CHEROKEE WARRIOR
SERVICE MANUAL

CARD 1 OF 2

PA-28-151 CHEROKEE WARRIOR

PA-28-161 WARRIOR II

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 539)

SERIAL NUMBER INFORMATION

PA-28-151, WARRIOR- 1974
Serial Numbers 28-7415001 to 28-7415713 inclusive
PA-28-151, WARRIOR - 1975
Serial Numbers 28-7515001 to 28-7515459 inclusive
PA-28-151, WARRIOR - 1976
Serial Numbers 28-7615001 to 28-7615445 inclusive
PA-28-151, WARRIOR - 1977
Serial Numbers 28-7715001 to 28-7715314 inclusive
PA-28-161, WARRIOR II - 1977
Serial Numbers 28-7716001 to 28-7716323 inclusive
PA-28-161, WARRIOR II - 1978
Serial Numbers 28-7816001 to 28-7816695 inclusive
PA-28-161, WARRIOR II - 1979
Serial Numbers 28-7916001 to 28-7916617 inclusive
PA-28-161, WARRIOR II - 1980
Serial Numbers 28-8016001 to 28-8016382 inclusive
PA-28-161, WARRIOR II - 1981
Serial Numbers 28-8116001 to 28-8116342 inclusive
PA-28-161, WARRIOR II - 1982
Serial Numbers 28-8216001 to 28-8216236 inclusive
PA-28-161, WARRIOR II - 1983
Serial Numbers 28-8316001 to 28-8316112 inclusive
PA-28-161, WARRIOR II - 1984
Serial Numbers 28-8416001 to 28-8416131 inclusive
PA-28-161, WARRIOR II - 1985
Serial Numbers 28-8516001 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 Serivce 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 761 539 issued August. 1973 ORG 730 822 are as follows:

Revisions	Date	Aerofiche Card Effectivity
PR740806	August 6. 1974	—
PR750630	June 30. 1975	—
PR760501	May 1. 1976	1 and 2
PR760507	May 7. 1976	1 and 2
PR761201	December 1. 1976	1 and 2
PR770527	May 27. 1977	1 and 2
PR771212	December 12. 1977	1 and 2
PR780801	August 1. 1978	1 and 2
PR790616	June 16. 1979	1 and 2
PR790823	August 23. 1979	1 and 2
PR800303	March 3. 1980	1 and 2
PR800724	July 24. 1980	1 and 2
PR801013	October 13. 1980	1 and 2
PR810623	June 23. 1981	1 and 2
PR820412	April 12. 1982	1 and 2
PR821130	November 30. 1982	1 and 2
PR830609	June 9. 1983	1 and 2
PR830712	July 12. 1983	1
PR840605	June 5. 1984	1 and 2

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

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SECTION I

INTRODUCTION

SECTION I

INTRODUCTION

1-1. GENERAL. This manual contains service and maintenance instructions for the Piper PA-28-151 and PA-28-161 Cherokee Warrior, 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. Section II and III comprise the service part of this manual, whereas Sections IV through 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 and 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 Cherokee Warrior 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 thermoplastic 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 manifold in each wing root, 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 navagation-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.

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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 fire wall; 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, open the baggage compartment door and 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.

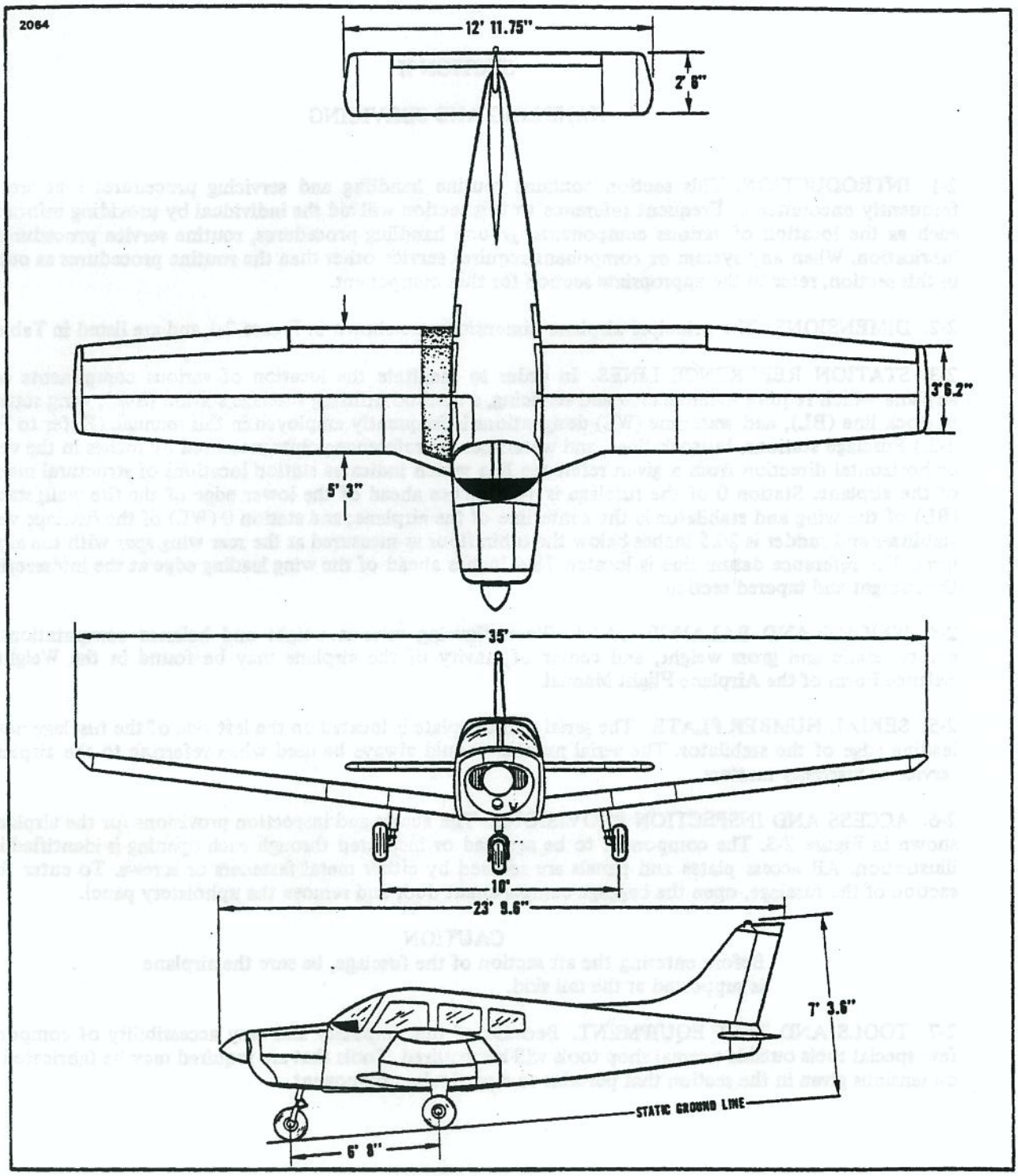

Figure 2-1. Three View

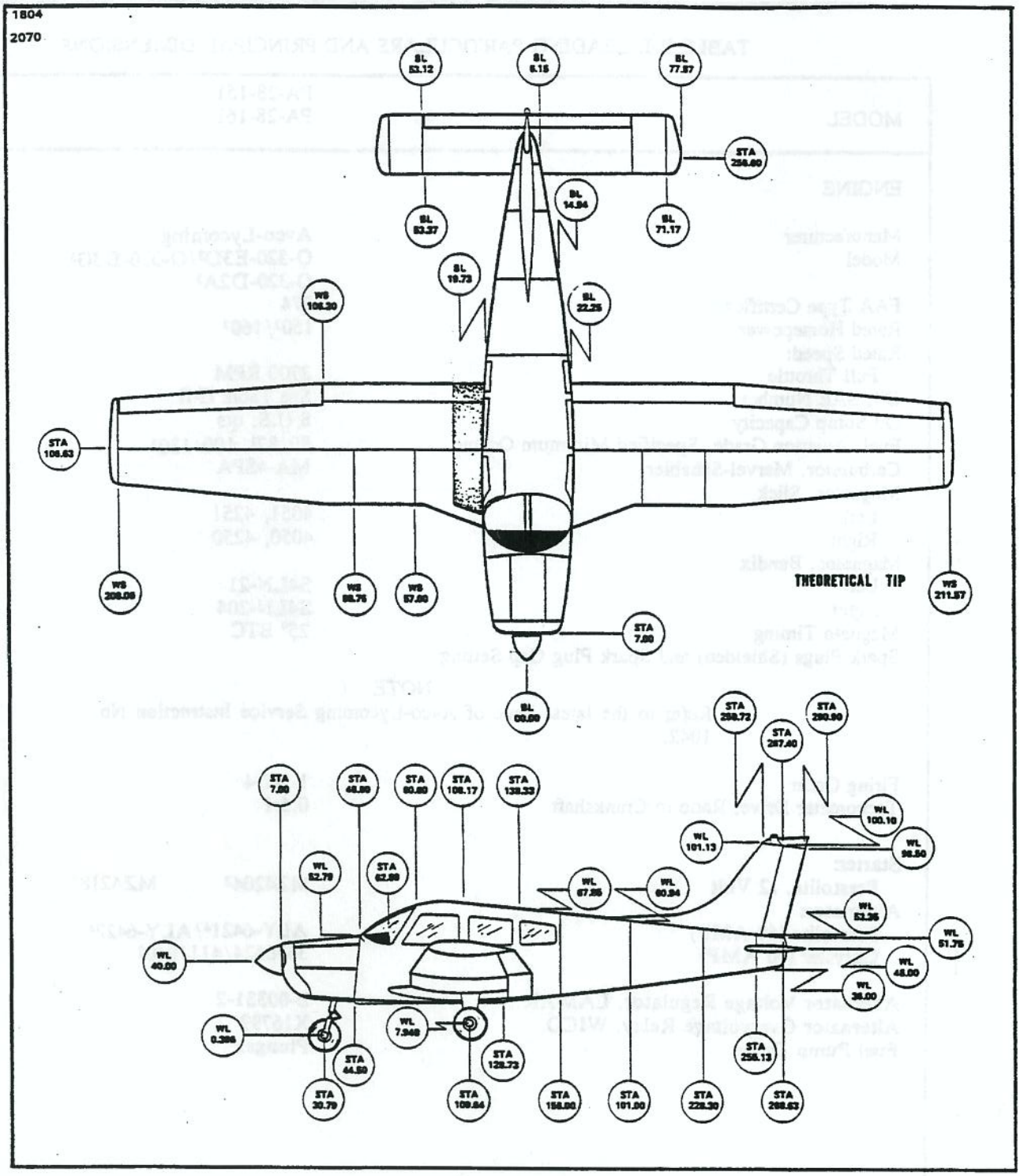

Figure 2-2. Station Reference Lines

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-28-151 PA-28-161
ENGINE	
Manufacturer	Avco-Lycoming
Model	O-320-E3D[2]/O-320-D3G[3] O-320-D2A[3]
FAA Type Certificate	274
Rated Horsepower	150[2]/160[3]
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	80/87[1], 100/130[3]
Carburetor, Marvel-Schebler	MA-4SPA
Magnetos, Slick	
Left	4051, 4251
Right	4050, 4250
Magnetos, Bendix	
Left	S4LN-21
Right	S4LN-204
Magneto Timing	25° BTC
Spark Plugs (Shielded) and Spark Plug Gap Setting	
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	MZ4204[2] MZ4218[3]
Alternator:	
Prestolite (60 AMP)	ALY-6421[4]/ALY-6422[4]
Chrysler (60 AMP)	3656624/4111810[3]
Alternator Voltage Regulator, LAMAR	B-00331-2
Alternator Overvoltage Relay, WICO	X16799
Fuel Pump Drive	Plunger

Refer to end of Table II-I for footnotes.

