CESSNA™ 210/CENTURION SERIES
1969 Service Manual
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Cessna®

AIRCRAFT COMPANY

COMMERCIAL AIRCRAFT DIVISION

Wichita, Kansas

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CROSS REFERENCE LISTING OF POPULAR NAME VS. MODEL NUMBERS AND SERIALS

All aircraft, regardless of manufacturer, are certificated under model number designations. However, popular names are often used for marketing purposes. To provide a consistent method of referring to the various aircraft, model numbers will be used in this publication unless names are required to differentiate between versions of the same basic model. The following table provides a cross reference listing popular name vs. model numbers.

POPULAR NAME	MODEL YEAR	MODEL	SERIALS BEGINNING	SERIALS ENDING
CENTURION	1969	210J	21059062	
TURBO-SYSTEM CENTURION	1969	T210J	21059062	

FOREWORD

This manual contains factory recommended procedures and instructions for ground handling, servicing and maintaining Cessna Model 210-Series aircraft. This includes the Models 210 and T210 which is identical to the Model 210 except that it is turbocharged.

Besides serving as a reference for the experienced mechanic, this book also covers step-by-step procedures for the less experienced man. This manual should be kept in a handy place for ready reference. If properly used, it will better enable the mechanic to maintain Cessna 210-Series aircraft and thereby establish a reputation for reliable service.

The information in this book is based on data available at the time for publication, and is supplemented and kept current by service letters and service news letters published by Cessna Aircraft Company. These are sent to all Cessna Dealers so that they have the latest authoritative recommendations for servicing Cessna aircraft. Therefore, it is recommended that Cessna owners utilize the knowledge and experience of the factory-trained Dealer Service Organization.

In addition to the information in this Service Manual, a group of vendor publications are available from the Cessna Service Parts Center which describe complete disassembly, overhaul, and parts breakdown of some of the various vendor equipment items. A listing of the available publications is issued periodically in service letters.

MAINTENANCE AND SAFETY SUGGESTIONS

1. When parting any lines, always cap or plug all lines and fittings to avoid entrance of dirt and air into the system. This applies to all test and fill equipment as well.

2. When installing any new lines or equipment, always be certain lines and equipment are clean, have been flushed with clean hydraulic fluid and are as near full of clean fluid as possible to minimize bleeding.

3. Avoid using the airplane hand pump to retract the landing gear.

4. Avoid subjecting the hydraulic system or any components to more than 2200 PSI. It is possible to exceed the pressure limit when an external pump is connected to bypass the Power Pack.

5. Avoid rigging adjustments or maintenance on the landing gear when the airplane is not securely on jacks.

6. Avoid pressure of more than 10 PSI to the Power Pack reservoir during filling operations; otherwise, damage to the reservoir seals may result.

7. Before performing any maintenance in any of the wheel or strut wells, always disconnect the doors to avoid injury from unintentional actuation of the doors.

8. Avoid using or installing gust locks on the flaps; otherwise, damage may result if flaps are accidentally operated.

SECTION 1

GENERAL DESCRIPTION

1-1. GENERAL DESCRIPTION.

1-2. Cessna Model 210-Series airplanes are single-engine, full cantilever, high-wing monoplanes, of all-metal, semi-monocoque airframe construction. Wings are full cantilever, with a sealed section which forms an integral fuel bay area in each wing. The aircraft employ a fully-retractable tricycle landing gear with spring-steel main gear struts. The steerable nose gear is an air-oil filled oleo strut. The landing gear is hydraulically-operated, and the wing flaps are electrically-operated. Standard seating consists of four individual seats and an individual child's seat located immediately aft of each rear passenger seat. The Model 210 is powered by a six-cylinder, horizontally opposed, air-cooled, fuel injection Continental engine, driving an all-metal, constant-speed propeller. The Model T210 engine is turbocharged.

1-3. Leading particulars of these aircraft, with dimensions based on gross weight, are given in the following charts. If these dimensions are used for constructing a hangar or computing clearances, remember that such factors as nose strut inflation, tire pressure, tire sizes and load distribution may result in some dimensions that are considerably different from those listed.

DESIGN GROSS WEIGHT	3400 lb
FUEL CAPACITY	
Total	90 gal
Usable	89 gal
OIL CAPACITY (Detergent Only)	10 qt
With External Oil Filter and All Turbocharged Engines	11 qt
ENGINE MODEL	
210	CONTINENTAL IO-520 SERIES
T210	CONTINENTAL TSIO-520 SERIES
PROPELLER (Constant Speed)	
Standard (Two Blades)	82" McCAULEY
Optional (Three Blades)	80" McCAULEY
LANDING GEAR (Retractable, Hydraulically Actuated)	Tricycle
MAIN WHEEL TIRES	6:00 x 6, 6-ply rating
Pressure	42 psi
NOSE WHEEL TIRE	5:00 x 5, 6-ply rating
Pressure	45 psi
NOSE GEAR STRUT PRESSURE (Strut Extended)	85 psi
WHEEL ALIGNMENT	
Camber	4°±1° 30'
Toe-in	0" to .06"
AILERON TRAVEL	
Up	20°±2°
Down	15°±2°
WING FLAP TRAVEL (Electrically Actuated)	0° to 30°, +1° -2°
RUDDER TRAVEL (Measured Perpendicular to hinge line)	
Right	27° 13' ±1°
Left	27° 13' ±1°
ELEVATOR TRAVEL	
Up	23° ±1°
Down	15° ±1°
ELEVATOR TRIM TAB TRAVEL	
Up	20° ±1°
Down	5° ±1°
PRINCIPAL DIMENSIONS	
Wing Span	36' 9"
Tail Span	13'
Length	28' 3"
Fin Height (Maximum with Nose Gear Depressed and Flashing Beacon Installed on Fin)	9' 7-1/2"
Track Width	8' 2-3/4"
BATTERY LOCATION	Left Side of Firewall

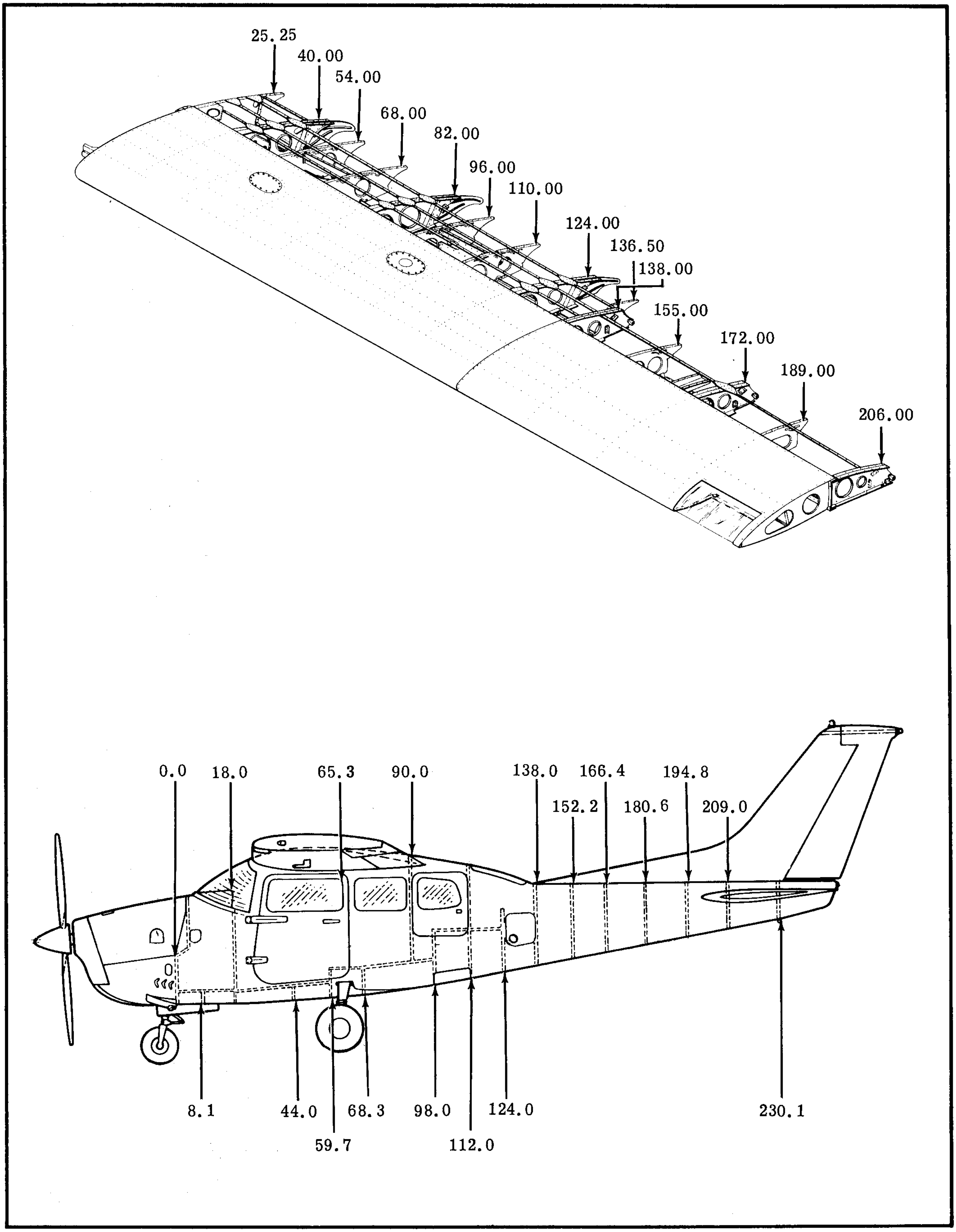

Figure 1-1. Reference Stations

RECOMMENDED NUT TORQUES

NOTE

THE TORQUE VALUES STATED ARE POUND-INCHES, RELATED ONLY TO OIL-FREE CADMIUM PLATED THREADS.

FINE THREAD SERIES				
TAP SIZE	TYPE OF NUT			
	TENSION		SHEAR	
	TORQUE		TORQUE	
	STD (NOTE 1)	ALT (NOTE 2)	STD (NOTE 3)	ALT (NOTE 2)
8-36	12-15		7-9	
10-32	20-25	20-28	12-15	12-19
1/4-28	50-70	50-75	30-40	30-48
5/16-24	100-140	100-150	60-85	60-106
3/8-24	160-190	160-260	95-110	95-170
7/16-20	450-500	450-560	270-300	270-390
1/2-20	480-690	480-730	290-410	290-500
9/16-18	800-1000	800-1070	480-600	480-750
5/8-18	1100-1300	1100-1600	660-780	660-1060
3/4-16	2300-2500	2300-3350	1300-1500	1300-2200
7/8-14	2500-3000	2500-4650	1500-1800	1500-2900
1-14	3700-5500	3700-6650	2200-3300	2200-4400
1-1/8-12	5000-7000	5000-10000	3000-4200	3000-6300
1-1/4-12	9000-11000	9000-16700	5400-6600	5400-10000
COARSE THREAD SERIES				
	(NOTE 4)		(NOTE 5)	
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		95-100	
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	1150-1600		700-950	
7/8-9	2200-3000		1300-1800	
1-8	3700-5000		2200-3000	
1-1/8-8	5500-6500		3300-4000	
1-1/4-8	6500-8000		4000-5000	

NOTES

1. Covers AN310, AN315, AN345, AN362, AN363, AN366, MS20365, "1452", "EB", "UWN", "Z1200", and other self-locking nuts.
2. When using AN310 or AN320 castellated nuts where alignment between bolt and cotter pin is not reached using normal torque values, use alternate torque values or replace nut.
3. Covers AN316, AN320, AN7502 and MS20364.
4. Covers AN310, AN340, AN366, MS20365, and other self-locking anchor nuts.
5. Covers AN316, AN320 and MS20364.

The above values are recommended for all installation procedures contained in this book except where other values are stipulated. They are not to be used for checking tightness of installed parts during service.

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SECTION 2

GROUND HANDLING, SERVICING, LUBRICATION, AND INSPECTION

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2-1. GROUND HANDLING.

2-2. TOWING. Moving the aircraft by hand is accomplished by using the wing struts and landing gear struts as push points. A tow bar attached to the nose gear should be used for steering and maneuvering the aircraft. When no tow bar is available, press down at the horizontal stabilizer front spar, adjacent to the fuselage, to raise the nose wheel off the ground. With the nose wheel clear of the ground, the aircraft can be turned by pivoting it about the main wheels.

CAUTION

When towing the aircraft, never turn the nose wheel more than 35 degrees either side of center or the nose gear will be damaged. Do not push on control surfaces or outboard empennage surfaces. When pushing on the tailcone, always apply pressure at a bulkhead to avoid buckling the skin.

2-3. HOISTING. The aircraft may be hoisted with hoists of two-ton capacity, either by using hoisting rings (optional equipment) or by using suitable slings. The front sling should be hooked to the engine lifting eye, and the aft sling should be positioned around the fuselage at the first bulkhead forward of the leading edge of the stabilizer. If the optional hoisting rings are used, a minimum cable length of 60 inches for each cable is required to prevent bending of the eyebolt type hoisting rings. If desired, a spreader jig may be fabricated to apply vertical force to the eyebolts.

2-4. JACKING. Refer to figure 2-2 for jacking procedures.

CAUTION

When using the universal jack point, flexibility of the gear strut will cause the main wheel to slide inboard as the wheel is raised, tilting the jack. The jack must then be lowered for a second jacking operation. Jacking both wheels simultaneously with universal jack points is not recommended.

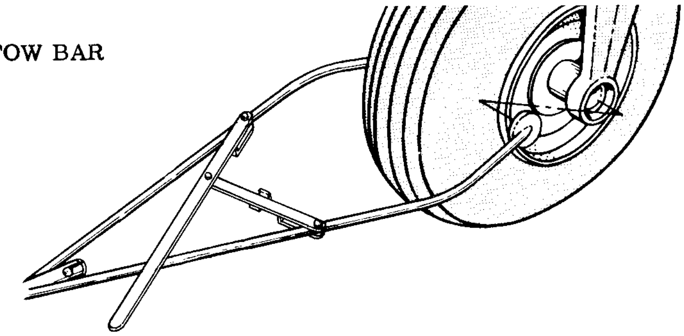


Figure 2-1. Typical Tow Bar

2-5. PARKING. Parking precautions depend principally on local conditions. As a general precaution, it is wise to set the parking brake or chock the wheels, and install the control lock. In severe weather, and high wind conditions, tie down the aircraft as outlined in paragraph 2-6 if a hangar is not available.

2-6. TIE-DOWN should be accomplished in anticipation of high winds. Tie down aircraft as follows:

a. Tie ropes or chains to the wing tie-down fittings located on the underside of each wing. Secure the opposite ends of the ropes or chains to ground anchors.

b. Secure a rope (no chains or cables) to the upper trunnion of the nose gear and secure opposite end of rope to a ground anchor.

c. Secure the middle of a rope to tail tie-down ring. Pull each end of rope away at 45-degree angle and secure to ground anchors at each side of tail.

d. Install surface control locks between wing tip and aileron, and over fin and rudder.

e. Install control lock on pilot's control column if available; if control lock is not available, tie pilot's control wheel back with front seat belt.

2-7. SHORT TERM STORAGE. Aircraft which are not in daily flight should have the engine started and warmed-up at least once each week. In damp climate and in storage areas where the daily temperature variation can cause condensation, the warm-up operation should be accomplished more frequently. Warming up the engine replaces oil which has drained from surfaces of internal parts while standing idle. Warm-up should be accomplished at speed and power necessary to produce minimum oil temperature of 100°F.

CAUTION

Do not allow cylinder head and oil temperatures to exceed their maximum limits. To avoid possible damage due to excessive temperatures, ground run-up of engine not equipped with a cylinder head temperature gage shall not exceed 10 minutes duration.

Engine warm-up also precludes excessive accumulations of water in the fuel system and other air spaces of the engine. Keep fuel tanks full to minimize moisture condensation in the fuel tanks. Keep battery fully charged to prevent the electrolyte from freezing in cold weather. If the aircraft is stored outside, tie-down in accordance with paragraph 2-6. In addition, the pitot tube, air vents, openings in the engine cowling and other similar openings should have protective covers installed.

2-8. EXTENDED STORAGE. Although the aircraft is constructed of corrosion-resistant Alclad aluminum, which will last indefinitely under normal conditions, if kept clean, these alloys are subject to oxidation. The first indication of corrosion on unpainted surfaces is the forming of white deposits or spots. On painted surfaces, the paint is discolored or blistered. Storage in a dry hangar is essential to good preservation and should be procured if possible. Varying conditions will alter the measures of preservation, but under normal conditions in a dry hangar and for storage periods up to 60 days, the following methods of treatment are suggested:

a. Fill fuel tanks with correct grade of gasoline.

b. Clean and wax aircraft thoroughly.

c. Clean any oil or grease from tires and coat tires with a tire preservative. Cover tires to protect against oil or grease.

d. Block up fuselage to remove weight from tires.

NOTE

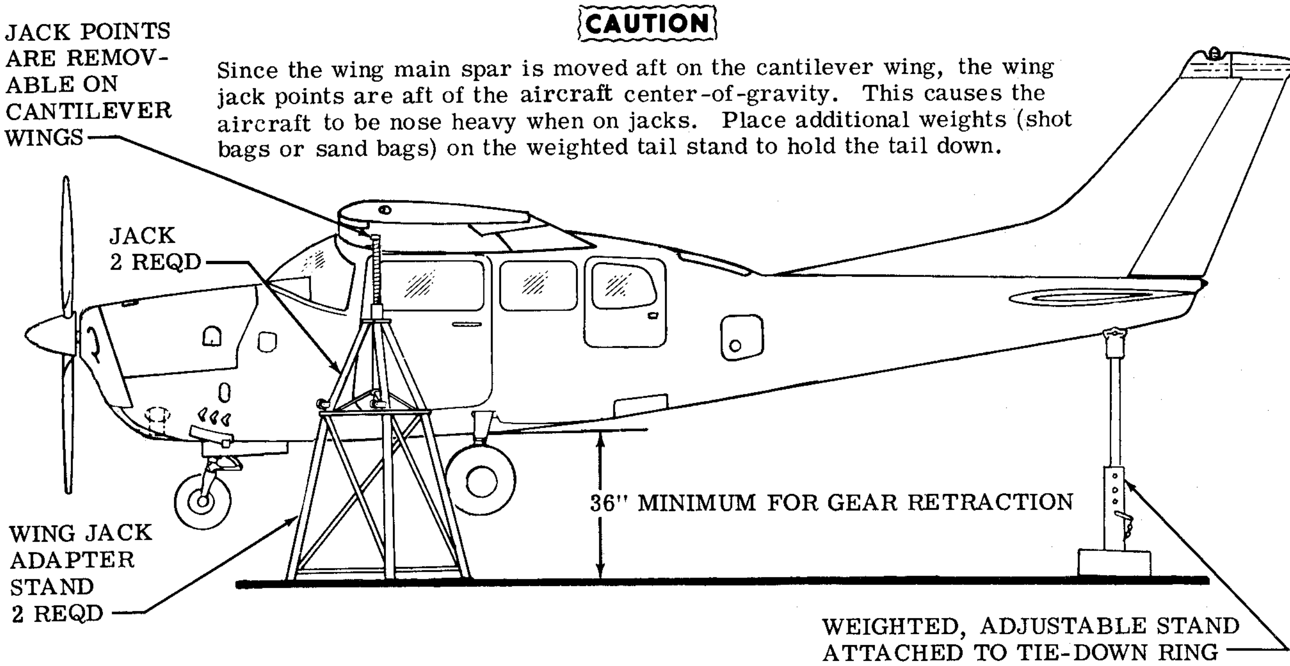
Tires will take a set, causing them to become out-of-round, if an aircraft is left parked for more than a few days. For this reason, a stored aircraft should not have its weight on the tires.

e. Lubricate all airframe items and seal or cover all openings.

f. Remove battery and store in a cool dry place; service battery periodically and charge as required.

CAUTION

Since the wing main spar is moved aft on the cantilever wing, the wing jack points are aft of the aircraft center-of-gravity. This causes the aircraft to be nose heavy when on jacks. Place additional weights (shot bags or sand bags) on the weighted tail stand to hold the tail down.



NOTE

Wing jacks available from the Cessna Service Parts Center are REGENT Model 4939-30 for use with the SE-576 wing stands. Combination jacks are the REGENT Model 4939-70 for use without wing stands. The 4939-70 jack (70-inch) may be converted to the 4939-30 jack (30-inch) by removing the leg extensions and replacing lower braces with shorter ones. The base of the adjustable tail stand (SE-767) is to be filled with concrete for additional weight as a safety factor. The SE-576 wing stand will also accommodate the SANCOR Model 00226-150 jack. Other equivalent jacks, tail stands, and adapter stands may be used. Universal jack point (Part No. 10004-98) available from Cessna Service Parts Center.

JACKING AIRCRAFT

1. Lower the aircraft tail so that wing jack and stands can be placed at wing jack points.
2. Raise aircraft tail and attach tail stand to tail tie-down ring. BE SURE the tail stand weighs enough to keep the tail down under all conditions and that it is strong enough to support any weight that may be placed upon it.
3. Raise jacks evenly until desired height is reached. When jacking the aircraft the main landing gear wheels must be a minimum of 16" above shop floor for landing gear retraction.
4. The universal jack point may be used to raise only one main wheel. Do not use brake casting as a jack point. Flex brake line away from gear strut when using universal jack point.
5. The nose may be raised by weighting down the tail. Place weight on each side of stabilizer, next to fuselage.
6. Whenever the landing gear is to be operated in the shop, use the wing jack and tail jack points to raise the aircraft.
7. The aircraft may be hoisted as outlined in paragraph 2-3.

REMOVING AIRCRAFT FROM JACKS

1. Place landing gear control handle in gear down position.
2. Operate ground hydraulic power source or airplane emergency hydraulic hand pump until landing gear is down and locked, the green (DOWN) light is illuminated and landing gear control handle has tripped to down neutral.
3. Disconnect ground hydraulic power source and/or stow emergency hydraulic hand pump handle.
4. Ascertain that green (DOWN) light is illuminated; then place master switch in OFF position.
5. Lower jacks evenly until aircraft rests on the landing gear and remove wing jacks and tail stand.
6. Compress nose landing gear shock strut to static position.

Figure 2-2. Jacking Details

2-9. EXTENDED STORAGE-CONTINENTAL ENGINE.

NOTE

Continental engines treated in accordance with the following may be considered protected against normal atmospheric corrosion for a period of 60 days.

a. Disconnect spark plug leads and remove upper and lower spark plugs from each cylinder.
b. Using a portable pressure sprayer, atomize spray preservative oil through the upper spark plug hole of each cylinder with the piston in down position. The following oils are approved for spraying operation by Continental Motors Corporation, Nucle Oil 105, Daubert Chemical Co., 4700 S. Central Ave., Chicago, Ill., Petrotect VA, Pennsylvania Refining Co., Butler, Pa., Ferro-Gard 1009-G, Ranco Laboratories, Inc., 3617 Brownsville Rd., Pittsburg, Pa.
c. After completing step "b," rotate crankshaft so that no piston is at a top position.
d. Again spray each cylinder through the upper spark plug hole without moving crankshaft.
e. Install spark plugs and connect spark plug leads.
f. Seal all engine openings exposed to atmosphere using suitable plugs or non-hygroscopic tape.
g. If the aircraft is to be stored outside, perform steps outlined in paragraph 2-6. In addition, the pitot tube, air vents, openings in the engine cowling and other similar openings should have protective covers installed.
h. Attach a warning placard on the propeller to the effect that it should not be rotated while the engine is in storage.

2-10. INSPECTION DURING STORAGE.
a. Inspect airframe for corrosion at least once a month and remove dust collections as frequently as possible. Clean and wax as required.
b. Inspect the interior of at least one cylinder through the spark plug hole for corrosion at least once a month.

NOTE

Do not move crankshaft when inspecting interior of cylinder for corrosion.

c. If at the end of the 60 day period, the aircraft is to be continued in storage, again perform procedures outlined in paragraph 2-7 through 2-10.

2-11. RETURNING AIRCRAFT TO SERVICE. After short term storage, returning the aircraft to service is accomplished by completing a thorough pre-flight inspection. After extended storage, use the following procedures to return the aircraft to service.
a. Remove aircraft from blocks and check tires for proper tire inflation. Check for proper nose gear strut inflation.
b. Check battery and install.
c. Service oil sump with proper grade and quantity of engine oil.
d. Service induction air filter and remove warning placard.
e. Remove materials used to cover openings.
f. Remove, clean, and gap spark plugs. See Section 12 or 12A for correct gap setting.
g. While spark plugs are removed, rotate propeller several revolutions to clear excess rust preventive oil from cylinders.
h. Install spark plugs. Torque spark plugs to values shown in Section 12 or 12A for the engine used.
i. Check fuel strainer. Remove and clean filter screen if necessary. Check fuel tanks and fuel lines for moisture and sediment, drain enough fuel to eliminate.
j. Perform a thorough pre-flight inspection, then start and warm-up engine.

2-12. LEVELING. On all models, remove the scuff plate at the baggage compartment door opening and use the lower sill to level the aircraft longitudinally. Also, the lower surface of the pilot's upper door sill, or the top centerline of the tailcone just aft of station 138.00 may be used to longitudinally level the aircraft. Corresponding points on either the upper or lower main door sills may be used to level the aircraft laterally.

2-13. SERVICING.

2-14. Servicing requirements are shown in the Servicing Chart (figure 2-3). The following paragraphs supplement figure 2-3 by adding details not included in the chart.

2-15. FUEL TANKS. An area of each wing is sealed to form an integral fuel tank. Recommended fuel grade is listed in figure 2-3, and fuel capacities are given in the charts in Section 1.

2-16. FUEL DRAINS are located at various points in the fuel system to provide drainage of water and sediment. Refer to Section 13 for location of drain plugs and valves. The strainer drain control is adjacent to the engine oil dipstick. Access to the control is through the cowling door on the left side of the upper cowl. Also, during daily inspection of the fuel strainer, if water is found in the fuel strainer, there is a possibility that the wing tank sumps, fuel lines, and fuel reservoir tanks contain water. Therefore, all fuel drain plugs should be removed and all water drained from the fuel system.

2-17. ENGINE OIL. Check engine lubricating oil with the oil dipstick five to ten minutes after the engine has been stopped. When checking oil level, the aircraft should be as near level as possible. Engine oil should be drained while the engine is still hot and the nose of the aircraft should be raised slightly for more positive draining of any sludge which may have collected in the engine oil sump.

On aircraft equipped with an external oil filter, change engine oil and filter element at 50-hour intervals. On aircraft not equipped with an external oil filter, change engine oil and clean oil screens EVERY 25 HOURS. Change oil every four months even though less than the specified hours have accumulated. Reduce these periods for prolonged operation in dusty areas, in cold climates where sludging conditions exist, or where short flights and long idle periods are encountered, which cause sludging conditions. Always change engine oil, clean filter screen, and replace filter element, whenever oil on dipstick appears dirty.

Oil capacity for each model is 10 quarts with a normal operating capacity of 8 quarts. Do NOT operate with less than the minimum-for-flight quantity of 7 quarts. To minimize loss of oil through the crankcase breather line, fill sump to the specified oil level shown on the dipstick for normal operation (flights of less than three hours). For extended flight, fill to full mark on the dipstick. If an external oil filter is installed, ONE additional quart of oil is required when filter element is changed.

New or newly overhauled engines should be operated on aviation grade straight mineral oil until the first oil change. If a detergent or ashless dispersant oil is used in a new engine, or a newly overhauled engine, high oil consumption might possibly be experienced. The anti-friction additives in detergent and ashless dispersant oil will retard "break-in" of the piston rings and cylinder walls. This condition can be avoided by the use of straight mineral oil until the first oil change, then change to detergent or ashless dispersant oil. The aircraft is delivered from Cessna with straight mineral oil of the correct viscosity.

Detergent or ashless dispersant oil conforming to Continental Motors Specification MHS-24A MUST BE USED at the first oil change. Multi-viscosity oil may be used to extend the operating temperature range, improve starting, turbocharger controller operation in cold weather, and improve lubrication of the engine during the critical warm-up period, thus permitting operations through wider ranges of climatic change without the necessity of changing engine oil. The multi-viscosity grades are recommended for aircraft engines subjected to wide variation in ambient air temperatures when cold starting of the engine must be accomplished at temperatures below 40 degrees F. When adding or changing engine oil use aviation grade oil in accordance with figure 2-3.

2-18. ENGINE INDUCTION AIR FILTERS keep dust and dirt from entering the induction system. Dust entering the intake system is probably the greatest single cause of early engine wear; therefore, the value of maintaining the induction air filter in good clean condition can never be overstressed. The frequency with which the filter should be removed and cleaned will be determined primarily by aircraft operating conditions. Some operators prefer to hold a spare filter(s) at their home base of operation so that a clean filter(s) is always readily available for use. Under extreme dusty conditions, daily maintenance of the filter is recommended. Engines use a dry type filter.

NOTE

Model T210 has one filter located at the upper right aft baffle. Model 210 has two filters located at the upper aft baffle on each side of the engine.

To service the dry type filter, proceed as follows:

a. Remove the filter as outlined in Section 12 and 12A.

b. Clean filter by blowing with compressed air (not over 100 psi) from direction opposite of normal air flow. Arrows on the filter frame indicate direction of normal air flow.

NOTE

Use care to prevent damage to filter element when cleaning with compressed air. Never use air pressure greater than 100 psi to clean filter.

c. After cleaning as outlined in step "b," filter may be washed, if necessary, in a solution of warm water and a mild household detergent. A cold water solution may be used.

CAUTION

Do not use solvent or cleaning fluids to wash filter. Use only a water and household detergent solution when washing the filter.

NOTE

The dry type filter may be cleaned with compressed air a maximum of 30 times or it may be washed a maximum of 20 times. The filter should be replaced after 500 hours of engine operating time or one year, whichever should occur first. However, the filter should be replaced at anytime it is damaged.

NOTE

A damaged filter may have sharp or broken edges in the filtering panels which would allow unfiltered air to enter the induction system. Any filter that appears doubtful should be replaced.

d. After washing, rinse filter with clear water until rinse water runs clear from filter. Allow water to drain from filter and dry with compressed air (not over 100 psi).

NOTE

The filtering panels of the filter may become distorted when wet, but they will return to their original shape when dry.

e. Be sure induction air box and air inlet ducts to the engine are clean, inspect and replace filter if it is damaged.

f. Install filter as outlined in Section 12 and 12A.

2-19. VACUUM SYSTEM AIR FILTERS. On aircraft equipped with a vacuum system, change the central filter every 500 hours of operation. Also change central air filter whenever suction gage reading drops below 4.6 inches of mercury. The new insturments are smaller with a beveled box type case. Also, these gyro insturments and related plumbing are used as service parts.

2-20. BATTERY. Battery servicing involves adding distilled water to maintain the electrolyte even with the horizontal baffle plate or split ring at the bottom of the filler holes, checking cable connections, and neutralizing and cleaning off any spilled electrolyte or corrosion. Use bicarbonate of soda (baking soda) and clean water to neutralize electrolyte or corrosion. Follow with a thorough flushing with clean water. Do not allow bicarbonate of soda to enter battery. Brighten cable and terminal connection with a wire brush, then coat with petroleum jelly before connecting. Check the battery every 50 hours (or at least every 30 days), oftener in hot weather. Add only distilled water, not acid or "rejuvenators," to maintain electrolyte level in the battery. Inspect the battery box and clean and remove any evidence of corrosion.

2-21. TIRES should be maintained at the air pressure specified in the charts of Section 1. When checking tire pressure, examine tire for wear, cuts, bruises, and slippage.

NOTE

Recommended tire pressure should be maintained. Especially in cold weather, remember that any drop in temperature of the air inside a tire causes a corresponding drop in pressure.

2-22. NOSE GEAR STRUT. The nose gear strut requires periodic checking to ascertain that the strut is filled with hydraulic fluid and is inflated to the correct air pressure. To fill the nose gear strut with hydraulic fluid and air, proceed as follows:

a. Weight tail to raise nose wheel off ground.

b. Remove filler valve cap from filler valve or from lower end of valve extension, and depress valve core to completely deflate nose strut.

c. Remove valve core from filler valve. It will be necessary to disconnect filler valve extension from valve at top of strut.

d. Attach a rubber hose to the filler valve.

e. With other end of rubber hose in a container of clean hydraulic fluid, compress and extend strut several times. This will draw fluid from container into the strut, filling strut with hydraulic fluid.

f. After strut has been cycled several times, allow strut to extend. Holding end of rubber hose above fluid level in container, slowly compress strut, allowing excess fluid to be drained into container.

g. While strut is compressed, remove hose and install valve core in filler valve.

h. Inflate strut to the pressure specified in the charts of Section 1.

NOTE

Keep the nose gear shock strut, especially the exposed portion of the strut piston, wiped off with a clean dry cloth to remove dust and grit which may cut the seals in the strut barrel. Do not wipe the strut piston with hydraulic fluid, since this tends to collect even more dust and grit.

2-23. NOSE GEAR SHIMMY DAMPENER. The shimmy dampener should be serviced at least every 100 hours. The dampener must be filled completely with hydraulic fluid, free of entrapped air with the compensating piston bottomed in the rod. Check that piston is completely bottomed as follows:

NOTE

Keep the shimmy dampener, especially the exposed portions of the dampener shaft, wiped off with a clean dry cloth to remove dust and grit which may cut the seals in the dampener barrel. Do not wipe the shaft with hydraulic fluid, since this tends to collect even more dust and grit.

a. Remove shimmy dampener from the aircraft.

b. While holding the shimmy dampener in a vertical position with the filler plug pointed upward, loosen the filler plug.

c. Allow the spring to bottom out the floating piston inside the shimmy dampener rod.

d. When the fluid stops flowing, insert a length of stiff wire through the air bleed hole in the setscrew at the end of the piston rod until it touches the floating piston. The depth of insertion should be 3-13/16 inches.

NOTE

If the wire insertion is less than 3-13/16 inches, the floating piston is lodged in the shaft. If the wire cannot be used to free the piston, the rod assembly and piston should be replaced.

Service the shimmy dampener as follows:

a. Remove filler plug from dampener.

b. Move piston completely to opposite end from filler plug.

c. Fill dampener with clean hydraulic fluid completely full.

d. Reinstall filler plug and safety.

e. Wash dampener in solvent and wipe dry with a cloth.

f. Reinstall shimmy dampener in aircraft.

2-24. HYDRAULIC BRAKE SYSTEMS should be checked for the correct amount of fluid at least every 100 hours. Add hydraulic fluid at the brake master cylinders. Bleed the brake system of entrapped air whenever there is spongy response to the brake pedals. Refer to paragraph 5-56 for the bleeding procedure.

2-25. HYDRAULIC RESERVOIR. The hydraulic reservoir should be filled as necessary whenever the fluid level in the reservoir sight window shows low. Filling is accomplished by using a pressure brake bleeder or Hydro Fill unit attached to the filler fitting, located on the right firewall. Hydraulic fluid should be pumped into the filler fitting until fluid flows from the reservoir vent line.

2-26. HYDRAULIC FILTER. The hydraulic filter, located on the right firewall in the hydraulic pump pressure line, uses a fine-mesh screen to filter the hydraulic fluid. The filter screen should be removed and cleaned at the first 25, first 50 hours, and thereafter, at 100 hour intervals or whenever improper fluid circulation is suspected.

2-27. HYDRAULIC FLUID SAMPLING. At the first 50 and first 100 hours, thereafter at each 500 hours or one year, whichever should occur first, a sample of fluid should be taken and examined for sediment and discoloration. This may be done as follows:

a. Place aircraft master switch in OFF position.

b. With landing gear control handle in down-neutral, actuate hydraulic hand pump to supply pressure to open landing gear doors.

c. Remove door open line from nose gear door actuator cylinder. Using the hydraulic hand pump, drain off a small sample of hydraulic fluid into a non-metallic container.

d. Reconnect nose gear door actuating cylinder line and analyze fluid sample in accordance with paragraph 5-33.

2-28. OXYGEN SYSTEM. Refer to Section 15.

2-29. FACE MASKS. Refer to Section 15.

2-30. CLEANING.

2-31. Keeping the aircraft clean is important. Besides maintaining the trim appearance of the aircraft, cleaning reduces the possibility of corrosion and makes inspection and maintenance easier.

2-32. UPHOLSTERY AND INTERIOR cleaning prolongs the life of upholstery fabrics and interior trim. To clean the interior, proceed as follows:

a. Empty all the ash trays.

b. Brush out or vacuum clean the upholstery and carpeting to remove dirt.

c. Wipe leather and plastic surfaces with a damp cloth.

d. Soiled upholstery fabrics and carpet may be cleaned with a foam-type detergent, used according to the manufacturer's instructions.

e. Oily spots and stains may be cleaned with household spot removers, used sparingly. Before using any solvent, read the instructions on the container and test it on an obscure place in the fabric to be cleaned. Never saturate the fabric with a volatile solvent; it may damage the packing and backing material.

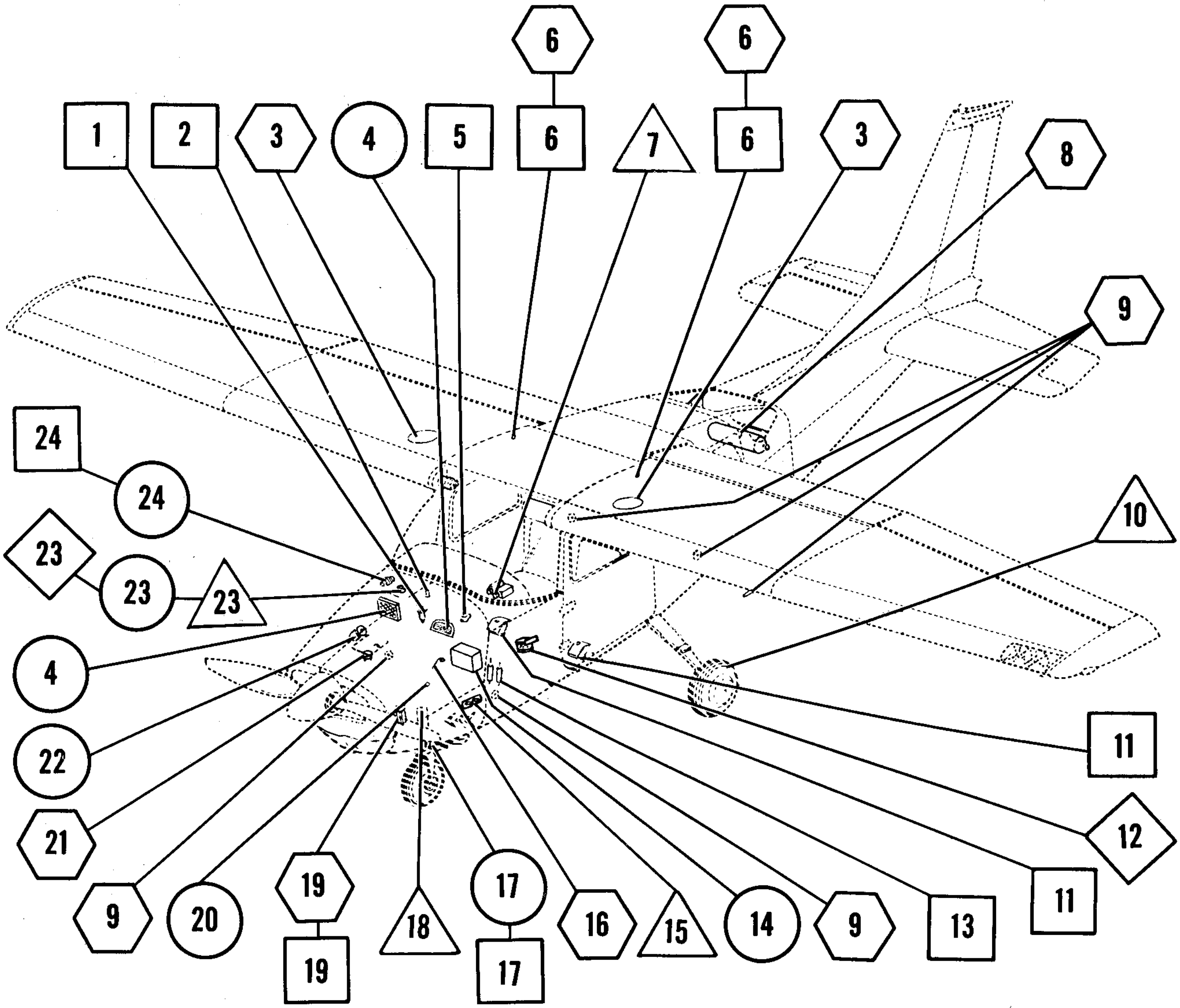
f. Scrape off sticky materials with a dull knife, then spot clean the area.

2-33. PLASTIC TRIM. The instrument panel, plastic trim and control knobs need only be wiped off with a damp cloth. Oil and grease on the control wheel and control knobs can be removed with a cloth moistened with Stoddard solvent.

CAUTION

Do not use gasoline, alcohol, benzene, acetone, carbon tetrachloride, fire extinguisher fluid, de-icer fluid, lacquer thinner or glass window cleaning spray. These solvents will soften and craze the plastic.

SHOP NOTES:



RECOMMENDED FUEL:
AVIATION GRADE---100/130 MINIMUM GRADE
*RECOMMENDED ENGINE OIL:
AVIATION GRADE---SAE 30 BELOW 40°F.
SAE 10W30 BELOW 40°F.
SAE 50 ABOVE 40°F.
HYDRAULIC FLUID:
SPEC. NO. MIL-H-5606
OXYGEN:
SPEC. NO. MIL-O-27210

*MULTI-VISCOSITY OIL WITH A RANGE OF SAE 10W30 IS RECOMMENDED FOR IMPROVED STARTING AND TURBOCHARGER CONTROLLER OPERATION IN COLD WEATHER. DETERGENT OR DISPERSANT OIL, CONFORMING TO CONTINENTAL MOTORS SPECIFICATION MHS-24, MUST BE USED.

Figure 2-3. Servicing (Sheet 1 of 4)

DAILY

3 FUEL TANKS:
Fill after each flight. Refer to paragraph 2-15 for details.

6 FUEL TANK SUMP DRAINS:
If quick-drain valves are installed, drain off water and sediment before the first flight of the day.

8 OXYGEN CYLINDER:
Check for anticipated requirements before each flight. Refer to Section 15 for details.

9 PITOT AND STATIC PORTS:
Check for obstructions before first flight of the day.

16 OIL DIPSTICK:
Check on preflight. Add oil as necessary. Refer to paragraph 2-17 for details.

21 OIL FILLER CAP:
Whenever oil is added, check that filler cap is tight and oil filler door is secure.

19 FUEL STRAINER:
Drain off any water and sediment before the first flight of the day.

50 HOURS

4 INDUCTION AIR FILTER:
Service oftener under dusty conditions. Refer to paragraph 2-18 for details.

20 22 ENGINE OIL SYSTEM:
Change engine oil and external filter element. Without external filter, change oil and clean oil screen EVERY 25 HOURS. Reduce these intervals under severe operating conditions. Refer to paragraph 2-17 for details.

14 BATTERY:
Check level of electrolyte. Check at least every 30 days, oftener in hot weather. Refer to paragraph 2-20 for details.

24 HYDRAULIC FILTER:
See under 100 hours.

23 HYDRAULIC FLUID RESERVOIR:
At first 50 and first 100 hours, thereafter at each 500 hours or one year, whichever comes first, a sample of hydraulic fluid should be examined for sediment and discoloration as outlined in paragraph 5-33.

17 SHIMMY DAMPENER:
Check shimmy dampener compensating mechanism. Refer to paragraph 2-23 for details.

Figure 2-3. Servicing (Sheet 2 of 4)

100 HOURS

1 VACUUM SYSTEM OIL SEPARATOR:
Remove, flush with solvent, and dry with compressed air.

2 FUEL/AIR CONTROL UNIT SCREEN:
Remove and clean the screen.

5 VACUUM RELIEF VALVE FILTER SCREEN:
Check air inlet screen for cleanliness. Remove, flush with solvent, and dry with compressed air. Remove retaining ring to remove screen.

6 FUEL TANK SUMP DRAINS:
If quick-drain valves are not installed, remove plugs and drain off any water or sediment. Reinstall and resafety plugs.

11 FUEL RESERVOIR TANK AND/OR SELECTOR VALVE DRAINS:
Remove plugs and drain off any water and sediment. Reinstall and resafety plugs. Some aircraft use drain valves instead of drain plugs.

13 BRAKE MASTER CYLINDERS:
Check fluid level and fill as required with hydraulic fluid.

24 HYDRAULIC FILTER:
Check and clean screen at first 25 and first 50 hours, thereafter at each 100 hours.

19 FUEL STRAINER:
Disassemble and clean strainer bowl and screen.

500 HOURS

12 VACUUM SYSTEM AIR FILTERS:
Replace central air filter.
Refer to paragraph 2-19 for details.

23 HYDRAULIC FLUID RESERVOIR:
At first 50 and first 100 hours, thereafter at each 500 hours or one year, whichever comes first, a sample of fluid should be examined for sediment and discoloration as outlined in paragraph 5-33.

Figure 2-3. Servicing (Sheet 3 of 4)

△ AS REQUIRED

10 TIRES:
Maintain proper tire inflation as listed in the Charts in Section 1. Also refer to paragraph 2-21.

18 NOSE GEAR SHOCK STRUT:
Keep strut filled and inflated to correct pressure. Refer to paragraph 2-22 for details.

23 HYDRAULIC FLUID RESERVOIR AND FILLER:
Check fluid level at least every 25 hours and fill as required. Refer to paragraph 2-25.

7 GYRO INSTRUMENT AIR FILTERS:
Replace instrument air filter when erratic or sluggish responses are noted with normal suction gage readings. Refer to paragraph 2-19 for details.

15 GROUND SERVICE RECEPTACLE (OPT):
Connect to 12-volt, DC, negative-ground power unit for cold weather starting and lengthy ground maintenance of the aircraft's electrical equipment with the exception of electronic equipment. Master switch should be turned on before connecting a generator type or battery type external power source. Refer to paragraph 12-78.

NOTE

The ground power receptacle circuit incorporates a polarity reversal protection. Power from the external power source will flow only if the ground service plug is connected correctly to the aircraft.

Figure 2-3. Servicing (Sheet 4 of 4)

2-34. WINDSHIELD AND WINDOWS should be cleaned carefully with plenty of fresh water and a mild detergent, using the palm of the hand to feel and dislodge any caked dirt or mud. A sponge, soft cloth, or chamois may be used, but only as a means of carrying water to the plastic. Rinse thoroughly, then dry with a clean moist chamois. Do not rub the plastic with a dry cloth since this builds up an electrostatic charge which attracts dust. Oil and grease may be removed by rubbing lightly with a soft cloth moistened with Stoddard solvent. Volatile solvents, such as mentioned in paragraph 2-33, must never be used since they soften and craze the plastic. After washing, the plastic windshield and windows should be cleaned with an aircraft windshield cleaner. Apply the cleaner with soft cloths, and rub with moderate pressure. Allow the cleaner to dry, then wipe it off with soft flannel cloths. A thin, even coat of wax, polished out by hand with clean soft flannel cloths, will fill in minor scratches and help prevent further scratching. Do not use a canvas cover on the windshield or windows unless freezing rain or sleet is anticipated since the cover may scratch the plastic surface.

2-35. ALUMINUM SURFACES require a minimum of care, but should never be neglected. The aircraft may be washed with clean water to remove dirt, and with carbon tetrachloride or other non-alkaline grease solvents to remove oil and/or grease. Household type detergent soap powders are effective cleaners, but should be used cautiously since some of them are strongly alkaline. Many good aluminum cleaners, polishers, and waxes are available from commercial suppliers of aircraft products.

2-36. PAINTED SURFACES. The painted exterior surfaces of the aircraft, under normal conditions, require a minimum of polishing or buffing. Approximately 15 days are required for acrylic or lacquer paint to cure completely and approximately 90 days are required for vinyl paint to cure completely; in most cases, the curing period will have been completed prior to delivery of the aircraft. In the event that polishing or buffing is required within the curing period, it is recommended that the work be done by an experienced painter. Generally, the painted surfaces can be kept bright by washing with water and mild soap, followed by a rinse with water and drying with cloths or a chamois. Harsh or abrasive soaps or detergents which cause corrosion or make scratches should never be used. Remove stubborn oil and grease with a cloth moistened with Stoddard solvent. After the curing period, the aircraft may be waxed with a good automotive wax. A heavier coating of wax on the leading edges of the wings and tail and on the engine nose cap will help reduce the abrasion encountered in these areas.

2-37. ENGINE COMPARTMENT cleaning is essential to minimize any danger of fire, and for proper inspection of engine components. The engine and engine compartment may be washed down with a suitable solvent, then dried thoroughly.

CAUTION

Particular care should be given to electrical equipment before cleaning. Solvent should not be allowed to enter magnetos, starters, alternators, voltage regulators, and the like. Hence, these components should be protected before saturating the engine with solvent. Any oil, fuel, and air openings on the engine and accessories should be covered before washing the engine with solvent. Caustic cleaning solutions should be used cautiously and should always be properly neutralized after their use.

2-38. PROPELLERS should be wiped occasionally with an oily cloth to remove grass and bug stains from the propeller blades. In salt water areas this will assist in corrosion-proofing the propeller.

2-39. WHEELS should be washed periodically and examined for corrosion, chipped paint, and cracks or dents in the wheel castings. Sand smooth, prime, and repaint minor defects.

2-40. LUBRICATION.

2-41. Lubrication requirements are shown on the Lubrication Chart (figure 2-4). Before adding grease to grease fittings, wipe off all dirt. Lubricate until new grease appears around parts being lubricated, and wipe off excess grease. The following paragraphs supplement this figure by adding details.

2-42. NOSE GEAR TORQUE LINKS. Lubricate nose gear torque links every 50 hours. When operating in dusty conditions, more frequent lubrication is recommended.

2-43. TACHOMETER DRIVE SHAFT. Refer to Section 16 for lubrication.

2-44. WHEEL BEARING LUBRICATION. Clean and repack wheel bearings at the first 100-hour inspection and at each 500-hour inspection thereafter. If more than the usual number of take-off and landings are made, extensive taxiing is required, or the aircraft is operated in dustry areas or under seacoast conditions, clean and lubricate wheel bearings at each 100-hour inspection.

2-45. WING FLAP ACTUATOR. At each 100-hour inspection, inspect wing flap actuator jack screw and ball retainer assembly for lubrication. Also, remove, clean, and lubricate the wing flap actuator at least once each year or whenever actuator slippage is experienced. Actuator slippage is caused by a breakdown of the lubricant and can result in the wing flaps inadvertently retracting in flight.

FREQUENCY (HOURS)

50 100 500

WHERE NO INTERVAL IS SPECIFIED, LUBRICATE AS REQUIRED AND WHEN ASSEMBLED OR INSTALLED.

METHOD OF APPLICATION

HAND GREASE GUN OIL CAN SYRINGE (FOR POWDERED GRAPHITE)

NOTE

The military specifications listed below are not mandatory, but are intended as guides in choosing satisfactory materials. Products of most reputable manufacturers meet or exceed these specifications.

LUBRICANTS

PG	— MIL-G-6711	POWDERED GRAPHITE
GG	— MIL-G-7711	GENERAL PURPOSE GREASE
GA	— MIL-G-25760	AIRCRAFT WHEEL BEARING GREASE
GH	— MIL-G-23827	AIRCRAFT AND INSTRUMENT GREASE
GL	— MIL-G-21164	HIGH AND LOW TEMPERATURE GREASE
OG	— MIL-L-7870	GENERAL PURPOSE OIL
PL	— VV-P-236	PETROLATUM

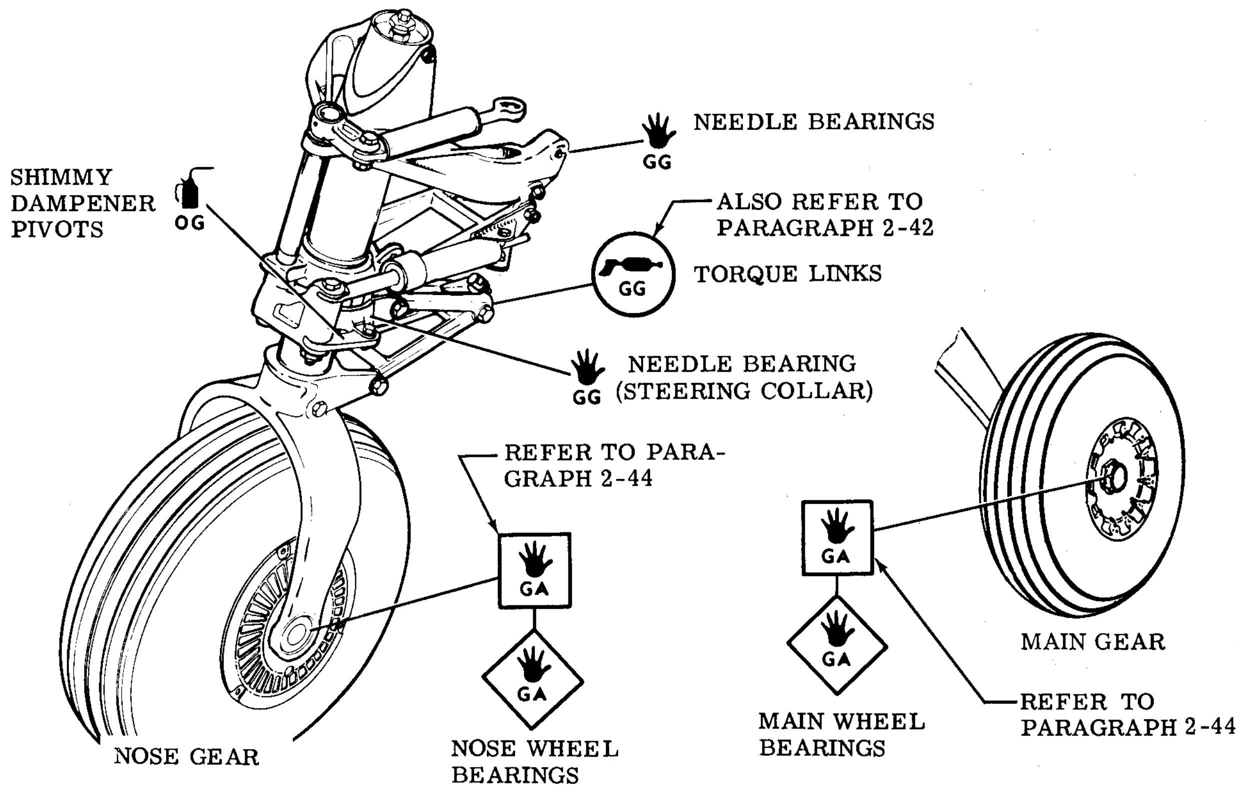


Figure 2-4. Lubrication (Sheet 1 of 4)

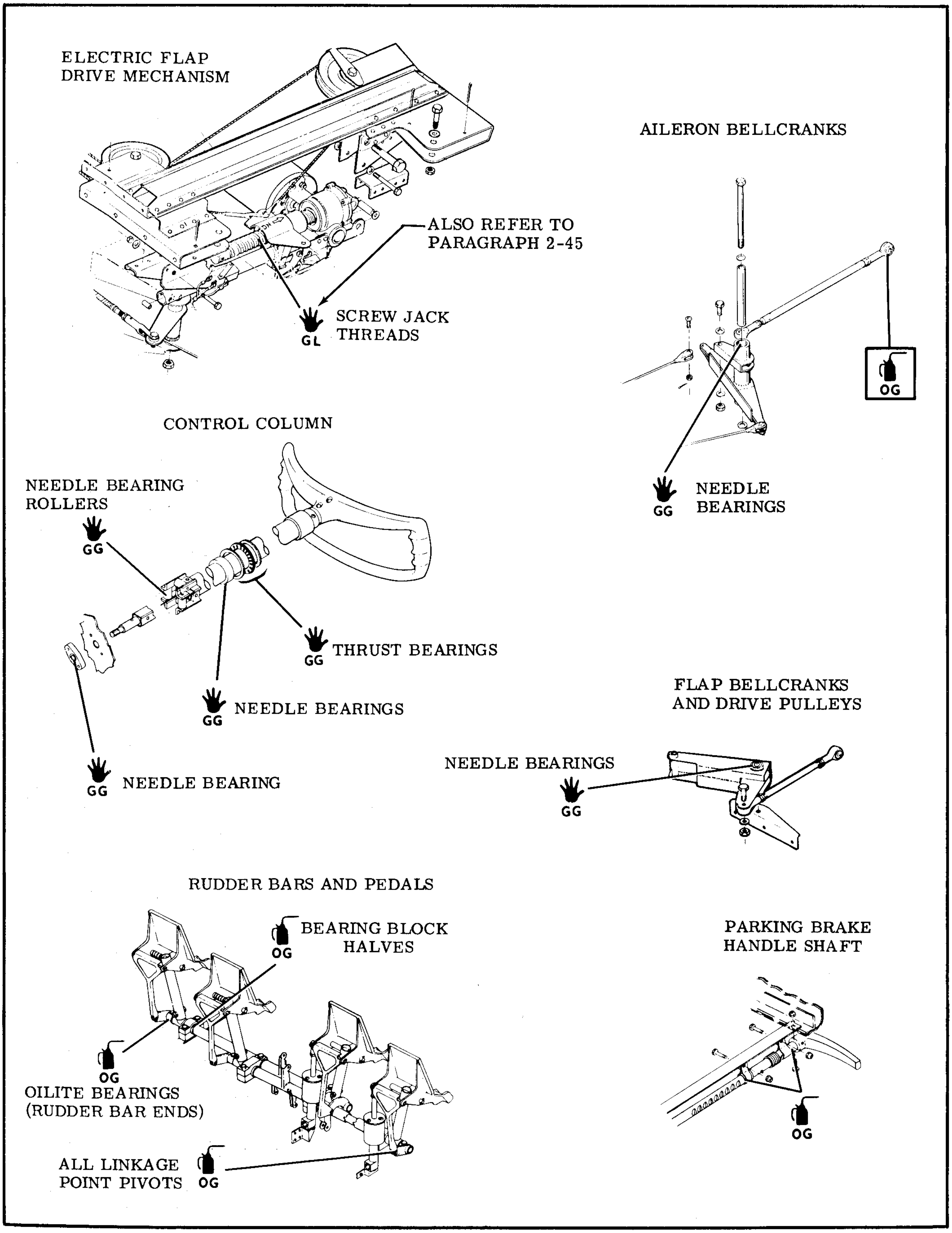


Figure 2-4. Lubrication (Sheet 2 of 4)

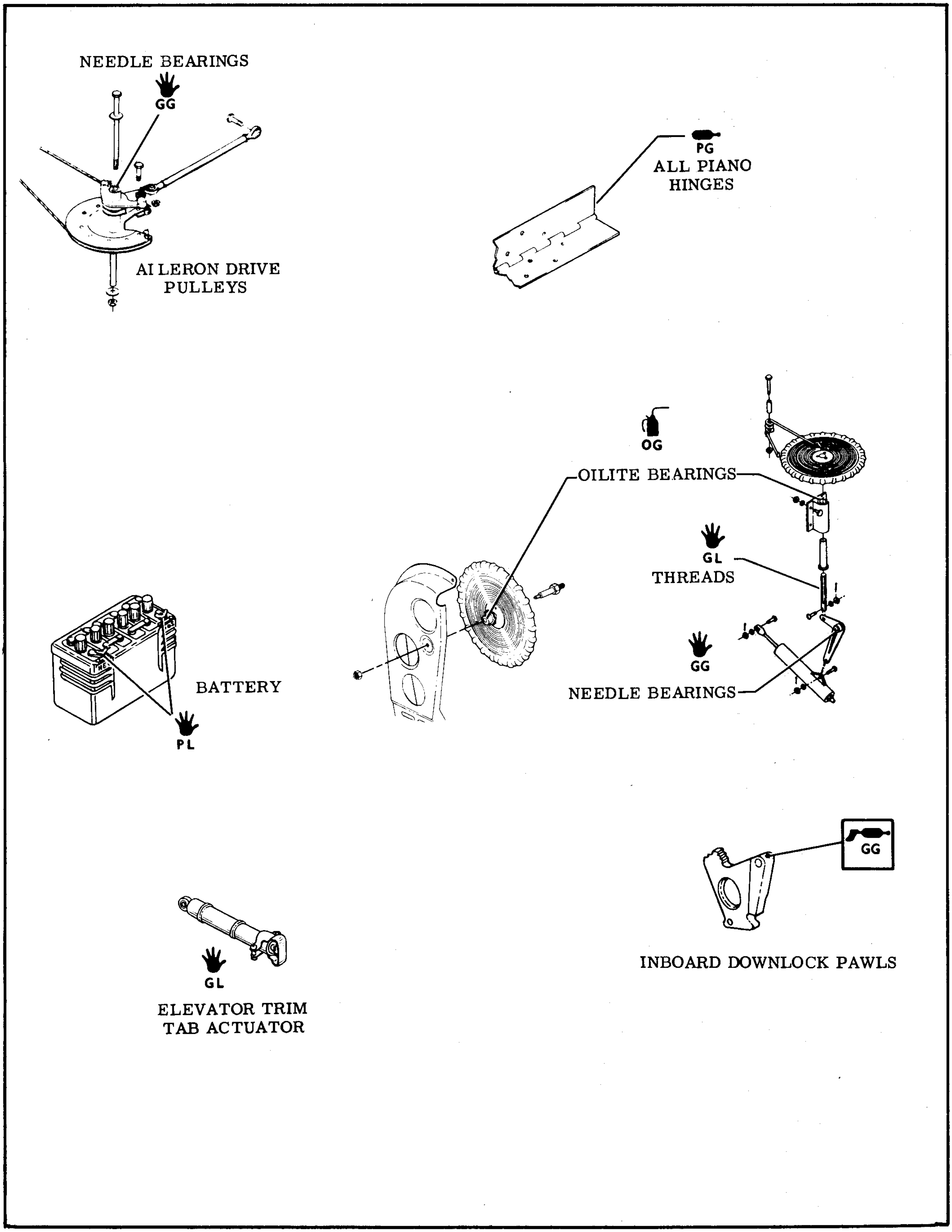
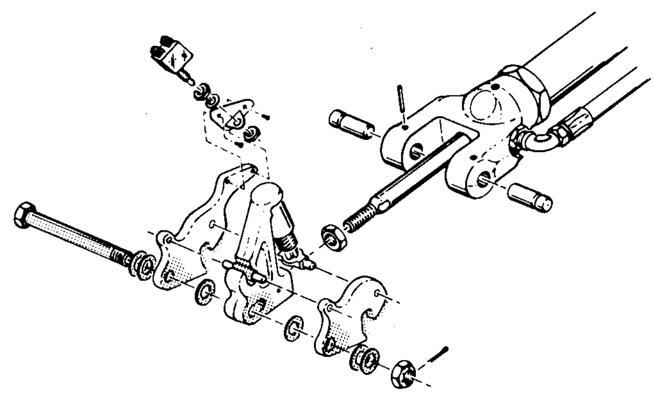
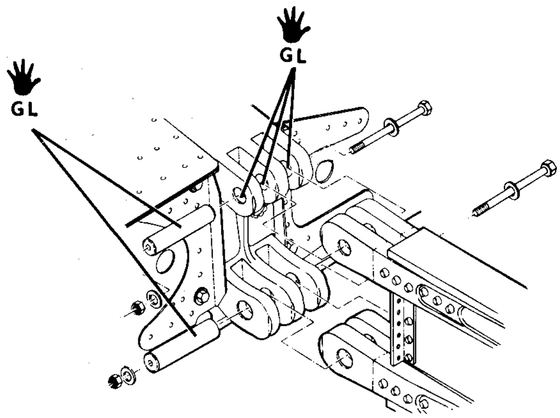


Figure 2-4. Lubrication (Sheet 3 of 4)

SPRAY BOTH SIDES OF SHADED AREAS WITH ELECTROFILM LUBRI-BOND "A" WHICH IS AVAILABLE IN AEROSOL SPRAY CANS, OR AN EQUIVALENT LUBRICANT. TORQUE ATTACHING BOLT TO 10-20 LB-IN.

NOSE GEAR
DOWNLOCK
MECHANISM





NOTES

Sealed bearings require no lubrication.

McCauley propellers are lubricated at overhaul and require no other lubrication.

Do not lubricate roller chains or cables except under seacoast conditions. Wipe with a clean, dry cloth.

Lubricate unsealed pulley bearings, rod ends, Oilite bearings, pivot and hinge points, and any other friction point obviously needing lubrication, with general purpose oil every 1000 hours or oftener if required.

Paraffin wax rubbed on seat rails will ease sliding the seats fore and aft.

Lubricate door latching mechanism with "Mechanics Miracle White" or equivalent lubricant, applied sparingly to friction points, every 1000 hours or oftener if binding occurs. No lubrication is recommended on the rotary clutch.

Figure 2-4. Lubrication (Sheet 4 of 4)

INSPECTION

To avoid repetition throughout the inspection, general points to be checked are given below. In the inspection, only the items to be checked are listed; details as to how to check, or what to check for, are excluded. The inspection covers several different models. Some items apply only to specific models, and some items are optional equipment that may not be found on a particular aircraft. Check FAA Airworthiness Directives and Cessna Service Letters for compliance at the time specified by them. Federal Aviation Regulations require that all civil aircraft have a periodic (annual) inspection as prescribed by the administrator, and performed by a person designated by the administrator. The Cessna Aircraft Company recommends a 100-hour periodic inspection for the aircraft.

CHECK AS APPLICABLE:

MOVABLE PARTS for: lubrication, servicing, security of attachment, binding, excessive wear, safetying, proper operation, proper adjustment, correct travel, cracked fittings, security of hinges, defective bearings, cleanliness, corrosion, deformation, sealing, and tensions.
FLUID LINES AND HOSES for: leaks, cracks, dents, kinks, chafing, proper radius, security, corrosion, deterioration, obstructions, and foreign matter.
METAL PARTS for: security of attachment, cracks, metal distortion, broken spotwelds, corrosion, condition of paint, and any other apparent damage.
WIRING for: security, chafing, burning, defective insulation, loose or broken terminals, heat deterioration, and corroded terminals.
BOLTS IN CRITICAL AREAS for: correct torque in accordance with the torque values given in the chart in Section 1, when installed or when visual inspection indicates the need for a torque check.
FILTERS, SCREENS, AND FLUIDS for: cleanliness, contamination and/or replacement at specified intervals.

AIRPLANE FILE.

Miscellaneous data, information, and licenses are a part of the airplane file. Check that the following documents are up-to-date and in accordance with current Federal Aviation Regulations. Most of the items listed are required by the United States Federal Aviation Regulations. Since the regulations of other nations may require other documents and data, owners of exported aircraft should check with their own aviation officials to determine their individual requirements.

To be displayed in the aircraft at all times:
1. Aircraft Airworthiness Certificate (Form FAA 1362B).
2. Aircraft Registration Certificate (Form FAA 500A).
3. Aircraft Radio Station License, if transmitter installed (Form FCC 404-2).

To be carried in the aircraft at all times:
1. Weight and Balance, and associated papers (Latest copy of the Repair and Alteration Form, Form FAA 337, if applicable).
2. Aircraft Equipment List.

To be made available upon request:
1. Aircraft Log Book and Engine Log Book.

ENGINE RUN-UP.

Before beginning the step-by-step inspection, start, run up, and shut down the engine in accordance with instructions in the Owner's Manual. During the run-up, observe the following, making note of any discrepancies or abnormalities:
1. Engine temperatures and pressures.
2. Static rpm.
3. Magneto drop (See Owner's Manual).
4. Engine response to changes in power.
5. Any unusual engine noises.
6. Propeller response (See Owner's Manual).
7. Fuel tank selector valve; operate engine on each tank position and off position long enough to make sure the valve functions properly.
8. Idling speed and mixture; proper idle cut-off.
9. Alternator and ammeter.
10. Suction Gage.
11. Fuel flow indicator.

After the inspection has been completed, an engine run-up should again be performed to ascertain that any discrepancies or abnormalities have been corrected.

SCOPE AND PREPARATION.

If the aircraft is NOT equipped with an external oil filter, the engine oil should be changed and the oil screen cleaned EVERY 25 HOURS.

The 50-hour inspection includes a visual check of the engine, propeller, and aircraft exterior for any apparent damage or defects; an oil change and filter element change on aircraft equipped with an external oil filter; and accomplishment of lubrication and servicing requirements. Remove propeller spinner and engine cowling, and replace after the inspection has been completed.

The 100-hour (or annual) inspection includes everything in the 50-hour inspection. Also loosen or remove all fuselage, wing, empennage, and upholstery inspection doors, plates, and fairings as necessary to perform a thorough, searching inspection of the aircraft. Replace after the inspection has been completed.

NOTE

Numbers appearing in the "AS SPECIFIED" column refer to the data listed at the end of the inspection chart.

	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
PROPELLER.			
1. Spinner and spinner bulkhead	●		
2. Blades	●		
3. Hub	●		
4. Bolts and nuts	●		
5. Governor and control	●		
ENGINE COMPARTMENT.			
Check for evidence of oil, hydraulic fluid and fuel leaks, then clean entire engine and compartment, if needed, prior to inspection.			
1. Engine oil, screen, filler cap, dipstick, drain plug and external filter element	●		1
2. Oil cooler	●		
3. Induction air filter (Also see paragraph 2-18)	●		
4. Induction airbox, air valves, doors, and controls	●		
5. Cold and hot air hoses	●		
6. Engine baffles	●		

Item		EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
7.	Cylinders, rocker box covers, and push rod housings	●		
8.	Crankcase, oil sump, accessory section, and front crankshaft seal	●		
9.	All lines and hoses	●		
10.	Intake and exhaust systems (Also see paragraphs 12-24 and 12A-28)	●		
11.	Ignition harness	●		
12.	Spark plugs and compression check		●	
13.	Crankcase, hydraulic, and vacuum system breather lines	●		
14.	Electrical wiring	●		
15.	Vacuum pump, oil separator, and relief valve	●		
16.	Vacuum relief valve screen		●	
17.	Engine controls and linkage	●		
18.	Engine shock mounts, engine mount structure, and ground straps	●		
19.	Cabin heater valves, doors, and controls	●		
20.	Starter, solenoid, electrical connections	●		
21.	Starter brushes, brush leads, and commutator		2	
22.	Alternator, drive belt, pulley, and electrical connections	●		
23.	Alternator brushes, brush leads, and slip ring		2	
24.	Voltage regulator mounting and electrical leads	●		
25.	Magnetos (externally) and electrical connections	●		
26.	Magneto timing		3	
27.	Magneto breaker compartment (Also see paragraph 12-68)		3	
28.	Fuel injection fuel-air control unit, fuel pump, fuel manifold valve, fuel lines, and nozzles	●		
29.	Fuel-air control unit screen		●	
30.	Hydraulic pump		●	
31.	Firewall		●	
32.	Engine cowling	●		
33.	Cowl flaps and control	●		

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
34. Turbocharger	●		4
35. Turbocharger pressurized vent lines to fuel pump, discharge nozzles, and fuel flow gage	●		
36. Turbocharger mounting brackets	●		
37. Waste gate, actuator and linkage, and controller	●		4
38. All oil lines to turbocharger, waste gate, and controller	●		
39. Exhaust system (Also see paragraph 12A-28)	●		
AIRFRAME.			
1. Aircraft exterior	●		
2. Aircraft structure (Also see figure 4-1)		●	
3. Windows, windshield, and doors	●		
4. Seats, stops, seat rails, upholstery, structure, and seat mounting	●		
5. Safety belts and attaching brackets	●		
6. Control column bearings, sprockets, pulleys, cables, chains, and turnbuckles		●	
7. Control lock, control wheel, and control column mechanism		●	
8. Instruments and markings		●	
9. Central air filter (Also see paragraph 2-19)		●	5
10. Magnetic compass compensation			4
11. Instrument wiring and plumbing		●	
12. Instrument panel, shock mounts, ground straps, cover, and decals and labeling		●	
13. Defrosting, heating, and ventilating systems, and controls		●	
14. Cabin upholstery, trim, sunvisors, and ash trays		●	
15. Area beneath floor, lines, hoses, wires, and control cables		●	
16. Electrical horns, lights, switches, circuit breakers, and clock fuse	●		
17. Exterior lights	●		

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
18. Pitot and static systems		●	
19. Stall warning sensing unit, and pitot and stall warning heaters		●	
20. Radios and radio controls		●	
21. Radio antennas		●	
22. Battery, battery box, and battery cables		●	
23. Battery electrolyte level (Also see paragraph 2-20)	●		
24. Oxygen system		●	6

CONTROL SYSTEMS.

In addition to the items listed below, always check for correct direction of movement, correct travel, and correct cable tension.

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
1. Cables, terminals, pulleys, pulley brackets, cable guards, turnbuckles, and fairleads		●	
2. Chains, terminals, sprockets, and chain guards		●	
3. Trim control wheels, indicators, actuator, and bungee		●	
4. Travel stops		●	
5. All decals and labeling		●	
6. Flap control switch, flap rollers and tracks, flap position transmitter and linkage, flap position indicator, flap electric motor and transmission, and synchronizing system		●	
7. Elevator downspring system		●	
8. Rudder pedal assemblies and linkage		●	
9. Skin and structure of control surfaces and trim tabs		●	
10. Balance weight attachment		●	

	Each 50 Hours	Each 100 Hours	As Specified
FUEL SYSTEM.			
1. Fuel strainer, drain valve, and control	●		
2. Fuel strainer screen and bowl		●	
3. Electric fuel pump, throttle switch, and electric connections	●		
4. Fuel tanks, fuel reservoir tanks, fuel lines, drains, filler caps, and placards		●	
5. Drain fuel and check tank interior, attachment, and outlet screens			4
6. Fuel vents and vent valves		●	
7. Fuel selector valve and placards		●	
8. Fuel quantity gages and transmitter units		●	
9. Engine primer		●	
10. Vapor return line and check valve		●	
11. Turbocharger vent system		●	
LANDING GEAR.			
1. Brake fluid, lines and hoses, linings, disc, brake assemblies, and master cylinders		●	
2. Main gear wheels, wheel bearings, step and spring strut and tires		●	
3. Nose gear strut servicing, and shimmy dampener servicing (Refer to paragraph 2-23)		●	
4. Nose gear wheel, wheel bearings, strut, steering system, shimmy dampener, tire and torque links		●	
5. Parking brake system		●	
LANDING GEAR RETRACTION SYSTEM.			

NOTE

When performing inspection of the landing gear retraction system, a hydraulic power source is required. Refer to paragraphs 5-134 through 5-150 for Hydro Test operation.

	Each 50 Hours	Each 100 Hours	As Specified
1. Operate the landing gear through five fault-free cycles, noting cycling time. Refer to paragraphs 5-144 and 5-150		●	7

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
2. Check landing gear doors for at least 1/2-inch clearance with any part of landing gear during operation, and for proper fit when closed		●	
3. Check down position of main gear struts. Refer to figure 5-10		●	
4. Check main gear downlock engagement. Refer to figures 5-10 and 5-20		●	
5. Check overcenter adjustments of retracted main gear downlock. Refer to figure 5-20		●	
6. Check main gear uplock hook operation. Refer to paragraph 5-118		●	
7. Check that main gear snubbing action occurs. Refer to paragraph 5-50		●	
8. Check adjustment and operation of main gear up and down indicator switches, nose gear up and down indicator switches, and nose gear safety switch. Refer to paragraphs 5-121, 5-122, 5-127, 5-128 and 5-129. Also check indicator lights for proper operation		●	
9. Check nose gear downlock adjustments. Refer to paragraph 5-125		●	
10. Check nose gear uplock operation. Refer to paragraph 5-126		●	
11. Check adjustment of landing gear handle up-down switch. Refer to paragraph 5-132		●	
12. Check all hydraulic system components for security, hydraulic leaks, and any apparent damage to components or mounting structure		●	

NOTE

Hydraulic fluid for the brakes passes through the actuator-to-saddle plate attachment and is sealed by an O-ring. After the bolts are checked for tightness, check that no leakage of brake fluid occurs with pressure applied to the brake pedals.

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
13. Check gear and door linkage for security, wear of pivot points and bearings, and for distortion or other damage		●	
14. Check main gear strut-to-saddle attachment		●	
15. Check condition of all springs		●	
16. Clean hydraulic filter. Refer to paragraph 5-11		●	7
17. Hydraulic fluid contamination check. Refer to paragraph 5-33		●	8

Item	EACH 50 HOURS	EACH 100 HOURS	AS SPECIFIED
18. Check operation of emergency hand pump		●	

NOTE

A high-time inspection is merely a 100-hour inspection with the addition of an engine overhaul. Continental Motors Corporation recommends overhaul at 1500 hours for the IO-520 series engines and 1400 hours for the TSIO-520 series engines. At the time of overhaul, constant-speed propellers, governors, engine accessories, turbocharger, controller, waste gate and waste-gate actuator should be overhauled.

1 Each 25 hours, if NOT equipped with an external filter.

2 Starters each 200 hours; alternators each 500 hours.

3 Check timing each 200 hours; check breaker compartment each 500 hours, unless timing is off.

4 Each 1000 hours, or to coincide with engine overhauls.

5 Replace central filter each 500 hours.

6 Refer to Section 15 for details.

7 At first 25 hours and first 50 hours of operation; at each 100-hour inspection thereafter.

8 At first 50 and first 100 hours, thereafter at each 500 hours or one year, whichever occurs first.

SECTION 3

FUSELAGE

TABLE OF CONTENTS Page

3-1. WINDOWS AND WINDSHIELDS.

3-2. CLEANING. (See section 2.)

3-3. WAXING will fill in minor scratches in clear plastic and help protect the surface from further abrasion. Use a good grade of commercial wax applied in a thin, even coat. Bring the wax to a high polish by rubbing lightly with a clean, dry flannel cloth.

3-4. REPAIRS. Damaged window panels and windshield should be removed and replaced if damage is extensive. However, certain repairs as prescribed in the following paragraph can be made successfully without removing the damaged part from the aircraft. Three types of temporary repairs for cracked plastic are possible. No repairs of any kind are recommended on highly-stressed or compound curves where the repair would be likely to affect the pilot's field of vision. Curved areas are more difficult to repair than flat areas and any repaired area is both structurally and optically inferior to the original surface.

3-5. SCRATCHES on clear plastic surfaces can be removed by hand-sanding operations followed by buffing and polishing, if the following steps are accomplished carefully.

a. Wrap a piece of No. 320 (or finer) sandpaper or abrasive cloth around a rubber pad or wood block. Rub the surface around the scratch with a circular motion, keeping the abrasive constantly wet with clean water to prevent scratching the surface further. Use minimum pressure and cover an area large enough to prevent the formation of "bull's eyes" or other optical distortions.

b. Continue the sanding operation, using progressively finer grade of abrasives until the scratches disappear.

c. When the scratches have been removed, wash the area thoroughly with clean water to remove all gritty particles. The entire sanded area will be clouded with minute scratches which must be removed to restore transparency.

d. Apply fresh tallow or buffing compound to a motor-driven buffing wheel. Hold the wheel against the plastic surface, moving it constantly over the damaged area until the cloudy appearance disappears. A 2000-foot-per-minute surface speed is recommended to prevent overheating and distortion.

NOTE

Polishing can be accomplished by hand but it will require a considerably longer period of time to attain the same result as a buffing wheel.

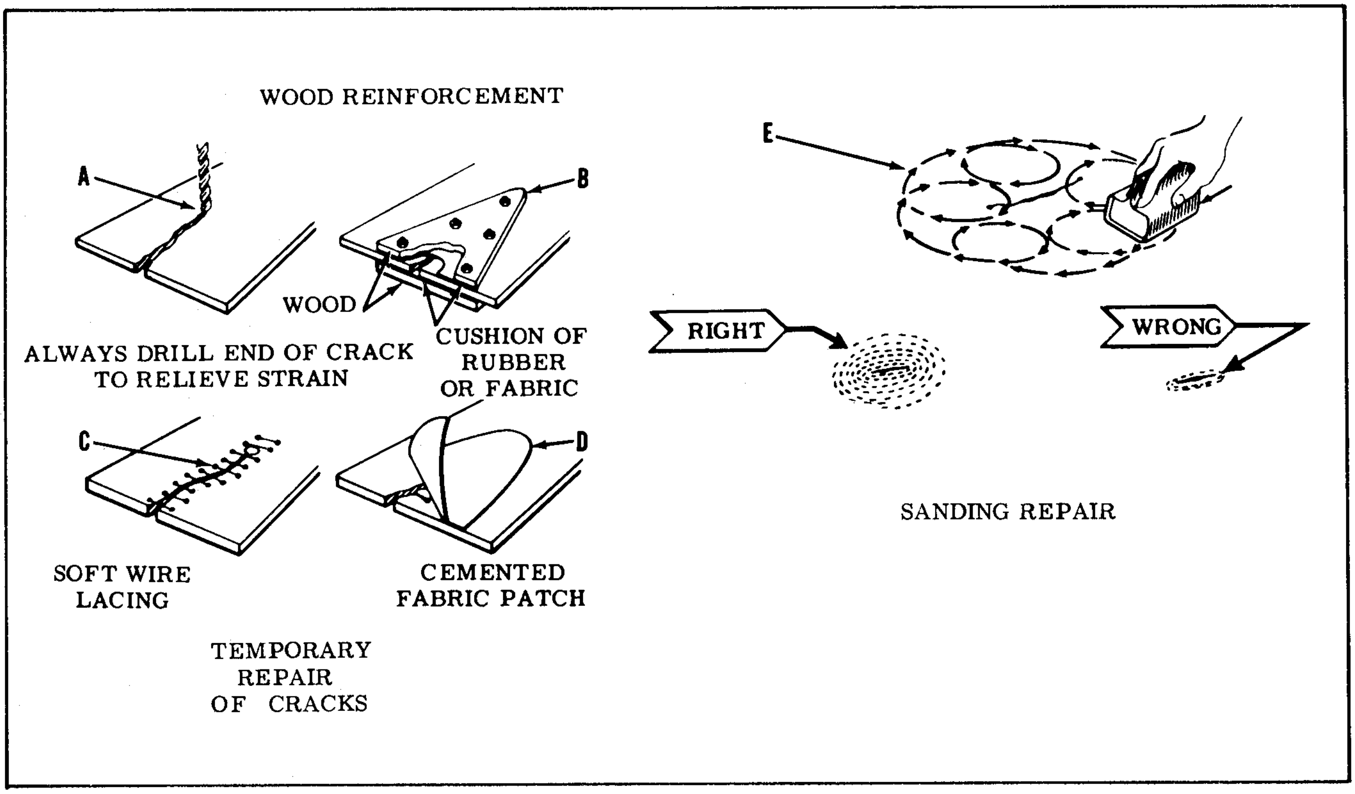


Figure 3-1. Repair of Windows and Windshields

e. When buffing is finished, wash the area thoroughly and dry it with a soft flannel cloth. Allow the surface to cool and inspect the area to determine if full transparency has been restored. Then apply a thin coat of hard wax and polish the surface lightly with a clean flannel cloth.

NOTE

Rubbing the plastic surface with a dry cloth will build up an electrostatic charge which attracts dirt particles and may eventually cause scratching of the surface. After the wax has hardened, dissipate this charge by rubbing the surface with a slightly damp chamois. This will also remove the dust particles which have collected while the wax is hardening.

f. Minute hairline scratches can often be removed by rubbing with commercial automobile body cleaner or fine-grade rubbing compound. Apply with a soft, clean, dry cloth or imitation chamois.

3-6. CRACKS. (See figure 3-1.)

a. When a crack appears in a panel, drill a hole at the end of the crack to prevent further spreading. The hole should be approximately 1/8 inch in diameter, depending on the length of the crack and thickness of the material.

b. Temporary repairs to flat surfaces can be effected by placing a thin strip of wood over each side of the surface and then inserting small bolts through the wood and plastic. A cushion of sheet rubber or aircraft fabric should be placed between the wood and plastic on both sides.

c. A temporary repair can be made on a curved surface by placing fabric patches over the affected area. Secure the patches with aircraft dope, Specification No. MIL-D-5549; or lacquer, Specification No. MIL-L-7178. Lacquer thinner, Specification No. MIL-T-6094 can also be used to secure the patch.

d. A temporary repair can be made by drilling small holes along both sides of the crack 1/4 to 1/8 inch apart and lacing the edges together with a soft wire. Small-stranded antenna wire makes a good temporary lacing material. This type of repair is used as a temporary measure only, and as soon as facilities are available the panel should be replaced.

3-7. WINDSHIELDS. (See figure 3-2.) Windshields are single-piece, "free-blown" acrylic plastic panels set in sealing strips and held by formed retaining strips that are secured to the fuselage by means of screws and rivets. Presstite No. 579.6 sealing compound used in conjunction with an adhesive-backed felt strip is applied to all edges of the windshield except the wing root area. The wing root fairing has a heavy felt strip that completes the windshield sealing.

3-8. REMOVAL.

a. Drill out rivets securing the top retainer strip, and remove screws securing the front retainer strip.

b. Remove wing fairings over windshield edges.

c. Pull windshield straight forward, out of side retainers.

3-9. REPLACEMENT.

a. Apply felt strip and sealing compound to all edges of windshield to prevent leaks.

b. Reverse steps listed in preceding paragraph to install a windshield.

c. When installing a new windshield, check the fit and carefully file or grind away any excess plastic.

d. Use care not to crack windshield when installing. Starting at an upper corner and gradually working the windshield into position is recommended.

3-10. MOVABLE WINDOWS. (See figure 3-3.) The movable windows, hinged at the top, are installed in the doors. Window assemblies, that is the clear plastic and frame units, may be replaced by removing the hinge pins and disconnecting the window stop. To remove the frame from the plastic panel, drill out the blind rivets at the frame splice. When replacing the plastic panel in a frame, make sure that the sealing strip and an adequate coating of Presstite No. 579.6 sealing compound is used around all edges of the plastic panel.

3-11. FIXED WINDOWS. (See figure 3-2.) Fixed windows are mounted in sealing strips and sealing compound, and are held in place by various retainer strips. To replace the side windows, remove upholstery and trim panels, then drill out rivets as necessary to remove the retainer strips. Except for the left door, the rear windows, and windshield, the aircraft is equipped with double windows.

3-12. REAR WINDOW. The rear window is a one-piece, "free-blown" acrylic plastic panel, set in sealing strips and held in place with retaining strips.

3-13. REMOVAL AND INSTALLATION.

a. Remove upholstery as required to expose retainer strips inside the cabin.

b. Drill out rivets as required to remove retainer strips. It is not necessary to remove all of the retainer strips.

c. Pull window into the rear cabin area.

d. Apply felt strip and sealing compound or sealing tape to all edges of rear window to prevent leaks.

e. When installing a new rear window, carefully check the fit and file or grind away any excess plastic.

f. Use care not to crack window when installing retainers.

g. Install upholstery and upholstery panels.

3-14. CABIN DOORS. (See figure 3-3.)

3-15. REMOVAL AND INSTALLATION Removal of cabin doors is accomplished either by removing the screws which attach the hinges or by removing the hinge pins. The door stop must also be disconnected. Some aircraft are equipped with removeable hinge pins to facilitate door removal. If the permanent hinge pins were removed, they may be replaced by clevis pins secured with cotter pins, or new hinge pins may be installed and "spin-bradded." When fitting a new door, some trimming of the door skin at the edges and some reforming with a soft mallet may be necessary to achieve a good fit.

3-17. CABIN DOOR WEATHERSTRIP is cemented around all edges of the door. New weatherstrip may be applied after mating surfaces of weatherstrip and door are clean, dry and free from oil or grease. Apply a thin, even coat of adhesive to each surface and allow to dry until tacky before pressing strip in place. Minnesota Mining and Manufacturing Co. No. EC-880 cement is recommended.

3-17. ADJUSTMENT OF CABIN DOOR WEDGES. Wedges at the upper forward edge of the door aid in preventing air leaks at this point. They engage as the door is closed. Several attaching holes are located in the wedges, and the set of holes which gives best results should be selected.

3-18. DOOR LATCH. (See figure 3-5.) The cabin door latch is a push-pull bolt type, utilizing a rotary clutch for positive bolt engagement. As the door is closed, teeth on the underside of the bolt engage the gear teeth on the clutch. The clutch gear rotates in one direction only, and holds the door until the handle is moved to the LOCK position, driving the bolt into the slot.

3-19. ADJUSTMENT OF DOOR LATCH. Adjustment of latch or clutch cover is afforded by oversize and/ or slotted holes. This adjustment ensures sufficient gear-to-bolt engagement and proper alignment.

NOTE

Lubricate door latch per Section 2. No lubrication is recommended for the rotary clutch.

3-20. DOOR LOCK. As standard equipment, in addition to interior locks, is a cylinder and key type lock on the left door. If the lock is to be replaced, the new one may be modified to accept the original key. This is desirable, as the same key is used for the ignition switch and the cabin door lock. After removing the old lock from the door, proceed as follows:

a. Remove lock cylinder from new housing.

b. Insert original key into new cylinder and file off any protruding tumblers flush with cylinder. Without removing key, check that cylinder rotates freely in housing.

c. Install lock assembly in door, and check lock operation with door open.

d. Destroy new key and disregard code number on cylinder.

3-21. BAGGAGE DOORS.

3-22. REMOVAL AND INSTALLATION. Baggage door removal is accomplished by disconnecting the door stop, then removing hinge pins or bolts securing door to hinges. When fitting a new door, some trimming of the door at the edges and some reforming with a soft mallet may be necessary to achieve a good fit.

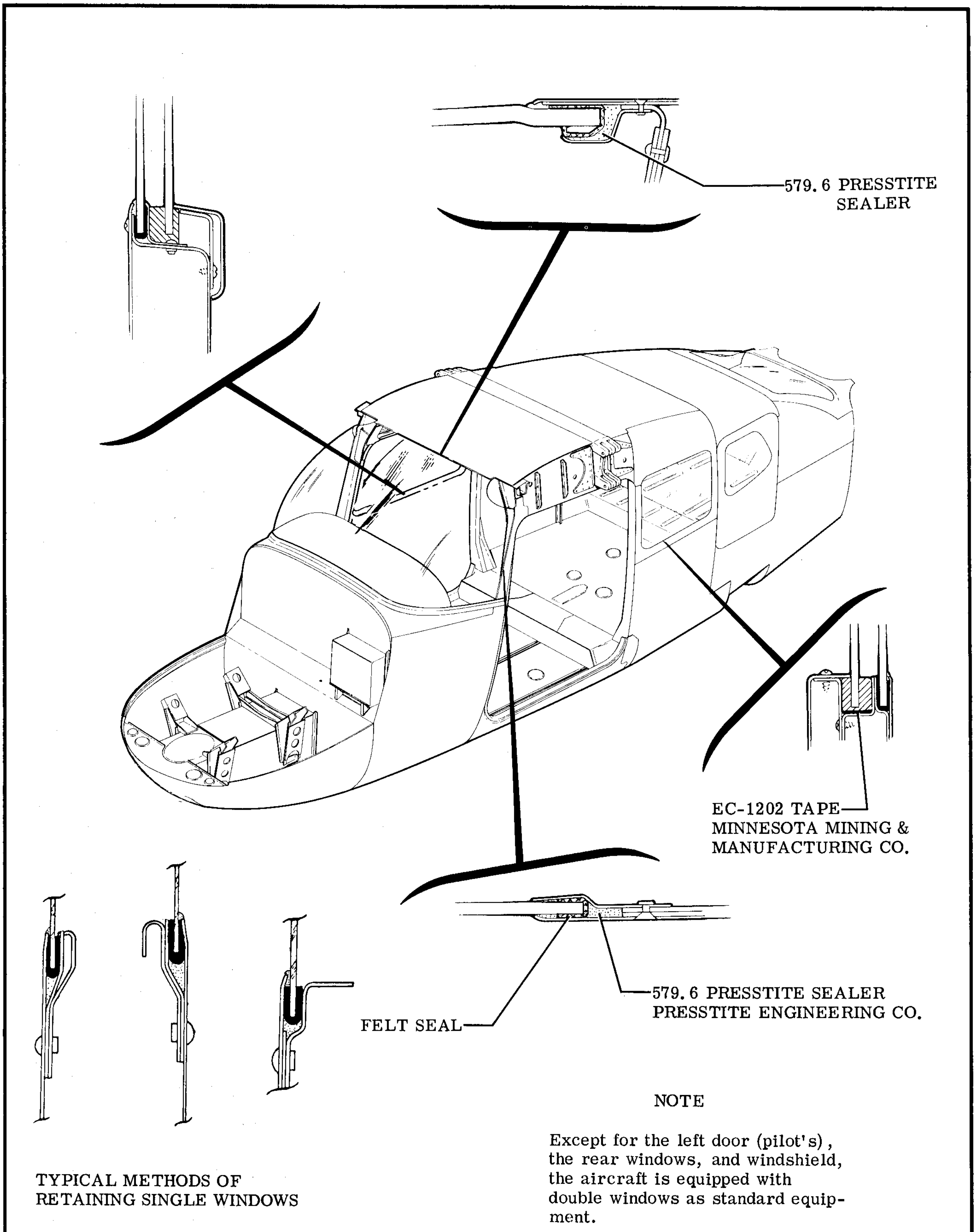
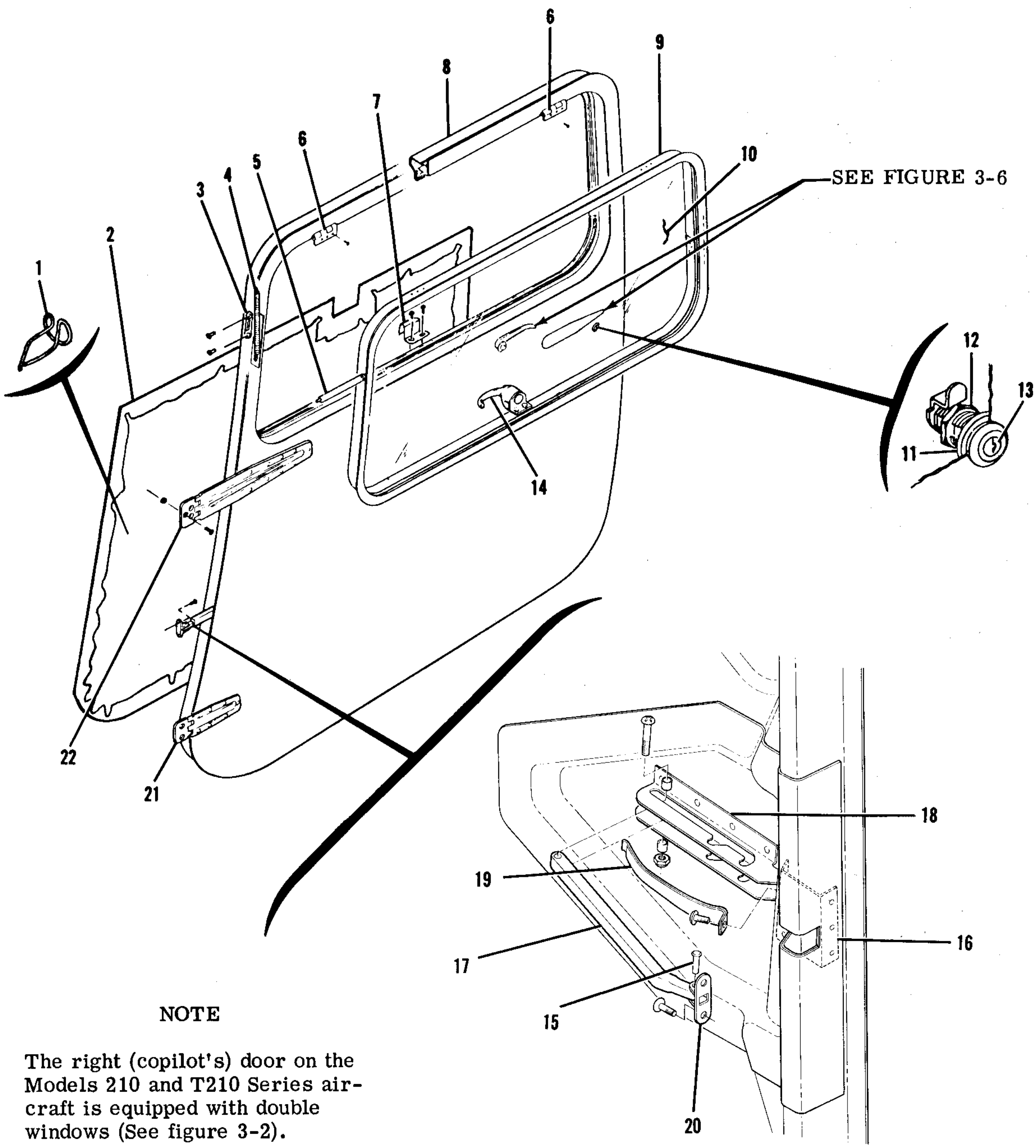


Figure 3-2. Cabin Window Retainers and Seals

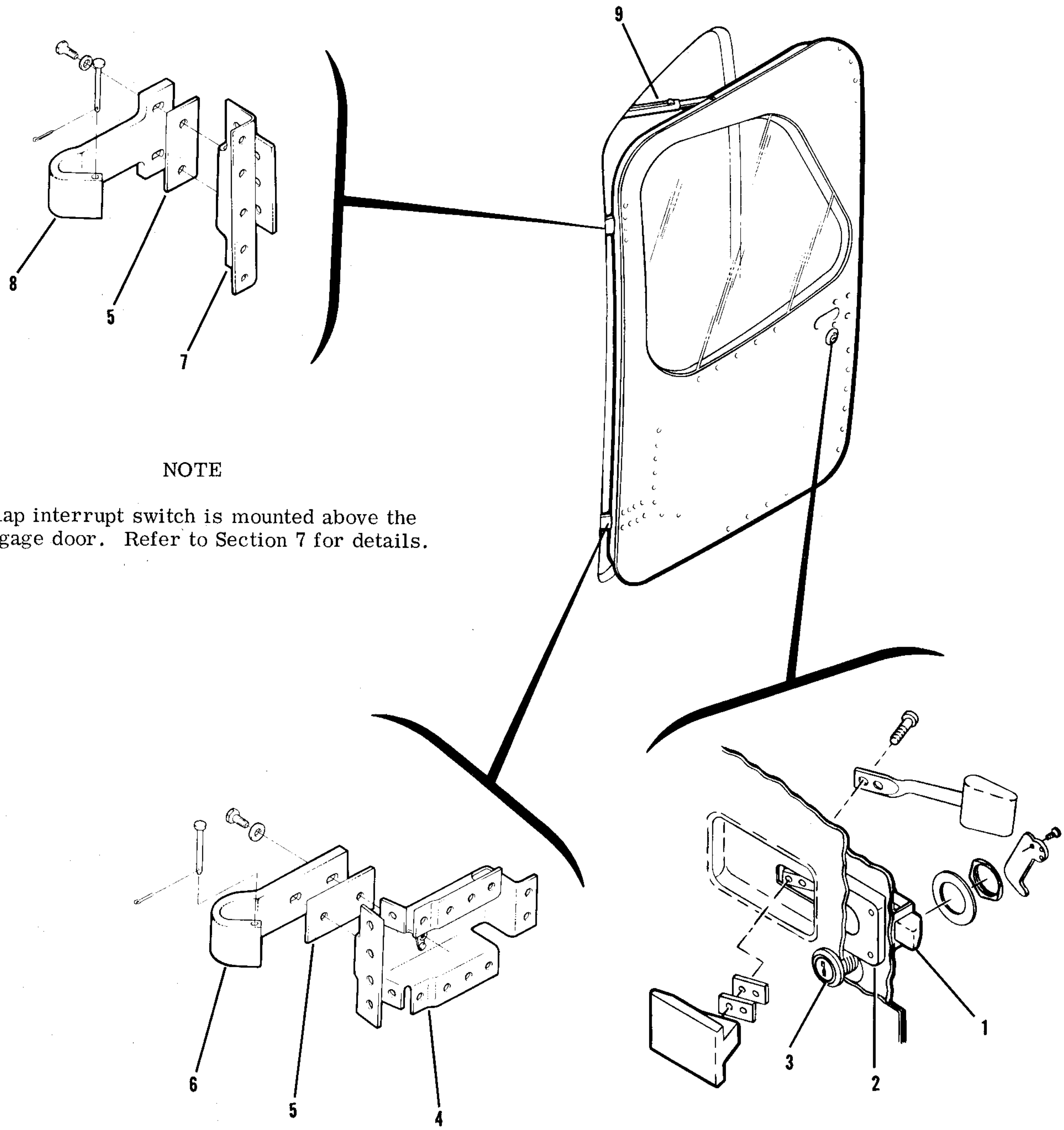


NOTE

The right (copilot's) door on the Models 210 and T210 Series aircraft is equipped with double windows (See figure 3-2).

1. Upholstery Clip
2. Upholstery Panel
3. Wedge
4. Spring
5. Window Stop
6. Window Hinge
7. Latch Plate
8. Cabin Door
9. Window Frame
10. Window
11. Washer
12. Nut
13. Lock Assembly
14. Latch Handle
15. Pin or Rivet
16. Reinforcement
17. Door Stop Arm
18. Stop Assembly
19. Spring-Loaded Plunger
20. Hinge
21. Lower Hinge
22. Upper Hinge

Figure 3-3. Cabin Door



NOTE

A flap interrupt switch is mounted above the baggage door. Refer to Section 7 for details.

1. Latch
2. Spacer
3. Lock
4. Lower Hinge Base
5. Shim
6. Lower Hinge Arm
7. Upper Hinge Base
8. Upper Hinge Arm
9. Swing Stop

Figure 3-4. Baggage Door Installation

3-23. SEATS. (See figures 3-6 thru 3-8.)

3-24. INDIVIDUAL SEATS. Individual seats are equipped with manually operated reclining seat backs. Rollers permit the seats to slide fore-and-aft on seat rails, and pins which engage various holes in seat rails lock seats in the selected positions. Seat stops limit travel. Removal is accomplished by removing the seat stops, and sliding the seats forward and aft to disengage them from the seat rails. Be sure to replace seat stops after installing a seat.

WARNING

It is extremely important that the pilot's seat stops are installed, since acceleration and deceleration could possibly permit the seat to become disengaged from the seat rails and create a hazardous situation, especially during take-off and landing.

3-25. TWO-PLACE SEATS. Deluxe rear seat bottoms are combined into a single bench type that is upholstered into a twin "bucket" effect. Individual reclining seat backs are also the narrow, structurally contoured type. The backs are higher than the front seat backs, and are equipped with fold-away head rest pads. The seat may be adjusted fore and aft by means of two individual handles located at each forward corner of the seat. The child's seat installation is not available with the deluxe interior. Removal is accomplished by removing the bolts which secure the seat bottom to the fuselage. Use care not to damage upholstery when removing seats. If desired, seat backs may first be removed from seat bottoms. Additional clearance may be obtained by removing one or more arm rests.

NOTE

To help prevent upholstery damage, several thicknesses of waxed heavy paper (waxed is preferred) should be inserted between the seat and the side panel and arm rest during removal and installation of the seat.

3-26. CHILD'S SEAT. (See figure 3-8.) An individual child's seat is located immediately aft of each rear passenger's seat. The seat backs fold into the cushion wells when not in use, to increase the baggage area.

3-27. REPAIR OF SEAT STRUCTURE. Replacement of defective parts is recommended in repair of seats. However, a cracked seat framework may be welded, provided the crack is not in an area of stress concentration (close to a hinge or bearing point). The square-tube aluminum framework is 6061 aluminum, heat-treated to a T-6 condition. Use a heliarc weld on these seats, as torch welds will destroy the heat-treatment of the frame structure. Figure 3-9 gives instructions for replacing defective cams on reclining seat backs.

3-28. CABIN UPHOLSTERY.

3-29. Due to the wide selection of fabrics, styles and colors, it is impossible to depict each particular type of upholstery. The following paragraphs describe general procedures which will serve as a guide in removal and replacement of upholstery. Major work, if possible, should be done by an experienced trim mechanic. If the work must be done by a mechanic unfamiliar with upholstery practices, the mechanic should take careful notes during the removal of each item to facilitate its replacement later.

3-30. UPHOLSTERY MATERIALS AND TOOLS will vary with the job. Scissors for trimming upholstery to size and a dull-bladed putty knife for wedging the material beneath the retainer strips are the only tools required for most trim work. Use industrial rubber cement to hold soundproofing mats and fabric edges in place. Refer to Section 18 for thermo-formed plastic repairs.

3-31. SOUNDPROOFING. The aircraft is insulated with spun glass mat-type insulation and a sound deadener compound applied to the inner surfaces of the skin in most areas of the cabin and baggage compartment. Some aircraft utilize aluminum foil-backed tape to help reduce noise level in the cabin. All soundproofing material should be replaced in its original position any time it is removed. A soundproofing panel is placed in the gap between the wing and fuselage and held in place by the wing root fairing. Cabin and baggage compartment upholstery and carpeting also assist in reducing noise level.

3-32. CABIN HEADLINER REMOVAL.

a. Remove sun visors, all inside finish strips and plates, door post upper shields, front spar trim shield, dome light panel, rear baggage shelf and any other visible retainers securing the headliner.

b. Work edges of headliner free from metal tabs which hold the fabric.

c. Starting at the front of the headliner, work the headliner down, removing screws through metal tabs which hold the wire bows to the cabin top. Pry loose the outer ends of the bows from the retainers above the doors. Detach each wire bow in succession.

NOTE

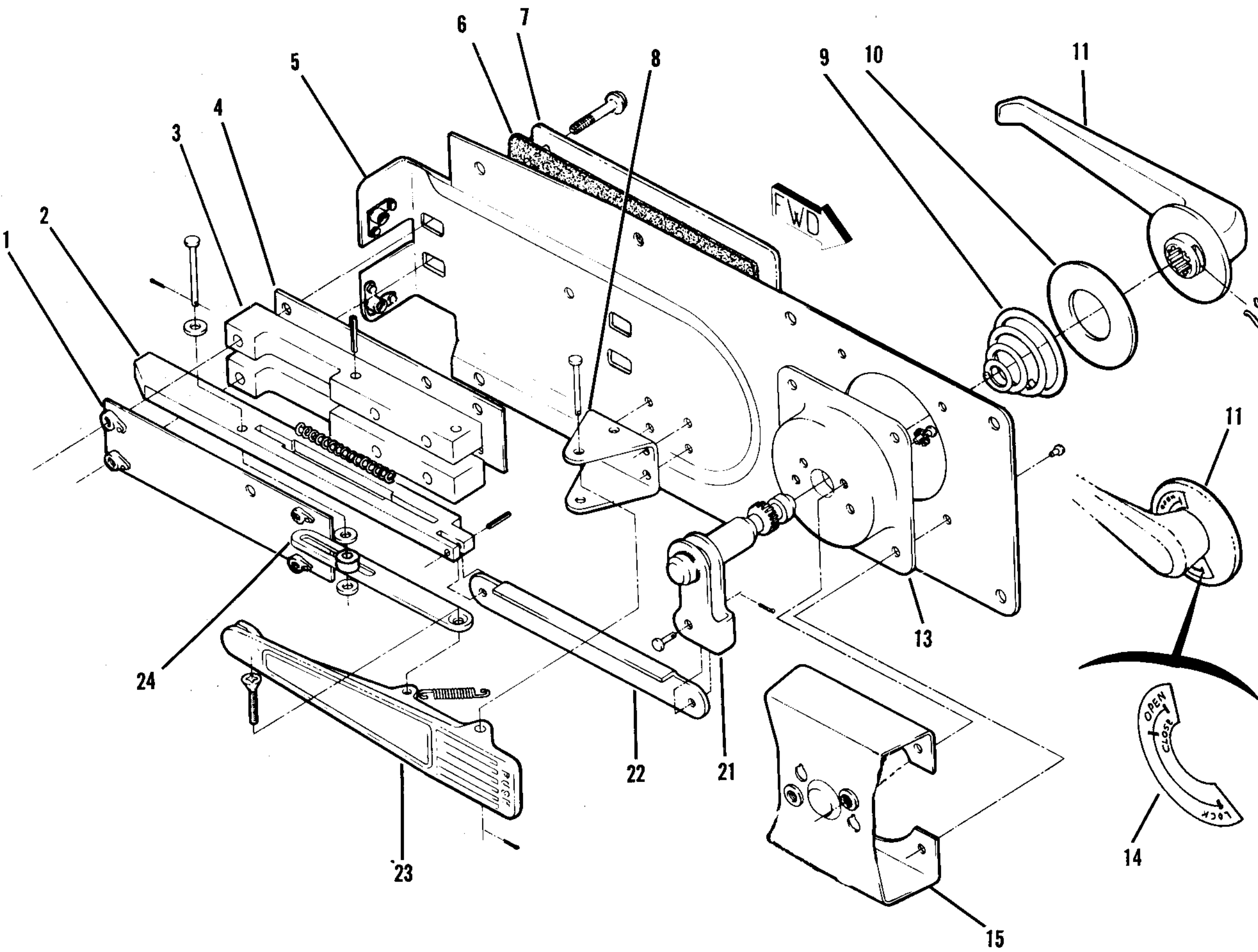
Always work towards the wing spar in center of cabin top when removing the headliner. It is impossible to detach wire bows when working away from the wing spar.

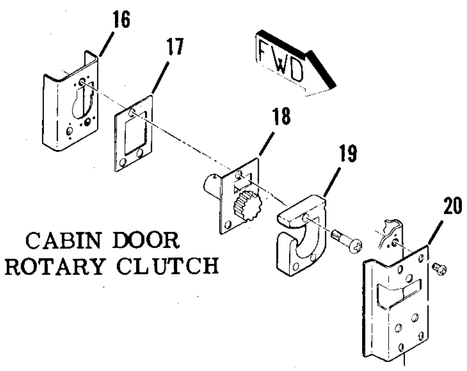
d. Remove the headliner assembly and bows from the aircraft.

NOTE

Due to the difference in length and contour of the wire bows, each bow should be tagged to assure proper location in the headliner.

e. Remove the spun glass soundproofing panels.





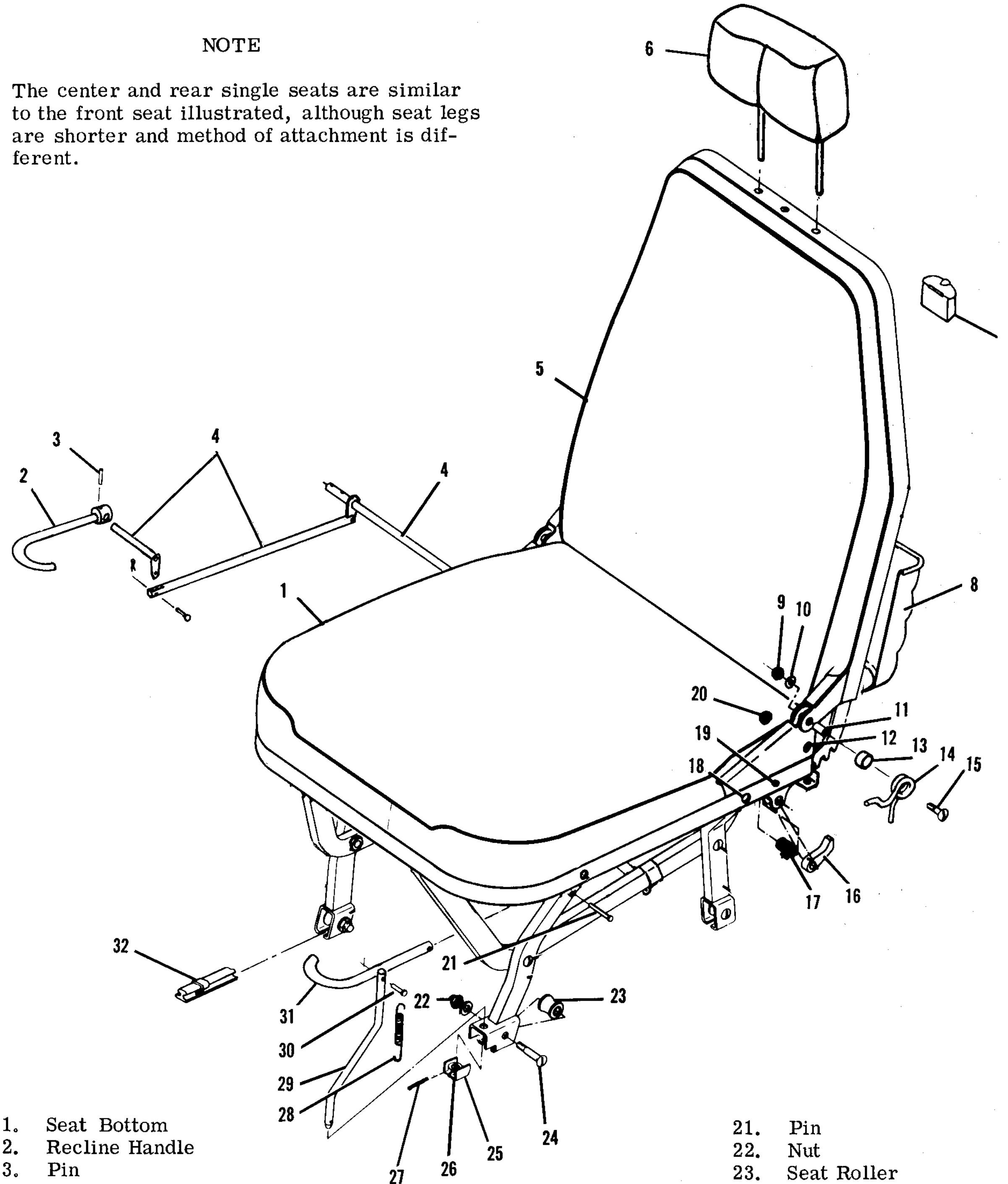
1.	Top Plate	13.	Guide
2.	Bolt	14.	Placard
3.	Side Plate	15.	Support
4.	Base Plate	16.	Bracket
5.	Plate	17.	Shim
6.	Abrasive Pad	18.	Clutch
7.	Lockplate	19.	Guide
8.	Bracket	20.	Cover
9.	Spring	21.	Push-Pull Shaft
10.	Nylon Escutcheon	22.	Push-Pull Bar
11.	Inside Handle	23.	Outside Handle
12.	Clip	24.	Pull Bar

Handle (11) is marked with OPEN, CLOSE and LOCK positions. The handle must be installed relative to position of bolt (2), which is spring-loaded to the CLOSE position. Temporarily install handle and move back and forth until spring-loaded position is noted. Remove handle, re-position with CLOSE mark at index mark on door (handle approximately vertical), and install. Bolt must clear doorpost, but teeth must engage when door is closed with handle at CLOSE position.

Figure 3-5. Door Latch and Rotary Clutch Components.

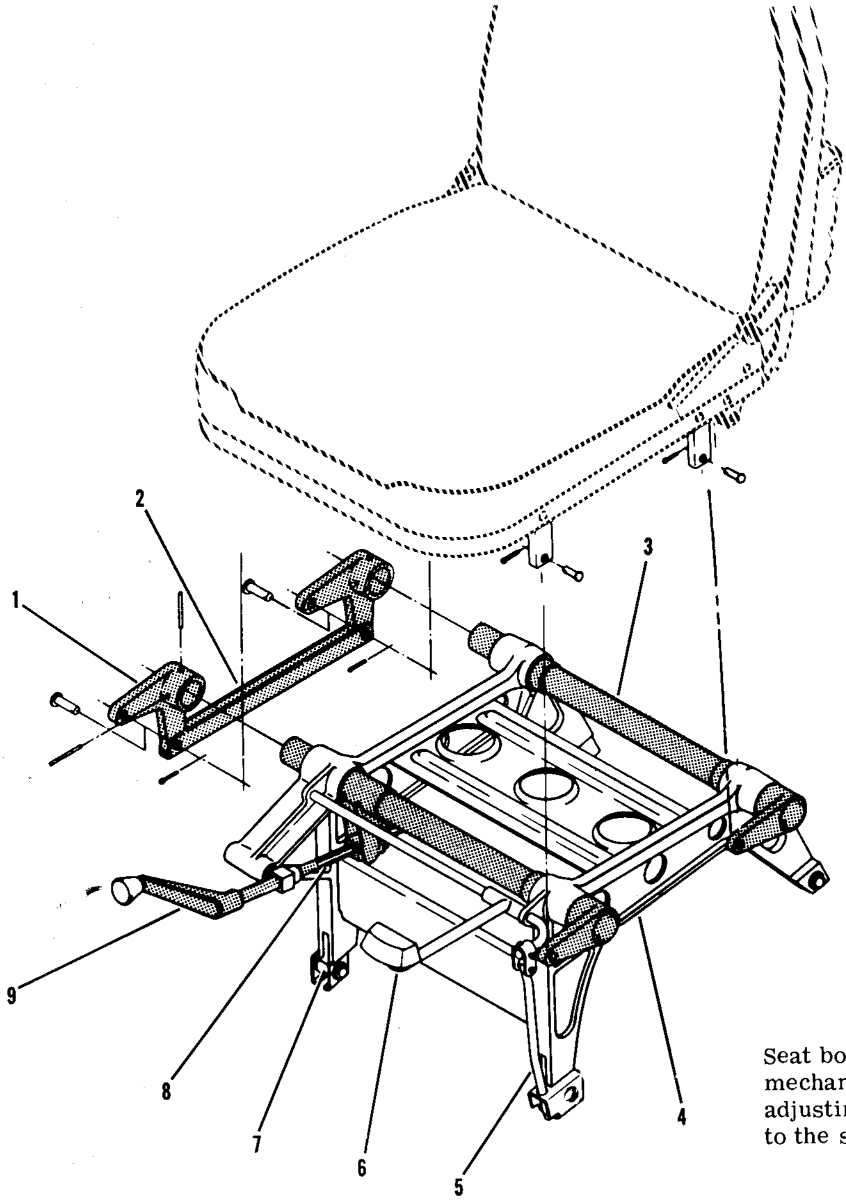
NOTE

The center and rear single seats are similar to the front seat illustrated, although seat legs are shorter and method of attachment is different.



1. Seat Bottom
2. Recline Handle
3. Pin
4. Shaft
5. Seat Back
6. Headrest
7. Ash Tray
8. Magazine Pocket
9. Nut
10. Washer
11. Bushing
12. Screw
13. Bushing
14. Spring
15. Screw
16. Seat Adjustment Pawl
17. Spring
18. Bolt
19. Bolt
20. Nut
21. Pin
22. Nut
23. Seat Roller
24. Bolt
25. Bracket
26. Washer
27. Pin
28. Adjustment Spring
29. Adjustment Pin
30. Pin
31. Fore/Aft Adjust Handle
32. Seat Stop

Figure 3-6. Standard Seat Installation



NOTE

Seat bottom, seat back, reclining mechanism, and fore-and-aft adjusting mechanism is similar to the standard seat.

1. Bellcrank
2. Channel
3. Torque Tube
4. Seat Structure
5. Pin
6. Fore-and-Aft Adjustment Handle
7. Seat Roller
8. Adjustment Screw
9. Vertical Adjustment Handle

Figure 3-7. Vertically Adjustable Seat Mechanism

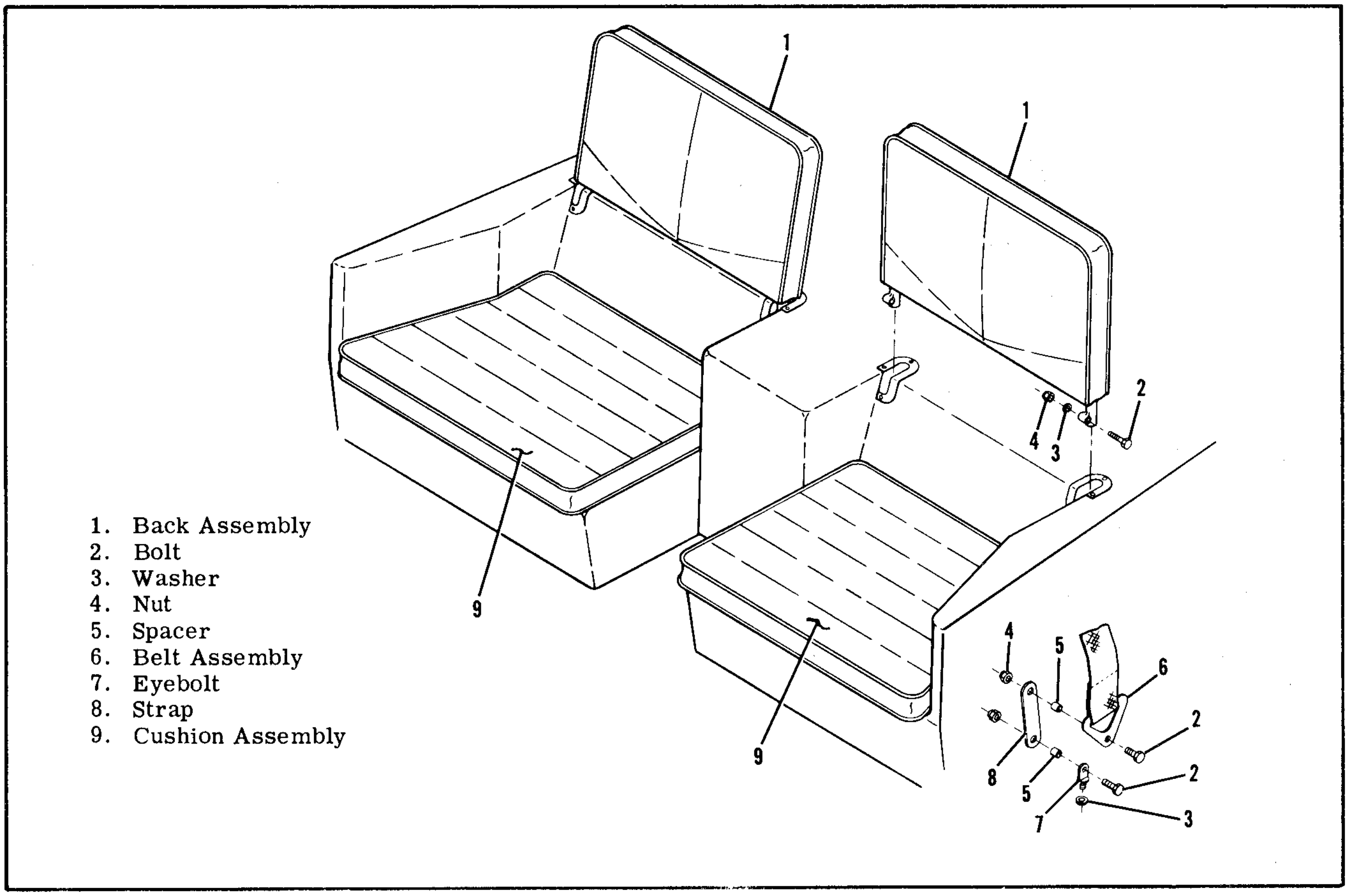


Figure 3-8. Child's Seat

NOTE

The lightweight soundproofing panels are held in place with industrial rubber cement.

3-33. CABIN HEADLINER INSTALLATION.

a. Before installing headliner, check all items concealed by the headliner to see that they are mounted securely. Use wide cloth tape to secure loose wires to the fuselage, and to seal any openings in the wing roots. Straighten any tabs bent during removal of the headliner.

b. Apply cement to inside of skin in areas where soundproofing panels are not supported by wire bows, and press soundproofing in place.

c. Insert wire bows into headliner seams, and secure headliner on each side of wing spar. Stretch the material along the edges to make sure it is properly centered, but do not stretch it tight enough to destroy the ceiling contours or distort the wire bows. Secure the edges of the headliner with sharp tabs or, when necessary, rubber cement.

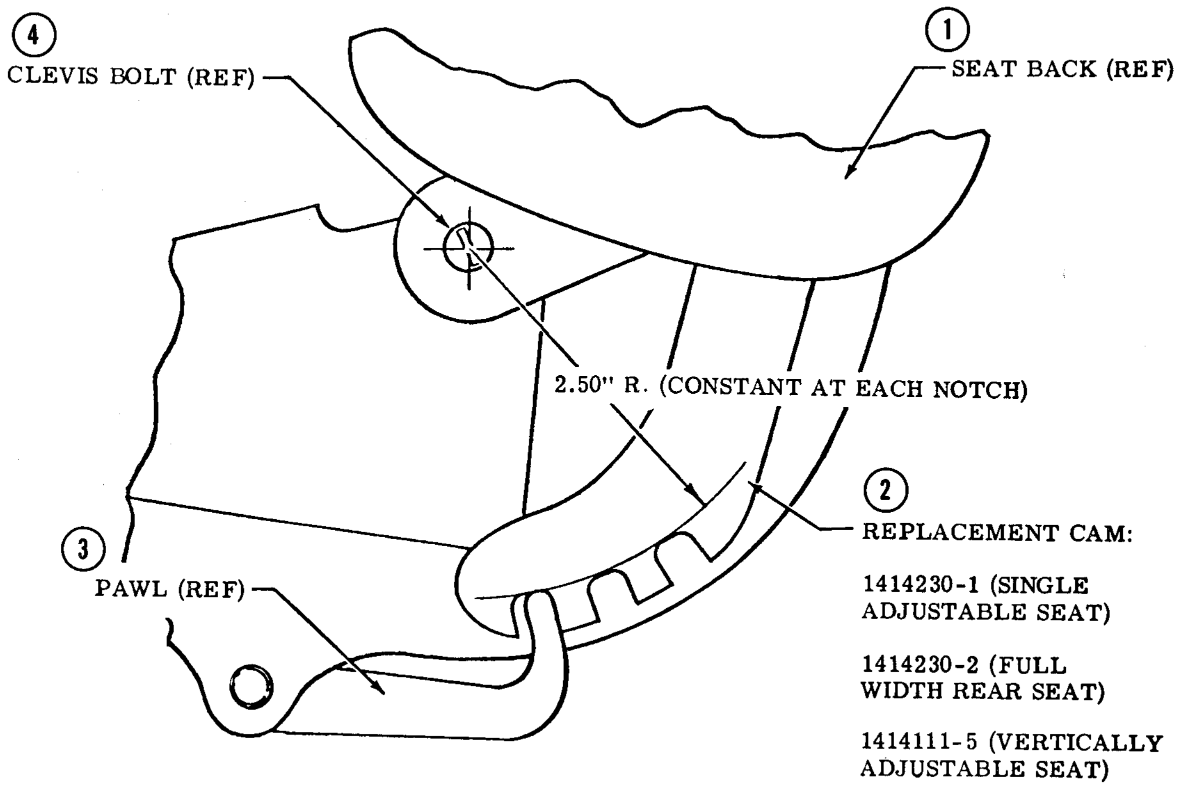
d. Work the headliner away from wing spar, installing each wire bow in place with the tabs. Wedge the ends of wire bows into the retainer strips. Stretch the headliner just taut enough to avoid wrinkles and maintain a smooth contour.

e. When all bows are in place and fabric edges are secured, trim off any excess fabric and reinstall all items removed.

3-34. UPHOLSTERY SIDE PANELS. Removal of upholstery side panels is accomplished by removing seats for access, then removing parts attaching the panels. Remove screws, retaining strips, and ash trays as required to free the various panels. Automotive type spring clips attach most door panels. A dull putty knife makes an excellent tool for prying loose the clips. When installing upholstery side panels, do not over-tighten sheet metal screws. Larger screws may be used in enlarged holes as long as the area behind the hole is checked for electrical wiring, fuel lines, and other components which might be damaged by using a longer screw.

3-35. WINDLACE (DOOR SEAL) is installed to provide additional sealing and provide an ornamental edging for the door opening. The windlace is held in position by sheet metal screws and is mounted between the upholstery panels or trim and the doorpost structure.

3-36. CARPETING. Cabin area and baggage compartment carpeting is held in place by rubber cement, small sheet metal screws, and retaining strips. When fitting a new carpet, use the old one as a pattern for trimming and marking the screw holes.



REPLACEMENT PROCEDURE:

a. Remove seat from aircraft.

b. Remove plastic upholstery panels from aft side of seat back, then loosen upholstery retaining rings and upholstery material as required to expose the rivets retaining the old cam assembly.

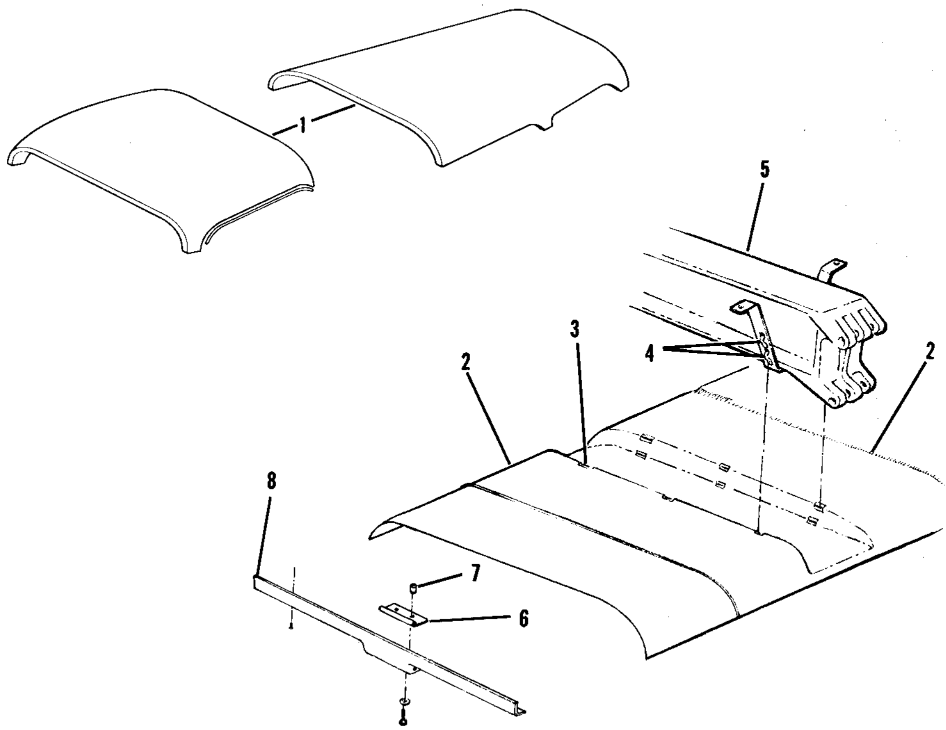
c. Drill out existing rivets and insert new cam assembly (2). Position seat back so that pawl (3) engages first cam slot as shown.

d. Position the cam so each slot bottom aligns with the 2.50" radius as shown.

e. Clamp securely in this position and check travel of cam. Pawl must contact bottom of each cam slot. Using existing holes in seat frame, drill through new cam and secure with MS20470AD6 rivets.

f. Reinstall upholstery, upholstery panels and seat.

Figure 3-9. Seat Back Cam Replacement



1. Soundproofing
2. Zipper
3. Tube
4. Tab
5. Wing Main Spar
6. Clamp
7. Spacer
8. Trim Shield

Figure 3-10. Cabin Headliner

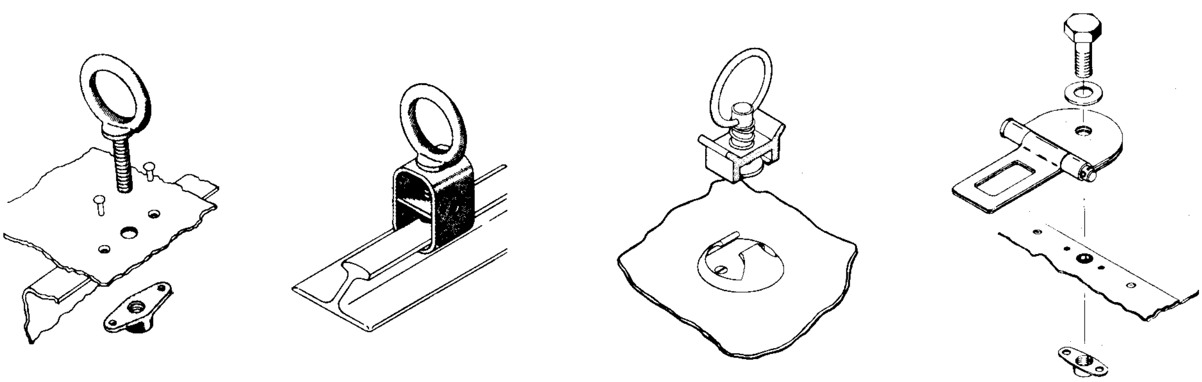


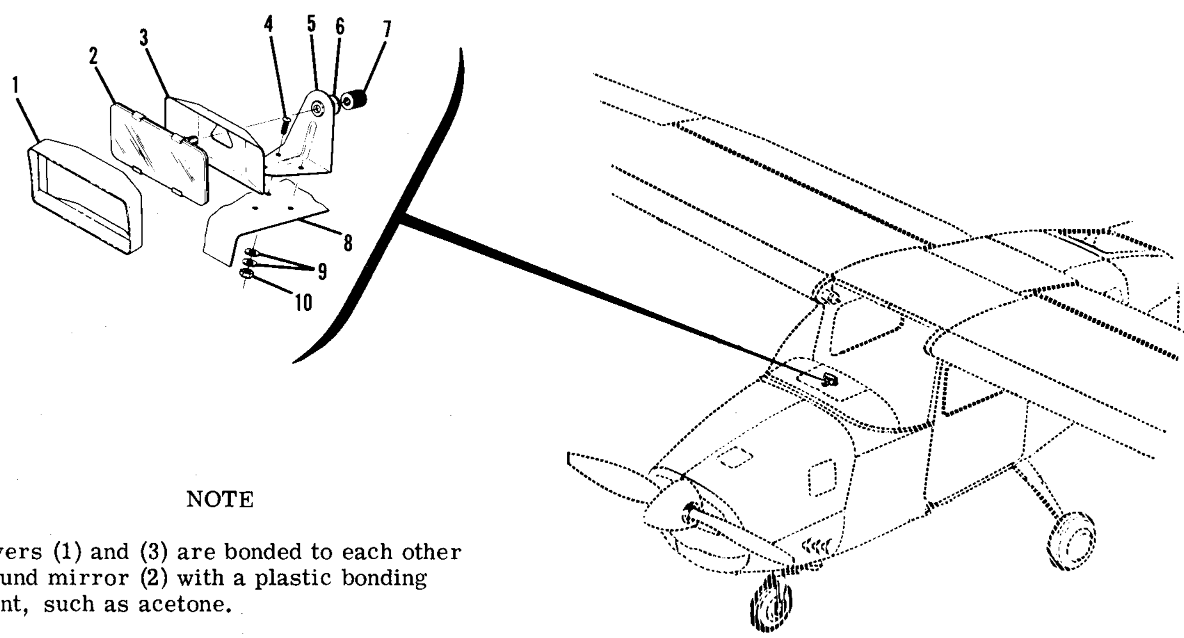
Figure 3-11. Cargo Tie-Down Rings

3-37. BAGGAGE COMPARTMENT UPHOLSTERY is cemented to the floor along the edges. Cargo tie-down and/or safety belt brackets may be removed as necessary where they are installed through the floor covering.

3-38. CARGO TIE-DOWN PROVISIONS. Four types of cargo tie-downs may be installed as shown in figure 3-11. Different combinations of all four may also be used. Small eyebolts are provided to attach a baggage net. The rearmost seats on some aircraft have plates bolted to the cabin floor that secure the rear legs. If the seats are removed, an anchor ring may be attached to the plate for cargo tie-down.

3-39. GLIDER TOW-HOOK. A glider tow-hook, which is mounted in place of the tail tie-down ring, is available for all models.

3-40. REAR VIEW MIRROR. An optional rear view mirror may be installed on the cowl deck above the instrument panel. Figure 3-12 shows details of the rear view mirror installation.



NOTE

Covers (1) and (3) are bonded to each other around mirror (2) with a plastic bonding agent, such as acetone.

1. Cover
2. Mirror
3. Cover
4. Screw
5. Bracket
6. Washer
7. Knurled Nut
8. Cowl Deck
9. Washer
10. Nut

Figure 3-12. Rear View Mirror Installation

WINGS AND EMPENNAGE

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4-1. WINGS AND EMPENNAGE.

4-2. WINGS. (See figure 4-1.)

4-3. Each wing is of all-metal construction with a single main spar, two fuel spars, formed ribs, and stringers. The front fuel spar also acts as an auxiliary spar and provides the forward attachment point for the wing. An inboard section of the wing, forward of the main spar is sealed to form an integral fuel tank area. Stressed skin is riveted to the spars, ribs, and stringers to complete the structure. An all-metal balanced aileron, a high lift flap, and a detachable wing tip are part of each wing assembly. A navigation light is mounted in each contoured wing tip.

4-4. REMOVAL. Removal of a wing is accomplished most easily if four men are available to handle the wing. Otherwise the wing should be supported with a sling or maintenance stand when the fasteners are loosened.

a. Remove wing gap fairings and fillets.
b. Drain fuel from wing being removed.
c. Disconnect:
   1. Electrical wires at wing root disconnects.
   2. Fuel lines at wing root.
   3. Pitot line (left wing only) at wing root.
   4. Cabin ventilator hoses at wing root.
   5. Aileron carry-thru cable and aileron direct cables of wing being removed, at turnbuckles behind headliner front shield and doorpost shield.

NOTE

To ease rerouting the cables, a guide wire may be attached to each cable before it is pulled free of the wing. Then disconnect cable from wire and leave the guide wire routed through the wing; it may be attached again to the cable during reinstallation and used to pull the cable into place.

d. If right wing is being removed, disconnect flap cables from right flap drive pulley, and remove cable guards and/or pulleys as required to pull flap cables into right wing root area.
e. If left wing is being removed, relieve tension on right flap cables at right flap drive pulley. Disconnect right flap cables at flap actuator in left wing and remove pulleys to pull flap cables into left wing root area.

NOTE

Rigging of flap actuator and components in left wing need not be disturbed to remove either wing. It is recommended that flap be secured in streamline position with tape during wing removal to prevent damage, since flap will swing freely.

f. Remove nut, washer, and bolt attaching front fuel spar to fuselage.
g. Remove bolts and washers that hold main spar dowel pins in position.
h. Support wing at inboard and outboard end, and remove dowel pins that attach main wing spar to fuselage. It is best to remove the top dowel pin first, then lower outboard end of wing before removing the bottom dowel pin.

NOTE

It may be necessary to use a long punch to drive out main wing spar attaching dowel pins, or to rock the wing slightly while removing the pins. Care must be used not to damage dowel pins, spar fittings, or spar carry-thru fittings as these are reamed holes and close tolerance dowel pins.

i. Remove wing and lay on padded stand.

4-5. REPAIR of a damaged wing panel may be accomplished in accordance with instructions given in Section 18. Extensive repairs of wing skin or structure are best accomplished by using the wing repair jig, which may be obtained from Cessna. The jig serves not only as a holding fixture, making work on the wing easier, but also assures absolute alignment of the repaired wing.

4-6. INSTALLATION.

NOTE

Refer to figure 4-1 for lubrication of dowel pins prior to installation.

a. Hold wing in position with wing tip low.
b. Install:
   1. Dowel pins attaching main spar to fuselage. (Install the bottom pin first then rotate wing up and install top pin.)
   2. Bolts, washers, and nuts that hold main spar attach dowel pins in position.
   3. Front fuel spar attach bolt, washer, and nut.
c. Route flap and aileron cables and make proper connections.
d. Connect:
   1. Electrical wires at wing root disconnects.
   2. Fuel lines at wing root.
   3. Pitot line (if left wing is being installed).
   4. Cabin ventilator hoses at wing root.
e. Rig aileron system (Section 6).
f. Rig flap system (Section 7).
g. Refuel wing tank and check all connections for leaks.
h. Check operation of navigation, courtesy, and landing lights.
i. Check operation of fuel gage.
j. Install wing gap fairings and fillets.

NOTE

Be sure to install soundproofing panel in wing gap before replacing fairings.

k. Install all inspection plates, interior panels, and upholstery.
l. Test operation of flap and aileron systems.

4-7. ADJUSTMENT (CORRECTING "WING-HEAVY" CONDITION). If considerable control wheel pressure is required to keep the wings level in normal flight, a wing-heavy condition exists. Refer to Section 6 for adjustment of aileron tabs.

4-8. FIN. (See figure 4-2.)

4-9. The fin is primarily of metal construction, consisting of ribs and spars covered with skin. Fin tips are of glass fiber construction. Hinge brackets at the rear spar attach the rudder.

4-10. REMOVAL. The fin may be removed without first removing the rudder. However, for access and ease of handling, the rudder may be removed if desired, following the procedures outlined in Section 10.
a. Remove fairings on both sides of fin.
b. Disconnect flashing beacon lead, tail navigation light lead, antennas and antenna leads, and rudder cables if rudder has not been removed.
c. Remove screws attaching dorsal fin to fuselage.
d. Remove bolts attaching fin front and rear spars to fuselage.
e. Remove the fin.

4-11. REPAIR of the fin should be accomplished in accordance with applicable instructions in Section 18.

4-12. INSTALLATION of the fin may be accomplished by reversing the procedure in paragraph 4-10. Be sure to check and reset rudder and elevator travel if any stop bolts were removed or settings disturbed.

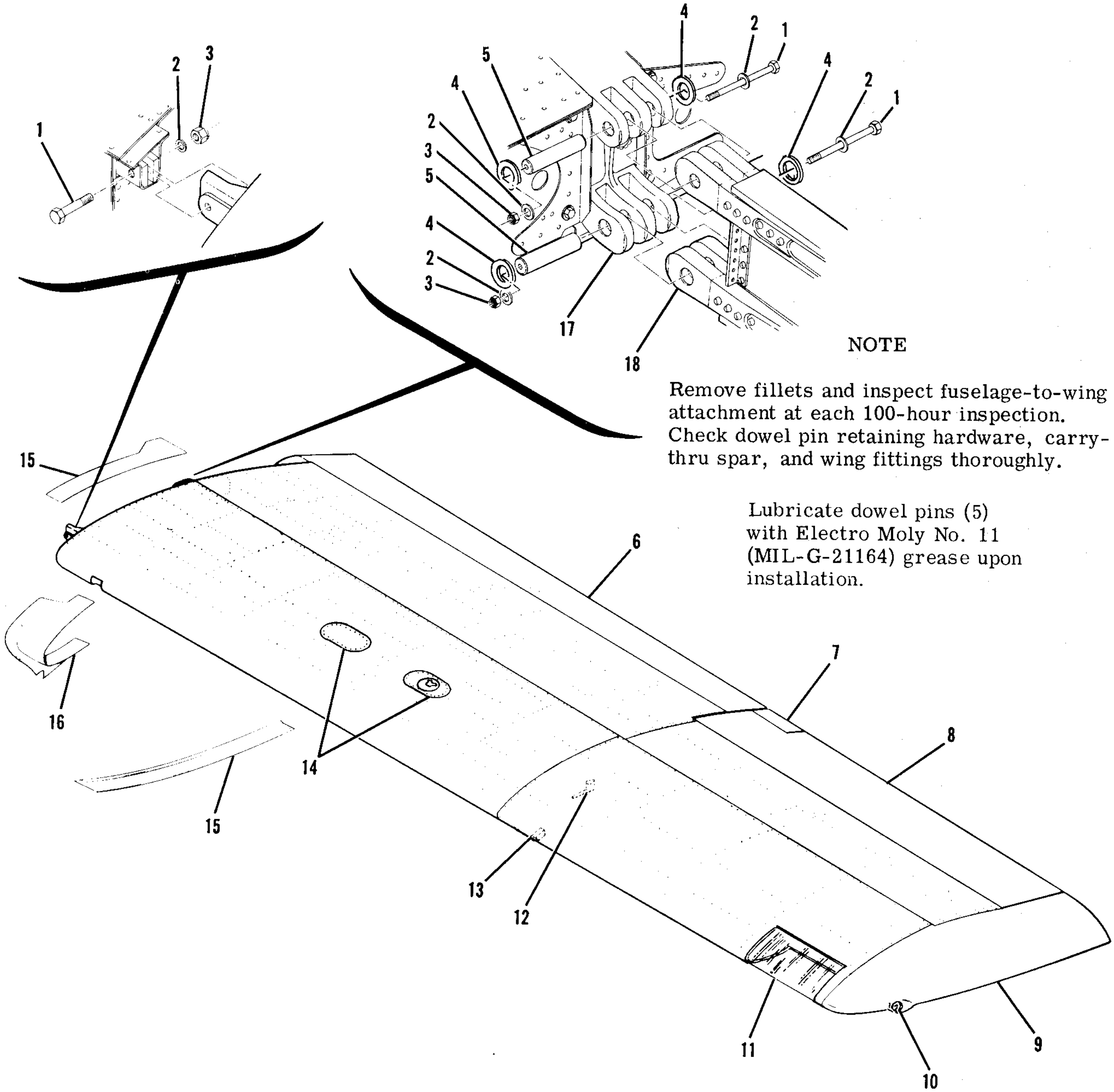
4-13. HORIZONTAL STABILIZER. (See figure 4-3.)

4-14. The horizontal stabilizer is primarily of metal construction, consisting of ribs and a front and rear spar which extend throughout the full span of the stabilizer. The skin is riveted to both spars and ribs. Stabilizer tips are of thermo-formed plastic construction. The elevator tab actuator screw is contained within the horizontal stabilizer assembly, and is supported by a bracket riveted to the rear spar. The underside of the stabilizer contains an opening which provides access to the elevator tab actuator screw. Hinges on the rear spar support the elevator.

4-15. REMOVAL.
a. Remove elevators and rudder in accordance with procedures outlined in Sections 8 and 10.
b. Remove vertical fin in accordance with procedures outlined in paragraph 4-10.
c. Disconnect elevator trim control cables at clevis and turnbuckle inside tailcone, remove pulleys which route the aft cables into horizontal stabilizer, and pull cables out of tailcone.
d. Remove bolts securing horizontal stabilizer to fuselage.
e. Remove horizontal stabilizer.

4-16. REPAIR of the horizontal stabilizer should be accomplished in accordance with applicable instructions in Section 18.

4-17. INSTALLATION.
a. Install the horizontal stabilizer by reversing the procedures outlined in paragraph 4-15, rigging the control systems as necessary. Check operation of tail navigation light and flashing beacon.



NOTE

Remove fillets and inspect fuselage-to-wing attachment at each 100-hour inspection. Check dowel pin retaining hardware, carry-thru spar, and wing fittings thoroughly.

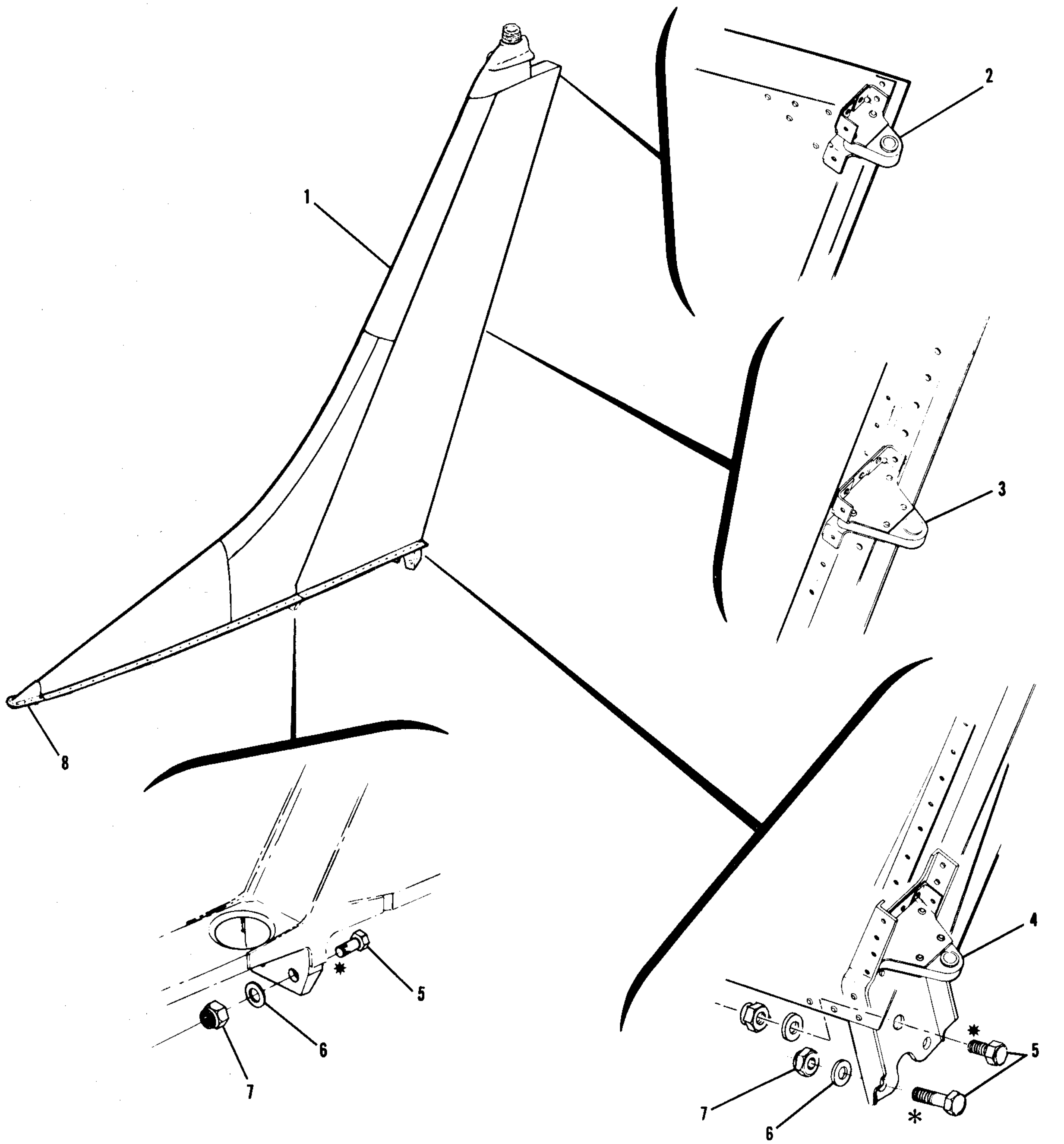
Lubricate dowel pins (5) with Electro Moly No. 11 (MIL-G-21164) grease upon installation.

NOTE

If there is damage to bushings in fittings (17) or (18), notify factory before anticipating replacement, as these are critical areas.

1. Bolt
2. Washer
3. Nut
4. Washer
5. Dowel Pin
6. Flap
7. Trim Tab
8. Aileron
9. Tip Assembly
10. Navigation Light
11. Landing and Taxi Lights
12. Pitot Tube
13. Stall Warning Unit
14. Access Plate
15. Fillet
16. Fairing
17. Fuselage Fitting
18. Wing Fitting

Figure 4-1. Wing

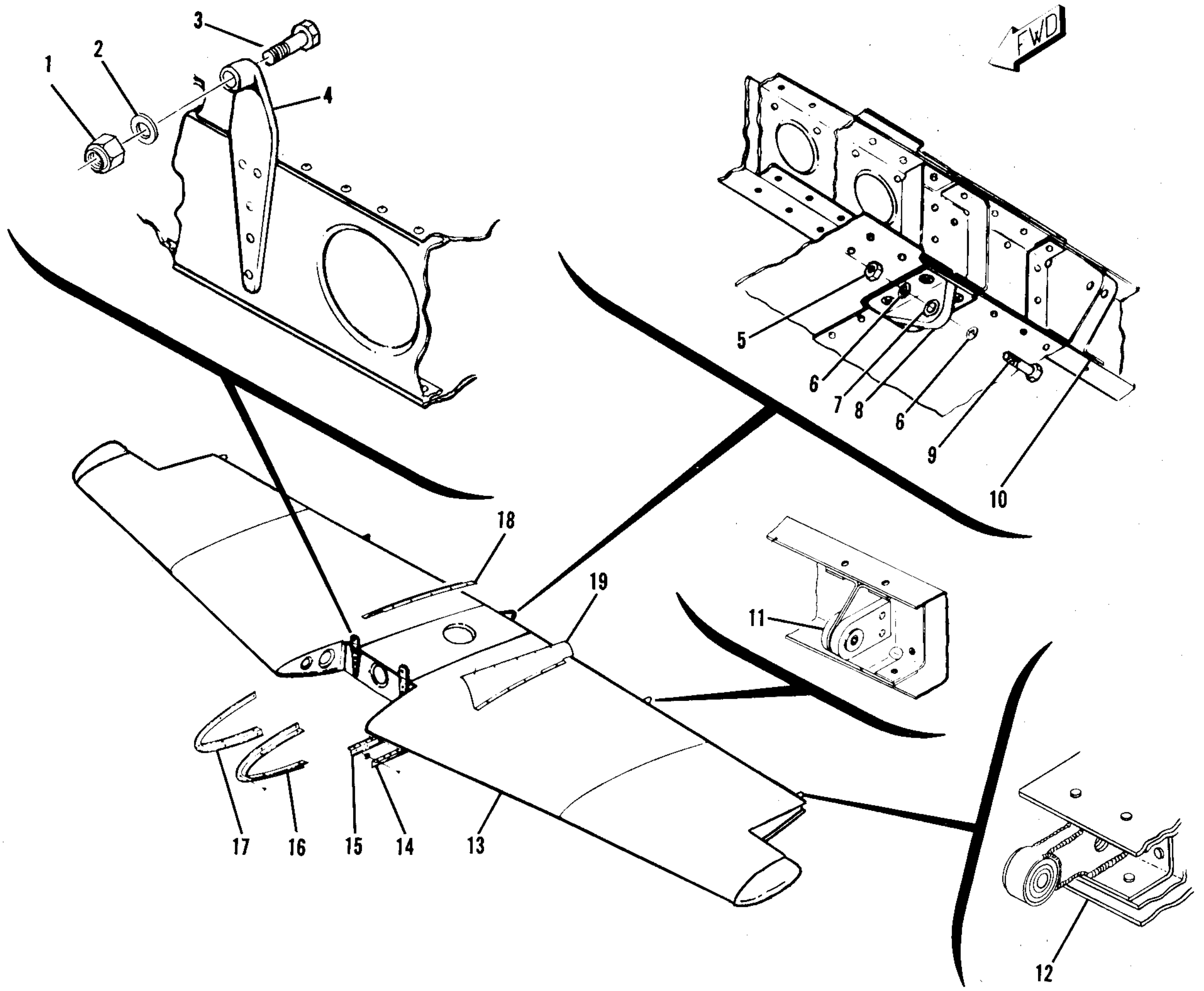


1. Fin Assembly
2. Upper Rudder Hinge
3. Center Rudder Hinge
4. Lower Rudder Hinge

✱ TORQUE AN5 BOLTS TO 140-225 LB IN.
* TORQUE AN6 BOLTS TO 190-390 LB IN.

5. Bolt
6. Washer
7. Nut
8. Fairing

Figure 4-2. Vertical Fin



1. Nut
2. Washer
3. Bolt
4. Bracket
5. Nut
6. Washer
7. Bushing
8. Bracket
9. Bolt
10. Elevator Pylon Bracket
11. Elevator Inboard Hinge
12. Elevator Outboard Hinge
13. Stabilizer Assembly
14. Lower Left Fairing
15. Lower Right Fairing
16. Forward Left Fairing
17. Forward Right Fairing
18. Upper Right Fairing
19. Upper Left Fairing

Figure 4-3. Horizontal Stabilizer

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SECTION 5

LANDING GEAR, BRAKES, AND HYDRAULIC SYSTEM

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It is sometimes necessary to open or close the landing gear door while the aircraft is on the ground with the engine stopped. Operate the doors with the landing gear handle in the "down" or "down-neutral" position. To open the doors, turn off the master switch and operate hand pump until doors open. To close the doors, turn the master switch on and operate the hand pump.

NOTE

Position of the master switch for gear door operation is easily remembered by the following rule: OPEN circuit = OPEN doors; CLOSED circuit = CLOSED doors.

5-1. LANDING GEAR RETRACTION SYSTEM.

5-2. OPERATION DESCRIPTION. Refer to the hydraulic schematic diagrams to trace the flow of hydraulic fluid as outlined in the following steps.

a. Fluid from the hydraulic pump enters the Power Pack where a passage connect to the primary relief valve. With the landing gear control lever in neutral, hydraulic fluid circulates back through the pump (unloaded).

b. When the landing gear control lever is moved out of neutral, fluid flows through a check valve to the solenoid-operated door control valve and to the gear priority valve.

c. Fluid flows through the door control valve (which is in the door-open position when the control lever is moved out of neutral) and opens the doors. The gear prority valve remains closed while the door system is being operated because the door system operates at less pressure than is required to open the priority valve.

d. After the doors are open, pressure builds up until the gear priority valve opens and permits fluid first to unlock, then to move the landing gear to either the up or down position, depending on the position selected by the landing gear control lever.

e. During the up-cycle of the landing gear, a metering pin in each main gear actuator causes a snubbing action in the actuator near the end of the gear-up travel.

f. After the landing gear is in full up or full down position, limit switches are actuated to cause the door control valve to move to the door-closed position, and fluid then flows through the valve to close the doors.

g. After the doors are closed, pressure builds up in the system until the 3 to 9 second time-delay valve, operated by pressure from the door-close line, opens and permits fluid to flow to the handle release valve, returning the handle to neutral.

h. As the handle returns to neutral, it moves a shaft which again permits fluid to circulate back through the pump (unloaded).

i. When extending the landing gear with the hand pump, fluid flows directly to the door control valve and the priority valve, where it first opens the doors then extends the landing gear through the same passages and lines used by the regular system. A check valve prevents fluid from entering the inlet passage from the engine-driven hydraulic pump.

j. In case of an electrical failure, the door control valve will move to the door-open position and remain in this position.

k. A valve in the Power Pack relieves any pressure from thermal expansion in the door system, to keep the doors closed while the aircraft is parked.

5-3. TROUBLE SHOOTING.

NOTE

Use the Hydro Test for trouble shooting landing gear malfunction. When the Hydro Test is employed to power the hydraulic system, landing gear operation can be slowed down to a "slow motion" during which hydraulic pressures can be noted precisely and mechanical action can be observed.

WARNING

Before performing maintenance in any of the wheel or strut wells, always disconnect the doors to avoid injury from unintentional actuation of the doors. They close rapidly and with considerable force.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE PUMP WILL NOT OPERATE GEAR BUT EMERGENCY HAND PUMP WILL OPERATE GEAR.		
Fluid level low in reservoir.	Check fluid through sight gage on reservoir.	Refill reservoir.

5-3. TROUBLE SHOOTING. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE PUMP WILL NOT OPERATE GEAR BUT EMERGENCY HAND PUMP WILL OPERATE GEAR.		
Engine pump or pump line failure.	Refer to paragraph 5-149.	Repair, replace pump or broken pump line
Faulty primary relief valve.	Refer to paragraph 5-148.	Remove Power Pack, repair or replace primary relief valve.
ENGINE PUMP OR EMERGENCY PUMP WILL NOT BUILD PRESSURE IN SYSTEM.		
No fluid in reservoir.	Check fluid level.	Refill reservoir.
Broken gear or door line.	Check visually.	Repair or replace hydraulic line.
Door solenoid valve jammed or sticking at mid travel.	Switch master switch on and off to free jammed valve by solenoid hammering; if this fails to dislodge valve spool, remove Power Pack for repair of jammed valve.	Repair solenoid valve.
DOORS WILL NOT CLOSE, GEAR INDICATOR LIGHT NOT ILLUMINATED.		
Master switch not on.	Check visually.	Turn master switch on.
Defective limit switch circuit.	Check circuit breaker, then check circuit continuity to isolate open in circuit.	Repair defective component in circuit.
DOORS WILL NOT CLOSE, GEAR INDICATED LIGHT ILLUMINATED.		
Defective handle-up-down (pre-select) switch or circuit.	Check circuit breaker, then check circuit continuity to isolate open circuit.	Repair or replace defective switch or wiring.
Defective door solenoid.	Place a steel scale against solenoid, checking for magnetic field. If magnetic field is not present, solenoid is defective.	Replace solenoid.
Door solenoid valve stuck.	Place a steel scale against solenoid checking for magnetic field. If magnetic field is present, solenoid valve is stuck.	Remove Power Pack, repair or replace solenoid valve.
GEAR OPERATES PUT DOOR WILL NOT OPEN.		
Solenoid valve jammed or stuck on door-closed position.	Turn master switch on and off to free jammed valve by solenoid hammering; if this fails to dislodge valve spool, Power Pack must be removed for repair of jammed valve.	Repair or replace solenoid valve. Repair any damage to doors or operating linkage.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
GEAR UNLOCKS BEFORE DOORS ARE FULL OPEN.		
Priority valve setting low.	Check setting using the Hydro Test. See paragraph 5-147.	Adjust valve.
Priority valve leaking or stuck open.	Check valve using the Hydro Test.	Remove Power Pack and repair or replace valve.
LANDING GEAR HANDLE WILL NOT LOCK IN UP OR DOWN DETENT.		
Handle release valve plunger setting too low or incorrect return spring adjustment.	Check using the Hydro Test.	Adjust handle release valve and return springs. See paragraph 5-19.
LANDING GEAR HANDLE RETURNS TO NEUTRAL BEFORE DOORS CLOSE.		
Fluid low in reservoir causing air in time-delay valve.	Check visually.	Fill reservoir and purge time-delay valve as outlined in paragraph 5-140.
Time-delay valve stuck or will not hold fluid charge due to faulty time-delay valve ball seat.	Bleed time-delay valve per paragraph 5-140. If not corrected, ball seat is faulty or valve is stuck open.	Remove Power Pack and repair or replace time-delay valve.
LANDING GEAR HANDLE FAILS TO RETURN TO NEUTRAL AFTER DOORS CLOSE (3 TO 9 SECONDS)		
Landing gear handle release pressure too high.	Refer to paragraph 5-146.	Adjust handle release pressure.
Landing gear handle return springs setting too low.	Handle does not return to neutral sharply after handle has tripped.	Adjust return springs.
Landing gear handle shaft binding.	Move handle up and down, feeling for binding or jerky movement.	Remove Power Pack, repair or place handle shaft. Also see Appendix A.
Landing gear selector spool binding.	See preceding isolation procedure.	Remove Power Pack and replace manifold, selector spool and time-delay valve plunger as an assembly only.
NOTE: Extremely cold temperatures will cause a longer time delay before handle trips after the doors close. This is normal. If landing gear handle does not return to neutral properly, Power Pack overheating will result.		
HAND PUMP DOES NOT BUILD UP PRESSURE, BUT ENGINE PUMP OPERATES GEAR PROPERLY.		
Faulty hand pump plunger check valve or O-ring.	Remove and inspect hand pump plunger.	Repair or replace parts as needed.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
HAND PUMP DOES NOT BUILD UP PRESSURE, BUT ENGINE PUMP OPERATES GEAR PROPERLY. (Cont)		
Faulty system inlet check valve or hand pump inlet check valve.	If plunger assembly is not defective, either the system inlet check valve or the hand pump inlet check valve is defective.	Remove Power Pack and repair or replace check valves.
LANDING GEAR OPERATION EXTREMELY SLOW.		
Reservoir fluid level low.	Check fluid level through sight gage.	Refill reservoir.
Engine-driven pump failure or internal leakage.	Refer to paragraph 5-149.	Repair or replace engine pump.
Air leakage in engine pump suction line.	Refer to paragraph 5-149.	Repair or replace suction lines or fittings.
Fluid leak in door or gear line.	Check visually for spilled fluid.	Tighten or replace lines.
Defective piston seal in door or gear cylinder.	Refer to paragraph 5-150.	Repair or replace defective parts.
Excessive internal Pack Pack leakage.	Refer to paragraph 5-150.	Remove and repair or replace Power Pack.
POWER PACK EXTERNAL LEAGAGE.		
SLIDING SEALS. (Seals have a moving part.)		
Handle release plunger.	Check visually.	Remove release plunger and replace O-rings.
Hand pump plunger gland.	Check visually.	Remove hand pump plunger and replace O-rings.
Landing gear selector spool.	Check visually.	Remove Power Pack and replace O-ring on spool and in manifold.
Priority valve.	Check visually.	Remove Power Pack and replace priority valve seals.
STATIC SEALS. (Seals with no moving parts.)		
All fittings.	Check visually.	Remove and replace O-rings and back-up rings as required.
Hand pump gland.	Check visually.	Remove hand pump and replace O-rings.
Door solenoid.	Check visually.	Replace O-ring.
Transfer tubes between manifold and body.	Check visually.	Remove Power Pack, disassemble and replace O-rings.
Reservoir cover.	Check visually.	Remove Power Pack and remove cover. Replace seals.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
POWER PACK LOSES FLUID WITH NO EVIDENCE OF LEAKAGE.		
Air leak at engine pump shaft seal.	Refer to paragraph 5-149.	Repair or replace engine pump.
Air leak in suction line to engine pump.	Refer to paragraph 5-149.	Repair or replace suction line or fittings.

