoses, and wires which are secured to the mount with clamps and Koroseal lacing. Mark all wires and lines for identification and reinstallation.

g. Remove the nose gear and engine mount by removing the five bolts which attach the mount to the fire wall.

6-10. CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect the nose gear assembly for the following:

1. Bolts, bearings, and bushings for excess wear, corrosion and damage.

2. Strut housing and torque links for cracks, bends or misalignment.

c. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.

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.

6-11. INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 6-2.)

a. Install the nose gear and engine mount assembly to the fire wall with bolts, washers and nuts. Torque nuts as specified in Torque Requirements, Section II of this manual.

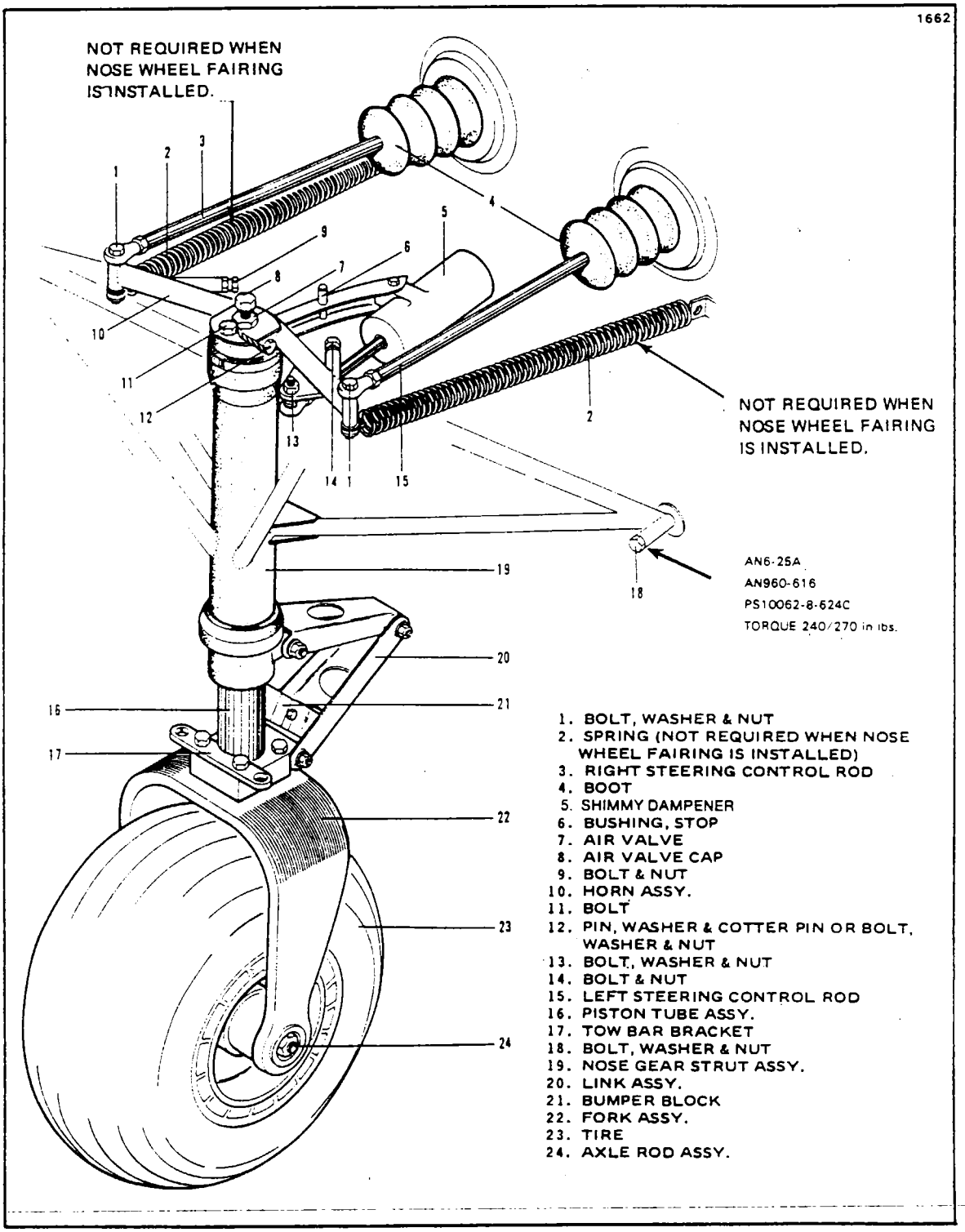


Figure 6-2. Nose Gear Installation

NOTE

To allow for manufacturing tolerances, it will be permissible to use AN960-616 washers as required to permit 1-1/2 to 2-1/2 threads exposed through the nut.

b. Attach the two steering rods (two bungee assemblies on 1974 models and up) to the nose gear steering horn with the bolts, washers and nuts.

c. If removed, connect the shimmy dampener to the steering horn with bolts, washers and nuts. A spacer bushing and cotter pin are required at the body attachment point.

d. Install the engine and connect controls. (Refer to Engine Installation, Section VII or VIIA.)

e. Attach hoses, wires, and cables to engine mount tubing, securing with clamps and Koroseal lacing where required.

f. Check the alignment of the nose gear per Paragraph 6-12.

g. Remove the aircraft from the jacks.

h. Install the propeller (refer to Installation of Propeller, Section VII or VIIA) and engine cowling.

6-12. ALIGNMENT OF NOSE GEAR.

a. Place the aircraft on a smooth level floor that will accommodate the striking of a chalk line.

b. Place the aircraft on jacks. (Refer to Jacking, Section II.)

c. Level the aircraft laterally and longitudinally. (Refer to Leveling, Section II.)

d. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.

e. Extend a chalk line from the mark on the floor below the tail skid to a point approximately three feet forward of the nose wheel. Allow the line to pass under the wheel at the center of the tire. Snap the chalk line.

f. Clamp the rudder pedals to align in a lateral position. (Refer to Figure 6-3.)

g. Adjust the rod end bearings of each steering control rod (on 1974 models and up, adjust rod end bearings on bungee assembly) to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle fore and aft. 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 straightedge with the chalk line. With the aircraft level, the neutral angle of the rudder pedal is 11 degrees (14 degrees on 1974 models and up) aft of the vertical line. Place a bubble protractor against a pedal steering tube to check this angle. (Refer to Figure 6-4.) One end of each rod must be disconnected and jam nuts loosened to make this adjustment, but do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of each rod. Check that rod ends have sufficient thread engagement by ascertaining that a wire will not go through the check hole in the rod. (Rods without check holes maintain a minimum of three-eighths of an inch thread engagement.) Reinstall rods; safety and tighten jam nuts.

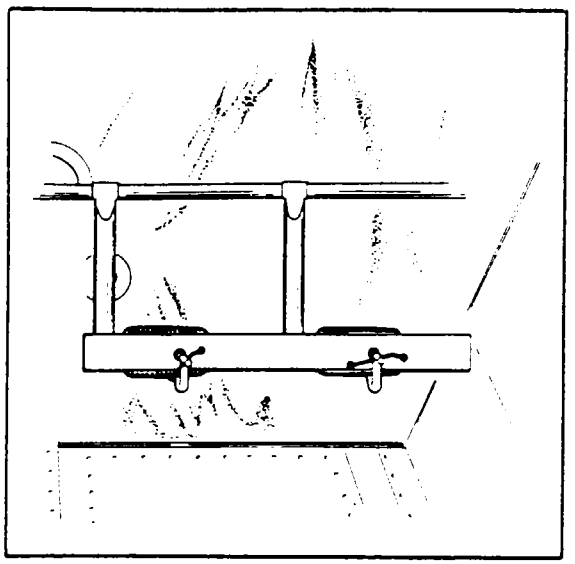


Figure 6-3. Clamping Rudder Pedals in Neutral Position

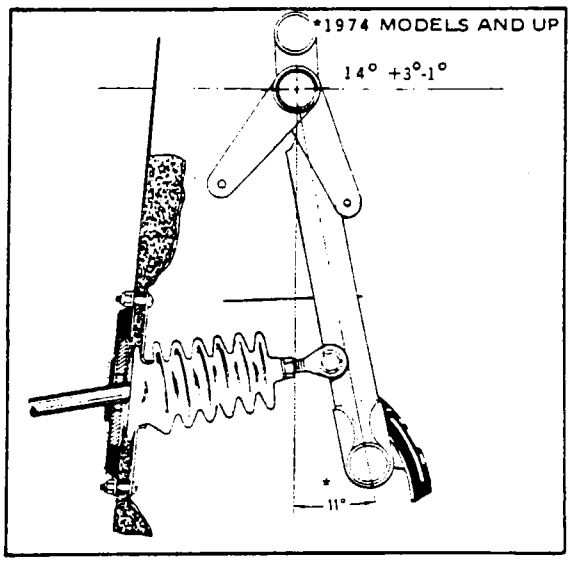


Figure 6-4. Rudder Pedals at Neutral Angle

h. To check nose gear steering for its 30 degrees maximum right and left travel, mark on each side of the nose wheel a 30 degree angle line from centerline and wheel pivot point. Turn wheel to maximum travel in both directions to check for allowable travel. Should the travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

i. When the wheel is turned to its extreme right or left travel, there should be .06 to .12 of an inch clearance between the nose wheel steering stops. This is due to the stops on the rudder making contact ahead of the nose gear steering stops. Prior to checking and/or making this adjustment, ascertain that the rudder travel is correct per Rigging and Adjustment of Rudder, Section V.

j. Adjust shimmy dampener by turning the nose wheel against its stops and adjusting the rod end of the dampener for adequate travel to both directions.

k. Remove the aircraft from jacks.

NOTE

When the nose wheel fairing is removed, centering springs should be installed for proper nose wheel centering. Refer to the latest revision of Piper Service Bulletin No. 291 for more information.

6-13. MAIN LANDING GEAR.

6-14. DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 6-5 or 6-6.) The main gear axle (19) and piston tube assembly (18) may be removed from the cylinder housing (9) with the gear removed from or installed on the airplane. The metering components of the gear, located in the top of the housing, may be removed only with the gear removed from the airplane.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Place a drip pan under the main gear to catch spillage.

c. The gear axle and piston tube assembly may be removed by the following procedure:

1. Remove the air from the oleo chamber by depressing the air valve core pin found in the inspection hole on top of the wing. After the pressure in the oleo chamber has diminished, remove the valve core pin, attach a small hose to the air valve, and drain the fluid by slowly compressing the piston tube. If it is desirable to extract more fluid from the chamber, remove the filler plug, insert a siphon hose and drain fluid from the upper area of the housing.

2. Disconnect the flexible brake line at the elbow on the brake assembly.

3. Disconnect the torque link assembly by removing any one of the three cotter pins, nuts, washers and bolts. Note arrangement of the components for reinstallation. Carefully slide the piston tube from the cylinder housing.

4. The scraper ring (15) located inside the lower end of the cylinder housing may be removed by first removing the retainer ring (17), spacer ring (16) and then the scraper ring.

5. The "O" ring seal (14) located just above the scraper ring, may be removed by using a curved wire or spoon shaped tool and inserting it under the ring.

d. To remove the metering components, located in the upper portion of the cylinder housing, the housing must first be removed from the spar assembly as described in paragraph 6-17. There are two types of housing and metering components used, and these may be removed by the following procedure:

NOTE

To distinguish the two types of oleo housing with their metering components, part numbers have been cast on the housings and should be used when referring to the landing gear for parts and service. The following information will be helpful in locating these numbers. The number 65319 is cast on one type housing below the lower spar attachment flange and on the other, the number 65441 is located between the upper and lower attachment flanges.

1. Cylinder Housing 65319: (Refer to Figure 6-5.)

(a) Cut safety wire and remove the bolts that secure the cylinder head (4) with metering tube (6) in the top of the housing. Remove the assembly from the housing.

(b) The orifice assembly (8) may be removed from within the housing by rotating it counterclockwise out of the housing with the use of a .50 x .125 stud type spanner wrench. Do not remove orifice unless it necessitates replacement.

2. Cylinder Housing 65441: (Refer to Figure 6-6.)

(a) Cut safety wire and remove the bolts that secure the head assembly (4) on the top of the housing. Remove assembly with components from the housing.

(b) The head assembly may be disassembled by turning the head (4) and the orifice plate (8) from the orifice tube (7).

6-15. 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 components for the following:

1. Bearing surfaces of housing for excess wear, corrosion, scratches and overall damage.
2. Retaining ring for cracks, burrs, etc.
3. Cylinder tube for corrosion, scratches, nicks, excessive wear and misalignment.
4. Air valve for operation and general condition.
5. Orifice plate for hole restriction.

c. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents, and replacement of parts.

6-16. ASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 6-5 or 6-6.)

a. Install the metering components within the upper portion of the gear housing. Of these, there are two types of housings and metering components identified by a casting number on the housing and by the distinct shape and size of the metering components as shown in Figures 6-5 and 6-6. The metering components may be installed as follows:

1. Cylinder Housing 65319: (Refer to Figure 6-5.)

(a) Lubricate with hydraulic fluid (MIL-H-5606A) and install an "O" ring (7) in the annular slot in the metering orifice (8).

(b) Insert the orifice through the opening in the top of the gear housing and turn it into the threaded hole web. Tighten the orifice with the use of a stud type spanner wrench.

(c) Lubricate and install an "O" ring or apply a thin layer of Permatex Forma-Gasket No. 6 Sealant directly underneath the flange of the cylinder head (4).

NOTE

On models without the groove for the "O" ring, apply Permatex Form-Gasket No. 6 Sealant beneath the flange of the cylinder head (4).

(d) Insert the tube of the metering assembly through the opening in the top of the housing and into the orifice. Use caution not to cut or dislodge the "O" ring slot in the orifice.

(e) Secure the metering tube assembly with bolts and safety with MS20995-C32 wire.

2. Cylinder Housing 65441: (Refer to Figure 6-6.)

(a) Assemble the head assembly by first placing an "O" ring (6) over the threaded stud of the orifice plate (8) and the head (4). Turn the plate and head on the orifice tube (7).

(b) Lubricate with hydraulic fluid (MIL-H-5606A) and install an "O" ring in the provided slot of the orifice plate and head.

(c) Insert the head assembly into the top of the housing and secure with cap bolts. Safety bolts with MS20995-C32 wire.

b. Assemble the components of the piston tube (18) on the tube by placing, in order, the retainer ring (17), spacer ring (16) and scraper ring (15). Insert an "O" ring (14) into the annular slot in the bottom of the housing.

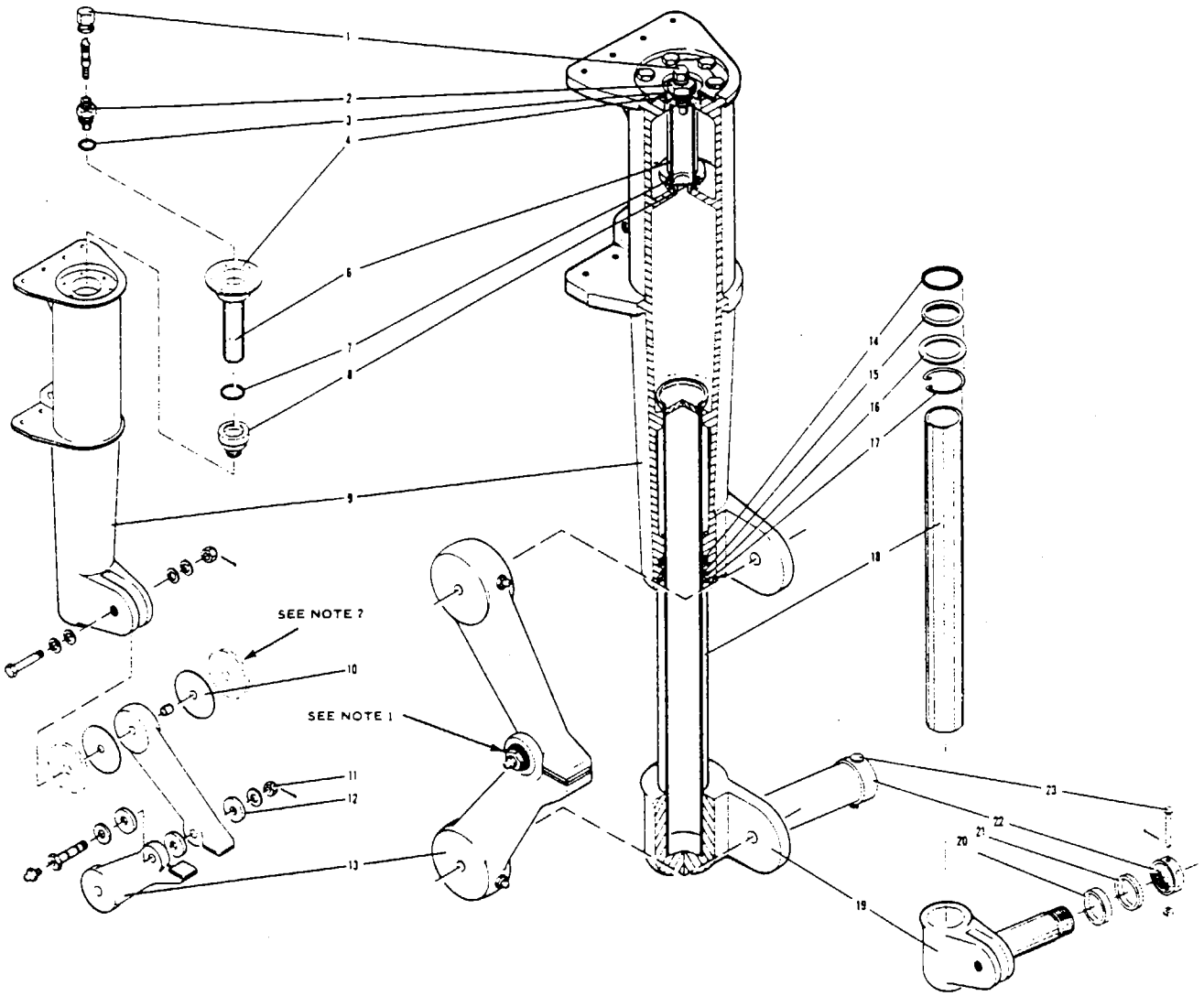
c. Lubricate the wall of the piston and carefully insert it into the housing being careful not to damage or dislocate the "O" ring in the housing.

d. Ascertain that the bushings are installed in the upper and lower torque links and then install links.

NOTE

Links should be loose enough to allow free action of the gear, but also resist side play. To eliminate side play shim washers 63311-03 (.005) may be used as required. Maximum side play .005/.007.

At cable end of each link, install with the use of brake line bracket, bearing washers, bolt, washer, nut and cotter pin. Do not over-tighten causing binding or damage to the link. At the connection point of the upper and lower links, attach with the use of brake line brackets, spacer washers, grease bolt, washers, nut and cotter pins. Install washers (AN960-816L) under the head of the bolt to allow a firm sliding fit between the two links.



1. CAP, VALVE
2. PLUG, FILLER
3. "O" RING
4. HEAD CYLINDER
5. DELETED
6. TUBE, METERING
7. "O" RING
8. ORIFICE ASSEMBLY
9. STRUT HOUSING
10. WASHER
11. NUT
12. WASHER
13. TORQUE LINKS
14. "O" RING OR QUAD RING
15. RING, SCRAPER
16. RING, SPACER
17. RING, RETAINER
18. TUBE, PISTON
19. AXLE STUB
20. SPACER
21. SPACER
22. NUT, WHEEL RETAINER
23. PIN, CLEVIS

NOTE: 1. PART NO. 78033-0 TORQUE LINK ASSEMBLY IS A MATCHED SET AND THEREFORE MUST NOT BE INTERCHANGED WITH 65691-0 TORQUE LINK ASSEMBLY EXCEPT AS A PAIR.

2. LINKS SHOULD BE LOOSE ENOUGH TO ALLOW FREE ACTION OF THE GEAR, BUT ALSO RESIST SIDE PLAY. TO ELIMINATE SIDE PLAY, ONE SHIM WASHER (63311-03 (.005)) PER LINK HINGE MAY BE USED IF REQUIRED. (IF BOTH LINK HINGES REQUIRE SHIMS, MAKE SURE TO INSTALL THE SHIMS ON THE SAME SIDE OF EACH HINGE.) MAXIMUM SIDE PLAY .005/.007.

Figure 6-5. Main Gear Oleo Strut Assembly, Cylinder Housing 65319

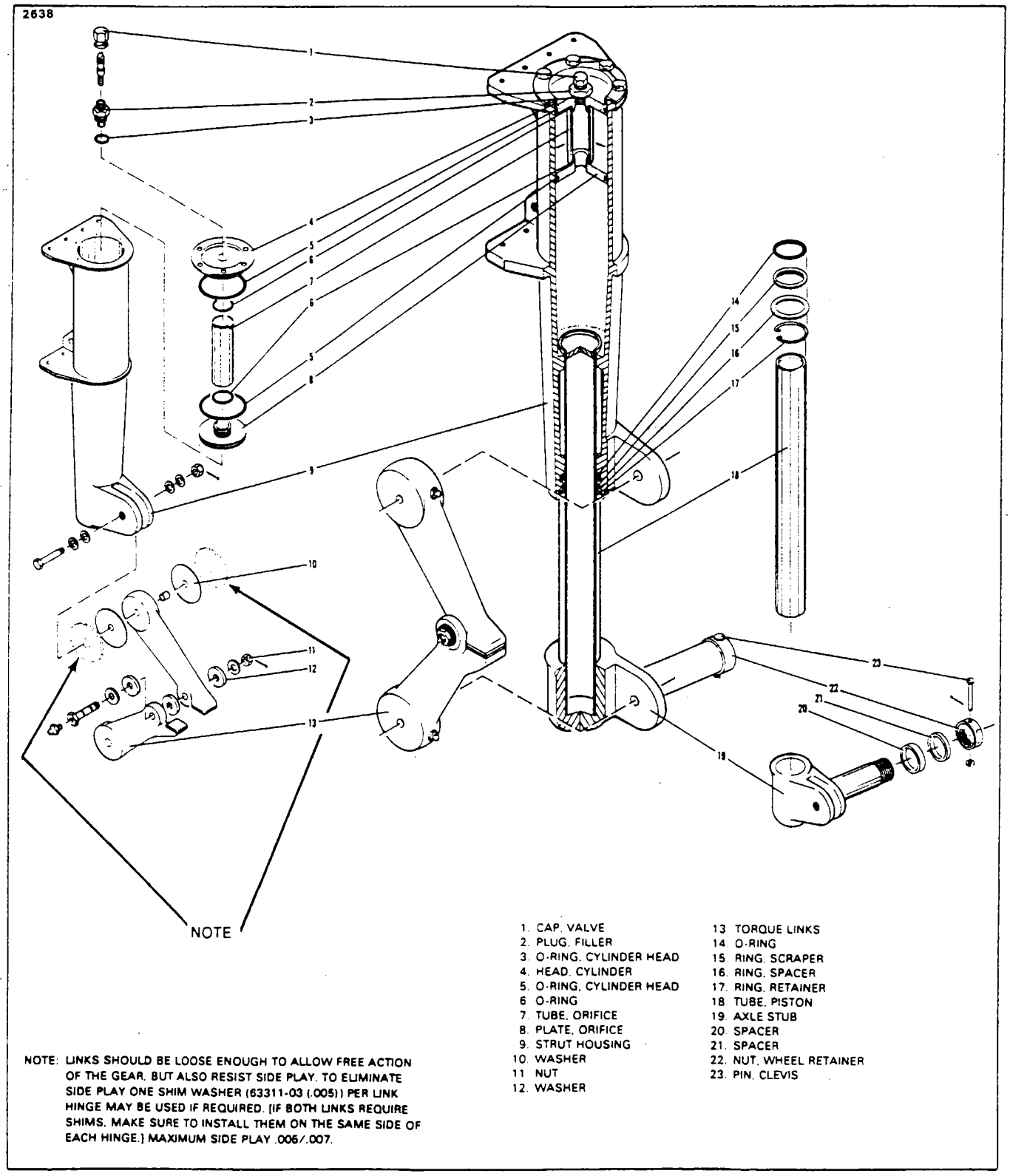


Figure 6-6. Main Gear Oleo Strut Assembly, Cylinder Housing 65441

e. Slide the scraper and spacer rings into place and secure with the retainer ring in the annular slot in the bottom of the housing.
f. Install the hydraulic brake line.
g. If removed, install the landing gear as described in paragraph 6-19.
h. Service the oleo strut as given in Oleo Struts, Section II.
i. Actuate the gear several times by hand to be certain it operates freely.

NOTE

Links should be loose enough to allow free action of the gear, but also resist side play, see Figures 6-5 and 6-6. For lubrication of links, refer to Section II.

j. Remove the drip pan and slowly lower the airplane from the jacks.
k. If necessary, bleed brakes by instructions in paragraph 6-45.

6-17. REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 6-7.)
a. Place the airplane on jacks. (Refer to Jacking, Section II.)
b. Place a drip pan under the main gear to catch spillage.
c. If desired, remove the air from the oleo chamber by depressing the air valve core pin found in the inspection hole on top of the wing. After the pressure in the oleo chamber has diminished, remove the valve core pin and attach a small hose to the air valve and drain the fluid by slowly compressing the piston tube. If it is desirable to extract more fluid from the chamber, remove the filler plug, insert the siphon hose and drain fluid from the upper area of the housing.
d. Remove the fairing from around the cylinder housing and the access plate located on the bottom of the wing and to the rear of the housing by removing attaching screws.
e. Unhook the hydraulic brake line inside the wing assembly. This is accessible through the access plate. Cap the line by use of a threaded cap or wrapping with plastic.
f. Remove the top four bolts by holding them with a slotted screwdriver and turning the nut with the appropriate wrench. Remove the remaining six by use of a wrench. Carefully remove the gear assembly from the wing.

6-18. CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.
a. Clean all parts with a suitable dry type cleaning solvent.
b. Inspect the gear components for excessive wear, corrosion and damage. Check the cylinder housing and torque links for cracks, nicks and misalignment.
c. Check lines for cracks as specified in Section III, Paragraph 3-12.
d. Repair of the landing gear should be limited to reconditioning of parts, replacement of parts, smoothing out nicks and scratches and repainting areas where paint has chipped or peeled.

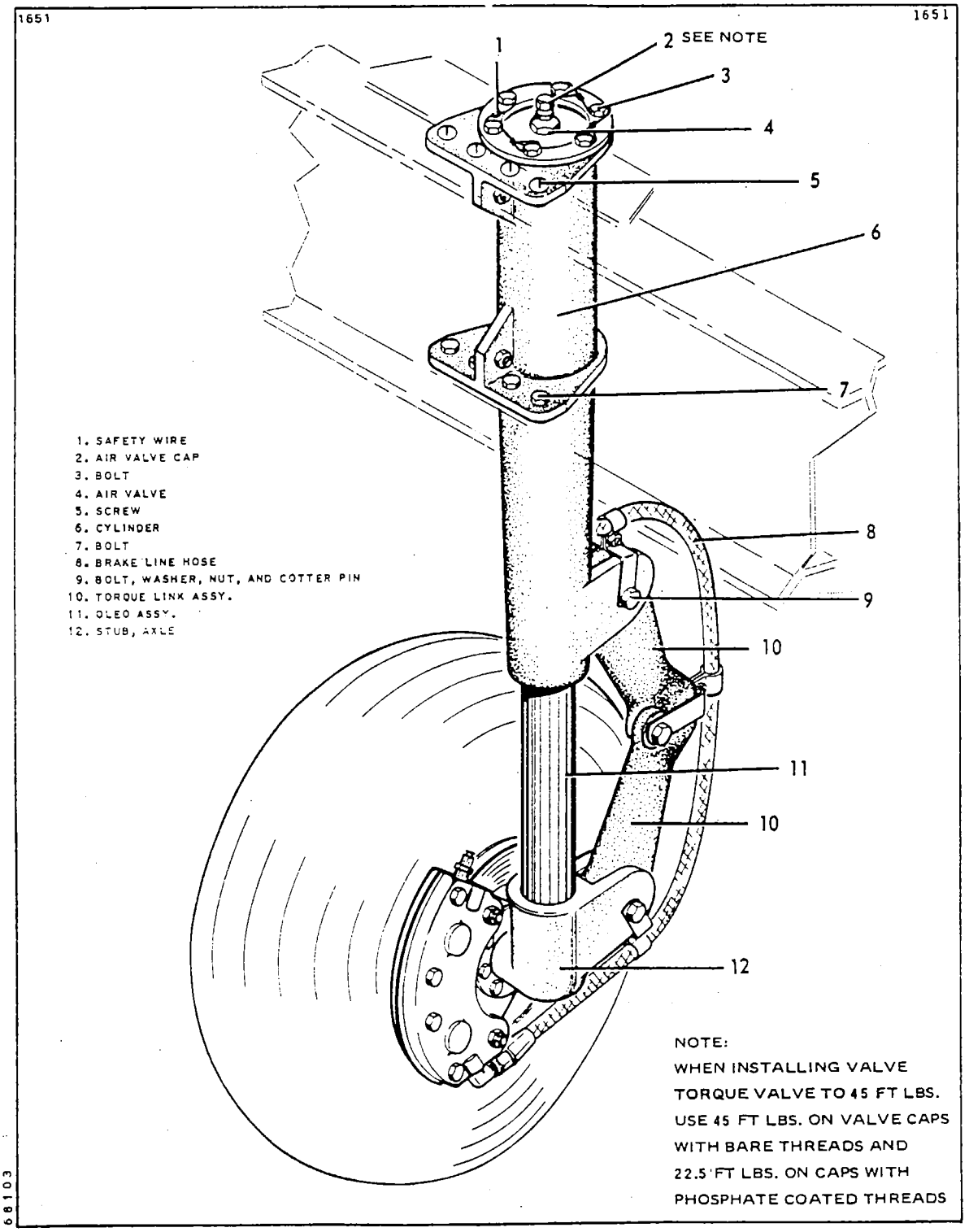


Figure 6-7. Main Gear Installation

6-19. INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 6-7.)

a. The main landing gear assembly may be installed on the wing by the following procedure:

1. Position the gear up in the wing through the access opening and secure with bolts, washers and nuts.

2. Reconnect the brake line at the point of disconnection.

b. Service the oleo strut. (Refer to Oleo Struts, Section II.)

c. Service the brake system. (Refer to Brake System, Section II.)

d. Install the access plate to the bottom of the wing and the oleo housing fairing to the gear.

e. Slide the drip pan from under the gear and remove the airplane from the jacks.

6-20. WHEELS.

6-21. REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 6-8.)

a. Jack the airplane enough to raise the nose wheel clear of the ground. (Refer to Jacking, Section II.)

b. If wheel fairing is installed, remove four bolts, two on each side, and the small plate on top held by metal screws. Slide fairing up on the gear until the wheel is removed.

c. Remove wheel by the following procedure:

1. Remove the nut and washer from one end of the axle rod and slide out the rod and axle plugs.

2. Lightly tap the axle tube out from the center of the wheel assembly by use of an object of near equal diameter.

NOTE

Be certain not to damage the axle tube end in any way. This will make removal and installation extremely difficult.

3. Remove the spacer tubes and the wheel assembly.

4. Slide down wheel fairing and remove by turning it sideways.

d. The wheel halves may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts. Pull the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the other half.

e. The wheel bearing assemblies may now be removed from each wheel half. The bearing cup should be removed only for replacement. See paragraph 6-26a for bearing cup replacement instructions.

6-22. INSPECTION OF NOSE WHEEL ASSEMBLY.

a. Degrease all parts and dry thoroughly.

b. Visually check all parts for cracks, distortion, defects and excess wear.

c. Check tie bolts for looseness or failure.

d. Check internal diameter of felt grease seals for distortion or wear. Replace the felt grease seal if surface is hard or gritty. Lightly coat felt grease seals with SAE 10 oil. (Do not soak felts in oil.)

e. Check tire for cuts, internal bruises and deterioration.

f. Check bearing cones and cups for wear and pitting and relubricate per lubrication chart.

g. Replace any wheel casting having visible cracks.

6-23. ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 6-8.)

a. Ascertain that the bearing cup for each wheel half is properly installed. Ascertain that the index mark on the tube is aligned with the index mark on the tire to insure proper tire, tube and wheel balance. Join the two wheel halves and install the through bolts with washers and nuts. Torque the nuts to torque indicated on the wheel and inflate tire. (Refer to Table II-I, Section II.)

b. Lubricate the bearing cone and install the cone, retainer, grease seal, retainer and retaining ring.

c. Replace the wheel fairing by turning sideways and slipping it up over the fork assembly.

d. Place the spacer tubes one on each side of the wheel and install unit in fork. Align and slide the axle tube through the spacer tubes and wheel assembly. Reinstall the axle plugs and rod with washer and nut. Tighten the nuts until no side play is felt, yet allowing the wheel to rotate freely.

e. Turn fairing so it will fall into place and reinstall it with the four bolts and screws in the small plate.

6-24. REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 6-9.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. To remove the main wheel, remove the cap bolts that join the brake cylinder housing and the lining back plate assemblies. Remove the back plate from between brake disc and wheel.

c. Remove the dust cover, the cotter pin and flat head pin that safeties the wheel nut, and the wheel nut. Slide the wheel from the axle.

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 (9). Pull the wheel halves from the tire by removing the inner half from the tire first, and then the outer half.

e. The wheel bearing assemblies may be removed from each wheel half by first removing the retainer snap rings (13) that secure the grease seal retainers (12 or 15), and then the retainers, grease seals (14) and bearing cone (11). The bearing cups (10) should be removed only for replacement. See paragraph 6-26a for bearing cup replacement instructions.

6-25. INSPECTION OF MAIN WHEEL ASSEMBLY. Inspect brake disc for cracks, excessive wear or scoring, rust, corrosion and warpage. Remove rust and blend out nicks, using fine 400 grit sandpaper. Replace disc if cracked or when disc is worn below minimum thickness. (Refer to paragraph 6-31.) In addition also perform the same inspection given for nose wheel in paragraph 6-22.

At each periodic maintenance inspection, brake disc p/n 164-46 used on wheel assembly 40-120, should be inspected for the development of heat checks on the wearing surface. The brake disc should be replaced if the crack length exceeds .800 or if the crack depth exceeds .210 inch. If the crack depth is not measurable, replace the disc if the crack length exceeds .400. Any crack which extends into the welded seam between the flange and cup is cause for immediate replacement of the disc.

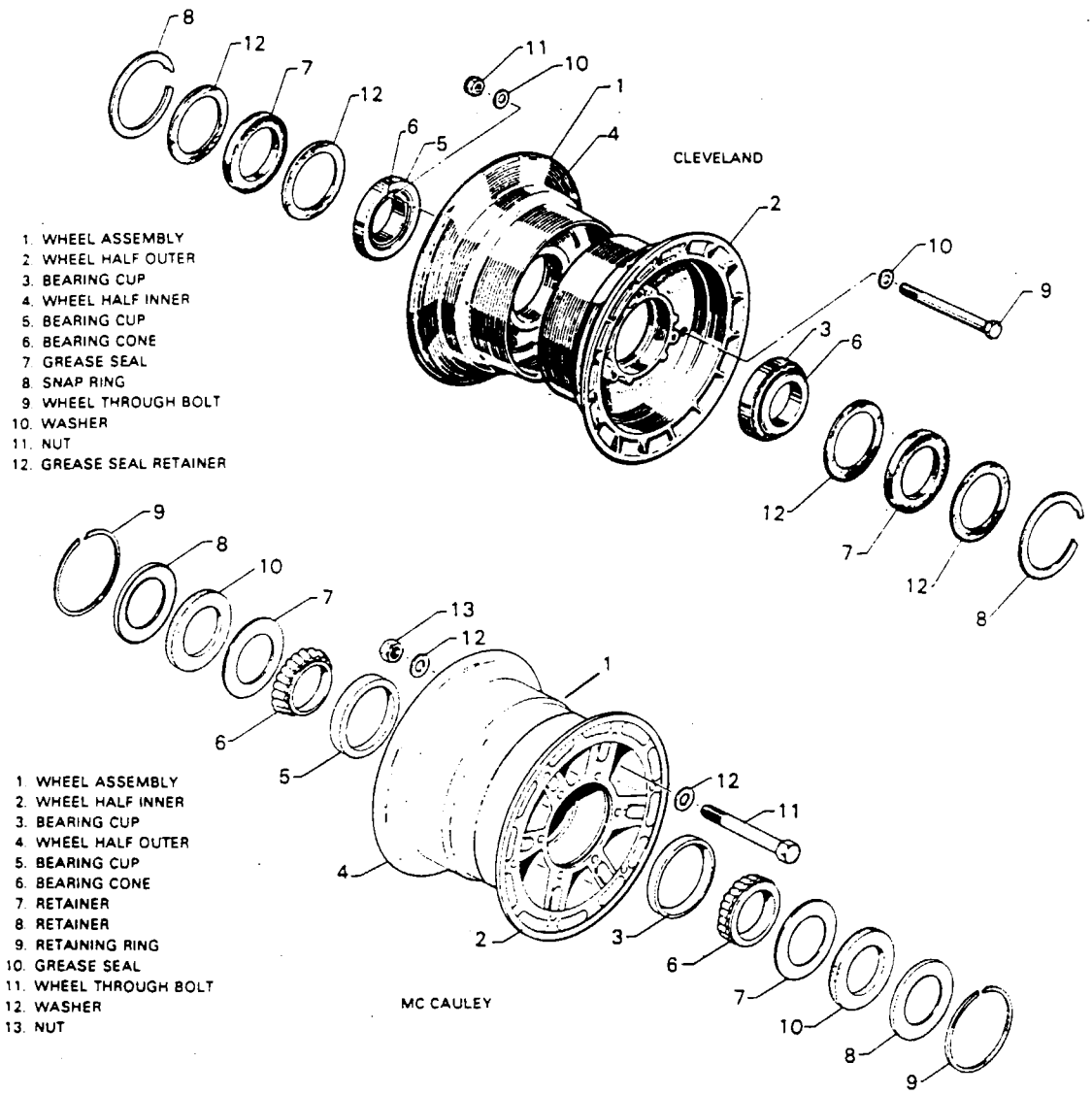


Figure 6-8. Nose Wheel Assembly

6-26. ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 6-9.)

a. Ascertain that the bearing cup (10) for each wheel half (1 and 2) is properly installed. Install the tire with tube and wheel half with the valve stem hole. Ascertain that the index mark is aligned with the index mark on the tire to insure proper tire, tube and wheel balance. Join the two wheel halves and position the brake disc (3) in the inner wheel half. Install the through bolts with nuts on the valve stem side. Torque the wheel nuts to 150 inch-pounds and inflate the tire. (Refer to Table II-I, Section II.)

b. Lubricate the bearing cones (11) and install the cones, grease seals (14) and seal retainer rings (12 or 15). Secure retainer with snap ring (13).

c. Slide the wheel on the axle and secure with retainer nut. Tighten the nut to allow no side play, yet allow the wheel to rotate freely. Safety the nut with a flat head pin, washer and cotter pin. Reinstall the dust cover.

d. Position the brake lining back plates between the wheel and brake disc and the brake cylinder on the torque plate. Insert the spacer blocks between the back plates and cylinder, and install the four bolts to secure the assembly. If the brake line was disconnected, reconnect the line and bleed the brakes per paragraph 6-45.

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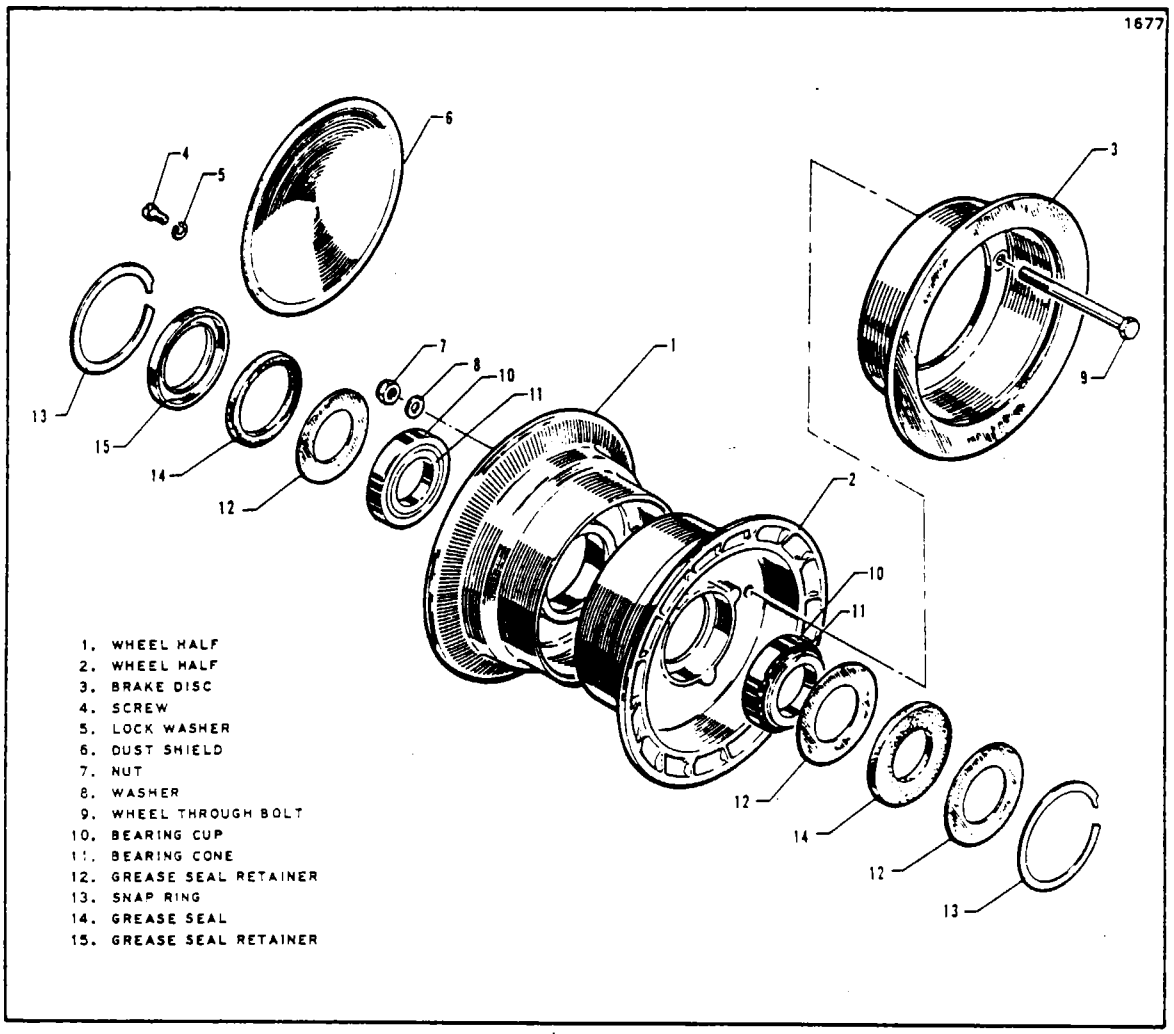


Figure 6-9. Main Wheel Assembly

6-26a. REPAIR OF NOSE AND MAIN WHEEL ASSEMBLIES. Repairs are limited to blending out small nicks, scratches, gouges and areas of slight corrosion, plus the replacement of parts which are cracked or badly corroded.

NOTE

Remove rust and blend out small nicks, using fine 400 grit sandpaper.

Wheels may also be repainted if the parts have been repaired and thoroughly cleaned. Paint exposed areas with one coat zinc chromate primer and one coat of aluminum lacquer.

NOTE

Never paint working surfaces of the bearing cups.

a. Bearing Cup Replacement:
   1. Removal:
      (a) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250°F (121°C) for 15 minutes.
      (b) Remove from source of heat and invert wheel half. If the cup does not drop out, tap the cup evenly from the axle bore with a fiber drift pin or suitable arbor press.
   2. Installation:
      (a) To replace a new cup, apply one coat of zinc chromate primer to wheel half bearing bore.
      (b) Insert wheel half into boiling water for 15 minutes or place in an oven not exceeding 250°F (121°C) for 15 minutes. Chill new bearing cup in dry ice for a minimum of 15 minutes.
      (c) Remove wheel half from source of heat and bearing cup from the dry ice. Install the chilled bearing cup into the bearing bore of the heated wheel half. Tap gently to seat evenly in place, using a fiber drift pin or suitable arbor press.

6-27. BRAKE SYSTEM.

6-28. WHEEL BRAKE ASSEMBLY.

6-29. BRAKE ADJUSTMENT AND LINING TOLERANCE. No adjustment of the brake lining 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 should be replaced if the thickness of any one segment becomes worn below .100 of an inch or unevenly worn.

6-30. REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 6-10.)

a. To remove the brake assembly, first disconnect the brake line from the brake cylinder at the tube fitting.

b. Remove the cap bolts that join the brake cylinder housing and the lining back plate assembly. Remove the back plate from between the brake disc and wheel.

c. Slide the brake cylinder housing from the torque plate.

d. Remove the pressure plate by sliding it off the anchor bolts of the housing.

e. The piston(s) may be removed by injecting low air pressure in the cylinder fluid inlet and forcing the piston from the housing.

f. Check anchor bolt for wear.

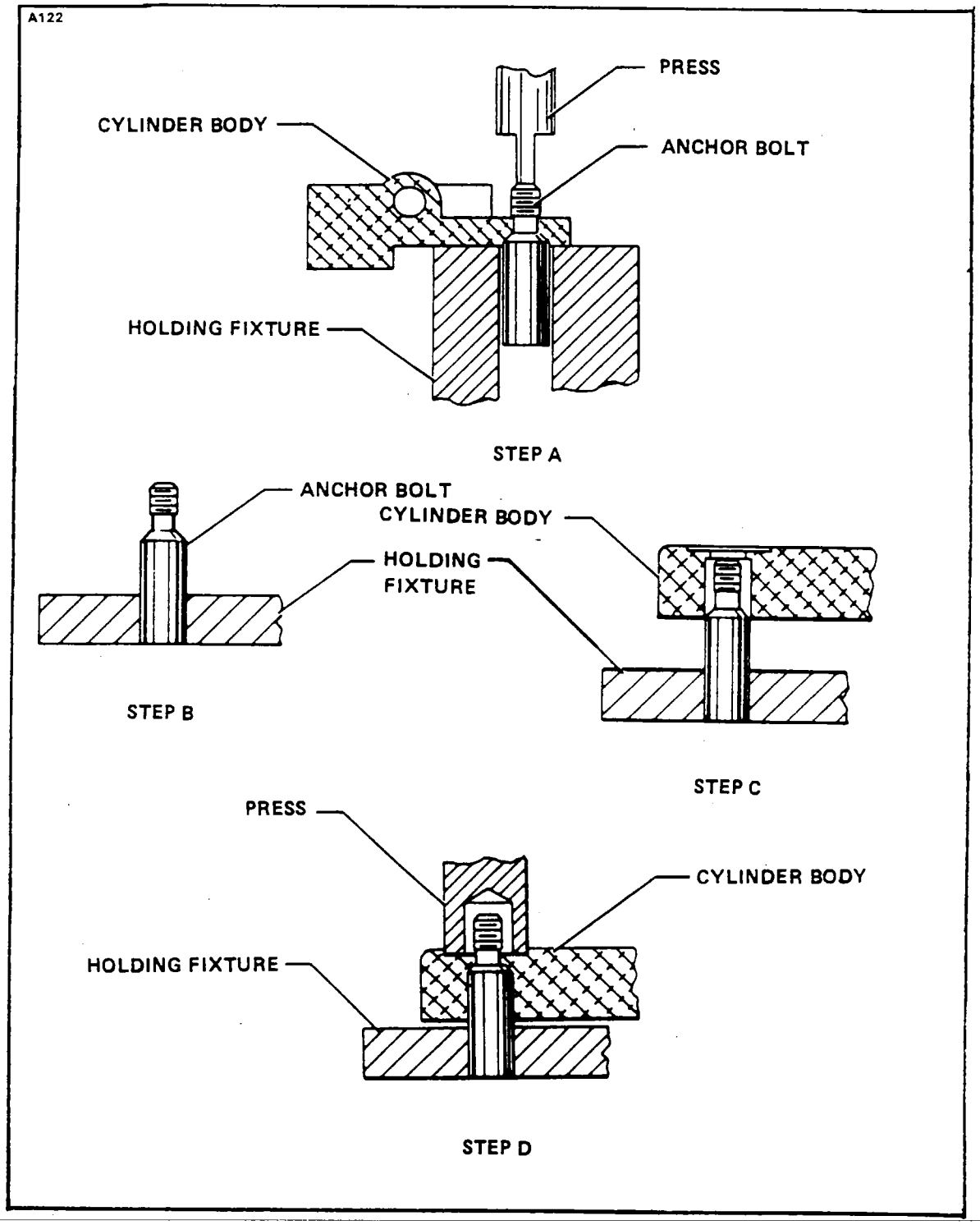


Figure 6-9a. Removal and Installation of Anchor Bolts

g. Remove anchor bolt by the following procedure:
1. Position cylinder assembly on a holding fixture. (Refer to Figure 6-9a.)
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 6-9b, Step A.)
2. Align cylinder body over anchor bolt. (Refer to Figure 6-9b, Step B.)
3. Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole. (Refer to Figure 6-9b, Step C.)

6-31. CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLY.

NOTE

Heavy duty wheel assemblies and brake discs may be easily identified by six (6) bolt hole pattern. Standard wheel assemblies and disc brakes have a three (3) bolt hole pattern.

a. Clean the assembly with a suitable solvent and dry thoroughly.

b. Check the wall of the cylinder housing and piston for scratches, burrs, corrosion, etc., that may damage "O" rings.

c. Check the general condition of the brake bleeder screw and lines.

d. Check the brake disc for wear, grooves, scratches, or pits. Minimum service thickness of Disc 164-22A used on Wheel Assembly 40-90A is .345. A heavy duty brake and wheel assembly is optional on PA-32R-300. The minimum disc thickness of Disc 164-46 used on heavy duty Wheel Assembly 40-120 is .405. 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 would necessitate replacement of the disc. Should it be necessary to remove the wheel disc, refer to paragraph 6-24.

e. At each periodic maintenance inspection, visually inspect both wearing surfaces of the brake disc for heat checks. Heat checks are considered to be superficial surface cracks and are not detrimental to the integrity or performance of the braking system. Replace brake disc if crack length exceeds .800, or crack depth exceeds .210. If crack depth is not measurable, replace disc if crack length exceeds .400.

NOTE

Any Crack, Irregardless Or Length And/Or Depth, Extending Into The Welded Seam Between The Flange And Cup, Is Cause For Immediate Replacement.

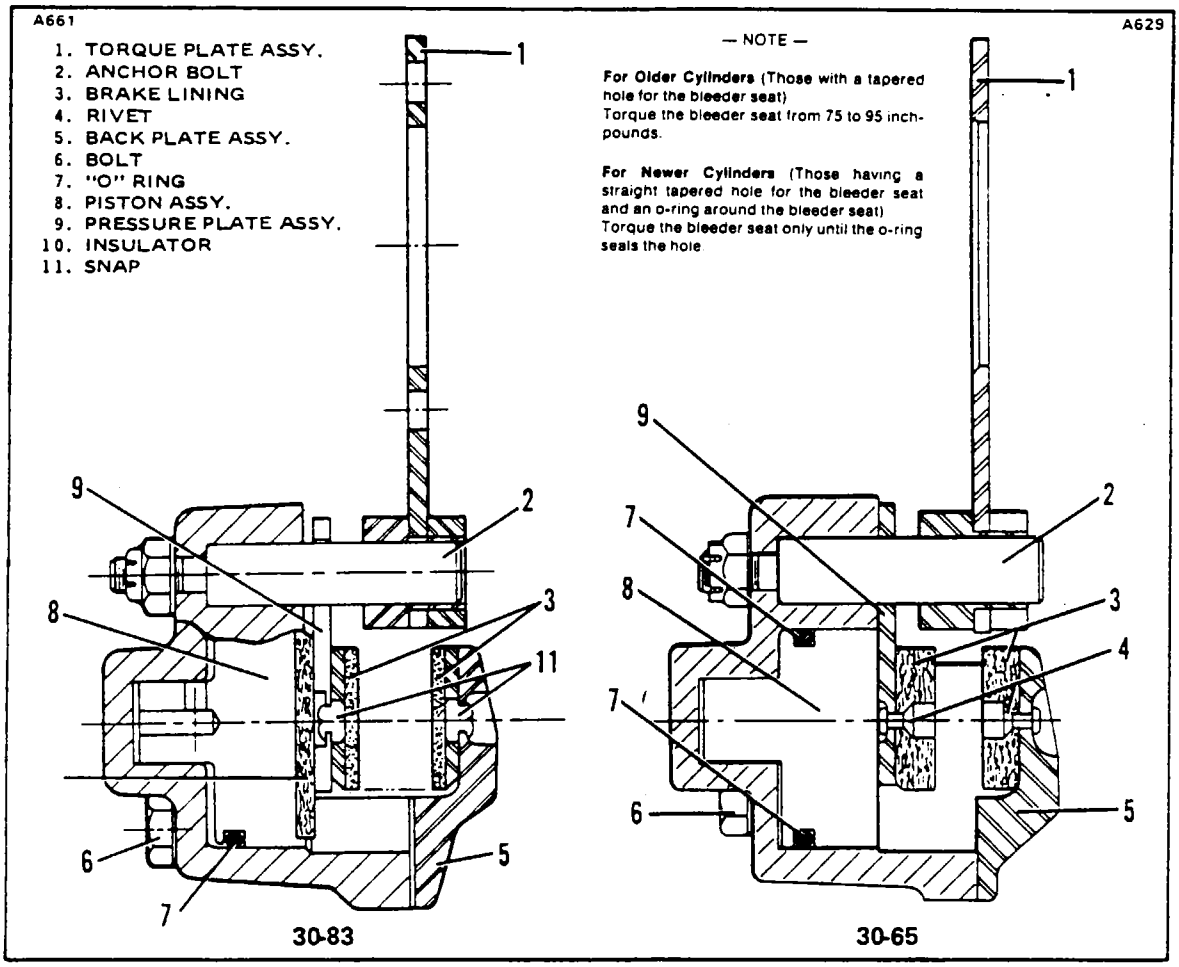


Figure 6-10. Wheel Brake Assembly

f. The riveted type lining may be removed from the backing plates by drilling out the old rivets using a 5/32 drill. Install a new set of linings using the proper rivets and a rivet set that will properly stake the lining and form a correct flair of the rivet. The snap-on type lining used on optional PA-32R-300 heavy duty assemblies may be removed by prying loose with a screwdriver or a thin flat wedge. Install the snap-on type by positioning onto the pins and applying pressure to snap into positon.

NOTE

To condition the organic brake linings used on the Cleveland 30-65 brakes, perform a minimum of six light pedal effort braking applications from 25-40 mph, allowing the brake discs to partially cool between stops.

To condition the metallic brake linings used on the Cleveland 30-83 brakes, perform three consecutive hard braking applications from 45-50 mph without allowing the brake discs to cool substantially between stops.

6-32. ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 6-10.)

a. Lubricate the piston "O" ring(s) with fluid MIL-H-5606A and install on piston(s). Slide the piston in cylinder housing until flush with surface of housing.

b. Slide the lining pressure plate onto the anchor bolts of the housing.

c. Slide the cylinder housing assembly on the torque plate of the gear.

d. Position the lining back plate between the wheel and brake disc. Install the bolts and torque to 40 inch-pounds to secure the assembly.

e. Connect the brake line to the brake cylinder housing.

f. Bleed the brake system as described in paragraph 6-45.

6-33. BRAKE MASTER CYLINDER. (Hand Parking Brake.)

6-34. REMOVAL OF BRAKE MASTER CYLINDER. (Hand Brake.) (Refer to Figure 6-11.)

a. To remove the brake master cylinder (8), first disconnect the inlet supply line (13) from the fitting at the top of the cylinder and allow fluid to drain from the reservoir and line into a suitable container.

b. Disconnect the pressure line from the fitting on the cylinder and allow fluid to drain from the cylinder line.

c. Disconnect the end of the cylinder rod from the brake handle (6) by removing the cotter pin that safeties the connecting clevis pin (12). Remove the clevis pin and spacer washers.

d. Disconnect the base of the cylinder from its mounting bracket by removing the attaching bolt assembly (11).

e. The handle assembly may be removed by removing the attaching bolt assembly that secures the handle to its mounting bracket.

1. BRAKE RESERVOIR
2. RIGHT BRAKE AND RUDDER PEDAL
3. LEFT BRAKE AND RUDDER PEDAL
4. RIGHT BRAKE CYLINDER
5. LEFT BRAKE CYLINDER
6. BRAKE HANDLE
7. HANDLE RELEASE BUTTON
8. MASTER CYLINDER ASSEMBLY
9. TORQUE TUBE
10. RUDDER PEDAL PADS
11. BOLT ASSEMBLY
12. CLEVIS PIN
13. LINE, INLET

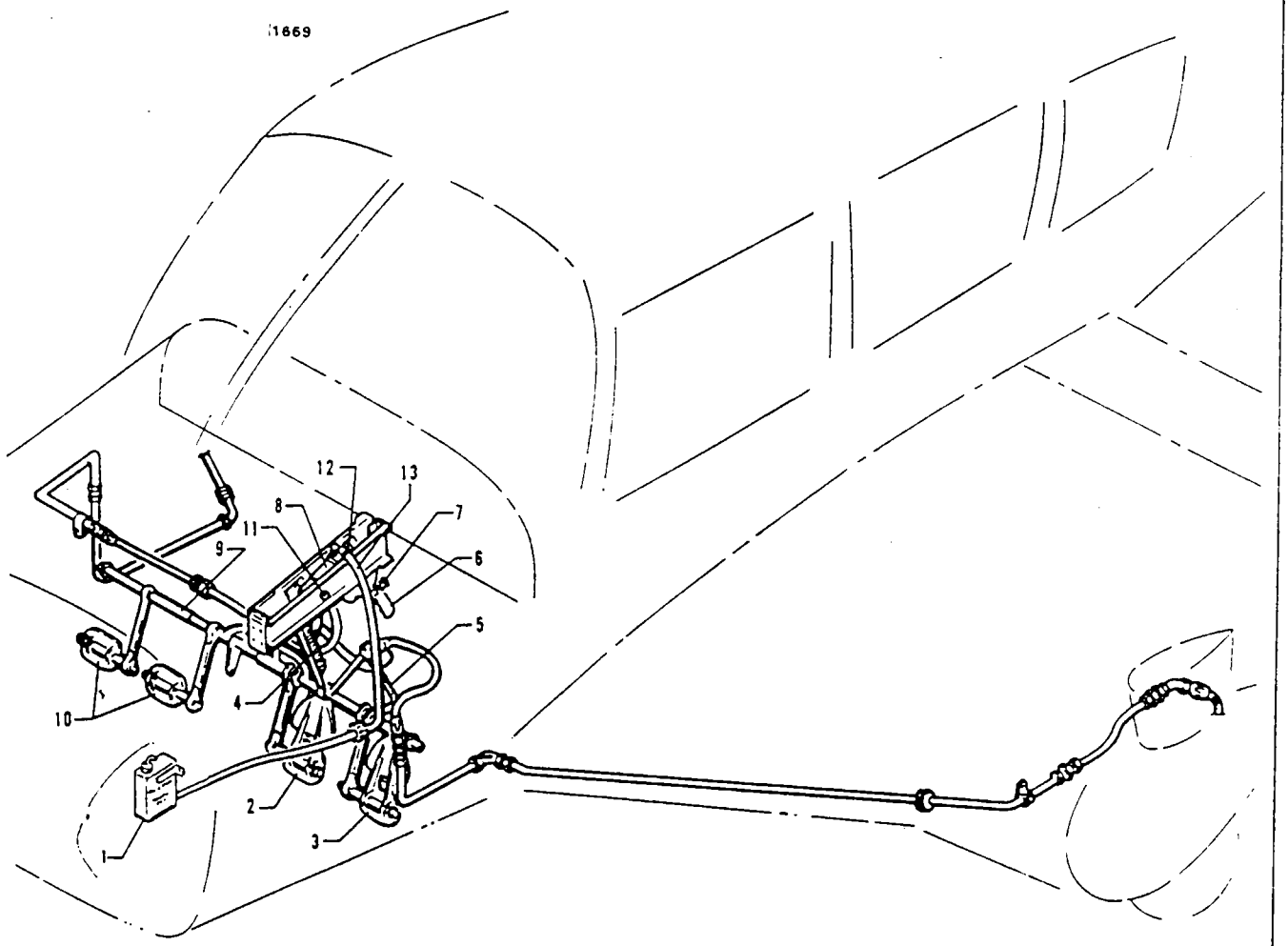


Figure 6-11. Brake System Installation

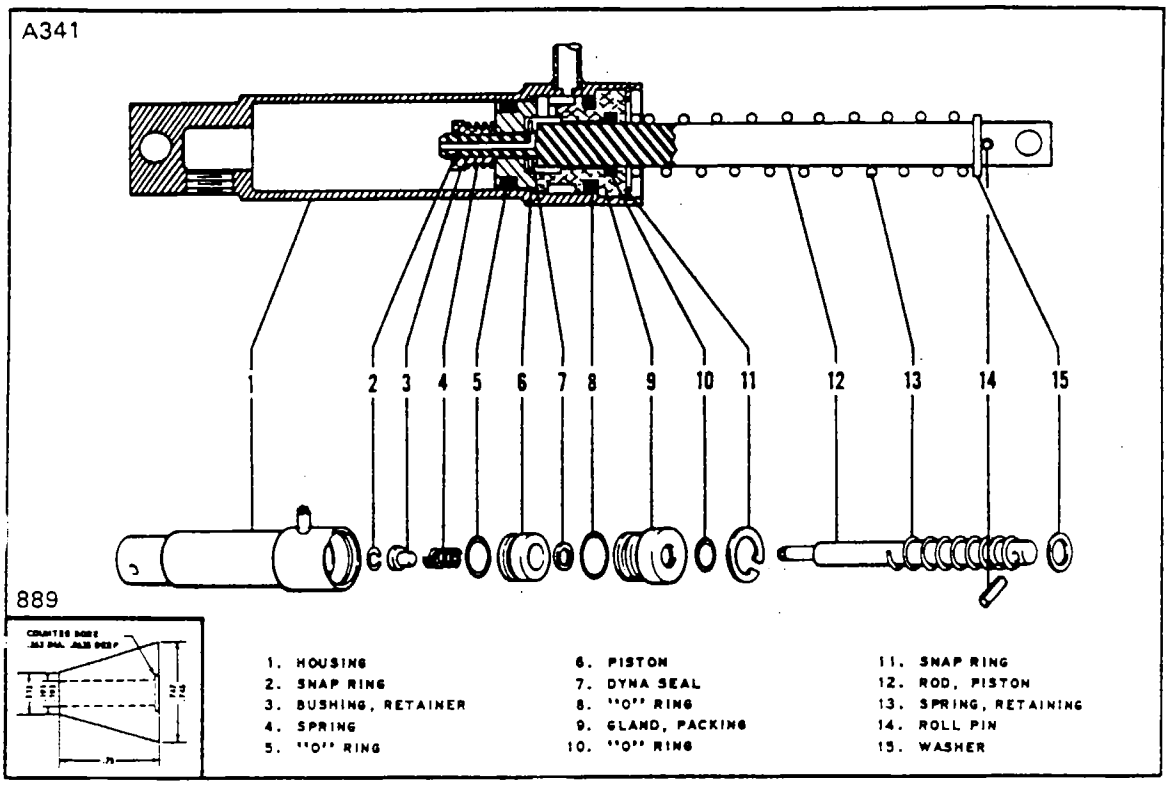


Figure 6-12. Brake Master Cylinder. (Hand/Parking Brake.)

6-35. DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 6-12.)

a. Remove the cylinder from its mounting bracket as per paragraph 6-34.

b. To disassemble the cylinder, first remove the piston rod assembly by removing the snap ring (11) from the annular slot at the rod end of the cylinder. Draw the piston rod assembly from the cylinder.

c. The piston rod assembly may be disassembled by first removing the small snap ring (2) securing the retainer bushing (3), spring (4), piston (6), seal (7), gland (9), and, if desired, the large return spring (13).

d. Remove the "O" rings from the piston and gland.

6-36. 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 for scratches, burrs, corrosion, etc.

e. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc., and "O" rings.

6-37. ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 6-12.)

NOTE

Use a small amount of hydraulic fluid (MIL-H-5606A) on the "O" ring and component parts to prevent damage and ease of handling during reassembly.

a. Install new "O" rings on the inside and outside of the packing gland (9) and on the outside of the piston (6). (When installing teflon "O" ring (5) on piston, it is recommended that it be installed with the use of a cone placed against the piston. The cone may be constructed of plastic or metal with dimensions shown in Figure 6-12.)

b. To assemble the piston rod assembly, install on the rod (12), in order, the roll pins (14), return spring retainer washer (15), return spring (13), packing gland (9) with "O" rings, seal (10), piston (6) with "O" ring, spring (4) and retainer bushing (3). Secure these pieces with small ring (2) on the end of the rod.

c. Insert the piston rod assembly in the cylinder (1) and secure packing gland with snap ring (11).

d. Install the cylinder per paragraph 6-38.

6-38. INSTALLATION OF BRAKE MASTER CYLINDER. (Hand Brake.) (Refer to Figure 6-11.)

a. Install the brake handle assembly between its mounting bracket and secure with bolt, washers, nut and cotter pin. Washers should be placed on each side of the handle, between the bracket, and under the nut.

b. Place the cylinder (8) between the mounting bracket and secure the base end with bolt, washers, nut and cotter pin. This, too, should have washers placed on each side of the cylinder and under the nut.

c. Connect the rod end of the cylinder to the brake handle with a clevis pin and thin washers. Safety the clevis with a cotter pin.

d. Connect the pressure line to the fitting at the bottom of the cylinder.

e. Connect the inlet supply line (12) to the fitting at the top of the cylinder and secure with spring clamp.

f. Bleed the brake system per paragraph 6-45.

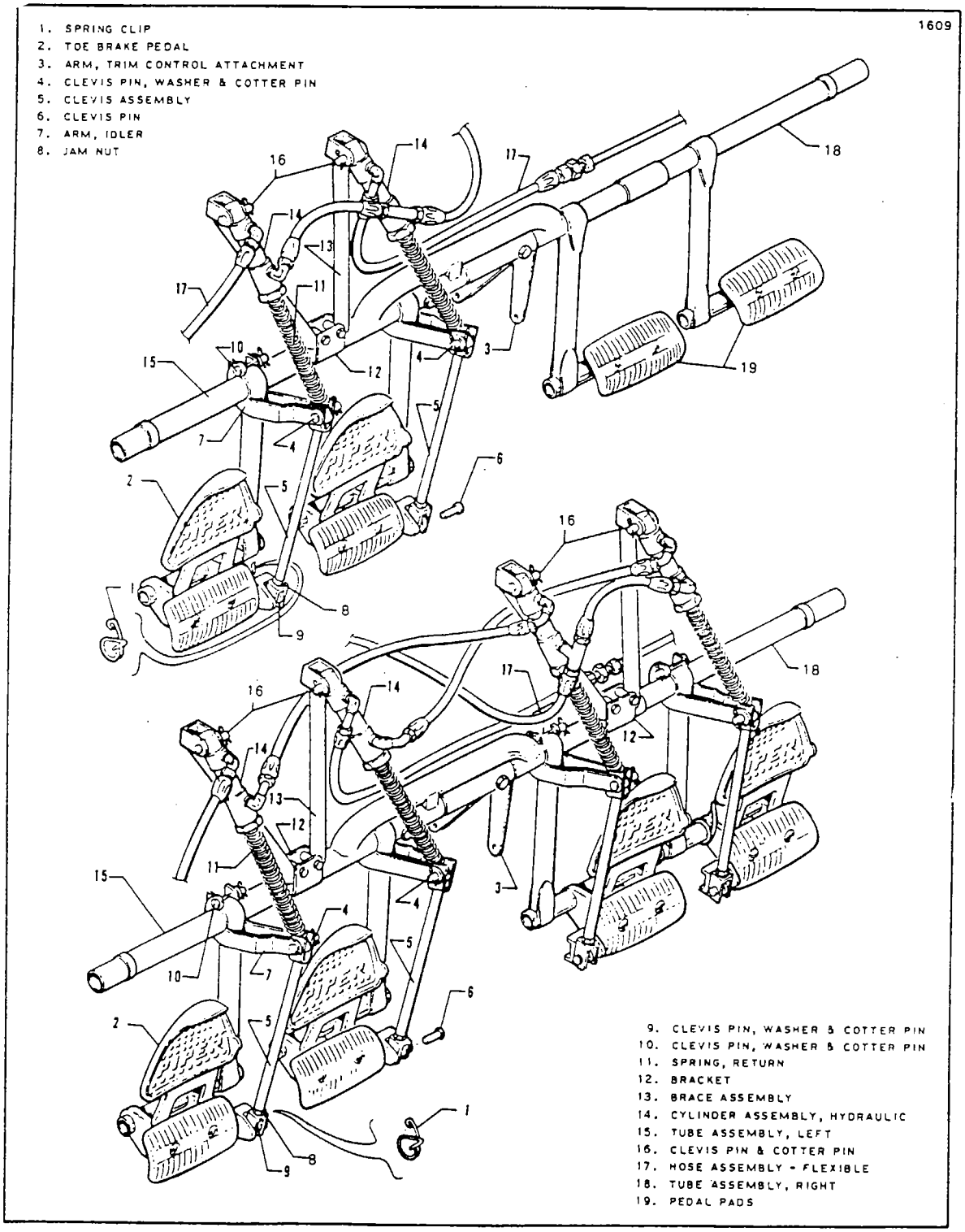


Figure 6-13. Toe Brake Installation

6-39. BRAKE CYLINDER. (Toe Brake).

6-40. REMOVAL OF BRAKE CYLINDER. (Refer to Figure 6-13.)

a. Disconnect the upper and lower lines from the cylinder (14) to be removed and cap the lines to prevent fluid leakage or drain the fluid from the brake reservoir and master cylinder.

b. Remove the cylinder from its attachment fittings by first removing cotter pins that safety the cylinder attaching pins (4 and 16) and then removing the pins.

6-41. DISASSEMBLY OF BRAKE CYLINDER.

a. Cleveland cylinder number 10-20. (Refer to Figure 6-14.)

1. Remove the cylinder from its mounting bracket as per Paragraph 6-40.

2. To disassemble the cylinder, first remove the piston rod assembly by unscrewing the packing gland (9) from the cylinder.

3. The piston rod assembly may be disassembled by first removing the small snap ring (2) securing the retainer bushing (3) and then removing the bushing, spring (4), piston(5), seal (7), gland (9), and, if desired, the large return spring.

4. Remove the O-rings from the piston and gland.

b. Cleveland cylinder number 10-27. (Refer to Figure 6-15.)

1. Remove the cylinder from its mounting bracket per Paragraph 6-40.

2. To disassemble the cylinder, first remove the piston rod assembly by removing the snap ring (10) from the annular slot in the cylinder housing (1). Draw the piston rod assembly from the cylinder.

3. The piston rod assembly may be disassembled by first removing the roll pin (12) and then the piston assembly (3), seal (5), packing gland (7).

4. Remove the O-rings from the piston and packing gland.

c. Cleveland cylinder number 10-30. (Refer to Figure 6-15a.)

1. Remove the cylinder from its mounting bracket per Paragraph 6-40.

2. To disassemble the cylinder, first remove the piston rod assembly by removing the retaining ring from the annular slot in the cylinder housing (1). Draw the piston rod assembly from the cylinder.

3. The piston rod assembly may be disassembled by first removing the retaining ring (2), sleeve (3), spring (4), and then the piston and O-ring assembly (6), O-ring (7), and gland (8), and, if desired, the return spring (13).

4. Remove the O-rings from the piston and packing gland.

d. Gar-Kenyon cylinder number 17000. (Refer to Figure 6-15b.)

1. Remove the cylinder from its mounting bracket as per Paragraph 6-40.

2. To disassemble the cylinder, first remove the piston rod assembly by unscrewing the fitting (8) from the cylinder.

3. The piston rod assembly may be disassembled by first removing the retaining ring (2) securing the sleeve (3) and then removing the spring (4), piston (6), seal (7), fitting (8), and, if desired, the large return spring (11).

4. Remove the O-rings from the piston and fitting.

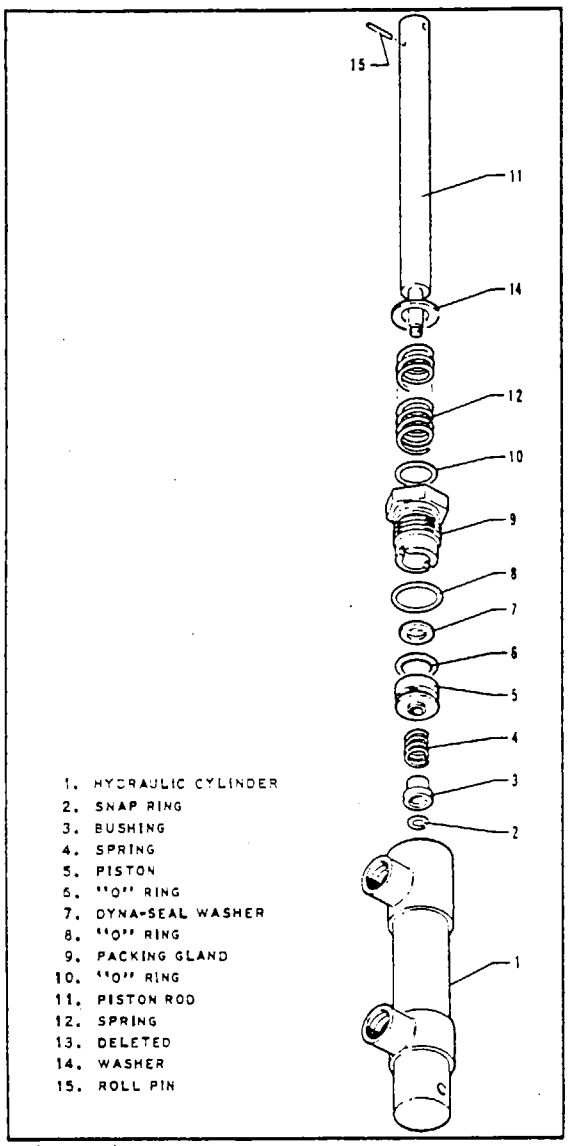


Figure 6-14. Brake Cylinder 10-20. (Toe Brake)

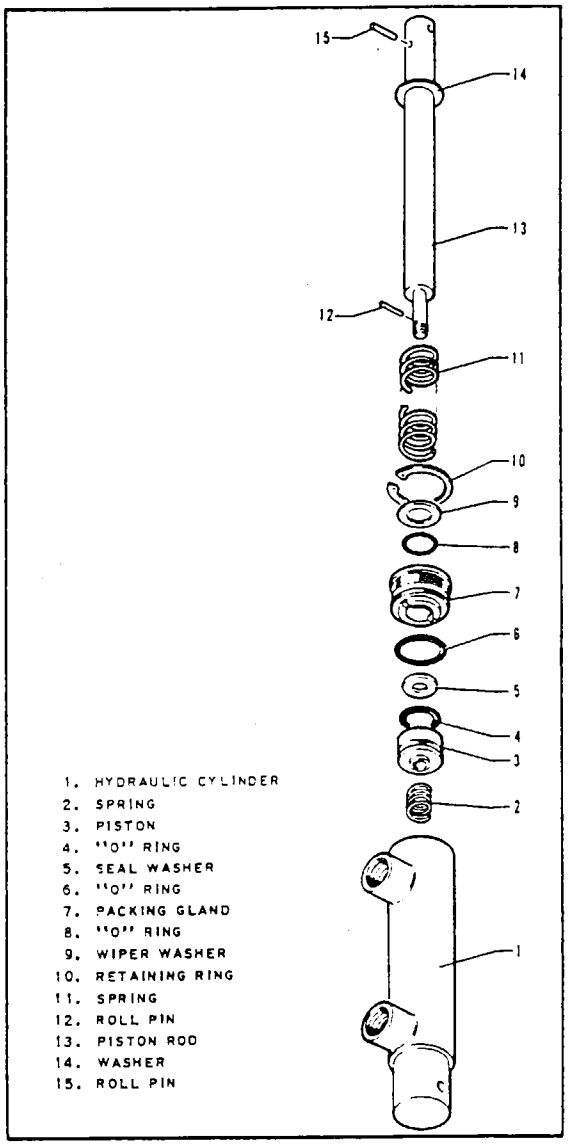


Figure 6-15. Brake Cylinder 10-27. (Toe Brake)

6-42. CLEANING, INSPECTION AND REPAIR OF BRAKE 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.

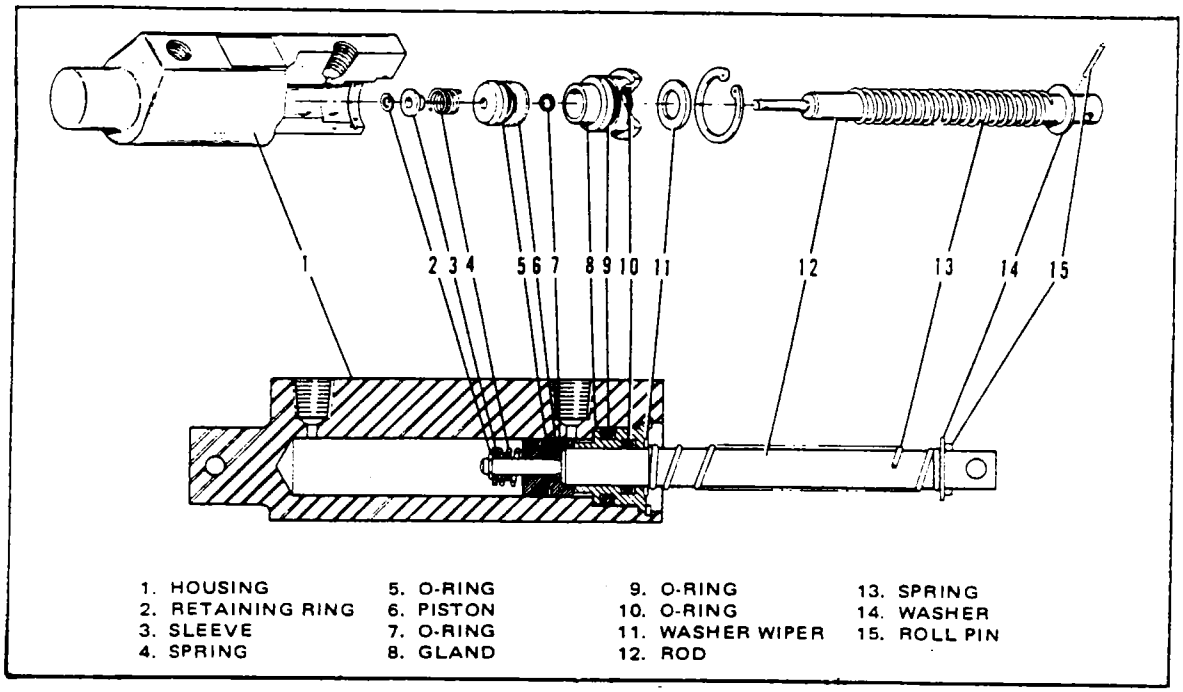


Figure 6-15a. Brake Cylinder
(10-30) (Toe Brake)

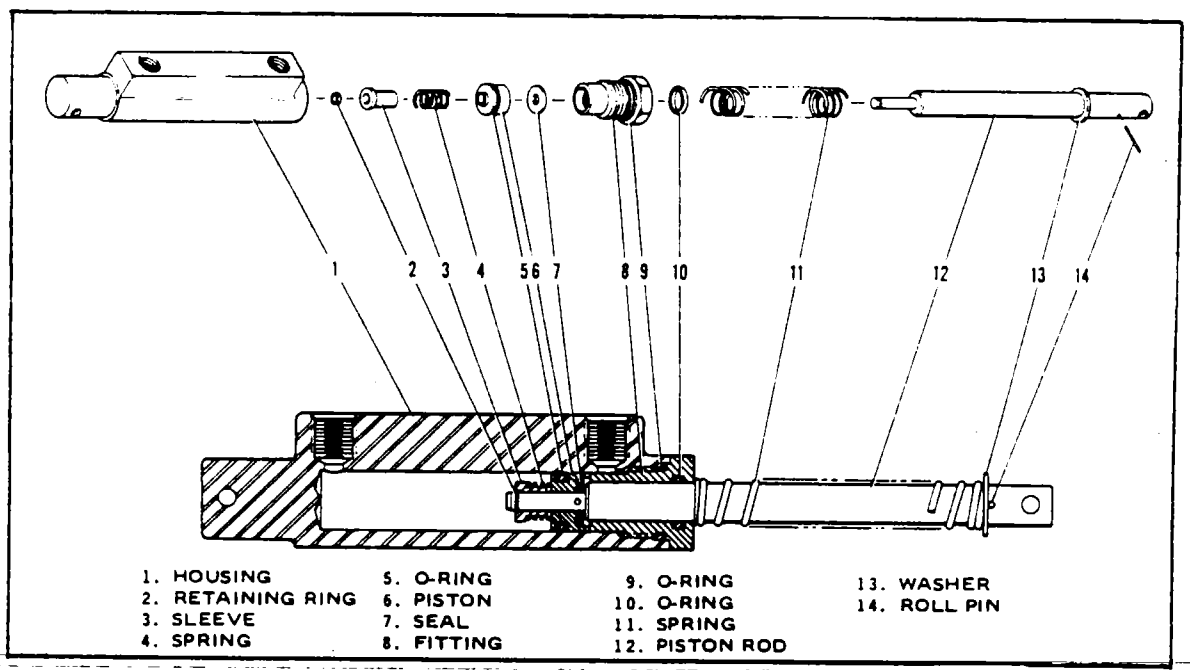


Figure 6-15b. Brake Cylinder
(17000) (Toe Brake)

6-43. ASSEMBLY OF BRAKE CYLINDER.

a. Cleveland cylinder number 10-20. (Refer to Figure 6-14.)

NOTE

Use a small amount of hydraulic fluid (MIL-H-5606A) on the O-ring and component parts to prevent damage and ease of handling during reassembly.

1. Install new O-rings on the inside and outside of the packing gland (9) and on the outside of the piston (5).
2. To assemble the piston rod assembly, install on the rod (11), in order, the roll pin (15), return spring retainer washer (14), return spring (12), packing gland (9) with O-rings, seal (7), piston (5) with O-rings, spring (4) and retainer bushing (3). Secure these pieces with the small ring (2) on the end of the rod.
3. Insert the piston rod assembly in the cylinder (1) and secure packing (9).
4. Install the cylinder per Paragraph 6-44.

b. Cleveland cylinder number 10-27. (Refer to Figure 6-15.)

1. Install new O-rings on the inside and outside of the packing gland (7) and on the outside of the piston (3).
2. To assemble the piston rod assembly, install on the rod (13), in order, the roll pin (15), washer (14), spring (11), washer (9), packing gland (7), seal (5), piston assembly (3), spring (2), and roll pin (12).
3. Insert the piston rod assembly in the cylinder (1) and secure with the snap ring (10).
4. Install the cylinder per Paragraph 6-44.

c. Cleveland cylinder number 10-30. (Refer to Figure 6-15a.)

1. Install new O-rings on the inside and outside of the packing gland (7) and on the outside of the piston (3).
2. To assemble the piston rod assembly, install on the rod (12), in order, the roll pin (15), washer (14), spring (13), washer (11), packing gland (8), with O-rings, seal (7), piston assembly (6) with O-ring, spring (4), sleeve (3), and retaining ring (2).
3. Insert the piston rod assembly in the cylinder (1) and secure with the retaining ring (10).
4. Install the cylinder per Paragraph 6-44.

d. Gar-Kenyon cylinder number 17000. (Refer to Figure 6-15b.)

1. Install new O-rings on the inside and outside of the fitting (8) and on the outside of the piston (6).
2. To assemble the piston rod assembly, install on the rod (12), in order, the roll pin (14), return spring retainer washer (13), return spring (11), fitting (8) with O-rings, seal (7), piston (6) with O-ring, spring (4) and sleeve (3). Secure these pieces with the retaining ring (2) on the end of the rod.
3. Insert the piston rod assembly in the cylinder (1) and secure fitting (8).
4. Install the cylinder per Paragraph 6-44.

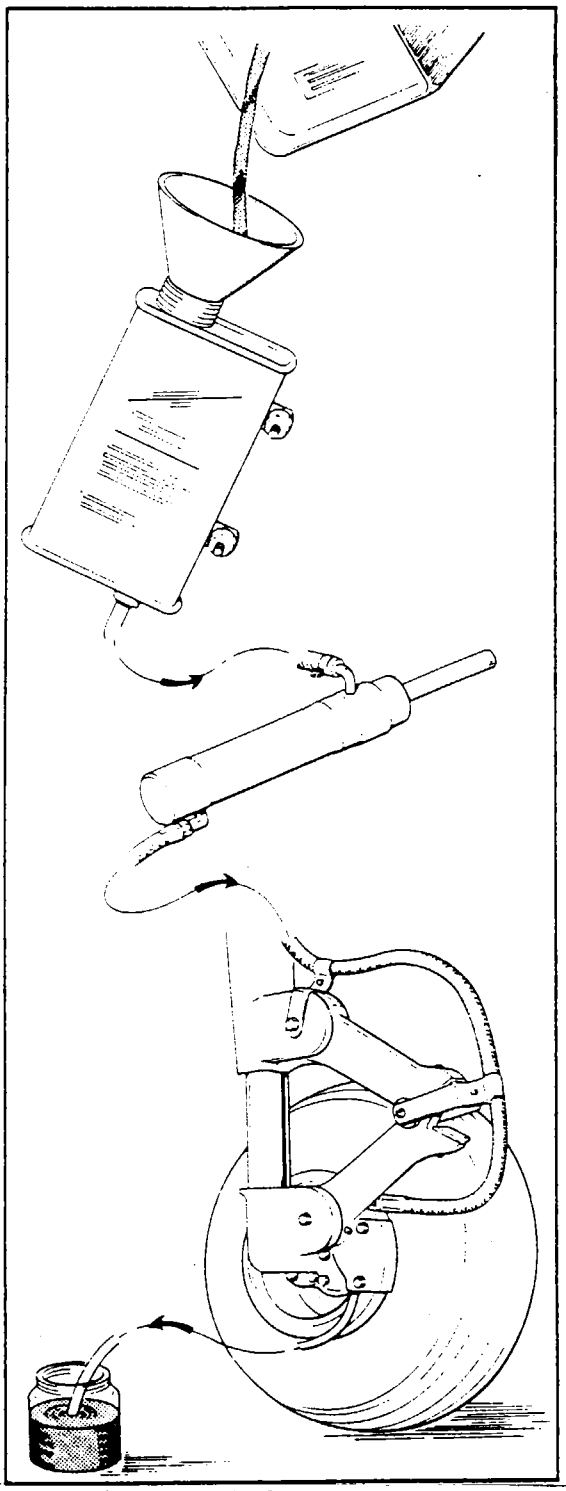


Figure 6-16. Bleeding Brake (Gravity)

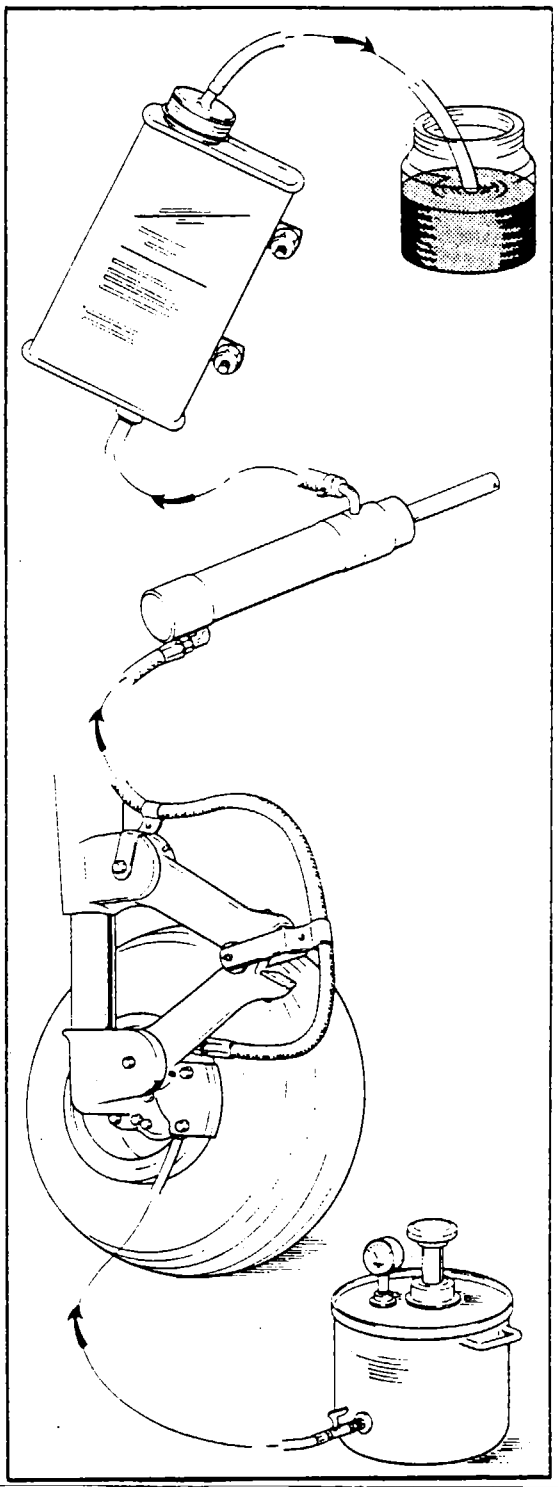


Figure 6-17. Bleeding Brake (Pressure)

6-44. INSTALLATION OF BRAKE CYLINDER. (Refer to Figure 6-13.)

a. Position the cylinder (14) at its mounting points and attach with clevis pins. Safety the pins with cotter pins.

b. Connect the brake lines to the cylinder fittings.

c. Bleed the brakes per Paragraph 6-45.

6-45. BLEEDING BRAKES.

6-46. BRAKE BLEEDING PROCEDURE (Gravity). (Refer to Figure 6-16.)

a. On both main landing gear wheel brake assemblies, attach a clear plastic hose to the brake bleeders and extend into container partially filled with hydraulic fluid, MIL-H-5606A. The ends of this hose should be submerged in the fluid. Open both bleeders approximately one and one-half to two turns.

b. Fill the brake reservoir on the fire wall with hydraulic fluid, MIL-H-5606A.

c. Disconnect the toe brake cylinders from the pedal connection by removing clevis pin, washer and cotter pin.

d. Invert toe brake cylinder to aid in releasing trapped air in the top of the cylinder.

e. Check toe brake pedals in the cockpit to insure pedals are pulled full aft.

f. Pull the hand brake handle, pumping the master cylinder very slowly approximately 25 times until fluid is observed passing through the clear plastic hoses at the wheel cylinder.

NOTE

Fluid level in the reservoir must be maintained to prevent air from entering in the line.

g. Tighten both wheel bleeders.

h. Pull hand brake until a firm handle is maintained.

6-47. BRAKE BLEEDING PROCEDURE (Pressure). (Refer to Figure 6-17.)

a. Place a small clear plastic hose on the vent tube of the brake reservoir and place a second small clear plastic hose on the bleeder fitting on one main landing gear. Place the open ends of these tubes in a suitable container to collect the fluid overflow. Open the bleeder fitting one or two turns.

b. On the other main gear, slide the hose of the pressure unit over the bleeder fitting then open the fitting one or two turns and pressure fill the brake system with MIL-H-5606A fluid.

c. With fluid continually flowing through the brake system, SLOWLY and together actuate the hand brake and the toe brake pedal of the side being bled, several times, to purge the cylinders of air. On dual brake installations, both right and left pedals must be actuated.

NOTE

By watching the fluid pass through the plastic hose at the fluid reservoir and the bleeder fitting on the gear being bled, it can be determined whether any air is left in the system. If air bubbles are evident, filling of the system shall be continued until all the air is out of the system and a steady flow of fluid is obtained. Should the brake handle remain spongy, it may be necessary to disconnect the bottom of the toe brake cylinders (next to the pedal) and rotating the cylinder horizontally or even above horizontal and by use of the hand brake alone, purge the air from the system.

d. Close the open bleeder fitting on the gear being bled. Close the open bleeder fitting to which the pressure hose is attached; then close the pressure unit and remove the hoses from the bleeder fittings. Check the brakes for proper pedal pressure. Replace the caps over the bleeder fittings.

NOTE

It may be necessary to remove any trapped air in the top of the wheel brake unit by applying pressure to the system with the brake hand lever and slowly opening the bleeder and release the hand lever.

e. Repeat this procedure, if necessary, on the other gear.
f. Drain excess fluid from the reservoir to fluid level line with a syringe.

6-48. BRAKE SYSTEM LEAK CHECK.

a. Pull for a good firm hand brake and lock parking brake mechanism. Allow system to stand for approximately 10 minutes; then by gripping the parking brake handle, it should not be able to be pulled aft further than the original set. Should the handle be able to be pulled towards the panel and feel spongy, a leak is present at some point in the system. This leak may appear at any one of the connections throughout the system or internally in the master brake cylinder or wheel brake assemblies.

6-49. BLEEDING OF THE BRAKES AFTER A UNIT HAS BEEN CHANGED.

a. Actuate the hand brake handle until some pressure builds up in the system. At this time, crack the attaching B nuts at any of the hose connections of the replaced unit. Most of the handle sponge feeling should be displaced by this action. Retighten B nuts.

b. Actuate the master cylinder and the toe brake cylinder of the side unit which was changed and bleed fluid through the brake assembly on the wheel by pumping pressure and cracking bleeder until pressure drops.

CAUTION

Do not allow pressure to bleed off before closing bleeders, for this will allow air to enter the system. Repeat the pumping and bleeding approximately 10 or more times or until all the air is released from the system. During all bleeding, fluid level of the reservoir must be maintained.

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TABLE VI-I. LANDING GEAR TROUBLESHOOTING

Trouble	Cause	Remedy
Nose landing gear shimmies during fast taxi, take-off, or landing.	Internal wear in shimmy dampener.	Replace shimmy dampener.
	Shimmy dampener or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Excessive or uneven wear on nose tire	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wear resulting from shimmy.	Refer to proceedings for correction.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing (Refer to Lubrication Chart).
		Cylinder and/or strut housing bushings damaged.

TABLE VI-I. LANDING GEAR TROUBLESHOOTING (cont)

Trouble	Cause	Remedy
Nose gear fails to steer properly (cont).	One brake dragging.	Determine cause and correct.
	Steering horn loose on attachment plate.	Readjust and tighten.
	Steering horn bearing and/or bolt worn.	Replace bearing and/or bolt.
	Shimmy dampener galling or binding.	Replace.
Main landing gear shimmies during fast taxi, take-off, or landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.

TABLE VI-I. LANDING GEAR TROUBLESHOOTING (cont)

Trouble	Cause	Remedy
Strut bottoms on normal landing or taxiing on rough ground	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.

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SECTION VIA

LANDING GEAR AND BRAKE SYSTEM (PA-32R-300)

		Aerofiche Grid No.
6A-1.	Introduction	2C7
6A-2.	Description	2C7
6A-3.	Troubleshooting	2C9
6A-4.	Landing Gear System	2C9
6A-5.	Nose Landing Gear System	2C9
6A-6.	Disassembly of Nose Gear Oleo	2C9
6A-7.	Cleaning, Inspection and Repair of Nose Gear Oleo	2C10
6A-8.	Assembly of Nose Gear Oleo	2C10
6A-9.	Removal of Nose Landing Gear	2C22
6A-10.	Cleaning, Inspection and Repair of Nose Landing Gear	2C22
6A-11.	Installation of Nose Landing Gear	2C23
6A-12.	Adjustment of Nose Landing Gear	2D1
6A-13.	Alignment of Nose Landing Gear	2D2
6A-14.	Removal of Nose Gear Door Assembly	2D3
6A-15.	Cleaning, Inspection and Repair of Nose Gear Door Assembly	2D4
6A-16.	Installation of Nose Gear Door Assembly	2D5
6A-17.	Adjustment of Nose Gear Doors	2D5
6A-18.	Main Landing Gear System	2D5
6A-19.	Disassembly of Main Gear Oleo	2D5
6A-20.	Cleaning, Inspection and Repair of Main Gear Oleo	2D9
6A-21.	Assembly of Main Gear Oleo	2D9
6A-22.	Removal of Main Landing Gear	2D10
6A-23.	Cleaning, Inspection and Repair of Main Landing Gear	2D11
6A-24.	Installation of Main Landing Gear	2D15
6A-25.	Adjustment of Main Landing Gear	2D16
6A-26.	Alignment of Main Landing Gear	2D17
6A-27.	Removal of Main Gear Door Assembly	2D20
6A-28.	Cleaning, Inspection and Repair of Main Gear Door Assembly	2D20
6A-29.	Installation of Main Gear Door Assembly	2D20

		Aerofiche Grid No.
6A-30.	Landing Gear Limit Switches	2D20
6A-31.	Adjustment of Nose Gear Up Limit Switch	2D21
6A-32.	Adjustment of Nose Gear Down Limit Switch	2D21
6A-33.	Adjustment of Main Gear Up Limit Switch	2D21
6A-34.	Adjustment of Main Gear Down Limit Switch	2D22
6A-35.	Adjustment of Landing Gear Safety Switch (Squat Switch)	2D23
6A-36.	Adjustment of Gear Back-up Extender Actuator Switch	2D23
6A-37.	Landing Gear Warning Switches (Throttle Switches)	2D23
6A-38.	Landing Gear Up/Power Reduced Warning Switch	2D23
6A-39.	Removal of Landing Gear Up/Power Reduced Warning Switch	2D23
6A-40.	Installation of Landing Gear Up/Power Reduced Warning Switch	2D23
6A-41.	Adjustment of Landing Gear Up/Power Reduced Warning Switch	2D24
6A-42.	Gear Down/Selector Handle Up Warning Switch	2E1
6A-43.	Removal of Gear Down/Selector Handle Up Warning Switch	2E1
6A-44.	Installation of Gear Down/Selector Handle Up Warning Switch	2E1
6A-45.	Nose Wheel	2E1
6A-46.	Removal and Disassembly of Nose Wheel	2E1
6A-47.	Inspection of Nose Wheel Assembly	2E2
6A-48.	Assembly and Installation of Nose Wheel	2E3
6A-49.	Main Wheel and Brake Instructions	2E3

SECTION VIA

LANDING GEAR AND BRAKE SYSTEM
PA-32R-300

6A-1. INTRODUCTION. In this section are instructions for the overhaul, inspection and adjustment of the various components of the PA-32R-300 landing gear and brake system. Also are adjustments for the electrical limit, safety and warning switches. This section though does not cover the hydraulic function of the landing gear, except brakes, and this information may be found in the hydraulic section listed as Section VA.

6A-2. DESCRIPTION. The PA-32R-300 airplane is equipped with a retractable tricycle air-oil strut type landing gear which is hydraulically operated by an electrically powered reversible pump. A selector handle on the instrument panel to the left of the control quadrant is used to select gear UP or DOWN positions.

Gear positions are indicated by three green lights located above the selector lever for gear down and locked, and a red light located at the top of the instrument panel for gear unsafe positions. There is no light to indicate the gear has fully retracted other than all lights are out. As the landing gear swings to the down position and each downlock hook moves into its locked position, a switch at each hook actuates to the switch normally closed (NC) circuit to indicate by a green light that the individual gear is safely down and locked. The activation of all three downlock switches will also shut the hydraulic pump off. As the instrument lights are turned on, the green lights will dim. When the gear begins to retract and the downlock hook disengages, the down limit switch actuates to the NC circuit and in series with the NC circuit of the up limit switch allows the gear unsafe light to come on. The gear unsafe light will remain on until the gear is up and all up limit switches are actuated to their normally open (NO) circuit.

The red gear unsafe light also operates simultaneously with the warning horn, and in conjunction they have a twofold purpose. Their primary purpose is to give warning when power is reduced below approximately 14 inches of manifold pressure and the landing gear has not reached the down and locked position. This circuit is controlled by the three paralleling down limit switches connected in series with a throttle switch (Switch "A") located in the control quadrant. The secondary function of the warning light and horn is to give warning when the gear selector handle is up when the airplane is on the ground or airspeed is below that required to close the hydraulic valve and the pump switch of the backup gear extender unit. When the airplane is setting on the ground, the warning circuit is controlled through the NO side of the safety switch (squat switch) located on the left gear and the up position of the selector lever. Should the airplane be raised from the ground, such as in flight, far enough to move the safety switch to its NC position, then current is directed in series through the hydraulic pressure switch, the pump switch (providing airspeed has actuated the switch to its NO position), throttle switch (Switch "B") and the up positioned selector lever. Throttle switch "B" is located forward of the instrument panel directly below the arm of the throttle lever. The up limit, safety, throttle, pressure and

selector switch, and pump solenoids are all protected by the landing gear control and warning circuit protector. (Refer to Section X for electrical schematic.)

Each landing gear is retracted and extended by a single hydraulic cylinder attached to the drag link assembly of the nose gear and the side brace link assembly of the main gears. As the gears retract, doors partially enclose each gear through mechanical linkage. The gears are held in their up position by hydraulic pressure alone on the cylinder. There are no uplocks and loss of hydraulic pressure will allow the gears to drop. It is preferred that the gears be extended and retracted with the use of the gear selector handle; however in the event of hydraulic loss or electrical failure, they can be lowered by pushing down on the emergency extension lever between the pilot seats or they will drop themselves should airspeed drop below approximately 118 MPH, engine power off. In either instant the hydraulic valve of the back-up extender unit opens to allow hydraulic pressure to neutralize between each side of the cylinder pistons. The emergency extension lever can also be used to manually overcome system malfunctions or to meet special pilot needs such as, a deliberate wheels up landing - needed for emergency landings on water, or during various flight maneuvers where airspeed and power settings would normally allow the gear to extend. It also permits gear retraction after take-off at speeds lower than those normally permitted by the automatic system. When using the manual extension lever, the gear position is controlled by the selector switch, regardless of airspeed/power combinations. An override latch mechanism is installed which allows the pilot to latch the extension lever in the up override position, thus bypassing the automatic portion of the system. A flashing warning light is mounted below the gear selector lever to indicate whenever the latch is in use. The latch is disengaged by pulling up on the extension lever. To assist the nose gear to extend under these conditions are two springs, one inside the other, mounted on arms above the gear links. The main gears require no assist springs. Once the gears are down and the downlock hooks engage, a spring maintains each hook in the locked position until hydraulic pressure again releases it. A further description of the hydraulic system and the gear back-up extender unit may be found in Section VA, Hydraulic System.

The nose gear is steerable through a 45 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. A shimmy dampener is also incorporated in the nose wheel steering mechanism.

The two main wheels are equipped with self-adjusting single-disc hydraulic brake assemblies (Cleveland 30-65). Optional heavy duty (Cleveland 30-83) dual-piston, single disc brakes may also be installed on the aircraft. Toe brakes are standard on both the pilot's and copilot's rudder pedals. A parking brake is incorporated with the handle, and may be used by pulling back on the handle and pushing forward on the button to the left of the handle. To release the hand brake, pull aft on the handle and allow it to swing forward. Hydraulic fluid for the cylinders is supplied by a reservoir installed on the left forward side of the firewall.

6A-3. TROUBLESHOOTING. Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Table VIA-IV at the back of this section. When troubleshooting, first eliminate hydraulic malfunctions as listed in Section VA. 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. To operate the gear, the emergency gear lever must be maintained in the up override position.

6A-4. LANDING GEAR SYSTEM.

6A-5. NOSE LANDING GEAR SYSTEM.

6A-6. DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 6A-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 spillage.

c. Remove air and fluid from the oleo strut. Depress the air valve core pin until strut chamber pressure has diminished; remove the filler plug and with a small hose siphon as much hydraulic fluid from the strut as possible.

d. To remove the complete cylinder and fork assembly from the oleo housing (21), cut safety wire (2) at the top of the unit and remove cap bolts (1) that attach steering arm (11) and aligner guide bracket (12) to the top of the oleo cylinder (23).

e. Disconnect the shimmy dampener by removing each cotter pin, nut, washer and bolt that connects the dampener to the oleo cylinder (23) and housing.

f. Release and remove the snap ring (17) and washer(s) (43), if installed, at the top of the housing (21), and pull the complete cylinder and fork assembly from the bottom of the housing. The upper and lower housing bushings (20 and 22) should remain pressed in the housing.

g. To remove the piston tube (39) and fork (42) from the cylinder (23), first separate the upper and lower torque links (24 and 26) by removing the link connecting bolt assembly (25) and then separate the two links. Note spacer washer between the two links.

h. Compress the piston tube (39); reach up along the tube and release the snap ring (38) from the annular slot at the bottom of the oleo housing.

i. Pull the piston tube (39) with component parts from the cylinder.

j. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retainer pins (27). Slide from the tube, the upper bearing (29), lower bearing (34) with outer and inner "O" rings (33 and 35), wiper strip (36), washer (37) and snap ring (38).

k. To remove the orifice tube (30), remove the large locknut (16) and lock washer (19) from the top of the cylinder. Pull the tube from the cylinder.

l. The orifice plate (31) is removed from the bottom of the orifice tube by releasing the snap ring (32) that holds the plate in position.

m. To remove the piston tube plug (40) with "O" ring (41) located in the lower end of the tube, remove the bolt assembly and insert a rod up through the hole in the body of the fork (42). Push the plug out through the top of the tube.

6A-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 component for the following:

1. Bearings and bushings for excess wear, corrosion, scratches and overall damage.
2. Retaining pins for wear and damage.
3. Lock rings for cracks, burrs, etc.
4. Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.
5. Upper and lower cylinder bushings loose or turning in cylinder.
6. Orifice plate for hole restriction.
7. Fork tube for corrosion, scratches, nicks, dents and misalignment.
8. Air valve general condition.

c. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

6A-8. ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 6A-1.)

a. Ascertain that parts are cleaned and inspected.

b. To install the piston tube plug (40), first lubricate the tube plug and "O" ring (41) with hydraulic fluid (MIL-H-5606A) and install the "O" ring on the plug. Lubricate the inside wall of the tube (39); insert the plug into the top of the tube and push it to the fork end. Align the bolt holes of the fork, tube and plug, and install bolt assembly.

c. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering between the fork and tube.

d. To assemble the components of the orifice tube (30), insert the orifice plate (31) into the bottom of the tube, with the countersunk side of the orifice hole exposed. Secure the plate with the snap ring (32), lubricate and install the "O" ring (28) on the upper end of the tube.

e. Insert the orifice tube (30) up through the bottom of the cylinder (23). With the tube exposed through the top of the cylinder, install the lock washer (19) and insert roll pin (18) through the lock washer into the piston. Install the tube locknut (16) finger tight at this time.

f. The fork (42) and tube (39) assembly may be assembled by installing the tube components on the tube. In order, slide onto the tube, the snap ring (38), washer (37), lower bearing (34) with outer and inner "O" rings (33 and 35) and upper bearing (29). Align the lock pin holes in the upper bearing with the pin holes in the piston tube (39) and install pins (27).

g. Lubricate the inner wall of the cylinder (23) with hydraulic fluid. Carefully insert the piston tube assembly into the bottom of the cylinder, allowing the orifice tube to guide itself into the fork tube, until the snap ring (38) can be installed in the annular slot at the bottom of the cylinder. Install wiper strip (36), slide washer (37) into position and secure assembly with snap ring (38).

h. At the top of the cylinder (23), tighten (torque) the orifice tube locknut (16).

i. Ascertain that bushings are installed in the upper and lower torque links (24 and 26) and then install both links. The torque link bolt assemblies should be lubricated and installed with the flat of the bolt head hex adjacent to the milled stop on the wide end of the link. Tighten the bolts only tight enough to allow no side play in the link, yet be free enough to rotate.

j. Ascertain that the upper and lower oleo housing bushings (20 and 22) are installed. Install the cylinder into the oleo housing, position spacer washer(s) (43) over the top of the cylinder and secure with snap ring (17). Install spacer washers as required to obtain .0 to .015 of an inch thrust of the cylinder within the housing.

k. At the top of the oleo housing, install on the cylinder the aligner guide bracket (12) and steering arm (11). Install cap bolts (1), tighten 20 to 25 inch-pounds torque and safety with MS20995C40 wire (2).

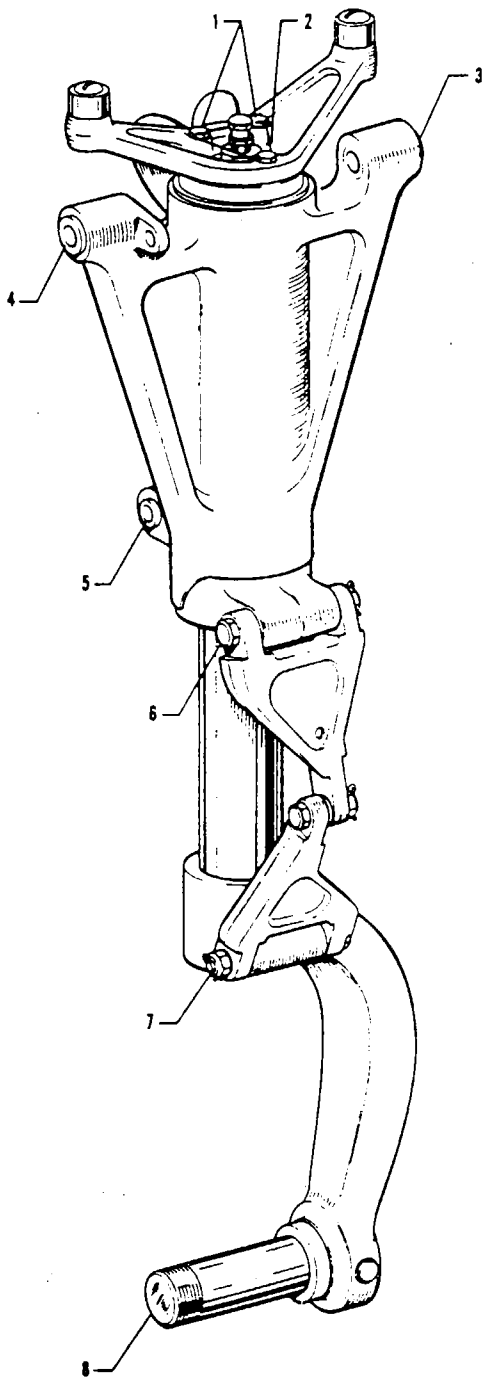
l. Install the shimmy dampener and safety.

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. Weight of the gear wheel and fork should allow the strut to extend.

o. Service the oleo strut with fluid and air. (Refer to Oleo Struts, Section II.)

p. Check nose gear for alignment (refer to Paragraph 6A-13) and gear operation.



1. CAP BOLTS AND WASHERS
2. SAFETY WIRE
3. SUPPORT FITTING
4. BUSHING, SUPPORT FITTING
5. BUSHING
6. BOLT, WASHERS, NUT AND COTTER PIN
7. BOLT, WASHERS, NUT AND COTTER PIN
8. AXLE
9. CAP BOLT
10. BUSHING, ROLLER
11. ARM, STEERING
12. BRACKET ALIGNER
13. CAP, AIR VALVE
14. CORE, AIR VALVE
15. BODY, AIR VALVE
16. NUT, ORIFICE TUBE
17. SNAP RING
18. ROLL PIN
19. WASHER, STOP
20. BUSHING, UPPER
21. HOUSING, STRUT
22. BUSHING, LOWER
23. OLEO CYLINDER
24. LINK, UPPER TORQUE
25. BOLT, WASHER, BUSHINGS, NUT AND COTTER PIN
26. LINK, LOWER TORQUE
27. PIN, BEARING RETAINING
28. "O" RING
29. BEARING, UPPER TUBE
30. TUBE, ORIFICE
31. PLATE, ORIFICE
32. SNAP RING
33. "O" RING
34. BEARING, LOWER TUBE
35. "O" RING
36. WIPER STRIP
37. WASHER
38. SNAP RING
39. TUBE, PISTON
40. PISTON TUBE PLUG
41. "O" RING
42. FORK
43. WASHER

Figure 6A-1. Nose Gear Oleo Strut Assembly

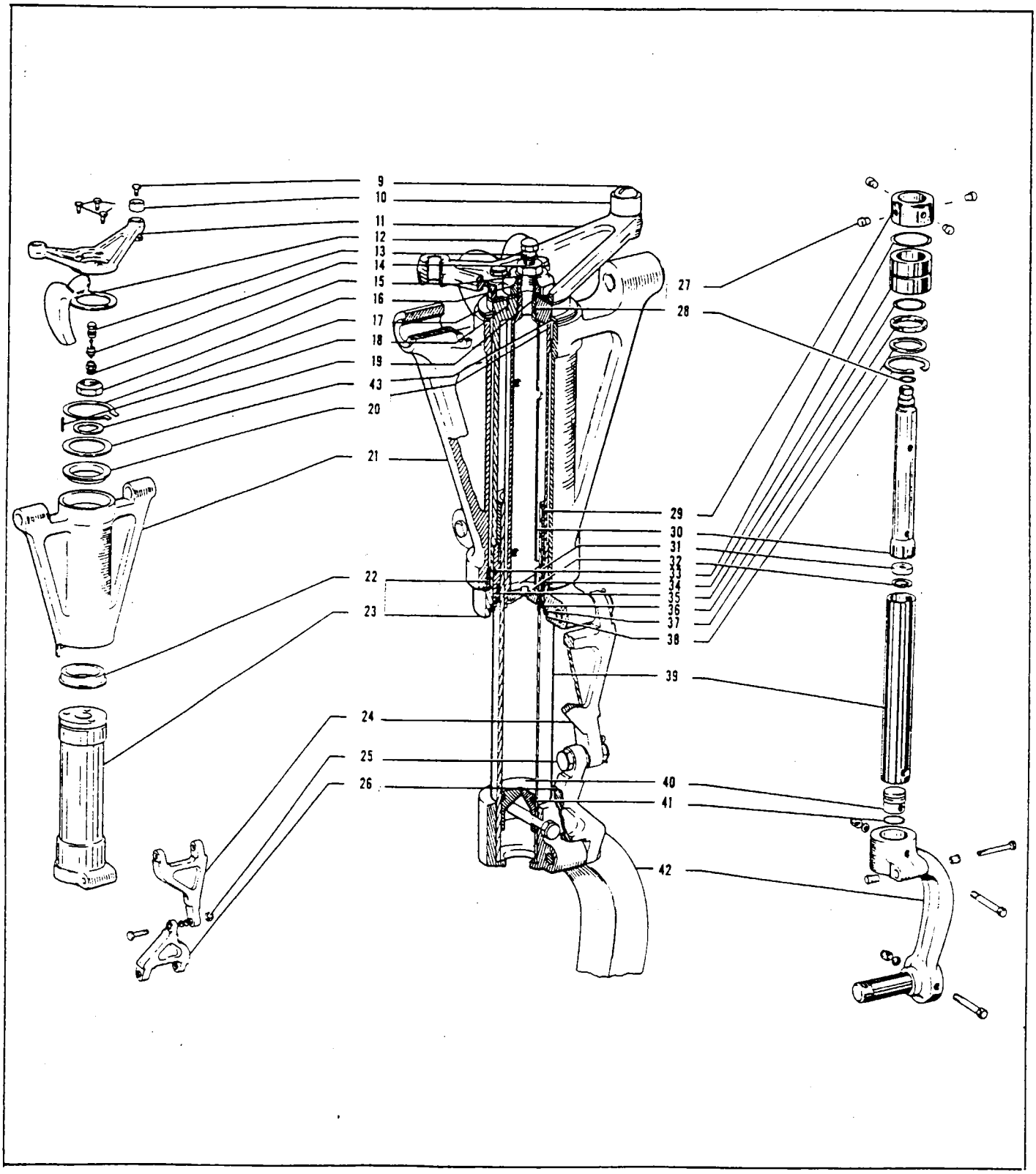


Figure 6A-1. Nose Gear Oleo Strut Assembly (cont.)