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

MODEL	PA-28-151 PA-28-161
PROPELLER	
Fixed Pitch:	
Manufacturer	Sensenich
Model	74 DM6-0-58[2], 74 DM6-0-60[3]
Diameter	74 in
Diameter, Minimum	72 in
Manufacturer	McCauley
Model	1C160/EGM7653[2]
Diameter	76 in
Diameter, Minimum	74.5 in
FUEL SYSTEM	
Inboard (Main Tanks)	Two
Capacity (each)	25 U.S. gal.
Unusable Fuel (each tank)	0.125 U.S. gal.
Total Capacity	50 U.S. gal.
Total Unusable Fuel	0.25 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 x 6
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.

Refer to end of Table II-I for footnotes.

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

MODEL	PA-28-151 PA-28-161
CONTROL SURFACE TRAVELS	
REFER TO SECTION V TABLE V-I.	
CABLE TENSIONS	
REFER TO SECTION V TABLE V-I.	

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

FOOTNOTES

1. The specified minimum octane aviation grade fuel for the PA-28-151 is 80/87 octane. Whenever 80/87 is not available, the lowest lead 100 grade should be used. The continuous use of the higher leaded fuels (more than 25% of the operating time) can result in increased engine deposits both in the combustion chamber and the engine oil. It may require increased spark plug maintenance and more frequent oil changes. This will be governed by the amount of lead per gallon and the type of operation, such as operating at full rich mixture. When using alternate fuels, refer to the latest revision of Lycoming Service Letter No. L185.
2. PA-28-151 only.
3. PA-28-161 only.
4. Refer to Piper Parts Catalog for serial number effectivities.

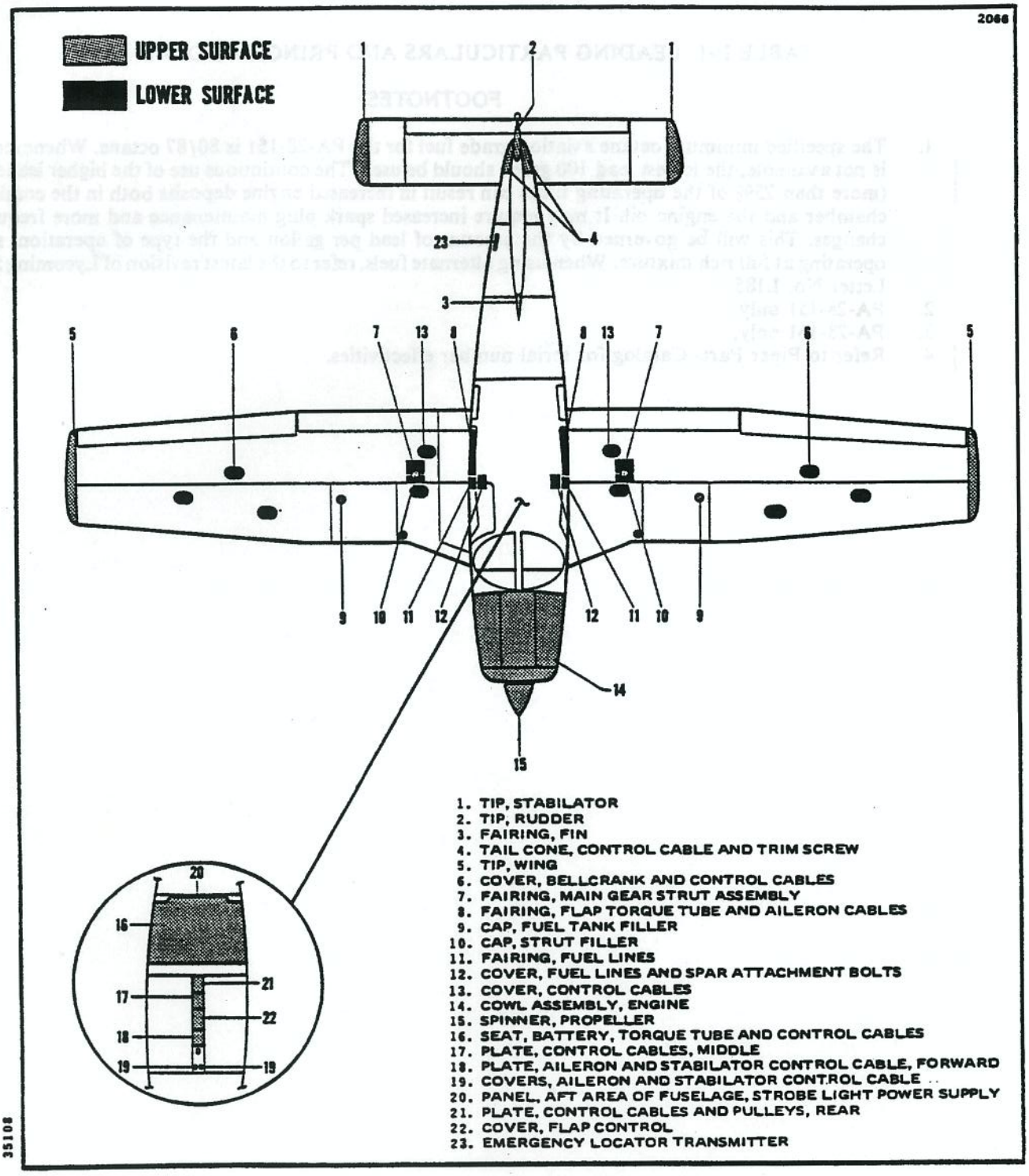

Figure 2-3. Access Plates and Panels

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 powerplant 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.

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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.)

TABLE A

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

*APPLICABLE TO COARSE THREADS ONLY.

TABLE B

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

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

PPS 20015E

Table II-II. 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 NK9 MS 24694 AN 525 NK525 MS 27039		MS 20004 thru MS 20024 NAS 144 thru NAS 158 NAS 333 thru NAS 340 NAS 583 thru NAS 590 NAS 624 thru NAS 644 NAS 1303 thru NAS 1320 NAS 172 NAS 174 NAS 517	Steel shear bolt NAS 464	AN 3DD thru AN 20DD AN 173DD thru AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD	
	NUTS		NUTS		NUTS	
	Steel Tension	Steel Shear	Steel Tension	Steel Shear	Alum. Tension	Alum. Shear
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 310 AN 315 AN 363 AN 365 MS 17825 MS 20365 MS 21045 NAS 1021 NAS 679 NAS 1291	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 365D AN 310D NAS 1021D	AN 320D AN 364D NAS 1022D

FINE THREAD SERIES

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

TABLE II-IIA. FLARE FITTING TORQUES

TORQUE - INCH-POUND						
TUBING OD INCHES	ALUMINUM - ALLOY TUBING FLARE - AND 10061 OR AND 10078		STEEL TUBING FLARE AND 10061		HOSE END FITTING AND HOSE ASSEMBLIES	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/8						
3/16			90	100	70	100
1/4	40	65	135	150	70	120
5/16	60	80	180	200	85	180
3/8	75	125	270	300	100	250
1/2	150	250	450	500	210	420
5/8	200	350	650	700	300	480
3/4	300	500	900	1000	500	850
1	500	700	1200	1400		1150
1-1/4	600	900				
1-1/2	600	900				
1-3/4						
2						

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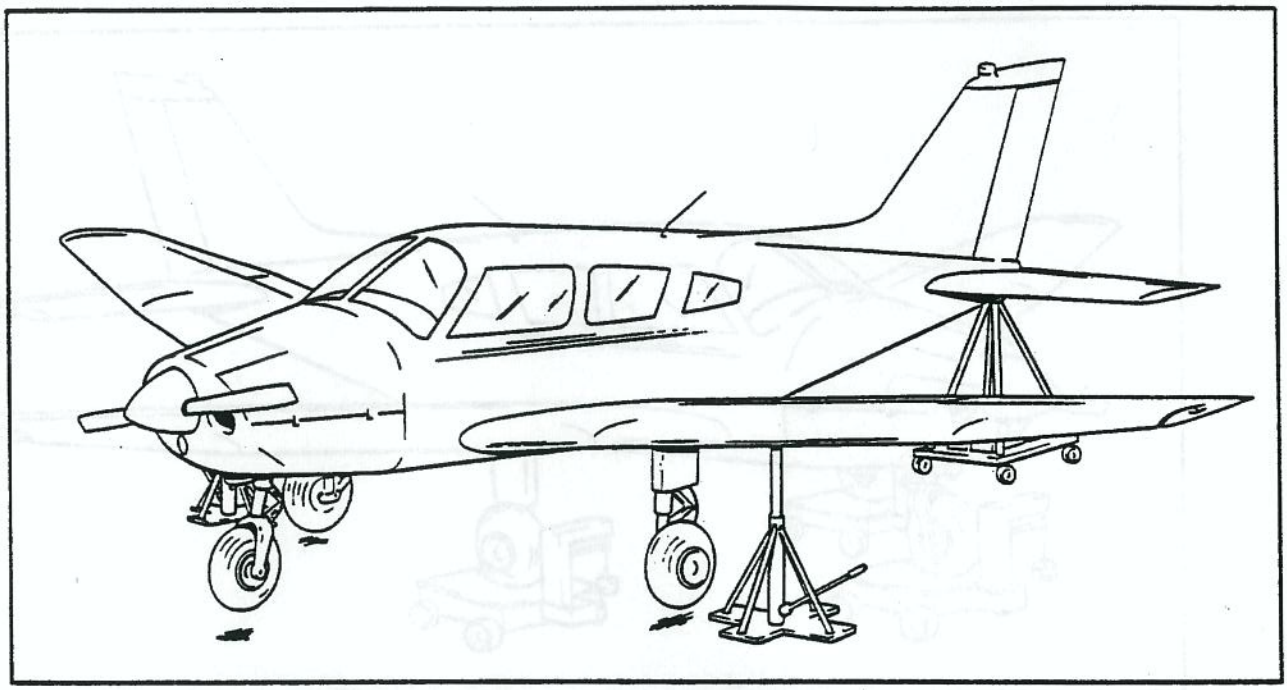


Figure 2-4. Jacking Arrangement

2-9. WALKWAY, HANDHOLD AND STEP. The walkway is made of a non-skid compound 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.)

