CADET

MAINTENANCE MANUAL

CARD 1 OF 2

PA-28-161 CADET

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 829)

SERIAL NUMBER INFORMATION

PA-28-161 Cadet - 1988 - Serial numbers 2841001 thru 2841036
Serial numbers 2841038 thru 2841040.
PA-28-161 Cadet - 1989 - Serial numbers 2841037
Serial numbers 2841041 thru 2841289
Serial numbers 2841294 thru 2841300
Serial numbers 2841304 thru 2841314.
PA-28-161 Cadet - 1990 - Serial numbers 2841290 thru 2841293
Serial numbers 2841301 thru 2841303
Serial numbers 2841315 thru 2841320
Serial numbers 2841322
Serial numbers 2841325 thru 2841330.
PA-28-161 Cadet - 1992 - Serial numbers 2841321
Serial numbers 2841323 thru 2841324
Serial numbers 2841331 thru 2841350.
PA-28-161 Cadet - 1994 - Serial numbers 2841360 thru 2841364.

AEROFICHE EXPLANATION AND REVISlON 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 Manufacturers 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 761-829 issued February 28, 1989 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG 890228	August 7, 1989	1 and 2
IR 950228 *	February 28, 1995	1

*** INTERIM CHANGE TO MAINTENANCE MANUAL 761-829**

Sections III and V of Card 1 have been revised. There are no other changes included in this interim change revision. Please discard your current card 1, and replace it with the revised card 1. DO NOT DISCARD CARD 2.

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SECTION I

INTRODUCTION

SECTION I

INTRODUCTION

1-1. GENERAL. This manual contains service and maintenance instructions for the PA-28-161 Cadet. This aircraft is 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 thru XIV comprise the maintenance instructions. The service instructions include ground handling, servicing and inspection. The maintenance instructions for each system include description, removal, inspection, installation,corrective maintenance and testing of components along with troubleshooting. 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 operation, refer to the Pilot's Operating Manual or Information Manual.

1-3. DESCRIPTION. The Cadet is a single-engine, low wing monoplane, of all-metal construction, with a seating capacity of four. Paragraphs 1-4 through 1-12 provide descriptions of the major components and systems.

1-4. WING. The laminar flow wing is of all-metal stressed-skin, full cantilever, tapered, low-wing design. Each tapered wing panel is bolted to a spar box assembly in the fuselage. The wing tips are made of tough resilient fiberglass and are easily removed. The ailerons are statically balanced and cable and push rod controlled. The trailing edge wing flaps are manually operated.

1-5. EMPENNAGE. The empennage consists of the fin, rudder, stabilator and stabilator trim tabs. The stabilator and rudder are statically balanced and cable operated.

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

1-7. LANDING GEAR. The tricycle landing gear is of the fixed type, consisting of shock absorbing air-oil type oleo struts.

1-8. BRAKE SYSTEM. The brake system is hydraulically operated and controlled by a hand lever connected to a single brake cylinder that operates both wheel brakes, plus individually operated toe brakes.

1-9. ENGINE. The engine installed in the airplane is a Avco-Lycoming direct drive, wet sump, horizontally opposed, air cooled model. The four cylinder engine is carburetor equipped. The engine model, rated horsepower and other related information may be found in Table II-I of Section II.

1-10. PROPELLER. The airplane is equipped with an all-metal fixed pitch propeller. Propeller specifications may be found in Table II-I of Section II.

1-11. FUEL SYSTEM. The fuel system consists of two aluminum tanks in the leading edge of the wings, a fuel strainer bowl with filter screen, one electric auxiliary pump and one engine driven pump. Fuel drains are provided throughout the system to remove any fuel contamination.

1-12. FLIGHT CONTROLS. The flight controls are conventional, consisting of dual control wheels which operate the ailerons and stabilator, and dual pedals which operate the rudder.

1-13. RADIO. Provisions are provided for the installation of various radio equipment along with microphone and headset jacks, loudspeaker and other radio navigation equipment.

1-14. CABIN HEATER, DEFROSTER, AND FRESH AIR SYSTEM. Heated air for the cabin and defroster is obtained directly from the exhaust system muffler shroud. Fresh air is picked up from air inlets in the leading edge of each wing. The air passes through the wings to individually controlled outlets located just forward of each front seat. Rear seat vents are available as optional equipment.

1-15. INSTRUMENT AND AUTOPILOT SYSTEM. Provisions for instrument installation include panels for engine instruments and advanced instruments, as well as for an Autopilot System.

1-16. WARNINGS, CAUTIONS, and NOTES are used throughout this manual to emphasize important operating information.

— WARNINGS —

Operating procedures, practices, etc., which may result in personal injury or loss of life if not carefully followed.

— CAUTION —

Operating procedures, practices, etc., which if not strictly observed may result in damage to equipment.

— Notes —

An operating procedure, condition, etc., which is essential to emphasize.

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SECTION II

HANDLING AND SERVICING

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 Figure 2-1 and are listed in Table II-I.

2-3. STATION REFERENCE LINES. In order to facilitate the location of various components of the airplane which require maintenance and servicing, a method utilizing fuselage station (Sta.), wing station or buttock line (BL), and waterline (WL) designations is frequently employed in this manual. (Refer to Figure 2-2.) Fuselage stations, buttock lines, and waterlines 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 44.5 inches ahead of the lower edge of the firewall; station 0 (BL) of the wing and stabilator is the centerline of the airplane; and station 0 (WL) of the fuselage 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.

2-5. SERIAL NUMBER PLATE. The serial number plate is located on the left side of the fuselage near the leading edge of the stabilator. The serial number should always be used when referring to the airplane on service or warranty matters.

2-6. 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 upholstery panel.

— Caution —

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

2-7. TOOLS AND TEST EQUIPMENT. Because of the simplicity and easy accessibility of components, few special tools outside normal shop tools will be required. Tools that are required may be fabricated from dimensions given in the section that pertains to a particular component.

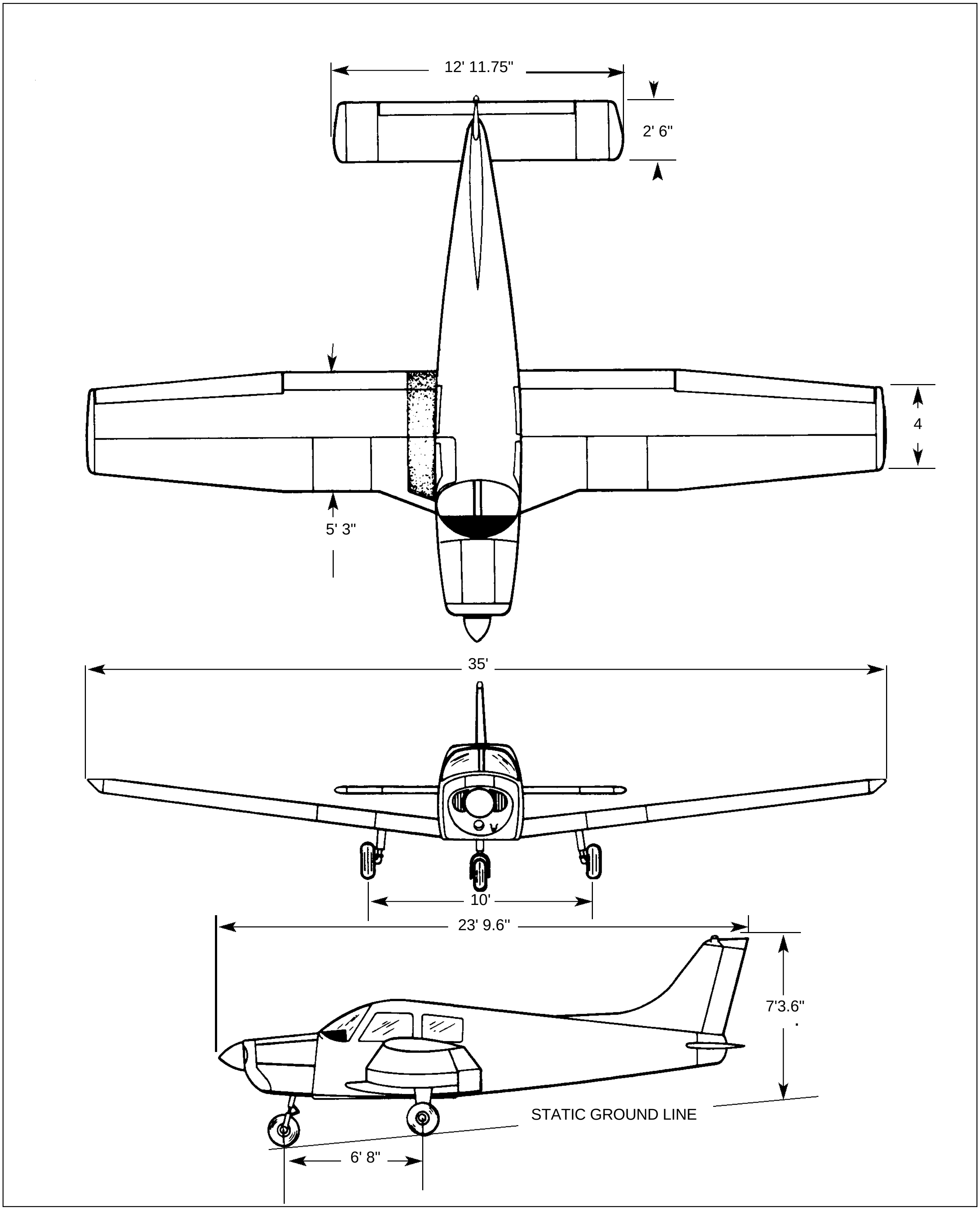


Figure 2-1. Three View

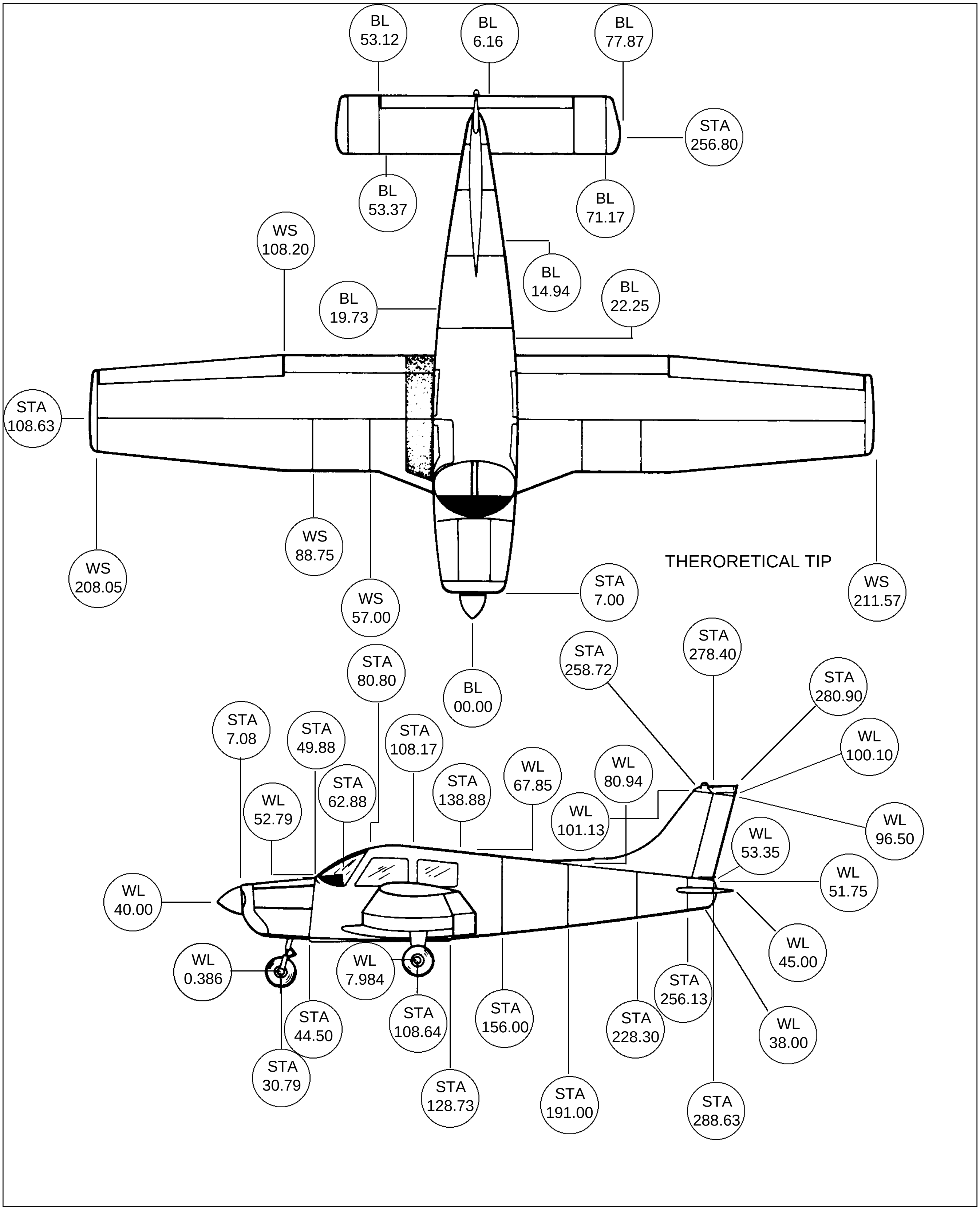


Figure 2-2. Station Reference Lines

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-28-161 CADET
ENGINE	
Manufacturer	Avco-Lycoming
Model	O-320-D3G
FAA Type Certificate	274
Rated Horsepower	160
Rated Speed:	
Full Throttle	2700 RPM
Oil, SAE Number	See Table II-II
Oil Sump Capacity	8 U.S. qts
Fuel, Aviation Grade, Specified Minimum Octane	100 LOW LEAD
Carburetor, Marvel-Schebler	MA-4SPA
Magnetos, Slick	
Left	4051, 4251
Right	4050, 4250
Magneto Timing	25° BTC
Spark Plugs (Shielded) and Spark Plug Gap Setting	SEE NOTE

— Note —

Refer to the latest issue of Avco-Lycoming Service Instruction No. 1042.

Firing Order	1-3-2-4
Tachometer Drive, Ratio to Crankshaft	0.5:1
Starter:	
Prestolite, 12 Volt	MZ4218
Alternator:	
Prestolite (60 AMP)	ALX-8421LS
Alternator Voltage Regulator, LAMAR	B-00371-1
Fuel Pump Drive	Plunger

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

MODEL	PA-28-161 CADET
PROPELLER	
Fixed Pitch:	
Manufacturer	Sensenich
Model	74 DM6-0-60
Diameter	74 in.
Diameter, Minimum	72 in.
FUEL SYSTEM	
Inboard (Main Tanks)	Two
Capacity (each)	25 U.S. gal.
Unusable Fuel (each tank)	1 U.S. gal.
Total Capacity	50 U.S. gal.
Total Unusable Fuel	2 U.S. gal.
LANDING GEAR	
Type	Fixed
Shock Strut Type	Combination Air-Oil
Fluid Required (Struts and Brakes)	MIL-H-5606
Strut Exposure (under static load):	
Nose	3.25 +/- .25 in.
Main	4.50 +/- .50 in.
Wheel Tread	10.0 ft.
Wheel Base	6 ft. 8 in.
Nose Wheel Travel	30° +/- 1° Left 30° +/- 1° Right
Wheel, Nose	Cleveland 40-77B, 5:00 x 5
Wheel, Main	Cleveland 40-28, 6:00 x6
Brake Type	Cleveland 30-55
Tires, Nose	5:00 x 5, 4 ply rating
Tires, Main	6:00 x 6, 4 ply rating
Tire Pressure, Nose	30 psi
Tire Pressure, Main	24 psi

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

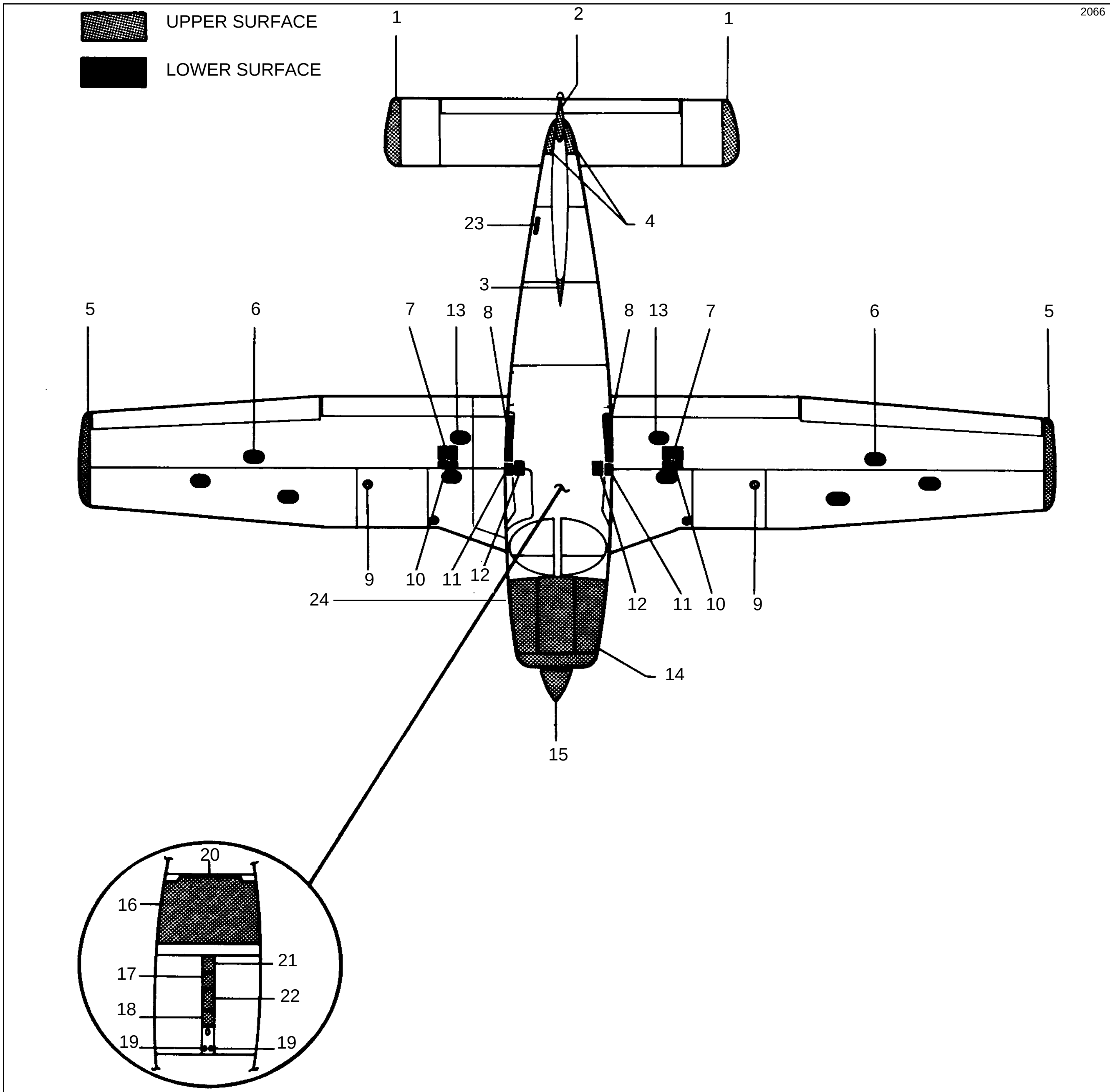
MODEL	PA-28-161 CADET
CONTROL SURFACE TRAVELS	
REFER TO SECTION V TABLE V-I.	
CABLE TENSIONS	
REFER TO SECTION V TABLE V-I.	

TABLE 11-1. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

FOOTNOTES

1. The specified minimum octane aviation grade fuel for the PA-28-l61 Cadet is 100 octane Low Lead. When using alternate fuels, refer to the latest revision of Lycoming Service Letter No. L185.

END



1. TIP, STABILATOR
2. TIP, RUDDER
3. FAIRING, FIN
4. TAIL CONE, CONTROL CABLE AND TRIM SCREW
5. TIP, WING
6. COVER, BELLCRANK AND CONTROL CABLES
7. FAIRING, MAIN GEAR STRUT ASSEMBLY
8. FAIRING, FLAP TORQUE TUBE AND AILERON CABLES
9. CAP, FUEL TANK FILLER
10. CAP, STRUT FILLER
11. FAIRING, FUEL LINES
12. COVER, FUEL LINES AND SPAR ATTACHMENT BOLTS
13. COVER, CONTROL CABLES
14. COWL ASSEMBLY, ENGINE
15. SPINNER, PROPELLER
16. SEAT, , TORQUE TUBE AND CONTROL CABLES
17. PLATE, CONTROL CABLES, MIDDLE
18. PLATE, AILERON AND STABILATOR CONTROL CABLE, FORWARD
19. COVERS, AILERON AND STABILATOR CONTROL CABLE
20. PANEL, AFT AREA OF FUSELAGE, STROBE LIGHT POWER SUPPLY
21. PLATE, CONTROL CABLES AND PULLEYS, REAR
22. COVER, FLAP CONTROL
23. EMERGENCY LOCATOR TRANSMITTER
24. BATTERY

Figure 2-3. Access Plates and Panels

2-8. TORQUE REQUIREMENTS. Proper torque application cannot be overemphasized. Undertorqued assemblies can result in premature failure due to fatigue from uneven loads, as well as causing unnecessary wear of nuts, bolts, and other parts. Overtorqued assemblies can be equally harmful by causing failure of a bolt or nut by overstressing the threaded areas.

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 torquing is required, unless otherwise noted in sections where other values are stipulated. Engine torque values are found in the latest revision of Avco-Lycoming Special Service Publications No. SSP1776, and propeller torque values are found in Section VIII of this manual. Table II-IIA lists the torque values for flared fittings of various sizes and material. Important procedures for torquing assemblies on Piper Aircraft are as follows:

a. Frequently check and/or calibrate the torque wrench.

b. Make sure bolt/screw and nut threads are clean and dry, unless otherwise required. If the threads are to be lubricated and no torque is specified, reduce recommended nut torque (plus the friction drag torque) by 50%.

c. Unless otherwise specified the charted torque values should be used. Should a bolt or nut be listed and not its mating fastener, use the lower torque.

d. When using "self-locking fasteners" and hardware with thread sizes 10 through 7/16" add the specified friction drag torque to the designated torque. Assume a friction drag torque of zero for non self-locking fasteners. For other bolt sizes, the friction drag torque is determined as follows:

1. Turn nut to "near contact" with the bearing surface (NOT IN CONTACT).

2. Attach a scale type torque wrench and determine the torque required to turn the nut on the bolt before it contacts the bearing surface. Add this value to the specified torque for the total torque value to be applied.

e. When torquing castellated nuts remember the following:

1. Determine maximum torque value (friction + max. torque) and do not exceed when aligning slot and hole, change washers if necessary.

2. When using castellated nuts on movable joints, tighten nuts only to remove looseness in the joint before installing cotter pin.

f. Use the latest information from LYCOMING for torquing power plant parts.

g. On critical installations the nut should be permanently marked red after torquing and not be further tightened or disturbed.

— NOTE —

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Table II-IIA. For more details on torquing, refer to FAA Manual AC 43-13-1A.

— CAUTION —

Do not overtorque fittings.

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 Table A for sizes 8 through 7/16" to the recommended torque from Table 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 Table 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 Tables 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)

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

COURSE 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

Table 11-11. Recommended Torques (cont)

	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 N K9 MS 24694 MS 27039	MS 20004 thru MS 20024 NAS 144 thru NAS 158 NAS 333 thru NAS ~0 NAS 583 thru NAS 590 NAS 624 thru NAS 644 NAS 1303 thru NAS 1320 NAS 172 NAS 174 NAS 517 1 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 20600 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

FINE THREAD SERIES

Nut-bolt size	Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs		Tonque 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	1,1000	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	1,400	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	5,000	2,300	3,650

TABLE II-IIA. FLARE FITTING TORQUES

TORQUE INCH-POUND						
TUBING O.D. lNCHES	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	48O
3/4	300	500	900	1000	500	850
1	500	700	1200	1400	700	1150
1-1/4	600	900	----	----	----	----
1-/2	600	900	----	----	----	----
1-3/4	----	----	----	----	----	----
2	----	----	----	----	----	-----

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2-9. WALKWAY, HANDHOLD AND STEP. The walkway is made of a non-skid material applied to the wing surface. A fixed handhold is located on the right side of the fuselage near the rear window. A step is available as optional equipment and is installed just aft of the trailing edge of the right flap.

2-10. GROUND HANDLING.

2-11. INTRODUCTION TO GROUND HANDLING. Ground handling covers all 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, the chance of possible damage to the airplane and its equipment will be prevented.

2-12. JACKING. Jacking the airplane is necessary to service the landing gear and to perform other service operations. Proceed as follows:

a. Place 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 hold down the tail.

— 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.

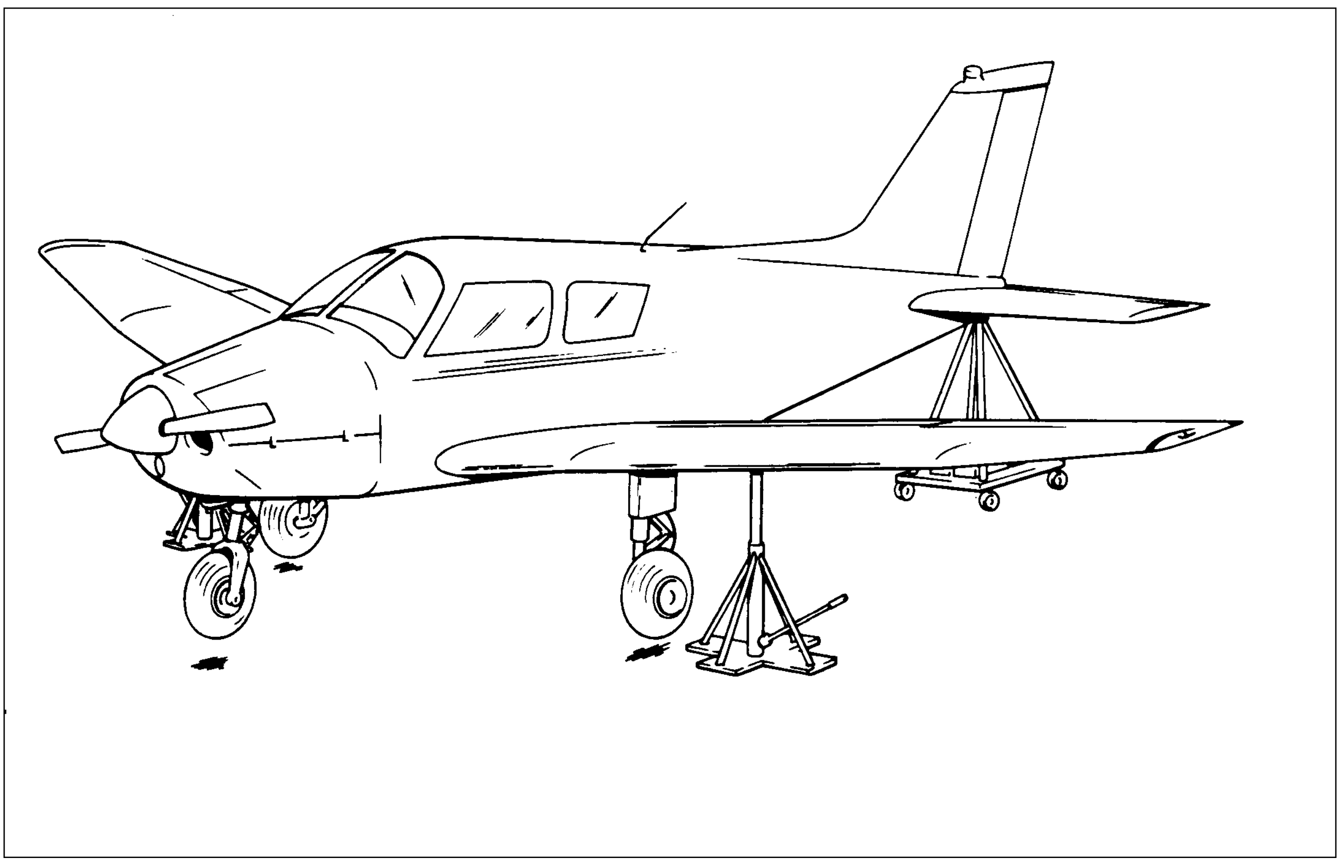


Figure 2-4. Jacking Arrangement

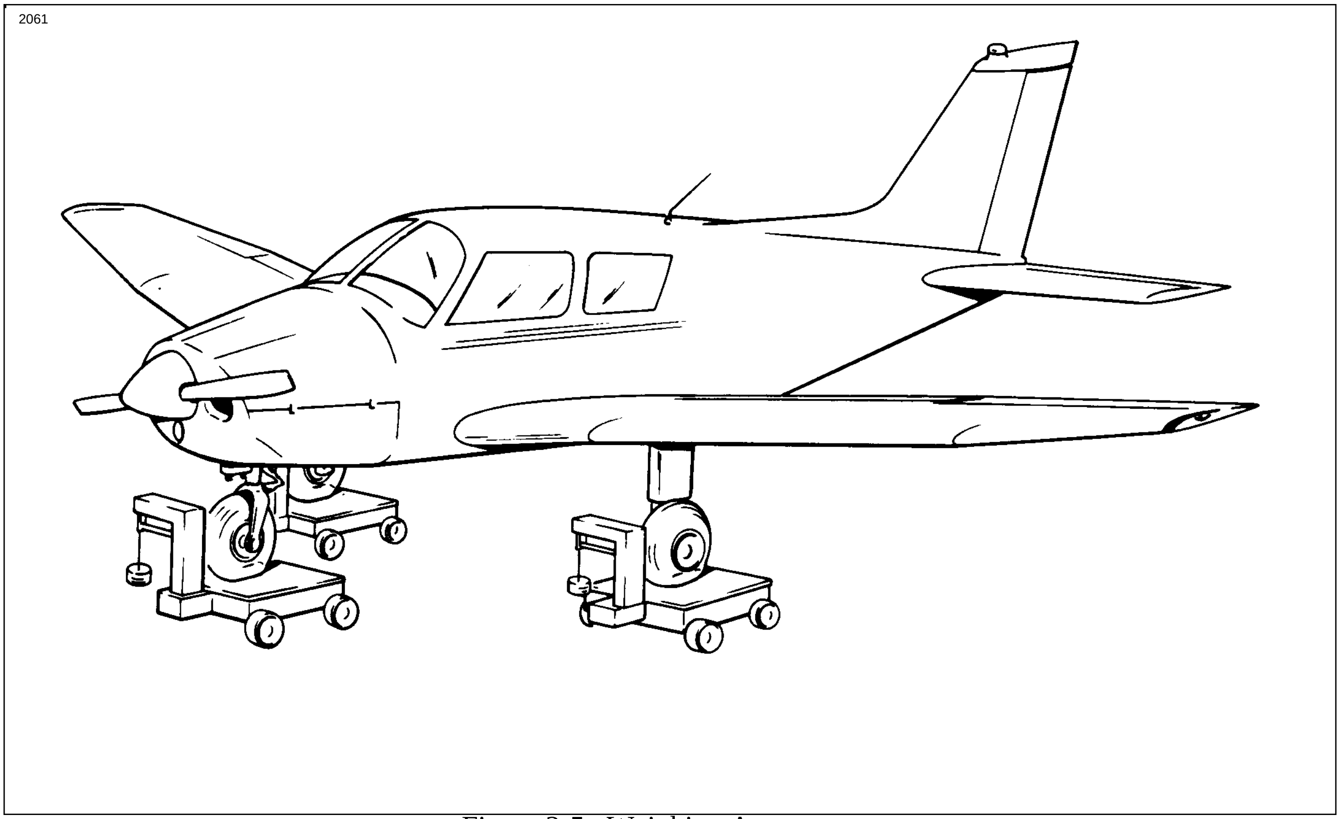


Figure 2-5. Weighing Arrangement

2-13. WEIGHING. (Refer to Figure 2-5.) The airplane may be weighed by the following procedure:

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.

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 2-14.

2-14. LEVELING. All configurations of the airplane are provided with a means for longitudinal and lateral leveling. The airplane may be leveled while on jacks, during the weighing procedure while the wheels are on scales, or while the wheels are on the ground. To level the airplane for 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 level on these screw heads and adjust the jacks until the level is centered. Should the airplane be either on scales or on the floor, first block the main gear oleos to full extension; then deflate the nose wheel until the proper position is reached.

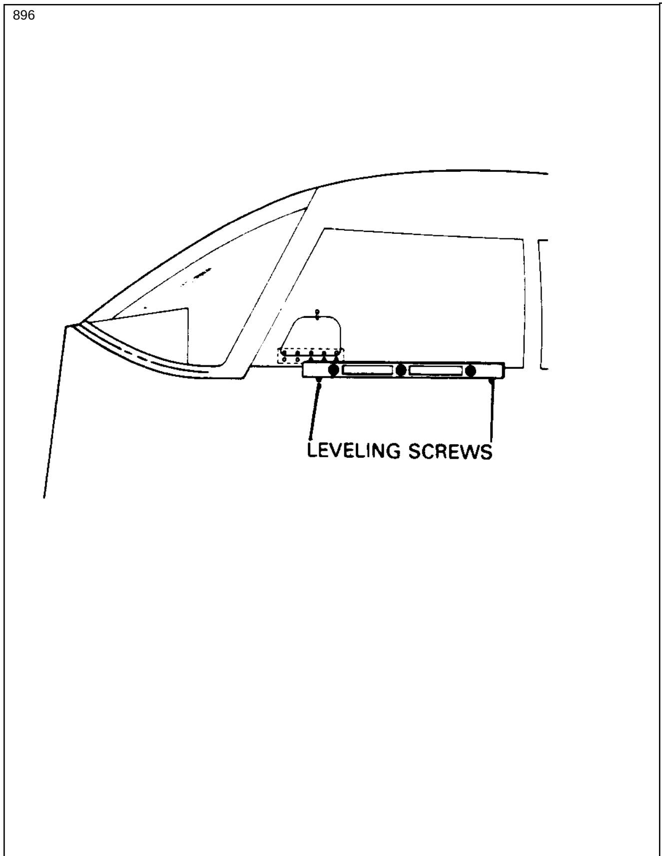


Figure 2-6. Leveling Longitudinally

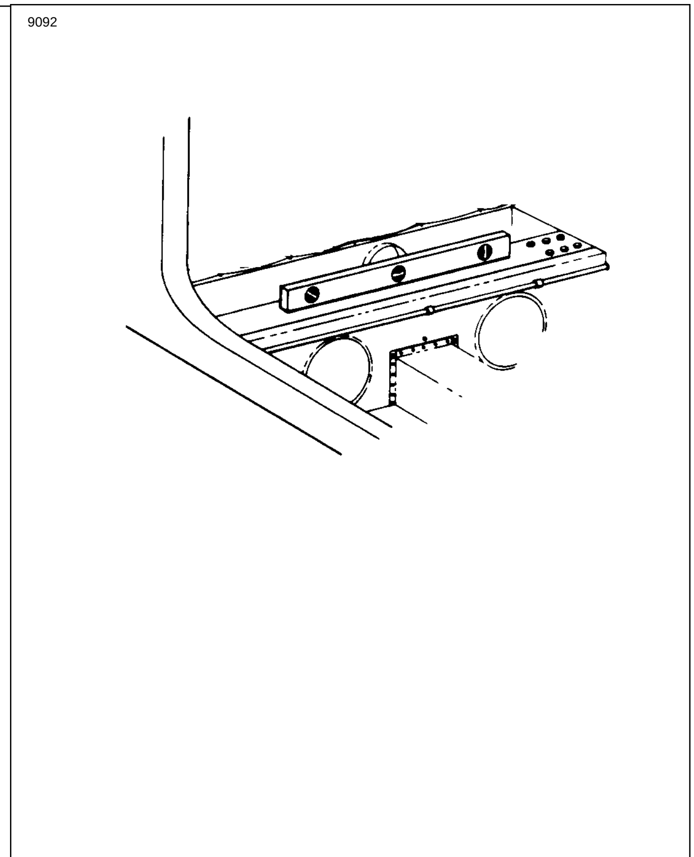


Figure 2-7.Leveling Laterally

b. To laterally level the airplane, place a level across the spar box assembly behind the pilots seat. (Refer to Figure 2-7.) Raise or lower one wing tip by deflating the appropriate tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

2-15. MOORING. The airplane is moored to ensure 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. Lock 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 from the landing gear forks and securing the rudder.

2-16. LOCKING AIRPLANE. The cabin door is provided with a key lock on the outside. The ignition switch and cabin door require the same key

2-17. 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 2-15.

a. To park the airplane, head it 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 brake, pull back on the brake lever to disengage the catch mechanism, and allow the handle to swing forward.

c. The aileron and stabilator may be locked by using the front seat belt.

— NOTE —

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

2-18. TOWING. The airplane may be moved by using the nose wheel steering bar that is stowed in the baggage area or power equipment that will not damage or cause excess strain to the nose gear steering assembly. Towing lugs are incorporated as part of the nose gear fork.

— 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.

— CAUTION —

Do not tow the airplane with control locks installed.

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 to ride in the pilot's seat to maintain control by use of the brakes.

2-19. TAXIING. Before attempting to taxi the airplane, ground personnel should be checked out by a qualified pilot or other responsible person. Engine starting and shutdown 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. While taxiing, make slight turns to determine the effectiveness of steering.

c. Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station a guide outside the airplane to observe.

d. When taxiing on uneven ground, avoid holes and ruts.

e. 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.

2-20. EXTERNAL POWER RECEPTACLE (OPTIONAL)

2-21. OPERATION OF EXTERNAL POWER RECEPTACLE. The external power receptacle is located on the right side of the fuselage forward of the wing. When using external power for starting or operation of any of the airplane's equipment, the following procedure should be followed:

a. Turn aircraft MASTER SWITCH and all electrical equipment OFF.

b. Ascertain that the RED lead of PEP (Piper External Power) kit jumper cable goes to the POSITIVE (+) terminal of external 12-volt battery and the BLACK lead goes to the NEGATIVE (-) terminal.

c. Insert the plug of the jumper cable into the socket located on the aircraft fuselage.

d. Turn the aircraft MASTER SWITCH ON and proceed with NORMAL engine starting technique.

e. After the engine has been started, turn the MASTER SWITCH and all electrical equipment OFF and remove the jumper cable plug from the aircraft.

f. Turn the aircraft MASTER SWITCH to the ON position and check the alternator ammeter for an indication of output. Do not attempt any flight if there is no indication of alternator output.

2-22. CLEANING.

2-23. CLEANING ENGINE COMPARTMENT. Before cleaning the engine compartment, place strips 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. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

— 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 ten minutes; then rinse the engine clean with additional solvent and allow to dry.

— CAUTION —

Do not operate engine until excess solvent has evaporated or otherwise been removed.

d. Remove the protective covers from the magnetos.

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

2-24. 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. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

c. Allow the solvent to remain on the gear from five to ten 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.

2-25. CLEANING EXTERIOR SURFACES. The airplane should be washed with a mild soap and water. Harsh abrasives 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 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.

2-26. 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 using a soft cloth or sponge and a straight rubbing motion. Do not rub surfaces harshly.

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 side 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-III. Consumable Materials for Specifications and Manufacturer's address.)

2-27. CLEANING HEADLINER, SIDE PANELS, AND SEATS.

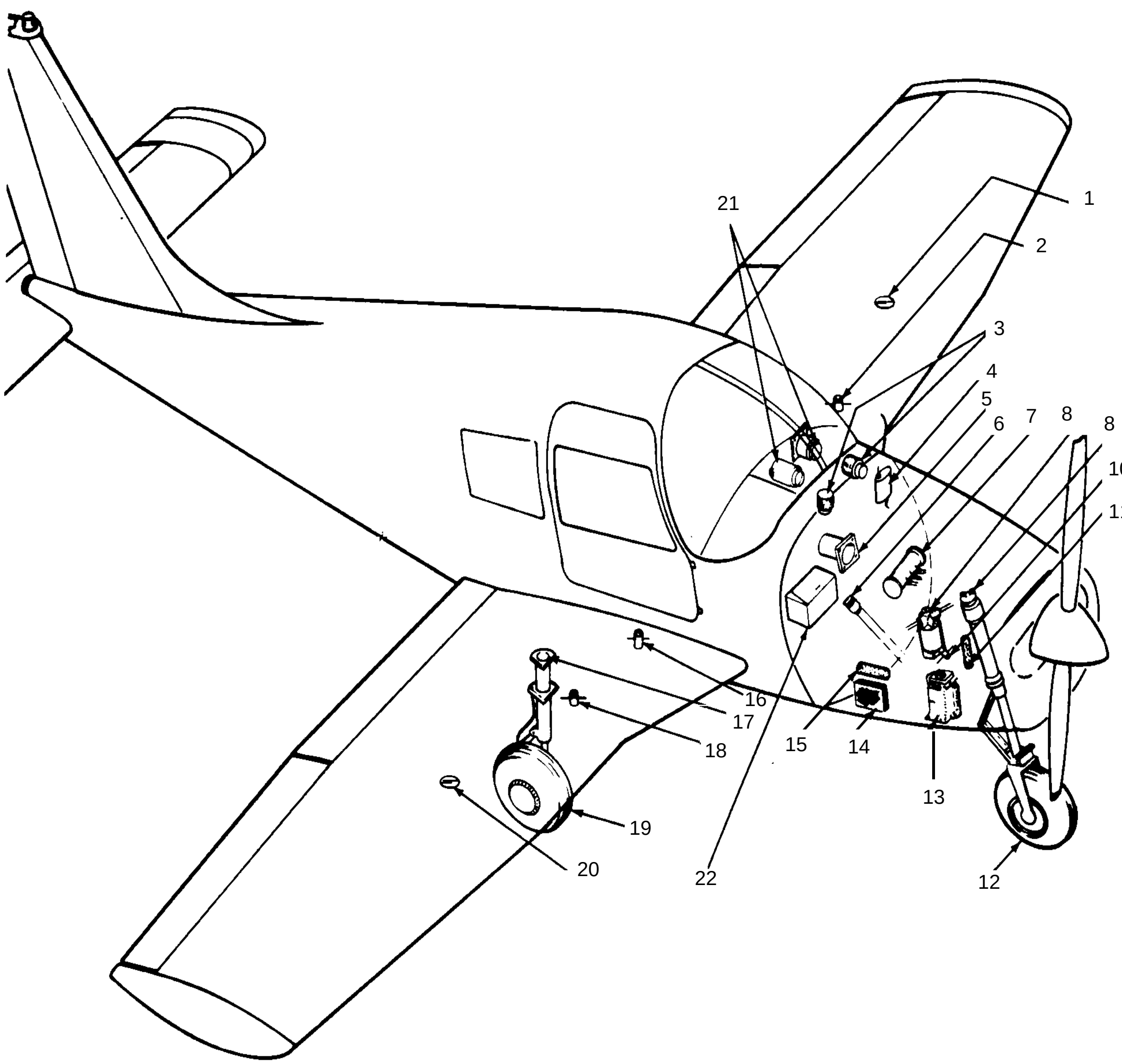
a. Clean headliner, side panels, and seats with a stiff bristle brush and vacuum where necessary.

b. Soiled upholstery, except leather, may be cleaned by using an approved air drying 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.



1. FILLER, FUEL TANK, LEFT
2. DRAIN, FUEL TANK, LEFT
3. FILTER, VACUUM REGULATOR
4. RESERVOIR, BRAKE SYSTEM
5. SCREEN OR CARTRIDGE FILTER, OIL PRESSURE, ENGINE
6. FILLER/INDICATOR, OIL, ENGINE
7. FILTER, FUEL PUMP, ELECTRIC
8. SCREEN, FUEL DRAIN
9. FILLER, OLEO SHOCK STRUT, NOSE
10. DRAIN, FUEL, ENGINE
11. SCREEN, OIL SUCTION, ENGINE
12. TIRE, NOSE WHEEL
13. CARBURETOR, ENGINE
14. FILTER, INDUCTION AIR
15. SCREEN, OIL PRESSURE, ENGINE
16. DRAIN, FUEL MANIFOLDS, L AND R
17. FILLER, OLEO SHOCK STRUT, L AND R
18. DRAIN, FUEL TANK, RIGHT
19. TIRE, MAIN WHEEL, L AND R
20. FILLER, FUEL TANK, RIGHT
21. FILTER, INSTRUMENTS
22. BATTERY

Figure 2-8. Servicing Points

2-28. CLEANING CARPETS. Use a small whisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid.

2-29. SERVICING

2-30. INTRODUCTION TO SERVICING. (Refer to Figure 2-8). Servicing the airplane includes the replenishment of fuel, oil, hydraulic brake fluid, tire pressures, lubrication requirements and other required items.

2-31. LANDING GEAR SYSTEM.

2-32. SERVICING LANDING GEAR. The landing gear consists of tires, brakes and oleo strut assemblies. These should be inspected for proper gear extension, scored piston tubes, possible hydraulic fluid leakage, security, and condition of all connection points. Check the brake linings for wear and frayed edges, and brake discs for scoring. Replace, if necessary. Minor servicing is described in the following paragraphs, and for detailed service and overhaul instructions, refer to Section VII.

2-33. OLEO STRUTS.

2-34. SERVICING OLEO STRUTS. Air-oil struts are incorporated in each landing gear oleo to absorb the shock resulting from the impact of the wheels on the runway during landing. To obtain proper oleo action, the nose gear oleo strut must have approximately 3.25 ± .25 inches of piston tube exposed, while the main gear struts require approximately 4.50 ± .50 inches of tube exposure.

— CAUTION —

Do not exceed these tube exposures.

These measurements are taken with the airplane setting on a level surface under normal static load (empty weight of airplane plus full fuel and oil). If the strut has less tube exposed than that prescribed, determine whether it needs air or oil by raising the airplane on jacks. With the strut extended, remove the cap from the air valve at the top of the housing and depress the valve core to allow air to escape from the strut piston until it is fully compressed. Allow the foam from the air-oil mixture to settle and then determine if oil is visible up to the bottom of the filler plug hole. If oil is visible at the bottom of the hole, then all that is required is the valve be checked for unsatisfactory conditions and air added as described in Paragraph 2-37. Should fluid be at any level below the bottom of the filler plug hole, the oleo should be checked for leaks, etc., and oil added as described in Paragraph 2-35 for the nose gear, or Paragraph 2-36 for the main gear. For repair procedures of the landing gear and/or oleo struts, refer to Section Vll.

— 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 quick drying solvent.

2-35. FILLING NOSE GEAR OLEO STRUT. To fill the nose gear oleo strut with hydraulic fluid (MIL-H-5606), 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 Paragraph 2-12.)

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:

Method I:

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 the plug in the top of the strut housing. Torque the plug from 350 to 400 inch-pounds.

Method 2:

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. Reinstall the filler plug and torque from 350 to 400 inch-pounds.

e. With the airplane raised, 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 2-37.

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

2-36. FILLING MAIN GEAR OLEO STRUT. To fill a main gear oleo strut with fluid that is partly full or one 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 Paragraph 2-12.)

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 ensuring that the bottom chamber is filled with fluid.

—CAUTION—

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:

Method 1:

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 finer plug and submerge the over end in a container of hydraulic fluid.
3. Fully compress and extend (10 ± 2 inches of strut tube exposed) the strut thus drawing fluid from the 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 to 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 the plug in the top of the strut housing Torque the plug from 350 to 400 inch-pounds.

Method 2:

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 (10 ±2 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. Reinstall the filler plug; torque from 350 to 400 inch-pounds

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

g. With the airplane raised, 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.

h. Clean off overflow of fluid and inflate the strut as described in Paragraph 2-37.

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

2-37. INFLATING OLEO STRUTS. After making certain that the 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 2-34.) Rock the airplane several times to ascertain that the gear settles back to the correct strut position. (If a strut pump is not available. the airplane may be raised and line pressure from a high pressure air system used. 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.

2-38. BRAKE SYSTEM.

2-39. 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 2-40. 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 VII.

2-40. 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 fire wall 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 VII.

2-41. 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 clean the brake system, flush with denatured alcohol.

2-42. TIRES.

2-43. 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 on the wheel. The tire, tube, and wheel shall be properly balanced when installed by aligning the red dot on the tire with the silver arrow on the tube.

2-44. POWER PLANT.

2-45. SERVICING POWER PLANT. Regularly check the engine compartment for oil and fuel leaks, chafing of lines, loose wires and tightness of all parts. For cleaning of the engine compartment, refer to Paragraph 2-23. Maintenance instructions for the power plant may be found in Section VIII of this manual and in the appropriate manufacturer's manuals.

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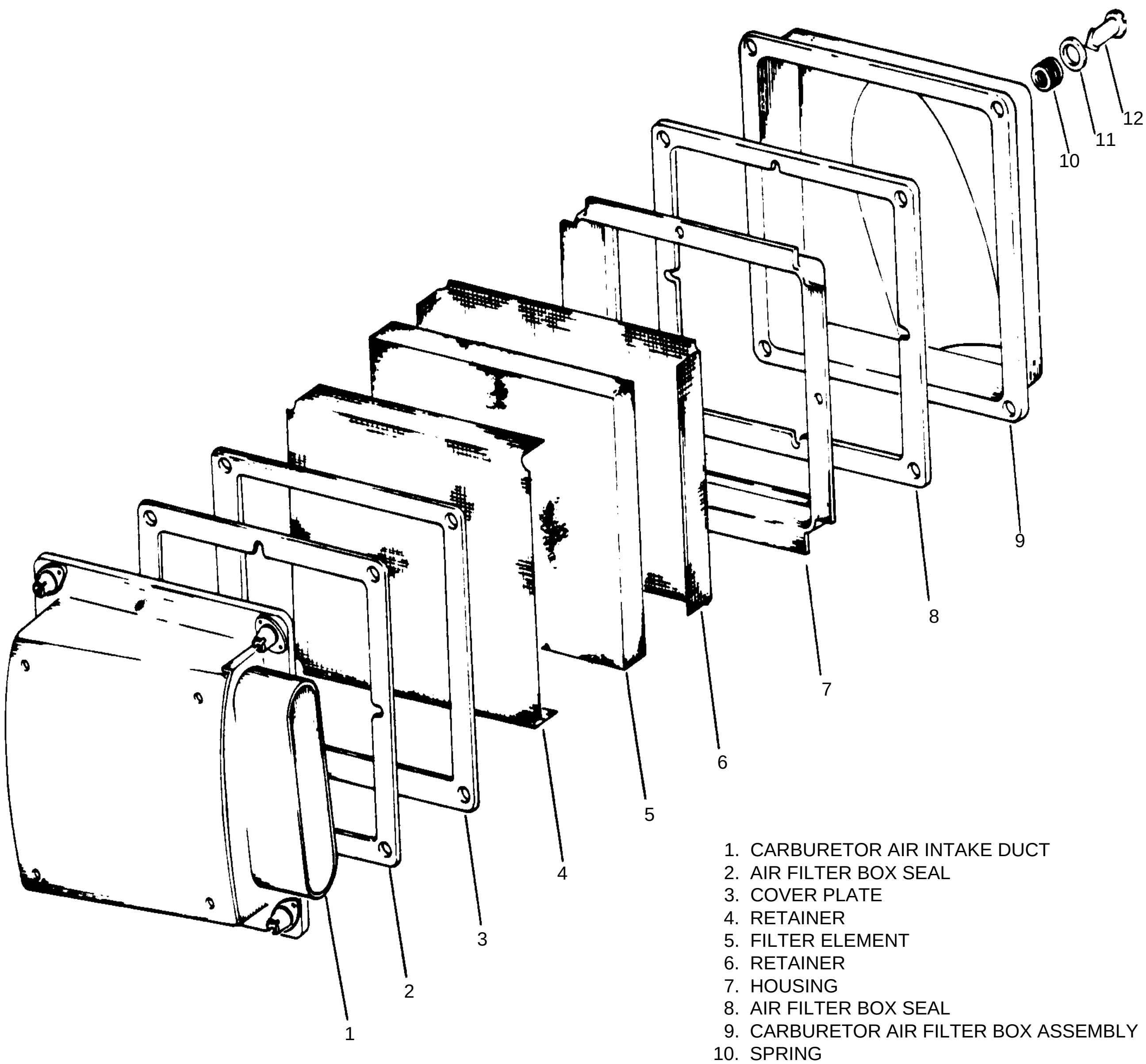


1. CARBURETOR AIR INTAKE DUCT
2. AIR FILTER BOX SEAL
3. COVER PLATE
4. RETAINER
5. FILTER ELEMENT
6. RETAINER
7. HOUSING
8. AIR FILTER BOX SEAL
9. CARBURETOR AIR FILTER BOX ASSEMBLY
10. SPRING
11. WASHER
12. FASTENER

Figure 2-9. Induction Air Filter

2-46. INDUCTION AIR FILTER.

2-47. REMOVAL OF AIR FILTER. The induction air filter is located on the right side and midway in the engine compartment, and may be removed by the following procedure:

a. Open the cowling on the right side of the engine.
b. Loosen the four quarter turn fasteners and separate the filter housing.
b. When returning existing filter element to service, shake filter to remove dirt particles.
c. Remove the filter element from its screen housing by removing the four screws.
d. Inspect filter per instructions in Paragraph 2-48.

2-48. SERVICE INSTRUCTIONS (INSPECTION AND REPLACEMENT).

a. The wet-type polyurethane foam air filter must be inspected at least once every 5O hours. Under extremely adverse operating conditions, it must be inspected more frequently. The maximum filter life is 100 hours, however, do not hesitate to replace filter if inspection reveals an excessively dirty, punctured or ruptured filter. Refer to the PA-28-161 CADET Parts Catalog for filter part number..

c. Inspect filter housing for damage and condition of seal.

d. The filter housing may be cleaned by wiping with a clean cloth soaked in a suitable quick drying type solvent. When housing is dry, reinstall filter.

2-49. INSTALLATION-OF AIR FILTER. After replacement and/or inspection. Install filter element in screen housing. Ensure the two retainers are properly positioned around the filter element according to Figure 2-9.

2-50. PROPELLER.

2-51. SERVICING PROPELLER. The propeller surfaces along with the spinner and back plate should be cleaned and inspected frequently for nicks, scratches, corrosion and cracks. Minor nicks and scratches on the propeller may be removed per instructions given in Section VIII. The rear face of each propeller blade should be painted when necessary with a flat black paint to retard glare. To prevent corrosion. wipe surfaces with a light oil or wax.

2-52. FUEL SYSTEM.

2-53. SERVICING FUEL SYSTEM. At intervals of 50 hours or 90 days, whichever comes first, clean the fuel strainer screen located in the fuel bowl, mounted on the lower left side of the firewall. There is a screen in the electric fuel pump, located at the lower left side of the engine compartment, and a screen in the inlet side of the carburetor.

Remove and clean the screens in accordance with the instructions outlined in Section IX. Additional service information may also be found in Section IX. Inspection intervals of the various fuel system component may be found in Section III.

2-54. FILLING FUEL TANKS. Observe all required precautions for handling gasoline. Fill the fuel tanks with the fuel as specified in Table II-I. Each fuel tank holds a maximum of 25 U.S. gallons. To obtain the standard fuel quantity of 36 U.S. gallons total, or 18 gallons per tank, the tanks are filled only to the bottom of the visual indicator. To obtain the standard plus reserve quantity, the tanks are filled to the top of the filler neck.

2-55. ANTI-ICING FUEL ADDITIVE. The operation of the aircraft is approved with an anti-icing additive in the fuel. When an anti-icing additive is used it must meet the specification MIL-I-27686, must be uniformly blended with the fuel while refueling, must not exceed .15% by volume of the refueled quantity, and to ensure its effectiveness, should be blended at not less than .10% by volume. One and one half liquid ozs. per ten gallon of fuel would fall within this range. A blender supplied by the additive manufacturer should be used. Except for the information contained in this section, the manufacturer's mixing or blending instructions should be carefully followed.

— CAUTION —

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

— CAUTION —

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

— CAUTION —

Fuel additive can not be used as a substitute for preflight draining of the fuel system drains.

2-56. DRAINING FUEL VALVE AND STRAINER.

a. The fuel strainer, equipped with an easy drain valve is mounted on the lower left side of the firewall. The fuel strainer should be drained regularly to check for wear or dirt accumulations. (Refer to Figure 2-10)

b. The procedure for draining the right and left tanks and lines is to open the easy drain valve for a few seconds with the fuel tank selector valve on one tank. Then change the fuel selector to the opposite tank and repeat the process, allowing enough fuel to flow out to clear the fuel line as well as the fuel strainer.

2-57. DRAINING FUEL SYSTEM. The bulk of the fuel may be drained from the system by opening the drain valve of each tank at the wing root. Push up on the arms of the drain valve and turn counterclockwise to hold the drain in the open position. The remaining fuel in the system may be drained through the filter bowl.

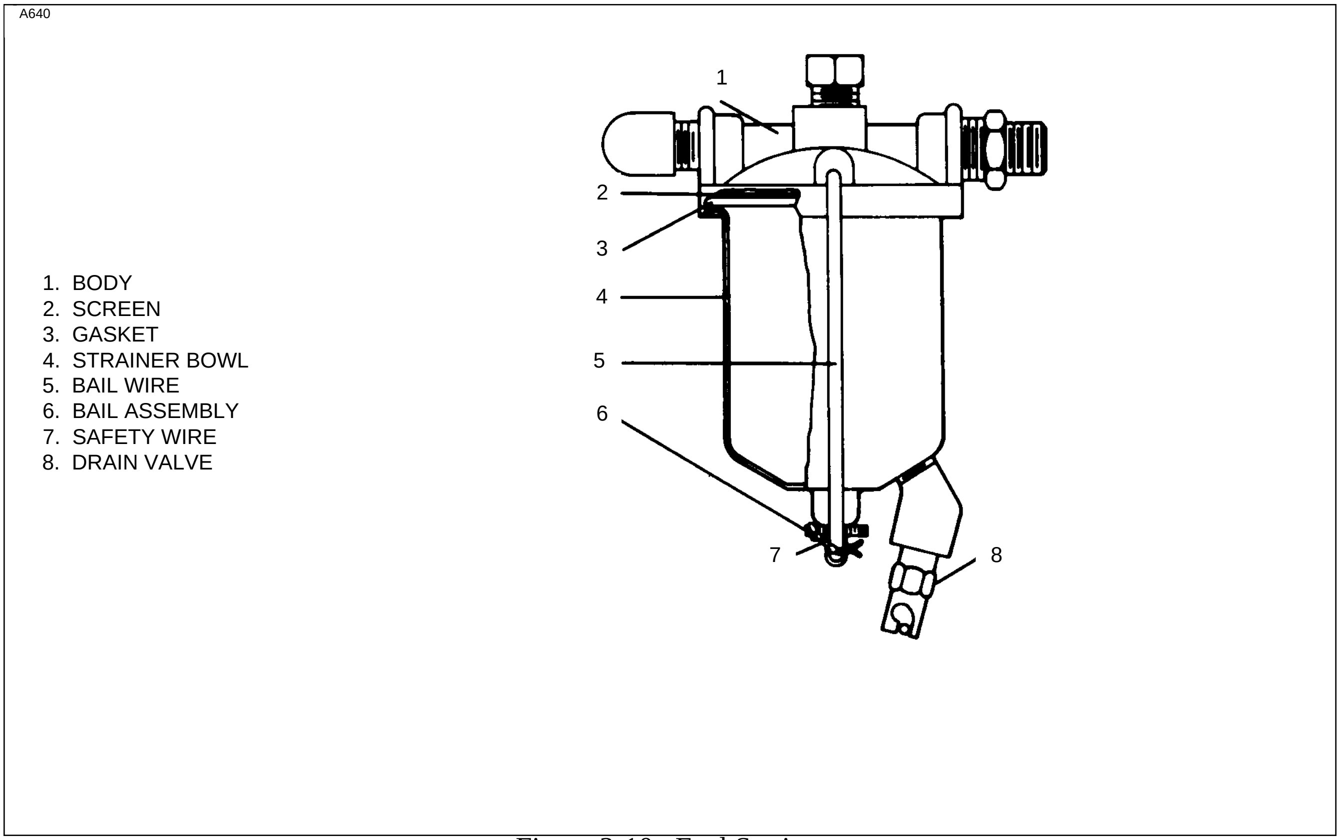


Figure 2-10. Fuel Strainer

2-58. ELECTRICAL SYSTEM.

2-59. SERVICING THE ELECTRICAL SYSTEM. Servicing the electrical system involves adding distilled water to the battery to maintain correct electrolyte level, checking cable connections, and checking for any spilled electrolyte that would lead to corrosion. (Refer to latest Piper Service Bulletin No. 631.) The security of all electrical connections should be checked as well as the operation of all lights, general condition of the alternator and starter. All electrical wires should be inspected for chafing and bare wires. For detailed information on this system, refer to Section XI of this manual.

2-60. LUBRICATION.

2-61. OIL SYSTEM (ENGINE).

2-62. SERVICING OIL SYSTEM. The engine oil level should be checked before each flight and changed after each 50 hours of engine operation. During oil change, the oil 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 and the specified octane fuel is used. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision of Lycoming Service Letter No. L185 for additional information and recommended service procedures. 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 detergent oil, refer to Paragraph 2-68 and/ or latest revision of Lycoming Service Instruction Letter No. 1014.

— CAUTION —

Do not introduce any trade additive to the basic lubricant unless recommended by the engine manufacturer.

2-63. 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. To service the engine with oil, open the right cowl panel, and remove the oil filler cap with dipstick.

2-64. 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 insure complete draining of the old oil.

2-65. OIL SCREENS (SUCTION). The oil suction screen, located either on the bottom aft end of the engine sump, installed horizontally, or forward of the carburetor installed vertically. To remove both types, 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-2099S-C41 safety wire.

2-66. 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 5O to 70 inch-pounds.

2-67. OIL FILTER (FULL FLOW).

a. The oil filter element should be replaced after each 5O 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, cut metal housing of oil filter open using a suitable tool 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 15 to 18 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.

2-68. RECOMMENDATIONS FOR CHANGING OIL. (Refer to latest revision of Lycoming Service Instruction.No. 1014.)

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

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

1.Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.

2. Do not operate the engine longer than five hours before the first oil change.

3. Check all oil screens for evidence of sludge or plugging and change oil every ten hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

2-69. 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 ensure 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 ensure 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.

2-70. 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.

2-71. APPLICATION OF GREASE. Care must be taken when lubricating bearings and bearing surfaces with a grease gun, to ensure that gun is filled with new, clean grease of the type and 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 off 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.

2-72. WINTERIZATION PLATE. For winter operations there is a winterization plate kit available. When the ambient temperature is 50°F or less the plate is installed on the inlet opening of the oil cooler pleunum chamber.

2-73. LUBRICATION CHART. (Refer to Figure 2-11.)

TABLE II-IIB. TYPE OF LUBRICANTS

LUBRICANT	SPECIFICATION	PREFERRED PRODUCT AND VENDOR
LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	MIL-L-7870	
LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	MIL-L-6082	
ENGINE (PISTON) GRADE AS SPECIFIED SAE 50 ABOVE 60°F AIR TEMP SAE 40 30° TO 90°F AIR TEMP SAE 30 0° TO 70°F AIR TEMP SAE 20 BELOW 10°F AIR TEMP		REFER TO THE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014.
HYDRAULIC FLUID PETROLEUM BASE	MIL-H-5606	
GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW	MIL-G-23827	
GREASE, AIRCRAFT HIGH TEMPERATURE		TEXACO MARFAX ALL PURPOSE GREASE, MOBIL GREASE 77 (OR MOBILUX EP2), SHELL ALVANIA EP GREASE 2
PARKER O-RING LUBRICANT		
DRY LUBRICANT	MIL-L-60326	
GREASE - LUBRICATION GENERAL PURPOSE AIRCRAFT	MIL-G-7711	
SILICONE, COMPOUND	MIL-C-21567	
GREASE, AIRCRAFT WIDE-TEMPERATURE	MIL-G-81322	MOBIL GREASE 28 AEROSHELL GREASE 22 RYOCO 22S
GREASE, HIGH AND LOW TEMPERATURE, WATERPROOF		MAG-1 AND AERO LUBRIPLATE FISKE BROS. REFINING CO. OR AERO SHELL 7

TABLE II-IIB. TYPE OF LUBRICANTS (cont)

SPECIAL INSTRUCTIONS

1. AIR FILTER - INSPECT FILTER AT LEAST ONCE EVERY 50 HOURS. UNDER EXTREMELY ADVERSE OPERATING CONDITIONS, IT MUST BE INSPECTED MORE FREQUENTLY. THE MAXIMUM FILTER LIFE IS 100 HOURS, HOWEVER, DO NOT HESITATE TO REPLACE FILTER IF INSPECTION REVEALS AN EXCESSIVELY DIRTY, PUNCTURED OR RUPTURED FILTER. ALSO REFER TO PARAGRAPH 2-48.
2. BEARINGS AND BUSHINGS - CLEAN EXTERIOR WITH A QUICK DRYING TYPE SOLVENT BEFORE LUBRICATING.
3. WHEEL BEARINGS - DISASSEMBLY AND CLEAN WITH A QUICK DRYING TYPE SOLVENT. ASCERTAIN THAT GREASE IS PACKED BETWEEN THE BEARING ROLLER AND CONE. DO NOT PACK GREASE IN WHEEL HOUSING.
4. OLEO STRUTS AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO SERVICE MANUAL, SECTION II.
5. O-RING, CONTROL SHAFT BUSHING - DISASSEMBLY O-RING RETAINER PLATES FROM INSTRUMENT PANEL. LUBRICATE O-RING AND REASSEMBLE.
6. LUBRICATION POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC., BEFORE LUBRICATING.
7. 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 AND THE SPECIFIED OCTANE FUEL IS USED. SHOULD FUEL OTHER THAN THE SPECIFIED OCTANE RATING FOR THE POWER PLANT BE USED, REFER TO THE LATEST REVISION OF LYCOMING SERVICE LETTER NO. L185 FOR ADDITIONAL INFORMATION AND RECOMMENDED SERVICE PROCEDURES.
8. LUBRICATE ALTERNATOR PULLEY BEARINGS BY REMOVING FRONT GREASE SEAL.

NOTES

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

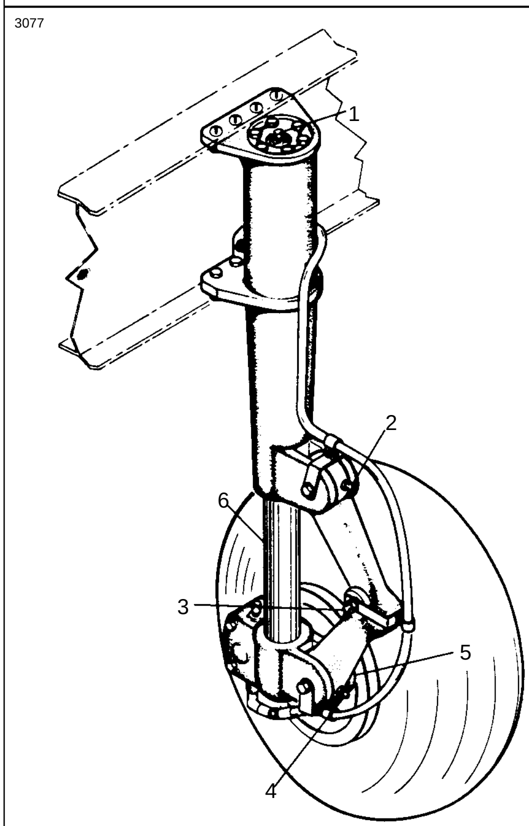
CAUTIONS

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.

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606	AS REQUIRED
2. UPPER TORQUE LINK BEARING	MIL-G-23827	100 HRS
3. TORQUE LINK BUSHING	MIL-L-7870 (See note 1) MIL-G-23827 (See note 2)	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	MIL-L-60326	100 HRS
7. BRAKE RESERVOIR	MIL-H-5606	100 HRS

SPECIAL INSTRUCTIONS

1. Main Wheel Bearings - Disassembly 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.



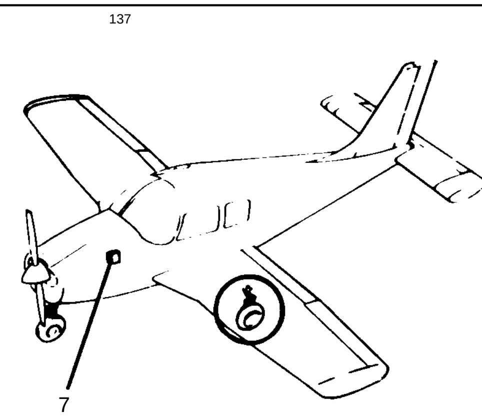


Figure 2-11. Lubrication Chart (Landing Gear, Main)

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606	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. MAIN WHEEL BEARING	TEXACO MARFAX ALL PURPOSE GREASE OR MOBILE GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. NOSE GEAR STEERING ROD END BEARINGS	MIL-L-7870	100 HRS
7. EXPOSED OLEO STRUT	MIL-L-60326	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 refer to service manual.

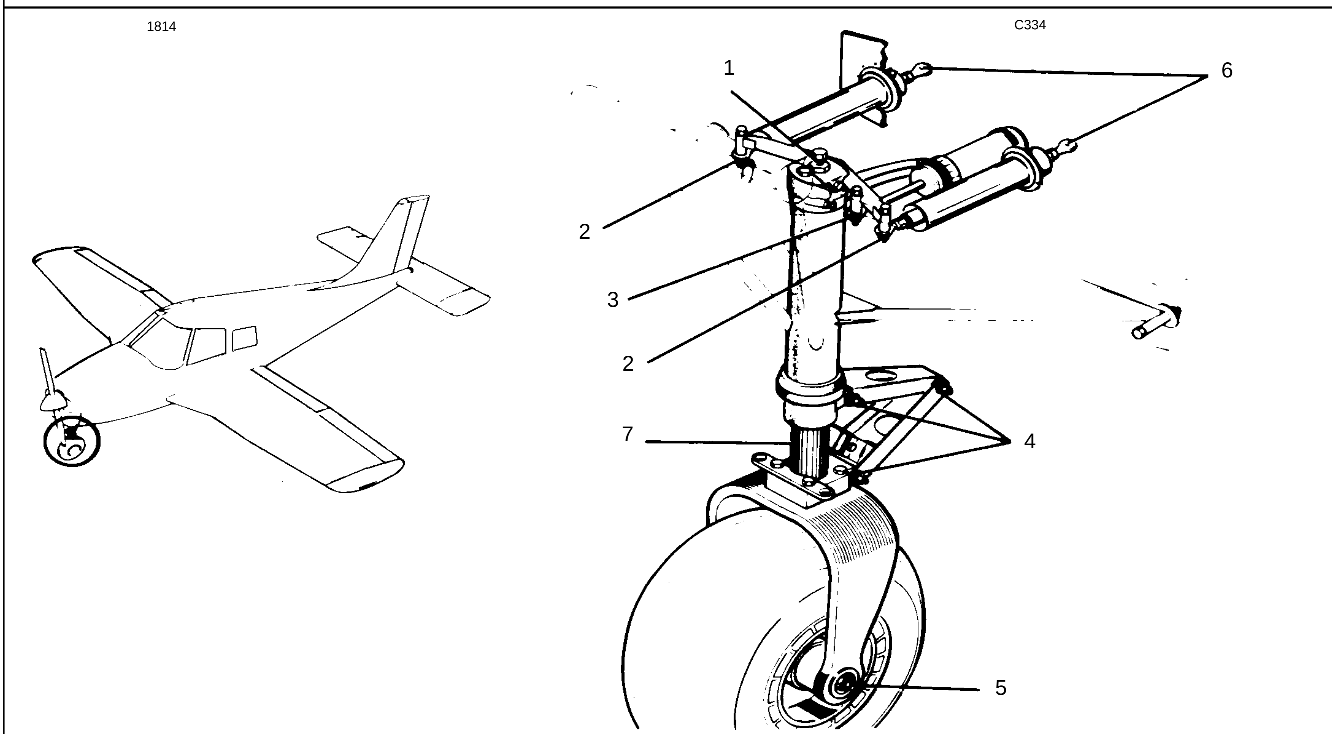


Figure 2-11. Lubrication Chart (Landing Gear, Nose) (Cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. AILERON HINGE PINS	MIL-L-7870[1]	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	100 HRS
7. O-RING, CONTROL SHAFT BUSHING	PARKER O-RING[2] 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

SPECIAL INSTRUCTIONS

1. 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.
2. Disassemble O-ring retainer plates from instrument panel; lubricate O-ring and reassemble

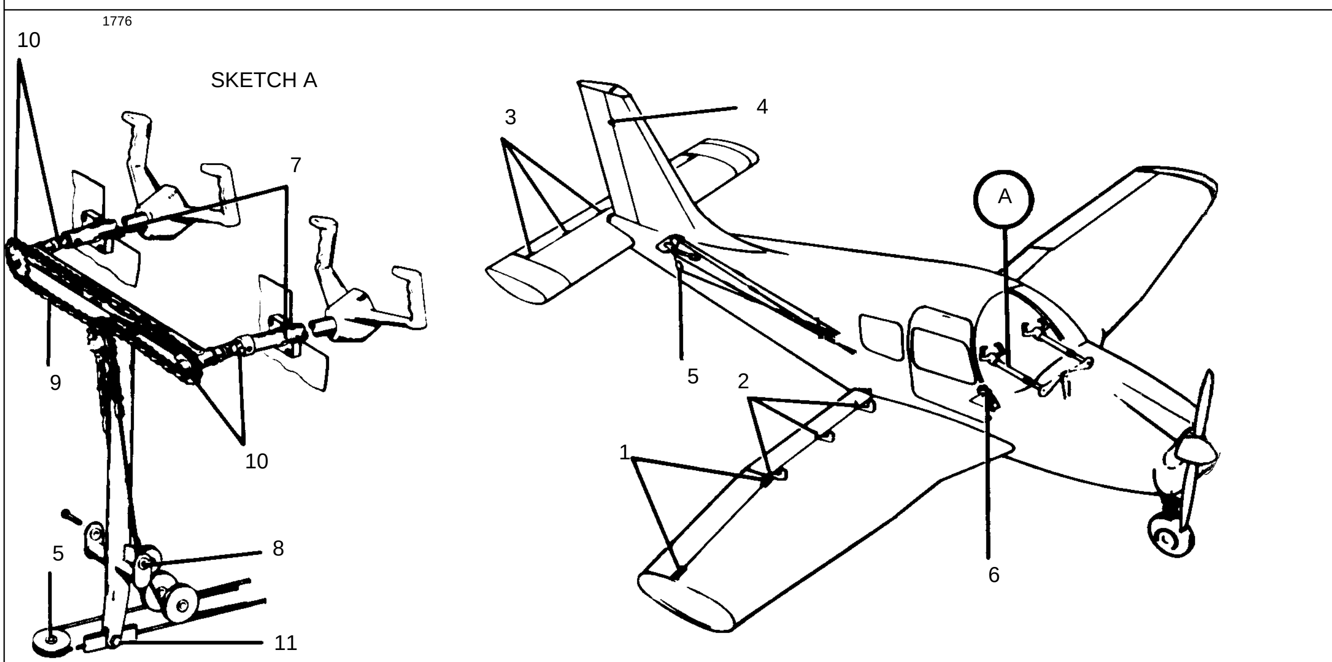


Figure 2-11. Lubrication Chart (Control System) (Cont.)

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, TURNBUCKLE END AND CABLE PULLEY	MIL-L-7870	100 HRS
4. FLAP RETURN AND TENSION CHAINS	MIL-L-7870	500 HRS
5. AILERON BELLCRANK PIVOT POINT	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

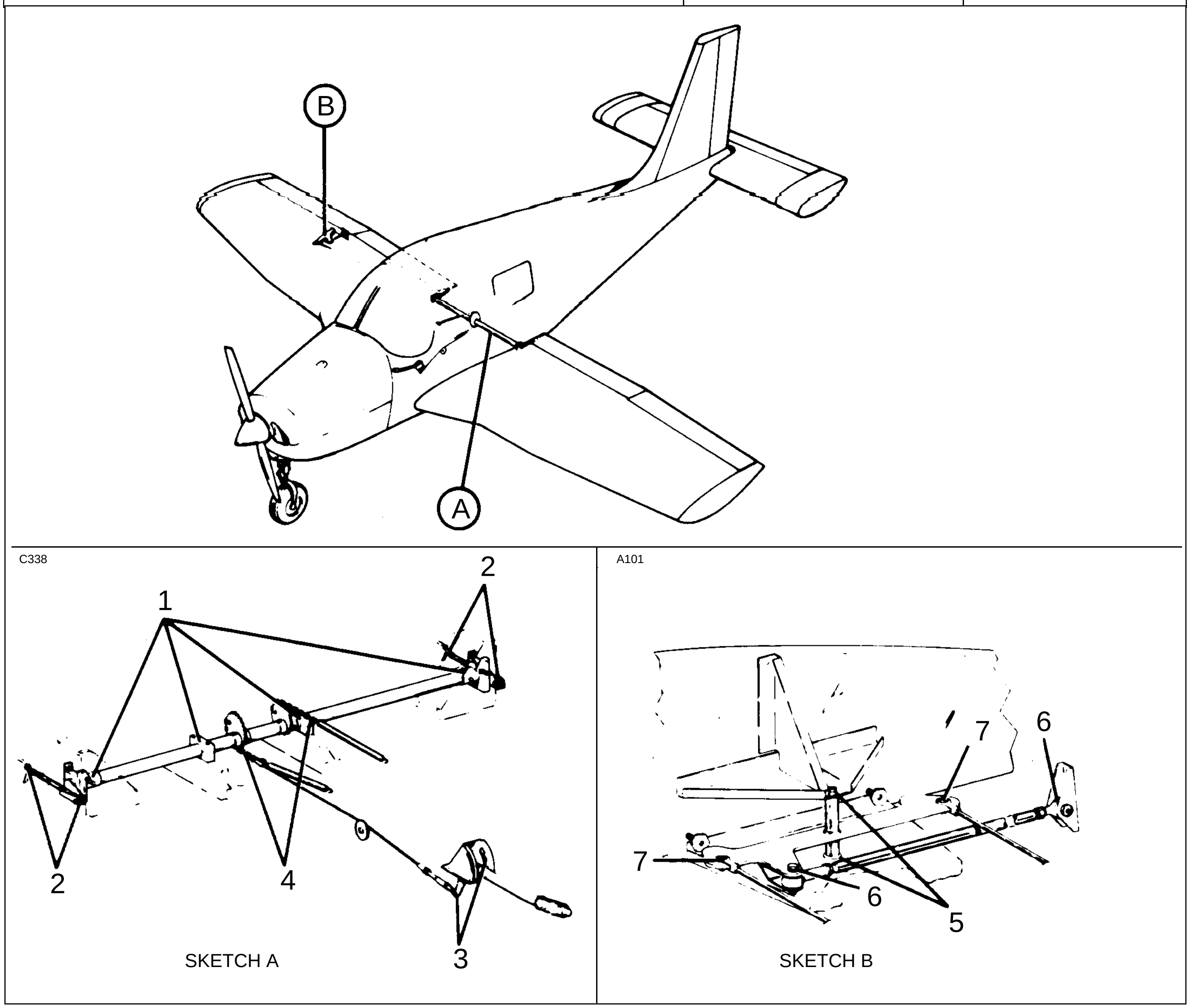
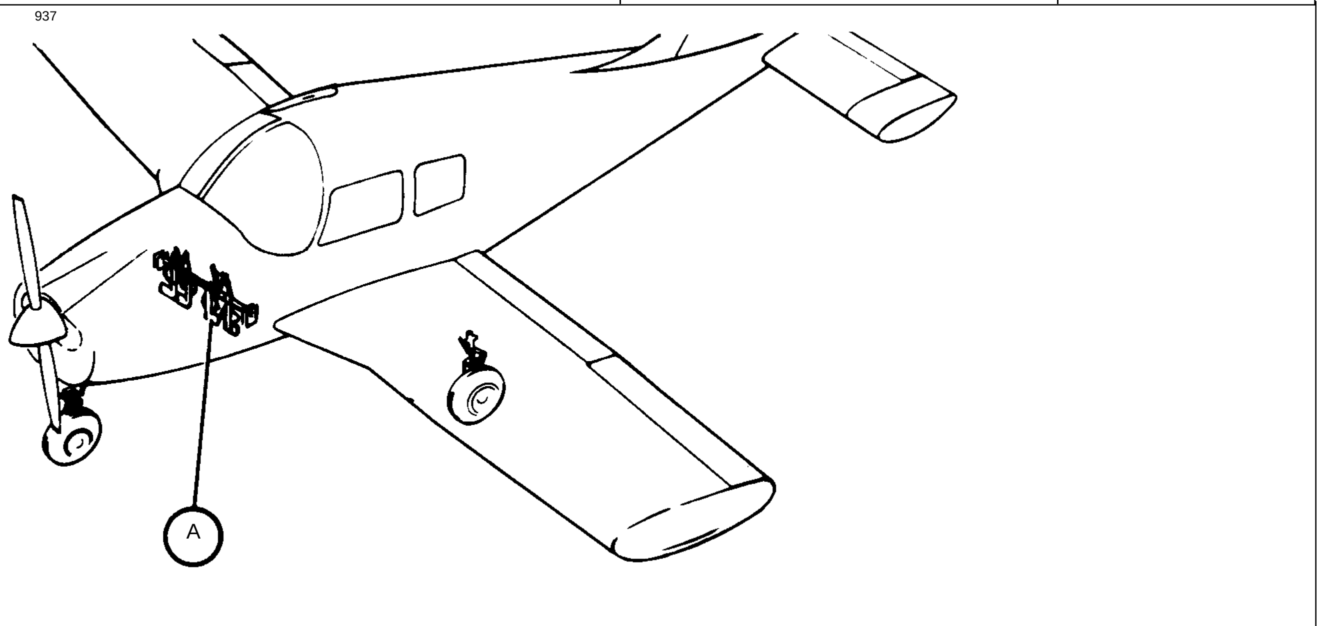


Figure 2-11. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS	MIL-L-60326	100 HRS
2. TOE BRAKE CYLINDER ATTACHMENTS	MIL-L-7870	100 HRS
3. RUDDER TUBE CONNECTIONS	MIL-L-7870	100 HRS
4. BRAKE ROD ENDS	MIL-L-7870	100 HRS
5. NOSE GEAR STEERING ROD ENDS	MIL-L-7870	100 HRS
6. RUBBER BEARINGS	MIL-L-60326	100HRS



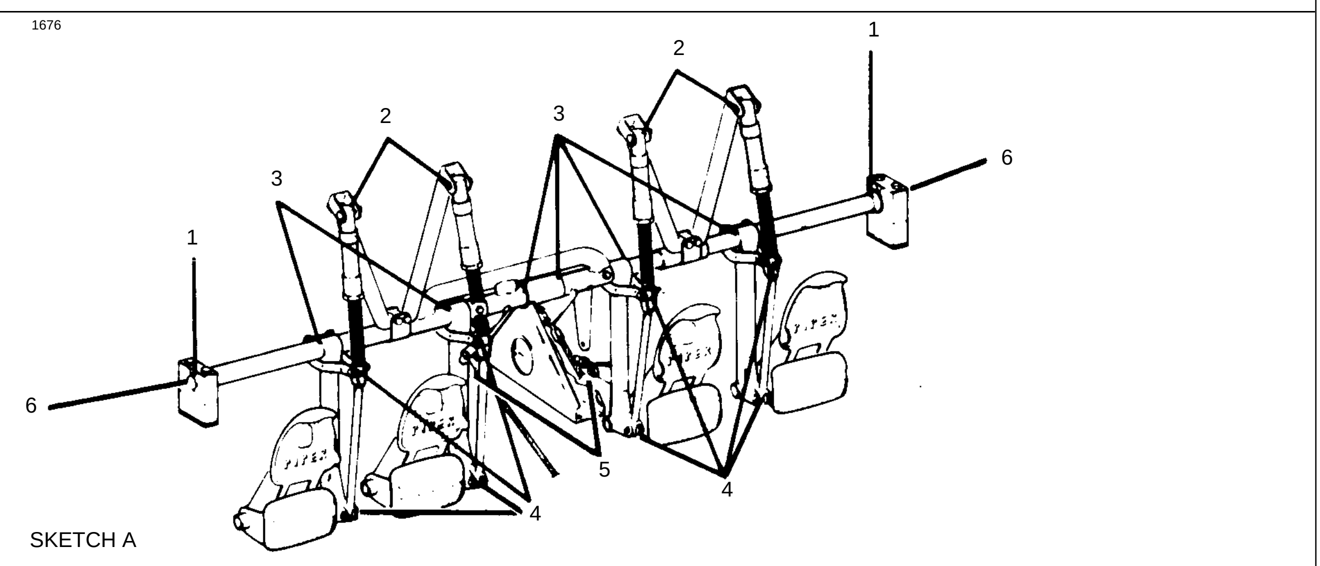


Figure 2-11. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER ARM CABLE ENDS	MIL-L-7870	100 HRS
2. STABILATOR TRIM SCREW	MAG-1 OR AERO LUBRIPLATE, FISKE BROS. REFINING CO. OR AERO SHELL 7	100 HRS
3. STABILATOR SCREW TAB LINKS	MIL-L-7870	100 HRS
4. STABILATOR HINGE POINTS	MIL-L-7870	100 HRS
5. RUDDER TRIM ASSEMBLY	MIL-L-7870	100 HRS

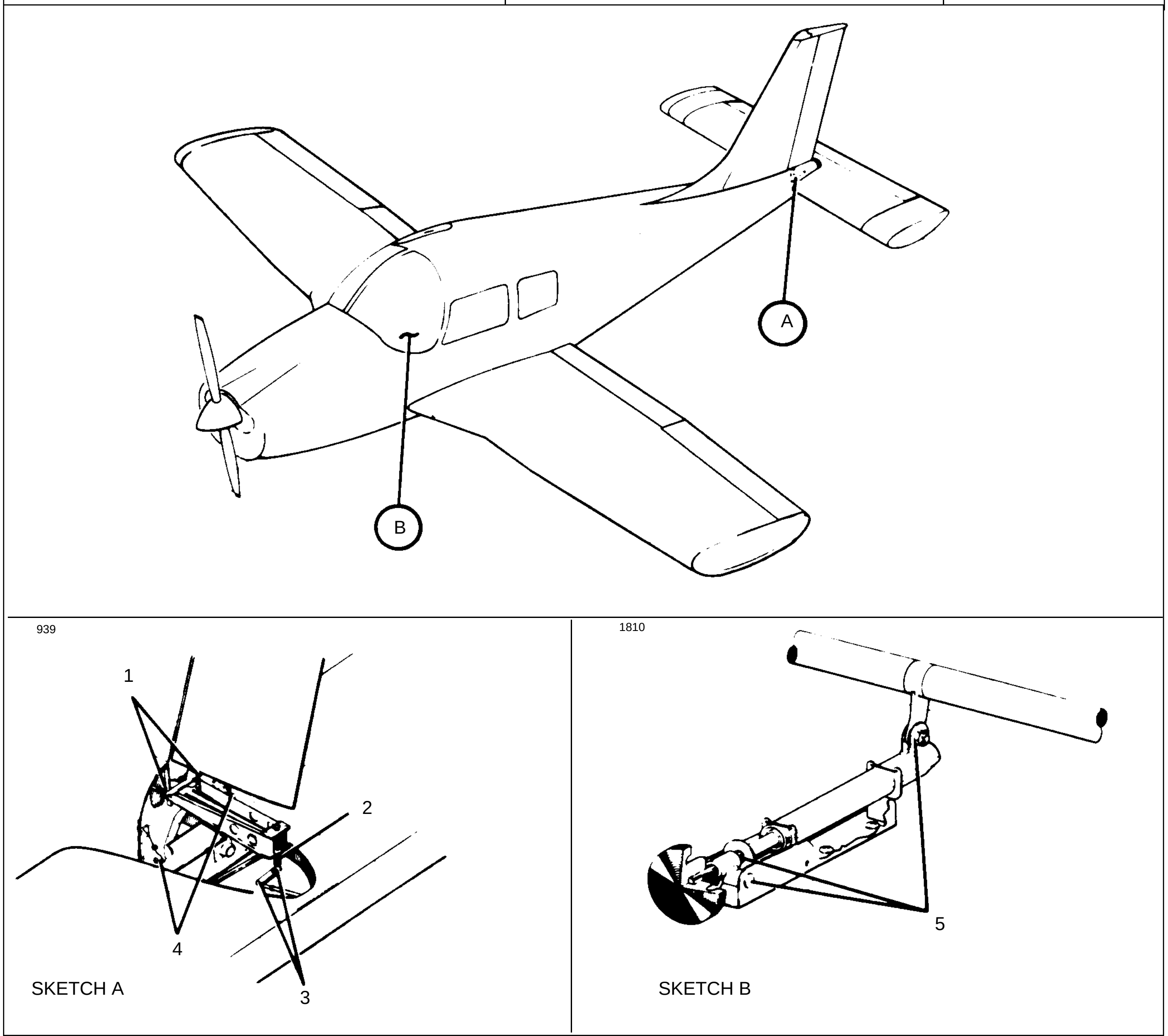


Figure 2-11. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. DOOR HINGES	MIL-L-7870	100 HRS
2. DOOR SEALS	MIL-L-60326	50 HRS
3. DOOR LATCH MECHANISMS	MIL-L-7870	500 HRS
4. SEAT TRACK ROLLERS, STOP PINS	MAG-1 OR AERO LUBRIPLATE, FISKE BROS. REFINING CO. OR AERO SHELL 7	100 HRS

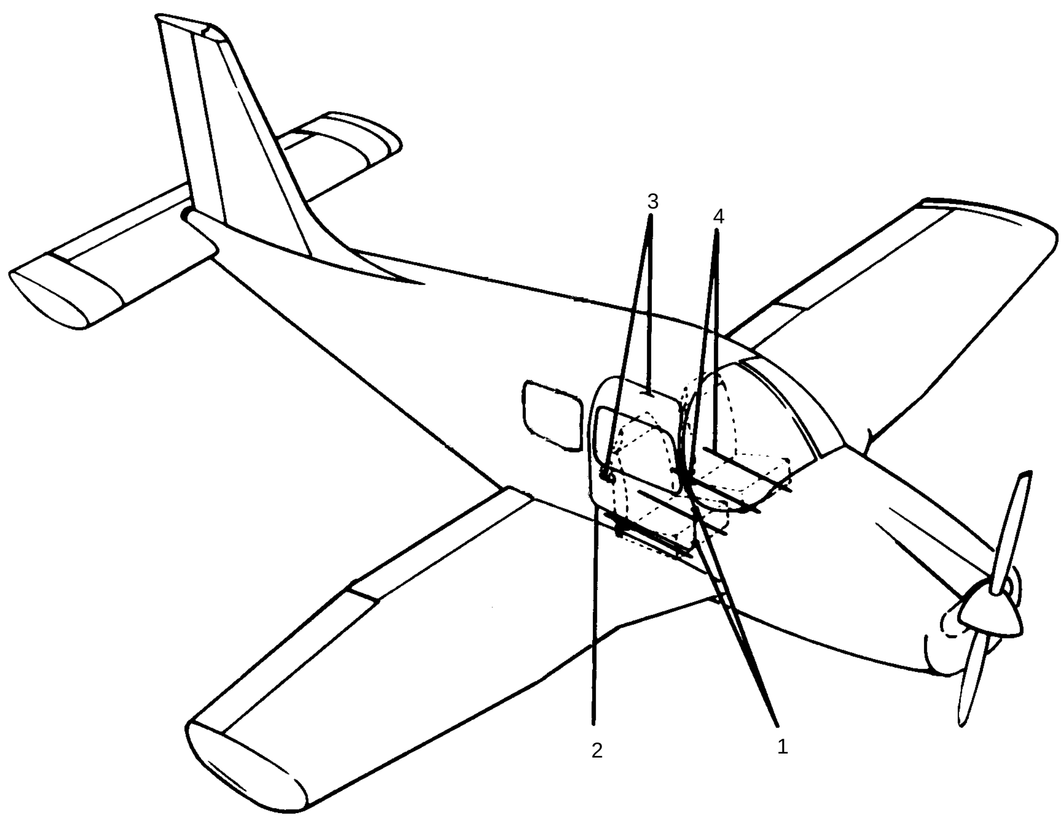


Figure 2-11. Lubrication Chart (Cabin Door, and Seat) (Cont.)

COMPONENT	LUBRICANT	FREQUENCY
1.ENGINE SUMP	MIL-L-6082 LUBRICATING OIL,AIR-CRAFT RECIPROCATING ENGINE (PISTON) GRADE AS SPECIFIED SAE 50 ABOVE 60°F AIR TEMP., SAE 40 30° TO 90°F AIR TEMP., SAE 30 0° TO 70°F AIR TEMP., SAE 20 BELOW 10°F AIR TEMP.	50 HRS
2.CARTRIDGE TYPE OIL FILTERS	————————	50 HRS
3.AIR FILTERS	————————	50 HRS
4.ENGINE CONTROL AND ENVIRON MENTAL CONTROL PIVOT POINTS	MIL-L-7870	100 HRS
5.FRESH AIR VENT SHAFTS	MIL-G-7711	100 HRS

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 specified octane fuel is used and the filter replaced each 50 hours of operation. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision of Lycoming Service Letter No. L185, for additional information and recommended service procedures.

NOTE

See the latest revision of Lycoming Service Instructions No. 1014 for use of detergent oil.

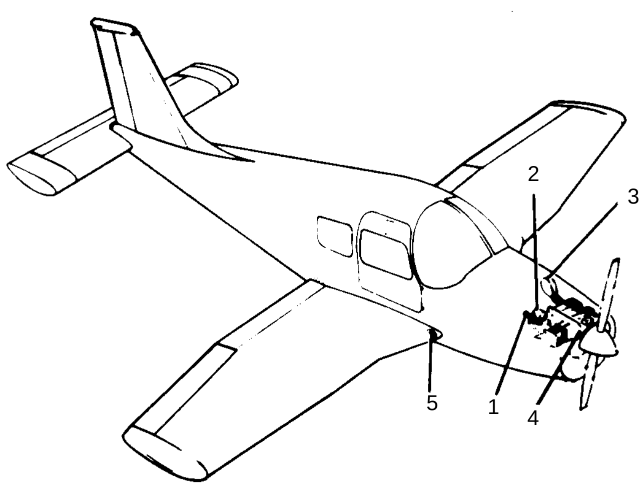


Figure 2-11. Lubrication Chart (Cont) (power Plant and Control Pivot Points.

2-74. CORROSION CONTROL. Corrosion is the deterioration of metal by chemical or electrochemical attack. Water which is allowed to remain on the aircraft and industrial pollution are the major causes of corrosion in aircraft. The two general types of corrosion are: 1. a direct chemical attack (ex. spilled battery acid); and, 2. electrochemical attack which requires a medium (usually water). The latter is the most common and is responsible for most forms of aircraft corrosion.

Since corrosion is a constant threat, the only effective method to control it is a routine of regular inspection, cleaning, and surface refinishing.

2-75. FORM OF CORROSION. The following are the most common forms of corrosion:

a. **Surface Corrosion** appears as a general roughening or pitting on the surface usually accompanied by a powdery deposit of corrosion products. It may spread under the surface and not be recognized until the paint or plating is lifted off the surface in small blisters.

b. **Dissimilar Metal Corrosion** may occur when two dissimilar metals are contacting each other. This type may be serious because it usually takes place out of sight. The only way to find it before structural failure is by disassembly and inspection. Insulating is necessary between two contacting dissimilar surfaces (2-3 coats of zinc chromate on each surface; plus a .003 thick piece of vinyl tape if one of the surfaces is magnesium).

c. **Intergranular Corrosion** is difficult to detect in its early stages. When severe, it causes the surface of the metal to "exfoliate" (flake or lift).

d. **Stress Corrosion** is the result of sustained tensile stresses and corrosive environment. It usually occurs in assemblies such as aluminum alloy bellcranks with pressed in bushings; landing gear shock struts with pipe thread grease fittings, clevis pin joints and shrink fit parts.

e. **Fretting Corrosion** takes place when two parts rub together, constantly exposing fresh active metal to the corrosive effects of the atmosphere.

f. **Filiform Corrosion** is the appearance of numerous meandering threadlike filaments of corrosion on the surface of various types of metal.

2-76. CONDITIONS AFFECTING CORROSION. Some conditions which affect the occurrence of corrosion are:

a. The environmental conditions affect the corrosion characteristics. A hot, humid climate increases corrosion. One of the worst conditions would be allowing the aircraft to be constantly exposed to the corrosive elements found near the ocean.

b. Different metals and their sizes affect resistance to corrosion.

c. The foreign materials which most frequently contribute to corrosion are:

1. Soil and atmospheric dust.
2. Oil, grease and exhaust residues.
3. Salt water and salt moisture condensation.
4. Spilled battery acids and caustic cleaning solution.
5. Welding, brazing and soldering flux residue.

A clean aircraft will resist corrosion better than a dirty one. Cleaning frequency depends on several factors (such as geographical location, type of operation, etc.). Soil should be removed as soon as possible, especially when it is on a high temperature area.

After cleaning, ensure that no cleaning solution remains in any holes, crevices or joints, as it may lead to increased corrosion. Also, all exposed areas (landing gear, flap tracks, control surface, hinge parts, etc.) should be lubricated after cleaning.

2-77. INSPECTION. Corrosion should be suspected at every inspection. In trouble areas, the inspection frequency should be increased.

In addition to routine inspections:

a. Aircraft operating around a marine environment should be given special checks on a weekly basis.

b. Aircraft operating in semi-acid condition should be inspected monthly.

c. Inspections for corrosion should be performed by personnel familiar with corrosive problems and their remedies as follows:

1. Daily and preflight inspections should include the engine frontal areas, all intake vents, engine compartment, gaps, seams, and faying surfaces in the exterior skins, wheel and wheel well areas, battery compartments, fuel cell and all other drains, and any bilge areas not requiring extensive removal of inspection access covers.

2. Detailed inspection should include the above referenced areas along with areas requiring removal of screw attached inspection plates and panels to thoroughly inspect the internal cavities of the aircraft.

d. During inspection, remember that paint tends to hide corrosion in its initial stages. However, the results of corrosion can sometimes be seen as blisters, flakes, chips and other irregularities in the paint.

2-78. CORROSION REMOVAL AND CONTROL. Corrosion cannot be prevented or eliminated on aircraft; it can only be reduced to an acceptable level by proper control methods.

All corrosion products must be removed prior to refinishing. If they are not removed, corrosion will begin again, even though the affected area is refinished.

Before beginning any rework:

a. Position the airplane in a wash rack or provide some type of washing apparatus for rinsing of all surfaces.

b. Connect a static ground line to the airplane.

c. Remove the airplane battery if required.

d. Protect the pitot-static ports, engine openings, airscoops, louvers, wheels, tires and other portions of the airplane from moisture and chemical brightening agents.

e. Protect the surfaces next to the rework areas from chemical paint strippers, corrosion removal agents and surface treatment materials.

An evaluation of the corrosion damage is necessary to determine the type and extent of repairs required. The following are general guidelines:

a. Light Corrosion: discoloration or pitting normally removed by light hand sanding or a small amount of chemical treatment.

b. Moderate Corrosion: similar to light corrosion except there could be some blistering or evidence of peeling and flaking; removed by extensive hand sanding or mechanical sanding.

c. Severe Corrosion: similar to moderate corrosion with severe blistering, exfoliation, sealing and/or flaking; normally removed by extensive mechanical sanding or grinding.

— CAUTION —

Removal of severe corrosion may be deemed as a major repair. The repair must be approved by the FAA upon completion.

There are several methods for removing corrosion; chemical treatment; hand sanding with abrasive paper or metal wool; and, mechanical sanding or buffing with abrasive materials or grinding wheels. The method selected depends on the type and extent of the corrosion.

Depressions resulting from rework must be faired into the surrounding surface.

The depth of materials removed should not exceed the safe limits.

Reprotecting the surface after corrosion removal is very important. It should be done as soon as the repair work is finished. The surface should be protected in the same manner as the original surface was protected unless the manufacturer recommends some other procedure or protective coating.

TABLE II-IIC. TYPES OF METAL CORROSION

Type of Material	**Type of Corrosion**	**Remedy ****
Steel	Rust *	Complete removal of corrosion by mechanical means.
Aluminum	White to grey powdery material.	Mechanical polishing or brushing with material softer than aluminum.
Magnesium (highly susceptible to corrosion)	White powdery snow-like mounds and white spots.	
Cadmium (plating)	White to brown to black mottling of surface (plating is still protecting until iron appears).	Mechanical removal of corrosion should be limited to metal surfaces from which the cadmium has been depleted.
Chromium (plating)	May pit in chloride environment.	Promotes rusting of steel where pits occur in the coating.

* Red rust generally shown on bolt heads, hold-down nuts and other aircraft hardware. Its presence in these areas is generally not dangerous. However, it is indicative of a need for maintenance and also of the possibility of corrosive attack in more critical areas.
Any corrosion on the surface of a highly stressed steel part is potentially dangerous. A careful removal of corrosion product using mild abrasives (rouge or fine grit aluminum oxide paper) is necessary, using care not to overheat the metal when removing the corrosion.
** For abrasion, do not use dissimilar materials (ex. steel on aluminum). Remove only the material required to clean up the affected area.