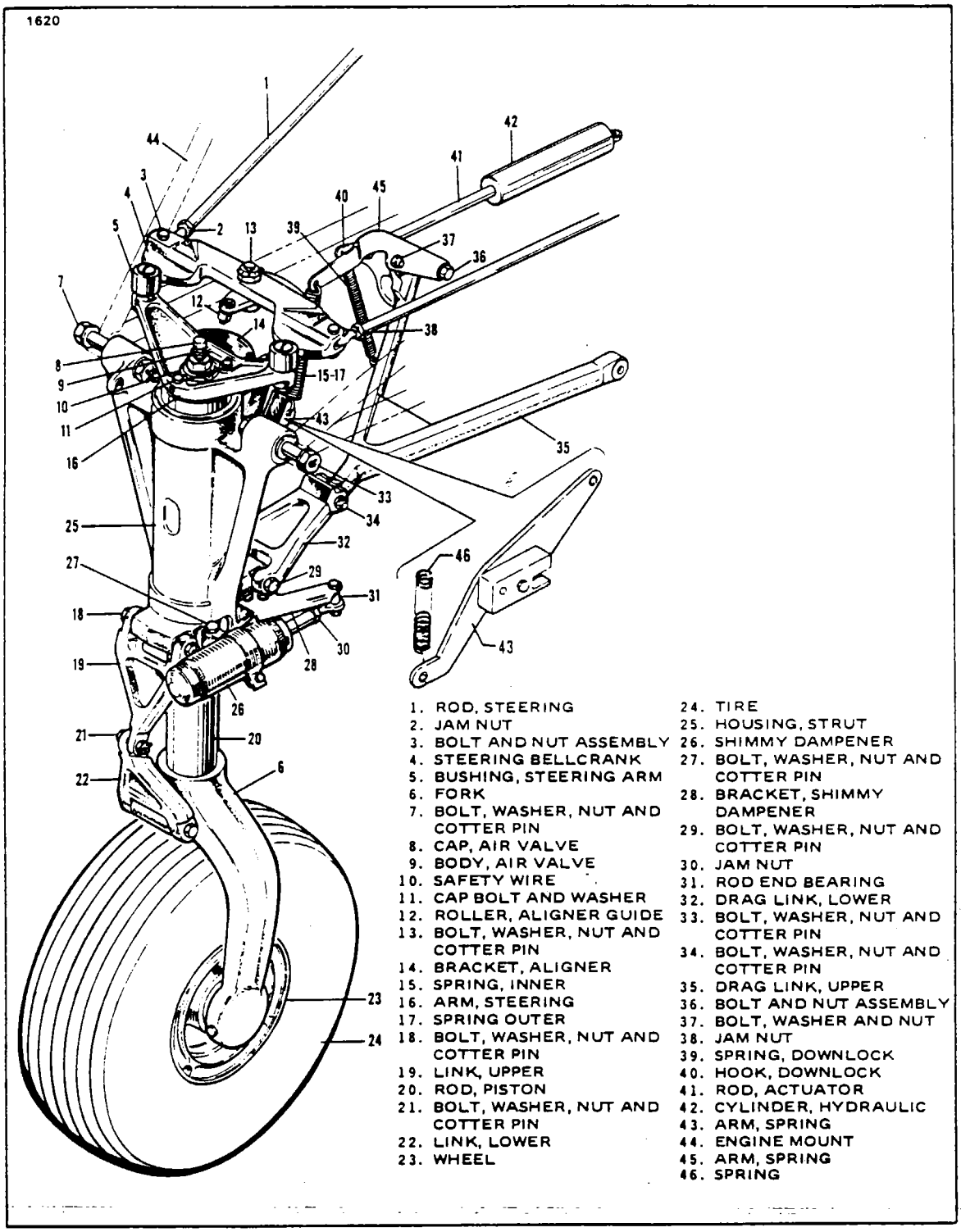


Figure 6A-2. Nose Gear Installation

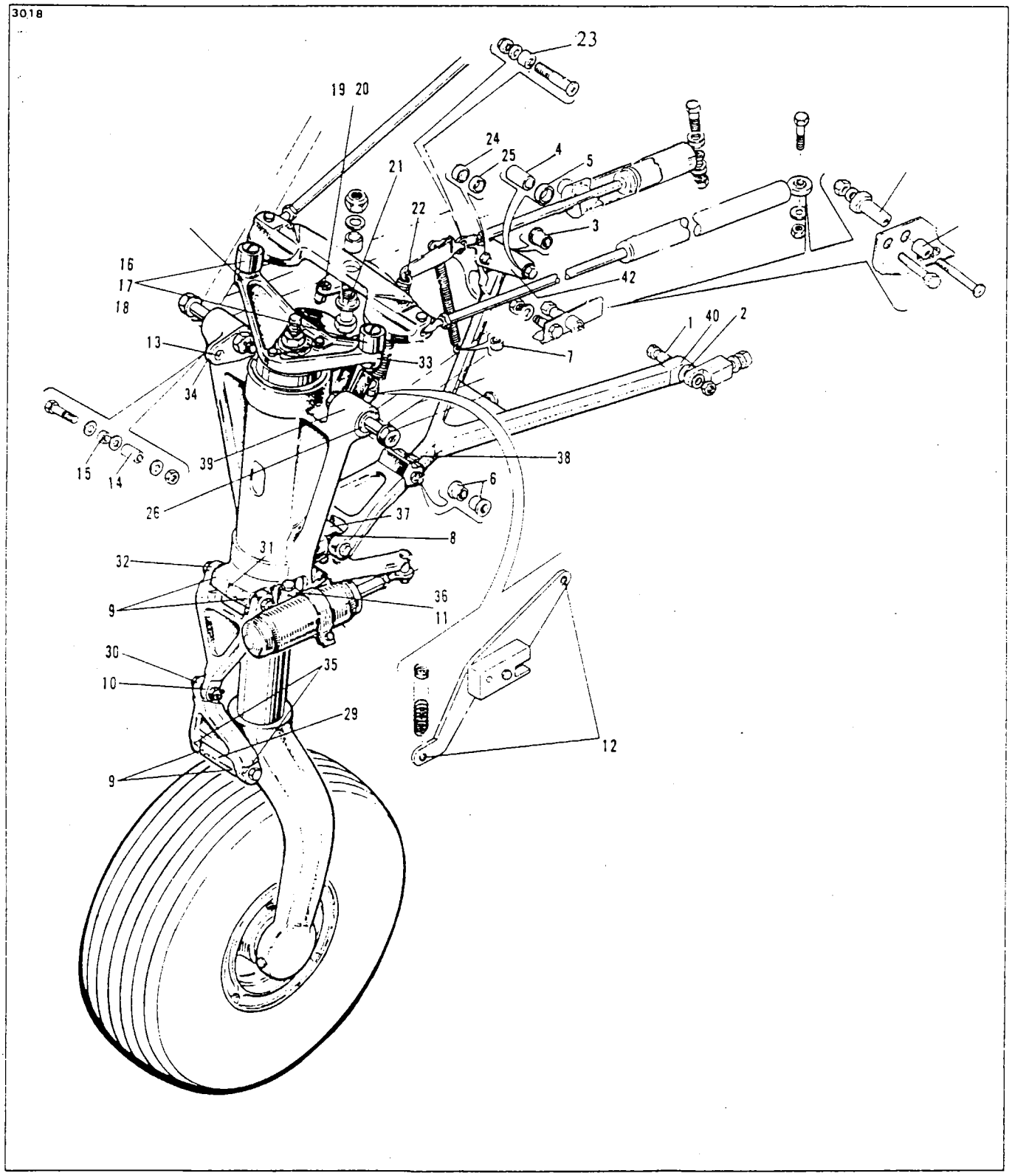


Figure 6A-2a. Nose Gear Service Tolerances

TABLE VIA-I. Nose Gear Service Tolerances

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
1	65003-45	Upper Draglink	.4385	.4395	.002	
		Bushing	.4375	.4375		
2	87319-03	LH Upper	.4385	.4395	.002	
		Draglink Bushing	.4375	.4375		
3	87319-04	RH Upper	.502	.503	.002	
		Draglink Bushing	.501	.501		
4	95061-133	Bushing	.376	.376	.002	
			.375	.377		
5	95061-134	Bushing	.645	.640	.002	
			.640	.647		
6	87319-02	Upper Drag	.2505	.2515	.002	
		Brace Bearing	.2495	.2495		
7	61402-93	Upper Drag	.189	.193	.004	
		Brace Bushing	.191	.189		
8	67026-07	Drag Link	.313	.3130	.0025	SEE NOTE 1
		Trunnion Bushing	.314	.3155		
9	67026-07	Bearing	.313	.313	.002	SEE NOTES 2, 3, AND 4
			.314	.315		
10	452-366	Link Assembly	.2495	.2495	.002	SEE NOTES 2 AND 3
		Bearing	.2505	.2515		
11	21831-4	Nose Gear Strut	.247	.247	.003	SEE NOTE 2
		Tube Bearing	.248	.250		
12	82732-99	Nose Gear	.241	.241	.010	
		Arm Bushing	.246	.251		
13	95061-144	Trunnion	.249	.249	.010	SEE NOTE 1
		Assembly Bushing	.250	.259		
14	63900-168	Bushing	.201	.211	.020	
			.181	.181		
15	82732-95	Bushing	.249	.253	.008	
			.245	.245		

Table VIA-I (cont.). Nose Gear Service Tolerances

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
16	63900-122	Nose Gear	.443	.443	.0015	
		Outer Bushing	.441	.4445		
17	452-477	Sleeve Bearing	.375	.395	.020	
				.375		
18	63900-109	Nose Gear	.3125	.3235	.011	
		Inner Bushing	.3180	.3125		
19	14976-15	Bushing	.385	.395	.010	
			.390	.385		
20	14976-16	Bushing	.260	.270	.010	
			.265	.260		
21	452-445	Steering Cam	.502	.512	.010	
		Bearing		.502		
22	82732-99	Nose Gear	.241	.241	.010	SEE NOTE 3
		Arm Bushing	.246	.251		
23	65003-30	Down Lock	.193	.196	.003	
		Bushing	.195	.193		
24	95061-136	Bushing	.2495	.2515	.002	
			.2505	.2495		
25	95061-135	Bushing	.2495	.2515	.002	
			.2505	.2495		
26	67026-11	Bearing				SEE NOTE 1
27		NOT USED				
28		NOT USED				
29	67050-02	Lower Strut Assembly Torque Link Fitting				
30	20735-05	Torque Link	.377	.377	.002	
			.3785	.3790		
31	67148-00	Trunnion	.4385	.4385	.0015	
		Torque Link Fitting	.4370	.4370		

Table VIA-I (cont.). Nose Gear Service Tolerances

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
32	20735-05	Torque Link	.312 .313	.312 .314	.002	
33	44386-03	Steering Arm	.4370 .4385	.4370 .4385	.0015	
34	67054-03	Trunnion Assy. Assist Spring Fitting	.302 .303	.302 .3035	.0015	
35	20735-05	Torque Link	.312 .313	.312 .314	.002	SEE NOTE 4
36	67148-00	Shimmy Damper Fitting	.3745 .3760	.3745 .3760	.0017	
37	67054-03	Trunnion Housing Drag Link Attachment	.4415 .4425	.4415 .4425	.0010	
38	38043-0	Drag Link, Upper	.378 .379	.3775 .3795	.002	SEE NOTE 5
39	67054-03	Trunnion Assy. Main Attach Fitting	.6285 .6295	.6285 .6295	.001	
40	38043-0	Drag Link, Upper	.4385 .4375	.4385 .4405	.002	SEE NOTE 5
41		NOT USED				
42	38043-0	Drag Link, Upper	.6235 .6245	.6230 .6250	.002	SEE NOTE 5

NOTES

1. INSTALL NEW BUSHING BY COATING O.D. OF BUSHING WITH LOCTITE 601 AND ROTATING BUSHING WHILE INSERTING IT TO INSURE COVERAGE.
2. INSTALL BUSHING WITH WET ZINC CHROMATE.
3. PRESS FIT.
4. LINE REAM TO THIS DIMENSION AFTER INSTALLATION OF PARTS.
5. PART OF LINK AND BRACE ASSEMBLY 38040-02

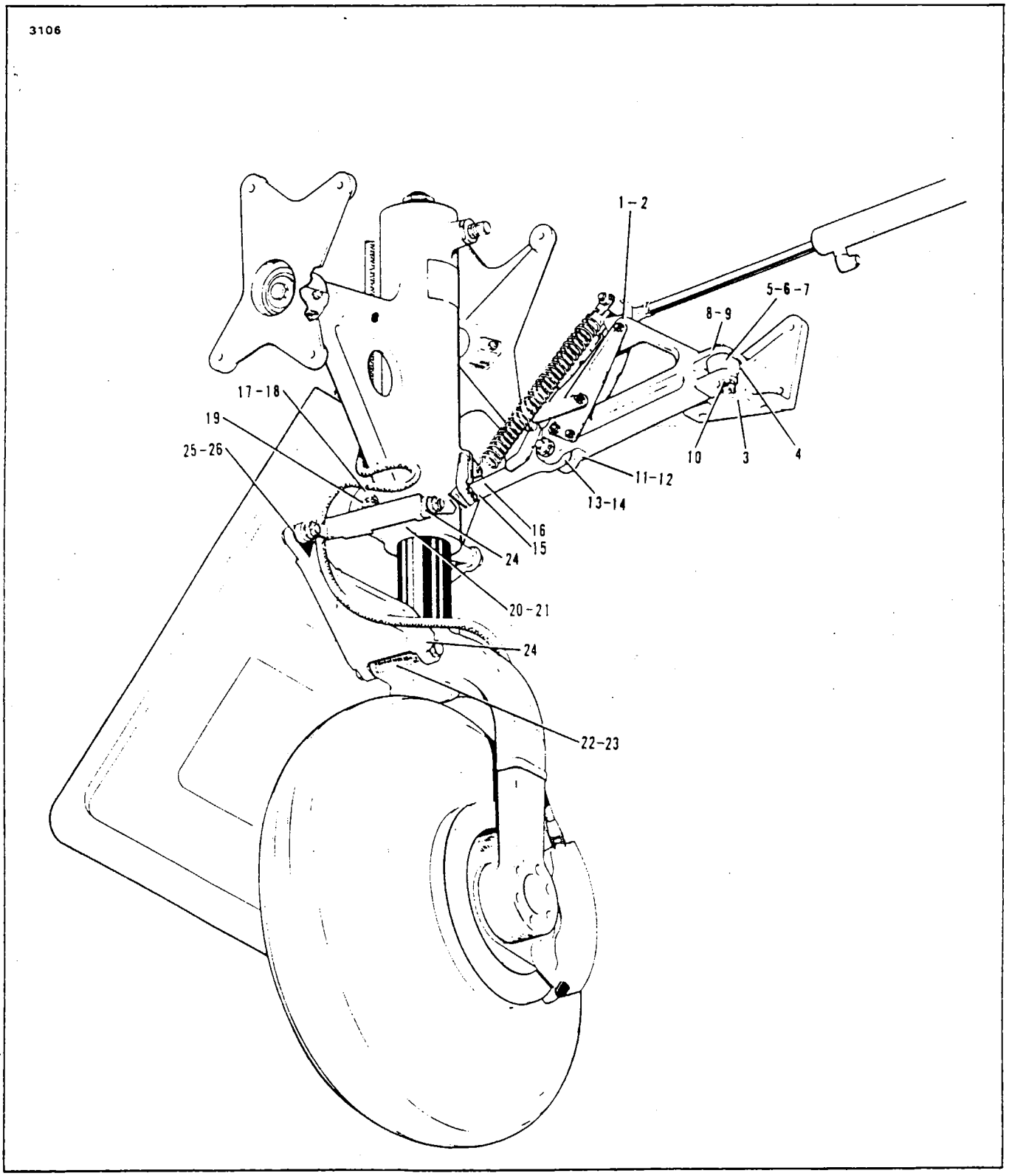


Figure 6A-2B. Main Gear Service Tolerances

Table VIA-II. Main Gear Service Tolerances

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
1	67025-2	Link, Upper Side Brace	.3645 .3625			NO ROTATION
2	63900-89	Upper Side Brace Link Bushing	.249 .251	.248 .252	.004	SEE NOTES 1 AND 4
3	95643-6 95643-7	Side Brace Support Bracket				
4	67026-12	Support Bracket Bushing	.624 .625	.624 .626	.002	SEE NOTE 3
5	78717-2	Side Brace Support Stud	OD .6235 .6225	OD .6220		
6	78717-2	Side Brace Support Stud	.4365 .4385	.4355 .4395	.004	
7	67025-2	Link Upper Side Brace	.4945 .4935	.4925		
8	14843-16	Side Brace Link Bushing	.376 .375	.374		SEE NOTES 1 and 4
9	AN26-25 400-761	Link/Stud Attaching Bolt	OD .373 + 0 -.002	.373 + 0 -.004	.004	
10	67025-2	Upper Side Brace Link	.4945 .4935	.4925		
11	14843-16	Side Brace Link Bushing	.3745 .3755	.374		SEE NOTE 1
12	67797-04 67797-05	Link, Lower Side Brace	.4925 .4905	.500		
13	65003-44	Lower Side Brace Link Bushing	.373 .375	.372 .376	.004	SEE NOTES 1 and 4
14	NAS 464-6-16	Side Brace Link Assembly Bolt	OD .3742 + 0 -.0005	.3740		
15	452368 (PS10020-2-2RG)	Rod End Lower Side Brace Link	.50 + .0015 -.0005	.50 + .003 -.0005	.0035	
16	67926-04 6792-05	Trunnion Housing Side Brace Attachment	.7530 .7550	.7530 .7550		

Table VIA-II (cont). Main Gear Service Tolerances

Fig. No.	Part No.	Nomenclature	Manufacturers Dimension	Service Dimension	Service Tol.	Remarks
17	67026-05	Trunnion Bushing	.499 .500	.498 .502	.004	SEE NOTE 2
18	NAS-464 P8A-44	Trunnion Side Brace Attaching Bolt	OD .4991 + .00 -.0009			
19	67926-04 67926-05	Trunnion Housing Torque Link Attachment	ID .4410 ID .4430	.4410 .4440		
20	67026-07	Trunnion Bearing	.313 .314	.315		SEE NOTES 1, 2, and 4
21	67037-06	Strut Assembly	.4385 .4370	.4395 .4370	.0025	
22	67026-07	Strut Bearing	.313 .314	.313 .315	.002	SEE NOTES 1 and 4
23	67012-00	Torque Link	.312 + .001 -.0	.312 + .002 -.0	.002	
24	67012-00	Torque Link	.3760 .3745	.3770 .3745	.0025	
25	31796-00	Torque Link Bushing	.252 .251	.253 .251	.002	SEE NOTES 1 and 4

NOTES

1. Line ream to this dimension after installation of new part.
2. Install bearing with wet zinc chromate or adjacent surfaces of bearings and casting.
3. Install using Loctite 601. Rotate part while inserting, if possible, to insure complete coverage.
4. Press fit.

6A-9. REMOVAL OF NOSE LANDING GEAR. (Refer to Figure 6A-2.)

a. Remove the engine cowling by the following procedure:

1. Release the cowl fasteners, two on each side and two at the top aft of the cowl.

2. Lift the aft end of the cowl and then slide it forward to release the two stud type front fasteners. Remove the top cowl.

3. Disconnect the landing light lead at the quick disconnect at the right rear side of the bottom cowl.

4. Remove the induction air filter access door, the filter and four bolts which hold the air box to the cowl.

5. Remove the screws securing the bottom cowl at its aft end and fuselage firewall flange.

6. Remove screws which support bottom cowl to the nose gear doors support brackets, and fuselage firewall flange.

7. Push nose gear doors inward against spring pressure and remove bottom cowl.

b. Place the airplane on jacks. (Refer to Jacking, Section II.)

c. Disconnect the gear tension springs (15, 17 and 46) from the forward spring arm (43) that is attached to the right side of the strut housing (25).

d. Retract nose gear slightly to remove the gear from its downlocked position.

e. To remove the upper and lower drag links (32 and 35), the following procedure may be used:

1. Disconnect the rod end of the hydraulic cylinder (42) from the downlock hook (40) by removing nut and bolt that connects these two units. This will require manually unlocking the nose gear to allow clearance from the engine mount.

CAUTION

Whenever aircraft is placed on jacks for the purpose of manually retracting the nose gear assembly, insure the nose gear downlock is fully disengaged before releasing the nose gear drag links. Damage could occure to the downlock if not disengaged fully.

2. Retract the gear and disconnect the gear downlock spring (39) from the upper drag link (35).

3. Remove the cotter pins, washers and nuts from the bolts that secure the upper drag link (35) and lower drag link (32).

4. Remove the lower and upper gear tension spring arms (43 and 45).

5. Slide the attachment bolts from the upper and lower drag links and remove the links.

f. With the lower drag link (32) disconnected from the gear oleo housing (25), the housing may be removed by removing cotter pins, nuts, washers, and bolts (7 and 33) at the attachment points on each side of the housing at the engine mount.

g. The steering bellcrank (4 may be removed by removing the nut and bolt (3) at the steering rod, and nut and bolt (13) with bushing at the bellcrank pivot point.

6A-10. CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect the gear components for the following unfavorable conditions:

1. Bolts, bearings and bushings for excess wear, corrosion and damage.

2. Gear housing, drag links, torque links, and tension spring arm for cracks, bends or misalignment.

3. Downlock hook for excess wear of the hook and bearing surfaces.

4. Downlock pin to insure no looseness is present.

c. Inspect the gear tension and downlock hook springs for the following:

1. Excess wear or corrosion, especially around the hook portion of the springs. A spring should be rejected if wear or corrosion exceeds one-quarter the diameter of the spring. Clean away all corrosion and repaint.

2. Check the gear tension springs for load tensions below minimum allowable tolerances. The minimum allowable tension of the inner spring is 37 pounds pull at 13.75 inches and the outer is 60 pounds pull at 13.75 inches. Measurement is taken from the inner side of each hook. If it is found that either spring should be rejected, replace both springs.

3. Check the gear downlock hook spring for load tension below minimum allowable tolerance. The minimum tension of the spring is 10.5 pounds pull at 4.5 inches. Measurement is also taken from the inner side of each hook.

d. Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

e. Check drag link through center travel by attaching the upper and lower drag links, and ascertaining that when the stop surfaces of the two links touch, linkage is not less than .125 nor more than .250 of an inch through center. Should the distance exceed the required through center travel and bolt and bushing are tight, replace one or both drag links.

f. The shimmy dampener requires no service other than routine inspection. In case of damage or malfunction, the dampener should be replaced rather than repaired.

g. 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.

h. Refer to Table VIA-I for service tolerance information.

6A-11. INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 6A-2.)

NOTE

When assembling any units of the landing gear, lubricate bearings, bushings, and friction surfaces with the proper lubricant as described in Section II.

a. Attach the steering bellcrank (4) with bushing to its mounting plate on the engine mount (44) and connect the steering rods (1). Secure each with bolt and nut (3). The adjustment, fore and aft, of the bellcrank may be made after the gear has been installed and rigged and adjusted.

b. To install the gear housing assembly, position the gear so that the bolt attachment points on the housing (25) align with the attachment points on the engine mount (44). Install pivot bolts, washers and nuts (7 and 33). Tighten the nuts to a snug fit, yet allowing the gear to swing free, and safety.

c. The drag links (32 and 35) and gear tension spring arms (43 and 45) may be installed by the following procedure:

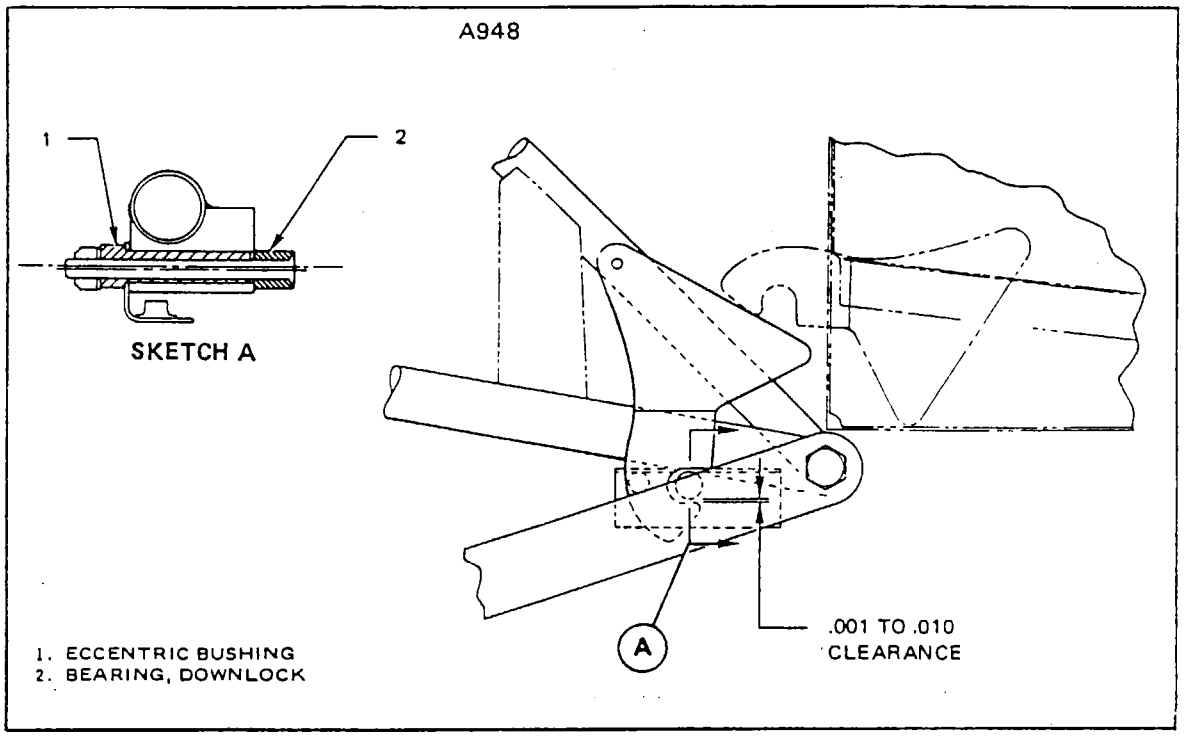


Figure 6A-2c. Adjustment of Eccentric Bushing

1. Ascertain that the upper and lower links (32 and 35) are assembled with the downlock hook attached, and the through travel of the links checked according to Paragraph 6A-10.

2. Position the link assembly to allow the bolt holes in links to align with holes in gear housing and engine mount.

3. Add the upper gear tension spring arm (45), bushings and washers on upper link (35) attachment bolt.

4. Install the bolt and tighten nut to allow the link to rotate freely and safety.

5. Install the lower gear tension spring arm (43) on the drag link bolt (29) on the right side of the gear oleo housing (25), secure and safety. A washer is installed on the bolt between the lower drag link and the arm.

d. Connect the gear downlock spring (39) between the downlock (40) and the upper drag link (35).

e. Connect the two gear tension springs (15 and 17).

f. Aircraft serial numbers 32R-77 and up, adjust the eccentric bushing (used for downlock pin) with the gear extended and downlock engaged to obtain .001 to .010 clearance between the bottom of the down lock pin (bearing) and the downlock hook (Refer to Figure 6A-2c.)

g. Retract gear and tighten with eccentric bushing in its adjusted position.

h. Ascertain that the landing gear is lubricated per Lubrication Chart, Section II.

i. Check adjustment of the gear per Paragraph 6A-12.

j. Install engine cowling.

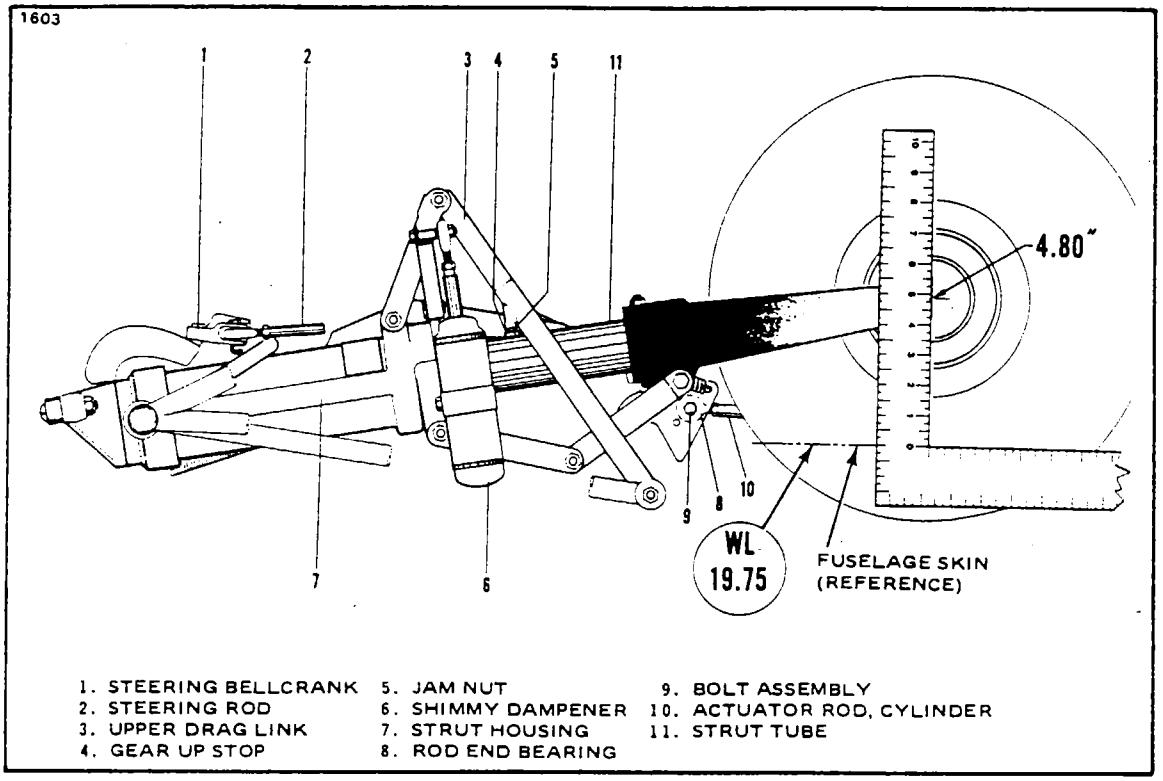


Figure 6A-3. Nose Gear Adjustment

k. Retract landing gear and check door operation as per Paragraph 6A-17.
l. Check the alignment of the nose gear per Paragraph 6A-13.
m. Remove the airplane from jacks.

6A-12. ADJUSTMENT OF NOSE LANDING GEAR. (Refer to Figure 6A-3.) The gear up stop (4) is located on underside of upper drag link (3).

a. Remove the engine cowl. For removal instructions, refer to Paragraph 6A-9, Step a.

b. Place the airplane on jacks. (Refer to Jacking, Section II.)

c. Retract the landing gear hydro-electrically by turning the master switch on, raising the emergency gear extension lever and moving the gear selector handle to the UP position. Retain the emergency extension lever in the UP Override position.

d. Check the adjustment of the gear up stop by placing a carpenters square with the longest end along the bottom of the fuselage, and the shortest end running up through the centerline of the wheel axle. Measure up along the square from the bottom of the fuselage 4.80 inches, to determine if the center of the wheel axle meets this measurement. If this measurement is incorrect, extend the gear, loosen the jam nut (5) on the gear up stop, and make the required adjustment by turning the stop.

e. Adjust rod end of nose gear retracting cylinder so that at least .07 to .10 rod travel remains to full extension when the downlock is fully engaged. Check rod end safety hole and tighten safety nut.

f. Recheck all adjustments and retighten the jam nut on the gear up stop. When the gear is fully retracted, the strut tube (11) should be firmly against the gear up stop. Extend the gear.

g. Adjust shimmy dampener by turning nose wheel against stops and adjusting the rod end of the dampener for adequate travel to both extremes.

h. Install engine cowling.

i. Remove the airplane from jacks.

6A-13. ALIGNMENT OF NOSE LANDING GEAR.

a. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.

b. Ascertain that the nose gear is properly adjusted as given in Paragraph 6A-12.

c. With the landing gear in the down-locked position, weight proportionally on the nose gear and the nose wheel facing forward, adjust the steering bellcrank. The bellcrank is attached at the lower front of the engine mount directly aft of the gear housing and may be adjusted by loosening its attachment bolt and sliding the bellcrank fore and aft until it contacts the rollers. Retighten the attachment bolt.

d. Place the airplane on jacks. (Refer to Jacking, Section II.)

e. Level the airplane laterally and longitudinally. (Refer to Leveling, Section II.)

f. From the center point of the tail skid, extend a plumb bob and mark the contact point on the floor.

g. Extend a chalk line from the mark on the floor below the tail skid to a point approximately three feet forward of the nose wheel. Allow the line to pass under the wheel at the centerline of the tire. Snap the chalk line.

h. Clamp the rudder pedals to align them in a lateral position. Ascertain that the rudder pedals are in their neutral position. (Refer to Figure 6A-4 and Figure 6A-5.)

i. Adjust the rod end bearings of each steering control rod to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle fore and aft.

j. Install the steering push rods on the rudder pedals. Adjust the rods so the lengths are both the same and the rudder pedals are at their neutral position.

k. 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 straightedge with the chalkline.

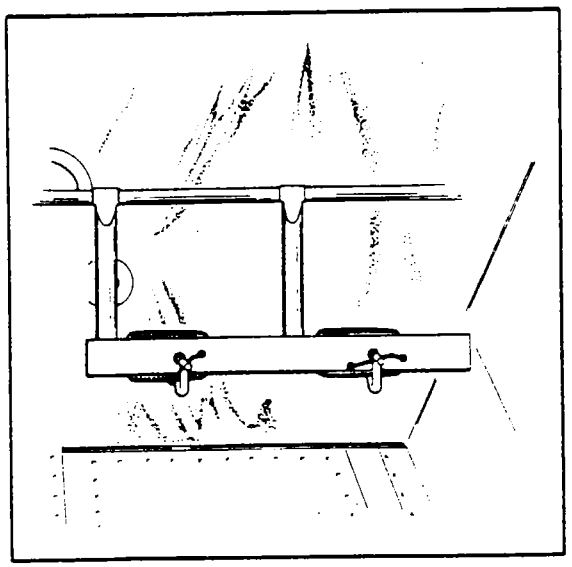


Figure 6A-4. Clamping Rudder Pedals in Neutral Position

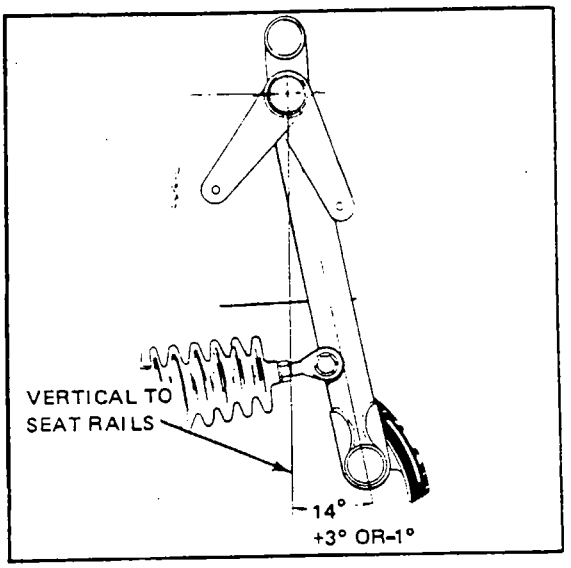


Figure 6A-5. Rudder Pedals at Neutral Angle

l. Place a bubble protractor against a rudder pedal steering tube to check the neutral angle. (Refer to Figure 6A-5.)

m. One end of each rod must be disconnected and the jam nuts loosened to make any adjustment. Do not attempt to make the adjustment by means of one rod end bearing, but divide the adjustment between the bearings at each end of each rod. Check that the rod ends have sufficient thread engagement by ascertaining that a wire will go through the check hole in the rod. Where no check holes are provided, ascertain a minimum of 3/8 inch thread engagement. Reinstall the rods and tighten the jam nuts.

n. To check the nose gear steering for its 22.5° ± 2° maximum right and left travel, mark on each side of the nose wheel an angle line from the centerline and wheel pivot point. Turn the wheel to its 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.

6A-14. REMOVAL OF NOSE GEAR DOOR ASSEMBLY. (Refer to Figure 6A-6.)

a. With the nose gear extended, disconnect springs (2) from door arms (3) by removing upper attachment hardware.

b. Disconnect link assemblies (4) from doors (1) and remove mechanism.

c. To remove the doors from cowl, bend the end of the hinge pin (8) straight and pull out the pin.

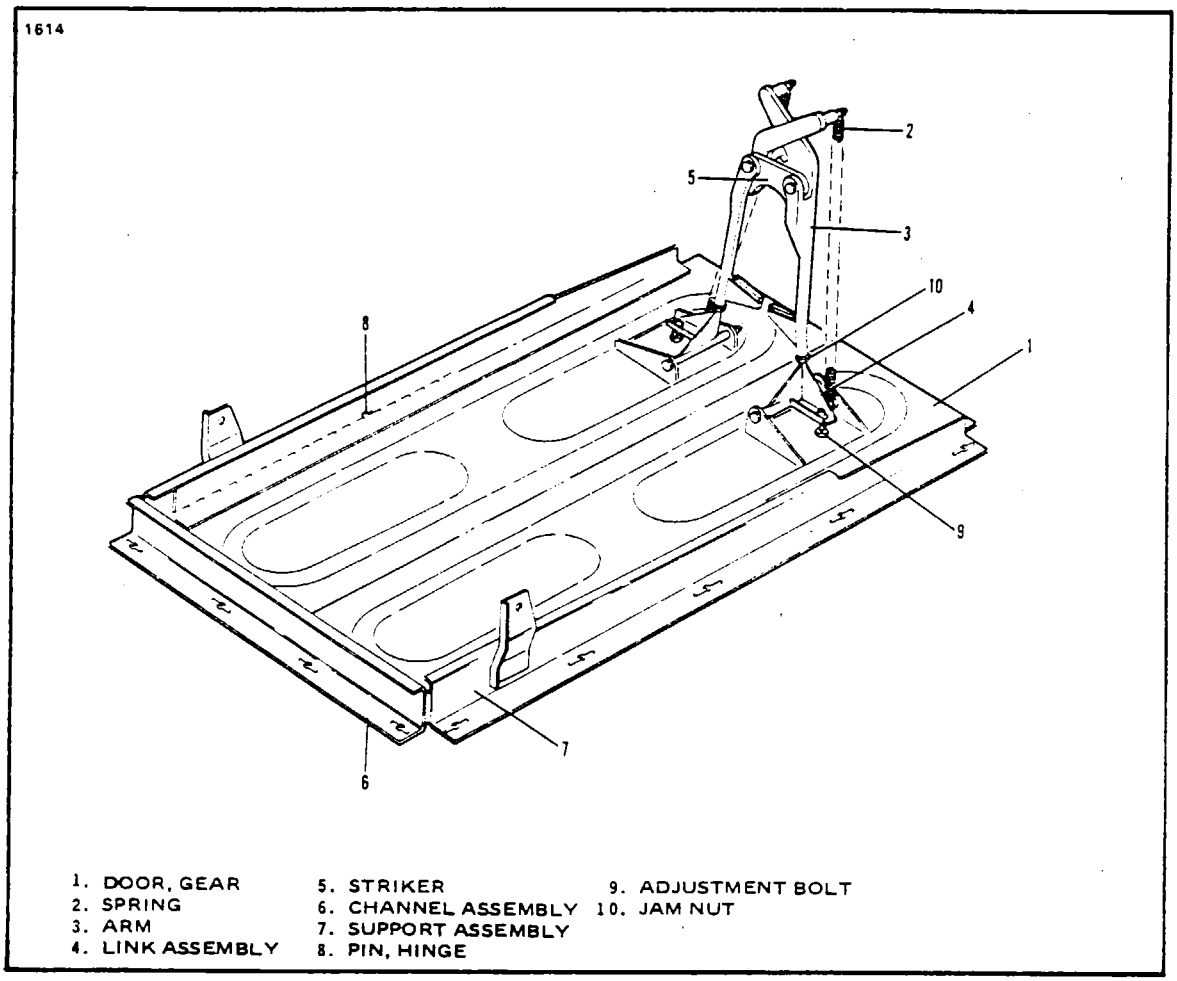


Figure 6A-6. Nose Gear Doors

6A-15. CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOOR ASSEMBLY.

a. Clean all parts with a suitable cleaning solvent.

b. Inspect doors for damage, loose or damaged hinges and brackets.

c. Inspect door retraction link assemblies and arms for damage and wear.

d. Check the door tension springs for wear and tension. Reject springs if tension does not maintain the doors in the full open position.

e. Repairs to the doors may be replacement of hinges and painting.

f. Repairs to the retraction mechanism is limited to replacement of parts, and sanding and painting.

6A-16. INSTALLATION OF NOSE GEAR DOOR ASSEMBLY. (Refer to Figure 6A-6.)

a. Install the gear doors by positioning the hinge halves of the door and the door support assembly, and inserting the hinge pins. It is recommended a new pin be used. Bend the ends of the pins to secure in place.

b. Assemble the door mechanism to the doors and attach springs.

6A-17. ADJUSTMENT OF NOSE GEAR DOORS.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Adjust the door retraction links to align doors with the lower cowl in the closed position.

c. The door down adjustment bolts should be positioned to limit the doors travel to 90 degrees from the closed position.

d. Check attaching hardware and jam nuts for safety and tightness.

e. Remove the airplane from jacks.

6A-18. MAIN LANDING GEAR SYSTEM.

6A-19. DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 6A-7.) The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed in the airplane.

a. Place airplane on jacks.

b. Place a drip pan under the main gear to catch spillage.

c. Remove air and fluid from the oleo. Depress air valve core pin until strut pressure has diminished; remove the filler plug and with a thin hose siphon as much hydraulic fluid from the strut as possible.

d. Disconnect brake line at the joint located in the wheel well.

e. To remove piston tube assembly (25) from oleo housing (11), remove the upper and lower torque link connecting bolt assembly (3) and separate links. Note number and thickness of spacer washer(s) between the two links (15 and 16).

f. Compress the piston tube (25); reach up into the tube and release the snap ring (24) from the annular slot at the bottom of the oleo housing.

g. Pull piston tube (25) with component parts from cylinder housing.

h. The piston tube (25) components may be removed by reaching in the tube and pushing out the upper bearing retainer pins (17). Slide off the upper bearing (18), lower bearing (20) with O-rings (19 and 20), wiper (22) and washer (23).

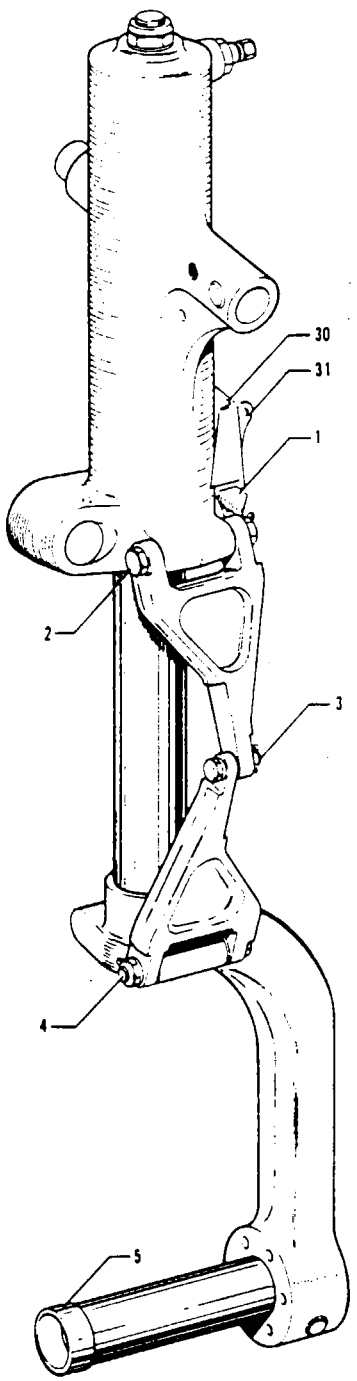
i. To remove orifice tube (12) from the oleo housing, remove locknut (6) and washer (7) from top of housing. Draw tube with O-ring (9) and retainer (8) from housing.

j. The orifice plate (13) is removed from the bottom of orifice tube (12) by releasing snap ring (14) holding the plate in position.

k. To remove piston tube plug (26) and O-ring (27) located in the bottom end of the tube, remove bolt assembly (29) and insert a rod up through the hole in the body of the fork (28) and push plug with O-ring from top of tube.

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1. BRACKET, SWITCH ACTUATOR
2. BOLT, WASHERS, NUT AND COTTER PIN
3. BOLT, WASHERS, NUT AND COTTER PIN
4. BOLT, WASHERS, NUT AND COTTER PIN
5. AXLE NUT
6. NUT
7. WASHER
8. RETAINER
9. O-RING
10. VALVE ASSEMBLY
11. HOUSING, OLEO STRUT
12. ORIFICE TUBE
13. PLATE, ORIFICE
14. SNAP RING
15. LINK ASSEMBLY, UPPER
16. LINK ASSEMBLY, LOWER
17. RETAINER PIN, BEARING
18. BEARING, UPPER
19. O-RING, OUTER
20. BEARING, LOWER
21. O-RING, INNER
22. WIPER STRIP
23. WASHER
24. SNAP RING
25. PISTON TUBE
26. PLUG
27. O-RING
28. FORK ASSEMBLY
29. BOLT ASSEMBLY
30. BRACKET - SQUAT SWITCH
31. PLATE, SPRING ATTACHMENT
32. PISTON RING

Figure GA-7. Main Gear Oleo Strut Assembly

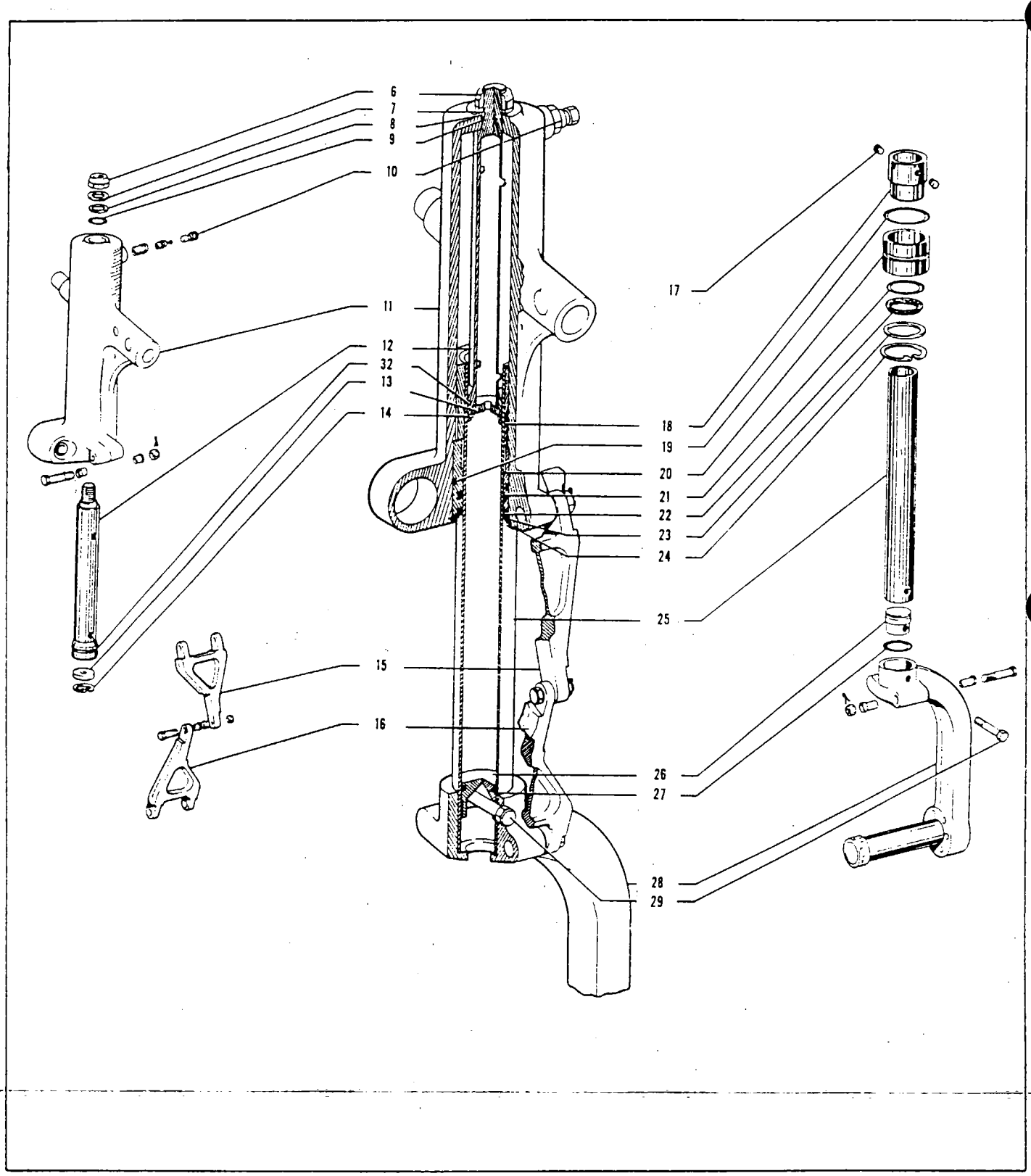


Figure GA-7. Main Gear Oleo Strut Assembly (cont.)

6A-20. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect landing gear oleo assembly components for the following:

1. Bearings and bushings for excess wear, corrosion, scratches and overall damage.
2. Retaining pins for wear and damage.
3. Lock 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.

6A-21. ASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 6A-7.)

a. Determine that all parts are cleaned and inspected.

b. To install the piston tube plug (26), first lubricate the plug O-ring (27) with hydraulic fluid (MIL-H-5606A) and install it on the plug. Lubricate the inside wall of the tube. Insert the plug into the top of the tube (25) and push it to the fork end. Align the bolt holes of the fork, tube and plug, and install bolt assembly.

c. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering between the fork and tube.

d. To assemble components of orifice tube (12), insert orifice plate (13) into the bottom of the tube and secure with snap ring (14).

e. To install tube (12) in oleo housing (11), insert the tube up through the housing. With the end of the tube exposed through the top of the housing, install the O-ring (9), retainer (8), washer (7), and locknut (6). Tighten locknut only finger tight at this time.

f. Assemble components of piston tube (25) on the tube by placing, in order, snap ring (24), washer (23), lower bearing (20) with outer and inner O-ring (19 and 21) and upper bearing (18). Align the two .125 diameter holes and the lock pin holes with the corresponding holes in the piston tube and install pins (17).

g. Lubricate the wall of the cylinder oleo housing (11) and tube (25), and carefully insert the tube assembly into the housing, guiding the orifice tube (12) into the piston tube. Install the wiper strip (22), slide the washer (23) into position and secure the assembly with snap ring (24).

h. Tighten locknut (6) at top of housing.

i. Ascertain that the bushings are installed in the upper and lower torque links (15 and 16) and then install links. The torque link bolt assemblies (2, 3 and 4) should be lubricated and installed with the flat of the bolt head hex adjacent to the milled stop of the wide end of the link. (Use the same thickness of spacer washers between the two links as those removed to maintain correct wheel alignment.) Tighten the bolts only tight enough to allow no side play in the links, yet be free enough to rotate.

NOTE

Instructions contained in Paragraph "j" pertain to left oleo strut assemblies only.

j. Assemble squat switch actuator bracket (1) on bolt assembly (2). Insert a rivet through the hole provided in the bracket into the upper link and install the nut. Install squat switch bracket (30) immediately above the actuator bracket.

k. Attach spring attachment plate (31) to the mounting lug on the base of the housing immediately above the upper link.

l. Connect brake line and bleed the brakes per Paragraph 6-46 or 6-47, of Section VI.

m. Lubricate gear assembly. (Refer to Lubrication Chart, Section II.)

n. Compress and extend the strut several times to ascertain the strut will operate freely. The weight of the gear wheel and fork should allow the strut to extend.

o. Service oleo strut with fluid and air. (Refer to Oleo Struts, Section II.)

p. Check main gear alignment (refer to Paragraph 6A-26) and gear operation. Ascertain that gear is down and locked.

q. Remove the airplane from jacks.

6A-22. REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 6A-8.)

a. Place the airplane on jacks.

b. The side brace link assembly may be removed by the following procedure:

1. With gear in the extended position, disconnect gear downlock spring (18).

2. Disconnect rod end (46) of actuating cylinder (24) from retraction fitting (21) on the upper side brace link (28) by removing nut, washer and bolt (47), and bushing and spring swivel (20).

3. Disconnect lower side brace link (33) from gear housing (13) by removing attachment nut, washer and bolt (7). Note bushings on each side of end bearing.

4. Disconnect upper side brace link (28) from side brace support fitting stud (26) by removing cotter pin, nut, washer and attachment bolt (25).

5. The side brace support fitting may be removed by removing the cap bolts securing the fitting to the web of the spar.

6. Remove the assembly and further disassemble and inspect as needed.

c. The strut housing (13) with components may be removed by the following procedure:

1. Disconnect brake line (42) at its upper end in the wheel well.

2. Disconnect gear door actuating rod (38) at the gear housing.

3. Remove access plate located on underside of wing, aft of landing gear.

4. If not previously disconnected, disconnect lower side brace link (33) from the gear housing.

5. Disconnect forward support fitting (16) of housing (13) from the web of the main spar by removing fitting attachment bolts.

6. Remove retainer tube (4) in aft support fitting (1) that supports the aft arm of the housing by reaching through the access opening on the underside of the wing, through the hole in the web and removing bolt (48) that secures the tube in the housing. Insert a hook through the bolt hole in the tube, and slide it aft from the support fitting. Remove the tube from the wing.

7. Allow the gear to drop free from the wing.

8. The aft support fitting (1) may be removed by holding the nuts in position, reaching through the access opening, and removing the fitting attachment bolts.

9. The forward support fitting (16) may be removed from the arm of the housing by removing the bolt and washer from the base side of the fitting. Slide the fitting from the arm. Remove washer (52) from the arm.

d. Either bearing (53 or 54) installed in the support fittings may be removed by removing the snap rings (2) that hold the bearing in the housing. Push the bearing from the housing.

6A-23. CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect the gear components for the following unfavorable conditions:

1. Bolts, bearing and bushings for excess wear, corrosion and damage.

2. Gear housing, side brace links, torque links and attachment plates for cracks, bends or misalignment.

3. Downlock hook for excessive wear of the bearing surfaces.

c. Inspect the gear downlock spring for the following:

1. Excessive wear or corrosion, especially around the hook portion of the spring. A spring should be rejected if wear or corrosion exceeds one-quarter the diameter of the spring. Clean away all corrosion and repaint.

2. Check the spring for load tensions below minimum allowable tolerance. The minimum tension of the spring is 48 pounds pull at 7.9 inches. Measurement is taken from the inner side of each hook.

d. Check the general condition of each limit switch and its actuator, and wiring for fraying, poor connections or conditions that may lead to failures.

e. Check side brace link through center travel by attaching the upper and lower links, setting them on a surface table, and ascertaining that when the stop surfaces of the two links touch, linkage is not less than .062 nor more than .125 of an inch through center. Should the distance exceed the required through center travel and bolt and bushings are tight, replace one or both links.

f. With side brace links assembled and checked, ascertain that when stop surfaces of the two links contact, the clearance between each downlock hook and the flat of the downlock pin is not less than 0.010 of an inch. Should clearance be less than that required, the hook only may be filed not to exceed a gap of more than 0.025 of an inch. The maximum allowable clearance between each hook and the downlock pin that are service worn is 0.055 of an inch. Should clearance be more than 0.055 of an inch, replace the pin, check clearance and then if still beyond tolerance, replace hooks. The gap between each hook should be equal.

g. Repair of the landing gear is limited to reconditioning of parts such as replacing components, bearings and bushings, smoothing out minor nicks and scratches and repainting areas where paint has chipped or peeled.

h. Refer to Table VIA-II for service tolerance information.

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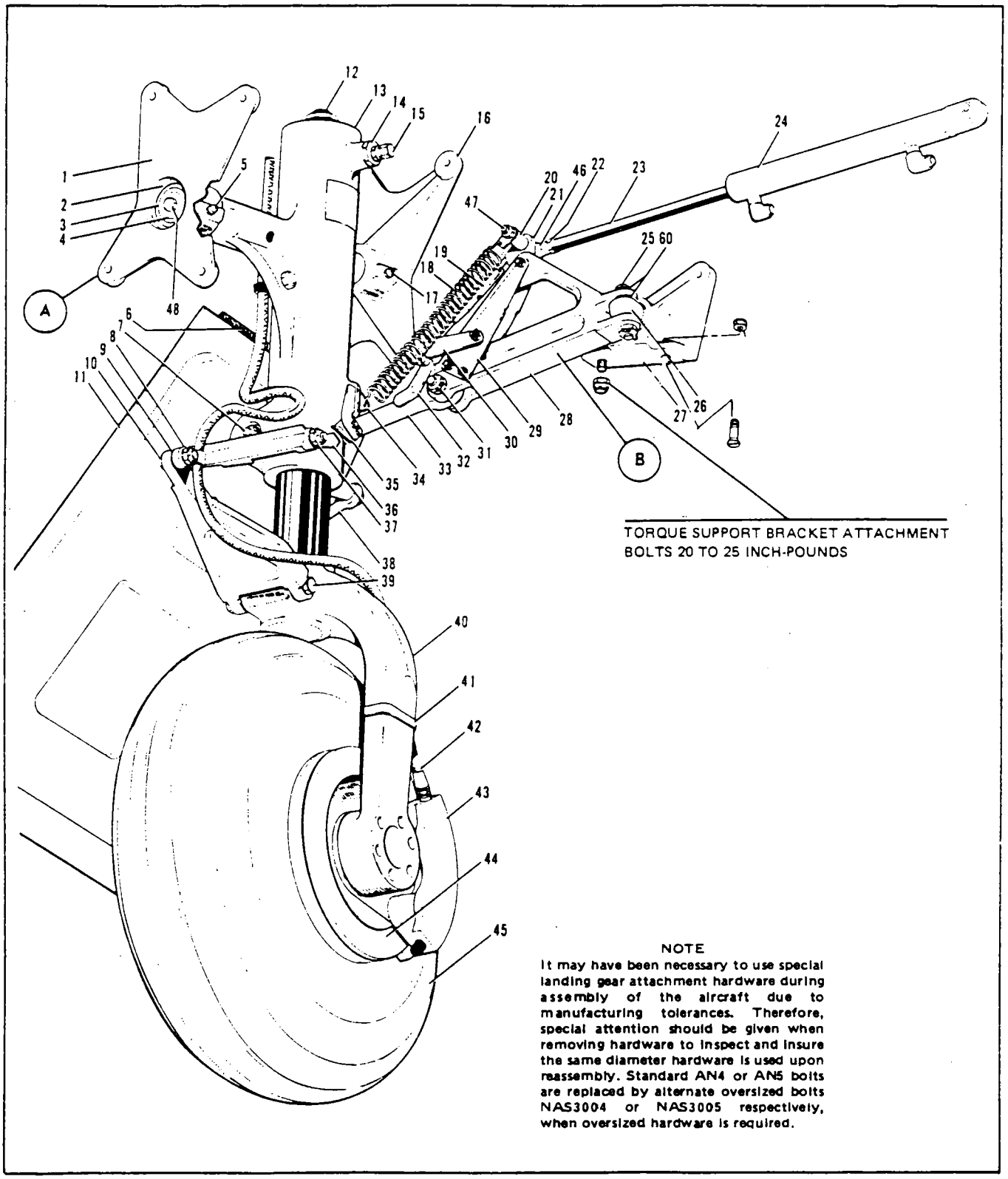
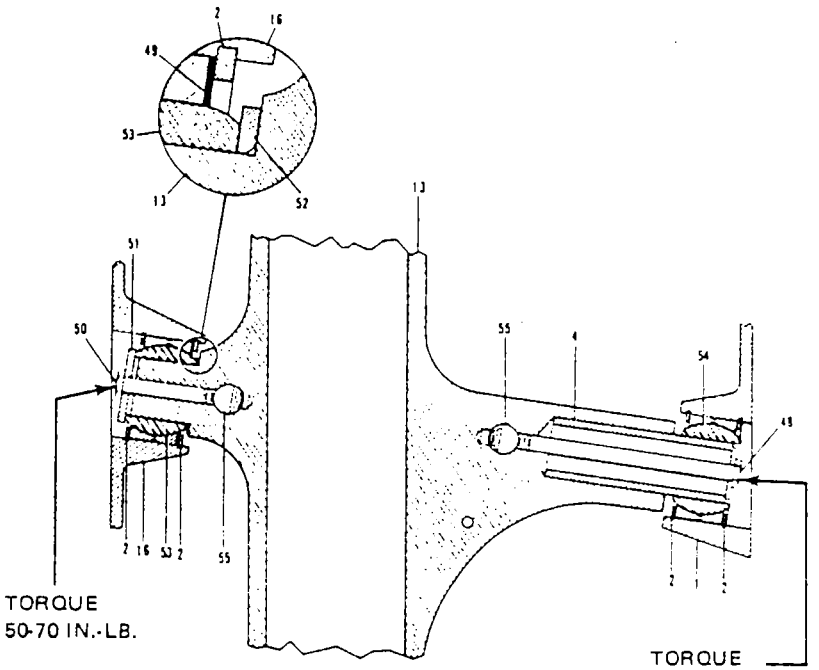


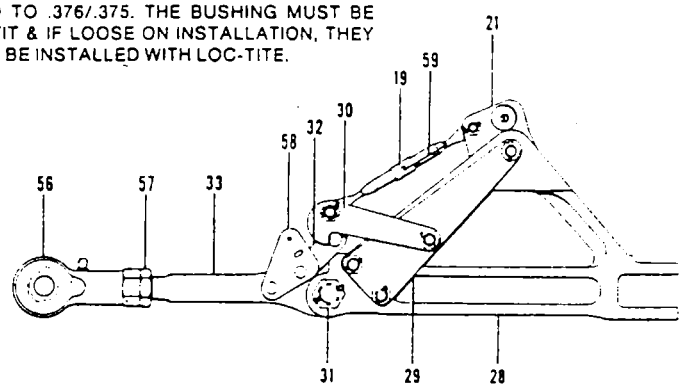
Figure GA-8. Main Gear Installation

1. SUPPORT FITTING, AFT
2. SNAP RING
3. BEARING
4. RETAINER, TUBE ASSEMBLY
5. FITTING, GREASE
6. HINGE, GEAR DOOR
7. BOLT, WASHERS AND NUT
8. LINK, UPPER
9. WASHER, SPACER
10. LINK, LOWER
11. DOOR, GEAR
12. NUT
13. HOUSING, STRUT
14. PLUG, HYDRAULIC FLUID
15. VALVE ASSEMBLY
16. SUPPORT FITTING, FORWARD
17. FITTING, GREASE
18. SPRING, DOWNLOCK
19. TURNBUCKLE
20. SWIVEL ASSEMBLY
21. RETRACTION FITTING
22. JAM NUT
23. ROD, PISTON
24. CYLINDER, HYDRAULIC ACTUATING
25. BOLT, WASHERS, NUT AND COTTER PIN
26. STUD, SIDE BRACE SUPPORT
27. SUPPORT BRACKET
28. LINK, UPPER SIDE BRACE
29. PLATE
30. HOOK, DOWNLOCK
31. BOLT, WASHERS, NUT AND COTTER PIN
32. PIN, DOWNLOCK
33. LINK, LOWER SIDE BRACE
34. BRACKET, SPRING
35. SWITCH, SAFETY
36. ACTUATOR, SAFETY SWITCH
37. BOLT, WASHERS, NUT AND COTTER PIN
38. ROD, GEAR DOOR
39. BOLT, WASHERS, NUT AND COTTER PIN
40. FORK GEAR
41. CLAMP
42. HOSE, BRAKE
43. BRAKE HOUSING
44. BRAKE DISC
45. TIRE
46. ROD END BEARING
47. BOLT, WASHER, NUT AND BUSHING
48. BOLT
49. SHIM WASHER
50. BOLT
51. WASHER
52. WASHER
53. BEARING, FORWARD SUPPORT
54. BEARING, AFT SUPPORT
55. SNAP RING
56. ROD END BEARING
57. JAM NUT
58. BRACKET, SWITCH
59. CLIP, SAFETY
60. BUSHING, TAPERED



SKETCH A

NOTE
WHEN NEW BUSHINGS ARE INSTALLED IN UPPER SIDE BRACE LINK 67025-02, THEY MUST BE LINE REAMED TO .376/.375. THE BUSHING MUST BE PRESS FIT & IF LOOSE ON INSTALLATION, THEY SHOULD BE INSTALLED WITH LOC-TITE.



SKETCH B

Figure GA-8. Main Gear Installation (cont.)

6A-24. INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 6A-8.)

NOTE

When assembling components of the landing gear, lubricate bearings, bushings, and friction surfaces with proper lubricant as described in Section II.

a. Insert a gear support bearing (53 and 54) in each support fitting (1 or 16) and secure with snap rings (2). Check bearing (53) for excess end play, shim as necessary with shim washers (49) (P/N 62833-44).

b. The gear housing may be installed in the wheel well of the wing by the following procedure:

1. Place spacer washer (52) and then forward support fitting (16) on forward arm of the housing. Determine that barrel nut (55) is properly positioned in the arm and insert attachment bolt (50) through washer (51) and the fitting into the arm. Tighten bolt and ascertain that the bearing is free to rotate.

2. Position aft support fitting (1) at its attachment point in the wheel well and secure with bolts, washers and nuts. Install nuts and washers by reaching through the access hole on the underside of the wing.

3. With the retainer tube (4) for the aft arm of the housing in hand, reach up through the access opening and insert the tube into the support fitting (1) through the hole in the web.

4. Position the gear housing up in the wheel well and install the forward support fitting (16) with bolts and washers. (One each AN960-416 and AN960-416L washer per bolt.)

5. Push the retainer tube into the arm of the housing and secure with bolt (48).

6. Check that the gear rotates freely in its support fittings and recheck thrust.

7. Connect the brake line to its mating line in the wheel well and bleed brakes as explained in Paragraph 6-46 or 6-47, of Section VI.

c. The gear side brace link assembly may be installed by the following procedure:

1. Position link support bracket (27) with swivel stud (26) installed at its attachment point on the web of the spar and secure with bolts and washers.

NOTE

When installing a new wing, it will be necessary to back drill two (2) holes 0.250 inch and countersink 100 x .499 through the spar cap. (Screw head should be flush with spar.) Use hole in the support bracket as a guide in the drilling.

2. Ascertain that the upper and lower links (28 and 33) are assembled with downlock hook (30), retraction fitting (21), etc., attached, and the through travel of the links and downlock hook clearance checked according to Paragraph 6A-23.

3. Attach the upper link to the swivel stud of the support fitting and secure with bolt, bushing, washer, nut and cotter pin (25).

4. The actuating cylinder rod end bearing (46) and lower side brace link (33) may be attached respectively to the retraction fitting (21) and strut housing during the adjustment of the landing gear.

d. Ascertain that the landing gear is lubricated per Lubrication Chart, Section II.

e. Check adjustment of landing gear per Paragraph 6A-25.

f. Check alignment of the wheel per Paragraph 6A-26.

g. Install the access plate on the underside of the wing and remove the airplane from jacks.

6A-25. ADJUSTMENT OF MAIN LANDING GEAR.

a. Place the airplane on jacks.

b. Level the airplane laterally and longitudinally. (Refer to Leveling, Section II.)

c. Disconnect the gear door actuating rods at either the door or the housing, as desired, by removing the rod attachment bolt. Secure the door out of the way.

d. Adjust rod end on upper side brace link with no load on wheels, to obtain 90 degree angle between wheel centerline and level floor line on outboard side of gear.

e. Check that the rod end has sufficient thread engagement in the end bearing, align the flat sides of the bearing casting with the flat side of the bearing and tighten the jam nut.

f. Adjust the turnbuckle of the downlock mechanism by first ascertaining that the gear is down and locked, and then move the retraction fitting outboard until it contacts the stop slot of the side brace link. Hold the fitting in this position and turn the turnbuckle barrel until the downlock hooks make contact with the lock pin. Safety the turnbuckle.

g. For easier adjustment of the downlock limit switch, it may be set at this time as explained in Paragraph 6A-34.

h. Retract and extend the gear manually several times to ascertain that the side brace link falls through center; the downlock hook falls into position and there is no binding of the gear assembly.

i. The gear should be adjusted in the up position to allow the gear fork to press lightly into the rubber bumper pad on the wing. The adjustment may be accomplished as follows:

NOTE

If it requires less than .025 of an inch to move the gear into the correct adjustment, Steps 2 and 6 thru 8 need only be followed.

1. Ascertain that the rod end bearing of the actuating cylinder is disconnected from the retraction fitting.

2. Actuate the hydraulic system to bring the hydraulic cylinder to the up position by turning the master switch on and moving the gear selector handle to the up position. The piston of the cylinder should be bottomed.

3. Raise the gear by pushing up on the retraction fitting, thus disengaging the hooks, and pushing up on the pivot point at the bottom of the side brace links to bring the links out of the locked position. Raise the gear until the fork presses lightly into the rubber pad. Retain the gear in this position.

4. Loosen the jam nut on the piston rod of the actuating cylinder and turn the rod end bearing in or out to allow a slip fit of the attachment bolt.

5. Install with the attachment bolt, bushing, spring swivel, and secure with washer and nut. Install the gear downlock spring.

6. When the gear is to within .125 of an inch of correct adjustment, the rod end need not be disconnected and therefore all that will be required is to loosen the jam nut, place a wrench on the flat at the end of the piston rod and turn to obtain correct adjustment.

7. Check the rod end bearing for adequate thread engagement and tighten jam nut.

8. If the downlock limit switch is properly adjusted, retract and extend the gear hydro-electrically to ascertain that the gear operates properly.

6A-26. ALIGNMENT OF MAIN LANDING GEAR. (Refer to Figure 6A-9.)

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 of the landing gear wheels. Jack the airplane up just high enough to obtain a six and one-half inch dimension between the centerline of the strut piston and the centerline of the center pivot bolt of the gear torque links. Devise a support 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 side of the brake disc. (It may be necessary to remove the brake assembly to have clear access to the disc.) If it touches both forward and rear flange, the landing gear is correctly aligned. The toe-in for the main landing gear wheels is 0 ± 1/2 degrees.

NOTE

A carpenter's square, because of its especially long legs, is recommended for checking main landing gear wheel alignment.

c. If the square contacts the rear side of the disc, leaving a gap between it and the front flange, the wheel is toed-out. If a gap appears at the rear flange, the wheel is toed-in.

d. To rectify the toe-in and toe-out condition, remove the bolt connecting the upper and lower torque links and remove or add spacer washers to move the wheel in the desired direction. Refer to the Toe-in, Toe-out Correction Chart (Table VIA-III).

e. Should a condition exist that all spacer washers have been removed and it is still necessary to move the wheel further in or out, then it will be necessary to turn the torque link assembly over. This will put the link connecting point on the opposite side allowing the use of spacers to go in the same direction.

f. Recheck wheel alignment. If the alignment is correct, safety the castellated nut with cotter pin.

TABLE VIA-III. TOE-IN — TOE-OUT CORRECTION CHART

TOE-IN TOE-OUT ANGLE	SHIM WASHERS	WASHERS UNDER HEAD	WASHERS UNDER NUT	AN 174 BOLT
0°		AN960-416	AN960-416 (3)	-14
0°33'	AN960-416	AN960-416	AN960-416 (2)	-14
0°48'	AN960-416L AN960-416	AN960-416	AN960-416	-14
1°04'	AN960-416 (2)	AN960-416	AN960-416	-14
1°19'	AN960-416L AN960-416 (2)	AN960-416L	AN960-416	-14
1°35'	AN960-416 (3)	AN960-416	AN960-416 (2)	-15
2°05' Max. Allow.	AN960-416 (4)	AN960-416	AN960-416	-15

AN960-416L Washers .031 Thick

AN960-416 Washers .062 Thick

g. If a new link on the top left main gear had to be installed or it had to be reversed during the alignment check, it will be necessary to check the gear safety switch (squat switch) bracket for engagement and locking in place. If the large machine surface of the link is inboard, the bracket is mounted with the small rivet hole next to link. (Refer to Sketch A, Figure 6A-9.) This hole should be aligned with centerline of the link and a .096 inch hole drilled .150 inch deep. Insert an MS20426AD3-3 rivet in the hole. This locking rivet is held in place by the flat washer, castellated nut and cotter pin. If link has to be reversed, then the bracket and bolt are also reversed. (Refer to Sketch B, Figure 6A-9.)

h. Check adjustment of landing gear safety switch (squat switch) per Paragraph 6A-35.

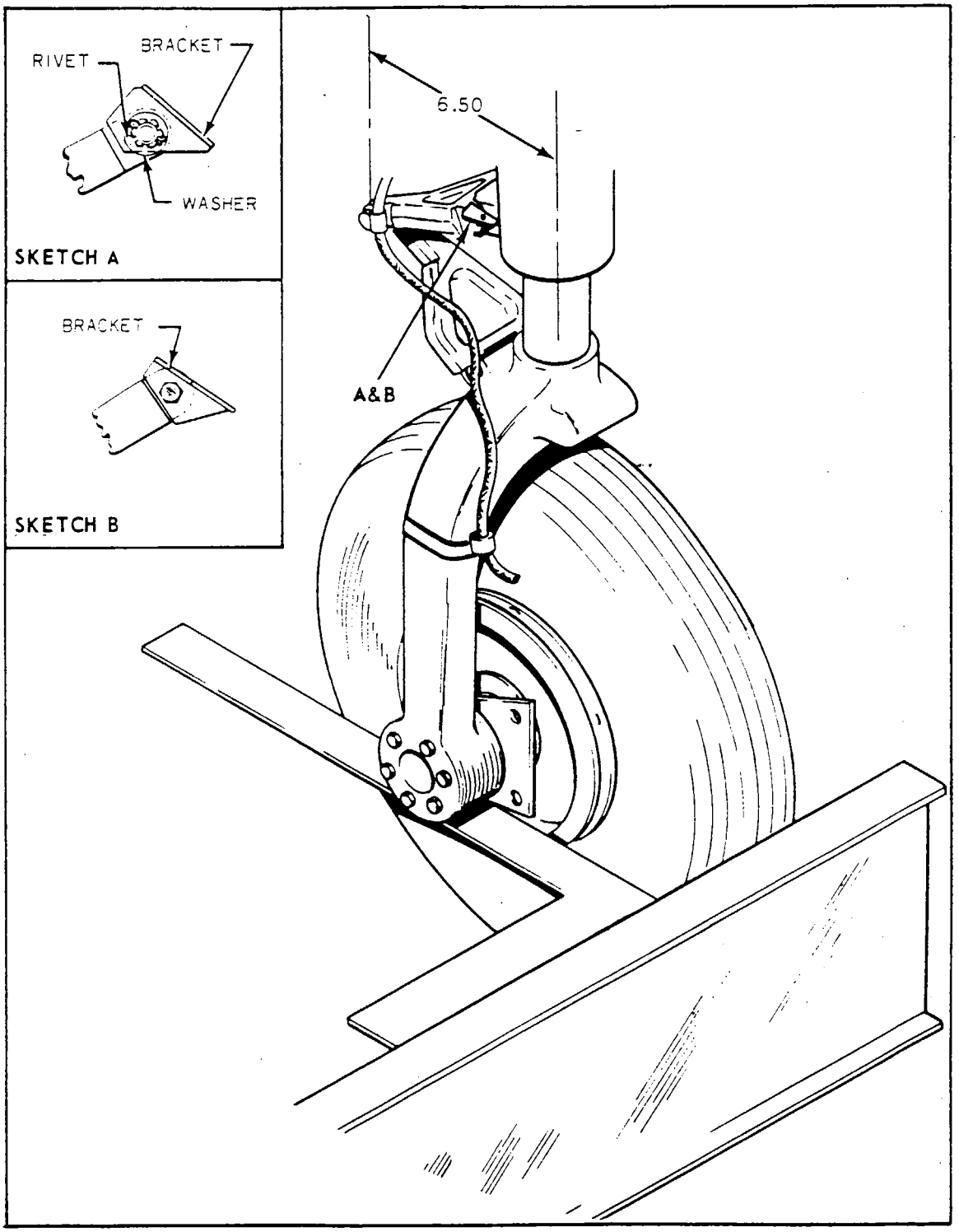


Figure 6A-9. Aligning Main Gear

6A-27. REMOVAL OF MAIN GEAR DOOR ASSEMBLY.

a. With the landing gear extended, disconnect the door retraction rod from the door by removing nut, washers and bolt.

b. Remove the door from the wing panel by bending the door hinge pin straight and from the other end pulling out the pin.

c. The door retraction rod may be removed from the gear housing by cutting the safety wire and removing the attachment bolt and washer. Note the number of washers between rod end bearing and housing.

6A-28. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR ASSEMBLY.

a. Clean the door and retraction rod with a suitable cleaning solvent.

b. Inspect the door for cracks or damage, loose or damaged hinges and brackets.

c. Inspect the door retraction rod and end bearing for damage and corrosion.

d. Repairs to a door may be replacement of hinge, repair of fiberglass and painting.

6A-29. INSTALLATION OF MAIN GEAR DOOR ASSEMBLY.

a. Install the door by positioning the hinge halves of the door and wing, and inserting the hinge pin. It is recommended a new pin be used. Bend the end of the pin to secure in place.

b. Install the door retraction rod by positioning the rod at its attachment points at the door and strut housing. At the door attachment, thin washers are inserted at each side of the rod end bearing and it is secured with bolt, washer and nut. At the strut housing, place washers between rod end bearing and housing not to exceed .12 of an inch to obtain proper clearance and secure with bolt. Safety bolt with MS20995C41 wire.

c. Check that the all around clearance between the door and the wing skin is not less than .032 of an inch.

6A-30. LANDING GEAR LIMIT SWITCHES.

NOTE

All adjustments of the limit switches should be made with the airplane on jacks. Do not bend actuator springs mounted on the limit switches.

6A-31. ADJUSTMENT OF NOSE GEAR UP LIMIT SWITCH. The gear up limit switch is mounted on a bracket above the point where the right side of the upper drag link attaches to the engine mount. (Refer to Figure 6A-10.)

a. To facilitate adjustment of the limit switch, disconnect the gear doors or remove the bottom cowl, as desired.

b. Retract the landing gear hydro-electrically by turning the master switch on, raising the emergency gear extension lever and moving the gear selector handle to the up position. Retain the emergency extension lever in the up position and turn the master switch off.

c. Block the nose gear in the up position and then slowly release the emergency extension lever. This will relieve hydraulic pressure and the main gears will drop.

d. Place a .027 of an inch spacer on the oleo strut housing between the housing and the crossover tube where the steering arm attaches. Push the gear up tight and block.

e. Loosen the lower attachment screw of the switch bracket and rotate the switch toward the actuator tang until it is heard to actuate. Retighten the bracket attachment screw of the switch.

f. Manually move the gear up and down only as far as necessary to ascertain that the switch actuates at the correct position. Remove the block from under the gear and allow it to slowly extend.

g. Retract the gear hydro-electrically and ascertain that the red gear unsafe light will go out when the gear has retracted and the pump has shut off.

6A-32. ADJUSTMENT OF NOSE GEAR DOWN LIMIT SWITCH. The gear down limit switch is mounted on the horizontal support tube of the engine mount that runs between the right attachment points of the gear housing and upper drag link.

a. Ascertain that the gear is down and locked.

b. The down limit switch should actuate only after the leading edge of the downlock hook, when moving to the locked position, has passed the downlock roller by .06 of an inch. (Refer to Figure 6A-10.) Position the hook at this location in relation to the roller by moving the actuator piston manually toward the up position. The downlock spring may be disconnected, if desired.

c. Loosen lower attachment screw of the switch mounting bracket and move bracket toward the downlock hook until it is heard to actuate. Retighten the bracket attachment screw.

d. Manually move the hook from the locked to the unlocked position and ascertain that the switch actuates at the correct location of the hook.

e. Retract and extend the gear hydro-electrically by turning the master switch on, raising the emergency gear extension lever and moving the gear selector handle to the up position. As the gear begins to retract the green light below the selector should go out and the red gear unsafe light at the top of the instrument panel should come on.

6A-33. ADJUSTMENT OF MAIN GEAR UP LIMIT SWITCH. A gear up limit switch is located in each wheel well above the gear door hinge. There is no adjustment of these switches other than checking that the gear, when retracting, will actuate the switch within .88 of an inch of full up. Switch operation turns the red gear unsafe light out.

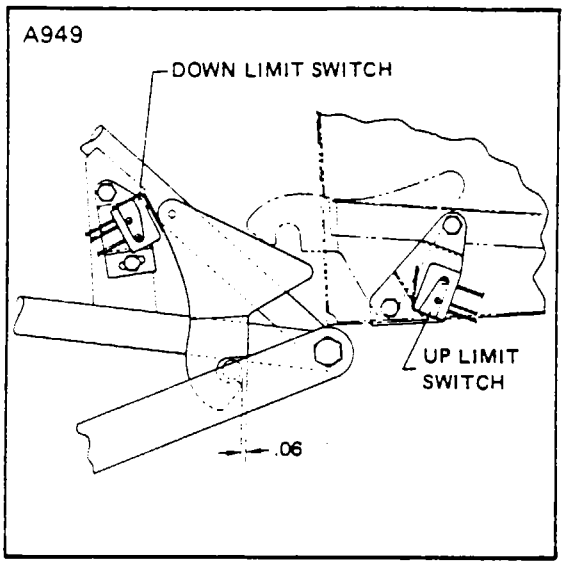


Figure 6A-10. Adjustment of Nose Gear Down Limit Switch

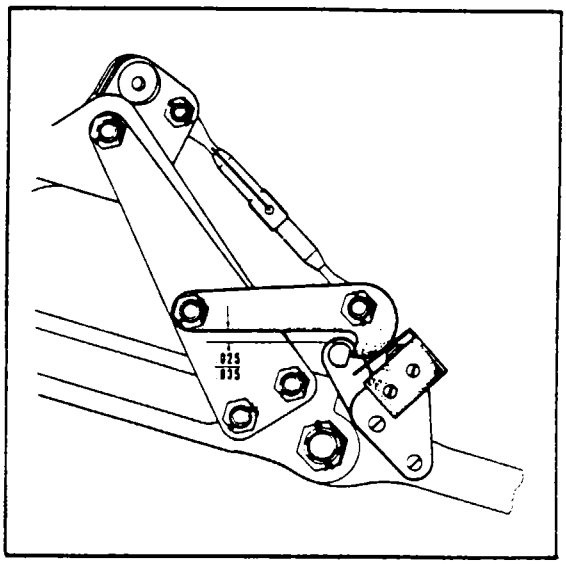


Figure 6A-11. Adjustment of Main Gear Down Limit Switch

6A-34. ADJUSTMENT OF MAIN GEAR DOWN LIMIT SWITCH. A gear down limit switch is mounted on a bracket which is attached to the lower drag link of each main gear. The switch should be adjusted to allow it to actuate thus turning on the green indicator light within the cockpit when the downlock hook has entered the locked position and is within .025 to .035 of an inch of contacting the downlock pin. (Refer to Figure 6A-11.) Adjustment of the switch may be as follows:

a. Ascertain that the main gear downlock is properly adjusted as described in Paragraph 6A-25.

b. Raise the airplane on jacks. (Refer to Jacking, Section II.)

c. Ascertain that the landing gear is down and pressure is relieved from the hydraulic system. To relieve pressure, hold down the emergency extender lever.

d. Raise the downlock hook assembly and place a .030 of an inch feeler gauge between the horizontal surface of the hook that is next to the switch (the surface that contacts the downlock pin) and the rounded surface of the pin. Lower the hook and allow it to rest on the feeler gauge.

e. Loosen the attaching screws of the switch and, while pushing up on the center of the link assembly, rotate the switch toward the hook until it is heard to actuate. Retighten the attaching screws of the switch.

f. Manually move the hook assembly up from the pin until the hook nearly disengages from the pin. Then, with pressure against the bottom of the link assembly, move back to ascertain that the switch actuates within .025 to .035 of an inch of full lock.

g. Retract and extend the gear hydro-electrically by turning the master switch on, raising the emergency gear extension lever and moving the gear selector handle to the up position. As the gear begins to retract, the green light below the selector should go out and the red gear unsafe light at the top of the instrument panel should come on.

6A-35. ADJUSTMENT OF LANDING GEAR SAFETY SWITCH (SQUAT SWITCH). The landing gear safety switch, located on the left main gear housing is adjusted so that the switch is actuated within the last quarter of an inch of gear extension.

a. Compress the strut until 7.875 inches is obtained between the top of the gear fork and the bottom of the gear housing. Hold the gear at this measurement.

b. Adjust the switch down until it actuates at this point. Secure the switch.

c. Extend and then compress the strut to ascertain that the switch will actuate within the last quarter of an inch of oleo extension.

6A-36. ADJUSTMENT OF GEAR BACK-UP EXTENDER ACTUATOR SWITCH. The back-up gear extender actuator switch is mounted on the extender unit located under the center seats floorboard. Inasmuch as the switch is a component of the back-up extender, instructions for the adjustment of the switch will be found with the adjustment instructions for the extender as found in Section VA.

6A-37. LANDING GEAR WARNING SWITCHES (THROTTLE SWITCHES).

6A-38. LANDING GEAR UP/POWER REDUCED WARNING SWITCH. The gear up/power reduced warning switch (Switch "A") is within the control quadrant below the throttle control lever. (Refer to Figure 6A-12.) This switch will actuate the warning horn and red light simultaneously when the landing gear is not down and locked, and the throttle is reduced to and below 14 inches of manifold pressure.

6A-39. REMOVAL OF LANDING GEAR UP/POWER REDUCED WARNING SWITCH.

a. Loosen the quadrant cover by removing the cover attaching screws from each side and at the bottom of the cover.

b. Pull the cover aft enough to remove the screws that secure the reinforcing clip to the top underside of the cover. Remove the cover.

c. Remove the switch from its mounting bracket by removing the switch attaching screws.

d. Disconnect the electrical leads from the switch.

6A-40. INSTALLATION OF LANDING GEAR UP/POWER REDUCED WARNING SWITCH.

a. Connect the electrical leads to the switch.

b. Position the switch with actuator follower against its mounting bracket and secure with screws.

c. The switch may be adjusted at this time per instructions in Paragraph 6A-41.

d. With the control levers aft, slide the quadrant cover into position around the controls far enough to allow the cover reinforcement clip to be installed to the top underside of the cover and secure with screws.

e. Install the cover and secure with screws.

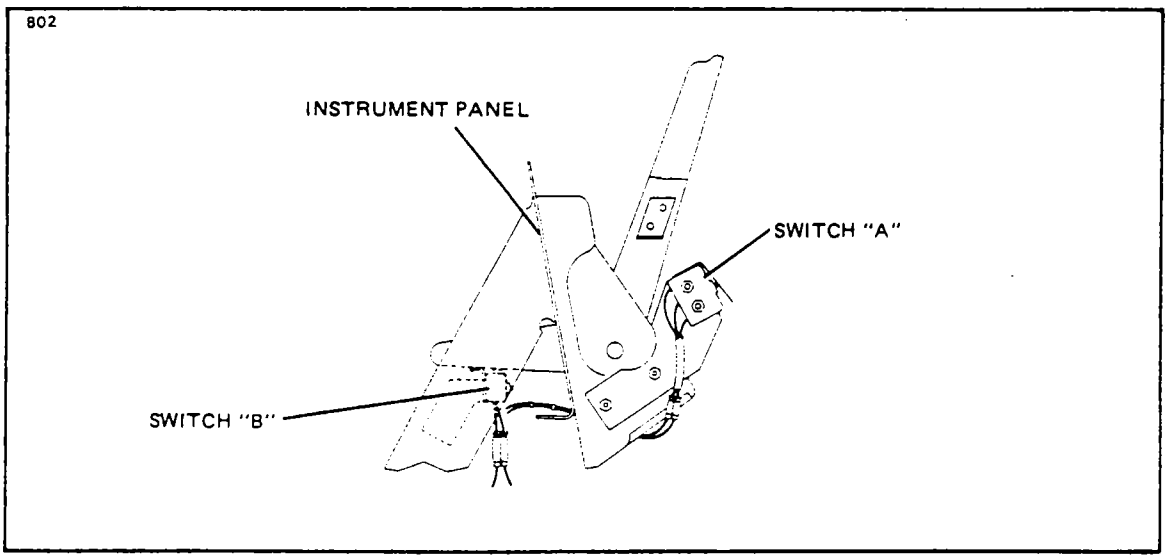


Figure 6A-12. Throttle Warning Switches

6A-41. ADJUSTMENT OF LANDING GEAR UP/POWER REDUCED WARNING SWITCH.

a. Remove the control quadrant cover as given in Paragraph 6A-39.

b. Flight test the airplane and at a safe altitude, establish a normal descent with gear up and the propeller control at a desired low pitch setting.

c. Retard the throttle to a manifold pressure of approximately 14 inches. This setting should be an airspeed above 120 MPH.

d. In some manner, mark the throttle lever in relation to its position next to the mounting bracket.

e. With the airplane on the ground and the throttle positioned to the mark, loosen the screws that secure the switch and rotate it toward the throttle until it is heard to actuate. Retighten the switch attachment screws.

f. Advance and retard the throttle to ascertain that the switch actuates at the desired throttle lever setting. The airplane may also be flown to ascertain that the horn and light will actuate when the throttle is reduced below approximately 14 inches of manifold pressure with gear up.

g. Reinstall the quadrant cover as given in Paragraph 6A-40.

6A-42. GEAR DOWN/SELECTOR HANDLE UP WARNING SWITCH. The gear down/selector handle up warning switch (Switch "B") is located directly forward of the instrument panel, below the arm of the throttle control lever. (Refer to Figure 6A-12.) This switch will actuate the gear warning horn and light simultaneously when the gear selector handle is at the up position and the airplane is on the ground or airspeed is below that required to close the hydraulic valve and the pump switch of the back-up gear extender. The latter applies except at full throttle.

6A-43. REMOVAL OF GEAR DOWN/SELECTOR HANDLE UP WARNING SWITCH.

a. Remove the switch from its mounting bracket by removing the switch attachment screws.

b. Disconnect the electrical leads from the switch.

NOTE

The switch with mounting bracket may be removed by removing the control quadrant cover and removing the two screws that secure the switch.

6A-44. INSTALLATION OF GEAR DOWN/SELECTOR HANDLE UP WARNING SWITCH.

a. Connect the electrical leads to the switch. Leads attach to terminals C and NC.
b. Position the switch against its mounting bracket and secure.
c. Ascertain that switch actuates by moving throttle control lever aft and then forward.
d. Reinstall the quadrant cover.

6A-45. NOSE WHEEL.

6A-46. REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 6A-13.)

a. Jack the airplane enough to raise the nose wheel clear of the ground. (Refer to Jacking, Section II.)

b. To remove the nose wheel, first remove the cotter pin and washer that secures the safety clevis pin of the wheel nut. Next remove the clevis pin, wheel nut and then slide the wheel from the axle.

c. The wheel halves (7 and 10) may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts (18). Pull the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the other half.

d. The wheel bearing assemblies may be removed from each wheel half by first removing the snap rings (1 or 16) that secure the grease seal retainers, and then the retainers, grease seals (4 or 13) and bearing cones (6 or 12). The bearing cups (5 or 11) should be removed by tapping out evenly from the inside.

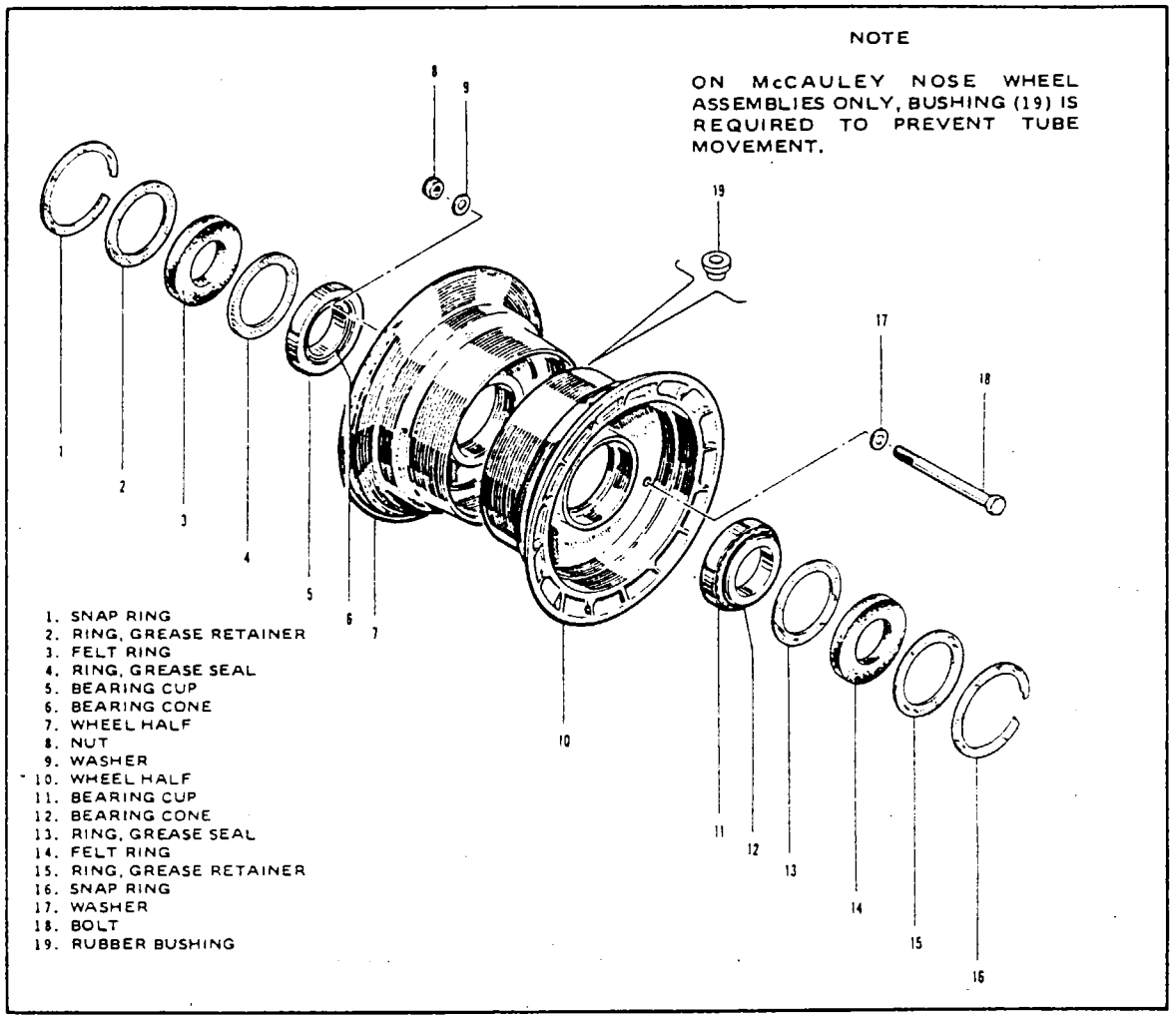


Figure 6A-13. Nose Wheel Assembly

6A-47. 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. Then relubricate.

f. Replace any wheel casting having visible cracks.

6A-48. ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 6A-13.)

a. Ascertain that the bearing cup (5 or 11) for each wheel half (7 and 10) is properly installed. Install the tire with tube on the wheel half with the valve stem hole and then join the two wheel halves. Install the through bolts (18) with the washers (9 and 17) and nuts (8) to the valve stem side.

NOTE

On aircraft models which use the Cleveland Wheel Assembly torque nuts to 90 inch-pounds. Those aircraft models which use the McCauley Wheel Assembly torque nuts to 140-150 inch-pounds.

NOTE

On McCauley Nose Wheel Assemblies only, bushing (19) is required to prevent tube movement.

b. Lubricate the bearing cones (6 and 12) and install the cones, grease seals (4 or 13), felt rings (3 and 14) and seal retainer rings (2 or 15). Secure with snap rings (1 or 16).

c. Slide the wheel on the axle and secure with retainer nut. Tighten nut to allow no side play, yet allow the wheel to rotate freely. Safety the nut with clevis pin and secure pin with washer and cotter pin.

6A-49. MAIN WHEEL AND BRAKE INSTRUCTIONS.

NOTE

Refer to Section VI for main wheel and brake instructions. Section VI includes main wheel and brake instructions for 32-260, 32-300 and 32R-300.

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TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR)

Trouble	Cause	Remedy
Red gear unsafe light out while gear is in transit.	Indicator lamp burned out.	Replace lamp.
	Indicator light ground incomplete.	Check ground circuit.
	Indicator light circuit wire broken.	Check wiring.
	Indicator light circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
Red gear unsafe light on though gear has retracted.	One or more up limit switches failed.	Isolate and replace switch.
	Nose gear up limit switch out of adjustment.	Check gear up adjustment and readjust up limit switch.
	Main gear not retracting far enough to actuate switch.	Check gear up adjustment.
Red gear unsafe light on though gear is down and locked.	One or more down limit switches failed.	Isolate and replace switch.
	Nose gear down limit switch out of adjustment.	Readjust down limit switch.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Red gear unsafe light on though gear is down and locked. (cont.)	Main gear down limit switch out of adjustment.	Readjust down limit switch.
NOTE The out of adjustment or failed switch may be determined by noting which down light is not lit.		
Red gear unsafe light operates on and off after gear has retracted.	Light circuit wire loose.	Check wiring.
	Hydraulic system losing pressure.	Refer to Hydraulic System, Section VA.
	Gear up switch out of adjustment.	Check gear up adjustment and then switch adjustment.
Red gear unsafe light out and one green gear down light out though gear is down and locked.	Lamp burned out.	Replace lamp.
	Gear down limit switch failed.	Replace switch.
NOTE: Ascertain navigation lights are off (daytime).	Light circuit wire broken.	Check wiring.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Red gear unsafe light and all green lights out.	Indicator lights circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
NOTE: Ascertain navigation lights are off (daytime).	Light circuit wire broken.	Check wiring.
Red gear unsafe light and horn fail to operate when throttle is near closed and landing gear is retracted.	Landing gear selector circuit breaker open.	Reset circuit breaker and determine cause for open circuit breaker.
	Micro switch "A" at throttle out of adjustment.	Adjust micro switch "A."
	Micro switch "A" failed.	Replace switch.
	Warning horn and light circuit wire broken.	Check wiring.
	Diode in circuit between throttle switch "A" and light/horn open.	Replace diode.
		NOTE: When replacing diode, connect banded end (cathode) to terminal ends of wires G2Q and G2K on mounting block.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Red gear unsafe light and horn fail to stop when throttle is closed and gear has extended. (Gear extended through the use of the free fall lever or lack of air speed.)	Gear selector handle in up position.	Place handle in down position.
Red gear unsafe light and horn fail to operate when selector switch is moved to up position with gear extended and throttle not full forward.	Warning light and horn circuit wire broken.	Check wiring.
Above condition on ground.	Defective safety (squat) switch.	Replace switch.
Above condition in the air.	Pressure switch open.	Replace switch.
Red gear unsafe light and horn fail to shut off at full throttle. Gear selector at up position and gear extended.	Throttle micro switch "B" out of adjustment. Throttle micro switch "B" failed.	Adjust switch. Replace switch.
Hydraulic pump shuts off, but red gear unsafe light remains on.	Gear not fully retracted.	Determine cause and remedy.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Green gear down lights dim though position light switch is off, and gear is down and locked.	Failed instrument panel light control switch. (Lights grounding through dimming resistor instead of instrument panel light control.)	Replace switch.
Green gear down light fails to go out with gear in transit or retracted.	Gear down limit switch failed.	Replace switch.
Green gear down lights will go out and not dim when position light switch is turned on though gear is down and locked.	Green light ground dimming resistor open.	Replace resistor.
Green gear down lights blink momentarily before the down lock is engaged on roller.	Micro switch out of adjustment.	Adjust micro switch.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Nose landing gear shimmies during fast taxi, take-off, or landing.	Internal wear in shimmy dampener.	Replace shimmy dampener.
	Shimmy dampener or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Excessive or uneven wear on nose tire.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wear resulting from shimmy.	Refer to proceedings for correction.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing (refer to Lubrication Chart).
		Cylinder and/or strut housing bushings damaged.
	One brake dragging.	Determine cause and correct.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Nose gear fails to steer properly. (cont.)	Steering arm roller sheared at top of strut.	Replace defective roller.
	Steering bellcrank loose on attachment plate.	Readjust and tighten.
	Steering bellcrank bearing and/or bolt worn.	Replace bearing and/or bolt.
	Shimmy dampener galling or binding.	Replace.
Nose gear fails to straighten when landing gear extends.	Steering arm roller sheared at top of strut.	Replace defective roller.
	Incorrect rigging of nose gear steering.	Check nose gear steering adjustment.
Nose gear fails to straighten when landing gear retracts.	Centering guide roller sheared.	Replace roller.
	Damaged guide.	Replace guide.

TABLE VIA-IV. TROUBLESHOOTING CHART (LANDING GEAR) (cont.)

Trouble	Cause	Remedy
Main landing gear shimmies during fast taxi, take-off, or landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wheel out of alignment (toe in or out).	Check wheel alignment.
	Lower side brace link out of adjustment, allowing gear to slant in or out.	Check gear adjustment.
Strut bottoms on normal landing or taxiing on rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.
Landing gear doors fail to completely close.	Landing gear not retracting completely.	Check adjustment of landing gear.
	Door retraction mechanism out of adjustment.	Check adjustment.

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SECTION VII

POWER PLANT
(PA-32-260)

		Aerofiche Grid No.
7-1.	Description	2E16
7-2.	Troubleshooting	2E16
7-3.	Propeller	2E16
7-4.	Removal of Propeller (Fixed Pitch)	2E16
7-5.	Installing Propeller (Fixed Pitch)	2E16
7-6.	Removal of Propeller (Constant Speed)	2E17
7-7.	Cleaning, Inspection and Repair of Propeller	2E17
7-8.	Installing Propeller (Constant Speed)	2E17
7-9.	Blade Track	2E20
7-10.	Propeller Governor	2E21
7-11.	Removal of Propeller Governor	2E21
7-12.	Installation of Propeller Governor	2E21
7-13.	Rigging and Adjustment of Propeller Governor	2E22
7-14.	Engine	2E24
7-15.	Removal of Engine	2E24
7-16.	Installation of Engine	2F1
7-17.	Installation of Oil Cooler	2F1
7-18.	Adjustment of Throttle and Mixture Controls	2F2
7-18a.	Adjustment of Throttle and Mixture Controls	2F3
7-19.	Induction Air Filter	2F4
7-20.	Carburetor	2F4
7-21.	Carburetor Maintenance	2F4
7-21a.	Throttle Arm	2F5
7-22.	Adjustment of Idle Mixture	2F5
7-23.	Adjustment of Engine Idling Speed	2F6
7-24.	Magneto	2F8
7-25.	Inspection of Magnetos	2F8
7-26.	Timing Procedure (Internal Timing)	2F10
7-27.	Installation and Timing Procedure (Timing Magneto to Engine)	2F12
7-28.	Spark Plugs	2F15
7-29.	Removal of Spark Plugs	2F15
7-30.	Inspection and Cleaning of Spark Plug	2F16
7-31.	Installation of Spark Plugs	2F16

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SECTION VII

POWER PLANT
(PA-32-260)

7-1. DESCRIPTION. The PA-32-260 is powered by a Lycoming engine of 260 horsepower. (Refer to Power Plant Specifications in Table II-I.) The engine is furnished with a starter, 60-ampere 12-volt alternator, voltage regulator, shielded ignition, vacuum pump drive, fuel pump, carburetor, and a dry paper type carburetor air filter. The exhaust system is stainless steel directing gases inboard to the muffler located directly under the engine. The large muffler with a heater shroud provides heat for both the cabin and defrosting. A shroud over the left exhaust stacks provides heat for the carburetor. The engine is provided with a fixed pitch or constant speed propeller.

7-2. TROUBLESHOOTING. Troubles peculiar to the power plant are listed in Table VII-I, at the back of this section, along with their probable causes and suggested remedies. When troubleshooting the engine, ground the magneto primary circuit before performing any checks on the engine.

7-3. PROPELLER.

7-4. REMOVAL OF PROPELLER. (Fixed Pitch.)

a. Insure master and magneto switches are off.
b. Move fuel selector to off position.
c. Place mixture control in idle cut-off.
d. Note position of each component to facilitate reinstallation.
e. Remove screws attaching spinner cuff and spinner assembly and remove spinner.
f. Remove the safety wire from the six propeller mounting bolts and remove the bolts and propeller.

7-5. INSTALLING PROPELLER. (Fixed Pitch.) The propeller is installed on the crankshaft flange with six stud bolts. Install the propeller as follows:

a. Install rear spinner bulkhead.
b. Install propeller and tighten each of the mounting bolts finger tight. Use a torque wrench for final tightening and tighten in sequence so that all bolts are pulled down evenly. Torque bolts per Table VII-I.
c. Check propeller track as given in Paragraph 7-9.
d. Safety propeller mounting bolts with MS20995-C41 safety wire.

e. Install the forward spinner bulkhead and torque bolts per Table VII-I. Safety bolts with MS20995-C41 safety wire.

f. Install spinner and spinner cuff. Torque all attachment screws per Table VII-I.

7-6. REMOVAL OF PROPELLER. (Constant Speed.)

a. Insure master and magneto switches are off.

b. Move fuel selector to off position.

c. Place mixture control in idle cut-off.

d. Note position of each component to facilitate reinstallation.

e. Remove screws from spinner cuff and spinner assembly and remove spinner.

f. Remove the safety wire from the six propeller mounting bolts and remove the bolts.

g. Place a drip pan under the propeller to catch oil spillage, then remove the propeller.

7-7. 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.

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 7-2 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.

7-8. INSTALLING PROPELLER. (Constant Speed.)

a. Insure master and magneto switches are off.

b. Place fuel selector to off position.

c. Place mixture control in idle cut-off.

d. 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 with an "O" mark.

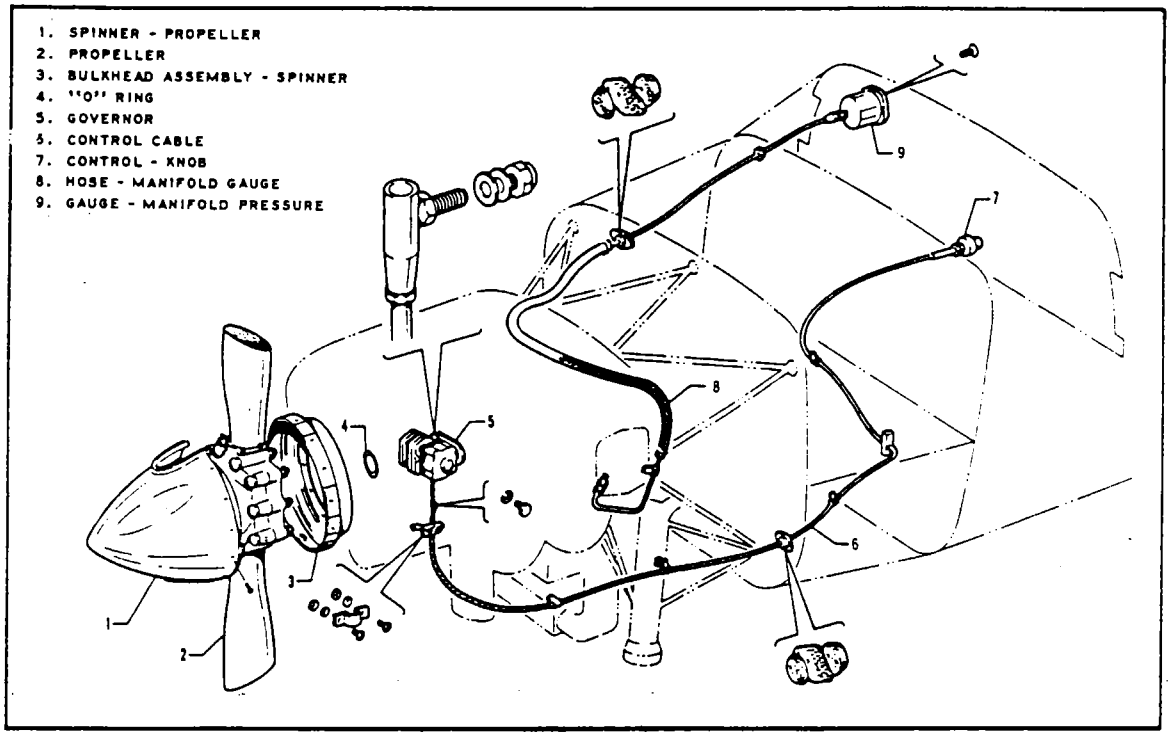


Figure 7-1. Propeller System Installation (Constant Speed)

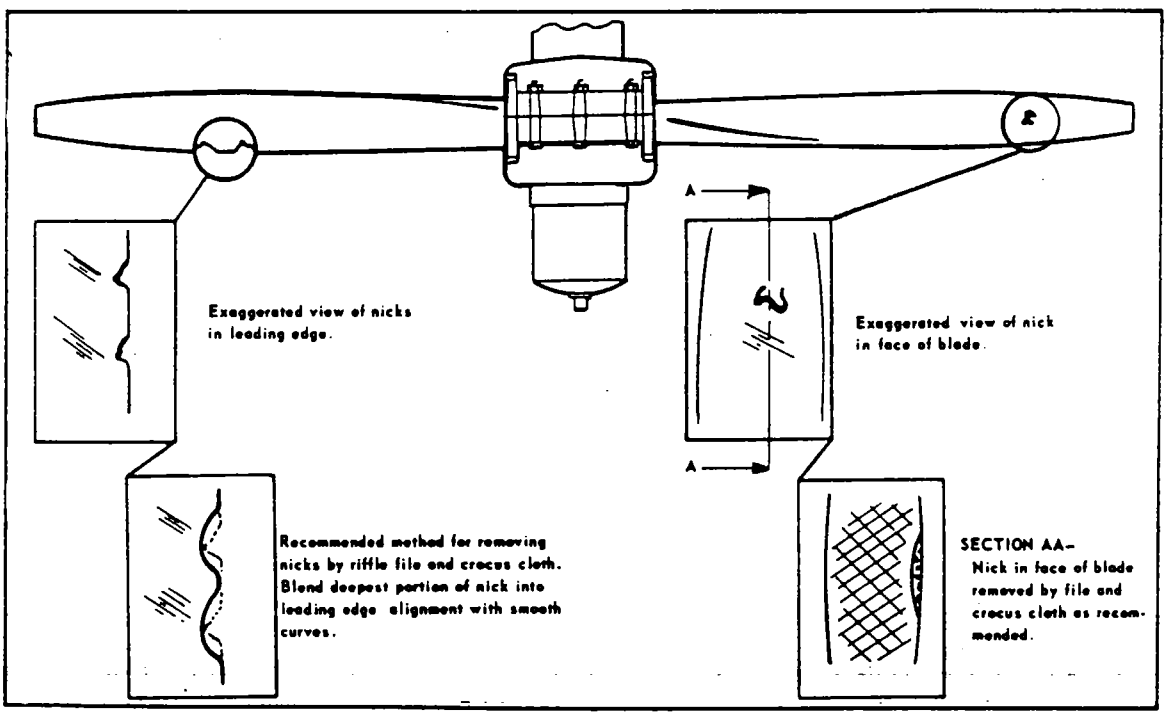


Figure 7-2. Typical Nicks and Removal Method

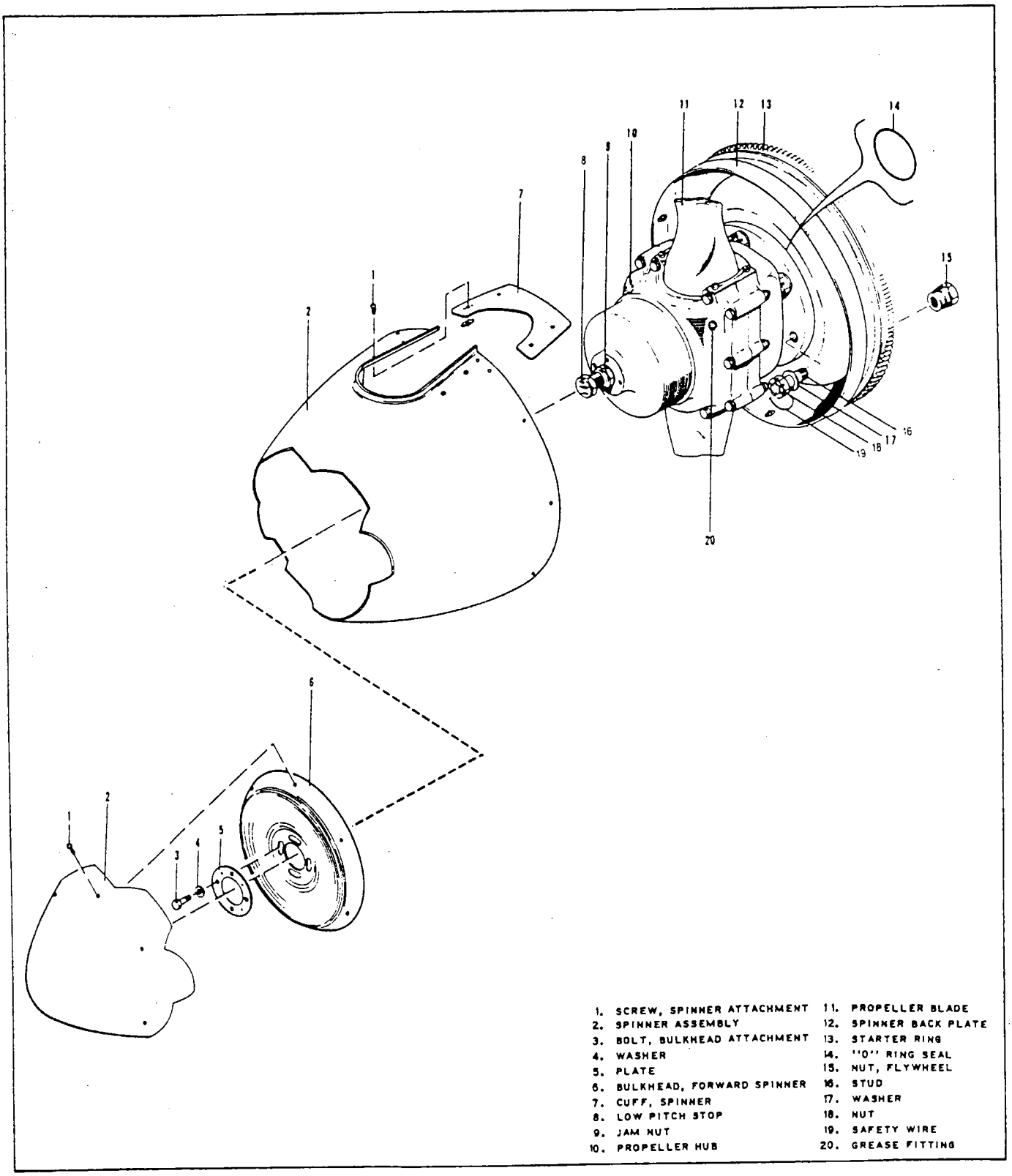


Figure 7-2a. Propeller Installation

TABLE VII-I. PROPELLER SPECIFICATIONS

Hub, Model	HC-C2YK-1 ( ) or HC-C2YK-1 ( ) F	
Blade, Model	8477-2 or F8477-2	
Diameter	82 in.	
Blade, Angle	Low Pitch (High RPM)	12° ± 0.2° (1)
	High Pitch (Low RPM)	32° ± 2.0° (1)
Propeller RPM Setting	Engine Static High RPM	2700 RPM max.
Propeller Torque Limits	Description	Required Torque (Dry)
	Propeller Mounting Nuts	55-65 foot-pounds (2)
	Fwd. Bulkhead Attachment Bolts	30-35 inch-pounds
	Spinner Attachment Screws	20-25 inch-pounds

(1) MEASUREMENT TAKEN AT 30 INCH RADIUS
(2) FIXED PITCH AND CONSTANT SPEED

e. Wipe crankshaft and propeller pilot to assure that no chips or foreign matter enter the propeller mechanism.

f. Check interior of propeller hub for proper seating of O-ring. Wipe inside of hub to remove any traces of dirt. Check to see that O-ring is covered with grease.

g. Install rear spinner bulkhead.

h. Slide propeller carefully over pilot, taking care that O-ring is not damaged, and making sure the extended bushing goes into the proper mounting hole.

i. Install the six hexagon head propeller hub mounting bolts and torque per Table VII-I.

j. Check propeller blade track as given in Paragraph 7-9.

k. Safety the propeller mounting bolts with MS20995-C41 safety wire.

l. Install the forward spinner bulkhead and torque bolts per Table VII-I. Safety bolts with MS20995-C41 safety wire.

m. Install spinner and spinner cuff. Torque all attachment screws per Table VII-I.

7-9. BLADE TRACK. Blade track is the ability of one blade tip to follow the other, while rotating, in almost the same plane. Excessive difference in blade track - more than .0625 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.

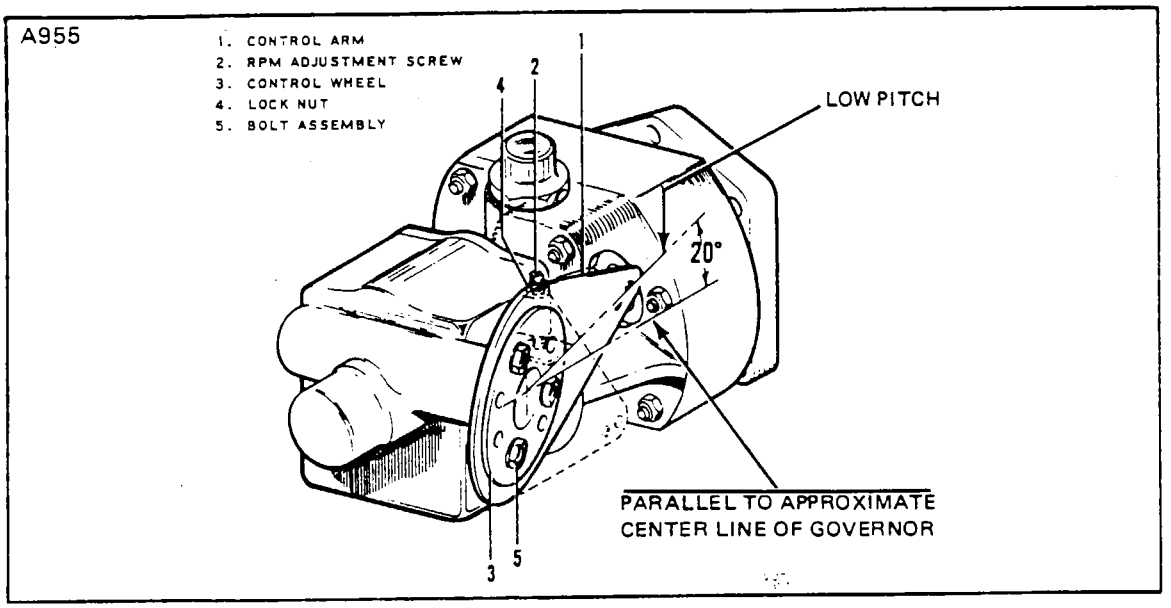


Figure 7-3. Propeller Governor

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 .0625 inch.

c. Propellers having excess 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 and overhaul of assembly.

7-10. PROPELLER GOVERNOR.

7-11. REMOVAL OF PROPELLER GOVERNOR.

a. Remove the upper engine cowl.

b. Disconnect the control cable end from the governor control arm.

c. Remove the governor mounting stud nuts. It will be necessary to raise the governor 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.

7-12. 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 evenly.

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 7-13.

g. Install engine cowl.

7-13. RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 7-3.)

a. Start engine, park 90° to wind direction and warm in normal manner.

b. To check high RPM, low pitch setting, move the propeller control all the way forward. At this position the governor speed control arm (1) should be against the high RPM fine adjusting screw (2). With the throttle full forward, observe engine RPM, which should be 2700 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 (2) for 2700 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 (1) is adjusted to the proper angle on the control wheel (3) as shown in Figure 7-3.

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 knob is 0.0625 to 0.125 of an inch from hitting the face of the instrument panel with Serial Nos. 32-1 to 31-1110 inclusive. Airplanes with Serial Nos. 32-1111 and up, control system adjustment clearance is 0.010 to 0.030 of an inch from forward stop on the power quadrant. To adjust the control knob travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the end to obtain the desired level 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.

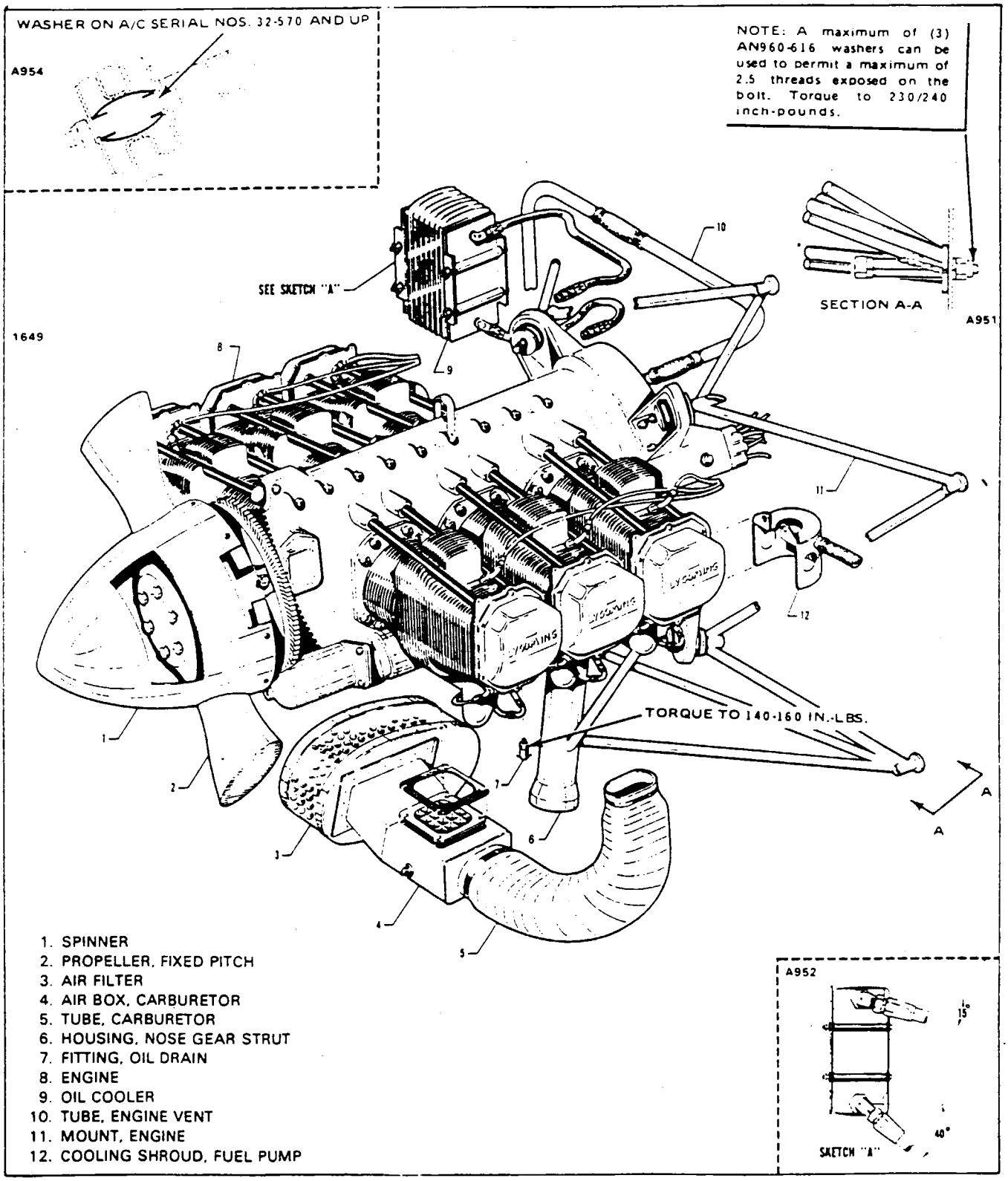


Figure 7-4. Engine Installation

7-14. ENGINE.

7-15. REMOVAL OF ENGINE.

a. Turn off all electrical switches in the cockpit and then disconnect the battery ground wire at the battery.

b. Move the fuel selector lever in the cockpit to "OFF".

c. Remove the engine cowling by the following procedure:

1. Release the cowl fasteners, two on each side and two at the top aft of cowl.

2. Lift the aft end of the cowl and then slide it forward to release the two stud type front fasteners. Remove the top cowl.

3. Disconnect the landing light lead at the quick disconnect at the right rear side of the bottom cowl.

4. Remove the screws securing the bottom cowl at its aft end and brace across bottom aft of cowl. Remove the bottom cowl.

d. Remove the propeller. (Refer to paragraph 7-4 or 7-6.)

e. Disconnect the cabin heat line and cabin defroster line from the heat muff.

f. Disconnect primer line at the tee connection.

g. Disconnect the mechanical fuel pump inlet line connected to the right side of the pump.

h. Disconnect the starter lead.

i. Disconnect alternator leads.

j. Disconnect the carburetor heat, throttle and mixture controls from the engine components.

k. Disconnect the tachometer cable from the rear of the engine.

l. Disconnect hose from vacuum pump.

m. Disconnect magneto "P" leads. Insert a protective cover over connection.

n. Disconnect the oil pressure line from the rear of the engine.

o. Disconnect manifold pressure line from the left rear cylinder of the engine.

p. Attach a one-half ton (minimum) hoist to the hoisting strap and relieve the tension on the engine mount.

NOTE

Place a tail stand under the tail of the airplane before removing the engine.

q. Check the engine for any attachments remaining to obstruct its removal.

r. Drain the engine oil, if desired, and then close drain.

s. Remove the four engine mount assemblies and swing the engine free, being careful not to damage any attaching parts.

7-16. INSTALLATION OF ENGINE.

a. Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points on the mount.

b. Insert an engine mount bolt through the hole of a mount attachment point (a washer is installed next to the head of the bolt) and slide a half of the shock mount assembly on the bolt. Repeat this procedure for the other three attachment points.

c. Position the mounting lugs of the engine so that they align with the engine mount attaching points, then move the engine rearward onto the mounts.

d. Slide onto each mounting bolt a spacer washer (on serial numbers 32-570 and up), spacer and the forward half of mount. Install washer and nut and torque nuts of bolts to 450 to 500 inch-pounds.

e. Reconnect all engine connections in the reverse order of removal.

NOTE

Prior to the initial start of the reinstalled engine, refer to the latest revision of Lycoming Service Instructions No. 1241A for information on pre-oiling the engine to prevent a possible high speed bearing failure.

7-17. 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. Where a rectangular fitting boss is provided, a back-up 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 cannot be positioned correctly as shown in Figure 7-4, using a torque of 10 to 15 foot-pounds, another fitting should be used.

e. When attaching lines to the cooler, a back-up 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.

7-18. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. (Serial Nos. 32-1 to 32-1110 inclusive.) (Refer to Figure 7-4a.) 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 arm is rotated forward against its full rich stop, the cockpit control knob of the throttle should be 0.75 to 1.0 and the mixture 0.062 to 0.125 of an inch from the cable housing face plate on the panel.

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 of the cable to obtain 0.062 to 0.125 of an inch spring back 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 fitting on the wire to obtain the 0.062 to 0.125 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 knobs in cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position.

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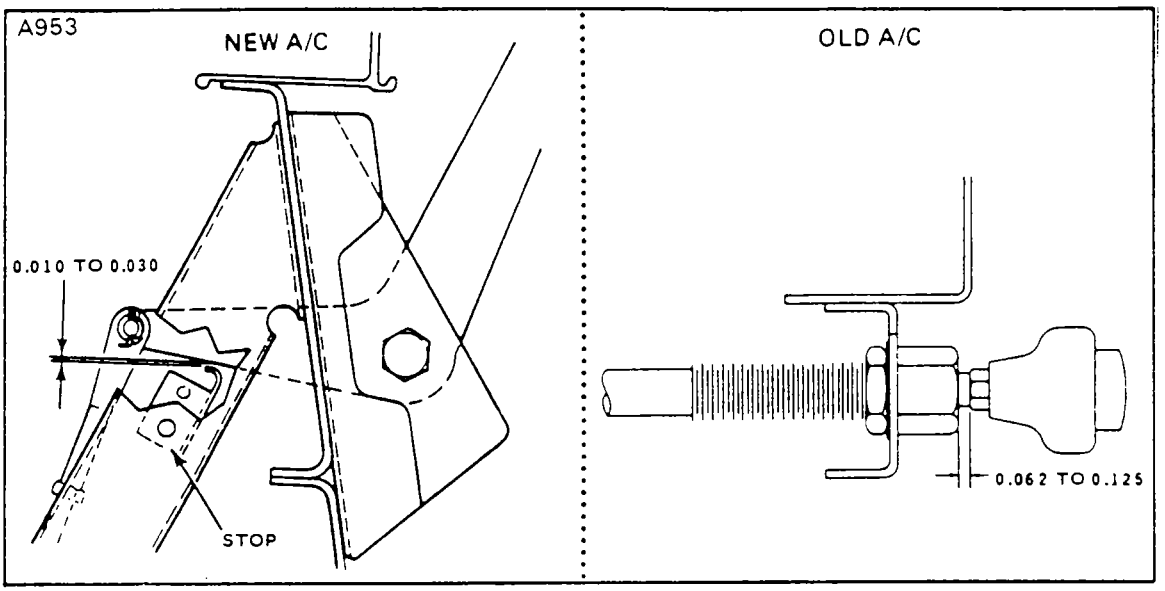


Figure 7-4a. Adjustment of Engine Controls

7-18a. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. (Serial Nos. 32-1111 and up.) (Refer to Figure 7-4a.) 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 levers of the throttle and mixture should have 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle or full rich 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 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle position.

3. Reconnect the clevis end to the control arm and safety.

b. The mixture may be adjusted as follows:

1. At the carburetor, disconnect the clevis end of the mixture 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 0.010 to 0.030 of an inch spring back on the instrument panel stop when in full rich position.

3. Reconnect the clevis end to the control arm and safety.

c. Check security of cable casing attachments.

d. Pull the throttle and mixture levers in the cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position. On 1975 models and up, a mixture control lock is incorporated in the quadrant cover which prevents the mixture control from being moved to the idle cutoff position inadvertently. The lock must be depressed before the control can be moved completely aft. Ascertain that the lock operates freely without any tendency to bind or hang up.

7-19. INDUCTION AIR FILTER.

a. The filter should be cleaned daily when operating in dusty conditions. If any holes or tears are noticed, the filter must be replaced immediately.

b. Remove the filter element and shake off loose dirt by rapping on a hard flat surface, being careful not to damage or crease the sealing ends. DO NOT wash filter element in any liquid or soak it in oil. Never attempt to blow off dirt with compressed air.

c. The filter housing can be cleaned by wiping with a clean cloth soaked in unleaded gasoline. When the housing is dry reinstall and seal the filter element.