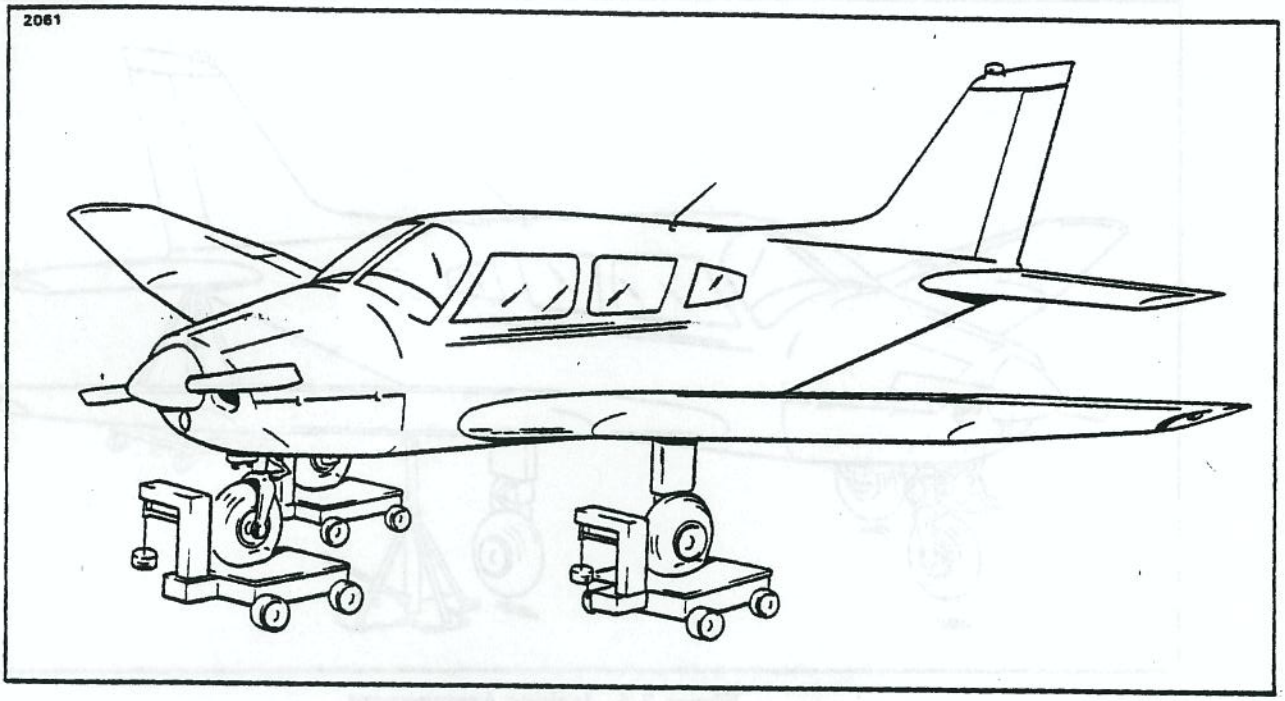


Figure 2-5. Weighing Arrangement

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

CAUTION

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

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

2-13. 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

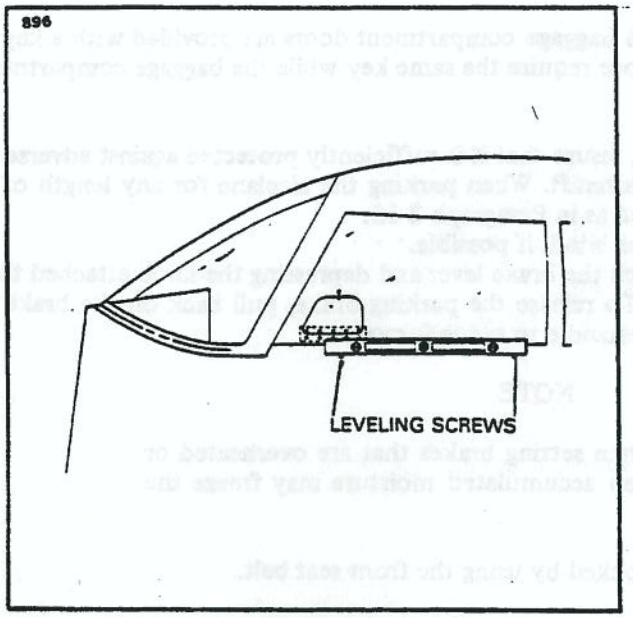


Figure 2-6. Leveling Longitudinally

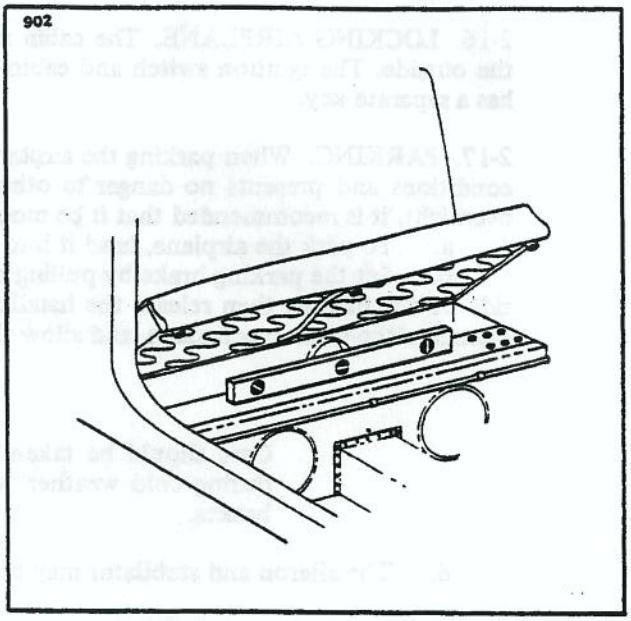


Figure 2-7. Leveling Laterally

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.

b. To laterally level the airplane, place a level across the spar box assembly under the rear 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 insure its immovability, protection, and security under various weather conditions. The following procedure gives the instructions for proper mooring of the airplane:

a. Head the airplane into the wind, if possible.
b. Block the wheels.
c. 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 and baggage compartment doors are provided with a key lock on the outside. The ignition switch and cabin door require the same key while the baggage compartment door has a separate key.

2-17. PARKING. When parking the airplane, insure that it is sufficiently protected against adverse weather conditions and presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is recommended that it be moored as in Paragraph 2-15.

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

b. Set the parking brake by 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.

NOTE

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

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

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 aft 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 be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

2-26. 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 sides and apply wax.
f. To improve visibility through windshield and windows during flights through rain, a rain repellent such as REPCON should be applied to the windshield and windows. The surfaces of the windshield and windows treated becomes so smooth that water beads up and readily flows off the surface. Apply this product in accordance with the manufacturer's instructions. (Refer to Table II-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

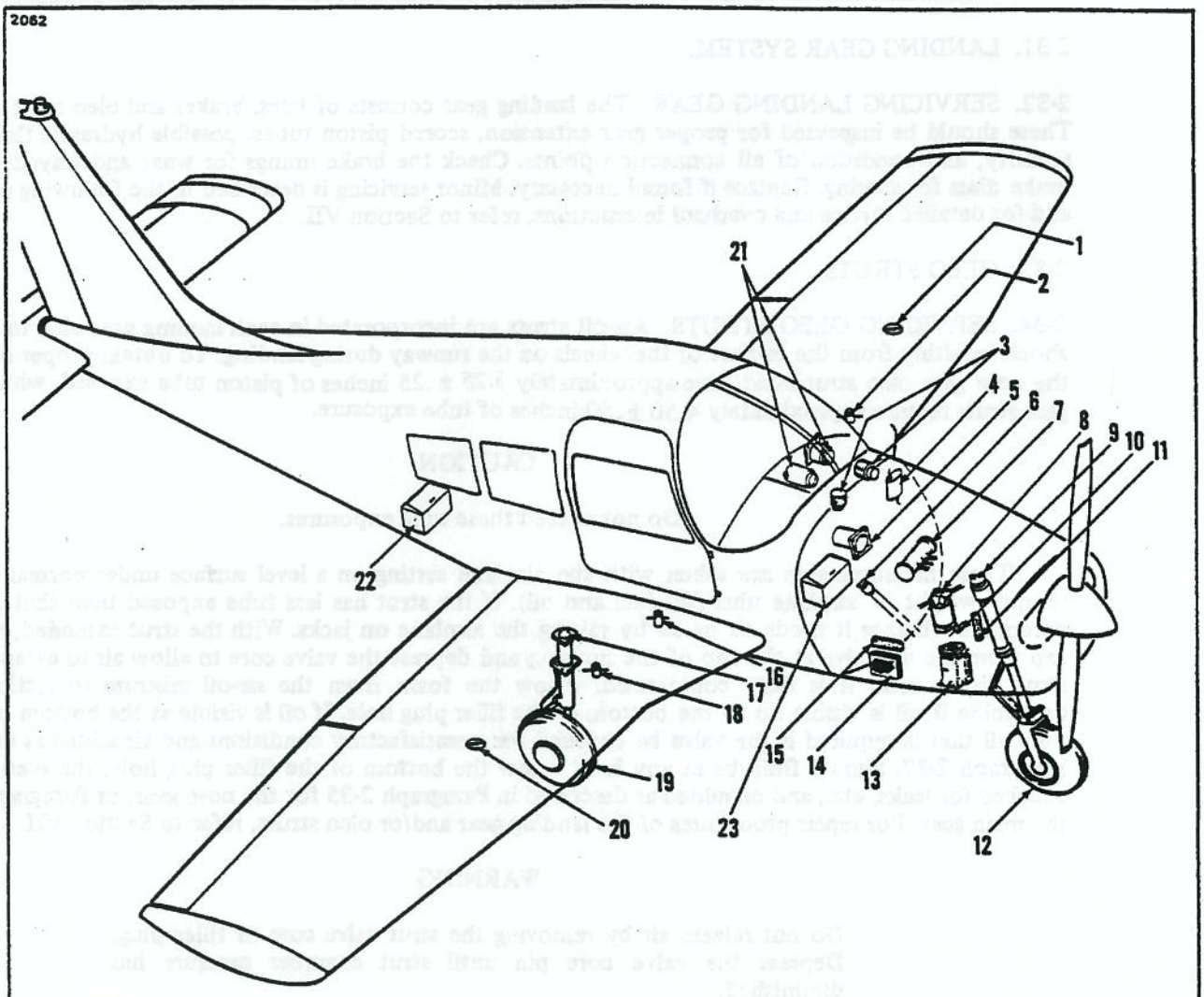
Solvent cleaners require adequate ventilation.

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

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.



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 (ALL PA-28-151 & PA-28-161 S/N's: 28-7716001 TO 28-8216231)
23. BATTERY (PA-28-161 S/N's: 28-8316001 AND UP)

Figure 2-8. Servicing Points

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 found 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 VII.

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 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 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 insuring 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 filler plug and submerge the other end in a container of hydraulic fluid.
3. Fully compress and extend (10 +2-0 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 +2-0 inches of strut exposure), and then fully compress and extend the strut three or four times to remove any air that may be trapped and to allow fluid to enter the bottom chamber of the housing.
5. Raise the strut to full compression and if needed, fill with fluid to the bottom of the filler plug.
6. 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, retract and extend the gear strut several times to ascertain that the strut actuates freely. The weight of the gear fork and wheel should extend the strut.

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

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.

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.
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 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. Refer to PA-28-151 Parts Catalog for filter part number.
b. When returning existing filter element to service, shake filter to remove dirt particles.
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.