2-79. AREAS PRONE TO CORROSION. Certain areas are more prone to corrosion than others. The following list is intended to be a general guide to areas where corrosion is frequently found:

a. Areas around steel fasteners are susceptible to corrosion. The paint on these areas cracks which allows moisture to seep in and corrode the under-lying metal. Each time the fastener is removed, it should be coated with zinc chromate before reinstallation. The paint should be wet when fasteners are installed.

b. Fluids tend to seep into faying surfaces, seams and joints due to capillary action. The effect of this type of intrusion is usually detectable by irregularities in the skin's surface.

c. Spot welded assemblies are particularly prone to corrosion. The only means to prevent this type of corrosion is by keeping potential moisture entry points in the spotweld filled with a sealant or preservative compound.

d. Areas which are exposed to exhaust gases may have their finish damaged by deposits. These deposits may result in an aggressive attack on the metal by corrosion. Heat from the exhaust may also blister or otherwise damage the paint. Gaps, seams, hinges and fairings are some places where exhaust gas deposits may be trapped and not reached by normal cleaning methods.

e. The wheel well and landing gear are the most exposed parts of the aircraft. Due to the complexity of its shape, maintaining a protective coverage is difficult. The especially troublesome areas are: magnesium wheels, around boltheads, lugs and wheel well areas; exposed rigid tubing, B-nuts, ferrules; under clamps and tubing identification tape; exposed position indicator switches and other electrical equipment; crevices between stiffeners, ribs and lower skin surfaces.

f. Flaps, flight controls and equipment installed in these areas may corrode unnoticed unless a careful surveillance is maintained.

g. Engine frontal areas, air inlet ducts and the leading edge of wings, because they are constantly exposed to abrasion by dirt, dust, gravel and rain, should be checked frequently for the beginning of corrosion.

h. Hinges (piano hinges especially) are extremely vulnerable to corrosion due to the wearing away of their protective coating and their being a natural trap for dirt, salt and moisture.

i. Control cables may have bare spots in their preservative coating which could lead to corrosion. Cables having external corrosion should be checked for internal corrosion. If internal corrosion is present, replace the cable. If only external corrosion is present, remove corrosion with a wire brush and recoat cable with preservative.

j. Any area where water may be trapped is a trouble spot for corrosion. Drain holes should be checked and cleaned regularly.

k. Battery compartment and vent openings are particularly prone to corrosion due to spilled electrolyte. Fumes from overheated battery electrolyte will spread to adjacent areas and cause rapid corrosion of unprotected surfaces. Frequent cleaning and neutralization of deposits will minimize corrosion from this cause.

l. Due to magnesium parts being prone to corrosion. Special attention should be given to their surface treatment, proper insulation (due to dissimilar metal corrosion) and paint coatings.

m. Electrical components and connectors should be checked. Their inspection frequency should be based on their operational environment and past trouble with them.

n. Skin joints and lap-overs are two areas which may contain moisture. Corrosion in these areas may go unnoticed unless particular attention is paid to them during inspection.

o. Hoses having an internal wire braid which are located in a position where they are frequently water soaked need a protective treatment.

p. Drilled holes and the trimmed end of sandwich panels should be protected. An inhibitor solution and/or sealant application is recommended. Any gaps or cavities which allow dirt or moisture to enter should be filled with a sealant.

2-80. REPAINTING. If it becomes necessary or desirable to repaint the aircraft, the following procedures will apply:

a. Mask all glass and areas not to be painted.

— NOTE —

Solvent resistant masking tapes are authorized for use.

— NOTE —

Masking tapes should be removed as soon as practicable after finish application.

b. Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils.

— NOTE —

Solvent may be applied by dipping, spraying or mopping.

c. If the metal surface has been stripped, prime with an aircraft quality primer according to instructions for appropriate finish.

d. If the previous coating has not been stripped or removed thoroughly, wet or dry sand the previous coating with 400 to 600 grit "wet or dry" abrasive paper.

e. Thoroughly wash the sanded area with a suitable cleaning solvent and wipe dry with clean rags or other suitable materials free of lint and silicones.

f. Repair with desired color according to instructions.

2-81. PRODUCT LISTING FOR URETHANE ENAMEL AIRCRAFT FINISH (OPTIONAL FINISH).

a. Prime Coat:
   DuPont Corlon Epoxy Zinc Chromate Primer 825S
   Primer Catalyst 826S
   Primer Reducer 3602S

b. Color Coat:
   DuPont Imron Urethane Enamel (Selective)
   Color Catalyst 192S
   Color Reducer Y8485S
   Accelerator 189S
   Additive 259S

c. Suggested Solvents:
   Safety Solvent per MIL-S-18718
   Sherwin Williams Lacquer Thinner R7KC120
   Glidden Thinner No. 207

2-82. PREPARATION OF EPOXY ZINC CHROMATE PRIMER.

a. MIXING RATIO: Two parts primer 825S with one part activator 826S. Thin with approximately one part reducer 3602S, mix thoroughly, and allow to stand for one hour minimum.

b. DRY FILM THICKNESS: 0.0005 to 0.0007 inch dry film thickness.

c. TOPCOAT: Urethane enamel may be applied after 30 minutes minimum at 75° ± 5°F.

2-83. PREPARATION AND APPLICATION OF DUPONT IMRON URETHANE ENAMEL.

a. MIXING RATIO: Three parts enamel with one part activator 192S. Thin with approximately one part reducer Y8485S.

— NOTE —

For each gallon of the above mixture, add and mix in four ounces of accelerator 189S, and two to four ounces per gallon (as required to prevent craters, surface imperfections, etc.) of additive 259S.

b. APPLICATION: Two wet coats of the enamel. The first coat shall be allowed to flash dry for ten minutes minimum prior to application of the second coat. The enamel shall be forced dried at 100° ± 5°F for 90 minutes minimum after the second coat.

c. DRY FILM THICKNESS: Of the combined coatings shall be 0.0018 to 0.0022 inch.

c. Suggested Solvents:
Safety Solvent per MIL-S-18718
Sherwin Williams Lacquer Thinner R7KC120
Glidden Thinner No. 207

2-84. PRODUCT LISTING FOR RANDOLPH PAINT FINISH.

a. Prime Coat:
Use zinc chromate primer per MIL-P-7962.

b. Color Coat:
Randolph Paints B5420/D7784
Thinner B5408A
Solvent P6737

2-85. PREPARATION AND APPLICATION OF ZINC CHROMATE PRIMER. This primer shall be used only on aluminum previously primed with MIL-P-8585 zinc chromate or MIL-C-8514 wash primer. The use of this primer over MIL-P-8585 is an exception and will result in a small reduction in gloss. This condition is acceptable on aircraft with special corrosion proofing.

a. MIXING RATIO: Mix approximately two parts of the packaged primer with three parts of lacquer thinner. Vary mix where needed to allow a thin wet coat application.

b. APPLICATION: A thin wet coat.

c. DRY FILM THICKNESS: Between .0003 and .0005 inches thick.

— NOTE —

Blushing may be controlled under conditions of high humidity by the replacing of up to 6% of the thinner with ethylene glycol monobutyl ether per TT-E-776.

2-86. FINISH PAINTING WITH RANDOLPH PAINT (B5420/D7784).

a. MIXING RATIO: When Randolph B5420 is sprayed it should be thinned for proper spraying results for either hot or cold spray. Randolph D7784 is prethinned, but may be thinned if required.

b. APPLICATION: May be hot or cold sprayed.

c. DRY FILM THICKNESS: Desirable finish varies from 0.00175 to 0.003 inch dry film thickness.

— NOTE —

Overspray may be redissolved by spraying with Randolph B5408A thinner or P6737 solvent.

2-87. REPAIRS. Removal of spots, sags, curtains, overspray and other blemishes which appear in the finished paint film can be removed by the most suitable of the following methods:

a. Remove the blemish using 400 to 600 grit "wet or dry" abrasive paper. Clean and dry thoroughly. If necessary, spray with the paint manufacturer's recommended thinner or thinned finish to blend.

b. Undried overspray may be leveled by spraying with a light coat of paint manufacturer's recommended thinner.

c. Rub with a fine grit rubbing compound manufactured for use on automotive finishes. Types containing wax shall not be used unless the wax is removed using a suitable solvent such as gasoline, turpentine, or soap solution. Water soluble types are preferred. After rubbing, spray with the paint manufacturer's thinner or thinned finish to blend, if required.

2-88. REMOVAL OF CHERRYLOCK RIVETS. To remove cherrylock rivet:

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 of the stem be drilled away to destroy the lock. (See View 2.)

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.)

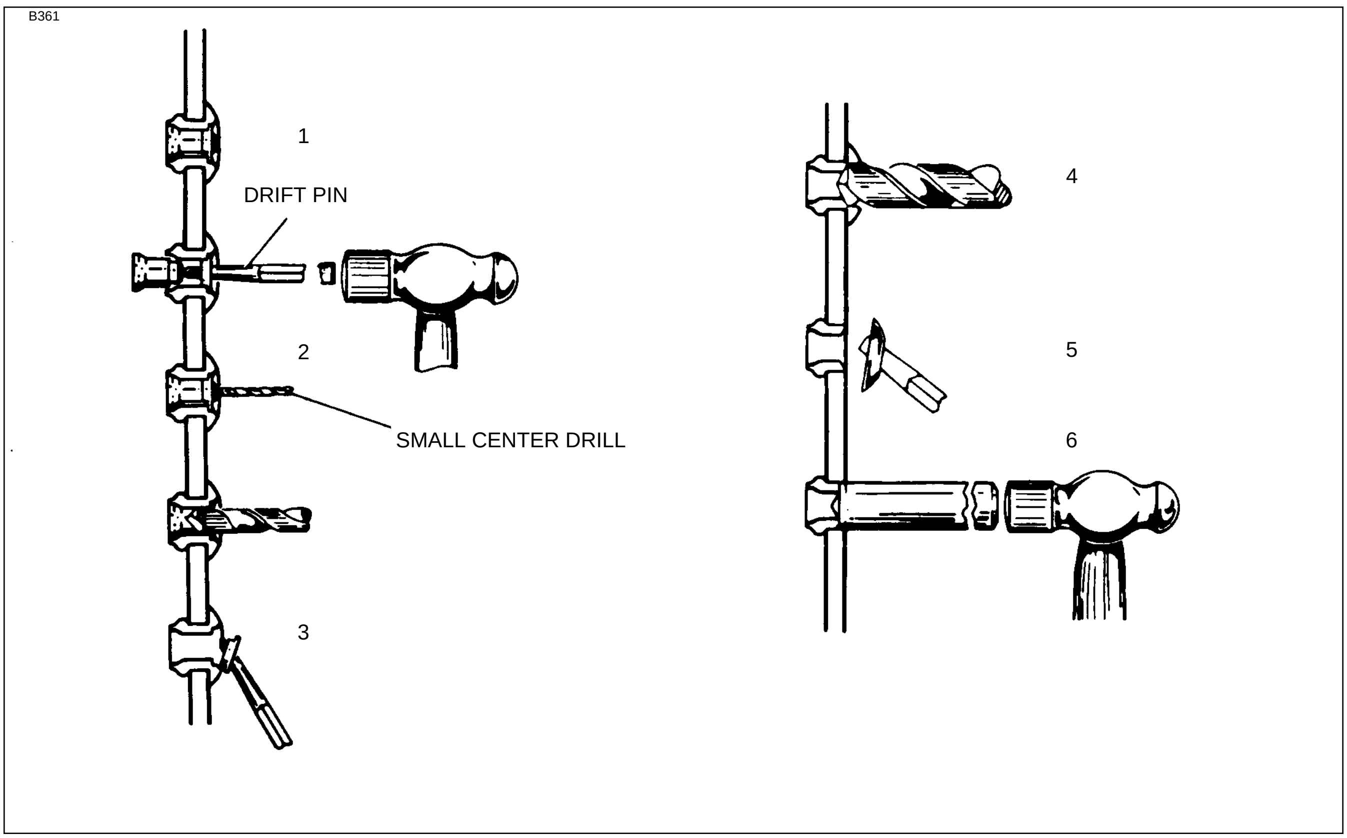


Figure 2-12. Cherrylock Rivet Removal

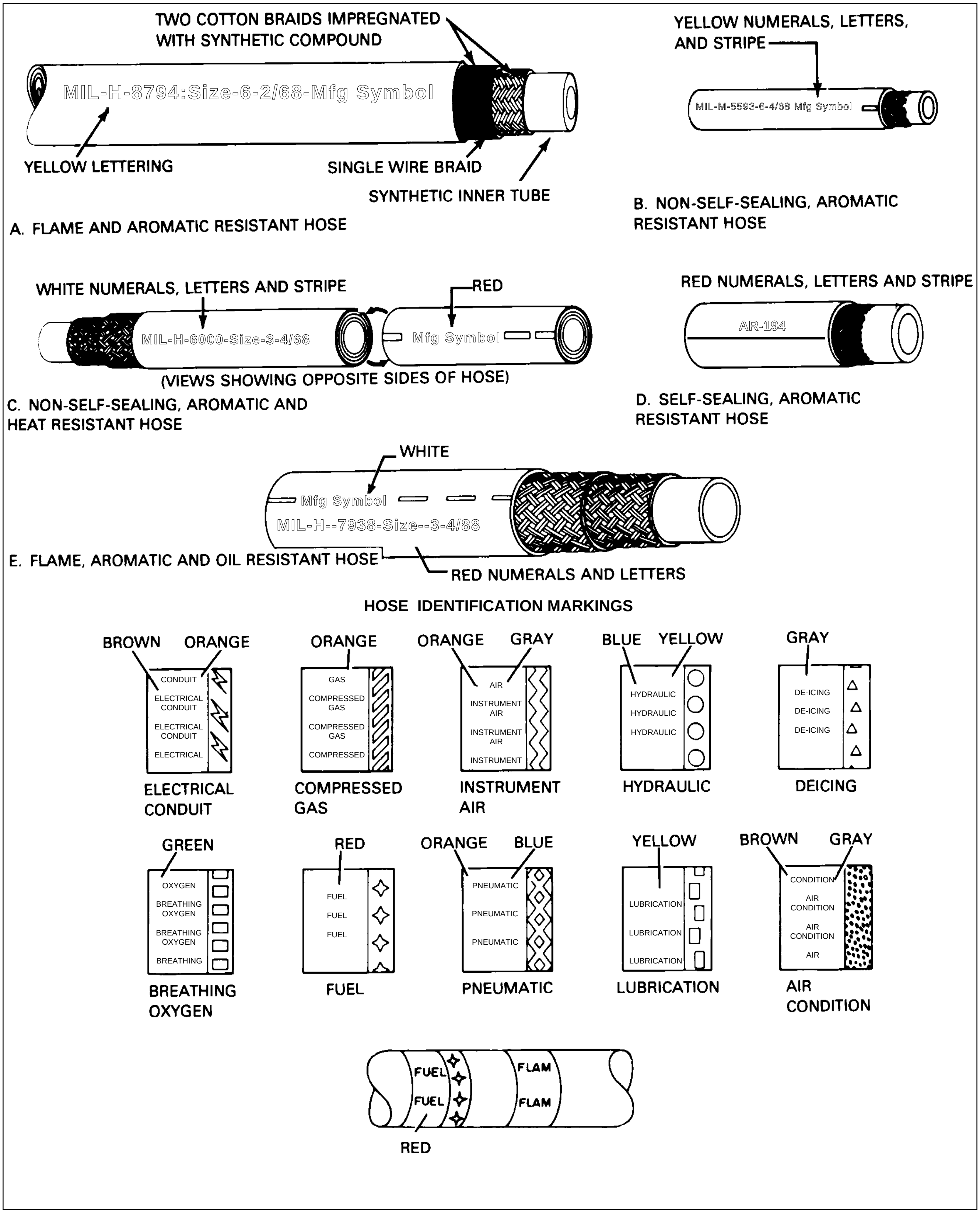


Figure 2-13. Identification of Aircraft Fluid Lines

2-89. STANDARD PRACTICE - AIRFRAME

2-90. TORQUE WRENCH. 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 2-14.)

T = Torque desired at the part.

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

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

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

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

EXAMPLE

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

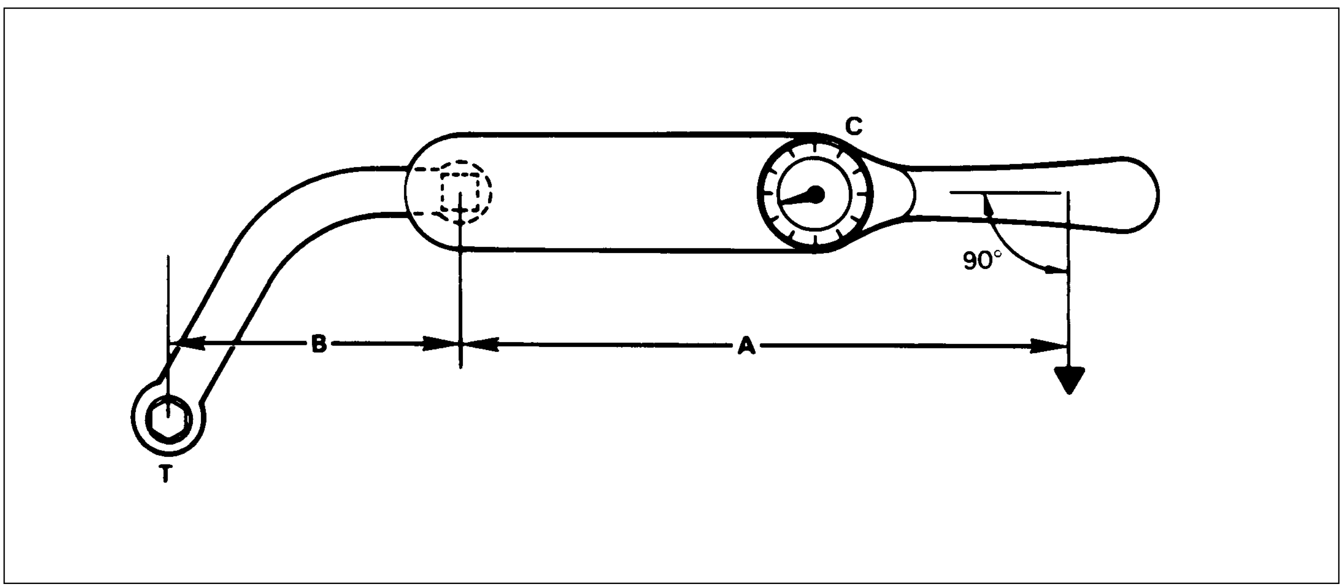


Figure 2-14. Torque Wrench Formula

TABLE II-III. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, High Temperature	MIL-G-3545 QPL-3545-15	High Temp. Grease, Marfax All Purpose	Texaco Inc., 1325 East 42nd,St. New York, New York 10017
		Shellaire Grease HT, Alvania EP Grease 2, Aeroshell Grease 5	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Grease 77, Mobilux EP2	Mobil Oil Corporation Shoreham Building, Washington, DC 20005
		Royco 45A	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936
		L-1231	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
Hydraulic Fluid	MIL-H-5606 QPL-5606-12	Aircraft Hydraulic Oil AA	Texaco, Inc., 135 East 42nd, New York, New York 10017
		RPM Aviation Oil No. 2 Code PED 2585, PED 3337	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		3126 Hydraulic Oil, Univis 40	Exxon Company, U.S.A., Box 2180, Houston, Texas 77001
		Aeroshell Fluid 4, Aeroshell Fluid 4 SL-7694	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Aero HF	Mobil Oil Corporation Shoreham Building Washington, DC 20005
		Royco 756, 756A, 756B	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Lubricating Grease	MIL-G-7711 QPL-7711-15	Regal AFB2, Regal Starfax Premium 2	Texaco Inc., 1325 East 42nd., New York, New York 10017
		PED 3040	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 6	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Royco 11	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936
Lubricating Oil General Purpose, Low Temperature	MIL-L-7870 QPL-7870-9	1692 Low Temp Oil	Texaco, Inc., 135 East 42nd., New York, New York 10017
		Aviation Instrument Oil	Standard Oil of California, 225 Bush St., San Francisco California 94120
		Royco 363	Royal Lubricants, Co., River Road, Hanover, New Jersey 07936
		Sinclair Aircraft Orbit Lube	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
		Caltex Low Temp Oil	Caltex Oil Products Co., New York, New York

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease Aircraft and Instrument, Gear and	MIL-G-23827 QPL-23827-10 (See Note 2)	Low Temp. Grease EP	Texaco, Inc., 135 East 42nd., New York, New York 10017
		5114 EP Grease, AV 55	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 7, Braycote 627S	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Mobil Grease 27	Mobil Oil Corporation Shoreham Building, Washington, DC 20005
		Royco 27A	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		Castrolease A1	Castrol Oils Inc., Newark, New Jersey
		Supermil Grease No. A72832	American Oil Company 165 N. Canal, Chicago, Illinois 60606
		BP Aero Grease 31B	BP Trading Limited Moore Lane, Brittannic House, London E.C. 2 England
Grease, Aircraft General Purpose Wide Temperature	MIL-81322 QPL-81322-3 (See Note 2)	Aeroshell Grease 22	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Mobil Grease 28	Mobile Oil Corporation Shoreham Building, Washington, DC 20005
		Royco 22 River Road, Hanover,	Royal Lubricants Co., New Jersey 07936

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, Aircraft and Instruments, High and Low Temperature	MIL-G-3278 QPL-3278-24	Unitemp EP	Texaco, Inc., 135 East 42nd., New York, New York 10017
		Rpmavn Grease 5, Supermil Grease No. 8723	Standard Oil of California, 225 Bush St., San Francisco, California 94120
		Aeroshell Grease 7A	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Mobil Grease 22	Mobil Oil Corporation Shoreham Building, Washington, DC 20005
		Royco 78	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		L-1212	Sinclair Refining Co., 600 Fifth Avenue, New York, New York 10020
		1916 Uni-Temp Grease	California Texas Oil Corp., 380 Madison Ave., New York, New York 10017
Lubricating Grease Molybdenum Disulfide	MIL-G-21164 QPL-21164-15	Aeroshell Grease 17	Shell Oil Co., 50 West 50th Street, New York, New York 10020
		Royco 64C	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
		Gastrolease MSA (C)	Castrol Oil Inc. 254-266 Doremus Avenue, Newark, New Jersey 07105

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Grease, Ball and Roller Bearing	MIL-G-18709 QPL-18709-55	Regal ASB-2 Formula TG-10293	Texaco, Inc., 135 East 42nd., New York, New York 10017
		Andok B	Exxon Company, U.S.A., Box 2180, Houston, Texas 77001
		Code 1 - 20481, Darina Grease 1 XSG-6213 Code 71-501, Darina Grease 2 XSG-6152 Code 71-502, Alvania Grease 2 XSG-6151 Code 71-012, Cyprina Grease 3 XSG-6280 Code 71-003	Shell Oil Co., 50 West 50th Street, New York, New York 10020
Lubricating Grease Plug, Valve, Gasoline and Oil Resistant	MIL-G-6032 QPL-6032-10	Royco 32	Royal Engineering Co., Whippany, New Jersey
		Gastrolease PV	Castrol Oils Inc., Newark, New Jersey
		Parker Fuel Lube 44	Parker Seal Co.
		BP Aero Grease 32	BP Trading Limited More Lane, Brittanic House, London E.C. 2 England
Anti-Seize Compound Graphite Petroleum	MIL-T-5544 TT-S-1732 (TT-A-580)	Royco 44	Royal Lubricants Co., River Road, Hanover, New Jersey 07936
Silicone Compound	MIL-S-8660 (MIL-C-21567) QPL-8660-7	DC-4, DC-6 Compound	Dow Corning, S.Saginaw Road Midland Michigan 48641
		G-624	General Electric Co., Silicone Products Dept., Waterford, New York 12188
		Y 2900	Union Carbide

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Dry Lubricant,	MIL-L-60326	MS-122-607S	
Waterproof Grease, High and Low Temperature		MAG-1 or Aero Lubriplate	Fiske Brothers Refining Company, 129 Lockwood, Newark, New Jersey 07105
Sealer		PR 1321 B1/2	Products Research Co. 2919 Empire Avenue Burbank, CA 91504
Solvent		PD680	
Toluol	TT-T-548		
Buffing and Rubbing Compounds		Automotive Type - DuPont #7	DuPont Company Wilmington, DL 19898
		Ram Chemical #69 x 6	Ram Chemicals Gardena, CA 90248
		Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, CA 92713
Cleaners		Fantastic Spray Perchlorethylene VM&P Naptha (Lighter Fluid)	Local Suppliers
ABS-Solvent Cements		Solarite #11 Series	Solar Compounds Corp. Linden, NJ 07036
Solvents		Methylethyl Ketone Methylene Chloride Acetone	Local Suppliers
Rain Repellent		Repcon FSCM50159	UNELKO Corporation 727 E. 110th Street Chicago, IL 60628

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

MATERIAL	SPECIFICATION	BRAND NAME	MANUFACTURER
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp. 1201 W. Blancke St. P.O. Box 27 Linden, NJ 07036
Hot Melt Adhesives Polyaminds and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long		Sear Roebuck & Co. or Most Hardware Stores
Sealant		PRC5000	Behr-Manning Division Norton
Tapes, Vinyl Foam	1/8 in. x 1 in.	510 Series, Type II	Norton Tape Division Dept. 6610 Troy, NY 12181
Black Vinyl Plastic	2 in. x 9 mil. and/or 1 1/2 in. x 9 mil		Norton Tape Division Troy, NY 12181
Vinyl Foam	1 in. x 1/8 in.	530 Series, Type I	Norton Tape Division Troy, NY 12181
Teflon Tape	.003 x .50 wide/-1		Minnesota Mining and Mfg. 3M Center St. Paul, MN 55101 Shamban W.S. and Co. 11543 W. Olympic Blvd. Los Angeles, CA 90064
	.003 x .25 wide/-2		Johnson & Johnson, Inc. Permacel Div. 501 George St. New Brunswick, NJ 08901

NOTES

1. Use 100 octane low lead (blue) fuel.
2. Precautions should be taken when using MIL-G-23827 and MIL-G-81322, since these greases contain chemicals harmful to painted surfaces.
3. Refer to the latest revision of Lycoming Service Instruction No. 1014 for Lubricating Recommendations.

TABLE II-IV. CONVERSION TABLES

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

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

3. Procedure for Converting Inches to Millimeters. Refer to Table II-IV.

   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. Refer to Table 11 - 1V.

   A. Example: Rear 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.

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TABLE II-IV. CONVERSION TABLES (cont)

MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937 0.03281	IN. FT.
CU. CENTIMETERS	0.001 0.06102 0.0002642	LITERS CU. IN U.S. GAL.
CU. FT.	28.320 1.728 7.481 28.32	CU. CM CU. IN. U.S. GAL. LITERS
CU. IN.	16.39 0.01639 0.004329 0.01732	CU. CM LITERS U.S. GAL. QUARTS
CU. METERS	1000000 35.314 61.023 264.17 999.97	CU. CM CU. FT. CU. IN GAL. LITERS
FEET	0.3048 12.000 304.8 0.3333	METERS MILS MM. YARDS
FT.-LB.	0.1383 0.001285 0.000000376	M-KG BTU KW-HR
FLUID OZ.	8 29.6	DRAM CU. CM
GAL., IMPERIAL	277.4 1.201 4.546	CU. IN. U.S. GAL. LITERS
GAL., U.S. DRY	268.8 0.1556 1.164 4.405	CU. IN. CU. FT. U.S. GAL., LIQ. LITERS
GAL., U.S. LIQ.	231.0 0.1337 3.785 0.8327 128	CU. IN. CU. FT. LITERS IMPERIAL GAL. FLUID OZ.
IN.	2.540 .08333	CM. FT.
JOULES	0.000948 0.7376	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

TABLE II-IV. CONVERSION TABLES (cont)

CENTIGRADE — FAHRENHEIT CONVERSION TABLE

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

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

TABLE II-IV. 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	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.558	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

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	175.26
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

TABLE II-V. 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-699). Anti-Seize Compound (White Lead Base)

-NOTE-

Lubricate Engine Fittings Only With The Fluid Contained In The Particular Lines

TABLE II-VI. HOSE CLAMP TIGHTENING, (INITIAL INSTALATION)

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-VI.I MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

TUBE O.D. (IN.)	DISTANCE BETWEEN SUPPORTS (IN.)	
	ALUMINUM ALLOY	STEEL
1/8	9-1/3	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

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TABLE II-VIII. DECIMAL MILLIMETER EQUIVALENTS OF DRILL SIZES

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

Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	11.9062	E-1/4	0.250	6.3500	24	0.152	3.8608	1/16	0.0625	1.5875
29/64	0.4531	11.5094	D	0.246	6.2484	25	0.1495	3.7973	53	0.0595	1.5113
7/16	0.4375	11.1125	C	0.242	6.1468	26	0.147	3.7338	54	0.055	1.397
27/64	0.4218	10.7156	B	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10.4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1.1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0.404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1.0922
X	0.397	10.0838	2	0.221	5.6134	30	0.01285	3.2639	58	0.042	1.0668
25/64	0.3906	9.9212	7/32	0.2187	5.5562	1/8	0.125	3.1750	59	0.041	1.0414
W	0.386	9.8044	3	0.213	5.4102	31	0.120	3.048	60	0.040	1.016
V	0.377	9.5758	4	0.209	5.3086	32	0.116	2.9464	61	0.039	0.9906
3/8	0.375	9.5250	5	0.2055	5.2197	33	0.113	2.8702	62	0.038	0.9652
U	0.368	9.3472	6	0.204	5.1816	34	0.111	2.8194	63	0.037	0.9398
23/64	0.3593	9.1262	13/64	0.2031	5.1594	35	0.110	2.794	64	0.036	0.9144
T	0.358	9.1281	7	0.201	5.1054	7/64	0.1093	2.7781	65	0.035	0.899
S	0.346	8.7884	8	0.199	5.0546	36	0.1065	2.7051	66	0.033	0.8382
11/32	0.3437	8.7300	9	0.196	4.9784	37	0.104	2.6416	1/32	0.0312	0.7937
R	0.339	8.6106	10	0.1935	4.9149	38	0.1015	2.5781	67	0.032	0.8128
Q	0.332	8.4328	11	0.191	4.8514	39	0.0995	2.5273	68	0.031	0.7874
21/64	0.3281	8.3337	12	0.189	4.8006	40	0.098	2.4892	69	0.029	0.7366
P	0.323	8.2042	3/16	0.1875	4.7625	41	0.096	2.4384	70	0.028	0.7112
O	0.316	8.0264	13	0.185	4.699	3/32	0.0937	2.3812	71	0.026	0.6604
5/16	0.3125	7.9375	14	0.182	4.6228	42	0.0935	2.3749	72	0.025	0.635
N	0.302	7.6708	15	0.180	4.572	43	0.089	2.2606	73	0.024	0.0696
19/64	0.2968	7.5387	16	0.177	4.4958	44	0.086	2.1844	74	0.0229	0.58166
M	0.295	7.4930	17	0.173	4.3942	45	0.082	2.0828	75	0.021	0.5334
L	0.290	7.3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0.020	0.508
9/32	0.2812	7.1425	18	0.1695	4.3053	47	0.0785	1.9939	77	0.018	0.4572
K	0.281	7.1374	19	0.166	4.2164	5/64	0.0781	1.9844	1/64	0.0156	0.3969
J	0.277	7.0358	20	0.161	4.0894	48	0.076	1.9304	78	0.016	0.4064
I	0.272	6.9088	21	0.159	4.0386	49	0.073	1.8542	79	0.0145	0.3683
H	0.266	6.7564	22	0.157	3.9878	50	0.070	1.778	80	0.0135	0.3429
17/64	0.2656	6.7462									

DRILL SIZES AVAILABLE

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

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SECTION III

INSPECTION

Paragraph	Aerofiche Grid No.

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. Required inspection procedures are listed in Table III-I. The inspection procedure is broken down into eight major groups which are Propeller, Engine, Cabin, Fuselage and Empennage, Wing, Landing Gear, 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 forms P/N 230 3005 furnished by the Piper Factory Service Department, available through Piper Dealers or Distributors.

— NOTE —

In addition to inspection intervals required in Table III-I, 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, Table III-I, 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 required because of special conditions or incidents that arise, and because of these conditions or incidents, an immediate inspection would be required to ensure 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. INSPECTION OF EXHAUST SYSTEM. (Refer to Figures 3-1 and 3-2.) The entire exhaust system, including heat exchange shroud, muffler, muffler baffles, stacks and all exhaust connections must be rigidly inspected at each 100 hour inspection. The possibility of exhaust system failure increases with use. It is recommended that the system be checked more carefully as the number of hours increase, therefore inspection at the 700 hour period, that the exhaust system has been in use, 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-28 airplanes be fitted with a new muffler at (or near) the 1000 hour period of which the muffler has been in use.

Removal of the 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 air stream 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.

3-9. PROGRAMMED INSPECTION. The programmed inspection was designed to permit the utilization of the aircraft, by scheduling inspections through the use of a planned inspection schedule. Programmed Inspection schedules are available from Piper Service Sales P/N 761 831.

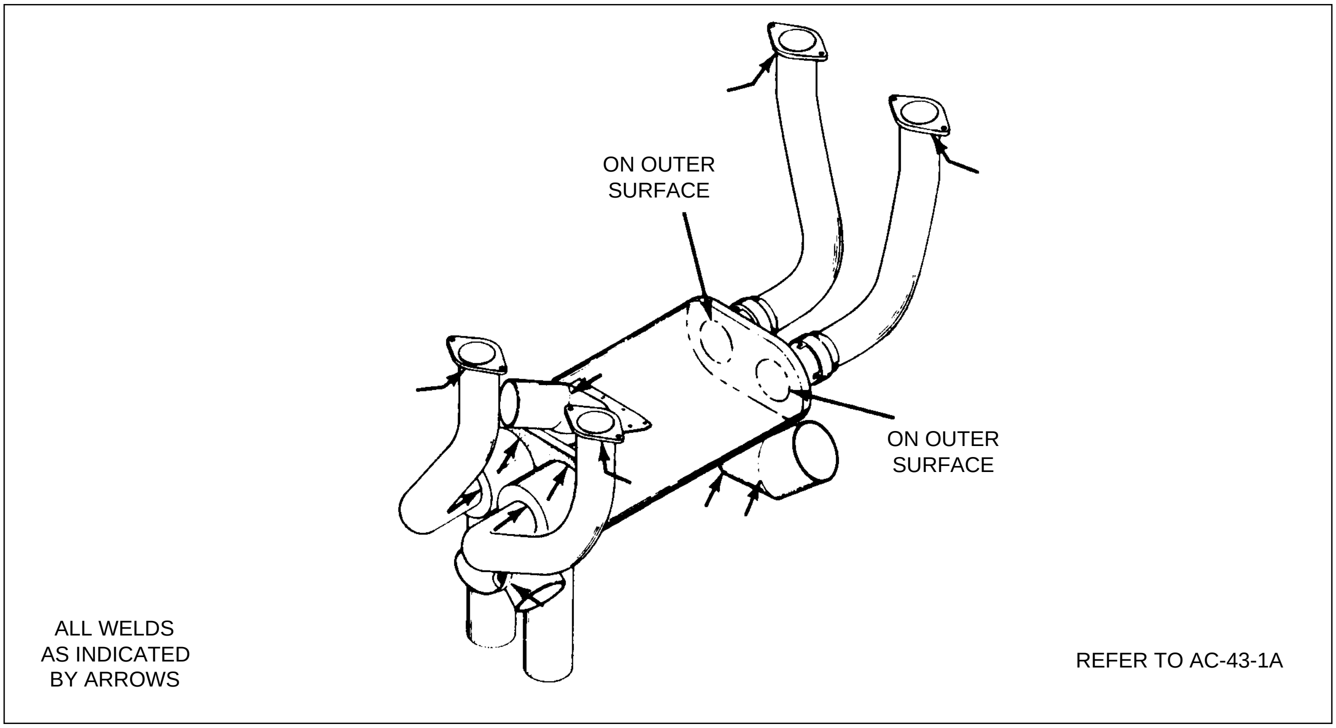

Figure 3-1. Inspection Areas of Exhaust System

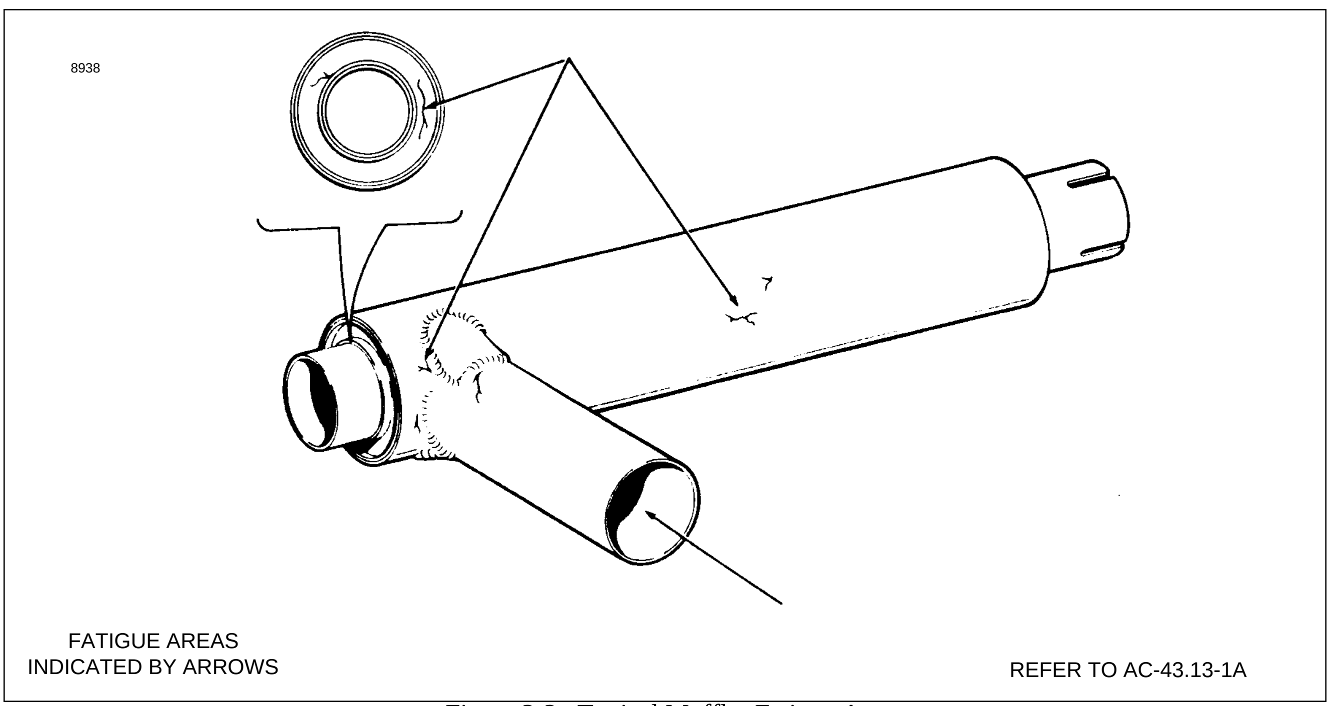

Figure 3-2. Typical Muffler Fatigue Areas

TABLE III-I. INSPECTION REPORT

— NOTE —

All inspection or operations must be performed at each of the inspection intervals as indicated by a circle (O). (See Notes 1, 2, 3, and 4.)

Nature of Inspection	**Inspection Time (hrs.)**			
A. PROPELLER GROUP	**50**	**100**	**500**	**1000**
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 spinner mounting brackets for cracks		O	O	O
4. Inspect propeller mounting bolts and safety (Check torque if safety is broken)		O	O	O
5. Inspect hub for cracks and corrosion		O	O	O
6. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear and correct installation		O	O	O
7. Recondition propeller. (See Note 14)				O
B. ENGINE GROUP				
NOTE: Read Note (3) prior to completing this inspection group				
WARNING: Ground Magneto to Primary circuit before working on engine.				
1. Remove and inspect engine cowling 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 4)	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 (cartridge type) oil filter element. (Inspect strainer or element for foreign particles)	O	O	O	O
6. Inspect oil temperature sender unit for leaks and security		O	O	O
7. Inspect oil lines and fittings for leaks, security, chafing dents, and cracks.(Replace per Note 6)	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
WARNING: Do not contaminate the vacuum pump with cleaning fluid. (Ref: Latest Revision of Lycoming Service Instructions No. 1221.)				
12. Inspect condition of spark plugs. (Clean and adjust gap as required, adjust per latest revision of Lycoming Service Instruction No. 1042) (See Note 10)		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.(See Note 8)		O	O	O

TABLE III-I. INSPECTION REPORT

Nature of Inspection	Inspection time (hrs)			
	50	100	500	1000
16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket, torque cover screws 50 inch-pounds. (See Note)	O	O	O	O
NOTE: Lycoming requires a valve inspection be made after every 400 hours of operation. (See Note 7.)				
17. Inspect ignition harness and insulators (high tension leakage and continuity)		O	O	O
18. Inspect magnetos for oil seal leakage		O	O	O
19. Check magneto to engine timing		O	O	O
20. Replace magneto. (See Note 5.)				O
21. Inspect security of carburetor throttle arm.			O	O
22. Remove air filter from screen housing and inspect and/or replace (refer to Section II of Service Manual)	O	O	O	O
23. Drain carburetor and clean inlet line fuel strainer.		O	O	O
24. Inspect condition of carburetor heat air door and box. (See Note 9.)	O	O	O	O
25. Inspect intake seals for leaks and clamps for tightness.		O	O	O
26. Inspect all air inlet ducts and alternate heat duct.	O	O	O	O
27. Clean screens in electric fuel pump.	O	O	O	O
28. Remove, drain, and clean fuel filter bowl and screen (drain and clean at least every 90 days).	O	O	O	O
29. Inspect condition of flexible fuel lines. (See Note 6.)		O	O	O
30. Replace flexible fuel lines				O
31. Inspect fuel system for leaks.		O	O	O
32. Inspect fuel pumps for operation (engine-driven and electric)		O	O	O
33. Overhaul or replace fuel pumps (engine-driven and electric) (See Note 5.)				O
34. Inspect engine-driven vacuum pump, clamps and hoses		O	O	O
35. Inspect auxiliary vacuum pump system hoses, clamps and electric harness for security.		O	O	O
36. Replace engine-driven vacuum pump				O
37. Replace the auxiliary vacuum pump (See Note 18)			O	O
38. Inspect throttle, carburetor heat, and mixture controls for security, travel and operating condition.		O	O	O
39. Inspect exhaust stacks, connections and gaskets (replace gaskets as required)		O	O	O
40. Inspect muffler, heat exchange, and baffles.		O	O	O
41. Check recommended time for replacement of muffler per service manual, section III		O	O	O
42. Inspect breather tube for obstructions and security.		O	O	O
43. Inspect crankcase for cracks, leaks and security of seam bolts.		O	O	O
44. Inspect engine mounts for cracks and loose mountings.		O	O	O
45. Inspect all engine baffles.		O	O	O
46. Inspect rubber engine mount bushings for deterioration (replace as required).		O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

Nature of Inspection	Inspection time (hrs)			
	50	100	500	1000
47. Inspect battery box and cables (inspect at least every 30 days. Flush box as required and fill battery per instructions on box) (See Note 16)........................	O	O	O	O
48. Inspect fire wall seals.		O	O	O
49. Inspect condition and tension of alternator drive belt. (refer to Section XI of Service Manual)..		O	O	O
50. Alternator pulley remove front grease seal and add grease (refer to lubrication chart in Service Manual)		O	O	O
51. Inspect condition of alternator and starter..		O	O	O
52. Inspect security of alternator mounting		O	O	O
53. Check fluid in brake reservoir (fill as required)...	O	O	O	O
54. Inspect and lubricate controls per lubrication chart (refer to latest revision of Piper Service Bulletin No. 538)..		O	O	O
55. Complete overhaul of engine or replace with factory rebuilt (See Note 5)..........				O
56. Install engine cowl	O	O	O	O
C. CABIN GROUP				
1. Inspect cabin entrance door and windows for damage, operation and security.		O	O	O
2. Inspect upholstery for tears.		O	O	O
3. Inspect seats and seat belts for security of brackets and bolts.		O	O	O
4. Inspect trim control operation.		O	O	O
5. Inspect rudder pedals for operation and adjustment.		O	O	O
6. Inspect parking brake and brake handle for operation and cylinder leaks...........		O	O	O
7. Inspect control column, pulleys and cables.		O	O	O
8. Check landing, navigation, cabin and instrument lights.	O	O	O	O
9. Inspect instruments, lines and attachments. (see latest revision of Piper Service Bulletin 582)...	O	O	O	O
10. Inspect gyro operated instruments and electric turn and bank (overhaul or replace as required).	O	O	O	O
11. Replace filters on gyro horizon and directional gyro..		O	O	O
12. 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.		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 flap control cable attachment bolts, replace if worn. (Refer to latest revision of Piper Service Bulletin 965)...		O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

Nature of Inspection	Inspection time (hrs)			
	50	100	500	1000
D. FUSELAGE AND EMPENNAGE GROUP				
1. Remove inspection plates and panels.	O	O	O	O
2. Inspect door latch and hinges for operation and security.		O	O	O
3. Inspect electronic installations.		O	O	O
4. Inspect bulkheads and stringers for damage.		O	O	O
5. Inspect condition and security of antenna mounts and electric wiring.		O	O	O
6. Inspect fuel lines, valves and gauges for damage and operation. (See Note 6.).		O	O	O
7. Clean screens in fuel pumps.		O	O	O
8. Remove, drain, and clean fuel strainer bowl and screen (drain and clean at least every 90 days).	O	O	O	O
9. Inspect security of all lines.		O	O	O
10. Inspect vertical fin and rudder surfaces for damage.		O	O	O
11. Inspect rudder hinges, horn and attachments for damage and operation.		O	O	O
12. Inspect rudder control stop to ensure stop has not loosened and lock nut is tight.		O	O	O
13. Inspect vertical fin attachments.		O	O	O
14. Inspect rudder hinge bolts for excess wear. (replace as required).		O	O	O
15. Inspect stabilator surfaces for damage.		O	O	O
16. Inspect stabilator tab hinges, horn, and attachments for damage and operation.		O	O	O
17. Inspect stabilator control stops to insure stop has not loosened and lock nut is tight.		O	O	O
18. Inspect stabilator attachments. (See latest revision of Piper Service Bulletin 856).		O	O	O
19. Inspect stabilator and tab hinge bolts and bearings for excess wear. (replace as required).		O	O	O
20. Inspect stabilator trim mechanism.		O	O	O
21. Inspect fuselage wing attach fittings for corrosion, general condition and security (See latest revision of Piper Service Bulletin 977.).		O	O	O
22. Check all cable tensions (use tensiometer). (See Note 13.).		O	O	O
23. Inspect cables, aileron, rudder, stabilator, stabilator trim, turnbuckles, guides and pulleys for safety, damage and operation. (See Notes 19 and 20.).	O	O	O	O
24. Clean and lubricate stabilator trim drum screw.				O
25. Clean and lubricate all exterior needle bearings.	O	O	O	O
26. Lubricate per lubrication chart in Service Manual.		O	O	O
27. Inspect strobe light for security and operation.		O	O	O
28. Inspect rotating beacon for security and operation.		O	O	O
29. Inspect security of Autopilot servo bridle cable clamps, if installed.		O	O	O
30. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation. (See Note 19).		O	O	O
31. Check Emergency Locator Transmitter battery replacement date and transmitter for operation.	O	O	O	O
32. Reinstall inspection plates and panels.	O	O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

Nature of Inspection	Inspection time (hrs)			
	50	100	500	1000
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	O
3. Inspect aileron hinges and attachments.		O	O	O
4. Inspect aileron control stops to ensure stops have not loosened and locknut is tight		O	O	O
5. Inspect aileron cables, pulleys, and bellcranks for damage and operation. (See Note 19).		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	O	O
8. Lubricate per lubrication chart in Service Manual.	O	O	O	O
9. Inspect forward and aft wing attach fittings for corrosion, general condition and security. (See latest revision of Piper Service Bulletin 977.)		O	O	O
10. Inspect wing attachment bolts and brackets.		O	O	O
11. Inspect fuel tanks and lines for leaks, water, and contamination. (See Note 11.).		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 Note 12.)		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. (See Note 19.).		O	O	O
16. Reinstall inspection plates and fairings.		O	O	O
F. LANDING GEAR GROUP				
1. Inspect oleo struts for proper extension (NLG-3.25 in./MLG-4.50 in.). (Check for proper fluid level as required.)	O	O	O	O
2. Inspect nose gear steering control and travel.		O	O	O
3. Inspect 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. Check tire pressure (N-30 psi, M-24 psi.).	O	O	O	O
7. Remove wheels: clean, inspect, and repack bearings.		O	O	O
8. Inspect wheels for cracks, corrosion, and broken bolts.		O	O	O
9. Inspect brake lining and disc for wear.		O	O	O
10. Inspect backing plates for condition.		O	O	O
11. Inspect brake lines for condition and security.		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

TABLE III-I. INSPECTION REPORT (cont)

Nature of Inspection	Inspection Time (hrs.)			
	50	**100**	**500**	**1000**
15. Inspect gear struts and mounting bolts for security and condition................		O	O	O
16. Inspect torque links for cracks,bolts for condition,(Refer to latest revision of Piper service letter 842) (check assembly for side play)..........................		O	O	O
17. Lubricate per lubrication chart in service manual...	O	O	O	O
18. Inspect all hydraulic lines and attaching parts for security, routing, chafing, deterioration, wear, and correct installation....................................	O	O	O	O
19. Remove airplane from jacks...		O	O	O
G. OPERATIONAL INSPECTION				
1. Check fuel pump and fuel tank selector...	O	O	O	O
2. Check fuel quantity..	O	O	O	O
3. Check oil pressure and temperature...	O	O	O	O
4. Check alternator output..	O	O	O	O
5. Check carburetor heat	O	O	O	O
6. Check parking brake..	O	O	O	O
7. Check vacuum gauge...	O	O	O	O
8. Check gyros for noise and roughness...	O	O	O	O
9. Check cabin heat..	O	O	O	O
10. Check magneto switch operation..	O	O	O	O
11. Check magneto RPM variation	O	O	O	O
12. Check throttle and mixture operation..	O	O	O	O
13. Check propeller smothness..	O	O	O	O
14. Check engine idle speed...	O	O	O	O
15. Check electronic equipment operation	O	O	O	O
16. Check operation of autopilot including automatic pitch trim, and manual electric trim (See Note 18)...	O	O	O	O
18. Check auxiliary vacuum pump system operation (See Note 18)..................	O	O	O	O
H. GENERAL				
1. Aircraft conforms to FAA specifications...	O	O	O	O
2. All FAA airworthiness directives complied with...	O	O	O	O
3. All 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

TABLE III-I. INSPECTION REPORT (cont)

NOTES:

1. Refer to last card of the Piper Parts Price List - Aerofiche, for a checklist of current revision dates to Piper Inspection Reports and Manuals.
2. **Piper service bulletins are of special importance and Piper considers compliance mandatory.** Piper service letters are product improvements and service hints pertaining to sevicing the airplane and should be given careful attention.
3. Inspections for the power plant are based on the engine manufacturer's operator's manual (**Lycoming Part Number 60297-16 for this airplane,dated March 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.
4. 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 engine operation and the specified octane fuel is used. Should fuel other than the specified octane rating for the power plant be used, refer to latest **Lycoming Service Letter No. L185** for additional information and recommended service procedures.
5. Replace or overhaul as required or at engine overhauls. **(For engine overhaul, refer to latest revision of Lycoming Service Letter 201.)**
6. Replace flexible lines as required, but not later than 1000 hours.
7. At every 400 hours of engine operation, remove the rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keepers, springs and spring seats. If any indications are found, the cylinder and all of its components 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 of **Lycoming Service Table of Limits No. SSPl 776.**
8. Check cylinders for evidence of excessive heat which is indicated by burned paint on the cylinders. This condition is indicative of internal damage to the cylinder and, if found. its cause must be determined and corrected before the 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.
9. Check carburetor throttle body attaching screws for tightness; the correct torque for these screws is 40 to 50 inch pounds.
10. When using alternate fuels. refer to latest **Lycoming Service Letter L185** for additional information and service procedures.
11. Replace flexible fuel tank supply hose at time of engine overhaul.
12. Replace fuel tank vent line flexible connections as required, but no later than 1000 hours of service .
13. Maintain cable tension as specified in section V of service manual.
14. The recommended flight time between reconditioning for Sensenich fixed-pitch metal propellers is 1000 hours, provided the propeller has not received prior damage requiring immediate attention. Reconditioning accomplishes the removal of fatigued surface metal and accumulated small nicks and cuts too numerous to repair individually. Contact a Sensenich factory approved repair station. **(Refer to latest Sensenich Service Letter 801 .)**

TABLE III-I. INSPECTION REPORT (cont.)

15. Refer to flight manual supplement for preflight and flight check for intended function in all modes.
16. Refer to latest revision of Piper Service Bulletin 631 for battery protection.
17. Refer to test procedure outlined in Section XI Electrical System.
18. Replacement of the auxiliary pump/motor assembly is required every 500 hours of operating time or 10 years, whichever occurs first.
19. Examine cables for broken strands by wiping the cable with a cloth along the length of the cable. Visually inspect the cable thoroughly for damage not detected by the cloth. Replace damaged cables. Refer to Advisory Circular 43.13-1A, Paragraph 198.
20. Special care should be taken to inspect stabilator control cables beneath aft baggage compartment floor.

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SECTION IV
STRUCTURES

SECTION IV
STRUCTURES

4-1. INTRODUCTION

This section explains the removal and installation procedure for the structural surfaces of the airplane. For the removal, installation, 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 FAA Advisory Circular 43.13-1A, unless otherwise stated in this section.

4-2. DESCRIPTION.

The airplane is an all metal semi-monocoque structure with an overall length 23 feet 8 inches. The fuselage is constructed of bulkheads, stringer and stiffeners, to which all of the outer skin is riveted. Windows include a single pane windshield and four side windows, all windows are single pane. A storm window is located in the forward lower section of the left window and can be opened inward when the latch is released. The cabin entrance door is located on the right side of the fuselage, above the wing, and is equipped with a safety latch on the top of the door, which can be operated from the inside or outside.

Each wing panel is an all-metal, full cantilever semi-monocoque type construction with a removable fiberglass tip. Installed in each wing ahead of the main spar is a metal fuel tank with a capacity of 25 U.S. gallons each or 50 U.S.. gallons gallons total Attached to each wing is an aileron,flap and main landing gear. The wings are attached to each side of the fuselage by inserting the butt ends of the main spars into a spar box carry-through. The spar box is an integral part of the fuselage structure which provides, in effect, a continuous main spar with splices at each side of the fuselage. There are also fore and aft attachments at the front and rear spars.

The all metal empennage group is a full cantilever design consisting of a vertical stabilizer (fin), rudder and stabilator, all with removable fiberglass tips. The stabilator has a trim tab attached that is controllable from the cockpit. The stabilator also incorporates a one channel main spar that runs the full length of the stabilator and hinges to the aft bulkhead assembly of the fuselage. All exterior surfaces are coated with enamel acrylic lacquer. As an option the airplane may be completely primed with zinc chromate.

4-3. WING GROUP.

— 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. WING TIP.

4-5. REMOVAL OF WING TIP

a. Remove the screws holding the wing tip to the wing, being careful not to damage the wing or fiberglass wing tip.

b. Pull the wing tip off far enough to disconnect the position light wire assembly. The ground lead may be disconnected at the point of connection on the wing rib, and the positive lead may be disconnected at the wire terminal or unscrewed from the light assembly.

c. Inspect the fiberglass wing tip to ensure that it is free of cracks, severe nicks and minor damage. If repair is required, refer to Paragraph 4-51.

4-6. INSTALLATION OF WING TIP.

a. Place the wing tip in a position that the navigation light leads may be connected. Connect the ground lead to the wing rib by use of a screw and nut, and the positive lead to the position light by connecting the wire terminals or screwing the connectors together. Insulate the wire terminals and be certain that the ground lead is free of dirt and film to insure a good connection.

b. Insert the wing tip into position and install the screws around the tip. Use caution to refrain from damaging the fiberglass tip or wing. Check the operation of the position light.

4-7. AILERON.

4-8. REMOVAL OF AILERON. (Refer to Figure 4-1.)

a. Disconnect the aileron control rod at the middle of the aileron by removing the nut, washers and bolt from the rod end bearing. To simplify installation note location of the washers.

b. Remove the attaching screws, with nuts, from the three hinges within the aileron, and remove the aileron by moving it aft

4-9. INSTALLATION OF AILERON. (Refer to Figure 4-1.)

a. Move the aileron into place and install attaching screws and nuts. Ensure that the aileron is free to move with no interference.

b. Attach the aileron control rod with bolt, washers and nut, dividing the washers so that the aileron is free to rotate from stop to stop without the control rod binding or rubbing on the opening in the aft spar. Be certain that the rod end bearing has no side play when tightening the bolt and that the rod does not contact the side of the bracket.

c. Actuate the aileron controls to insure freedom of movement.

4-10. WING FLAP.

4-11. REMOVAL OF WING FLAP.

a. Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing by use of an angle or offset screwdriver.

b. Remove the nuts, washers, hinge and hinge bolts that hold the flap to the wing assembly.

c. Pull the flap straight back off the wing.

4-12. INSTALLATION OF WING FLAP. (Refer to Figure 4-1.)

a. Replace the wing flap by placing the flap onto its proper position and inserting the hinge bolts, bushings, washers, and nuts.

b. With the flap control in the full down position, place the bushing on the outboard side of the rod end bearing and insert and tighten the bolt.

c. Operate the flap several times to be certain it is operating freely.

4-13. WING.

4-14. REMOVAL OF WING. (Refer to Figure 4-2.)

—NOTE —

To help facilitate reinstallation of control cables, and fuel and brake lines, mark cable and line ends in some identifying manner and attach a line where applicable to cables before drawing them through the fuselage or wing.

a. Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Section II.)

b. Drain the brake lines and reservoir. (Refer to Draining Brake System, Section II.)

c. Remove the access plate at the wing butt rib and wing inspection panels. (Refer to Access Plates and Panels, Section II.)

d. Remove the seats from the airplane.

e. Expose the spar box and remove the cockpit side trim panel assembly that corresponds with the wing being removed.

—CAUTION —

To prevent damage or contamination of fuel, hydraulic and miscellaneous lines, place protective covers over the line fittings and ends.

f. Place the airplane on jacks. (Refer to Jacking, Section II.)

g. Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.

h. If the left wing is being removed, remove the cotter pin from the pulley bracket assembly to allow the left aileron balance cable end to pass between the pulley and bracket.

i. Disconnect the flap from the torque tube by extending the flap to its fullest down position and removing the bolt and bushing from the bearing at the aft end of the control rod.

j. Disconnect the fuel line at the fitting located aft of the spar at the wing butt line.

k. Remove the clamps necessary to release the electrical harness assembly. Disconnect the leads from the terminal strip assembly by removing the cover, and appropriate nuts and washers.

l. With the appropriate trim panel removed, disconnect the hydraulic brake line at the fitting located within the cockpit at the leading edge of the wing.

m. If the left wing is being removed, it will be necessary to disconnect the pitot and static tubes at the elbows located within the cockpit at the wing butt line.

n. Arrange a suitable fuselage cradle and supports for both wings.

o. Remove the wing jacks.

p. Remove the front and rear spar nuts, washes and bolts.

q. Remove the eighteen main spar bolts.

r. Slowly remove the wing being certain that all electrical leads, cables and lines are disconnected.

4-15. INSTALLATION OF WING. (Refer to Figure 4-2.)

a. Ensure that the fuselage is positioned solidly on a support cradle.

b. Place the wing in position for installation, with the spar end a few inches from the side of the fuselage and set on supports.

c. Prepare the various lines,control cables, etc. for inserting into the wing or fuselage when the wing is slid into place. Insure that the bushing is in place in the forward wing fitting.

d. Slide the wing into position of the fuselage.

e. Install the eighteen main spar bolts in accordance with the bolt legend in Figure 4-2.

—NOTE—

When replacing a wing assembly, ascertain that-the wing butt clearance is maintained. (Refer to Sketch A of Figure 4-2.)

—WARNING—

The shim, part number 62121-00 must be installed under the washers on bolts B1,B2,B3,B4 as per figure 4-2

f. Install the bolt, washes and nut that attaches the front spar with the fuselage fitting. Refer to Sketch A of Figure 4-2 for required hardware and torque value.

g. Install the bolt, washers, and nut that attaches the rear spar with the fuselage fitting. (Refer to Sketch B or E of Figure 4-2 for required hardware and torque value.)

h. Insert the number of washers required between the forward face of the wing fitting and the aft face of the fuselage fitting. It is acceptable to have the faces of the fittings against each other. Refer to Sketch B or E of Figure 4-2.

i. Torque the eighteen main spar bolts to 360-390 inch-pounds. Ensure that the bolts, nuts, and washers are installed in accordance with the bolt legend. The forward spar attachment bolt should be torqued to 50-60 inch-pounds. Identify hardware, then torque the rear spar attachment bolt as shown in Sketch B or E of Figure 4-2.

j. Install the wing jacks and tail support to the tail skid with approximately 250 pounds of ballast on the base of the tail support. Remove the fuselage cradle and wing supports.

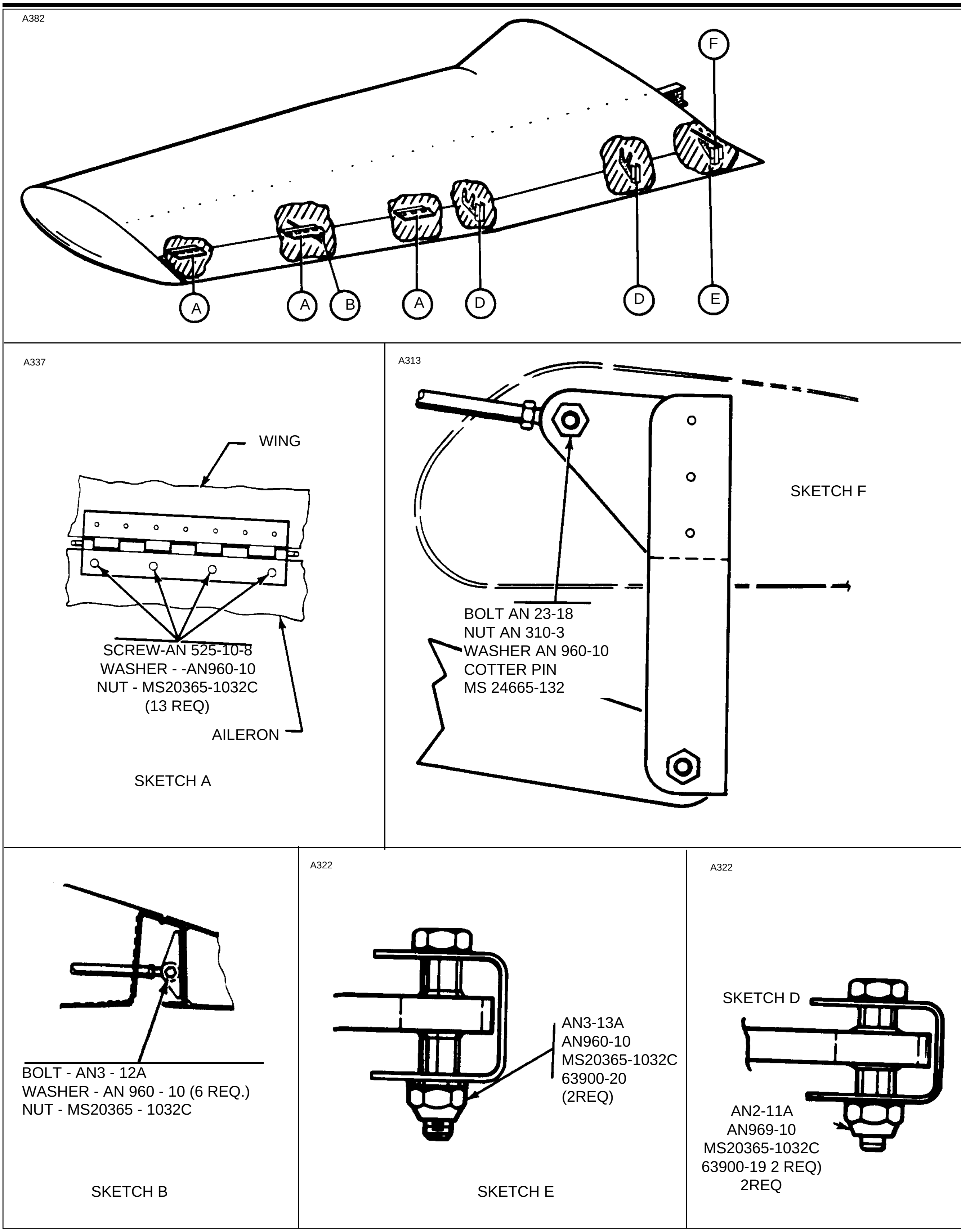

Figure 4-1. Aileron and Flap Installation

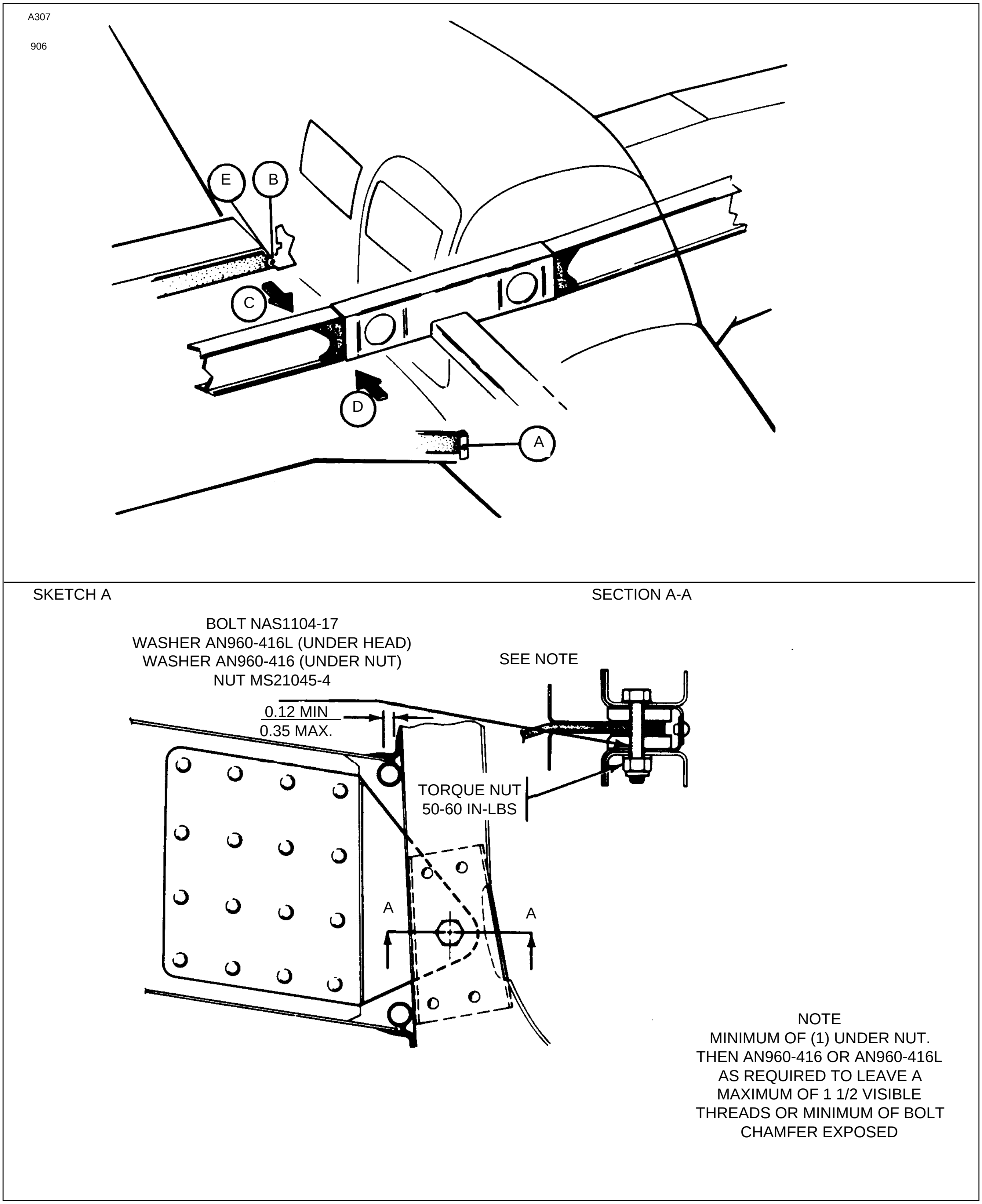

Figure 4-2. Wing Installation

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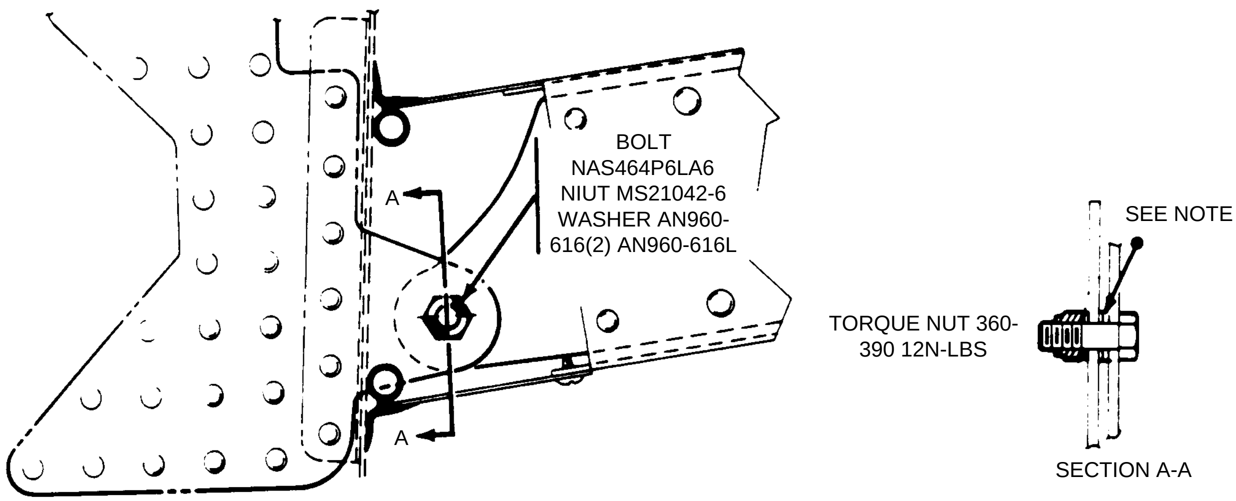
SKETCH E



NOTES

1. THE INFORMATION IN THIS SKETCH APPLIES TO SERVICE WINGS FOR ALL AIRCRAFT OR TO REINSTALLATION OF WINGS
2. MAXIMUM NUMBER OF WASHERS ALLOWED BETWEEN FORWARD FACE OF WING FITTING AND AFT FACE OF FUSELAGE FITTING IS ONE AN960-616L AND ONE AN960-616. (ALL 3 WASHERS ALWAYS REQUIRED WITH ONLY THE AN960-616L WASHER ALLOWED UNDER BOLT HEAD.)

Figure 4-2. Wing Installation (cont)

BOLT LEGEND			WASHER	
POSITION	BOLT*	NUT*	UNDER HEAD	UNDER NUT
A-1	AN176-13A	MS20365-624C	(1) AN960-616	(1) AN960-616 & (1) 96352-3
A-2	AN176-12A	MS20365-62C	(1) AN960-616	(1) AN960-616 & (1) 96352-3
A-3	AN176-12A	MS20365-624C	(1) AN960-616	(1) AN960-616 & (1) 96352-3
A-4	AN176-12A	MS20365-624C	(1) AN960-616	(1) AN960-616 & (1) 96352-3
B-l	AN176 14A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-2	AN176-13A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-3	AN176-13A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-4	AN176-13A	MS20365-624C	(1) AN960-616	(2) AN960-616
C-l	AN176-13A	MS20365-624C	(1) AN960-616	(1) AN960-616
C-2	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-3	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-4	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-5	AN176-13A	MS20365-624C	(1) 96352-3	(1) 96352-3
D-l	AN176-13A	MS20365-624C	(1) 96352-3	(1) AN960-616
D-2	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-3	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-4	AN176-13A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-5	AN176-13A	MS20365-624C	(1) 96352-3	(1) 96352-3

*Torque Boltheads on Upper Spar Cap and Nut on Lower Spar Cap 360-390 in-lbs

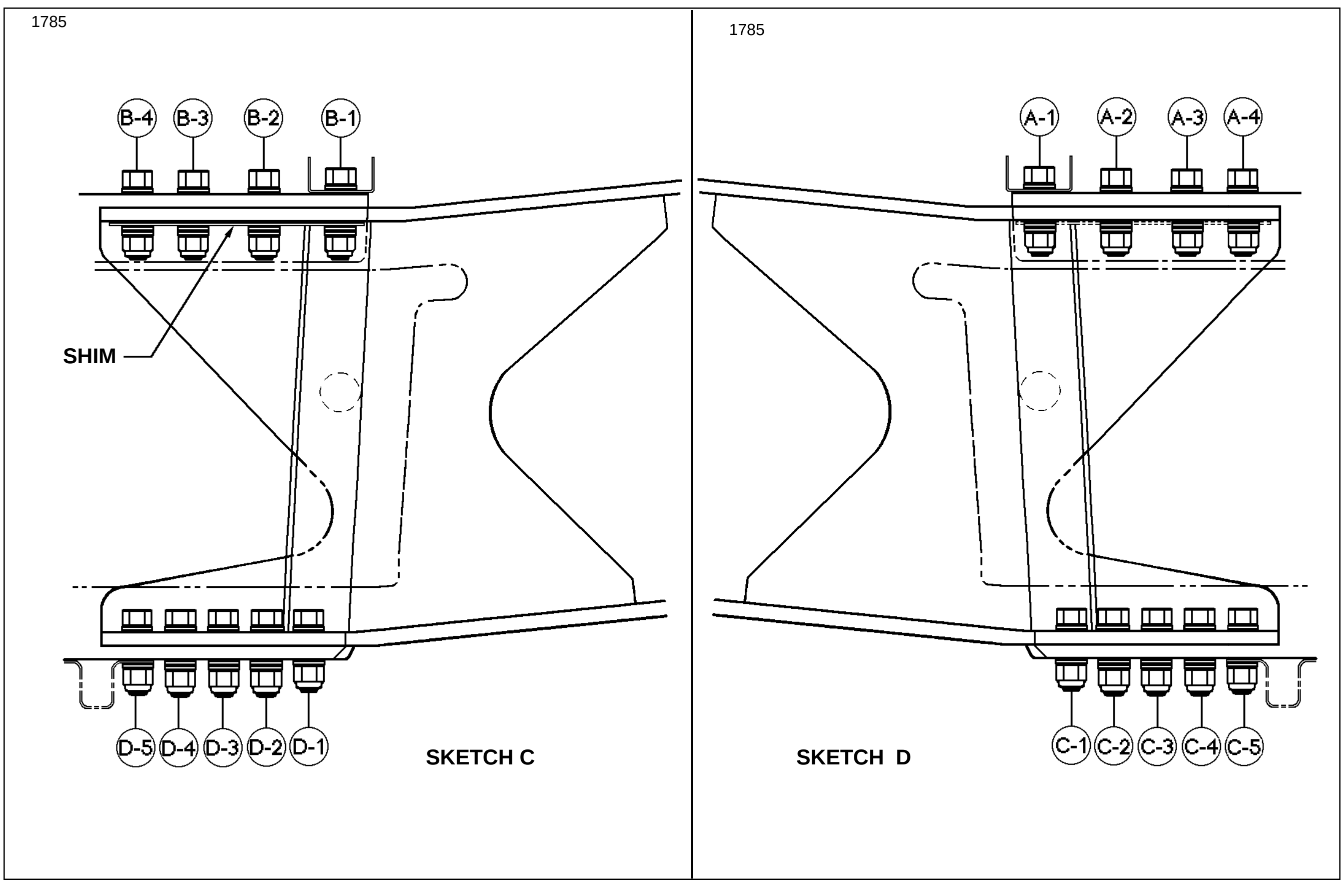


Figure 4-2. Wing Installation (cont)

k. If the left wing was removed, it is necessary that the pitot and static tubes be reconnected at the elbows located within the cockpit at the wing butt line. One tube may be painted red, denoting the pitot tube. In the event that a heated pitot is installed, the electrical plus lead must be connected at the fuselage.

l. Connect the hydraulic brake line onto the fitting located in the cockpit at the leading edge of the wing.

m. Connect the electrical leads to the appropriate posts on the terminal strip and install the washers and nuts. (For assistance in connecting the electrical lead, refer to the Electrical Schematics in Section XI.) Place the clamps along the electrical harness to secure it in position and install the terminal strip dust cover.

n. Remove the cap from the fuel line and connect it at the fitting located aft of the spar at the wing butt line.

o. Connect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar. After the left balance cable has been inserted through the bracket assembly and connected, install a cotter pin cable guard into the hole that is provided in the bracket assembly.

p. Connect the flap by placing the flap handle in the full flap down position; place the bushing on the outside of the rod end bearing and insert and tighten the bolt.

q. Check the rigging and control cable tension of the ailerons and flaps. (Refer to Section V for rigging and adjustments of the appropriate control systems and cable tensions.)

r. Service and refill the brake system with hydraulic fluid. (Refer to Section II, Servicing Brake System.) Bleed the system per instructions given in Section VII, and check the system for leaks.

s. Service and fill the fuel system. (Refer to Section II, Servicing Fuel System.) Open the fuel valve and check for leaks and fuel flow.

t. Check the operation of all electrical equipment and pitot and static system.

u. Remove the airplane from the jacks.

v. Install the cockpit trim panel assembly, spar box carpet, the seats, and wing butt rubber molding.

w. Reinstall all access plates and panels on the wing involved.

4-16. EMPENNAGE GROUP

—NOTE—

Before entering the aft portion of the fuselage, attach a stand to the tail skid for support; and with the use of a heavy pad, protect the inside of the fuselage. Be certain to distribute weight on top of the bulkheads so as not to damage the fuselage skin.

4-17. STABILATOR

4-18. REMOVAL OF STABILATOR. (Refer to Figure 4-4.)

—NOTE—

Should it be necessary to move the rudder to its extreme left or right for clearance, do so with the use of the rudder pedals or tow bar.

a. Remove the screws from around the upper and lower tail cone fairing assembly and remove the fairing separately.

b. Block the trim cable at the barrel of the trim screw assembly to prevent the cable from unwrapping.

c. Remove the access panel to the aft section of the fuselage located at the back wall of the passenger compartment.

d. Install cable blocks, as illustrated in Figure 4-3, on the stabilator trim control cable at the first set of pulleys forward of the cable turnbuckles to prevent the forward cable from unwrapping.

e. Disconnect the trim cables at the turnbuckles within the aft section of the fuselage.

f. Relieve tension from the stabilator control cables by loosening one of the cable turnbuckles in the aft section of the fuselage.

g. Disconnect the stabilator control cables from the stabilator balance arm by removing cotter pins, nuts, washers, bushings and clevis bolts.

h. Disconnect the trim assembly from the aft bulkhead of the fuselage by removing the attaching nuts, washers and bolts of the horizontal and diagonal support brackets.

i. Move the trim assembly up through the tail cone fairing cutout in the stabilator and remove, with cable, from the airplane.

j. Remove the stabilator by disconnecting and removing attaching nuts, washers and bolts at the hinge points.

4-19. INSTALLATION OF STABILATOR. (Refer to Figure 4-4.)

a. Insert the stabilator in position and install attaching hinge bolts, washers and nuts.

—NOTE—

A clearance of .25 ±.06 of an inch between the stabilator and the side of the fuselage and .18 of an inch minimum between all parts of the stabilator and the tail cone assembly must be maintained throughout the stabilator travel. Use a proper washer combination on the stabilator hinges to attain the necessary tolerance.

b. Move the trim assembly through the cutout in the stabilator and attach the brackets of the assembly to the aft bulkhead with bolts, washers and nuts. Insert the trim cable ends into the fuselage.

c. Attach the stabilator control cables to the stabilator balance arm with clevis bolts, bushings, washers, nuts and cotter pins.

d. Connect the ends of the fore and aft trim cables at the turnbuckles within the aft section of the fuselage.

e. Remove the cable block from the trim control cable within the fuselage.

f. Set stabilator control cable tension and check rigging and adjustment according to Rigging and Adjustment of Stabilator, Section V.

g. Remove the cable blocks from the trim cable at the barrel of the trim screw assembly.

h. Set stabilator trim control cable tension and check rigging and adjustment according to Rigging and Adjustment of Stabilator Trim, Section V.

i. Remove the pad and any other foreign material from the aft section of the fuselage and replace the access panel.

j. Install the tail cone fairing and remove the tail stand.

4-20. STABILATOR TRIM TAB

4-21. REMOVAL OF STABILATOR TRIM TAB. (Refer to Figure 4-4.)

a. Disconnect the stabilator trim control rod by removing the bolts that attach the control rod to the stabilator tim tab.

b. Remove the stabilator trim hinge pins by cutting one end of the wire pins and removing.

c. The stabilator trim tab can now be removed.

4-22. INSTALLATION OF STABILATOR TRIM TAB. (Refer to Figure 4-4.)

a. Place the trim tab in position on the aft end of the stabilator.

b. Replace the old hinge pins. Refer to Parts Catalog for replacement pins.

c. Insert the pins and secure by bending the end to a 45 degree angle.

d. Install the control rod and attach with the four bolts and washers.

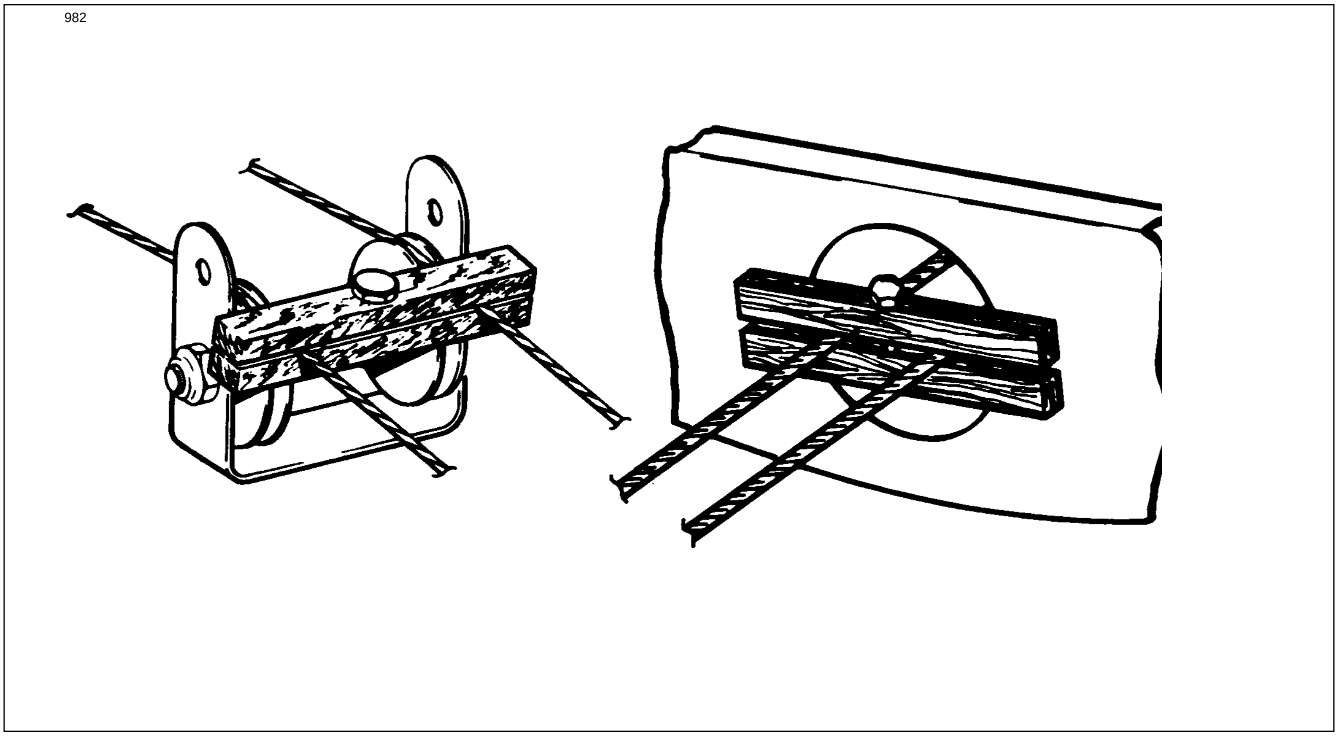


Figure 4-3. Methods of Securing Control Cables

4-23. RUDDER.

4-24. REMOVAL OF RUDDER.

a. Remove the screws from around the upper tail cone fairing assembly and remove the fairing.

b. Remove the rudder tip by removing the attaching screws and disconnect the tail position light wire at the quick disconnect located at the tip of the rudder. Open the access panel in the rear of the passenger compartment to gain access to the aft section of the fuselage.

c. Relieve the cable tension from the rudder control system by loosening one of the cable turnbuckles in the aft section of the fuselage.

d. Disconnect the two control cables from the rudder horn by removing the cotter pins, nuts, washers, bushings and bolts.

e. Remove the cotter pins, nuts, washers and bolts from the upper and lower rudder hinge pivot points.

f. Pull the rudder up and aft from the vertical fin.

4-25. INSTALLATION OF RUDDER. (Refer to Figure 4-4)

a. Place the rudder in position and install the hinge bolts, washers, nuts and cotter pins.

—NOTE—

Use any washer combination on the hinge assembly to best suit, the centering and operation of the rudder.

b. Connect the tail position light electrical lead at the quick disconnect and cover the connector with an insulating sleeve. Tie both ends of the sleeve with number six electrical lacing twine.

c. Connect the control cables to the rudder horn with bolts, washers, nuts and cotter pins.

d. Check the rudder in accordance with Rigging and Adjustment of Rudder, Section V.

e. Install the upper tail cone fairing and rudder tip and secure with the attachment screws. Secure the access panel to the aft section of fuselage.

4-26. VERTICAL FIN.

4-27. REMOVAL OF VERTICAL FIN.

a. Remove the screws from the upper and lower tail cone fairing, the fin tip cover and the fairing at the forward base of the fin.

b. Remove the rudder per instructions given in Paragraph 4-24.

c. Disconnect the leads from the antenna terminals and attach a line to the leads to assist in reinstallation.

d. Disconnect the wire antenna if installed, that attaches to the leading edge of the fin.

e. Disconnect the positive lead to the rotating beacon if installed, and attach a line prior to removal. Disconnect the ground lead by removing the attachment screw.

f. Remove the stabilator trim assembly and aft trim cable in accordance with Removal of Stabilator Trim Assembly (Aft), Section V.

g. Remove the bolt and washer that attaches the leading edge of the fin to the fuselage.

h. Remove the nuts, washers and bolts that secure the fin spar to the aft bulkhead and remove the vertical fin.

4-28. INSTALLATION OF VERTICAL FIN.

a. Insert the vertical fin into position and install the bolts, washers and nuts that secure the fin spar to the aft bulkhead.

b. Install the bolt and washer that attaches the leading edge of the fin to the fuselage.

c. Install the stabilator trim assembly and aft trim cable per instructions given in Installation of Stabilator Trim Assembly, Section V.

d. Install the rudder per Paragraph 4-25.

e. Pull the electrical and antenna leads through the vertical fin with the line that was attached.

f. Connect the antenna leads to the proper terminals and secure with washers and nuts.

g. Connect the electrical leads at the disconnects and insulate.

h. Rig and adjust the rudder and trim control cables as given in Section V.

i. Check the operation of the radios and electrical lights.

j. Replace all fairings and access plates, and secure with attaching screws.

4-29. FUSELAGE ASSEMBLY.

4-30. WINDSHIELD.

4-31. REMOVAL OF WINDSHIELD.

—NOTE—

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

a. Remove the collar molding from around the bottom of the windshield and the trim strip from between the windshield halves by removing the attaching screws.

b. Remove the windshield by raising the lower portion of the windshield and carefully pulling it out and downward to release the top and side edges.

c. Clean the old tape and sealer from the windshield channels, strips and divider post.

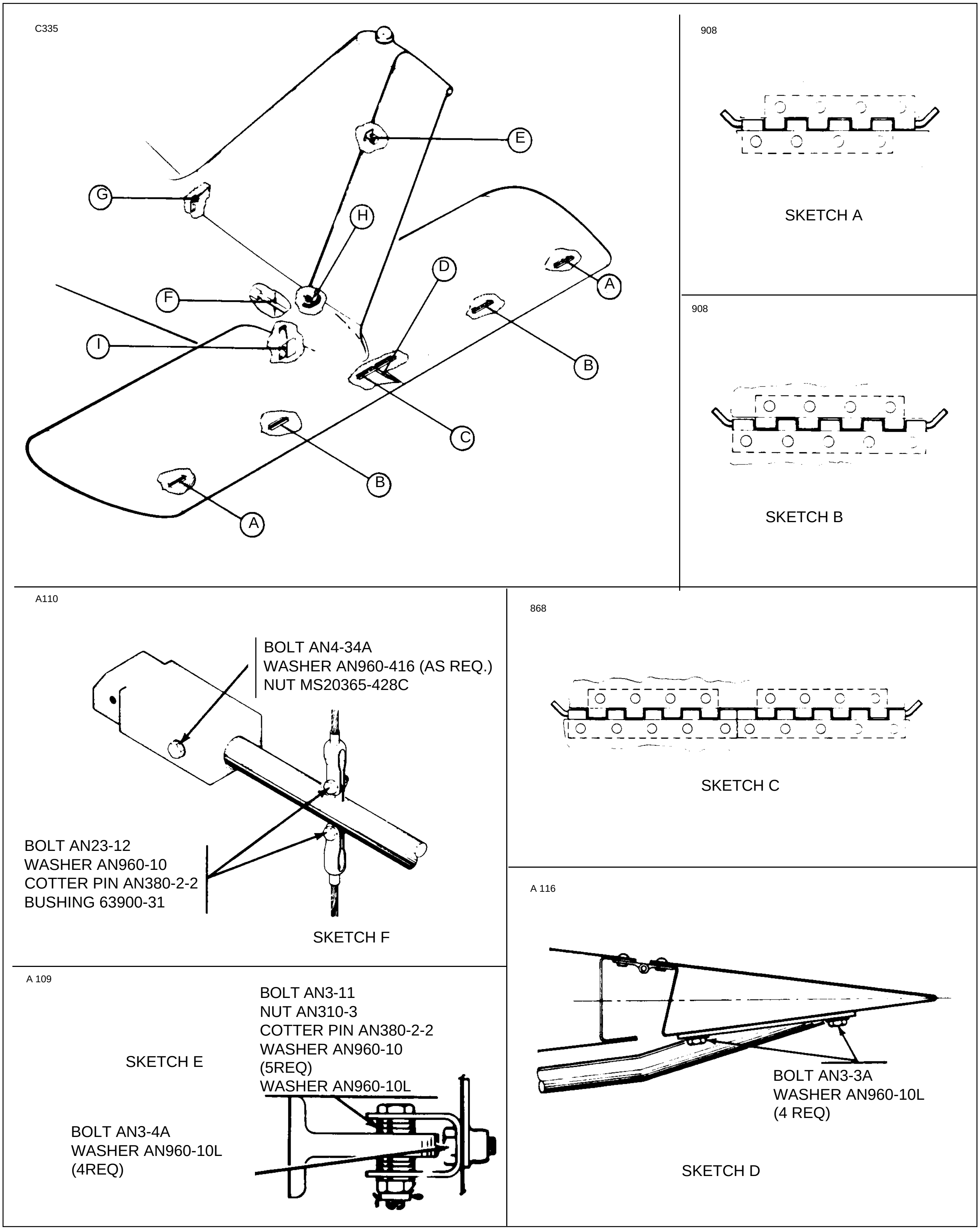
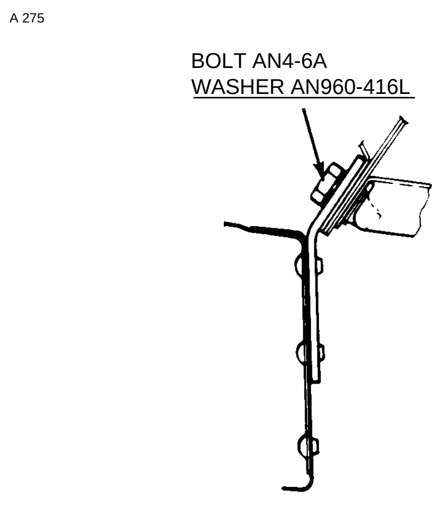
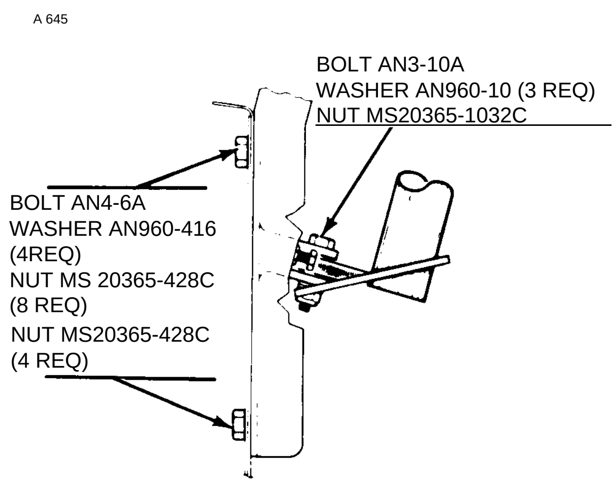


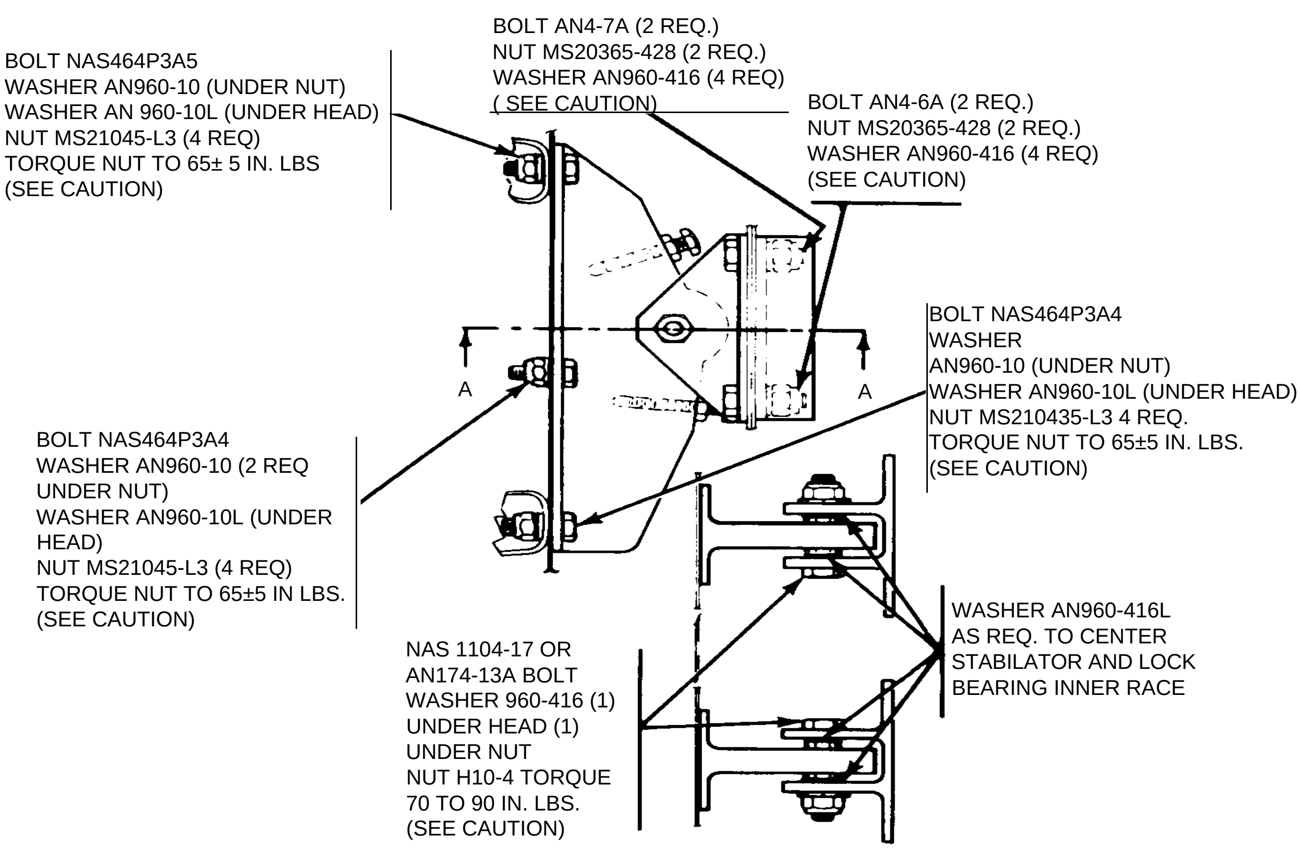
Figure 4-4. Empennage Group Installation



SKETCH G



SKETCH H



SECTION A-A

SKETCH I

CAUTION: IDENTIFY HARDWARE BEFORE TORQUING

Figure 4-4. Empennage Group Installation (cont)

4-32. INSTALLATION OF WINDSHIELD. (Refer to Figure 4-5.)

a. Be certain that the new windshield outside contours are the same as that of the old windshield. It may be found that it is necessary to cut or grind the new windshield to acquire the proper dimensions.

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

c. Apply Behr-Manning vinyl foam tape number 560 or equivalent over the plastic tape, completely around the edges of the windshield.

d. Apply sealant (Piper Part number 179 876) or equivalent under the edge of the moldings and trim strips.

e. Place the windshield in position for installation and slide the windshield aft and up into place, using caution not to dislocate the tape around the edges. Allow clearance between the two windshields 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 the windshield.

j. Remove excess exposed sealer and tape.

4-33. SIDE WINDOWS.

4-34. REMOVAL OF SIDE WINDOWS.

a. Remove the retainer molding from around the window by removing the attachment screws.

b. Carefully remove the window from the frame.

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

—NOTE—

A damaged window should be saved to provide a pattern for shaping the new window.

4-35. INSTALLATION OF SIDE WINDOWS. (Refer to Figure 4-6.)

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

b. Apply Behr-Manning vinyl foam tape number 560 or equivalent, on both sides of the window around the outer edges.

c. Apply Sealant (Piper Part number 179 876) or equivalent, completely around the outer surface of the windows at all attachment flanges

d. Insert the window in the frame and install the retainer moldings

e. Secure the molding with attachment screws and tighten until the vinyl foam tape is 25% compressed by the retainers.

f. Remove the excess exposed sealer and tape.

4-36. DOOR .

4-37. REMOVAL OF DOOR.

a. Remove the clevis bolt, washer and bushing from the door holder assembly.

b. Remove cotter pins, clevis pins and washers from serrated door hinges.

c. Remove the door from the airplane.

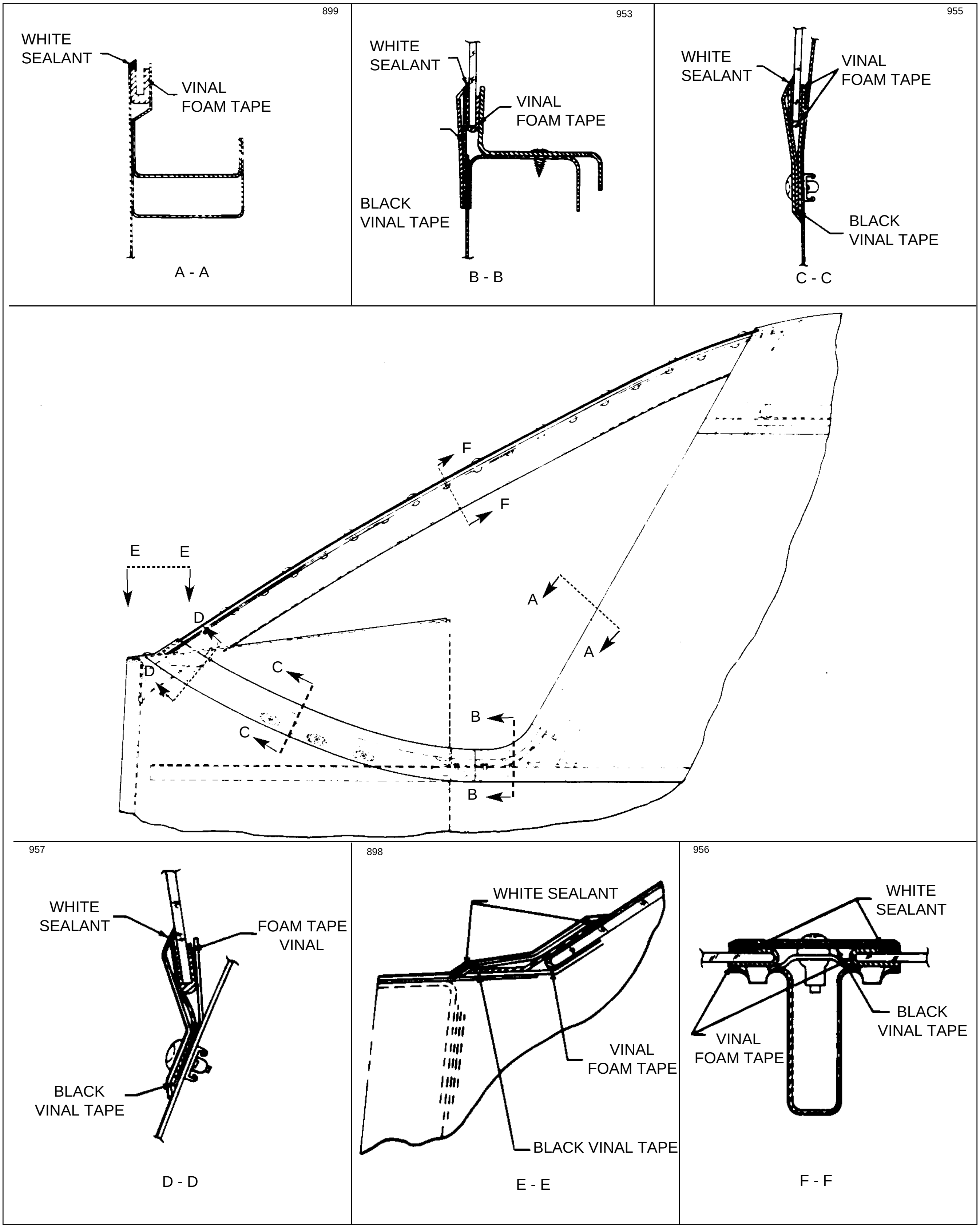


Figure 4-5. Windshield Installation (Typical)

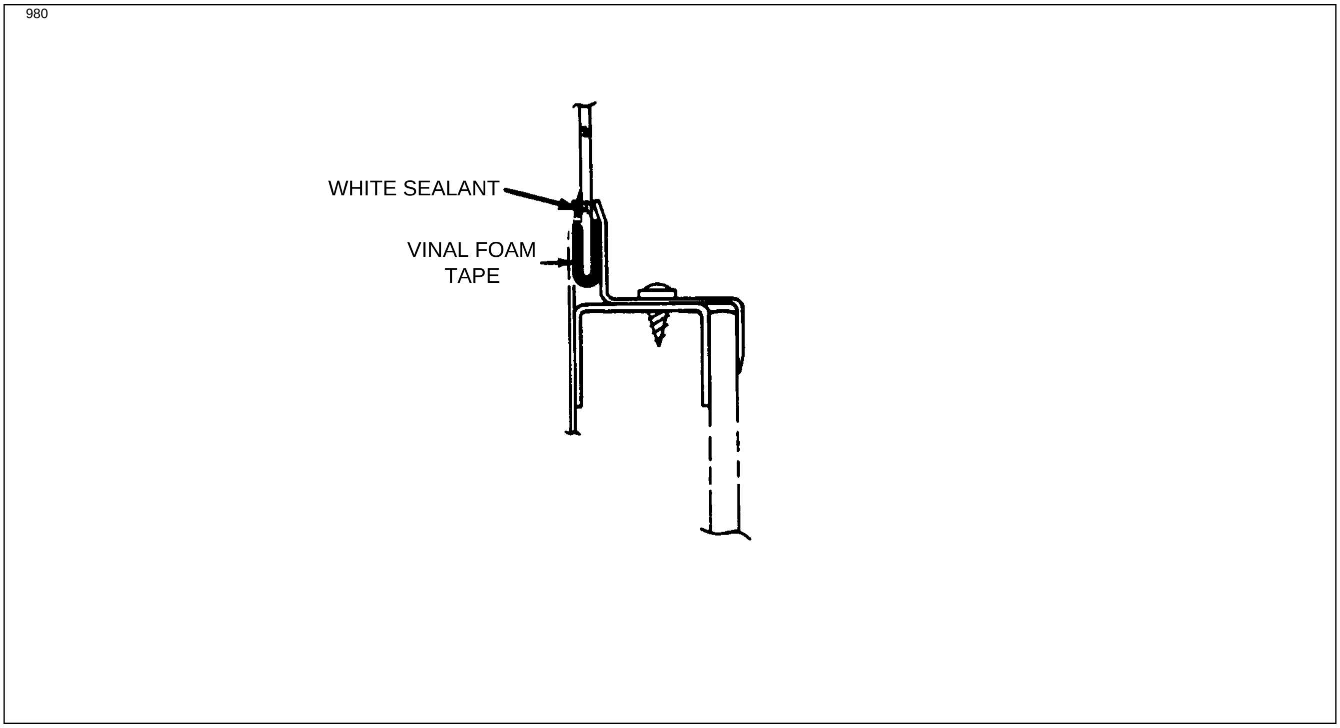


Figure 4-6. Side Window Installation (Typical)

4-38. INSTALLATION OF DOOR.

a. Insert the door into position and install the washers, clevis bolts and cotter pins on the door hinges.

b. For adjustment of door, refer to Paragraph 4-39.

c. Hook up and install the clevis bolt, bushing and washer into the door holder assembly.