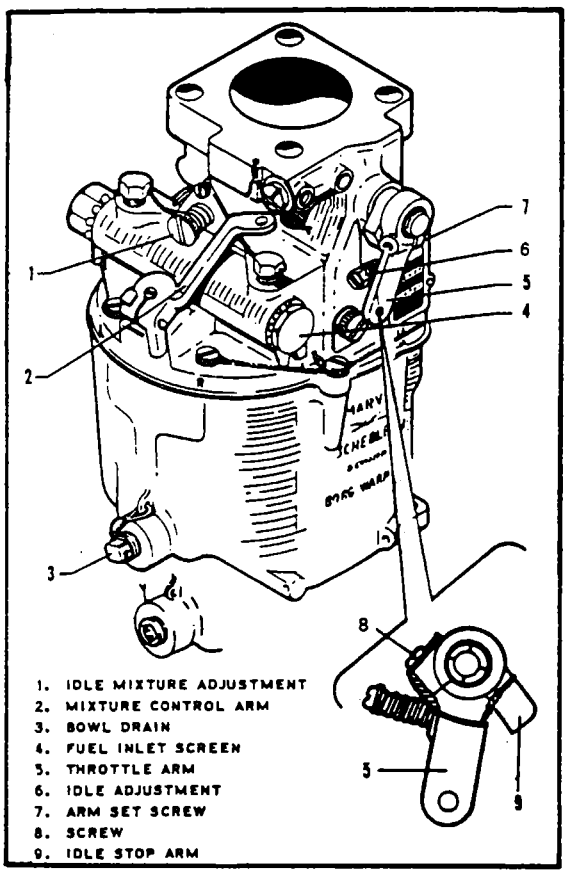


Figure 7-5. Carburetor

7-20. CARBURETOR.

7-21. 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 lock wiring.

d. Clean the fuel inlet screen. (Refer to Figure 7-5.)

e. Remove plug at aft position of carburetor and drain any accumulation of foreign matter. Later models have allen type drain plugs installed. This plug should be torqued to 40 inch pounds. No safety wire is required on this installation.

f. Check carburetor air box for wear and full travel of heat door.
g. Check adjustment of idle mixture and idle speed.

NOTE

If a pipe plug is found to leak after it has been tightened to the above limits, do not tighten further but rather, remove the plug and apply more sealing compound to the threads. Reinstall the plug and tighten to the desired torque. When plugs are tightened in a hot engine, reduce the recommended torques by 20% owing to the different expansion characteristics of the steel plugs and the housings.

7-21a. THROTTLE ARM.

a. Remove screw securing the throttle arm to the carburetor. Do not remove the throttle arm.
b. Remove and discard lock tab.
c. Examine the screw to determine if there is a hole through the head of the screw. If not, drill a 1/16 inch diameter hole through the head of the screw.
d. Reinstall the screw, torque to 20 to 28 inch pounds.

NOTE

Be sure the torque handle is correctly calibrated to insure the attaching screw is neither under nor over tightened.

e. Using a .032 inch diameter safety wire, first tie the wire to the idle stop lever and then continue as shown in Figure 7-5.
f. Depending upon the carburetor model, the sequence and direction of tying may vary however, the idle stop arm, throttle arm and attaching screws must all be tied together.

7-22. ADJUSTMENT OF IDLE MIXTURE.

a. After performing the standard engine starting procedure, operate the engine for at least 2 minutes between 800 to 1200 RPM to insure proper engine warm-up.

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.

b. Draw back on the cockpit throttle control lever to obtain a reading of approximately 550 RPM on the tachometer.

c. Turn the idle mixture adjusting screw (1, Figure 7-5), 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.

7-23. 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 idle adjustment screw (6, Figure 7-5) to obtain from 550 to 650 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.

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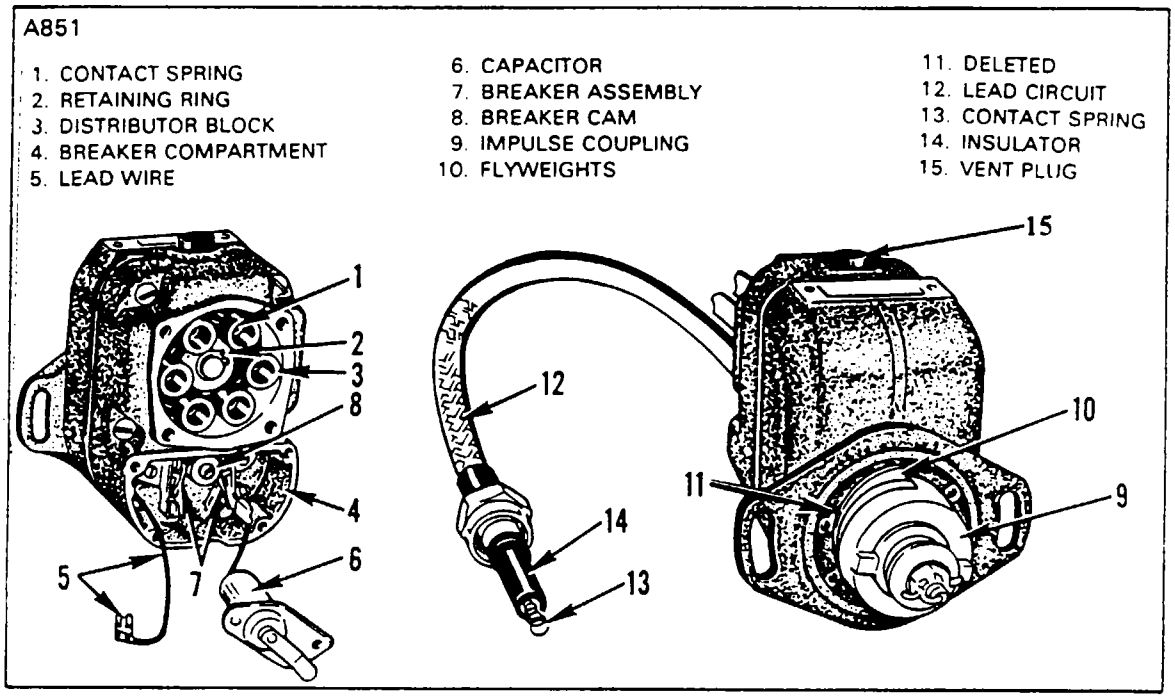


Figure 7-6. Magneto Inspection

7-24. MAGNETO.

CAUTION

Ascertain that the primary circuits of both magnetos are grounded before working on the engine.

7-25. 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 check list is keyed by number to a part shown in Figure 7-6.

1. Inspect distributor block contact springs. Top of spring must not be more than .422 inches below top of tower. If broken or corroded, they should be replaced.

2. Inspect oil felt washer. It should be saturated with oil. If dry, check for worn bushing. If O.K., add No. 30 oil.

3. Inspect distributor block for cracks or burned areas. The wax coating on the block should not be removed. Do not use solvents.

4. 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.

5. 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.

6. Inspect capacitor visually. If possible test for leakage, capacity and series resistance. Remember, an electrical failure of an aircraft capacitor is rare.

7. Adjustment of breakers must be correct for proper internal timing of magneto. (See paragraph 7-26.)

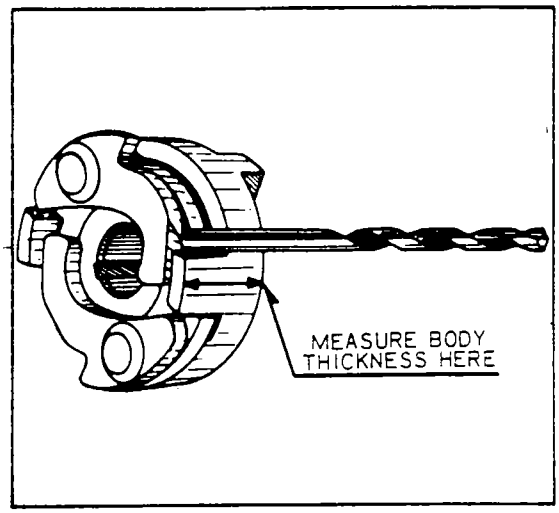


Figure 7-7. Impulse Coupling

8. Check if breaker cam is clean and smooth, if cam screw is tight (25 in. lbs.). If new points are installed, blot a little oil on cam.

9. Inspect impulse coupling (-21 magneto) flyweights for excessive looseness on the axles. Design couplings having .927 inch thick body should be checked with 1/8 inch drill. Couplings with .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 7-7.)

10. Check impulse coupling for excess wear on the contact edges of body and flyweights.

11. Check that the impulse coupling flyweight axle rivets are tight and there are no cracks in body.

12. 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 light-weight 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.

13. Check the springs for breaks, corrosion, or deformation. If possible, check continuity from block with tester or light.

14. Check insulators for cracks, breaks, or evidence of "old age". Be sure they are clean.

15. 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.

7-26. 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. To internally time the -20 series and the early -200 series magneto without the case in timing marks, the magneto should be removed from the engine to determine "E" gap.

b. To determine "E" gap, find neutral position of the magneto drive by rotating drive coupling in a left hand direction until the red or white chamfered tooth on the distributor drive gear appears through the timing inspection hole. At the same location, the drive should feel to have fallen into a notch or neutral position.

c. With timing plate and pointer attached (Refer to Figure 7-9) and pointer set at zero, rotate coupling from neutral, in a left hand direction 10°. Appearing through timing hole, ascertain if the white or red tooth aligns with the white line of the distributor block. (Refer to Figure 7-8.) Alignment may not vary over ± 4°.

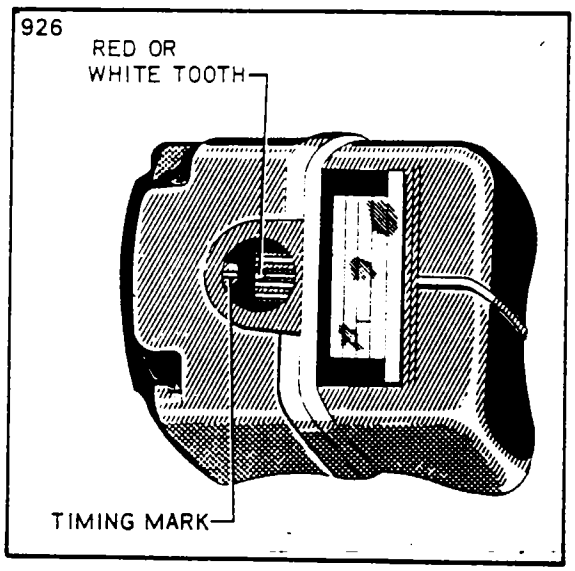


Figure 7-8. Magneto Timing Marks

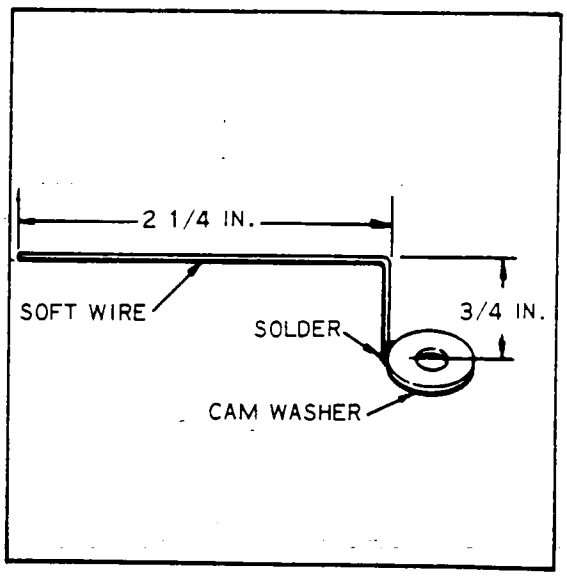


Figure 7-9. Timing Pointer

NOTE

A timing kit, including timing plate, etc. may be purchased through the engine or magneto manufacturer. A pointer may be formed as shown in Figure 7-9.

d. Using the alignment of the gear marked with the white line of the distributor block as a reference, adjust breaker points to open at this point. Turn the magneto drive until the cam follower is on high point of the cam lobe. Measure contact clearance, it must be 0.018 inch ± 0.006 with the "E" gap set 10° ± 4°. If breaker points do not come within tolerances, they should be replaced.

NOTE

A pointer can also be made by wrapping a piece of soft wire tightly around the head of cam securing screw and bending it to extend over timing marks.

e. If magneto is type which has "cast in" timing marks (-200 series, see Figure 7-10) main breaker may be adjusted with magneto on engine as follows; turn engine crankshaft until notch in cam is aligned with mark at top of breaker compartment. Set wire pointer in center of the "E" gap boss at the side of breaker compartment. Connect timing light across main breaker. Adjust main breaker contacts to open at this point. Turn engine crankshaft until cam follower is on the high point of the cam lobe. Measure contact clearance. It must be .018 ± .006. If necessary readjust breaker and recheck to be sure that contacts will open within "E" gap tolerance ± 4°. (Width of "E" gap boss.)

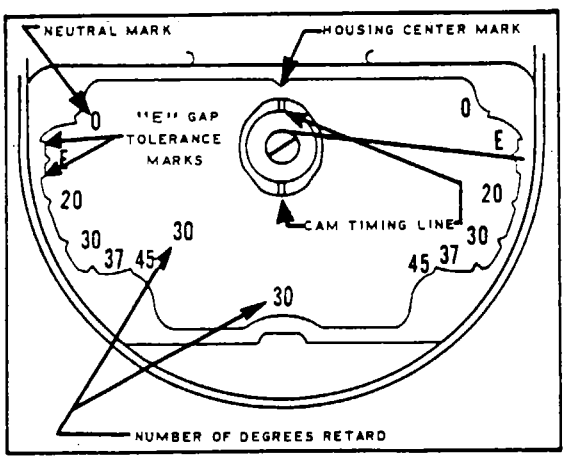


Figure 7-10. Breaker Compartment with Cast Timing Marks

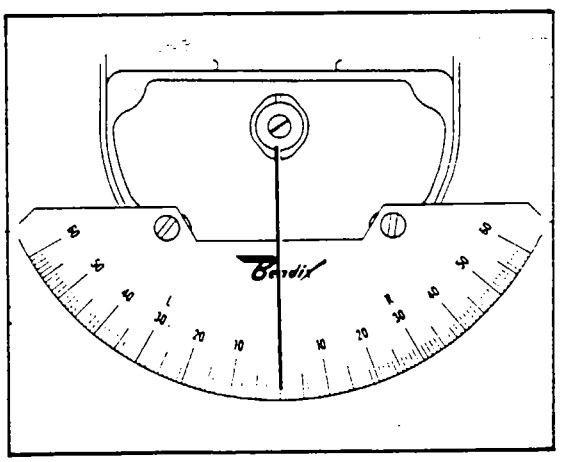


Figure 7-11. Timing Kit Installed

CAUTION

If cam screw was removed be sure to replace flat washer, lock washer and screw. Torque to 25 inch pounds.

NOTE

On Bendix 1200 and D2000 series magnetos, a new self-locking cam retaining screw should be installed in place of the old non-self-locking screw. Torque the self-locking screw from 21 to 25 inch pounds. Refer to latest revision of Lycoming Service Instructions No. 1400 and Bendix Service Bulletin No. 608 for additional information.

f. With internal timing checked the magneto may be timed to the engine. (Refer to paragraph 7-27.)

7-27. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine)

The magnetos can be installed and timed to the engine by the following procedure:

NOTE

Ascertain that the breakers are correct for proper internal timing of magnetos.

a. Remove the top spark plug from No. one cylinder. Place the thumb of one hand over the spark plug hole and rotate the crankshaft in direction of normal rotation until the compression stroke is reached. The compression stroke is indicated by a positive pressure inside the cylinder tending to lift the thumb off the spark plug hole. In this position both valves of No. one cylinder are closed. Turn the crankshaft opposite to its normal direction of rotation until it is approximately 35 degrees BTC on the compression stroke of No. one cylinder. Rotate the crankshaft in its normal direction of rotation until the 25 degrees mark on the starter gear and the crankcase parting flange are aligned.

b. Rotate the magneto gear on the right magneto until the chamfered tooth on the distributor gear inside the magneto aligns with the white pointer as seen through the window in the magneto cover. Without allowing the gear to turn from this position, assemble the magneto and gasket. Secure magneto in place with washers and nuts; tighten the nuts only finger tight.

c. Fasten ground wire on electric timing light to any unpainted metallic portion of the engine, and one of the positive wires of the timing light to a suitable terminal connected to the ground terminal connection of the right magneto. Turn engine crankshaft several degrees from BTC in direction opposite to that of normal rotation.

d. Turn on the switch of the timing light. Turn the crankshaft very slowly in direction of normal rotation until the timing mark on the front face of the ring gear support aligns with the drilled hole in the starter, at which point the light should go on, (on battery operated models). If not, turn the magneto in its mounting flange slots and repeat the procedure until the light goes on at 25 degrees be-

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fore top dead center. Tighten the two mounting nuts and replace magneto inspection plug.

e. Install the impulse coupling magneto adapter and gasket on the left magneto mounting pad of the accessory housing.

CAUTION

The impulse coupling magneto can be used only on the left side of the engine (as viewed from rear).

f. Remove inspection plug, depress pawl on impulse coupling shaft and turn impulse coupling on left magneto until the white beveled tooth (or middle tooth, if timing gear has three beveled teeth) aligns with the timing pointer. Without allowing the magneto gear to turn from this position, assemble the left magneto to the accessory housing and secure with washers and nuts. Tighten nuts only finger tight.

g. Connect the other positive wire of the timing light to a suitable terminal connection of the left magneto and time the magneto in the same manner as described for the right magneto.

h. After both magnetos have been timed, leave the timing light wires connected and recheck magneto timing as previously described to make sure that both magnetos are set to fire together. If timing is correct, both timing lights will go on simultaneously when the 25 degree mark aligns with the centerline of the crankcase. If the breaker points open too early, loosen the mounting nuts and rotate the magneto clockwise. If the breaker points open too late, rotate the magneto counter-clockwise. Remove timing light and ignition timing pointer, and replace timing inspection plug in magneto.

i. After the magnetos have been properly timed, clean the breaker points to remove any trace of oil or dirt. Replace breaker cover and lock the retaining screws together with lockwire.

NOTE

The crankshaft should not be rotated more than 10 degrees 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 crankshaft in normal direction until sharp click is heard; this will indicate that the impulse coupling has passed through firing position. Turn crankshaft in direction opposite normal rotation to approximately 35 degrees BTC and proceed with timing check.

7-28. SPARK PLUGS.

7-29. 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 centerline 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.

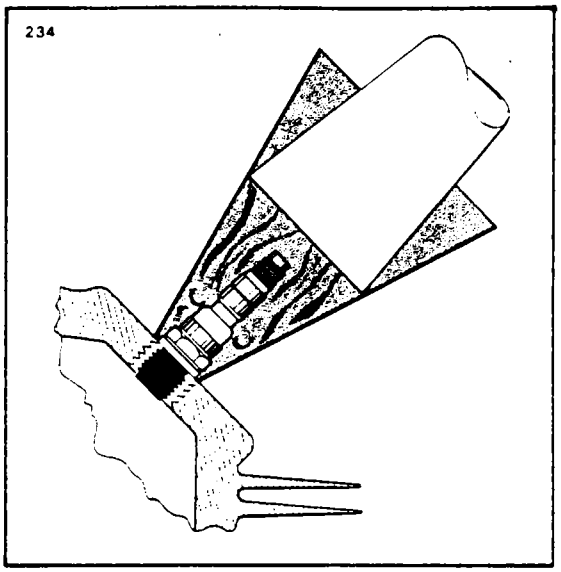


Figure 7-12. Removing Spark Plug Frozen to Bushing

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 7-12.) 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.

7-30. 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 round 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; removing carbon and foreign deposits.

c. Test the spark plug both electrically and for resistance.

d. Set the electrode gap at 0.017 to 0.021 inch.

7-31. 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 threads, 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. Carefully insert the terminal insulator in the spark plug and tighten the coupling nut.

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TABLE VII-II. ENGINE TROUBLESHOOTING

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 cocks.
		Check fuel selector valve for proper tank.
		Check fuel pressure with electric boost pump ON.
		Check mixture control knob for full rich.
	Underpriming.	Prime with two or three strokes of primer.
	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.
	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.
	Improper operation of magneto breaker points.	Check internal timing of magnetos.
		Check points.
	Defective ignition wire.	Check with electric tester and replace any defective wires.
	Defective battery.	Replace with charged battery.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Failure of engine to start. (cont.)	Internal failure.	Check oil sump screen 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 - left magneto only.	Demagnetize impulse couplings.
	Frozen spark plug electrodes.	Replace spark plugs or dry out removed plugs.
	Mixture control in idle cut-off.	Open mixture control.
	Shorted ignition switch.	Check and replace or repair.
	Lack of sufficient fuel flow.	Disconnect fuel line and check fuel flow.
	Water in carburetor.	Drain carburetor and fuel lines.
Failure of engine to idle properly.	Incorrect carburetor idle adjustment.	Adjust throttle stop to obtain correct idle.
	Idle mixture.	Adjust mixture. Refer to engine manufacturer's handbook for proper procedure.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Failure of engine to idle properly. (cont.)	Faulty ignition system.	Check entire ignition system.
	Open primer.	Lock primer.
	Improper spark plug setting for altitude.	Check spark plug gap.
	Dirty air filter.	Clean or replace.
	Insufficient fuel pressure.	Adjust fuel pressure.
Low power and uneven running.	Mixture too rich: indicated by sluggish engine operation, red exhaust flame (at night) and black smoke in extreme cases.	Check primer. Readjustment of carburetor indicated.
	Mixture too lean: indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Check fuel supply. Readjustment of carburetor is indicated.
	Leaks in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean and gap or replace spark plugs.
	Improper grade of fuel.	Fill tank with recommended grade.
	Magneto breaker points not working properly.	Clean points and check internal timing of magneto.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Low power and uneven running engine. (cont.)	Restriction in exhaust system.	Check for loose muffler baffles.
	Improper ignition timing.	Check magnetos for timing and synchronization.
Failure of engine to develop full power.	Throttle lever out of adjustment.	Adjust throttle lever.
	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 tank with recommended fuel.
	Faulty ignition.	Tighten all connections.
		Check system. Check ignition timing.
	Improper fuel flow.	Check strainer, gauge and flow at the fuel line.
Rough running engine.	Cracked engine mounts.	Repair or replace engine mount.
	Unbalanced propeller.	Remove propeller and have it checked for balance.
	Uneven compression.	Check compression.
	Bent propeller blades.	Check propeller for track.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Rough running engine (cont.)	Defective mounting bushings.	Install new mounting bushings.
	Lead deposit on spark plug.	Clean or replace plugs.
	Malfunctioning engine.	Check entire engine.
Low oil pressure.	Insufficient oil.	Check oil supply.
	Dirty oil screens.	Remove and clean oil screens.
	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 and 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.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
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.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Failing or failed bearing(s).	Examine sump for metal particles and, if found, overhaul of engine is indicated.
	Defective thermostats.	Replace.
	Defective temperature gauge.	Replace gauge.
	Excessive blow-by.	Usually caused by weak or stuck rings. Overhaul.
	Improper engine operation.	Check entire engine.
	Low grade of oil.	Replace with oil conforming to specifications.
Excessive oil consumption.	Failing or failed bearing(s).	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.

TABLE VII-II. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Excessive oil consumption. (cont.)	External oil leakage.	Check engine carefully for leaking gaskets, "O" rings or sand holes.
	Leakage through engine fuel pump vent.	Replace fuel pump "O" ring.
	Engine breather or vacuum pump breather.	Check engine and overhaul or replace pump.
	Low grade of oil.	Replace with oil conforming to specifications.
	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.
Overpriming.	Cold weather.	Rotate the crankshaft in the counterclockwise direction with throttle FULL OPEN and ignition switch OFF.
Inaccurate pressure readings.	Cold weather.	Oil pressure readings up to 100 pounds are not unusual. High or low 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.

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SECTION VIIA

POWER PLANT

(PA-32-300 & PA-32R-300)

		Aerofiche Grid No.
7A-1.	Description	2G6
7A-2.	Troubleshooting	2G6
7A-3.	Propeller	2G6
7A-4.	Removal of Propeller	2G6
7A-5.	Cleaning, Inspection and Repair of Propeller	2G8
7A-6.	Installing Propeller	2G8
7A-7.	Blade Track	2G9
7A-8.	Propeller Governor	2G10
7A-9.	Removal of Propeller Governor	2G10
7A-10.	Installation of Propeller Governor	2G10
7A-11.	Rigging and Adjustment of Propeller Governor	2G10
7A-12.	Engine	2G12
7A-13.	Removal of Engine	2G12
7A-14.	Installation of Engine	2G13
7A-14a.	Installation of Oil Cooler	2G15
7A-15.	Adjustment of Throttle and Mixture Controls (Serial Nos. 32-40000 to 32-40565 incl.)	2G16
7A-15a.	Adjustment of Throttle and Mixture Controls (Serial Nos. 32-40566 and up, and 32R-7680001 and up)	2G17
7A-16.	Induction Air Filter	2G17
7A-17.	Alternate Air Door	2G18
7A-18.	Fuel Injector	2G18
7A-19.	Fuel Injector Maintenance	2G18
7A-20.	Adjustment of Idle Speed and Mixture	2G20
7A-21.	Fuel Air Bleed Nozzle	2G21
7A-22.	Removal of Fuel-Air Bleed Nozzle	2G21
7A-23.	Cleaning and Inspection of Fuel-Air Bleed Nozzle	2G21
7A-24.	Installation of Fuel-Air Bleed Nozzle	2G22
7A-25.	Ignition System Maintenance	2G22
7A-26.	Magneto (200 and 1200 Series)	2G22
7A-27.	Inspection of Magneto	2G22
7A-28.	Removal of Magneto	2G24
7A-29.	Timing Procedure (Internal Timing)	2H1
7A-30.	Installation and Timing Procedure (Timing Magneto to Engine)	2H4

Revised: 6/18/76

		Aerofiche Grid No.
7A-31.	Harness Assembly	2H6
7A-32.	Inspection of Harness	2H6
7A-33.	Removal of Harness	2H6
7A-34.	Maintenance of Harness	2H7
7A-35.	Installation of Harness	2H12
7A-36.	Magneto (D-2000 Series)	2H12
7A-37.	Description and Principle of Operation	2H12
7A-38.	Inspection of Magneto	2H12
7A-39.	Magneto Installation and Timing Procedure (Timing Magneto to Engine)	2H14
7A-40.	Magneto Timing Procedure (Internal Timing)	2H17
7A-41.	Impulse Coupling Removal	2H21
7A-42.	Inspection of Impulse Coupling	2H22
7A-43.	Impulse Coupling Installation	211
7A-44.	Harness Assembly	212
7A-45.	Inspection of Harness	212
7A-46.	Maintenance of Harness	213
7A-47.	Spark Plugs	217
7A-48.	Removal of Spark Plugs	217
7A-49.	Inspection and Cleaning of Spark Plug	219
7A-50.	Installation of Spark Plugs	219

SECTION VIIA

POWER PLANT

(PA-32-300 and PA-32R-300)

7A-1. DESCRIPTION. The PA-32-300 and PA-32R-300 are powered by a Lycoming engine of 300 horsepower. (Refer to Power Plant Specifications in Table II-I.) The engine is furnished with a starter, 60 ampere, 12-volt alternator, voltage regulator, shielded ignition system, vacuum pump drive, fuel pump, fuel injector and a dry paper type induction air filter. In the event of air stoppage through the filter an alternate air source can be opened when selected manually by the use of a lever in the cockpit.

The exhaust system for the PA-32-300 is stainless steel directing gases inboard to mufflers located directly under the engine. The large muffler with a heater shroud provides heat for both the cabin and defrosting.

The exhaust system for the PA-32R-300 consists of three individual mufflers combined into one unit. Each set of opposing cylinders feeds into one muffler. A heat shroud encircles the complete unit to provide heat for both the cabin and defrosting.

The engine is provided with a constant speed propeller controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures.

7A-2. TROUBLESHOOTING. Troubles peculiar to the power plant are listed in Table VIIA-I along with their probable causes and suggested remedies. When troubleshooting the engine, ground the magneto primary circuit before performing any checks of the engine.

7A-3. PROPELLER.

7A-4. REMOVAL OF PROPELLER.

a. Insure master and magneto switches are off.
b. Move fuel selector to off position.
c. Place mixture control in idle cut-off.
d. Note position of components to facilitate reinstallation.
e. Remove screws attaching spinner cuff and spinner assembly and remove spinner.
f. Remove the safety wire from the six propeller mounting bolts and remove the bolts and propeller.
g. Place a drip pan under propeller to catch oil spillage, remove propeller.

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.

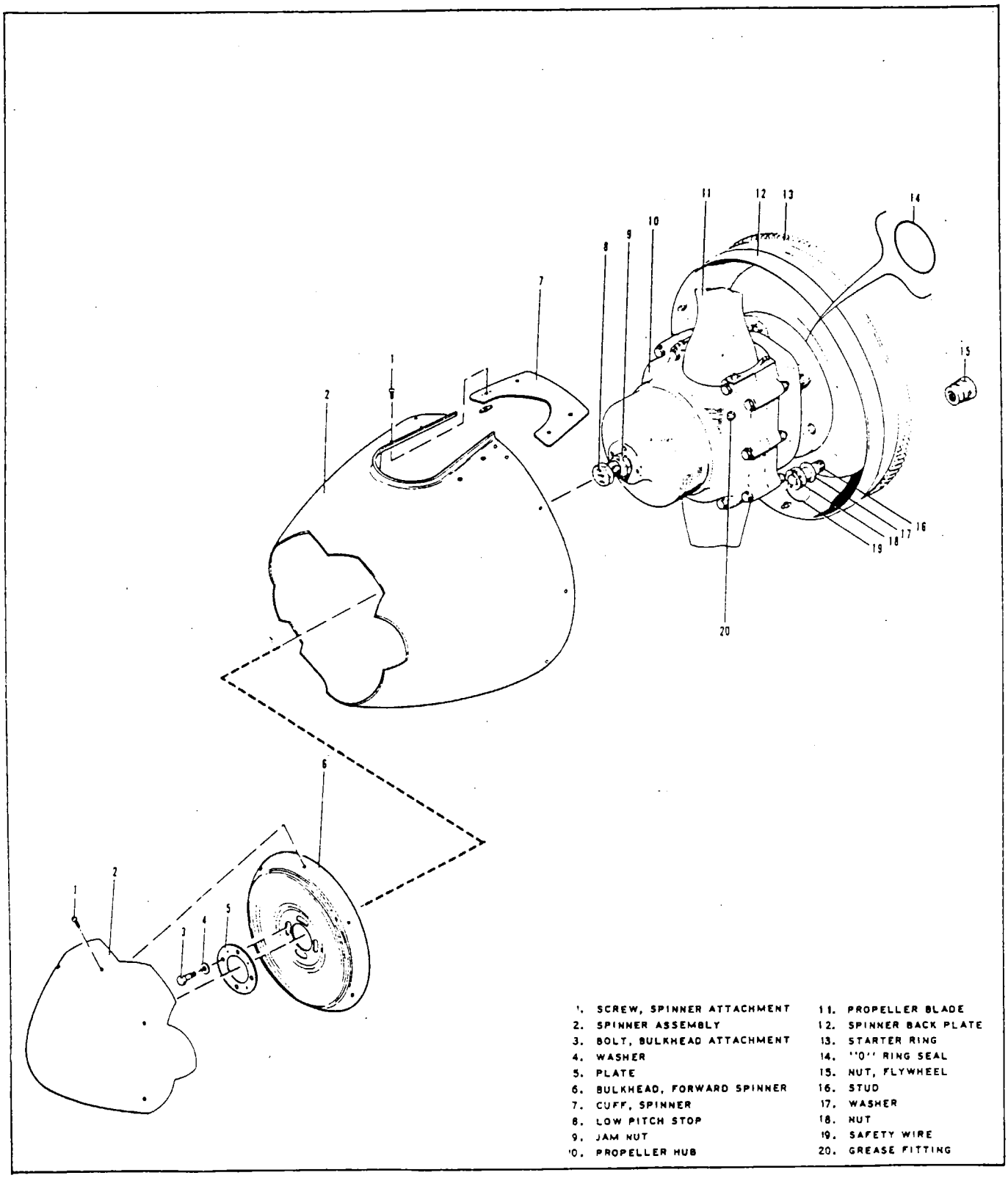


Figure 7A-1. Propeller Installation

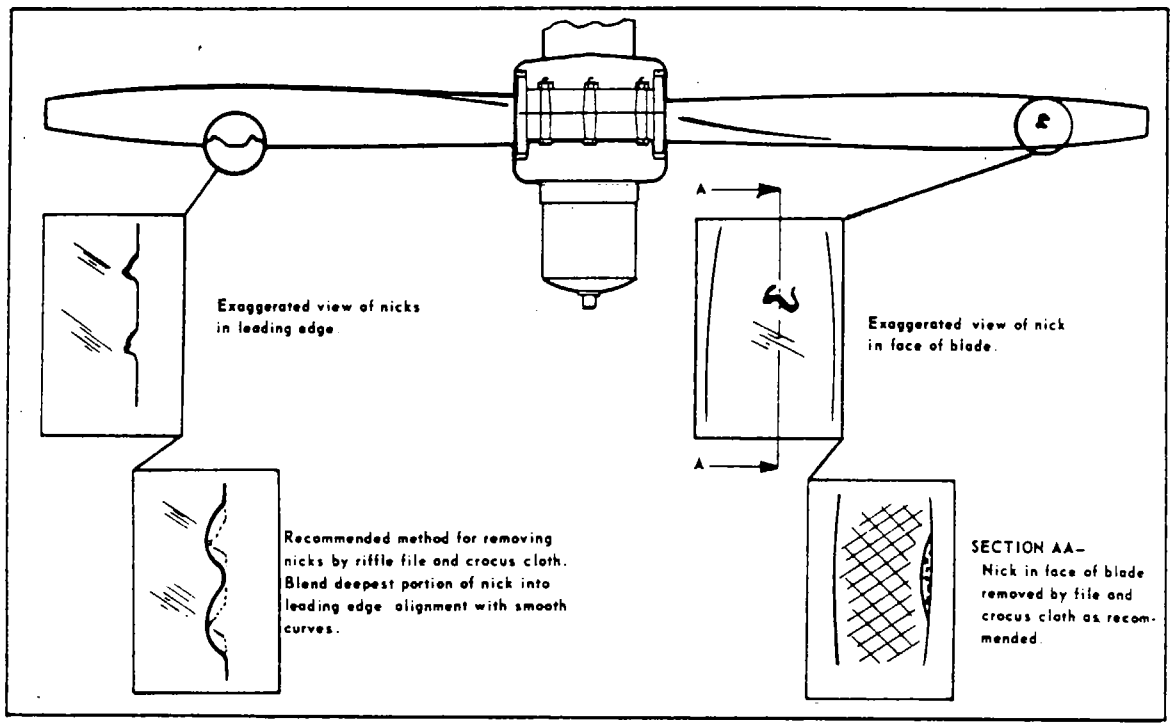


Figure 7A-2. Typical Nicks and Removal Method

7A-5. 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.

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 7A-2 for propeller blade care.

7A-6. INSTALLING PROPELLER. (Constant Speed.)

a. Insure master and magneto switches are off.

b. Place fuel selector to off position.

c. Place mixture control in idle cut-off.

TABLE VIIA-I. PROPELLER SPECIFICATIONS

Hub, Model	HC-C2YK-1 ( ) or HC-C2YK-1 ( ) F	
Blade, Model	8475D-4, F8475D-4, 8475R-0 or F8475-0	
Diameter	80 in.	
Blade Angle	Low Pitch (High RPM)	13.5° ± 0.2° (1)
	High Pitch (Low RPM)	34.0° ± 1.0° (1)
Propeller RPM Setting	Engine Static High RPM	2700 RPM max.
Propeller Torque Limits	Description	Required Torque (Dry)
	Propeller Mounting Nuts	60-70 foot-pounds (2)
	Fwd. Bulkhead Attachment Bolts	30-35 inch-pounds
	Spinner Attachment Screws	20-25 inch-pounds

(1) MEASUREMENT TAKEN AT 30 INCH RADIUS
(2) FIXED PITCH AND CONSTANT SPEED

d. 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 with an "O" mark.

e. Wipe crankshaft and propeller pilot to assure that no chips or foreign matter enter the propeller mechanism.

f. Check interior of propeller hub for proper seating of "O" ring. Wipe inside of hub to remove any traces of dirt. Check to see that "O" ring is covered with grease.

g. Install rear spinner bulkhead.

h. Slide propeller carefully over pilot, taking care that "O" ring is not damaged.

i. Install the six hexagon head propeller hub mounting bolts and torque per Table VIIA-I.

j. Check propeller blade track as given in Paragraph 7-9.

k. Safety the propeller mounting bolts with MS20995-C41 safety wire.

l. Install the forward spinner bulkhead and torque bolts per Table VIIA-I. Safety bolts with MS20995-C41 safety wire.

m. Install spinner and spinner cuff. Torque all attachment screws per Table VIIA-I.

7A-7. BLADE TRACK. Blade track is the ability of one blade tip to follow the other, while rotating, in almost the same plane. Excessive difference in blade track - more than .0625 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 .0625 inch.

c. Propellers having excess 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.

7A-8. PROPELLER GOVERNOR.

7A-9. REMOVAL OF PROPELLER GOVERNOR.

a. Remove the upper engine cowl.

b. Disconnect the control cable end from the governor control arm.

c. Remove the governor mounting stud nuts. It will be necessary to raise the governor 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.

7A-10. 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 7A-11.

g. Install engine cowl.

7A-11. RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 7A-3.)

a. Start engine, park 90° to wind direction and warm in normal manner.

b. To check high RPM, low pitch setting, move the propeller control all the way forward. At this position the governor speed control arm (1) should be against the high RPM fine adjusting screw (2). With the throttle full forward, observe engine RPM, which should be 2700 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.

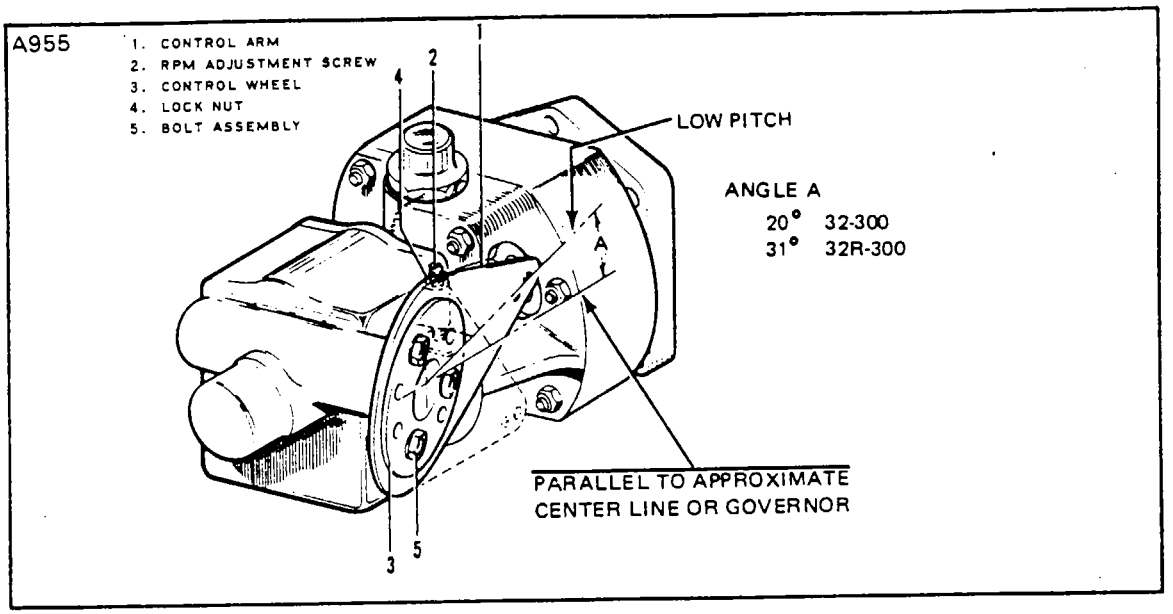


Figure 7A-3. Propeller Governor

2. Adjust the governor by means of the fine adjustment screw (2) for 2700 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 (1) is adjusted to the proper angle on the control wheel (3) as shown in Figure 7A-3.

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 knob is 0.062 to 0.125 of an inch from hitting the face of the instrument panel with Serial Nos. 32-40000 and 32-40565. Airplanes with Serial Nos. 32-40566 and up, control system adjustment clearance is 0.010 to 0.030 of an inch from forward stop on the power quadrant. To adjust the control knob travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the end to obtain the desired level 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.

7A-12. ENGINE.

7A-13. REMOVAL OF ENGINE.

a. Turn off all electrical switches in the cockpit and then disconnect the battery ground wire at the battery.

b. Ascertain that the fuel selector lever is in the "OFF" position.

c. Remove the engine cowling by the following procedure:

1. Release the cowl fasteners, two on each side and two at the top aft of the cowl.

2. Lift the aft end of the cowl and then slide it forward to release the two stud type front fasteners. Remove the top cowl.

3. Disconnect the landing light lead at the quick disconnect at the right rear side of the bottom cowl.

4. On PA-32R-300 aircraft remove the induction air filter access door, the filter and four bolts which hold the air box to the cowl.

5. Remove the screws securing the bottom cowl at its aft end and fuselage firewall flange.

6. On PA-32R-300 aircraft, remove screws which support bottom cowl to the nose gear doors support brackets and fuselage firewall flange.

7. Push nose gear doors inward against spring pressure and remove bottom cowl.

d. Remove the propeller. (Refer to Paragraph 7A-4.)

e. Disconnect the starter positive and ground leads at the injector. (The injector may be removed if desired.)

f. Disconnect the governor control cable at the governor and cable attachment clamps.

g. Disconnect the heater hose at the muffler.

h. Disconnect the throttle and mixture cables at the injector. (The injector may be removed if desired.)

i. On PA-32-300 fixed gear aircraft remove the air filter box by removing the bolts that secure the box to its attachment clamps. The cover may remain attached to the alternate air door control cable.

j. Disconnect the fuel pump supply line at the left side of the pump. Disconnect the pump vent line.

NOTE

Where a question may arise as where to reconnect a hose, line or wire; the item at the separation should be identified (tagged) to facilitate reinstallation. Open fuel, oil, vacuum lines and fittings should be covered to prevent contamination.

k. Disconnect both lines from each oil cooler at the coolers.

l. Disconnect the magneto "P" leads at the magnetos.

m. Disconnect the engine vent tube at the engine.

n. Disconnect the engine oil temperature lead at the aft end of the engine.

o. Disconnect the tachometer drive cable at the engine.

p. Untie the ignition harness hoses and lines at the aft of the engine.

q. Disconnect the vacuum pump lines at pump and remove fittings from pump.

r. Disconnect the oil pressure line at the engine.
s. Disconnect the static and fuel flow line at the right rear engine baffle.
t. Disconnect the manifold pressure line at the right rear side of the engine.
u. Disconnect the injector line at the flow divider.
v. Disconnect the alternator leads and the cable attachment clamps.
w. Attach a one-half ton (minimum) hoist to the hoisting straps and relieve the tension from the engine mounts.

NOTE

Place a tail stand under the tail of the airplane before removing the engine.

x. Check the engine for any attachments remaining to obstruct its removal.
y. Drain the engine oil, if desired, and then close drain.
z. Remove the four engine mount assemblies and swing the engine free, being careful not to damage any attaching parts.

7A-14. INSTALLATION OF ENGINE. (Refer to Figure 7A-4.)

a. Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points.
b. Insert an engine mount bolt, with washer against head, in the engine mount and slide half of the mount assembly on the bolt. (Refer to Figure 7A-4 for proper shock mount assembly.) Repeat this procedure for the other three attachment points.

NOTE

Shock mount Part No. J-3049-38 sandwich (17) must be positioned on the compression side of the engine lugs, with the upper mounts on the forward side, and the lower mounts on the aft side. The part number is stamped on the metal face of the mount. (Refer to Figure 7A-4.)

c. Position the mounting lugs of the engine so that they align with the engine mount attaching points, then move the engine rearward onto the mounts.
d. Slide onto each mounting bolt a spacer washer (on serial numbers 32-40000 thru 32-7240055 only), spacer and the forward half of the mount. Install washer and nut, and torque the nuts of the bolts to 450 to 500 inch-pounds.
e. Connect the alternator leads and secure cable with clamps.
f. Connect the injector line to the flow divider.
g. Connect the manifold pressure line at the right rear side of the engine.
h. Connect the static and fuel flow line at the right rear engine baffle.
i. Connect the oil pressure line.
j. Install the line fitting in the vacuum pump and install lines.

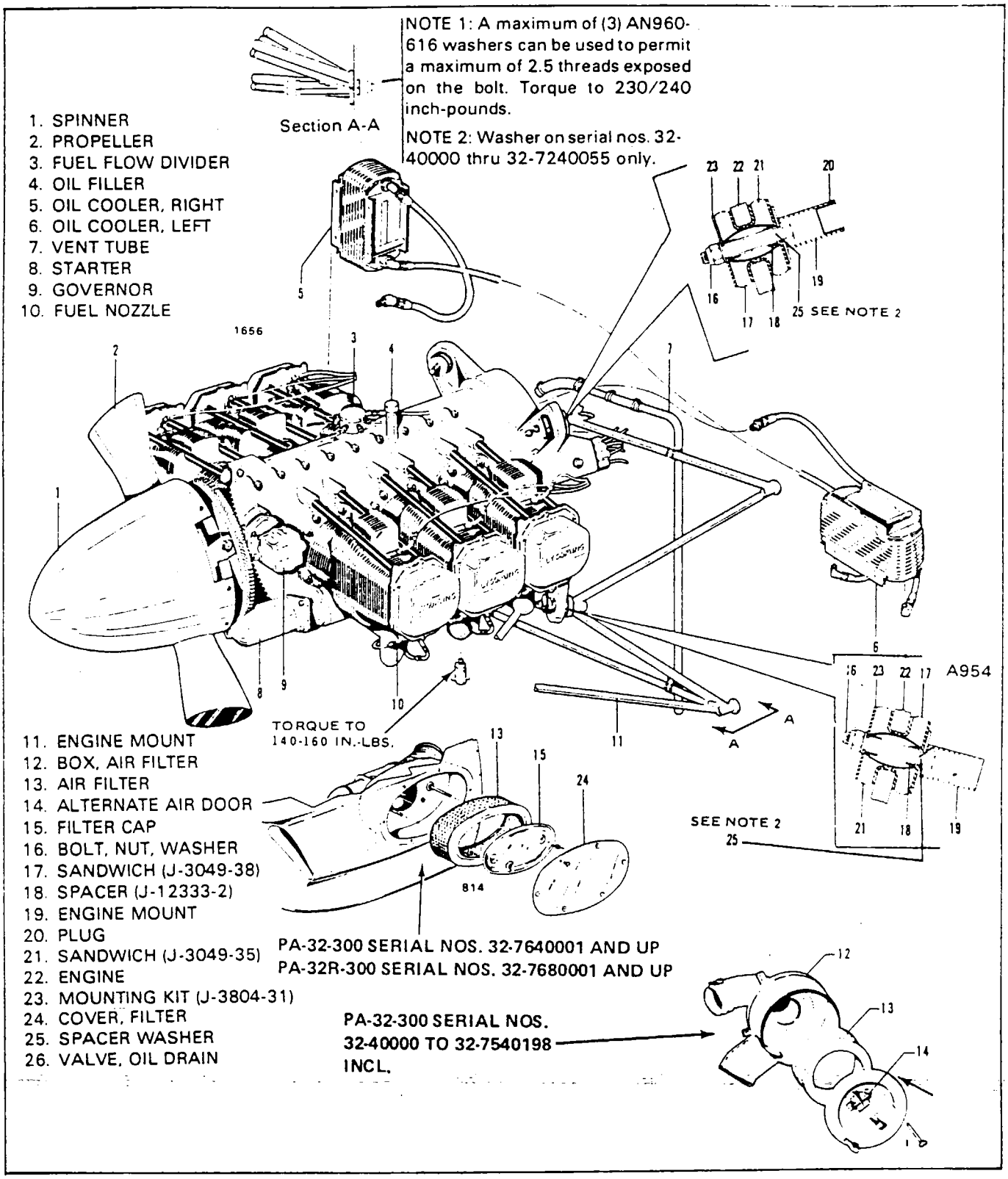


Figure 7A-4. Engine Installation

k. Connect the tachometer drive cable.
l. Connect the oil temperature lead.
m. Connect the engine vent tube.
n. Connect the oil cooler lines to each oil cooler.
o. Connect the magneto "P" leads. Check that magneto switch is "OFF."
p. Connect the fuel pump supply and vent line.
q. Install the injector.
r. Connect the throttle and mixture cables to the injector. Check adjustment of the control by referring to Paragraph 7A-15. (See the latest revision of Piper Service Bulletin No. 537.)
s. Connect the heater hose to the muffler.
t. On PA-32-300 fixed gear aircraft install the air filter box, filter and box cover. Check adjustment of the alternate air door by referring to Paragraph 7A-17.
u. Connect the governor control cable and secure with clamps.
v. Connect the starter positive and ground leads and secure cables with clamps.
w. Secure the ignition harness, lines, hoses, wires, etc., that may be loose.
x. On PA-32R-300 aircraft install the bottom cowl by the following procedure:
1. Position the bottom cowl and secure in place with screws along the sides and nose gear doors support brackets.
2. Connect the air box to the cowl with four bolts and install the filter and access cover. (Refer to Paragraph 7A-17 for proper adjustment of alternate air control.)
y. Install the propeller. (Refer to Figure 7A-1.)
z. On PA-32-300 fixed gear aircraft install the bottom cowling by attaching the bottom cowl to the firewall.
aa. Connect the electrical lead to the landing light.
ab. Install the proper grade and amount of engine oil.
ac. Turn on fuel valve; open throttle full and turn on the electric fuel pump, and check the fuel lines and fittings for leaks.
ad. Install the upper cowling and perform an engine operational check.

7A-14a. 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. Where a rectangular fitting boss is provided, a back-up 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 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, a back-up 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.

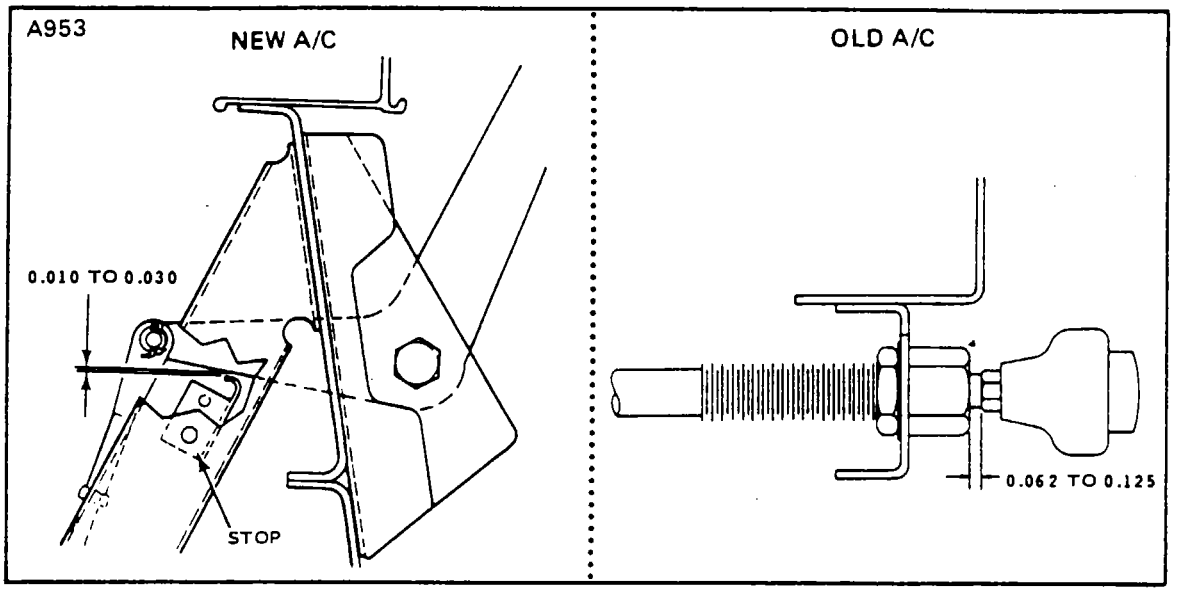


Figure 7A-4a. Adjustment of Engine Controls

7A-15. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. (Serial Nos. 32-40000 to 32-40565 inclusive.) (Refer to Figure 7A-4a.) 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 arm is rotated forward against its full rich stop, the cockpit control knob of the throttle should be 0.75 to 1.0 and the mixture 0.062 to 0.125 of an inch from the cable housing face plate on the panel.

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 of the cable to obtain 0.062 to 0.125 of an inch spring back 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 fitting on the wire to obtain the 0.062 to 0.125 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 knobs in cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position.

7A-15a. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. (Serial Nos. 32-40566 and up, and 32R-7680001 and up.) (Refer to Figure 7A-4a.) 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 levers of the throttle and mixture should have 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle or full rich 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 0.010 to 0.030 of an inch spring back on instrument panel stop when in full throttle position.

3. On aircraft equipped with air conditioning systems, a micro switch is located below the throttle control which is set to actuate in the full open position. With the throttle control adjusted to obtain a clearance of .010 to .030, adjust the micro switch to actuate at this point also.

4. Reconnect the clevis end to the control arm and safety.

b. The mixture may be adjusted as follows:

1. At the carburetor, disconnect the clevis end of the mixture 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 0.010 to 0.030 of an inch spring back on the instrument panel stop when in full rich position.

3. Reconnect the clevis end to the control arm and safety.

c. Check security of cable casing attachments.

d. Pull the throttle and mixture levers in the cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position. On 1975 models and up, a mixture control lock is incorporated in the quadrant cover which prevents the mixture control from being moved to the idle cutoff position inadvertently. The lock must be depressed before the control can be moved completely aft. Ascertain that the lock operates freely without any tendency to bind or hang up.

NOTE

Throttle and mixture free play of up to .30 inches measured at the point where the control lever comes through the quadrant is acceptable providing the throttle or mixture arm at the injector is held against its stops when the control lever is at the full forward and full aft positions.

7A-16. INDUCTION AIR FILTER.

a. The filter should be cleaned daily when operating in dusty conditions. If any holes or tears are noticed, the filter must be replaced immediately.

b. Remove the filter element and shake off loose dirt by rapping on a hard flat surface, being careful not to damage or crease the sealing ends.

CAUTION

Never wash the filter element in any liquid or soak it in oil.
Never attempt to blow off dirt with compressed air.

c. The filter housing can be cleaned by wiping with a clean cloth soaked in unleaded gasoline. When the housing is dry, reinstall and seal the filter element.

7A-17. ALTERNATE AIR DOOR. The two types of alternate air door installations are covered below, along with the serial number effectivity. (Refer to Figure 7A-4.)

PA-32-300 with Serial Nos. 32-40000 to 32-7540198 inclusive:

This alternate air door is located in the cover of the filter box to provide a source of air to the engine should there be an air stoppage through the filter system. The following should be checked during inspection:

a. Check that the air door seals are tight and hinge is secure.

b. Ascertain that the spring tension of the door is tight enough to allow the door to remain closed at full engine RPM, yet should there be an air stoppage it will be drawn open.

c. Actuate the door by pushing in on it with the fingers to determine that it is not sticking or binding.

d. Check the cockpit control cable for free travel.

e. Check that when the control knob in the cockpit is full in, the cable is adjusted to allow approximately .0625 to .125 inch between the actuating arm roller and the door when fully closed.

PA-32-300 with Serial Nos. 32-7640001 and up and PA-32R-300 with Serial Nos. 32-7680001 and up:

This alternate air door is located on the backside of the air filter box which is part of the lower cowl and controlled by a lever mounted next to the engine control quadrant in the cockpit. The alternate air source is taken off the exhaust stack assembly. The following should be checked during inspection:

a. Check that the air door seals are tight and hinge is secure.

b. Actuate the door to determine that it is not sticking or binding and the control cable has free travel.

c. Check that when the air door is fully opened and the cockpit control is in the open position, the cable has 6 to 8 pounds tension when lever goes into full open and locked position. This insures positive seal in the air box. (Cable tension is measured at the control lever with a spring scale. Adjust as required.)

7A-18. FUEL INJECTOR.

7A-19. 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; torque all nuts to 135-150 inch-pounds. Seat pal type nuts finger tight, against plain nuts, and then tighten an additional 1/3 to 1/2 turn.

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 rod ends and levers for tightness and lock.

4. Remove and clean the injector inlet strainer at the first 25 hours of operation and each 50 hour inspection thereafter. Check the screen for distortion or openings in the strainer. Replace for either of these conditions. Clean screen assembly in solvent and dry with compressed air. Damaged strainer O-rings should be replaced. To install the screen assembly, place the gasket on the screen assembly and install the assembly in the throttle body and tighten to 35-40 inch-pounds torque.

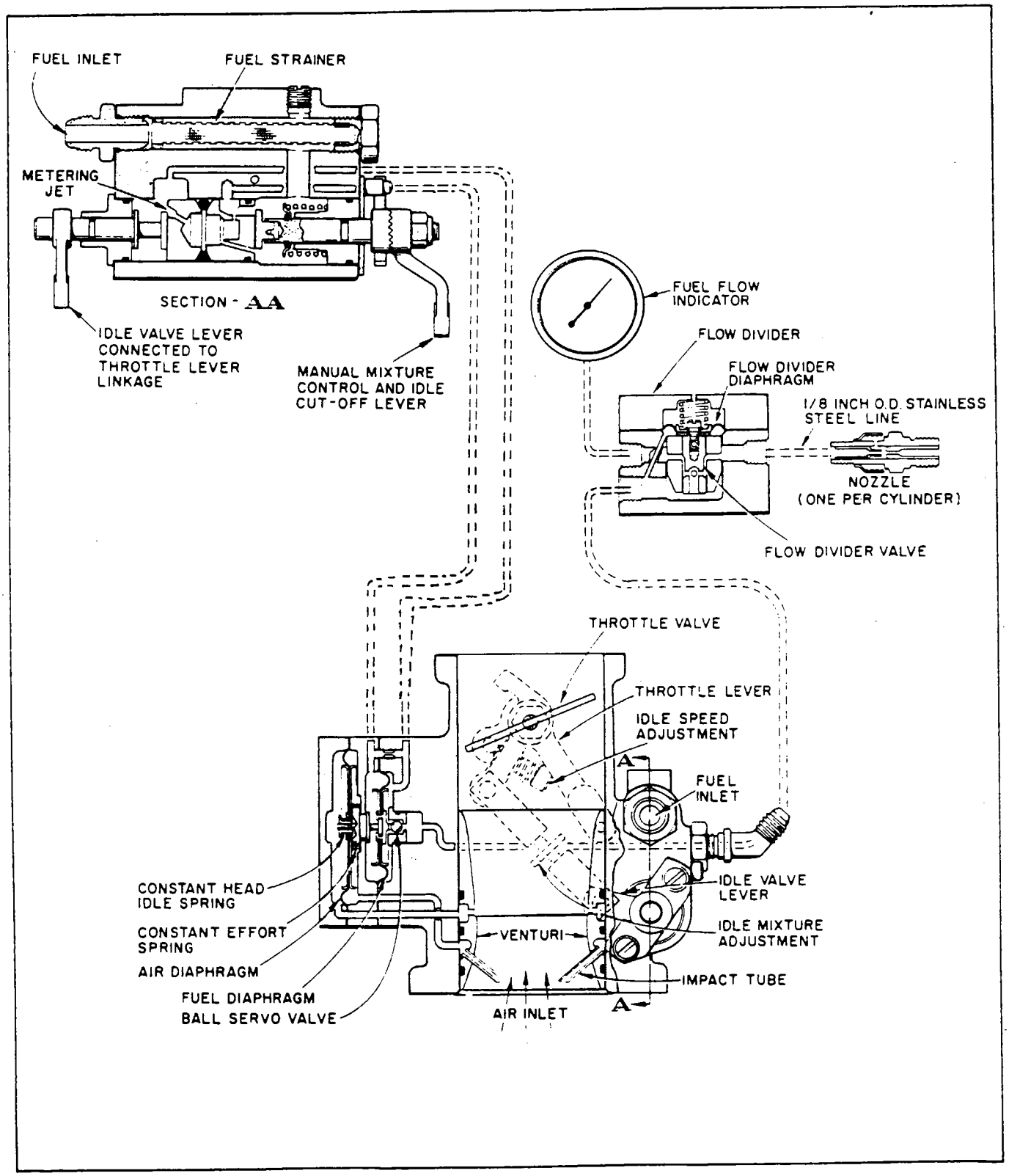


Figure 7A-5. Schematic Diagram of RSA Fuel Injection System

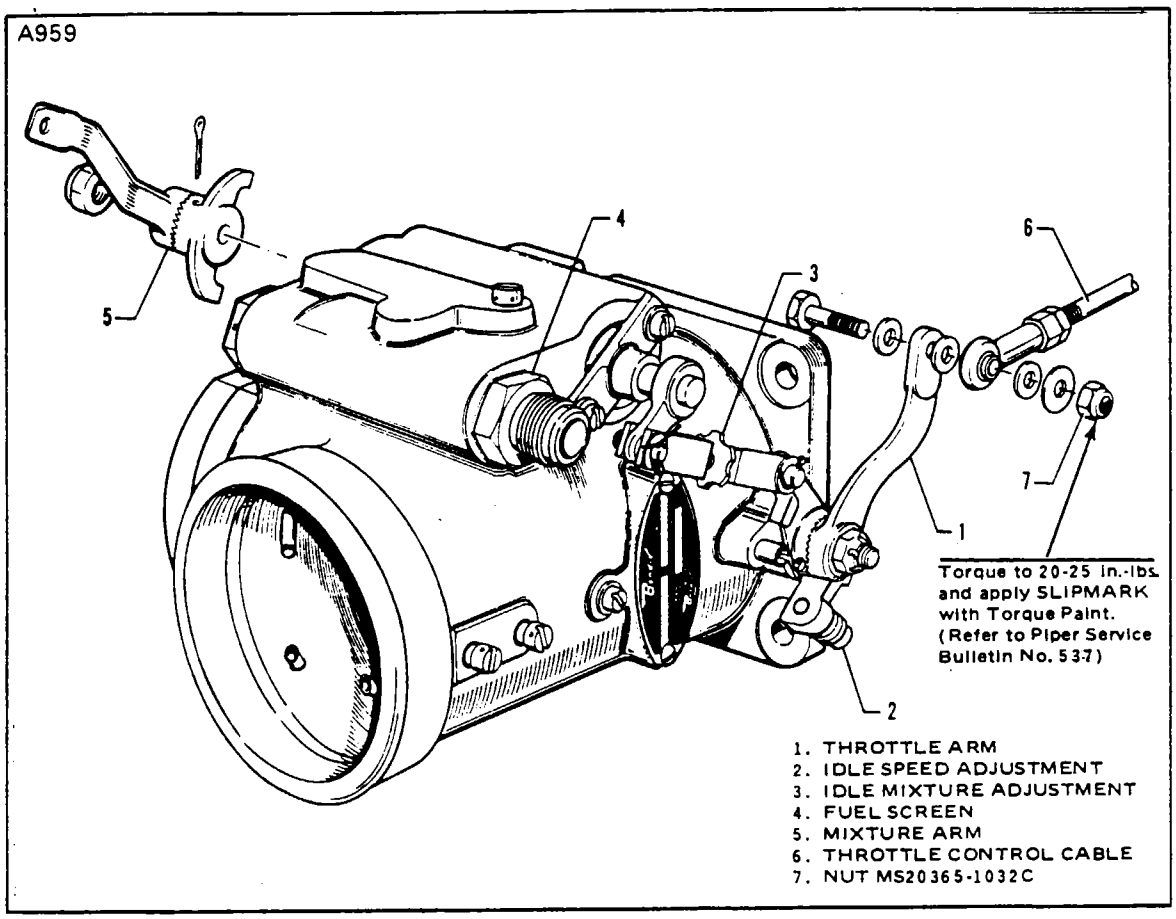


Figure 7A-6. Fuel Injector

7A-20. 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. The electric fuel pump must be "ON" for b, c, d and e below.

b. Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.

c. Set throttle stop screw so that the engine idles at 550-600 RPM. If the RPM changes appreciably after making the mixture adjustment during the succeeding steps, readjust the idle speed to the desired RPM.

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.

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 until a check results in a momentary pick-up of approximately 50 RPM. 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.

7A-21. FUEL AIR BLEED NOZZLE.

7A-22. 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.
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 7A-23.

7A-23. CLEANING AND INSPECTION OF FUEL-AIR BLEED NOZZLE.

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.

b. Inspect the nozzle and cylinder threads for nicks, stripping or cross-threading.

c. Inspect for battered or rounded hexagons.

7A-24. INSTALLATION OF FUEL-AIR BLEED NOZZLE.

a. Install nozzle and torque 60 inch pounds.

CAUTION

Start nozzles and line couplings by hand to prevent the possibility of cross-threading.

b. Connect fuel line to nozzle.

c. Install engine cowl.

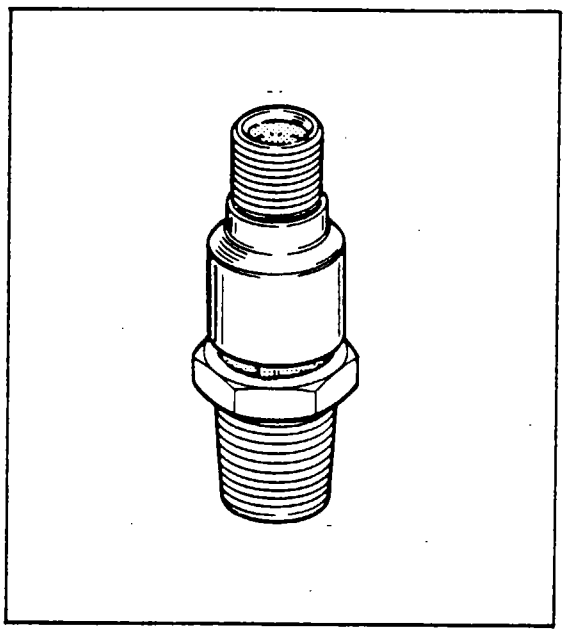


Figure 7A-7. Fuel-Air Bleed Nozzle

7A-25. IGNITION SYSTEM MAINTENANCE.

7A-26. MAGNETO (200 AND 1200 SERIES).

CAUTION

Ascertain that the primary circuit of both magnetos is grounded before working on the engine.

7A-27. 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

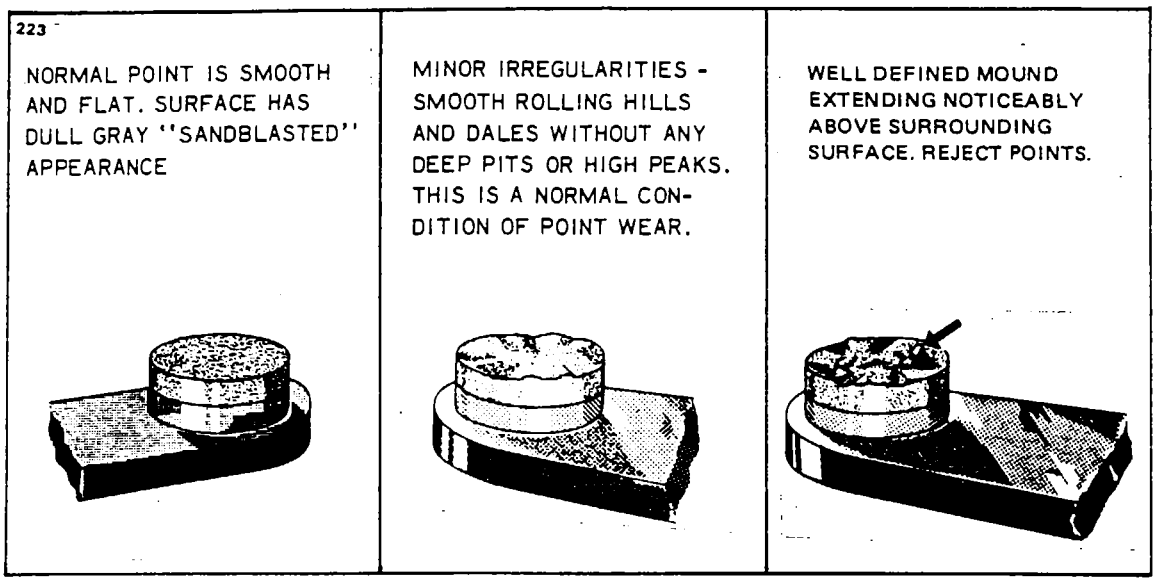


Figure 7A-8. Contact Points

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. Also check for broken leads or damaged insulation. If either is present, remove magneto and replace with one known to be in satisfactory condition.

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 7A-8 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 7A-8 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 7A-8, right, reject contact assembly.

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 Scintilla 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 contact assembly.

2. Slowly bring the engine up to number one cylinder advance firing position as instructed in paragraph 7A-30. 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.

7A-28. REMOVAL OF MAGNETO. Before removing the magneto, make sure magneto switches are off.

a. Remove the harness assembly terminal plate from the magneto.

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. Disconnect the ground lead at the magneto.

c. Remove the nuts and washers and draw the magneto from the engine.

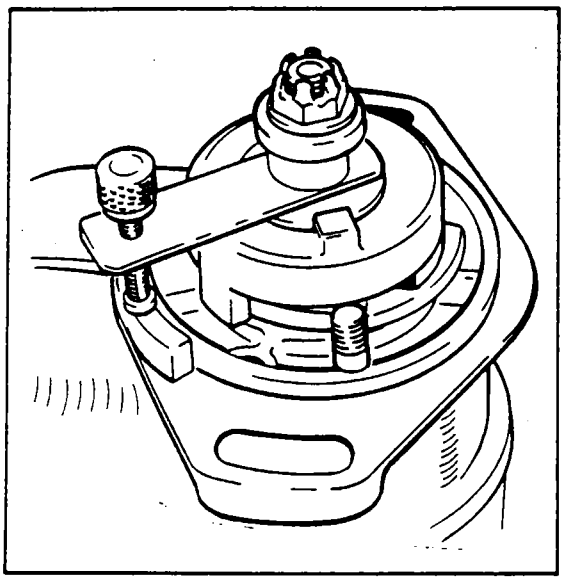


Figure 7A-9. Rotor Holding Tool Installed

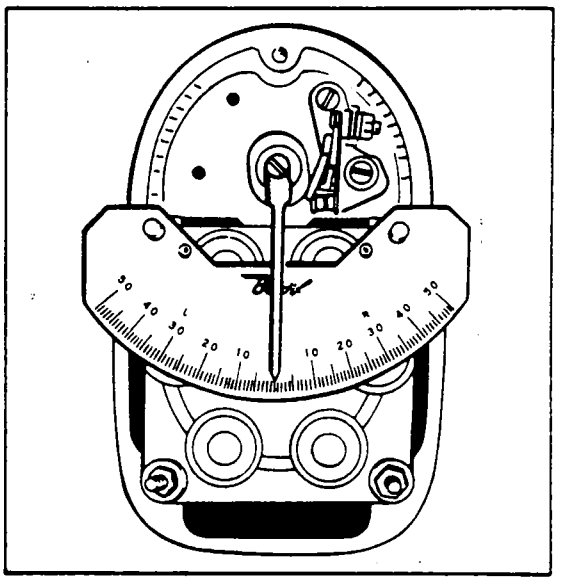


Figure 7A-10. Timing Kit Installed

7A-29. TIMING PROCEDURE (Internal Timing).

a. Remove the cover to the contact(s), distributor block, etc.

b. To internally time the contact assembly of 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 7A-9. Tighten the nut securely.

2. Remove the timing inspection plug from the top of the magneto. Turn rotating magneto 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 contact assembly rests on highest point of cam lobe. Adjust contact assembly to obtain the clearance of 0.016 of an inch. Tighten 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 7A-10) Align pointer assembly with the 0° 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° ± 2°). Tighten adjusting knob of 11-8465 Tool and remove the 11-8149 Point-

er Assembly from magneto. Using a timing light, adjust contact points to just open. This adjustment shall be made by rotating cam, in opposite 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° 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° ± 2°).

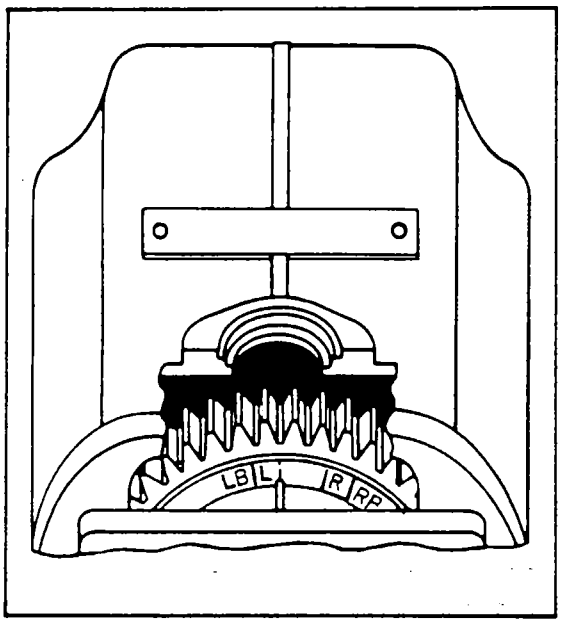


Figure 7A-11. Aligning Timing Marks

c. 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 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, if possible.

d. If the distributor block was removed from the housing, the distributor gear alignment and internal check may be accomplished as follows:

1. Turn rotating magnet in direction of rotation until it is located in firing position (keyway up and 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. The rib should favor the L mark, if possible. (Refer to Figure 7A-11.)

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 contact assembly

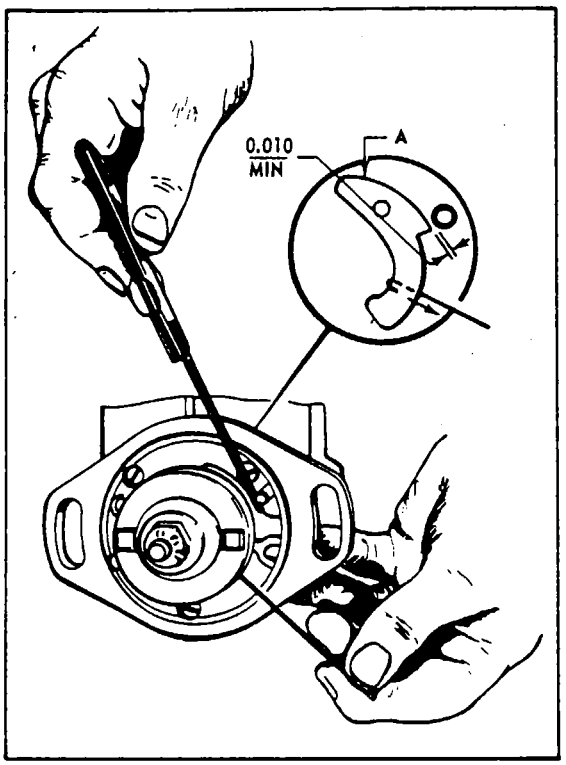


Figure 7A-12. Checking Flyweight Clearance of Impulse Coupling

had 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° apart on gear. If backlash is not evident, replace large distributor gear.

5. Install the breaker cover and complete reassembly of the magneto. Refer to the manufacturer's publications for complete disassembly and reassembly procedures.

e. On the magneto employing the impulse coupling, check clearance between each flyweight and each stop pin as follows:

1. Bend the end of a stiff piece of wire into a right angle 1/8 inch long (maximum).

2. Hold magneto as shown in Figure 7A-12. Pull heel of flyweight outward with the hooked wire and make certain that feeler gauge of 0.010 inch minimum thickness will pass between stop pin and the highest point of the flyweight.

NOTE

A true and accurate check of the clearance between flyweight and stop pin can only be obtained by pulling the flyweight outward as described above. Do not attempt the check by pushing in on flyweight at point "A".

f. Install and time magneto, removed from engine, in accordance with paragraph 7A-30.

g. Secure external switch leads to the breaker cover terminals. Connect harness assembly to the magneto.

7A-30. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine.) Although only the left magneto is equipped with an impulse coupling, the timing procedure, in the following paragraphs, is the same for both magnetos.

a. Remove the spark plug from No. 1 cylinder and place a thumb over the spark plug hole. Rotate the crankshaft in direction of normal rotation until the compression stroke is reached, this is indicated by a positive pressure inside the cylinder tending to push the thumb off the spark plug hole. Continue rotating the crankshaft in direction of normal rotation until the advance timing mark of 25° on the front face of the starter ring gear is in exact alignment with the small hole located at the two o'clock position on the front face of the starter housing. (Refer to Figure 7A-13.)

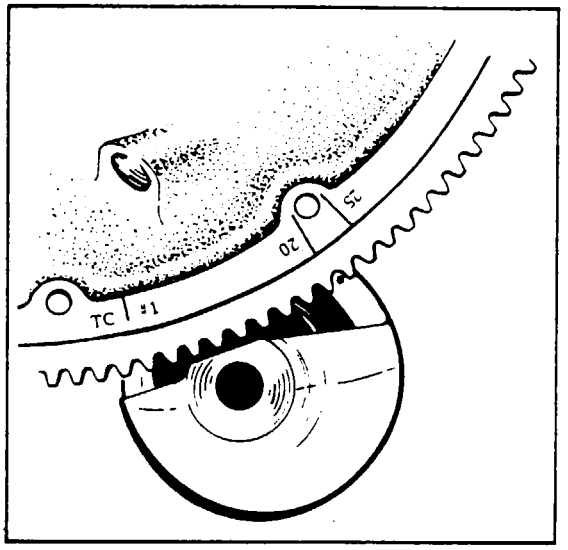


Figure 7A-13. Engine Timing Marks

NOTE

The advance timing mark on the top face of the starter ring gear is marked at both 20° and 25° BTC. Use only the 25° BTC mark when timing the magnetos to the engine.

NOTE

If the crankshaft is accidently turned in the direction opposite normal rotation, repeat the above procedure as accumulated backlash will make the final timing incorrect.

b. At this point, the engine is ready for assembly of the magnetos. Remove the inspection plugs from both magnetos and turn the drive shafts in direction of normal rotation until the first painted chamfered tooth on the distributor gear is aligned in the center of the inspection window. (Refer to Figure 7A-14.) Being sure that the gear does not move from this position, install gaskets and magnetos on the engine. Secure with washers and nuts; tighten only finger tight.

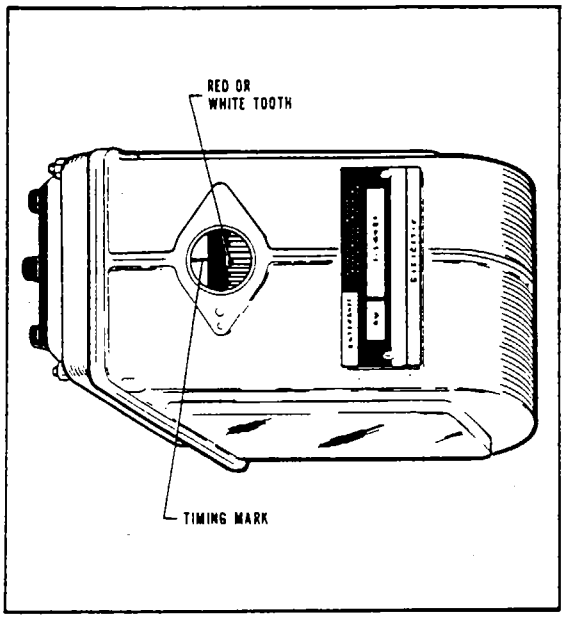


Figure 7A-14. Magneto Timing Marks

NOTE

In order to turn the shaft on an impulse coupling magneto, depress the pawl on the impulse coupling with the finger.

c. Using a battery powered timing light, attach the positive lead to a suitable terminal connected to the ground terminal of the magneto and the negative lead to any unpainted portion of the engine. Rotate the magneto in its mounting flange to a point where the light comes on, then slowly turn it in the opposite direction until the light goes out. Bring the magneto back slowly until the light just comes on. Repeat this with the second magneto.

NOTE

AC timing lights operate in the reverse manner as described above, the light goes out when the breaker points open.

d. After both magnetos have been timed, check, as described below, to ascertain that both magnetos are set to fire together.

e. Back off the crankshaft a few degrees, the timing lights should go out. Bring the crankshaft slowly back in direction of normal rotation until the timing mark and the hole in the starter housing are in alignment. At this point, both lights should go on simultaneously. Tighten nuts to specified torque.

f. After magnetos have been properly timed, replace breaker cover and secure.

g. Install the ground lead and the retard spark lead on the left magneto.

h. 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.

7A-31. HARNESS ASSEMBLY.

7A-32. 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.

7A-33. 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.

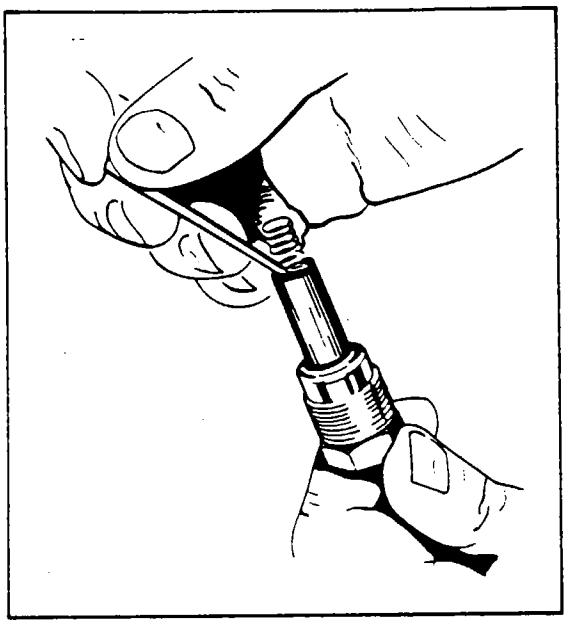


Figure 7A-15. Removing Spring From Lead Assembly

7A-34. 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 7A-15.

2. Using the 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 7A-16 for installing the insulating sleeves over cable terminals.

(b) Push the tool thru insulating sleeve and spring retainer assembly as shown in Figure 7A-17. 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.

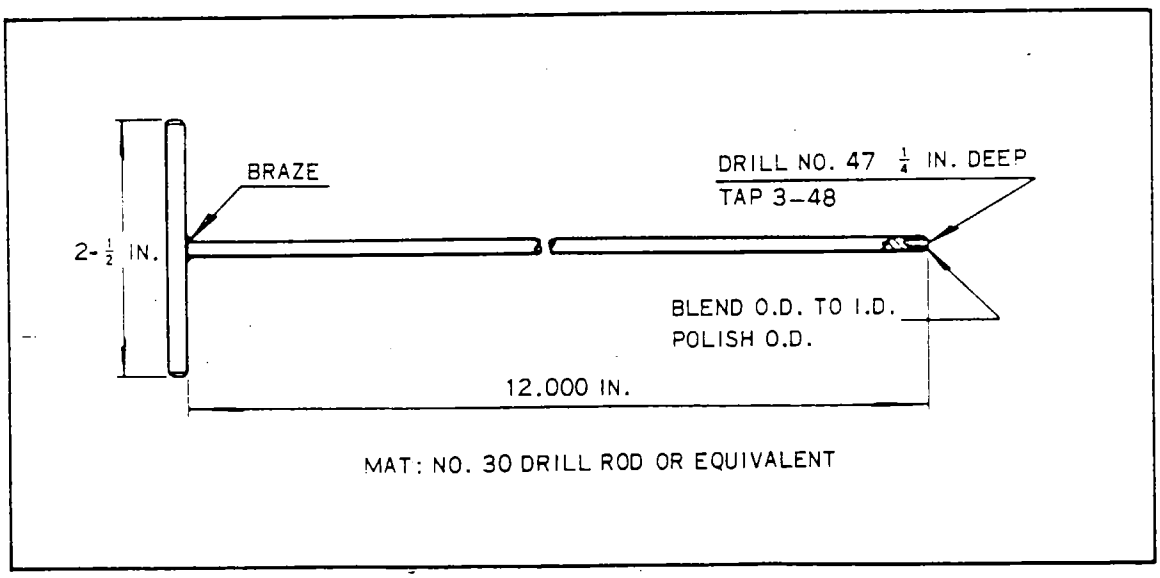


Figure 7A-16. Assembly Tool

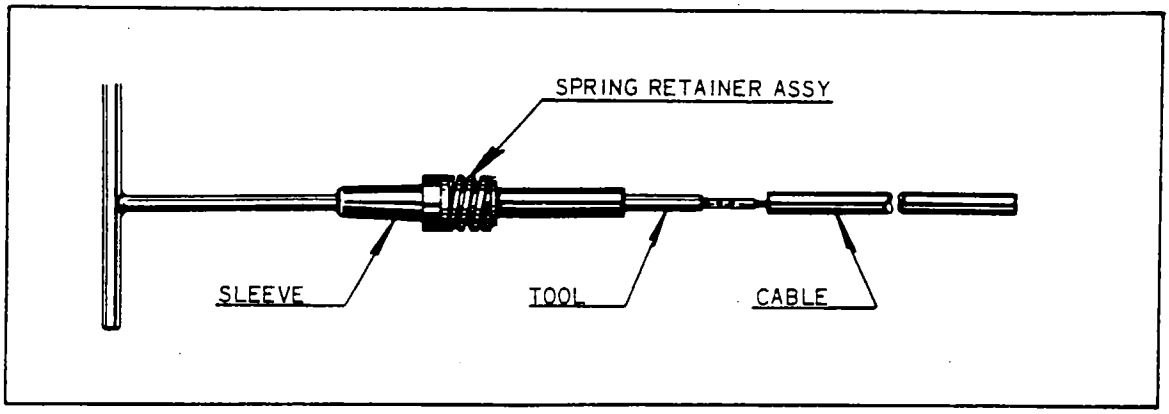


Figure 7A-17. Using Assembly Tool

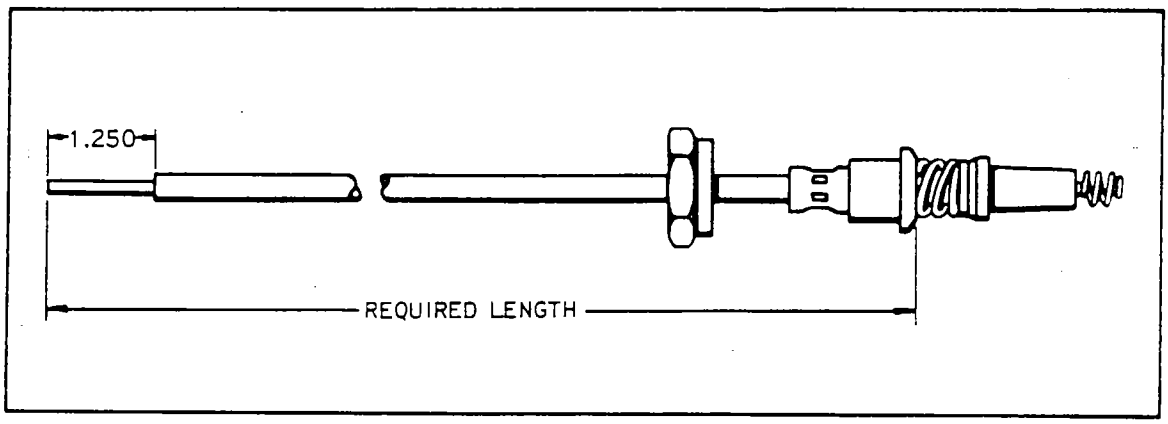


Figure 7A-18. Measuring Lead Assembly Length

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.

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 surface of plate, drive out tapered ferrule and remaining pieces of insulation and shielding.

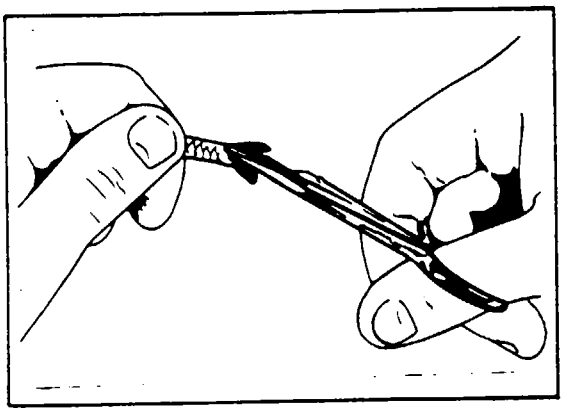


Figure 7A-19. Cutting Metallic Braid from End of Lead

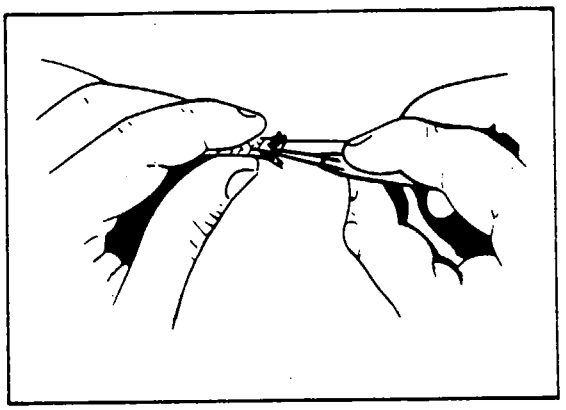


Figure 7A-20. Unbraiding Metallic Shielding

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. (See Figure 7A-18.)

(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.

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.

8. Using electrician's scissors, carefully remove 1.250 inch of outer braid from end of lead. Refer to Figure 7A-19.

CAUTION

Use care not to nick or cut insulation when removing braid.

9. Using a scribe or similar pointed tool, unbraid 3/8 inch of braided shielding. (Refer to Figure 7A-20.) Wrap a single thickness of electrical tape around unbraided strands to facilitate insertion of lead end thru hole in cable outlet plate.

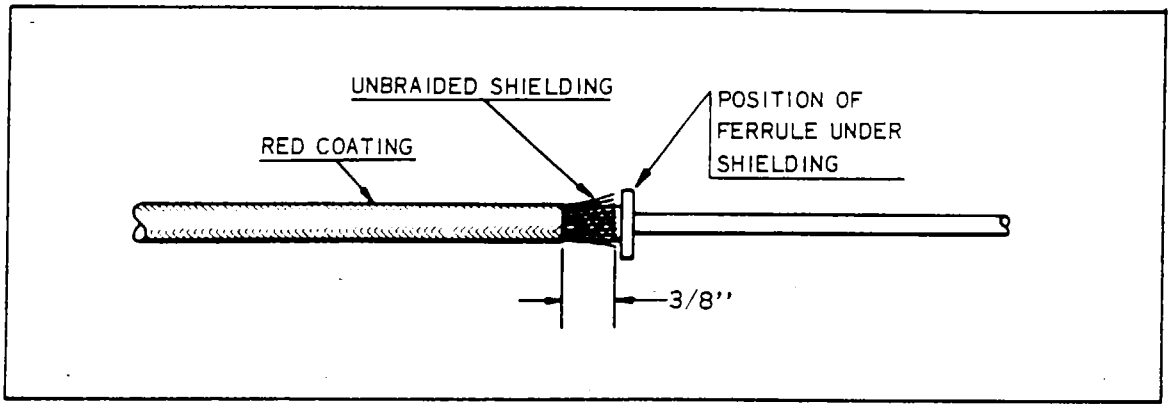


Figure 7A-21. Forming Shielding Around Ferrule

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 tapered end of ferrule under the unbraided strands of shielding. Form strands of shielding evenly around tapered ferrule as shown in Figure 7A-21 and pull lead assembly back through cable outlet plate until ferrule binds in the outlet well. Position the Scintilla 11-7074 Ferrule Seating Tool (Figure 7A-22) 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 7A-24.)

13. Insert Scintilla 11-7073 Needle (Figure 7A-23) thru small hole of grommet and over stripped end of wire. (Refer to Figure 7A-25.) Slide grommet down needle until it seats tightly against the tapered ferrule.

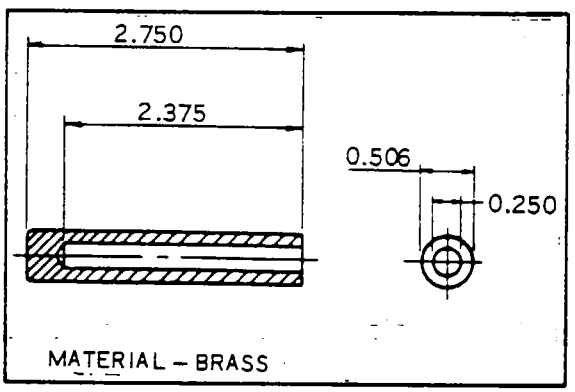


Figure 7A-22. Ferrule Seating Tool

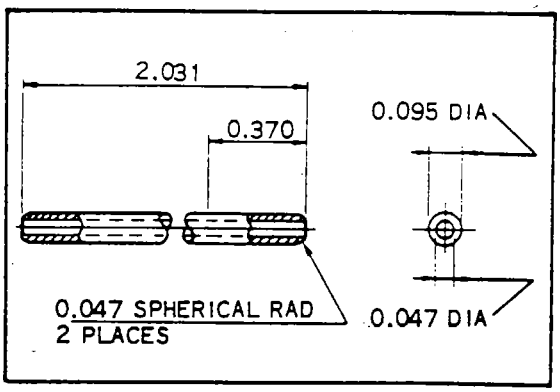


Figure 7A-23. Needle

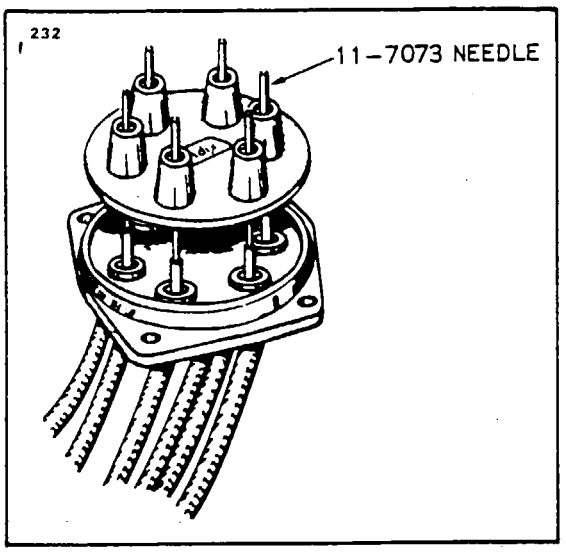


Figure 7A-24. Measuring Wire From Top of Ferrule

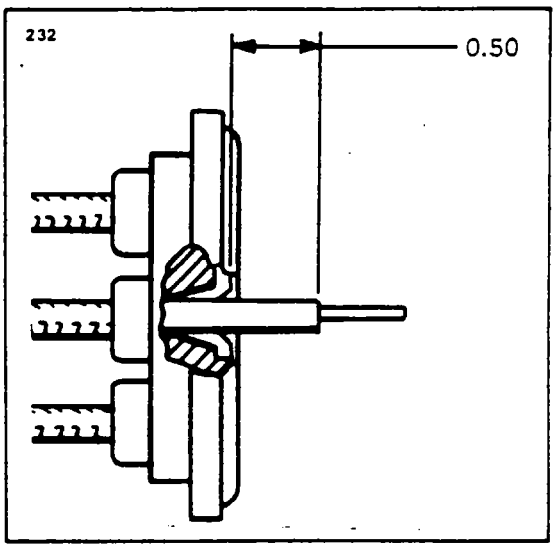


Figure 7A-25. Installing Grommet Over Lead Assemblies

14. Cut wire 3/8 inch from top of grommet outlet (See Figure 7A-25). Double wire over as shown in A of Figure 7A-27. 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 wire should extend from end of eyelet after crimping. See B of Figure 7A-27.

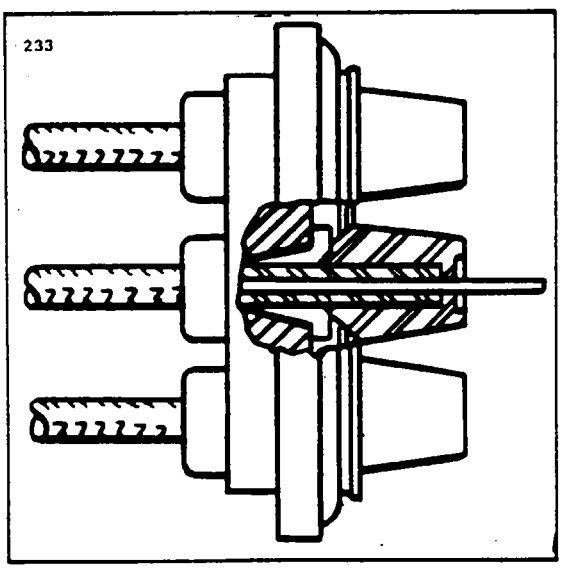


Figure 7A-26. Lead Assembly Installed in Grommet

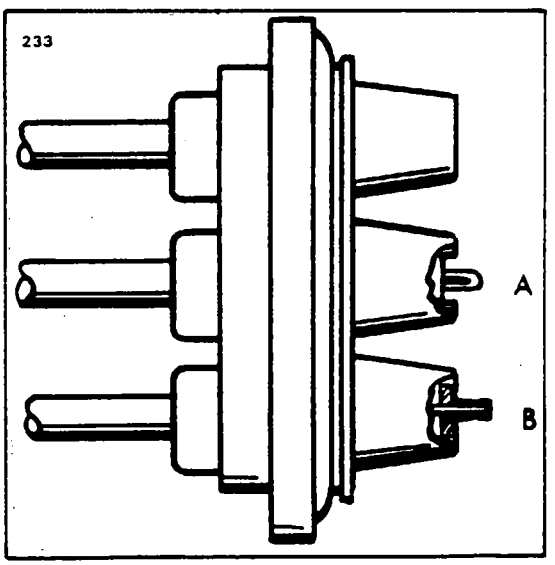


Figure 7A-27. Wire Doubled Over For Installation of Eyelet

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.

7A-35. 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 Silicon 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.
d. Connect the leads to the spark plugs.

7A-36. MAGNETO (D-2000 SERIES).

7A-37. DESCRIPTION AND PRINCIPLE OF OPERATION. The D-2031 magnetos feature two electrically independent ignition circuits in one housing. A single four pole rotor provides the magnetic energy for both circuits. This magneto uses an impulse coupling to provide reliable ignition at engine cranking speed. A single cam operates the main breakers for both magneto circuits. Suppression of contact point arching and conducted radio interference is accomplished by feed-thru capacitors which are mounted in the magneto cover which forms a part of the magneto harness assembly. At low engine cranking speeds the impulse coupling automatically retards the magneto until the engine is also at its retard firing position. The spring action of the impulse coupling is then released to spin the rotating magnet and produce the spark required to fire the engine. After the engine starts, the impulse coupling flyweights do not engage due to centrifugal action. The coupling than acts as a straight drive and the magneto fires at the normal firing position of the engine.

7A-38. INSPECTION OF MAGNETO. After the first 50 hour period and every 100 hours thereafter, the magneto ignition system should be checked. 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 magneto. Should 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. Should this not be possible, a visual inspection of the following items may disclose the source of trouble.

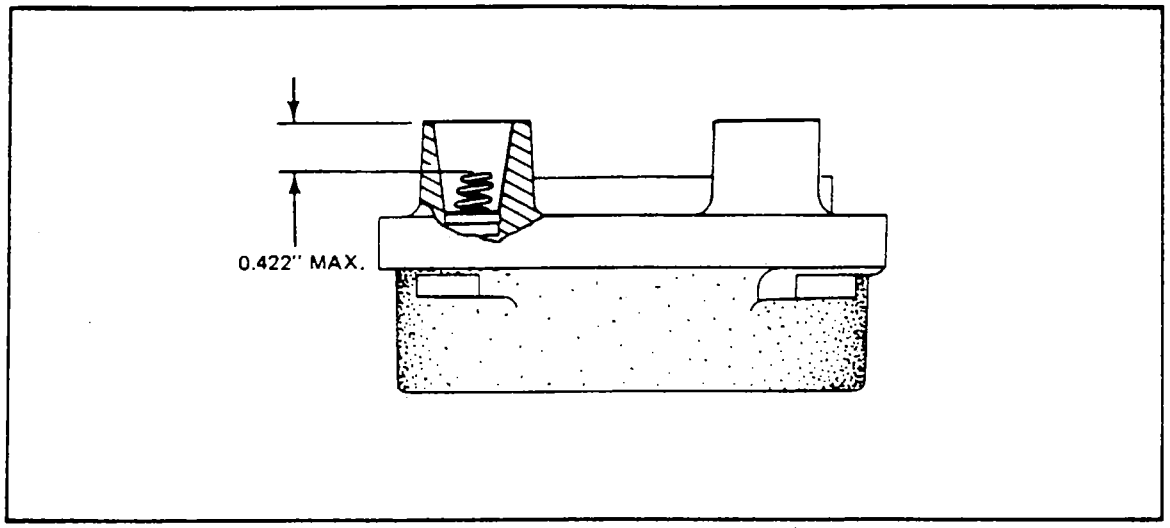


Figure 7A-28. Height of Spring in Distributor Block Tower

a. Check the lead terminals for definite contact with spring contacts in outlets.

b. Remove the harness outlet cover from the magneto and inspect for the presence of moisture and carbon tracking due to moisture.

c. Check contact springs in distributor block for evidence of spark erosion.

d. Check height of contact springs (0.422 maximum from top of block tower to spring). (Refer to Figure 7A-28.)

e. With the cover and harness separated from the magneto housing, check contact assemblies to see that cam follower is securely riveted to its spring.

f. Examine the contact points for excessive wear or burning. Figure 7A-8 shows how the average contact point will look when surfaces are separated for inspection.

CAUTION

Do not open point contacts more than .0625 of an inch for examination of contact surfaces. Excessive spreading of the breaker points will overstress and damage the contact spring.

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. Minor irregularities or roughness of point surfaces are not harmful. (Refer to Figure 7A-8, center.) Neither are small pits or mounds, if not too pronounced. If there is a possibility of pit becoming deep enough to penetrate pad (refer to Figure 7A-8, right), reject contact assembly.

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 condition of cam follower felts for proper lubrication. If oil has migrated from one follower felt to another, it may be necessary to remove the lubrication from one felt strip while oiling another. If felt is over lubricated, remove oil by using a clean, lintless cloth. If dry, apply one or two drops of Bendix Breaker Felt Lubricant 10-86527.

h. Check the capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. Using a Bendix 11-1767-1, -2 or -3 condenser tester or equivalent, check capacitors for capacitance, series resistance and leakage. Capacitance shall be 0.34 to 0.41 microfarads.

i. Check magneto to engine timing per instructions given in Paragraph 7A-39.

j. Check action of impulse coupling. With the ignition switch off, observe breaker cam end of rotor while manually cranking the engine through a firing sequence. The rotor should alternately stop and then (with an audible snap) be rotated rapidly through a retard firing position. If impulse action is not correct, remove the magneto for overhaul.

7A-39. MAGNETO INSTALLATION AND TIMING PROCEDURE (TIMING MAGNETO TO ENGINE).

WARNING

Do not attach harness spark plug ends to the spark plugs until all magneto to engine timing procedures and magneto to switch connections are entirely completed.

NOTE

The use of a timing light unit Part No. 11-9110 or 11-9110-1 will simplify the timing procedure. This unit is available from the Bendix Corporation at Sidney, New York 13838.

a. Remove the spark plug from the No. 1 cylinder and turn the crankshaft in the direction of normal rotation until the compression stroke is reached.

b. Continue turning the crankshaft until the 20 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 7A-13.)

c. The D-2000 series magneto may be mounted to the engine without removing the cover from the magneto. The cover also has switch terminal outlets for the right and left sides of the magneto, located in the center of the harness lead outlet section of the cover. (Refer to Figure 7A-29.)

NOTE

It is recommended that short adapter leads be fabricated to facilitate connecting the timing light unit to the switch outlet terminals of the cover. (Refer to Figure 7A-29.)

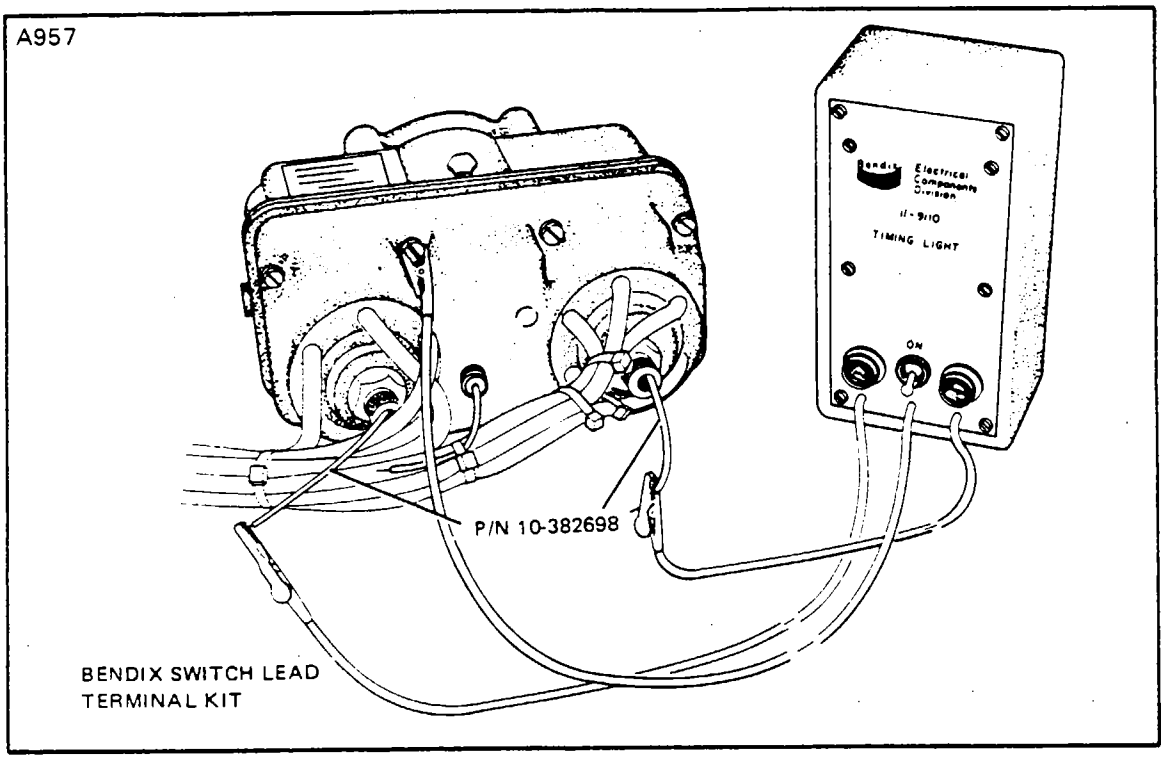


Figure 7A-29. Timing Light Connected to Magneto

d. The magneto incorporates a built-in pointer and a degree wheel with sufficient reference to assist the mechanic in magneto timing procedures. Printed upon the rotating magnet are marks to indicate magneto neutral and magneto "E" gap (8°). (Refer to Figure 7A-30.) Also included are retard angle references of 10, 15, 20 and 25 degrees. These marks are set up for either clockwise (R) or counterclockwise (L) rotation of the magneto as viewed from the magneto drive end. The timing tooth of each large distributor gear is marked with red paint. (Refer to Figure 7A-31.)

NOTE

If magneto has counterclockwise rotation then the marks on the (L) side of the "K" are used to set timing. A magneto, correctly timed internally, will have the timing teeth of the large distributor gears approximately centered in the timing windows at each end of the magneto; the R ("E" gap) mark which is closest to the "K" or keyway up position indicator on the rotor in alignment with the pointer, and both main breaker points opening all at the same time. These three references, "E" gap, painted teeth, and point opening are all used when timing the magneto to the engine.

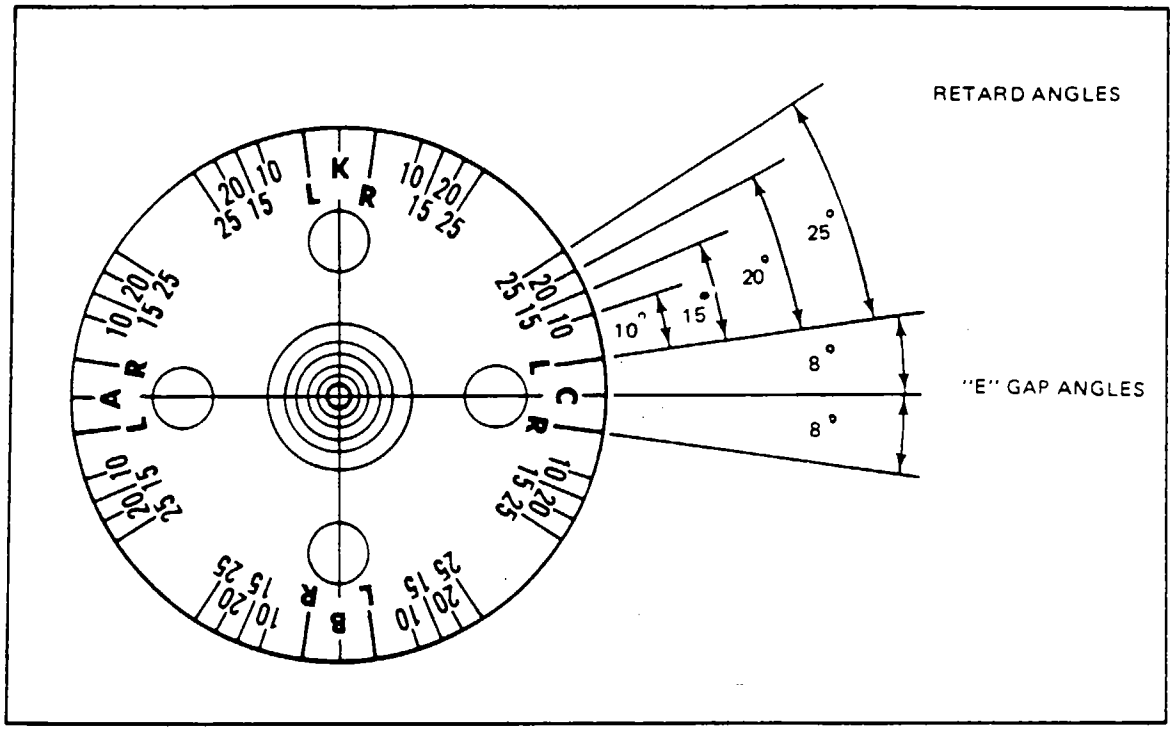


Figure 7A-30. Timing Marks on Magneto Rotor

e. Remove the magneto drive gear backlash by turning the propeller opposite to normal rotation approximately 40° past No. 1 firing position; then turn propeller in direction of normal rotation up to No. 1 firing position of 20° BTC.

f. Remove the plug from the distributor inspection windows at either end of the magneto housing. (Refer to Figure 7A-31.) Also remove the plug from the "E" gap inspection window on the data plate side of the magneto housing. (Refer to Figure 7A-32.)

g. Turn the rotating magnet drive shaft in the normal direction of magneto rotation until the red distributor tooth appears in the distributor inspection window, and also check to see if the letter "K" appears in the "E" gap inspection window on the data plate side. If the letter "B" is in the window, turn the magneto shaft 1-1/2 times in the direction of rotation and check again to be sure the "K" is in the window on the data plate side and the red distributor tooth appears in each distributor inspection window.

h. Install the magneto to engine gasket on the magneto flange.

i. Feel the magnet into its No. 1 neutral position as described in Step g. With the engine in its recommended No. 1 cylinder firing position of 20° BTDC, place the magneto in position on the engine mounting pad and secure with the flange clamps finger tight.

j. Install short adapter leads made from Bendix terminal kit (part number 10-382698) into magneto switch terminals and connect to Bendix timing light (part number 11-9110) or equivalent.

k. Bump the magneto in the direction opposite the normal shaft rotation until the first breaker opens. Due to normal tolerances, one breaker may open slightly before the other and timing should be done to the first or early breaker. Evenly tighten the magneto mounting clamps.

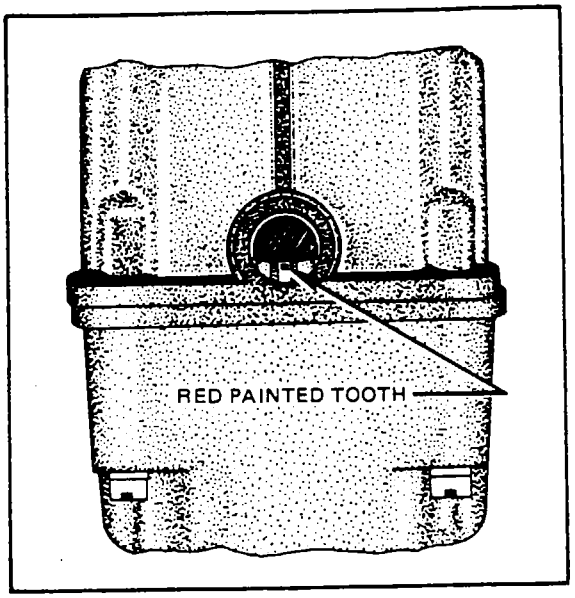


Figure 7A-31. Painted Tooth Centered in Timing Window

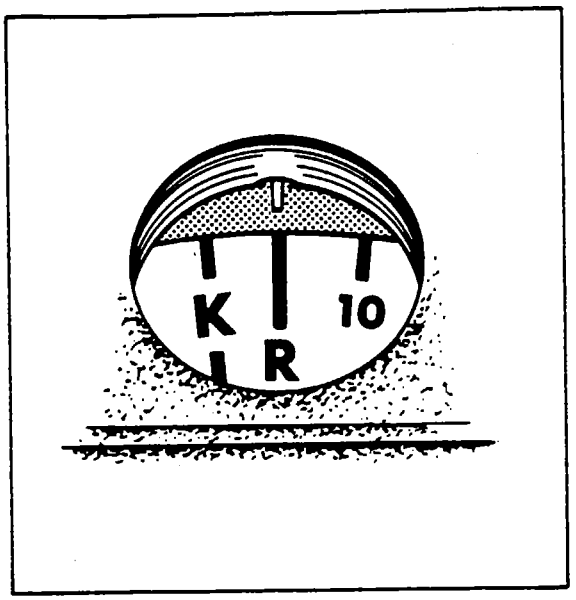


Figure 7A-32. Timing Mark on Rotor Aligned with Pointer

l. When the final timing check is done, back the engine up approximately 10 degrees; then carefully bump the engine forward and observe the position that the breakers open. The first breaker should open at the No. 1 engine firing position and the late breaker must open within 3 engine degrees from the first breaker opening. It makes no difference which breaker opens first.

m. Repeat Step k if necessary until conditions of Step l are met. If the late breaker opens more than 3 degrees from the early one, the internal timing of the magneto must be rechecked. (Refer to Internal Timing, Paragraph 7A-40.)

n. Torque the magneto securing clamps to 150 inch-pounds. Recheck timing once more and if satisfactory disconnect the timing light and remove the adapter leads.

o. Reinstall the plugs in the timing inspection holes and torque to 12-15 inch-pounds. Loosely install the harness with clamps and/or brackets.

7A-40. MAGNETO TIMING PROCEDURE (INTERNAL TIMING).

a. Remove magneto cover.

b. Loosen flange clamps and remove magneto from engine.

c. Check condition of points; replace if necessary.

d. Rotate the magneto drive shaft until a main cam lobe touches the follower of the left main breaker assembly and adjust the breaker points to an initial opening of .016 inch. Wire feeler gauge is recommended.

e. Adjust right main breaker contact assembly to an initial point opening of .016 inch just as in Step d.

f. Fixed contact support may be bent to adjust clearance. If support is bent, main breaker contact must be rechecked. Torque breaker securing screws to 20-25 inch-pounds.

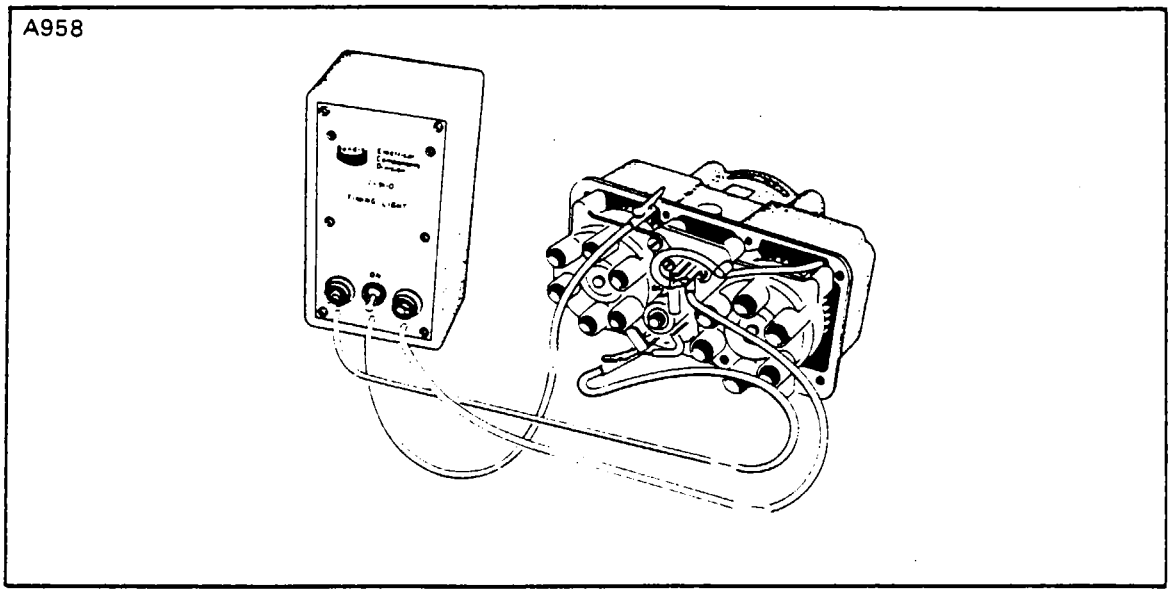


Figure 7A-33. Timing Light Connected to Magneto and Breakers

NOTE

Bend bracket carefully. Do not correct by bending back if bent too much; this weakens the bracket.

g. Position rotor so keyway is at 12 o'clock position and red painted distributor teeth are visible in timing windows.

h. Loosen drive shaft nut and position the Rotor Holding Tool (Bendix part number 11-8465) under washer or bushing on drive end of rotor shaft with clamp at 4 o'clock position so any shaft deflection caused by clamping action will be in a plane parallel to breaker contacts. Tighten nut to secure holding tool to shaft. Check to insure proper location of keyway and tighten adjusting screw of holding tool to lock rotor in position.

i. Loosen rotor holding tool and turn magnet in direction of rotation until adjacent "R" ("E" gap) mark is aligned with pointer and lock in position. Both red painted teeth should be approximately centered in timing windows.

NOTE

The use of the timing light unit, part number 11-9110-1 available from Bendix will simplify the internal timing procedure and breaker synchronization.

j. Connect the timing light black lead to any unpainted surface of the magneto.

k. Connect the red timing light lead to the left breaker terminal and the green lead to the right main breaker terminal. (Refer to Figure 7A-33.)

l. Loosen rotor holding tool and move the rotor back a few degrees; then move it forward. Both lights should go out to indicate opening of the main breakers when the timing pointer is indicating within the width of the "R" mark and the red painted teeth are centered in timing windows.

m. If breaker timing is not correct, loosen cam securing screw (refer to Figure 7A-34) and unseat main breaker cam from taper. Using 11-3031 Retaining Ring Pliers inserted in holes in cam, rotate main breaker cam in direction of rotation until left main breaker points just open and press cam onto taper. Tighten screw to seat main breaker cam.

n. Loosen rotor holding tool to turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Timing light should go out when timing pointer is aligned with "R" ("E" gap) mark. Lock rotating magnet in position where points just open.

o. Loosen right main breaker securing screws and position breaker so cam follower is pressed against cam with points closed. Tighten contact assembly securing screws to prevent contact assembly from bouncing back when moved. Using a small mallet and drift, tap right breaker in until points just open.

p. Turn rotating magnet back a few degrees; then turn rotating magnet in normal direction of rotation. Both timing lights should go out within one degree or half the width of "R" mark on rotor. If breakers are not properly synchronized, reset right breaker.

q. Check right main breaker contact for 0.016 ± .004 inch point opening and torque right breaker contact securing screws to 20-25 inch-pounds. If point opening is out of limits, repeat timing procedure setting left main breaker opening at .016 ± .002 inch. If right contacts open beyond .020 inch, set left contacts closer to .018 inch. If right contacts open less than .012 inch, set left contacts closer to .014 inch.

r. Using timing light, recheck timing to insure main breakers open within one-half the width of "R" mark and that retard breaker opens at correct degree setting. Using a wire feeler gauge, check left main breaker for .016 ± .002 inch point opening and right main breaker and retard breaker for .016 ± .004 inch point opening.

NOTE

If correct breaker timing cannot be achieved, remove magneto and have it overhauled.

s. Check capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. The capacitors should be checked for capacitance, series resistance and leakage. Capacitance should be 0.34 to 0.41 microfarads. The use of a Bendix condenser tester, part number 11-1767-1, -2 or -3 or equivalent will simplify this test. Replace defective capacitors and torque securing nut to 60-70 inch-pounds.

NOTE

Spring in capacitor outlet may cause an indication of a short to ground if adapter lead is not used. (Refer to Paragraph 7A-39, Step c, Note.)