NOTE

In this condition, hydraulic fluid is foaming due to air being pumped into the system, and the fluid is being blown overboard through the Power Pack line.

HYDRAULIC SYSTEM PRESSURES

COMPONENT	OPENING PRESSURE	RESEATING PRESSURE
Handle Release Valve.	750 to 1250 psi.	-------
Priority Valve.	750 to 800 psi.	-------
Primary Relief Valve.	1800 psi. (Max.)	1450 psi. (Min.)
Inlet Check Valve.	10 psi. (Max.)	2 psi. (Min.)
Hand Pump Check Valves.	10 psi. (Max.)	2 psi. (Min.)

5-4. HYDRAULIC POWER SYSTEM COMPONENTS.

5-5. The hydraulic power system includes equipment required to provide a flow of pressurized hydraulic fluid to the retractable landing gear system. Main components of the hydraulic system are listed in the following chart.

ITEM	PURPOSE	LOCATION AND ACCESS
Engine-driven hydraulic pump.	To provide a flow of pressurized hydraulic fluid to the system.	Right rear accessory pad of engine. Remove upper cowling.
Hydraulic filter.	To filter fluid from the pump before entering remainder of system.	Upper right side of firewall in engine compartment. Remove the upper engine cowling.
Hydraulic Power Pack.	(1) To "load" the engine-driven pump when landing gear handle is moved out of neutral. (2) To provide a reservoir of hydraulic fluid. (3) To afford control of gear and door systems through use of valves and appropriate passages.	At top of pedestal. Partially accessible for adjustment with the decorative cover and pedestal front panels removed.
Emergency hand pump.	(4) To provide emergency hydraulic pressure through use of hand pump in the unit.	Integral with Power Pack.

5-6. ENGINE-DRIVEN HYDRAULIC PUMP.

5-7. The gear-type hydraulic pump is mounted on the right rear accessory pad of the engine. Driven at approximately 1-1/2 times engine crankshaft speed, the pump supplies a controlled flow of hydraulic fluid to the Power Pack and hydraulic system whenever the landing gear control handle is operated. While the control handle is in neutral, the pump by-pass in the Power Pack allows the pump to cycle the hydraulic fluid. Pump flow is controlled to approximately one gallon-per-minute.

5-8. REMOVAL AND INSTALLATION.

a. Remove upper cowling. Except on the T210, remove induction airbox.

b. Disconnect hydraulic lines and hoses from pump and cap or plug open fittings, lines and hose.

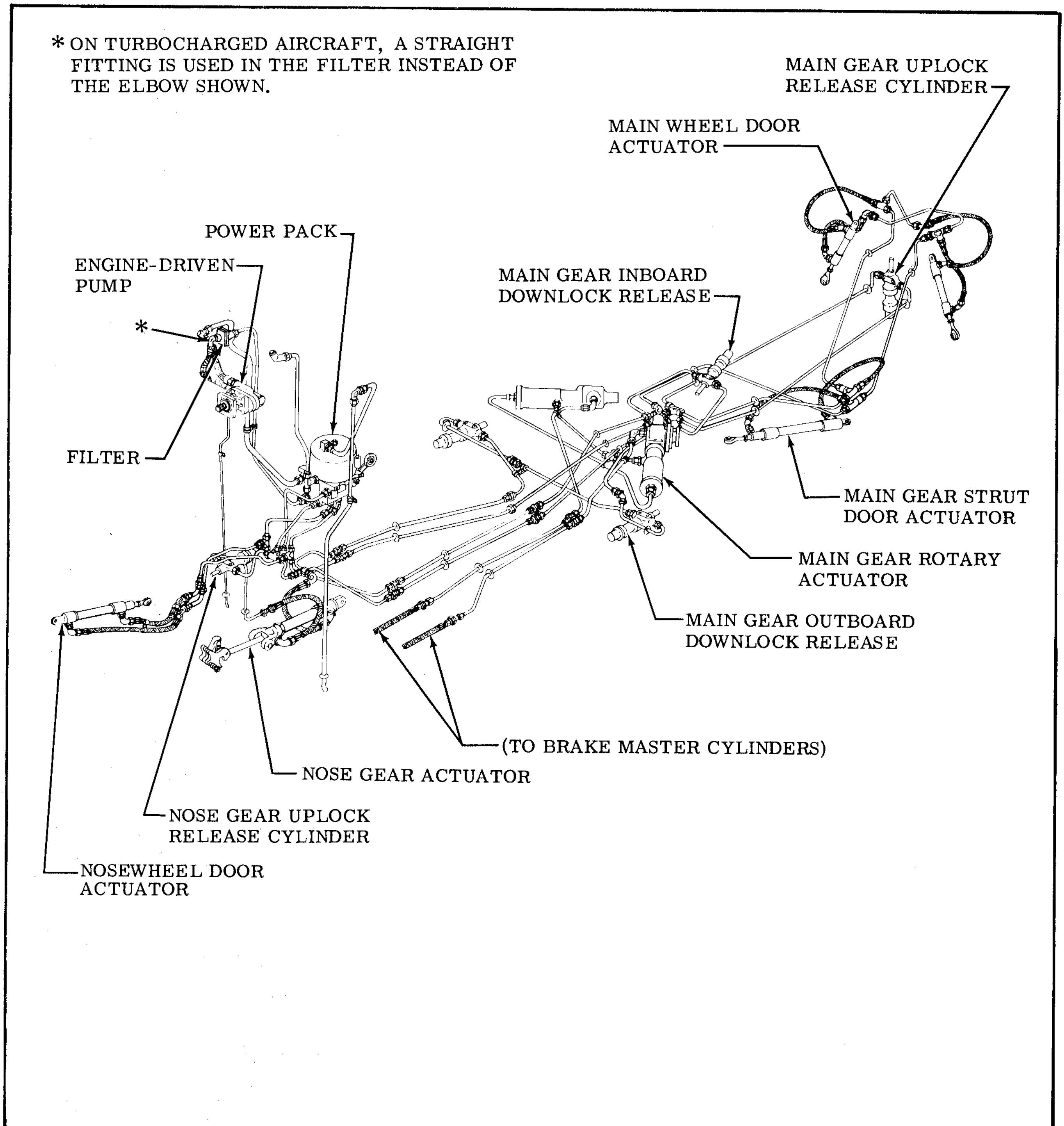


Figure 5-1. Hydraulic System Components Location

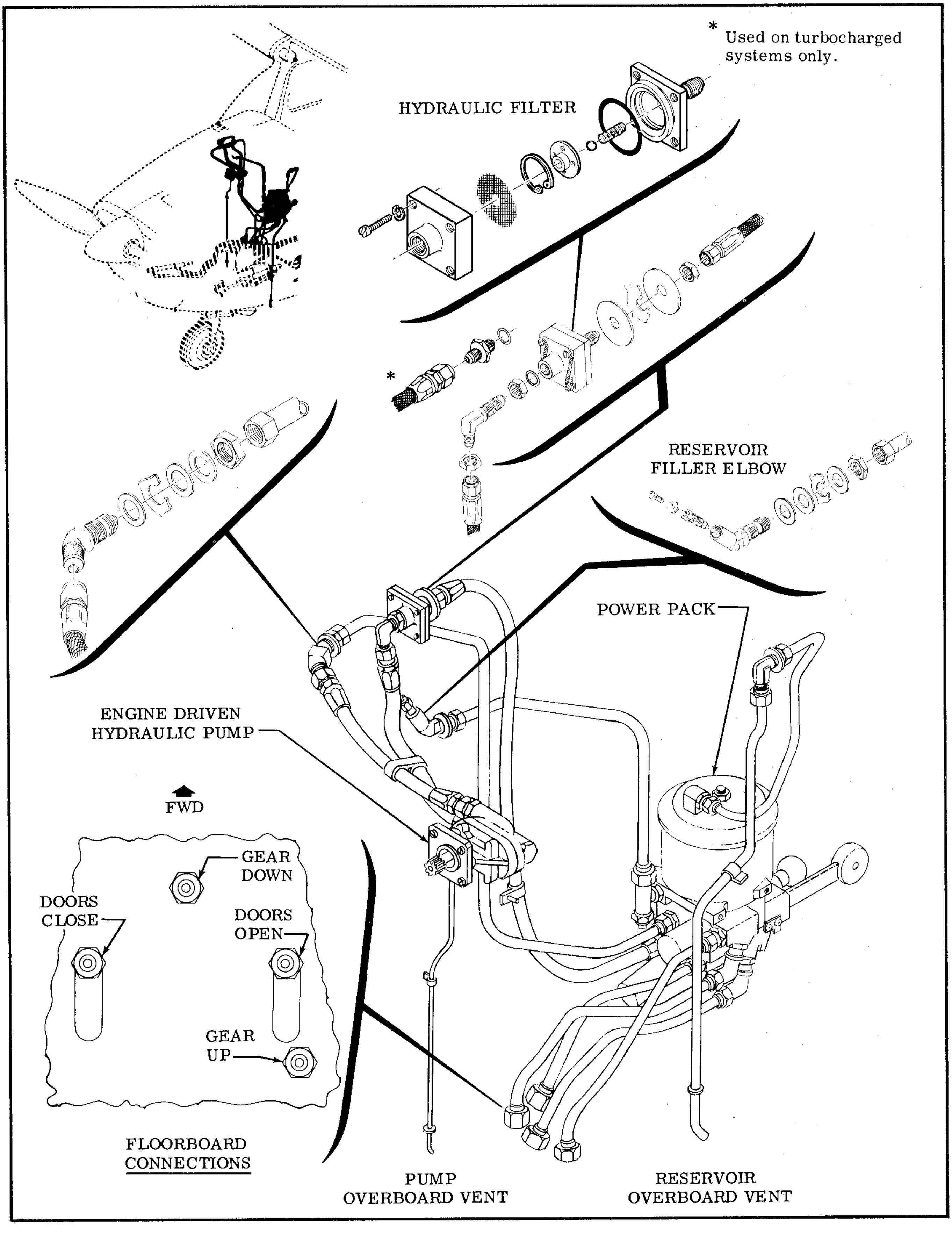


Figure 5-2. Hydraulic Power System

c. Remove four nuts securing pump to accessory case and pull pump aft to remove. Retain washers.
d. To install pump, install a new mounting gasket, grease pump drive splines lightly with general purpose grease, and slide pump into position. Rotate pump shaft as necessary for smooth meshing of splines, and reverse the preceding steps.
e. To prevent initial dry-running of the pump:
1. Loosen suction hose fitting at pump inlet fitting.
2. Remove Power Pack reservoir overboard vent line from fitting at top of firewall.
3. Connect suitable pressure filler unit to reservoir filler line fitting on right side of firewall.
4. Hold finger over open end of overboard vent line fitting and fill hydraulic reservoir until fluid is forced from loosened end of the suction hose.
5. Tighten suction hose, reconnect reservoir vent line, and disconnect filler unit.
f. The pump may be disassembled and repaired as outlined in Appendix A.

5-9. HYDRAULIC FILTER.

5-10. A hydraulic filter is installed in the pump pressure line at the filter to filter the hydraulic fluid before it enters the Power Pack. The filter screen disc is a 31 micron screen capable of passing hydraulic fluid at the rate of approximately 1.12 gallons-per-minute.

5-11. REMOVAL AND CLEANING. The screen in the hydraulic filter should be removed and cleaned with solvent (Federal Specification P-S-661, or equivalent) at the first 25 hours, the first 50 hours, and at each 100-hour inspection thereafter. Also the screen should be removd and cleaned whenever improper fluid circulation is suspected. Figure 5-2 shows details of the filter and may be used as a guide during removal, disassembly, assembly, and installation.

5-12. POWER PACK.

5-13. The hdyraulic Power Pack, located in the pedestal, is a multi-purpose control unit in the hydraulic system. It contains a hydraulic reservoir, valves which control flow of pressurized fluid to the various actuators in the door and landing gear system, and an electrical switch connected to a gear warning horn and indicator lights. An emergency hand pump uses reservoir fluid to permit extension of the landing gear if hydraulic pressure should fail.

5-14. REMOVAL.

NOTE

As hydraulic lines are disconnected or removed, plug or cap all openings to prevent entry of foreign material into the lines or fittings.

a. Remove front seats and spread drip cloth over forward carpet.
b. Remove landing gear control lever knob and remove decorative cover from pedestal.
c. Position a gallon can under fill-and-drain tee fitting, then remove pressure cap on tee and drain reservoir fluid into can. A funnel with attached hose will simplify draining.
d. Cut safety wire and disconnect electrical plug from door solenoid valve.
e. Disconnect and cap or plug all hydraulic lines from the Power Pack.
f. Remove upper panel assembly from pedestal.
g. Remove the three studs and one bolt securing the Power Pack to the pedestal side members, then work Power Pack aft out of the pedestal.

NOTE

The two studs on the left side of the Power Pack serve also as pivots for the elevator trim wheel and pointer. The studs may be unscrewed from the Power Pack threads without major disturbance to the elevator trim system components by using an open end wrench to remove them. The stud on the right side of the Power Pack is the pivot for the cowl flap control arm. The cowl flap control must be removed from the pedestal side structure to remove this stud.

5-15. DISASSEMBLY AND REPAIR. Refer to Appendix A for disassembly and repair of the hydraulic Power Pack.

5-16. INSTALLATION.

NOTE

When installing a new Power Pack, leave the bulkhead nuts loose on the tubing fittings. This will allow proper positioning of these fittings, making it easier to align and connect the hydraulic lines.

a. Work Power Pack into position and install the three studs and one bolt that secure it to the pedestal sides.

NOTE

The three studs serve as pivots for the elevator trim wheel, trim wheel pointer, and the cowl flap control arm. Adjust these systems and controls as necessary, according to instructions contained in appropriate sections of this manual, before installing the pedestal decorative cover.

b. Connect all hydraulic lines to Power Pack fittings. Make sure fittings are properly installed, with jam nuts tight, after lines are tightened.
c. Connect and safety electrical plug at door solenoid valve.
d. Install upper panel assembly on pedestal.
e. Connect filler unit and fill reservoir with clean hydraulic fluid.
f. With aircraft on jacks, use Hydro Test to operate landing gear through several cycles to bleed system. Check for proper operation and any signs of hydraulic fluid leakage.

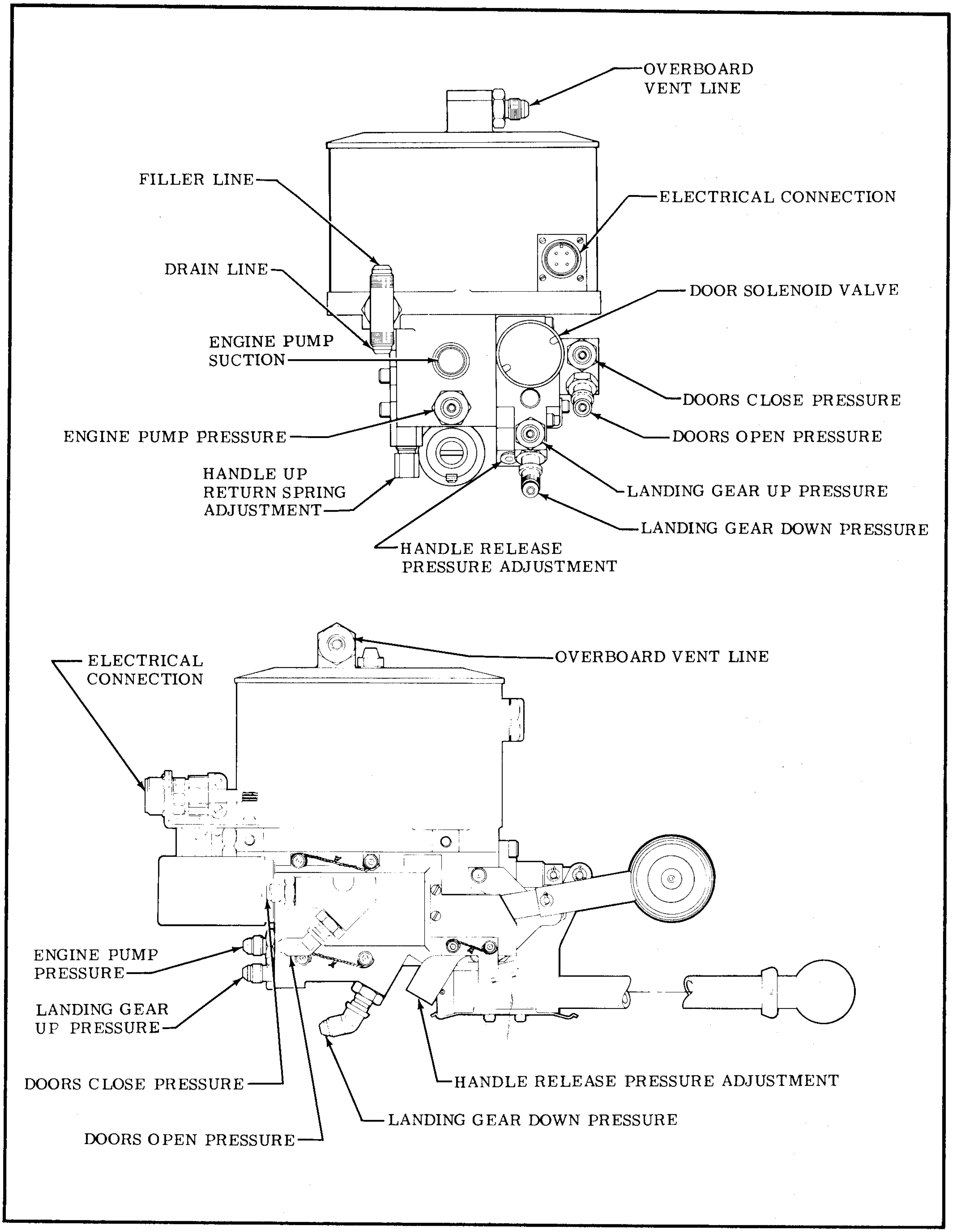


Figure 5-3. Location of Power Pack Fittings

g. Check elevator trim operation and cowl flap operation, and rig as required.

h. Install decorative cover and landing gear control lever knob.

5-17. PRIMARY RELIEF VALVE ADJUSTMENT. If the primary relief valve should get out of adjustment, fluid contamination, wear of parts, or defective parts should be suspected. Remove the Power Pack, disassemble, repair, and adjust as outlined in Appendix A.

5-18. PRIORITY VALVE ADJUSTMENT. The prioroty valve may be adjusted while the Power Pack is installed in aircraft as follows:

a. Jack the aircraft and connect Hydro Test in accordance with paragraph 5-137.

b. Check priority valve setting in accordance with paragraph 5-147.

c. If adjustment is required, turn priority valve adjusting screw (see figure 5-5) in to increase pressure at which priority valve opens. Adjust so that the valve opens at 750 to 800 psi as noted on the Hydro Test gage.

d. Cycle the landing gear to check for proper operation, then lower the landing gear.

e. Fill reservoir and disconnect Hydro Test in accordance with paragraph 5-138.

f. Remove aircraft from jacks.

5-19. HANDLE-RELEASE ADJUSTMENT. (See figure 5-6.) Correct adjustment of the landing gear handle-release mechanism is necessary because incorrect adjustments can cause excessive pressures in the Power Pack and can prevent free circulation of fluid, resulting in damage to the Power Pack. If the mechanism releases too soon, the landing gear handle may return to neutral before the landing gear doors are closed, if the time-delay should function improperly. Pressure build-up after the doors are closed operates the time-delay valve. After the valve opens, pressure then disengages a spring-loaded plunger from a detent and a handle return spring then pushes the handle back to neutral. The spring load on the detent plunger and the spring load on each handle return spring are adjustable. To adjust the handle-release mechanism, proceed as follows:

a. Jack the aircraft, then connect Hydro Test in accordance with paragraph 5-137.

b. Remove pedestal decorative cover to gain access to adjusting plugs at bottom of Power Pack.

c. If Power Pack is being installed or if reservoir fluid level has been low, fill reservoir and bleed time-delay valve in accordance with paragraph 5-140.

d. Using Hydro Test, cycle landing gear through at least two full cycles, unless handle will not hold or fails to release.

NOTE

If the handle will not hold, either the detent spring load adjustment is set too low, the handle-return spring load adjustments are set too high, or the handle-return springs are bottoming out and not permitting the handle-release plunger to reach the detent positions. Check that the handle can be moved manually into the detent positions. If it cannot, loosen handle-return spring adjusting plugs (2 and 3) until the handle will engage the detents. If the handle will not release, either the detent spring load adjustment is set too high (forcing the detent plunger partially into the detent and making it mechanically impossible for the plunger to move completely out of the detent) or the handle-return spring load adjustments are set too low. Tighten detent spring load adjusting plug (1) until detent plunger bottoms out in detent, then loosen plug (1) approximately two full turns, until handle will release.

e. Using the Hydro Test, check the pressure at which the handle-release plunger disengages the detents, and readjust handle-release detent spring adjusting plug (1) as necessary to obtain a release pressure of approximately 1000 psi. Tolerance is 750 psi to 1250 psi. Use a very slow flow, and be sure time is allowed for time-delay valve to open. Cycle the landing gear between each adjustment.

f. Readjust handle-return spring adjusting plugs (2 and 3) until handle trips back from up and down positions with a positive snap. Again, cycle the landing gear between each adjustment.

g. Recheck the handle-release pressure specified in step "e."

h. Operate landing gear through several cycles, lower the landing gear, and remove aircraft from jacks.

i. Disconnect Hydro Test and install decorative cover on pedestal.

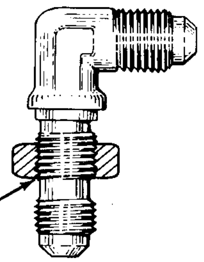
5-20. EMERGENCY HAND PUMP.

5-21. The emergency hand pump is internally mounted in the Power Pack. The pump supplies a flow of pressurized hydraulic fluid to open the doors and extend the landing gear if hydraulic pressure should fail. The hand pump receives a reserve supply of fluid from the Power Pack reservoir and pumps the fluid directly to the door control valve and gear priority valve, then into passages and lines used by the regular system.

5-22. DISASSEMBLY AND REPAIR. The emergency hand pump may be repaired while in the aircraft. Refer to Appendix A for disassembly and repair of the emergency hand pump.

1

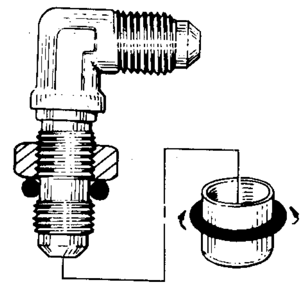
INSTALL NUT



THESE THREADS MUST NOT PROTRUDE BELOW NUT. POSITION NUT EXACTLY AT TOP OF NON-THREADED AREA.

2

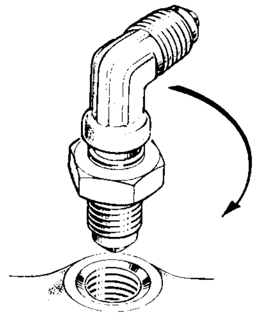
POSITION O-RING



COVER THREADS WITH A PLASTIC THIMBLE OR TAPE, APPLY PETROLATUM TO O-RING, THEN ROLL IT UP INTO POSITION AGAINST NUT. REMOVE THIMBLE OR TAPE AFTER O-RING IS IN POSITION.

3

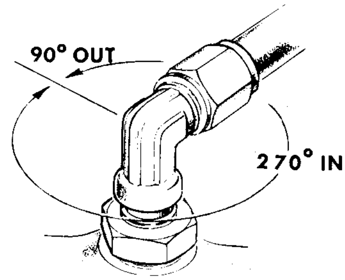
INSTALL ELBOW IN THREADS UNTIL O-RING CONTACTS CHAMFER, AND NUT CONTACTS FACE OF BOSS



ROTATE NUT AND FITTING TOGETHER TO RETAIN THE ORIGINAL POSITION OF THE NUT ON THE FITTING.

4

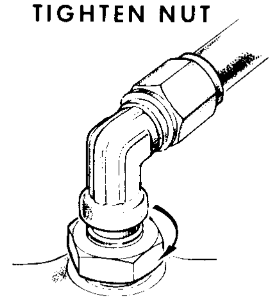
ATTACH LINE TO ELBOW (ELBOW MAY BE TURNED TO LIMITS SHOWN TO ALIGN WITH HOSE OR LINE)



HOLD NUT STATIONARY, TURN FITTING TO DESIRED POSITION.

5

TIGHTEN NUT

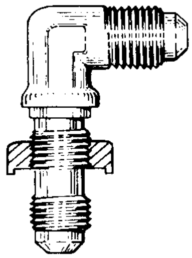


INSTALL O-RINGS CAREFULLY. MOST HYDRAULIC LEAKS ARE CAUSED BY CARELESS INSTALLATION.

Figure 5-4. Installation of Hydraulic Fittings (Sheet 1 of 2)

1

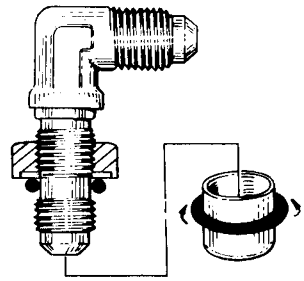
INSTALL NUT



POSITION NUT WITH RECESS DOWN.

2

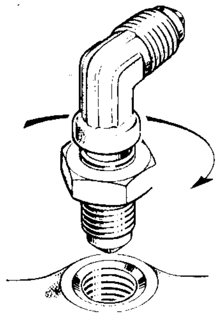
POSITION BACK-UP RING & O-RING



APPLY PETROLATUM TO BACK UP RING AND O-RING, THEN WORK THEM UP INTO POSITION AGAINST NUT. TURN NUT DOWN UNTIL O-RING IS PUSHED DOWN FIRMLY AGAINST LOWER THREADS.

3

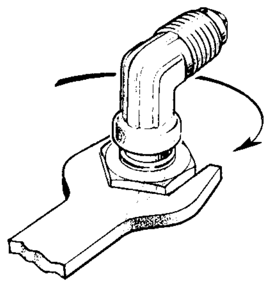
INSTALL ELBOW IN THREADS UNTIL O-RING CONTACTS FACE OF BOSS



ROTATE NUT AND FITTING TOGETHER TO RETAIN THE ORIGINAL POSITION OF THE NUT ON THE FITTING.

4

WITH NUT HELD, TURN FITTING IN 1½ TURNS

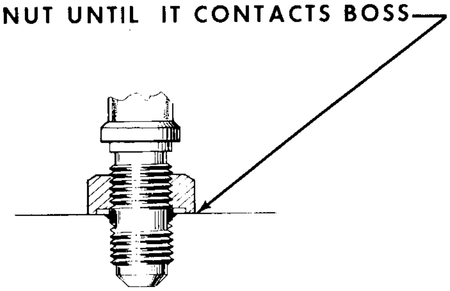


1-1/2 TURNS PLUS A MAXIMUM OF 1 ADDITIONAL TURN TO ALIGN WITH HYDRAULIC LINE.

ATTACH LINE TO FITTING.

5

TIGHTEN NUT UNTIL IT CONTACTS BOSS



INSTALL O-RINGS CAREFULLY. MOST HYDRAULIC LEAKS ARE CAUSED BY CARELESS INSTALLATION.

Figure 5-4. Installation of Hydraulic Fittings (Sheet 2 of 2)

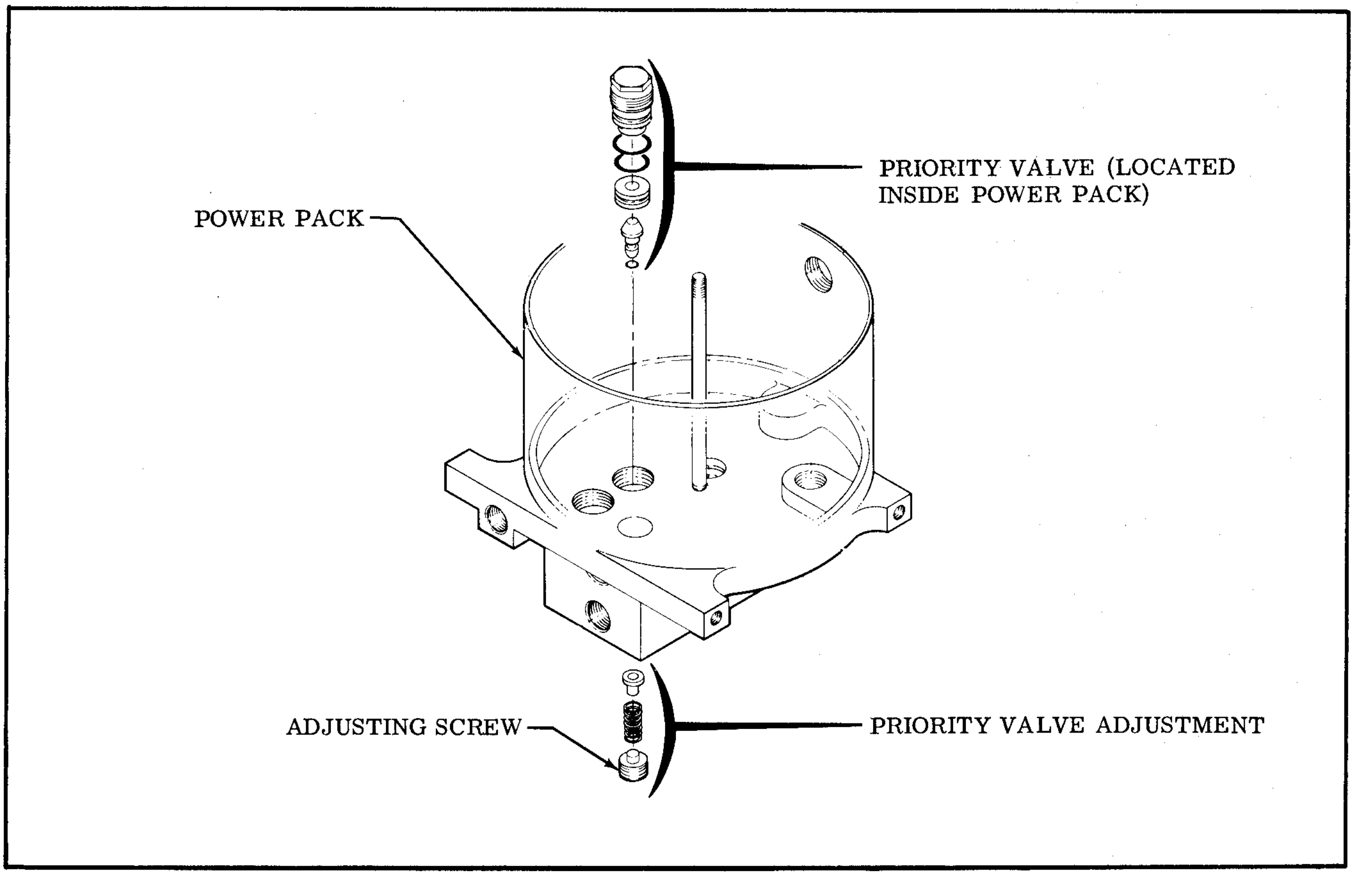


Figure 5-5. Priority Valve Adjustment

5-23. LANDING GEAR ELECTRICAL CIRCUITS.

5-24. Landing gear electrical circuits are shown in figure 5-7, which shows the switches in the gear down and locked, weight-on-gear condition. The following chart describes what each electrical component in the circuit does, and what causes it to operate.

ITEM	OPERATED BY	FUNCTION
Up indicator switches.	Gear in up and locked position.	Closes circuit to gear up indicator light, handle up-down switch, and door solenoid valve.
Down indicator switches.	Gear in down and locked position.	Closes circuit to gear down indicator light, handle up-down switch, and door solenoid valve.
Handle up-down switch.	Power Pack selector spool.	"Preselects" up or down circuit. (Completes up circuit to door solenoid valve when gear reaches up position, completes down circuit to door solenoid valve when gear reaches down position.)
Door solenoid valve.	Completion of up circuit or down circuit. (Handle up-down switch and all gear indicator switches closed.)	Shifts valve to door-close position when energized. Spring-loaded to door-open position. Thus, with an electrical failure, the solenoid valve will remain in the door-open position and doors cannto be closed.

NOTE

Remember this rule: CLOSED circuit = CLOSED doors; OPEN circuit = OPEN doors. Applying this rule, the doors can be opened or closed at will by placing handle in down or down neutral, turning master switch either on or off, and supplying pressure with the hand pump.

Nose gear safety switch.	Actuating arm on lower torque link.	When aircraft weight causes shock strut to compress, switch opens circuit to handle lock-out solenoid, which is spring-loaded to lock position. When airborne, strut extends and closes switch, to unlock handle from gear-down range.
Handle lock-out solenoid.	Nose gear safety switch.	Prevents handle from being moved out of gear-down range while aircraft is on ground.

CAUTION

Since a fully extended strut (too much air pressure, extremely aft weight distribution, etc.) simulates an airborne condition, be especially careful not to move gear handle from gear-down range under these conditions, or nose gear will retract.

CAUTION

Plug (1) should be adjusted in 1/3 turn increments. Screwing it in too far will result in the system relief valve opening before sufficient pressure is built up to operate the release plunger.

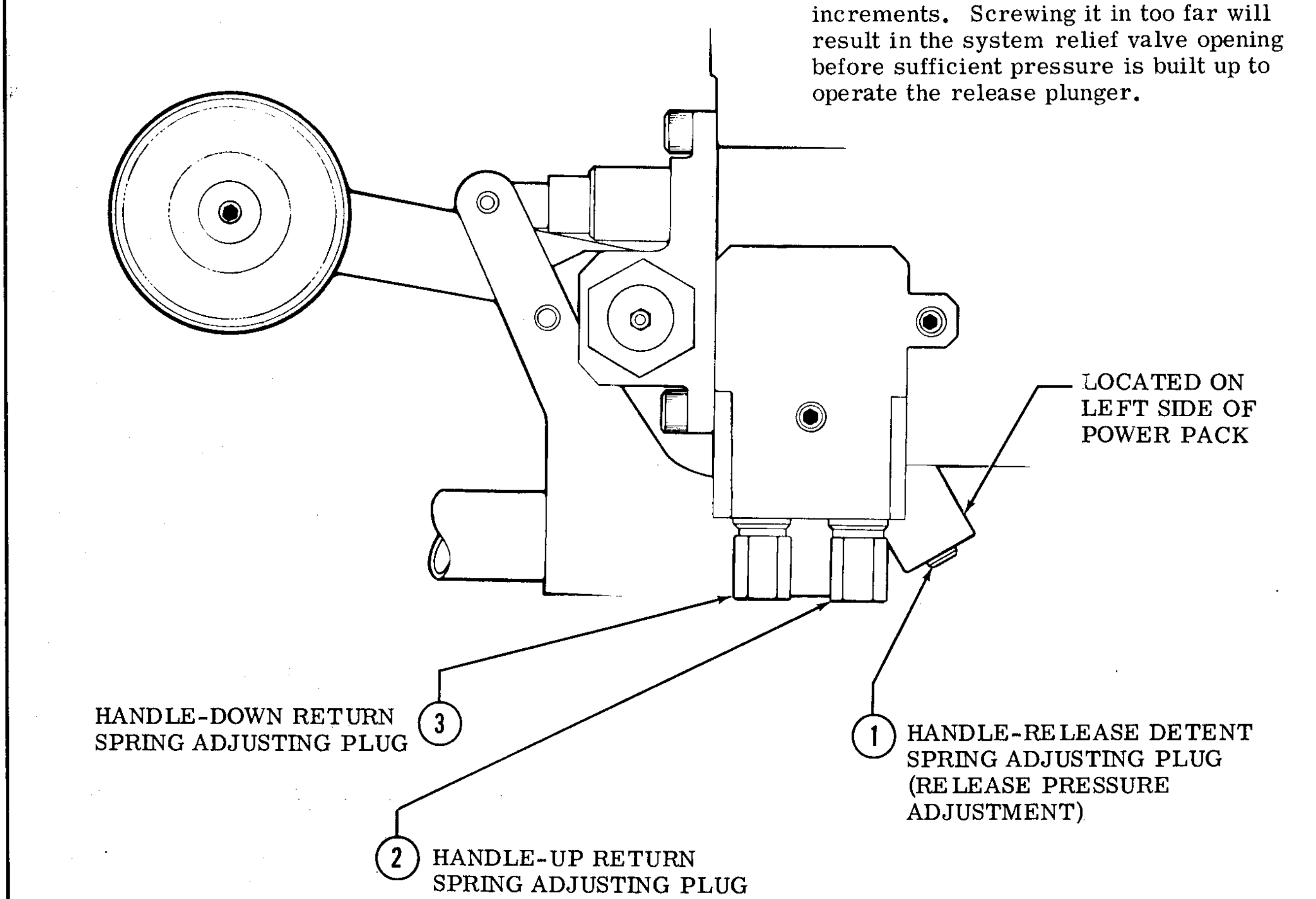


Figure 5-6. Handle Release Adjustment

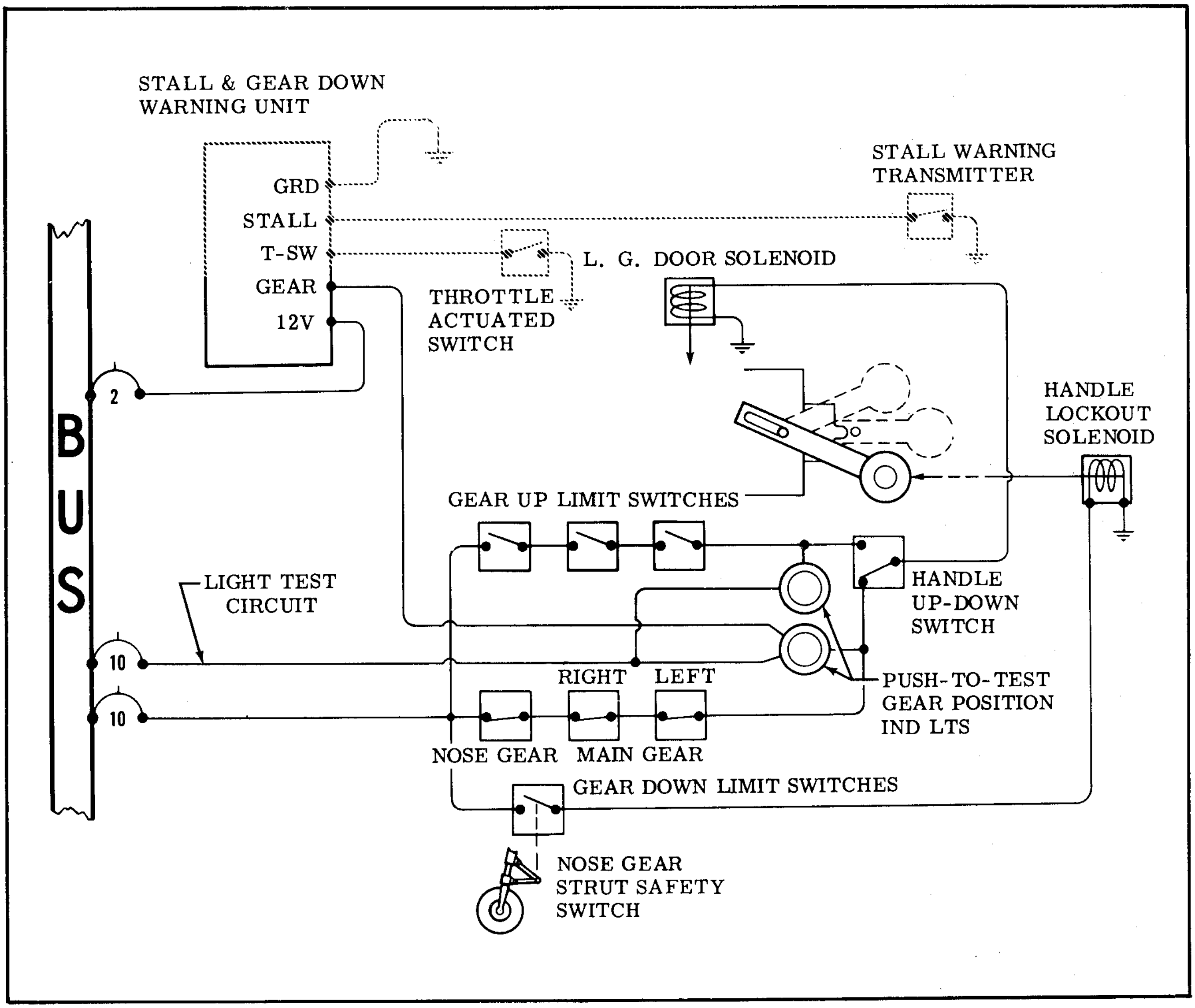


Figure 5-7. Simplified Electric Schematic

5-25. ADJUSTMENT OF SWITCHES. Landing gear up indicator switches, down indicator switches, nose gear safety switch, and handle up-down switch may be adjusted as outlined in the rigging procedures beginning with paragraph 5-115. Adjustment of the throttle actuated switch is contained in paragraph 12-54.

5-26. HYDRAULIC TOOLS AND EQUIPMENT.

5-27. HYDRO TEST UNIT. A special portable hydraulic servicing unit is available from the Cessna Service Parts Center. The Hydro Test unit combines a motor-driven pump, pressure jack, pressure gage, reservoir, and controls into a compact unit. The Hydro Test or its equivalent is indispensable for servicing, testing, and rigging of the landing gear system.

WARNING

When using the Hydro Test, make sure personnel are in the clear before cycling the landing gear. Apply hydraulic pressure carefully; gear and door operations are rapid when hydraulic flow is set near the full capacity of the Hydro Test unit.

A hydraulic test unit may be assembled locally if desired. Specifications for a test unit are listed in the following chart:

1. Flow	1.25 - .50 gpm
2. Reservoir	1 gallon
3. Check Valve	Aft of Pump in pressure line.

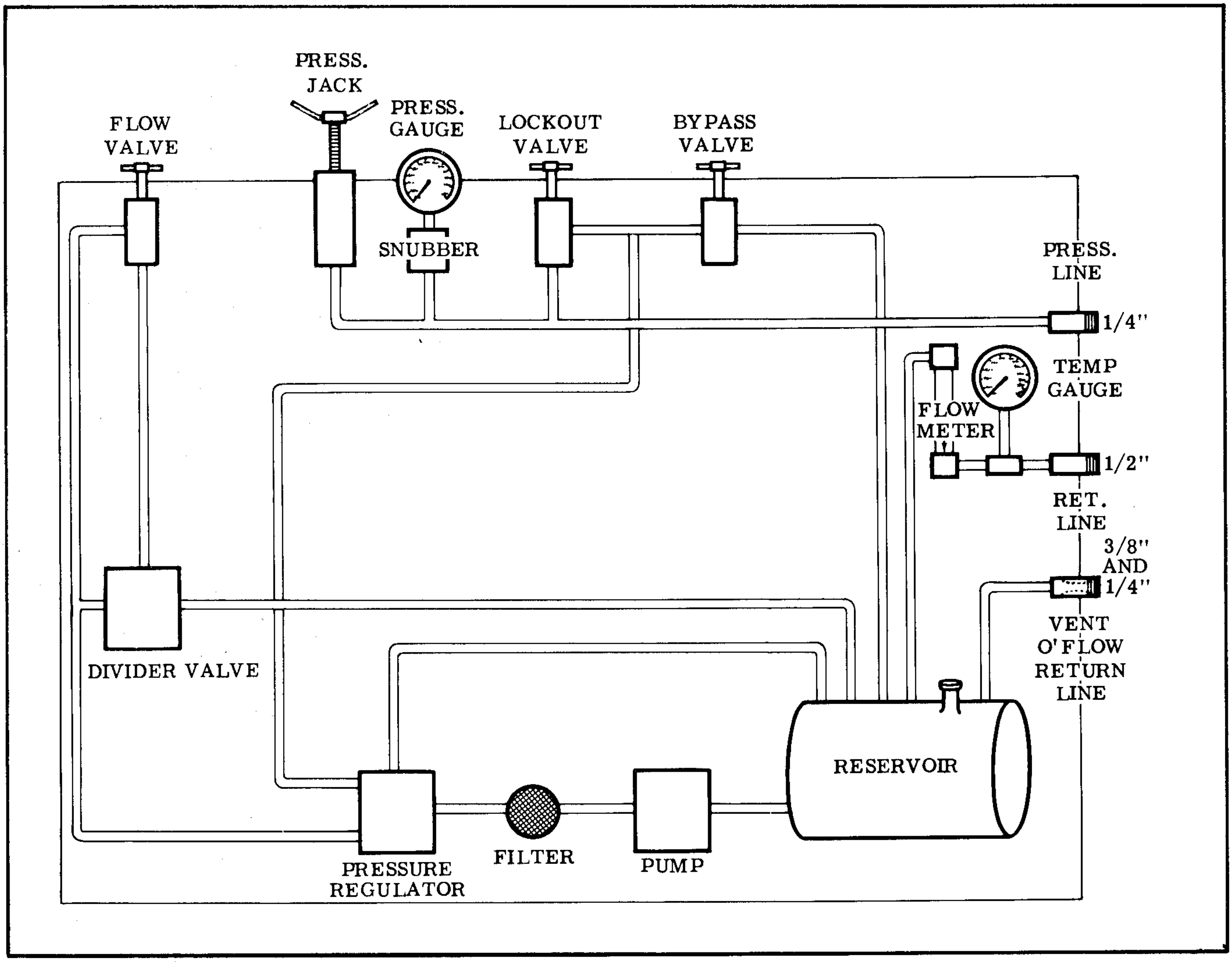


Figure 5-8. Simplified Schematic of Hydro Test Unit

4.	Filter	3 gpm, 10 micro in pressure line after pump and before relief valve.
5.	Relief Valve	Pressure line after filter and discharging to reservoir.
6.	Relief Valve Setting	1700 - 00 crack to 1500 psi (min) reseat.
7.	Pressure Gage	2000 psi dial on pressure line and snubbed.
8.	Temperature Gage	50 to 200° at pump outlet.
9.	Suction Hose and Lines	-8 (1/2 inch tube size) (min)
10.	Pressure Hose and Line	-4 (1/4 inch tube size) (min)
11.	Power Input	3 hp (desired) 2 hp (min)

CAUTION

Means should be provided to keep connections to aircraft system clean and free of foreign material at all times.

5-28. HYDRO FILL UNIT. A special filler can with a manually operated pump is available from the Cessna Service Parts Center. In addition to providing a handy means of filling hydraulic reservoirs, the unit may be used to bleed the brake system.

5-29. BLEEDING AND LEAK TESTING.

NOTE

Refer to paragraph 5-134 for Hydro Test operation.

5-30. BLEEDING OF THE HYDRAULIC SYSTEM. Bleeding may be accomplished by jacking the aircraft and using the Hydro Test to cycle the landing gear and door system through several complete cycles. Refer to paragraph 5-140 for bleeding of the time-delay valve inside the Power Pack. Use only clean, filtered hydraulic fluid in the hydraulic system. Hydraulic fluid preservative (MIL-H-6083) may be used for flushing and storage of hydraulic components.

NOTE

There is only one reason to have to bleed the hydraulic system. The entrance of considerable air into the hydraulic system. The most probable means of air getting into the system are: permitting reservoir fluid level to become low, air leaks in the engine-driven pump or pump suction line, and poor maintenance procedures when connecting lines and installing actuators, etc.

5-31. BLEEDING OF THE EMERGENCY HAND PUMP may be accomplished by operating the hand pump, with the master switch OFF, until landing gear doors are fully open. Continue to operate hand pump very slowly, increasing pressure until the relief valve opens and all air is bled from hand pump and valve.

CAUTION

It is very important that the hand pump be operated very slowly as pressure is being increased to bleed the relief valve. If the hand pump is operated rapidly, damage to the valve can occur as air permits parts to "slam" against each other.

5-32. LEAK-TESTING. When testing a system for leakage, the Power Pack must be bypassed. Connect Hydro Test into applicable system to be tested, apply a pressure of 2200 psi, and hold for 5 minutes. Refer to paragraph 5-143 for Hydro Test operation during leak-testing. When checking an actuating cylinder for internal leakage, connect the Hydro Test to one port of unit and leave other port open.

CAUTION

When leak-testing any actuator, with pressure applied to one port of the cylinder, always have the opposite port open to atmospheric pressure. Otherwise, excessive pressure may be built up due to the differential area across the piston. (The rod side of the piston has less area than the head side. Thus, pressure applied to the head side of the piston may apply a far greater pressure to fluid on the rod side of the piston.)

The total of line assemblies, fittings, actuators, and any other part subject to hydrostatic (dead end) pressure shall be deemed faulty due to overstressing if hydraulic pressure in that immediate sub-system is allowed to exceed 2275 psi for any period of time.

5-33. CHECKING HYDRAULIC FLUID CONTAMINATION. At the frequencies specified in Section 2, check contamination of hydraulic fluid as follows:

a. Disconnect a door actuator hose and drain a small quantity of fluid by actuating the hand pump. If the fluid is clear and is not appreciably darker in color than new fluid, continue to use the present fluid.

b. If fluid coloration is doubtful, place fluid sample in a non-metallic container and insert a strip of polished copper in the fluid. Keep copper in the fluid for six hours at a temperature of 70°F or more. A slight darkening of the copper is permissible, but there should be no pitting or etching visible up to 20X magnification.

5-34. MAIN LANDING GEAR.

5-35. The main landing gear struts rotate aft and inboard to stow the main wheels beneath the baggage compartment. Struts are down-locked by spring-loaded pawls at the inboard edge of the struts and by additional pawls which wedge the struts securely at the outboard supports. Uplocks are located on the main wheel stowage bay forward bulkhead. Up-locking the pawls here hold the struts in the stowed position. Rotation of the gear to extend or retract the struts is achieved by saddles which are in turn bolted to the shaft flange of the hydraulic rotary actuators.

NOTE

As an additional downlock safety feature, the inboard downlocks are released by "gear up pressure" and the outboard downlocks are in the "door-open pressure" circuit.

5-36. REMOVAL OF MAIN WHEELS. (See figure 5-22.)

NOTE

It is not necessary to remove the main wheel to reline brakes or remove brake parts, other then the brake disc or torque plate.

a. Using the universal jack point, jack the wheel as outlined in Section 2.
b. Remove hub caps.
c. Remove cotter pin and axle nut.
d. Remove bolts and washers attaching back plate and remove back plate.
e. Pull wheel from axle.

5-37. DISASSEMBLY OF MAIN WHEEL.
a. Deflate tire and break tire beads loose.

CAUTION

Avoid damaging wheel flanges when breaking tire beads loose. A scratch, gouge, or nick may cause wheel failure.

b. Remove thru-bolts and separate wheel halves, removing tire, tube, and brake disc.
c. Remove the grease seal rings, felts, and bearing cones from the wheel halves.

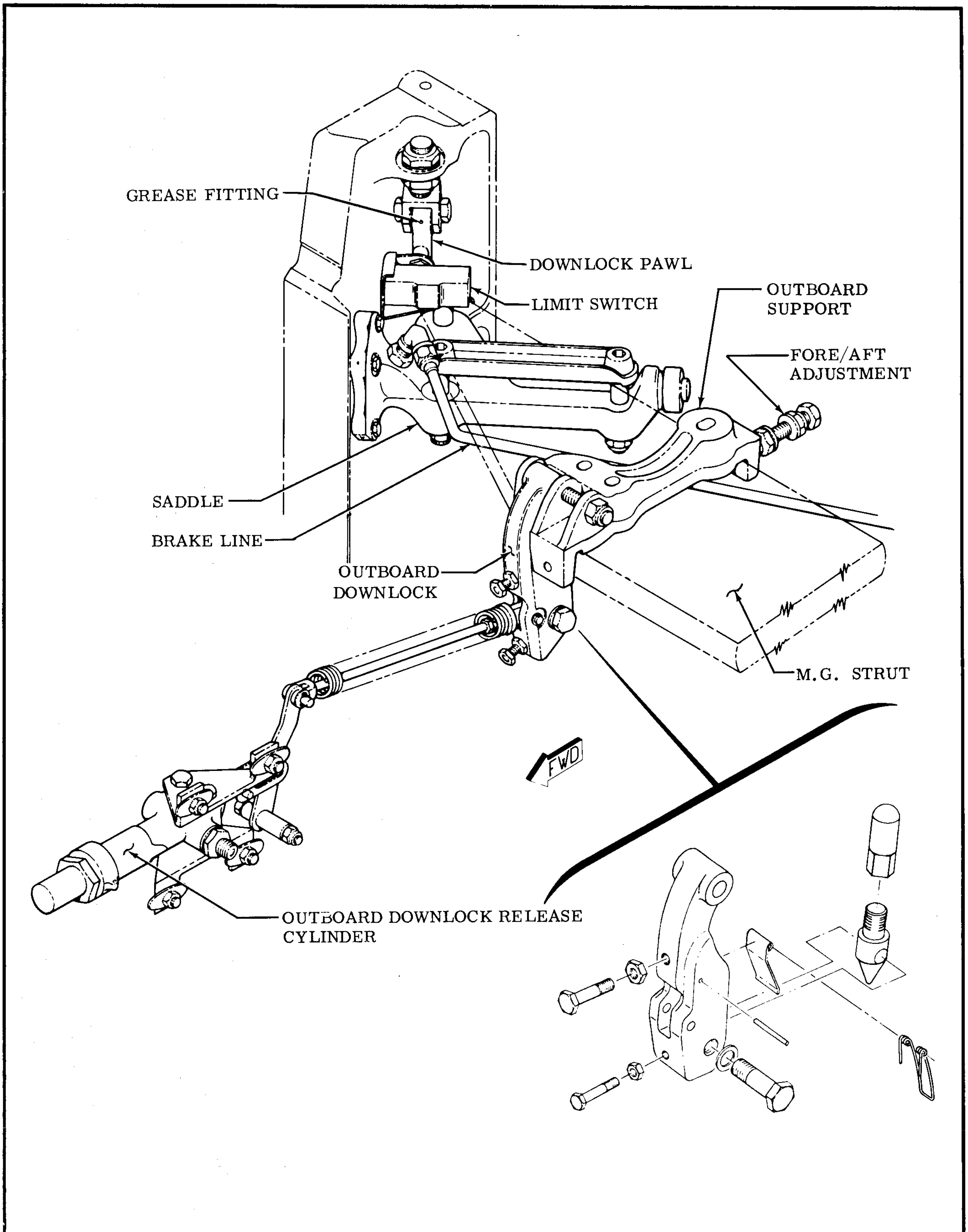


Figure 5-9. Main Gear Down Locks

NOTE

The bearing cups are a press fit in the wheel halves and should not be removed unless replacement is necessary. To remove the bearing cups, heat the wheel half in boiling water for 15 minutes. Using an arbor press, if available, press out the bearing cup and press in the new cup while wheel is still hot.

5-38. INSPECTION AND REPAIR OF WHEELS.

a. Clean all metal parts and the grease seal felts in solvent and dry thoroughly.

b. Inspect wheel halves for cracks. Cracked wheel halves should be replaced. Sand out nicks, gouges, and corroded areas. When the protective coating has been removed, the area should be cleaned thoroughly, primed with zinc chromate and repainted with aluminum lacquer.

c. Brake disc should be replaced if excessively scored or warped. Small nicks and scratches should be sanded smooth.

d. Bearing cups and cones should be inspected carefully for damage and discoloration. After cleaning, repack cones with clean aircraft wheel bearing grease (figure 2-6) before installation in the wheel.

5-39. ASSEMBLY OF MAIN WHEEL.

a. Insert thru-bolts through brake disc and position in the inner wheel half, using the bolts to guide disc. Assure that the disc is bottomed in wheel half.

b. Position the tire and tube with the inflation valve through hole in outboard wheel half. Place the inner wheel half in position. Apply a light force to bring wheel halves together. Maintaining the light force, assemble a washer and nut on one thru-bolt and tighten sungly. Assemble the remaining nuts and washers on thru-bolts and torque to value marked on wheel.

CAUTION

Uneven or improper torque of thru-bolt nuts may cause failure of bolts, with resultant wheel failure.

c. Clean and repack bearing cones with clean aircraft wheel bearing grease (figure 2-6).

d. Assemble the bearing cones, grease seal felts, and rings into the wheel halves.

e. Inflate tire to seat tire beads, then adjust to correct pressure.

5-40. INSTALLATION OF MAIN WHEELS.

a. Place wheel on axle.

b. Install axle nut and tighten until a slight bearing drag is obvious when the wheel is rotated. Back off nut to nearest castellation and install cotter pin.

c. Place brake back plate in position and secure with bolts and washers. Safety wire the bolts.

d. Install hub caps.

5-41. REMOVAL OF MAIN WHEEL AND AXLE.

a. Remove hub caps.

b. Remove wheel in accordance with paragraph 5-36.

c. Disconnect, drain, and plug the hydraulic brake line at the brake cylinder.

d. Remove four nuts and bolts securing axle and brake components to spring strut.

NOTE

When removing axle from spring strut, note number and position of the wheel alignment shims. Mark these shims or tape them together carefully so they can be reinstalled in exactly the same position to ensure that wheel alignment is not disturbed.

5-42. INSTALLATION OF MAIN WHEEL AND AXLE.

a. Secure axle and brake components to spring strut, making sure that wheel alignment shims are reinstalled in their original position.

b. Install wheel assembly on axle in accordance with paragraph 5-40.

c. Connect hydraulic brake line to brake cylinder.

d. Fill and bleed affected brake system.

e. Install hub caps.

5-43. REMOVAL OF MAIN GEAR STRUT AND WHEEL.

a. Remove individual rear seats or bench type rear seat.

b. Remove rear carpet over the raised portion of floorboard and remove access plates over landing gear bulkhead.

c. Jack aircraft in accordance with paragraph 2-4.

d. Place landing gear handle up, with master switch off, and operate emergency hand pump until main gear downlocks release.

e. Disconnect wheel brake line from elbow at top of saddle.

f. Remove bolts, washers, and nuts securing clamp and strut to saddle.

g. Carefully work strut out through door openings, leaving brake line attached to strut.

5-44. INSTALLATION OF MAIN GEAR STRUT AND WHEEL.

a. Reverse the steps in paragraph 5-43 to install the main gear strut and wheel.

b. Check rigging of main landing gear in accordance with paragraphs 5-115 through 5-123.

c. After removal from jacks, check wheel alignment in accordance with paragraph 5-57.

5-45. REMOVAL OF MAIN GEAR ACTUATOR AND SADDLE.

a. Remove strut and wheel as outlined in paragraph 5-43.

b. Remove access plates above actuators.

c. Disconnect and cap or plug all hydraulic lines at actuator.

d. Remove swivel fitting from actuator.

e. Remove bolts attaching the actuator mounting flange to the bulkhead casting, and holding saddle assembly in place, move the actuator inboard to separate the actuator from the saddle assembly. Work the actuator free and remove. Note position of O-ring seal between the mating flanges of the rotary actuator and saddle flange.

g. Slide the saddle assembly inboard, free of the bearing.

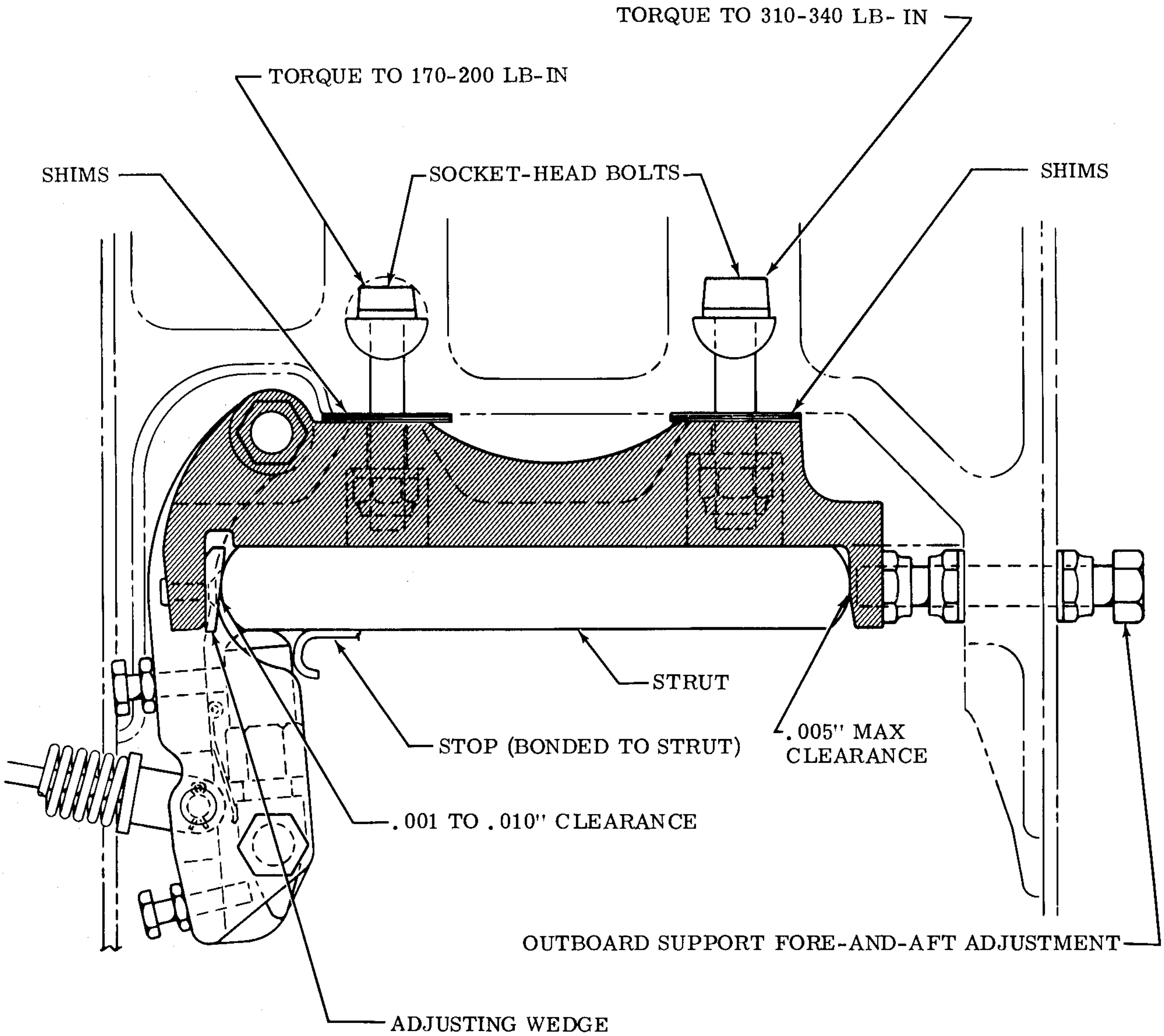


Figure 5-10. Main Gear Outboard Support and Downlock

NOTE

Seal or tape the exposed bearing surface of the saddle to exclude dirt.

5-46. SADDLE BEARING REPAIR. A worn saddle bearing may necessitate reaming the bearing oversize and installing an oversize bushing to fit the bearing. The bearing should be hand-reamed after the landing gear, saddle assembly, and gear actuator have been removed to gain access to the bronze bearing.

5-47. DISASSEMBLY AND REPAIR OF MAIN GEAR ACTUATOR. Refer to Appendix A for disassembly and repair of the main gear actuator.

5-48. INSTALLATION OF MAIN GEAR ACTUATOR AND SADDLE.

a. Slide the saddle assembly in place, in the hole in the bulkhead forging.

b. Work the actuator into position, make sure O-ring seal is in groove on actuator flange, and install bolts which attach saddle and actuator flanges.

c. Install bolts which attach the actuator to the structure. Bend tangs of washers to safety the bolts.

d. Connect hydraulic lines to the actuator.

e. Install brake line swivel fitting and line at saddle fitting.

f. Install strut and wheel as outlined in paragraph 5-43.

g. Rig main gear and check wheel alignment as outlined in paragraphs 5-56 and 5-57.

h. Bleed the affected brake and remove the aircraft from jacks.

5-49. MAIN GEAR SNUBBER. An adjustable metering pin is installed in each main landing gear actuator cylinder. This metering pin causes a snubbing in the actuator the final .5 to 1.0 second up travel of the main gear.

5-50. ADJUSTMENT OF MAIN GEAR SNUBBER. With the landing gear rigged and the limit switches adjusted as outlined in paragraphs 5-115 through 5-133, adjust main actuator snubbers so that snubbing action occurs during the final .5 to 1.0 second of main gear up travel. This may be done as follows:

a. With aircraft on jacks and Hydro Test connected, retract landing gear and see that both main gears lock at the same time in the up position.

b. If the main gears are not locking at the same time, but both main gears are snubbing, adjust the slower gear as follows:

1. Loosen door line and lock nut at end of actuator.

NOTE

When adjusting metering pin, wait a minimum of 30 seconds between up or down cycle of the landing gear. This allows time for the time-delay valve cavity to refill.

2. Adjust metering pin in (clockwise facing the cylinder head end of actuator) until main gear lock simultaneously in the up position. Cycle landing gear after each adjustment.

c. If one main gear is not snubbing, adjust the faster main gear as follows:

1. Loosen door line and lock nut at end of actuator.

CAUTION

When adjusting metering pin out, use care to prevent damage to the snap ring on the metering pin. Adjust out only until snap ring bottoms against actuator cylinder head. DO NOT FORCE. Approximately two threads will be showing through locknut with snap ring against cylinder head of actuator.

2. Adjust metering pin out (counterclockwise facing cylinder head end of actuator) until main gears lock simultaneously in the up position. Cycle landing gear after each adjustment.

d. After adjustments are completed, tighten locknut and door line on actuators and resafety metering pin locknut.

NOTE

Snubbing time is determined by observing the Hydro Test pressure gage. A sudden increase in pressure during the gear up cycle indicates the start of the snubbing action and a sudden decrease indicates that the gear is up and locked.

5-51. REMOVAL AND INSTALLATION OF MAIN GEAR UPLOCK MECHANISM. Figure 5-10 shows details of the main gear uplock mechanism and may be used as a guide during replacement of parts.

5-52. DISASSEMBLY AND REPAIR OF MAIN GEAR UPLOCK CYLINDER. Refer to Appendix A for disassembly and repair of the main landing gear uplock cylinder.

5-53. MAIN GEAR DOWNLOCKS AND DOWNLOCK RELEASE CYLINDERS. One cylinder releases both the right and left inboard downlocks and is operated by pressure in the gear up lines. The outboard downlocks are released by a cylinder on each side and the cylinder is operated by pressure in the door open lines.

5-54. REMOVAL AND INSTALLATION OF MAIN GEAR DOWNLOCK RELEASE CYLINDERS. Removal of the main gear downlock release cylinders consists of disconnecting the hydraulic lines and push-pull rods to the downlock pawls. Then remove mounting bolts and work actuator free of aircraft. Reverse procedure to install cylinder.

5-55. DISASSEMBLY AND REPAIR OF DOWNLOCK RELEASE CYLINDERS. Refer to Appendix A for disassembly and repair of the main landing gear downlock release cylinders.

11-56. MAIN GEAR RIGGING. Refer to paragraphs 5-115 through 5-123 for rigging and adjustments to the main landing gear.

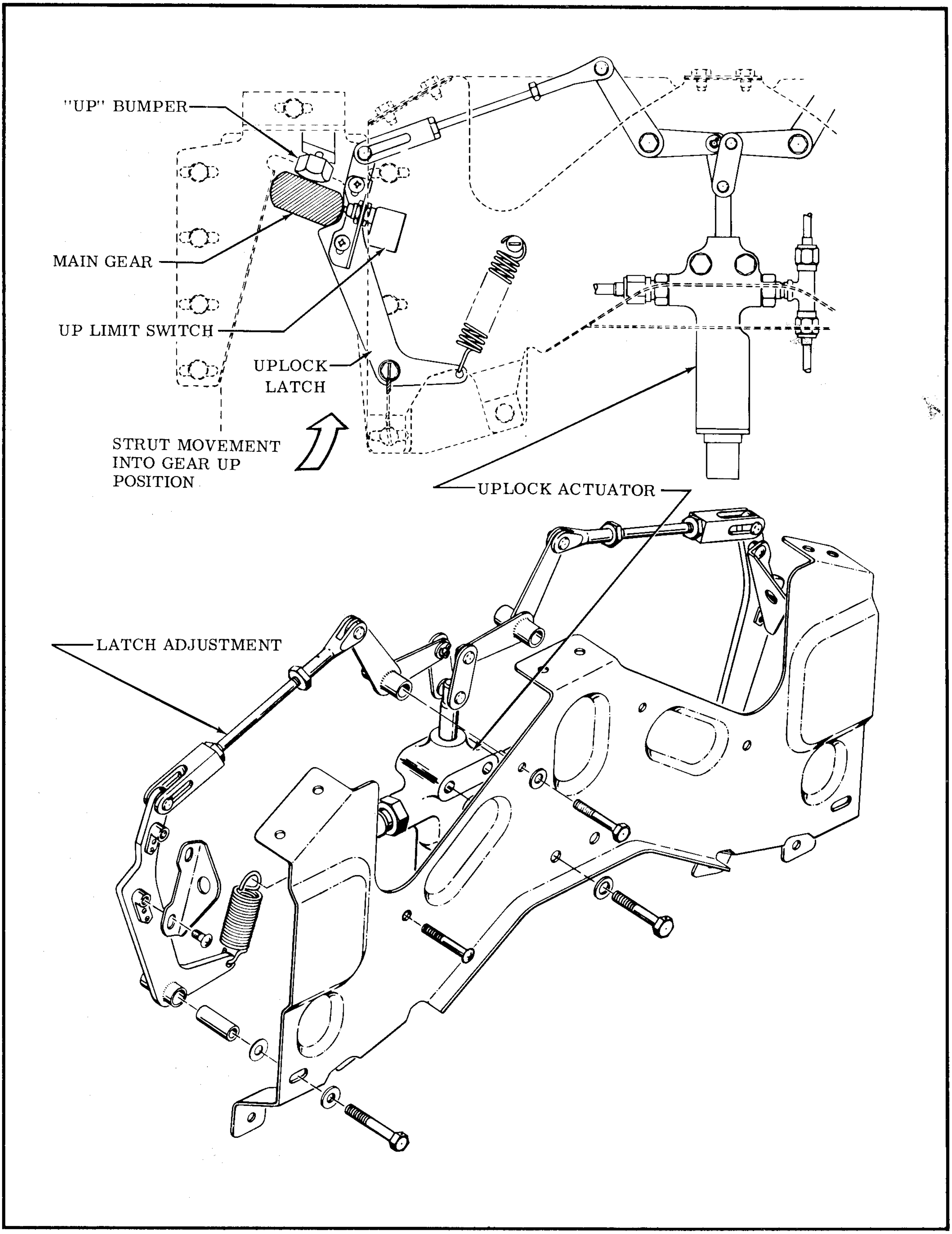
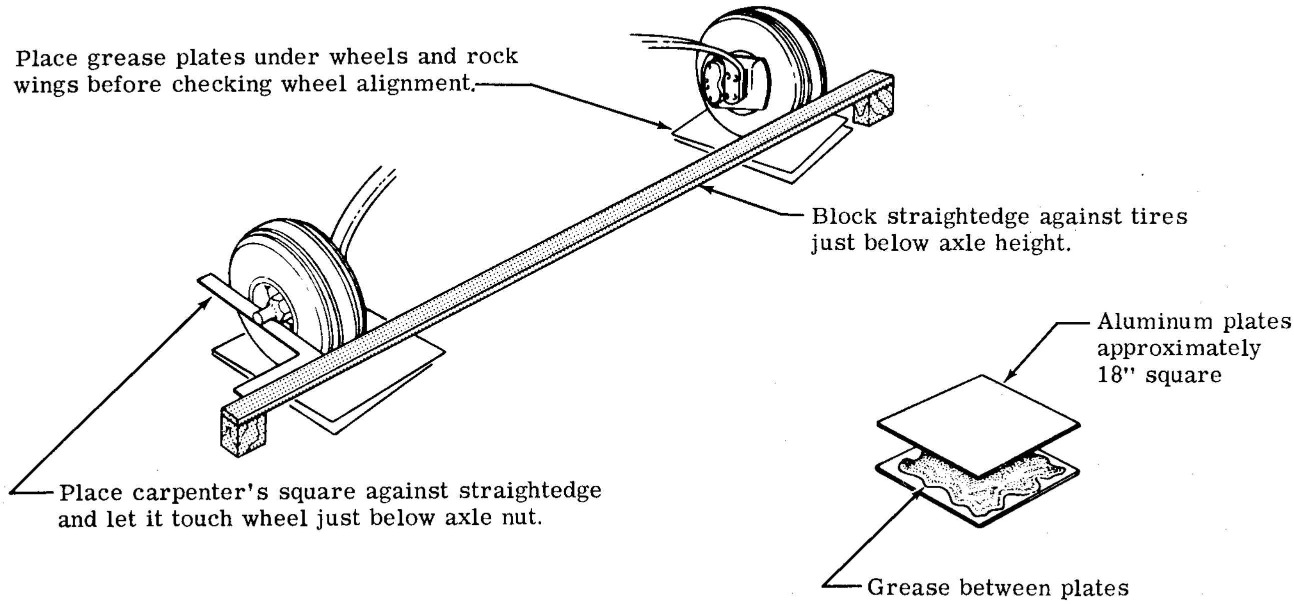
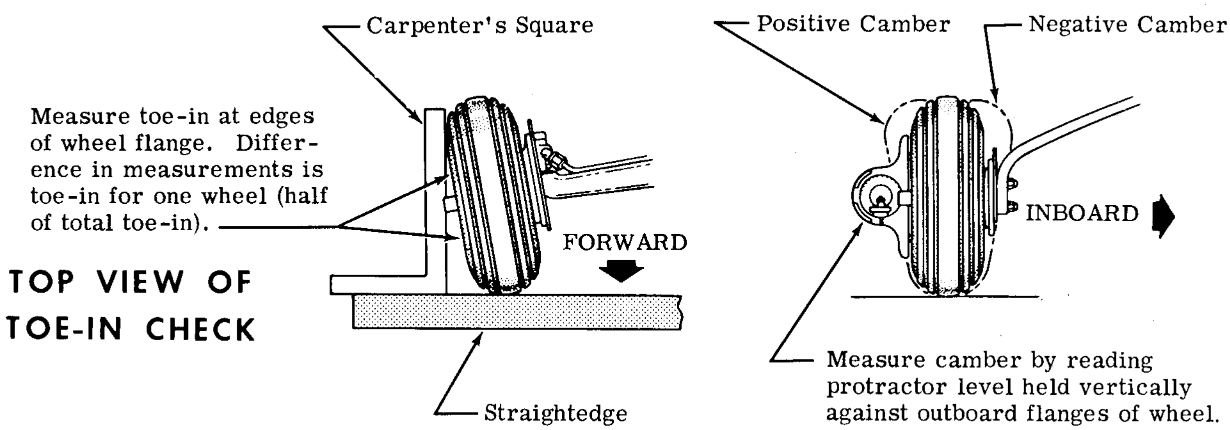


Figure 5-11. Main Gear Uplock Details





TOE-IN (TOTAL OF BOTH WHEELS) -------- 0" to .06"

POSITIVE CAMBER (EACH WHEEL) ----- 1°30' to 4°30'

NOTE

Setting toe-in and camber within these tolerances while the cabin and fuel tanks are empty will give approximately zero toe-in and zero camber at gross weight. Ideal setting is zero toe-in and zero camber at normal operating weight. Therefore, if normally operated at less than gross weight and abnormal tire wear occurs, realign the wheels to attain the ideal setting for the load conditions under which the airplane normally operates. Refer to the following page for shims available and their usage. Always use the least number of shims possible to obtain the desired result.

Figure 5-12. Main Wheel Alignment (Sheet 1 of 2)

SHIM CHART					
SHIM PART NO.	POSITION OF THICKEST CORNER OR EDGE OF SHIM	CORRECTION IMPOSED ON WHEEL			
		TOE-IN	TOE-OUT	POS. CAMBER	NEG. CAMBER
0541157-1	AFT FWD	.06" ----	---- .06"	---- 0°3'	0°3' ----
0541157-2	UP DOWN	.006" ----	---- .006"	0°30' ----	---- 0°30'
1241061-1	UP & FWD UP & AFT DOWN & FWD DOWN & AFT	.008" .04" ---- ----	---- ---- .04" .008"	2°50' 2°49' ---- ----	---- ---- 2°49' 2°50'
0441139-5	UP & FWD UP & AFT DOWN & FWD DOWN & AFT	---- .12" ---- .11"	.11" ---- .12" ----	0°25' 0°11' ---- ----	---- ---- 0°11' 0°25'
0441139-6	UP & FWD UP & AFT DOWN & FWD DOWN & AFT	---- .24" ---- .22"	.22" ---- .24" ----	0°50' 0°22' ---- ----	---- ---- 0°22' 0°50'

Figure 5-12. Wheel Alignment (Sheet 2 of 2)

5-57. MAIN WHEEL ALIGNMENT. Correct main wheel alignment is obtained through the use of tapered shims between the gear strut and the flange of the axle. See figure 5-12 for procedure to use in checking alignment. Wheel shims, and the correction imposed on the wheel by the various shims, are listed in the illustration.

NOTE

Failure to obtain acceptable wheel alignment through the use of the shims indicates a deformed main gear strut or strut attaching bulkhead out of alignment.

5-58. WHEEL BALANCING. Since uneven tire wear is usually the cause of wheel unbalance, replacing the tire probably will correct this condition. Tire and tube manufacturing tolerances permit a specified amount of static unbalance. The lightweight point of the tire is marked with a red dot on the tire sidewall and the heavyweight point of the tube is marked with a contrasting color line (usually near the valve stem). When installing a new tire, place these marks adjacent to each other. If a wheel becomes unbalanced during service, it may be statically rebalanced. Wheel balancing equipment is available from the Cessna Service Parts Center.

5-59. STEP BRACKET REPLACEMENT.

NOTE

The step bracket is secured to the landing gear spring strut with Conley-Weld, or a similar epoxy base adhesive.

a. Mark the position of the bracket so that the replacement bracket will be installed in approximately the same position.
b. Remove all traces of the original adhesive as well as any rust, paint, or scale with a wire brush and coarse sandpaper.
c. Leave surfaces slightly roughened or abraided, but deep scratches or nicks should be avoided.
d. Clean the surfaces to be bonded thoroughly. If a solvent is used, remove all traces of the solvent with a clean, dry cloth. It is important for the surfaces to be clean and dry.
e. Check the fit of the step bracket on the spring. A gap of not more than 1/32 inch is permissible.
f. Mix the adhesive carefully according to manufacturer's directions.
g. Spread a coat of adhesive on the surfaces to be bonded, and place step bracket in position on the spring. Tap the bracket upward to insure a tight fit.
h. Form a small fillet of the adhesive at all edges of the bonded surfaces. Remove excess adhesive with lacquer thinner.

i. Allow the adhesive to cure thoroughly according to manufacturer's recommendations before flexing the gear spring or apply loads to the step.

j. Repaint gear spring and step bracket after curing is complete.

5-60. MAIN GEAR DOOR SYSTEM.

5-61. Main gear doors, shown in figure 5-13, open for main gear retraction or extension and return to closed position at the completion of either cycle. The strut doors are opened and closed by a double-acting hydraulic actuator. The wheel doors are actuated by a double-actuating hydraulic actuator for each door. Each door actuator contains an internal locking device to hold the doors in the closed position when the actuator is retracted. This lock is released on first flow of hydraulic pressure to the door system.

5-62. REMOVAL AND INSTALLATION OF MAIN WHEEL DOORS.

a. Open landing gear doors.

b. Disconnect door from actuator linkage by removing pin or bolt.

c. Remove door hinge pins or bolts.

d. Install doors by reversing the preceding steps.

e. Rig doors in accordance with paragraph 5-119.

5-63. REMOVAL AND INSTALLATION OF MAIN WHEEL DOOR ACTUATOR.

a. Open landing gear doors.

b. Disconnect and cap or plug hydraulic hoses at actuator.

c. Disconnect actuator rod by removing attaching nut and bolt at door.

d. Remove nut and bolt attaching actuator to fuselage bracket and remove actuator.

e. Install actuator by reversing the preceding steps.

NOTE

Fill actuator with clean hydraulic fluid before installing.

f. After installation of actuator, rig doors and actuator in accordance with paragraph 5-119.

5-64. DISASSEMBLY AND REPAIR OF DOOR ACTUATOR. Refer to Appendix A for disassembly and repair of door actuating cylinders.

5-65. REMOVAL AND INSTALLATION OF MAIN GEAR STRUT DOORS.

a. Open landing gear doors.

b. Remove nut and bolt attaching push-pull rod to bracket on door.

c. Remove small cotter pin at forward end of hinge pin and pull hinge pin from door hinge. Door will fall free.

d. Install door by reversing the preceding steps.

e. Rig doors in accordance with paragraph 5-119.

5-66. REMOVAL AND INSTALLATION OF MAIN GEAR STRUT DOOR ACTUATOR.

a. Open landing gear doors.

b. Remove carpet and access covers as required for access to actuator.

c. Disconnect and cap or plug hydraulic hoses at actuator.

d. Disconnect actuator rod end by removing nut and bolt attaching rod end to bellcrank.

e. Remove bolt and nut attaching actuator to fuselage bracket and work actuator from aircraft. Retain spacers and washers.

f. Install actuator by reversing the preceding steps.

NOTE

Fill actuator with clean hydraulic fluid before installing.

g. Rig in accordance with paragraph 5-119.

5-67. DISASSEMBLY AND REPAIR OF MAIN GEAR STRUT DOOR ACTUATOR. Refer to Appendix A for disassembly and repair of the main gear strut door actuator.

5-68. RIGGING MAIN GEAR DOOR SYSTEM. Refer to paragraph 5-119 for rigging and adjustments to the main wheel and gear strut doors.

5-69. NOSE GEAR.

5-70. The nose gear shock strut is pivoted just forward of the firewall. Retraction and extension of the nose gear is accomplished by a double-acting hydraulic cylinder, the forward end of which contains the nose gear downlock. Initial action of the cylinder disengages the downlock before retraction begins. A separate single-acting hydraulic cylinder unlocks the nose gear uplock hook.

5-71. REMOVAL AND INSTALLATION OF NOSE WHEEL.

a. Weight the tail of the aircraft to raise the nose wheel off the ground.

b. Remove nose wheel axle bolt.

c. Use a rod or long punch inserted in ferrule to tap the opposite ferrule out of the nose wheel fork. Remove both ferrules and pull nose wheel from fork.

d. Remove spacers, axle tube and hub caps before disassembling the nose wheel.

e. Reverse the preceding steps to install the nose wheel. Tighten the axle bolt until a slight bearing drag is obvious when the wheel is turned. Back off the nut to the nearest castellation and install the cotter pin.

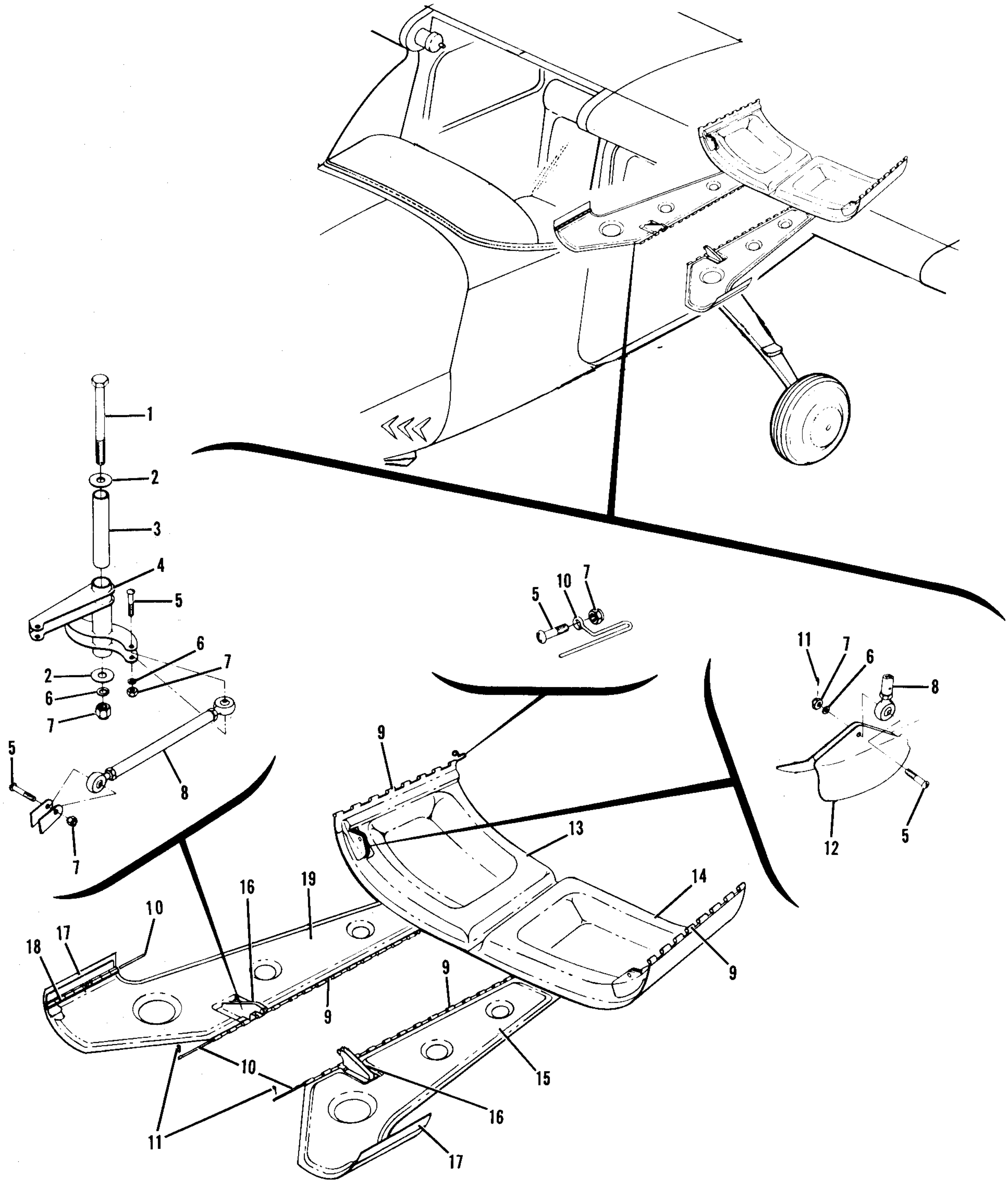
5-72. DISASSEMBLY OF NOSE WHEEL.

a. Remove valve core, completely deflate tire, and break tire beads loose.

WARNING

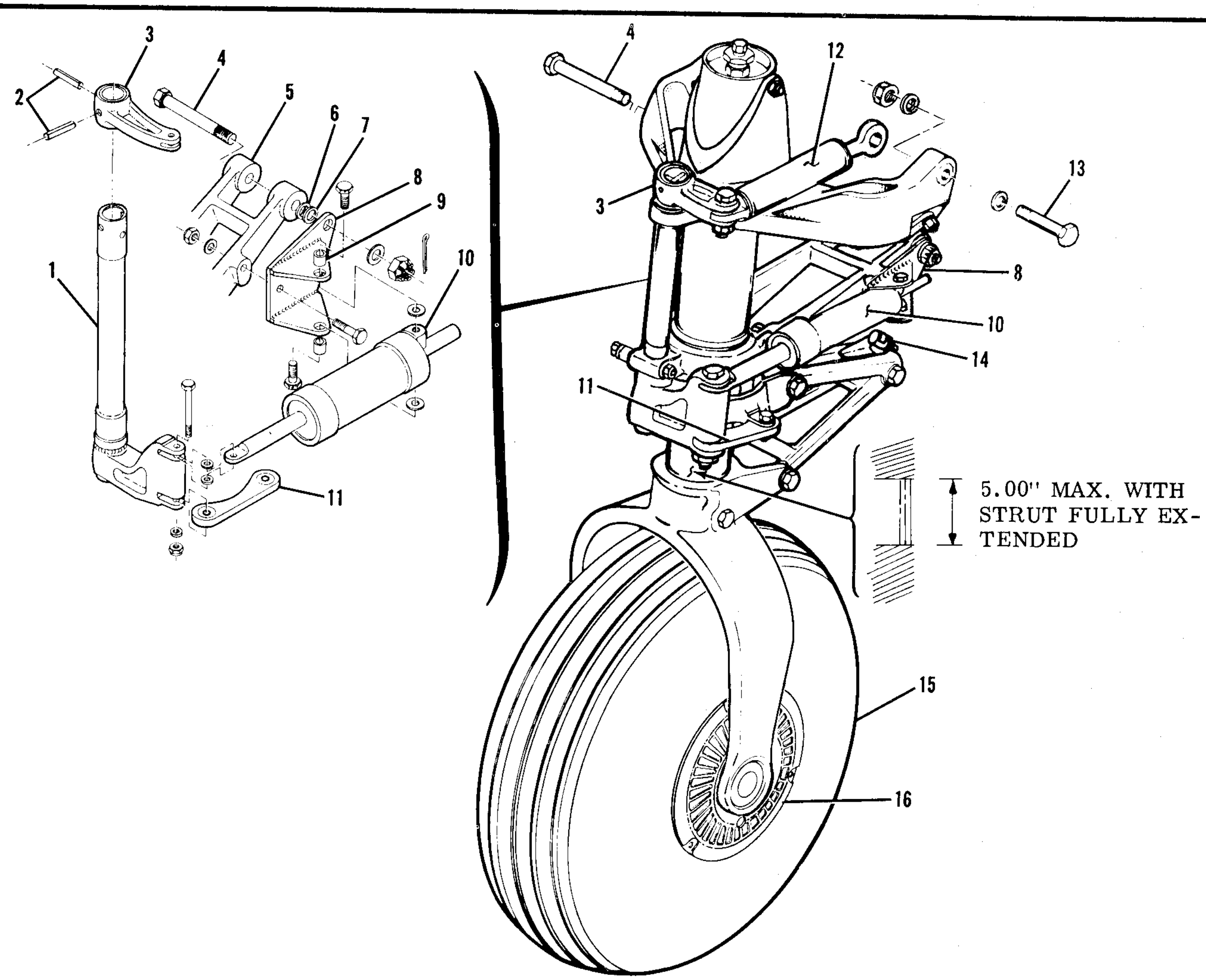
Injury can result from attempting to separate the wheel halves with the tire inflated. Avoid damaging the wheel flanges when breaking the tire beads loose.

b. Remove thru-bolts and separate wheel halves.



1. Bolt
2. Washer
3. Spacer
4. Strut Door Crank Assembly
5. Screw
6. Washer
7. Nut
8. Push-Pull Rod Assembly
9. Hinge Half
10. Hinge Pin
11. Cotter Pin
12. Bracket Assembly
13. Right Wheel Door
14. Left Wheel Door
15. Left Strut Door
16. Actuator Arm
17. Stub Door
18. Hinge Assembly
19. Right Strut Door

Figure 5-13. Main Landing Gear Doors



1. Steering Shaft
2. Roll Pin
3. Steering Arm
4. Bolt
5. Lower Trunnion
6. Thin Washer
7. Thick Washer
8. Bracket
9. Bushing
10. Shimmy Dampener
11. Link
12. Steering Bungee
13. Bolt
14. Safety Switch
15. Tire
16. Hub Cap

Figure 5-14. Nose Landing Gear (Sheet 2 of 2)

c. Remove tire and tube.
d. Remove bearing retaining rings, grease seals, and bearing cones.

NOTE

The bearing cups are a press fit in the wheel halves and should not be removed unless replacement is necessary. To remove, heat wheel half in boiling water for 15 minutes. Using an arbor press, if available, press out bearing cup and press in the new one while the wheel is still hot.

5-73. INSPECTION AND REPAIR OF NOSE WHEEL. Instructions given in paragraph 5-38 for the main wheels may be used as a guide for inspection and repair of the nose wheel.

5-74. ASSEMBLY OF NOSE WHEEL.
a. Place tube inside tire and align balance marks on tire and tube.
b. Place tire and tube on wheel half with tube valve stem through hole in wheel half.

WARNING

Uneven or improper torque of the thru-bolt nuts may cause bolt failure with resultant wheel failure.

c. Insert thru-bolts, position other wheel half, and secure with nuts and washers. Torque bolts to value marked on wheel.
d. Clean and repack bearing cones with clean wheel bearing grease.
e. Assemble bearing cones, seals, and retainers into wheel half.
f. Inflate tire to seat tire beads, then adjust to correct pressure.

5-75. WHEEL BALANCING. Refer to paragraph 5-58 for wheel balancing.

5-76. REMOVAL AND INSTALLATION OF NOSE GEAR ASSEMBLY.
a. Jack the aircraft or weight the tail of the aircraft to raise nose wheel off the ground.
b. Open landing gear doors and disconnect nose wheel doors push-pull rods.
c. Tag for identification and disconnect the electrical wires at the gear-down microswitch located on the nose gear actuator.
d. Tag for identification and disconnect the electrical wires at nose gear safety switch on torque links and remove clamps attaching wires to nose strut.
e. Disconnect steering bungee from steering bellcrank.
f. Disconnect nose gear actuator from strut by removing cotter pin, castellated nut, washers, and bolt. Retain spacer washers between downlock hooks on end of actuator.
g. Disconnect nose gear strut door push-pull rods from nose gear.
h. Remove trunnion bolts.

NOTE

The trunnion bolts are accessible from inside the cabin, at the very forward end of the tunnel cover. Two men will be required to remove these bolts, one working inside the cabin, the other working in the nose wheel well.

i. Work the entire nose gear assembly free of the aircraft.
j. Install the nose gear by reversing the preceding steps.
k. When connecting nose gear actuator to strut, lubricate and torque bolt as outlined in figure 2-6.
l. Rig nose gear and nose gear doors as outlined in paragraphs 5-124 through 5-130.

5-77. DISASSEMBLY OF NOSE GEAR STRUT. (See figure 5-15.) The following procedure applies to the nose gear shock strut after it has been removed from the aircraft, and the nose wheel has been removed. In many cases, separating the upper and lower struts will permit inspection and parts replacement without removal or complete strut disassembly.

WARNING

Deflate strut completely before removing bolt (33), lock ring (31), or bolt (2). Also deflate strut before disconnecting torque links.

a. Remove torque links. Note position of washers, shims, spacers, and bushings.
b. Remove shimmy dampener and steering bungee.
c. Remove link from steering shaft and collar.
d. Remove lock ring from groove inside of lower end of upper strut. A small access hole is provided at the lock ring groove to facilitate removal of lock ring.

NOTE

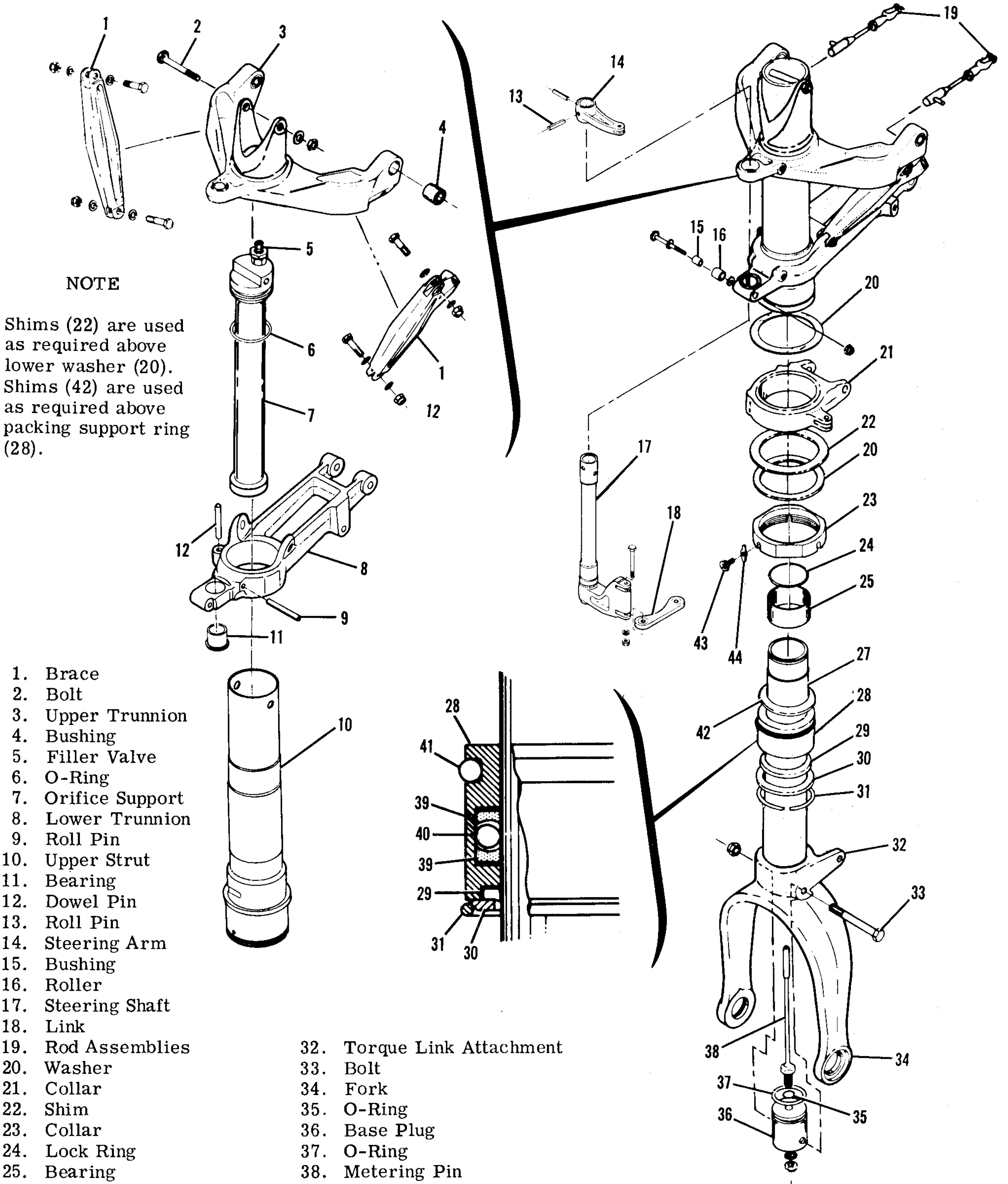
Hydraulic fluid will drain from strut as lower strut is pulled from the upper strut.

f. Using a straight, sharp pull, remove lower strut from upper strut. Invert lower strut and drain hydraulic fluid from strut.
g. Remove lock ring and bearing (figure 5-13) from lower strut.
h. Slide shims, if used, packing support ring, scraper ring, retaining ring, and lock ring, from lower strut. Note number of shims, relative position, and top side of each ring and bearing to aid in reassembly.
i. Remove and discard O-rings and back-up rings from packing support ring.
j. Remove metering pin and base plug by removing bolt from lower strut and fork assembly.

NOTE

Lower strut and fork are a press fit, drilled on assembly. Separation of these parts is not recommended, except for replacement of parts.

k. Remove and discard O-rings from metering pin



NOTE

Shims (22) are used as required above lower washer (20). Shims (42) are used as required above packing support ring (28).

1. Brace
2. Bolt
3. Upper Trunnion
4. Bushing
5. Filler Valve
6. O-Ring
7. Orifice Support
8. Lower Trunnion
9. Roll Pin
10. Upper Strut
11. Bearing
12. Dowel Pin
13. Roll Pin
14. Steering Arm
15. Bushing
16. Roller
17. Steering Shaft
18. Link
19. Rod Assemblies
20. Washer
21. Collar
22. Shim
23. Collar
24. Lock Ring
25. Bearing
26. Deleted
27. Lower Strut
28. Packing Support Ring
29. Scraper Ring
30. Retaining Ring
31. Lock Ring
32. Torque Link Attachment
33. Bolt
34. Fork
35. O-Ring
36. Base Plug
37. O-Ring
38. Metering Pin
39. Back-Up Ring
40. O-Ring
41. O-Ring
42. Shim
43. Bolt
44. Tab Washer

Figure 5-15. Nose Gear Shock Strut

and base plug.

l. Remove orifice support by removing bolt at top of strut. Remove and discard O-ring from orifice support.

m. Remove collar from upper strut. To remove collar, remove bolt and tab washer. Remove washers, shims, if installed, and steering collar.

n. Bushings and bearings in upper trunnion and lower trunnion may be replaced as required. Needle bearing in collar should not be replaced; replace the steering collar if needle bearing is defective.

NOTE

Upper and lower trunnions are press-fitted to the upper strut with braces installed during assembly. Pin is also press-fitted to the lower trunnion.

5-78. ASSEMBLY OF NOSE GEAR STRUT. (See figure 5-15.)

a. Thoroughly clean all parts in solvent and inspect them carefully. Replace all worn or defective parts and all O-rings, seals, and back-up rings with new parts.

b. Assemble the strut by reversing the order of the procedure outlined in paragraph 5-77 with the exception that special attention must be paid to the following procedures.

c. Sharp metal edges should be smoothed with No. 400 emery paper, then thoroughly cleaned with solvent.

d. Used sparingly, Dow Corning DC-4 compound is recommended for O-ring lubrication. All other internal parts should be liberally coated with hydraulic fluid during assembly.

NOTE

Cleanliness and proper lubrication, along with careful workmanship are important during assembly of the shock strut.

e. Lubricate needle bearings as shown in figure 2-6 before installing.

f. When installing collar, screw it onto the upper strut until it is flush with bottom end of the strut, to the nearest one-third turn. Use shims as required above lower washer to fill gap between collars. Use a new tab washer to safety bolt. Shims are available from the Cessna Service Parts Center as follows:

1243030-5 .... 0.006"
-6 .... 0.012"
-7 .... 0.020"

g. Install the contoured back-up rings, one on each side of O-ring with concave surface of back-up ring next to the O-ring.

h. If new parts are being installed, place packing support ring, scraper ring, retaining ring, in the upper strut and install lock ring. Measure the up-down movement of the packing support ring in the upper strut. Shims are used as required above packing support ring to eliminate up-down movement of the packing support ring. Remove packing support ring from upper strut.

i. Slide lock ring, retaining ring, scraper ring, packing support ring, and required shims on lower strut.

j. When installing bearing at top of the lower strut, be sure that beveled edge of bearing is installed up next to lock ring.

k. When installing lock ring, position lock ring so that one of its ends covers the small access hole in the lock ring groove in the botton of the upper strut.

l. When installing shimmy dampener, do not tighten attaching bolts to a torque value in excess of 10 lb-in.

m. Tighten torque link center bolt snug, then tighten to next castellation and install cotter pin.

n. Service the shock strut with hydraulic fluid and compressed air and install strut in aircraft.

NOTE

It is easier to service the shock strut just before installation, although it may be serviced after installation if desired. Refer to paragraph 2-22.

o. When assembling and attaching the nose gear actuator and downlock mechanism, lubricate and torque attaching bolt as shown in figure 2-6.

5-79. TORQUE LINKS. The torque links are shown in figure 5-17, which may be used as a guide for removal, disassembly, assembly, and installation. Grease fittings and torque link bushings should not be removed except for replacement. Excessively worn parts should be replaced. Always deflate nose gear strut before disconnecting the torque links.

5-80. SHIMMY DAMPENER. The shimmy dampener is illustrated in figure 5-16.

5-81. REMOVAL AND INSTALLATION. Figure 5-16 may be used as a guide for removal, disassembly, and installation. Replace any parts found defective. When assembling shimmy dampener, use new O-rings and back-up rings. Lubricate parts during assembly with clean hydraulic fluid. Refer to paragraph 2-22 for shimmy dampener servicing procedures. When installing shimmy dampener, do not tighten attaching bolts to a torque value in excess of 10 lb-in.

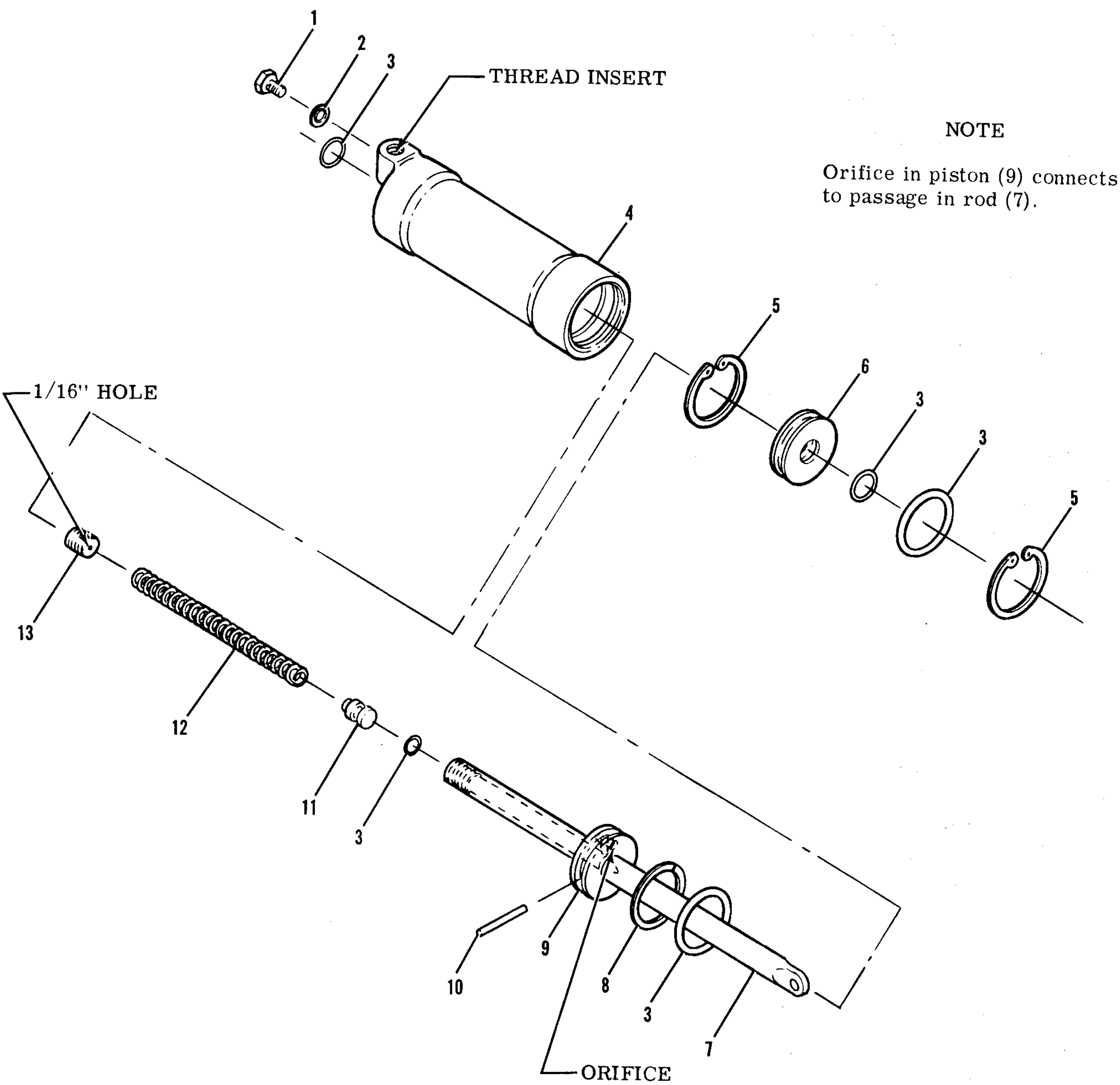
5-82. NOSE GEAR ACTUATOR. The double-acting nose gear actuator extends and retracts the nose gear and serves as a rigid drag strut in the gear-down position. The claw-like hook on the actuator serves as the downlock for the nose gear. An internal lock position-locks the piston within the cylinder until hydraulic pressure of approximately 125 psi is applied to the gear up port of the actuator.

5-83. REMOVAL OF NOSE GEAR ACTUATOR.

a. Tag for identification and disconnect the electrical wires at the gear-down switch located on the forward end of the actuator.

b. Jack aircraft or weight down the tailcone of the aircraft to raise the nose wheel off the ground.

c. Disconnect hydraulic hose from actuator. Cap or plug hose and fitting openings to prevent entry of foreign material.



1. Filler Plug	5. Retainer	10. Roll Pin
2. Stat-O-Seal	6. Bearing Head	11. Floating Piston
3. O-Ring	7. Rod	12. Spring
4. Barrel	8. Back-Up Ring	13. Set Screw
	9. Piston	

Figure 5-16. Shimmy Dampener

d. Disconnect nose gear actuator from strut by removing cotter pin, castellated nut, washers, and bolt. Retain individual parts of downlock mechanism, which will be freed by bolt removal.

e. At aft end of actuator remove nut, washer, and bolt attaching actuator to fuselage structure. Tap bolt with a fiber drift or mallet for removal. With bolt removed, actuator is freed.

5-84. DISASSEMBLY AND REPAIR OF NOSE GEAR ACTUATOR. Refer to Appendix A for disassembly and repair of the nose gear actuator.

5-85. INSTALLATION OF NOSE GEAR ACTUATOR.

NOTE

Before installing the nose gear actuator, check the condition and fit of attaching bolts and bushings. Replace any defective parts. Fill actuator with hydraulic fluid.

a. Attach aft end of actuator to fuselage structure with bolt, washer and nut.

b. Connect hydraulic hose to actuator.

c. Connect electrical wire to gear-down switch.

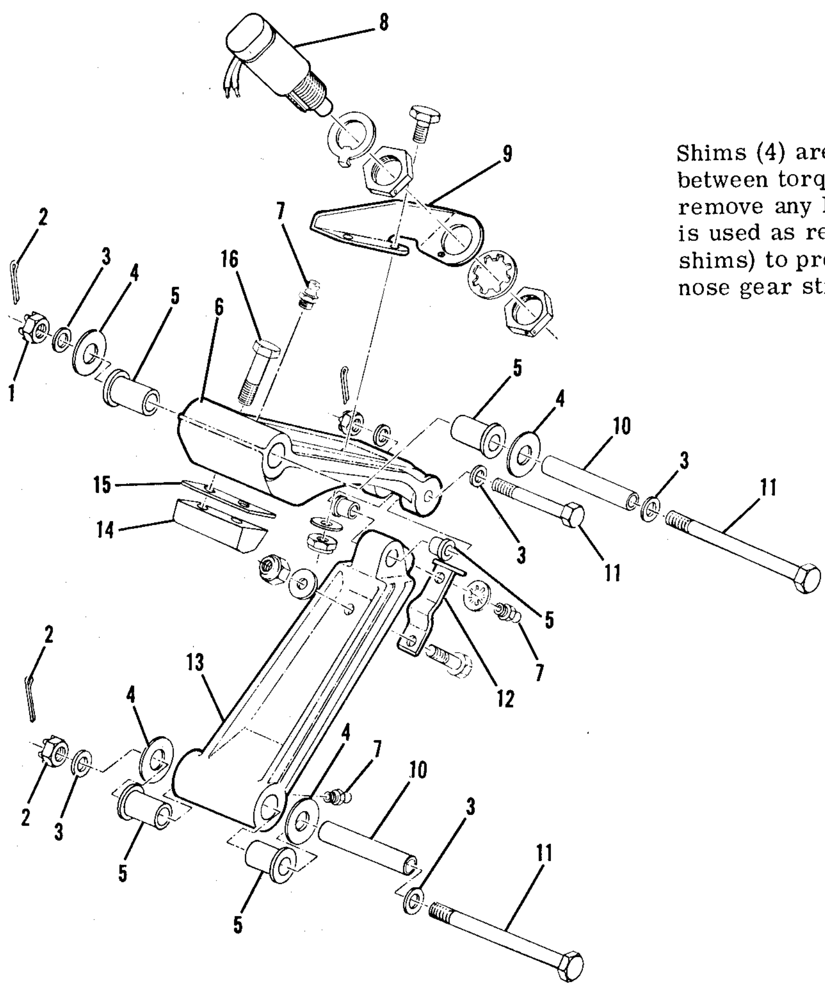
d. Attach the actuator to the strut with bolt, washers, and nut. Safety nut with a cotter pin.

NOTE

When assembling and attaching the nose gear downlock mechanism to strut, lubricate and torque attaching bolt as shown in figure 2-6.

e. Adjust nose gear down indicator switch as outlined in paragraph 5-127.

5-86. NOSE GEAR UPLOCK MECHANISM. Figure 5-25 shows the nose gear uplock mechanism. The uplock hook is located at the top of the nose wheel well and is released by a hydraulically operated actuator also located in the nose wheel well.



NOTE

Shims (4) are available to use as required between torque link and nose gear fork to remove any looseness. Also, shim (15) is used as required (maximum of three shims) to prevent over extension of the nose gear strut. Refer to figure 5-14.

1. Nut
2. Cotter Pin
3. Washer
4. Shim
5. Bushing
6. Upper Torque Link
7. Grease Fitting
8. Safety Switch
9. Bracket
10. Spacer
11. Bolt
12. Switch Actuator
13. Lower Torque Link
14. Centering Lug
15. Shim
16. Bolt

Figure 5-17. Torque Links

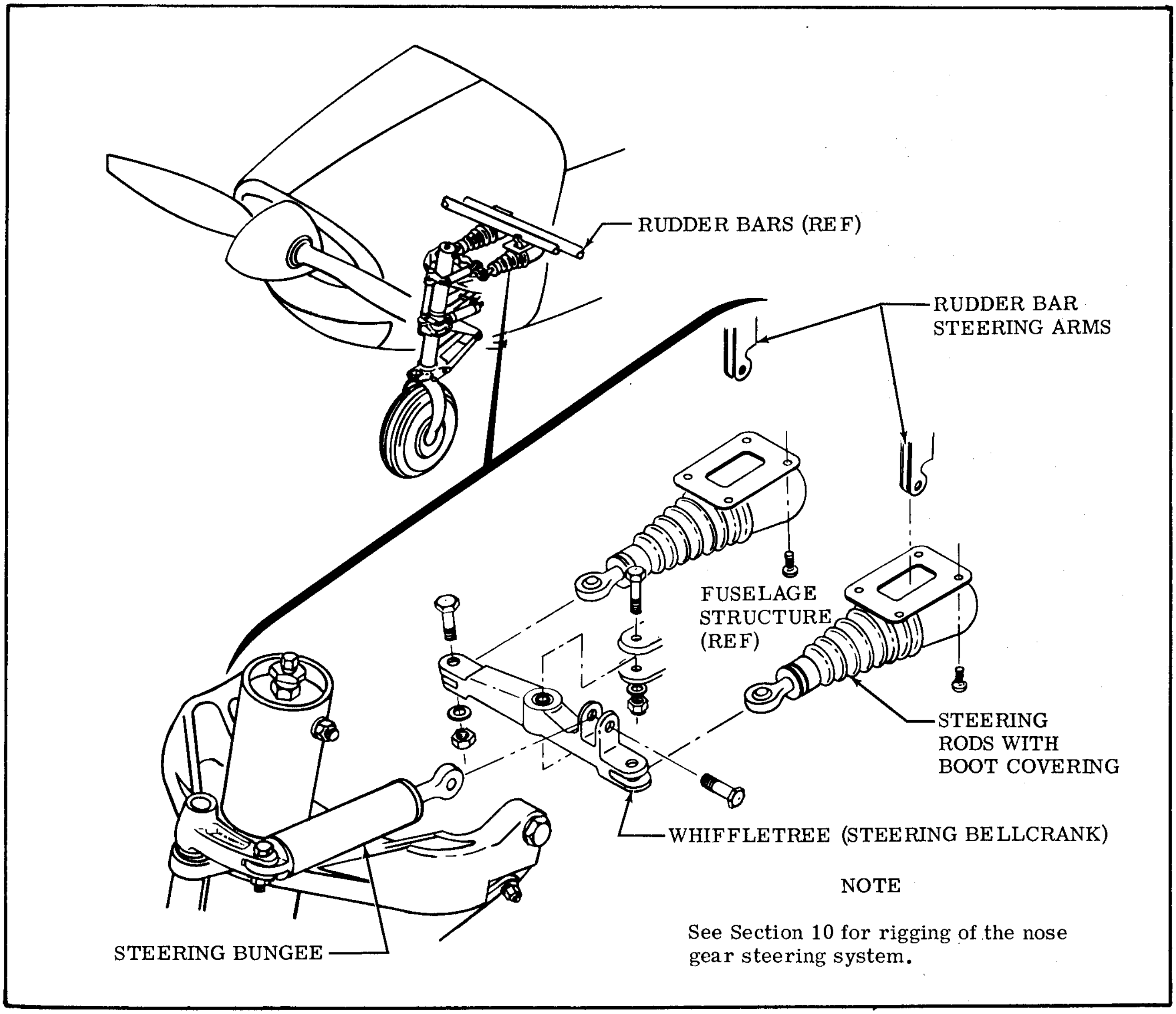


Figure 5-18. Nose Wheel Steering System

5-87. REMOVAL AND INSTALLATION OF NOSE GEAR UPLOCK AND RELEASE ACTUATOR.

a. Disconnect uplock spring.

b. Disconnect and cap or plug hydraulic lines at actuator.

c. Disconnect and tag electrical wires at up limit switch.

d. Remove four nuts and washers attaching up-lock mechanism to top of nose wheel well. Remove up-lock mechanism and actuator from aircraft.

e. Remove cotter pin and clevis pin attaching actuator to uplock mechanism.

f. Remove nuts, washers and screws attaching actuator to uplock mechanism.

g. Install uplock mechanism and actuator by reversing the preceding steps.

h. Rig up-limit switch as shown in figure 5-26.

5-88. DISASSEMBLY AND REPAIR OF UPLOCK RELEASE ACTUATOR. Refer to Appendix A for disassembly and repair of uplock release cylinder.

5-89. RIGGING. Refer to paragraphs 5-124 and 5-126 for nose gear rigging and adjustments.

5-90. NOSE WHEEL STEERING SYSTEM. The nose wheel steering system links the rudder pedals to the nose wheel fork, affording steering control through the use of the rudder pedals. The steering linkage straightens the nose wheel as the landing gear is retracted.

5-91. REMOVAL AND INSTALLATION. Figure 5-18 shows details of the nose wheel steering system and may be used as a guide for parts replacement.

5-92. RIGGING. Since the nose wheel steering is connected to the rudder control system, refer to Section 10 for rigging of the system.

5-93. NOSE GEAR DOOR SYSTEM.

5-94. The nose gear doors are shown in figure 5-19. The nose gear forward doors open for nose gear retraction or extension and close again when the cycle is completed. These doors are held in the closed position by an internal lock in the actuator until hydraulic pressure of approximately 125 psi is applied to the anchor port of the actuator. Actuating of the nose gear forward doors is by a double-acting hydraulic cylinder. The nose gear aft doors are mechanically linked to the nose gear trunnion. These doors open as the gear extends and close as it is retracted.

5-95. REMOVAL AND INSTALLATION OF NOSE WHEEL DOORS.
a. Open landing gear doors.
b. Remove engine cowl.
c. Disconnect push-pull rod from bracket on door by removing nut, bolt and washers.
d. Remove nuts and bolts attaching each hinge pivot. Work from upper side of cowl opening to remove bolts. Retain bushings in hinge pivot.
e. To replace the nose wheel doors, reverse the preceding steps.
f. Rig as outlined in paragraph 5-99.

5-96. REMOVAL AND INSTALLATION OF NOSE WHEEL DOOR MECHANISM. (See figure 5-19.)
a. Open landing gear doors.
b. Disconnect actuator at torque tube by removing nut, washer, and bolt.
c. Disconnect and cap or plug hydraulic hose at actuator.
d. Remove nut, washer, and bolt attaching actuator to its mounting bracket in nose wheel well.
e. Disconnect door push-pull rods at door bracket.
f. Remove torque tube by removing nuts, washer and bolts securing it to its mounting brackets.
g. For installation, reverse the preceding steps.
h. Rig as outlined in paragraph 5-99.

5-97. DISASSEMBLY AND REPAIR OF NOSE WHEEL DOOR ACTUATOR. Refer to Appendix A for disassembly and repair of nose wheel door actuator.

5-98. REMOVAL AND INSTALLATION OF NOSE GEAR STRUT DOORS.
a. Disconnect door rod assemblies from door.
b. Remove screw, washer, and nut securing door hinge pin and pull hinge pin from door hinge allowing door to be removed.
c. To remove door rod assemblies, remove nut securing tie-rod to nose gear trunnion. Do not change length of rod assembly unless necessary; changing rod assembly length will make readjustment necessary on installation.
d. Install strut doors and linkage by reversing the preceding steps and rig doors in accordance with paragraph 5-99.

5-99. RIGGING. Refer to paragraphs 5-124 and 5-130 for nose gear door system rigging and adjustments.

5-100. BRAKE SYSTEM.

5-101. The hydraulic brake system consists of two master cylinders, brake lines connecting each master cylinder to its wheel brake cylinder, and the single-disc type brake assembly, located at each main landing gear wheel.

5-102. TROUBLE SHOOTING THE BRAKE SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DRAGGING BRAKES.		
Brake pedal binding.	If brake pedals fail to return properly, check pedal for binding.	Check and adjust properly.
Parking brake linkage holding brake pedal down.	Check parking brake if pedal fails to return when released.	Check and adjust properly.
Worn or broken piston return spring. (In master cylinder.)	If brake pedal fails to return after it is released and linkage is not binding, the master cylinder is faulty.	Repair or replace master cylinder.
Insufficient clearance at Lock-O-Seal in master cylinder.	If pressure remains in brake system when pedals are released, disassemble master cylinder and check Lock-O-Seal clearance.	Adjust as shown in figure 5-21.

5-102. TROUBLE SHOOTING THE BRAKE SYSTEM. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DRAGGING BRAKES.		
Restriction in hydraulic lines or restriction in compensating port in master brake cylinders.	Jack up wheel to be checked. Have someone apply and then release brakes. Wheel should rotate freely as soon as brakes are released. If wheel fails to rotate freely, loosen brake line at brake housing to relieve any pressure trapped in the line. If wheel now turns freely, the brake line is restricted or there is a restriction in the brake master cylinder.	Drain brake lines and clear the inside of the brake line with filtered compressed air. Fill and bleed brakes. If cleaning the lines fails to give satisfactory results, the master cylinder may be faulty and should be repaired.
Worn, scored or warped brake discs.	Visually check discs.	Replace brake disc and linings.
Damage or accumulated dirt restricting free movement of wheel brake parts.	Check parts for freedom of movement.	Clean and repair or replace parts as necessary
BRAKES FAIL TO OPERATE.		
Leak in system.	Check entire system for leaks.	If brake master cylinders or wheel brake assemblies are leaking, they should be repaired or replaced.
Air in system.		Bleed system.
Lack of fluid in master cylinders.	Check fluid level.	Fill and bleed if necessary.
Master cylinder defective.		Repair or replace master cylinder.

5-103. BRAKE MASTER CYLINDERS. The brake master cylinders, located just forward of the pilot's rudder pedals, are actuated by applying toe pressure at the top of the rudder pedals. A small reservoir is incorporated into each master cylinder to supply it with fluid. Where dual brakes are installed, mechanical linkage permits the copilot's pedals to operate the master cylinders.

5-104. REMOVAL AND INSTALLATION OF BRAKE MASTER CYLINDERS.

a. Remove bleeder screw at wheel brake assembly and drain hydraulic fluid from brake system.

b. Remove front seats and rudder bar shield for access to brake master cylinders.

c. Disconnect parking brake linkage and brake master cylinders from rudder pedals.

d. Disconnect brake master cylinders at bottom attach points.

e. Disconnect hydraulic hose from brake master cylinders and remove cylinders.

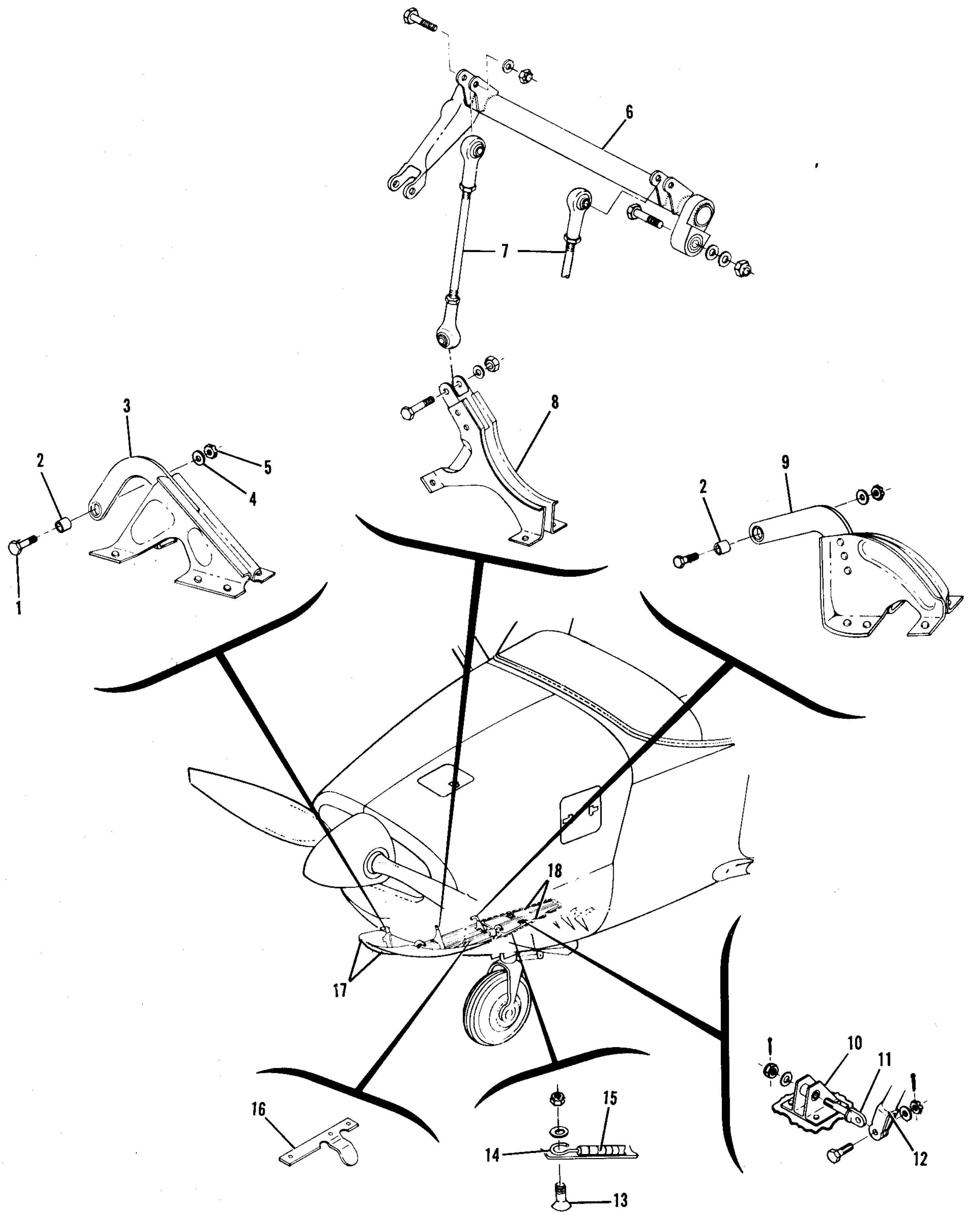
f. Plug or cap hydraulic fittings, lines, and hose to prevent entry of foreign materials.

g. Reverse the preceding steps to install brake master cylinders, then fill and bleed brake system in accordance with paragraph 5-114.

5-105. DISASSEMBLY AND REPAIR OF BRAKE MASTER CYLINDERS. Figure 5-21 may be used as a guide during disassembly and assembly of the brake master cylinders. Repair is limited to replacement of parts, cleaning, and adjustment. Use clean hydraulic fluid as a lubricant during assembly of the cylinders.

5-106. HYDRAULIC BRAKE LINES are of rigid aluminum tubing, except for flexible hose used at the brake master cylinders. A separate line is used to connect each brake cylinder to its corresponding wheel brake cylinder.

5-107. WHEEL BRAKE ASSEMBLIES. The wheel brake assemblies use a disc which is attached to the main wheel with the wheel thru-bolts, and a floating brake assembly. See figure 5-22.



1. Bolt
2. Bushing
3. Front Hinge
4. Washer
5. Nut
6. Torque Tube Assembly
7. Push-Pull Rod Assembly
8. Center Hinge
9. Rear Hinge
10. Tee Assembly
11. Eyebolt
12. Push-Pull Rod Assembly
13. Screw
14. Hinge Pin
15. Strut Door Hinge
16. Guide Clip
17. Wheel Doors
18. Strut Doors

Figure 5-19. Nose Landing Gear Doors

5-108. REMOVAL OF WHEEL BRAKES. Wheel brake assemblies are a floating type and can be removed after disconnecting the brake line and removing the back plates.

NOTE

The brake disc can be removed after wheel removal and disassembly. To remove the torque plate, remove the wheel and axle in accordance with paragraph 5-41.

5-109. INSPECTION AND REPAIR OF WHEEL BRAKES.

a. Clean all parts except brake linings and O-rings in dry cleaning solvent and dry thoroughly.

b. O-rings are usually replaced at each overhaul. If their re-use is necessary, they should be wiped with a clean cloth soaked in hydraulic fluid and inspected for damage.

NOTE

Thorough cleaning is important. Dirt and chips are the greatest single cause of malfunctions in the hydraulic brake system.

c. Check brake linings for deterioration and maximum permissible wear. See paragraph 5-112.

d. Inspect brake cylinder bore for scoring. A scored cylinder may leak or cause rapid O-ring wear. A scored brake cylinder should be replaced.

e. If the anchor bolts on the brake assemblies are nicked or gouged, they should be sanded smooth to prevent binding with the pressure plate or torque plate. When the anchor bolts are replaced they should be pressed out. New bolts can be installed by tapping in place with a soft hammer.

5-110. ASSEMBLY OF WHEEL BRAKES. Lubricate parts with hydraulic fluid and assemble components

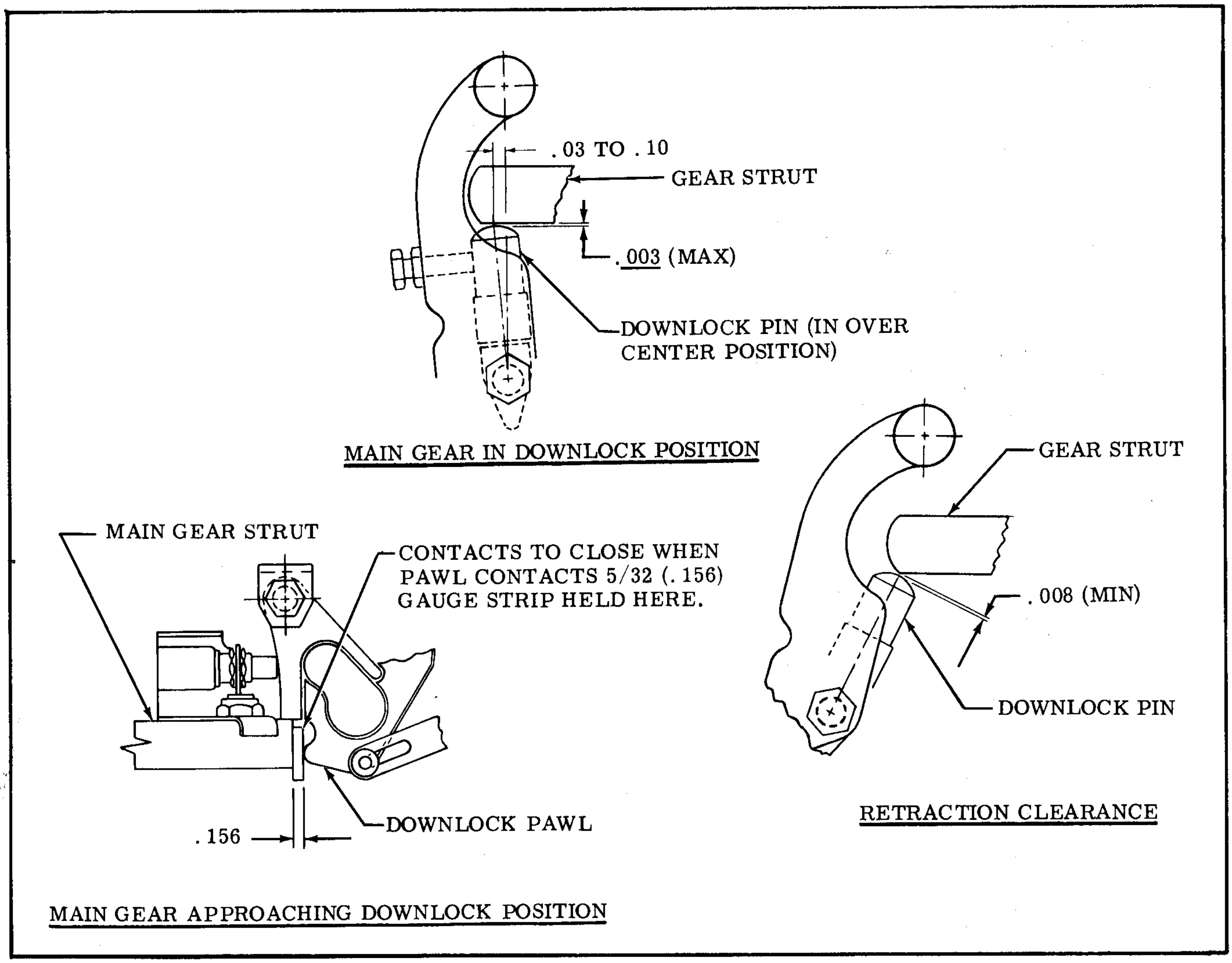
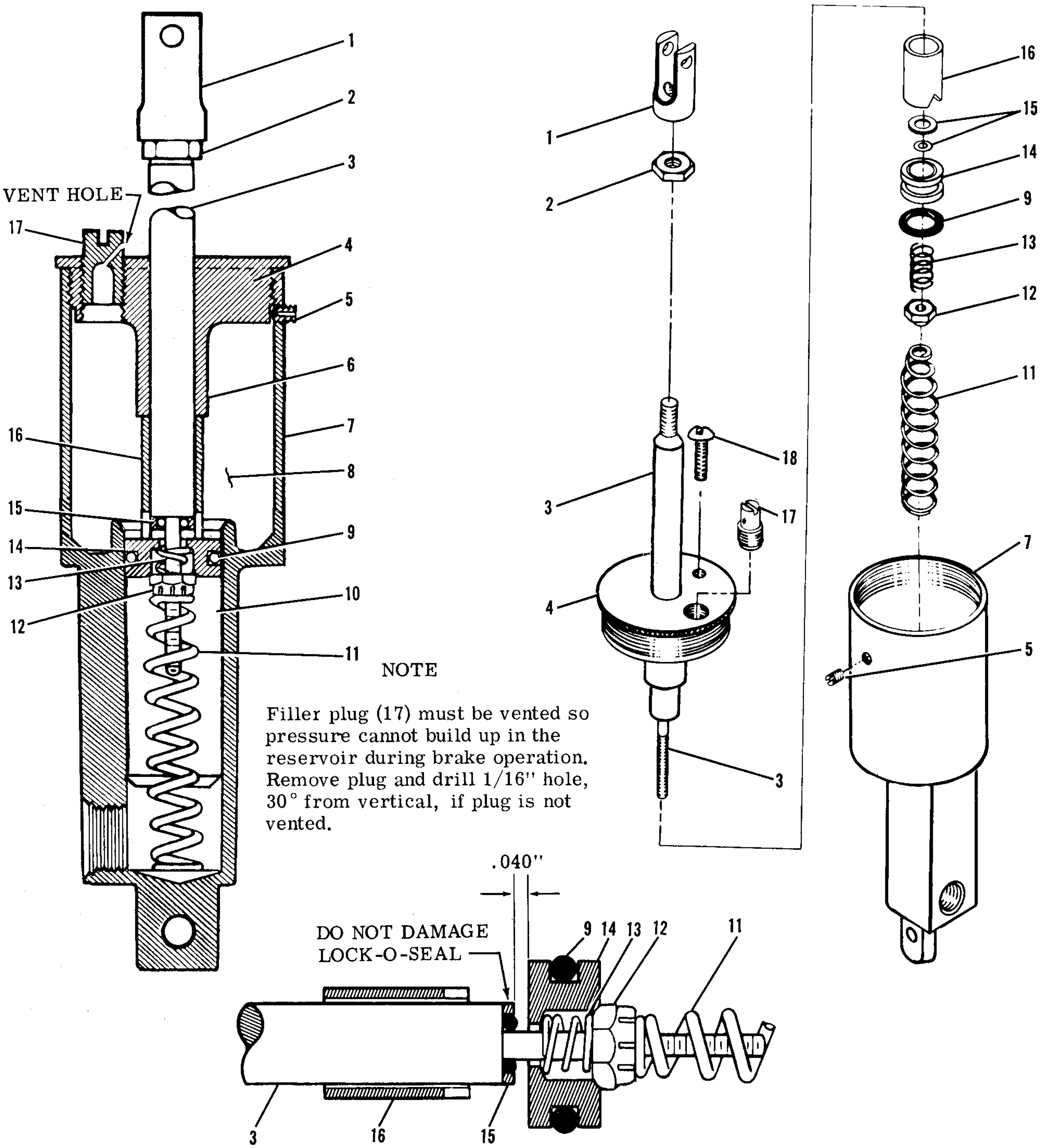
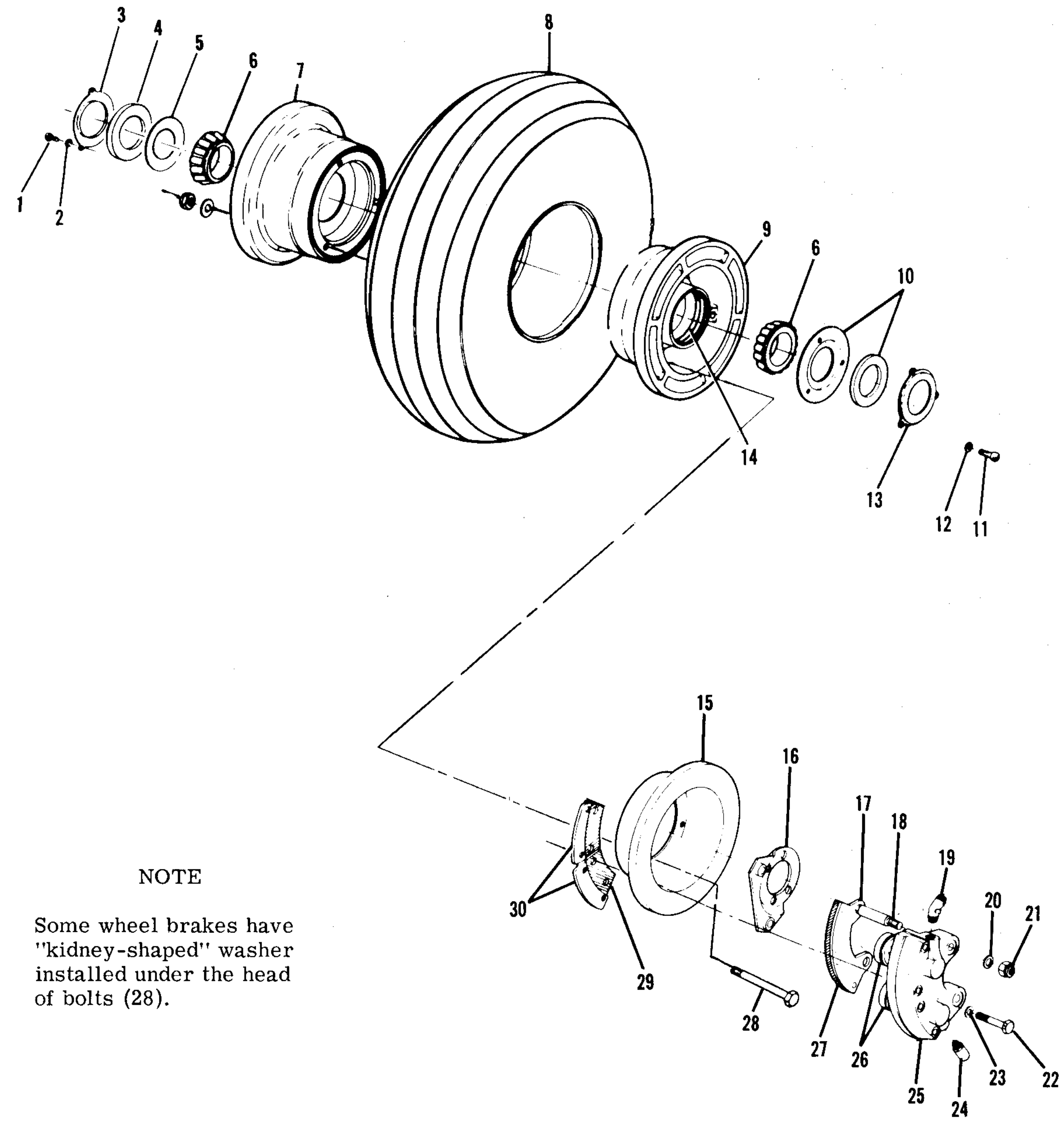


Figure 5-20. Main Gear Downlock Clearances



1. Clevis
2. Jamb Nut
3. Piston Rod
4. Cover
5. Setscrew
6. Cover Boss
7. Body
8. Reservoir
9. O-Ring
10. Cylinder
11. Piston Return Spring
12. Nut
13. Piston Spring
14. Piston
15. Lock-O-Seal
16. Compensating Sleeve
17. Filler Plug
18. Screw

Figure 5-21. Brake Master Cylinder



NOTE

Some wheel brakes have "kidney-shaped" washer installed under the head of bolts (28).

1. Screw
2. Lockwasher
3. Grease Seal Ring
4. Felt Seal
5. Grease Seal Ring
6. Bearing Cone
7. Outer Wheel Half
8. Tire and Tube
9. Inner Wheel Half
10. Grease Seal Plate and Felt
11. Screw
12. Washer
13. Grease Seal Ring
14. Bearing Cup
15. Brake Disc
16. Torque Plate
17. Pressure Plate
18. Anchor Bolt
19. Hydraulic Fitting
20. Washer
21. Nut
22. Bolt
23. Washer
24. Bleeder Cap
25. Brake Cylinder
26. Piston
27. Brake Lining
28. Bolt
29. Brake Lining
30. Back Plate

Figure 5-22. Wheel and Brakes

with care to prevent damage to O-rings. Refer to figure 5-10 during assembly of wheel brakes.

5-111. INSTALLATION OF WHEEL BRAKES. Place the brake assembly in position with pressure plate in place, then install back plate and safety the attaching bolts. If the torque plate was removed, install as the wheel and axle are installed. If the brake disc was removed from the wheel, install as the wheel is assembled.

5-112. CHECKING BRAKE LININGS. The brake linings should be replaced when they are worn to a minimum thickness of 3/32 inch. Visually compare a 3/32-inch strip of material held adjacent to each lining to measure the thickness of the lining. The shank end of correct size drill bits make excellent tools for checking minimum thickness of brake linings.

5-113. BRAKE LINING REPLACEMENT. (See figure 5-10.)

a. Remove bolts, washers, and back plate.
b. Pull the brake cylinder out of torque plate and slide pressure plate off anchor bolts.
c. Place back plate on a table with lining side down flat. Center a 9/64-inch (or slightly smaller) punch in the rolled rivet, and hit the punch crisply with a hammer. Punch out all rivets securing the linings to the back plate and pressure plate in the same manner.

NOTE

A rivet setting kit, Part No. R561, is available from the Cessna Service Parts Center. This kit consists of an anvil and punch.

d. Clamp the flat sides of the anvil in a vise.
e. Align new lining on back plate and place brake rivet in hole with the rivet head in the lining. Place rivet head against the anvil.
f. Center the rivet setting punch on the lips of the rivet. While holding the back plate down firmly against the lining, hit the punch with a hammer to set the rivet. Repeat blows on the punch until lining is firmly against the back plate.
g. Realign the lining on the back plate and install rivets in remaining holes.
h. Install a new lining on pressure plate in the same manner.
i. Position pressure plate on anchor bolts, and place cylinder in position so the anchor bolts slide into torque plate.
j. Install the back plates with bolts and washers. Safety wire the bolts.

5-114. BRAKE BLEEDING. Standard bleeding, with a clean hydraulic pressure source connected to the wheel cylinder bleeder, is recommended.

a. Remove brake master cylinder filler plug and screw a flexible hose with a suitable fitting into the filler hole. Immerse the free end of the hose in a container with enough hydraulic fluid to cover the end of the hose.
b. Connect a clean hydraulic pressure source, such as a hydraulic hand pump or Hydro Fill unit, to the bleeder valve in the wheel cylinder.
c. As fluid is pumped into the system, observe the immersed end of the hose at the brake master cylinder for evidence of bubbles being forced from the brake system. When bubbling has ceased, remove the bleeder source from the brake wheel cylinder and tighten the bleeder valve.

NOTE

Ensure that the free end of the hose from the brake master cylinder remains immersed during the entire bleeding process.

d. Remove hose from brake master cylinder and replace filler plug. Be sure vent hole in filler plug is open.

5-115. RIGGING OF MAIN LANDING GEAR.

NOTE

All of the following rigging adjustments should be accomplished with the aircraft on jacks. To rig the main gear downlock pawls, it is necessary that the aircraft be level. Since the engine-driven pump cannot be used to supply pressure for these rigging procedures, a Hydro Test or other ground hydraulic power source should be used.

5-116. RIGGING OF ADJUSTING SUPPORT. (See figure 5-10.) The adjusting support is bolted to the outboard forging and forms the down stop for the main gear.

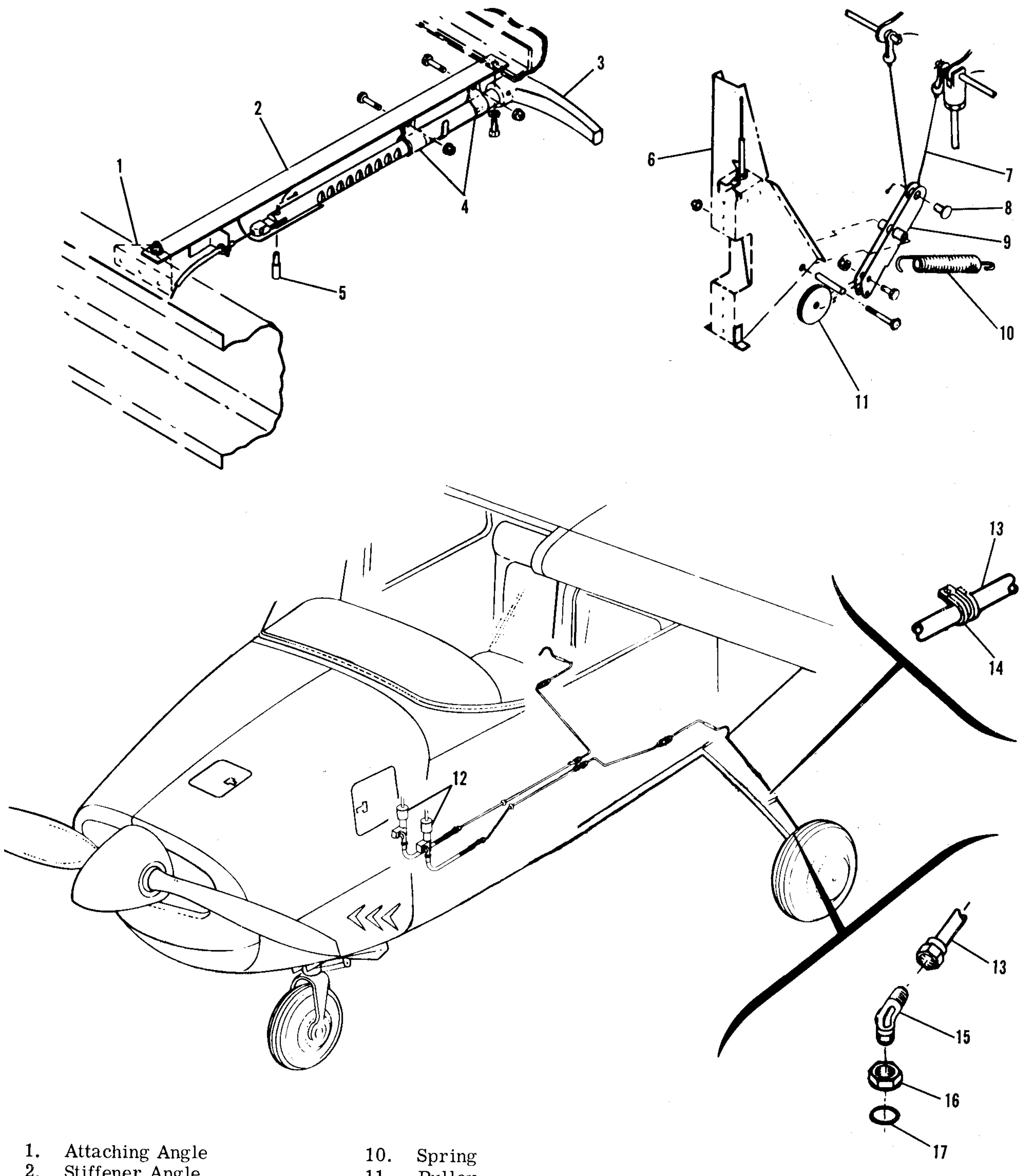
NOTE

The spring strut must be installed and secured before rigging the adjusting support. Also, check that gear is level laterally over the saddle, using C-bar (Special Tool No. SE-587-1) and the spirit level, with 1500 psi hydraulic pressure applied to gear down port of the main gear actuator. Shim as required be-between support pin bolt and structure to obtain this level condition. Refer to the following step "a" for the varying thickness of the shims.

a. Check for contact between flat surface of strut and lower surface of adjusting support. Minor gaps may exist as long as 50% of strut is in contact with support. Shim as required between outboard forging and adjusting support to obtain correct contact. The following shims are available from the Cessna Service Parts Center.

AFT

1241418-1	*
-2	.030"
-3	.032"
-4	.006"
-9	



1. Attaching Angle
2. Stiffener Angle
3. Parking Brake Handle
4. Clamp
5. Positioning Pin
6. Bracket
7. Cable Assembly
8. Clevis Pin
9. Bellcrank Assembly
10. Spring
11. Pulley
12. Brake Master Cylinders
13. Brake Line
14. Clamp
15. Fitting
16. Nut
17. O-Ring

Figure 5-23. Brake System

FWD	
1241418-5	*
-6	.012"
-7	.020"
-8	.032"
-10	.006"

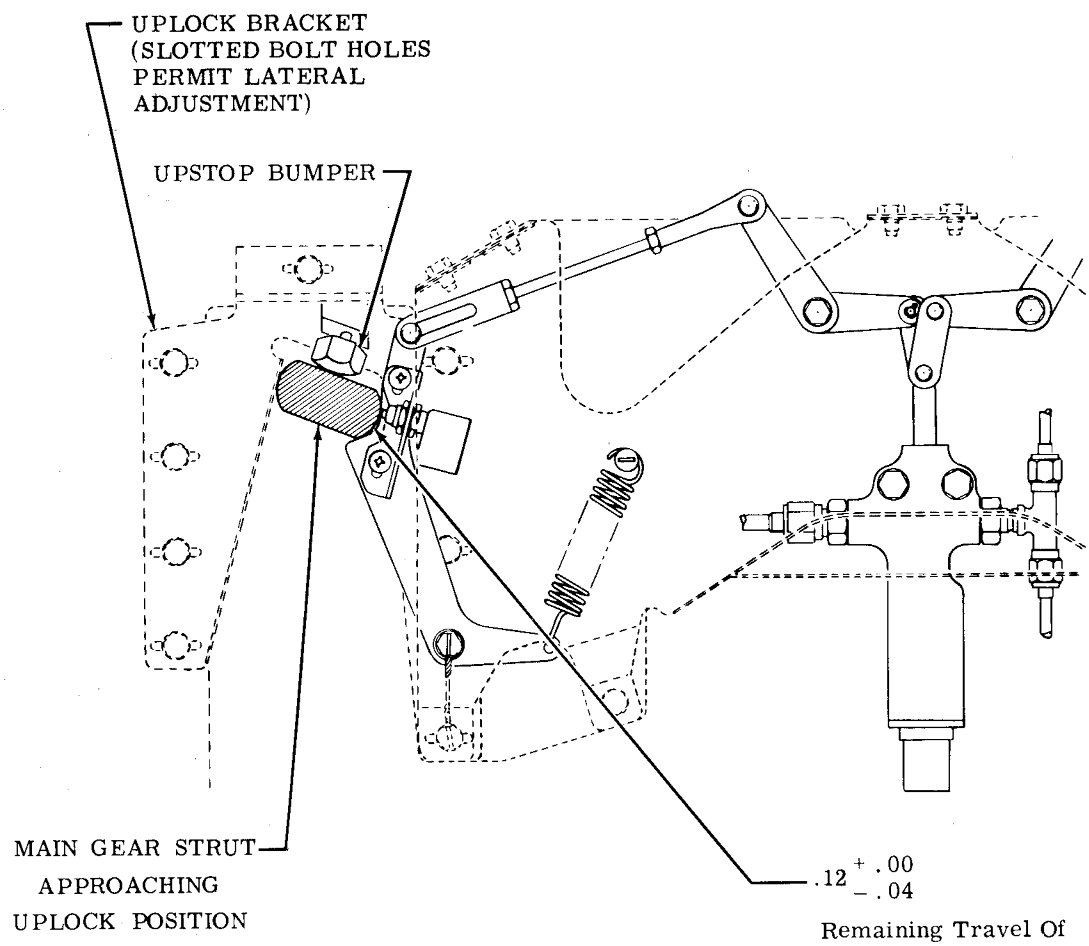
*Sheet of .025" laminated with ten .002" additional removable laminations.

b. Check that the aft edge of strut contacts adjusting support (.005 inch maximum clearance) as shown in figure 5-10, when gear is down. To shift adjusting support fore and aft, first loosen bolts securing support (elongated holes are provided in the support), then adjust two jam nuts as required and retighten the mounting bolts. Torque aft mounting bolts to 310-340 pound-inches and torque forward mounting bolts to 170-200 pound-inches.

c. Check that the forward edge of the strut contacts wedge (.001 to .010 clearance) as shown in figure 5-10, when the gear is down. If adjustment is necessary, locate, drill, and countersink a new wedge, and install with one MS20427M rivet. The following wedges (measured at thickest part) are available from the Cessna Service Parts Center.

1241404-1	.175"
-2	.220"
-3	.200"

5-117. RIGGING OF DOWNLOCK MECHANISM. The inboard and outboard downlocks are hydraulically operated pawls containing adjustable downlock pins



NOTE

If uplock bracket shows undue wear or damage from gear strut, loosen attaching bolts and re-position prior to adjusting latch and switch.

Figure 5-24. Main Gear Uplock and Uplock Limit Switch Clearance which wedge against the strut to lock the gear in the down position. Jack the aircraft and rig as follows:

NOTE

Before rigging the downlock pawls, refer paragraph 5-44 to ascertain that the main landing gear strut is correctly installed.

a. Check that clearance between the inboard downlock pawl and gear strut is .003 +.004 -.000 inches when 1500 psi hydraulic pressure is applied to the gear down port of the main gear actuator (to ensure that the gear is in the full down position). Inboard pawl clearance during the retraction cycle is shown in figure 5-20. The pawl is adjusted up or down with relation to the gear strut by inserting or removing washers on the fork-bolt that attaches the pawl to the fuselage structure.
b. Check that outboard downlock pin reaches the overcenter position shown in figure 5-20 (.03 to .10 inch). Adjust upper stop bolt as required to obtain this position.
c. Check over-all length of outboard downlock pin as shown in figure 5-20 (snugly against strut to .003 inch maximum clearance), with hydraulic pressure on gear. Downlock pin assembly must be removed to change over-all length.
d. With outboard downlock pin fully retracted, check that pin clears any part of strut at least .008 inches during manual retraction as shown in figure 5-20.
e. Check that inboard downlock pawls release the struts simultaneously.

5-118. RIGGING OF UPLOCK MECHANISM. (See figure 5-24.) The main gear uplocks are located on the main wheel stowage bay forward bulkhead. The uplock pawls are spring-loaded to lock position and are hydraulically operated to the unlocked position. Jack aircraft and rig uplock mechanism as follows:
a. While retracting landing gear, check that landing gear strut edge contacts uplock bracket at the last .375 inch of strut up travel before strut contacts upstop bumper.

NOTE

If uplock bracket shows excessive damage from gear strut, loosen attaching bolts and re-position prior to adjusting uplock pawls and switches.

b. With the main gear strut firmly against the upstop bumper, the uplock pawl should extend easily into the locked position. Adjust upstop bumper so that locking face of uplock pawl clears strut by .002 to .005 inche.
c. With uplock release actuator retracted, adjust push-pull rod so that uplock pawls release landing gear struts simultaneously.

NOTE

When gear strut is extending, the strut should clear the uplock pawls at least .09 inch at the closest point.

5-119. RIGGING OF MAIN LANDING WHEEL AND STRUT DOORS. After jacking the aircraft, main landing gear door adjustments are accomplished by adjusting push-pull rod ends and actuator rod ends as required to cause the doors to close snugly. Doors must not close so tight that internal locks in actuating cylinders are not reached. When installing new doors, some trimming and forming at edges may be necessary to achieve a good fit and permit actuators to lock. The doors must clear the gear during retraction and extension at least 1/2-inch.

5-120. ADJUSTMENT OF SNUBBER VALVES. Refer to paragraph 5-50 for adjustment of the main landing gear snubbers.

5-121. RIGGING MAIN GEAR DOWN INDICATOR SWITCHES. Main landing gear down indicator switches are mounted on brackets attached to the strut and actuated by the inboard downlock pawl. Adjust switches as shown in figure 5-20.

5-122. RIGGING MAIN GEAR UP INDICATOR SWITCHES. Main landing gear up indicator switches are mounted on brackets attached to the uplock pawls. After jacking the aircraft and retracting the landing gear, adjust the switches as shown in figure 5-24.

5-123. RIGGING THROTTLE-OPERATED GEAR WARNING SWITCH. Refer to Section 12 for rigging of the throttle-operated gear warning switch.

5-124. RIGGING OF NOSE GEAR.

NOTE

The nose gear shock strut must be correctly inflated prior to rigging of the nose gear.

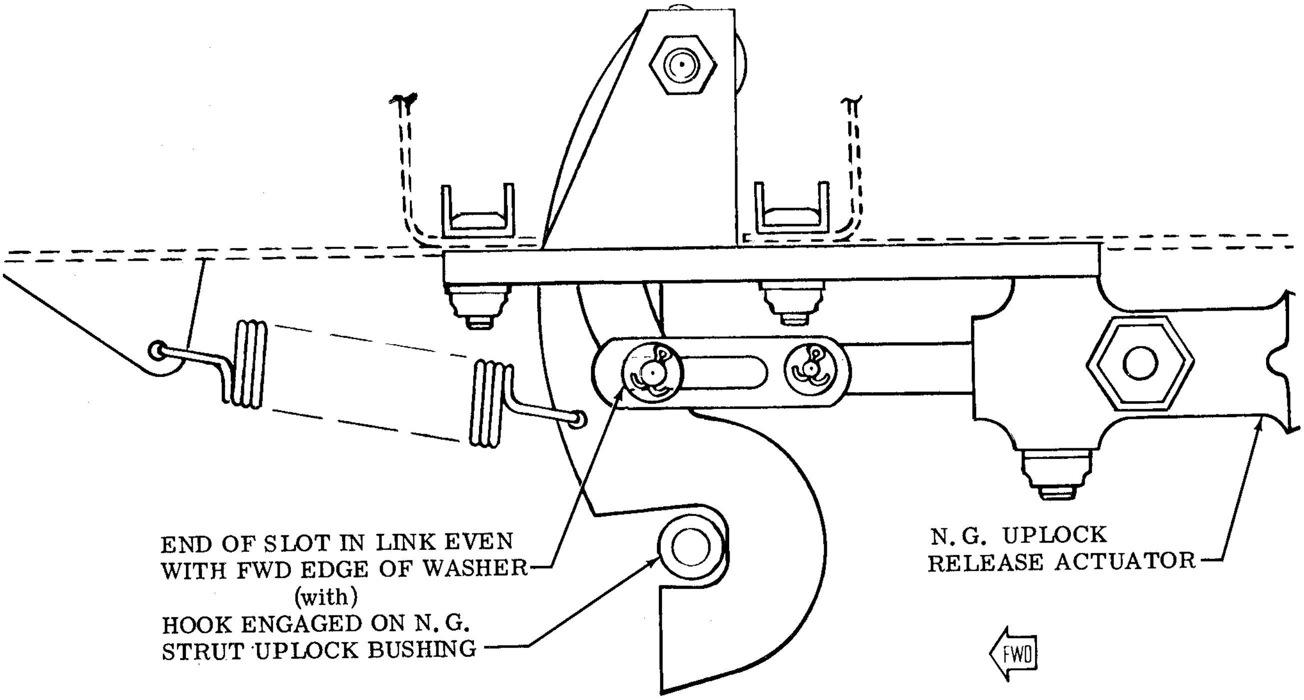
5-125. RIGGING OF DOWNLOCK MECHANISM. (See figure 5-25.) The nose gear downlock mechanism is basically a claw hook at the piston rod end of the nose gear actuator. The actuator contains an internal lock to hold the claw hook mechanism overcenter. Jack the aircraft and rig the downlock mechanism as follows:
a. Check that the hooks and crossbar are free from drag. Adjust rod end of actuator piston rod as required.

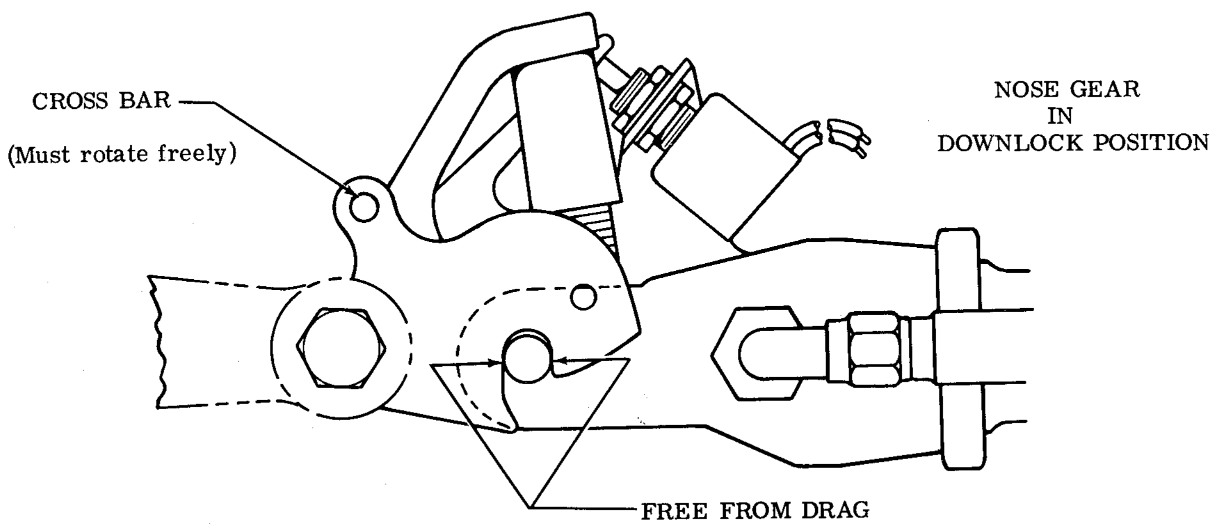
CAUTION

The piston rod is flattened near the threads to provide a wrench pad. Do not grip the rod with pliers, as tool marks will cut seal in the actuator.