4-39. ADJUSTMENT OF DOOR.

a. To acquire the proper vertical adjustment of the door, insert the necessary washer combination between the cabin door hinge and fuselage bracket assembly.

b. Additional adjustments may be made by tapping out the serrated door hinge, bushings and rotating them to obtain the hinge centerline location that will provide proper door fit.

4-40. REMOVAL OF DOOR LATCH MECHANISM

a. Remove the door latch mechanism by removing the door trim upholstery and the screws that attach the latch plate and latch mechanism to the door.

b. Disconnect the latch pull rod from the inside door handle.

c. Remove the complete latch mechanism.

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4-41. INSTALLATION OF DOOR LATCH MECHANISM.

a. Place the latch assembly into position on the door.

b. Connect the latch push-pull rod to the inside door handle.

c. Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

4-42. ADJUSTMENT OF DOOR LATCH MECHANISM. To adjust the door latch. Loosen the screws on the striker plate, make necessary adjustment and retighten the screws.

4-43. REMOVAL OF DOOR LOCK ASSEMBLY.

a. Remove the door trim upholstery by removing the attachment screws.

b. Loosen the nut on the lock assembly and remove the lock by turning it sideways.

4-44. INSTALLATION OF DOOR LOCK ASSEMBLY.

a. Install the lock in the door by turning it sideways and placing it through the opening provided.

b. Replace the nut on the back of the lock assembly and tighten.

c. Replace the door trim upholstery and secure with the attachment screws.

4-45. REMOVAL OF DOOR SAFETY LATCH.

a. Remove the two handles and the screws holding the pan on the inside of the door.

b. Remove the pan and pull the latch assembly through the opening on the door.

4-46. INSTALLATION OF DOOR SAFETY LATCH.

a. Place the latch assembly into position for installation.

b. Replace the pan and install the screws and handles.

c. Check the latch assembly for operation and be certain that it is not rubbing on the trim panels.

4-47. ADJUSTMENT OF DOOR SAFETY LATCH.

a. To adjust the door safety latch remove the screws from the latch plate found at the top of the door opening.

b. Remove the plate and turn the loop assembly in or out to make necessary adjustments.

c. Replace the latch plate and secure with the attachment screws.

4-48. REMOVAL AND INSTALLATION OF DOOR SEAL SNUBBER.

a. If the existing door seal is torn or has deteriorated it should be replaced. If rebonding is required use (1). 3M EC I 300L (preferred) OR (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 the scuff plate.

d. Remove the sticker plate. (Refer to Figure 4-7.)

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 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.

2. To effect a clean installation it is recommended that the door jamb be masked off with tape as shown in Figure 4-7. View D.

3. Apply adhesive to the door jamb with a small brush on the area indicated in Figure 4-7, View D.

—NOTE—

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

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 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 all adjustments and curing have been accomplished, coat the snubber with silicone. Wipe off any excess.

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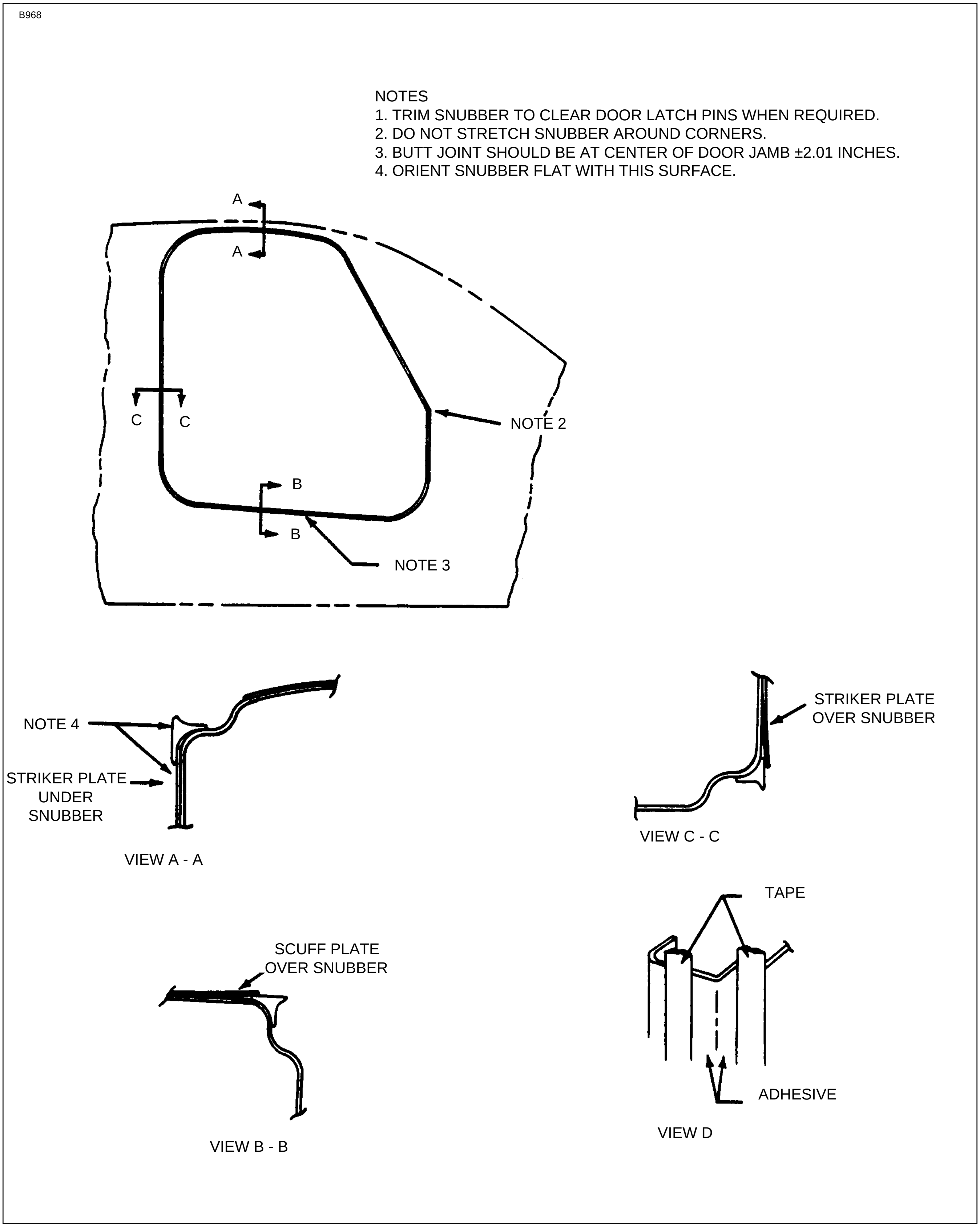

Figure 4-7. Door Seal Snubber Installation

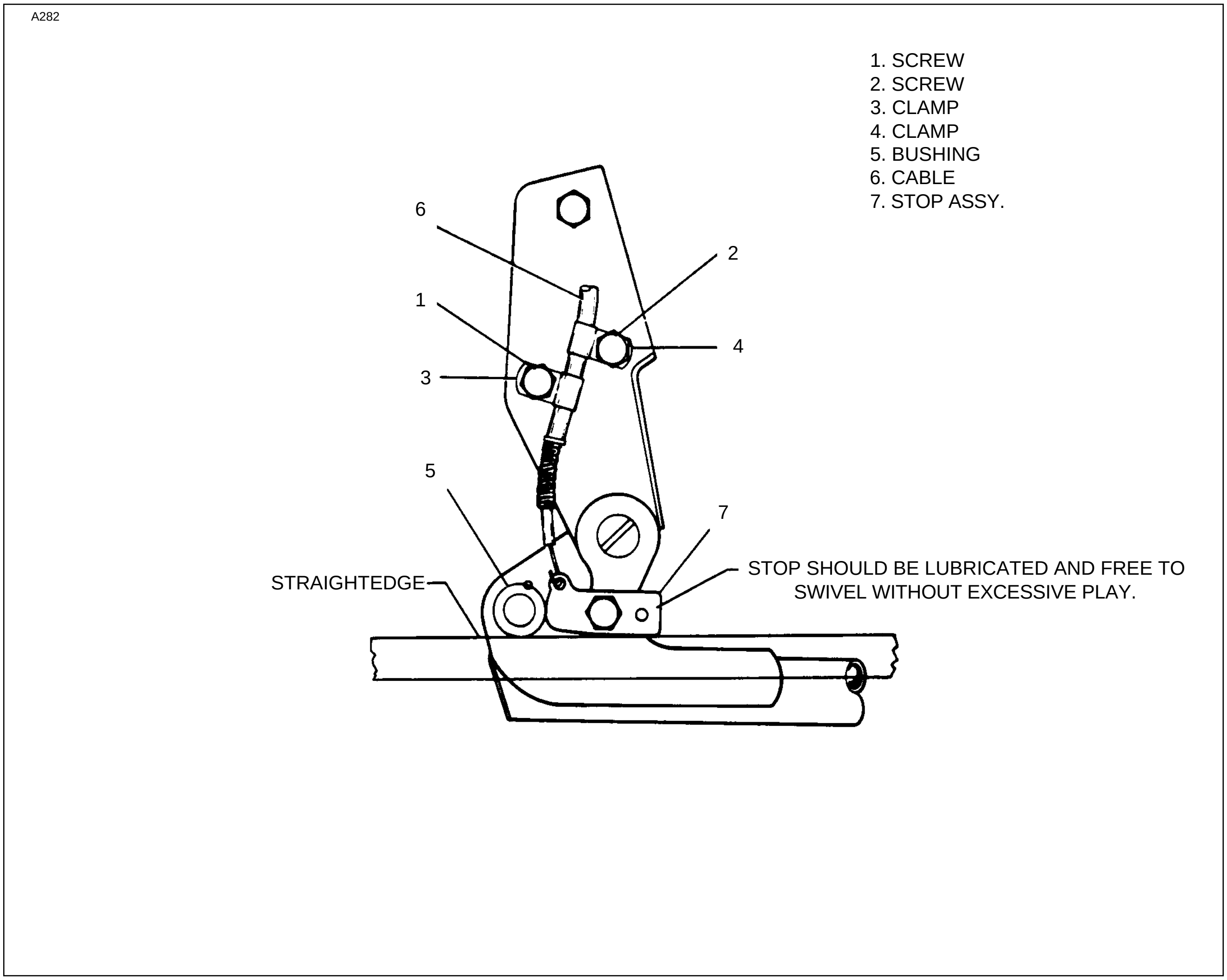

Figure 4-8. Seat Back Lock

4-49. RIGGING INSTRUCTIONS - SEAT BACK LOCK AND RELEASE. (Refer to Figure 4-8)

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 (l and 2) on clamps (3 and 4). The stop (7) should be lubricated and free to swivel without excessive play.

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

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4-50. STRUCTURAL REPAIRS.

Structural repair methods used must be made in accordance with the regulations set forth in FAA Advisory Circular 43-13-1 A. To assist in making repairs and/or replacements, Figure 4-9 identifies the type and thickness of various skin material used. Never make a skin replacement or patch plate from material other than the type of the original skin, or of a different thickness than the original skin. The repair must be as strong as the original skin. However, flexibility must be retained so the surrounding areas will not receive extra stress.

—WARNING—

NO access holes are permitted in any control surfaces.

4-51. FIBERGLASS REPAIRS.

The repair procedure in this manual will describe the methods for repair of fiberglass reinforced structures. Paragraph 4-52 describes Fiberglass TouchUp and Surface Repairs such as blisters, open seams, delamination, cavities, small holes and minor damages that have not harmed the fiberglass cloth material. Paragraph 4-53 describes Fiberglass 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 will furnish the necessary material for such repairs, and is available through Piper Aircraft Dealers.

—WARNING—

The use of patch plates for repairs of all movable tail surfaces is prohibited. The use of any filler material normally used for repair of minor dents and/or materials used for fllling the inside of surfaces is also prohibited on all movable tail surfaces.

4-52. FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.

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

b. The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, skip to step h.)

—NOTE—

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

c. Pour a small amount of resin into a jar lid or on a piece of clean 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.

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 about 1/16 inch above the surrounding undamaged area

e. Lay a piece of cellophane or waxed paper over the repair to 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 covering and trim flush with surface, using a sharp razor blade or knife. Replace the covering and allow the patch 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 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 fingertips, fill the hole to about 1 /16 inch above the surrounding surface with the gel coat mixture.

j. Lay a piece of cellophane over the patch to start the curing process. Repeat step f, trimming patch when partially cured.

k. After trimming the patch, immediately place another small amount of gel coat on cut edge of the patch and cover with cellophane. Then, using a squeegee or other suitable tool, 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 the patched area using a sanding block with fine wet sandpaper. Finish by priming, sanding and applying color coat.

4-53. FIBERGLASS FRACTURE AND PATCH REPAIRS.

a. Remove wax, oil and dirt from around 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° 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 a 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 structure 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 the area.

i. Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edge and to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should 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 roughen 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 fiber 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 a 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 other suitable tool, 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 and 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, 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.

4-54. CHECKING CONTROL SURFACE 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 limits 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 the control wheel. 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 at the actuator location and gently move the aileron up and down; mark the limits 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 limits stated, make the necessary repairs required to eliminate excessive free play.

4-55. CONTROL SURFACE BALANCING.

TABLE IV-I BALANCE SPECIFICATIONS

Maximum Limits - Flight Conditions STATIC BALANCE LIMlTS (In-Lbs)			
SURFACE	HEAVY SIDE Leading Edge		HEAVY SIDE Trailing Edge
Aileron	0	to	-25
Stabilator	+5	to	-40
Rudder	0	to	-13

4-56. 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 lV-I. 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 4-58 thru 4-60. The static balance of the surfaces must be as specified in Table IV-I.

Before balancing any control surface, it must be complete including tip, trim/ servo tabs 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.

4-57. BALANCING EQUIPMENT. (Refer to Figure 4-20.)

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 configuration is shown in Figure 4-11.
To use this tool:

a. Insure that the control surface is in its final right configuration, static wicks, trim tabs, trim tab push pull rod and control surface tip (as applicable) should be installed. The surface should be painted and trim/servo tabs should be in the neutral position.

b. Place hinge bolts through control surfaces and place control surface on a holding fixture.

c. Avoiding rivets, place the balancing tool on the control surface with the tool's hinge centerline directly over the hinge line of the control surface.

d. Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.

e. Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

f. Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balancing bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline

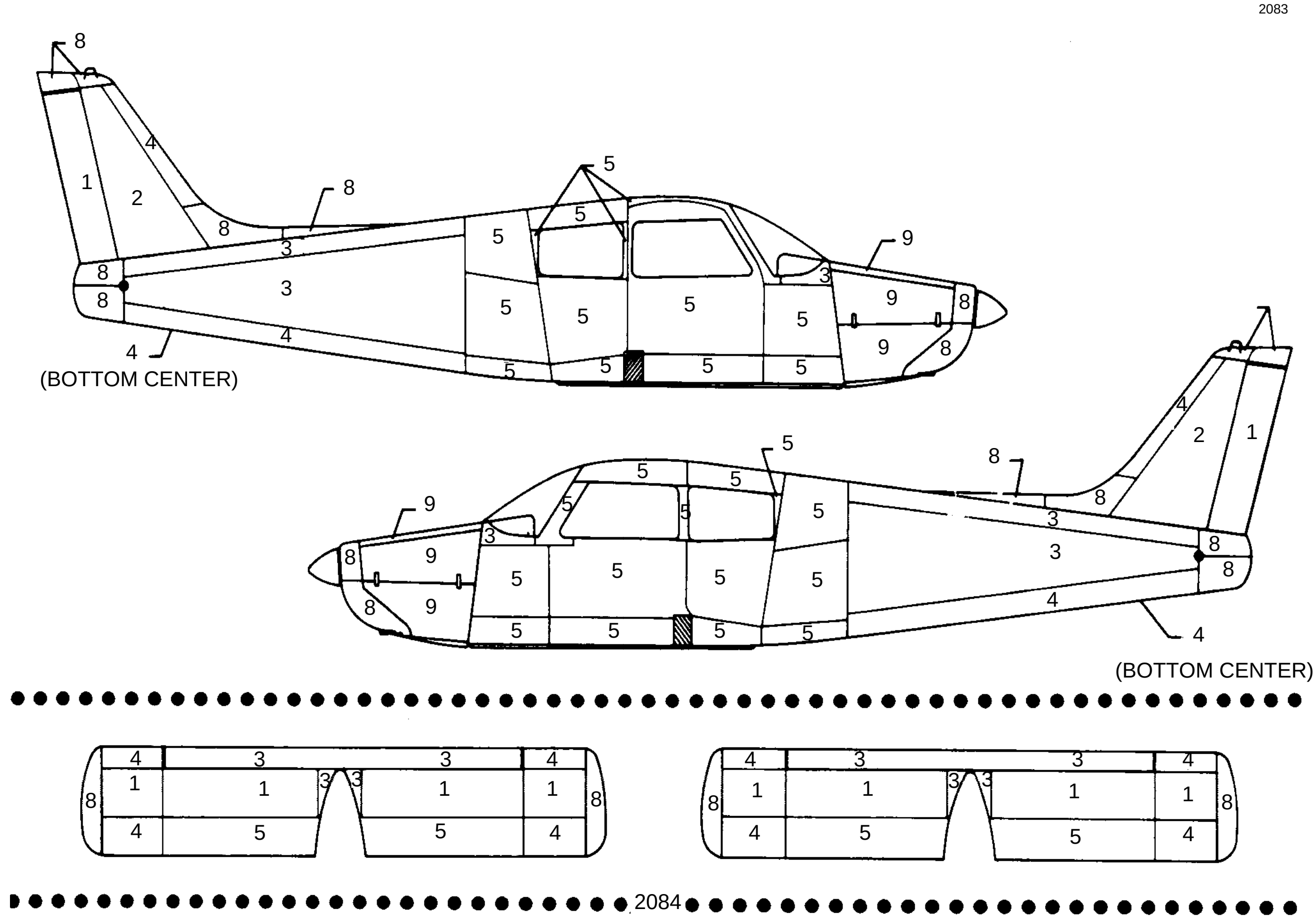
.g. After balancing the tool, reattach it to the control surface. Keep the beam positioned 90^{o} from the control surface hinge line.

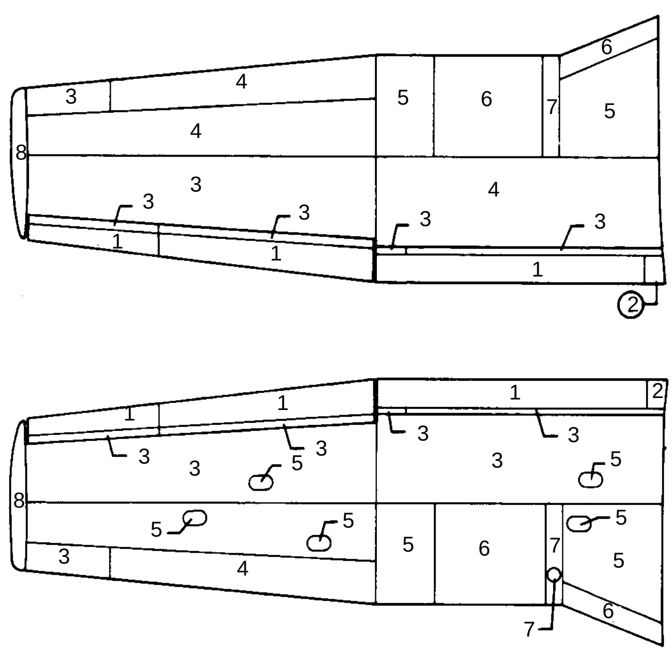
h. Determine balance of control surface by sliding movable weight along the balance beam.

i. Read the scale when the bubble in the level has been centered. Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-pounds of force.

—NOTE—

Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.





LEFT WING SHOWN, RIGHT WING SAME AND OPPOSITE EXCEPT AS NOTED

0 - RIGHT WING ONLY

NUMBER (SKINS)	MATERIAL	THICKNESS
1	2024 - T3	.016
2	2024 -0*	.020
3	2024 - T3	.020
4	2024 - T3	.025
5	2024 - T3	.032
6	2024 - T3	.040
7	2024 -T3	.051
8	FIBERGLASS	—
9	5052 - H34	.032

*HEAT TREAT TO T3 CONDITION AFTER FORMING

Figure 4-9. Skin Materials and Thicknesses

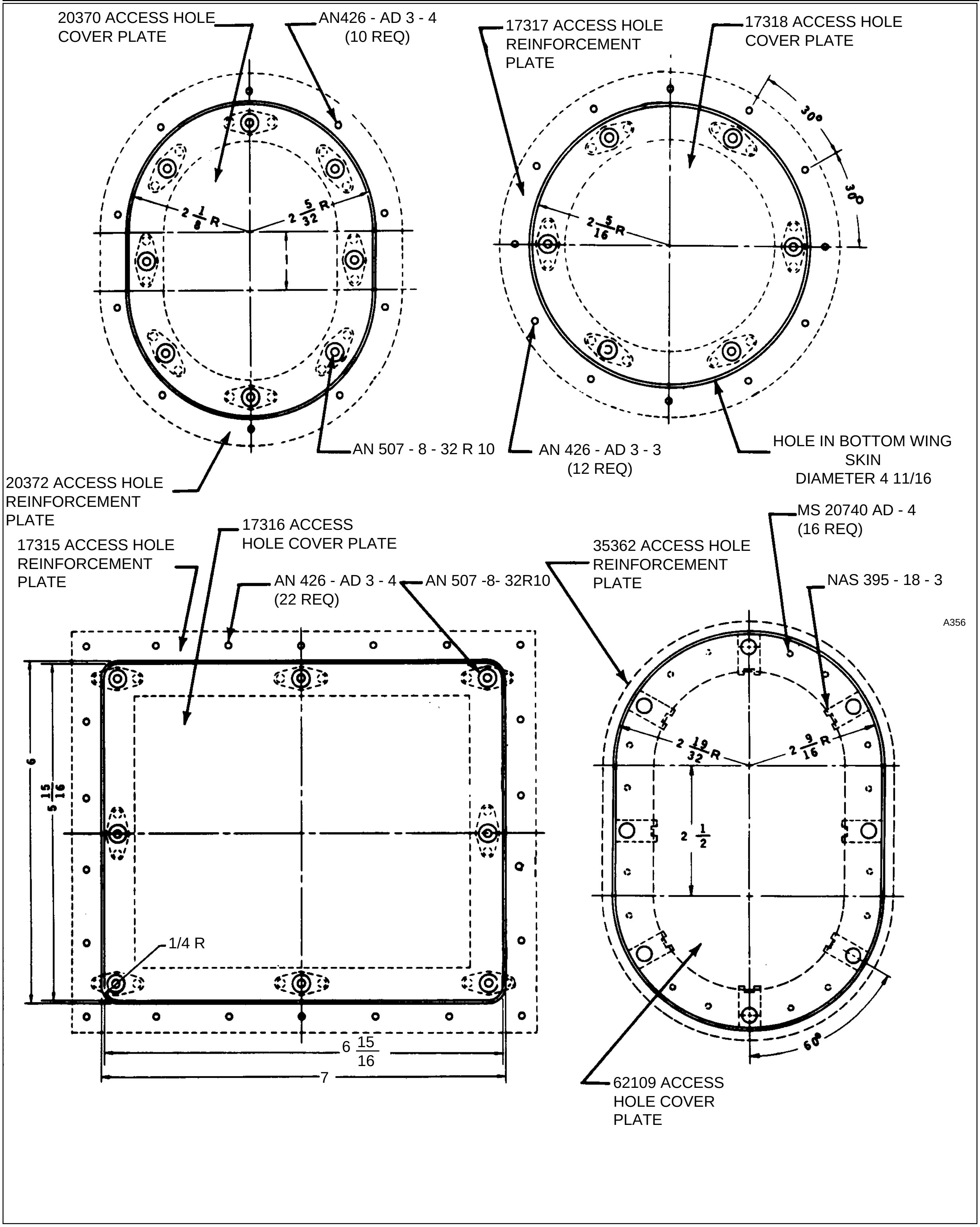


Figure 4-10. Typical Access Plates

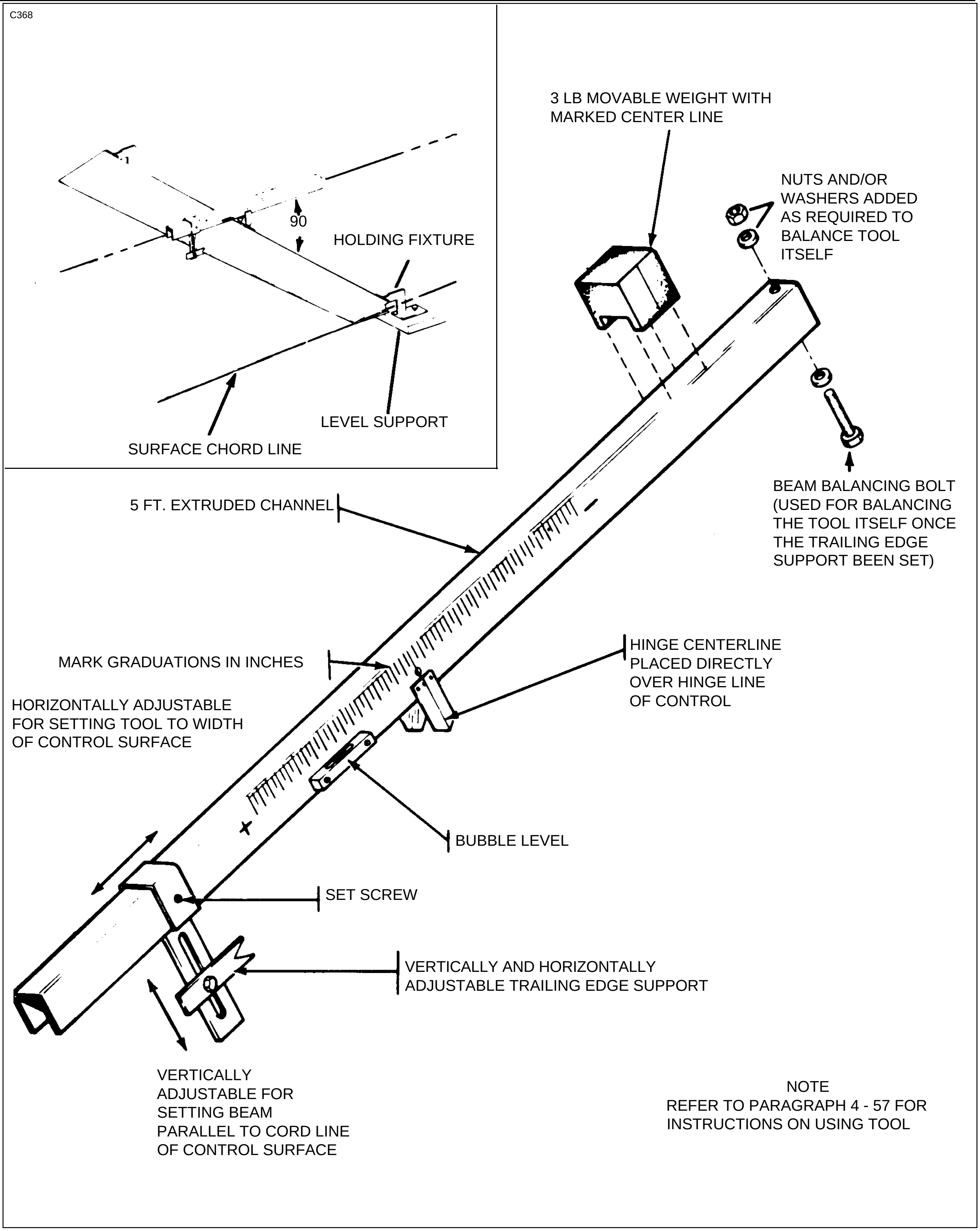


Figure 4-11. Control Surface Balance Tool

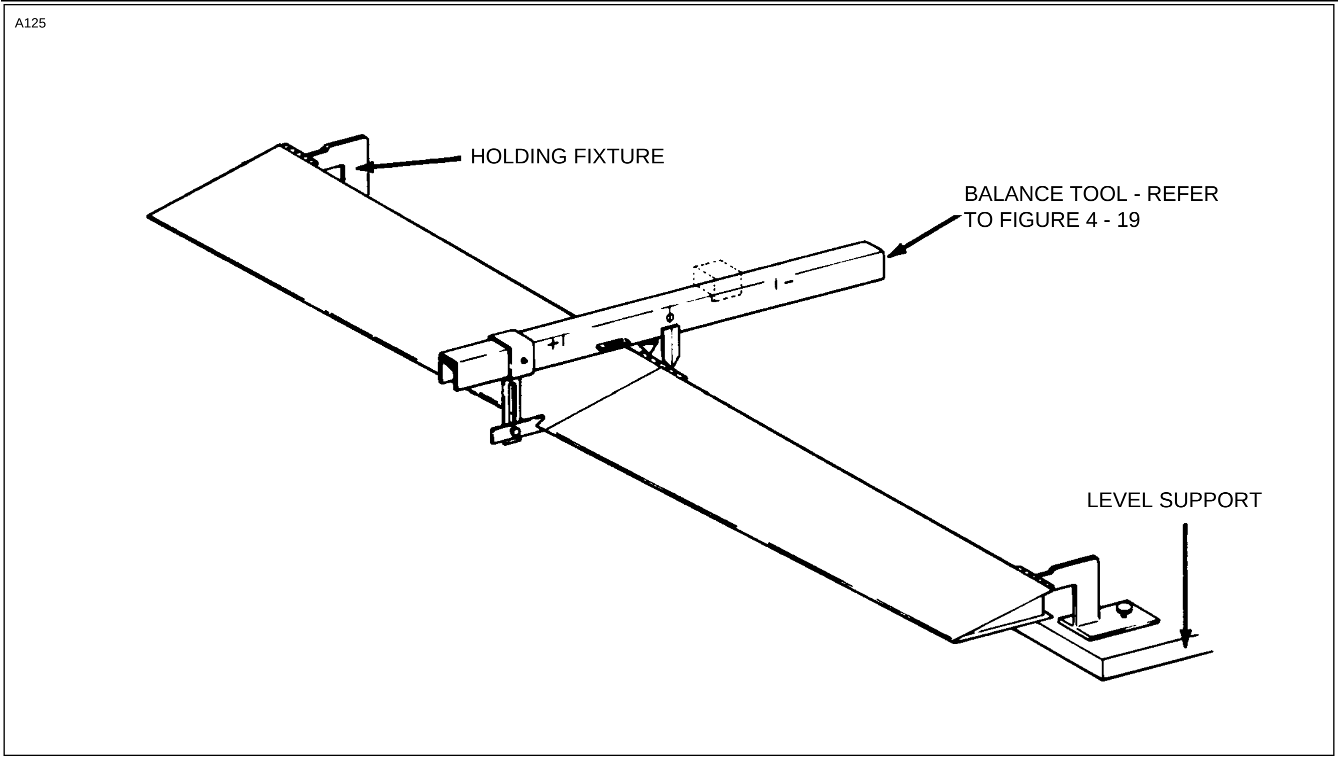


Figure 4-12. Aileron Balance

4-58. BALANCING AILERONS. (Refer to Figure 4-12.)
Position the aileron on the balancing fixture in a draft free area and in a manner which allows unrestricted movement of the aileron. Place the tool on the aileron, avoid rivets and keep the beam perpendicular to the hinge centerline. Calibrate the tool as described in Paragraph 4-57. Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance. If the static balance is not within the limits specified in Table IV-I, proceed as follows:

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

b. Trailing Edge Heavy: It will be necessary to determine the exact cause of the underbalance. If the aileron is too heavy because of paint build-up, it will be necessary to strip all paint from the aileron and repaint. If the aileron is too heavy resulting from repair to the skin or ribs, it will be necessary to replace all damaged parts and recheck the balance.

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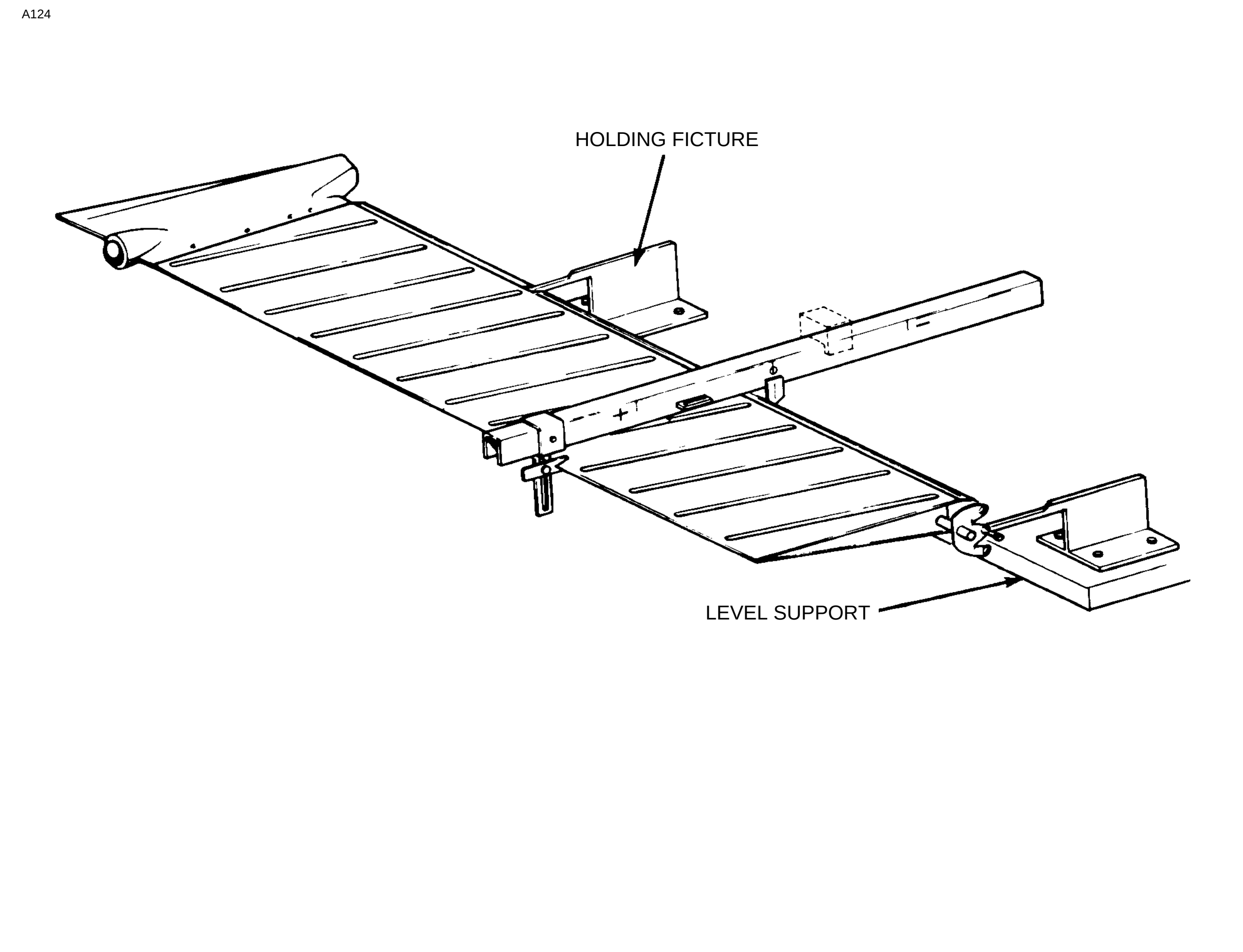

Figure 4-13. Rudder Balance

4-59. BALANCING RUDDER. (Refer to Figure 4-21)

To balance the rudder, the assembly must be complete including the tip assembly with all attaching screws and position light wiring. Place the complete assembly horizontally on knife edge supports in a draft free area in a manner that allows unrestricted movement. Place the tool on the rudder with the beam perpendicular to the hinge centerline. Calibrate the tool as described in Paragraph 4-57. Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance limit. If the static balance is not within the limits given in Table IV-I, proceed as follows:

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

b. Nose Light: This condition is caused by a light balance weight or a heavy rudder as a result of paint or repairs. A light balance weight is highly improbable because it is enclosed in fiberglass per Figure 4-14, Section A-A. Paint build-up must be stripped and surface repainted. If the rudder is too heavy as a result of repairs, the repairs must be removed and damaged parts replaced.

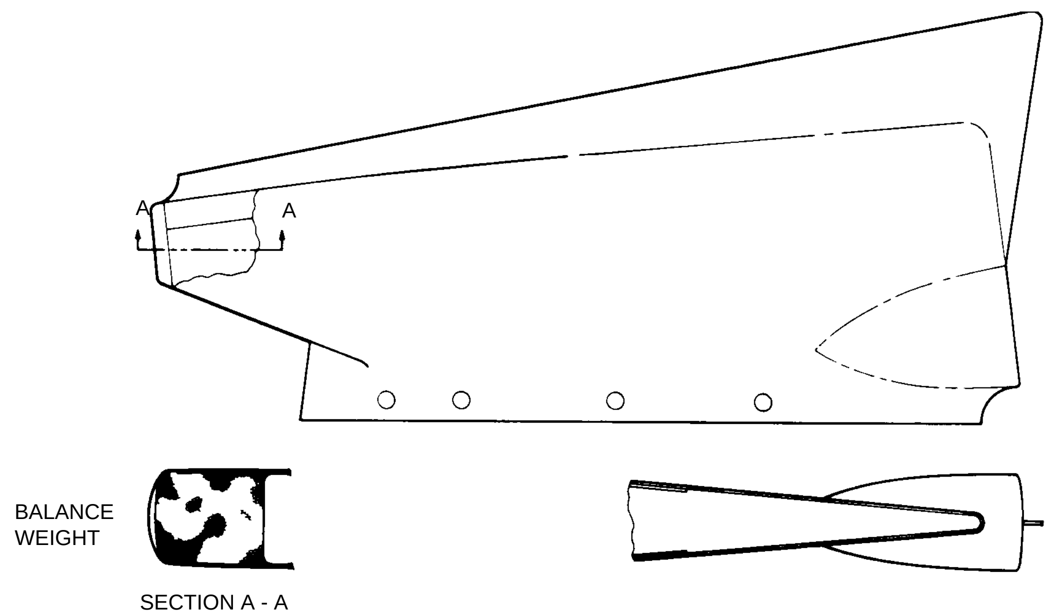

Figure 4-14 Rudder Balance Weight

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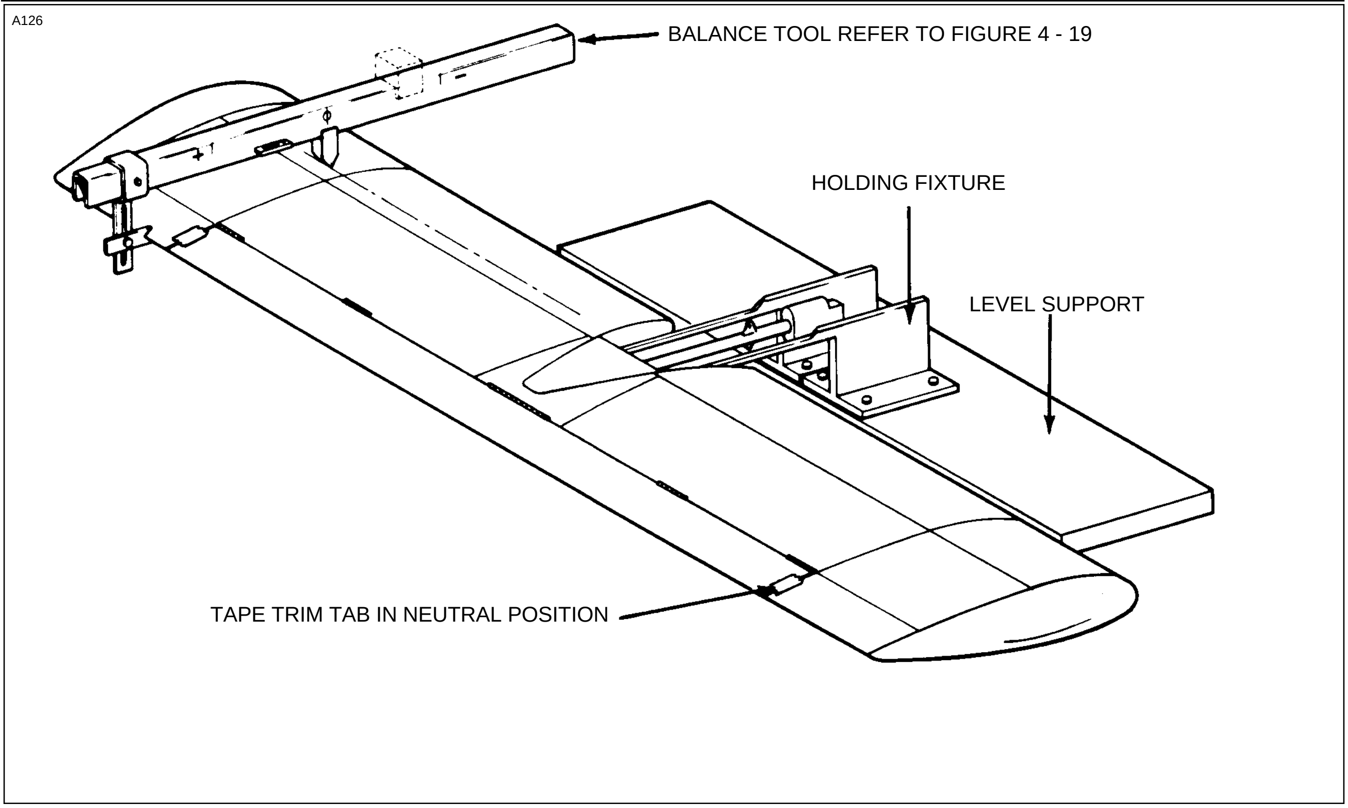

Figure 4-15. Stabilator Balance

4-60. BALANCING STABILATOR. (Refer to Figure 4-23.)

To balance the stabilator, the assembly must be complete including the trim tab, the tab push rod and end bearing, stabilator tips and all attaching screws. Before balancing, tape the trim tab in neutral position with a small piece of tape. Place the complete assembly on the knife edge supports in a draft free area in a manner that allows unrestricted movement. Place the tool on the stabilator with the beam perpendicular to the hinge centerline. Do not place the tool on the trim tab. Calibrate the tool as described in Paragraph 4-57. Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance limit. If the static balance is not within the limits given in Table IV-I proceed as follows:

a. If the stabilator is out of limits on the leading edge heavy side, remove balance plates from the mass balance weight until the static balance is within limits.

b. If the stabilator is out of limits on the trailing edge heavy side, add balance plates to the mass balance weight until the static balance is within limits.

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4-61. SAFETY WALK REPAIR.

4-62. SURFACE PREPARATION FOR PRESSURE SENSITIVE SAFETY WALK.

The area to which the pressure sensitive safety walk is to be installed must be free from all contaminates and no moisture present.

4-63. APPLICATION OF PRESSURE SENSITIVE SAFETY WALK.

Wipe area with a clean dry cloth to insure that no moisture remains on surface. Do not apply when surface temperature is below 5O°F. Apply pressure sensitive safety walk as follows:

a. Peel back the full width of the protective liner approximately 2 inches from the leading edge of the safety walk.

b. Apply the safety walk to the wing area, begin at the leading edge, insure proper alignment and position from wing flap.

c. Remove the remaining protective liner as the safety walk is being applied from front to back of wing area.

d. Roll firmly with a long handled cylindrical brush in both lengthwise directions. Make sure all edges adhere to the wing skin.

e. Install and rivet leading edge retainer.

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SECTION V

SURFACE CONTROLS

SECTION V

SURFACE CONTROLS

5-1. INTRODUCTION. This section contains the explanation for the removal, installation, rigging and adjustment procedures for the control assemblies of the various structural surfaces. The assemblies need not be removed in order of paragraphs since each paragraph describes the individual removal and installation of the component. For the removal and installation of the structural surfaces of the airplane, refer to Section IV.

5-2. DESCRIPTION. The aircraft is controlled in flight by the use of three standard primary control surfaces, consisting of the ailerons, stabilator and rudder. Operation of these controls is through the movement of the dual control columns and dual rudder pedals. The individual surfaces are connected to the control components through the use of cables and push-pull tubes. Provision for directional and longitudinal trim control is provided by an adjustable trim mechanism for the rudder and stabilator. The flaps are mechanically operated and can be positioned in four locations of 0, 10, 25, and 40 degrees.

The aileron controls consist of two-control wheels connected by torque tubes to sprockets on each end of the horizontal control column. A chain is wrapped around the sprockets and around a double socket on the vertical post of the control column. The chain is connected to the primary aileron control cable which is routed through the center of the fuselage to the main spar and out through the wings to a bellcrank in each wing. A balance cable is also connected to the bellcrank. As the control wheels are moved, the control cables move the bellcranks and actuate push-pull rods to move the ailerons.

The stabilator controls are also connected to the control column. From the connecting point, cables are routed around a series of pulleys down under the floor and aft to the tail section of the airplane. The aft end of the cables connect to the stabilator balance arm which in turn is connected to the stabilator. When the control wheels are moved forward or aft, the cables move the balance arm on the stabilator up or down rotating the stabilator at its hinge points.

The rudder is controlled by the pilot's and copilot's rudder pedals. Cables are connected to both sides of the rudder pedal assembly and are routed aft through the bottom of the fuselage to the rudder horn. When one rudder pedal is pushed, the cables move in opposite directions turning the rudder horn and rudder. The wing flap system is operated by a lever located between the front seats.

For a visual description of the various control systems, refer to the illustrated figures throughout this section.

5-3. STANDARD PROCEDURES. The following tips may be helpful in the removal, installation and rigging of the various assemblies:

a. It is recommended, though not always necessary to level and place the airplane on jacks during rigging and adjustment.

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

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

d. Turnbuckle stations are given at their neutral positions.

e. When referring to marking cable ends, etc., before disconnecting, a felt marking pen may be used.

f. Assemble and adjust the turnbuckles so that each terminal is screwed an approximately equal distance into the barrel. Do not turn the terminals in such a manner that will put a permanent "twist" into the cables.

g. Cable tensions should be taken with the appropriate control surface in its neutral position.

h. After completion of each adjustment, check the turnbuckles to be sure not more than three terminal threads are visible outside the barrel. Install the locking clips, and check for proper installation by trying to remove the clips using fingers only. Both locking clips may be installed in opposite holes. Locking clips which have been installed and removed must be scrapped and not reused.

i. When push rods or rod ends are provided with an inspection hole, the screw must be screwed in far enough to pass the inspection hole. This can be determined visually or by feel, inserting a piece of wire into the inspection hole. If no hole is provided, there must be a minimum of .375 of an inch thread engagement.

j. After completion of adjustments, each jam nut must be tightened securely.

— NOTE —

Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked, using Table V-II.

k. Torque all nuts in the flight control surface rigging system (including nose wheel steering) in accordance with Table II-II, Recommended Torques, unless specific torques are given in text.

5-4. CONTROL COLUMN ASSEMBLY.

5-5. REMOVAL OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 5-1.)

a. To remove either control wheel (1) with its 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 from 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 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 the 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), chains (7 and 8) and 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. Remove the tunnel cover by removing the rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly, by removing the plate attaching screws.

6. Remove the tee bar assembly by removing the attaching bolts (15), 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.

TABLE V-I. CONTROL SURFACE TRAVEL AND CABLE TENSION

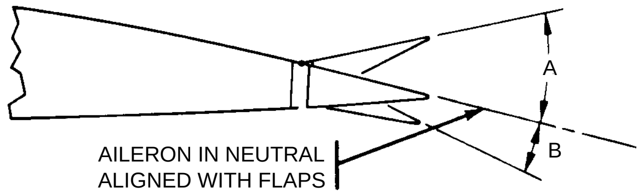
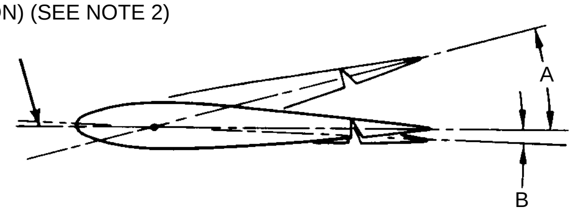
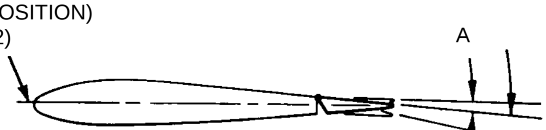
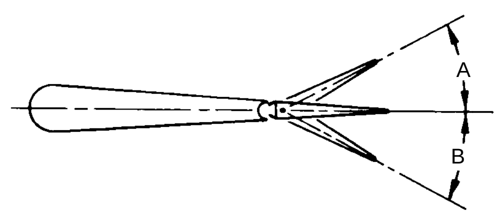
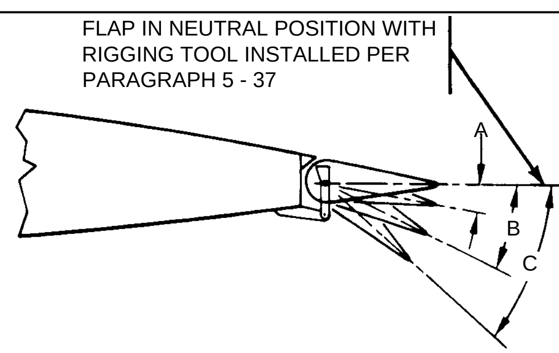
AILERON A = 25° ± 2°UP B = 12.5° ± 2° DOWN	 **NOTES** 1. FLAP ADJUSTMENT MUST BE COMPLETE BEFORE STARTING AILERON ADJUSTMENT 2. MAXIMUM FREE PLAY IS 0.24 OF AN INCH MEASURED AT THE ACTUATOR LOCATION TRAILING EDGE
STABILATOR A. STABILATOR TRAILING EDGE UP TRAVEL FROM NEUTRAL 14° ± 1° B. STABILATOR TRAILING EDGE DOWN TRAVEL FROM NEUTRAL 2° ± 1°	STABILATOR CHORD LINE (NEUTRAL POSITION) (SEE NOTE 2) 
STABILATOR TRIM TAB A. STABILATOR TAB TRAILING EDGE UP TRAVEL FROM NEUTRAL 3° ± 1° B. STABILATOR TAB TRAILING EDGE DOWN TRAVEL FROM NEUTRAL 12° ± 1°	STABILATOR CHORD LINE (NEUTRAL POSITION) (SEE NOTE 2)  1. MAXIMUM FREE PLAY FOR CONTROL SURFACE TAB IS 0.15 OF AN INCH MEASURED AT TAB TRAILING EDGE. 2. NEUTRAL POSITION OF STABILATOR IS WITH THE STABILATOR CHORD LINE PARALLEL WITH THE TOP OF THE FRONT SEAT TRACKS
RUDDER A. 27° ± 2° LEFT B. 27° ± 2° RIGHT **RUDDER PEDAL NEUTRAL ANGLE** **14° + 3° - 1° AFT OF NEUTRAL**	
FLAP A. 10° ± 2° FIRST NOTCH TRAVEL B. 25° ± 2° SECOND NOTCH TRAVEL C. 40° ± 2° THIRD NOTCH TRAVEL	

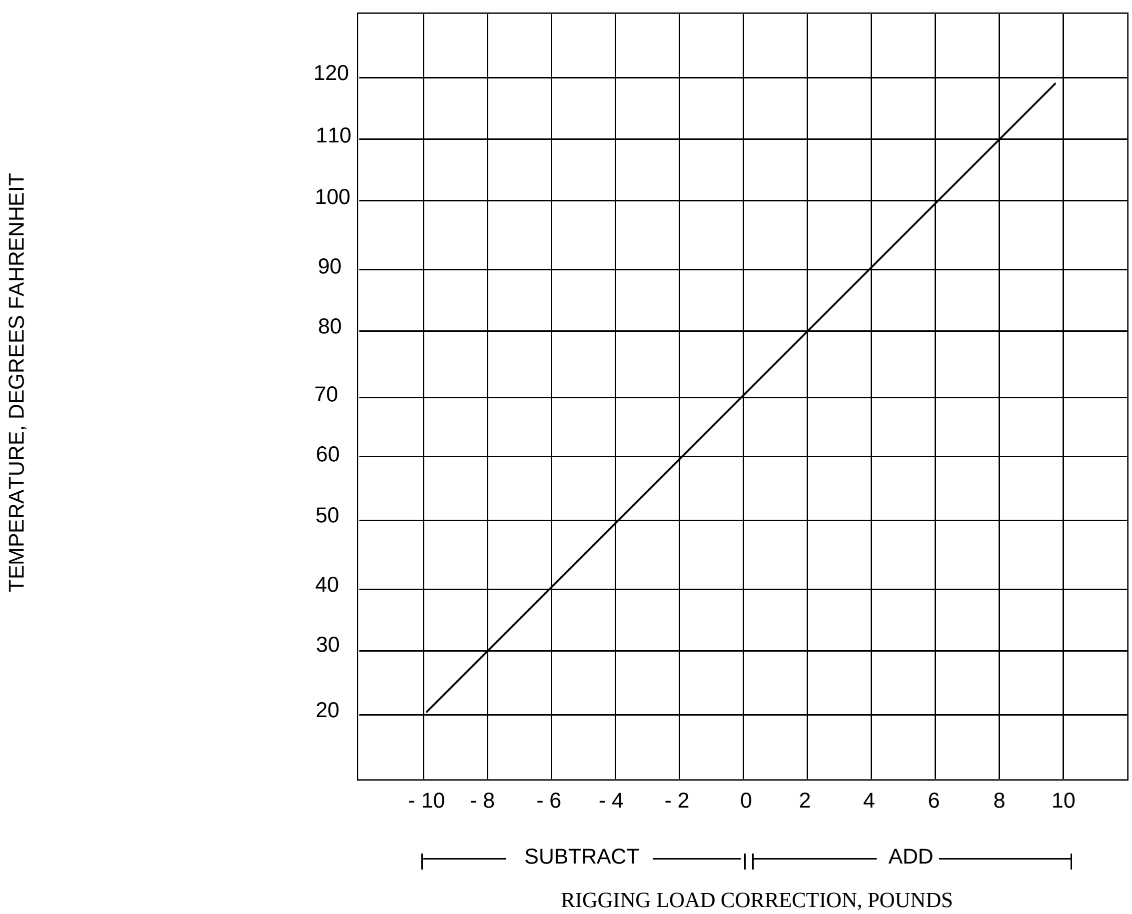
TABLE V-I. CONTROL SURFACE TRAVEL AND CABLE TENSION (cont.)

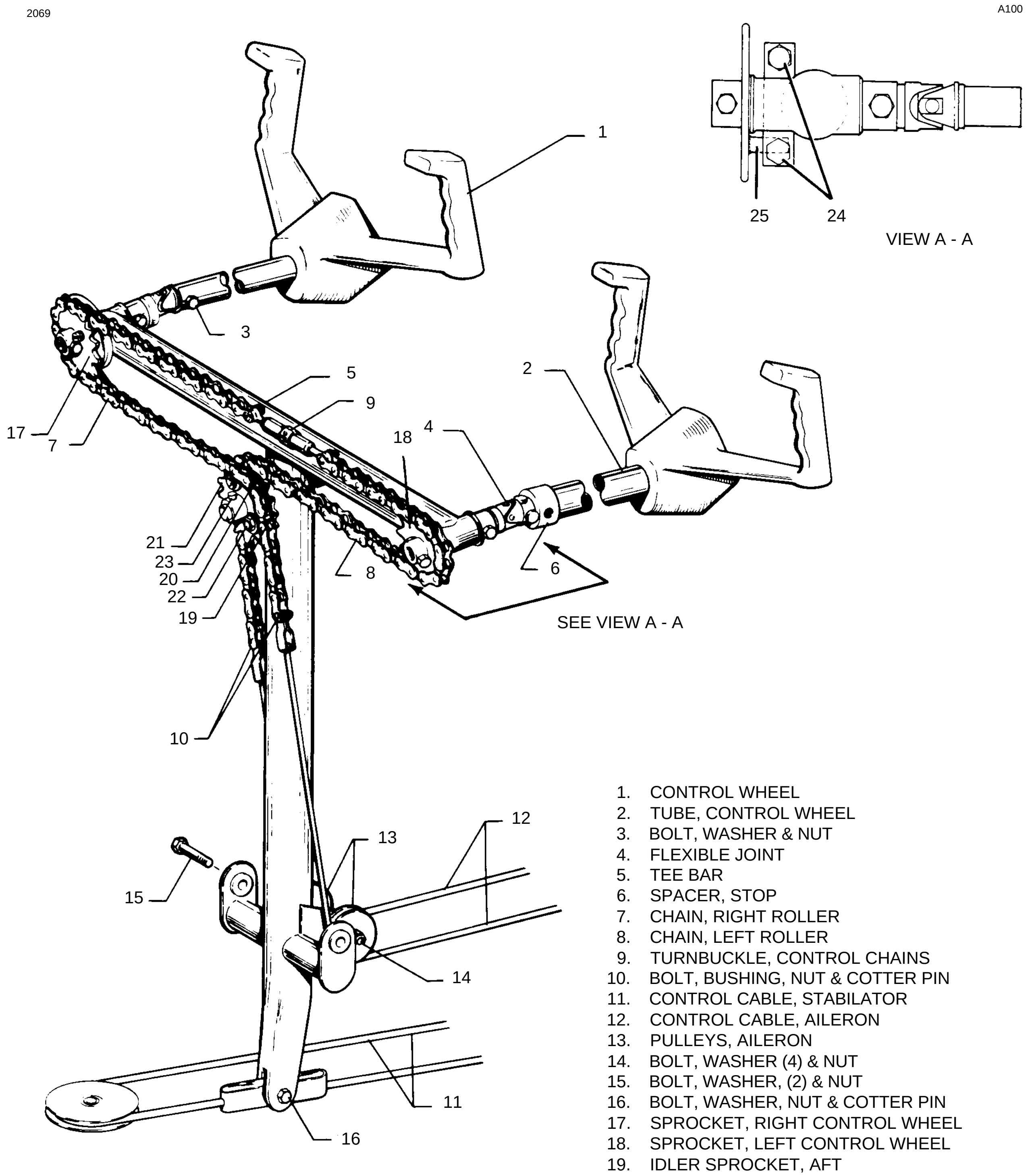
CABLE TENSION	
AILERON	40 LBS ± 5 LBS
FLAP	10 LBS ± 1 LB
STABILATOR	40 LBS ± 5 LBS
STABILATOR TRIM TAB	14 LBS ± 1 LB
RUDDER	35 LBS ± 5 LBS

—NOTE—

CABLE TENSION GIVEN APPLIES ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLES ATTACHED. REFER TO APPROPRIATE AUTOPILOT SERVICE MANUAL FOR PROPER CABLE TENSIONS WHEN ATTACHING BRIDLE CABLES.

TABLE V-II. CABLE TENSION VS. AMBIENT TEMPERATURE





1. CONTROL WHEEL
2. TUBE, CONTROL WHEEL
3. BOLT, WASHER & NUT
4. FLEXIBLE JOINT
5. TEE BAR
6. SPACER, STOP
7. CHAIN, RIGHT ROLLER
8. CHAIN, LEFT ROLLER
9. TURNBUCKLE, CONTROL CHAINS
10. BOLT, BUSHING, NUT & COTTER PIN
11. CONTROL CABLE, STABILATOR
12. CONTROL CABLE, AILERON
13. PULLEYS, AILERON
14. BOLT, WASHER (4) & NUT
15. BOLT, WASHER, (2) & NUT
16. BOLT, WASHER, NUT & COTTER PIN
17. SPROCKET, RIGHT CONTROL WHEEL
18. SPROCKET, LEFT CONTROL WHEEL
19. IDLER SPROCKET, AFT
20. SPACER, IDLER SPROCKETS
21. IDLER SPROCKET, FORWARD
22. BOLT ASSEMBLY
23. PIN
24. AILERON TEE BAR STOPS
25. SPROCKET STOP PIN

Figure 5-1. Control Column Assembly

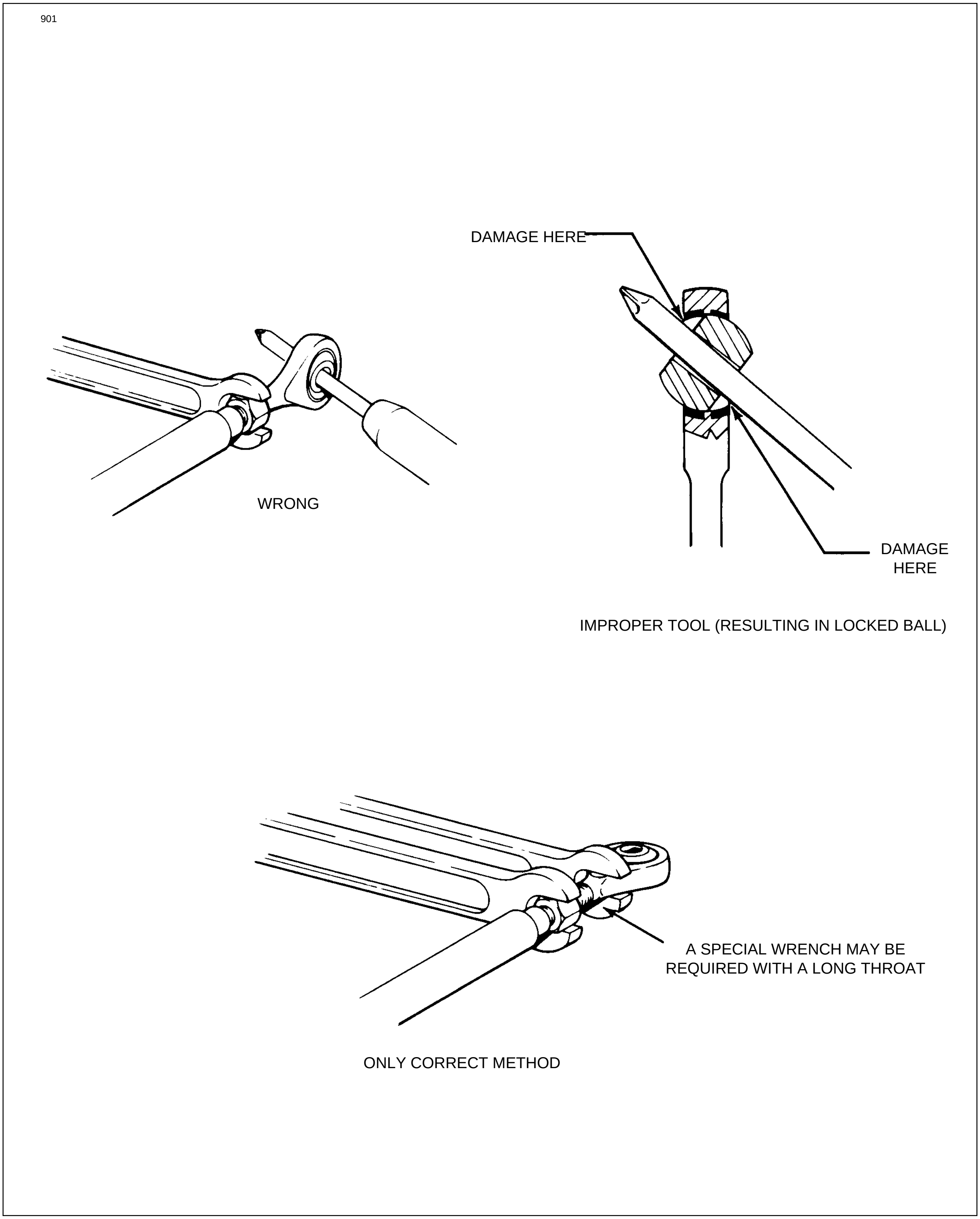


Figure 5-2. Correct Method of Installing Rod End Bearings

5-6. INSTALLATION OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 5-1.)

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

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

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

3. Place the aileron control cables (12) around the pulleys (13) that attach to the lower section of the tee bar (5); position the 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 crossover sprockets (19 and 21). This 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 the 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 5-12. Before safetying the turnbuckle, check to determine that the ailerons and control wheels are both in their neutral position and the chain turnbuckle is centered. Also, the aileron bellcranks should hit their stops before the control wheel hits its stop. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts

9. Set the stabilator cable tension with turnbuckles in the aft section of the fuselage and instructions given in Paragraph 5-17. Check safety of all turnbuckles upon completion of adjustments.

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

11. Place the tunnel plate into position for installation and secure with the appropriate screws. Roll the carpet into place and install the rudder trim cover and 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 side of the tube ahead of the control wheel. Position the rubber grommet in the hole in the side of the tube to protect wires.

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.

5-7. AILERON CONTROLS.

5-8. REMOVAL OF AILERON CONTROL CABLES. (Refer to Figures 5-2 and 5-3.)

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

1. Remove the two front seats from the airplane.

2. Remove the tunnel cover located aft of the tee bar assembly by removing the rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located aft of the tee bar assembly by removing the plate attaching screws.

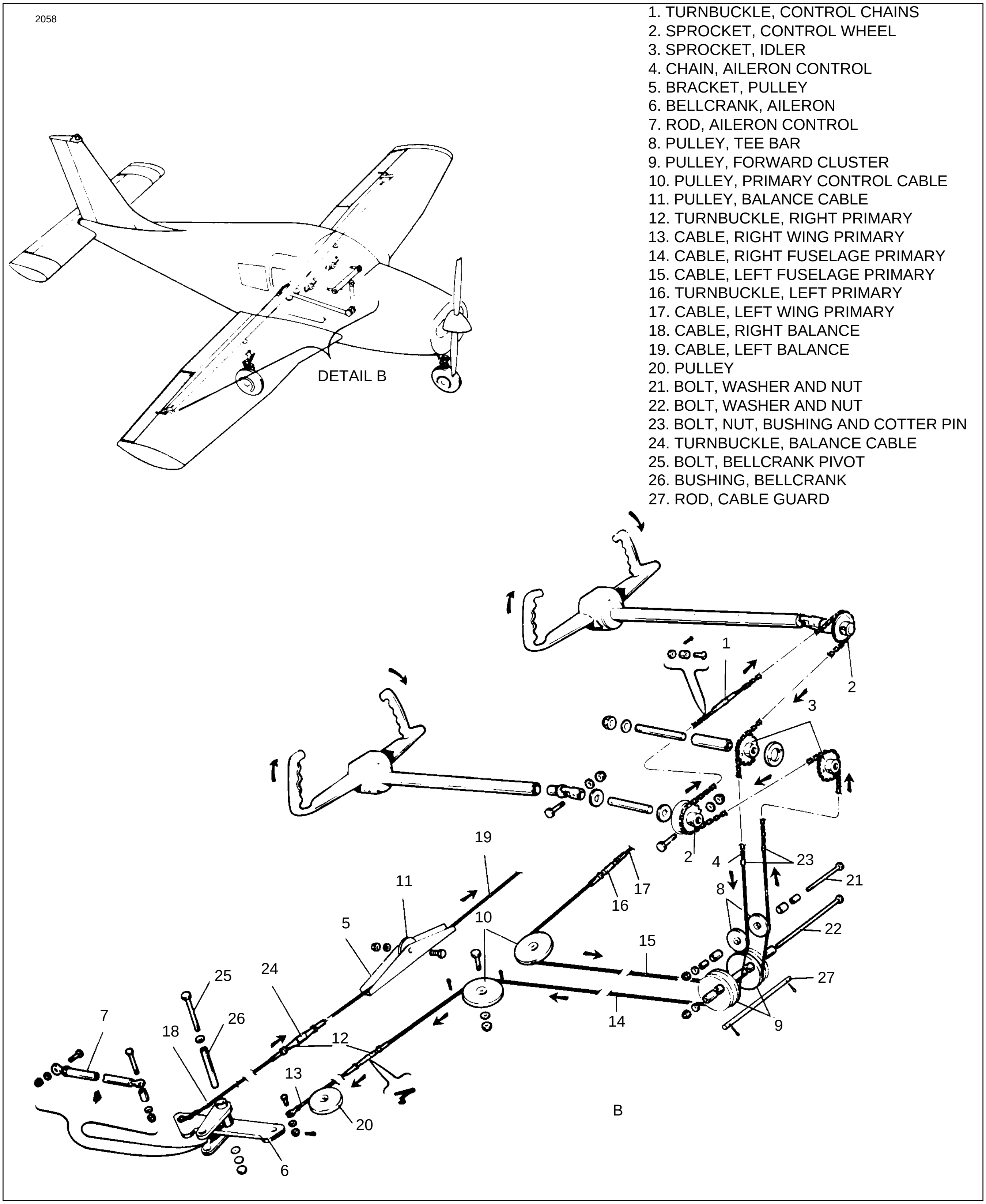


Figure 5-3. Aileron Controls

— NOTE —

To help facilitate reinstallation of control cables, mark the cable ends and attach a line where applicable before drawing them through the fuselage or wing.

3. Separate the primary control cable (14 or 15) at the turnbuckle (12 or 16) located under the floor panel aft of the main spar.

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

5. Move the cable guard (28) under the pulley cluster (9) located just aft of the lower portion of the tee bar by removing the cotter pin from the exposed end of the guard and sliding it to the left or right as required.

6. 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.

7. Disconnect the cable (14 or 15) from the control chain (4) at the control column tee bar assembly 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.

8. Draw the cable back through the floor tunnel.

b. 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 area aft of the main spar.

3. Disconnect the aileron centering springs from the plate on the bellcrank.

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

5. Draw the cable from the wing.

c. 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 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 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 aileron centering springs from the plate on the bellcrank.

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

6. Draw the cable from the wing.

d. When both the primary control cable and the balance cable are removed, the plate on the bellcrank used as part of the aileron centering device is also removed.

5-9. INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figures 5-2 and 5-3.)

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 aft of the tee bar. Install the cable guard (28) only after cables have been tensioned.

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 within access 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 within access opening just aft of the main spar.

7. Check rigging and adjustment per Paragraph 5-12.

8. Install the floor tunnel plate trim covers by placing the tunnel plate into position and secure with the attachment screws. Roll the carpet into place and install the rudder trim cover and knob.

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, along with the aileron centering plate, 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 aft of the main spar.

4. Hookup aileron centering springs from angle assembly to plate.

5. Check rigging and adjustment per Paragraph 5-12.

6. 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, along with the aileron centering plate, 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) that is located aft of the main spar.

4. If the left cable was removed, install the cotter pin cable guard at the pulley (10) located within the fuselage, aft of the main spar.

5. Hookup aileron centering springs from the angle assembly to the plate.

6. Check rigging and adjustment per Paragraph 5-12.

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

d. Replace the floor panel and the two front seats.

5-10. REMOVAL OF AILERON BELLCRANK ASSEMBLY. (Refer to Figures 5-2 and 5-3.)

a. Remove the access plate to the aileron bellcrank (6) located on the underside of the wing, forward of the center aileron hinge.

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

d. Disconnect the aileron centering springs from the plate on the bellcrank.

e. 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. (This also disconnects the aileron centering plate from the bellcrank.)

f. Disconnect the aileron control rod (7) at the aft or forward end, as desired, by removing the cotter pin, nut, washer and bolt.

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

h. Remove the bellcrank from within the wing.

5-11. INSTALLATION OF AILERON BELLCRANK ASSEMBLY. (Refer to Figures 5-2 and 5-3.)

a. Install the bellcrank pivot bushing (26) with teflon tube (29) in 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 within 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 5-12.

e. Connect ends of the primary (13 or 17) and balance (18 or 19) control cables along with the aileron centering plate 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 5-12.

g. Hookup the aileron centering springs from angle assembly to plate.

h. Install the access plate on the underside of the wing and replace the floor panel

5-12. RIGGING AND ADJUSTMENT OF AILERON CONTROLS. (Refer to Figure 5-3)

— NOTE —

Flap adjustment must be completed before starting aileron adjustment.

a. To check and adjust the rigging of the aileron controls, first set the right and left aileron bellcranks at neutral potion. (Ascertain that the control chains have been rigged per Paragraph 5-6.) This may be accomplished by the following procedure:

1. Remove the access plate to each aileron bellcrank located on the underside of the wing, forward of the center aileron hinge by moving the plate attaching screws.

2. Affix a bellcrank rigging tool, as shown in Figure 5-3, between the forward arm of each bellcrank and the adjacent rib. (This tool may be fabricated from dimensions given in Figure 5-3.) 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. The neutral position may also be found by locating the position at which the forward and aft cable connection holes are an equal distance from the adjacent outboard wing rib.

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

1. Ascertain that the flaps are rigged in accordance with Paragraph 5-37, and in their up locked position.

2. Place the control column tee bar in the full forward position and maintain in this position by use of a suitable tool, or by placing weights on the aft side of the stabilator, if the stabilator cables have been previously tensioned.

3. Ascertain that both bellcranks are at their neutral positions.

4. With aileron control rod connected between the bellcrank and aileron, check that the trailing edge of the aileron is even with the trailing outboard edge of the flaps. Ensure that the flaps are rigged correctly per Paragraph 5-37. This is the aileron neutral position.

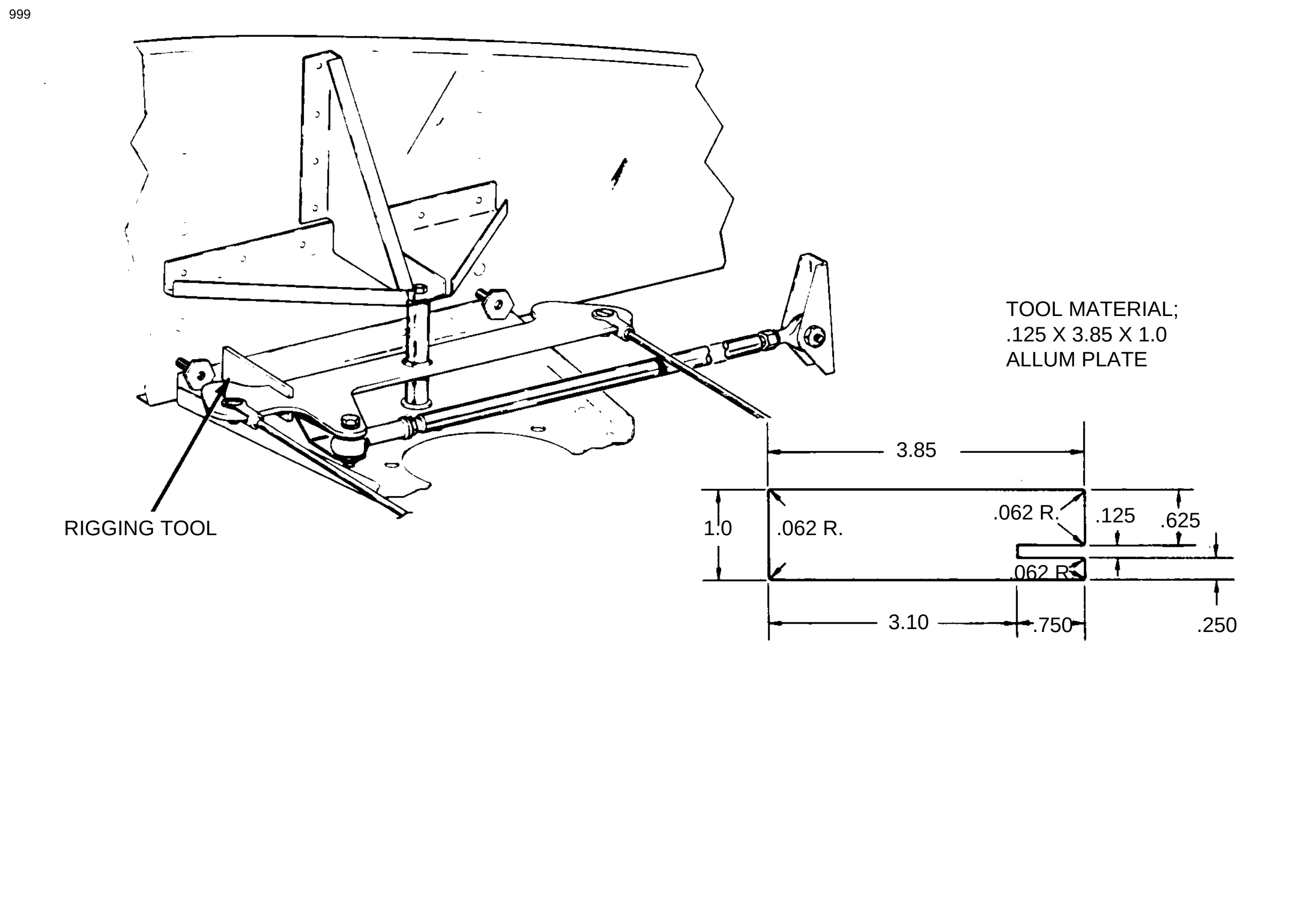


Figure 5-4 Bellcrank Rigging Tool

5. Should the two trailing edges (aileron and flap) not align, disconnect the aileron control push rod from the bellcrank and aileron, and loosen the jam nuts at each rod end and adjust the rod ends to obtain trailing edge alignment. Apply a slight up pressure against the trailing edge of the aileron while making this adjustment. Ascertain that there is sufficient thread engagement at both rod ends. Any adjustment should be distributed between both rod ends. The inboard ends of the ailerons may be allowed to droop by approximately 1/8 inch.

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

1. Remove the two front seats if desired to facilitate in the necessary operation.

2. Loosen the connecting bolts of the idler crossover sprockets at the control tee bar to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets; then tighten bolts.

3. Ascertain that both bellcranks are at their neutral position.

4. Adjust the turnbuckles (located in the access opening just aft of the main spar) of the primary and balance cables to their 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. Refer to Table V-I for correct cable tension and finish adjustment with even tension on all cables. Remove rigging pin or tool.

d. Check the ailerons for correct travel from neutral per dimensions given in Table V-I. When measuring down travel, maintain a light up pressure on the center of the aft edge of the aileron. When measuring up travel, maintain a light down pressure (at the up position only). Use only enough pressure to remove slack between the bellcrank and the aileron.

e. Check the bellcranks stops to assure that the bellcrank contacts are made simultaneously, but still have cushion before contacting the control wheel stops. The aforementioned cushion should be maintained at .030 to .040 between sprocket pin and adjustable stop bolts. (Refer to Figure 5-1.)

f. Check complete system for operation and safety of turnbuckles, bolts, etc.

g. Install the access plates and panels and any seats which were removed.

5-13. STABILATOR CONTROLS.

5-14. REMOVAL OF STABILATOR CONTROL CABLES. (Refer to Figure 5-4.)

a. To remove either the forward or aft stabilator cables, remove the access panel to the aft section of the fuselage and the two front seats.

b. Disconnect the desired control cable at the turnbuckle 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 rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly by removing the plate attaching screws.

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

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

4. Within the access opening aft of the main spar, remove the cable rub blocks that are attached to the spar housing by removing the block attaching screws.

5. Remove the cotter pin cable guard at the pulley cluster located in the access opening aft of the main spar.

— NOTE —

To facilitate in the installation of control cables, a line may be attached to the cable end prior to removal.

6. 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.

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5-15. 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(s) (14) in the forward area of the floor tunnel.

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

3. If the aft control cable (4 and 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 guards at the pulley(s) (14) in the forward area of the tunnel.

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

7. In the access opening, install the cotter pin cable guard at the pulley cluster (6).

8. Set cable tension and check rigging and adjustment per Paragraph 5-16.

9. Place the tunnel plate into position for installation and secure with the attaching screws. Roll the carpet into place and install the rudder trim cover and knob.

10. Install the front seats.

b. Either aft stabilator control cable (4 or 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). (Ensure 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 5-16.

6. Install the seats and access panels.

5-16. RIGGING AND ADJUSTMENT OF STABILATOR CONTROLS.

a. Level the airplane. (Refer to Leveling, Section II.)

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

1. Check the stabilator travel by placing a rigging tool on the upper surface of the stabilator as shown in Figure 5-5. (This tool may be fabricated from dimensions given in Figure 5-18.)

2. Set a bubble protractor to 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 stops. (Refer to Figure 5-1 for tee bar stops).

3. Set the protractor to 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.

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. BOLT, WASHER (7) & NUT
12. BOLT, WASHER (11) & NUT
13. PULLEY, FORWARD
14. BOLT, WASHER, NUT & COTTER PIN
15. TURNBUCKLE
16. WEIGHT, BALANCE ARM
17. BALANCE ARM, STABILATOR

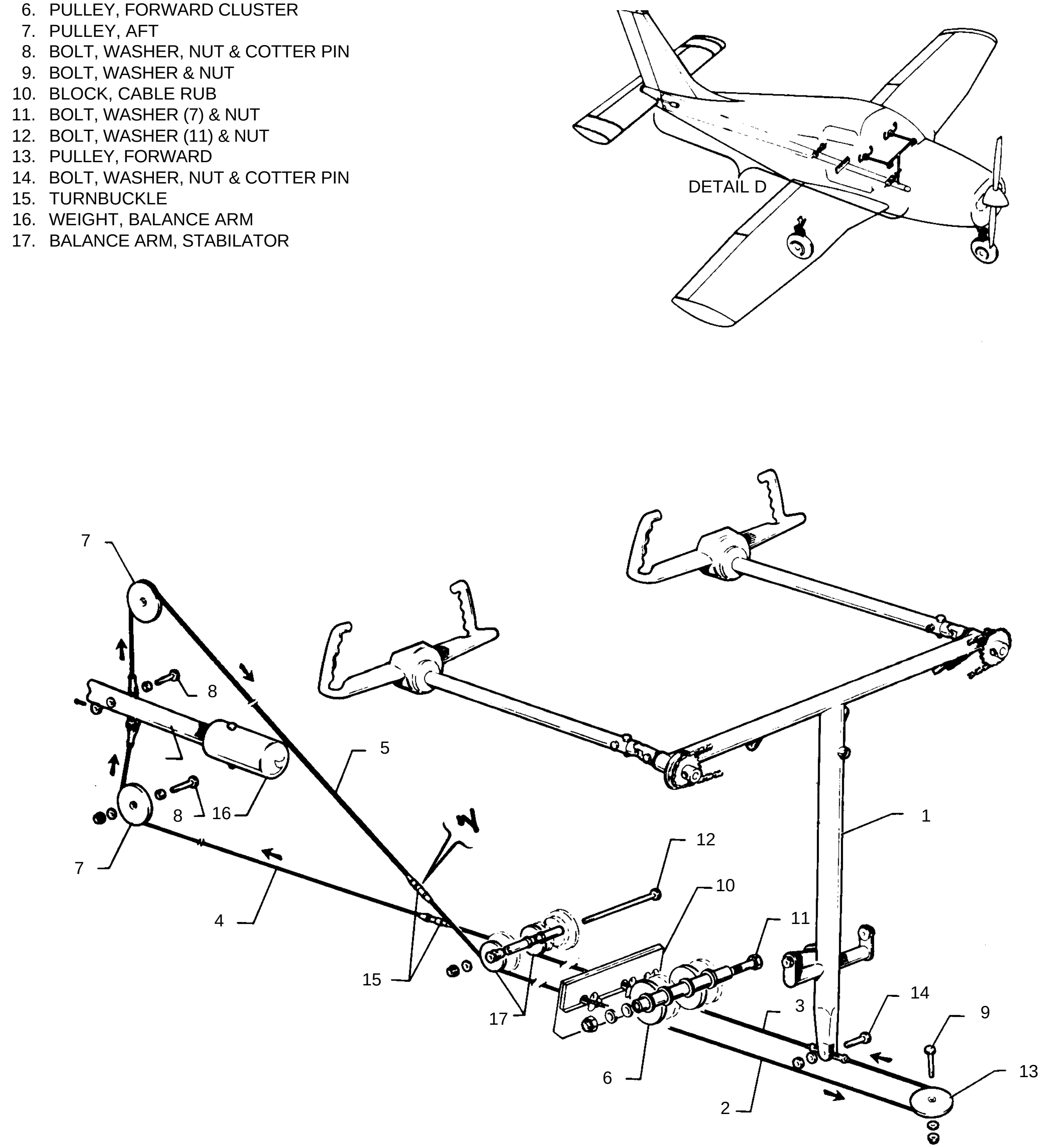

Figure 5-5. Stabilator Controls

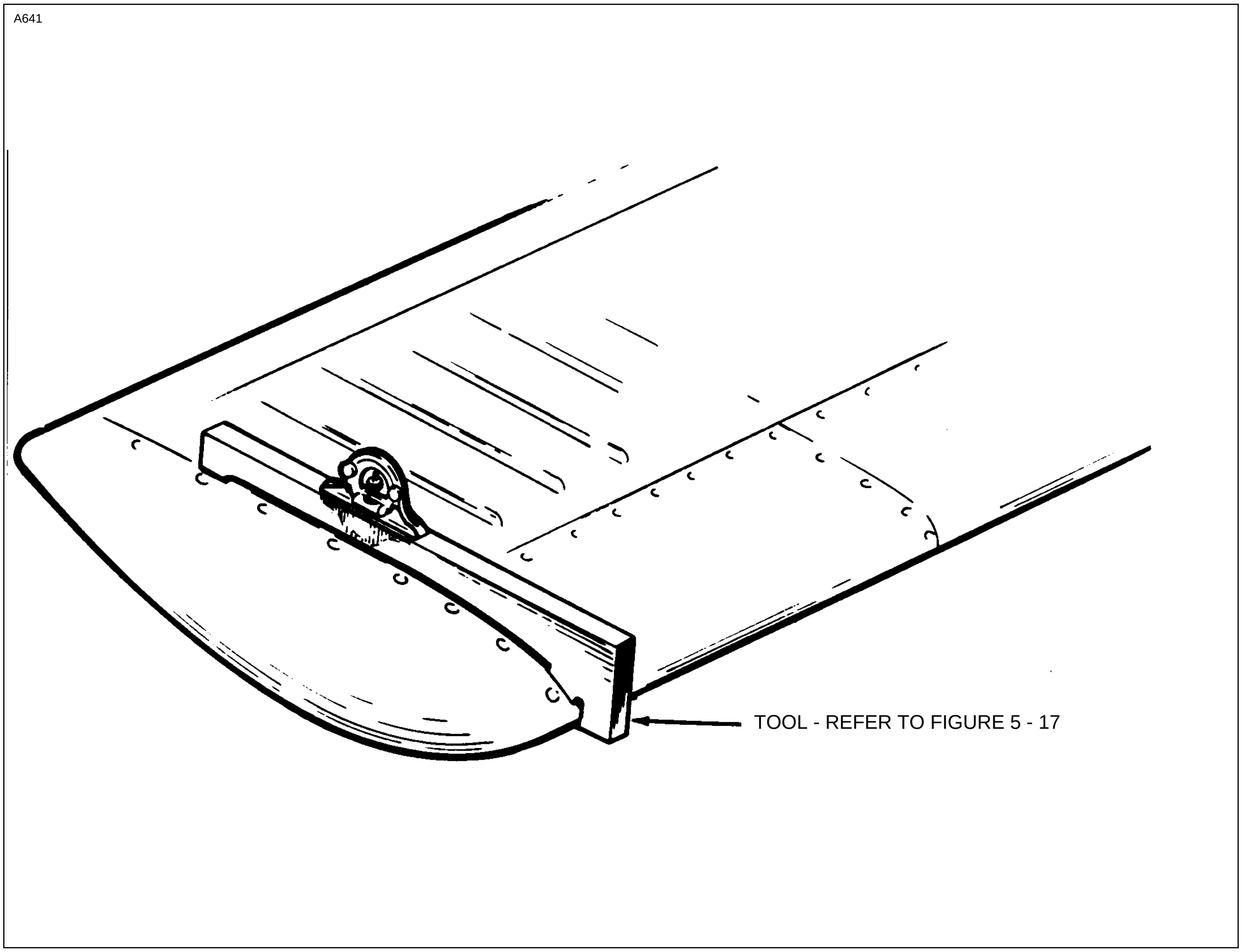

Figure 5-6. Stabilator Rigging Tool

4. Should the stabilator travel be incorrect in either the up or down position, remove the tail cone fairing by removing the attaching 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 5-12) to obtain the correct degree of travel.

5. Ascertain that the locknuts of the stop screws are secure and reinstall the tail cone fairing.

c. 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. Set .25 + 0.12 - 0.03 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 the 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 approximately equal. Readjust turnbuckles if incorrect.

9. Reinstall access panels.

d. Remove airplane from jacks.

5-17. STABILATOR TRIM CONTROLS.

5-18. REMOVAL OF STABILATOR TRIM ASSEMBLY. (FORWARD) (Refer to Figure 5-6.)

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 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 tunnel.

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

1. Remove the front seats, if desired.

2. Unfasten the carpet from the aft portion of the floor tunnel and lay it forward.

3. Remove the tunnel cover located between the trim control wheel and the spar cover by removing attaching screws.

4. Remove the cable pulleys (6) located in the tunnel by removing the cotter pin, washer and clevis pin (5).

5. Remove the cable rub blocks (37) located on the aft side of the main spar by removing the block attaching screws.

6. Remove the cable guard pin (36) at the pulley cluster (34) located just aft of the wing flap torque tube at station 127.25.

7. If installed, remove the cable pulleys (33) within the aft section of the fuselage at station 156.5 by removing nut, washer, bushing and bolt.

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

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5-19. INSTALLATION OF STABILATOR TRIM ASSEMBLY. (FORWARD) (Refer to Figure 5-6.)

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

1. Wrap the right trim cable 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 to the cable drum 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 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. Ascertain that the end of the trim indicator wire is positioned in the spiraled slot of the drum with no bind on the end. Install the retainer bolt from the left side and install washer and nut

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 may be installed by the following procedure.

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

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

3. Position the cable pulleys on their mounting bracket within the floor tunnel and install the clevis pin, washer and cotter pin.

4. Connect the cable to the aft cable at the turnbuckle in the aft section of the fuselage. Install aft cable if not installed.

5. If not previously installed, install the pulleys in the aft lower section of the fuselage at station 156.5 forward of the cable turnbuckles.

6. Install the cable guard at the underside of the pulleys located just aft of the flap torque tube at station 127.25 and secure.

7. Install the cable rub blocks located on the aft side of the main spar housing and secure with screws.

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

c. Set cable tension and check rigging and adjustment per Paragraph 5-22. Check safety of all turnbuckles.

d. Install the tunnel cover on the tunnel and secure with screws.

e. Install the carpet over the floor tunnel.

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

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

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

5-20. REMOVAL OF STABILATOR TRIM ASSEMBLY. (AFT) (Refer to Figure 5-6.)

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

b. Block the trim cables at the first set of pulleys (33) forward of the cable turnbuckles (10 and 11) in the aft section of the fuselage by 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 attaching 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 trust 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 attaching nuts, washers and bolts.

i. Draw the trim cable (12) from the fuselage

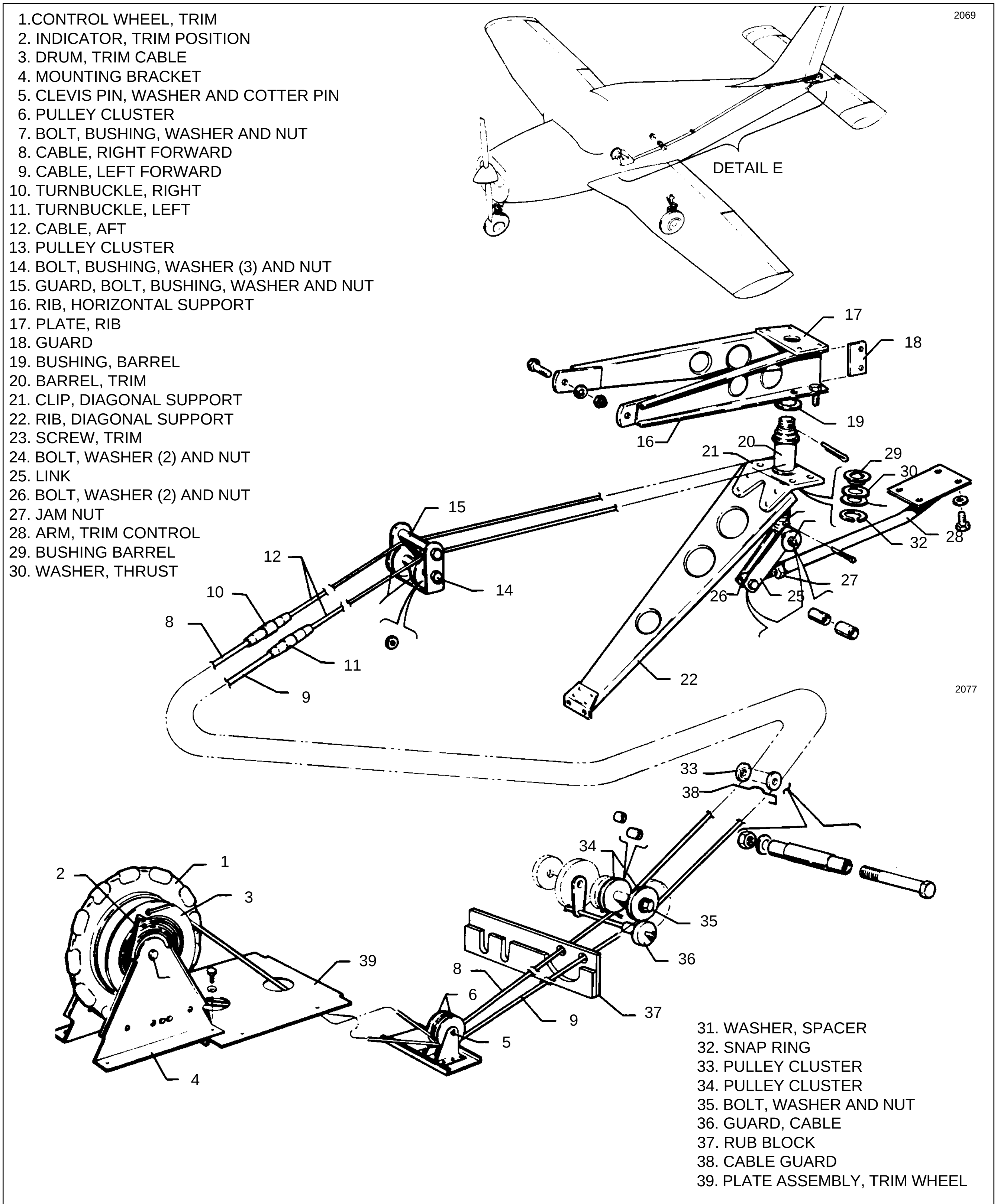


Figure 5-7. Stabilator Trim Controls

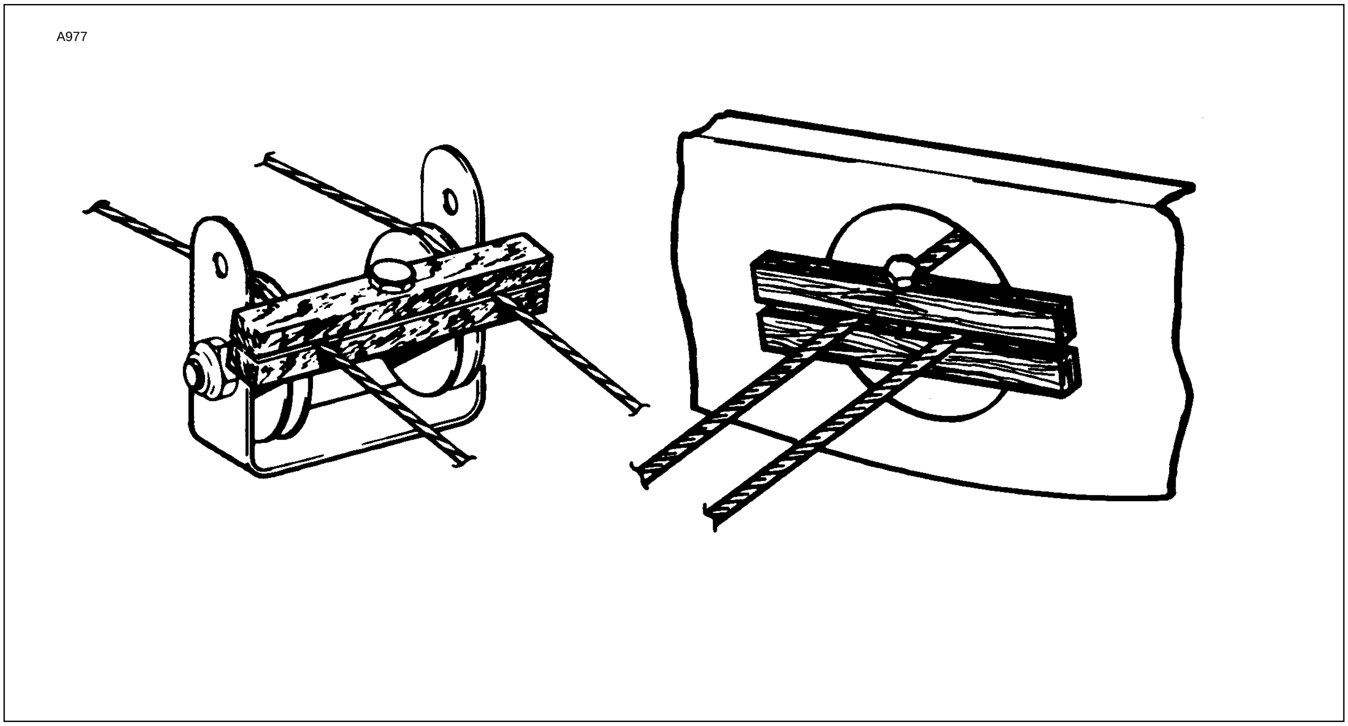


Figure 5-8. Methods of Securing Trim Cables

5-21. INSTALLATION OF STABILATOR TRIM ASSEMBLY. (AFT) (Refer to Figure 5-6.)

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 counterclockwise 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 5-22. 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.

5-22. RIGGING AND ADJUSTMENT OF STABILATOR TRIM. (Refer to Figure 5-6.)

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 5-5. 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 228.3.

e. Check that the trim screw (23) is turned down until the cotter pin stop in the stop 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, the links (25) between the screw (23) and the trim control arm (28) are not disconnected, disconnect the two by removing the connecting 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 travel, 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 interference between turnbuckles and pulleys, and location of tab indicator.

5-23. RUDDER AND STEERING PEDAL ASSEMBLY.

5-24. REMOVAL OF RUDDER AND STEERING PEDAL ASSEMBLY. (Refer to Figure 5-8.)