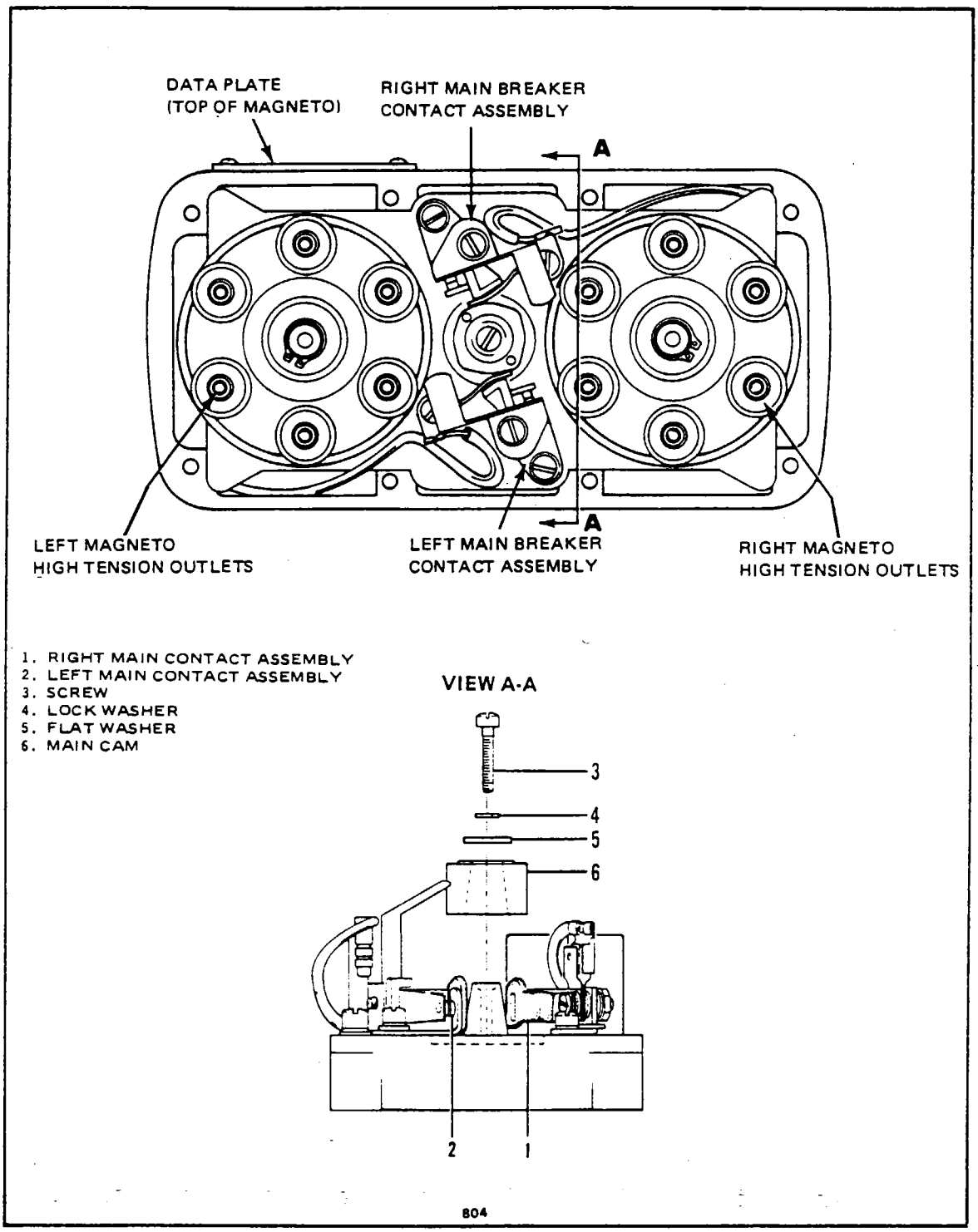


Figure 7A-34. Cam End View of Magneto

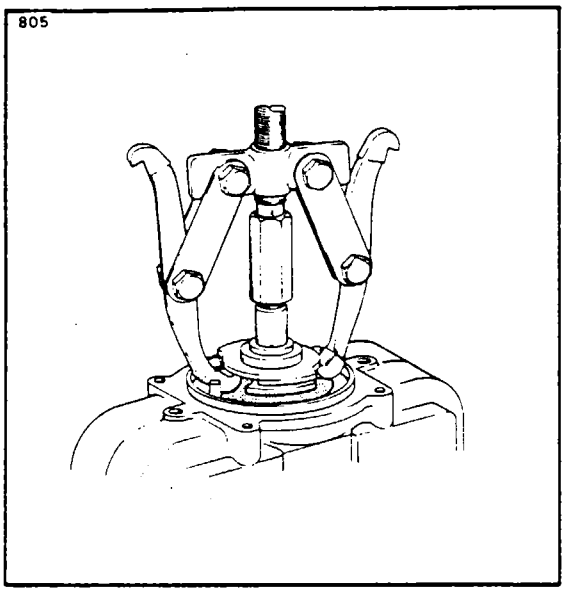


Figure 7A-35. Removing Impulse Coupling

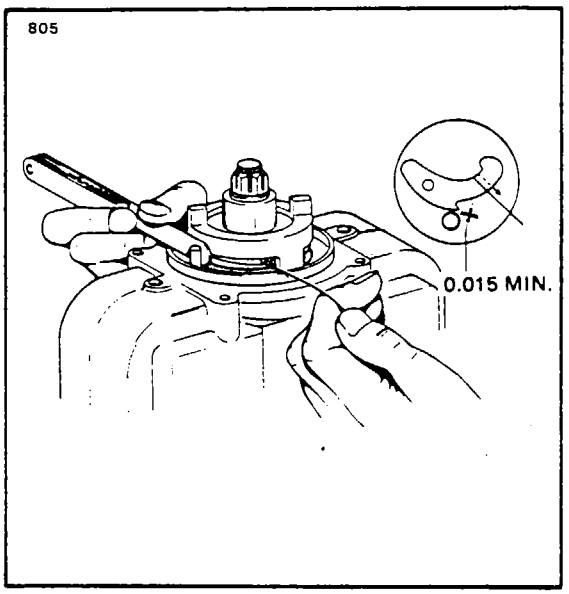


Figure 7A-36. Checking Flyweight to Stop Pin Clearance

7A-41. IMPULSE COUPLING REMOVAL.

a. Using heavy gloves or shop cloth, grasp the coupling body firmly to prevent the internal spring from unwinding suddenly. Pull outward on the coupling body only enough to release it from the cam assembly. Keep the coupling body close against the cam and allow the body to turn as the spring unwinds. After one or two turns, the spring coils will wedge against the projections on the body, restraining the spring from further unwinding.

b. Look into the hole in body and note the location of the inner eye of spring where it engages with mating recess in cam hub. Insert a screwdriver under spring end and pry spring eye out of recess. Remove the body and spring together. Uncoil spring from body and pry spring eye from body recess to disengage spring.

c. Thread protective cap of 11-702-1 puller securely on end of shaft. Engage puller over protective cap and cam assembly with wide jaws of puller hooked under cam assembly as shown in Figure 7A-35.

d. Tighten puller handle to remove coupling from shaft. If coupling does not release with maximum hand torque at puller handle, apply penetrating thread release compound between coupling and shaft. Then while puller is still fully tightened, hold tip of hot heavy duty soldering iron in contact with hub of coupling cam assembly. Solder wetting of the tip at point of contact with the cam hub will assist in heat transfer to the parts. Retighten puller after about a minute of heat application.

CAUTION

Do not strike the puller with a hammer. If puller is struck with a hammer the main bearings must be replaced.

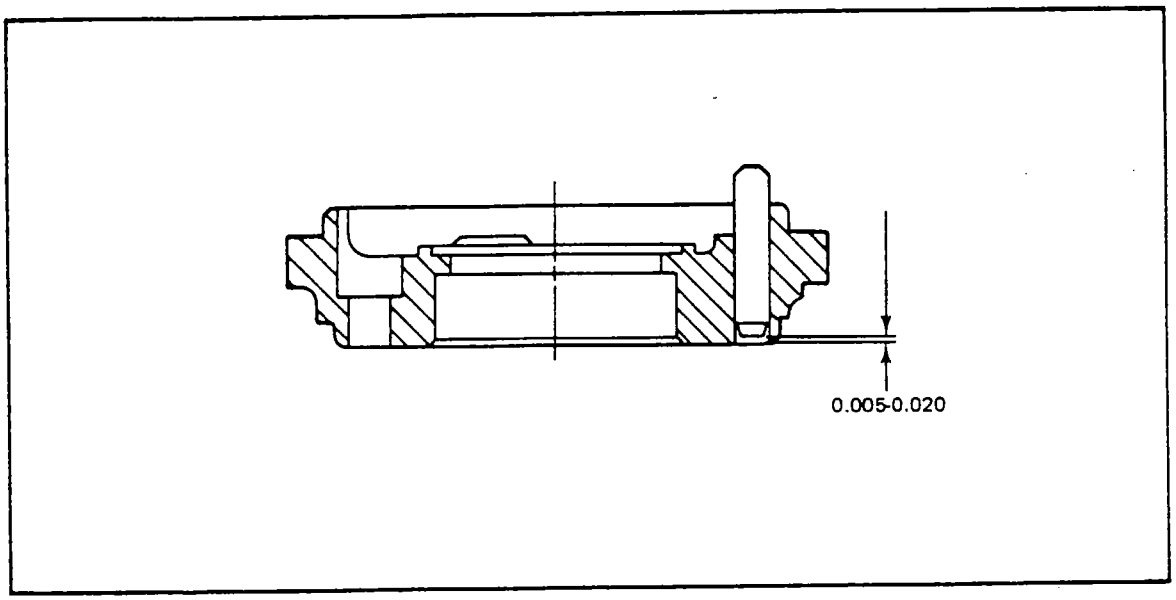


Figure 7A-37. Stop Pin Installation Dimension

e. Do not tighten puller handle further after coupling cam releases from the shaft. This could damage the flyweight if the flyweight is caught under the woodruff key. Remove the puller from the shaft. Then while holding both flyweight tips inward, left cam from the shaft, and remove woodruff key from rotor shaft.

7A-42. INSPECTION OF IMPULSE COUPLING.

a. Check clearance between each flyweight and each stop pin by the following method:

1. Bend the end of a stiff piece of wire into a right angle, 1/8 inch long maximum.

2. Hold the magneto as shown in Figure 7A-36. Pull the heel of the flyweight outward with the fabricated hooked wire and make certain that a feeler gauge of 0.015 of an inch minimum thickness will pass between the stop pin and the highest point of the flyweight.

NOTE

A true and accurate check of the clearance between the flyweights and stop pins can only be obtained by pulling the flyweight outward as described. Do not attempt the check by pushing in on the flyweight at point "A" of Figure 7A-36.

b. Inspect impulse coupling stop pins for damage. If pins are bent, damaged or excessively worn, remove pins using a suitable drift and arbor press. Press new pins into flange until dimension shown in Figure 7A-37 is obtained.

c. Visually inspect flyweight securing washers and flyweights, particularly in area around the axle hole for cracks. Grip washers with pliers and exert moderate turning force to check looseness. If washer moves or any cracks are found, reject cam assembly.

POWER PLANT
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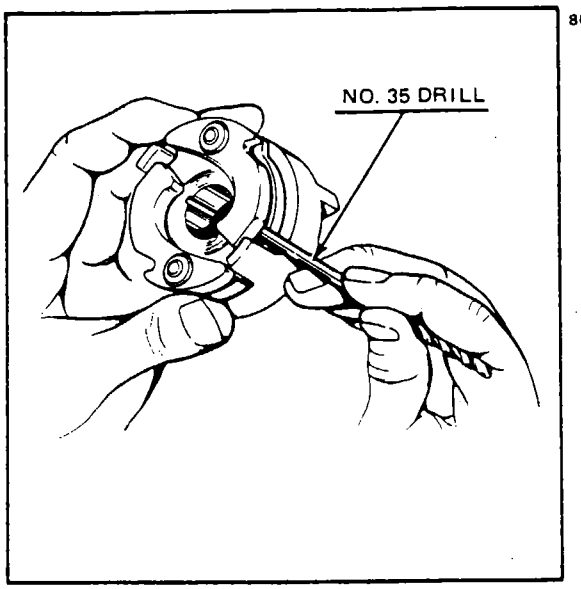


Figure 7A-38. Checking Flyweight Axial Wear with Drill Shank

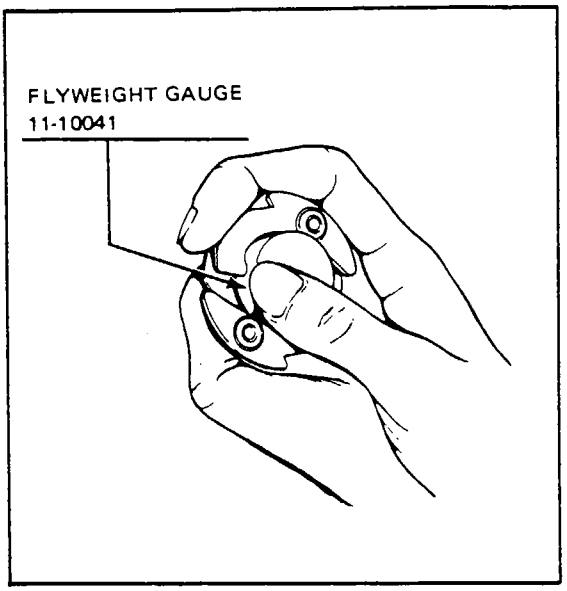


Figure 7A-39. Checking Flyweight Radial Wear with Gauge

d. Inspect for axial wear between flyweight and axle using shank of a new No. 35 drill as a gauge. Hold flyweight so the outer radius is in alignment with the rim of the cam flange and try to insert the drill shank between the flange and flyweight as shown in Figure 7A-38. Do not force the drill. If the drill can be inserted, replace the cam assembly.

e. Inspect for excess radial wear between the flyweight and axle using the 11-10041 flyweight gauge. Insert the gauge between flyweights and against cam hub as shown in Figure 7A-39. If the gauge cannot be inserted easily, remove burr from edges of hub keyway with a small file. Hold the gauge firmly against the hub, at the same time squeezing the flyweights against the gauge. If the inner end of either flyweight heel touches the gauge, replace the cam assembly. If parts are near limits, check clearance between flyweight and gauge with a .003 inch feeler. If flyweight heel is tight on feeler, replace the cam assembly.

CAUTION

Never attempt to repair any part of a rejected cam and flyweight assembly.

f. Inspect ears of the coupling body for grooves worn by the tail of the flyweights and wear at the triggering ramp and cam stop contact areas. (Refer to Figure 7A-40.) If either ear shows a perceptible groove or a ridge can be felt when fingernail is drawn across the surface, replace the coupling body.

g. Inspect drive lugs of body. If wear is noted, measure difference between worn and unworn areas on drive lug surface. If difference is in excess of .015 of an inch, replace the body.

h. With spring released and free, it should form a smooth spiral curve with no sharp bends or flat spots. (Refer to Figure 7A-41.) If spring is deformed, replace it.

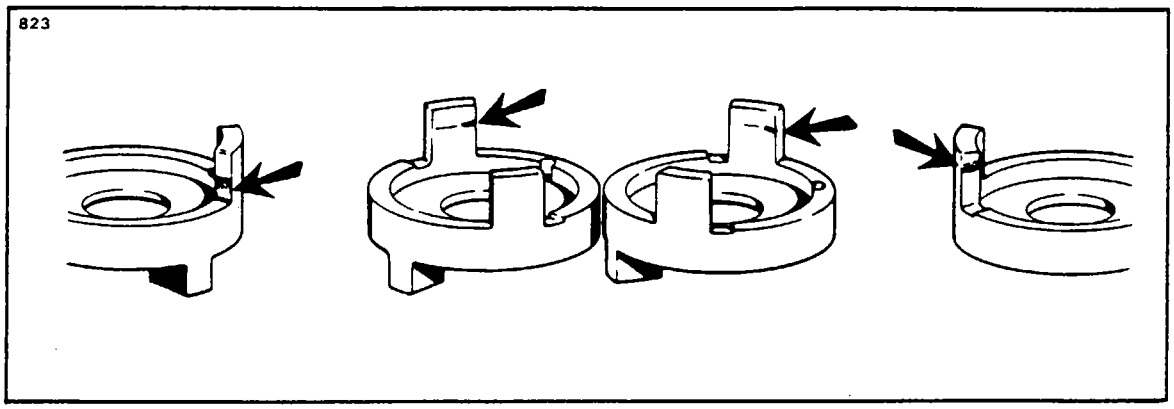


Figure 7A-40. Points of Coupling Body Wear

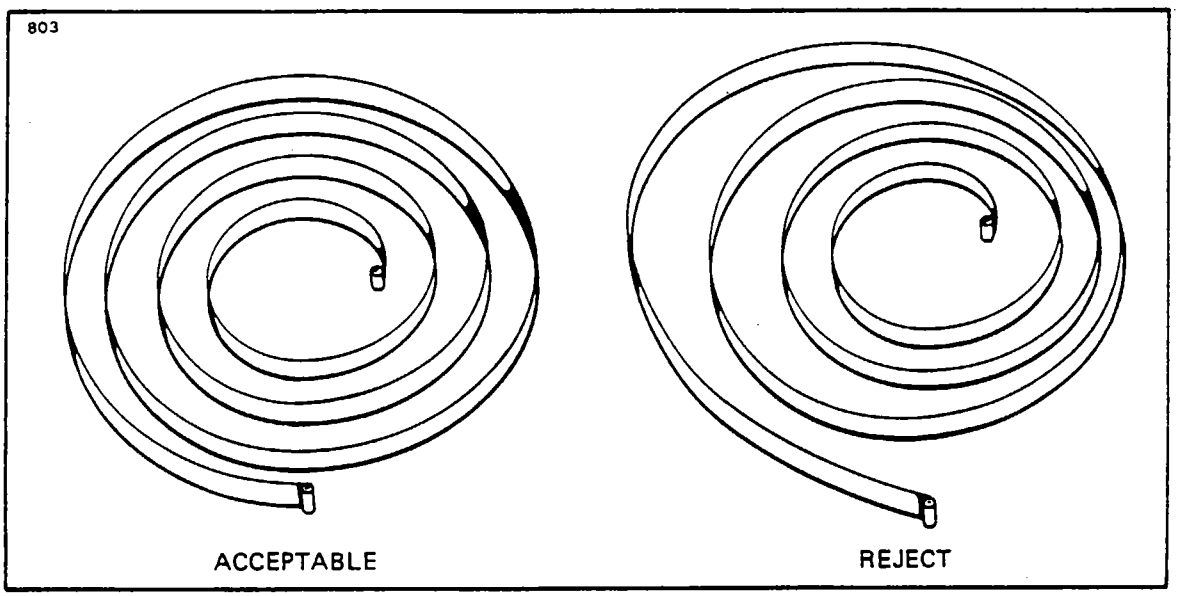


Figure 7A-41. Acceptable and Deformed Coupling Springs

i. Inspect spring for cracks particularly at the ends and around spring eyes. Inspect coils of spring for excessive wear. If grooves or ridges are worn in coils or cracks are found, replace spring.

j. Inspect the housing for cracks, stripped threads or other damage. Replace if necessary.

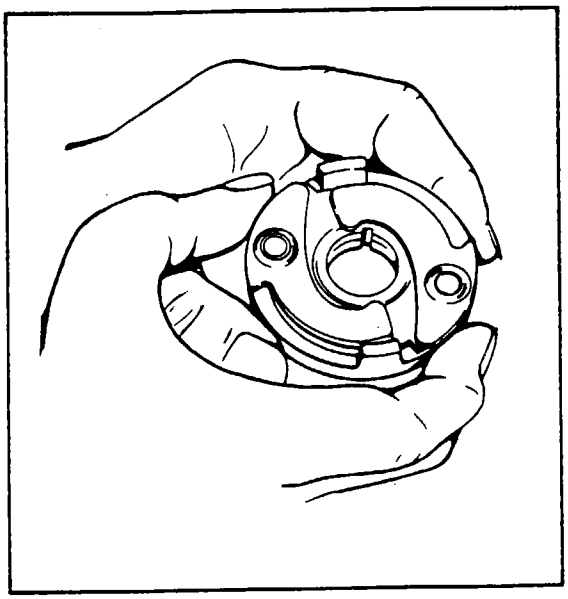


Figure 7A-42. Checking Impulse Coupling for Magnetization

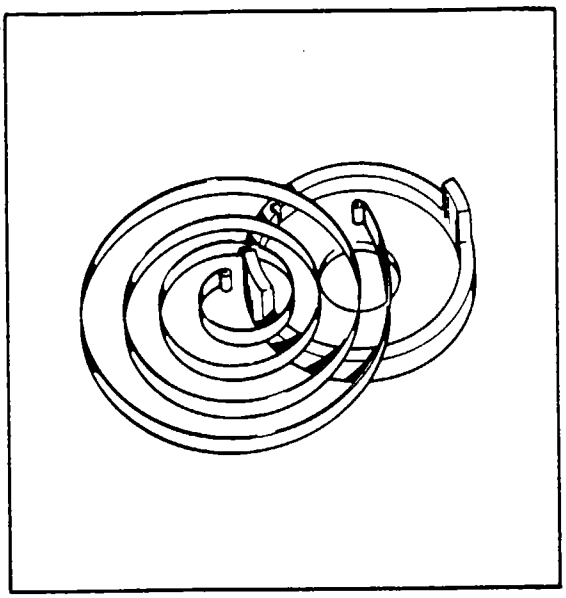


Figure 7A-43. Orientation of Spring in Coupling Body

7A-43. IMPULSE COUPLING INSTALLATION.

a. Check mating cam assembly and body for magnetization which would prevent flyweights from engaging. Hold the assembly as shown in Figure 7A-42 and push upper flyweight against body. When released, flyweight must drop down. If flyweight sticks to body, parts are magnetized and coupling may not function. Perform test on both flyweights.

b. To demagnetize, place body over shaft of a charged rotating magnet and spin body rapidly by hand. While body is still spinning, invert magnet so body falls off. Catch body in hand and repeat test for magnetization.

c. Clamp one drive lug of the body in a padded jaw vise with the spring recess side up.

d. Orient the spring with the body for correct rotation. On clockwise couplings, the spring must coil in a clockwise direction from the outside toward the center when viewed from the spring recess side of the body. (Refer to Figure 7A-43.) Insert eye of outer end of spring into hole drilled in inner rim of body.

e. Using heavy gloves to protect the hands, wind spring into body manually, lifting spring coils one at a time over projections on body. Extreme care should be used to avoid scratching or nicking the spring. After winding the spring, brush a coating of light oil over the spring coils.

f. Pry up one and one-half turns at the inner end of the spring with a small screwdriver and support in position as shown in Figure 7A-44.

g. Engage recess in the hub on the cam assembly with eye at inner end of spring. With eye engaged, rotate cam assembly slightly in direction to unwind spring to permit hub of cam to slip into the inner turn of the spring. Rotate the cam in the opposite direction, winding spring slightly, until projections on edge of cam clear over the projections on the body. Push the cam assembly down into the body, at the same time taking the screwdriver out.

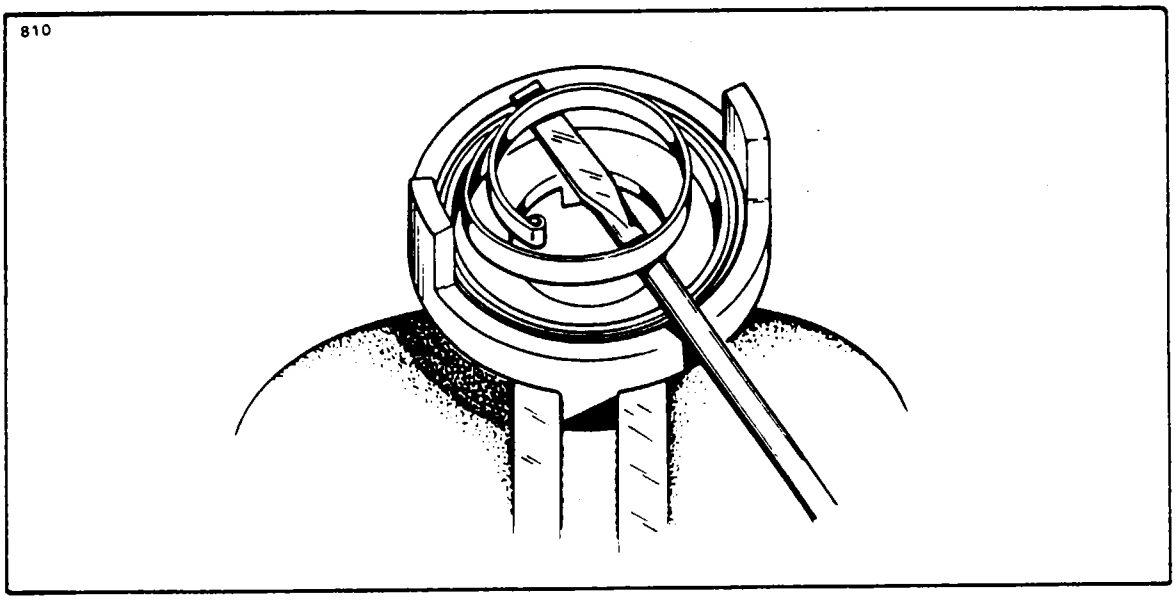


Figure 7A-44. Lifting Inner End of Spring

h. Insert a spare rotating magnet, with woodruff key in taper, into cam assembly. Turn magnet slightly in direction of coupling rotation (to wind spring). Lift magnet with cam only enough to clear projections on the body. Wind spring one-half turn and re-engage the cam assembly into the body.

i. Tension of the spring assembly in the assembled coupling when wound to point of impulse tripping must not be less than 9 or more than 15 inch-pounds.

7A-44. HARNESS ASSEMBLY.

7A-45. INSPECTION OF HARNESS.

a. Inspect cover for cracks or other damage. Inspect lead assemblies for abrasions, mutilated braid or other physical damage.

b. Inspect grommets for tears and eyelets for spark erosion.

c. Disconnect harness coupling nuts from the spark plugs and extract the lead terminations. Inspect contact springs and compression springs for any damage or distortion. Inspect sleeves for cracks or carbon tracking.

d. Inspect coupling nuts and elbow assemblies for damaged threads or other defects.

NOTE

Replace any damaged components per instructions given in Paragraph 7A-46.

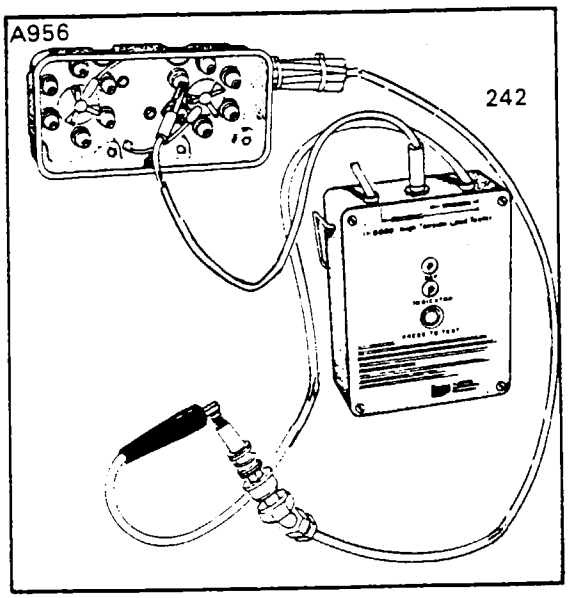


Figure 7A-45. Checking Harness Lead Continuity

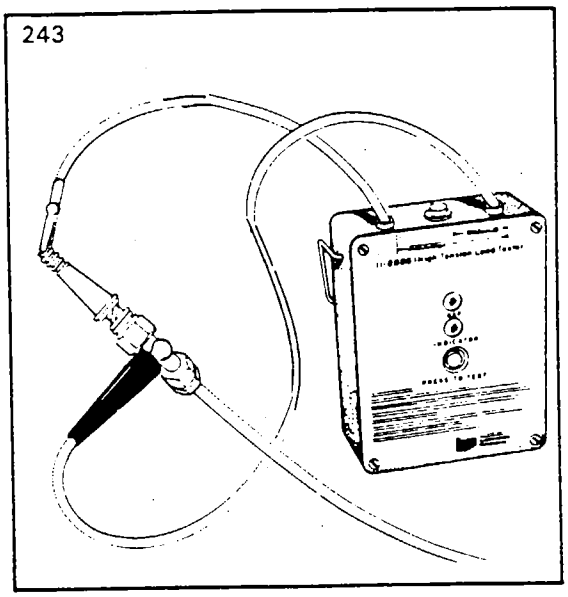


Figure 7A-46. Checking Harness Lead Insulation Resistance

e. Test continuity of each harness lead using a High Tension Lead Tester, Part No. 11-8888 or 11-8888-1 from Bendix as follows:

1. Connect black test lead to contact spring and red lead to eyelet of the same lead. (Refer to Figure 7A-45.)

2. Observe that the continuity lamp illuminates.

f. Test insulation resistance of each harness lead by using the 11-8888 or 11-8888-1 tester as follows:

1. Attach the red high voltage test lead to contact spring of harness lead. (Refer to Figure 7A-46.)

2. Attach the black test lead to the ferrule of the same harness lead. (Refer to Figure 7A-46.)

3. Depress PRESS-TO-TEST pushbutton switch.

4. Observe that indicator lamp flashes and GAP fires simultaneously as long as the PRESS-TO-TEST switch is held depressed. Whenever indicator lamp flashes and GAP fails to fire, lead under test is defective and must be replaced.

7A-46. MAINTENANCE OF HARNESS. Minor repairs of the harness assembly, such as replacement of contact springs, sleeves, compression springs, eyelets, or grommets can be accomplished with the harness mounted on the engine. Lead assemblies may also be replaced with harness mounted on the engine unless inaccessibility of installation or number of leads to be replaced makes it unreasonable.

To replace grommets or eyelets, pull the conductor through the shielding sufficiently to make eyelet accessible. Remove the eyelet being careful not to damage conductor wire. Replace grommet and eyelet using the "AB" groove of Crimping Tool No. 11-4152 or a pair of diagonal pliers modified as shown in Figure 7A-47. Work the wire back into the shielding

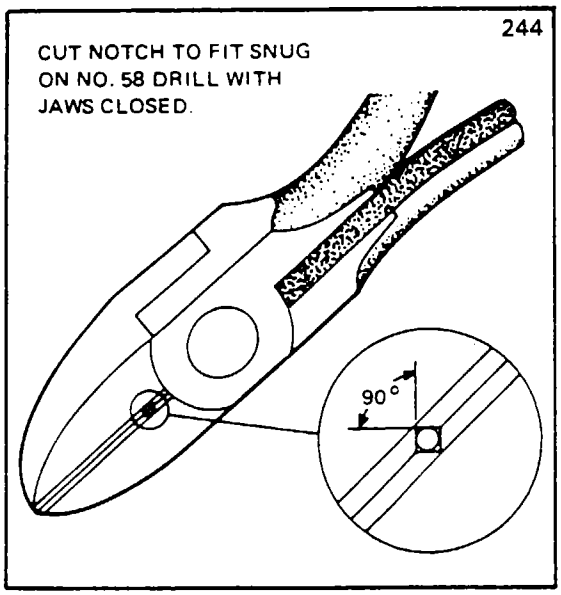


Figure 7A-47. Modified Pliers

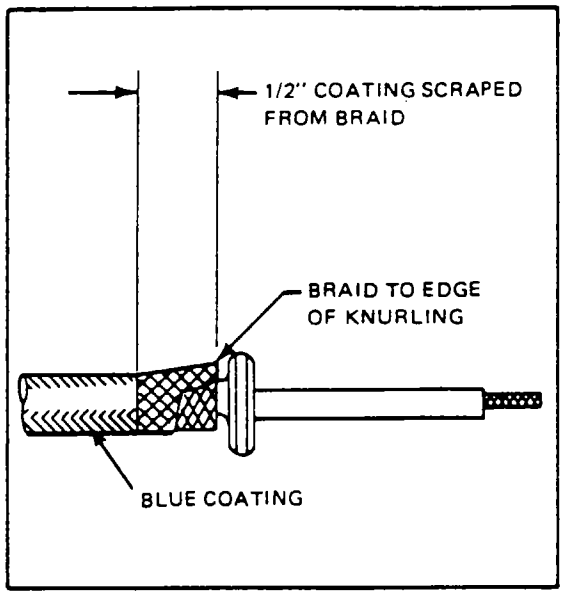


Figure 7A-48. Ferrule Positioned Under Braid

so the grommet fits properly against the ferrules in the plate. Slack in shielding or wire can be removed by grasping the lead in one hand and sliding the other hand firmly along the lead towards the magneto cover.

To replace contact springs, insulating sleeves, compression spring or elbows, proceed as follows:

a. Using a Bendix 11-7073 needle or a mechanical pencil with the lead retracted, hook the end of the contact spring as shown in Figure 7A-15.

b. Using the needle or pencil, unscrew the spring.

c. Slide insulating sleeve and spring retainer assembly off end of lead assembly.

d. Replace defective component and reassemble as follows:

1. Fabricate a tool as shown in Figure 7A-16 for installing the insulating sleeves over cable terminals.

2. Slide elbow assembly over lead and attach nut finger tight to ferrule.

3. Push the fabricated tool through insulating sleeve and spring retainer assembly as shown in Figure 7A-17. Screw the cable terminal into the tool.

4. 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 DC-200 (200,000 centistokes) or commercial grade alcohol to facilitate assembly.

e. To replace one of the lead assemblies, proceed as follows:

1. Remove clamps and brackets from defective lead assembly. Cut cable ties from assembly and discard.

POWER PLANT
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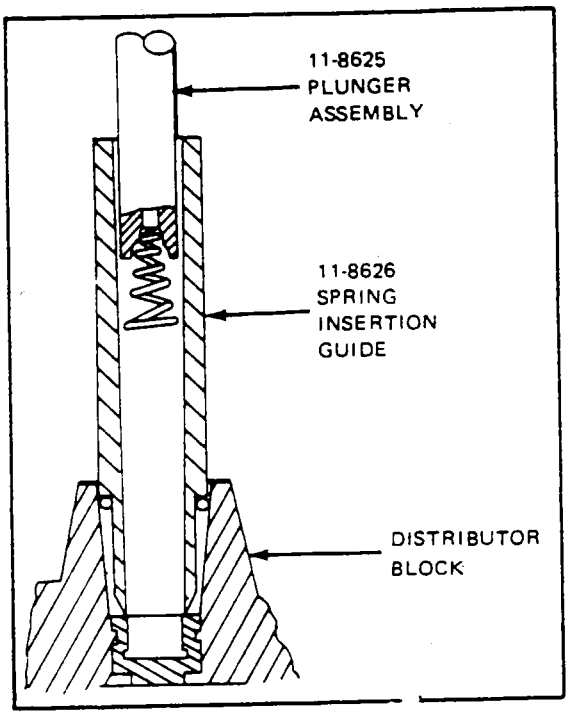


Figure 7A-49. Position of 11-8627 Kit and Contact Spring at Start of Installation

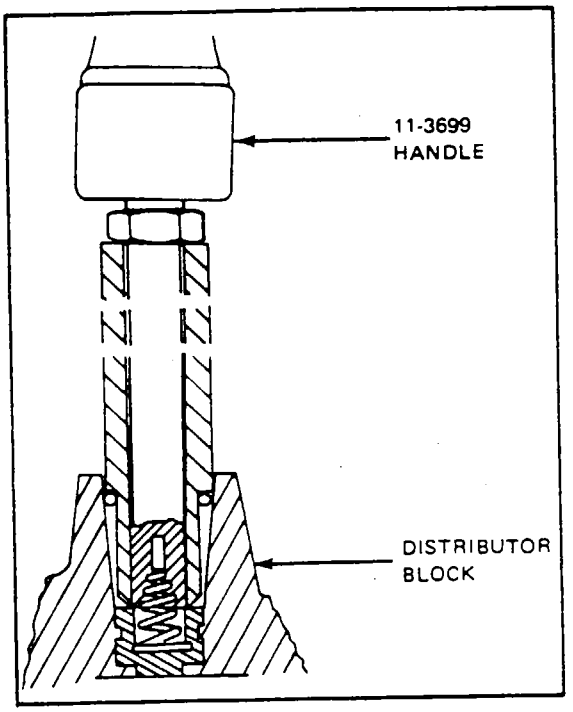


Figure 7A-50. Position of 11-8627 Kit and Contact Spring after Installation

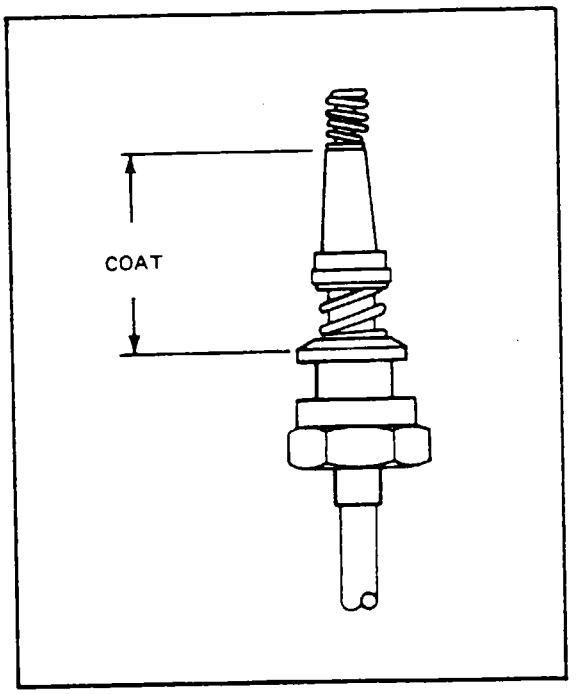


Figure 7A-51. Lubricating Sleeve

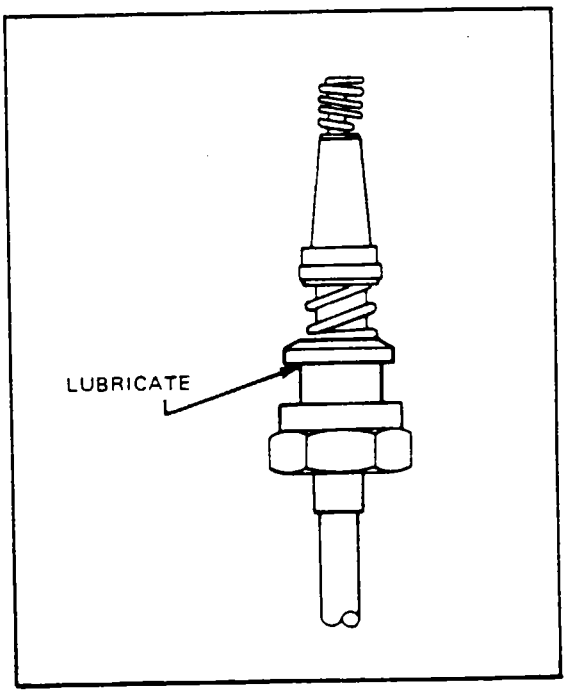


Figure 7A-52. Lubricating Ferrule Shoulder

2. Cut the eyelet from the lead and remove grommet.

3. Grip the ferrule of the lead with a pair of vise grip or water pump pliers and with a twist-pull action remove the ferrule from the cover and discard ferrule. Pull lead from cover.

4. Thread pre-stripped end of replacement lead through cover.

NOTE

Replacement leads are available from Bendix in lengths of 17 thru 74 inches in 3 inch increments. Use nearest next longer length to replace defective lead.

5. Scrape blue coating being careful not to cut braid for .50 of an inch from end of lead.

6. Push back braid and thread a new ferrule over wire and under braid until braid just covers knurling. (Refer to Figure 7A-48.)

CAUTION

New ferrules must be used and inserted under the braid exactly as stated in Step 6.

7. Pull the lead back into the cover to wedge the braid between the tapers of the cover and ferrule.

8. Provide a back up support for the cover and seat the ferrule using the 11-7074 Ferrule Seating Tool (refer to Figure 7A-22) and a mallet. Ferrule must be driven straight into the cover and fully seated.

9. Thread the pre-stripped end of conductor through grommet. Place a new eyelet on conductor and crimp per instructions given in second paragraph of Maintenance of Harness, 7A-46.

f. When lead being replaced is of the elbow type, salvage the used elbow and compression springs for installation on replacement lead. Install these and new sleeve and contact spring (refer to Figures 7A-49 and 7A-50) furnished with replacement lead per instructions given in Steps a thru d.

g. Reposition clamps and brackets and replace cable ties removed earlier. Clean the grommets, sleeves and the inside of the cover with methylethylketone or denatured alcohol.

h. Spray grommets and sleeves with Fluorocarbon Spray, such as MS-S-122, supplied by Miller-Stephenson Chemical Co. Inc., 16 Sugar Hollow Road, Danbury, Connecticut 06810, or equivalent.

i. Prior to seating spark plug lead terminal in plug barrel use fluorocarbon spray on spark plug terminal insulating sleeve (refer to Figure 7A-51) to prevent heat from sticking sleeve to spark plug barrel. Lightly lubricate the shoulder of ferrule to minimize twisting of ferrule. (Refer to Figure 7A-52.) Use GO-JO NO LOK manufactured by Goger Inc., Akron, Ohio 44309.

j. Check cam securing screw. Screw must be torqued to 16-20 inch-pounds.

k. With all high tension terminal grommets seated against the ferrules in the cover, attach the bottom capacitor lead to the right main breaker and then the top capacitor lead to the left main breaker. Position the cover on the magneto and secure. Torque cover screws to 30-35 inch-pounds.

l. Carefully route the high tension spark plug leads away from any hot spots such as manifolds and sharp edges which might cause heat damage or chafing. Check leads for proper location in clamps so when clamps are tightened the leads will not be crushed. Leads should be taut to prevent chafing due to vibration, but not so taut as to produce undue strain or leads.

m. After all leads have been properly routed and secured to the engine, recheck all clamp securing screws for tightness. Fasten coupling nuts to proper spark plugs and torque as specified in Table VIIA-II. Do not allow ferrules to turn while torquing nuts.

TABLE VIIA-II. COUPLING TORQUES

Spark Plug Coupling Threads	Torque (lb.-in.)
5/8-24	90-95
3/4-20	110-120

7A-47. SPARK PLUGS.

7A-48. 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 centerline 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

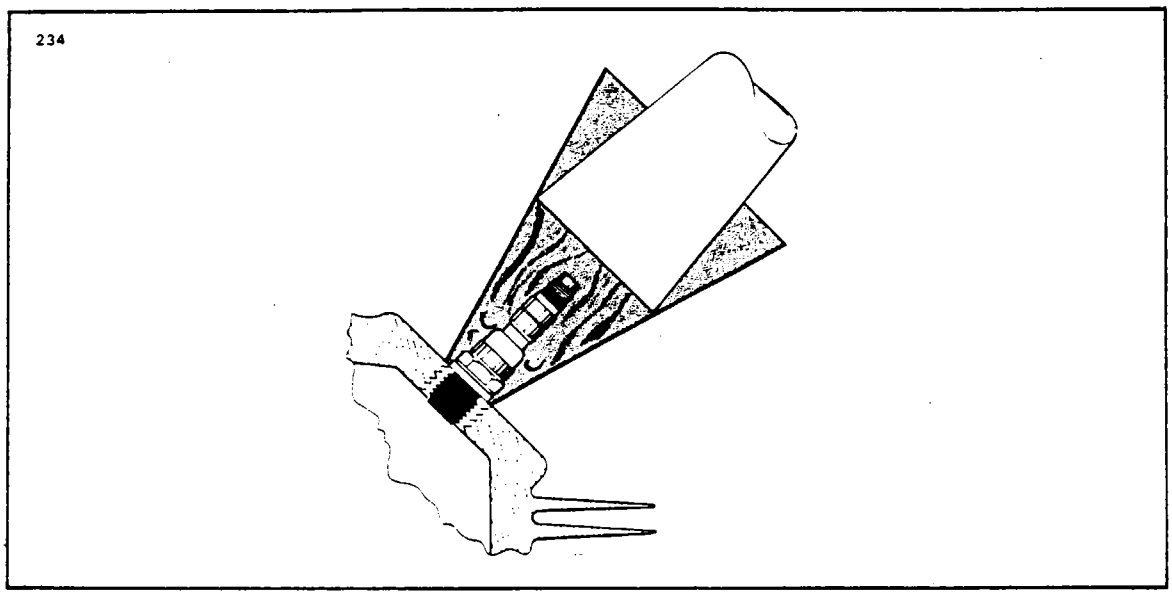


Figure 7A-53. Removing Spark Plug Frozen to Bushing

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 used 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 CO2 bottle. (Refer to Figure 7A-53.) 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 CO2 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.

7A-49. 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 at 0.017 to 0.021 inches.

7A-50. 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 threads and 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. Carefully insert the terminal insulator in the spark plug and tighten the coupling nut.

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TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART

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.
		Check fuel selector valve for proper tank.
		Check fuel pressure with electric boost pump ON.
		Check mixture control knob for full rich.
	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.
	Incorrect throttle setting.	Open throttle to one-eighth of its range.
	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester and replace 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 at fuel injector and check fuel flow.
	Water in fuel injector.	Drain fuel injector and fuel lines.

TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART (cont.)

Trouble	Cause	Remedy
Failure of engine to start. (cont.)	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of 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.
	Leak in air bleed nozzle balance line.	Check connection and replace if necessary.
	Plug fuel injector nozzle.	Clean or replace nozzle.
	Flow divider fitting plugged.	Clean fitting.
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 by authorized personnel is indicated.

TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART (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. Check fuel injection nozzles. Readjustment of fuel injector 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.
	Plugged fuel injector nozzle.	Clean or replace nozzle.
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections and replace defective parts.
	Plugged fuel injector nozzle.	Clean or replace nozzle.
	Throttle lever out of adjustment.	Adjust throttle lever.
	Improper fuel flow.	Check strainer, gauge and flow at the fuel line.

TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART (cont.)

Trouble	Cause	Remedy
Failure of engine to develop full power. (cont.)	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.
	Plugged fuel injector nozzle.	Clean or replace nozzle.
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.
	Dirty oil strainers.	Remove and clean oil strainers.
	Defective pressure gauge.	Replace gauge.

TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART (cont.)

Trouble	Cause	Remedy
Low oil pressure. (cont.)	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	High oil temperature.	See "High Oil Temperature" in "Trouble" column.
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 gauge.	Replace gauge.
Excessive oil consumption.	Low grade of oil.	Fill tank with oil conforming to specifications.

TABLE VIIA-III. ENGINE TROUBLESHOOTING CHART (cont.)

Trouble	Cause	Remedy
Excessive oil consumption. (cont.)	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 with high oil temperature until oil consumption stabilizes.
High fuel flow indicated on fuel gauge.	Plugged fuel injector nozzle.	Clean or replace nozzle.

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SECTION VIII

FUEL SYSTEM

		Aerofiche Grid No.
8-1.	Description (PA-32-260 and 300 to S/N 7840222)	2I20
8-2.	Description (PA-32R-300)	2I20
8-3.	Troubleshooting	2I24
8-4.	Fuel Tanks	2I24
8-5.	Inspection and Repair of Fuel Tanks (Aluminum)	2I24
8-6.	Inspection and Repair of Tip Tanks(PA-32-260 and 300)	2J1
8-7.	Removal of Main Fuel Tank (PA-32-260 and 300)	2J1
8-7a.	Installation of Main Fuel Tank (PA-32-260 and 300)	2J1
8-8.	Removal and Installation of Tip Tank (PA-32-260 and 300)	2J1
8-9	Removal of Inboard Fuel Tank (PA-32R-300 and 32-300 S/N 32-7940001 and up)	2J1
8-10.	Installation of Inboard Fuel Tank (PA-32R-300 and 32-300 S/N 32-7940001 and up)	2J2
8-11.	Removal of Outboard Fuel Tank (PA-32R-300 and 32-300 S/N 32-7940001 and up)	2J2
8-12.	Installation of Outboard Fuel Tank (PA-32R-300 and 32-300 S/N 32-7940001 and up)	2J2
8-13.	Inspection of Fuel System	2J2
8-14.	Fuel Quantity Sender/Gauge Check (Installed) (PA-32-260 and 300)	2J3
8-15.	Fuel Quantity Sender Unit (PA-32R-300 and 32-300 S/N 7940001 and up)	2J3
8-16.	Fuel Quantity Sender/Gauge Check Installed (PA-32R-300 and 32-300 S/N 32-7940001 and up)	2J4
8-17.	Fuel Selector Valve and Filter	2J6
8-18.	Fuel Selector Valve Operation	2J6
8-19.	Removal of Fuel Selector Valve and Filter	2J6
8-20.	Cleaning Filter Assembly	2J7
8-21.	Port Repair of 1H26-4 Fuel Selector	2J7
8-22.	Installation of Fuel Selector and Filter Valve	2J8
8-23.	Cleaning Fuel System	2J8
8-24.	Electric Fuel Pump	2J8
8-25.	Removal and Installation of Electric Fuel Pump	2J8
8-26.	Cleaning Electric Fuel Pump Screen	2J9

Revised: 9/18/78

SECTION VIII

FUEL SYSTEM

NOTE

Through a model change all future PA-32-300 aircraft, Serial Numbers 32-7940001 and up, will have incorporated the same fuel system as the PA-32R-300.

8-1. DESCRIPTION (PA-32-260 and 300 to S/N 7840222).

The fuel system consists of two aluminum tanks contained in the inboard leading edge section of the wings plus two fiberglass tanks, one located in each wing tip. The main tanks have a maximum capacity of 25 U. S. gallons each while the tip tanks hold a maximum capacity of 17 U.S. gallons each.

Fuel is taken from each tank through a screen located in the tank outlet fitting and onto a combination fuel selector valve and strainer located under the floor panel under the middle seats. The fuel selector valve is controlled remotely by a selector lever located on the sloping face of the control tunnel. The strainer portion of the valve is operated by a lever located on the right front side of the spar cover under the forward end of the right middle seat. From the selector valve, fuel is drawn through the electric fuel pump(s) located in the area under the middle seats, through the engine driven pump and onto the carburetor or injector.

Four electric fuel quantity gauges are mounted in the instrument cluster located on the right side of the instrument panel. Each gauge is connected to a sender unit installed in the fuel tanks.

Refer to Figures 8-1 or 8-2 for the layout and relationship of the fuel system and components.

8-2. DESCRIPTION (PA-32R-300). The fuel system consists of two interconnected aluminum tanks in each wing, having a combined capacity of 49 U.S. gallons, for a total capacity of 98 U.S. gallons. These tanks form an integral part of the wing surface when installed. Fuel flow is indicated on the gauge located in the instrument panel. A fuel quantity gauge for each wing system is also located in the instrument panel, and indicates the amount of fuel remaining as transmitted by the electric fuel quantity sending units located in the wing tanks. An exterior sight gauge is installed in the inboard tank of each wing so fuel quantities can be checked on the ground during the preflight of the airplane.

Fuel is drawn through a finger screen located in the inboard fuel tank and routed to a three position fuel selector valve and filter unit which is located aft of the main spar. The valve has "OFF," "LEFT" and "RIGHT" positions which are remotely selected by means of a torque tube operated by a handle located in the pedestal. The handle has a spring loaded detent to prevent accidental selection to the "OFF" position. From the selector valve the fuel goes to the electric fuel pump which is also mounted aft of the main spar and then goes forward to the engine driven fuel pump which forces the fuel through the injector unit into the engine.

Refer to Figure 8-3 for layout and relationship of the fuel system and components.

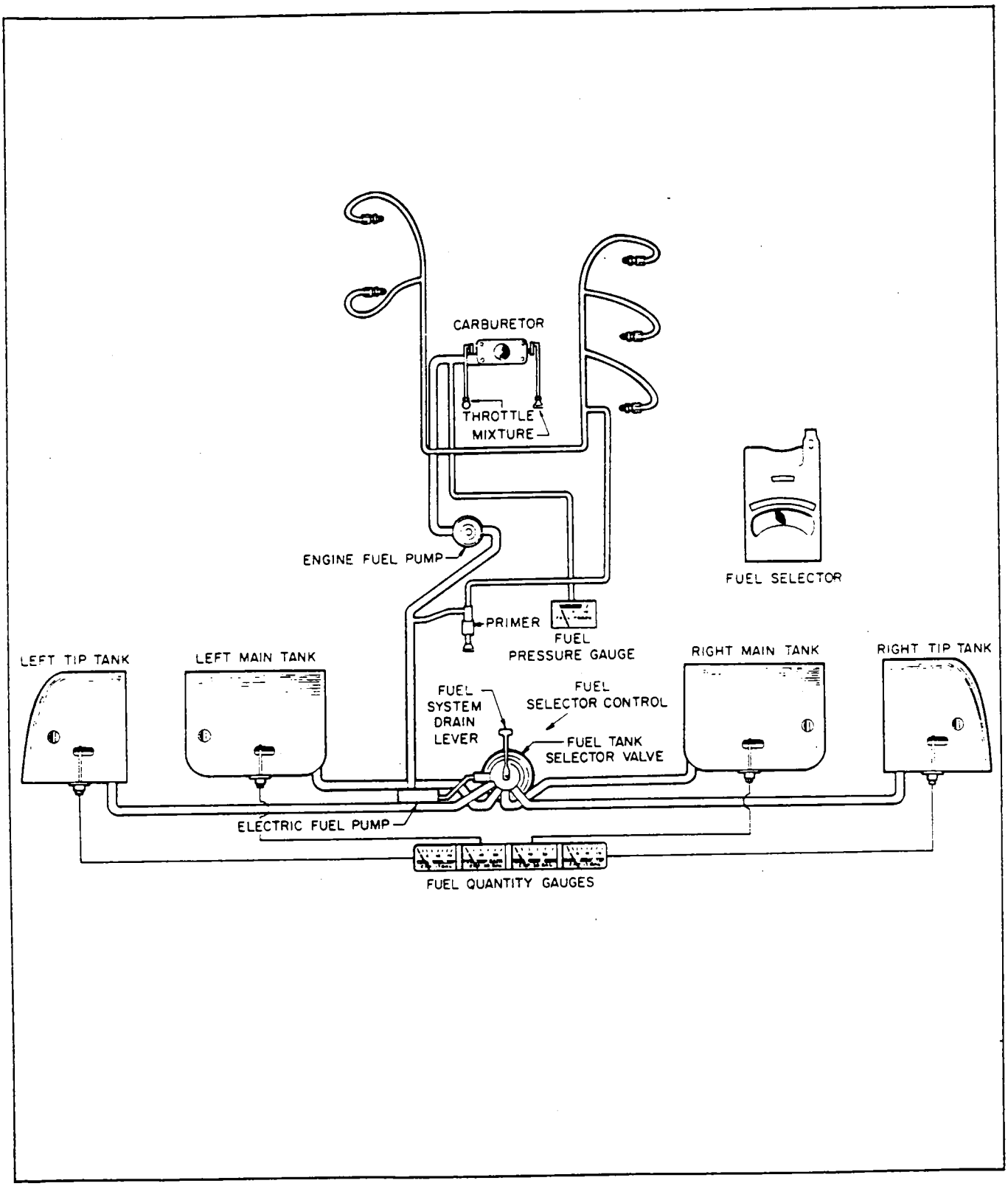


Figure 8-1. Fuel System (PA-32-260)

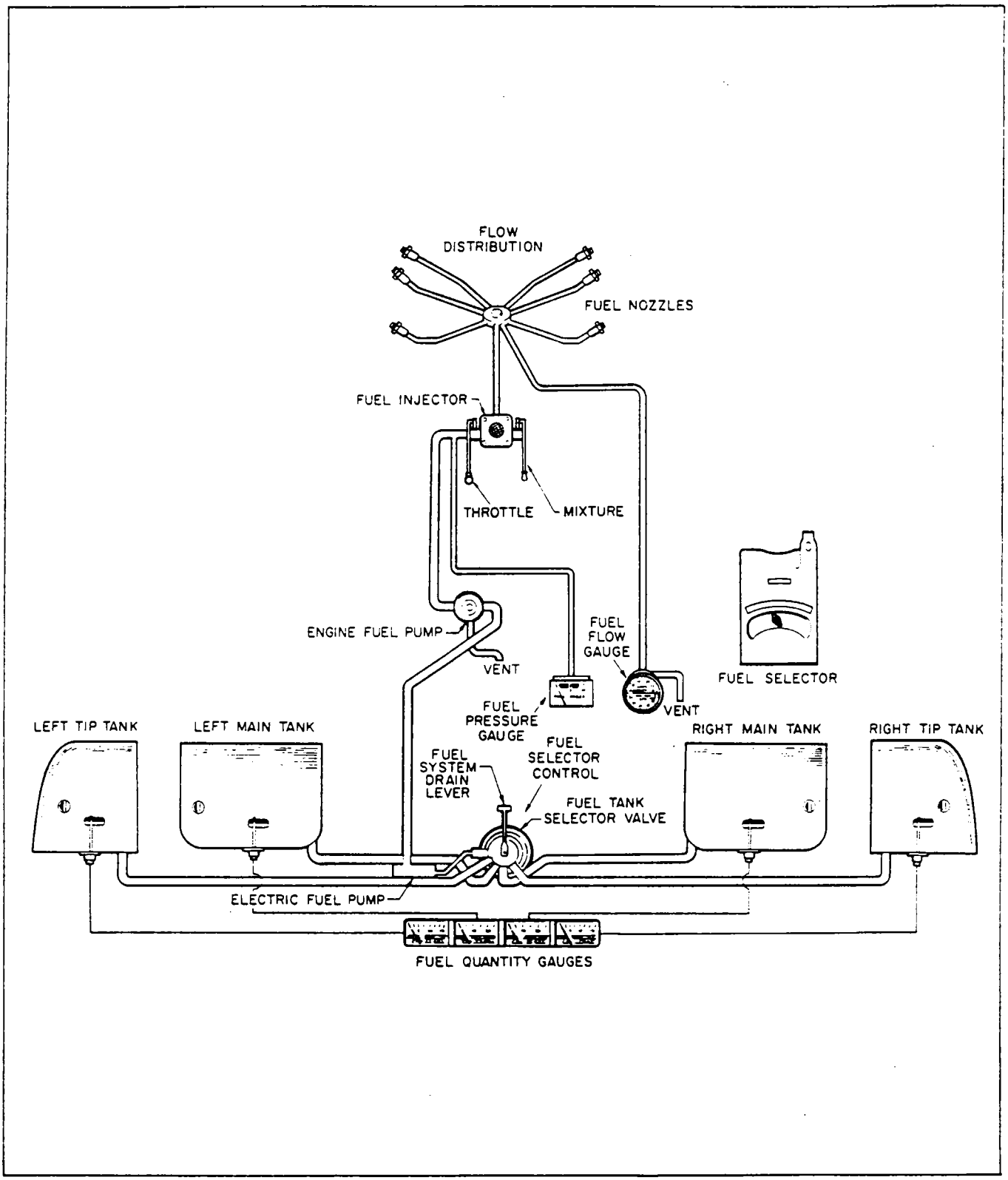


Figure 8-2. Fuel System (PA-32-300)

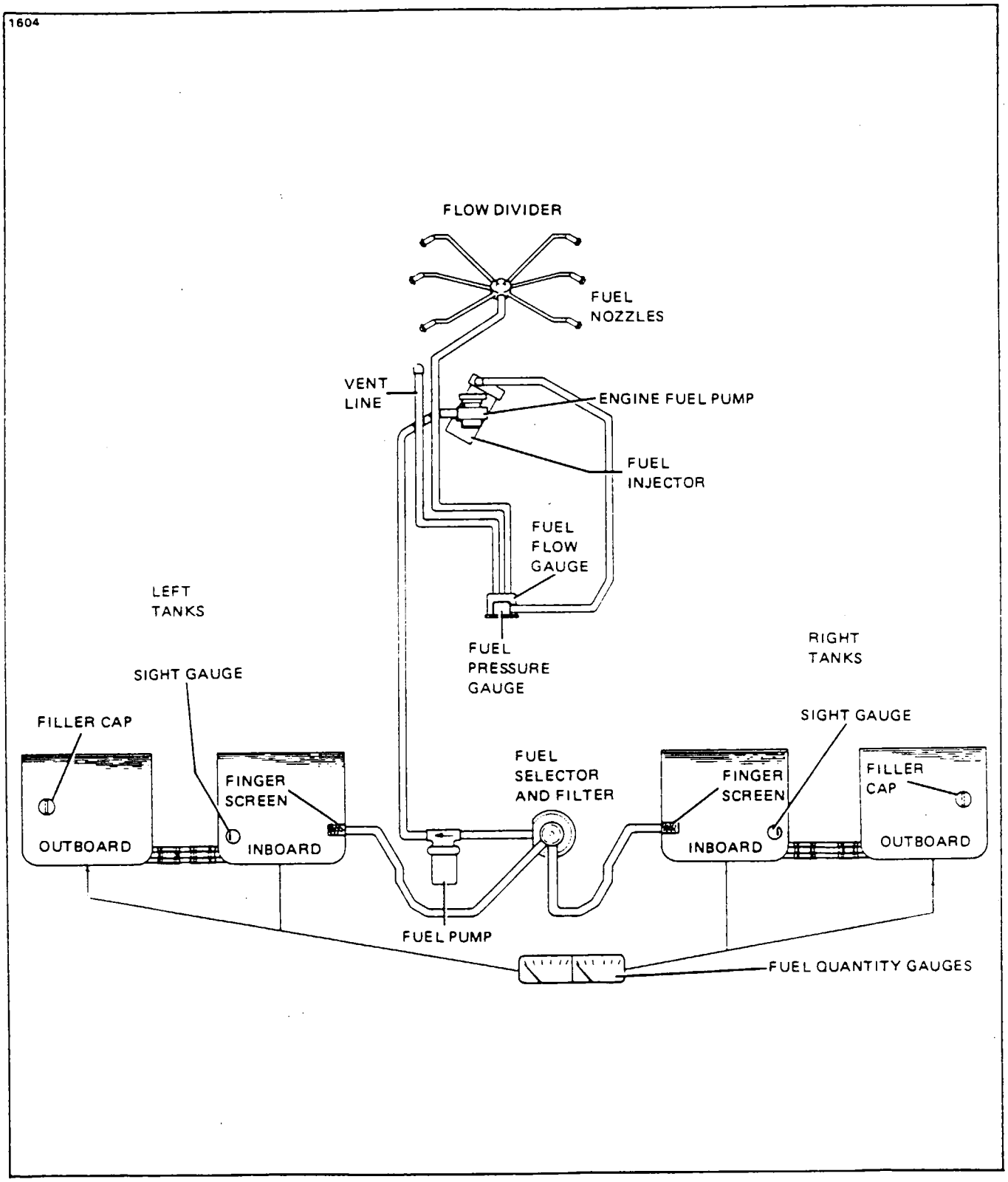


Figure 8-3. Fuel System
(PA32-300, Serial No. 32-7940001 and up; PA-32R-300, All)

8-3. TROUBLESHOOTING. Troubles peculiar to the instruments and related areas of the fuel system are listed in Section IX along with their probable causes and suggested remedies. Electrical and mechanical troubles of the system are found in Table VIII-III at the back of this section. When troubleshooting, check from the power 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 an identical unit or units, tested and known to be good, installed in their place.

8-4. FUEL TANKS.

NOTE

Through a model change all future PA-32-300 aircraft, Serial Numbers 32-7940001 and up, will have incorporated the same fuel system as the PA-32R-300.

8-5. INSPECTION AND REPAIR OF FUEL TANKS (ALUMINUM). Fuel tanks should be completely drained before inspection. (Refer to Draining Fuel System, Section II.) Each tank should be carefully inspected for signs of leaks as indicated by telltale stains. In the event a fuel leak is detected, the fuel tank must be removed as explained in Paragraphs 8-7, 8-9 or 8-11, and repaired as follows:

a. The main fuel tanks on PA-32-260, 300 and PA-32R-300 aircraft should be sloshed in accordance with instructions provided on each can of Randolph Sloshing Sealer 802, (MIL-L-6047B), Piper P/N 757 572. One gallon of sealer is required for each tank. When sloshing, the finger strainer, fuel sender unit, sight gauge and drain valves must be removed before proceeding. Seal all openings. After sloshing, check for leaks using a water and soap solution and apply 1.5 pounds of pressure.

b. If the tank being inspected has previously been sloshed, the interior of the tank should be inspected for signs of peeling or chipping sealer. Particular attention should be given the area around the filler neck as a result of the metal nozzle of the gas filler hose nicking the sealer. This inspection can best be accomplished using a mirror and inspection light through the filler neck. If peeling and/or chipping has occurred and separated material is found, the tank should be sloshed as explained in Step a.

c. After sloshing, reinspect as outlined in Step b at intervals of 100 hours.

NOTE

The fuel tank should be replaced if it has been damaged to the extent it cannot be repaired by above procedures.

NOTE

When reinstalling drain valves, apply Parker Hannifin thread lube, Piper code no. 913 224, to the male pipe threads. Do not allow lubricant to enter fuel system.

8-6. INSPECTION AND REPAIR OF TIP TANKS (PA-32-260 and 300) (FIBERGLASS). Drain tanks completely before inspection. (Refer to Draining Fuel System, Section II.) Check the tank for signs of leaks. Minor repair of the tank can be accomplished with the use of fiberglass repair kit 756 729. This kit along with instructions is obtained from Piper Dealers or Distributors.

8-7. REMOVAL OF MAIN FUEL TANK (PA-32-260 and 300).

a. Drain the fuel tank. (Refer to Draining Fuel System, Section II.)
b. Remove the screws from around the perimeter of the tank assembly.
c. Disconnect fuel line attached to tank.
d. Pull the tank away from the wing assembly far enough to gain access for removal of the sender wire.
e. Remove the tank from the wing assembly.

8-7a. INSTALLATION OF MAIN FUEL TANK (PA-32-260 and 300).

a. Slide the main tank partly into position and connect the sender wire.
b. Slide the tank completely into place and secure with screws around its perimeter.
c. Connect fuel line on inboard side of tank. The flexible hose from the fuel tank must not be twisted during installation on applicable models.
d. Fill the fuel tank and check for leaks, unrestricted Fuel flow and proper sender indications on the quantity gauge.

8-8. REMOVAL AND INSTALLATION OF TIP TANK (PA-32-260 and 300).

a. Drain the fuel tank. (Refer to Draining Fuel System, Section II.)
b. Remove the access plate on the underside of the wing adjacent to the fuel tank.
c. Remove the two bolts that secure the tank to the end of the main spar by entering through the access hole on the underside of the wing.
d. Disconnect the fuel line and sender wire through the access hole.
e. Remove the screws that secure the tank to the wing from around the outside of the tank.
f. Remove the tank from the wing assembly.
g. Reinstall the tank in reverse of the removal instructions.

8-9. REMOVAL OF INBOARD FUEL TANK (PA-32R-300 and 32-300 with S/N 32-7940001 and up).

a. Locate and remove cover from access hole located on underside of wing between wing station 88.75 and wing station 115.95.
b. With fuel completely drained from tank, loosen clamps at hose connections on fuel line and fuel vent line and slide hose connections away from fuel tank.
c. Disconnect fuel line on inboard side of tank.
d. Remove screws from around the perimeter of the tank. Carefully pull tank away from the wing far enough to gain access to/and remove sender wire.
e. The tank is now free to be removed.

8-10. INSTALLATION OF INBOARD FUEL TANK (PA-32R-300 and 32-300 with S/N 32-7940001 and up).

a. Position fuel tank in its recess in the wing. Connect fuel sender wires. Slide tank completely into position and secure with screws around its perimeter.

b. Using access hole located on underside of wing, slide hose on interconnecting fuel line and fuel vent line into position and tighten clamps.

c. Connect fuel line on inboard side of tank.

d. Fill fuel tanks and check for leaks, unrestricted fuel flow, accurate sender indications on fuel quantity gauge, and that ground wire is securely attached to interconnecting fuel line, fuel vent line and wing rib at wing station 88.75.

8-11. REMOVAL OF OUTBOARD FUEL TANK (PA-32R-300 and 32-300 with S/N 32-7940001 and up).

a. Using the same access hole described in Paragraph 8-9 and with fuel completely drained from the tank, loosen clamps at hose connections on fuel line and fuel vent line. Slide hose connections away from fuel tank.

b. Gain access to outboard fuel vent elbow by removing wing tip. Disconnect or cut hose and remove elbow.

c. Remove screws from around the perimeter of the tank. Carefully pull tank away from the wing far enough to gain access to remove sender wires.

d. The tank is now free to be removed.

NOTE

In the event the interconnecting fuel line and fuel vent line are being removed, it will be necessary to first disconnect the ground wire attached to the rib at wing station 88.75.

8-12. INSTALLATION OF OUTBOARD FUEL TANK (PA-32R-300 and 32-300 with S/N 32-7940001 and up).

a. Position fuel tank in its recess in the wing. Connect fuel sender wires. Slide tank completely into position and secure with screws around its perimeter.

b. Using access hole located on underside of wing, slide hose on interconnecting fuel vent line into position and tighten clamps.

c. Slide hose connection on interconnecting fuel line into position and tighten clamps.

d. Connect fuel vent line on outboard side of tank.

e. Fill the fuel tank and check for leaks and unrestricted fuel flow, accurate sender indications on fuel quantity gauge, and that ground wire is securely attached to interconnecting fuel line, fuel vent line and wing rib at wing station 88.75.

8-13. INSPECTION OF FUEL SYSTEM. Fill tanks with fuel. Inspect tanks and fuel line connections for leaks. If fuel tanks leak, follow instructions given in Paragraph 8-5 or 8-6. If fuel line connections leak, tighten clamps or replace hose connections after first draining tanks.

8-14. FUEL QUANTITY SENDER/GAUGE CHECK (INSTALLED) (PA-32-260 and 300).

a. Turn the fuel selector valve off. Completely drain the fuel tank that relates to the gauge to be checked. (Refer to Draining Fuel System, Section II.)

b. Level the airplane longitudinally and laterally.

NOTE

The electrical system should supply 12 to 14-volts to the gauge.

c. Turn the master switch on and observe the fuel quantity gauge, it should read empty. Refer to Table VIII-I for tolerances that are permitted between the fuel gauge reading and the actual fuel in the tank.

d. Add fuel to the tank in the amount of five U.S. gallon increments until the tank is full and observe the gauge readings.

NOTE

It will be permissible to adjust the fuel tank float support wire to obtain the specified tolerances.

TABLE VIII-I. SENDER/FUEL QUANTITY GAUGE TOLERANCES (PA-32-260 & 300)

MAIN TANK		TIP TANK	
Actual Fuel in Tank (U.S. Gal)	Gauge Reading (U.S. Gal)	Actual Fuel in Tank (U.S. Gal)	Gauge Reading (U.S. Gal)
Full	22 to 28	Full	15 to 17
20	17 to 24	10	7 to 12
15	12 to 17	5	3 to 7
10	7 to 12	0	0 to -2
5	2 to 6		
0	0 to -2		

8-15. FUEL QUANTITY SENDER UNIT (PA-32R-300 and 32-300 with S/N 32-7940001 and up).

NOTE

Inboard and outboard fuel tanks in each wing are interconnected and have a total capacity of 49 gallons. Fuel quantity sender units mounted in each fuel tank transmit electrically the cumulative quantity of fuel in each set of tanks, to fuel quantity gauges mounted in the instrument panel.

8-16. FUEL QUANTITY SENDER/GAUGE CHECK (INSTALLED) (PA-32R-300 and those 32-300's above S/N 32-7940001). Fuel quantity sender units and fuel quantity gauges can be checked while mounted in the airplane by using the following procedure:

a. Put the fuel selector levers in the "OFF" position. Completely drain fuel tanks that relate to the fuel quantity senders and gauge to be checked. (Refer to Draining Fuel System, Section II.)

b. Level airplane laterally (refer to Leveling, Section II) and position the aircraft with a 1 degree nose up attitude.

NOTE

The electrical system should supply 12 to 14-volts to the gauge.

c. With the master switch in the "OFF" position, the gauge needle should be centered on the white dot to the left of the "O" radial mark, with a maximum deviation of 1/4 needle width. If not within this tolerance, the gauge should be replaced.

d. With the master switch in the "ON" position and no fuel in the tanks, the gauge needle should be centered on the white dot to the left of the "O" radial mark with a maximum deviation of 1/4 needle width. If not within this tolerance, the gauge should be replaced.

e. Place 2 gallons of fuel in the wing fuel tank that relates to the gauge and sender unit being checked.

f. With 12 to 14-volts DC supplied to the electrical system and the master switch in the "ON" position, the needle should be centered on the "O" radial mark; plus O, minus 1 needle width.

g. If the needle does not read within the above tolerance, remove the sender wire from the rear of the gauge and check the resistance to ground through the sender circuit. If the resistance is not within 5 ± 1 ohms, replace the inboard sender. Then, recheck as specified above.

h. Add fuel to the tanks in accordance with the information given in Table VIII-II until tanks are full. Observe the gauge reading at each 10 gallon increment.

i. With the tanks full and master switch "ON," the needle should be centered on the "F" radial mark within ± 1 needle width. If not within this tolerance, adjust the electrical adjustment (refer to Figure 8-4) just sufficiently to bring it within tolerance; do not center the needle.

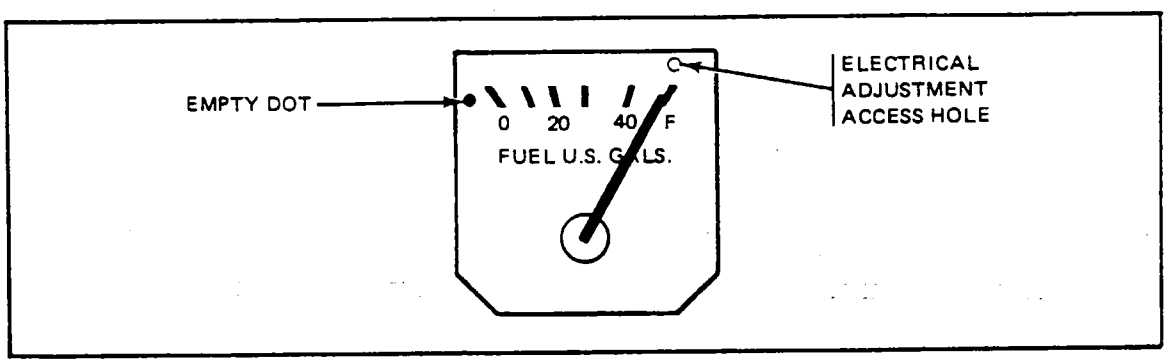


Figure 8-4. Fuel Gauge (PA-32R-300)

TABLE VIII-II. SENDER/FUEL QUANTITY GAUGE TOLERANCES (PA-32R-300 and those 32-300's above S/N 32-7940001)

Actual Fuel in Tank (U.S. Gallons)	Gauge Reading (U.S. Gallons)
49 FULL	F
42	40
32	30 ± Pointer Width
22	20
12	10
2	Not More Than Zero
0 EMPTY	White Dot

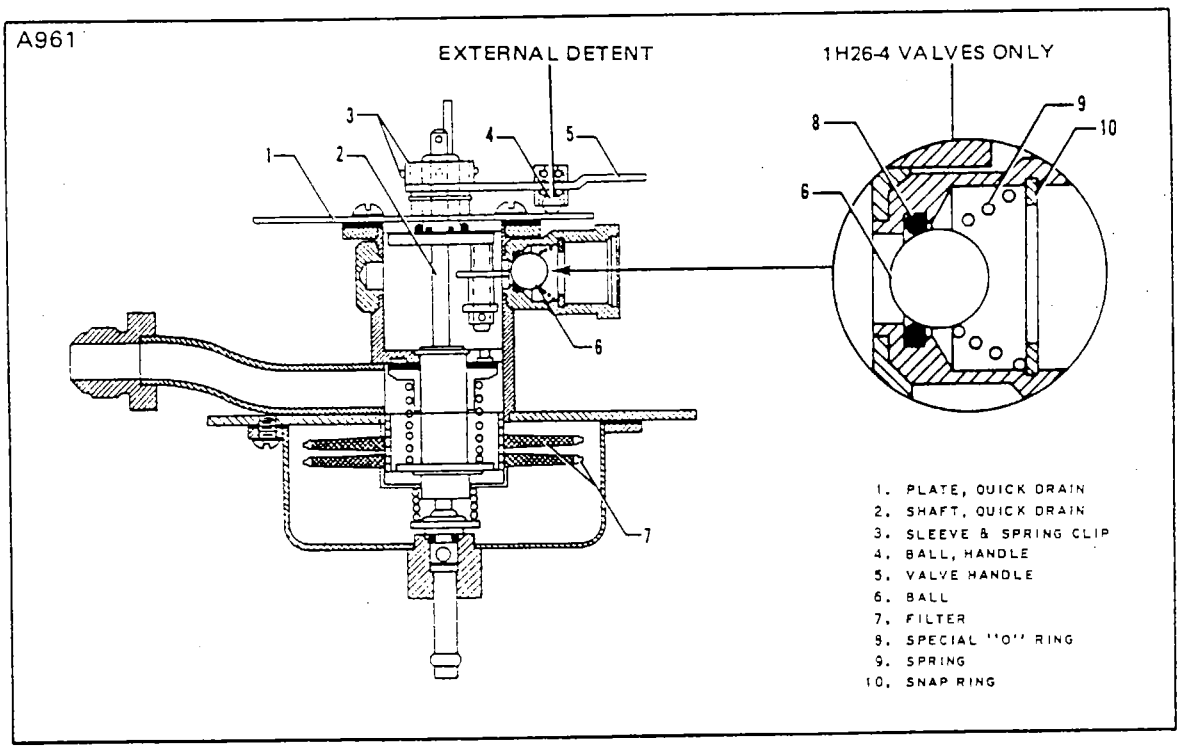


Figure 8-5. Fuel Selector and Filter

8-17. FUEL SELECTOR VALVE AND FILTER.

8-18. FUEL SELECTOR VALVE OPERATION. When the fuel selector handle is not in a positive selector detent position, more than one fuel port will be open at the same time. It should be ascertained that the fuel selector is positioned in a detent, which can be easily felt when moving the handle through its various positions.

8-19. REMOVAL OF FUEL SELECTOR VALVE AND FILTER.

a. Drain fuel from tanks. (Refer to Draining Fuel System, Section II.)

b. Remove center seats, seat belt attachments and floor panel just aft of the main spar by removing the floor attachment screws. Lift the panel and remove.

c. Remove plate from bottom of the fuselage which covers fuel selector.

d. Disconnect the fuel lines and selector linkage from valve assembly.

e. Remove the four mounting screws which hold the fuel selector in place and remove the selector assembly.

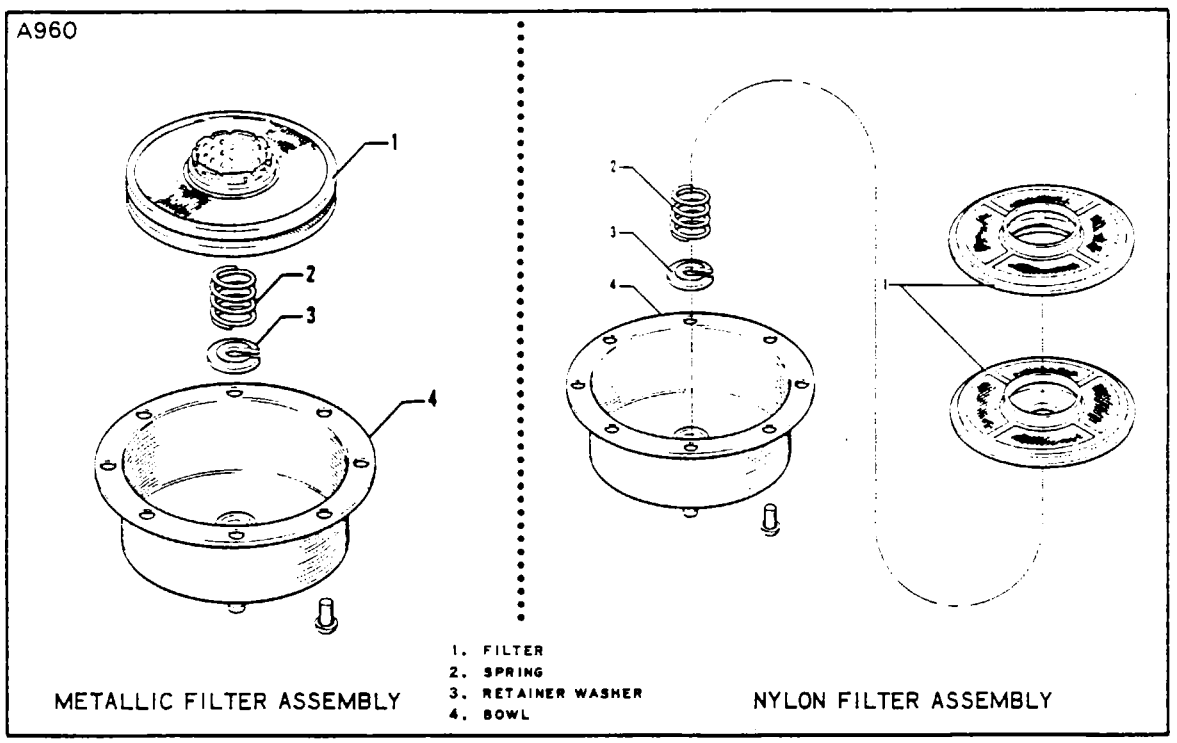


Figure 8-6. Fuel Filter

8-20. CLEANING FILTER ASSEMBLY.

a. Remove the access panel to the filter bowl on the bottom of the fuselage.

b. Remove fuel strainer bowl.

c. Remove filter disc assembly from center stem by compressing filter retainer spring and removing filter retainer washer. (Refer to Figure 8-6.)

d. Inspect bowl gasket and replace if necessary.

e. Filter discs may be cleaned as follows:

1. Plug open ends of filter disc center with stoppers to prevent dirt from entering.

2. Wash metallic filter disc in acetone, gasoline, carbon tetrachloride, trichlorethylene (permachor) or Bendix cleaner. Wash nylon filter disc with soap and water.

CAUTION

Do not use acetone, methylethylketone, etc., to clean nylon filter discs.

3. Remove stubborn deposits from filter disc with a soft bristle brush.

4. Rinse all traces of soap solution. Drain or blow dry and remove stoppers.

f. Replace the filter disc if damage is evident.

g. Reinstall filter disc assembly and strainer bowl.

8-21. PORT REPAIR OF 1H26-4 FUEL SELECTOR. (Refer to Figure 8-5.) The following information is for the 1H26-4 valves only, and the PA-32 parts catalog should be used to order replacement parts.

a. Remove and discard the snap ring (10), spring (9), ball (6) and "O" ring (8) from the valve port.

b. Replace parts removed in Step a with new parts.

NOTE

Use only special "O" ring provided by service spares and use care not to push "O" ring into center of valve housing.

c. Pressure check valve with 10 +5 -0 psi of air applied at outlet port. No bubbles should be observed when valve is held with the four inlet ports pointing up and gasoline placed in each port.

d. Rotate the fuel selector through its full cycle of tank positions to insure proper operation.

e. Reinstall fittings with new "O" rings in each inlet port and reinstall the valve into the airplane in accordance with Paragraph 8-22.

8-22. INSTALLATION OF FUEL SELECTOR AND FILTER VALVE.

a. Position the valve inside the airplane just aft of the main spar.
b. Secure the valve with machine screws, washers and self-locking nuts.
c. Connect the fuel lines.
d. Connect fuel selector valve linkage to insure that selector handle engages the left indent position when it is against the safety stop on the console cover.
e. Fill the fuel tanks and check all connections for leaks.
f. Install the rear seat and fuel drain placard cover.
g. Install the access plate to the bottom of the fuselage with attaching screws.

NOTE

When installing the fuel selector valve, it is recommended the complete fuel system and tanks be drained and flushed to ascertain no contamination is present. (Refer to Paragraph 8-23.)

8-23. CLEANING FUEL SYSTEM.

a. Remove all fuel from tanks. The fuel should be drained through a chamois or other straining equipment to inspect for the presence of foreign matter.
b. Each tank should be flushed by opening the tank drain and adding two-three gallons of clean fuel. While the fuel is draining, the aircraft wing should be raised and lowered to allow the fuel to rinse any contamination still remaining in the tank out the drain.
c. After the valve is installed and the aircraft refueled, the fuel inlet line to the injector or carburetor should be disconnected and with boost pump on, lines should be flushed while selector is moved from one tank to another.
d. Make proper logbook entry.

8-24. ELECTRIC FUEL PUMP.

8-25. REMOVAL AND INSTALLATION OF ELECTRIC FUEL PUMP. The PA-32-260 is equipped with two electric pulsate type fuel pumps in models bearing serial numbers 32-1 to 32-375 and one pulsate pump in models bearing serial numbers 32-376 and up. These pumps are alike in construction as shown in Figure 8-7. The PA-32-300 and PA-32R-300 are equipped with one rotary vane type pump. All pumps may be removed by the following procedure:

a. Turn the fuel selector to the off position.
b. Remove the floor panel that is located directly aft of the main spar by removing the center seats, seat belt attachments and the screws that secure the panel. Lift the panel and remove it from the airplane.
c. On PA-32-260 remove the pump cover located in the left side of the floor opening.
d. Disconnect the electrical lead from the pump.
e. Disconnect the inlet and outlet lines from the pump.
f. Remove the pump by removing the pump attachment bolts.
g. Reinstall the fuel pump in reverse of removal instructions.

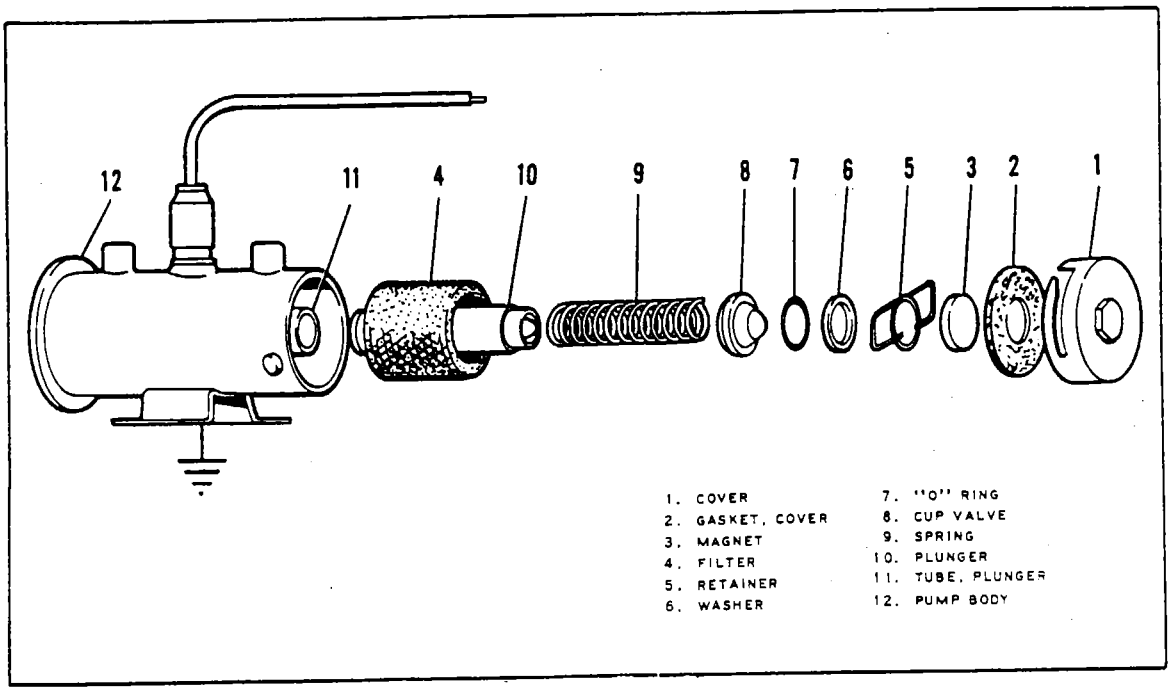


Figure 8-7. Pulsate (Plunger) Fuel Pump

8-26. CLEANING ELECTRIC FUEL PUMP SCREEN (PA-32-260). (Refer to Figure 8-7.)

a. Turn the fuel selector to the off position.

b. Remove the floor panel that is located directly aft of the main spar by removing the center seats, seat belt attachments and screws that secure the panel. Lift the panel and remove it from the airplane.

c. Remove the cover of the fuel pump box located in the left side of the opening.

d. Remove the safety wire that secures the cover (1) on the pump.

e. Turn the cover on the pump in a counterclockwise direction and remove.

f. Usually the fuel pump filter (4) comes off with the fuel pump cover, although it may stick inside the fuel pump. Carefully remove the filter and rinse it in acetone, gasoline or kerosene to thoroughly clean it. If the gasket (2) is badly compressed or damaged, replace it.

g. Clean the fuel pump cover and magnet (3) in the same manner as the screen.

h. Replace the fuel pump filter, gasket and cover. Secure the cover with safety wire.

TABLE VIII-III. TROUBLESHOOTING CHART (FUEL SYSTEM)

Trouble	Cause	Remedy
Failure of fuel to flow.	Fuel line blocked.	Flush fuel system.
	Fuel vent cap blocked.	Check and clean vent hole in cap.
	Mechanical or electrical fuel pump failure.	Check and replace if necessary.
	Fuel selector valve in improper position.	Reposition as required.
		Check for obstructions in the fuel selector leverage mechanism.
	Damaged fuel selector valve.	Replace fuel selector valve.
Fuel quantity gauge fails to operate.	Broken wire.	Check and repair.
	Gauge inoperative.	Replace gauge.
	Fuel sender float partially or completely filled with fuel.	Replace sender.
	Circuit breaker open.	Check and reset.
	Float and arm assembly of fuel sender sticking.	Check.
	Bad ground.	Check for good contact at ground lip or rear of gauge.

FUEL SYSTEM
Added: 7/28/75

TABLE VIII-III. TROUBLESHOOTING CHART (FUEL SYSTEM) (cont.)

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel selector valve stuck.	Check fuel selector valve.
	Fuel tanks empty.	Check fuel tanks and fill.
	Defective gauge.	Replace gauge.
	Fuel selector valve in improper position.	Reposition fuel selector valve lever.
Low pressure or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Air in line to pressure gauge.	Bleed line.

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SECTION IX

INSTRUMENTS

		Aerofiche Grid No.
9-1.	General	2J18
9-2.	Non-Electrical Instruments	2J18
9-3.	Vacuum System	2J18
9-4.	Vacuum System and Gyro Pressure Service Tips	2J18
9-5.	Troubleshooting	2J20
9-6.	Suction Gauge	2K10
9-7.	General	2K10
9-8.	Troubleshooting	2K10
9-9.	Vacuum Regulator Valve	2K10
9-10.	General	2K10
9-11.	Troubleshooting	2K10
9-12.	Adjustments of Vacuum Regulator Valve	2K10
9-13.	Removal and Replacement	2K11
9-14.	Vacuum Pump	2K11
9-15.	General	2K11
9-16.	Troubleshooting	2K11
9-17.	Removal and Replacement	2K11
9-17a.	Replacing Pump Fittings	2K11
9-17b.	Instrument Air System	2K13
9-18.	Directional Gyro	2K13
9-19.	General	2K13
9-20.	Troubleshooting	2K14
9-21.	Removal and Replacement	2K14
9-22.	Gyro Horizon	2K14
9-23.	General	2K14
9-24.	Troubleshooting	2K15
9-25.	Removal and Replacement	2K16
9-26.	Rate of Climb Indicator	2K16
9-27.	General	2K16
9-28.	Troubleshooting	2K16
9-29.	Removal and Replacement	2K17
9-30.	Sensitive Altimeter	2K17
9-31.	General	2K17
9-32.	Troubleshooting	2K18
9-33.	Removal and Replacement	2K19

Revised: 7/28/75

		Aerofiche Grid No.
9-34.	Airspeed Indicator	2K19
9-35.	General	2K19
9-36.	Troubleshooting	2K20
9-37.	Removal and Replacement	2K20
9-38.	Magnetic Compass	2K21
9-39.	General	2K21
9-39a.	Adjustment of Compass	2K21
9-40.	Troubleshooting	2K22
9-41.	Manifold Pressure Gauge	2K23
9-42.	General	2K23
9-43.	Troubleshooting	2K23
9-44.	Removal and Replacement	2K23
9-45.	Tachometer Indicator	2K23
9-46.	General	2K23
9-47.	Troubleshooting	2K24
9-48.	Removal and Replacement	2K24
9-49.	Engine Oil Pressure Gauge	2K24
9-50.	General	2K24
9-51.	Troubleshooting	2L1
9-52.	Removal and Replacement	2L1
9-53.	Fuel Pressure Gauge	2L1
9-54.	General	2L1
9-55.	Troubleshooting	2L2
9-56.	Removal and Replacement	2L3
9-57.	Turn and Bank Indicator	2L3
9-58.	General	2L3
9-59.	Troubleshooting	2L3
9-60.	Electrical Instruments	2L4
9-61.	Removal and Replacement	2L4
9-62.	Fuel Quantity Indicator	2L4
9-63.	General	2L4
9-64.	Troubleshooting	2L4
9-65.	Removal and Replacement	2L5
9-66.	Oil Temperature Indicator	2L5
9-67.	General	2L5
9-68.	Troubleshooting	2L5
9-69.	Removal and Replacement	2L5
9-70.	Ammeter	2L5
9-71.	General	2L5
9-72.	Troubleshooting	2L5
9-73.	Removal and Replacement	2L5
9-74.	Removal and Replacement of Face Mounted Instruments	2L6
9-75.	General	2L6
9-76.	Removal and Replacement of Cluster Mounted Instruments	2L7
9-77.	General	2L7

Paragraph		Aerofiche Grid No.
9-78.	Exhaust Gas Temperature Gauge (Alcor)	2L7
9-79.	General	2L7
9-80.	Removal of EGT Probe and Gauge	2L7
9-81.	Cleaning and Inspection	2L7
9-82.	Installation of EGT Probe and Gauge	2L8
9-83.	Troubleshooting	2L9
9-84.	Cylinder Head Temperature Gauge	2L10
9-85.	General	2L10
9-86.	Troubleshooting	2L10
9-87.	Removal and Replacement	2L10
9-88.	Fuel Flow Gauge	2L10
9-89.	General	2L10
9-90.	Troubleshooting	2L11
9-91.	Removal and Replacement	2L11
9-92.	Piper AutoControl System	2L11
9-93.	Annunciator Panel	2L11
9-94.	General	2L11
9-95.	Troubleshooting	2L11
9-96.	Removal and Replacement	2L11

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SECTION IX

INSTRUMENTS

9-1. GENERAL. The instrumentation in the Cherokee Six is designed to give a quick and actual indication of the attitude, performance and condition of the airplane. Maintenance, other than described in these sections shall be done by the instrument manufacturer or an authorized repair station.

The two types of instruments have been classified in this section as non-electrical and electrical. The first part of this section will pertain to maintenance and troubleshooting of all the instruments and their systems which depend on non-electrical sources for their operation. The remaining portion of this section is directed to maintenance and troubleshooting of all the electrically operated instruments.

9-2. NON-ELECTRICAL INSTRUMENTS.

9-3. VACUUM SYSTEM.

9-4. VACUUM SYSTEM AND GYRO PRESSURE SERVICE TIPS. The following information is intended to acquaint field service personnel with a means to diagnose vacuum system service symptoms on those components which are serviced by removal and replacement. These items include hoses, clamps, gyro filters, vacuum regulating valves and vacuum gauges.

a. Hoses and Clamps:

1. These items should be examined periodically and inspected carefully whenever engine maintenance activities cause hose disconnections to be made at the pump, regulating valve, gyros and/or vacuum gauge.

2. The ends of the hoses should be examined for rubber separation and slivers of rubber on the inside diameter of the hoses. These slivers can and do become detached. If this happens, the vacuum pump sucks these loose particles and eventually ingests them. This can cause premature pump service.

3. Hose clamps and fittings should be replaced when broken, damaged or corroded.

CAUTION

When replacing any of the threaded fittings, DO NOT USE PIPE DOPE or any other anti-seize compound. The AIRBORNE fittings are all cadmium plated to avoid the need for any other anti-seize materials. The reason for this caution is to protect the pump from ingesting any foreign materials that could cause premature service.

b. Vacuum Gauges:

1. Vacuum gauges seldom require service and usually are replaced when malfunctions occur.

NOTE

Vacuum gauge failure in a properly operating vacuum system does not impair safety of flight.

2. If the vacuum gauge malfunctions in a manner to cause an incorrect reading in normal cruise conditions, the gauge must be checked by comparing the reading with a gauge of known accuracy. If the gauge is indicating correct values and the system vacuum level is not in accordance with the specified vacuum, then and only then should the regulator be reset.

3. Visual examination of the gauge performance should cover the following steps:

(a) With engine stopped and no vacuum applied to the gauge, its pointer should rest against the internal stop in the 9 o'clock position. Any other displacement from this position suggests need for replacement.

(b) A slight overshoot during engine startup, not to exceed half an inch (1/2") of mercury, is normal and is not cause to replace gauge.

(c) With engine operating at normal cruise RPM, the gauge should read from 4.9 inches to 5.1 inches of mercury (vacuum).

(d) At 1200 RPM, the vacuum gauge reading should be more than four inches of mercury.

c. Gyro Filters:

1. Gyro filters must be serviced on a scheduled basis, not to exceed 100 hours, or sooner as condition indicates.

NOTE

Several gyro filter systems have been used on various aircraft, depending on when the aircraft was built.

2. The oldest aircraft installations generally did not have central filters. They depended on the small cloth or paper disc-type filters built into the instruments themselves. This type of filter requires frequent replacement for proper gyro operation.

3. The later system installation employed a large central filter which eliminated the frequent replacement of the small internal filters in the gyros.

4. The latest system installation employs a large central filter and differential vacuum gauge that continuously monitors the filter condition while indicating vacuum readings.

NOTE

In the aircraft systems described in Items (2) and (3) above, failure to replace filters would cause a slight increase in vacuum gauge readings. The AIRBORNE regulator will automatically adjust to the flow changes that result when dirty filters are allowed to remain in the system.

NOTE

The latest systems which employ a central filter in combination with a differential vacuum gauge will indicate a decline in panel gauge reading when the filter becomes clogged and vacuum declines below the recommended value. The filters should be replaced when gauge reading declines below the recommended value; do not adjust regulator.

d. Vacuum Regulator:

1. The vacuum regulating valve seldom needs replacement. Symptoms that suggest replacement are:

(a) Chatter as indicated by rapid fluctuation of the vacuum gauge needle or an audible sound.

(b) Non-repeatability of the vacuum gauge reading when the panel gauge is not suspect or has been checked against a known test gauge (cruise RPM only).

2. All modes of regulator malfunction tend to increase the vacuum power applied to the gyros. Thus, although excess vacuum is applied, a loss of vacuum does not occur.

3. The gyros themselves act as a limiting device to keep the vacuum power applied from exceeding safe levels.

NOTE

If the panel gauge has been checked and found OK and the vacuum gauge reading does not repeat within the range of 4.8 to 5.2 inches of mercury, then the regulating valve should be changed. Observe the usual precautions for maintaining system cleanliness to avoid premature pump service.

9-5. TROUBLESHOOTING.

TABLE IX-I. VACUUM SYSTEM

NOTE

For Serial Numbers before 32-7100001 and 32-7140001.

Trouble	Cause	Remedy
No vacuum pressure gauge indication.	Pump inoperative, disconnected. Broken or restricted lines.	Replace pump. Locate trouble and correct.

TABLE IX-I. VACUUM SYSTEM (cont)

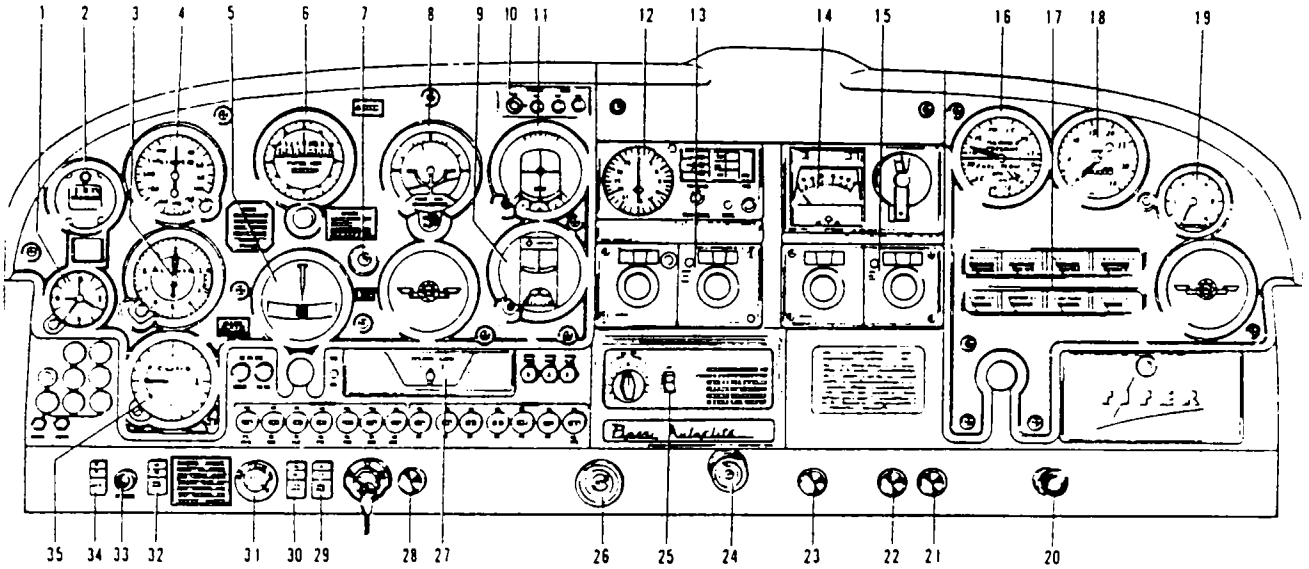
Trouble	Cause	Remedy
No vacuum gauge indication at instrument.	Hose from instrument to gauge leaking or restricted.	Check all lines and connections.
No vacuum gauge indication at either instrument or source.	Faulty gauge. Malfunctioning, regulator valve, or vacuum pump.	Check operation of instrument. If operation is normal, replace gauge. If instruments are inoperative, check operation of vacuum pump or regulator valve.
	Vacuum lines restricted or broken.	Check system.
Low vacuum system pressure.	Vacuum regulator valve incorrectly adjusted.	Adjust regulator valves in accordance with Adjustments of this section.
	Leaking of the system lines or fittings.	Check all lines and fittings.
	Malfunctioning pump.	Replace pump.
	Overboard line from vacuum pump restricted. Sealing plugs loose in gyros.	Replace line.
Normal pressure indication, but sluggish operation of instruments.	Instruments air filter elements dirty.	Remove and clean or replace.
	Line restricted between gyro and filter.	Check all lines and fittings.

TABLE IX-I. VACUUM SYSTEM (cont)

Trouble	Cause	Remedy
High system pressure.	Vacuum regulator valve incorrectly adjusted.	Adjust in accordance with Adjustments of this section.
	Vacuum regulator valve sticking or dirty screen.	Clean and check operation of regulator valve.
	Faulty gauge.	Replace gauge.
Aircraft Serial Numbers 32-7100001 and 32-7140001 and above.		
No vacuum gauge indication at instrument.	Filter clogged or dirty.	Clean or replace filter.
	Line from gyro to filter restricted.	Check line.
No vacuum gauge indication at instrument or source.	Faulty gauge and/or malfunctioning pump.	Replace gauge. Replace pump.
Low vacuum system pressure.	Filter dirty.	Clean or replace filter.
	Vacuum regulator valve incorrectly adjusted.	Adjust regulator valve in accordance with Adjustments in this section.
	Line from gyros to filter restricted.	Repair line.
	Line from pump to gyros leaking.	Check all lines and fittings.
Normal pressure indication but sluggish operation of instruments.	Faulty instrument.	Replace instrument.

TABLE IX-I. VACUUM SYSTEM (cont)

Trouble	Cause	Remedy
High system pressure.	Vacuum regulator incorrectly adjusted.	Adjust regulator.
	Vacuum regulator sticking or dirty screen.	Clean and check operation of regulator.
Regulator cannot be adjusted to produce correct pressure.	Lines leaking.	Check lines and fittings.
	Vacuum pump malfunctioning.	Replace pump.
Vacuum correct on ground but will not maintain pressure at altitude.	Vacuum pump malfunctioning.	Replace pump.
	Regulator sticky.	Clean regulator.
Vacuum correct but pilot reports pressure erratic or shows complete loss in flight.	Regulator sticky.	Clean regulator.
	Oil in pump due to leaky engine seal or cleaning fluid blown into pump while cleaning engine.	Replace pump.
Pressure can only be maintained at full throttle on ground.	Leak in system.	Repair or replace lines.
	Worn pump.	Replace pump.
	Stuck regulator.	Clean or replace regulator.

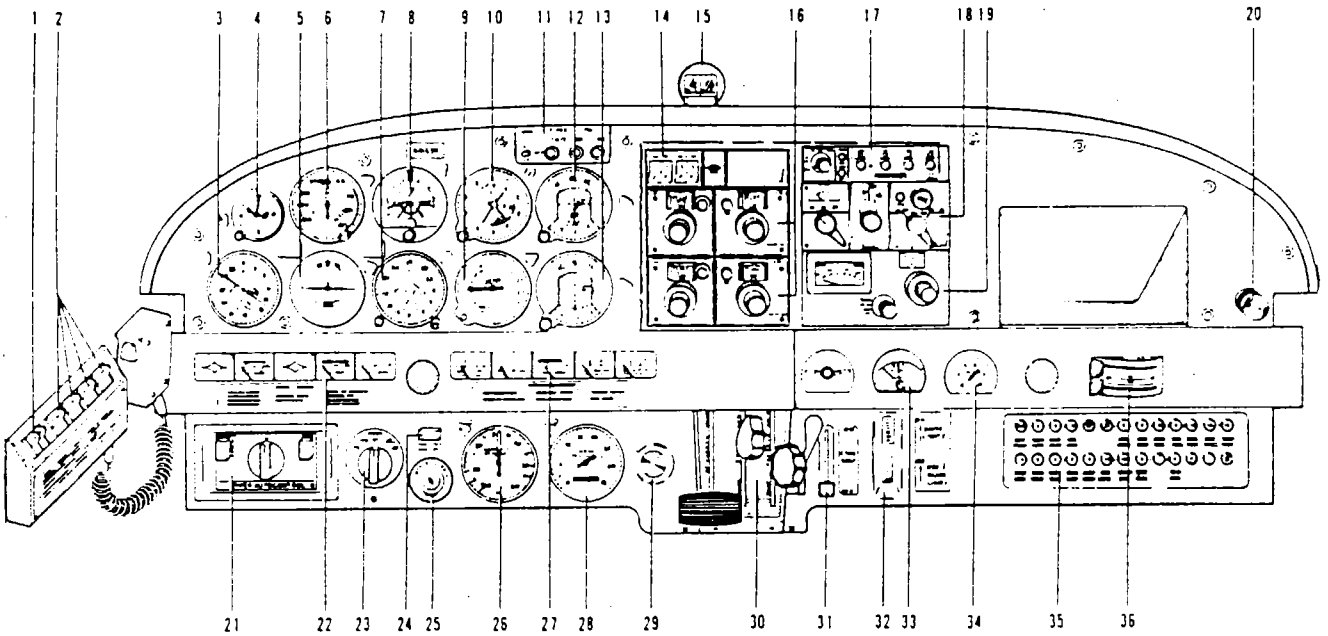


1. CLOCK
2. COMPASS
3. ALTIMETER
4. AIRSPEED INDICATOR
5. TURN & BANK INDICATOR
6. DIRECTIONAL GYRO
7. STALL WARNING INDICATOR
8. GYRO HORIZON
9. OMNI INDICATOR
10. MARKER BEACON LIGHTS
11. GLIDESLOPE INDICATOR
12. ADF RECEIVER
13. COMM/NAV TRANSCEIVERS
14. DME
15. COMM/NAV TRANSCEIVERS
16. MANIFOLD PRESSURE & FUEL FLOW GAUGE
17. ENGINE CLUSTER
18. TACHOMETER
19. VACUUM
20. CIGAR LIGHTER
21. DEFROSTER
22. CABIN HEAT
23. MIXTURE CONTROL
24. PROPELLER CONTROL
25. AUTOFLITE CONTROL
26. THROTTLE
27. TRANSMITTER SELECTOR
28. ALTERNATE AIR
29. ROTATING BEACON
30. LANDING LIGHTS
31. NAVIGATION LIGHT
32. ELECTRIC FUEL PUMP
33. STARTER SWITCH
34. MASTER SWITCH
35. RATE OF CLIMB INDICATOR

Figure 9-1. Instrument Panel
PA-32-260, Serial Nos. 32-1 to 32-1110 inclusive
PA-32-300, Serial Nos. 32-40000 to 32-40565 inclusive

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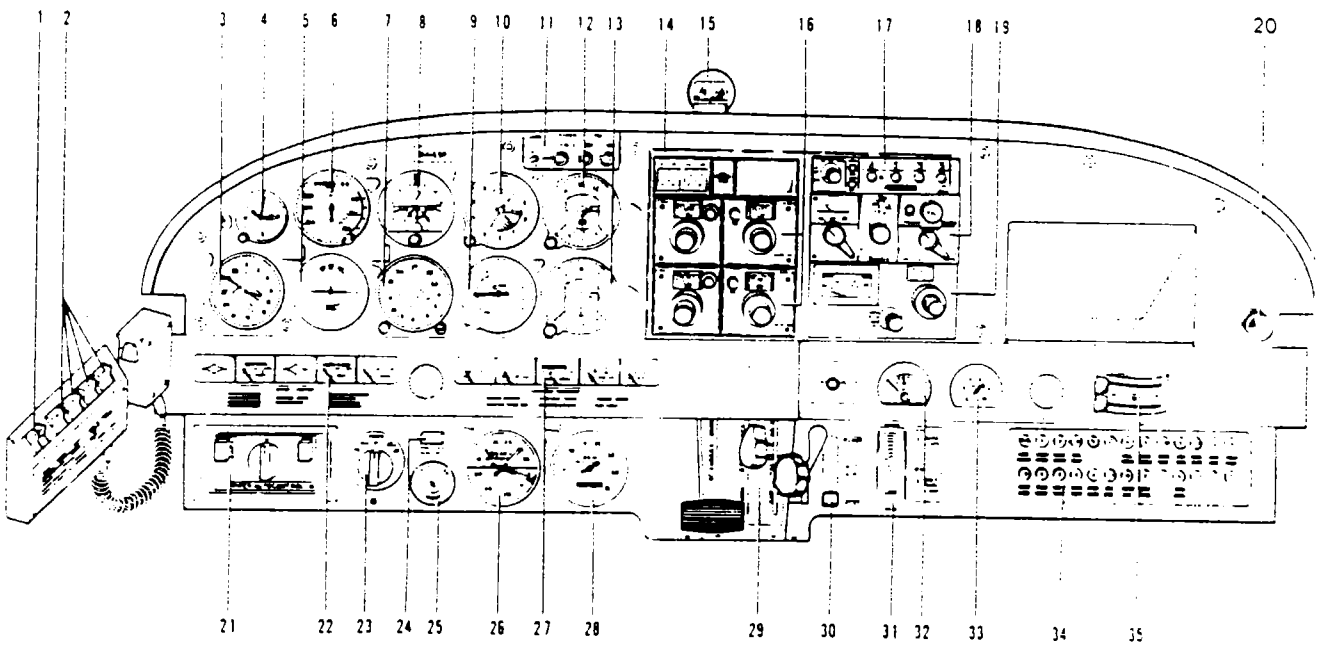
1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN COORDINATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICIAL HORIZON
9. RATE OF CLIMB INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. GLIDESLOPE INDICATOR
13. OMNI BEARING HEAD
14. RADIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME
20. LIGHTER



21. AUTOCONTROL
22. ENGINE GAUGES
23. NAV COUPLER
24. PITCH TRIM SWITCH
25. MAGNETO & STARTER SWITCH
26. MANIFOLD PRESSURE
27. FUEL INDICATOR
28. TACHOMETER
29. PRIMER
30. POWER CONTROL QUADRANT
31. CARBURETOR HEAT
32. NAV & INSTRUMENT LIGHTS
33. MIXTURE INDICATOR
34. GYRO SUCTION GAUGE
35. CIRCUIT BREAKERS
36. HEAT & DEFROSTER CONTROLS

Figure 9-2. Instrument Panel
PA-32-260, Serial Nos. 32-1111 to 32-1320

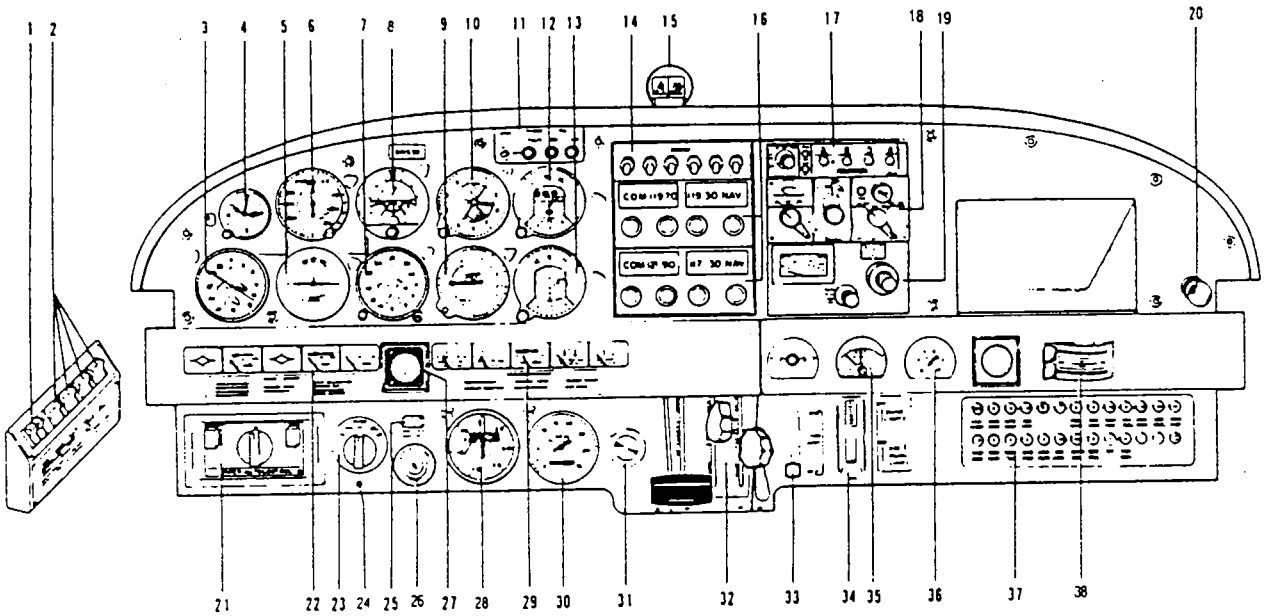
1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN COORDINATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICAL HORIZON
9. RATE OF CLIMB INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. GLIDE SLOPE INDICATOR
13. OMNI BEARING HEAD
14. RADIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME
20. LIGHTER



21. AUTOCONTROL
22. ENGINE GAUGES
23. NAV COUPLER
24. PITCH TRIM SWITCH
25. MAGNETO & STARTER SWITCH
26. MANIFOLD PRESSURE & FUEL FLOW
27. FUEL INDICATORS
28. TACHOMETER
29. POWER CONTROL QUADRANT
30. ALTERNATE AIR CONTROL
31. NAV & INSTRUMENT LIGHTS
32. MIXTURE INDICATOR
33. GYRO SUCTION GAUGE
34. CIRCUIT BREAKERS
35. HEAT & DEFROSTER CONTROLS

Figure 9-3. Instrument Panel
PA-32-300, Serial Nos. 32-40566 to 32-41018

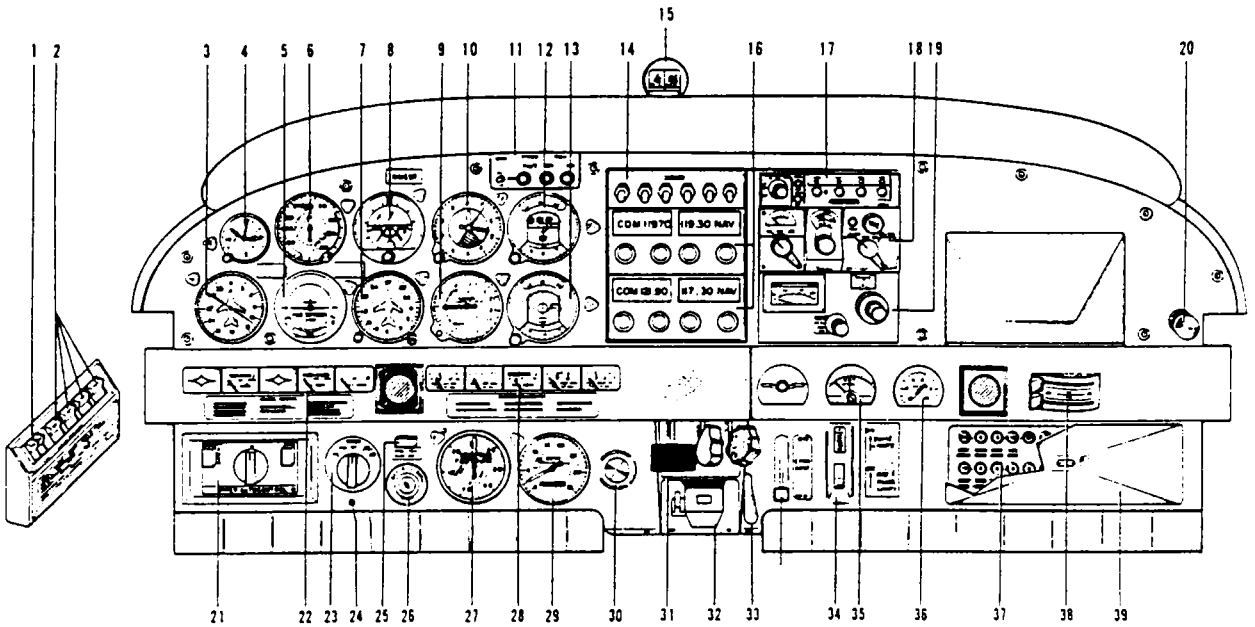
1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN INDICATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICIAL HORIZON
9. VERTICAL SPEED INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. GLIDE SLOPE INDICATOR
13. OMNI BEARING HEAD
14. AUDIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME RADIO
20. CIGAR LIGHTER



21. AUTOCONTROL
22. ENGINE INSTRUMENT CLUSTER
23. NAV COUPLER
24. TRANSMITTER SELECTOR
25. PITCH TRIM SWITCH
26. MAGNETO AND STARTER SWITCH
27. CONTROL LOCK
28. MANIFOLD PRESSURE GAUGE
29. FUEL SYSTEM INSTRUMENT CLUSTER
30. TACHOMETER
31. PRIMER - PA-32-260 ONLY
32. THROTTLE QUADRANT
33. CARBURETOR HEAT CONTROL
PA-32-260 ONLY
33. ALTERNATE AIR CONTROL
PA-32-300 ONLY
34. NAV/INSTRUMENT LIGHTS
35. EGT INDICATOR
36. GYRO SUCTION GAUGE
37. CIRCUIT BREAKER PANEL
38. HEAT AND DEFROST CONTROLS

Figure 9-4. Instrument Panel
PA-32-260, Serial Nos. 32-7100001 to 32-7200055

2602

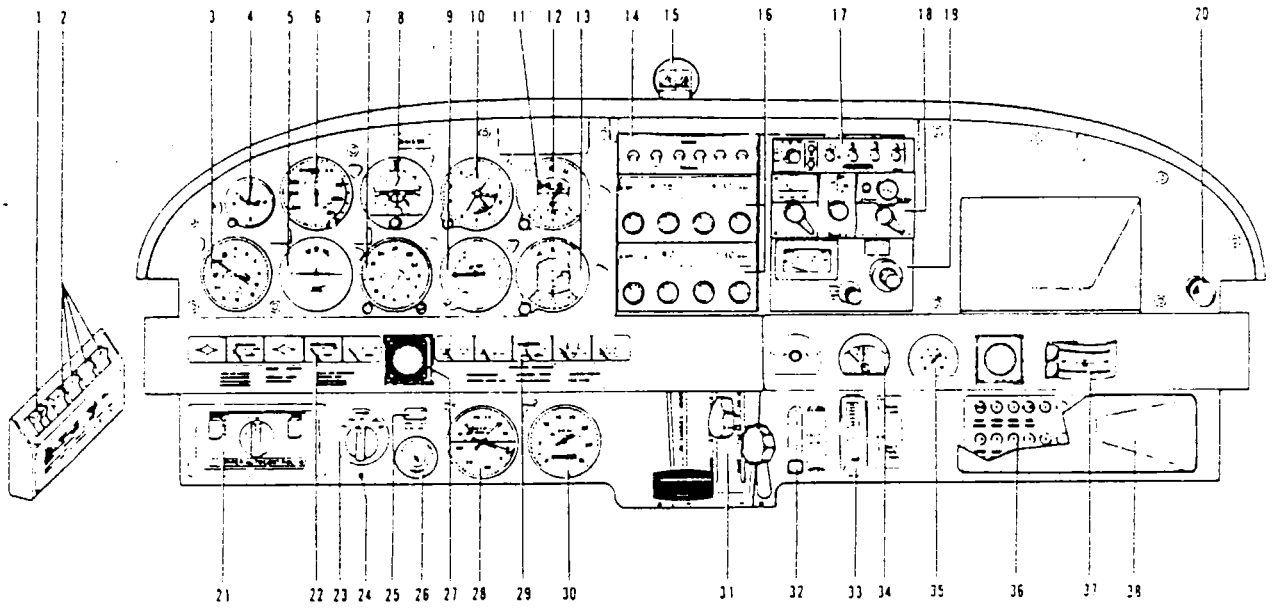


1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN INDICATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICIAL HORIZON
9. VERTICAL SPEED INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. VOR/LOC INDICATOR
13. VOR/ILS INDICATOR
14. AUDIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME RADIO
20. CIGAR LIGHTER
21. AUTOCONTROL
22. ENGINE. INSTRUMENT CLUSTER
23. NAV COUPLER
24. TRANSMITTER SELECTOR
25. PITCH TRIM SWITCH
26. MAGNETO AND STARTER SWITCH
27. MANIFOLD PRESSURE
28. FUEL GAUGES
29. TACHOMETER
30. PRIMER
31. THROTTLE QUADRANT
32. MICROPHONE
33. FRICTION LOCK
34. NAV/INSTRUMENT LIGHTS
35. EGT INDICATOR
36. GYRO SUCTION GAUGE
37. CIRCUIT BREAKER PANEL
38. HEAT & DEFROSTER CONTROLS
39. CIRCUIT BREAKER COVER
40. CARBURETOR HEAT

Figure 9-4a. Instrument Panel
PA-32-260, Serial Nos. 32-7300001 thru 32-7400061

2604

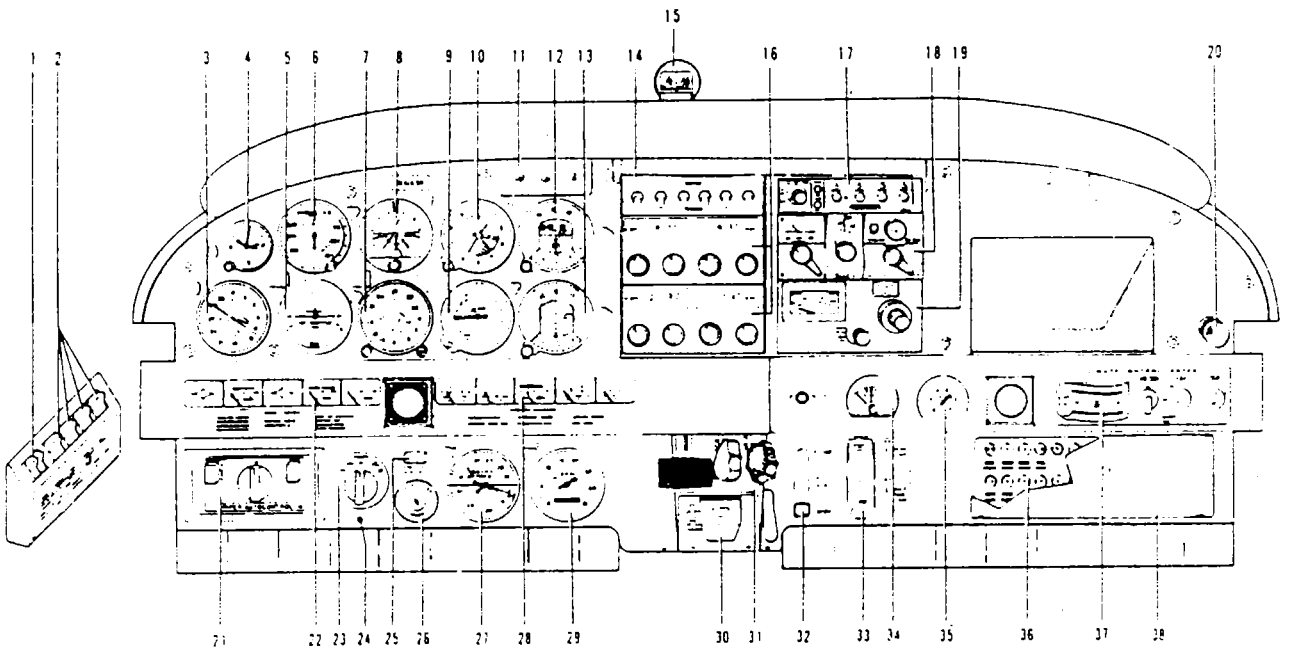
1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN INDICATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICIAL HORIZON
9. VERTICAL SPEED INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. GLIDE SLOPE INDICATOR
13. OMNI BEARING NAV HEAD
14. AUDIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME RADIO
20. CIGAR LIGHTER
21. AUTOCONTROL



22. ENGINE INST. CLUSTER
23. RADIO COUPLER
24. TRANSMITTER SELECTOR
25. PITCH TRIM SWITCH
26. MAGNETO AND STARTER SWITCH
27. CONTROL LOCK
28. MANIFOLD PRESSURE GAUGE
29. FUEL SYSTEM INST. CLUSTER
30. TACHOMETER
31. THROTTLE QUADRANT
32. ALTERNATE AIR CONTROL
33. NAV AND INSTRUMENT LIGHTS
34. EGT INDICATOR
35. GYRO SUCTION GAUGE
36. CIRCUIT BREAKER PANEL
37. HEAT AND DEFROST CONTROLS
38. CIRCUIT BREAKER COVER

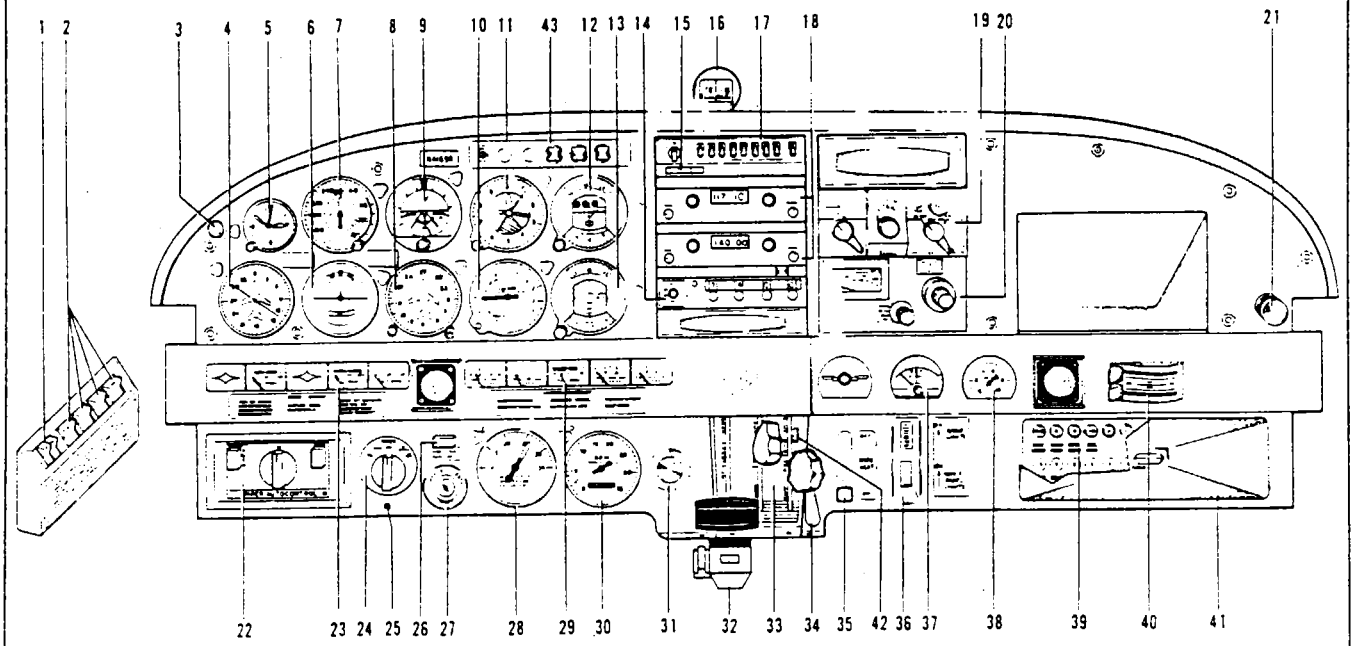
Figure 9-4b. Instrument Panel
PA-32-300, Serial Nos. 32-7140001 thru 32-7240147

2603



1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. RADIO COMPASS
4. CLOCK
5. TURN INDICATOR
6. AIRSPEED INDICATOR
7. DIRECTIONAL GYRO
8. ARTIFICIAL HORIZON
9. VERTICAL SPEED INDICATOR
10. ALTIMETER
11. MARKER BEACON LIGHTS
12. VOR/ILS INDICATOR
13. VOR/ILS INDICATOR
14. AUDIO SELECTOR PANEL
15. MAGNETIC COMPASS
16. NAV/COMM TRANSCEIVERS
17. TRANSPONDER
18. ADF RADIO
19. DME RADIO
20. CIGAR LIGHTER
21. AUTOCONTROL
22. ENGINE INST. CLUSTER
23. RADIO COUPLER
24. TRANSMITTER SELECTOR
25. PITCH TRIM SWITCH
26. MAG. AND STARTER SW.
27. MANIFOLD PRESS. GAUGE
28. FUEL GAUGES
29. TACHOMETER
30. MICROPHONE
31. THROTTLE QUADRANT
32. ALTERNATE AIR
33. NAV/INSTRUMENT LIGHTS
34. EGT INDICATOR
35. GYRO SUCTION GAUGE
36. CIRCUIT BREAKER PANEL
37. CLIMATE CONTROL CENTER
38. CIRCUIT BREAKER COVER

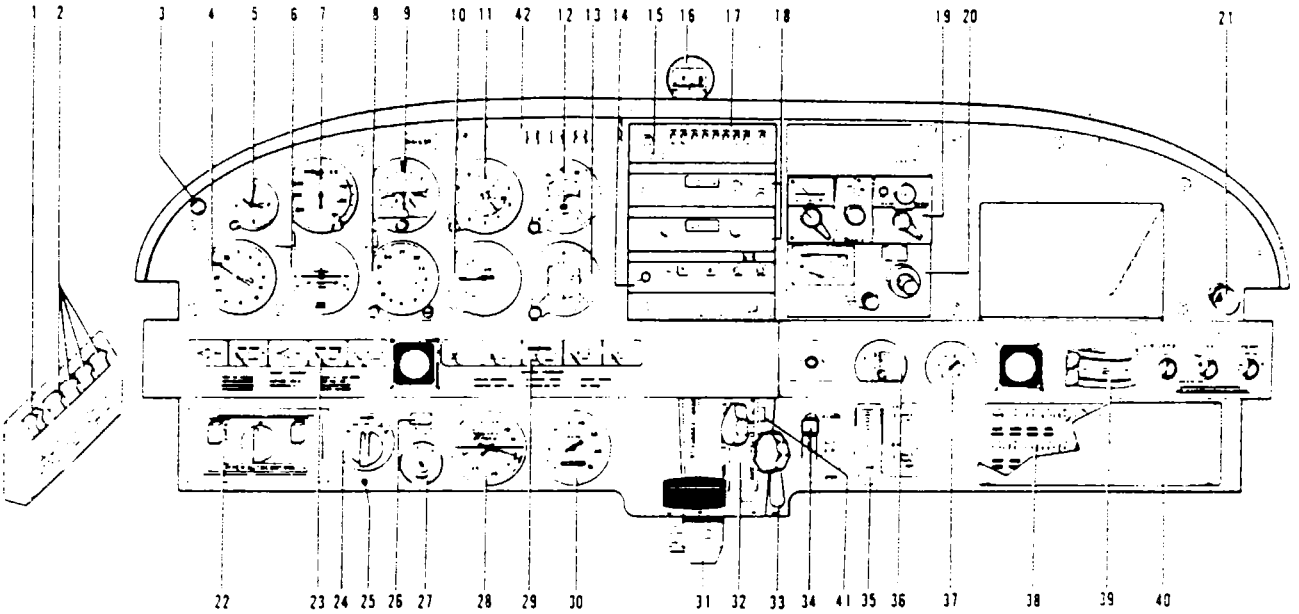
Figure 9-4c. Instrument Panel
PA-32-300, Serial Nos. 32-7340001 thru 32-7440182



1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. STALL WARNING INDICATOR
4. ADF INDICATOR
5. CLOCK
6. TURN INDICATOR
7. AIRSPEED INDICATOR
8. DIRECTIONAL GYRO
9. ARTIFICIAL HORIZON
10. VERTICAL SPEED INDICATOR
11. ALTIMETER
12. VOR/ILS INDICATOR
13. VOR INDICATOR
14. TRANSPONDER
15. MARKER BEACON LIGHTS
16. MAGNETIC COMPASS
17. AUDIO SELECTOR PANEL
18. VHF TRANSCEIVERS
19. ADF RADIO
20. DME RADIO
21. CIGAR LIGHTER
22. AUTOPILOT
23. ENGINE INSTRUMENT CLUSTER
24. NAV COUPLER
25. NAV SELECTOR SWITCH
27. MAGNETO AND STARTER SWITCH
28. MANIFOLD PRESSURE GAUGE
29. FUEL SYSTEM INSTRUMENT CLUSTER
30. TACHOMETER
31. PRIMER
32. MICROPHONE
33. THROTTLE QUADRANT
34. FRICTION LOCK
35. CARBURETOR HEAT CONTROL
36. NAV/INSTRUMENT LIGHT SWITCHES
37. EGT GAUGE
38. GYRO SUCTION GAUGE
39. CIRCUIT BREAKER PANEL
40. HEAT AND DEFROST CONTROLS
41. CIRCUIT BREAKER COVER
42. MIXTURE CONTROL LOCK
43. ANNUNCIATOR PANEL

Figure 9-4d. Instrument Panel
PA-32-260, Serial Nos. 32-7500001 and up

1. MASTER SWITCH
2. ACCESSORY SWITCHES
3. STALL WARNING INDICATOR
4. ADF INDICATOR
5. CLOCK
6. TURN INDICATOR
7. AIRSPEED INDICATOR
8. DIRECTIONAL GYRO
9. ARTIFICIAL HORIZON
10. VERTICAL SPEED INDICATOR
11. ALTIMETER
12. VOR/ILS INDICATOR
13. VOR INDICATOR
14. TRANSPONDER
15. MARKER BEACON LIGHTS
16. MAGNETIC COMPASS
17. AUDIO SELECTOR PANEL
18. VHF TRANSCEIVERS
19. ADF RADIO
20. DME RADIO
21. CIGAR LIGHTER

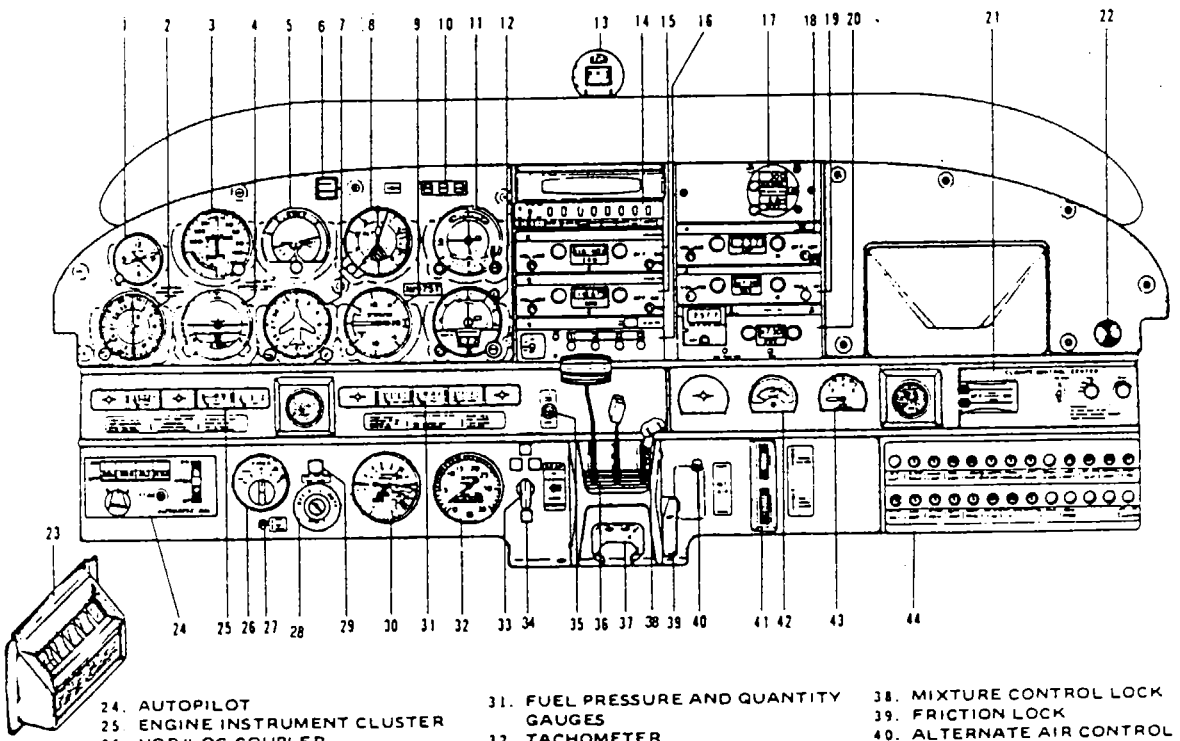


22. AUTOPILOT
23. ENGINE INSTRUMENT CLUSTER
24. NAV COUPLER
25. NAV SELECTOR SWITCH
26. PITCH TRIM SWITCH
27. MAGNETO AND STARTER SWITCH
28. MANIFOLD PRESSURE/FUEL FLOW GAUGE
29. FUEL SYSTEM INSTRUMENT CLUSTER
30. TACHOMETER
31. MICROPHONE
32. THROTTLE QUADRANT
33. FRICTION LOCK
34. ALTERNATE AIR CONTROL
35. NAV/INSTRUMENT LIGHT SWITCHES
36. EGT GAUGE
37. GYRO SUCTION GAUGE
38. CIRCUIT BREAKER PANEL
39. HEAT, DEFROST AND A.C. CONTROLS
40. CIRCUIT BREAKER COVER
41. MIXTURE CONTROL LOCK
42. ANNUNCIATOR PANEL

Figure 9-4e. Instrument Panel
PA-32-300, Serial Nos. 32-7540001 and up

2605

1. CLOCK
2. ADF INDICATOR
3. AIRSPEED INDICATOR
4. TURN (AND BANK) CO-ORDINATOR
5. ATTITUDE GYRO
6. GEAR UNSAFE LIGHT
7. DIRECTIONAL GYRO
8. ALTIMETER
9. VERTICAL SPEED INDICATOR
10. ANNUNCIATOR PANEL
11. GS/LOC/VOR INDICATOR
12. VOR INDICATOR
13. COMPASS
14. AUDIO SELECTOR PANEL
15. COM 1 AND COM 2
16. TRANSPONDER
17. R NAV
18. ADF RADIO
19. NAV 1 RADIO
20. DME RADIO
21. HEAT, DEFROST, A/C AND VENT BLOWER CONTROLS
22. CIGAR LIGHTER
23. MASTER AND ACCESSORY SWITCH PANEL



24. AUTOPILOT
25. ENGINE INSTRUMENT CLUSTER
26. VOR/LOC COUPLER
27. NAV SELECTOR SWITCH
28. MAGNETO AND STARTER SWITCH
29. PITCH TRIM SWITCH
30. MANIFOLD PRESSURE AND FUEL FLOW GAUGE
31. FUEL PRESSURE AND QUANTITY GAUGES
32. TACHOMETER
33. GEAR SELECTOR
34. "AUTO-EXT OFF" LIGHT
35. AIR CONDITION DOOR LIGHT
36. THROTTLE QUADRANT
37. MICROPHONE BRACKET
38. MIXTURE CONTROL LOCK
39. FRICTION LOCK
40. ALTERNATE AIR CONTROL
41. NAV AND PANEL LIGHT SWITCHES
42. EGT GAUGE
43. GYRO SUCTION GAUGE
44. CIRCUIT BREAKER PANEL

Figure 9-4f. Instrument Panel (PA-32R-300)

9-6. SUCTION GAUGE.