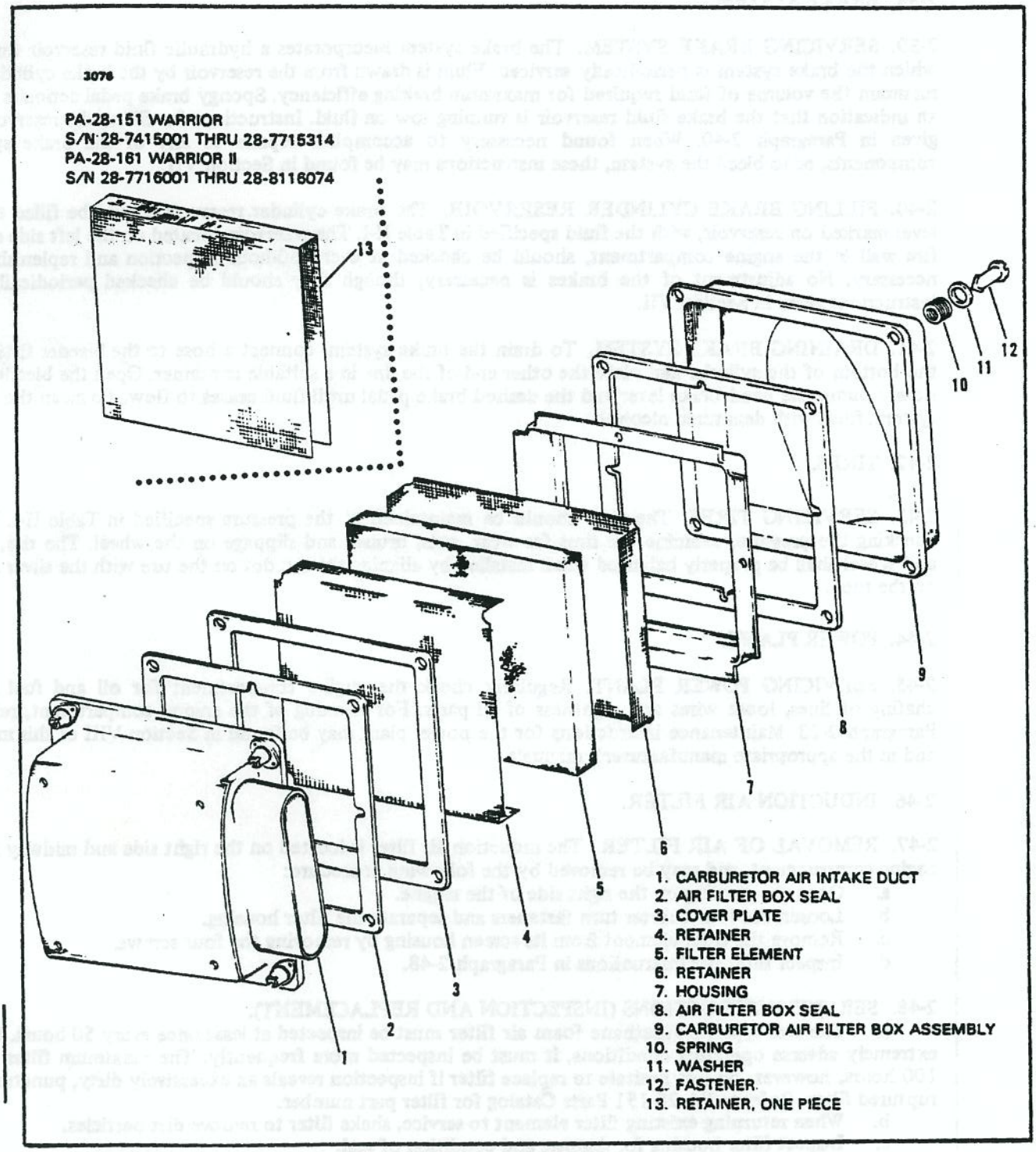


Figure 2-8a. Induction Air Filter

2-49. INSTALLATION OF AIR FILTER. After replacement and/or inspection, install filter element in screen housing. On PA-28-151 (S/N 28-7415001 through 28-7715314) and PA-28-161 (S/N 7716001 through 28-8116074) insure the two retainers are properly positioned around the filter element according to figure 2-8a. Also available is a one-piece retainer screen which can replace the two retainer screen (refer to latest revision of Service Letter 891). The one-piece retainer screen will be installed in PA-28-161 (S/N 28-8116075 and up) and is mounted to the lower cowl or housing. Position in place and secure with four quarter turn fasteners.

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 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 fire wall. 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.

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

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 fire wall. The fuel strainer should be drained regularly to check for water or dirt accumulations. (Refer to Figure 2-9.)

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 at the manifold assembly inboard of each fuel 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. Any individual tank may be drained by closing the selector valve and then draining the desired tank.

2-58. ELECTRICAL SYSTEM.

2-59. SERVICING 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.

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2-56. DRAINING FUEL VALVE AND STRAINER.

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2-57. DRAINING FUEL SYSTEM. The bulk of the fuel may be drained from the system by opening the drain valve at the manifold assembly inboard of each fuel 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. Any individual tank may be drained by closing the selector valve and then draining the desired tank.

2-58. ELECTRICAL SYSTEM.

2-59. SERVICING 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.

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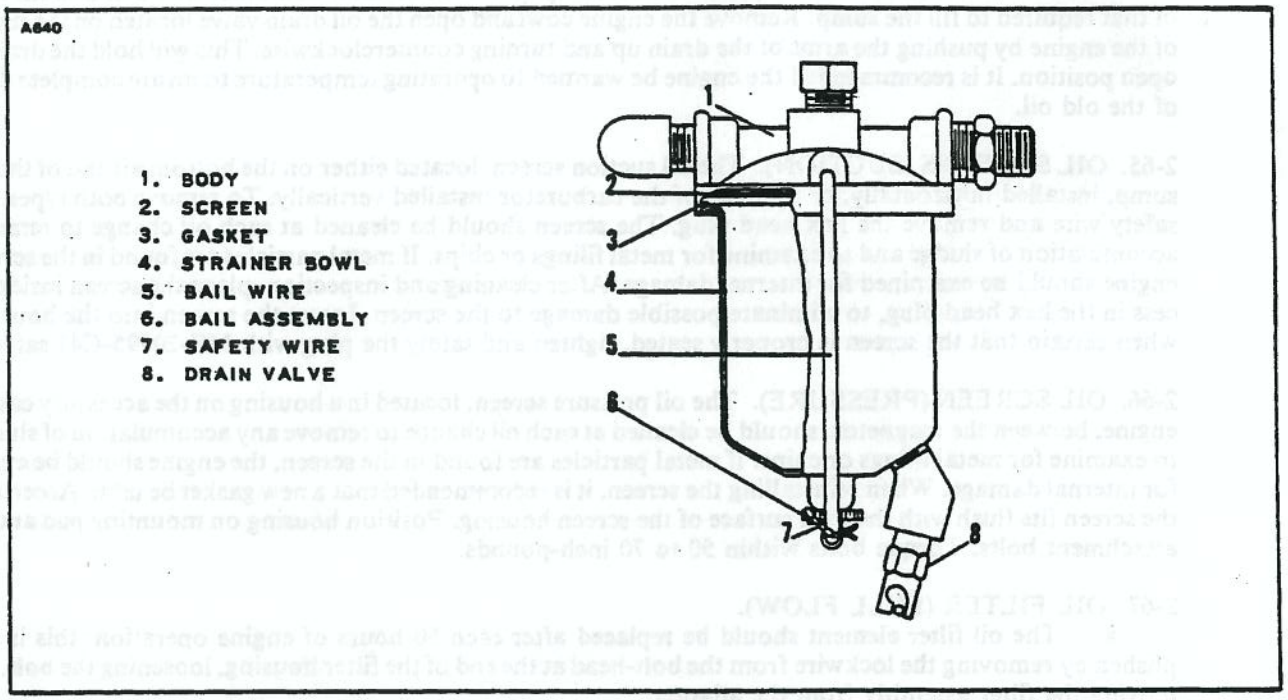


Figure 2-9. Fuel Strainer

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-20995-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 50 to 70 inch-pounds.

2-67. OIL FILTER (FULL FLOW).

a. The oil filter element should be replaced after each 50 hours of engine operation: this is accomplished by removing the lockwire from the bolt-head at the end of the filter housing, loosening the bolt, and removing the filter assembly from the adapter.

b. Before discarding the filter element, remove the outer perforated paper cover, and using a sharp knife, cut through the folds of the element at both ends, close to the metal caps. Then, carefully unfold the pleated element and examine the material trapped in the filter for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particle of metallic shavings might be found: these are generally of no consequence and should not be confused with particles produced by impacting, abrasion or pressure. Evidence of internal engine damage found in the oil filter justifies further examination to determine the cause.

c. After the element has been replaced, tighten the attaching bolt within 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 insure the maximum efficiency and utmost service of all moving parts. Lubrication instruction regarding the locations, time intervals, and type of lubricants used may be found in the Lubrication Chart. To insure the best possible results from the application of lubricants, the following precautions should be observed:

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

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

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

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 insure that gun is filled with new, clean grease of the grade specified for the particular application before applying lubricant to the grease fittings.

a. Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe 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 2-10.)

TABLE II-IIB. TYPE OF LUBRICANTS

LUBRICANT	SPECIFICATION	PREFERRED PRODUCT AND VENDOR
LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	MIL-L-7870	
LUBRICATING OIL, AIRCRAFT 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.	MIL-L-6082	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 MARFAK ALL PURPOSE GREASE, MOBIL GREASE 77 (OR MOBILUX EP2), SHELL ALVANIA EP GREASE 2
PARKER O-RING LUBRICANT		
FLUOROCARBON RELEASE AGENT DRY LUBRICANT	MS-122	
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 ROYCO 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 - DISASSEMBLE 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 - DISASSEMBLE 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 AND COMPRESSOR IDLER PULLEY BEARINGS BY REMOVING FRONT GREASE SEAL.

NOTES

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

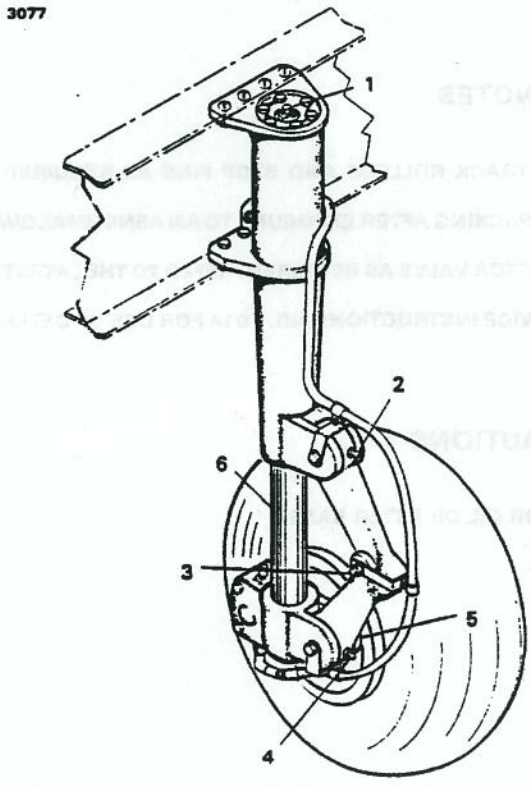
CAUTIONS

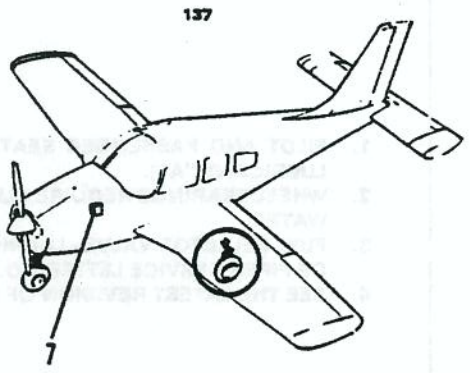
1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVERLUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

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	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
7. BRAKE RESERVOIR	MIL-H-5606	100 HRS

SPECIAL INSTRUCTIONS

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





NOTES:
1. PA-28-151
2. PA-28-151 (S/N 28-7716001 to 28-7816253 inclusive) and PA-28-161.