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 tunnel plate located just aft of the tee bar by removing the rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly by removing the plate attaching screws.

d. Disconnect the stabilator control cable from the lower end of the tee bar assembly.

e. Remove the tee bar attaching bolts with their washers and nuts which are through each side of the floor tunnel. Pull the lower end of the tee bar aft.

f. Disconnect the control cable ends (19) from the arms on the torque tube (3) by removing the cotter pins, washers, nuts and bolts (20).

g. Disconnect the rudder trim from the torque tube assembly removing the cotter pin, washers and bolt that connects the arm to the trim.

h. Disconnect the steering rods (21) at the inboard rudder bars (14) by removing nuts and bolts (24).

i. Disconnect the brake cylinders (12) at the lower end of each cylinder rod (11) by removing the cotter pins and clevis pins (13).

j. Disconnect the vee braces (29) from the torque tube by removing nuts, washers and bolts (27) that secure the strap bracket (28) to the vee brace.

k. Disconnect the torque tube support bracket (35) where it attaches by removing its attaching bolts.

l. 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.

m. Disconnect the torque tube support blocks (7 and 8) from their support brackets on each side of the fuselage by removing the attaching nuts, washers and bolts (6).

n. Remove the trim side panels, if desired.

o. Remove the assembly from the airplane. Note the spacer washer (9) on each end and between the support blocks.

5-25. INSTALLATION OF RUDDER AND STEERING PEDAL ASSEMBLY. (Refer to Figure 5-8.)

a. Assemble the torque tube assembly (1, 2, 3 and 4) as shown in Figure 5-8. 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, 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 braces (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. 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).

h. 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 VII .

i. 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.

j. 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 cable ends to rotate freely.

k. 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 panel.

l. Connect the stabilator control cables to the lower end of the tee bar with bolt, washer and nut, and secure with cotter pin. Allow the cable ends free to rotate.

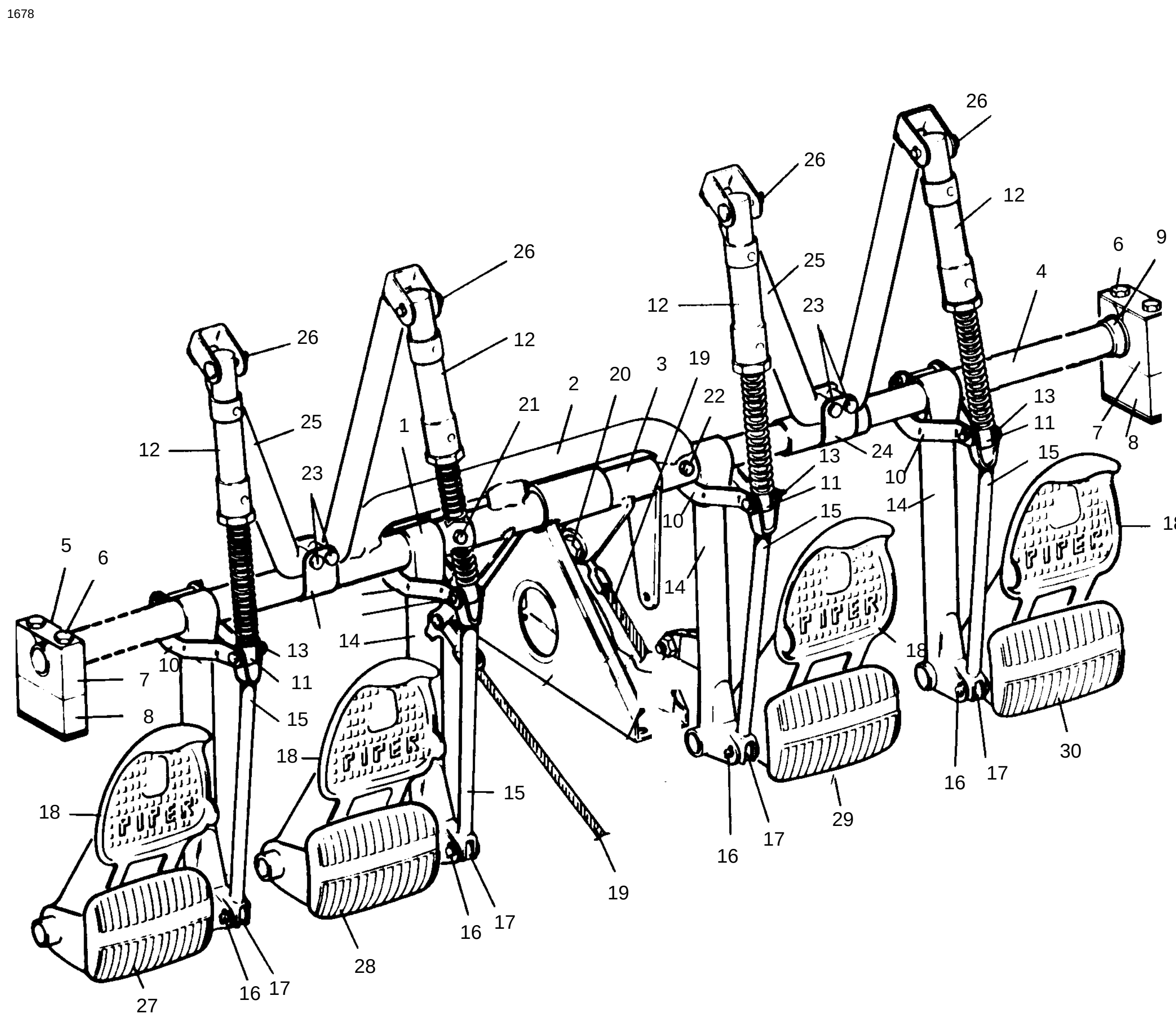
m. Set rudder cable tension per specifications in Table V-I and check rigging and adjustment per Paragraph 5-33.

n. Check safety of bolt and turnbuckles.

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

p. Install the rudder trim cover and control knob.

q. Install the access panel to the aft section of the fuselage.



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. BOLT, WASHER AND NUT
22 BOLT, WASHER AND NUT.
23 BOLT, WASHER AND NUT
24. BRACKET
25 VEE BRACE
25. BOLT, WASHER & NUT
26. CLEVIS PIN & COTTER PIN
27. RUDDER PEDAL, L. OUTER
28. RUDDER PEDAL, L. INNER
29. RUDDER PEDAL, R. INNER
30. RUDDER PEDAL, R. OUTER
31. BRACKET, TUBE SUPPORT

Figure 5-9. Rudder and Steering Pedal Assembly

5-26. RUDDER CONTROLS.

5-27. REMOVAL OF RUDDER CONTROL CABLES. (Refer to Figure 5-9.)

a. To remove either the forward (10 or 11) or aft (14 or 15) rudder cables, first remove the access panel to the aft section of the fuselage.

b. Disconnect the desired cable at the turnbuckle (12 or 13) in the aft section of the fuselage.

c. Either forward rudder cable may be removed by the following procedure:

1. Remove the floor panel and the front seats.

2. Remove the cable guard pin (7) from the underside of the pulley cluster (9) that is located in the aft area of the flap torque tube.

3. From within the area aft of the main spar, remove the cable rub blocks (6) that are attached to the spar housing by removing the block attaching screws.

4. Remove the rudder trim knob and the cover attaching screws.

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

6. Move the cable guard pin (4) located under the pulley cluster (5) just aft of the tee bar by removing the cotter pin from the exposed end and sliding it to the left or right, as required.

7. 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).

8. Draw the cable from the floor tunnel.

d. The aft rudder control cables may be removed by the following procedure:

1. Remove the tail cone fairing by removing its attaching screws.

2. Disconnect the cable (14 or 15) from the rudder horn (17) by removing cotter pin, nut, washer and bolt (16).

3. Draw the cable through the fuselage.

5-28. INSTALLATION OF RUDDER CONTROL CABLES. (Refer to Figure 5-9.)

a. The forward rudder control cables 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 by installing bolt, washer, nut and cotter pin (2). Allow the cable end free to rotate on the arm.

3. Connect the cable to the aft control cable at the turnbuckle (12 or 13) 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) into position, that is located in the forward area of the tunnel, under the pulley cluster (5) and secure with cotter pin.

5. Within the area aft of the main spar, install the cable guard blocks (6) onto the spar housing and secure with screws.

6. Install the cable guard (7) under the pulley cluster (9) located just aft of the flap torque tube.

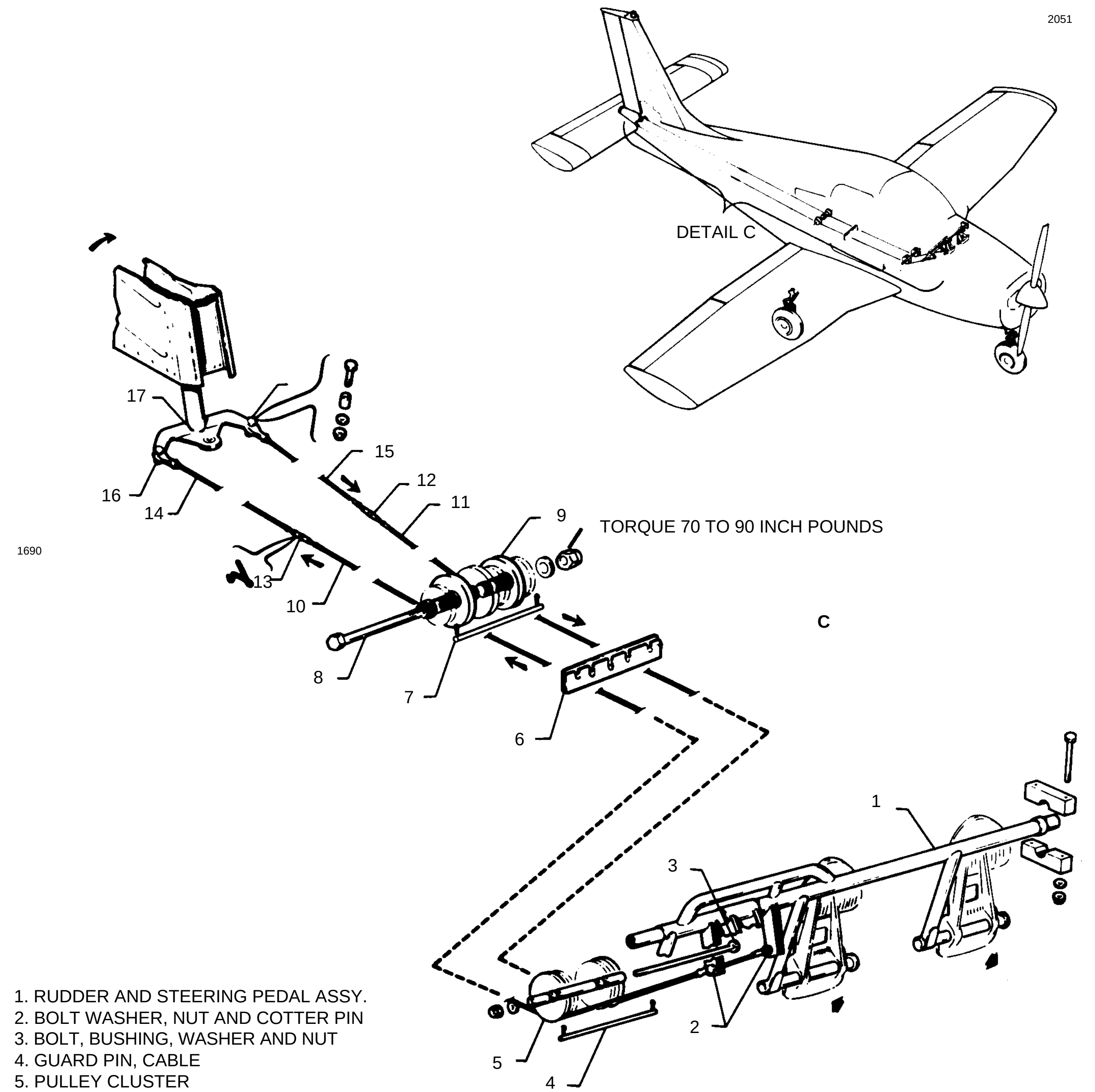
7. Set cable tension and check rigging and adjustment per Paragraph 5-29.

8. Install the forward tunnel plate aft of the tee bar and secure with screws.

9. Put the floor carpet in place and secure.

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

11. Install the floor panel and the seats.



1. RUDDER AND STEERING PEDAL ASSY.
2. BOLT WASHER, NUT AND COTTER PIN
3. BOLT, BUSHING, WASHER AND NUT
4. GUARD PIN, CABLE
5. PULLEY CLUSTER
6. RUB BLOCKS
7. GUARD PIN, CABLE
8. BOLT, BUSHING, WASHER AND NUT
9. PULLEY CLUSTER
10. CABLE, RIGHT FORWARD
11. CABLE, LEFT FORWARD
12. TURNBUCKLE, LEFT
13. TURNBUCKLE, RIGHT
14. CABLE, RIGHT AFT
15. CABLE, LEFT AFT
16. BOLT, BUSHING,WASHER AND NUT
17. HORN, RUDDER

Figure 5-10 Rudder Controls

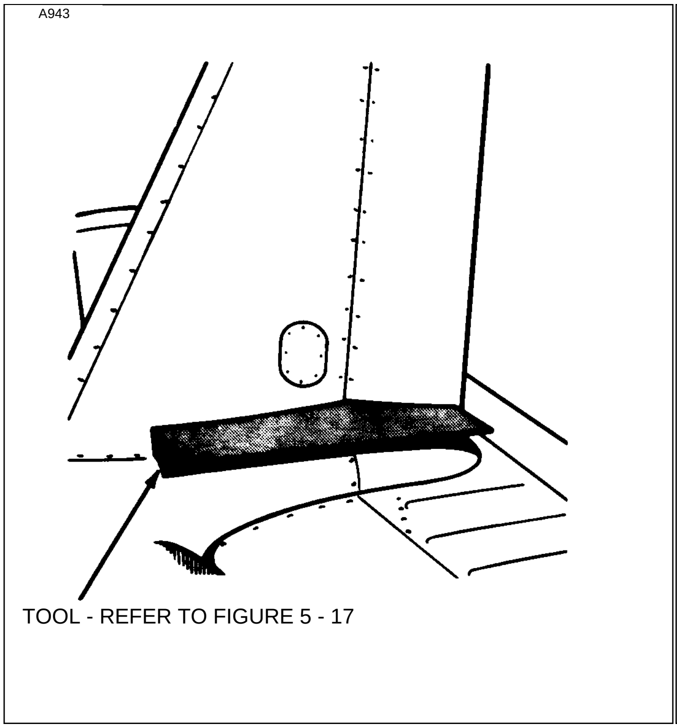


Figure 5-11. Rudder Rigging Tools

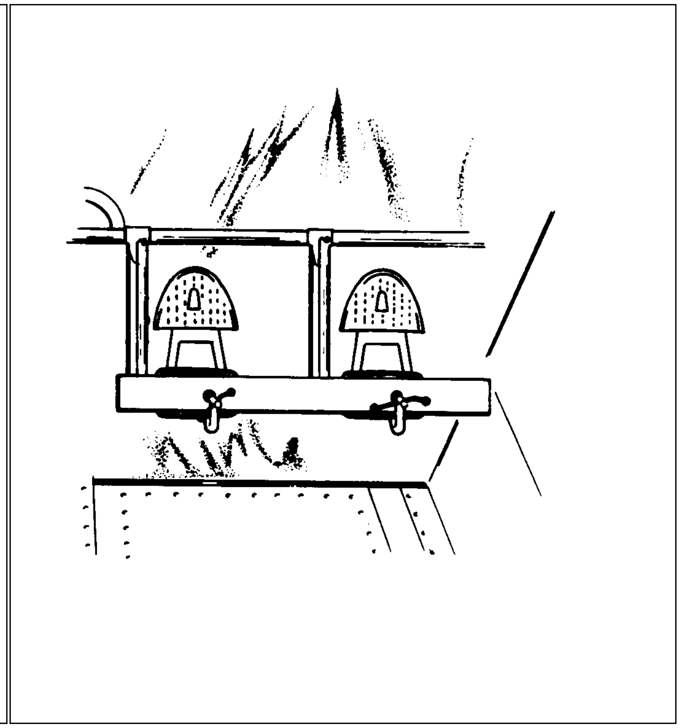


Figure 5-12. Clamping Rudder Pedals

b. The aft rudder control cables may be installed by the following procedure:

1. Position the control cable in the fuselage

2. Connect the end of the cable (14 or 15) to the rudder horn (17) with bolt, washer, nut and cotter pin (16). Allow the cable end to rotate freely.

3. Connect the other cable end to the forward control cable (10 or 11) at the turnbuckle (12 or 13) in the aft section of the fuselage.

4. Set cable tension and check rigging and adjustment per Paragraph 5-30.

5. Install tail cone fairing and secure with screws

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

5-29. RIGGING AND ADJUSTMENT OF RUDDER CONTROLS.

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

1. If the rudder cables are connected use the rudder pedals to swing the rudder until it contacts its stops. If the cables are disconnected the rudder may be moved by hand. Refer to Table V-I for required rudder travel..

2. A rigging tool may be fabricated from dimensions given in Figure 5-17 to aid in rudder rigging. With the rudder against its stop, place the rigging tool against the side of the rudder and vertical stabilizer as shown in Figure 5-10. Ascertain that the tool is not contacting any rivets. If no gaps exist between the rigging tool and the surface's of the rudder and stabilizer the stop for that direction of travel is correct as required in Table V-I.

3. Swing the rudder in the other direction and check the travel as directed in step 2. Should the rudder travel be incorrect, showing a gap between the tool and any part of the control surface, the tail cone fairing should be removed and the stop reset to obtain the correct rudder travel. (Refer to Figure 5-12.)

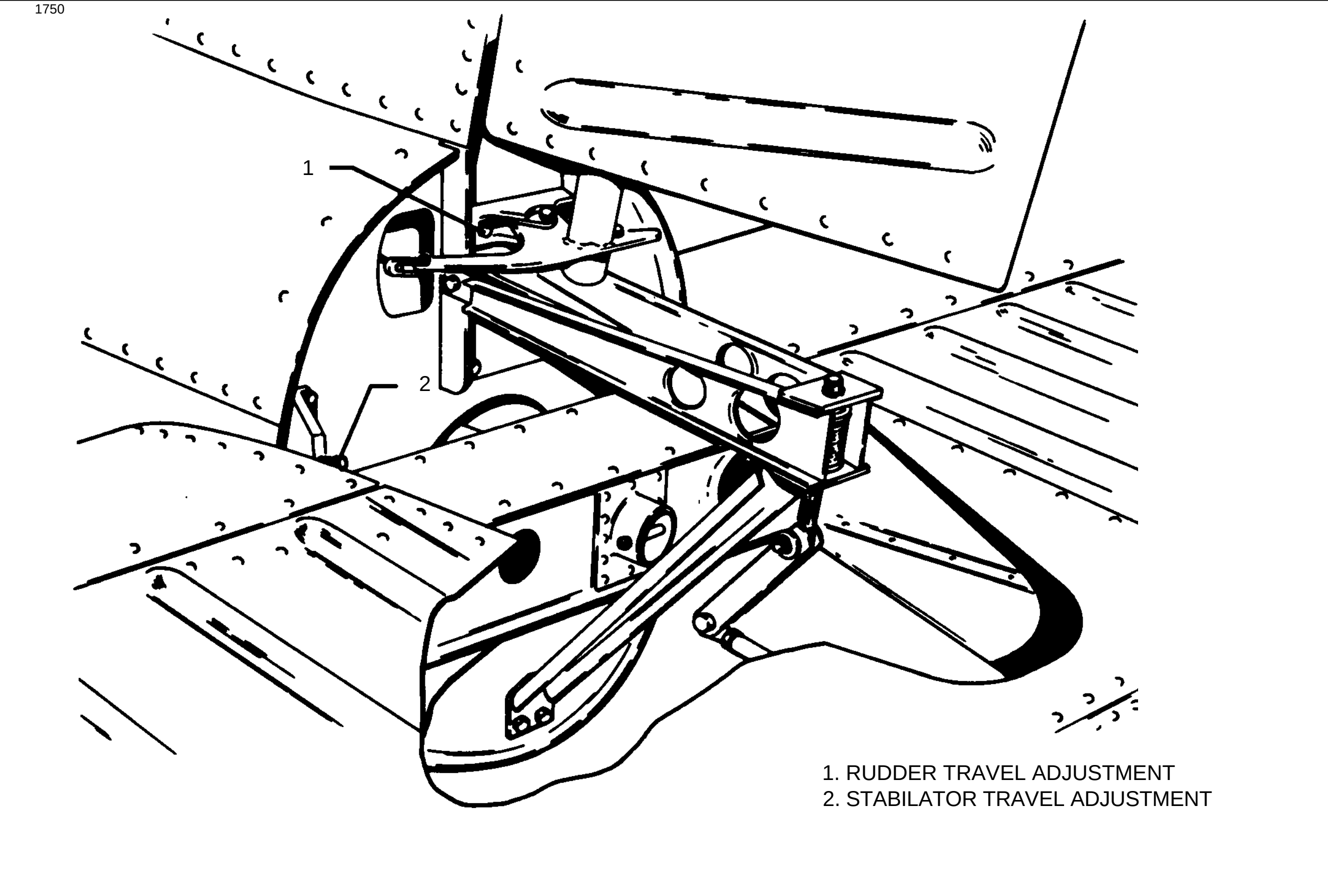


Figure 5-13. Rudder and Stabilator Travel Adjustments

b. To set rudder cable tension and alignment of the rudder and rudder pedals, 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 in accordance with Alignment of Nose Landing Gear, Section VII.

3. Clamp the rudder pedals, so they align in a lateral position as shown in Figure 5-11.

4. Adjust the turnbuckles in the aft section of the fuselage to obtain the required cable tension, as given in Table V-I and to allow the rudder to align at its 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 the safetys on the turnbuckles.

c. Check the adjustment of the rudder pedal stops by the following procedure:

1. Remove the clamp securing the rudder pedals in their neutral position, if not previously removed.

2. Push on the pilots left rudder pedal until the rudder stop (at the tail) is contacted.

3. Ascertain that the rudder pedal stop (at the firewall) has 0.060 to 0.120 of an inch clearance between the pedal stop and the rudder pedal.

4. Repeat steps 2 and 3 with the copilots right rudder pedal. Do not push harder than necessary to avoid cable stretch.

d. Install the tail cone fairing access panel to the aft section of the fuselage.

5-30. RUDDER TRIM CONTROLS.

5-31. REMOVAL OF RUDDER TRIM CONTROLS. (Refer to Figure 5-13.)

a. Remove the cover (1) from over the trim control assembly by removing attaching screws.

b. Remove the rudder trim knob (2) and the cover attaching screws.

c. Rotate the trim knob 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 may be removed by removing the channel attaching screws at the inside of the channel.

5-32. INSTALLATION OF RUDDER TRIM CONTROLS. (Refer to Figure 5-13.)

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 attaching screws (9) which are secured with anchor nuts.

b. Before attaching the assembly to the mounting channel, ascertain that the clips (11) are installed so the safety wire (12) will be on top. Also, that the threaded bushing (4) is installed on the assembly shaft (15) with the welded attachment bushing forward or toward the housing.

c. 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.

d. Clamp the rudder pedals in neutral and position the threaded bushing in the mounting channel (8). Turn the control shaft 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.

e. With the rudder pedals neutral and no pressure fore and aft on the clevis pin, install the assembly cover (l) so that the indicator washer (13) and the neutral mark on the cover align.

f. Install the trim cover, secure with screws, and install the trim control knob.

5-33. 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 5-32.

5-34. WING FLAP CONTROLS.

5-35. REMOVAL OF WING FLAP CONTROLS. (Refer to Figure 5-14.)

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 two front seats and the floor panel.

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 (12) and washers from the inner side of each crank. It will be necessary to remove bolt 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 (33) and allow the flap to return to the retracted position. **Use caution as forward pressure will be on the handle with the tension spring disconnected.**

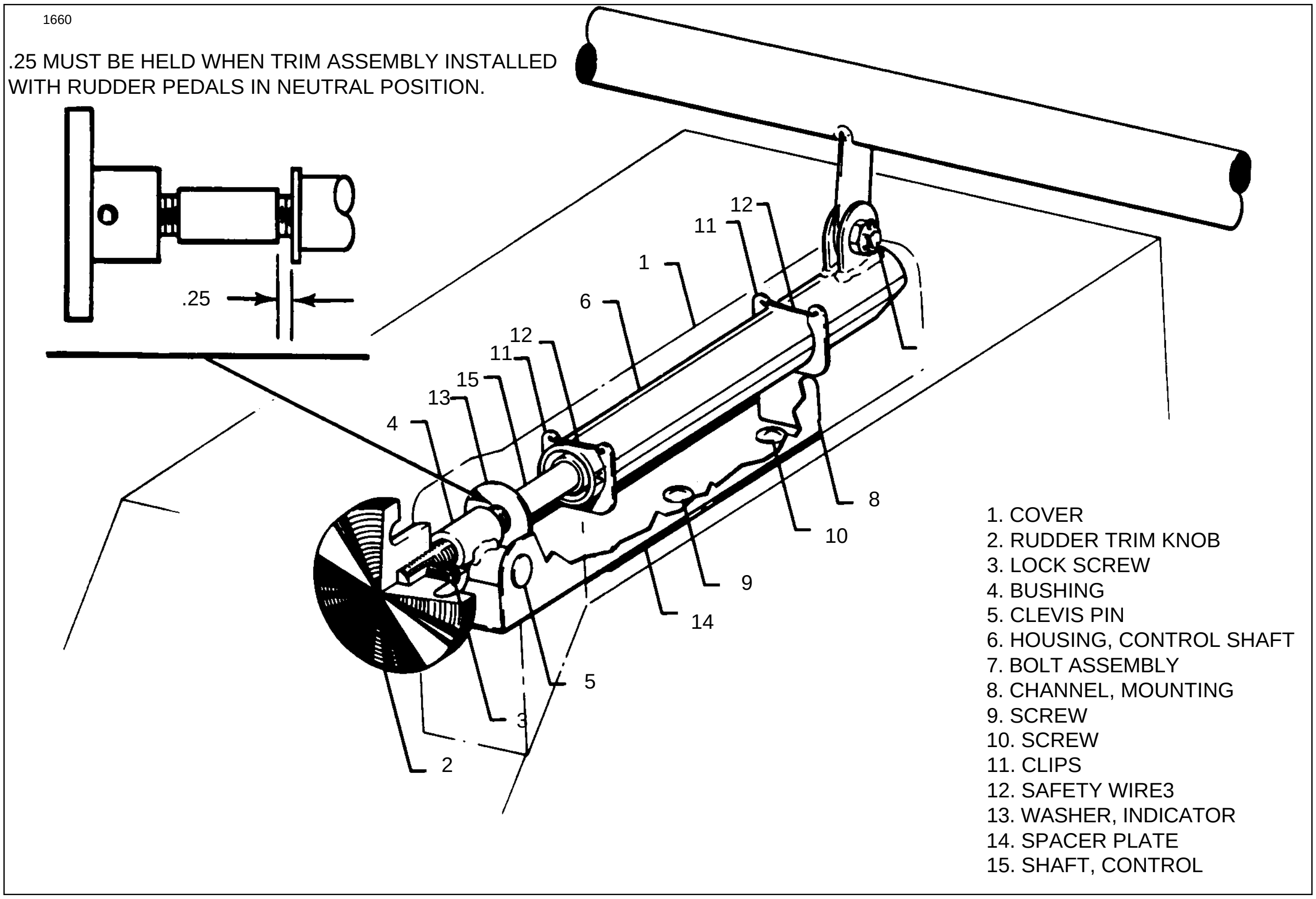


Figure 5-14. Rudder Trim Control

6. Disconnect the flap return spring (32) at the spar or return chain (30) 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 31) by removing the block attaching 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 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 front seats have not been removed, remove the seats.

2. Disconnect the flap tension spring (22) from the cable, if not previously disconnected, by extending the flaps to relieve spring tension.

3. Retract the flaps. **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 cover

6. 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.

7. Remove the cotter pin guard from the flap cable pulley (24) located inside the floor tunnel just ahead of the spar housing.

8. Remove the cable rub blocks located in the floor opening on the aft side of the spar housing by removing the attaching screws.

9. Disconnect the cable turnbuckle (25) at the flap handle by removing cotter pin, nut, washer, bushing*, and bolt (26). Check clevis bolt (26) for wear. Replace bolt if any wear is evident. *(See latest revision of Piper Service Bulletin 965.)

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.

5-36.INSTALLATION OF FLAP CONTROLS. (Refer to Figure 5-14.)

a. The flap torque tube assembly may be installed by the following procedure:

1. Install the chain sprocket (17) with chain (20 and 30) on the torque tube (14) and secure with bolts, washers and nuts (18).

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 31) on their support brackets (19) and secure with bolts (15).

9. Connect the flap return spring (32) to the return chain (30) 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 and turnbuckle (25) to the flap handle arm and secure with clevis bolt, bushing*, washer, nut and cotter pin (26). Ascertain that the turnbuckle end is free to rotate on the arm. *(See latest revision of Piper Service Bulletin 965.)

2. Route the cable through the tunnel and spar housing.

3. Install the cable rub blocks on the aft side of the spar housing and secure with screws.

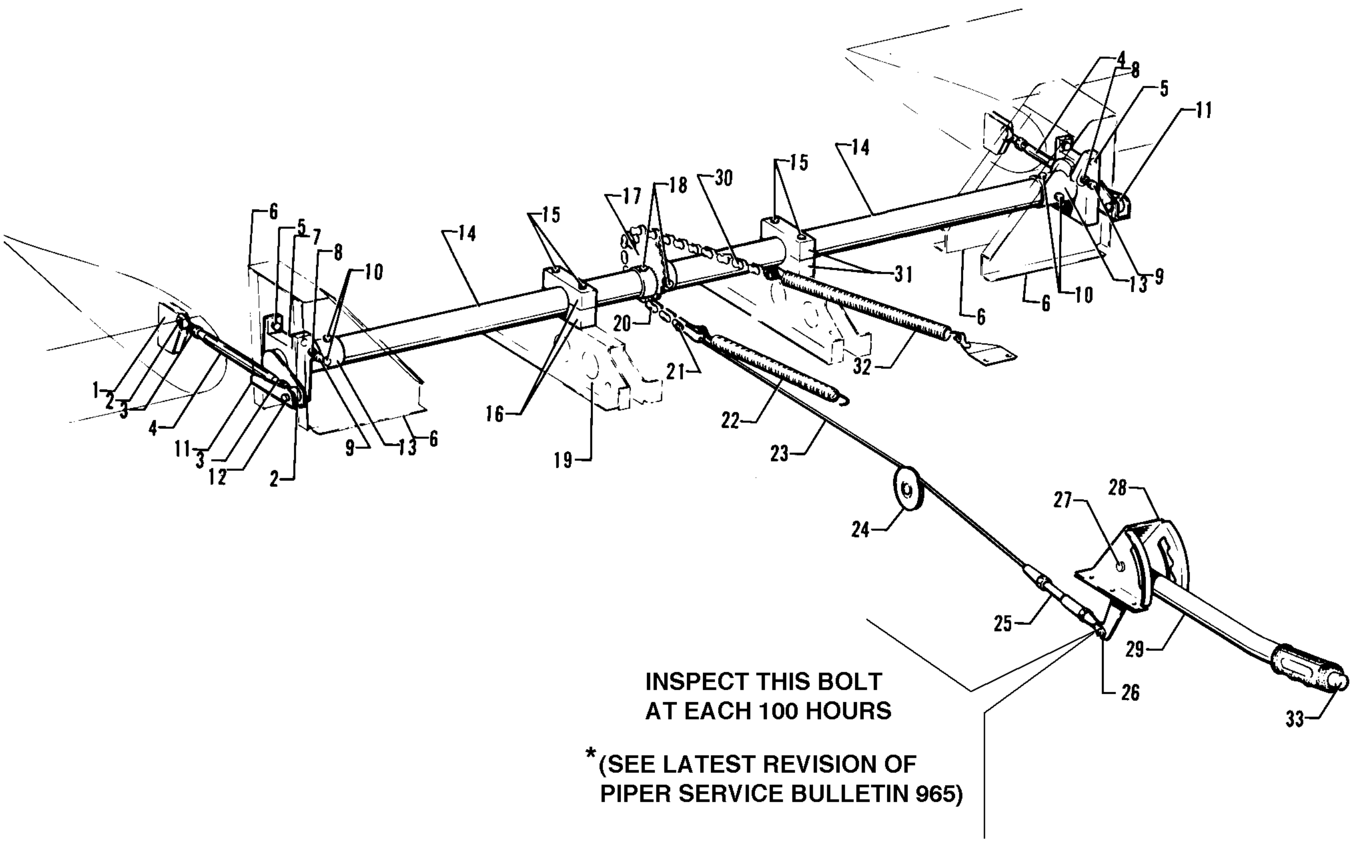
4. Install cotter pin cable guard over pulley (24) located just ahead of the spar housing in the floor tunnel.

5. Attach the cable end to the tension chain (20) and secure with bushings, 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 and bracket cover.

f. Install and secure the seats.



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, BUSHING,* WASHER, NUT AND COTTER PIN
27. BOLT, BUSHING, WASHER & NUT
28. BRACKET, FLAP HANDLE
29. HANDLE, FLAP
30. CHAIN, RETURN SPRING
31. BLOCK, BEARING
32. SPRING, RETURN
33. BUTTON, FLAP RELEASE

Figure 5-15. Flap Control System

5-37. RIGGING AND ADJUSTMENT OF WING FLAPS.

a. Place the flap handle in the full forward position. (Flaps Up)

b. 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 5-15.) It may be necessary to loosen the adjustment screw of the left stop.

c. 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 uplock 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.

d. Rotate the left stop adjustment screw until it contacts the stop fitting. Tighten the jam nut.

e. Set the flap control cable tension (handle next to floor, 0 degrees) as given in Table V-l 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 the tube to be pulled away from its stops.

f. To check up neutral position of the flaps, place a flap rigging tool as shown in Figure 5-16 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 Figure 5-19.)

g. 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.

h. 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.

i. 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. Rod ends without check holes,- maintain a minimum of .375 of an inch thread engagement. Do not raise the flap of the other wing above neutral.

j. Check the flap for full down travel to the degrees required in Table V-l. 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 c thru i.

k. Check operation of the flap and flap handle ratchet mechanism.

l. Install access plates and panels.

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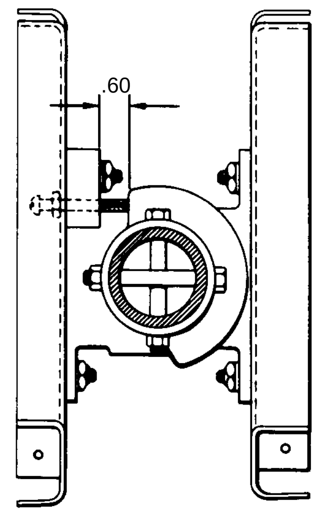


Figure 5-16. Flap Stop Adjustment

A551

1. .375 HEIGHT SPACER IS TO BE IN LINE WITH AFT SPAR RIVET LINE, BUT SHOULD NOT MAKE CONTACT WITH ANY RIVETS

* UP NEUTRAL (0°) OF FLAPS WILL OCCUR WHEN THESE POINTS MAKE CONTACT WITH WING AND FLAP SKIN.

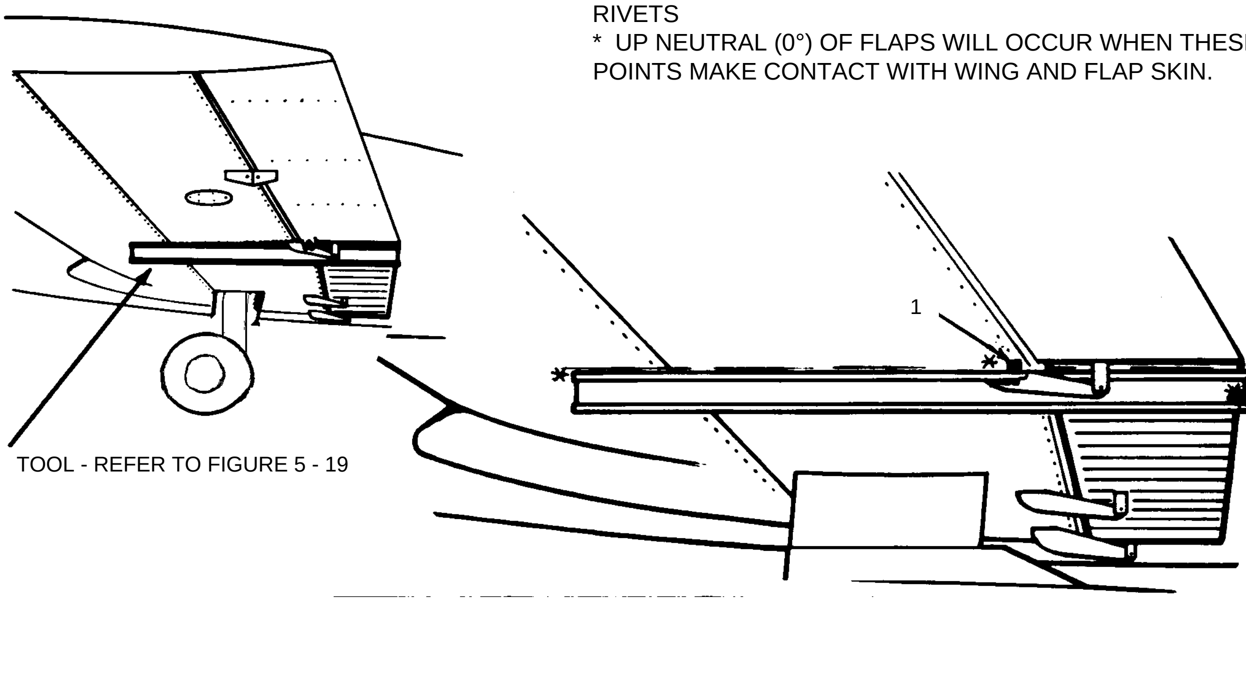


Figure 5-17. Flap Rigging Tool

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 5-12.)
	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 5-12.)
	Control column horizontal chain improperly adjusted.	Adjust chain tension.(Refer to Paragraph 5-6.)
	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 aiIeron and/or hinge.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Control wheels not synchronized	Incorrect control column rigging	Rig in accordance with Paragraph 5-6.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rig in accordance with Paragraph 5-12.
Incorrect aileron travel.	Aileron control rods not adjusted properly.	Adjust in accordance with Paragraph 5-12.
	Aileron bellcrank stops not adjusted properly.	Adjust in accordance with Paragraph 5-12.
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 5-12.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rig in accordance with Paragraph 5-12.

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 5-16.
	Linkage loose or worn.	Check linkage, 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 5-16.
	Binding control column.	Adjust and lubricate per Paragraph 5-6.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulley 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 5-16.
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Rig cables in accordance with Paragraph 5-16.

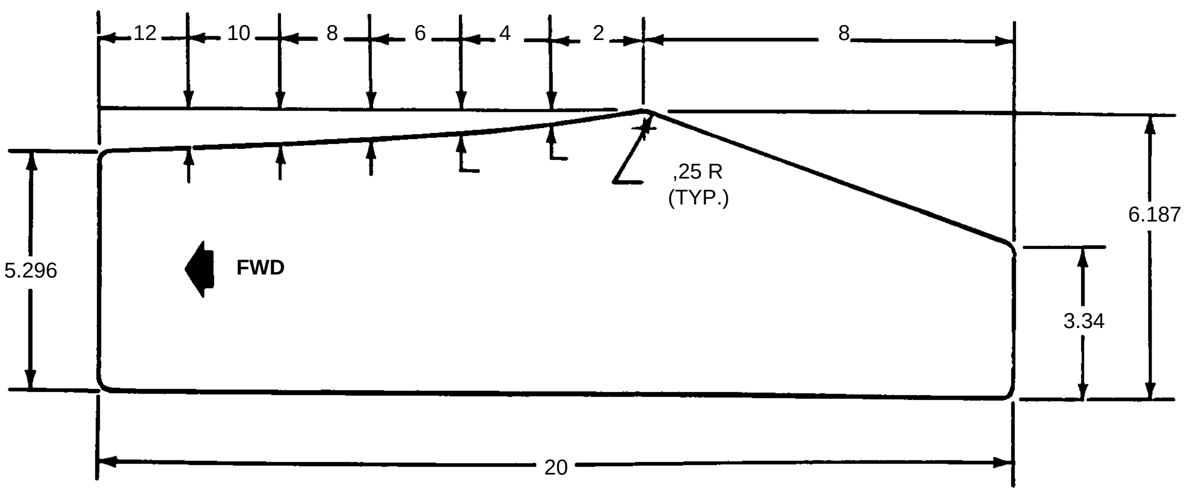
TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (CONT)

Trouble	Cause	Remedy
STABILATOR TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust in accordance with Paragraph 5-22.
	Cables not in place on pulleys.	Install cables according to Paragraphs 5-19 and 5-21.
	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 5-22.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Refer to Paragraphs 5-19 and 5-21
Trim tab hinge binding.		Lubricate hinge. If necessary, replace.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging per Paragraph5-22.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging per Paragraph5-22.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Adjust in accordance with Paragraph 5-22.

TABLE V-III. TROUBLESHOOTING CHART (SURFACE CONTROLS) (CONT)

Trouble	Cause	Remedy
	RUDDER CONTROL SYSTEM	
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension per Paragraph 5-29.
	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	Lubricate system.properly.
	Rudder pedal torque tube bearing in need of lubrication.	Lubricate torque tube bearings.
	Cable tension too high.	Adjust cable tension
	FLAP CONTROL SYSTEM	
Flaps fail to extend or retract.	Control cable broken or disconnected.	Replace or reconnect control cable. (Refer to Paragraph 5-36.)
Flaps not synchronized- or fail to move evenly when retracted.	Incorrect rigging of system.	Adjust flaps per instructions in Paragraph 5-37.

C 341



MATERIAL;
STEEL OR HARD ALLUMINUM PLATE
.125 X 20.0 X 6.187

Figure 5-18 Fabricated Rudder Rigging Tool

932

MATERIAL; 1.0 X 23.19 X 3.82 ALUMINUM BAR

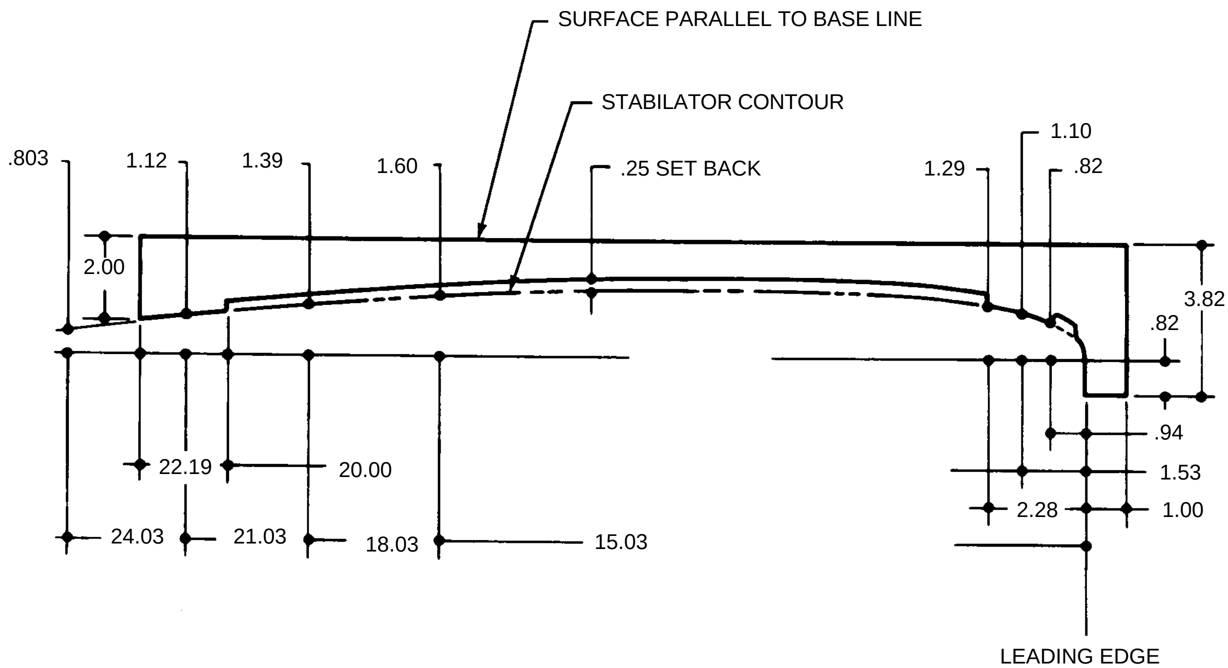
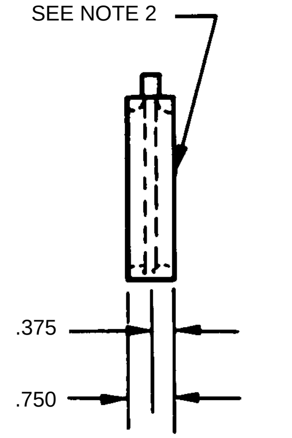


Figure 5-19 Fabricated Stabilator Rigging Tool

A116

MATERIAL:
.750 X 31.50 X 4.00 ALUMINUM BAR
OR
.750 X 31.50 X .750 SQ. ALUYMINUM BAR STOCK (MIN)

NOTES:
1. DRILL AND TAP TO 10 - 32 NF. AN - 3 BOLT, JAM NUT AND INTERNAL STAR WASHER MAY BE USED FOR SPACER OR AN - 3 BOLT WITH HEAD FILED TO REQUIRED LENGTH.
2. SPAR STOCK MAY BE USED IN PLACE OF ALUMINUM BAR STOCK



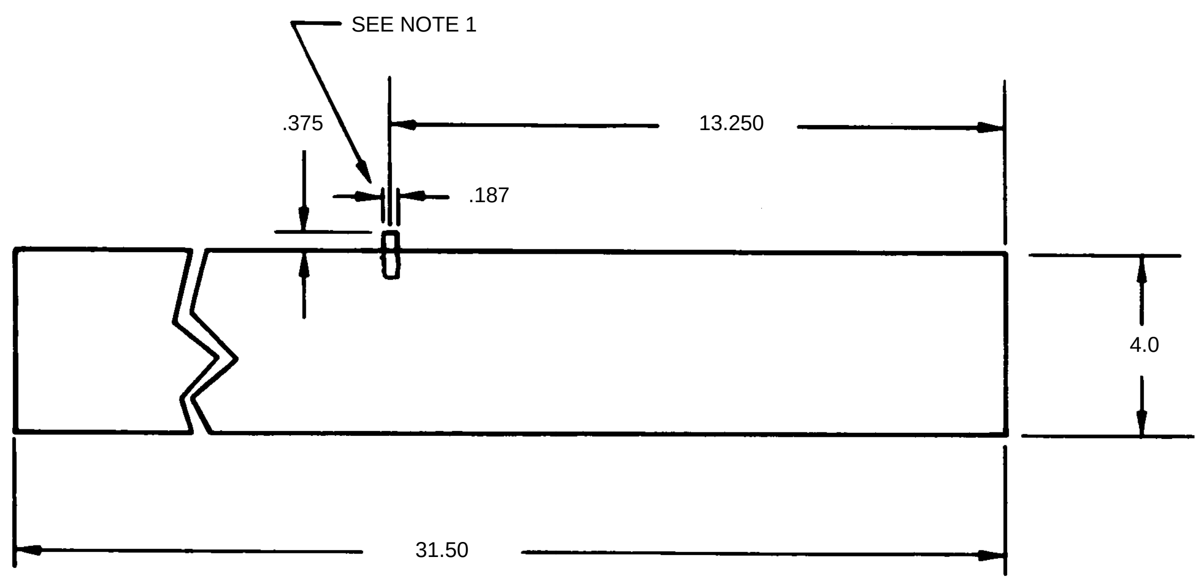


Figure 5-20 Fabricated Flap Rigging Tool

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SECTION VII

LANDING GEAR AND BRAKE SYSTEM

Paragraph		Aerofiche Grid No.

SECTION Vll
LANDING GEAR AND BRAKE SYSTEM

7-1. 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 the alignment of the nose gear, and the repair and service of the brake system.

7-2. DESCRIPTION. The landing gear incorporated on this airplane is a fixed, tricycle type, fitted with two 600 x 6 main wheels and a 500 x 5 nose wheel. The landing gear struts are of the air-oil type. The nose gear, steerable through a wide arc, enable a short turning radius in each direction. (For turning arc of the airplane, refer to Table 11-1.). To aid in nose wheel and rudder centering there are styeering rods attached to the rudder pedal torque tube assemblies. 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 hand brake handle. A brake fluid reservoir is installed on the left forward face of the engine firewall.

7-3. TROUBLESHOOTING. Troubles peculiar to the landing gear are listed in Table VII-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 11.

7-4. LANDING GEAR SYSTEM.

7-5. NOSE LANDING GEAR.

7-6. DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 7-1.). 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. Remove induction air hose between filter and airbox.

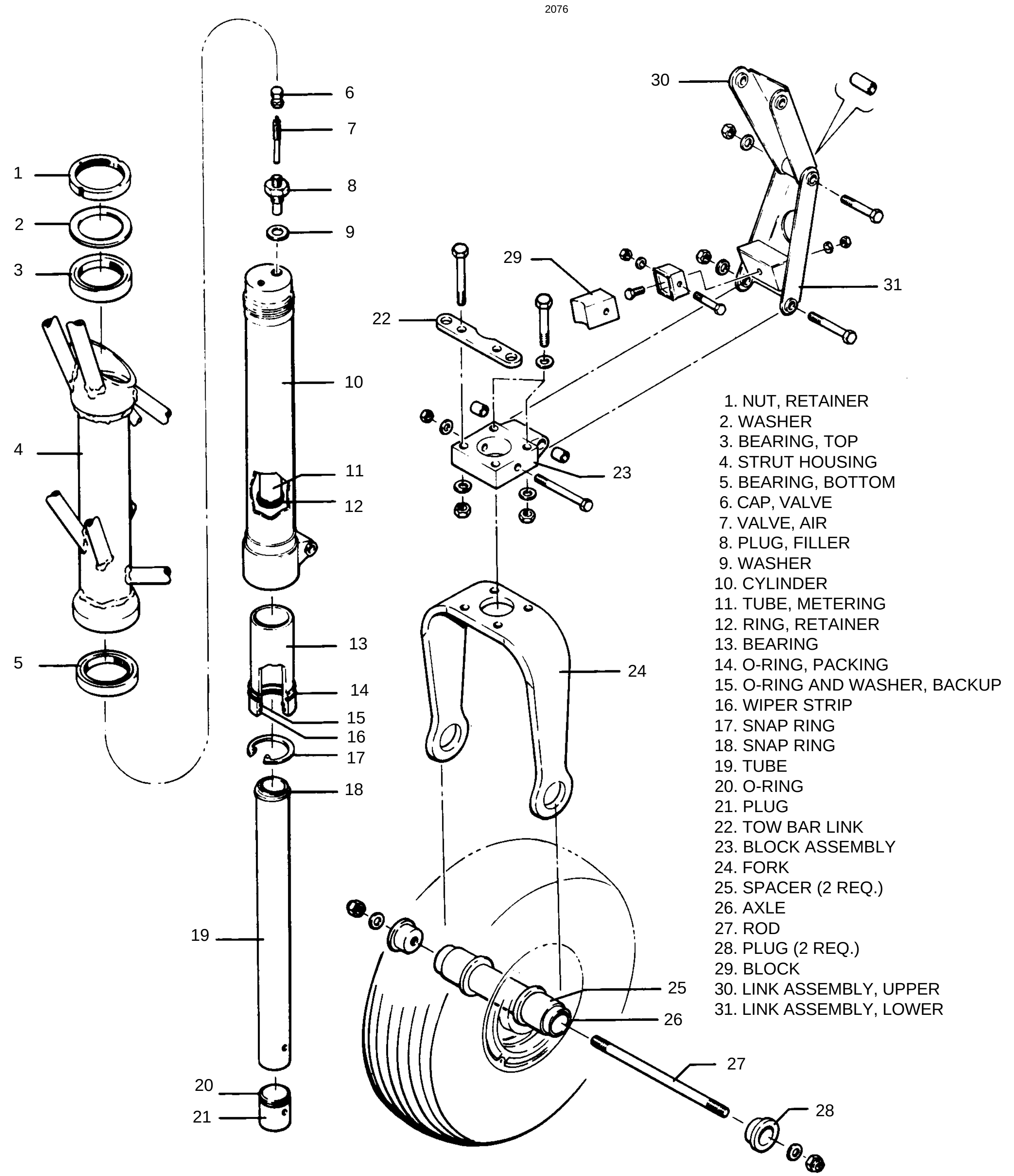
3. Remove the bottom cowl attaching screws from around its aft end and remove cowl.

b. Place airplane on jacks. (Refer to Jacking, Section 11.)

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.



1. NUT, RETAINER
2. WASHER
3. BEARING, TOP
4. STRUT HOUSING
5. BEARING, BOTTOM
6. CAP, VALVE
7. VALVE, AIR
8. PLUG, FILLER
9. WASHER
10. CYLINDER
11. TUBE, METERING
12. RING, RETAINER
13. BEARING
14. O-RING, PACKING
15. O-RING AND WASHER, BACKUP
16. WIPER STRIP
17. SNAP RING
18. SNAP RING
19. TUBE
20. O-RING
21. PLUG
22. TOW BAR LINK
23. BLOCK ASSEMBLY
24. FORK
25. SPACER (2 REQ.)
26. AXLE
27. ROD
28. PLUG (2 REQ.)
29. BLOCK
30. LINK ASSEMBLY, UPPER
31. LINK ASSEMBLY, LOWER

Figure 7-1 Nose Gear Oleo Strut Assembly

f. Loosen the strut assembly retainer nut (I) 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 (I) 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.

h. To remove the piston tube (19) and fork assembly (24) from the cylinder (10), 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 (17) from the annular slot in the bottom of the cylinder tube. Then remove the piston tube and fork assembly by sliding it out from the bottom of the cylinder tube (10).

i. To remove the bearing assembly from the piston tube, release the snap ring (18) 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 and quad ring or O-ring (15) from the inside of the bearing sleeve, and also the O-ring gasket (14) from the outside of the bearing sleeve.

j. To remove the piston tube plug (21) with O-ring (20) 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 7-22.
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.

7-7. CLEANlNG, 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.

7-8. NOSE GEAR OIL ORIFICE RETAINER RING INSTALLATION. (Refer to Figures 7-1 and 7-17.)

a. With the piston tube (19) and fork (24) removed from the cylinder (10), ascertain that all traces of the old retainer ring (12) are removed from the metering tube (11).

b. A tool can be fabricated to simplify the installation of the new retainer ring. (Refer to Figure 7-17.)

c. With the use of the fabricated tool, position the new retainer ring on the end of the tool with the locating stud.

d. Insert the tool into the cylinder (10), with the centering stud positioned into the hole in the base of the metering tube (11).

e. Hold the tool tightly against the metering tube and slide the sleeve of the tool towards the metering tube. This will move the new retainer ring (12) over the end of the metering tube and position itself into the groove of the metering tube (11).

7-9. ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 7-1.)

a Ascertain that all parts are cleaned and inspected.

b. To install the piston tube plug, proceed as follows:

1. Lubricate the tube plug (21) and O-ring (20) 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 (15), back-up washer and the wiper strip (16). Slide the O-ring (14) in place on the outside sleeve.

d. Lubricate the bearing assembly and carefully install it on the piston tube (24).

e. Position the snap ring (18) on the upper end of the piston tube.

f. Insert the piston tube with bearing assembly in the cylinder tube (10). Secure it with the retainer ring (17) 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 (I) with MS20995C40 wire.

1. 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 7-13.)

7-10. REMOVAL OF NOSE LANDING GEAR. (Refer to Figure 7-2.)

a. Remove the engine cowling by the following procedure:

1. Release the fasteners, two on each side and six screws at the aft end of the top cowl.

2. Remove the screws on the sides of the nose cowl.

3. Lift the top cowl with the upper nose cowl attached and remove the assembly from the airplane.

4. Disconnect the electrical lead to the landing light at the quick disconnect inside the bottom cowl and remove the induction air hose from filter housing.

5. Remove strut fairing if installed, by removing attaching screws.

6. Remove the bottom cowl attaching screws from around the aft end of the cowl and remove the bottom cowl with the lower nose cowl attached.

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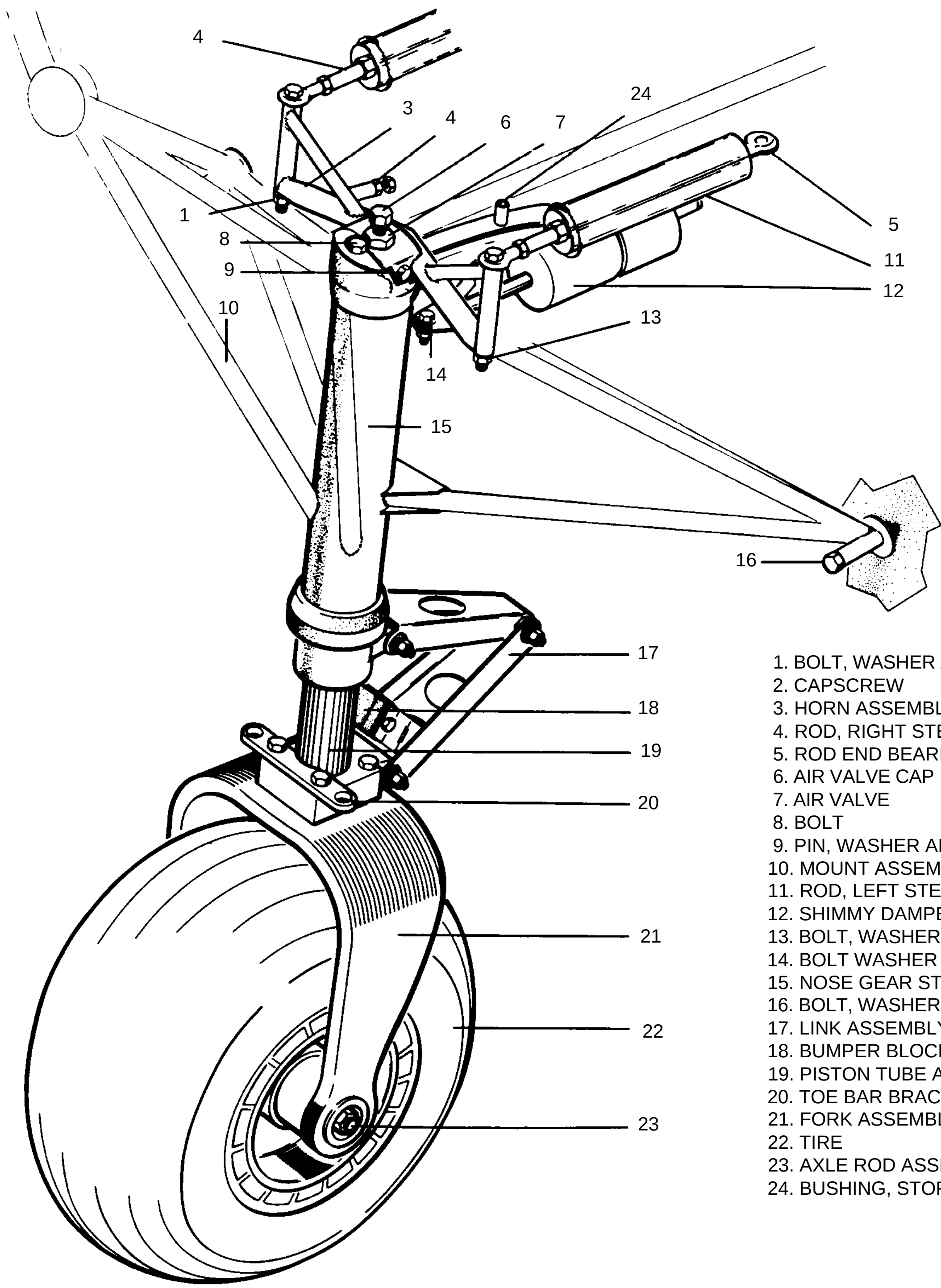

1. BOLT, WASHER AND NUT
2. CAPSCREW
3. HORN ASSEMBLY
4. ROD, RIGHT STEERING CONTROL
5. ROD END BEARING
6. AIR VALVE CAP
7. AIR VALVE
8. BOLT
9. PIN, WASHER AND COTTER PIN
10. MOUNT ASSEMBLY
11. ROD, LEFT STEERING CONTROL
12. SHIMMY DAMPENER
13. BOLT, WASHER AND NUT
14. BOLT WASHER AND NUT
15. NOSE GEAR STRUT ASSEMBLY
16. BOLT, WASHER AND NUT
17. LINK ASSEMBLY
18. BUMPER BLOCK
19. PISTON TUBE ASSEMBLY
20. TOE BAR BRACKET
21. FORK ASSEMBLY
22. TIRE
23. AXLE ROD ASSEMBLY
24. BUSHING, STOP

Figure 7-2 Nose Gear Installtion

b. Remove the propeller. (Refer to Removal of Propeller, Section VIII.)

c. Place the airplane on jacks.

d. Remove the engine. (Refer to Removal of Engine, Section VIII.)(Refer to Jacking, Section II.)

e. Disconnect the two rod steering assemblies (4 and 11) at the steering horn assembly (3)by removing the cotter pins, nuts and washers and bolts.

f. Disconnect the oil lines, vacuum lines, fuel lines, hoses and wires which are secured to the engine 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 (16) which attach the mount to the firewall.

7-11. CLEANING, INSPECTION,AND REPAIR OF NOSE LANDING GEAR.

a. Clean all parts with a suitable quick drying 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 the repaired.

d. Repair to the landing gear is limited to reconditioning of parts, such as replacing bearings and bushings, smoothing minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts.

7-12. INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 7-2.)

a Install the nose gear and engine mount assembly to the firewall with bolts, washers and nuts.

—NOTE—

The use of either one or two AN960-616 washers is permissible on the bolt attachments of the engine mount to the fuselage. Torque the bolt heads to 240-270 inch-pounds.

b. Attach the two rod steering assemblies (4 and 11) to the nose gear steering horn (3) with bolts. washers and nuts (1).

c. If removed, connect the shimmy dampener (12) to the steering horn with bolts, washers and nuts (14). A spacer bushing and cotter pin are required at the body attachment point.

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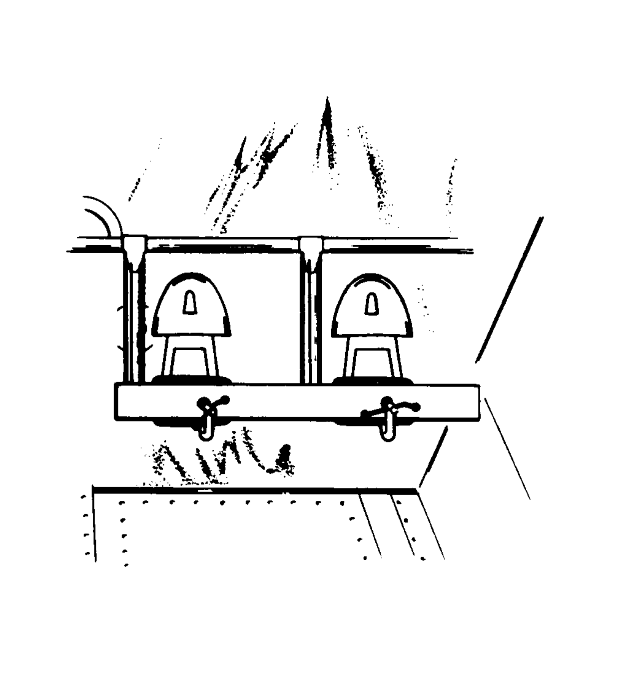


Figure 7-3 Clamping Rudder Pedals in Neutral Angle

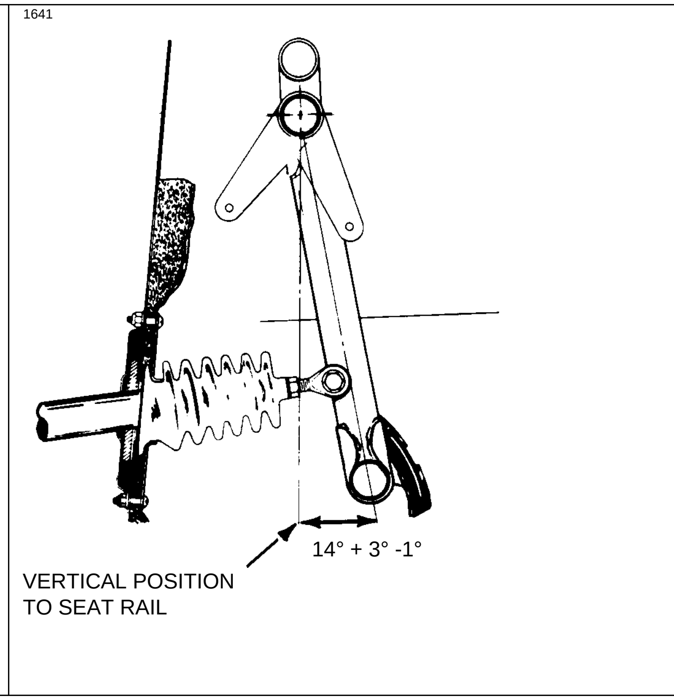


Figure 7-4 Rudder Pedals at Neutral Angle

d. Install the engine and connect the controls. (Refer to Installation of Engine, Section Vlll.)

e. Attach hoses, wires and cables to the engine mount tubing. Securing them with clamps, and Korosel lacing where required

f. Check the rigging of the nose gear per Paragraph 7-12.

g. Remove the airplane from jacks.

h. Install the propeller (refer to Installation of Propeller, Section Vlll) and engine cowl.

i. Install strut fairing.

7-13 ALIGNMENT OF NOSE GEAR.

a. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.

b. Place the airplane on jacks, (Refer to Jacking, Section 11.)

c. Level the airplane. (Refer to Leveling, Section 11.)

d. From the center of the tail skid, extend a plum 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 at the centerline of the tire. Snap the chalk line.

f. Ascertain that the rudder is properly rigged and the rudder cable tension is correct. (Refer to Rigging of Rudder, Section V.)

g. Clamp the rudder pedals together to align them in a lateral position. (Refer to Figure 7-3.) The rudder pedals are tilted 14 +3°-1° aft of vertical when in their neutral position.

h. Ascertain that the nose wheel is in alignment with the longitudinal axis of the airplane. (chalk line.)

i. Should the nose wheel require adjustment to bring it into proper alignment, disconnect the rod assemblies at the steering horn and adjust the nose wheel steering horn stops to contact the steering horn when the nose wheel is turned 30° ± 1° left and right of center. Center the nose wheel.

j. Adjust the rod ends to obtain a no load setting, and connect the bungees to the steering horn.

—NOTE—

Check that the rod ends have sufficient thread engagement, by use of the check holes in the rods.

k. Ascertain that the rudder pedal stops are adjusted in accordance with instructions given in Rigging and Adjustment of Rudder Controls, Section V.

l. Adjust the shimmy dampener by turning the nose wheel against its stops and adjusting the rod end of the dampener for adequate travel to both directions. (Maintain a minimum of one-quarter inch thread engagement.)

m. Remove the airplane from jacks.

7-14. MAIN LANDING GEAR.

I7-15. DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 7-5.) The main gear axle (19) and piston tube assembly (18) may be removed from the cylinder housing (7) with the gear removed from or installed on the airplane.

a. Place the airplane on jacks. (Refer to Jacking, Section 11.)

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 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) is 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 before the scraper ring may be removed by using a curved wire or spoon shaped tool and inserting it under the ring.

d. The cylinder head, may be removed cutting the wire and removing the bolts that secure the cylinder head (4) in the top of the housing. Remove the assembly from the housing.

7-16. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

a. Clean all parts with a suitable quick drying 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.

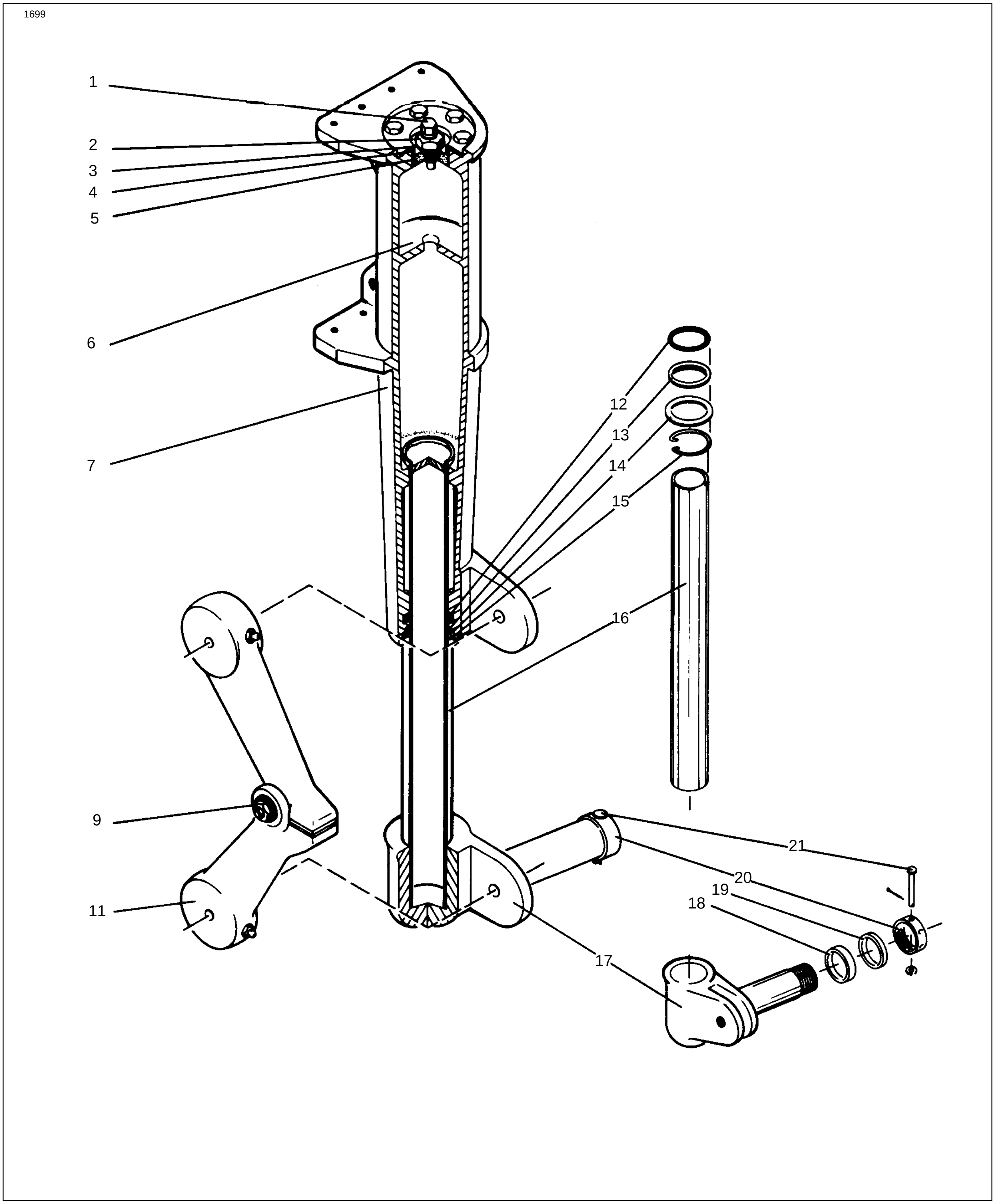


Figure 7-5 main Gear Oleo Strut Assembly

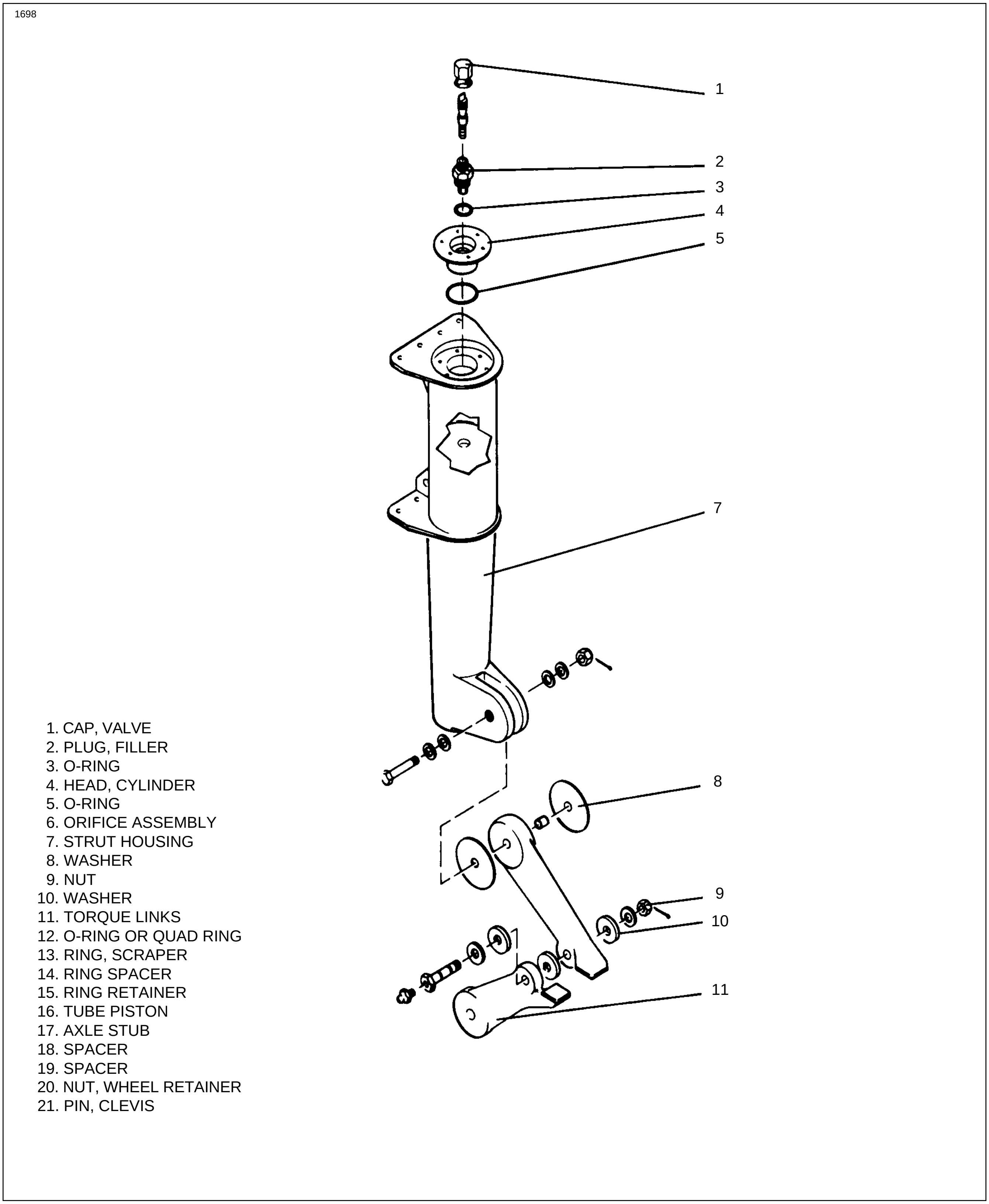
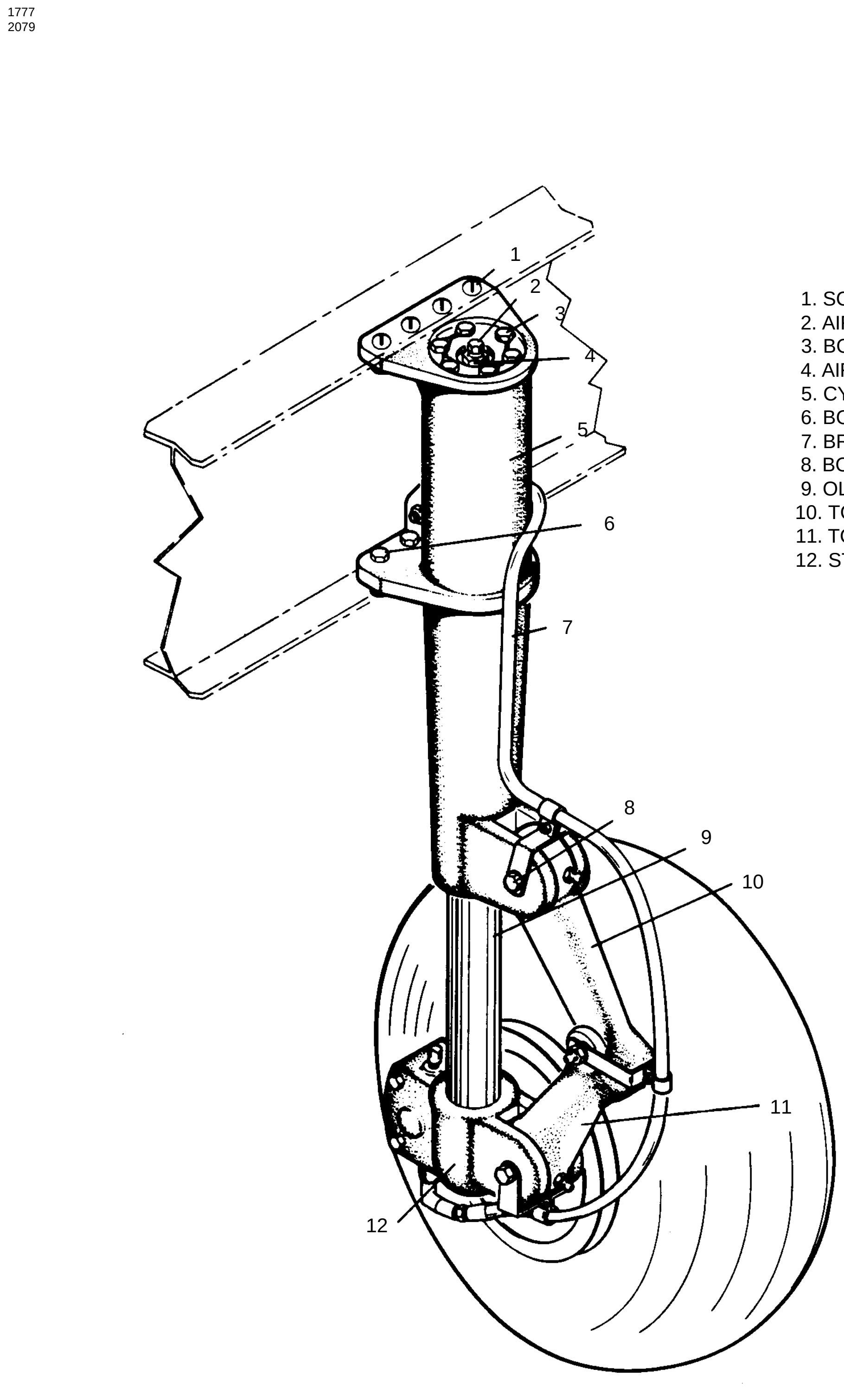


Figure 7-5 main Gear Oleo Strut Assembly (cont)



1. SCREW
2. AIR VALVE CAP
3. BOLT
4. AIR VALVE
5. CYLINDER
6. BOLT
7. BRAKE LINE HOSE
8. BOLT, WASHER, NUT AND COTTER PIN
9. OLEO ASSEMBLY
10. TORQUE LINK ASSEMBLY
11. TORQUE LINK ASSEMBLY
12. STUB AXLE

Figure 7-6 Main Gear Installation

7-17. ASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 7-5.)

a. 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.

b. 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.

c. Ascertain that the bushings are installed in the upper and lower torque links and then install links. At cable end of each link, install with the use of brake line bracket, bearing washers, bolt, washer, nut and cotter pins. Install washers (AN960-816L) under the head of the bolt to allow a firm sliding fit between the two links.

d. Slide the scraper and spacer rings into place and secure with the retainer ring in the annular slot in the bottom of the housing.

e. Lubricate and install an O-ring (5) or apply a thin layer of Permatex Form-a-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-a--gasket No. 6 Sealant beneath the flange of the cylinder head (4).

f. Install the hydraulic brake line.

g If removed, install the landing gear as described in Paragraph 7-20.

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. To eliminate side play shim washers 6331 1-03 (.005) may be used as required. Maximum side play is.005/.007. For lubrication of links, refer to Section II.

7-18. REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 7-6)

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.

7-l9. 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. Repair of the landing gear is limited to reconditioning of parts, replacement of parts, smoothing out minor nicks and scratches and repainting areas where paint has chipped or peeled.

7-20. INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 7-6.)

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 per Oleo Struts, Section II.

c. Service the brake system. (Refer to Brake System, Section 11.)

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.

7-21. WHEELS.

7-22. REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 7-7.)

a. Jack the airplane enough to raise the nose wheel clear of the ground. (Refer to Jacking, Section 11.)

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 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.

d. 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.

e. The wheel bearing assemblies may be removed from each wheel half by first removing the snap rings (1 or 16) that secures 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.

7-23. INSPECTlON OF NOSE WHEEL ASSEMBLY.

a. Visually check all parts for cracks, distortion, defects and excess wear.

b. Check tie bolts for looseness or failure.

c. Check internal diameter of felt grease seals. Replace the felt grease seal if surface is hard or gritty.

d. Check tire for cuts, internal bruises and deterioration.

e. Check bearing cones and cups for wear and pitting and relubricate.

f. Replace any wheel casting having visible cracks.

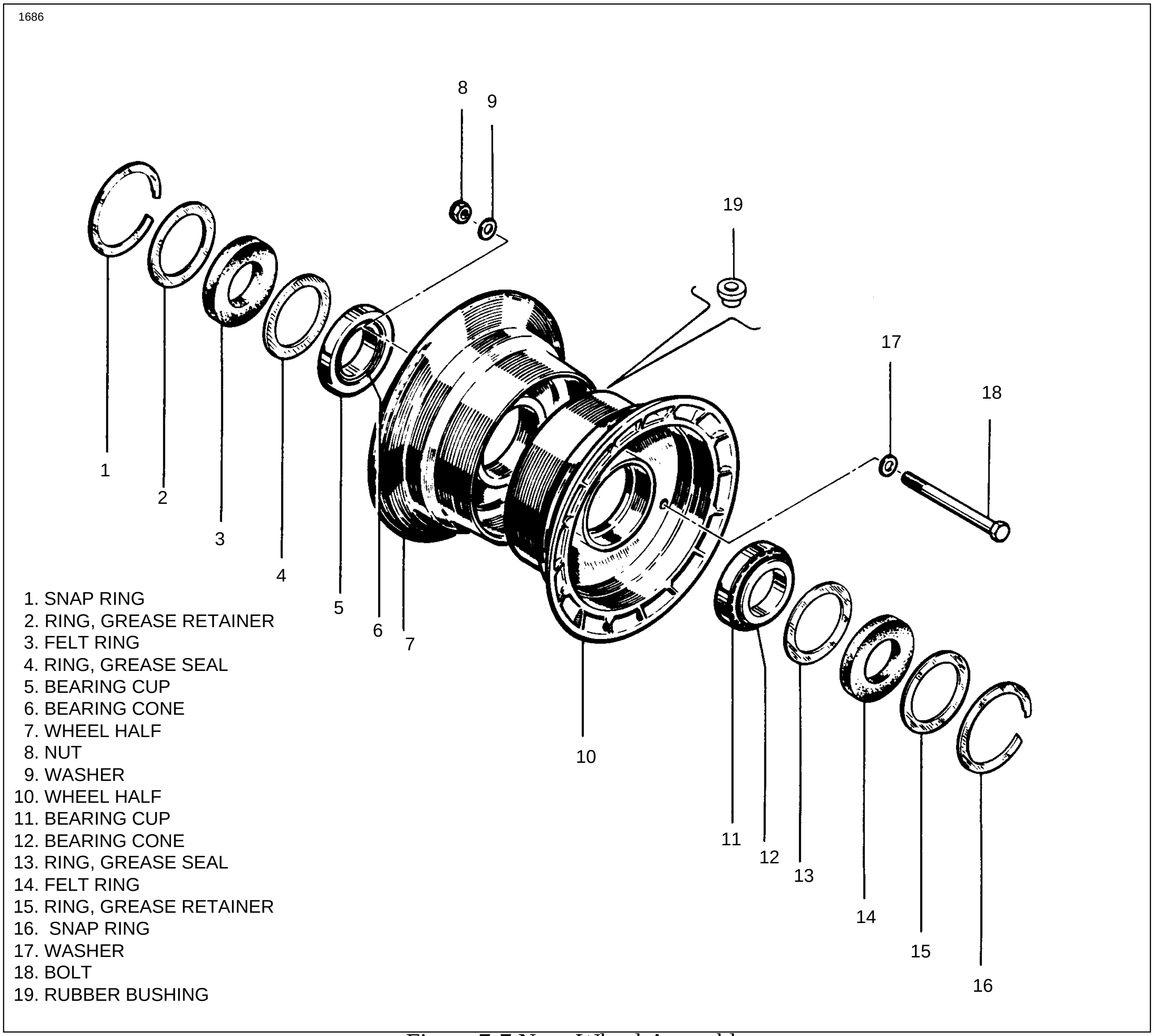


Figure 7-7 Nose Wheel Assembly

7-24. ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 7-7.)

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.

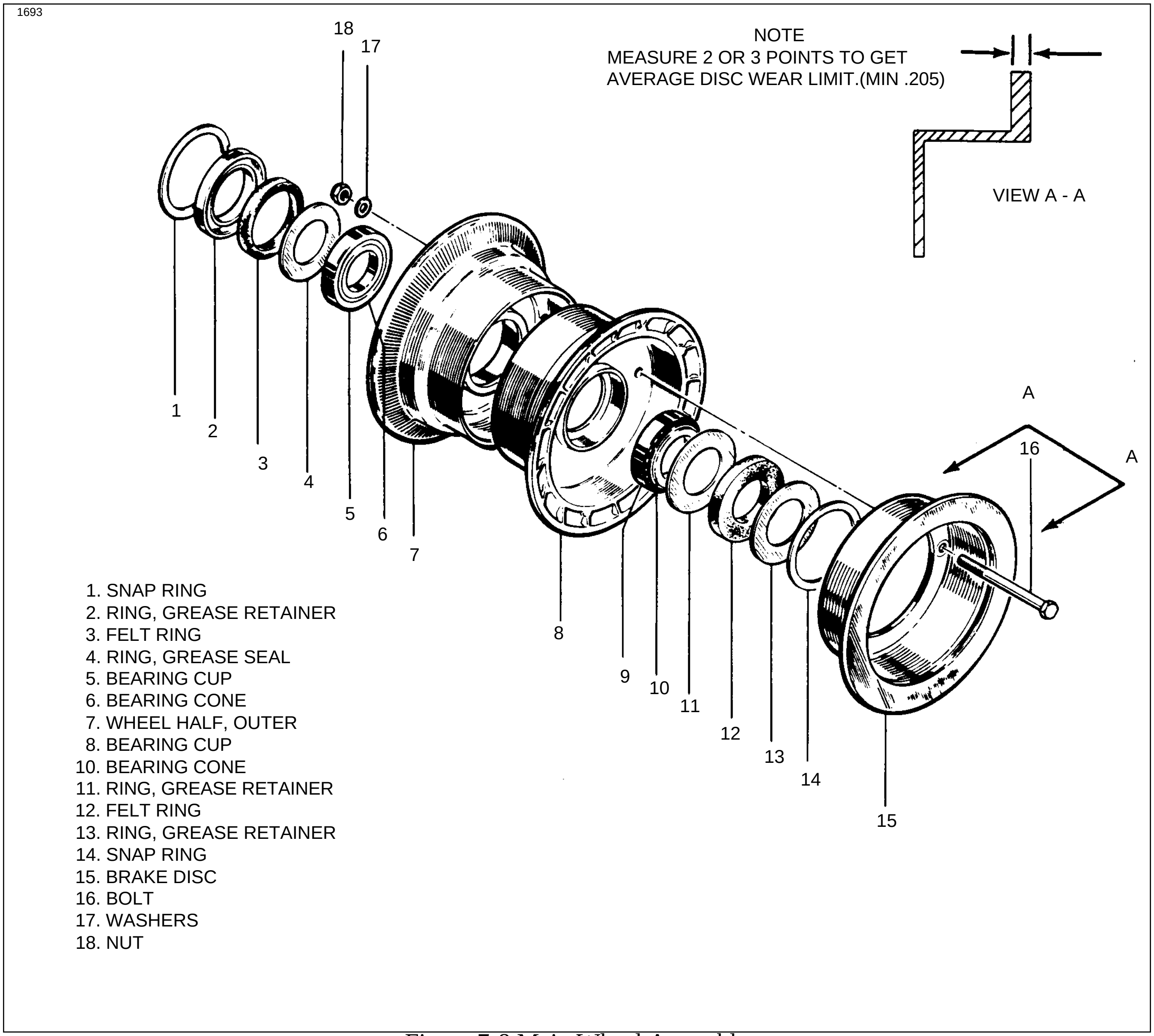


Figure 7-8 Main Wheel Assembly

—*NOTE*—

On McCauley Nose Wheel Assemblies only, bushing (19) is required to prevent tube movement.

b. Position the tire and tube so the index mark on the tire is aligned with the index mark on the tube. This will maintain proper balance of the wheel. Inflate the tire to the specified pressure as given in Table II-I of Section II.

c. Lubricate the bearing cones (6 and 12) and install the cones, grease seals (4 or 13), felt rings (3 or 14) and seal retainer ring (2 or 15). Secure with snap ring (l or 16).

d. Install the axle and spacer into the wheel assembly and install the wheel into the fork of the strut assembly, Secure in place with an axle plug on each end, axle rod, washers and self-locking nuts. 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 install it with the four bolts and screws in the small plate.

7-25 REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 7-8.)

a. Place the airplane on jacks. (Refer to Jacking, Section 11.)

b. If wheel fairing is installed, remove attaching screws, bolt and remove the fairing.

c. To remove the main wheel, remove the four cap bolts that join the brake cylinder housing and the lining back plate assemblies. Remove the back plate from between brake disc and wheel.

d. Remove the dust cover and the cotter pin that safeties the wheel nut, remove the wheel nut and slide the wheel from the axle.

e. The wheel halves (7 and 8) may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts (16). Pull the wheel halves from the tire by removing the inner half (8) from the tire first,and then the other half.

f. The wheel bearing assemblies may be removed from each wheel half by first removing the snap rings (1 or 14) that secure the grease seal retainers (2 or 13), and then the retainers, grease seals (4 or 11) and bearing cones (6 or 10). The bearing cups (5 or 9) should not be removed (except for replacement). They may be removed by tapping out evenly from the inside.

7-26. INSPECTION OF MAIN WHEEL ASSEMBLY. The inspection of the main wheel is the same as that given for the nose wheel, paragraph 7-22.

7-27. ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 7-8.)

a. Ascertain that the bearing cup (5 or 9) for each wheel is properly installed. Install the tire with tube on the outer wheel half (7) and then join the two wheel halves. Position the brake disc (15) in the inner wheel half and install the through bolts with the nuts on the valve stem side. Torque wheel nuts to 150 inch-pounds.

b. Position the tire and tube so the index mark on the tire is aligned with the index mark on the tube. This will maintain proper balance of the wheel. Inflate the tire to the specified pressure as given in Table II-I of Section II.

c. Lubricate the bearing cones (6 or 10) and install the cones, grease seals (4 or 11), seal retainer rings (2 or 13) and felt rings (3 or 12). Secure with snap rings (l or 14).

d. 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 cotter pin and install a dust cover.

e. Position the brake lining back plates between the wheel and brake disc and the brake cylinder on the torque plate. Install the four bolts to secure the assembly. If the brake line was disconnected, reconnect the line and bleed the brakes.

f. Position the wheel fairing and secure it with attaching screws, bolt and remove airplane from jacks.

7-28. BRAKE SYSTEM.

7-29. WHEEL BRAKE ASSEMBLY.

7-30. 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 0.099 of an inch or unevenly worn.

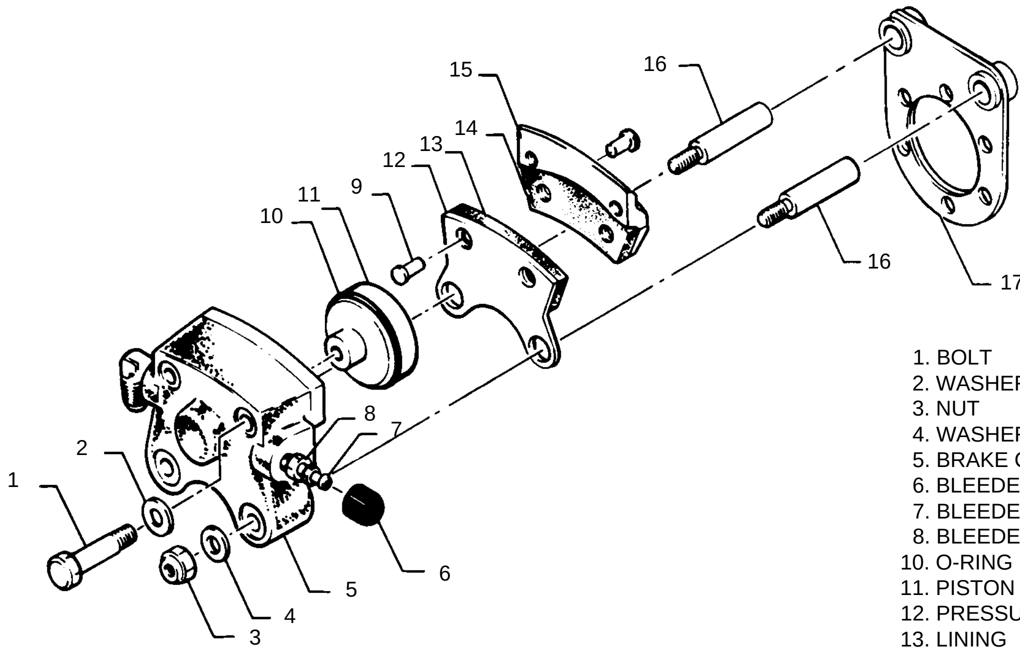


Figure 7-9 Wheel Brake Assembly

7-31. REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 7-9.)

a. To remove the brake assembly, first disconnect the brake line from the brake cylinder at the tube fitting.

b. Remove the two 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 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. .

g. Remove anchor bolt by the following procedure:

1. Position cylinder assembly on a holding fixture. (Refer to Figure 7-10).
2. Use a suitable arbor press to remove the anchor bolt from the cylinder body.

h. Install Anchor Bolt by the following procedure:

1. Support Anchor Bolt in a holding fixture. (Refer to Figure 7-11. Step A).
2. Align cylinder body over anchor bolt. (Refer to Figure 7-11, Step B).

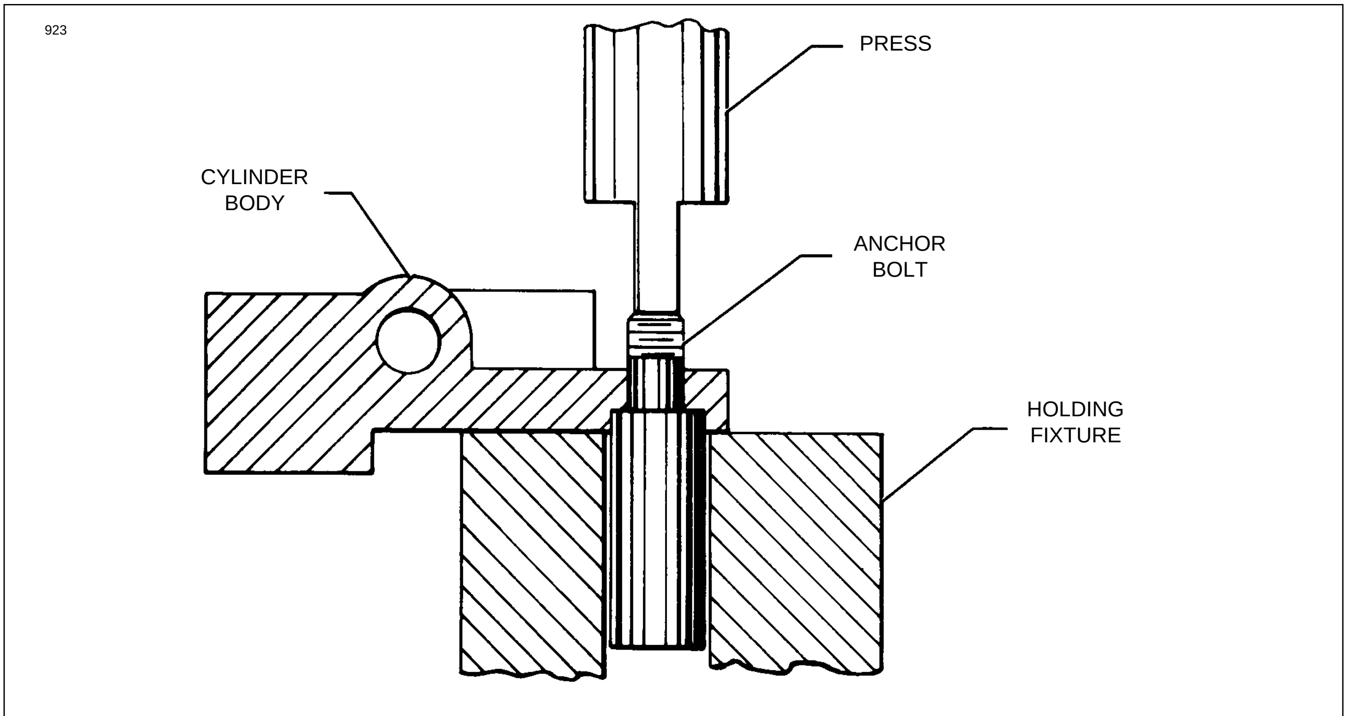


Figure 7-10 Removal of Anchor Bolt

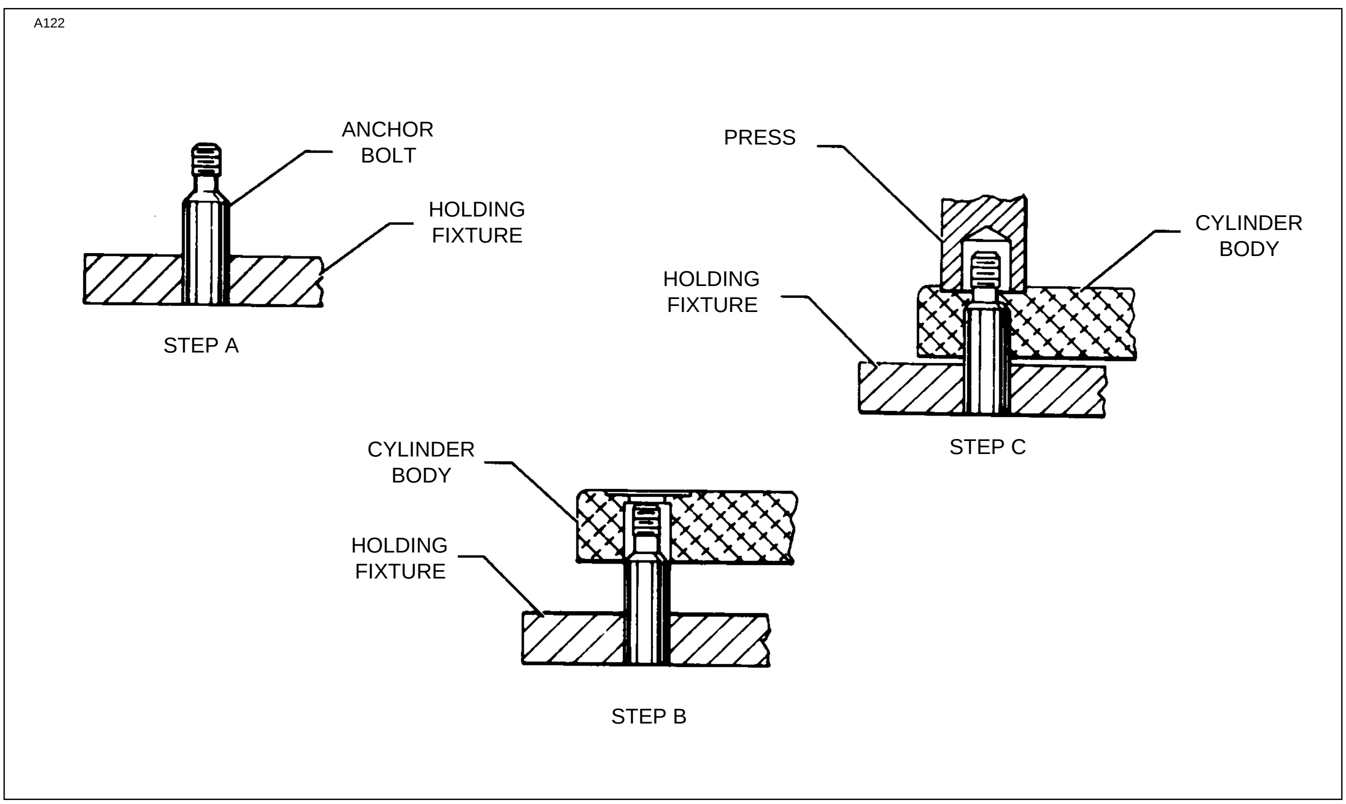


Figure 7-11Installation of Anchor Bolt

3. Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole.(Refer to Figure 7-11. Step C).

7-32. CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLIES.

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 grooves, scratches, pits or coning. Coning beyond .015 in either direction would be cause for replacement. A single groove or isolated grooves up to 0.031 of an inch deep would not necessitate replacement, but a grooving of the entire surface would reduce lining life and should be replaced. If a powdery rust appears on the disc, one or two taxi-braking applications should clear the rust up. Heavier rust may require removal of the disc to wire brush it. Then finish sand with 220 grit sandpaper. Should it be necessary to remove the wheel disc, refer to paragraph 7-25.

e. Lining may be removed from the backing plates by drilling or punching out the old rivets, and installing a new set using the proper rivets and a rivet set that will properly stake the lining and form a correct flare of the rivet. (A rivet setting kit is available through Piper Dealers under part number 754 165) After replacing brake linings, condition them as follows:
Perform a minimum of six light pedal effort braking applications from 25 to 40 MPH. Allow the brake discs to partially cool between stops.