9-7. GENERAL. The suction gauge is mounted in the right side of the instrument panel. This gauge is calibrated in inches of mercury and indicates the amount of vacuum created by the engine driven vacuum pump. The suction gauge installed in "71" models 32-260-7100001 and up, and 32-300-7140001 and up, have a direct pressure line and a vent line. Therefore, these aircraft indicate the differential pressure or actual pressure being applied to the gyro instruments. As the system filter becomes clogged or lines obstructed, the gauge will show a decrease in pressure. Do not reset the regulator until the filter and lines have been checked.

9-8. TROUBLESHOOTING. For troubleshooting of this instrument, refer to Table IX-I of this section.

9-9. VACUUM REGULATOR VALVE.

9-10. GENERAL. One vacuum regulator valve is incorporated in the system to control vacuum pressure to the gyro instruments. The regulator valve is located under the instrument panel. Access to the valve for maintenance and adjustment is gained from below the instrument panel.

9-11. TROUBLESHOOTING. For troubleshooting of the vacuum regulator refer to Table IX-I.

9-12. ADJUSTMENTS OF VACUUM REGULATOR VALVE.

a. Loosen the locking nut or remove the protective cap from the valve, depending on which type is installed.

NOTE

Do not attempt adjustment of this valve with the engine in operation.

b. Start the engine, after allowing time for warm-up, run the engine at medium RPM.

c. With the engine at full throttle, the suction gauge should indicate 4.4 inches of mercury on PA 32-260 S/N 32-1 through 32-450; 4.6-5.0 inches of mercury on PA 32-260 S/N 32-451 through 32-1110 and PA-32-300 S/N 32-40000 through 32-40565; and 5.0 +.1 -.2 on PA-32-260 S/N 32-1111 and up, PA-32-300 S/N 32-40566 and up, and all 32R-300.

d. After the system pressure has been adjusted to these recommended settings; retighten the locking nut or replace the protective cap, whichever applies to the type of valve installed.

9-13. REMOVAL AND REPLACEMENT.

a. To remove the regulator valve; disconnect the three lines, remove the mounting screws and remove the valve.

b. Replace regulator in reverse order given for removal. Check complete vacuum system for proper operation.

9-14. VACUUM PUMP.

9-15. GENERAL. The vacuum pump is of the rotary vane, positive displacement type. This unit consists essentially of an aluminum housing containing a tempered sleeve in which an offset rotor, with moving blades, is incorporated. This assembly is driven by means of a coupling mated to the engine driven gear assembly. The pump is mounted on the accessory section of the engine.

9-16. TROUBLESHOOTING. For troubleshooting of the pumps, refer to Table IX-I of this section.

9-17. REMOVAL AND REPLACEMENT. The vacuum pump can be removed by the following procedure:

a. Remove the top portion of the engine cowling.

b. Loosen the hose clamp and remove the hose from the vacuum pump fitting.

c. Remove the vacuum pump by removal of the four retaining nuts, lockwasher and plain washers.

d. Reinstall pump in reverse order of removal, noting alignment of spline on the pump drive with the spline on the engine drive assembly.

CAUTION

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.

9-17a. REPLACING PUMP FITTINGS.

a. The handling procedure for securing the pump while installing or removing fittings are as follows:

1. Use two soft wood blocks in a vise to protect pump from vise jaws.
2. The pump square mounting flange must be held between the wood blocks at right angles to the vise jaws.
3. Use only enough vise pressure to hold pump firmly.

CAUTION

Do not apply vise pressure to outside diameter or overall length of the pump.

b. Thread lubricant, if required, should be applied sparingly to the external threads of the fitting only. Use a powdered moly sulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray.

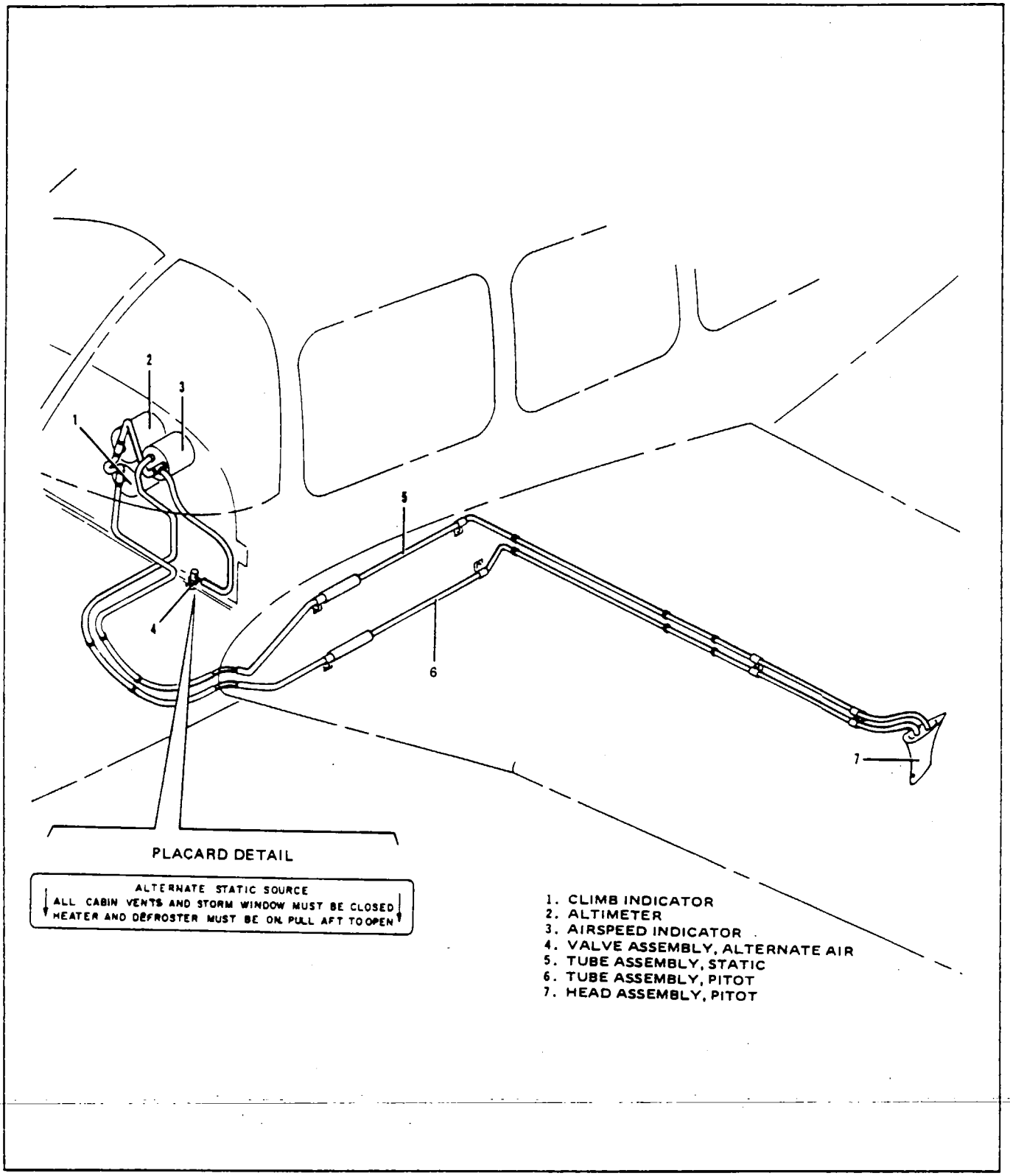


Figure 9-5. Instrument Air System Installation

CAUTION

Do not use thread dope, hydrocarbon oil or grease, as these can contaminate pump and cause malfunction.

c. Use the following steps for fitting installation:

1. Secure pump as noted above.
2. The use of 3M-48x1/4 Teflon tape on fitting threads is recommended. Insure 1 to 2 lead-in threads are free of sealant tape. (Refer to para. 9-75, d. of this section for application instructions).
3. Insert fittings in pump ports and hand tighten firmly.
4. Using a wrench, tighten each fitting from one-half to two additional turns.

9-17b. INSTRUMENT AIR SYSTEM. (Refer to Figure 9-5.)

The instrument air system consists of a pitot air system and a static air system. Refer to Figure 9-5 for system layout.

Pitot air system consists of a pitot mast located on the bottom side of the left wing, with its' related plumbing. Impact air pressure entering the pitot is transmitted from the pitot inlet through hose and tubing routed in through the wing to the airspeed indicator on the instrument panel.

Static air system consists of a static port located on the bottom of the pitot mast. The static port is directly connected to the airspeed indicator, altimeter and rate of climb indicator, on the instrument panel, by means of hose and tubing routed through the wing along with the pitot line. An alternate static air source is located below the instrument panel in front of the pilot. The alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed. A placard giving instructions for use is located on the instrument panel.

9-18. DIRECTIONAL GYRO.

9-19. GENERAL. 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 simular to a compass card. The dial, when set to agree with the airplane magnetic compass provides a positive indication free from swing and turning error. However, the directional gyro has no sense of direction and must be set to the magnetic compass, since the magnetic compass is subject to errors due to magnetic fields, electric instruments etc., the directional gyro is only accurate for the heading it has been set for. If the gyro is set on 270°, for instance, and the aircraft is turned to some other heading, there can be a large error between the gyro and the magnetic compass due to the error in compass compensation, this will appear as gyro precession. The gyro should only be checked on the heading on which it was first set, also due to internal friction, spin axis error, air turbulence and airflow, the gyro should be set at least every 15 minutes for accurate operation, whether it has drifted or not.

9-20. TROUBLESHOOTING.

TABLE IX-II. DIRECTIONAL GYRO INDICATOR

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	See Part 9-19.
	Defective instrument.	Replace instrument.
	High or low vacuum. If vacuum is not correct, check for the following:	
	a. Relief valve improperly adjusted.	a. Adjust.
	b. Incorrect gauge reading.	b. Replace gauge.
	c. Pump failure.	c. Repair or replace.
	d. Vacuum line kinked or leaking.	d. Check and repair. Check for collapsed inner wall of hose.
Dial spins during turn.	Limits (55° bank) of gimbal exceeded.	Recage gyro in level flight.
Dial spins continuously.	Defective mechanism.	Replace.

9-21. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-22. GYRO HORIZON.

9-23. GENERAL. 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 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. The gyro horizon is marked for different degrees of bank.

9-24. TROUBLESHOOTING.

TABLE IX-III. GYRO HORIZON INDICATOR

Trouble	Cause	Remedy
Bar fails to respond.	Insufficient vacuum.	Check pump and tubing.
	Filter dirty.	Clean or replace filter.
Bar does not settle.	Insufficient vacuum.	Check line and pump. Adjust valve.
	Incorrect instrument.	Check part number.
	Defective instrument.	Replace.
Bar oscillates or shimmies continuously.	Instrument loose in panel.	Tighten mounting screws.
	Vacuum too high.	Adjust valve.
	Defective mechanism.	Replace instrument.
Instrument does not indicate level flight.	Instrument not level in panel.	Loosen screws and level instrument.
	Aircraft out of trim.	Trim aircraft.
Bar high after 180° turn.	Normal, if it does not exceed 1/16 inch.	
Instrument tumbles in flight.	Low vacuum.	Reset regulator.
	Dirty filter.	Clean or replace filter.
	Line to filter restricted.	Replace line.
	Plug missing or loose in instrument.	Replace or tighten plug.

9-25. REMOVAL AND REPLACEMENT. (Refer to Paragraph 9-74 of this section.)

9-26. RATE OF CLIMB INDICATOR.

9-27. GENERAL. 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. But due to the lag of the instrument, the aircraft will be climbing or descending before the instrument starts to read and the instrument will continue to read after the aircraft has assumed level flight. In rough air this should not be considered a malfunction.

9-28. TROUBLESHOOTING.

TABLE IX-IV. RATE OF CLIMB INDICATOR

Trouble	Cause	Remedy
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. Clear line.
	Pitot head frozen over.	
	Water in static line.	Check individual instruments for obstruction in lines.
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	Leaks in static lines.	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.

TABLE IX-IV. RATE OF CLIMB INDICATOR (cont)

Trouble	Cause	Remedy
Rate of climb indicates when aircraft is banked.	Water in static line.	Disconnect static lines and blow out lines from cockpit out to pitot head.
Pointer has to be set before every flight.	Temperature compensator inoperative.	Replace instrument.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Case of instrument broken or leaking.	Replace instrument.

NOTE

When any connections in the static system are opened for checking, system must be rechecked per F.A.R. 23.1325.

9-29. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-30. SENSITIVE ALTIMETER.

9-31. GENERAL. The altimeter indicates pressure altitude in feet above sea level. The indicator has three pointers and a dial scale, the long pointer is read in hundreds of feet, the middle pointer in thousandths of feet and the short pointer in ten thousandth of feet. A barometric pressure window is located on the right side of the indicator dial and is 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.

9-32. TROUBLESHOOTING.

TABLE IX-V. ALTIMETER

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High or low reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of airspeed tube.
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.	Not tight when altimeter was reset.	Tighten instrument screw, if loose. Replace instrument, if screw is missing.
Cracked or loose cover glass.	Case gasket hardened.	Replace instrument.
Dull or discolored markings.	Age.	
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.	Reset pointers, per AC 43.13-1 Ch. 7.

TABLE IX-V. ALTIMETER (cont)

Trouble	Cause	Remedy
Altimeter sticks at altitude or does not change with change of altitude.	Water or restriction in static line.	Remove static lines from all instruments, blow line clear from cockpit to pitot head.
Altimeter changes reading as aircraft is banked.	Water in static line.	Remove static lines from all instruments, and blow line clear from cockpit to pitot head.
Altimeter requires resetting frequently.	Temperature compensator inoperative.	Change instrument.

NOTE

When any connections in the static system are opened for check, system must be rechecked per F.A.R. 23.1325.

9-33. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-34. AIRSPEED INDICATOR.

9-35. GENERAL. 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 to 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 indicated 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.

9-36. TROUBLESHOOTING.

TABLE IX-VI. AIRSPEED TUBES AND INDICATOR

Trouble	Cause	Remedy
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.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot head not aligned correctly.	Realign pitot head.
Airspeed changes as aircraft is banked.	Water in pitot line.	Remove lines from static instruments and blow out lines from cockpit to pitot head.

NOTE

When any connections in static system are opened for checking, system must be checked per F.A.R. 23.1325.

9-37. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-38. MAGNETIC COMPASS.

9-39. GENERAL. The magnetic compass is a self-contained instrument. This instrument has an individual light which is connected to the instrument lighting circuit. The compass correction card is located in the card holder mounted on the instrument. The compass should be swung whenever instruments or radios are changed and at least once a year.

9-39a. ADJUSTMENT OF COMPASS. Before attempting to compensate compass, every effort should be made to place the aircraft in simulated flight conditions; check to see that the doors are closed, flaps in retracted position, engine running, throttle set at cruise position and aircraft in level flight attitude. Aircraft master switch, alternator switch and all radio switches should be in the ON position. All other cockpit controlled electrical switches should be in the OFF position.

a. Set adjustment screws of compensator on zero. Zero position of adjusting screws is when the dot of the screw is lined up with the dot of the frame.

b. Head aircraft on a magnetic North heading. Adjust N-S adjustment screw until compass reads exactly North.

c. Head aircraft on a magnetic East heading and do the same as Step b, adjusting E-W adjusting screw.

d. Head aircraft on a magnetic South heading and note resulting South error. Adjust N-S adjusting screw until one-half of this error has been removed.

e. Head aircraft on magnetic West and do same as Step d, adjusting E-W adjustment screw.

f. Head aircraft in successive magnetic 30° degree headings and record compass readings on appropriate deviation card. Deviations must not exceed $\pm$ 10 on any heading.

9-40. TROUBLESHOOTING.

TABLE IX-VII. MAGNETIC COMPASS

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument. (Refer to Para. 9-39a.)
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace instrument.
Card sluggish.	Weak card magnet.	Replace instrument.
	Excessive pivot friction or broken jewel.	Replace instrument.
Liquid leakage.	Loose bezel screws.	Replace instrument.
	Broken cover glass.	Replace instrument.
	Defective sealing gaskets.	Replace instrument.
Discolored markings.	Age.	Replace instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
Card sticks.	Altitude compensating diaphragm collapsed.	Replace instrument.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets are stripped.	Replace instrument.
Compass swings erratically when radio transmitter is keyed.	Normal.	

9-41. MANIFOLD PRESSURE GAUGE.

9-42. GENERAL. The manifold pressure gauge is a vapor proof, absolute pressure type instrument. Pressure from the intake manifold of the engine is transmitted to the instrument through a line. A pointer indicates the manifold pressure available at the engine in inches of mercury.

9-43. TROUBLESHOOTING.

TABLE IX-VIII. MANIFOLD PRESSURE INDICATOR

Trouble	Cause	Remedy
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instruments.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument.	Replace instrument.
Dull or discolored marking.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and blow out.

9-44. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-45. TACHOMETER INDICATOR.

9-46. GENERAL. The tachometer is connected to the engine accessory by a flexible cable and provides an indication of crankshaft speed in revolutions per minute. The instrument has a recording mechanism for recording the time that the engine is in actual operation.

9-47. TROUBLESHOOTING.

TABLE IX-IX. TACHOMETER

Trouble	Cause	Remedy
No reading on indicator, either permanent or intermittent.	Broken shaft.	Replace instrument.
	Loose cable connections.	Tighten cable.
Pointer oscillates excessively.	Rough spot on, or sharp bend in shaft.	Repair or replace.
	Excessive friction in instrument.	Replace instrument.
Indicator changes in climb.	Excessive clearance in speed cup.	Replace instrument.
Pointer goes all the way to stop, more noticeable in cold weather.	Excessive lubricant in instruments.	Replace instruments.
Pointer jumps at idle.	Speed cup hitting rotating magnet.	Replace instrument.
Tachometer cable breaks.	Cable bent too sharply.	Reroute cable.

9-48. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-49. ENGINE OIL PRESSURE GAUGE.

9-50. GENERAL. The oil pressure gauge is mounted in the cluster on the instrument panel. This gauge will indicate the amount of oil pressure available at the pressurized engine oil passage.

9-51. TROUBLESHOOTING.

TABLE IX-X. ENGINE OIL PRESSURE GAUGE

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Overpressure or seasoning of bourdon tube.	Replace instrument.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Air in line or rough engine relief.	Disconnect line and fill with light oil. 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.	Clean and check.

9-52. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-53. FUEL PRESSURE GAUGE.

9-54. GENERAL. The fuel pressure gauge instrument is mounted in the cluster on the instrument panel. This gauge is connected to the fuel system at the carburetor fuel inlet fitting.

9-55. TROUBLESHOOTING.

TABLE IX-XI. FUEL PRESSURE GAUGE

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel valve stuck.	Check valve.
	No fuel in tanks.	Check fuel, fill.
	Defective fuel pump.	Check pump for pressure build-up. Check diaphragm and relief valves in engine pump. Check for obstruction in electric pump. Check bypass valve. Air leak in intake lines.
	Defective gauge.	Replace gauge.
Pressure low or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty bypass valve.	Replace.
	Faulty diaphragm.	Replace or rebuild pump.
Needle fluctuation.	Surge dome on pump filled with fuel.	Remove and empty.
	Air in line.	Loosen line at gauge, turn on electric pump. Purge line of air and retighten.
High fuel pressure with engine shut off right after flight.	Fuel in line expanding due to heat build up in cowling.	Normal.

9-56. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-57. TURN AND BANK INDICATOR.

9-58. GENERAL. The turn and bank indicator can be either vacuum driven or electric. The turn portion of the indicator is a gyroscope, while the bank portion of the indicator is a ball sealed in a curved glass tube filled with damping fluid. There are two styles of this unit, the first is the old style with a vertical needle in the center of the dial. This instrument reads only rate of turn, and unless the aircraft is turning, the needle will not move regardless of bank angle. The other style is the turn coordinator which will also indicate rate of turn but due to its construction will read rate of roll also, which means if the aircraft is rolled right and left rapidly, the indicator will move, indicating a turn, but if the aircraft is held in a bank, by applying rudder, the indicator will come back to zero indicating no turn.

9-59. TROUBLESHOOTING.

TABLE IX-XII. TURN AND BANK INDICATOR

Trouble	Cause	Remedy
Pointer fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
Incorrect sensitivity.	Out of calibration.	Replace instrument.
Incorrect turn rate (vacuum style).	High or low vacuum.	Check vacuum and adjust.
	Filter dirty.	Replace filter.
Incorrect turn rate (electric).	Out of calibration.	Replace instrument.
	Aircraft not in coordinated turn.	Center ball in turn.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when aircraft is correctly trimmed.	Instrument not level in panel.	Level instrument.
Instrument will not run (electric).	No power to instrument.	Check circuit and repair.
	Instrument malfunction.	Replace instrument.

9-60. ELECTRICAL INSTRUMENTS.

9-61. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-62. FUEL QUANTITY INDICATOR.

9-63. GENERAL. The two fuel quantity gauges are mounted in the cluster on the instrument panel. These instruments are calibrated in fractional devisions 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.

9-64. TROUBLESHOOTING.

TABLE IX-XIII. FUEL QUANTITY INDICATORS

Trouble	Cause	Remedy
Fuel gauge fails to indicate.	Broken wiring.	Check and repair.
	Gauge not operating.	Replace.
	Blown fuse.	Replace fuse.
Fuel gauge indicates empty when tanks are full.	Incomplete ground.	Check ground connections at fuel transmitter in wings.
Fuel gauge indicates full with tanks empty.	Incomplete ground.	Check ground at instrument.
	Float arm stuck.	Replace fuel transmitter.
Fuel gauge indicates incorrectly.	Intermittent ground.	Check ground at transmitter and instrument.
	Float arm sticky.	Replace fuel transmitter.

9-65. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-66. OIL TEMPERATURE INDICATOR.

9-67. GENERAL. The oil temperature indicator is mounted in the instrument cluster on the instrument panel. This instrument will provide a temperature indication of the engine oil in degrees Fahrenheit. The instrument has a temperature bulb located in the oil screen assembly, on the engine accessory section.

9-68. TROUBLESHOOTING.

TABLE IX-XIV. OIL TEMPERATURE INDICATORS

Trouble	Cause	Remedy
Instrument fails to show any reading.	Broken or damaged bulb. Wiring open.	Check engine unit and wiring to instrument.
Excessive scale error.	Improper calibration adjustment.	Repair or replace.
Pointer fails to move as engine is warmed up.	Broken or damaged bulb or open wiring.	Check engine unit and wiring.
Dull or discolored marking.	Age.	Replace instrument.

9-69. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-70. AMMETER.

9-71. GENERAL. The ammeter is mounted in the instrument cluster located on the instrument panel. This instrument measures the output of the alternator into the entire electrical system including the battery charging demand.

9-72. TROUBLESHOOTING. Refer to Section X. (Alternator Section)

9-73. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-74. REMOVAL AND REPLACEMENT OF FACE MOUNTED INSTRUMENTS.

9-75. GENERAL. Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide for the removal and installation of the instruments. Special care should be taken when any operation pertaining to the instruments is performed.

a. Remove the face panel by removing the screws from around the perimeter of the panel.

b. With the face panel removed, the mounting screws for the individual instruments will be exposed. Remove the connections to the instrument prior to removing the mounting screws of the instrument to be removed.

NOTE

Tag instrument connections for ease of installation.

c. Installation of the instruments will be in the reverse given for removal. After the installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

d. The following procedure applies to those aircraft having the Edo-Aire air driven gyro installation. The use of Teflon tape on fitting threads is recommended and should be installed in the following manner:

CAUTION

Permit no oil, grease, pipe compound or any foreign material to enter parts prior to installation of fittings. Make certain all air lines are clean and free of foreign particles and/or residue before connecting lines to gyro. Select proper fittings.

NOTE

Use of thread lube on fittings or in parts will create a *warranty void condition.*

1. Carefully lay Teflon tape on the threads allowing one thread to be visible from the end of the fitting. Hold in place and wrap in the direction of the threads so tape will remain tight when fitting is installed.
2. Apply sufficient tension while winding to assure that tape forms into thread grooves. One full wrap plus 1/2 inch overlap is sufficient.
3. After wrap is complete, maintain tension and tear tape by pulling in direction of wrap. The resulting ragged end is the key to the tape staying in place.
4. Press tape well into threads.
5. Screw fitting into part being careful not to exceed torque requirements as noted on decal located on gyro cover.

9-76. REMOVAL AND REPLACEMENT OF CLUSTER MOUNTED INSTRUMENTS.

9-77. GENERAL. A cluster, located on the instrument panel, contains six individual instruments. Removal of these instruments can be accomplished by the following procedure.

a. Remove the face panel by removing the screws from around the perimeter of the panel.

b. With the face panel removed, the clear plastic cover on the cluster assembly will be exposed. Remove the cover and cluster by removing the six mounting screws.

c. Remove the connection to the individual instrument to be removed and remove the instrument from the cluster assembly.

d. Replace instrument in the reverse order of removal. Check all mountings and connections for security.

9-78. EXHAUST GAS TEMPERATURE GAUGE. (ALCOR)

9-79. GENERAL. 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 leaving the engine cylinders. This gauge is adjustable. If it is found defective after checking with troubleshooting chart, it should be replaced. If the leads to the gauge are defective in any way, they should be replaced. When replacing leads, it is very important to use the same type and length of wire as the resistance of the leads is critical for the proper operation of this gauge.

9-80. REMOVAL OF EGT PROBE AND GAUGE

a. Remove gauge in the following manner.
   1. Disconnect the wires from the gauge on the instrument panel.
   2. Remove the four bolts securing the gauge to the instrument panel.

b. Remove EGT probe in the following manner.
   1. At the number six cylinder exhaust stack, cut the safety wire and unscrew the worm clamp.
   2. Carefully expand the clamp and remove the probe from the exhaust stack.
   3. Remove the ties holding the cable to the engine mount and other lines.
   4. Pull the cable through the firewall from the engine compartment.

9-81. CLEANING AND INSPECTION. Unless mechanical damage is evident, broken glass, bent or broken pointer, or broken case, the following checks should be performed before removing the instrument.

a. Remove probe from exhaust stack and check for broken weld (at tip end) or burnt off end. Measured resistance of probe should be .8 ohms. Clean the connections with steel wool before reassembly.

b. Disconnect lead wires at instrument and measure. Resistance with lead wires connected to probe should be 3.3 ohms. Clean connections with steel wool before reassembly.

c. With leads connected to instrument, heat probe with propane torch to dull red. The meter should read up to the fourth graduation or approximately 1500° F. Before making this check, make sure that the adjustment screw, which is located in the rear of the instrument case, is in the center of its travel. If this screw has been turned to either end of full travel, it will shut the instrument off and no indication will be shown on the pointer. If meter still does not read, replace it.

CAUTION

Do not connect ohmmeter across meter. It will burn out the movement of the meter.

9-82. INSTALLATION OF EGT PROBE AND GAUGE.

a. Install probe in the following manner.

1. Locate the hole for the probe in the exhaust stack of the number six cylinder. The .129 inch hole is located 2.25 inches from the mating side of the mounting flange.
2. Carefully expand the clamp that the probe is mounted to and slide the probe through the hole.
3. Tighten the worm clamp down to 45 in.-lbs. and safety wire.
4. Route cable back and up along the engine mount, and through the firewall where the magneto switch wires go, keeping at least a minimum of 1/2 inch lead wire to allow for normal engine shock mount movement.

NOTE

On aft side of firewall make sure to provide clearance from T-bar and rudder bar.

b. Install gauge in the following manner.

1. Insert the gauge into the instrument panel and secure with four bolts.
2. Connect the thermocouple wires to the back of the gauge.

9-83. TROUBLESHOOTING.

TABLE IX-XV. EXHAUST GAS TEMPERATURE GAUGE (ALCOR)

Trouble	Cause	Remedy
Gauge inoperative.	Defective gauge, probe or wiring.	Check probe and lead wires for chafing, breaks or shorting between wires and/or metal structure.
	Adjusting potentiometer turned off scale.	Reset potentiometer.
Fluctuating reading.	Loose, frayed or broken electrical leads or faulty connections.	Clean and tighten connections. Repair or replace defective leads.

9-84. CYLINDER HEAD TEMPERATURE GAUGE.

9-85. GENERAL. The cylinder head temperature gauge is in the instrument cluster, located on the instrument panel. This instrument measures the cylinder head temperature using a sender located in a cylinder head. The head location is determined by the engine manufacturer. It is an electrical instrument and is wired thru the instruments circuit breaker.

9-86. TROUBLESHOOTING.

TABLE IX-XVI. CYLINDER HEAD TEMPERATURE GAUGE

Trouble	Cause	Remedy
Instrument shows no indication.	Power supply wire broken.	Repair wire.
	Defective instrument.	Replace instrument.
	Master switch off.	
Instrument goes all the way to upper stop.	Wire broken between sender and gauge.	Repair wire.
	Defective sender.	Replace sender.

9-87. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-76 of this section.

9-88. FUEL FLOW GAUGE.

9-89. GENERAL. The fuel flow gauge is a non-electric pressure gauge mounted in the bottom half of the manifold pressure gauge located in the lower portion of the instrument panel.

This instrument measures flow by reading the pressure drop across a fixed orifice located in the fuel divider. With a constant fuel pressure being supplied by the engine driven pump, and putting a fixed orifice in the fuel divider head, and then measuring the pressure drop downstream of the orifice against a constant static pressure, the resultant pressure can be calibrated in gallons per hour flow. The constant static pressure is supplied by a vent line running to the engine compartment. The vent line to the engine compartment automatically compensates the instrument for altitude.

9-90. TROUBLESHOOTING.

TABLE IX-XVII. FUEL FLOW GAUGE

Trouble	Cause	Remedy
Pointer oscillates.	Air in fuel line.	Purge line.
Gauge reads low at altitude.	Vent line restricted.	Check line and fittings.
Pointer does not return to zero.	Fuel in diaphragm of gauge.	Replace gauge.

9-91. REMOVAL AND REPLACEMENT. Refer to Paragraph 9-74 of this section.

9-92. PIPER AUTOCONTROL SYSTEM. (See AutoControl Service Manual)

9-93. ANNUNCIATOR PANEL.

9-94. GENERAL. The annunciator panel consists of three amber lights and a push-button test switch located on the upper left center portion of the instrument panel. (Refer to Figure 9-4d.) The panel monitors alternator output, oil pressure and the vacuum system. The ALT warning light will illuminate when alternator output is zero; the VAC light when the pressure difference is below 3.5 in. Hg, and the OIL light when the oil pressure is below 35 psi. A test button is included to check the operation of the lights. This installation is available on 1975 models and up. (Refer to Section X for service information.)

9-95. TROUBLESHOOTING. (Refer to Table X-III.)

9-96. REMOVAL AND REPLACEMENT. (Refer to paragraph 9-74.)

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CHEROKEE SIX

Service Manual

PA-32-260 PA-32-300 PA-32R-300

CARD 3 OF 3

PIPER AIRCRAFT CORPORATION

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3A1

AEROFICHE EXPLANATION AND REVISION STATUS

The Service Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aviation Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Service Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual Table of Contents is for all fiche in this set.
2. A complete list of Illustrations is given and follows the Table of Contents.
3. A complete list of Tables is given for all fiche in this set and follows the list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:
   Revised text and illustrations are indicated by a black 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.
6. Revisions to this Service Manual 753 690 issued May 1, 1965 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
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* INTERIM CHANGE

Revisions appear in Table III-I and Table III-II of card 1. There are no other changes included in this maintenance manual. Please discard your current card 1 and replace it with this revised one. DO NOT DISCARD CARDS 2 or 3.

The date on Aerofiche cards should not be earlier than the date noted for the respective card effectivity. Consult the latest card in this series for current Aerofiche card effectivity.

TABLE OF CONTENTS

SECTION	AEROFICHE CARD NO. 1	GRID NO.
I	INTRODUCTION	1A13
II	HANDLING AND SERVICING	1A17
III	INSPECTION	1D10
IV	STRUCTURES	1E14
V	SURFACE CONTROLS	1G11
VA	HYDRAULIC SYSTEM (PA-32R-300)	1I22
	AEROFICHE CARD NO. 2	
VI	LANDING GEAR AND BRAKE SYSTEM (PA-32-260/300)	2A8
VIA	LANDING GEAR AND BRAKE SYSTEM (PA-32R-300)	2C5
VII	POWER PLANT (PA-32-260)	2E14
VIIA	POWER PLANT (PA-32-300 & 32R-300)	2G4
VIII	FUEL SYSTEM	2I19
IX	INSTRUMENTS	2J14
	AEROFICHE CARD NO. 3	
X	ELECTRICAL SYSTEM	3A8
XI	ELECTRONICS	3F7
XII	HEATING AND VENTILATING	3F21
XIII	ACCESSORIES AND UTILITIES	3G8

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
10-1a.	Alternator and Starter System, PA-32-260, Serial Nos. 32-1 to 32-855 inclusive	3A15
10-1b.	Alternator and Starter System, PA-32-260, Serial Nos. 32-856 and up. PA-32-300, Serial Nos. 32-40000 to 32-40566)	3A16
10-1c.	Alternator and Starter System, PA-32-260, Serial Nos. 32-1112 to 32-7400061 incl. and PA-32-300, Serial Nos. 32-40567 to 32-7440182 incl.	3A17
10-2a.	Alternator and Starter System, PA-32-260, Serial Nos. 32-7500001 to 32-7600033 incl. PA-32-300, Serial Nos. 32-7540001 to 32-7640142 incl. and PA-32R-300, Serial Nos. 32R-7680001 to 32R-7680538 incl.	3A18
10-2b.	Alternator and Starter System, PA-32-260, Serial Nos. 32-7700001 to 32-7800008 incl., PA-32-300, Serial Nos. 32-7740001 and up, and PA-32R-300, Serial Nos. 32R-7780001 to 32R-7880068	3A19
10-3.	Lamp-Bank Load	3A22
10-4.	Checking Field Current	3A22
10-5.	Testing Field Circuit	3A23
10-6.	Testing Rectifiers (Positive)	3A24
10-7.	Testing Rectifiers (Negative)	3B1
10-8.	C-3928 Fixtures and Adapters	3B2
10-9.	Removing Rectifiers	3B2
10-10.	Installing Rectifiers	3B3
10-11.	Soldering Rectifier Lead	3B4
10-12.	Testing Stator Coils	3B5
10-13.	Removing End Bearing	3B7
10-14.	Installing End Bearing	3B7
10-15.	Removing Drive Pulley	3B8
10-16.	Removing Drive End Bearing	3B8
10-17.	Removing Slip Ring	3B9
10-18.	Aligning Slip Ring	3B9
10-19.	Installing Slip Ring	3B10
10-20.	Installing Retainer	3B10
10-21.	Solder Points	3B11
10-22.	Installing Driver End Shield and Bearing (Typical)	3B12
10-23.	Installing Pulley	3B12
10-24.	Meter Connections for Alternator Performance Test	3B15
10-24a.	Exploded View of Alternator	3B18
10-24b.	Removal of Slip Ring End Bearing	3B19
10-24c.	Removal of Rectifier	3B19
10-24d.	Removal of Drive End Head	3B20
10-24e.	Removal of End Head Bearing	3B20
10-24f.	Testing Rotor for Ground	3B21
10-24g.	Testing Rotor for Shorts	3B21
10-24h.	Installation of Bearing	3B22
10-24i.	Installation of Rectifier	3B22
10-24j.	Terminal Assembly	3B23
10-24k.	Slip Ring End Bearing Assembly	3B24
10-24l.	Testing Alternator	3B24
10-24m.	Brush Installation	3C1

LIST OF ILLUSTRATIONS (cont)

Figure		Aerofiche Grid No.
10-24n.	Internal Wiring Schematic	3C1
10-25.	No-Load Test	3C6
10-26.	Resistance Test	3C7
10-27.	Exploded View of Gear Reduction Starting Motor	3C11
10-28.	Turing Starter Motor Commutator	3C14
10-29.	Testing Motor Armature for Shorts	3C14
10-30.	Testing Fields for Grounds	3C14
10-31.	No-Load Test Hook-Up	3C15
10-32.	Stall-Torque Hook-Up	3C16
10-32a.	Ignition Switch	3C24
10-32b.	Terminal Block	3D16
	NOTE: (Figures 10-33 thru 10-76. See Table X-1)	3A11-3A13
11-1.	Two Year, Magnesium Battery Connections	3F9
11-2.	ELT Schematic (NARCO)	3F10
11-3.	ELT Portable Folding Antenna (NARCO)	3F11
11-4.	ELT Using Fixed Aircraft Antenna (NARCO)	3F11
11-5.	Communications Components ELT Schematic	3F16
12-1.	Cabin Heater, Defroster and Fresh Air System	3F23
12-2.	Cabin Heater and Defroster Fresh Air System, Serial Nos. 32-7100001 to 32-7340191	3F24
12-3.	Cabin Heater and Defroster Fresh Air System, Serial Nos. 32-7400001 and up	3G1
12-4.	Cabin Heater and Defroster Fresh Air System, PA-32R-300 only	3G2
13-1.	Air Conditioning System Installation	3G11
13-2.	Service Valves	3G16
13-3.	Test Gauge and Manifold Set	3G17
13-4.	Manifold Set Operation	3G18
13-5.	Leak Test Hook-Up	3G19
13-6.	Evacuation Hook-Up	3G21
13-7.	Charging Stand	3G23
13-8.	Charging Hook-Up	3H1
13-9.	Compressor and Fabricated Oil Dipstick	3H5
13-10.	Compressor and Alternator Belt Installation	3H7
13-11.	Magnetic Clutch	3H11
13-12.	Condensor Air Scoop Installation	3H15
13-13.	Expansion Valve	3H16
13-14.	Components Installation	3H17
13-15.	Control Head - Diode Mounting Board, Diode Location and Number, Serial Nos. 32-7240056 to 32-7340042	3H19
13-16.	Air Conditioning Wiring Schematic, Serial Nos. 32-7240056 to 32-7340042	3H20
13-17.	Air Conditioning Wiring Schematic, Serial Nos. 32-7340043 and up	3H21
13-18.	Air Conditioning Wiring Schematic (32R-300)	3H22

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LIST OF TABLES

Table		Aerofiche Grid No.
X-I.	Electrical System Schematics	3A11
X-II.	Electrical System Components Loads	3C20
X-III.	Electrical System Troubleshooting	3D1
X-IIIA.	Electrical Symbols	3D17
X-IV.	Electrical Wire Coding	3D18
XII-I.	Blower System Wire Color Codes	3G5
XIII-I.	Temperature Pressure Chart	3G13
XIII-II.	Aluminum Tubing Torque	3G15
XIII-III.	Compressor Oil Charge	3H4
XIII-IV.	Troubleshooting Chart (Air Conditioner)	3H24

SECTION X

ELECTRICAL SYSTEM

		Aerofiche Grid No.
10-1.	Description	3A14
10-2.	Troubleshooting	3A14
10-3.	Electrical Power Supply	3A14
10-4.	Alternator System Test Procedure (Chrysler)	3A21
10-5.	Bench Testing the Alternator	3A22
10-6.	Field Current Draw	3A22
10-7.	Testing Alternator Internal Field Circuit for a Ground	3A23
10-8.	Inspection	3A23
10-9.	Testing Rectifiers (Positive)	3A23
10-10.	Testing Rectifiers (Negative)	3B1
10-11.	Removing and Installing Rectifiers	3B2
10-12.	Removing Rectifiers	3B3
10-13.	Installing Rectifiers	3B3
10-14.	Testing Stator Coils for Ground	3B6
10-15.	Testing Alternator Capacitors	3B6
10-16.	Removing Needle Bearing from End Shield	3B7
10-17.	Installing Needle Bearing in End Shield	3B7
10-18.	Removing Drive Pulley	3B8
10-19.	Removing Drive End Bearing	3B8
10-20.	Replacing Slip Rings	3B9
10-21.	Removing Slip Rings	3B10
10-21a.	Installation of Slip Rings	3B10
10-22.	Installing Grease Retainer	3B13
10-23.	Installing Drive End Bearing	3B13
10-24.	Installing Pulley	3B13
10-25.	Assembling End Shield Sub-Assemblies	3B14
10-26.	Bench Run-Up Test	3B14
10-27.	Bench Hot Stabilation Output Test	3B15
10-27a.	Alternator System (Prestolite)	3B16
10-27b.	Checking Alternator System	3B16
10-27c.	Alternator Nomenclature	3B17
10-27d.	Alternator Service Precautions	3B17
10-27e.	Description of Alternator	3B17
10-27f.	Overhaul of Alternator	3B18
10-27g.	Disassembly of Alternator	3B19
10-27h.	Inspection and Testing of Components	3B20

Paragraph			Aerofiche Grid No.
	10-27i.	Assembly of Alternator	3B22
	10-27j.	Testing of Alternator	3B23
	10-27k.	Alternator Service Test Specifications	3B24
	10-27l.	Checking Alternator Belt Tension	3C1
10-28.	Voltage Regulator		3C1
	10-29.	Checking Voltage Regulator	3C1
10-30.	OverVoltage Relay		3C2
	10-31.	Checking OverVoltage Relay	3C2
10-32.	Checking Alternator Belt Tension		3C3
10-33.	Cranking Motors (Delco-Remy)		3C4
	10-34.	General	3C4
	10-35.	Checking Cranking Motor	3C4
	10-36.	Test and Maintenance of Cranking Motor	3C6
	10-37.	Inspection	3C6
	10-38.	Checks	3C6
	10-39.	No-Load Test Check	3C6
	10-40.	Resistance Test	3C7
	10-41.	Disassembly	3C8
	10-42.	Component Inspection and Repair	3C8
	10-43.	Reassembly	3C9
	10-44.	Cranking Motor Service Test Specifications	3C10
10-45.	Cranking Motors (Prestolite)		3C10
	10-46.	Description	3C10
	10-47.	Operation	3C10
	10-48.	Maintenance	3C12
	10-49.	Overhaul	3C12
	10-50.	Removal	3C13
	10-51.	Disassembly	3C13
	10-52.	Brushes	3C13
	10-53.	Armature	3C13
	10-54.	Field Coils	3C14
	10-55.	Brush Holders	3C14
	10-56.	Gear and Pinion Housing	3C14
	10-57.	Bendix Drive	3C15
	10-58.	Assembly	3C15
	10-59.	Bench Tests	3C15
	10-60.	Starting Motor Control Circuit	3C16
	10-61.	Cranking Motor Service Test Specifications	3C16
10-62.	Battery		3C17
	10-63.	Servicing Battery	3C17
	10-64.	Hydrometer Reading and Battery Charge Percent	3C18
	10-65.	Removal and Installation of Battery	3C18
	10-66.	Battery Box Corrosion Prevention	3C21
	10-66a.	Starting Through External Power With Airplane's Battery Nearly Depleted	3C22
10-67.	Instrument and Panel Lights		3C22
	10-68.	Removal of Dimmer Control Assembly	3C22
	10-69.	Installation of Dimmer Control Assembly	3C22

Revised: 11/4/83

		Aerofiche Grid No.
10-70.	Annunciator Panel	3C22
10-71.	Description	3C23
10-71A.	Removal of Annunciator Panel	3C23
10-72.	Removal of Oil Pressure Sensor	3C23
10-73.	Installation of Oil Pressure Sensor	3C23
10-74.	Removal of Vacuum Sensor	3C23
10-75.	Installation of Vacuum Sensor	3C23
10-76.	Ignition Switch	3C24
10-77.	Removal of Ignition Switch	3C24
10-78.	Installation of Ignition Switch	3C24

TABLE X-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS

Subject	Figure	Aerofiche Grid No.
Electrical System Schematic (PA-32-260, Serial Nos. 32-1 to 32-375 incl.)	10-33	3D21
Electrical System Schematic (PA-32-260, Serial Nos. 32-376 to 32-855 incl.)	10-33a	3D23
Electrical System Schematic (PA-32-260, Serial Nos. 32-856 to 32-1111 and PA-32-300, Serial Nos. 32-40000 to 32-40566 incl.)	10-33b	3E1
Electrical System Schematic (PA-32-260, Serial Nos. 32-1112 to 32-7300066 and PA-32-300, Serial Nos. 32-40567 to 32-7340191 incl.)	10-33c	3E3
Deleted		
A/C Air Blower (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-47	3E9
A/C Air Blower (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-62	3E20
A/C Air Blower (PA-32-300, Serial No. 32-7940275 and up)	10-73	3F2
Alternator, Starter, Forward Baggage Light, Cigar Lighter and External Power Receptacle (PA-32-260, Serial Nos. 32-7400001 to 32-7400061 and PA-32-300, Serial Nos. 32-7440001 to 32-7440182 incl.)	10-39	3E7
Alternator, Starter, Forward Baggage Light, Cigar Lighter and External Power Receptacle (PA-32-260, Serial Nos. 32-7500001 to 32-7600033 incl., and PA-32-300, Serial Nos. 32-7540001 to 32-7640142 incl.)	10-52	3E12
Alternator, Starter, Forward Baggage Light, Cigar Lighter and External Power Receptacle (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7680538 incl.)	10-57	3E18
Alternator, Starter, Cigar Lighter and External Power Receptacle (PA-32-260, Serial Nos. 32-7700001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7740001 and up)	10-53	3E13
Alternator, Starter, Cigar Lighter and External Power Receptacle (PA-32R-300, Serial Nos. 32R-7780001 to 32R-7880068 incl.)	10-58	3E19
Anti-Collision Light (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-42	3E8
Anti-Collision Light (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-60	3E20
Anti-Collision (Rotating Beacon) (PA-32-300, Serial No. 32-7940275 and up)	10-72	3F1
Anti-Collision (Wings and Fin Strobe) (PA-32-300 Serial No. 32-7940275 and up)	10-74	3F2
Anti-Collision (Fin Strobe) (PA-32-300, Serial No. 32-7940275 and up)	10-75	3F2
Avionics (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., PA-32-300, Serial Nos. 32-7440001 and up, and PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-49	3E11
Avionics Master Switch (Optional) (PA-32-300, Serial No. 32-8040001 and up)	10-70	3F1
Courtesy Lights	10-35	3E5

TABLE X-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS (cont)

Subject	Figure	Aerofiche Grid No.
Engine Gauges (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 to 32-7840202 incl.)	10-37	3E6
Engine Gauges (PA-32-300, Serial Nos. 32-7940001 and up)	10-36	3E5
Engine Instruments (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-55	3E17
Engine Gauges (PA-32-300. Serial No. 32-7940275 and up)	10-76	3F3
Deleted	10-69	3E24
Forward Baggage Light	10-68	3E24
Fuel Pump (PA-32-260, Serial Nos. 32-7400001 to 32-7400061 and PA-32-300, Serial Nos. 32-7440001 to 32-7440182 incl.)	10-46	3E9
Fuel Pump (PA-32-260, Serial Nos. 32-7500001 to 32-7800008 incl.)	10-50	3E11
Fuel Pump (PA-32-300, Serial Nos. 32-7540001 and up)	10-51	3E11
Fuel Pump (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-64	3E21
Fuel Pump Circuit (PA-32-300. Serial No. 32-7940259 and up)	10-71	3F1
Instrument, Navigation and Radio Lights (PA-32-260, Serial Nos. 32-7400001 to 32-7400061 and PA-32-300, Serial Nos. 32-7440001 to 32-7440182 incl.)	10-48	3E10
Instrument, Navigation and Radio Lights (PA-32-260, Serial Nos. 32-7500001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7540001 to 32-7840202 incl.)	10-54	3E14
Instrument, Navigation and Radio Lights (PA-32-300, Serial Nos. 32-7940001 and up)	10-54a	3E15
Instrument, Navigation and Radio Lights (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-66	3E22
Landing Light (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-43	3E8
Landing Light (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-61	3E20
Landing Gear (PA-32R-300 Models, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-67	3E23
Passenger Reading Lights (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-38	3E6
Passenger Reading Lights (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-56	3E17
Pitch Trim (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., PA-32-300, Serial Nos. 32-7440001 and up, and PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-44	3E9
Pitot Heat (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-45	3E9

TABLE X-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS (cont)

Subject	Figure	Aerofiche Grid No.
Pitot and Pressure Head Heat (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-63	3E21
Strobe and Beacon Anti-Collision Lights (PA-32R-300, Serial Nos. 32R-7880001 to 32R-7880068 incl.)	10-65	3E21
Stall Warning (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., and PA-32-300, Serial Nos. 32-7440001 and up)	10-41	3E8
Stall Warning (PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-59	3E20
Turn and Bank (PA-32-260, Serial Nos. 32-7400001 to 32-7800008 incl., PA-32-300, Serial Nos. 32-7440001 and up, and PA-32R-300, Serial Nos. 32R-7680001 to 32R-7880068 incl.)	10-40	3E8

SECTION X

ELECTRICAL SYSTEM

10-1. DESCRIPTION. The electrical system of the PA-32 is a 14-volt, direct current, single wire, negative ground system. All electrical equipment is grounded to the metal structure of the airplane, therefore, the structure takes the place of the second wire. A 12-volt battery is incorporated in the system to furnish power for starting and as a reserve power source in case of alternator failure. The battery and alternator are both connected to the bus bar; from which all the electrical equipment is powered, with the exception of the starter which receives its power from the load side of the battery. The master switch controls the battery relay and the alternator field circuit. The master switch must be on before any electrical equipment will operate. The Cherokee Six can be equipped with the standard position lights, anti-collision lights, and one landing light located in the nose cowl assembly.

10-2. TROUBLESHOOTING. Troubles peculiar to the electrical system are listed in Table X-III at the back of this section along with their probable causes and suggested remedies. The wiring diagrams included in back of this section will give a physical breakdown of the different electrical circuits used in this airplane.

After the trouble has been corrected, check the entire electrical system for security and operation of its components.

10-3. ELECTRICAL POWER SUPPLY. The electrical power is supplied by one 12-volt battery and a 14-volt direct current alternator. The alternator is located on the front lower right side of the engine and utilizes a belt drive from the engine crankshaft. Many advantages both in operation and maintenance are derived from this system. The main advantage is that full electrical power output is available at lower engine RPM.

The alternator has no armature or commutator and only a small pair of carbon brushes, which make contact with a pair of copper slip rings. The rotating member of the alternator, known as the rotor, is actually the field windings. The rotor draws only 1/20th of the current output. Therefore, there is very little friction and negligible wear and heat in this area. The alternating current is converted to direct current by diodes pressed into the end bell housing of the alternator. The diodes are highly reliable solid-state devices, but are easily damaged if current flow is reversed through them.

The alternator system does not require a reverse current relay, because of the high back resistance of the diodes and the inability of the alternator to draw current or motorize. A current regulator is unnecessary because the windings have been designed to limit the maximum current available. Therefore, the voltage control is the only control needed.

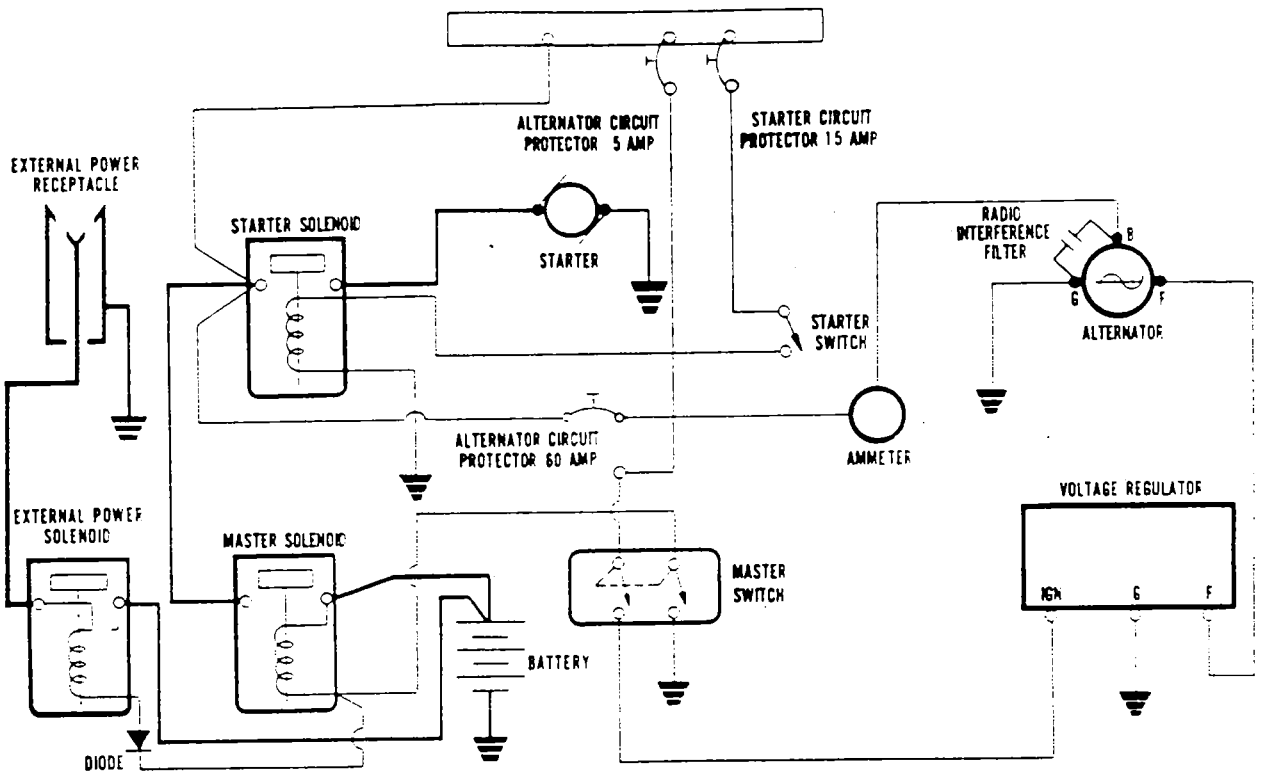


Figure 10-1a. Alternator and Starter System
(PA-32-260, Serial Nos. 32-1 to 32-855 inclusive)

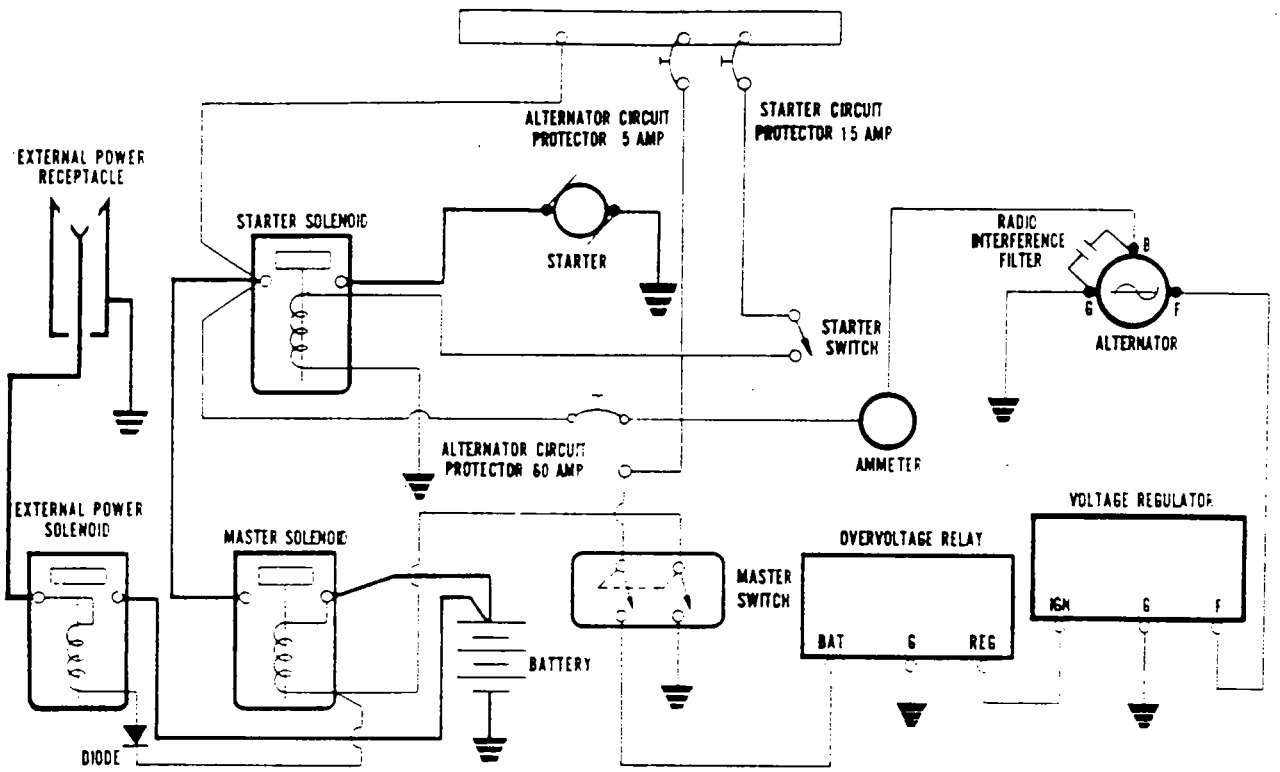


Figure 10-1b. Alternator and Starter System
(PA-32-260 Serial Nos. 32-856 to 32-1111 and
PA-32-360 Serial Nos. 32-40000 to 32-40566)

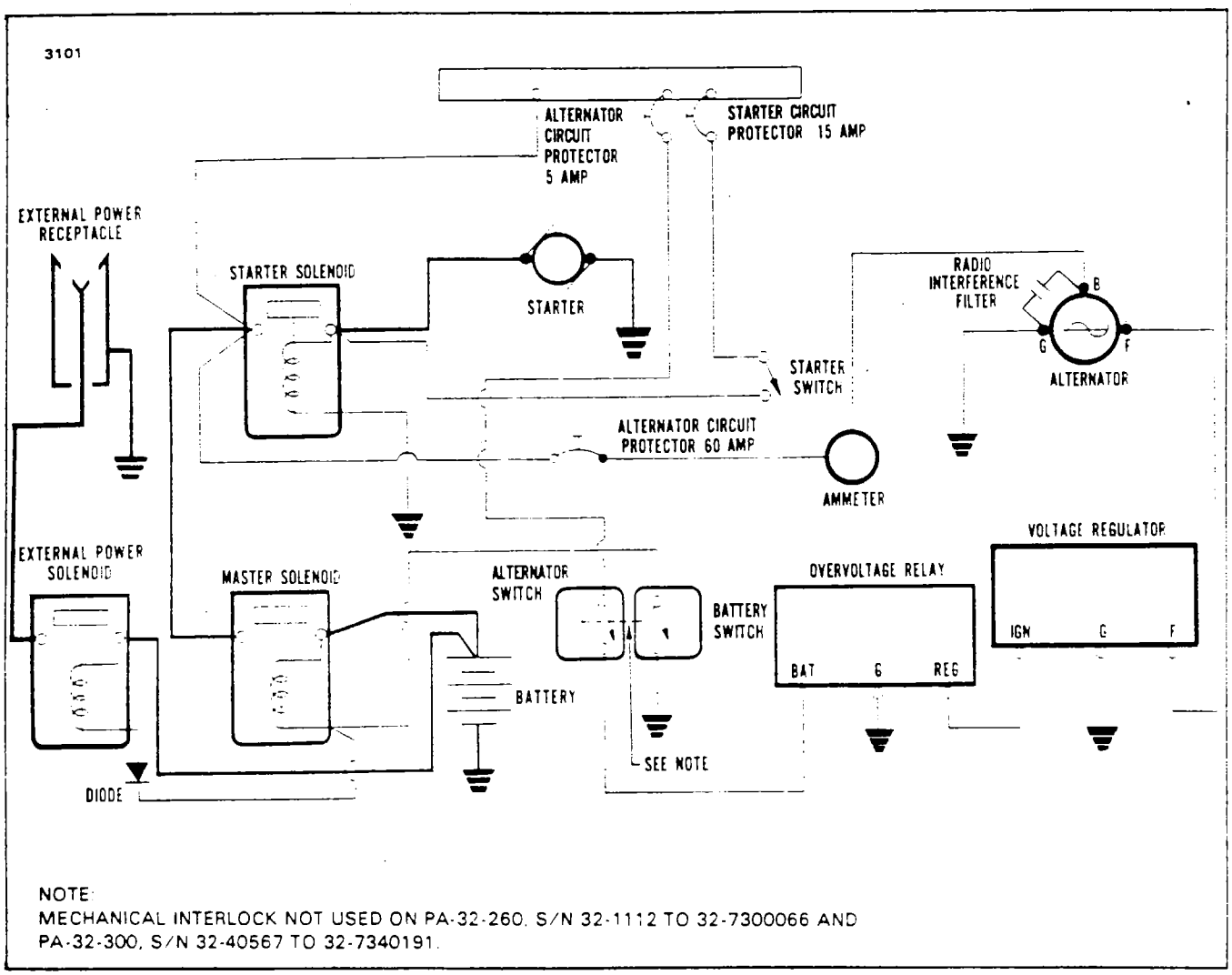


Figure 10-1c. Alternator and Starter System
(PA-32-260, Serial Nos. 32-1112 to 32-7400061 inclusive and
PA-32-300, Serial Nos. 32-40567 to 32-7440182 inclusive)

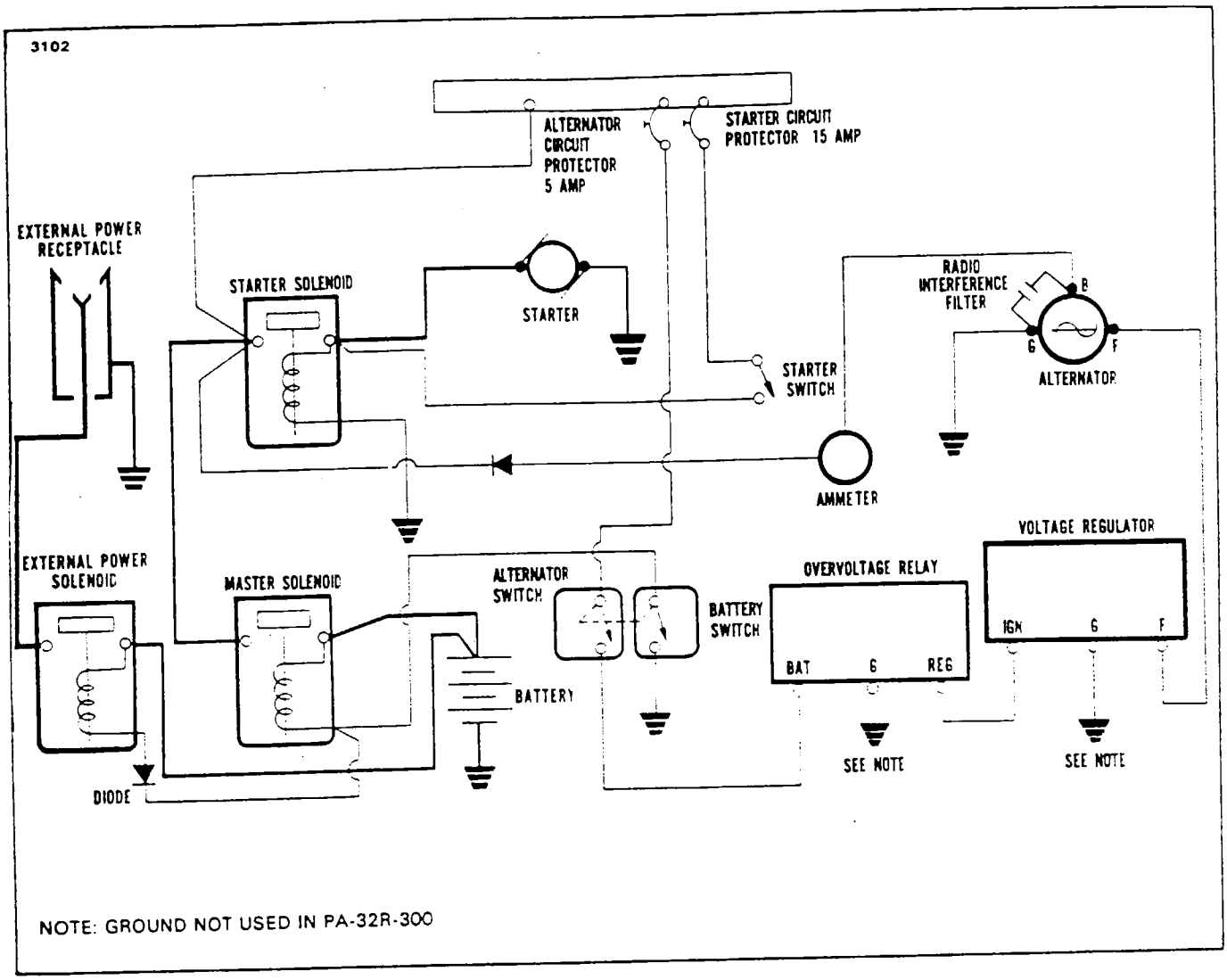


Figure 10-2a. Alternator and Starter System
(PA-32-260 Serial Nos. 32-7500001 to 32-7600033 inclusive,
PA-32-300 Serial Nos. 32-7540001 to 32-7640142 inclusive and
PA-32R-300 Serial Nos. 32R-7680001 to 32R-7680538 inclusive)

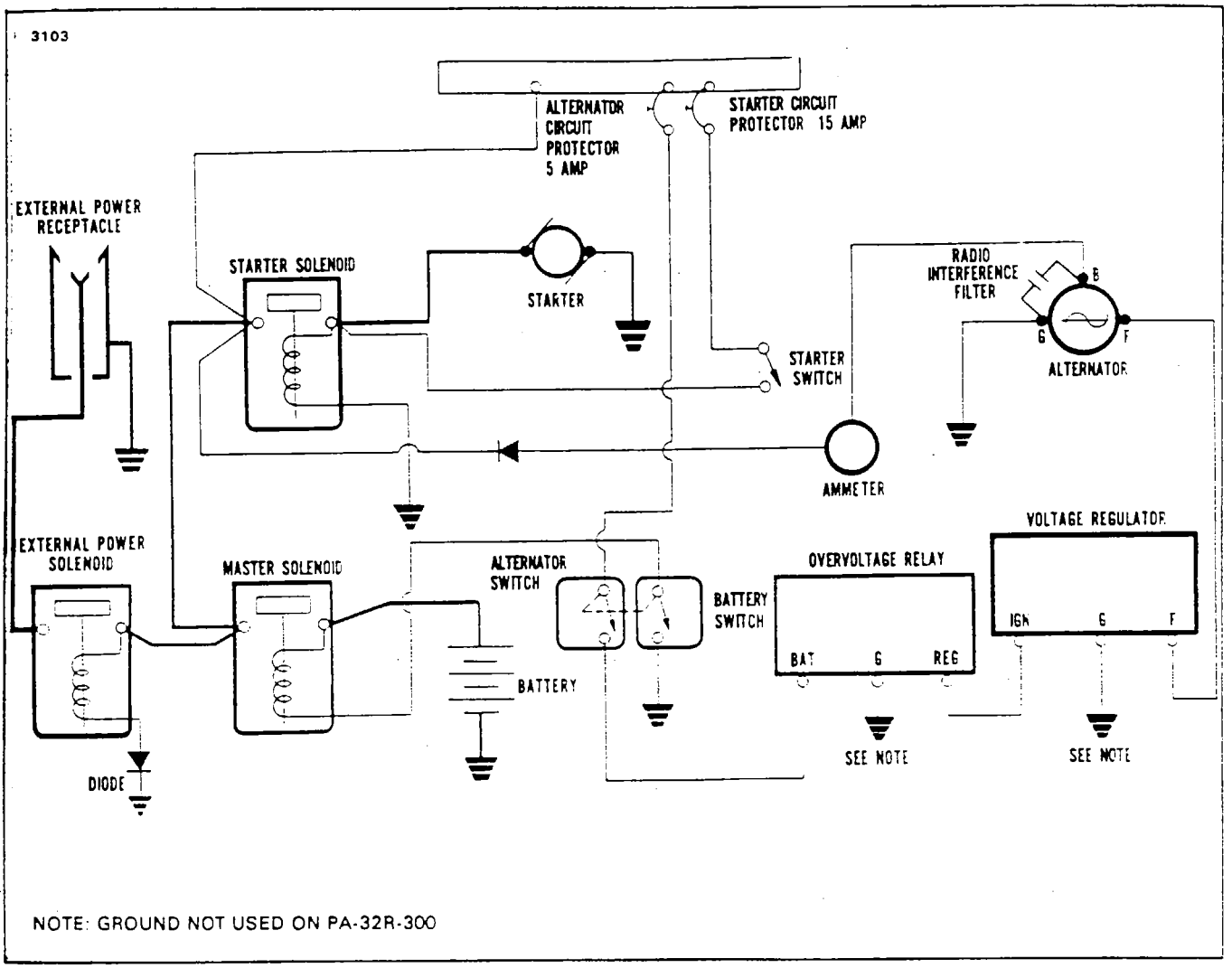


Figure 10-2b. Alternator and Starter System
(PA-32-260 Serial Nos. 32-7700001 to 32-7800008 inclusive
PA-32-300 Serial Nos. 32-7740001 and up, and
PA-32R-300 Serial Nos. 32R-7780001 to 32R-7880068)

Located on the instrument panel are two circuit breakers marked "alternator"; one of which is marked "output" and the other "field." The output circuit breaker is 60 amperes and its purpose is to protect the alternator and electrical system from overload. The field circuit breaker for the voltage regulator and field wiring protection is 5 amperes. If either of these breakers trip, it will result in a complete failure of power from the generating system. After a one or two minute cool-down, they can be reset manually. If tripping recurs, holding the breakers down will not prevent their continued tripping, and indicates a breakdown of wiring or equipment in the generator circuit.

Unlike previous systems, the ammeter does not indicate battery discharge, but displays the load in amperes placed on the generating system. With all electrical equipment off (except master), the ammeter will indicate the amount of charging current demanded by the battery. This amount will vary, depending on the percentage of charge in the battery at the time. As the battery becomes charged, the amount of current displayed on the ammeter will reduce to approximately two amperes. The amount of current shown on the ammeter will tell immediately whether or not the alternator system is operating normally, if the following principles are kept in mind.

NOTE

The amount of current shown on the ammeter is the load in amperes that is demanded by the electrical system from the alternator. As a check, take for example a condition where the battery is demanding 10 amperes charging current, then switch on the landing light. Note the value in amperes placarded on the panel for the circuit breaker (10 amps) and multiply this by 80 per cent, you will arrive at a current of 8 amperes. This is the approximate current drawn by the landing light. Therefore, when the landing light is switched on, there will be an increase of current from 10 to 18 amperes displayed on the ammeter. As each unit of electrical equipment is switched on, the currents will add up and the total, including the battery, will appear on the ammeter.

10-4. ALTERNATOR SYSTEM TEST PROCEDURE (CHRYSLER).

a. Start engine and set throttle for 2000 to 2200 RPM.

b. Switch on the following loads and observe the ammeter reading increases as follows:

1. Rotating beacon	3.5 amps
2. Anti-Collision lights (PA-32R-300)	4.4 amps
3. Landing light	8.0 amps
4. Navigation and all instrument panel lights	6.5 amps
5. All passenger reading lights	4.0 amps
6. Pitot heat	13.0 amps
7. Cigar lighter	8.0 amps

c. If the ammeter fails to show an increase as indicated, refer to troubleshooting chart.

d. Additional loads may be simulated by adding landing lights (8.0 amps per light) from the bus bar to the aircraft ground. (Refer to Figure 10-3.)

e. Maximum output of the alternator should be 60 ± 5.0 amps at 2000 to 2200 RPM.

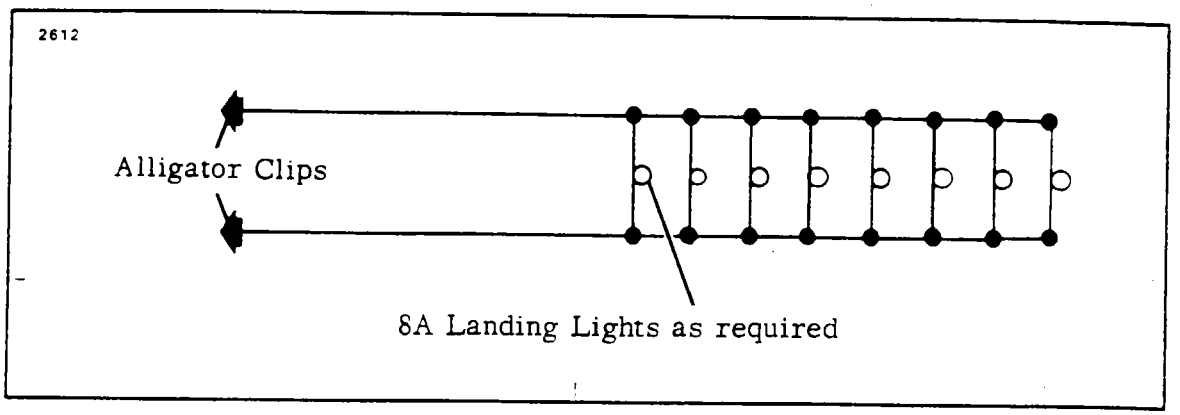


Figure 10-3. Lamp-Bank Load

10-5. BENCH TESTING THE ALTERNATOR.

10-6. FIELD CURRENT DRAW. Connect a test ammeter in series between a 12-volt battery positive post and the alternator field terminal. (Refer to Figure 10-4.)

Connect a jumper wire to a machined surface on one of the alternator end shields (ground) and to the negative battery post. The reason for connecting to the machined surface is to ensure a good electrical connection. The end shields are treated to oppose corrosion. The material used to treat the end shields is not a good electrical conductor.

Observe the ammeter to determine the current flowing through the rotor coil and connected circuit and record the amount. Slowly rotate the rotor with the pulley while watching the meter. The current will be a little less while rotating the rotor than when stationary. However, if the slip rings are clean and the brushes are making good contact, the reading should be fairly even. A slight fluctuation will be normal due to variation in turning speed when operated by hand.

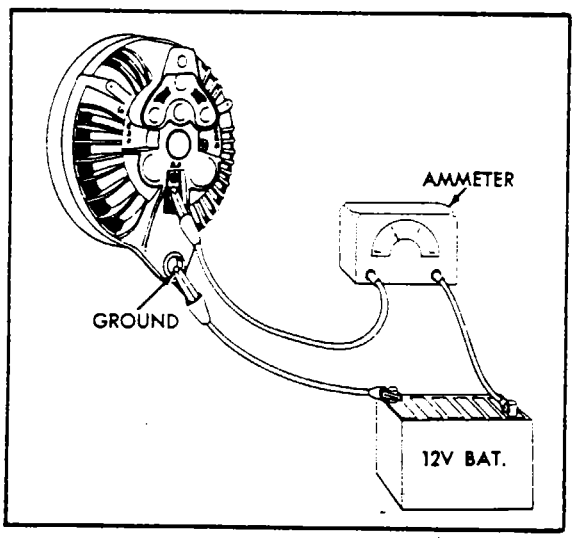


Figure 10-4. Checking Field Current

The current draw should not be less than 2.3-amperes nor more than 2.7-amperes. A reading of less than 2.3-amperes indicates high resistance due to poorly soldered coil leads at the slip rings, dirty, oily slip rings or poor brush contact. A reading higher than 2.7-amperes indicates shorted coil windings.

10-7. TESTING ALTERNATOR INTERNAL FIELD CIRCUIT FOR A GROUND.

To test the alternator internal field circuit for a short circuit to ground, proceed as follows:

Remove the ground brush and using a 110 volt test lamp, place one test probe to the field terminal and the remaining test probe to a machined surface at one of the alternator end shields. (Refer to Figure 10-5.) The test lamp should not light.

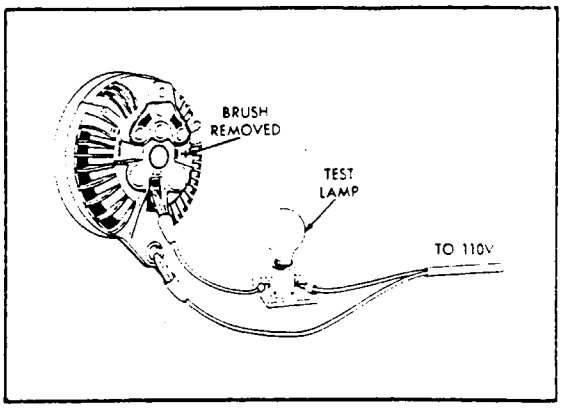


Figure 10-5. Testing Field Circuit

If the test lamp lights, carefully observe the order in which the parts were installed as you remove the insulated brush assembly. Remove the three through bolts. Then, separate the two end shield assemblies. Touch one of the test lamp probes to one of the slip rings and the remaining test probe to the rotor shaft. The lamp should not light. If the lamp lights, the rotor assembly is grounded and requires replacement.

If the test lamp does not light, the ground condition was in the insulated brush assembly and the parts were either assembled wrong or damaged and short circuiting through to ground. Inspect the brush holder and insulated washer. Replace if damaged. The stack of parts attaching the insulated brush holder assembly to the end shield must always be installed in the proper sequence as follows: Insulated brush holder, "FLD" terminal, insulating washer, lockwasher and attaching screw.

10-8. INSPECTION. Inspect the condition of the alternator components paying special attention to the condition of the slip rings for indications of oil, being burnt or worn. Inspect brushes for signs of sticking in holder or shield and for wear.

Inspect the bearing surface of the rotor shaft and the roller bearings at the rectifier end. Rotate the rotor in the drive end shield to feel for roughness in the drive end bearing. Inspect the grease retainer, if so equipped, on late alternators. Inspect the rectifier leads especially at connections for a good solder joint, also inspect insulation. Rectifier/stator lead must be pushed down into the slots that are cast into the end shield and cemented with MoPar Cement #2299314.

10-9. TESTING RECTIFIERS (POSITIVE). (Refer to Figure 10-6.) Special test box tool C-3829 has been developed to test the diode rectifiers without opening

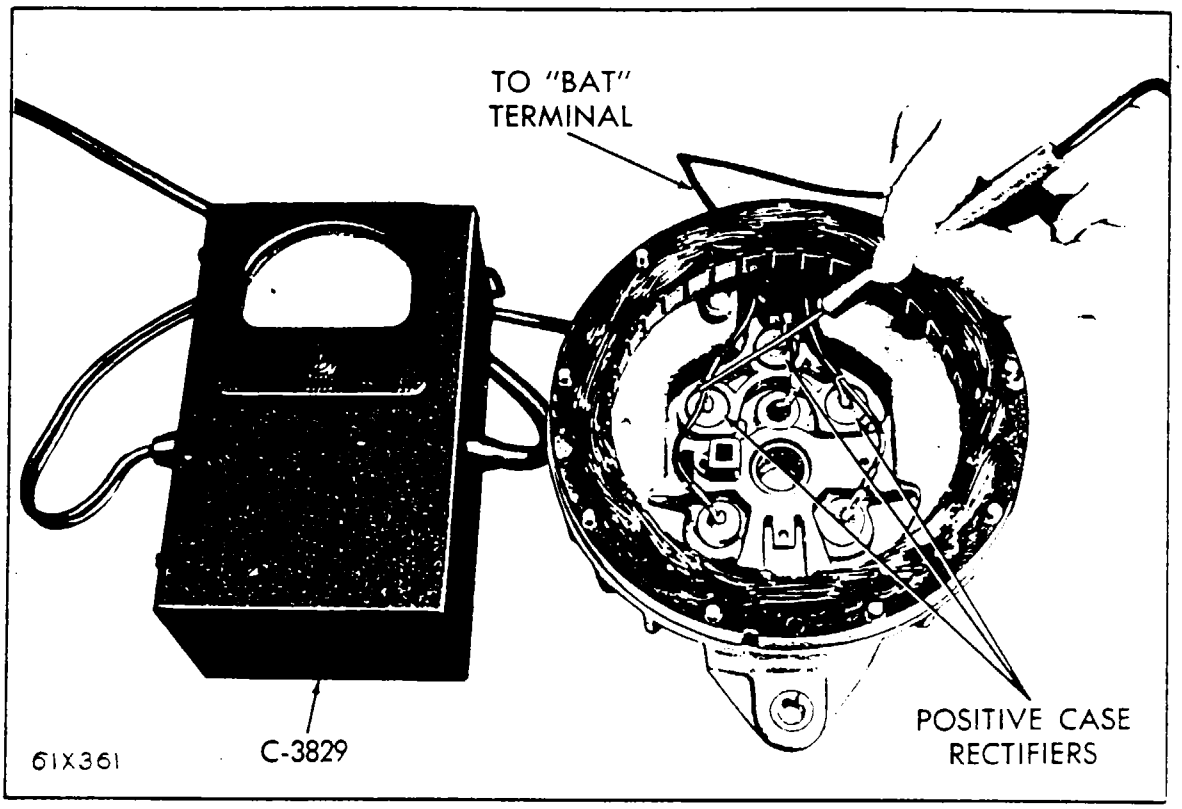


Figure 10-6. Testing Rectifiers (Positive)

the "Y" connection as is necessary where the test lamp method is used.

Due to the short leads at the "Y" connection it is quite difficult to separate and reconnect them properly. This tool C-3829 will save much time and is accurate.

Insulate alternator from metal bench and plug tester tool C-3829 into a 110 volt supply. Connect the alligator clip of tool C-3829 to the alternator "BAT" terminal and touch the bare metal of each of the positive case rectifier lead wires in the heat sink at the rectifiers.

The meter reading for each of the rectifiers should be the same. Always contact the connection nearest the rectifiers.

Do not break the sealing on the rectifier lead wire or on the top of the rectifiers. The sealing material is used for corrosion protection.

The reading on the meter will indicate 1.7 or over for good rectifiers. Where two of the rectifiers are good and one is shorted, the reading taken at the good rectifiers will show low. The reading at the shorted rectifier will be zero. Cut the lead at the bad rectifier and the reading at the two good rectifiers will come up to normal. Where one of the rectifiers is open, it will read low (1 amp or less) the two good rectifiers will show normal.

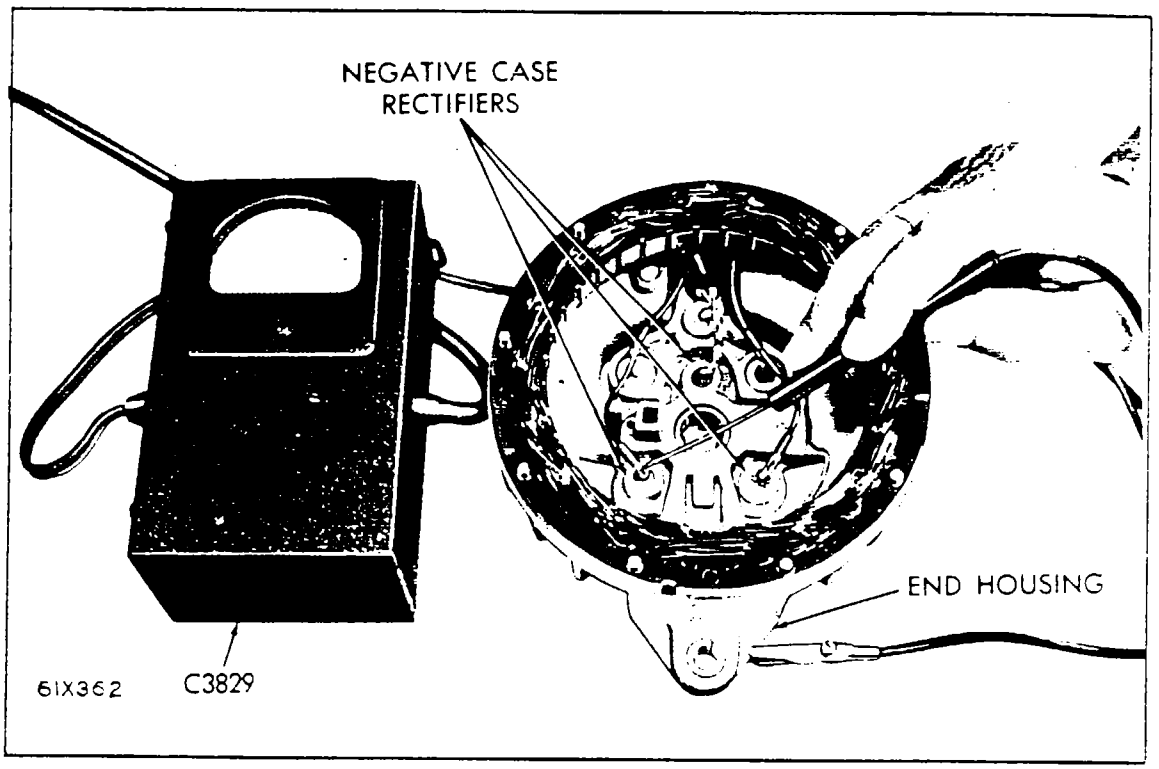


Figure 10-7. Testing Rectifiers (Negative)

10-10. TESTING RECTIFIERS (NEGATIVE). To test the negative case rectifiers in the end shield, connect the alligator clip of tool C-3829 to the end shield.

Touch the test prod to the bare wire of the rectifier leads at the rectifiers in the end shield. The meter will indicate the condition of the rectifier.

The test indications are the same for the negative case rectifiers in the end shield as they are for the positive case rectifiers in the heat sink. However, the meter will read at the opposite end of the scale.

NOTE

If all three of the negative rectifiers read low, before condemning the rectifiers, test for a grounded stator. A grounded stator will cause the negative rectifiers (in the end shield) to read low.

NOTE

A common cause of an open or a shorted rectifier is a defective capacitor or a battery that has been installed

in reverse polarity. If the battery is installed properly and the rectifiers are open, test the capacitor with a condenser tester.

10-11. REMOVING AND INSTALLING RECTIFIERS. The use of proper tools for the removal and installation of rectifiers cannot be over emphasized. A special tool kit has been developed to remove and replace new rectifiers without damage.

NOTE

Only new rectifiers should be installed. It is not recommended to reinstall rectifiers once they have been removed.

The new tool kit can be used on all Chrysler built alternators. A press is not required when using the new C-3928 tool kit for removing or installing rectifiers. Three diode rectifiers are pressed into the heat sink and three in the end shields.

The new tool consists of a clamp type fixture with special adapters. This tool makes it unnecessary to use a press.

The tool assembly consists of the following components:

C-3928 - Fixutre and Adapters
SP-3821 - Removing Adapter
SP-3818 - Installing Adapter
SP-3820 - Installing Support

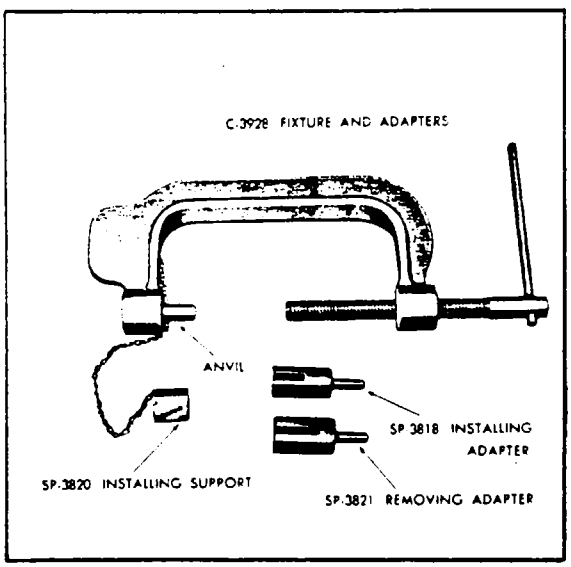


Figure 10-8. C-3929 Fixtures and Adapters

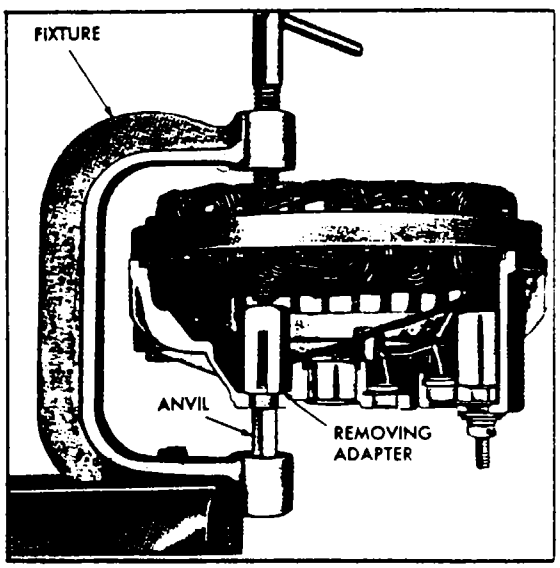


Figure 10-9. Removing Rectifiers

10-12. REMOVING RECTIFIERS. After cutting the lead from the malfunctioning rectifier, position the fixture with the rectifier to be removed over the fixture anvil.

Position the removing adapter SP-3821 around the rectifier. Rotate the threaded screw clockwise. As the screw approaches the removing adapter, guide its shank into the hole in the end of the screw.

Just before the downward motion of the screw bottoms, recheck the adapter to be sure it is in the proper position. Then continue to rotate the screw until the rectifier is free of the end shield or heat sink.

Reverse the screw by rotating it counter-clockwise. Remove adapter and old rectifier.

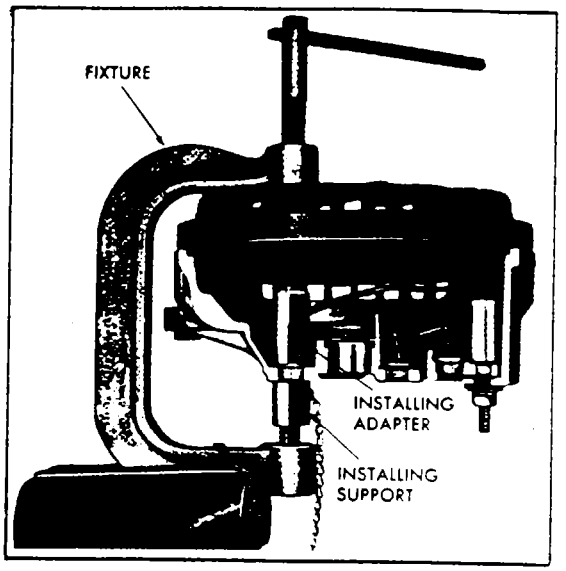


Figure 10-10. Installing Rectifiers

Remove the end shield assembly from the fixture and position SP-3820 installing support on the fixture anvil.

10-13. INSTALLING RECTIFIERS. Start the new rectifier as squarely as possible into the hole the old rectifier was removed from after first checking to be sure it is of the proper polarity. The negative rectifiers are marked with black numerals and the positive with red.

Reposition the end shield in the fixture, locating the hole over the installing support.

With the installing adapter SP-3818 positioned on the rectifier, rotate the screw clockwise.

Guide the shank of the adapter into the screw. Continue to move the screw downward until just before bottoming.

CAUTION

Check carefully to be certain that the adapter is positioned properly over the rectifier and the rectifier is started squarely in the hole.

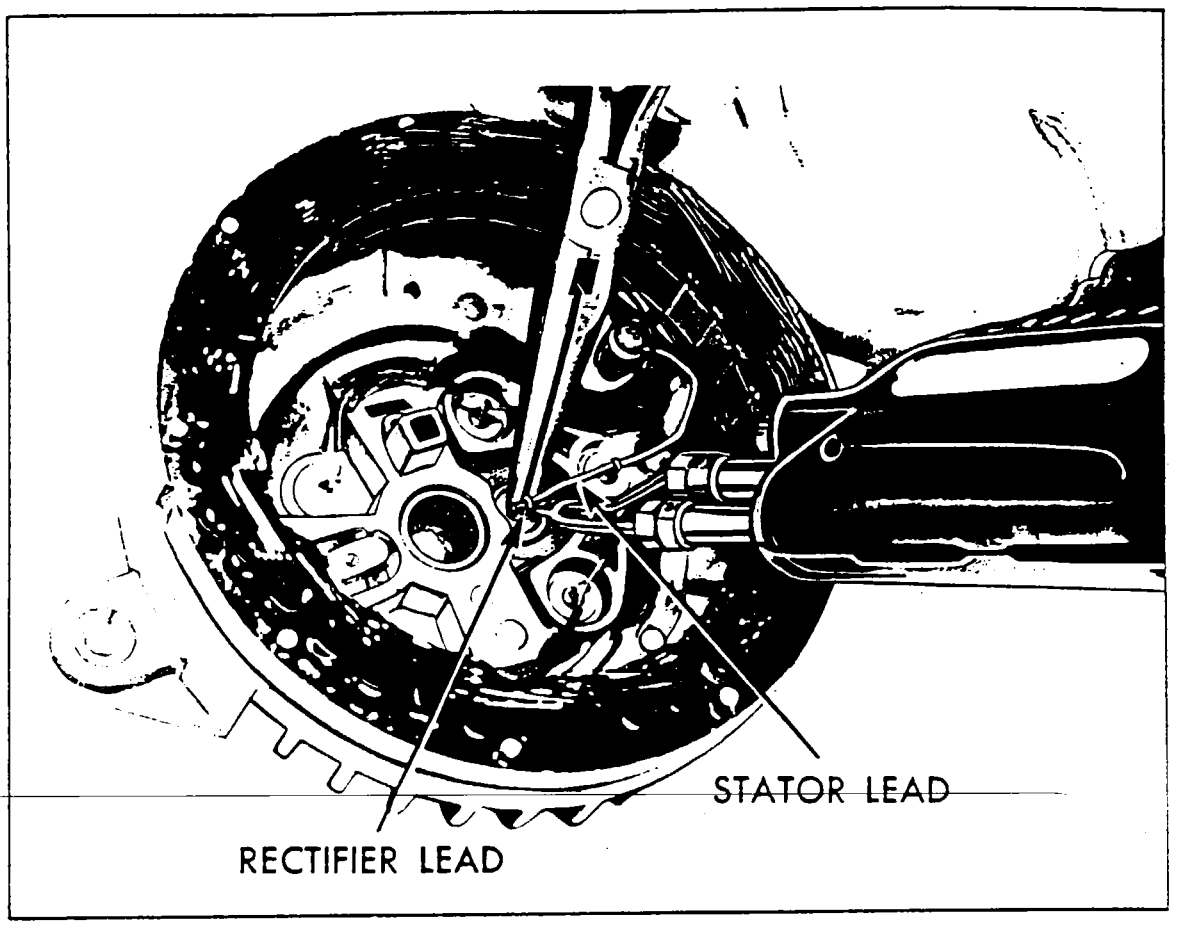


Figure 10-11. Soldering Rectifier Lead

Rotate the screw clockwise pressing the rectifier in place until it bottoms. When the rectifier bottoms, it can easily be felt. Remove the end shield assembly from the fixture and inspect to see that rectifier is installed properly.

NOTE

Clean all wires before soldering. Form the rectifier lead around the connector, being very careful not to crack the seal. To protect the rectifier from overheating, grip the rectifier lead between the rectifier and the point being soldered with a pair of long nose pliers. The pliers absorb heat to protect the rectifier. Under no circumstances use acid flux or acid core solder. Use rosin core solder only. The solder must be hot enough to flow and form a positive con-

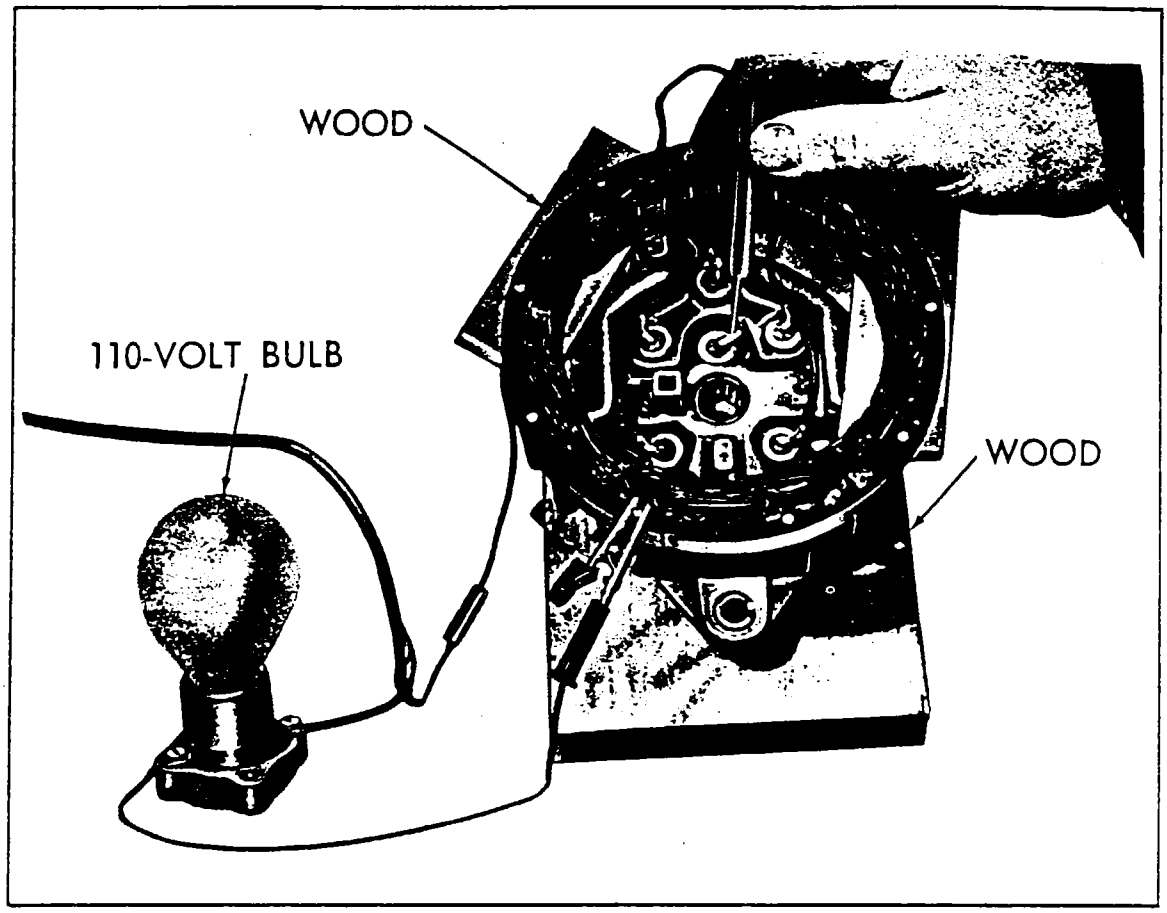


Figure 10-12. Testing Stator Coils

nection. Cold solder joints will break open. A good solder connection will be smooth while a poor solder joint (cold) will be rough and pitted.

NOTE

After soldering, to quickly cool the soldered connection, touch a dampened cloth against it. This will aid in forming a solid joint.

With the rectifier properly installed, test to ensure that the rectifier has not been damaged while installing. If the lead wires have been pulled away from the end shield, recement them.

10-14. TESTING STATOR COILS FOR GROUND. The stator coils are insulated from the core. A break in the insulation allowing the bare wire to touch the core will ground the coil and result in no output.

To test the stator for a ground (end shields separated), lift the stator away from the end shield and place wooden blocks approximately .50 inch thick between the stator and the shield to keep them separated.

Using a 110 volt test lamp, place one test probe on the core and the other test probe to one of the rectifier leads, making certain to have good electrical connections at both test probes. The lamp should not light. If the lamp lights, it is an indication that the coil windings are grounded to the core and a replacement of the stator is required.

10-15. TESTING ALTERNATOR CAPACITORS. Capacitors are used in connection with alternators to suppress any transient peak voltage that may occur. It is essential therefore, to test the capacitor when servicing the alternator.

This is especially true where diode rectifiers test open or short circuited.

The capacitor is connected to the inner end of the alternator "BAT" terminal screw and to the inner surface of the rectifier end shield (ground).

NOTE

On some early models, the capacitor was installed on the outside.

Connect the capacitor tester to the alternator "BAT" terminal screw and the disconnected ground lead.

CAUTION

Do not allow the tester probes or clips to touch the end shield or the rectifier leads while the test is in progress or damage to the rectifiers may occur.

Specified capacity for alternator capacitors of the early models is as follows:

Internally mounted	.158 MFD (min.)
Very early external mount	.5 MFD (min.)

The specified capacity for later built alternators (capacitor part of terminal screw) is .5 $\pm$ .1 MFD (min.).

Replace capacitors with low capacity, shorted or with high series resistance.

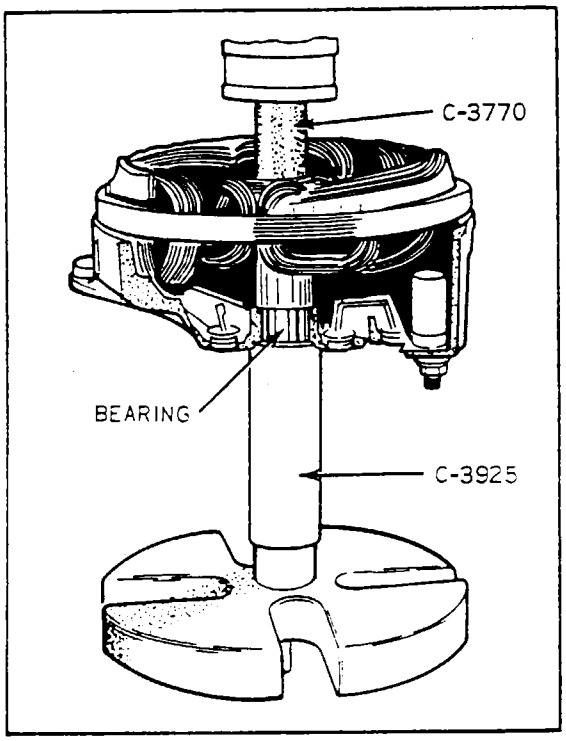


Figure 10-13. Removing End Bearing

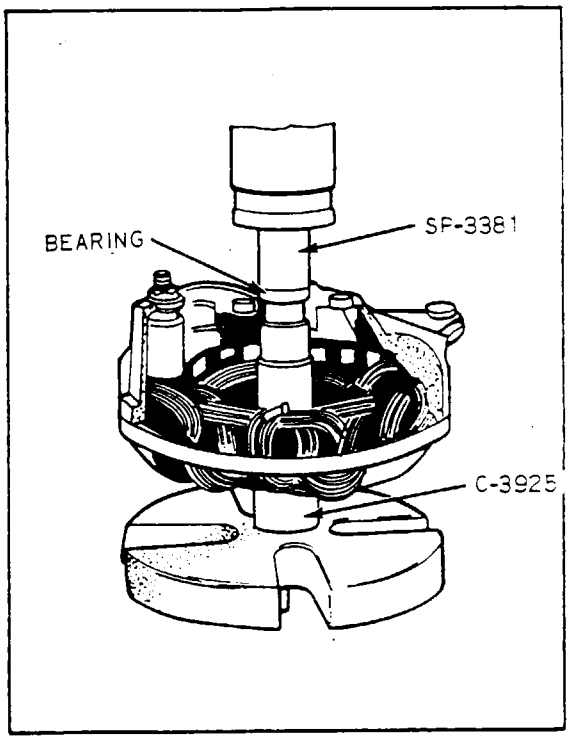


Figure 10-14. Installing End Bearing

10-16. REMOVING NEEDLE BEARING FROM END SHIELD. (Refer to Figure 10-13.) If inspection indicates that the needle bearing is faulty, it may be replaced.

The bearing is a press fit in the end shield. To protect the end shield, it is necessary to support it with tool C-3925 while pressing the bearing out with tool C-3770.

NOTE

Tool C-3925 is a double end tool. One end will only fit into the counterbore on alternators provided with the grease retainer. The opposite end is used as a support for end shields without the grease retainer counterbore.

10-17. INSTALLING NEEDLE BEARING IN END SHIELD. (Refer to Figure 10-14.) Support the end shield on the C-3925 tool and press the bearing into the end shield with tool SP-3381. Tool SP-3381 has a concaved end that is shaped to fit over the end of the bearing case. It is essential to use this tool to prevent damage to the bearing.

The face of the tool has been relieved to prevent pressure being applied on the center of the bearing. The use of a flat object to press in the bearing can cause the bearing to become distorted and result in a noisy bearing. Tool SP-3381 will also position the bearing properly. When the tool contacts the end shield, the bearing is in the end shield the proper distance.

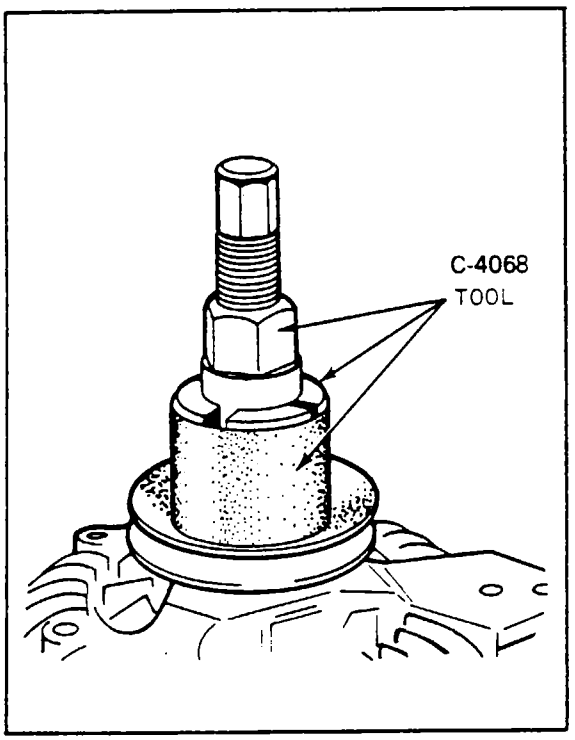


Figure 10-15. Removing Drive Pulley

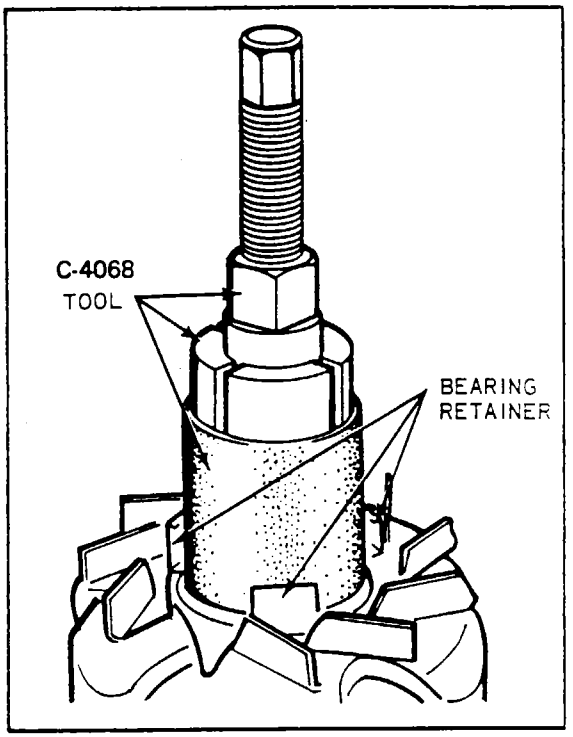


Figure 10-16. Removing Drive End Bearing

NOTE

New bearings are prelubricated, additional lubrication is not required and should not be used.

10-18. REMOVING DRIVE PULLEY. The drive pulley is an interference fit on the rotor shaft. The pulley is removed with puller C-3934. The use of this puller set to remove the pulley will prevent damage to the pulley.

10-19. REMOVING DRIVE END BEARING. The drive end bearing is an interference fit on the rotor shaft. It is also retained in the end shield by a retainer. The retainer on the early production alternators was attached to the end shield by three stud nuts and washers.

All late retainers are of spring steel construction and three integral fingers snap over a shoulder on the end shield.

Remove the drive end shield from the bearing by removing either the three retaining nuts from the retainer studs or by unsnapping the spring retainer fingers with a screwdriver. The end shield may then be removed by tapping on the end of the rotor shaft with a soft hammer while holding the end shield.