5-126. RIGGING OF UPLOCK MECHANISM. (See figure 5-25.)
a. Check uplock hook adjustment. With uplock fully retracted, the nose gear uplock bushing should clear the uplock hook .06 to .09 inch and strike the flat surface of upstop side of hook.

5-127. RIGGING THE DOWN INDICATOR SWITCH. (See figure 5-26.) The nose gear down indicator switch is operated by an arm on the downlock mechanism. After jacking the aircraft, adjust the switch

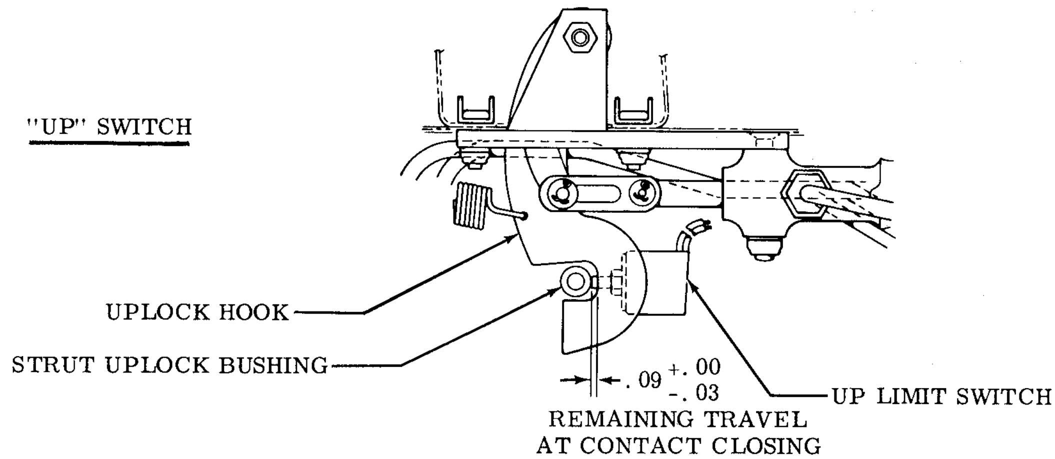




NOTE: Locking of internal lock is indicated by inability to lift and disengage external claw locks manually. Locks shall release only when hydraulic pressure is applied at anchor end port of actuator.

Figure 5-25. Nose Gear Up and Downlock Clearances

"UP" SWITCH



"DOWN" SWITCH

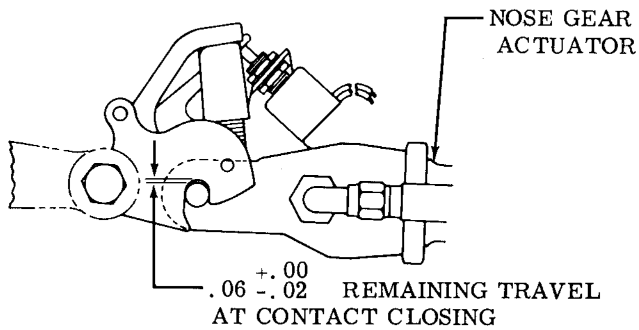


Figure 5-26. Rigging Nose Gear Limit Switches

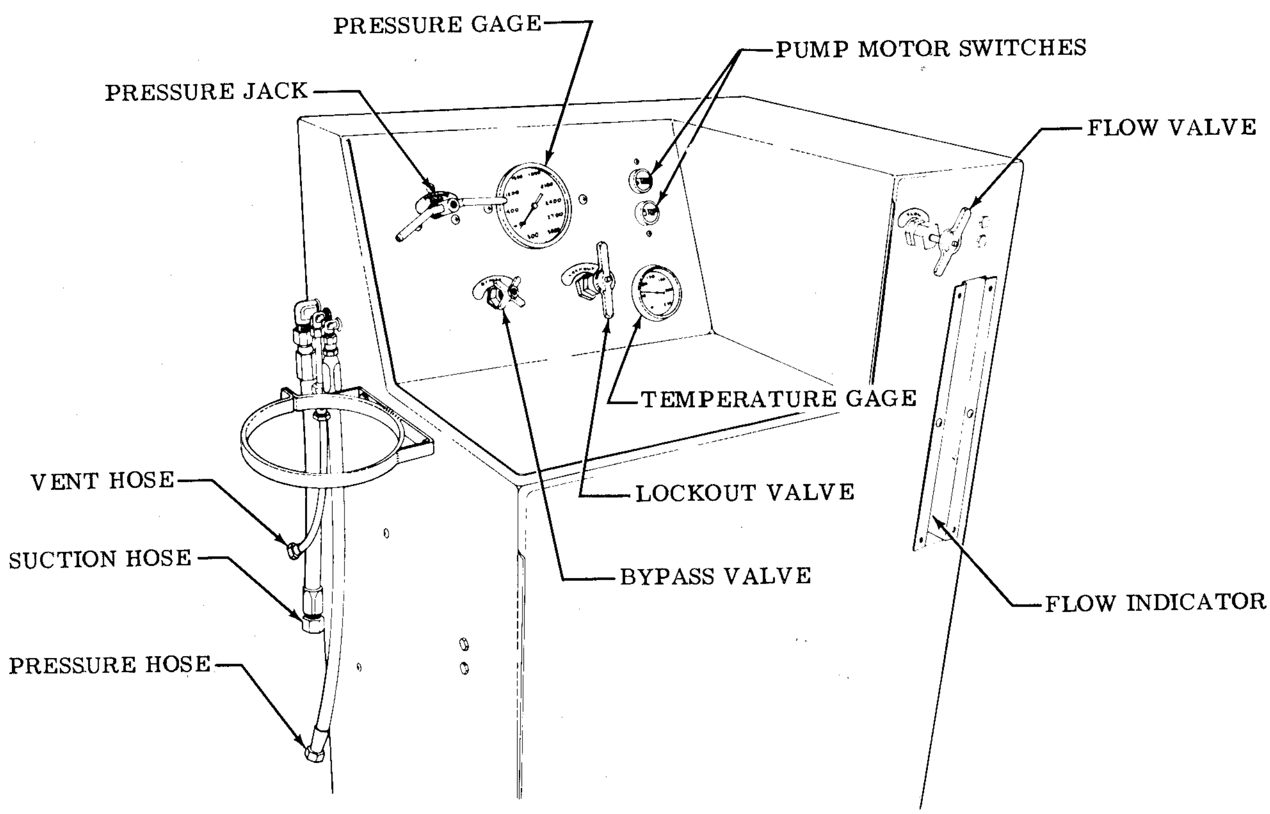


Figure 5-27. Hydro Test Unit

to actuate with .04 to .06 travel of the downlock hooks remaining.

5-128. RIGGING OF UP INDICATOR SWITCH. (See figure 5-26.) The nose gear up indicator switch is attached to the uplock hook in the top of the nose wheel well. After jacking the aircraft, adjust the switch to actuate with .06 to .09 travel of the uplock hook remaining.

5-129. RIGGING OF SAFETY SWITCH. The safety switch, which is electrically connected to the landing gear handle lockout solenoid, is operated by an actuator attached to the lower torque link. Adjust the switch to actuate when the strut is between .25 to .25 inch from full extended position.

5-130. RIGGING OF NOSE GEAR DOORS. After jacking the aircraft, nose landing gear door adjustments are accomplished by adjusting push-pull rod ends and actuator rod ends as required to cause the doors to close snugly, Doors must not close so tight that internal lock in the actuating cylinder is not reached. When installing new doors, some trimming and forming at edges may be necessary to achieve a good fit and permit actuators to lock. The doors must clear the gear during retraction and extension at least 1/2-inch.

5-131. RIGGING OF POWER PACK SWITCH AND LOCKOUT SOLENOID.

5-132. RIGGING OF UP-DOWN SWITCH. The handle up-down switch is located on the Power Pack and is normally rigged during assembly of the Power Pack, outlined in Appendix A. With landing gear handle at centerline of barrier, adjust up-down switch so that switch clicks at an equal distance up and down from centerline of barrier as landing gear handle is moved up and down.

5-133. RIGGING OF GEAR HANDLE LOCKOUT. The handle lockout solenoid contains a plunger which prevents the handle from being moved upward from the gear-down range. Adjust the small nut on the solenoid plunger so the plunger fully locks the handle, but clears the handle when actuated, even with slight side-pressure exerted manually on the handle.

5-134. HYDRO TEST OPERATION.

5-135. GENERAL OPERATION.

a. Always open bypass valve before starting Hydro Test motor. This procedure permits the motor to start under a no-load condition and, if practiced, will contribute to the service life of the Hydro Test unit.

b. Operation of the Hydro Test with bypass and lockout vlaves closed simultaneously should not be continued for more than one minute.

c. Avoid unnecessary, continuous operation of the Hydro Test under high pressure-low flow conditions. Such operation causes rapid heating of the fluid supply and will be indicated on the Hydro Test temperature gage. When pressure is no longer needed, open the bypass valve. This will relieve pressure and allow the fluid to recirculate freely.

d. Normal position of the pressure jack will expose approximately 1-1/2 inches of the threaded area of the pressure jack. Rotating the pressure jack out any further is unnecessary and serves no useful purpose.

e. Do not operate the Hydro Test with the pressure jack removed.

f. All hoses should be capped or plugged and stowed on rack provided when they are not in use.

g. Avoid contamination of the Hydro Test unit by checking condition of the fluid in the aircraft before making connections.

h. Before disconnecting the Hydro Test from the airplane make certain that the airplane reservoir is full of fluid. If the Hydro Test remains idle for any length of time while connected to the aircraft, fluid may siphon from the aircraft reservoir to the Hydro Test reservoir.

NOTE

The Hydro Test unit is a precision test instrument as well as a hydraulic power source. The retention of its accuracy and the length of its service life depend on good care and proper operation.

5-136. FLOW REGULATION. The following procedure is used to adjust the Hydro Test flow to any value desired for a specific operation, with the Hydro Test connected to the aircraft hydraulic system and the aircraft on jacks.

a. Open bypass valve and lockout valve.

b. Start Hydro Test pump motor.

c. Close bypass valve.

d. Open flow valve, then slowly close it until indicator in flow gage sight glass aligns with mark indicating desired flow. To read flow indicator, match line on widest part of indicator with fixed line on external part of gage.

5-137. CONNECTING HYDRO TEST.

a. Remove engine cowling from right side of engine.

b. Disconnect hydraulic pump suction (larger) hose from firewall fitting and connect Hydro Test suction (larger) hose to firewall fitting. Cap or plug disconnected pump hose.

c. Disconnect hydraulic pump pressure (smaller) hose from fitting in filter at firewall and connect Hydro Test pressure (smaller) hose to the fitting. Cap or plug disconnected hose.

d. Connect Hydro Test vent hose to airplane reservoir vent line protruding below lower edge of firewall.

NOTE

Before making this connection, be certain the line is wiped clean and free of any dirt or foreign material which might have worked into the line. If the line is dirty internally, remove and flush with solvent, then dry with compressed air and reinstall.

e. Connect Hydro Test electric cable to appropriate electrical power source.

5-138. DISCONNECTING HYDRO TEST.

a. Be sure landing gear is down and locked, and doors are closed.

b. With bypass closed, and lockout valve open, operate Hydro Test until airplane reservoir is full, then open bypass valve and stop Hydro Test pump motor.

c. Disconnect all Hydro Test hoses from airplane immediately, beginning with the suction hose. If the suction hose remains connected for any length of time after Hydro Test is shut down, fluid will transfer from airplane reservoir into Hydro Test reservoir.

d. Connect all airplane hoses and install cowling.

5-139. FILLING AIRCRAFT RESERVOIR. Normally operated pressure brake bleeder or Hydro Fill unit (available from the Cessna Service Parts Center). The Hydro Test is used to fill the reservoir system, as outlined in paragraph 5-138.

5-140. BLEEDING TIME-DELAY VALVE. The time-delay valve in the Power Pack may be purged of air by operating the engine-driven pump, or the Hydro Test may be used.

a. Make sure reservoir is full.

b. Start engine and let run at 1000 rpm, or connect Hydro Test in accordance with paragraph 5-137.

c. Place landing gear handle in down position and hold for approximately one minute, while turning the master switch OFF until doors open, then ON until doors close.

d. Repeat step "c" four times, waiting one minute between each repeat. This allows time-delay valve to refill.

e. Check that time-delay valve operates properly by moving landing gear handle sharply to the down position and recording time as handle returns to neutral.

NOTE

The time delay between closing of the landing gear doors and releasing the landing gear handle to neutral should be between 3 and 9 seconds at room temperature. Colder temperatures will cause a longer delay.

f. Shut down engine, or disconnect Hydro Test in accordance with paragraph 5-138.

5-141. BLEEDING AIRCRAFT HYDRAULIC SYSTEM. Refer to paragraph 5-30.

5-142. BLEEDING OF THE EMERGENCY HAND PUMP. Refer to paragraph 5-31.

5-143. LEAK-TESTING. When testing a system for leakage, the Power Pack must be bypassed. When checking an actuating cylinder for internal leakage, connect the Hydro Test to one port of the unit and leave other port open. Perform test as follows:

a. Jack the aircraft (see paragraph 2-4).
b. Connect Hydro Test pressure hose to system or unit to be leak-tested, using suitable fittings.
c. Set flow valve for minimum flow.
d. Set lockout valve cracked open.
e. Set bypass valve open.
f. Set pressure jack out approximately 1-1/2 inches.
g. Start Hydro Test pump motor.
h. Slowly close bypass valve until pressure reaches 1950 psi (maximum obtainable with Hydro Test pump motor).
i. Close lockout valve to trap fluid, then stop Hydro Test pump motor immediately.
j. Screw pressure jack in, increasing pressure to 2200 psi, and hold 5 minutes. Check for leaks while system or unit is under pressure. The pressure jack has a pressure capability to the limit of the Hydro Test pressure gage.

CAUTION

When leak-testing any actuator, with pressure applied to one port of the cylinder, always have the opposite port open to atmospheric pressure. Otherwise, excessive pressure may be built up due to the differential area across the piston. (The rod side of the piston has less area than the head side. Thus, pressure applied to the head side of the piston may apply a far greater pressure to fluid on the rod side of the piston.)

The total of line assemblies, fittings, actuators, and any other part subjected to hydrostatic (dead end) pressure shall be deemed faulty due to overstressing if hydraulic pressure in that immediate sub-system is allowed to exceed 2275 psi for any period of time.

k. After completion of test, open Hydro Test lockout valve to relief pressure, then disconnect Hydro Test and reconnect hydraulic system lines.
l. Remove aircraft from jacks.

5-144. CYCLING LANDING GEAR.

a. Connect Hydro Test in accordance with paragraph 5-137 and jack the aircraft as outlined in paragraph 2-4.
b. Observe color of hydraulic fluid through sight gage in aircraft reservoir. If fluid appears discolored, or any other reason exists to suspect fluid contamination, draw off a fluid sample as outlined in paragraph 5-33.

NOTE

Fluid sampling is necessary only when good reason exists to suspect contamination. If examination of fluid reveals contamination, flush complete hydraulic system with clean hydraulic fluid and examine several seals and cylinder bores for damage.

c. Set Hydro Test flow vlave closed, lockout valve open, and bypass valve open.
d. Start Hydro Test pump motor.
e. Slowly closs bypass valve completely.
f. Observe fluid flowing through Hydro Test sight gage. When all air bubbles have disipated, operations may be continued.
g. Using landing gear control handle in aircraft, operate gear as desired.

NOTE

Gear cycling time can be prolonged by slowly opening the Hydro Test bypass valve part way. This will bleed off part of the pump flow.

h. After completion of cycling, open Hydro Test bypass valve and stop pump motor.
i. Disconnect Hydro Test in accordance with paragraph 5-138.
j. Make sure landing gear is down and locked, and remove aircraft from jacks.

5-145. CHECKING TIME-DELAY VALVE.

NOTE

The time delay between closing of the landing gear doors and releasing of the landing gear handle to neutral should be between 3 to 9 seconds at room temperature. Colder temperatures will cause a longer delay.

a. Connect Hydro Test in accordance with paragraph 5-137.
b. Set Hydro Test at approximately 1500 psi, with a one gallon-per-minute flow rate.
c. With aircraft master switch OFF to open the doors, move landing gear handle to down position and turn master switch to ON position. Note the time delay between closing of the doors and releasing of the handle to neutral. See the preceding "NOTE."
d. There is no adjustment of the time-delay valve. If it is defective, refer to Appendix A for disassembly and repair of the Power Pack.
e. Disconnect Hydro Test in accordance with paragraph 5-138.

5-146. CHECKING HANDLE-RELEASE TO NEUTRAL.

a. Cycle the landing gear through two complete cycles in accordance with paragraph 5-144, ending with the gear down and locked, and the doors closed.
b. Set Hydro Test bypass valve full open.

c. Place landing gear handle to full down.
d. Very slowly close bypass valve until handle trips back to neutral. Read gage at point of handle trip. This pressure should be 750 to 1250 psi. Be sure to allow time for time-delay valve to open.

NOTE

One release valve serves to release the handle from both the gear down and the gear up positions. If the handle-return springs are adjusted correctly, the release valve should release the handle from both positions at the same pressure. The foregoing procedure checks the release pressure from the gear down position, and the following procedure checks the release pressure from the gear up position. This is performed only to assure satisfactory operation of other equipment relative to handle release operations.

e. Set Hydro Test bypass valve full open.
f. Place landing gear handle full up.
g. Very slowly close bypass valve until handle trips back to neutral. Read gage at point of handle trip. This pressure should be 750 to 1250 psi. Be sure to allow time for time-delay valve to open.
h. Refer to paragraph 5-19 for handle-release adjustment.
i. Make sure landing gear is down and locked and disconnect Hydro Test unit in accordance with paragraph 5-138.
j. Remove aircraft from jacks.

5-147. CHECKING PRIORITY VALVE.
a. Cycle landing gear through two complete cycles in accordance with paragraph 5-144.
b. With landing gear down, turn master switch OFF to open gear doors. Leave the switch OFF to permit doors to remain open, thereby making it easier and faster to complete this check.
c. Open Hydro Test bypass valve.
d. Place landing gear handle full up. Very slowly close bypass valve, observing Hydro Test pressure gage and Hydro Test flow gage, until priority valve opens. Priority valve should open at a pressure of 750 to 800 psi.

NOTE

As the priority valve opens, the nose gear downlock starts to release. Read Hydro Test pressure gage at this point. The Hydro Test flow gage will also aid in positively establishing opening of the priority valve. As pressure slowly builds up in the door system, there is practically no flow of fluid and the flow indicator will be resting on the bottom of the sight glass. As the priority valve opens, the sudden increase in flow will cause the indicator to rise in the sight glass.

e. Refer to paragraph 5-18 for priority valve adjustment.
f. Make sure landing gear is down and locked, and disconnect Hydro Test in accordance with paragraph 5-138.
g. Remove aircraft from jacks.

5-148. CHECKING PRIMARY (SYSTEM) RELIEF VALVE.
a. Connect Hydro Test in accordance with paragraph 5-137.
b. Open Hydro Test bypass valve.
c. Place landing gear handle full down.
d. Slowly close bypass valve observing pressure build-up and point at which pressure stabilizes on Hydro Test gage. Stabilization indicates relief valve setting. The relief valve pressure should be 1750 to 1800 psi, at a flow rate of approximately one gallon-per-minute on the Hydro Test.
e. The Power Pack must be removed and partially disassembled to adjust the primary relief setting. Refer to Appendix A.
f. Disconnect Hydro Test in accordance with paragraph 5-138.

5-149. CHECKING FOR SUCTION AIR LEAKAGE.
a. Remove engine cowling as necessary for access.
b. Disconnect hydraulic pump suction (larger) hose from pump and connect Hydro Test suction (larger) hose to the airplane suction hose, using a suitable fitting.
c. Disconnect hydraulic pump pressure (smaller) hose from pump and connect Hydro Test pressure (smaller) hose to aircraft pressure hose, using a suitable fitting.

NOTE

Before making this connection, be certain the line is wiped clean and is free of any dirt or foreign material which might have worked into the line. If the line is dirty internally, remove and flush with solvent, then dry with compressed air and reinstall.

d. Connect Hydro Test vent hose to aircraft reservoir vent line, protruding below lower edge of firewall.
e. Connect Hydro Test electrical cable to appropriate electrical power source.
f. Jack the aircraft and cycle the landing gear through five complete cycles. No air should be visible in Hydro Test sight gage.
g. Air visible in sight glass indicages leakage in suction line, hose, or fittings. Replace defective parts.

NOTE

If replacement of parts stops any visible air in Hydro Test sight glass but air still enters hydraulic system, engine-driven pump may have a suction leak.

h. Make sure landing gear is down and locked, and remove aircraft from jacks.
i. Disconnect Hydro Test in accordance with paragraph 5-138.

5-150. CHECKING LANDING GEAR CYCLE. TIME. When the hydraulic system or aircraft pump is suspected of malfunction because gear cycle time is slow, it could be caused by low fluid in aircraft reservoir, causing system to be full of air. The following procedure will purge air from system and fill the reservoir.

a. Ctcle the landing gear through two complete cycles in accordance with paragraph 5-144.

b. With landing gear extended, place gear handle in full up position and record time required for gear to retract and doors to close. Time should not exceed 10.5 seconds (+5 seconds, -0 seconds), plus the time required for the time-delay valve to operate (see paragraph 5-145.)

c. With landing gear retracted, place gear handle in full down position and record time required for gear to extend and doors to close. Time should not exceed 7.5 seconds (+9 seconds, -2 seconds), plus the time required for the time-delay valve to operate (see paragraph 5-145).

NOTE

If time is within limit when operated by Hydro Test, but exceeds limit when operated by engine-driven pump, there is internal leakage in pump. Repair or replace pump. If time exceeds limit when operated either by Hydro Test or engine-driven pump, internal leakage is in hydraulic system. Check actuators for internal leakage. Refer to paragraph 5-143. Repair or replace actuators as required. If actuators are not defective, Power Pack internal leakage is indicated. Repair or replace Power Pack. Refer to Appendix A for repair of hydraulic components.

5-151. BENCH TESTING HYDRAULIC POWER PACK WITH HYDRO TEST.

5-152. A new or newly overhauled hydraulic Power Pack may be tested, using the Hydro Test, prior to installing the unit in the airplane. When bench testing the hydraulic Power Pack it will be necessary to use a serviceable hydraulic actuator cylinder. A main landing gear rotary actuator cylinder may be used in place of a nose landing gear actuator. For control of the door valve solenoid it will be necessary to fabricate an electrical harness as shown in figure 5-22. This harness, when connected to a 12-volt battery, will allow control of the electrical current to the door valve solenoid, permitting complete operation of the door hydraulic circuits.

5-153. CONNECTING POWER PACK TO HYDRO TEST.

a. Connect Hydro Test to Power Pack as follows:

1. Connect Hydro Test suction hose to suction port on Power Pack.

2. Connect Hydro Test pressure hose to pressure port on Power Pack.

3. Connect Hydro Test vent hose to vent port at top of Power Pack reservoir.

b. Using hydraulic hose of adequate length, connect serviceable nose landing gear actuator cylinder or main landing gear rotary actuator cylinder to Power Pack, at gear or door system fittings.

NOTE

Check to be sure that door open and door close ports on the Power Pack are connected to the correct port of the actuator cylinder. Also check that gear up and gear down ports of the Power Pack are connected to the correct ports of the actuator cylinder.

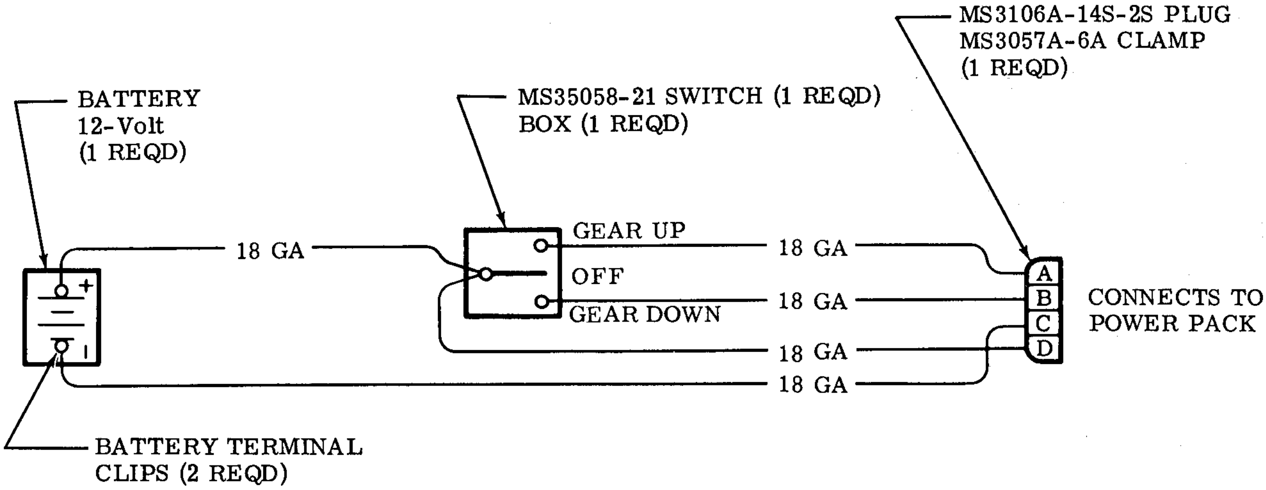
c. Install caps on all other open ports on Power Pack.

d. Connect electrical test harness to Power Pack electrical connector and to a 12-volt battery as shown in figure 5-22.

5-154. OPERATIONAL CHECK OF POWER PACK VALVES. Bench checking the priority valve, time-delay valve, and system relief valve with the Hydro Test may be performed in accordance with the foregoing paragraphs except that Power Pack is on the bench instead of in the aircraft. When checking priority valve, read pressure just as the actuator starts to move.

NOTE

At completion of gear up or gear down cycle, return manual switch in test harness to neutral or power off position before placing the landing gear control handle in the opposite position.



NOTE

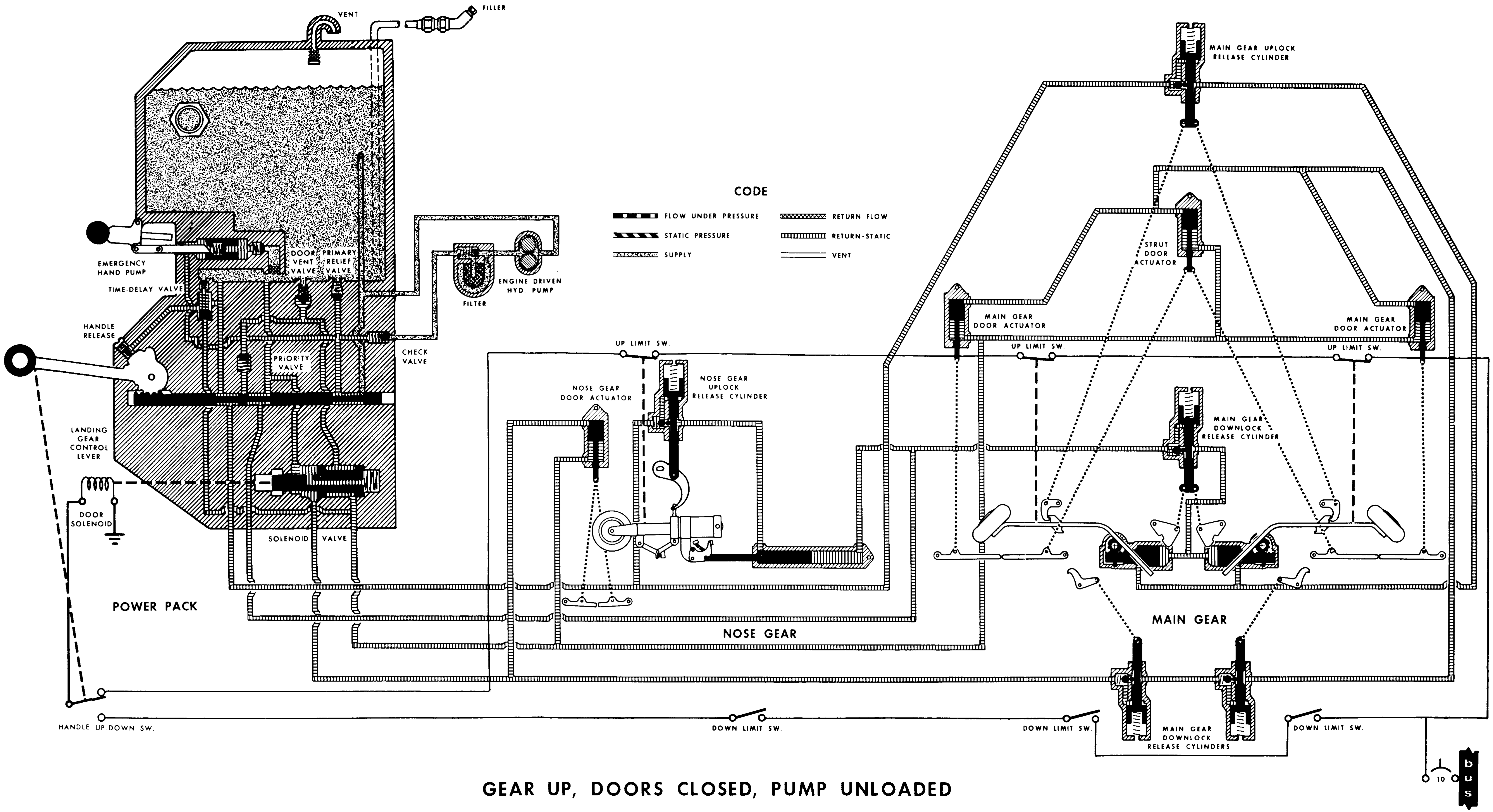
SK210-42, Hydraulic Power Pack Bench Test Harness, is available from the Cessna Service Parts Center.

Figure 5-28. Test Harness Schematic

SHOP NOTES:

HYDRAULIC SYSTEM SCHEMATICS

The 10 following fold-out pages contain coded schematic diagrams of the hydraulic system. Sheet 1 shows the system "at rest" with the landing gear up. Sheets 2 through 5 show various stages of the gear-down cycle, after which the system is again "at rest" with the landing gear down. Sheets 6 through 9 show various stages of the gear-up cycle, after which the system returns to the condition shown on sheet 1. Sheet 10 shows the landing gear being extended with the emergency hand pump without electrical power.



GEAR UP, DOORS CLOSED, PUMP UNLOADED

Figure 5-29. Hydraulic System Schematic (Sheet 1 of 10)

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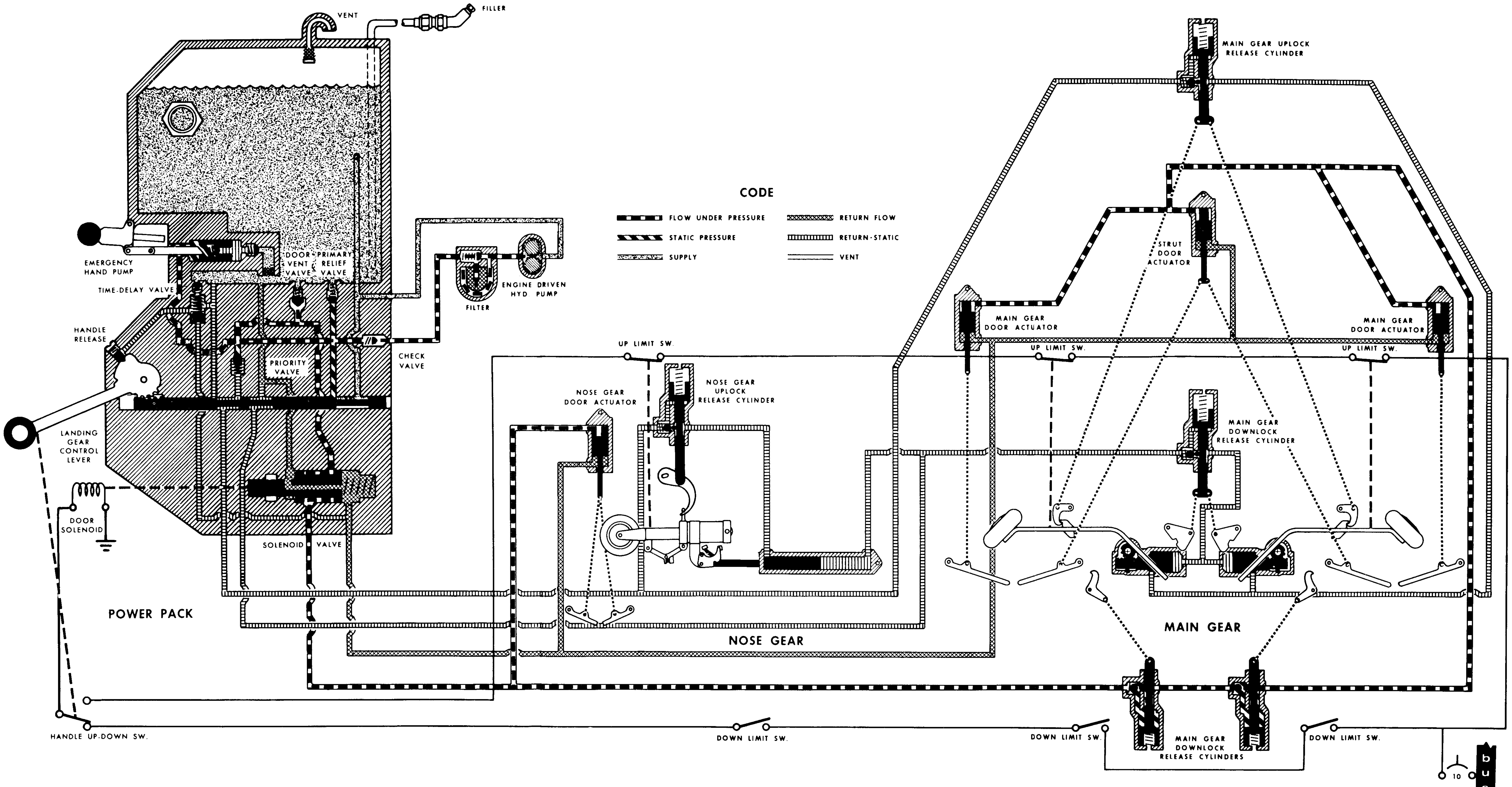

LANDING GEAR CONTROL JUST PLACED DOWN, DOORS OPENING

Figure 5-29. Hydraulic System Schematic (Sheet 2 of 10)

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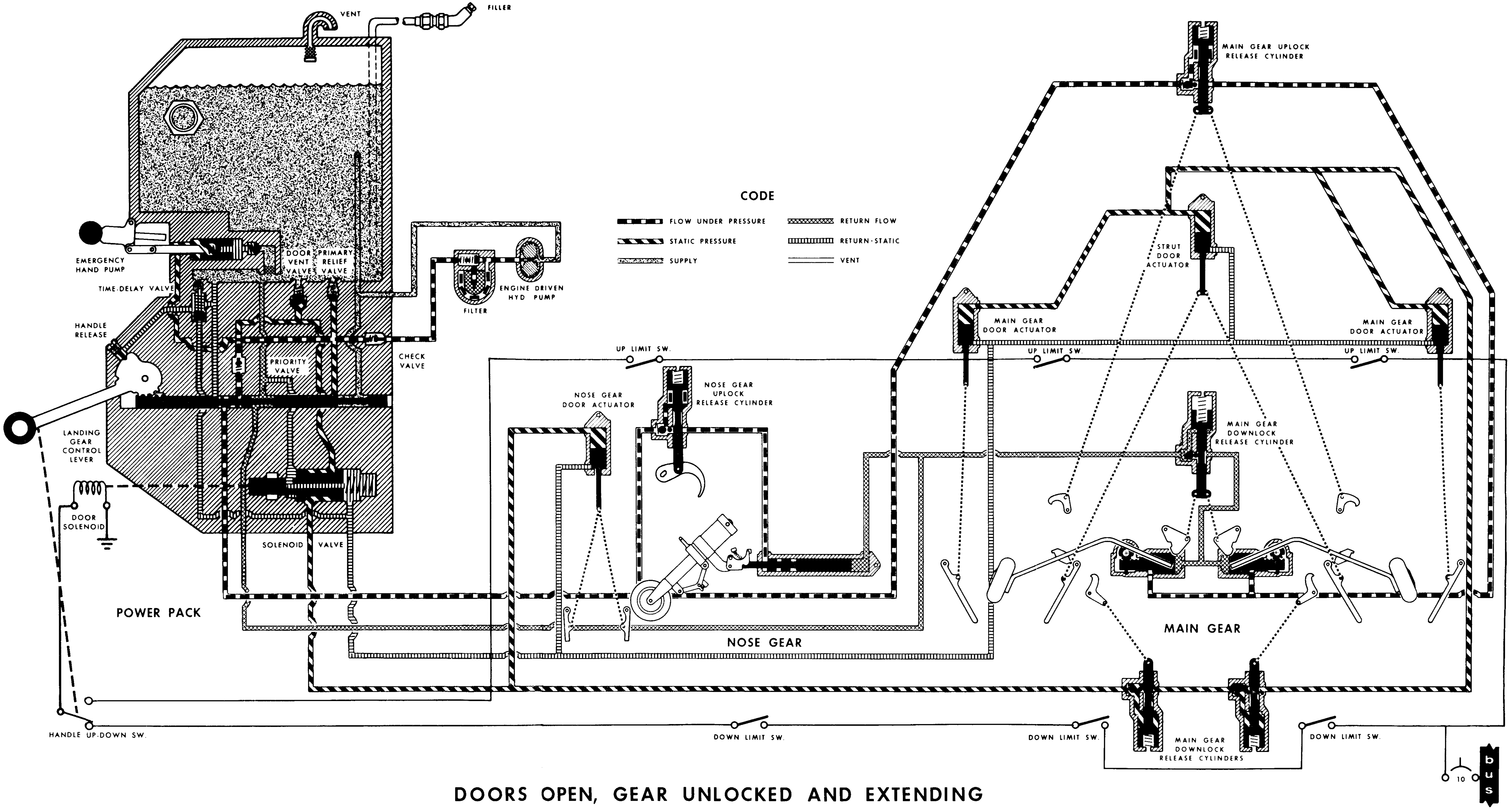

DOORS OPEN, GEAR UNLOCKED AND EXTENDING

Figure 5-29. Hydraulic System Schematic (Sheet 3 of 10)

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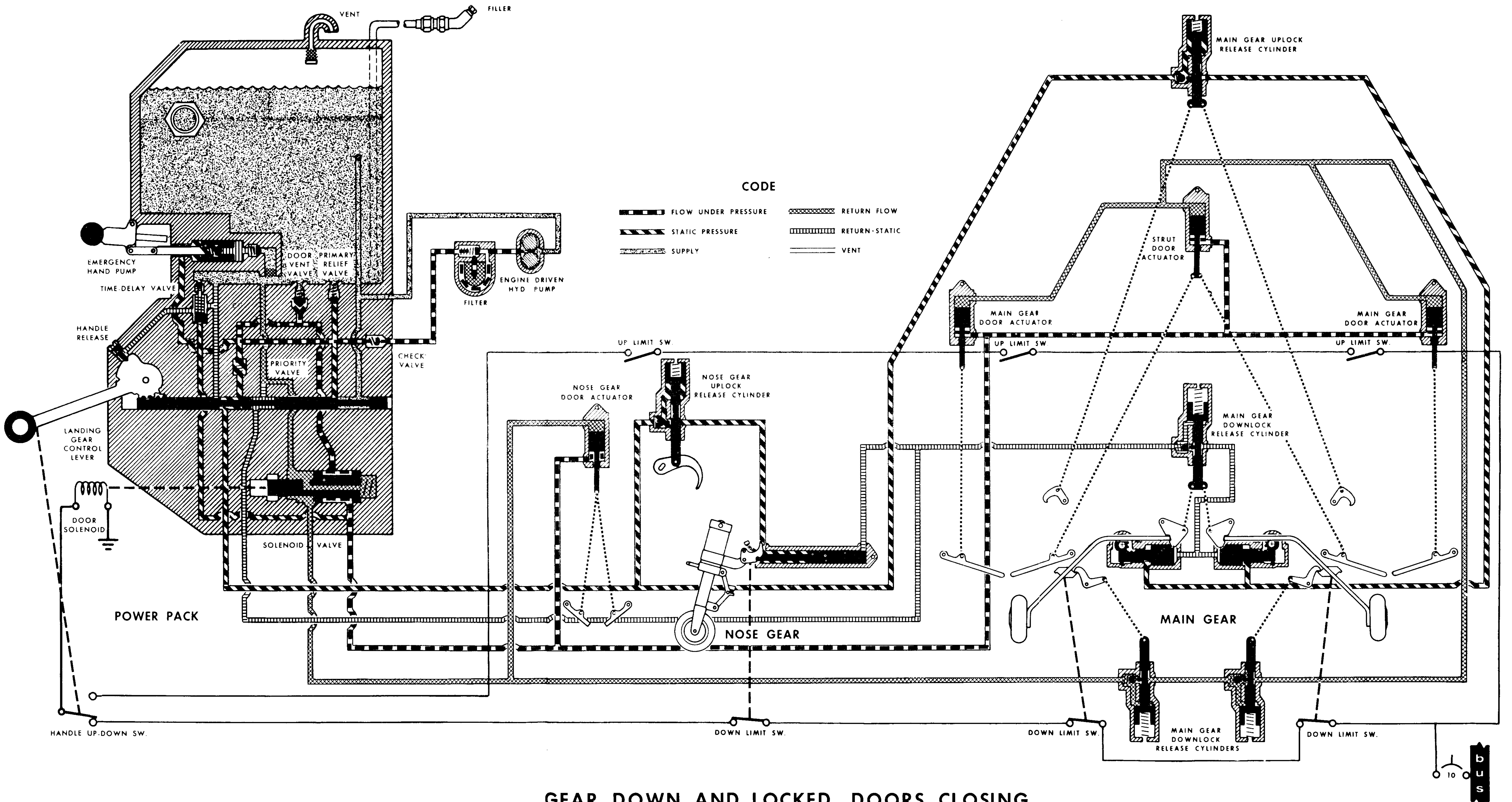

GEAR DOWN AND LOCKED, DOORS CLOSING

Figure 5-29. Hydraulic System Schematic (Sheet 4 of 10)

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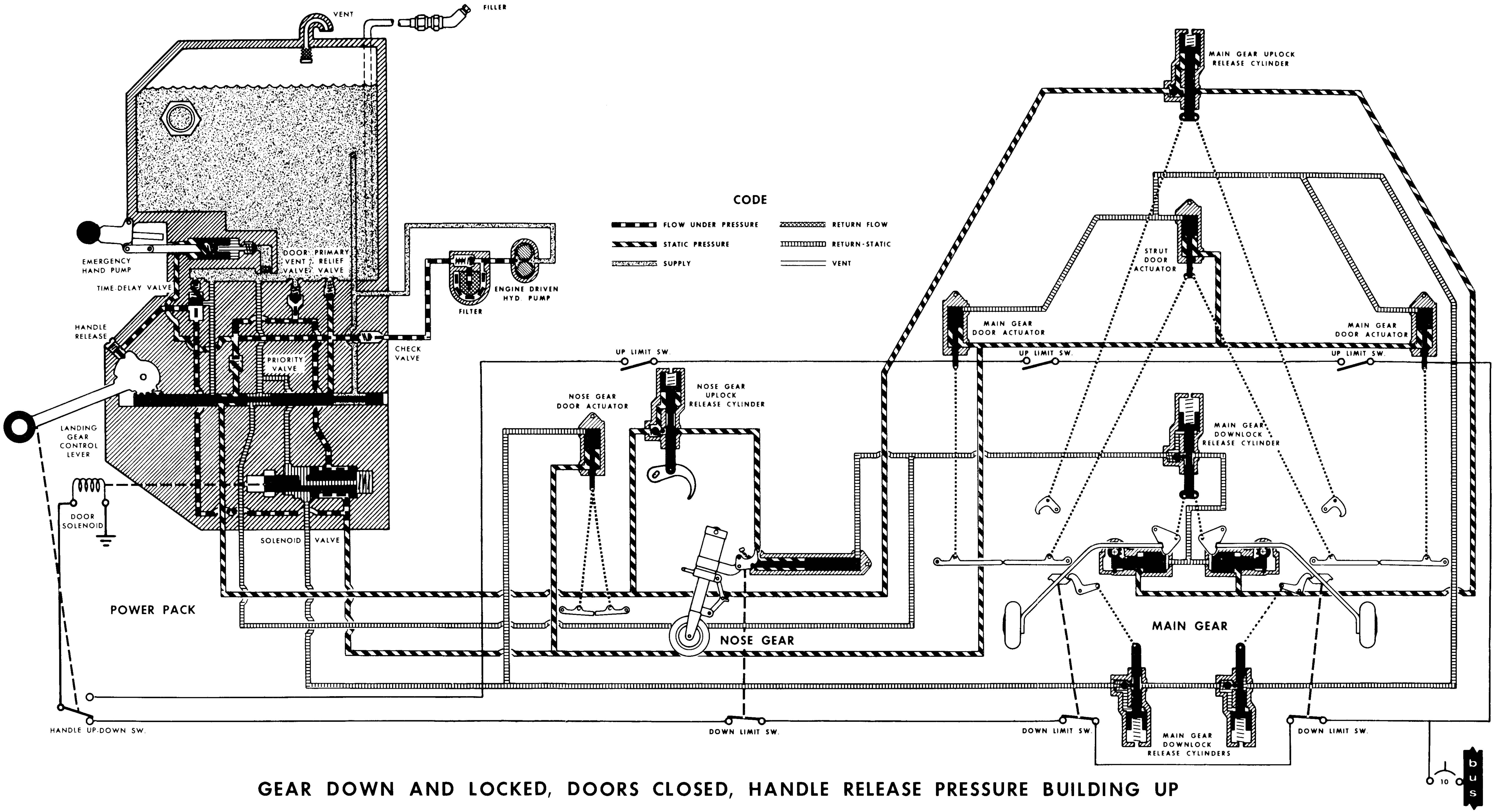

GEAR DOWN AND LOCKED, DOORS CLOSED, HANDLE RELEASE PRESSURE BUILDING UP

Figure 5-29. Hydraulic System Schematic (Sheet 5 of 10)

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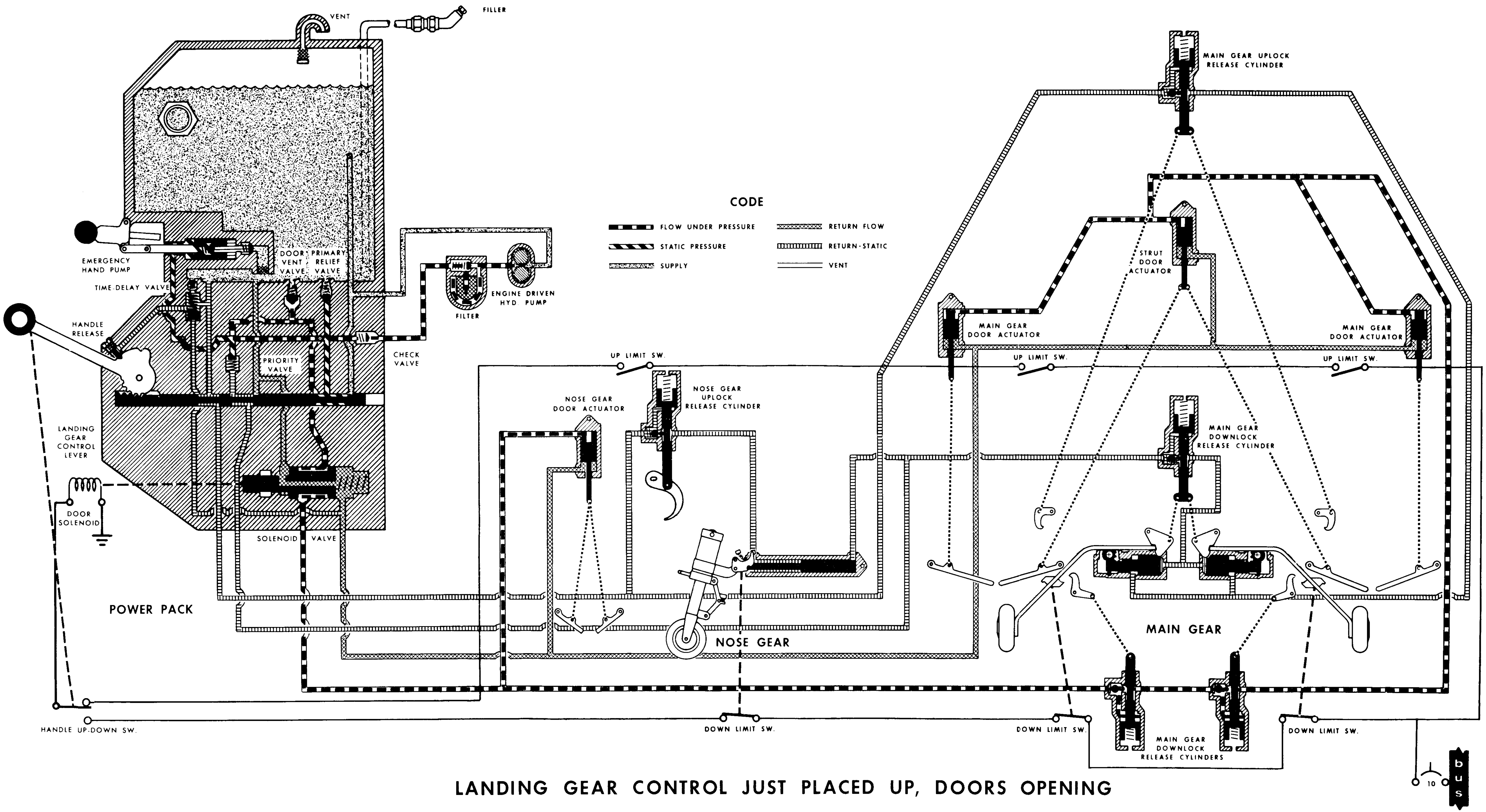

LANDING GEAR CONTROL JUST PLACED UP, DOORS OPENING

Figure 5-29. Hydraulic System Schematic (Sheet 6 of 10)

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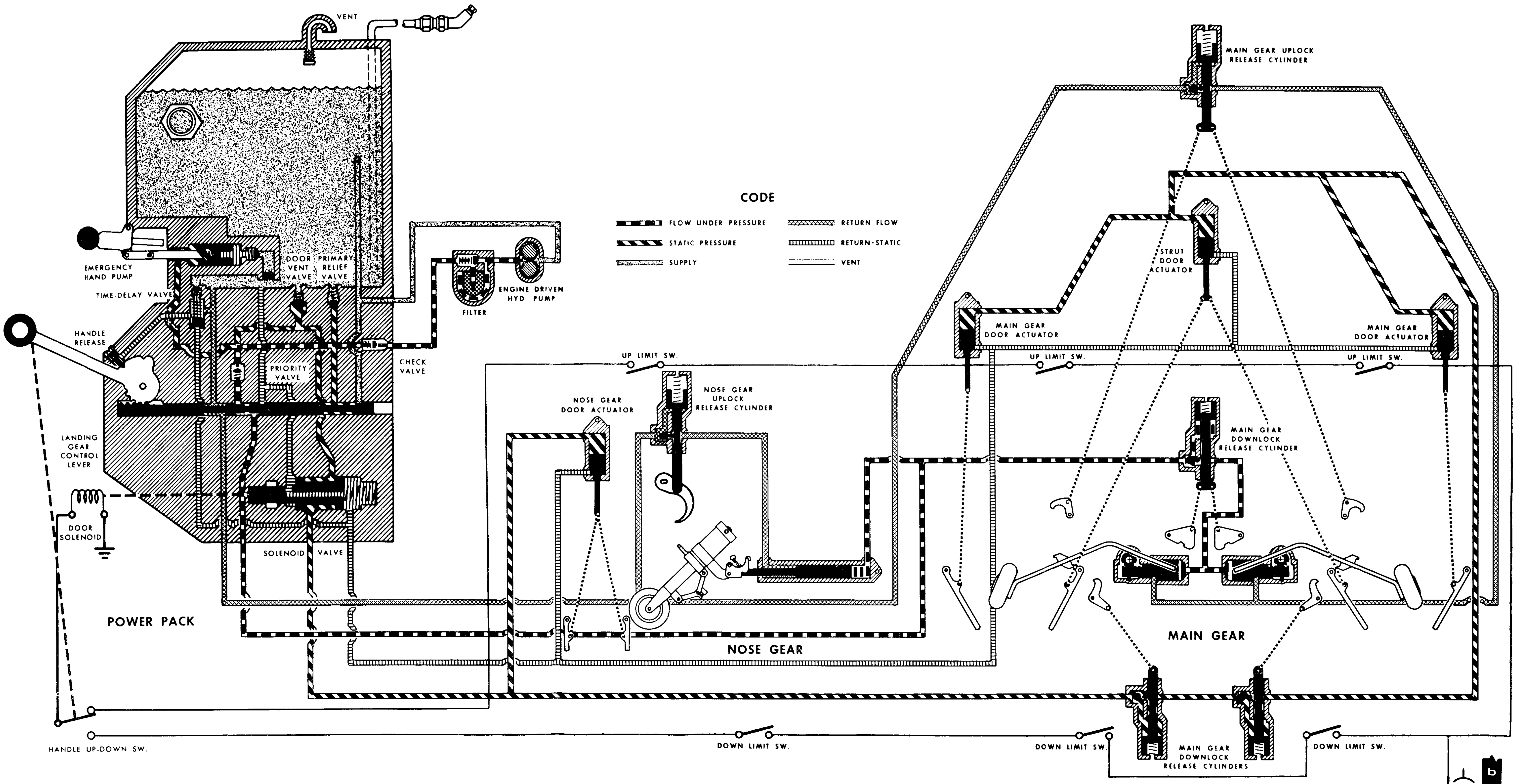

DOORS OPEN, GEAR UNLOCKED AND RETRACTING

Figure 5-29. Hydraulic System Schematic (Sheet 7 of 10)

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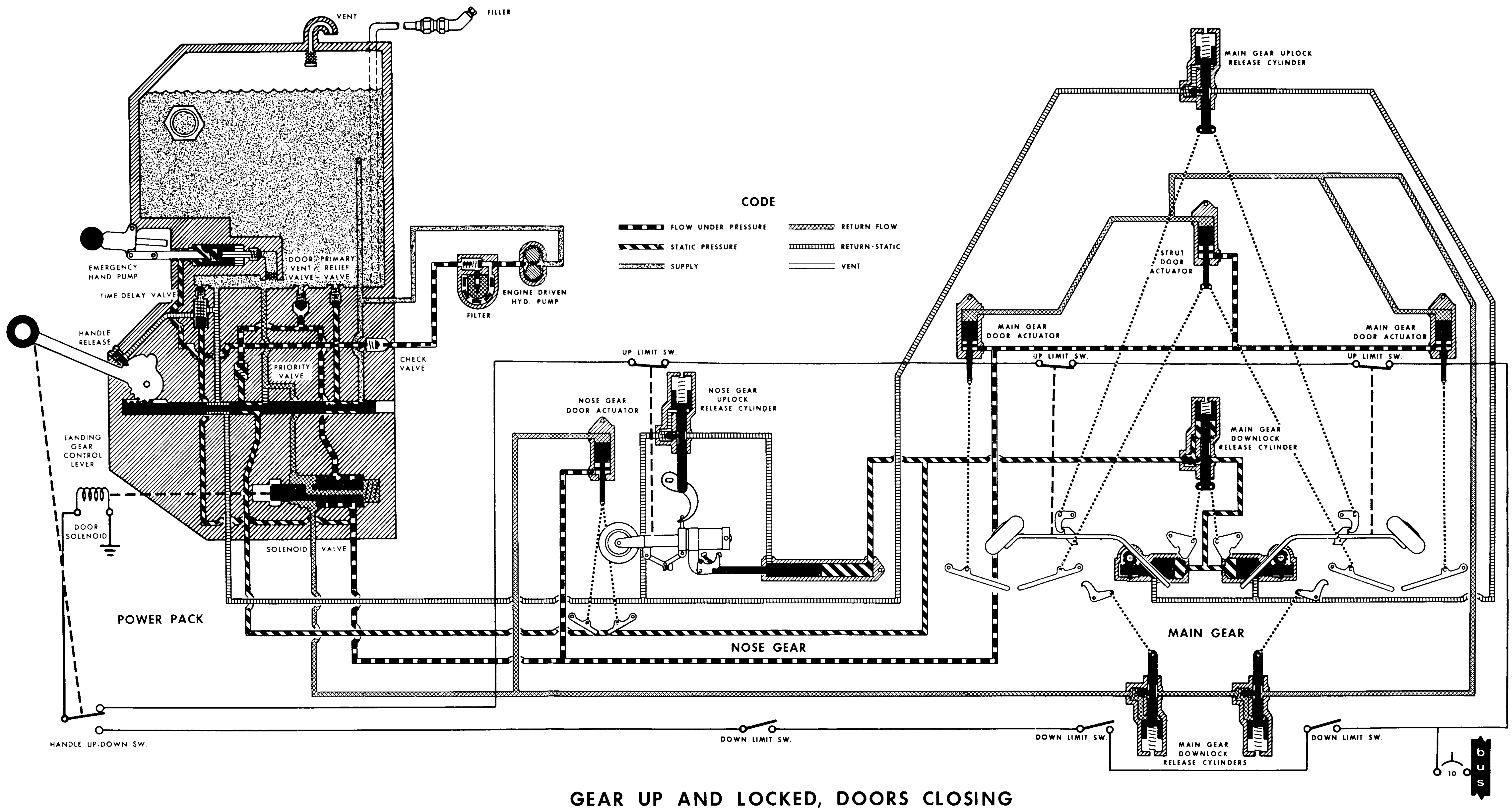

GEAR UP AND LOCKED, DOORS CLOSING

Figure 5-29. Hydraulic System Schematic (Sheet 8 of 10)

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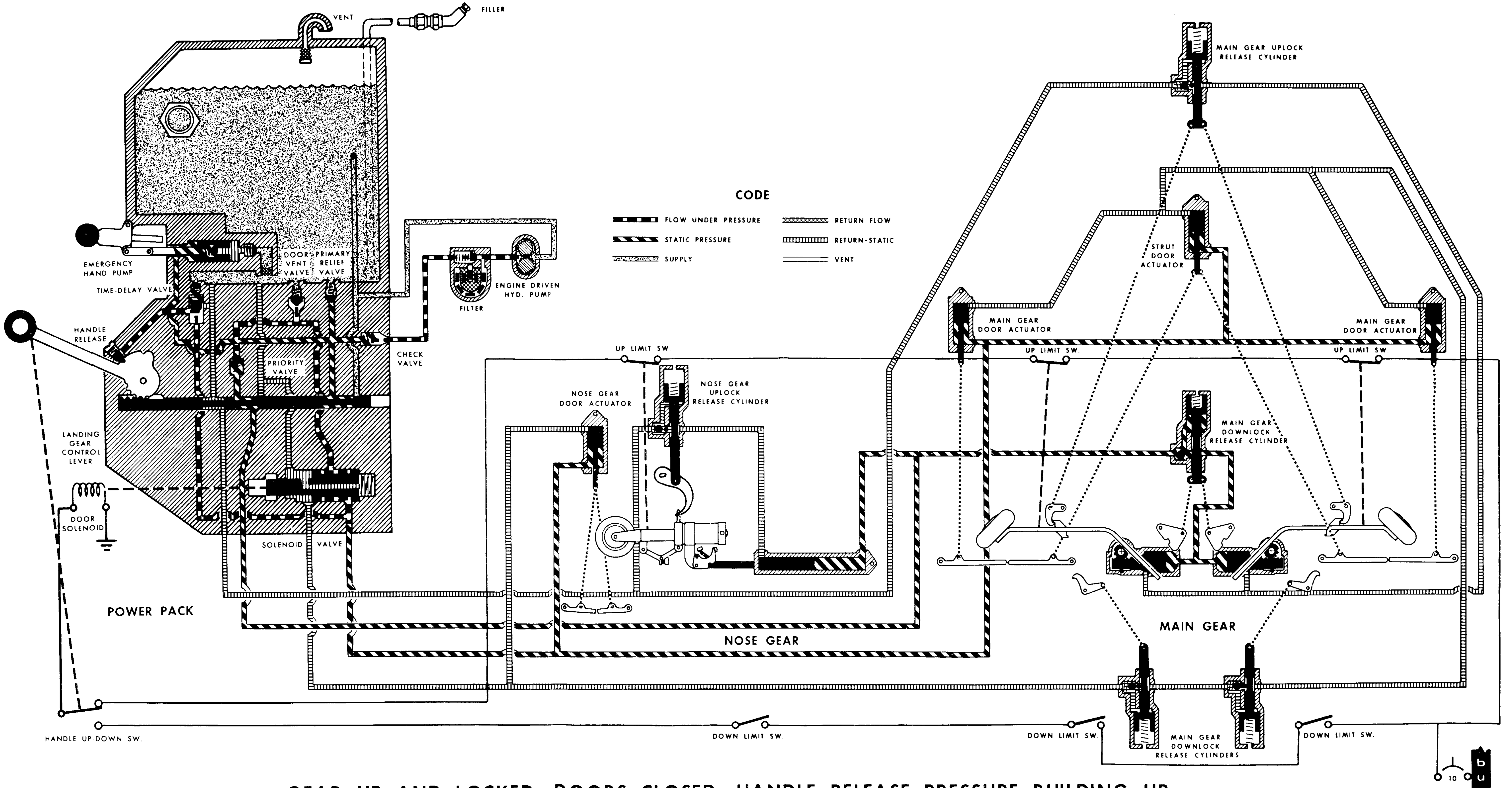

GEAR UP AND LOCKED, DOORS CLOSED, HANDLE RELEASE PRESSURE BUILDING UP

Figure 5-29. Hydraulic System Schematic (Sheet 9 of 10)

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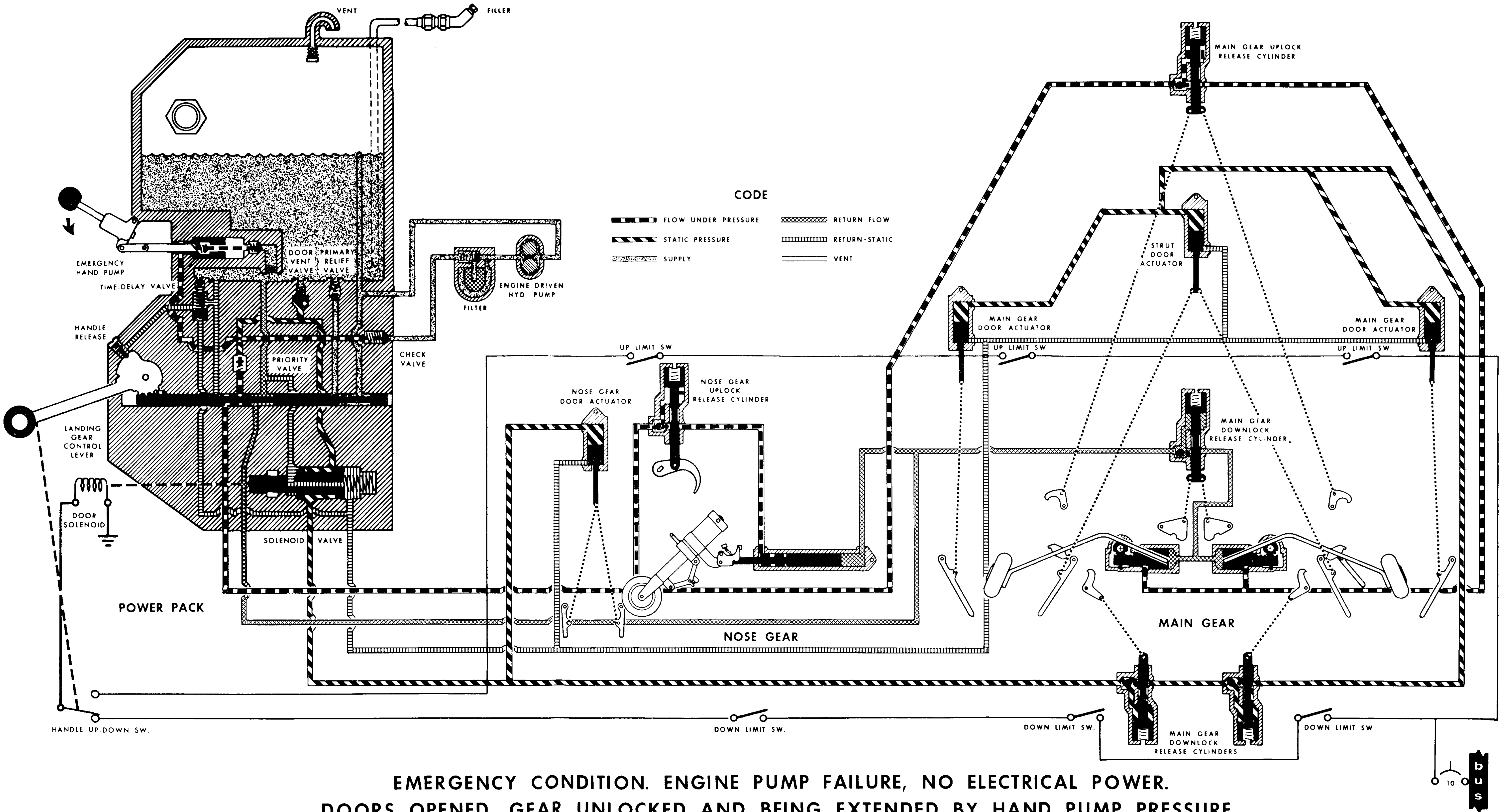

EMERGENCY CONDITION. ENGINE PUMP FAILURE, NO ELECTRICAL POWER.
DOORS OPENED, GEAR UNLOCKED AND BEING EXTENDED BY HAND PUMP PRESSURE

Figure 5-29. Hydraulic System Schematic (Sheet 10 of 10)

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SECTION 6

AILERON CONTROL SYSTEM

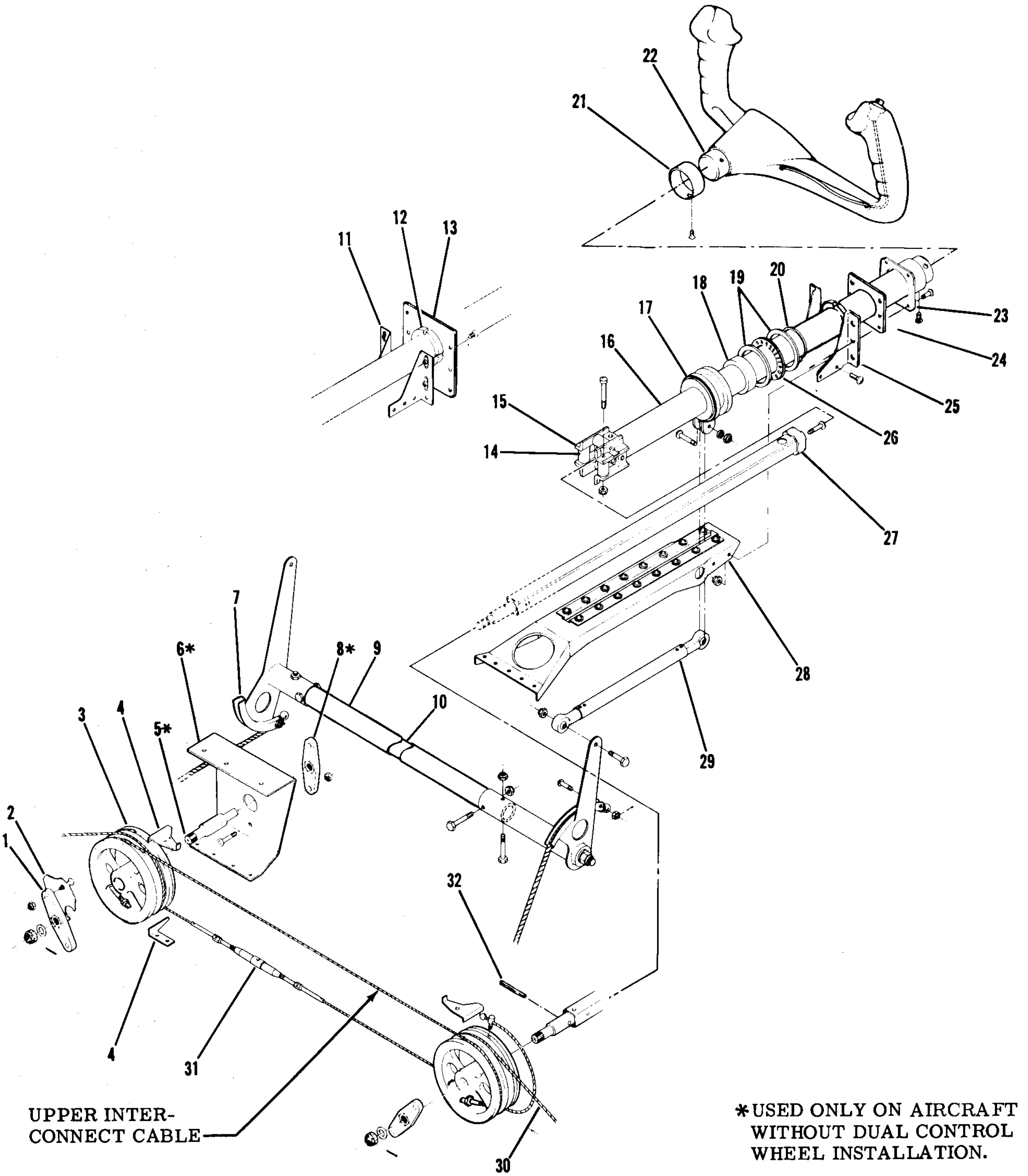
TABLE OF CONTENTS Page

6-1. AILERON CONTROL SYSTEM.

6-2. The aileron control system is comprised of push-pull rods and bellcranks in the wing, cables, pulleys, cable drums, and components forward of the instrument panel, all of which, link the control wheel (or wheels) to the ailerons at the trailing edge of the wings.

6-3. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
LOST MOTION IN CONTROL WHEEL.		
Loose control cables.	Check cable tension.	Adjust cables to proper tension.
Broken pulley or bracket, cable off pulley, or worn rod end bearings.	Check visually.	Replace worn or broken parts, install cables correctly.
RESISTANCE TO CONTROL WHEEL MOVEMENT.		
Cables too tight.	Check cable tension.	Adjust cables to proper tension.
Pulleys binding or cable off.	Observe motion of the pulleys. Check cables visually.	Replace defective pulleys. Install cables correctly.
Drive pulley distorted or damaged.	Check visually.	Replace drive pulley.
Defective drum assembly.	Check visually.	Replace.
Clevis bolts in system too tight.	Check connections where used.	Loosen, then tighten properly and safety.



1.	Bearing Block	9.	Phenolic Sleeve	17.	Sleeve Assembly	25.	Support Plate
2.	Firewall	10.	Elevator Torque Tube	18.	Bearing	26.	Bearing
3.	Cable Drum	11.	Bracket	19.	Bearing Race	27.	Nylon Control Glide
4.	Cable Guard	12.	Plate	20.	Snap Ring	28.	Guide Assembly
5.	Idler Shaft	13.	Grommet	21.	Collar	29.	Push-Pull Rod
6.	Support	14.	Bearing Roller	22.	Control Wheel	30.	Aileron Control Cable
7.	Arm	15.	Retainer	23.	Escutcheon	31.	Turnbuckle
8.	Bearing Block	16.	Tube and Bearing Assembly	24.	Spacer	32.	Roll Pin

Figure 6-1. Aileron Control Column

6-3. TROUBLE SHOOTING (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
CONTROL WHEEL NOT LEVEL WITH AILERONS NEUTRAL.		
Improper adjustment of cables.	Check rigging.	Readjust cable turnbuckles.
Improper adjustment of aileron push-pull rods.	Check rigging.	Adjust push-pull rods to obtain proper alignment.
DUAL CONTROL WHEELS NOT COORDINATED.		
Cables improperly adjusted.		Adjust in accordance with rigging procedure.
INCORRECT AILERON TRAVEL.		
Push-pull rods not adjusted properly.	Check rigging.	Adjust in accordance with rigging procedure.
Incorrect adjustment of travel stop bolts.	Check rigging.	Adjust in accordance with rigging procedure.

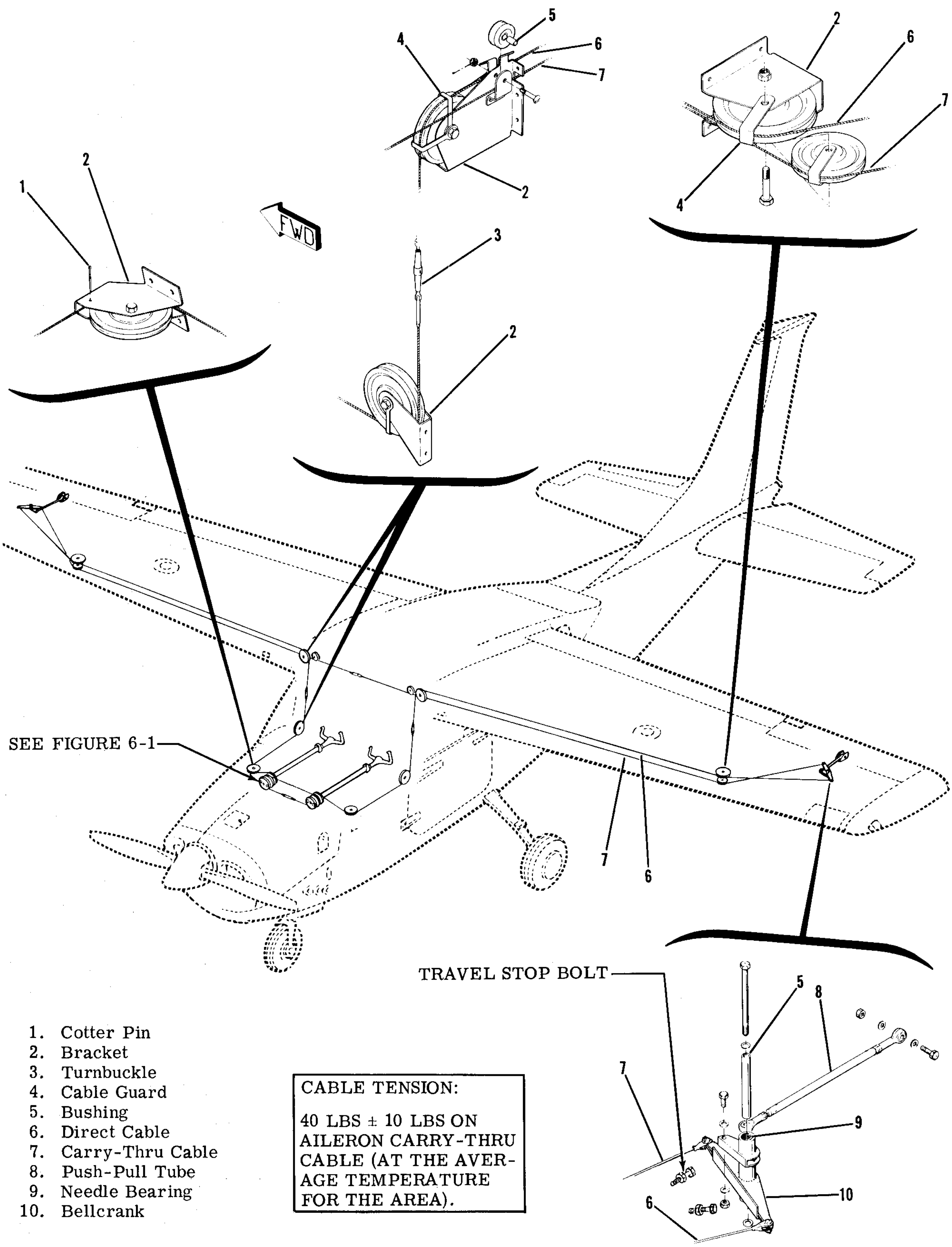
6-4. CONTROL COLUMN. Details of the control column are shown in figure 6-1. Rotation of the control wheel rotates four roller assemblies on the end of the control wheel tube which, in turn, rotates a square tube inside and extending from the control wheel tube. Attached to this square tube is a cable drum which operates the aileron system. The same arrangement is provided for both control wheels and synchronization of the control wheels is obtained by cables and adjustable turnbuckles. The forward end of the square tube is mounted in a bearing block on the firewall and does not move fore and aft, but rotates with the control wheel. The four roller assemblies on the end of the control wheel tube reduce friction as the control wheel is moved fore and aft for elevator system operation. A sleeve weld assembly, containing bearings which permit the control wheel tube to rotate within it, is secured to the control wheel tube by a sleeve and retaining ring in such a manner that it moves fore and aft with the control wheel tube. This movement allows the push-pull tube attached to the weld assembly to operate an elevator arm assembly, to which one elevator cable is attached. A torque tube connects this arm assembly to the one on the opposite end of the torque tube, to which the other elevator cable is attached. When dual controls are installed, the copilot control wheel is linked to the aileron and elevator control systems in the same manner as the pilot control wheel.

6-5. REMOVAL. (See figure 6-1.)

a. Remove screws attaching control wheel to control tube and remove control wheel, disconnect wires.
b. Remove decorative panel from instrument panel. (See Section 15.)
c. Remove screws securing support plate at instrument panel.
d. Disconnect elevator push-pull rod at control column.
e. Loosen turnbuckle and remove interconnect cables from drum.
f. Cut safety wire and remove roll pin through drum and tube assembly.
g. Remove nut and washer from tube protruding through bearing on forward side of firewall.
h. Disconnect wiring at bracket behind panel.
i. Pull control wheel tube assembly aft to remove. Copilot control column is removed in a similar manner.
j. After removal, detail parts may be removed or replaced as necessary.

6-6. INSTALLATION. (See figure 6-1.) Installation of the control column may be accomplished by reversing the removal procedure. Be sure to resafety all parts that were safetied. Check elevator and aileron system for correct rigging. The nut securing the control column to the firewall should be tightened snugly, then loosened the least amount required to eliminate binding and to align a cotter pin hole, but not more than 0.030 inch maximum clearance.

6-7. REPAIR. Worn, damaged, or defective shaft, bearings, bushings, and other components should be replaced. Refer to lubrication diagram in Section 2 for lubrication recommendations.



1. Cotter Pin
2. Bracket
3. Turnbuckle
4. Cable Guard
5. Bushing
6. Direct Cable
7. Carry-Thru Cable
8. Push-Pull Tube
9. Needle Bearing
10. Bellcrank

CABLE TENSION:

40 LBS ± 10 LBS ON AILERON CARRY-THRU CABLE (AT THE AVERAGE TEMPERATURE FOR THE AREA).

Figure 6-2. Aileron Control System

6-8. AILERON BELLCRANK REMOVAL.

a. Remove access cover inboard of bellcrank on underside of wing.

b. Release control cable tension by loosening turnbuckle barrels and disconnect cables from bellcrank. Retain all spacers.

c. Disconnect aileron push-pull rod at bellcrank.

d. Remove nut, washers, and bolt securing bellcrank stop-bushing to wing structure.

e. Remove nut, washers, and bolt securing the bellcrank to the wing structure. Remove bellcrank through access opening, using care that bushing is not dropped from bellcrank.

NOTE

Brass washers may be used as shims between lower end of bellcrank and wing structure. Retain these shims. Tape open ends of bellcrank bearings to prevent dust and dirt from entering bellcrank needle bearings.

6-9. AILERON BELLCRANK REPAIR. Repair of aileron bellcranks consists of the replacement of defective parts. If needle bearings are dirty or in need of lubrication, clean thoroughly and lubricate as outlined in Section 2.

6-10. AILERON BELLCRANK INSTALLATION.

a. Place bushing, and stop-bushing in bellcrank and position bellcrank in wing.

b. Install brass washers between lower end of bellcrank and wing structure to shim out excess clearance between bellcrank and wing structure.

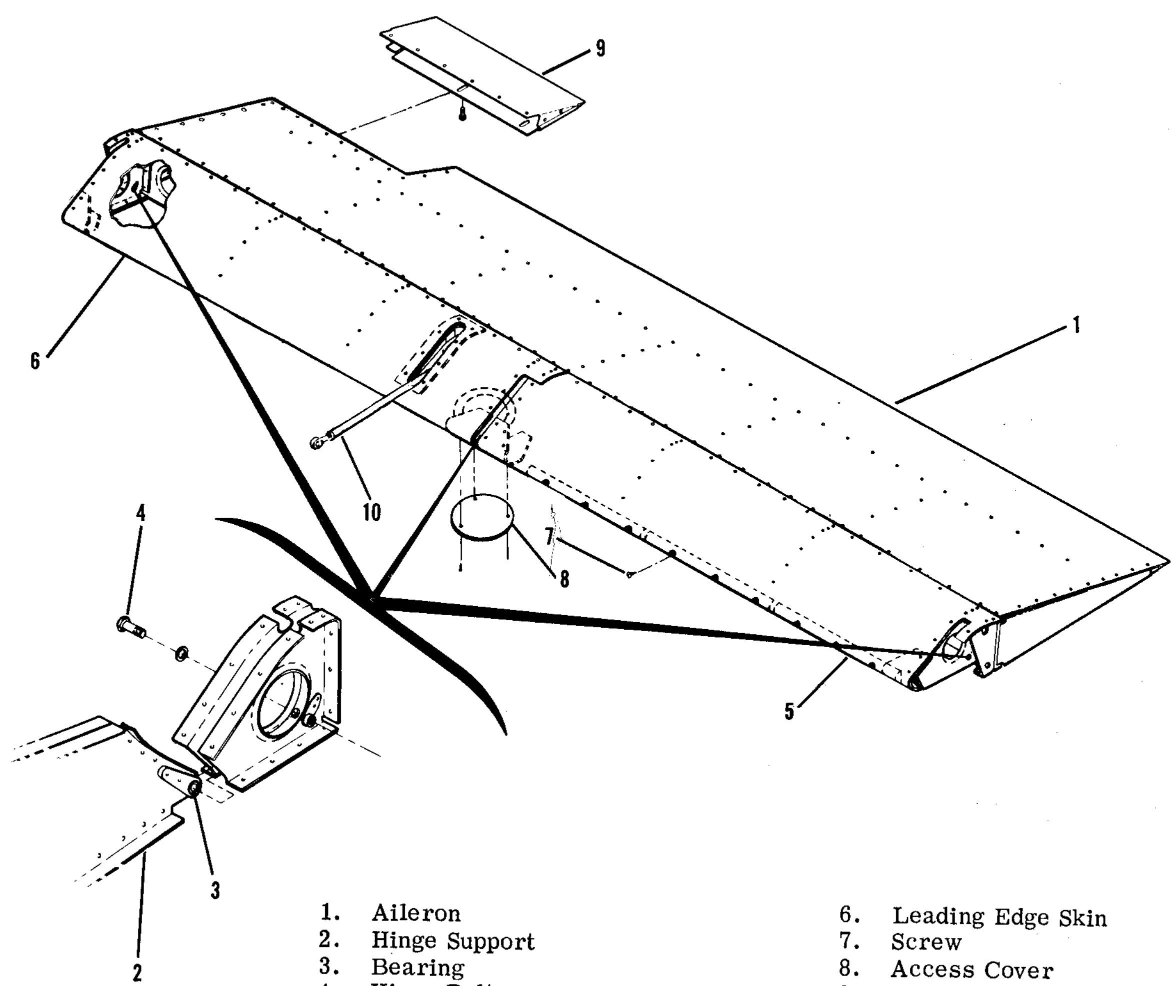
c. Install bellcrank pivot bolt, washers, and nut.

d. Position bellcrank stop-bushing and install attaching bolt, washers, and nut.

e. Connect aileron cables to bellcrank.

f. Rig aileron system in accordance with applicable paragraph in this section and install access covers.

6-11. CONTROL CABLE REMOVAL AND INSTALLATION. Aileron cables may be removed after disconnecting both ends of the cables and removing



1. Aileron
2. Hinge Support
3. Bearing
4. Hinge Bolt
5. Balance Weight
6. Leading Edge Skin
7. Screw
8. Access Cover
9. Aileron Trim Tab
10. Push-Pull Tube

Figure 6-3. Aileron Installation

cables guards and pulleys as necessary to work the cables free of the aircraft. When installing a cable, be sure cable is in pulley groove and cable guards are properly installed.

NOTE

To ease rerouting of cables, a length of wire may be attached to the end of the cable before it is withdrawn from the aircraft. Leave the wire in place, routed through the structure; then attach it to the cable being installed and use it to pull the cable into position.

6-12. REMOVAL OF AILERON. (See figure 6-3.) Removal is accomplished by disconnecting push-pull rod, then removing aileron hinge bolts.

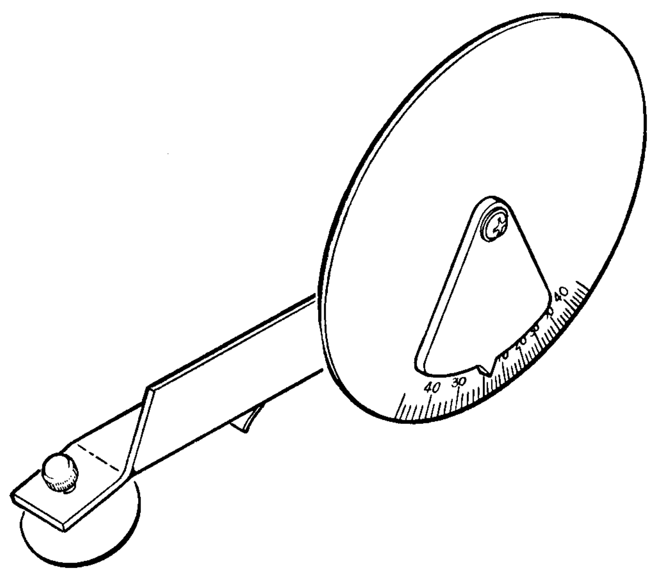
6-13. AILERON REPAIR. Repair of the aileron may be accomplished in accordance with instructions contained in Section 18. After an aileron has been repaired, check static balance and rebalance as outlined in Section 18. Before installation, check balance weights for security.

6-14. AILERON INSTALLATION.
a. Position aileron at trailing edge of wing and install hinge bolts.
b. Connect push-pull rod to aileron. If rigging was correct and push-pull rod adjustment was not disturbed, it should not be necessary to re-rig the system. Check aileron travel and alignment, and rig if necessary in accordance with applicable paragraph in this section.

6-15. AILERON SYSTEM RIGGING.
a. Relieve all tension on aileron control system by loosening turnbuckles.
b. Disconnect aileron push-pull tubes.
c. Adjust turnbuckle on lower interconnect cable, pins and swaged balls on upper interconnect cable to remove slack from interconnect cables and position control wheels level (synchronized).
d. Block control wheels in neutral.
e. Adjust direct and carry-thru cable turnbuckles to position bellcranks approximately in neutral while maintaining proper cable tension.
f. Streamline aileron with reference to flaps (flaps full UP and disregarding aileron trim tabs), then adjust push-pull tube to fit and install.
g. With aileron streamlined, mount inclinometer on trailing edge of aileron and set pointer to 0°.
h. Unblock control wheels, then adjust travel stops to obtain correct aileron travel.
i. Be sure all turnbuckles are safetied, all cables and cable guards are properly installed, and all jam nuts are tightened, then replace all parts removed for access.

WARNING

Be sure ailerons move in the correct direction when operated by the control wheel.



AVAILABLE FROM CESSNA SERVICE PARTS CENTER (TOOL NO. SE 716)

Figure 6-4. Inclinometer for Measuring Control Surface Travel

SECTION 7

WING FLAP CONTROL SYSTEM

TABLE OF CONTENTS

7-1. FLAP CONTROL SYSTEM.

7-2. Electrically operated flaps are standard equipment on Models 210J and T210J aircraft. Power from the motor and transmission assembly is transmitted to the flaps by a system of cables and interconnect cables. Electrical power to the motor is controlled by a combination of two microswitches mounted on a "floating" arm, a camming lever and follow-up control. As the camming lever is moved to a desired flap setting, its cam trips a switch and actuates the flap motor. As the actuator moves, the floating arm is rotated by the follow-up control until the active switch clears the camming lever, breaking the circuit. To reverse the direction of travel, the control lever is moved in the opposite direction. When its cam contacts the second switch it reverses the flap motor. Likewise the follow-up control moves the floating arm until the second switch is clear of the camming lever.

7-3. OPERATIONAL CHECKOUT OF FLAP CONTROL SYSTEM.

a. Operate flaps through their full range of travel, observing for jumpy or lost motion.

b. Check for positive shut-off of flap motor at travel extremes, motor should not continuously freewheel at travel extremes.

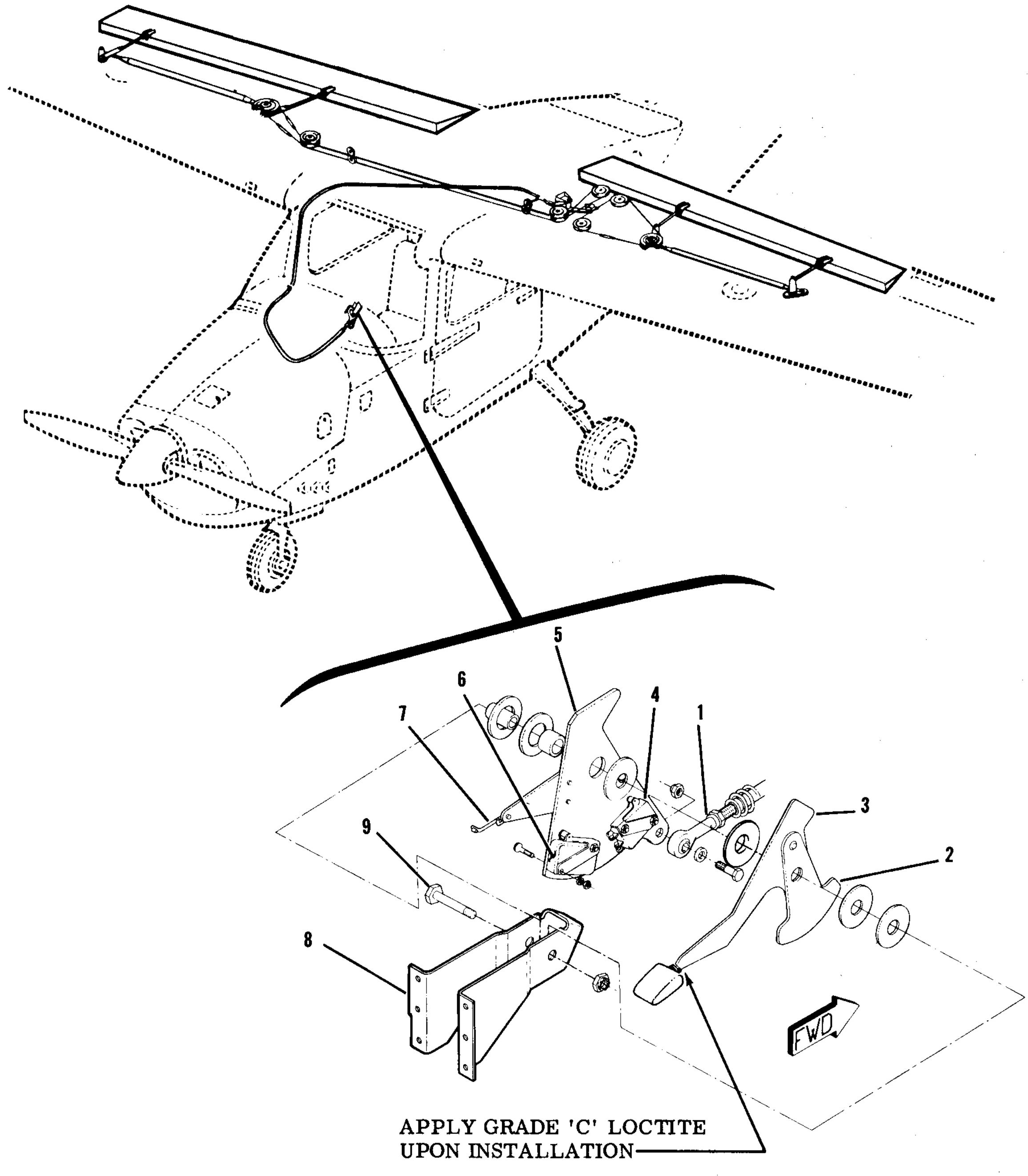
c. Check for sluggish operation. Flaps should extend in approximately 5.25 seconds and retract in approximately 6.25 seconds.

d. With flaps FULL UP, mount an inclinometer on one flap and set to 0°. Lower flap to full down position and check flap angle. Check mid-range percentage setting, (approximate), against degrees as indicated on inclinometer. Repeat same procedure for opposite flap.

e. Remove flap bellcrank and drive pulley access plates, and check bellcrank and drive pulleys for excessive wear.

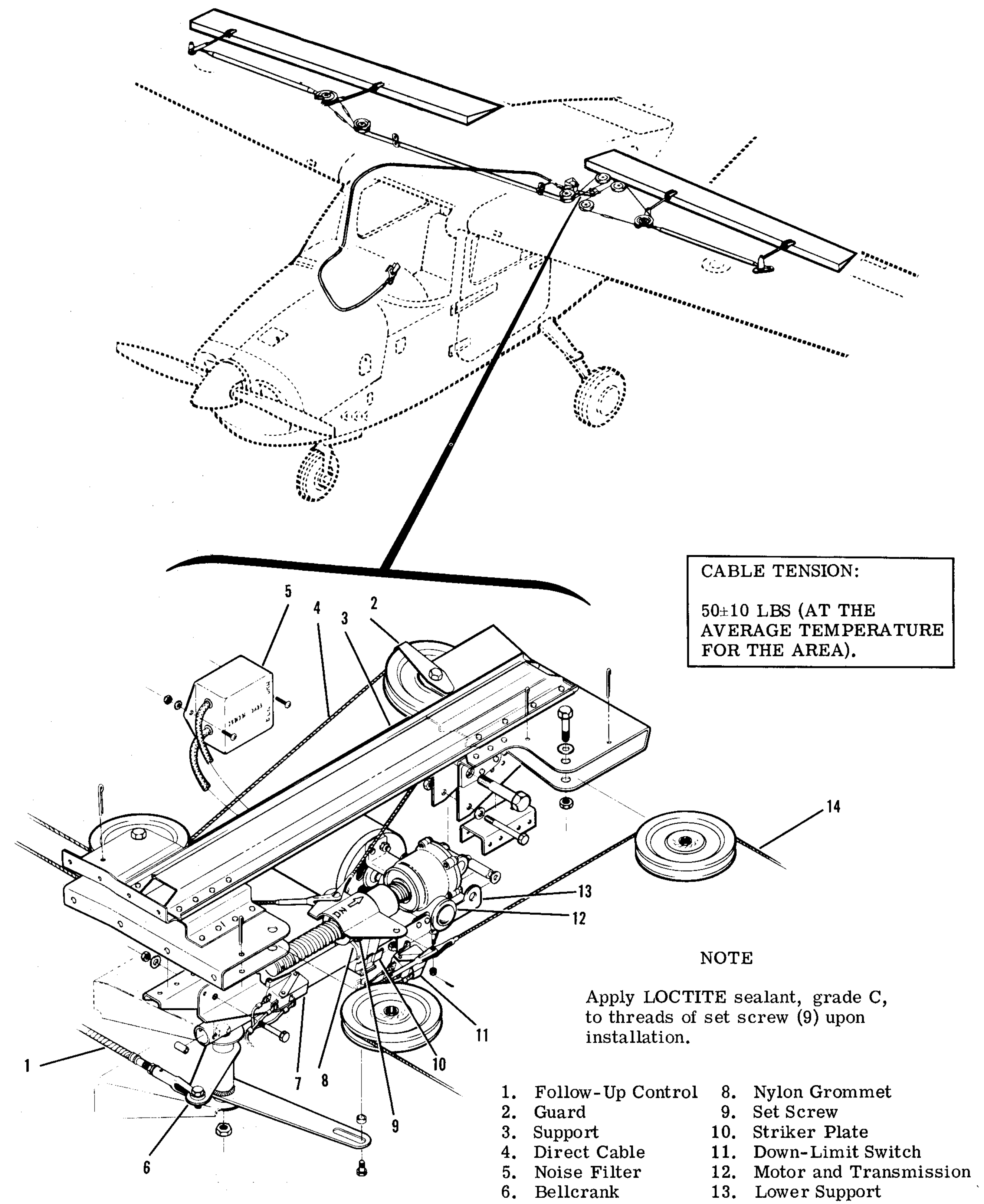
7-4. TROUBLE SHOOTING THE FLAP CONTROL SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
BOTH FLAPS FAIL TO MOVE.		
Popped circuit breaker.	Check citcuit breaker.	Reset circuit breaker.
Defective switch.	Place jumper across switch.	Replace switch.
Defective motor.	Remove and bench test motor.	Replace motor.
Broken or disconnected wires.	Run continuity check of wiring.	Connect or repair wiring.
Defective or disconnected transmission.	Check to see transmission is connected to flap system. If connected, remove for bench test.	Connect or replace transmission.
Defective flap interrupt switch.	Check continuity.	Replace switch.
LEFT FLAP FAILS TO MOVE.		
Disconnected or broken cable.	Check cable tensions.	Connect or replace cable.
Disconnected push-pull rod.	Check push-pull rod attachment.	Attach push-pull rod.
BINDING IN SYSTEM AS FLAPS ARE RAISED AND LOWERED.		
Cables not riding on pulleys.	Open access covers and ovserve pulleys.	Route cables correctly over pulleys.
Broken or binding pulleys.	Check pulleys for free rotation or breaks.	Replace defective pulleys.
Frayed cable.	Check condition of cables.	Replace defective cable.
Bind in drive pulleys.	Check drive pulleys in motion.	Replace drive pulley.
Flaps binding on tracks.	Observe flap tracks and rollers.	Replace defective parts.
INCORRECT FLAP TRAVEL.		
Incorrect rigging.		Rig flaps correctly.



1. Follow-Up Control
2. Cam
3. Control Lever
4. Flaps Down Operating Switch
5. Switch Mounting Arm
6. Flaps Up Operating Switch
7. Flap Position Pointer
8. Bracket
9. Bolt

Figure 7-1. Flap Control System (Sheet 1 of 3)



CABLE TENSION:

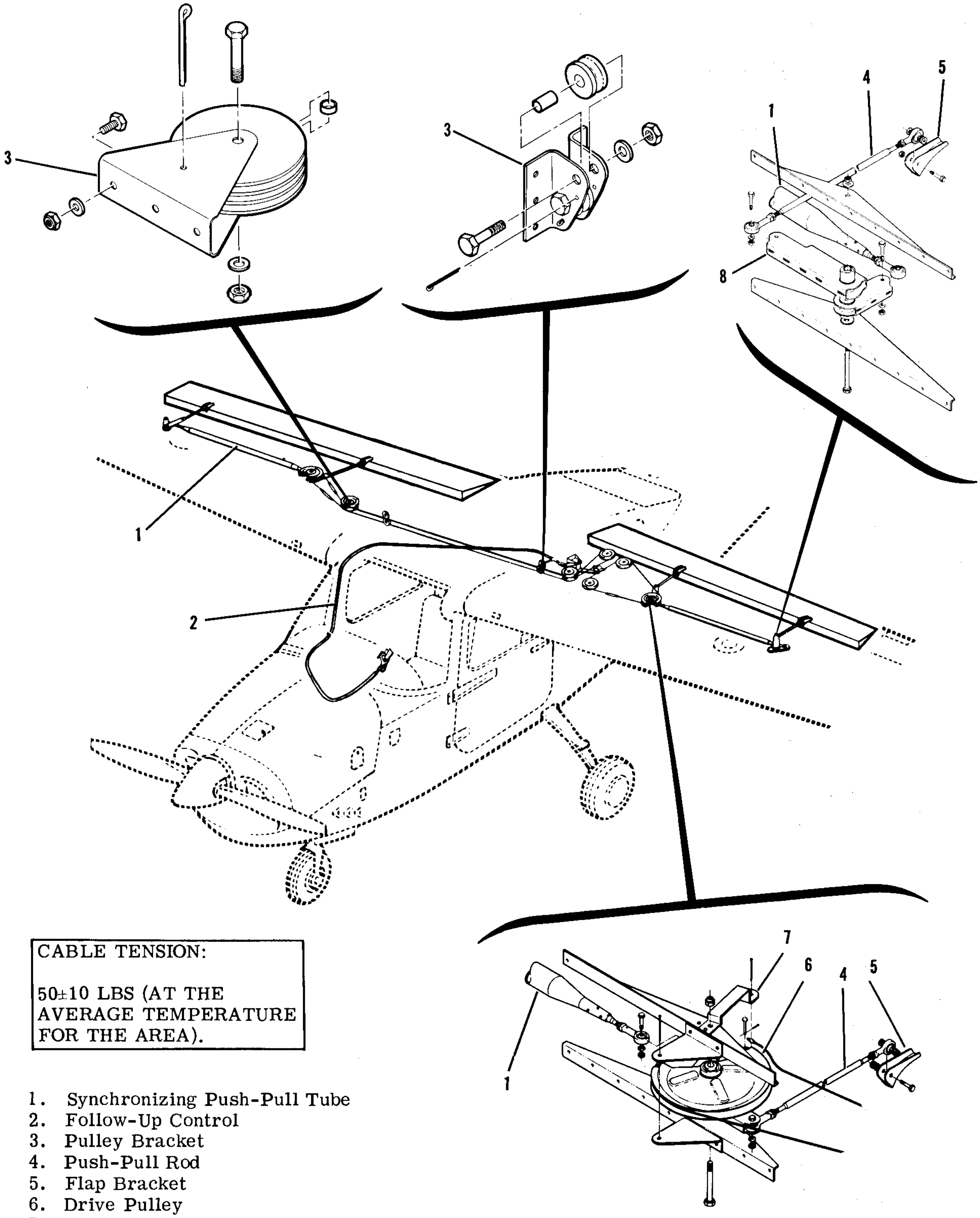
50±10 LBS (AT THE AVERAGE TEMPERATURE FOR THE AREA).

NOTE

Apply LOCTITE sealant, grade C, to threads of set screw (9) upon installation.

1. Follow-Up Control
2. Guard
3. Support
4. Direct Cable
5. Noise Filter
6. Bellcrank
7. Up-Limit Switch
8. Nylon Grommet
9. Set Screw
10. Striker Plate
11. Down-Limit Switch
12. Motor and Transmission
13. Lower Support
14. Retract Cable

Figure 7-1. Flap Control System (Sheet 2 of 3)



CABLE TENSION:

50±10 LBS (AT THE AVERAGE TEMPERATURE FOR THE AREA).

1. Synchronizing Push-Pull Tube
2. Follow-Up Control
3. Pulley Bracket
4. Push-Pull Rod
5. Flap Bracket
6. Drive Pulley
7. Cable Guard
8. Bellcrank

Figure 7-1. Flap Control System (Sheet 3 of 3)

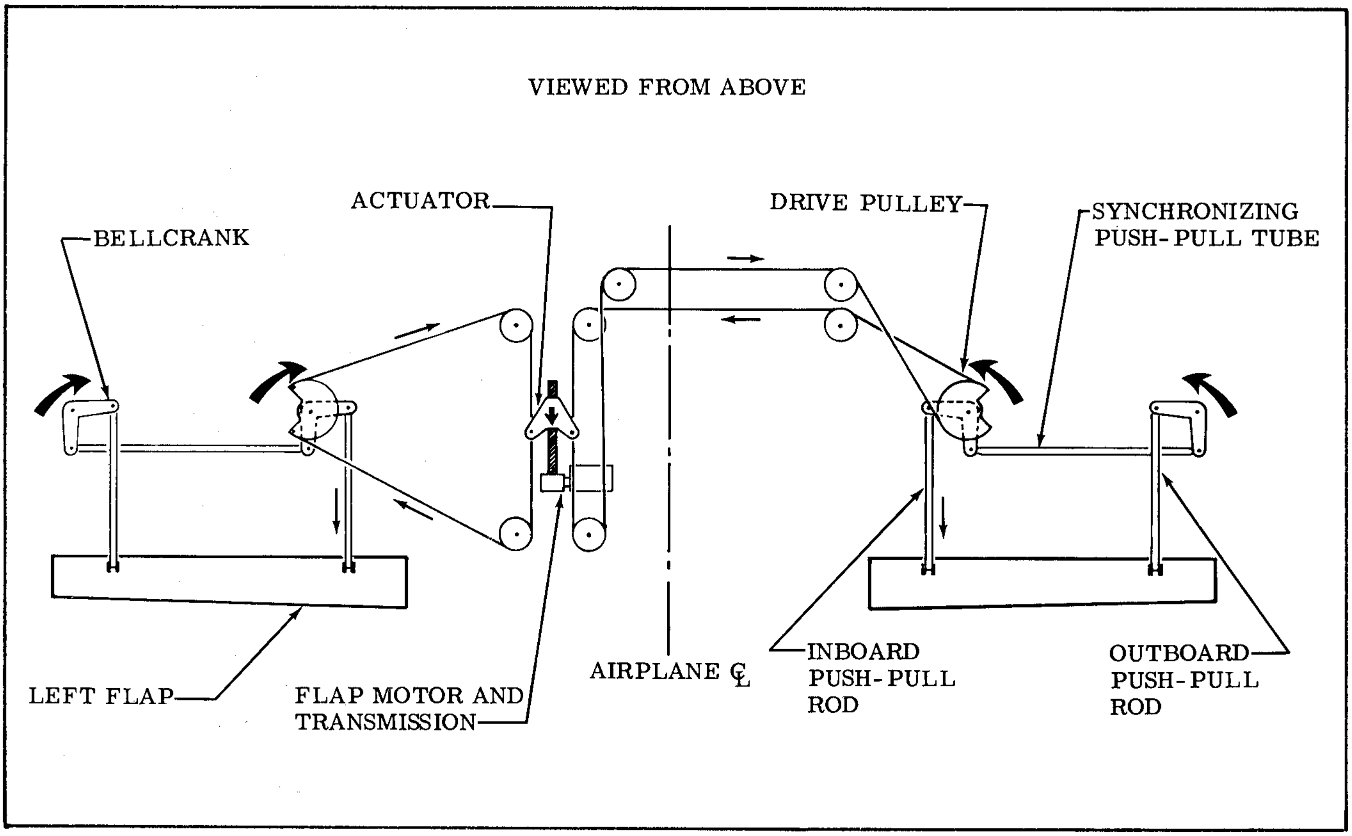


Figure 7-2. Flap System Schematic

7-5. REMOVAL AND INSTALLATION OF FLAP CONTROL LEVER. (See figure 7-1, sheet 1.)

a. Remove follow-up control from switch mounting arm.

b. Remove flap operating switches.

c. Remove knob from control lever.

d. Remove remaining items by removing bolt (9).

e. Reverse steps "a" through "d" to install flap control lever. Do not overtighten bolt (9) causing control lever to bind. Refer to paragraph 7-11, steps "g" and "h", for adjustment procedure.

7-6. REMOVAL, REPAIR AND INSTALLATION OF FLAP ACTUATOR ASSEMBLY. (See figure 7-1, sheet 2.)

a. Remove transmission, motor, actuator and lower support as a unit.

b. Remove access cover, beneath flap actuator assembly, on left wing.

c. Remove access covers beneath flap bellcranks, and relieve cable tension.

d. Disconnect cables from actuator.

e. Disconnect lower support at forward end. Disconnect aft end of lower support and transmission and motor, then remove assembly from wing.

f. Repair consists of replacement of motor, transmission or coupling.

g. Installation may be accomplished by reversing the preceding steps and rigging system.

7-7. REMOVAL, REPAIR AND INSTALLATION OF DRIVE PULLEY. (See figure 7-1, sheet 3.)

a. Remove access covers beneath bellcranks and relieve cable tension.

b. Remove access covers beneath drive pulleys and relieve cable tension.

c. Disconnect cables from drive pulleys and lower flap gently.

d. Remove bolt securing push-pull rod to drive pulley.

e. Remove bolt securing synchronizing tube to drive pulley.

NOTE

Protect needle bearings by covering open ends with tape. One or more brass washers may be used under drive pulleys and bellcranks.

f. Remove bolt securing drive pulley to wing, then remove drive pulley using care that bushing is not dropped.

g. Repair of drive pulley is limited to replacement of needle bearings.

h. Installation may be accomplished by reversing the preceding steps and rigging system.

7-8. REMOVAL, REPAIR AND INSTALLATION OF OUTBOARD BELLCRANKS. (See figure 7-1, sheet 3.)

a. Remove access covers under outboard bellcranks.
b. Remove bolt securing outboard push-pull rod to bellcrank. Also, remove bolt attaching inboard push-pull rod to drive pulley. Lower flap gently.
c. Remove bellcrank pivot bolt, then position bellcrank as necessary to expose synchronizing tube attach point.
d. Remove bolt attaching synchronizing push-pull tube to bellcrank, then remove bellcrank through access hole.

NOTE

To remove synchronizing push-pull tube, disconnect it at both ends and position it through lightning holes until it can be removed through the access hole.

e. Repair of bellcrank is limited to replacement of needle bearings.
f. Installation may be accomplished by reversing the preceding steps and then rigging system.

7-9. REPLACEMENT OF FLAP CABLES AND PULLEYS may be accomplished while using figure 7-2 as a guide. Refer to applicable rigging paragraph for proper cable attachment.

NOTE

To ease rerouting of cables, a length of wire may be attached to the end of the cable before it is withdrawn from the aircraft. Leave the wire in place, routed through the structure; then attach it to the new cable and use it to pull cable into place.

7-10. REMOVAL, REPAIR, AND INSTALLATION OF FLAPS. Figure 7-3 shows details of the flap installation and may be used as a guide during removal and installation of flaps. If flap push-pull rod adjustment is not disturbed, it should not be necessary to rerig the flap system. Check flap travel and rerig if necessary. Repair of damaged flap may be accomplished in accordance with instructions contained in Section 18.

7-11. RIGGING FLAP CONTROL SYSTEM. (See figure 7-2.)
a. Run flaps to full down position.
b. Disconnect push-pull rods at flaps.
c. If cables are being replaced, attach 1/2" direct cable to forward side of drive pulley and the 3/32" retract cables to the aft side of the drive pulleys. If drive pulleys are not installed, it may be easier to attach the cable before installing the drive pulleys.
d. Adjust synchronizing push-pull tube to 41.87 inches between rod end holes, then tighten jam nuts and install.
e. Adjust inboard push-pull rods to 10.81 inches; adjust outboard push-pull rods to 10.39 inches, then tighten jam nuts and install.
f. Check that cables are in pulley grooves, then adjust turnbuckles to obtain correct cable tension and place flaps in full up position (flap actuator in full up position). Adjust up limit switch to operate and shut-off motor at this position.
g. Mount an inclinometer on one flap and set to 0°.

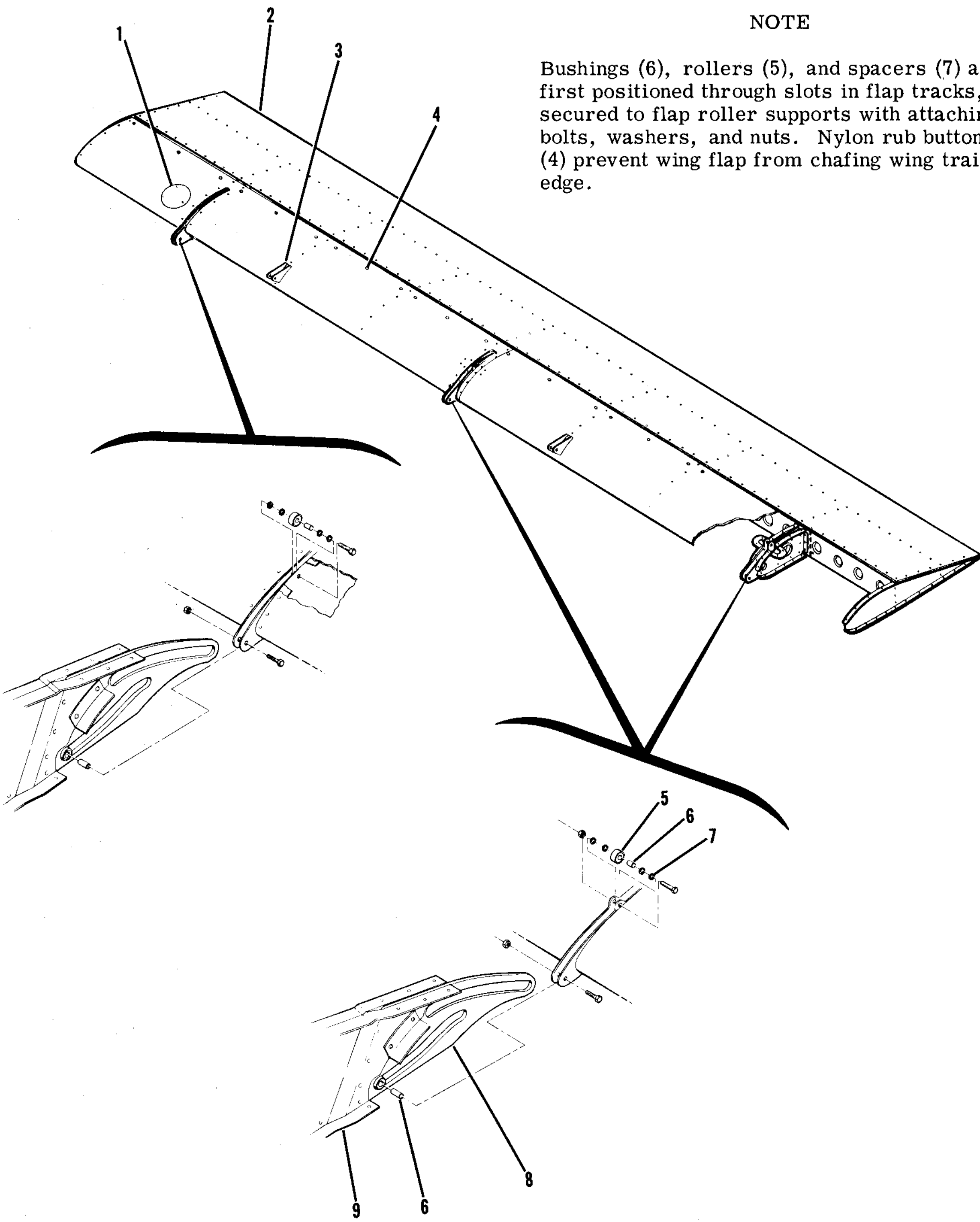
NOTE

An inclinometer for measuring control surface travel is available from the Cessna Service Parts Center. (See figure 6-4 of the Service Manual.)

h. Lower flaps to specified down angle, then adjust down limit switch to operate and shut-off motor at this position.
i. Repeat steps "g" and "h" for opposite flap.
j. Run flaps to full up position, then disconnect follow-up control at switch mounting arm.
k. Move control lever to full UP position, then without moving control lever, move switch mounting arm (5) until control lever cam (2) is centered between mid-range switches. Adjust follow-up control to fit and secure at this position.
l. Adjust mid-range switches in slotted holes until rollers just clear cam, then secure switches.
m. Turn on master switch and run flaps through several cycles, stopping at various mid-range settings and checking that cable tension is within specified limits. Retract cable tension may increase to 90 pounds when flaps are fully retracted.
n. Flight test aircraft and check that follow-up control does not cause automatic cycling, which indicates the operating switches do not have sufficient clearance at the cam. If cycling occurs, readjust operating switches as necessary per step "l," then complete rigging.
o. Check that all rod ends and clevis ends have sufficient thread engagement, all jam nuts are tight, then replace all parts removed for access.

NOTE

Bushings (6), rollers (5), and spacers (7) are first positioned through slots in flap tracks, then secured to flap roller supports with attaching bolts, washers, and nuts. Nylon rub buttons (4) prevent wing flap from chafing wing trailing edge.



1. Access Cover
2. Flap Assembly
3. Actuating Bracket
4. Nylon Rub Buttons
5. Roller
6. Bushing
7. Spacer
8. Flap Track
9. Wing Structure

Figure 7-3. Flap Installation

SECTION 8

ELEVATOR CONTROL SYSTEM

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8-1. ELEVATOR CONTROL SYSTEM.

8-2. The elevators are operated by power transmitted through forward and aft movement of the pilot or copilot control column. This power reaches the elevators through a system consisting of the control column, an elevator torque tube, cables, and pulleys. The elevator control cables, at their aft ends, are attached to a bellcrank mounted on brackets on a bulkhead in the tailcone. A push-pull tube connects this bellcrank to the elevator bellcrank, installed between the elevators. An elevator trim tab is installed in the trailing edge of the right elevator. The elevator trim tab control system is described in Section 9.

8-3. TROUBLE SHOOTING THE ELEVATOR CONTROL SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
NO RESPONSE TO CONTROL WHEEL FORE-AND-AFT MOVEMENT.		
Forward or aft push-pull tube disconnected.	Check visually.	Attach push-pull tube and rig per paragraph 8-10.
Cables disconnected.	Check visually.	Attach cables and rig per paragraph 8-10.
BINDING OR JUMPY MOTION FELT IN MOVEMENT OF ELEVATOR SYSTEM.		
Defective bellcrank pivot bearing	Check bellcrank; move to check for play or binding.	Replace bellcrank.
Defective elevator bellcrank pivot bearing.	Check bellcrank; move to check for play or binding.	Replace bellcrank.

8-3. TROUBLE SHOOTING THE ELEVATOR CONTROL SYSTEM (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
BINDING OR JUMPY MOTION FELT IN MOVEMENT OF ELEVATOR SYSTEM. (Cont.)		
Cables slack.	Check for correct tension.	Adjust to correct tensions.
Cables not riding correctly on pulleys.	Check cable routing.	Route cables correctly on pulleys.
Defective elevator hinges.	Disconnect rear push-pull tube and move elevator by hand, checking hinges.	Replace defective hinges.
Defective push-pull tube bearings.	Disconnect push-pull tube and check that bearings rotate freely.	Replace defective rod end.
Defective control column needle bearing rollers.	Check visually.	Replace rollers.
Defective control column torque tube bearings.	Disconnect parts and check that torque tube rotates freely.	Replace bearings.
ELEVATOR FAILS TO ATTAIN PRESCRIBED TRAVEL.		
Stops incorrectly set.		Rig per paragraph 8-10.
Cables unevenly tightened.		Rig per paragrapn 8-10.
Interference at firewall or instruments.	Check visually.	

8-4. REPLACEMENT OF COMPONENTS.

8-5. THE CONTROL COLUMN may be removed, repaired, and installed as outlined in Section 6.

8-6. CABLES, PULLEYS, AND BELLCRANKS. Cables, pulleys, and bellcranks, as well as other components of the elevator systems may be removed and installed while using the illustrations in this section as a guide. Repair consists of replacement of defective parts. If rigging has been affected by replacement of components, rerig in accordance with paragraph 8-10.

NOTE

To ease rerouting of cables a length of wire may be attached to the end of the cable before it is withdrawn from the aircraft. Leave the wire in place, routed through the structure; then attach it to the cable being installed and use it to pull the cable into position.

8-7. ELEVATOR REMOVAL. (See figure 8-2.)
a. Remove stinger.
b. Disconnect elevator trim tab push-pull tube from trim tab.
c. Remove three bolts (10) securing right and left elevators to elevator bellcrank (8).

NOTE

If precautions are taken to see that the elevator trim system is not moved and actuator screw is not turned, it will not be necessary to rerig the elevator trim control system.

d. Remove elevator hinge bolts to remove elevator.
e. Elevator bellcrank (8) may be removed after disconnecting push-pull tube (7) and removing pivot bolt (9). Bolts (10) must be removed, but it is not necessary to remove elevators to remove the bellcrank.

8-8. ELEVATOR REPAIR may be accomplished as outlined in Section 18. Hinge bearings may be replaced as necessary. If repair has affected static balance, check static balance and rebalance as required.

8-9. ELEVATOR INSTALLATION. Reverse procedure outlined in paragraph 8-7 to install the elevators. When tightening bolts (10), be sure

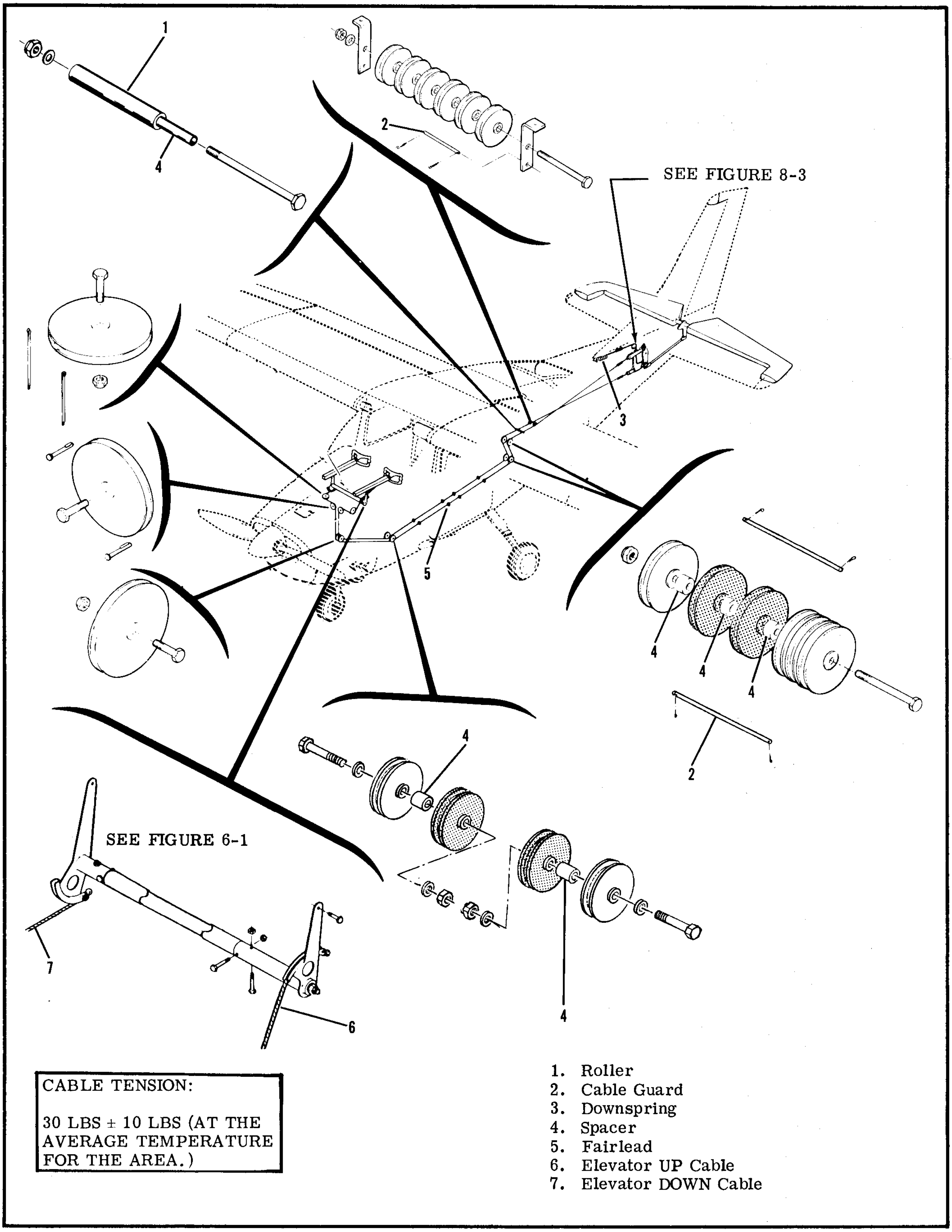
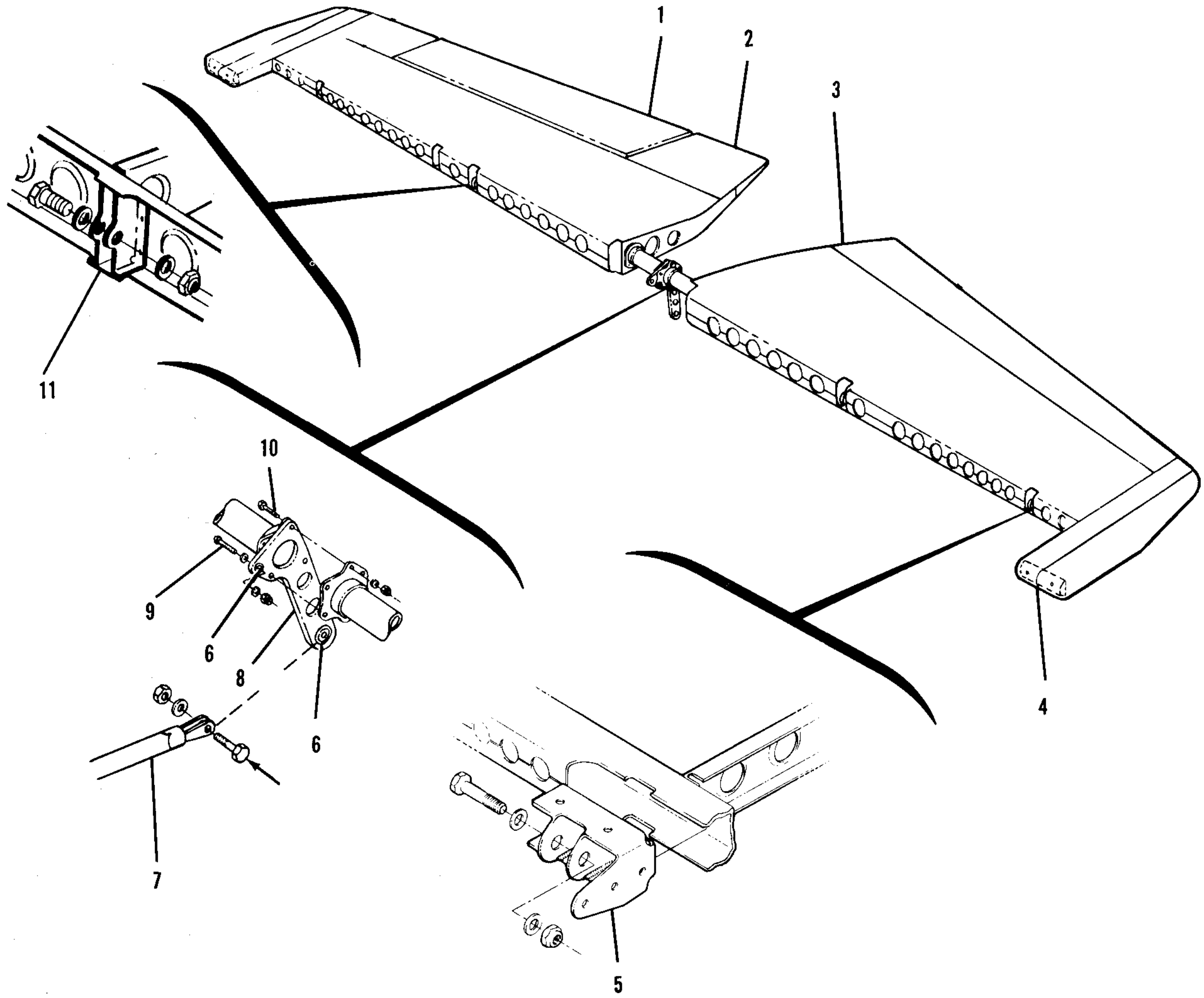


Figure 8-1. Elevator Control System



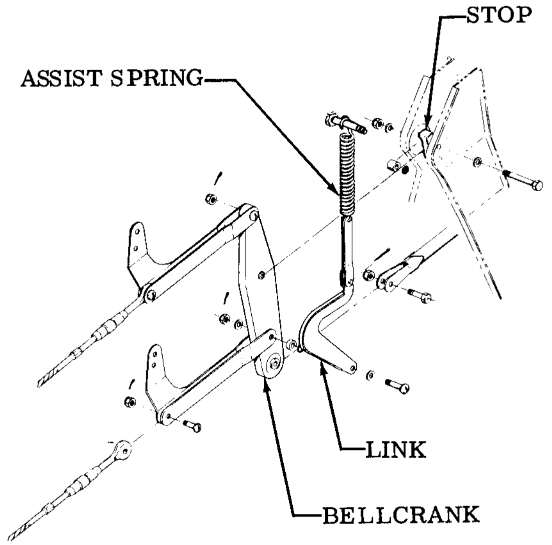
1. Elevator Trim Tab
2. Right Elevator
3. Left Elevator
4. Static Balance Weight
5. Outboard Hinge
6. Needle Bearing
7. Push-Pull Tube
8. Elevator Bellcrank
9. Bolt
10. Bolt
11. Inboard Hinge

NOTE

Do not attempt to align the elevator trailing edges as there is a 0° 54' twist designed into the connecting torque tube. This twist causes the right elevator to be higher than the left.

The trailing edge of the elevator sections are foam filled.

Figure 8-2. Elevator Installation



NOTE

As the elevator bellcrank pivots, the assist spring link moves over-center and exerts pressure in the direction the bellcrank is pivoting. The spring pressure is not adjustable.

Figure 8-3. Elevator Bellcrank Installation

NOTE

The holes are drilled off center in the bellcrank stops to provide elevator travel adjustments. Every 90° of rotation of the bellcrank stop provides approximately 1° of control surface travel.

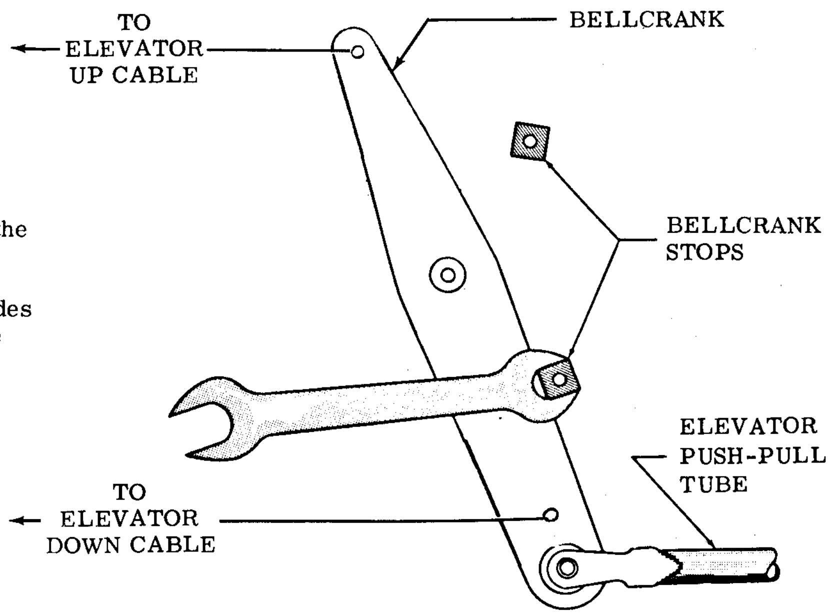


Figure 8-4. Travel Stops on Elevator Rear Bellcrank

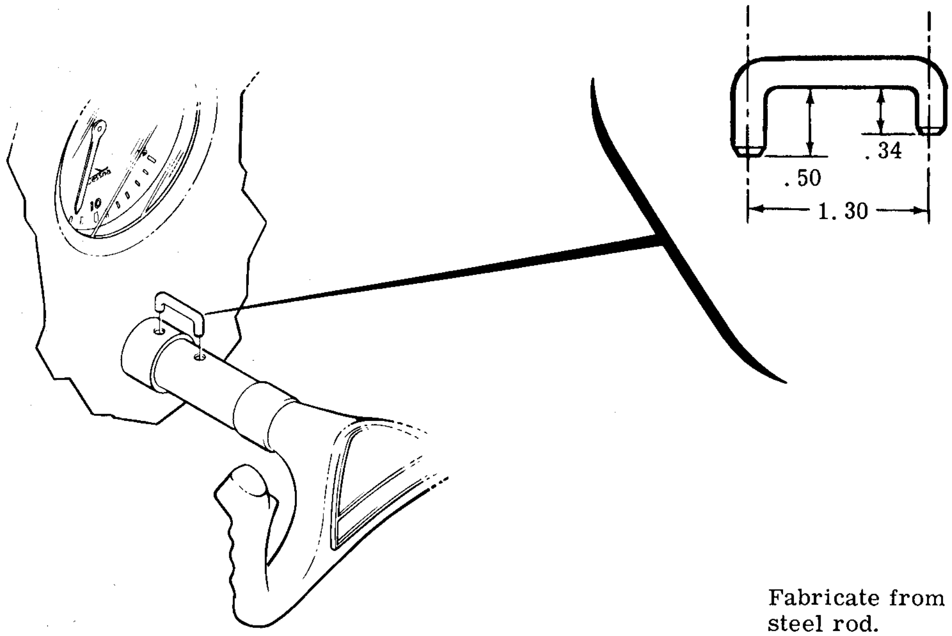


Figure 8-5. Control Column Neutral Rigging Tool

elevators are aligned with each other. Do not attempt to align the elevator trailing edges as there is a 0° 54' twist designed into the connecting torque tube. This twist causes the right elevator to be higher than the left. Check elevator and trim tab travel, and rig if necessary. Trim system rigging is given in Section 9.

8-10. RIGGING THE ELEVATOR CONTROL SYSTEM. (See figures 8-1 and 8-2.) The elevator control system can be rigged using the following procedure:

a. Lock control wheel tube in neutral by installing rigging tool. Refer to figure 8-5 for control tube rigging tool.
b. Adjust elevator cable turnbuckles to streamline elevators with horizontal stabilizer and to obtain 30 pounds cable tension, then safety turnbuckles.

NOTE

Disregard the counterweight areas of the elevators when streamlining. These areas are contoured so that they will be streamlined at cruising speed (elevators approximately 3° down).

c. Mount an inclinometer on one elevator and set to zero degrees.

NOTE

An inclinometer for measuring control surface travels is available from Cessna Service Parts Center. Refer to figure 6-4.

d. Remove rigging tool, then adjust elevator travel stops to obtain correct elevator travel as listed in Section 1.
e. Move control wheel through full range of travel and check cable tension in various positions. Tension should not be less than 20 pounds or more than 40 pounds in any position.
f. Check that all turnbuckles are safetied and all parts are secured, then reinstall all parts removed for access.

WARNING

Be sure elevators move in correct direction when operated by the control wheel.

SECTION 9

ELEVATOR TRIM CONTROL SYSTEMS

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9-1. ELEVATOR TRIM CONTROL SYSTEM. The elevator trim tab is located on the right elevator and is controlled by a trim wheel, roller chains, screw-jack actuator, and cable system arrangement. A position indicator in the trim wheel mechanism indicates nose attitude of the aircraft. Forward rotation of the wheel trims the nose down, and aft rotation of the wheel trims the nose up. The standard elevator trim control system may be equipped with an electric trim assist as optional equipment. (See figure 9-5.) The system is operated by a control wheel-mounted switch. The servo unit includes a motor and a chain driven, solenoid operated adjustable clutch. The trim tab up cable enters the servo housing and double wraps around a drive drum. While the clutch is not energized, the drive drum freewheels so manual operation is not affected.

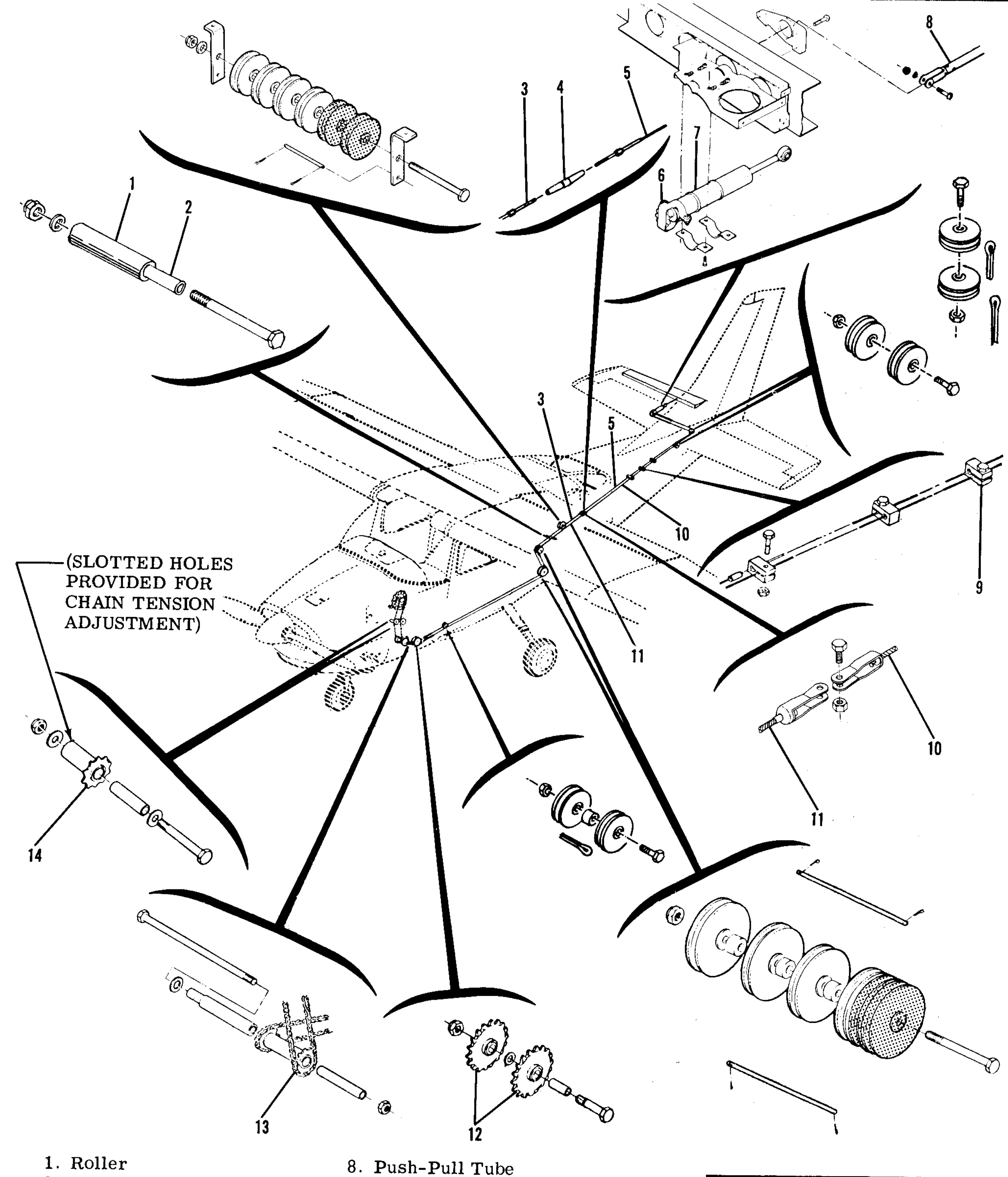
9-2. TROUBLE SHOOTING ELEVATOR TRIM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
EXCESSIVE RESISTANCE IN TRIM CONTROL WHEEL.		
Cable tension too high.	Check cable tension.	Adjust tension.
Pulleys binding or rubbing.	Check pulleys	Repair or replace as necessary.
Cables not in place on pulleys.	Check visually.	Install cables correctly.
Trim tab hinge binding.	Disconnect actuator and move tab up and down to check hinge resistance.	Lubricate or replace hinge as necessary.
Defective trim tab actuator.	Remove chain from actuator sprocket and operate actuator manually.	Replace actuator.
Rusty chain.	Visually check chain.	Remove and replace rusty chain.
Damaged sprocket.	Visually check sprockets.	Remove and replace damaged sprockets.
Bent sprocket shaft.	Observe motion of sprockets.	Remove and replace bent sprocket shafts.

9-2. TROUBLE SHOOTING ELEVATOR TRIM. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
LOST MOTION BETWEEN CONTROL WHEEL AND TRIM TAB.		
Cable tension too low.	Check cable tension.	Adjust tension.
Broken pulley.	Check pulleys.	Replace as necessary.
Cables not in place on pulleys.	Check visually.	Install cables correctly.
Actuator attachment loose.	Check actuator for security.	Tighten actuator attachment.
TRIM INDICATION INCORRECT.		
Indicator incorrectly engaged on wheel track.	Check visually.	Reset indicator.
INCORRECT TRIM TAB TRAVEL.		
Stop blocks loose or incorrectly adjusted.	Stop blocks should contact each other at correct travel.	Adjust stop blocks on cables.
Incorrect rigging.	Check rigging.	Rig system correctly.

SHOP NOTES:



1. Roller
2. Spacer
3. Right Forward Cable
4. Turnbuckle
5. Right Aft Cable
6. Chain Guard
7. Trim Tab Actuator
8. Push-Pull Tube
9. Travel Stop
10. Left Aft Cable
11. Left Forward Cable
12. Sprocket
13. Drive Sprocket Assembly
14. Idler Sprocket

CABLE TENSION:
10 TO 15 LBS (AT THE AVERAGE TEMPERATURE FOR THE AREA.)

Figure 9-1. Elevator Trim Control System

9-3. REMOVAL OF ELEVATOR TRIM CONTROL SYSTEM may be accomplished while using the illustrations in this Section as a guide.

9-4. REPAIR OF ELEVATOR TRIM CONTROL SYSTEM. Any worn, damaged, or defective components of the elevator trim control system should be replaced.

9-5. INSTALLATION OF ELEVATOR TRIM CONTROL SYSTEM may be accomplished while using the illustrations in this Section as a guide.

9-6. REMOVAL AND INSTALLATION OF ELEVATOR TRIM TAB.

a. Disconnect push-pull link from arm on trim tab.

NOTE

Tape or otherwise secure link from actuator screw so it cannot turn to retain proper rigging.

b. Remove screw from end of hinge pin and remove hinge pin. Trim tab and/or hinges may then be replaced as required.

c. After installation, connect push-pull link. If the link was not rotated, it is not necessary to re-rig the elevator trim control system.

9-7. REMOVAL AND INSTALLATION OF ELEVATOR TRIM TAB ACTUATOR.

a. Release trim tab cable tension at turnbuckle.

b. Disconnect push-pull link from actuator.

c. Remove access cover on lower skin of stabilizer beneath trim tab actuator.

d. Loosen chain guard at forward end of actuator and disengage chain from actuator sprocket.

e. Remove screws and clamps attaching actuator to bracket and remove actuator.

f. To install the elevator trim tab actuator, reverse the preceding steps. Rig elevator trim system in accordance with paragraph 9-8.

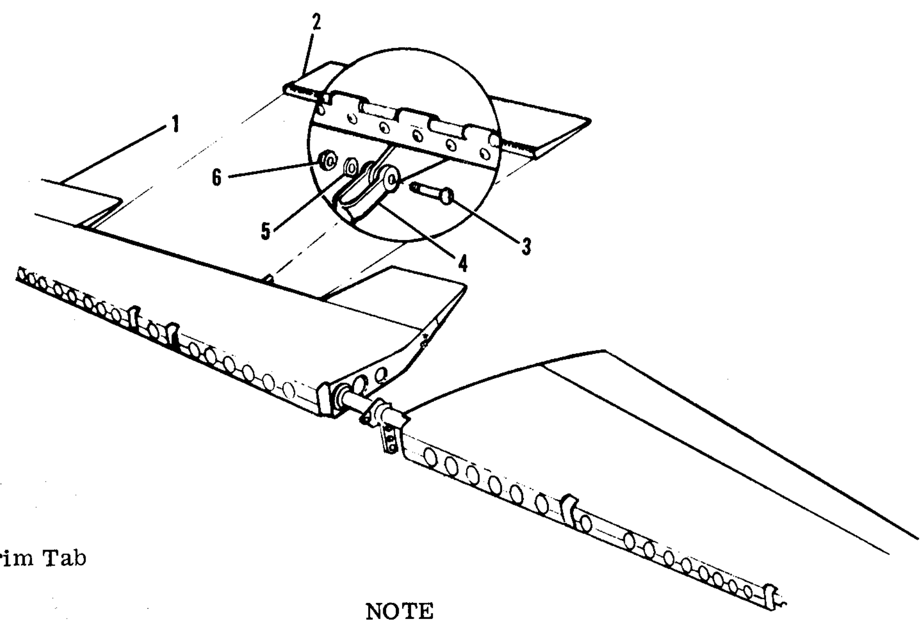
9-8. RIGGING THE ELEVATOR TRIM CONTROL SYSTEM. (See figure 9-1.)

a. Loosen travel stop blocks on trim tab cables and disconnect actuator screw from link to trim tab.

b. Check cable tension and readjust turnbuckle, if necessary. Resafety turnbuckle. If chains and/or cables are being installed, permit actuator screw to rotate freely as chains and cables are connected, set cable tension with turnbuckle, and safety the turnbuckle.

c. Rotate trim control wheel full forward (nose down), making sure pointer does not restrict trim wheel movement. If necessary to reposition pointer where it will not restrict trim wheel movement, proceed as follows:

1. Remove control pedestal cover. Refer to paragraph 11-5.
2. Loosen nut at trim wheel pivot shaft.
3. Loosen screws securing chain guard (see figure 9-3) far enough that trim wheel can be moved 1/8 inch, then use a thin screwdriver to pry trailing

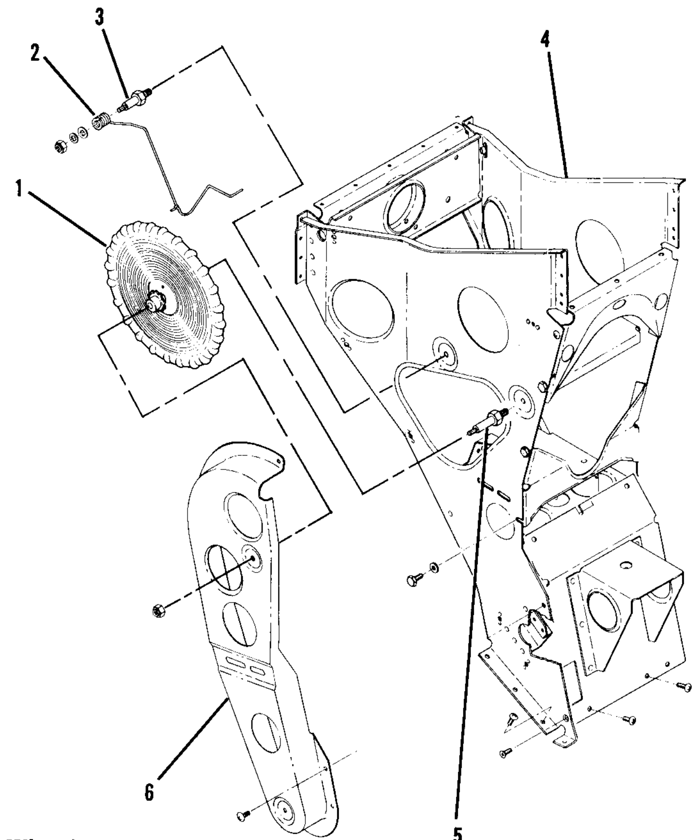


1. Elevator
2. Elevator Trim Tab
3. Bolt
4. Clevis
5. Washer
6. Nut

NOTE

Do not overtighten nut (6).

Figure 9-2. Elevator Trim Tab Installation



1. Elevator Trim Wheel
2. Position Pointer
3. Pointer Pivot Stud
4. Pedestal
5. Trim Wheel Pivot Stud
6. Chain Guard

Figure 9-3. Elevator Trim Wheel Installation leg of pointer out of groove in trim wheel.

4. Reinstall screws and nuts, but do not install pedestal cover until rigging has been completed.

NOTE

Full forward (nose down) position of trim wheel is the position where further movement is prevented by chain or cable ends contacting sprockets or pulleys.

d. With elevator and trim tab both in neutral (streamlined), place inclinometer on tab and set to zero. Disregard the counterweight areas of the elevators when streamlining. These areas are contoured so that they will be approximately 3° down at cruising speed.

NOTE

An inclinometer for measuring control surface travels is available from the Cessna Service Parts Center. Refer to figure 6-5.

e. Rotate actuator screw in or out as required to place trim tab up with a maximum of 2° overtravel, when actuator screw is connected to link from trim tab.

f. Rotate trim control wheel to place trim tab up and down, readjusting actuator screw as required to obtain overtravel in both directions.

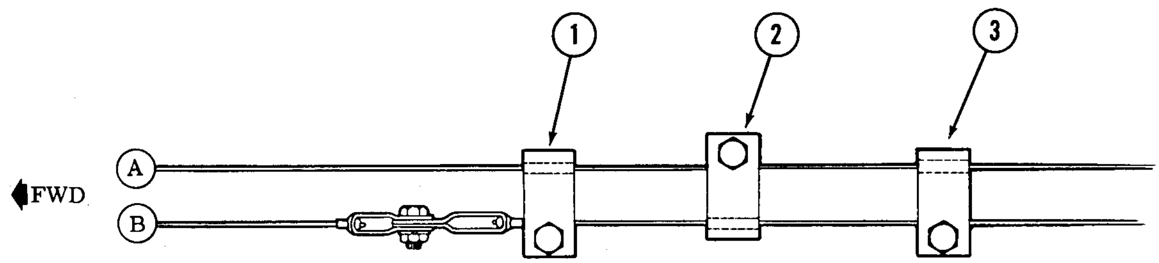
g. Position stop blocks and adjust as shown in figure 9-5 to limit travel as noted in Section 1.

h. Install control pedestal cover and check that trim wheel pointer travels the same distance from ends of slot in cover. Reposition trailing leg of pointer, if necessary (refer to step "c").

i. Check that all safeties are installed and all parts are secure, then reinstall all parts removed for access.

WARNING

Be sure trim tab moves in correct direction when operated by trim control wheel. Nose down trim corresponds to tab up position.



1. With elevators in neutral, set trim tab to neutral (streamlined).
2. Position stop block (1) against clevis on cable B and secure to cable B.
3. Place inclinometer on trim tab and lower tab to degree specified in Section 1.
4. Position stop block (2) against stop block (1) and secure to cable A.
5. Raise trim tab to specified degree, place stop block (3) against stop block (2) and secure to cable B.

Figure 9-4. Elevator Trim Tab Travel Adjustment

9-9. ELECTRIC TRIM SYSTEM. (See figure 9-5.)

9-10. TROUBLE SHOOTING ELECTRIC TRIM SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
SYSTEM INOPERATIVE.		
Circuit breaker out.	Check visually.	Reset circuit breaker.
Defective circuit breaker.	Check continuity.	Replace circuit breaker.
Defective wiring.	Check continuity.	Repair wiring.
Defective trim switch.	Check continuity.	Replace switch.
Defective trim motor.	Remove and bench test.	Replace motor.
TRIM MOTOR OPERATING - TRIM TAB FAILS TO MOVE.		
Defective clutch solenoid.	Check continuity.	Replace clutch solenoid.
Improperly adjusted clutch tension.	Check tension.	Adjust friction washer.
Disconnected or broken cable.	Operate manual trim wheel.	Connect or replace cable.
Defective actuator.	Check actuator operation.	Replace actuator.

9-11. REMOVAL AND INSTALLATION.

a. Remove aft cabin wall for access.
b. Disconnect trim cable at actuator.
c. Remove cable from drive drum, then disconnect electrical wires to servo unit.
d. Remove mounting bolts, then remove unit from aircraft.

NOTE

Before installing the servo, adjust the clutch to slip at 42±2 in. lbs by means of the friction washers and spanner nuts. The spanner nuts jam against each other as a lock.

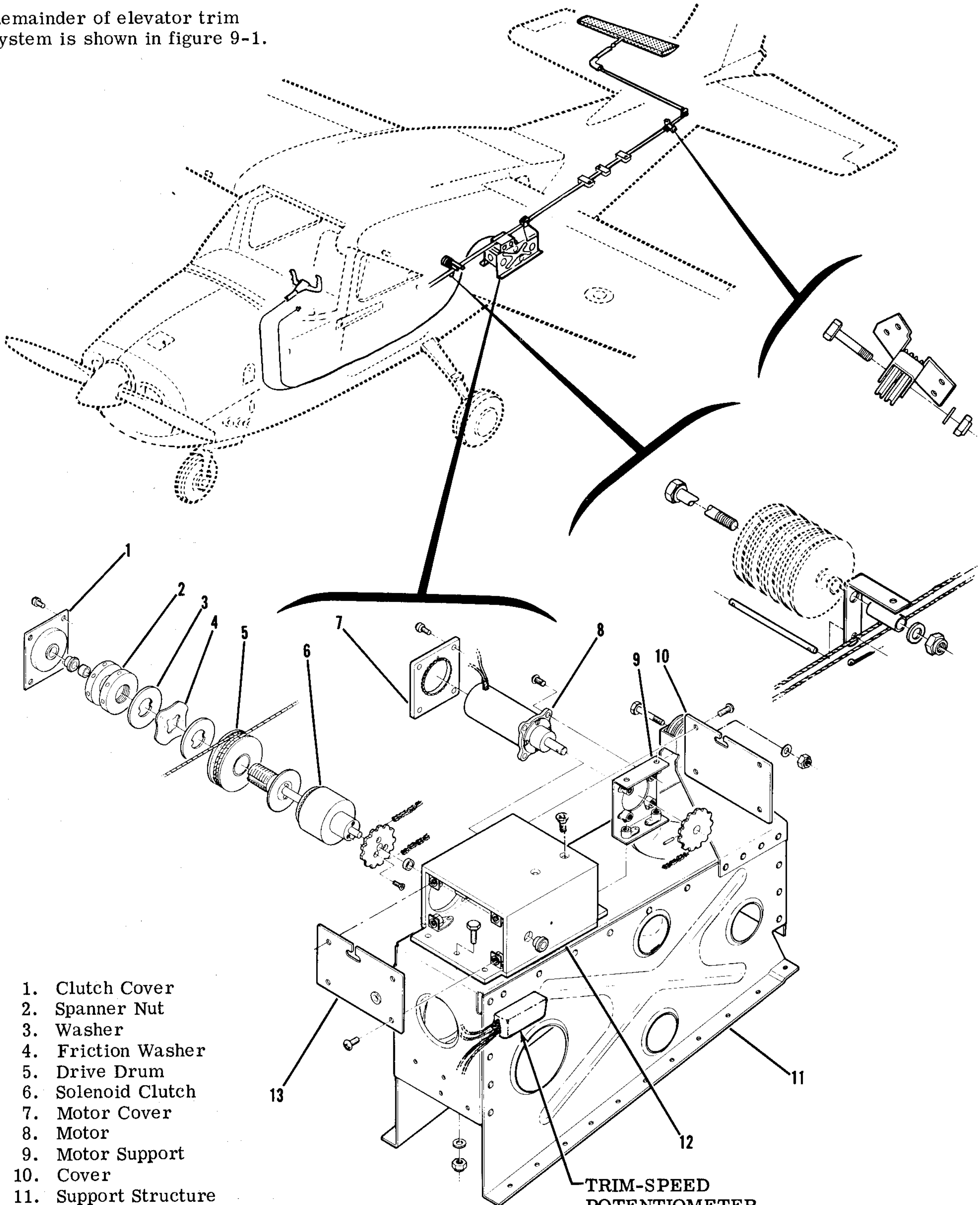
e. Install unit by reversing preceding steps.
f. Install trim tab cable and adjust turnbuckle to obtain correct cable tension, then check trim tab travel and rig if necessary.

NOTE

Rigging for the electric trim system is the same as the manual system. After rigging is complete, adjust the potentiometer (located adjacent to the electric trim housing) to obtain a 24-second travel time from full nose down (tab up) trim to full nose up (tab down) trim. This test and adjustment procedure must be made with engine running to obtain normal operating voltage.

NOTE

Remainder of elevator trim system is shown in figure 9-1.



1. Clutch Cover
2. Spanner Nut
3. Washer
4. Friction Washer
5. Drive Drum
6. Solenoid Clutch
7. Motor Cover
8. Motor
9. Motor Support
10. Cover
11. Support Structure
12. Housing
13. Cover

Figure 9-5. Electric Elevator Trim

SECTION 10

RUDDER CONTROL SYSTEM

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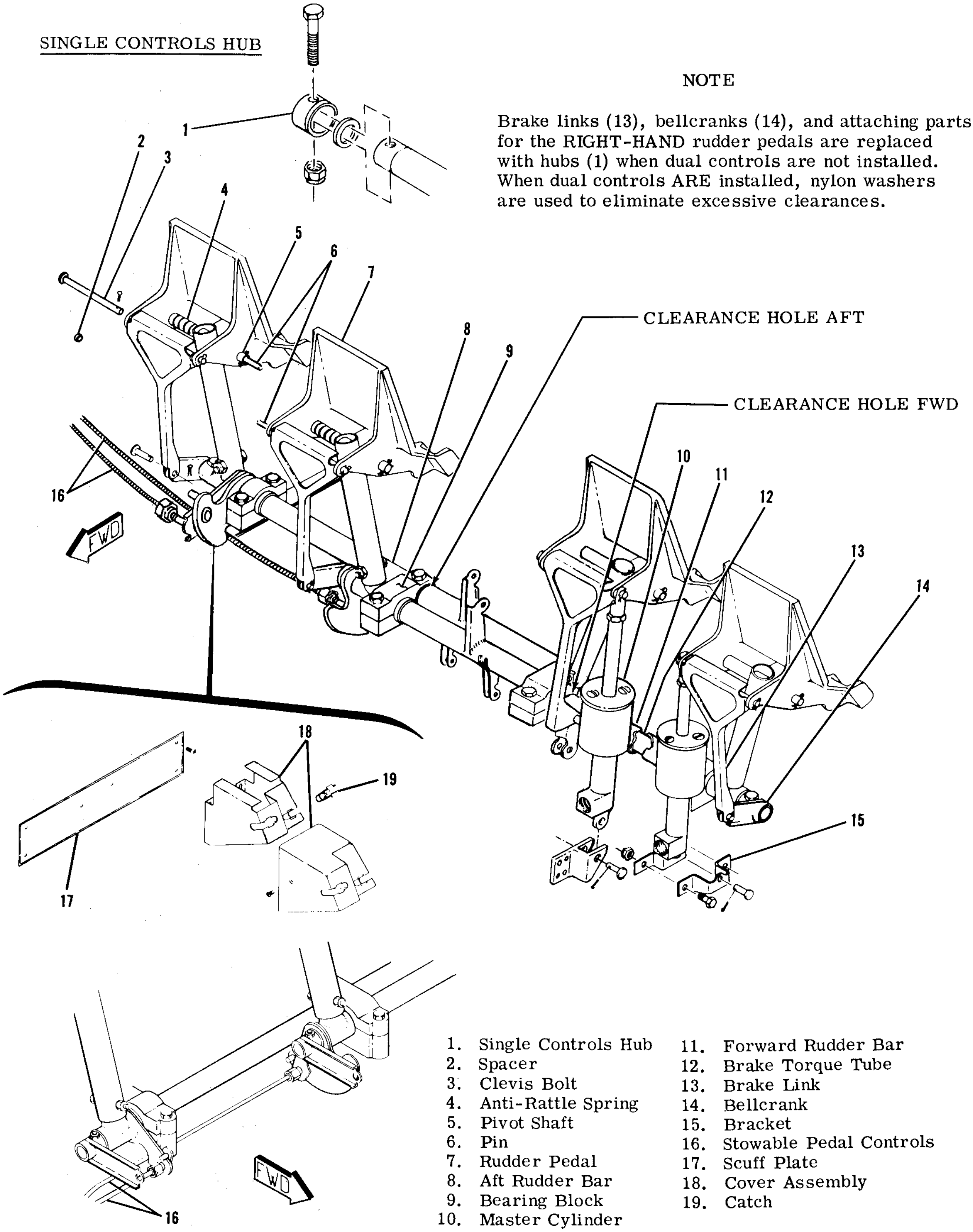
10-1. RUDDER CONTROL SYSTEM. Rudder control is maintained through use of conventional rudder pedals which also control nose wheel steering. When dual controls are installed, stowable rudder pedals are provided at the copilot's position.

10-2. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RUDDER DOES NOT RESPOND TO PEDAL MOVEMENT.		
Broken or disconnected cables.	Visually check cables.	Connect or replace cables.
UNDUE EFFORT REQUIRED TO ACTUATE RUDDER.		
Cables too tight.	Check cable tension.	Adjust cable tension.
Cables not riding properly on pulleys.	Check visually.	Route cables correctly on pulleys.
Binding, broken, or defective pulleys.	Check visually, rotate pulleys by hand to check for binding.	Replace defective pulleys.
Pedal bars need lubrication.		Lubricate with general purpose oil.
Defective rudder bar bearings.	Lubrication fails to eliminate binding.	Replace bearing blocks.
Defective rudder hinge bearings.		Replace defective bearings.
LOST MOTION BETWEEN RUDDER PEDALS AND RUDDER.		
Rudder cables loose.	Check cable tension.	Adjust cable tension.



NOTE

Brake links (13), bellcranks (14), and attaching parts for the RIGHT-HAND rudder pedals are replaced with hubs (1) when dual controls are not installed. When dual controls ARE installed, nylon washers are used to eliminate excessive clearances.

1. Single Controls Hub
2. Spacer
3. Clevis Bolt
4. Anti-Rattle Spring
5. Pivot Shaft
6. Pin
7. Rudder Pedal
8. Aft Rudder Bar
9. Bearing Block
10. Master Cylinder
11. Forward Rudder Bar
12. Brake Torque Tube
13. Brake Link
14. Bellcrank
15. Bracket
16. Stowable Pedal Controls
17. Scuff Plate
18. Cover Assembly
19. Catch

Figure 10-1. Rudder Pedals Installation

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STOWABLE PEDALS DO NOT DISENGAGE.		
Broken or defective control.	Disconnect control and check manually.	Replace control
STOWABLE PEDALS DO NOT STOW.		
Defective cover, catch, or latch pin.	Check visually.	Replace defective parts.
STOWABLE PEDALS DO NOT RE-ENGAGE.		
Binding control.	Check control operation.	Repair or replace control.
Misaligned or bent mechanism.	Check visually.	Repair or replace defective parts.

10-3. REMOVAL OF RUDDER PEDAL ASSEMBLY.

a. Remove carpeting, shields, and soundproofing from the rudder pedal and tunnel areas as necessary for access.
b. Disconnect the brake master cylinders and the parking brake cables at the pilot's rudder pedals, then remove the pilot's rudder pedals and copilot's rudder pedals and brake links if installed.
c. Slack off rudder system tension by loosening turnbuckles.
d. Disconnect the rudder cables and the nosewheel steering system push-pull rods from the rudder bars.
e. Disconnect the rudder trim bungee from the rudder bar.
f. On aircraft equipped with stowable rudder pedals, disconnect controls at the pedals.
g. Remove the bolts securing the rudder bar bearing blocks and work the rudder bars out of the tunnel area to remove.

NOTE

Since the two inboard bearing blocks contain clearance holes for the rudder bars at one end and a bearing hole at the other end, they should be tagged so they can be reinstalled in the same positions.

10-4. INSTALLATION OF RUDDER PEDAL ASSEMBLY.

NOTE

Rudder bar assemblies should be checked for lubrication before installation. Internal bearings are oilite bearings which should be saturated with engine oil. The bearing blocks bear against the steel shafts and require no lubrication unless binding occurs. A few drops of general purpose oil will eliminate such binding.

a. Position the rudder bar assemblies and install bearing blocks in the same position from which they were removed.
b. Connect the rudder bungee to the rudder bar.
c. Connect the rudder cables and the nose wheel steering system push-pull rods to the rudder bars.
d. Install the copilot's rudder pedals and brake links if used, install the pilot's rudder pedals, then attach the brake master cylinders and parking brake cables to the pilot's rudder pedals.
e. Connect stowable rudder pedal controls, if installed.
f. Rig the system as outlined in paragraph 10-10.
g. Replace soundproofing, carpeting, and shields removed for access.