Figure 2-10. 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. NOSE WHEEL BEARING	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. NOSE GEAR STEERING ROD END BEARINGS	MIL-L-7870	100 HRS
7. BUNGEE SEAL	PARKER O-RING LUBRICANT	100 HRS
8. EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS

SPECIAL INSTRUCTIONS

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

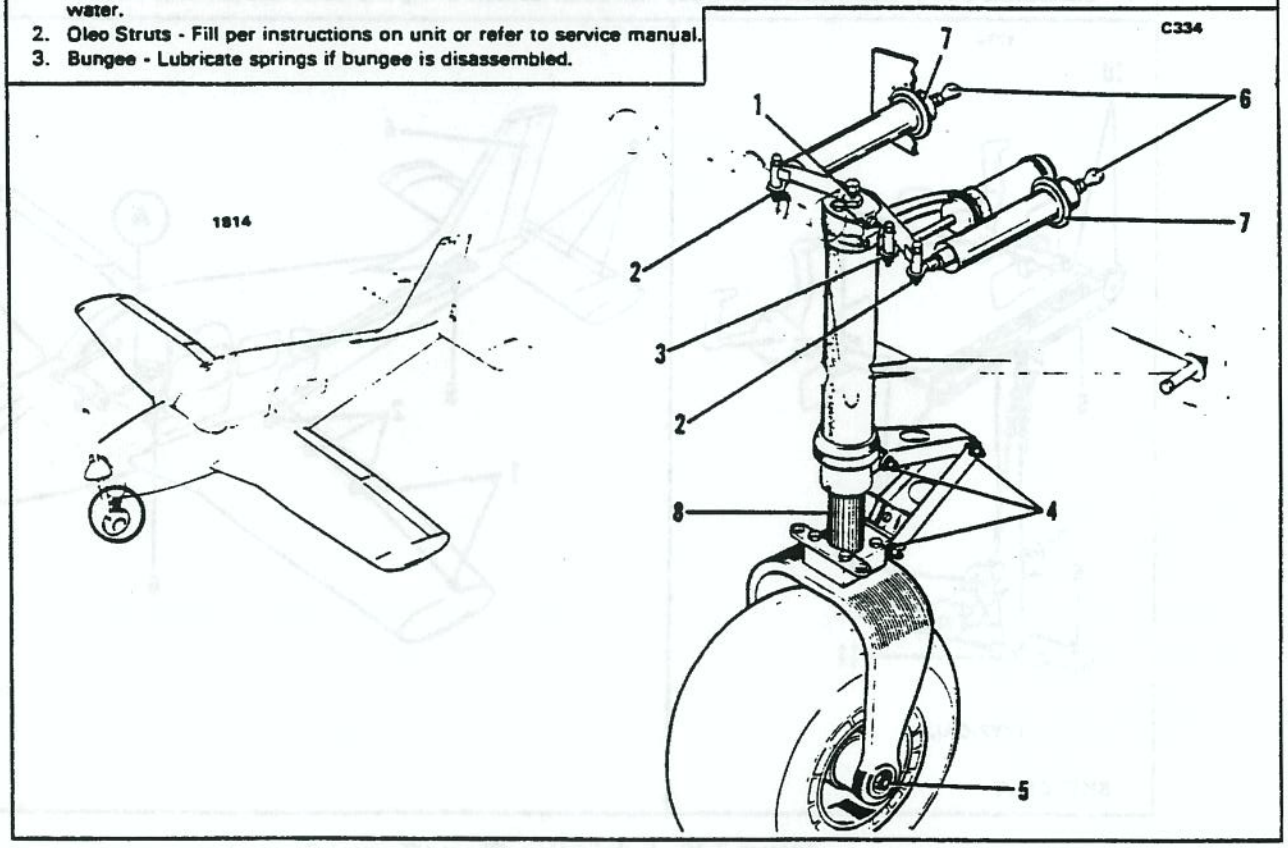


Figure 2-10. Lubrication Chart (Landing Gear, Nose)

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 OR OVERHEAD CRANK	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 (on 1.125 inch dia. shaft only).

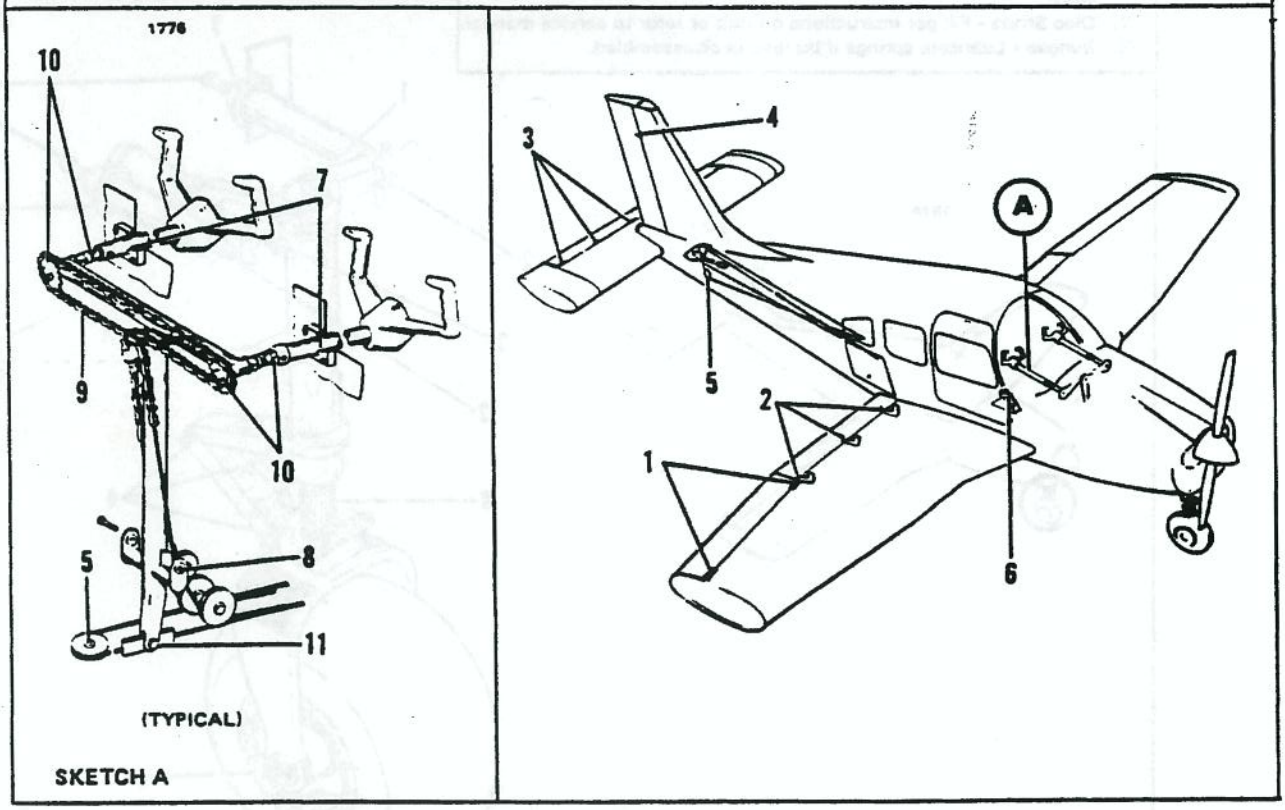
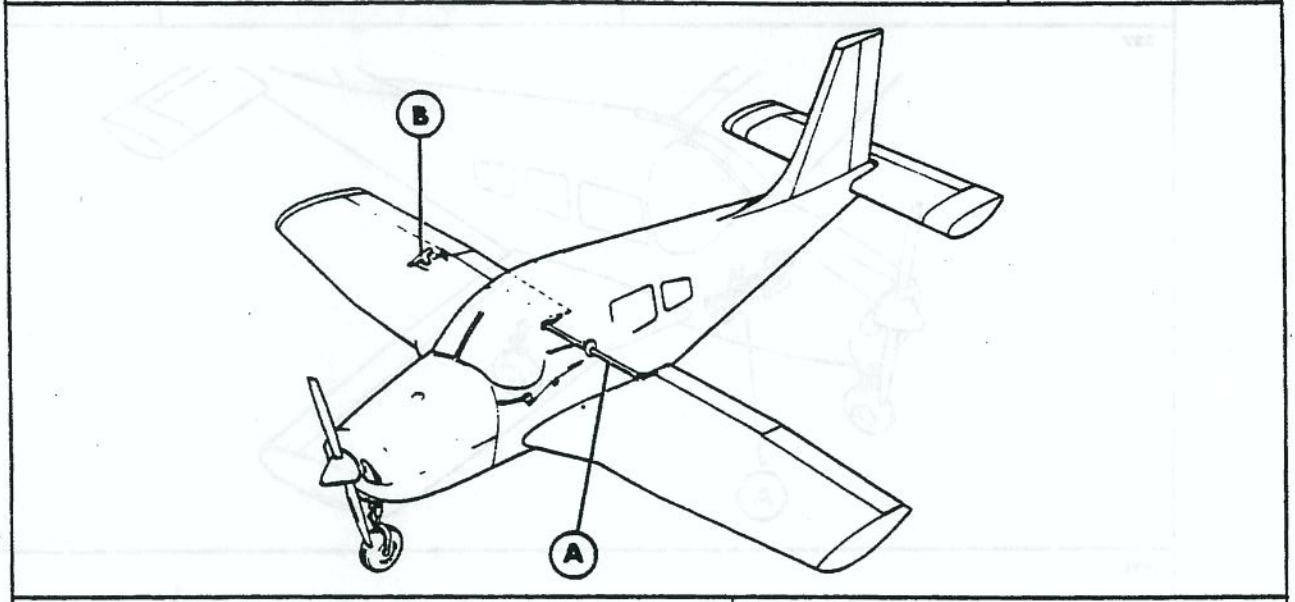
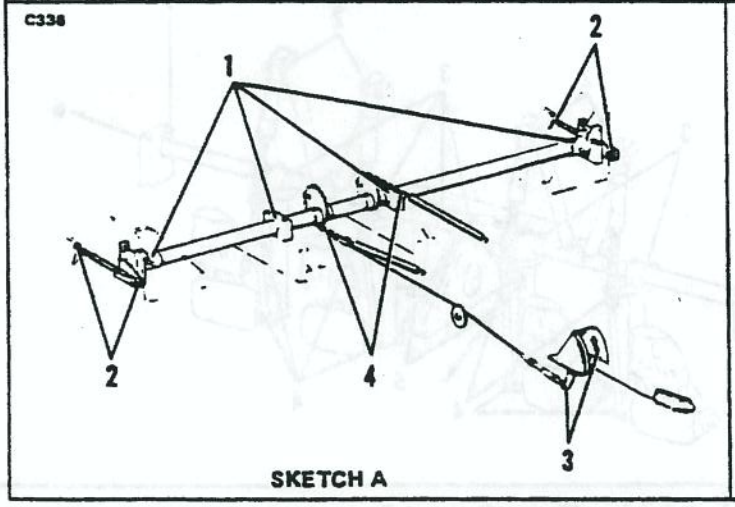