7-33. ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 7-9.)

a. Lubricate the piston O-ring with fluid MIL-H-5606 and install on piston. 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 two bolts to secure the assembly.

e. Connect the brake line to the brake cylinder housing.

f. Bleed the brake system as described in paragraph 7-46.

7-34. BRAKE MASTER CYLINDER. (Hand Parking Brake.)

7-35. REMOVAL OF BRAKE MASTER CYLINDER. (Hand Brake.) (Refer to Figure 7-12.)

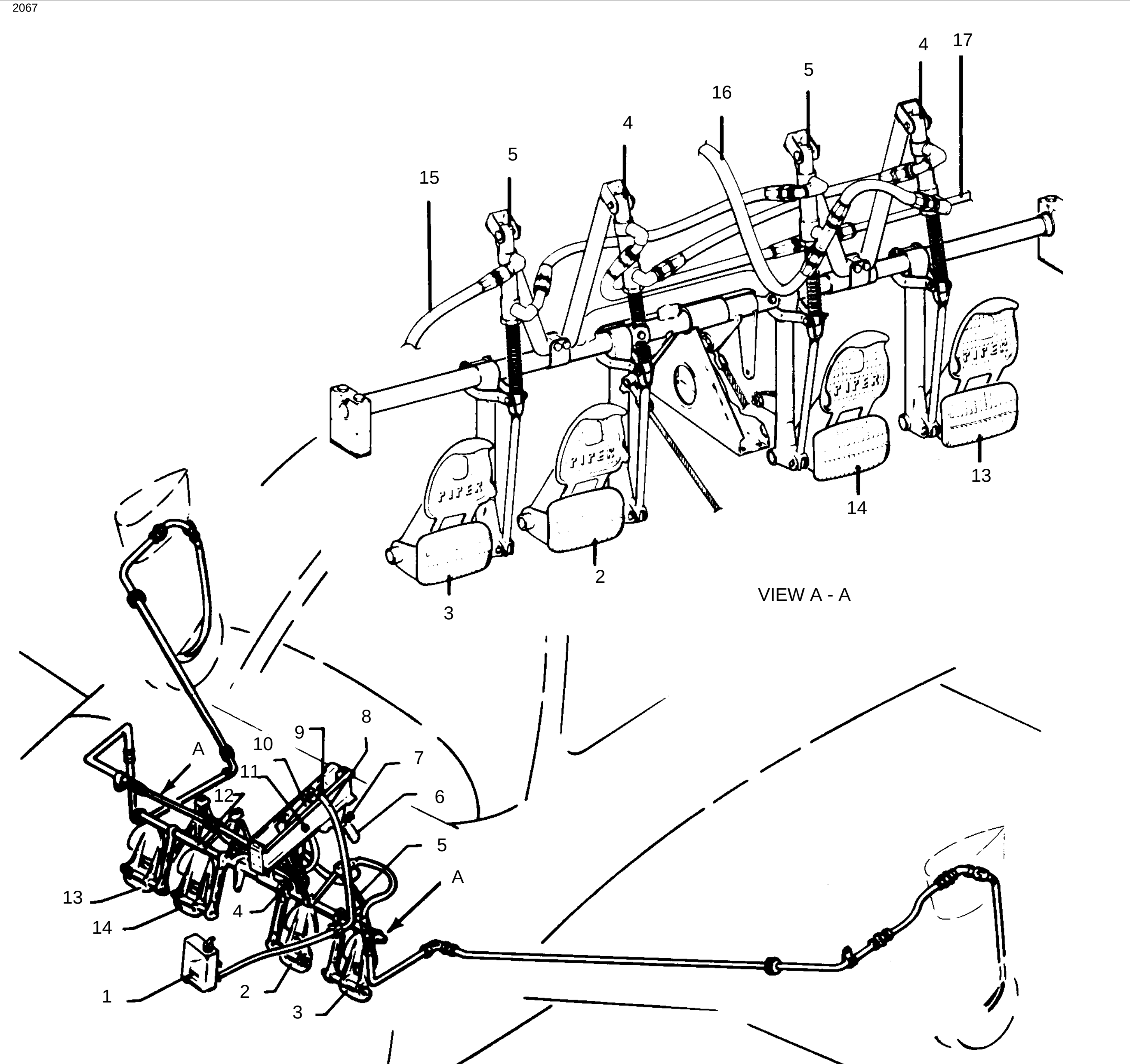
a. To remove the brake master cylinder (10) first disconnect the inlet supply line (8) from the fitting at the top of the cylinder and allow fluid to drain from the reservoir and line into a suitable container.

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 (9). Remove the clevis pin and spacer washers.

d. Disconnect the base of the cylinder from its mounting bracket by removing the attaching bolt assembly (II).

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. LINE, INLET
9. CLEVIS PIN
10. MASTER CYLINDER ASSEMBLY
11. BOLT ASSEMBLY
12. TORQUE TUBE]
13. RIGHT COPILOT'S BRAKE AND RUDDER PEDAL
14. LEFT COPILOT'S BRAKE AND RUDDER PEDAL
15. TO LEFT WHEEL BRAKE
16. TO HAND BRAKE
17. TO RIGHT WHEEL BRAKE

Figure 7-12. Brake System Installation

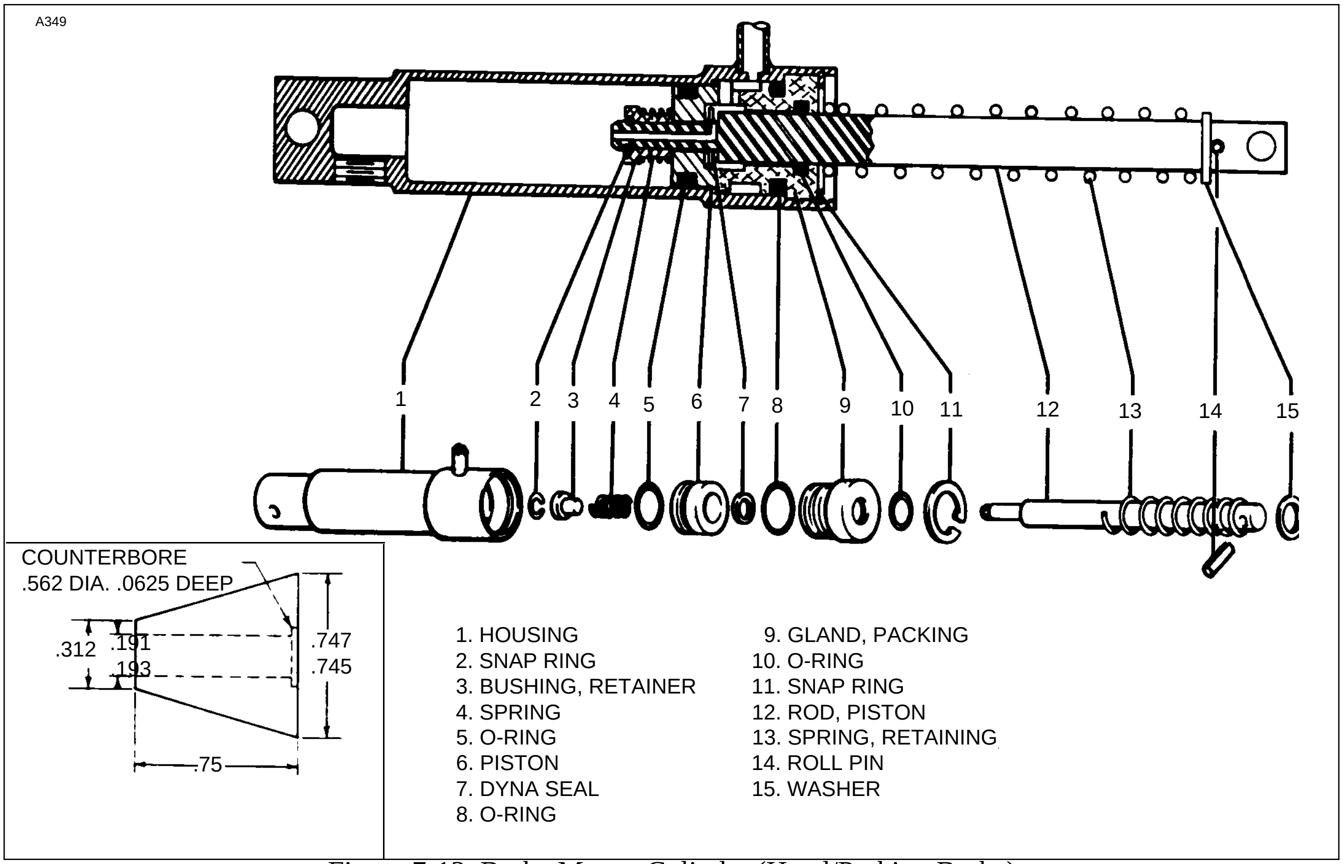


Figure 7-13. Brake Master Cylinder (Hand/Parking Brake)

7-36. DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 7-13.)

a. Remove the cylinder from its mounting bracket in accordance with instructions given in paragraph 7-35.

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.

7-37. 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 replacing 0-rings.

7-38. ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 7-13.)

—NOTE—

Use a small amount of hydraulic fluid (MIL-H-5606) on the O-rings 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, from dimensions shown in Figure 7-13.)

b. To assemble the piston rod assembly, install the following parts on the rod (12) in order, the roll pin (14), return spring retainer washer (15), return spring (13), packing gland (9) with new O-rings, seal (10), piston (6) with new O-ring, spring (4) and retainer bushing (3). Secure these pieces with the small snap ring (2) on the end of the rod.

c. Insert the piston rod assembly in the cylinder (1) and secure the packing gland with snap ring(11)

d. Install the cylinder per paragraph 7-39.

7-39. INSTALLATION OF BRAKE MASTER CYLINDER. (Hand Brake.) (Refer to Figure 7-12.)

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 (10) 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 (8) to the fitting at the top of the cylinder and secure with spring clamp.

f. Bleed the brake system per paragraph 746.

7-40. BRAKE CYLINDER. (Toe Brake.)

7-41. REMOVAL OF BRAKE CYLINDER. (Refer to Figure 7-12.)

a. Disconnect the upper and lower lines from the cylinder 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 and then removing the pins.

7-42. DISASSEMBLY OF BRAKE CYLINDER.

a. Cleveland cylinder number 10-27. (Refer to Figure 7-14.)

1. Remove the cylinder from its mounting bracket per Paragraph 7-41.

2. To disassemble the cylinder, first remove the piston rod assembly by removing the retaining 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.

b. Cleveland cylinder number 10-30. (Refer to Figure 7-14.)

1. Remove the cylinder from its mounting bracket per Paragraph 7-41.

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 assembly, O-ring (5), and g1and (8), and, if desired, the return spring (14).

4. Remove the O-rings from the piston and packing gland.

c. Gar-Kenyon cylinder number 17000. (Refer to Figure 7-14.)

1. Remove the cylinder from its mounting bracket as per Paragraph 7-41.

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 (I1).

4. Remove the O-rings from the piston and fitting.

7-43. CLEANING, INSPECTION AND REPAIR OF BRAKE CYLINDER.

a. Clean cylinder components with a suitable solvent and dry thoroughly.

b. Inspect interior walls of cylinder for scratches, burrs, corrosion, etc.

c. Inspect general condition of fitting threads.

d. Inspect piston for scratches, burrs, corrosion, etc.

e. Repairs to the cylinder are limited to polishing out small scratches and burrs, and replacing seals and O-rings.

7-44. ASSEMBLY OF BRAKE CYLINDER. (Refer to Figure 7-14.)

—NOTE—

Rub a small amount of hydraulic fluid (MIL-H-5606) on all O-rings and component parts for ease of handling during reassembly and to prevent damage.

a. Cleveland cylinder number 10-27. (Refer to Figure 7-14.)

I. 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 retaining ring (10).

4. Install the cylinder per Paragraph 7-45.

b. Cleveland cylinder 10-30. (Refer to Figure 7-14.)

I. Install new O-rings on the inside and outside of the packing gland (8) and on the outside of the piston (6).

2. To assemble the piston rod assembly, install on the rod (13), in order, the roll pin (16), washer (15), spring (14), washer (11), packing gland (8) with O-rings,seal(5), 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, (12).

4. Install the cylinder per Paragraph 7-44.

c. Gar-Kenyon cylinder number 17000. (Refer to Figure 7-14.)

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 7-45.

7-45. INSTALLATION OF BRAKE CYLINDER. (Refer to Figure 7-12.)

a. Position the cylinder 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 7-46.

7-46. BLEEDING BRAKES.

7-47. BRAKE BLEEDING PROCEDURE (Gravity).

a. Attach a clean, clear plastic tube to the brake bleeder of the right landing gear. Extend the free end of the tube to a container partially filled with hydraulic fluid (MIL-H-5606). Determine that the end of the tube is submerged in the fluid. Open the bleeder 1/2 to 1 turn.

b. Fill the brake fluid reservoir located on the firewall with hydraulic fluid.

c. Check to determine the right hand toe brake pedal(s) in the cockpit have been pulled full aft.

d. Pull the hand brake handle and slowly pump the master cylinder approximately 50 times or until hydraulic fluid is observed passing through the plastic tube at the brake bleeder.

—NOTE—

Fluid level in the reservoir must be maintained to prevent air from entering the system.

e. Pump right brake cylinder very slowly approximately 12 times. This will purge air from the toe brake cylinder system. Watch for any air forced through the clear plastic tube during this operation to insure air has been forced from the toe brake system.

f. Pump the hand brake an additional 25 times or until no air is observed through the clear plastic tube.

g. Tighten brake bleeder and remove the plastic tube.

h. Repeat steps a through f to the left main landing gear.

7-48. BRAKE BLEEDING PROCEDURE (Pressure).

a. Place a clean. clear plastic tube on the vent fitting on top of the brake fluid reservoir. extend the free end of the tube to a container partially filled with hydraulic fluid (MIL-H-5606). Be certain the end of the tube is submerged in the fluid.

b. Attach another clear plastic tube to the brake bleeder of the right landing gear. Connect the free end of this tube to the pressure source. Open the bleeder 1 to 2 turns and pressure fill the system with fluid.

c. With fluid continually flowing through the system. SLOWLY and simultaneously actuate the hand brake and toe brake pedal of the side being bled several times to purge the cylinders of air. On dual brake installations,both pedals for the brake being bled must be actuated.

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—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 to which the pressure hose is attached. Do not remove the tube from the fluid reservoir until both brakes have been bled. Check the brakes on the side being bled for proper pedal pressure. Replace cap on bleeder fitting.

—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 steps b through d to the left main landing gear.
f. Drain excess fluid from the reservoir to fluid level with a syringe.

7-49. BRAKE SYSTEM LEAK CHECK. Pull for a good, firm hand brake and lock parking brake mechanism. Allow system to stand for approximately 10 minutes, then by gripping the park 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.

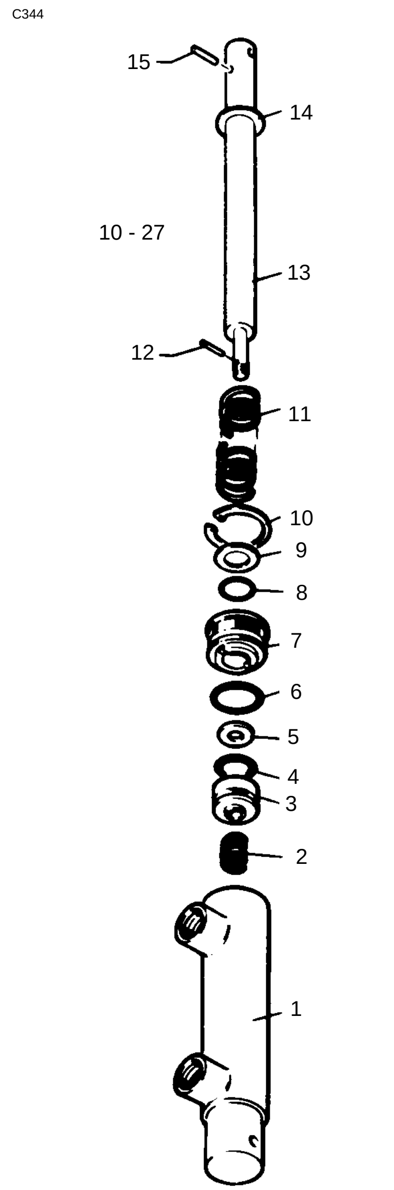
7-50. BLEEDING OF THE BRAKES AFTER A UNIT HAS BEEN CHANGED.

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.

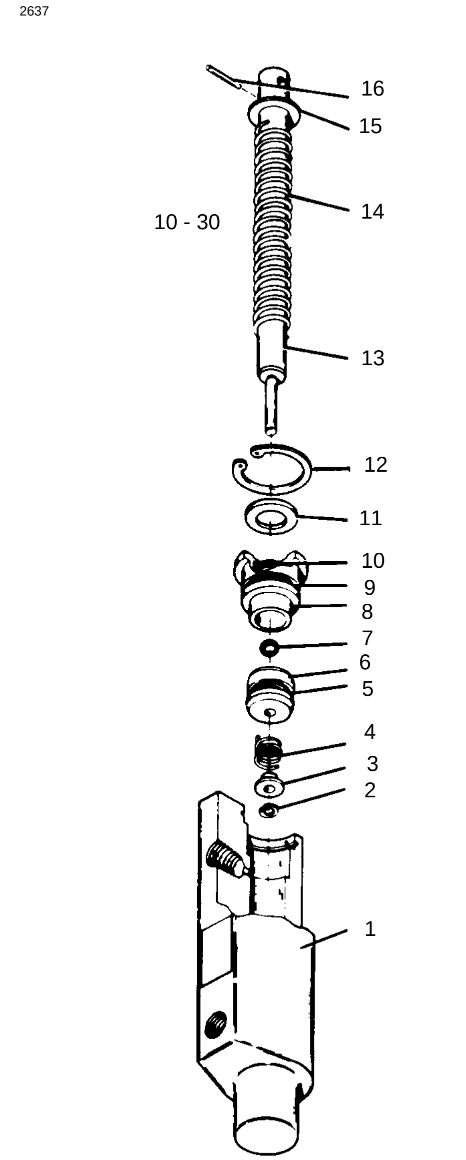
b. Actuate the master cylinder and the toe brake cylinder of the side unit was changed and bleed fluid through the brake assembly on the wheel by pumping pressure and cracking bleeder until pressure drops.

—CAUTION—

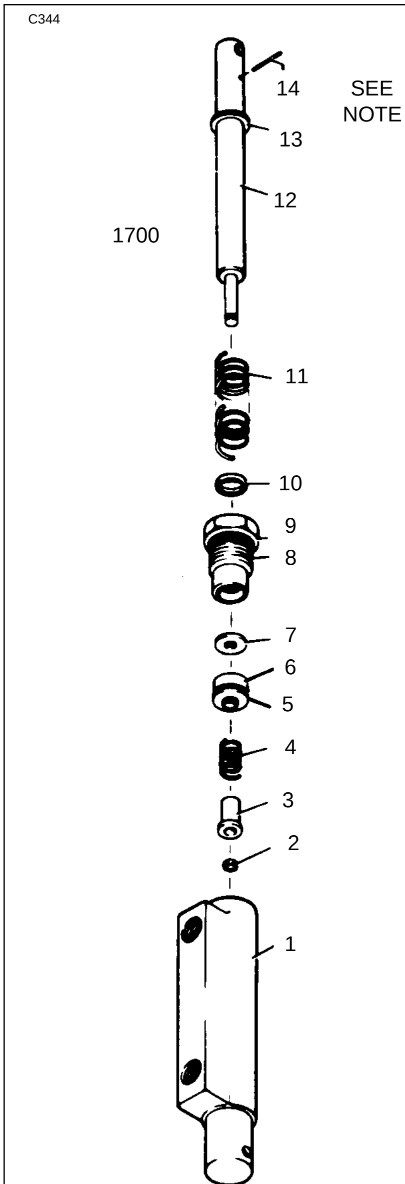
Do not allow pressure to bleed off before closing bleeders, for this will allow air to enter the system. Repeat the pumping and bleeding approximately 10 or more times or until all the air is released from the system. During all bleeding, fluid level of the reservoir must be maintained.



1. HYDRAULIC CYLINDER
2. SPRING
3. PISTON
4. O-RING
5 SEAL WASHER
6. O-RING
7. PACKING GLAND
8. O-RING
9. WIPER WASHER
10. RETAINER SPRING
11. SPRING
12. ROLL PIN
13. PISTON ROD
14. WASHER
15. ROLL PIN



1. HOUSING
2. RETAINING RING
3. SLEEVE
4. SPRING
5. O-RING
6. PISTON
7. O-RING
8. GLAND
9. O-RING
10. O-RING
11. WASHER WIPER
12. RETAINING RING
13. ROD
14. SPRING
15. WASHER
16. ROLL PIN



1. HOUSING
2. RETAINING RING
3. SLEEVE
4. SPRING
5. O-RING
6. PISTON
7. SEAL
8. FITTING
9. O-RING
10. O-RING
11. SPRING
12. PISTON ROD
13. WASHER
14. ROLL PIN

NOTE
ON NEWER VERSIONS, THE ROLL PIN (14) IS DELETED AND ITEM (13) IS A PERMANENT SHOULDER RING.

Figure 7-14 Brake Cylinder 10-27, 10-30, 17000 (Toe Brake)

TABLE VII-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.
	One brake dragging.	Determine cause and correct.
	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.

TABLE VII-I. LANDING GEAR TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Main landing 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.
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	Replace defective parts. in strut.

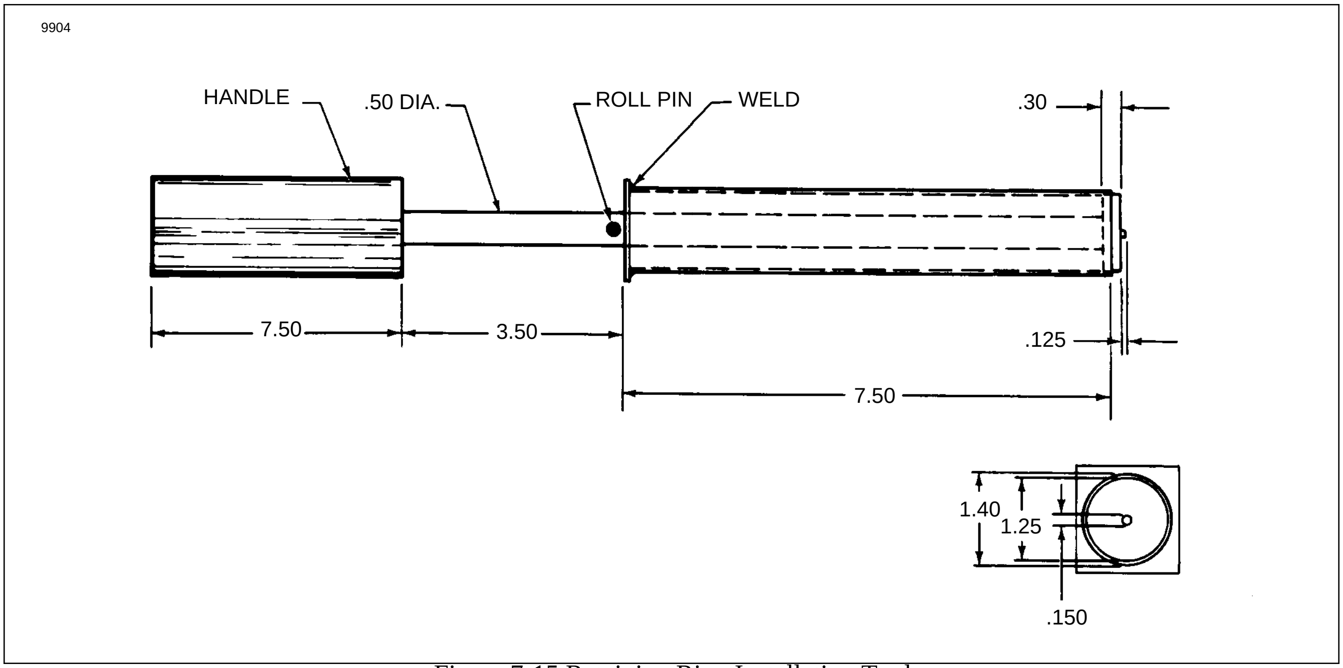


Figure 7-15 Retaining Ring Installation Tool

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SECTION VIII

POWER PLANT

SECTION VIII

POWER PLANT

8-1. INTRODUCTION. This section covers the power plant used in the PA-28-161 CADET airplane, and is comprised of instructions for the removal and installation, minor repairs and service of the propeller, engine, induction system components, ignition system components and engine lubrication system.

For further instructions and for major repairs, consult the appropriate publications of the engine or component manufacturer.

8-2. DESCRIPTION. The PA-28-161 CADET is powered by an Avco-Lycoming engine, of 160 horsepower (Refer to Power Plant Specifications in table 11-1.) The engine is an 0-320 series, four cylinder, wet sump, horizontally opposed, direct drive, air cooled power plant. The cylinders are not directly opposed from each other but are staggered, thus permitting a separate throw on the crankshaft for each connecting rod.

The propeller installed on the aircraft is a fixed pitch type. (Refer to Table 11-1 for Propeller Specifications).

The induction system on these engines consists of a wet type air filter, a Marvel-Schebler float type carburetor and a diaphragm type fuel pump. (Refer to Table 11-1 for Specifications).

The magneto used on these engines may be either Slick 4000 series, Slick 4200 series. The Slick 4000 series magnetos are installed with their associated components. These magnetos are engineered to give trouble free ignition, and are exchanged for factory rebuilt units upon engine overhaul, for a nominal cost. These magnetos are non-serviceable units. The 4200 series magnetos are completely self contained and consist of impulse coupling on the left magneto to aid in starting. These magnetos are serviceable units.

In addition to the previously mentioned components, each engine is furnished with a starter, 60 ampere alternator, 14 volt electrical system, shielded ignition, vacuum pump drive and fuel pump. The exhaust system is stainless steel with two mufflers. A shroud is provided to supply heat for both the cabin and carburetor.

The lubrication system is the pressure wet sump type. The oil pump is located in the accessory housing and draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing, which feeds the oil to a threaded connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil through the pressure screen or filter. In the event that cold oil or an obstruction should restrict the flow of oil to the cooler, an oil by-pass also is provided to pass the oil directly from the oil pump to the oil pressure screen or filter.

The oil pressure screen or filter element, located on the accessory housing is provided as a means to filter any solid particles from the oil that may have passed through the suction screen in the sump. After being filtered, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing. This relief valve regulates the engine oil pressure by allowing excess oil to return to the sump while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump where, after passing through the suction screen in the sump, it is again circulated through the engine.

8-3 STANDARD PRACTICES- ENGINE.

The following suggestions should be applied wherever they are needed when working on the power plant.

a. To insure proper reinstallation and or assembly, tag and mark all parts. clips. and brackets as to their location prior to their removal and or disassembly.

b. During removal of various tubes or engine parts,inspect them for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag any unserviceable parts and or units for investigation and possible repair.

c. Extreme care must be taken to prevent foreign matter from entering the engine. such as lockwire, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine. either on or off the aircraft. suitable protective caps. plugs. and covers must be used to protect all openings as they are exposed.

—NOTE—

Dust caps used to protect open lines must always be installed OVER the tube ends and NOT in the tube ends, Flow through the lines may he blocked off if lines are inadvertently installed with dust caps in the tube ends.

d. Should any items be dropped into the engine, the assembly process must stop and the item removed. even though this may require considerable time and labor. Insure that all parts are thoroughly clean before assembling.

e. Never reuse any lockwire, lockwashers, tablocks, tabwashers, or cotter pins. All lockwire and cottcr pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.

f. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Insure the new nonmetallic parts being installed show no sign of having deteriorated in storage.

g. When installing engine parts which require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

h. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures. molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

—CAUTION—

Ensure that Anti-seize compounds are applied in thin even coats, and that excess compound is completely removed to avoid contamination of adjacent parts.

i. Temporary marking methods are those markings which will ensure identification during ordinary handling, storage and final assembly of parts.

8-4. TROUBLESHOOTING. Troubles peculiar to the power plant are listed in Table Vl11-11. at the end of this section, along with their probable cause and suggested remedies. When troubleshooting the engine. ground the magneto primary circuit before performing any checks on the engine.

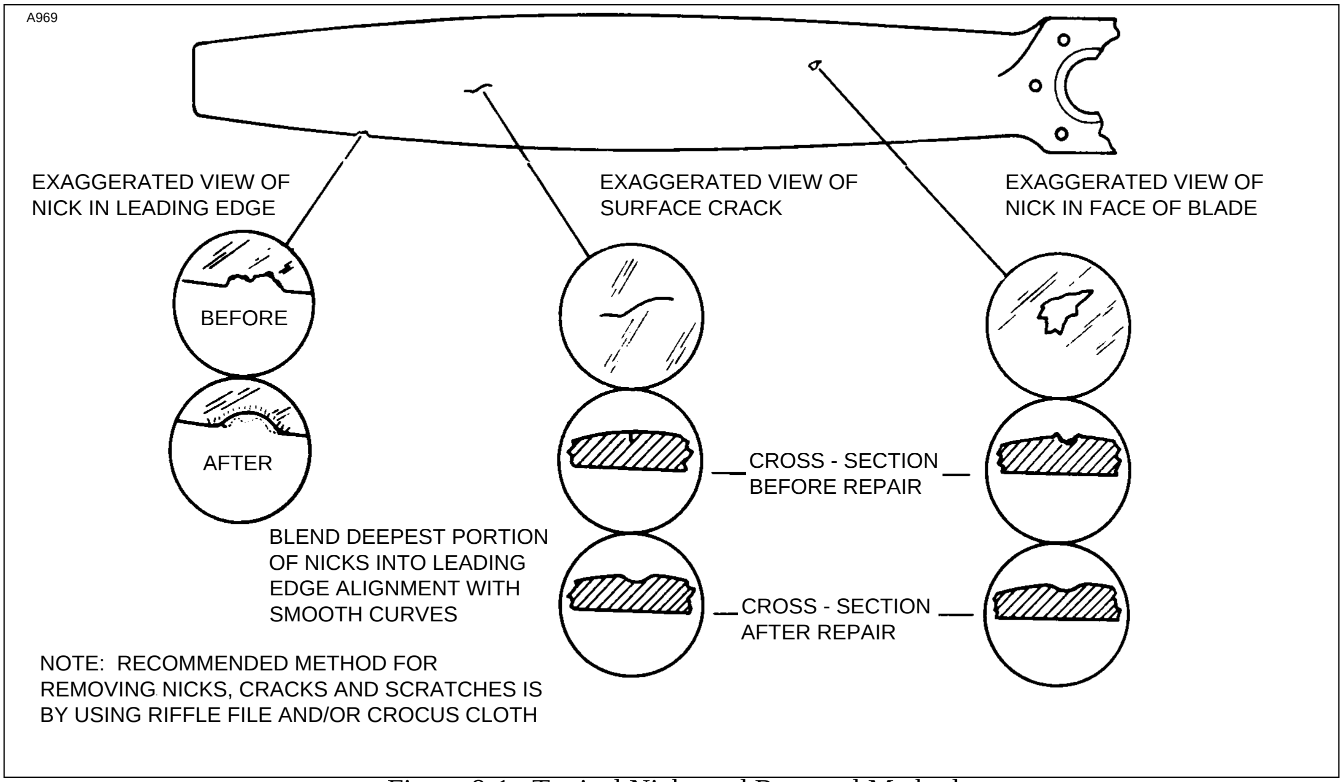


Figure 8-1 . Typical Nicks and Removal Method

8-5. PROPELLER.

8-6. REMOVAL OF PROPELLER.

a. Insure master and magneto switches are off.
b. Move fuel selector to off position and place mixture control in idle cut-off.
c. Note the position of each component to facilitate reinstallation.
d. Remove the screws attaching the spinner assembly and remove the spinner.
e. Remove the safety wire that secures the six attaching bolts and remove the bolts. The propeller is now free to be removed.

8-7. CLEANING, INSPECTION AND REPAIR OF PROPELLER.

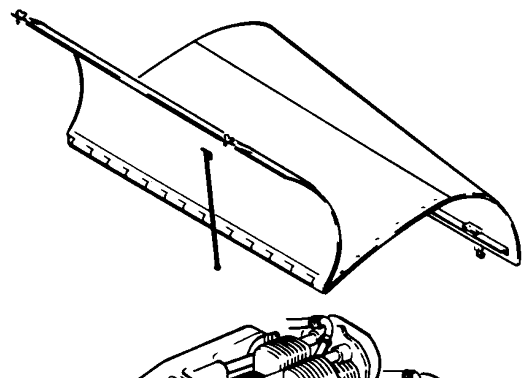
a. Clean the spinner, back plate and propeller surfaces with a non-corrosive solvent, and inspect for nick, scratches, corrosion and cracks.
b. Nicks in the leading edges of the blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. (Refer to Figure 8-1 for propeller blade care.) A propeller with several nicks, scratches, corrosion or cracks should be returned to a propeller overhaul shop or the manufacturer for inspection and repair.
c. Each blade face should be sanded lightly and painted, when necessary, with a flat black paint to retard glare. A light application of oil or wax may be applied to the surfaces to prevent corrosion.

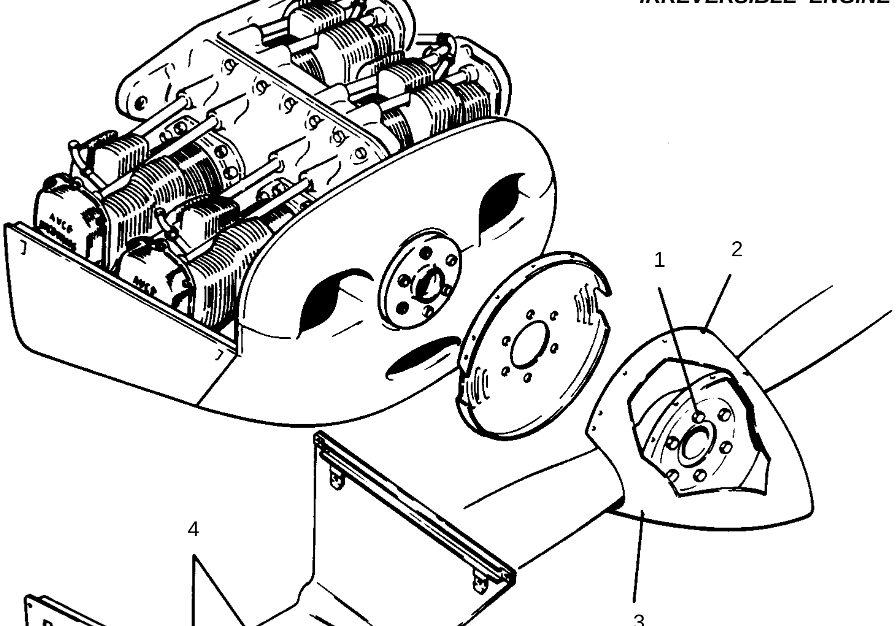
TABLE VIII-I. PROPELLER TORQUE LIMITS	
DESCRIPTION	REQUIRED TORQUE
Propeller Mounting Bolts	280-300 in-lbs.
Spinner Backplate Attachment Screws	30-35 in-lbs.
Spinner Attachment Screws	20-25 in-lbs.

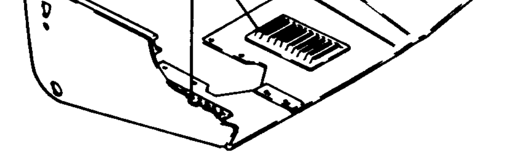
2075

—CAUTION—

GROUND RUNNING WITH THE COWLING REMOVED: MAXIMUM POWER GROUND RUNNING IS LIMITED TO TWO (2) MINUTES OR CYLINDER HEAD TEMPERATURE OF 475*F. WHICHEVER IS REACHED FIRST. AIRCRAFT WITHOUT CYLINDER HEAD TEMPERATURE GAUGE MUST NOT BE OPERATED AT MAXIMUM POWER WITH COWLING REMOVED. PROLONGED GROUND RUNNING WITH THE COWLING REMOVED COULD CAUSE LOCAL HOT SPOTS IN THE CYLINDERS AND IRREVERSIBLE ENGINE DAMAGE







1. PROPELLER MOUNTING BOLTS
2. SPINNER BACKPLATE ATTACHMENT SCREWS
3. SPINNER ATTACHMENT SCREWS
4. LOUVERS

Figure 8-2 Propeller and Cowling Installation

8-8. INSTALLATION OF PROPELLER. (Refer to Figure 8-2.)

a. Insure magneto switch is OFF.

b. Place the alternator drive belt in the groove of the starter ring gear and position the starter gear on the flange of the crankshaft. Ascertain that the stamped "O" on the gear is aligned with the "O" on the crankshaft flange.

c. Install the propeller spinner back plate or bulkhead on the starter ring gear.

d. Rotate crankshaft until the top center (TC) mark on the starter gear and the crankcase parting flange or the index mark on the starter housing are aligned.

e. Install propeller by indexing number one propeller blade over "O" mark on ring gear support.

f. Place the doubler in position. Install and tighten each propeller bolt, with washer, finger tight. Use a torque wrench for final tightening and tighten in sequence so that all bolts are pulled down evenly. (Refer to Table Vlll-l for specific torque requirements.)

g. Check the propeller blade track as given in Paragraph 8-9.

h. Safety the propeller mounting bolts with MS20995-C41 wire.

i. Install the spinner and torque attachment screws per Table Vlll-l., the minimum allowable gap between prop and spinner components is .040 inch.

j. Adjust alternator drive belt as given in Checking Alternator Belt Tension Section Xl.

—NOTE—

If the propeller-engine combination feels rough on initial run-up or flight, propeller may be rotated 180° from initial installation.

8-9. 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 0.062 inch) may be an indication of bent blades or improper propeller installation. Check blade track as follows:

a. With the engine shut down and blades vertical. Secure to the aircraft a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full "blade-shake" travel, making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.

b. Carefully rotate propeller by hand to bring the opposite blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than 0.062 inch.

c. Propellers having excess blade track should be removed and inspected for bent blades. Bent blades will require repair and overhaul of assembly.

8-10. ENGINE.

8-11. REMOVAL OF ENGINE. (Refer to Figure 8-3.)

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 the OFF position.

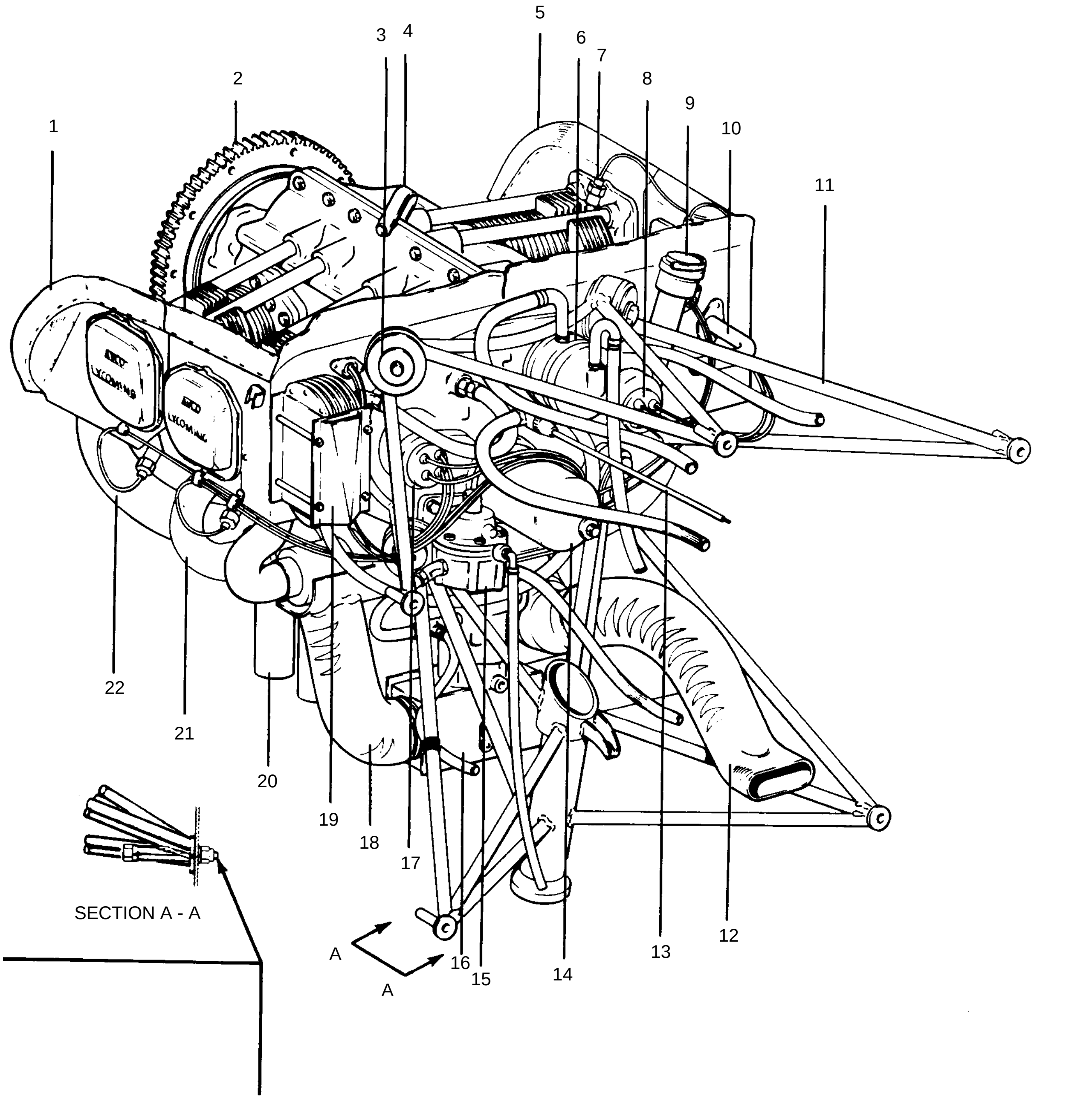
c. Remove the engine cowlings by releasing the cowl fasteners and the attachment screws. Be certain that all electrical leads are disconnected prior to removal of the cowl.

d. Remove the propeller per Paragraph 8-5.

e. Disconnect the starter positive and ground leads at the starter and their attachment clamps.

f. Disconnect the cabin heat and defroster tubes from the muffler.

g. Disconnect the primer line at the tee connection.



—NOTE—

A MAXIMUM OF (3) AN 960 - 616 WASHERS CAN BE USED TO PERMIT A MAXIMUM OF 2.5 THREADS EXPOSED ON THE BOLT. TORQUE TO 240/270 INCH POUNDS.

1. BAFFLE ASSEMBLY, LEFT
2. STARTER RING GEAR
3. SHOCK MOUNT (SEE FIGURE 8 - 4)
4. LIFTING STRAP
5. BAFFLE ASSEMBLY, RIGHT
6. VACUUM PUMP
7. SPARK PLUG
8. MAGNETO, RIGHT
9. OIL FILTER
10. MAGNETO BLAST TUBE
11. ENGINE MOUNT ASSEMBLY
12. HEATER DUCT
13. TACHOMETER DRIVE CABLE
14. OIL FILTER
15. FUEL PUMP, ENGINE
16. INDUCTION AIRBOX
17. MAGNETO, LEFT
18. HEAT MUFF TUBE
19. OIL COOLER
20. MUFFLER
21. EXAUST STACK
22. INTAKE TUBE

Figure 8-3 Engine Installation

h. Disconnect the throttle and mixture cables at the carburetor and carburetor heat control. The carburetor may be removed if it is desirable.

i. Disconnect the mechanical fuel pump supply line at the pump.

—NOTE—

All hoses, lines and wires should be identified (tagged) as they are disconnected and separated to facilitate reinstallation, and do away with the question as to where to reconnect them. Open fuel, oil, vacuum lines and fittings should be capped to prevent contamination.

j. Disconnect the engine oil cooler lines from the cooler.

k. Disconnect the magneto "P" leads at the magnetos. Insert a protective cover over the connection.

1. Disconnect the engine oil temperature lead at the aft end of the engine.

m. Disconnect the tachometer drive cable from the rear of the engine.

n. Untie the ignition harness, hoses and lines at the aft end of the engine.

o. Disconnect the vacuum pump lines at the pump.

p. Disconnect the oil pressure line from the rear of the engine.

q. Disconnect the generator or alternator leads and the cable attachment clamps.

r. Attach a one-half ton (minimum) hoist to the hoisting straps and relieve the tension from the mounts.

—NOTE—

Place a tail stand under the tail of the airplane before removing the engine.

s. Check the engine for any attachments remaining to obstruct its removal.

t. Drain the engine oil, if desired, and close the drain.

u. Remove the four engine mount assemblies and swing the engine free, being careful not to damage any attaching parts.

8-12. INSTALLATION OF ENGINE. (Refer to Figure 8-3.)

a. Prior to installing the engine, be certain that all components of the engine such as exhaust stacks, carburetor, etc. are installed.

—NOTE—

Ascertain that all hex nuts on the exhaust stack flanges are tightened until the underside of the flange contacts its mating surface at all four locations, then torque hex nuts to 110-115 inch pounds.

b. Attach a one-half ton (minimum) hoist to the engine hoisting straps and swing the engine into alignment with its attaching points.

c. Assemble the engine shock mounts as shown in Figure 8-4. Note the position of each mount carefully. The upper right and lower left mounts are installed the same. The upper left and lower right are installed the same.

d. Swing the engine into place and position the engine mounting lugs so they align with the engine mount attachment points.

e. Position the shock mount bolts through the mounting lugs and secure with nuts. Torque the nuts progressively, following a circular sequence until a torque value of 450-500 inch pounds is reached.

f. Connect the alternator leads and secure cables with clamps.

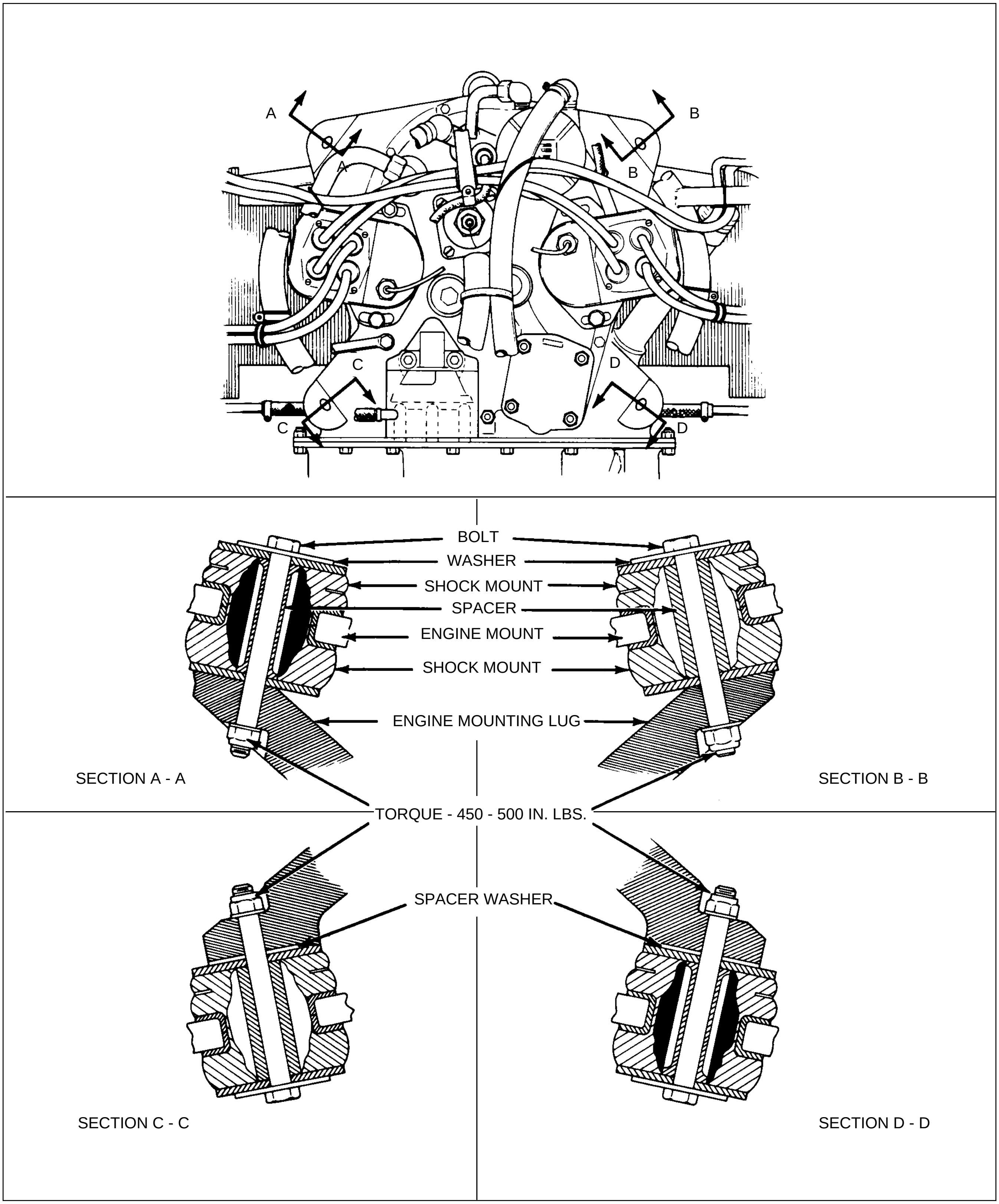


Figure 8-4 Engine Shock Mount Installation

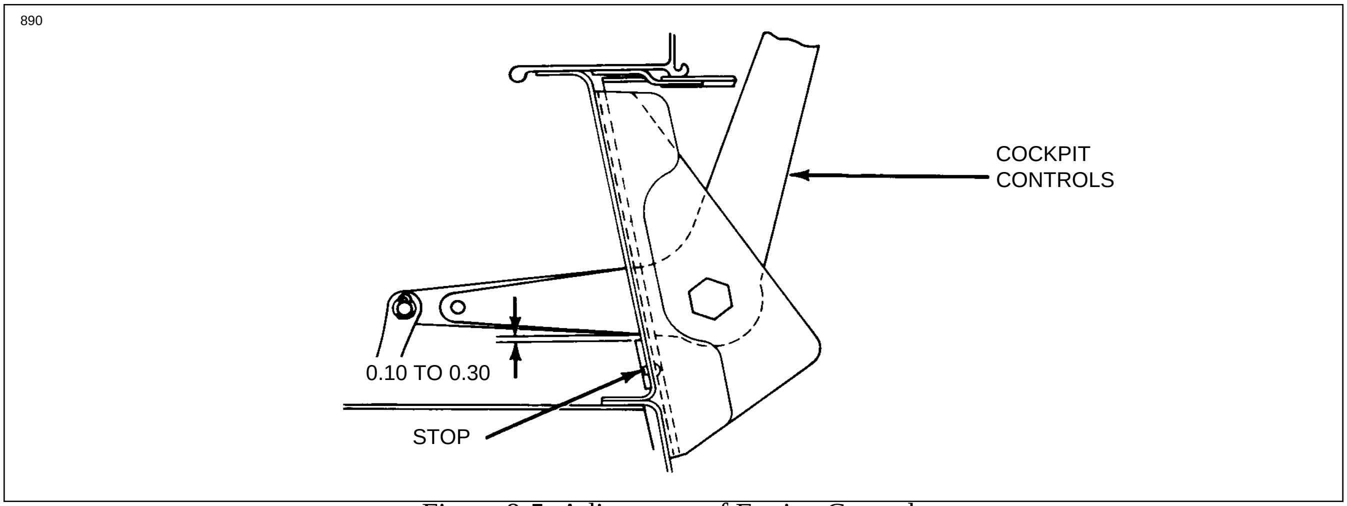


Figure 8-5. Adjustment of Engine Controls

g. Connect the oil pressure line, tachometer drive cable, oil temperature lead and the engine vent tube to the aft end of the engine.

h. Connect the vacuum pump line at the pump.

i. Secure the ignition harness, hoses and lines at the aft end of the engine using koroseal lacing.

j. Connect both lines to the oil cooler. Use a back up wrench on the cooler fitting.

k. Connect the mechanical fuel pump supply line at the pump.

1. Connect the magneto "P" leads to the magnetos.

m. Connect the throttle, mixture and carburetor heat cables at the engine components.

n. Connect the cabin heat and defroster tubes to the muffler.

o. Connect the starter positive and ground leads at the starter and secure with attachment clamps.

p. Be certain that the magneto switches are OFF and install the propeller per paragraph 8-7.

q. Install the proper grade and amount of engine oil. Refer to Lubrication Chart. Section 11.

r. Connect the battery ground wire at the battery.

s. Open the throttle and fuel valve completely. Turn on the electric fuel pump and check the fuel line for leaks.

t. Install the engine cowlings and remove the tail stand.

—CAUTION—

To avoid possible high speed bearing failure resulting from a lack of lubrication refer to the latest revision of Lycoming Service Instruction 1241 for instructions on pre-oiling the engine prior to an initial start after reinstalling the engine.

u. Perform an engine operational check. Refer to the engine manufacturer's appropriate operators manual.

8-13. INSTALLATION OF ENGINE SHOCK MOUNTS. (Refer to Figure 8-4.)

a. Assemble the engine shock mounts on the engine mount as shown in Figure 8-4. Note the position of each mount carefully. The upper right and lower left mounts are the same, as are the upper left and lower right.

b. Swing the engine into place, positioning the engine mounting lugs so they align with the engine mount attachment points.

c. Position the shock mount bolts through the mounting lugs and secure with nuts. Torque the nuts progressively, following a circular sequence until a torque value of 450-500 inch pounds is reached

8-14. INSTALLATION OF OIL COOLER.

a. When installing fittings in the oil coolers, care should be used to prevent excessive torque to the cooler. Where a rectangular fitting boss is provided, a backup wrench should be used employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss, care should be taken to prevent excessive torque on the fitting.

b. Apply LUBON 404 sealing compound to all male pipe thread fittings. Do not allow sealant to enter the system.

c. When attaching hoses to the oil cooler a backup wrench should be used.

d. After installation, inspect the cooler for distorted end cup.

e. Oil line routing should provide .5O in. minimum clearance between oil line and engine, engine mount or cowling. Except for oil outlet line where it crosses over the engine mount. This area should have a clearance of .75 in. minimum.

f. If a fitting (3/8 inch) cannot be positioned correctly by torquing it from 9 to I5 ft.-lbs., it should be replaced with another.

g. After tightening the fitting, apply an alignment mark to the fitting and oil cooler boss.

h. Run up engine. After run-up, check for oil leaks.

8-15. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. (Refer to Figure 8-5.) 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 rod end of the throttle control cable from the control arm. Loosen the jam nut that secures the rod end.

2. Adjust the linkage by rotating the rod 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 rod end to the control arm and safety.

b. The mixture may be adjusted as follows:

1. At the carburetor, disconnect the rod end of the mixture control cable from the control arm. Loosen the jam nut that secures the rod end.

2. Adjust the linkage by rotating the rod end of 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 rod 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 stop.

8-16. INDUCTION AIR FILTER. Refer to Section 11, Paragraphs 2-47, 2-48 and 2-49 for information regarding removal. service instructions and installation of induction air filter.

8-17. CARBURETOR.

8-18. CARBURETOR MAINTENANCE. In general, little attention is required between carburetor overhauls. However, it is recommended that the following items be checked during recommended inspection periods of the engine.

a. Check tightness and safety of all nuts and screws which fasten the carburetor to the engine.

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1. IDLE MIXTURE ADJUSTMENT
2. MIXTURE CONTROL ARM
3. BOWL DRAIN
4. FUEL INLET SCREEN
5. THROTTLE ARM
6. IDLE ADJUSTMENT
7. ARM SET SCREW (TORQUE 20-25 IN LBS AND SAFETY)

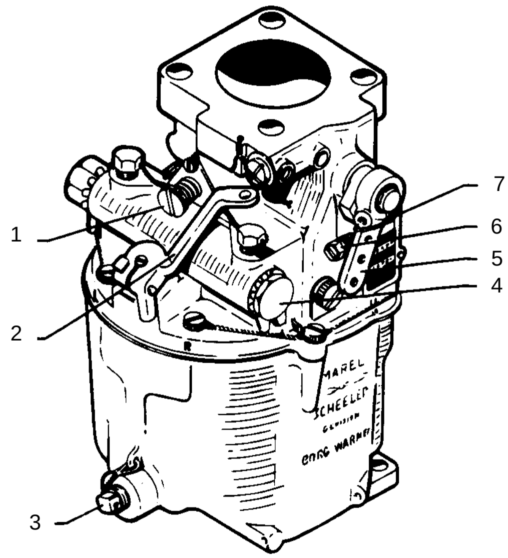

Figure 8-6. Carburetor

b. Check all fuel lines for tightness and evidence of leakage.

c. Check throttle and mixture control rods and levers for travel, tightness and safety.

d. Clean the fuel inlet screen. (Refer to Figure 8-6.)

e. Remove the plug at the aft position of the carburetor and drain any accumulation of foreign matter.

f. Check carburetor air box for wear and full travel of heat door.

g. Check the adjustment of the idle mixture and idle speed. (Refer to Paragraphs 8-18 and 8-19.)

8-19. ADJUSTMENT OF IDLE MIXTURE. (Refer to Figure 8-6.)

a. After performing the standard engine starting procedure, operate the engine for at least two minutes between 800 to 1200 RPM to insure proper engine warmup.

—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) 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 minimum speed for idle mixture settings.

8-20. ADJUSTMENT OF IDLE SPEED.

a. Pull back the cockpit throttle control lever until it is completely aft and in the closed position. Observe the engine speed on the tachometer.

b. Adjust the idle speed adjustment screw to obtain from 55O to 650 RPM. Rotate the screw clockwise to increase the speed of the engine: counterclockwise to decrease the 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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8-21. MAGNETOS (4000 and 4200 series)

—NOTE—

The 4000 series magnetos are non-serviceable. Refer to the latest revision of Lycoming Service Letters Nos. L173 and L177.

—CAUTION—

Ascertain that the primary circuit of the engine is grounded before working on the engine.

8-22. REMOVAL OF MAGNETOS. (4000 and 4200 series) Before removing the magnetos, make sure the magneto switches are OFF.

a. Remove the harness assembly with the spark plug wire housing from the magneto.

—WARNING—

The magneto is not internally grounded, when the ground lead is disconnected, the magneto is hot. Removing the harness assembly 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 remove the magnetos from the engine.

8-23. INSPECTION OF MAGNETOS. (4000 and 4200 series) The 4000 series magnetos require very little in the way of inspection. These units are sealed and should not be tampered with, as this would void their warranty. (Refer to the latest revision of Lycoming Service Letter No. L 177 and Slick pro rata instruction form No. 1001). At the time of engine inspection or when a magneto has been removed from the engine. The 4200 series magnetos can be inspected in the field, the following checks may be performed:

a. The magneto to engine timing for the 4000 series should be checked every 200 hour interval and the 4200 series magneto to engine timing should be checked every 100 hours or at annual inspection, whichever comes first.

b. Inspect the distributor block for cracks and burned areas.

c. Check the contact assemblies on 4200 series for burning and wear every 500 hours. The following steps may be performed:

1. Inspect the points for discoloring. If points have a white frosty surface around edges, the points are functioning properly. Apply M-1827 cam grease sparingly to each cam lobe before reassembly.

2. Inspect points for discoloring and pitting. If these conditions are evident, replace both condenser and points.

—NOTE—

Point opening for these magnetos is critical. When setting the breaker points, be sure to stay within the specified .008-.010 inch tolerance. The most efficient spark is obtained at this point setting.

3. Recheck the gap after retainer screws have been tightened. (Refer to Paragraph 8-27 for reassembly.)

d. Inspect the carbon brush in the distributor gear (4200 series magnetos) for wear, cracks and chipping every 500 hours. The following steps may be performed:

1. Measure carbon brush length from distributor gear shaft to end of brush. Minimum length is 11/32 inch. If the above conditions are evident the distributor gear must be replaced.

2. Check bearing in distributor block and bearing bar for lubrication. If required, put a drop of SAE #20 non-detergent oil in each oilite.

e. Inspect the high tension lead from the coil (4200 series magnetos) to make sure it makes contact with the carbon brush on distributor gear shaft.

f. Visually inspect the impulse coupling shell and hub (4200 series magnetos) for cracks, loose rivets or rounded pawls every 500 hours. If pawls are rounded they may slip when latching up on the pin. If any of these conditions are evident, the coupling should be replaced.

g. Look for frayed insulation or broken wire strands in the leads at the back of the magnetos. Ascertain that terminals are secure and properly positioned.

h. Check the lead conduits. A few broken strands are acceptable, but if the insulation is deteriorated, replace it. The special high temperature coating, used on the harness 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.

i. Check the springs for breaks, corrosion, or deformation. If possible, check continuity from block with tester or light.

j. Check insulators for cracks, breaks or evidence of "old age". Be sure they are clean.

k. Check ventilator plugs. Ventilator has drilled holes and should be in the lowest hole in the magneto to serve as a drain for excess water or oil.

8-24. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine.) (4000 series magnetos) The magnetos can be installed and timed to the engine by the following procedure:

a Remove the top spark plug from the number one cylinder. Place the thumb of one hand over the spark plug hole and rotate the crankshaft in the 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 the number 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 number one cylinder. Rotate the crankshaft in its normal direction of rotation until the 25 degree mark on the starter ring gear and hole in the starter housing align.

—NOTE—

Be sure to "Spark Out" the magnetos before installing them on the engine. Use the following method:

1. Remove the bottom vent plug from the magneto.
2. Hold the lead wire spring 0.062 to 0.125 of an inch away from the magneto frame.
3. Turn the impulse coupling or gear one "click" at a time until a strong spark jumps between the spring and magneto frame.

—NOTE—

Hold the magneto firmly so the coupling will not move beyond the point where it trips and spark occurs.

4. Reverse the rotation approximately 25 degrees until the timing pin hole appears in the center of the vent plug hole.

5. Hold the rotor by inserting the timing pin, and line the timing pin with the center of the vent plug holes and install the magneto and gasket on the mounting pad of the accessory housing and remove the timing pin. Tighten the nuts only finger tight.

—CAUTION—

The impulse coupling magneto can only be used on the left side of the engine (as viewed from the rear).

b. Fasten the ground wire of an 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 left magneto. Turn the engine crankshaft several degrees from BTC in direction opposite to that of normal rotation.

c. Turn on the switch of the timing light. Turn the crankshaft very slowly in the direction of normal rotation until the timing mark on the front face of the starter ring gear aligns with the drilled hole in the starter housing, at which point the light should come 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 before top dead center. Tighten the two mounting nuts and replace the bottom vent plug.

—NOTE—

AC timing lights operate in the reverse manner as described, the light goes out when the breaker points open.

d. For the model 4050 magneto (without impulse coupling) "Spark-Out" the magneto by the following method:

1. Install the gear and hold the number one lead wire 0.062 of an inch away from the magneto frame.

2. Turn the gear counterclockwise (left hand) vigorously through the flux lines until a strong spark occurs at the number one lead.

3. Reverse the rotation until the timing pin hole appears. Insert the timing pin in the hole and install the magneto and gasket on the right magneto mounting pad of the accessory housing. Remove the timing pin and tighten the nuts finger tight only, proceed with the timing.

e. Connect the other positive wire of the timing light to a suitable terminal connection of the right magneto and time the magneto in the same manner as described for the left magneto.

f. After both magnetos have been timed, leave the timing light wires connected and recheck the magneto timing as previously described to make sure both magnetos are set to fire together. If timing is correct, both timing lights will come on simultaneously when the 25 degree mark on the ring gear aligns with the drilled hole in the starter housing. If the points open early, loosen the mounting nuts and rotate the magneto counterclockwise. Secure the nuts and remove the timing lights.

8-25. OVERHAUL INSTRUCTIONS FOR MAGNETOS. (4200 series) The 4200 series magnetos must be completely overhauled at every engine overhaul or when conditions indicate.

8-26. DISASSEMBLY OF MAGNETOS. (4200 series) (Refer to Figure 8-8.) Magneto disassembly is accomplished in the following manner:

—NOTE—

Although not required, use of the slick T-100 assembly and timing kit is strongly recommended. (Refer to Figure 8-7.) The tools contained in this kit will greatly facilitate magneto disassembly / assembly and help prevent damage to parts.

a. Remove cotter pin, nut, washer and gear. Grasp shell of impulse coupling assembly and gently pull the assembly outward to clear the unlatching ears.

b. Allow the shell to turn, cautiously releasing spring tension, and withdraw the shell and coil spring. Using slick puller T-106 engaged in the grooves on the impulse hub, pull the assembly off shaft taper and discard. Remove key.

c. Remove four screws, and four washers. Separate the distributor housing sufficiently to disconnect the condenser lead at the contact breaker assembly.

d. Remove two screws and two washers. Withdraw and discard bearing bar, distributor gear and distributor block from distributor housing.

e. Using two flat blade screwdrivers or equivalent, placed under the rotor gear, gently pry the gear off the rotor shaft and discard.

f. Remove and discard the breaker assembly by removing screw and washer. Remove cam by prying straight up with a screwdriver blade and discard.

g. Remove two screws, two washers and two bearing plate clamps. Press against the drive end of the rotor shaft and withdraw the rotor, bearing plate, loading spring and washer from the end frame. Place the rotating magnet in a suitable keeper and press the ball bearings off the journals. Discard the ball bearings and washer.

h. Using coil wedge extractor T- 122, remove coil wedges and lift out and discard coil. (Refer to Figure 8-9.) Remove air vents. Remove and discard oil seal.

—NOTE—

The following parts MUST BE REPLACED at overhaul on 4200 series magnetos. Nine thick washers, one condenser, one distributor block, one bearing bar, two ball bearings, one distributor gear, one coil, one retaining washer, one loading spring, one impulse coupling, oil seal, one contact point kit and one rotor gear. Refer to Slick Part List for part No's.

8-27. CLEANlNG AND INSPECTION OF MAGNETOS. (4200 series)

a. Inspect internal and external threads of all threaded hardware. Damaged or worn parts must be replaced.

b. Inspect the bearing plate for excessive wear and damage. (Maximum bearing bore l.D. to be 1.5752 inch.)

c. Check the rotor for damaged or worn keyway. Check the rotor bearing surfaces for wear. (Minimum O.D. to be 0.6690 inch.)

d. Inspect the magneto frame and distributor housing for cracks or other damage. Check the bearing bore in the drive end frame for wear. (Maximum I.D. to be 1.5741 inch.)

e. Clean all parts thoroughly with a grease solvent before reassembly.

—NOTE—

No internal repairs are permissible. Replace all items showing wear or damage, or that are not within the tolerances specified.

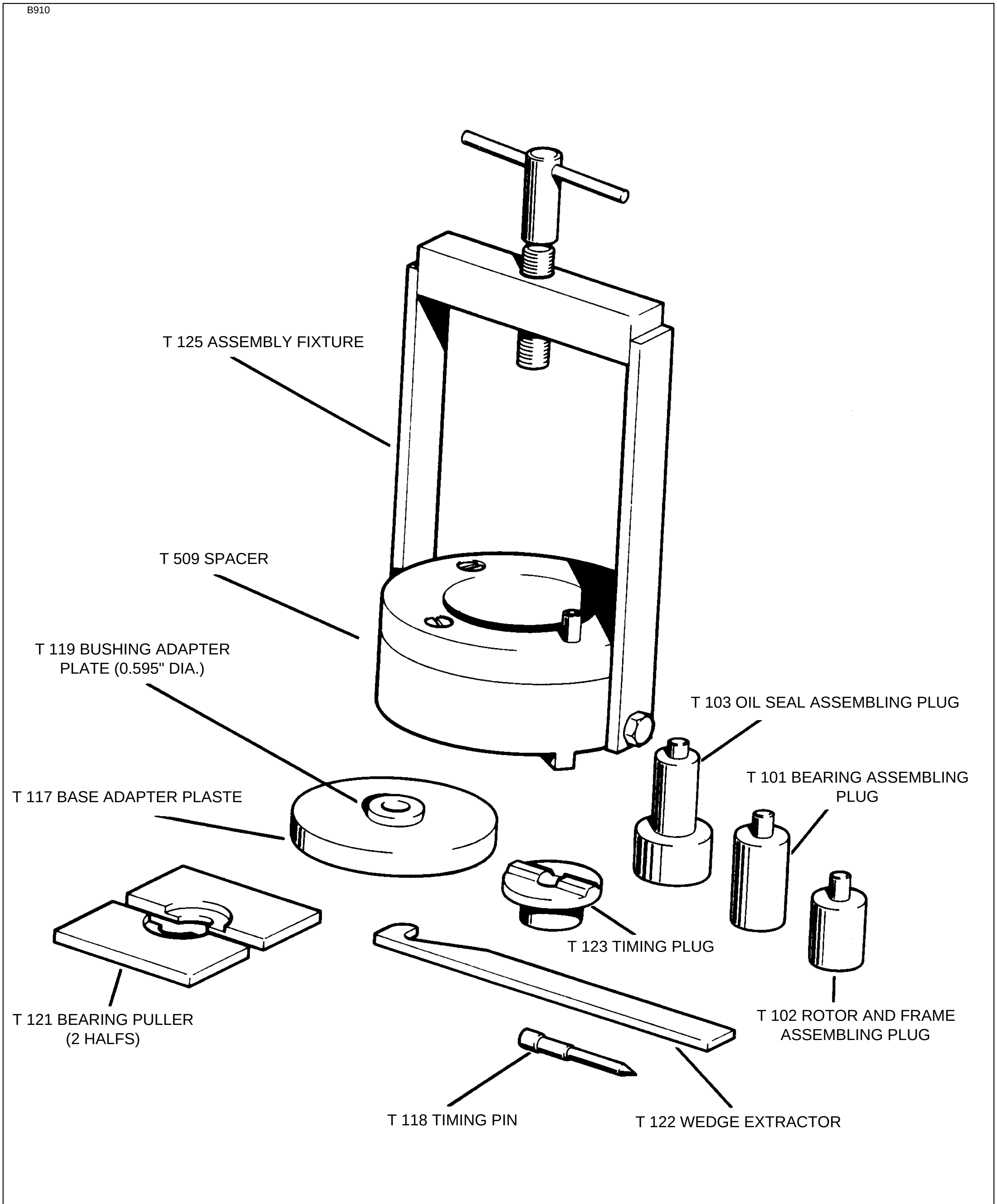

Figure 8-7 T-1000 Assembly and Timing Tool Kit

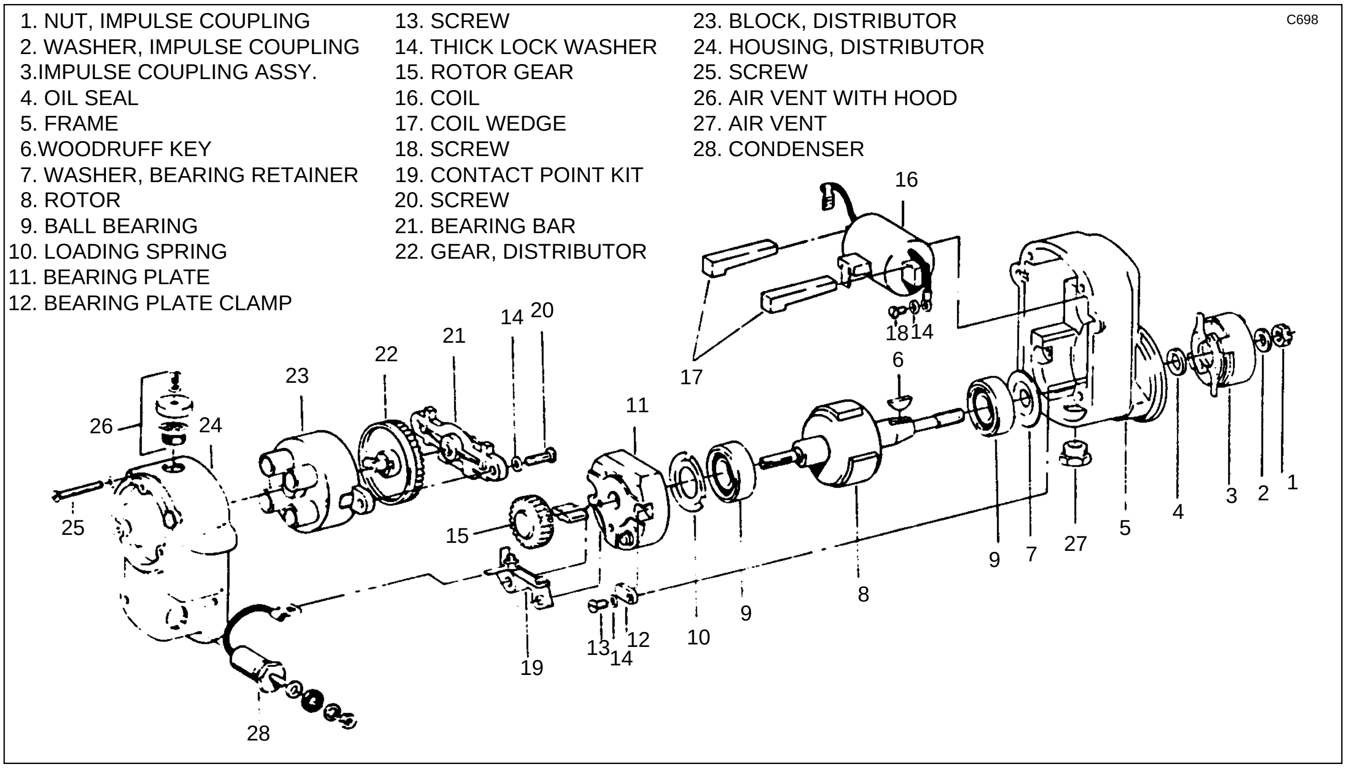

Figure 8-8 Exploded View of Magneto (4200 Series)

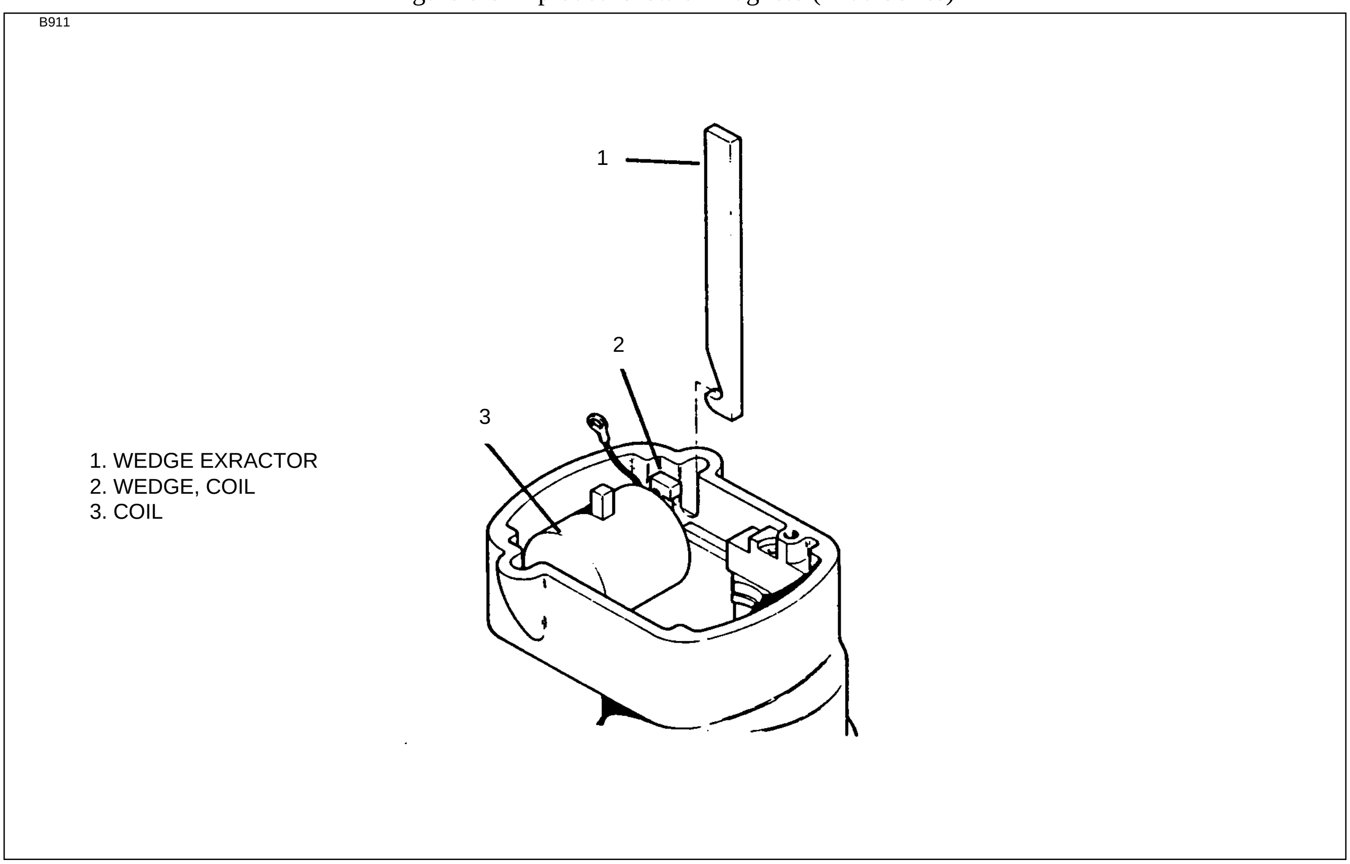

Figure 8-9 Removing Coil Wedges

8-28. REASSEMBLY OF MAGNETOS. (4200 series) (Refer to Figures 8-10 thru 8-13.)

—NOTE—

Before using the slick T-100 assembly and timing tool, it will be necessary to align the index plate (bottom of tool) to number 67 to time the magneto. (Refer to Figure 8-10.)

a. Loosen the screws and align number 67 with the mark on the base of tool.

b. Tighten screws and check alignment. Reverse the tool.

c. Place the frame on the T-100 assembly and timing tool. Insert the coil into the frame, making sure that it is back against the stops. Insert the coil wedges between the bridge and the frame.

d. Drive the two wedges tight, using a hammer and flat punch. Attach the white ground wire of the coil to the frame, using screw and lockwasher. Torque to 20 in. Ibs.

e. Check the vertical portion of the high tension lead of the coil, making sure it protrudes 1/16" beyond the face of the frame. This provides spring pressure against the thrust bearing in the distributor block.

f. Insert the baseplate (T-117) and the adapter plate bushing (T-ll9) into the base of the T-lOO assembly and timing tool. Assemble both ball bearings on the rotor shaft, making sure the grease shield of each bearing is toward the magnet. Place the rotor shaft into the base plate, threaded end down. (See Figure 8-11 .) Using bearing assembly plug (T-101), turn the T-screw down until both bearings are seated tightly against the shoulder on the rotor shaft. Remove the base plate (T-117) and adapter plate bushing (T-119).

g. Assemble the bearing retaining washer into the frame, raised side against the frame. Place the loading spring into the bearing plate flat side down.

h. Assemble by hand, the rotor shaft with bearings (cam slot end) into the bearing plate making sure it is square on the bearing.

i. Using rotor and frame assembling plug (T-102), turn the T-screw down until the plate bottoms in the frame. (Refer to Figure 8-11.) Install bearing plate clamp on bearing plate and install screw and lockwasher. Torque to 20-24 in. Ibs.

j. Reverse the magneto on the T-100 assembly and timing tool so the flange of the magneto is facing up. (Refer to Figure 8-12.)

k. Lubricate the oil seal with light grease and assemble the seal over the end of the rotor shaft. Using oil seal assembling plug (T-103), turn the T-screw to press the seal flush with the frame of the magneto.

l. Assemble the Woodruff key into the key slot of the rotor shaft.

m. Install the impulse coupling assembly on the shaft, and tighten the nut. Torque to 120 to 300 in. Ibs., so the coupling is properly seated on the taper shaft and install cotter pin. Check to see if the coupling is free by snapping it through 3 or 4 times.

—NOTE—

It will be necessary to wait until the magneto is timed before installing the gear. Then install cotter pin.

n. Assemble the contact point kit on the bearing plate using screws from the kit. Insert the cam in the cam slot with a screwdriver blade, and tap with a light hammer. Drive the cam all the way to the bottom of the cam slot. Apply M-1827 cam grease sparingly to each lobe of cam before reassembly.

o. Assemble the rotor gear onto the rotor, making sure the key slot of the gear fits into the cam slot of the rotor. Tap with a light hammer until the gear bottoms on the shaft.

p. To time the magneto internally, place the magneto on the T-100 assembly and timing tool base, making sure the coupling lugs are in the slots of the index plate. Swing the frame counterclockwise against the pin which will line up the rotor and cam for "E" gap position.

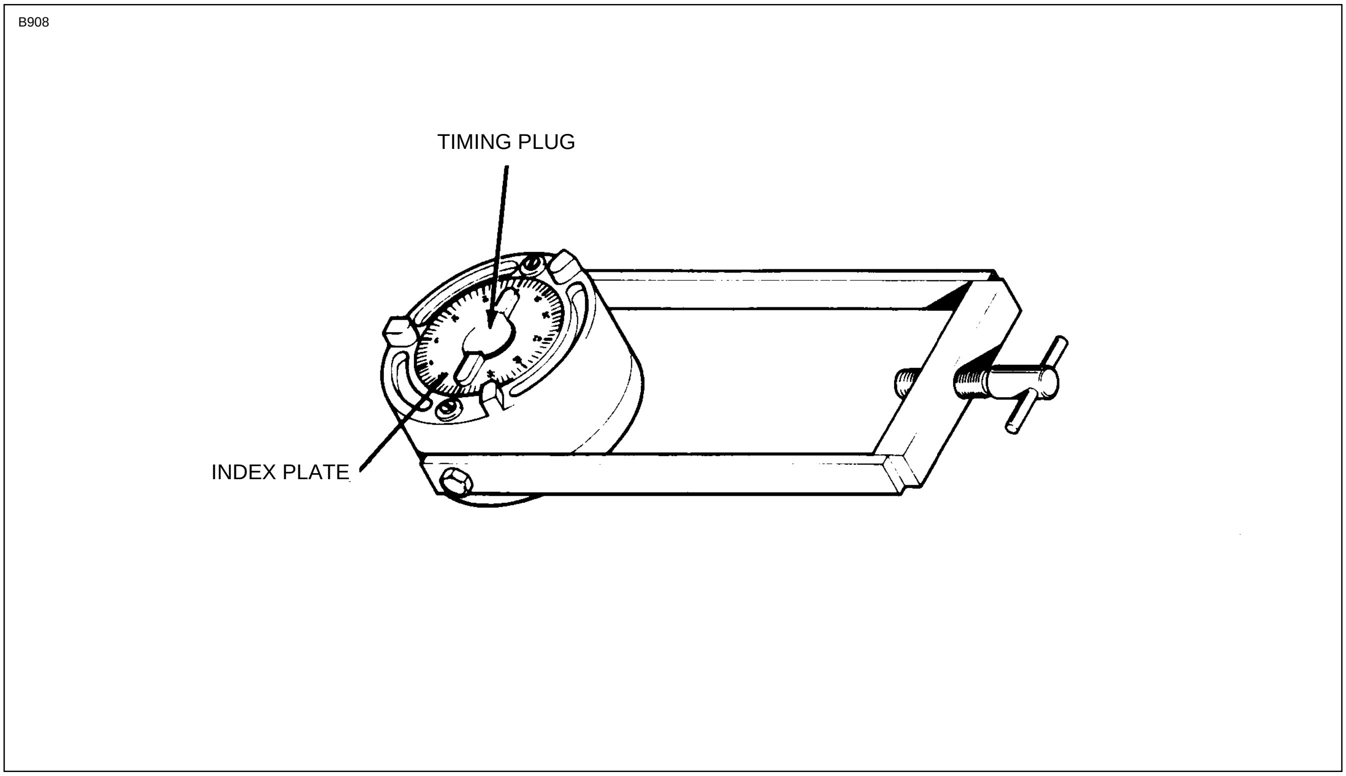

Figure 8-10 Index Plate and Timing Plug

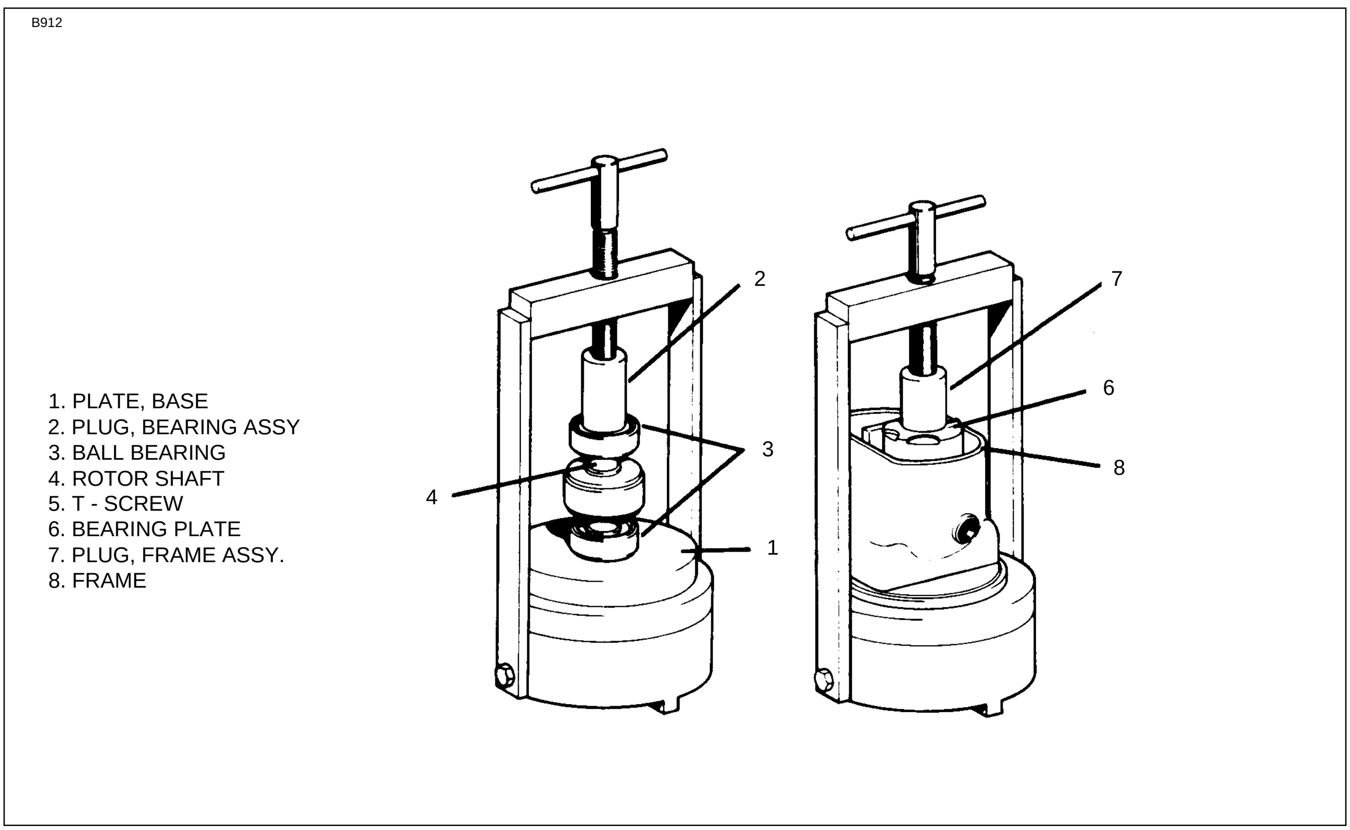

Figure 8-11 Installation of Bearings and Bearing Plate

q. Attach either the red or green wire of the timing light to the bronze point terminal and the black wire to the frame of the magneto. (Refer to Figure 8-13.) With a screwdriver, adjust the points so the timing light indicates point openings and the points open. Secure the points by tightening the screws. This will provide a point gap of .008 - .010 in. Attach the coil wire to the vertical bronze male terminal of the point assembly.

r. Assemble the condenser into the distributor housing, being careful to rotate the condenser wire the same rotation as the condenser is tightened in the housing. Torque to 110 in. Ibs. Assemble the distributor gear in the distributor block, with the L and R facing you. Assemble the bearing bar to the distributor block so that the open side of the dust collector is toward the air vent and hood. Assemble the distributor block in the distributor housing, with the cut-away toward the condenser. Use screws and lockwashers. Torque to 18-20 in. Ibs.

s. Connect the condenser wire to the slip terminal on the point assembly . Align the L or R (depending on magneto rotation) on the rotor gear so it points toward the high tension lead of the coil.

t. Align the L or R on the distributor gear with the L or R on the distributor block and insert the timing pin (T-l18) through the block into the gear.

u. Fit the distributor housing to the frame making sure the bosses of the distributor housing are seated in the slots of the frame. Start by fitting the top boss (next to the vent) and assemble the distributor housing into place.

—CAUTION—

Do not bend the high tension lead of the coil.

v. Secure the distributor housing to the frame with four screws and four lockwashers. Torque to 24 in. Ibs. and remove timing pin.

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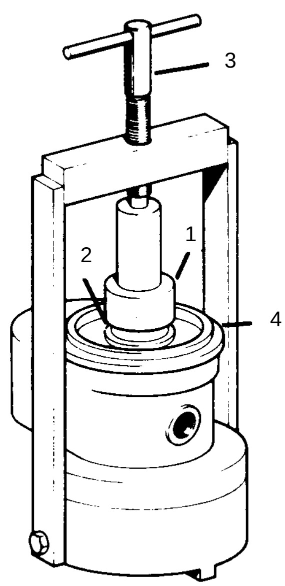

1. PLUG,OIL SEAL ASSY.
2. OIL SEAL
3. T - SCREW
4. FLANGE

Figure 8-12. Position of magneto on T-100 and Oil Seal Installation

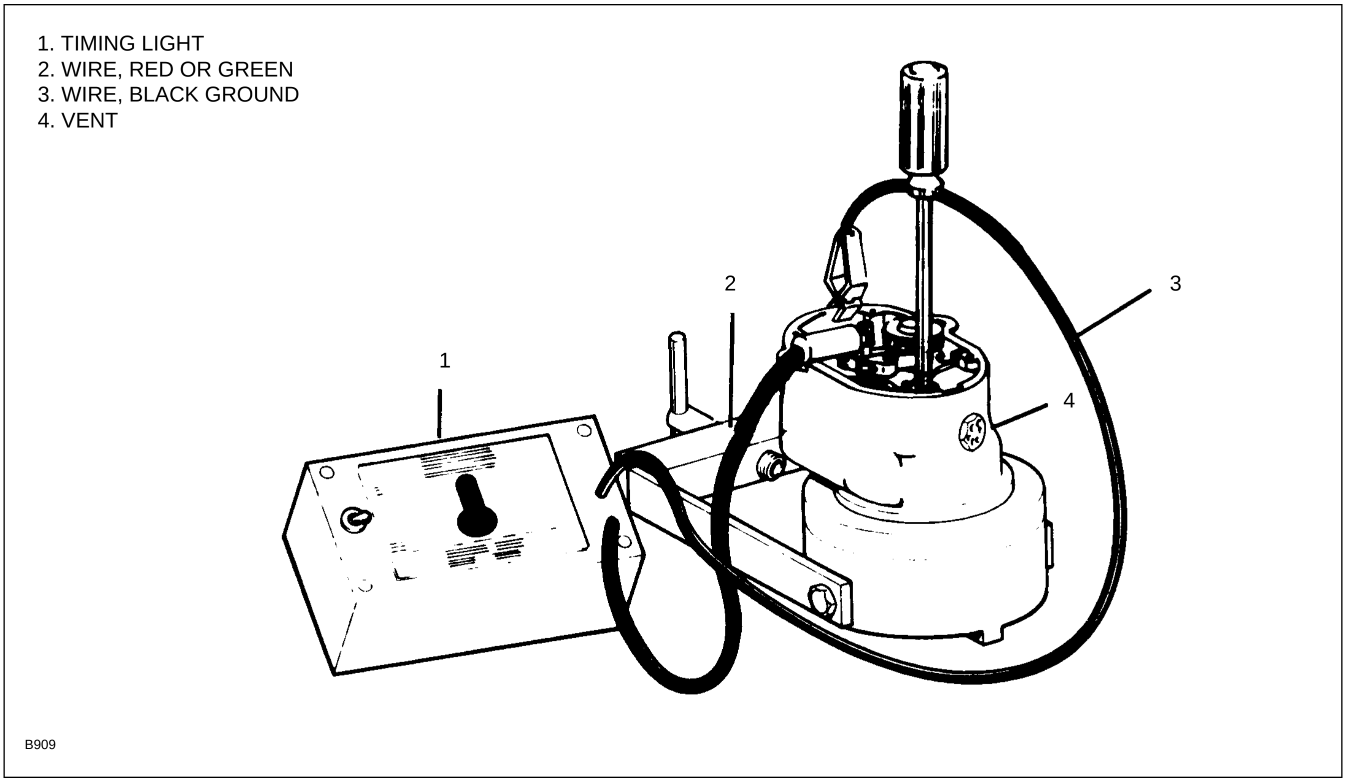

Figure 8-13. Timing Magneto Internally and Assembly

8-29. TIMING PROCEDURE. (Internal Timing) (4200 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. To find number one tower, the following instructions should be performed:

—NOTE—

No need to spark out these magnetos.

a. Insert the T-118 timing pin (refer to Figure 8-7) in the L or R hole in the distributor block (depending on rotation of the magneto).

b. Turn rotor opposite the rotation of the magneto until the pin engages the gear.

c. If the pin is binding and will not go in the hole in the gear, you have hit the pointer on the gear. Pull the pin out, enough to continue opposite rotation until the pointer has passed re-insert pin.

d. When the pin sticks through the hole in the gear about 1/4 inch, you are now ready to fire number one cylinder.

e. After the magneto is installed on the engine, remove the timing pin. The magneto is now ready to be timed to the engine.

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8-30. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine) (4200 series magnetos.)

The magnetos can be installed and timed to the engine by the following procedure:

—WARNING—

Be sure switch is in "OFF" position and the "P" lead is grounded.

a. Remove the top spark plug from the number one cylinder. Place a thumb over the spark plug hole and turn the engine crankshaft in the normal direction of rotation until the compression stroke is reached. The compression stroke is indicated by positive pressure inside the cylinder tending to lift the thumb off the spark plug hole. In this position both valves of the number 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 number one cylinder. Rotate the crankshaft in its normal direction of rotation until the 25 degree mark on the starter ring gear and hole in the starter housing align.

b. Insert the T-l18 timing pin (refer to Figure 8-7) in L or R hole in the distributor block. Turn rotor opposite the rotation of magneto until the pin engages the gear and install magneto and gasket on the mounting pad of the accessory housing and remove the timing pin. Tighten the bolts finger tight.

c. Connect a standard timing light between engine ground and the left magneto condenser-terminal. Switch must be"ON".

d. Rotate the complete magneto opposite normal rotation of the magneto on the engine mounting until the timing light indicates the contact breaker points are just opening. Secure the magneto in this position. Turn switch "OFF".

e. Turn on the switch of the timing light. Turn the crankshaft very slowly in the direction of normal rotation until the timing mark on the front face of the starter ring gear aligns with the drilled hole in the starter housing, at which point the light should come 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 before top dead center. Tighten the two mounting bolts.

f. Connect the other positive wire of the timing light to the right magneto condenser terminal and time the magneto in the same manner as described for the left magneto.

g. After both magnetos have been timed, leave the timing light wires connected and recheck the magneto timing as previously described to make sure both magnetos are set to fire together. If timing is correct, both timing lights will come on simultaneously when the 25 degree mark on the ring gear aligns with the drilled hole in the starter housing. If the points open early, loosen the mounting bolts and rotate the magneto counterclockwise. Secure the bolts and remove the timing lights.

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8-31. HARNESS ASSEMBLY.

8-32. 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 damage 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 to 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.

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8-33 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 so as 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.

18-34. DISASSEMBLY OF HARNESS.

a. To remove spring, Slick M-1455, from a damaged lead, turn the spring counterclockwise while pulling gently. This will remove the spring and the M-1498 Electrode Screw from the end of the coiled conductor.

b. To separate the spring and the screw, hold the electrode screw with a pair of pliers and turn the spring clockwise until it is through the threaded portion.

c. Remove the insulator sleeve from the end of the wire.

d. To remove a lead from the M-l 569 Plug Wire Housing, use diagonals or cutting pliers and cut the lead off close to the housing. A drift or punch can be used to tap the ferrule loose from the housing.

—NOTE —

Do not reuse the M-1458 Drive Ferrule.

—NOTE—

Further service on the Slick harness will require the use of Slick M-1495 Service Tool Kit, obtained from:

SLICK ELECTRO, INC.
530 Blackhawk Park Avenue
Rockford, Illinois 61101

8-35. HARNESS ASSEMBLY INSTRUCTIONS.

a. Cut a piece of harness wire to the length required. Do not stretch the wire when measuring it.

b. On the magneto end, make a final mark 0.75 inch for slick magnetos or .562 for Bendix magnetos from the end of the wire. A 0.937 inch mark should be made from the spark plug end of the wire.

c. Flare out shielding, then without allowing any of the shielding to fold under, insert Slick M-1743 Stripping Tool under the braided shielding. Refer to Figure 8-14.

d. Make sure.the stripping tool is inserted past the cutting mark, then cut the shielding with a sharp knife using a rolling motion and remove the shielding and stripping tool. Take care not to cut the silicone insulation. Refer to Figure 8-15.

e. Cut exposed insulation 0.062 inch and .125 inch for Bendix magnetos back from end and roll the insulation clockwise to remove it. Do not pull the insulation off the wire. Trim the end of the coiled conductor to make a clear hole for inserting the stud. Refer to Figure 8-16.

f. Using M-1742 Pin Vise, insert M-1741 Drill (#72 drill). Drill out the silicone rubber from inside of coiled conductor approximately 0.375 inch deep. Refer to Figure 8-17.

g. On spark plug end of wire install M-1673 Nut followed by M-1671 Female Taper Hex Ferrule. Refer to Figure 8-18.

h. After installation of nut and ferrule, bend and rotate the silicone insulation as illustrated in Figure 8-26 to flare out the shielding so a drive ferrule can be inserted. Take care not to cut the silicone insulation with the sharp braiding while the wire is being rotated. (Refer to Figure 8-19.)