10-5. REMOVAL OF RUDDER CABLES. (See figure 10-2.)

a. Disconnect cables at rudder bars and at the short cables near the rudder.
b. Connect guide wires to the aft end of each rudder cable.

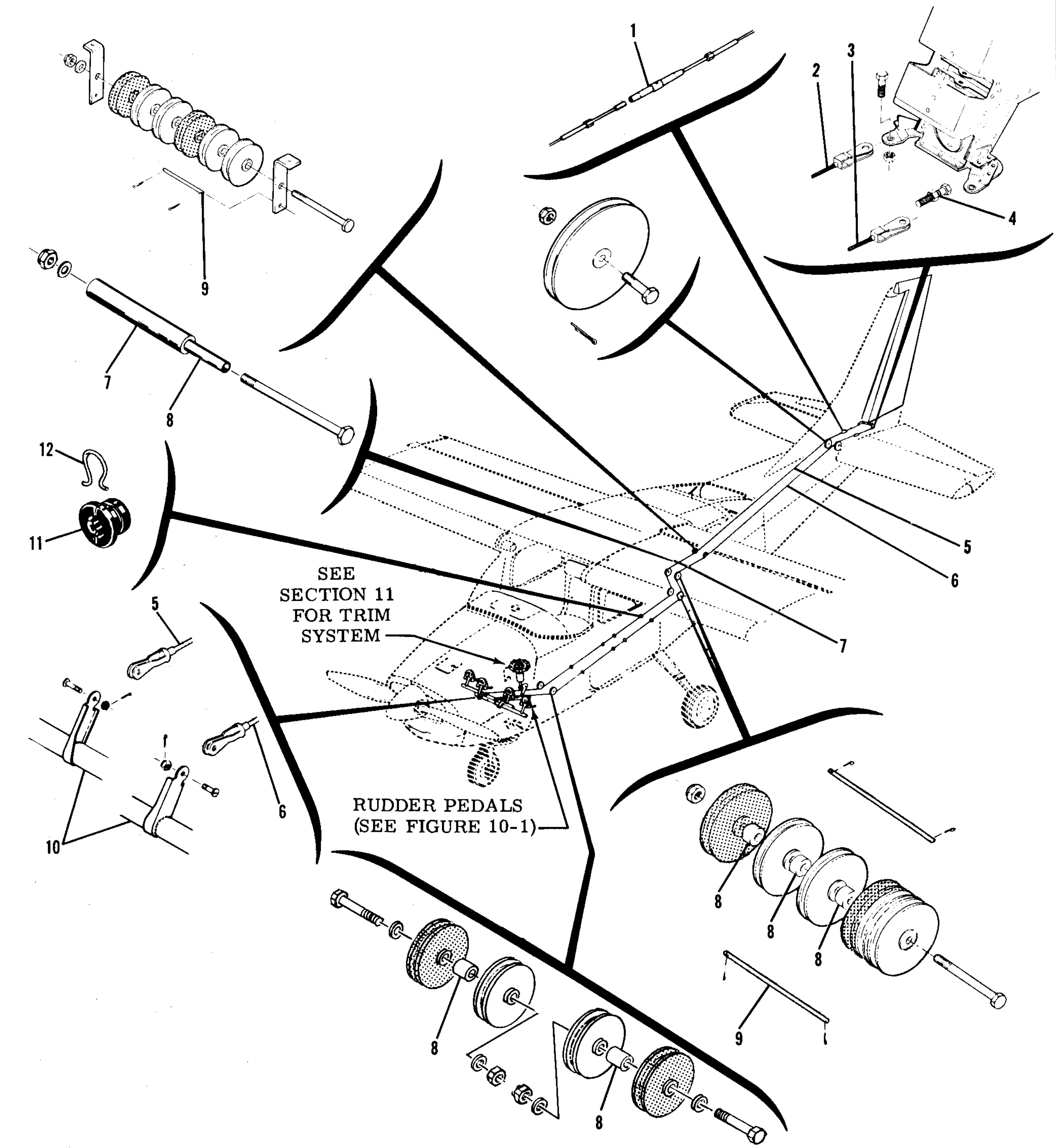
NOTE

The guide wires are used as an aid in reinstallation of the rudder cables. As the rudder cables are pulled forward, out of the aircraft, the guide wires are drawn into place and are left in the position formerly occupied by the cables.

c. Remove cable guards, pulleys and fairleads as necessary to withdraw each cable.

10-6. INSTALLATION OF RUDDER CABLES. (See figure 10-2.)

a. Connect aft end of each rudder cable to forward end of guide wires. Pull the cables through the fuselage with the wires and detach guide wires.



CABLE TENSION:
30 LBS ±10 LBS (AT THE AVERAGE TEMPERATURE FOR THE AREA)
Rudder travel measured perpendicular to hinge line. Refer to Chart in Section 1.

1. Turnbuckle
2. Right Rear Rudder Cable
3. Left Rear Rudder Cable
4. Stop Bolt
5. Right Forward Rudder Cable
6. Left Forward Rudder Cable
7. Roller
8. Spacer
9. Cable Guard
10. Rudder Bars
11. Fairlead
12. Clip

Figure 10-2. Rudder Control System

1. Steering Arm
2. Steering Bungee
3. Rod End
4. Nut
5. Washer
6. Whiffletree (Steering Bellcrank)
7. Bolt
8. Link Rod
9. Boot
10. Rudder Bar Arm
11. Retainer
12. Screw

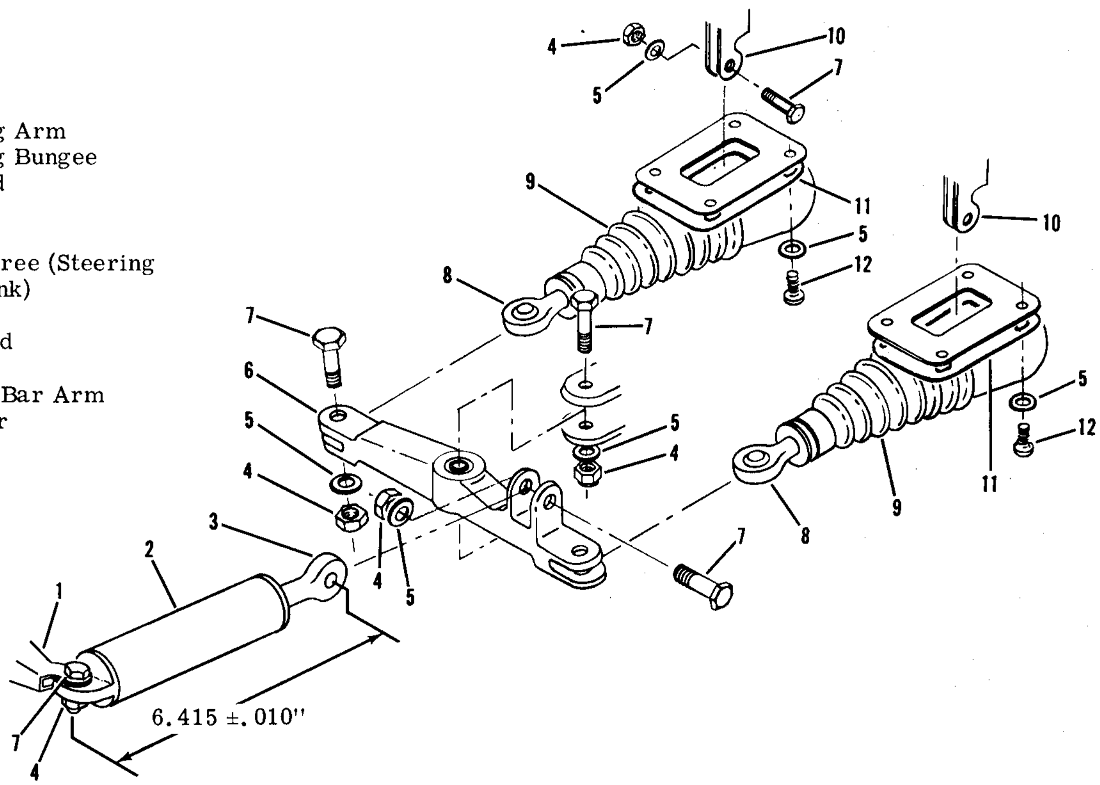


Figure 10-3. Nosewheel Steering Linkage

b. Check cable routing and install pulleys, cable guards, and fairleads.
c. Connect the rudder cables to the rudder bars and to the short cables near the rudder.
d. Rig the system as outlined in paragraph 10-10.

10-7. REMOVAL OF RUDDER. (See figure 10-4.)
a. Remove the stinger and upper stabilizer fairings and disconnect the tail navigation light wire.
b. Loosen the aft rudder cable turnbuckles and disconnect the rudder cables from the rudder.
c. With rudder supported, remove all rudder hinge bolts and lift the rudder free of the vertical fin.

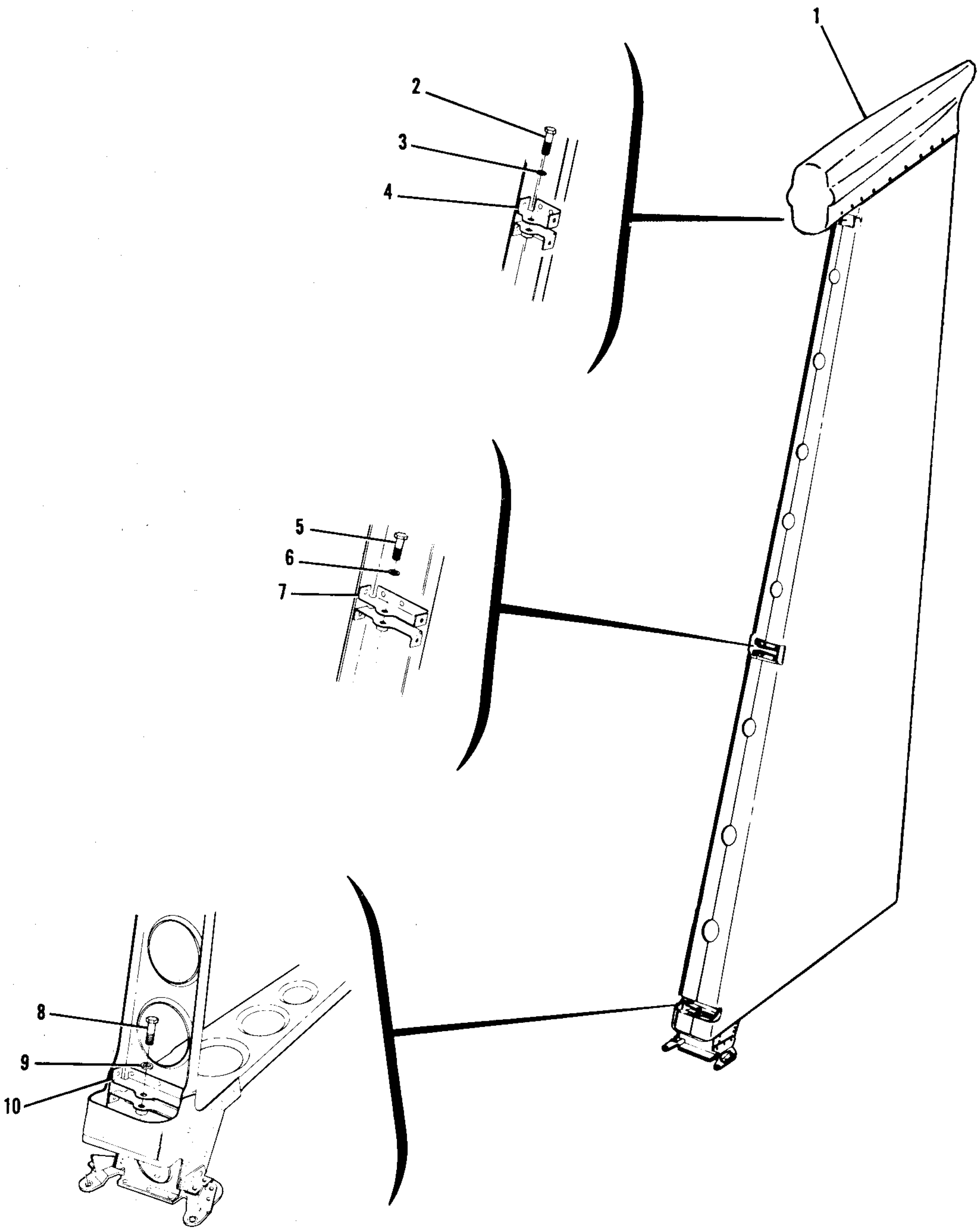
10-8. REPAIR OF RUDDER may be accomplished in accordance with structural repair instructions contained in Section 18.

10-9. INSTALLATION OF RUDDER. (See figure 10-4.) To install the rudder, reverse the procedure outlined in paragraph 10-7. Rig rudder control system.

10-10. RIGGING RUDDER CONTROL SYSTEM.
a. Loosen rudder cable aft turnbuckles to relieve tension on rudder system.
b. Weight the tail down to raise the nose wheel off the ground.
c. On all models, disconnect nose gear steering bungee.
d. Disconnect rudder trim bungee from rudder bar arm.
e. Set free length of nose gear steering bungee at 6.415 ±.010 inches between centers of mounting holes at each end, as shown in figure 10-3 and reconnect steering bungee.
f. Rig rudder travel per figure 10-5.
g. Clamp rudder pedals in neutral with a board.
h. Adjust rudder cable aft turnbuckles to streamline rudder with 30 pounds tension on rudder cables.
i. Remove board used to clamp rudder pedals in neutral.
j. Set rudder stop bolts to obtain correct rudder travel.
k. Reconnect the rudder trim bungee to the rudder bar arm and rig as outlined in Section 11.
l. Operate rudder system, checking for ease of movement and full travel. Check cable tension with rudder in various positions. Cable tension should not be less than 20 pounds or more then 40 pounds in any position.
m. Check that all turnbuckles are safetied, all jam nuts are tight, and all parts removed for access are reinstalled, then lower nose wheel to the ground.

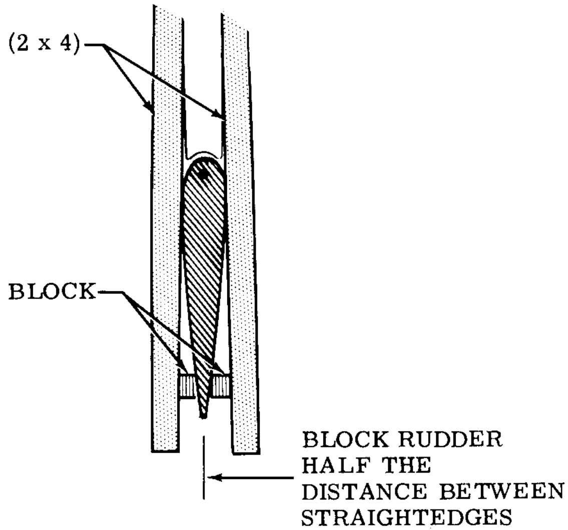
WARNING

Be sure rudder moves in correct direction when operated by the rudder pedals.

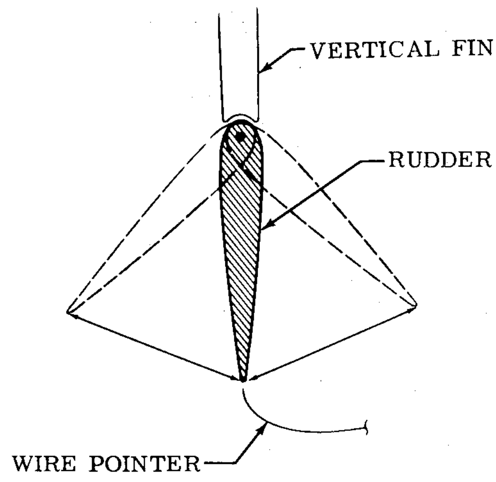


1. Rudder
2. Bolt
3. Washer
4. Upper Hinge
5. Bolt
6. Washer
7. Center Hinge
8. Bolt
9. Washer
10. Lower Hinge

Figure 10-4. Rudder Installation



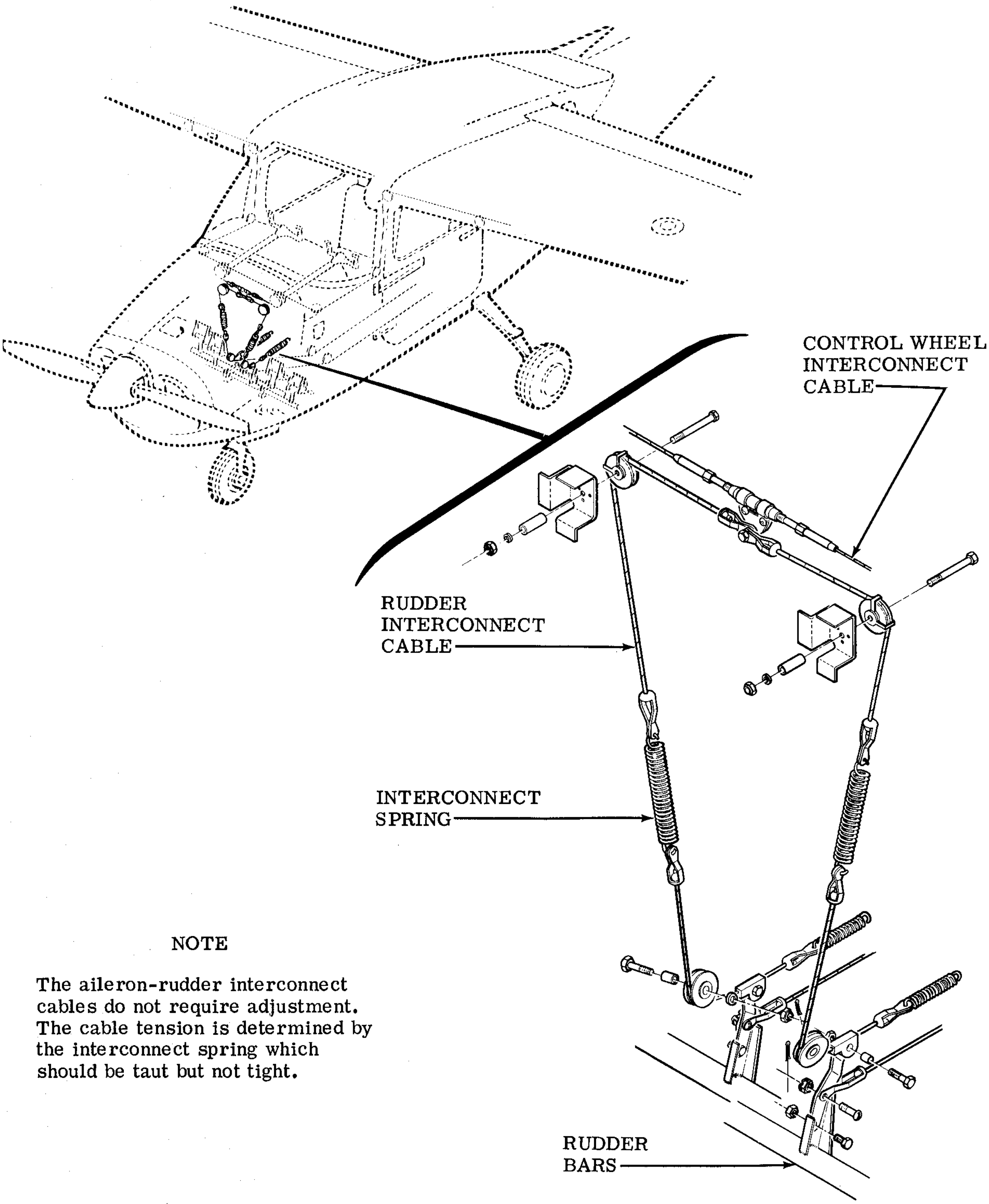
ESTABLISHING NEUTRAL
POSITION OF RUDDER



MEASURING
RUDDER
TRAVEL

1. Establish neutral position of rudder by clamping straightedge (such as wooden 2 × 4) on each side of fin and rudder and blocking trailing edge of rudder half the distance between straightedges as shown.
2. Tape a length of soft wire to the stinger in such a manner that it can be bent to index at the lower corner of the rudder trailing edge.
3. Using soft lead pencil, mark rudder at point corresponding to soft wire indexing point (neutral).
4. Remove straightedges and blocks.
5. Hold rudder against right, then left, rudder stop. Measure distance from pointer to pencil mark on rudder in each direction of travel. Distance should be between 8.12" and 8.72".

Figure 10-5. Checking Rudder Travel



NOTE

The aileron-rudder interconnect cables do not require adjustment. The cable tension is determined by the interconnect spring which should be taut but not tight.

Figure 10-6. Aileron-Rudder Interconnect System

SECTION 11

RUDDER TRIM CONTROL SYSTEM

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11-1. Rudder Trim Control System.

11-2. The rudder trim system is operated by a rudder trim control wheel, mounted in the console. A portion of the wheel extends through the console cover. The nosewheel steering system, rudder control system, and rudder trim control system are interconnected, and adjustments to one system will affect the others.

11-3. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
FALSE READING ON POSITION INDICATOR.		
Improper rigging.		Rig in accordance with paragraph 11-7.
Worn, bent, or disconnected linkage.	Observe visually.	Repair or replace as necessary.
HARD OR SLUGGISH OPERATION.		
Worn, bent, or binding linkage.	Observe visually.	Repair or replace as necessary.
Incorrect rudder cable tension.	Check rudder cable tension.	Adjust rudder cable tension as outlined in Section 10.
FULL TRAVEL NOT OBTAINED.		
Rudder trim system improperly rigged.		Rig in accordance with paragraph 11-7.

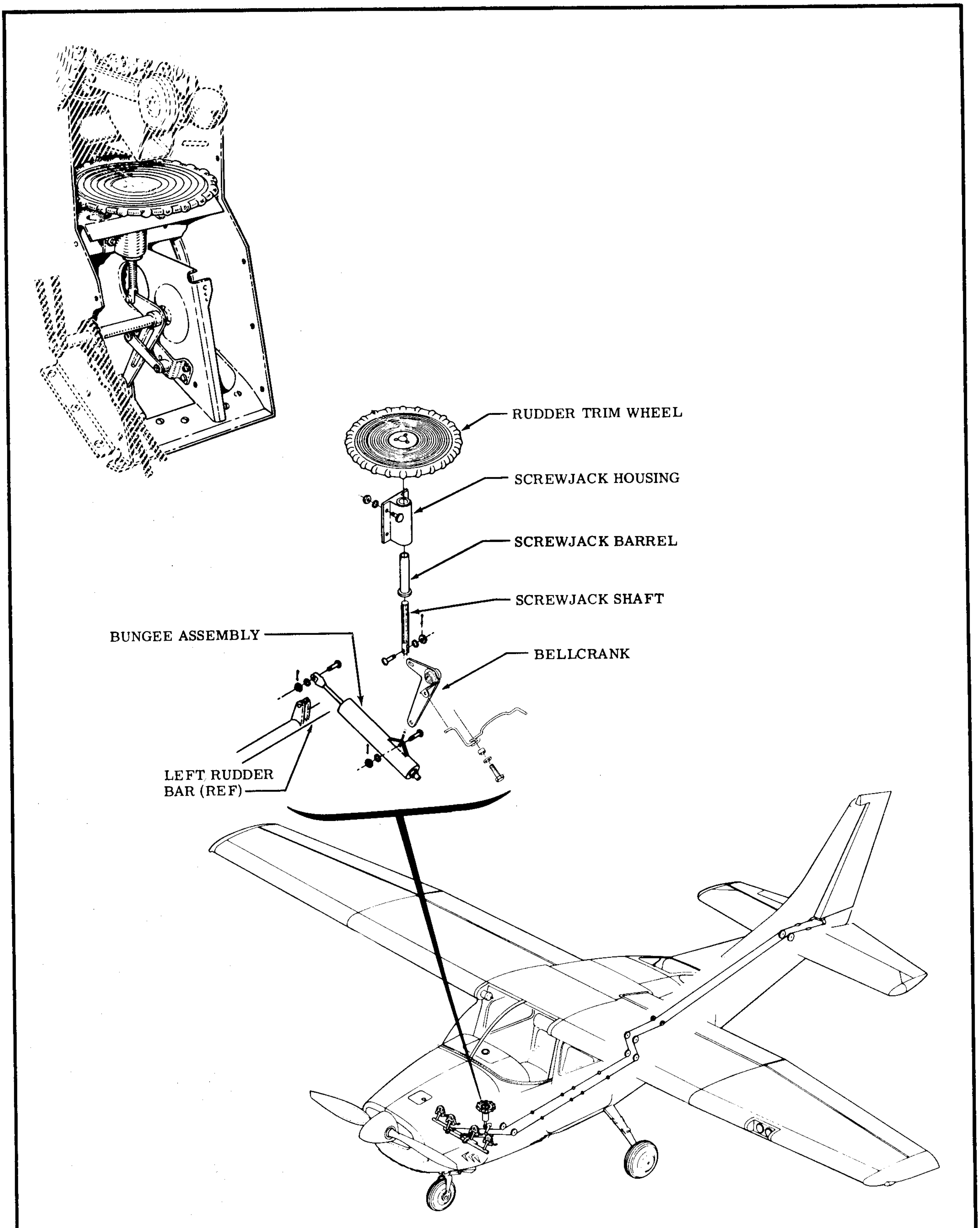

Figure 11-1. Rudder Trim Control System

11-4. REPLACEMENT OF RUDDER TRIM SYSTEMS. The trim system shown in figure 11-1, may be used as a guide during removal and installation.

11-5. REMOVAL AND INSTALLATION OF CONTROL PEDESTAL COVER.

a. Turn fuel selector valve to OFF, drain fuel strainer, then remove knurled nut from optional engine primer and pull plunger from primer. Protect primer from dirt.
b. Remove fuel selector handle by removing roll pin, and remove fuel selector plate or cup.
c. Remove cowl flap knob.
d. Remove nut from microphone jack when attached to cover.
e. Remove screws securing pedestal cover and remove the cover.
f. Reverse the preceding steps to install the cover.

11-6. REPAIR OF RUDDER TRIM SYSTEMS. Any worn, damaged, or defective components of the rudder trim system should be replaced.

11-7. RIGGING THE RUDDER TRIM SYSTEM. (See figure 11-1.)

NOTE

The only rigging adjustment possible, or necessary, on this rudder trim system is adjustment of the trim pointer to correspond with the spring-load being brought to bear on the rudder control system. The rigging method employed here involves merely "centering" the rudder and then "centering" the trim wheel indicator. Unless trim mechanism parts are deformed, this results in a correctly rigged system. The rudder control system and nose wheel steering bungee must be properly rigged before rigging the rudder trim system.

a. Remove pedestal decorative cover and sheet metal covers to gain access to rudder trim components in pedestal.
b. Weight the tail to raise nosewheel off ground.
c. Turn rudder trim wheel until rudder is streamlined.
d. Using trim wheel, run pointer through its full travel, checking to see that there is corresponding response of rudder.
e. Lower nosewheel to ground and reinstall all parts removed for access.

WARNING

Be sure rudder moves in proper direction when moved by trim control wheel.

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SECTION 12

POWERPLANT

(NORMALLY ASPIRATED)
REFER TO SECTION 12A FOR TURBOCHARGED POWERPLANT

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12-1. ENGINE COWLING.

12-2. The upper cowling is divided into four removable sections. The right and left nose caps are fastened to the lower section and to each other with screws. The right and left upper cowl sections are secured with quick release fasteners and either section may be removed individually. The left cowl section has two access doors. One at the upper front provides easy access to the engine oil filler neck, and one at the lower left provides easy access to the oil dipstick. The lower engine nacelle is an extension of the fuselage and provides fairing for the nose wheel in its retracted position.

12-3. CLEANING, INSPECTION, AND REPAIR OF ENGINE COWLING. The cowling should be cleaned by spraying with solvent (Federal Specification P. S. -661 or equivalent) and wiping clean with a cloth. After cleaning, inspect cowling for dents, cracks, and loose rivets. Repair all defects to prevent spread of damage.

12-4. ENGINE.

12-5. The non-turbocharged powerplant is an air-cooled, six-cylinder, horizontally-opposed, wet sump, fuel-injected Continental engine. Refer to paragraph 12-6 for engine data.

12-6. ENGINE DATA.

Aircraft Series	210 Series
Model (Continental)	IO-520-J
BHP at RPM	285 at 2700
Number of Cylinders	6-Horizontally Opposed
Displacement	520 Cubis Inches
Bore	5.25 Inches
Stroke	4.00 Inches
Compression Ratio	8.5:1
Magnetos	Slick #662
Right Magneto	Fires 22° BTC Upper Right and Lower Left
Left Magneto	Fires 22° BTC Upper Left and Lower Right
Firing Order	1-6-3-2-5-4
Spark Plugs	SL-350
Gap	.015 to .018 Inch
Torque Value	330±30 Lb-In.
Fuel Metering System	Continental Fuel Injection
Unmetered Fuel Pressure	9.0 to 11.0 PSI at 600 RPM 29.2 to 30.8 PSI at 2700 RPM
Fuel	Aviation Gasoline
Grade-Minimum	100/130
Oil Sump Capacity	10 U.S. Quarts
Tachometer	Type AS-54 Mechanical Drive
Alternator	14-Volt, 60-Ampere
Dry Weight with Accessories (Approx)	471
Oil Pressure	
Minimum Idling	10 PSI
Normal	30 to 60 PSI
Oil Temperature	
Normal Operating	Within Green Arc
Maximum Temperature	Red Line (240°F)
Cylinder Head Temperature	460°F Maximum
Probe Location	Lower Side of Number 2 Cylinder

12-7. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE FAILS TO START.		
Improper use of starting procedure.		Review starting procedure.
Defective aircraft fuel system.	See paragraph 13-4.	See paragraph 13-4.
Engine flooded.	See paragraph 12-81.	See paragraph 12-81.
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace if defective.
Failure of magneto impulse couplings.	With ignition switch off, rotate propeller by hand and listen for loud clicks as impulse couplings operate.	Repair or replace magnetos.
Defective magneto switch or grounded magneto leads.	Check continuity.	Repair or replace switch or leads.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Excessive induction air leaks.	Check visually.	Correct the cause of air leaks.
Dirty screen in fuel control unit, or defective fuel control unit.	Remove screen and check visually. Check fuel flow through fuel control unit.	Clean dirty screen. Replace fuel control unit if defective.
Defective electric fuel pump.	See paragraph 13-4.	See paragraph 13-4.
Defective fuel manifold valve, or dirty screen inside valve.	Check fuel flow through valve.	Remove and clean per paragraph 12-37. Replace if defective.
Clogged fuel injection lines or discharge nozzles.	Check fuel flow through lines and nozzles.	Clean lines and nozzles. Replace if defective. Refer to paragraph 12-41.
Fuel pump not permitting fuel from electric pump to bypass.	Check fuel flow through engine-driven fuel pump.	Replace fuel pump.
Vaporized fuel.	Vaporized fuel is most likely to occur in hot weather with a hot engine.	See paragraph 12-81.
ENGINE STARTS BUT DIES, OR WILL NOT IDLE.		
Propeller control in low rpm position.	Check visually.	Use high rpm for all ground operations.
Defective aircraft fuel system.	See paragraph 13-4.	See paragraph 13-4.
Improper idle speed or idle mixture adjustment.	See paragraph 12-34.	See paragraph 12-34.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE STARTS BUT DIES, OR WILL NOT IDLE (Cont).		
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace if defective.
Water in fuel system.	Open fuel strainer drain valve and check for water.	Drain fuel tank sumps, fuel lines, and fuel strainer.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Excessive induction air leaks.	Check visually.	Correct the cause of air leaks.
Dirty screen in fuel control unit, or defective fuel control unit.	Remove screen and check visually. Check fuel flow through fuel control unit.	Clean dirty screen. Replace fuel control unit if defective
Defective fuel manifold valve, or dirty screen inside valve.	Check fuel flow through valve.	Remove and clean per paragraph 12-37. Replace if defective.
Restricted fuel injection lines or discharge nozzles.	Check fuel flow through lines and nozzles.	Clean lines and nozzles. Replace if defective. Refer to paragraph 12-41.
Defective engine-driven fuel pump.	If engine continues to run with electric pump turned on, but stops when it is turned off, the engine-driven pump is defective.	Replace engine-driven fuel pump.
Vaporized fuel.	Vaporized fuel is most likely to occur in hot weather with a hot engine.	See paragraph 12-81.
Manual primer leaking.	Disconnect primer outlet line. If fuel leaks through primer, it is defective.	Repair or replace primer.
Defective engine.	Check compression. Listen for unusual engine noises.	Engine repair is required.
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER.		
Propeller control in low rpm position.	Check visually.	Use high rpm for all ground operations.
Restriction in aircraft fuel system.	See paragraph 13-4.	See paragraph 13-4.
Restriction in fuel injection system.	Check fuel flow through discharge nozzles, fuel lines, manifold valve, fuel control unit, and fuel pump until restriction is located.	Clean out restriction. Replace any item found defective.
Fuel pump pressure improperly adjusted.	See paragraph 12-46.	See paragraph 12-46.

12-7. TROUBLE SHOOTING (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER (Cont).		
Worn or improperly rigged throttle or mixture control.	Check visually.	Rig properly. Replace worn linkage.
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace if defective.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Defective engine.	Check compression. Listen for unusual engine noises.	Engine repair is required.
POOR IDLE CUT-OFF.		
Worn or improperly rigged mixture control.	Check that idle cut-off stop on fuel control unit is contacted.	Rig properly. Replace worn linkage.
Dirty or defective fuel manifold valve.	Operate electric fuel pump and check that no fuel flows through manifold valve with mixture control in idle cut-off.	Remove and clean per paragraph 12-37. Replace if defective.
Fuel contamination.	Check all screens in fuel and fuel injection system.	Drain all fuel and flush out fuel system. Clean all screens, fuel lines, discharge nozzles, fuel strainer, fuel manifold valve, and fuel pump.
Defective mixture control valve in fuel control unit.	If none of the preceding causes are found, fuel control unit is probably at fault.	Replace defective fuel control unit.

12-8. ENGINE REMOVAL. Identify each item as it is disconnected to aid in replacement.

NOTE

Plug or cap all disconnected lines, hoses and fittings.

a. Turn all cabin switches and fuel selector valve OFF.
b. Remove the engine cowling.
c. Open the battery circuit by disconnecting the ground cable.

WARNING

These magnetos DO NOT have internal grounding springs. Ground the magneto points to prevent accidental firing.

d. Disconnect magneto ground wires at the magnetos and pull them aft clear of the engine baffle.
e. Drain the engine oil.
f. Remove propeller. (See paragraph 14-7.)
g. Disconnect the induction air control, the throttle control, the mixture control, and the propeller govenor control.
h. Disconnect wires and cables as follows:
1. Disconnect oil temperature connector located directly below oil cooler.
2. Disconnect tachometer drive from adapter.
3. Disconnect starter cable.
4. Disconnect cylinder head temperature bulb lead.
5. Disconnect alternator cable and cable shielding ground.
6. Disconnect the throttle microswitch(es).
7. Remove all clamps attaching wires or cables to the engine. Pull all wires and cables aft to clear the engine assembly.

WARNING

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent the accumulation of such fuel when lines and/or hoses are disconnected.

i. Disconnect lines and hoses as follows:
1. Disconnect hydraulic lines at the hydraulic

pump.

2. Disconnect vacuum line at the vacuum pump.
3. Disconnect the manifold pressure line.
4. Disconnect the fuel supply line and the vapor return line at the fuel pump.
5. Disconnect the fuel pressure line at the fuel manifold valve.
6. Disconnect oil pressure line at the engine.
7. Disconnect and remove the left and right manifold drain lines and the balance tube drain.

j. Remove clamps securing the throttle control, the mixture control, and the propeller governor control. Pull these controls free of the engine, using care not to damage them by bending too sharply.
k. Disconnect the flexible ducting.
l. Disassemble and remove the right and left exhaust stack assemblies.

CAUTION

Place a stand under the tail tie-down ring before removing the engine. The loss of engine weight will allow the tail to drop.

m. Attach a hoist to the lifting eye at the top center of the engine crankcase. Lift the engine just enough to relieve the weight from the engine mounts.

CAUTION

Hoist engine slowly and make sure all wires, lines, and hoses have been disconnected.

n. Remove the engine as follows:

1. Remove bolts and ground strap.
2. Hoist engine out of nacelle and clear of aircraft.
3. Remove mount pads, spacers, ground strap and pins. Before removing shock mounts, refer to figure 12-1.

12-9. INSPECTION AND REPAIR. For specific items to be inspected, refer to engine manufacturer's manual.

a. Inspect all hoses for internal swelling, chafing through protective plys, cuts and breaks. Replace any damaged or doubtful hoses.
b. Inspect all fittings for thread damage.
c. Visually inspect the engine for loose nuts, bolts, cracks, and fin damage.
d. For major repairs refer to the manufacturer's overhaul and repair manual.

12-10. POWERPLANT BUILD-UP consists of the installation of parts, accessories and components to the basic engine to build-up a powerplant unit ready for installation on the airplane. All safety wire, lockwashers, palnuts, elastic stop nuts, gaskets and rubber connections should be new parts.

12-11. ENGINE INSTALLATION.

a. Hoist engine to a point just above the nacelle.
b. Install engine on mount pads as follows:

1. Install mount pads, spacers, pins, and ground strap on engine mount, positioning the shock mounts as noted in figure 12-1.
2. Lower the engine slowly into place on the engine mounts.
3. Torque the engine shock mount bolts to the value shown in figure 12-1. Bend tab washers.

c. Install the flexible ducting.
d. Route the propeller governor control cable along the inside of the left intake manifold and secure.
e. Connect lines and hoses as follows:

1. Install and connect the hydraulic pump vent line.
2. Install and connect the left and right manifold drain lines and the balance tube drain.
3. Connect the oil pressure line at its fitting between No. 2 and 4 cylinders.

NOTE

Throughout the airplane fuel system, from the tanks to the engine-driven fuel pump, use Parker Sealube (or equivalent) as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always be sure that a compound, the residue from a previously used compound, or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on the fitting threads. Do not use any other form of thread compound on the injection system fittings.

4. Connect the fuel flow gage line at the fuel manifold valve.
5. Connect the fuel supply line and the vapor return line at the fuel pump.
6. Connect the manifold pressure line.
7. Connect vacuum line at the vacuum pump.
8. Connect hydraulic lines at the hydraulic pump. See paragraph 5-8.

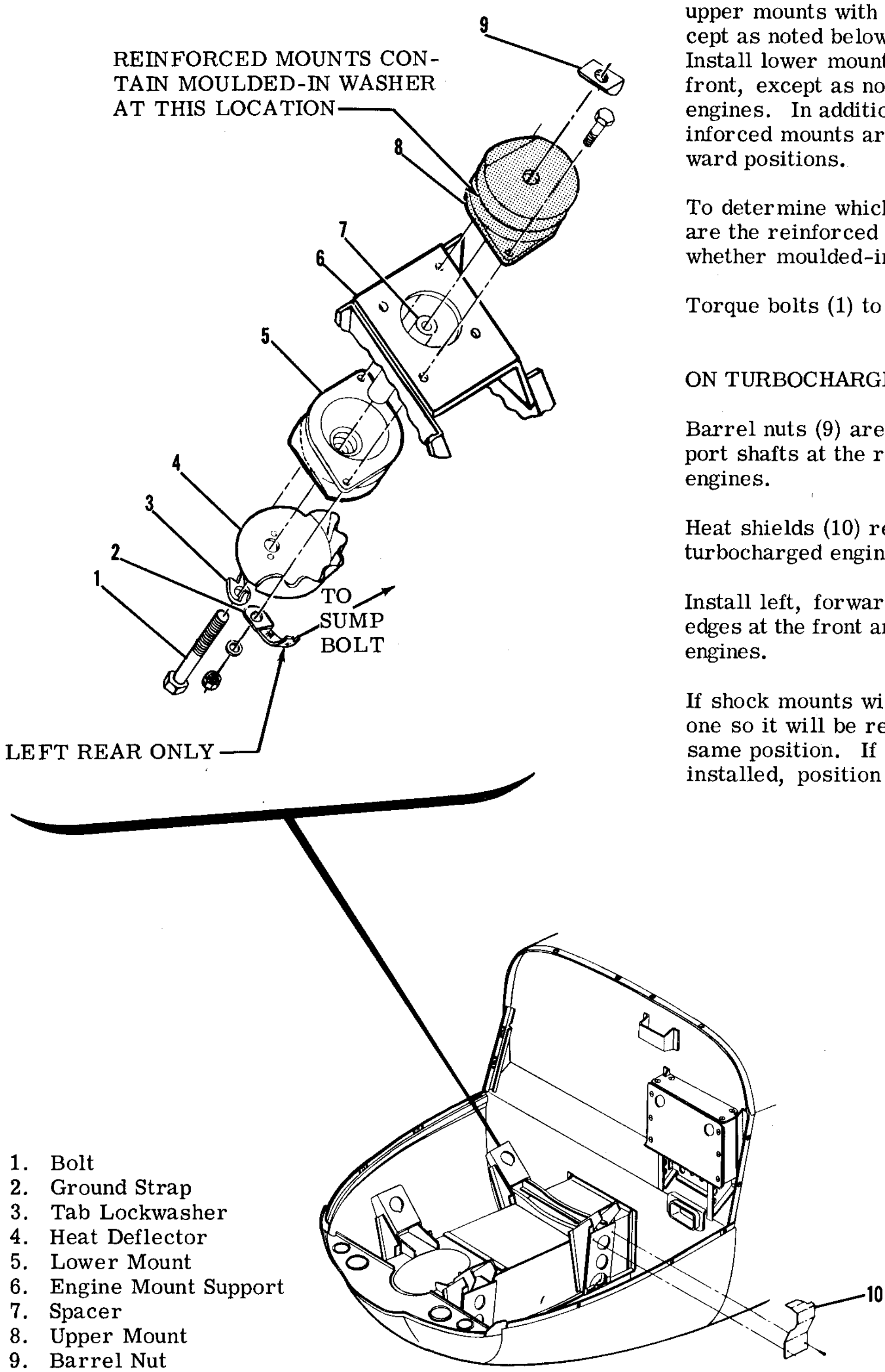
f. Connect wires and cables as follows:

WARNING

The magnetos DO NOT have internal grounding springs. If the magneto ground wires are not installed and the switch turned off, ground the magneto points to prevent accidental firing.

1. Connect the oil temperature connector located directly below the oil cooler.
2. Connect tachometer drive to adapter and torque to 100 lb-in.
3. Connect starter cable.
4. Connect cylinder head temperature bulb lead.
5. Connect alternator wires and wire shielding ground.
6. Connect the throttle microswitch(es).
7. Install all clamps attaching wires or cables to engine.

g. Install the right and left exhaust stack assemblies. Use all new gaskets regardless of apparent condition of old gaskets.
h. Install the engine controls.
i. Rig the engine controls in accordance with



NOTE

ON ALL MODELS:

It is important that the correct engine mounts be installed in the correct positions. Install upper mounts with beveled edge at the top, except as noted below for turbocharged engines. Install lower mounts with beveled edge at the front, except as noted below for turbocharged engines. In addition, be sure that the two reinforced mounts are used at the upper, forward positions.

To determine which two of the eight mounts are the reinforced ones, use fingernail to feel whether moulded-in washer is present.

Torque bolts (1) to 300, +50, -00 lb-in.

ON TURBOCHARGED ENGINES:

Barrel nuts (9) are replaced with turbine support shafts at the right mounts of turbocharged engines.

Heat shields (10) replace heat deflectors (4) on turbocharged engines.

Install left, forward, lower mount with beveled edges at the front and at the top on turbocharged engines.

If shock mounts will be re-used, mark each one so it will be reinstalled in exactly the same position. If new shock mounts will be installed, position them as noted above.

1. Bolt
2. Ground Strap
3. Tab Lockwasher
4. Heat Deflector
5. Lower Mount
6. Engine Mount Support
7. Spacer
8. Upper Mount
9. Barrel Nut
10. Heat Shield

Figure 12-1. Engine Mounts

paragraph 12-50.

j. Connect the battery ground cable.

k. Make a magneto switch ground-out and continuity check. Connect the magneto primary wires to the magnetos.

WARNING

Be sure the magneto switch is OFF.

l. Install propeller. (See Section 14.)

m. Service the engine in accordance with the applicable instructions in Section 2.

n. Inspect the engine installation.

o. Perform engine run-up.

12-12. AIR INDUCTION SYSTEM.

12-13. Ram air enters through filters, located at the upper left and right hand engine baffles, into air ducts to the induction airbox. The induction airbox has an opening for unfiltered air from the engine compartment with a door spring -loaded to the closed position which is opened by engine suction in the event the air filters become clogged by foreign objects, in the event of engine backfire, to prevent the backfire from discharging into the engine compartment, which would create a fire hazard. From the induction airbox, air passes through the fuel air control unit and is supplied to the cylinders through the manifold intake piping. Drains are provided in the left and right intake manifolds and balance tube. The balance tube connects the right and left intake manifold at the front of the engine.

12-14. REMOVAL OF AIR INTAKE BOX.

a. Disconnect induction air control at control arm.

b. Disconnect throttle switch(es).

c. Remove induction air filters.

d. Remove clamps attaching lines and wires to airbox.

e. Remove bolts securing airbox to fuel-air control unit and remove airbox and gasket.

12-15. CLEANING AND INSPECTION OF AIR INTAKE BOX. Clean all metal parts with a suitable solvent. Inspect for cracks, dents, loose rivets, etc. Minor cracks may be stop-drilled. In case of continued or severe cracking, replace airbox.

12-16. INSTALLATION OF AIR INTAKE BOX.

a. Place airbox and gasket in place on engine and fuel-air control unit.

b. Install attaching bolts.

the engine air filters, remove these four bolts.

12-19. CLEANING OF ENGINE AIR FILTERS. The filters should be serviced in accordance with instructions outlined in Section 2.

12-20. INSTALLATION OF ENGINE AIR FILTERS. Place the engine air filter in position between the upper left rear engine baffle and the induction airbox intake. Make certain the gasket is in place between the filter and the airbox intake. Install the four bolts which secure the assembly. Install the right induction filter in the same manner as the left.

12-21. ENGINE EXHAUST SYSTEM. The exhaust system consists of two exhaust stack assemblies, one for the left and one for the right bank of cylinders. Each cylinder has a riser pipe attached to the exhaust port. The three risers at each bank of cylinders are joined together into a collector pipe which connects to a muffler and tailpipe, forming an exhaust stack assembly. The center riser on each bank is detachable, but the front and aft risers are welded to the collector pipe. The left muffler is enclosed in a shroud which captures exhaust heat used to heat the aircraft cabin.

12-22. REMOVAL OF ENGINE EXHAUST SYSTEM.

a. Remove engine cowling for access.

b. Disconnect ducts from heater shroud on left stack assembly.

c. Disconnect tailpipe braces from shock mounts at firewall brackets.

d. Remove nuts, springs, and bolts attaching tailpipe and muffler to collector pipe and remove muffler and tailpipe assembly.

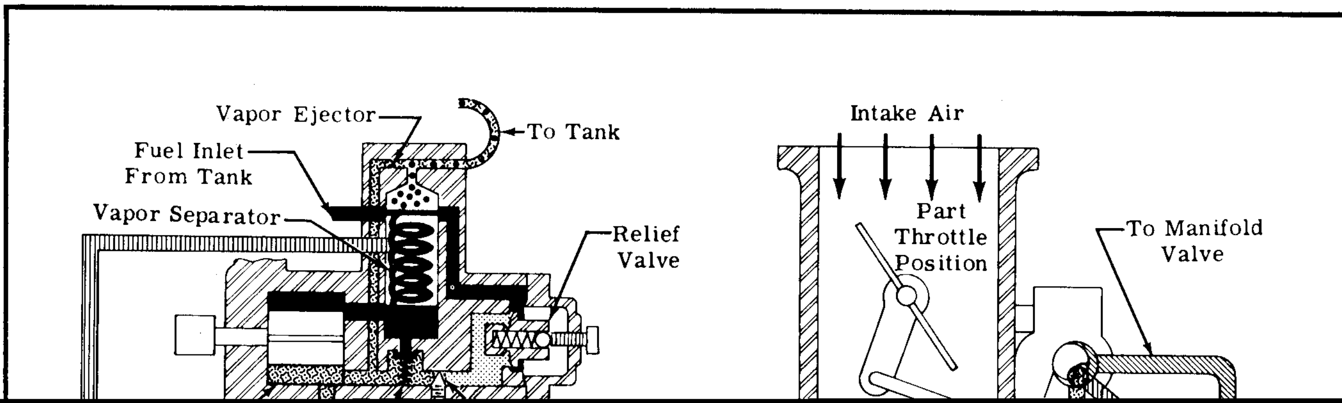
e. Remove nuts attaching exhaust stacks to the cylinders and remove exhaust stacks and gaskets.

12-23. INSPECTION of the exhaust system should be thorough because the cabin heating system uses air heated by the heat exchangers of the exhaust system. Since exhaust systems of this type are subject to burning, cracking, and general deterioration from alternate thermal stresses and vibration (comparable to those affecting automotive mufflers), inspection is important and should be accomplished every 100 hours of operation. In addition, an inspection should be performed any time exhaust fumes are detected in the cabin.

a. Remove engine cowling, and loosen or remove heater shrouds so that ALL surfaces of the exhaust stack assembly can be visually inspected. Especially check the areas adjacent to welds. Look for exhaust pressure system of injecting fuel into the intake valve port in the cylinder head. It is a multi-nozzle, continuous-flow type which controls fuel flow to match engine airflow. Any change in throttle position, engine speed, or a combination of both, causes changes in fuel flow in the correct relation to engine

a. Place the fuel-air-control unit in position on the engine.

b. Before tightening the hose clamps which secure the fuel-air control unit to the intake manifold, temporarily bolt the fuel-air control unit to the fuel-air control unit support to obtain the correct position.


Vapor Ejector
To Tank
Fuel Inlet
From Tank
Vapor Separator
Relief
Valve
Intake Air
Part
Throttle
Position
To Manifold
Valve

ter nut and rotate and lift at the same time to work gently out of the body.

they are the same for all nozzles being installed on a particular engine.

12-40. REMOVAL OF FUEL DISCHARGE NOZZLES.

NOTE

Plug or cap all disconnected lines and fittings.

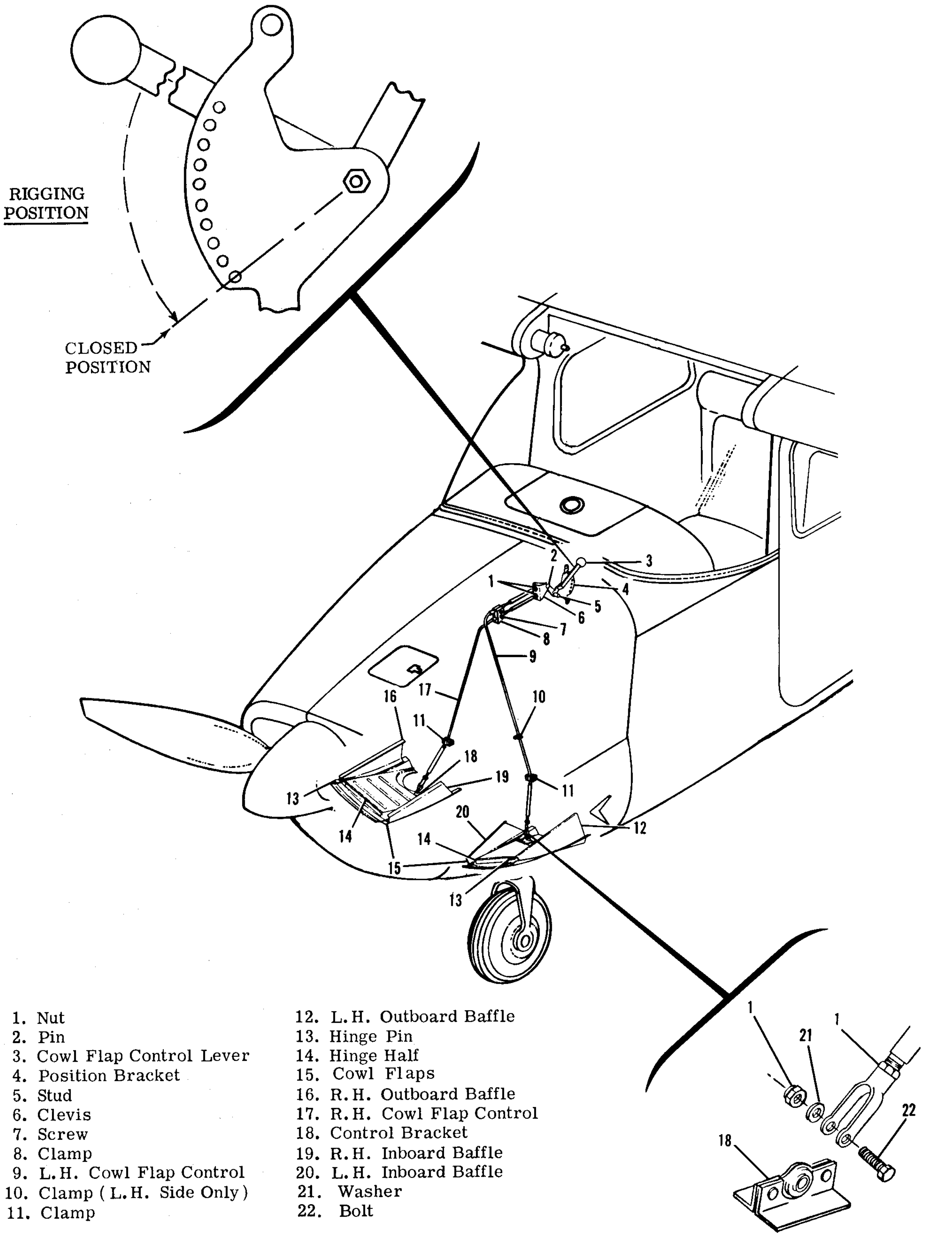
a. Disconnect the fuel injection lines at the fuel discharge nozzles. Remove the nozzles with a 1/2-inch deep socket.

12-41. CLEANING AND INSPECTION OF FUEL DISCHARGE NOZZLES. To clean nozzles, immerse in clean solvent and use compressed air to dry them. When cleaning the nozzle with compressed air, direct air through the nozzle in the direction opposite of normal fuel flow. Do not remove the nozzle shield or distort it in any way. Do not use a wire or other metal object to clean the orifice or metering jet. After cleaning, check the shield height from the hex portion of nozzle. The bottom of the shield should be approximately 1/16 inch above the wrench pads on

pump is connected to the accessory drive section of the engine. Fuel enters the pump at the swirl well of the vapor separator. Here, vapor is separated by a swirling motion so that only liquid fuel is fed to the pump. The vapor is drawn from the top center of the swirl well by a small pressure jet of fuel and is fed into the vapor return line and returned to the fuel tank. Since the pump is engine-driven, changes in engine speed affect total pump flow porportionally. The pump supplies more fuel than is required by the engine; therefore, a relief valve is provided to maintain a constant fuel pump pressure. A check valve allows auxiliary fuel pump pressure to bypass the engine-driven fuel pump for starting, or in the event of engine-driven pump failure. The fuel pump also has an adjustable orifice which allows the exact desired pressure setting at the full throttle setting. The fuel pump is ram-air cooled to help prevent high fuel temperatures. The ram air is picked up at the upper left engine baffle and directed through a flexible tube to the fuel pump shroud. The fuel supply

when mixture control is moved toward the lean posi-
tion.

marily for precision control setting. The throttle
has neither a locking button nor a vernier adjust-

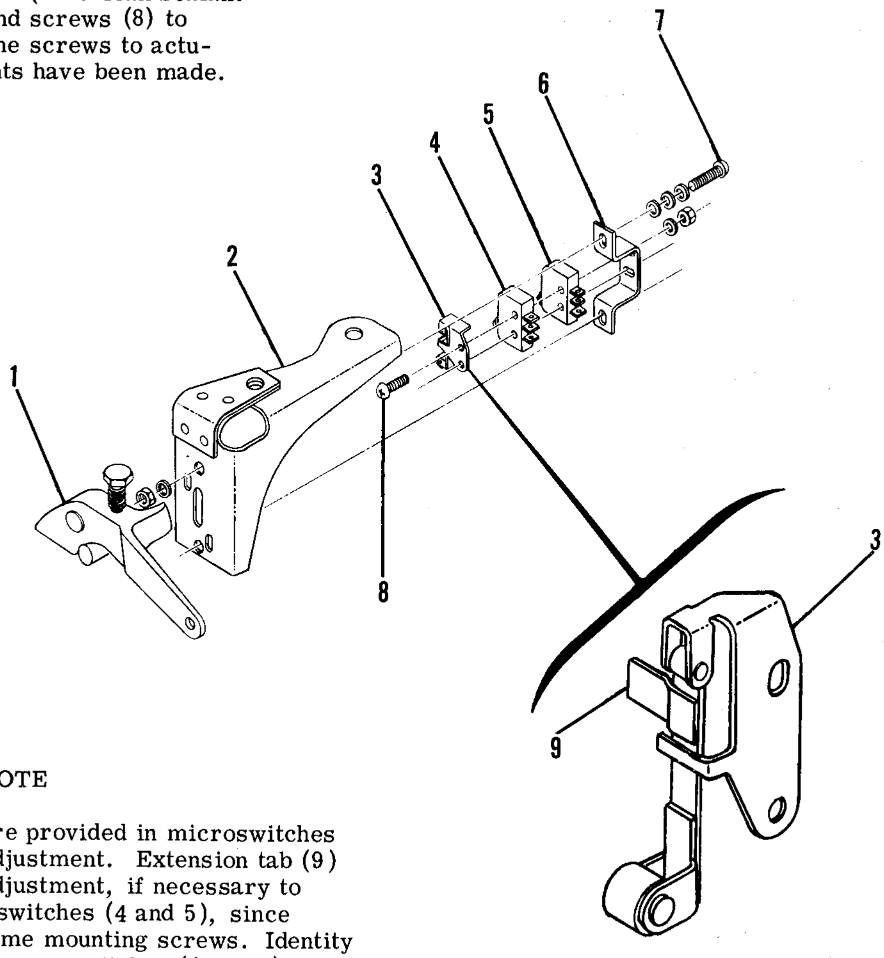


1. Nut
2. Pin
3. Cowl Flap Control Lever
4. Position Bracket
5. Stud
6. Clevis
7. Screw
8. Clamp
9. L.H. Cowl Flap Control
10. Clamp (L.H. Side Only)
11. Clamp
12. L.H. Outboard Baffle
13. Hinge Pin
14. Hinge Half
15. Cowl Flaps
16. R.H. Outboard Baffle
17. R.H. Cowl Flap Control
18. Control Bracket
19. R.H. Inboard Baffle
20. L.H. Inboard Baffle
21. Washer
22. Bolt

Figure 12-4. Cowl Flaps

NOTE

Use LOCTITE sealant Grade C (American Sealant Co., Hartford, Conn.) to bond screws (8) to attaching nuts and heads of the screws to actuator (3) after final adjustments have been made.



NOTE

Slotted and oversize holes are provided in microswitches and attaching brackets for adjustment. Extension tab (9) may be bent for additional adjustment, if necessary to obtain proper adjustment of switches (4 and 5), since they are attached with the same mounting screws. Identity of the gear warning and fuel pump switches (4 and 5) may be established by noting that the ground wire is always attached to the gear warning switch.

1. Throttle Shaft Lever Cam
2. Airbox Bracket
3. Microswitch Actuator
4. Landing Gear Warning Microswitch
5. Electric Fuel Pump Microswitch
6. Switch Mounting Bracket
7. Mounting Bracket Screw
8. Switch Mounting Screw
9. Microswitch Actuator Extension Tab

Figure 12-5. Rigging Throttle Microswitches ment, but contains a knurled friction knob which is rotated for more or less friction as desired. A "Palnut" type locknut is installed in back of the existing locknut at the engine end of the throttle, mixture, and propeller controls.

12-50. RIGGING PROCEDURES - ENGINE CONTROLS.

CAUTION

Some engine controls have a small retaining ring brazed (or attached with epoxy resin) in a groove .97 inch from the threaded end of the control. The purpose of these retaining ring is to prevent inadvertent withdrawal and possible damage to the knob end of the controls while jam nuts and rod ends are removed.

12-51. RIGGING PROPELLER GOVERNOR CONTROL. (See Section 14.)

12-52. RIGGING MIXTURE CONTROL.

a. Push control full in, then pull it out approximately 1/8 inch for cushion.

b. Check that mixture control arm is in full rich position. If necessary, loosen locknut and screw the rod end in or out until attaching bolt slides in easily.

c. Pull mixture control full out (idle cut-off), remove bolt at rod end, and check that mixture arm is in full idle cut-off. Reinstall bolt.

d. The mixture arm must reach mechanical stops in both positions and control should have approximately 1/8 inch cushion at the instrument panel.

12-53. RIGGING THROTTLE CONTROL.

a. Push control full in, then pull it out approximately 1/8 inch for cushion.

b. Check that throttle control arm is against the mechanical stop. If necessary, loosen locknut and screw rod end in or out until attaching bolt slides in easily.

c. Pull throttle control full out, remove bolt at rod end, and check that throttle arm contacts idle stop. Reinstall bolt.

d. Throttle arm must reach mechanical stops in both positions and control should have approximately 1/8 inch cushion at the instrument panel.

12-54. RIGGING THROTTLE MICROSWITCHES. Aircraft are equipped with a throttle microswitch which operates the landing gear warning system whenever the throttle is retarded while the gear is not down and locked. In addition, another throttle microswitch slows down the electric fuel pump whenever the throttle is retarded while the electric pump is being used. The landing gear warning microswitch should cause the horn to blow as the throttle is retarded to approximately 12 inches of mercury manifold pressure and the electric fuel pump microswitch should slow down the pump as the throttle is retarded to approximately 16 inches of mercury.

a. Start engine and set throttle to obtain 16 inches of mercury manifold pressure. Mark position of throttle control at instrument panel. Continue to retard throttle to 12 inches of mercury manifold pressure and also mark this position. Shut down engine.

b. (Refer to figure 12-5.) Two microswitches are located at the engine throttle shaft lever. Both are actuated by a single actuator and both are attached with the same screws. Adjust the fuel pump microswitch to cause the electric fuel pump to slow down as the throttle is retarded to the first marked position (16±1 inches of mercury). Adjust the landing gear warning horn microswtich to sound the warning horn as the throttle is retarded to the second marked position (12±.5 inches of mercury).

NOTE

Actuation of the fuel pump microswitch may be determined as outlined in step "b." Because the landing gear is down and locked, it will be necessary to keep the gear-down (green) indicator light depressed approximately half its travel distance, with master switch turned on, in order to determine when the gear warning microswitch actuates the warning horn system.

c. Perform flight test to check gear warning system at 2500 feet pressure altitude as follows:

1. Set propeller control at 2300 rpm.
2. Slowly reduce throttle until warning horn blows, and note manifold pressure at which horn blows. Horn should blow between 11.5 and 12.5 inches of mercury manifold pressure.
3. If horn actuation does not fall within this tolerance, mark throttle at 12 inches of mercury manifold pressure for ground reference.

NOTE

After flight testing, if required results were not obtained, set throttle at the marked position and readjust microswitch to actuate horn at this setting. Recheck electric fuel pump microswitch setting. Repeat flight test until desired results are obtained.

12-55. STARTING SYSTEM.

12-56. The automatically engaged starting system employs an electric starter motor mounted to a 90-degree adapter. A starter solenoid is activated by the ignition key on the instrument panel. When the solenoid is activated, its contacts close and electrical current energizes the starter motor. Initial rotation of the starter motor engages the starter through an overrunning clutch in the starter adapter, which incorporates worm reduction gears. The starter is located just aft of the right rear cylinder.

12-57. STARTER REMOVAL AND INSTALLATION.

CAUTION

When disconnecting starter cable do not permit starter terminal bolt to rotate. Rotation could break conductor between terminal and field coils causing starter to be inoperative.

a. Disconnect electrical power lead from the starter. Insulate the disconnected terminal as a safety precaution.

b. Remove the nuts securing the starter and remove the starter.

c. To install the starter, reverse this procedure. Install a new O-ring on the starter, then install the starter. Be sure that starter drive engages with the drive in the starter adapter.

12-58. STANDARD MAINTENANCE of starters includes replacing brushes and brush springs, cleaning dirty commutators and turning down burned or out-of-round commutators.

CAUTION

Never lubricate the commutator. Starter bearings are sealed and require no lubrication.

Starter brushes should be replaced when worn down to one-half their original length (compare with new ones). Brush spring tension should be sufficient to give brushes a good firm contact with the commutator. Brush leads should be unbroken, with their terminal screws tight. A glazed or dirty commutator can be cleaned by holding a strip of No. 00 sandpaper or brush seating stone against it. Move sandpaper or stone back and forth across the commutator to avoid wearing a groove. Do not use emery paper or carborundum because of their possible shorting action.

CAUTION

Never operate the cranking motor for more than 30 seconds at a time without allowing it to cool. Blow out all dust after the commutator is cleaned.

Roughness, out-of-roundness, or high mica may necessitate turning down the commutator. After the turning operation, the mica should be undercut.

12-59. TROUBLE SHOOTING THE STARTER.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STARTER WILL NOT OPERATE.		
Defective master switch or circuit.	Check master circuit.	Repair circuit.
Defective starter switch or switch circuit.	Check switch circuit continuity.	Replace switch or wires.
Defective starter.	Check through items above. If another cause is not apparent starter is defective.	Remove and repair or replace starter.
STARTER MOTOR RUNS, BUT DOES NOT TURN CRANKSHAFT.		
Defective overrunning clutch or drive.	Remove starter and check starter drive and overrunning clutch.	Replace defective parts.
Damaged starter pinion gear or crankshaft gear.	Remove starter and check pinion	Replace defective parts.
STARTER DRAGS.		
Low battery.	Check battery.	Charge or replace battery.
Starter switch or relay contacts burned or dirty.		Replace with serviceable unit.
Defective starter power cable.	Check cable.	Replace cable.
Defective starter.	Check starter brushes, brush spring tension, thrown solder or brush cover.	Repair or replace starter.
Dirty, worn commutator.	Clean, check visually.	Turn down commutator.

STARTER EXCESSIVELY NOISY.		
Worn starter pinion.	Remove and examine pinion.	Replace starter drive.
Worn or broken teeth on crankshaft gears.	Remove starter and turn over engine by hand to examine crankshaft gear.	Replace crankshaft gear.

12-60. SLICK MAGENTOS.

NOTE

A spark plug that is kept clean and properly gapped will give better and longer service than one that is allowed to collect lead deposits and is improperly gapped. The proper gap setting is given in paragraph 12-6. At each 100-hour inspection, remove, clean, inspect, and re-gap all spark plugs. Install lower plugs in upper portion of cylinder and vice-versa. Since deterioration of lower spark plugs is usually more rapid than that of the upper spark plugs, rotating them helps prolong spark plug life.

12-61. Slick magnetos contain a conventional two-pole rotating magnet (rotor), mounted in ball bearings. Driven by the engine through an impulse coupling at one end, the rotor shaft operates the breaker points at the other end. The nylon rotor gear drives a nylon distributor gear which transfers high tension current from the wedge-mounted coil to the proper outlet in the distributor block. A coaxial capacitor is mounted in the distributor block housing to serve as the condenser as well as a radio noise suppressor. Both nylon gears are provided with timing marks for clockwise or counterclockwise rotation, and the distributor gear and distributor block have timing marks, visible through the air vent holes, for timing to the engine. A timing hole is provided in the bottom of the magneto adjacent to the magneto flange. A timing pin or 6-penny nail can be inserted through this timing hole into the mating hole in the rotor shaft to lock the magneto approximately in the proper firing position. The breaker assembly is accessible after removing the screws fastening the magneto halves together and disconnecting capacitor slip terminal.

12-62. REMOVAL. When removal of the complete magneto is desired, remove the spark plug leads from the magneto and tag them for identification, disconnect the capacitor lead, and remove the nuts securing the magneto to the engine. For replacement of the breaker assembly or where removal of only the aft (engine) half of the magneto is desired, remove the screws fastening the halves together, pull the front half forward only far enough to disconnect the capacitor slip terminal, and remove the nuts securing the magneto to the engine. As the halves are separated, be sure that the large distributor gear is not dropped.

CAUTION

When removing the distributor block housing from the aft case, do not pull it away far enough to break or damage the capacitor lead or slip terminal.

12-63. INTERNAL TIMING.

a. Whenever the nylon gear on the rotor shaft or the plastic cam (which also serves as the key for the gear) has been removed, be sure that the gear and cam are installed so the timing mark on the gear aligns with the "O" stamped on the rotor shaft.

b. When replacing breaker assembly or adjusting contact points, place a timing pin (or .093" 6-penny nail) through the timing hole in the bottom of the magneto next to the flange and into the mating hole in the rotor shaft. Adjust contact points so they just break in this position, with a maximum point opening of 0.008 to 0.012 inch when the timing pin is removed. Temporarily assemble the magneto halves and capacitor slip terminal, and use a timing light to check that the timing mark, visible through the ventilating plug holes, are aligned at the instant the contact points break. Readjust the points if necessary.

NOTE

The side of the magneto with the manufacturer's insignia has a red timing mark and the side opposite the insignia has a black timing mark. The distributor gear also has a red timing mark and a black timing mark. The contact points should break when the two red lines are aligned at the insignia side of the magneto, or when the two black lines are aligned at the opposite side of the magneto. Do not time with red and black lines together on the same side.

c. Whenever the large distributor gear and the rotor gear have been disengaged, they must be re-engaged with their timing marks aligned for the correct rotation. Align the timing mark on the rotor gear with RH on the distributor gear. Care must be be taken to keep these two gears meshed in this position until the magneto halves are assembled.

12-64. INSTALLATION AND TIMING TO THE ENGINE. To install and time the magneto to the engine, proceed as follows:

a. Turn the propeller in normal direction of rotation until No. 1 cylinder is in correct firing position on compression stroke.

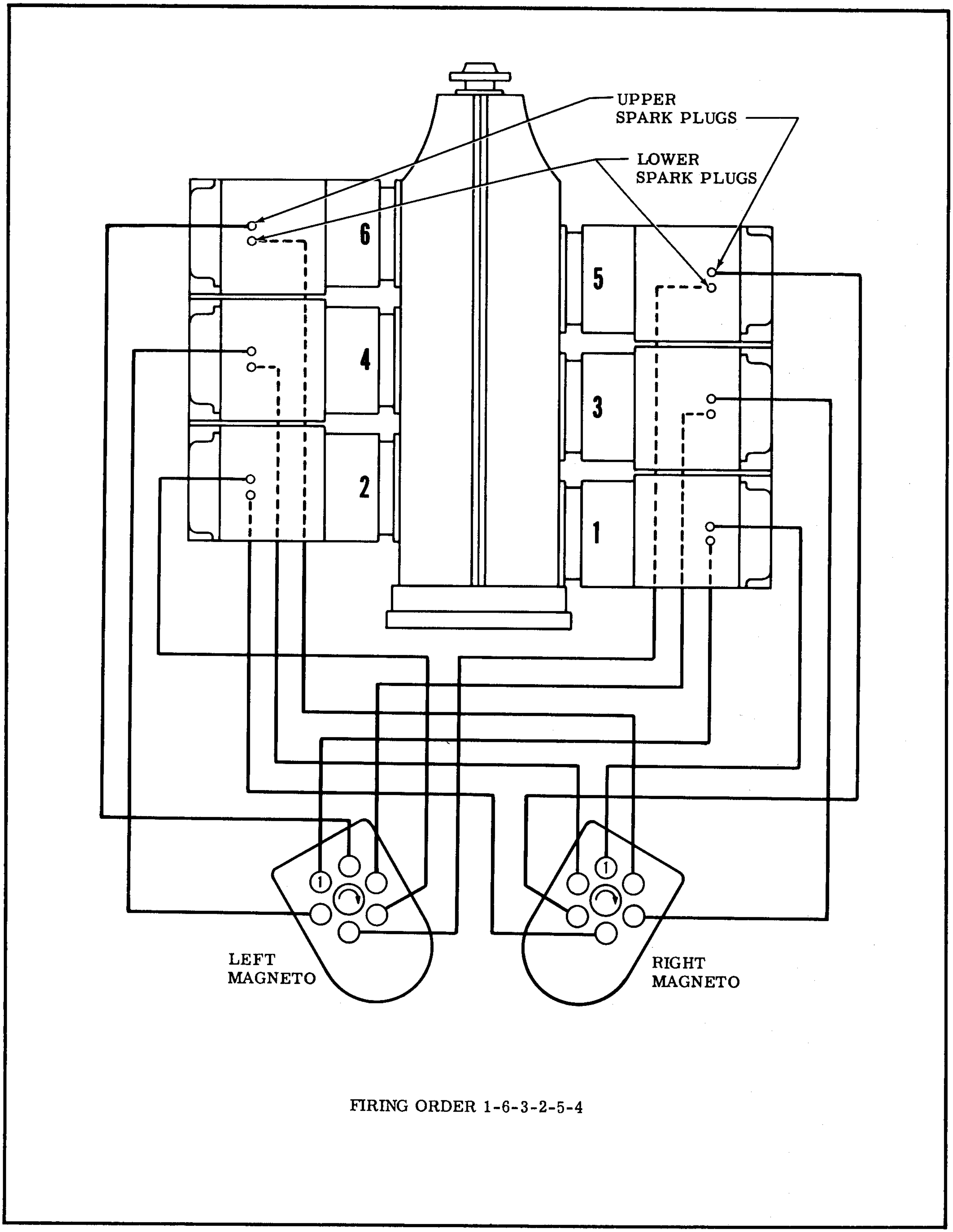


Figure 12-6. Ignition Schematic

NOTE

IO-520 Series engines have degrees marked on a bracket attached to the starter adapter, with a timing mark on the alternator drive pulley as the reference point.

b. Turn the magneto shaft until the timing marks visible through the ventilation plug holes are aligned (red-to-red or black-to-black) and insert a timing pin (or .093" 6-penny nail) through the timing hole in the bottom of the magneto next to the flange and into the mating hole in the rotor shaft. This locks the magneto approximately in firing position while installing on the engine.
c. After magneto gasket is in place, position the magneto on the engine and secure, then remove the timing pin from the magneto. Be sure to remove this pin before turning the propeller.
d. Connect a timing light to the capacitor terminal at the front of the magneto and to a good ground.
e. Turn propeller back a few degrees to close the contact points.

NOTE

Do not turn the propeller back far enough to engage the impulse coupling or the propeller will have to be turned in normal direction of rotation until the impulse coupling releases, then backed up to slightly before the firing position.

f. Slowly advance the propeller in normal direction of rotation until timing light indicates the position of contact point breaking. Magneto mounting clamps may be loosened so that the magneto may be shifted to break the points at the correct firing position.
g. Tighten magneto mounting nuts, recheck timing, then remove timing light.
h. Connect spark plug leads to their correct magneto outlets.

NOTE

The No. 1 magneto outlet is the one closest to the ventilation plug on the side of the magneto having the manufacturer's insignia. The magneto fires at each successive outlet in clockwise direction. Connect No. 1 magneto outlet to No. 1 cylinder spark plug lead, No. 2 outlet to the next cylinder to fire, etc. Engine firing order is listed in paragraph 12-6.

i. Connect ignition switch primary lead to the capacitor terminal on the magneto.

12-65. MAINTENANCE. Magneto-to-engine timing should be checked with a timing light every 200 hours. If timing is off more than 1° in either direction, the magneto should be retimed to the engine. The magneto mounting clamps may be loosened for this purpose. If the internal timing marks visible through the ventilation plug holes on the sides of the magneto are misaligned more than 1/16" when the magneto fires, the magneto should be retimed internally. Whenever the magneto halves are separated, the breaker assembly should always be checked. As long as internal timing and magneto-to-engine timing are within the preceding tolerances, it is recommended that the magneto be checked internally only at 500-hour intervals.

NOTE

If ignition trouble should develop, spark plugs and ignition wiring should be checked first. If the trouble appears definitely to be associated with a magneto, the following may be used to help disclose the source of trouble without overhauling the magneto.

a. Moisture Check.
1. Remove screws securing magneto halves together, disconnect capacitor slip terminal, remove distributor cap, and inspect for moisture.
2. Check distributor gear finger and carbon brush for moisture.
3. Check breaker assembly for moisture, especially on contact points.
4. If any moisture is evident, lightly wipe with a soft, dry, clean, lint-free cloth.
b. Breaker Compartment Check.
1. Check all parts of the breaker assembly for security.
2. Check contact points for absence of excessive wear, burning, deep pits, and carbon deposits. Points may be cleaned with a hard-finish paper. Replace defective breaker assemblies. Make no attempt to stone or dress contact points. Clean new points with oleum spirits before installing.
3. Check cam oiler pad. If dry, apply 2 or 3 drops of SAE 70 oil to the pad. Remove any excessive oil from breaker assembly. Too much oil may result in fouling and excessive burning of points. The corner of the cam oiler pad should touch the cam lobe lightly.
4. Check the capacitor.
5. Check the carbon brush on the distributor gear for excessive wear. The brush must extend a minimum of 1/32" beyond the end of the gear shaft. The spring which the brush contacts should be bent out approximately 20° from vertical, since spring pressure on the brush holds the distributor gear shaft against the thrust bearings in the distributor cap.
6. Oil the bearings at each end of the distributor gear shaft with a drop of SAE 20 oil. Wipe off excess.
7. Make sure internal timing is correct and reassemble the magneto. If removed from the engine, install and time properly.

12-66. OIL SYSTEM.

12-67. A wet sump, pressure-lubricating oil system is employed in this engine. Oil under pressure from the oil pump is fed through drilled crankcase passages which supply oil to the crankshaft main bearings and camshaft bearings. Connecting rod bearings are pressure lubricated through internal passages in the crankshaft. Valve mechanisms are lubricated through the hollow push-rod, which are supplied with oil from the crankcase oil passages. Oil is returned by gravity to the engine oil sump. Cylinder walls

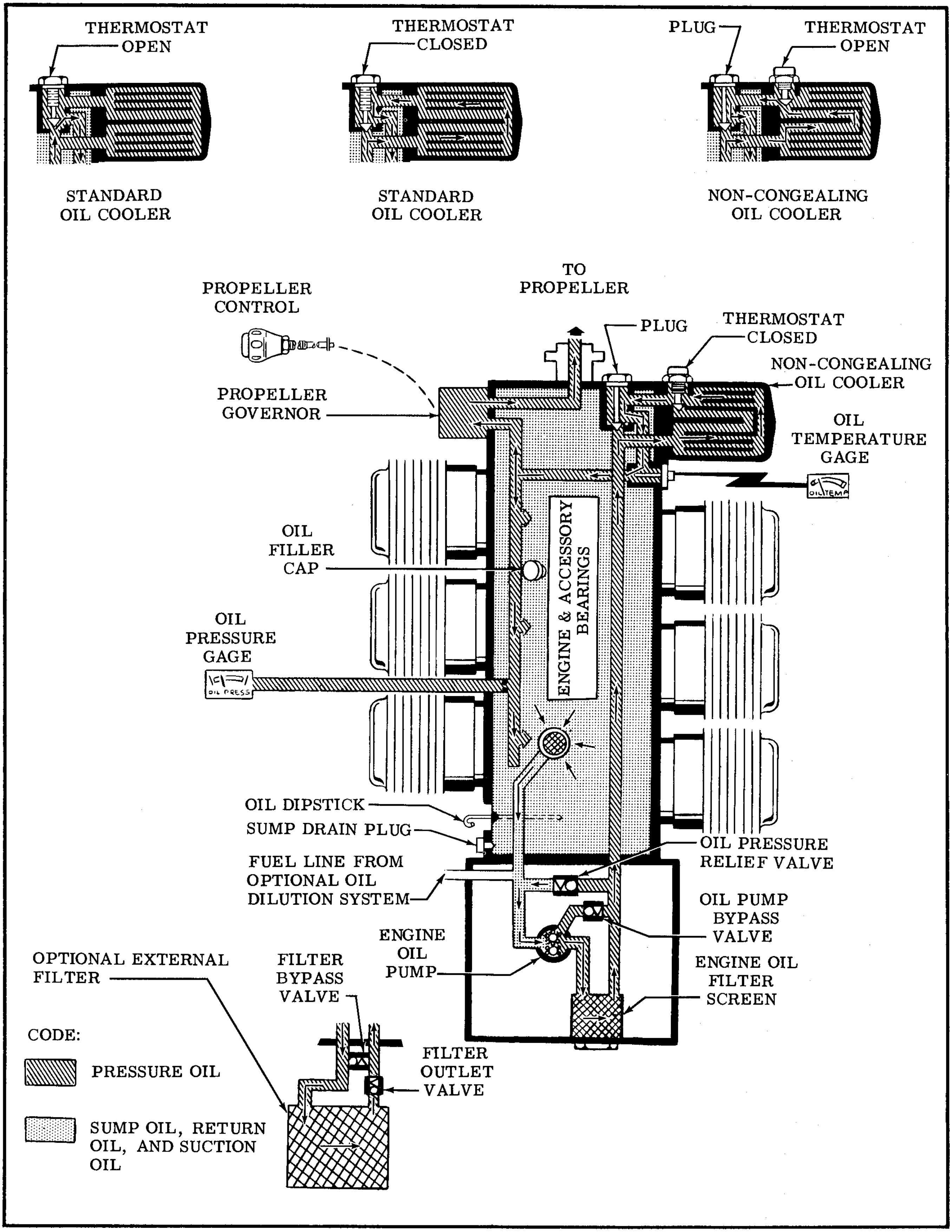


Figure 12-7. Oil System Schematic

and piston pins are spray-lubricated by oil escaping from connecting rod bearings. The engines are equipped with an oil cooler and conventional verna-therm-controlled oil temperature regulation. A pressure relief valve is installed to maintain proper oil pressure at higher engine speeds. Removable oil filter screens are provided within oil systems. External, replaceable element oil filters and non-congealing oil coolers are optional equipment.

12-68. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
NO OIL PRESSURE.		
No oil in sump.	Check with dipstick.	Fill sump with proper grade and amount of oil.
Oil pressure line broken, disconnected, or pinched.	Inspect oil pressure line.	Replace or connect.
Oil pump defective.	Remove and inspect.	Examine engine. Metal particles from damaged pump may have entered engine oil passages.
Defective oil pressure gage.	Check with another gage. If second reading is normal, airplane gage is defective.	Replace gage.
Oil congealed in gage line.	Disconnect line at engine and gage. Flush with kerosene.	Pre-fill with kerosene and install.
Relief valve defective.	Remove and check for dirty or defective parts.	Clean and reinstall. Replace if defective.
HIGH OIL TEMPERATURE.		
Oil cooler thermo bypass valve defective.	Feel front of cooler core with hand. If core is cold, oil is bypassing cooler.	Replace thermo bypass valve.
Oil cooler air passages clogged.	Inspect cooler core.	Clean air passages.
Oil cooler oil passages clogged.	Attempt to drain cooler. Inspect any drainings for sediment.	Clean oil passages.
Oil congealed in oil cooler.	This condition can only occur in extremely cold temperatures.	If congealing is suspected, use external heater or a heated hangar to thaw the congealed oil.
Secondary effect of low oil pressure.	Observe oil pressure gage for low indication.	Determine and correct reason for low oil pressure.
Defective oil temperature gage.	Check with another gage. If second reading is normal, airplane gage is defective.	Replace gage.
Defective oil temperature bulb.	Check for correct oil pressure, oil level and cylinder head temperature. If they are not correct, check oil temperature gage for being defective; if a similar reading is observed, bulb is defective.	Replace temperature bulb.

12-68. TROUBLE SHOOTING (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
LOW OIL TEMPERATURE.		
Defective oil temperature bulb or gage.	Check with another gage. If reading is normal, airplane gage is defective. If reading is similar, temperature bulb is defective.	Replace defective part.
Oil cooler thermo bypass valve defective or stuck closed.	Remove valve and check for proper operation.	Replace thermo bypass valve.
LOW OIL PRESSURE.		
Low viscosity oil.		Drain oil and refill sump with proper grade of oil.
Low oil level.	Check with dipstick.	Fill sump to proper level with proper grade of oil.
Oil pressure relief valve spring weak or broken.	Remove and check spring.	Replace weak or broken spring.
Defective oil pump.	Check oil temperature and oil level. If temperature is higher than normal and oil level is correct, internal failure is evident.	Examine engine. Metal particles from damaged oil pump may have entered engine oil passages.
Secondary result of high oil temperature.	Observe oil temperature gage for high indication.	Determine and correct reason for high oil temperature.
HIGH OIL PRESSURE.		
High viscosity oil.		Drain oil and refill sump with proper grade and amount of oil.
Relief valve defective.	Remove and check for dirty or defective parts.	Clean and reinstall. Replace if defective.
Defective oil pressure gage.	Check oil pressure with another gage. If second gage gives a normal reading, airplane gage is defective.	Replace oil pressure gage.

12-69. FULL-FLOW OIL FILTER. An external oil filter may be installed on the engine. The filter and filter adapter replaces the internal oil pressure screen. The filter adapter incorporates a bypass valve and an outlet valve. If the filter element should become clogged, the bypass valve and outlet valve will open, allowing pressure oil to flow to the engine oil passages.

12-70. FILTER ELEMENT REMOVAL AND INSTALLATION. (See figure 12-8.)

NOTE

New filter element kits are available from the Cessna Service Parts Center.

a. Remove engine cowling as necessary for access.
b. Remove both safety wires from filter can and unscrew hollow stud to detach filter assembly from adapter as a unit. Remove from aircraft discarding upper gasket. Oil will drain from filter assembly as assembly is removed from adapter.
c. Press downward on hollow stud to remove from filter element and can. Discard metal gasket.
d. Lift lid from can, and discard lower gasket.
e. Pull filter element from can.

NOTE

Before discarding removed filter element, remove the outer perforated paper cover; using a sharp knife, cut through the folds of the filter element at both ends, close to the metal caps. Then carefully unfold the pleated element and examine the material trapped in the filter element for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particles or 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 element justifies further examination to determine the cause.

f. Wash lid, hollow stud, and can in cleaning solvent and dry with compressed air.

NOTE

When installing a new filter element, it is important that all gaskets are clean, lubricated, and positioned properly, and that the correct amount of torque is applied to the filter hollow stud. If the hollow stud is under-torqued, oil leakage will occur. If the hollow stud is over-torqued, the filter can might possibly be deformed, again causing oil leakage.

Lubricate rubber grommets in each end of new filter element, upper and lower gaskets, and metal gasket with clean engine oil or general purpose grease before installing. Dry gaskets can cause false torque readings, again resulting in oil leakage.

Before assembly, place a straightedge across bottom of filter can. Check for distortion or out-of-flat condition greater than 0.010 inch. Install a new can if either of these conditions exists.

After installing a new upper gasket on the lid, turn lid over. If gasket falls, try a different gasket and repeat test. If this gasket falls off, install a new lid.

g. Inspect adapter gasket seat for gouges, deep scratches, wrench marks, and mutilation. If any of these conditions are found, install a new adapter.
h. Place a new filter element in can and insert hollow stud with a new metal gasket in place, through the can and filter element.
i. Position a new lower gasket inside flange of lid. Place lid in position on can.
j. Install filter assembly on adapter with a new upper gasket in place. While holding can to prevent it from turning, tighten hollow stud and torque to 20-25 lb-ft (240-200 lb-in), using a torque wrench.
k. Install parts removed for access, and service the engine with proper grade and quantity of engine oil. One additional quart of oil is required each time filter element is changed.
l. Start engine and check for proper oil pressure. Check for oil leaks after warming up engine.
m. Again check for oil leakage after engine has been run at a high power setting (preferably a flight around the field).
n. Check to make sure that the filter has not been in contact with adjacent parts due to engine torque.
o. While engine is still warm, recheck torque on hollow stud, then safety hollow stud to bracket on can, and safety adapter nut to other bracket on filter can.

12-71. ADAPTER REMOVAL. (See figure 12-8.)
a. Remove filter can as outlined in paragraph 12-70.

NOTE

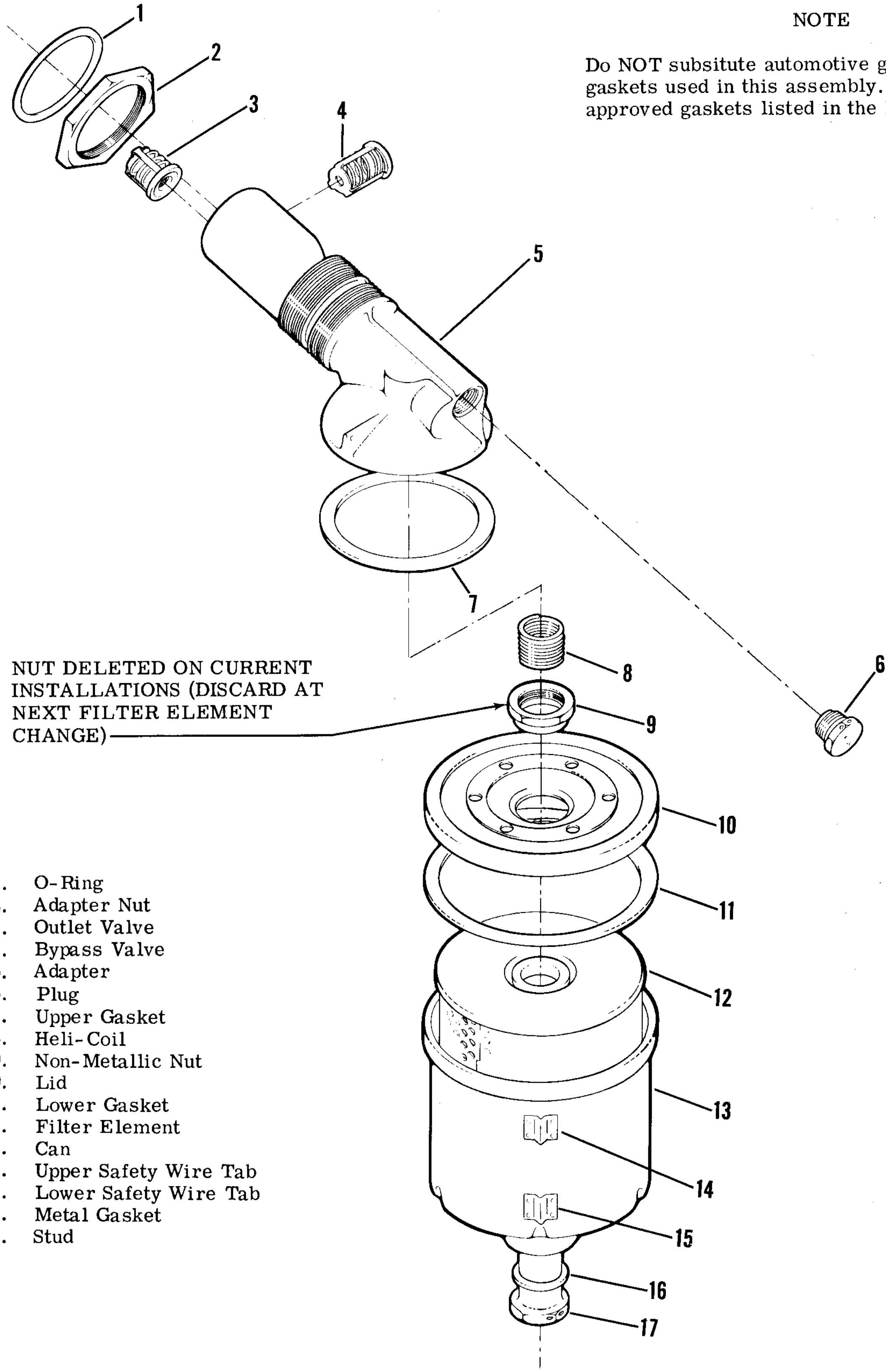
A special wrench adapter (Part No. SE709) for the adapter nut, is available from the Cessna Service Parts Center.

b. Note angular position of adapter, then remove safety wire and loosen adapter nut.
c. Unscrew adapter and remove adapter from engine. Discard adapter O-ring.

12-72. DISASSEMBLY, INSPECTION AND ASSEMBLY. Figure 12-8 shows the relative position of the internal parts of the filter adapter and may be used as a guide during installation of parts. The bypass valve is to be installed as a complete unit, with the valve being staked three places. A new helio-type thread insert in the adapter may be installed although special tools are required. Follow instructions of the tool manufacturer for their use. Inspect threads on adapter and in engine for damage. Clean

NOTE

Do NOT subsitute automotive gaskets for any gaskets used in this assembly. Use only approved gaskets listed in the Parts Catalogs.



1. O-Ring
2. Adapter Nut
3. Outlet Valve
4. Bypass Valve
5. Adapter
6. Plug
7. Upper Gasket
8. Heli-Coil
9. Non-Metallic Nut
10. Lid
11. Lower Gasket
12. Filter Element
13. Can
14. Upper Safety Wire Tab
15. Lower Safety Wire Tab
16. Metal Gasket
17. Stud

Figure 12-8. Full-Flow Oil Filter

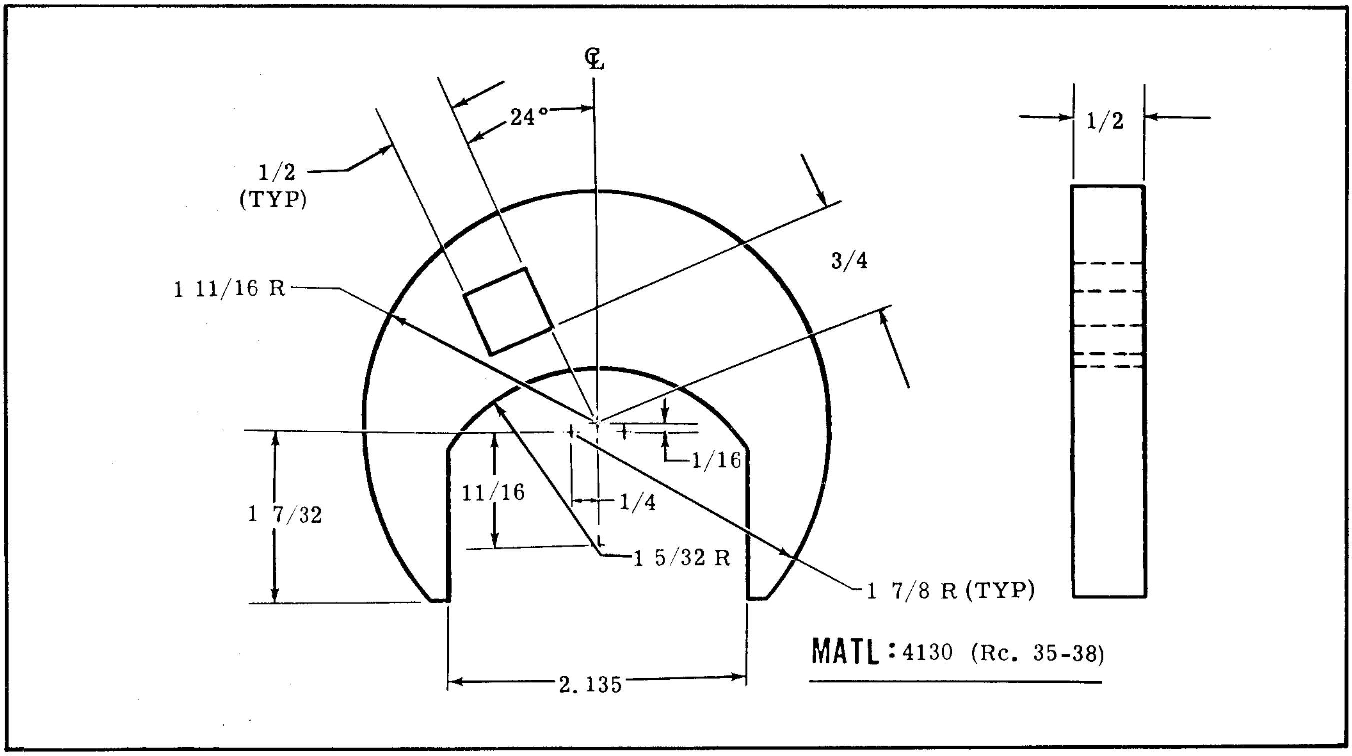


Figure 12-9. Wrench Adapter Fabrication

adapter in solvent and dry with compressed air. Ascertain that all passages in the adapter are open and free of foreign material. Also, check that by-pass valve is seated properly.

12-73. ADAPTER INSTALLATION.

a. Assemble adapter nut and new O-ring on adapter in sequence illustrated in figure 12-8.

b. Lubricate O-ring on adapter with clean engine oil. Tighten adapter nut until O-ring is centered in its groove on the adapter.

c. Apply anti-seize compound sparingly to the adapter threads, then simultaneously screw adapter and adapter nut into engine until O-ring seats against engine boss without turning adapter nut. Rotate adapter to approximate angular position noted during removal of adapter. Do not tighten adapter nut at this time.

d. Temporarily install filter assembly on adapter, and position so adequate clearance with adjacent parts is attained. Maintaining this position of the adapter, tighten adapter nut to 50-60 lb-ft (600-700 lb-in) and safety. Use a torque wrench when tightening adapter nut.

e. Using new gaskets, install filter assembly as outlined in paragraph 12-70. Be sure to service engine oil system.

12-74. OIL COOLER. An optional non-congealing oil cooler may be installed. As noted in Section 12A, the non-congealing oil cooler is standard equipment on the turbocharged engines. Oil circulating through the engine is allowed to circulate continuously through warm-up passages to prevent the oil from congealing when operating in low temperatures. On the standard and non-congealing oil coolers, as the oil increases to a certain temperature, the thermostat valve closes, causing the oil to be routed to all of the cooler passages for cooling.

12-75. EXTREME WEATHER MAINTENANCE.

12-76. COLD WEATHER starting willlbe made easier by the installation of an oil dilution system and a ground service receptacle which permits quick connection of an external power source. After the last flight of the day, drain the engine oil into a clean retainer so the oil can be preheated. Cover the engine to prevent ice or snow from collecting inside the cowling. When preparing the aircraft for flight or engine run-up after these conditions have been followed, preheat the drained oil. After preheating the oil, gasoline may be mixed with the oil in a ratio of 1 part gasoline to 12 parts oil before pouring into the engine oil sump. If the free air temperature is below -29°C (-20°F), the engine compartment should be preheated by a ground heater. After the engine compartment has been preheated, inspect all engine compartment drain and vent lines for presence of ice. After this procedure has been followed, pull the propeller through several revolutions by hand before starting the engine.

WARNING

Do not heat oil above 121°C (250°F). A flash fire may result. Before pulling propeller through, ensure that magneto switch is in the OFF position to prevent engine from firing.

CAUTION

Due to the desludging effect of the diluted oil, engine operation should be observed closely during the initial warm-up of the engine. Engines that have a considerable amount of operational hours accumulated since their last dilution period may be seriously affected by the dilution process. This will be caused by the diluted oil dislodging sludge and carbon deposits within the engine. This residue will collect in the oil sump and possibly clog the screened inlet to the oil pump. Small deposits may actually enter the oil pump and be trapped by the main oil filter screen. Partial or, in some cases, complete loss of engine lubrication may result from either condition. If these conditions are anticipated after oil dilution, the engine should be run for several minutes at normal operating temperatures and then stopped and inspected for evidence of sludge and carbon deposits in the oil sump, oil cooler, and oil filter screen. Future occurence of this condition can be prevented by diluting the oil prior to each oil change. This will prevent the build-up accumulation of the sludge and carbon deposits within the engine.

Winterization Kits are available for non-turbocharged engines only. The kits are essentially devices to restrict the entry of air through the front opening of the cowl, or to restrict the outlet of air at the rear opening of the cowl. All kits are designed for easy installation on the aircraft and should be used in accordance with instructions accompanying the kits.

A manually-operated priming system may be installed on these aircraft. The primer is located on the pedestal. Fuel to the primer pump is taken from the fuel strainer and is delivered to the aft end of each intake manifold, thus priming the entire length of the intake manifold for each bank of cylinders.

12-77. LOW BATTERY STARTING.

12-78. If a ground service receptacle is installed, the use of an external power source is recommended for cold weather starting and lengthy maintenance work on the airplane's electrical system with the exception of electronic equipment.

NOTE

Electrical power for the aircraft electrical circuits is provided through a split bus bar having all electronic circuits on one side of the bus and other electrical circuits on the other side of the bus. When an external power source is connected, a contactor automatically opens the circuit to the electronic portion of the bus bar as a protection against damage to the semiconductors in the electronic equipment by transient voltages from the power source. Therefore, the external power source cannot be used as a source of power when checking electronic components. Just before connecting an external power source (generator type or battery cart), the master switch should be turned ON.

The ground service plug receptacle circuit incorporates a polarity reversal protection. Power from the external power source will flow only if the ground service plug is correctly connected to the airplane. If the plug is accidentally connected backwards, no power will flow to the airplane's electrical system, thereby preventing any damage to electrical equipment.

The battery and external power circuits have been designed to completely eliminate the need to "jumper" across the battery contactors to close it for charging a completely "dead" battery. A special fused circuit in the external power system supplies the needed "jumper" across the contacts so that with a "dead" battery and an external power source applied, turning the master switch ON will close the battery contactor.

12-79. HAND-CRANKING. A normal hand-cranking procedure may be used to start the engine.

12-80. HOT WEATHER. Engine starting in hot weather or with a hot engine is sometimes hampered by vapor formation in the fuel lines. To purge the vapor, move the mixture control to full rich, open the throttle 1-1/2 inches, and prime with the auxiliary fuel pump switch in the HI position until the fuel flow indicator reads 4-6 gal/hr. Then shut off the fuel pump switch and engage the starter. As the flooded mixture beocmes progressively leaner, reaching a combustible mixture, the engine will start. If the engine tends to die, turn the auxiliary fuel pump switch momentarily to HI at appropriate intervals until vapor is fully cleared and the engine runs smoothly.

If prolonged cranking is necessary, allow the starter motor to cool at frequent intervals, since excessive heat may damage the armature.

12-81. DUSTY CONDITIONS. Dust inducted into the engine intake system is probably the greatest single cause of early engine wear. Under high dust conditions the induction air filter should be serviced daily as outlined in Section 2.

12-82. SEACOAST AREAS, HUMID AREAS. In salt water areas, special care should be given to keep the engine and engine accessories clean to prevent oxidation. Fuel and oil should be checked frequently and drained of condensed moisture in humid areas.

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SECTION 12A

TURBOCHARGED POWERPLANT

TABLE OF CONTENTS Page

12A-1. ENGINE COWLING.

12A-2. The engine cowling is similar to that described in Section 12, except it is wider at the front, with additional ram air openings in the right and left nose caps. The opening in the right side supplies ram air to the turbocharger. The opening in the left side supplies ram air to the cabin heating system. When removing the nose caps, remove clamps and disconnect the flexible ducts from the induction air and heater air inlet ducts. Be sure to connect the heater and induction air inlet ducts to the flexible duct when installing the nose caps.

12A-3. CLEANING, INSPECTION, AND REPAIR OF ENGINE COWLING may be accomplished as outlined in paragraph 12-3.

12A-4. ENGINE.

12A-5. The turbocharged powerplant is an air-cooled, six-cylinder, horizontally-opposed, wet-sump, fuel-injected, turbocharged Continental engine. Refer to paragraph 12A-6 for engine data.

12A-6. ENGINE DATA.

MODEL (Continental)	TSIO-520-H
BHP at RPM	285 at 2700
Limiting Manifold Pressure (Sea Level)	32.5 Inches Hg.
Number of Cylinders	6-Horizontally Opposed
Displacement	520 Cubic Inches
Bore	5.25 Inches
Stroke	4.00 Inches
Compression Ratio	7.5:1
Magnetos	Slick #662
Right Magneto	Fires 20° BTC Upper Right and Lower Left
Left Magneto	Fires 20° BTC Upper Left and Lower Right
Firing Order	1-6-3-2-5-4
Spark Plugs	SL-350
Gap	.015 to .018 Inch
Torque Value	330±30 Lb-In.
Fuel Metering System	Continental Fuel Injection
Unmetered Fuel Pressure	5.5 to 6.5 PSI at 600 RPM 30.8 to 32.2 PSI at 2700 RPM
Fuel	Aviation-100/130 Grade (Min.)
Oil Sump Capacity.	11 U.S. Quarts
Tachometer	Type AS-54 Mechanical Drive
Alternator	14 Volt, 60 Ampere
Approximate Dry Weight with Accessories (Excluding Turbocharger System)	483 Pounds
Oil Pressure	
Minimum Idling	10 PSI
Normal	30 to 60 PSI
Oil Temperature	
Normal Operation	Within Green Arc
Maximum Permissible	Red Line (240°F)
Cylinder Head Temperature	460°F Maximum

12A-7. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE FAILS TO START.		
Improper use of starting procedure.		Review starting procedure.
Defective aircraft fuel system.	See paragraph 13-3.	See paragraph 13-3.
Engine flooded.	See paragraph 12A-81.	See paragraph 12A-81.
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace if defective.
Failure of magneto impulse couplings.	With ignition switch off, rotate propeller by hand and listen for loud clicks as impulse couplings operate.	Repair or replace magnetos.
Defective magneto switch or grounded magneto leads.	Check continuity.	Repair or replace switch or leads.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Excessive induction air leaks.	Check visually.	Correct the cause of air leaks.
Dirty screen in fuel control unit, or defective fuel control unit.	Remove screen and check visually. Check fuel flow through fuel control unit.	Clean dirty screen. Replace fuel control unit if defective.
Defective electric fuel pump.	See paragraph 13-3.	See paragraph 13-3.
Defective fuel manifold valve, or dirty screen inside valve.	Check fuel flow through valve.	Remove and clean per paragraph 12-37. Replace if defective.
Clogged fuel injection lines or discharge nozzles.	Check fuel flow through lines and nozzles.	Clean lines and nozzles. Replace if defective. Refer to paragraph 12A-49.
Fuel pump not permitting fuel from electric pump to bypass.	Check fuel flow through engine-driven fuel pump.	Replace fuel pump.
Vaporized fuel.	Vaporized fuel is most likely to occur in hot weather with a hot engine.	See paragraph 12A-81.
ENGINE STARTS BUT DIES, OR WILL NOT IDLE.		
Propeller control in low rpm position.	Check visually.	Use high rpm for all ground operations.
Defective aircraft fuel system.	See paragraph 13-3.	See paragraph 13-3.
Improper idle speed or idle mixture adjustment.	See paragraph 12-34.	See paragraph 12-34

12A-7. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE STARTS BUT DIES, OR WILL NOT IDLE. (Cont)		
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace defective.
Water in fuel system.	Open fuel strainer drain valve and check for water.	Drain fuel tank sumps, fuel lines, and fuel strainer.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Excessive induction air leaks.	Check visually.	Correct the cause of air leaks.
Dirty screen in fuel control unit, or defective fuel control unit.	Remove screen and check visually. Check fuel flow through fuel control unit.	Clean dirty screen. Replace fuel control unit if defective.
Defective fuel manifold valve, or dirty screen inside valve.	Check fuel flow through valve.	Remove and clean per paragraph 12-37. Replace if defective.
Restricted fuel injection lines or discharge nozzles.	Check fuel flow through lines and nozzles.	Clean lines and nozzles. Replace if defective. Refer to paragraph 12A-49.
Defective engine-driven fuel pump.	If engine continues to run with electrical pump turned on, but stops when it is turned off, the engine-driven pump is defective.	Replace engine-driven fuel pump.
Vaporized fuel.	Vaporized fuel is most likely to occur in hot weather with a hot engine.	See paragraph 12A-81.
Manual primer leaking.	Disconnect primer outlet line. If fuel leaks through primer, it is defective.	Repair or replace primer.
Discharge nozzle air vent manifolding restricted or defective.	Check visually.	Check for bent or loose connections. Tighten loose connections. Check for restriction and replace defective components.
Defective engine.	Check compression. Listen for unusual engine moises.	Engine repair is required.
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER.		
Propeller control in low rpm position.	Check visually.	Use high rpm for all ground operations.
Restriction in aircraft fuel system.	See paragraph 13-3.	See paragraph 13-3.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER. (Cont)		
Restriction in fuel injection system.	Check fuel flow through discharge nozzles, fuel lines, manifold valve, fuel control unit, and fuel pump until restriction is located.	Clean out restriction. Replace any item found defective.
Fuel pump pressure improperly adjusted.	See paragraph 12A-54.	See paragraph 12A-54.
Worn or improperly rigged throttle or mixture control.	Check visually.	Rig properly. Replace worn linkage.
Spark plugs fouled or improperly gapped.	Remove and check.	Clean and regap. Replace if defective.
Defective ignition system.	See paragraph 12-65.	See paragraph 12-65.
Exhaust system leakage.	Check visually.	Tighten or repair exhaust system.
Turbocharger wheels rubbing.	Check manually.	Replace turbocharger.
Improperly adjusted or defective waste-gate controller.	See paragraph 12A-21.	See paragraph 12A-21. Replace if defective.
Leak in turbocharger discharger pressure system.	Inspect turbocharger installation.	Replace or repair damaged parts.
Manifold pressure overshoot.	Normal, when engine is accelerated too rapidly.	Move throttle about two-thirds open. Let engine accelerate to 30 inches Hg. and peak. Move throttle to full open position.
Defective engine.	Check compression. Listen for unusual engine noises.	Engine repair is required.
POOR IDLE CUT-OFF.		
Worn or improperly rigged mixture control.	Check that idle cut-off stop on fuel control unit is contacted.	Rig properly. Replace worn linkage.
Dirty or defective fuel manifold valve.	Operate electric fuel pump and check that no fuel flows through manifold valve with mixture control in idle cut-off.	Remove and clean per paragraph 12-37. Replace if defective.
Fuel contamination.	Check all screens in fuel and fuel injection system.	Drain all fuel and flush out fuel system. Clean all screens, fuel lines, discharge nozzles, fuel strainer, fuel manifold valve, and fuel pump.
Defective mixture control valve in fuel control unit.	If none of the preceding causes are found, fuel control unit is probably at fault.	Replace defective fuel control unit.

NOTE

Refer to paragraph 12A-18 for trouble shooting of the controller and waste-gate actuator.

12A-8. ENGINE REMOVAL. Remove the engine as a complete unit with all accessories installed.

NOTE

Tag each item disconnected to aid in identifying wires, hoses, and control linkage when engine is replaced. Protect openings, exposed as a result of removing or disconnecting units.

a. Turn off all cabin switches and fuel selector valve.
b. Remove engine cowling and nose cap.
c. Open battery circuit by disconnecting the ground cable.

WARNING

The magneto is NOT internally grounded when the primary lead is disconnected. The magneto primary circuit must be grounded or all spark plug leads must be disconnected to prevent the engine from firing when the propeller is rotated.

e. Drain the engine oil.
f. Remove propeller. (See Section 14.)
g. Disconnect throttle, mixture, and propeller control. Remove clamps attaching controls to engine and pull controls aft to clear engine assembly. Use care to avoid bending controls too sharply.

NOTE

During the following procedures, remove any clamps which secure controls, wires, hoses or lines to the engine, engine mount, or attached brackets, so they will not interfere with engine removal. Some of the items listed can be disconnected at more than one place. It may be desirable to disconnect some of these items at other than the places indicated. The reason for engine removal should be the governing factor in deciding at which point to disconnect them. Omit any of the items which are not present on a particular engine.

h. Disconnect wires and cables as follows:
   1. Disconnect oil temperature connector located directly below oil cooler.
   2. Disconnect tachometer drive from adapter.
   3. Disconnect starter electrical cable.
   4. Disconnect cylinder head temperature bulb lead at the bulb.
   5. Disconnect electrical wires and wire shielding ground from alternator.
   6. Disconnect electrical wires at throttle switches.
   7. Disconnect exhaust gas temperature wires, if installed.
   8. Remove all clamps attaching wires or cables to the engine. Pull all wires and cables aft to clear the engine assembly.

WARNING

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent the accumulation of such fuel when lines and/or hoses are disconnected.

i. Disconnect lines and hoses as follows:
   1. Disconnect the hydraulic supply and pressure lines at hydraulic pump. Disconnect and remove hydraulic pump vent line.
   2. Disconnect vacuum line at the vacuum pump, and remove oil separator vent line.
   3. Disconnect manifold pressure line at intake manifold.
   4. Disconnect the fuel supply and the vapor return lines at the fuel pump. Disconnect and remove fuel pump drain line.
   5. Disconnect the fuel-flow gage line at firewall.
   6. Disconnect oil pressure line at the engine.
   7. Disconnect and remove the right and left manifold drain lines and the balance tube drain line.
   8. Disconnect air and oil lines at waste-gage controller, located on the firewall.
   9. Disconnect air vent line to fuel-flow gage, at firewall.
   10. Disconnect engine primer lines at right and left intake manifold, if installed.
   11. Disconnect oil drain line from oil deflector under external oil filter, if installed.
   12. Remove all clamps attaching disconnected lines and hoses to engine or structure.
j. Disconnect flexible ducting at cabin heater.

CAUTION

Place a stand under the tail tie-down ring before removing the engine. The loss of engine weight will allow the tail to drop.

k. Attach a hoist to the lifting eye at the top center of the engine crankcase. Lift engine just enough to relieve the weight from the engine mount.

l. Remove the engine as follows:

   1. Remove heat shields, engine mount bolts, and ground strap.

CAUTION

Hoist engine slowly and make sure all wires, lines, and hoses have been disconnected. Also, use care to prevent damage to left intake manifold by the battery box.

   2. Hoist engine out of nacelle and clear of aircraft.

3. Remove mount pads, spacers, ground strap, and pins.

12A-9. INSPECTION AND REPAIR. For specific items to be inspected refer to the manufacturer's manual.

a. Inspect all hose for internal swelling, chafing through protective plys, cuts and breaks, hardening and loose connections. Excessive heat on hose will cause them to become brittle and easily broken Hose and lines are most likely to crack or break near the end fittings and support points. At engine overhaul, install all new hose.

b. Inspect all fittings for damaged threads.

c. Visually inspect the engine for loose nuts, bolts, cracks, and fin damage.

d. Inspect baffles, baffle seals, and brackets for cracks, deterioration, and breakage.

e. For major repairs refer to the manufacturer's overhaul and repair manual.

12A-10. POWERPLANT BUILD-UP. Refer to paragraph 12-10 for powerplant build-up.

12A-11. ENGINE INSTALLATION.

a. Hoist engine to a point just above the nacelle.

b. Install engine mount pads as shown in figure 12-1.

c. Install engine on mount pads as follows:

1. Lower engine slowly into place on the engine mount pads.

2. Attach ground strap under engine sump bolt and install engine mount bolts. Torque engine mount bolts to 300 + 50 -00 lb-in. Bend tab washers to form lock for mount bolts, Install heat shields.

NOTE

If exhaust system was loosened or removed, refer to paragraph 12A-32.

d. Connect flexible ducting on heater shroud and cabin valve.

e. Route propeller governor control along left side of engine and secure with clamps.

f. Connect lines and hoses as follows:

1. Install and connect the hydraulic pump vent line.

2. Install and connect the left and right manifold drain lines and the balance tube drain line.

3. Connect the oil pressure line at its fitting between No. 2 and 4 cylinders.

NOTE

Throughout the airplane fuel system, from the tanks to the engine-driven fuel pump, use Parker Sealube (or equivalent) as a thread lubricate or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always be sure that a compound, the residue from a previously used compound, or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on the fitting threads. Do not use any other form of thread compound on the injection system fittings.

4. Connect the fuel-flow gage line at firewall.

5. Connect the fuel supply and the vapor return lines at the fuel pump. Connect and install fuel pump drain line.

6. Connect manifold pressure line at intake manifold.

7. Connect vacuum line at the vacuum pump, and install oil separator vent line.

8. Connect hydraulic supply and pressure lines at hydraulic pump. See paragraph 5A-8.

9. Connect air and oil lines at waste-gate controller on firewall.

10. Connect air vent line to fuel-flow gage line at firewall.

11. Connect engine primer lines at right and left intake manifold, if used.

12. Connect oil drain line to oil deflector under external oil filter, if installed.

13. Install all clamps securing lines and hoses to engine or structure.

g. Connect wires and cables as follows:

1. Connect oil temperature connector located directly below oil cooler.

2. Connect tachometer drive to adapter and torque to 100 lb-in.

3. Connect starter electrical lead.

4. Connect cylinder head temperature bulb lead.

5. Connect electrical wires and wire shielding ground to alternator.

6. Connect electrical wires to throttle switches.

7. Connect exhaust gas temperature wires, if installed.

8. Install clamps that attach wires or cables, to engine or structure.

h. Connect engine controls and install block clamps.

i. Rig engine controls in accordance with paragraph 12A-58.

WARNING

Be sure the magneto switch is OFF when connecting primary leads to magnetos.

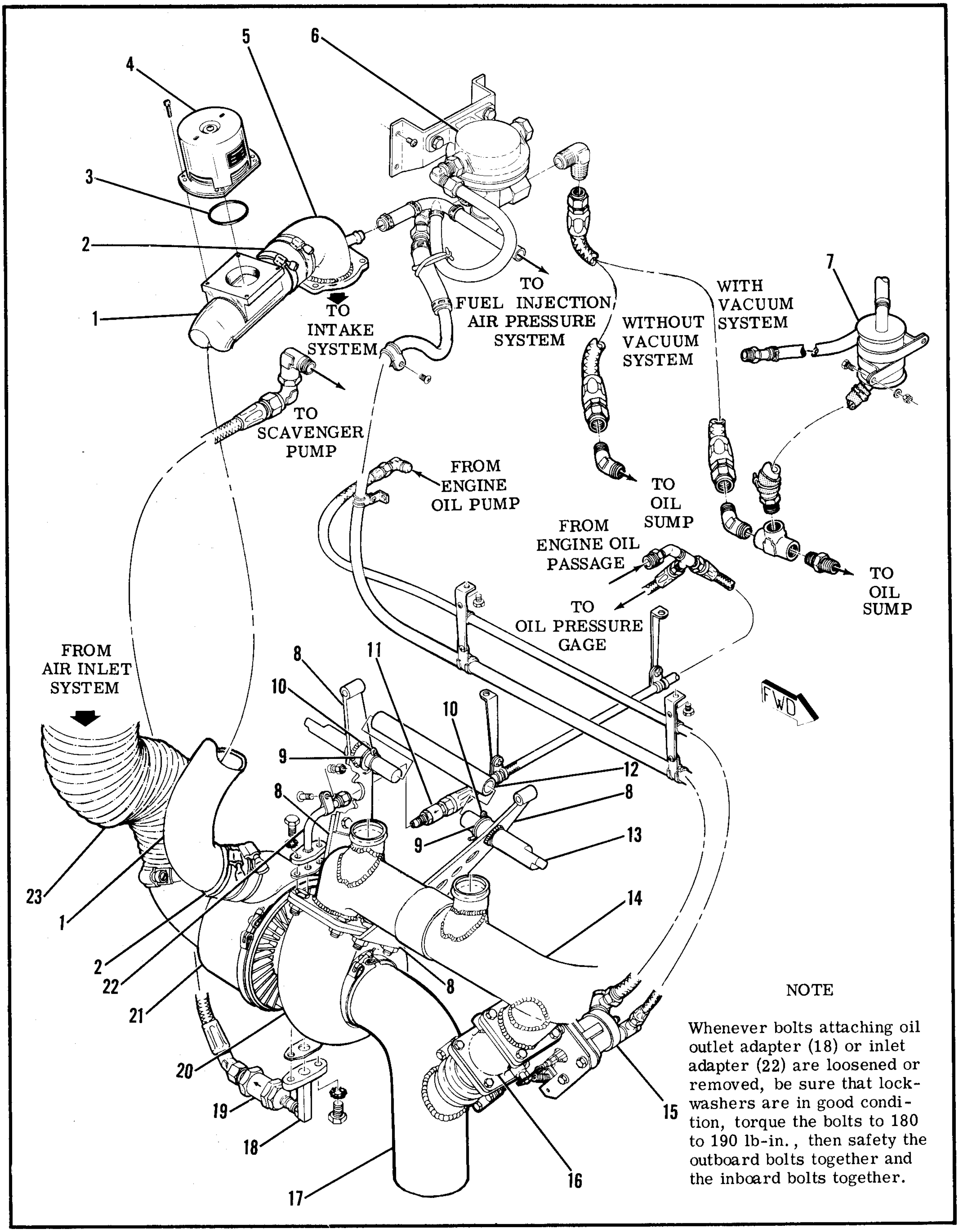
j. Make a magneto switch ground-out and continuity check, then connect the magneto primary lead wires to the magnetos. Remove temporary ground or connect spark plug leads, whichever procedure was used at removal.

k. Install propeller. (See Section 14.)

l. Service the engine in accordance with the applicable instructions in Section 2.

NOTE

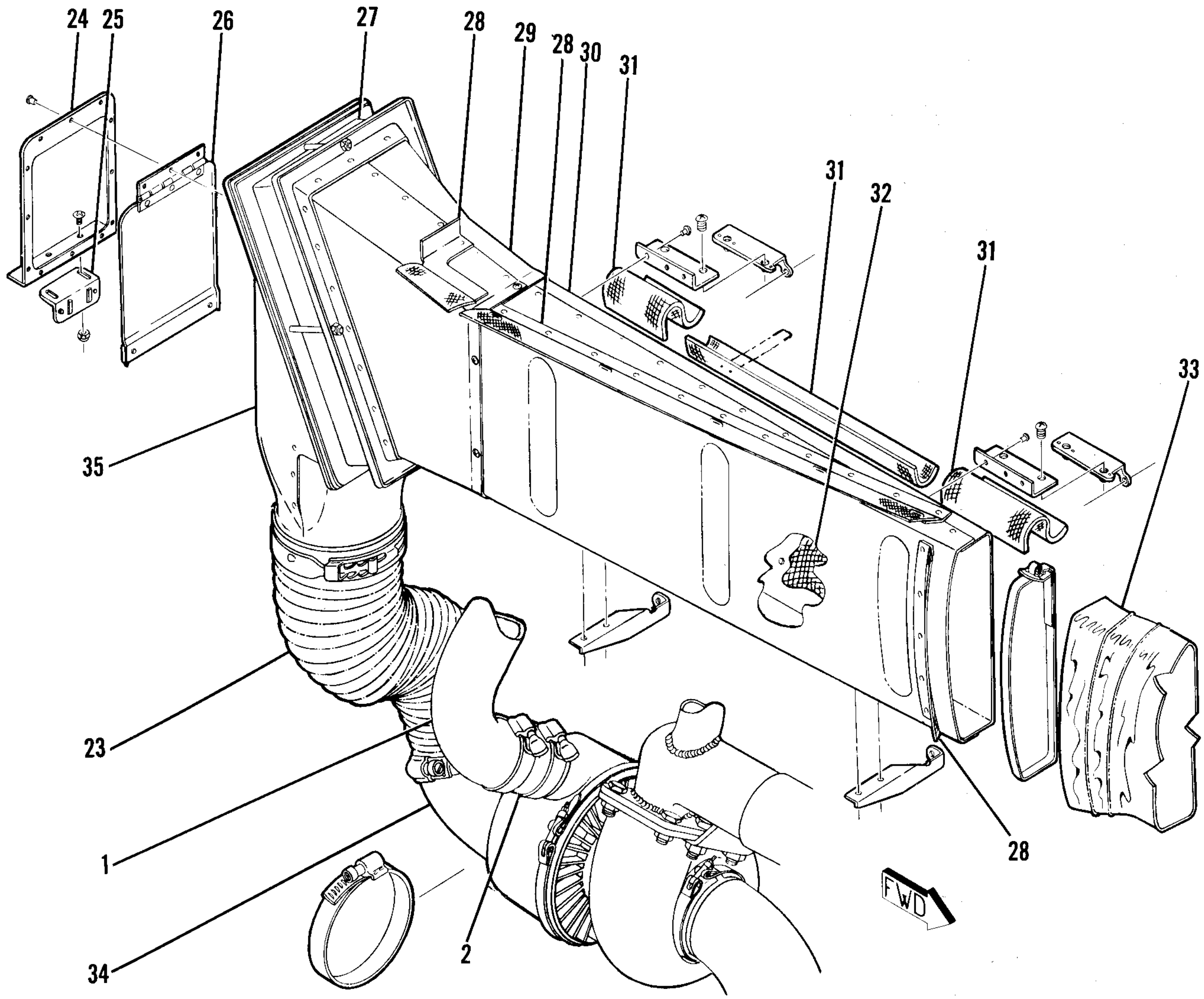
When installing a new or newly overhauled engine, and prior to starting the engine, disconnect the oil inlet line at the controller and the oil outlet line at the controller. Connect these oil lines to a full-flow oil filter, allowing oil to bypass the controller. With filter connected, operate engine approximately 15 minutes to filter out any foreign particles from the oil. This is done to pre-



NOTE

Whenever bolts attaching oil outlet adapter (18) or inlet adapter (22) are loosened or removed, be sure that lockwashers are in good condition, torque the bolts to 180 to 190 lb-in., then safety the outboard bolts together and the inboard bolts together.

Figure 12A-1. Turbocharger System (Sheet 1 of 2)



1.	Turbocharger Discharge Duct	13.	Shaft	24.	Doubler
2.	Coupler	14.	Exhaust System	25.	Magnet
3.	O-Ring Seal	15.	Waste-Gate Actuator	26.	Door
4.	Overboost Control Valve	16.	Waste Gate	27.	Induction Air Filter
5.	Throttle Body Adapter	17.	Tail Pipe	28.	Baffle Assembly
6.	Absolute Controller	18.	Oil Outlet Adapter	29.	Center Duct
7.	Vacuum System Oil Seperator	19.	Check Valve	30.	Forward Duct
8.	Turbocharger Support	20.	Turbine Housing	31.	Seal
9.	Washer	21.	Compressor Housing	32.	Wear Guard
10.	Cotter Pin	22.	Oil Inlet Adapter	33.	Nose Cap Flexible Duct
11.	Check Valve	23.	Turbocharger Inlet Hose	34.	Turbocharger Inlet Elbow
12.	Tube			35.	Aft Duct

Figure 12A-1. Turbocharger System (Sheet 2 of 2) vent foreign material from entering the controller.

m. Inspect entire engine installation and install cowling.
n. Perform engine run-up.

12A-12. TURBOCHARGER.

12A-13. The turbocharger is an exhaust gas-driven compressor, or air pump, which provides high velocity air to the engine intake manifold. The turbocharger is composed of a turbine wheel, compressor wheel, turbine housing, and compressor housing. The turbine, compressor wheel, and interconnecting drive shaft comprise one complete assembly and are the only moving parts in the turbocharger. Turbocharger bearings are lubricated with filtered oil supplied from the engine oil system. Engine exhaust gas enters the turbine housing to drive the turbine wheel. The turbine wheel, in turn, drives the compressor wheel, producing a high velocity of air entering the engine induction intake manifold. Exhaust gas is then dumped overboard through the exhaust outlet of the turbine housing and exhaust tailpipe. Air is drawn into the compressor through the induction air filter, and is forced out of the compressor housing through a tangential outlet to the intake manifold. The degree of turbocharging is varied by means of a waste-gate valve, which varies the amount of exhaust gas allowed to bypass the turbine.

12A-14. REMOVAL AND INSTALLATION OF TURBOCHARGER.
a. Remove engine cowling as required.
b. Remove waste-gate to tailpipe clamp.
c. Loosen clamp at turbine exhaust outlet and work tailpipe from turbine outlet.
d. Loosen clamps and remove air inlet and outlet ducts from turbocharger compressor.
e. Disconnect oil pressure and scavenger lines from turbocharger. Plug or cap open oil lines and fittings. Remove clamp on oil supply line to the turbocharger.
f. Loosen clamp and remove induction air inlet elbow at turbocharger compressor.
g. Remove right cowl flap by disconnecting control at cowl flap and removing hinge pin.
h. Cut safety wire and remove two bolts attaching turbine to forward mounting bracket.
i. Remove three bolts attaching turbine to turbine rear mounting bracket.
j. Remove three remaining bolts, washers, and nuts attaching turbine to exhaust manifold.
k. Work turbocharger from aircraft through cowl flap opening in lower cowling.
l. To install the turbocharger, reverse the preceding steps. When installing the turbocharger, install a new gasket between exhaust manifold and turbine exhaust inlet. Reinstall safety wire.

12A-15. CONTROLLER AND WASTE-GATE ACTUATOR.

12A-16. FUNCTIONS. The waste-gate actuator and controller uses engine oil for power supply. The turbocharger is controlled by the waste-gate, waste-gate actuator, the absolute pressure and overboost control valve. The waste-gate bypasses engine exhaust gasses around the turbocharger turbine inlet. The waste-gate actuator, which is physically connected to the waste-gate by mechanical linkage, controls the position of the waste-gate butterfly valve. The absolute pressure controller controls the maximum turbocharger compressor discharge pressure, the overboost control valve prevents an excessive pressure increase from the turbocharger compressor.

12A-17. OPERATION. The waste-gate actuator is spring-loaded to position the waste-gate to the normally open position when there is not adequate oil pressure in the waste-gate actuator power cylinder during engine shut down. When the engine is started, oil pressure is fed into the waste-gate actuator power cylinder through the capillary tube. This automatically fills the waste-gate actuator power cylinder and lines leading to the controllers, blocking the flow of oil by normally closed metering and/or poppet valves. As oil pressure builds up in the waste-gate actuator power cylinder, it overcomes the force of the waste-gate open spring, closing the waste-gate. When the waste-gate begins to close, the exhaust gases are routed through the turbocharger turbine. As the engine increases its power and speed, the increase of temperature and pressure of the exhaust gases causes the turbocharger to rotate faster, raising the turbocharger compressor outlet pressure. As the compressor outlet pressure rises, the aneroid bellows in the absolute pressure controller sense the increase in pressure. When at high engine speed and load, and the proper absolute pressure is reached, the force on the aneroid bellows opens the normally closed metering valve. When the oil pressure in the waste-gate actuator power cylinder is lowered sufficiently, the waste-gate actuator open spring forces the mechanical linkage to open the waste-gate. A portion of the exhaust gases then bypasses the turbocharger turbine, thus preventing further increase of turbocharger speed and holding the compressor discharge absolute pressure to the desired valve. Conversely, at engine idle, the turbocharger runs slowly with low compressor pressure output; therefore, the low pressure applied to aneroid bellows is not sufficient to affect the unseating of the normally closed metering valve. Consequently, engine oil pressure keeps the waste-gate closed. The overboost control valve acts as a pressure relief valve and will open to prevent an excessive pressure increase from the turbocharger compressor. Above 19,000 feet, the absolute pressure controller will continue to maintain 32.5±.5 inches of mercury manifold pressure at full throttle. It is necessary to reduce manifold pressure with the throttle to follow the maximum manifold pressure versus altitude schedule shown on the instrument panel placard.

CAUTION

All turbocharged engine installations on Cessna aircraft are equipped with controller systems which automatically control the engine power within prescribed manifold pressure limits. Although these automatic controller systems are very reliable and eliminate the need for manual control through constant throttle manipulation, they are not infallible. For instance, such things as rapid throttle manipulation (especially with cold oil), momentary waste gate sticking, air in the oil system of the controller, etc., can cause overboosting.

Consequently, it is still necessary that the pilot observe and be prepared to control the manifold pressure, particularly during take-off and power changes in flight.

The slight overboosting of manifold pressure beyond established minimums, which is occasionally experienced during initial take-off roll or during a change to full throttle operation in flight, is not considered detrimental to the engines as long as it is momentary. Momentary overboost is generally in the area of 2 to 3 inches and can usually be controlled by slower throttle movement. No corrective action is required where momentary overboosting corrects itself and is followed by normal engine operation. However, if overboosting of this nature persists, or if the amount of overboost goes as high as 6 inches, the controller and overboost control should be checked for necessary adjustment or replacement of the malfunctioning component.

OVERBOOST EXCEEDING 6 INCHES beyond established minimums is excessive and can result in engine damage. It is recommended that overboosting of this nature be reported to your Cessna Dealer, who will be glad to determine what, if any, corrective action needs to be taken.

12A-18. TROUBLE SHOOTING THE CONTROLLER AND WASTE-GATE ACTUATOR.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
UNABLE TO GET RATED POWER BECAUSE MANIFOLD PRESSURE IS LOW.		
Controller not getting enough oil pressure to close the waste-gate.	Check pump outlet pressure, oil filter, and external lines for obstructions.	Determine cause of low pressure and correct. Replace oil filter. Clean lines and replace if defective.
Controller out of adjustment or defective.	See paragraph 12A-21.	Replace if defective.
Defective actuator.	See paragraph 12A-23.	Replace actuator.
Leak in exhaust system.	Check that exhaust clamps fit properly and are tight. Check visually for cracks and other obvious defects.	Replace defective components.
Leak in intake system.	Tighten all hose clamps and fittings, since an intake leak if very difficult to locate. Check visually for cracks and other obvious defects.	Replace defective components.
ENGINE SURGES OR SMOKES.		
Defective controller.	See paragraph 12A-21.	Replace controller.
Actuator linkage binding.	See paragraph 12A-23.	Correct the cause of binding.
Actuator leaking oil.	Check visually.	Replace actuator.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
TURBOCHARGER NOISY WITH PLENTY OF POWER.		
Turbocharger overspeeding from defective or improperly adjusted controller.	See paragraph 12A-21.	Replace if defective.
Waste-gate sticking closed.	See paragraph 12A-23.	Correct cause of sticking. Replace defective parts.
Controller drain line (oil return to sump) obstructed.	Disconnect and check.	Clean line. Replace if defective.
ENGINE POWER INCREASES SLOWLY OR SEVERE FLUCTUATIONS OF MANIFOLD PRESSURE WHEN THROTTLE ADVANCED RAPIDLY.		
Overboost control valve.		Replace if defective.
Waste-gate operation is sluggish.	See paragraph 12A-23.	Correct cause of sluggish operation. Replace defective parts.
ENGINE POWER INCREASES RAPIDLY AND MANIFOLD PRESSURE OVERBOOSTS WHEN THROTTLE ADVANCED RAPIDLY.		
Overboost control valve.		Replace if defective.
Waste-gate operation is sluggish.	See paragraph 12A-23.	Correct cause of sluggish operation. Replace defective parts.
FUEL PRESSURE DECREASES DURING CLIMB, WHILE MANIFOLD PRESSURE REMAINS CONSTANT.		
Compressor discharge pressure to fuel pump aneroid blocked.	Check lines for obstructions.	Clean out lines.
Leaking or otherwise defective fuel pump aneroid.		Replace fuel pump.
MANIFOLD PRESSURE DECREASES DURING CLIMB AT ALTITUDES BELOW THE NORMAL PART-THROTTLE CRITICAL ALTITUDE, OR POOR TURBOCHARGER PERFORMANCE INDICATED BY CRUISE RPM FOR CLOSED WASTE-GATE. (Refer to paragraph 12A-19.)		
Leak in intake system.	Tighten all hose clamps and fittings, since an intake leak is very difficult to locate. Check visually for cracks and other obvious defects.	Replace defective components.
Leak in exhaust system.	Check that exhaust clamps fit properly and are tight. Check visually for cracks and other obvious defects.	Replace defective components.
Leak in compressor discharge pressure line to controller.	Tighten fittings. Check for cracks and other obvious defects.	Replace defective components.
Controller seal leaking.	Check visually.	Replace controller.

12A-18. TROUBLE SHOOTING THE CONTROLLER AND WASTE-GATE ACTUATOR. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
MANIFOLD PRESSURE DECREASES DURING CLIMB AT ALTITUDES BELOW THE NORMAL PART-THROTTLE CRITICAL ALTITUDE, OR POOR TURBOCHARGER PERFORMANCE INDICATED BY CRUISE RPM FOR CLOSED WASTE-GAGE. (Refer to paragraph 12A-19.) (Cont)		
Waste-gate actuator leaking oil.	Check visually.	Replace actuator.
Waste-gate butterfly-closed gap is excessive.	Refer to paragraph 12A-23.	Adjust per paragraph 12A-23.
Intake air filter obstructed.	Check visually.	Remove and clean. Refer to Section 2 for servicing instructions.
FUEL FLOW DOES NOT DECREASE AS MANIFOLD PRESSURE DECREASES AT PART-THROTTLE CRITICAL ALTITUDE.		
Defective fuel pump aneroid mechanism.		Replace fuel pump.
Obstruction or leak in compressor discharge pressure line to fuel pump.	Check for leaks or obstruction in lines and fittings.	Clean out lines and tighten fittings.
FUEL FLOW INDICATOR DOES NOT REGISTER CHANGE IN POWER SETTINGS AT HIGH ALTITUDES.		
Water freezing in indicator lines.	Disconnect lines and check.	Clean out lines.
SUDDEN POWER DECREASE ACCOMPANIED BY LOUD NOISE OF RUSHING AIR.		
Intake system air leak from hose becoming detached.	Check visually.	Check hose condition. Install hose and hose clamps securely.
MANIFOLD PRESSURE GAGE INDICATION WILL NOT REMAIN STEADY AT CONSTANT POWER SETTINGS.		
Defective controller.		Replace controller.
Waste-gate operation is sluggish.	See paragraph 12A-23.	Correct cause of sluggish operation. Replace if defective.

12A-19. CONTROLLER AND TURBOCHARGER OPERATION FLIGHT CHECK. The following procedure details the method of checking the operation of the absolute controller overboost control valve, and a performance check of the turbocharger.

1 TAKE-OFF - ABSOLUTE CONTROLLER CHECK.

a. Cowl Flaps - Open.
b. Airspeed - 110 MPH IAS.
c. Oil Temperature - Middle of green arc.
d. Engine Speed - 2700 ± 25 RPM.
e. Fuel Flow - 28.0 to 29.5 GPH (Full Rich Mixture).
f. Full Throttle M. P. - Absolute controller should maintain 32.5 ± .5 in. Hg (stabilized).

Climb 2000 feet after take-off to be sure manifold pressure has stabilized. It is normal on the first take-off of the day for full throttle manifold pressure to decrease 1/2 to 1.0 inch of mercury within one minute after the initial application of full power. Refer to paragraph 12A-21 for absolute controller adjustment.

(2) CLIMB - ABSOLUTE CONTROLLER AND TURBOCHARGER PERFORMANCE CHECK.

a. Cowl Flaps - Open.
b. Airspeed - 120 MPH IAS.
c. Engine Speed - 2500 RPM.
d. Fuel Flow - Adjust mixture for 20 GPH.
e. Part-Throttle M.P. - 27.5 in. Hg.
f. Climb to 20,000 feet - Check part-throttle critical altitude during climb.

This part-throttle critical altitude is where manifold pressure starts decreasing during the climb at a rate of approximately 1.0 inch of mercury per 1000 feet. After noting this altitude and the outside air temperature, the desired manifold pressure should be maintained by advancing the throttle during the remainder of the climb.

Once the climb power setting is established after take-off, the controller should maintain a steady manifold pressure up to the part-throttle critical altitude indicated in the following chart. If part-throttle critical altitude has not been reached by 20,000 feet, discontinue check and proceed to cruise check.

Outside Air Temperature	Part-Throttle Critical Altitude (75% Power)
Standard or Colder	Above 24,000 feet
20°F Above Standard	16,000 to 22,000 feet
40°F Above Standard	10,000 to 16,000 feet

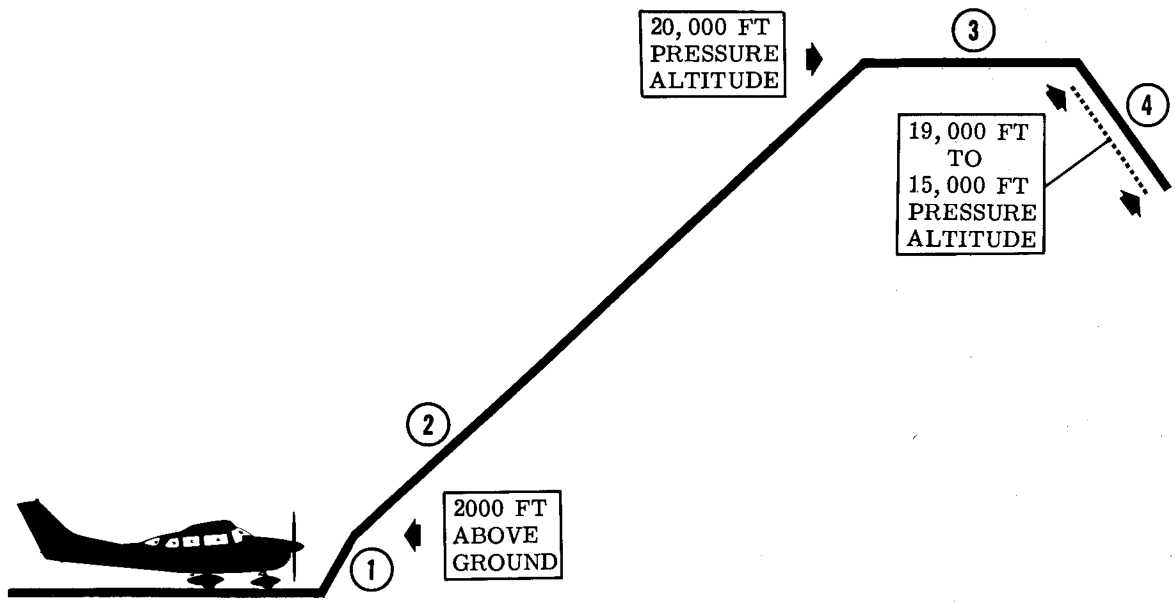
Part-throttle critical altitudes lower than those listed indicate the turbocharger system is not operating properly (refer to the trouble shooting chart in paragraph 12A-18). Critical altitudes above those listed indicate turbocharger performance better than normal. Also check that fuel flow decreases as manifold pressure decreases at critical altitude. Refer to the trouble shooting chart if fuel flow does not decrease.

(3) CRUISE - TURBOCHARGER PERFORMANCE CHECK.

a. Cowl Flaps - Closed.
b. Airspeed - Level flight.
c. Pressure Altitude - 20,000 feet.
d. Engine Speed - 2700 RPM.
e. Part-Throttle M.P. - 27.5 in. Hg.
f. Fuel Flow - Lean to 18 GPH.
g. Propeller Control -
   (1) Slowly decrease RPM until manifold pressure starts to drop, indicating waste-gate is closed.
   (2) Note outside air temperature and RPM as manifold pressure starts to drop, which should be in accordance with the following chart.
   (3) After noting temperature and RPM, increase engine speed 50 RPM to stabilize manifold pressure, with the waste-gate modulating exhaust flow to control compressor output.

Outside Air Temperature	RPM where M.P. Starts to Decrease
40°F Above Standard	2700 to 2550
20°F Above Standard	2600 to 2450
Standard Temperature	2500 to 2350
20°F Below Standard	2400 to 2250
40°F Below Standard	2300 to 2150

If the waste-gate is closed at engine speeds higher than those listed, refer to the trouble shooting chart in paragraph 12A-18. Closing of the waste-gate at engine speeds lower than those listed indicates turbocharger performance better than normal.



NOTE

Circled numbers refer to corresponding flight checks required in preceding text.

12A-20. REMOVAL AND INSTALLATION OF TURBOCHARGER CONTROLLER.

a. Disconnect and tag oil lines from controller and plug or cap open lines and fittings.
b. Disconnect compressor outlet pressure sensing line from controller and plug or cap open line and fitting.
c. Remove two bolts attaching controller to mounting bracket on firewall.
d. Remove controller from aircraft, being careful not to drop controller unit.
e. Installation of the controller may be accomplished by reversing the preceding steps. Resafety bolts attaching controller to bracket.

12A-21. ABSOLUTE CONTROLLER ADJUSTMENTS. (See figure 12A-1.)

a. With engine oil temperature at middle of green arc, slowly open throttle and note maximum manifold pressure obtainable. Do not exceed 32.5±.5 in. Hg.
b. Cut safety wire and remove plug from bottom of absolute controller (the vertical unit).
c. Using a flat-bladed screwdriver, rotate metering valve seat clockwise to increase manifold pressure and counterclockwise to decrease manifold pressure. Lightly tap the unit after each adjustment to seal internal parts.

NOTE

When adjusting, rotate in VERY small increments as this is an extremely sensitive adjustment. Approximately 13 degrees rotation will change the manifold pressure reading about one inch Hg.

d. Install and safety plug in absolute unit, then operate engine as in step "a" to ascertain that adjustment has not caused radical change in manifold pressure.

NOTE

When making adjustment on the ground, the hotter the engine gets, the lower the manifold pressure will be.

e. After each adjustment, the airplane must be flight tested to check results.
f. Repeat this procedure until desired results are obtained.

12A-22. REMOVAL AND INSTALLATION OF WASTE-GATE AND ACTUATOR.

a. Disconnect and tag oil lines from actuator, and plug or cap open lines and fittings.
b. Remove bolts, washers, and nuts attaching waste-gate and actuator assembly to tailpipe.
c. Loosen clamp attaching tailpipe to turbine exhaust outlet and work tailpipe from turbine.
d. Remove bolts, washers, and nuts attaching the assembly to the exhaust manifold.
e. Remove the assembly from aircraft, being careful not to drop the unit.

f. Installation may be accomplished by reversing the preceding steps.

NOTE

When installing the assembly, be sure the gaskets at inlet and outlet of valve are installed and are in good condition. Replace gaskets if damaged.

12A-23. ADJUSTMENT OF WASTE-GATE ACTUATOR. (See figure 12A-4.)

a. Remove waste-gate actuator in accordance with paragraph 12A-22.

b. Plug actuator outlet port and apply a 50 to 60 psig air pressure to the inlet port of the actuator.

c. Check for 0.010, -0.005 inch gap between butterfly and waste-gate body as shown in figure 12A-4.

d. If adjustment is required, remove pin from actuator shaft.

e. Hold clevis end and turn shaft clockwise to increase gap or counterclockwise to decrease gap of butterfly. Install pin through clevis and shaft, securing pin with washer and cotter pin.

f. After adjusting closed position, and with zero pressure in cylinder, check butterfly for a clearance of 1.100 +.000, -.125 inch in the full-open position as shown in figure 12A-4.

g. If adjustment is required, loosen locknut and turn stop screw clockwise to decrease or counterclockwise to increase clearance of butterfly.

h. Recheck butterfly in the closed position to ascertain that gap tolerance has been maintained.

NOTE

To assure correct spring loads, actuate butterfly with air pressure. Actuator shaft and butterfly should move freely. Actuator shaft should start to move at 15±2 psig and fully extend at 35±2 psig. Two to four psi hysteresis is normal, due to friction of O-ring against cylinder wall.

i. Remove air pressure line and plug from actuator.

j. Install waste-gate and actuator as outlined in paragraph 12A-22.

12A-24. INDUCTION AIR SYSTEM.

12A-25. Ram air to the engine enters an induction air duct at the right side of the nose cap. The air is filtered through a dry filter, located in the induction airbox. From the induction air filter, the air passes through a flexible duct to the inlet of the turbocharger compressor. The compressor compresses the induction air. The pressurized induction air is then routed through a duct to the fuel-air control unit mounted behind the engine, and is then supplied to the cylinders through the intake manifold piping. The fuel-air control unit is connected to the cylinder intake manifold by elbows, hoses, and clamps. The intake manifold is attached to each cylinder by four bolts through a welded flange, which is sealed by a gasket. A balance tube passes around the front side of the engine to complete the manifold assembly. An alternate air door, mounted in the duct between the filter and the turbocharger compressor, is held closed by a small magnet. If the induction air filter should become clogged, suction from the turbocharger compressor will open the door. This permits the compressor to draw heated induction air from within the engine compartment. This induction air is unfiltered air. The alternate air door should be checked periodically for freedom of operation and complete closing. The induction air filter should be removed and cleaned at each 50-hour inspection, more often when operating under dusty conditions. Refer to Section 2.

12A-26. REMOVAL AND INSTALLATION OF DUCTING AND AIRBOX.

a. Remove engine cowling as required for access to the induction air ducts.

b. Loosen clamp at lower end of airbox and remove flexible duct from airbox.

c. Remove two screws, washers and nuts attaching airbox to upper rear engine baffle.

d. Remove four screws attaching airbox to induction air duct and work airbox and filter from induction air duct.

e. Remove screws attaching clips on duct to clips on rocker box covers.

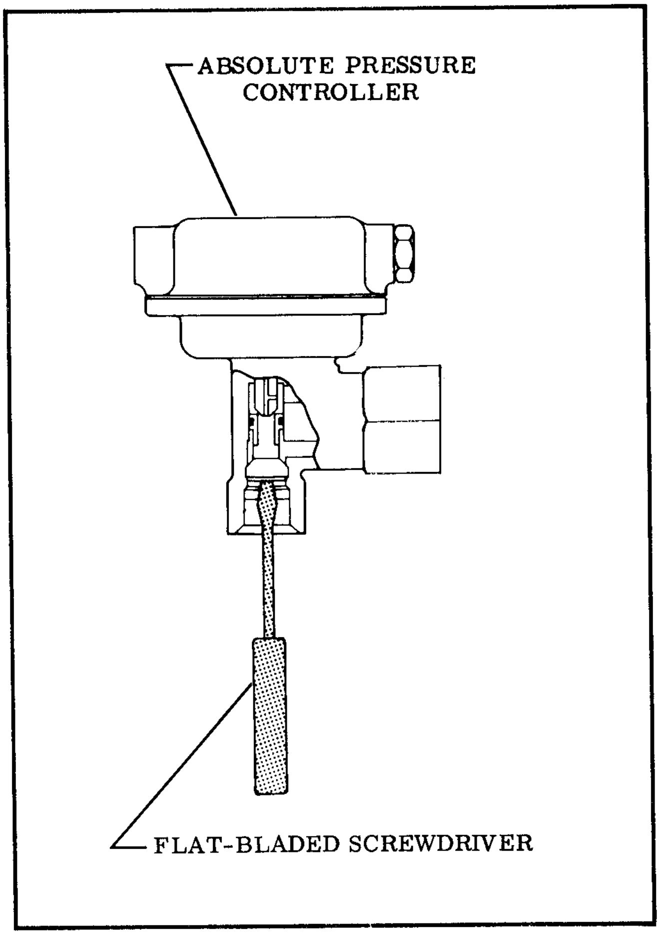


Figure 12A-2. Controller Adjustments

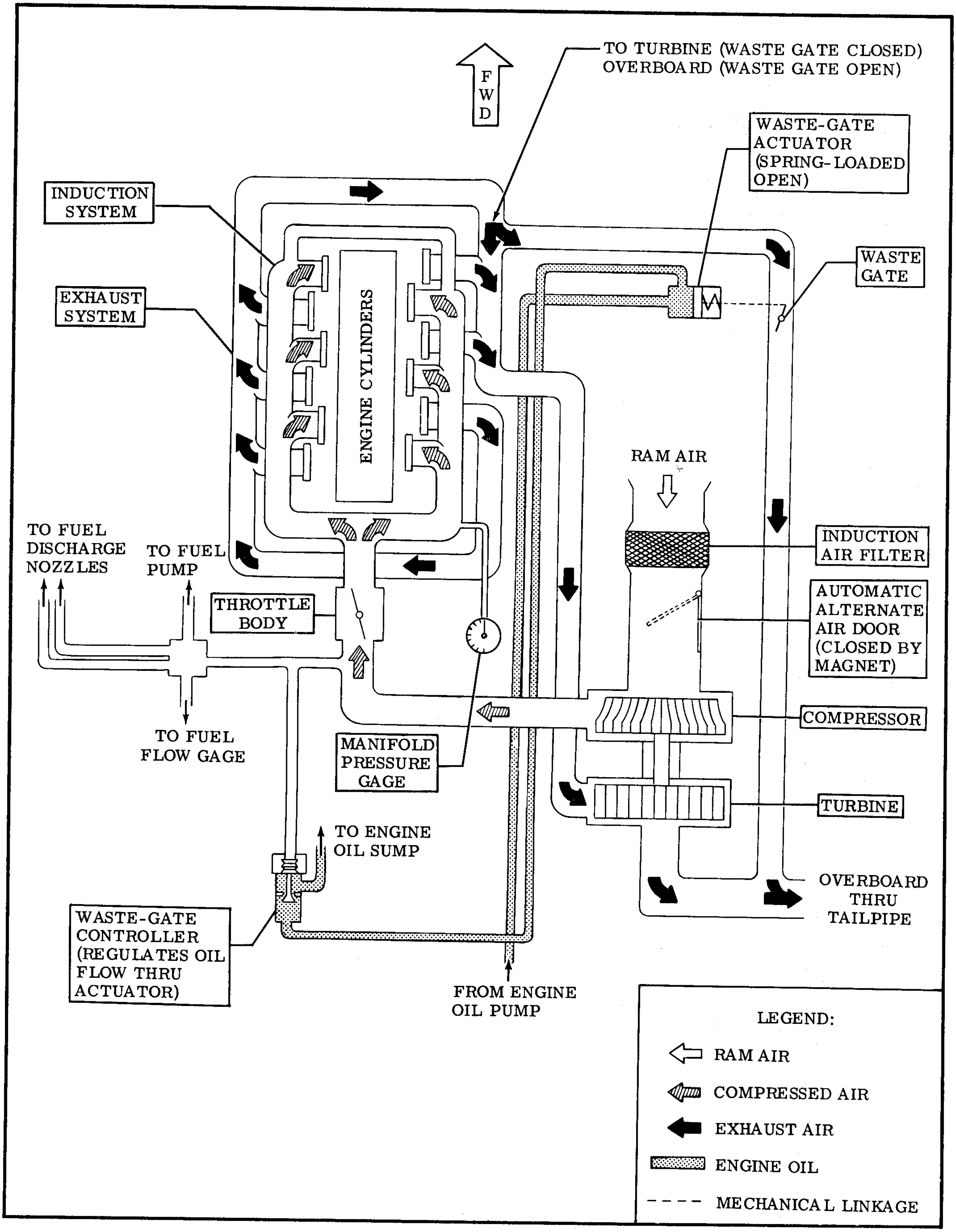


Figure 12A-3. Turbocharger System Schematic

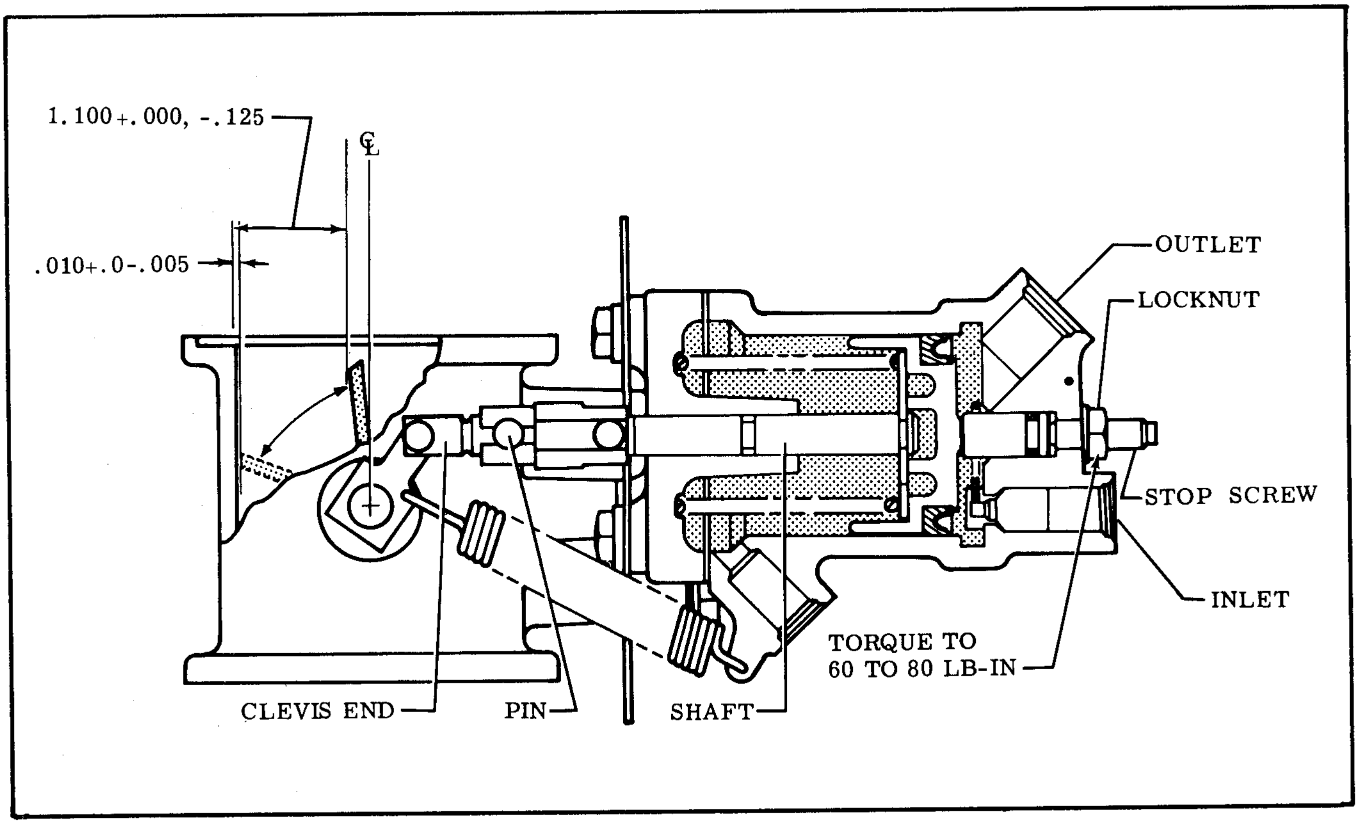


Figure 12A-4. Waste Gate Adjustment

f. Remove screws attaching lower side of induction air duct to the two front cylinder rocker box covers.
g. Loosen clamp and remove air duct from flexible inlet air duct, and remove induction air duct.
h. Installation of the induction air duct is the reversal of the removal procedure.

NOTE

Clean filter and ascertain that induction air ducts and airbox are clean when installing.

12A-27. REMOVAL AND INSTALLATION OF FILTER.
a. Remove right half of engine cowling.
b. Remove screws attaching airbox to upper rear baffle.
c. Loosen clamp and disconnect flexible air duct to airbox.
d. Remove four screws attaching airbox to forward air duct and work airbox and filter from airplane.
e. Remove four bolts, washers, and nuts attaching filter between airbox halves.
f. Clean filter as outlined in Section 2.

NOTE

When installing filter, note direction of air flow on the filter. Inspect and install gasket at aft face of filter assembly. Also, when tightening bolts fastening air filter, push inward on lower end of the upper duct (where turbocharger inlet connects to the upper duct). This is done so that inlet hose doesn't chafe against the cowling.

g. Installation of filter and airbox is the reversal of the removal procedure.

12A-28. EXHAUST SYSTEM.

12A-29. The exhaust system consists of two exhaust stack assemblies, one for the left and one for the right bank of cylinders. These exhaust stack assemblies are joined together to route the exhaust from all cylinders through the waste-gate or turbine. The three risers on the left bank of cylinders are joined together into a common pipe to form the left stack assembly. The right rear cylinder exhaust is routed down and aft to the rear of the engine where it connects to the left stack assembly. The risers on the two right front cylinders are connected to a common pipe to form the right stack assembly. The right stack assembly connects to the left stack assembly at the front of the engine. Mounting pads for the waste-gate and turbine are provided on the right stack assembly. From the exhaust port of the turbine, a tailpipe routes the exhaust overboard through the lower cowl. The exhaust port of the waste-gate is routed into the tailpipe so the exhaust gas can be expelled from the system when not needed at the turbine. The waste-gate is actuated by the waste-gate actuator which, in turn, is controlled by the waste-gate controller. Figure 12A-5 illustrates the engine exhaust system and heat shields. Also, sleeving is installed on the fuel hose from the engine-driven pump to the fuel metering body, and on the hose from the auxiliary fuel pump to the engine-driven pump. This is to prevent excessive heat on these fuel hoses as they route close to the exhaust stack.