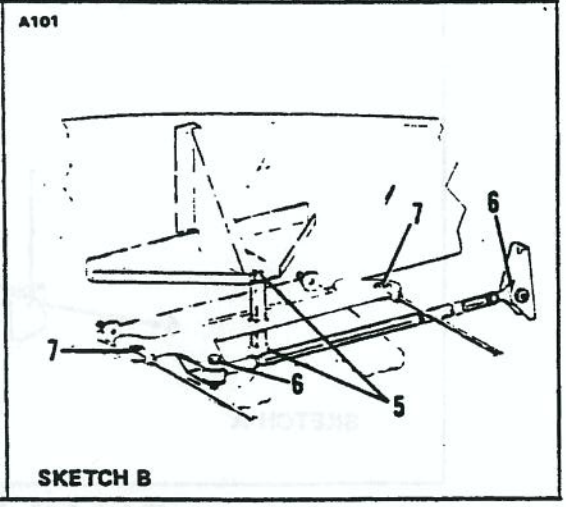
Figure 2-10. Lubrication Chart (Control System)

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





SKETCH A



SKETCH B

Figure 2-10. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS
2. TOE BRAKE CYLINDER ATTACHMENTS	MIL-L-7870	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	FLUOROCARBON RELEASE AGENT DRY LUBRICANT MS-122	100 HRS

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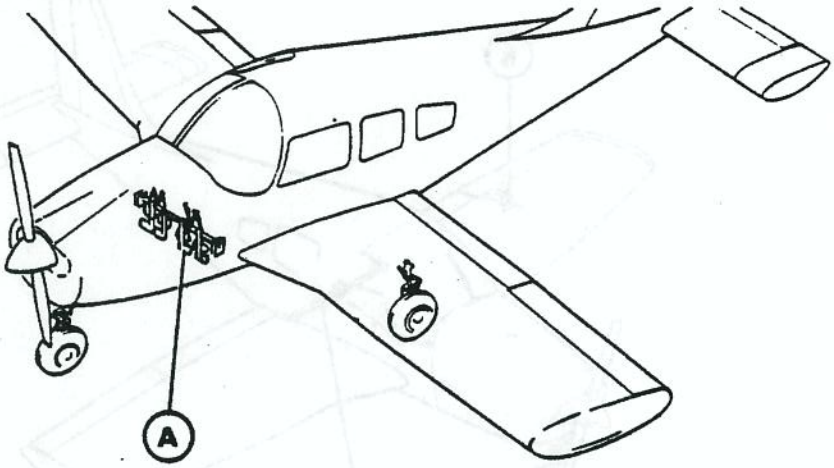

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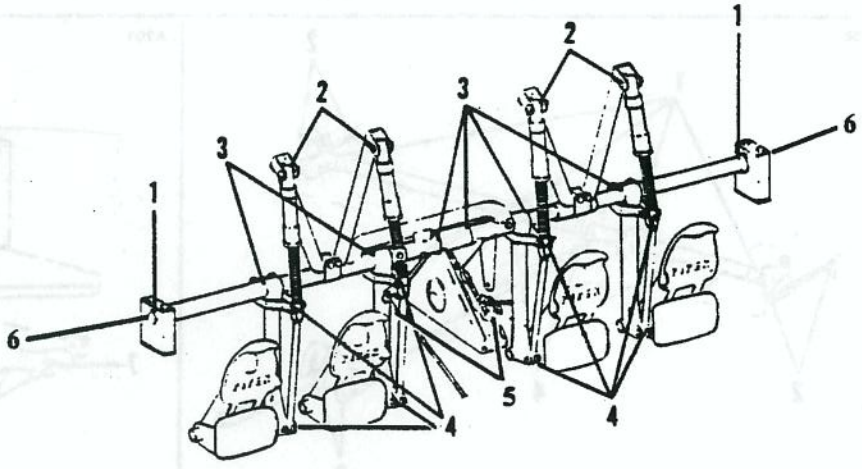
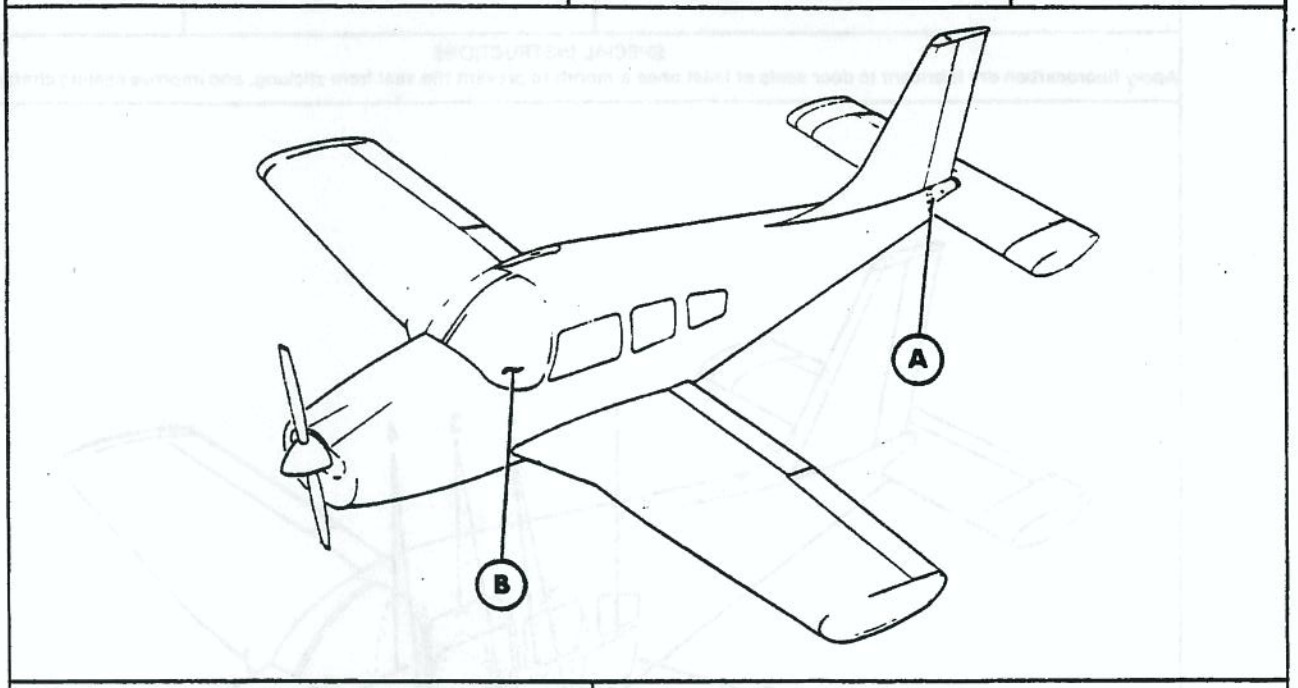
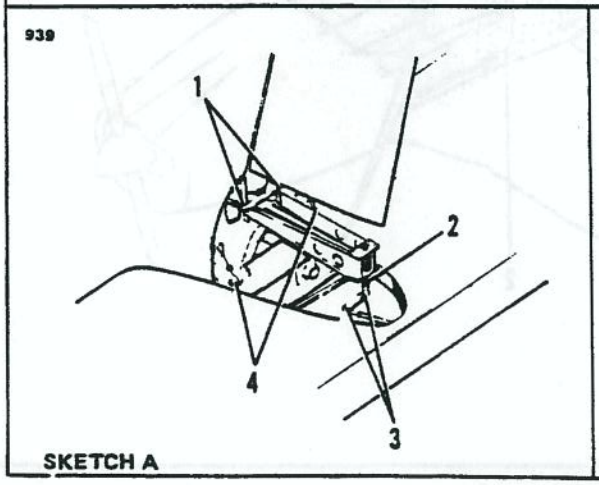


SKETCH A

Figure 2-10. 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





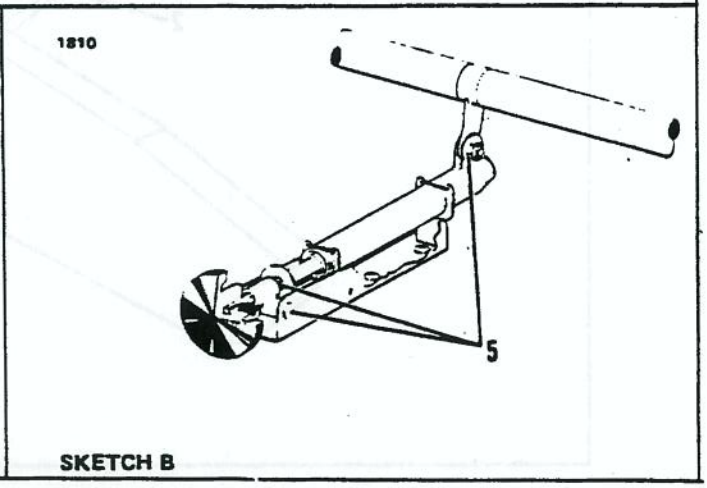


Figure 2-10. Lubrication Chart (Control System) (cont)

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

SPECIAL INSTRUCTIONS

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

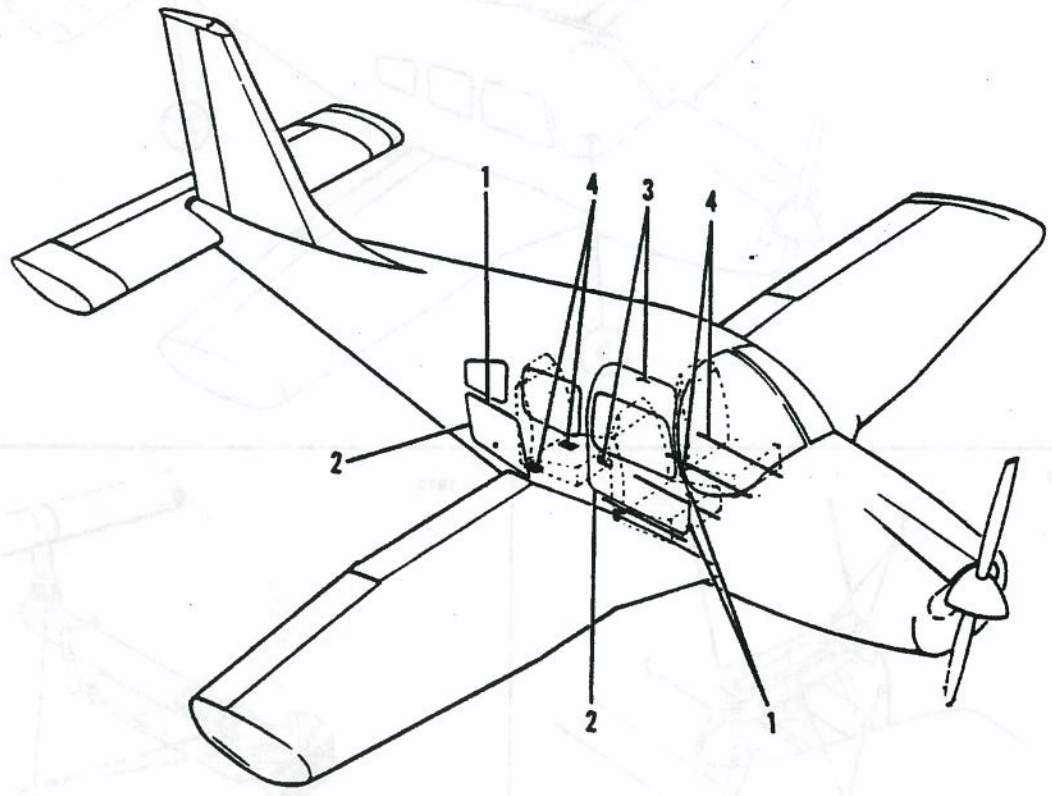


Figure 2-10. Lubrication Chart (Cabin Door, Baggage Door and Seat)

COMPONENT	LUBRICANT	FREQUENCY
1. ENGINE SUMP	MIL-L-6082 LUBRICATING OIL, AIRCRAFT 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 ENVIRONMENTAL CONTROL PIVOT POINTS	MIL-L-7870	100 HRS
5. FRESH AIR VENT SHAFTS	MIL-G-7711	500 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.