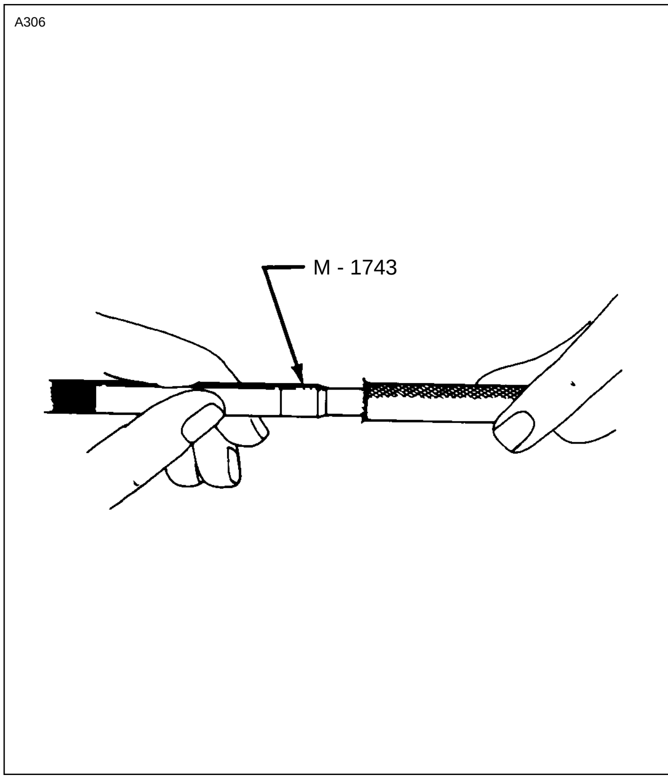

Figure 8-14 Stripping Tool

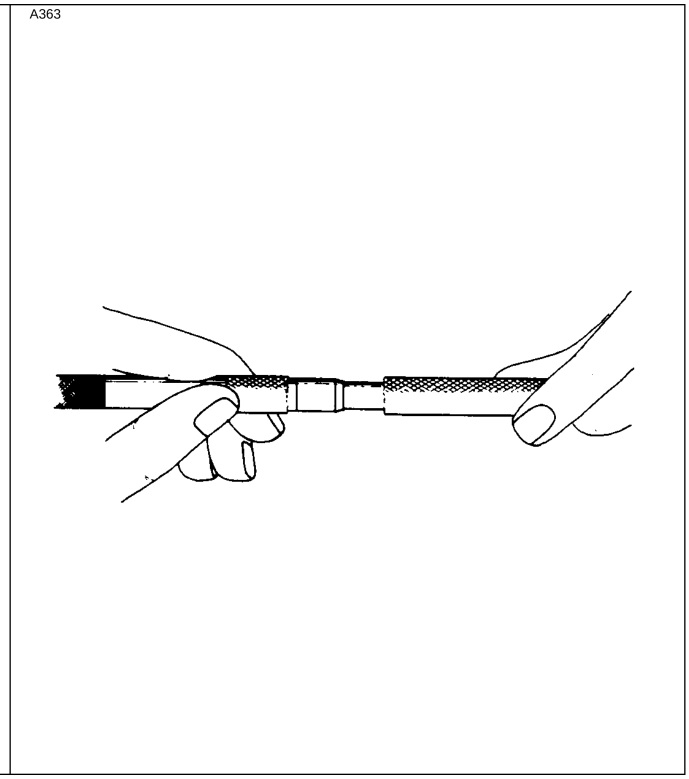

Figure 8-15 Inserting Stripping Tool

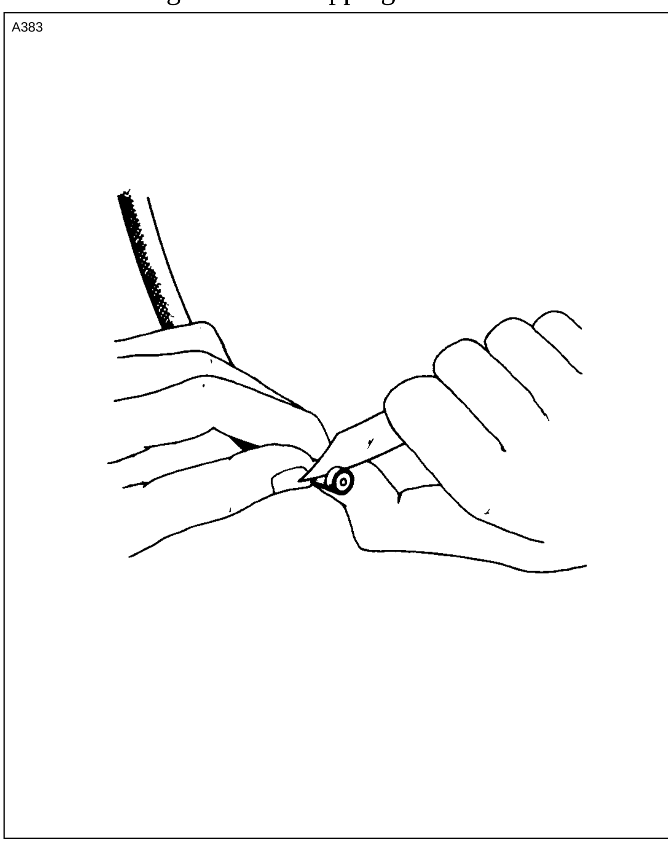

Figure 8-16 Cutting Insulation

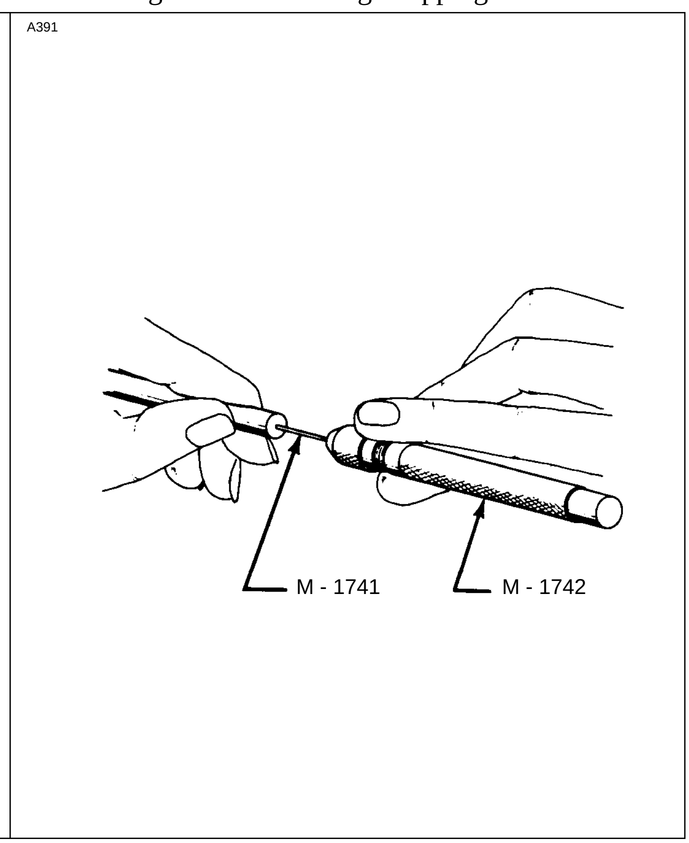

Figure 8-17 Removing Silicone Rubber from Wire

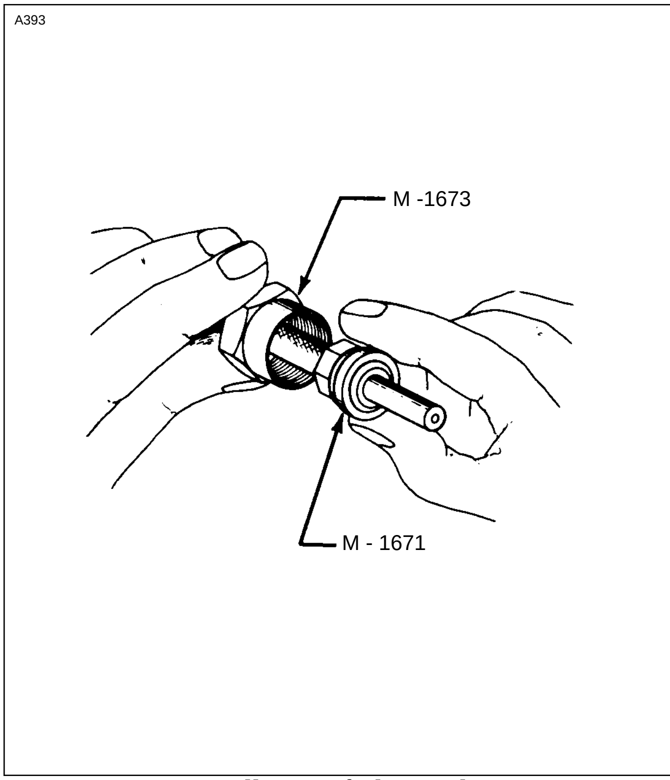

Figure 8-18 Installation of Plug Endpoint

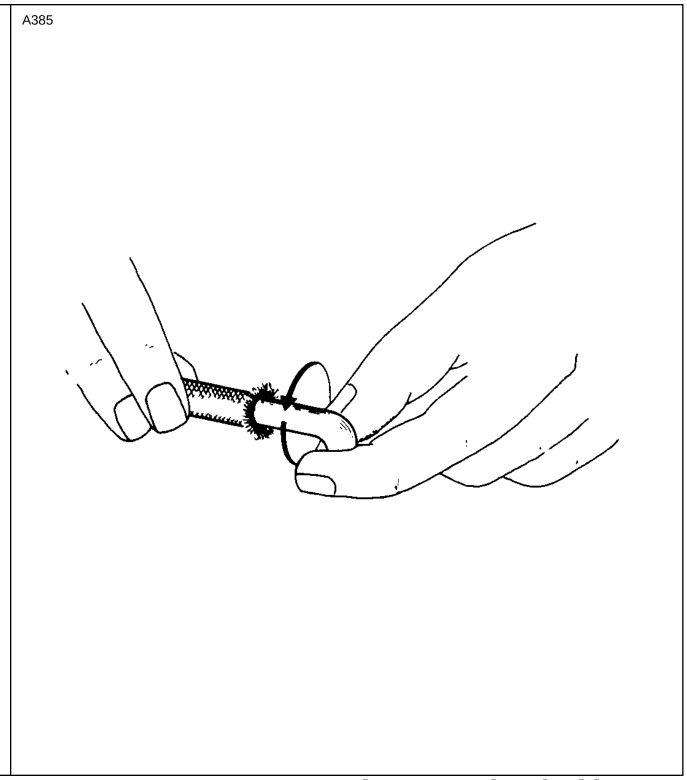

Figure 8-19 Flaring out the Shielding

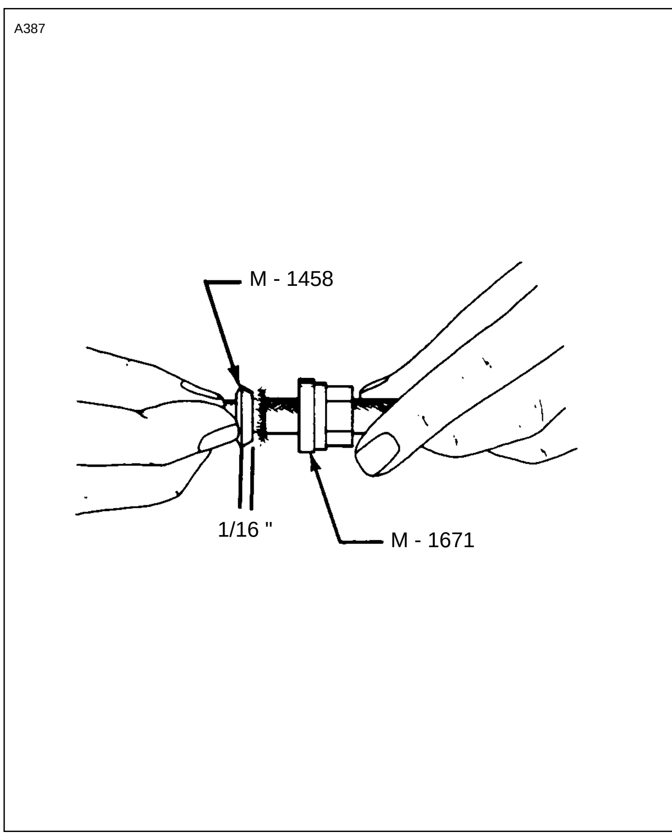

Figure 820 Installation

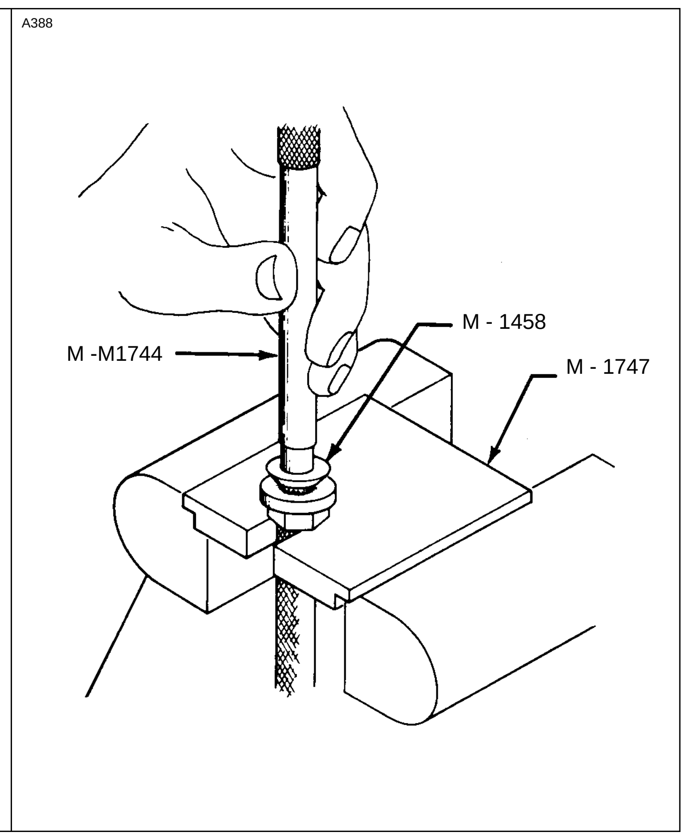

Figure 8-21 Driving Tool

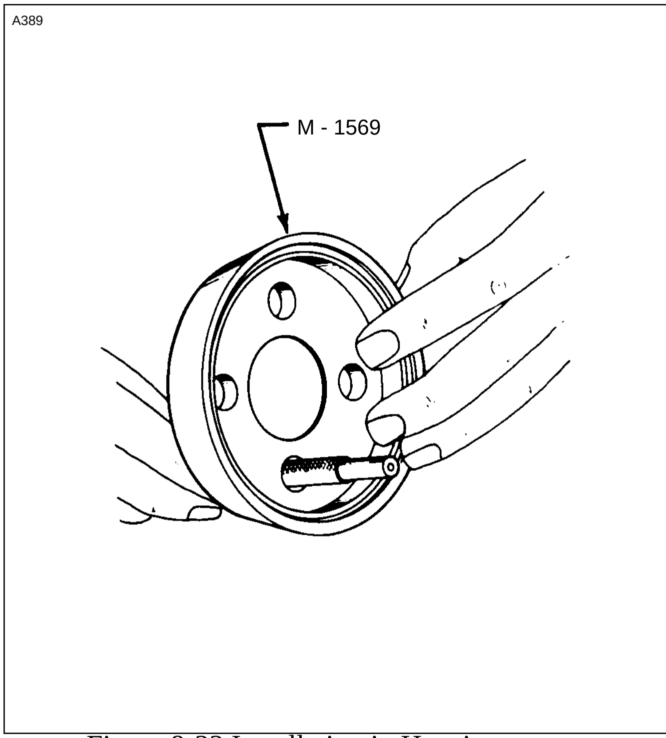

Figure 8-22 Installation in Housing

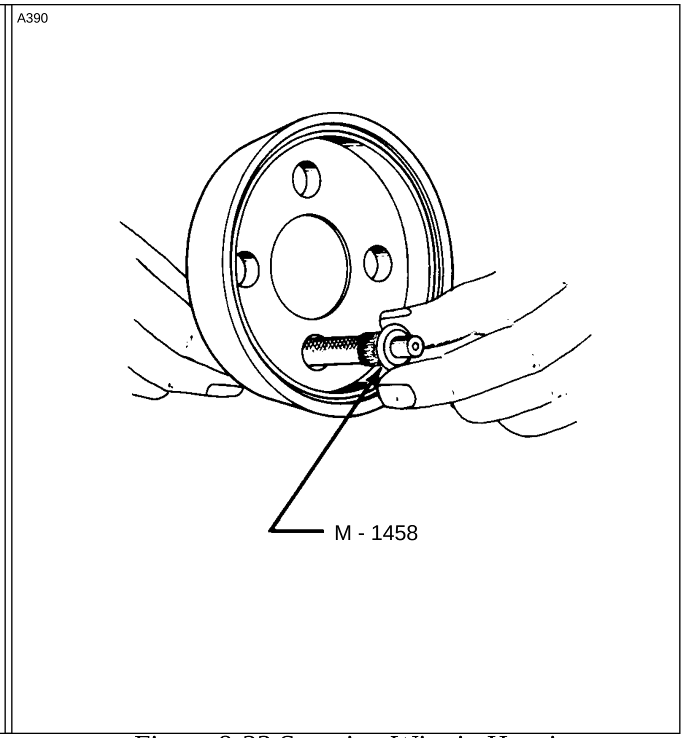

Figure 8-23 Securing Wire in Housing

i. On spark plug end of wire install M-1458 Male Tapered Drive Ferrule over silicone insulation and under shielding to within .062 inch from flange of ferrule. Make certain that shielding is away from ferrule flange then slide Ferrule M-1671 over the M-1458 Drive Ferrule until tight. Refer to Figure 8-20.

j. For spark plug end, mount M-1747 Drive Plate in a bench vise. Set the hex ferrule in the slot of the drive plate. Drive the M-1458 Drive Ferrule flush against the hex ferrule using the M-1744 Drive Tool. Refer to Figure 8-21.

k. For magneto end of wire, insert wire through appropriate hole in the M-1569 Plug Wire housing so the shielding is through the hole as shown in Figure 8-22.

1. Install an M-1458 Male Tapered Drive Ferrule over insulation and under shielding as in step "i" then drive the ferrule into the M-1569 or M-1893 Housing using the M-1744 Drive Tool, similar to step "j ". Refer to figure 8-23.

m. Clamp the threaded end of the M-1498 Electrode Screw in theM-1742 Pin Vise. lnsert the tapered pin of the electrode screw into the center of the coiled conductor by turning the pin vise counterclockwise and pushing at the same time until the screw is flush with the insulation. This is done at both ends of the wire assembly. Refer to Figure 8-24.

n. On the magneto end of the wire, place M-1738 Insulator Sleeve (brown, 0.75 inch long) over the silicone insulation. On the spark plug end of the wire, use green M-1677 Insulator Sleeve. Refer to Figure 8-25.

o. Turn M-1455 Spring clockwise on the electrode screw three full turns until the end is flush with the first large coil of the spring. This applies to both ends of the wire. Refer to Figure 8-26.

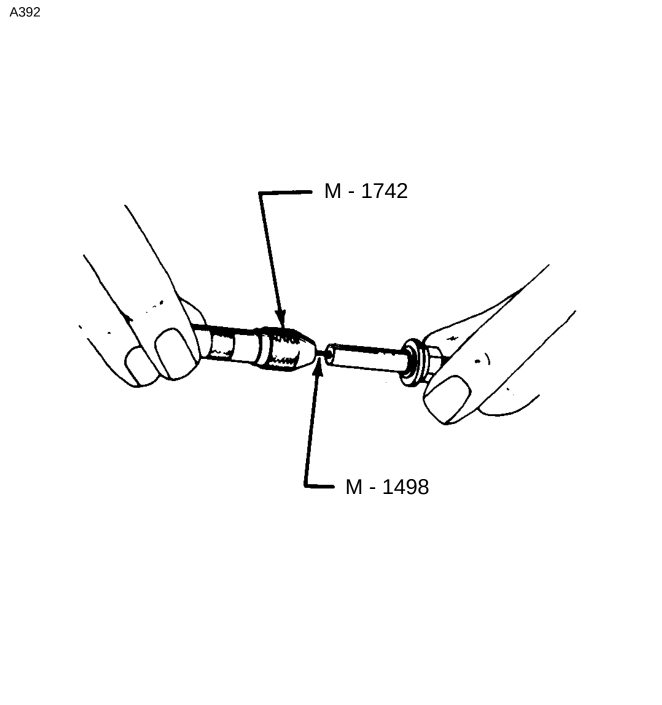

Figure 8-24 Installation of Electrical Screw

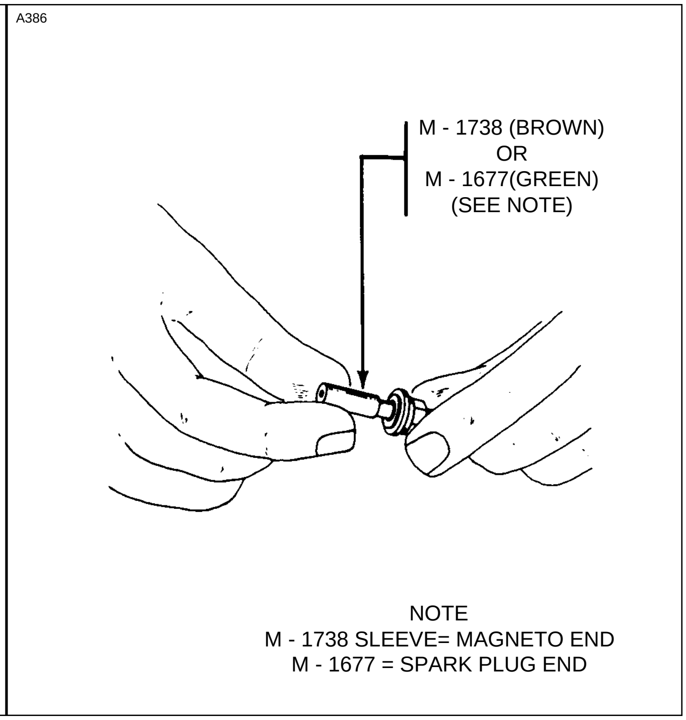

Figure 8-25 Installation of Insulator Sleeve

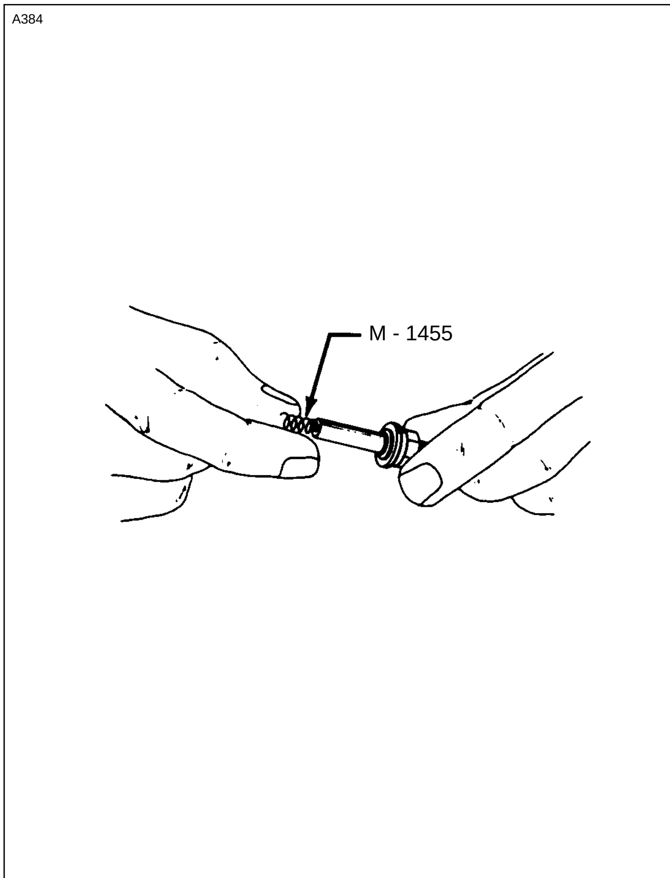

Figure 8-26 Installation of Spring

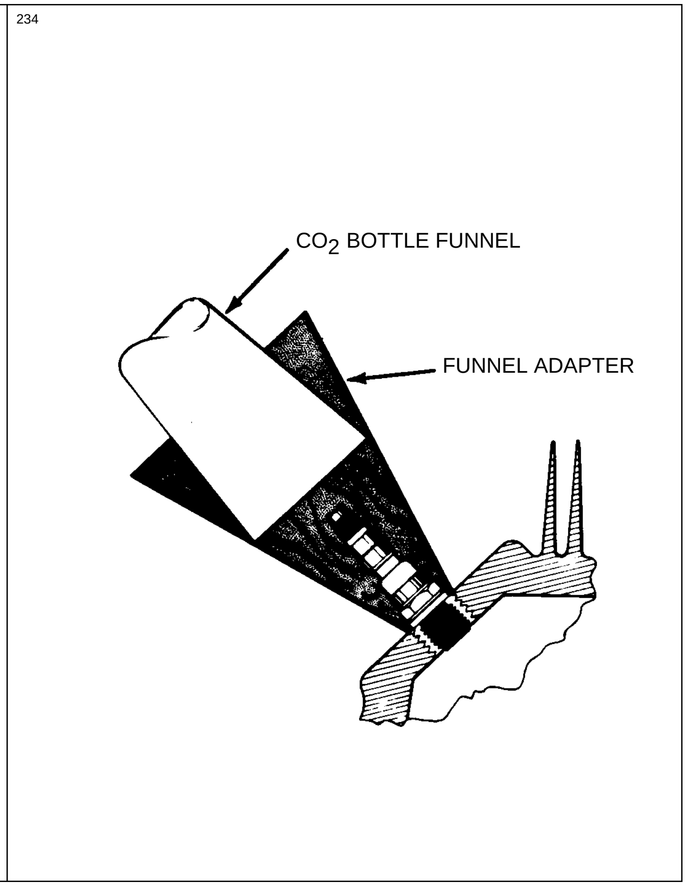

Figure 8-27 Removing Spark Plug Frozen to Bushing

8-36. INSTALLATION OF HARNESS. Before installing harness on magneto, check mating surfaces for cleanliness.

a. Place the harness terminal plate on the magneto and tighten nuts around the plate alternately to seat cover squarely on magneto. Torque nuts from 18 to 22 inch pounds.

b. Route ignition wires to their respective cylinders.

c. Clamp the harness assembly in position and replace the engine baffle plate.

d. Connect the leads to the spark plugs.

8-37. SPARK PLUGS.

8-38. REMOVAL OF SPARK PLUGS. (Refer to Figure 8-27.)

a. Loosen the coupling nut on the harness lead and remove the terminal insulator from the spark plug barrel well.

—NOTE—

When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise, a side load will be applied which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator.

b. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

—NOTE—

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

c. Place spark plugs in a holder 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 CO_2 bottle. (Refer to Figure 8-27.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO_2 bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in the removal of an excessively seized plug.

e. Do not allow foreign objects to enter the spark plug hole.

8-39. 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 .015 to .018 of an inch or if a smoother operation at idle speed and reduced magneto drop-off is desired, set at .018 to .022 of an inch. However, with wide gap setting the plugs must be serviced at more frequent intervals. Fine wire platinum or iridium electrodes should be set at .015 to .018 of an inch only.

8-40. 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.

8-41. LUBRICATION SYSTEM. (ENGINE).

8-42. OIL PRESSURE RELIEF VALVE. Subject engines may be equipped with either an adjustable or nonadjustable oil pressure relief valve. A brief description of both types follows:

a. Non-adjustable Oil Pressure Relief Valve - The valve is not adjustable; however, the pressure can be controlled by the addition of a maximum of three STD425 washers under the cap to increase pressure or the use of a spacer (Lycoming P/N 73629 or 73630) to decrease pressure. Particles of metal or other foreign matter lodged between the ball and seat will result in a drop in oil pressure. It is advisable, therefore, to disassemble, inspect, and clean the valve if excessive pressure fluctuations are noted. **THE OIL PRESSURE RELIEF VALVE IS NOT TO BE MISTAKEN FOR THE OIL COOLER BY-PAS VALVE**, whose function is to permit pressure oil to by-pass the oil cooler in case of an obstruction.

b. Adjustable oil Pressure Relief Valve. The adjustable oil pressure relief valve enables the operator to maintain engine oil pressure within the specified limits (refer to the engine manufacturer's appropriate manual). The valve is located above and to the rear of No. 3 cylinder. If the pressure under normal operating conditions should consistently exceed 90 psi., or run less than 60 psi., adjust the valve as follows:

With the engine thoroughly warmed up and running at a maximum of 2200 RPM, observe the reading on the oil pressure gauge. If the pressure is above 90 psi, stop engine, loosen the adjusting locknut; and back off the adjusting screw one or two full turns. Tighten locknut and retest. If pressure is too low, turn adjusting screw further into the relief valve plug, thereby increasing the tension on the relief valve spring. When the valve has been satisfactorily adjusted, tighten the locknut and lockwire the crown nut to the drilled ear projecting from the valve mounting boss.

8-43. CARBURETOR ICE DETECTOR.

The operational carburetor ice detection system used on the PA-28-161 CADET utilizes an optical probe installed in the carburetor throat, just upstream of the throttle valve. As ice forms and blocks the passage of light within the probe, the warning is triggered. When the ice has melted and enough light is sensed, the warning light will be extinguished. The probe has an expected service life of 50,000 hours. A built in test circuit is activated such that each time the switch is turned on the light will come on momentarily.

8-44. REMOVAL OF ICE DETECTOR PROBE.

a. Remove the engine cowl.

b. The probe is mounted in the carburetor or just below the throttle valve control arm. Remove the safety wire and carefully unscrew the probe from the carburetor. Measure and note how far the probe extends into the carburetor.

c. Where the wires for the probe come off the engine mount remove the wire insulation sleeves; make note of the respective wire interconnects; and, disconnect the wires.

d. If the engine is to be operated, install a suitable blanking plug.

8-45. INSTALLATION OF ICE DETECTOR PROBE.

a. If a blanking plug has been installed, remove the plug from the carburetor housing. The probe is mounted just below the throttle valve on the left side of the carburetor.

—CAUTION—

Do not bend the probe components.

b. Carefully screw in the probe. When installed, the index mark on the probe housing should face towards the carburetor air inlet. If necessary use AN960-416L shim washers to position the probe properly.

c. Tighten the probe as much as possible by hand, and then, only a quarter turn more using a 3/8 inch short handle open end wrench.

d. Connect the appropriate wires and position the sleeves over the connectors. If heat shrink has not been used, tie with #6 electrical lacing wire.

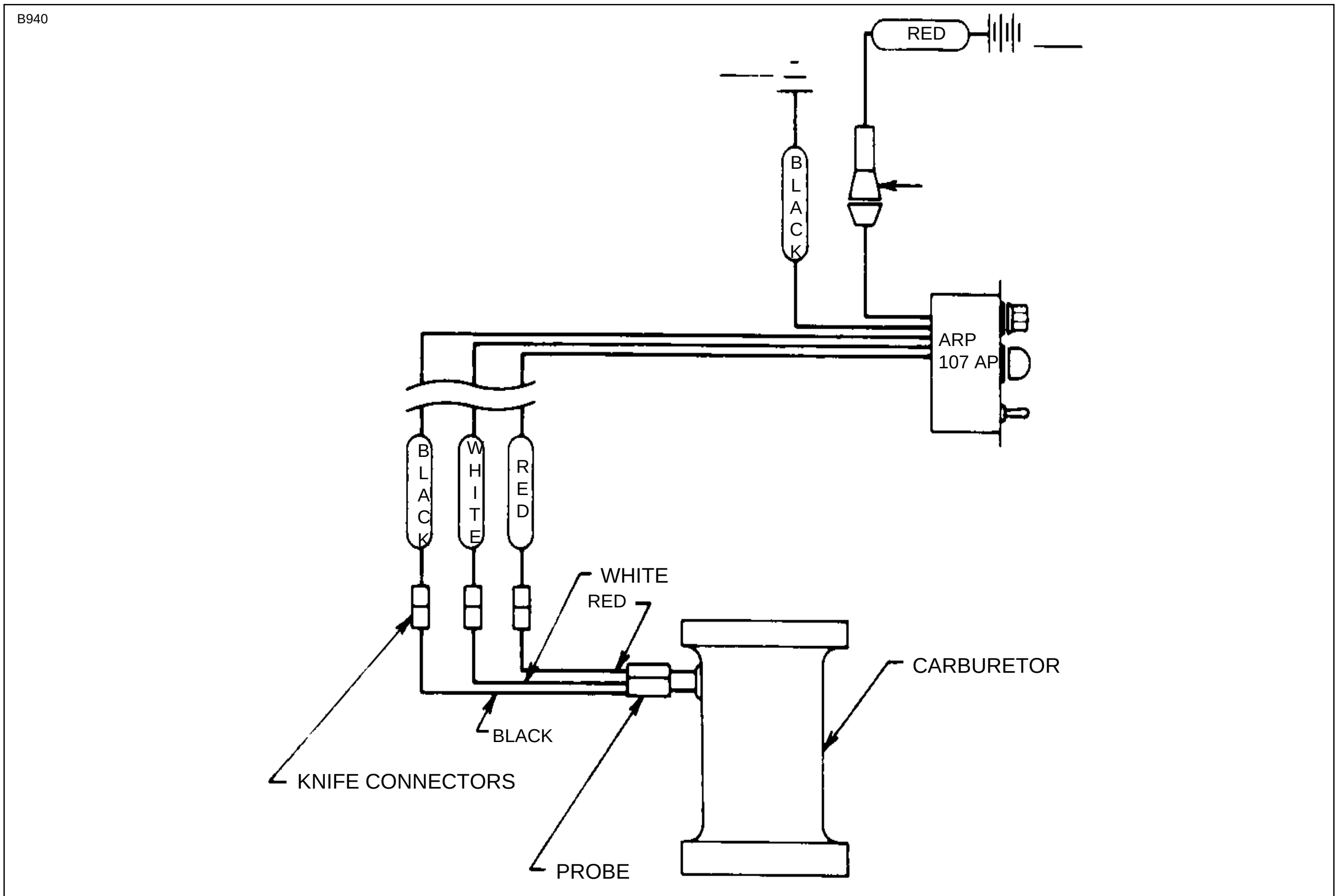

Figure 8-28. Ice Detection System

8-46. CARBURETOR ICE DETECTION SYSTEM TEST.

—CAUTION—

Do not attempt to test the probe or instrument by applying a voltage to each. Any voltage over 2 volts will burn out the probe lamp, sensor, and the instrument red light switching transistor.

a. To test the probe:

1. Disconnect probe from instrument at the knife connections.
2. Connect a red + ohmmeter test probe to black wire of ice detection probe.
3. In a subdued light (not in sunlight) touch the black ohmmeter test probe to the red wire of the ice detection probe. The ohmmeter reading should be approximately 600 ohms with ordinary light on the probe sensor.
4. Cover the ice detection probe sensor with the hand to eliminate most light. The ohmmeter reading should be very high: approximately 10,000 ohms or more.
5. Remove ohmmeter black test probe from the red wire and touch it to the white wire. The ohmmeter reading should be approximately 5 ohms. This indicates that the probe lamp is operating.
6. Test probe housing for short to ground. Housing is insulated.
7. If the tests contained in the previous steps are satisfactory, the probe will operate satisfactorily.

b. To test the instrument:

1. Disconnect the probe at the knife connectors.

2. Apply +12 volts DC to the red wire with a fuseholder. Apply -12 volts DC to the black ground wire.

3. The red carburetor ice light should come on, if it does not, the instrument is inoperative and must be returned to the manufacturer. (See Note)

4. If the red light comes on, touch the red wire connector to the black wire connector. The red light must go out. If it does not go out, the instrument is inoperative and should be returned to the manufacturer. (See Note)

c. To test the probe and instrument's function:

1. Turn power on.

2. Turn sensitivity control up from its full counterclockwise position until red light just goes out. This should be between 1/4 and 3/4 turn.

3. Place a piece of paper in the air gap of the probe (between the sensor and housing lens). The red light should come on.

—NOTE—

The only FAA approved repair shop for this instrument is ARP Industries, Inc.; 36 Bay Drive E.; Huntington, New York 11743; Tel. 516-427-1585.

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TABLE VIII-II. 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 cocks.
	Underpriming.	Prime with two or three strokes of primer.
	Overpriming.	Open throttle and "unload" engine by turning in counter-clockwise direction.
	Incorrect throttle setting.	Open throttle to one-tenth of its range.
	Defective spark plugs.	Clean and adjust or replace spark plug or plugs. Refer to Table I for spark plug gap adjustments.
	Defective ignition wire.	Check with electric tester and replace any defective wires.
	Improper operation of magneto.	Check timing of magnetos.
	Internal failure.	Check oil sump screen for metal particles. If found, complete overhaul of the engine may be indicated.
	Improper switch wiring for Ieft magneto starting.	Reverse magneto switch wires.
	Magnetized impulse coupling	Demagnetize impulse couplings. Ieft magneto only.
	Frozen spark plug electrodes.	Replace spark plugs or dry out removed plugs.
	Mixture control in idle cut-off.	Open mixture control.
	Shorted ignition switch or loose ground	Check and replace or repair.

TABLE Vlll-ll. ENGINE TROUBLESHOOTING CHART (cont)

Trouble	Cause	Remedy
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.
	Low cylinder compression.	Check cylinder compression.
	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.
Low power and uneven running engine.	Mixture too rich; indicated by sluggish engine operation, red exhaust flame and black smoke.	Check primer, Readjustment of carburetor indicated.
	Mixture too lean, indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Check fuel supply.
	Leaks in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean or replace spark plug.
	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.

TABLE Vlll-ll. ENGINE TROUBLESHOOTING CHART (cont)

Trouble	Cause	Remedy
Low power and uneven running engine. (cont.)	Improper grade of fuel.	Fill tank with recommended grade.
	Magneto not working properly .	Check 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.
	Restriction in exhaust system.	Check for loose muffler baffles.
	Improper ignition timing. and synchronization.	Check magnetos for trimming
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.

TABLE VIII-II. ENGINE TROUBLESHOOTING CHART (cont)

Trouble	Cause	Remedy
Rough running engine.	Cracked engine mounts.	Repair or replace engine mount.
	Unbalanced propeller.	Remove propeller and have it checked for balance.
	Bent propeller blades.	Check propeller for blade track.
	Defective mounting.	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 crankcase.
	High oil temperature.	See "High Oil Temperature" in Trouble Column.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction screen.
	Worn or scored bearings.	Overhaul.
High oil temperature.	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level.
	Clogged oil lines or screens.	Remove and clean oil screens.

TABLE VIII-II. ENGINE TROUBLESHOOTING CHART (cont)

Trouble	Cause	Remedy
High oil temperature. (cont.)	Failing or failed bearing.	Examine sump for metal particles and, if found, overhaul engine.
	Defective thermostats.	Replace.
	Defective temperature	replace gauge. gauge.
	Excessive blowby.	Usually caused by weak or stuck rings.Overhaul.
	Improper engine operation.	Check entire engine.
Excessive oil consumption.	Leakage through engine fuel pump vent.	Replace fuel pump O-ring.
	Engine breather or vacuum pump breather.	Check engine and overhaul or replace pump.
	Failing or failed bearing.	Check sump for metal particles and, if found, overhaul of engine is indicated.
	Worn or broken piston rings.	Install new rings.
	Incorrect installation of	Install new rings. piston rings.
	External oil leakage.	Check engine carefully for leaking gaskets, O-rings or sand holes.

TABLE VIll-II. ENGINE TROUBLESHOOTING CHART (cont.)

Trouble	Cause	Remedy
Inaccurate pressure	Cold weather.	In extremely cold weather readings.oil pressure readings up to 100 pounds do not necessarily indicate malfunctioning.
Overpriming.	Cold weather.	Rotate the crankshaft in the counter-clockwise direction with throttle FULL OPEN and ignition switch OFF
Inaccurate pressure	Cold weather.	High or low pressure readings due to extremely cold weather are not necessarily a malfunction. Small and long oil lines will not transfers pressure readings accurately until engine is quite warm.

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CADET

MAINTENANCE MANUAL

CARD 2 OF 2

PA-28-161 CADET

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 829)

SERIAL NUMBER INFORMATION

PA-28-161, CADET - 1988
Serial Numbers 28-41001 and up

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 Aircraft 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 761 829 issued February 28, 1989 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG 890228	August 7, 1989	1 and 2

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AEROFICHE CARD NO. 1 GRID NO.

AEROFICHE CARD NO. 2

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (CONT.)

LIST OF TABLES

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SECTION IX
FUEL SYSTEM

SECTION IX

FUEL SYSTEM

9-1. INTRODUCTION. The fuel system components covered in this section consist of the fuel tanks, selector valves, filter screens and fuel pump. Instructions are given for remedying difficulties which may arise in the normal operation of the fuel system. The instructions are organized so the mechanic can refer to: Removal, Repair, Installation and Adjustment of each part of the system.

Maintenance for carburetion and fuel injection may be found under Power Plant, Section V 111 .

9-2. DESCRIPTION. The airplanes are equipped with aluminum fuel tanks consisting of one in the inboard leading edge section of each wing. Each tank has a capacity of 25 gallons. A strainer is installed in the fuel outlet of each tank. From the tank outlet a fuel line is routed through the wings to the fuel selector valve located on the left side of the cabin in front of the pilot's seat; from the fuel selector valve a line leads to the fuel strainer bowl mounted on the left forward face of the firewall. A fuel line is routed from the strainer bowl to the electric fuel pump, engine driven fuel pump and then to the carburetor or injection inlet port. Two electrical fuel quantity gauges are mounted within the instrument cluster. Each gauge is connected to a transmitter unit installed in the fuel tanks.

9-3. TROUBLESHOOTING. Troubles peculiar to the fuel system are listed in Table IX-III along with their probable causes and suggested remedies. 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 be removed from the airplane and an identical unit or units, tested and known to be good, installed in their place.

9-4. FUEL TANKS.

9-5. REMOVAL OF FUEL TANKS.

a. Drain the fuel from the fuel tank. (Refer to Draining Fuel System, Section 11.)

b. Remove the screws from around the perimeter of the tank assembly.

c. Pull the tank away from the wing assembly far enough to gain access for removal of the sender wire and disconnect the fuel line from the forward and aft outlets.

d. The tank is now free to be removed.

9-6. INSPECTION AND REPAIR OF FUEL TANK.

Inspection and repair of fuel tanks is limited to inspecting for dents and leaks.

9-7. INSTALLATION OF FUEL TANK.

a. Slide the main tank partly into position and connect the sender wire and fuel line to the forward and aft outlets

b. Slide the tank completely into place and secure with screws around its perimeter.

c. Fill the fuel tank and check for leaks, unrestricted fuel flow and proper sender indications on the quantity gauge. (Refer to paragraph 9-14.)

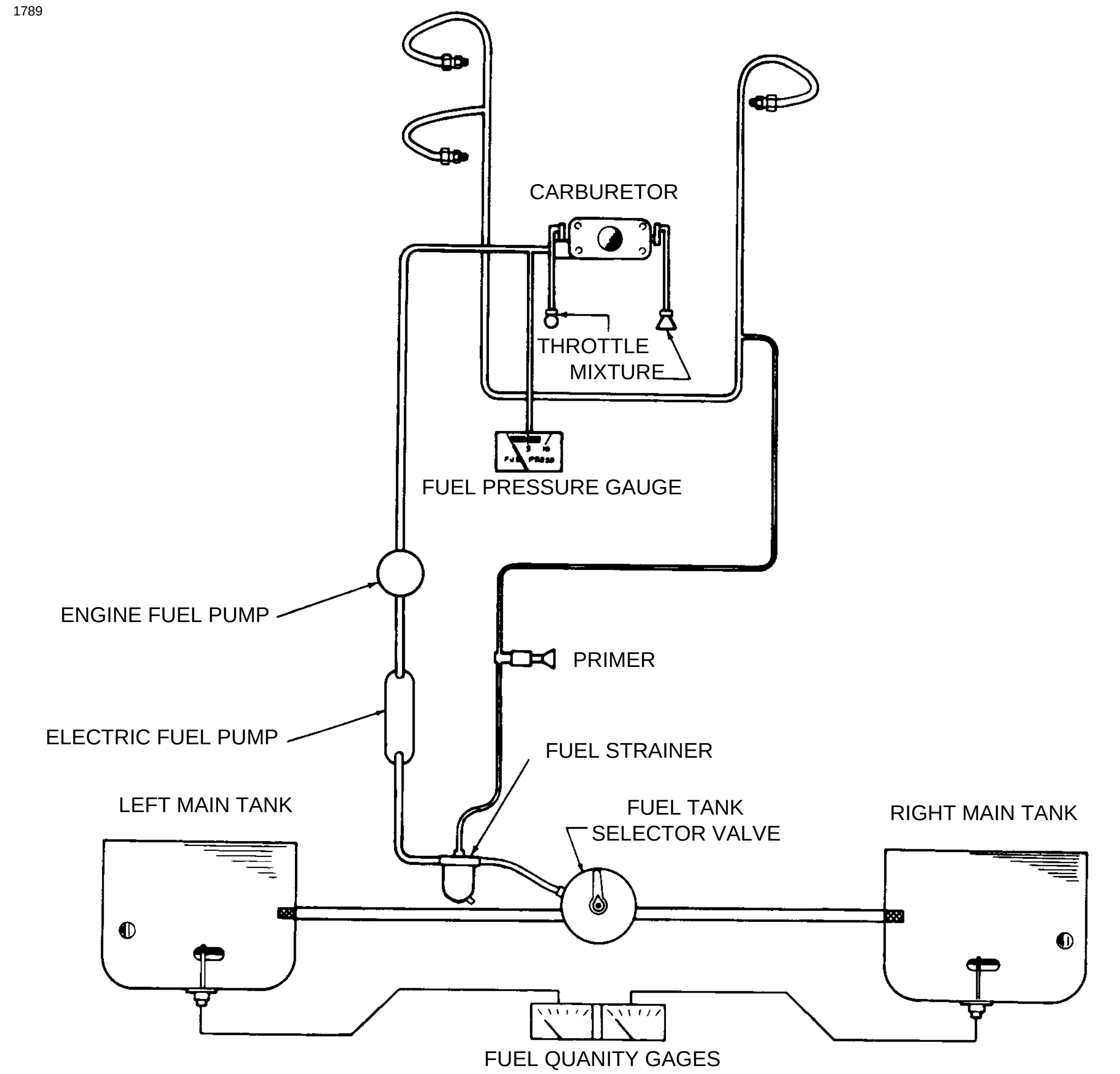

Figure 9-1 Fuel System Diagram

9-8. FUEL LINES.

9-9. INSPECTION AND TIGHTENING OF FUEL LINE UNION FITTINGS

a. Remove the aft inboard inspection panel from the lower surface of the right and left wing.

b. Remove the pilot's seat and left cabin side panel. Fold back the carpeting that covers the forward side of the spar box and remove the cover from the fuel line(s).

c. Inspect all union fittings used in the fuel system for signs of leakage. Note any leaking fittings for later re-check

.d. Using a torque wrench and tubing crow's foot, carefully tighten each union fitting to the torques listed below:

	Tube Size	Applied Torque	
	I/4 in. O.D. 3/8 in. O.D.	75-95 inch-pounds 175-195 inch-pounds	Using a Tubing Crow's Foot.

—CAUTION—

Using a crow's foot adapter other than a tubing type will result in deformation or severe damage to the union nut and will probably cause a leak which will require replacement of the union and tubing.

—NOTE—

If during the torque check a galled nut and union are suspected, backoff the nut and inspect the threads. If the union is serviceable, apply a thread lube such as Slip Spray Lubricant (Dupont) or Ferrulube (Parker-Hannifin), and torque the nut to the proper values as listed in Step d. If the union is unserviceable, it must be replaced per instructions given in paragraph 9-10

When applying thread lubricant insure its application to the male connector threads only. Care should be taken that no lubricant enters the throat of the connector seat or contacts the ferrule seat face.

e. After torquing each fitting. measure between the face of the union nut and face of tubing nut. Refer to Figure 9-2 for tolerance.

f. Any fitting found out of tolerance must be replaced in accordance with instructions given in paragraph 9-10.

g. After all unions have been checked for proper tightness and all repairs (if any) have been made. Insure that the airplane is full of fuel and run the engine for three to five minutes on each tank. Perform engine operation in a safe manner and location.

h. After engine shut down, wiggle all unions. If any fittings are found leaking, repairs must be accomplished in accordance with paragraph 9-10.

i. When system is found leak free, replace the side panel, carpet, access plates and seat.

j. Make an appropriate logbook entry.

9-10. REPLACEMENT OF FITTINGS.

—NOTE—

Defueling of airplane may be required for union and/or tubing replacement.

a. If fittings show evidence of galling, or does not meet the dimensional requirements of Figure 9-2. or continues to leak after being tightened it must be repaired.

b. The recommended repair is to remove the leaking union and replace it using a standard AN fitting as outlined in AC 43. 13-1 A paragraph 392. This will require cutting off the swaged ferrule and adding a short length of tubing.

c. If a replacement tube and union purchased from Piper is being used, the ferrule is pre-swaged onto the tube. Install the pre-fabricated tube as follows:

1. Apply a thread lube as recommended in Step d of paragraph 9-9 to the threads of the union.
2. Carefully align the tube into the union and snug up the nut using a wrench.
3. Then using the wrench, tighten the nut one to two flats (1/ 6 to 1/ 3 of a turn).

d. If a repair is being made using Parker-Hannifin unions and tubes without pre-swaged ferrules they should be installed as follows:

1. Cut off the tubing at a convenient location back from the fitting.
2. De-burr the end of the tube and prepare a short length of tube to splice into the line.
3. Screw the nut and ferrule onto the union until solidly finger tight.
4. Insert the tubes into the unions, being careful to insure proper straight alignment of the tubing and union.
5. Using a tubing wrench tighten the nut one and one-quarter (1-1/4) turns.

e. After corrective action has been completed perform leak test as outlined in Steps g and h of paragraph 9-9.

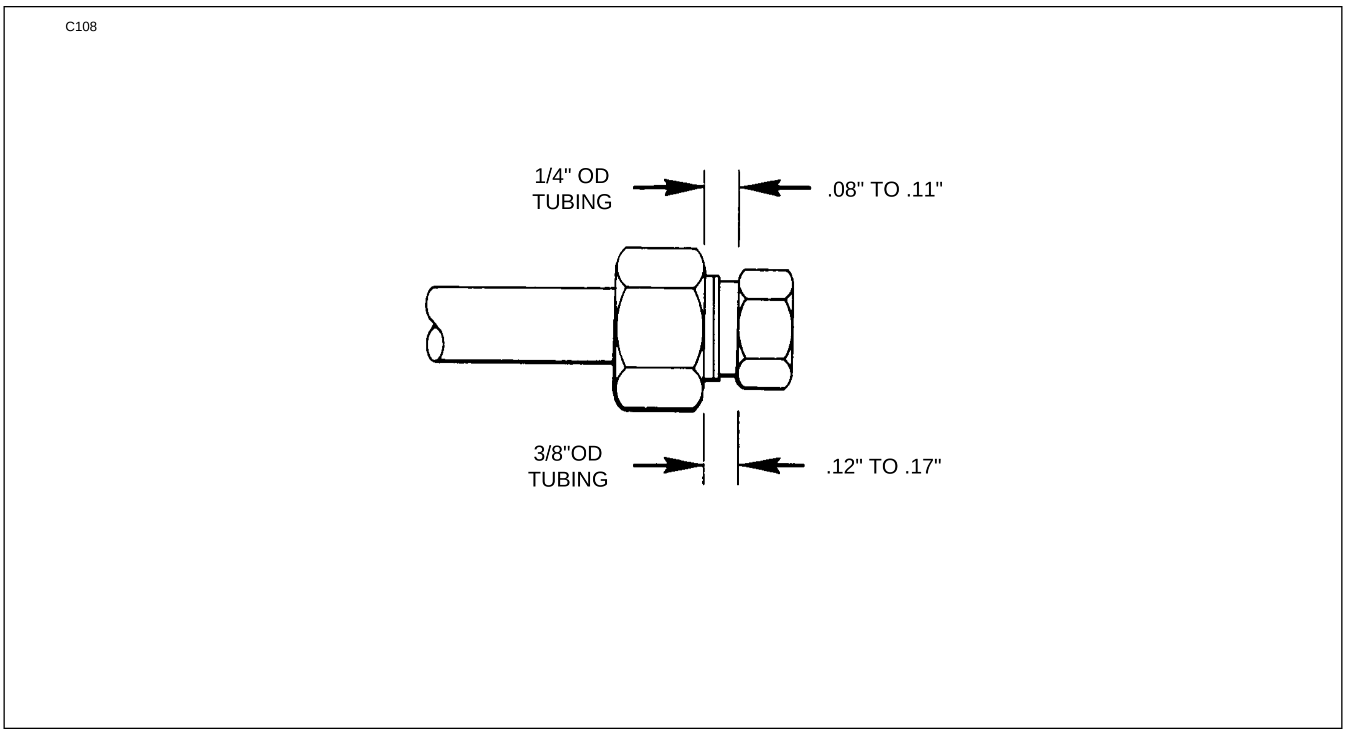

Figure 9-2. Tolerances. Union Nut and Tubing

9-11. FUEL QUANTITY TRANSMITTER UNIT.

9-12. REMOVAL OF FUEL QUANTITY TRANSMITTER UNIT.

a. Remove the fuel tank. (Refer to Paragraph 9-5.)

b. Disconnect the transmitter wire from the connection post.

c. Cut the safety wire which secures the five attaching screws.

d. Remove the five screws and remove the unit.

9-13. INSTALLATION OF FUEL QUANTITY TRANSMITTER UNIT.

a. Position the transmitter and gasket on the fuel tank and secure with machine screws and washers. (Tip tank installation, install ground wire under head of mounting screw.)

b. Safety the machine screws with MS20995-C32 wire.

c. Install the fuel tank. (Refer to Paragraph 9-7.)

9-14. FUEL QUANTITY TRANSMITTER/GAUGE CHECK. Fuel quantity transmitter unit and gauge may be checked, while installed in the airplane, by the following procedure.

a. Turn the fuel selector valve off.

b. Completely drain the fuel tank that relates to the gauge to be checked. (Refer to Draining Fuel System, Section 11.)

c. Level the airplane longitudinally and laterally.

—NOTE—

The electrical system should apply 14-volts to the gauge.

9-15. FUEL QUANTITY GAUGE CALIBRATION. A calibration chart has been included for use in verifying that the suspect faulty gauge is within tolerance. (Refer to Figure 9-4.)

—Note—

Actual recalibration of the gauge must be preformed by the manufacturer or an approved instrument repair facility

a. With the instrument installed in the aircraft, the aircraft power connected (14 VDC) and the ground connected.

b. Remove the connection to the terminal marked SEND and connect a specified amount of resistance as indicated on the chart, by use of a fixed resistor or a test unit capable of simulating the resistance indicated on the chart (Power Resistor Decade Box)

c. If the gauge does not meet the tolerances set forth in the chart, it must be replaced or recalibrated.

d. Reinstallation is the reverse of the procedure used to remove it

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TABLE IX-I. TRANSMITTER/FUEL GAUGE TOLERANCES

Actual Fuel in Tank(U.S. gal.)	Gauge Reading (U.S.Gal.)
Full	Full *
15	12 to 17
10	7 to 12
5	2 to 6
1	0 to -2
0	Dot *Plus one needle width

d. Turn the master switch on and observe the fuel quantity gauge. It should read empty. Refer to Table IX-I for tolerances that are permitted between the fuel gauge reading and the actual fuel in the tank.

e. Add one (1) gal.of fuel to the tank and observe the gauge readings then add four (4) gal. to total five (5) gal. Then add fuel in the amount of five U. S. gallon increments until the tank is full and observe the gauge readings at each addition of fuel.

—NOTE—

It will be permissible to adjust the float assembly to obtain specified tolerances. This adjustment may be accomplished per instructions given in Paragraph 9-15.

9-16. CHECK AND ADJUSTMENT OF FUEL QUANTITY TRANSMITTER UNIT. (Refer to Figure 9-3)

a. If not previously removed, remove the transmitter unit to be checked from the fuel tank. (Refer to Paragraph 9-12.)

b. Check and adjust the transmitter unit float position by using the following procedure:

1. Fasten the unit to a fabricated checking jig with washer and nuts. (This jig may be fabricated from dimensions given in Figure 9-9.)

2. Ascertain that with the float arm down against the mechanical stop on the transmitter, the float is just touching the top of a 0 .27 of an inch spacer block. Should the float not be touching the spacer or the float arm is not against the bottom stop, adjust the arm stop of float assembly, by bending it where shown in Figure 9-3. The entire surface of the float must be horizontal with the base of the jig.

c. Check the transmitter unit for correct resistance and dead spots by the following procedure:

1. Connect an ohmmeter to the transmitter unit and move the float arm to its bottom mechanical stop. The ohmmeter should indicate the ohms resistance as indicated in Table IX-II.

2. Move the float arm to its upper mechanical stop and check the ohms resistance.

3. Check for dead spots by slowly moving the float arm from the bottom stop to the upper stop and back. Watch the ohmmeter indicator; it should steadily move up and down the scale without fluctuation as the float arm is moved.

4. If an incorrect resistance and/or dead spots are found, the transmitter unit should be replaced.

TABLE IX-II. FUEL QUANTITY TRANSMITTER CALIBRATION TOLERANCES

UNIT	POSITION	RESISTANCE
P/N P.S. 10013 - 11 (NITROPHYL FLOAT)	EMPTY FULL	3 ± .5 OHMS 45 ± 2 OHMS

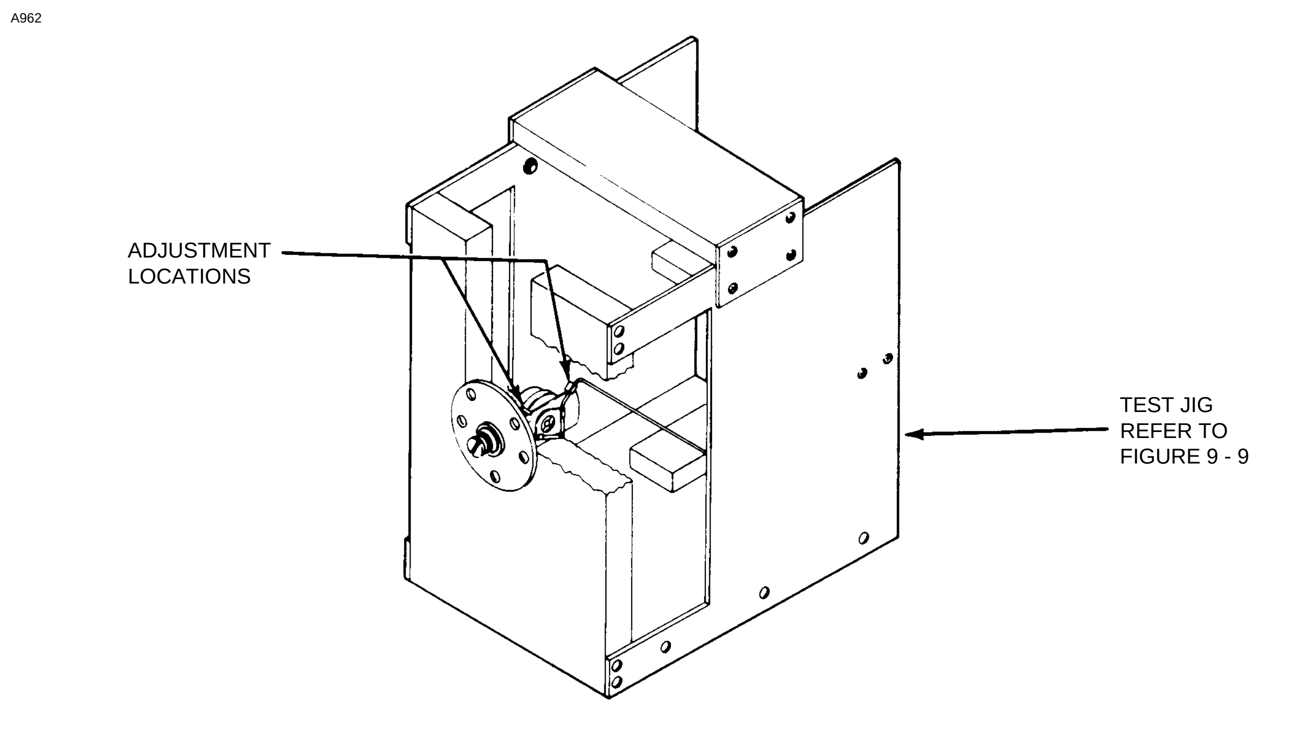


Figure 9-3 Fuel Quantity Transmitter Checking Jig

CALIBRATION CHART

GRADUATION	OHMS	DEGREES	TOLERANCE *
DOT	MECH. ZERO	—40°	±1/2
0	3	—32	-1+0
5	14	—15°	±1
10	23	+2	±1
15	33	+20	±1
F	45	+32°	±1/2

—NOTE—

TOLERANCE IS IN POINTER WIDTHS

(USE 14 VOLTS)

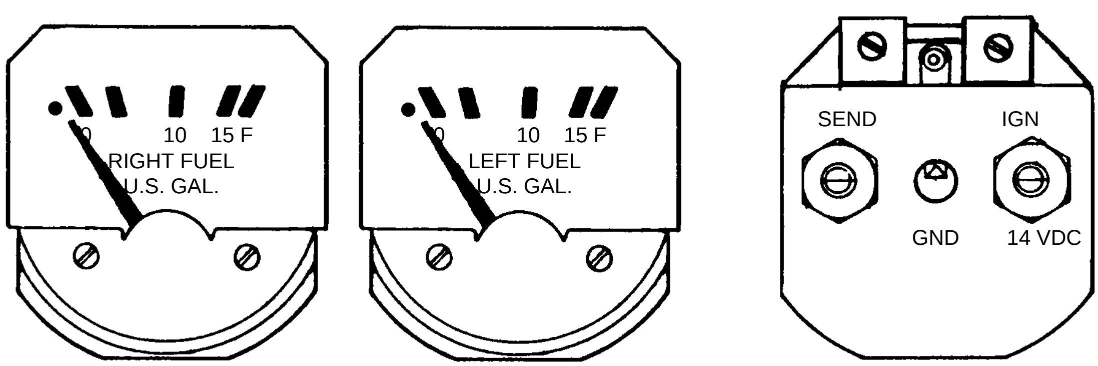


Figure 9 -4. Fuel Quanity Indicators

9-17. LOCKING FUEL CAP.

—NOTE—

The vent groove on the cover is filled with sealant PR1422.

9-18. DISASSEMBLY OF LOCKING FUEL CAP. (Refer to Figure 9-5).

a. Remove two screws on the back of the fuel cap.
b. Remove screw which secures the pawl to the back of the key lock assembly.
c. Remove the pawl from the back of the key lock assembly.
d. Remove the nut which secures the key lock to the cover.
e. Slide the lock, rubber gasket, teflon gasket and spring over the back of the key lock.
f. The key lock may be removed by pushing the key lock through the cover. Ensure that the O-ring under the key lock is not lost.

9-19. ASSEMBLY OF LOCKING FUEL CAP. (Refer to Figure 9-5.)

a. Insert the key lock through the cover, making sure that the O-ring is installed under the key lock.
b. Slide the spring, teflon gasket, rubber gasket and lock over the back of the key lock.
c. Reinstall the nut which secures the key lock to the cover.
d. Attach the pawl to the back of the lock assembly with screw. (Use Loctite #271 thread sealing compound)
e. Reinstall the two screws on the back of the fuel cap. (Use Loctite #271 thread sealing compound.)

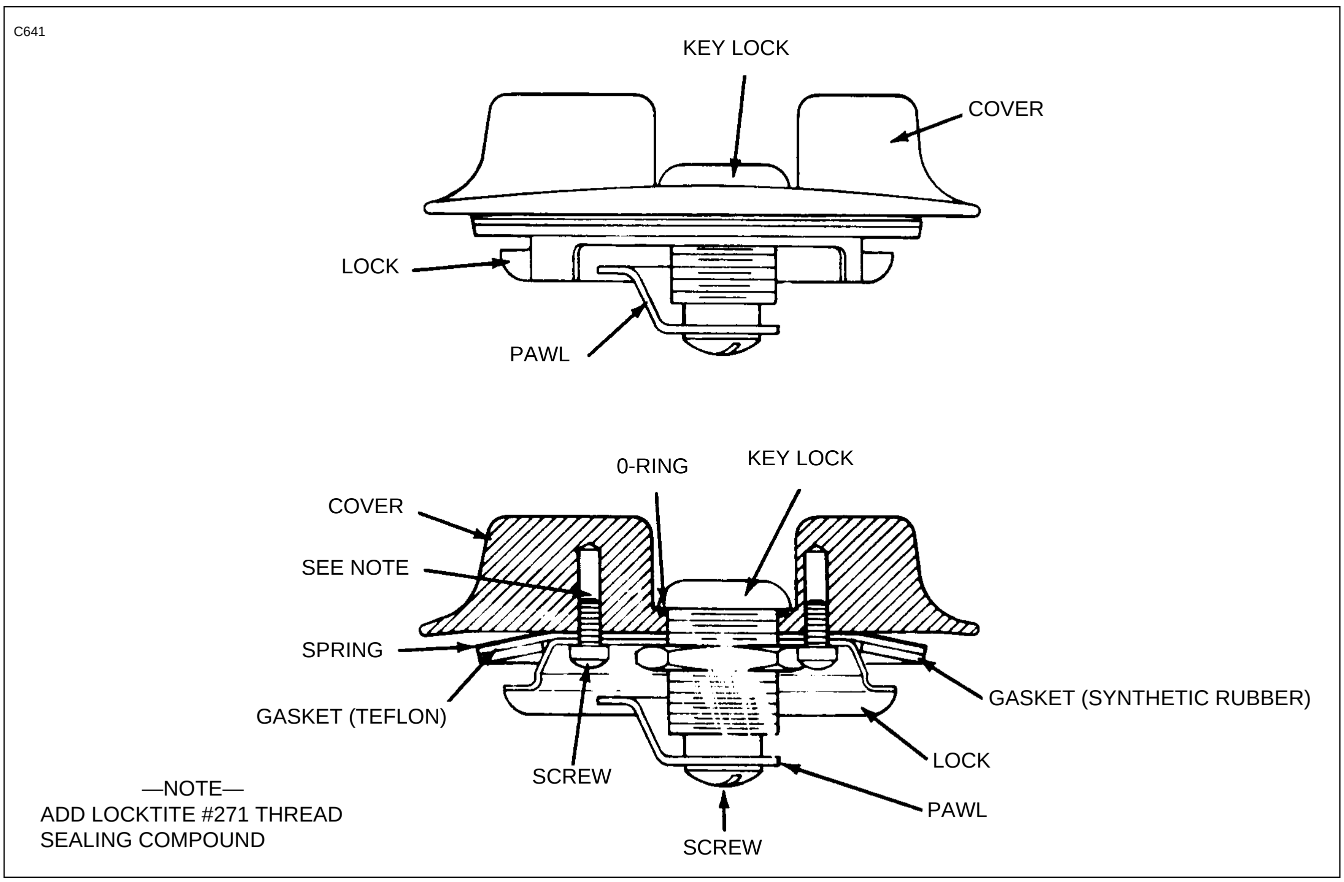


Figure 9-5. Locking Fuel Cap

9-20. FUEL SHUTOFF VALVE.

9-21. REMOVAL OF FUEL SHUTOFF VALVE.

a. Remove two screws holding the fuel valve placard plate and the screw holding the fuel shutoff valve handle.

b. Remove fuel shutoff valve handle and placard plate.

c. Disconnect right and left fuel inlet lines from fuel valve assembly.

d. Disconnect fuel outlet line from fuel valve assembly.

e. Remove fuel valve assembly by removing attaching screws.

9-22. INSTALLATION OF SHUTOFF VALVE.

a. Secure the valve to the bulkhead attachment plate with attaching screws.

b. Connect the fuel lines to the valve.

c. Install the fuel valve placard with attaching screws.

d. Install the valve control handle with attaching screws.

9-23. FUEL FILTER BOWL AND SCREEN. (Refer to Figure 9-6.)

A640

1. BODY
2. SCREEN
3. GASKET
4. STRAINER BOWL
5. BAIL WIRE
6. BAIL ASSEMBLY
7. SAFETY WIRE
8. DRAIN VALVE

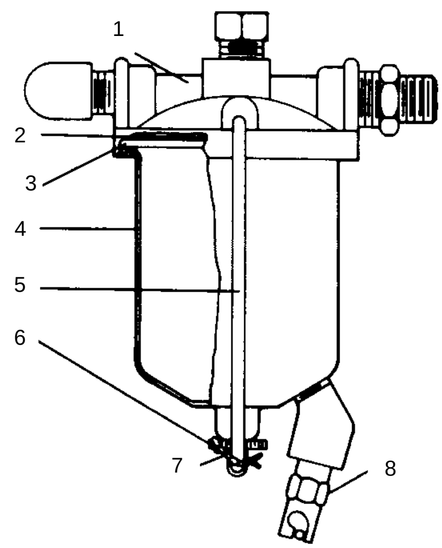


Figure 9-6. Fuel Filter Bowl and Screen

9-24. REMOVAL OF FUEL FILTER BOWL AND HOUSING.

a. Ascertain that the fuel shutoff is in the off position.

b. Remove the engine cowlings by releasing the cowl fasteners or the attaching screws, depending on the type installed. Be certain that all electrical leads are disconnected prior to removal of the cowl.

c. Disconnect the fuel lines from the filter bowl housing.

d. Remove the housing of the filter bowl by spreading the ends of the bail wire allowing the housing to be lifted from the bracket.

9-25. INSTALLATION OF FUEL FILTER BOWL AND SCREEN.

a. Position the top of the filter bowl to the bracket and connect the fuel lines.

b. Spread the bail wire ends and insert them through the holes in the side of the mounting bracket and the top of the filter bowl.

c. Position the bowl and bail wire, and tighten the bail nut.

d. Safety the bail nut and the bail wire assembly.

e. Install the engine cowling.

9-26. CLEANING AND INSPECTION OF FILTER BOWL SCREEN.

a. Follow steps a, b and d of paragraph 9-24 for removal of the filter bowl.

b. Remove the gasket and screen from the filter housing.

c. Clean the screen and bowl with acetone or a suitable dry type solvent. If damaged, replace screen.

d. Replace the screen followed by a new gasket.

e. Position the bowl and bail wire, and tighten the bail nut.

f. Safety the bail nut and the bail wire assembly.

9-27. ELECTRIC FUEL PUMPS.

9-28. PLUNGER FUEL PUMPS.

9-29. REMOVAL OF FUEL PUMP. The fuel pump may be removed by the following procedure:

a. Remove the cowling by releasing the attaching screws. Be certain all electrical leads are disconnected prior to removal.

b. Ascertain that the fuel shutoff valve is in the off position.

c. Disconnect the fuel pump electrical leads.

d. Disconnect the fuel lines from the inlet and outlet sides of the pump.

e. Remove the nuts and bolts securing the pump to its mounting bracket and remove the pump.

9-30. DISASSEMBLY 0F FUEL PUMP. (Refer to Figure 9-6.) The following procedure is given for complete disassembly of the fuel pump. For cleaning and servicing purposes only, refer to Step a, then proceed to Paragraph 9-31 for cleaning, inspection and repair of component parts.

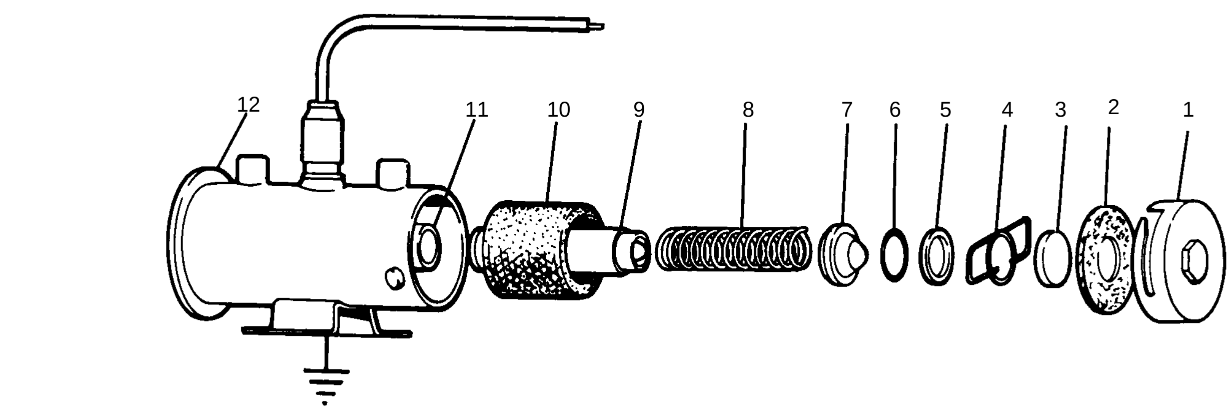
a. Cut the safety wire and remove the bottom cover, gasket, magnet and filter screen from the pump.

—NOTE—

If the screen does not come out easy use caution removing it from the pump housing so as not to damage it.

b. Remove the retainer spring from the plunger tube using thin nose pliers to spread and remove the ends of the retainer from the tube.

c. Remove the washer, O-ring seal, cup valve, plunger assembly from the pump.



1. COVER
2. COVER GASKET
3. MAGNET
4. FILTER SCREEN
5. RETAINER
6. WASHER
7. O-RING
8. CUP VALVE
9. SPRING
10. PLUNGER
11. PLUNGER TUBE
12. PUMP BODY

Figure 9-7 Plunger Fuel Pump

—CAUTION—

Do not remove the buffer spring and valve from the plunger assembly. Do not tamper with seal at center of mounting bracket at side of pump as it retains the dry gas which surrounds the electric system in the upper portion of the pump.

9-31. CLEANING, INSPECTION AND REPAIR OF FUEL PUMP.

a. Clean all parts with acetone or a suitable dry type solvent. If plunger assembly does not come clean or there are any rough spots, polish gently with crocus cloth.

b. Inspect the pump for the following:

1. Check the filter screen for damage or distortion.
2. Gently touch the cup valve and check for freedom of movement. Do not disassemble.
3. Shake the plunger assembly and listen for clicks to indicate valve action.
4. Check the condition of the O-ring.
5. Check the condition of the cover gasket and plunger spring cup gasket.

c. Repair of the pump is limited to replacement of parts found defective during inspection.

9-32 . RESISTANCE CHECK (PLUNGER TYPE PUMP). To check the resistance of the pump, connect an ohmmeter to the lead wire of the pump and the pump body. A reading of 4.87 to 6.4 ohms for a 12-volt pump should be obtained.

9-33. ASSEMBLY OF FUEL PUMP. (Refer to Figure 9-7.)

a. Insert the plunger spring assembly (10) in the tube with the buffer spring end first. Check fit by slowly raising and lowering the plunger in the tube. It should move fully without any tendency to stick. If a click cannot be heard, the interrupter assembly is not functioning properly in which case the pump should be replaced.

b. Install the plunger spring cup gasket (use a new one) and the plunger spring cup. Draw the screws reasonably tight, but do not over tighten them. Be sure the cup is not cocked to prevent the plunger from binding in the tube.

c. Place the filter screen around the bottom cover magnet.

d. Carefully guide the screen around the plunger spring cup. The screen must fit snugly at both ends. Do not pinch or distort the screen. Draw the bottom cover tight with a wrench and safety.

9-34. ADJUSTMENT OF ELECTRIC FUEL PUMP (BENCH TEST).

a. Ascertain that the pump is sufficiently lubricated to prevent damage if run dry for a period greater than five minutes.

b. Connect the electrical lead of the pump to a 14-volt DC power source.

c. Using a suitable container with the proper octane fuel, connect a fuel line from a container to the inlet side of the pump.

d. Connect another line from the outlet side of the pump to a pressure gauge and by-pass valve and back to the container.

e. Run the pump with the by-pass valve open until a steady flow of fuel is obtained. Then close the by-pass valve and check the pressure gauge for the proper reading of 4 to 4.75 psi maximum, no flow.

f. Repeat steps b through e for the second fuel pump.

g. If the proper pressure is not obtained, the plunger spring may be replaced or it may be necessary to replace the complete pump assembly.

9-35. ADJUSTMENT OF ELECTRIC FUEL PUMP (IN AIRPLANE).

a. With the access panel removed and the fuel selector in the OFF position, remove the fuel line from the outlet end of the pump.

b. Connect a test line with a by-pass valve and pressure gauge to the outlet end of the pump to be checked.

c. Place a container below the pump to catch any fuel from the test line during the adjustment of the pump.

d. Disconnect the electrical lead to the pump that is not being checked.

e. Turn the fuel selector on, open the by-pass valve on the test line and start the pump.

f. When a steady flow of fuel is obtained, close the by-pass valve and check the reading on the pressure gauge. It should read 4 to 4.75 psi maximum, no flow. Do not keep by-pass valve closed for more than one minute during pump operation and adjustment.

g. Repeat steps b through f for the other pump.

h. If the proper pressure is not obtained, the plunger spring may be replaced or it may be necessary to replace the complete pump assembly.

i. Reconnect the original fuel line to the pump. Open fuel selector and run the pump to check for any fuel leaks.

j. Shut off the pump, close the fuel selector and replace and secure the access panel.

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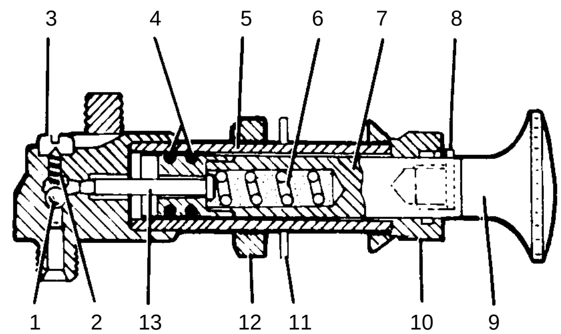

1. CHECK BALL
2. BALL SPRING
3. RETAINER SCREW
4. 0-RINGS
5. CYLINDER
6. SEALING SPRING
7. PISTON
8. STOP PIN
9. PUMP HANDLE
10. FACE NUT
11. WASHER
12. LOCK NUT
13. SEALING PIN

Figure 9-8 Engine Primer

9-36. INSTALLATION OF FUEL PUMP. Install the fuel pump by the following procedure:

a. Position the fuel pump to the engine mount frame and secure with bolts, washers and nuts.
b. Connect the fuel lines to the pump.
c. Connect the electrical leads to the pump.
d. Turn the fuel shutoff on and operate the fuel pump. Check all fuel line fittings for leakage.
e. Install the cowling.

9-37. ENGINE PRIMER PUMP.

9-38. REMOVAL OF ENGINE PRIMER. (Refer to Figure 9-8.)

a. Disconnect the fuel lines from the primer behind the instrument panel.
b. Loosen the locknut (12) from behind the panel.
c. Unscrew the knurled face nut (10), and withdraw the pump handle (9) and piston (7) from the cylinder (5).
d. Remove the remaining portion of the primer.

9-39. DISASSEMBLY, CLEANING AND ASSEMBLY OF ENGINE PRIMER. (Refer to Figure 9-8.)

a. The primer may be further disassembled after removal by removing the screws (3), springs (2) and check balls (1) from the end of the cylinder housing.
b. Clean the primer parts with acetone or a dry type solvent.
c. Install new O-rings to the piston (7) and lubricate with light motor oil.
d. Install the balls (1), springs (2) and screws (3) to the cylinder housing.
e. Insert the pump handle (9) and piston (7) into the cylinder (5), and finger tighten the knurled face nut.
f. Immerse the pump in gasoline and operate several times to insure proper operation.

9-40. INSTALLATION OF ENGINE PRIMER PUMP. (Refer to Figure 9-8.)

a. Remove the pump handle (9) and piston (7) by unscrewing the knurled face nut (10), if previously installed.

b. Insert the cylinder assembly through the back side of the panel.

c. Insert the piston into the cylinder (5) and tighten the knurled face nut.

d. Position the primer and tighten the locknut (12) on the cylinder behind the panel.

e. Connect the fuel lines to the primer.

f. Disconnect the primer line inside the engine compartment. Operate the pump to ascertain proper operation.

9-41. PRIME JETS

a. To remove the prime jets, disconnect the supply line from each jet. With a deep socket and light pressure, remove the jet from the cylinder.

b. To clean the jets, soak in carbon remover solution long enough to loosen any dirt and blow clean with air pressure. Do not use sharp objects or wire brush to clean the jet tube.

c. Install the jet finger tight to assure that the threads are not crossed and then torque 60 inch-pounds. Align and install the fuel supply lines, tighten to a snug fit.

—NOTE—

Should further fuel stoppage of the primer system exist, check the supply lines for stoppage, bent or collapsed walls.

9-42. CLEANING FUEL SYSTEM.

a. To flush the fuel tanks and selector valve, disconnect the fuel line at the carburetor or injector.

b. Select a fuel tank, turn on the electric fuel pump and flush fuel through the system until it is determined there is no dirt and foreign matter in the fuel valve or tank. During this operation, agitation of the fuel within the tank will help pick up and remove any dirt.

c. Repeat this procedure for each tank.

d. When all tanks are flushed, clean all filters.

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TABLE IX-III. FUEL SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Failure of fuel to flow.	Blockage in fuel line.	Flush fuel system.
	Blockage of cap vent.	Check and clean vent hole in cap.
	Failure of mechanical or electrical fuel pump.	Check and replace if necessary.
	Failure of fuel selector to be in proper position.	Check position of selector and adjust if required.
	Damaged fuel selector valve.	Replace fuel valve.
Fuel gauge fails to operate.	Broken wire.	Check and repair.
	Gauge inoperative	Replace.
	Circuit breaker open or fuse blown	Check and reset or replace.
	Incomplete ground.	Check ground connections at fuel transmitter in wings.
	Float and arm assembly of fuel transmitter in wing sticking.	Check fuel transmitter in wings and repair or replace.
Fuel gauge indicates full when tanks are not full	Incomplete ground on transmitter wire.	Check ground connections at fuel transmitter in wings.

TABLE IX-III. FUEL SYSTEM TROUBLESHOOTING (cont)

Trouble	Cause	Remedy
No fuel pressure indication.	Fuel valve stuck. No fuel in tanks.	Check valve. Check fuel level and fill.
	Defective fuel pump.	Check pump for pressure build up. Check diaphragm and relief valves in engine pump. Check for obstructions in electric pump. Check by-pass valve. Air leak in intake lines.
	Defective gauge	Replace gauge.
	Failure of fuel selector to be in proper position.	Check position of selector and adjust if required.
Pressure low or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty by-pass valve.	Replace.
	Faulty diaphragm.	Replace or rebuild pump.
Unidentified leak.	Fuel line damaged or improperly installed.	Locate and repair or tighten.
Fuel valve leaks.	Worn O-rings.	Replace O-rings or valve.

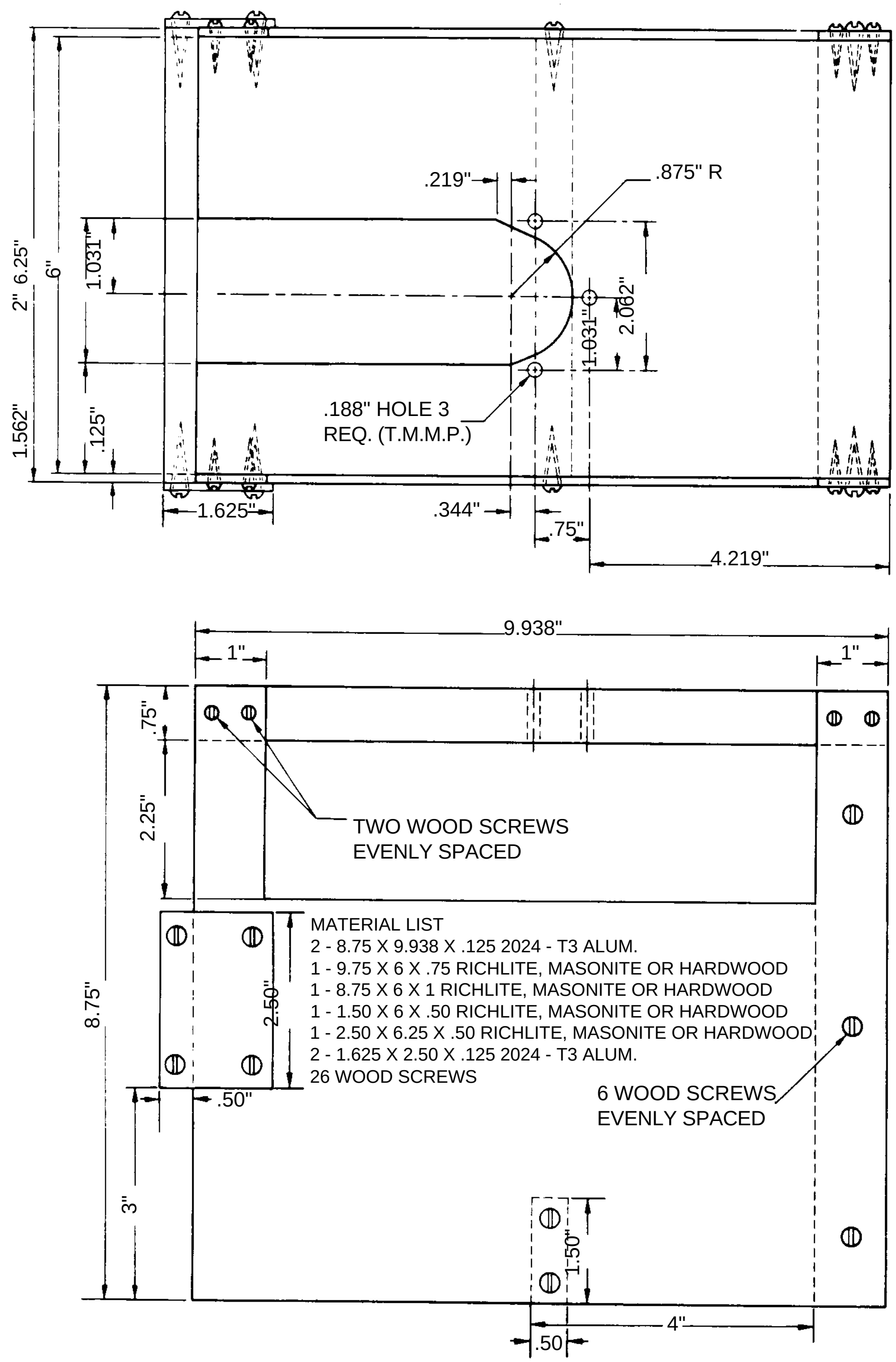

Figure 9-9 Fabricated Fuel Quantity Transmitter Checking Jig

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SECTION X
INSTRUMENTS

SECTION X

INSTRUMENTS

10-1. GENERAL.

The instrumentation 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 manufacture 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.

10-2. NON-ELECTRICAL INSTRUMENTS.

10-3. VACUUM SYSTEM.

10-4. 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, along with recommended service practices. These items include hoses, clamps, gyro filters, vacuum regulating valves, vacuum gauges and vacuum pumps.

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 suck these loose particles and eventually ingest 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 tape or compound. The AIRBORNE fittings are 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. If a thread lubricant is required, use a powdered moly sulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray. Apply sparingly to external threads of fittings only.

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 startups, 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 4.8 inches to 5.2 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.

2. This system installation employs a large central filter and differential vacuum gauge that continuously monitors the filter condition while indicating vacuum readings.

—NOTE—

This 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.

e. Vacuum Pump:

1. Before installation of fittings on pump, check for external damage. A pump that has been damaged or dropped should not be installed.

2. When a vise is used to secure the pump while installing fittings, caution must be exercised to avoid pump damage. The square mounting flange must be held between soft wood blocks and only at right angles to the vise jaws. Use only enough vise pressure to hold the pump firmly. Do not apply vise pressure to the outside diameter or overall length of the pump.

3. With the pump properly secured in the vise, insert fittings into the ports and hand tighten firmly; then using a wrench, tighten each fitting from one-half to two additional turns.

—NOTE—

Do not use pipe tape, thread dope, hydrocarbon oil or grease, as these can contaminate the pump and cause malfunction.

10-5. TROUBLESHOOTING. (Refer to Table X-l of this section.)

10-6. SUCTION GAUGE.

10-7. GENERAL. The suction gauge is mounted in the right side of the instrument panel above the hour meter. This gauge is calibrated in inches of mercury and has a direct pressure line and vent line. Therefore,the gauge indicates 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.

10-8. TROUBLESHOOTING. For troubleshooting of this instrument, refer to Table X-I of this section.

10-9. VACUUM REGULATOR VALVE

10-10. 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.

10-11. TROUBLESHOOTING. For troubleshooting of the vacuum regulator, refer to Table X-I.

10-12. 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 running at medium RPM, the suction gauge should indicate 4.8 to 5.2 inches of mercury. If the pressure reading fails to fall within this range, shut down the engine and adjust the regulator valve by moving the valve adjustment screw clockwise to increase the pressure, and counterclockwise to decrease the pressure. Start the engine and repeat the check. With engine running at medium RPM, the suction gauge should indicate 4.8 to 5.2 inches of mercury. If the airplane is not equipped with a suction gauge. it will be necessary to connect a gauge by removing the plug from the back of the artificial horizon, and attaching a temporary gauge.

d. Restart the engine and repeat the check.

e. After the system pressure has been adjusted to these recommended settings, remove the gauge and install the plug, replace the protective cap or retighten the lock nut. whichever applies to the type of valve installed .

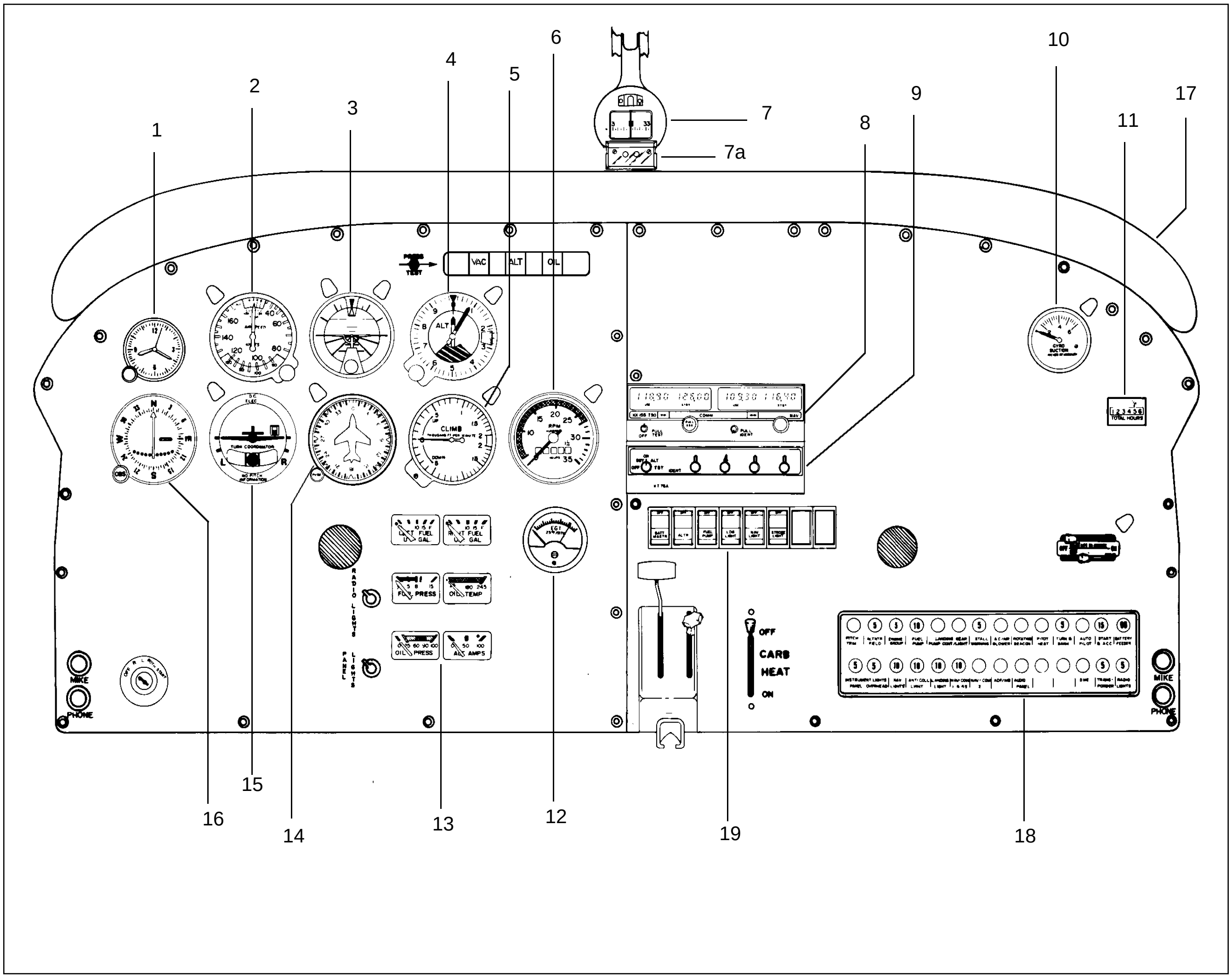


Figure 10-1. Instrument Panel (Typical)

1. CLOCK
2. AIRSPEED INDICATOR
3. ATTITUDE GYRO
4. ALTIMETER
5. RATE OF CLIMB
6. TACHOMETER
7. COMPASS
7a. COMPASS CARD
8. NAV/COM TRANSCEIVER
9. TRANSPONDER
10. SUCTION GAUGE
11. ENGINE HOUR METER
12. EXHAUST GAS TEMPERATURE (OPTIONAL)
13. ENGINE CLUSTER ASSEMBLY
    FUEL QUANTITY LEFT
    FUEL QUANTITY RIGHT
    FUEL PRESSURE
    OIL TEMPERATURE
    OIL PRESSURE
    AMMETER
14. DIRECTIONAL GYRO
15. TURN COORDINATOR (ELECTRIC)
16. INDICATOR-VOR/LOC
17. GLARESHIELD ASSEMBLY
18. CIRCUIT BREAKER PANEL
19. SWITCH PANEL

TABLE X-I. VACUUM SYSTEM

Trouble	Cause	Remedy
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 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.
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.

TABLE X-I. VACUUM SYSTEM (cont.)

Trouble	Cause	Remedy
Vacuum correct but pilot reports pressure erratic or shows complete loss in flight.	Regulator sticky. Oil in pump due to leaky engine seal or cleaning fluid blown into pump while cleaning engine.	Clean regulator. Replace pump.
Pressure can only be maintained at full throttle on ground.	Leak in system. Worn pump. Stuck regulator.	Repair or replace lines. Replace pump. Clean or replace regulator.

10-13. VACUUM PUMP.

10-14. 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 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.

10-15. TROUBLESHOOTING. For troubleshooting of the pumps, refer to Table X-l of this section.

10-16. REMOVAL OF VACUUM PUMP. 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 removing the four retaining nuts, lock washer and plain washers.

10-17. REPLACING PUMP FITTINGS.

a. Before installing any fittings on the pump, check for any external damage. A pump that has been damaged or dropped should not be installed.

b. When a vise is used to hold the pump while installing fittings, suitable caution must be exercised to avoid pump damage. The square mounting flange must be held between soft wood blocks and only at right angles to the vise jaws. Use only enough vise pressure to hold the pump firmly.

—CAUTION —

DO NOT apply vise pressure to the outside diameter or overall length of the pump.

c. The ports of the AIRBORNE pump have been treated with a dry film lubricant and the AIRBORNE fittings are cadmium plated thus eliminating any need for thread lubricants. If thread lubricant is required, use a powdered moly-sulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray. Apply sparingly to external threads of fittings only.

—CAUTION—

DO NOT use pipe tape, thread dope, hydrocarbon oil or grease, as these can contaminate the pump and cause malfunction.

d. With the pump properly secured in the vise, insert fittings in ports and hand tighten firmly.
e. Using a wrench, tighten each fitting from one-half to two additional turns.

10-18. INSTALLATION OF VACUUM PUMP

a. Place the pump gasket in its proper place and align the spline on the pump drive with the spline on the engine drive assembly.

—CAUTION—

The only pump mounting gasket authorized and approved for use on the Airbome vacuum pump is the Airbome 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.

b. Secure the pump to the engine with four plain washers, lock washers and retaining nuts. Torque the nuts 40 to 5O inch-pounds.
c. Connect the hoses to the pump and secure with hose clamps.
d. Reinstall the engine cowling.

10-19. AUXILIARY VACUUM PUMP.

10-20 GENERAL.

The auxiliary dry air pump system provides an independent backup source of pneumatic power to operate the gyro flight instruments in the event the engine driven air pump fails. The system consists of a 14 VDC electrically driven dry air pump that connects to the pneumatic system through a manifold downstream of the vacuum regulator. Isolation of the auxiliary from the primary system is provided by check valves in the manifold. The pump is controlled through a panel mounted switch that also incorporates annunciator lights to inform the pilot of the system operational status. Accumulated pump operating time is recorded by an elapsed time indicator installed under the instrument panel.

—note—

Poor system installations and maintenance practices will reduce the maximum altitude at which a given vacuum can be obtained

10-21. SYSTEM ADJUSTMENT AND FUNCTIONAL CHECKS.

—Note—

In-service time for the 4A3- 1 auxiliary pump/motor assembly is limited to 500 hours actual pump operating time (established by the elapsed time indicator) or 10 years whichever occurs first. Under normal usage, 500 hours of pump operating time is equivalent to 8000 or more aircraft operating hours

10-22. VACUUM REGULATOR SETTING - AUXILIARY PUMP OFF

a. The aircraft vacuum regulator should be set to obtain 5.0 ± .2 in. Hg. on the instrument panel vacuum gage. If adjustment is required perform the following steps.

1. Remove the central air filter.
2. Operate engine at medium =R.P.M. on the ground
3. Adjust regulator to obtain 4.8 to 5.2 in. Hg.
4. Insure that the central air filter is clean. Reinstall the central air filter.

—Note—

If gage reading drops noticeably, install a new central air filter.

—Warning—

The basic aircraft pneumatic system must be properly maintained. If the vacuum regulator is adjusted to compensate for faults (leaks, pinched hoses, dirty filters, etc.) in the basic system, both the engine-driven pump and the auxiliary pump will be subjected to conditions that may produce high wear and/or premature failure.

10-23 AUXILIARY AIR PUMP FUNCTIONAL CHECK - ENGINE SHUT DOWN.

—Note—

If it is required to run the auxiliary pump for more than a couple of minutes, it is recommended that the aircraft have an APU connected.

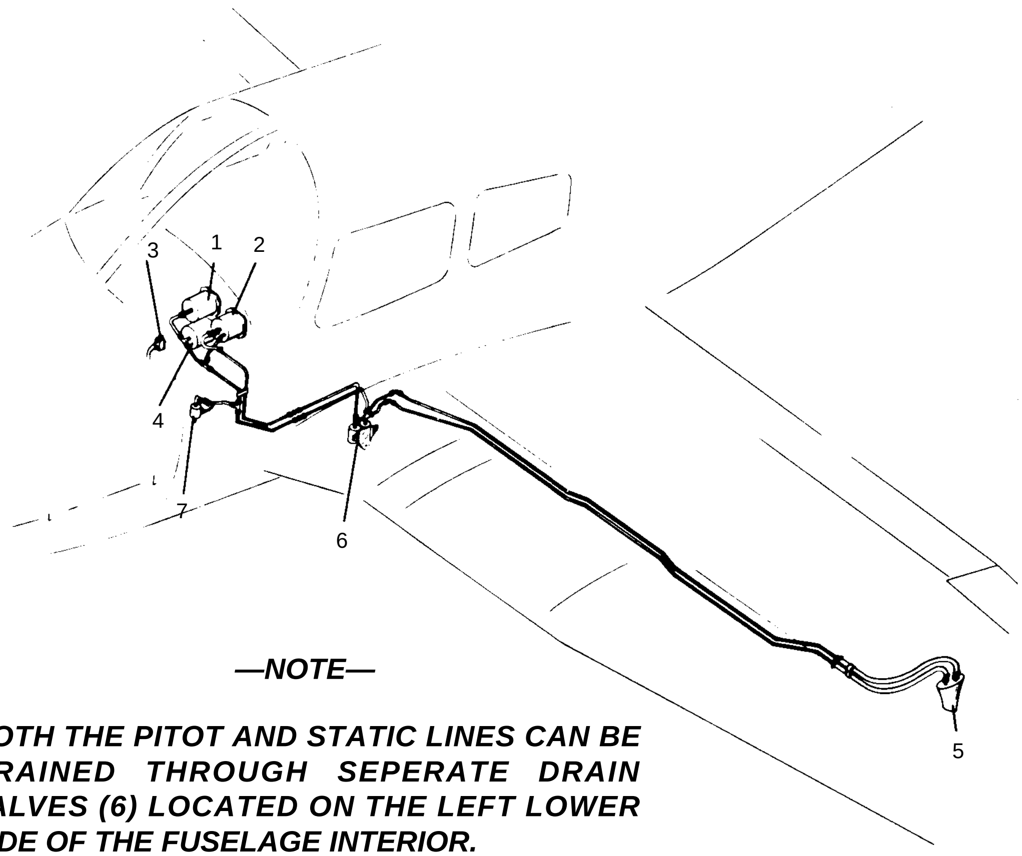
a. Turn aircraft master switch "on".

b. Check the "VAC OFF' side of the auxiliary dry air pump switch to see if it is illuminated. If not, trouble shoot the wiring system.

—Note—

The switch 'VAC OFF' light and the aircraft annunciator light should operate simultaneously.

c. Push in auxiliary dry air pump switch to cycle it to the "on" position.
d. Auxiliary pump "AUX ON" light should be illuminated.
e. The "VAC OFF" light should be extinguished shortly after pump is turned on.
f. Check vacuum gage for proper system vacuum 4.8 to 5.2 in. Hg.
g. After the operational check is complete, push in on the auxiliary pump switch to cycle to the "off" position.
h. The auxiliary pump "AUX ON' light should go off.
i. The "VAC OFF' should illuminate.
j. Turn aircraft master switch "off".
k. System operational check is complete.



—NOTE—

BOTH THE PITOT AND STATIC LINES CAN BE DRAINED THROUGH SEPERATE DRAIN VALVES (6) LOCATED ON THE LEFT LOWER SIDE OF THE FUSELAGE INTERIOR.

1. ALTIMETER
2. AIRSPEED INDICATOR
3. PITOT HEAT SWITCH
4. VERTIACAL SPEED INDICATOR
5. PITOT HEAD
6. DRAIN VALVES
7. ALTERNATE STATIC SOURCE

Figure 10-2. Pitot-Static System

10-24. AUXILIARY SYSTEM FUNCTIONAL CHECK - ENGINE RUNNING.

a. Start engine

b.Check to see that the "VAC OFF' light on the auxiliary pump switch is extinguished and the vacuum gage registers at the proper level. If not, trouble shoot the pneumatic system.

c. Turn the auxiliary pump on.

d. Check the " AUX ON' light for illumination.

e. Check to see the "VAC OFF" light is still extinguished and that the vacuum gage still registers at the proper level

f. Turn the auxiliary pump off.

g. Shut engine down.

10-25. MAINTENANCE AND SERVICE.

The auxiliary pump system should be inspected and functionally checked on a regular 100 hour/ annual basis. The following should be checked

a. Mounting hardware

b. Solenoid and noise filter

c. Motor cradle.

d. Motor and pump assembly

e. Hoses, fitting and clamps.

f. Vacuum switches.

g. Wire and electrical connectors.

h. Elapsed time indicator (ETI) - under/behind instrument panel.

10-26. REMOVAL/REPLACEMENT — PUMP/MOTOR ASSEMBLY.

—Note—

The motor/pump assembly (P/N 4A3 -1) must be replaced at 500 hours operating time as indicated on the elapsed time indicator (ETI) or at 10 years of installed time in the aircraft, whichever occurs first. The ETI (P/N F7 - 97 - 1) is matched to the pump/motor assembly and must also be removed and replaced at the same time.

a. Turn off aircraft master switch and auxiliary pump switch.

b. Disconnect hoses from the pump/motor assembly.

c. Disconnect electrical leads at terminals on pump/motor assembly. If a replacement assembly is not to be installed immediately, insulate and secure the lead ends.

d. Loosen band clamps and remove pump/motor assembly from aircraft.

e. Remove fittings from pump/motor assembly. If serviceable, save fittings for use with replacement pump.

—Warning—

Do not place pump or motor housing in a vise. Hold by hand when removing or tightening fittings.

f. Locate ETI under/behind instrument panel and disconnect electrical; leads. If a replacement ETI is not to be installed immediately, insulate and secure the leads remaining in the aircraft.

g. Remove ETI. If attached with adhesive backing, pry loose or slice tape with a flat blade, being careful not to scratch or cut any airframe components. Secure ETI to pump/motor assembly for later disposition.

—Note—

If a replacement auxiliary pump/motor assembly is not installed prior to the next flight, cover the auxiliary pump switch on the instrument panel with an "INOP' placard

h. Install replacement auxiliary pump/motor assembly by reversing the removal procedure.

—Caution—

Do not overtighten motor electrical terminal screws.

10-27. INFREQUENT AIRCRAFT OR AUXILIARY PUMP USAGE.
If the aircraft has been idle or the auxiliary pump has not been used for six months or more, the auxiliary pump should be checked out prior to IFR flight as follows:

a. Turn on the auxiliary pump and let it run continuously for approximately 20 minutes. (This can be done on the ground with the engine running or with an APU attached).