12A-30. REMOVAL OF EXHAUST SYSTEM.

a. Remove engine cowling and right and left nose caps.

b. Remove intake manifold balance tube from front of engine.

c. Remove heat shield at front of engine.

d. Loosen clamp and disconnect flexible duct at aft end of cabin heater shroud on left exhaust stack assembly.

e. Remove clamps and bolts securing rear heat shield to engine and remove heat shield.

f. Remove clamps attaching left exhaust stack assembly to riser pipes and to rear crossover pipe on left side of engine.

g. Work left exhaust stack assembly down from risers and out of crossover pipes at front and rear of engine.

h. Remove four nuts and washers attaching exhaust riser pipe to each cylinder on left bank of cylinders, and remove riser pipes and gaskets.

i. Remove clamp attaching exhaust tailpipe to ex-

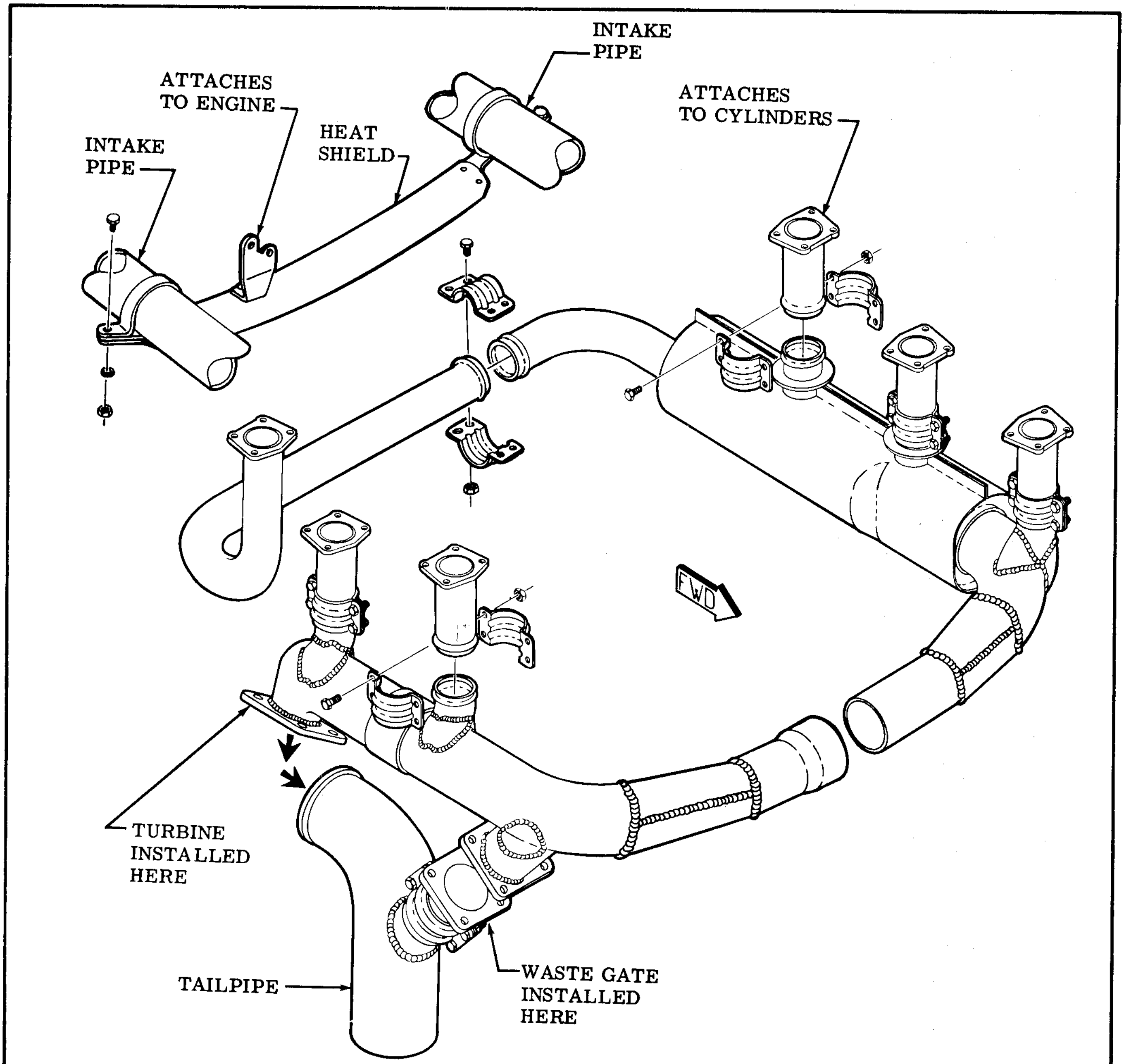
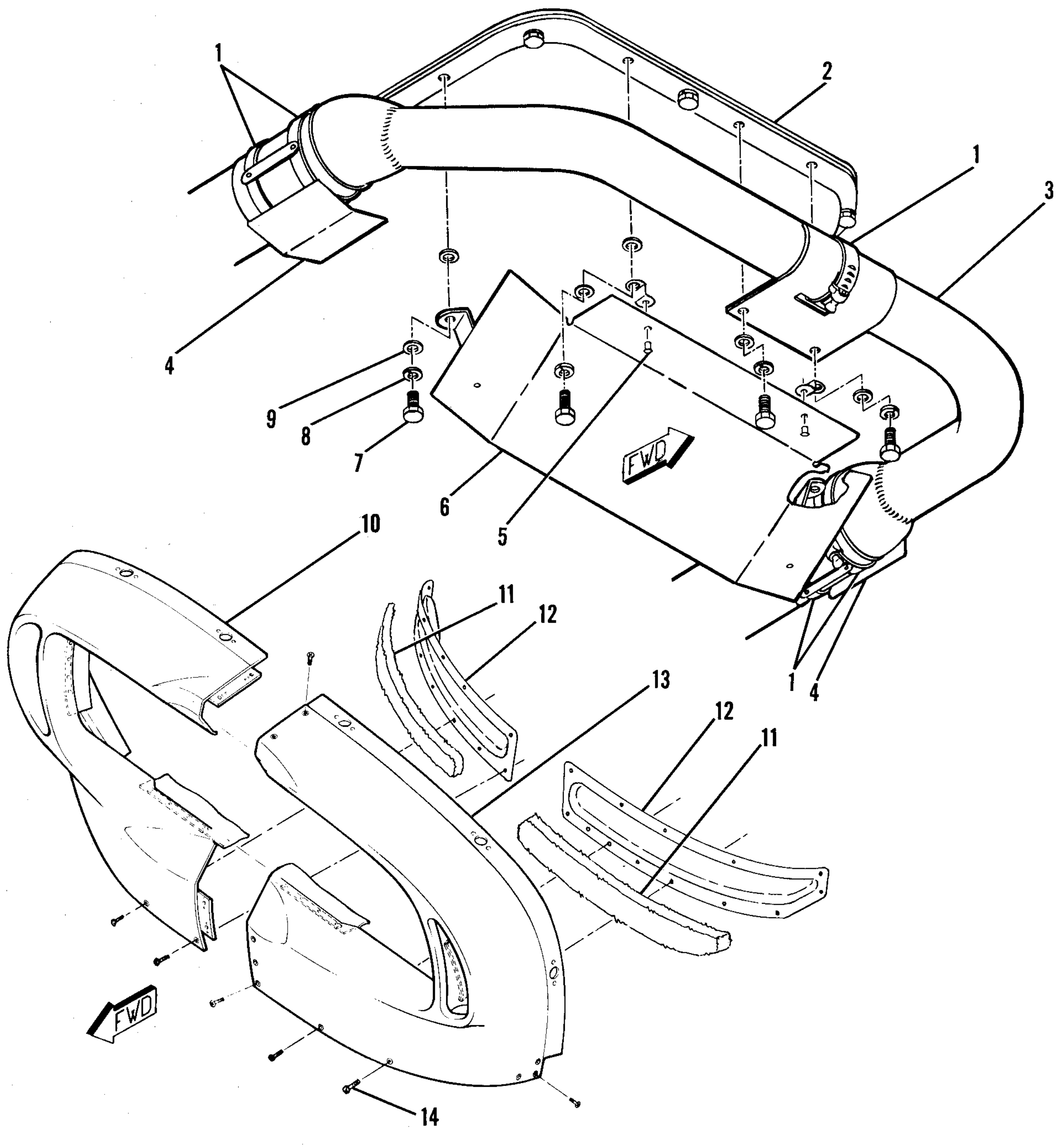


Figure 12A-5. Exhaust System (Sheet 1 of 2)



HEAT DEFLECTORS AND INSULATORS

1. Clamp
2. Crankcase
3. Intake Manifold Balance Tube
4. Heat Deflector
5. Rivet
6. Heat Shield
7. Bolt
8. Lockwasher
9. Washer
10. Right Nosecap
11. Insulation
12. Retaining Skin
13. Left Nosecap
14. Screw

Figure 12A-5. Exhaust System (Sheet 2 of 2) haust port of turbine.

j. Remove bolts attaching waste-gate to right exhaust stack assembly. Work tailpipe from turbine and lower waste-gate and tailpipe into cowling.

k. Remove bolts attaching turbocharger to mounting brackets.

l. Remove bolts and nuts attaching turbocharger to right exhaust stack assembly. Lower turbocharger into cowling.

m. Remove bolts, nuts, and clamps attaching right exhaust stack assembly to riser pipes on right side of engine.

n. Work right exhaust stack assembly down from risers and remove.

o. Remove nuts and washers attaching riser pipes to front two cylinders on right side of engine, and remove riser pipes and gaskets.

p. Remove nuts and washers attaching exhaust pipe to rear cylinder on right side of engine and remove pipe and gasket.

12A-31. INSPECTION OF EXHAUST SYSTEM. Inspection of the exhaust system should be thorough, because the cabin heating system uses air heated by the heat exchanger of the exhaust system. Since exhaust systems of this type are subject to burning, cracking, and general deterioration from alternate thermal stresses and vibration, inspection is important and should be accomplished every 100 hours of operation. In addition, an inspection should be performed any time exhaust fumes are detected in the cabin. Also, a thorough inspection of the engine exhaust system should be made to detect any cracks causing leaks which might result in loss of optimum turbocharger efficiency and engine power. To inspect the engine exhaust system, proceed as follows:

a. Remove engine cowling, heater shroud, and heat shields so that ALL surfaces of the exhaust assemblies can be visually inspected.

NOTE

Especially check the areas adjacent to welds. Look for exhaust gas deposits in surrounding areas, indicating that exhaust gases are escaping through a crack or hole.

b. After visual inspection, an air leak check should be made on the exhaust system, as follows:

1. Attach the pressure side of an industrial vacuum cleaner to the tailpipe opening, using a rubber plug to effect a seal as required.

NOTE

The inside of the vacuum cleaner hose should be free of any contamination that might be blown into the engine exhaust system.

2. With the vacuum cleaner operating, all joints in the exhaust system may be checked manually by feel, or by using a soap and water solution and watching for bubbles. All joints should be free of air leaks with the exception of the waste-gate bearings which will show some bubbling. Also, some small bubbles will appear at the joint of the turbocharger turbine and compressor bearing housing.

c. For a more thorough inspection, or if fumes have been detected in the cabin, the following procedure is recommended:

1. Remove exhaust stack assemblies.
2. Use rubber expansion plugs to seal openings.
3. Using a manometer or gage, apply approximately 1-1/2 psi (3 inches of mercury) air pressure while each stack assembly is submerged in water. Any leaks will appear as bubbles and can be readily detected.
4. It is recommended that exhaust stacks found defective be replaced before the next flight.

d. After installation of exhaust system components, perform the inspection in step "b" of this paragraph to ascertain there are no leaks at the joints of the system.

12A-32. INSTALLATION OF EXHAUST SYSTEM.

NOTE

It is important that the complete exhaust system, including the turbocharger and waste-gate, be installed without pre-loading any section of the exhaust stack assembly.

a. Use new gaskets between exhaust stacks and engine cylinders, at each end of waste-gate, and between turbocharger and exhaust stack.

b. Place all sections of exhaust stacks in position and torque nuts attaching them to the cylinders evenly to 60±10 lb-in., while riser clamps are loose.

c. Manually check that front and rear crossover pipe slip-joints do not bind. Tighten clamps attaching left risers to left stack assembly. Tighten the clamp attaching right stack to right front riser.

d. Raise turbocharger into position and install bolts and nuts attaching turbocharger to right exhaust stack and those attaching turbocharger to front and rear turbocharger supports (figure 12A-1). Tighten bolts securely.

e. Install bolts and nuts attaching waste-gate to right hand exhaust stack and tighten securely.

f. While applying an upward force of one G to counteract weight of turbocharger and waste-gate assembly, tighten clamp attaching exhaust stack to riser.

g. Tighten clamp securing tailpipe to turbocharger.

h. Be sure all parts are secure and safetied as required, then perform step "b" of paragraph 12A-27 to check for air leaks.

i. Install heater shroud duct and heat shields.

j. Install intake manifold balance tube at front of engine and install heat shields at front of engine, then install nose caps and cowling.

NOTE

The lower sections of turbocharger supports (8, figure 12A-1) are supplied as service parts with their upper holes omitted. These undrilled parts are also supplied when a new turbocharger inlet stack, right front stack, or either of the two right front risers is ordered. The following steps outline the proper procedure for drilling and installing the supports.

k. Install all parts but do not tighten attaching clamps or bolts.
l. Torque nuts attaching risers to cylinders evenly to 60±10 lb-in.
m. Tighten bolts and clamps per steps "d" through "g."

NOTE

It is important that weight of turbocharger and waste-gate assembly be counteracted, as listed in step "f," when tightening clamps attaching stacks to risers.

n. Make hole locations in undrilled supports to match existing holes in upper supports.
o. Remove lower supports, leaving all other parts tight.
p. Drill the marked holes with a size F (.257) drill.
q. Reinstall supports, install bolts fastening upper and lower supports together, then tighten all bolts securely. If any exhaust system bolts or clamps were loosened while lower supports were not installed, loosen all clamps and bolts and repeat the installation procedure to be sure no pre-loading is present.
r. Be sure all parts are secure and safetied as required, reinstall any parts removed for access, then install nose caps and cowling.

12A-33. ENGINE BAFFLES. The sheet metal baffles installed on the engine direct the cooling airflow around the cylinders and other components. The baffles incorporate rubber-asbestos composition seals at points of contact with the engine cowl to help confine and direct the airflow to the desired area. Baffles and seals must be maintained in good condition and replaced whenever they become worn or damaged. It is very important to engine cooling that the baffles and seals are installed correctly.

12A-34. CLEANING AND INSPECTION OF BAFFLES. The engine baffles should be cleaned with a suitable solvent to remove oil and dirt.

NOTE

The rubber-asbestos seals are oil and grease resistant but should not be soaked in solvent for long periods.

Inspect baffles for cracks in the metal and for loose and/or torn seals. Replace defective parts.

12A-35. FUEL INJECTION SYSTEM.

NOTE

Throughout the airplane fuel system, from the tanks to the engine-driven fuel pump, use Parker Sealube (or equivalent) as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always be sure that a compound, the residue from a previously used compound, or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on the fitting threads. Do not use any other form of thread compound on the injection system fittings.

12A-36. The fuel injection system is a simple, low-pressure system of injecting fuel into the intake valve port in each cylinder head. It is a multi-nozzle, continuous-flow type which controls fuel flow to match engine airflow. Any change in air throttle position, engine speed, or a combination of both, causes changes in fuel flow in the correct relation to engine airflow. A manual mixture control and a fuel flow gage, indicating metered fuel flow in gallons per hour, are provided for leaning at any combination of altitude and power setting. The four major components of the system are; the fuel injection pump, fuel-air control unit, fuel manifold valve, and the fuel discharge nozzles. The fuel injection pump incorporates an adjustable aneroid sensing unit which is pressurized from the discharge side of the turbocharger compressor. Turbocharger discharge air pressure is also used to vent the fuel discharge nozzles and the vent port of the fuel flow gage.

WARNING

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent the accumulation of such fuel when lines and/or hoses are disconnected throughout the fuel injection system.

12A-37. FUEL-AIR CONTROL UNIT. The fuel-air control unit occupies the position ordinarily used by the carburetor at the intake manifold inlet. The function of this unit is to control engine air intake and to set the metered fuel pressure for proper fuel-air ratio. There are three control elements in this unit, one for air and two for fuel. One of the fuel control elements is for fuel mixture and the other is for fuel metering. Fuel under pressure from the fuel pump enters the control unit through a strainer and passes to the metering valve. The position of the metering valve controls the fuel passed to the manifold valve and discharge nozzles. An adjustable linkage connecting the metering valve to the air throttle proportions air flow to fuel flow. The position of the mixture valve determines the amount of fuel returned to the fuel pump. The fuel control portion of the fuel-air control unit is enclosed in a shroud and is blast-air cooled to help prevent vapor lock.

12A-38. REMOVAL OF FUEL-AIR CONTROL UNIT.
a. Place fuel selector valve handle in OFF position.
b. Remove upper engine cowling.
c. Loosen clamp and disconnect flexible duct from elbow at top of air throttle.
d. Tag and disconnect electrical wires from landing gear warning and electric fuel pump microswitches.
e. Disconnect throttle and mixture control rod ends at fuel-air control unit.

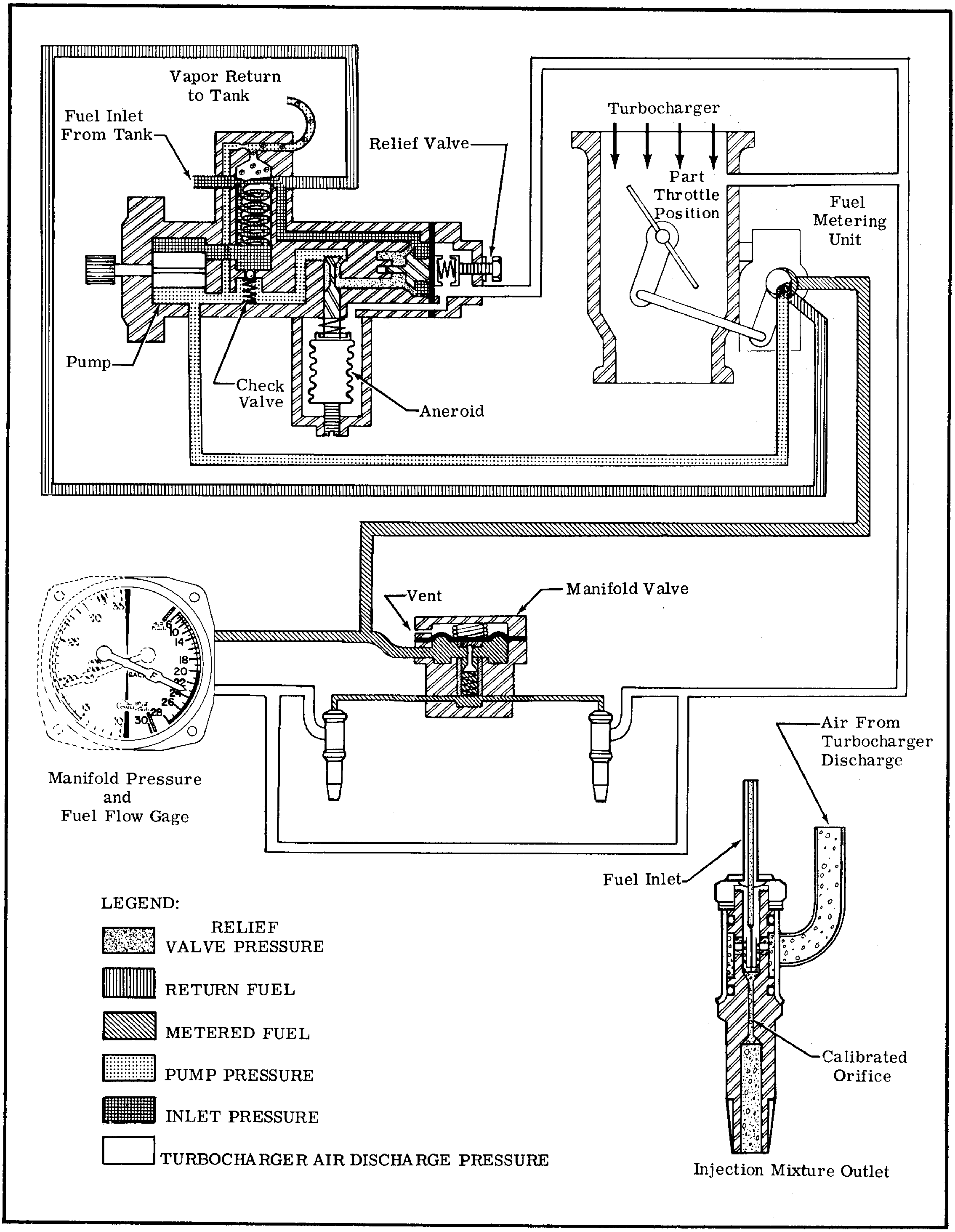


Figure 12A-6. Fuel Injection Schematic

NOTE

Cap or plug all disconnected hoses, lines and fittings.

f. Disconnect cooling air blast tube from fuel control valve shroud.
g. Disconnect and tag all fuel lines at the fuel control valve.
h. Remove nuts and washers securing triangular brace to fuel-air control unit and engine, at lower end of control unit. Remove brace.
i. Remove bolt attaching fuel-air control unit to brace at top of control unit.
j. Loosen hose clamps which secure fuel-air control unit to right and left intake manifold assemblies and slip hoses from fuel-air control unit.
k. Remove fuel-air control unit.

12A-39. CLEANING AND INSPECTION OF FUEL-AIR CONTROL UNIT. Refer to paragraph 12-32 for cleaning and inspection of fuel-air control unit.

12A-40. INSTALLATION OF FUEL-AIR CONTROL UNIT.
a. Place fuel-air control unit in position at rear of engine.
b. Install bolt attaching fuel-air control unit to brace at top of the control unit. Ascertain that shock mount is in place and in good condition.
c. Install triangular brace at lower end of control unit.
d. Install hoses and clamps which secure fuel-air control unit to right and left intake manifold assemblies. Tighten hose clamps.
e. Connect fuel lines to control unit and connect air blast tube at fuel control shroud.
f. Connect throttle and mixture control rod ends to fuel-air control unit.
g. Connect electrical wires to landing gear warning and electric fuel pump microswitches. Check switch rigging in accordance with paragraph 12-55.
h. Install induction air duct to elbow at top of fuel-air control unit.
i. Inspect entire installation.
j. Install engine cowling.

12A-41. FUEL-AIR CONTROL UNIT ADJUSTMENTS. Refer to paragraph 12-34 for fuel-air control unit adjustments.

12A-42. FUEL MANIFOLD (FUEL DISTRIBUTOR). Refer to paragraph 12-35.

12A-43. REMOVAL OF FUEL MANIFOLD. Refer to paragraph 12-36 for removal of the fuel manifold.

12A-44. CLEANING OF FUEL MANIFOLD. Refer to paragraph 12-37 for cleaning of fuel manifold.

12A-45. INSTALLATION OF FUEL MANIFOLD. Refer to paragraph 12-38 for installation of the fuel manifold.

12A-46. FUEL DISCHARGE NOZZLES.

12A-47. From the fuel manifold valve, individual, identical size and length fuel lines carry metered fuel to the fuel discharge nozzles located in the cylinder heads. The outlet of each nozzle is directed into the intake port of each cylinder. An air bleed and nozzle pressurization arrangement is incorporated in each nozzle to aid in vaporization of the fuel. The nozzles are calibrated in several ranges. All nozzles furnished for one engine are of the same calibrated range and are identified by a number and suffix letter stamped on the flat portion of the nozzle body. When replacing a fuel discharge nozzle, be sure that it is of the same calibrated range as the rest of the nozzles in that engine. When a complete set of nozzles is being replaced, the number must be the same as the one removed but the suffix letter may be different, as long as they are the same for all nozzles being installed in a particular engine.

12A-48. REMOVAL OF FUEL DISCHARGE NOZZLES.
a. Remove engine cowling as required.

NOTE

Plug or cap all disconnected lines and fittings.

b. Disconnect nozzle pressurization line at nozzles and disconnect pressurization line at "tee" fitting so that pressurization line may be moved away from discharge nozzles.
c. Disconnect fuel injection line at fuel discharge nozzle.
d. Using care to prevent damage or loss of washers and O-rings, lift sleeve assembly from fuel discharge nozzle.
e. Using a standard 1/2-inch deep socket, remove fuel discharge nozzle from cylinder.

12A-49. CLEANING OF FUEL DISCHARGE NOZZLES. To clean the fuel discharge nozzles, immerse nozzle assembly in fresh cleaning fluid. Do not use any metal removing chemicals for this cleaning. Do not use wire or any other metal object to remove foreign material from orifice or metering jet in nozzle. Dry nozzle assembly with compressed air. When drying internal part of nozzle with compressed air, direct air through nozzle in the direction opposite to normal fuel flow.

12A-50. INSTALLATION OF FUEL DISCHARGE NOZZLES.
a. Using a standard 1/2-inch deep socket, install nozzle body in cylinder and tighten to a torque value of 60-80 lb-in.
b. Install O-rings, sleeve assembly, and washers.
c. Align sleeve assembly and connect pressurization line to nozzles. Connect pressurization line to "tee" fitting.
d. Install O-ring and washer at top of discharge nozzle, and connect fuel injection line to nozzle.
e. Inspect installation for crimped lines and loose fittings.
f. Inspect nozzle pressurization vent system for leakage. A tight system is required, since turbocharger discharge pressure is applied to various other components of the injection system.

g. Install cowling.

12A-51. FUEL INJECTION PUMP. The fuel pump is a positive-displacement, rotating vane type. It has a splined shaft for connection to the accessory drive section of the engine. Fuel enters the pump at the swirl well of the pump vapor separator. Here, vapor is separated by a swirling motion so that only liquid fuel is fed to the pump. The vapor is drawn from the top center of the swirl well by a small pressure jet of fuel and is fed into the vapor return line, where it is returned to the fuel tank. Since the pump is engine-driven, changes in engine speed affect total pump flow proportionally. A check valve allows the auxiliary fuel pump pressure to bypass the engine-driven pump for starting, or in the event of engine-driven fuel pump failure in flight. The pump supplies more fuel than is required by the engine; therefore, a relief valve is provided to maintain a constant fuel pump pressure. The engine-driven fuel pump is equipped with an aneroid. The aneroid and relief valve are pressurized from the discharge side of the turbocharger compressor to maintain a proper fuel/air ratio at altitude. The aneroid is adjustable for fuel pump outlet pressure at full throttle and the relief valve is adjustable for fuel pump outlet pressure at idle. Refer to paragraph 12A-54.

12A-52. REMOVAL OF FUEL INJECTION PUMP.
a. Place fuel selector valve handle in OFF.
b. Remove upper engine cowling.
c. Remove alternator and left rear intake elbow.
d. Hoist engine far enough to remove weight from engine mount and remove left rear engine mount leg, shock mount, and alternator bracket.
e. Remove flexible duct and shroud, removing fuel lines and fittings as necessary. Tag each fitting and line for identification, and cap or seal to prevent entry of foreign material. Flanges of shroud may be straightened to facilitate removal and installation, but must be re-formed after installation. Note angular position of fittings before removal.
f. Remove nuts and washers attaching fuel pump to engine, and pull pump aft to remove. Remove thin gasket.
g. Place temporary cover on pump mounting pad.

12A-53. INSTALLATION OF FUEL INJECTION PUMP.
a. Install and align any fittings removed after pump removal.
b. Using new thin gasket, install pump with aneroid chamber down.
c. Install cooling shroud and remainder of fittings, bending flanges of shroud to their original position and aligning fittings as noted during removal.
d. Connect all fuel lines and shroud flexible duct.
e. Install alternator bracket, shock mount, and engine mount leg. Remove hoist, then adjust alternator drive belt tension. Refer to Section 17.
f. Install intake elbow.
g. Start engine and perform operational check, adjusting fuel pump if required. See paragraph 12A-54.
h. Install engine cowling.

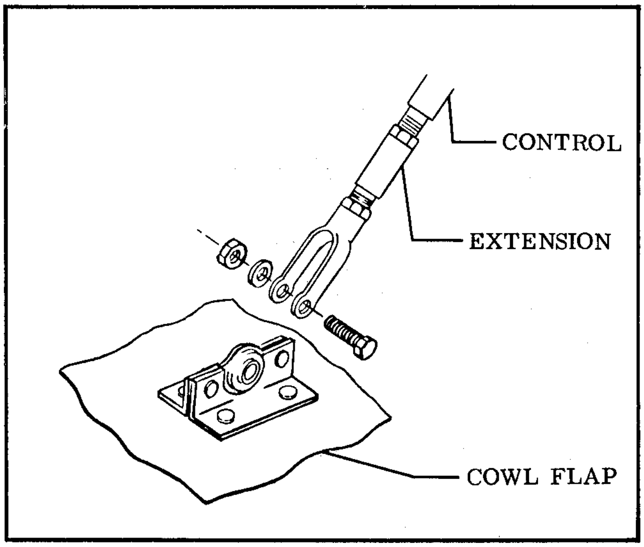


Figure 12A-7. Cowl Flap Control

12A-54. ADJUSTMENT OF FUEL INJECTION PUMP. The fuel injection pump adjustments require special equipment and procedures. Cessna Service Kit No. SK320-2 (available from the Cessna Service Parts Center) supplies a special indicator, lines, and instructions for performing accurate calibration of the engine-driven fuel pump pressure. With engine at normal operating temperature and mixture control set at full rich, set the unmetered fuel pressure to the values listed in paragraph 12A-6.

NOTE

After adjusting the unmetered fuel pressure, idle rpm and idle mixture must be readjusted as outlined in paragraph 12-34.

12A-55. ENGINE COWL FLAPS. Cowl flaps are provided as a means of controlling engine temperature. Two cowl flaps, operated by a single control in the cabin, are located at the lower aft end of the engine nacelle. The overboard exhaust tube for the cabin heater extends through the cutout in the aft portion of the left cowl flap. The right hand flap, except for the hinge loops, is painted with heat-resistant paint (Part No. CES1054-743), which is available from the Cessna Service Parts Center. Whenever the cowl flap is repainted, this type paint should be used. The cowl flap controls have been rerouted for improved control action.

12A-56. RIGGING ENGINE COWL FLAPS.

NOTE

The cowl flap control extensions, shown in figure 12A-7, were deleted during the 1966 model-year because of rerouting of the cowl flap controls and changes in their length.

a. Disconnect cowl flap control clevis from cowl flaps.

b. Check to make sure that the flexible controls reach their internal stops in each direction. Mark controls so that full control travel can readily be checked and maintained during the remaining rigging procedure.

c. Place cowl flap control lever in the OPEN position, which is the top hole in the bracket. Be sure that correct hole in bracket is used. If control lever cannot be placed in correct hole in bracket, loosen clamp at upper end of controls and slip housings in clamp or adjust controls at upper clevis to position control lever in correct hole in bracket.

d. Adjust clevis at lower end of control to open one cowl flap 5.50 inches. This measurement is made in a straight line from the aft edge of the cowl flap, just outboard of cutout (if present), to lower edge of firewall. Do not measure from aft corners of cowl flap. Repeat for other cowl flap. If either control needs to be lengthened or shortened, the lower clamp may be loosened and housing slipped in the clamp, or lower clevis may be adjusted. Maintain sufficient thread engagement of clevis.

e. Check that locknuts are tight, clamps are secure, and all bolts and nuts are installed.

NOTE

In all cases, the flexible controls must reach their internal stops in each direction to assure full travel of the controls.

12A-57. ENGINE CONTROLS. The engine controls are described in paragraph 12-49, except for minor routing of the controls.

12A-58. RIGGING PROCEDURES - ENGINE CONTROLS.

CAUTION

Some engine controls have a small retaining ring brazed (or attached with epoxy resin) in a groove 0.97 inch from the threaded end of the control. The purpose of these retaining rings is to prevent inadvertent withdrawal and possible damage to the knob end of the controls while jam nuts and rod ends are removed.

12A-59. RIGGING PROPELLER CONTROL. Refer to Section 14 for propeller control rigging.

12A-60. RIGGING MIXTURE CONTROL. Refer to paragraph 12-52 for mixture control rigging.

12A-61. RIGGING THROTTLE CONTROL. Refer to paragraph 12-53 for throttle control rigging.

12A-62. RIGGING THROTTLE MICROSWITCHES. Refer to paragraph 12-54 for rigging of throttle microswitches.

12A-63. STARTING SYSTEM.

12A-64. The automatically engaged starting system employs an electric starter motor mounted to a 90-degree adapter. A starter solenoid is activated by the ignition key on the instrument panel. When the solenoid is activated, its contacts close and electrical current energizes the starter motor. Initial rotation of the starter motor engages the starter through an overrunning clutch in the starter adapter, which incorporates worm reduction gears. The starter is located just aft of the right rear cylinder.

12A-65. REPLACEMENT OF STARTER.

a. Remove induction airbox and filter to gain access to starter.

b. Disconnect electrical power lead from the starter. Insulate the disconnected terminal as a safety precaution.

c. Remove nuts securing the starter and remove the starter.

d. To install the starter, reverse this procedure. Install a new O-ring on the starter, then install the starter. Be sure that starter drive engages with the drive in the starter adapter.

12A-66. STANDARD MAINTENANCE. Refer to paragraph 12-58.

12A-67. TROUBLE SHOOTING STARTER. Refer to paragraph 12-60 for trouble shooting the starter.

12A-68. MAGNETOS. The engine is equipped with Slick magnetos. Refer to paragraphs 12-60 through 12-69 for maintenance of magnetos.

12A-69. OIL SYSTEM. (See figure 12A-8.) The engine lubrication system is a full-pressure, wet-sump type. Lubricating oil is drawn from the engine sump to the oil pump through a suction screen and tube. From the oil pump, engine oil under pressure is passed to the full-flow oil filter, where it is filtered before entering the passages of the engine. Bypass valves are provided. Engine oil from the filter is routed through drilled and cored passages to all moving parts requiring lubrication. Oil furnished to the propeller governor for propeller operation is also routed through internal passages. Oil pressure is maintained by an adjustable, spring-loaded relief valve mounted in the lower portion of the pump body. Oil temperature is automatically regulated by an oil cooler and a thermostat control valve. When the oil temperature reaches a predetermined temperature the thermostat valve closes, causing the engine oil to be routed through the externally mounted cooler. Engine oil is also used to control the waste-gate and lubricate the turbocharger bearings. Engine oil is returned to the engine sump from the turbocharger sump by a scavenger pump, which is integral with the engine oil pump. The engine oil filler neck is located on top of the engine and is reached through an access door in the top of the left cowl. The oil level in the sump is checked on a dipstick at the rear of number two cylinder and is reached through an access door in the side of the left cowl.

12A-70. TROUBLE SHOOTING OIL SYSTEM. Refer to paragraph 12-68 for trouble shooting of the oil system.

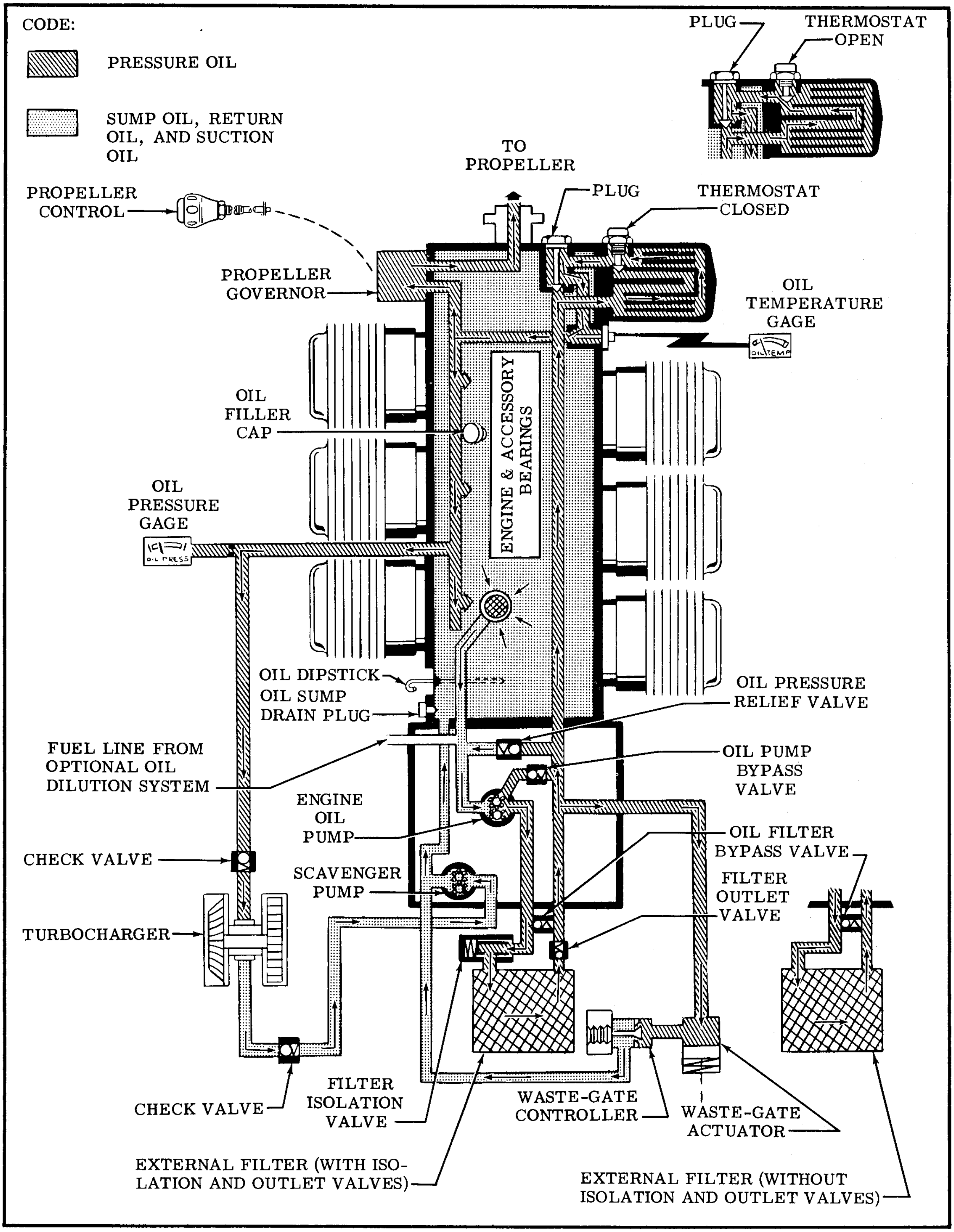


Figure 12A-8. Oil System Schematic

12A-71. FULL-FLOW OIL FILTER. An external oil filter is installed on these airplanes. The filter and filter adapter replace the regular engine oil filter screen. In some filter installations, the filter adapter incorporates a bypass valve, outlet valve, and isolation valve. Normally, oil from the oil pump flows through the isolation valve, through the filter element, through the outlet valve, to the engine oil passages. If the filter element should become blocked, the bypass valve will open, allowing oil to flow to the engine oil passages. The isolation valve blocks off the filter assembly, and oil then flows through the bypass valve, if excessive oil pressure should occur. In some filter installations the filter adapter incorporates only a bypass valve. This type adapter is the latest and is also available for all earlier aircraft. Refer to note on figure 12-8.

12A-72. FILTER ELEMENT REPLACEMENT. Refer to paragraph 12-70 for replacement of either filter element. Beginning with the 1967 Models, an oil deflector and drain line have been added beneath the external filter to prevent engine oil from dripping on the exhaust stack assembly.

12A-73. FILTER ADAPTER REMOVAL. Refer to paragraph 12-71 for removal of either filter adapter.

12A-74. DISASSEMBLY, REPAIR, AND ASSEMBLY OF FILTER ADAPTER. Refer to paragraph 12-72 for filter adapter disassembly, repair, and assembly.

12A-75. FILTER ADAPTER INSTALLATION. Refer to paragraph 12-73 for installation of filter adapter.

12A-76. OIL COOLER. The engine is equipped with a non-congealing oil cooler as standard equipment. Refer to paragraph 12-74.

12A-77. EXTREME WEATHER MAINTENANCE.

12A-78. COLD WEATHER. The turbocharged engine installation is designed so that a winterization kit is not required. Refer to paragraph 12-76 for other cold weather operating recommendations.

12A-79. LOW BATTERY STARTING. Refer to paragraph 12-77.

12A-80. HAND-CRANKING. Refer to paragraph 12-81.

12A-81. HOT WEATHER. When the engine is hot or the outside air temperature is high, the engine may die after running several seconds because the mixture became either too lean due to fuel vapor or too rich due to excessive prime fuel. The following procedure will prevent over-priming and take care of fuel vapor in the system.

a. Set the throttle 1/3 to 1/2 open.

b. When the ignition key is on BOTH and you are ready to engage the starter, turn the fuel pump on HI until the fuel flow comes up to 4-6 gal/hr and then turn the pump off.

NOTE

During a restart after a brief shut-down in extremely hot weather, the presence of fuel vapor may require the pump to run on HI for up to 1 minute or more before the vapor is cleared sufficiently to obtain 4-6 gal/hr for starting.

c. Without hesitation, engage the starter and the engine should start in 3 to 5 revolutions. Adjust the throttle for 1200-1400 RPM.

d. If there is fuel vapor in the lines, it will pass into the injector nozzles in 2 to 3 seconds and the engine will gradually slow down and stop. When engine speed starts to decrease, turn the fuel pump on HI for approximately one second to clear out the vapor. Intermittent use of HI boost is needed since prolonged use of HI pump after the vapor is cleared will flood out the engine.

e. Let the engine run at 1200 to 1400 RPM until the vapor is eliminated and the engine idles normally.

If prolonged cranking is necessary, allow the starter motor to cool at frequent intervals, since excessive heat may damage the armature.

12A-82. DUSTY CONDITIONS. Refer to paragraph 12-82.

12A-83. SEACOAST AREAS, HUMID AREAS. Refer to paragraph 12-83.

SECTION 13

FUEL SYSTEM

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13-1. FUEL SYSTEM.

NOTE

The fuel system as described in this section does not include the fuel injection system. Refer to Section 12 or 12A for that part of the fuel system.

13-2. Fuel from the fuel bay areas in the wings is gravity-fed through fuel reservoir tanks installed forward of the front doorpost bulkheads, beneath the cabin floor, to the engine-driven fuel pump. The fuel line from the lower forward corner of each fuel bay to the reservoir tank serves as a combination fuel feed and vapor return line. The fuel bypasses the electric auxiliary fuel pump when the pump is not in operation. The fuel bays are individually vented overboard through vent lines with a check valve located at each wing tip.

13-3. PRECAUTIONS.

NOTE

There are certain general precautions and rules concerning the fuel system which should be observed when performing the operations and procedures in this Section. These are as follows:

a. During all fueling, defueling, tank purging, and tank repairing or disassembly, ground the airplane to a suitable ground stake.

b. Residual fuel draining from lines and hoses constitutes a fire hazard. Use caution to prevent the accumulation of fuel when lines or hoses are disconnected.

c. Cap open lines and cover connections to prevent thread damage and the entrance of foreign matter.

NOTE

Throughout the airplane fuel system, from the fuel bays to the engine-driven fuel pump, use Parker Sealube (or equivalent) as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always ensure that the residue from a previously used compound, or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on fitting threads. Do not use any other form of thread compound on the injection system fittings.

13-4. TROUBLE SHOOTING.

NOTE

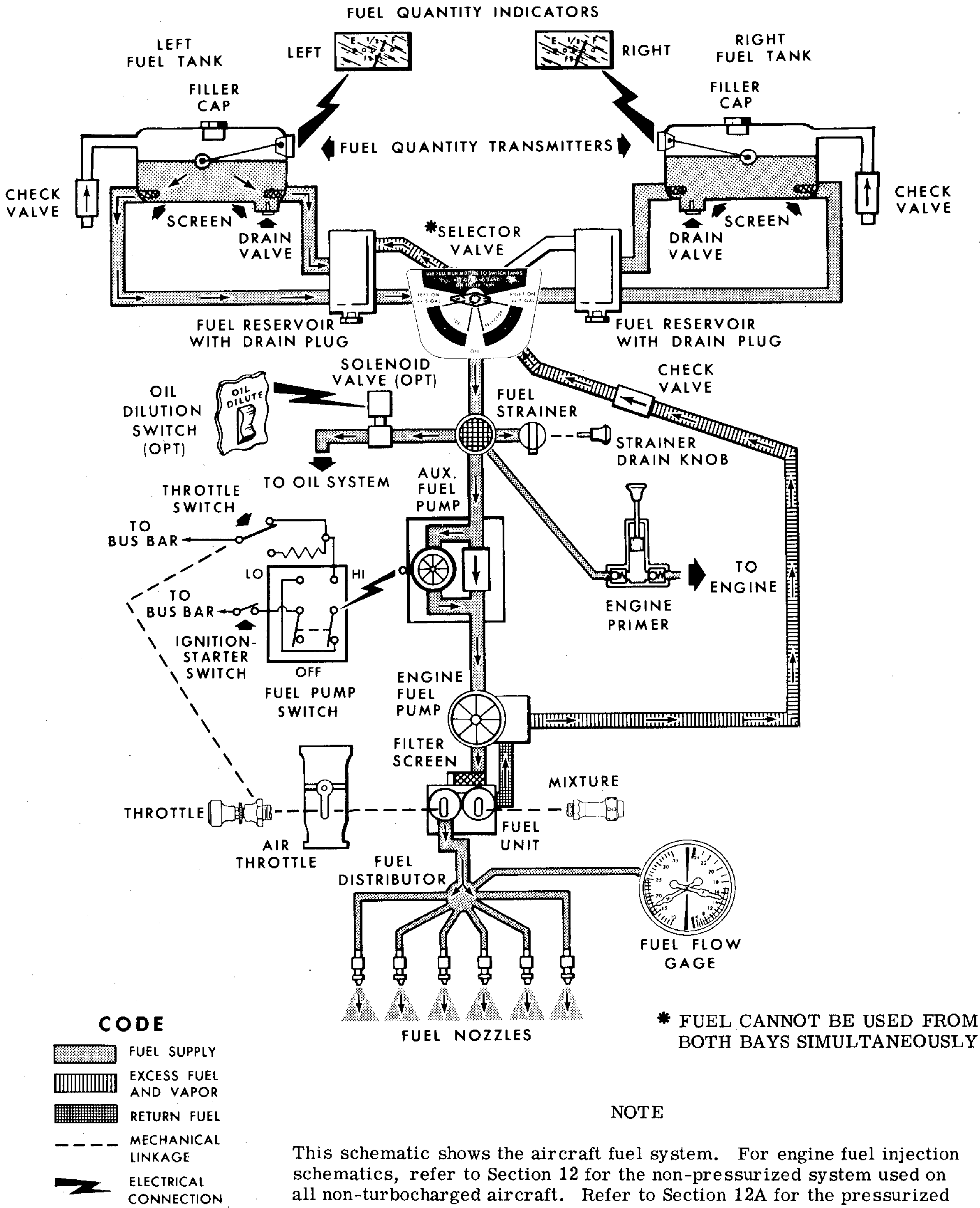
Use this trouble shooting chart in conjunction with the engine trouble shooting chart in Section 12 or 12A.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
NO FUEL FLOW TO ENGINE-DRIVEN FUEL PUMP.		
Fuel selector valve not turned on.	Check position of selector valve.	Turn fuel selector valve on.
Fuel bays empty.	Check fuel quantity.	Service with proper grade and amount of fuel.
Fuel line disconnected or broken.	Inspect fuel lines.	Connect or repair fuel lines.
Fuel cell screen plugged.	Disconnect fuel line from cell outlet. No flow indicates plugged screen.	Remove and clean screen. Flush out fuel cell.
Defective fuel selector valve.	Disconnect inlet and outlet lines from valve. If fuel flows from inlet line but not through valve, it is defective.	Remove and repair or replace selector valve.
Plugged fuel strainer.	Inspect strainer.	Remove and clean strainer and screen.
Defective check valve in electric fuel pump.	Disconnect inlet and outlet lines from fuel pump. If fuel flows from inlet line but not through pump, it is defective.	Repair or replace electric pump.
Fuel line plugged.	Disconnect at fuel pump inlet. No flow indicates plugged line.	Disconnect lines as necessary to locate obstructions, then clean.
FUEL STRAVATION AFTER STARTING.		
Partial fuel flow from the preceding causes.	Use the preceding isolation procedures, checking for sufficient rate of flow.	Use the preceding remedies.
Malfunction of engine-driven fuel pump or fuel injection system.	Refer to Section 12 or 12A.	Refer to Section 12 or 12A.
Fuel vents plugged.	Check per paragraph 13-9.	See paragraph 13-9.
Water in fuel.	Open fuel strainer drain valve and check for water.	Drain fuel tank sumps, fuel lines, and fuel strainer.
NO FUEL FLOW WHEN ELECTRIC PUMP OPERATED.		
Defective fuel pump switch.	Check continuity of switch.	Replace defective switch.
Open or defective circuit breaker.	Check visually; if not open, check continuity.	Reset. Replace if defective.
Loose connections or open circuit.	Check connections and wiring.	Tighten connections; repair or replace wiring.
Defective electric fuel pump.	Disconnect outlet line. With proper fuel supply to pump, fuel under pressure should flow from pump.	Replace defective pump.

13-4. TROUBLE SHOOTING (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
NO FUEL FLOW WHEN ELECTRIC PUMP OPERATED. (Cont)		
Defective engine-driven fuel pump bypass or defective fuel injection system.	Refer to Section 12 or 12A.	Refer to Section 12 or 12A.
NO FUEL QUANTITY INDICATION.		
Fuel bays empty	Check fuel quantity.	Service with proper grade and amount of fuel.
Circuit breaker open or defective.	Check visually; if not open, check continuity.	Reset. Replace if defective.
Loose connections or open circuit.	Check connections and wiring.	Tighten connections; repair or replace wiring.
Defective fuel quantity indicator.	Refer to paragraph 16-43.	Replace defective indicator or sending unit.

SHOP NOTES:

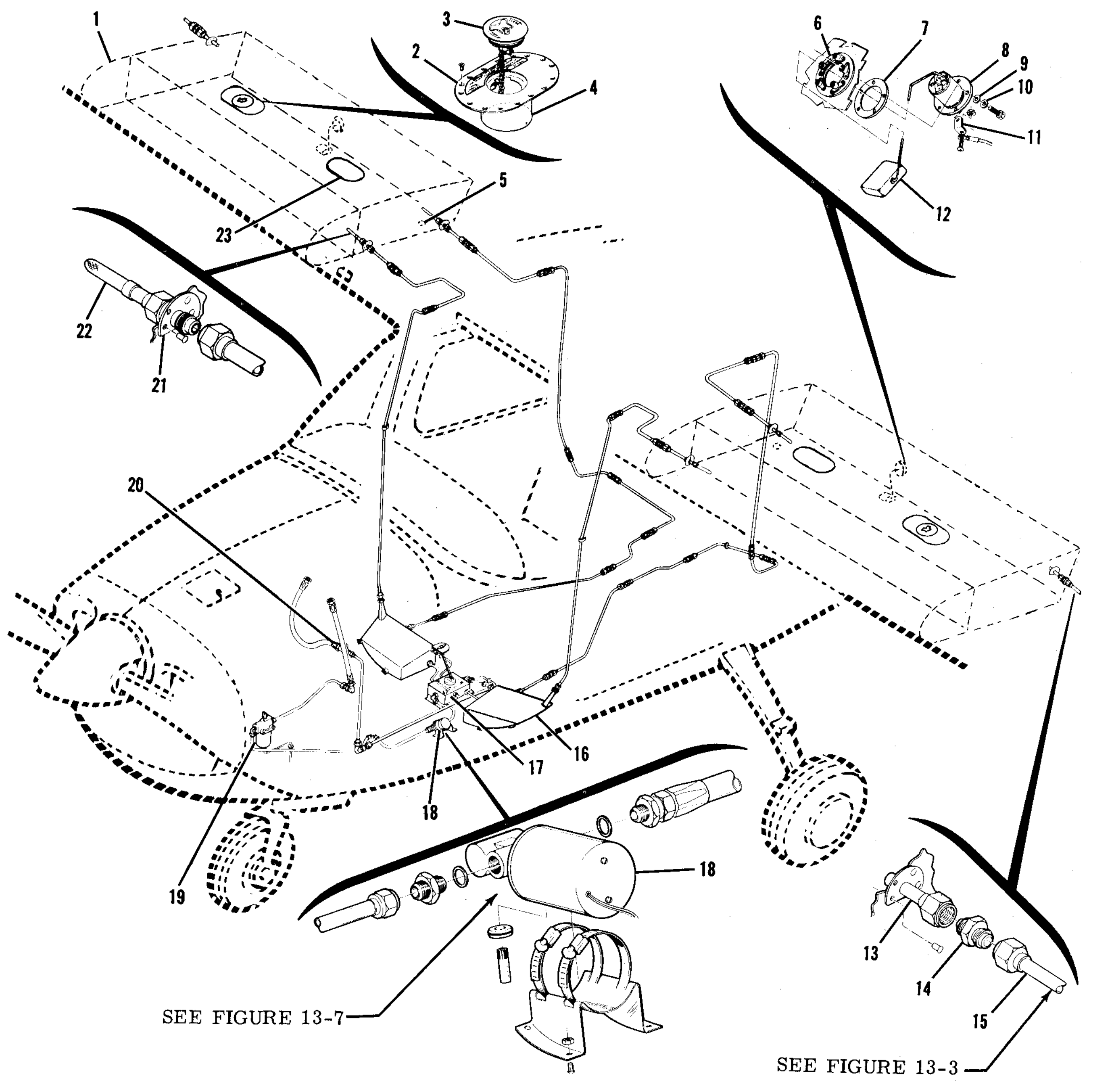


* FUEL CANNOT BE USED FROM BOTH BAYS SIMULTANEOUSLY

NOTE

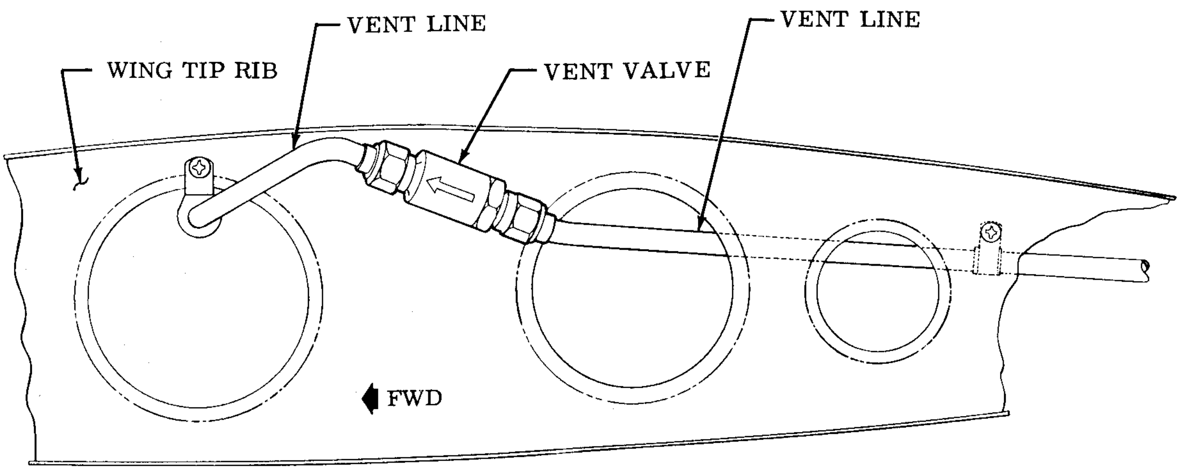
This schematic shows the aircraft fuel system. For engine fuel injection schematics, refer to Section 12 for the non-pressurized system used on all non-turbocharged aircraft. Refer to Section 12A for the pressurized system used on turbocharged aircraft.

Figure 13-1. Fuel System Schematic



1. Fuel Bay
2. Plate
3. Filler Cap
4. Standpipe
5. Flush Valve
6. Adapter
7. Gasket
8. Fuel Quantity Transmitter
9. Cork Washer
10. Washer
11. Ground Strap
12. Float
13. Fuel Vent Fitting
14. Union
15. Vent Line
16. Reservoir Tank
17. Selector Valve
18. Electric Fuel Pump
19. Fuel Strainer
20. Vapor Return Check Valve
21. Fuel Outlet Fitting
22. Strainer
23. Access Plate

Figure 13-2. Fuel System



NOTE

Hinge for vent valve must be at top and vent valve installed with arrow in direction shown.

Figure 13-3. Fuel Bay Vents

13-5. FUEL VENTS.

13-6. The fuel bay vent line extends from the upper aft outboard corner of each fuel bay to the wing tip. This vent line contains a check valve to prevent fuel drainage through the vent line, but still allows the positive pressure from expanding fuel to escape from the bays. Check all fittings and clamps for tightness and vent line for clearance to prevent chafing against inner wing structure. The fuel vent line at the trailing edge of the wing tip should be checked daily for evidence of foreign matter.

13-7. REMOVAL OF FUEL VENT.

a. Remove wing tip and access covers located on underside of wing as necessary for access.

b. Disconnect fuel vent line at fuel bay and disconnect clamps attaching vent line to wing structure.

c. Disconnect vent line from the check valve at wint tip.

d. Remove vent line by carefully pulling it from the outboard end of the wing.

13-8. INSTALLATION OF FUEL VENT. Installation of fuel vent is accomplished by reversing the procedure outlined in paragraph 13-7.

CAUTION

Make sure the vent line check valve is installed as shown in figure 13-3.

13-9. CHECKING FUEL VENTS. Field experience has demonstrated that the fuel vents can become plugged, causing possible fuel starvation of the engine. Also the bleed hole in the vent valve assembly could possibly become plugged, allowing pressure from expanding fuel to pressurize the fuel bays. To check the vent and bleed hole in the vent valve assembly, proceed as follows:

a. Attach a rubber tube to the end of the vent line at the trailing edge of one wing tip.

b. Turn off fuel selector valve and check that both fuel filler caps are securely installed.

c. Blow into tube to slightly pressurize the fuel bay. If air can be blown into bay, the vent line is open.

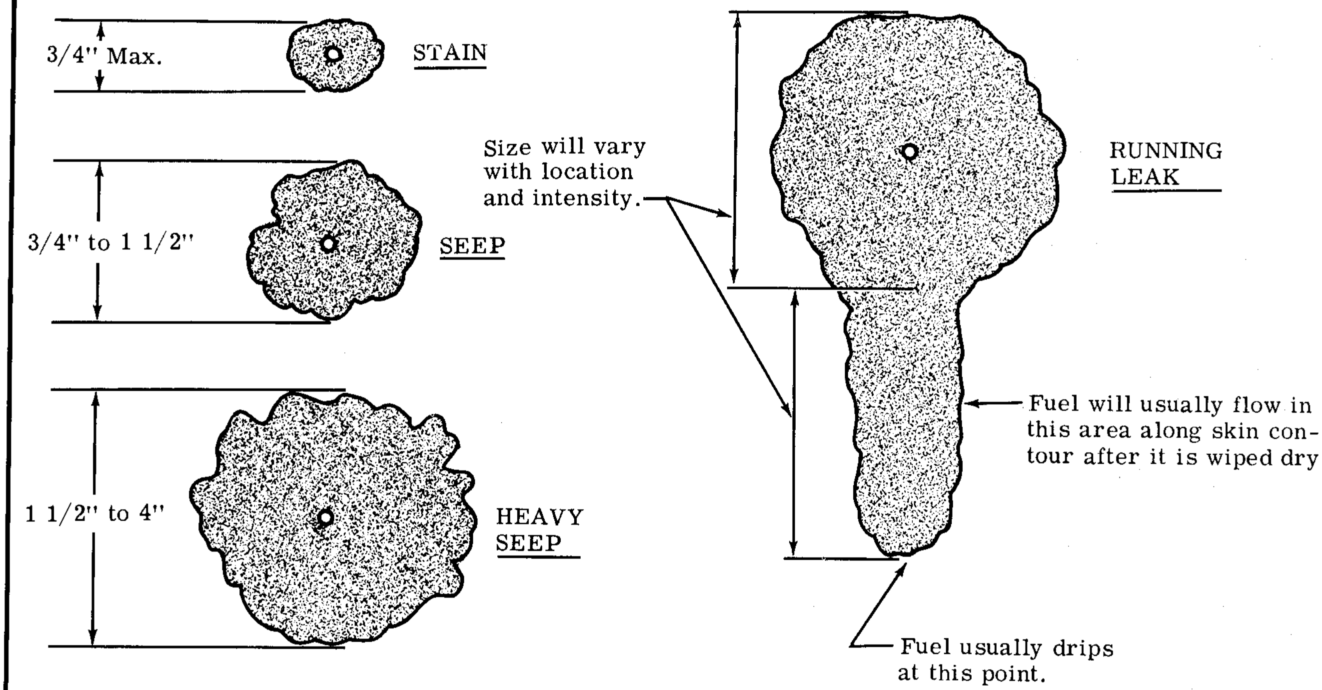
d. After the fuel bay is slightly pressurized, insert end of rubber tube into a container full of water and watch for a continuous stream of bubbles, which indicates the bleed hole in valve assembly is open and relieving pressure.

e. Repeat this procedure for fuel vent at opposite wing tip.

NOTE

Remember that a plugged vent line or bleed hole can cause either fuel starvation or the pressurizing of the bay by fuel expansion.

f. Any fuel vent found plugged or restricted must be corrected before returning airplane to service.



WARNING

REFER TO PARAGRAPH 13-19 FOR FUEL BAY PURGING WHICH SHOULD BE ACCOMPLISHED BEFORE REPAIRING FUEL BAYS.

Figure 13-4. Classification of Fuel Leaks

13-10. FUEL BAYS.

13-11. Airplanes with cantilever wings have an inboard section of each wing forward of the main spar sealed to form an integral fuel bay area. The fuel bay consists of a front and rear fuel spar, inboard, outboard and intermediate ribs, and stringers. A standpipe at the fuel bay filler acts as a visual aid, when loading fuel, to indicate the quantity of fuel in the bay.

13-12. FUEL BAY LEAKS.

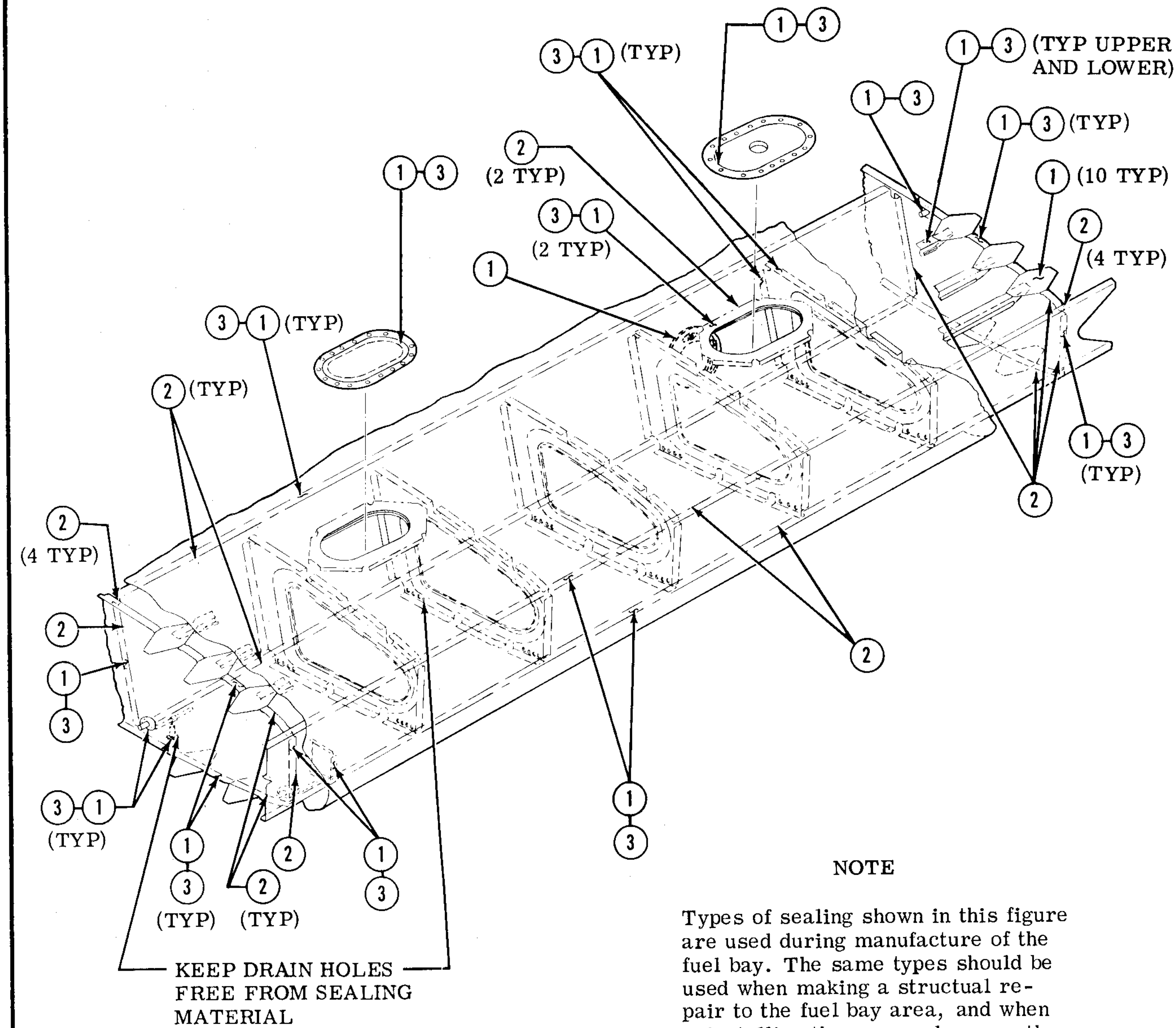
13-13. CLASSIFICATION OF FUEL LEAKS. Fuel leaks which do not constitute a flight hazard are stains, seeps, and heavy seeps NOT in an enclosed area. However, they should be repaired when the airplane is grounded for other maintenance. Fuel leaks which constitute a flight hazard are running leaks in any area, and seeps, heavy seeps, or stains in an enclosed area, such as the wing leading edge, in the sections of wing inboard and outboard of the fuel bay, and the area between the rear fuel spar and the main spar. These leaks must be repaired prior to the next flight. The wet or stained spot on the wing in the area of the bay is an indication of the intensity of the leak. Fuel leak classifications are shown in figure 13-4.

NOTE

Stains and seeps that are not considered a flight hazard must be inspected after each flight to ensure that they have not grown in intensity to the point of causing a flight hazard.

If a leak causing a flight hazard should occur at a place where there are no facilities available to make an acceptable repair, it is recommended that the leaking fuel bay be drained and some suitable material placed over the leak, if it is within an enclosed area of the wing, to eliminate escaping of fumes. By switching the fuel selector valve to the other bay, the airplane can then be flown to a base where the fuel leak can be repaired.

13-14. INTEGRAL FUEL BAY SEALANT. Two kinds of sealants are used, one to seal the fuel bay and the other to seal the access doors and fuel quantity transmitter adapter. The access door sealant is more pliable and will not adhere to metal as firmly as the bay sealant does. This permits the access doors and fuel quantity transmitter adapter to be removed without damage to them. Service Kit SK210-56, available from the Cessna Service Parts Center, contains these sealants with the proper quantity of



NOTE

Types of sealing shown in this figure are used during manufacture of the fuel bay. The same types should be used when making a structual repair to the fuel bay area, and when reinstalling the access doors or the fuel quantity transmitter adapter.

CODE

1. FAYING SURFACE SEAL
2. FILLET SEAL
3. RIVET AND FASTENER SEAL

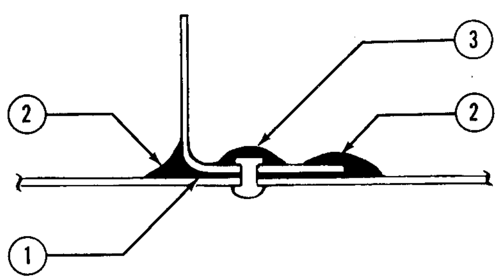
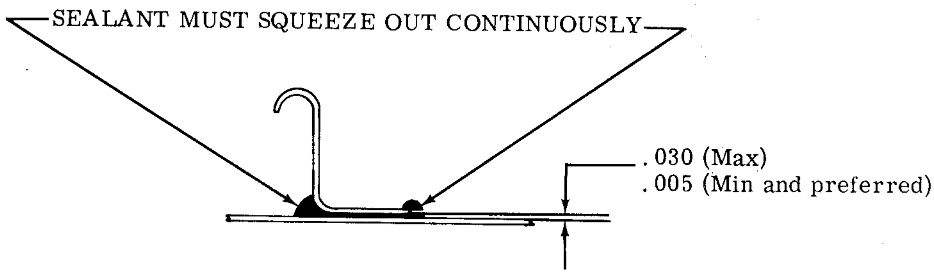
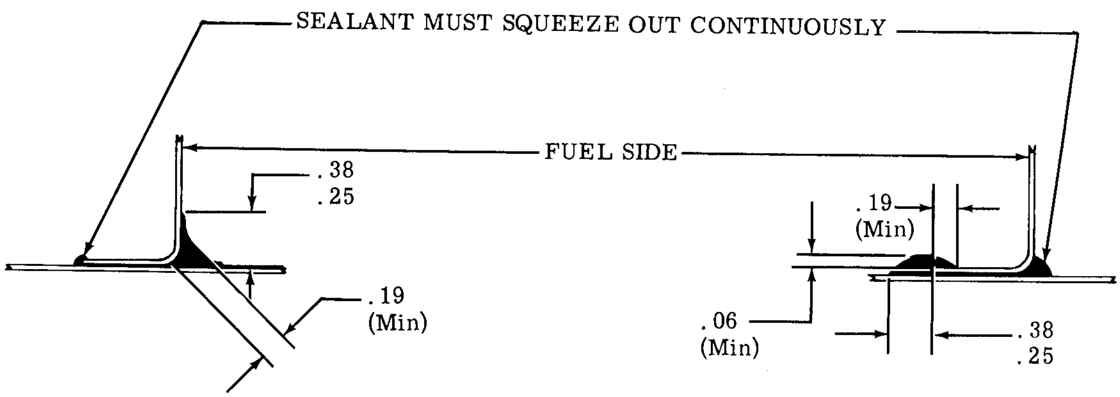


Figure 13-5. Fuel Bay Sealing (Sheet 1 of 2)



FAY SURFACE SEALING



FILLET SEALING (With fay surfaces sealed)

FASTENER SEALING

Figure 13-5. Fuel Bay Sealing (Sheet 2 of 2) accelerator for each sealant. The sealants can be identified by color. The bay sealant is white and its accelerator is a black paste. The access door sealant is gray and its accelerator is a clear liquid. When mixing the accelerator with the sealant, use all the material in the container to ensure the proper ratio of accelerator to sealant. Stir the accelerator to absorb all floating liquid before it is mixed with the sealant. The accelerator can then be poured into the container of sealant for mixing; otherwise, a wax-free container must be used. Stir accelerator and sealant until it becomes a uniform mixture. Do not allow air bubbles to mix in. If this occurs, work air bubbles out.

13-15. SEALING DURING AND AFTER STRUCTURAL REPAIR.

CAUTION

Protect drain holes and fuel outlet screens when applying sealants.

Any repair that breaks the fuel bay seal will necessitate resealing of that area of the bay. Repair parts that need sealing must be installed and riveted during the sealing operation. All joints within the boundary of the fuel bay, but which do not provide a direct fuel path out of the bay, such as stringers and rib flanges within the bay, must be fay surface sealed only. Joints which provide a direct fuel path out of the bay area, such as fuel spar flanges and inboard and outboard rib flanges, must be fay surface sealed and fillet sealed on the fuel side. Fay surface sealing is applying sealant to one mating part before assembly. Enough sealant must be applied so it will squeeze out completely around the joint when the parts are riveted or fastened together. The fillet seal is applied after the joint is fay surface sealed and riveted or fastened together. Fillet sealing is applying sealant to the edge of all riveted joints, any joggles, bend reliefs, voids, all rivets and/or fasteners through the boundary of the bay, and any place that could produce a fuel leak. The fay sealant need not be cured before the fillet seal is applied, but the squeezed out sealant, to which the fillet sealant is applied, must be free of dirt and contamination. Fillets laid on intersecting joints shall be joined together to produce a continuous fillet. Filler sealant must be pressed into the joint, working out all entrapped air. The best method of applying sealant is with an extrusion gun. Then work the sealant into the joint with a small paddle, being careful to eliminate all air bubbles.

NOTE

During structural repair, parts must be predrilled, countersunk and/or dimpled if required, and cleaned before being sealed and positioned for final installation.

a. Remove all existing sealant from area to be sealed, leaving a taper on the remaining sealant. The taper will allow a scarf bond and a continuous seal when the new sealant is applied.

NOTE

The best method of removing sealant is with a chisel-like tool made of hard fiber. Remaining sealant may then be removed with aluminum wool. Steel wool or sandpaper must not be used.

b. Vacuum thoroughly to remove all chips, filings, dirt, etc., from the bay area.

c. All surfaces and areas to be sealed shall be thoroughly cleaned by wiping with a clean cloth dampened with Methyl Ethyl Ketone (MEK), acetone or similar solvent, and dried with a clean cloth before the solvent evaporates. Always pour the solvent on the cloth. Never use contaminated solvent. The cloth shall not be so saturated that dripping occurs.

NOTE

Allowable work life of either sealant is four hours from the starting time of mixing. This applies to standard conditions of 77° Fahrenheit and 50% relative humidity. An increase in temperature or a decrease in humidity will shorten the work life of the sealant.

d. Apply fay surface sealant to one mating part and install rivets or fasteners while sealant is still within its allowable work life.

NOTE

During the sealing operation, sealant must be checked at various times to determine that it has not exceeded its allowable work life. Use a small wood paddle, such as a tongue depressor, to gather some sealant. Touch the sealant to a piece of clean sheet metal. If the sealant adheres to the sheet metal, it is still within its allowable work life. If the sealant does not adhere to the sheet metal, it is beyond its allowable work life and must not be used.

e. Apply a fillet seal to the repaired area on the inside of the bay.

f. Apply fay surface door sealant to access doors and fuel quantity transmitter adapter, if removed, and install the doors and adapter.

g. Allow the sealant to cure. Refer to paragraph 13-17 for curing time.

h. Clean stains from outside of the bay area.

i. Test fuel bay for leaks as described in paragraph 13-18.

13-16. SEALING FUEL LEAKS. First determine the source of the fuel leaks. Fuel can flow along a seam or the structure of the wing for several inches making the leak source difficult to find. A stained area is an indication of the leak source. Fuel leaks can be found by testing the complete bay as described in paragraph 13-18. Another method of detecting the source of a fuel leak is to remove access doors and blow with an air nozzle from the inside of the bay in the area of the leak while a soap bubble solution is applied to the outside of the bay. After the leak source has been found, proceed as follows:

a. Remove existing sealant in the area of the leak as described in paragraph 13-15, step "a."

b. Clean the area and apply a fillet seal. Press sealant into leaking area with a small paddle, being sure to work out all entrapped air.

c. If a leak occurs around a rivet or bolt, restrike the rivet or torque the bolt to the maximum allowable torque, and repair any damaged sealant.

d. Apply fay surface door sealant to access doors or fuel quantity transmitter adapter, if removed, and install the doors and adapter.

e. Test fuel bay for leaks as described in paragraph 13-18.

13-17. CURING TIME. Normal curing time for fillet sealant is 90 hours based on a standard condition of 77° Fahrenheit and 50% relative humidity. This time may be accelerated as shown in the following chart.

Temperature of Sealant °F.	Time in Hours
160	3
140	4
120	7

NOTE

Temperature shall not exceed 160°F. Bay must be vented to relieve pressure during accelerated curing.

Normal curing time for access door sealant is 24 hours based on a standard condition of 77° Fahrenheit and 50% relative humidity.

WARNING

Access door sealant must not be heated above 90° until sealant is cured for 24 hours based on a standard condition of 77° Fahrenheit and 50% relative humidity. Harmful vapors are released if sealant is heated above 90°F.

13-18. TESTING INTEGRAL FUEL BAY.

a. Remove vent line from vent fitting and cap the fitting.

b. Remove forward and aft fuel lines from bay.

c. To one of the bay fittings, attach a water manometer capable of measuring 20 inches of water.

d. To the other bay fitting, connect a well regulated supply of air (1/2 PSI MAXIMUM or 13.8 INCHES OF WATER). Nitrogen may be used where the bay might be exposed to temperature changes while testing.

e. Make sure filler cap is installed and sealed.

CAUTION

Do not attempt to apply pressure to the bay without a good regulator and a positive shut-off in the supply line. Do not pressurize the fuel bay to more than 1/2 psi or damage may occur.

f. Apply pressure slowly until 1/2 PSI is obtained.

g. Apply soap solution as required.

h. Allow 15 to 30 minutes for pressure to stabilize.

i. If bay holds for 15 minutes, without pressure loss, bay is acceptable.

j. Reseal and retest if any leaks are found.

13-19. FUEL BAY PURGING.

WARNING

To reduce the possibility of an explosion while repairing integral fuel cavities which have been fueled, the cavities may be purged with an inert gas.

The following procedure may be used to purge the cell with Argon or carbon dioxide.

a. Ground the aircraft to a suitable ground stake.

b. Set fuel selector valve handle in "OFF" position.

c. Drain all fuel from cavity being repaired.

WARNING

Fuel draining from fuel bays and disconnected lines or hoses constitutes a fire hazard. Adequate safety precautions should be taken whenever it is necessary to drain fuel or to disconnect lines or hoses.

d. Remove access door and insert hoses to each end of bay simultaneously.

e. Allow inert gas to flow into bay for several minutes (time dependent upon hose size, rate of flow, etc.) to remove all gasoline vapors.

Since Argon or carbon dioxide are heavier than air, these gases will remain in the bay during the repair. The repair shall be made using non-sparking tools (air motors, plastic scrapers, etc.)

NOTE

Portable vapor detectors are available to determine presence of explosive mixtures, and are calibrated for leaded gasoline and could be used to determine that is is safe to make repairs.

13-20. FUEL QUANTITY TRANSMITTERS.

13-21. A fuel quantity transmitter is located on each aft fuel spar. It is the float arm actuated, variable resistor type and is powered by the airplane electrical system. (See figure 13-2).

13-22. REMOVAL OF FUEL QUANTITY TRANSMITTER. Removal of the fuel quantity transmitter can be accomplished through the access door on the underside of the wing forward of the flap bellcrank.

a. Remove access door.

b. Drain enough fuel from bay to lower fuel level below fuel transmitter.

c. Disconnect electrical leads at transmitter.

d. Remove bolts attaching transmitter to fuel spar.

e. Remove gasket and fuel transmitter.

13-23. INSTALLATION OF FUEL QUANTITY TRANSMITTER. The fuel quantity transmitter can be installed by reversing the procedure outlined in paragraph 13-22. Use new gasket around opening in fuel bay and new sealing washers. Do not damage float or bend float arm when placing transmitter into bay as incorrect fuel readings can result. After installation is complete, turn on master switch and check fuel gage reading against known quantities in bay. Minor adjustments can be made by bending float arm on fuel quantity transmitter unit (see paragraph 16-44).

13-24. REMOVAL AND INSTALLATION OF FUEL RESERVOIR TANKS.

a. Remove front seats, carpeting, and access plates as necessary for access to tank to be removed.
b. Disconnect fuel lines at the tank to be removed.
c. Remove four screws securing tank mounting legs to fuselage structure.
d. Lift out the tank.
e. Reverse the preceding steps to install a reservoir tank.

13-25. REMOVAL AND INSTALLATION OF FUEL SELECTOR VALVE.

a. Drain all fuel from wing tanks at fuel tank sump drain plugs. With valve turned to LEFT TANK, drain left fuel lines at selector valve; with valve turned to RIGHT TANK, drain right fuel lines.
b. Remove control pedestal cover. (Refer to paragraph 11-5 for procedure.)
c. Remove access hole covers in floorboard and fuselage skin in area of fuel selector valve.
d. Disconnect all fuel lines from selector valve.
e. Disconnect square shaft from valve by removing attached roll pin.
f. Remove bolts or screws attaching valve to support bracket and remove valve.
g. Install valve by reversing this procedure.

13-26. FUEL SELECTOR VALVE REPAIR. (See figure 13-6.) The fuel selector valve may be repaired by disassembly, replacement of defective parts, and reassembly as follows:

a. Mark sump plate (23) and body (1) to ensure correct reassembly, then remove sump plate (23) and O-ring (22) after removing four screws.
b. Drive out roll pin (5) securing yoke (6) to shaft. As yoke is lifted off, balls (8) and springs (7) are free. Retain them.
c. Lift off washer (9).
d. Mark cover (4) and body to assure later alignment of parts and remove screws (3).
e. With fine emery paper, sand off any burrs or sharp edges on shaft (21). Apply petrolatum to shaft as a lubricant, then work cover off shaft.
f. Drive back roll pin (13) and remove rotor (12). Teflon seal (14), O-rings (15), washers (16), and springs (17) are now free to be removed. Check all parts carefully to locate any defects.
g. Remove burrs or sharp edges on shaft, lubricate and slide it down, out of body (1). Remove teflon seals (20) and O-rings (19).
h. Remove O-ring (18) within body and O-ring (10) within cover.
i. Replace all O-rings, lap or replace teflon seals, and lubricate O-rings before installation.

CAUTION

Install all parts in the relative position depicted in figure 13-6, otherwise the valve will not operate correctly.

j. Install O-ring (18) in body shaft hole. Install O-rings (19) and teflon seals (20), then slide shaft and rotor into place. Position rotor in exact relative position shown in figure 13-6, then install O-ring (22) and sump plate (23).
k. Install .169" diameter pins in body ports, then slide springs (17), washers (16), O-rings (15) and teflon seals over pins. Slide rotor (12) over shaft. Remove .169" dia. pins and, readjusting rotor vs. shaft position as necessary, tap roll pin (13) into place, letting it protrude on the side depicted.

NOTE

This roll pin serves also as a stop, limiting valve shaft travel.

l. Install O-ring (10) in cover, lubricate shaft (21) with petrolatum, install large O-ring (11), and slide cover down into place.

CAUTION

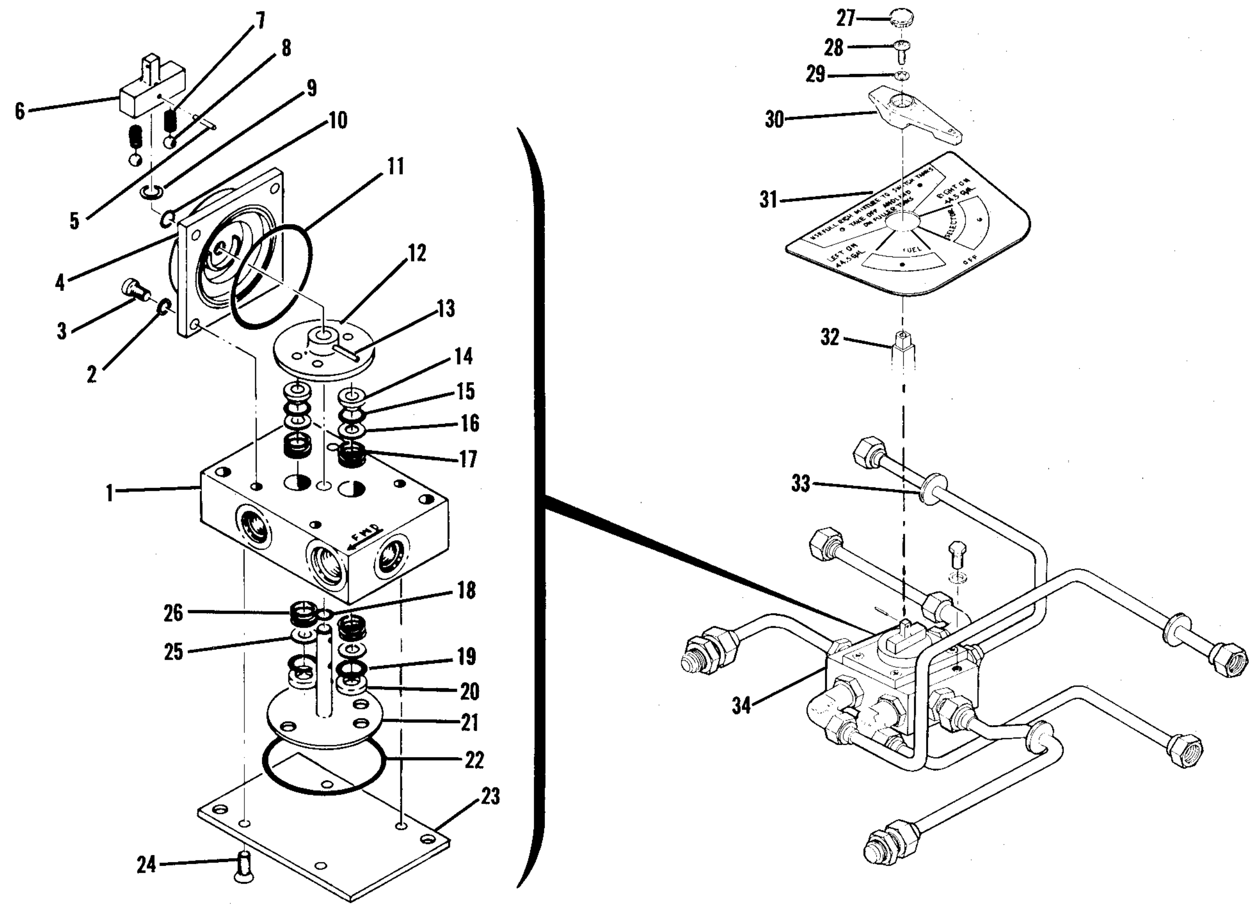
Make sure cover is installed in relative position illustrated. A lug on the cover protrudes to serve as a stop detent and if the cover is not installed correctly, the valve will not operate correctly.

m. Install brass washer (9) and yoke (6). Note the position of the small hole in the squared, upper portion of the yoke. If this is reversed, the valve linkage will not attach properly.

13-27. ELECTRIC FUEL PUMP. The electric fuel pump is located forward of the left fuel reservoir. An integral bypass and check valve permits fuel flow through the pump even when the pump is inoperative but prevents reverse flow. A separate overboard drain line from the pump prevents entry of fuel into the electric motor, in the event of pump internal leakage.

13-28. REMOVAL AND INSTALLATION OF ELECTRIC FUEL PUMP.

a. Place fuel selector valve in "OFF" position.
b. Remove left front seat, carpeting and plates as necessary for access to pump.
c. Disconnect all fuel lines and electrical connections from pump.
d. Loosen the two securing clamps and lift pump out.
e. Reverse the preceding steps for installation.



1. Valve Body
2. Lockwasher
3. Screw
4. Cover
5. Roll Pin
6. Yoke
7. Spring
8. Ball
9. Brass Washer
10. O-Ring
11. O-Ring
12. Rotor
13. Roll Pin
14. Seal
15. O-Ring
16. Washer
17. Spring
18. O-Ring
19. O-Ring
20. Seal
21. Rotor
22. O-Ring
23. Sump Plate
24. Screw
25. Washer
26. Spring
27. Cap
28. Screw
29. Washer
30. Handle
31. Placard
32. Selector Shaft
33. Grommet
34. Selector Valve

Figure 13-6. Fuel Selector Valve Assembly

13-29. DISASSEMBLY. (See figure 13-7.)

a. Remove screws (29) and washers (13), and separate motor from pump.

CAUTION

Use care when removing screws (29) as spring (20) is under compression.

13-30. DISASSEMBLY OF MOTOR.

a. Loosen screws (19) but do not remove.
b. Remove cover (3) by removing screws (1) and washers (2).
c. Remove brush holders (6) and brush assemblies (7) by removing screws (5).
d. Loosen screws (19) and remove end bell (8), but do not remove screws (19) from shaft end bell (18).
e. Remove bearing (9) from end bell (8).
f. Remove armature (11).
g. Remove springs (12), washers (13), field (14), shell (15), spacers (17), screws (19), and washers (2) from shaft bell end (18).
h. Remove bearing (9) from shaft bell end (18).
i. Do not remove spacer (22), truarc rings (10), or motor shaft pin (21) unless replacement is necessary.

13-31. INSPECTION OF MOTOR COMPONENTS.

a. Thoroughly wash all parts of motor, except brushes (7), bearings (9), armature (11), and field (14), in cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air.
b. Wipe parts not washed in solvent with a clean cloth.
c. Inspect all parts for damage and evidence of excessive wear.
d. Inspect all parts for breakage or distortion.
e. Replace any worn or damaged parts.

13-32. REASSEMBLY OF MOTOR. The assembly procedure for the motor is the reverse of the disassembly procedure. When reassembling, pay special attention to the following items:

a. Spacers (17), springs (12), and washers (13) must be held in place by screws (19) when assembling end bell (8).
b. Compress end bell (8) until screws (19) are engaged, then tighten screws (19) evenly to a torque value of 10 pound-inches.
c. Brushes (7) are contoured, therefore the contour of the brush must match the armature commutator when being installed.

13-33. DISASSEMBLY OF PUMP.

a. Remove pin (23) and remove slinger ring (41).
b. Remove bearing and seal assembly (40) and rotor and shaft assembly (39) from pump body (30).

NOTE

Vanes (25) and pins (26) are attached to rotor (39) and are removed with rotor and shaft assembly.

c. Remove spacer (39), bearing plate (37), O-ring (27), and body bearing (28) from pump body (30).

13-34. INSPECTION OF PUMP COMPONENTS.

a. Thoroughly wash all parts in cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air.
b. Inspect all parts for damage and evidence of excessive wear.
c. Replace all O-rings, and bearing and seal assembly.
d. Replace any damaged or worn parts.

13-35. REASSEMBLY OF PUMP. The assembly procedure for the pump is the reverse of the disassembly procedure. When reassembling, pay special attention to the following items:

a. Pin (36) must be correctly located in pump body (30) in order to properly position bearing plate (37) and spacer (38). Location holes in bearing plate and spacer must align with pin.
b. Vanes (25) and pins (26) must be assembled to the rotor and shaft assembly (39), and held in place while installing in pump body (30).
c. Use a suitable lubricant on O-rings to prevent damage when installing. A recommended lubricant for O-rings is Dow Corning Silicone No. 4.

13-36. DISASSEMBLY OF BYPASS AND PRESSURE RELIEF.

a. Remove nameplate (34), plug assembly (33), spring (32), and swing check assembly (31) from pump body (30).

13-37. INSPECTION OF BYPASS AND PRESSURE RELIEF.

a. Thoroughly wash all parts in cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air.
b. Inspect all parts for damage and evidence of excessive wear.
c. Inspect swing check assembly seat for damage.
d. Replace O-rings and all other damaged parts.

13-38. REASSEMBLY OF BYPASS AND PRESSURE RELIEF. The assembly procedure for the bypass and pressure relief is the reverse of the disassembly procedure. When reassembling, pay special attention to the following:

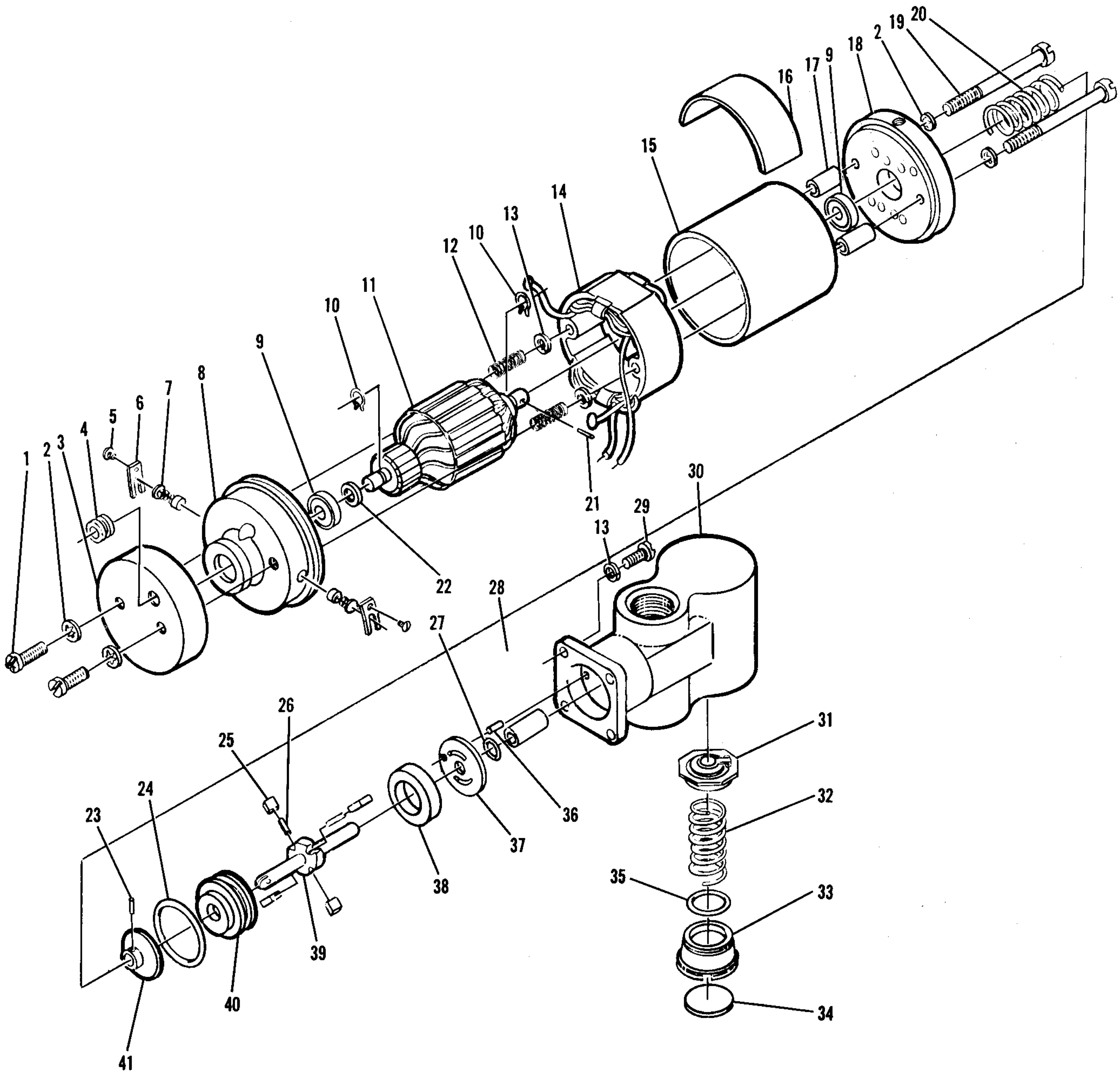
a. Install swing check assembly (31) so it is seated on seat in pump body (30). The valve must open inwardly.

13-39. ADJUSTING PRESSURE RELIEF.

a. Install pump assembly in appropriate test stand. (See figure 13-8.)
b. While maintaining a no flow condition, adjust plug (33) until a relief pressure of 23 to 24 psi is obtained.
c. After correct pressure is obtained, seal plug (33) at threads with Epocast Epoxy No. 212-10 mixed with hardener No. 9816 (Reference: Furane Plastics.)
d. Allow Epoxy to dry and install nameplate (34).

13-40. FUNCTIONAL TEST PROCEDURE. Each unit shall be set up in test stand as shown in figure 13-8 and functionally tested as follows:

a. Flow Tests.
    1. Apply 14 vdc to test unit.



1. Screw
2. Lockwasher
3. Cover
4. Grommet
5. Screw
6. Brush Retainer
7. Brush Assembly
8. End Bell
9. Bearing
10. Truarc Ring
11. Armature
12. Spring
13. Lockwasher
14. Field Assembly
15. Shell
16. Nameplate
17. Spacer
18. Shaft End Bell
19. Screw
20. Retention Spring
21. Motor Shaft Pin
22. Spacer
23. Slinger Pin
24. Bearing O-Ring
25. Vane
26. Vane Pin
27. Bearing O-Ring
28. Body Bearing
29. Screw
30. Pump Body
31. Swing Check Assembly
32. Spring
33. Adjusting Plug
34. Nameplate
35. O-Ring
36. Housing Pin
37. Bearing Plate
38. Spacer
39. Rotor and Shaft Assembly
40. Bearing and Seal Assembly
41. Slinger Ring

Figure 13-7. Electric Fuel Pump

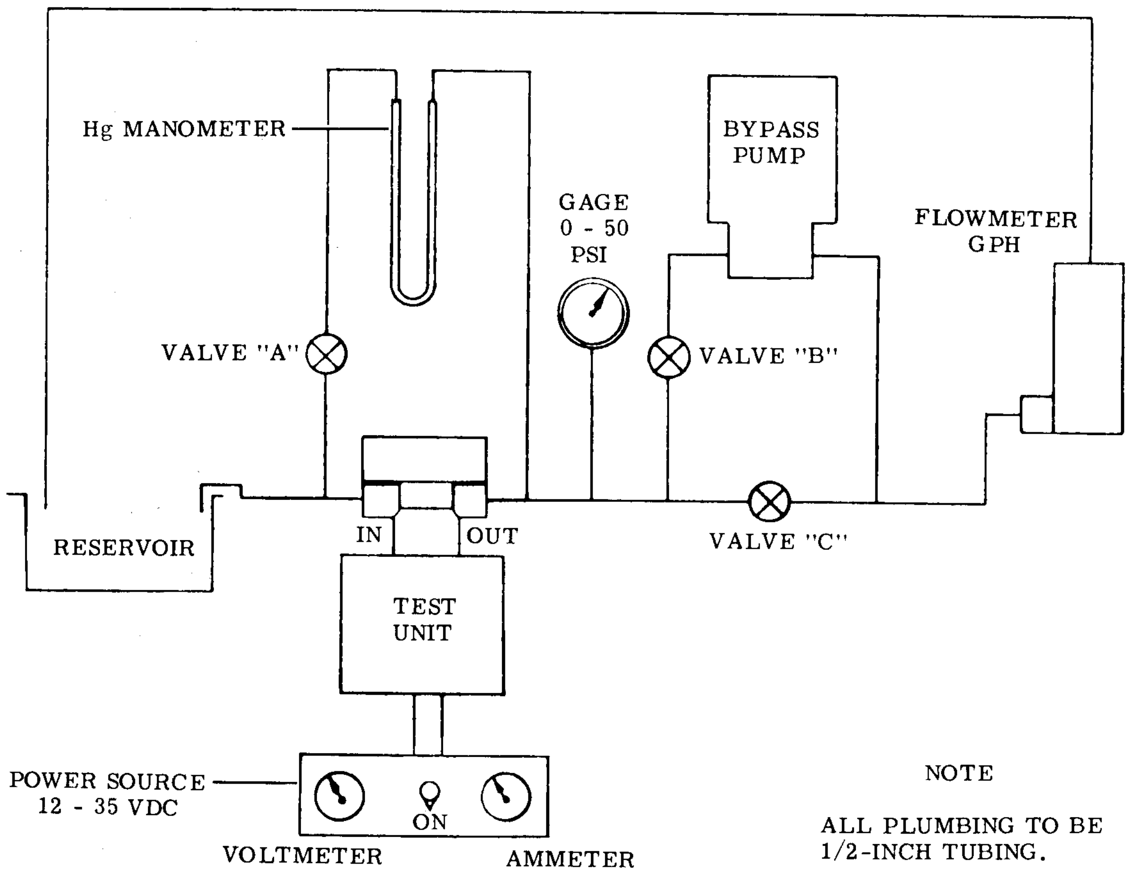


Figure 13-8. Test Stand Schematic

2. With valves "A" and "B" closed, adjust valve "C" to outlet pressures of 5.0 psi increments until maximum relief is reached at no flow.

NOTE

No flow pressure shall be 27.5 psig maximum.

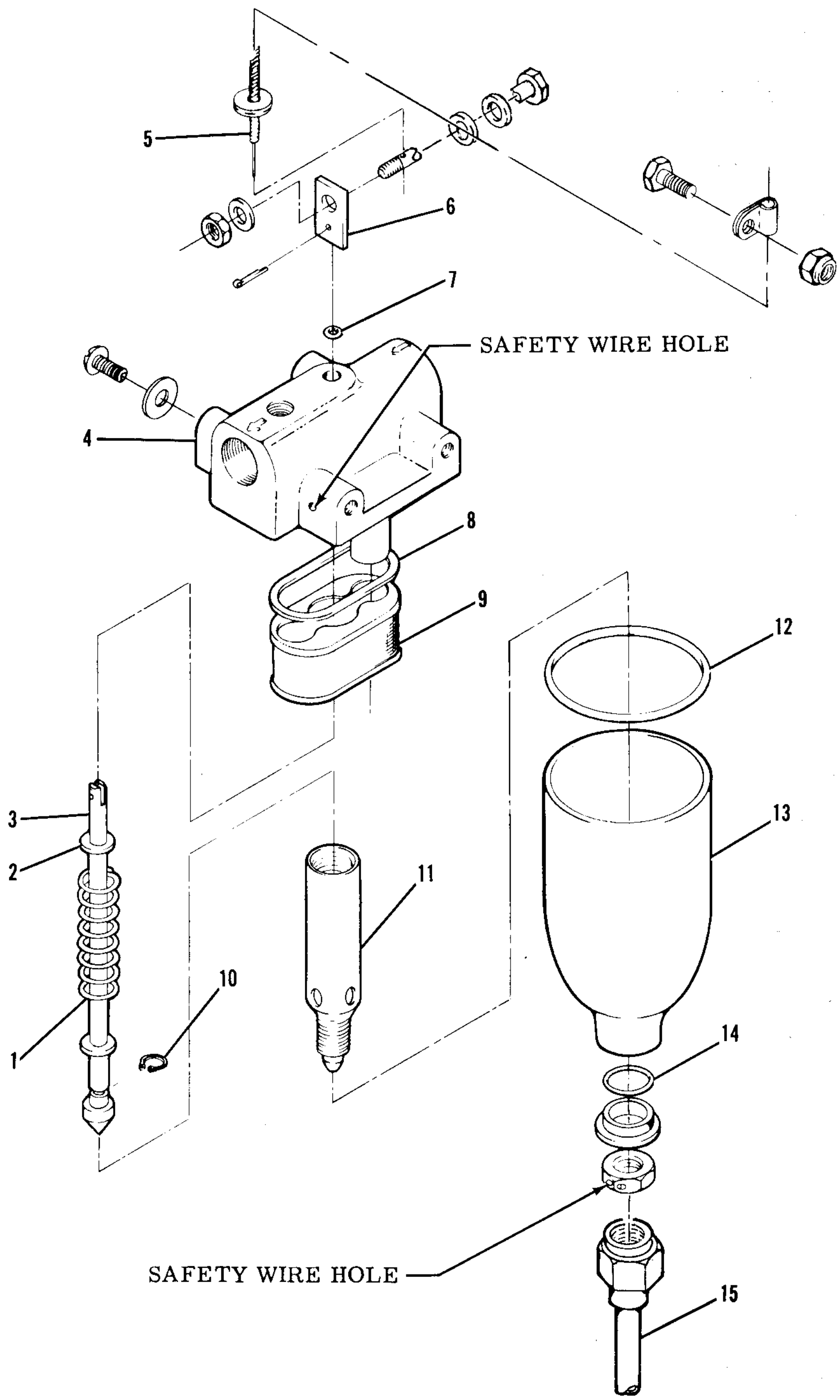
b. Bypass Pressure Drop.
1. With test unit shut off, open valves "A" and "B".
2. Close valve "C" and energize bypass pump.
3. Adjust valve "B" until flowmeter reads 40 gph and record inches of mercury as read on Hg manometer.

NOTE

Pressure drop shall not exceed 0.60 inches of mercury. Bypass pressure drop is 0.35 psi maximum at 40 gph.

c. Insulation Resistance Test.
1. Apply 50 volts dc across both leads and pump case. Insulation resistance shall be 50 megohms minimum.

13-41. ELECTRIC FUEL PUMP CIRCUITS. The electric fuel pump circuit is operated by a split rocker-type switch. The low side of the switch is connected through the "START" position of the ig-



1. Spring
2. Washer
3. Plunger
4. Top
5. Drain Control
6. Plate
7. O-Ring
8. Gasket
9. Filter
10. Retainer Ring
11. Standpipe
12. O-Ring
13. Bowl
14. O-Ring
15. Drain Line

Figure 13-9. Fuel Strainer

nition switch so that the fuel pump will operate only while the ignition switch is in the "START" position and the low side of the fuel pump switch is turned on. When the ignition key is released, the pump will stop. The high side of the fuel pump switch will operate the pump regardless of ignition switch position. A throttle shaft operated microswitch adds a resistance to the high circuit to slow down the pump when the throttle is retarded to prevent an excessively rich mixture as throttle is retarded while the electric pump is operating in the high position. Refer to Section 12 for rigging of the microswitch.

NOTE

A landing gear warning system microswitch is also operated by the throttle shaft. (Refer to Section 12 or 12A as applicable).

13-42. FUEL STRAINER. The fuel strainer is located in the nose wheel well and is readily accessible with the nose gear doors open. The fuel strainer drain control located adjacent to the oil dipstick. Access to the strainer drain control is made through the oil dipstick cowling door.

13-43. FUEL STRAINER DISASSEMBLY. (See figure 13-9.) To disassemble and assemble the strainer, proceed as follows:

a. Turn off fuel selector valve.
b. Disconnect strainer drain tube and remove safety wire, nut, and washer at bottom of filter bowl and remove bowl.
c. Carefully unscrew standpipe and remove.
d. Remove filter screen and gasket. Wash filter screen and bowl in solvent (Federal Specification P-S-661, or equivalent) and dry with compressed air.
e. Using a new gasket between filter screen and top assembly, install screen and standpipe. Tighten standpipe only finger tight.
f. Using all new O-rings, install bowl. Note that step-washer at bottom of bowl is installed so that step seats against O-ring. Connect strainer drain tube.
g. Turn on fuel selector valve, close strainer drain, and check for leaks. Check for proper operation.
h. Safety wire bottom nut to top assembly. Wire must have right hand wrap, at least 45 degrees.

SECTION 14

PROPELLERS AND GOVERNOR

TABLE OF CONTENTS

NOTE

Federal Aviation Regulations, Part 43, (FAR 43) define major and minor repairs and alterations and who may accomplish them. This section may be used as a guide, but the Federal Aviation Regulations and the propeller manufacturer's instructions must be observed.

14-1. PROPELLERS AND GOVERNOR.

14-2. All aircraft are equipped with all-metal, constant-speed, governor-regulated propellers. Two-bladed propellers are standard equipment, with three-bladed propellers being optional on these models. Propeller blades have a built-in tilt of approximately 5/8 degree beginning about the 16-inch station. This tilt provides the blades with a greater centrifugal restoring moment.

14-3. REPAIR of metal propellers first involves evaluating the damage and determining whether the repair will be a major or minor one and, in accordance with Federal Aviation Regulations, who is permitted to accomplish the repair.

a. General Repair Considerations:

1. Under no circumstances are the raised edges of defects to be corrected by peening. No welding, soldering or compounds of any nature are to be used to fill or correct defects. All repair is to be in accordance with standard approved and accepted practice.

2. More than one defect on blade is not cause for considering blade not airworthy if repair is within indicated limits. A reasonable number of repairs per blade is permissible if their location with respect to each other is not such as to form a continuous line that may materially weaken blade. Any transverse crack shall be cause for considering blade not airworthy.

3. Repair necessitating the removal of an appreciable amount of metal shall be reason to check horizontal and vertical balance.

4. The repair of defects is permissible providing the treatment does not materially weaken the blade, reduce its weight, or impair its performance.

b. Defects on Thrust Face or Camber Side:

1. Repair by removal of metal to form shallow, large radius, round bottomed depressions. Periodic inspection during repair should be made to avoid removal of excessive amounts of metal. All raised edges should be carefully smoothed out to reduce the area of the defect and the amount of metal to be removed. Repair with suitable fine cut files and coarse grain emery cloth and smooth all edges and surfaces with fine grain emery cloth. Any blade repair on these surfaces which necessitates a depression that exceeds the manufacturer's tolerances or those listed in FAR 43 shall be cause for considering blade not airworthy.

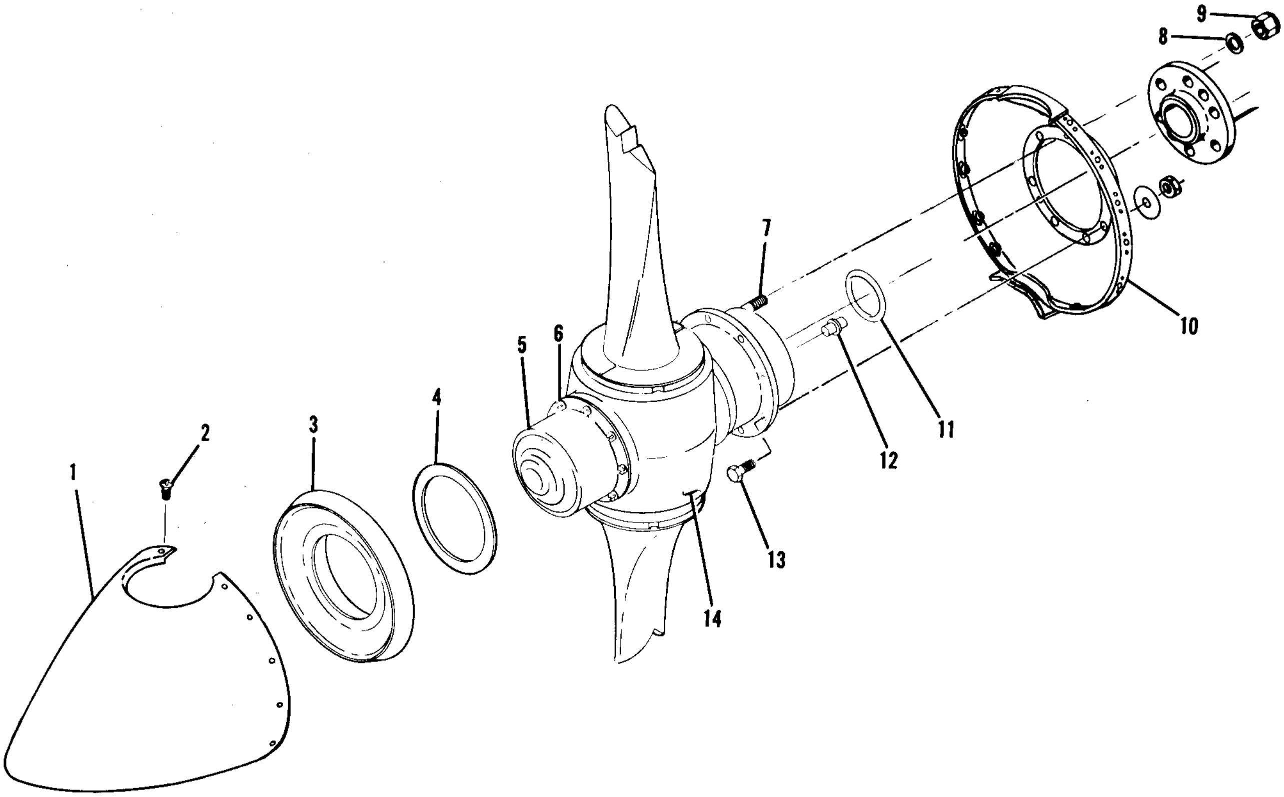
c. Defects on Leading and Trailing Edge:

1. Repair defects as outlined in step "b" with suitable half round file and emery cloth. Carefully smooth all edges of repaired defect. Any blade repair on leading and trailing edges which necessitates metal removal that exceeds the manufacturer's tolerances or those listed in FAR 43 shall be cause for considering blade not airworthy.

2. Blades that have leading or trailing edges pitted from normal wear may be reworked by removing sufficient metal to eliminate the pitting. Start well back from the edge and work over the edge in such a manner that the contour of the blade remains substantially the same. Avoid abrupt section changes and blunt edges. Permissible reductions in blade thickness and width, listed in the manufacturer's publicationr or FAR 43, must be observed.

d. Tip Damage:

1. Damage on blade tips may be removed in accordance with "b" and "c," as long as metal removed is within the tolerances specified. Damage which cannot be repaired by local removing of metal may be repaired by removing metal so as to shorten blades, although shortening blades is a propeller major repair. Any shortening of one blade requires an identical shortening of the other one(s), and any change in tip plan form or contour of one blade requires an identical change on the other one(s). Limitations concerning shortening of blades are specified



NOTE

Use spacers (4) as required to cause a snug fit between the spinner and the spinner support.

1. Propeller Spinner
2. Screw
3. Spinner Support
4. Spacer
5. Cylinder
6. Screw
7. Stud
8. Washer
9. Nut
10. Spinner Bulkhead
11. O-Ring
12. Dowel Pin
13. Bolt
14. Propeller

Figure 14-1. Two-Bladed, Extended Hub Propeller in the manufacturer's publications or FAR 43.

e. Refinishing:

1. Prior to corrosion protection treatments, all repair areas should be smoothly polished out and blended in to finish repair and improve appearance. Wherever possible, all repaired blades should be anodized in a sulfuric acid anodize bath. The blades must be anodized with loose blade retention hardware on shank end; therefore, the blade must be supported vertically with steel hardware out of the solution and suitably protected to be unaffected by fumes. The same holds true for caustic baths.

2. Where anodizing is not readily available, local repaired or inspected areas may be treated by other approved methods for corrosion protection; so-called chromodizing, alodine solution, painting, etc. It is doubtful that the finish of these treatments, other than sulfuric acid anodize, will blend in with regard to appearance. If desired, both camber and thrust face sides may be painted with zinc chromate primer and black lacquer to improve appearance. The thrust face side should always be painted.

14-4. PROPELLER.

14-5. The constant-speed propeller used on the 210-Series aircraft is a single-acting propeller in which oil pressure from the engine, boosted and regulated by a governor, is used to increase blade pitch, and the natural, centrifugal twisting moment of the rotating blades and the force of a spring are used to decrease blade pitch. The propeller is illustrated in figures 14-1 and 14-2.

14-6. TROUBLE SHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
FAILURE TO CHANGE PITCH.		
Control disconnected or broken.	Check visually.	Connect or replace control.
Governor not correct for propeller. "Sensing wrong."	See paragraph 14-11.	Install correct governor.
Defective governor.	See paragraph 14-12.	See paragraph 14-12.
Defective pitch changing mechanism inside propeller or excessive blade friction.	Check manually.	Propeller repair or replacement is required.
FAILURE TO CHANGE PITCH FULLY.		
Improper rigging of governor control.	Check that arm on governor has full travel.	Rig correctly.
Defective governor.	See paragraph 14-12.	See paragraph 14-12.
SLUGGISH RESPONSE TO PROPELLER CONTROL.		
Excessive friction in pitch changing mechanism inside propeller or excessive blade friction.	Check manually.	Propeller repair or replacement is required.
STATIC RPM TOO HIGH.		
Governor high rpm stop set too high.	See "Note" following this chart.	Rig correctly.
Defective governor.	See paragraph 14-12.	See paragraph 14-12.
Incorrect propeller or incorrect low pitch blade angle.	Check aircraft specifications.	Install correct propeller, with correct blade angle.

14-6 TROUBLE SHOOTING. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STATIC RPM TOO LOW.		
Governor high rpm stop set too low.	See "Note" following this chart.	Rig correctly.
Defective governor.	See paragraph 14-12.	See paragraph 14-12.
Incorrect propeller or incorrect low pitch blade angle.	Check aircraft specifications.	Install correct propeller, with correct blade angle.
ENGINE SPEED WILL NOT STABILIZE.		
Sludge in governor.	See paragraph 14-12.	See paragraph 14-12.
Air trapped in propeller actuating cylinder.	This condition may occur after the propeller has been reinstalled, or has been idle for an extended period.	Trapped air should be purged by exercising the propeller several times prior to take-off after the propeller has been reinstalled or has been idle for an extended period.
Excessive friction in pitch changing mechanism inside propeller or excessive blade friction.	Check manually.	Propeller repair or replacement is required.
Defective governor.	See paragraph 14-12.	See paragraph 14-12.
OIL LEAKAGE AT MOUNTING FLANGE.		
Damaged O-ring seal between engine and propeller.	Check visually for oil leakage.	Replace O-ring seal.
Foreign material between engine and propeller mating surfaces or nuts not tight.	Check visually for oil leakage.	Clean propeller and engine mating surfaces and tighten nuts properly.
OIL LEAKAGE BETWEEN HUB AND CYLINDER.		
Defective gasket or screws not tight.	Check visually for oil leakage.	Replace gasket and tighten screws properly.
OIL LEAKAGE AT ANY OTHER PLACE.		
Defective seals, gaskets, threads, etc, or incorrect assembly.	Check visually for oil leakage.	Propeller repair or replacement is required.

NOTE

It is possible for either the propeller low pitch (high rpm) stop or the governor high rpm stop to be the high rpm limiting factor. It is desirable for the governor stop to limit the high rpm at the maximum rated rpm for a particular airplane. Due to climatic conditions, field elevation, low pitch blade angle, and other considerations, an engine may not reach rated rpm on the ground. It may be necessary to readjust the governor stop after test flying to obtain maximum rated rpm when airborne.

14-7. REMOVAL. (See figures 14-1 and 14-2.) The propeller and propeller spinner may be removed as a complete unit. To remove propeller, proceed as follows:

a. If spinner is to be removed, remove attaching screws and remove spinner, spinner support, and spacers. Retain any spacers behind spinner support.
b. Remove cowling to gain access to propeller attaching nuts.
c. Loosen nuts attaching propeller about 1/4" and pull propeller forward until halted by nuts.

NOTE

As the propeller is separated from the engine, oil will drain from the propeller and engine cavities.

d. Remove attaching nuts and pull propeller forward to remove from engine.
e. If desired, the spinner bulkhead can be removed by removing bolts (figures 14-1 and 14-2).

14-8. CLEANING OF PROPELLER HUB.

a. Remove propeller spinner. Remove spinner support from front of propeller. Remove any spacers used behind the spinner support.
b. Remove screws securing cylinder to hub and remove cylinder.
c. Use a solution of one part light engine oil and two parts solvent to clean exposed parts and interior of cylinders. Dry gently with compressed air, then use clean engine oil to lubricate parts lightly before assembly.
d. Install new O-rings and gaskets at each cleaning of propeller hub.
e. Reassemble cylinder to hub.
f. Install any spacers used between the spinner support and cylinder, then install the spinner support and spinner. Spacers are used as required to cause a snug fit between the spinner and the spinner support.

14-9. INSTALLATION.

a. If spinner bulkhead was removed, position it so the propeller blades will emerge from the spinner with ample clearance and install spinner bulkhead attaching bolts (figures 14-1 and 14-2).

CAUTION

Avoid scraping metal from bore of spinner bulkhead and wedging scrapings between engine flange and propeller. Trim the inside diameter of the bulkhead as necessary when installing a new spinner bulkhead.

b. Clean propeller hub cavity, mating surfaces, and crankshaft.
c. Lightly lubricate a new O-ring and the crankshaft pilot with clean engine oil, and install the O-ring in the propeller hub.
d. Align propeller mounting studs and dowel pins with proper holes in engine crankshaft flange and slide propeller carefully over crankshaft pilot until mating surface is approximately 1/4 inch from crankshaft flange.
e. Install propeller attaching washers and nuts and work propeller aft as far as possible, then tighten nuts evenly and torque to 55-65 pound-feet.
f. Install any spacers used between spinner support bulkhead and propeller cylinder, then install spinner support and spinner. The spacers are used as required to cause a snug fit between the spinner and the spinner support.

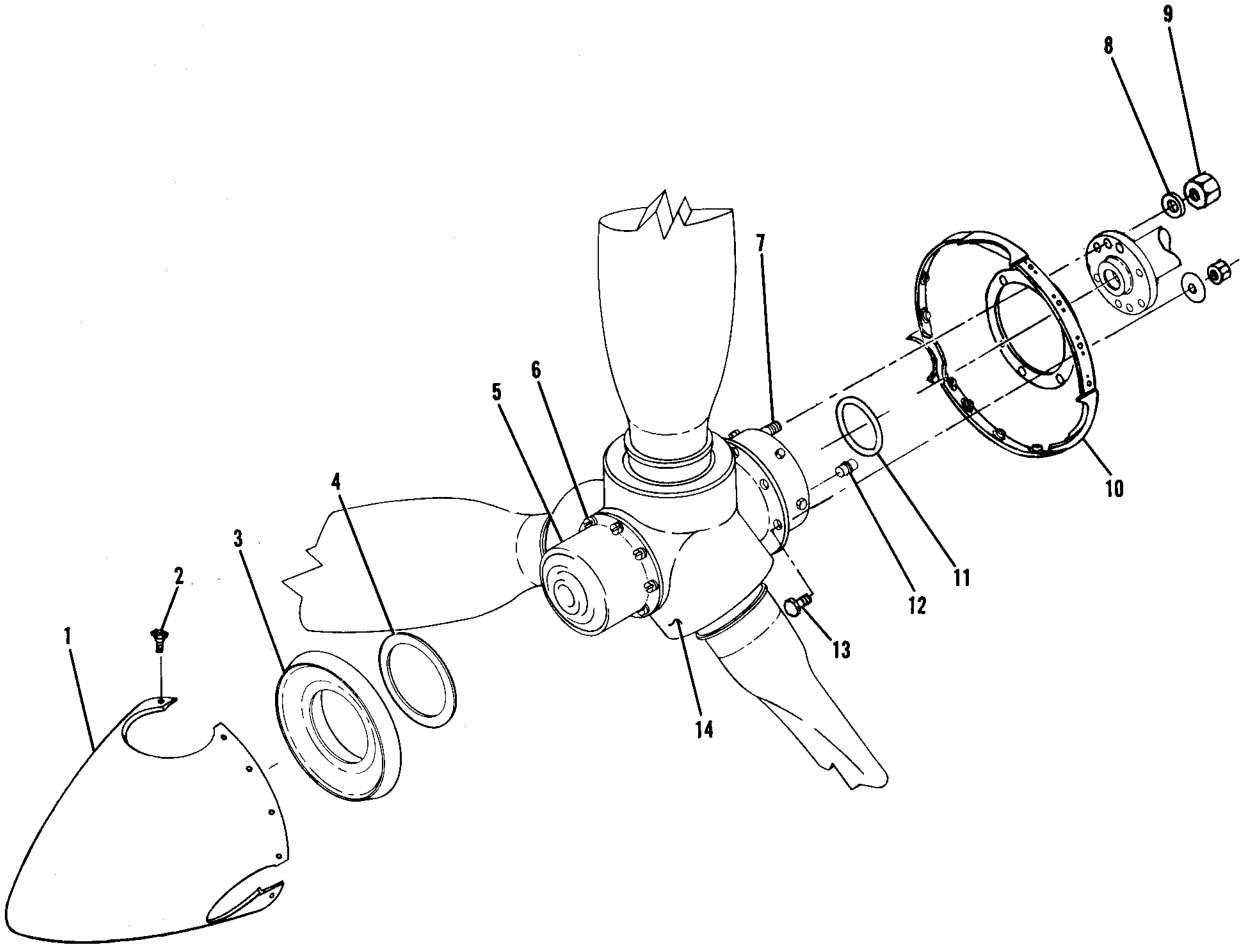
14-10. PROPELLER GOVERNOR.

14-11. The propeller governor is a single-acting, centrifugal type, which boosts oil pressure from the engine and directs it to the propeller where the oil is used to increase blade pitch. A single-acting governor uses oil pressure to effect a pitch change in one direction only; a pitch change in the opposite direction results from a combination of centrifugal twisting moment of rotating blades and compressed springs. Oil pressure is boosted in the governor by a gear type oil pump. A pilot valve, flyweight, and a speeder spring act together to open and close governor oil passages as required to maintain a constant engine speed.

NOTE

Outward physical appearance of specific governors is the same, but internal parts determine whether it uses oil pressure to increase or decrease blade pitch. Always be sure the correct governor is used.

The propellers used on the aircraft require governors which "sense" in a certain manner. "Sensing" is determined by the type pilot valve installed inside the governor. Since the same basic governor may be set to "sense" oppositely, it is important to ascertain that the governor is correct for the propeller being used.



NOTE

Use spacers (4) as required to cause a snug fit between the spinner and the spinner support.

1. Propeller Spinner
2. Screw
3. Spinner Support
4. Spacer
5. Cylinder
6. Screw
7. Stud
8. Washer
9. Nut
10. Spinner Bulkhead
11. O-Ring
12. Dowel Pin
13. Bolt
14. Propeller

Figure 14-2. Three-Bladed, Extended Hub Propeller

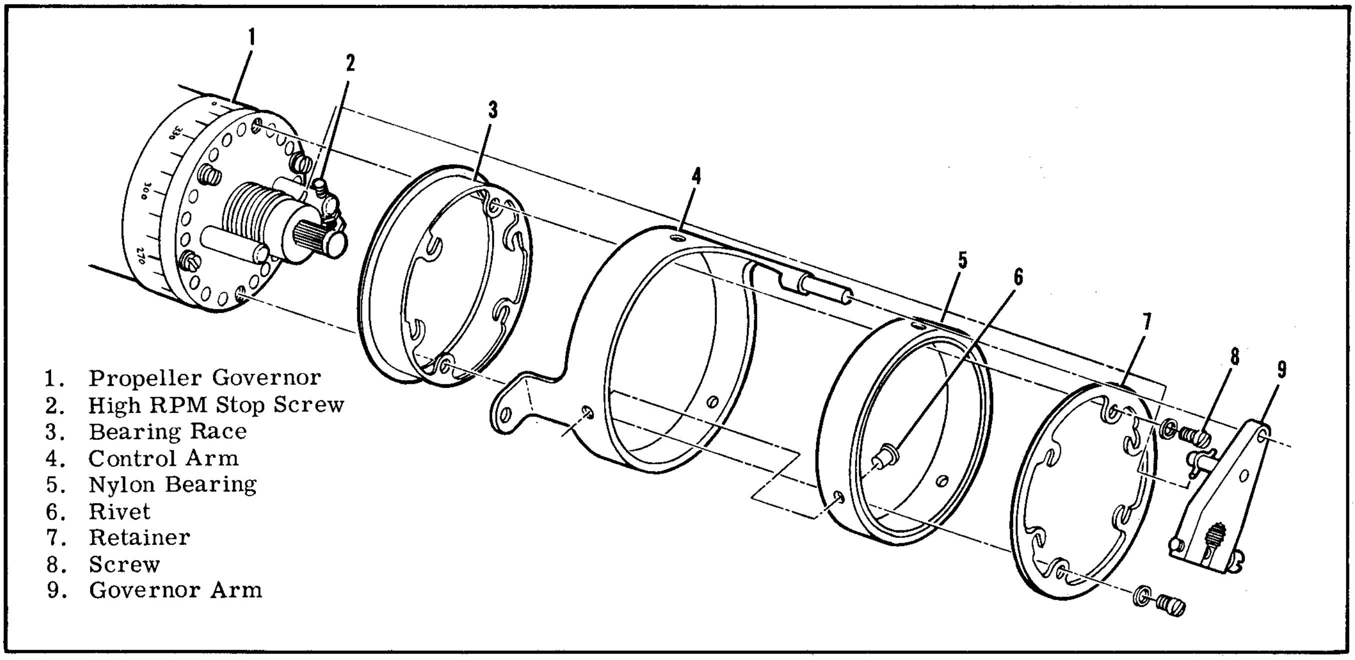


Figure 14-3. Governor Control Arm and Bearing Assembly

14-12. TROUBLE SHOOTING. When trouble shooting the propeller-governor combination, it is recommended that a governor known to be in good condition be installed to check whether the propeller or the governor is at fault. Removal and replacement, rigging, high-speed stop adjustment, desludging, and replacement of the governor mounting gasket are not major repairs and may be accomplished in the field. Repairs to propeller governors are classed as propeller major repairs in Federal Aviation Regulations, which also define who may accomplish such repairs.

14-13. REMOVAL.

a. Remove cowling, engine baffles, and nose cap as required for access.
b. Disconnect governor control from governor.
c. Disconnect intake manifold balance tube at front of engine and move as required for clearance during governor removal, if necessary.
d. Remove nuts and washers securing governor to engine and work governor from mounting studs.
e. Remove gasket between governor and engine mounting pad.

14-14. REMOVAL AND INSTALLATION OF GOVERNOR CONTROL ARM AND BEARING ASSEMBLY. (See figure 14-3.)

a. Using a scribe, make aligning index marks on governor arm and end of governor serrated shaft.

NOTE

The governor arm must be reinstalled on the governor shaft in the same serration or the governor speed will be changed approximately 200 rpm.

b. Remove safety wire from governor arm screw and from screws attaching governor head to governor.
c. Remove two screws that pass through the non-notched holes in the retainer.
d. Loosen, but do not remove, four remaining screws so that retainer may be rotated.
e. Loosen screw in governor arm so that arm may be slipped toward end of serrated shaft.
f. Slip governor arm toward end of serrated shaft and work retainer and control arm from governor.

NOTE

If governor arm becomes disengaged from serrated shaft, align index marks and install arm on serrated shaft. The control arm spring has approximately 1-1/2 turn preload.

g. Rotate and remove bearing race from governor.
h. Installation of the control arm and bearing assembly is the reversal of the removal procedure.

14-15. INSTALLATION.

a. Wipe governor and engine mounting pad clean.
b. Install a new gasket on the mounting studs. Install gasket with raised surface of the gasket screen toward the governor.
c. Position governor on mounting studs, aligning governor splines with splines in engine, and install mounting nuts and washers. Do not force spline engagement. Rotate engine crankshaft slightly and splines will engage smoothly when properly aligned.
d. Connect governor control to governor and rig.
e. Connect intake manifold balance tube, if removed. Ascertain that intake manifold clamps are tight.
f. Reinstall all parts removed for access.

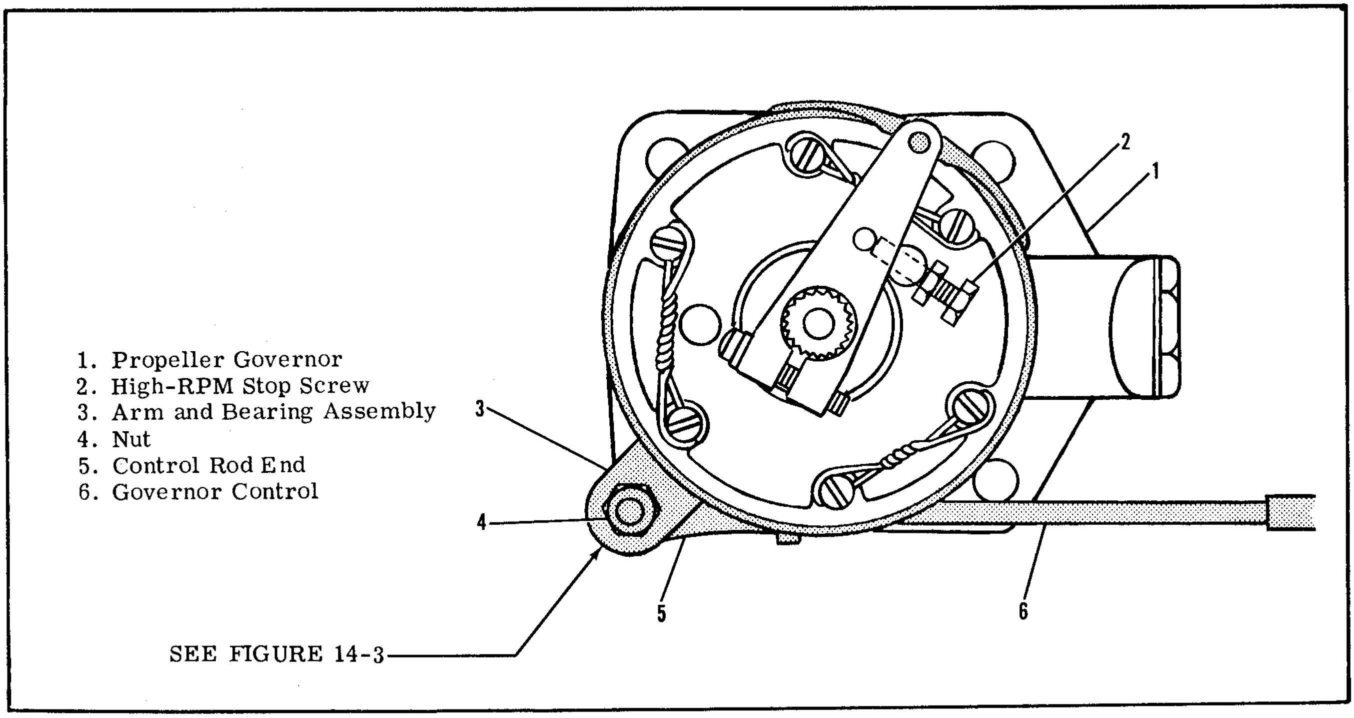


Figure 14-4. Governor and Control Adjustments

14-16. HIGH RPM STOP ADJUSTMENT.

a. (Figure 14-4.) Remove engine cowling. Disconnect cabin heater inlet air duct as required for access to governor.

b. Loosen the high-speed stop screw jam nut.

c. Turn the stop screw in to decrease maximum rpm and out to increase maximum rpm. One full revolution of the stop screw causes a change of approximately 25 rpm.

d. Tighten stop screw jam nut and make propeller control linkage adjustment as necessary to maintain full travel.

e. Reinstall cabin heater inlet air duct, cowling, or plug button removed for access.

f. Test operate propeller and governor.

NOTE

It is possible for either the propeller low pitch (high rpm) stop or the governor high rpm stop to be the high rpm limiting factor. It is desirable for the governor stop to limit the high rpm at the maximum rated rpm for a particular aircraft. Due to climatic conditions, field elevation, low pitch blade angle, and other considerations, an engine may not reach rated rpm on the ground. It may be necessary to readjust the governor stop after test flying to obtain maximum rated rpm when airborne.

14-17. RIGGING PROPELLER GOVERNOR CONTROL.

a. Disconnect control end from governor.

b. Place propeller control in cabin full forward, then pull back approximately 1/8" and lock in this position. This will allow "cushion" to assure full contact with governor high rpm stop screw.

c. Place governor arm against high rpm stop screw.

d. Loosen jam nut and adjust control rod until attaching holes align while governor arm is against high rpm stop screws. Be sure to maintain sufficient thread engagement of the control and the rod end. If necessary, shift the control in its clamps to achieve this.

e. Attach control rod end to the governor, tighten jam nut, and install all safeties.

f. Operate the propeller control to see that the governor arm attains full travel in both directions.

NOTE

Some models are equipped with an offset extension to the governor arm. The offset extension has an elongated slot to permit further adjustment. The preceding steps may still be used as an outline in the rigging procedure. The result of rigging, in all cases, is full travel of the governor arm (bottom out against both high and low pitch stops) with some "cushion" at both ends of control travel.

SECTION 15

UTILITY SYSTEMS

TABLE OF CONTENTS

15-1. UTILITY SYSTEMS.

15-2. HEATING SYSTEM.

15-3. DESCRIPTION. On non-turbocharged aircraft, the heating system is comprised of the heat exchange section of the left exhaust muffler, a heater valve, mounted on the left forward side of the firewall, a duct across the aft side of the firewall, a push-pull control on the instrument panel, and flexible ducts connecting the system. On aircraft with turbocharged engines, the heating system consists of an opening in the left side of the nose cap, an exhaust shroud, a heater valve, mounted on the left forward side of the firewall, to which is attached an adapter and a tube extending downward and overboard. The system also includes a duct across the aft side of the firewall, a push-pull control on the instrument panel, and flexible ducts connecting the system.

15-4. HEATER OPERATION. On airplanes with non-turbocharged engines, ram air is ducted through an engine baffle and the heat exchange section of the left exhaust muffler, to the heater valve at the firewall. On aircraft with turbocharged engines, ram air is ducted through an opening in the left side of the nose cap, through an exhaust shroud, to the heater valve at the firewall. On both models, heated air flows from the heater valve into a duct across the aft side of the firewall, where it is distributed into the cabin. The heater valve, operated by a push-pull control marked "CABIN HEAT", located on the instrument panel, regulates the volume of heated air entering the system. Pulling the heater control full out supplies maximum flow, and pushing it in gradually decreases flow, shutting off flow completely when the control is pushed full in.

15-5. TROUBLE SHOOTING. Most of the operational troubles in the heating system are caused by sticking or binding air valves and their controls, damaged air ducting, or defects in the exhaust muffler. In most cases, valves or controls can be freed by proper lubrication. Damaged or broken parts should be repaired or replaced. When checking controls, be sure valves respond freely to control movement, that they move in the correct direction, and that they move through their full range of travel and seal properly. Check that hose are properly secured and replace hose that are burned, frayed or crushed. If fumes are detected in the cabin, a very thorough inspection of the exhaust muffler should be accomplished. Refer to the applicable paragraph in Section 12 for the non-turbocharged engine exhaust system inspection, or for the turbocharged engine, refer to Section 12A. Since any holes or cracks may permit exhaust fumes to enter the cabin, replacement of defective parts is imperative because fumes constitute an extreme danger. Seal any gaps in heater ducts across the firewall with Pro-Seal #700 (Coast Pro-Seal Co., Los Angeles, California) compound, or equivalent compound.

15-6. REMOVAL AND INSTALLATION OF COMPONENTS. Figure 15-1 may be used as a guide for removal and installation of components of the heater system. Cut replacement hose to length and install in the original routing. Trim hose winding shorter than the hose to allow hose clamps to be fitted. Defective heater valves should be repaired or replaced. Check for proper operation of valves and their controls after installation or repair.

15-7. DEFROSTER SYSTEM.

15-8. DESCRIPTION. The system is composed of a duct across the aft side of the firewall, a defroster outlet, mounted in the left side of the cowl deck immediately aft of the windshield, a defroster control knob on the instrument panel, and flexible ducting connecting the system.

15-9. DEFROSTER OPERATION. Air from the duct across the aft side of the firewall flows through a flexible duct to the defroster outlet. The defroster control operates a damper in the outlet to regulate the amount of air deflected across the inside surface of the windshield. The temperature and volume of this air is controlled by the settings of the cabin heating system control.

15-10. TROUBLE SHOOTING. Most of the operational troubles in the defrosting system are caused by sticking or binding of the damper in the defroster outlet or its control. Since the defrosting system depends on proper operation of the cabin heating system, refer to paragraph 15-5 for trouble shooting the heating and defrosting system.

15-11. REMOVAL AND INSTALLATION OF COMPONENTS. Figure 15-1 may be used as a guide for removal and installation of components of the defrosting system. Cut replacement hose to length and install in the original routing. Trim hose winding shorter than the hose to allow hose clamps to be fitted. A defective defroster outlet should be repaired or replaced. Check for proper operation of defroster outlet and its control after installation or repair.

15-12. VENTILATING SYSTEM.

15-13. DESCRIPTION. The system is comprised of an airscoop mounted in the inboard leading edge of each wing, two plenum chambers mounted in the cabin ceiling, immediately forward of the pilot and copilot, a plenum chamber mounted in the left and right rear cabin wing root areas, two fresh airscoop doors, one on each side of the fuselage, just forward of the front seats, a control on the instrument panel for each of these scoop doors, and flexible ducting connecting the system.

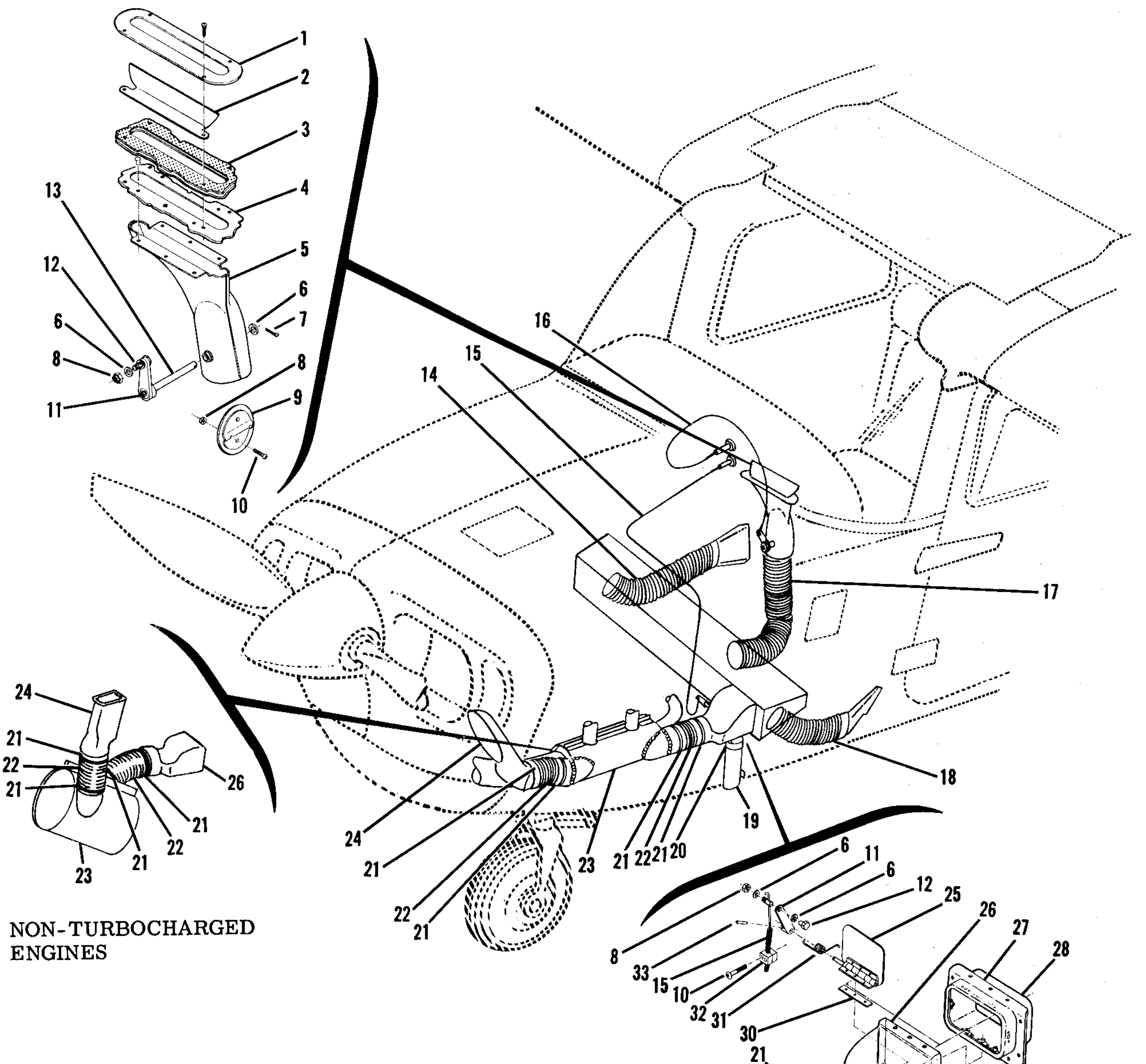
15-14. VENTILATING SYSTEM OPERATION. Air received from scoops mounted in the inboard leading edges of the wings is ducted to two plenum chambers mounted in the cabin ceiling immediately forward of the pilot and copilot. Rear seat ventilation is provided by plenum chambers mounted in the left and right rear cabin wing root areas. These plenum chambers receive ram air from the airscoops in the inboard leading edges of the wings. Each plenum chamber is equipped with a valve which meters the incoming cabin ventilation air. This provides a chamber for the expansion of cabin air which greatly reduces inlet air noise. Filters at the air inlets are primarily noise reduction filters. Forward cabin ventilation is provided by two fresh airscoop doors, one on each side of the fuselage, just forward of the front seats. The left scoop door is operated by a control in the instrument panel marked "CABIN AIR," and the right scoop door is operated by a control in the instrument panel marked "AUX CABIN AIR." Fresh air from the scoop doors is routed to the duct across the aft side of the firewall, where it is distributed into the cabin. As long as the "CABIN HEAT" control is pushed full in, no heated air can enter the firewall duct; therefore, when the "CABIN AIR" or "AUX CABIN AIR" controls are pulled out, only fresh air from the scoops will flow through the duct into the cabin. As the "CABIN HEAT" control is gradually pulled out, more and more heated air will blend with the fresh air from the scoops and be distributed into the cabin. All of the controls may be set at any position from full open to full closed.

15-15. TROUBLE SHOOTING. Most of the operational troubles in the ventilating system are caused by sticking or binding of the lever in the inlet scoop door or its control. The spring or plate in the plenum chambers could also bind or stick, requiring repair or replacement of the plenum chamber. Check the filter elements in the airscoops in the leading edges of the wings for obstructions. The elements may be removed and cleaned or replaced. Since air passing through the filters is emitted into the cabin, do not use a cleaning solution which would contaminate cabin air. The filters may be removed to increase air flow. However, their removal will cause a slight increase in noise level.

15-16. REMOVAL AND INSTALLATION OF COMPONENTS. Figure 15-2 may be used as a guide for removal and installation of components of the ventilating system. Cut replacement hose to length and install in the original routing. Trim hose winding shorter than the hose to allow hose clamps to be fitted. A defective plenum chamber should be repaired or replaced. Check for proper operation of ventilating controls after installation or repair.

15-17. WING AND HORIZONTAL STABILIZER DE-ICE SYSTEM.

15-18. DESCRIPTION. De-icing of the wing and horizontal stabilizer is accomplished by inflation and deflation of rubber boots attached to these surfaces. The duration of each inflation and deflation cycle is controlled by valves which in turn, are controlled by an electronic timer.



1. Retainer
2. Defroster Deflector
3. Upholstery
4. Cowl Deck
5. Defroster Outlet
6. Washer
7. Cotter Pin
8. Nut
9. Valve
10. Screw
11. Arm
12. Clamp Bolt
13. Shaft
14. Right Air Duct
15. Cabin Heat Control
16. Defroster Control
17. Defroster Hose
18. Left Air Duct
19. Tube
20. Adapter
21. Clamp
22. Hose
23. Shroud
24. Ram Air Intake
25. Valve Plate
26. Valve Body
27. Valve Seat
28. Valve Extension
29. Reinforcement
30. Shim
31. Spring
32. Block
33. Roll Pin

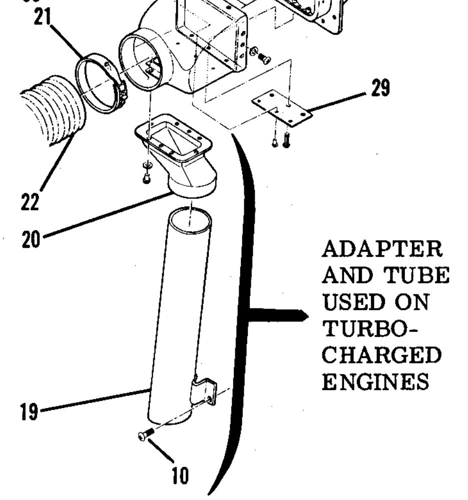
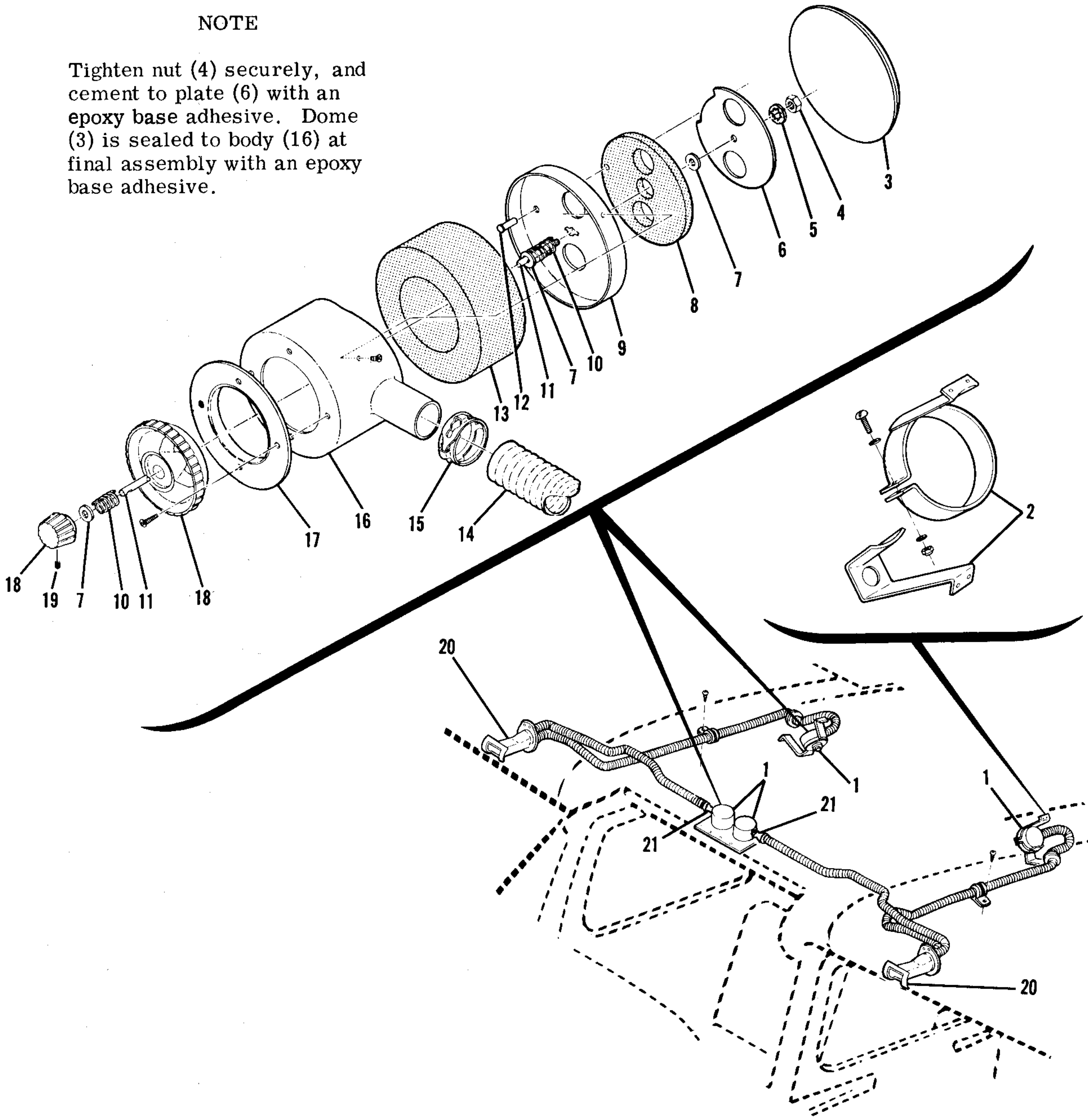


Figure 15-1. Heating and Defrosting System

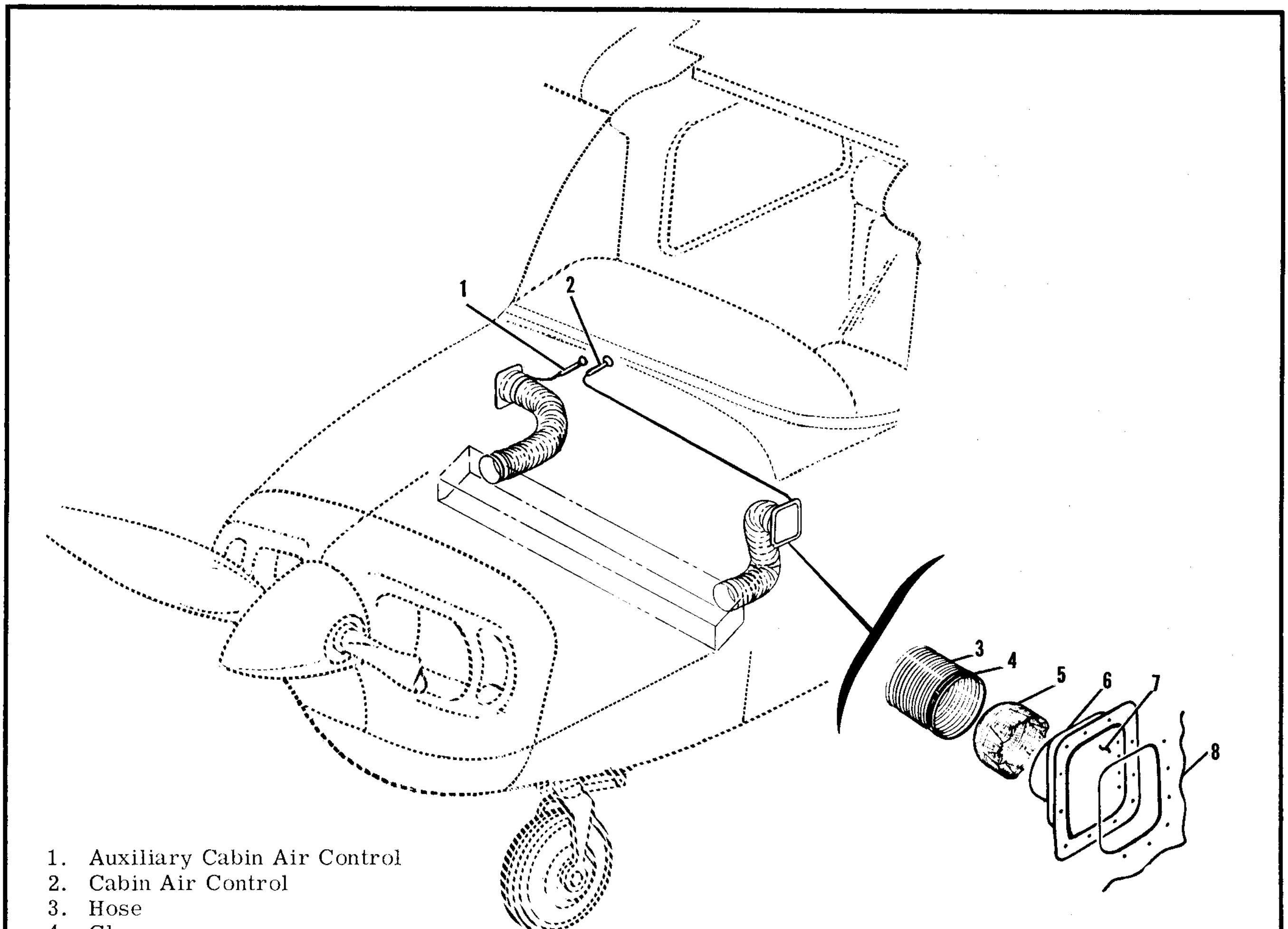
NOTE

Tighten nut (4) securely, and cement to plate (6) with an epoxy base adhesive. Dome (3) is sealed to body (16) at final assembly with an epoxy base adhesive.



1. Silencer Assembly
2. Bracket
3. Dome
4. Nut
5. Star Washer
6. Plate
7. Washer
8. Seal
9. Cap
10. Spring
11. Shaft
12. Spacer
13. Insulator
14. Hose
15. Clamp
16. Valve Body
17. Escutcheon
18. Knob
19. Setscrew
20. Scoop
21. Connector

Figure 15-2. Overhead Ventilating System



1. Auxiliary Cabin Air Control
2. Cabin Air Control
3. Hose
4. Clamp
5. Screen
6. Air Valve Assembly
7. Scoop Door
8. Fuselage Skin

Figure 15-3. Forward Ventilating System

CAUTION

Always allow sufficient ice build-up for efficient ice removal before actuating the de-ice system. If de-ice system is actuated continuously or before ice has reached sufficient thickness, the ice will build up over the boots instead of cracking off.

The de-ice system consists of an engine-driven vacuum pump with an oil separator, pressure relief valve, air filter, and shuttle valve. A pressure switch, timer, a boot on the leading edge of each wing, and a boot on the leading edge of each horizontal stabilizer complete the system. The vacuum system components also serve the de-ice vacuum system and the vacuum relief adjustment should be maintained in the manner outlined in the Relief Valve Adjustment paragraph in Section 16. The standard dry-type vacuum pumps are replaced with oil-lubricated pumps. An ice detector light is incorporated in the left side of the cowl deck below the windshield to aid checking for ice formations during night operation.

NOTE

If the vacuum relief valve to the gyros is set too low, suction to the gyros will drop momentarily during the boot inflation cycle. This suction variation can be corrected with proper vacuum relief valve adjustment.

15-19. DE-ICE SYSTEM OPERATION. An engine-driven vacuum pump is mounted on the top center of the engine accessory housing and provides both pressure and vacuum for the inflation and deflation of the de-ice boots. Air from the outlet (pressure)

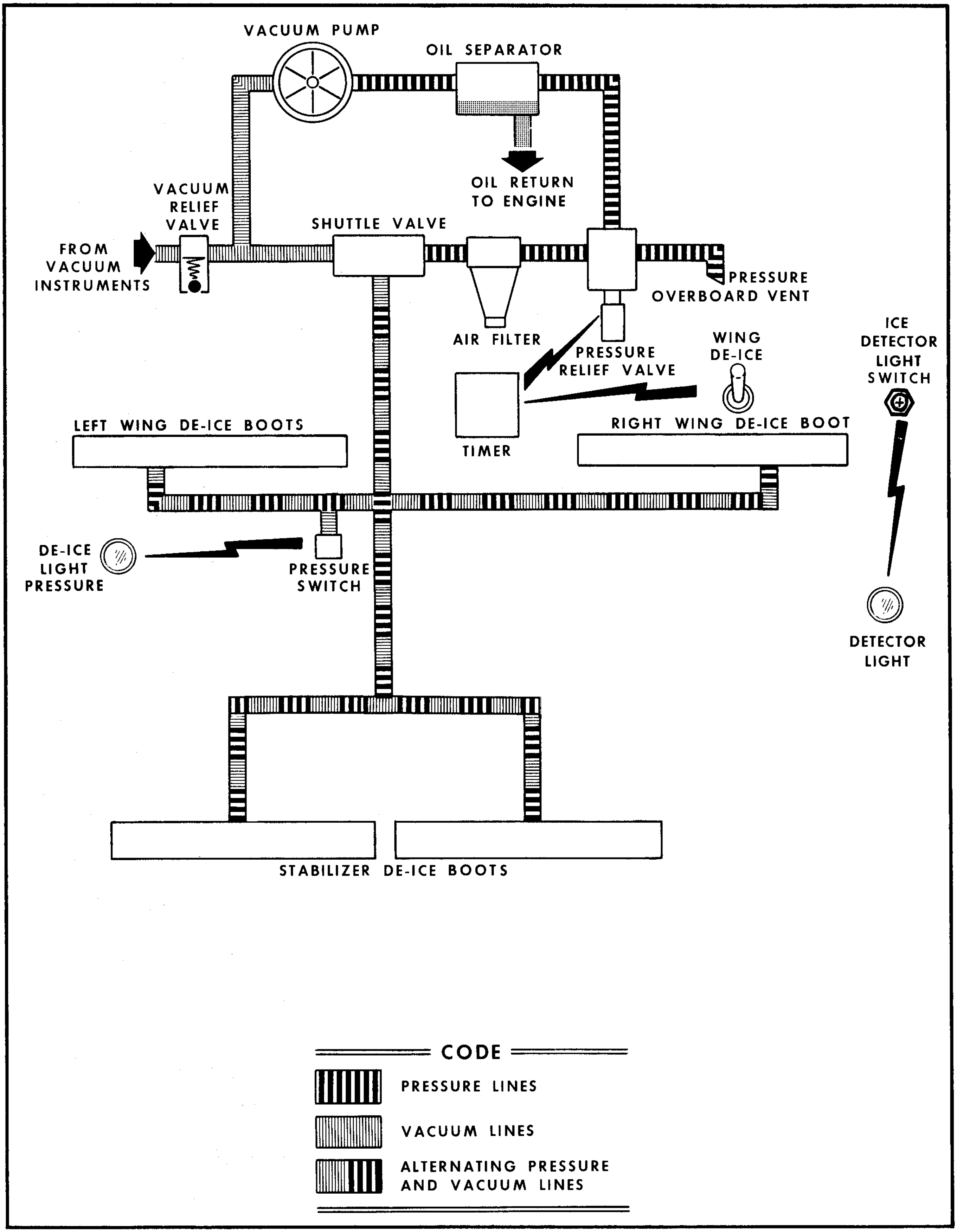
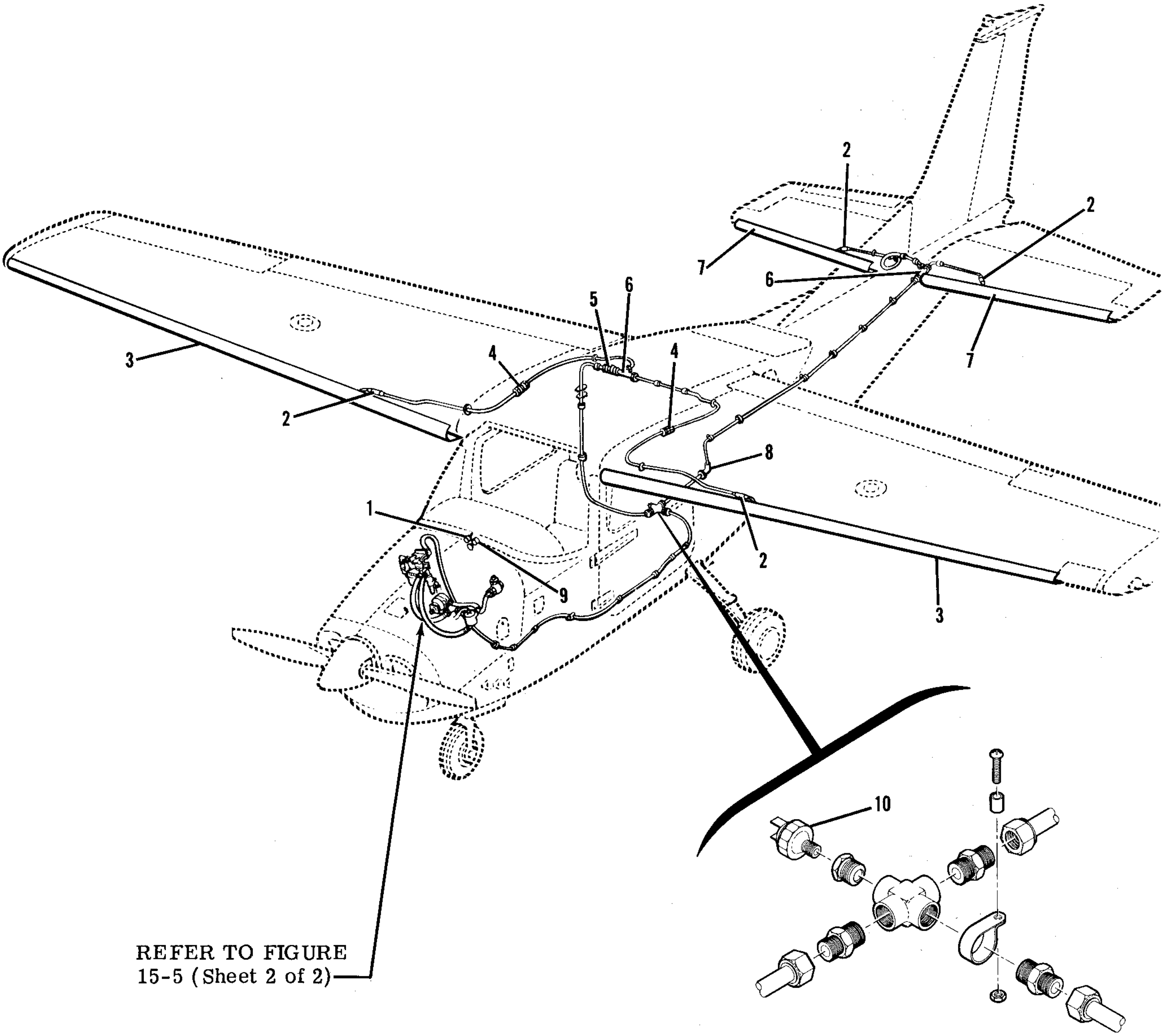
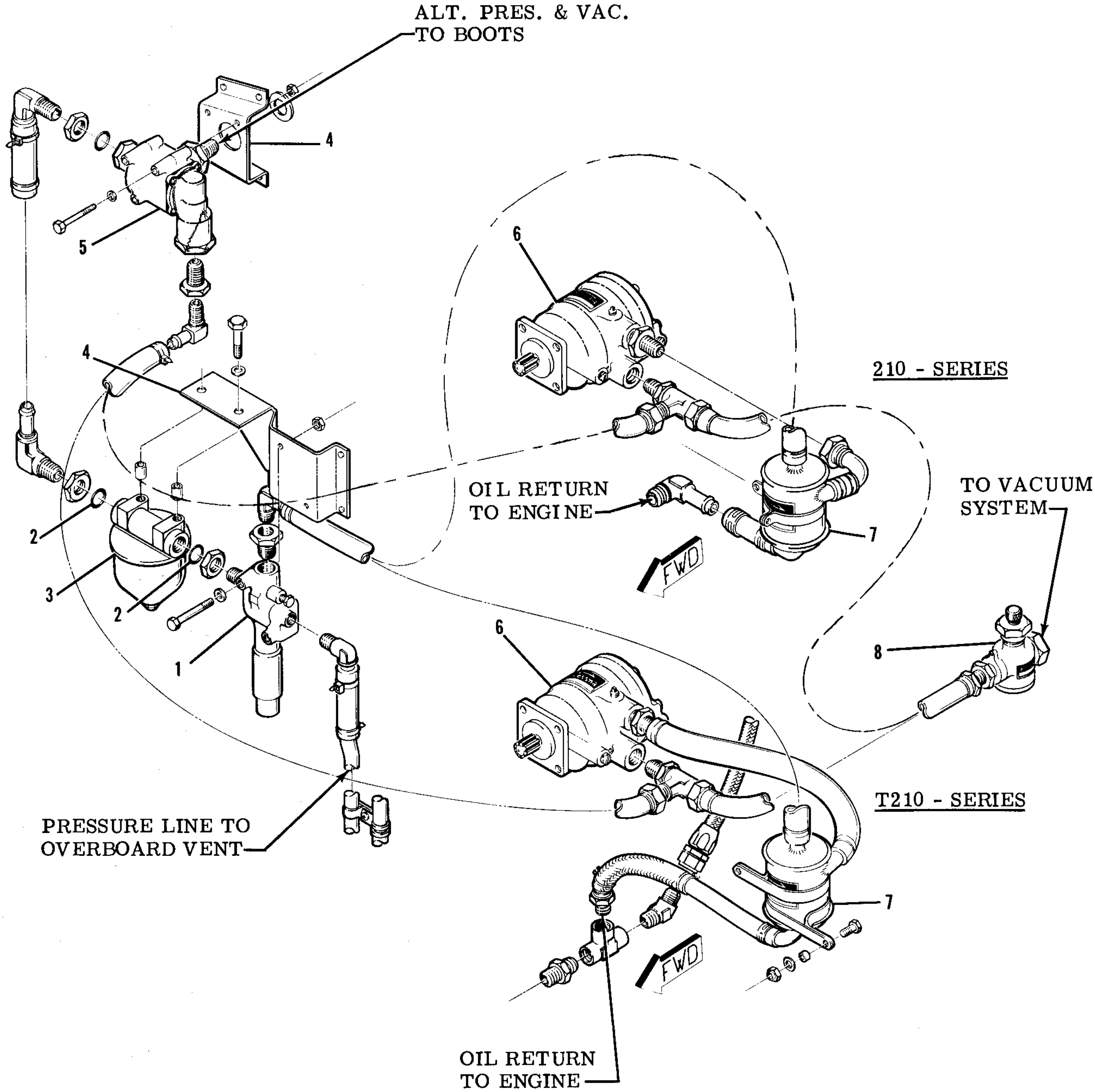


Figure 15-4. Wing and Horizontal Stabilizer De-Ice System Schematic



1. Timer and Control Switch
2. Coupling
3. Wing De-Ice Boots
4. Union
5. Female Connector
6. Tee
7. Horizontal Stabilizer De-Ice Boots
8. Elbow
9. Press to Test Light
10. Pressure Switch

Figure 15-5. Wing and Horizontal Stabilizer De-Ice System (Sheet 1 of 2)



1. Pressure Relief Valve
2. O-Ring
3. Filter
4. Bracket
5. Shuttle Valve
6. Engine Driven Pump
7. Oil Separator
8. Vacuum Relief Valve

Figure 15-5. Wing and Horizontal Stabilizer De-Ice System (Sheet 2 of 2) side of the pump passes through an oil separator, across the pressure relief valve, and overboard when the system is not operating. When the de-ice switch is turned on, the timer closes the pressure relief valve overboard line and directs the air from the pressure side of the vacuum pump through a filter, shuttle valve, and into the de-ice boots for the inflation cycle. Inflation time of the boots is approximately six seconds and the de-ice light on the switch panel should be illuminated during the inflation cycle. At the completion of the inflation cycle, the timer opens the pressure relief valve, returning vacuum pump pressure overboard. Pressure in the boots is returned through the system and overboard through the pressure relief valve. When the shuttle valve has less than one psi against it, it closes and the vacuum side of the vacuum pump holds the boots in a deflated position. The timer automatically repeats the cycle after a pause of approximately 3 minutes to allow sufficient ice build-up for efficient de-icing.