Remove the drive end bearing from the rotor shaft with puller C-3615 and special adapters as follows:

A. Position the center screw of tool C-3615 on the rotor shaft.
B. Place the thin lower end of the adapters SP-3375 under the bearing equally spaced

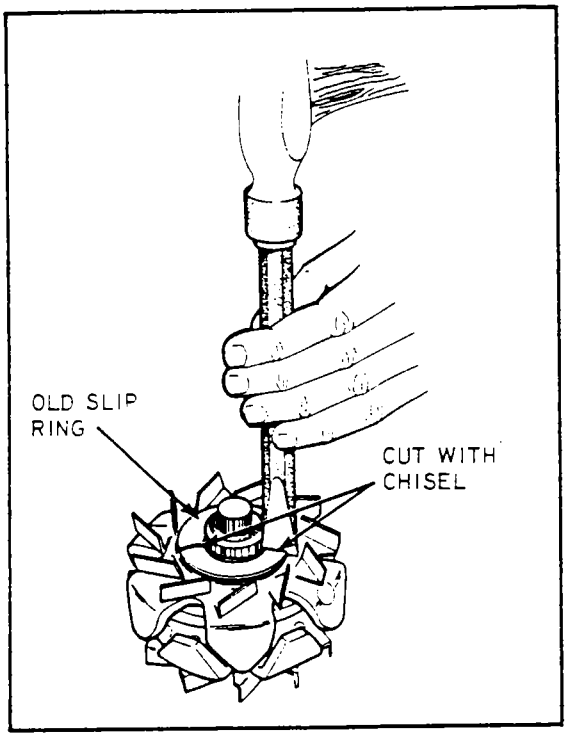


Figure 10-17. Removing Slip Ring

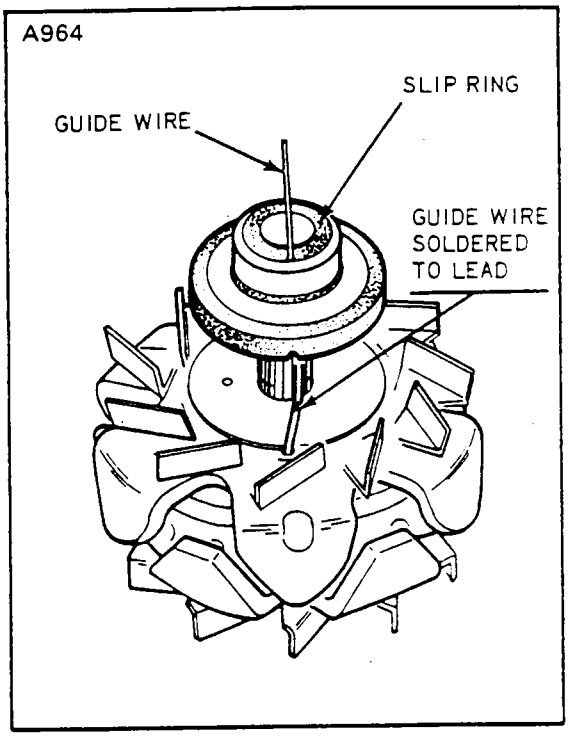


Figure 10-18. Aligning Slip Ring

and the upper end of the adapters around the center screw.

C. Hold adapters and center screw in position with the tool sleeve.

CAUTION

Tool sleeve must bottom on bearing, otherwise adapters may be damaged.

D. Turning the center screw while holding the outer body of the tool will withdraw the bearing from the shaft.

10-20. REPLACING SLIP RINGS. Slip rings that are damaged may be replaced. Two sizes are available. The early rotor shaft was smooth and the slip rings were pressed on and the ring cemented to the rotor fan. Later rotor shafts were knurled and the slip rings were pressed on the knurled surface of the shaft.

The early slip rings have a smaller inside diameter and must be pressed on the smooth rotor shafts ONLY.

The later slip rings have a larger inside diameter and must be pressed on the knurled shaft ONLY.

There is also another difference in the rotor shafts installed on the late alternators. This shaft has a grease retainer and an insulator. The retainer is pressed on over the insulator ahead of the slip rings. These rotors are not interchangeable with rotors used on alternators without the counterbore in the rectifier end shield.

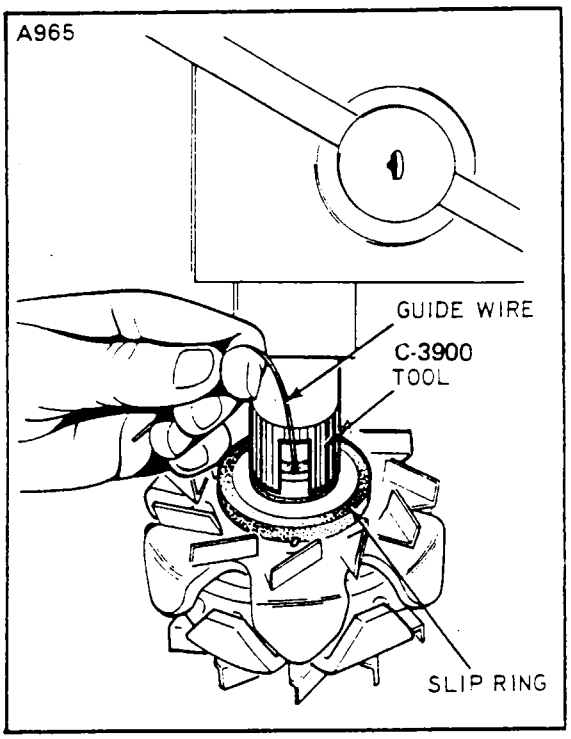


Figure 10-19. Installing Slip Ring

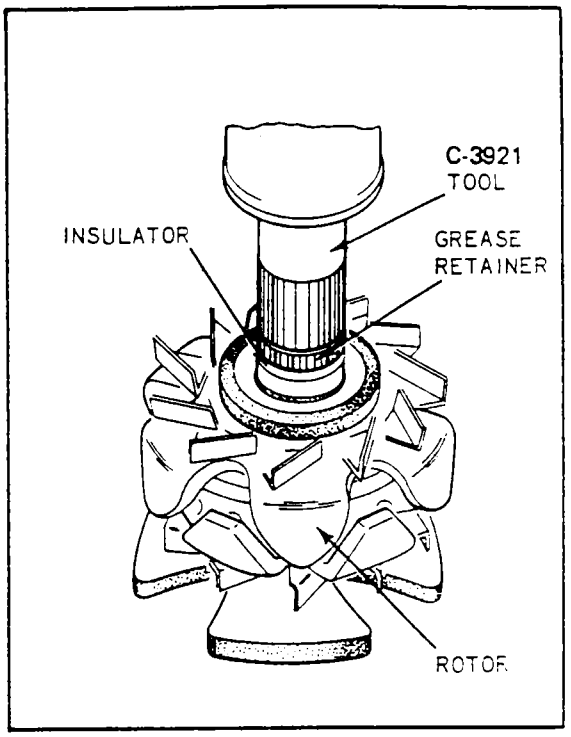


Figure 10-20. Installing Retainer

10-21. REMOVING SLIP RINGS. (Refer to Figure 10-17.)

a. Unsolder the rotor coil (field) leads from the solder lugs.

b. If the rotor has a grease retainer (installed on all late production alternators), remove it with a pair of diagonal pliers.

c. Cut through the copper of both slip rings at opposite points (180° apart) with a chisel.

d. Break the insulator and remove the ring.

e. Clean away any dirt and all particles of the old ring.

f. Scrape the face of the fan to be sure it is smooth.

g. Clean the shaft surface on the area that contacts the inner diameter of the ring and also the ends of the rotor coil leads.

10-21a. INSTALLATION OF SLIP RINGS. (Refer to Figure 10-20.) There are two types of slip rings which can be installed. The following instructions will describe each type.

a. Old Style:

1. Obtain a three inch long piece of bare wire (approx. 18 gauge) and scrape one end (about 0.19 of an inch) clean and tin this area with rosin core solder.

2. Lap the tinned end of the wire over the field coil lead to the insulated ring and solder the two together. (Refer to Figure 10-18.)

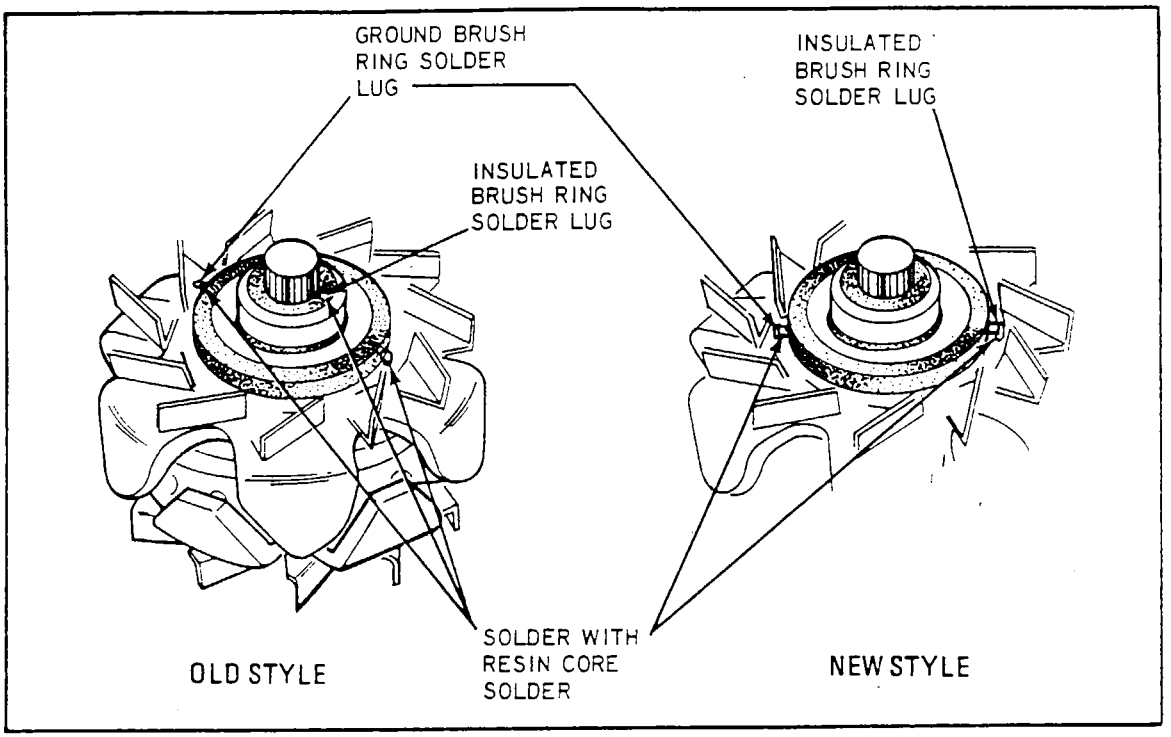


Figure 10-21. Solder Points

3. Position the slip ring carefully over the bare wire and the shaft so the wire will lay in the slip ring groove.

4. The groove in the slip ring must be in line with the insulated brush field lead to provide room for the lead without damaging it.

5. Place installing tool C-3900 over the rotor shaft with the guide wire protruding from the slot in the tool. (Refer to Figure 10-19.)

6. Position the assembly in an arbor press. Pull up on the guide wire being careful to guide the insulated field lead into the slip ring groove.

7. While guiding the insulated field lead through the groove, press the slip ring on the shaft. When the slip ring bottoms on the rotor fan, the end of the field lead should be visible at the solder lug.

8. Unsolder the guide wire from the insulated slip ring lead. Press the field lead into the solder lug and solder to lug with rosin core solder. (Refer to Figure 10-21.) Solder securely but do not leave an excessive blob of solder on rotors equipped with grease retainer.

CAUTION

Under no circumstance use acid core solder. A short circuit may result and corrosion will definitely occur.

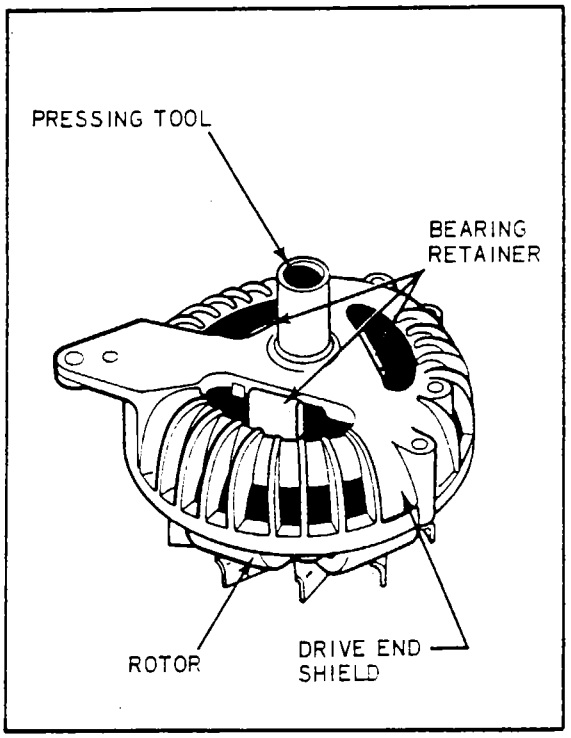


Figure 10-22. Installing Driver End Shield and Bearing (Typical)

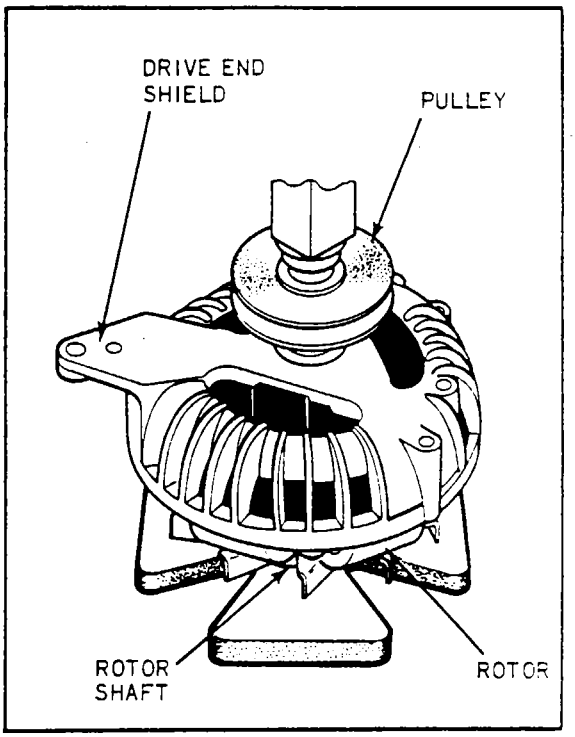


Figure 10-23. Installing Pulley

9. Coil the ground brush ring field lead around the solder lug and solder with rosin core solder.

10. Test slip rings for ground with 110 volt test lamp by touching one test probe to rotor pole shoe and remaining probe to slip rings. Test lamp should not light. If lamp lights, slip rings are shorted to ground, possibly due to grounding insulated field lead when installing slip ring. If rotor is not grounded, lightly clean slip ring surface with -00- sandpaper and assemble alternator.

b. New Style (Refer to Figure 10-21):

1. Position the slip ring on the rotor shaft so the solder lugs align with the rotor coil leads.

2. Place assembly tool C-3900 over rotor shaft and slip ring.

3. Position assembly in an arbor press and press the slip ring on the shaft until it bottoms on the rotor fan.

4. Coil the insulated brush slip ring lead around the solder lug and solder securely with rosin core solder.

5. Coil the ground brush ring field lead around the solder lug located 180° from the slip ring lug and solder with rosin core solder.

6. Test the slip rings for ground with 110 volt test lamp as outlined in step a-10.

10-22. INSTALLING GREASE RETAINER. If the solder connection where the rotor field coil lead is soldered to the insulated brush ring lug has a sharp point or if the blob of solder is excessive, smooth with a scraper or file before installing the grease retainer insulator. If smooth, place fiber insulator on shaft and press the retainer (cupped side to end of shaft) on the shaft with tool C-3921 in an arbor press.

10-23. INSTALLING DRIVE END BEARING. Insert the sealed drive end bearing in the drive end shield and install the bearing retainer. Install the washers and nuts to hold the bearing in place on all early production models. Snap the spring steel retainer fingers in place on all later production models.

If the rotor and its components require no service, position the bearing and the drive end shield assembly on the rotor shaft and while supporting the parts on the end of the rotor shaft, press the bearing and end shield assembly in position on the rotor shaft using an arbor press and tool C-3769.

CAUTION

Make sure that the bearing is installed squarely at the start; otherwise, damage to the bearing will result. Press the bearing on the rotor shaft until the bearing contacts the shoulder on the rotor shaft.

10-24. INSTALLING PULLEY. Install pulley on the rotor shaft using an arbor press before the rectifier end shield is assembled to the drive end shield.

WARNING

Do not press pulley on with a vise. Use a press.

The shaft must be the support while the pulley is pressed on with the pressure being applied to the pulley hub.

NOTE

Do not exceed 6800 pounds pressure. Press the pulley on the rotor shaft until the pulley contacts the inner face of the drive end bearing.

10-25. ASSEMBLING END SHIELD SUB-ASSEMBLIES. Position the rotor and drive end shield assembly on the rectifier end shield. Align the through bolt holes through the drive end shield, stator and the rectifier end shield.

Compress stator and both end shields by hand and install the through bolts.

Install the insulated brush and holder, terminal, insulating washer, lockwasher and terminal attaching screw. Install the ground brush and attaching screw.

Rotate the pulley slowly by hand to be sure that the rotor fans do not hit the rectifiers and stator connectors.

After installing the alternator on the engine, always test the complete charging system to be certain it is functioning properly.

NOTE

New through bolt locking tabs should be installed at each alternator disassembly. Torque through bolts evenly to 25 inch pounds and bend both ears of the locking tabs against bolt head. Check proper belt tension.

10-26. BENCH RUN-UP TEST. This test is to be performed at room ambient conditions and consists of four checks which are to be made quickly to avoid heating of the windings. These are as follows:

NOTE

For test c and d external field excitation may be used but must be removed and self excitation used to obtain output amperes. (Refer to Figure 10-24 for meter connections.)

a. With the alternator at rest, apply 15 volts between the alternator battery terminal and ground with polarity such that the rectifiers will block current flow (positive of supply to positive of the alternator). Monitor rectifier reverse current which shall be not more than 1 milliampere.

b. With the alternator at rest, apply 15 volts to the field circuit and monitor field current. This shall be between the limits of 3.3 amperes minimum and 3.6 amperes maximum.

c. Drive the alternator at 1500 rpm with an electrical load connected to the alternator. Adjust the load to obtain 15 volts. Net output (not including field current) shall be not less than 26.5 amperes.

d. Drive the alternator at 2500 rpm with an electrical load connected to the alternator. Adjust the load to obtain 15 volts. Net output (not including field current) shall be not less than 49.0 amperes.

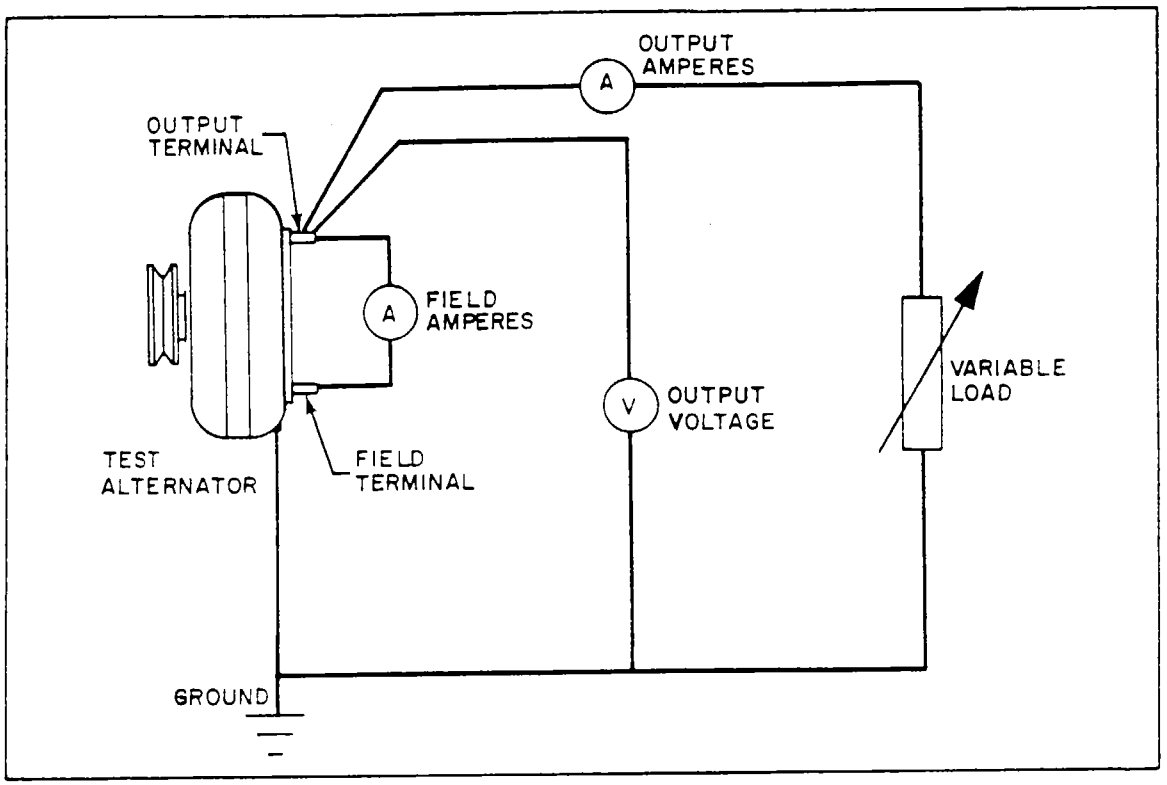


Figure 10-24. Meter Connections for Alternator Performance Test

10-27. BENCH HOT STABILATION OUTPUT TEST. To determine the hot stabilized output, the alternator must be driven with a suitable driving mechanism. During this test, the following shall be monitored: (Refer to Figure 10-24 for meter connections.)

a. Alternator output voltage.
b. Alternator output current.
c. Field current.
d. Alternator rpm.

Drive the alternator at sufficient rpm to obtain 14 volts at the alternator battery terminal. Alternator shall be self excited, otherwise no external load shall be applied. An external D.C. power source may be used to polarize the field but must be removed as soon as the alternator is self sustaining. Maintain 14 volts at no load by adjusting rpm for a period of 15 minutes, at which time record the above specified data.

Apply an electrical load to the alternator and increase speed so as to obtain 5 amperes output (not including field excitation) at 14 volts. Maintain this condition for 15 minutes by adjusting the rpm. At the end of this period record the above specified data.

Maintain output voltage at 14 volts and vary the load in 5 ampere intervals. At each 5 amp interval allow a 15 minute stabilization period maintaining output by varying rpm. Record the required data at each interval. Continue this procedure through the maximum output (approximately 10,000 rpm).

10-27a. ALTERNATOR SYSTEM (PRESTOLITE).

10-27b. CHECKING ALTERNATOR SYSTEM. With all electrical equipment off (except master switch) the ammeter will indicate the amount of charging current demanded by the battery. This amount will vary, depending on the percentage of charge in the battery at the time. As the battery becomes charged, the amount of current displayed on the ammeter will reduce to approximately two amperes. The amount of current shown on the ammeter will tell immediately whether or not the alternator system is operating normally, if the following principles are kept in mind.

NOTE

The amount of current shown on the ammeter is the load in amperes that is demanded by the electrical system from the alternator. As a check, take for example a condition where the battery is demanding 10 amperes charging current, then switch on the landing light. Note the value in amperes placarded on the circuit breaker panel for the landing light circuit breaker (10 amps) and multiply this by 80 percent, you will arrive at a current of 8 amperes. This is the approximate current drawn by the light. Therefore, when the light is switched on, there will be an increase of current from 10 to 18 amperes displayed on the ammeter. As each unit of electrical equipment is switched on, the current will add up and the total, including the battery, will appear on the ammeter.

Using the example that the airplane's maximum continuous load with all equipment on is approximately 48 amperes for the 60 ampere alternator. This approximate 48 ampere value, plus approximately two amperes for a fully charged battery, will appear continuously under these flight conditions. If the ammeter reading were to go much below this value, under the aforementioned conditions, trouble with the alternator system would be indicated and corrective action should be taken by switching off the least essential equipment.

The following test procedure could be helpful in locating faulty components:

a. Ascertain that the airplane is positioned so that the prop blast will not interfere with other operations going on near by. Start engine and set throttle for 1000 to 1200 RPM.

b. Switch on the following loads and observe the ammeter output increase as indicated.
   1. Rotating beacon - 3 to 6 amps.
   2. Navigation and instrument lights (bright position) - 4 to 6 amps.
   3. Landing light - 7 to 9 amps.

If alternator does not meet above indications, refer to troubleshooting chart. Follow troubleshooting procedure outlined on the chart in a step by step fashion checking each cause and isolation procedure under a given trouble before proceeding to the next.

On airplanes without night-flying equipment, load required by test can be simulated by connecting a lamp-bank load consisting of 8 landing lights wired in parallel from main bus (+) to airframe ground (-) (Refer to Figure 10-3) or 3 ohm, 100 watt resistors.

10-27c. 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 pressed 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 one-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 10-24m to hold the brushes in the holder during assembly. Remove the pin after the brush holder retaining screws have been tightened. 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.

10-27d. ALTERNATOR SERVICE PRECAUTIONS. Since the alternator and regulator are designed for use on only one polarity system, the following precautions must be observed when testing or servicing the electrical system. Failure to observe these precautions will result in serious damage to the electrical equipment.

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 output lead must not be removed from the alternator while the rotor winding is energized and the alternator is operating.

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.

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.

10-27e. DESCRIPTION OF ALTERNATOR. (Refer to Figure 10-24a.)

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 insulator. One brush is connected to a terminal stud and is insulated from ground. The other brush is connected to ground through the brush holder. The brush and holder assembly can easily be removed for inspection or brush replacement purposes.

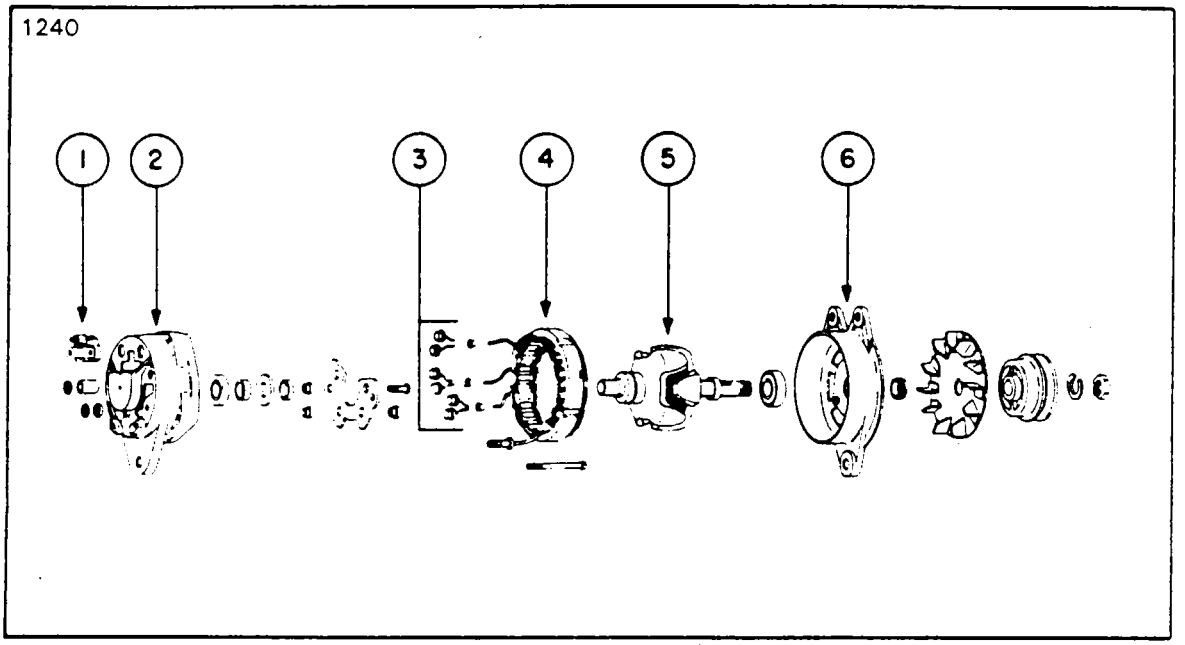


Figure 10-24a. Exploded View of Alternator

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 (P.I.V.) 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. 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.

10-27f. 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.

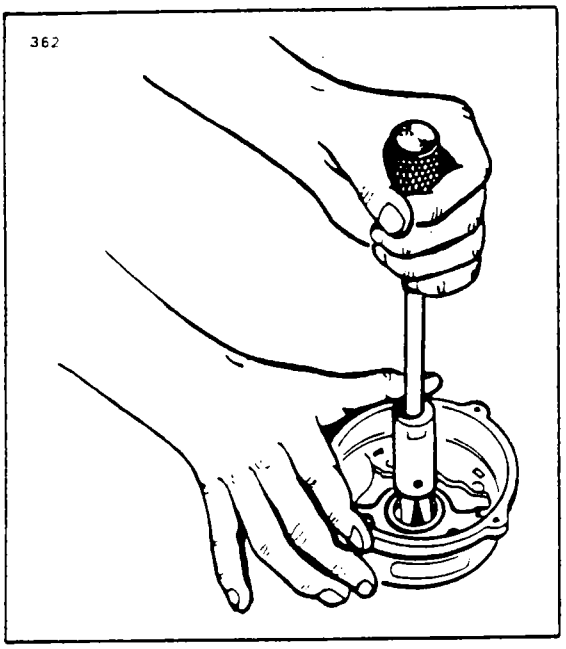


Figure 10-24b. Removal of Slip Ring End Bearing

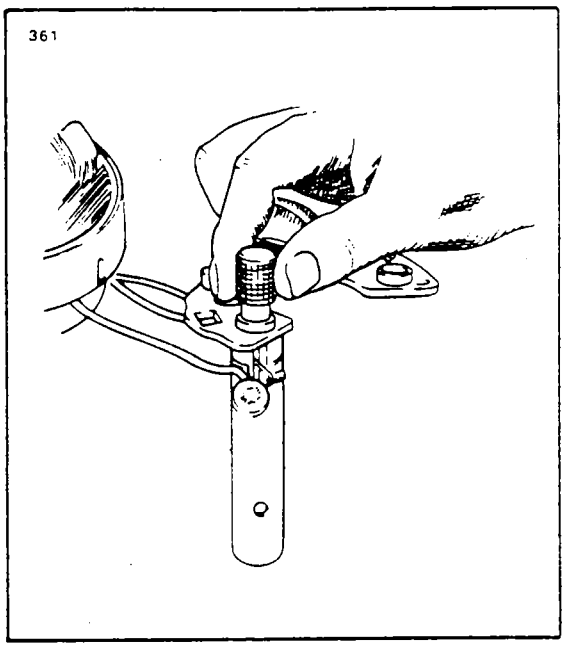


Figure 10-24c. Removal of Rectifier

10-27g. 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 10-24c, 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 10-24b. Do not remove the bearing unless replacement is necessary.

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.

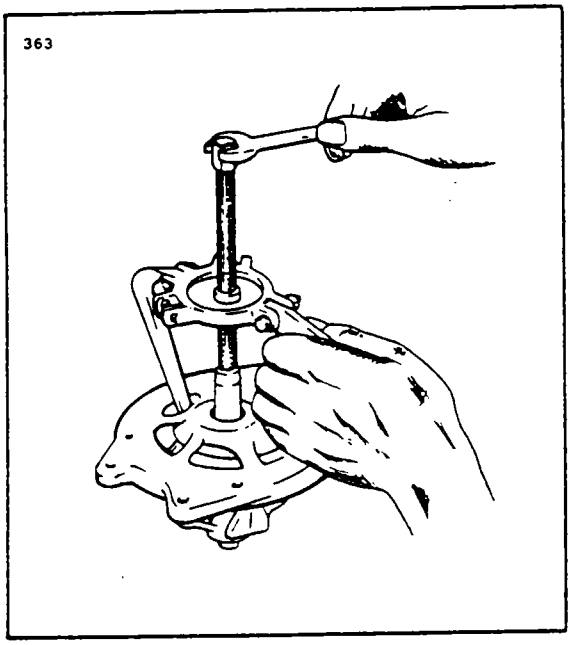


Figure 10-24d. Removal of Drive End Head

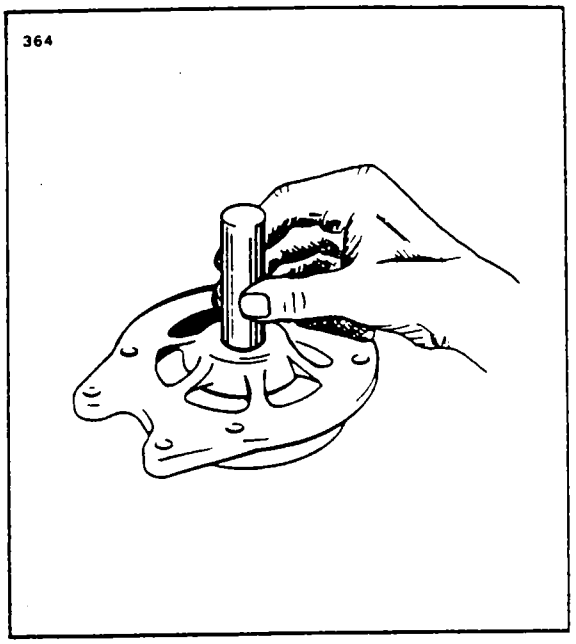


Figure 10-24e. Removal of End Head Bearing

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 10-24d. 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 10-24e.)

10-27h. INSPECTION AND TESTING OF COMPONENTS. 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 10-24f.) 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 10-24g, or use an ohmmeter. Rotor current draw and resistance are listed in 10-27k, Alternator Service Test Specifications. 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

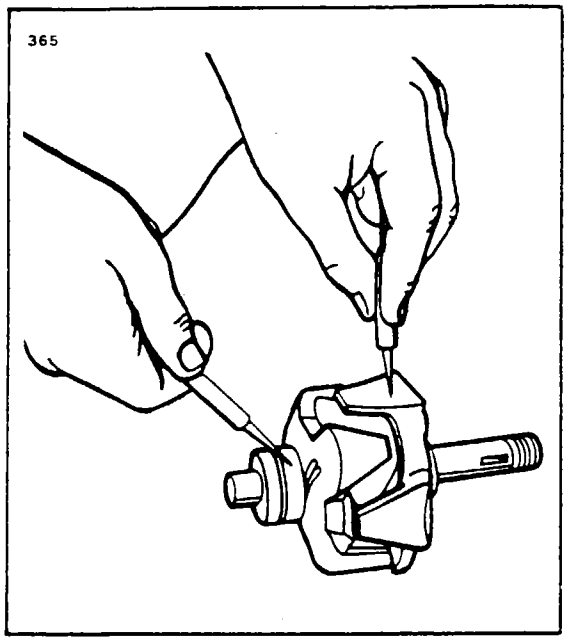


Figure 10-24f. Testing Rotor for Ground

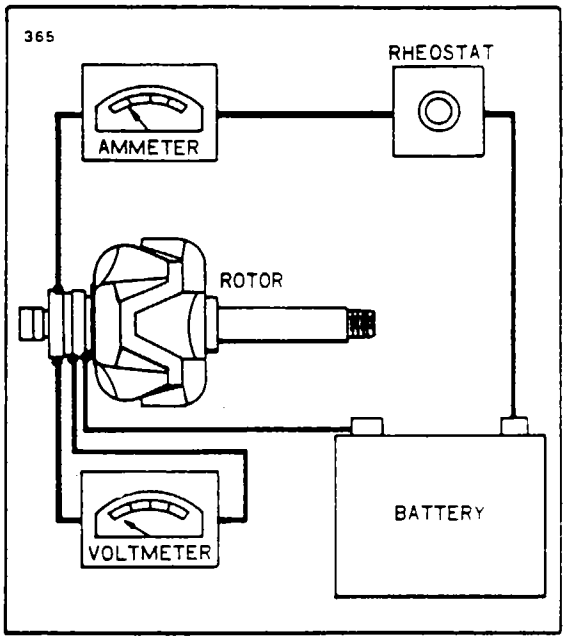


Figure 10-24g. Testing Rotor for Shorts

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 auxiliary terminal or any stator lead, and the other test bulb or ohmmeter probe to the stator frame. If the test bulb lights, or the ohmmeter indicates continuity, the stator is grounded. To test for open windings, connect one test probe 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 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.

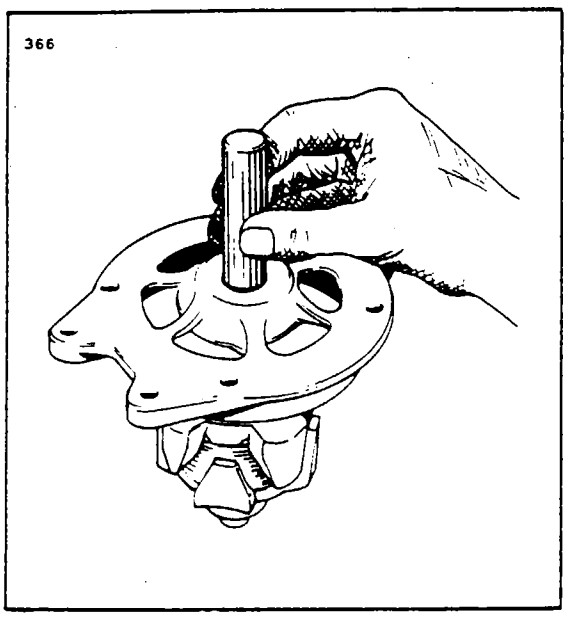


Figure 10-24h. Installation of Bearing

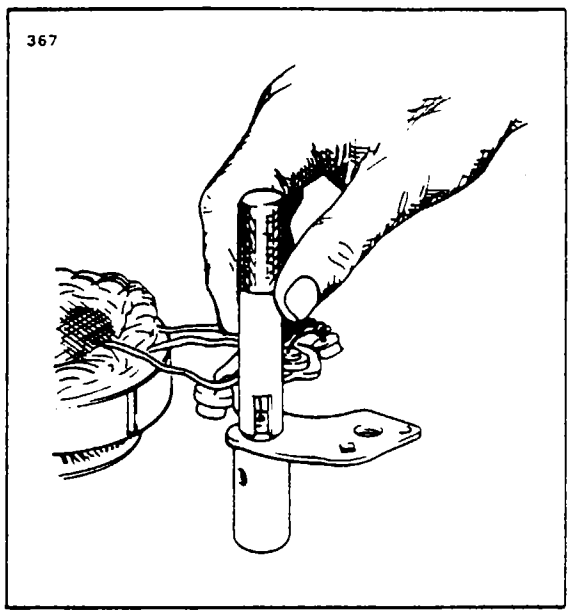


Figure 10-24i. Installation of Rectifier

10-27i. 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 10-24h.)

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 10-24i.

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 10-24j.)

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. Stake the seal in place. Correct assembly of bearing, seal, inner race and spacer as shown in Figure 10-24k.

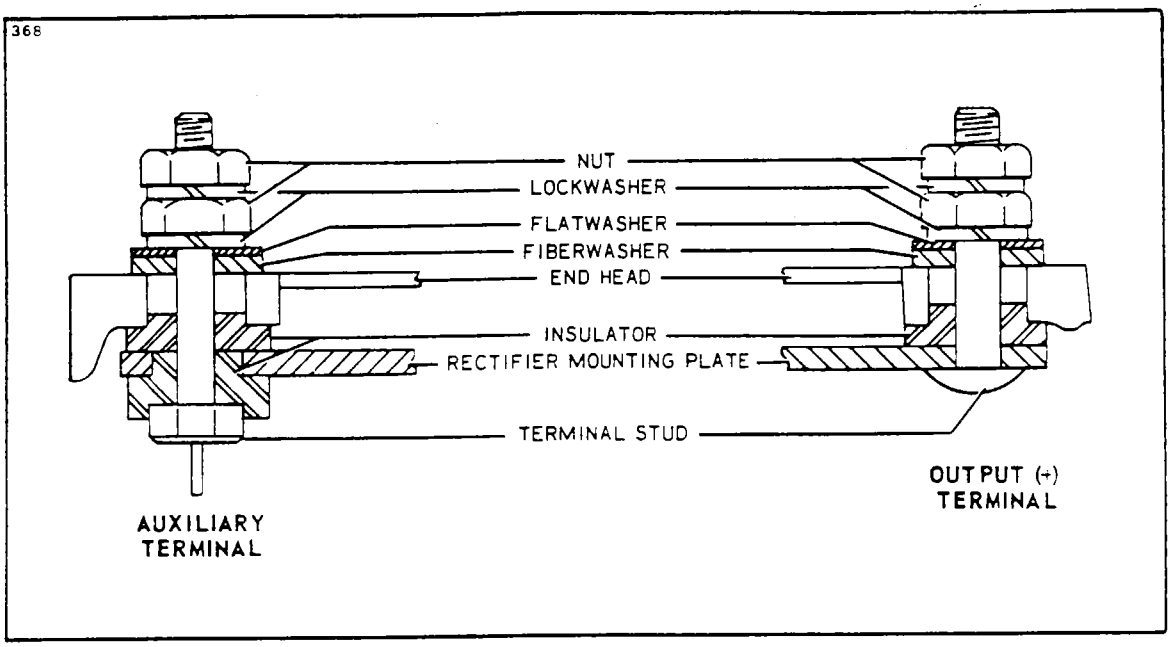


Figure 10-24j. Terminal Assembly

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, lock washer and nut. Torque the nut to 35 foot pounds, using a strap wrench to hold the pulley.

g. Install the brush and holder assembly and retaining screws. Spin the rotor and check for interference between the brush holder and rotor. Check between the field terminal and ground with an ohmmeter. The ohmmeter must indicate the amount of rotor resistance listed with paragraph 10-27k, Alternator Service Test Specifications.

10-27j. TESTING OF ALTERNATOR.

a. Wiring connections for bench testing the alternator are shown in Figure 10-24l. 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 install the alternator on the engine.

NOTE

Always refer to the alternator wiring diagram (refer to Electrical Schematic Index) when installing the alternator or testing the alternator.

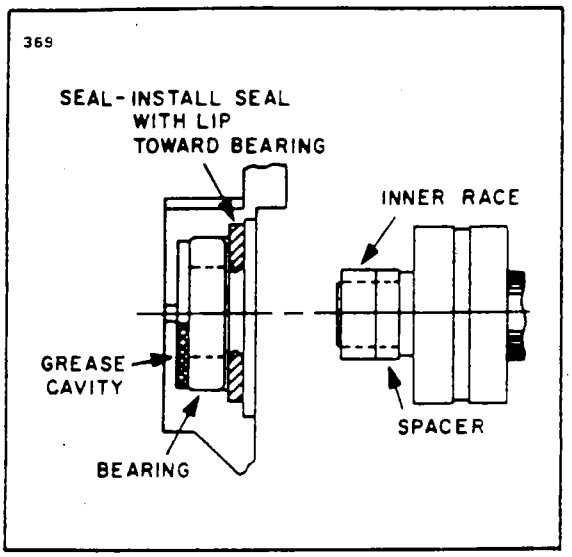


Figure 10-24k. Slip Ring End Bearing Assembly

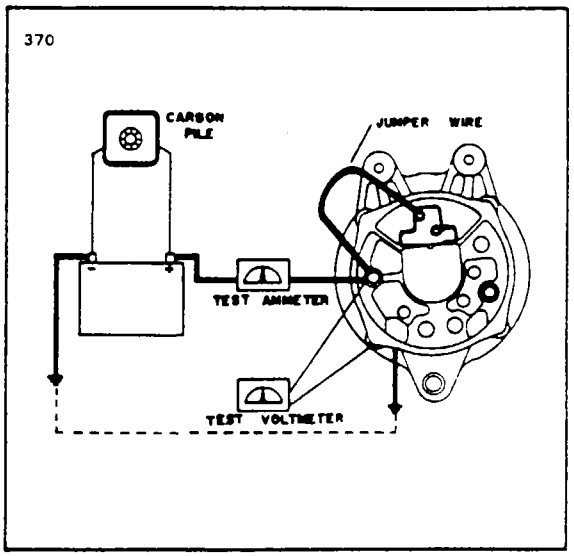


Figure 10-24l. Testing Alternator

10-27k. ALTERNATOR SERVICE TEST SPECIFICATIONS. Prestolite specifications for the 14 volt alternators installed as standard equipment on PA-32 airplanes equipped with air conditioning.

ALTERNATOR SPECIFICATIONS		
Alternator Model	ALY 6409; ALY 6422	
Voltage	12 volts	
Rated Output	60 amperes	
Ground Polarity	Negative	
Rotation	Bi-Directional	
Rotor:		
Current Draw (70° F-80° F)	2.4 to 4.0 amps @ 12.0 volts	
Resistance (70° F-80° F)	3.5 to 5.0 ohms	
Output Test (70° F-80° F):		
Volts	14.0	14.0
Amperes Output	13.0	47.0
Min. Alternator RPM	2000	4000

PRESTOLITE SI ALY 9.31.79

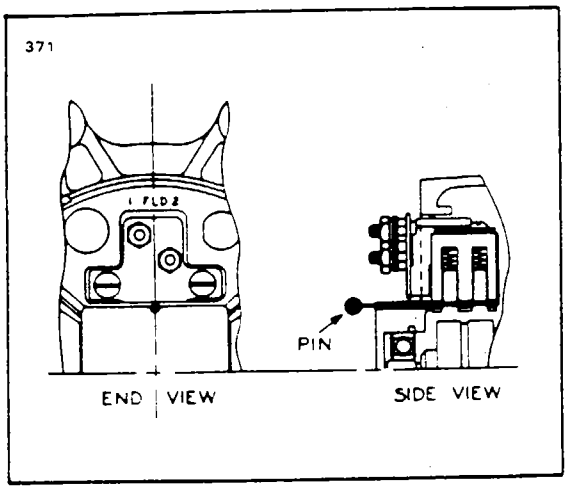


Figure 10-24m. Brush Installation

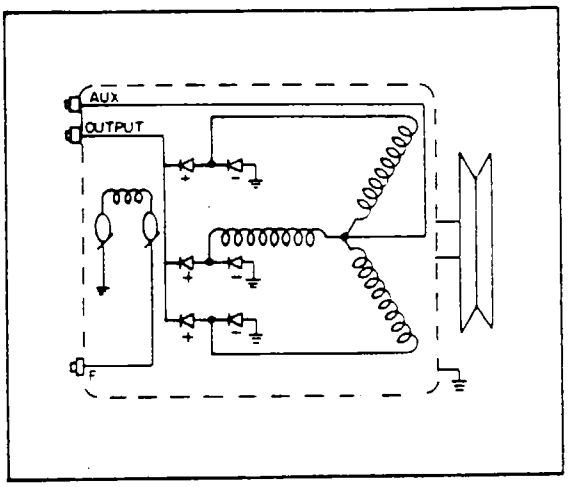


Figure 10-24n. Internal Wiring Schematic

10-27. CHECKING ALTERNATOR BELT TENSION. If properly installed, tensioned and checked periodically, the alternator drive belt will give very satisfactory service. However, an improperly tensioned belt will wear rapidly and may slip and reduce alternator output. Consequently, a belt should be checked for proper tension at the time it is installed, again after 25 hours operation and at each 100 hour inspection thereafter. (Refer to Paragraph 10-32.) For aircraft with airconditioning installed refer to Paragraph 13-22 & 13-23 for alternator belt tensions.

10-28. VOLTAGE REGULATOR.

10-29. CHECKING VOLTAGE REGULATOR. The regulator is a fully transistorized unit in which all of the components are encapsulated in epoxy, which makes field repair of the unit impractical, and if it does not meet the specifications, it must be replaced. The regulator may be tested by the following procedure:

a. Be sure that the battery is fully charged and in good condition.

b. Check the alternator according to the manufacturer's instructions, to determine if it is functioning properly. This test must be done with the regulator out of the circuit. After completing this test, reconnect the regulator into the circuit.

c. Use a good quality accurate voltmeter with at least a 15 volt scale.

d. Connect the positive voltmeter lead to the red wire at the regulator harness connector, or terminal block. Connect the negative voltmeter lead to the regulator housing. (Note) Do not connect the voltmeter across the battery, because the regulator is designed to compensate for resistance contained within the wiring harness.

e. With the alternator turning at sufficient rpm to produce a half load condition, or approximately 25 amperes output, the voltmeter should read between 13.6 and 14.6 volts. The ambient temperatures surrounding the voltage regulator should be between 50° F. to 100° F. while this test is being made.

f. The voltage regulator heat sink, or case, is the ground connection for the electronic circuit. Therefore, if this unit is tested on the bench, it is most important that a wire, No. 8 or larger, be connected between the regulator case and the alternator. If the regulator does not regulate between 13.6 and 14.6 volts, one of the following conditions may exist:

1. Regulates, but out of specification. The regulator is out of calibration and must be replaced.
2. The voltmeter continues to read battery voltage.
   (a) Poor or open connections within the wiring harness.
   (b) The regulator is "open."
3. Voltage continues to rise.
   (a) Regulator housing not grounded.
   (b) Regulator shorted, must be replaced.

g. These are some of the things to look for in case of failure:

1. Poor or loose connections.
2. Poor ground on the regulator housing.
3. Shorted alternator windings.
4. A grounded yellow wire (This will cause instantaneous failure.)
5. Disconnecting the regulator while the circuit energized.
6. Open circuit operation of the alternator (The battery disconnected.)

10-30. OVER VOLTAGE RELAY.

10-31. CHECKING OVER VOLTAGE RELAY. The relay may be tested with the use of a good quality, accurate voltmeter, with a scale of at least 20-volts and a suitable power supply, with an output of at least 20-volts, or sufficient batteries with a voltage divider to regulate voltage. The test equipment may be connected by the following procedure:

a. B+ is connected to "Bat" of the over-voltage control.

b. B- is connected to the frame of the over-voltage control.

c. Be sure both connections are secure, and connected to a clean, bright surface.

d. Connect the positive lead of the voltmeter to the "Bat" terminal of the over-voltage control.

e. Connect the negative lead of the voltmeter to the frame of the over-voltage control.

f. The over-voltage control is set to operate between 16.2 volts and 17.5 volts. By adjusting the voltage, an audible "click" may be heard when the relay operates.

g. If the over-voltage control does not operate between 16.2 and 17.5 volts, it must be replaced.

10-32. CHECKING ALTERNATOR BELT TENSION. If properly installed, tensioned and checked periodically, the generator drive belt will give very satisfactory service. However, an improperly tensioned belt will wear rapidly and may slip and reduce generator output. Consequently, a belt should be checked for proper tension at the time it is installed, again after 25 hours operation and each 100 hour inspection thereafter.

The method for checking alternator belt tension is described below:

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:

a. Apply a torque indicating wrench to the nut that attaches the pulley to the generator and turn it in a clockwise direction. Observe the torque shown on the wrench at the instant the pulley slips.

b. Check the torque indicated in step (a) with torque specified in the following chart. Adjust belt tension accordingly.

Width of Belt	Condition	Torque indicated at generator 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.

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.

10-33. CRANKING MOTORS. (Delco Remy)

10-34. GENERAL.

When the cranking 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 splines 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.

10-35. CHECKING CRANKING MOTOR. Several checks, both visual and electrical, should be made in a defective cranking circuit to isolate trouble before removing any unit. Many times a component is removed from the aircraft only to find it is not defective after reliable tests. Therefore, before removing a unit in a defective cranking 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 cranking motor, solenoid or magnetic switch, ignition switch or any other control switch, and battery, including all ground connections. Clean and tighten all connections and wiring as required. Many engine manufacturers specify allowable voltage drops in the cranking circuit. For this information, refer to the engine manufacturer's shop manual.

NOTE

If a solderless terminal on an aluminum cable is loose, corroded or otherwise unsatisfactory, it is recommended that the complete cable assembly be replaced instead of replacing or repairing the solderless terminal.

Should replacement of the complete assembly not be practical, it is permissible to replace the aluminum cable assembly with a copper cable assembly which is two sizes smaller (ex.: An AL-1 aluminum cable assembly is replaced with an AN-3 copper cable assembly).

The new cable should be installed in accordance with AC-43-13-2A.

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c. Inspect all control switches and the ignition switch, to determine their condition. Connect a jumper lead around any switch suspected of being defective. If the system functions properly using this method, repair or replace the bypassed switch.

d. If specified battery voltage can be measured at the motor terminal of the cranking 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.

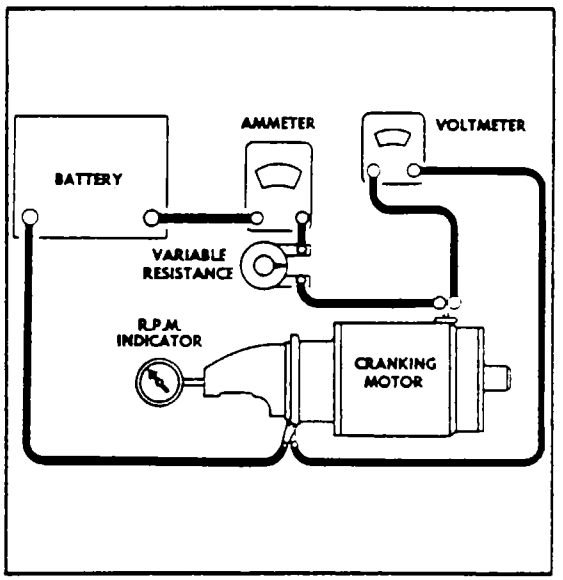


Figure 10-25. No-Load Test

10-36. TEST AND MAINTENANCE OF CRANKING MOTOR. (Delco-Remy)

10-37. INSPECTION. With the cranking 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. (Refer to paragraph 10-39 & 10-40.)

10-38. CHECKS.

10-39. NO-LOAD TEST CHECK. (Refer to Figure 10-25.) Connect the cranking 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 r.p.m. indicator is necessary to measure armature speed. Obtain the speci-

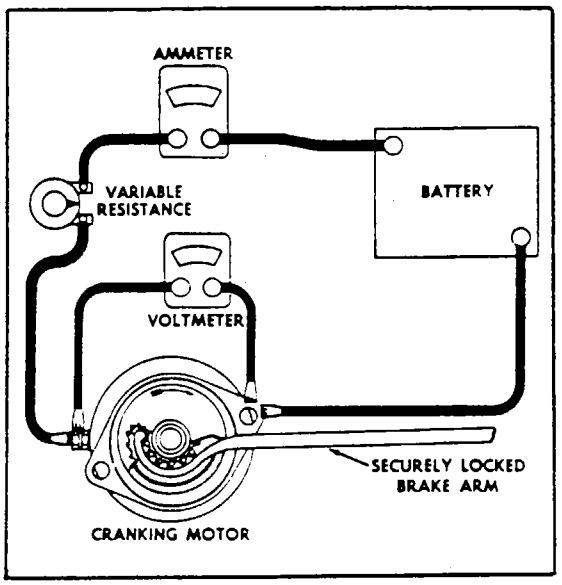


Figure 10-26. Resistance Test

fied voltage by varying the resistance unit. Then read the current draw and armature speed and compare these readings with the values listed in the published specifications. Interpret the test results as follows:

a. Rated current draw and no-load speed indicate normal condition of the cranking motor.

b. Low free speed and high current draw indicate:

1. Too much friction-tight, dirty, or loose pole shoes allowing armature to drag.

2. Shorted armature. This can be further checked on a growler after disassembly.

3. Grounded armature or fields. Check further 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.

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:

1. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under (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.

10-40. RESISTANCE TEST. (Refer to Figure 10-26.) This test requires that the pinion be locked securely so it cannot rotate. When the specified voltage is applied, the current should fall in a range as indicated in published specifications.

A high current indicates grounded or shorted conductors, and a low current indicates excessive resistance.

10-41. 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 cranking 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 the cranking motor. Following are general instructions for disassembling a typical Bendix drive cranking 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 of 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.

10-42. 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 test specification) 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 hack saw 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 probes. If the lamp lights when one test probe is placed on the commutator and other test probe 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 probe 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 probes 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.

10-43. REASSEMBLY. 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 de-meshed position.

10-44. CRANKING MOTOR SERVICE TEST SPECIFICATIONS. Delco-Remy specifications for 12 volt cranking motors installed as standard equipment on the PA-32 aircraft are as follows:

Motor Model	1109657
Delco-Remy, Ref. Service Bulletin	1M-110
Min. Brush Tension	24 oz.
No-Load Test Volt Min. Amps Max. Amps Min. R.P.M. Max. R.P.M.	 10.6 48.0 80 5800 8200
Resistance Test Volts Min. Amps Max. Amps	 4.0 365 420

10-45. CRANKING MOTORS. (Prestolite)

10-46. 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 10-27.

10-47. 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 wind-

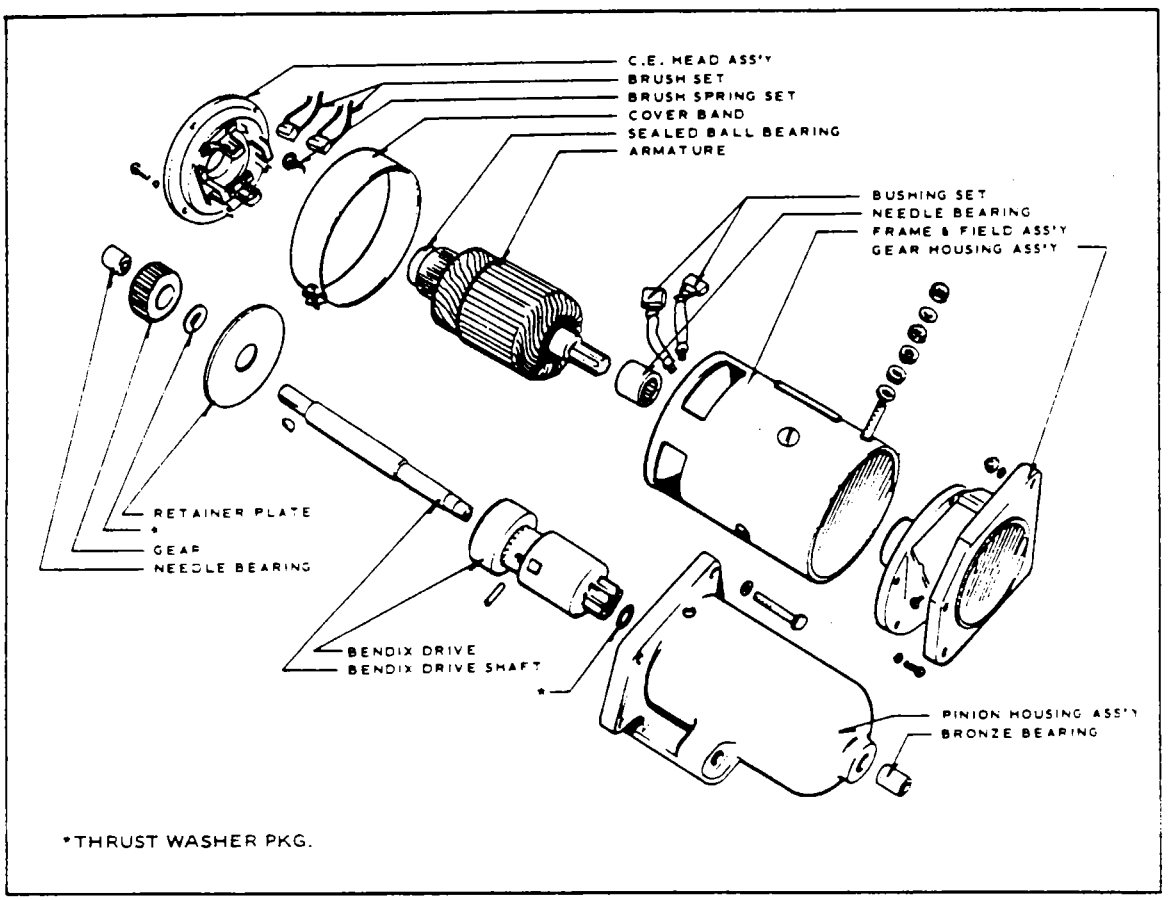


Figure 10-27. Exploded View of Gear Reduction Starting Motor

ings 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.

10-48. 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 aircraft is operated. It is recommended that such inspection be made at each 100 hours and include the following:

a. The battery should be checked with a hydrometer to be sure if 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, or in airplanes with a combination starter and ignition switch, by disconnecting the magneto "P" leads. This is to determine that the pinion engages properly and that it turns freely without binding or excessive noise. After checking the system, reconnect the "P" leads. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is shut down.

10-49. 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.

10-50. 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.

10-51. 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.

10-52. 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.

10-53. 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 10-28. 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

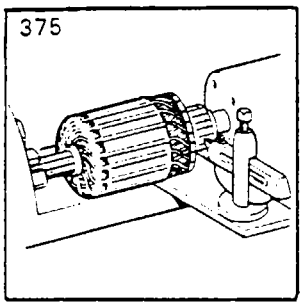


Figure 10-28. Turning Starting Motor Commutator

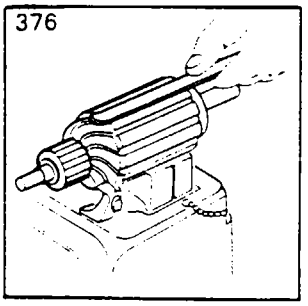


Figure 10-29. Testing Motor Armature for Shorts

10-29.) 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.

10-54. FIELD COILS.

a. Check the field coils for grounds (Refer to Figure 10-30) 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.

10-55. 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.

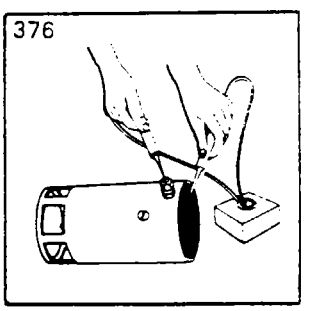


Figure 10-30. Testing Motor Fields for Grounds

10-56. GEAR AND PINION HOUSING. Inspect housings for cracks and bear-

ings for excessive wear. Remove rust, paint or grease from mounting surfaces.

10-57. 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.

10-58. 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 .005 to .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.

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.

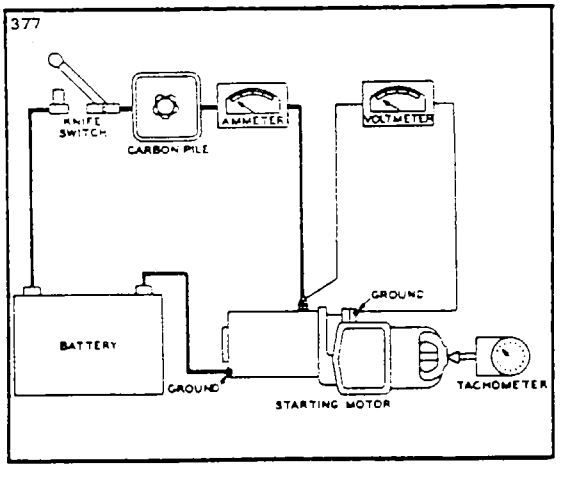


Figure 10-31. No-Load Test Hook-up

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 10-61.

10-59. 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 10-61. To make this test, connect as shown in Figure 10-31. If current is too high, check the bearing a-

lignment 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 10-32.

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.

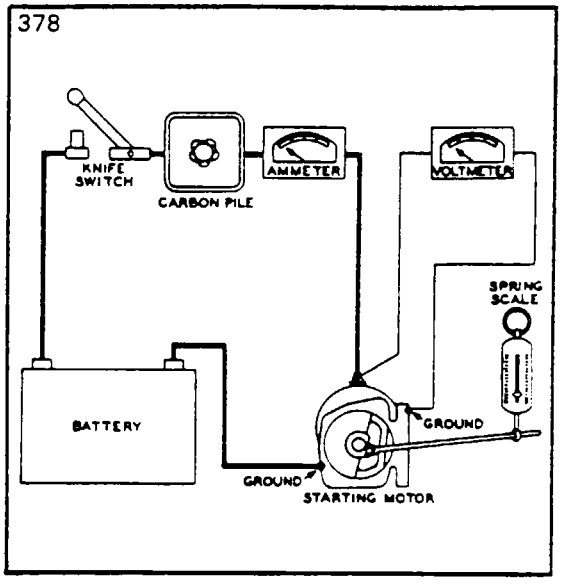


Figure 10-32. Stall-Torque Hook-up

10-60. 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.

10-61. CRANKING MOTOR SERVICE TEST SPECIFICATIONS. Prestolite specifications for 12-volt cranking motors installed as standard equipment on the PA-32 are as follows:

Motor Model	MZ-4206
Min. Brush Tension Max. Brush Tension	32 oz. 40 oz.

No-Load Test (77° F):	
Volt	10
Max. Amps	75
Min. R.P.M.	1600
Stall Torque:	
Amps	560
Min. Torque, Ft.-Lbs.	37.5
Approx. Volts	4.0

PRESTOLITE SI MZ 9-31-79

10-62. BATTERY.

10-63. SERVICING BATTERY. The battery is located under the floor of the forward baggage compartment. It is enclosed in a box with a vent system and a drain. The vents allow fresh air to enter the box and draw off fumes that may accumulate due to the charging process of the battery. The drain is capped off from the bottom of the fuselage and should be opened occasionally to drain any accumulation of liquid or during cleaning of the box. 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 in the battery. All connections must be clean and tight. If the battery is not up to normal charge, recharge starting with a charging rate of four amperes and finishing with two. A fast charge is not recommended. Access to the battery on standard PA-32-260 and 300 aircraft is through the access panel within the nose baggage compartment floor. On PA-32R-300 models the external access panel on the right side of the fuselage at station 43 is removed.

10-64. HYDROMETER READING AND BATTERY CHARGE PER CENT.

Hydrometer Reading	Per cent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	discharged

10-65. REMOVAL AND INSTALLATION OF BATTERY.

a. On standard PA-32-260 and 300 models, remove the floor panel located in the forward baggage compartment.

b. On the PA-32R-300 model remove the external access panel and the floor panel located in the forward baggage compartment.

c. Cut the safety wire and remove the wing nuts that secure the battery box cover.

d. Disconnect the battery cables.

NOTE

Always remove the ground cable first and install last to prevent accidental short circuiting or arcing.

e. Lift the battery from the box.

f. The battery may be installed in reverse order of removal.

CAUTION

Do not install battery with reverse polarity. Connect ground to negative terminal of battery.

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TABLE X-II. ELECTRICAL SYSTEM COMPONENT LOADS

DUTY CYCLE		EQUIPMENT	LOAD (AMPS)	PA-32		
CON'T.	INM'T.			260	300	R-300
X		Anti-Collision Light				
		Grimes 40-0101-XX-12	3.5	X	X	OPT
		Whelen WRML-12	3.5	X	X	OPT
		Whelen Red Strobe	3.4	OPT	OPT	–
		Whelen Red/White Strobe	3.8	OPT	OPT	–
		Whelen White Strobe	4.4	–	–	OPT
X		Position Lights	5.4	X	X	OPT
	X	Landing Lights	8.0	X	X	OPT
X		Instrument Lights	(Max.)			
		Red Flood	1.0	X	X	OPT
		Panel	1.5	X	X	OPT
	X	Reading Light				
		Passenger	1.0	X	X	OPT
	X	Fuel Pump				
		Pulsating (Carb.)	0.5	X	–	–
		Rotary (Fuel Inj't)	6.0	–	X	X
X		Engine Gages	Approx 1.0	X	X	X
X		Elec. Turn & Bank	0.5	X	X	OPT
X		Pitot Heat	13.2	X	X	OPT
X		Pitot and Pressure Mast				
		Heat	20.5	–	–	OPT
	X	Cigar Lighter	8.0	X	X	OPT
X		Master Solenoid	0.8	X	X	X
	X	Starter Solenoid	10.0	X	X	OPT
		Radio (See Mfg's Installation Manual)				
	X	Baggage Comp't Light	0.6	X	X	OPT
	X	Landing Gear				
		Pump (Circuit Breaker)	25.0	–	–	X
		Solenoid	0.8	–	–	X
	X	Gear Down Lights	Total 0.3	–	–	X

10-66. CORROSION PREVENTION. The battery should be checked for spilled electrolyte or corrosion at least each 50 hour inspection or at least every 30 days, whichever comes first. Should this be found in the box, on the terminals or around the battery, the battery should be removed and both the box and battery cleaned by the following procedure:

a. Remove the box drain cap from the underside of the fuselage and drain off any electrolyte that may have overflowed into the box.

b. Clean the battery and the box. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to a consistency of thin cream. The application of this mixture should be applied until all bubbling action has ceased.

CAUTION

Do not allow soda solution to enter battery.

c. Rinse the battery and box with clean water and dry.

d. On metal battery boxes, paint the box with an acid resistant paint. Allow the paint to dry thoroughly.

e. Place the cap over the battery box drain.

f. Reinstall the battery.

NOTE

If a solderless terminal on an aluminum cable is loose, corroded or otherwise unsatisfactory, it is recommended that the complete cable assembly be replaced instead of replacing or repairing the solderless terminal.

Should replacement of the complete assembly not be practical, it is permissible to replace the aluminum cable assembly with a copper cable assembly which is two sizes smaller (ex.: An AL-1 aluminum cable assembly is replaced with an AN-3 copper cable assembly).

The new cable should be installed in accordance with AC-43-13-2A.

10-66a. STARTING THROUGH EXTERNAL POWER WITH AIRPLANE'S BATTERY NEARLY DEPLETED.

a. When using a 12 volt battery for external power starting and the airplane's battery is nearly depleted, the following procedure should be used:

1. Disconnect the airplane's battery at the negative terminal to prevent excessive loading of the external starting battery.

2. Check that all of the airplane's electrical equipment is turned OFF.

3. Connect the external battery to the external power receptacle; turn master switch ON and start engine using normal starting procedure.

4. Turn master switch OFF; remove external battery, and then reconnect the battery at the negative terminal.

5. Turn master switch ON.

When starting with a power cart and the airplane's battery is nearly depleted, the procedure in step 1 need not be followed. The capacity of a power cart is sufficient to start an aircraft with a low battery.

10-67. INSTRUMENT AND PANEL LIGHTS. The instrument and panel lights are broken up into five groups: Upper Panel Lights, Lower Panel Lights, Console Lights, Coupler Lights and Compass Light. The instrument lights are controlled by a 5 amp circuit breaker through a transistorized dimmer. The dimmer control is located in the middle of the instrument panel just above the pedestal. In earlier model airplanes there is one control knob connected to a varible resistor that controls the intensity of the instrument lights. On Serial Nos. 7400001 & up on the 32-260 and Serial Nos. 7440001 & up on the 32-300 there is a second control knob connected to a varible resistor which controls the light intensity for all the avionic equipment. It may be necessary to gain access to the Dimmer Control Assembly; if so follow the instructions given below.

10-68. REMOVAL OF DIMMER CONTROL ASSEMBLY.

a. Access to the Dimmer Control Assembly is from beneath the instrument panel.

b. Disconnect the electrical connection from the assembly.

c. Remove the two screws securing the assembly to the instrument panel.

d. Remove assembly from the airplane.

10-69. INSTALLATION OF DIMMER CONTROL ASSEMBLY.

a. Position the assembly in the instrument panel with the control knobs inserted into their appropriate slots.

b. Secure the assembly to the instrument panel with the two screws previously removed.

c. Connect the electrical connection to the assembly.

d. Check operation of Dimmer Control Assembly.

10-70. ANNUNCIATOR PANEL.

10-71. DESCRIPTION. The annunciator panel is a small cluster of lights which warn of malfunctions in the various circuits or systems. A malfunction is identified by the illumination of an individual warning light. There are three amber warning lights and a push-button test switch. (Refer to Figure 9-4d.) Power is supplied from the bus bar through a 5 amp fuse located behind the suction gauge.

The VAC warning light is controlled by a vacuum sensor switch located at the bulkhead and is attached to the vacuum regulator. The sensor switch will activate when the differential pressure is below 3.5 in. Hg.

The OIL warning light is controlled by an oil pressure sensor switch incorporated in the oil line to the oil pressure gauge and is located at the bulkhead. The sensor switch will activate when the oil pressure is below 35 psi.

The ALT warning light is illuminated by current flowing from the bus bar to the alternator circuit. (Refer to Figure 10-52.) This condition exists when the alternator is not operating properly and the output is zero. During normal operation, the alternator warning circuit is also supplied with power from the top diode terminal. This current flows through a 5 amp fuse, located above the diode heat sink, to the resistor and diode creating a no-flow condition which does not allow the warning light to light.

The test button is used to check the operation of the lights when the engine is running. The lights will work when the engine is not running with the master switch turned on.

|| 10-71A. REMOVAL OF ANNUNCIATOR PANEL (Refer to Paragraph 9-74).

10-72. REMOVAL OF OIL PRESSURE SENSOR. Access to the sensor unit is gained by reaching up under the instrument panel. Removal is accomplished by the following:

a. Disconnect the two electrical leads.
b. Unscrew the sensor unit from the bulkhead fitting.
c. Catch spillage and cover hole to prevent foreign matter from entering oil line.

10-73. INSTALLATION OF OIL PRESSURE SENSOR.

a. Screw the sensor unit into the bulkhead fitting.
b. Reconnect the two electrical leads.
c. Perform operational check.

10-74. REMOVAL OF VACUUM SENSOR. Access to the sensor unit is gained by reaching up under the instrument panel to the vacuum regulator. Removal is accomplished by the following:

a. Disconnect the two electrical leads.
b. Unscrew the sensor unit from the vacuum regulator.
c. Cover hole to prevent foreign matter from entering regulator.

10-75. INSTALLATION OF VACUUM SENSOR.

a. Screw sensor unit into vacuum regulator.
b. Reconnect the two electrical leads.
c. Perform operational check.

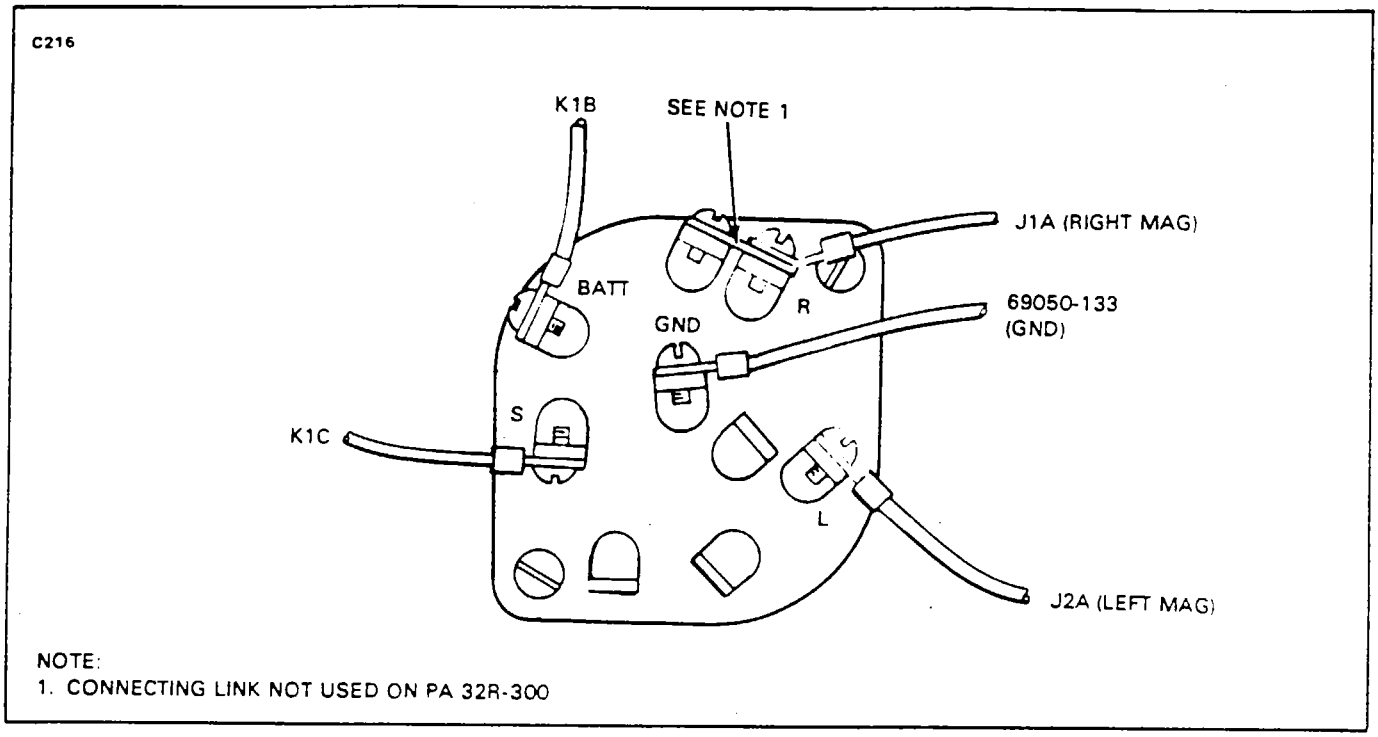


Figure 10-32a. Ignition Switch

10-76. IGNITION SWITCH.

10-77. REMOVAL OF IGNITION SWITCH.

a. Insure the ignition switch is in the OFF position.

b. Gain access to and disconnect the power lead (+) from the battery.

c. Remove the ignition switch, retaining nut from the switch on the forward side of the instrument panel and withdraw the switch from the panel.

d. Mark the wires and note their position on the switch, then disconnect the wires.

10-78. INSTALLATION OF IGNITION SWITCH. (Refer to Figure 10-32a.)

a. Attach wires to switch as shown in Figure 10-32a.

b. Position the ignition switch in the instrument panel and secure with retaining nut.

c. Connect the power lead (+) to the battery and reinstall any access covers previously removed.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING

Trouble	Probable Cause	Isolation Procedure and Remedy
ALTERNATOR		
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure)	Open field circuit.	With master switch turned on check for battery voltage (12V) from ship's main buss through entire field circuit to alternator field terminal. Measure voltage from ground (-) to the following points (+) in sequence: buss bar, output circuit breaker (60A), field circuit breaker (5A), field terminals of master switch, voltage regulator and alternator field terminal. Interruption of voltage through any of these points isolates the faulty component or wire which must be replaced. (See Fig. 10-1)
	Open output circuit.	With master switch turned on check for battery voltage (12V) from ship's main buss

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure) (cont)	Open output circuit. (cont)	through entire output circuit to alternator battery post. Measure voltage from ground (-) to the following points (+) in sequence: buss bar, output circuit breaker (60A), ammeter, and alternator battery post. Interruption of voltage through any of these points isolates the faulty component or wire which must be replaced (See Figure 10-1)
	Open field winding in alternator.	Disconnect field terminal of alternator from field wiring and check for continuity from field terminal to ground with ohmeter (20-100 ohms) depending on brush contact resistance. (Pull propeller slowly by hand turning alternator rotor through 360° of travel.) CAUTION Turn magneto switch to off before turning prop.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure) (cont)	Open field winding in alternator. (cont)	If resistance is high check brushes for spring tension and excessive wear and replace if necessary. If brushes are okay and field reads open, replace alternator.
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure.	Faulty voltage regulator.	Start engine, turn on load (Ref. alternator test procedure), set throttle at 2300 RPM. Check voltage at buss bar (convenient check point, remove cigar lighter and check from center contact (+) to ground (-). Voltage should be 13.5 volts minimum. If voltage is below this value replace regulator.
	High resistance connections in field or output circuit.	Check visually for loose binding posts at the various junction points in system, alternator battery post, lugs on ammeter, connections at voltage regulator, circuit breaker, etc., (See Figure 10-1) Examine crimped terminal ends for signs of

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure. (cont)	High resistance connections in field or output circuit.	deterioration at crimp or strands of broken wire at crimp. Tighten any loose binding posts or replace bad wire terminals.
	Open rectifier.	If any of the six rectifiers pressed into the rear bell housing of the alternator open up internally it will result in a definite limitation on the current that can be drawn from the alternator. After Having checked the previous causes of low output it can be assumed that a faulty rectifier exists. Refer to Paragraph 10-27b.
Field Circuit Breaker trips.	Short circuit in field circuit.	Disconnect field wiring at terminal of alternator. Turn on master switch. If breaker continues to trip, proceed to disconnect each leg of field circuit, working from the alternator towards the circuit breaker until breaker can be reset

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Field Circuit Breaker trips. (cont)	Short circuit in field circuit. (cont)	and will hold. Replace component or wire which was isolated as defective. (See Figure 10-1)
	Short circuit in field winding of alternator.	Disconnect field wiring at terminal of alternator. Turn on master switch. Reset breaker and if breaker fails to retrip, this isolates short circuit to field of alternator itself. Check brush holders for shorting against frame. If there are no obvious signs of a physical short circuit at field terminal or brush holder replace alternator. (Note: Intermittent short circuit.) Internal short circuiting of the field can occur at various positions of the rotor, therefore, reconnect field, reset breaker, pull propeller slowly by hand turning alternator rotor through 360° of travel. Observe circuit breaker for signs of tripping.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Field Circuit Breaker trips. (cont)	Short circuit in field winding of alternator. (cont)	CAUTION Turn magneto switch to off before turning propeller.
Output circuit breaker trips.	Short circuit in output circuit	Disconnect wiring at battery post of alternator. Turn on master switch. Reset breaker and if breaker continues to trip proceed to disconnect each leg of output circuit, working from the alternator towards the circuit breaker until breaker can be reset and will hold. Replace component or wire which was isolated as defective (See Figure 10-1).
	Shorted alternator diode.	Disconnect wiring at battery post of alternator. Turn on master switch. Reset breaker and if breaker fails to retrip, this isolates short circuit to alternator. Refer to Paragraph 10-27b.
	Battery installed with reversed polarity.	Remove battery and reinstall with correct

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Output circuit breaker trips. (cont.)	Battery installed with reversed polarity. (cont.)	polarity.
	Battery charged backwards.	Remove battery. Connect load such as landing light lamp or similar load and discharge battery. Recharge with correct polarity and test each cell for signs of damage due to reversed charging. NOTE: This type of condition can only occur in a case where a discharged battery has been removed from the airplane and put on a charger with the polarity reversed. This reversal in polarity cannot occur in the airplane due to any fault in the alternator system.
Excessive ammeter fluctuation.	Excessive resistance in field circuit.	Check all connections and wire terminals in field circuit for deterioration such as loose binding posts, broken wire strands at terminals, etc. Tighten all connections and replace faulty terminals.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Excessive ammeter fluctuation. (cont.)	High field circuit resistance.	If problem persists, jump across terminals of the following components one at a time until the faulty unit is isolated. a. Field 5 amp (alternator) circuit protector. b. Alternator half of master switch. c. Overvoltage relay.
	Defective voltage regulator.	Replace voltage regulator.
STARTER		
Motor fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to electrical 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 side 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 percent seated; however, if

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Probable Cause	Isolation Procedure and Remedy
Motor fails to operate. (cont.)	Binding, worn, or improperly seated brush, or brushes with excessive side play. (cont.)	facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of number 000 sandpaper between the brush and commutator, with the sanded side next to the brush. Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator. CAUTION: Do not use coarse sandpaper 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 number 0000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Motor fails to operate (cont)	Shorted, grounded, or open armature	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test, repair if possible or replace with a new part.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect, and relubricate, replacing ball bearings if worn.
	Same electrical causes as listed under "Motor fails to operate."	Same remedies listed for these troubles.
Excessive arcing of motor 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 outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	BATTERY	
Discharged battery.	Battery worn out.	Replace battery.
	Charging rate not set right.	Reset.
	Standing too long.	Remove and recharge battery if left in unused airplane 3 weeks or more.
	Equipment left on accidentally.	Remove and recharge.
	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 top of plates.	Maintain electrolyte.
	Sulfation due to disuse.	Replace.

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Battery life is short. (cont)	Impurities in electrolyte. Low charging rate.	Replace battery. Adjust voltage regulator.
Cracked cell jars.	Hold-Down bracket loose. Frozen battery.	Replace battery and tighten. Replace.
Compound on top of battery melts.	Charging rate too high.	Reduce charging rate by adjusting voltage regulator.
Electrolyte runs out of vent plugs.	Too much water added to battery and charging rate too high.	Drain and keep at proper level and adjust voltage regulator.
Excessive corrosion inside container.	Spillage from overfilling. Vent lines leaking or clogged. Charging rate too high.	Use care in adding water. Repair or clean. Adjust voltage regulator.
Battery freezes.	Discharged battery. Water added and battery not charged immediately.	Replace. Always recharge battery for 1/2 hour following addition of water in freezing weather.
Leaking battery jar.	Frozen.	Replace.
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery chould be slowly discharged completely

TABLE X-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
		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 X-III. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
ANNUNCIATOR PANEL		
All the warning lights fail to operate.	Blown fuse.	Replace the 5 amp fuse behind instrument panel.
	No current from bus.	Check all wire segments, connections, and the receptacle at the left side of the annunciator panel.
All the warning lights fail to extinguish after engine is running.	Test switch grounded out.	Check terminals and replace switch if necessary.
OIL warning light fails to operate.	Bulb burned out.	Replace.
	No current to sensor.	Check all wire segments and connections.
	Sensor activates at a too low setting.	Replace.
	Defective sensor.	Replace.
OIL warning light fails to extinguish.	Sensor activates at a too high setting.	Replace.
	Sensor terminals bridged.	Remove material between terminals.
	Defective sensor.	Replace.

TABLE X-III. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
ANNUNCIATOR PANEL (cont.)		
VAC warning light fails to operate.	Bulb burned out.	Replace.
	No current to sensor.	Check all wire segments and connections.
	Sensor activates at a too low setting.	Replace.
	Defective sensor.	Replace.
VAC warning light fails to extinguish.	Sensor activates at a too high setting.	Replace.
	Sensor terminals bridged.	Remove material between terminals.
	Defective sensor.	Replace.
ALT warning light fails to operate.	Bulb burned out.	Replace.
	No current from bus to resistor.	Check all wire segments and connections.
ALT warning light fails to extinguish.	Blown fuse.	Replace 5 amp fuse above the diode heat sink.
	No current from the fuse to the resistor.	Check all wire segments and connections.
Test switch fails to activate warning lights.	Bad switch or connections.	Check wires and replace switch if necessary.

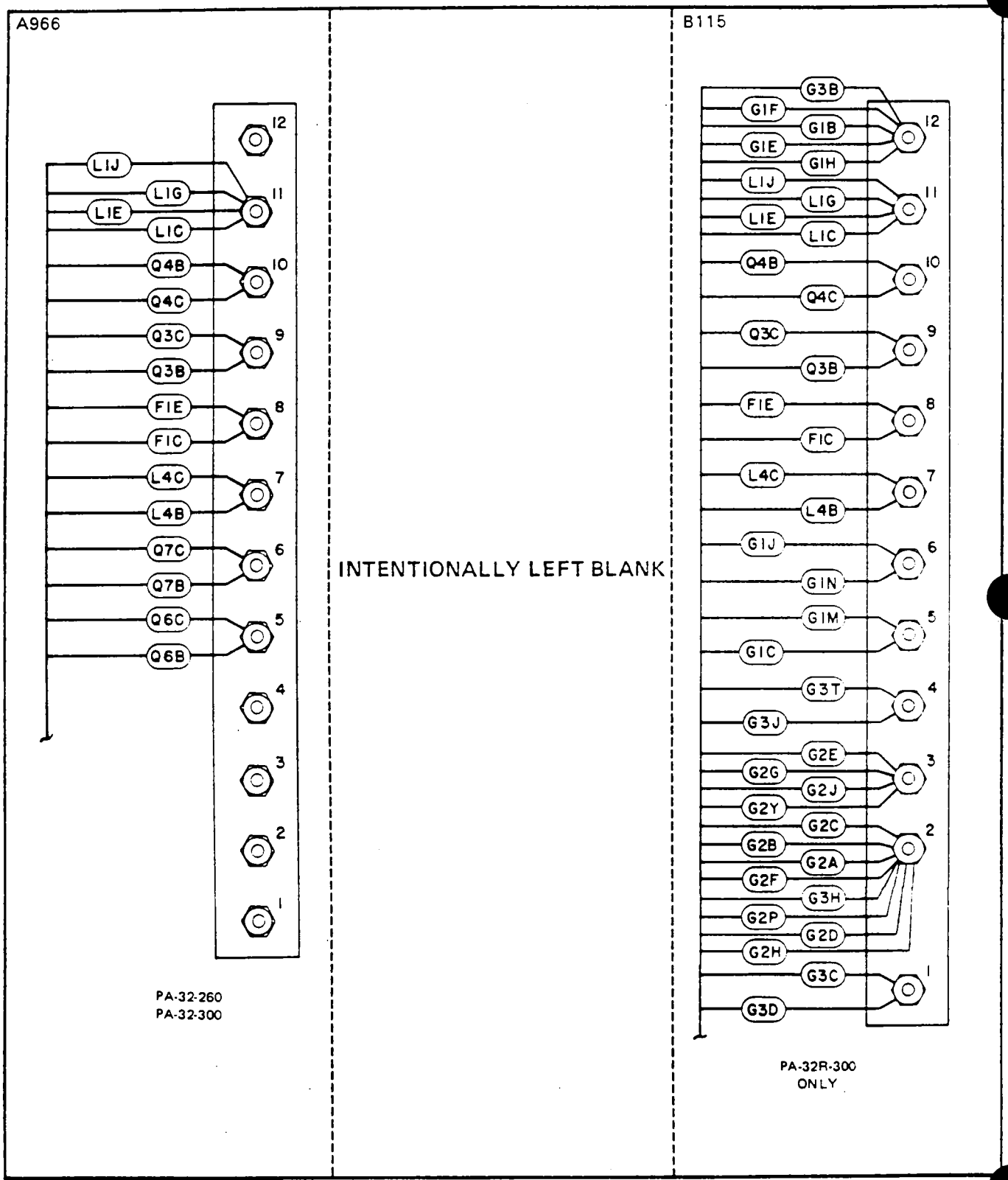


Figure 10-32b Terminal Block

TABLE X-IIIA. ELECTRICAL SYMBOLS

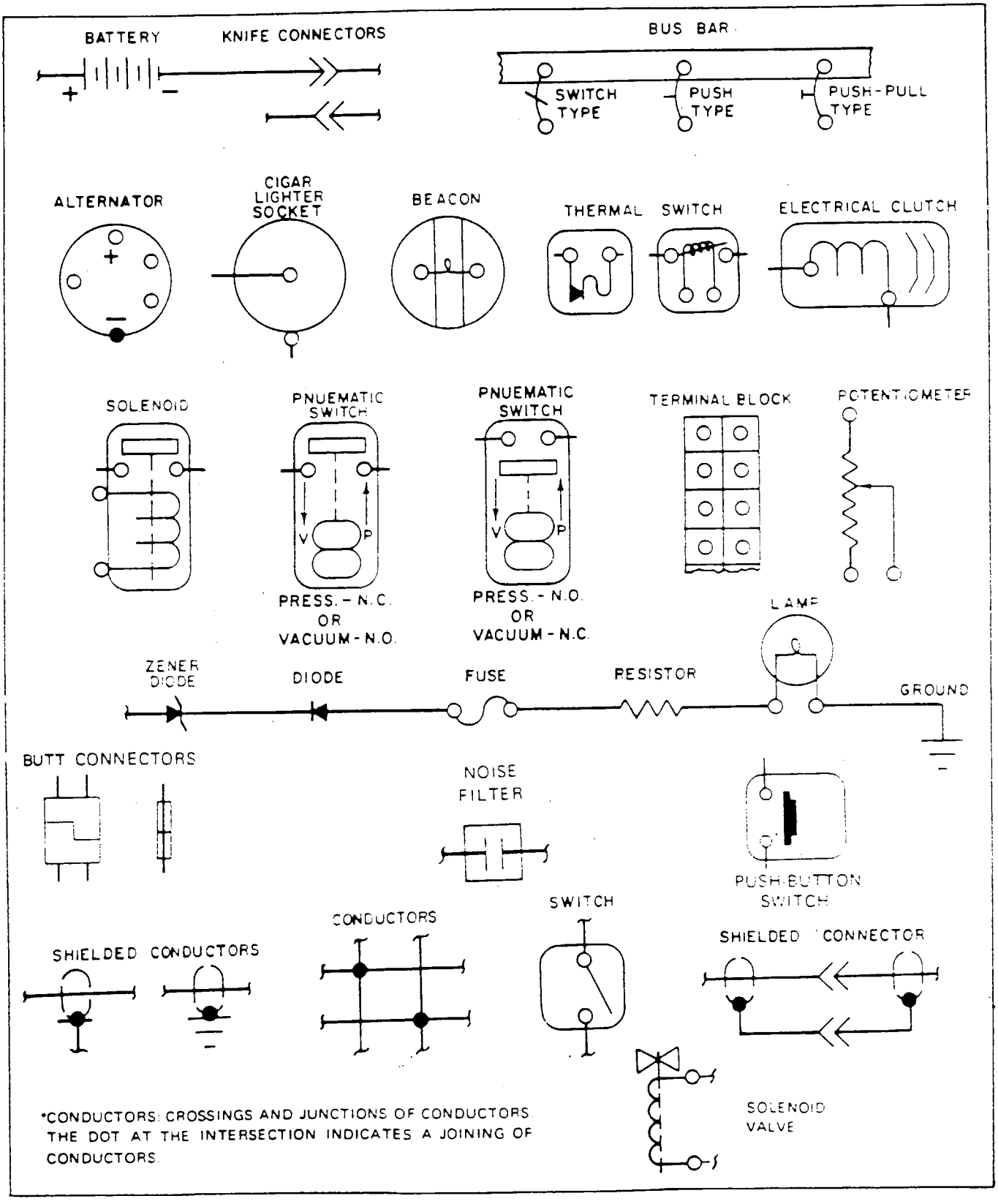
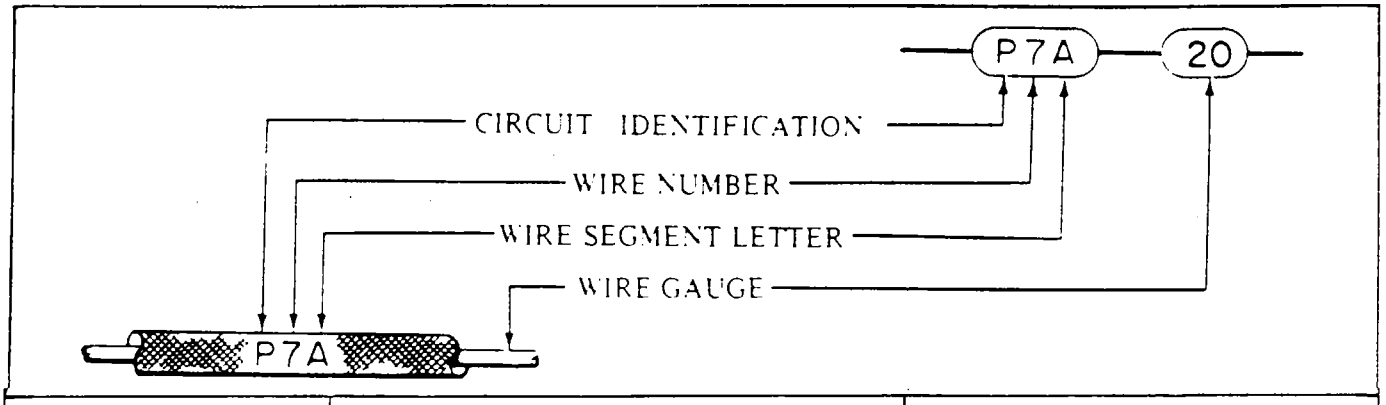


TABLE X-IV. ELECTRICAL WIRE CODING



CIRCUIT FUNCTION LETTER	CIRCUITS	HARNESS CONNECTOR NUMBERS AND LOCATIONS
A	AUTOPILOT	E 100 Series = Left Wing
C	CONTROL SURFACE	E 200 Series = Right Wing
E	ENGINE INSTRUMENT	
F	FLIGHT INSTRUMENT	E 300 Series = Aft Fuselage
G	LANDING GEAR	E 400 Series = Forward Fuselage
H	HEATER - VENTILATING & DEICING	
L	LIGHTING	
P	POWER	
Q	FUEL & OIL	
RP	RADIO POWER	
RG	RADIO GROUND	
RZ	RADIO AUDIO & INTERPHONE	
J	IGNITION	
W	WARNING	
K	STARTER	

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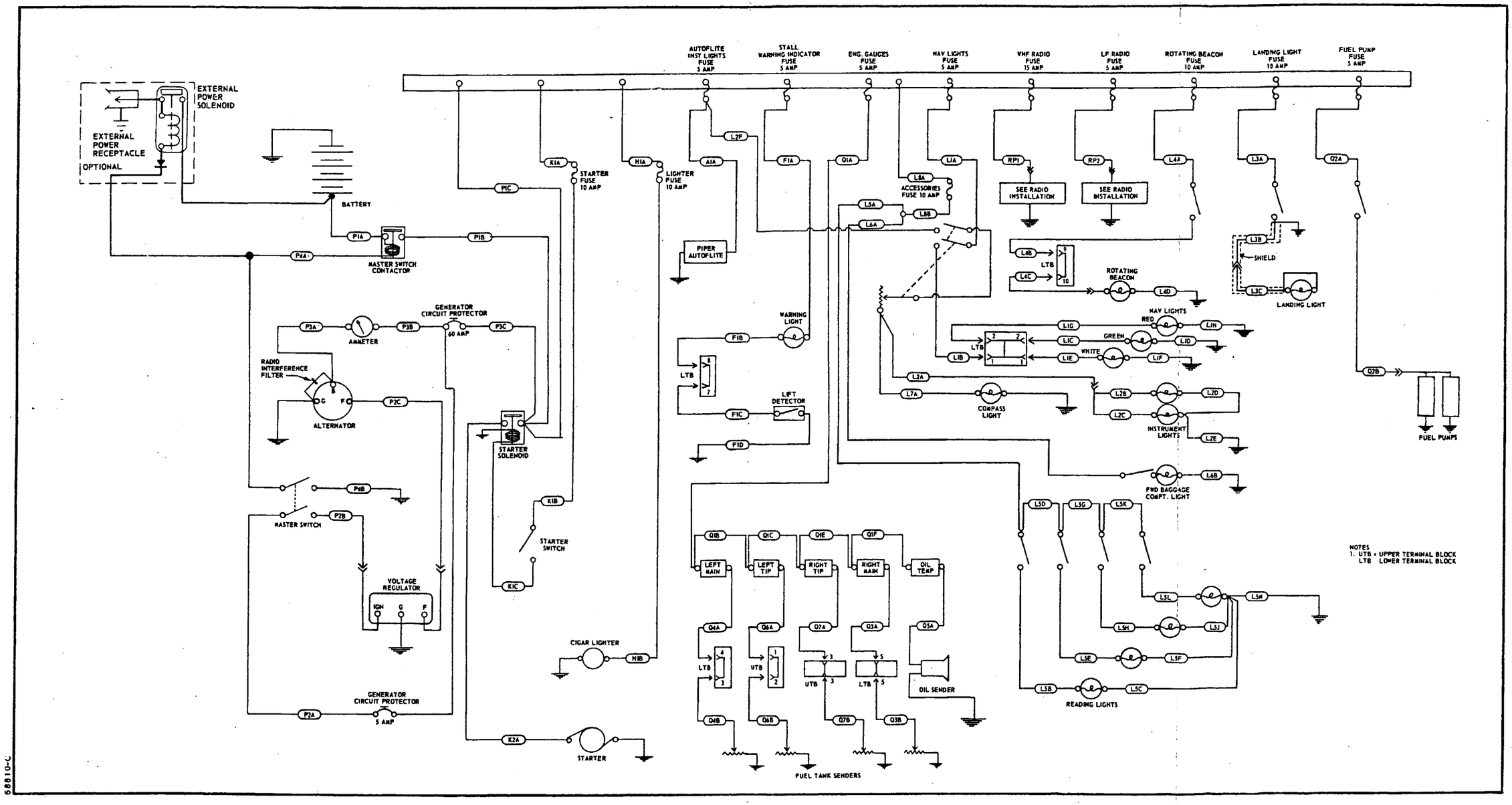


Figure 10-33. Electrical System Schematic
PA-32-260, Serial Nos. 32-1 to 32-375 incl.

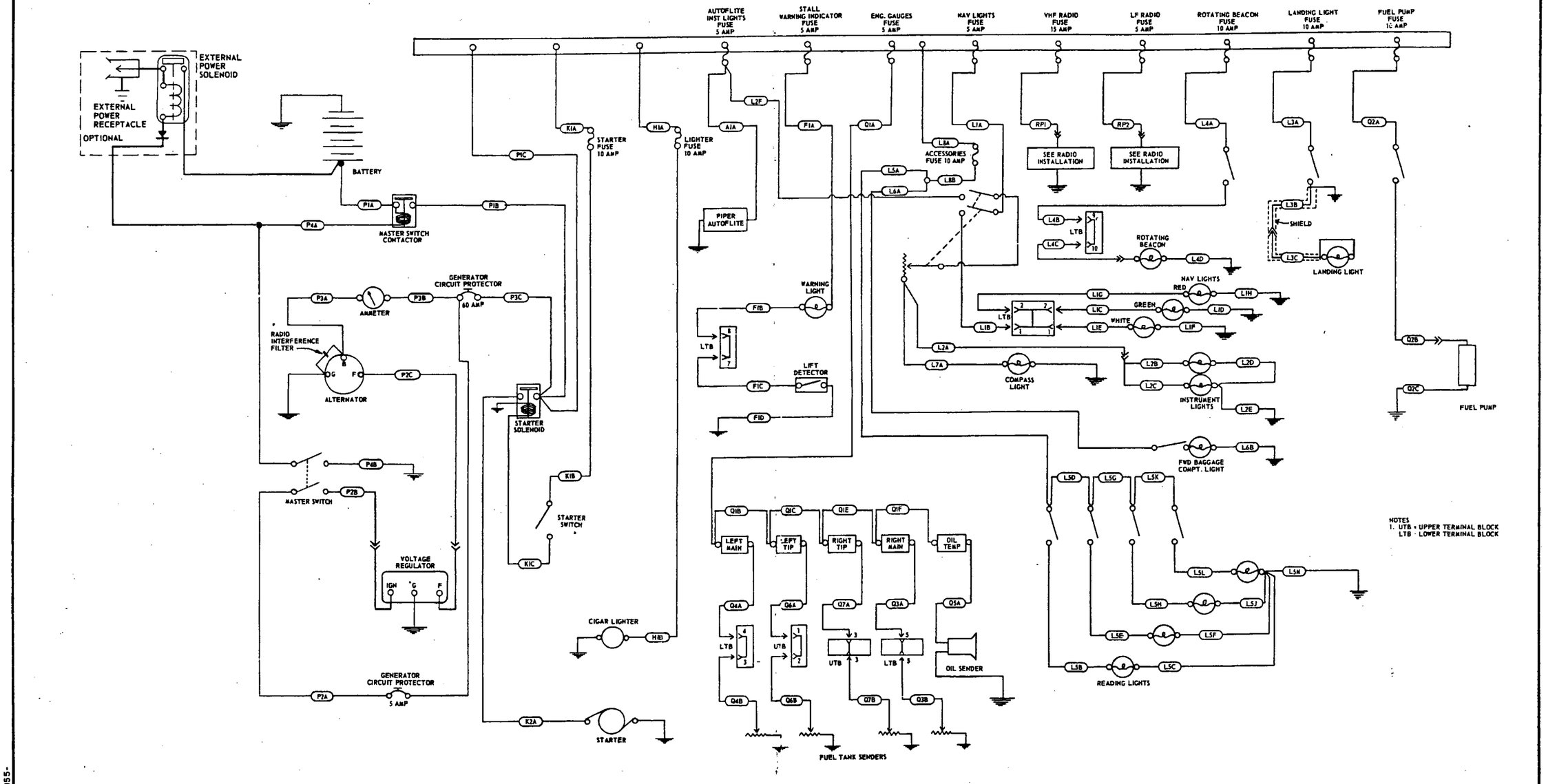


Figure 10-33a. Electrical System Schematic
PA-32-260, Serial Nos. 32-376 to 32-855 incl.

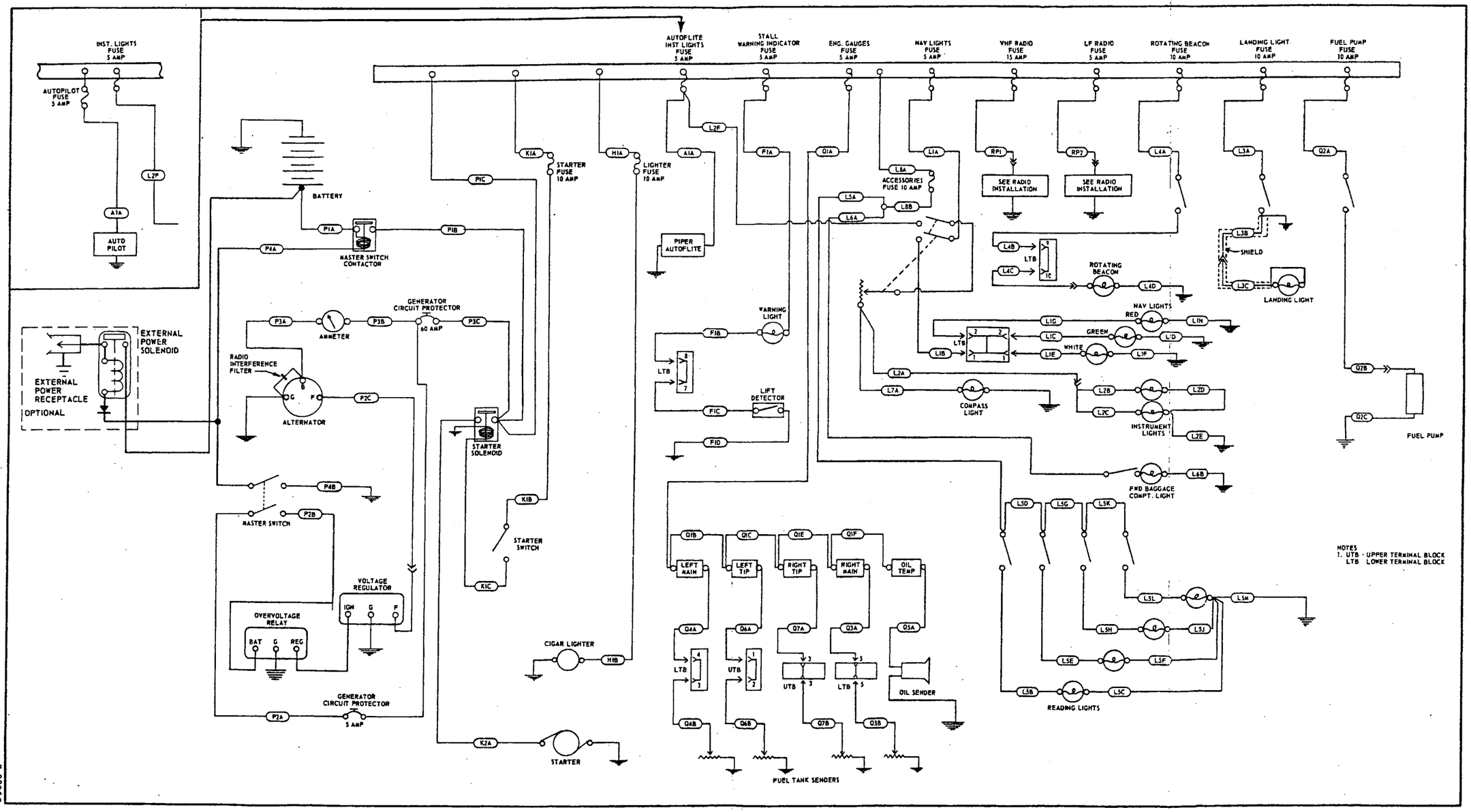


Figure 10-33b. Electrical System Schematic
PA-32-260, Serial Nos. 32-856 to 32-1111 and
PA-32-300, Serial Nos. 32-40000 to 32-40566

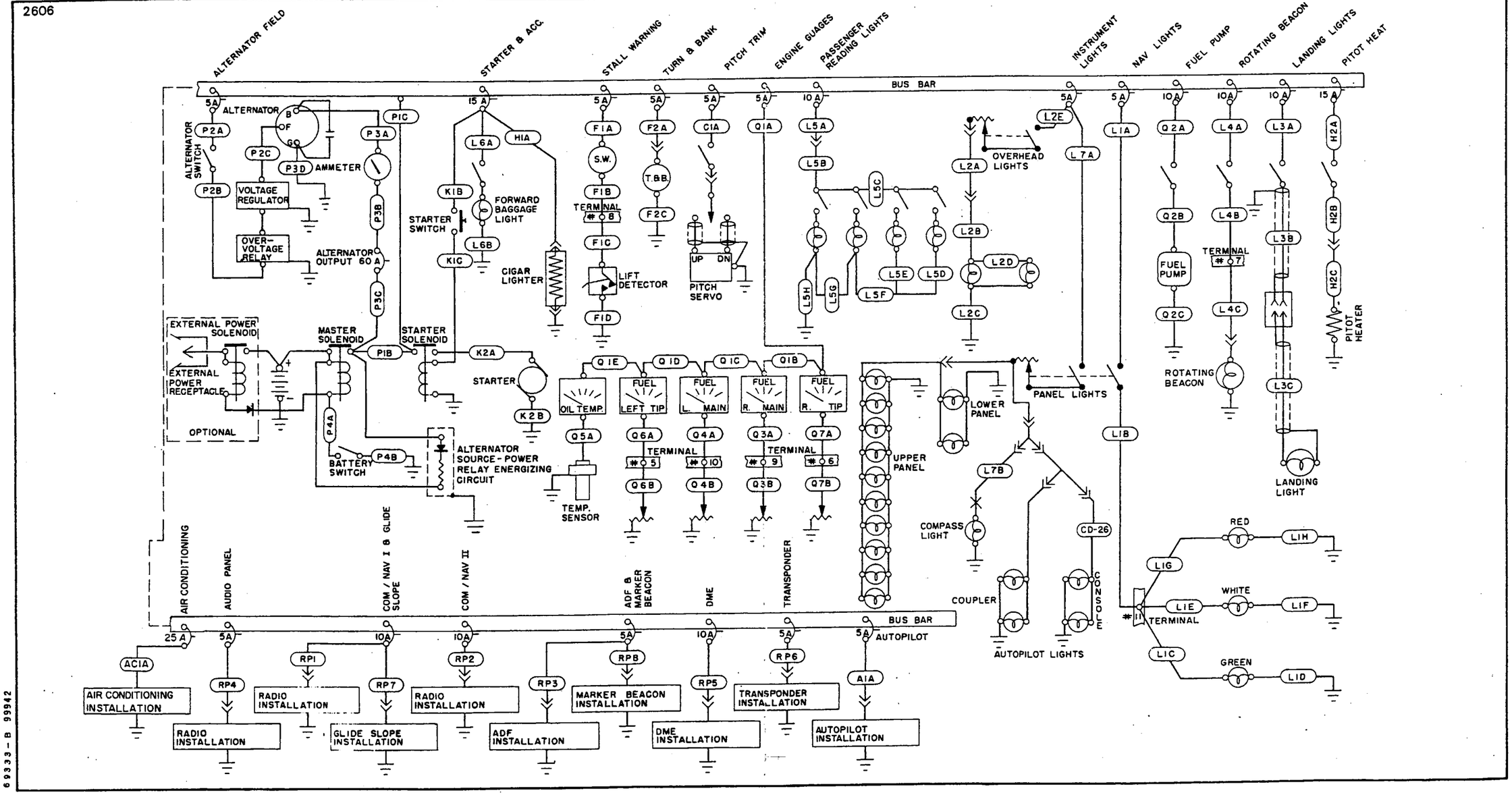


Figure 10-33c. Electrical System Schematic
PA-32-260, Serial Nos. 32-1112 to 32-7300066 and
PA-32-300, Serial Nos. 32-40567 to 32-7340191.