NOTES

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

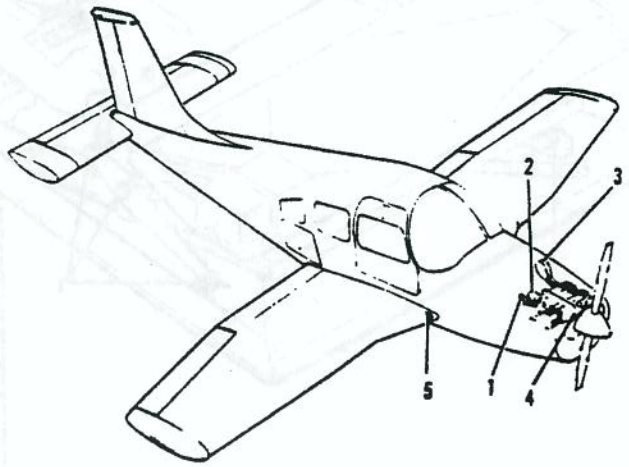


Figure 2-10. Lubrication Chart (Power Plant and Control Pivot Points)

COMPONENT	LUBRICANT	FREQUENCY
1. CONDENSER HINGE AND ACTUATORS	MIL-L-7870	100 HRS
2. CONDENSER DOOR ACTUATING TRANSMISSION	MIL-G-23827	500 HRS
3. ALTERNATOR IDLER PULLEY BEARING	MIL-G-81322	100 HRS

SPECIAL INSTRUCTIONS

1. Transmission to be 1/2 full of grease. Apply grease during assembly and lubricate transmission ball nut and screw with MIL-G-23827 grease.
2. Lubricate alternator idler pulley bearing by removing front grease seal.

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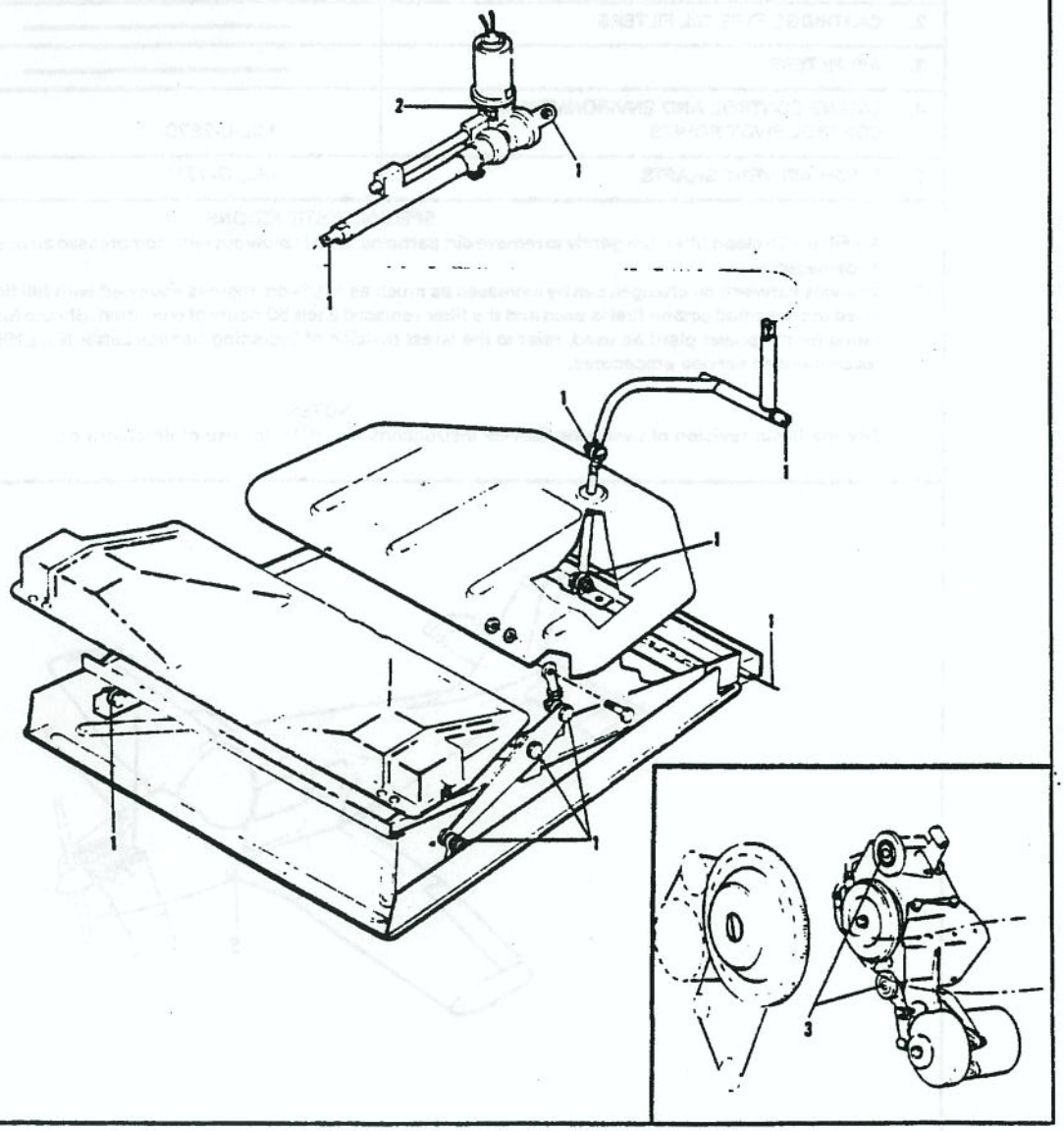

Figure 2-10. Lubrication Chart (Air Conditioning Condenser and Compressor)

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 pipethread 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 occurance 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, insure 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 inspected for 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 sealing 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 mats 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 brashing 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 motting 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 shows 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 control slots 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. Repaint 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. DRY TO 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.

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

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

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.

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., 135 East 42nd, 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, D.C. 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, D.C. 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 Starfak Premium 2	Texaco, Inc., 135 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 Actuator Screw	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, D.C. 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 Range	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	Mobil Oil Corporation Shoreham Building, Washington, D.C. 20005
		Royco 22	Royal Lubricants Co., River Road, Hanover, 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, D.C. 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
		Castrolease 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
		Castrolease PV	Castrol Oils Inc., Newark, New Jersey
		Parker Fuel Lube 44	Parker Seal Co.
		BP Aero Grease 32	BP Trading Limited Moore 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, Fluorocarbon Release Agent	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 B½	Products Research Co. 2919 Empire Avenue Burbank, Cal. 91504
Solvent		PD680	
Toluol	TT-T-548		
Buffing and Rubbing Compounds		Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
		Ram Chemical #69 x 1	Ram Chemicals Gardena, Cal. 90248
		Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners		Fantastic Spray Perchlorethylene VM&P Naptha (Lighter Fluid)	Local Suppliers
ABS-Solvent Cements		Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents		Methylethyl Ketone Methylene Chloride Acetone	Local Suppliers
Rain Repellent		Repcon FSCM50159	UNELKO Corporation 727 E. 110th Street Chicago, Illinois 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, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form ½ in.dia. 3 in. long		Sears Roebuck & Co. or Most Hardware Stores
Sealant		PRC5000	Behr-Manning Division Norton
Tapes, Vinyl Foam	⅛ in. x 1 in.	510 Series, Type II	Norton Tape Division Dept. 6610 Troy, New York 12181
Black Vinyl Plastic	2 in. x 9 mil. and/or 1½ in. x 9 mil.		Norton Tape Division Troy, New York
Vinyl Foam	1 in. x ⅛ in.	530 Series, Type I	Norton Tape Division Troy, New York
Teflon Tape	.003 x .50 wide/-1		Minnesota Mining and Mfg. 3M Center St. Paul, Minn. 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, N.J. 08901

NOTES

1. If 100 octane (green) fuel is not available, 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 Chart 9109.)

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

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

TABLE II-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	BTU 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	0.0787	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1473	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	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	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

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-669), 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 INSTALLATION)

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

MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

TABLE II-VII.

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

TABLE II-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	8	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10 4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1 1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0 404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1 0922
X	0.397	10.0838	2	0.221	5.6134	30	0.1285	3.2639	58	0.042	1 0668
25/64	0.3906	9 9212	7 32	0.2187	5.5562	1/8	0 125	3.1750	59	0 041	1 0414
W	0.386	9 8044	3	0.213	5.4102	31	0.120	3.048	60	0.040	1.016
V	0.377	9.5758	4	0.209	5.3086	32	0 116	2.9464	61	0.039	0.9906
3/8	0.375	9 5250	5	0.2055	5.2197	33	0.113	2.8702	62	0.038	0.9652
U	0.368	9.3472	6	0.204	5.1816	34	0.111	2.8194	63	0.037	0.9398
23/64	0.3593	9.1262	13/64	0.2031	5.1594	35	0.110	2.794	64	0.036	0.9144
T	0.358	9.1281	7	0.201	5.1054	7/64	0.1093	2.7781	65	0.035	0.899
S	0.346	8.7884	8	0.199	5.0546	36	0.1065	2.7051	66	0.033	0.8382
11/32	0.3437	8.7300	9	0.196	4.9784	37	0.104	2.6416	1/32	0.0312	0.7937
R	0.339	8.6106	10	0.1935	4 9149	38	0.1015	2.5781	67	0.032	0.8128
Q	0.332	8 4328	11	0.191	4.8514	39	0.0995	2.5273	68	0.031	0.7874
21/64	0.3281	8.3337	12	0.189	4.8006	40	0.098	2.4892	69	0.029	0.7366
P	0 323	8.2042	3/16	0.1875	4.7625	41	0.096	2.4384	70	0.028	0.7112
O	0 316	8.0264	13	0.185	4.699	3/32	0.0937	2.3812	71	0.026	0.6604
5 16	0 3125	7 9375	14	0.182	4.6228	42	0 0935	2.3749	72	0.025	0.635
N	0 302	7 6708	15	0.180	4 572	43	0 089	2.2606	73	0 024	0 6096
19 64	0 2968	7 5387	16	0.177	4 4958	44	0.086	2 1844	74	0.0229	0 58166
M	0 295	7 4930	17	0.173	4 3942	45	0 082	2.0828	75	0 021	0.5334
L	0 290	7 3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0 020	0.508
9 32	0 2812	7 1425	18	0 1695	4 3053	47	0.0785	1.9939	77	0.018	0 4572
K	0 281	7 1374	19	0 166	4 2164	5/64	0.0781	1.9844	1 64	0.0156	0 3969
J	0 277	7 0358	20	0 161	4 0894	48	0.076	1 9304	78	0.016	0.4064
I	0 272	6 9088	21	0 159	4 0386	49	0 073	1 8542	79	0.0145	0 3683
H	0 266	6 7564	22	0.157	3.9878	50	0.070	1 778	80	0 0135	0.3429
17 64	0 2656	6 7462									