15-20. REMOVAL AND INSTALLATION OF DE-ICE SYSTEM. For removal and installation of de-ice system components refer to figures 15-5 through 15-6. Refer to figure 15-6 for ice detector light.

15-21. TROUBLE SHOOTING DE-ICE SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DE-ICE BOOTS DO NOT INFLATE OR INFLATE SLOWLY.		
Loose or faulty wiring.	Check circuit for continuity.	Repair or replace wiring.
Loose or damaged hose.	Check for leaks as outlined in paragraph 15-22, Air Leakage Test.	Tighten or replace hose.
Loose or missing gasket.	Check for leaks as outlined in paragraph 15-22, Air Leakage Test.	Tighten fitting and/or replace gasket.
Shuttle valve malfunction.	Check shuttle valve for proper sequence of operation.	Replace shuttle valve.
Pressure relief valve set too low.	Install gage and check pressure relief valve setting for 15 psi.	Reset or replace valve.
Pressure relief valve malfunction.	Place a steel scale against solenoid, checking for magnetic field. If magnetic field is not present, solenoid is defective.	Replace pressure relief valve.
Defective timer.	Refer to wiring diagram and run voltage check through timer.	Replace timer.
DE-ICE BOOTS DO NOT DEFLATE OR DEFLATE SLOWLY.		
Pressure relief valve malfunction.	Place a steel scale against solenoid, checking for magnetic field. If magnetic field is not present, solenoid valve is defective.	Replace pressure relief valve.
Shuttle valve malfunction.	Check shuttle valve for proper sequence of operation.	Replace shuttle valve.
Defective timer.	Refer to wiring diagram and run voltage check through timer.	Replace timer.

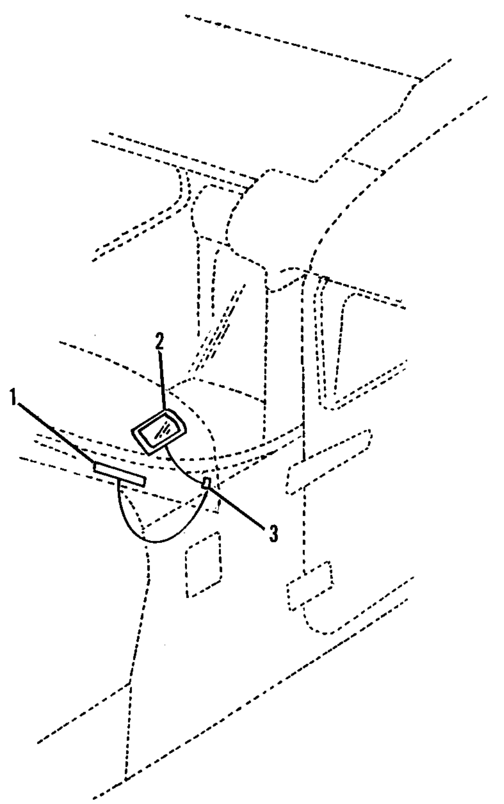


Figure 15-6. Ice Detector Light System

15-22. DE-ICE SYSTEM OPERATIONAL CHECK.

a. Electrical Test:

1. Turn WING DE-ICE switch to off position.
2. Place master switch in ON position.
3. Press WING DE-ICE indicator light to check light circuit and bulb. Make sure dimming lens on indicator is open.
4. Turn WING DE-ICE switch on and repeat step 3.
5. If indicator light does not function in steps 3 and 4, the circuit breaker may have opened. Check for short in the system. Reset circuit breaker and repeat step 3.

b. Air Leakage Test:

1. This test can be performed in the engine compartment.
2. Disconnect pressure hose from pressure relief valve inlet port.
3. Disconnect vent tube from overboard port, and cap port.
4. Connect a source of clean air to the pressure relief valve inlet port. It is necessary that the inlet pressure be a minimum of 18-20 psi to perform this test. Include a pressure gage in the air line to observe the system pressures.
5. Apply 18 psi pressure to the system and, by means of a hand-operated valve, trap the pressure in the de-ice system. Observe the system for leakage. The leakage rate should not exceed a pressure drop of 4.0 psi per minute.
6. If the leakage exceeds 4.0 psi per minute, use a soap and water solution to locate leaks. Tighten connections as required.
7. To check the pressure switch, place master switch on while de-ice system is pressurized. The indicator light should illuminate.
8. Remove test equipment, lubricate all threads and connect all system components disconnected.

c. Vacuum Relief Valve Adjustment and System Test:

1. Adjust vacuum relief valve as outlined in paragraph 16-32.
2. With vacuum relief valve adjusted and engine operating at 2400 rpm, place WING DE-ICE switch to ON position and observe de-ice system operation. System is functioning satisfactorily if the WING DE-ICE indicator light illuminates within 4.0 seconds after turning WING DE-ICE switch on.

d. Timer Cycle Check:

1. With engine operating at 2100 rpm, place WING DE-ICE switch to ON position. As soon as de-ice boots inflate, reduce engine speed to normal idle for approximately 2-1/2 minutes. This permits timer to complete its cycle. At the end of the 2-1/2 minute idle period, increase engine speed to 2100 rpm and observe de-ice boots for inflation. Elapsed time from inflation to inflation should be approximately 3 minutes.

2. If it appears that the timer is defective, apply 14 vdc to pins #1 and #2 and listen for action of stepping switch.

CAUTION

The negative ground must be applied to pin #1; pin #2 is positive. A reverse voltage will ruin the timer diode. The 14 vdc must be filtered if it is rectifed from ac; a battery should be used.

15-23. DE-ICE BOOT REPAIR (COLD PATCH).

NOTE

B. F. Goodrich "cold patch" Repair Kit No. 3306, for surface ply de-ice boot repair, is available from the Cessna Service Parts Center.

15-24. There are four types or areas of damage that are most common to the de-ice boots. The following procedures describe the damage and technique for the repair.

NOTE

When repairing the de-ice boots and replacement layers are being installed, exercise care to prevent trapping air beneath the replacement layers. If air blisters appear after material is applied, remove them with a hypodermic needle.

Scuffed or Damaged Surface:

This type of damage is the most commonly encountered and is usually caused by scuffing the outer surface of the de-ice boots while using scaffolds, refueling hose, ladders, etc. Repair is generally not necessary because the thick outer veneer provides protection to the natural rubber underneath. If the damage is severe and has caused removal of the entire thickness of veneer (exposing the brown natural rubber underneath), the damage should be repaired as follows:

a. Select a patch (Part Number 3306-1, 3306-2, or 3306-3) large enough to cover the damaged area.
b. Using a clean cloth dampened with solvent, thoroughly clean the damaged area.
c. Buff the area around the damage with steel wool so that the area is moderately but completely roughened.
d. Wipe the buffed area clean with a cloth slightly dampened with solvent to remove all loose particles.
e. Apply one even coat of EC-1403 cement to the patch and corresponding damaged area of the de-ice boot and allow cement to dry completely.
f. Reactivate cemented surfaces with solvent. Apply patch to the de-ice boot with an edge or the center adhering first, and work the remainder of the patch down, being careful to avoid air pockets between patch and boot.
g. Roll the patch thoroughly with a stitcher-roller (Part Number 3306-10) and allow to set for 10 to 15 minutes.
h. Wipe the patch and surrounding area, from the center of the patch outward, with a cloth slightly dampened with solvent.
i. Apply one light coat of A-56-B conductive cement (Part Number 3306-13) to the patched area to restore conductivity.

NOTE

Satisfactory adhesion should be obtained in four hours; however, if the patch is allowed to cure for a minimum of 20 minutes, the de-ice boots may be inflated to check the repair.

Damage to Tube Area:

This type of damage consists of cuts, tears, or ruptures to the inflatable tube area and a fabric reinforced patch must be used for this repair. Damage to the tube area should be repaired as follows:

a. Select a patch (Part Number 3306-4, 3306-5, or 3306-6) of ample size to extend at least 5/8-inch beyond the damage area.

NOTE

If none of these patches are of proper size, one may be cut to the size desired from one of the larger patches. If this is done, the edge should be beveled by cutting with the shears at an angle. These patches are manufactured so they will stretch in one direction only. Be sure to cut patch selected so that the stretch is in the widthwise direction of the inflatable tubes.

b. Using a clean cloth dampened with solvent, thoroughly clean the area to be repaired.
c. Buff the area around the damage with steel wool so that the area is moderately but completely roughened.
d. Wipe the buffed area clean with a cloth slightly dampened with solvent to remove all loose particles.
e. Apply one even, thorough coat of EC-1403 cement to the patch and the corresponding damaged area of the de-ice boot. Allow cement to dry completely.
f. Reactivate cemented surfaces with solvent. Apply patch to de-ice boot with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place first and working remainder down with a very slight pulling action so the injury is closed. Use care to avoid air pockets between patch and de-ice boot surface.
g. Roll the patch thoroughly with a stitcher-roller and allow to set for 10 to 15 minutes.
h. Wipe the patch and surrounding area, from the center of the patch outward, with a cloth slightly dampened with solvent.
i. Apply one light coat of A-56-B conductive cement to restore conductivity.

NOTE

Satisfactory adhesion of patch to de-ice boot should be reached in four hours; however, if the patch is allowed to cure for a minimum of 20 minutes, the de-ice boots may be inflated to check the repair.

Damage to Fillet Area:

This includes any tears or cuts to the tapered area aft of the inflatable tubes. Damage to the fillet area should be repaired as follows:

a. Trim damaged area square and remove excess material. Cut must be sharp and clean to permit a good butt joint of the inlay.
b. Cut an inlay from tapered filler (Part Number 3306-7) to match cutout area.
c. Using solvent, loosen edges of de-ice boot around cutout area approximately 1-1/2 inches from all edges.
d. Thoroughly clean the area to be repaired, using a cloth dampened with solvent.
e. Lift edges of loosened boot around cutout, and apply one coat of EC-1403 cement to underneath side of boot.
f. Apply one coat of EC-1403 cement to the wing skin underneath the loosened edges of de-ice boot, allowing cement to extend 1-1/2 inches beyond edges of boot into cutout area.
g. Apply a second coat of EC-1403 cement to underneath side of boot as outlined in step "e."
h. Apply one coat of EC-1403 cement to one side of a 2-inch wide, neoprene-coated fabric tape (Part Number 3306-8) and allow cement to dry. Trim the tape to size of cutout. This tape is necessary to reinforce splice.

i. Reactivate cemented surface of tape and wing skin with solvent and apply tape to wing skin. Use care to center tape under all edges of cutout.
j. Roll down tape on wing skin with stitcher-roller to assure good adhesion, being careful to avoid air pockets between tape and wing skin.
k. Apply one coat of EC-1403 cement to top surface of tape and allow cement to dry approximately 5 to 10 minutes.
l. Reactivate cemented surfaces of boot wing skin and tape with solvent. Working toward the cutout, roll down carefully the edges of the loosened boot to prevent trapping air. The boot edges should overlap the tape approximately 1 inch.
m. Roughen back surface of inlay repair material (Part Number 3306-7, previously cut to size) with steel wool. Thoroughly clean with solvent and apply one coat of EC-1403 cement.
n. Apply one coat of EC-1403 cement to wing skin inside cutout area and allow to dry.
o. Apply the second coat of EC-1403 cement to inlay repair material and allow to dry.
p. Reactivate cemented surfaces with solvent and carefully insert inlay material with feathered edge of inlay aft. Working from forward edge aft, carefully roll down the inlay to avoid trapping air.
q. Roughen area on outer surface of de-ice boot and inlay with steel wool 1-1/2 inch on either side of splice. Clean with solvent and apply one coat of EC-1403 cement.
r. Apply one coat of EC-1403 cement to one side of 2-inch wide, neoprene-coated fabric tape (Part Number 3306-8), trim to size, and center tape over splice on three sides.
s. Roll down tape on de-ice boot and inlay with stitcher-roller to assure good adhesion, being careful to avoid trapping air.
t. Apply one light coat of A-56-B conductive cement to restore conductivity.

Veneer Loose From De-Ice:

If the veneer should become loose from the de-ice boot, repair should be made as follows:

a. Peel and trim the loose veneer to a point where the adhesion of veneer to the de-ice boot is good.
b. Roughen area in which veneer is removed with steel wool. Motion must be parallel to cut edge of veneer ply, to prevent loosening it.
c. Taper edges of veneer down to the tan rubber ply by rubbing parallel to cut edge of veneer with steel wool and solvent.
d. Cut a piece of veneer material (Part Number 3306-9) large enough to cover the damaged area and extend at least 1 inch beyond in all directions.
e. Mask off the damaged boot area 1/2-inch larger in width and length than the patch.
f. Apply one coat of EC-1403 cement to damaged boot area and allow to dry.
g. Apply second coat of EC-1403 cement to damaged boot area and allow to dry.
h. Reactivate cement surface with solvent. Peel the backing from the veneer, and for 6 inches of its length, and roll the veneer to the boot with a 2-inch roller. Roll edges with stitcher-roller.
i. Continue stripping the backing from the veneer as the rolling progresses, applying a slight tension on the veneer ply to prevent wrinkling.
j. Be careful to prevent trapping air. If air blisters appear after veneer is applied, remove them with a hypodermic needle.
k. Wipe the patch and surrounding area, from the center of the patch outward, with a cloth slightly dampened with solvent.
l. Apply one light coat of A-56-B conductive cement to restore conductivity.

15-25. MATERIALS REQUIRED FOR INSTALLATION OF DE-ICE BOOTS.

1. No. EC-1300L (EC-1403) Cement, Minnesota Mining & Manufacturing Company.
2. Methyl-Isobutyl Ketone (MIBK).
3. Cleaning Solvent - Toluol.
4. Cleaning Solvent - Hexane.
5. Clean, lint-free cleaning cloths.
6. Four yards clean, heavy canvas duck fabric 48 inches wide.
7. Several empty tin cans.
8. Three-inch paint brushes.
9. Two-inch rubber hand rollers.
10. 1/4-inch metal hand stitcher roller, B. F. Goodrich Company (Part Number 3306-10).
11. Carpenters' chalk line.
12. One-inch masking tape.
13. Steel measuring tape.
14. Sharp knives.
15. Fine sharpening stone.
16. No. EC-539 Sealing Compound, Minnesota Mining & Manufacturing Company.
17. No. A-56-B Cement, B. F. Goodrich Company (Part Number 3306-15).

15-26. REPLACEMENT OF DE-ICE BOOTS. To remove or loosen installed de-ice boots, use toluol or toluene to soften the "cement" line. Apply a minimum amount of this solvent to the cement line as tension is applied to peel back the boot. Removal should be slow enough to allow the solvent to undercut the cement so that parts will not be damaged. To install a wing de-icer boot, proceed as follows:

a. Clean the metal surfaces and the bottom side of the de-icer thoroughly with Methyl Ethyl Ketone or Methyl Isobutal Ketone. This shall be done by wiping the surfaces with a clean, lint-free rag soaked with the solvent and then wiping dry with a clean, dry, lint-free rag before the solvent has time to dry.

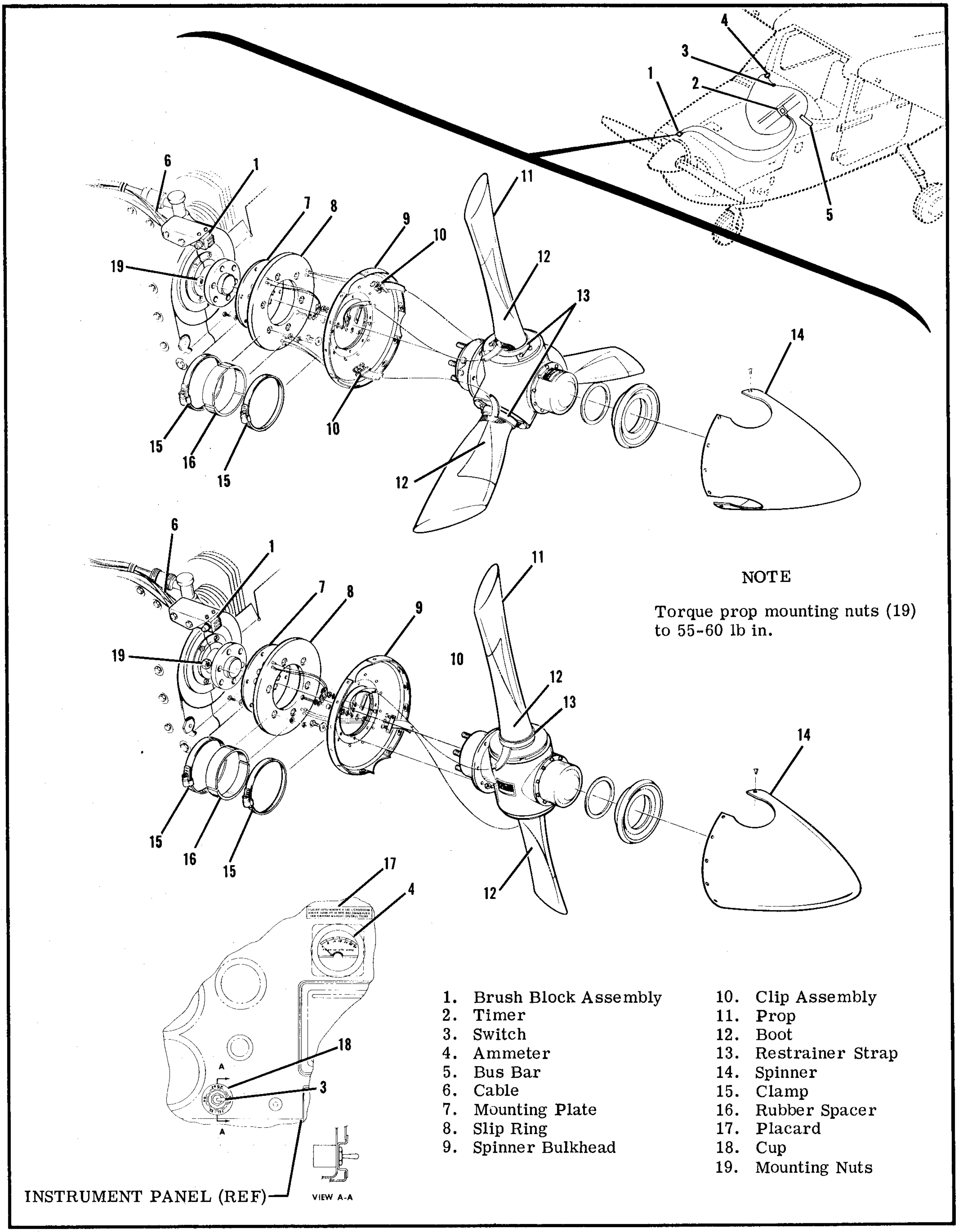
b. Place one inch masking tape on wing to mask off boot area allowing 1/2 inch margin. Take care to mask accurately so that clean-up time will be reduced.

c. Stir EC-1300L (EC-1403) cement thoroughly before using. Apply one even brush coat to the metal and to the rough side of the boot, brushing well into the rubber. Allow cement to air dry for a minimum of 30 minutes and then apply a second coat to each of the surfaces. Allow at least 30 minutes, preferably one hour, for drying.

d. Snap a chalk line along the leading edge line of the wing and a corresponding line on the inside of the de-icer if it does not have a centerline. Securely attach hoses to the de-icer connections. Position the centerline of the boot with the leading edge of the wing, and using a clean, lint-free cloth heavily moistened with toluol, reactivate the surface of the cement on the wing and the boot in small spanwise areas about six inches wide. Avoid excess rubbing of the cement, which would remove it from the surface. Have enough help to hold boot in a vertical plane. Place the chalk lines in alignment, and starting at one end of the boot, tack it to the wing along the leading edge line. Hold the rest of the boot clear of the wing. Roll along the leading edge line with a rubber roller, and an inch or two on either side. Taking approximately six inches of chord at a time, roll from the leading edge aft in firm, overlapping chordwise strokes of the rubber roller until the entire boot is in contact with the airfoil. It is important that all air be removed from between the rubber and the metal, and that the boots be distorted to a minimum amount. If any air is trapped between the rubber and the metal, it may be removed by the careful use of a small hypodermic needle, except in the tube area. Use the metal stitcher roller around the edges of the boot and connections. Fill any gaps between adjoining boots with EC-539 sealer. Apply a brush coat of A-56-B cement to exposed surfaces of cement and along trailing edges of boot to form a neat straight line. Remove masking tape and clean surfaces with toluol.

15-27. PROPELLER ANTI-ICE SYSTEM. The propeller anti-ice system is of an electrothermal type. The system consists of the following components added to the aircraft: Propeller blade anti-icers bonded to propeller blades, a slip ring assembly mounted on the propeller, a brush holder assembly mounted on the engine crankcase, a repeat cycle timer, an ammeter mounted in the instrument panel, a switch and a circuit breaker. The anti-icing is accomplished by raising the temperature of the ice and anti-icer interface to a point, at which centrifugal force removes the ice. The cycle timer used on the anti-icing system heats the propeller anti-icer outer elements from 28 to 40 seconds, then cycles to the propeller inner elements from 28 to 40 seconds. It then returns to the outer elements and continues cycling action. Heating may begin at any phase in the cycle, depending on the timer position when the switch was turned off from previous use. Ground checkout of the system is permitted with the engines not running. When a new slip ring or brush assembly has been installed, allow a minimum of five hours engine running time before operating anti-ice system.

SHOP NOTES:



NOTE

Torque prop mounting nuts (19) to 55-60 lb in.

1. Brush Block Assembly
2. Timer
3. Switch
4. Ammeter
5. Bus Bar
6. Cable
7. Mounting Plate
8. Slip Ring
9. Spinner Bulkhead
10. Clip Assembly
11. Prop
12. Boot
13. Restrainer Strap
14. Spinner
15. Clamp
16. Rubber Spacer
17. Placard
18. Cup
19. Mounting Nuts

Figure 15-7. Propeller Anti-Ice System

15-28. TROUBLE SHOOTING PROPELLER ANTI-ICE SYSTEM.

NOTE

The propeller anti-ice ammeter may be used while trouble shooting the system. The ammeter needle should rest within the shaded band except for "flickers" approximately 30 seconds apart, as the step switch of the timer operates. The ammeter will also reflect a bad connection or open circuit by reading below normal or zero. A high reading indicates a short circuit.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ELEMENTS DO NOT HEAT.		
Circuit breaker out or defective.	Check visually. If not out, check continuity through circuit breaker.	Reset circuit breaker. If it pops out again, determine cause and correct. Replace defective parts.
Defective wiring.	Check continuity.	Repair or replace wiring.
Defective switch.	Check continuity through switch.	Replace switch.
Defective timer.	Refer to paragraph 15-29.	Replace timer.
Defective brush-to-slip ring connection.	Check continuity through brush-to-slip ring area.	Check alignment. Replace defective parts.
SOME ELEMENTS DO NOT HEAT.		
Incorrect wiring.	Check wiring diagram.	Correct wiring.
Defective wiring.	Check continuity.	Repair or replace wiring.
Defective timer.	Refer to paragraph 15-29.	Replace timer.
Defective brush-to-slip ring connection.	Check continuity through brush-to-slip ring area.	Check alignment. Replace defective parts.
Defective element.	Check continuity through each element.	Replace element.
CYCLING SEQUENCE NOT CORRECT OR NO CYCLING.		
Crossed connections.	Check wiring diagram.	Correct wiring.
Defective timer.	Refer to paragraph 15-29.	Replace timer.
RAPID BRUSH WEAR, FREQUENT BREAKAGE, SCREECHING OR CHATTERING.		
Brush block or slip ring out of alignment.	Check per figure 15-8.	Align properly.

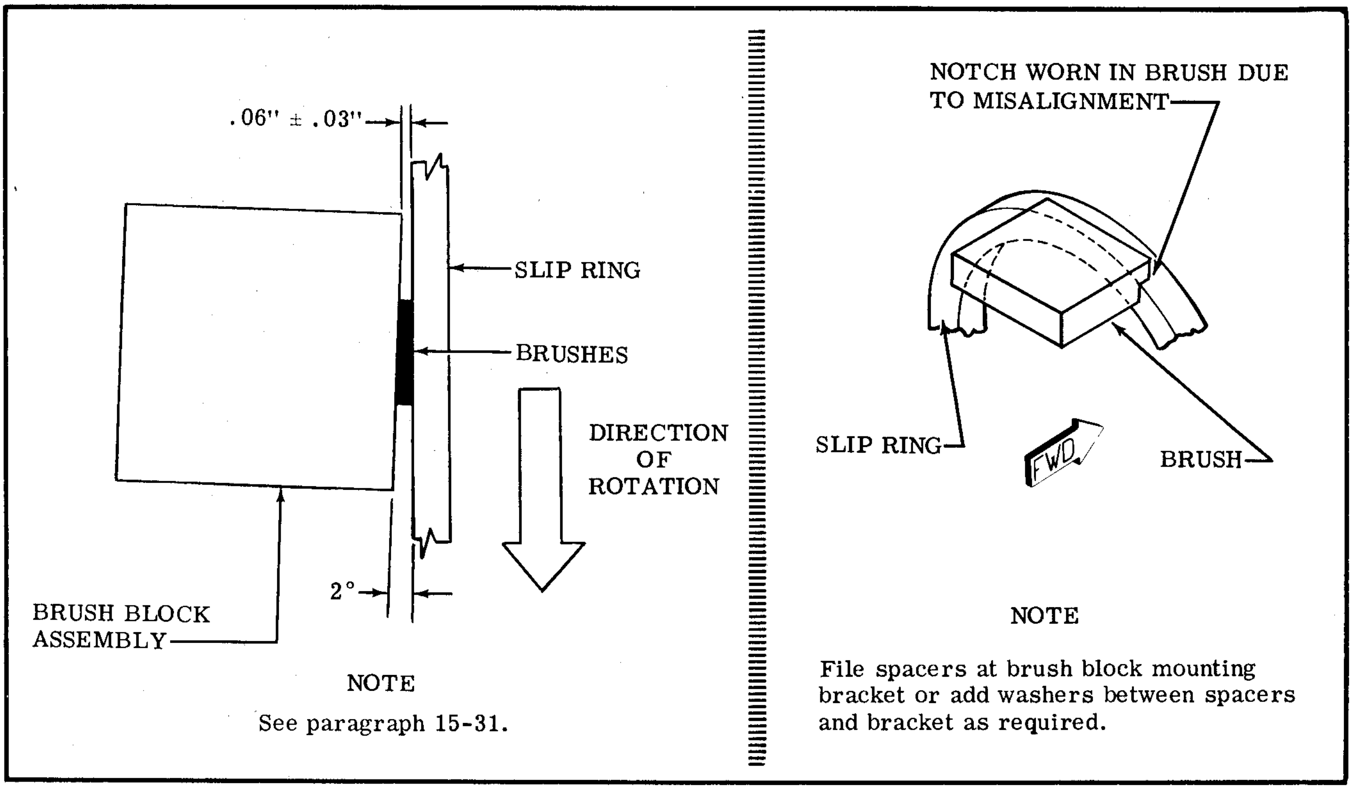


Figure 15-8. Brush Alignment

15-29. TIMER TEST.

a. Disconnect harness at timer. With master and control switches turned on, check for system voltage from pin B of harness plug to ground. If system voltage is present, check ground circuit, using ohmmeter, from harness plug pin G to ground. These checks assure that power and ground circuits to the timer are not defective.

b. After power and ground circuits have been checked, connect jumper wire from pin B of harness to B contact of timer socket. Connect jumper wire from pin G of harness to G contact of timer socket. Use voltmeter from ground to contacts C. D. E. and F of timer socket, in that order. Each of these contacts must deliver voltage for approximately 30 seconds, in turn, and there must be zero voltage on the three contacts not energized. These checks assure that the timer is cycling correctly.

NOTE

The ON time is approximately 30 seconds when engines are running. When operating on battery voltage, as in this check, ON time will be slightly longer. The timer does not reposition itself to start at pin C, but begins cycling at the same position in which it was last turned off. Cycling will then proceed in the sequence noted.

15-30. REMOVAL AND INSTALLATION OF COMPONENTS. After removing propeller and spinner dome in accordance with instructions in Section 14, the slip ring, spinner bulkhead, and electrical components may be replaced while using figure 15-7 as a guide. The brush block assembly may be replaced without removing the propeller.

15-31. INSTALLATION OF BRUSH BLOCK ASSEMBLY. When installing a brush block assembly, it must clear the slip ring. .06"±.03" at the closest point. Loosen mounting screws and move in elongated holes as required. Check that brush block has approximately 2° angle as shown in figure 15-8. Loosen mounting bolts and twist block while tightening to attain proper angle.

15-32. REPLACEMENT OF ANTI-ICE BOOTS. To remove or loosen installed anti-ice boots, use toluol to soften the "cement" line. Apply a minimum amount of this solvent to the cement line as tension is applied to peel back the boot. Removal should be slow enough to allow the solvent to undercut the cement so that parts will not be damaged. To install a propeller anti-ice boot, proceed as follows:

a. Clean the metal to be bonded with Methyl Ethyl Ketone, (MEK). For final cleaning, wipe the solvent film off quickly with a clean, dry cloth before it has time to dry.

b. Prepare a pattern the size of the boot, including three inches of the boot strap. Draw a centerline (lengthwise) through the pattern.

c. Draw a line on the centerline of the leading edge of the blade. Position the pattern centerline over the leading edge centerline. Position pattern so bottom of boot is 1/4" below spinner cutout. Draw a line on the propeller hub on each side of the pattern boot strap where it crosses the hub. Check boot strap position by fitting strap clamp on the hub and comparing its position with the marked position of the strap.

d. Mask off an area 1/2" from each side and outer end of the pattern, and remove the pattern.

e. Mix EC-1403 cement (Minnesota Mining & Mfg. Co.) thoroughly and apply one even coat to the cleaned metal surface. Allow to dry for a minimum of one hour, then apply a second coat of the cement.

f. Moisten a clean cloth with Methyl Ethyl Ketone and clean the unglazed back surface of the boot, changing cloths frequently to avoid contamination of the cleaned area.

g. Apply one even coat of EC-1403 cement to back surface of boot. It is not necessary to cement more than 1/2" of the boot strap.

h. Using a silver-colored pencil, mark a centerline along the leading edge of the propeller blade and a corresponding centerline on the cemented side of the boot.

i. Reactivate the surface of the cement using a clean, link-free cloth, heavily moistened with toluol. Avoid excessive rubbing of cement; which would remove the cement.

j. Position the boot centerline on the propeller leading edge, starting at the hub end at the position marked. Make sure that boot strap will fall in the position marked. Tack the boot centerline to the leading edge of the propeller blade. If the boot is allowed to get off-center, pull up with a quick motion and replace properly. Roll firmly along centerline with a rubber roller.

k. Gradually tilting the roller, work the boot carefully over either side of the blade contour to avoid trapping air in pockets.

l. Roll outwardly from the centerline to the edges. If excess material at the edges tends to form wrinkles, work them out smoothly and carefully with fingers.

m. Apply one even coat of EC-539 (Minnesota Mining & Mfg. Co.), mixed per manufacturer's instructions, around the edges of the installed boot.

n. Remove masking tape from the propeller and clean the surface of the propeller by wiping with a clean cloth dampened with toluol.

o. Place strap clamp in position and secure with screws, washers, and sleeves.

15-33. OXYGEN SYSTEM.

15-34. DESCRIPTION. The system is comprised of an oxygen cylinder and regulator assembly, filler valve, pressure lines and six outlets, four in the left and right cabin wing root areas, and two in the overhead console, above the pilot and copilot. Oxygen mask and line assemblies are furnished with the system. The pilot's supply line is designed to provide a greater flow of oxygen than the passenger's lines. The pilot's oxygen mask is equipped with a microphone that is keyed by a switch button on the pilot's control wheel. A pressure gage is mounted in the overhead console above the pilot and copilot. An access door is provided on the left side of the tailcone, just aft of the baggage door. This door provides access to the oxygen cylinder and the filler valve.

15-35. MAINTENANCE PRECAUTIONS.

a. Working area, tools and hands must be clean.

b. Keep oil, grease, water, dirt, dust, and all other foreign matter from system.

c. Keep all lines dry and capped until installed.

d. All compounds used on fittings must conform to MIL-T-5542. No compounds shall be used on aluminum flared fittings. Compounds are used only on the first three threads of the male fittings. No compound is used on coupling sleeves or outside of tube flares.

e. Fabrication of pressure lines is not recommended. Lines should be replaced by part numbers.

f. Lines and fittings must be clean and dry. One of the following methods may be used.

1. Clean with a vapor degreasing solution of stabilized trichlorethylene, conforming to MIL-T-7003. This specification has been superseded by Federal Specification O-T-634 and/or MIL-T-27602. Although MIL-T-7003 has been superseded, material can still be supplied to the requirements of the particular specifications. These items can be obtained from American Mineral Spirits of Houston, Texas.

NOTE

Most air compressors are oil lubricated, and a minute amount of oil may be carried by the airstream. If only an oil lubricated air compressor is available, drying must be accomplished by heating at a temperature of 250° to 300°F for a suitable period.

2. Flush with naptha conforming to Specification TT-N-95 (aliphatic naptha). Blow clean and dry off all solvents with clean, dry, oil-free, filtered air. Flush with anti-icing fluid conforming to Specification MIL-F-5566, or anhydrous ethyl alcohol. MIL-F-5566 has been superseded by Federal Specification TT-T-735. Rinse thoroughly with fresh water. Dry thoroughly with a stream of clean, dry, oil-free, filtered air.

3. Flush with hot inhibited alkaline cleaner until free from oil and grease. Rinse with fresh water and dry with clean, dry, filtered air.

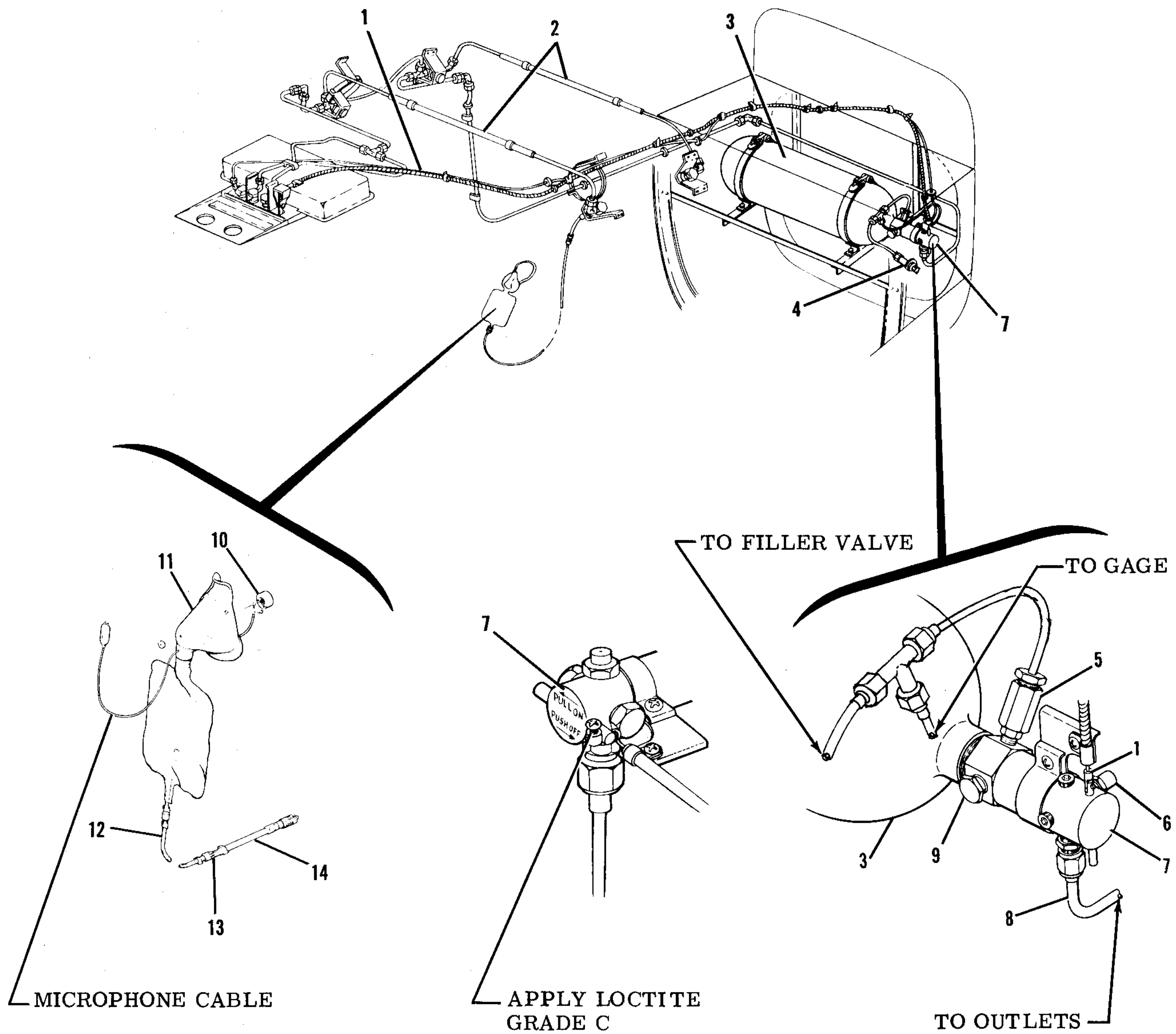
NOTE

Cap lines at both ends immediately after drying to prevent contamination.

15-36. REPLACEMENT OF COMPONENTS. Removal, disassembly, assembly and installation of components may be accomplished while using figure 15-9 as a guide.

CAUTION

The pressure regulator, pressure gage and line, and filler valve and line should be removed and replaced only by personnel familiar with high-pressure fittings. Observe the maintenance precautions listed in the preceding paragraph.

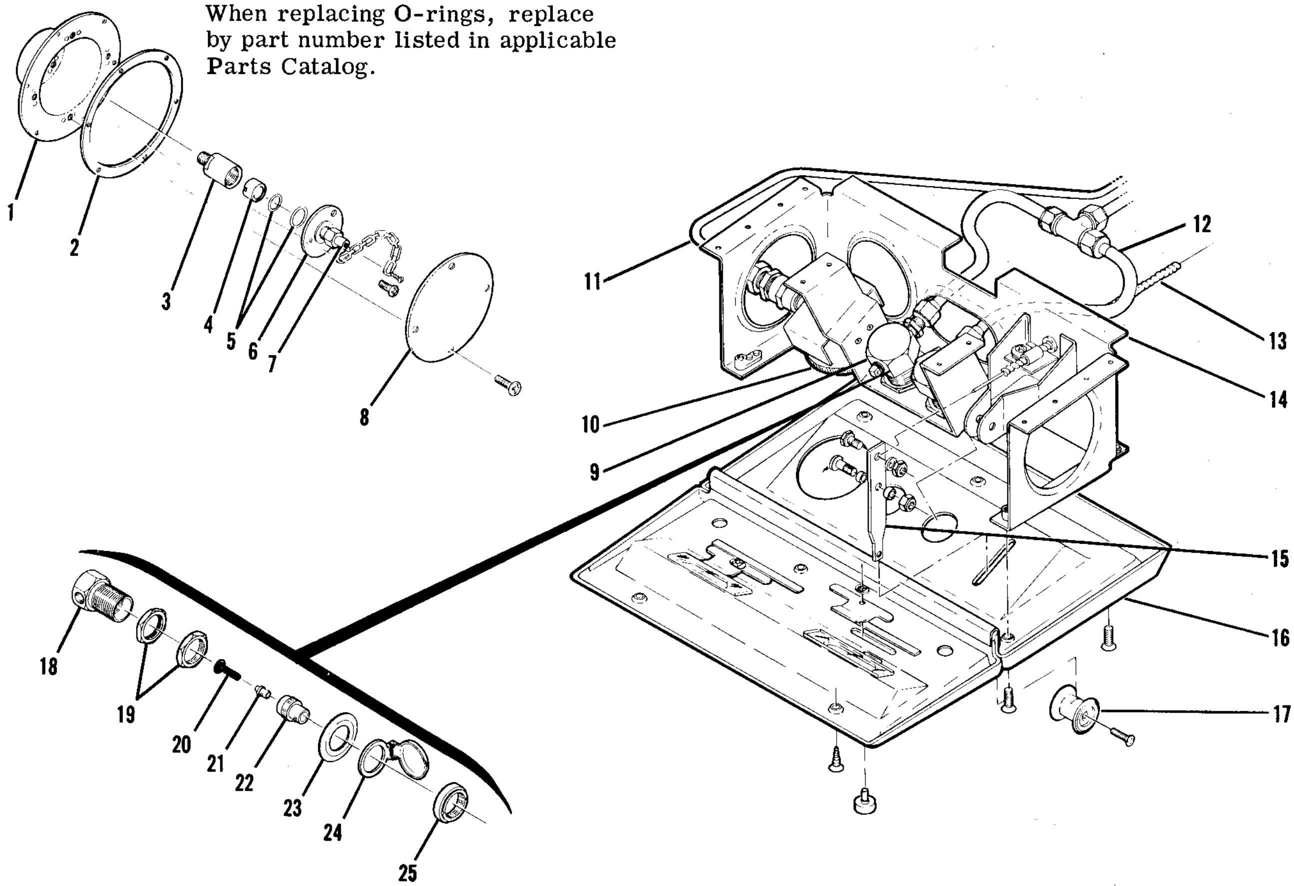


1. ON-OFF Control
2. Sleeve
3. Cylinder
4. Filler Valve
5. Quick-Disconnect Valve
6. Low Pressure Relief Valve
7. Regulator
8. Low Pressure Outlet Line
9. High Pressure Relief Valve
10. Microphone
11. Mask
12. Hose
13. Flow Indicator
14. Line

Figure 15-9. Oxygen System (Sheet 1 of 2)

NOTE

Items (3) thru (7) constitute a standard filler valve. Filler valves are mounted in different locations on various models. When replacing O-rings, replace by part number listed in applicable Parts Catalog.



TYPICAL OUTLET

1. Adapter
2. Spacer
3. Seat
4. Piston
5. O-Ring
6. Valve
7. Cap
8. Cover
9. Outlet
10. Pressure Gage
11. Pressure Gage Line
12. Outlet Pressure Line
13. ON-OFF Control
14. Bracket
15. Arm
16. Cover
17. Knob
18. Base
19. Jam Nut
20. Spring
21. Poppet
22. Core
23. Escutcheon
24. Cover
25. Lock Ring

OUTLET & FILLER VALVE DETAILS

Figure 15-9. Oxygen System (Sheet 2 of 2)

NOTE

Oxygen cylinder and regulator assemblies may not always be installed in the field exactly as illustrated in figure 15-9, which shows factory installation. Important points to remember are as follows:

a. The vent hole in the regulator body must not be covered by the control clamp installed around the regulator body.
b. The low pressure relief valve should not be removed from the regulator except for replacement as it is installed in a specific port only. Although the other three low pressure ports are common to each other, the low pressure relief valve port is not.
c. The high pressure relief valve should not be removed from the regulator except for replacement. Although all high pressure ports are common to each other, the thread size is different for the high pressure relief valve.
d. Before removing cylinder, release low pressure line by opening cabin outlets. Disconnect push-pull control cable, filler line, pressure gage line, and outlet line from regulator. CAP ALL LINES IMMEDIATELY.
e. If it is necessary to replace filler valve O-rings, remove door on the left side of tailcone, just aft of the baggage door for access. Remove line from quick-disconnect valve at the regulator, then disconnect chain but do not remove cap from filler valve. Remove screws securing valve and disconnect pressure line. Referring to figure 15-9, cap pressure line and seat (3). Disassemble valve, replace O-rings, and reassemble valve. Install filler valve by reversing procedure outlined in this step.
f. Figure 15-9 illustrates a cabin outlet. To replace valve core (22), unscrew core with a suitable tool that will engage lugs protruding at each side of core. When installing core, be sure that poppet (21) is in place in spring (20), and that other end of poppet enters center of core. If these parts are not positioned properly, the outlet will not operate properly.
g. To remove entire oxygen system, headliner must be lowered and soundproofing removed to expose lines. Refer to Section 3 for headliner removal.

15-37. INSPECTION REQUIREMENTS.
a. ICC 3AA 1800 OXYGEN CYLINDER (Cessna Part Number C166001-0501). This cylinder shall be hydrostatically tested to 5/3 working pressure every five years by an FAA approved facility. The month and year of the latest test is stamped near the neck of the cylinder. The date should also be recorded in the aircraft log book. When an oxygen system is delivered in a new aircraft, the cylinder life date will coincide with the date of the manufacture of the aircraft. The cylinders that are installed in new aircraft are new cylinders. The shelf life of the cylinder has no bearing on the cylinder life date of the bottle since the bottles are completely protected during storage and bottle life starts at the installation date. The life limitations on cylinders is 12 years or 4, 380 filling cycles (12 years multiplied by 365 days per year equals the 4, 380 filling cycles). Therefore, a log book entry for each oxygen system recharge would be indicated only if it is anticipated that the system will be charged more than once per day.
b. Regulators shall be removed and overhauled by an FAA approved facility every five years.
c. PRESSURE GAGE. The pressure gage shall be checked for accuracy and cleaned by an FAA approved facility every five years.
d. Individual outlets shall be disassembled and inspected, and the sealing core replaced, regardless of condition, every five years.
e. Filler valve shall be disassembled, inspected and O-rings replaced, regardless of condition, every five years.
f. SYSTEM LEAK TEST. With 200 to 500 PSI on gage, check entire system for leaks, using leak detector compound for use with oxygen system. With system under full pressure, repeat leak test on high-pressure lines and fittings. Perform a complete leak test at least every five years. When components are removed and reinstalled or replaced, perform leak test on applicable connections. After the test has been completed, wash away all traces of the leak detector.
g. SYSTEM PURGING. Whenever components have been removed and reinstalled or replaced, plug masks into all outlets and turn the pilot's control to ON position, and purge system by allowing the oxygen to flow far at least 10 minutes. Smell oxygen flowing from outlets and continue to purge until system is odorless. Refill cylinder as necessary during and after purging the system.

15-38. FUNCTIONAL TEST. Whenever the oxygen system regulator and cylinder assembly has been replaced or overhauled, perform the following flow and internal leakage tests to check that the system functions properly.
a. Fully charge oxygen system in accordance with procedures outlined in paragraph 15-39.
b. Disconnect line and fitting assembly from pilot's mask and line assembly. Insert outlet end of line and fitting assembly into cabin outlet and attach opposite end of line to a pressure gage (gage should be calibrated in one-pound increments from 0 to 100 PSI). Place control lever in ON position. Gage pressure should read 75±10 PSI.
c. Insert mask and line assemblies into all remaining cabin outlets. With oxygen flowing from all outlets, test gage pressure should still read 75±10 PSI.
d. Place oxygen control lever in OFF position, and allow test gage pressure to fall to 0 PSI. Remove mask and line assemblies from cabin outlets. Line and fitting assembly with test gage must remain connected to its cabin outlet. Observe test gage for one minute. Test gage pressure must not rise above 0 PSI. Remove line and fitting assembly and test gage from cabin outlet.

NOTE

If pressures specified in the preceding procedures are not obtained, the oxygen regulator is not operating properly. Remove and replace cylinder and regulator assembly with another unit and repeat test procedure.

NOTE

Each interconnected series of oxygen cylinders is equipped with a single gage. The trailer type cascade may also be equipped with a nitrogen cylinder (shown reversed) for filling landing gear struts, accumulators, etc. Cylinders are not available for direct purchase, but are usually leased and refilled by a local compressed gas supplier.

Service Kit SK310-32 (available from the Cessna Service Parts Center) contains an adapter, a pressure gage, hose, lines, and fittings for equipping two oxygen cylinders to service oxygen systems. As noted in the Service Kit, a tee (Part No. 11844) and a pigtail (Part No. 1243-2) should be ordered for each additional cylinder to be used in the cascade of cylinders. Be sure to ground the airplane and ground servicing equipment before use.

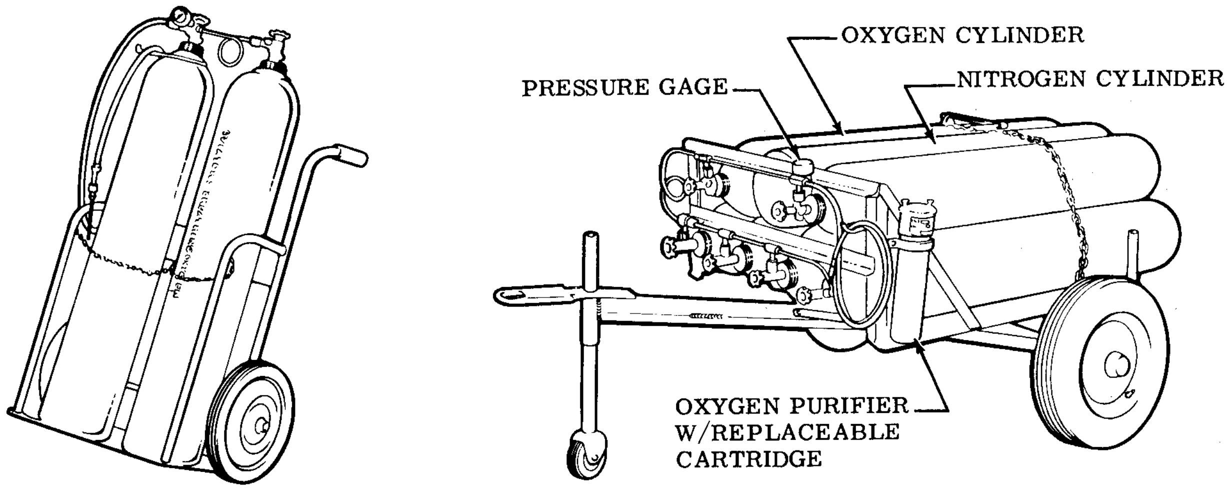


Figure 15-10. Typical Portable Oxygen Cascades

e. Connect mask and line assemblies to each cabin outlet and check each mask for proper operation. After checking, return all masks to mask case.

f. Check pilot's mask microphone and control wheel switch for proper operation.

g. Recharge oxygen system as required.

WARNING

BE SURE TO GROUND AIRPLANE AND GROUND SERVICING EQUIPMENT BEFORE CHARGING OXYGEN SYSTEM.

15-39. CHARGING. Do not charge oxygen system if servicing equipment fittings or filler valve are corroded or contaminated. If in doubt, clean with stabilized trichlorethylene and let air dry. Do not allow solution to enter internal parts. Before charging, check hydrostatic test date on cylinder as noted in paragraph 15-37. step "a."

CAUTION

Do not charge an oxygen cylinder if it has become contaminated. The regulator and cylinder assembly must then be disassembled, inspected, and cleaned by an FAA approved facility before filling. Contamination, as used here, means dirt, dust, or other foreign matter, as well as ordinary air in large quantities. If a gage line or filler line is disconnected and the fittings capped immediately, the cylinder will not become contaminated unless temperature variation has created a suction within the cylinder. Ordinary air contains water vapor which could condense and freeze. Since there are very small orifices in the system, it is very important that this condition not be allowed to occur.

a. Connect portable oxygen cascade (see figure 15-10) to filler valve.

b. Slowly open valve on cascade cylinder with lowest pressure, as noted on cascade pressure gage, allow pressure to equalize, then close cascade cylinder valve.

c. Repeat this procedure, using a progressively higher pressure cascade cylinder, until system has been charged to the pressure indicated in the chart immediately following step "d" of this paragraph.

d. This chart automatically compensates for temperature rise as a result of compression. Ambient temperature listed in the chart is the air temperature in the area where the system is to be charged. Approach the chart filling pressures slowly and do not overcharge.

TABLE OF FILLING PRESSURES

Ambient Temp. °F	Filling Press. psig	Ambient Temp. °F	Filling Press. psig
0	1600	50	1825
10	1650	60	1875
20	1700	70	1925
30	1725	80	1975
40	1775	90	2000

15-40. CLEANING OXYGEN MASKS. Oxygen masks may be washed and cleaned in household detergent-type solutions. However, the radio microphone installed in the pilot's mask must either be removed or protected from moisture. Masks may be disinfected with a hospital-type antiseptic spray (Zep Aero SBT-12, or equivalent).

SECTION 16

INSTRUMENTS AND INSTRUMENT SYSTEMS

TABLE OF CONTENTS Page

16-1. GENERAL.

16-2. This section describes typical instrument installations and the system operating them, with emphasis on trouble shooting and corrective measures for the systems themselves. It does not deal with specific instrument repairs since this usually requires special equipment and data and should be handled by instrument specialists. Federal Aviation Regulations require that malfunctioning instruments be sent to an approved instrument overhaul and repair station or returned to the manufacture for servicing. Our concern here is with preventive maintenance on the various instrument system and correction of system faults which result in instrument malfunctions.

The descriptive material, maintenance and trouble shooting information in this section is intended to help the mechanic determine malfunctions, and correct them, up to the defective instrument itself, at which point the instrument technician should be called in.

Some instruments, such as fuel quantity and oil pressure gages, are so simple and inexpensive that repairs usually will be more costly than a new instrument; on the other hand, aneroid and gyro instruments usually are well worth repairing. The words "replace instrument" in the text, therefore, should be taken only in the sense of physical replacement in the airplane. Whether the replacement is to be with a new instrument, an exchange one, or the original instrument is to be repaired, must be decided on the basis of individual circumstances.

16-3. INSTRUMENT PANEL ASSEMBLY. (See figure 16-1.)

16-4. The instrument panel assembly consists of a stationary panel, a removable panel and a shock-mounted panel. The stationary panel, normally not considered removable, contains instruments, such as the tachometer, manifold/fuel pressure and fuel and oil gages. The removable flight instrument panel contains the airspeed, vertical speed, and other

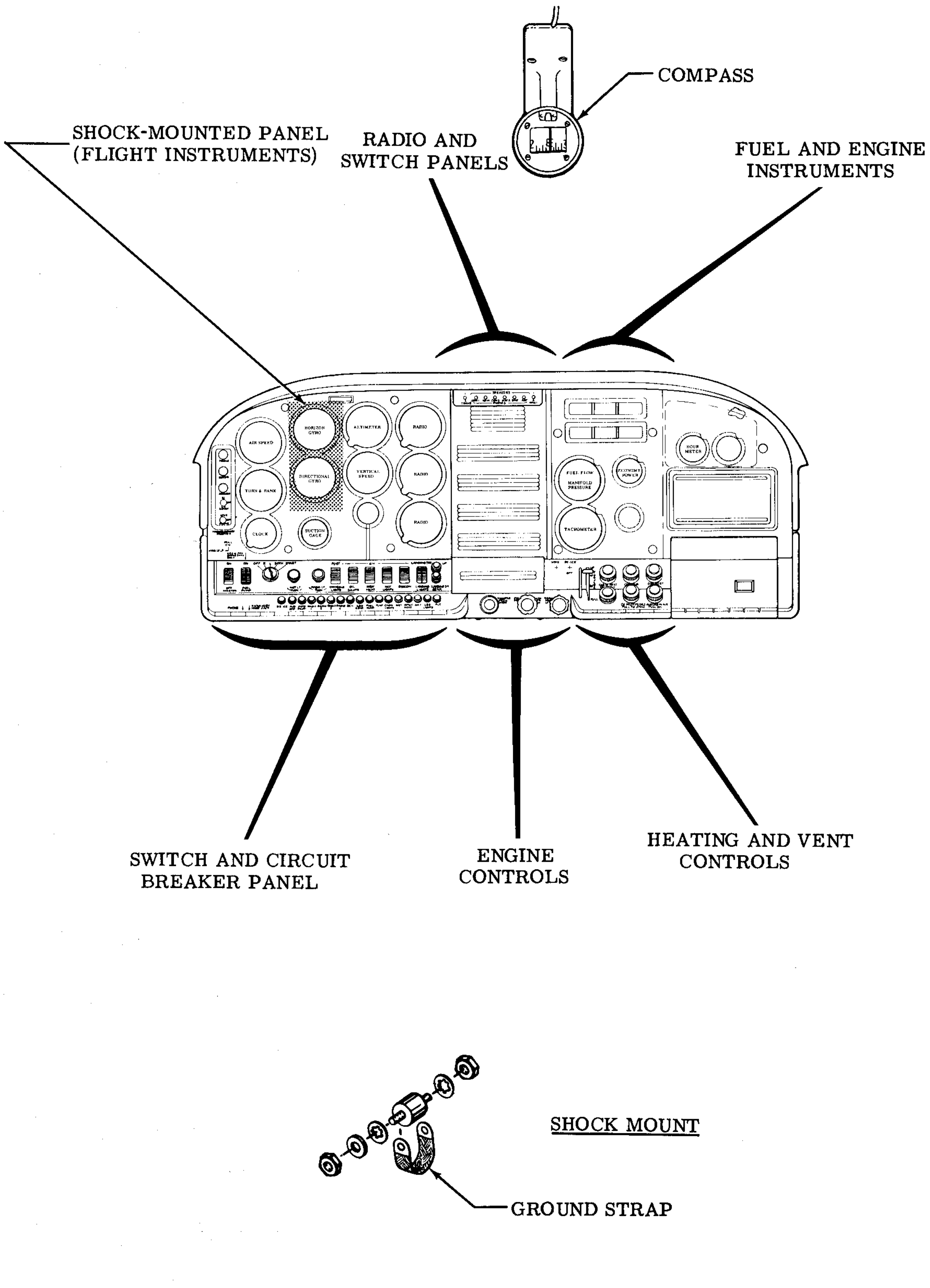


Figure 16-1. Typical Instrument Panel

flight instruments which are not sensitive to vibration. The shock-mounted panel, located in the flight instrument panel, carries the major flight instruments that are affected by vibration. Most of the instruments are screw-mounted on the backs of the panels, which in turn are covered with decorative panels.

16-5. REMOVAL. The stationary instrument panel is secured to engine mount stringers and ordinarily is not considered removable. The removable flight instrument panel is secured to the stationary panel with screws. The shock-mounted instrument panel is secured to the removable panel by rubber shock-mount assemblies.

a. To remove the flight instrument panel, remove the clips securing the decorative panel by carefully prying under the bottons on the clips. Remove any control knobs or switches on the panel which would interfere, and pull off cover. Remove screws securing panel to stationary panel, tag and disconnect the instrument wiring and plumbing, and pull the panel straight back. If panel is to be removed from aircraft, the control wheel can be removed from the control shaft by removing securing screws.

16-6. INSTALLATION.

a. To install the shock-mounted panel, set it in place in the stationary panel, aligning the shock mounts with the holes in the panel, and install the nuts on the shock mount screws.

b. Replace the instruments and connect the wiring and plumbing. Position the decorative cover and press the retainer clips through the holes in the panel. A light coat of paraffin, beeswax or soap on the prongs of the retainer clips will make their insertion easier.

c. Install any previously removed control knobs and switches. If the control wheel was previously removed for complete removal of the shock panel and decorative cover, reinstall the control wheel.

16-7. SHOCK MOUNTS. The service life of instruments are directly related to adequate shock mounting of the panel. If removal of panel is necessary, check shock mounts for deterioration and replace as necessary.

16-8. INSTRUMENT REMOVAL. The instruments in the stationary and shock-mounted panels are securred with screws inserted through the panel face under the decorative cover. To remove an instrument, remove the decorative cover, disconnect the plumbing or wiring to the instrument concerned, remove the retainer screws and take the instrument out from behind. The instrument cluster, containing fuel and oil gages, is installed as a unit and secured by screws on each corner of the cluster. The cluster must be removed from the rear of the stationary panel to replace an individual gage.

In all cases when an instrument is removed, the lines or wires disconnect from it should be protected. Cap open lines and cover pressure connections on the instrument, to prevent thread damage and the entrance of foreign matter. Wire terminals should be insulated or tied up so they will not ground accidentally, or short-circuit on another terminal.

16-9. INSTRUMENT INSTALLATION. Generally, installation procedure is the reverse of the removal procedure. Make sure mounting screw nuts are tightened firmly, but do not overtighten them, particularly on instruments having plastic cases. The same rule generally applies to connecting plumbing and wiring. If thread lubricate or sealer is used on plumbing, it should be applied sparingly and only on the male threads. When replacing an electrical gage in an instrument cluster assembly, avoid bending the pointer or dial plate. Distortion of the dial or back plate could change calibration of the gages.

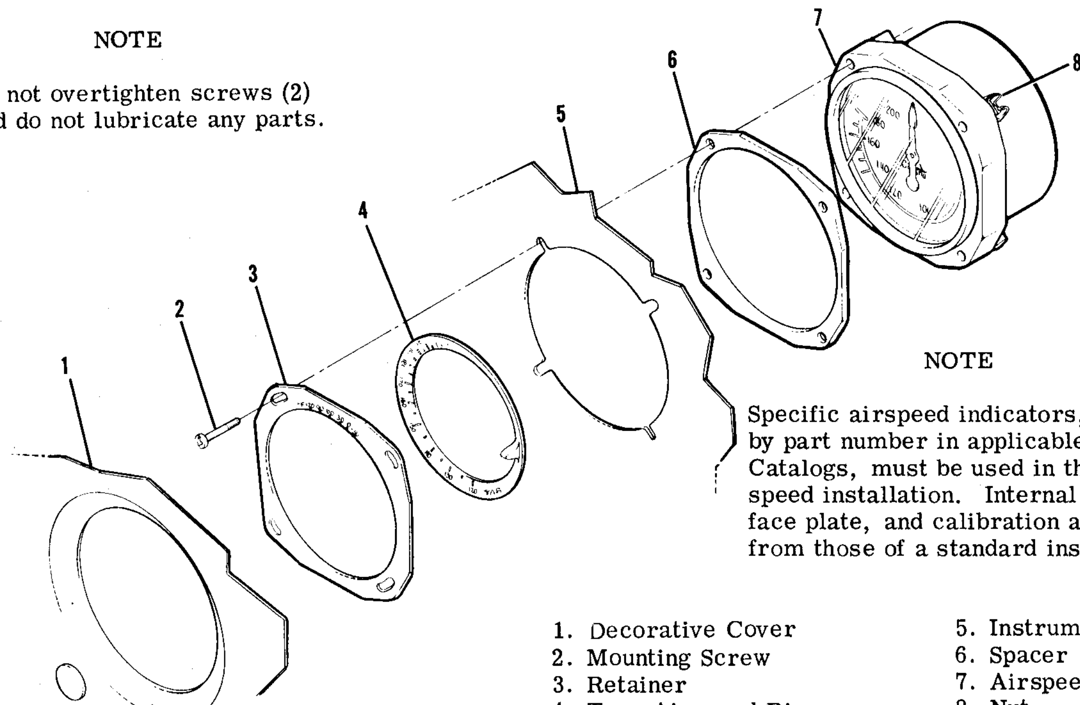
16-10. PITOT AND STATIC SYSTEMS. (See figure 16-3.)

16-11. The pitot system conveys ram air pressure to the airspeed indicator. The static system vents the vertical speed indicator and altimeter to atmospheric pressure through plastic tubing connected to static ports. The airpseed indicator is also connected to the static system. An alternate static source is installed as standard equipment on turbocharged aircraft, and optional equipment on standard aircraft. This source is to be used only in emergencies. When used as a static source, cabin pressure is substituted for atmospheric pressure, causing instrument readings to vary from normal. Refer to Owner's Manual for flight operation using alternate static source pressure. A pitot tube heater and stall warning heater may be installed as optional equipment. The heating element is controlled by a switch at the instrument panel and powered by the electrical system.

16-12. TRUE AIRSPEED INDICATOR. A true airspeed indicator may be installed as optional equipment. The indicator is equipped with a true airspeed conversion ring. The ring may be rotated until pressure altitude is aligned with outside air temperature, then indicated airspeed on the gage is read as true airspeed on the adjustable ring. The instrument may be removed using figure 16-2 as a guide. Upon installation, and before tightening mounting screws (2), the instrument must be calibrated. This is accomplished as follows: Rotate ring (4) until 120 mph on the adjustable ring aligns with 120 mph on the indicator. Holding this setting, move retainer (3) until 60°F aligns with zero pressure altitude, then tighten mounting screws (2) and replace decorative cover.

NOTE

Do not overtighten screws (2) and do not lubricate any parts.



NOTE

Specific airspeed indicators, listed by part number in applicable Parts Catalogs, must be used in the true airspeed installation. Internal mechanism, face plate, and calibration are different from those of a standard instrument.

1. Decorative Cover
2. Mounting Screw
3. Retainer
4. True Airspeed Ring
5. Instrument Panel
6. Spacer
7. Airspeed Indicator
8. Nut

Figure 16-2. True Airspeed Indicator

SHOP NOTES:

16-13. TROUBLE SHOOTING PITOT-STATIC SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
LOW OR SLUGGIST AIRSPEED INDICATION.		
Normal altimeter and vertical speed - Pitot tube obstructed, leak or obstruction in pitot line.	Test pitot tube and line for leaks or obstructions.	Blow out tube and line, Repair or replace damaged line. (See paragraph 16-21.)
INCORRECT OR SLUGGISH RESPONSE.		
All three instruments - leaks or obstruction in static line.	Test line for leaks and obstructions.	Repair or replace line, blow out obstructed line. (See paragraph 16-21.)
Alternate static source valve open.	Check visually.	Close for normal operation.

16-14. TROUBLE SHOOTING AIRSPEED INDICATOR.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
HAND FAILS TO RESPOND		
Pitot pressure line not properly connected to airspeed indicator connection.	Test line and connection for leaks.	Repair or replace damaged line, tighten connections.
Pitot or static lines clogged.	Check lines for obstructions.	Blow out lines. (See paragraph 16-21.)
INCORRECT INDICATION OR HAND OSCILLATES.		
Leak in pitot or static lines.	Test lines and connections for leaks.	Repair or replace damaged lines, tighten connections.
Defective mechanism.	Substitute known-good indicator and check reading.	Replace instrument.
Leaking diaphragm.	Substitute known-good indicator and check reading.	Replace instrument.
Alternate static source valve open.	Check visually.	Close for normal operation.
HAND VIBRATES.		
Excessive vibration.	Check panel mounting screws.	Secure as required.
Excessive tubing vibration.	Check clamps and line connections for security.	Tighten clamps and connections, replace tubing with flexible hose.

16-15. TROUBLE SHOOTING ALTIMETER.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
INSTRUMENT FAILS TO OPERATE.		
Static line plugged.	Check line for obstructions.	Blow out line. (See paragraph 16-21.)
Defective mechanism.	Substitute known-good altimeter and check reading.	Replace instrument.
INCORRECT INDICATION.		
Hands not carefully set.	Reset hands with knob.	
Leaking diaphragm.	Subsititue known-good altimeter and check reading.	Replace instrument.
Pointers out of calibration.	Compare reading with known-good altimeter.	Replace instrument.
HAND OSCILLATES.		
Static pressure irregular.	Check line for obstructions or leaks.	Blow out line, tighten connections. (See paragraph 16-21.)
Leak in airspeed or vertical speed indication installations.	Check other instruments and system plumbing for leaks and obstructions.	Blow out lines, tighten connections. (See paragraph 16-21.)

16-16. TROUBLE SHOOTING VERTICAL SPEED INDICATOR.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
INSTRUMENT FAILS TO OPERATE.		
Static line plugged.	Check line for obstructions.	Blow out line. (See paragraph 16-21.)
Static line broken.	Check line for damage, connections for security.	Repair or replace damaged line, tighten connections.
INCORRECT INDICATION.		
Partially plugged static line.	Check line for obstructions.	Blow out line. (See paragraph 16-21.)
Ruptured diaphragm.	Substitute known-good indicator and check reading.	Replace instrument.
Pointer off zero.		Reset pointer to zero.

16-16. TROUBLE SHOOTING VERTICAL SPEED INDICATOR. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
HAND VIBRATES.		
Excessive vibration.	Check panel mounting screws.	Secure as required.
Defective diaphragm.	Substitute known-good indicator and check for vibration.	Replace instrument.
POINTER OSCILLATES.		
Partially plugged static line.	Check line for obstructions.	Blow out line. (See paragraph 16-21.)
Leak in static line.	Test line and connections for leaks.	Repair or replace damaged line, tighten connections.
Leak in instrument case.	Substitute known-good indicator and check reading.	Replace instrument.

16-17. TROUBLE SHOOTING PITOT TUBE HEATER.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
TUBE DOES NOT HEAT OR CLEAR ICE.		
Switch turned "OFF."		Turn switch "ON."
Circuit breaker out.	Check circuit breaker.	Reset circuit breaker.
Break in wiring.	Test for open circuit.	Repair wiring.
Heating element burned out.	Check resistance of heating element.	Replace element.

16-18. PITOT AND STATIC SYSTEM MAINTENANCE. Proper maintenance of the pitot and static system is essential for the proper operation of the altimeter, and vertical speed and airpseed indicators. Leaks, moisture and obstructions in the pitot system will result in false airspeed indications, while static system malfunctions will affect the readings of all three instruments. Under instrument flight conditions, these instrument errors could be hazardous. Cleanliness and security are the principal rules for pitot and static pressure system maintenance. Both the pitot tube and the static ports must be kept clean and unobstructed.

16-19. CHECKING PITOT SYSTEM FOR LEAKS. To check the pitot system for leaks, fasten a piece of rubber or plastic tubing over the pitot tube, close the opposite end of the tubing and slowly roll up the tube until the airspeed indicator registers in the cruise range. Secure the tube and after a few minutes recheck the airspeed indicator. Any leakage will have reduced the pressure in the system, resulting in a lower airspeed indication. Slowly unroll the tubing before removing it, so the pressure is reduced gradually. Otherwise, the instrument may be damaged. If the test reveals a leak in the system, check all connections for tightness.

16-20. STATIC PRESSURE SYSTEM INSPECTION AND LEAKAGE TEST. The following procedure outlines inspection and testing of the static pressure system, assuming that the altimeter has been tested and inspected in accordance with current Federal Aviation Regulations.

a. Ensure that the static system is free from entrapped moisture and restrictions.

b. Ensure that no alterations or deformations of the airframe surface have been made that would affect the relationship between air pressure in the static pressure system and true ambient static air pressure for any flight configuration.

c. Seal off one static pressure source with plastic tape. This must be an air-tight seal.

d. Close the static pressure alternate source valve, if installed.

e. Attach a source of suction to the remaining static pressure source opening. Figure 16-4 shows one method of obtaining suction.

f. Slowly apply suction until altimeter indicates a 1000-foot increase in altitude.

CAUTION

When applying or releasing suction, do not exceed the range of the vertical speed indicator or airspeed indicator.

g. Cut off the suction source to maintain a "closed" system for one minute. Leakage shall not exceed 100 feet of altitude loss as indicated on altimeter.

h. If leakage rate is within tolerance, slowly release suction source, then remove tape used to seal static source.

NOTE

If leakage rate exceeds the maximum allowable, first tighten all connections then repeat the leakage test. If leakage rate still exceeds the maximum allowable, use the following procedure.

i. Disconnect static pressure lines from airspeed indicator and vertical speed indicator, and use suitable fittings to connect the lines together so that the altimeter is the only instrument still connected into the static pressure system.

j. Repeat the leakage test to check whether the static pressure system or the removed instruments are the cause of leakage. If instruments are at fault, they must be repaired by an "appropriately rated repair station" or replaced. If the static pressure system is at fault, use the following procedure to locate the leakage.

k. Attach a source of positive pressure to the static source opening. Figure 16-4 shows one method of obtaining positive pressure.

CAUTION

Do not apply positive pressure with the airspeed indicator or vertical speed indicator connected to the static pressure system.

l. Slowly apply positive pressure until altimeter indicates a 500-foot decrease in altitude, and maintain this altimeter indication while checking for leaks. Coat line connections, static pressure alternate source valve, and static source flange within solution of mild soap and water, watching for bubbles to locate leaks.

m. Tighten leaking connections. Repair or replace any parts found defective.

n. Reconnect airspeed indicator and vertical speed indicator into the static pressure system and repeat leakage test per steps "c" through "h."

16-21. BLOWING OUT PITOT AND STATIC LINES. Although the pitot system is designed to drain down to the pitot tube opening, condensation may collect at other points in the system and produce a partial obstruction. To clear the line, disconnect it at the airspeed indicator and, using low pressure air, blow from the indicator end of the line toward the pitot tube.

CAUTION

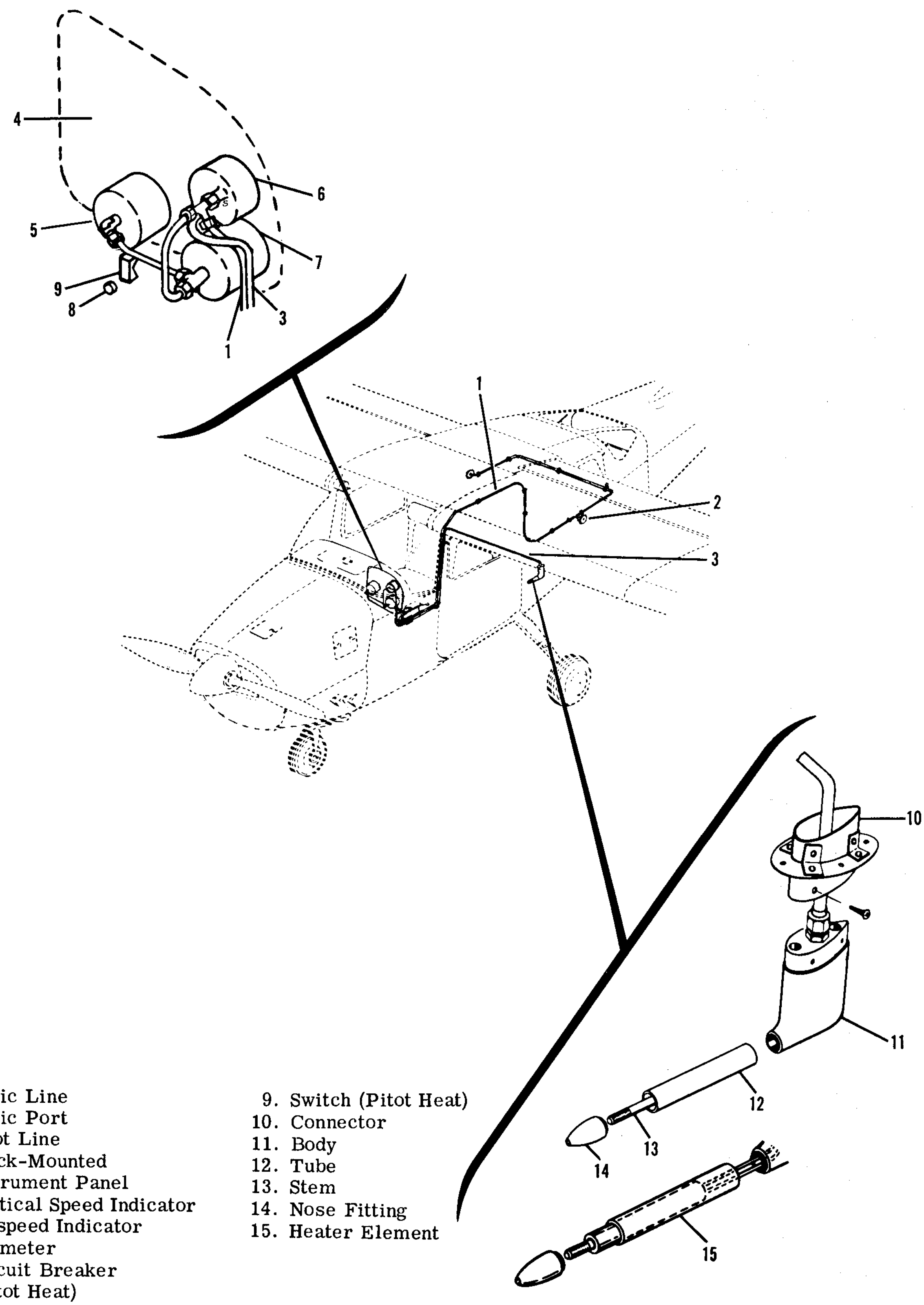
Never blow through pitot or static lines toward the instruments. Doing so may damage them.

Like the pitot lines, the static pressure lines must be kept clear and the connections tight. When necessary, disconnect the static line at the first instrument to which it is connected, then blow the line clear with low pressure air.

NOTE

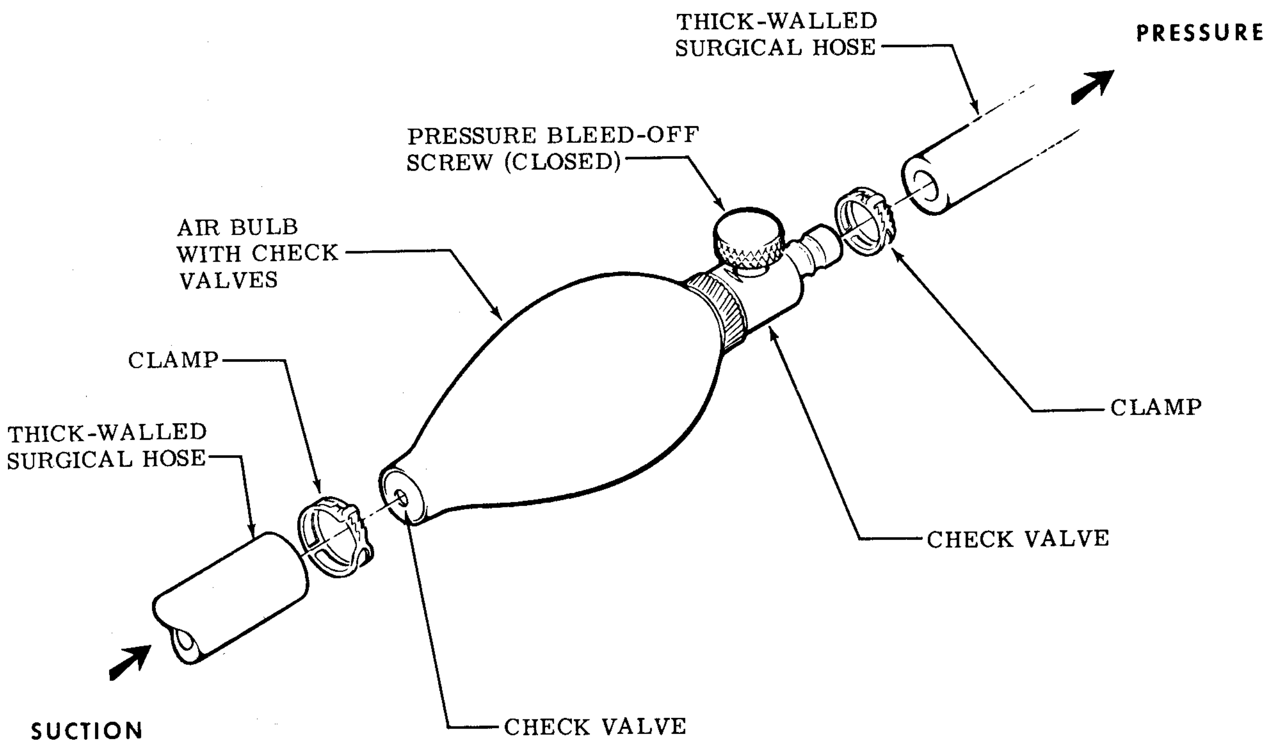
On aircraft equipped with alternate static source, use the same procedure, opening alternate static source valve momentarily to clear its line, then close valve and clear remainder of the system.

16-22. REMOVAL OF PITOT AND STATIC PRESSURE SYSTEM. To remove the pitot mast, remove the four mounting screws on the side of the attaching connector and pull the mast out of the connector far enough to disconnect the pitot line. Electrical connections to the heater assembly (if installed) may be disconnected through the wing access opening just inboard of the mast. The pitot and static lines are removed in the usual manner, after removing the wing access openings, decorative cover over the left doorpost and left forward upholstery panel. If it is necessary to remove all static system plumbing, the cabin left sidewall upholstery and left side of headliner must be loosened for access to the static line in these areas. The static pressure port connections are accessible through the main gear wheel wells. Reinstallation of the pitot line in the wing will be simpler if a guide wire is drawn in as the line is removed from the wing.



1. Static Line
2. Static Port
3. Pitot Line
4. Shock-Mounted Instrument Panel
5. Vertical Speed Indicator
6. Airspeed Indicator
7. Altimeter
8. Circuit Breaker (Pitot Heat)
9. Switch (Pitot Heat)
10. Connector
11. Body
12. Tube
13. Stem
14. Nose Fitting
15. Heater Element

Figure 16-3. Pitot Static Systems



TO APPLY SUCTION:

1. Squeeze air bulb to expel as much air as possible.
2. Hold suction hose firmly against static pressure source opening.
3. Slowly release air bulb to obtain desired suction, then pinch hose shut tightly to trap suction in system.
4. After leak test, release suction slowly by intermittently allowing a small amount of air to enter static system. To do this, tilt end of suction hose away from opening, then immediately tilt it back against opening. Wait until vertical speed indicator approaches zero, then repeat. Continue to admit this small amount of air intermittently until all suction is released, then remove test equipment.

TO APPLY PRESSURE:

CAUTION

Do not apply positive pressure with airspeed indicator or vertical speed indicator connected into static system.

1. Hold pressure hose firmly against static pressure source opening.
2. Slowly squeeze air bulb to apply desired pressure to static system. Desired pressure may be maintained by repeatedly squeezing bulb to replace any air escaping through leaks.
3. Release pressure by slowly opening pressure bleed-off screw, then remove test equipment.

Figure 16-4. Static System Test Equipment

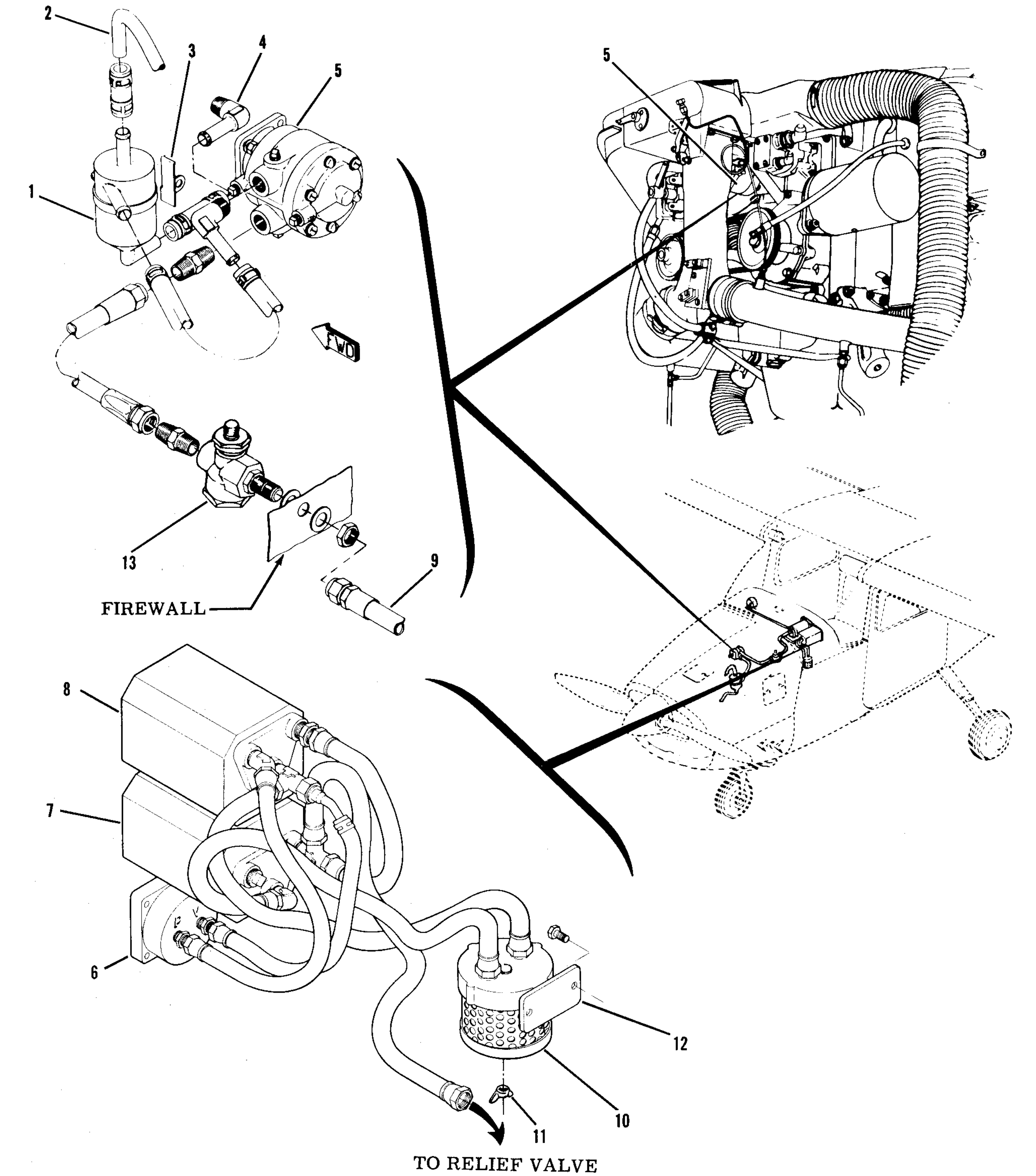
16-23. REPLACEMENT OF PITOT AND STATIC PRESSURE SYSTEM. When replacing components of the pitot and static pressure systems, use anti-seize compound sparingly on the male threads on both metal and plastic connections. Avoid excess compound which might enter the lines. Tighten connections firmly, but avoid overtightening and distorting the fittings. If twisting of plastic tubing is encountered when tightening the fittings, VV-P-236 or USP Petrolatum may be applied sparingly between the tubing and fittings.

16-24. VACUUM SYSTEM.

16-25. Suction to operate the directional gyro and gyro horizon instruments is provided by an engine-driven vacuum pump mounted on the engine accessory section. The pump is gear-driven through a spline-type coupling. The vacuum pump discharge is through an oil separator, where the oil, which passes through the pump and lubricates it, is returned to the engine sump and the air is expelled overboard. A suction relief valve, to control system pressure, is connected between the pump inlet and the firewall fitting. In the cabin, the vacuum line runs from gyro instruments to the relief valve at the firewall. A suction gage indicates suction at the gyro instruments. A central air filtering system is utilized in all vacuum systems. The reading of the suction gage in the central filter system indicates net difference in suction before and after air passes through a gyro. This differential pressure will gradually decrease as the central filter becomes dirty, causing a lower reading on the suction gage.

16-26. TROUBLE SHOOTING VACUUM SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
HIGH SUCTION GAGE READINGS.		
Gyros function normally, relief valve screen clogged, relief valve malfunction.	Check screen, then valve. Compare gage readings with new gage.	Clean screen, reset valve. Replace gage.
LOW SUCTION GAGE READINGS.		
Leaks or restriction between instruments and relief valve, relief valve out of adjustment, defective pump, restriction in oil separator or pump discharge line.	Check lines for leaks, check pump discharge volume, disconnect and test pump.	Repair or replace lines, adjust or replace relief valve, repair or replace pump, clean oil separator.
Central air filter dirty.	Check operation with filter removed.	Clean or replace filter.
SUCTION GAGE FLUCTUATES.		
Defective gage or sticking relief valve.	Check suction with test gage.	Replace gage. Clean sticking valve with Stoddard solvent. Blow dry and test. If valve sticks after cleaning, replace it.
OIL COMES OVER IN PUMP DISCHARGE LINE.		
Oil separator clogged, oil return line obstructed, excessive oil flow through pump.	Check oil separator and return line. Check that pump oil return rate does not exceed 120 cc/hour (approx. 8 drops/minute), at 50 psi oil pressure.	Clean oil separator in Stoddard solvent, blow dry. Blow out lines. If pump oil consumption is excessive, replace oil metering collar and pin in pump.



1. Oil Separator
2. Vent
3. Bracket
4. Oil Return (To Engine)
5. Vacuum Pump
6. Suction Gage
7. Directional Gyro
8. Gyro Horizon
9. Hose
10. Filter Element
11. Wing Nut
12. Bracket
13. Relief Valve

NOTE

The relief valve on turbocharged aircraft is altitude compensated by an internal aneroid. Operation of the compensating mechanism is automatic. Standard relief valve adjustment also applies to the compensated relief valve.

Figure 16-5. Typical Vacuum System

16-27. TROUBLE SHOOTING GYROS.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
HORIZON BAR FAILS TO RESPOND.		
Central or instrument air filters dirty.	Check filters.	Clean or replace filters.
Suction relief valve improperly adjusted.		Adjust or replace relief valve.
Faulty suction gage.	Substitute known-good suction gage and check gyro response.	Replace suction gage.
Vacuum pump failure.	Check pump.	Replace pump.
Vacuum line kinked or leaking.	Check lines for damage and leaks.	Repair or replace damaged lines, tighten connections.
Defective mechanism.	Substitute known-good gyro and check indication.	Replace instrument.
Insufficient vacuum		Adjust or replace relief valve.
Excessive vibration.	Check panel shock mounts.	Replace defective shock mounts.
HORIZON BAR OSCILLATES OR VIBRATES EXCESSIVELY.		
Central or instrument air filter dirty.	Check filters.	Clean or replace filters.
Suction relief valve improperly adjusted.		Adjust or replace relief valve.
Faulty suction gage.	Substitute known-good suction gage and check gyro indication.	Replace suction gage.
Defective mechanism.	Substitute known-good gyro and check indication.	Replace instrument.
Excessive vibration.	Check panel shock mounts.	Replace defective shock mount.
EXCESSIVE DRIFT IN EITHER DIRECTION.		
Central or instrument air filter dirty.	Check filters.	Clean or replace filters.
Low vacuum, relief valve improperly adjusted.		Adjust or replace relief valve.
Faulty suction gage.	Substitute known-good suction gage and check gyro indication.	Replace suction gage.
Vacuum pump failure.	Check pump.	Replace pump.
Vacuum line kinked or leaking.	Check lines for damage and leaks.	Repair or replace damaged lines, tighten connections.

16-27. TROUBLE SHOOTING GYROS. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DIAL SPINS IN ONE DIRECTION CONTINUOUSLY.		
Operating limits have been exceeded.		Cage and reset when airplane is level.
Defective mechanism.	Substitute known-good gyro and check indication.	Replace instrument.

16-28. TROUBLE SHOOTING VACUUM PUMP.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
EXCESSIVE OIL IN DISCHARGE.		
Excessive flow to pump.	Check pump vent plugs.	Clean vent plugs.
Clogged oil separator.	Check separator for obstructions.	Clean separator.
Damaged engine drive seal.		Replace gasket.
HIGH SUCTION.		
Suction relief valve screen clogged.	Check screen for obstructions.	Clean or replace screen.
LOW SUCTION.		
Relief valve leaking.		Replace relief valve.
Vacuum pump failure.	Substitute known-good pump and check pump suction.	Replace vacuum pump.
LOW PRESSURE.		
Safety valve leaking.		Replace safety valve.
Vacuum pump failure.	Substitute known-good pump and check pump pressure.	Replace vacuum pump.

16-29. REMOVAL OF VACUUM SYSTEM. The various components of the vacuum system are secured by conventional clamps, mounting screws and nuts. To remove a component, remove the mounting screws, nuts, or clamps and disconnect lines.

16-30. REPLACEMENT OF VACUUM SYSTEM. When replacing a vacuum system component, make sure connections are made correctly. Use thread lubricant sparingly and only on male threads. Avoid overtightening connections. Before reinstalling a vacuum pump, probe the oil passages in the pump and engine, to make sure they are open. Place the mounting pad gasket in position over the studs and make sure it does not block the oil passages. Coat the pump drive splines lightly with a high-temperature grease such as Dow Silicone #30 (Dow-Corning Co., Midland, Mich.). After installing the pump, before connecting the plumbing, start the engine and hold a piece of paper over the pump discharge to check for proper lubrication. Proper oil flow through the pump is one to four fluid ounces per hour.

16-31. CLEANING OF VACUUM SYSTEM. In general, low-pressure, dry compressed air should be used in cleaning vacuum system components removed from the aircraft.

CAUTION

Never apply compressed air to lines or components installed in the aircraft. The excessive pressures will damage the gyro instruments. If an obstructed line is to be blown out, disconnect it at both ends and blow from the instrument panel out.

Components such as the oil separator and suction relief valve which are exposed to engine oil and dirt should be washed with Stoddard solvent, then dried with a low pressure air blast. Check hoses for collapsed inner liners as well as external damage.

16-32. VACUUM RELIEF VALVE ADJUSTMENT. A suction gage reading of 5.3 inches of mercury is desirable for gyro instruments. However, a range of 4.6 to 5.4 inches of mercury is acceptable. To adjust the relief valve, remove central air filter, run engine to 2200 rpm on the ground, and adjust relief valve to 5.3±.1 inches of mercury. Reinstall filter. Whenever suction gage reading drops to 4.6 inches of mercury, remove central air filter and check relief valve adjustment, then install a new filter if drop in reading was caused by clogged filter.

16-33. ENGINE INDICATORS.

16-34. TACHOMETER. The tachometer used is a mechanical indicator driven at half crankshaft speed by a flexible shaft. Most tachometer difficulties will be found in the driveshaft. To function properly, the shaft housing must be free of kinks, dents and sharp bends. There should be no bend on a radius shorter than six inches, and no bend within three inches of either terminal. If a tachometer is noisy or the pointer oscillates, check the cable housing for kinks, sharp bends and damage. Disconnect the cable at the tachometer and pull it out of the housing. Check the cable for worn spots, breaks and kinks.

NOTE

A kink may be detected by holding the cable vertically by one end and slowly rotating it between the fingers to feel for binding and jumpy motion.

Before replacing a tachometer cable in the housing, coat the lower two thirds with AC Type ST-640 Speedometer cable grease or Lubriplate No. 110. Insert the cable in the housing as far as possible, then slowly rotate it to make sure it is seated in the engine fitting. Insert the cable in the tachometer, making sure it is seated in the drive shaft, then reconnect the housing and torque to 50 pound-inches (at instrument).

16-35. MANIFOLD PRESSURE/FUEL FLOW INDICATOR. The manifold pressure and fuel flow indicators are in one instrument case. However, each instrument operates independently. The manifold pressure gage is a barometric instrument which indicates absolute pressure in the intake manifold in inches of mercury. The fuel flow indicator is a pressure instrument that is calibrated in gallons per hour. It indicates the approximate number of gallons of fuel being metered per hour to the engine. Pressure for operating the indicator is obtained through a hose from the fuel manifold valve. The fuel-flow indicator is vented to atmospheric pressure with standard engine installations, and to turbocharger outlet pressure with turbocharger engine installation.

16-36. TROUBLE SHOOTING MANIFOLD PRESSURE GAGE.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
EXCESSIVE ERROR AT EXISTING BAROMETRIC PRESSURE.		
Pointer shifted.		Replace instrument.
Leak in vacuum bellows.		Replace instrument.
Loose pointer.		Replace instrument.
Leak in pressure line.	Test line and connections for leaks.	Repair or replace damaged line, tighten connections.
Condensate or fuel in line.	Check line for obstructions.	Blow out line.

16-36. TROUBLE SHOOTING MANIFOLD PRESSURE GAGE. (Cont)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
JERKY MOVEMENT OF POINTER.		
Excessive internal friction.		Replace instrument.
Rocker shaft screws tight.		Replace instrument.
Link springs too tight.		Replace instrument.
Dirty pivot bearings.		Replace instrument.
Defective mechanism.		Replace instrument.
Leak in pressure line.	Test line and connections for leaks.	Repair or replace damaged line, tighten connections.
SLUGGISH OPERATION OF POINTER.		
Foreign matter in line.	Check line for obstructions.	Blow out line.
Damping needle dirty.		Replace instrument.
Leak in pressure line.	Test line and connections for leaks.	Repair or replace damaged line, tighten connections.
EXCESSIVE POINTER VIBRATION.		
Tight rocker pivot bearings.		Replace instrument.
Excessive panel vibration.	Check panel mounting screws.	Secure as required.
IMPROPER CALIBRATION.		
Faulty mechanism.		Replace instrument.
NO POINTER MOVEMENT.		
Faulty mechanism.		Replace instrument.
Broken pressure line.	Check line and connections for breaks.	Repair or replace damaged line.

16-37. TROUBLE SHOOTING FUEL FLOW INDICATOR.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DOES NOT REGISTER.		
Pressure line clogged.	Check line for obstructions.	Blow out line.
Pressure line broken.	Check line for leaks and damage.	Repair or replace damaged line.
Fractured bellows or damaged mechanism.		Replace instrument
Clogged snubber orifice.		Replace instrument.
Pointer loose on staff.		Replace instrument.
POINTER FAILS TO RETURN TO ZERO.		
Foreign matter in line.	Check line for obstructions.	Blow out line.
Clogged snubber orifice.		Replace instrument.
Damaged bellows or mechanism.		Replace instrument.
INCORRECT OR ERRATIC READING.		
Damaged or dirty mechanism.		Replace instrument.
Pointer bent, rubbing on dial or glass.		Replace instrument
Leak or partial obstruction in pressure or vent line.	Check line for obstructions or leaks.	Blow out dirty line, repair or tighten loose connections.

16-38. FUEL QUANTITY INDICATORS. The fuel quantity indicators are magnetic types that are used in conjunction with float-operated variable-resistance transmitters in the fuel tanks. The tank-full position of the transmitter float produces a minimum resistance through the transmitter, permitting maximum current flow through the fuel quantity indicator and maximum pointer deflection. As the fuel level of the tank is lowered, resistance in the transmitter is increased, producing a decreased current flow through the fuel quantity indicator and a smaller pointer deflection.

16-39. FUEL QUANTITY TRANSMITTER CALIBRATION. While the chance of transmitter calibration change during normal service is remote, it is possible to bend the float arm or steps while the transmitter is out of the tank, changing its calibration. A calibration check, therefore, is advisable before the transmitter is installed. Float travel is limited by the float arm stops.

WARNING

Use extreme caution while working with electrical components of the fuel system. The possibility of electrical sparks around an "empty" fuel tanks creates a hazardous situation.

Before installing a transmitter in a tank, attach the electrical wires to transmitter and place master switch on the ON position. Allow float arm to rest against the lower float arm stop and read fuel quantity indicator. The pointer should be on E (empty) position. Adjust lower float arm stop with float arm against stop so that pointer indicator is on E (empty). Raise float until float arm is against the upper stop and adjust stop to permit fuel quantity indicator pointer to be on F (full).

16-40. TROUBLE SHOOTING FUEL QUANTITY INDICATORS.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
FAILURE TO INDICATE.		
No power to indicator or transmitter. (Pointer stays below E)	Check circuit breaker, inspect for open circuit.	Reset breaker, repair or replace defective wire.
Grounded wire. (Pointer stays above F)	Check for partial ground between transmitter and gage.	Repair or replace defective wire.
Low voltage.	Check voltage at indicator.	Correct voltage.
Defective indicator.	Substitute known-good indicator and check reading.	Replace indicator.
OBVIOUSLY INCORRECT INDICATION.		
Defective indicator.	Substitute known-good indicator and check reading.	Replace indicator.
Defective transmitter.	Check internal resistance of transmitter.	Recalibrate or replace.
Low or High voltage.	Check voltage at indicator.	Correct voltage.
STICKY OR SLUGGISH INDICATOR OPERATION.		
Defective indicator.	Substitute known-good indicator and check operation.	Replace indicator.
Low voltage.	Check voltage at indicator.	Correct voltage.
ERRATIC READINGS.		
Loose or broken wiring on indicator or transmitter.	Inspect circuit wiring.	Repair or replace defective wire.
Defective indicator or transmitter.	Substitute known-good indicator or transmitter and check reading.	Replace indicator or transmitter.
Defective master switch.		Replace switch.

16-41. CYLINDER HEAD TEMPERATURE GAGE. The temperature bulb regulates electrical power through the cylinder head temperature gage. The gage and bulb require little or no maintenance other than cleaning, making sure the lead is properly supported, and all connections are clean, tight and properly insulated.

16-42. OIL TEMPERATURE GAGE. The oil temperature gage is a Bourdon-type pressure instrument connected by armored capillary tubing to a temperature bulb in the engine. The temperature bulb, capillary tube, and gage are filled with fluid and sealed. Expansion and contraction of the fluid in the bulb with temperature changes operates the gage. Checking the capillary tube for damage and fittings for security is the only maintenance required. Since the tube's inside diameter is quite small, small dents and kinks which would be quite acceptable in larger tubing may partially or completely close off the capillary, making the gage inoperative.

16-43. TROUBLE SHOOTING CYLINDER HEAD TEMPERATURE GAGE.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
GAGE INOPERATIVE.		
No current to circuit.	Check circuit breaker, electrical circuit to gage.	Repair electrical circuit.
Defective gage, bulb or circuit.	Isolate with ohmmeter check of circuits.	Repair or replace defective item.
GAGE FLUCTUATES RAPIDLY.		
Loose or broken wire permitting alternate make and break of gage current.	Inspect circuit wiring.	Repair or replace defective wire.
GAGE READS TOO HIGH ON SCALE.		
High voltage.	Check supply voltage.	
Gage off calibration.		Replace instrument.
GAGE READS TOO LOW ON SCALE.		
Low voltage.	Check supply voltage.	
Gage off calibration.		Replace instrument.
GAGE READS OFF SCALE AT HIGH END.		
Break in bulb.		Replace instrument.
Break in bulb lead.		Replace instrument.
Internal break in gage.		Replace instrument.
OBVIOUSLY INCORRECT READING.		
Defective gage mechanism		Replace instrument.
Incorrect calibration.		Replace instrument.

16-44. OIL PRESSURE GAGE. The Bourdon-type oil pressure gage is a direct-reading gage, operated by a pressure pickup line connected to the engine main oil gallery.

16-45. TROUBLE SHOOTING OIL PRESSURE GAGE.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
GAGE DOES NOT REGISTER.		
Pressure line clogged.	Check line for obstructions.	Clean line.
Pressure line broken.	Check line for leaks and damage.	Repair or replace damaged line.
Fractured Bourdon tube.		Replace instrument.
Gage pointer loose on staff.		Replace instrument.
Damaged gage movement.		Replace instrument.
GAGE POINTER FAILS TO RETURN TO ZERO.		
Foreign matter in line.	Check line for obstructions.	Clean line.
Foreign matter in Bourden tube.		Replace instrument.
Bourdon tube stretched.		Replace instrument.
GAGE DOES NOT REGISTER PROPERLY.		
Faulty mechanism.		Replace instrument.
GAGE HAS ERRATIC OPERATION.		
Worn or bent movement.		Replace instrument.
Foreign matter in Bourdon tube.		Replace instrument.
Dirty or corroded movement.		Replace instrument.
Pointer bent and rubbing on dial, dial screw or glass.		Replace instrument.
Leak in pressure line.	Check line for leaks and damage.	Repair or replace damaged line.

16-46. MAGNETIC COMPASS. (See figure 16-6.)

16-47. The magnetic compass is liquid-filled, with expansion provisions to compensate for temperature changes. It is equipped with compensating magnets adjustable from the front of the case. The compass is individually lighted by a GE No. 330 lamp inside the compass case, controlled by the instrument lights rheostat switch. No maintenance is required on the compass except an occasional check on a compass rose with adjustment of the compensation, if necessary, and replacement of the lamp. The compass mount is attached by three screws to a base plate. The base plate is bonded to the windshield with Methylene Chloride. A tube containing the compass light wires is attached to the metal strip at the top of the windshield. Removal of the compass is accomplished by removing the screw at the forward end of the compass mount, unfastening the metal strip at the top of the windshield, and cutting the two wire splices. Removal of the compass mount is accomplished by removing the three screws attaching the mount to the base plate. Access to the inner screw is gained through a hole in the bottom of the mount, through which a thin screwdriver can be inserted. When installing the compass, it will be necessary to resplice the compass light wires.

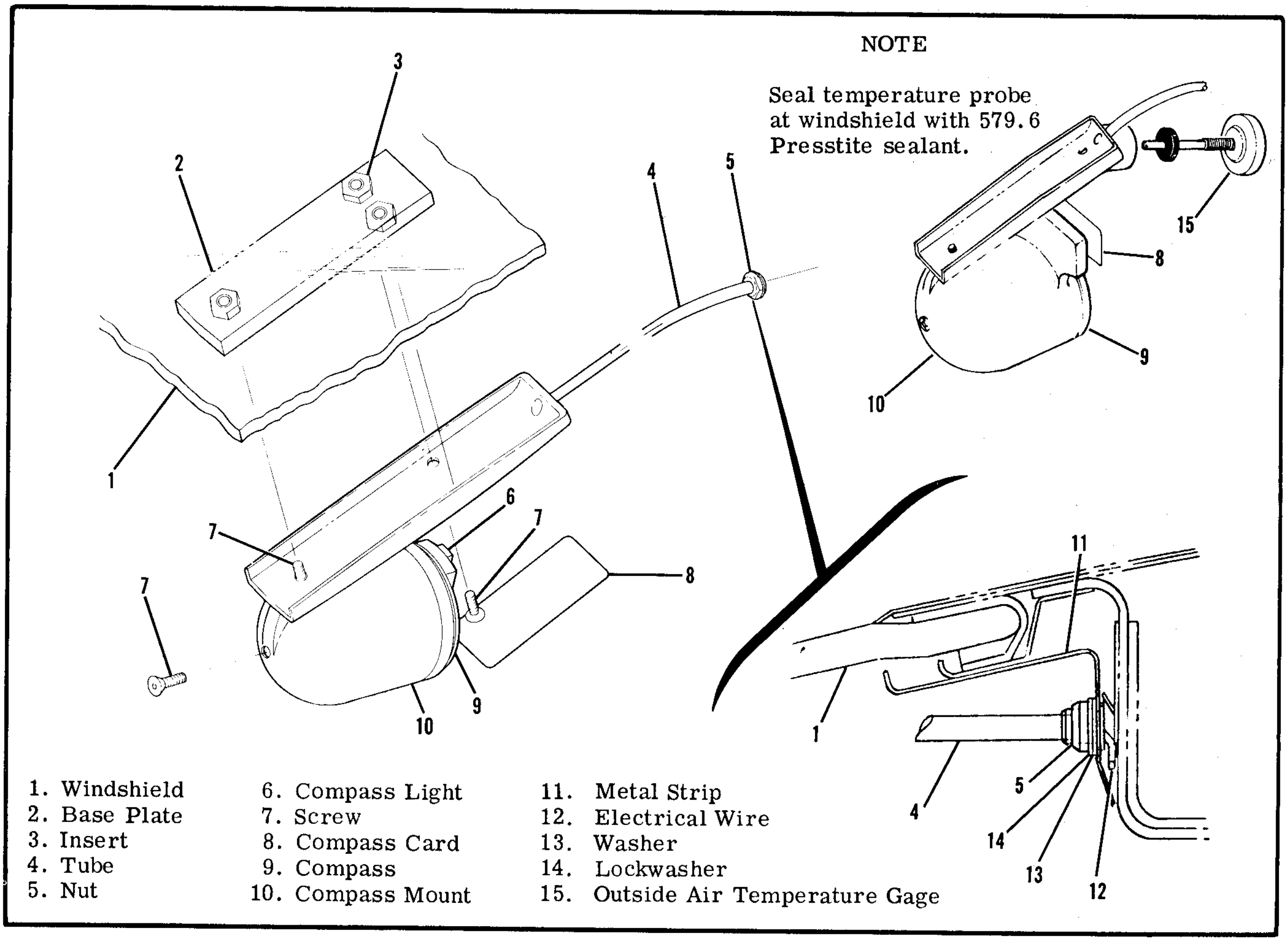


Figure 16-6. Magnetic Compass

16-48. STALL WARNING HORN AND TRANSMITTER.

16-49. The stall warning horn is contained in the dual warning unit mounted on the right side of the firewall behind the glove box. It is electrically operated, and is controlled by a stall warning transmitter mounted on the leading edge of the left wing. For further discussion of the warning horn and trans mitter, refer to Section 17.

16-50. ELECTRIC CLOCK.

16-51. All aircraft are equipped with an electric clock which operates on 12 volts and requires a one-amp fuse. The fuse holder is located adjacent to the battery box. The clock's electrical circuit is separate from the aircraft's electrical system, and will operate when the master switch is "OFF."

16-52. TURN COORDINATOR is an electrical operated, gyroscopic, roll-turn rate indicator. Its gyro simultaneously senses rate of motion roll and yaw axes which is projected on a single indicator. The gyro is a non-tumbling type requiring no caging mechanism, and incorporates an ac brushless spin motor with a solid state inverter.

16-53. TROUBLE SHOOTING TURN COORDINATOR

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
INDICATOR DOES NOT RETURN TO CENTER.		
Friction caused by contamination in the indicator damping.		Replace instrument.
Friction in gimbal assembly.		Replace instrument.
DOES NOT INDICATE A STANDARD RATE TURN (TOO SLOW).		
Low voltage.	Measure voltage at instrument.	Correct voltage.
Inverter frequency changed.		Replace instrument
NOISY MOTOR.		
Faulty bearings.		Replace instrument.
ROTOR DOES NOT START.		
Faulty electrical connection.	Check continuity and voltage.	Correct voltage or replace faulty wire.
Inverter malfunctioning.		Replace instrument.
Motor shorted.		Replace instrument.
Bearings frozen.		Replace instrument.
IN COLD TEMPERATURES, HAND FAILS TO RESPOND OR IS SLUGGISH.		
Oil in indicator becomes too thick.		Replace instrument.
Insufficient bearing end play.		Replace instrument.
Low voltage.	Check voltage at instrument.	Correct voltage.
NOISY GYRO.		
High voltage.	Check voltage to instrument.	Correct voltage.
Loose or defective rotor bearings.		Replace instrument.

16-54. CESSNA ECONOMY MIXTURE INDICATOR (optional) is an exhaust gas temperature (EGT) sensing device which is used to aid the pilot in selecting the most desirable fuel-air mixture for cruising flight at less than 75% power. Exhaust gas temperature (EGT) varies with the ratio of fuel-to-air mixture entering the engine cylinders. See appropriate airplane Owner's Manual for operating procedures of system.

16-55. TROUBLE SHOOTING ECONOMY MIXTURE INDCATOR

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
INDICATOR INOPERATIVE.		
Defective indicator, probe or circuit.	Isolate with ohmmeter check of circuit.	Repair or replace defective part.
INCORRECT READING.		
Indicator needs calibrating.	See paragraph 16-56.	See paragraph 16-56.
FLUCTUATING READING.		
Loose, frayed, or broken lead, permitting alternate make and break of current.	Check for defective circuit.	Tighten connections, and repair or replace defective leads.

16-56. CALIBRATION. Calibration is done at the potentiometer adjustment screw at the back of the case. Turning the screw clockwise increases the meter reading, and turning it counterclockwise decreases the meter reading. There is a stop in each direction and damage can occur if too much torque is applied against the stops. Approximately 600°F total adjustment is provided. The adjustable yellow pointer on the face of the instrument is a reference pointer only.

NOTE

The meter reading will change slightly after initial calibration because of lead deposit build-up on the probe. These deposits, however, will reach an equilibrium level and will result in a small drop in EGT indication, so that a small recalibration will be desirable. These lead deposits do not in any way affect the use of the indicator for mixture control or trouble detection.

16-57. REMOVAL AND INSTALLATION. Removal of the indicator is accomplished by removing the mounting screws and disconnecting leads. The thermocouple probe is secured to the exhaust stack with a clamp. The clamp should be tightened to 45 lb-in., and safetied as required.

16-58. HOURMETER.

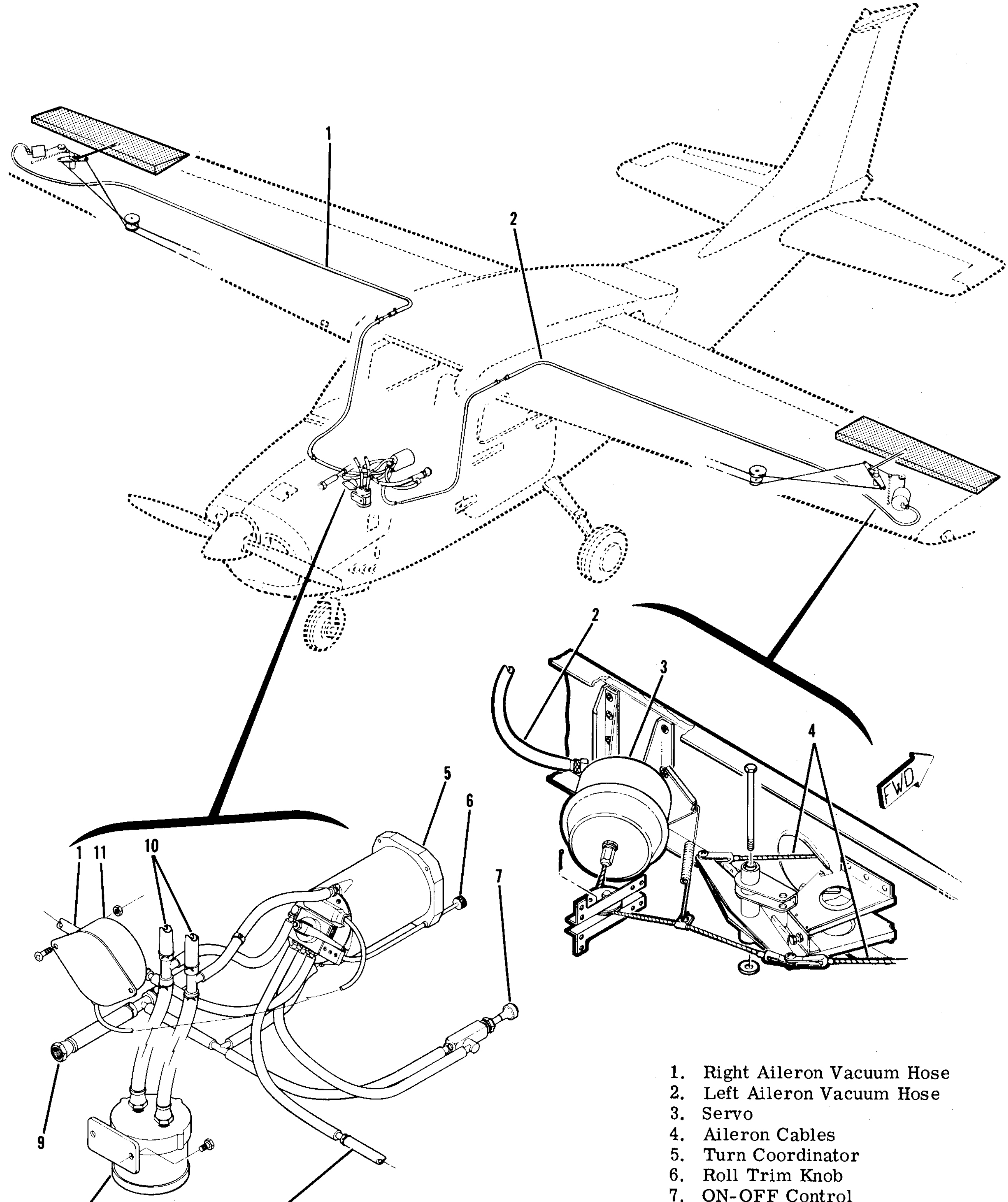
16-59. An hourmeter may be installed as optional equipment. The meter operates electrically, and is actuated by a pressure switch in the oil system. The meter is powered by the clock's electrical system, and therefore will operate independent of the master switch. A small indicator on the dial face rotates when the meter is actuated. If the meter is inoperative, and the clock is operating, the meter or its wiring is faulty and must be replaced.

16-60. WING LEVELER.

16-61. A wing leveler system, consisting of a turn coordinator, pneumatic servos and connecting cables and hoses may be installed as optional equipment. The turn coordinator gyro senses changes in roll attitide, then electrically meters vacuum power from the engine-driven vacuum pump to the cylinder-piston servos, operating the ailerons for longitudinal stability. Manual control of the system is afforded by the roll trim knob. The roll trim should not be used to correct faulty rigging or "wing heaviness." Manual override of the system may be accomplished without damage to the aircraft or system. The ON-OFF valve controls the vacuum supply to the distirbutor valve, but does not affect the electrically operated turn coordinator gyro.

The system may be removed and installed while using figure 16-7 as a guide and observing general precautions outlined in this section. Installation of the wing leveler system does not change the vacuum relief valve settings specified in paragraph 16-32. Refer to appropriate publication issued by manufacturer for trouble shooting.

16-62. RIGGING. The aileron servos are rigged by positioning the left aileron up, then pulling the servo cable until the piston is extended and the seal is taut but not stretched. Holding this position, attach the servo cable to the aileron cable as shown in applicable figure. Repeat procedure for right wing.



1. Right Aileron Vacuum Hose
2. Left Aileron Vacuum Hose
3. Servo
4. Aileron Cables
5. Turn Coordinator
6. Roll Trim Knob
7. ON-OFF Control
8. Filter
9. Relief Valve Hose
10. Gyro Hose
11. Inverter

Figure 16-7. Wing Leveler Control System

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SECTION 17

ELECTRICAL SYSTEMS

TABLE OF CONTENTS Page

17-1. ELECTRICAL SYSTEMS.

17-2. GENERAL. This section contains service information necessary to maintain the Aircraft Electrical Power Supply System, Battery and External Power Supply System, Alternator Power System, Aircraft Lighting System, Pitot Heater, Stall Warning, Cigar Lighter and Electrical Load Analysis.

17-3. ELECTRICAL POWER SUPPLY SYSTEM.

17-4. DESCRIPTION. Electrical energy for the aircraft is supplied by a 14-volt, direct-current, single-wire, negative ground electrical system. A single 12-volt battery supplies power for starting and furnishes a reserve source of power in the event of alternator failure. An engine-driven alternator is the normal source of power during flight and maintains a battery charge controlled by a voltage regulator. An external power source receptacle is offered as optional equipment to supplement tne battery alternator system for starting and ground operation.

17-5. SPLIT BUS BAR. Electrical power is supplied through a split bus bar. One side of the bus bar supplies power to the electrical equipment while the other side supplies the electronic installations. When the master switch is closed the battery contactor engages and battery power is supplied to the electrical side of the split bus bar. The electrical bus feeds battery power to the electronics bus through a normally-closed relay; this relay opens when the starter switch is engaged or when an external power source is used, preventing transient voltages from damaging the semiconductor circuitry in the electronic installations. (See figure 17-1.)

17-6. SPLIT BUS POWER RELAY. A power relay is installed behind the instrument panel on all airplanes utilizing a split bus bar. The relay is a normally-closed type, opening when external power is connected or when the starter is engaged, thus removing battery power from the electronic side of the split bus bar and preventing transient voltages from damaging the electronic installations. (See figure 17-1.)

17-7. MASTER SWITCH. The operation of the battery and alternator systems is controlled by a master switch. The switch is a rocker type with double-pole, single-throw contacts. The switch, when operated, connects the battery contactor coil to ground and the alternator field circuit to the battery, activating the power systems. The master switch is located on the stationary instrument panel. (See figure 17-1.)

17-8. AMMETER. The ammeter is connected between the battery and the aircraft bus. The meter indicates the amount of current flowing either to or from the battery. With a low battery and the engine operating at cruise speed the ammeter will show the full alternator output when all electrical equipment is off. When the battery is fully charged and cruise RPM is maintained with all electrical equipment off, the ammeter will show a minimum charging rate.

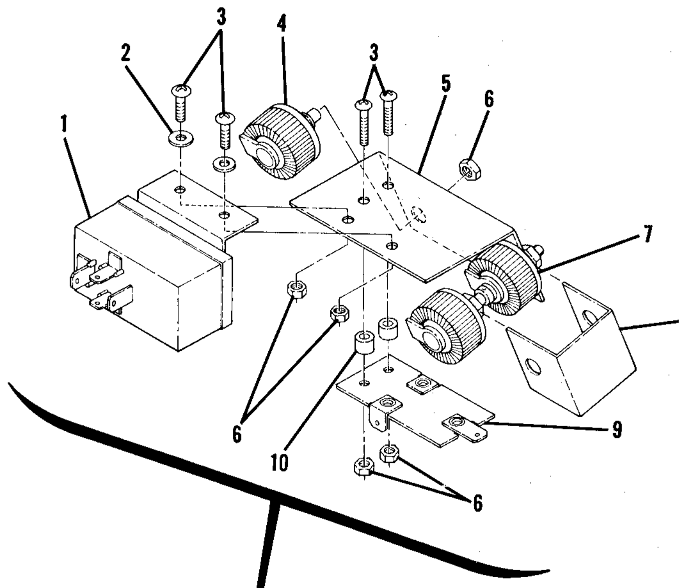
17-9. BATTERY POWER SYSTEM.

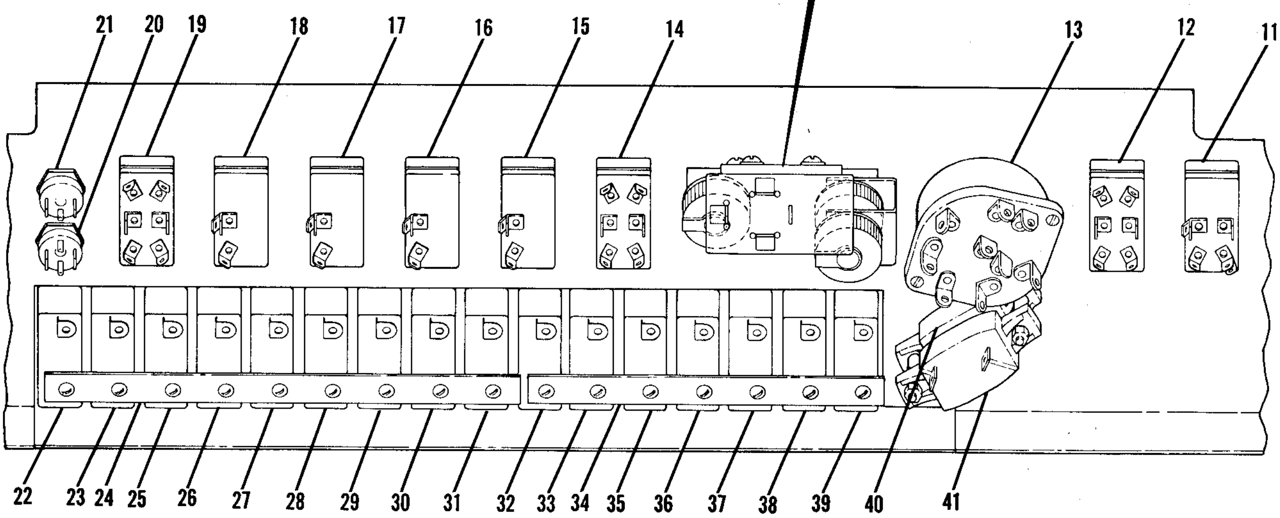
17-10. BATTERY. The battery is 12-volts and is approximately 33 ampere-hour in capacity. The battery is mounted on the forward left side of the firewall and is equipped with non-spill type filler caps.

17-11. TROUBLE SHOOTING THE BATTERY POWER SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE.		
Battery discharged.	1. Measure voltage at "BAT" terminal of battery contactor with master switch and a suitable load such as a taxi light turned on. Normal battery will indicate 11. 5 volts or more.	If voltage is low, proceed to step 2. If voltage is normal, proceed to step 3.
Battery faulty.	2. Check fluid level in cells and charge battery at 20 amps for approximately 30 minutes or until the battery voltage rises to 15 volts. Check battery with a load type tester.	If tester indicates a good battery, the malfunction may be assumed to be a discharged battery. If the tester indicates a faulty battery, replace the battery.
Faulty contactor or wiring between contactor and master switch.	3. Measure voltage at master switch terminal (smallest) on contactor with master switch closed. Normal indication is zero volts.	If voltage reads zero, proceed to step 4. If a voltage reading is obtained, check wiring between contactor and master switch. Also check master switch.

1. Split Bus Power Relay
2. Washer
3. Screw
4. Radio Light Rheostat
5. Bracket - Relay Mounting
6. Nut
7. Tandem Rheostat Assembly
8. Bracket - Rheostat Mounting
9. Diode Assembly Board
10. Spacer
11. Master Switch
12. Fuel Pump Switch
13. Magneto Switch
14. Console Light Switch (Opt)





VIEWED FROM THE BACK SIDE OF THE SWITCH PANEL

15. Oil Dilution Switch (Opt)
16. Pitot Heat Switch (Opt)
17. Navigation Light Switch
18. Flashing Beacon Light Switch
19. Landing Light Switch
20. Landing Gear Down Warning Light
21. Landing Gear Up Warning Light
22. Generator Circuit Breaker
23. Landing Light Circuit Breaker
24. Primary Bus Bar
25. Navigation Lights Circuit Breaker
26. Pitot Heat Circuit Breaker (Opt)
27. Instrument Light Circuit Breaker
28. Cabin Light Circuit Breaker
29. Flap Circuit Breaker
30. Fuel Pump Circuit Breaker
31. Landing Gear Circuit Breaker
32. Beacon Light Circuit Breaker
33. Radio #4 Circuit Breaker (Opt)
34. Electronics Bus Bar
35. Radio #3 Circuit Breaker (Opt)
36. Radio #2 Circuit Breaker (Opt)
37. Radio #1 Circuit Breaker (Opt)
38. Auto Pilot Circuit Breaker (Opt)
39. Audio Amp. Circuit Breaker (Opt)
40. Automatic Circuit Breaker, Gen. Field
41. Automatic Circuit Breaker, Turn Coordinator and Stall Horn

Figure 17-1. Split Bus Bar and Split Bus Power Relay Installation

BROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE (Cont).		
Open coil on contactor.	4. Check continuity between "BAT" terminal and master switch terminal of contactor. Normal indication is 16 to 24 ohms (Master switch open).	If ohmmeter indicates an open coil, replace contactor. If ohmmeter indicates a good coil, proceed to step 5.
Faulty contactor contacts.	5. Check voltage on "BUS" side of contactor with master switch closed. Meter normally indicates battery voltage.	If voltage is zero or intermittant, replace contactor. If voltage is normal, proceed to step 6.
Faulty wiring between contactor and bus.	6. Inspect wiring between contactor and bus.	Repair or replace wiring.

17-12. REMOVAL AND REPLACEMENT OF BATTERY. (See figure 17-2.)

a. To gain access to the battery, remove the upper left half of cowling.

b. Remove the battery box lid and disconnect the battery ground cable.

CAUTION

Always remove the ground cable first and connect it last to prevent accidentally shorting the battery to the airframe with tools.

c. Disconnect the positive cable from the battery and remove the battery from the aircraft.

d. To install a battery, reverse this procedure.

17-13. CLEANING THE BATTERY. For maximum efficiency, the battery and connections should be kept clean at all times.

a. Remove the battery in accordance with preceding paragraph.

b. Tighten battery cell filler caps to prevent the cleaning solution from entering the cells.

c. Wipe battery cable ends, battery terminals and entire surface of the battery with a clean cloth moistened with a solution of bicarbonate of soda (baking soda) and water.

d. Rinse with clear water, wipe off excess water and allow battery to dry.

e. Brighten up cable ends and battery terminals with emery cloth or a wire brush.

f. Install the battery according to the preceding paragraph.

g. Coat the battery terminals and the cable ends with petroleum jelly.

17-14. ADDING ELECTROLYTE OR WATER TO THE BATTERY. A battery being charged and discharged with use will decompose the water from the electrolyte by electrolysis. When the water is decomposed, hydrogen and oxygen gases are formed which escape into the atmosphere through the battery vent system. The acid in the solution chemically combines with the plates of the battery during discharge or is suspended in the electrolyte solution during charge. Unless the electrolyte has been spilled from a battery, acid should not be added to the solution. The water will decompose into gases and should be replaced regularly. Add distilled water as necessary to maintain the electrolyte level even with the horizontal baffle plate inside the battery. When "dry charged" batteries are put into service, fill as directed with electrolyte. However, as the electrolyte level falls below normal with use add only distilled water to maintain the proper level. The battery electrolyte contains approximately 25% sulphuric acid by volume. Any change in this volume will hamper the proper operation of the battery.

CAUTION

Do not add any type of "battery rejuvenator" to the electrolyte. When acid has been spilled from a battery, the acid balance may be adjusted by following instructions published by the Association of American Battery Manufacturers.

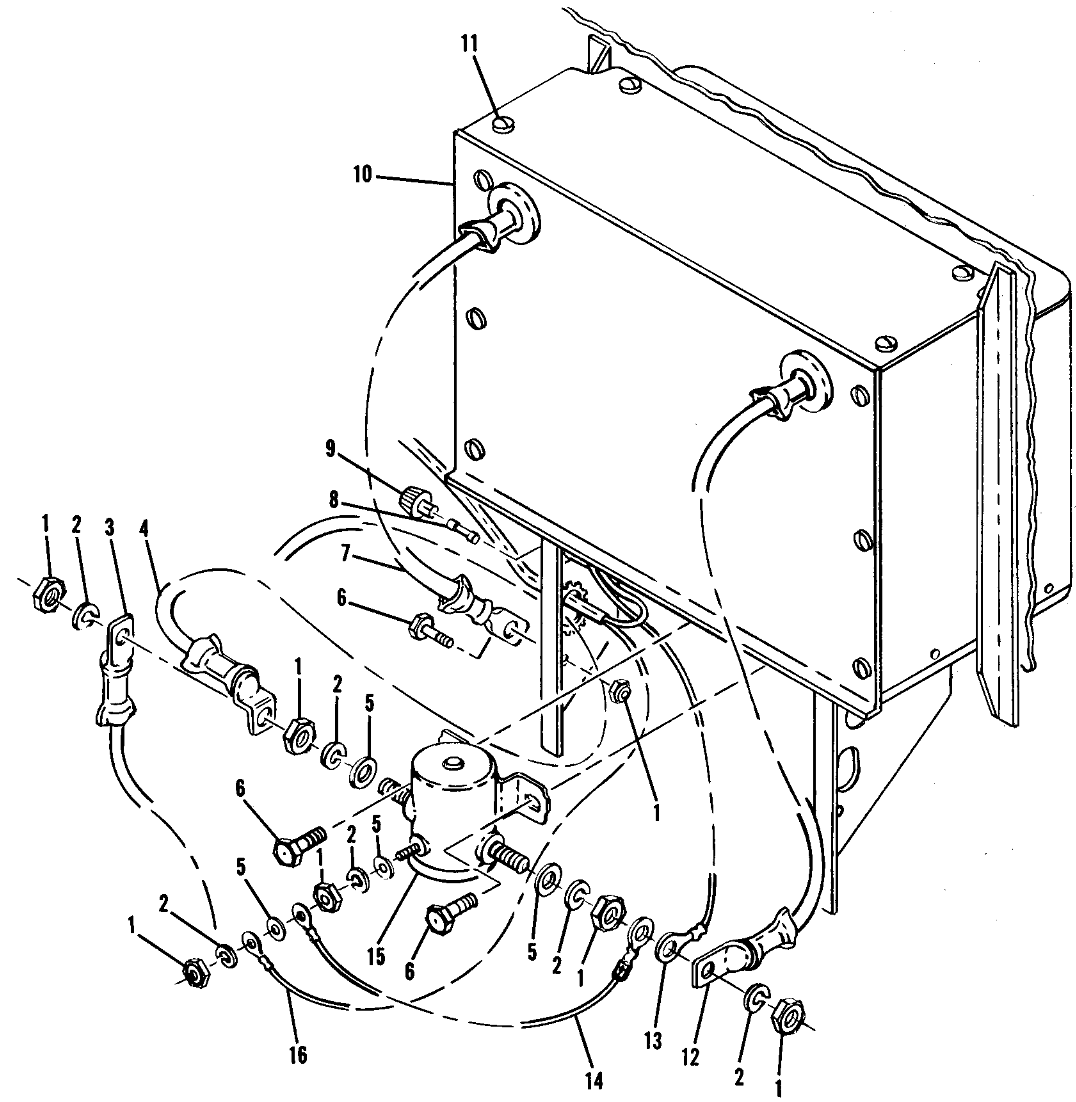
17-15. TESTING THE BATTERY. The specific gravity check method of testing the battery is prefered when the condition of the battery is in a questionable state-of-charge. However, when the aircraft has been operated for a period of time with an alternator output voltage which is known to be correct, the question of battery capability may be answered more correctly with a load type tester. If testing the battery is deemed necessary, the specific gravity should be checked first and compared with the following chart.

BATTERY HYDROMETER READINGS

1.280 Specific Gravity	100% Charged
1.250 Specific Gravity	75% Charged
1.220 Specific Gravity	50% Charged
1.190 Specific Gravity	25% Charged
1.160 Specific Gravity	Practically Dead

NOTE

All readings shown are for an electrolyte temperature of 80° Fahrenheit. For higher temperatures the readings will be slightly lower. For cooler temperatures the read-



1. Nut
2. Lockwasher
3. Gnd Ser Recpt Cable
4. Starter Contactor Cable
5. Washer
6. Bolt
7. Ground Cable
8. Fuse
9. Cap-Fuse
10. Battery Box
11. Fasteners
12. Power Cable
13. Clock Wire
14. Diode Wire
15. Battery Solenoid
16. Master Switch Wire

Figure 17-2. Battery Installation

ings will be slightly higher. Some hydrometers have a built-in temperature compensation chart and a thermometer. If this type tester is used, disregard this chart.

If a specific gravity reading indicates that the battery is not fully charged, the battery should be charged at approximately 20 amperes for 30 minutes, or until the battery voltage rises to 15 volts. After charging, a load type tester will give more meaningful results. A specific gravity check can be used after charging but the check cannot spot cells which short under load, broken connectors between plates of a cell, etc.

17-16. CHARGING THE BATTERY. When the battery is to be charged, the level of electrolyte should be checked and adjusted by adding distilled water to cover the tops of the internal battery plates. The battery cables and connections should be clean.

WARNING

When a battery is charging, hydrogen and oxygen gases are generated. Accumulation of these gases can create a hazardous explosive condition. Always keep sparks and open flame away from the battery. Allow unrestricted ventilation of the battery area during charging.

The main points of consideration during a battery charge are excessive battery temperature and violent gassing. Under a reasonable rate of charge (20 amperes or less) the battery temperature should not rise over 125°F nor should gassing be so violent that acid is blown from the vents.

17-17. BATTERY BOX. The battery is completely enclosed in a box which is painted with acid proof paint. The box has a vent tube which protrudes through the bottom of the aircraft allowing battery gases and spilled electrolyte to escape. The battery box is riveted to the left forward side of the firewall.

17-18. REMOVAL AND REPLACEMENT OF BATTERY BOX. (See figure 17-2.) The battery box is riveted to the firewall. The rivets must be drilled out to remove the box. When a battery box is installed and riveted into place, all rivets and scratches inside the box should be painted with acid-proof lacquer, Part No. CES 1054-381, available from the Cessna Service Parts Center.

17-19. MAINTENANCE OF BATTERY BOX. The battery box should be inspected and cleaned periodically. The box and cover should be cleaned with a strong solution of bicarbonate of soda (baking soda) and water. Hard deposits may be removed with a wire brush. When all corrosive deposits have been removed from the box, flush it thoroughly with clean water.

WARNING

Do not allow acid deposits to come in contact with skin or clothing. Serious acid burns may result unless the affected area is washed immediately with soap and water. Clothing will be ruined upon contact with battery acid.

Inspect the cleaned box and cover for physical damage and for areas lacking proper acid proofing. A badly damaged or corroded box should be replaced. If the box or lid require acid proofing, paint the area with acid-proof black lacquer, Part No. CES 1054-381, available from the Cessna Service Parts Center.

17-20. BATTERY CONTACTOR. The battery contactor is bolted to the firewall below the battery box. The contactor is a solenoid plunger type, which is actuated by turning the master switch on. When the master switch is off, the battery is disconnected from the electrical system. A silicon diode is used to eliminate spiking of the transistorized radio equipment. The cathode (+) terminal of the diode connects to the battery terminal of the battery contactor. The anode (-) terminal of the diode connects to the same terminal on the contactor as the master switch wire. This places the diode directly across the contactor solenoid coil so that inductive spikes originating in the coil are clipped when the master switch is opened. See figure 17-2 for pictorial installation of the battery contactor and diode.

17-21. REMOVAL AND REPLACEMENT OF BATTERY CONTACTOR. (See figure 17-2.)

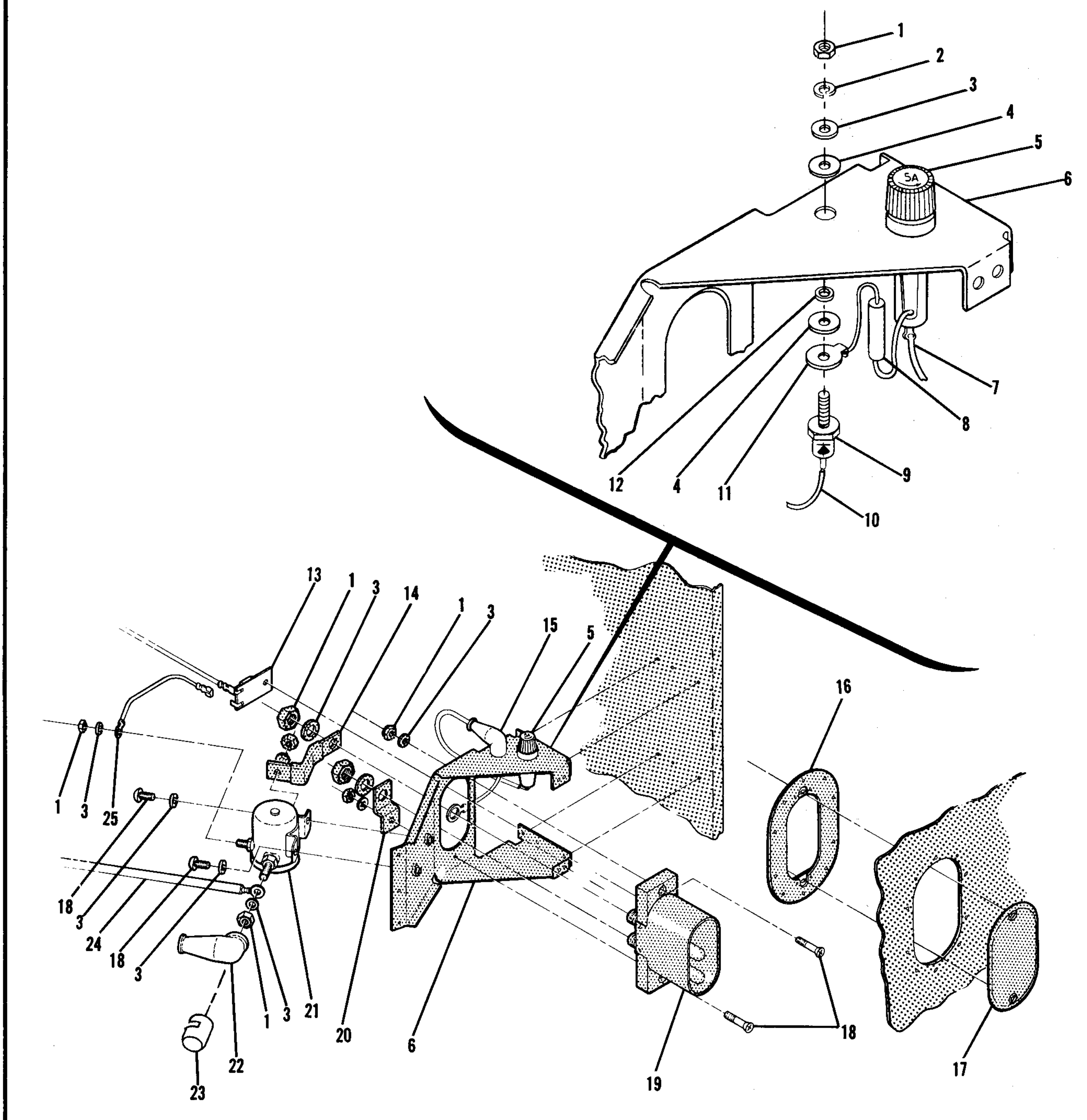
a. Open battery box and disconnect ground cable from negative battery terminal. Pull cable clear of battery box.
b. Remove the nut, lockwasher and the two plain washers securing the battery cables to the battery contactor.
c. Remove the nut, lockwasher and the two plain washers securing the wire which is routed to the master switch.
d. Remove the bolt, washer and nut securing each side of the battery contactor to the firewall. The contactor will now be free for removal.
e. To replace the contactor, reverse this procedure.

17-22. BATTERY CONTACTOR CLOSING CIRCUIT. This circuit consists of a 5-amp fuse, a resistor and a diode mounted on the ground service receptacle bracket. This serves to shunt a small charge around the battery contactor so that ground power may be used to close the contactor when the battery is too dead to energize the contactor by itself. (See figure 17-3.)

17-23. GROUND SERVICE RECEPTACLE. A ground service receptacle is installed to permit the use of external power for cold weather starting or when performing lengthy electrical maintenance. A reverse polarity protection system is utilized whereby ground power must pass through an external power contactor to be connected to the bus. A silicon junction diode is connected in series with the coil on the external power contactor so that if the ground power source is inadvertently connected with a reversed polarity, the external power contactor will not close. This feature protects the diodes in the alternator, and other semiconductor devices used in the airplane, from possible reverse polarity damage.

NOTE

Maintenance of the electronic installations can-



1. Nut
2. Lockwasher
3. Washer
4. Insulating Washer
5. Fuse
6. Bracket
7. Wire to Battery Contactor
8. Resistor-.75 ohm
9. Diode
10. Wire to Ext. Pwr. Recept.
11. Solder Terminal
12. Spacer
13. Diode Board
14. Bus Bar
15. Nipple - Used before resistor was added
16. Doubler
17. Cover Plate
18. Screw
19. Receptacle
20. Ground Strap
21. Ext. Power Contactor
22. Nipple - Early Airplanes
23. Cover - Late Airplanes
24. Power Cable
25. Contactor Control Wire

Figure 17-3. Ground Service Receptacle Installation not be performed when using external power. Application of external power opens the relay supplying voltage to the electronics bus. For lengthy ground testing of electronics systems, connect a well regulated and filtered power supply directly to the battery side of the battery contactor. Adjust the supply for 14 volts and close the master switch.

NOTE

When using ground power to start the airplane, close the master switch before removing the ground power plug. This will ensure closure of the battery contactor and excitation of the alternator field in the event that the battery is completely dead.

CAUTION

Failure to observe polarity when connecting an external power source directly to the battery or directly to the battery side of the battery contactor, will damage the diodes in the alternator and other semiconductor devices in the airplane.

WARNING

External power receptacle must be functionally checked after wiring, or after replacement of components of the external power or split bus systems. Incorrect wiring or malfunctioned components can cause immediate engagement of starter when ground service plug is inserted.

17-24. TROUBLE SHOOTING THE EXTERNAL POWER SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STARTER ENGAGES WHEN GROUND POWER IS CONNECTED.		
Shorted or reversed diode in split bus-bar system.	Check wiring to, and condition of diode mounted on the split bus relay bracket adjacent to the magneto switch.	Correct wiring. Replace diode board assembly.
GROUND POWER WILL NOT CRANK ENGINE.		
Ground service connector wired incorrectly.	1. Check for voltage at all three terminals of external power contactor with ground power connected and master switch off.	If voltage is present on input and coil terminals but not on the output terminal, proceed to step 4. If voltage is present on the input terminal but not on the coil terminal, proceed to step 2. If voltage is present on all three terminals, check wiring between contactor and bus.
	2. Check for voltage at small terminal of ground service receptacle.	If voltage is not present, check ground service plug wiring. If voltage is present, proceed to step 3.
Open or mis-wired diode on ground service diode board assembly.	3. Check ploarity and continuity of diode on diode board at rear of ground service receptacle.	If diode is open or improperly wired, replace diode board assembly.
Faulty external power contactor.	4. Check resistance from coil terminal of external power contactor to ground (master switch off and ground power unplugged). Normal indication is 16-24 ohms.	If resistance indicates an open coil, replace contactor. If resistance is normal, proceed to step 5.
Faulty contacts in external power contactor.	5. With master switch off and ground power applied, check for voltage drop between two large terminals of external power contactor (turn on taxi light for a load). Normal indication is zero volts.	If voltage is intermittantly present or present all the time, replace contactor.

17-25. REMOVAL AND REPLACEMENT OF THE GROUND SERVICE RECEPTACLE. (See figure 17-3.)

a. Open the battery box and disconnect the ground cable from the negative terminal of the battery and pull the cable free of the box.

b. Remove the nuts, washers, ground strap, bus bar and diode board from the studs of the receptacle and remove battery cable.

c. Remove the screws and nuts holding the receptacle; ground strap will then be free from the bracket.

d. To install a ground service receptacle, reverse this procedure.

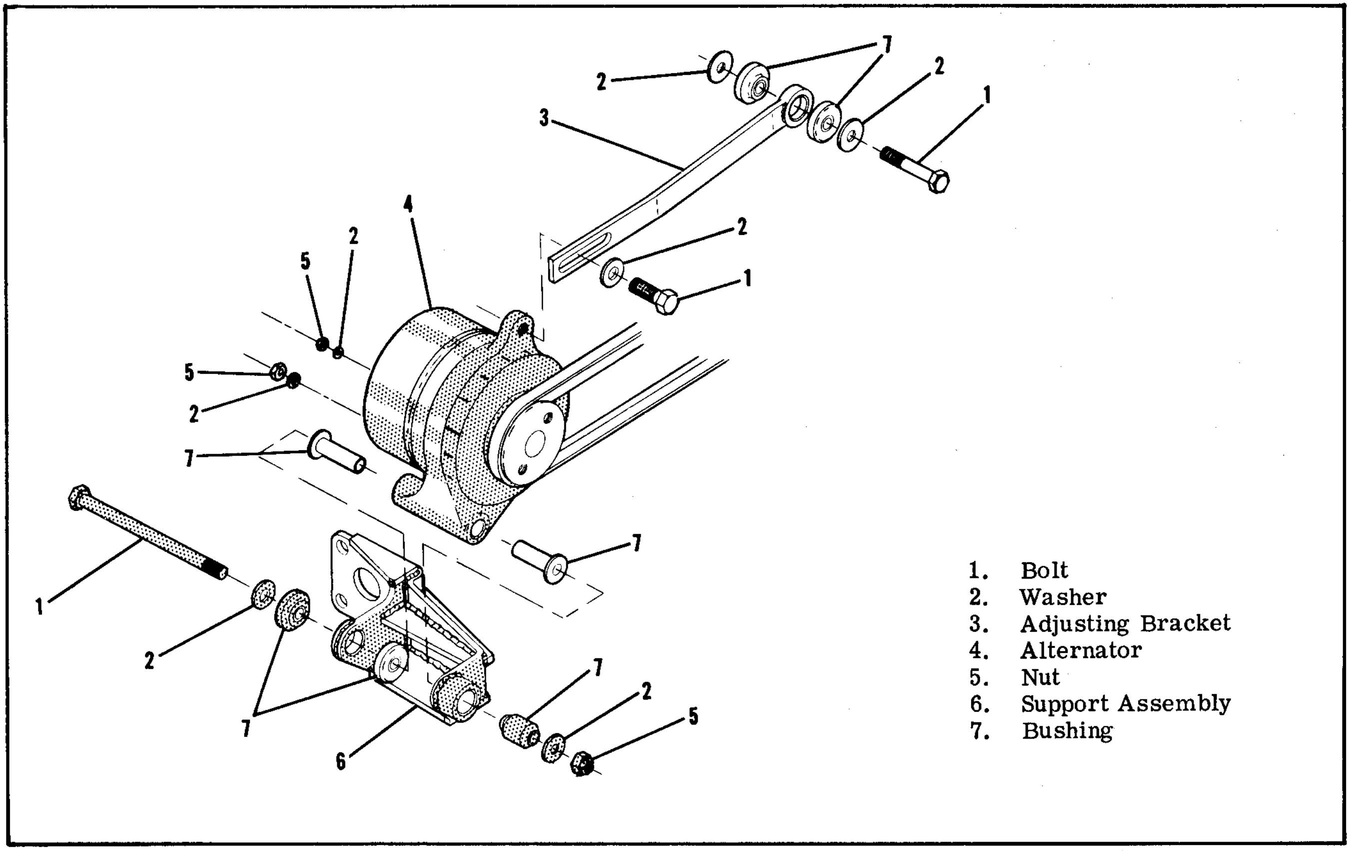


Figure 17-4. Alternator Installation

17-26. ALTERNATOR POWER SYSTEM.

17-27. DESCRIPTION. The introduction of the high current silicon diode resulted in a reduction of mass required for an alternator rectifier system. This inovation made the alternator practical for use in light aircraft power systems. The alternator, like the generator, produces ac by electromagnetic induction. Rectification of the ac is accomplished by silicon diodes rather than by a comutator as in the generator. The alternators higher efficiency arises from the fact that the ac is produced in a three phase system which means that all of the windings carrying ac are working to produce power most of the time. In the generator, only a small portion of the ac windings are in use at any given time.

The alternator, unlike the generator, is self-limiting in its output current capability. Therefore, no current limiting device is required in the alternator regulator. Also, because of the use of silicon diodes in the output network of an alternator the flow of current back into the alternator is impossible and no reverse current protection device is required either. The alternator field is designed to retain no residual magnetic flux and, therefore, the alternator requires excitation to be applied from an external source (the battery) before the alternator will function.

17-28. ALTERNATOR. The 60-ampere alternators used on Cessna single engine aircraft are three phase, delta connected with integral silicon diode rectifiers. The alternator is rated at 14-volts at 60-amperes continuous output. The moving center part of the alternator (rotor) consists of an axial winding with radial interlocking poles which surround the winding. With excitation applied to the winding through slip rings the pole pieces assume magnetic polarity. The rotor is mounted in bearings and rotates inside the stator which contains the windings in which the ac current is generated. The stator windings are three-phase, delta connected and are attached to two diode plates, each of which contains three silicon diodes.

The diode plates are connected to accomplish full-wave, rectification of the ac. The resulting dc output is applied to the aircraft bus and sensed by the voltage regulator. The regulator controls the excitation applied to the alternator field thus controlling the output voltage of the alternator.

17-29. ALTERNATOR REVERSE VOLTAGE DAMAGE. The alternator is very susceptible to reverse polarity damage due to the very low resistance of the output windings and the low resistance of the silicon diodes in the output. If a high current source, such as a battery or heavy duty ground power cart is attached to the aircraft with the polarity inadvertently reversed, the current through the alternator will flow almost without limit and the alternator will be immediately damaged.

17-30. TROUBLE SHOOTING THE ALTERNATOR SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
AMMETER INDICATES HEAVY DISCHARGE WITH ENGINE NOT RUNNING OR ALTERNATOR CIRCUIT BREAKER OPENS WHEN MASTER SWITCH IS TURNED ON.		
Shorted field in alternator.	1. Remove plug from regulator with master switch on and observe if heavy drain persists.	If heavy drain is reduced, go to step 2. If heavy drain is not reduced, go to step 3.
	2. Check resistance from terminal "F" on alternator to the alternator case. Normal indication is 6-7 ohms.	If resistance is too low, repair or replace alternator.
Shorted radio noise filter or shorted wire.	3. Remove cable from output terminal of alternator. Check resistance from end of cable to ground (MASTER SWITCH MUST BE OFF).	If resistance does not indicate a direct short, go to step 6. If resistance indicates a direct short, go to step 4.
	4. Remove cable connections from radio noise filter. Check resistance from the filter input terminal to ground. Normal indication is infinite resistance.	If reading indicates a direct short, replace filter. If no short is evident, go to step 5.
	5. Check resistance from ground to the free ends of the wires which were connected to the radio noise filter (or alternator if no noise filter is installed). Normal indication does not show a direct short.	If a short exists in wires, repair or replace wiring.
Shorted diodes in alternator.	6. Check resistance from output terminal of alternator to alternator case. Reverse leads and check again. Resistance reading may show continuity in one direction but should show an infinite reading in the other direction.	If an infinite reading is not obtained in at least one direction, repair or replace alternator.
ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED.		
Regulator faulty or improperly adjusted.	1. Start engine and adjust for 1500 RPM. Ammeter should indicate a heavy charge rate with all electrical equipment turned off. Rate should taper off in 1-3 minutes. A voltage check at the bus should indicate a reading consistant with the voltage vs temperature chart on page 17-13.	If charge rate tapers off very quickly and voltage is normal, check battery for malfunction. If ammeter shows a low charge rate or any discharge rate, and voltage is low, proceed to step 2.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED (Cont).		
	2. Stop engine, remove cowl, and remove cover from voltage regulator. Turn master switch ON/OFF several times and observe field relay in regulator. Relay should open and close with master switch and small arc should be seen as contacts open.	If relay is inoperative, proceed to step 3. If relay operates, proceed to step 4.
	3. Check voltage at "S" terminal of regulator with master switch closed. Meter should indicate bus voltage.	If voltage is present, replace regulator. If voltage is not present, check wiring between regulator and bus.
	4. Remove plug from regulator and start engine. Momentarily jumper the "A+" and "F" terminals together on the plug. Ship's ammeter should show heavy rate of charge.	If heavy charge rate is observed, replace regulator. If heavy charge rate is not observed, proceed to step 5.
Faulty wiring between alternator and regulator, or faulty alternator.	5. Check resistance from "F" terminal of regulator to "F" terminal of alternator. Normal indication is a very low resistance.	If reading indicates no, or poor continuity, repair or replace wiring from regulator to alternator.
	6. Check resistance from "F" terminal of alternator to alternator case. Normal indication is 6-7 ohms.	If resistance is high or low, repair or replace alternator.
	7. Check resistance from case of alternator to airframe ground. Normal indication is very low resistance.	If reading indicates no, or poor continuity, repair or replace alternator ground wiring.
ALTERNATOR OVERCHARGES BATTERY - BATTERY USES EXCESSIVE WATER.		
Regulator faulty or improperly adjusted.	Check bus voltage with engine running. Normal indication agrees with voltage vs temperature chart on page 17-13. Observe ship's ammeter, ammeter should indicate near zero after a few minutes of engine operation.	Replace regulator.

SHOP NOTES:

17-31. REMOVAL AND REPLACEMENT OF THE ALTERNATOR. (See figure 17-4.)

a. Make sure that the master switch remains in the off position or disconnect the negative lead from the battery.

b. Disconnect the wiring from the alternator.

c. Remove the safety wire from the upper adjusting bolt and remove the bolt from the alternator.

d. Remove the nut and washer from the lower mounting bolt.

e. Remove the alternator drive belt and lower mounting bolt to remove the alternator.

f. To replace the alternator, reverse this procedure.

g. Adjust belt tension to obtain 3/8" deflection at the center of the belt when applying 12 pounds of pressure to the belt. After the belt is adjusted and the bolt is safety wired, tighten the bottom bolt to 50-70 lb.-ft. torque to remove any play between the alternator mounting foot and the U-shaped support assembly.

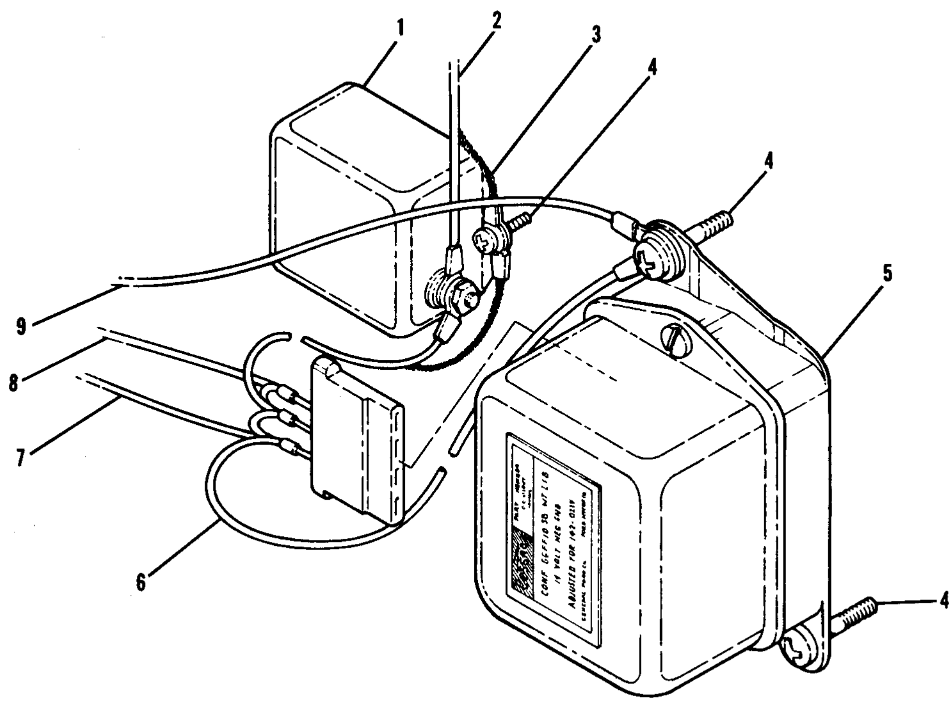
CAUTION

Whenever a new belt is installed, belt tension should be checked within 10 to 25 hours of operation.

NOTE

When tightening the alternator belt, apply pry bar pressure only to the end of the alternator nearest to the belt pulley.

17-32. ALTERNATOR FIELD CIRCUIT PROTECTION. A 2-amp automatic resetting circuit breaker located on the back of the instrument panel is provided to protect the alternator field circuit. (See figure 17-1.)



1. Filter - Radio Noise
2. Wire to Master Switch
3. Shield - Ground
4. Screw
5. Voltage Regulator
6. Wire Shields to Ground
7. Wire to Alternator "F"
8. Wire to Alternator "A+"
9. Wire to Alternator Ground

Figure 17-5. Voltage Regulator Installation

17-33. ALTERNATOR VOLTAGE REGULATOR. The alternator voltage regulator contains two relays. One relay is actuated by the aircraft master switch and connects the regulator to the battery. The second relay is a two-stage, voltage sensitive device which is used to control the current applied to the field winding of the alternator. When the upper set of contacts on the voltage regulator relay are closed, full bus voltage is applied to the field. This condition will exist when the battery is being heavily charged or when a very heavy load is applied to the system. When the upper contacts open, as the voltage begins to rise toward normal bus voltage, the voltage to the alternator field is reduced through a resistor network in the base of the regulator thus reducing the output from the alternator. As the voltage continues to rise, assuming a very light load on the system, the lower contacts will close and ground the alternator field and shut the alternator completely off. Under lightly loaded conditions the voltage relay will vibrate between the intermediate charge rate and the lower (completely off) contacts. Under a moderate load, the relay will vibrate between the intermediate charge rate and the upper (full output) contacts.

The voltage relay is temperature compensated so that the battery is supplied with the proper charging voltage for all operating temperatures. With the battery fully charged (ship's ammeter indicating at or near zero) and a moderate load applied to the system (a taxi light turned on) the voltage at the bus bar should be within the range shown according to the air temperature on the following chart:

TEMPERATURE	BUS VOLTAGE
60 - 74°F	13.8 - 14.1
75 - 90°F	13.7 - 14.0
91 - 100°F	13.6 - 13.9

The voltage regulator is adjustable but adjustments on the airplane is not recommended. A bench adjustment procedure is outlined in the Cessna Alternator Charging Systems Service/Parts Manual.

17-34. TROUBLE SHOOTING THE VOLTAGE REGULATOR. For trouble shooting the voltage regulator, refer to paragraph 17-30.

17-35. REMOVAL AND REPLACEMENT OF VOLTAGE REGULATOR. (See figure 17-5.)

a. Make sure that the master switch is off or disconnect the negative lead from the battery.
b. Remove the connector plug from the regulator.
c. Remove two screws holding the regulator on the firewall.
d. To replace the regulator, reverse this procedure. Be sure that the connections for grounding the alternator, wiring shields and the base of the regulator are clean and bright before assembly. Otherwise, poor voltage regulation and/or excessive radio noise may result.

SHOP NOTES:

17-36. AIRCRAFT LIGHTING SYSTEM.

17-37. DESCRIPTION. The aircraft lighting system consists of landing and taxi lights, navigation lights, flashing beacon light, interior and instrument panel flood lights, electroluminescent panel lighting, instrument post lighting, pedestal lights, oxygen lights, courtesy lights, de-ice light, control wheel map light, compass and radio dial lights.

On the 1969 model, snap-in type rocker switches are introduced. These switches have a design feature which permits them to snap into the panel from the panel side and can subsequently be removed for easy maintenance. These switches also feature spade type slip-on terminals.

17-38. TROUBLE SHOOTING THE AIRCRAFT LIGHTING SYSTEM.

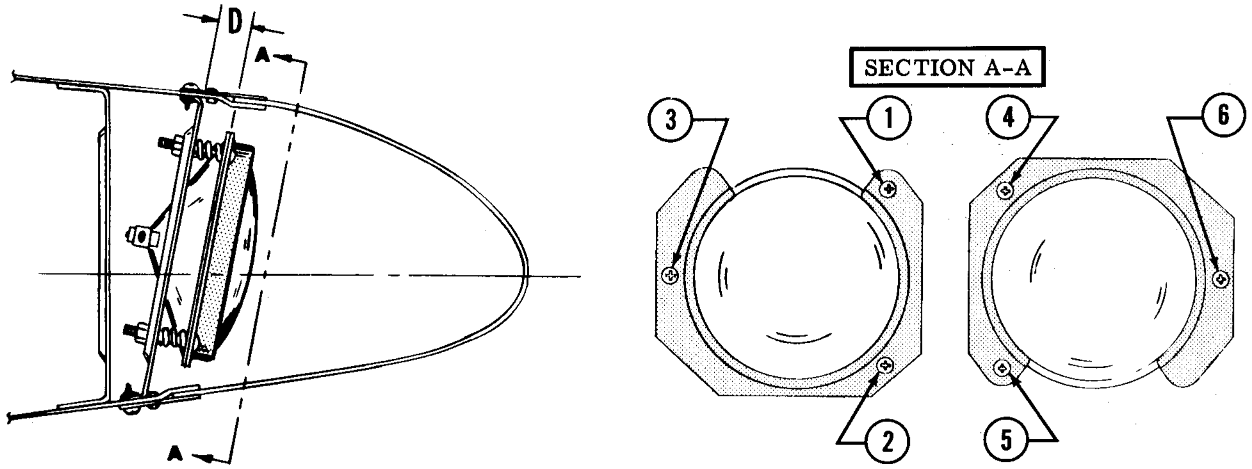
PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
LANDING AND TAXI LIGHTS OUT.		
Short circuit in wiring.	1. Inspect circuit breaker.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
Defective wiring.	2. Test each circuit separately until short is located.	Repair or replace wiring.
Defective switch.	3. Check voltage at lights with master, landing and taxi light switches ON. Should read battery voltage.	Replace switch.
LANDING OR TAXI LIGHT OUT.		
Lamp burned out.	1. Test lamp with ohmmeter or new lamp.	Replace lamp.
Open circuit in wiring.	2. Test wiring for continuity.	Repair or replace wiring.
ALL NAV LIGHTS OUT.		
Short circuit in wiring.	1. Inspect circuit breakers.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
Defective wiring.	2. Isolate and test each nav light circuit until short is located.	Repair or replace wiring.
Defective switch.	3. Check voltage at nav light with master and nav light switches on. Should read battery voltage.	Replace switch.
ONE NAV LIGHT OUT.		
Lamp burned out.	1. Inspect lamp.	Replace lamp.
Open circuit in wiring.	2. Test wiring for continuity.	Repair or replace wiring.
FLASHING BEACON DOES NOT LIGHT.		
Short circuit in wiring.	1. Inspect circuit breaker.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
FLASHING BEACON DOES NOT LIGHT (Cont).		
Defective wiring.	2. Test circuit until short is located.	Repair or replace wiring.
Lamp burned out.	3. Test lamp with ohmmeter or a new lamp.	Replace lamp. If lamp is good, proceed to step 4.
Open circuit in wiring.	4. Test circuit from lamp to flasher for continuity.	If no continuity is present, repair or replace wiring. If continuity is present, proceed to step 5.
Defective switch.	5. Check voltage at flasher with master and beacon switch on. Should read battery voltage.	Replace switch. If voltage is present, proceed to step 6.
Defective flasher.	6. Install new flasher.	
FLASHING BEACON CONSTANTLY LIT.		
Defective flasher.	1. Install new flasher.	
DOME LIGHT TROUBLE.		
Short circuit in wiring.	1. Inspect circuit breaker.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
Defective wiring.	2. Test circuit until short is located.	Repair or replace wiring.
	3. Test for open circuit	Repair or replace wiring. If no short or open circuit is found, proceed to step 4.
Lamp burned out.	4. Test lamp with ohmmeter or new lamp.	Replace lamp.
Defective switch.	5. Check for voltage at dome light with master and dome light switch on. Should read battery voltage.	Replace switch.
ELECTROLUMINESCENT PANELS WILL NOT LIGHT.		
Short circuit in wiring.	1. Inspect circuit breaker.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
Defective wiring.	2. Test circuit until short is located.	Repair or replace wiring.
	3. Test for open circuit.	Repair or replace wiring. If no open or short circuit is found, proceed to step 4.
Defective resistor.	4. Check resistor for continuity. (Located in line between rheostat and inverta-pak.)	Replace resistor.