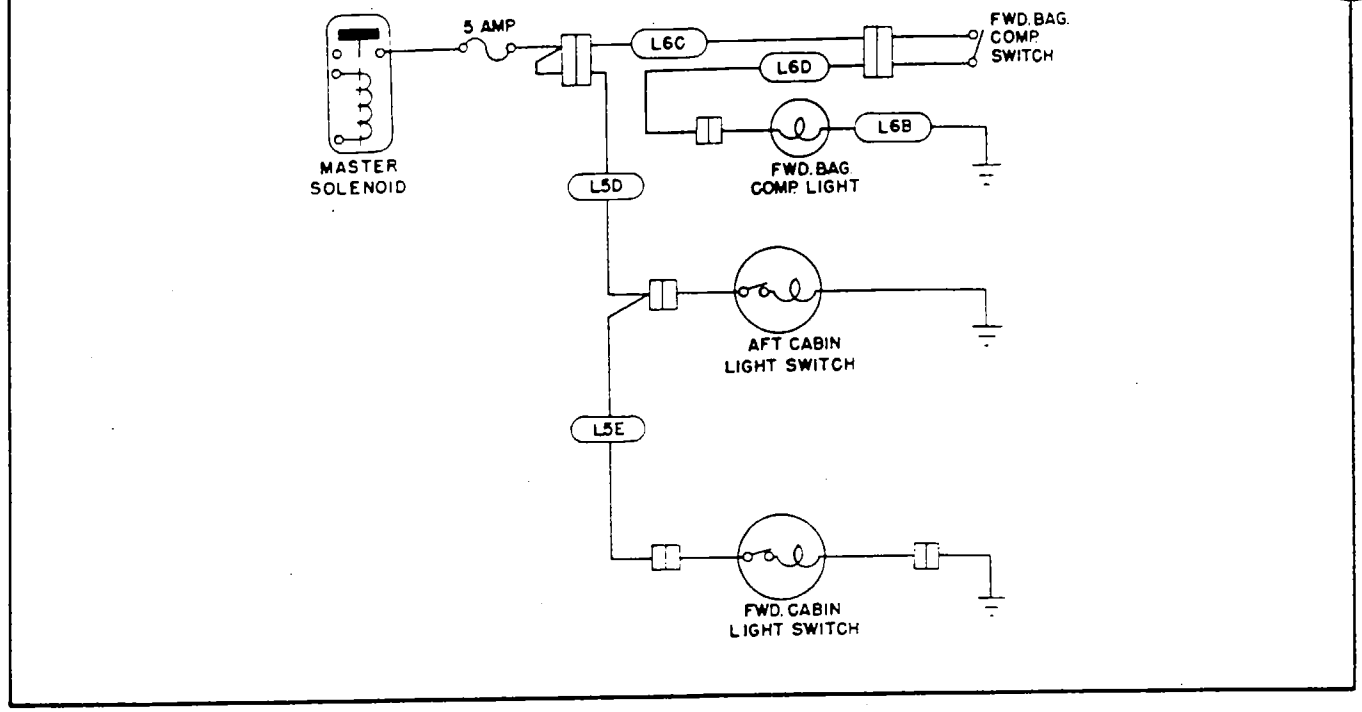


Figure 10-35. Courtesy Lights

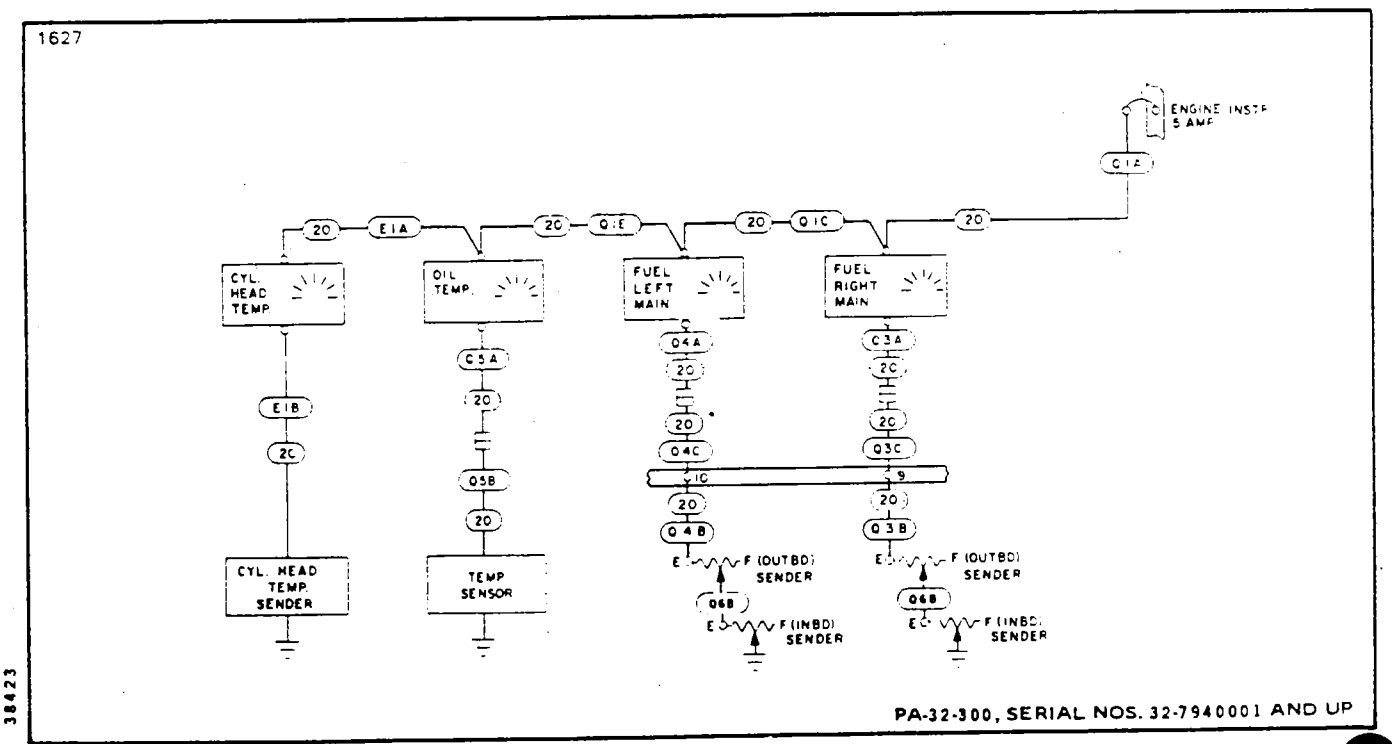


Figure 10-36. Engine Gauges

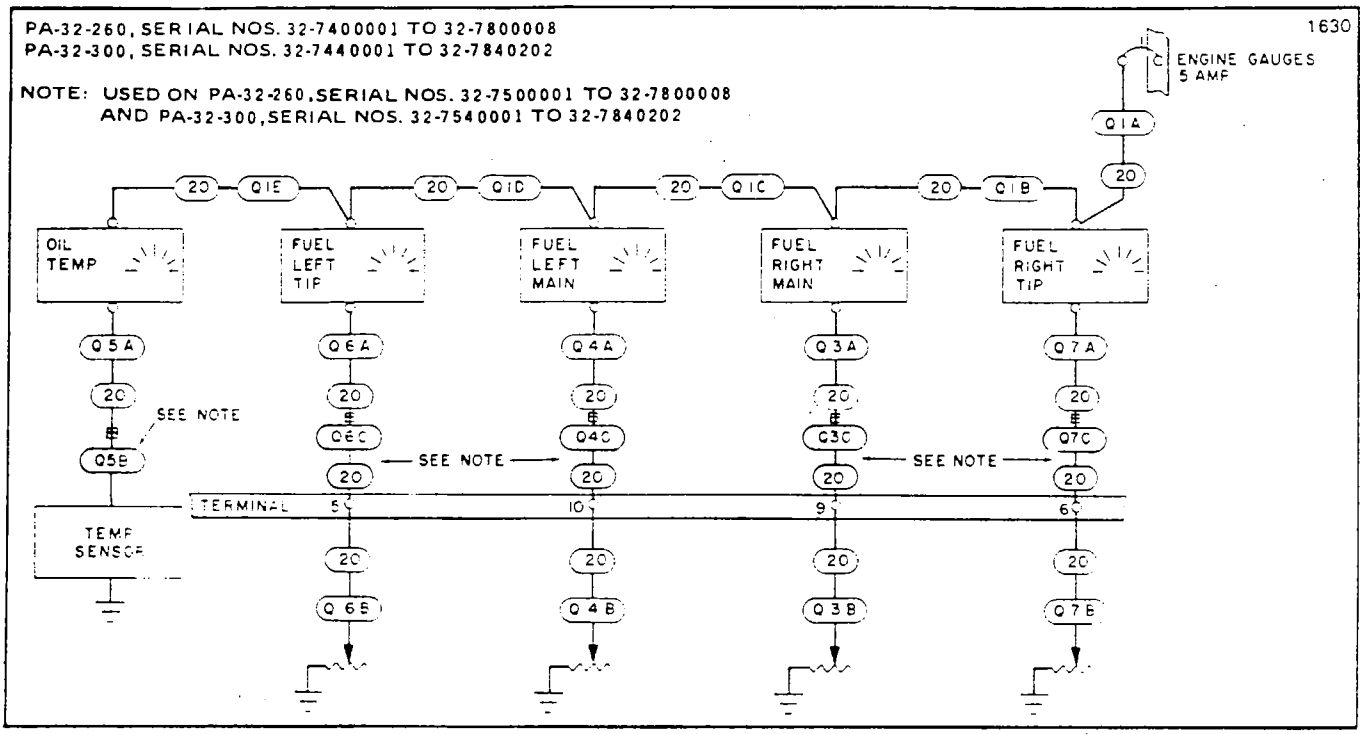


Figure 10-37. Engine Gauges

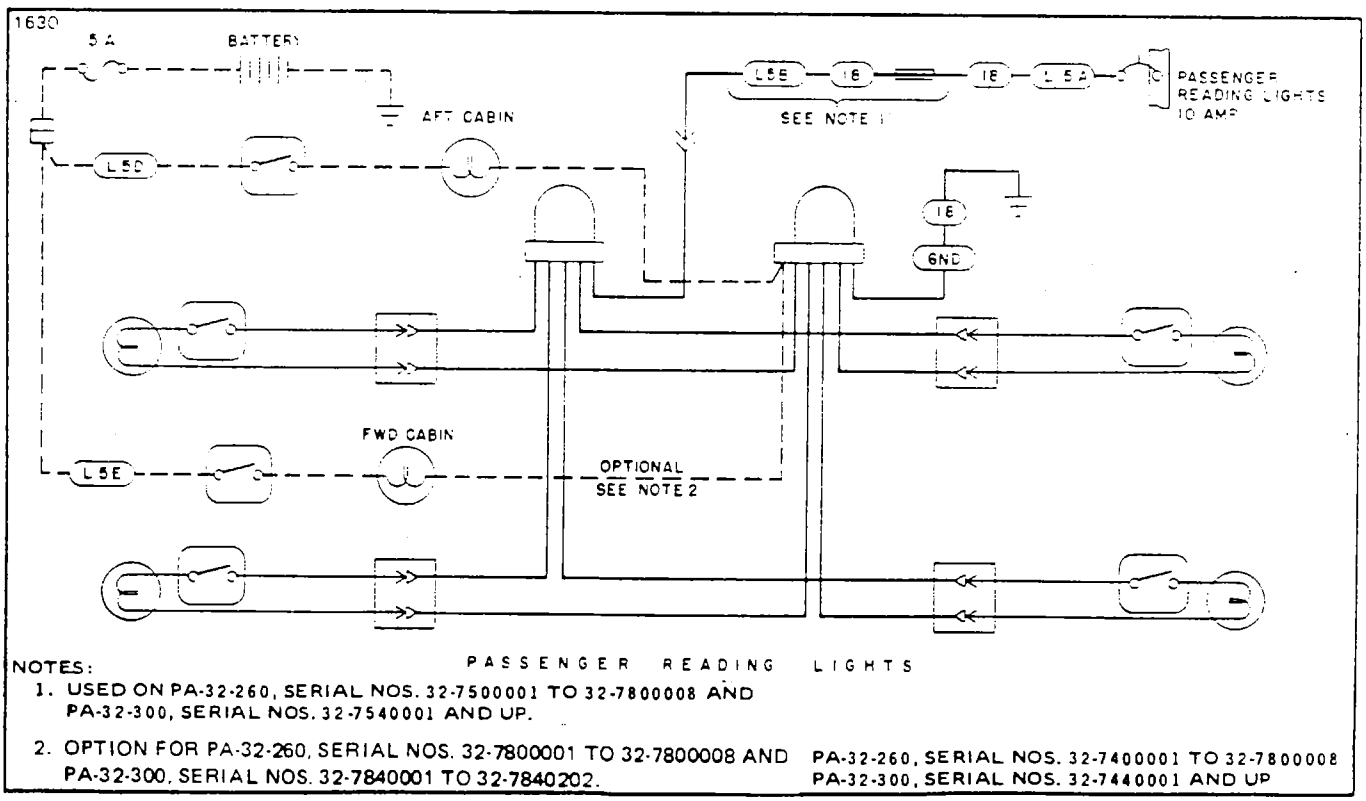


Figure 10-38. Passenger Reading Lights

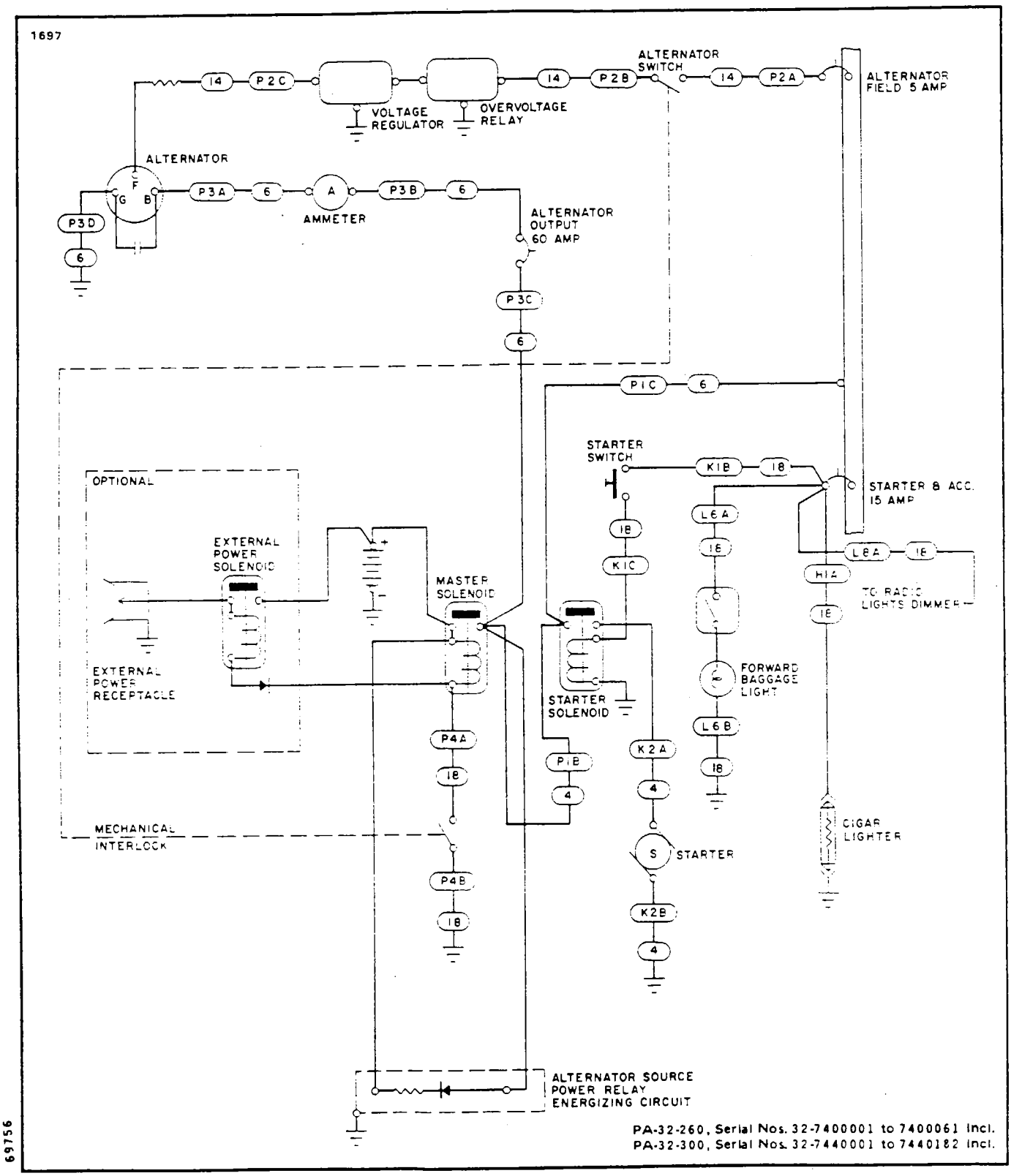


Figure 10-39. Alternator, Starter, Forward Baggage Light, Cigar Lighter and External Power Receptacle

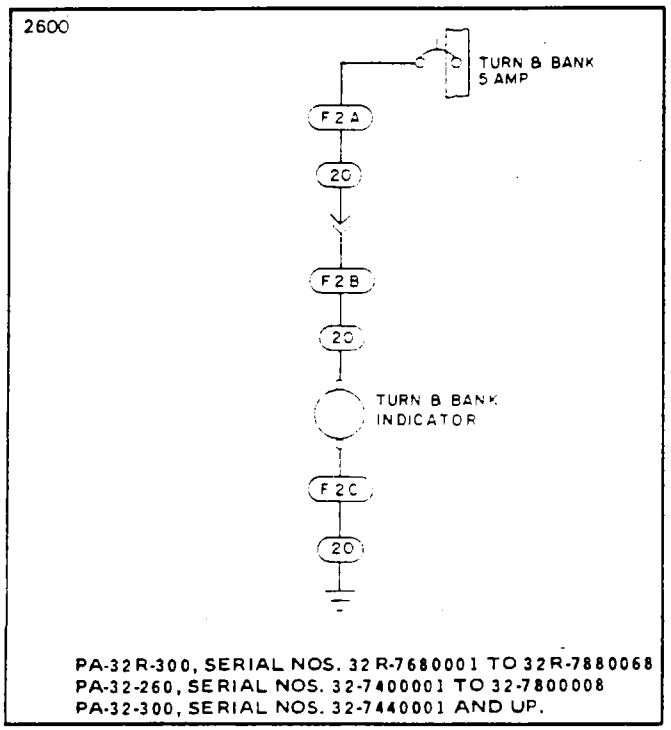


Figure 10-40. Turn and Bank

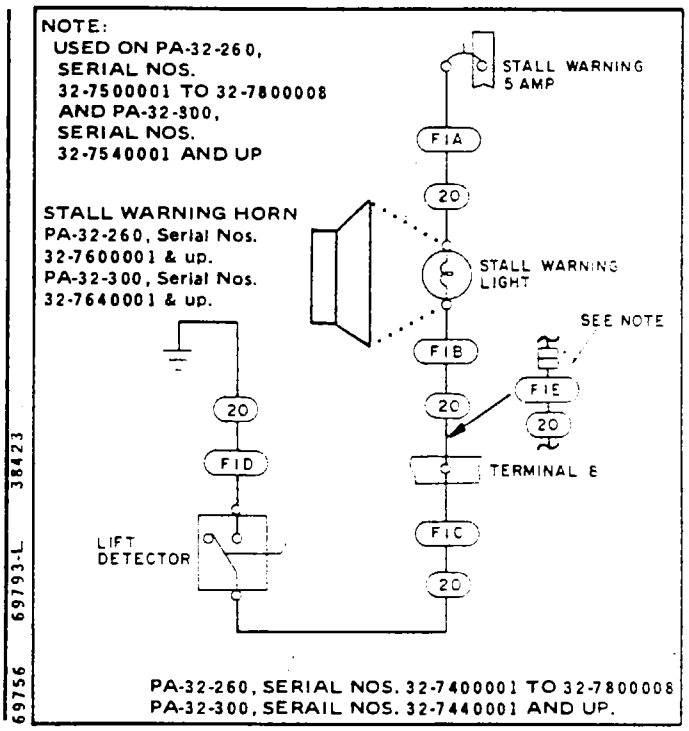


Figure 10-41. Stall Warning

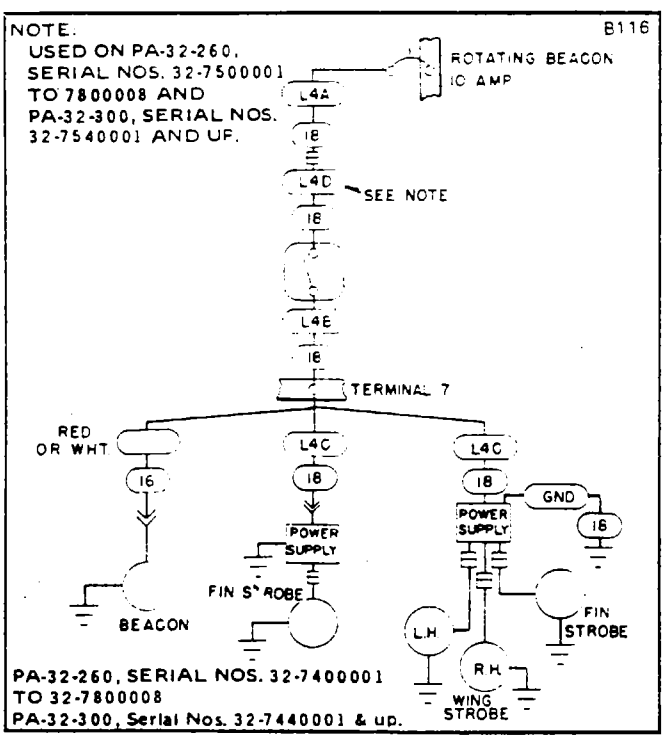


Figure 10-42. Anti-Collision Light

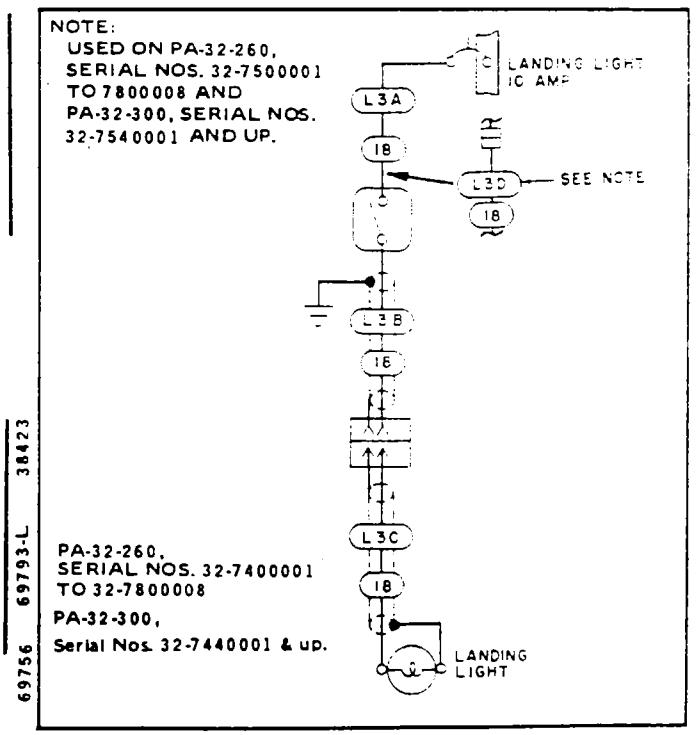


Figure 10-43. Landing Light

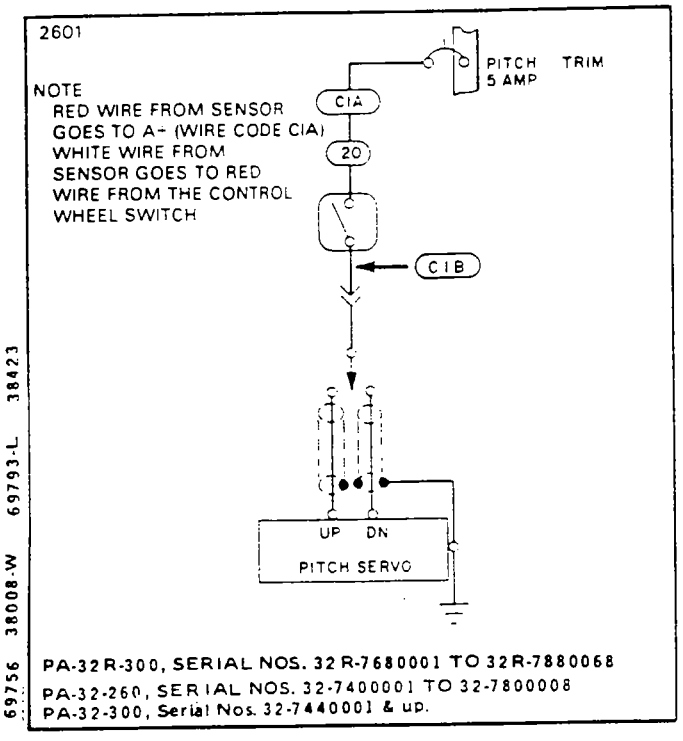


Figure 10-44. Pitch Trim

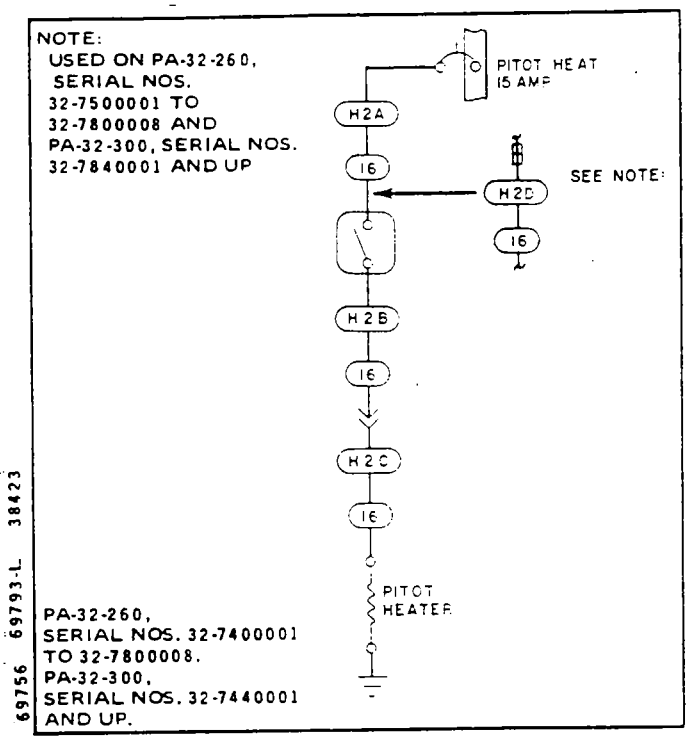


Figure 10-45. Pitot Heat

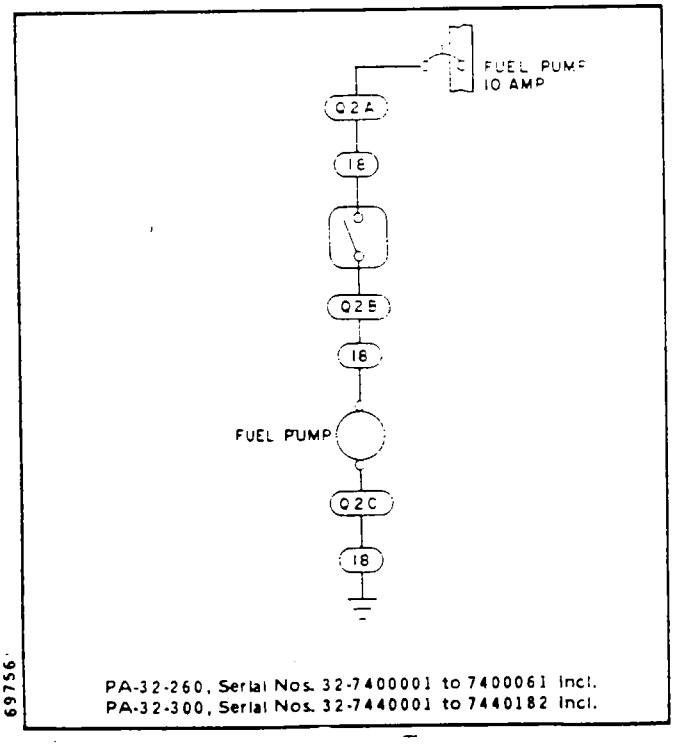


Figure 10-46. Fuel Pump

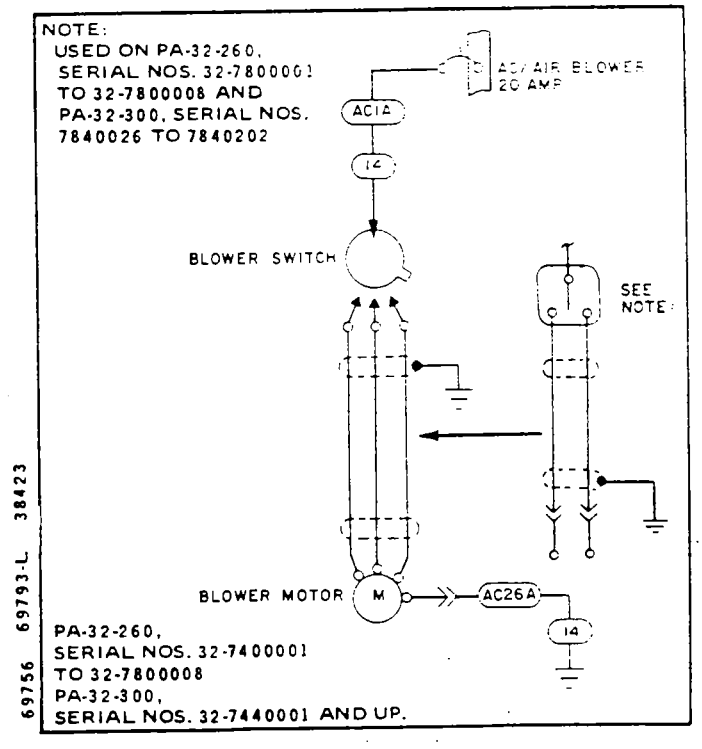


Figure 10-47. A/C Air Blower

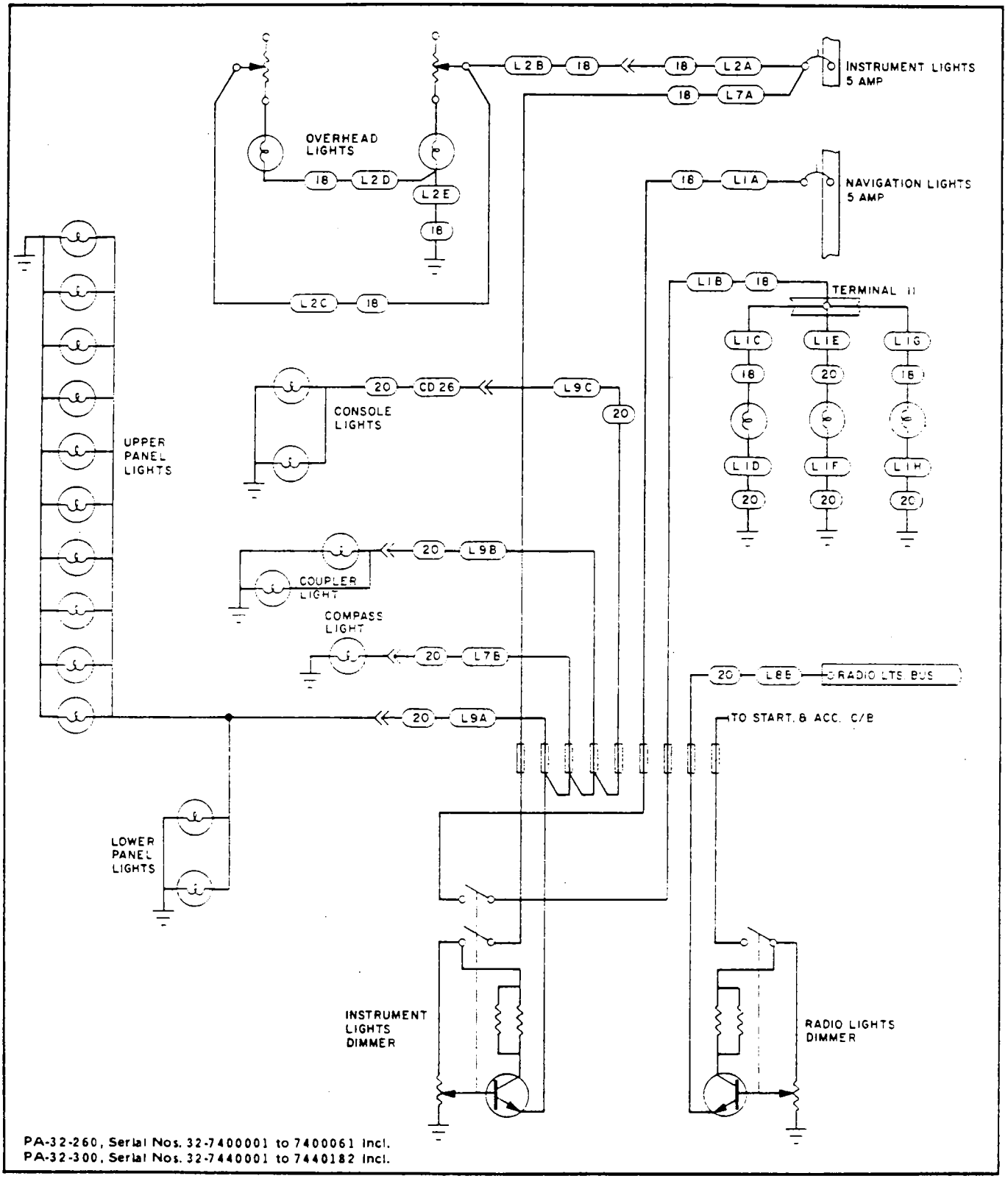


Figure 10-48. Instrument, Navigation and Radio Lights

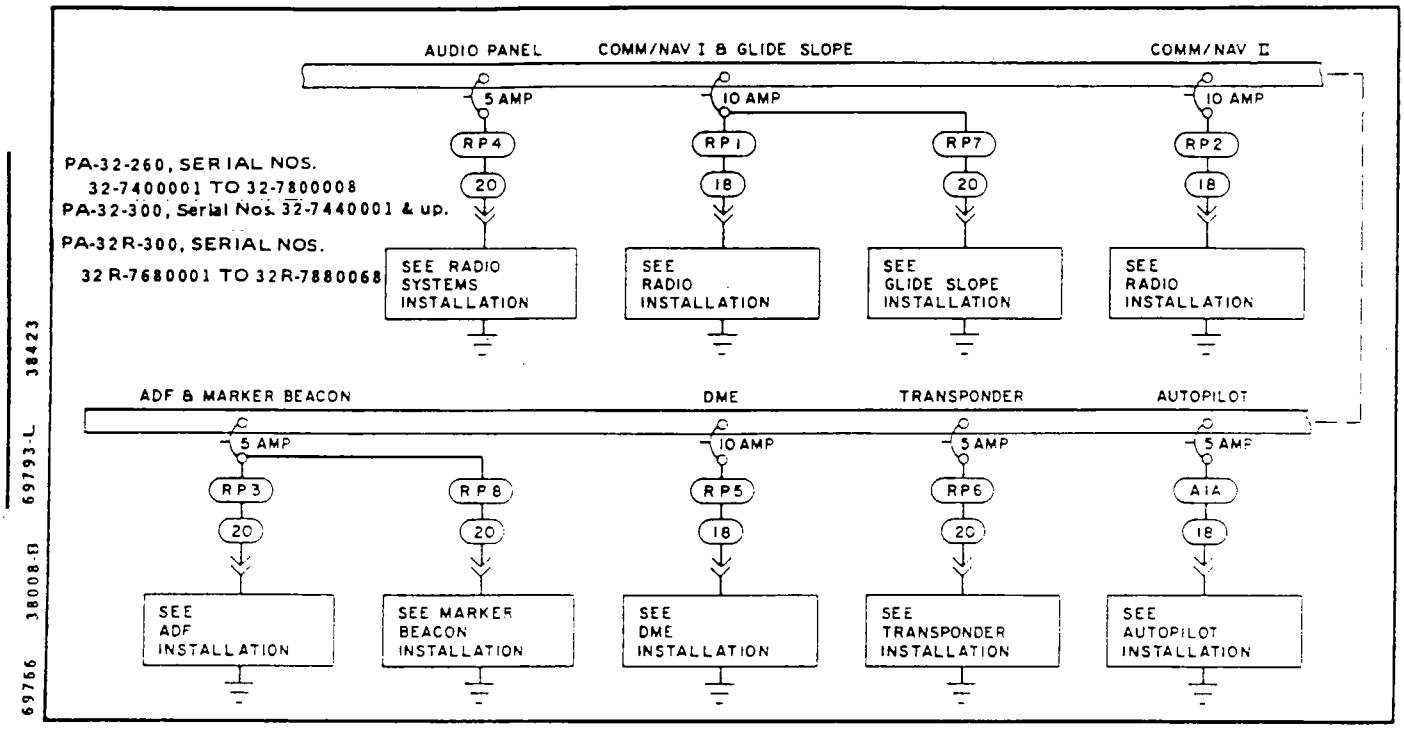


Figure 10-49. Avionics

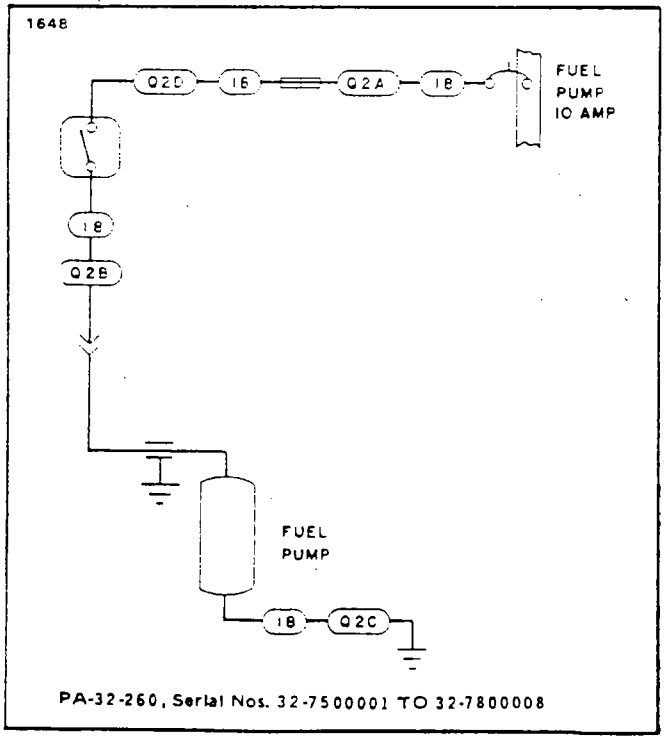


Figure 10-50. Fuel Pump

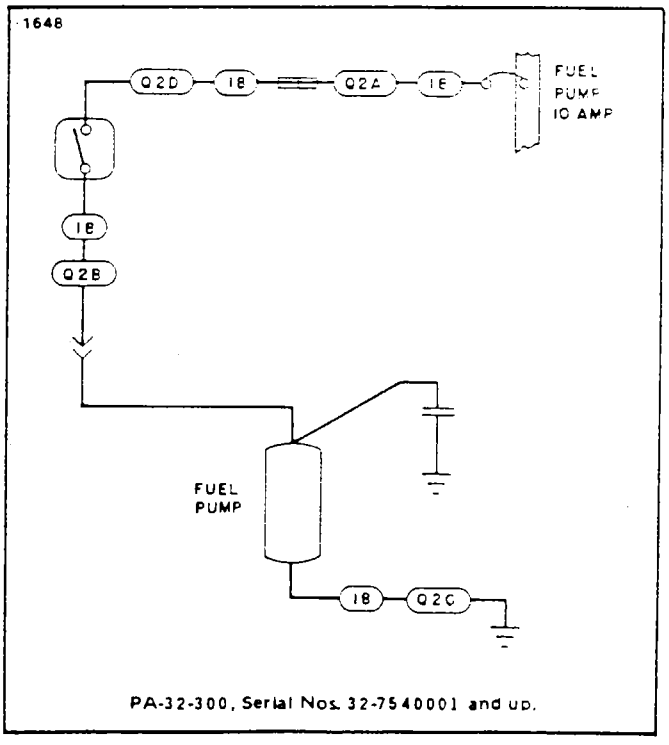


Figure 10-51. Fuel Pump

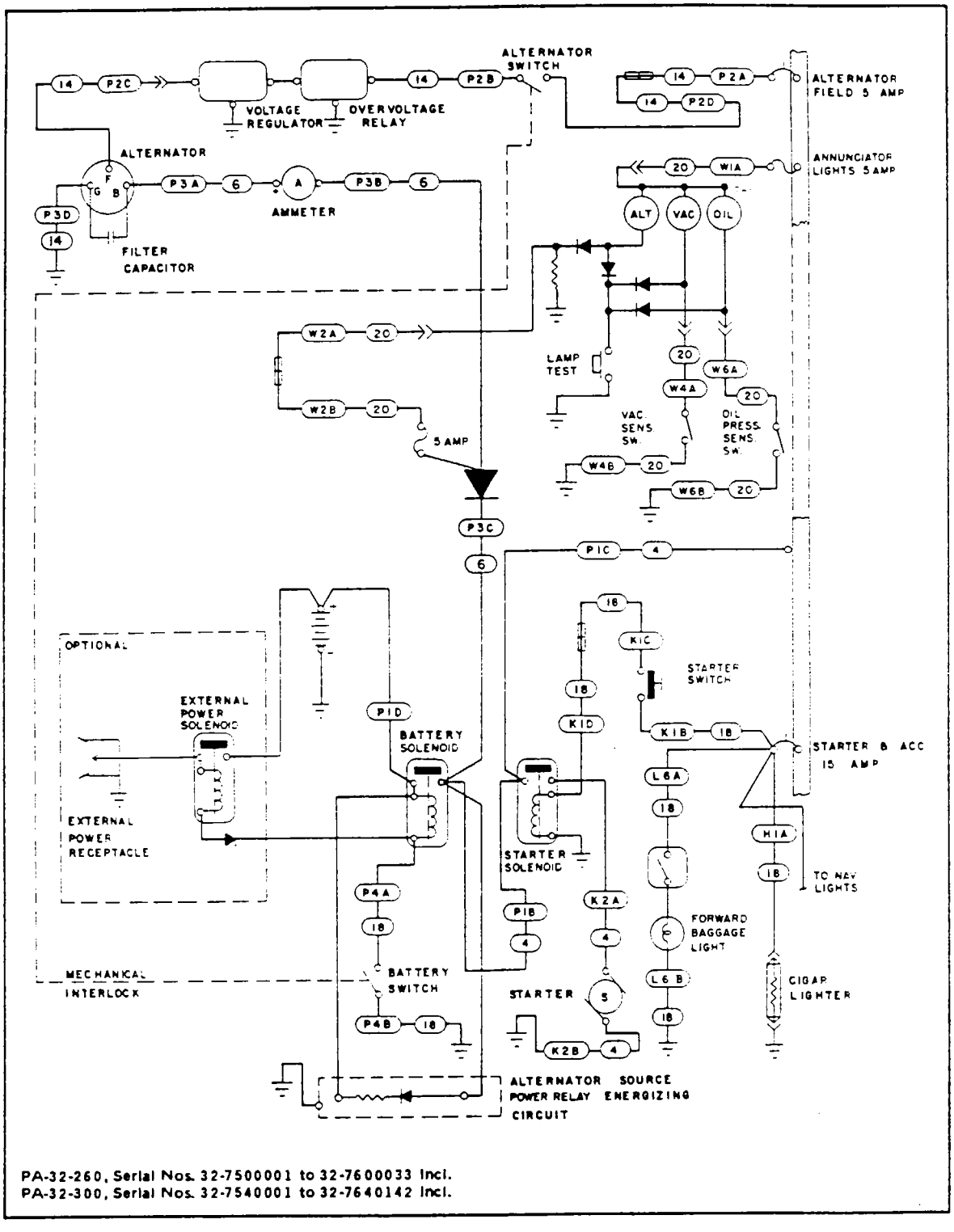


Figure 10-52. Alternator, Starter, Forward Baggage Light. Cigar Lighter and External Power Receptacle

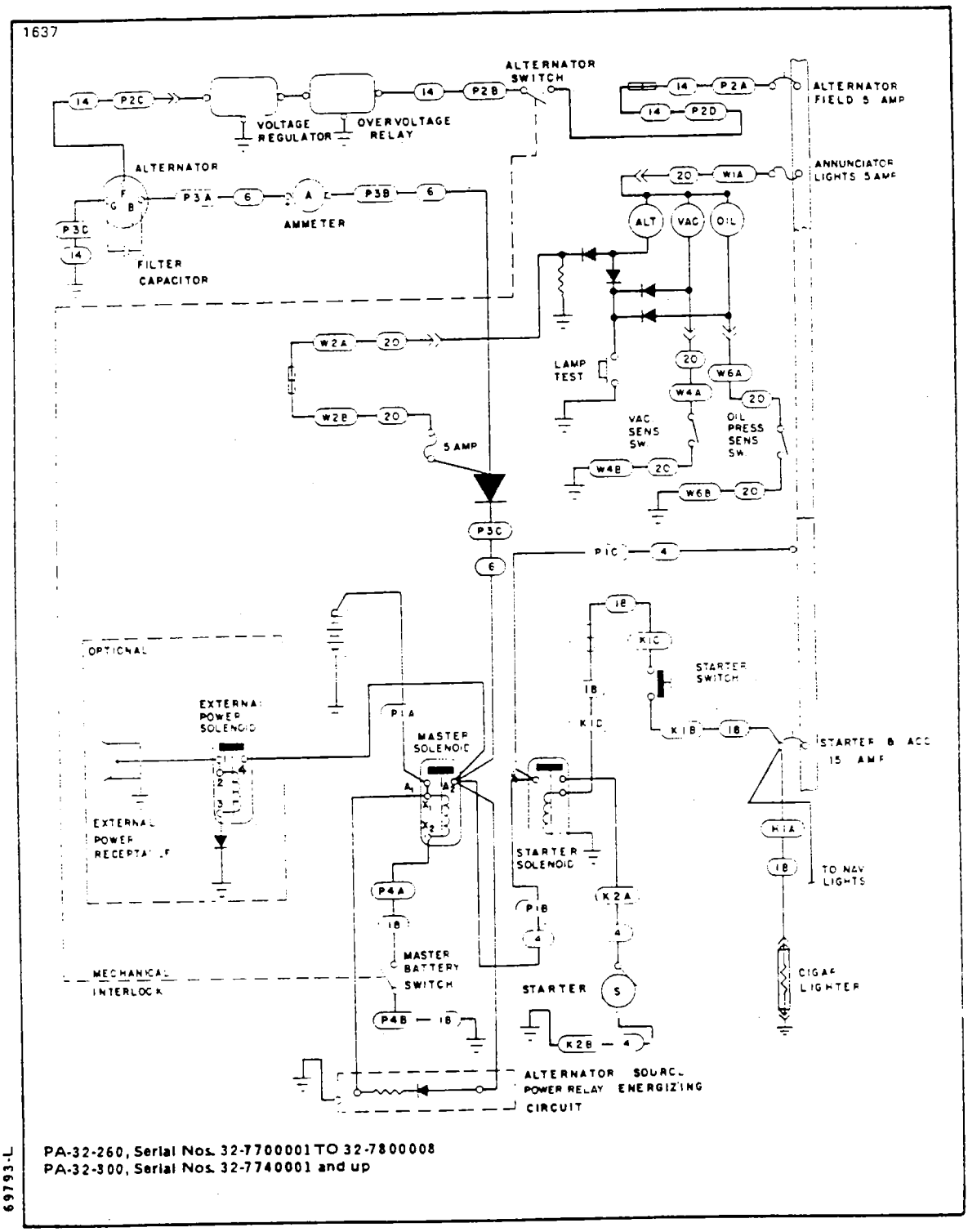


Figure 10-53. Alternator, Starter, Cigar Lighter and External Power Receptacle

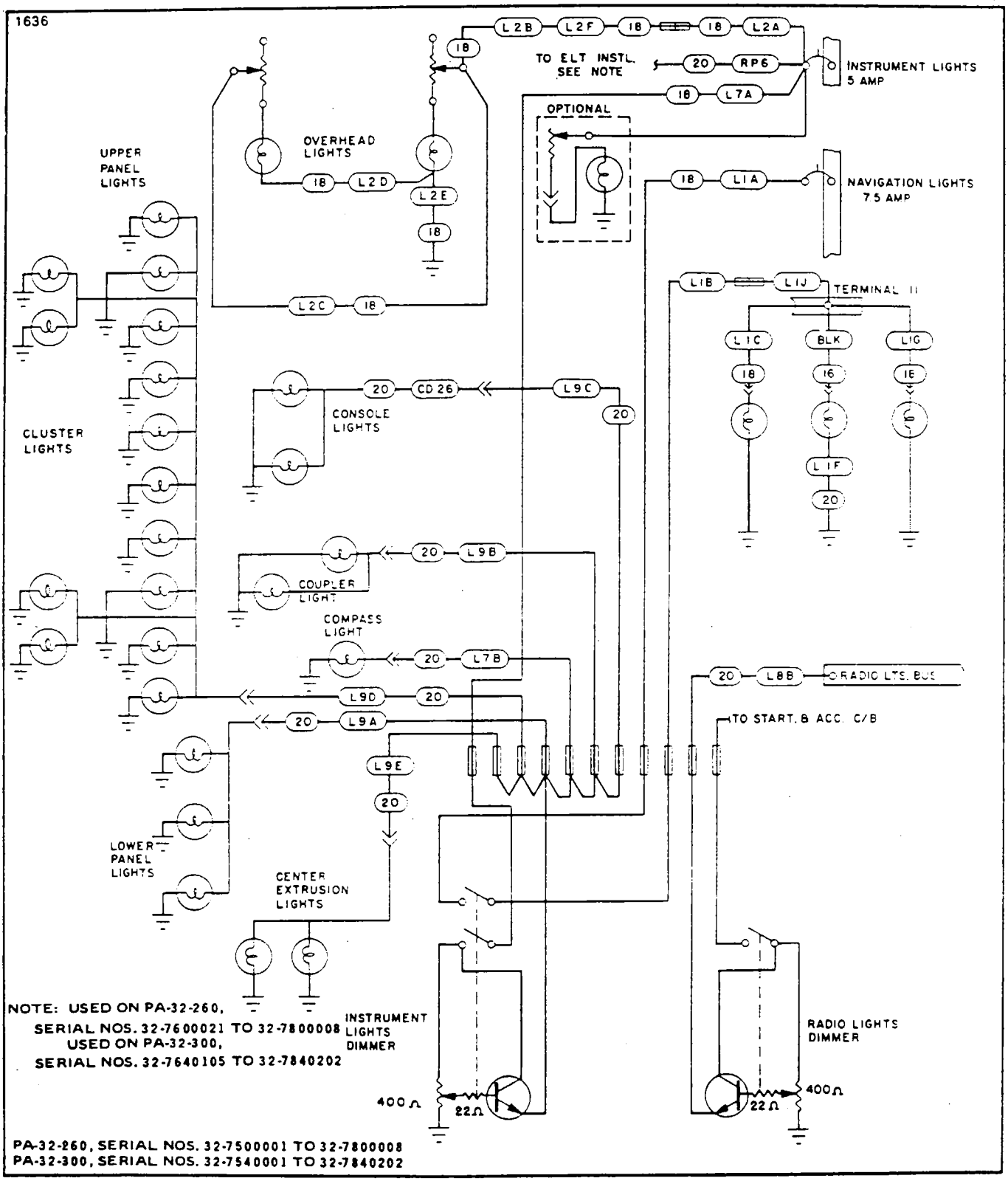


Figure 10-54. Instrument, Navigation and Radio Lights

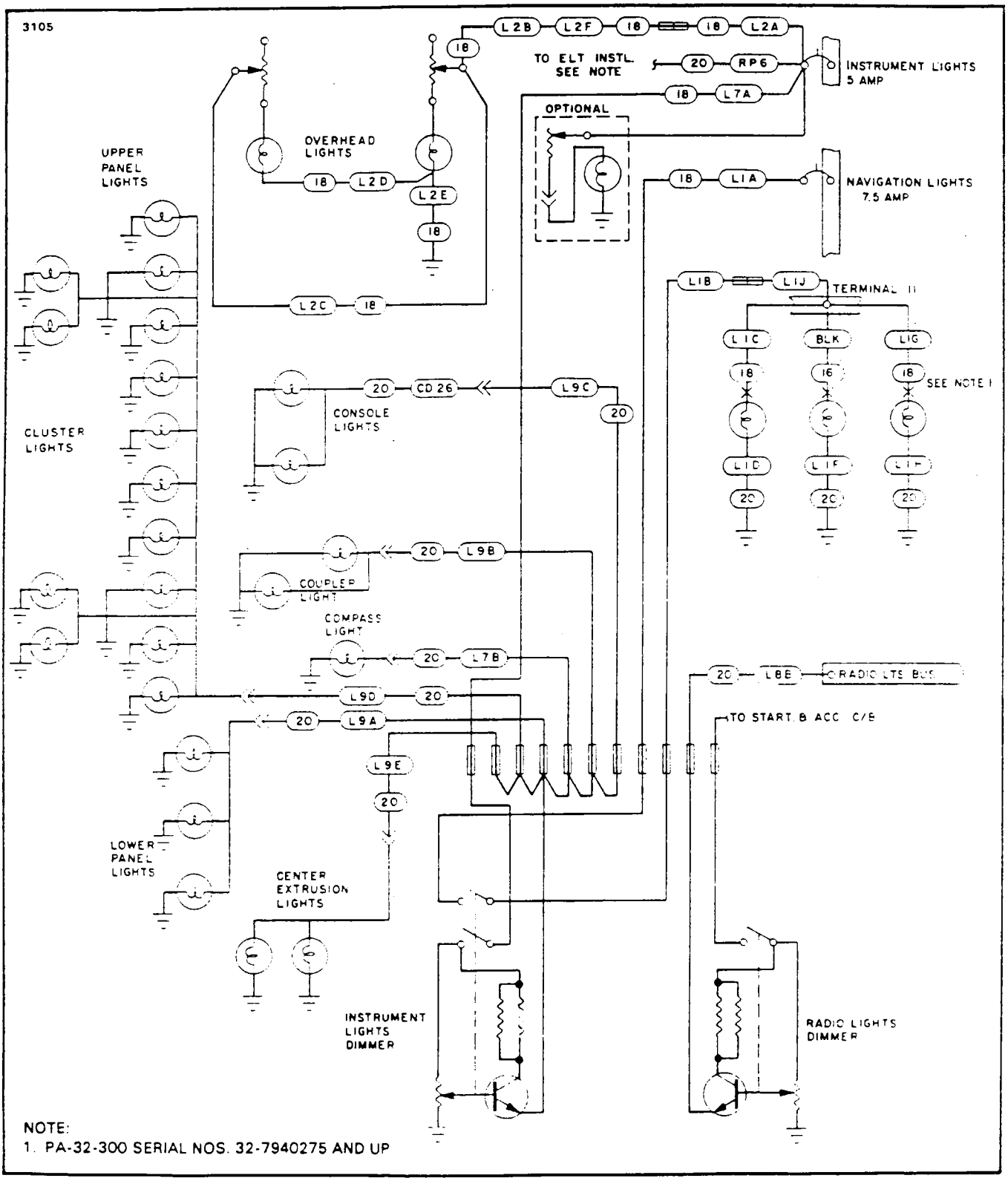


Figure 10-54a. Instrument, Navigation and Radio Lights

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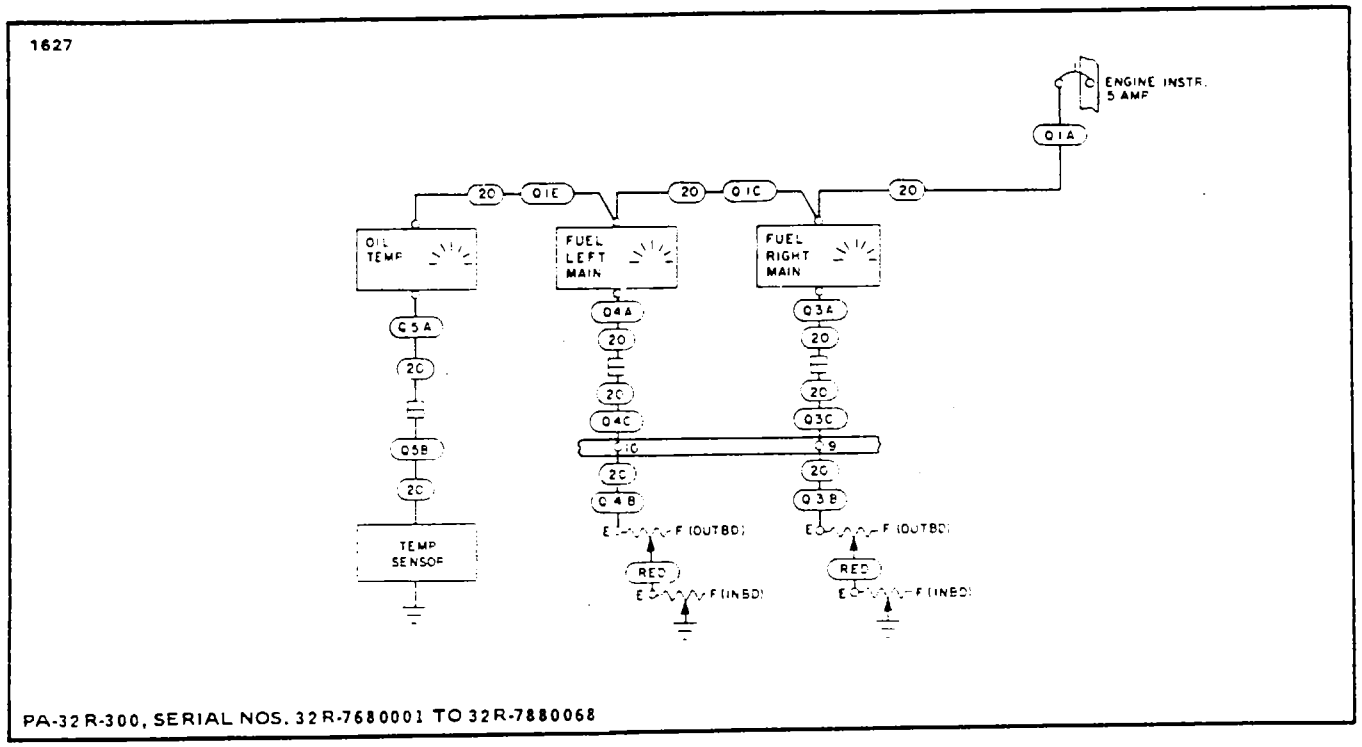


Figure 10-55. Engine Instruments

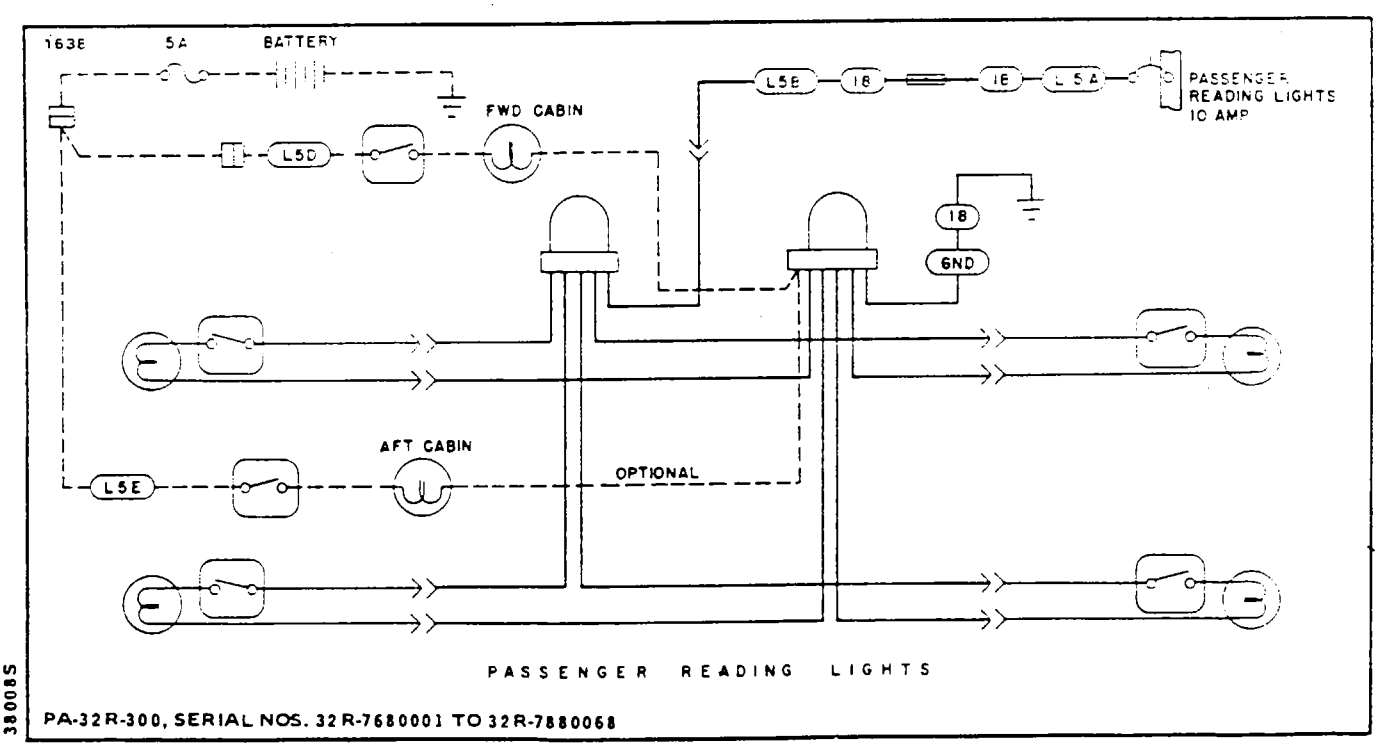


Figure 10-56. Passenger Reading Lights

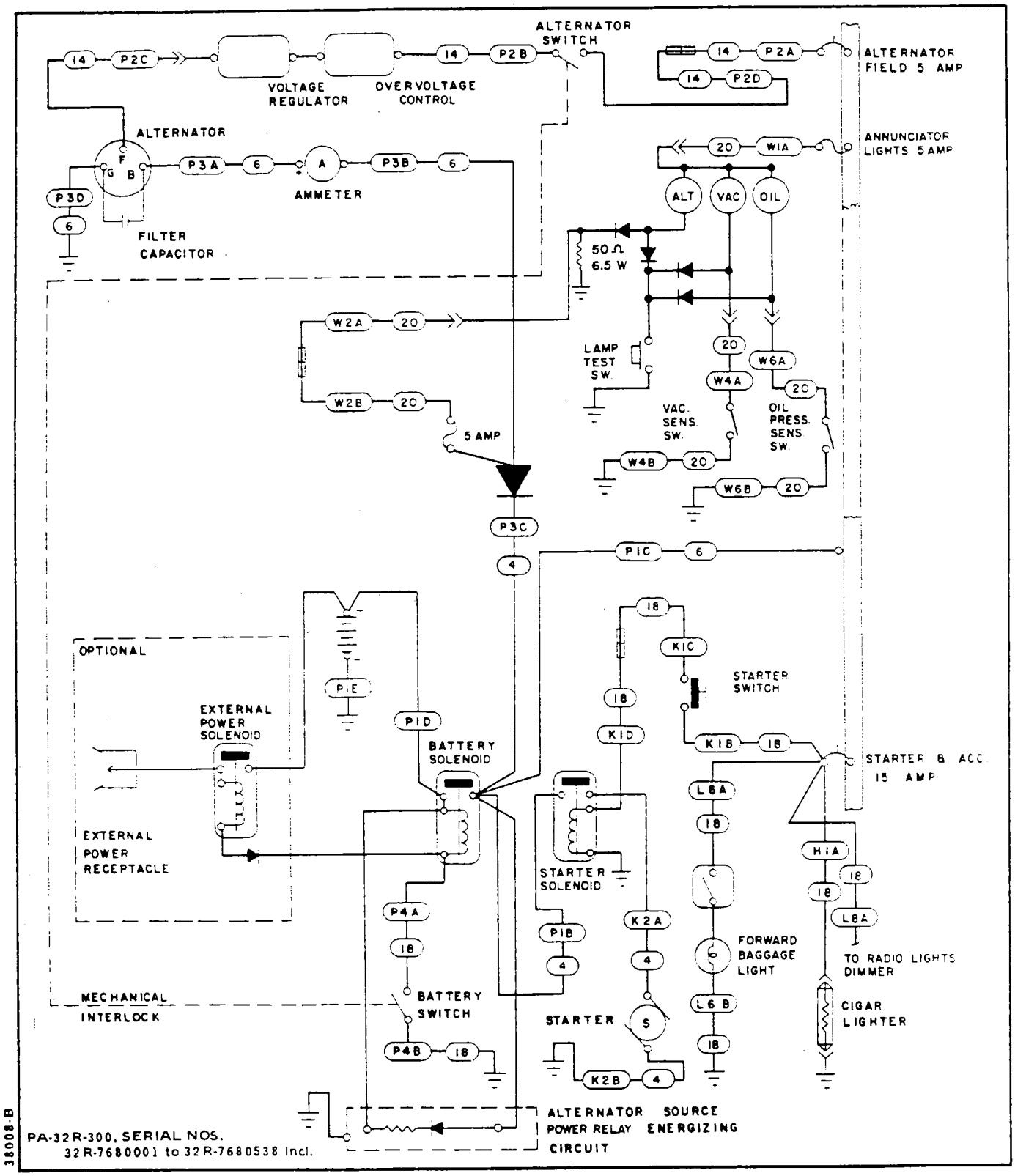


Figure 10-57. Alternator, Starter, Forward Baggage Light, Cigar Lighter and External Power Receptacle

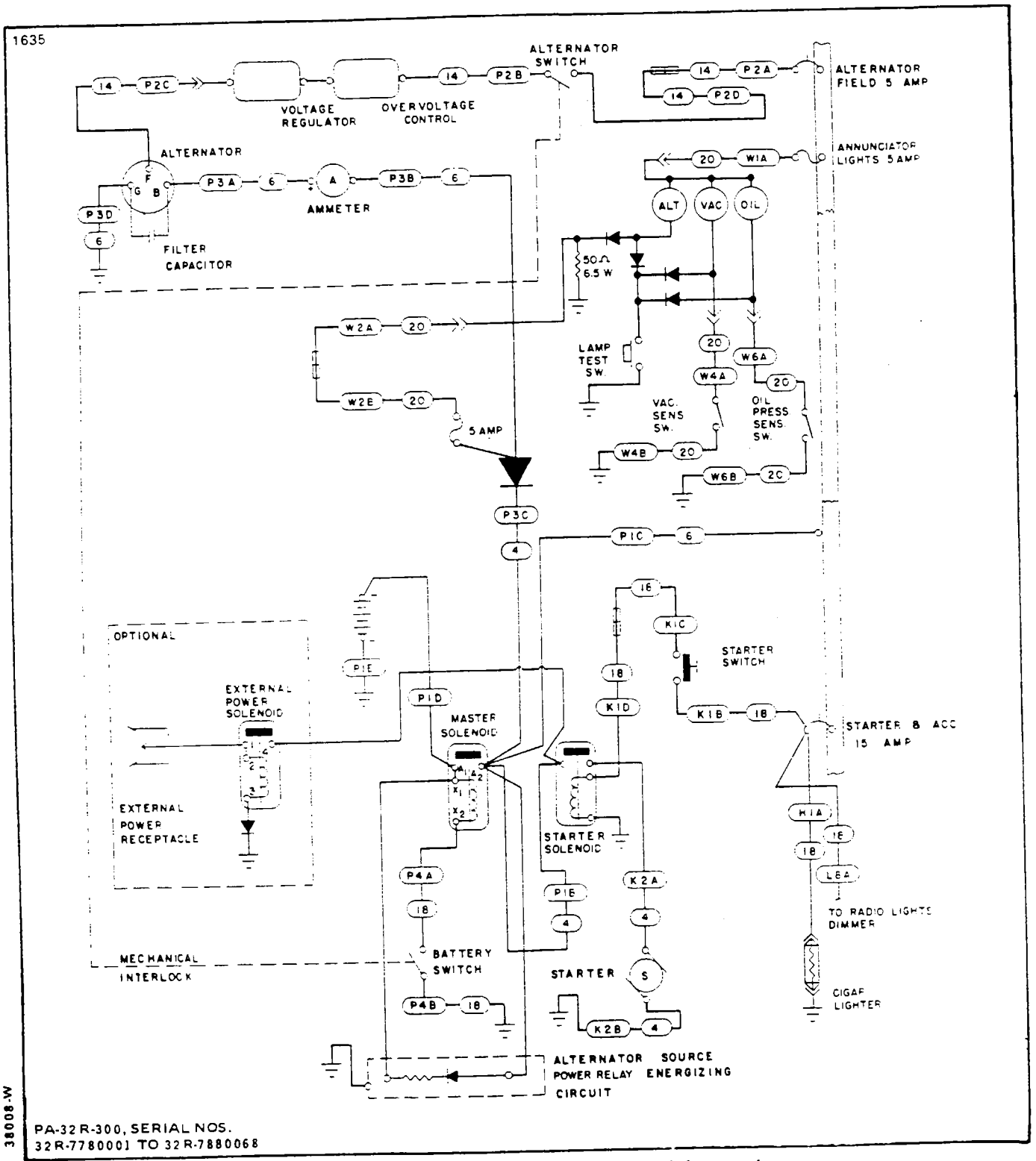


Figure 10-58: Alternator, Starter, Cigar Lighter and External Power Receptacle

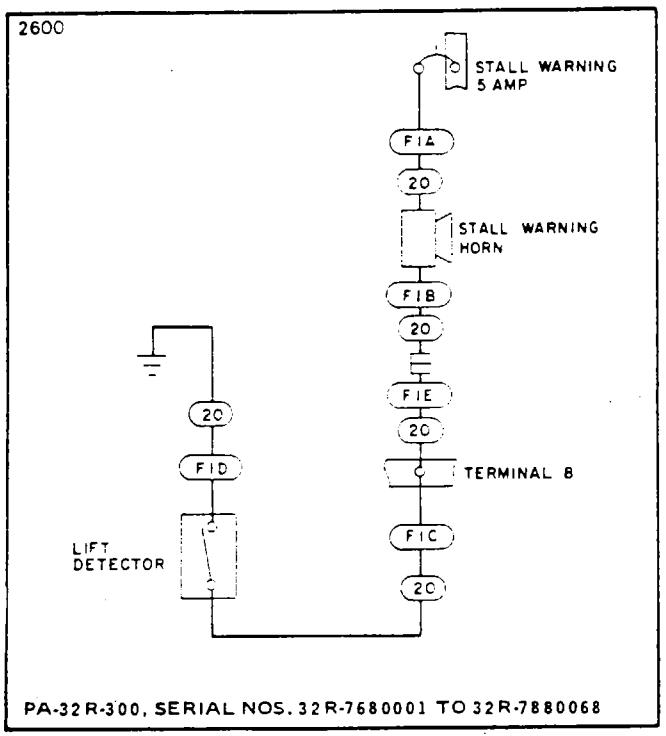


Figure 10-59. Stall Warning

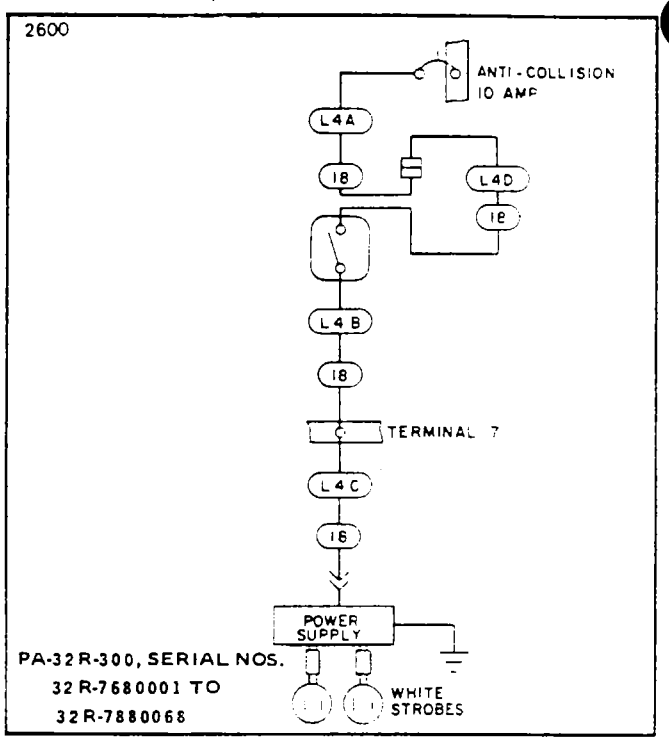


Figure 10-60. Anti-Collision Lights

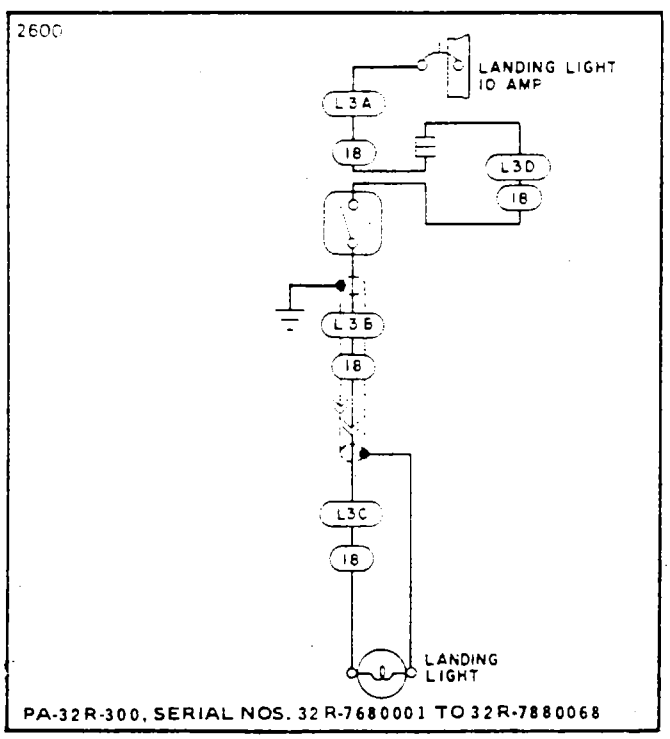


Figure 10-61. Landing Light

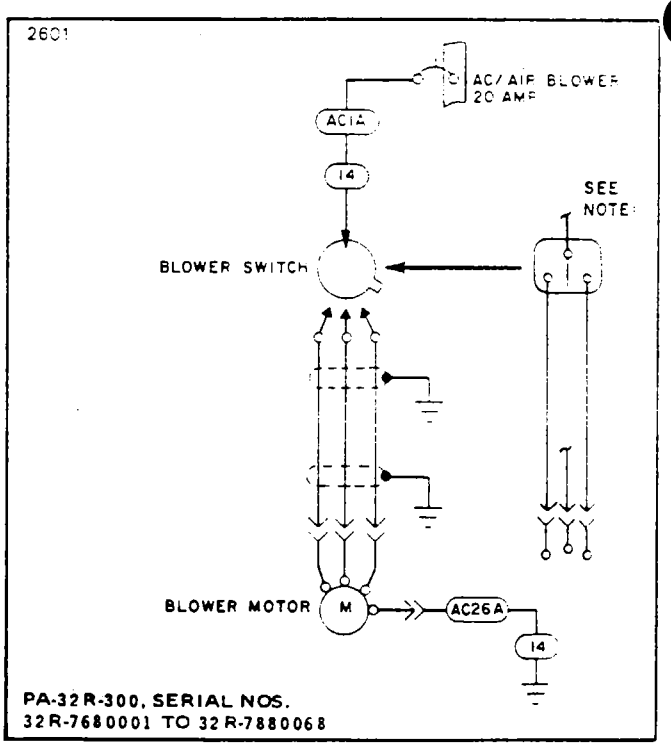


Figure 10-62. A/C Air Blower

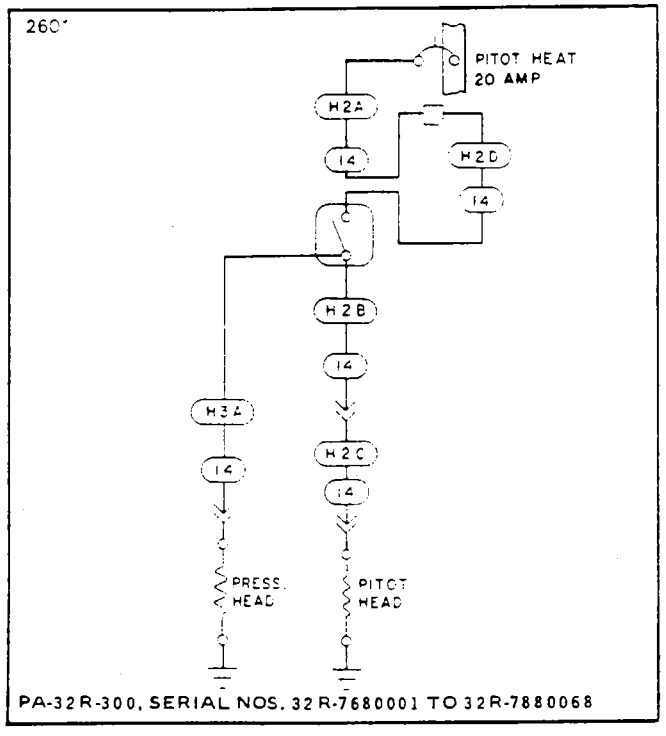


Figure 10-63. Pitot and Pressure Head Heat

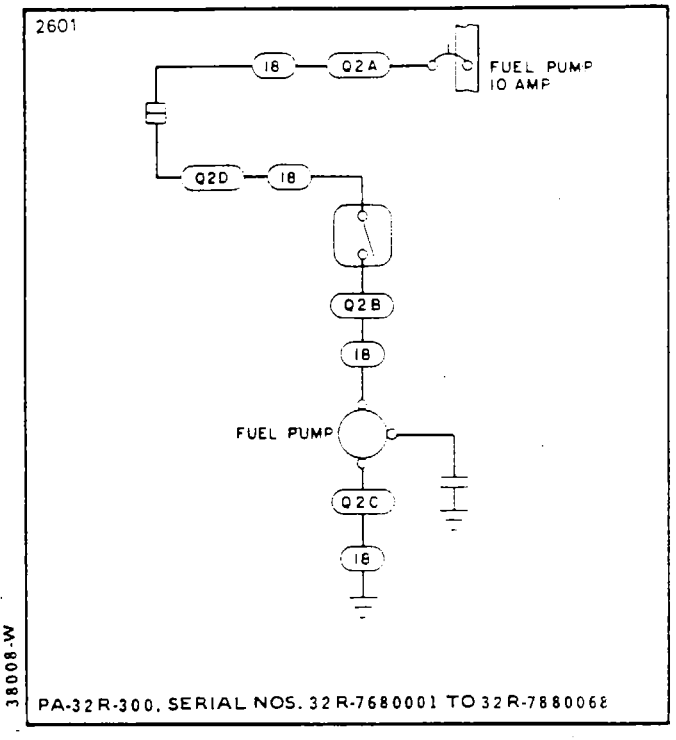


Figure 10-64. Fuel Pump

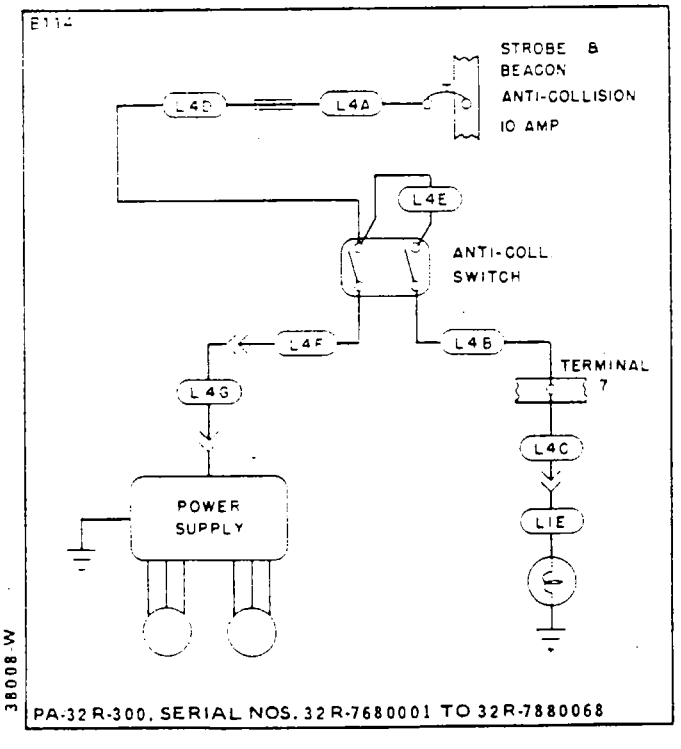


Figure 10-65. Strobe and Beacon Anti-Collision Lights

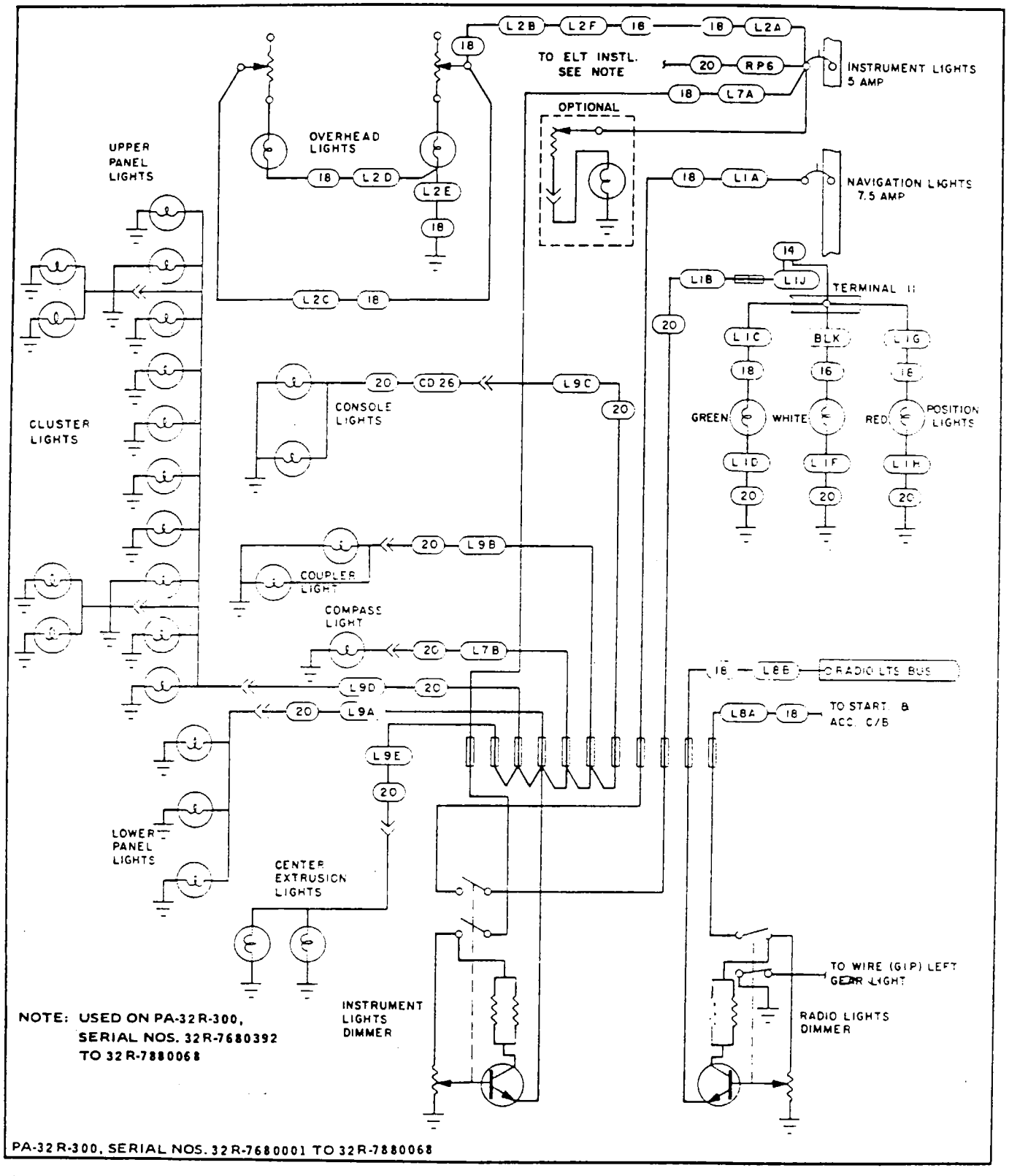


Figure 10-66. Instrument, Navigation and Radio Lights

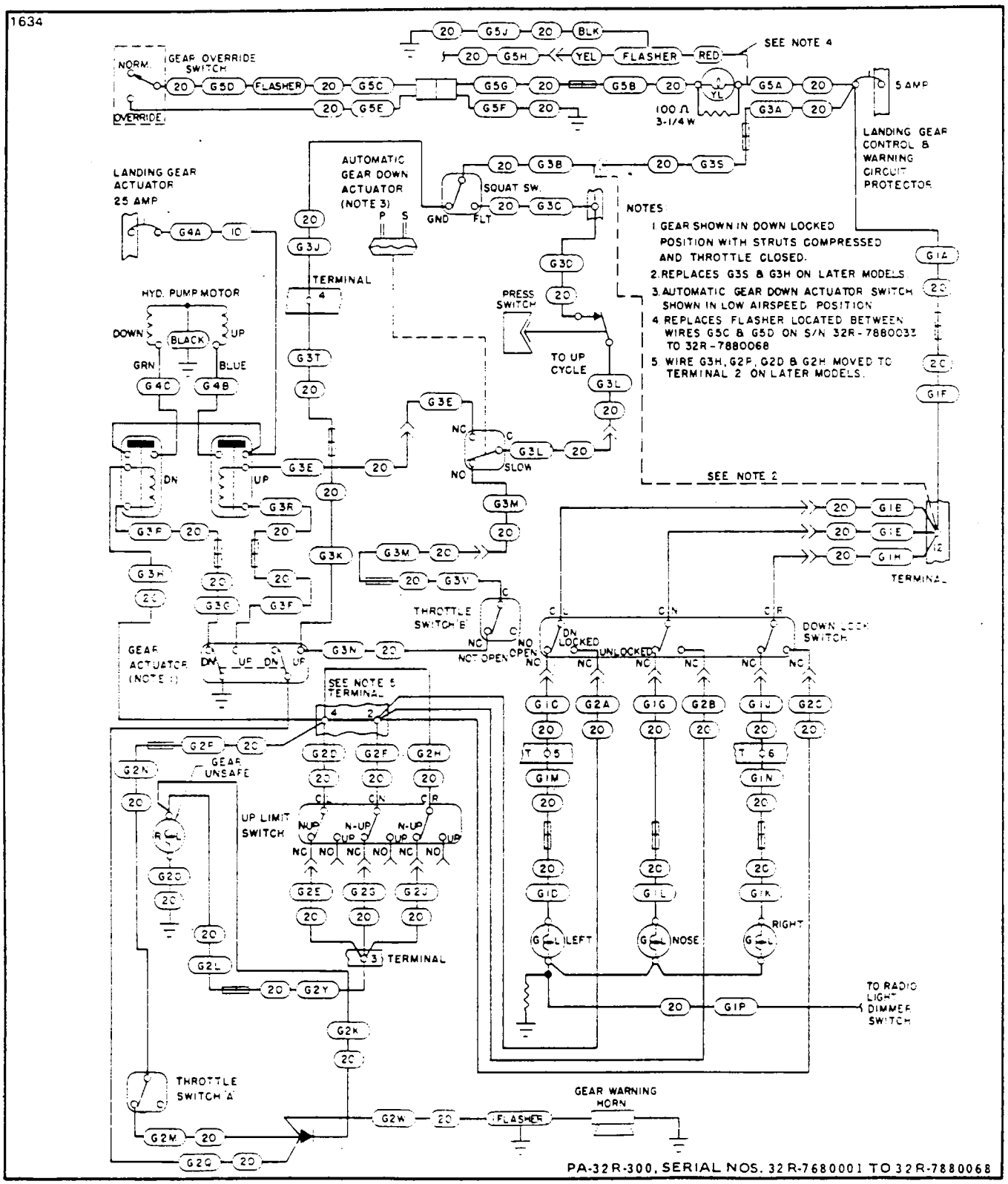


Figure 10-67. Landing Gear, PA-32R-300

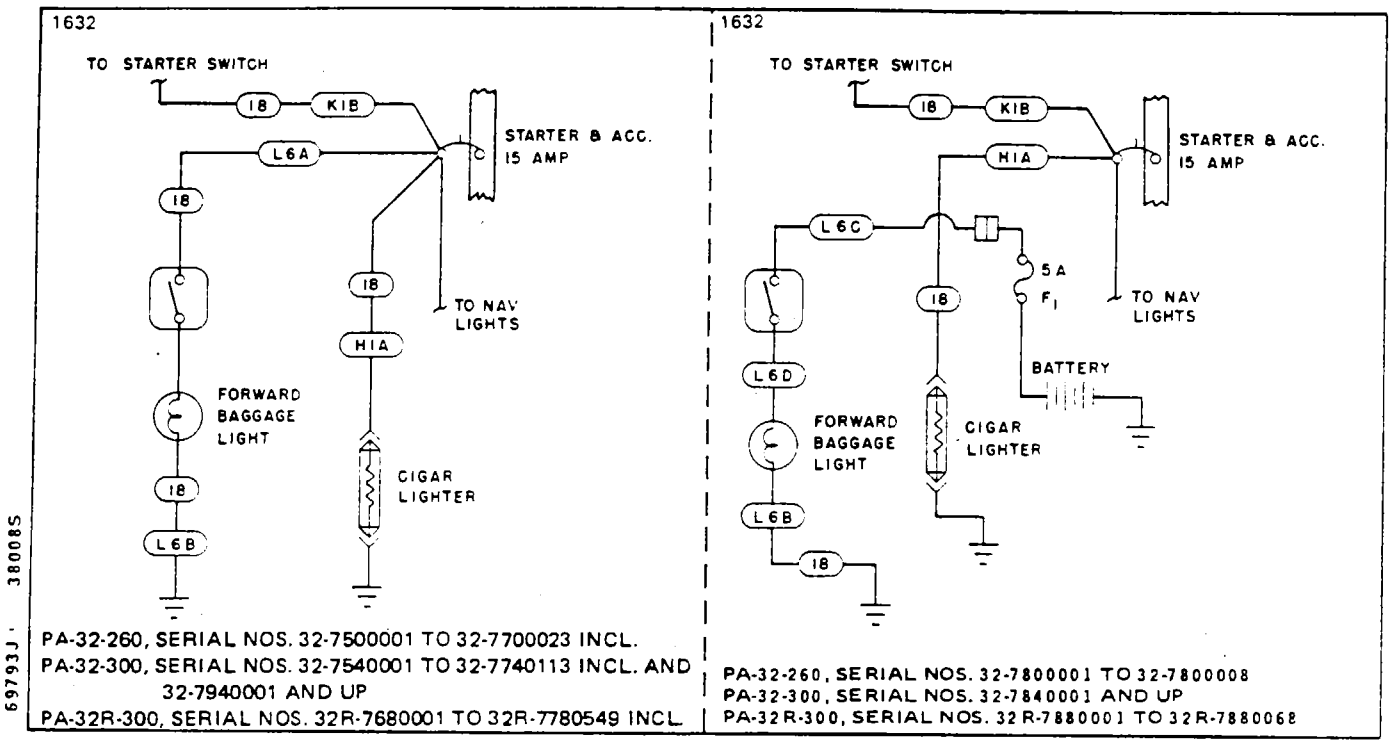


Figure 10-68. Forward Baggage Light

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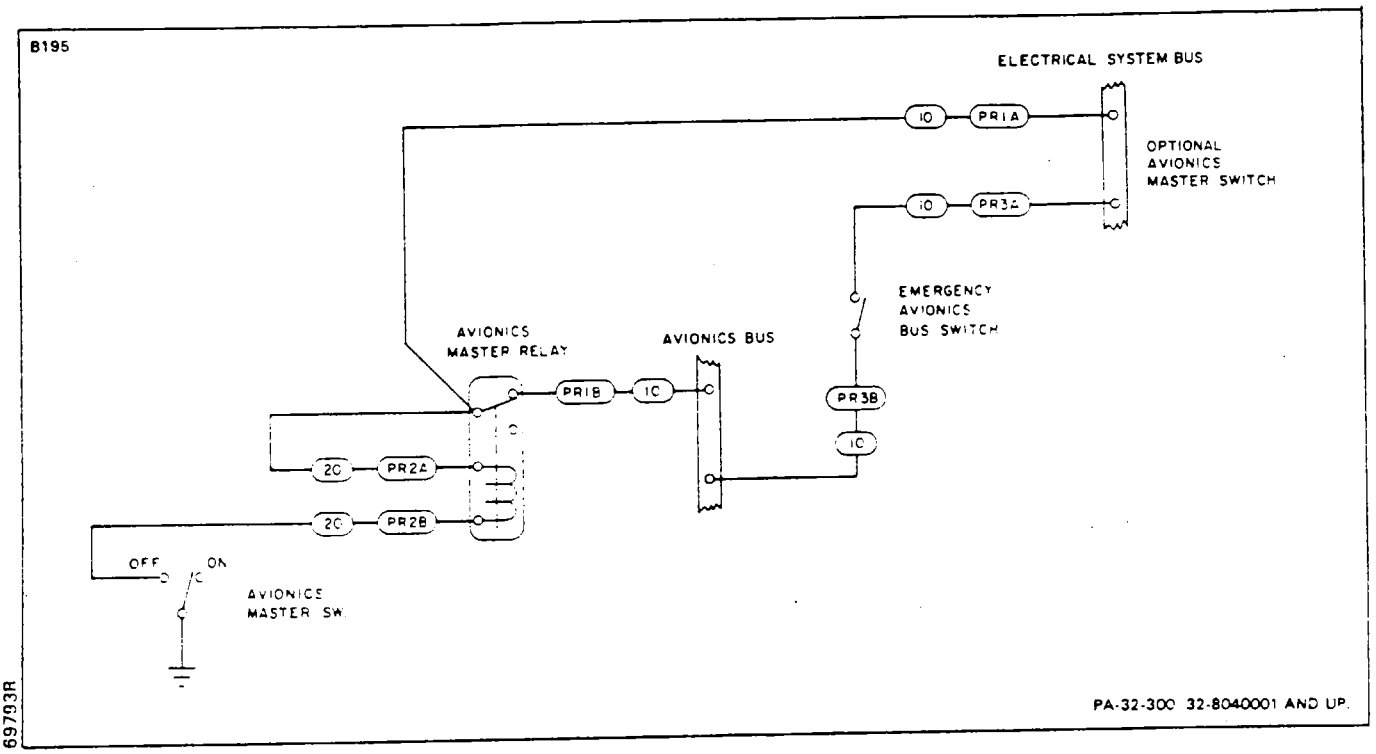


Figure 10-70. Avionics Master Switch (optional)

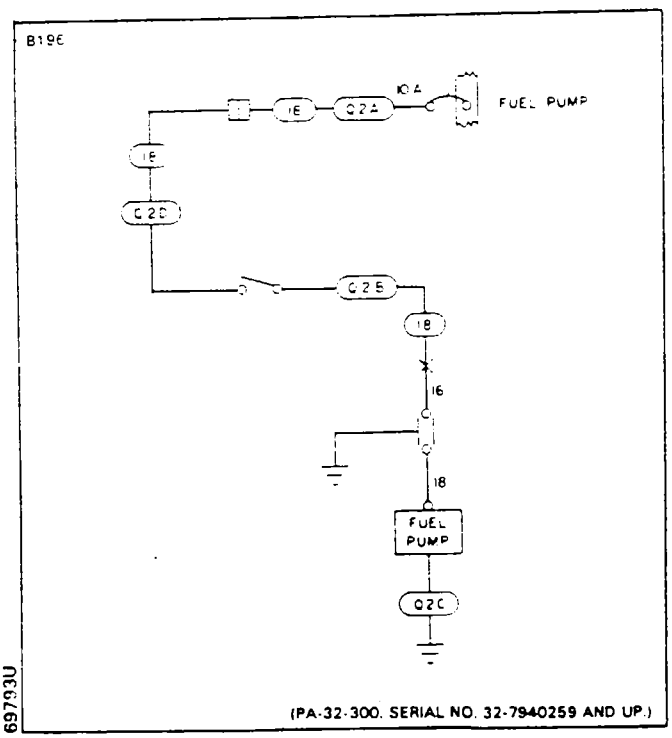


Figure 10-71. Fuel Pump Circuit

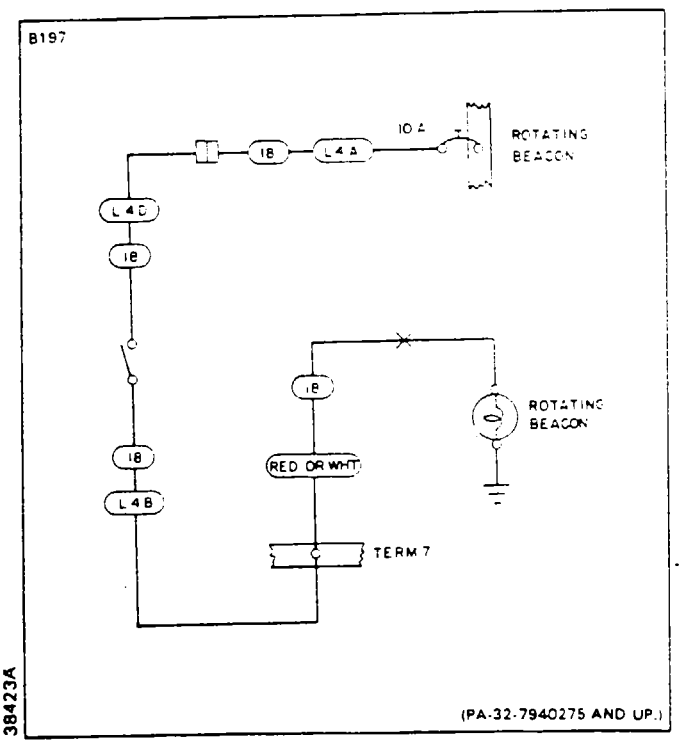


Figure 10-72. Anti-Collision (Rotating Beacon)

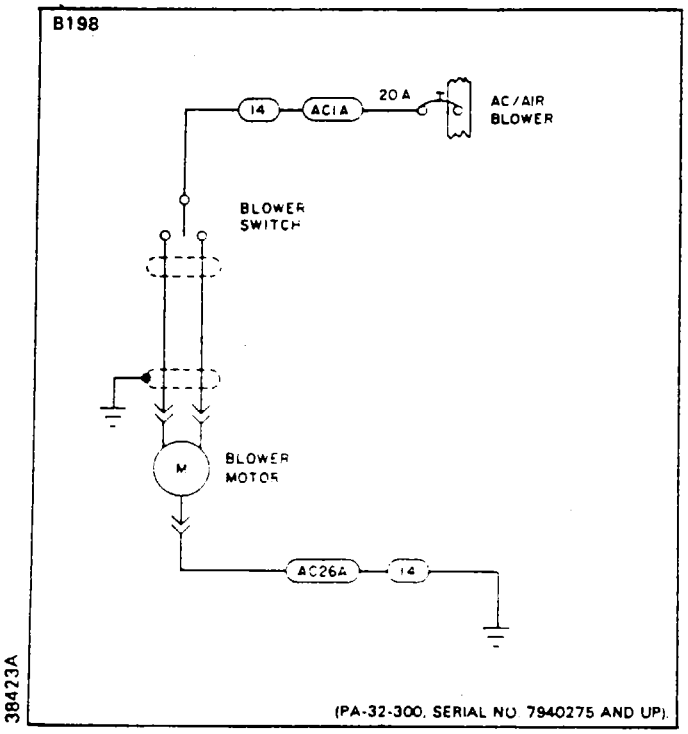


Figure 10-73. A/C Air Blower

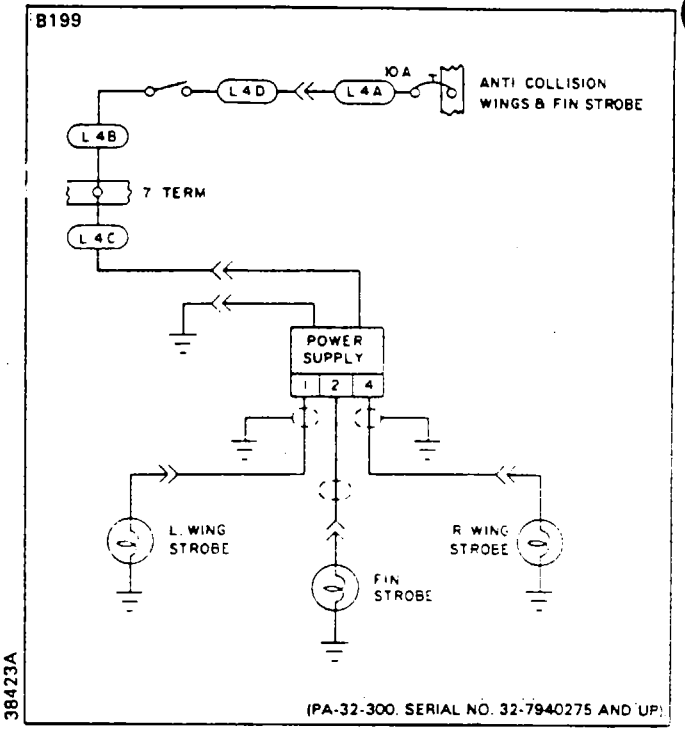


Figure 10-74. Anti Collision, (Wings and Fin Strobe)

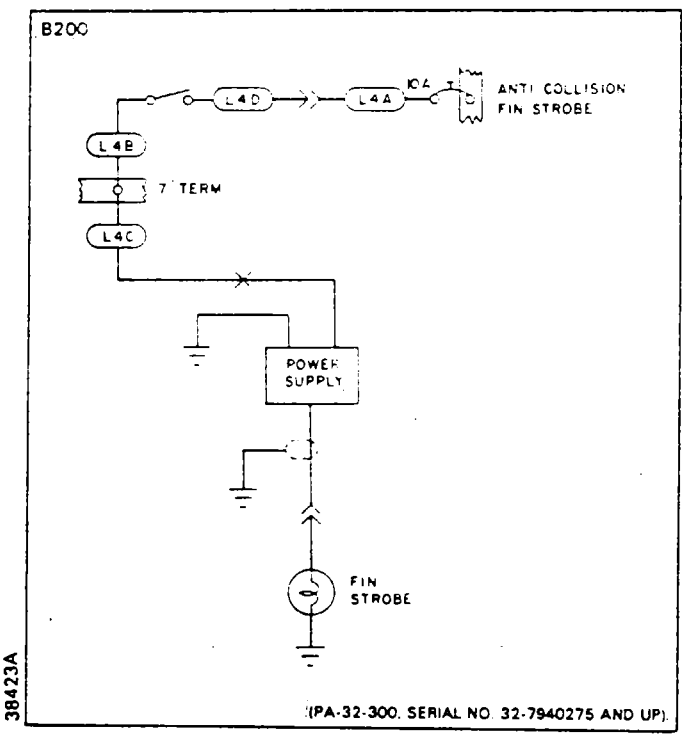


Figure 10-75. Anti-Collision (Fin Strobe)

Added: 12/4/79

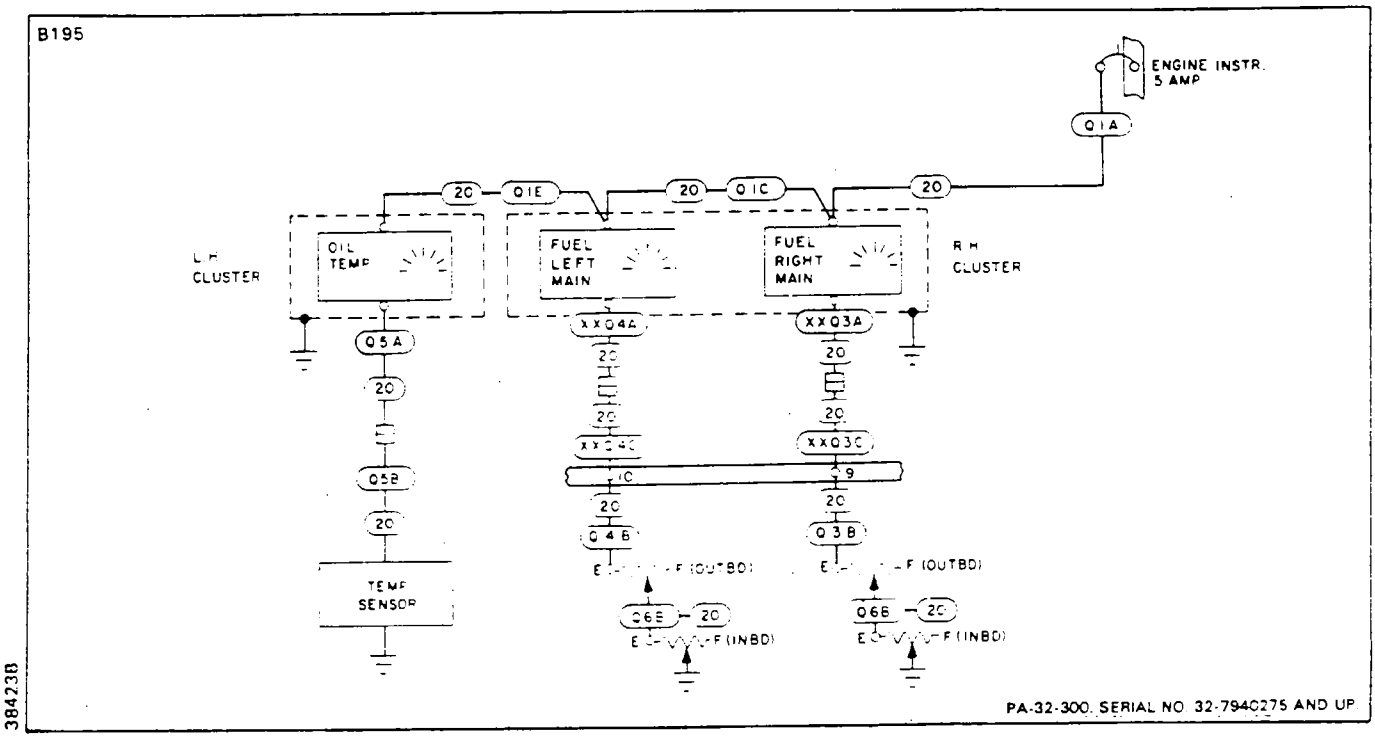


Figure 10-76. Engine Gauges

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SECTION XI

ELECTRONICS

Paragraph		Aerofiche Grid No.
11-1.	Introduction	3F8
11-2.	Emergency Locator Transmitter	3F8
11-3.	Description	3F8
11-4.	Battery Removal and Installation (2 Year, Magnesium Battery)	3F8
11-5.	Battery Removal and Installation (NARCO)	3F10
11-6.	Testing Emergency Locator Transmitter	3F12
11-7.	Pilot's Remote Switch	3F14
11-8.	Testing Pilot's Remote Switch	3F14
11-9.	Inadvertent Activation	3F15
11-10.	Radar System Installation (Optional)	3F15
11-11.	Description	3F15
11-12.	Antenna Removal	3F15
11-13.	Antenna Installation	3F16
11-14.	AutoFlight	3F17
11-15.	General	3F17
11-16.	Non-Piper A.F.C.S. Equipment Contacts	3F17
11-17.	Piper A.F.C.S. Equipment	3F18

SECTION XI

ELECTRONICS

11-1. INTRODUCTION. This section of the manual contains instructions relating to the removal, installation and operational checks of the Emergency Locator Transmitter (ELT) and also removal and installation of the RCA Weather Scout radar antenna.

11-2. EMERGENCY LOCATOR TRANSMITTER.

11-3. DESCRIPTION. The electrical power for the ELT is totally supplied by its own self-contained battery. The magnesium batteries used on early models have a service life of four years. However, to comply with FAA regulations, magnesium batteries must be replaced every 2 years. If the transmitter has been used in an emergency situation during this 2 year period or it has more than one hour of accumulated test time, the battery must be replaced according to FAA regulations. To replace the battery pack in the transmitter, it is necessary to remove the transmitter from the aircraft. (Refer to paragraph 11-4.)

11-4. BATTERY REMOVAL AND INSTALLATION. (2 year, magnesium battery, refer to Figure 11-1.) The ELT is located on mounting brackets on the right side of the fuselage aft of sta. 259.30.

a. Remove the access plate on the right side of the fuselage aft of sta. 259.30.
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.
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 printed on the battery. Transfer this date onto the outside of the ELT.
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.
l. Insure O-ring is fitted in plain end cap and correctly seated.

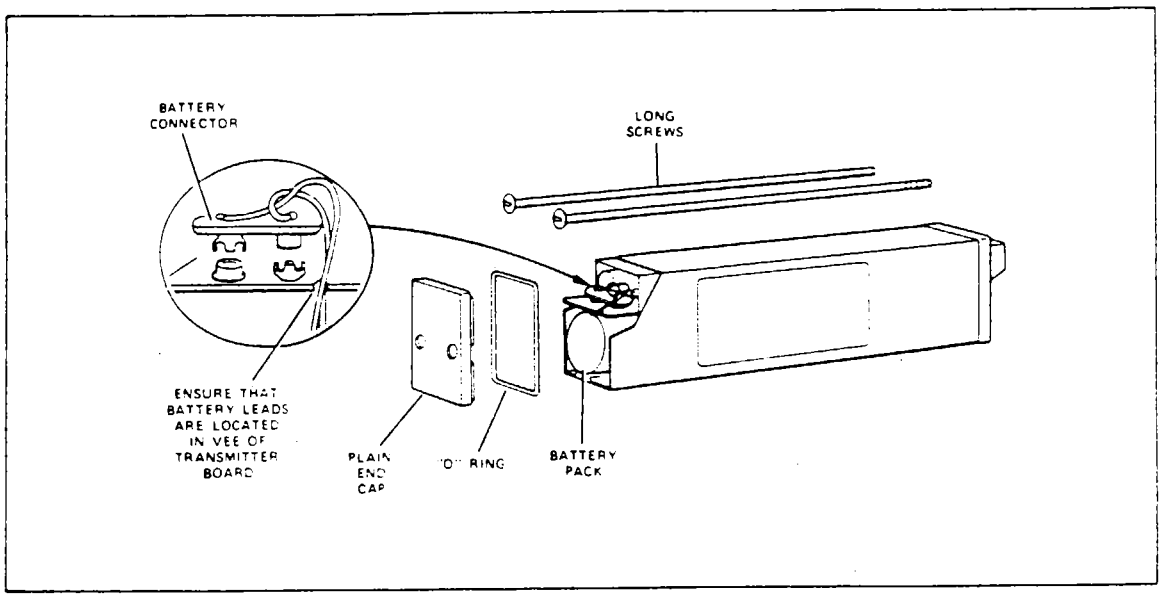


Figure 11-1. Two Year, Magnesium Battery Connections

NOTE

Red ELT's have no O-ring; replace end cap using fresh RTV silicone rubber compound.

m. Refit end cap and secure with the screws previously removed.

NOTE

Do not overtighten the end cap 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 plate on the right side of the fuselage aft of sta. 259.30. Make an entry in the aircraft logbook, including the new battery run out date.

NOTE

It may be advisable to test the unit operation before installing the access plate. (Refer to paragraph 11-6.)

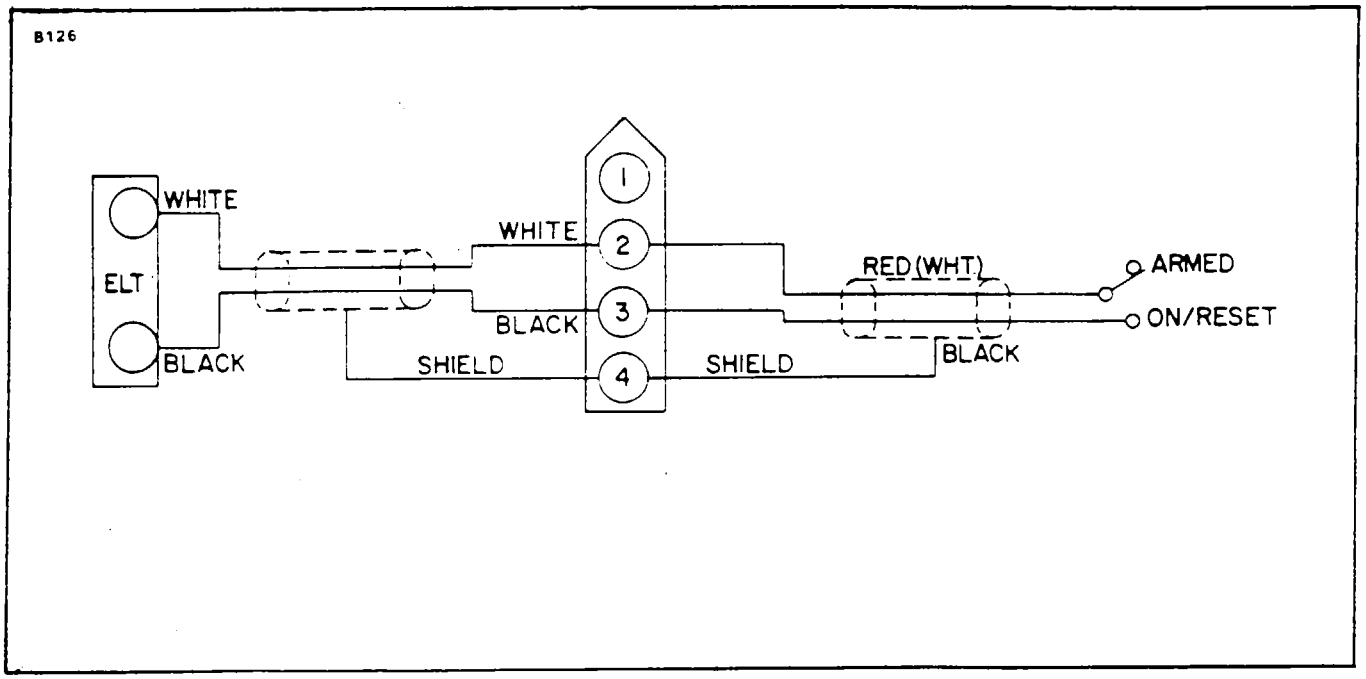


Figure 11-2. ELT Schematic (Narco).

11-5.BATTERY REMOVAL AND INSTALLATION (NARCO).

a. Set the ON/OFF/ARM switch on the transmitter to OFF.
b. Disconnect antenna coaxial cable from ELT.
c. Remove ELT from its mounting bracket by releasing the latch on the strap and sliding the ELT off the bracket.
d. Extend the portable antenna.
e. Unscrew the four screws that hold the control head to the battery casing and slide apart.
f. Disconnect the battery by unsnapping the snap-off battery pigtail terminals from the bottom of the transmitter printed circuit board.
g. 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.

h. Connect new battery pack terminals to the bottom of the circuit board.
i. Reinsert the control head section into 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.
j. Slide the portable antenna back into the stowed position.
k. Place transmitter into its mounting bracket and fasten the strap latch.
l. Connect the antenna coaxial cable to the ELT and ensure that the contact separator is inserted between the antenna contact finger and portable antenna. (Refer to Figure 11-4.)
m. Press RESET button and set ON/OFF/ARM switch to ARM.
n. Make an entry in the aircraft logbook, including the new battery expiration date.
o. A unit operational check may now be peformed on the ELT. (Refer to Testing ELT.)
p. Install the access plate on the right side of the fuselage aft sta. 259.30.

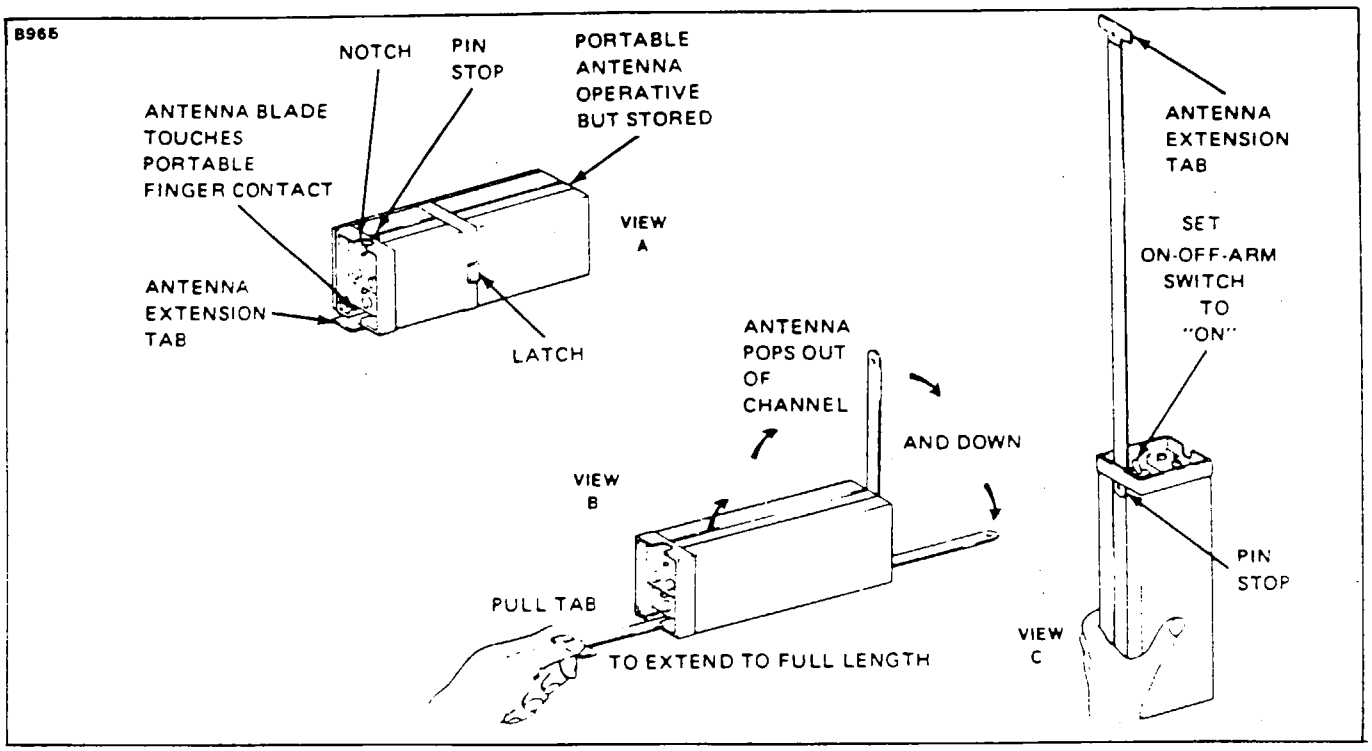


Figure 11-3. ELT Portable Folding Antenna (Narco)

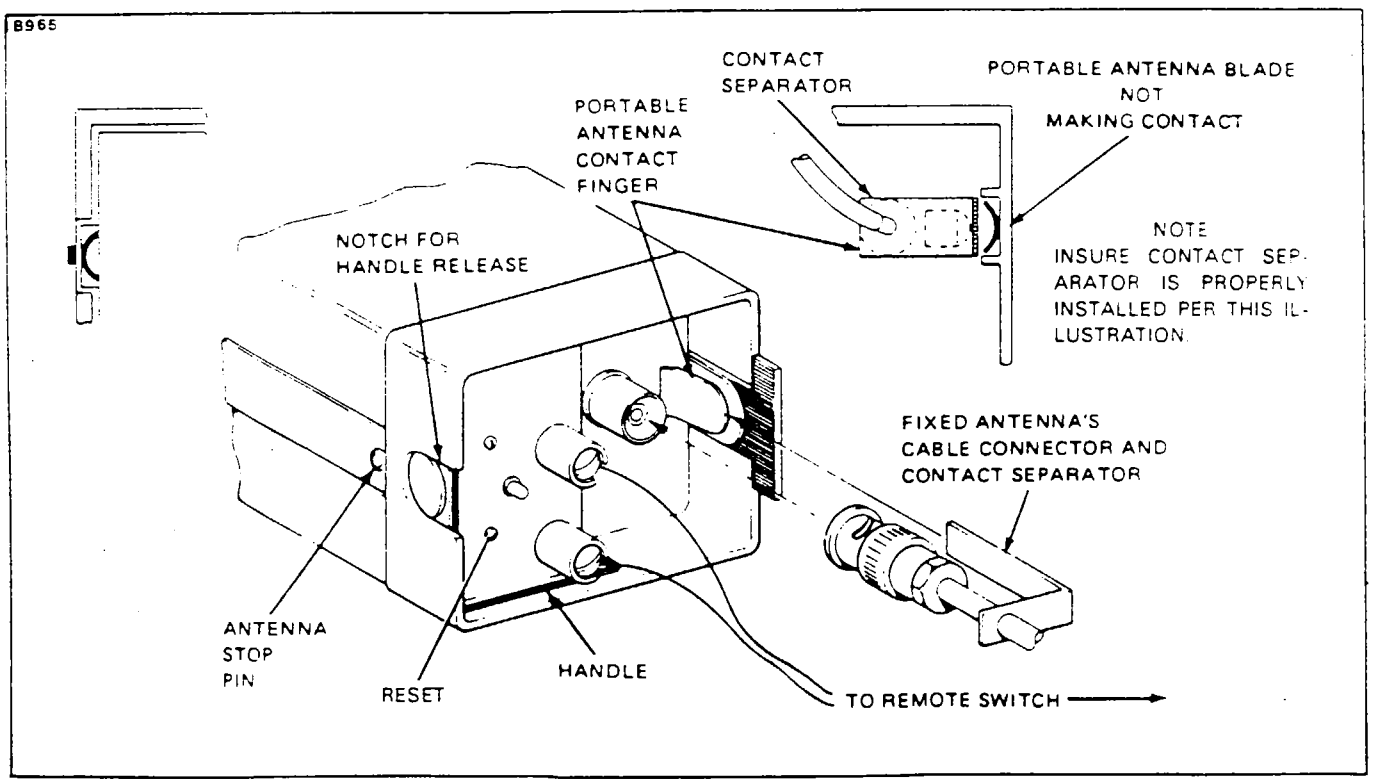


Figure 11-4. ELT Using Fixed Aircraft Antenna (Narco)

11-6. TESTING EMERGENCY LOCATOR TRANSMITTER. Before performing any operational test of the ELT, 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 should be obtained from the FAA/FCC Representative (or other applicable Authority) prior to testing. Keep your test transmission to a minimal duration.

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a. Remove the access plate on the right side of the fuselage aft of sta. 259.30.

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. 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. 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.

d. A transmitter which is functioning properly should emit a characteristic downward swept tone.

e. When the test is completed, ascertain the transmitter ON/ARM/OFF switch is in the ARM position.

f. Place the access panel on the right side of the fuselage aft of sta. 259.30.

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 before reverting to the ARM position again.

CAUTION

Under normal conditions, the transmitter switch must be set to arm.

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.

11-7. PILOT'S REMOTE SWITCH. A pilot's remote switch, located on the left side panel, is provided to allow the transmitter to be controlled from inside the cabin. The switch is locked into each position. To move the switch, the toggle must be pulled out and moved to the new desired position. On early models the pilot's remote switch is placarded "ON," "ARM," "OFF RESET." If the pilot's remote switch has been placed in the "ON" position for any reason, the "OFF RESET" position must be selected for one second before the switch is placed in the "ARM" position. On later models the pilot's remote switch is placarded "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 tests 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.

11-8. 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 should be obtained from the FAA/FCC Representative (or other applicable Authority) prior to testing. Keep your test transmission to a minimal duration.

a. 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.

b. Set the pilot's remote switch to the ON position. Hold the switch in this position for only a few seconds.

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.

c. Set the pilot's remote switch to the RESET position for one second; then select the ARM position.

11-9. 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 paragraphs 11-4 or 11-5.) Put the ON/ARM/OFF switch in 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 RESET position; then return it to the ARM position. (See Note.)

NOTE

As a routine precaution, it is recommended that the ELT be replaced at the earliest opportunity after inadvertent activation. Note, however, that the problem may not be in the transmitter. Check the following:

1. Proper spacing of antennas 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 position.

11-10. RADAR SYSTEM INSTALLATION (OPTIONAL)

11-11. DESCRIPTION. The PA-32-300 and PA-32R-300 may be equipped with the RCA Weather Scout radar installation. The basic components are the receiver/transmitter antenna and the cockpit indicator. The antenna is mounted in a radome at the outboard leading edge of the right wing while the cockpit indicator is mounted in the instrument panel.

11-12. ANTENNA REMOVAL. The antenna is in a radome between wing stations 147.700 and 171.350 of the right wing.

a. Remove the screws securing the radome to the wing leading edge.

b. Pull the radome away from the wing far enough to gain access for removal of vacuum hose and electrical cable. Remove the radome from the wing.

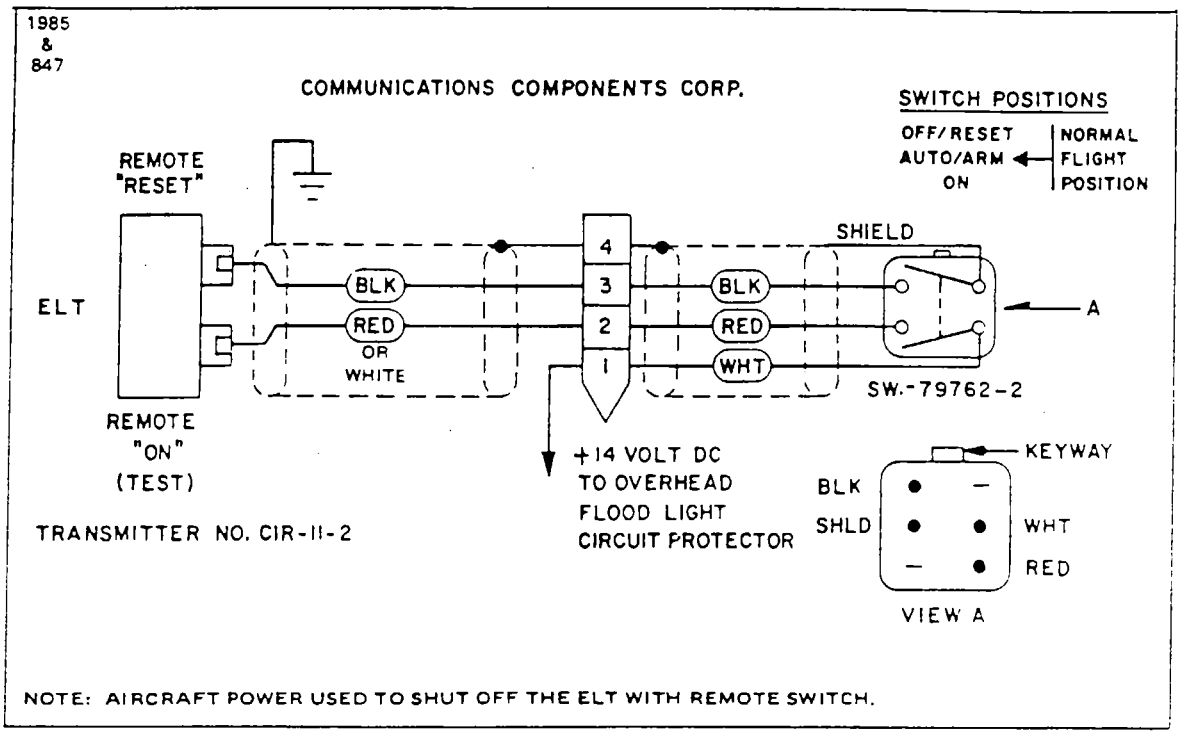


Figure 11-5. Communications Components ELT Schematic

c. Remove the screws and washers which secure the antenna to the radome assembly and remove the antenna.

11-13. ANTENNA INSTALLATION.

a. Secure the antenna and gasket assembly to the radome with the appropriate screws and washers.

b. Place the radome assembly into position in the wing leading edge leaving access for attaching the vacuum hose and electric cable to the antenna.

c. Place the radome into position and secure with the appropriate screws and washers.

d. Further information relating to operation and maintenance of the RCA Weather Scout radar system may be found in the RCA Pilot's Handbook (1B8023102) and the RCA Weather Scout Manual (1B8023100).

11-14. AUTOFLIGHT.

11-15. GENERAL. Due to the wide varity of A.F.C.S. (Automated 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 & installation, servo clutch adjustments, etc.

11-16. 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 Blvrd.
P.O. Box 9028
VanNuys, CA. 91409
(213) 894-8111 Telex: 65-1367

Global Navigation
2144 Michelson Drive
Irvine, CA. 92715
(714) 851-0119

11-17. 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 aircrafts parts catalog for replacement parts.

NAME	PIPER PART NO.
AutoControl I/II & AltiMatic I/II	753 798
AutoControl III and AltiMatic III and IIIB	753 723
AutoControl IIIB and AltiMatic IIIB-1	761 502
AltiMatic IIIC	761 602
AltiMatic V and V-1	761 525
AltiMatic V F/D and V F/D-1	761 526
AltiMatic X F.D./A.P./ & X A.P.	761 668
AutoFlite	753 720
AutoFlite II	761 481
Piper Pitch Trim (Manual-Electric)	757 771

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SECTION XII

CABIN HEATER AND VENTILATOR SYSTEM

Paragraph		Aerofiche Grid No.
12-1.	General	3F22
12-2.	Description	3F22
12-3.	Heater Maintenance	3F22
12-4.	Overhead Vent Blower	3G3
12-5.	Description	3G3
12-6.	Removal of Blower Assembly	3G3
12-7.	Disassembly of Blower Assembly	3G3
12-8.	Reassembly of Blower Assembly	3G4
12-9.	Installation of Blower Assembly	3G4

SECTION XII

CABIN HEATER AND VENTILATOR SYSTEM

12-1. GENERAL.

12-2. DESCRIPTION. Heat for the cabin of the Cherokee Six is provided by a hot air heater installed on the exhaust manifold. Fresh air enters the engine compartment through the nose cowling, passes to the heater muff through a flexible hose located on the left front of the engine. The air is then heated and vented into the cabin area through a valve which can be controlled from the instrument panel. When the valve is completely closed off, the heated air is vented back into the engine compartment. The heater outlets in the cabin are located between each set of seats. Control for the heater system is located on the right panel, below the instruments. The windshield is kept clear of frost, ice, etc., by a defroster system which operates from the heater muff, but has an individual control.

Fresh air for the cabin interior is picked up from air inlets in the leading edge of each wing at the intersection of the tapered and straight section and passed to outlets located beside the front and center set of seats. In addition, an air scoop located on top of the fuselage or in the leading edge of the fin on 1971 Models directs air to individual overhead vents.

12-3. HEATER MAINTENANCE. If the exhaust manifold should become defective, carbon monoxide fumes may be discharged into the cabin area, therefore, it is imperative that the exhaust manifold be inspected regularly. The heater muff must be removed in order to inspect the manifold assembly. Check the operation of the push-pull controls to insure the valve doors function properly. When the controls are pulled out, the door should be completely open to permit full airflow. When the controls are pushed in, the valves should close off all air passage and vent the air into the engine compartment. Refer to Figure 12-1 or 12-2 for an illustration of the heater system.