—Note—

An inflight operational test of the auxiliary air pump should be limited to 30 seconds or less. Continuous operation in flight when the engine driven pump is running is not recommended.

b. After running the pump continuously for approximately 20 minutes, check the entire system for proper operation according to section 10-23

10-28. ANNUNCIATOR LIGHT REPLACEMENT.
The annunciator lamps (P/N F7-94-1) in the auxiliary pump control switch are the sub-miniature T-1 3/4 flange base (type 330, or MS25273 - 330). To replace the lamps, pull the button off the switch and remove the lamps. Insert new lamps and press the switch button back in place.

10-29. ENGINE CLEANING PRECAUTIONS.
Protect the engine driven and auxiliary air pumps and manifold before cleaning the engine compartment. Cleaning solvents can enter the pneumatic system through the components and can reduce air pump life.

—Caution—

During engine cleaning, do not blast pneumatic system components with high pressure solvents of allow protective wraps to become saturated with solvents. Either case may allow fluid to enter the system and contaminate the pumps and manifold.

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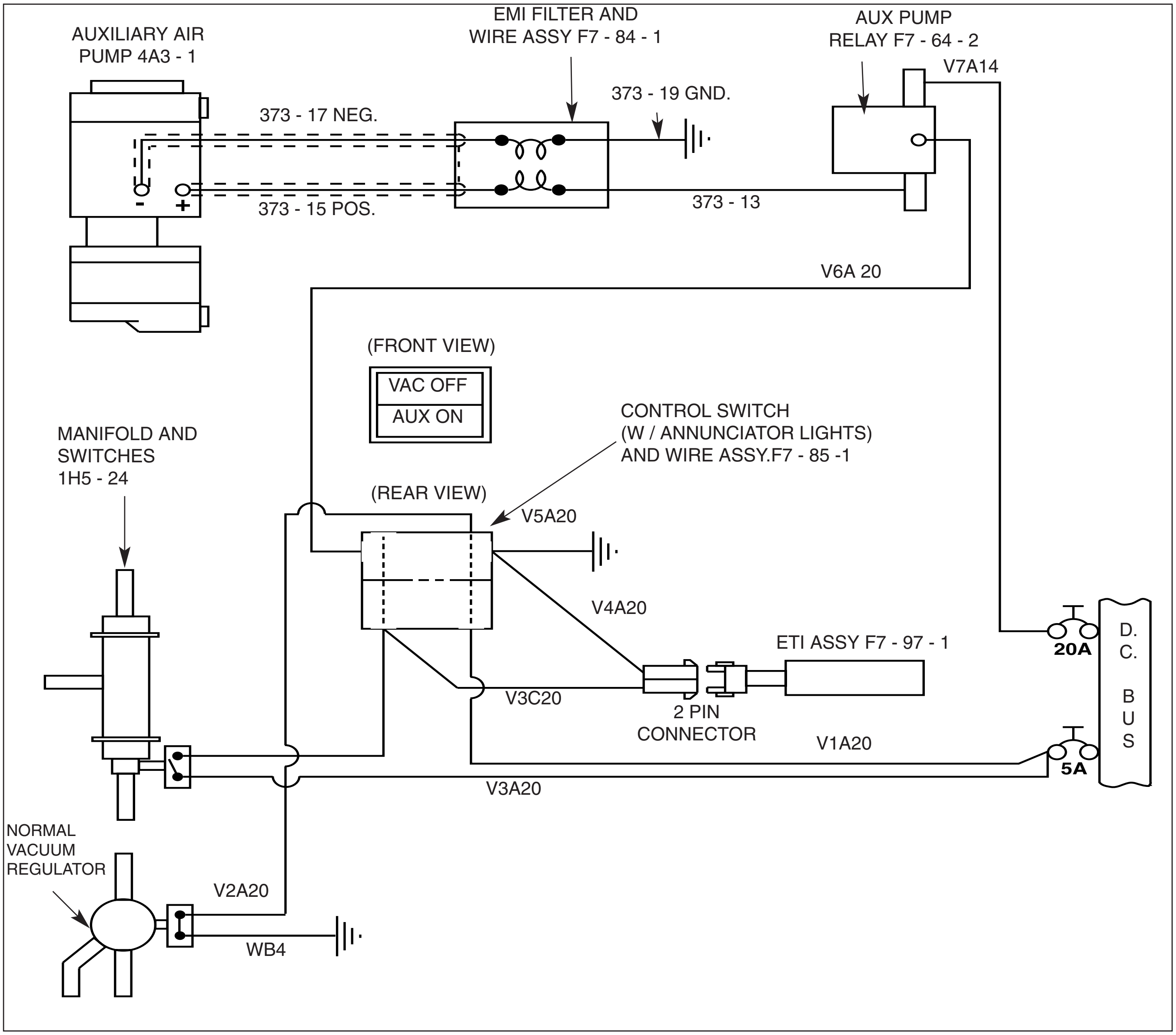


FIGURE 10 -3 AUXILIARY VACUUM SYSTEM

10-30. INSTRUMENT AIR SYSTEM. (Refer to Figure 10-2.)
The instrument air system consists of a pitot air system and a static air system. Refer to Figure 10-2 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.

10-31. DIRECTIONAL GYRO.

10-32 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.

10-33. TROUBLESHOOTING.

TABLE X-II. DIRECTIONAL GYRO INDICATOR

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	Reset per Paragraph 10-21.
	Defective instrument	Replace instrument.
	High or low vacuum. If vacuum is not correct check for the following:	
	a. Relief valve properly 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.

10-34. REMOVAL AND REPLACEMENT. (Refer to Paragraph 10-87 of this section.)

10-35. GYRO HORIZON.

10-36. 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.

10-37. TROUBLESHOOTING.

TABLE X-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 lines 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. instrument.	Loosen screws and level
	Aircraft out of trim	Trim aircraft.
Bar high after 180^{o} 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.

10-38. REMOVAL AND REPLACEMENT. (Refer to Paragraph 10-87 of this section.)

10-39. RATE OF CLIMB INDICATOR.

10-40. 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.

10-41. TROUBLESHOOTING.

TABLE X-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.
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.

10-42. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-87 of this section.

10-43. SENSITIVE ALTIMETER.

10-44. 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 thousandths 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.

10-45. TROUBLESHOOTING.

TABLE X-V. ALTIMETER

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
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.
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.

TABLE X-V. ALTIMETER (cont.)

Trouble	Cause	Remedy
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.	Replace instrument.
Barometric scale and reference markers out of synchronism.	Slippage of mating parts.	Replace instrument.
Barometric scale and reference markers out of synchronism with Pointers.	Drift in mechanism.	Reset pointers. refer to the latest revision of AC 43 13-1

—NOTE—

When any connections in the static system are opened for checking. system must be rechecked per F.A.R. 23.1325.

10-46. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-87 of this section.

10-47. AIRSPEED INDICATOR.

10-48. 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 a 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.

10-49. TROUBLESHOOTING.

TABLE X-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 blowout lines from cockpit to pitot head.

—NOTE—

When any connections in static system are opened for checking. system must be rechecked per F.A.R. 23.1325.

10-50. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-87 of this section.

10-51. MAGNETIC COMPASS.

10-52. 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.

10-53 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 the same as Step d, adjusting E-W adjustment screw.

f. Head aircraft in successive magnetic 30° headings and record compass readings on appropriate deviation card. Deviations must not exceed ± 10°on any heading.

10-54. TROUBLESHOOTING.

TABLE X-VII. MAGNETIC COMPASS

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated. External magnetic interference.	Compensate instrument. (Refer to Paragraph 10- 53) Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace instrument.
Card sluggish.	Weak card magnet. Excessive pivot friction or broken jewel.	Replace instrument. Replace instrument.
Liquid leakage.	Loose bezel screws. Broken cover glass. Defective sealing gaskets.	Replace instrument. Replace instrument. Replace instrument.
Discolored markings.	Age.	Replace instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity or 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.	

10-55. TACHOMETER INDICATOR.

10-56 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

10-57. TROUBLESHOOTING.

TABLE X-VIII. TACHOMETER

Trouble	Cause	Remedy
No reading on indicator either permanent or intermittent.	Broken shaft.	Replace instrument.
Pointer oscillates excessively.	Loose cable connections.	Tighten cable.
	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.

10-58. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-87 of this section.

10-59. ENGINE OIL PRESSURE GAUGE.

10-60. 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.

10-61. ENGINE OIL PRESSURE GAUGE CALIBRATION. A calibration chart has been included for use in verifying that the suspect faulty gauge is within tolerance.(Refer to Figure 10-4 .)

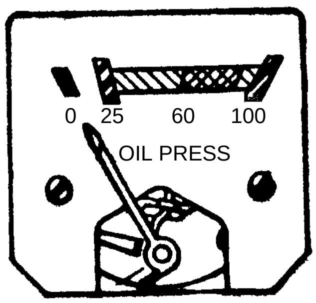
—Note—

Actual recalibration of the gauge must be preformed by the manufacturer or an approved instrument repair facility

CALIBRATION CHART		
GRADUATION	DEGREES FROM ZERO	TOLERANCE *
0#	-30°	±1
25#	-14.5°	±1/2
60#	+8°	±1
90#	+24°	±1
100#	+30°	±1/2

—NOTE—

TOLERANCE IS IN POINTER WIDTHS



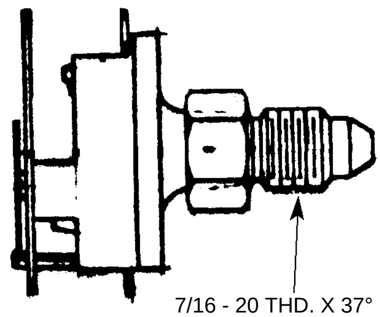


Figure 10-4. Engine Oil Pressure Gauge

10-62. TROUBLESHOOTING.

TABLE X-IX. 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 valve.	Disconnect line and fill with light oil. Check for leaks. If trouble persists, clean and adjust relief valve.
Sluggish operation ofpointer or pressure fails to build up.	Engine relief valve open.	Clean and check.

10-63. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-89 of this section.

10-64. FUEL PRESSURE GAUGE.

10-65. 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.

10-66. FUEL PRESSURE GAUGE CALIBRATION. A calibration chart has been included for use in verifying that the suspect faulty gauge is within tolerance.(Refer to Figure 10-5.)

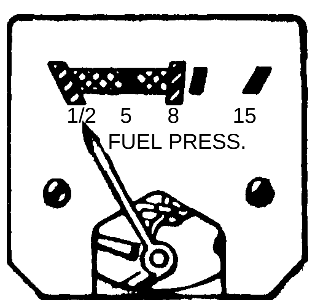
—Note—

Actual recalibration of the gauge must be preformed by the manufacturer or an approved instrument repair facility

CALIBRATION CHART		
GRADUATION	DEGREES FROM ZERO	TOLERANCE *
1/2#	-29°	-1/2 +0
5#	-11.5°	±1
8#	0°	±1/2
10#	+9.5°	±1
15#	+30°	±1

—NOTE—

TOLERANCE IS IN POINTER WIDTHS



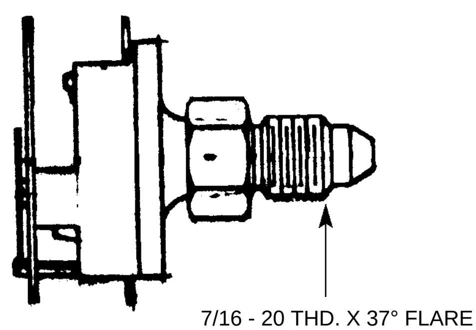


Figure 10-5. Fuel Pressure Gage

10-67. TROUBLESHOOTING.

TABLE X-X. 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 or 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.

10-68. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-89 of this section.

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10-69. ELECTRICAL INSTRUMENTS.

l0-70. TURN AND BANK INDICATOR.

10-71. GENERAL. The turn and bank indicator is an electrical instrument. The turn portion of the indicator is driven by a permanent magnet DC governor controlled gyro motor. Damping action is provided by a precision air dashpot. The indicator is designed to indicate the rate of turn and roll; 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. The bank portion of the indicator is a ball sealed in a curved glass tube filled with damping fluid. In an improperly coordinated turn the ball is forced from the center of the tube, thus indicating attitude error.

10-72. TROUBLESHOOTING.

TABLE X-XI. 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	Out of calibration.	Replace instrument.
	Aircraft not in coordinated turn.	Center ball in turn.
Instrument will not run.	No power to instrument.	Check circuit and repair.
	Instrument malfunction.	Replace instrument.

10-73. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-87 of this section.

10-74. FUEL QUANTITY INDICATOR. Refer to paragraph 9- 15 of Section IX.

10-75. GENERAL. The two fuel quantity gauges are mounted in the cluster on the instrument panel. These instruments are calibrated in fractional divisions of zero, 5gal., 10 gal., 15 gal. and full. A transmitter unit is installed in each fuel cell. This unit contains a resistance strip and removable 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.

10-76. TROUBLESHOOTING.

TABLE X-XII. 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.

10-77. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-89 of this section.

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10-78. OIL TEMPERATURE INDICATOR.

10-79. 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.

10-80. ENGINE OIL TEMPERATURE GAUGE CALIBRATION. A calibration chart has been included for use in verifying that the suspect faulty gauge is within tolerance.(Refer to Figure 10-6 .) The gauge may be checked as follows:

—Note—

Actual recalibration of the gauge must be preformed by the manufacturer or an approved instrument repair facility

a. With the instrument installed in the aircraft, the aircraft power connected (14 VDC) and the ground connected.

b. Remove the connection to the terminal marked SEND and connect a specified amount of resistance as indicated on the chart, by use of a fixed resistor or a test unit capable of simulating the resistance indicated on the chart (Power Resistor Decade Box)

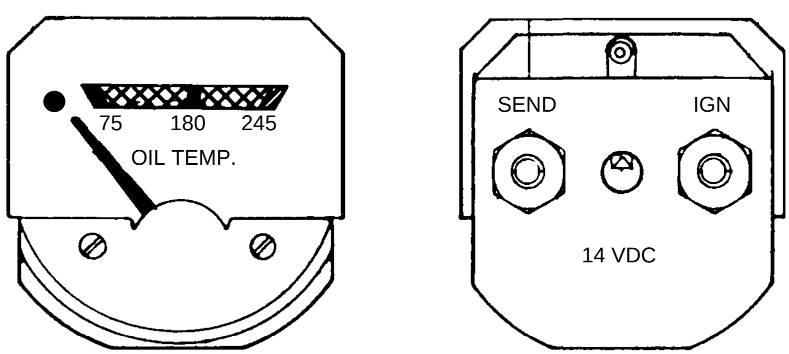
c. If the gauge does not meet the tolerances set forth in the chart, it must be replaced or recalibrated.

d. Reinstallation is the reverse of the procedure used to remove it

CALIBRATION CHART			
GRADUATION	OHMS	DEGREES	TOLERANCE *
DOT	MECH. ZERO	-40*	±1/2
75°F.	903 OHMS	-331/2°	±1
180°F.	100 OHMS	+12 1/2°	±1
245° F.	36 OHMS	+35°	+1 -0

***—NOTE—**

TOLERANCE IS IN POINTER WIDTHS



Figuer 10-6 Oil Temperature Gauge

10-81. TROUBLESHOOTING.

TABLE X-XIII. OIL TEMPERATURE INDICATOR.

Trouble	Cause	Remedy
Instrument fails to show any reading.	Broken 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.

10-82. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-89 of this section.

10-83. AMMETER.

10-84. GENERAL. The ammeter is mounted in the instrument panel. This instrument measures the output of the alternator into the entire electrical system including the battery charging demand.

10-85. TROUBLE SHOOTING. Refer to Section XI. (Alternator Section)

10-86. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-89 of this section.

10-87. REMOVAL AND REPLACEMENT OF FACE MOUNTED INSTRUMENTS.

10-88. GENERAL. Since an 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.

—CAUTION—

DO NOT use thread lube on fittings or in ports. The use of thread lube can cause contamination which shortens the life expectancy of the gyro and can cause premature failures. Any evidence of thread lube will create a WARRANTY VOID CONDITION. Make sure that all air lines are clean and free of foreign particals and/or residue before connecting lines to gyro.

c. The use of teflon tape on fitting threads is recommended and should be installed in the following manner:

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" overlap is sufficient.
3. After wrap is complete, maintain tension and tear tape by pulling in direction of wrap. The ragged end is the key to the tape staying in place. (If sheared or cut, tape may loosen.)
4. Press tape well into threads.
5. Screw fitting into port being careful not to exceed torque requirements as noted on decal located on cover of gyro.

d. Installation of the instruments will be in the reverse order 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.

10-86. REMOVAL AND REPLACEMENT OF CLUSTER MOUNTED INSTRUMENTS

10-87. GENERAL. A cluster, located on the instrument panel, contains 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.

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10-92. PIPER AUTO CONTROL SYSTEM. (See Auto Control Service Manual)

10-93. ANNUNCIATOR PANEL.

10-94. 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 10-1.) 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 OIL light when the oil pressure is below 35 psi. A test button is included to check the operation of the lights.

10-95. TROUBLESHOOTING. Refer to Table XI-VI.

10-96. REMOVAL AND REPLACEMENT. Refer to Paragraph 10-85.

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SECTION XI

ELECTRICAL SYSTEM

Paragraph | Aerofiche Grid No.

TABLE Xl-l. ELECTRICAL SCHEMATIC INDEX

SECTION XI

ELECTRICAL SYSTEM

11-1. INTRODUCTION. This section contains instructions and schematics for correcting difficulties which may arise in the operation of the electrical system in the aircraft.

The instructions are organized so the mechanic can refer to: Description and Principles of Operation for a basic understanding of the various electrical systems; Troubleshooting for a methodical approach in locating the difficulty; Corrective Maintenance for removal, repair and installation of components; and adjustments and tests for operation of the repaired system.

Schematics for the individual systems are located at the end of this section. For information concerning electronic equipment, refer to Section Xll, Electronics.

11-2. DESCRIPTION Electrical power is supplied by a 14-volt. direct current. negative ground electrical system. A 12-volt battery is incorporated into the system to furnish power for starting and as a reserve power source in case of alternator failure. The battery is located forward of the firewall on the right side of the airplane. Access to the battery is gained by releasing the cowl fasteners and lifting up the engine cowl

The electrical generating system consists of an engine driven 60 ampere alternator. A solid state voltage regulator maintains the system bus voltage at 14 volts. Also incorporated is an over voltage relay,which prevents damage to electrical and avionic equipment in case of regulator malfunction. The loads from the electrical bus system are protected by manual reset type circuit breakers mounted on the lower right hand side of the instrument panel.

The master switch must be on before any electrical equipment will operate. The master switch controls the battery relay and field circuit. The switch is a double pole single throw type.

The lighting system for night time operation is optional equipment and consists of a landing light, anti-collision lights and navigation lights.

11-3. TROUBLESHOOTING. Troubles peculiar to the electrical system are listed in Table XI-VI at the back of this section along with their probable causes and suggested remedies. The wiring diagrams included in the 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 system for security and operation of its components.

11-4. ALTERNATOR SYSTEM. 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 regardless of 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.

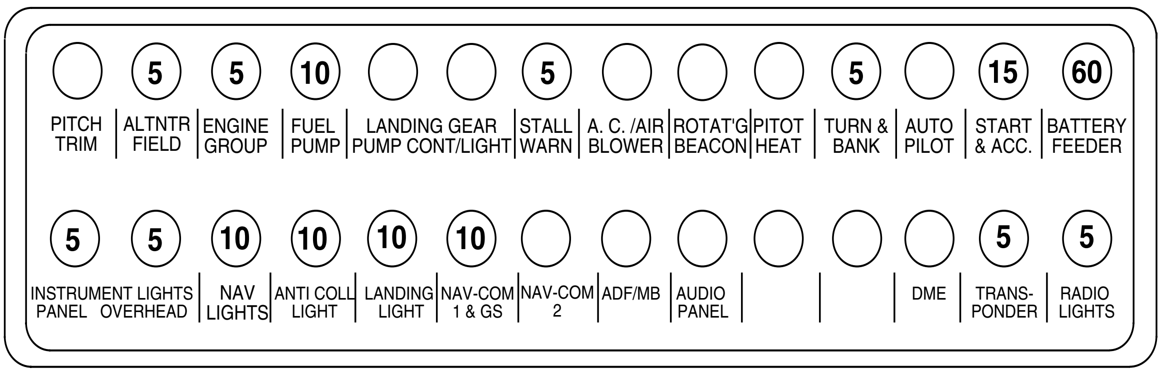

Figure 11-1 Instrument Panel (Circuit Breaker Panel)

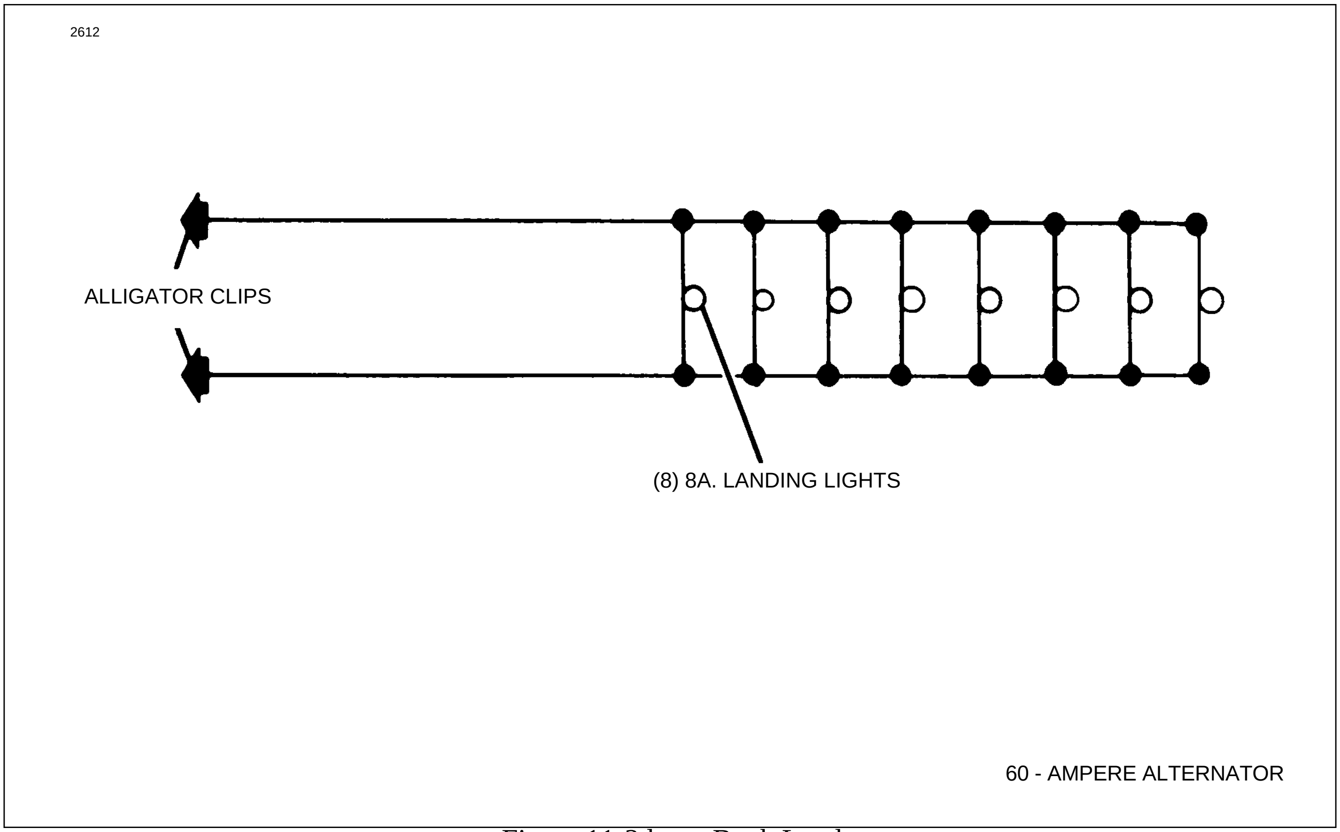

Figure 11-2 lamp Bank Load

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.

There is a circuit breaker which control the generating system.marked "Alternator Field." the breaker is to protect the alternator and electrical system from overload. The circuit breaker is for the voltage regulator and alternator field. If the the field circuit breaker trips, it will result in a complete shut down of power from the generating system. After a one or two minute cool down period, the breaker can be reset manually. If tripping reoccurs, this indicates a short in the alternator circuit.

The ammeter does not indicate battery discharge, but displays the load in amperes placed on the generating system. With all electrical equipment off, except the master switch, the ammeter will indicate the amount of charging current demanded by the battery. This amount will vary depending on the percent 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 example is kept in mind.

EXAMPLE

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 (10amps) 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.

—NOTE—

On airplanes without night flying equipment a simulated load can be made by connecting 8 landing lights wired in parallel from the main bus to airframe ground or fourteen 3 ohm, 100 watt resistors. (See Figure 11-2.)

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11-5. ALTERNATOR AND COMPONENTS

I1-6. DESCRIPTION OF ALTERNATOR. (See Figure 11-3.)

The principle 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 thru the brush holder. The brush and holder assembly can easily be removed for inspection or brush replacement purposes.

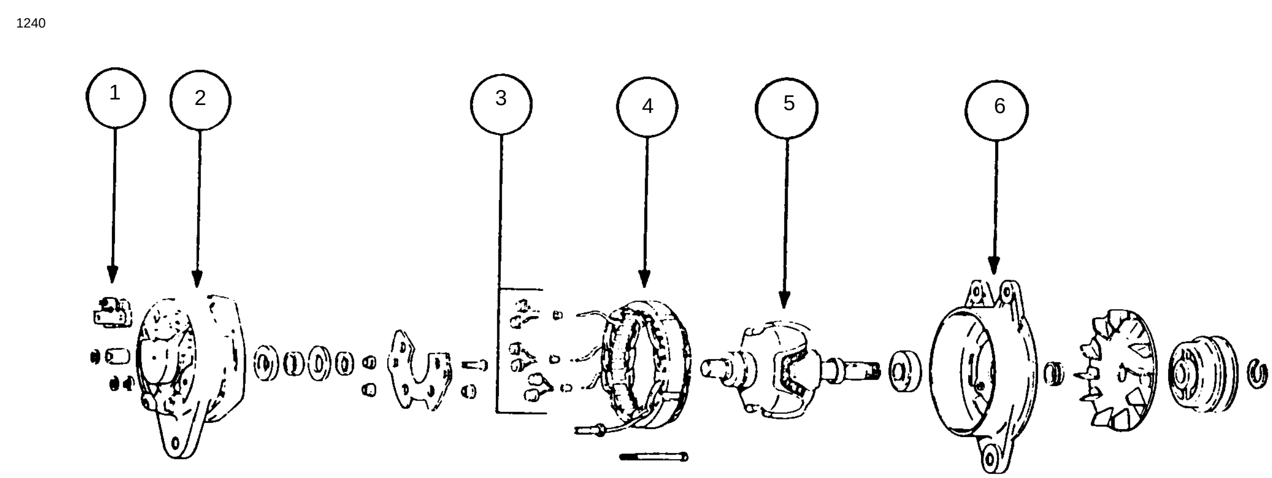
b. The slip ring end head provides the mounting for the rectifiers and rectifier mounting plate, output and auxiliary terminal studs, and the brush and holder assembly. The slip ring end head contains a roller bearing and outer race assembly and a grease seal.

c. The rectifiers used in these units are rated at 150 peak inverse voltage (PIV) minimum for transient voltage protection. Three positive rectifiers are mounted in the rectifier mounting plate while the three negative rectifiers are mounted in the slip ring end head. Each pair of rectifiers is connected to a stator lead with high temperature solder. The stator leads are anchored to the rectifier mounting plate with epoxy cement for vibration protection.

d. The stator contains a special lead which is connected to the center of the three phase windings. 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



1. BRUSH HOLDER
2. SLIP RING END HEAD
3. RECTIFIERS
4. STATOR
5. ROTOR
6. DRIVE END HEAD

.Figure 11-3 Exploded View of Alternator

11-7. CHECKING ALTERNATOR SYSTEM. An ammeter is used which enables an independent output check of the alternator, as well as the electrical output-input of the battery. Should the alternator show no output on the ammeter, check the circuit breakers of the alternator. If a further check of the ammeter shows no output from the alternator, check the alternator system. (Refer to appropriate alternator and starter schematic.).

a. Ascertain that the ammeter is operating properly.

b. Disconnect the battery lead (+) at the alternator.

c. Disconnect field leads at the alternator.

d. Ascertain that all electrical units are off and the battery is fully charged.

e. Turn on the master switch.

f. To check the alternator output circuit, connect a voltmeter or 12 volt test light to the battery lead and to ground. If a reading of approximately 12 volts registers on the voltmeter or the test light lights,the battery circuit is operational.

g. Should there be no indication of voltage, trace back through the output circuit until voltage is indicated. (Refer to appropriate alternator and starter schematic.) A component that allows no voltage to pass through it should be replaced.

h. Check the field circuit by the following procedure:

1. On lead connected to (F-l) terminal, connect a voltmeter to the field lead and to Ground. If the voltmeter indicates any voltage, the circuit is operational.

i. If voltage is indicated at both the battery lead and field lead, the alternator should be checked for possible malfunction. (Refer to Paragraph 11-9.)

11-8. SERVICE PROCEDURES. Since the alternator and regulator are designed for use on only one polarity system, the following procedures must be observed when working on the charging circuit. Failure to observe these service procedures will result in serious damage to the electrical equipment.

a. When installing a battery, always make sure the ground polarity of the battery and the ground polarity of the alternator are the same.

b. When connecting a booster battery, make certain to connect the negative battery terminals together and the positive battery terminals together.

c. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.

d. Never operate the alternator on an open circuit. Make absolutely certain all connections in the circuit are secure.

e. Do not short across or ground any of the terminals on the alternator or regulator.

f. Do not attempt to polarize the alternator.

11-9. OVERHAUL OF ALTERNATORS. When repairing the alternator, complete disassembly may not be required. In some cases it will only be necessary to perform those operations which are required to effect the repair. However, in this section, the complete overhaul is covered step by step to provide detailed information on each operation. In actual service practice these operations may be used as required.

11-10. DISASSEMBLY OF ALTERNATORS.

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, wodruff 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 bushing. Using the special tools shown in Figure 11-5, support the end head and press out the three rectifiers. The end head can now be separated from the stator assembly.

e. To remove the slip ring end bearing and grease seal, it will be necessary to have a hook type or impact type bearing puller as shown in Figure 11-6. 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.

f. To remove the drive end head from the rotor shaft, use a puller that grips on the bearing retainer plate as shown in Figure 11-7. Do not attempt to remove by supporting the end head and pressing on the shaft, as this may result in distortion of the end head or stripping of the retainer plate screws. Remove the three retainer plate screws and press the bearing out of the end head. (Refer to Figure 11-7.)

11-11. INSPECTION AND TESTING OF COMPONENTS. Upon completion of disassembly, all parts should be cleaned and visually inspected for cracks, wear or distortion and any signs of overheating or mechanical interference.

a. Rotor: The rotor should be tested for grounded or shorted windings. The ground test can be made with test probes, connected in series with a 110 volt test lamp, an ohmmeter or any type of continuity tester. (Refer to Figure 11-8). 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 11-9, or use an ohmmeter. Rotor current draw and resistance are listed in Paragraph 11-16 and Table XI-II. Excessive current draw or a low ohmmeter reading indicates shorted windings. No current draw or an infinite ohmmeter reading would indicate an open winding.

b. Rectifiers: A diode rectifier tester will detect and pinpoint open or shorted rectifiers without going through the operation of disconnecting the stator leads. However, if a tester is not available, test probes and a No. 57 bulb, connected in series with a 12 volt battery, can be used in the following manner. Touch one test probe to a rectifier heat sink and the other test probe to a lead from one of the rectifiers in that heat sink. Then reverse the position of the leads. The test bulb should light in one direction and not light in the other direction. If the test bulb lights in both directions, one or more of the rectifiers in that heat sink is shorted. To pinpoint the defect he 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 other stator lead, and the other test bulb or ohmmeter probe to the stator frame. If the test bulb lights, or 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.

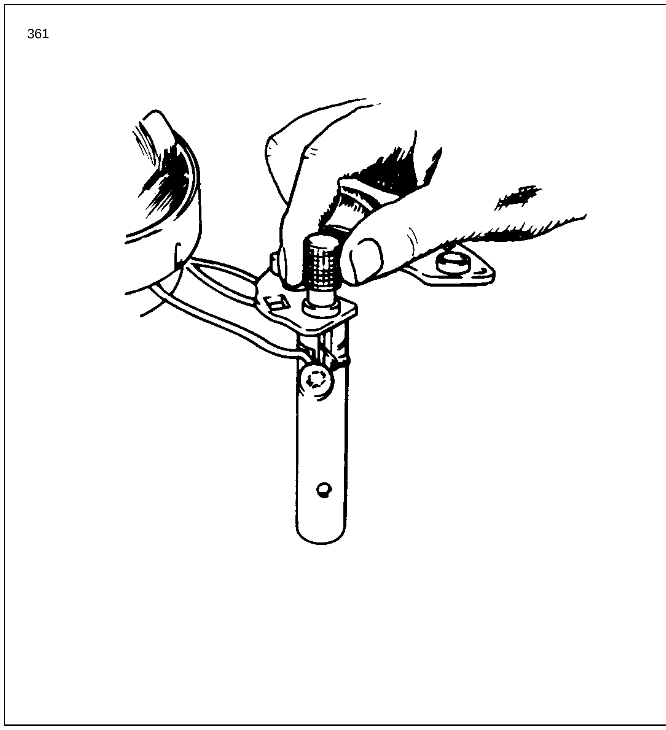


Figure 11-4 Removal of Rectifer

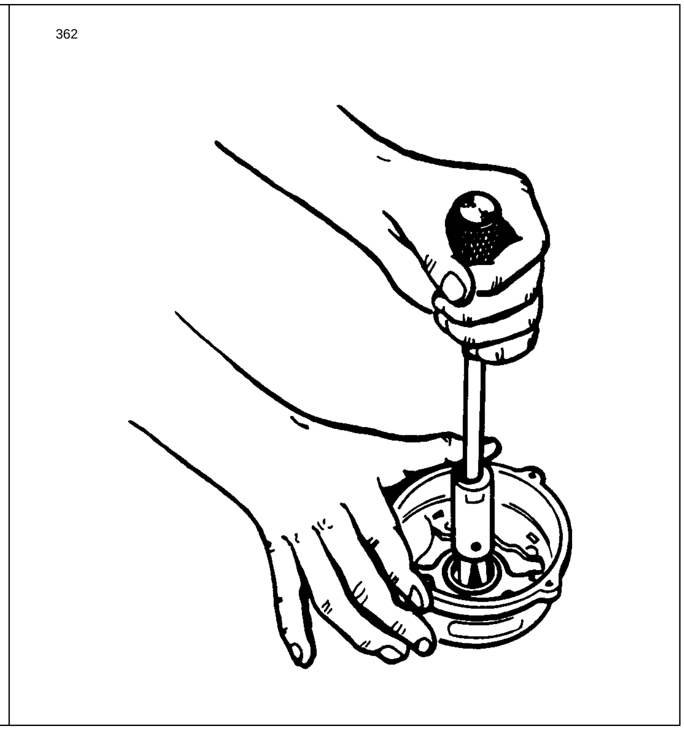


Figure 11-5 Removal of Slip Ring End Bearing

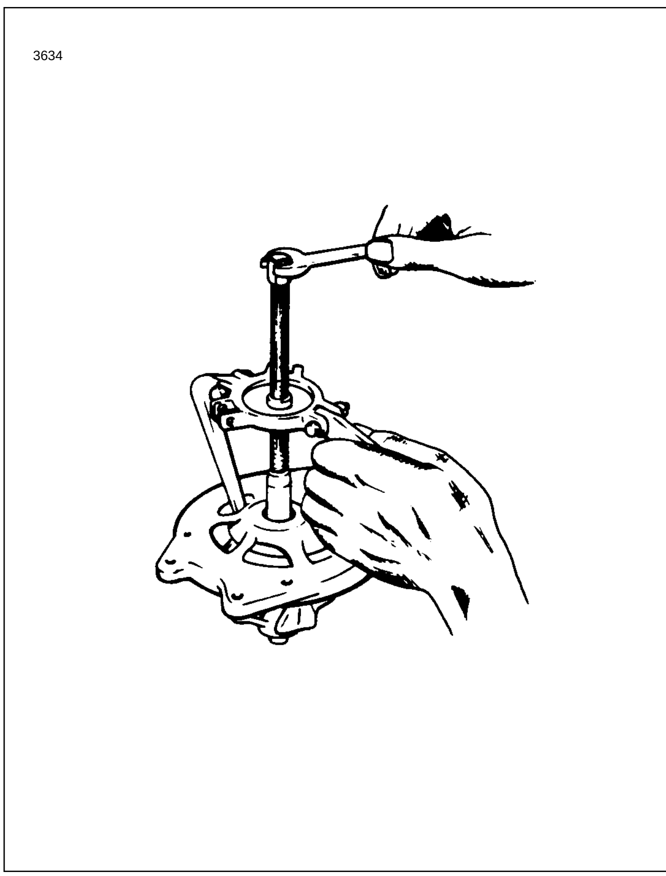


Figure 11-6 Removal of Drive End Head

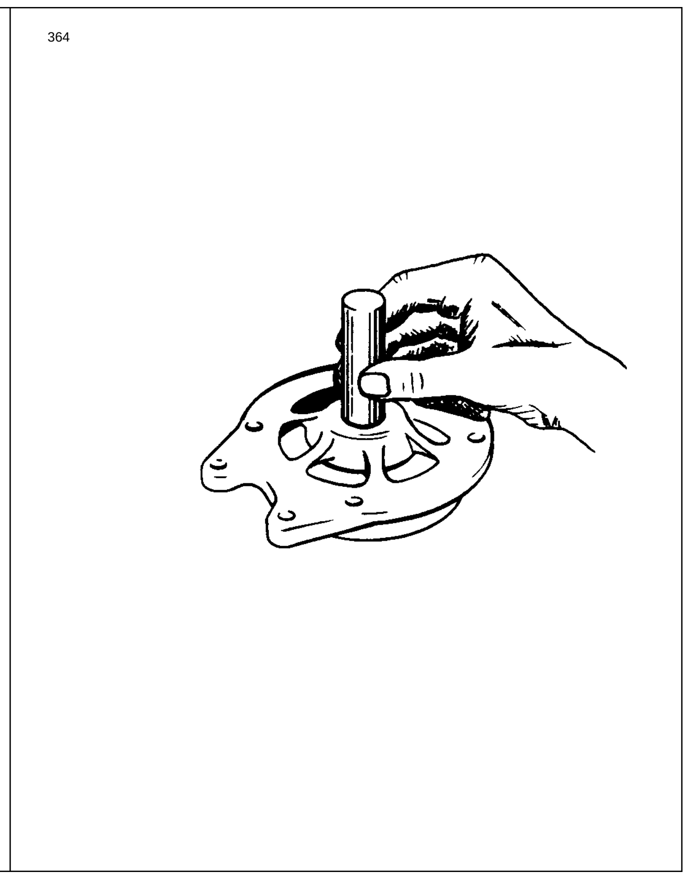


Figure 11-7 Removal of End Head Bearing

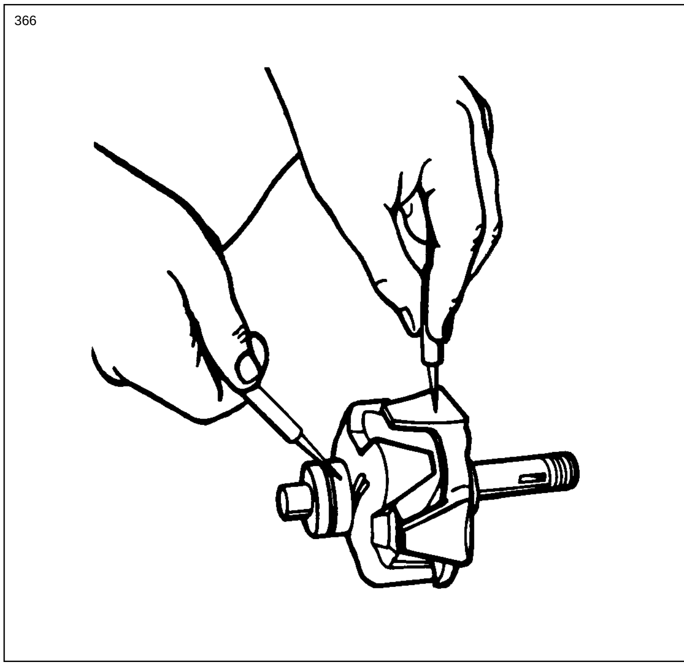


Figure 11-8 Testing Rotor for Grounds

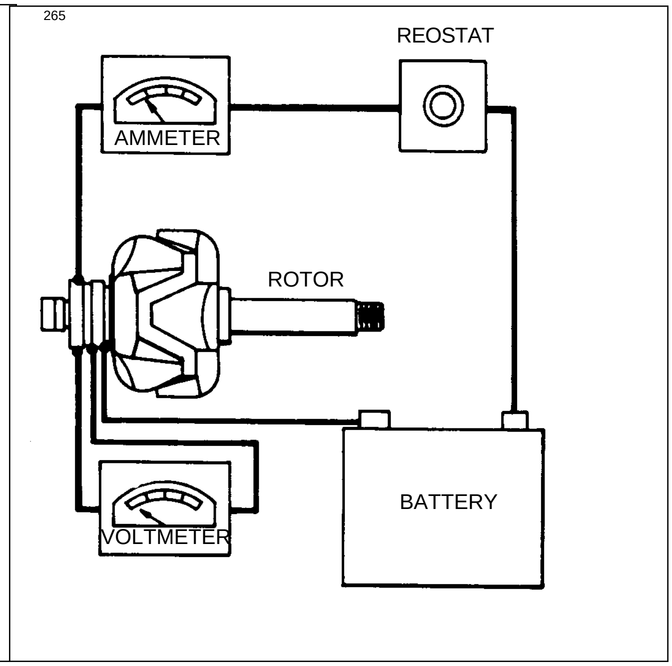


Figure 11-9 Testing Rotor for Shorts

d. Bearing and Seals: Whenever the alternator is overhauled, new bearings and oil or grease seals are recommended, even though the bearing and seals appear to be in good condition. A faulty seal can cause an alternator to fail within a very short period of time.

11-12. ASSEMBLY OF ALTERNATOR.

a. Press the ball bearing into the drive end head using a flat block approximately two inch square so that the pressure is exerted on the outer race of the bearing. Install the retainer plate. With the snap ring and retainer cup in place on the rotor shaft, use a tool that fits over the shaft and against the inner bearing race, and press until the inner bearing race is against the snap ring retainer cup. (Refer to Figure 11-10).

b. Carefully install the rectifier in the slip ring end head or rectifier mounting plate by supporting the unit and using the special tools illustrated in Figure 11-11.

—CAUTION—

Use an arbor press, do not hammer. Reconnect the stator leads to the rectifier. When soldering these connections use pliers as a heat sink on the lead between the solder joint and the rectifier. Too much heat will damage the rectifier.

c. Reassemble the rectifier mounting plate studs and insulators, making sure they are in the correct order. (Refer to Figure 11-12).

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 is as shown in Figure 11-13.

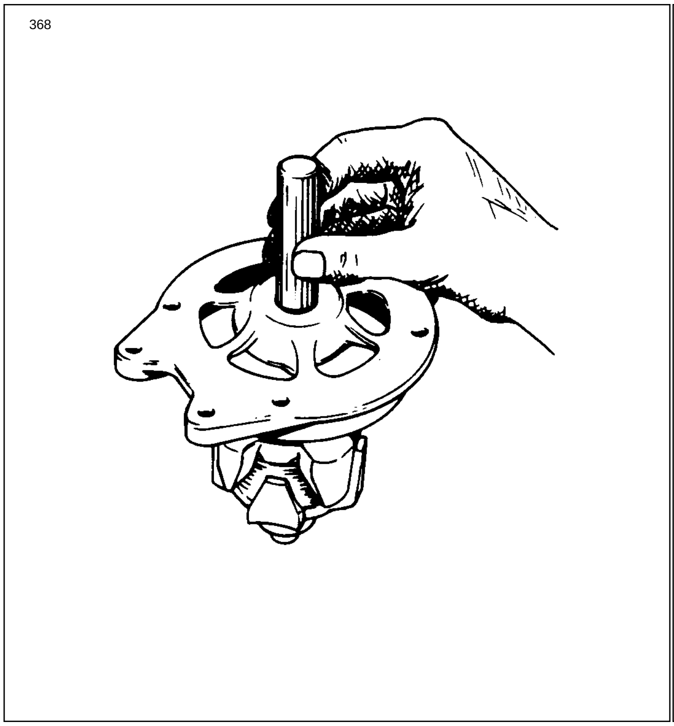


Figure 11-10 Installation of Bearing

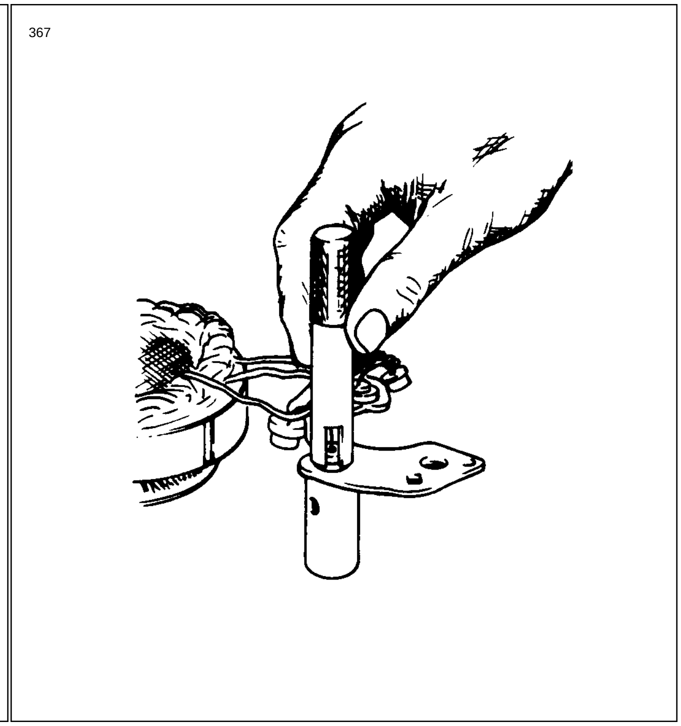


Figure 11-11 Installation of Rectifier

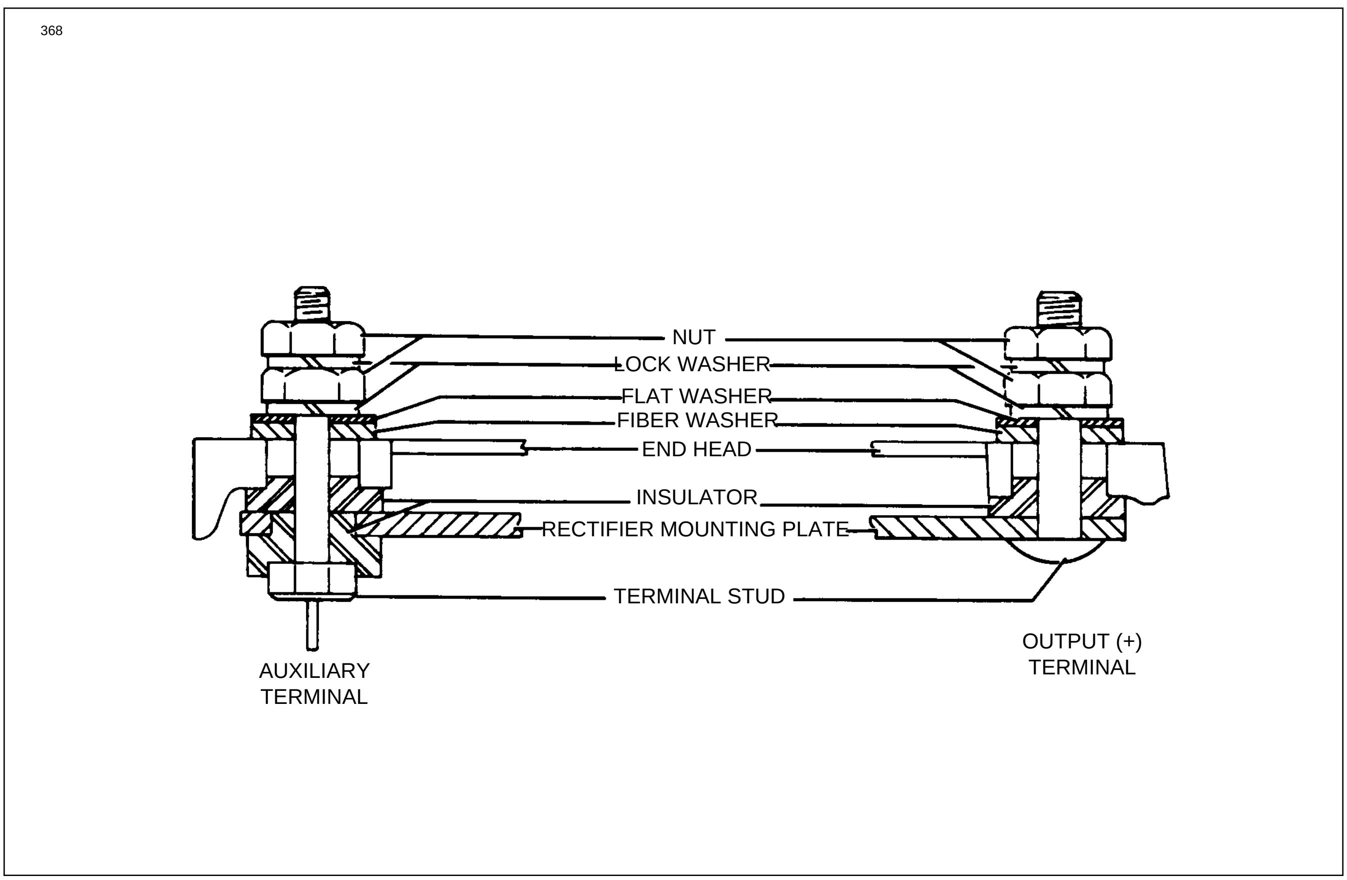


Figure 11-12 Terminal Assembly

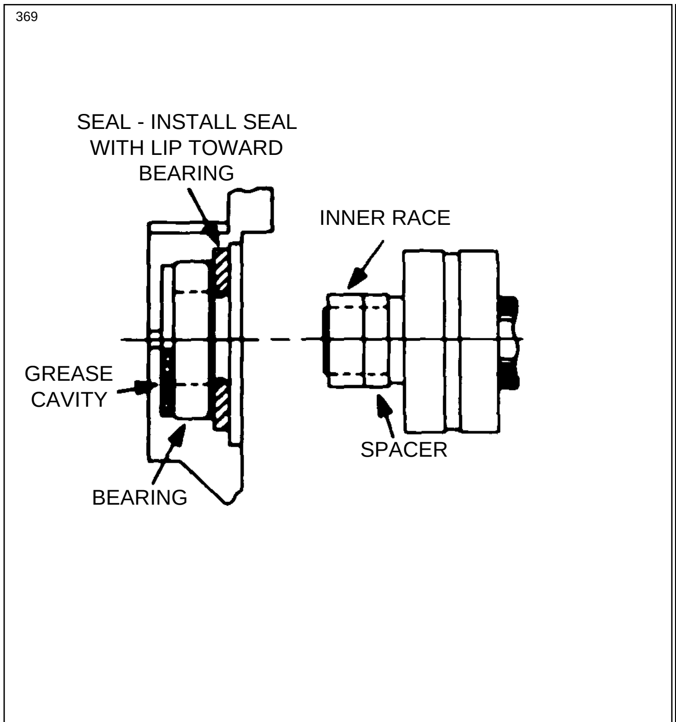


Figure 11-13. Slip Ring End Bearing Assembly

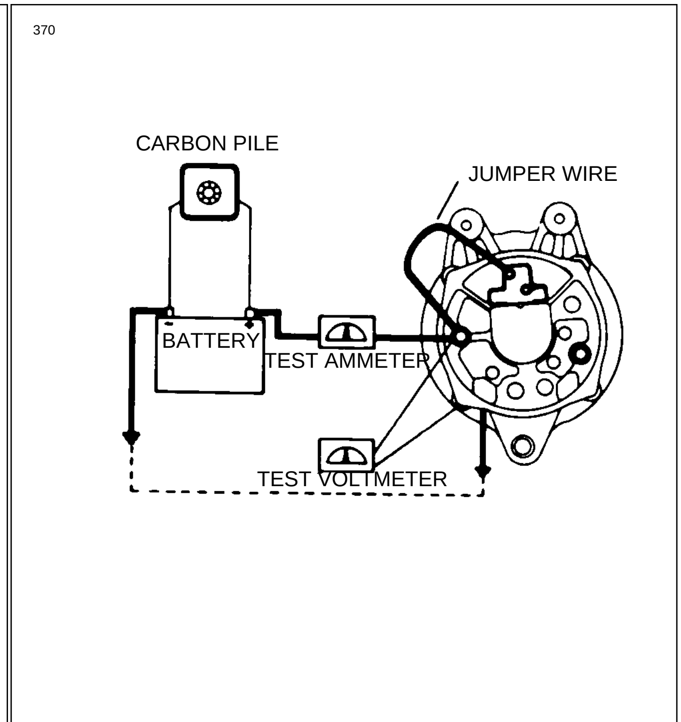


Figure 11-14 Testing Alternator

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, wing 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 in Paragraph 11-16 and Table XI-II.

11-13. TESTING OF ALTERNATORS.

a. Wiring connections for bench testing the alternator are shown in Figure 11-14. Refer to the Alternator Service Test Specification paragraph for output test figures. Adjust the carbon pile if necessary. to obtain the specified voltage. The alternator is not to be run more than 2 minutes for each test point.

b. After bench testing the alternator, install the safety wire and install the alternator on the engine.

—NOTE—

Always refer to the appropriate alternator and starter schematic wiring diagram when installing the alternator or testing the alternator.

11-14. PRECAUTIONS. The following precautions are to be observed when testing or servicing the electrical system.

a. Disconnect the battery before connecting or disconnecting test instruments, except voltmeter, or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and/or wiring.

b. The alternator must not be operated on an open circuit with the rotor winding energized.

c. Do not attempt to polarize the alternator. No polarization is required. Any attempt to do so may result in damage to the alternator, regulator or circuits.

d. Grounding of the alternator output terminal may damage the alternator and/or circuit and components.

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. This aircraft is 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.

Il-I5. ALTERNATOR NOMENCLATURE.

a. Bearing: This unit has 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 11-15 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 (minimum) to 40 foot-pounds (maximum).

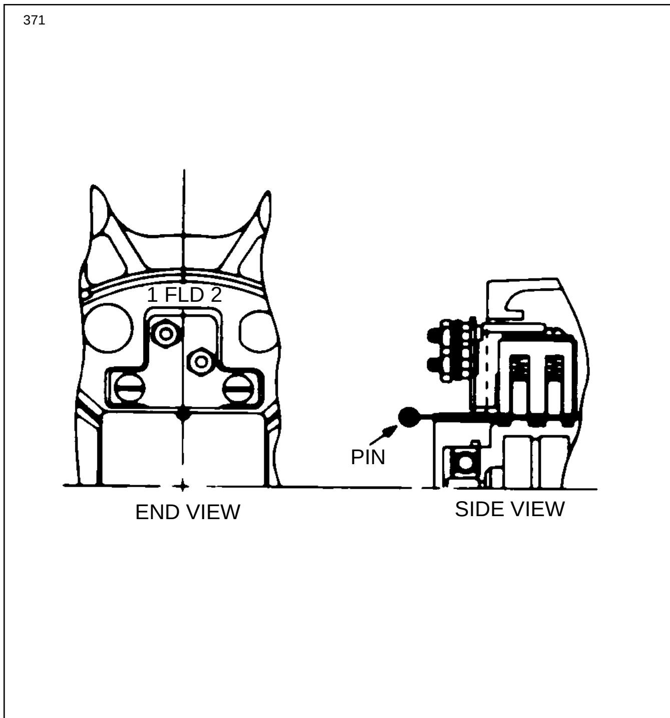


Figure 11-15. Brush Installation

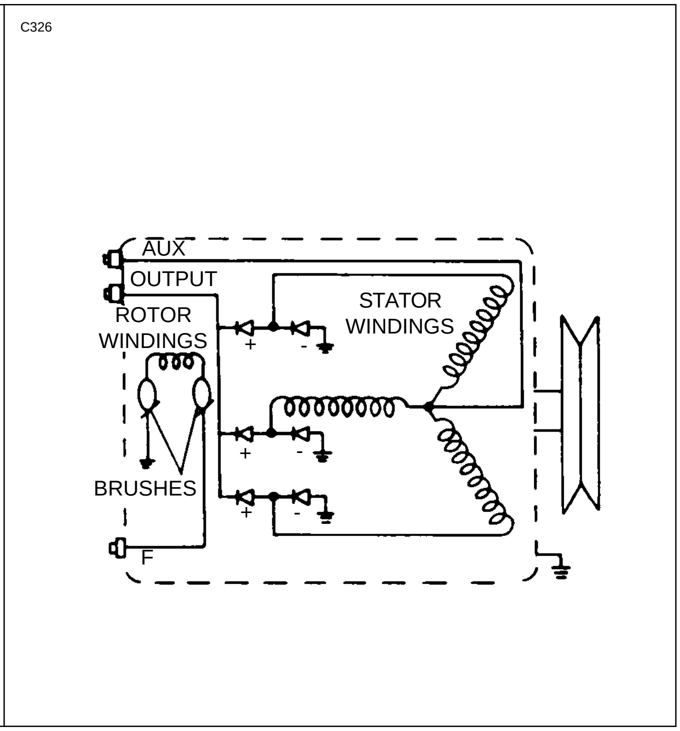


Figure 11-16. Internal Wiring Diagram

11-16 ALTERNATOR SERVICE TEST SPECIFICATIONS. Refer to Figure 11-14. for test circuit used. Prestolite specifications for the 14-volt alternators installed as original equipment are as follows:

TABLE Xl-ll. ALTERNATOR SPECIFICATIONS

Alternator Model	ALY 6421 6422	
Voltage	12-volts	
Rated Output	60 amperes	
Ground Polarity	Negative	
Rotation	Bi-Directional	
Rotor (70° to 80° F):		
Current Draw	2.4 to 4 0 amps @ 12.0-volts	
Resistance	3.5 to 5.0 ohms	
Output Test (70° to 80° F):		
Volts	14.0	14.0
Amperes Output	13 0	47.0
Alternator RPM	2000 min	4000 max

11-17. 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. Consequent1y, a belt should be checked for proper tension at the time it is installed, again after 25 hours of operation and at each 100 hour inspection thereafter.

The torque method for checking alternator belt tension is given as follows:

a. Apply a torque indicating wrench to the nut that attaches the pulley to the alternator 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 tension accordingly.

TABLE XI-III. ALTERNATOR BELT TENSION

Width of Belt	Condition	Torque indicated at alternator pulley
3/8 inch	New	11 to 13 ft-lbs
3/8 inch	Used	7 to 9 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 have previously been used.

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11-18. BATTERY.

11-19. BATTERY DESCRIPTION. The battery is located forward of the firewall on the right side of the airplane. Access to the battery is gained by releasing the cowl fasteners and lifting up the engine cowl. The battery is enclosed in a thermoplastic box. (Refer to Figure 11-17.).

11-20. SERVICING BATTERY. 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.(Refer to Table XI-IV.).

TABLE XI-IV. HYDROMETER READING AND BATTERY CHARGE PERCENT

Hydrometer Reading	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	discharged

11-21. REMOVAL OF BATTERY.

a. To gain access to the battery lift the right engine cowl
b. Loosen and remove four cam locks from battery box lid and remove lid.
c. Disconnect the battery cables.

—NOTE—

Always remove the ground cable first and install last to prevent accidental short circuiting or arcing.

d. Lift the battery from the box.

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11-22. INSTALLATION OF BATTERY

a. Ascertain that the battery and battery box have been cleaned and are free of acid. (Refer to Paragraph 11-30.). Also insure that the drain tube is capped per Paragraph 11-27.

b. Position battery in battery box.

c. Connect the positive lead to the positive battery terminal and secure.

d. Connect the ground cable to the negative battery terminal and secure.

e. Replace battery box lid and secure with four cam locks.

f. If not already accomplished, refer to latest Piper Service Bulletin No. 631 for battery protection.

g. Close and secure cowling.

—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-I aluminum cable assembly is replaced with an AN-3 copper cable assembly). The new cable should be installed in accordance with AC-43.13-1A.

11-23. CHARGING BATTERY. If the battery is not up to normal charge, remove the battery and charge starting with a charging rate of 4 amps and finishing with 2 amps. A fast charge is not recommended.

11-24. STARTING THROUGH EXTERNAL POWER RECEPTACLE 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 0N.

When starting with a power cart and the airplane's battery is nearly depleted. the procedure in Step (a) need not be followed. The capacity of a power cart is sufficient to start an aircraft with a low battery.

11-25. TESTING THE BATTERY. The Specific Gravity check method is listed in Table Xl-IV. If the alternator output is known to be correct, the question of battery capability can be more accurately determined with a load type tester.

11-26. BATTERY BOX.

11-27. DESCRIPTION. The box is made of thermoplastic with a vent and drain system. 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 at the bottom of the fuselage and should be opened occasionally to drain any accumulation of liquid or during cleaning of the box.

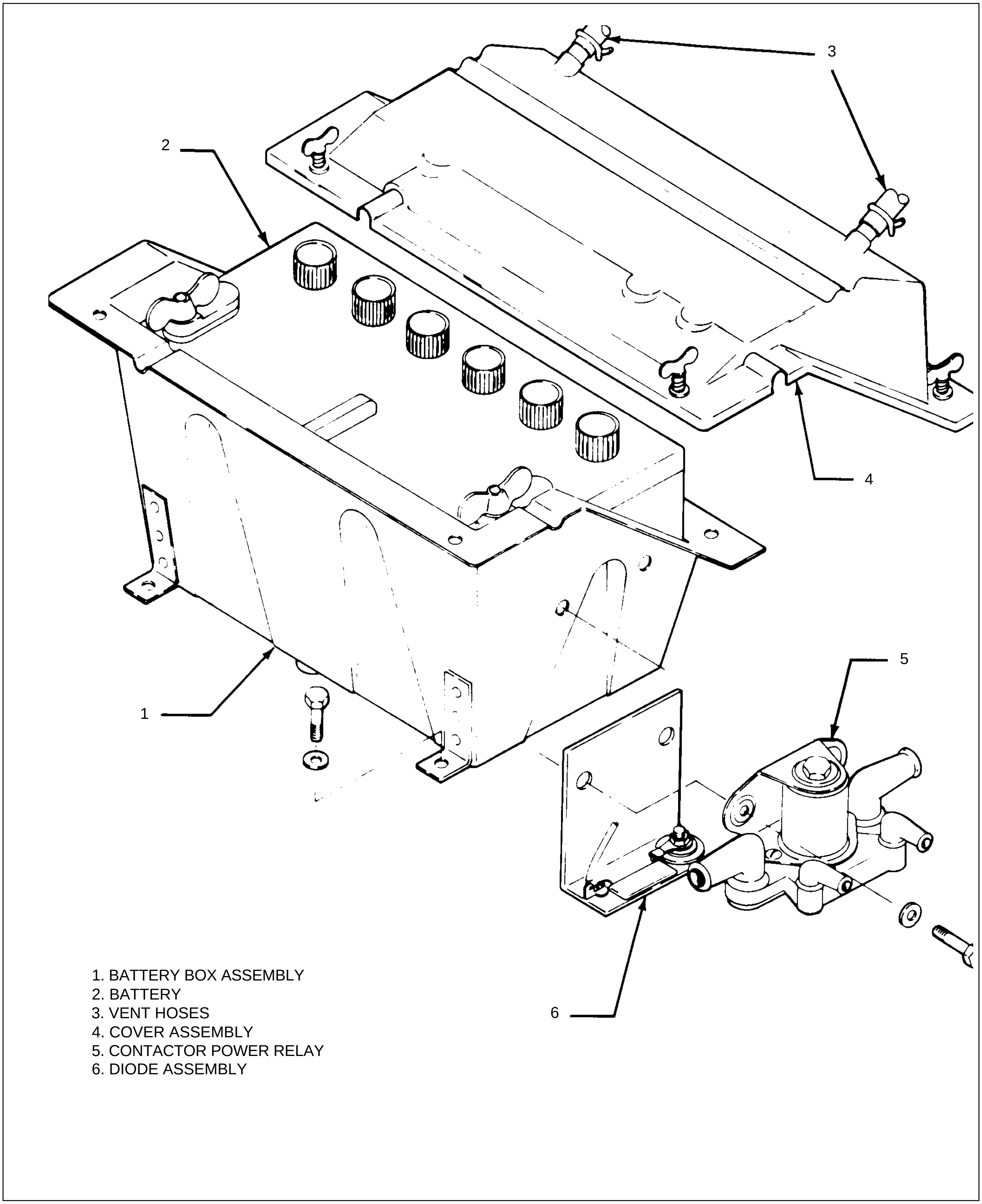

Figure 11-17 Battery Box

11-28. REMOVAL OF BATTERY BOX. (Refer to Figure 11-17.).

a. Remove battery according to instructions in Paragraph 11-21.

b. Remove the two bolts and nuts securing the Master Contactor to the side of the battery box. Lay the.master contactor aside.

c. Remove the four mounting bolts securing the battery box to the airframe. These are located on the four corners at the bottom of the box.

d. Remove the battery box from the airplane.

11-29. INSTALLATION OF BATTERY BOX.

a. Position the battery box into place.

b. Secure the battery box with the four bolts previously removed.

c. Position the master contactor on the side of the battery box and secure with the two bolts and nuts previously removed.

d. Install the battery according to instructions in Paragraph 11-22.

11-30. BATTERY BOX CORROSION PREVENTION. The battery should be checked for spilled electrolyte or corrosion at each 5O hour inspection or at least every 30 days, whichever comes first. Should corrosion 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. Place the cap over the battery box drain.

e. Reinstall battery. (Refer to Paragraph 11-22.)

11-31. ALTERNATOR CONTROL

11-32. CHECKING ALTERNATOR CONTROL. This unit contains both a solid state voltage regulator and overvoltage cutout. the system is tested by checking the alternator for proper output.

11-33. REMOVAL OF ALTERNATOR CONTROL

a. Disconnect battery

b. Disconnect red wire to master switch.

c. Disconnect blue wire to field terminal on alternator.

d. Remove mounting screws.

e. Remove unit.

11-34. INSTALLATION OF ALTERNATOR CONTROL.

a. Slip a plastic sleeve over each of the two wires.

b. Mount the voltage regulator using the mounting hardware from the old unit.

c. Attach the ring terminal on the black wire to one of the attachment screws.

d. Attach the knife connector on the red wire to the knife connector on the red wire to the master switch (ignition/battery)

e. Attach the knife connector on the blue wire to the knife connector installed on the field wire to the alternator.

f. Slip the plastic sleeves over the connectors and tie in place.

g. Tie off wires as necessary to keep them away from moving parts and sharp edges on the structure.

h. Reconnect battery.

i. Test system for proper alternator output.

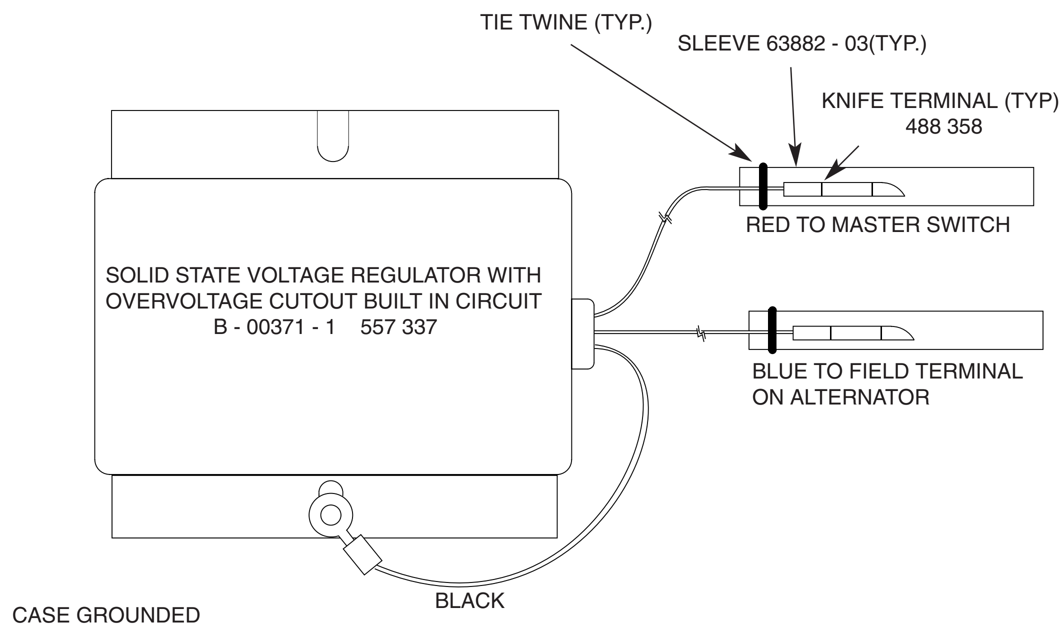

Figure 11-18. Application of Alternator Control

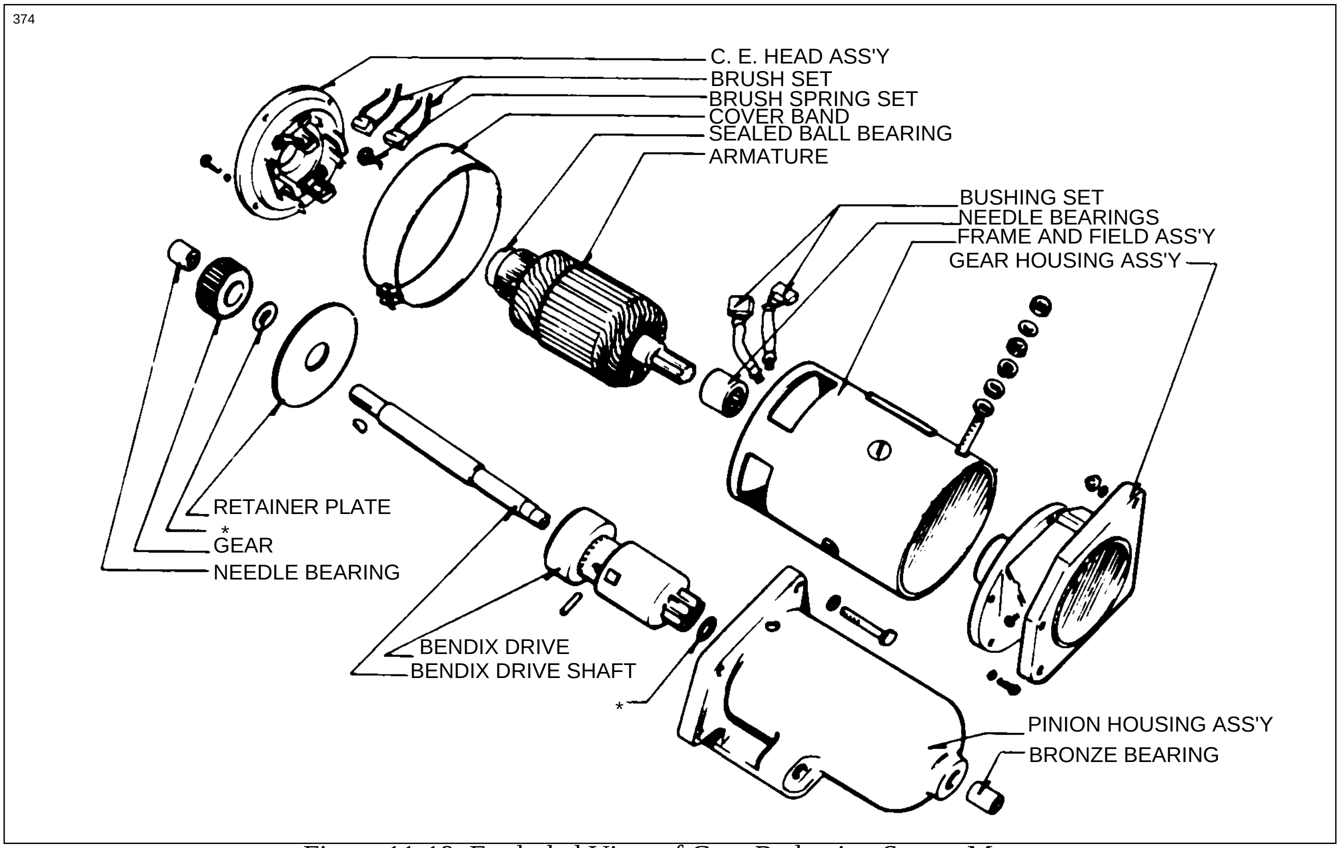

Figure 11-19. Exploded View of Gear Reduction Starter Motor

11-35. STARTING MOTORS.

11-36. DESCRIPTION. (See Figure 11-19.) 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.

11-37. OPERATION. When the starting circuit is energized battery current is applied to the starting motor terminal. Current flows through the field coils, creating a strong magnetic field. At the same time, current flows through the brushes to the commutator, through the armature windings to ground. The magnetic force created in the armature combined with that created in the field windings begins to turn the armature.

The gear cut on the drive end of the armature shaft extends through the gear housing, where it is supported by a roller bearing. The gear mates with the teeth of the reduction gear that drives the bendix shaft. The shaft is keyed to the reduction gear. The Bendix drive is held in position on the shaft by a"spirol" pin. The shaft is supported in the gear housing by a closed end roller bearing and in the pinion housing by a graphitized bronze bearing.

When the armature turns the reduction gear, the Bendix drive pinion meshes with the flywheel ring gear by inertia and action of the screw threads within the Bendix sleeve. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start when the starting circuit is denergized.

When the engine reaches a predetermined speed, centrifugal action forces the detent pin out of the notch in the screw shaft and allows the pinion to demesh from the flywheel.

11-38. 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 it is fully charged and filled to the proper level with approved water. A load test should be made to determine battery condition. If dirt and corrosion have accumulated on the battery, it should be cleaned with a solution of baking soda and water. (See Paragraph 11-30.)

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. 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 "0" or equivalent.

d. The starting motor should be operated for a few seconds with the ignition switch off to make sure that the pinion engages properly and that it turns freely without binding or excessive noise. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is turned off.

I1-39. OVERHAUL. If during the above inspection any indication of starting motor difficulty is noted, the starting motor should be removed from the engine for cleaning and repair.

11-40. REMOVAL. To remove the starting motor from the engine, first disconnect the ground cable from the battery post to prevent short circuiting. Disconnect the lead from the starting motor terminal, then take out the mounting bolts. The motor can then be lifted off and taken to the bench for overhaul.

11-41. DISASSEMBLY

a. Remove the frame screws from the commutator end head and pull end head and armature from frame Lift 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 bearings 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 the Bendix shaft from the pinion housing. Do not lose the steel spacer that is located on the pinion end of the shaft. Remove reduction gear, woodruff key and spacer from shaft.

c. Turn the Bendix pinion until it locks in the extended position. Locate "spirol" pin and use a punch to remove. Slide drive assembly off the shaft. Do not attempt to disassemble the drive and do not dip it in cleaning solvent.

d. To remove the roller bearings from the gear housing, use an arbor press and the correct bearing arbor. DO NOT HAMMER OUT. Each part should be cleaned and inspected for excessive wear or damage. Bearings should be checked for proper clearance and evidence of roughness or galling. Oil and dirt should be removed from insulation and the condition of the insulation checked.

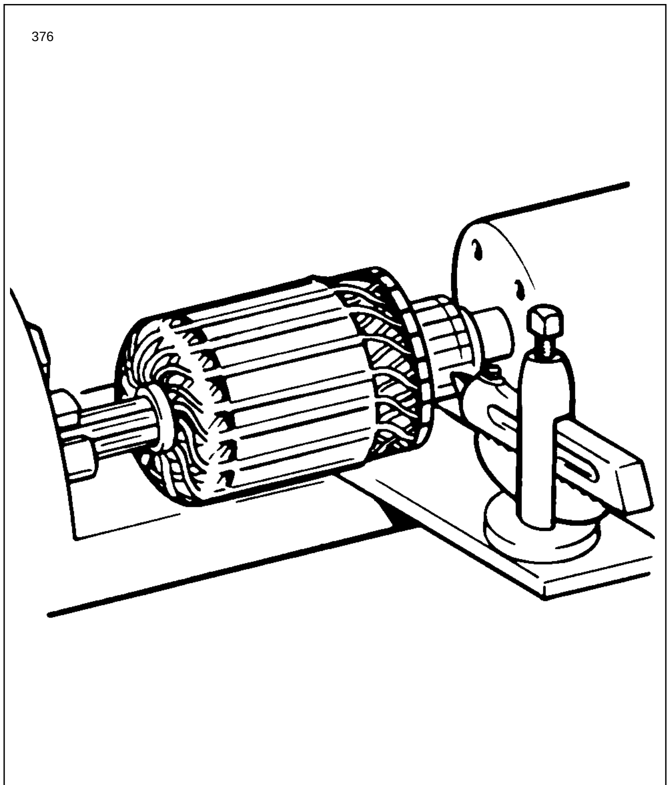

Figure 11-20 Turning Motor Commutator

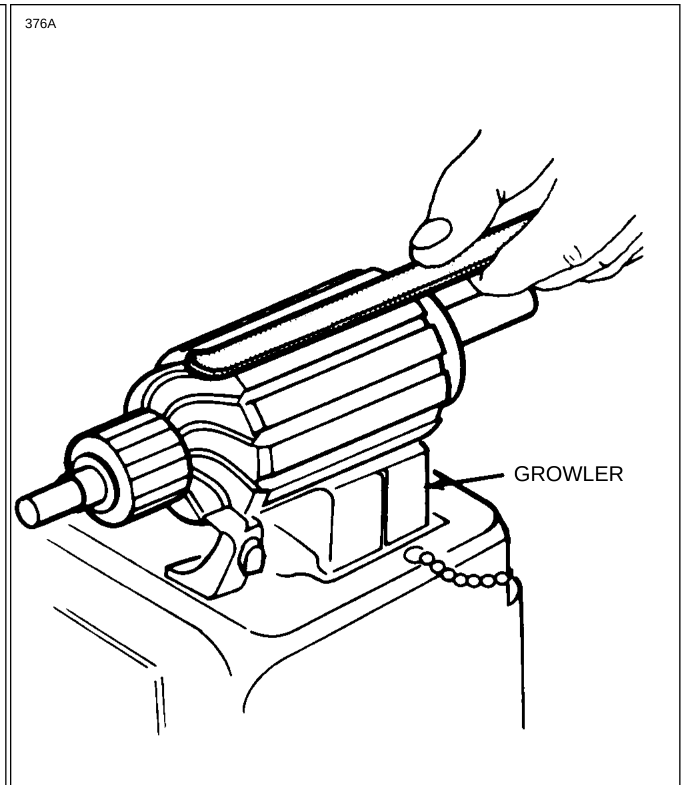

Figure 11-21 Testing Motor Armature for Shorts

11-42. BRUSHES. Check the brushes to see that they slide freely in their holders and make full contact on the commutator. If worn to half their original length or less, they should be replaced.

11-43. ARMATURE.

a. Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If only slightly dirty, glazed or discolored, the commutator can be cleaned with 00 or 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe. Refer to Figure 11-20. 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 I10 volt light should be used. Touch one probe to a commutator segment and the other to the armature core. If the test lamp lights, the armature is grounded and should be replaced.

c. To test for shorted armature coils, a growler is used. Refer to Figure 11-21. The armature is placed on the growler and slowly rotated by hand while a steel strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steel strip will vibrate.

d. A quick check for opens can be made by inspecting the trailing edge (in direction of rotation) of the commutator segments for excessive discoloration. This condition indicates an open circuit.

11-44. FIELD COILS. (See Figure 11-22).

a. Check the field coils for grounds by placing one test probe on the frame and the other on the starter terminal. Be sure the brushes are not accidently touching the frame. If the lamp Iights, the fields are grounded. Repair or Replace.

b. Inspect all connections to make sure they are clean and tight and inspect insulation for deterioration.

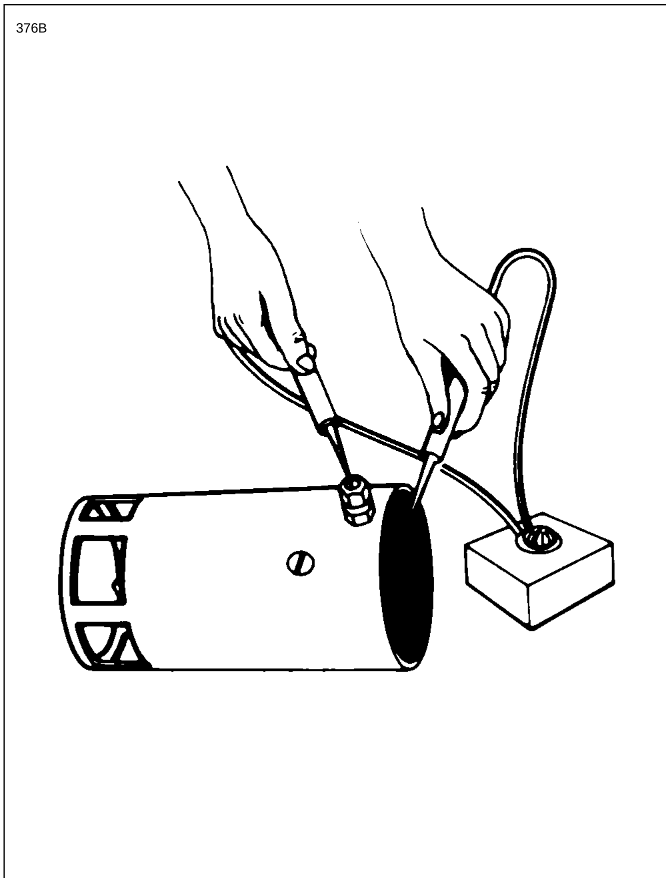

Figure 11-22 Testing Motor Fields for Grounds

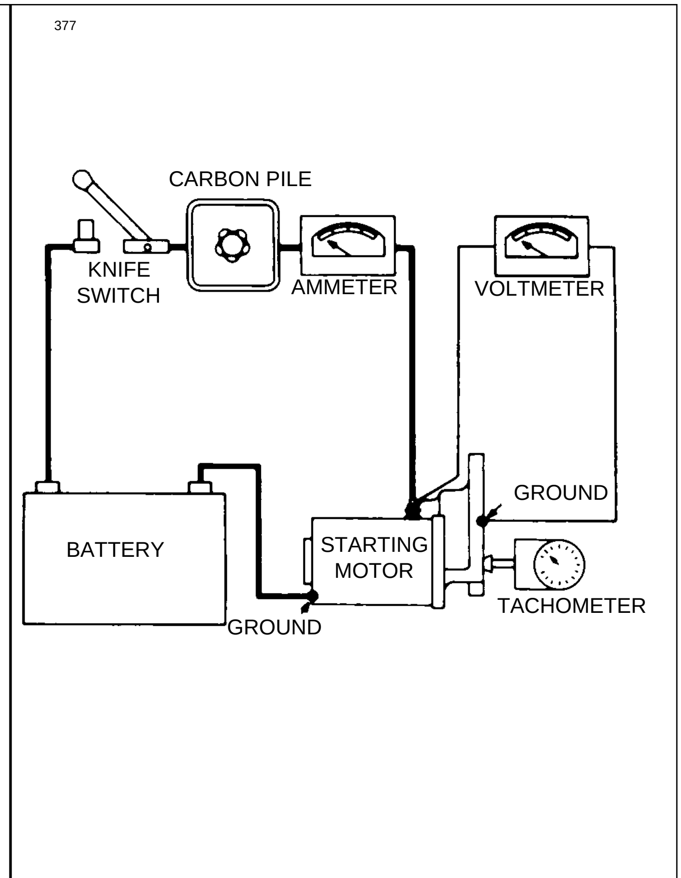

Figure 11-23 No Load Test Hookup

11-45. BRUSH HOLDERS.

a. To test brush holders, touch one test probe to the brush plate and the other to each brush holder.

b. The test lamp should light when the grounded brush holders are touched and should not light when the insulated brush holders are touched.

11-46. GEAR AND PINION HOUSING. Inspect the housing for cracks and bearings for excessive wear. Remove rust, paint or grease from mounting surfaces.

11-47. BENDIX DRIVE. The Bendix Drive should be wiped clean with a dry cloth. The pinion should turn smoothly in one direction and should lock in the other direction. Replace drive if it fails to check as above or if the pinion teeth are excessively worn or damaged.

11-48. ASSEMBLY.

a. When assembling the starter 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 Lubriphte 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 sanding side out, l-1/4 to 1-1/2 times maximum. Lower brushes on to sandpaper covered commutator and turn the armature slowly in the direction of rotation. Dust should be blown out of the motor after sanding.

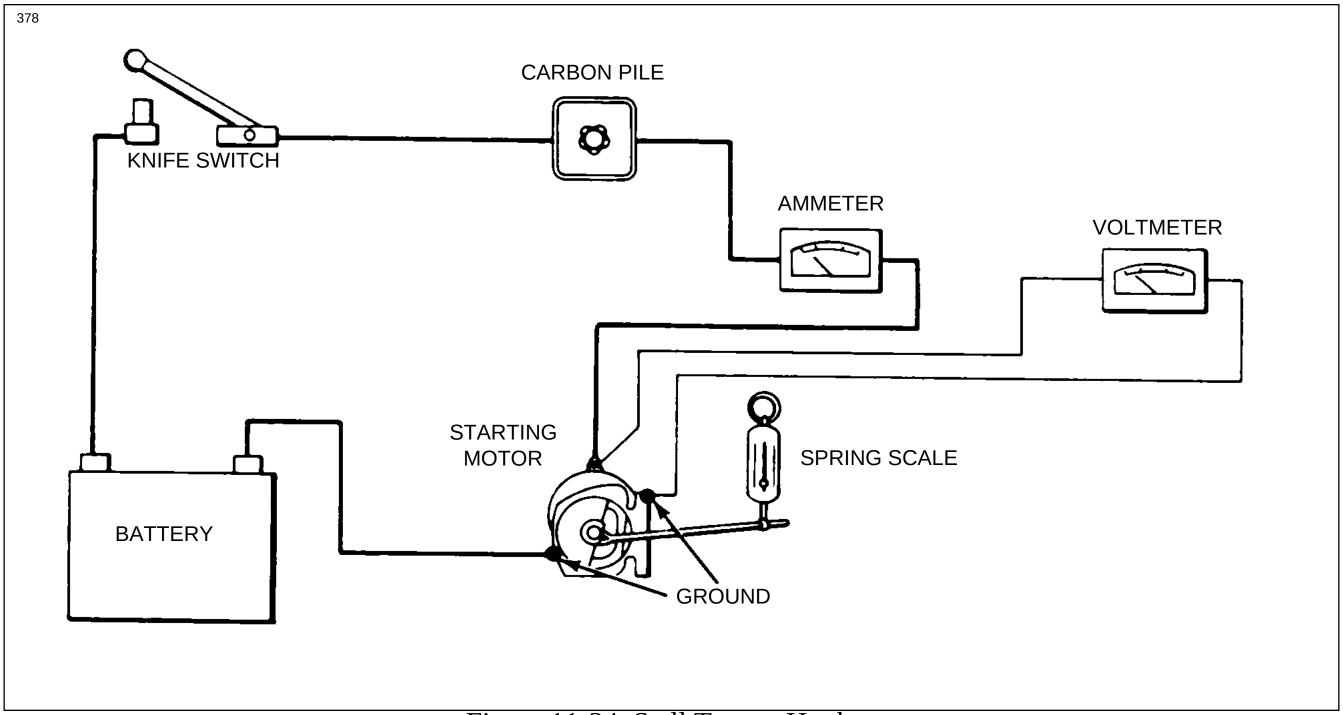

Figure 11-24. Stall Torque Hookup

—NOTE—

The spring tension is 32 to 40 ounces with new brushes. This tension is measured with a spring scale hooked under the brush spring near the brush and the reading is taken at right angles to the line of force exerted by the brush spring.

c. Check the position of the pinion to be sure the unit will mesh properly with the flywheel ring gear. See Paragraph 11-51 and Table XI-V for specifications.

11-49. 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 specification as given in Paragraph 11-51. To make this test, connect as shown in Figure 11-23. If current is too high, check the bearing alignment and end play to make sure there is no binding or interference. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.

b. If no difficulty is indicated in the above test, a stall torque test may be made to see if the starting motor is producing its rated cranking power. Make test connections as shown in Figure 11-24.

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 good order, replace frame and field assembly and retest starter.

11-50. STARTING MOTOR CONTROL CIRCUIT.

a. Inspect the control circuit wiring between the battery, solenoid and manual starting switch for breaks, poor connections and faulty insulation. Tighten all ground 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 amps, the solenoid should be replaced.

c. If solenoid fails to operate when the manual starting switch is turned on, or if it fails to release when the manual starting switch is released, it should be replaced.

11-51. STARTING MOTOR SERVICE TEST SPECIFICATIONS. Prestolite specifications for 12 volt starting motors installed as standard equipment on PA-28-161 CADET airplanes are as follows:

TABLE XI-V. STARTING MOTOR SPECIFICATIONS (PRESTOLITE)

Motor Model	MZ-4204/MZ-4206/MZ/MZ-4218
Min. Brush Tension	32 oz.
Max. Brush Tension	40 oz
No Load Test (77° F)	
Volt	10
Max. Amps	75
Min R.P.M.	2000
Stall Torque	
Amps	560
Min. Torque, Ft. lbs	38.0
Approx. Volts	4.0
Pinion Position*	
Drive at rest	1.748in. - 1.855 in.
Drive extended	2.388 in. - 2.495 in.

* This dimension is measured from the centerline of the mounting hole nearest hole the drive end head to the edge of the pinion

11-52. LANDING AND TAXI LIGHT.

11-53. DESCRIPTION. The landing and taxi light consists of one light bulb. It is 100 watts and located in the nose cowl section. The light is controlled by a switch to a 10 amp circuit breaker.

11-54. REMOVAL.

a. Remove the screw securing the clamp to the bottom of the lamp.

b. Pull lamp out and remove the two electrical leads from the back of the lamp. Lamp is now free.

—NOTE—

Make note of the placement of the wires to facilitate reinstallation.

11-55. INSTALLATION.

a. Replace electrical leads and secure with the appropriate screws.

b. Insert lamp into position fit clamp on bottom of lamp and secure with appropriate screw.

11-56. NAVIGATION LIGHTS.

11-57. DESCRIPTION. There are three navigation lights one on each wing tip and one on the tail. The navigation lights are controlled by a single switch and a 10 amp circuit breaker.

11-58. REMOVAL OF WING NAVIGATION LIGHTS.

a. Remove screw securing the lens retainer.

b. Remove the lens and bulb.

—NOTE—

To remove the complete lamp assembly, the wing tip must be removed.

11-59. INSTALLATION OF WING NAVIGATION LIGHT.

a. Install bulb, lens and lens retainer.

b. Secure with the appropriate screw.

11-60. REMOVAL OF TAIL NAVIGATION LIGHT.

a. Remove the two screw securing the lens and lens retainer.

b. Remove the bulb.

—NOTE—

To remove the complete tail light assembly, unsolder the electrical lead from the base of the light assembly and disconnect the remaining electrical lead at the connector.

11-61. INSTALLATION OF TAIL NAVIGATION LIGHT.

a. Install bulb and lens in light assembly.
b. Place light assembly in position on tail and secure with screws previously removed.

11-62. ANTI - COLLISION LIGHT (ROTATING BEACON.).

11-63. REMOVAL.

a. Loosen screw securing clamp around rotating beacon lens. Remove clamp and lens.
b. Remove light bulb from bayonet socket.

—NOTE—

To remove complete rotating beacon assembly remove screws securing it to rudder tip. Next pull rotating beacon assembly out and disconnect the electrical leads. Take note of their placement to facilitate reinstallation. Rotating beacon assembly can now be removed.

11-64. INSTALLATION.

a. Install light bulb in bayonet socket.
b. Replace lens and clamp and secure by tightening screw on clamps.

11-65. ANTICOLLISION (STROBE)

11-66. DESCRIPTION. The lights are located on each wing tip in the same assembly with the navigation lights and on the fin tip. They are rated to flash at approximately 50 times per minute. There is just one power supply for all three lights.

11-67. REMOVAL OF WING TIP STROBE LIGHT.

a. Remove the screw securing the navigation light cover and remove cover.
b. Remove the three screws securing navigation light bracket assembly and pull out.
c. Remove the strobe lamp by cutting the wires on the lamp beneath the mounting bracket.
d. Remove the defective lamp.
e. Remove and discard the plug with the cut wires from its electrical socket.

11-68. INSTALLATION OF WING TIP STROBE LIGHT.

a. Route the wires from the new lamp down through the hole in the navigation light bracket.
b. Insert the wire terminals in the plastic plug supplied with the new lamp. Wire according to the schematic diagram located in the back of this section.
c. Position strobe lamp on navigation light bracket.
d. Secure navigation light assembly and bracket with appropriate screws.
e. Install navigation light cover and secure with appropriate screw.

11-69 . REMOVAL OF FIN TIP STROBE LIGHT.

a. Remove clamp securing lens to mounting plate on fin tip.
b. Remove lens from strobe light assembly.
c. Remove screws securing fin tip to fin

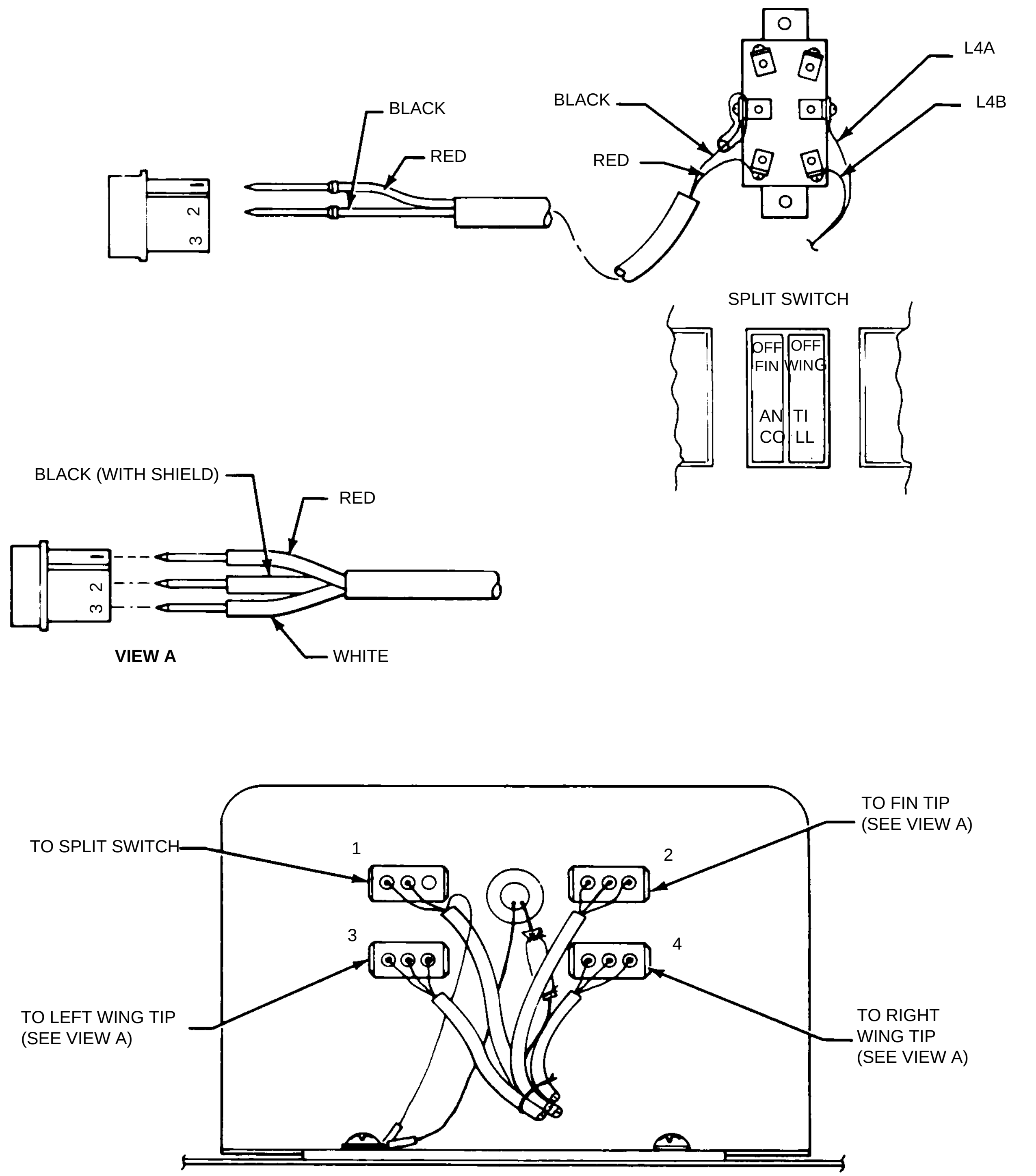

Figure 11-25 Strobe Light Connections (With Fin Strobe)

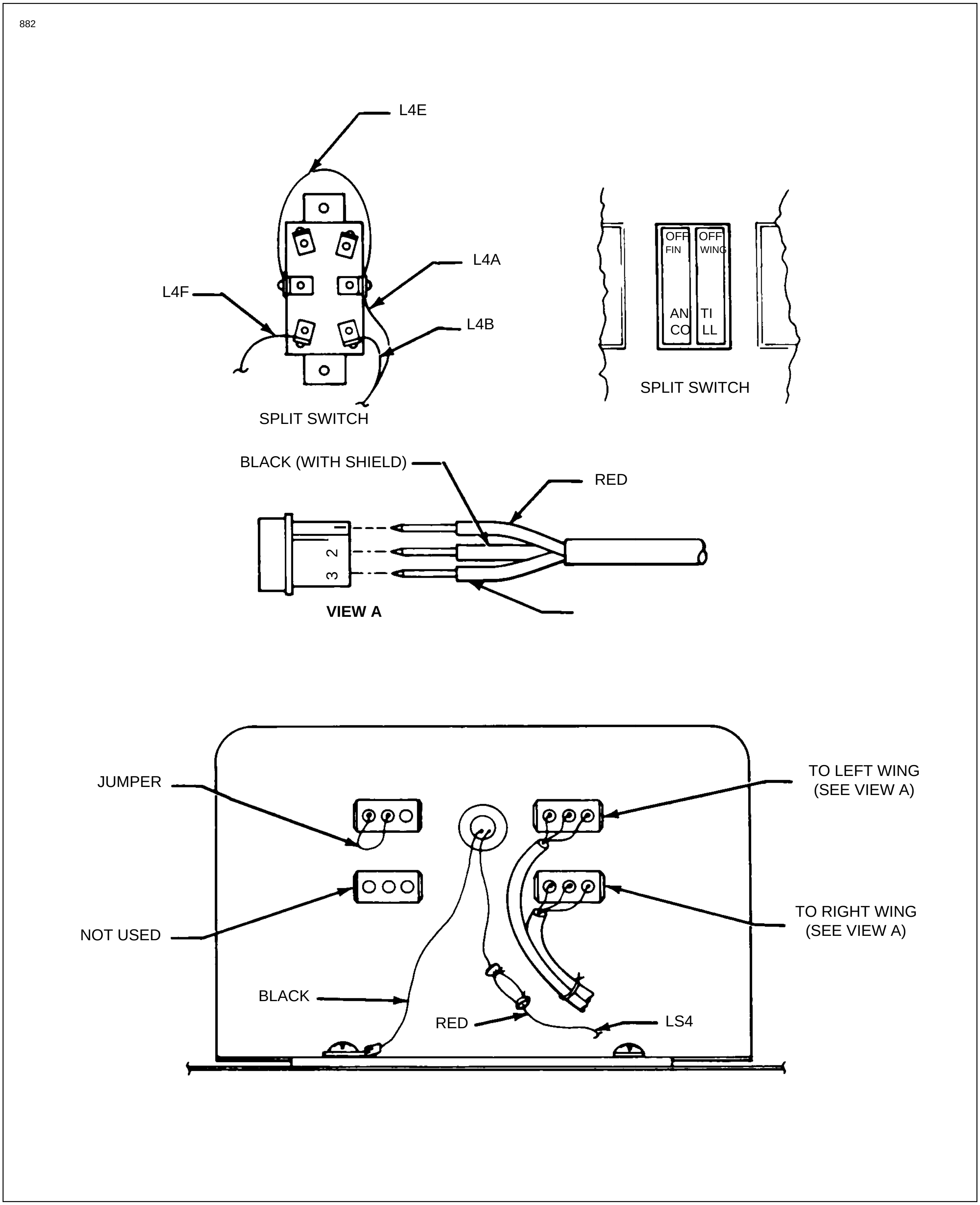

Figure 11-26 Strobe Light Connections (with Rotating Beacon)

d. Lift up fin tip and disconnect electrical plug.

e. Pull Strobe light assembly out of fin tip, electrical plug will pull up through hole in middle of.mounting plate.

11-70. INSTALLATION OF FIN TIP STROBE LIGHT.

a. Insert new electrical plug down through hole in mounting plate and position strobe light assembly in place.

b. Position lens in place.

c. Secure lens to mounting plate by the clamp previously removed.

d. Reconnect electrical plugs underneath fin tip.

e. Replace fin tip and secure with appropriate screws.

11-71. REMOVAL OF STROBE POWER SUPPLY. The strobe power supply is in the aft section of the fuselage.

a. Remove access panel to the aft section of the fuselage in the to gain access to power supply.

b. To remove power supply disconnect the electrical plugs. (one to four plugs depending on installation.).

c. Disconnect the three other electrical leads.