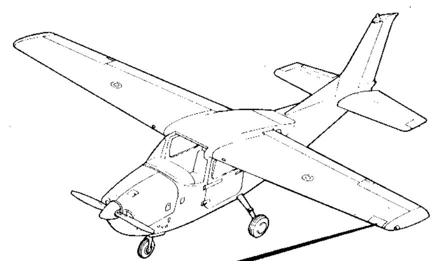
PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ELECTROLUMINESCENT PANELS WILL NOT LIGHT (Cont).		
Defective rheostat.	5. Check input voltage at inverta-pak with master switch on. Voltmeter should give a smoothly varied reading over the entire control range of the rheostat.	If no voltage is present or voltage has a sudden drop before rheostat has been turned full counterclockwise, replace rheostat.
Defective inverta-pak.	6. Check output voltage at inverta-pak with ac voltmeter. Should read about 125 volts ac with rheostat set for full bright	Replace inverta-pak.
INSTRUMENT LIGHTS WILL NOT LIGHT.		
Short circuit in wiring.	1. Inspect circuit breaker.	If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
Defective wiring.	2. Test circuit until short is located.	Repair or replace wiring.
	3. Test for open circuit.	Repair or replace wiring. If no short or open circuit is found, proceed to step 4.
Defective rheostat.	4. Check voltage at instrument light with master switch on. Should read battery voltage with rheostat turned full clockwise and voltage should decrease as rheostat is turned counterclockwise.	If no voltage is present or voltage has a sudden drop before rheostat has been turned full counterclockwise, replace rheostat.
Lamp burned out.	5. Test lamp with ohmmeter or new lamp.	Replace lamp.
CONTROL WHEEL MAP LIGHT WILL NOT LIGHT.		
Nav light switch turned off.	1. Nav light switch has to be ON before map light will light.	
Short circuit in wiring.	2. Check 1-amp fuse on terminal board located on back of stationary panel with ohmmeter.	If fuse is open, proceed to step 3. If fuse is OK, proceed to step 4.
Defective wiring.	3. Test circuit until short is located.	Repair or replace wiring.
	4. Test for open circuit.	Repair or replace wiring. If a short or open circuit is not found, proceed to step 5.
Defective map light assembly.	5. Check voltage at map light assembly with master and nav light switches ON.	If battery voltage is present, replace map light assembly.

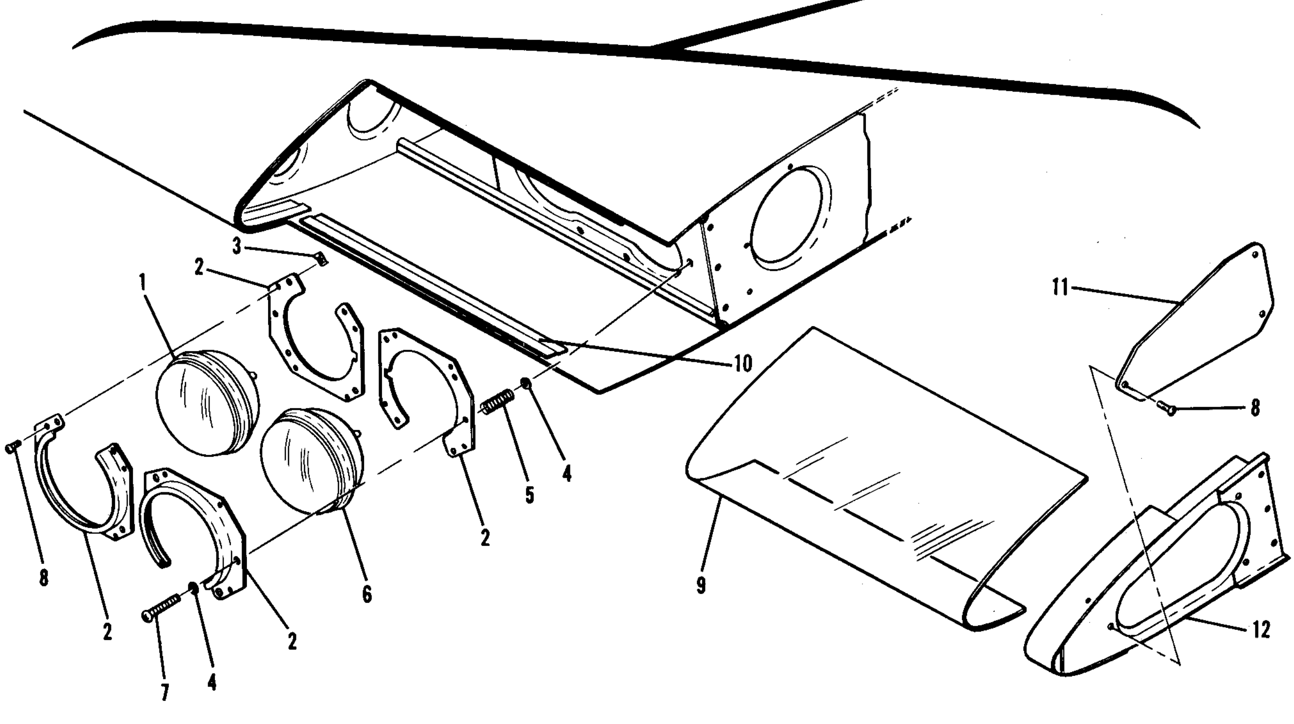
CAUTION

Failure to observe polarity shown on wiring diagram (page 20-25), will result in immediate failure of the transistor on the map light circuit board assembly.



POSITION	1	2	3	4	5	6
"D" (210)	1.37	1.25	1.12	.81	.44	.94





1. Landing Lamp
2. Bracket
3. Tinnerman Nut
4. Washer
5. Spring
6. Taxi Lamp
7. Adjusting Screw
8. Screw
9. Window
10. Retainer
11. Seal
12. Rib

Figure 17-6. Landing Light Installation and Adjustment

17-39. LANDING AND TAXI LIGHTS. The landing and taxi lights are mounted in the leading edge of the left wing. A clear plastic cover provides weather protection for the lamps and is shaped to maintain the leading edge curvature of the wing. The landing lamp is mounted on the inboard side and is adjusted to throw its beam further forward than the taxi lamp. Both lights are controlled by a split rocker switch.

17-40. REMOVAL AND REPLACEMENT OF LANDING AND TAXI LIGHTS. (See figure 17-6.)

a. Remove screws holding wing tip to wing, disconnect navigation light wire and remove wing tip.
b. Remove screws holding seal on rib to gain access to lights through the lightening hole in rib.
c. Using a short screwdriver, reach in through the lightening hole and remove the four attaching screws (8) from the bracket assembly and remove the bracket.

NOTE

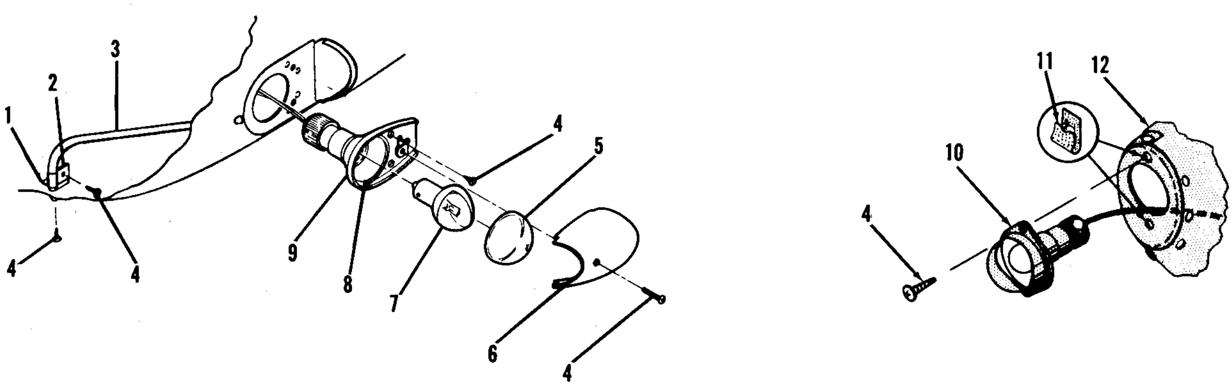
Do not reposition the landing and taxi light adjustment screws (7). If readjustment is required, refer to figure 17-6.

d. Remove the two screws securing the wiring to the lamp contacts and remove the lamp.
e. Install new lamp and reassemble.
f. To replace plastic window, remove screws holding leading edge of rib to wing and remove leading edge of rib.
g. Slide the plastic window out of the retainer, install new window and reassemble.

17-41. NAVIGATION LIGHTS. The navigation lights are located on each wing tip and the stinger. Operation of the lights is controlled by a single two position switch. A plastic light detector on each wing tip allows the pilot to determine if the lamps are working properly during flight.

17-42. REMOVAL AND REPLACEMENT OF NAVIGATION LIGHTS. Figure 17-7 shows in detail all components of the navigation lights. Use this figure as a guide for removal and replacement.

17-43. FLASHING BEACON LIGHT. The flashing beacon light is attached to a thermoformed plastic mounting on the vertical fin tip. The flashing beacon is an iodine-vapor lamp electrically switched by a solid-state flasher assembly. The flasher assembly is located in the vertical fin under the fin tip. The switching frequency of the flasher assembly operates the beacon at approximately 45 flashes per minute.

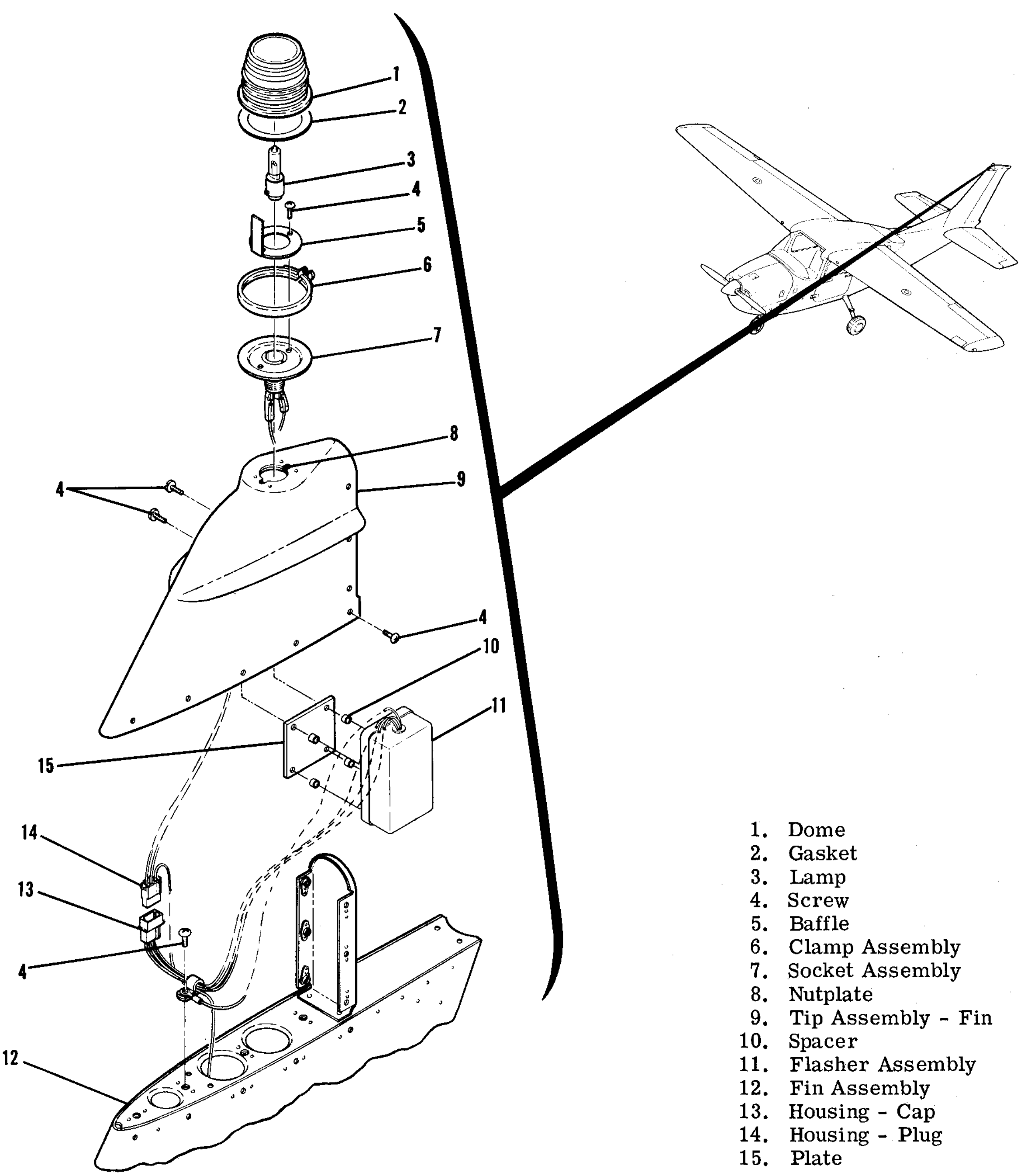


1. Bracket
2. Clamp
3. Detector - Light
4. Screw
5. Lens
6. Shield
7. Lamp
8. Gasket
9. Base - Lamp
10. Tail Light
11. Tinnerman Nut
12. Stinger

Figure 17-7. Navigation Lights Installation

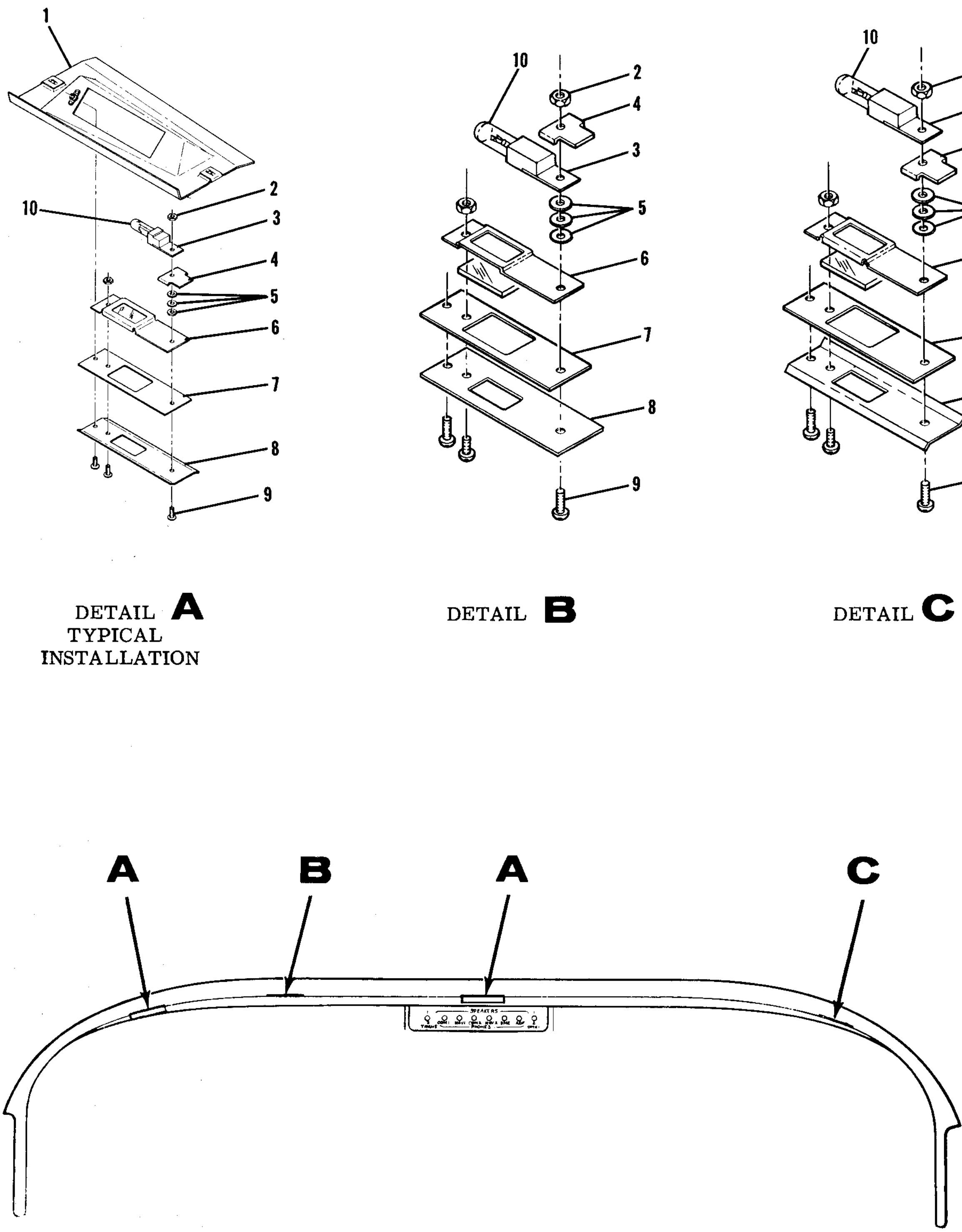
17-44. REMOVAL AND REPLACEMENT OF FLASHING BEACON LIGHT. Figure 17-8 shows in detail all components of the flashing beacon light installation. Use this figure as a guide for removal and replacement.

17-45. INSTRUMENT LIGHTING. The instrument panel lighting is fabricated in two separate sections. The lower tow-thirds of the instrument panel is illuminated by two lights mounted in the overhead light console. The lighting for the upper one-third



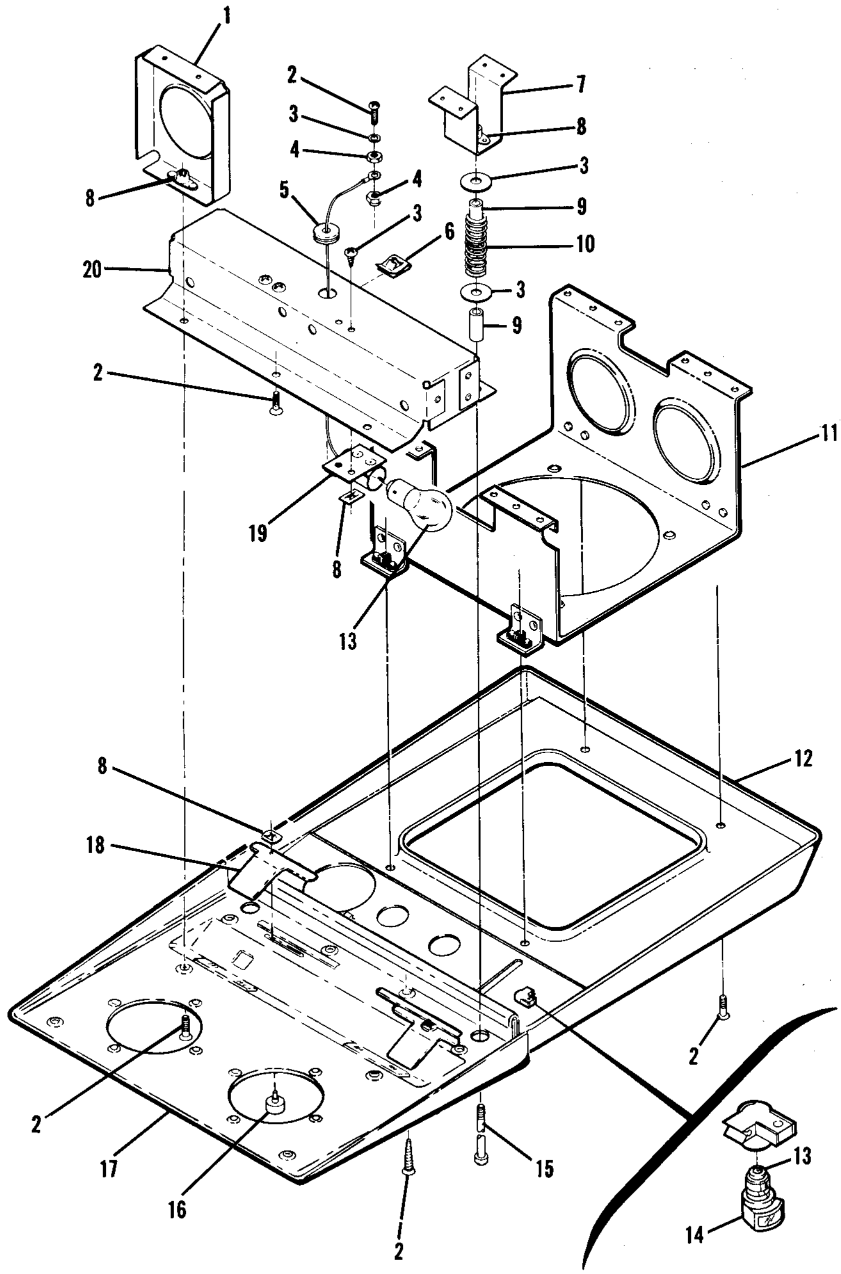
1. Dome
2. Gasket
3. Lamp
4. Screw
5. Baffle
6. Clamp Assembly
7. Socket Assembly
8. Nutplate
9. Tip Assembly - Fin
10. Spacer
11. Flasher Assembly
12. Fin Assembly
13. Housing - Cap
14. Housing - Plug
15. Plate

Figure 17-8. Flashing Beacon Light Installation



1. Light Fitting Assembly
2. Nut
3. Light Assembly
4. Retainer
5. Washer
6. Bracket
7. Gasket
8. Cover
9. Screw
10. Bulb

Figure 17-9. Instrument Panel Glare Shield Light Installation



1. Support Assembly - Panel Light
2. Screw
3. Washer
4. Nut
5. Grommet
6. Slide Nutplate
7. Bracket Assembly - Panel Light
8. Nutplate
9. Spacer
10. Spring
11. Support Assembly - Speaker
12. Cover - Aft Overhead Console
13. Lamp
14. Cap and Prism Assembly
15. Light Adjustment Screw
16. Slide Knob
17. Console Assembly - Front
18. Slide Cover
19. Socket
20. Housing Assembly - Panel Light

Figure 17-10. Overhead Console Installation of the instrument panel is provided by four small lights located in the instrument panel glare shield. The intensity of the instrument panel lighting is controlled by a dimming rheostat located on the left side of the instrument panel.

17-46. REMOVAL AND REPLACEMENT OF INSTRUMENT PANEL LIGHTS. For removal and replacement of instrument panel lights, refer to figures 17-9 and 17-10.)

17-47. ELECTROLUMINESCENT PANEL LIGHTING. The electroluminescent lighting consists of two "EL" panels; the switch panel and the comfort control panel. The ac voltage required to drive the "EL" panels is supplied by a small inverta-pak (power supply) located behind the instrument panel. The intensity of the "EL" panel lighting is controlled by a rheostat located on the instrument panel. These "EL" panels have an expected life of over 16, 000 hours and no replacement should be necessary during the life of the aircraft.

17-48. PEDESTAL LIGHTS. The pedestal lights consist of two post type lights mounted on the pedestal to illuminate the rudder and elevator trim controls. The pedestal lights are controlled by the instrument light rheostat.

17-49. REMOVAL AND REPLACEMENT OF PEDESTAL LIGHTS. For removal and replacement of the pedestal lamp, slide the cap and lens assembly from the base. Slide the lamp from the socket and replace.

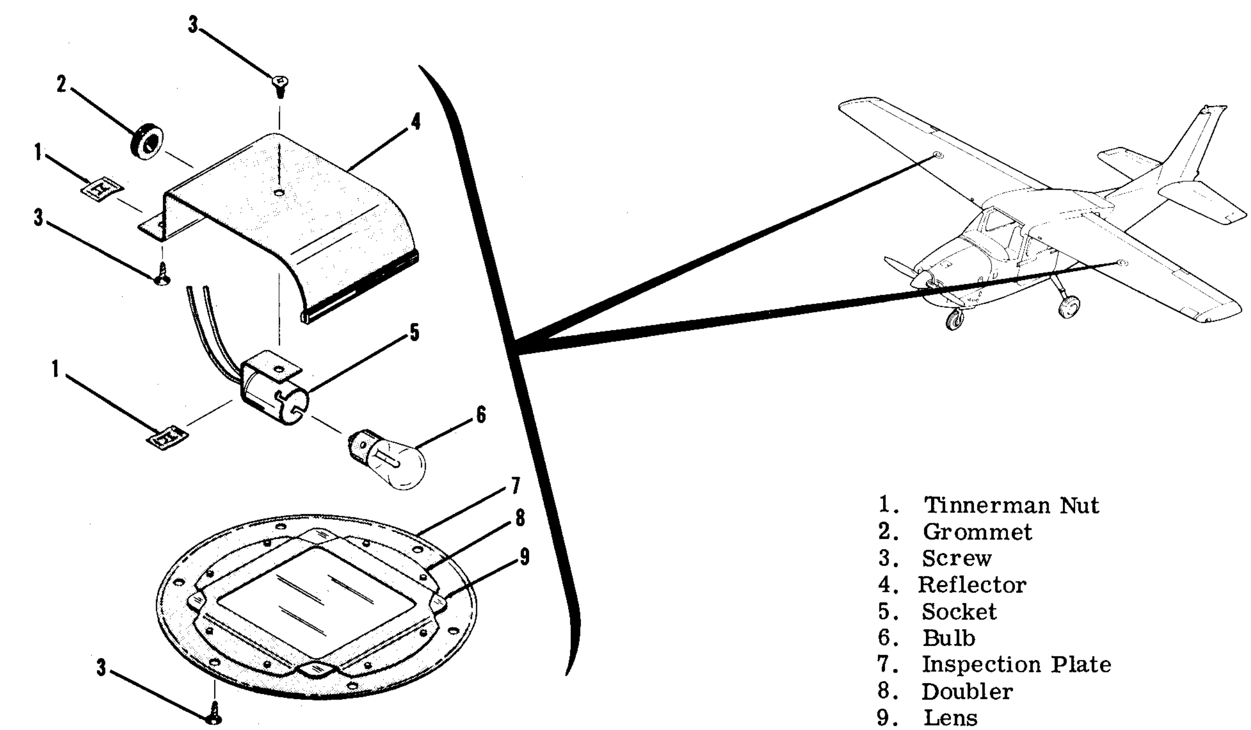
17-50. INSTRUMENT POST LIGHTING. Individual post lighting may be installed as optional equipment to provide for non-glare instrument lighting. The post light consists of a cap and a clear lamp assembly with a tinted lens. The intensity of the instrument post lights is controlled by the radio light dimming rheostat located on the switch panel.

17-51. REMOVAL AND REPLACEMENT OF INSTRUMENT POST LIGHTS. For removal and replacement of the instrument post lamps, slide the cap and the lens assembly from the base. Slide the lamp from the socket and replace.

17-52. OXYGEN LIGHTS. The oxygen lights consist of two post type lights installed on the overhead oxygen console. The intensity of the oxygen lights is controlled by the radio light dimming rheostat located on the switch panel.

17-53. REMOVAL AND REPLACEMENT OF OXYGEN LIGHTS. For removal and replacement of oxygen lamps refer to paragraph 17-51 and figure 17-10.

17-54. COURTESY LIGHTS. The lights consist of one light located on the underside of each wing to provide ground lighting around the cabin area. The courtesy lights have clear lens and are controlled by a single slide switch labeled, "Utility Lights," located on the left rear door post. The switch also operates the dome lights.



1. Tinnerman Nut
2. Grommet
3. Screw
4. Reflector
5. Socket
6. Bulb
7. Inspection Plate
8. Doubler
9. Lens

Figure 17-11. Courtesy Light Installation

17-55. REMOVAL AND REPLACEMENT OF COURTESY LIGHTS. Figure 17-11 shows in detail all components of the courtesy lights installation. Use this figure as a guide for removal and replacement.

17-56. INTERIOR LIGHTING. The cabin interior is illuminated by two dome lights, one dome light on each side of the aft cabin. The dome lights are controlled by a single slide switch labeled "Utility Lights," located on the left door post. The switch also operates the courtesy lights.

17-57. REMOVAL AND REPLACEMENT OF INTERIOR LIGHTS.

a. Pry dome light out of retainer.
b. Pry socket out of dome light assembly.
c. Install new bulb and reassemble.

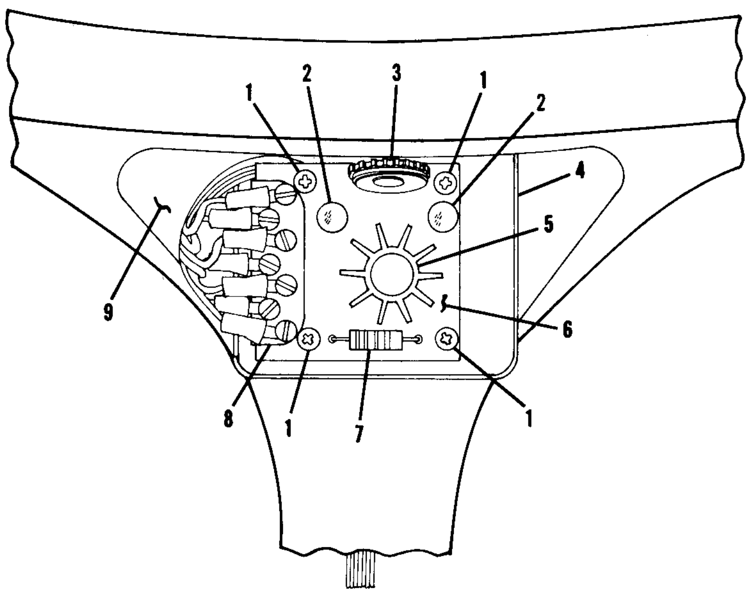
17-58. CONTROL WHEEL MAP LIGHT. As optional equipment, a white, dimmable map light may be installed on the underside of the pilot's control wheel. A solid-state dimming circuit has been utilized so that a miniature dimming control may be used. The dimming control extends just below the edge of the control wheel for convenient thumb operation. For dimming, the control should be turned clockwise.

17-59. REMOVAL AND REPLACEMENT OF THE CONTROL WHEEL MAP LIGHT. (See figure 17-12.)

a. Rotate the control wheel 90° to the left to gain access to the under side of the wheel.
b. Remove four screws at the corners of the etched circuit board assembly.
c. Detach the wires from the terminal strip along the edge of the circuit board. Note the connection for reference when replacing the board.
d. To install the control wheel map light, reverse this procedure.

NOTE

It is recommended that the board be replaced as an assembly if the lamps should become defective. If personnel familiar with etched circuit board repair work are available, emergency repairs of the map light assembly may be made by soldering leads to #330 lamps and then soldering the lamps to the board in place of those provided. The lamps should be secured in place with a spot of epoxy cement after soldering.



1. Screw
2. Lamp
3. Dimming Control
4. Map Light Housing
5. Transistor
6. Circuit Board
7. Resistor
8. Terminal Board
9. Control Wheel

VIEWED LOOKING UP FROM BOTTOM

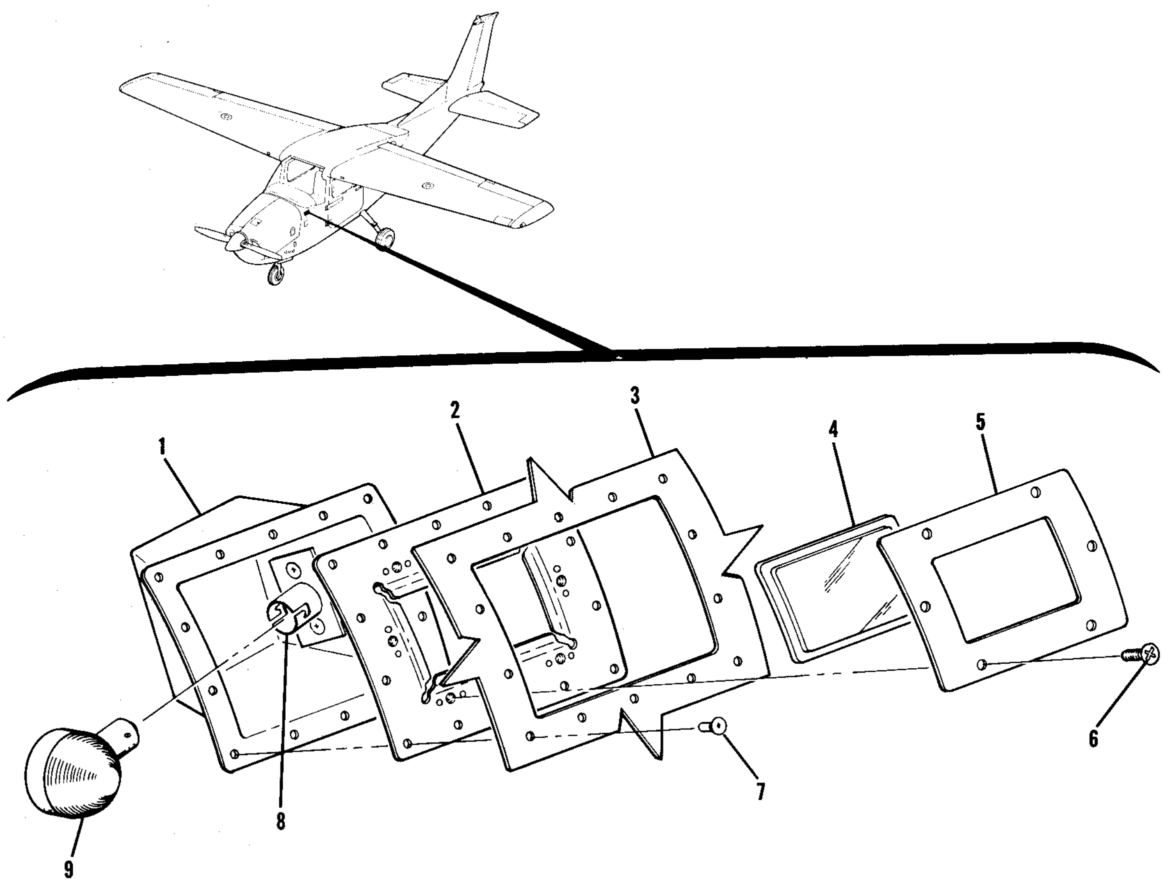
Figure 17-12. Control Wheel Map Light Installation

17-60. COMPASS AND RADIO DIAL LIGHTS. The compass and radio dial lights are contained within the individual units. The light intensity is controlled by the radio dial light dimming rheostat mounted on the lower left side of the instrument panel.

17-61. ICE DETECTOR LIGHT. An optional ice detector light may be installed on the upper left hand side of the engine cowl. The ice detector light will illuminate the leading edge of the left wing so the pilot can visually detect ice formation on the wing. A push-button switch located below the master switch controls the ice detector light.

17-62. REMOVAL AND REPLACEMENT OF ICE DETECTOR LIGHT. Figure 17-13 shows the installation details of the ice detector light.

17-63. STALL WARNING UNIT. The stall warning unit is mounted on the bottom of the map compartment. The 210 series aircraft have a dual purpose warning unit which contains the horn for the stall warning and a second horn for the gear warning. The stall warning horn emits a high-pitched, steady sound when actuated by the stall warning switch on the wing.



1. Bracket Assembly
2. Doubler Assembly
3. Skin - Cowl Deck
4. Lens
5. Cover
6. Screw
7. Rivet
8. Socket
9. Lamp

Figure 17-13. Ice Detector Light Installation

17-64. REMOVAL AND REPLACEMENT OF STALL WARNING UNIT. Figure 17-14 shows installation details of the stall warning unit.

17-65. STALL WARNING SWITCH. The stall warning switch is installed in the leading edge of the left wing and is actuated by airflow over the surface of the wing. The switch will close as a stall condition is approached, actuating the stall warning horn. The horn should sound at approximately five to ten miles per hour above the actual stall speed. Initial installation of the switch should be with the lip of the warning switch approximately one sixteenth of an inch below the center line of the wing skin cutout. Test fly the aircraft to determine if the horn sounds at the desired speed. If the horn sounds too soon, move the unit down slightly; if too late, move the unit up slightly.

17-66. REMOVAL AND REPLACEMENT OF THE STALL WARNING SWITCH. Figure 17-15 shows the installation details of the stall warning switch.

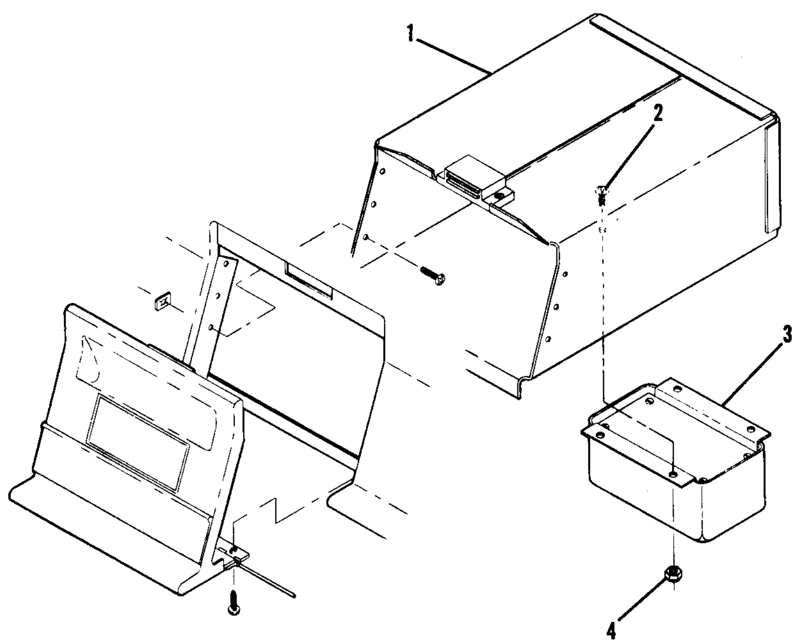
17-67. PITOT AND STALL WARNING HEATER CIRCUITS. Electrical heater units are incorporated in some pitot tubes and stall warning switch units. The heaters offset the possibility of ice formation on the pitot tube and stall warning actuator switch. The heaters are integrally mounted in the pitot tube and stall warning actuator switch. Both heaters are controlled by the pitot heat switch.

17-68. REMOVAL AND REPLACEMENT OF PITOT HEATER. Figure 17-16 shown the installation details of the pitot heater.

17-69. LANDING GEAR INDICATOR LIGHTS. The position of the landing gear on the model 210 series is indicated by two press-to-test lamp assemblies mounted on the right side of the switch panel. The green light is on when all the wheels are down and locked; the red is on when all the wheels are up and locked. If any wheel assumes an intermediate position of neither up and locked nor down and locked, both lights will be dark. The hood of each light is removabel for bulb replacement, and has a dimming shutter.

17-70. REMOVAL AND REPLACEMENT OF LANDING GEAR INDICATOR LIGHTS.

a. Remove the hood on either light by unscrewing counter-clockwise. The lamp bulb is in the hood



1. Map Compartment
2. Screw
3. Stall and Gear Warning Unit
4. Nut

Figure 17-14. Stall Warning Unit

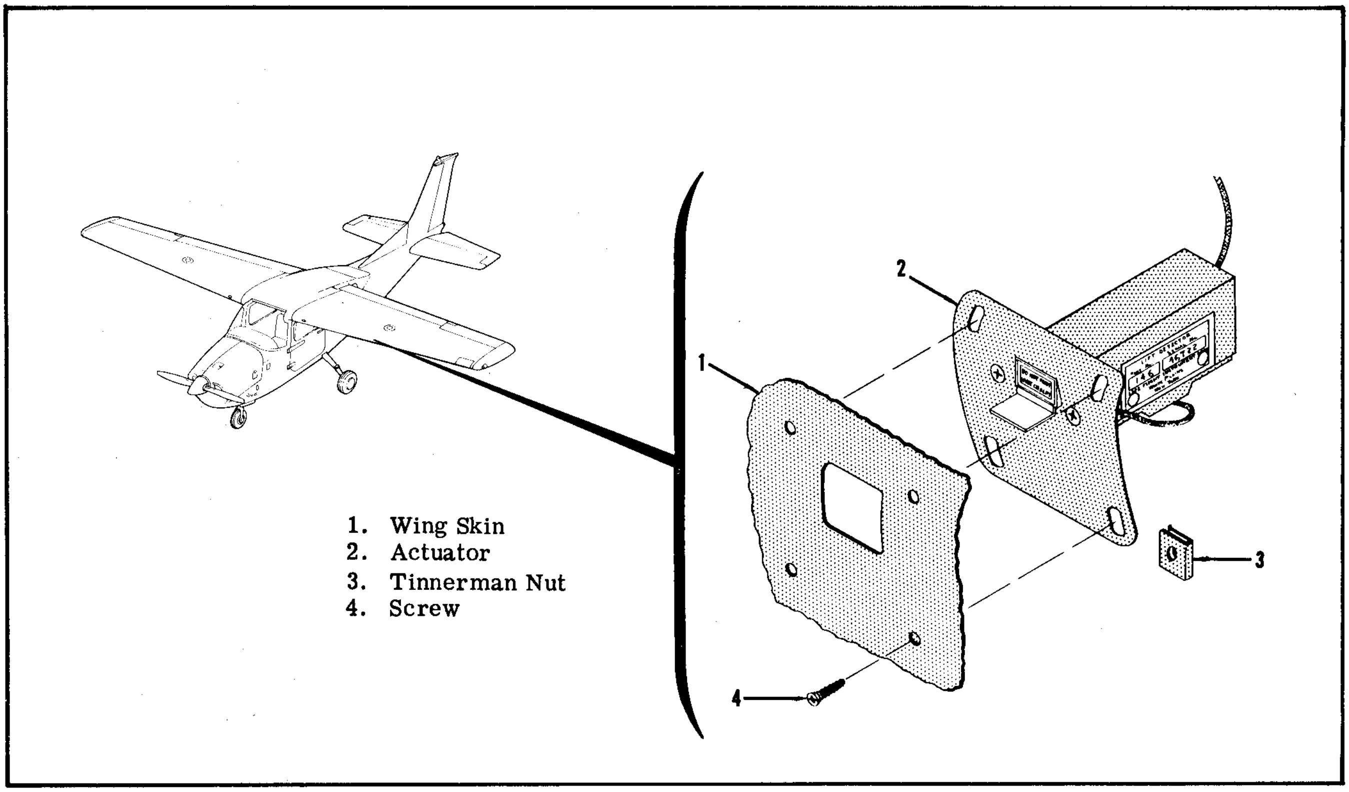


Figure 17-15. Stall Warning Switch

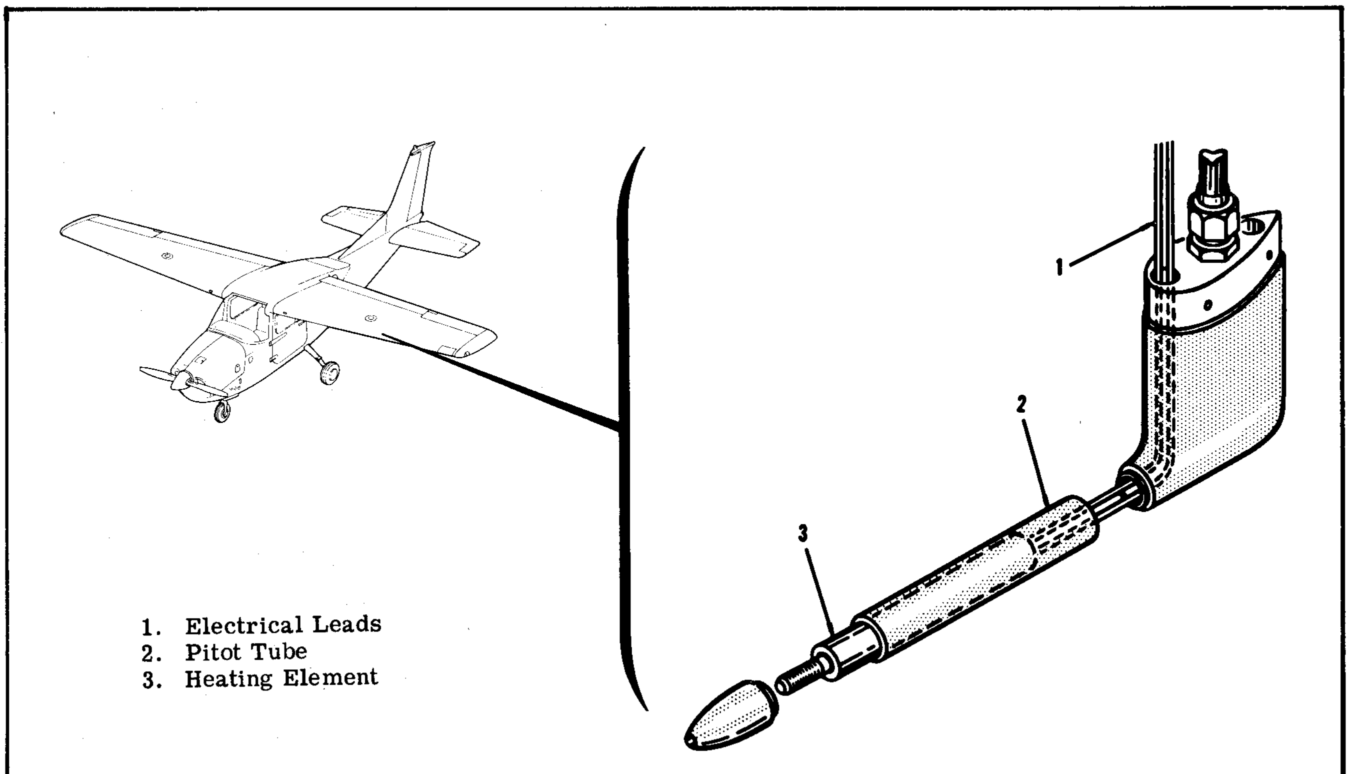


Figure 17-16. Pitot Heater

and may be replaced by pulling it out and inserting a new lamp.

b. To remove the lamp socket assembly, remove the nut around the assembly on the front side of the panel.

c. Tag and unsolder the wires from the socket assembly.

d. To replace a lamp socket assembly, reverse the above procedure.

17-71. CIGAR LIGHTER. A special circuit breaker is contained in a small cylinder screwed directly on the back of the cigar lighter socket. The circuit breaker is a bi-metallic type and is resettable. To reset a breaker, make sure that the master switch is off, then insert a small diameter pin (end of a paper clip works) into the hole in the phenolic back plate of the breaker and apply pressure. A small click will be heard when the breaker resets.

17-72. REMOVAL AND REPLACEMENT OF CIGAR LIGHTER. (See figure 17-17.)

a. Ensure that the master switch is "OFF."

b. Remove cigar lighter element.

c. Disconnect wire on back of lighter.

d. Remove shell that screws on socket back of panel.

e. The socket will then be free for removal.

f. To install a cigar lighter, reverse this procedure.

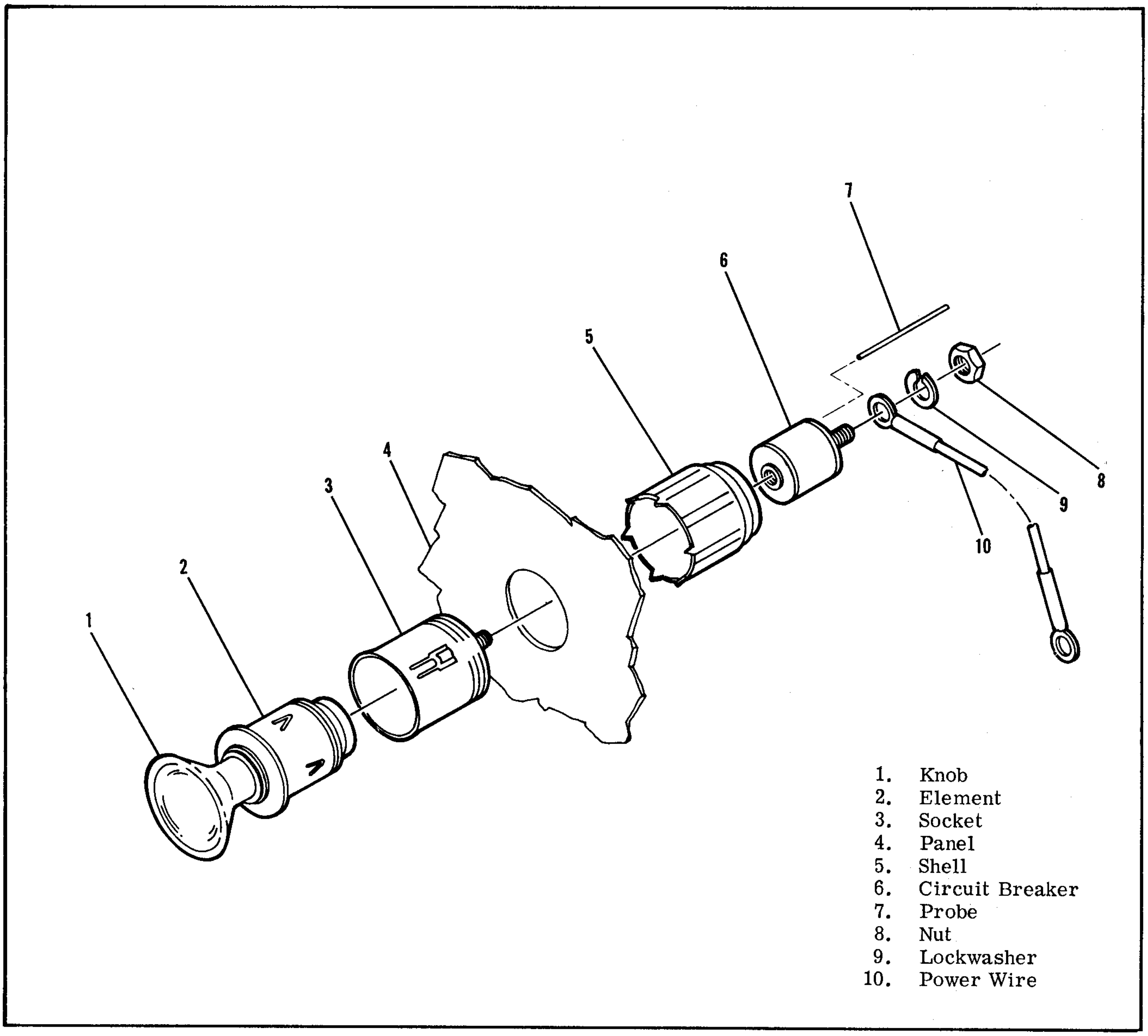


Figure 17-17. Cigar Lighter Installation

ELECTRICAL LOAD ANALYSIS CHART

1969 MODEL 210 & T210

STANDARD EQUIPMENT (Running Load)	AMPS REQD
Battery Contactor	0.6
Clock	Negligible
Cylinder Head Temperature Indicator	0.2
Fuel Quantity Indicator	0.4
Instrument Lights	
a. Electroluminescent Panel	.75
b. Cluster	0.3
*c. Console	2.0
d. Compass	0.1
Lamp - Gear Up or Gear Down	0.1
Position Lights	5.6
Solenoid Valve - Door Opening	2.7
† Solenoid Valve - Gear Handle Lock	0.6
Turn Coordinator	0.8
OPTIONAL EQUIPMENT (Running Load)	
Cessna 300 ADF	1.6
Cessna 300 DME	5.0
Cessna 300 HF Transceiver	6.5
Cessna 300 Marker Beacon	.02
Cessna 300 Nav/Com	4.5
Cessna 300 Nav-O-Matic Autopilot	2.0
Cessna 300 Transceiver	3.2
Cessna 300 Transponder	1.5
Cessna 400 ADF	2.0
Cessna 400 Glideslope	.45
Cessna 400 Nav/Com	1.8
Cessna 400 Nav-O-Matic Autopilot	3.0
Cessna 400 Transceiver	1.9
Cessna 400 Transponder	1.5
Flashing Beacon Light	7.0
Heaters, Stall Warning and Pitot	10.0
Narco Mark 12A Nav/Com	4.6
Narco UGR-2 Glideslope Receiver	.23
* Post Lighted Panel	2.0
ITEMS NOT CONSIDERED AS PART OF RUNNING LOAD	
Auxiliary Fuel Pump	3.0
Cigarette Lighter	10.0
Flap Motor	15.0
HF Antenna Reel Motor	14.0
Landing Lights	15.6
Oil Dilution System	1.0
Stall Warning Horn	0.25
Wing Courtesy Lights and Cabin Lights	3.3

* Console lights not used with post lights.
Only one or the other may be used at one time.
† In flight running load only.

SECTION 18

STRUCTURAL REPAIR

TABLE OF CONTENTS

18-1. STRUCTURAL REPAIR.

18-2. REPAIR CRITERIA.

18-3. Although this section outlines repair permissible on structure of the aircraft, the decision of whether to repair or replace a major unit of structure will be influenced by such factors as time and labor available, and by a comparison of labor costs with the price of replacement assemblies. Past experience indicates that replacement, in many cases, is less costly than major repair. Certainly, when the aircraft must be restored to its airworthy condition in a limited length of time, replacement is preferable.

18-4. Restoration of a damaged aircraft to its original design strength, shape and alignment involves careful evaluation of the damage, followed by exacting workmanship in performing the repairs. This section suggests the extent of structural repair practical on the aircraft and supplements Federal Aviation Regulations, Part 43. Consult the factory when in doubt about a repair not specifically mentioned here.

18-5. EQUIPMENT AND TOOLS.

18-6. Equipment and tools for repair of structure may be fabricated locally for all but major repair jobs. For major repair of wings and fuselage, special jigs, available from the factory, are recommended. These jigs are precision equipment designed to ensure accurate alignment of these airframe components.

18-7. CONTROL BALANCING requires the use of a fixture to determine the static balance moment of the control surface assembly. Plans for, and the use of, such a fixture are shown in figure 18-3.

18-8. SUPPORT STANDS shown in figure 18-1 are used to hold a fuselage or wing when it is removed. The stands may be manufactured locally of any suitable wood.

18-9. FUSELAGE REPAIR JIG. The fuselage jig, which may be obtained from the factory, is a sturdy, versatile fixture used to hold an entire fuselage and to locate the firewall, wing and landing gear attachment points. The jig is ideal for assembling new parts in repair of a badly damaged fuselage.

18-10. WING JIG. The wing jig, which may also be obtained from the factory, serves as a holding fixture during extensive repair of a damaged wing. The jig locates the root rib, leading edge, and tip rib of the wing.

18-11. WING AND STABILIZER ANGLE-OF-INCIDENCE. Angle-of-incidence and wing twist are listed in the following chart. Stabilizers do not have twist. The cantilever wing has a uniform twist from the root rib to the tip rib. The amount of twist between these two ribs is the difference between the angle-of-incidence at the root and the angle-of-incidence at the tip. See figure 18-2.

WING

Angle-of-incidence, Root	+1°30'
Angle-of-incidence, Tip	-1°30'
Twist (Washout)	3°

STABILIZER

Angle-of-incidence	-3°±15'

18-12. REPAIR MATERIALS.

18-13. Thickness of material on which a repair is to be made can easily be determined by measuring with a micrometer. In general, material used in Cessna aircraft covered in this manual is made from 2024 aluminum alloy, heat treated to a -T3, -T4, or -T42 condition. If the type of material cannot be readily determined, 2024-T3 may be used in making repairs, since the strength of -T3 is greater than -T4 or -T42 (-T4 and -T42 may be used interchangeably, but they may not be substituted for -T3.) When necessary to form a part with a smaller bend radius than the standard cold bending radius for 2024-T4, use 2024-0 and heat treat to 2024-T42 after forming. The repair material used in making a repair must equal the gage of the material being repaired unless otherwise noted. It is often practical to cut repair pieces from service parts listed in the Parts Catalogs.

A few components (empennage tips, for example) are fabricated from thermo-formed plastic or glass fiber constructed materials.

18-14. WING.

18-15. The wing is sheet metal constructed, with a single main spar, two fuel spars, formed ribs and stringers. The front fuel spar also serves as an auxiliary spar and is the forward wing attaching point. An inboard section forward of the main spar is sealed to form an integral fuel tank area. The main spar consists of milled spar caps and attaching fittings joined by a web section. The aft fuel spar is a formed channel. The front fuel spar is a built-up assembly consisting of a formed channel, doubler, attach strap and support angle. Stressed skin, riveted to the ribs, spars and stringers, completes the wing structure.

18-16. ACCESS openings (hand holes with removable cover plates) are located in the underside of the wing between the wing root and tip section. These openings afford access to the flap and aileron bellcranks, flap drive pulleys, flap actuator in left wing, flap and aileron control cable disconnect points, fuel transmitter, air scoop connectors and electrical wiring.

18-17. WING SKIN.

18-18. NEGLIGIBLE DAMAGE. Any smooth dents in the wing skin that are free from cracks, abrasions and sharp corners, which are not stress wrinkles and do not interfere with any internal structure or mechanism, may be considered as negligible damage. In areas of low stress intensity, cracks, deep scratches or deep, sharp dents, which after trimming or stop drilling can be enclosed by a two-inch circle, can be considered negligible if the damaged area is at least one diameter of the enclosing circle away from all existing rivet lines and material edges. Stop drilling is considered a temporary repair and a permanent repair should be made as soon as practicable.

18-19. REPAIRABLE DAMAGE. Figure 18-4 outlines typical repairs to be employed in patching skin. Before installing a patch, trim the damaged area to form a rectangular pattern, leaving at least a one-half inch radius at each corner, and de-burr. The sides of the hole should lie span-wise or chord-wise. A circular patch may also be used. If the patch is in an area where flush rivets are used, make a flush patch type of repair; if in an area where flush rivets are not used, make an overlapping type of repair. Where optimum appearance and airflow are designed, the flush patch may be used. Careful workmanship will eliminate gaps at butt-joints; however, an epoxy type filler may be used at such joints.

18-20. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Repairs must not be made to upper or lower wing skin inboard of wing station 40.00 without factory approval. However, an entire skin may be replaced without factory approval. Refer to figure 1-1 for wing stations. Outboard of station

40.00, the following will apply. If a skin is badly damaged, repair should be made by replacing an entire skin panel, from one structural member to the next. Repair seams should be made to lie along existing structural members and each seam should be made exactly the same in regard to rivet size, spacing, and pattern as the manufactured seams at the edges of the original sheet. If the manufactured seams are different, the stronger should be copied. If the repair ends at a structural member where no seam is used, enough repair panel should be used to allow an extra row of staggered rivets, with sufficient edge margin, to be installed.

18-21. WING STRINGERS.

18-22. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-23. REPAIRABLE DAMAGE. Figure 18-5 outlines a typical wing stringer repair. Two such repairs may be used to splice a new section of stringer material in position, without the filler material.

18-24. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If a stringer is so badly damaged that more than one section must be spliced into it, replace the entire stringer.

18-25. WING FUEL SPARS.

18-26. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-27. REPAIRABLE DAMAGE. The type of repairs outlined in figure 18-6 for rib repairs also applies to fuel spars. For area where repairs are restricted, refer to the following paragraph.

18-28. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Repairs must not be made to the front fuel spar inboard of wing station 54.00 without factory approval. However, an entire fuel spar may be replaced without factory approval. Refer to Section 1 for wing station locations.

18-29. WING RIBS.

18-30. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-31. REPAIRABLE DAMAGE. Figure 18-6 outlines typical wing rib repairs.

18-32. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Any wing rib damaged extensively should be replaced. However, due to the necessity of disassembling so much of the wing in order to replace a rib, especially in the fuel tank area which involves sealing, ribs should be repaired if practicable.

18-33. WING SPARS.

18-34. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-35. REPAIRABLE DAMAGE. Figure 18-7 outlines a typical main spar repair. For area where repairs are restricted, refer to the following paragraph.

18-36. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Repairs must not be made to the main spar inboard of wing station 155.00 without factory approval. However, an entire main spar may be replaced without factory approval. Refer to Section 1 for wing station locations.

18-37. WING LEADING EDGE.

18-38. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-39. REPAIRABLE DAMAGE. A typical leading edge skin repair is shown in figure 18-9. Extra access holes, outlined in figure 18-10, must not be installed on the wing without factory approval. For area where repairs are restricted, refer to the following paragraph.

18-40. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Repairs must not be made to the leading edge skin inboard of wing station 40.00 without factory approval. However, an entire leading edge skin may be replaced without factory approval. Refer to Section 1 for wing station locations.

18-41. AILERONS.

18-42. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-43. REPAIRABLE DAMAGE. The leading edge skin repair shown in figure 18-9 should be used to repair damage to aileron leading edge skins. The flush-type skin patches shown in figure 18-4 should be used to repair damage to the remaining skins. Filler material must match existing corrugations. Doubler material may be flat. If damage would require a repair which could not be made between adjacent ribs, see the following paragraph.

18-44. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damage would require a repair which could not be made between adjacent ribs, complete skin panels should be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the aileron assembly is recommended. After repair and/or repainting, balance in accordance with figure 18-3.

18-45. WING FLAPS.

18-46. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-47. REPAIRABLE DAMAGE. Flap repairs should be similar to aileron repairs discussed in paragraph 18-43. A flap leading edge repair is shown in figure 18-9.

18-48. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Flap repairs which require replacement of parts should be similar to aileron repairs discussed in paragraph 18-44.

18-49. ELEVATORS AND RUDDERS.

18-50. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18. The exception to negligible damage on the elevator surfaces is the front spar, where a crack appearing in the web at the hinge fittings or in the tip rib which supports the overhanging balance weight is not considered negligible. Cracks in the overhanging tip rib, in the area at the front spar intersection with the web of the rib, also cannot be considered negligible.

18-51. REPAIRABLE DAMAGE. Skin patches shown in figure 18-4 may be used to repair skin damage. If the damaged area would require a repair which could not be made between adjacent ribs, see the following paragraph.

18-52. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs, complete skin panels should be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the entire assembly is recommended. After repair and/or repainting, balance in accordance with figure 18-3.

18-53. FOAM-FILLED ELEVATOR TRAILING EDGES AND ELEVATOR TRIM TABS. Skin replacement and/or rebonding the filler material may be accomplished on the foam-filled elevator trailing edges and elevator trim tabs. Rebonding may be accomplished by use of an epoxy resin adhesive. Any damage to the filler materials, such as crushing or broken pieces, should be repaired by replacing the trailing edge or trim tab as a bonded unit. Standard repairs may be accomplished on the elevator.

18-54. FIN AND STABILIZER.

18-55. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18.

18-56. REPAIRABLE DAMAGE. Skin patches shown in figure 18-4 may be used to repair skin damage. Access to the dorsal area of the fin may be gained by removing the horizontal closing rib at the bottom of the fin. Access to the internal fin structure is best gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. Access to the stabilizer structure may be gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. If the damaged area would require a repair which could not be made between adjacent ribs, or a repair would be located in an area with compound curves, see the following paragraph.

18-57. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs or the repair would be located in an area with compound curves, complete skin panels should be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where damage is extensive, replacement of the entire assembly is recommended.

18-58. FUSELAGE.

CAUTION

Repairs must not be made to the main wing spar carry-thru section of the airplane without factory approval.

18-59. The fuselage is of semi-monocoque construction consisting of formed bulkheads, longitudinal stringers, reinforcing channels and skin platings.

18-60. NEGLIGIBLE DAMAGE. Refer to paragraph 18-18. Mild corrosion appearing upon alclad surfaces does not necessarily indicate incipient failure of the base metal. However, corrosion of all types should be carefully considered, and approved remedial action taken. Small cans appear in the skin structure of all metal airplanes. It is strongly recommended, however, that wrinkles which appear to have originated from other sources, or which do not follow the general appearance of the remainder of the skin panels, be thoroughly investigated. Except in the landing gear bulkhead area, wrinkles occurring over stringers which disappear when the rivet pattern is removed may be considered negligible. However, the stringer rivet holes may not align perfectly with the skin holes because of a permanent "set" in the stringer. If this is apparent, replacement of the stringer will usually restore the original strength characteristics of the area.

NOTE

Wrinkles occurring in the skin of the main landing gear bulkhead areas should not be considered negligible. The skin panel should be opened sufficiently to permit a thorough examination of the lower portion of the landing gear bulkhead and its tie-in structure.

Wrinkles occurring on open areas which disappear when the rivets at the edge of the sheet are removed, or a wrinkle which is hand removable, may often be repaired by the addition of a 1/2 x 1/2 x .060 inch 2024-T4 extruded angle, riveted over the wrinkle and extended within 1/16 to 1/8 inch of the nearest structural members. Rivet pattern should be identical to the existing manufactured seam at the edge of the sheet.

18-61. REPAIRABLE DAMAGE. Fuselage skin repairs may be accomplished in the same manner as wing skin repairs outlined in paragraph 18-19. Stringers, formed skin flanges, bulkhead channels, and similar parts may be repaired as shown in figure 18-5.

18-62. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Fuselage skin major repairs may be accomplished in the same manner as wing skin repairs outlined in paragraph 18-20. Damaged fittings should be replaced. Seat rails serve as structural parts of the fuselage and should be replaced if damaged.

18-63. BULKHEADS.

18-64. LANDING GEAR BULKHEADS. Since these bulkheads are highly stressed members irregularly formed to provide clearance for control lines, actuators, fuel lines, etc., patch type repairs will be, for the most part, impractical. Minor damage consisting of small nicks or scratches may be repaired by dressing out the damaged area, or by replacement or rivets. Any other such damage should be repaired by replacing the landing gear support assembly as an aligned unit.

18-65. REPAIR AFTER HARD LANDING. Buckled skin or floorboards and loose or sheared rivets in the area of the main gear support will give evidence of damage to the structure from an extremely hard landing. When such evidence is present, the entire support structure should be carefully examined and all support forgings should be checked for cracks, using a dye penetrant and proper magnification. Bulkheads in the area of possible damage should be checked for alignment and a straightedge should be used to determine deformation of the bulkhead webs. Damaged support structure, buckled floorboards and skins, and damaged or questionable forgings should be replaced. Landing gear components should be replaced and rigged properly.

18-66. REPLACEMENT OF HI-SHEAR RIVETS with close tolerance bolts or other commercial fasteners of equivalent strength properties is permissible. Holes should not be elongated and the Hi-shear substitute should be a smooth push fit. Forgings may be spot-faced the least amount necessary for proper seating of the fasteners.

18-67. NOSE GEAR WHEEL WELL AND FIREWALL. The nose gear wheel well is made of stainless steel, as is the firewall bulkhead. Refer to paragraph 18-18 for negligible damage, and paragraph 18-19 for repairable damage. Stainless steel patches should be used in nose wheel well and firewall repairs. Any repairs in these areas will require resealing with Pro-Seal #700 (Coast Pro-Seal Co., Chemical Division, 2235 Beverly Blvd., Los Angeles, California), or equivalent compound.

18-68. LANDING GEAR DOORS. Landing gear doors may be repaired by any method consistent with good sheet metal practice. However, any repairs to these doors should be made only after careful consideration of the door function and clearance is made. Close tolerances are required here for correct landing gear operation.

18-69. BAFFLES.

18-70. CONSIDERATIONS. Baffles ordinarily should be replaced if damaged or cracked. However, small plate reinforcements riveted to the baffle will often prove satisfactory both to the strength and cylinder cooling requirements of the unit.

18-71. ENGINE COWLING.

18-72. REPAIR OF COWLING SKINS. If extensively damaged, complete sections of cowling should be replaced. Standard flush-type skin patches, however, may be used if repair parts are formed to fit. Small cracks may be stop-drilled and dents straightened, if they are reinforced on the inner side with a doubler of the same material.

18-73. REPAIR OF REINFORCEMENT ANGLES. Cowl reinforcement angles, if damaged, should be replaced. Due to their small size they are easier to replace than to repair.

18-74. REPAIR OF THERMO-FORMED PLASTIC COMPONENTS.

18-75. Repair of puncture or holes in thermo-formed plastics can be made by trimming the damaged area, removing any paint in the area, and installing an overlapping, beveled, or flush patch of identical material. Doublers may be installed behind the patch where additional strength is desired. MEK, or any commercially available solvent that will soften and dissolve the plastic, may be used as the bonding agent. Dissolving some of the plastic shavings in the solvent will furnish additional working time. Moderate pressure is recommended for best results Curing time will vary with the agent used, but repairs should not be strained until fully cured. Cracks can be repaired by saturating the crack itself with the solvent, then filling with an epoxy filler or a paste made of the plastic shavings and the solvent. Again, the crack may be reinforced with a doubler on the back side for additional strength. After the repair has been made, the area may be sanded smooth and painted. Parts that are extensively damaged should be replaced instead of repaired.

18-76. REPAIR OF GLASS FIBER CONSTRUCTED COMPONENTS.

18-77. Glass fiber constructed components on the aircraft may be repaired as stipulated in instructions furnished in SK182-12. Observe the resin manufacturer's recommendations concerning mixing and application of the resin. Epoxy resins are preferable for making repairs, since opoxy compounds are usually more stable and predictable than polyester and, in addition, give better adhesion.

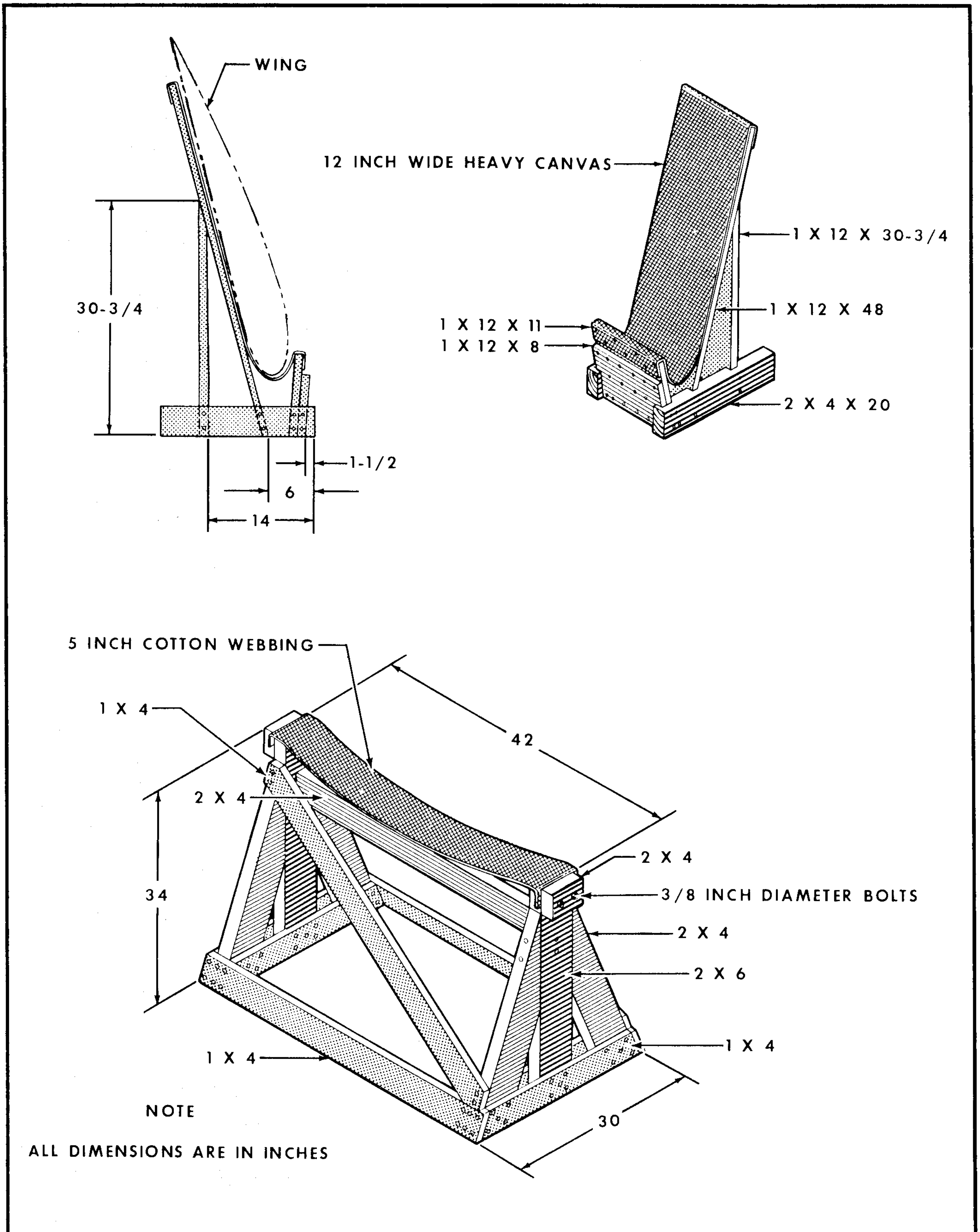
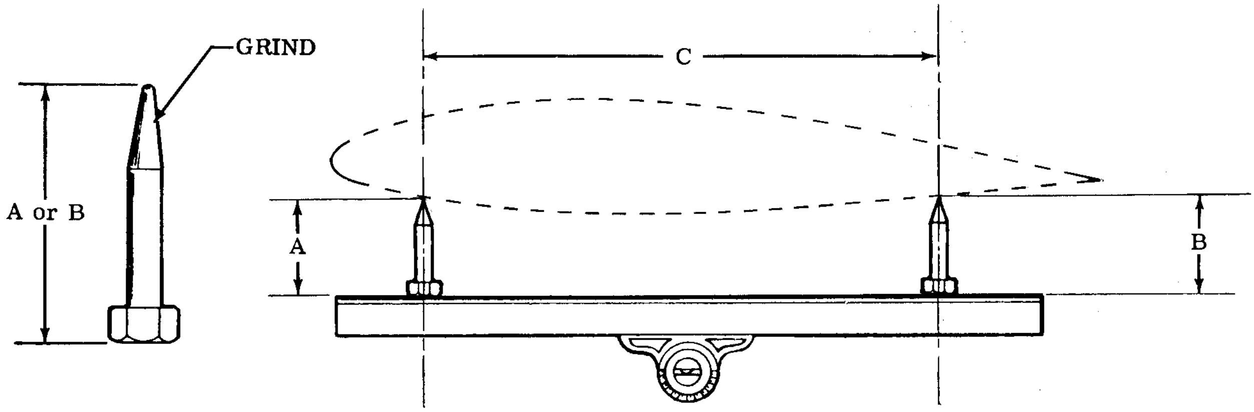


Figure 18-1. Wing and Fuselage Support Stands



A	B	C	WING STATION
2.00	2.00	40.50	26.50
.75	2.00	25.50	205.00

(REFER TO PARAGRAPH 18-10)

MEASURING WING TWIST

If damage has occurred to a wing, it is advisable to check the twist. The following method can be used with a minimum of equipment, which includes a straightedge (42" minimum length of angle, or equivalent), three modified bolts for a specific wing, and a protractor head with level.

1. Check chart for applicable dimension for bolt length (A or B).
2. Grind bolt shanks to a rounded point as illustrated, checking length periodically.
3. Tape two bolts to straightedge according to dimension C.
4. Locate inboard wing station to be checked and make a pencil mark approximately one-half inch aft of first lateral row of rivets aft of wing leading edge. Extend pencil line through landing light as required.
5. Holding straightedge parallel to wing station, (staying as clear as possible from "cans"), place bolt on pencil mark and set protractor head against lower edge of straightedge.
6. Set bubble in level to center and lock protractor to hold this reading.
7. Omitting step 6, repeat procedure for outboard wing station, using dimensions specified in chart. Check to see that protractor bubble is still centered.
8. Proper twist is present in wing if protractor readings are the same (parallel). Forward or aft bolt may be lowered from wing .10 inch maximum to attain parallelism.

Figure 18-2. Checking Wing Twist

GENERAL NOTES

1. Balance control surfaces in a draft-free area.
2. Place hinge bolts through control surface hinges, and position on knife edge balancing mandrels.
3. Make sure all control surfaces are in their final flight configuration: painted (if applicable), trim tabs installed, all foreign matter removed from inside of control surface, elevator trim tab push-pull rod installed, and all tips installed.
4. Place balancing mandrels on a table or other suitable flat surface.
5. Adjust trailing edge support to fit control surface being balanced while center of balancing beam is directly over hinge line. Remove balancing beam and balance the beam itself by adding washers or nuts as required at end opposite the trailing edge support.
6. When positioning balancing beam on control surface, avoid rivets to provide a smooth surface for the beam, and keep the beam 90° to the hinge line of the control surface.
7. Paint is a considerable weight factor. In order to keep balance weight to a minimum, it is recommended that existing paint be removed before adding paint to a control surface. Increase in balance weight will also be limited by the amount of space available and clearance with adjacent parts. Good workmanship and standard repair practices should not result in unreasonable balance weight.
8. The approximate amount of weight needed may be determined by taping loose weight at the balance weight area.
9. Lighten balance weight by drilling off part of weight.
10. Make balance weight heavier by fusing bar stock solder to weight after removal from control surface. The ailerons should have balance weight increased by ordering additional weight and gang channel, listed in Parts Catalog, and installing next to existing inboard weight, the mininum length necessary for correct balance, except that a length which contains at least two attaching screws must be used. If necessary, lighten new weight and/or existing weights for correct balance.

BALANCING BEAM

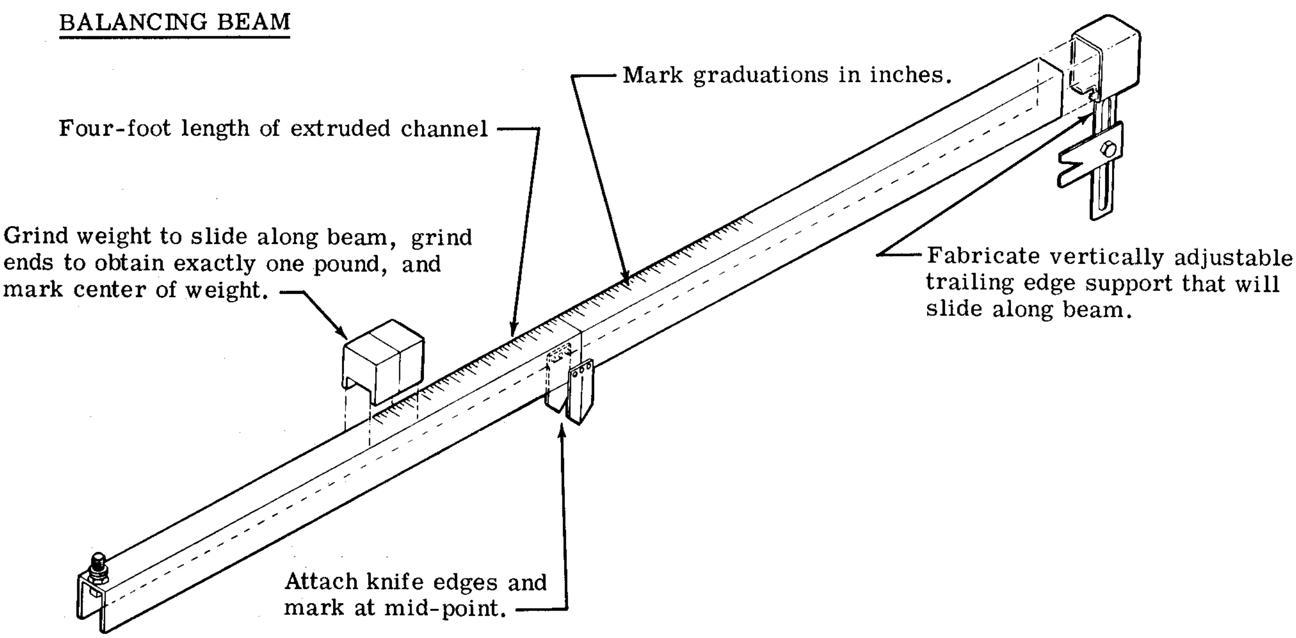


Figure 18-3. Control Surface Balancing (Sheet 1 of 3)

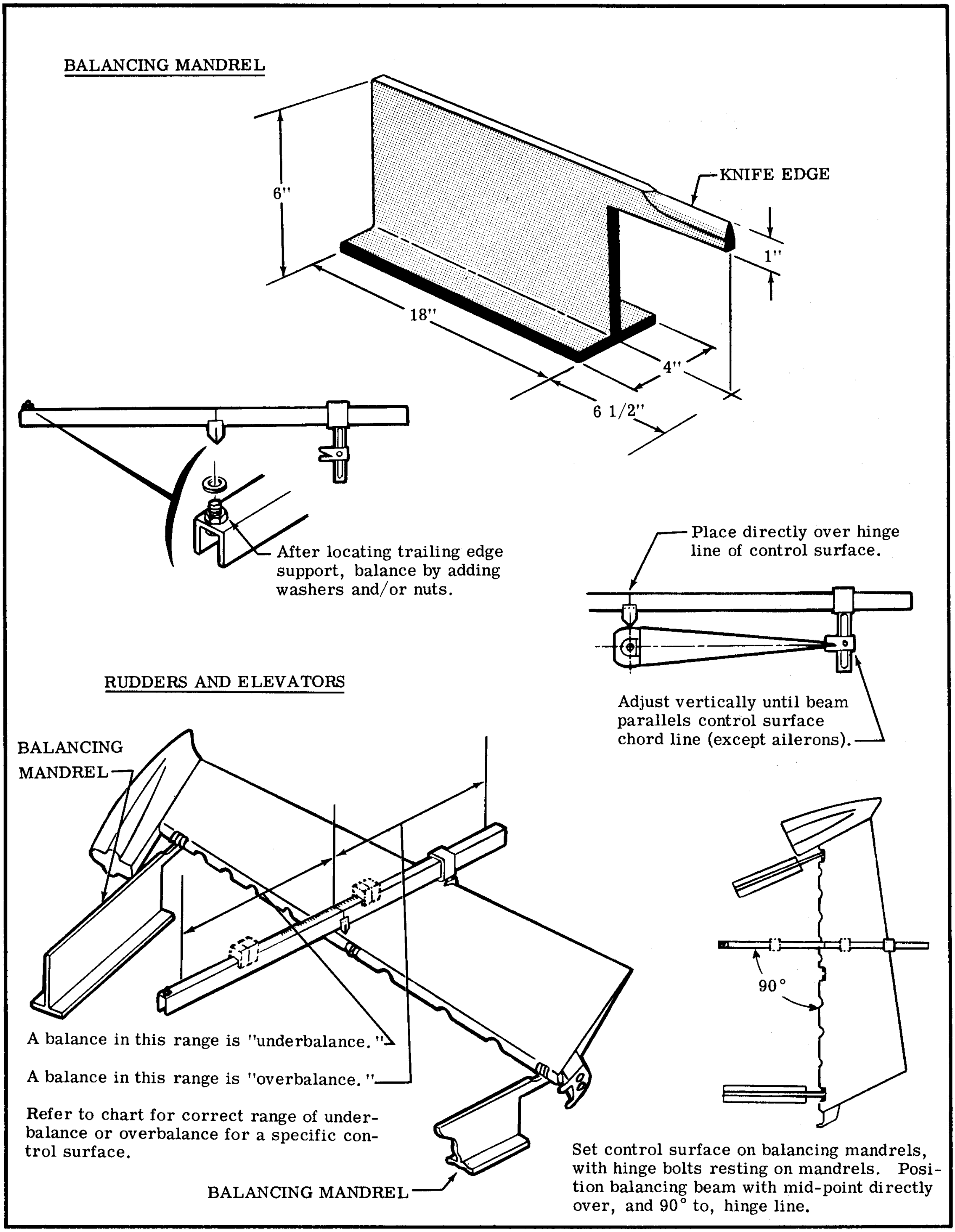
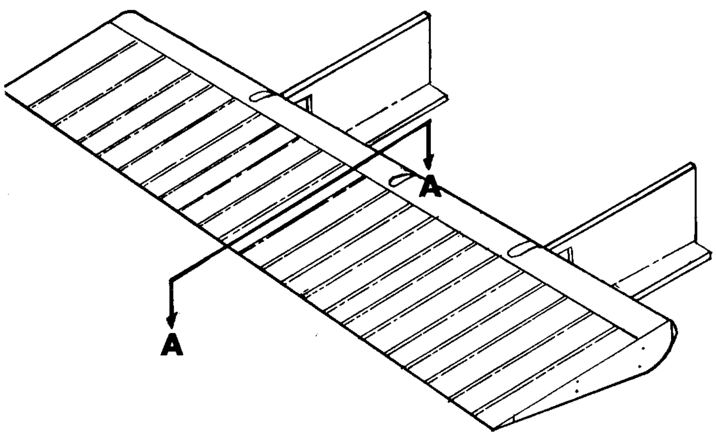
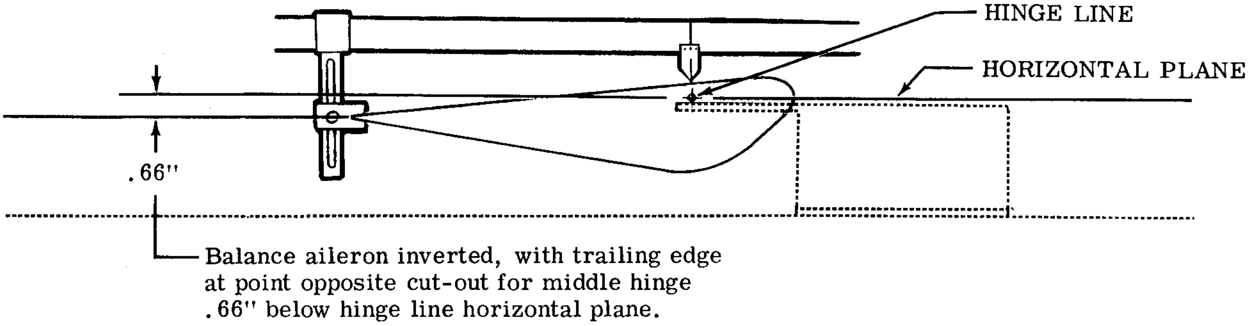


Figure 18-3. Control Surface Balancing (Sheet 2 of 3)

AILERONS



DETAIL **A-A**



MODEL	AILERONS	RUDDER	RIGHT ELEVATOR	LEFT ELEVATOR
	Underbalance (Inch-Pounds)	Underbalance (Inch-Pounds)	Underbalance (Inch-Pounds)	Underbalance (Inch-Pounds)
210-Series	+7.00 to +11.16	-0.97 to -1.87	0.0 to +12.1	0.0 to +11.9

NOTE

The "Underbalance" columns list the moment tolerances within which the control surface must balance. These tolerances must never be exceeded in the final flight configuration.

Figure 18-3. Control Surface Balancing (Sheet 3 of 3)

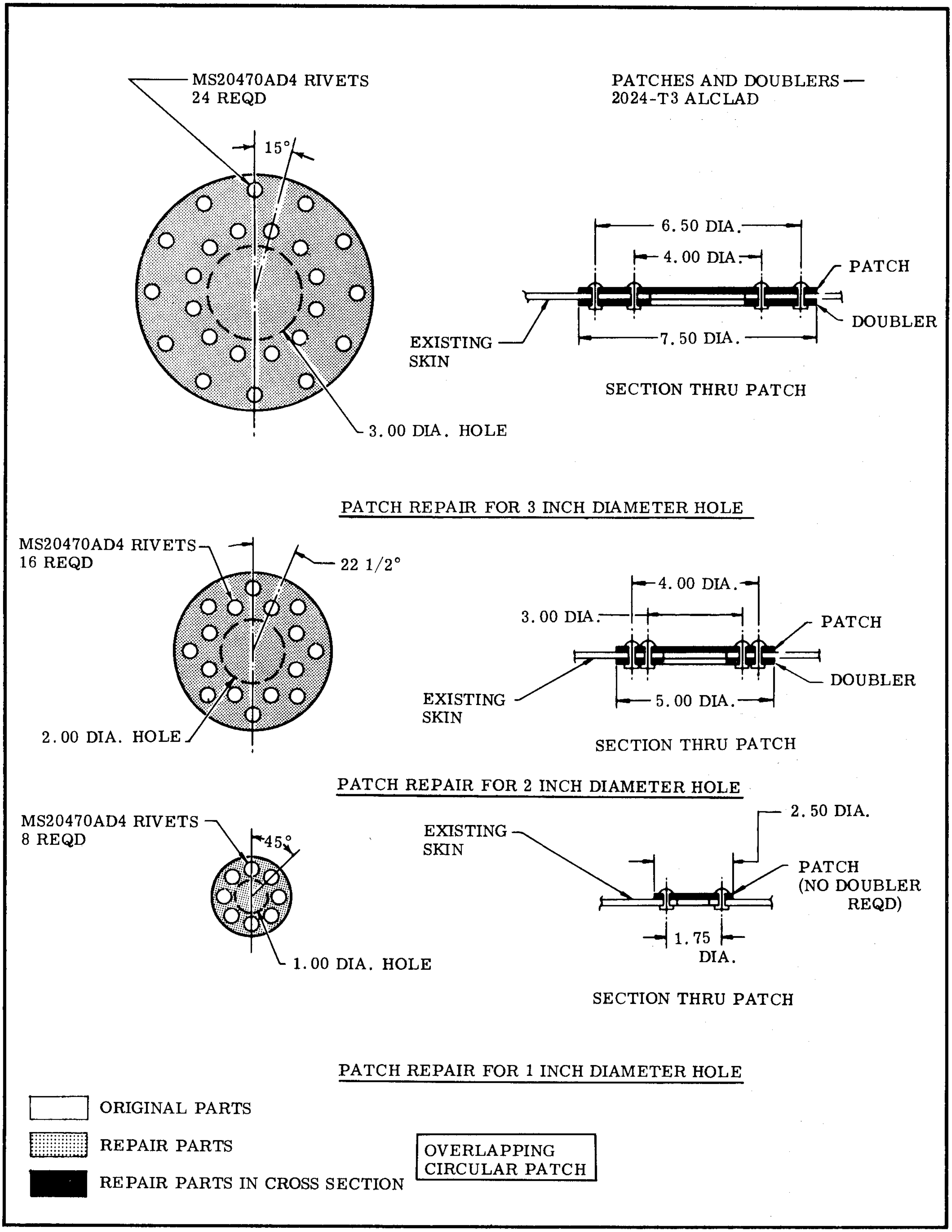
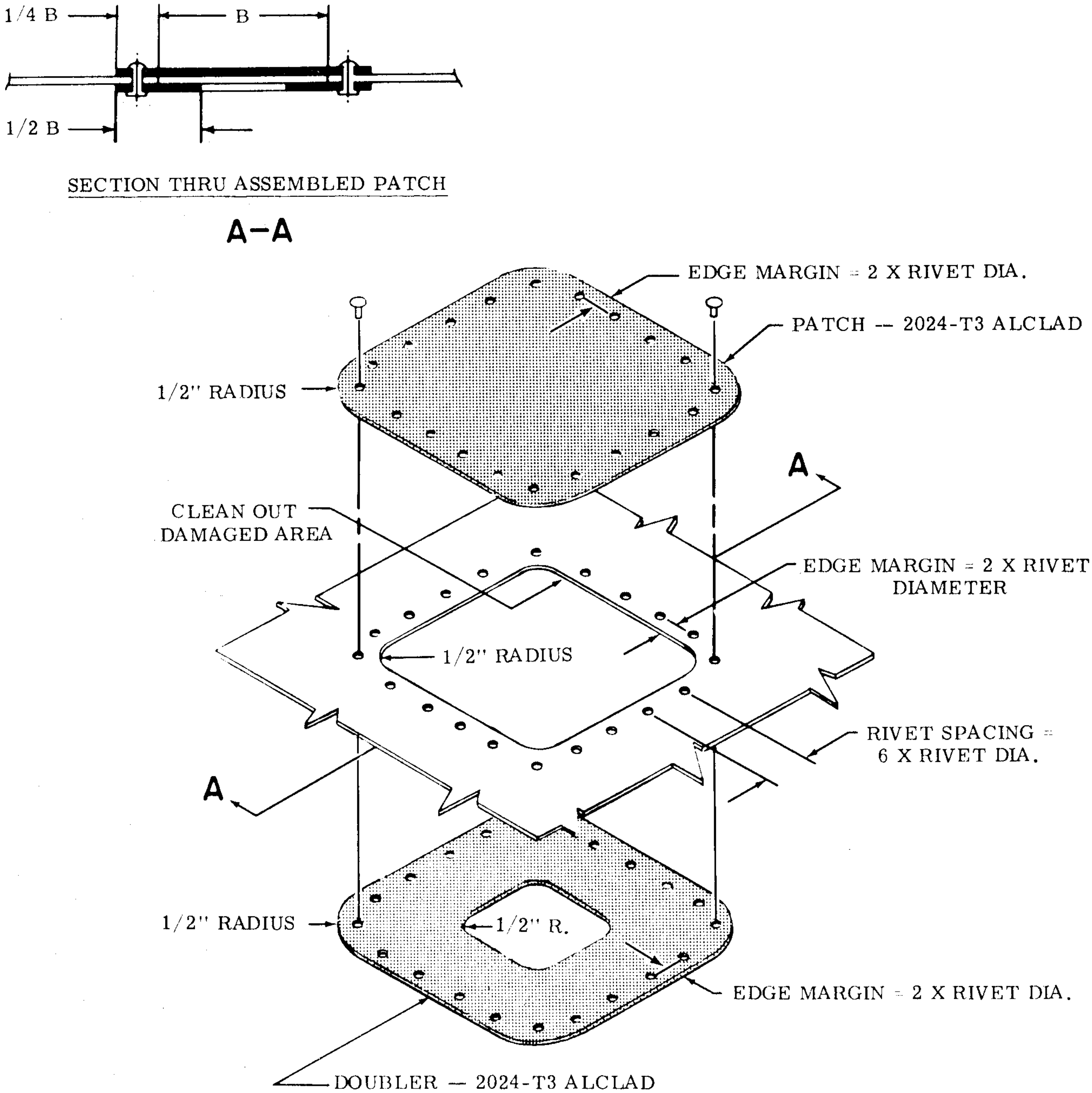


Figure 18-4. Skin Repair (Sheet 1 of 6)



ORIGINAL PARTS

REPAIR PARTS

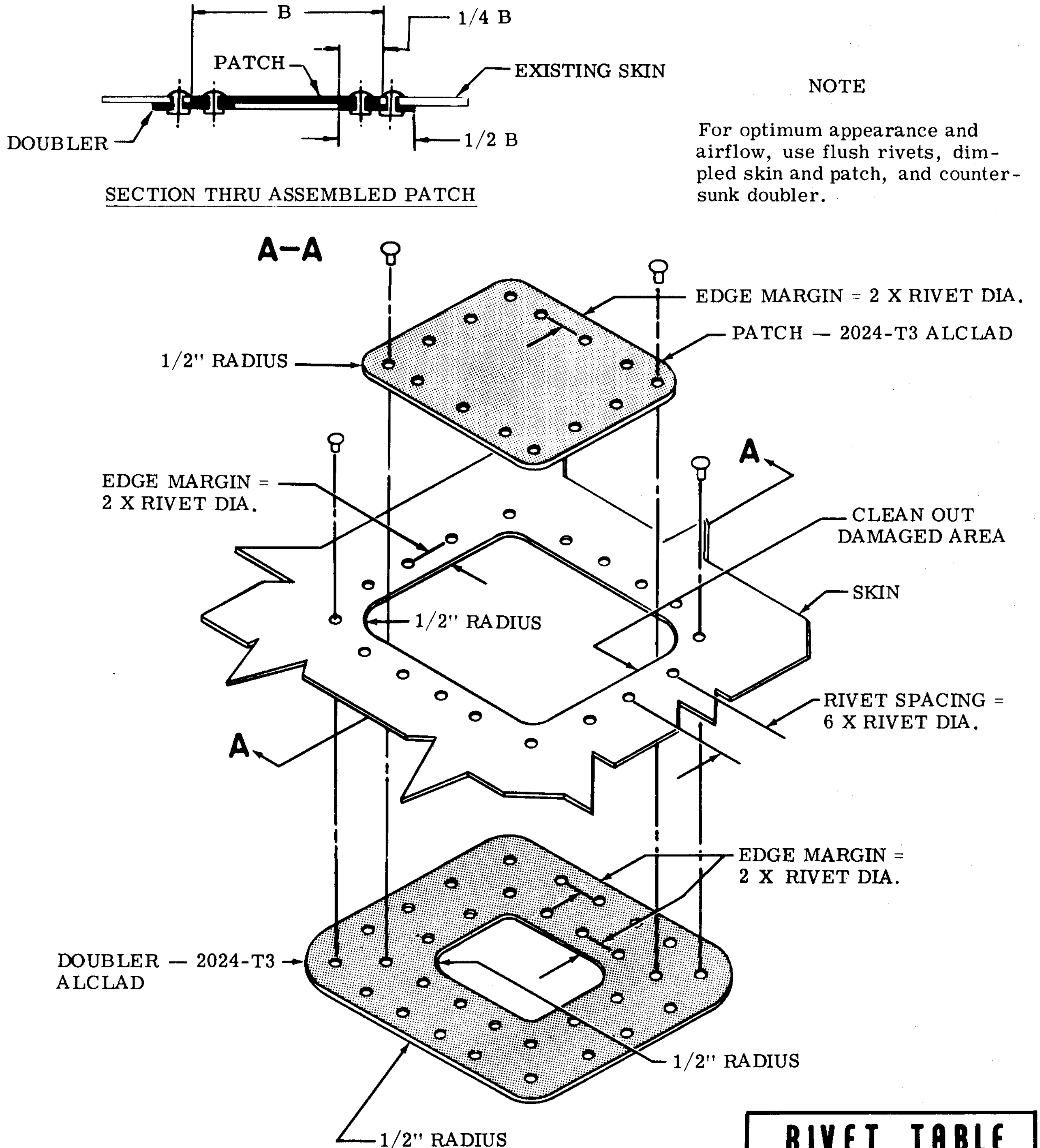
REPAIR PARTS IN CROSS SECTION

OVERLAPPING RECTANGULAR PATCH

RIVET TABLE

SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 18-4. Skin Repair (Sheet 2 of 6)



ORIGINAL PARTS

REPAIR PARTS

REPAIR PARTS IN CROSS SECTION

FLUSH RECTANGULAR PATCH (CIRCULAR FLUSH PATCH IS SIMILAR)

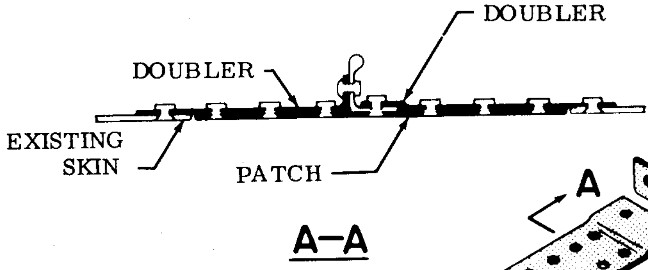
RIVET TABLE

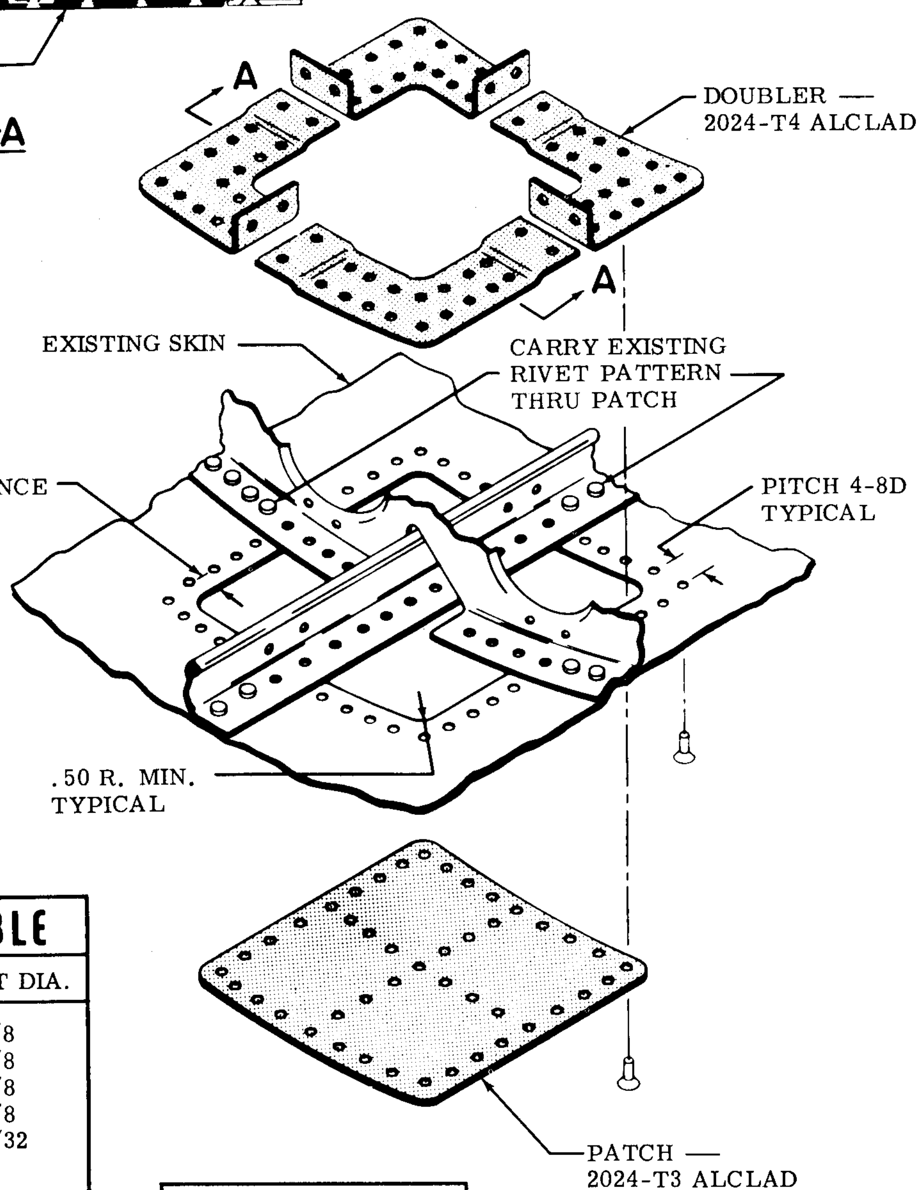
SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 18-4. Skin Repair (Sheet 3 of 6)

NOTE

Countersink doublers, and dimple skin and patch.





RIVET TABLE

SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

FLUSH PATCH AT STRINGER/BULKHEAD INTERSECTION

ORIGINAL PARTS

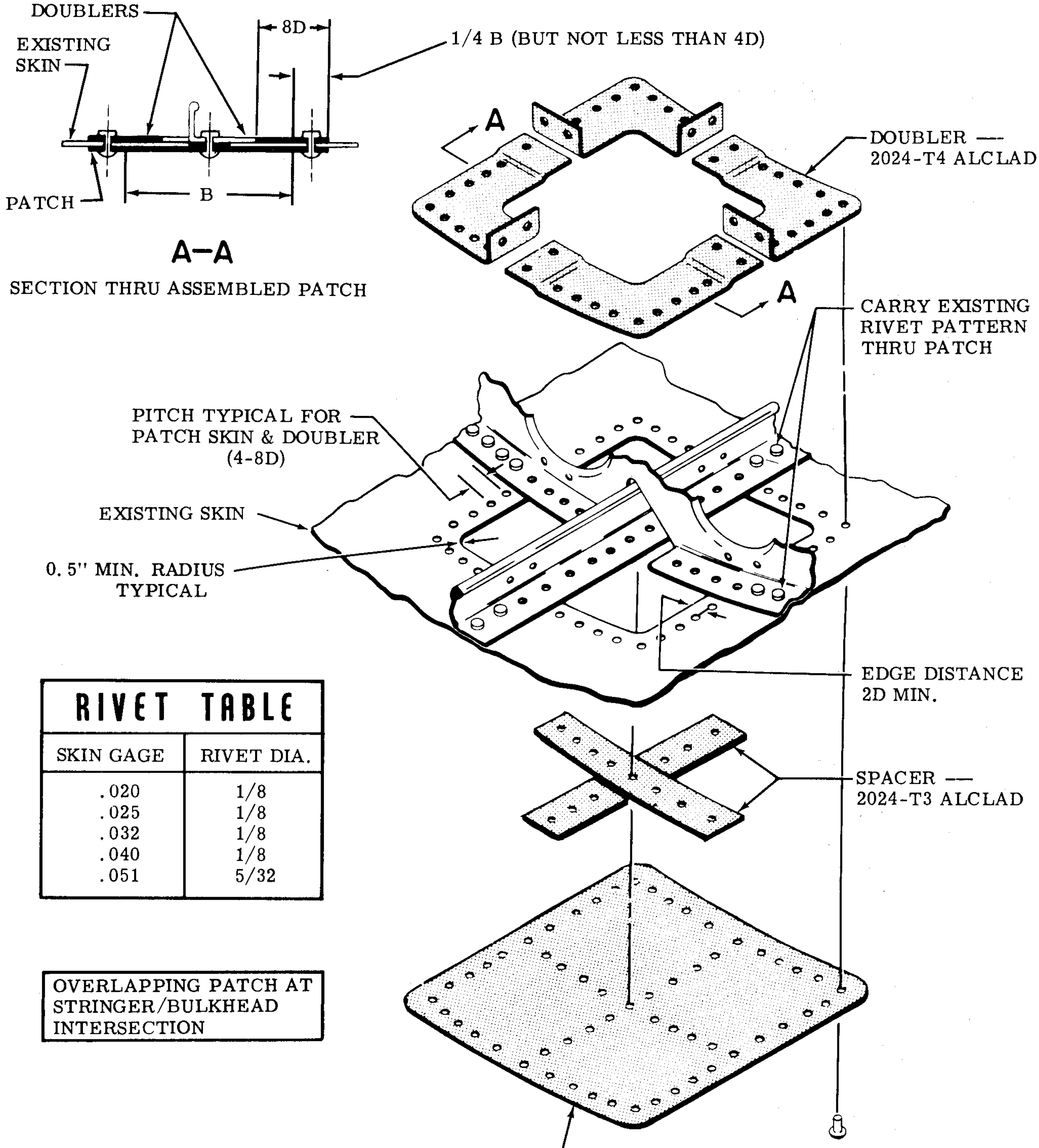
REPAIR PARTS

REPAIR PARTS IN CROSS SECTION

NOTE

This procedure is not recommended in areas where stringers are riveted to bulkheads.

Figure 18-4. Skin Repair (Sheet 4 of 6)



RIVET TABLE

SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

OVERLAPPING PATCH AT STRINGER/BULKHEAD INTERSECTION

ORIGINAL PARTS

REPAIR PARTS

REPAIR PARTS IN CROSS SECTION

Figure 18-4. Skin Repair (Sheet 5 of 6)

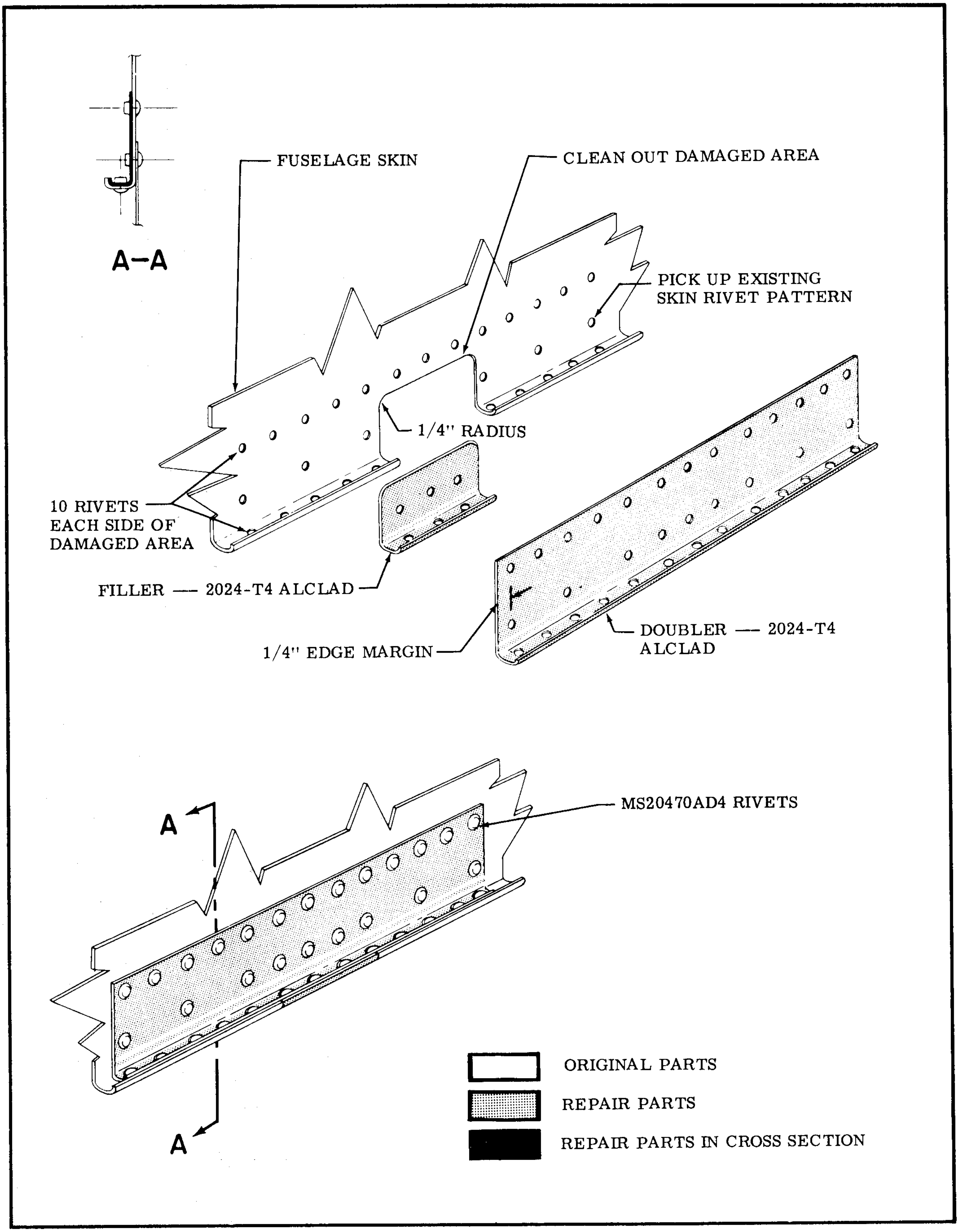


Figure 18-4. Skin Repair (Sheet 6 of 6)

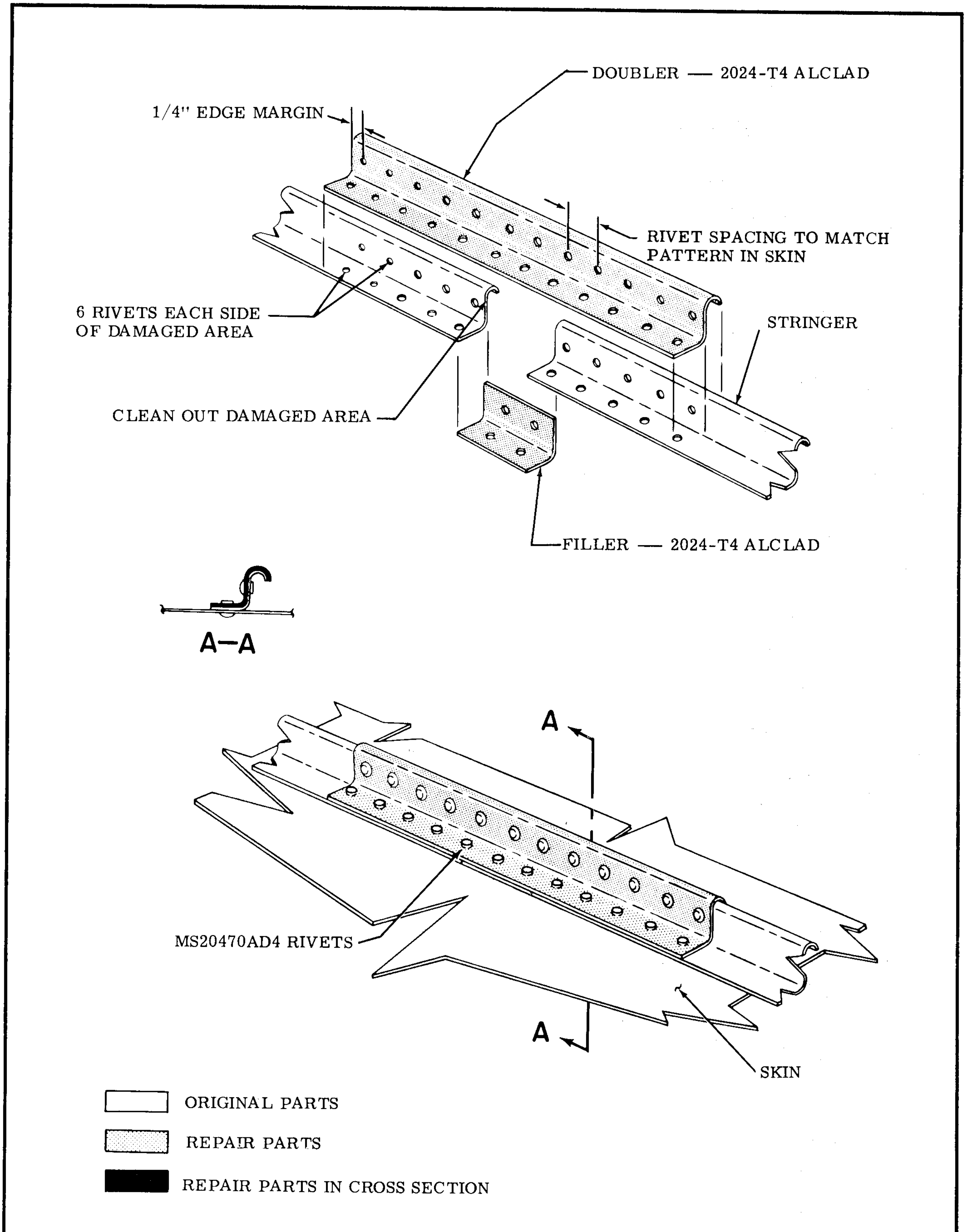


Figure 18-5. Stringer and Channel Repair (Sheet 1 of 4)

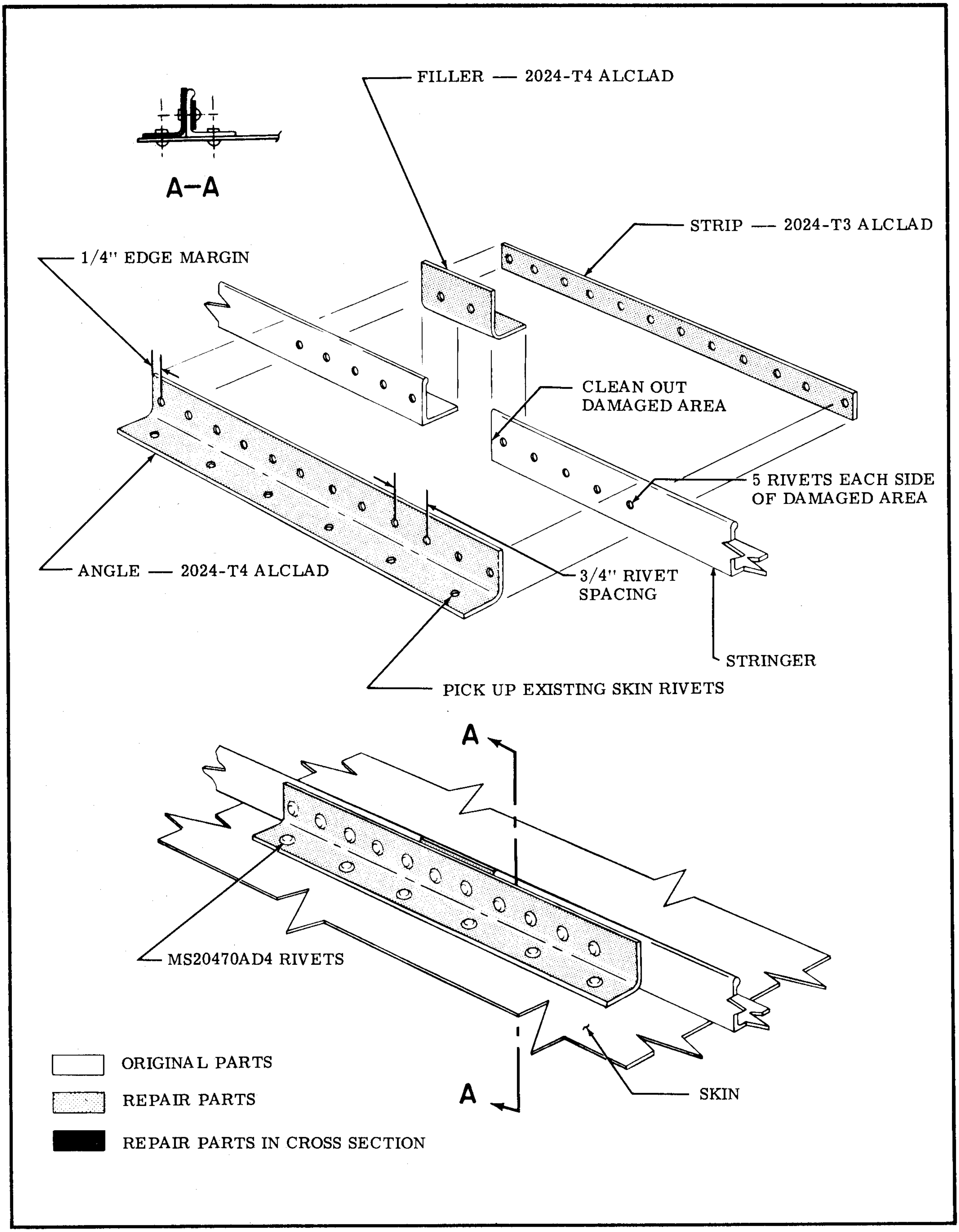


Figure 18-5. Stringer and Channel Repair (Sheet 2 of 4)

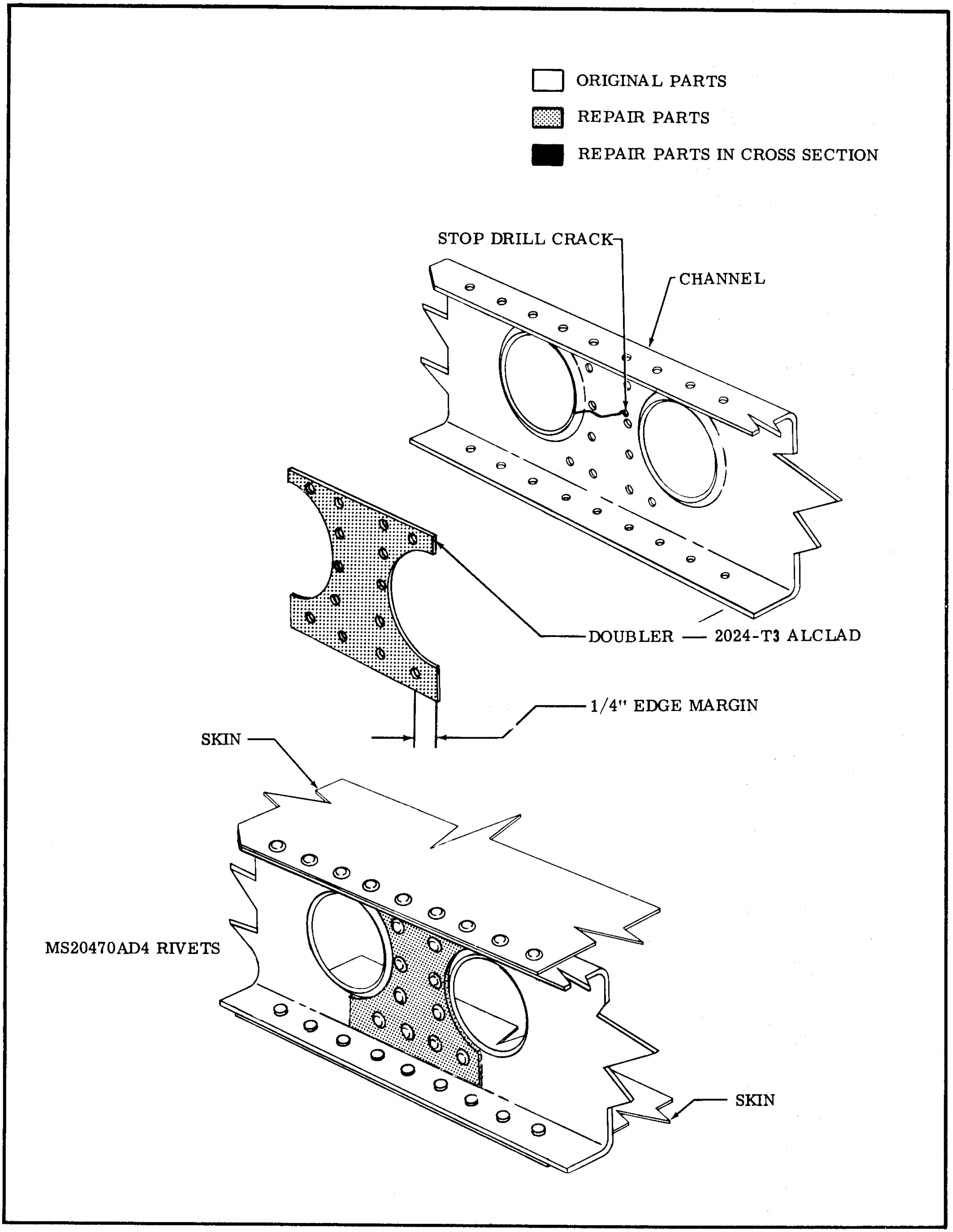


Figure 18-5. Stringer and Channel Repair (Sheet 3 of 4)

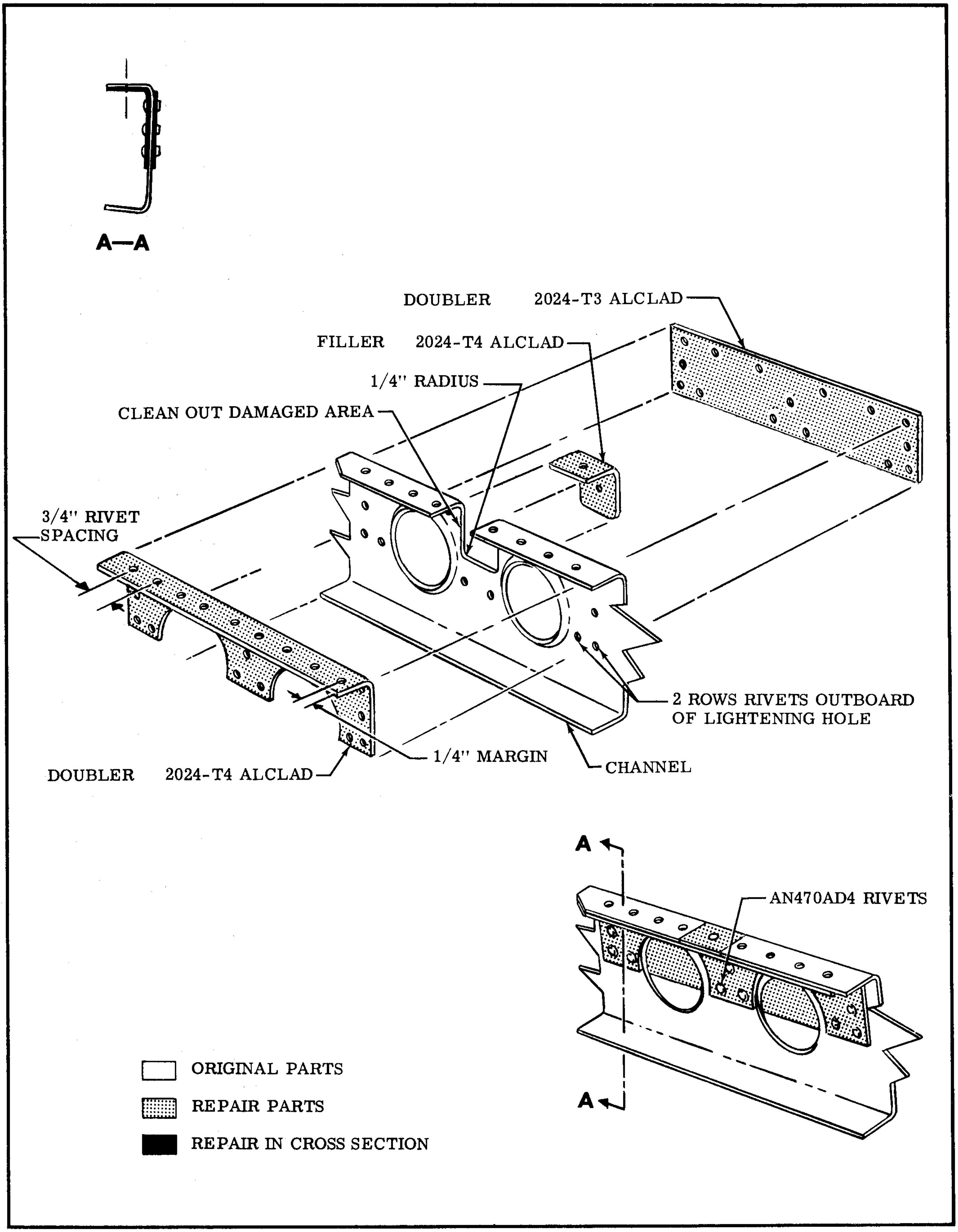


Figure 18-5. Stringer and Channel Repair (Sheet 4 of 4)

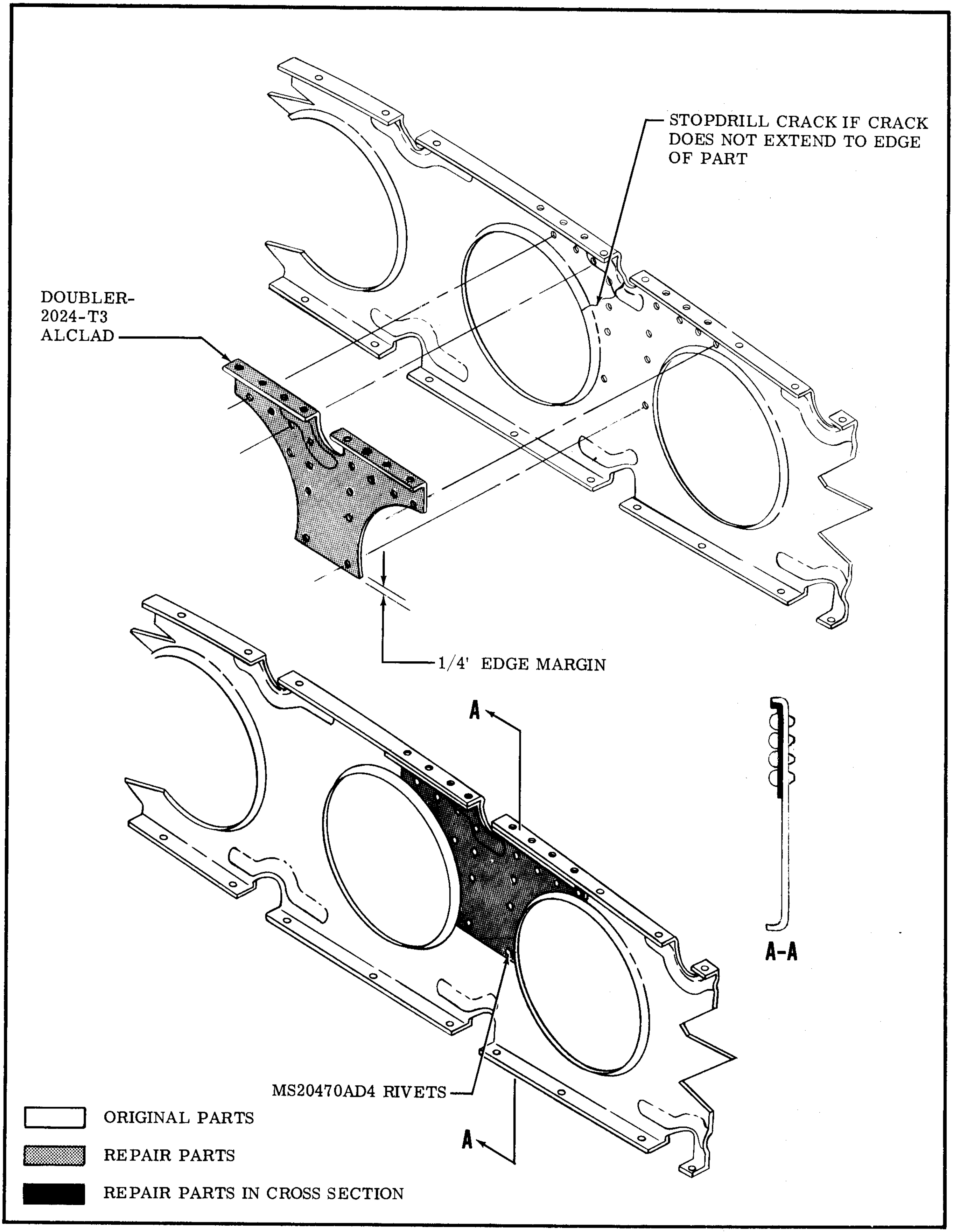


Figure 18-6. Rib Repair (Sheet 1 of 2)

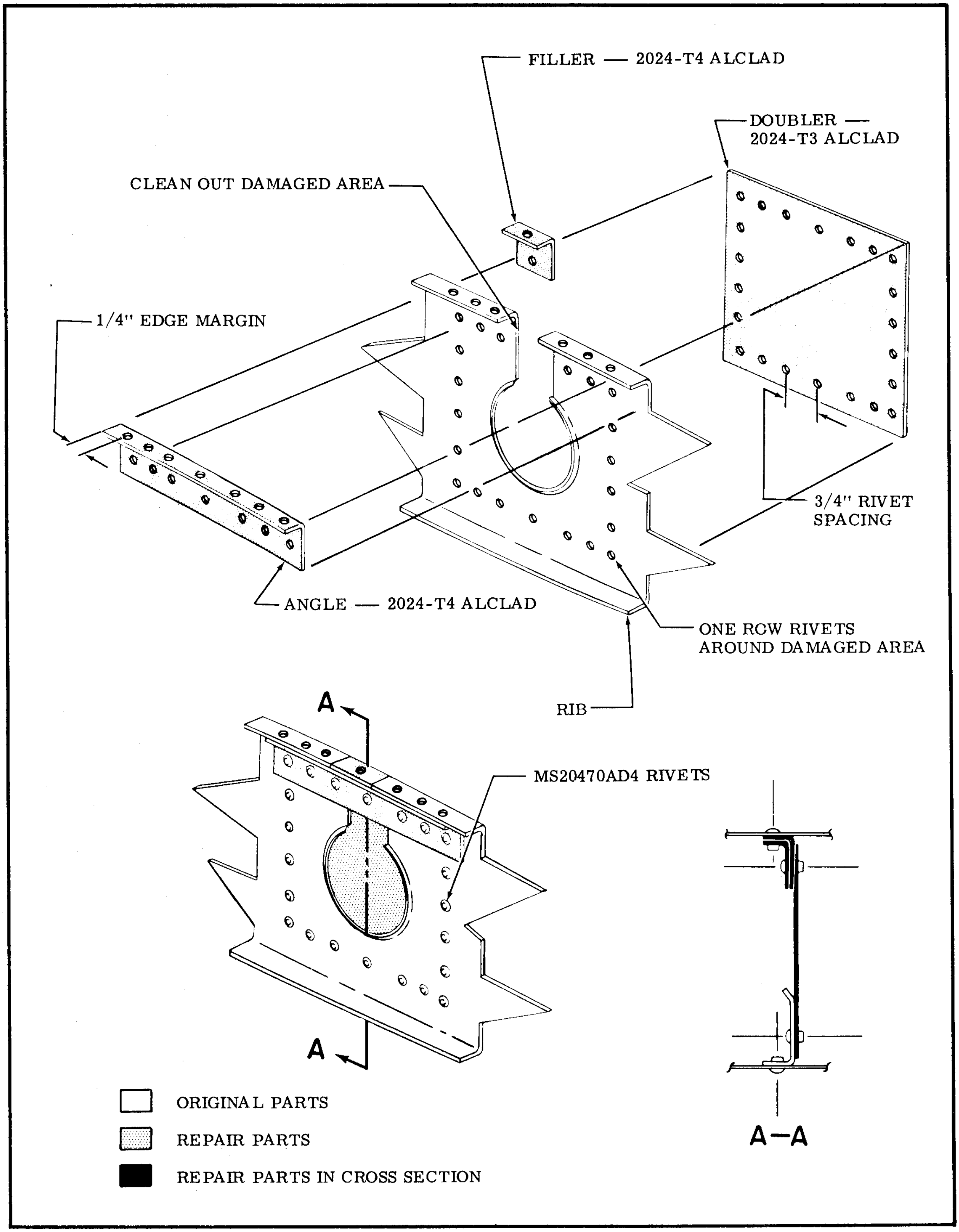


Figure 18-6. Rib Repair (Sheet 2 of 2)

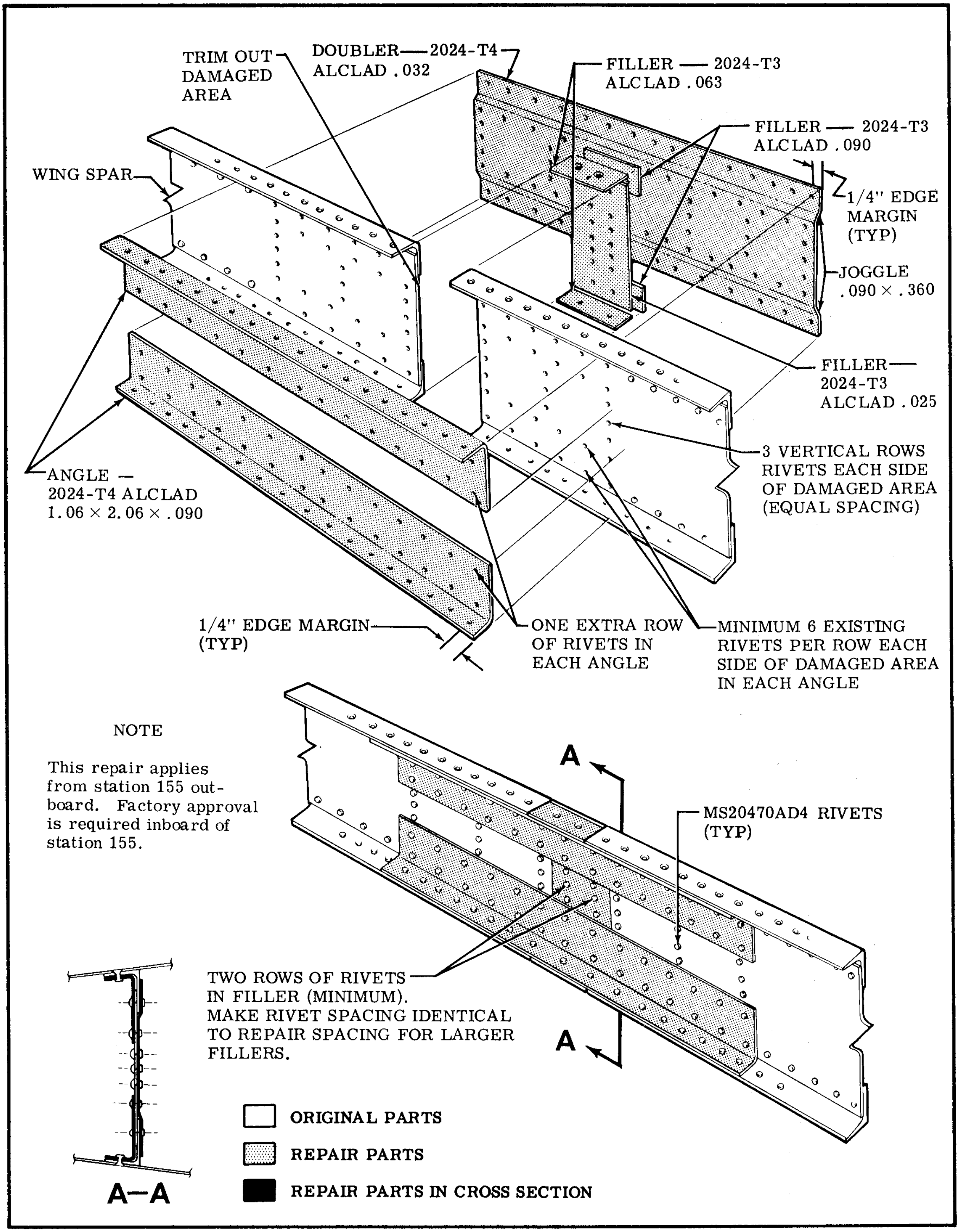


Figure 18-7. Wing Spar Repair

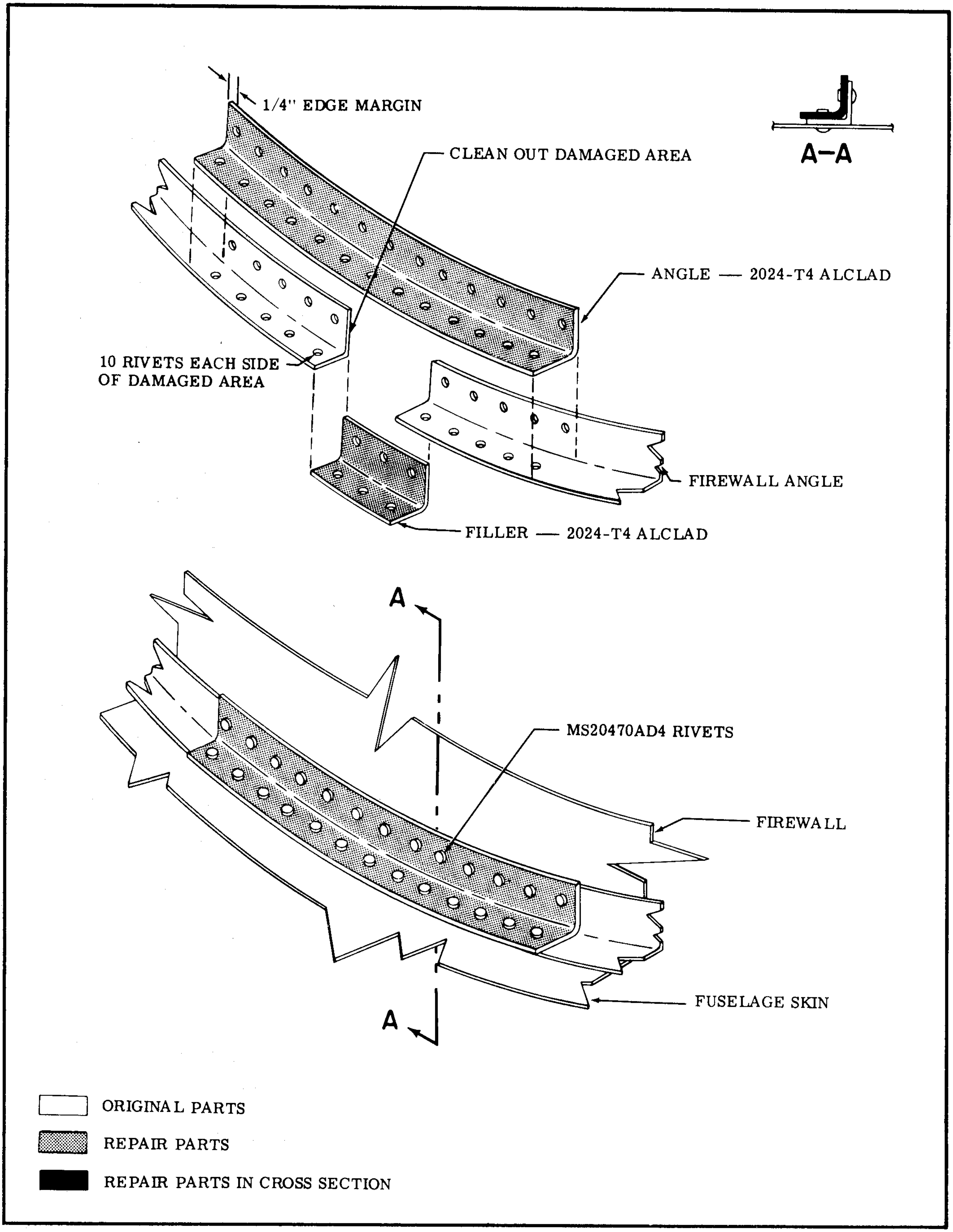


Figure 18-8. Firewall Angle Repair

NOTES:

1. Dimple leading edge skin and filler material; countersink the doubler.
2. Use MS20426AD4 rivets to install doubler.
3. Use MS20426AD4 rivets to install filler, except where bucking is impossible. Use CR162-4 Cherry (blind) rivets where regular rivets cannot be bucked.
4. Contour must be maintained; after repair has been completed, use epoxy filler as necessary and sand smooth before painting.
5. On cantilever wing, vertical size is limited by ability to install doubler clear of front fuel spar or stringers outboard of spar. On other wings, flaps and ailerons, vertical size is limited by ability to install doubler clear of front spar.
6. Lateral size is limited to seven inches across trimmed out area.
7. Number of repairs is limited to one in each bay. On cantilever wings, consider a bay in the area forward of front fuel spar as if ribs extended to leading edge.

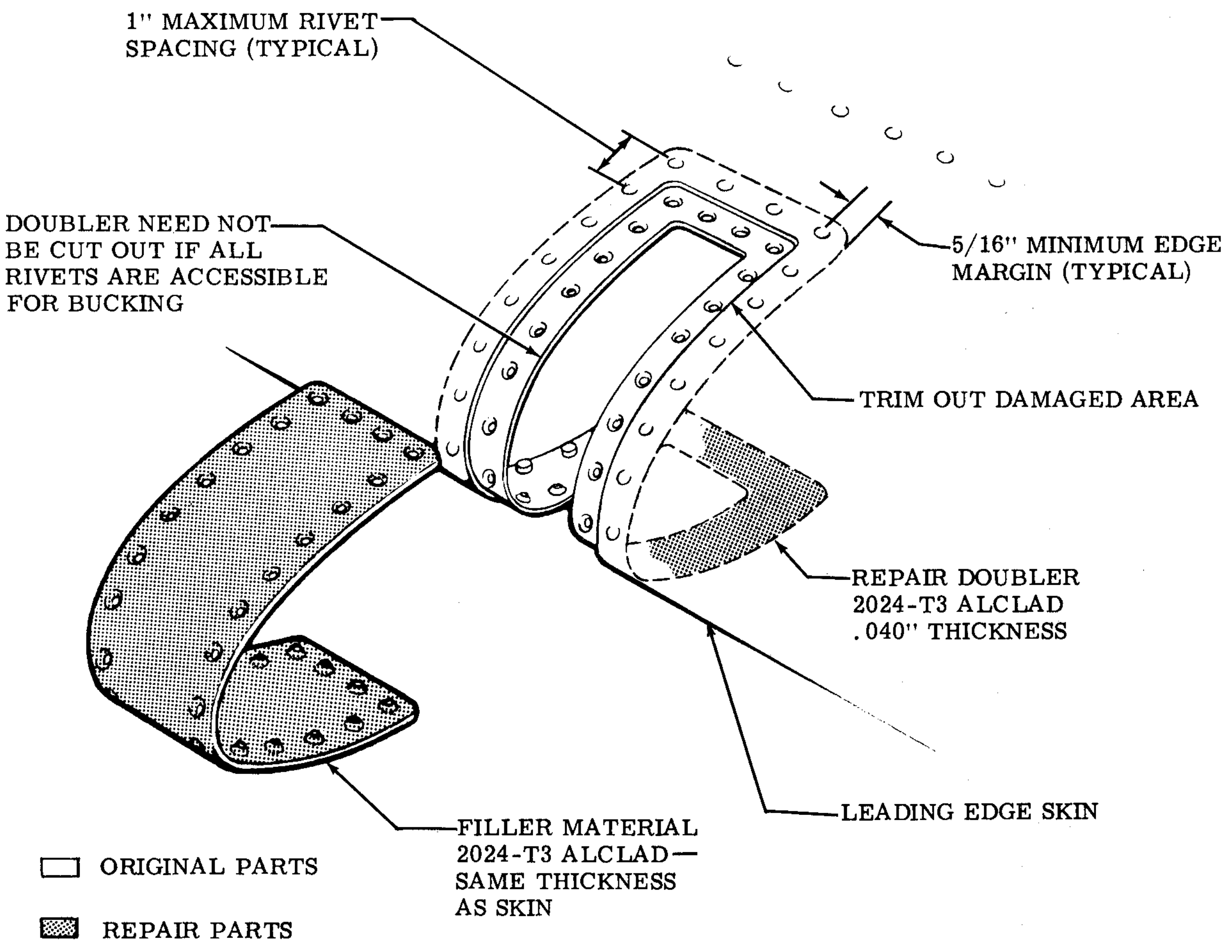
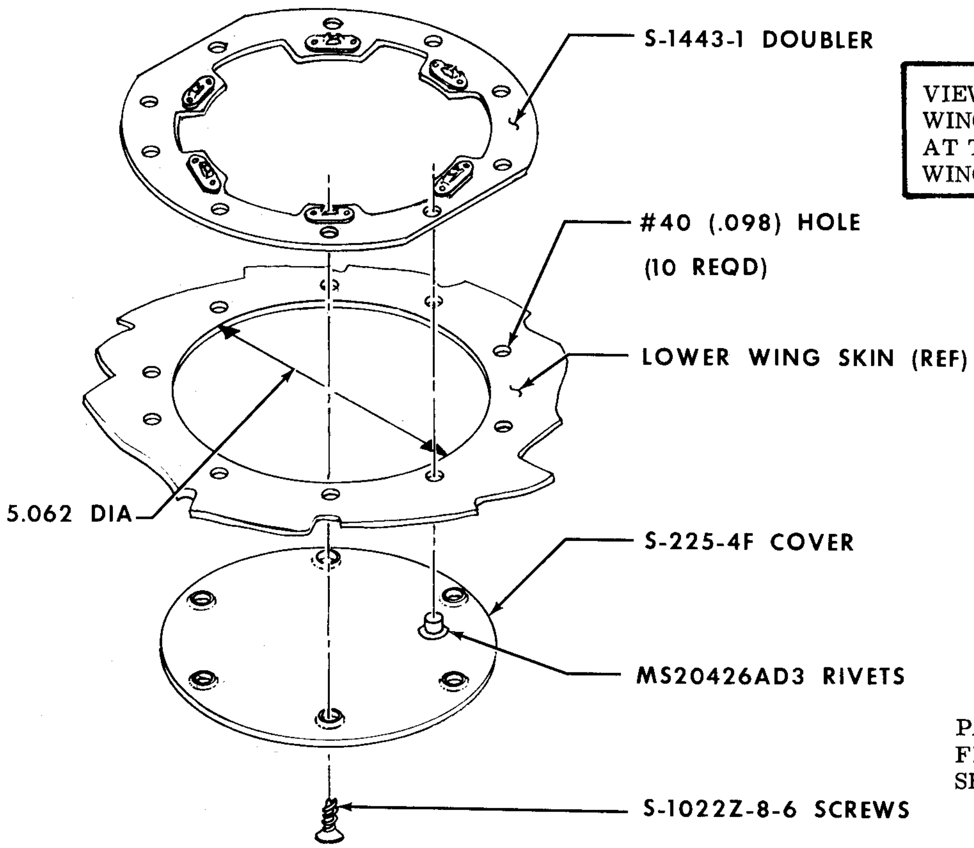


Figure 18-9. Leading Edge Repair Applicable to Aileron, Flap, and Wing



VIEWED FROM INSIDE WING LOOKING DOWN AT TOP OF LOWER WING SKIN.

CAUTION

Do not install on cantilever wing without factory approval.

NOTE

PARTS ARE AVAILABLE FROM THE CESSNA SERVICE PARTS CENTER.

PRECAUTIONS

1. Add the minimum number of access holes necessary.
2. Any circular or rectangular access hole which is used with approved optional equipment installations may be added in lieu of the access hole illustrated.
3. Use landing light installations instead of adding access holes where possible. Do not add access holes at outboard end of wing; remove wing tip instead.
4. Do not add an access hole in the same bay where one is already located.
5. Locate new access holes near the center of a bay (spanwise).
6. Locate new access holes forward of the front spars as close to the front spar as practicable.
7. Locate new access holes aft of the front spar between the first and second stringers aft of the spar. When installing the doubler, rotate it so the two straight edges are closest to the stringers.
8. Alternate bays, with new access holes staggered forward and aft of the front spar, are preferable.
9. A maximum of five new access holes in each wing is permissible; if more are required, contact the Cessna Service Department.
10. When a complete leading edge skin is being replaced, the wing should be supported in such a manner so that wing alignment is maintained.

a. Establish exact location for inspection cover and inscribe centerlines.

b. Determine position of doubler on wing skin and center over centerlines. Mark the ten rivet hole locations and drill to size shown.

c. Cutout access hole, using dimension shown.

d. Flex doubler and insert through access hole, and rivet in place.

e. Position cover and secure, using screws as shown.

Figure 18-10. Access Hole Installation

SECTION 19

PAINTING

This section is divided into two parts. Part 1 covers the procedures used, at the factory, for over-all painting of the aircraft. Part 2 covers the procedures for touch-up painting on the aircraft. Before attempting any touch-up painting on the aircraft, determine the type and color of the paint that is on the aircraft. The color and type of paint, on the aircraft when it left the factory, is stamped in code on the Trim Plate located on the left front door post. Applying this code to the Parts Catalog, type and color of the paint can be determined. In all cases determine the type of paint that is on the aircraft before adding touch-up paint as some types of paint are not compatible.

PART 1

OVER-ALL PAINTING

19-1. PAINTING.

19-2. Painting an aircraft requires little special equipment. The average shop will have the compressor, spray gun, and clean place to work required for a good paint job. Ordinarily, painting involves four basic steps. They are:

1. Stripping - Removing of paint to the bare metal.
2. Cleaning - Washing down the aircraft thoroughly to remove all oil, grease, and dirt.
3. Priming - Applying priming coat(s) before applying color coat.
4. Painting - Applying coat of final paint, then adding decorative stripes and identification markings.

19-3. MATERIALS. The materials required and called out in both Part 1 and Part 2 can be obtained from the Cessna Service Parts Center.

19-4. CLEANING.

a. Inspect aircraft for any surface defects, such as small dents or unsatisfactory previous repairs.
b. Wipe excess sealer from around windows and skin laps.
c. Mask windows and any other areas not to be primed, with Class A Solvent Proof Paper and Permacel Tape No. 781.
d. Use Klad Polish to remove stains, oxides, etc., from bare aluminum.
e. Use T-6094A thinner for final cleaning of the aircraft prior to applying primer. Saturate a contaminate-free, lint free cloth in T-6094A thinner and wring out so no thinner is dripping from cloth. Wipe the aircraft surface using the thinner saturated cloth and immediately following, wipe surface with a dry, lint free cloth.

NOTE

It is important that the thinner is wiped before it evaporates. Change cloths often, so that aircraft surface is thoroughly cleaned and the surface is not contaminated from the use of a dirty cloth. Always use clean thinner for the final cleaning. Be sure that thinner is disposed of when contaminated.

19-5. PRIMER PREPARATION.

NOTE

Mix EX2016G primer only in quantities required for use within six hours and then only in a stainless steel container. Mixed primer shall be discarded if not used within six hours.

a. Mix EX2016G primer and EX2016A activator in a 1:1 ratio and stir thoroughly.

NOTE

The mixed primer shall stand a minimum of 30 minutes prior to being applied to the aircraft.

b. Check all tapes to make sure that they are adhered to paper and masked surface. Cover flap tracks, nose gear strut tube, wheels, and shimmy dampener and steering rod ends.
c. Blow all contaminates from surface of aircraft with a jet of dry compressed air.

19-6. PRIMER APPLICATION.

NOTE

Air pressure at gun shall be between 40 to 50 psig. At all times, keep gun six to eight inches from surface and perpendicular to surface being painted. DO NOT PAINT WITH ARCING MOTION. Keep paint room at 75 to 80 degrees Fahrenheit.

a. Apply EX2016G mixed primer in one well broken up wet, even coat to 0.0003 to 0.0005 inch dry film thickness.
b. Allow primer to dry until a firm pressure with the finger nail will not penetrate the coating.

NOTE

Primed surface shall be top coated within four hours of application of primer.

19-7. PAINT PREPARATION (ACRYLIC WHITE).
a. Thoroughly stir and mix in original container to make sure all pigments are in solution.
b. Mix required amount of acrylic white with T-8204A thinner. Recommended thinning ratio is 100 parts paint to 100-120 parts thinner by volume. This variation in thinning may be required to facilitate application during hot weather and is permitted.
c. Scuff sand the primer only where runs or large dirt particles are in evidence. (Over-all sanding operation will be performed after application of the first coat of paint.)

19-8. PAINT APPLICATION (ACRYLIC WHITE).

NOTE

Air pressure at the gun should be 40 to 50 psig and 12±1 psig at the pot during application. At all times, keep gun six to eight inches from the surface and perpendicular to surfaces being painted. DO NOT PAINT WITH ARCING MOTION.

a. Apply one light wet even coat of paint to the aircraft.
b. Let dry until not tacky and lightly sand with No. 400 paper and wipe with a tack cloth.
c. Apply second coat even and wet. The minimum thickness necessary to provide good hiding is recommended. Heavy coats, applied in an attempt to improve gloss, should definitely not be applied or the acrylic may craze.
d. Burn down with T-8402A where necessary as soon after application of paint as practicable. Burn down should be held to a minimum.
e. Allow the finish to flash off for 10 minutes and move aircraft to force dry oven and dry for 1-1/2 hours at 120 to 140 degrees Fahrenheit.
f. Remove aircraft from oven and allow aircraft to cool to room temperature.

19-9. PREPARATION FOR STRIPES (ACRYLIC COLORS).
a. Mask stripe area using Permacel No. 781 tape and Class A solvent proof paper. Double tape all skin laps to prevent blow by.

NOTE

If an unpainted aircraft is to receive stripes only, clean and prime as outlined in paragraphs 19-4 through 19-6.

b. Scuff sand stripe area with No. 400 or No. 600 sandpaper. The use of power sanders should be held to a minimum with care exercised to preclude sanding through the white base coat.
c. Wipe sanded surface with a tack cloth and check all tapes to be sure they are adhered to surface.

19-10. PAINT PREPARATION (ACRYLIC COLORS).
a. Thoroughly stir and mix in original container to make sure all pigments are in solution.
b. Mix required amount of stripe color with T-7945 thinner. Recommended thinning ratio is 100 parts paint to 100-120 parts thinner by volume. This will allow for the slight thinner variation required with different colors.

19-11. APPLICATION OF STRIPES.

NOTE

Air pressure at the gun shall be 40 to 50 psig. At all times keep gun six to eight inches from the surface and perpendicular to the surface being painted. DO NOT PAINT WITH ARCING MOTION.

a. Keep first coat even and light. The first coat should be somewhat lighter than the second to avoid sags, but should be wet enough to achieve a smooth surface.
b. Apply second coat in wet passes to achieve full coverage. Heavy coats, applied in an attempt to improve gloss, should definitely not be applied or the acrylic may craze.
c. Inspect for overspray and apply burn down agent, T-7945 thinner, to any area showing overspray. Care in application will minimize overspray.

NOTE

Burn down of non-metallic colors shall be accomplished with T-7945 thinner. Burn down of metallic colors shall be accomplished with T-7987 thinner.

d. The masking tape and paper shall not be removed until the paint has dried a minimum of 15 minutes. Care shall be used in removal of masking to prevent damage to the finish.

19-12. PROCEDURE FOR PAINTING WITH CESSNA LACQUER (27H SERIES).

19-13. CLEANING. Clean aircraft in accordance with paragraph 19-4.

19-14. PRIMER PREPARATION AND APPLICATION.

NOTE

Mix EX2016G primer only in quantities required for use within six hours and then only in stainless steel bucket.

a. Mix EX2016G primer and T-6070 or EX2016A activator in a 1:1 ratio and stir thoroughly.

NOTE

The primer shall stand after mixing a minimum of 30 minutes prior to being applied to the aircraft.

b. Apply EX2016G primer in a well broken up, wet, even coat.

c. Allow primer to dry until a firm pressure with the finger nail will not penetrate the coating.

d. Mix one part EX2414 yellow lacquer primer with two parts T-6094A thinner.

e. Apply one well broken up, wet even coat of the EX2414 primer over the EX2016G primer.

19-15. PAINT PREPARATION (LACQUER COLORS - 27H SERIES).

a. Thoroughly stir and mix in original container to make sure all pigments are in solution.

b. Thin required amount of lacquer color with T-6094A thinner in a 1:1 ratio. Mix thoroughly and strain into cups before using.

19-16. PAINT APPLICATION (LACQUER COLORS - 27H SERIES).

NOTE

Air pressure at gun should not exceed 40 psig. At all times, keep paint room at 75 to 85 degrees Fahrenheit.

a. Apply first coat even and wet; second and third coats in the same manner.

b. Check carefully before second and third coats for defects and correct before final coats.

c. Using T-6094A thinner as a "burn-down" agent, "burn-down" to give smooth, even surfaces free from overspray.

NOTE

Before applying the decorative vinyl tape, wipe the surface lightly with naphtha cleaner or mineral spirits. These solvents may be used in addition to xylene, toluene, and lacquer thinner on unpainted surfaces. After cleaning, wipe dry with a clean, lint-free cloth.

Tape should be applied with a plastic squeegee applicator. Tape improperly positioned may be removed immediately before adhesive has set. No tape shall be removed unless it is reinforced by application tape over the face of the tape. This prevents stretch and distortion caused by removal. After application, remove application tape and prick the tape at rivet base with a pin point tool to permit escape of trapped air. Press tape firmly around rivet head. Avoid stretching tape. For optimum adhesion around rivets a heat lamp may be used to momentarily soften the tape.

PART 2

TOUCH-UP PAINTING

19-17. TOUCH-UP-GENERAL.

19-18. Where necessary to touch-up or refinish an area, the edge of the finish adjacent to the defect shall be feathered by sanding with No. 320 paper and followed with No. 400 paper. Avoid, if possible, sanding through the primer. If the primer is penetrated over an area 1/2-inch or larger, repriming is necessary. Avoid spraying metal primer on the adjacent paint as much as possible.

a. When touching up acrylic, vinyl or lacquer, use EX2016G primer mixed one part primer to one part EX2016A or T-6070 activator. Stir thoroughly and allow to set 30 minutes before applying primer to surface.

b. When touching up epoxy, use Dupont 818-012 primer mixed two parts primer to one part 8539 activator. Stir thoroughly and allow to set 30 minutes before applying.

CAUTION

Before attempting touch-up, determine the type of paint that is on the aircraft. Some types of paint are not compatible. Acrylic paint does not adhere to vinyl paint satisfactorily. Therefore, when acrylic paint is to be applied over vinyl paint, a barrier coat of lacquer paint is required between the vinyl and acrylic paint.

19-19. TOUCH-UP-ACRYLIC.

a. Fill the feathered areas by spraying on several light coats of EX8229B Primer Surfacer. Only sufficient Surfacer should be used to assure filling. Allow five to eight minutes drying time between coats of Surfacer used. Sand the Surfacer smooth with No. 400 sandpaper. Apply a light coat of EX8229A Sealer over the sanded Surfacer. After drying for five to eight minutes, apply the acrylic top coat.

NOTE

Dry overspray may be removed by burn down with T-8402A (White), T-7945 (non-metallic color), T-7087 (metallic color), or by compounding with Dupont No. 808 Rubbing Compound.

19-20. TOUCH-UP-VINYL.

a. If priming with EX2016G primer is required, a light coat of MIL-P-8585 Zinc Chromate primer thinner, four parts Toluol to one part primer, shall be applied over the EX2016G primer.

b. Fill the feathered areas by spraying on several light coats of ACME 538 Dark Grey Surfacer. Allow five to eight minutes drying time for each coat of Surfacer. Sand the area smooth with No. 400 sandpaper and apply top coat of vinyl paint.

NOTE

Dry overspray may be removed by burn down with T-1411, or by compounding with Dupont 808 Rubbing Compound.

19-21. TOUCH-UP-LACQUER.

a. When priming with EX2016G is required, a light coat of EX2414 primer shall be sprayed over the EX2016G primer. Mix one part EX2414 Yellow Lacquer Primer with two parts T-6094A thinner.

b. Fill the feathered areas by spraying on several light coats of ACME 538 Dark Grey Surfacer. Allow five to eight minutes drying time for each coat of Surfacer. Sand the area smooth with No. 400 sandpaper and apply top coat of lacquer paint.

NOTE

Dry overspray may be removed by burn down with T-6094A thinner, or by compounding with Dupont 808 Rubbing Compound.

19-22. TOUCH-UP-EPOXY.

a. If bare metal is not exposed, or after the metal is primed, spray a light coat of Dupont Epoxy Primer over the rework area. Mix two parts 825-8500 Primer with one part VG5943 activator. If a thinner is required, use T-3871 thinner. Stir primer and allow to set 45 minutes before applying.

NOTE

Top coat must be applied over primer within 72 hours of priming.

b. When the primer is DRY, apply top coat, Cessna Part Number CES1054-826. To the Dupont Chemical Resistance Enamel white epoxy base coat shall be mixed one part VG8339 activator. If thinning is required, use T-3871 thinner.