DRILL SIZES AVAILABLE

Drill may be obtained in regular sizes to a 4 inch diameter, and increase in 64ths of an inch
The regular metric drills vary from 2 to 76mm and increase in 0 5mm variations

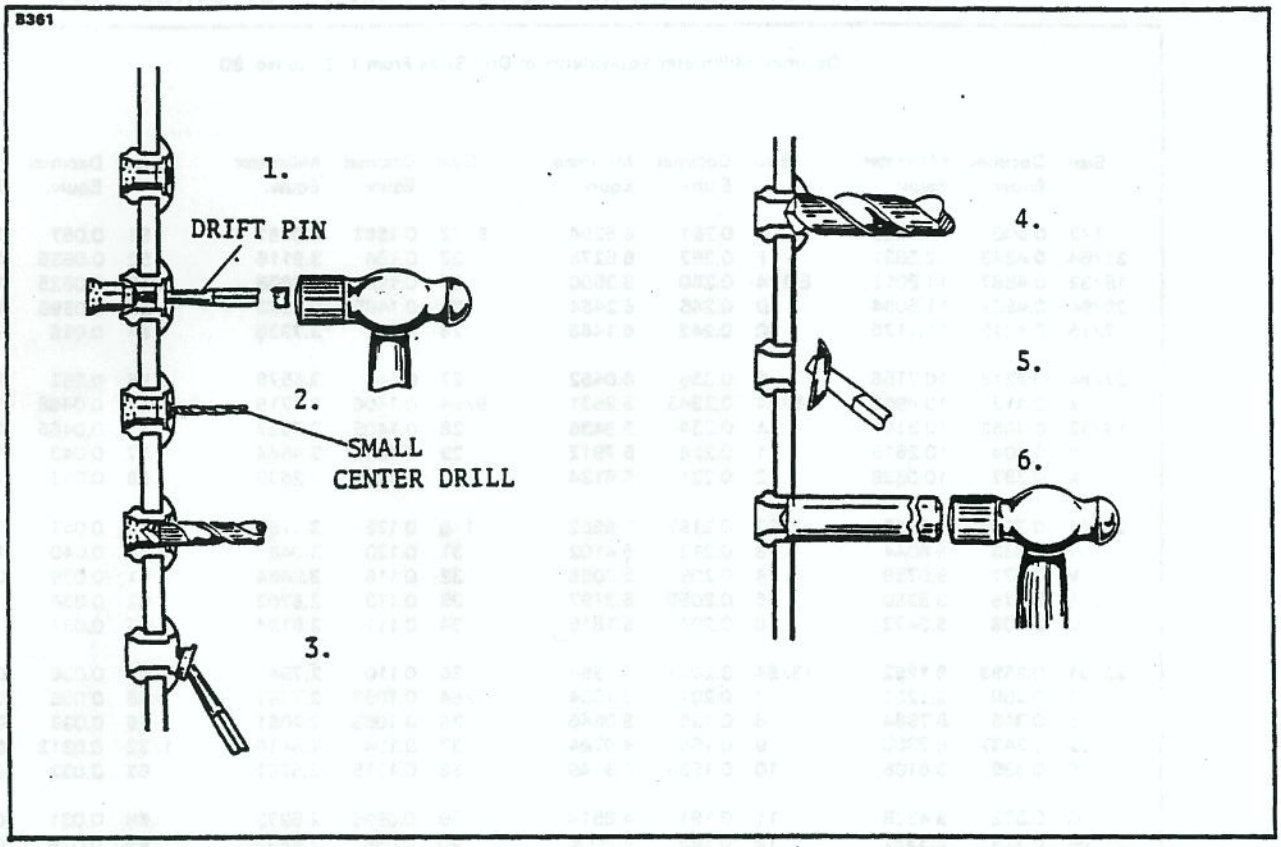

Figure 2-11. Cherry Lock Rivet Removal

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 the stem be drilled away to destroy the lock.

e. Remove the remainder of the locking collar out of the rivet head by prying it loose with the drift pin. (See View 3.)

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

g. Pry off the rivet head using the drift pin. (See View 5.)

h. Drive out the remaining shank with a pin having the same diameter as the rivet shank. (See View 6.)

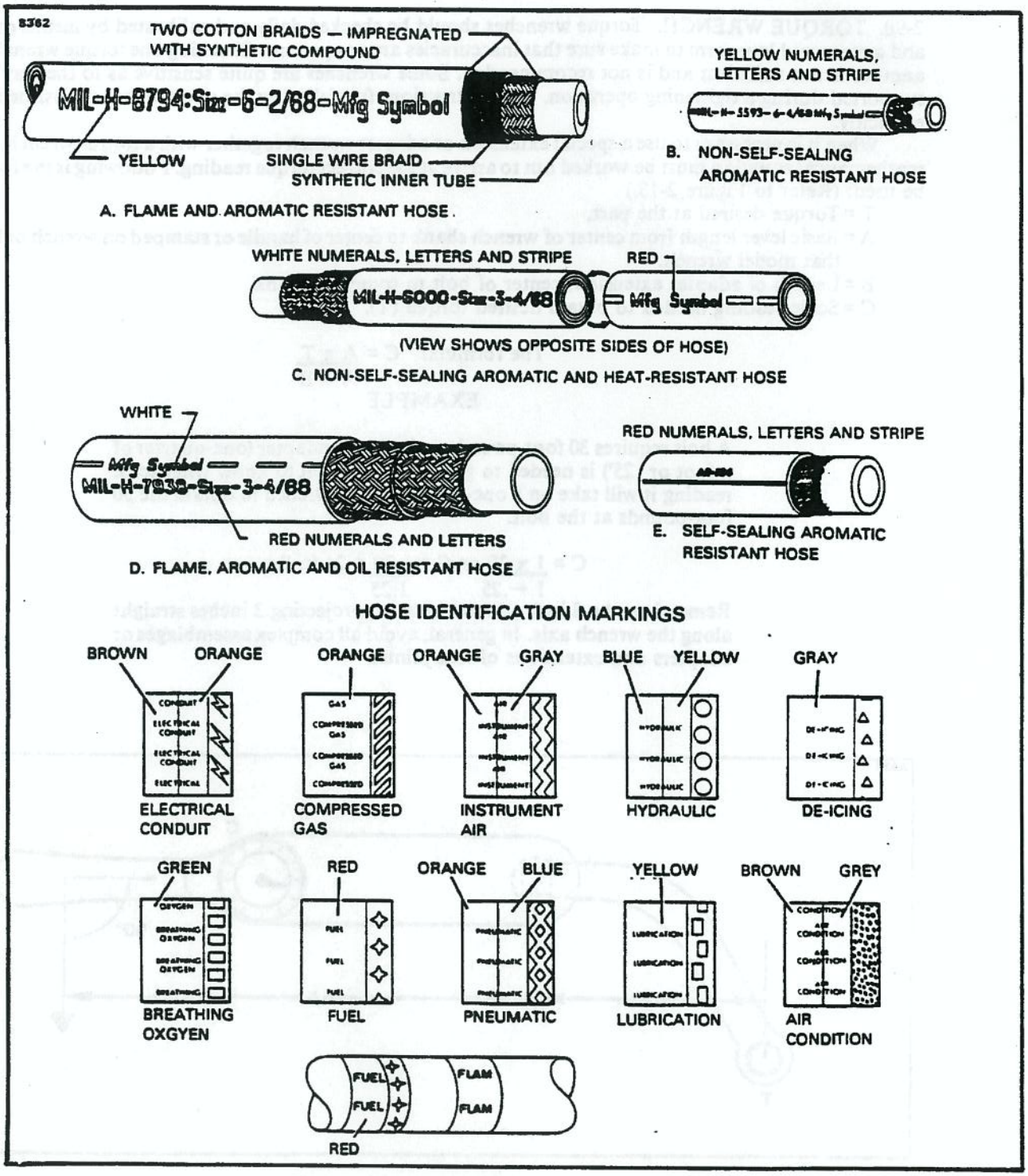

Figure 2-12. Identification of Aircraft Fluid Lines

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 2-13.)

T = Torque desired at the part.
A = Basic lever length from center of wrench shank to center of handle or stamped on wrench or listed for that model wrench.
B = Length of adapter extension, center of bolt to center of shank.
C = Scale reading needed to obtain desired torque (T).

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

EXAMPLE

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

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

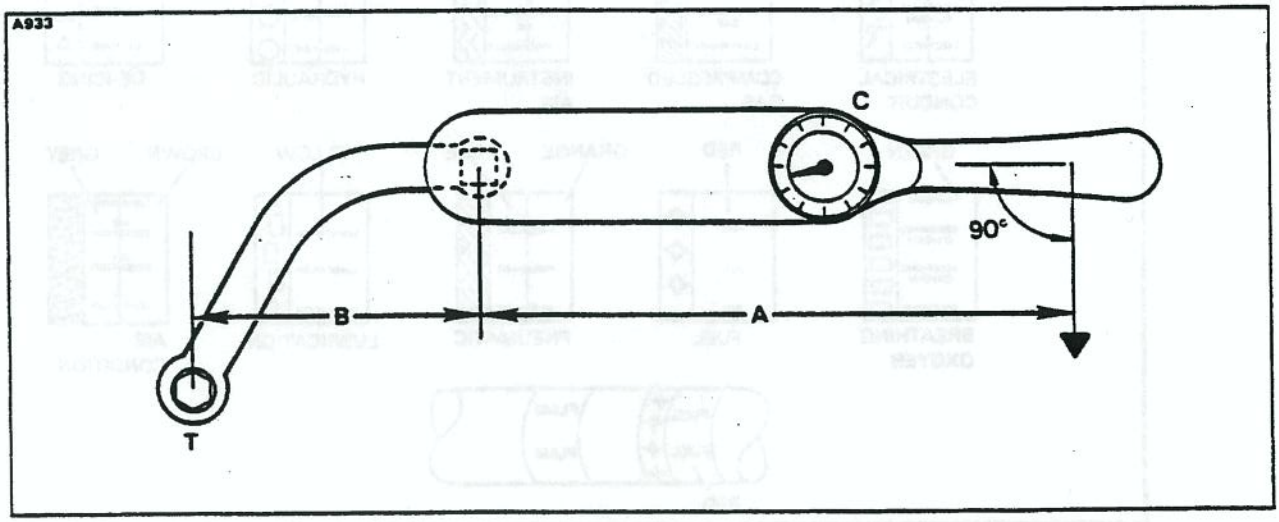

Figure 2-13. Torque Wrench Formula

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