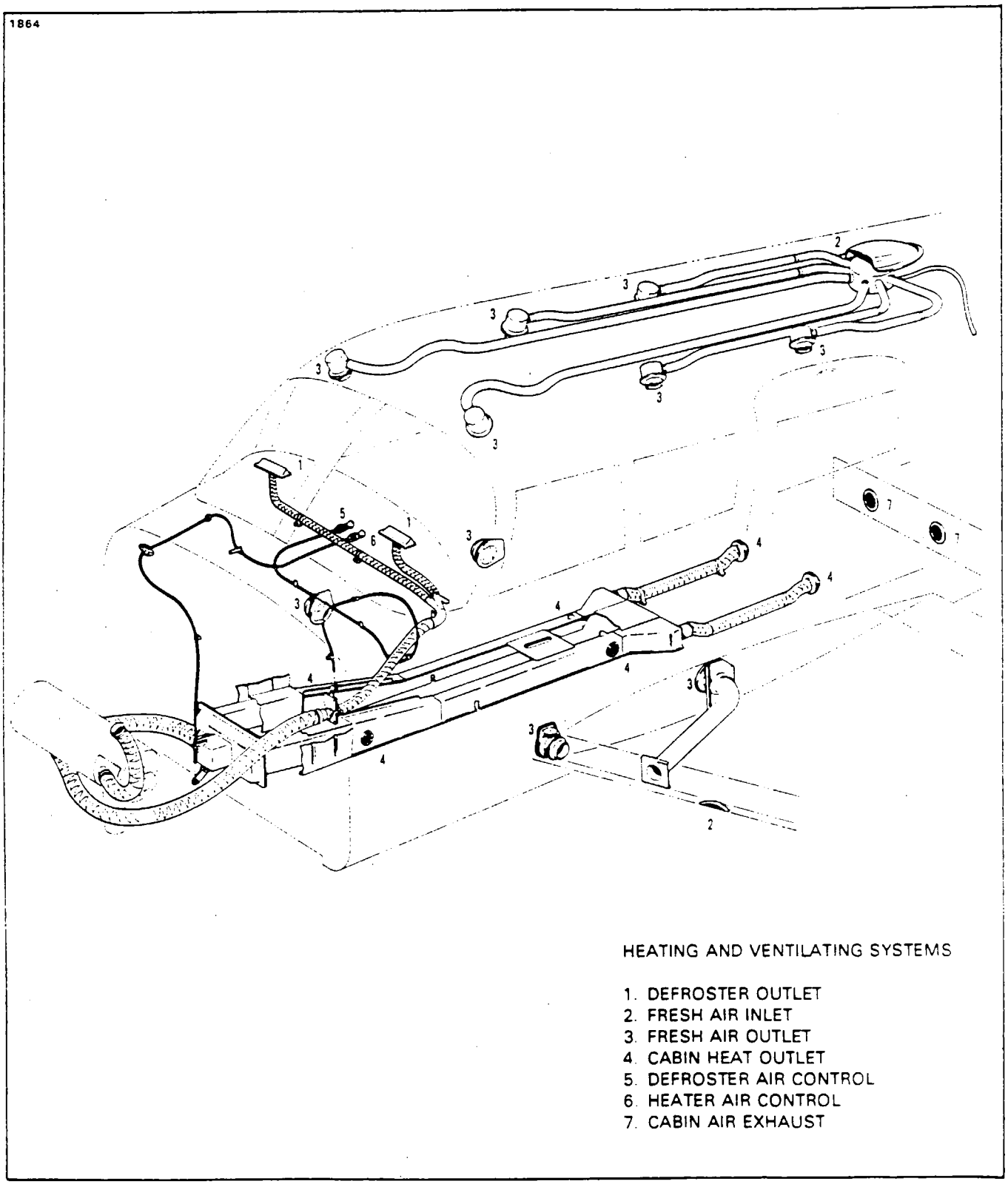


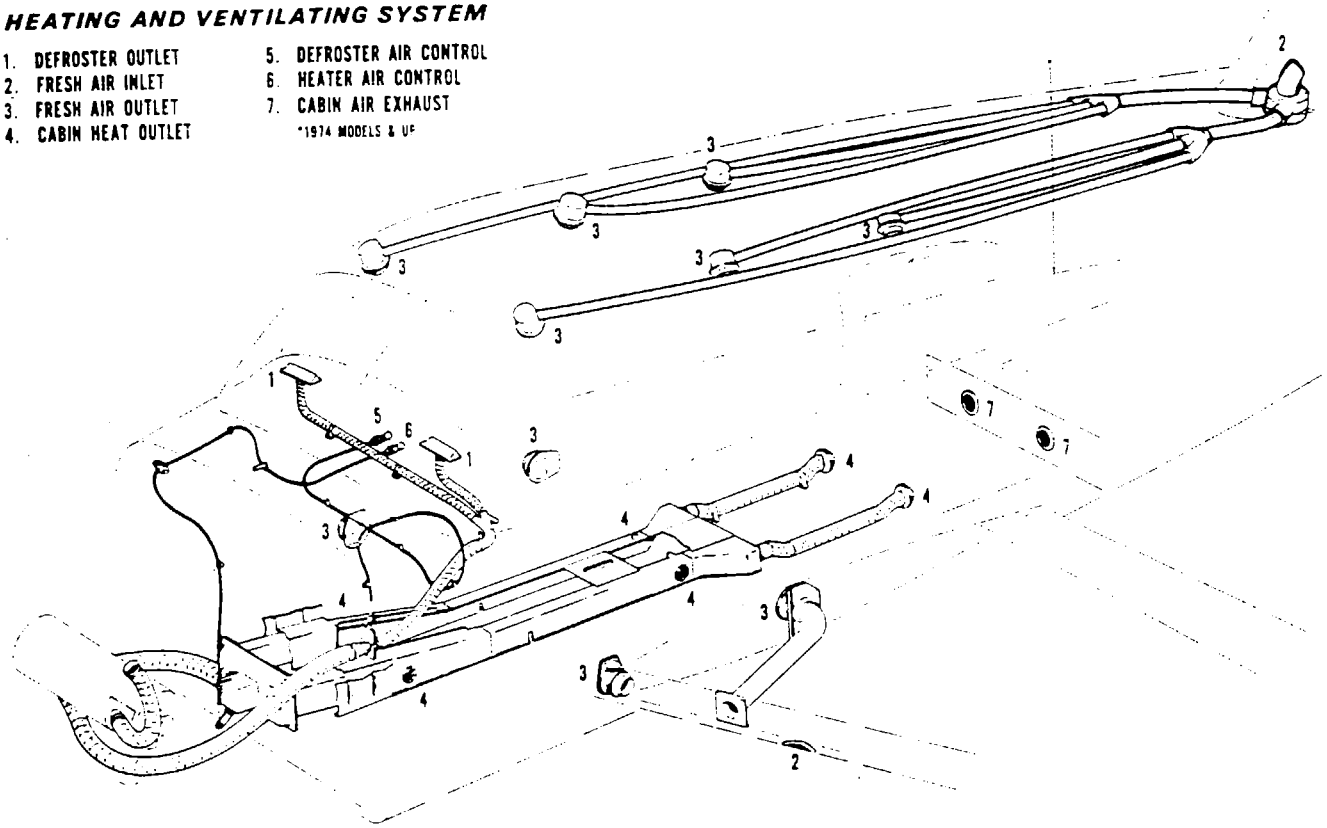
Figure 12-1. Cabin Heater, Defroster and Fresh Air System

1900

HEATING AND VENTILATING SYSTEM

1. DEFROSTER OUTLET
2. FRESH AIR INLET
3. FRESH AIR OUTLET
4. CABIN HEAT OUTLET
5. DEFROSTER AIR CONTROL
6. HEATER AIR CONTROL
7. CABIN AIR EXHAUST

*1974 MODELS & UP



SERIAL NOS. 32-7100001 TO 32-7340191

Figure 12-2. Cabin Heater and Defroster Fresh Air System

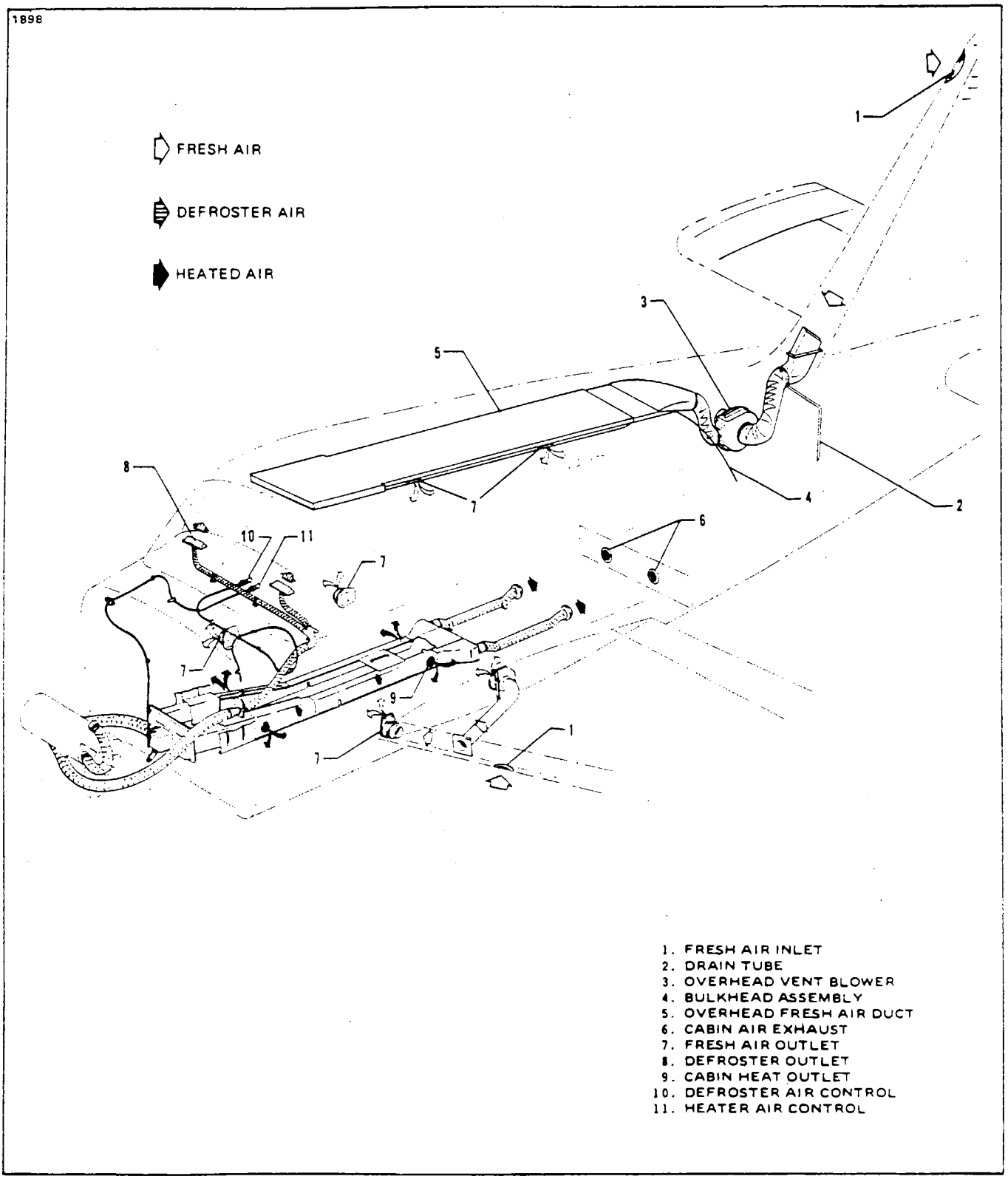


Figure 12-3. Cabin Heater, Defroster and Fresh Air System (1974 Models and Up)

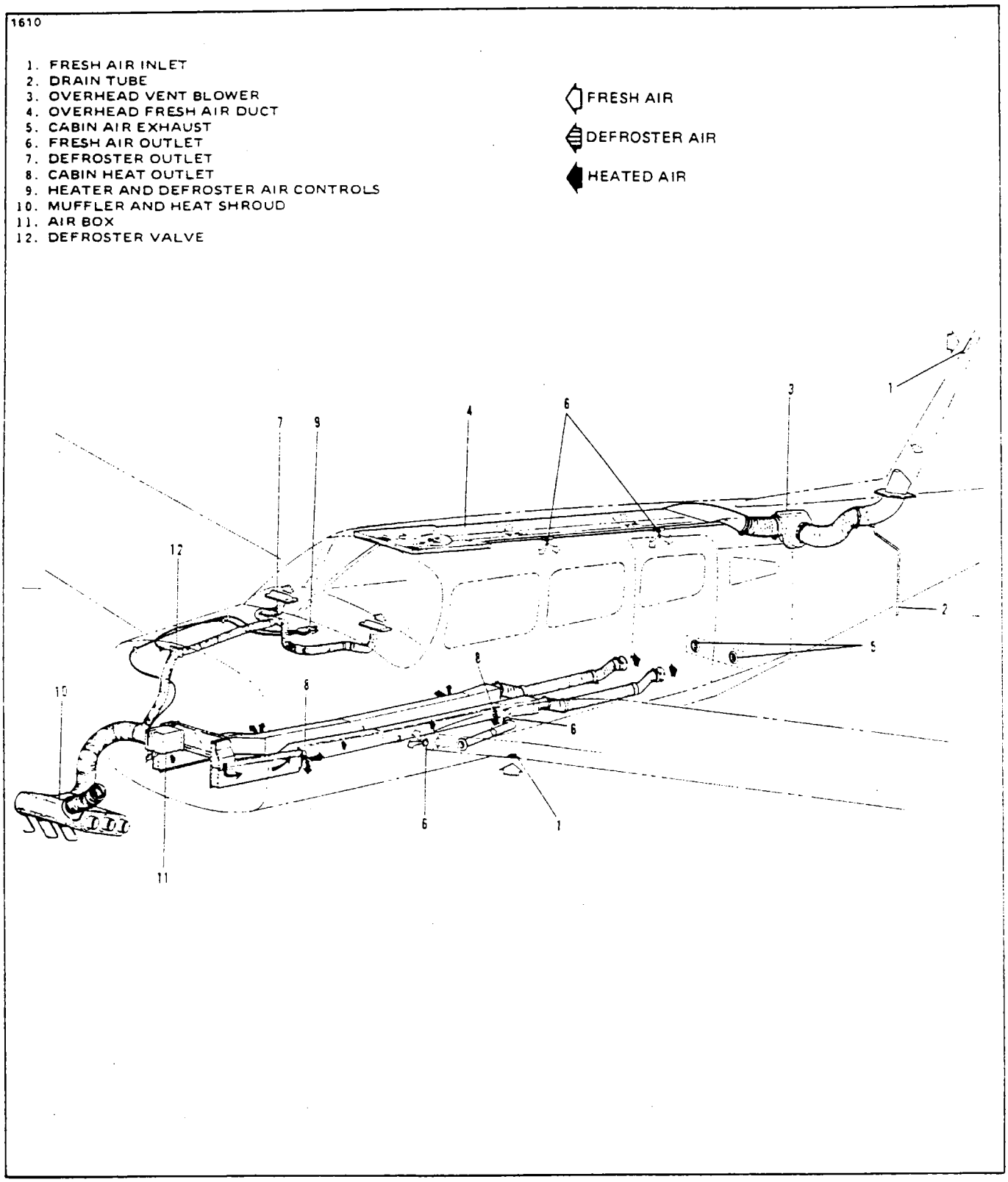


Figure 12-4. Cabin Heater and Defroster Fresh Air System (PA-32R-300 Only)

12-4. OVERHEAD VENT BLOWER (OPTIONAL).

12-5. DESCRIPTION. The blower is mounted in the aft section of the fuselage and is connected to the overhead vent system. The blower draws air in from the dorsal fin and forces it through the ducting whenever desired. The four position blower switch is mounted in the overhead panel and controls the three speed blower.

12-6. REMOVAL OF BLOWER ASSEMBLY.

a. Remove the access door from the aft wall of the baggage area.

b. With the master switch off, disconnect the plug assemblies at the blower assembly.

c. Remove the inlet and outlet hoses from the blower assembly by removing the clamps.

d. Remove the screws, washers, and nuts that secure the blower assembly to the hangar braces.

e. Remove the screws and washers which secure the blower assembly to the retainer and hangars.

f. Remove the blower assembly from the aircraft.

12-7. DISASSEMBLY OF BLOWER ASSEMBLY.

a. Remove the hose duct from the forward edge of the blower assembly by removing the nuts, washers and screws.

b. Remove the cover from the blower assembly by removing the nuts, washers and screws.

c. Remove the blower fan from the motor shaft by removing the set screw.

d. For removal of the motor, proceed as follows:

1. Separate the plate from the motor cover by carefully drilling out the connecting rivets.

2. Cut the motor wires at the edge of the receptacle and plug, and remove the wire ends from the blocks.

3. Remove the motor from the mounting plate by removing the nuts, washers and bolts.

12-8. REASSEMBLY OF BLOWER ASSEMBLY.

a. Mount the motor on the plate and secure it with the bolts, washers and nuts. Be sure that the motor nuts are snug and the shaft spins freely.

b. Position the cover over the motor plate with the motor wires protruding through the cover grommet.

c. With the holes in the cover matching the holes in the motor plate, secure the two parts together with rivets.

d. Apply PRC-5000 sealant to fill any opening left after the wires are brought through the grommet.

e. Install the wires in the plug and receptacle according to Table XII-I.

f. Position the blower fin on the motor shaft and secure with set screw.

g. Secure the cover to the blower assembly with screws, washers and nuts.

h. Position the hose duct on the blower assembly and secure it with screws, washers and nuts. The screws must be installed with their heads inside the duct.

i. After cleaning the surfaces of all old sealant, use white rubber chalk PRC-5000 sealant to seal where the duct attaches to the blower assembly.

12-9. INSTALLATION OF BLOWER ASSEMBLY.

a. Position the blower assembly in the hangars and retainer and install the washers and screws.

b. Install the nuts, washers, and screws securing the blower assembly to the hangar braces.

c. Seal all hose joints with Arno No. C-520 gray tape; then install the inlet and outlet hoses securing them with the clamps.

d. With the master switch off, connect the plug and receptacles at the blower.

e. Check the blower for the proper operation.

f. Install the access door to the aft wall of the baggage area and secure with the attaching hardware.

TABLE XII-I. BLOWER SYSTEM WIRE COLOR CODES

	MOTOR WIRES					AIRCRAFT WIRES		
		Pin. Nos.	15920-01 General Industries	E362Q Singer Controls	F0018075FA Leece-Neville	Aircraft Harness	Pin Nos.	
Ground	Plug	2	Brown	Brown	Black	AC26A	2	Receptacle
Low Speed		1	Red	Yellow	Yellow	Black	1	
Medium Speed	Receptacle	2	Black	Red	Red	White	2	Plug
High Speed		1	Yellow	Orange	Orange	Red	1	

NOTE

Pin number 1 is at the pointed side of the plug and receptacle. Wire color codes for YY15062 ESB — Universal Elect. Company are same as E362Q Singer Controls color code listed above.

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3G6

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3G7

SECTION XIII

ACCESSORIES AND UTILITIES

		Aerofiche Grid. No.
13-1.	Air Conditioning Installation	3G10
13-2	Description	3G10
13-3.	Air Conditioning System Operation	3G10
13-4.	Malfunction Detection	3G12
13-5 .	Special Servicing Procedures	3G14
13-6.	Service Valves	3G16
13-7.	Service Valve Replacement	3G16
13-8.	Test Gauge and Manifold Set	3G17
13-9.	Checking the System for Leaks	3G17
13-10.	Leak Check - Method I	3G19
13-11.	Leak Check - Method II	3G20
13-12.	Discharging	3G20
13-13.	Evacuating the System	3G21
13-14.	Charging the System	3G22
13-15.	With a Charging Stand	3G23
13-16.	Using the Airplane Compressor to Charge the System	3G24
13-17.	Addition of Partial Charge to System	3H2
13-18.	Compressor Service	3H2
13-19.	Compressor Removal	3H3
13-20.	Compressor Installation	3H3
13-21.	Checking Compressor Oil	3H4
13-22.	Replacement of Compressor and/or Alternator Drive Belts	3H5
13-23.	Adjustment of Drive Belt Tension	3H10
13-24.	Magnetic Clutch	3H10
13-25.	Magnetic Clutch Removal	3H10
13-26.	Magnetic Clutch Installation	3H11
13-27.	Refrigerant Lines and Routing	3H12
13-28.	Receiver-Dehydrator	3H12
13-29.	Receiver-Dehydrator Removal	3H12
13-30.	Receiver-Dehydrator Installation	3H12
13-31.	Condenser	3H13
13-32.	Condenser Assembly Removal	3H13
13-33.	Condenser Installation	3H13
13-34.	Condenser Door Actuator	3H14
13-35.	Condenser Assembly Rigging Instructions	3H14

Revised: 7/29/77

		Aerofiche Grid No.
13-36.	Expansion Valve	3H14
13-37.	Expansion Valve Removal	3H14
13-38.	Expansion Valve Installation	3H16
13-39.	Evaporator Assembly	3H16
13-40.	Evaporator Assembly Removal	3H16
13-41.	Evaporator Assembly Installation	3H17
13-42.	Pressure Relief Switch (Ranco)	3H18
13-43.	Electrical Installation	3H18
13-44.	Adjustment of Throttle Switch	3H18
13-45.	Fuse Replacement	3H23
13-46.	Fuse Replacement	3H23
13-47.	Shoulder - Harness Inertia Reel Adjustment	3H23

SECTION XIII

ACCESSORIES AND UTILITIES

13-1. AIR CONDITIONING INSTALLATION.

13-2. DESCRIPTION. Components used for this installation consist of a two cylinder, piston type compressor supported by special bracketry located on the front of the engine. The compressor is driven by a V-belt connected to the engine ring gear which drives the compressor through a magnetic clutch. An evaporator mounted in a fabricated housing along with the receiver-dehydrator, circulating fan, thermal expansion valve and related plumbing is mounted in the rear of the cabin aft of the baggage area. The condenser is installed in the bottom portion of the fuselage tail section and is hinge mounted to allow its extension into the airstream during system operation. The condenser is electrically operated to provide two positions automatically, as required (system on - fully extended and system off - fully retracted). The system is protected by a Ranco type pressure switch which automatically controls the condenser maximum head pressures by temporarily de-clutching the compressor in the event the pressure becomes excessively high. The controls are located in the aircraft instrument panel adjacent to the heater and defroster levers, and consist of an air conditioning ON-OFF control, a three position fan control (LOW - MED - HIGH) to govern the cold air velocity and a temperature control.

The system design is such that there is no increase in drag to the aircraft, during its take-off flight conditions. During maximum power demands the compressor is de-clutched and the condenser door is automatically retracted.

13-3. AIR CONDITIONING SYSTEM OPERATION.

The air conditioning system in this aircraft is a recirculating, independent unit. It filters, dehumidifies and cools the air as it cycles through the evaporator. The unit is operated from controls mounted on the right side of the instrument panel. On earlier models the air conditioning master switch has three positions: "FAN only, OFF and AIR COND." On later models the switch has two positions: "ON and OFF." When the "AIR COND" position is selected the compressor clutch engages, the condenser scoop opens and the circulating fan is turned on. The temperature is controlled by a thermostat operated by the temperature control selector. A three position fan switch (LOW - MED - HIGH) operates the blower. The fan may be operated to circulate air without using the air conditioning unit.

The air conditioning system uses Refrigerant 12 as the refrigerant. The refrigerant enters the compressor as a vapor. The compressor pressurizes the heat-laden vapor until its pressure and heat reach a point that is much hotter than the outside air and pumps the vapor to the condenser where it cools and changes to a liquid. The liquid then passes to the receiver-dehydrator. Its function is to filter, remove any moisture and insure a steady flow of liquid refrigerant into the evaporator through the expansion valve. The expansion valve is a temperature controlled metering valve which regulates the flow of the liquid refrigerant to the evaporator. The evaporator absorbs the heat from the air passing over the coils. From the evaporator the refrigerant vapor returns to the compressor where the cycle is repeated.

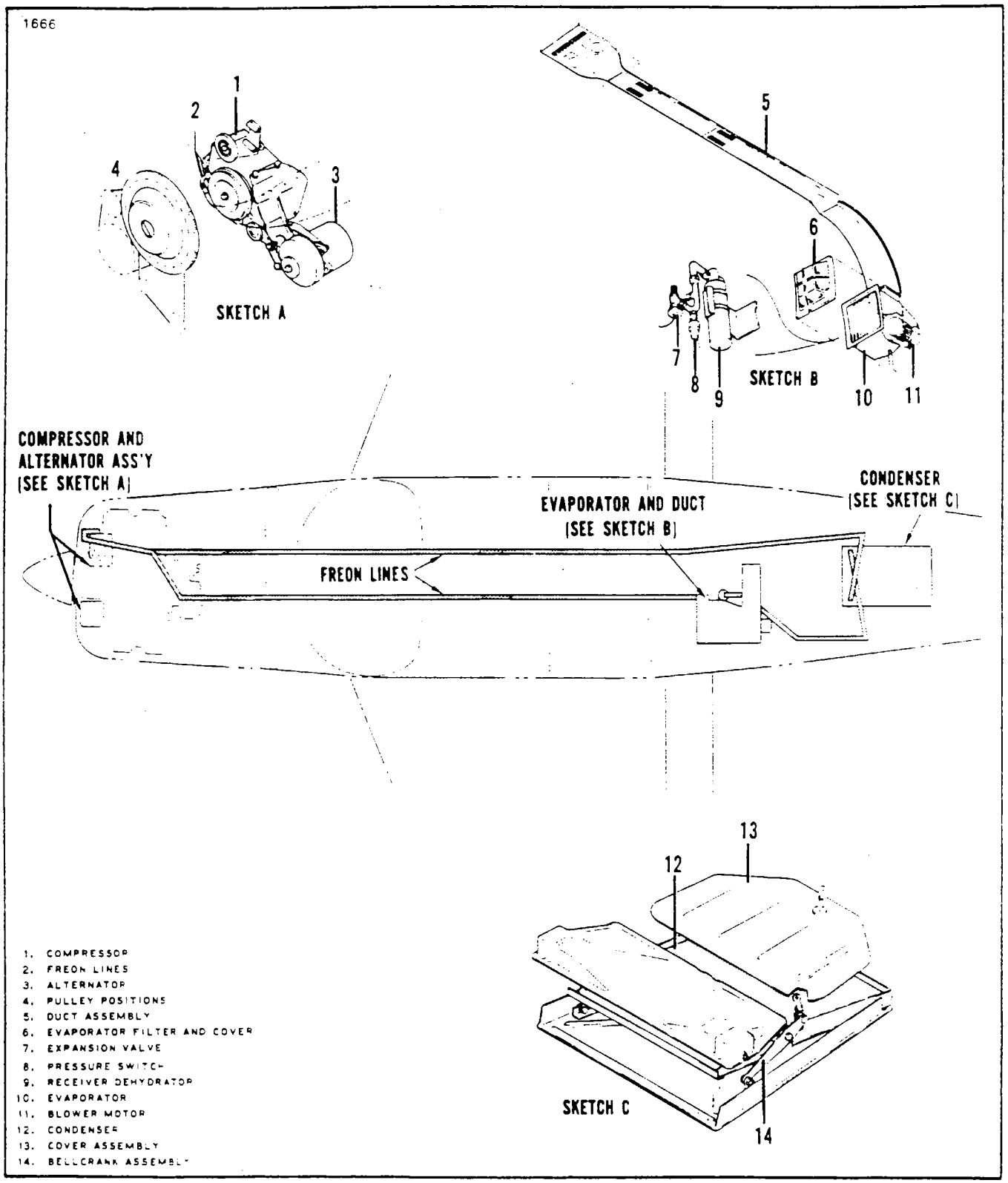


Figure 13-1. Air Conditioning System Installation

NOTE

A table at the end of these instructions will assist in locating and correcting malfunctions which may arise in this system.

NOTE

The air conditioning system should be operated at least once a month to prevent sticking valves and keep the system lubricated.

13-4. MALFUNCTION DETECTION. The detection of system malfunction largely depends on the mechanic's ability to interpret the gauge pressure readings into system problems. A system operating normally will have a low side gauge pressure reading that will correspond with the temperature of the refrigerant evaporating in the evaporator, allowing for a few degrees temperature rise due to loss in the tube walls and fins. The high side will have a gauge pressure that will correspond with the temperature of the refrigerant condensing in the condenser, allowing for a few degrees temperature drop due to loss in the tube walls and fins.

Any deviation from that which is normal indicates a malfunction within the system due to a faulty control device, obstruction, defective part, or improper installation.

Detection of system malfunction is made easier with the knowledge that the temperature and pressure of Refrigerant 12 is in close proximity between the pressures of twenty and eighty pounds per square inch (psi). A glance at the temperature-pressure chart will show that there is only a slight variation between the temperature and pressure of the refrigerant in the lower range.

It is correct to assume that for every pound of pressure added to the low side, a temperature increase of about one degree Fahrenheit takes place. For instance, a pressure of 23.8 on the chart indicates a temperature of 24°F. A change of pressure of almost one pound to 24.6 psi gives us a temperature increase to 25° F.

NOTE

For each 1,000 feet of elevation above sea level, the gauge readings will be about one inch of mercury or 1/2 psi higher than the chart indicates.

It must be pointed out that the actual temperature of the air passing over the coils of the evaporator will be several degrees warmer allowing for a temperature rise caused by the loss in the fins and tubing of the evaporator.

The importance of a seasonal check up of the air conditioning system should be brought to the attention of the customer whenever possible. A thorough check of the system performed in a methodical manner will reveal trouble the customer is often not aware of.

TABLE XIII-I. TEMPERATURE PRESSURE CHART

Evaporator Pressure Gauge Reading p.s.i.	Evaporator Temperature °F.	High Pressure Gauge Reading p.s.i.	Ambient Temperature °F.
0	-21	72	40
2.4	-15	86	50
4.5	-10	105	60
10.1	2	109	62
11.2	4	113	64
12.3	6	117	66
13.4	8	122	68
14.6	10	126	70
15.8	12	129	71
17.1	14	132	72
18.3	16	134	73
19.7	18	137	74
21	20	140	75
22.4	22	144	76
23.1	23	148	77
23.8	24	152	78
24.6	25	156	79
25.3	26	160	80
26.1	27	162	81
26.8	28	165	82
27.6	29	167	83
28.4	30	170	84
29.2	31	172	85
30	32	175	86
30.9	33	177	87
31.7	34	180	88
32.5	35	182	89
33.4	36	185	90
34.3	37	187	91
35.1	38	189	92
36	39	191	93
36.9	40	193	94
37.9	41	195	95
38.8	42	200	96
39.7	43	205	97
41.7	45	210	98
43.6	47	215	99
45.6	49	220	100
48.7	52	228	102
49.8	53	236	104
55.4	57	260	110
60	62	275	115
64.9	66	290	120

Locating and repairing the trouble early will usually result in savings to the customer both in time and additional troubles that too often result from neglect.

A Performance Test of the system is the only positive way in which the complete system can be checked for efficient operation. The air conditioning system should be given this test before work is begun on the system whenever possible, however, if the system is completely inoperative, repairs must be performed before the system can be properly tested. The test can uncover further work that must be performed before the system is brought to its full operating efficiency. The Performance Test should always be performed after repair work has been done and before the aircraft is released to the customer. The serviceman performing this test carefully will insure that the repairs have been properly performed and that the system will operate satisfactorily.

The Performance Test when properly performed includes a thorough examination of the outside of the system as well as the inside. Many related parts are overlooked because it is felt they are of no bearing on the operating efficiency of the unit. For this reason, a thorough visual inspection of the complete system should be performed, followed by an operating inspection of the system.

13-5. SPECIAL SERVICING PROCEDURES. The air conditioning system should be serviced by a qualified shop with trained personnel. The following procedures and precautions should be observed.

The efficiency of this system depends upon the pressure-temperature relationship of pure refrigerant. As long as the system contains only pure refrigerant plus a specified amount of compressor oil (which is mixed with the refrigerant), it is considered to be chemically stable. Foreign materials within the system will affect the chemical stability, contaminate the system, and decrease its efficiency.

I. GENERAL REFRIGERATION SYSTEM PROCEDURES.

A. REFRIGERANT SAFETY PRECAUTIONS.

1. Refrigerant 12 (commonly known as R-12 or "Freon" 12) is odorless and colorless in either the liquid or gaseous state. R-12 for charging refrigeration systems is supplied in pressurized containers (approx. 70 psi at 70 ° F) in liquid form. Since this material is essentially inert at room temperatures the dangers are primarily associated with the pressure and the refrigeration effects of the release and subsequent evaporation of this pressurized liquid.
2. Wear suitable eye protection when handling R-12 due to the possibility of freezing of the eye if contacted by escaping liquid refrigerant. If liquid R-12 does strike the eye, the following actions should be taken:
   a. DO NOT RUB THE EYE.
   b. Splash large quantities of cool water into the eye to raise the temperature.
   c. Tape on an eye patch to avoid the possibility of dirt entering the eye.
   d. Rush to a physician or hospital for immediate professional aid.
   e. DO NOT ATTEMPT TO TREAT IT YOURSELF.
3. If liquid R-12 strikes the skin frostbite can occur. Treat with cool water and protect with petroleum jelly.
4. Do not discharge large quantities of R-12 into closed rooms. It may displace most of the air in the room and this could cause oxygen starvation. Gaseous R-12 is heavier than air and flows to the bottom of a container.

5. Do not discharge R-12 into an open flame or onto a very hot surface (500°F+). Poisonous phosgene gas is generated by the action of the heat on the refrigerant.
6. Do not apply direct flame or other high heat source to a R-12 container due to the high pressures which will result. If any heating is done to R-12 containers the container pressure should be monitored and kept below 150 psi.

B. SYSTEM SERVICING PRECAUTIONS.

1. Systems should be discharged slowly to prevent the escape of liquid refrigerant and the loss of the lubricating oil.
2. Systems should not be left open to the atmosphere when discharged. Moisture and other contamination may enter and damage open systems.
3. Never introduce anything but pure refrigerant and refrigerant oil into a system.
4. Keep refrigerant oil containers tightly sealed and clean to prevent absorption of moisture or other contamination.
5. Use only approved refrigeration oil in the compressor. If any doubt exists about the cleanliness of the compressor oil, replace it with new oil.
6. Never reuse oil removed from the system. Discard it.
7. When Loctite Refrigerant Sealant has been used on a joint it must be heated to 400°F prior to disassembly. Loctite must be used to seal any pipe threads in the system lines.
8. Replace the receiver-dehydrator assembly on any system which has been operating with a leak allowing air to enter the system. If a receiver-dehydrator is left open to the atmosphere it should be replaced due to the loss of effectiveness of the drying compound it contains.

NOTE

A very strong acid (HCL) is formed when R-12 comes in contact with moisture.

A new receiver-dehydrator should be opened and connected to the system only when ready to charge the system with refrigerant.

9. Recommended torque values must be used on all flare fitting and O-ring joints. See Table XIII-II.

TABLE XIII-II. ALUMINUM TUBING TORQUE

Metal Tube O.D.	Thread and Fitting Size	Alum. Tubing Torque
1/4	7/16	5-7 ft. lbs.
3/8	5/8	11-13 ft. lbs.
1/2	3/4	15-20 ft. lbs.
5/8	7/8	21-27 ft. lbs.
3/4	1-1/16	28-33 ft. lbs.

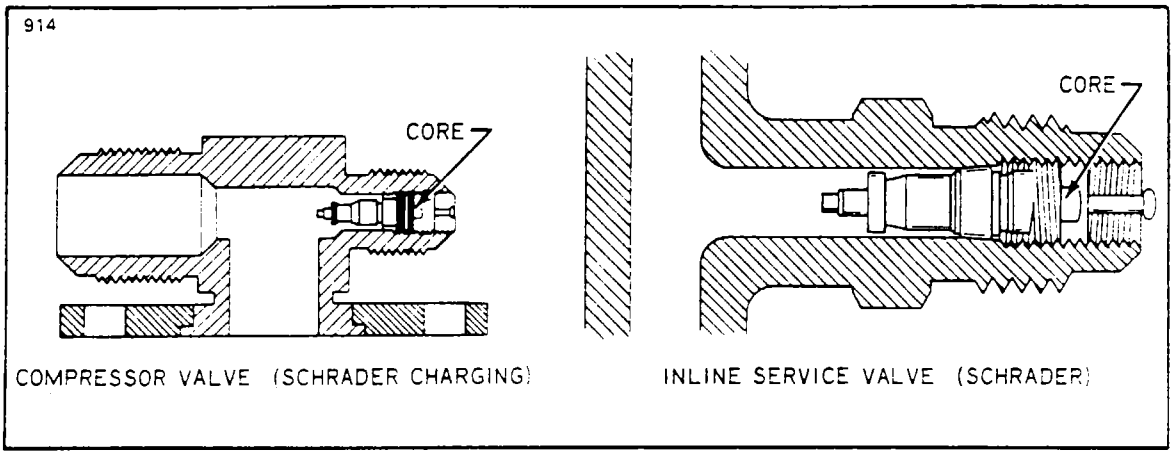


Figure 13-2. Service Valves

13-6. SERVICE VALVES. The purpose of the service valve is to service the air conditioning system. (Testing, Bleeding, Evacuating and Charging). This aircraft is equipped with service valves mounted in the suction and discharge lines of the evaporator assembly. These valves are the "2" position type Schrader valves. All normal air conditioning service should be performed at the evaporator assembly mounted valves.

NOTE

Service valves are also located on the compressor. However, use of these valves in servicing is not recommended.

NOTE

If a Schrader service valve is not serviceable, the core assembly must be replaced.

13-7. SERVICE VALVE REPLACEMENT. The valves on the compressor are sealed with a gasket placed in the valve port boss. Lubricate the gasket with refrigerant oil of the type used in the compressor, place the valves with the tube fitting facing aft and secure with .312 bolts, torque to 15-23 inch pounds.

NOTE

Whenever the air conditioning refrigerant lines or system is opened for any reason, the lines and fittings should be capped and sealed immediately to prevent dirt and other contaminants from entering the system. (It is not advisable to put a plug into the hoses or fittings.)

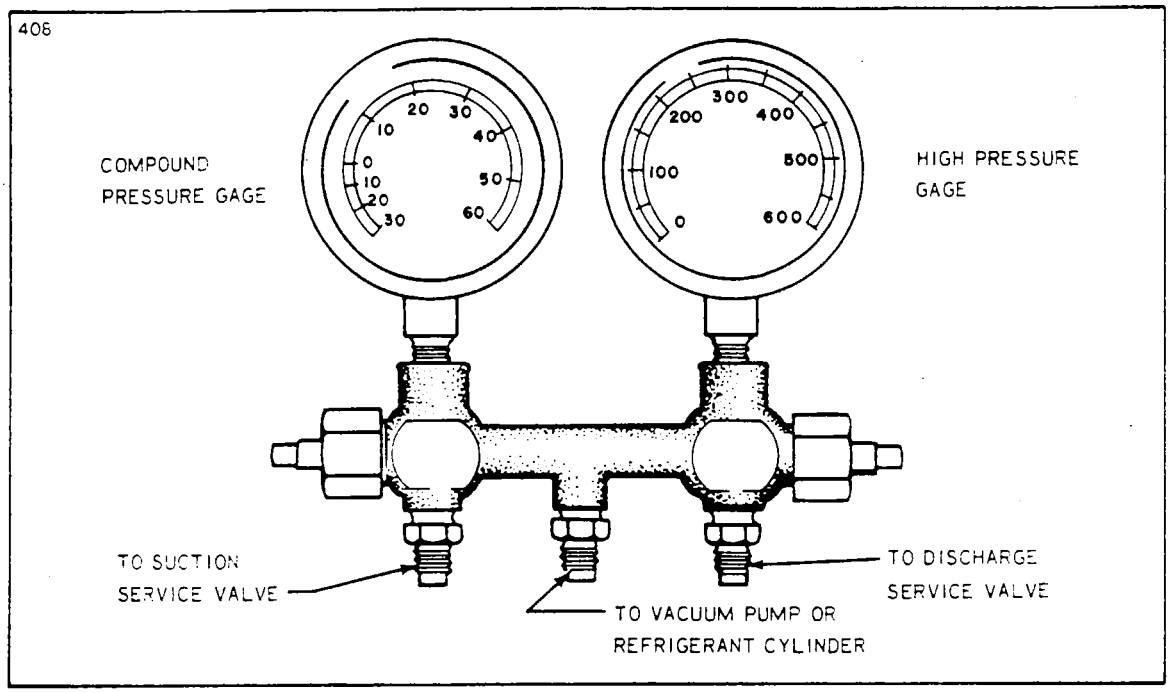


Figure 13-3. Test Gauge and Manifold Set

13-8.. TEST GAUGE AND MANIFOLD SET. The proper testing and diagnosis of the air conditioning system require that a manifold gauge set be attached into the system. This set consists of two gauges mounted to a manifold. One gauge is a high pressure gauge used in the discharge side of the system. The other is a low pressure gauge used in the suction side of the system. The manifold is a device having fittings for both gauges and connection hoses with provisions for controlling the flow of refrigerant through the manifold. See Figures 13-3 and 13-4.

The center port of the manifold set is used for charging or evacuation procedures, or any other service that may be necessary.

Both the high and low side of the manifold have hand shut-off valves. When the hand valve is turned all the way in, in a clockwise direction, the manifold is closed. The pressures on that side of the system will, however, be recorded on the gauge above the hose.

Cracking the hand valve, in the counterclockwise direction, opens the system to the middle service port of the manifold set. This is desirable only when it is necessary to let refrigerant out or into the system. Refer to Figures 13-3 and 13-4.

13-9. CHECKING THE SYSTEM FOR LEAKS. There are several methods of doing this operation, depending on the type of equipment which is available. Two methods of performing this check will be covered in the following paragraphs.

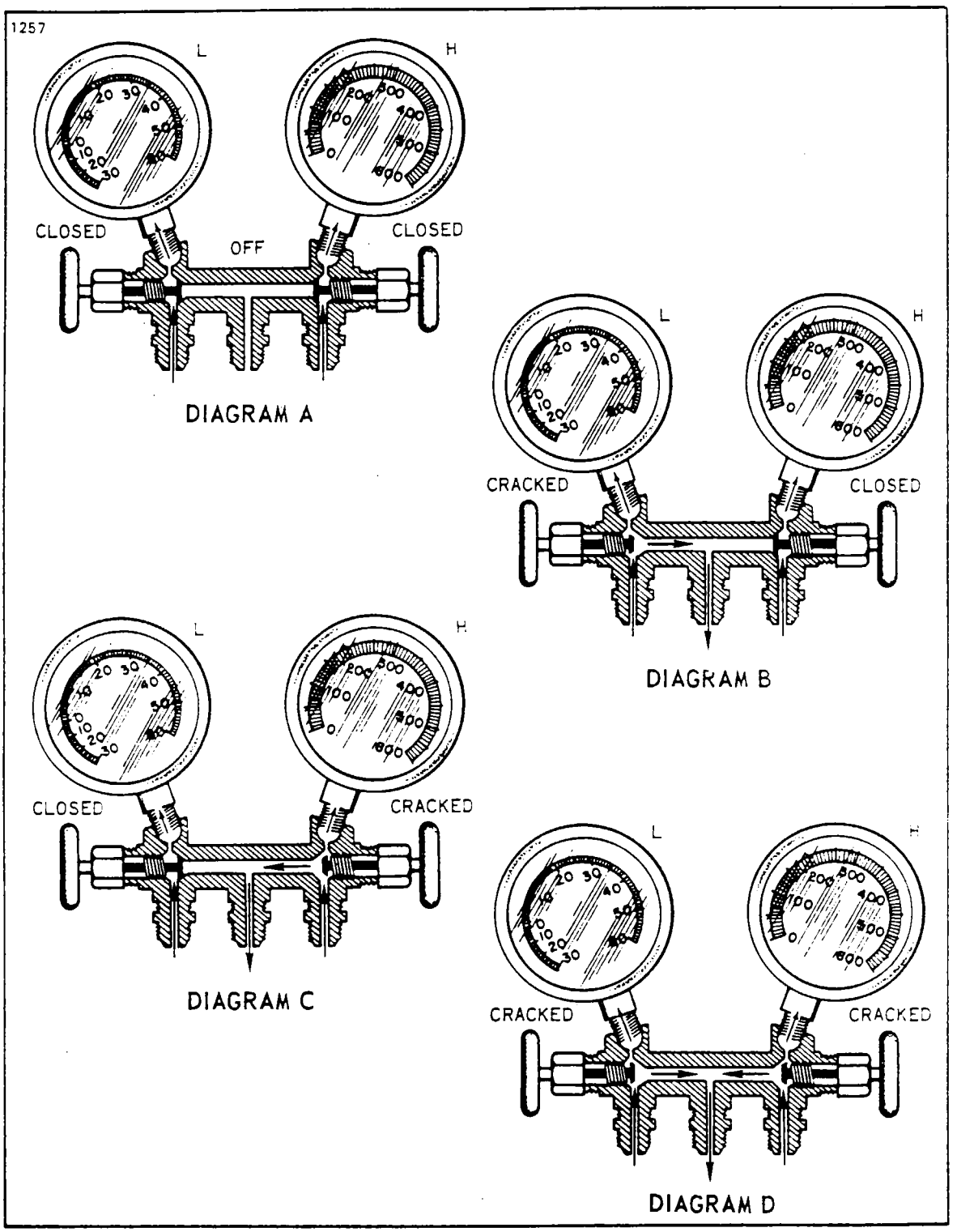


Figure 13-4. Manifold Set Operation

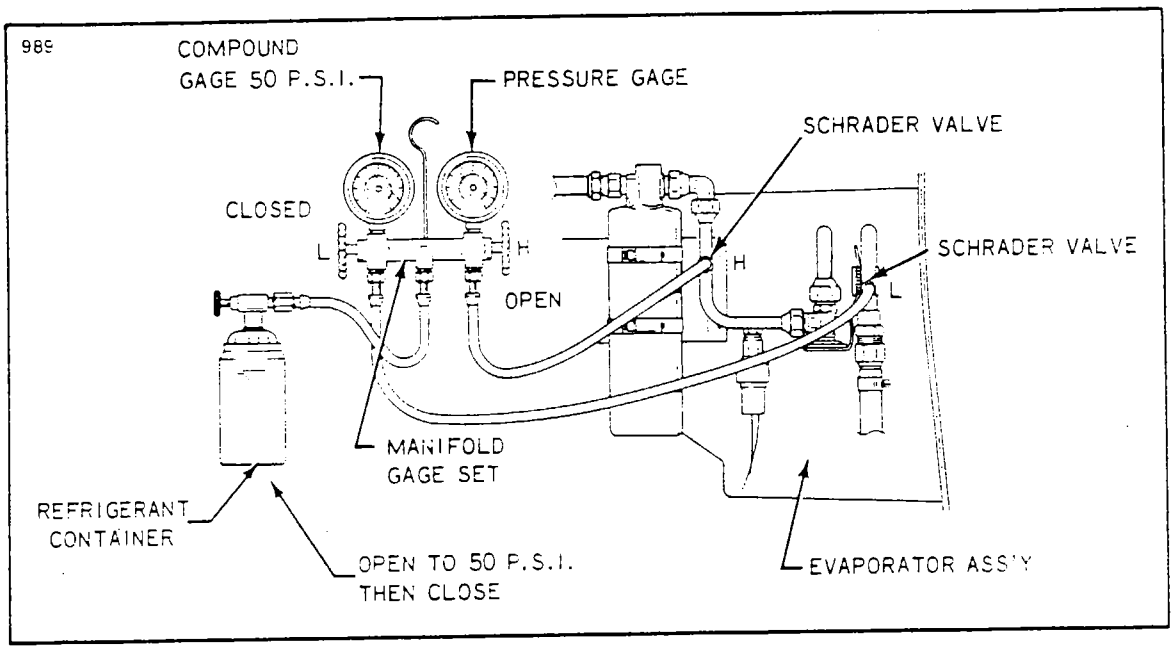


Figure 13-5. Leak Test Hookup

NOTE

Evacuate system prior to leak check.

13-10. LEAK CHECK - METHOD I.

a. Connect the manifold gauge set into the system and determine if there is any refrigerant in the system. A minimum of 50 psi refrigerant pressure in the system is needed for leak detection. (Refer to Figure 13-5.)

b. Purge the hoses of air by allowing some refrigerant to escape from the connections at the service valves. Then tighten connections at the service valve.

c. Close the low side manifold valve and open the high side manifold valve.

d. Open the refrigerant container service valve and allow the pressure at the low side gauge to reach 50 psi at which time close the high side manifold valve.

e. Close the refrigerant container service valve and remove the hose if no leaks are evident.

f. It is advisable to use an electronic leak detector to check this system instead of an open flame leak detector due to the possible presence of gasoline fumes in the engine area.

g. If any leaks are found, purge the system of refrigerant, make the necessary repairs and check the compressor oil.

h. Add oil, if required, (refer to Paragraph 13-21 and Table XIII-III) then repeat steps a thru e.

i. If no further leaks are found, the system may be evacuated and charged. Refer to Paragraphs 13-13 and 13-14.

13-11. LEAK CHECK - METHOD II.

a. Remove the access panel at the rear of the cabin to gain access to the service valves.

b. Remove the protective cap on the high pressure Schrader valve fitting and connect a charging hose with a shut-off valve arrangement to the fitting. The charging hose must have a Schrader fitting or adapter to fit the valve.

c. Connect the other end of the charging hose to a small cylinder of refrigerant and purge the hose by allowing a slight amount of refrigerant gas to escape from the Schrader valve fitting.

d. The cylinder of refrigerant should be placed upright in a container of warm (125° F max.) water on a small scale.

e. Allow approximately 1/2 pound of refrigerant to enter the system by opening the valve on the charging hose and observing the weight change on the scale.

f. Using an electronic leak detector, check all joints and repair any leaks.

g. After completion of repair of any leaks, proceed to check the system in accordance with one of the methods outlined for any other leaks.

h. If no further repair is required on the system, it is now ready to evacuate in accordance with paragraph 13-13.

13-12. DISCHARGING. (Required only if system contains refrigerant.)

NOTE

Applies to Kent Moore J23500 or similar charging station. Refer to Figure 13-7.

a. Close all valves on charging station.

b. Connect red high pressure charging line to high pressure Schrader valve at the evaporator fitting.

c. Open valve (high pressure control) on charging station one turn.

d. Hold end of blue low pressure charging line in a shop rag and slowly open valve (low pressure control) on charging station allowing refrigerant to exhaust from system into shop rag.

CAUTION

Refrigerant can cause freezing of skin. Be particularly careful not to allow contact with the eyes.

Do not allow refrigerant to escape too rapidly, as excessive oil may be carried out of system. When hissing stops, system is empty and valve should be closed if no further work is planned.

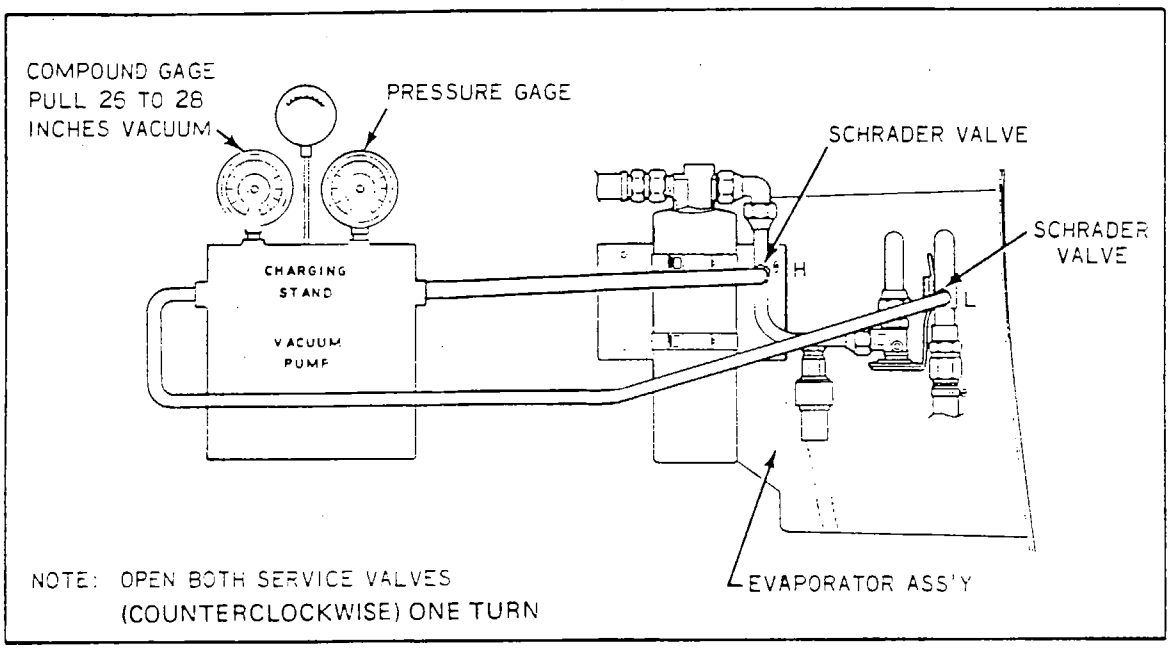


Figure 13-6. Evacuation Hookup

13-13. EVACUATING THE SYSTEM. If the system has been operated in a discharged condition or anytime the system has been open to atmospheric pressure, the receiver-dehydrator must be replaced and the system evacuated to remove any trapped air and moisture which has entered it. A vacuum pump capable of pulling 29 inches of mercury or better should be used. As we lower the pressure in the air conditioning system, we lower the boiling temperature of the water (moisture) that may be present. Then we are able to pull this water, in the form of vapor, out of the system. The following table demonstrates the effectiveness of moisture removal under a given vacuum.

	System Vacuum	Temperature °F.
COMPOUND GAUGE READING IN INCHES OF MERCURY VACUUM	27.99	100
	28.89	80
	29.40	60
	29.71	40
	29.82	20
	29.88	0

NOTE

For each 1,000 feet of elevation above sea level, the compound gauge reading will be about one inch lower, numerically.

The following steps should be of help when performing this operation.

a. Remove access panel at the rear of the cabin to gain access to the Schrader service valves.

CAUTION

Ascertain that all system pressure is released before attempting the evacuation. (Refer to Paragraph 13-5.)

b. Connect the manifold gauge set to the airplane service valves. (Refer to Figure 13-6.)

c. The high and low manifold hand valves should be in the closed position. (Refer to Figures 13-3 and 13-4.)

d. Connect the center manifold hose to the inlet of the vacuum pump.

NOTE

Make sure the exhaust port on the vacuum pump is open to avoid damage to the vacuum pump.

e. Start the vacuum pump and open the low side manifold hand valve. Observe the compound, low pressure gauge needle, it should show a slight vacuum.

f. Continue to operate the vacuum pump until 26 to 28 inches of vacuum is attained on the low pressure gauge, then extend the operation for another 25 minutes.

g. If the system cannot maintain 26 to 28 inches of vacuum, close both manifold hand valves and observe the compound gauge.

h. Should the compound gauge show a loss of vacuum, there is a leak in the system which must be repaired before continuing with evacuation.

i. If no leaks are evident, reopen both manifold hand valves and continue the evacuation for another 30 minutes.

j. Close both manifold hand valves, stop vacuum pump and disconnect center manifold hose from the vacuum pump.

k. Proceed to charge the system in accordance with paragraph 13-14.

NOTE

The system should be charged as soon as it has been evacuated.

13-14. CHARGING THE SYSTEM. When the system is completely evacuated in accordance with instructions given in paragraph 13-13, one of the following procedures should be used to charge the system.

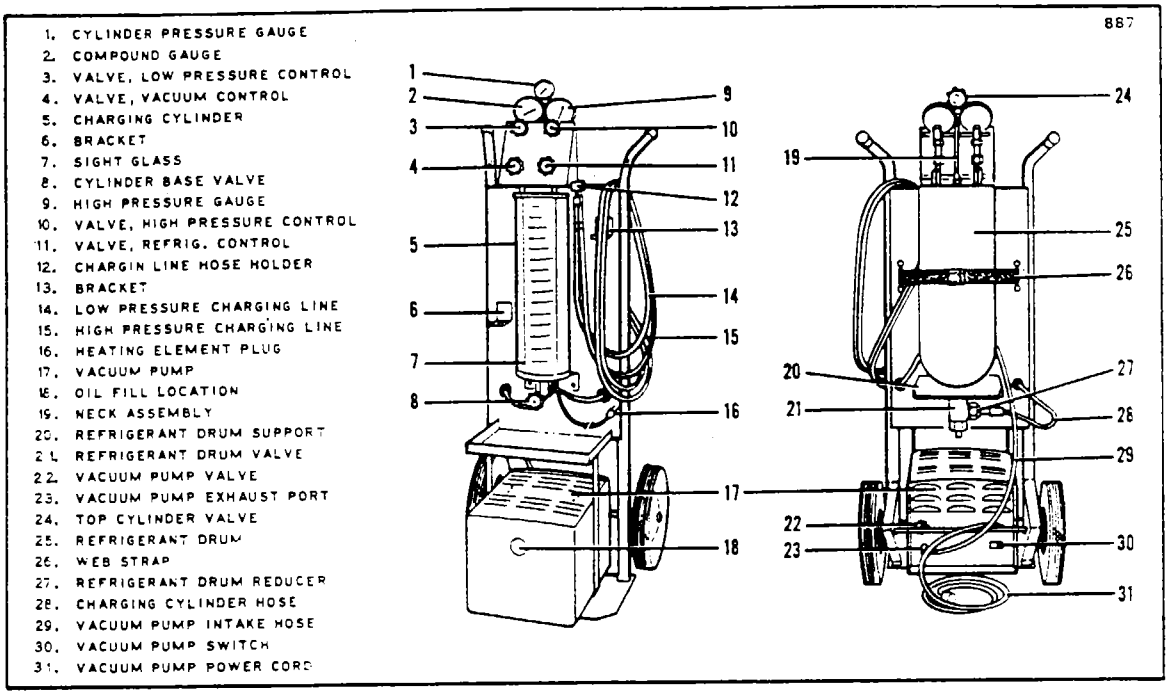


Figure 13-7. Charging Stand

13-15. WITH A CHARGING STAND. This is the preferred method of charging the system.

NOTE

The following instructions apply to Kent Moore, J23500 charging stand. Refer to Figure 13-7.

a. With the system discharged and evacuated, proceed to hook-up the charging stand. (Refer to Figure 13-8.)

b. Fill the charging cylinder by opening the valve at the base of the charging cylinder and filling the sight glass with two pounds of liquid refrigerant.

c. If refrigerant stops filling the sight glass, open the valve at the top of the gauge neck assembly intermittently to relieve head pressure and allow refrigerant to continue filling the sight glass to the required amount.

d. When refrigerant reaches the required level in the sight glass, close both the valve at the base of the cylinder and the valve at the bottom of refrigerant tank. Be sure the top valve is fully closed.

NOTE

If bubbling occurs in sight glass, reopen the cylinder base valve momentarily to equalize drum and cylinder pressure.

e. Connect the heating element plug to a 110 volt outlet.

f. Turn cylinder sight glass to match pressure reading on cylinder pressure gauge, this scale should be used during entire charging operation.

g. Close valve (low pressure control), fully open valve (refrigerant control) and allow all liquid refrigerant contained in the charging cylinder to enter high side of aircraft system.

h. When the full charge of refrigerant has entered the system, close valve (refrigerant control) and valve (high pressure control).

i. After completion of charging, close all valves on the charging stand. Disconnect the high and low pressure charging lines from the aircraft system. (A small amount of refrigerant remaining in the lines will escape.) Replace lines on holder of charging stand to keep air and dirt out of lines. Open the valve at the top of cylinder to relieve any remaining pressure, then reclose the valve.

j. Reinstall protective caps of Schrader valves and any access panels previously removed.

13-16. USING THE AIRPLANE COMPRESSOR TO CHARGE THE SYSTEM. This method is the least desirable due to the requirement of operating the airplane's engine to run the compressor.

CAUTION

Ascertain that the area around the airplane is clear and a qualified person is at the controls of the airplane.

a. With the system evacuated as outlined in paragraph 13-13, connect the refrigerant charging hose to the manifold (refer to Figure 13-8) and purge the charging hose of air.

b. Place the refrigerant container on a scale to observe the amount of refrigerant entering the system. Open the high pressure valve and add as much refrigerant as possible.

c. Close the high pressure valve, start the engine and operate it at 900 to 1000 RPM with the airplane heading into the wind.

d. Operate the air conditioner and set controls to maximum cooling.

e. Open the low pressure valve and complete charging the system.

f. Close the low pressure valve after two pounds of refrigerant have been added to the system.

g. With the system still operating, observe the sight glass in the top of the receiver-dehydrator by removing the plastic plug.

h. The sight glass should be clear of any bubbles or foam. If bubbles or foam are seen passing through the sight glass, it is an indication of a low refrigerant charge in the system and more refrigerant is required. This check should be made with OAT of 70° F or higher and with the air conditioner operating.

i. If more refrigerant must be added to the system, open the low pressure valve and increase engine speed to 2000 RPM and observe the sight glass. After the sight glass has cleared, close the low pressure valve and observe the pressure gauges. At 1000 RPM the gauge pressure should be 15 to 20 psi on the low side and 150 to 200 on the high side.

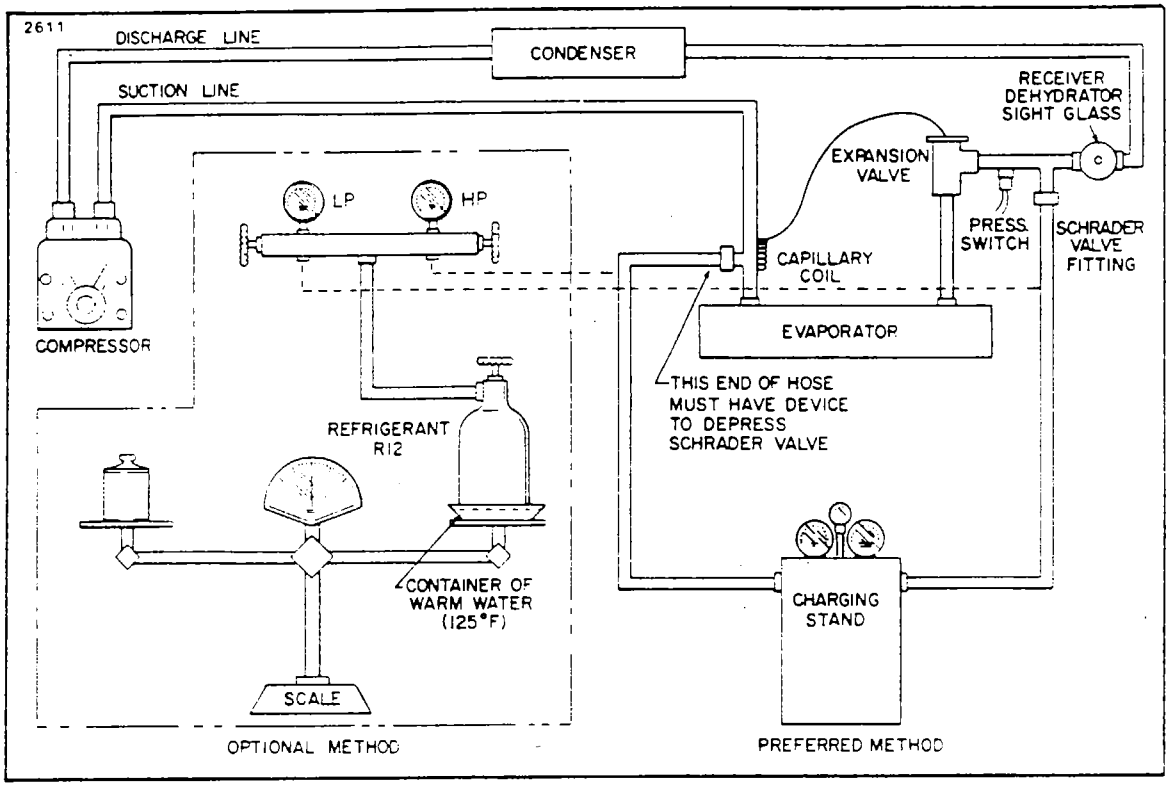


Figure 13-8. Charging Hookup

NOTE

Suspect leaks or an inaccurate scale if two pounds of refrigerant does not fill the system.

j. Shut off the air conditioning system and airplane engine. Then, remove the charging lines from the Schrader valves with care due to the refrigerant remaining in the hose.

NOTE

A shop cloth should be used to divert escaping refrigerant when disconnecting the charging hose from the Schrader valve. Recap the valve.

13-17. ADDITION OF PARTIAL CHARGE TO SYSTEM. It is possible to top off this system with refrigerant by the following method.

a. Remove the access panel at the rear of the cabin.

b. Connect a charging hose to a refrigerant cylinder and also to the Schrader valve fitting on the suction line. (Refer to Figure 13-8.)

c. Purge the charging hose by allowing a small amount of refrigerant gas to escape at the Schrader valve fitting.

d. Start the engine and operate at 1000 RPM and turn the air conditioner on maximum cool.

e. Remove the plastic plug from the sight glass in the top of the receiver-dehydrator.

f. With a low refrigerant charge in the system, bubbles will be seen passing thru the sight glass when the system is operating.

g. Open the valve on the refrigerant cylinder.

h. Allow refrigerant to flow into the system until the bubbles disappear from the sight glass.

i. Close the refrigerant valve and check to see that the sight glass remains clear during system operation.

j. When the sight glass stays clear of bubbles, add an additional 1/4 pound of refrigerant to the system. (Engine should be operating at 1000 RPM.)

NOTE

This should be done with OAT at 70° F, or higher, with the air conditioner operating.

k. Shut off the air conditioner and engine. Remove the charging hose from the Schrader valve with care due to refrigerant remaining in the line.

l. Replace the access panels.

13-18. COMPRESSOR SERVICE. It is not advisable to service the compressor in the field. It should be done by a qualified shop which has the special equipment and trained personnel required to properly service the unit.

Maintenance to this unit and its related components is limited to the replacement of worn drive belt and magnetic clutch. Any other service requires removal of the compressor from the system.

NOTE

An important factor in air conditioning servicing is cleanliness and care should be exercised to prevent dirt or foreign material from entering the system. All hose and tubing ends should be capped immediately. Any lubrication required in the assembly of the components should be refrigerant oil of the type used in the compressor.

13-19. COMPRESSOR REMOVAL. The removal of the compressor requires a complete system discharge. (See Paragraph 13-12.)

a. Be certain the circuit protector is off for the air conditioning system.
b. Remove the engine cowling and right front baffles.
c. Disconnect the electrical leads to the magnetic clutch on the compressor.
d. Depressurize the air conditioning system.
e. Remove the suction and discharge lines from the service valves on the compressor.

NOTE

All open lines should be capped immediately to prevent dirt and moisture from entering the system.

f. Loosen the bolt securing the compressor idler pulley to release the belt tension and remove belt from compressor pulley. (Do not force belt over the pulleys.)
g. Support the compressor and remove the 6 bolts securing the compressor to the engine mounting brackets.

13-20. COMPRESSOR INSTALLATION.

a. Place the compressor to the mounting brackets. Install the six bolts and progressively torque to 13-17 ft. pounds. (Safety all bolts with .032 safety wire.)
b. Check the oil level in the compressor in accordance with instructions given in paragraph 13-21.
c. Place drive belt over clutch pulley and adjust the alignment of the pulleys and belt in accordance with instructions given in paragraph 13-22.

CAUTION

Do not force the belt into the pulley sheave. If necessary, remove the idler assembly.

d. Connect the discharge and suction lines to their respective service valve fittings.
e. Evacuate and charge the system per paragraphs 13-13 and 13-14.

WARNING

If the air conditioner is to be operated on the ground for servicing, the test area should be clean and free of any loose objects lying on the ramp. Only the service valves located on the evaporator assembly should be used for testing.

13-21. CHECKING COMPRESSOR OIL. The oil level should be checked any time the system is discharged. The following steps should be followed to perform this check:

a. It will be necessary to discharge the system. (Refer to Paragraph 13-12.)

b. Fabricate an oil dipstick. (Refer to Figure 13-9.)

c. Remove the oil fill plug. (A .375 inch plug in the top side of the compressor crankcase.)

d. Before inserting the dipstick, the crankshaft Woodruff key should be located in the up position. (The front face of the compressor clutch is marked with a stamped "K" indicating the key position.) The oil level should be measured from the lowest point in the crankcase. Use the long end of the dipstick. (See Figure 13-9.)

e. With the compressor in the installed position use Table XIII-III to determine the amount of oil in the crankcase.

f. The compressor should never be operated with less than 6 ounces of oil. When oil is added the level should not go above 12 ounces. Suniso No. 5, Texaco Capellae, Texaco Capallae (wax-free), Napa Temp. Refrigerant Oil No. 9500 or equivalent 500 viscosity refrigerant oil must be used.

g. Reinstall the oil fill plug. Insure that the sealing O-ring is not twisted when slipping it over the oil fill plug threads. Insert and tighten the plug. If it leaks, do not attempt to stop the leak by overtightening the plug. The leak may be caused by dirt under the O-ring or on the seat, a fractured O-ring or a damaged seat on the oil fill plug or oil fill opening. To stop the leak correct the mechanical damages and insert a new O-ring.

h. Evacuate and charge system. (Refer to Paragraphs 13-13 and 13-14.)

NOTE

The 10 ounce oil level is required in compressors installed on new systems. Some oil is distributed in the system during operation. Replacement compressors should be charged with 10 ounces of oil.

CAUTION

The oil plug should not be removed with pressure in the system.

TABLE XIII-III. COMPRESSOR OIL CHARGE

Oil Charge Ounces Dipstick Reading Inches	6 13/16"	8 1.00"	10 1-3/16"	16 1-15/16"

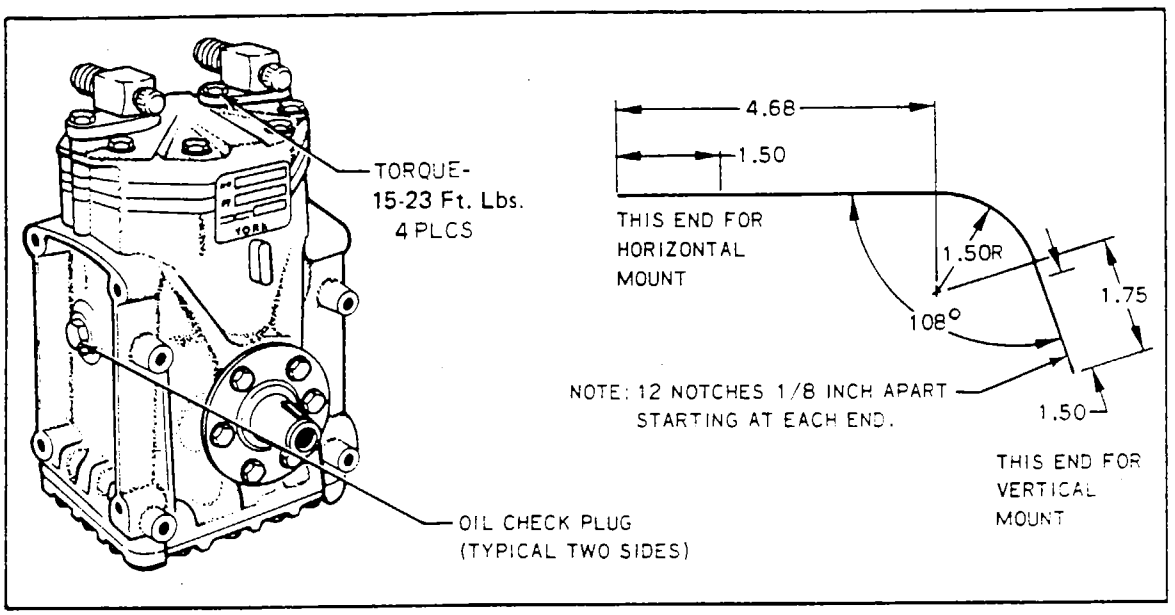


Figure 13-9. Compressor And Fabricated Oil Dipstick

13-22. REPLACEMENT OF COMPRESSOR AND/OR ALTERNATOR DRIVE BELTS. (Refer to Figure 13-10.)

a. Remove the old belts by removing the spinner, propeller, nose cowl, right front baffle, starter ring gear assembly and drive belts.

b. Place the new belt or belts in their appropriate positions on the starter ring gear sheaves.

c. Reinstall the starter ring gear assembly, propeller and spinner.

d. Route the belts to the proper pulley sheaves as shown in Figure 13-10.

CAUTION

Do not force the belts into the pulley sheaves. Remove the idler assemblies, if necessary, and the alternator lower mounting bolts in order to install the belts.

e. Check the belt and pulley alignment of the compressor and/or alternator by the following method:

1. A datum line must be established for checking belt and pulley alignment. A nominal dimension must be established between the forward edge of each belt and the forward machined surface of the ring gear. This dimension should be taken at the ring gear assembly where the belts are in their sheaves. The amount of misalignment can then be determined at the other pulley sheaves by using a stiff straightedge of sufficient length to extend from the front of the ring gear to the component sheaves.

NOTE

Insure adequate ring gear surface contact to provide a solid base for the straightedge.

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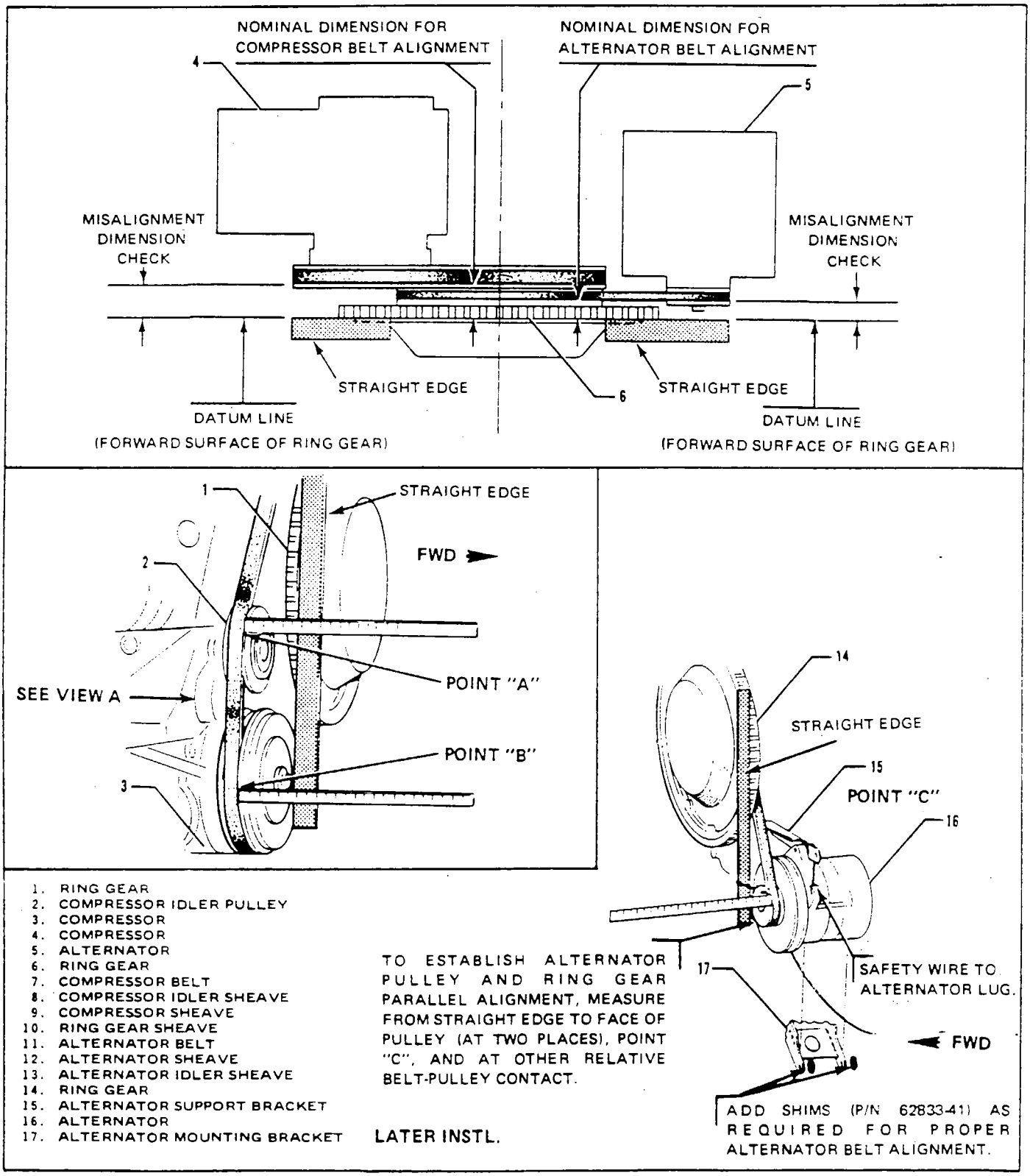


Figure 13-10. Compressor and Alternator Belt Installation

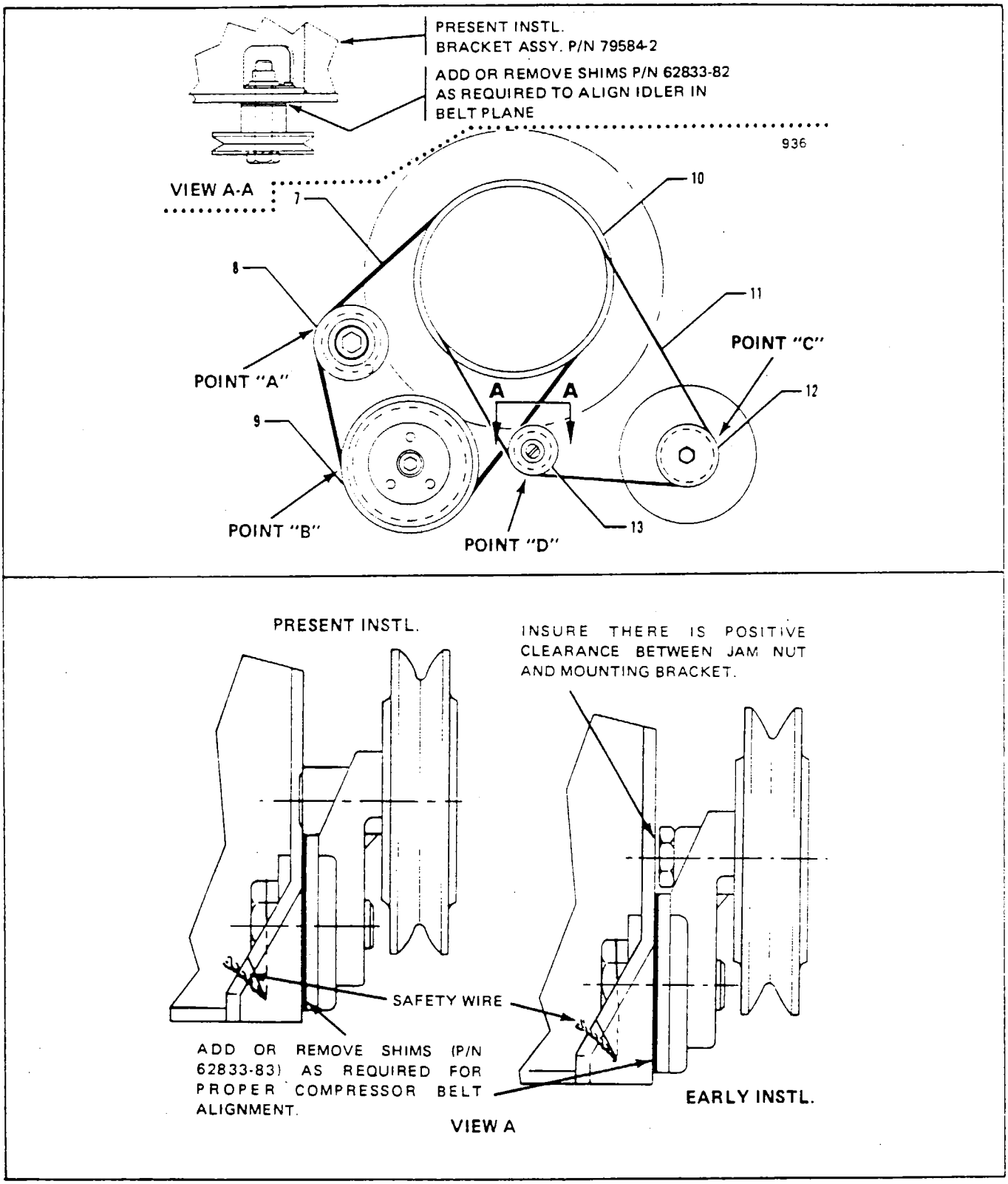


Figure 13-10. Compressor and Alternator Belt Installation (cont.)

2. Obtain a basic measurement from the top of the ring gear by measuring the width of the starter ring gear plus the dimension from the forward machined surface of the ring gear to the forward edge of the compressor or alternator (on early installations) drive belt. (Refer to Figure 13-10.)

3. The check and adjustments of the compressor and/or alternator drive belts require different procedures. Refer to following appropriate instructions.

f. Compressor Belt Alignment: (Refer to Figure 13-10.)

1. Place the straightedge against the right forward side of the ring gear and measure belt alignment at compressor sheave (Point-B).

2. Measure belt alignment at the compressor idler pulley (Point-A). The belt misalignment at Point-A should be half the misalignment of Point-B and the dimension at the top of the ring gear and in the same direction fore and aft.

3. If at Point-A nominal misalignment is not within ± .030 of an inch, as obtained from step 2 add or remove shims as required. Belt alignment should be made as close to nominal as shims will allow.

4. On earlier installations, insure that there is a positive clearance between the jam nut on the idler pulley shoulder bolt and the face of the mounting bracket. Refer to paragraph 13-23 for belt tension adjustment. No jam nut is used on newer idler pulley bracket.

g. Alternator Belt Alignment - Early Installations: (Refer to Figure 13-10.) On early installations there are no provisions for shimming the alternator and/or the alternator idler pulley in the forward direction. On later installations, shims can be transferred as required from forward or aft of the alternator mounting lugs to achieve alignment. If shimming is required, insure that the alternator mounting bolts are of adequate length. For present installations which incorporate the new bracket assembly, P/N 79584-02, proceed to step h. Older installations must still follow steps 1 thru 5 until the new bracket is used:

1. Place the straightedge against the left forward side of the ring gear and measure belt alignment at the alternator pulley sheave (Point-C).

2. If at Point-C nominal misalignment is not within ± .025 of an inch, add or remove shims as required between the alternator mounting bracket and the alternator mounting lugs. (Refer to Figure 13-10.) On later installations, transfer shims as required from forward or aft of the alternator mounting lugs to achieve alignment.

3. On later installations, measure belt alignment at the alternator idler pulley sheave (Point-D). The belt misalignment at Point-D should be halfway between the misalignment of Point-C and the dimension at the top of the ring gear and in the same direction fore and aft. Earlier models provide no means of shimming at the alternator idler pulley, and therefore need not comply with this paragraph.

4. Alternator Pulley Skew: (Refer to Figure 13-10.) The face of the alternator pulley must be parallel to the starter ring gear. If skew (misalignment) is in excess of .015 of an inch, loosen the alternator attachment bolts and adjust the alternator to the minimum skew. Tighten the mounting bolts and safety the support bracket bolt if not already safetied.

5. The belt alignment at the alternator pulley should be made as close as possible to the nominal alignment, and pulley skew is to be held within this alignment. Refer to paragraph 13-23 for belt tension alignment.

h. Alternator Belt Alignment - Present Installation: (Refer to Figure 13-10.)

1. With the alternator belt installed, align the idler pulley in the belt plane by adding or removing shims, P/N 62833-82 as required. Refer to paragraph 13-23 for belt tension adjustment.

13-23. ADJUSTMENT OF DRIVE BELT TENSION. The adjustment of the compressor and/or alternator drive belts is very important to obtain long belt life and proper component operation.

a. Adjust new compressor belt to 120 pounds span tension and new alternator belt to 90-100 pounds span tension. If a plastic-type alternator belt (Gates P/N 8075-1191) is installed, adjust the tension to 65-70 lbs. for a new belt. Use a calibrated belt tension gauge.

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. See Tensions noted below for used belts.

b. Install the right front engine baffle and secure the side engine cowl latches, if previously removed.

c. Run the engine for a 15 minute period at 1200 RPM.

WARNING

If the air conditioner is to be operated on the ground for servicing, the test area should be clean and free of any loose objects lying on the ramp. Only the service valves located on the evaporator assembly should be used for testing.

d. Shut down engine and recheck both belt tensions. If compressor belt tension falls as low as 60 pounds, retension to 80 pounds. If alternator belt tension falls below 50 pounds, retension to 70 pounds. If a plastic-type alternator belt (Gates P/N 8075-1191) is installed, insure that the tension is 35-40 lbs.

e. This tension check should be made at every 100 hours or annual inspection, whichever occurs first.

f. Check all idler and bracket bolts for safety and replace engine cowling.

13-24. MAGNETIC CLUTCH.

13-25. MAGNETIC CLUTCH REMOVAL. (Refer to Figure 13-11.)

a. Remove the self-locking capscrew and washer (1) from the compressor shaft.

b. Insert a 5/8 - 11 UNC-2B bolt in the threaded portion of the hub and tighten. The pressure exerted by the bolt on the end of the compressor crankshaft will force off the rotor pulley assembly (2) without damage to the clutch or compressor.

CAUTION

Do not use a wheel puller on the outer flange of the pulley. This can damage the pulley grooves or clutch bearings.

c. Remove the four bolts securing the field assembly against the compressor bosses and remove the bolts, washers and field assembly.

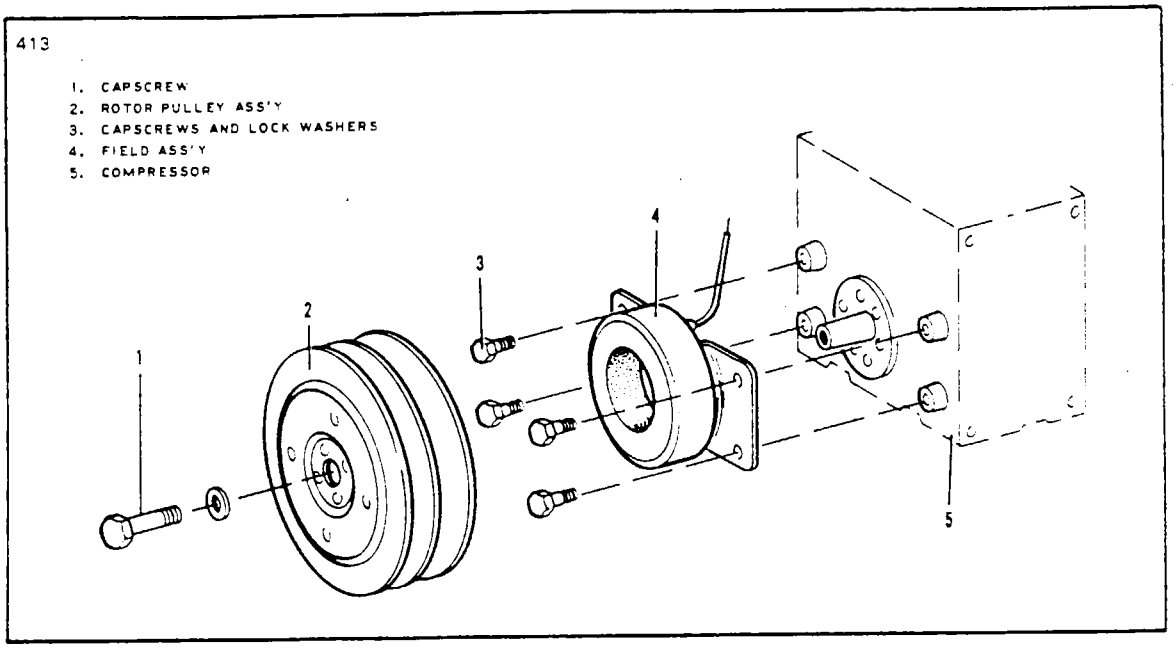


Figure 13-11. Magnetic Clutch

13-26. MAGNETIC CLUTCH INSTALLATION. (Refer to Figure 13-11.)

a. Position the field assembly (4) against the compressor bosses, with the electrical leads to the cylinder side of the compressor.

b. Secure the field assembly (4) with four capscrews and lockwashers (3), do not torque at this time.

c. Connect the electrical lead from the field assembly.

NOTE

The compressor shaft must be clean and free from burrs.

d. Slide the pulley assembly (2) over the field assembly and onto the crankshaft, now torque the field assembly 85 to 120 inch pounds. Then secure pulley assembly with washer and new self-locking capscrew (1). Torque the capscrew to 180 to 240 inch pounds.

NOTE

If the clutch is not engaged while tightening the capscrew, insert a spanner into the holes provided in the armature face.

e. Spin the pulley by hand to check for any interference between the field (4) and rotor pulley assemblies (2). A rubbing noise can be heard as the pulley rotates if there is interference. The rotor pulley assembly must be removed and the mounting of the field assembly adjusted until the interference is eliminated.

13-27. REFRIGERANT LINES AND ROUTING.

The refrigerant lines in this aircraft are flexible high pressure hoses and should be handled accordingly. The hoses in the power plant area are routed so as to provide maximum protection from heat and abrasion. They couple at the firewall to hoses routed through the two inboard, external hat section on the bottom of the fuselage, up thru the floor to the condenser and evaporator in the tail cone. The discharge is in the right hat section and the suction in the left.

NOTE

Before any of the hose couplings are uncoupled, the system must be completely discharged. (See Paragraph 13-12.)

13-28. RECEIVER-DEHYDRATOR.

13-29. RECEIVER-DEHYDRATOR REMOVAL. This unit is mounted on the inboard side of the evaporator assembly housing.

a. Discharge the system of all refrigerant. (See Paragraph 13-12.)
b. Uncouple the refrigerant lines at the receiver-dehydrator. (See Paragraph 13-5, B-7.)
c. Remove the clamp attaching the unit to the evaporator housing.

NOTE

This part is not serviceable, it must be replaced. The receiver-dehydrator should be replaced when the system has been operated without a charge or is left open.

13-30. RECEIVER-DEHYDRATOR INSTALLATION.

a. Slip the mounting bracket around the receiver and put it in place on the evaporator housing with the tube fitting on top. Align the fittings to the proper line before securing the mounting bracket.

NOTE

Torque the fittings (See Table XIII-II)

b. Evacuate and recharge the system in accordance with paragraphs 13-13 and 13-14.

13-31. CONDENSER. The condenser is mounted in a frame assembly located in the bottom of the fuselage between stations 187.00 and 222.00.

13-32. CONDENSER ASSEMBLY REMOVAL.

a. Discharge the system. (See Paragraphs 13-5 and 13-12.)
b. Remove access panel from the aft bulkhead of cabin.
c. Remove the forward cover panel.
d. Uncouple the suction and discharge hoses at the condenser fitting. (See Paragraph 13-5, B-7.) Remove the hose clamps holding the hoses to the condenser frame.
e. Remove the AN-3 bolts from the upper ends of the side hinges and rod ends.
f. Support the condenser assembly and remove the bolt attaching the actuating rod to the condenser assembly.
g. Lower the aft end of the assembly on the piano hinge at the forward end of assembly.
h. Remove the eight screws attaching the piano hinge to the condenser frame assembly and remove from aircraft.
i. To remove condenser core from assembly, remove the screws in the side mounting frame.

13-33. CONDENSER INSTALLATION.

a. Install the condenser core to the frame assembly with the hose fittings forward and up.
b. Place the condenser and frame assembly to the fuselage frame mounting bracket and insert the (8) screws into the piano hinge.
c. Attach the side hinges and actuating rod and rig per paragraph 13-35.
d. Seal and couple the hose fittings (seal with Loctite refrigerant sealant applied to flanges only).
e. Adjust the condenser in accordance with paragraph 13-35.
f. Seal all around forward cover panel (and aft cover panel if removed) with Permagum Bead No. 576 purchased from Prestolite Engineering Company. (See Figure 13-12.)

NOTE

Whenever it is necessary to remove and replace the cabin rear panel, it should be replaced and sealed in the original manner. If it is not, because of the low pressure area in the cabin, exhaust gases may seep into the cabin.

WARNING

Make a carbon monoxide test on ground and in flight with and without the air conditioner operating. Presence of CO shall not exceed 1 part in 20,000.

13-34. CONDENSER DOOR ACTUATOR. The actuator is on a bracket mounted between two bulkheads in the tail cone. It is coupled to the condenser assembly through a bellcrank mounted to a bracket on the bulkhead aft of the condenser. The actuator travel is controlled by two limit switches. Both the up and down switches are located on the actuator. Refer to Figure 13-12 for the switch locations.

13-35. CONDENSER ASSEMBLY RIGGING INSTRUCTIONS. (Refer to Figure 13-12.)

The condenser assembly is actuated by an electric motor through bellcranks, push rods and limit switches.

It is necessary for the condenser door to fit flush with the fuselage skin, and with increased force along the forward edge. The following steps will help accomplish this requirement:

a. Adjust open limit switch (5) to open the condenser door (8) 5.00 ± .50 inches when measured from the leading edge of the door to the fuselage skin.

b. Adjust side push rods so that a vertically measured gap of .16 of an inch exists along the trailing edge of the door at the instant the forward edge of the door becomes flush with the fuselage skin.

c. With the door fully closed adjust the "CLOSED" limit switch (6) so that the actuator (1) travels an additional .12 of an inch after the door is fully closed, this is necessary to preload the mechanism. Refer to Figure 13-12, View A-A.

d. Cycle the assembly several times to be certain it operates properly without binding.

13-36. EXPANSION VALVE. (See Figure 13-13.)

13-37. EXPANSION VALVE REMOVAL. The expansion valve is located in the evaporator assembly between the receiver drier and the evaporator inlet. The capillary coil is attached to the evaporator outlet line.

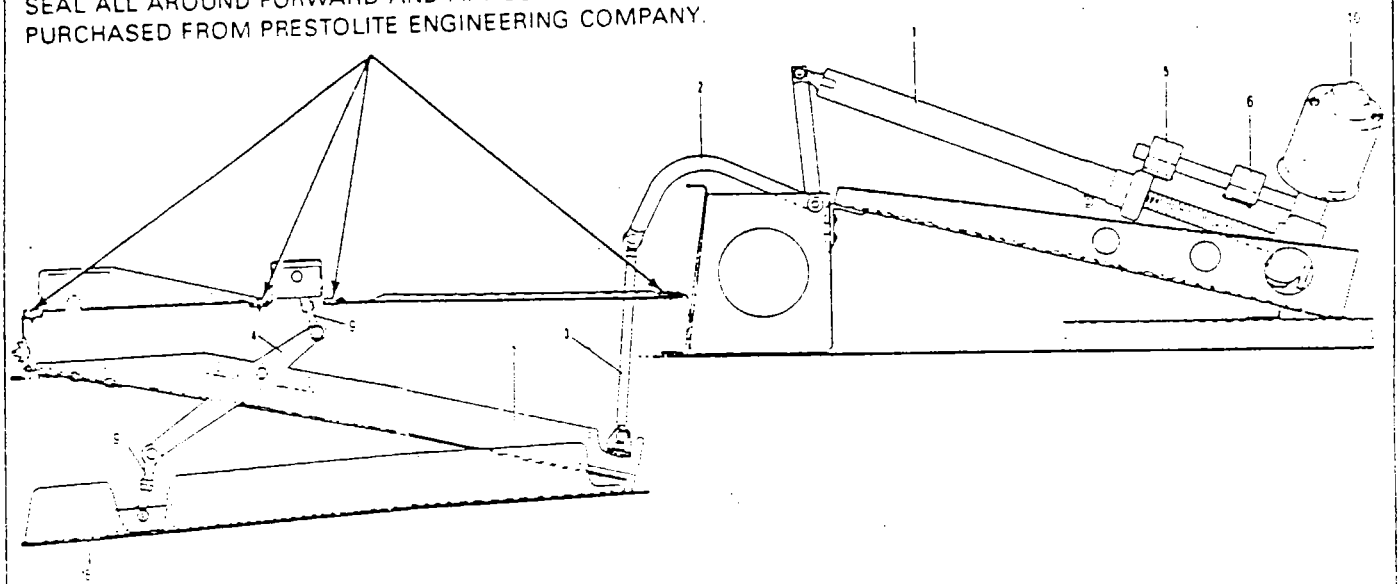
a. Remove the necessary access panels and discharge system.
b. Remove the capillary coil from the outlet line. (Do not kink the capillary tube.)
c. Uncouple all related tube fittings. (See Paragraph 13-5, B-7.)

NOTE

If this part is not serviceable, it must be replaced with a new part.

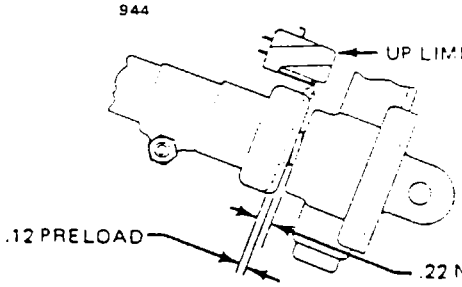
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SEAL ALL AROUND FORWARD AND AFT COVERS WITH PERMAGUM BEAD NO. 576 PURCHASED FROM PRESTOLITE ENGINEERING COMPANY.



1. ACTUATING TRNASMISSION ASSY.
2. BELLCRANK ASSY. (CONDENSER)
3. PUSH ROD ASSY.
4. BELLCRANK ASSY. (MECHANISM)
5. OPEN LIMIT SWITCH
6. CLOSED LIMIT SWITCH
7. CONDENSER
8. CONDENSER DOOR
9. PUSH ROD
10. TRANSMISSION MOTOR ASSY.

944



VIEW A

Figure 13-12. Condenser Air Scoop Installation

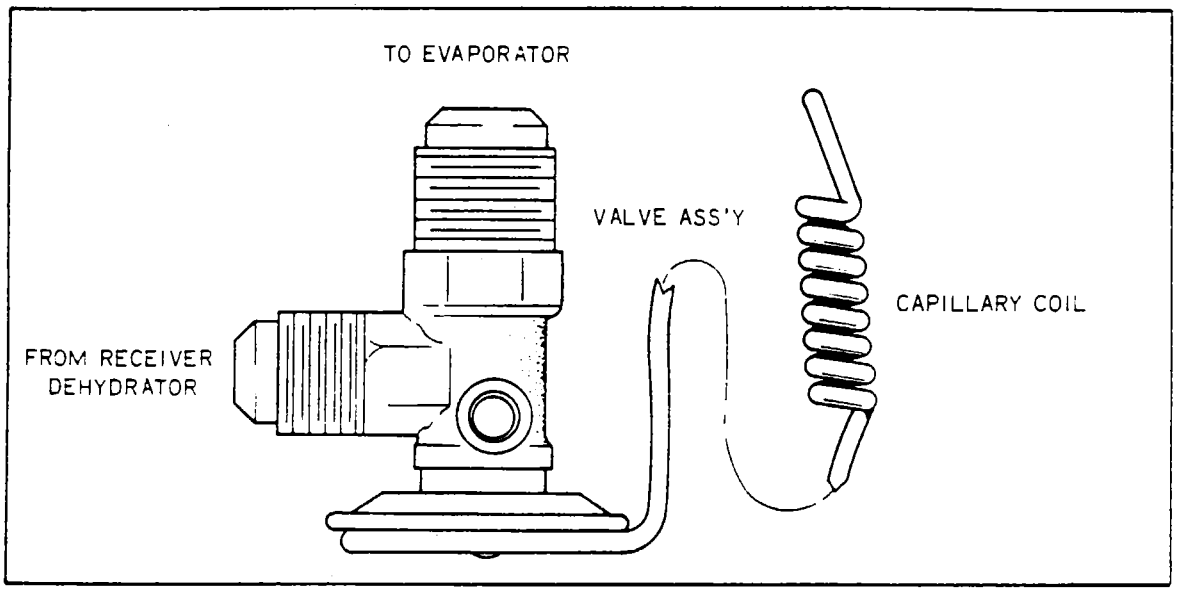


Figure 13-13. Expansion Valve

13-38. EXPANSION VALVE INSTALLATION.

a. Install the expansion valve in the inlet line of the evaporator core by coupling the related fittings. (Seal all couplings with sealant applied to tube flanges only.) Torque fittings per Table XIII-II.

b. Secure the capillary coil to the evaporator outlet line.

c. Evacuate and charge the system. (See Paragraphs 13-13 and 13-14.) Check for leaks. (See Paragraph 13-9.)

d. Replace access panels.

13-39. EVAPORATOR ASSEMBLY. The evaporator assembly consists of the evaporator core, receiver-dehydrator, expansion valve, circulating fan and pressure switch together with necessary housing and plumbing. The housing is fabricated of Cycolac type material. The condensed moisture is dumped overboard through a hose clamped to a fitting on the bottom of the evaporator housing.

13-40. EVAPORATOR ASSEMBLY REMOVAL. The evaporator assembly is located behind the cabin rear panel, attached to the mounting panel with 12 screws and washers and a bracket securing the back to the mounting panel.

a. Remove air conditioning filter cover, filter and rear access panels.

NOTE

Discharge the system before disassembling any components for service.

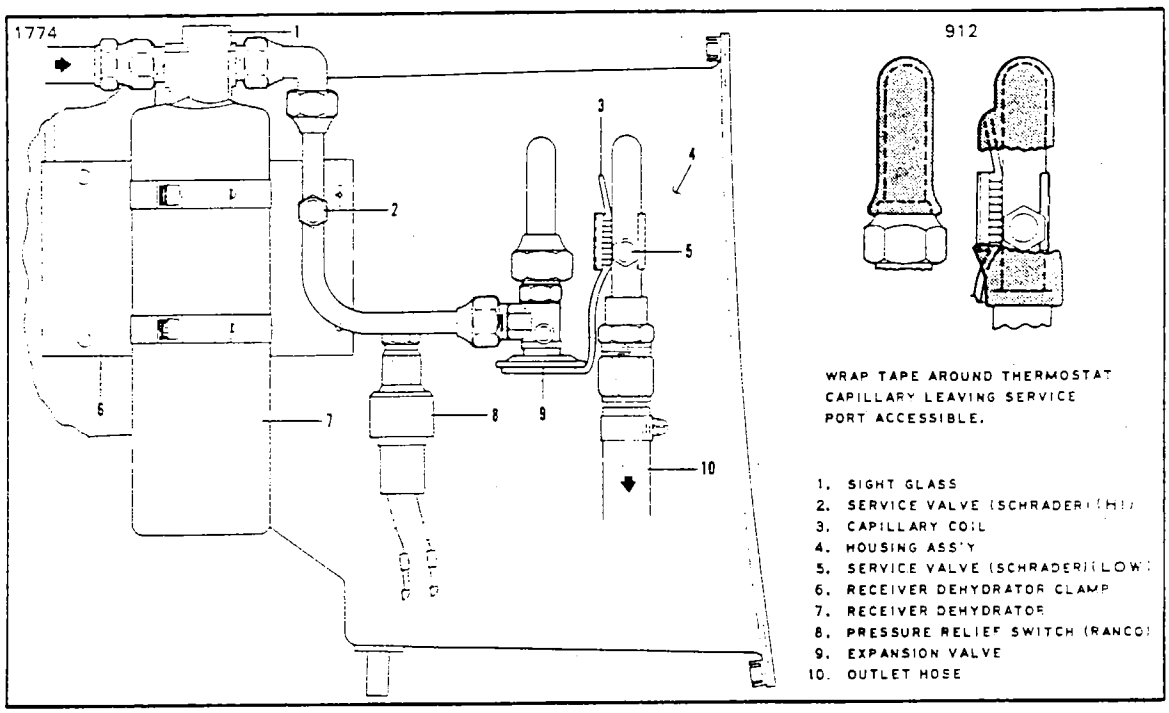


Figure 13-14. Components Installation

b. Uncouple the liquid line from the inlet side of the reveiver-dehydrator and the suction line from the evaporator core outlet. (See Paragraph 13-5, B-7.)

c. Disconnect the related electrical wires.

d. Remove flexible air duct from housing outlet. Remove drain hose from housing.

e. Remove temperature probe from evaporator housing.

f. Remove the screws attaching the support bracket and evaporator housing to the mounting panel. Remove the assembly through the access hole in the bulkhead.

13-41. EVAPORATOR ASSEMBLY INSTALLATION.

a. Cement gasket in place on the flanges of the evaporator housing and attach the large end of the mounting gasket to the back of the housing.

b. Install the housing through the access hole with the air duct outlet on top. Mate the mounting flanges to the mating surface of the mounting panel and insert the screws. (Do not tighten at this time.)

c. Line up the mounting bracket with mating holes in mounting panel, insert screws and tighten. Tighten screws in the flange at this time. Be certain gasket is in place. The flange must have an air tight seal.

d. Couple the suction and discharge lines to their respective fittings (apply Loctite refrigerant sealant to tube flanges only).

e. Evacuate and charge system. (See Paragraphs 13-13 and 13-14.)

f. Check for leaks (see Paragraph 13-9) if no leaks are detected. Seal and install access panel on evaporator housing.

g. Couple flexible air duct and drain tube.
h. Make and check electrical connections. (Refer to Figure 13-15.)
i. Check operation of blower and refrigerant systems.
j. Install rear bulkhead panels. Be certain to seal. (See NOTE.)

WARNING

Whenever it is necessary to remove and replace the rear cabin panel, it should be replaced and sealed in the original manner to prevent exhaust from entering the cabin. After removing and replacing the rear panel, conduct a carbon monoxide test on the ground and in flight with and without the air conditioner operating. Presence of CO shall not exceed one part in 20,000.

13-42. PRESSURE RELIEF SWITCH (Ranco). The pressure relief switch automatically prevents the system from over pressurization by breaking the electrical circuit to the magnetic clutch, stopping the compressor until pressure is reduced. The switch is located in the line between the receiver and expansion valve.

NOTE

Before the relief switch is removed, the air conditioning system must be discharged. (See Paragraph 13-12.)

13-43. ELECTRICAL INSTALLATION. The electrical system, routing and components are installed and routed in the conventional aircraft manner. The wiring harness is connected to switches in the climate control center on the right side of the instrument panel. The harnesses cross the instrument panel to the left side where two (2) wires are taken off for the compressor clutch. The harness then passes aft along the left side of the fuselage where it connects to the blower motor, pressure relief switch and the condenser actuating motor.

13-44. ADJUSTMENT OF THROTTLE SWITCH. The throttle switch is mounted forward and below the throttle arm. The switch must be adjusted so it will actuate at the last quarter inch of full open throttle travel.

The switch should be positioned so the throttle arm contacts the center of the switch actuator button.

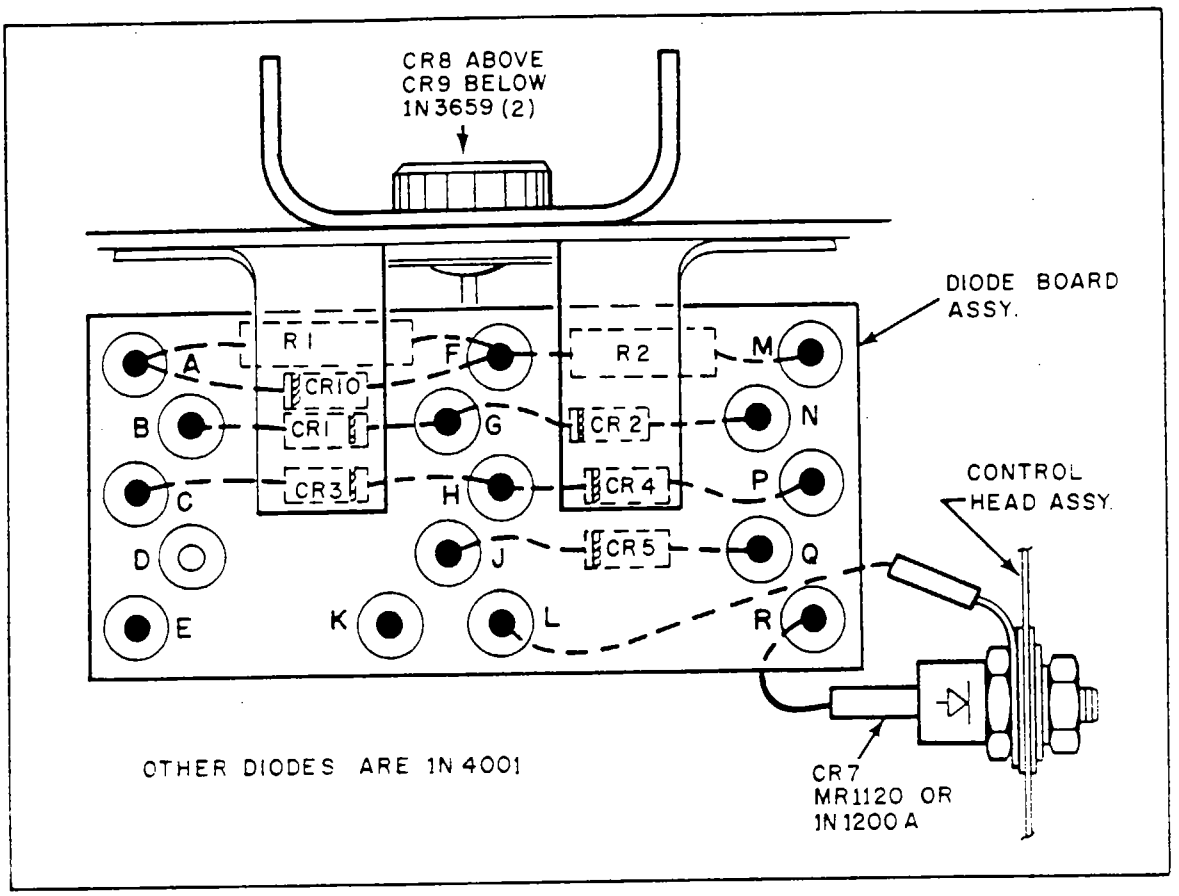


Figure 13-15. Control Head - Diode Mounting Board. Diode Location and Number. Serial Nos. 32-7240056 to 32-7340042

NOTE

Control head will be replaced when needed, with new parts used in aircraft Serial Nos. 32-7340043 and up. Refer to PA-32 Parts Catalog 753 689 for complete list.

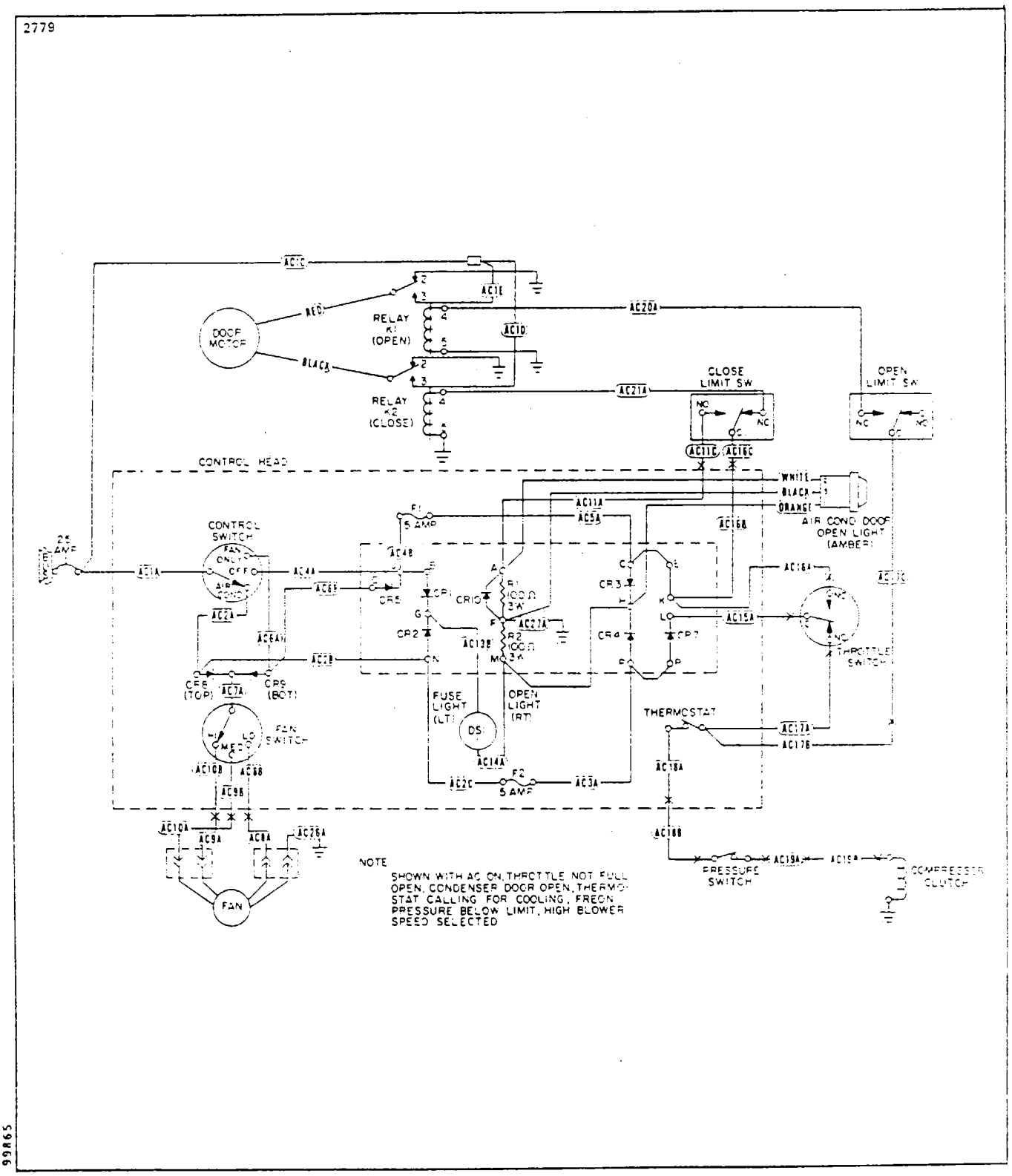


Figure 13-16. Air Conditioning Wiring Schematic
Serial Nos. 32-7240056 to 32-7340042

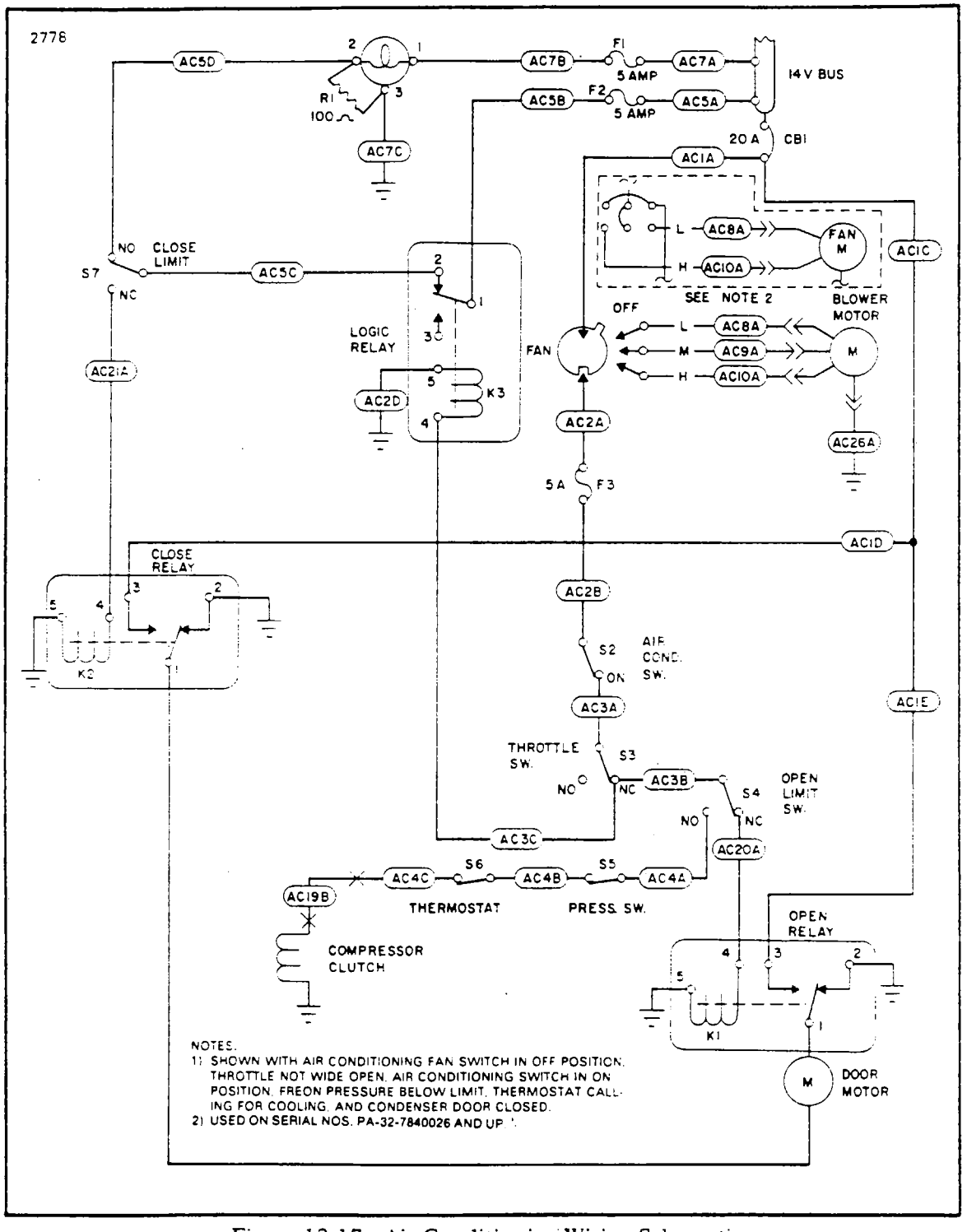


Figure 13-17. Air Conditioning Wiring Schematic
Serial Nos. PA-32-7340043 and up

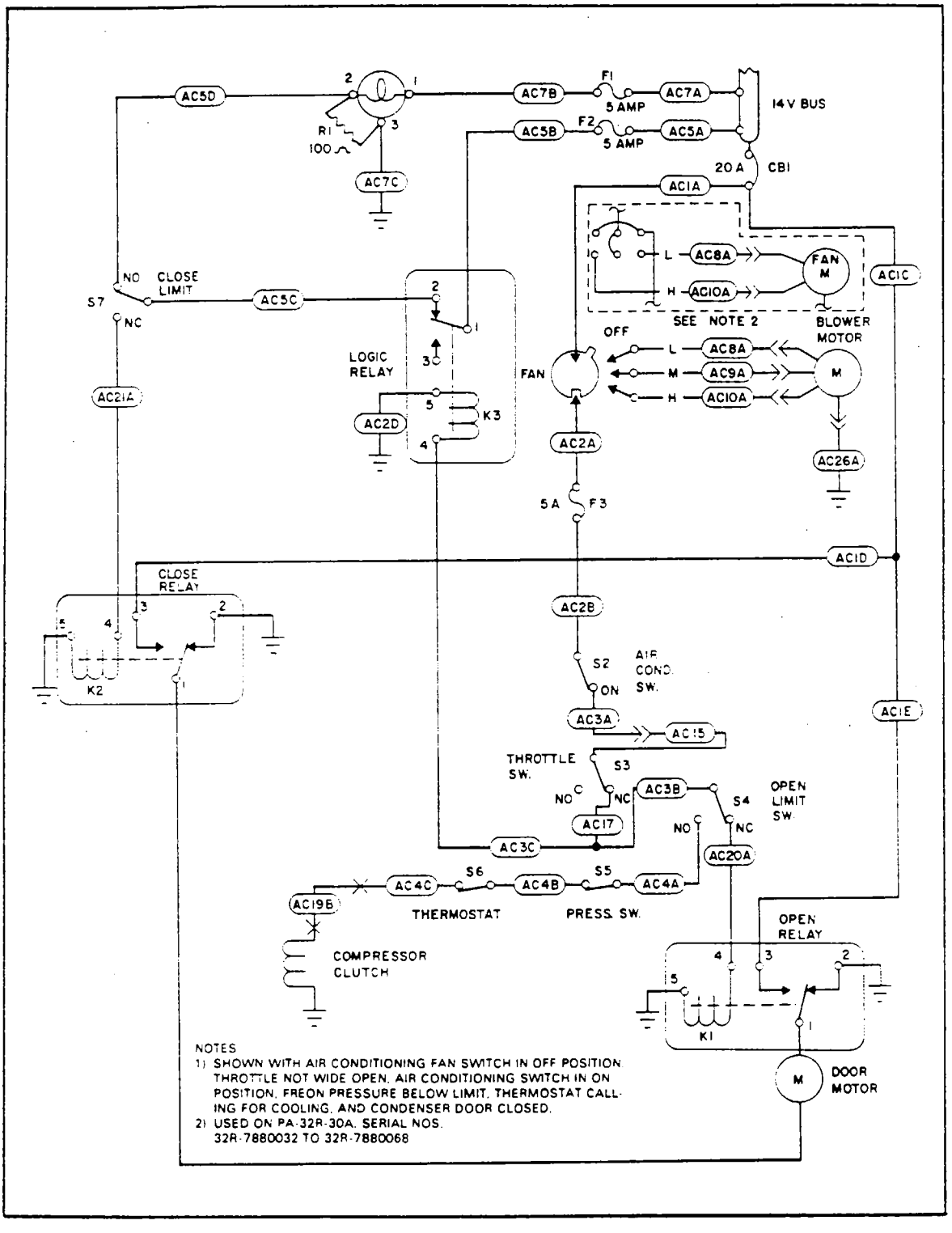


Figure 13-18. Air Conditioning Wiring Schematic (PA-32R-300)

13-45. FUSE REPLACEMENT. (Serial Nos. 32-7240056 to 32-7340042.) There are two fuses located behind the air conditioning system control panel. A 25 amp circuit breaker mounted in the circuit breaker panel protects the complete air conditioning electrical system.

13-46. FUSE REPLACEMENT. (Serial Nos. 32-7340043 and up.) There are three fuses located behind the air conditioning system control panel. A 20 amp circuit breaker mounted in the circuit breaker panel protects the complete air conditioning electrical system.

13-47. 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 tang, wind spring 6 turns ± 1/2 turn and snap 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.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER)

Gauge Indication	Probable Causes	Remedy
High discharge pressure.	Overcharge of refrigerant.	Purge excess refrigerant.
	Air in system.	Check for leaks. Bleed charge from system. Evacuate and recharge system 13-13 and 13-14.
	Overheated condenser due to blocking air passage.	Clean bugs and dirt from condenser fins. Straighten fins if bent.
	Flooded evaporator indicated by heavy frosting on suction line and compressor suction service valve.	Check that capillary bulb is securely clamped to suction line. If capillary bulb OK replace expansion valve.
	Restriction in liquid line from condenser.	Check for kinked hoses and stopped up filter.
Low discharge pressure.	Undercharge of refrigerant. Sight glass shows bubbles or foam.	Add refrigerant until bubbles disappear. Check system leaks 13-9, 13-10 and 13-11.
	Damaged compressor valves or dirt under valves.	Replace compressor, 13-18.
	Damaged compressor. Worn or broken piston or piston rings.	Replace compressor. 13-18.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITION) (cont.)

Gauge Indication	Probable Causes	Remedy
Low suction pressure. (Accompanied by icing evaporator.)	Low air supply through evaporator.	Repair blower or blower motor. Clean stoppage in air ducts.
	Very dirty evaporator fins and coils.	Clean and flush with water.
Low suction pressure. (Evaporator not cold enough) suction gauge may read a vacuum indicating evaporator lacks refrigerant.	Undercharge of refrigerant. Moisture freezing in expansion valve. Valve will show frost. Expansion valve inlet screen clogged. Inoperative expansion valve. Valve stuck closed or capillary bulb has lost its charge.	Add refrigerant. Install new dryer. Evacuate and recharge 13-13 and 13-14. Remove screen. Clean with solvent and replace. Warm capillary by holding in hand. If suction pressure does not charge, replace expansion valve.
	Restriction anywhere in liquid line. Restriction will show frost.	Locate restriction and repair.
High suction pressure.	Capillary bulb clamp loose on suction line. Suction line shows frost.	Clean contact surfaces of suction line and cap bulb. Tighten clamp.
	Expansion valve not closing. Evaporator flooded. Suction line frosted to compressor.	Replace expansion valve.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER) (cont.)

Gauge Indication	Probable Causes	Remedy
High suction pressure. (cont.)	Compressor drive belt slipping.	Adjust belt tension, 13-23.
	Magnetic clutch slipping.	Check electrical circuit for correct voltage to clutch coil. Clean clutch surfaces of oil.
	Leaking or broken compressor valves.	Replace compressor.
Trouble	**Cause**	**Remedy**
Condenser door will not close when air conditioner switch is in the "OFF" position.	Faulty relay "K-2."	Replace relay.
System produces no cooling.	Electrical	
	Blown fuse in control head.	Replace fuse.
	Open circuit breaker.	Reset circuit breaker.
	Broken or disconnected electrical wire.	Check all terminals for loose connections; check wiring for hidden breaks.
	Broken or disconnected ground wire.	Check ground wire to see if loose, broken, or disconnected.
	Clutch coil burned out or disconnected.	Check current flow to clutch, replace if inoperative.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System produces no cooling. (cont.)	Electrical (cont.)	
	Thermostat sensing element defective.	Check thermostat and cabin comfort control panel.
	Blower motor disconnected or burned out.	Check current flow to blower motor. Repair or replace if inoperative.
	Mechanical	
	Loose or broken drive belt.	Replace drive belts and/or tighten to specifications, 13-22 and 13-23.
	Compressor partially or completely frozen.	Remove compressor for service or replacement, 13-18.
	Expansion valve stuck in open position.	Replace expansion valve, 13-38.
	Refrigeration	
	Broken refrigerant line.	Examine all lines for evidence of breakage by external stress or rubbing wear.
	Leak in system.	Evacuate system, apply static charge, leak test system, and repair leak as necessary, 13-13 and 13-9.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System produces no cooling. (cont.)	Refrigeration (cont.)	
	Compressor shaft seal leaking.	Replace compressor, 13-18.
	Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.
System will not produce sufficient cooling.	Electrical	
	Blower motor sluggish in operation.	Remove blower motor for service or replacement.
	Mechanical	
	Compressor clutch slipping.	Remove clutch assembly for service or replacement, 13-24.
	Obstructed blower passage.	Examine entire passage for obstruction. Correct as necessary.
	Insufficient air circulation over condenser coils; fins clogged with dirt or bugs.	Clean condenser coils.

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
System will not produce sufficient cooling. (cont.)	Mechanical (cont.)	
	Evaporator filter clogged.	Clean with cleaning solvent to remove cigarette tars.
	Refrigeration	
	Insufficient refrigerant in system.	Recharge system until bubbles disappear in receiver dehydrator and gauge readings stabilize to specifications, 13-14.
	Clogged screen in expansion valve.	Purge system and replace expansion valve, 13-38.
	Expansion valve thermal bulb has lost charge.	Purge system; replace expansion valve, 13-38.
	Clogged screen in receiver dehydrator.	Purge system; replace receiver dehydrator, 13-28.
	Excessive moisture in system.	Purge system; replace receiver dehydrator, 13-28.
	Air in system.	Purge, evacuate and charge system, 13-13 and 13-14. (Replace receiver dehydrator, 13-28.)

TABLE XIII-IV. TROUBLESHOOTING CHART (AIR CONDITIONER) (cont.)

Trouble	Cause	Remedy
Excessively noisy system.	Electrical	
	Defective winding or improper connection in compressor clutch coil.	Replace or repair as necessary, 13-24.
	Mechanical	
	Loose or excessively worn drive belts	Tighten or replace as required, 13-22 and 13-23.
	Noisy clutch.	Remove clutch for service or replacement as necessary, 13-24.
	Compressor noisy.	Check mountings and repair; remove compressor for service or replacement, 13-18.
	Compressor oil level low.	Fill with correct amount of specified oil, 13-21.
	Refrigeration	
	Excessive charge in system.	Discharge excess freon until high pressure gauge drops within specifications.
	Low charge in system.	Check system for leaks; charge system, 13-9 and 13-14.
	Excessive moisture in system.	Replace dehydrator; purge, evacuate, and charge system, 13-28, 13-13 and 13-14.

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