—NOTE—

Make note of the placement of the leads to facilitate reinstallation.

d. Remove the four screws securing power supply to fuselage. Power supply can now be removed.

11-72. INSTALLATION OF STROBE POWER SUPPLY. (Refer to Figure 11-25.).

a. Position the power supply in place and secure with the four screws previously removed.

b. Reconnect the three electrical leads in their proper place.

c. Reconnect the electrical plugs previously removed, in their proper place.

d. Replace access panel in rear compartment.

11-73. TROUBLESHOOTING PROCEDURE. The strobe light functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450 volts DC then discharged across the Xenon flash tube at intervals of approximately 5O flashes per minute. The condenser is parallel across the Xenon flash tube which is designed to hold the 450 volts DC applied until the flash tube is triggered by an external pulse. This pulse is generated by a solid state timing circuit in the power supply. When troubleshooting the strobe light system, it must first be determined if the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm if the tube is defective. A normally operating power supply will emit an audible tone of 1 to 1.5 KHZ. If there is no sound emitted, check the system according to the following instructions. (When troubleshooting the system, utilize the appropriate schematic at the back of this section.).

a. Ascertain the input voltage at the power supply is 14 volts.

—CAUTION—

When disconnecting and connecting the power supply input connections, do not get the connections reversed. Reversed polarity of the input voltage for just an instant will permanently damage the power supply. The reversed polarity destroys a protective diode in the power supply, causing self-destruction from overheating of the power supply. This damage is sometimes not immediately apparent, but will cause failure of the system in time.

b. Check for malfunction in interconnecting cables.

1. Ascertain Pins 1 and 3 of interconnecting cable are not reversed.

2. Using an ohmmeter, check continuity between Pin 1 and 3 of interconnecting cable. If a reading is obtained on the meter, the cable is shorted and should be replaced.

—NOTE—

A short of the type described in steps 1 and 2 will not cause permanent damage to the power supply, but the system will be inoperative if such a short exists. Avoid any connection between Pins 1 and 3 of the interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuits.

—CAUTION—

When disconnecting the power supply, allow five minutes of bleed down time prior to handling the unit.

c. Check interconnecting cables for shorts.

1. Disconnect the output cables from the power supply outlets.

2. The following continuity checks can be made with an ohmmeter.

(a). Check for continuity between the connectors of each interconnecting cable by checking from Pin 1 to Pin 1, Pin 2 to Pin 2, and Pin 3 to Pin 3. When making these checks if no continuity exists, the cable is broken and should be replaced.

(b). Check continuity between Pins I and 2, 1 and 3, 2 and 3 of the interconnecting cable. If continuity exists between any of these connections, the cable is shorted and should be replaced.

d. Check the tube socket assembly for shorts.

1. Disconnect the tube socket assembly of the anti-collision light from the interconnecting cable.

2. The following continuity checks can be made with an ohmmeter.

(a). Check for continuity between Pin 1 of AMP connector to Pin 1 of tube socket, Pin 2 of AMP connector to Pins 6 and 7 of tube socket and Pin 3 of AMP connector to Pin 4 of tube socket. When making these tests, if no continuity exists, the tube socket assembly is broken and should be replaced.

11-74. INSTRUMENT AND PANEL LIGHTS. The instrument and panel lights are broken up into two groups; Upper panel and Lower panel. The instrument lights are controlled by a 5 amp circuit breaker through a switch to a transistorized dimmer control unit located in the middle of the instrument panel. There are two control knobs the one on the right is for radio light dimming and the one on the left is for panel light dimming. To gain access to the dimmer control assembly follow the instructions below.

11-75. REMOVAL OF DIMMER CONTROL ASSEMBLY.

a. From behind the instrument panel remove the electrical plug from the dimmer control assembly.

b. From behind the instrument panel remove the two machine screws securing the dimmer control assembly to the instrument panel there is one on top and one on the bottom of the assembly.

c. Dimmer control assembly can now be removed.

11-76. INSTALLATION OF DIMMER CONTROL ASSEMBLY.

a. Position the assembly into place.

b. Insert and secure with the machine screws previously removed.

c. Reconnect the electrical plug.

11-77. STALL WARNING HORN AND LIFT DETECTOR. This system consists of a lift detector which is electrically connected to a stall warning horn. The following ground check can be performed to determine that the lift detector is functioning properly.

The left detector is located on the left wing. A tab will extend beyond the leading edge. With the master switch ON gently lift tab. Stall warning horn should activate.

11-78. REMOVAL OF LIFT DETECTOR.

—NOTE—

The master switch must be off prior to performing any work on the lift detector or warning horn.

a. Remove the four screws holding the plate around the tab. The lift detector is fastened to this plate; remove the unit from wing.

b. Identify the electrical leads to facilitate reinstallation and disconnect the electrical leads.

11-79. INSTALLATION OF LIFT DETECTOR.

a. Attach the electrical leads to the appropriate terminals of the lift detector.

b. Position the lift detector with its mounting plate on the wing, determining that the sensor blade of the unit drops down freely, and secure in position with the four screws previously removed.

11-80. ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

11-81. DESCRIPTION. The switches are of the rocker type. The switches are mounted in the middle of the instrument panel. The circuit breakers are single hole mounting, push button type with manual reset; they must be reset by the pilot whenever tripped. They are on a circuit breaker panel on the lower right hand corner of the instrument panel.

11-82. REMOVAL OF ELECTRICAL SWITCHES.

a. For a particular switch removal, remove the screw above and screw below the switch on the front of the instrument panel.

b. From behind the instrument panel remove the switch, and disconnect the electrical connections.

—NOTE—

Make note of the placement of the electrical leads to facilitate reinstallation.

11-83. INSTALLATION OF ELECTRICAL SWITCHES.

a. Reconnect electrical leads with mounting screws in their proper place.

b. Insert switch into its designated slot on the instrument panel and secure with the two screws previously removed.

11-84. REMOVAL OF CIRCUIT BREAKERS.

a. Remove knurled nut from circuit breaker face plate on front of instrument panel.

b. From behind instrument panel remove circuit protector from instrument panel.

c. Disconnect electrical connections fastened with screws to the circuit breaker.

—NOTE—

Make note of the placement of the electrical leads to facilitate reinstallation.

11-85. INSTALLATION OF CIRCUIT BREAKERS.

a. Connect the electrical leads to their proper screw and secure.

b. Insert circuit protector into its proper hole on the instrument panel.

c. Fasten and tighten knurled nut to circuit breaker face plate, front of instrument panel.

11-86. SWITCHING.

11-87. 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.

11 88. INSTALLATION OF IGNITION SWITCH (Refer to Figure 1l-27.).

a. Attach wires to switch as shown in Figure 1l-27.

b. Check for proper operation of the ignition switch as follows:

1. Remove the P-lead from the right magneto.
2. Attach the P-lead of the right magneto to an ohmmeter and to the airframe ground.
3. With the switch in the "OFF", "L" or "START" positions, the ohmmeter should indicate a closed circuit.
4. With the switch in the "R" or "BOTH " positions the ohmmeter should indicate an open circuit.

c. Reconnect the P-lead to the magneto.

d. Position the ignition switch in the instrument panel and secure with retaining nut.

e. Connect the power lead (+) to the battery and reinstall any access covers previously removed.

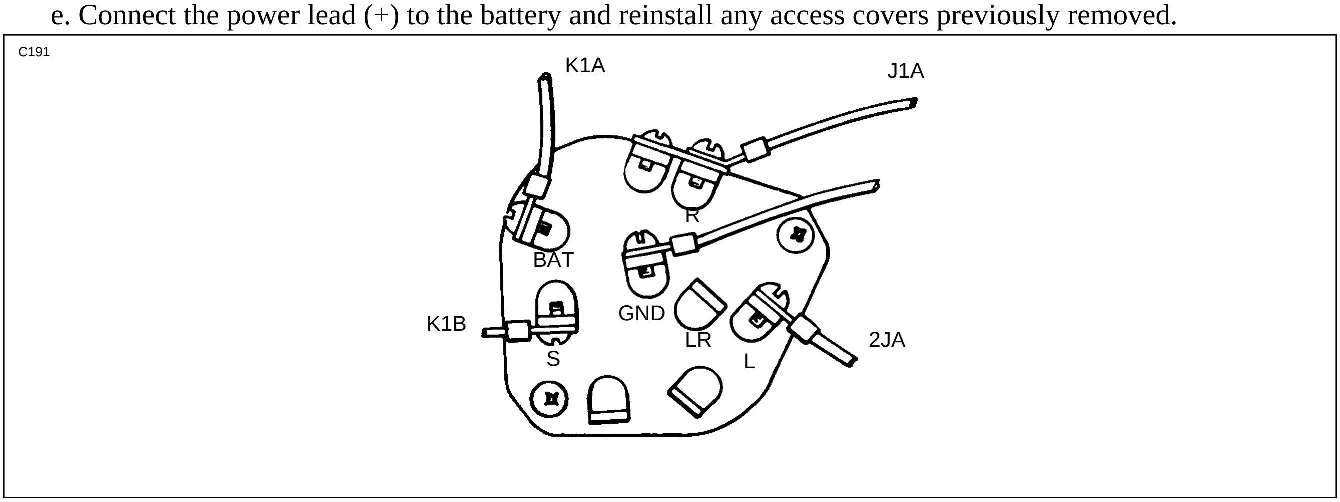

Figure 11-27 Ignition Switch Wire Positions

11-89. ANNUNCIATOR PANEL.

11-90. 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 10-1.) Power is supplied from the bus bar through a 5 amp fuse located behind the instrument panel directly above the ammeter.

The VAC warning light is controlled by a vacuum sensor switch located at the firewall 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 firewall. 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 appropriate alternator and starter schematic). 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 aft of 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.

11-91. 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.

11-92. INSTALLATION OF OIL PRESSURE SENSOR.

a. Seal sensor unit pipe threads with thread sealant tape (3M-Teflon 48 x 1/4).
b. Screw the sensor unit into the bulkhead fitting.
c. Reconnect the two electrical leads.
d. Perform operational check.

11-93. 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.

11-94. INSTALLATION OF VACUUM SENSOR.

a. Screw sensor unit into vacuum regulator.
b. Reconnect the two electrical leads.
c. Perform operational check.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM)

Trouble	Cause	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 (I2V) from ship's main bus through entire field circuit to alternator field terminal. Measure voltage from ground(-) to the following points (+) in sequence: - bus bar, 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.
	Open output circuit.	With master switch turned on check for battery voltage (12V) from ship's main bus through entire output circuit Measure voltage from ground (-) to the following points (+) in sequence: bus bar and ammeter,
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure)	Open output circuit.	Interruption of voltagethrough any of thesepoints isolates thefaulty component or wire which must be replaced
	Open field winding in alternator.	Disconnect field of alternator terminal from field wiring and check for continuity from field terminal to ground with ohmmeter (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.*** 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.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	ALTERNATOR (cont)	
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 bus bar
	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, Examine crimped terminal ends for signs of deterioration at crimp or strands of broken wire at crimp.Tighten any loose binding posts or replace badwire 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 and replacement of the rectifier is recommended.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	ALTERNATOR (cont)	
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 and will hold. Replace component or wire which was isolated as defective.
	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.
Excessive ammeter fluctuation.	Defective voltage regulator.	Replace voltage regulator.
	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.

— CAUTION—

Turn magneto switch to off before turning propeller.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	STARTER	
Starter fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to 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 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.
	Binding, worn, or improperiy seated brush, or brushes with excessive side play.	**—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 roughor dirty, smooth and polish with numbe r0000 sandpaper. If too rough and pitted, remove and turn down.Blow out all particles.
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test, repair if possible or replace with a new part.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	STARTER (cont)	
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 XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	BATTERY	
Discharged battery.	Battery worn out.	Replace battery.
	Low electrical system voltage.	Check voltage regulator voltage.
	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.
	Impurities in electroIyte.	Replace battery.
	Low charging rate.	Check voltage regulator voltage.

TABLE XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	BATTERY (cont)	
Cracked cell jars.	Hold-down bracket loose.	Replace battery and tighten.
	Frozen battery.	Replace.
Compound on top of battery melts.	Charging rate too high.	Reduce charging rate. Check voltage regulator voltage.
Electrolyte runs out of vent plugs.	Too much water added to battery and charging rate too high.	Drain and keep at proper level and check voltage regulator voltage.
Excessive corrosion inside container.	Spillage from over-filling.	Use care in adding water.
	Vent lines leaking or clogged.	Repair or clean.
	Charging rate too high.	Adjust voltage regulator.
Battery freezes.	Discharged battery-	Replace.
	Water added and battery not charged immediately.	Always recharge battery for 1/2 hour following addition of water in freezing weather.
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery should be slowly discharged completely and then charged correctly and tested.
Battery consumes excessive water.	charging rate too high (if in all cells).	Correct charging rate.
	Cracked jar (one cell only).	Replace battery.

TABLE XI-VI. 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 XI-VI. TROUBLESHOOTING CHART (ELECTRICAL SYSTEM) (cont.)

Trouble	Cause	Remedy
	ANNUNCIATOR PANEL (cont.)	
VAC waning 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 aft of 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 re-place switch if necessary.

TABLE Xl-VII. LAMP REPLACEMEN'T GUIDE

Location	Piper Part No.	Lamp No.
Annunciator Panel	453 695	328
	472 054	330
Cabin Light	472 036	89
Flood Light	472 034	1414
		4509
Landing Light		472 661
Magnetic Compass Light	472 665	330
Navigation Light:		
Wing Tip	751 381	1512
Tail	753 431	1073
Panel Lights	472 056	
Rotating Beacon		1940
Strobe Lights:		
Wing Tip	761 156	A427
Fin Tip	757 635	A406

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TABLE XI-VIII. ELECTRICAL SYSTEM COMPONENT LOADS

Duty Cycle			Circuit	Load	
Cont.	Inter.	Equipment	Breaker	(Amps)	Optional
X		Alternator Field	5	3.0	
X		Anticollision (Strobe)	I 5	4.4	X
X		Cabin Dome Light	15	0.5	
X		Cockpit Flood Light	5	0.5	X
	X	Fuel Pump	10	5.0	
X		Instrument Cluster	5	0.7	
X		Instrument Lights (18)	5	2.2	X
	X	Landing Light	10	8.0	X
X		Master Contactor		0.6	
X		Pitot Heat	15	13.2	X
X		Position Lights	10	4.0	X
	X	Stall Warning	5	negl.	
	X	Starter		175.0	
	X	Starter Contactor	15	10	
X		Turn & Bank	5	0.5	X

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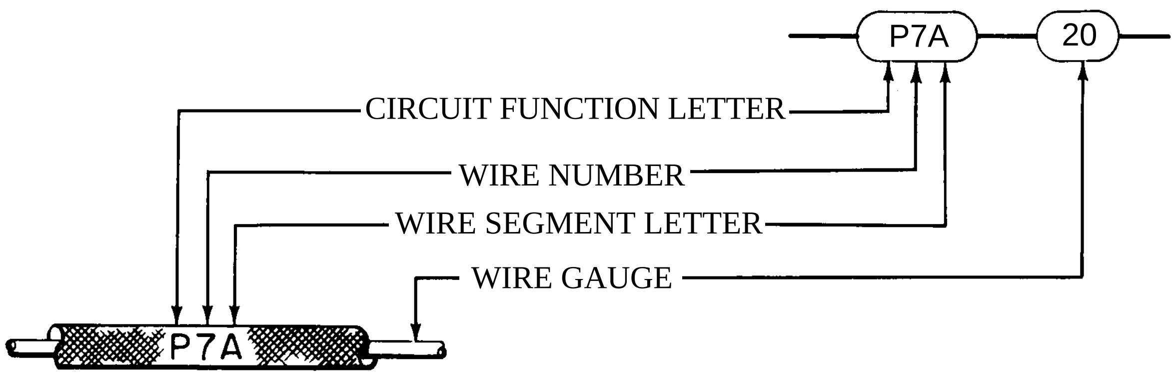
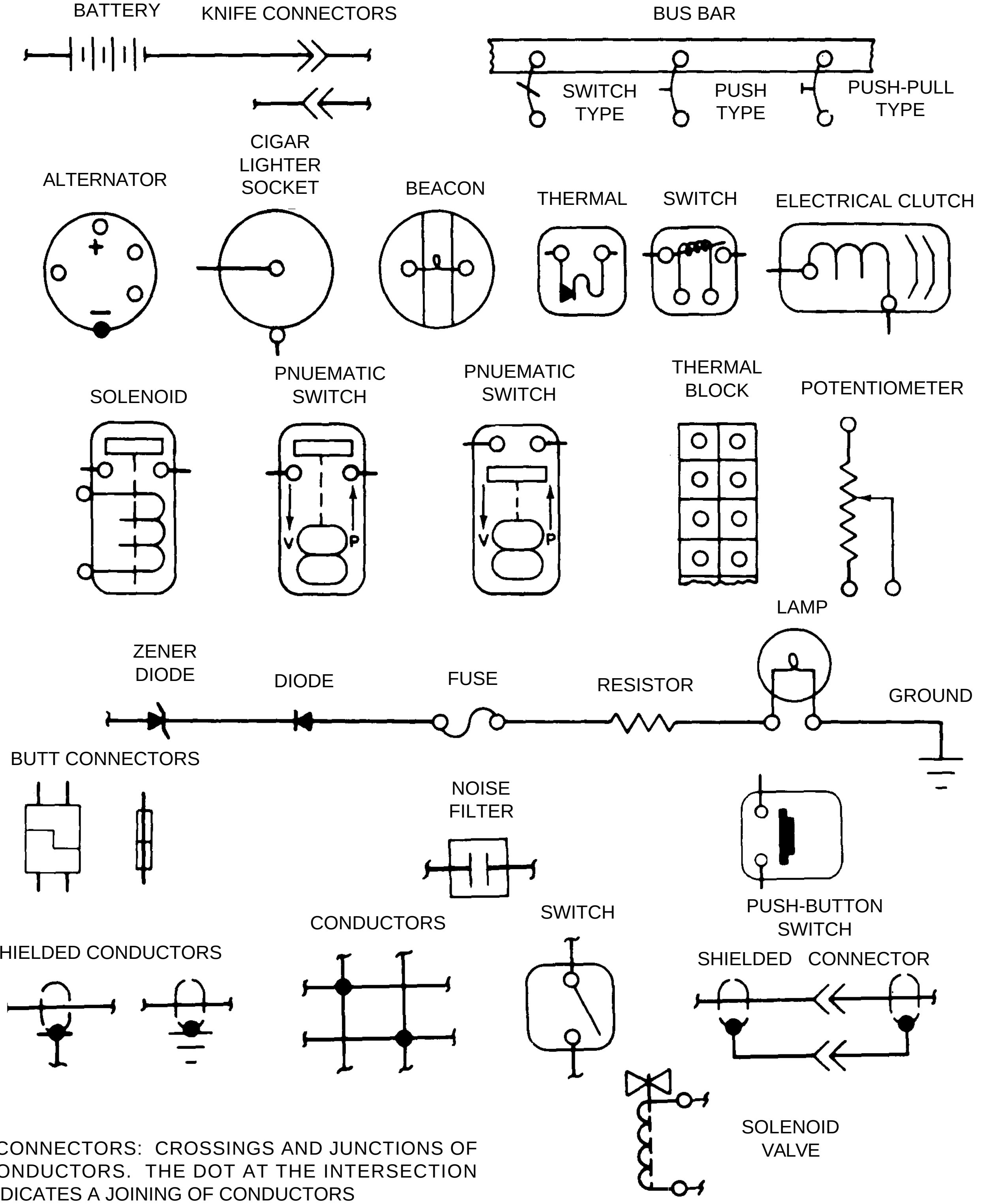
CHART XI - IX. ELECTRICAL WIRE CODING



CIRCUIT FUNTION LETTER	CIRCUITS
A	AUTOPILOT
C	CONTROL SURFACE
F	FLIGHT INSTRUMENT
G	LANDING GEAR
H	HEATER - VENTILATING & DEICING
L	LIGHTING
P	POWER
Q	FUEL, OIL & ENGINE INSTRUMENT
RP	RADIO POWER
RZ	RADIO AUDIO
J	IGNITION
W	WARNING
K	STARTER

CHART XI - X. ELECTRICAL SYMBOLS



* CONNECTORS: CROSSINGS AND JUNCTIONS OF CONDUCTORS. THE DOT AT THE INTERSECTION INDICATES A JOINING OF CONDUCTORS

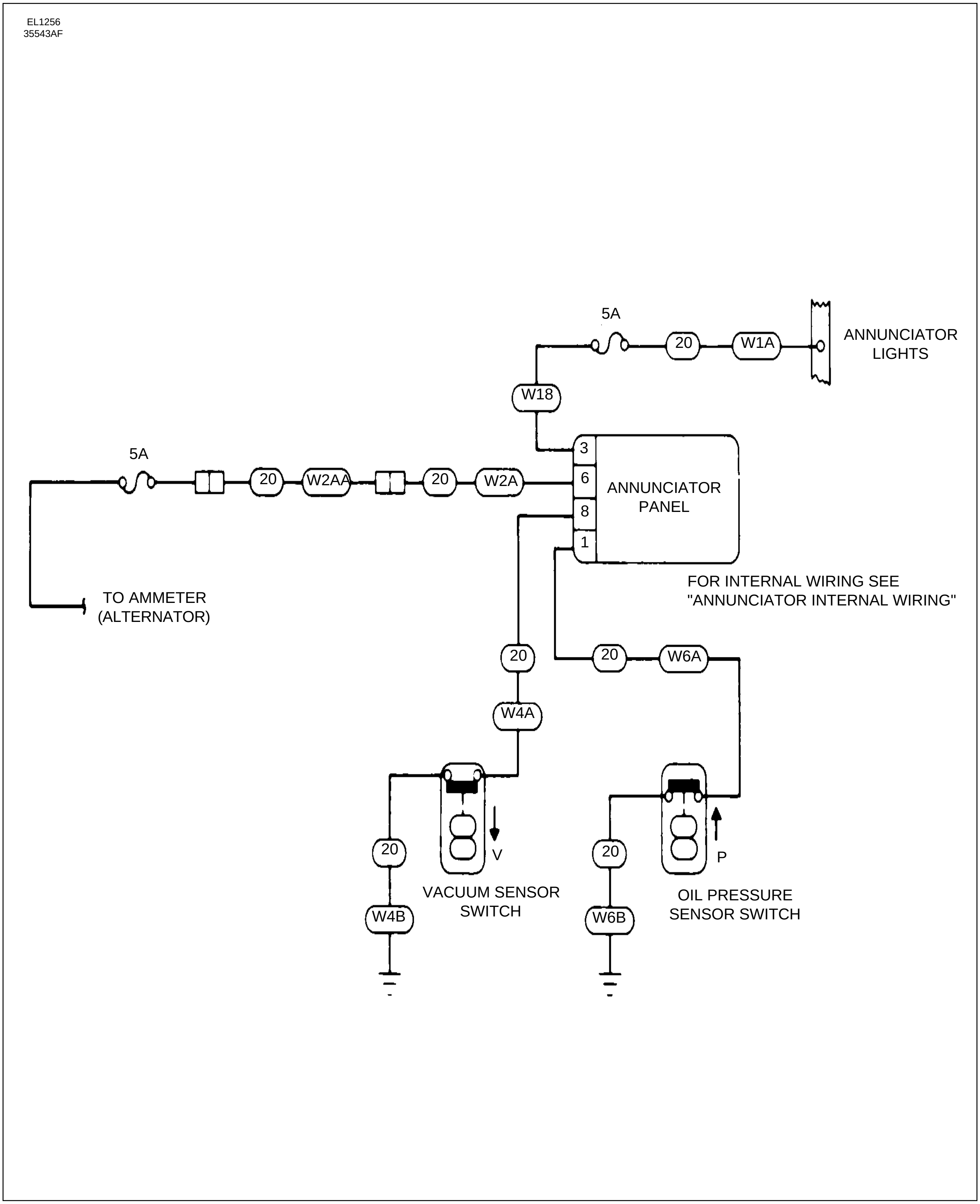


Figure 11-28. Annunciator

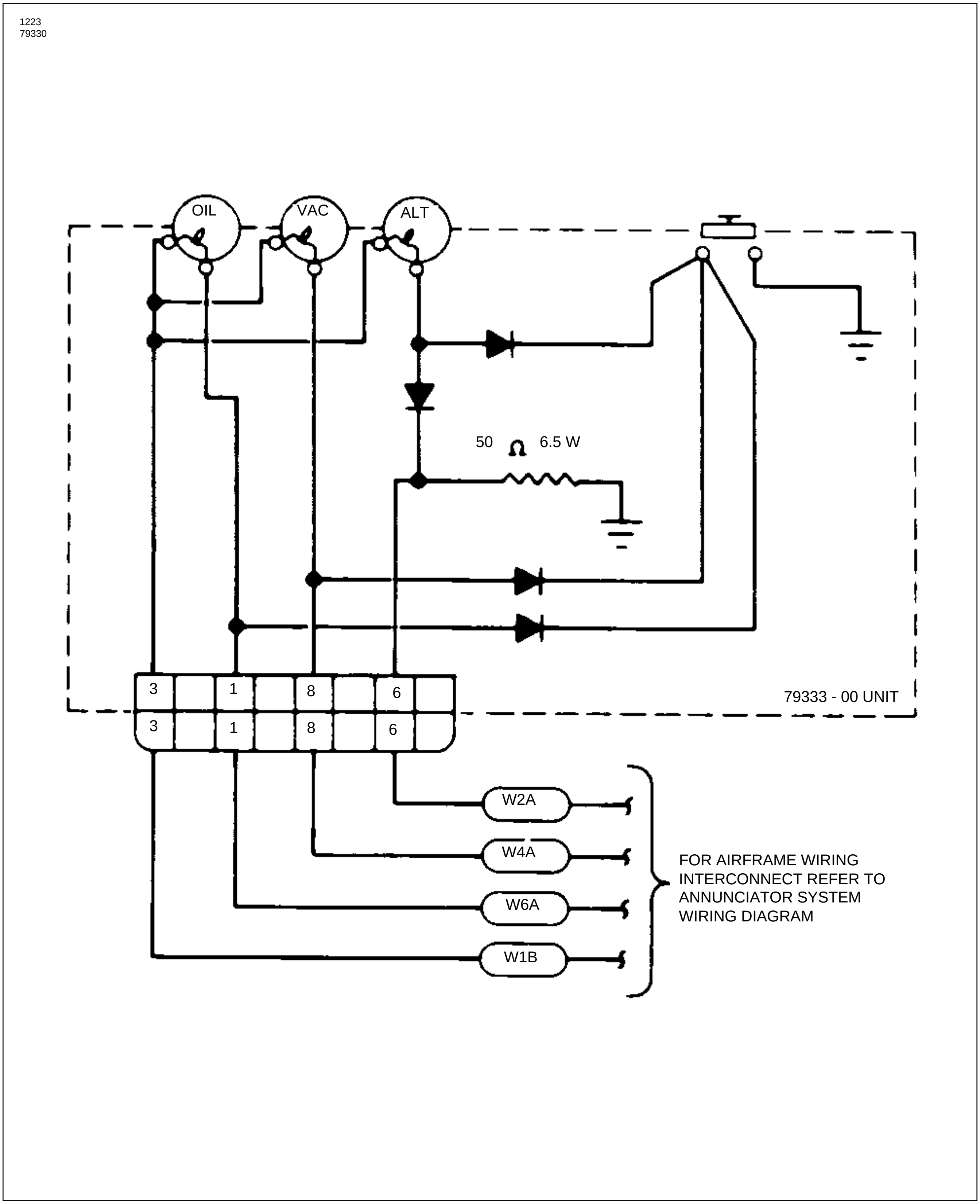


Figure 11-29. Annunciator Internal Wiring

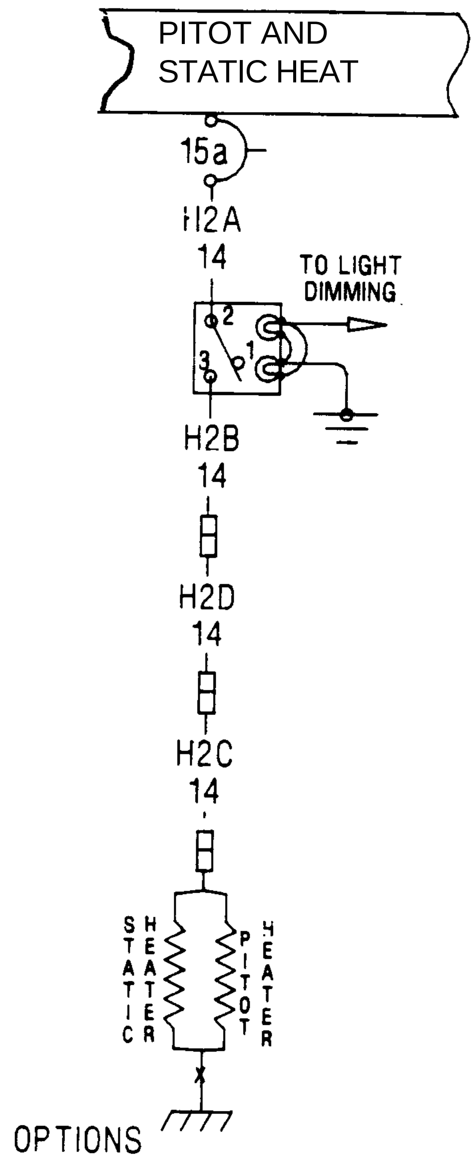
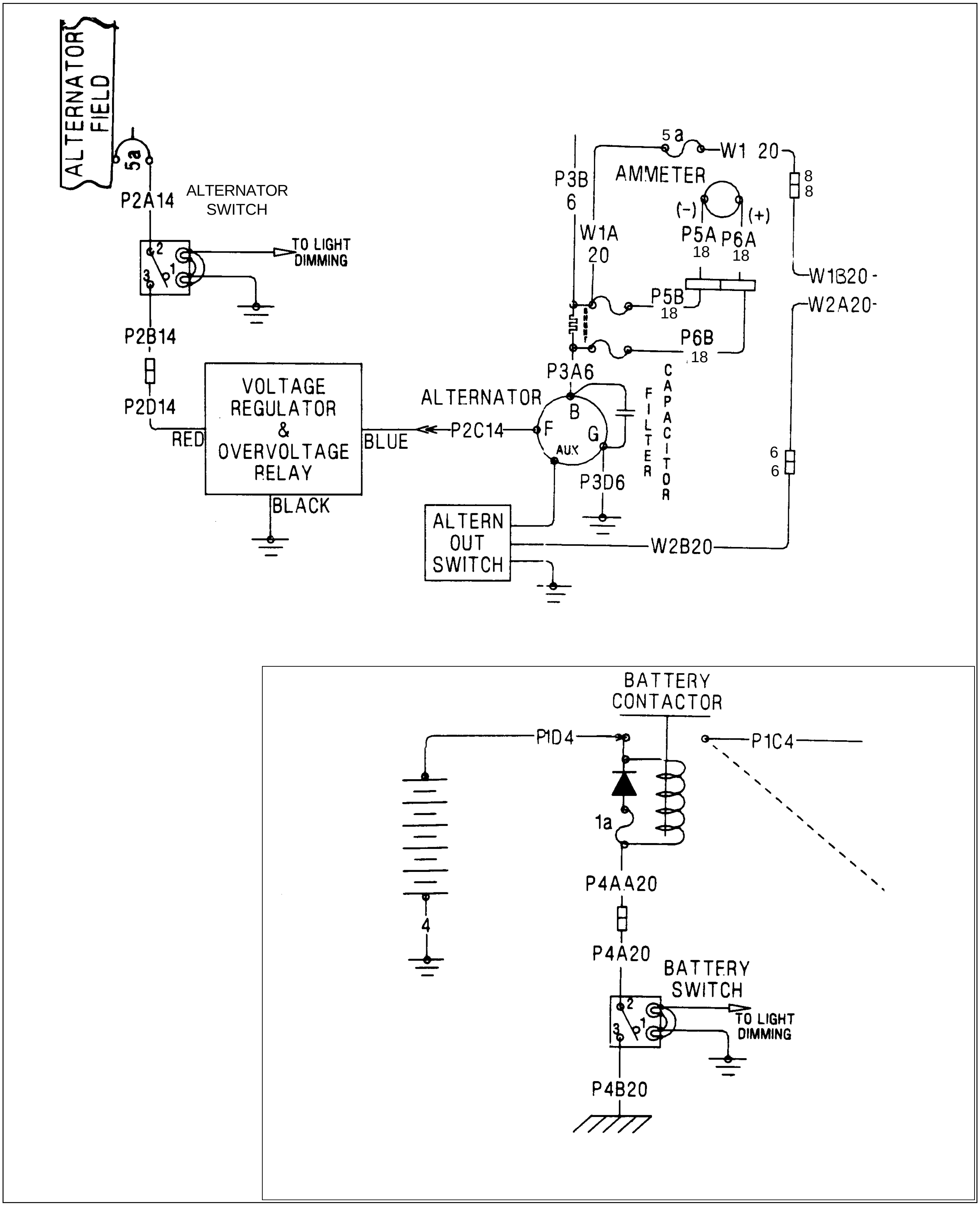


Figure 11-30. Pitot/Static Heat.



11-31. Alternator

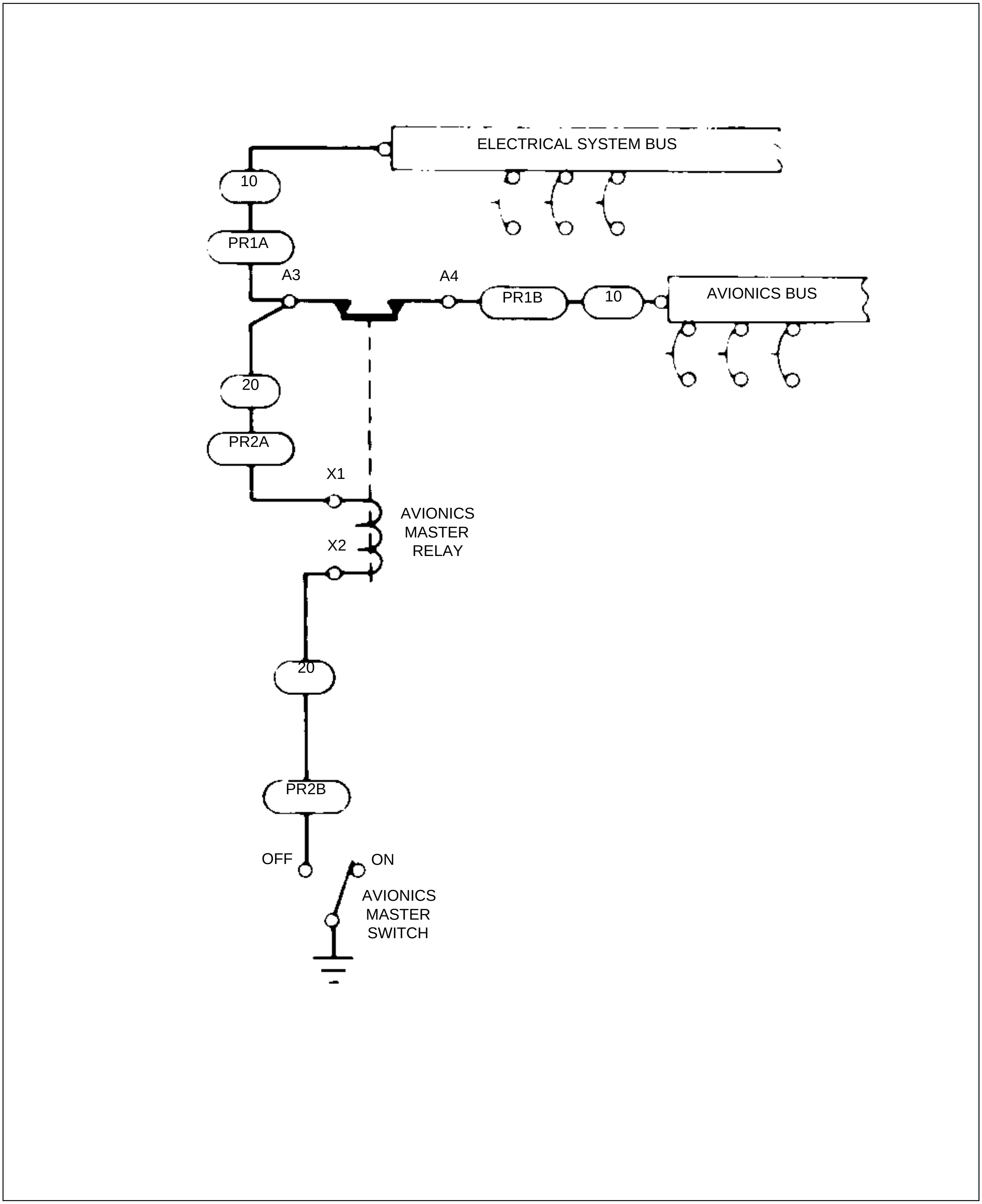
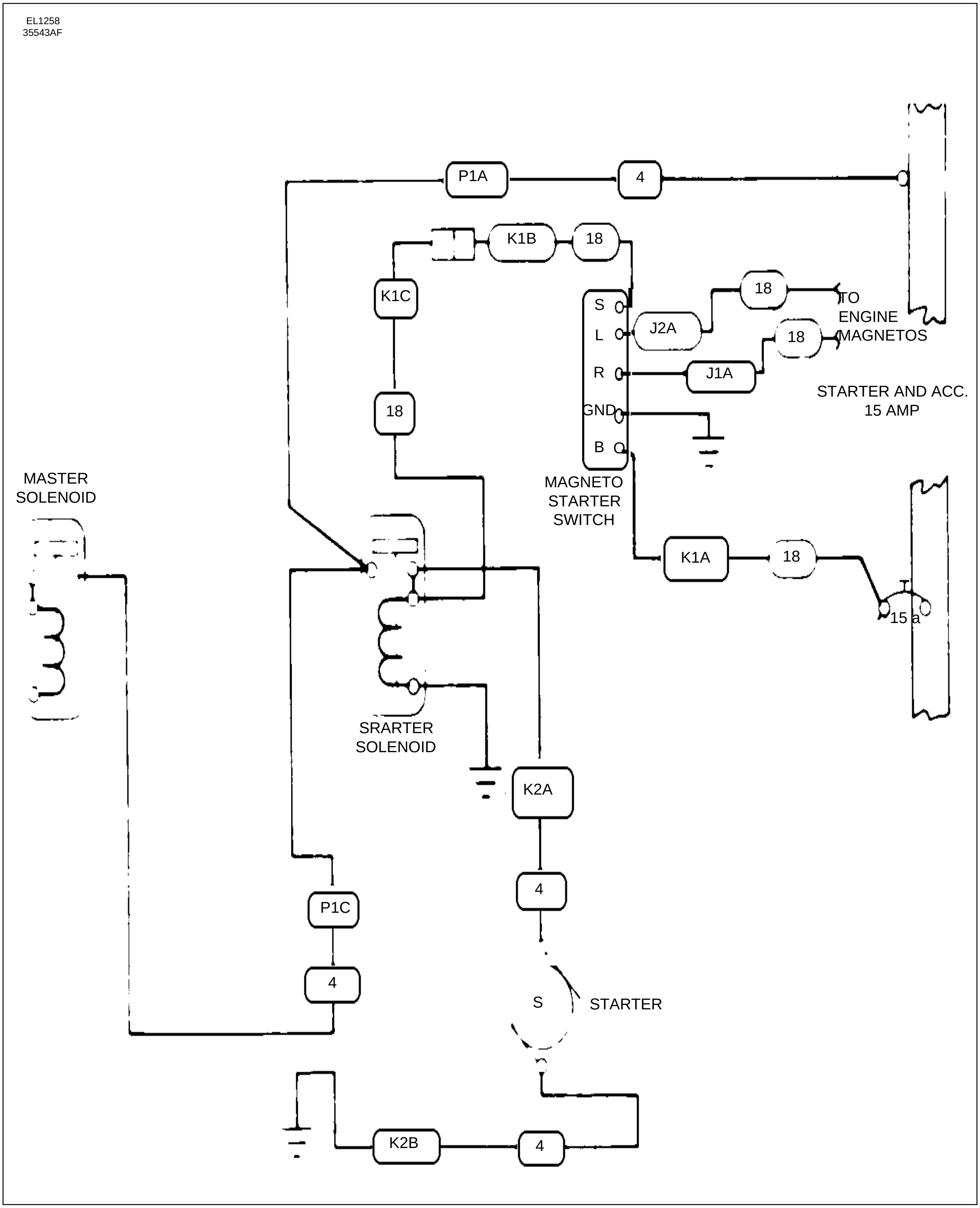


Figure 11-32. Avionics Master Switch.



11-33. Starter.

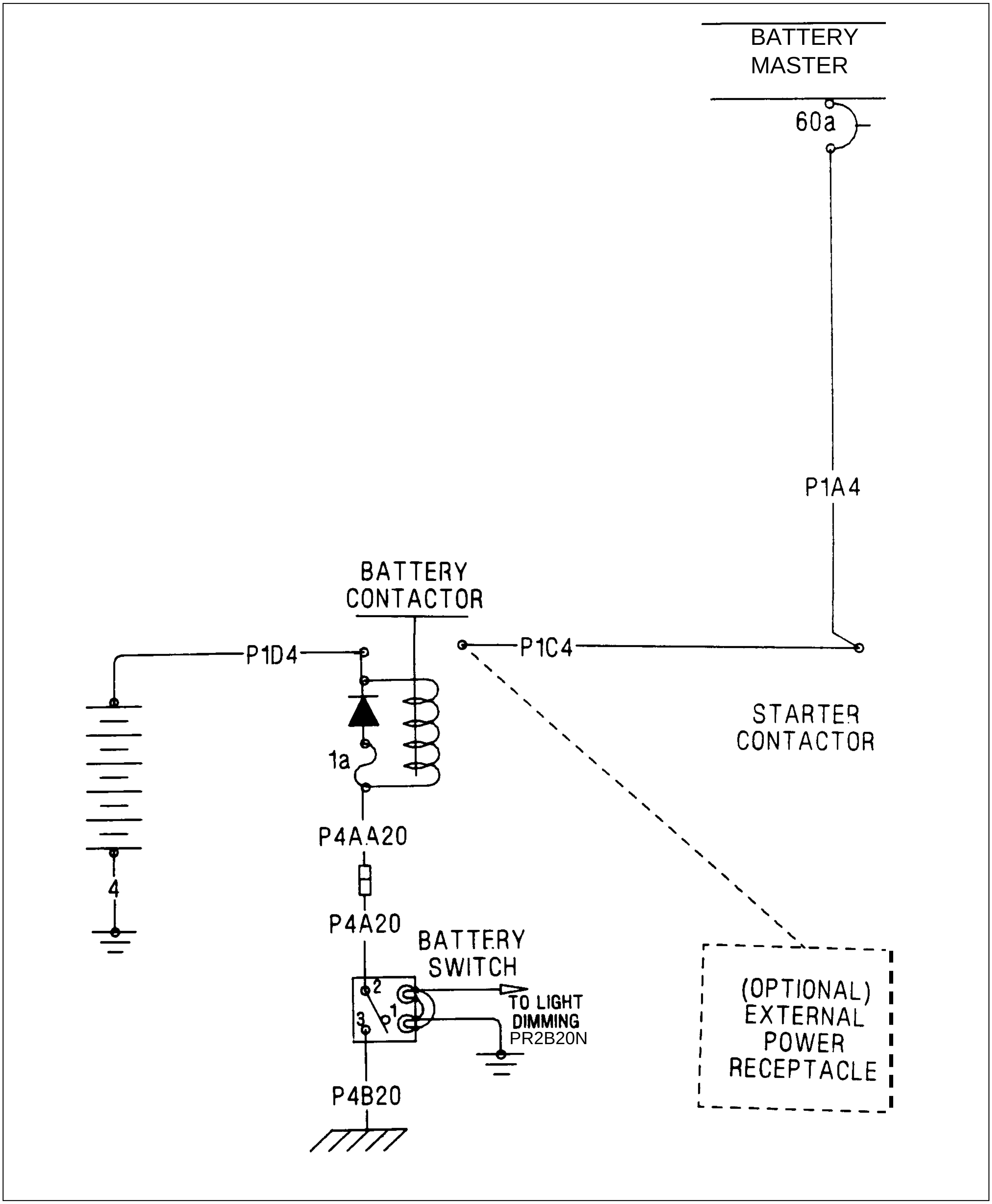


Figure 11-34. Battery Master Switch

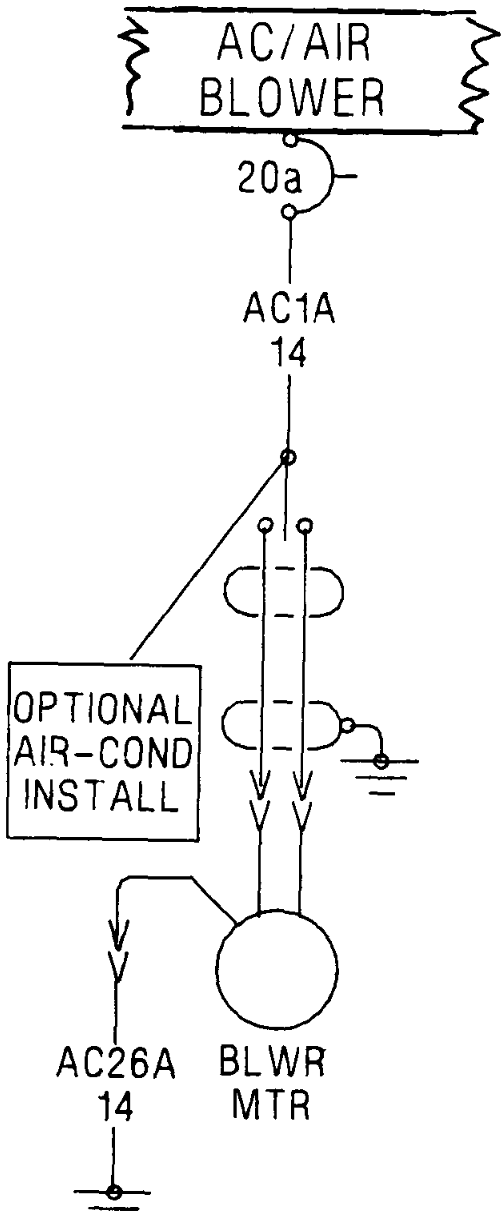


Figure 11-35. Air Blower

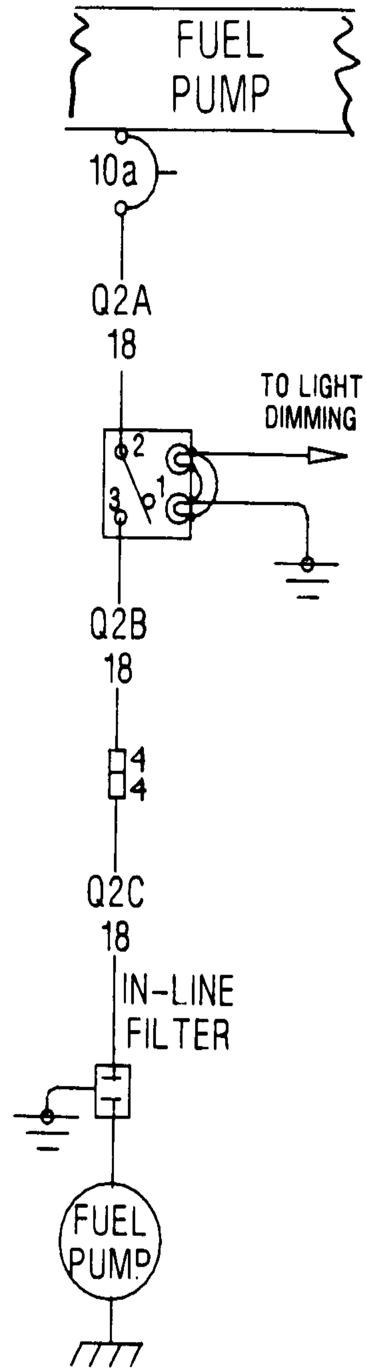


Figure 11-36. Fuel Pump

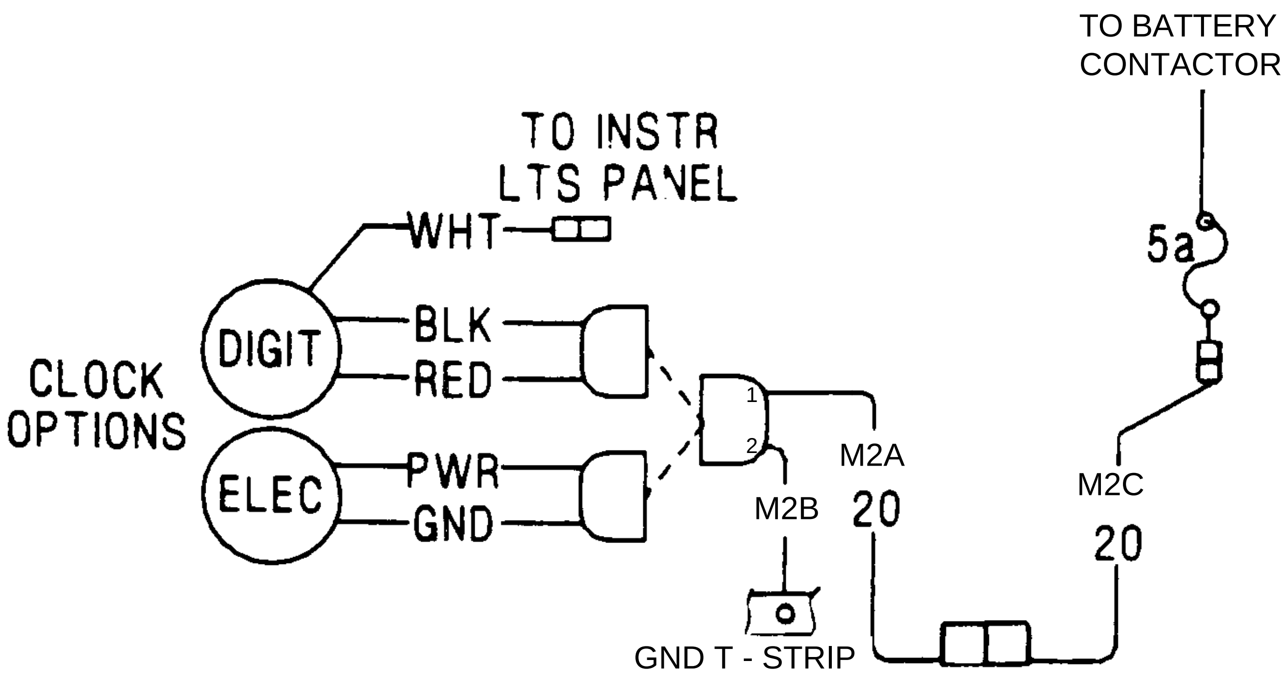


Figure 11-37. Clock, Electric and Optional Digital.

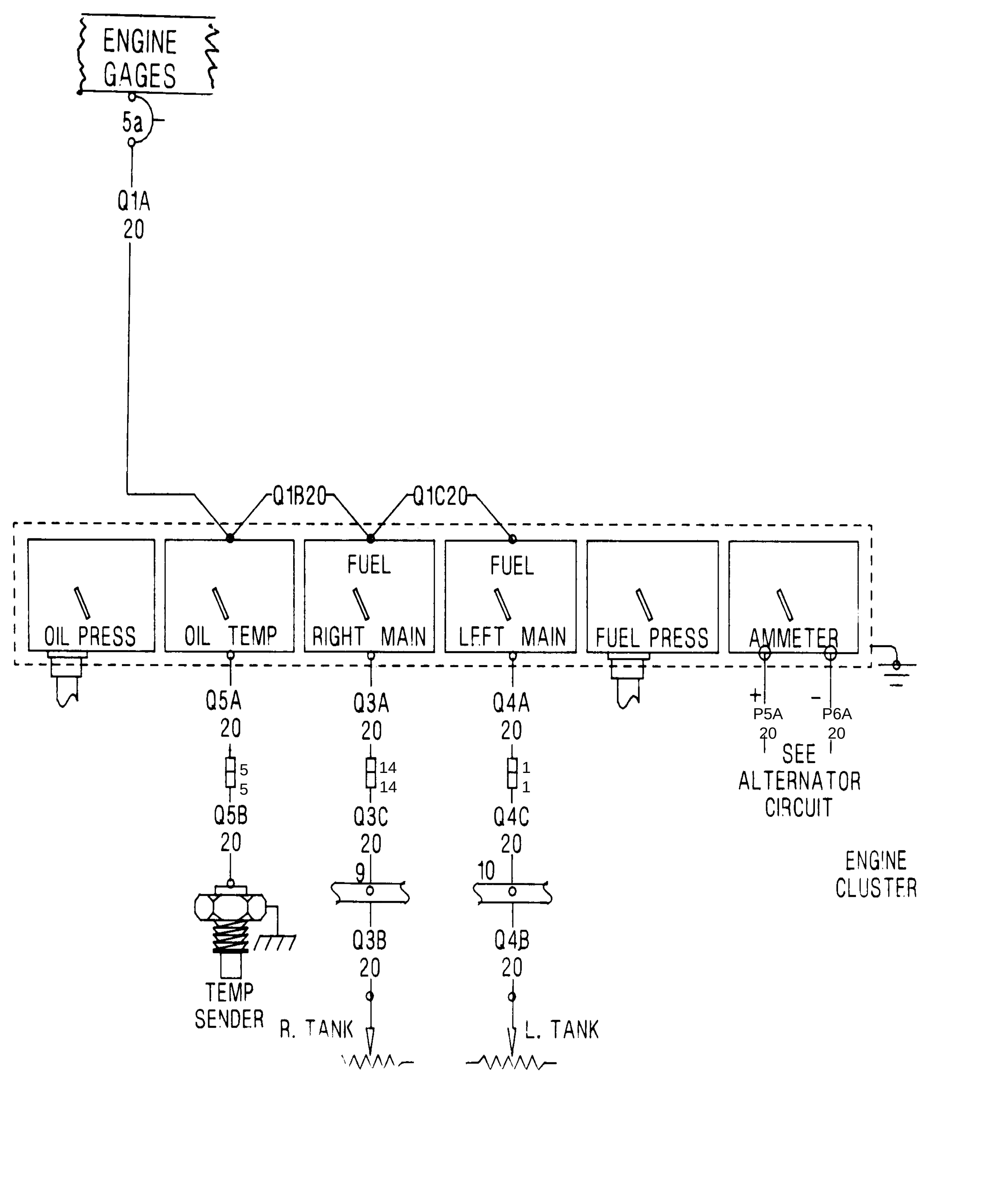
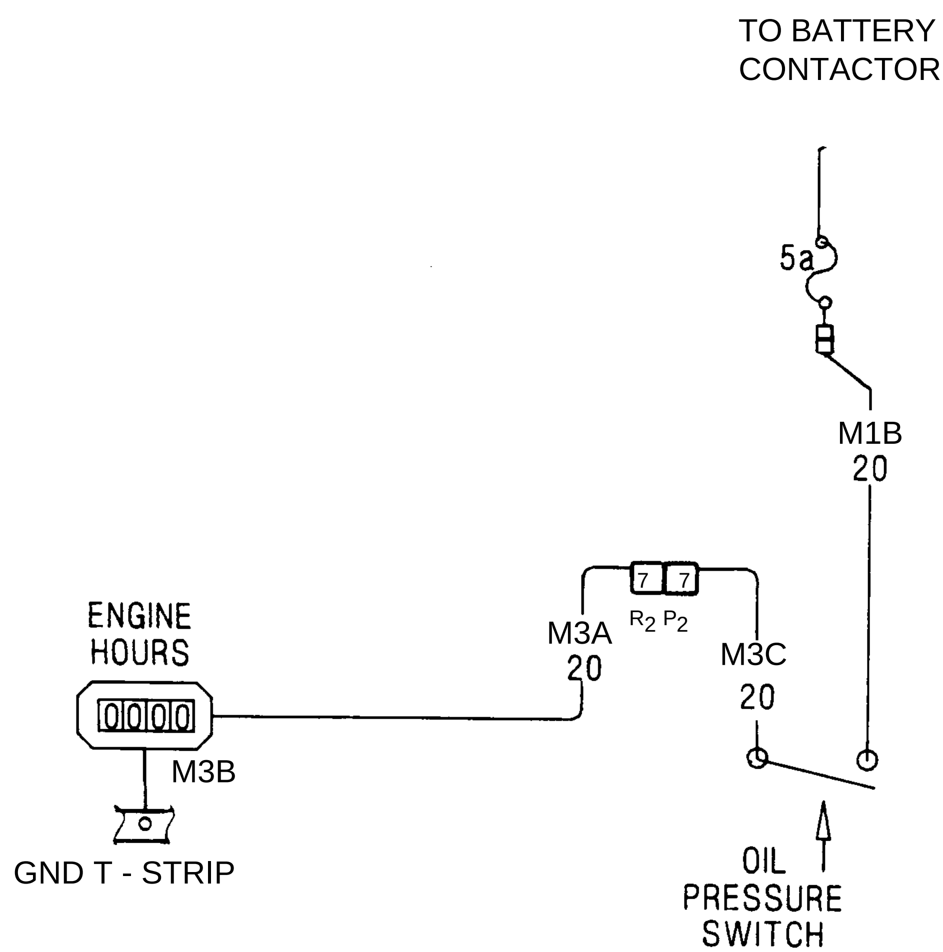


Figure 11-38. Engine Gauges.



11-39. Hourmeter (Optional)

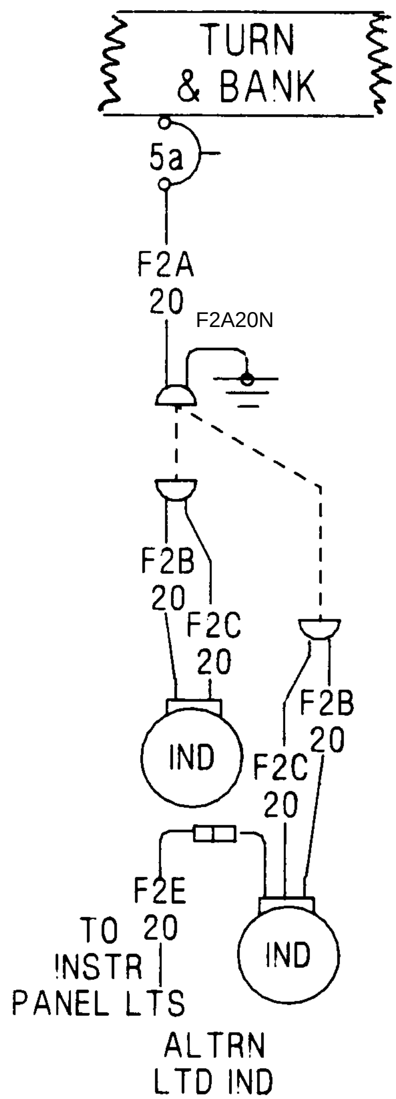


Figure 11-40. Turn and Bank.

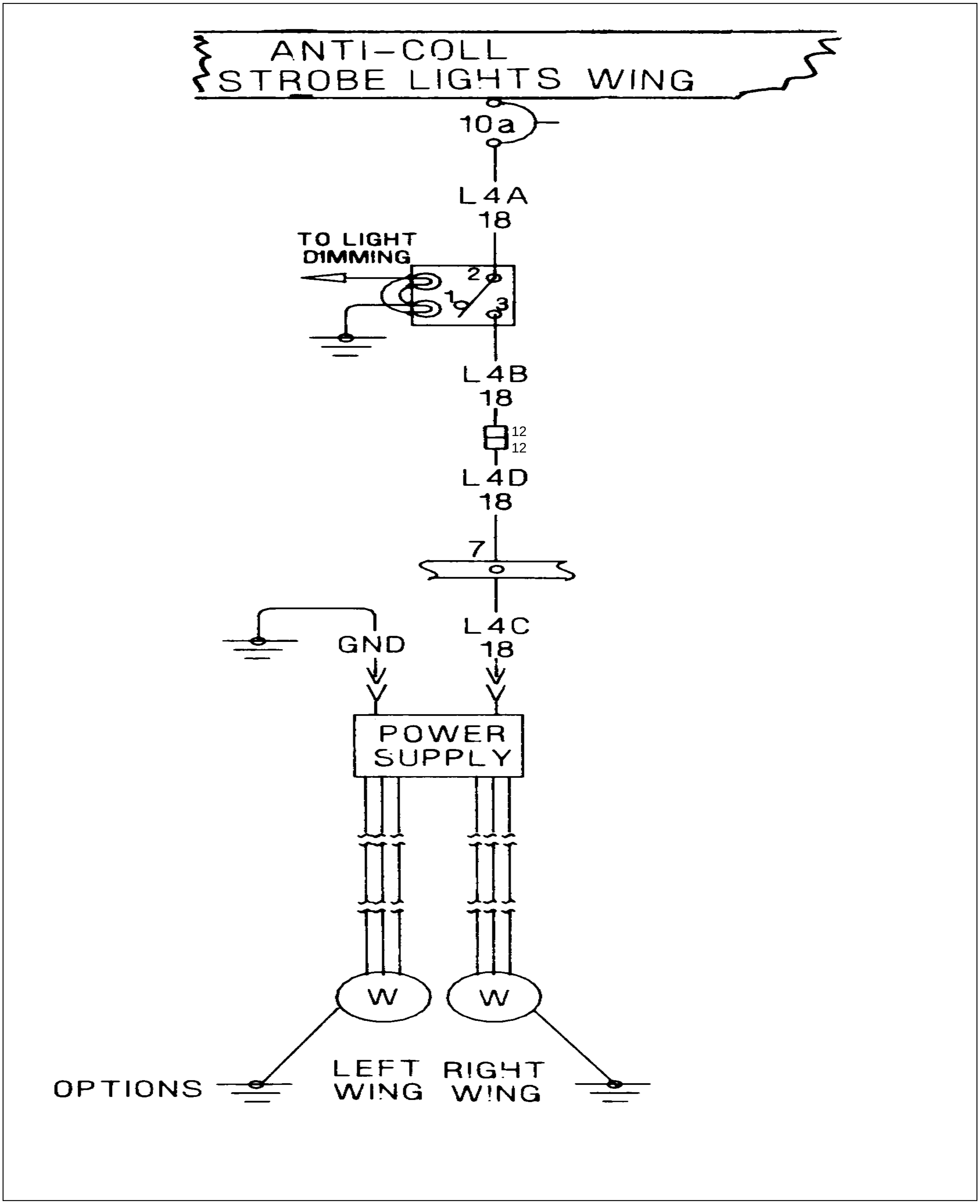


Figure 11-41 Anti Collision Strobe Lights (Wing)

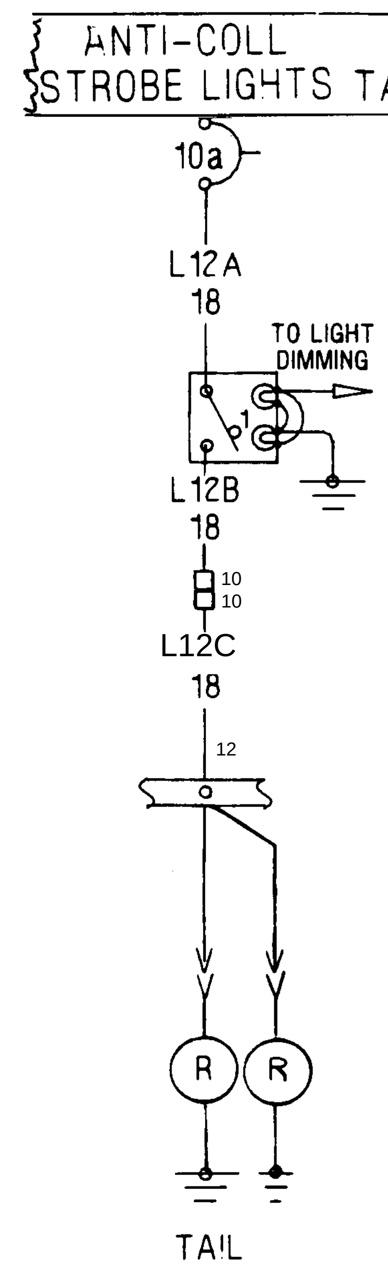


Figure 11-42. Anti-Collision,Strobe Lights (Tail)

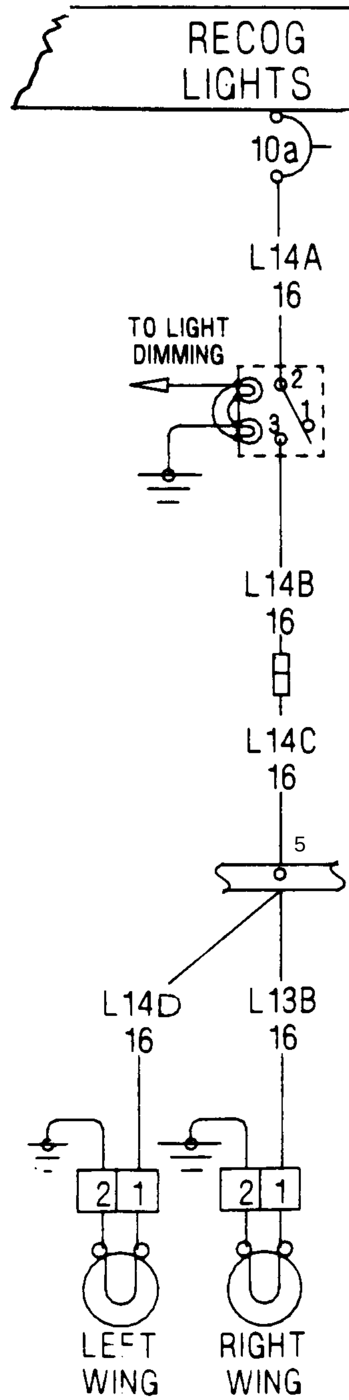


Figure 11-43. Recognition Lights (Optional)

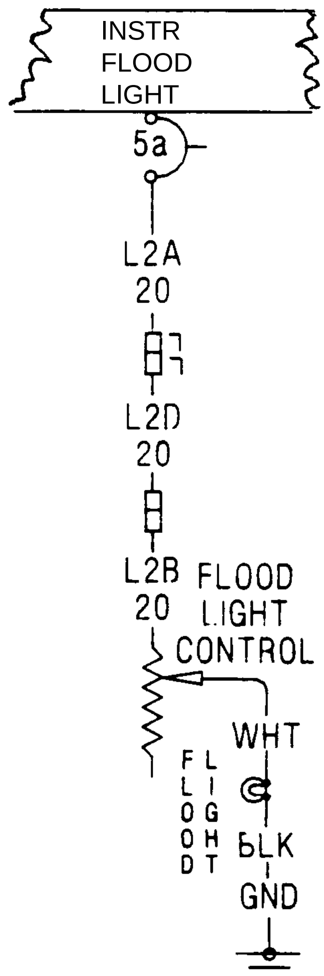


Figure 11-44. Instrument Flood Lights

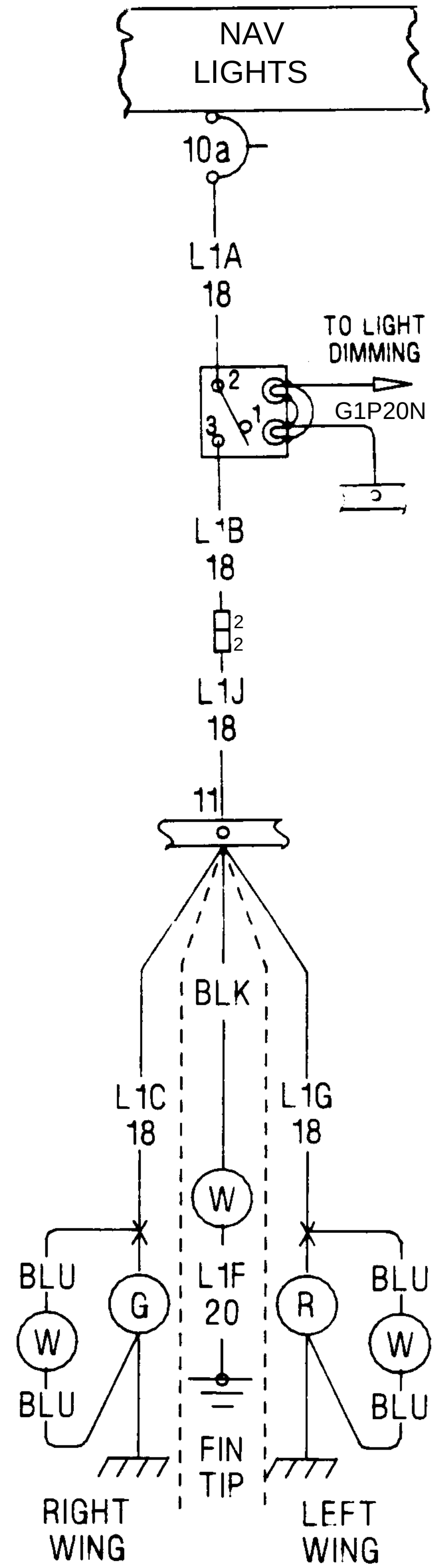
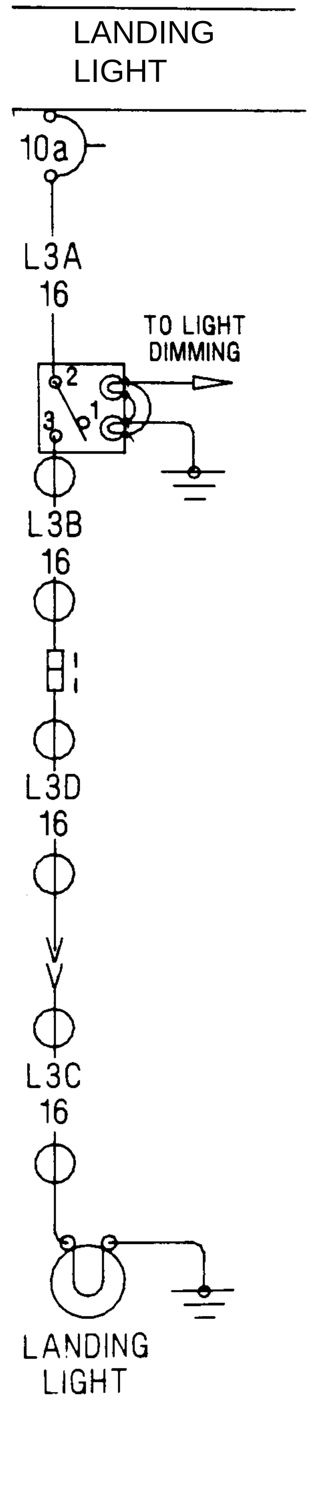


Figure 11-45. Navigationa Lights



11-46. Landing Light

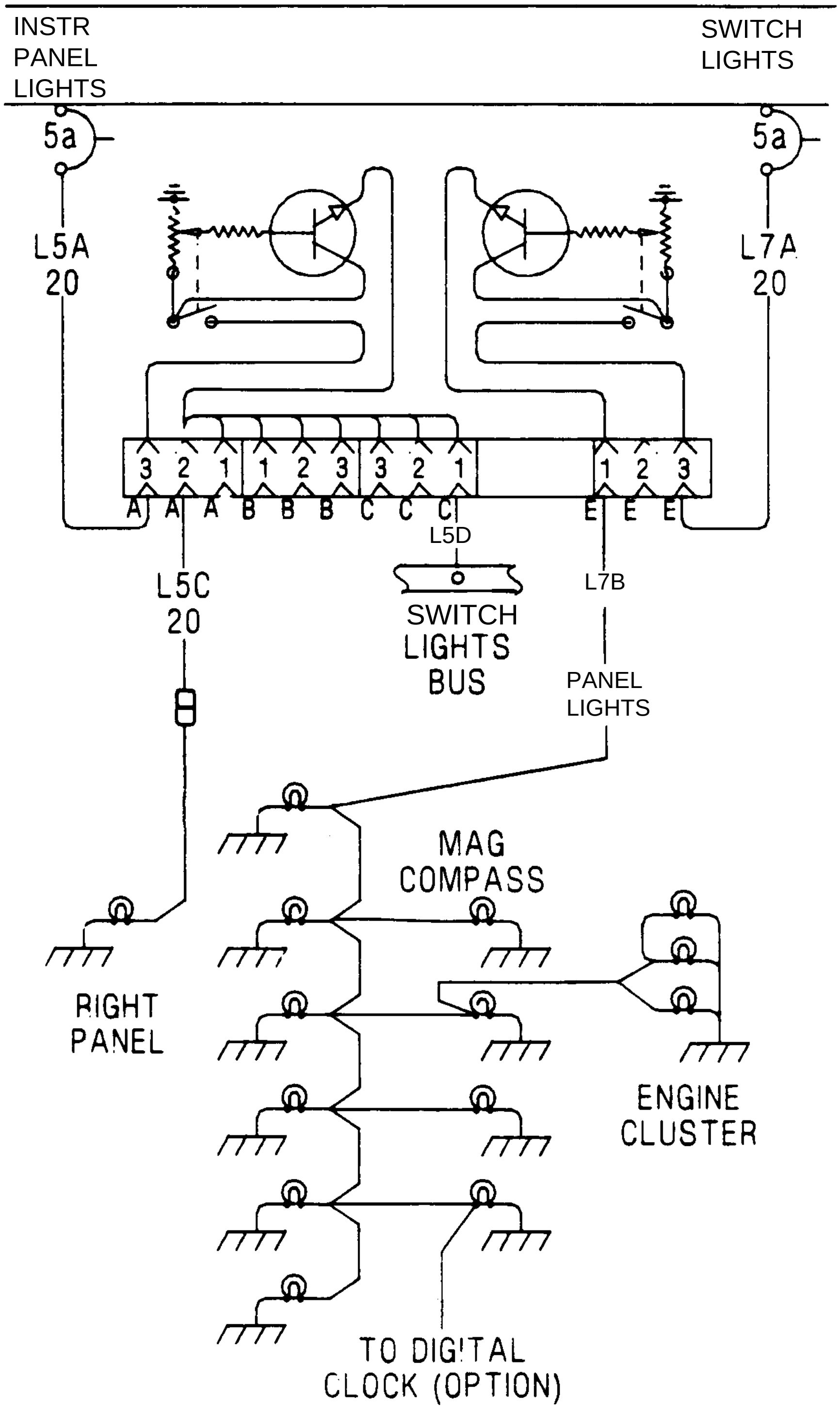


Figure 11-47. Instrument Panel and Switch Lights

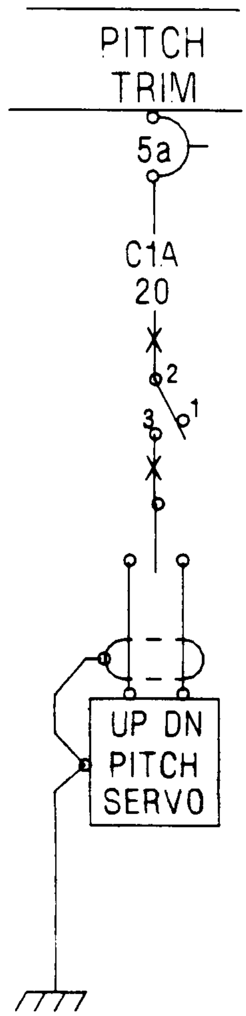
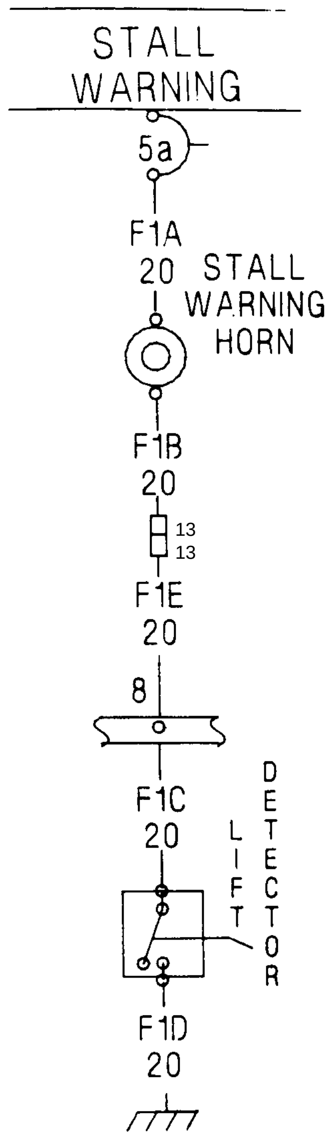


Figure 11-48. Pitch Trim



11-49. Stall Warning

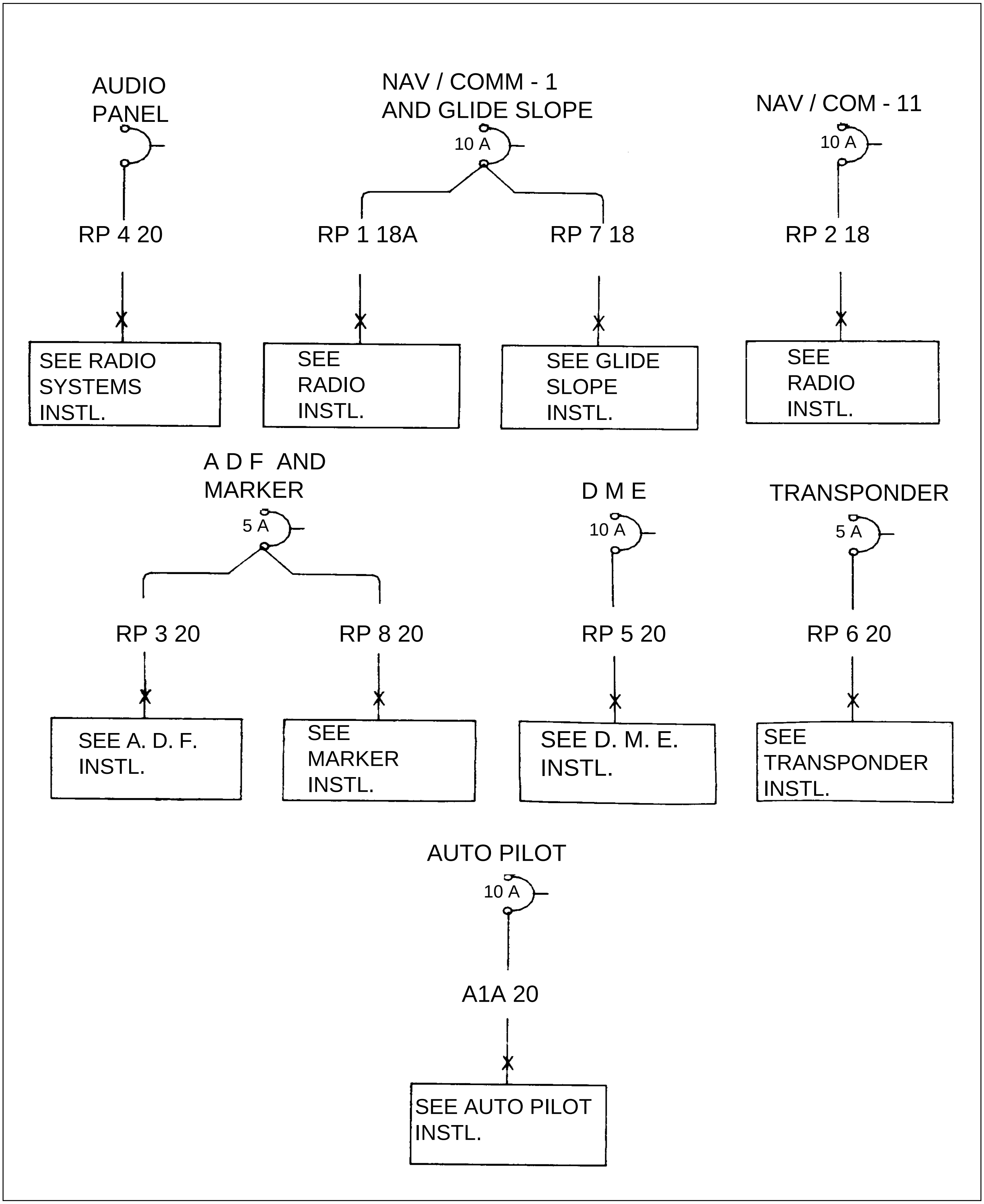


Figure 11-50. Optional Avionics

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SECTION XII
ELECTRONICS

SECTION XII

ELECTRONICS

12-1. INTRODUCTION. This section of the manual contains the information necessary to perform operational checks of the Emergency Locator Transmitter (ELT), with and without a pilot's remote switch. Included are the appropriate removal and installation instructions to facilitate battery replacement. For further information on Auto-Flight Systems, refer to the appropriate Manufacturers Maintenance Manual

—CAUTION—

It is very important to never use a substitute trim system component part for an original design part because of the fail-safe characteristics of the system might be compromised. Refer to the P.O.H. for ground check of Electric Pitch Trim System before the first flight after servicing. A trim system running the wrong direction is the same as a run-away. It is possible to experience excessive pilot yoke force in only 3 or 4 seconds under such conditions.

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12-2. EMERGENCY LOCATOR TRANSMITTER. (NARCO)

12-3. DESCRIPTION. The electrical power for the ELT is totally supplied by its own self-contained battery. The battery must be replaced on or before replacement date marked on battery pack label. If the transmitter has been used in an emergency situation or it has more than one hour of accumulated test time, the battery must be replaced.

A remote switch located on the left side panel is provided to allow the transmitter to be turned on from inside the cabin. The pilot's remote switch is placarded "ON" and "ARMED". The switch is normally in the ARMED position. Moving the switch to ON will activate the transmitter. Moving the switch back to the ARMED position will turn off the transmitter only if the impact switch has not been activated.

12-4. BATTERY REMOVAL AND INSTALLATION (NARCO.) (Refer to Figure 12-1 or 12-2.)

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 12-1.)

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 performed on the ELT. (Refer to Testing ELT.)

p. Install the access plate on the right side of the fuselage aft sta. 228.30.

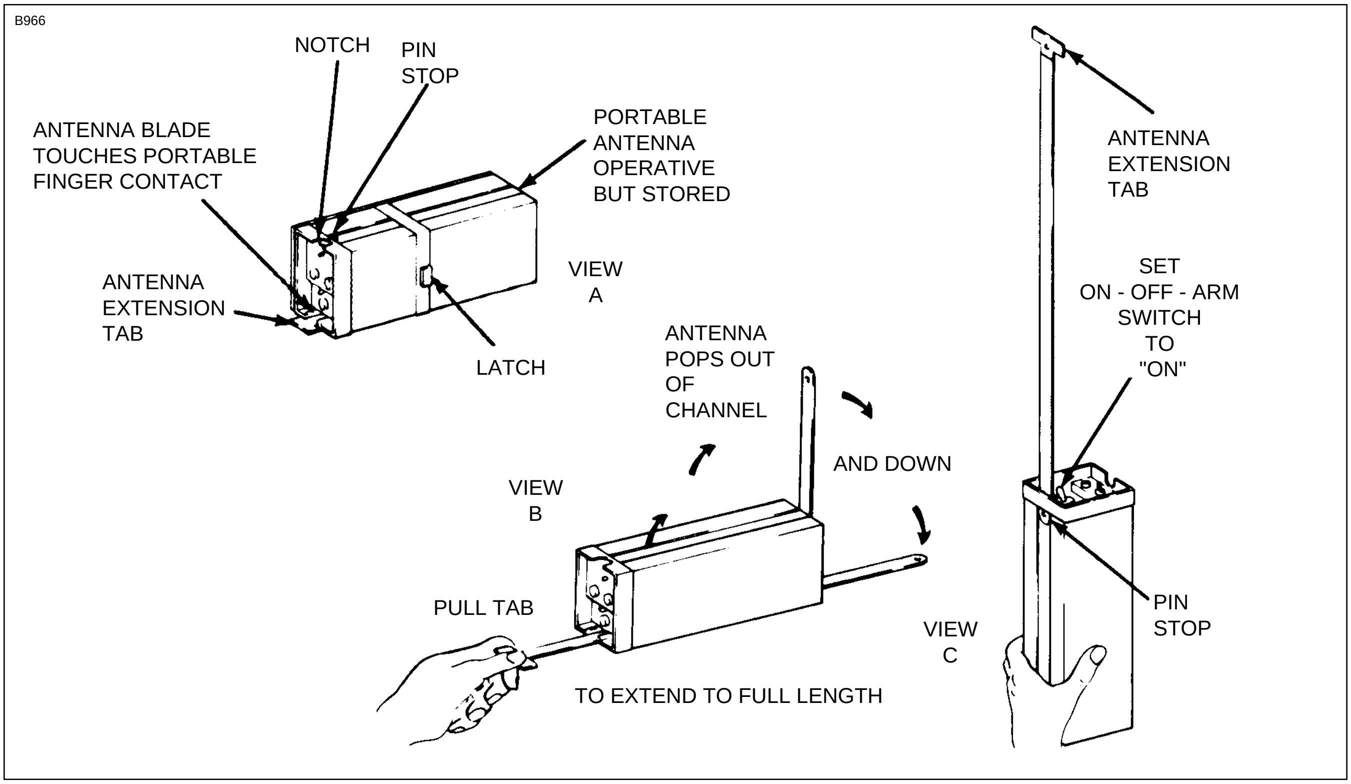

Figure 12-1. ELT Portable Folding Antenna.

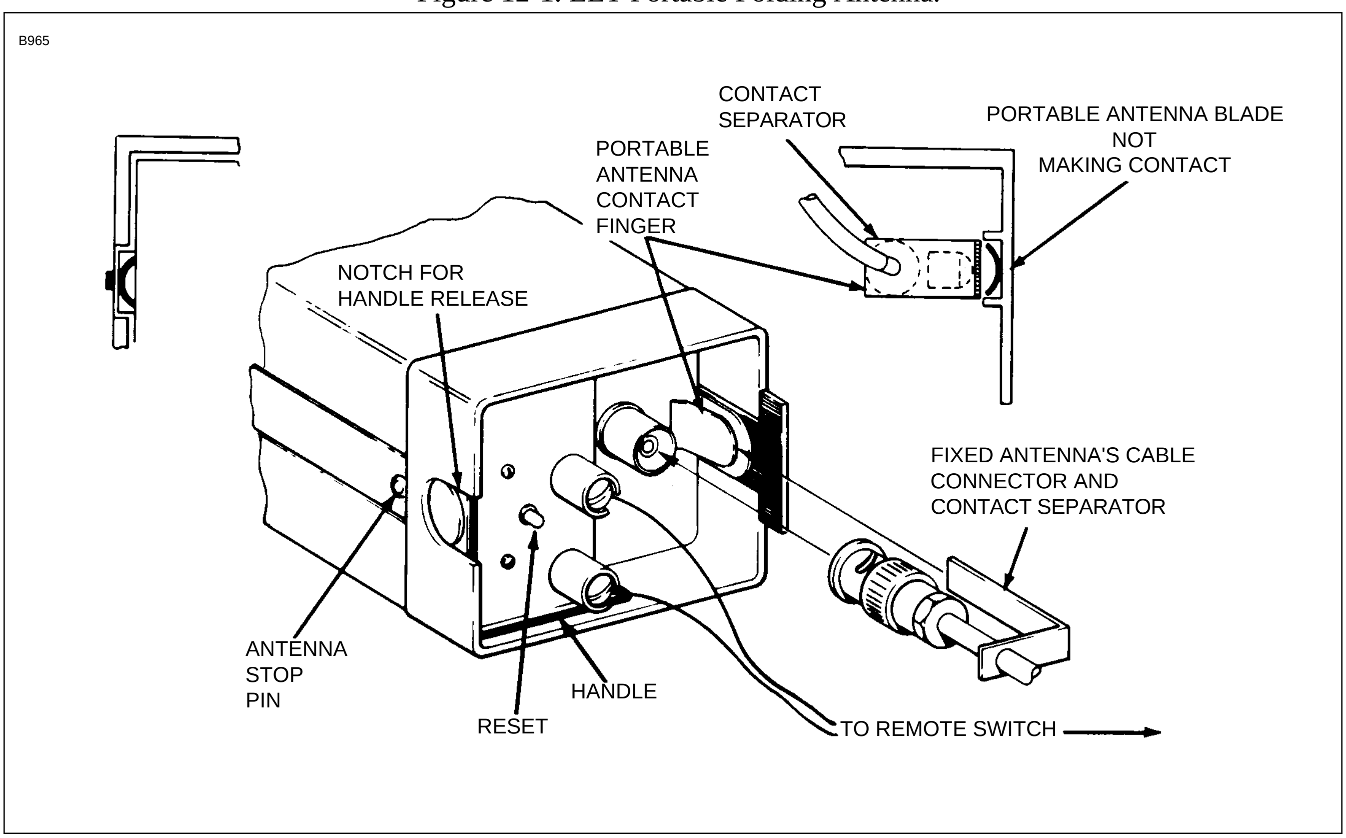

Figure 12-2. ELT Using Fixed Aircraft Antenna.

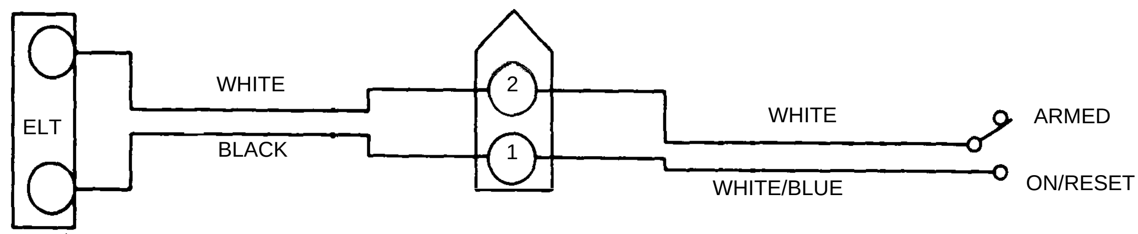

Figure 12-3. ELT Schematic.

—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 a of whip in flight.

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12-5 TESTING EMERGENCY LOCATOR TRANSMITTER. The transmitter operates on the emergency frequencies of 121.5 and 243 MHz; both of these frequencies are monitored by the various FAA installations. Before performing any operational test of the ELT. the following precautions should be observed:

—CAUTION—

Testing of an ELT should be conducted in a screen room or metal enclosure to ensure that electromagnetic energy is not radiated during testing. If a shielded enclosure is not available, testing may be performed in accordance with the following procedures:

1. Test should be no longer than three audio sweeps.

2. If the antenna is removed, a dummy load should be substituted during the test.

3. Test should be conducted only within the time period made up of the first five minutes after any hour.

4. If the operational tests must be made at a time not included within the first five minutes after the hour, the test should be coordinated with the closest FAA Tower or Flight Service Station. Consult FAA Advisory Circular AC 20-81 for detailed information concerning above caution.

a. Remove the access plate on the right side of the fuselage aft of sta. 228.30.

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. Install the access panel on the right side of the fuselage aft of sta. 228.30.

—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 in flight.

12-6 DESCRIPTION, OPERATION AND TESTING OF PILOT'S REMOTE SWITCH. (Refer to Pilot's Operating Handbook.)

12-7. AVIONICS MASTER AND EMERGENCY SWITCH CIRCUIT. (Refer to Figure 12-4.)

12-8. DESCRIPTION AND OPERATION. Electrical power for the various avionics components is controlled by the Avionics Master Switch located near the top of the instrument panel between the radio stacks. It controls the power to all radios through the aircraft master switch.

An emergency bus switch is also provided to provide auxiliary power to the avionics bus in event of a radio master switch circuit failure. The emergency bus switch is located behind the lower right shin guard left of the circuit breaker panel.

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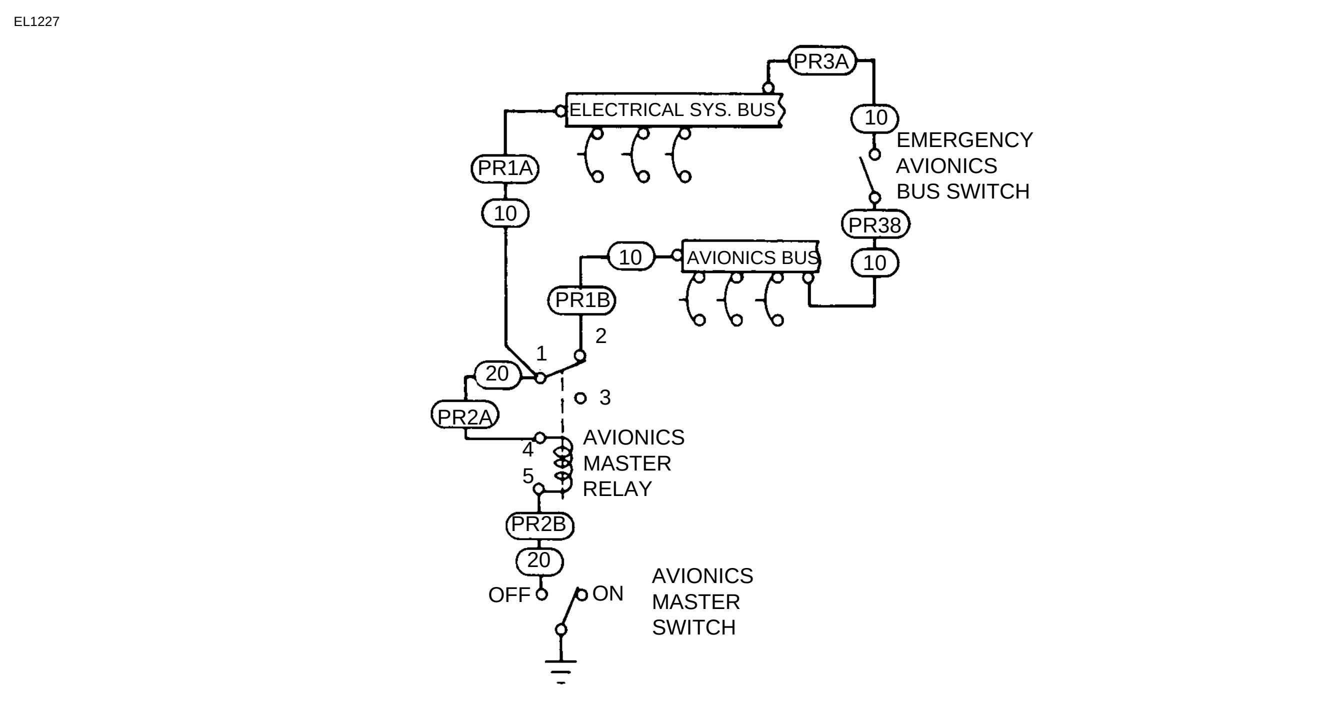

Figure 12-4. Avionics Master and Emergency Switch Circuit

12-9. AUTOPILOT.

12-10. GENERAL. Due to the wide variety 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 and installation. servo clutch adjustments. etc.

12-11. A.F.C.S. EQUIPMENT MANUFACTURERS. Refer to the following list of Auto Pilot Flight Director manufacturers to obtain service direction. parts support. and service literature.

Bendix Avionics Division
2100 N.W. 62nd Street
Fort lauderdale. Fla. 33310
(305) 776-4100/TWX 5109559884

Collins General Aviation Division
Rockwell International
Cedar Rapids. Iowa 52406
(319) 395-3625/Telex: 464-421

Edo Corporation - Avionics Division
Box 610
Municipal Airport
Mineral Wells. Texas 76067
(817) 325-2517 Telex 76067

King Radio Corporation
400 North Rodgers Road
Olathe. Kansas 66061
(913) 782-0400 Telex.4-2299-Kingrad

Sperry Flight Systems/Avionics Div.
8500 Balboa Blvd.
P.O. Box 9028
Van Nuys. CA 91409
(213) 894-8111 Telex: 65- 1367

Global Navigations
2144 Michelson Drive
Irvine. CA 92715
(714) #51-01119

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SECTION XIII

HEATING AND VENTILATING

Paragraph	Aerofiche Grid No.

SECTION XIII
HEATING AND VENTILATING SYSTEM

13-1. INTRODUCTION. Because of the simplicity of the heating and ventilating system installed on the PA-28-161 CADET, the operation and maintenance instructions of the components are contained in Paragraph 13-3. A pictorial description of these systems may be found in Figure 13-1.

13-2. DESCRIPTION. Heat for the cabin is provided by a hot air heater installed on the exhaust manifold. Fresh air enters the engine compartment through the nose cowling, passes over the engine and is vented to the heater muffler through a flexible hose located on the baffling at the rear 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 outlet in the cabin is located between the two front 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 is picked up from an inlet in the leading edge of each wing. The air passes through the wings to individually controlled outlets located just forward of each seat. An air vent is located in the bottom of the fuselage to take exhaust air from the cabin interior.

13-3. 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, Refer to Section III for inspection of exhaust system. 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. Refer to Figure 13-1 for an illustration of the heater system.

13-4. OVERHEAD VENT SYSTEM. The overhead vent system utilizes the ducting noted in Figure 13-1. Air enters an inlet at the top of the fin and is ducted through the vent system. Small louvers control the flow of air into the cabin. This vent system may also be equipped with a blower (optional). This blower, mounted aft of the closeout panel underneath the top of the fuselage, will force air through the overhead vent system whenever desired. (For blower information refer to Section XIV.)

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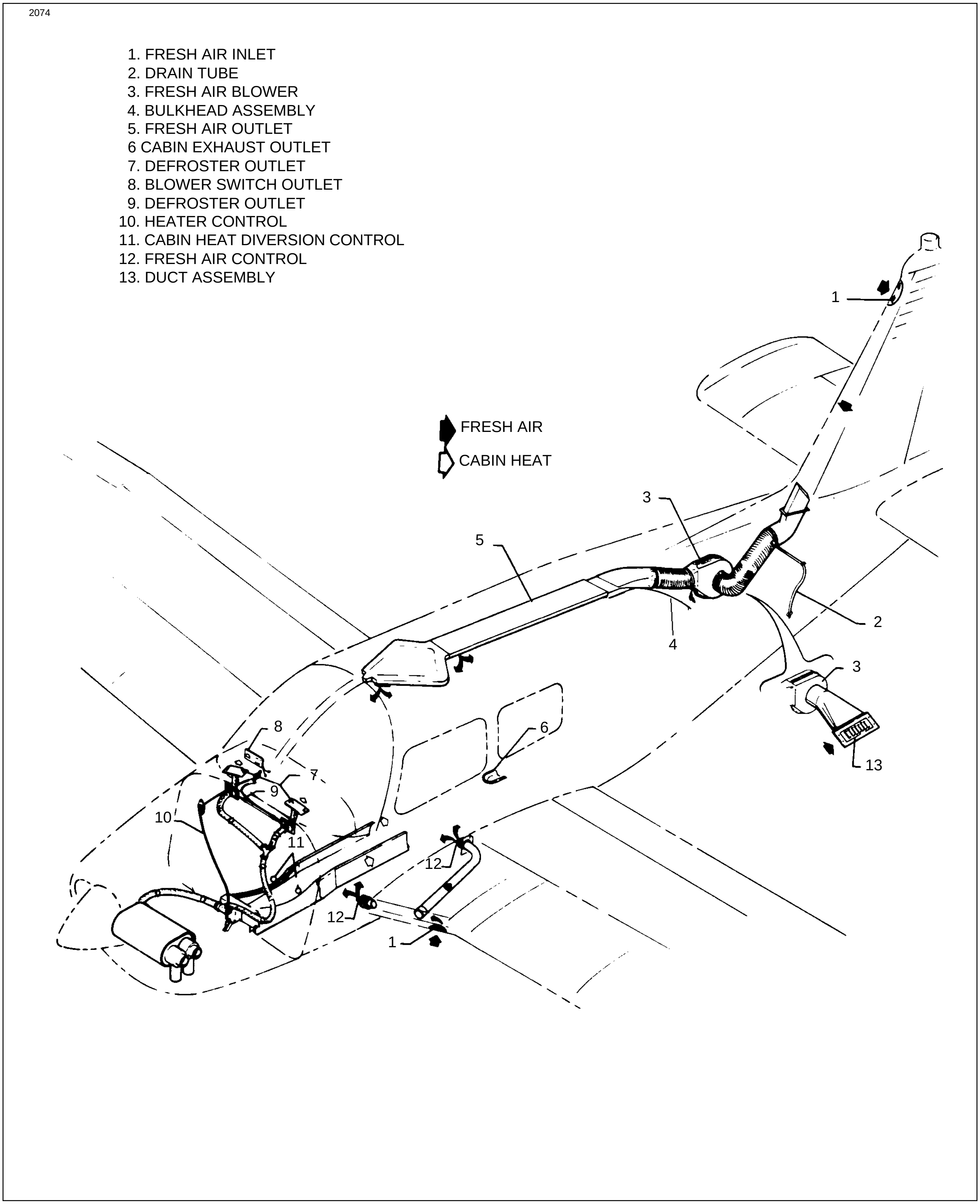

Figure 13-1 Cabin Heater, Defroster and Fresh Air System

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SECTION XIV

ACCESSORIES AND UTILITIES

Paragraph	Aerofiche Grid No.

14-1. 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, 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.

14-2. OVERHEAD VENT BLOWER.

14-3. 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.

14-4. REMOVAL OF BLOWER ASSEMBLY.

a. Remove the access door from the aft wall of the cabin 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.

14-5. 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, preceed 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.

14-6. 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-5OOO 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 XIV-V

f. Position the blower fan 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-5OOO sealant to seal where the duct attaches to the blower assembly.

14-7. 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 XIV-I. BLOWER SYSTEM WIRE COLOR CODES

	MOTOR WIRES					AIRCRAFT WIRES		
		Pin Nos	15920-01 General Industries	E362Q Singer or YY7S062 ESB - Universal Elect Company	F0018075FA Leece-Neville	Aircraft Harness	Pin Nos	
Ground Low Speed	Plug Plug	2 1	Brown Red	Brown Yellow	Black Yellow	AC26A Black	2 1	Receptacle Receptacle
Medium Speed High Speed	Receptacle Receptacle	2 1	Black Yellow	Red Orange	Red Orange	White Red	2 1	Plug Plug

NOTE

Pin number 1 is at the pointed side of the plug and receptacle.

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