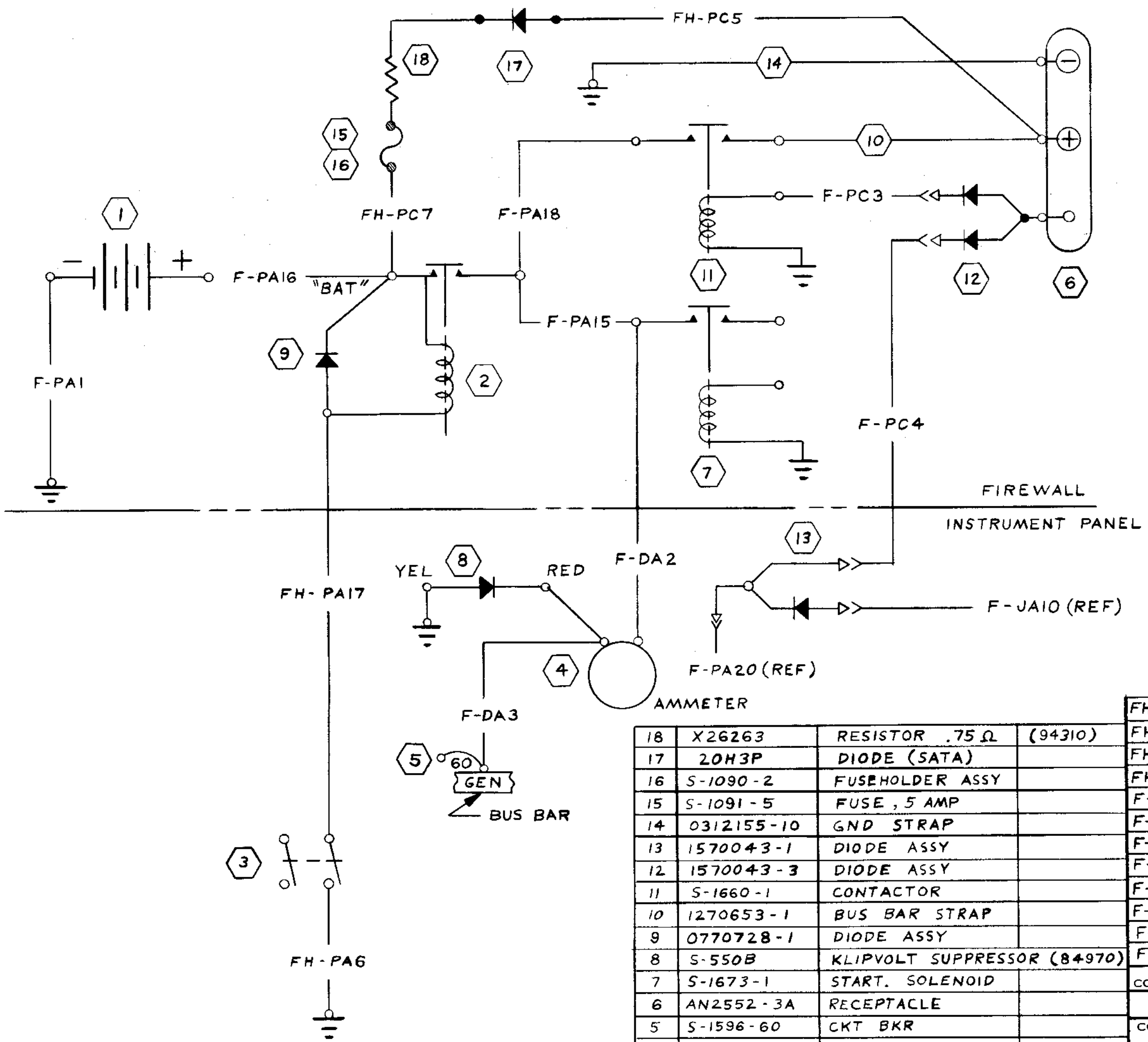
c. The ENMAR 5400 series color epoxy is used to paint the stripes. All colors, except the Valor Red, shall be mixed one part by volume paint to one part by volume T-5400 Adduct Thinner. Mix the Valor Red in the same ratios, except use T-6487 Adduct Activator. If a thinner is required, use T-5402 Thinner. Stir thoroughly and allow the mixed paint to set for 30 minutes prior to applying.

SECTION 20

WIRING DIAGRAMS

TABLE OF CONTENTS Page

REVISION			
LET	DESCRIPTION	DATE	APPD



ITEM NO	PART NO.	DESCRIPTION	
18	X26263	RESISTOR .75 Ω	(94310)
17	20H3P	DIODE (SATA)	
16	S-1090-2	FUSEHOLDER ASSY	
15	S-1091-5	FUSE, 5 AMP	
14	0312155-10	GND STRAP	
13	1570043-1	DIODE ASSY	
12	1570043-3	DIODE ASSY	
11	S-1660-1	CONTACTOR	
10	1270653-1	BUS BAR STRAP	
9	0770728-1	DIODE ASSY	
8	S-550B	KLIPVOLT SUPPRESSOR (84970)	
7	S-1673-1	START. SOLENOID	
6	AN2552-3A	RECEPTACLE	
5	S-1596-60	CKT BKR	
4	C669502-0102	INST CLUSTER KIT	
3	S-1884-1-1	SWITCH - MASTER	
2	S-1579-1	CONTACTOR - BAT.	
1	0712605-1	BATTERY	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
FH-PC7	18			SOLDER	S-1367-1-13		
FH-PC5	18			S-1367-1-14	SOLDER		
FH-PA17	18		141	S-1367-1-6	S-1493-1		
FH-PA6	18		6	S-1493-1	S-1367-1-8		
F-DA3	8		42	S-1367-4-10	S-1367-4-10		
F-DA2	8		58	S-1367-4-10	S-1367-4-14		
F-PC4	18			S-1493-1	S-1493-1		
F-PC3	18			S-1493-1	S-1367-1-10		
F-PA18	2			S-1367-7-14	S-1367-7-13		
F-PA16	2		15	S-1367-7-13	S-1367-7-13		
F-PA15	2		42	S-1606-1	S-1367-7-14		
F-PA1	2		14	S-1367-7-12	S-1367-7-13		

WIRE TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: P. 4.1.1

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	[illegible]	6-14-68
GROUP	[illegible]	8-14-68
DRAWN	R.B. IRWIN	8-5-68
CHECK	G. IRVIN	8-7-68
STRESS	R.F. GEIDE	8-8-68
PROJECT	[illegible]	9-16-68
APPD	SWANEY	8-7-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — BATTERY & EXTERNAL POWER SYSTEMS

SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

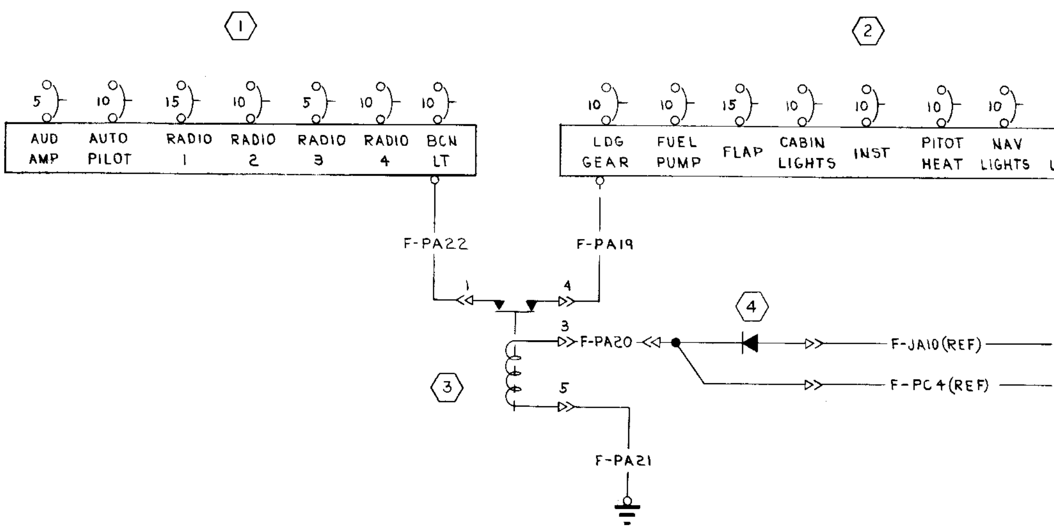
SCALE: NONE | MODEL: 210, T210 | PAGE: 4.1.2

FORM NO. 80-218A

ED & RR 03405 SER 21059062 & T210-0393

SER 21058819 & ON
SER T210-0198 & ON

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REV: 0713854-2 WAS 0713854-1 F-PA22 WIRE WAS F-PA18 20 AMP BREAKER WAS 10 AMP BKR SER 21058819 & ON, SER T210-0198 & ON	GLW 5-6-66	YAK HLW



F-PA21	18			S-1493-1	S-1367-1-8		
F-PA20	18			S-1493-1	S-1493-1		
F-PA19	14			S-1493-2	S-1367-2-6		
F-PA22	14			S-1493-2	S-1367-2-6		
WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
4	1570043-1	DIODE ASSY	
3	S-1668-1	RELAY - POWER	
2	0713854-2	BUS BAR - PRIMARY	
1	0713854-1	BUS BAR - ELECT	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	J Wedel	1/4/66
GROUP	H. Wise	1-27-66
CHECK	P. Stuck	1-28-66
PROJ	H. McCartney	2-3-66

TITLE: WIRING DIAGRAM— SPLIT BUS BAR

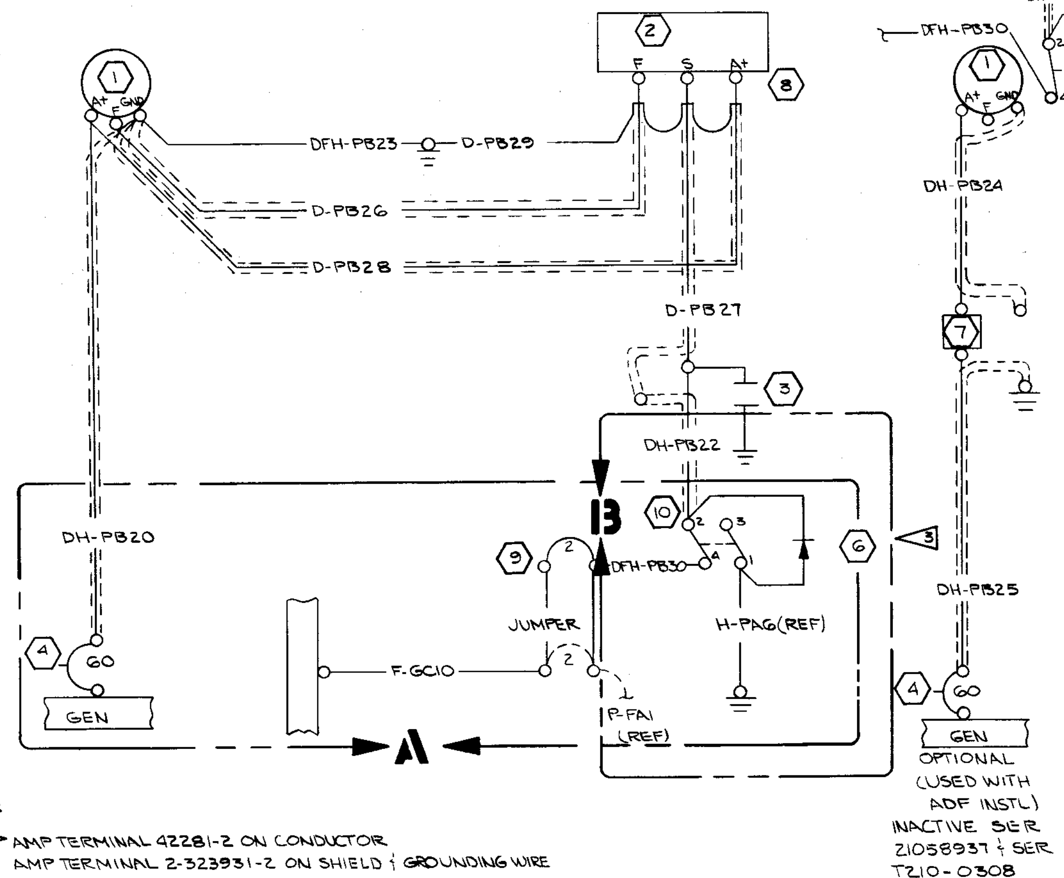
Cessna

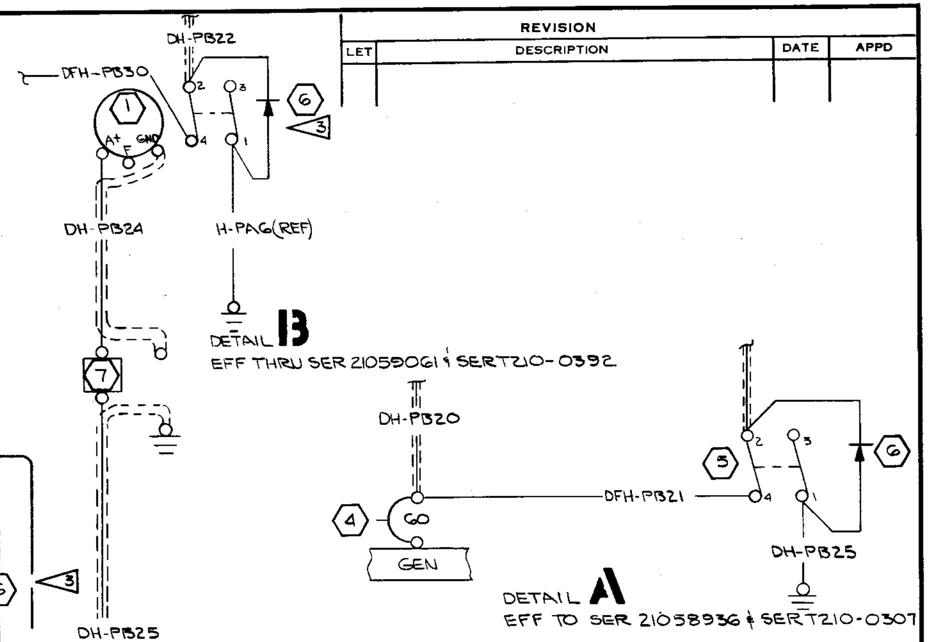
DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: | MODEL: 210 & T210 | REV: A | PAGE: 4.5

FORM NO. 80-161A

REVISION			
LET	DESCRIPTION	DATE	APPD





NOTES:

1. AMP TERMINAL 42281-2 ON CONDUCTOR
   AMP TERMINAL 2-323931-2 ON SHIELD & GROUNDING WIRE
2. 8 GAUGE SHIELDED WIRE MATERIAL PER S-1534-8-9
3. OBSERVE POLARITY SYMBOL ON DIODE WHEN INSTALLING ON SWITCH TERMINALS OR DIODE WILL FAIL WHEN SYSTEM IS ENERGIZED
4. "D" PREFIX IS USED ON THESE WIRES INSTEAD OF "F". THESE WIRES ARE SAME AS THOSE USED IN 182. THIS DRAWING IS SCHEMATICALLY IDENTICAL TO 0770610 PG 4.7
5. EFF THRU SER 21059061 & SER T210-0392
6. EFF SER 21059062 & SER T210-0393

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
DFH-PB33	18S						OBSOLETE-NEVER USED
DFH-PB32	18						OBSOLETE-NEVER USED
DFH-PB22	18S	◁4		S-1367-1-6	S-1493-1	◁6	
DFH-PB30	18			S-1367-1-10	S-1493-1	◁6	
D-PB31				S-1367-1-6	S-1367-1-6		SER 21058937 & SER T210-0308 & ON
DFH-PB30				S-1367-1-10	S-1367-1-6	◁5	
D-PB29	18			S-1367-1-12	◁1		
D-PB28	18S			S-1367-1-12 S-1367-2-10			
D-PB27	18S			S-1367-1-6 S-1367-2-8			
D-PB26	18S			S-1367-2-10 S-1367-10	◁1		
DH-PB25	8S	◁2		S-1367-4-10 S-1367-3-8	S-1367-1-10		
DH-PB24	8S	◁2		S-1367-4-12 S-1367-3-10	S-1367-4-10 S-1367-3-8		
DFH-PB23	10			S-1367-3-10	S-1367-3-10		
DH-PB22	18S			S-1367-1-6	S-1367-1-6 S-1367-3-8	◁5	
DFH-PB21	18			S-1367-1-6	S-1367-1-10		OBS-SER 21058936 & SER T210-0307
DH-PB20	8S	◁2 ◁4		S-1367-4-12 S-1367-3-10	S-1367-1-10		

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	
10	S-1844-1-1	SWITCH-MASTER	
9	CA-2	CKT BKR(80602)	
8	C6AB-10A730A	HOUSING(ECWS)	
7	S-1629-1	NOISE FILTER	
6	0770719-1	DIODE ASSY	
5	S-1159-1-1	SWITCH-MASTER	
4	S-1596-60	CIRCUIT BREAKER	
3	0770038-2	FILTER	
2	C611001-0101	REGULATOR	
1	C611501-0101	ALTERNATOR ASSY	

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: 1270405 PG 4.4

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN		
GROUP	H. WISE	6-3-66
DRAWN	ACKERSON	3-3-66
CHECK	YAKSHAW	6-30-66
STRESS		
PROJECT	McCARTER	7-7-66
APPD		

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — ALTERNATOR SYSTEM — 60 AMP

SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: 210 & T210 PAGE: 4.6

FORM NO. 80-215A

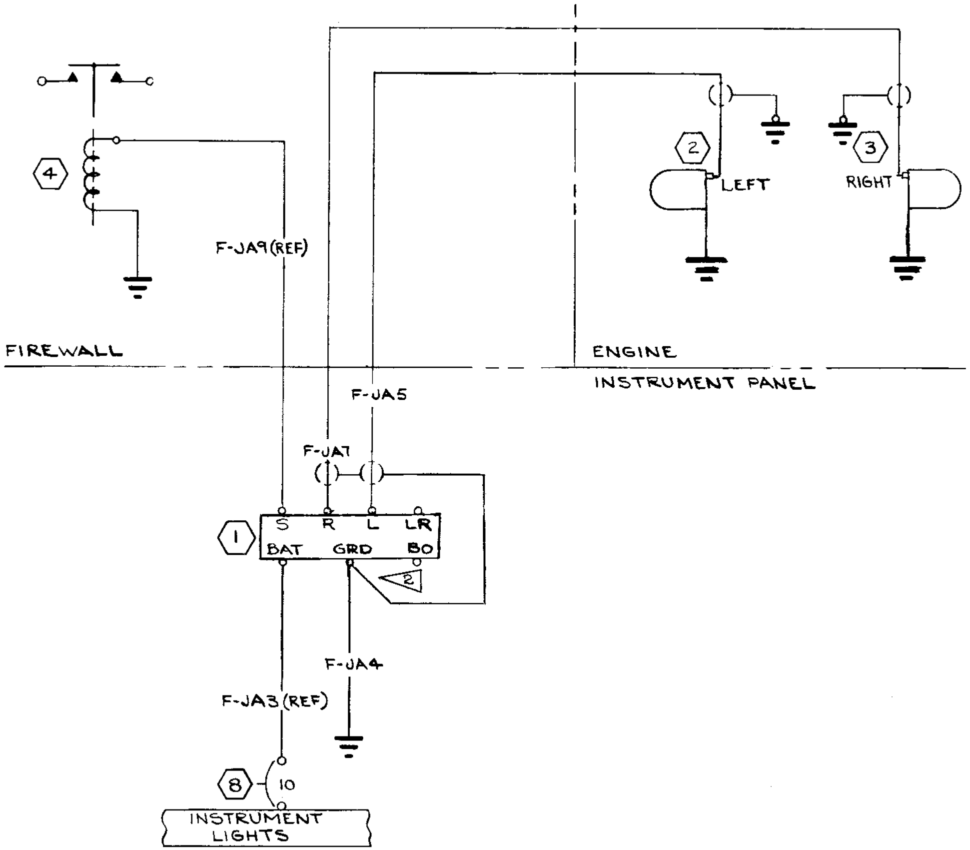
CHG LET	REVISION	BY / DATE	CHK / APPD
A	REROUTE F-JA9 TO COIL TERMINAL; S-1360-10 WAS S-1232-10; REMOVED 1270429-1 BUS BAR, F-JA3 & F-JA9 FROM E/T; ADDED WIRE LENGTHS TO W/T	WJR 6-25-64	RRS
B	ON WIRES F-JA5 & F-JA7 18-S WAS 18-DS	GLW 11-1-65	RRS

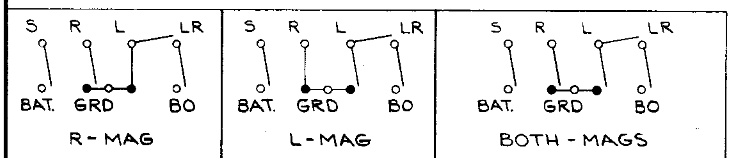
NOTES:

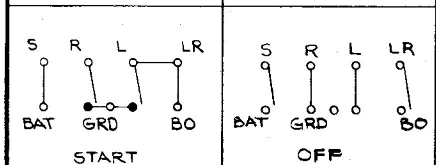
1. SHORTING BAR BETWEEN "R" AND UNMARKED TERMINAL ADJACENT TO IT IS NOT USED FOR THIS CIRCUIT.

2▷ TERMINATE SHIELDS ON F-JA5 & F-JA7 WIRES AT THE SWITCH WITH S-1367-2-6 TERMINALS & CONNECT TO "GND" TERMINAL ON SWITCH.

3▷ S-1367-1-10 TERMINAL ON HOT LEAD, S-1367-3-10 ON SHIELD.







DIAGRAMS SHOW NOT ACTUAL SWITCH BUT CIRCUIT CONTINUITY AT EACH POSITION.

o EXTERNALLY ACCESSIBLE TERMINAL.

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
8	S-1360-10	CIRCUIT BREAKER	
7			
6			
5			
4	0750027-1	START. SOLENOID	
3	SLICK #662	RIGHT MAGNETO	
2	SLICK #662	LEFT MAGNETO	
1	0713129-1	SWITCH, MAG	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-JA7	18-S		65	S-1367-1-6	3▷	2▷	
F-JA5	18-S		65	S-1367-1-6	3▷	2▷	
F-JA4	18		9	S-1367-1-6	S-1367-1-8		

WIRE TABLE

CESSNA AIRCRAFT CO COMMERCIAL AIRCRAFT DIVISION WICHITA, KANSAS

	NAME	DATE
DRAWN	RIODER	9-11-62
GROUP	TM	10-12-62
CHECK	R. Stuck	10-5-62
PROJ	H. McCall	10-12-62

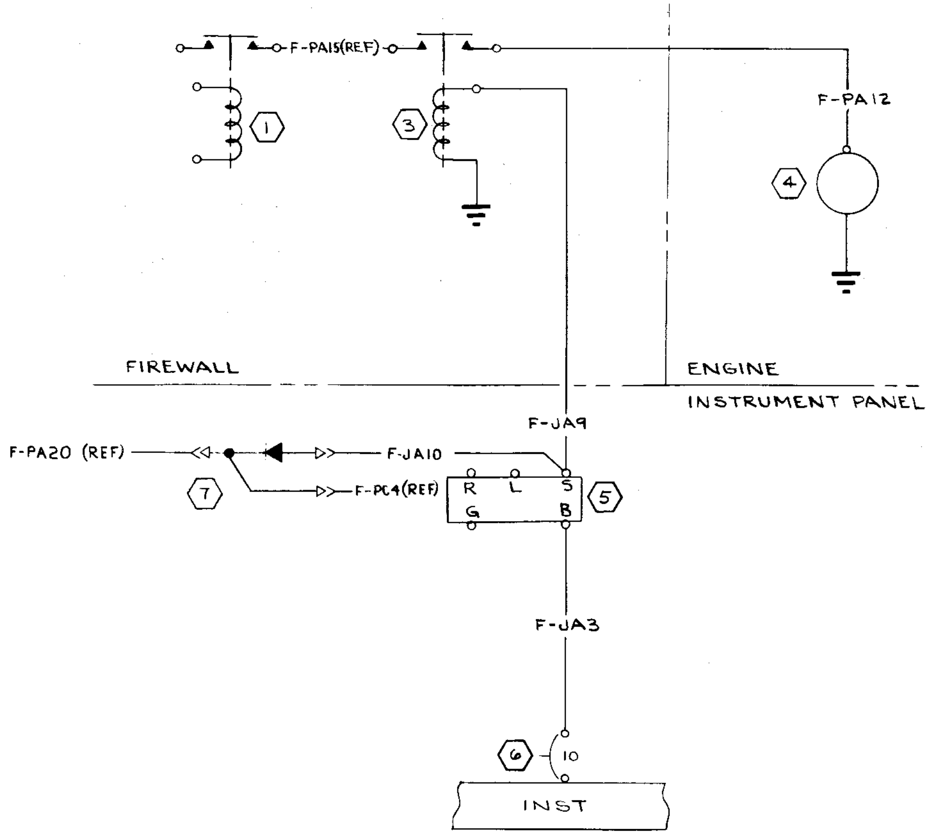
TITLE: WIRING DIAGRAM — IGNITION SYSTEM

Cessna.

DWG NO: 1270405

SUPERSEDED BY: SUPERSEDES: MODEL: 210 REV: B PAGE: 5.1

FORM NO. 80-161



NOTES:
1 PART OF 1250400 ENGINE INSTALLATION.

CHG LET	REVISION	BY / DATE	CHK / APPD
A	INST WAS INSTRUMENT LIGHTS REMOVED 1270429-1 BUS BAR FROM E/T. S-1360-10 WAS S-1232-10 REMOVED F-PA10 FROM E/T; ADDED WIRE LENGTHS TO W/T	WJR 6-29-64	RPS Hfw
B	ADD F-JA10, 1570043-1 F-PA15(REF) WAS F-PA10 (REF) (SR4886 & SR4887)	J. Wedel 1/4/66	RPS Nme Hfw

WIRE TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-JA10	18			S-1493-1	S-1367-1-6		SER210S8819 & T210-0198 & ON
F-PA12	2		12	S-1367-7-14	S-1367-7-14		
F-JA9	18		89	S-1367-1-6	S-1367-1-10		
F-JA3	18		10	S-1367-1-6	S-1367-1-8		

EQUIPMENT TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
7	1570043-1	DIODE ASSY	
6	S-1360-10	CIRCUIT BREAKER	
5	0713129-1	SWITCH	
4	1	STARTER	
3	0750027-1	START. SOLENOID	
2			
1	0712603-2	CONTACTOR BAT.	

CESSNA AIRCRAFT CO COMMERCIAL AIRCRAFT DIVISION WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	9-11-62
GROUP	[illegible]	10-12-62
CHECK	R. Stuck	10-5-62
PROJ	H. McCarty	10-12-62

TITLE: WIRING DIAGRAM — STARTER SYSTEM

Cessna.

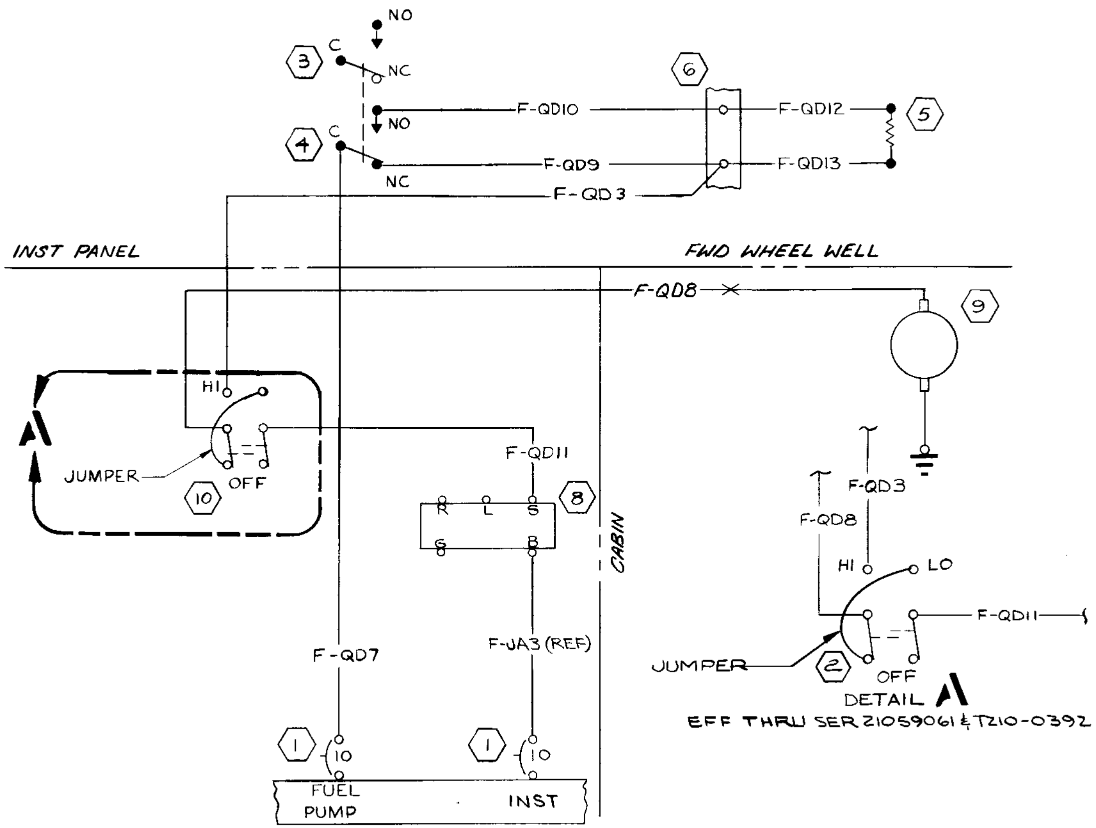
DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: | MODEL: 210 | REV: B | PAGE: 6.1

FORM NO. 80-161

SER 21058221

CHG LET	REVISION	BY / DATE	CHK / APPD
A	S-1160-1-2 WAS S-1160-1-1; INST WAS INST LIGHTS; REMOVED 12 10461-1 BUS BAR & 12 10405-JA3 FROM E/T; ADDED WIRE LENGTHS TO W/T	WJR 6-30-64	
B	ADD DETAIL A. USM5-B WAS USMW76-B. ADD ITEM 10. C292501-0101 SWITCH WAS 0713129-1 (SR4886)(SR4887)-9	GLW 5-7-66	
C	DELETE DETAIL A. OBSOLETE WIRES F-QD15 F-QD16 & F-QD14. USM5-B WAS E33-10K. REACTIVATED F-QD7, F-QD9, F-QD10 (SR4886)(SR4887)-9	GLW 8-30-66	
D	BY REV: ADD DETAIL A & EFF SER, F-QD17, F-QD19, F-QD18 & S-1846-1-2, INACTIVATE F-QD3, F-QD8, F-QD11 & S-1160-1-2. ED & RR 02330 (SR5403) IX (SR5404) IX	JDH 4-15-68	
E	BY REV: ADD NOTES 1 & 2; OBSOLETE (NEVER USED) F-QD17, F-QD18, & F-QD19; SER IN F-QD3, F-QD8, & F-QD11, CHANGED TERMINALS TO AGREE ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	
F	BY REV: ADD CABIN LINE & RELOCATE FWD WHEEL WELL LINE; SER, 21059062 & T210-0393 ED & RR 10221	A.A.S. 11-1-68	



NOTES:

1. EFF THRU SER 21059061 & T210-0392
2. EFF SER 21059062 & T210-0393

ITEM NO	PART NO.	DESCRIPTION	VENDOR
13			
12			
11			
10	S-1846-1-2	SWITCH	
9	4140-00-1	FUEL PUMP	DUKA
8	C292501-0101	SWITCH, MAG	
7			
6	AN3436-2-6	TERMINAL BLOCK	
5	MOR-20-2	RESISTOR	94310
4	USM5-B	SWITCH, FUEL PUMP	80207
3	USM5-B	SWITCH, T-SW	80207
2	S-1160-1-2	SWITCH	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-QD19	18						OBSOLETE (NEVER USED)
F-QD18	18						OBSOLETE (NEVER USED)
F-QD17	18						OBSOLETE (NEVER USED)
F-QD11	18		8	S-1367-1-8	S-1493-1	2	
F-QD8	18		100	S-1493-1	S-1370-1	2	
F-QD3	18		100	S-1493-1	S-1367-1-6	2	
F-QD16	18		120	S-1367-1-4	S-1367-1-6		OBSOLETE (NEVER USED)
F-QD15	18		120	S-1367-1-4	S-1367-1-6		OBSOLETE (NEVER USED)
F-QD14	18		100	S-1367-1-4	S-1367-1-6		OBSOLETE (NEVER USED)
F-QD3	18		100	S-1367-1-6	S-1367-1-6	1	
F-QD13	18		6	S-1367-1-6	SOLDER		
F-QD12	18		5	S-1367-1-6	SOLDER		
F-QD11	18		8	S-1367-1-6	S-1367-1-8	1	
F-QD10	18		120	S-1367-1-6	SOLDER		
F-QD9	18		120	S-1367-1-6	SOLDER		
F-QD8	18		100	S-1367-1-6	S-1370-1	1	
F-QD7	18		100	SOLDER	S-1367-1-6		

WIRE TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	G WOOD	1-17-63
GROUP	Ted Woody	3-26-63
CHECK	R. Stuck	3-28-63
PROJ	H. McCarta	3-29-63

TITLE: WIRING DIAGRAM — FUEL PUMP SYSTEM

Cessna.

DWG NO 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 7.1 | MODEL: 210 & T210 | REV: F | PAGE: 7.1.1

FORM NO. 80-161

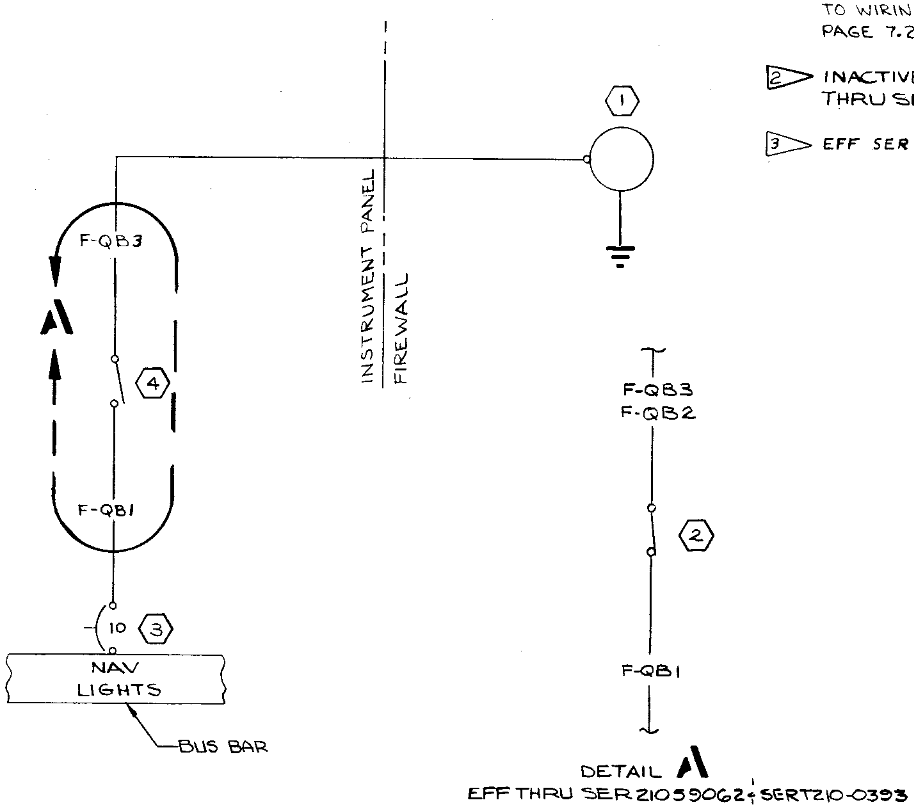
NOTES:

1. WIRES MADE PER THIS DRAWING ARE USED ON MODELS 205 & P206 U206. CHANGES MADE TO THIS DRAWING SHOULD ALSO BE MADE TO WIRING DIAGRAM ON 1270625 PAGE 7.2.

2. INACTIVE: SER (SR4661)(SR4637) THRU SER (SR5403) & (SR5404)

3. EFF SER 21059062 & T210-0393

CHG LET	REVISION	BY / DATE	CHK / APPD
A	S-1360-10 CKT BKR WAS S-1232-10; 1270461-1 BUS BAR WAS 1270429-1; ADDED NOTE 1.; 1200687 N/A WAS 1200437	WJR 11-1-63	RRS
B	REMOVED 1270461-1 BUS BAR FROM E/T; ADDED WIRE LENGTHS TO W/T	WJR 7-1-64	RRS
C	ADDED F-QB3 WIRE; INACTIVATED F-QB2 WIRE; N/A ON F-QB1 WAS 1200687; ADDED T210 TO MODEL BLOCK (SR4637), (SR4661)	WJR 5-4-65	RRS ALH
D	BY REV: ADD DETAIL A, F-QB4, F-QB5, S-1845-2-2 & EFF SER; INACTIVATE: F-QB1, F-QB3 & S-1158-1-1 ED & RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS DRB
E	BY REV: ADD NOTE 3; OBSOLETE (NEVER USED) F-QB4 & F-QB5; SER IN F-QB1 & F-QB3, CHANGE TERMINALS TO AGREE ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	GKI MDS KFG



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		N/A	SERIALS
F-QB5	18						OBSOLETE (NEVER USED)
F-QB4	18						OBSOLETE (NEVER USED)
F-QB3	18			S-1493-1	S-1367-1-10	1200711	3
F-QB1	18		7	S-1367-1-8	S-1493-1	1200711	3
F-QB3	18			S-1367-1-6	S-1367-1-10	1200711	2
F-QB2	18		60	S-1367-1-6	S-1367-1-10	1200687	INACTIVE (SR4661) & ON
F-QB1	18		7	S-1367-1-8	S-1367-1-6	1200711	2

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
4	S-1845-2-2	SWITCH	
3	S-1360-10	CIRCUIT BREAKER	
2	S-1158-1-1	SWITCH	
1	AN4078-1	OIL DIL VALVE	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	9-12-62
GROUP	[illegible]	10-12-62
CHECK	R. Stuck	10-5-62
PROJ	N. McCarter	10-12-62

TITLE: WIRING DIAGRAM — OIL DILUTION SYSTEM (OPT)

Cessna.

DWG NO: 1270405

SUPERSEDED BY: SUPERSEDES: MODEL: 210 & T210 REV: E PAGE: 7.2

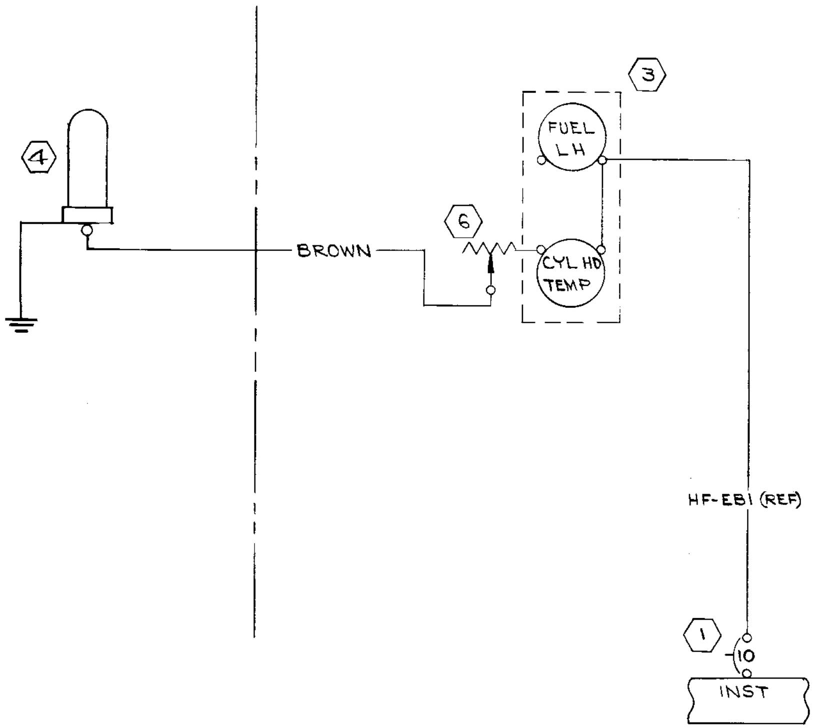
FORM NO. 80-161

SERZ1058086

NOTES:

1. PART NO. 110691 (PRSO) COLOR: BROWN
2. AT GIVEN SERIALS, MODEL 210 TEMP BULB MOVES FROM NO. 1 CYL TO NO. 2 CYL.

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADDED NOTE 1. MATL WAS PER MIL-W-5086A, TYPE I 1213505-2 WAS 0713602-1 S-1360-10 WAS S-1232-10 S-1372-1 WAS 0750603-1 1270461-1 WAS 1270429-1 INST WAS INST LIGHTS 1270405-EB1 WAS 0700603-EB1 (SR4039)	HLW 8-16-63	RRS HMC
B	1 WAS MATL PER MIL-W-16878D TYPE "E" 200°C GRADE EXTRUDED TEFLON DILECTRIC. REMOVED 1 FROM H-EC1; INACTIVATED H-EC1 & ADDED BROWN WIRE; ADDED WIRE LENGTHS & 2; REMOVED 1270461-1 BUS BAR & 1270405-EB1 FROM E/T; C669502-0104 WAS 1213505-2 (SR4955)	WJR 7-6-64	RRS TM HJW



BROWN	18	1		S-1367-1-8	S-1367-1-4	NO.2 CYL	2	SERZ1058511 & ON
BROWN	18	1	93	S-1367-1-8	S-1367-1-4	NO.1 CYL	2	21058231 THRU SERZ1058510
F-EC1	18		93	S-1367-1-8	S-1367-1-4			INACTIVE 21058231 & ON
WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS				SERIALS

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
6	0713602-4	POTENTIOMETER	
5			
4	S-1372-1	BULB, CYL HD TEMP	
3	C669502-0104	INST CLUSTER KIT	
2			
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	H. WISE	8-27-62
GROUP	C.V. Mackin	9-10-62
CHECK	R. Stuck	9-5-62
PROJ		

TITLE: WIRING DIAGRAM — CYLINDER HEAD TEMPERATURE

Cessna.

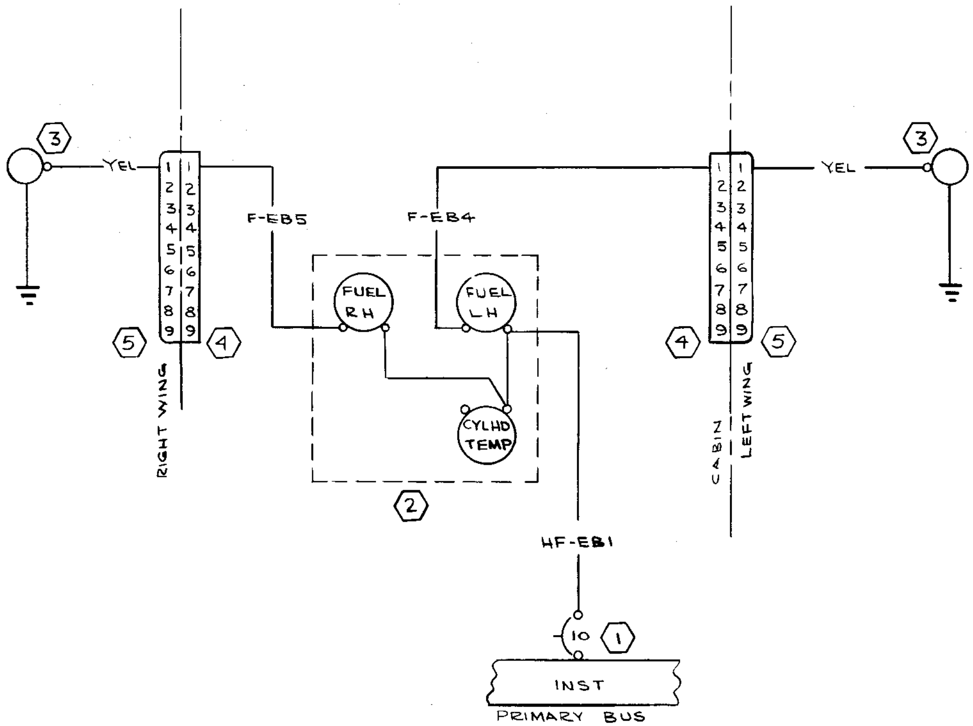
DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: | MODEL: 210 | REV: B | PAGE: 8.1

FORM NO. 80-161

SER Z1058819 & T210-0198

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REVISION: ITEMS 4 & 5 WERE REVERSED. S-1636 & S-1635 CHGD TO AGREE WITH ITEMS 4 & 5. (SR4886)(SR4887)	GLW 5-7-66	YAK



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
YEL	18	S-1460-18-4		S-1636-2	S-1367-1-10		
YEL	18	S-1460-18-4		S-1636-2	S-1367-1-10		
HF-EB1	18		50	S-1367-1-6	S-1367-1-8		
F-EB5	18			S-1367-1-10	S-1635-2		
F-EB4	18			S-1367-1-10	S-1635-2		

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
5	S-1641-9	HOUSING-SOCKET	
4	S-1640-9	HOUSING - PIN	
3	0726110-1	XMTR, FUEL LEVEL	
2	C669502-0104	INST CLUSTER KIT	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	J. HUSTON	2-1-66
GROUP	H. Wise	2-17-66
CHECK	R. Stuck	2-18-66
PROJ	H. McCarter	2-24-66

TITLE: WIRING DIAGRAM— FUEL QUANTITY INDICATOR

Cessna®

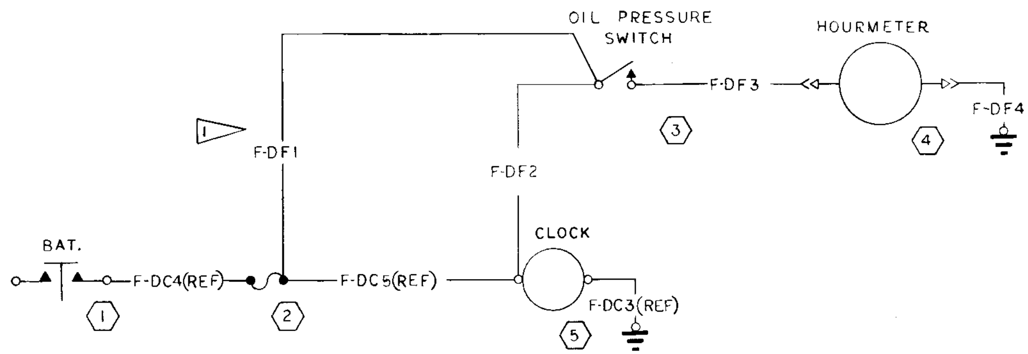
DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 8.2 | MODEL: 210 & T210 | REV: A | PAGE: 8.2.1

FORM NO. 80-161A

SER T210-0304 & ON
SER 21058936 & ON

CHG LET	REVISION	BY / DATE	CHK / APPD



NOTE:
1 WIRING DIAGRAM SHOWN IS FOR USE WHEN AN OPTIONAL ELECTRIC CLOCK IS INSTALLED. WHEN ELECTRIC CLOCK IS NOT INSTALLED WIRE F-DF1 CONNECTS PRESSURE SWITCH TO FUSEHOLDER. INSTALL S-1091-1 FUSE AND S-1690-22 FUSEHOLDER.

WIRE TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-DF4	18			S-1493-1	S-1367-1-8		
F-DF3	18			S-1493-1	S-1367-1-6		
F-DF2	18			S-1367-1-6	S-1367-1-6		
F-DF1	18			S-1367-1-6	SOLDER		

EQUIPMENT TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
5	S-1317N1	CLOCK	
4	C664501-0101	HOURMETER	
3	S-1711-1	OIL PRESSURE SW.	
2	S-1091-1	FUSE	
1	S-1579-1	BAT. CONTACTOR	

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	Wedel	9-23-66
GROUP	H. West	9-27-66
CHECK	R. Stuck	9-28-66
PROJ	Wm Carter	9-29-66

TITLE: WIRING DIAGRAM— HOURMETER (OPT)

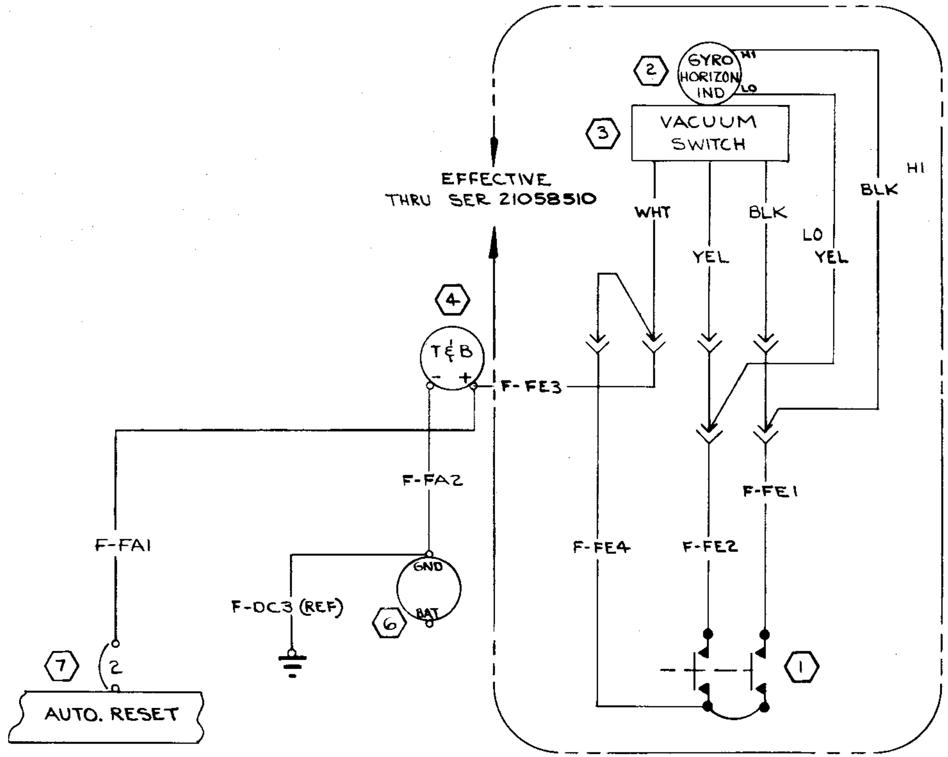
Cessna®

DWG NO: 1270405

SUPERSEDED BY: SUPERSEDES: MODEL: 210, T210 REV: PAGE: 8.3

FORM NO. 80-161

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADDED LIMITING SERIALS TO FIELD & INACTIVATED WIRES F-FE1 THRU F-FE4; REMOVED F-DB1 & 1270429-1 FROM E/T; ADDED WIRE LENGTHS TO W/T; F-FA2 WAS GROUNDED TO AIR FRAME; ADDED CLOCK TO E/T & FIELD (SR 4455)	WJR 7-14-64	RRS
B	REMOVED S-1318-1 INDICATOR & F-DB1 (REF). ADD MODEL T210	GLW 5-6-66	



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-FE4	20		6	S-341-2	SOLDER	0713705	(OPT) Inactive SER 21058511 ON
F-FE3	20		8	S-341-2	S-1367-1-8	0713705	(OPT) Inactive
F-FE2	20		6	S-341-2	SOLDER	0713705	(OPT) Inactive
F-FE1	20		6	S-341-2	SOLDER	0713705	(OPT) Inactive SER 21058511 ON
F-FA2	18		16	S-1367-1-8	S-1367-1-8		
F-FA1	18		12	S-1367-1-8	S-1367-1-10		

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
8			
7	CA-2	CKT BKR (MTCC)	
6	S-1317N1	CLOCK	
5			
4	S-1302N1	INDICATOR, T&B	
3	S-1365-1	SWITCH, VACUUM	
2	S-1326N1	IND, GYRO HORIZON	
1	S-1284-1	SWITCH	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO COMMERCIAL AIRCRAFT DIVISION, WICHITA KANSAS

	NAME	DATE
DRAWN	RIDDER	9-14-62
GROUP		10-29-62
CHECK	R. Stuck	10-26-62
PROJ	H. McCarter	11-2-62

TITLE: WIRING DIAGRAM — TURN & BANK AND GYRO HORIZON INDICATOR

Cessna.

DWG NO: 1270405

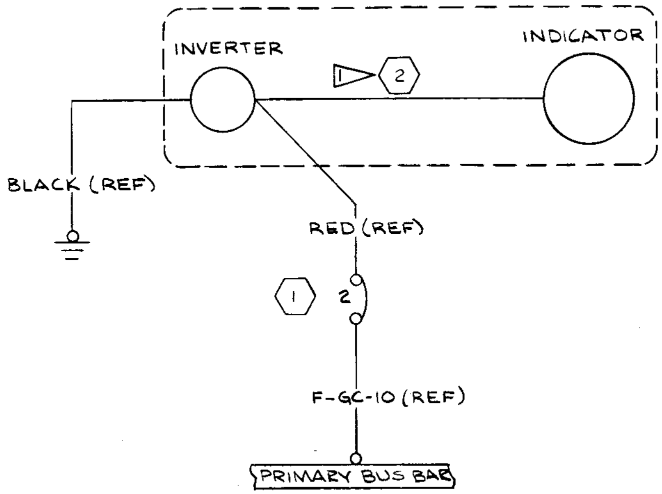
SUPERSEDED BY: | SUPERSEDES: | MODEL: 210 & T210 | REV: B | PAGE: 9.1

FORM NO. 8

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

NOTES:

1. TURN COORDINATOR INDICATOR INCLUDES ALL WIRES AND CABLES BETWEEN INVERTER, INDICATOR AND CIRCUIT BREAKER.



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION
2	C661003-0401	TURN COORDINATOR
1	CA-2	CKT BKR (73803)

EQUIPMENT TABLE

CONTRACT NO:

	NAME	DATE
DESIGN		
GROUP	H. Wise	5-25-67
DRAWN	HARRIS	5/22/67
CHECK	YAKSHAW	5-23-67
STRESS	[illegible]	5-25-67
PROJECT	N. McCarter	5-26-67
APPD	[illegible]	5-24-67

Cessna AIRCRAFT CO. COMMERCIAL AIRCRAFT DIV. 5800 E. PAWNEE WICHITA, KANSAS

TITLE
WIRING DIAGRAM — BRITTAIN WING LEVELER (OPT)

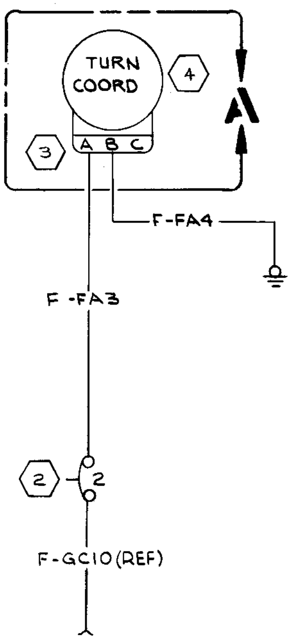
SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

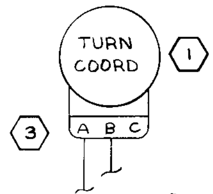
SCALE: NONE PAGE: 9.2

FORM NO. 80-215

SER 21058937 IX

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: ADDED DETAIL A *ITEM 4. ED&RR 02376 (SR 5403) (SR5404) IX	LES 6-12-68	GKI MDS RFG HFW DGK





DETAIL A
EFF THRU SER 21059061 & SER T210-0393

F-FA4	18			S-1367-1-14	SOLDER		
F-FA3	18			S-1367-1-8	SOLDER		
WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	
4	C661003-0501	TURN COORDINATOR	
3	MS3106A10SL3S	CONNECTOR	
2	CA-2	CIRCUIT BREAKER	(80602)
1	C661003-0201	TURN COORDINATOR	

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES:

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	COOK	9-13-67
GROUP	H Wise	9-13-67
DRAWN	Harris	9-8-67
CHECK	LAURIE	9-9-67
STRESS	[illegible]	9-11-67
PROJECT	H. McCarter	9-14-67
APPD	R.E. Moore	9-9-67

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — TURN COORDINATOR

SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

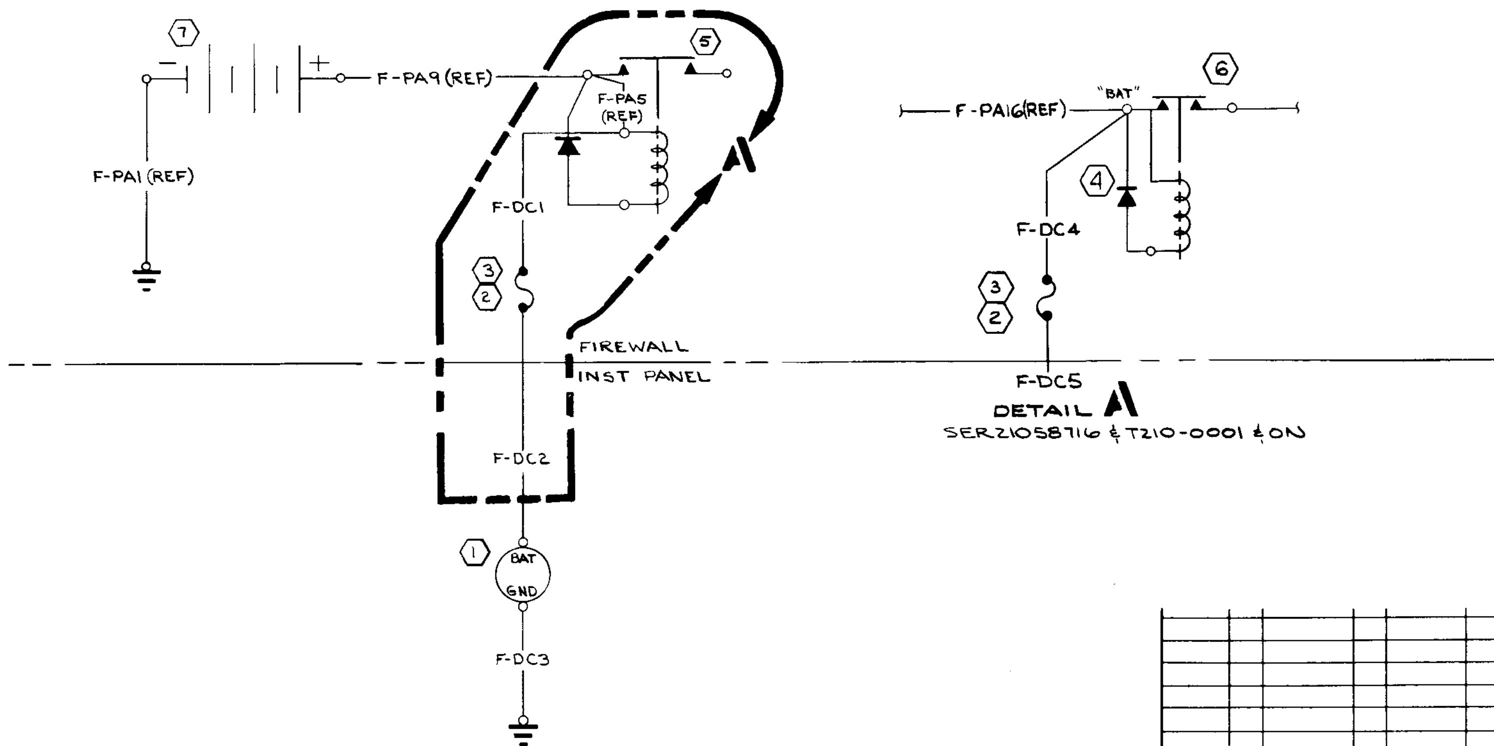
SCALE: NONE | 210 & T210 | PAGE: 9.3

FORM NO. 80-215A

SER 21058937 & ON,
SER T210-0308 & ON

SER21058112

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADDED WIRE LENGTHS TO W/T; REMOVED F-PA1, F-PA5 & F-PA9 FROM E/T	WJR 7-16-64	RRS / TM / HEW
B	BY REV: ADDED DETAIL A, F-DC4, & ITEM 6; INACTIVATED F-DC1 (SR4661)	LPB 1-4-65	RRS / TM / HEW
C	ADDED F-DC5; INACTIVATED F-DC2; ADDED T-210 TO MODEL BLOCK (SR4637) (SR4661)	WJR 4-29-65	RRS / ALA / TM / HEW



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-DC5	18			S-1367-1-6	SOLDER		SER21058716 & T210-0001 & ON
F-DC4	18		8	S-1367-1-13	SOLDER		SER21058716 & T210-0001 & ON
F-DC3	18		11	S-1367-1-6	S-1367-1-8		
F-DC2	18		120	S-1367-1-6	SOLDER		EFF THRU SER21058715
F-DC1	18		8	S-1367-1-6	SOLDER		EFF THRU SER21058715

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
8			
7	0712605-1	BATTERY	
6	S-1579-1	CONTACTOR - BAT	
5	0712603-2	CONTACTOR BAT	
4	0770728-1	DIODE ASSY	
3	S-1091-1	FUSE	
2	S-1090-22	FUSEHOLDER	
1	S-1317N1	CLOCK ASSY	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO COMMERCIAL AIRCRAFT DIVISION WICHITA KANSAS

	NAME	DATE
DRAWN	RIDDER	10-8-62
GROUP	TM	10-12-62
CHECK	R. Stuck	10-11-62
PROJ	H. McCarter	10-12-62

TITLE: WIRING DIAGRAM — CLOCK

Cessna.

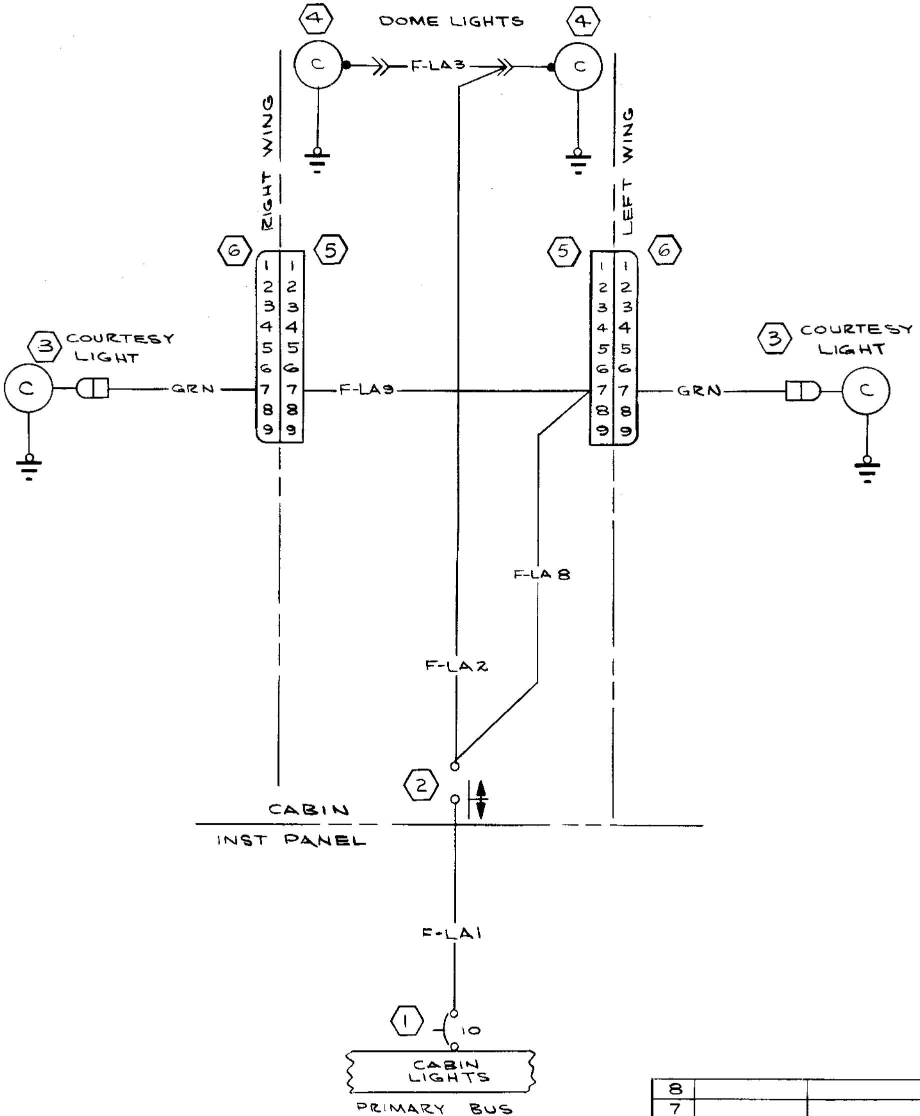
DWG NO: 1270405

SUPERSEDED BY: SUPERSEDES: MODEL: 210 & T210 REV: C PAGE: 10.1

FORM NO. 80-161

SER 21058819 & T210-0198

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REVISION: INTERCHANGED ITEMS 5 & 6. S-1636-2 WAS S-1635-2 & VICE VERSA IN W/T. (SR1886) (SR4887) -9	GLW 5-10-66	YAK



NOTES:

1. COURTESY LIGHTS ARE OPTIONAL, WING WIRING IS STANDARD.

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
8			
7			
6	S-1641-9	HOUSING-SOCKET	
5	S-1640-9	HOUSING-PIN	
4	181522	LIGHT ASSY (UCTE)	
3	0700615-5	LIGHT ASSY	
2	0713029	SWITCH	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
GRN	18	S-1460-18-5		S-1636-2	S-1637-2 S-1636-2		
GRN	18	S-1460-18-5		S-1636-2	S-1637-2 S-1636-2		
F-LA 9	18			S-1635-2	S-1635-2		
F-LA 8	18			S-1367-1-6	SEE F-LA9		
F-LA 3	18		43	S-341-2	S-341-2		
F-LA 2	18		36	S-1367-1-6	SEE F-LA3		
F-LA 1	18		114	S-1367-1-6	S-1367-1-6		

WIRE TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	J. HUSTON	2-16-66
GROUP	H. Wise	2-18-66
CHECK	R. Fluck	2-18-66
PROJ	H. McCarty	2-24-66

TITLE: WIRING DIAGRAM— DOME & COURTESY LIGHTS

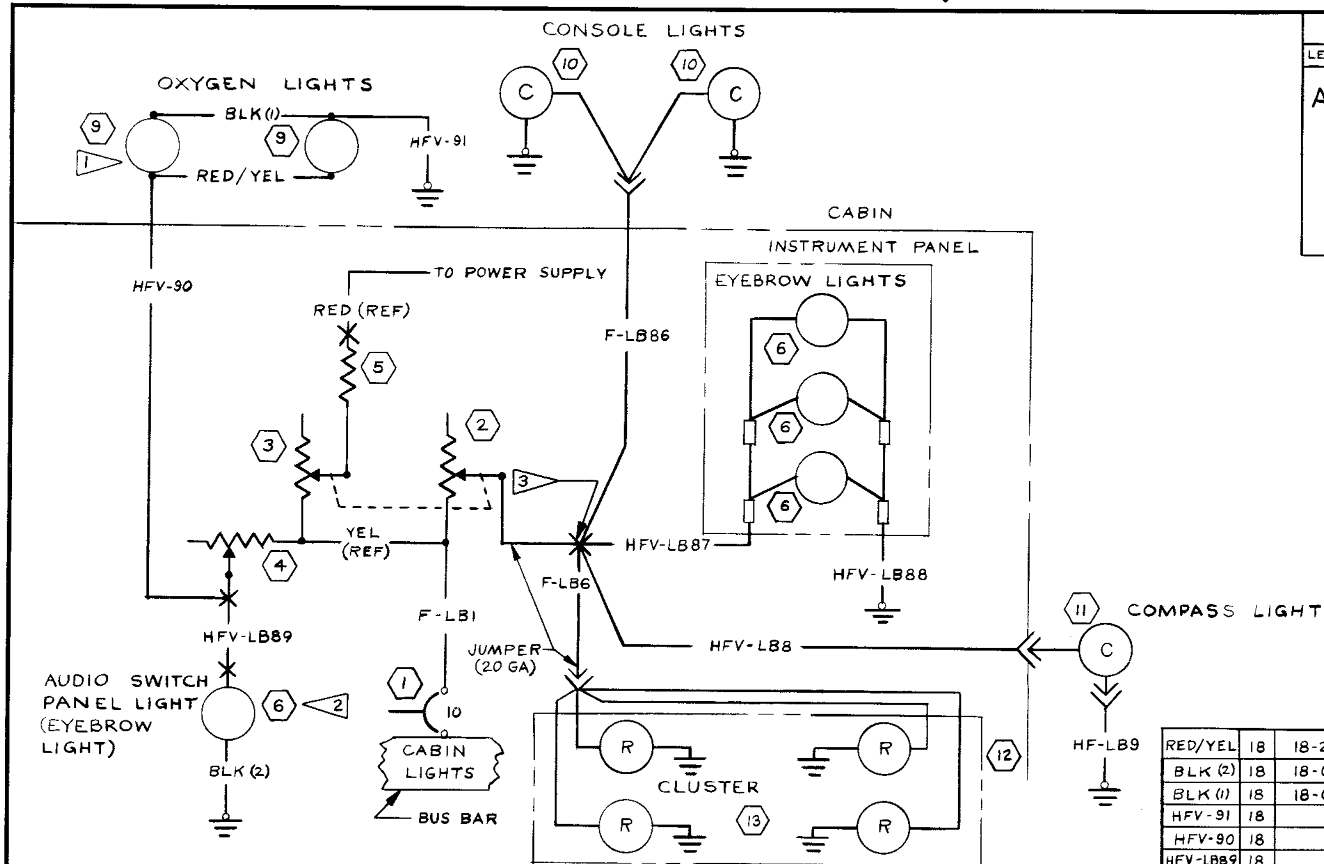
Cessna®

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 11.1 | MODEL: 210 T210 | REV: A | PAGE: 11.1.1

FORM NO. 80-161A

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: DELETE S-1894-3 & S-1902-1; ADD 1270479-1 ; HFV-LB8 WAS HDFV-LB8; HFV-LB87 WAS HDFV-LB87; HFV-LB88 WAS HDFV-LB88; HFV-LB89 WAS HDFV-89; HFV-90 WAS HDFV-90; HFV-91 WAS HDFV-91 EDRR 10161 & 10169 (SR 5403)(SR 5404) IX	10-17-68 DGP	JWH MDS RFG AKM



NOTES:

1. OXYGEN LIGHTS ARE STANDARD ON T210, OPT ON 210
2. STANDARD LENSES FOR EYEBROW LIGHTS ARE RED, CESSNA WHITE IS OPTIONAL
3. CC2 STAK-ON TERMINAL (59730)
4. PERMANENT SPLICE

ITEM NO.	PART NO.	DESCRIPTION	
13	1270479-1	LIGHT ASSY	
12	C669502-0202	INST CLUSTER KIT	
11	C660501-0101	COMPASS ASSY	
10	1211012	CONSOLE ASSY	
9	S-1899-1	POST LIGHT ASSY	
8			
7			
6	23-288	LIGHT ASSY	95263
5	VAL-3	6.8 OHM RESISTOR	94310
4	S-1880-2	RHEOSTAT	
3	S-1880-1	RHEOSTAT	
2	S-1880-4	RHEOSTAT	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		SERIALS
RED/YEL	18	18-2-4		SOLDER	SOLDER	
BLK (2)	18	18-0		SOLDER	S-1367-1-8	
BLK (1)	18	18-0		SOLDER	SOLDER	
HFV-91	18			SOLDER	S-1367-1-8	
HFV-90	18			4	SOLDER	
HFV-LB89	18			4	4	
HFV-LB88	18			S-1370-1	S-1367-1-8	
HFV-LB87	18			3	S-1370-1	
HFV-LB8	18			3	S-341-2	
F-LB86	18			S-341-2	3	
F-LB9	18			S-341-2	S-1367-1-8	
F-LB6	20			3	S-341-2	
F-LB1	18			S-1367-1-8	SOLDER	

WIRE TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: P 11.2
SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G WOOD	8-1-68
GROUP	H. Wise	8-1-68
DRAWN	RB IRWIN	7-26-68
CHECK	G. IRVIN	7-31-68
STRESS		
PROJECT	[illegible]	8-2-68
APPD	MDS	7-31-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — INSTRUMENT LIGHTS

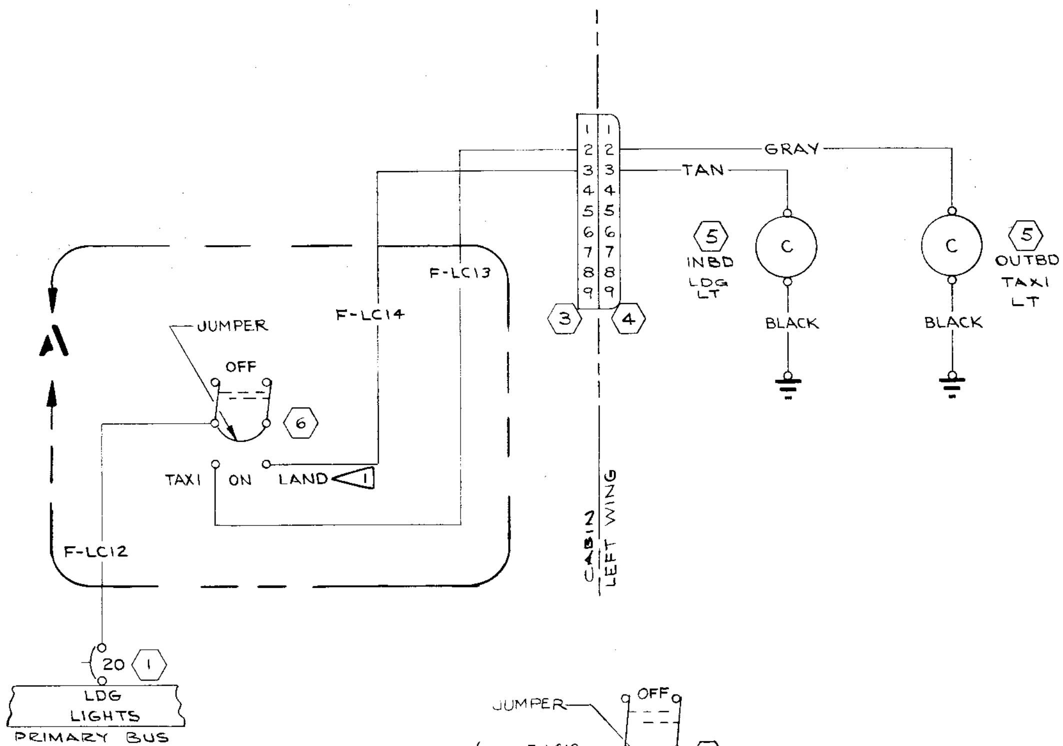
SIZE C | CODE IDENT. NO. 71379 | DWG NO. 1270405
SCALE: NONE | 210, T210 | PAGE: 11.2.1

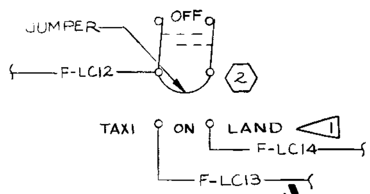
FORM NO. 80-215A

ED RR 03409 SER 21059062 & SER T210-0393 IX

SER 21058819
SER T210-0198

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REV: ADD DETAIL A & EFF SER, F-LC15, F-LC16, F-LC17 & S-1846-1-1; INACTIVATE F-LC12, F-LC13, F-LC14 & S-1160-1-1 ED & RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS RFI HW AKM
B	BY REV: ADD NOTES 2 & 3; OBSOLETE (NEVER USED) F-LC15, F-LC16, & F-LC17; SER IN F-LC12, F-LC13, & F-LC14, CHANGED TERMINALS TO AGREE ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	GKI MDS RFC WHH AKM





DETAIL A
EFF THRU SER 21059061 & SER T210-0392

NOTES:

1. SWITCH IS MECHANICALLY INTERCONNECTED SO THAT DEPRESSING "LAND" PORTION OF SWITCH TO "ON" POSITION ALSO CARRIES "TAXI" PORTION OF SWITCH TO "ON" POSITION.
2. EFF THRU SER 21059061 & SER T210-0392
3. EFF SER 21059062

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
8			
7			
6	S-1846-1-1	SWITCH-MASTER	
5	0523118-1	LANDING LIGHT	
4	S-1640-9	HOUSING-PIN	
3	S-1641-9	HOUSING-SOCKET	
2	S-1160-1-1	SWITCH	
1	S-1360-20	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			IN	SERIALS
F-LC17	14							OBSOLETE (NEVER USED)
F-LC16	14							OBSOLETE (NEVER USED)
F-LC15	14							OBSOLETE (NEVER USED)
F-LC14	14			S-1493-2	S-1636-2	3		
F-LC13	14			S-1493-2	S-1636-2	3		
F-LC12	14			~~S-1367-2-6~~	S-1493-2	3		
BLACK	16	S-1460-16-0		S-1367-2-8	S-1367-2-8			
TAN	14	S-1460-14-10		S-1635-2	S-1367-2-8			
BLACK	16	S-1460-16-0		S-1367-2-8	S-1367-2-8			
GRAY	14	S-1460-14-8		S-1635-2	S-1367-2-8			
F-LC14	14			S-1367-2-6	S-1636-2	2		
F-LC13	14			S-1367-2-6	S-1636-2	2		
F-LC12	14			S-1367-2-6	S-1367-2-6	2		

WIRE TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	1-4-66
GROUP	H. Wied	2-17-66
CHECK	R. Stuck	2-18-66
PROJ	N. McCarty	2-24-66

TITLE: WIRING DIAGRAM—LANDING LIGHTS

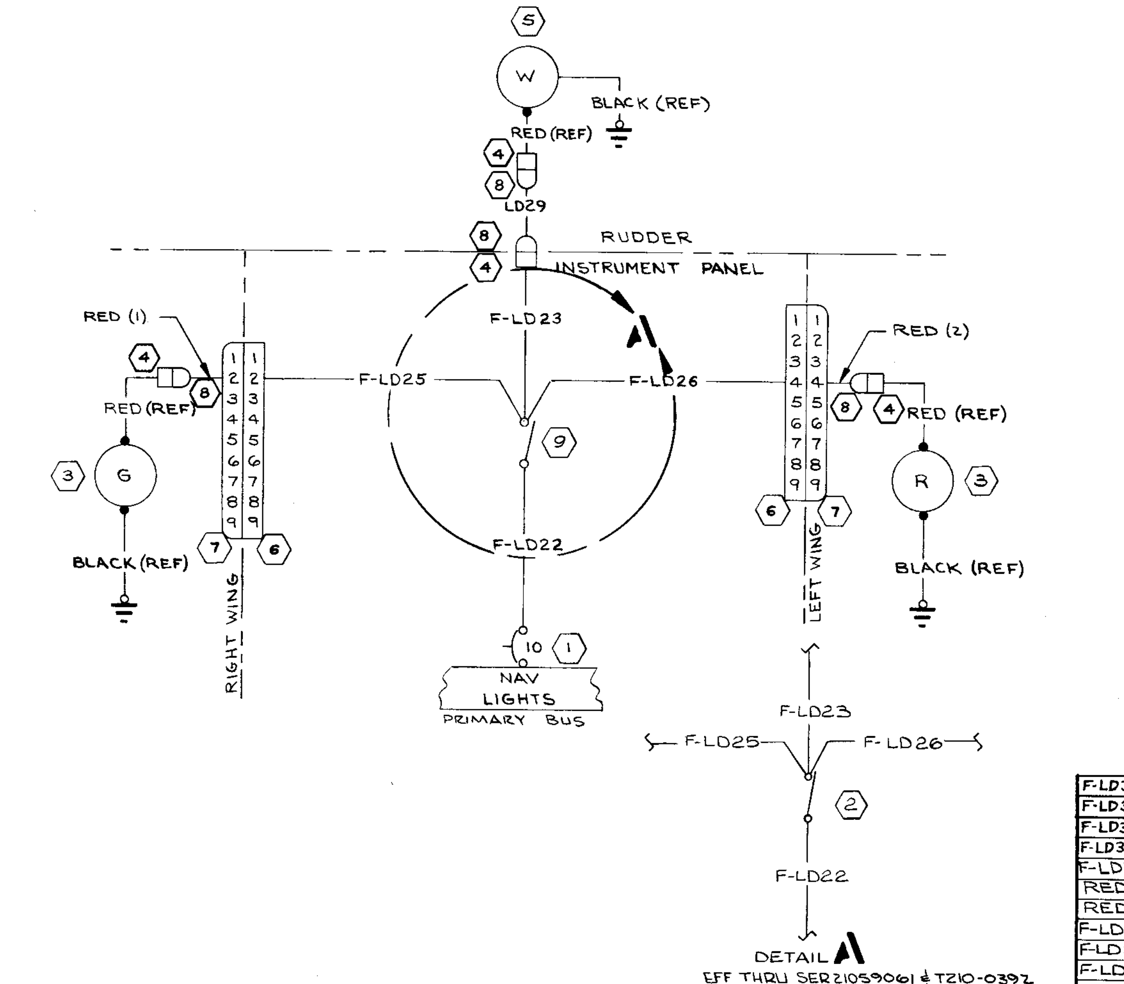
Cessna

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 11.3 | MODEL: 210 & T210 | REV: B | PAGE: 11.3.1

FORM NO 80-161A

SER 21058819 & ON,
SER T210-0198 & ON



CHG LET	REVISION	BY DATE	CHK APPD
A	BY REV: C622001-0202 WAS 122112-1 E-2, C622001-0102 WAS 0433006-7, ITEM 3 WAS ITEM 4 & F-LD29 WAS F-LD24; ADD F-LD27, F-LD28 S-1637-1, S-1637-2; DELETE 3 RED & 3 BLACK WIRES ED&RR 01163 ED&RR 01335	RCC 1-6-67	RLL JB HW
B	BY REV: RED WIRE WAS LD27 & RED WIRE WAS LD28 ED & RR 01999	RLY 4-2-68	GKI MDS DRB HW
C	BY REV: ADD DETAIL A, F-LD30, F-LD31, F-LD32, F-LD33, S-1845-1-1 & EFF SER; INACTIVATE F-LD22, F-LD23, F-LD25, F-LD26 & S-11582-1 ED& RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS DRB HW AKM
D	BY REV: ADD NOTES 3 & 4; OBSOLETE (NEVER USED) F-LD30, F-LD31, F-LD32, & F-LD33; SER IN F-LD22, F-LD23, F-LD25, & F-LD26, CHANGED TERMINALS TO AGREE; ITEMS 8 WAS 4, 4 WAS 8 (3 PLACES) IN FLD, ITEMS 6 WAS 7, 7 WAS 6 (2 PLACES) IN FLD OF DWG; DELETE NOTES 1 & 2. ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	GKI MDS RFG WHH MS GKM

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-LD33	18						OBSOLETE (NEVER USED)
F-LD32	18						OBSOLETE (NEVER USED)
F-LD31	18						OBSOLETE (NEVER USED)
F-LD30	18						OBSOLETE (NEVER USED)
F-LD29	18			S-1636-1	S-1636-1		
RED(2)	18	-18-2		S-1636-2	S-1636-1		
RED(1)	18	-18-2		S-1636-2	S-1636-1		
F-LD22	18			S-1367-1-6	S-1493-1	4	
F-LD23	18			S-1493-1	S-1635-2	4	
F-LD25	18			S-1493-1	S-1635-2	4	
F-LD26	18			S-1493-1	S-1635-2	4	
F-LD26	18			S-1367-1-6	S-1635-2	3	
F-LD25	18			S-1367-1-6	S-1635-2	3	
F-LD24	18			S-1636-2	SOLDER		THRU SER 21058974 & T210-0344
F-LD23	18			S-1367-1-6	S-1635-2	3	
F-LD22	18			S-1367-1-6	S-1367-1-6	3	

WIRE TABLE

NOTES:

1. ~~S-1636-2 SOCKET & S-1637-2 HOUSING-PLUG.~~
2. ~~S-1635-2 PIN & S-1637-1 HOUSING-CAP.~~
3. EFF THRU SER 21059061 & T210-0392
4. EFF SER 21059062 & T210-0393

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
9	S-1845-1-1	SWITCH	
8	S-1637-2	HOUSING-SOCKET	
7	S-1641-9	HOUSING-SOCKET	
6	S-1640-9	HOUSING-PIN	
5	C622001-0102	POSITION LIGHT	
4	S-1637-1	HOUSING-PIN	
3	C622001-0202	WING LIGHT ASSY	
2	S-1158-2-1	SWITCH	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	1-5-66
GROUP	H. Wiese	2-17-66
CHECK	R. Stuck	2-18-66
PROJ	H. McCarter	2-24-66

TITLE: WIRING DIAGRAM—NAVIGATION LIGHTS

Cessna

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 11.4 | MODEL: 210 & T210 | REV: D | PAGE: 11.4.1

FORM NO. 80-161A

SER 21058819 & T210-0198

NOTES:

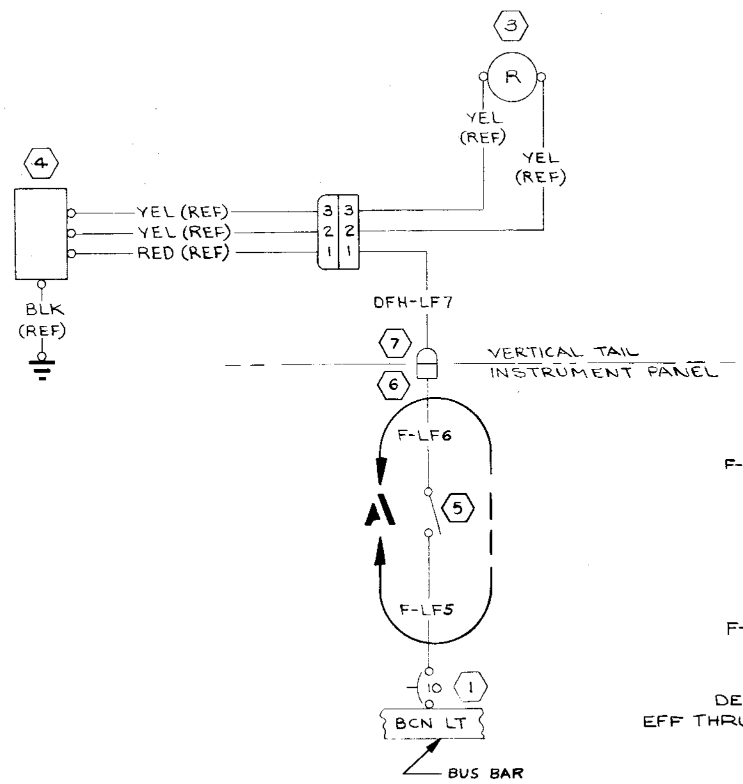
~~1 S-1636-2 SOCKET & S-1637-2 HOUSING-PLUG.~~

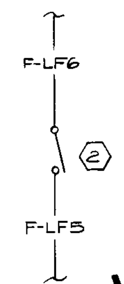
~~2 S-1635-2 PIN & S-1637-1 HOUSING-CAP.~~

3 EFF THRU SER 21059061 & T210-0392

4 EFF SER 21059062 & T210-0393 & ON

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REV: ADD DETAIL A & EFF SER, F-LF8, F-LF9 & S-1845-1-1; INACTIVATE F-LF5, F-LF6 & S-1158-2-1. ED & RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS BRG HJW ... AKM ...
B	BY REV: ADD NOTES 3 & 4; OBSOLETE (NEVER USED) F-LF8 & F-LF9; SER IN F-LF5 & F-LF6; CHANGED TERMINALS TO AGREE; DELETED NOTES 1 & 2. ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	GKI MDS RFG WHH ... AKM ...





DETAIL A
EFF THRU SER 21059062 & T210-0393

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		N/A	SERIALS
F-LF9	16						OBSOLETE (NEVER USED)
F-LF8	16						OBSOLETE (NEVER USED)
F-LF6	16			S-1493-2	S-1635-2		4
F-LF5	16			~~S-1367-2-6~~	S-1493-2		4
DFH-LF7	16			S-1636-2	S-1635-2		(STD)
F-LF6	16			S-1367-2-8	S-1635-2		(STD) 3
F-LF5	16			S-1367-2-6	S-1367-2-8	0700169	3

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
7	S-1637-2	HOUSING - PLUG	
6	S-1637-1	HOUSING - CAP	
5	S-1845-1-1	SWITCH-MASTER	
4	C59450-0101	FLASHER UNIT	
3	C621001-0101	LIGHT ASSY	
2	S-1158-2-1	SWITCH	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	12-21-65
GROUP	H Wise	1-24-66
CHECK	R. Sluck	1-25-66
PROJ	H. McCarter	1-27-66

TITLE: WIRING DIAGRAM— FLASHING BEACON LIGHT (OPT)

Cessna®

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 11.5 | MODEL: 210 & T210 | REV: B | PAGE: 11.5.1

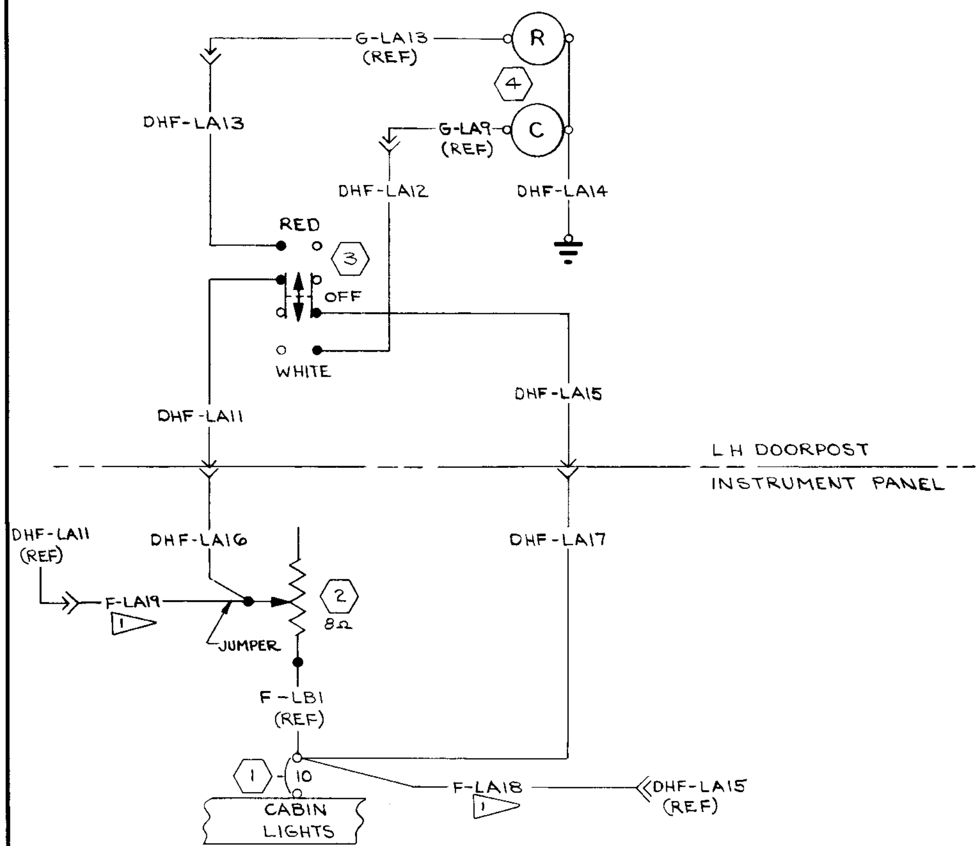
FORM NO. 80-161A

SER. 21058511

NOTES:

1. WIRES F-LA18 & F-LA19 REQUIRED FOR RH MAP LIGHT INSTL. RH INSTL IS OPTIONAL (INSTALLED WITH OPT POST LIGHTS).

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADD T210 TO MODEL. REMOVED OPT FROM TITLE. ADD OPT TO F-LA19 & F-LA18 WIRES IN NOTE 1, REMOVE 18-1 INSULATOR (GRAY) (SR9886) (SR9887)-9	GLW 5-14-66	YAK KM HJW
B	ITEM 2 XR6637 WAS R12½-8-RS34 (SR5160) & (SR5161) & ON	VRS 6/27/67	YAK HJW



	WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		N/A	SERIALS
1	F-LA19	18			SOLDER	S-341-2	1200736	(OPT)
1	F-LA18	18			S-1367-1-6	S-341-2		(OPT)
	DHF-LA17	18			S-1367-1-6	S-341-2		
	DHF-LA16	18			SOLDER	S-341-2		
	DHF-LA15	18			SOLDER	S-341-2		
	DHF-LA14	18			S-1367-1-8	S-1367-1-10		
	DHF-LA13	18			SOLDER	S-341-2		
	DHF-LA12	18			SOLDER	S-341-2		
	DHF-LA11	18			SOLDER	S-341-2	1200736	

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
5			
4	1470089-14	LIGHT ASSY	
3	S-1501-1	SWITCH	
2	XR6637	RHEOSTAT	(83777)
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	8-13-64
GROUP	Ed Mader	8-31-64
CHECK	R. Stuck	8-24-64
PROJ	H. Wise	9-1-64

TITLE: WIRING DIAGRAM — MAP LIGHT

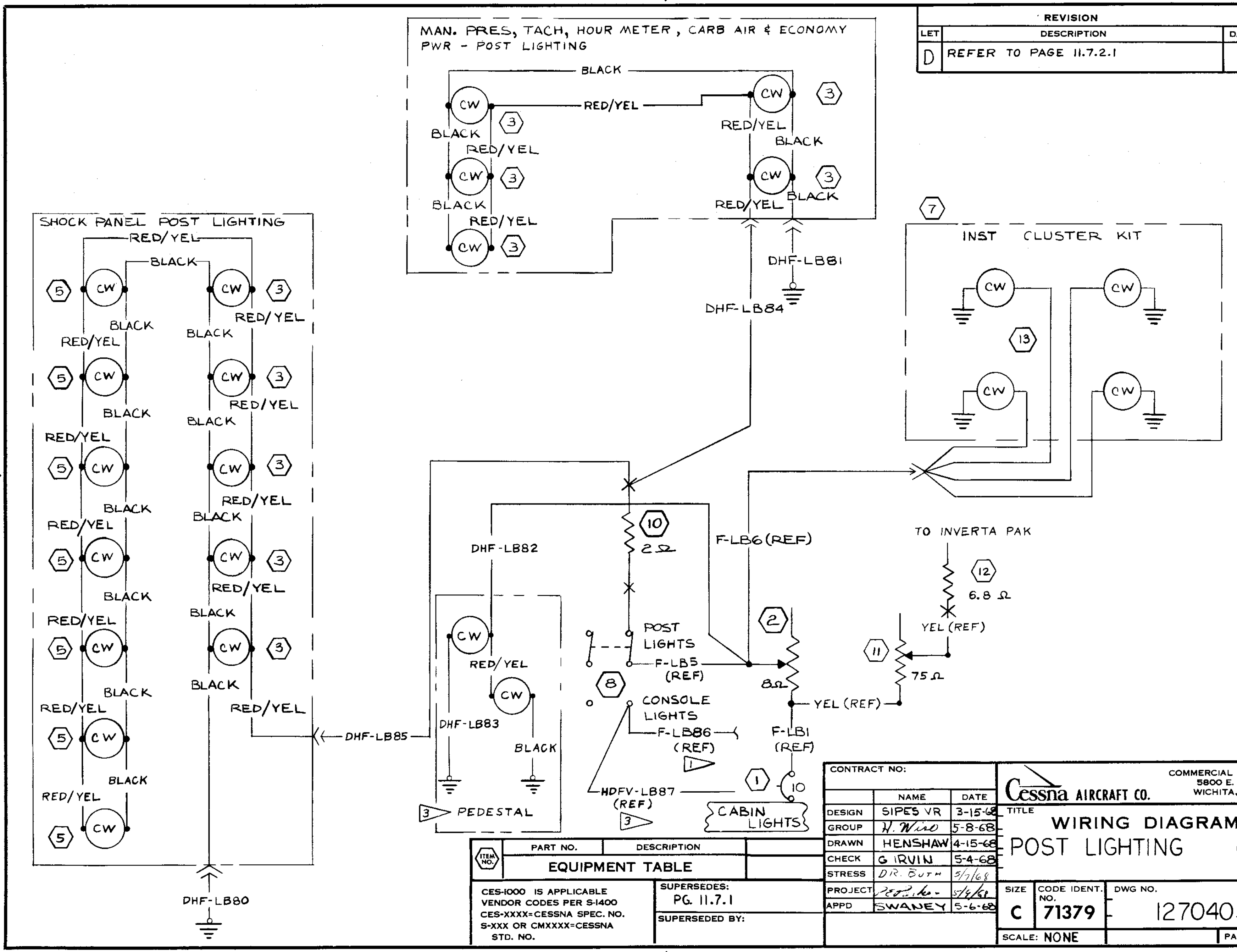
Cessna

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 11.6 | MODEL: 210, T210 | REV: B | PAGE: 11.6.1

FORM NO. 80-161

REVISION			
LET	DESCRIPTION	DATE	APPD
D	REFER TO PAGE 11.7.2.1		



ITEM NO.	PART NO.	DESCRIPTION
	EQUIPMENT TABLE	

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: PG. 11.7.1

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	SIPES VR	3-15-68
GROUP	H. Wise	5-8-68
DRAWN	HENSHAW	4-15-68
CHECK	G IRVIN	5-4-68
STRESS	D.R. Buth	5/7/68
PROJECT	[illegible]	5/4/68
APPD	SWANEY	5-6-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — POST LIGHTING (OPT)

SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: NONE PAGE: 11.7.2.0

FORM NO. 80-215A

NOTES:

1. WITH POST & BACK LIGHTING, WIRE F-LB86 IS CONNECTED TO CONSOLESIDE OF S-1847-1-1 SWITCH INSTEAD OF S-1880-4 RHEOSTAT. PART OF F-LB83 IS USED AS A JUMPER
2. JUMPERS ARE 20 GAGE WIRE
3. STANDARD EQUIPMENT

REVISION

LET	DESCRIPTION	DATE	APPD
C	BY REV: S-1847-2-1 WAS S-1847-1-1 ED&RR 10090 (SR5403)&(SR5404) IX	JWH 9/27/68	RCA MDS RFG HRW AKM
D	BY REV: DELETE 1813/2 LWI, S-1894-1 & S-1902-1; ADD 1270479-2 EDRR 10169 (SR5707) IX	DGP 10-21-68	JWH MDS RFG AKM HRW Nmc

REVISION

LET	DESCRIPTION	DATE	APPD
A	BY REV: REVISED & REDRAWN; F-LB83 WAS F-LB5; S-1847-1-1 WAS S-1238-2-1 ED&RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS RRO AKM HRW
B	BY REV: ADD S-1899-1 (1), VAL-3, S-1880-1, YEL(REF), HDFV-LB87(REF), RED/YEL WIRE, BLACK WIRE & NOTE 3; DELETE S-1899-2 (1); F-LB86(REF) WAS F-LB83(REF), S-1880-4 WAS XR6637, ONE TERMINAL OF DHF-LB82 WAS S-1370-0; REROUTE DHF-LB82; S-1899-1 WAS 5952-3RH-CW-14, S-1899-2 WAS 5952-3LH-CW-14, S-1902-1 WAS 25-240XP16, S-1894-1 WAS 336, C669502-0202 WAS C669502-0204 ED&RR 03409 (SR5403) IX (SR5404) IX	RBI 7-26-68	GKI MDS ALA HRW AKM JDP

WIRE TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		S-341-2	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	S-341-2		
RED/YEL	22	22-2-4		SOLDER	S-341-2		

WIRE TABLE

WIRE CODE NO	GA	MATERIAL	LG	TERMINALS			SERIALS
BLACK	22	22-0		SOLDER	S-1367-1-8		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
RED/YEL	22	22-2-4		SOLDER	SOLDER		
BLACK	22	22-0		SOLDER	SOLDER		
DHF-LB85	20	20-0		S-341-1	S-1370-0		
DHF-LB84	20	20-0		S-341-1	S-1370-0		
DHF-LB83	20	20-0		SOLDER	S-1367-1-8		
DHF-LB82	20	20-0		SOLDER	SOLDER		
DHF-LB81	20	20-0		S-341-1	S-1367-1-8		
DHF-LB80	20	20-0		S-341-1	S-1367-1-8		
BLACK	22	22-0		SOLDER	SOLDER		
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0					
BLACK	22	22-0		SOLDER	SOLDER		

EQUIPMENT TABLE

ITEM NO.	PART NO.	DESCRIPTION	VENDOR
13	1270479-2	LIGHT ASSY	
12	VAL-3	6.8 OHM RESISTOR	94310
11	S-1880-1	RHEOSTAT	
10	FRL-5-2	2 OHM RESISTOR	94310
9			
8	S-1847-2-1	SWITCH	
7	C669502-0202	INST CLUSTER	
6			
5	S-1899-1	POST LIGHT ASSY	
4			
3	S-1899-2	POST LIGHT ASSY	
2	S-1880-4	RHEOSTAT	
1	S-1360-10	CIRCUIT BREAKER	

CES-1000 IS APPLICABLE VENDOR CODES PER S-1400 CES-XXXX=CESSNA SPEC. NO. S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: 1270405 PAGE 11.7.1

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN		
GROUP	H. WISE	7-15-66
DRAWN	G. WOOD	5-14-66
CHECK	YAKSHAW	7-16-66
STRESS		
PROJECT	AKM/HMC	
APPD		

Cessna AIRCRAFT CO.

COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE

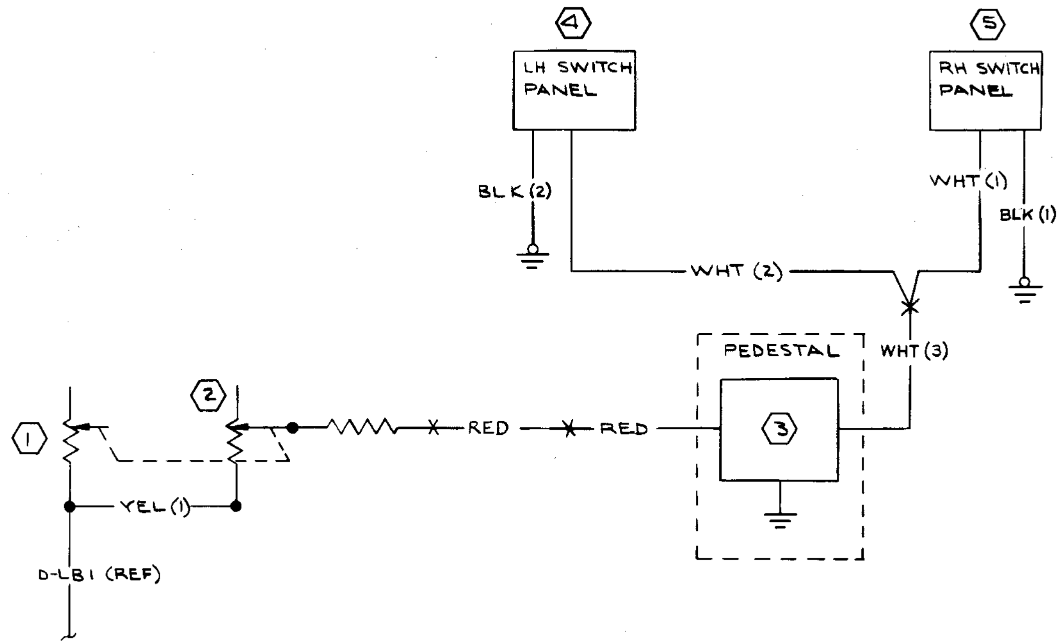
WIRING DIAGRAM — POST LIGHTING (OPT)

SIZE C | CODE IDENT. NO. 71379 | DWG NO. 1270405

SCALE: NONE | 210 | PAGE: 11.7.2.1

FORM NO. 80-215A

LET	REVISION DESCRIPTION	DATE	APPD



NOTES:

1. TO BE RETAINED IN TERMINAL WIRE MUST BE STRIPPED, DOUBLED & TWISTED
2. THESE WIRES ARE VENDOR FURNISHED.

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
WHT (2)	22	22-9		SEE WHT(3)		2	
WHT (1)	22	22-9		SEE WHT(3)		2	
BLK (2)	22	22-0		SOLDER	S-1367-1-8	1	2
BLK (1)	22	22-0			S-1367-1-8	1	2
WHT (3)	22	22-9			S-1370-0	2	
RED	18	18-2		S-1370-1	SOLDER		
YEL (1)	18	18-4		SOLDER	SOLDER		

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	
6	VAL-3	6.8Ω RESISTOR	(94310)
5	1213192-1	PANEL	
4	1213191-1	PANEL	
3	C613001-0201	POWER SUPPLY	
2	S-1880-1	RHEOSTAT	
1	S-1880-4	RHEOSTAT	

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: P11.9

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN		
GROUP	H. Wise	8-1-68
DRAWN	RB IRWIN	7-26-68
CHECK	G. IRVIN	7-31-68
STRESS	ASHER	8-1-68
PROJECT	[illegible]	8-2-68
APPD	MDS	7-31-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — ELECTRO LUMINESCENT PANEL

SIZE C | CODE IDENT. NO. 71379 | DWG NO. 1270405

SCALE: NONE | MODEL: 210, T210 | PAGE: 11.9.1

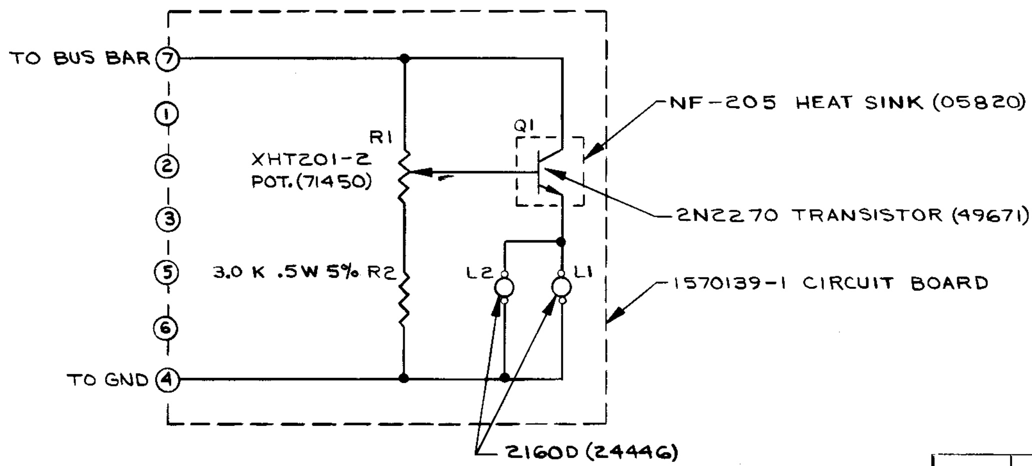
FORM NO. 80-218A

ED & RR 03409 SER 21059062 & T210-0393

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

NOTES:

1. ALL MATERIALS DEFINED ON THIS DRAWING ARE FOR REFERENCE AND TECHNICAL USE ONLY



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		SERIALS

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION

EQUIPMENT TABLE

CONTRACT NO:

	NAME	DATE
DESIGN	J WEDEL	7-28-67
GROUP	H. Wise	7-27-67
DRAWN	C. GARCIA	9-19-67
CHECK	R. STUCK	9-19-67
STRESS	aws	9-19-67
PROJECT	[illegible]	9-19-67
APPD	R.G. Moore	9-19-67

SUPERSEDES: 12337-794

Cessna AIRCRAFT CO. COMMERCIAL AIRCRAFT DIV. 5800 E. PAWNEE WICHITA, KANSAS

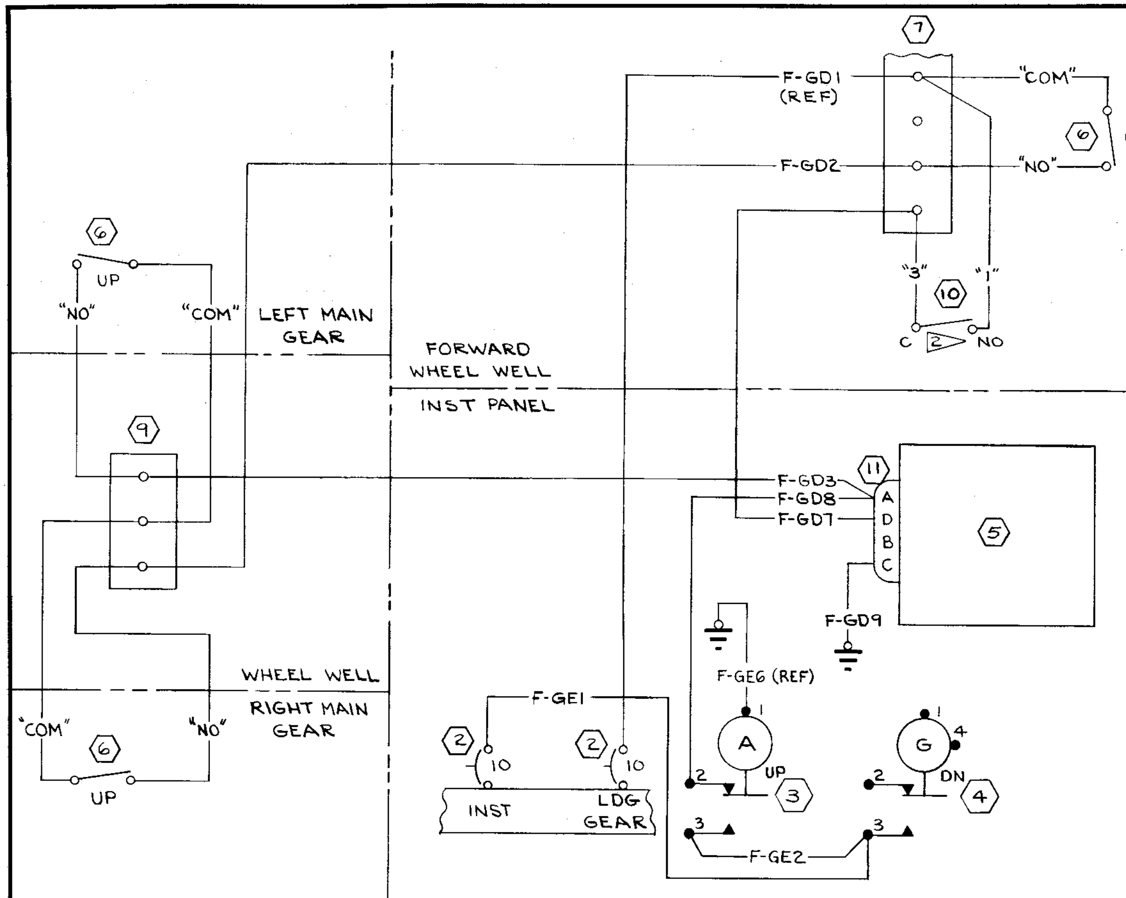
TITLE WIRING DIAGRAM — MAP LIGHT, CONTROL WHEEL (12 VOLT)

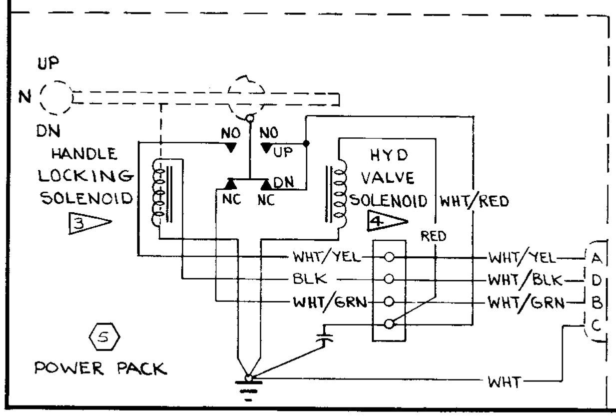
SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: NONE PAGE: 11.10

SER 21058937

FORM NO 80-215





NOTES:

1. FOR GEAR DOWN SWITCHES REFER TO 1270405 PAGE 15.2
2. NOSE GEAR SQUAT SWITCH CLOSED WHEN STRUT IS EXTENDED.
3. CONTROL HANDLE CANNOT BE PLACED IN GEAR - UP POSITION EXCEPT WHEN SOLENOID IS ENERGIZED I.E. WHEN NOSE GEAR STRUT IS EXTENDED.
4. HYD VALVE SOLENOID IS ENERGIZED WHEN GEARS ARE EITHER LOCKED UP OR LOCKED DOWN AND POWER PACK CONTROL HANDLE IS IN ITS UP-NEUTRAL OR DN-NEUTRAL POSITION.
5. GEAR UP SWITCHES ARE CLOSED WHEN GEARS ARE LOCKED.

CHG LET	REVISION	BY DATE	CHK APPD
A	ADDED WIRE LENGTHS TO W/T; REMOVED 1270429-1 FROM E/T; S-1360-10 WAS S-1232-10; 2940-1 WAS 1280500-1; S-1377-1 WAS 65-430001; REMOVED F-GD1 FROM E/T; INST WAS INST LIGHTS; ADDED COLOR CODED WIRES TO (OAC) POWER PACK DIAGRAM; VM911M-4A WAS VM911-2A (SR44559)	WJR 8-13-64	RRS JM HFW
B	BY REVISION: REVISED SYMBOL FOR ITEMS 3 & 4. ADD T210 TO MODEL BLOCK (SR4886) (SR4887)-9	GLW 5-12-66	YAK 4KA HFW

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
11	MS3106A-14S-2S	PLUG	
10	1270034-1	SWITCH	
9	AN3436-2-3	TERMINAL	
8			
7	AN3436-2-6	TERMINAL	
6	S-1377-1	SWITCH	
5	2940-1	POWER PACK (OAC)	
4	VM920M-3	LIGHT ASSY(MARI)	
3	VM911M-4A	LIGHT ASSY(MARI)	
2	S-1360-10	CIRCUIT BREAKER	
1			

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		SERIALS
F-GD9	18		35	S-1367-1-8	SOLDER	
F-GD8	18		26	SOLDER	SOLDER	
F-GD7	18		58	S-1367-1-6	SOLDER	
F-GD3	18		170	S-1367-1-6	SOLDER	
F-GD2	18		210	S-1367-1-6	S-1367-1-6	
F-GE2	18		3	SOLDER	SOLDER	
F-GE1	18		13	S-1367-1-8	SOLDER	

WIRE TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	10-10-62
GROUP	Ted Mosby	10-29-62
CHECK	R. Stuck	10-26-62
PROJ	H. McCarter	11-2-62

TITLE: WIRING DIAGRAM — LANDING GEAR DOOR CONTROL SYSTEM

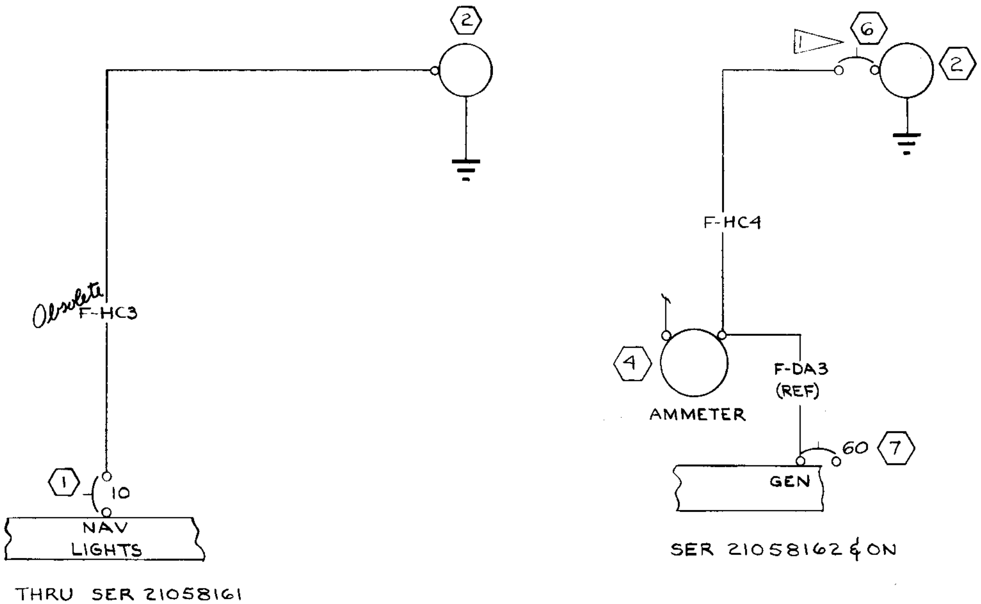
Cessna.

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: | MODEL: 210, T210 | REV: B | PAGE: 12.1

FORM NO. 80-161

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADD 60232-1 CKT BKR TO CIGAR LIGHTER, F-HC4 WIRE, NOTE 1, S-1232-50 & 0713602-1. OBSOLETE F-HC3 H-HC3 WIRE WAS 18 GA S-1367-2-8 TERM WAS S-1367-1-8 (SR 4081)	G L W 12-10-62	HW RRS
B	ADDED WIRE LENGTH TO W/T; C669502-0104 WAS 0713602-1; S-1360-50 WAS S-1232-50; REMOVED 1270429-1 & 1270405 -DA1 FROM E/T	W J R 8-14-64	RRS TM HWC
C	F-DA3 (REF) WAS F-DA1 (REF) S-1596-60 WAS S-1360-50 ADD MODEL T210 (SR4886) (SR4887) -9	G L W 5-10-66	YAK ATM NMC HFW



NOTE:

1 CIRCUIT BREAKER IS RESET BY INSERTING A PROBE INTO THE 5/64 DIA HOLE IN BREAKER FACE AND PUSHING LIGHTLY UNTIL A CLICK IS HEARD.

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-HC4	16		15	S-1367-2-10	S-1367-2-8		SER 21058162 & ON
F-HC3	16		14	S-1367-2-8	S-1367-2-8		OBSOLETE 21058162 & ON

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
7	S-1596-60	CIRCUIT BREAKER	
6	60232-1	CKT BKR (CUE)	
5			
4	C669502-0104	INST CLUSTER KIT	
3			
2	0513052-3	CIGAR LIGHTER	
1	S-1232-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	10-5-62
GROUP	Ed Mooske	10-24-62
CHECK	R. Stuck	10-25-62
PROJ	H. McCarta	11-2-62

TITLE: WIRING DIAGRAM — CIGAR LIGHTER

Cessna.

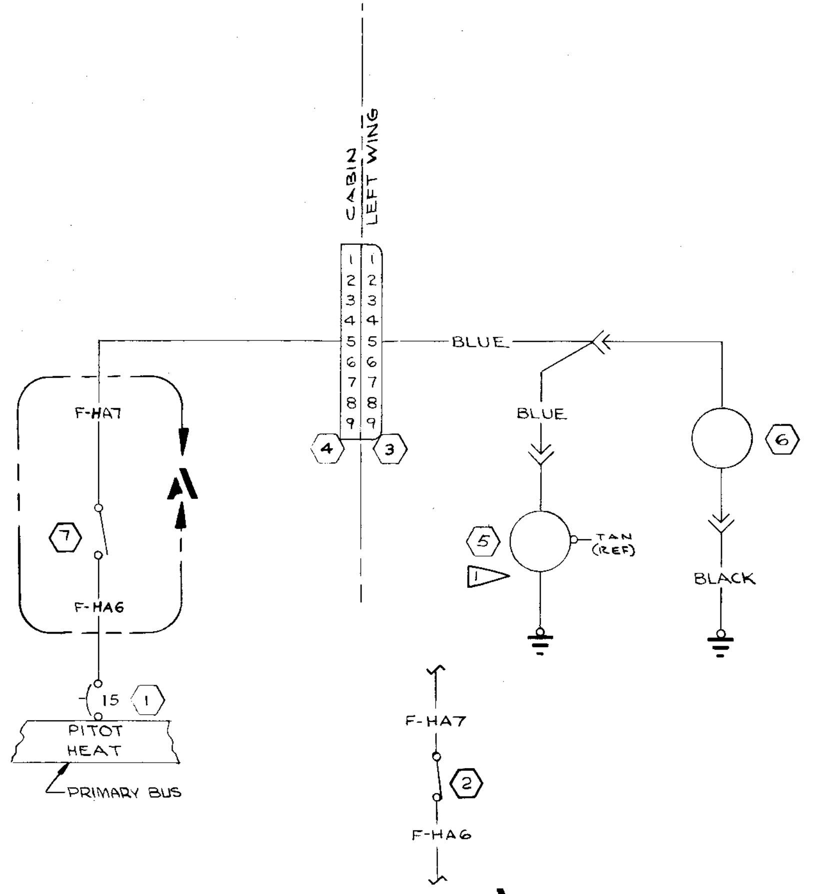
DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: | MODEL: 210, T210 | REV: C | PAGE: 13.1

FORM NO. 80-161

SER 21058819
SER T210-0198

CHG LET	REVISION	BY / DATE	CHK / APPD
A	S-1360-15 WAS S-1360-10 (SR5144)	GLW 7-22-66	KRS
B	BY REV: ADD DETAIL A, F-FB6, F-JA7, & S-1845-1-1 & EFF SER; INACTIVATE: F-HA7, F-HA6 & S-11582-1 ED & RR 02330 (SR5403) IX (SR5404) IX	JDH 4-16-68	GKI MDS
C	BY REV: ADD NOTES 2 & 3; OBSOLETE (NEVER USED) F-FB6 & F-JA7 ; SER IN F-HA6 & F-HA7 ; CHANGED TERMINALS TO AGREE ; ITEMS 4 WAS 3 & 3 WAS 4 IN FLD OF DWG. ED & RR 03405 (SR5403) (SR5404) IX	RBI 8-5-68	GKI MDS RFG



DETAIL A
EFF THRU SER 21059061 & T210-0392

NOTES:
1. ONLY HEATER CIRCUIT SHOWN, FOR STALL WARNING CIRCUIT, SEE PAGE 15.1.2.
2. EFF THRU SER 21059061 & T210-0392
3. EFF SER 21059062 & T210-0393 & ON

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
7	S-1845-1-1	SWITCH	
6	0721105-15	PITOT TUBE, HEATED	
5	S-1672-2	XMTR STALL WARN, HTD	
4	S-1640-9	HOUSING - PIN	
3	S-1641-9	HOUSING - SOCKET	
2	S-1158-2-1	SWITCH	
1	S-1360-15	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS		N/A	SERIALS
F-JA7	16						OBSOLETE (NEVER USED)
F-FB6	16						OBSOLETE (NEVER USED)
F-HA7	16			S-1493-2	S-1635-2		3
F-HA6	16			S-1367-2-6	S-1493-2		3
BLUE	16	S-1460-16-6		SEE BLUE	S-341-2		(STD)
BLACK	18	S-1460-18-0		S-1369-1	S-1367-1-8		(STD)
BLUE	16	S-1460-16-6		S-1636-2	S-1369-2		(STD)
F-HA7	16			S-1367-2-6	S-1635-2	1200440	2
F-HA6	16			S-1367-2-6	S-1367-2-6	1200440	2

WIRE TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	1-6-66
GROUP	H. Wise	2-17-66
CHECK	R. Stuck	2-18-66
PROJ	H. McCarty	2-24-66

TITLE: WIRING DIAGRAM— HEATED PITOT TUBE & HEATED STALL WARNING SYSTEM (OPT)

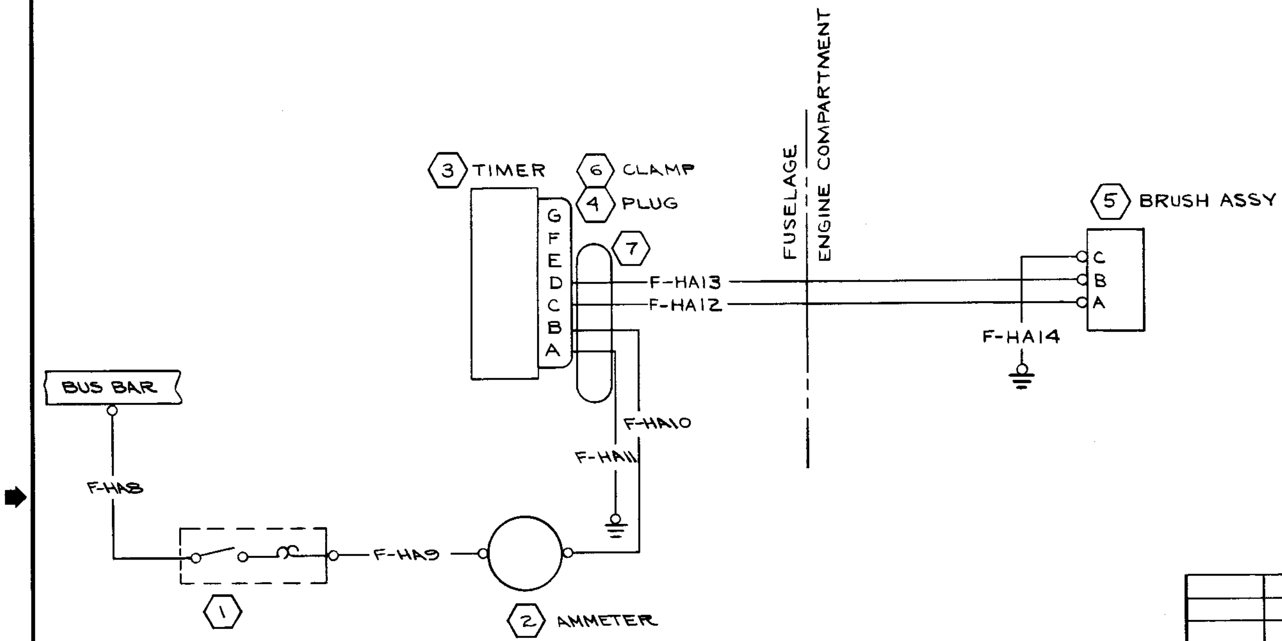
Cessna

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 13.2 | MODEL: 210 & T210 | REV: C | PAGE: 13.2.1

FORM NO. 80-161A

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: 1E1324 WAS 1E1140: ADD MS3057-12A & 1201013-6 ED & RR 03416	FER 7-15-68	GRL MDS RFG HFW AKM [illegible]



F-HA14	10			S-1367-3-10	S-1367-3-13		
F-HA13	10			SOLDER	S-1367-3-10		
F-HA12	10			SOLDER	S-1367-3-10		
F-HA11	10			SOLDER	S-1367-3-8		
F-HA10	10			S-1367-3-10	SOLDER		
F-HA9	10			S-1367-3-10	S-1367-3-10		
F-HA8	10			S-1367-3-10	S-1367-3-10		
WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS

WIRE TABLE

7	1201013-6	CABLE ASSY	
6	MS3057-12A	CLAMP	
5	4E1387-4	BRUSH BLOCK ASSY	(25472)
4	MS3106A20-15S	PLUG	
3	3E1540-1	TIMER	(25472)
2	3E1219-7	AMMETER	(25472)
1	1E1324	SWITCH	(25472)
ITEM NO.	PART NO.	DESCRIPTION	VENDOR

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES:

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G WOOD	3-11-68
GROUP	H. Wise	3-8-68
DRAWN	C. GARCIA	3-4-68
CHECK	IRVIN	3-5-68
STRESS	[illegible]	3/7/68
PROJECT	[illegible]	3/11/68
APPD	L.K.WHITE	3-6-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM —
PROP DE-ICING SYSTEM
3 BLADE (OPTIONAL)

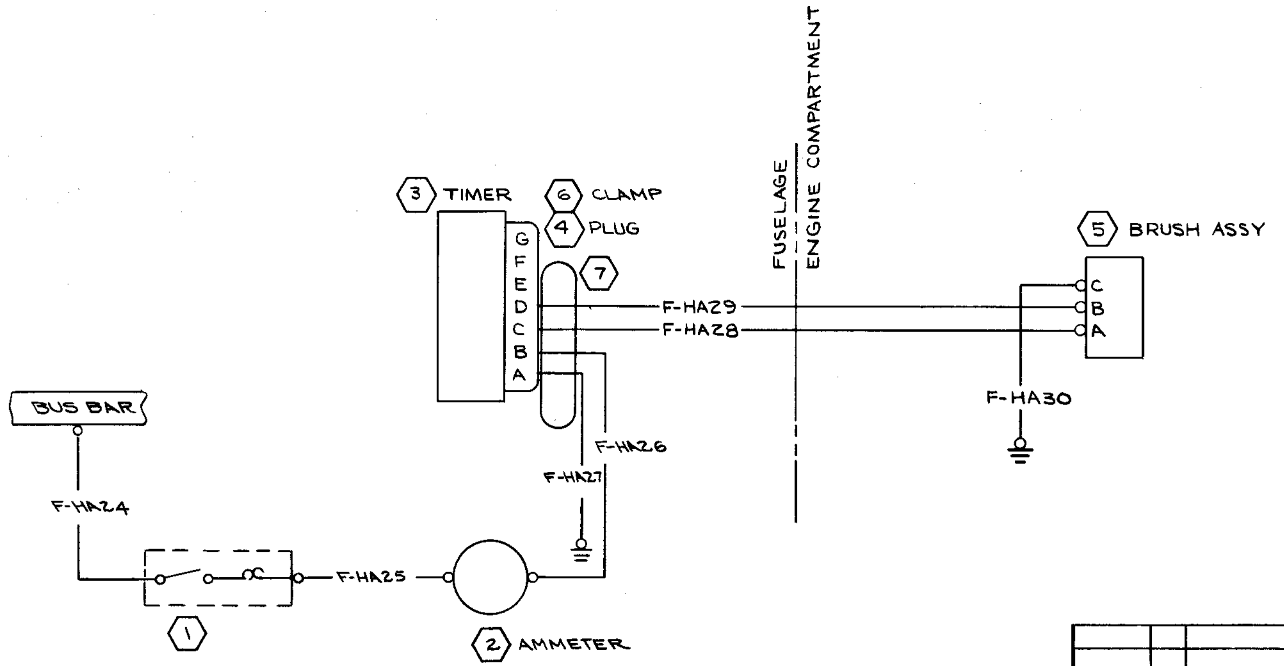
SIZE C | CODE IDENT. NO. 71379 | DWG NO. 1270405

SCALE: NONE | 210-T210 | PAGE: 13.3.0

ED & RR 00868

FORM NO. 80-215A

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: ADD MS3057-12A & 1201013-5 ED&RR 03416	FER 7-15-68	GKI MDS RFG



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-HA30	12			S-1367-3-10	S-1367-3-13		
F-HA29	12			SOLDER	S-1367-3-10		
F-HA28	12			SOLDER	S-1367-3-10		
F-HA27	12			SOLDER	S-1367-3-8		
F-HA26	12			S-1367-3-10	SOLDER		
F-HA25	12			S-1367-3-10	S-1367-3-10		
F-HA24	12			S-1367-3-10	S-1367-3-10		

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	VENDOR
7	1201013-5	CABLE ASSY	
6	MS3057-12A	CLAMP	
5	4E1387-4	BRUSH BLOCK ASSY	(25472)
4	MS3106A20-15S	PLUG	
3	3E1540-1	TIMER	(25472)
2	3E1219-6	AMMETER	(25472)
1	1E1140	SWITCH	(25472)

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES:

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G WOOD	3-11-68
GROUP	H. Wise	3-8-68
DRAWN	C. GARCIA	3-4-68
CHECK	IRVIN	3-5-68
STRESS	D R Buth	3/7/68
PROJECT	[illegible]	3/11/68
APPD	LKWHITE	3-6-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM —
PROP DE-ICING SYSTEM
2 BLADE (OPTIONAL)

SIZE: C | CODE IDENT. NO.: 71379 | DWG NO.: 1270405

SCALE: NONE | 210-T210 | PAGE: 13.4.0

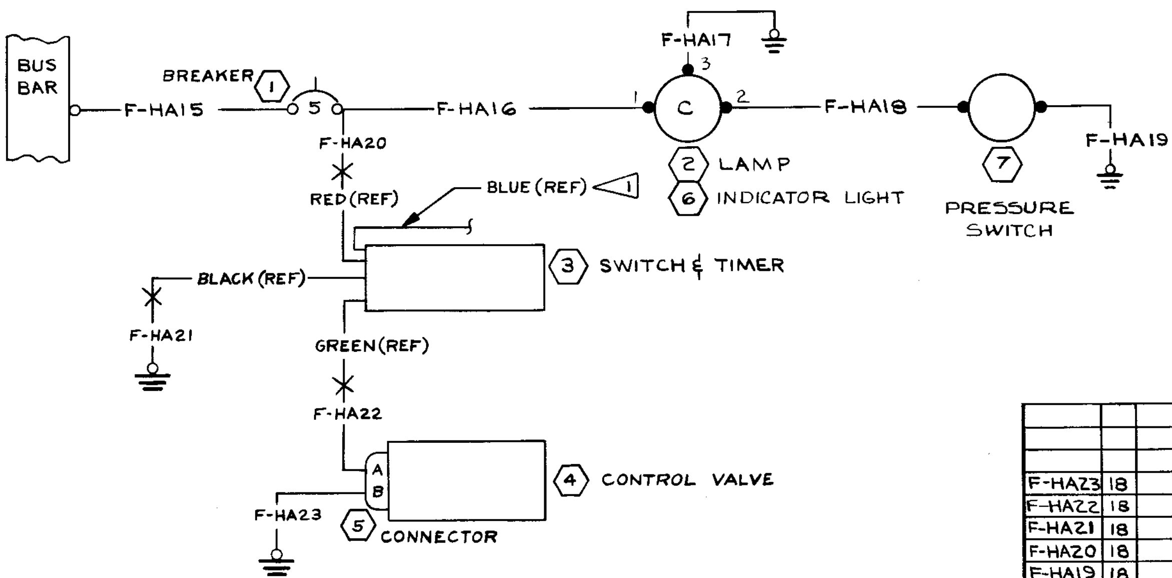
FORM NO. 80-215A

ED&RR 00868

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: ADD 1D1194-1. ED&RR 02350	JDH 4-17-68	
B	BY REV: ADD BLUE (REF), BLACK (REF), GREEN (REF), RED (REF) WIRES & NOTE 1 ED&RR 10029 (SR5403)(SR5404)	RBI 8-9-68	JWH MDS

NOTES:

1. BLUE WIRE ON SWITCH & TIMER NOT TO BE USED. CAP END WITH S-1557-1 CAP



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-HA23	18			SOLDER	S-1367-1-8		
F-HA22	18			S-1370-1	SOLDER		
F-HA21	18			S-1370-1	S-1367-1-8		
F-HA20	18			S-1367-1-6	S-1370-1		
F-HA19	18			SOLDER	S-1367-1-8		
F-HA18	18			SOLDER	SOLDER		
F-HA17	18			SOLDER	S-1367-1-8		
F-HA16	18			S-1367-1-6	SOLDER		
F-HA15	18			S-1367-1-6	S-1367-1-6		

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	VENDOR
7	1D1194-1	PRESSURE SWITCH	(25472)
6	MS25041-3	INDICATOR LIGHT	
5	MS3106A-12S-3S	CONNECTOR	
4	3D1726	CONTROL VALVE	(25472)
3	3D1772-01	SWITCH & TIMER	(25472)
2	MS25237-330	LAMP	
1	S-1360-5	CIRCUIT BREAKER	

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES:

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G WOOD	3-11-68
GROUP	H. Wise	3-8-68
DRAWN	C.GARCIA	3-4-68
CHECK	IRVIN	3-5-68
STRESS	D R Bush	3/7/68
PROJECT		3/11/68
APPD	L.V.WHITE	3-6-68

Cessna AIRCRAFT CO.

COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE

WIRING DIAGRAM — WING DE-ICING SYSTEM (OPTIONAL)

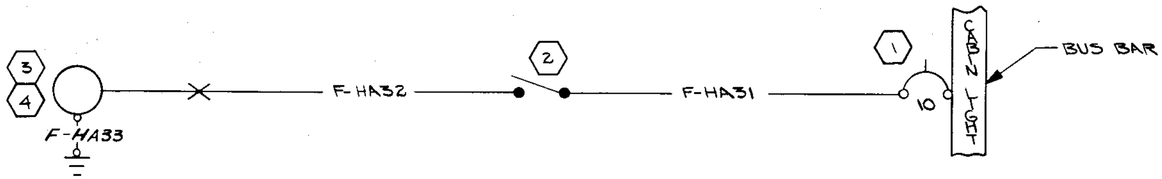
SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: NONE | 210, T210 | PAGE: 13.5.0

ED&RR 00868 REV: A

FORM NO. 80-215A

REVISION			
LET	DESCRIPTION	DATE	APPD
A	BY REV: ADD F-HA33 MER 210 #5 SER 21059062 & ON ED & RR04134 SER T210-0393 & ON	EGY	



NOTES:

1. TO BE MODIFIED PER INST DWG

F-HA33	20			S-1367-1-4	S-1367-1-4		
F-HA32	20			SOLDER	S-1370-1		
F-HA31	20			SOLDER	S-1367-1-6		
WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS

WIRE TABLE

ITEM NO.	PART NO.	DESCRIPTION	
4	A-70798-12	LAMP	72914
3 (1)	#11-225	LAMPHOLDER	95263
2	S-1284-1	SWITCH	
1	S-1360-10	CIRCUIT BREAKER	

EQUIPMENT TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES:

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G. WOOD	8-14-68
GROUP	[illegible]	8-14-68
DRAWN	F. RUNNER	8-1-68
CHECK	G. IRVIN	8-2-68
STRESS	ASHKER	8-6-68
PROJECT	[illegible]	8-20-68
APPD	SWANEY	8-5-68

Cessna AIRCRAFT CO.
COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

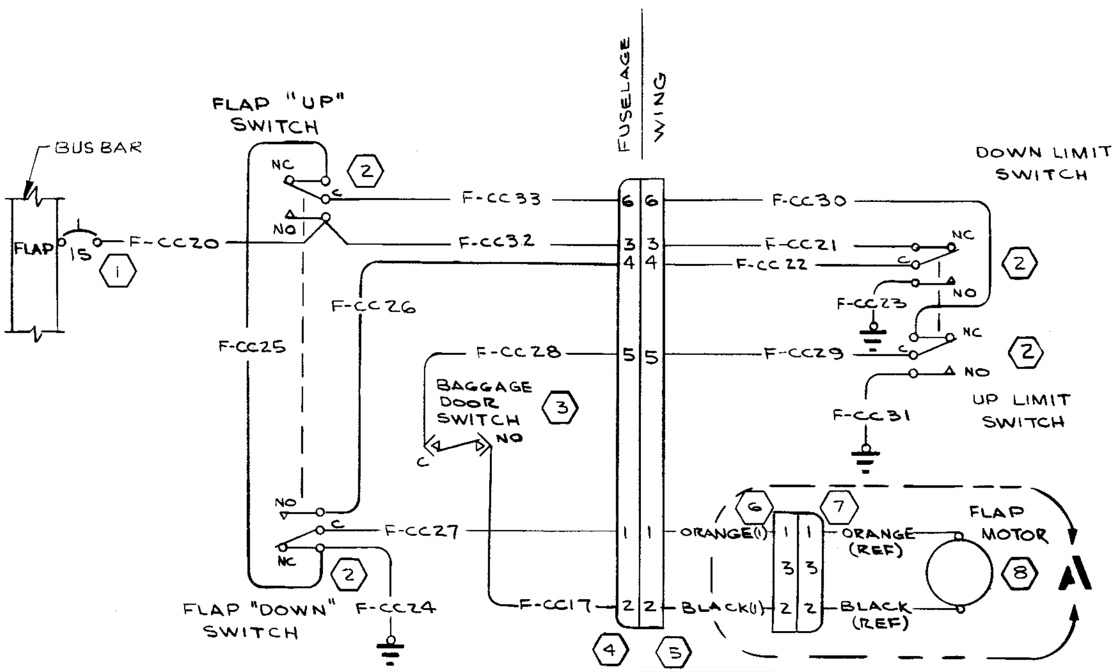
TITLE
WIRING DIAGRAM — LIGHT, ICE DETECTOR (OPT)

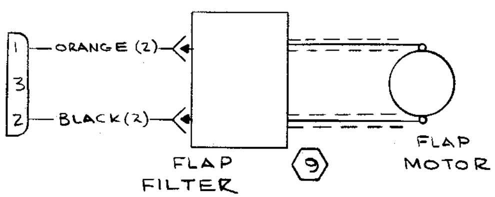
SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: NONE | T210 & 210 | PAGE: 13.6.0

FORM NO. 80-218A

ED & RR 10009 SER 21059062 & T210-0393





OPTIONAL WIRING USED WHEN RADIO IS INSTALLED

DETAIL A

REVISION			
LET	DESCRIPTION	DATE	APPD

ITEM NO.	PART NO.	DESCRIPTION	VENDOR
9	C301001-0206	ACTUATOR ASSY	
8	C301001-0205	ACTUATOR ASSY	
7	S-1638-2	HOUSING-CAP	
6	S-1638-1	HOUSING-PLUG	
5	S-1641-6	HOUSING-SOCKET	
4	S-1640-6	HOUSING-PIN	
3	E13-00M	SWITCH	(01963)
2	E33-10K	SWITCH	(01963)
1	S-1360-15	CIRCUIT BREAKER	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
ORN(2)	16	-16-3		S-1493-2	S-1636-2		
BLK(2)	16	-16-0		S-1493-2	S-1636-2		
ORN(1)	16	-16-3		S-1635-2	S-1636-2		
BLK(1)	16	-16-0		S-1635-2	S-1636-2		
F-CC33	16			S-1367-1-4	S-1636-2		
F-CC32	16			S-1367-1-4	S-1636-2		
F-CC31	16			S-1367-1-4	S-1367-1-8		
F-CC30	16			S-1635-2	S-1367-1-4		
F-CC29	16			S-1635-2	S-1367-1-4		
F-CC28	16			S-1493-2	S-1636-2		
F-CC27	16			S-1367-1-4	S-1636-2		
F-CC26	16			S-1367-1-4	S-1636-2		
F-CC25	16			S-1367-1-4	S-1367-1-4		
F-CC24	16			S-1367-1-4	S-1367-2-8		
F-CC23	16			S-1367-1-4	S-1367-2-8		
F-CC22	16			S-1636-2	S-1367-1-4		
F-CC21	16			S-1635-2	S-1367-1-4		
F-CC20	16			S-1367-2-8	S-1367-1-4		
F-CC17	16			S-1493-2	S-1367-1-4		

WIRE TABLE

CES-1000 IS APPLICABLE
VENDOR CODES PER S-1400
CES-XXXX=CESSNA SPEC. NO.
S-XXX OR CMXXXX=CESSNA STD. NO.

SUPERSEDES: 1270405 PAGE 14.3.1 10.2.1

SUPERSEDED BY:

CONTRACT NO:

	NAME	DATE
DESIGN	G. WOOD	7-19-67
GROUP	H. Wise	8-21-67
DRAWN	J. HUSTON	7-19-67
CHECK	YAKSHAW	8-24-67
STRESS	[illegible]	8-29-67
PROJECT	[illegible]	8-29-67
APPD		

Cessna AIRCRAFT CO.

COMMERCIAL AIRCRAFT DIV.
5800 E. PAWNEE
WICHITA, KANSAS

TITLE
WIRING DIAGRAM — WING FLAPS

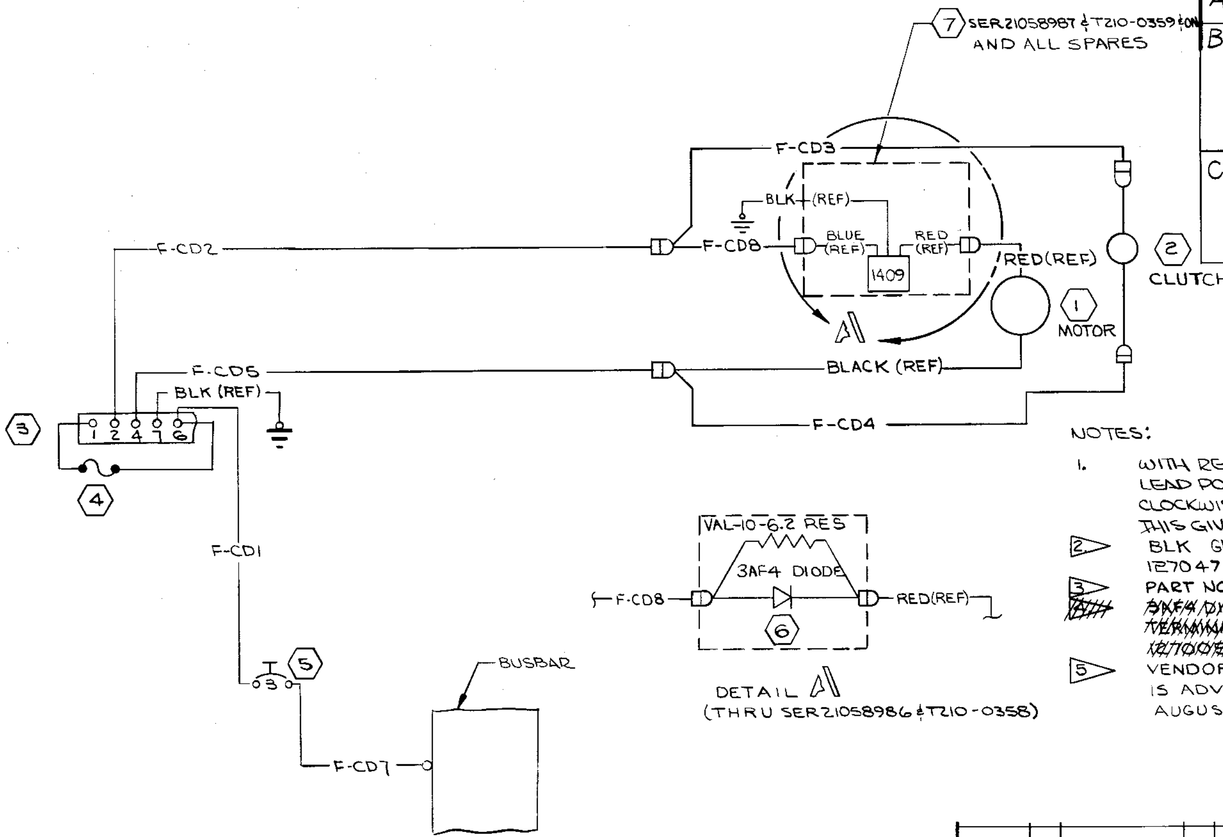
SIZE	CODE IDENT. NO.	DWG NO.
C	71379	1270405

SCALE: NONE | SER 21058937 & ON | PAGE: 14.5

SER T210-0308 & ON

FORM NO. 80-215A

CHG LET	REVISION	BY / DATE	CHK / APPD
A	BY REV: ADD NOTE 3 & SR'S. SER 21058937 & ON, SER T210-0308 & ON	JWH 8-30-67	YAK HMC KEW
B	BY REV: ADD 1270057-1, F-CD8, NOTE 4 & S-1635-1 & S-1637-1 TERMINALS TO F-CD4 WIRE; 1560332-25 WAS 1560332-26 EDRR 01362 SER 210-5976 & ON, SER T210-0338 & ON	C.G.	RRS LFW AA ARM PSP
C	BY REV: ADD 1409; SER OUT 1270057-1 & DELETE NOTE 4; ADD DETAIL A & NOTE 5 EDRR 01958 (SR5747)	JEL 2-13-68	RRS KEW HJW



NOTES:

1. WITH RED MOTOR LEAD NEGATIVE & BLACK LEAD POSITIVE, MOTOR WILL ROTATE IN A CLOCKWISE DIRECTION (LOOKING INTO SHAFT) THIS GIVES A "NOSE
2. BLK GND WIRE IS DESCRIBED ON 1270475, PG 2.47.0
3. PART NO. IS 329636, VENDOR CODE IS 00779.
4. ~~3AF4 DIODE, VAL-10-6.2 RESISTOR, TERMINATIONS & HOUSINGS ARE PART OF 1270057-1 RESISTOR & DIODE ASSY~~
5. VENDOR FOR 1409 VOLTAGE REGULATOR IS ADVANCED AVIONICS P.O. BOX 188 AUGUSTA, KANSAS

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-CD8	18			S-1635-1 S-1637-1	S-1636-3 S-1637-2		SER 210-5976 & ON, SER T210-0338 & ON
F-CD7	18			S1367-1-6	S-1367-1-8		
F-CD5	20			S-1637-2 S-1636-2	3		
4				S-1636-1 S-1637-2	S-1635-1 S-1637-1		
3				SEE-CD8	S-1636-1 S-1637-2		
2				3	S-1637-2 S-1636-2		
F-CD1	20			S-1367-1-8	3		

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
7	1409	VOLTAGE REG.	5
6	1270057-1	RES & DIODE ASSY	4
5	7271-8-3	CKT BKR	(82647)
4	1570141-2	FUSE ASSY	
3	8-171	TERM BLOCK	(71785)
2	1560321-12	CLUTCH	
1	1560322-25	MOTOR ASSY	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	HARDEN	7-28-67
GROUP	H. Wise	7-29-67
CHECK	YAKSHAW	8-30-67
PROJ	McCarty	8-4-67

TITLE: WIRING DIAGRAM— ELECTRIC ELEVATOR TRIM (OPTIONAL)

Cessna.

DWG NO: 1270405

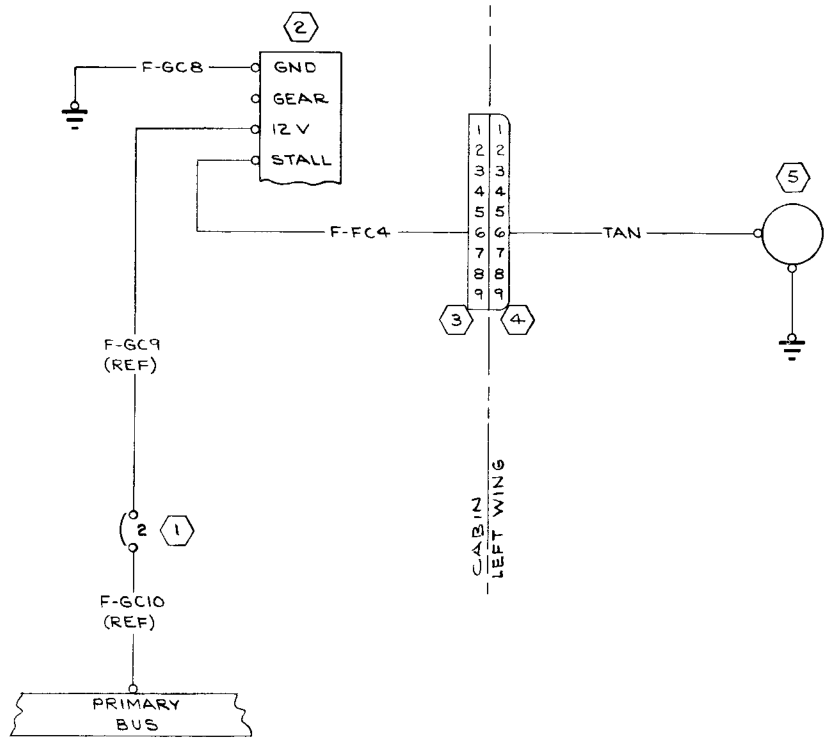
SUPERSEDED BY: SUPERSEDES: MODEL: 210-T210 REV: C PAGE: 14.6

FORM NO 80-161A

SER 21058937 & ON, SER T210-0308 & ON

SER 21058819
SER T210-0198

CHG LET	REVISION	BY / DATE	CHK / APPD



WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
TAN	18	S-1460-18-10		S-1635-2	S-1367-1-6		
F-GC8	18		14	S-1367-1-6	S-1367-1-8		
F-FC4	18			S-1367-1-6	S-1636-2		

WIRE TABLE

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
5	S-1672-1	XMTR, STALL WARN	
4	S-1640-9	HOUSING - PIN	
3	S-1641-9	HOUSING - SOCKET	
2	1213242-1	WARNING UNIT	
1	CA-2	CKT BKR (MTCC)	

EQUIPMENT TABLE

CESSNA AIRCRAFT CO., COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	RIDDER	1-6-66
GROUP	H. Wise	2-17-66
CHECK	[illegible]	2-18-66
PROJ	H. McCarter	2-24-66

TITLE: WIRING DIAGRAM — STALL WARNING SYSTEM (NON-HEATED)

Cessna

DWG NO: 1270405

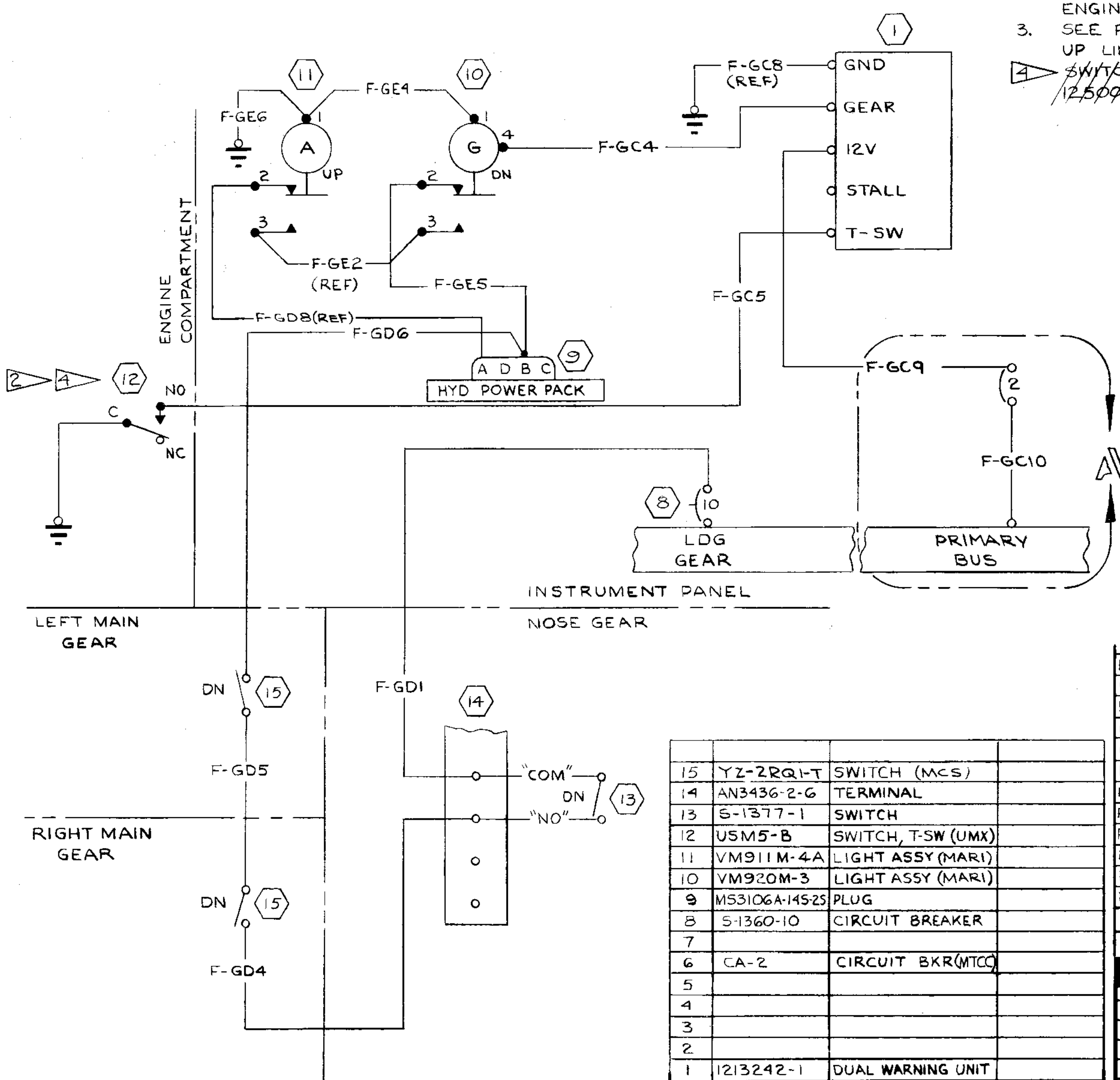
SUPERSEDED BY:
SUPERSEDES: 1270405 PAGE 15.1.1
MODEL: 210 & T210
REV:
PAGE: 15.1.2

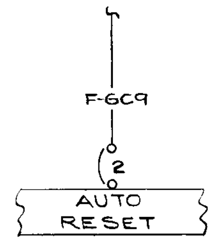
FORM NO. 80-161A

SER 21058221
SER 21058623

NOTES:
1. GEAR DOWN SWITCHES ARE CLOSED WHEN GEARS ARE LOCKED DOWN.
2. SWITCH IS CLOSED WHEN THROTTLE IS CLOSED I.E. ENGINE POWER IS REDUCED.
3. SEE PAGE 12.1 FOR GEAR UP LIMIT SWITCHES.
4. ~~SWITCH IS PART OF 1250046-4 SWITCH ASSY.~~

CHG LET	REVISION	BY / DATE	CHK / APPD
A	ADDED WIRE LENGTHS TO W/T; REMOVED 1270461-1 & F-GC8 FROM E/T; GEAR UP LIGHT "A" WAS "R"; VM911M-4A WAS VM911M-2A; S-1377-1 WAS 65-430001 (SR4455)	WJR 8-15-64	RRS TM NMC
B	ADDED F-GC10 TO B/M USM5-B WAS USMW76-B YZ-2RQ1T WAS 10-3222 (LITW) ADDED F-GD8 (REF) ADD DETAIL "A" (SR4886)(SR4887) -9	JH 1-31-66	RRS ALA AKM NMC HLW
C	F-GC11 WAS F-GC5, E33-10K (CRYE) SWITCH WAS USM5-B (UMX) REWORKED SYMBOL OF ITEMS 10 & 11 (SR4886)(SR4887) -9	GLW 5-12-66	YAK AKM NMC HLW
D	OBSOLETE F-GC11 WIRE. USM5-B (UMX) WAS E33-10K (CRYE). DELETE NOTE 4 REACTIVATED F-GC5 (SR4886)(SR4887) - 9	GLW 8-30-66	RRS NMC HLW





DETAIL A
APPLIES THRU SER 21050818 & SERT210-0197

ITEM NO	PART NO.	DESCRIPTION	INSTALLED ON
15	YZ-2RQ1-T	SWITCH (MCS)	
14	AN3436-2-6	TERMINAL	
13	S-1377-1	SWITCH	
12	USM5-B	SWITCH, T-SW (UMX)	
11	VM911M-4A	LIGHT ASSY (MARI)	
10	VM920M-3	LIGHT ASSY (MARI)	
9	MS3106A-14S-2S	PLUG	
8	S-1360-10	CIRCUIT BREAKER	
7			
6	CA-2	CIRCUIT BKR (MTCC)	
5			
4			
3			
2			
1	1213242-1	DUAL WARNING UNIT	

EQUIPMENT TABLE

WIRE CODE NO.	GA	MATERIAL	LG	TERMINALS			SERIALS
F-GC11	18			S-1367-1-6	S-1367-1-4		OBSOLETE NEVER USED
F-GC10	18			S-1367-1-6	S-1367-1-8		SER 21058819 & T210-0198
F-GC9	18		47	S-1367-1-6	S-1367-1-8		SER 21058263 & ON
F-GE6	20		6	S-1367-1-6	SOLDER		
F-GE5	20		26	SOLDER	SOLDER		
F-GE4	18		3	SOLDER	SOLDER		
F-GD6	18		164	S-1367-1-4	SOLDER		
F-GD5	18		80	S-1367-1-4	S-1367-1-4		
F-GD4	18		205	S-1367-1-4	S-1367-1-6		
F-GD1	18		65	S-1367-1-8	S-1367-1-6		
F-GC5	18		58	S-1367-1-6	SOLDER		
F-GC4	18		38	S-1367-1-6	SOLDER		

WIRE TABLE

CESSNA AIRCRAFT CO. COMMERCIAL AIRCRAFT DIVISION, WICHITA, KANSAS

	NAME	DATE
DRAWN	G WOOD	2-22-63
GROUP	Ed Moody	3-26-63
CHECK	R. Stuck	3-28-63
PROJ	Nimclate	3-29-63

TITLE: WIRING DIAGRAM — GEAR WARNING SYSTEM

Cessna.

DWG NO: 1270405

SUPERSEDED BY: | SUPERSEDES: 1270405 PAGE 15.2 | MODEL: 210 & T210 | REV: D | PAGE: 15.2.1

FORM NO. 80-161

APPENDIX A

HYDRAULIC COMPONENTS REPAIR

TABLE OF CONTENTS

SECTION A

GENERAL INFORMATION

A1-1. The following pages cover, in step-by-step procedure, the repair of the Power Pack and other hydraulic system components. Since emphasis here is on repair, not overhaul, of the basic components of the hydraulic system, it is unlikely that the mechanic will go through all of the operations described. Instead, he will repair the particular item which is causing the difficulty.

NOTE

To isolate the hydraulic item causing malfunction, see the Trouble Shooting Charts in Section 5, and if possible, perform Hydro Test testing.

A1-2. REPAIR VERSUS REPLACEMENT. Often the moderate trade-in price for a factory-rebuilt component is less than the accumulated cost of labor, parts, and (often time consuming) trial and error adjustment. Repair or replacement of a component will depend on the time, equipment, and skilled labor that is locally available.

A1-3. REPAIR parts and equipment are available from the Cessna Service Parts Center.

A1-4. EQUIPMENT AND TOOLS.

A1-5. HYDRO TEST. The Hydro Test is a portable Hydraulic Service Unit, designed specifically to supply hydraulic pressure for cycling the landing gear for checking or servicing this system when the engine is not operating. In addition to cycling the landing gear, the Hydro Test can be used for filling the Power Pack reservoir, bleeding the system, reading system pressure, and testing components prior to installation. The unit is mounted in a metal cabinet and is on wheels.

A1-6. HAND TOOLS. The following tools are necessary for repair work on the Power Pack and other hydraulic components:

Snap Ring Pliers
Strap Wrench (for removing door solenoid and various cylinder barrels of the hydraulic actuators)
Needle-nose Pliers
Pin Punches
Duck-bill Pliers
Box and Open End Wrenches

Locally fabricated items, handy for Power Pack repair, are various 1/4" aluminum rods ground to a gradual taper and hooks formed from brass welding rod to extricate small plungers from hydraulic ports. Hook formed on brass welding rod must not be over 1/16-inch in length so as not to scratch or score the bore. Various sizes of Allen wrenches may be welded or brazed to "T" handles for use when removing, installing, or adjusting the various internal wrenching plugs or valves.

A1-7. COMPRESSED AIR. The easiest way to remove some hydraulic parts in inaccessible galleries of the Power Pack is a quick blast of compressed air from behind. Parts can be blown out in seconds which would take endless "fishing" operations to extricate otherwise. An air hose and nozzle is a common-sense tool.

A1-8. GENERAL REASSEMBLY CONDITIONS. During reassembly of the hydraulic components, lubricate O-rings and back-up rings with Dow Corning DC-4 compound applied sparingly. All other moving parts should be lubricated with hydraulic fluid.

SHOP NOTES:

SECTION A2

REPAIR OF POWER PACK

TABLE OF CONTENTS Page

A2-1. POWER PACK DISASSEMBLY. After the Power Pack has been removed from the aircraft and all ports are capped or plugged, spray with cleaning solvent (Federal Specification P-S-661, or equivalent) to remove all accumulated dust or dirt. Dry with filtered compressed air. To disassemble the unit, proceed as follows:

a. Remove reservoir cover retaining nut and O-ring. Cover is a snug fit on reservoir. Use a soft mallet and tap cover lightly to remove. Remove large O-ring.

b. Remove spacer from center bolt, cut safety wire and remove baffle from reservoir. Drain remaining hydraulic fluid from reservoir.

c. Remove reservoir cover attaching stud (center). This stud may be removed by using a double lock nut at top of stud. Use care to prevent damage to stud threads.

d. Turn Power Pack upside down so that top of reservoir serves as a support base.

NOTE

A holding fixture (Part No. HF-1025) may be used instead of removing the center stud if desired. This is a plate type fixture for use in a vise. The fixture is available from the Cessna Service Parts Center.

e. Remove pivot clevis pin and forward clevis pin from hand pump handle linkage, and remove hand pump handle assembly.

f. Remove screws attaching electrical wires to terminal strip and Power Pack. Remove small capacitor from beneath electrical wires and remove terminal strip.

NOTE

All electrical wires are coded with color stripes. Disregard color of wire terminals or plastic sleeving. If color codes are matched when wires are reinstalled, the wires will be connected correctly.

g. Cut safety wire and remove screws attaching landing gear up-down switch and bracket. Retain washers between bracket and Power Pack.

h. Cut safety wire and remove four Allen head screws attaching hand pump bracket, and remove bracket.

i. Remove lock-out solenoid retaining nut from hand pump bracket and remove solenoid from bracket. Use care to prevent damage to solenoid electrical wires.

j. Turn Power Pack over and cut safety wire at time-delay valve.

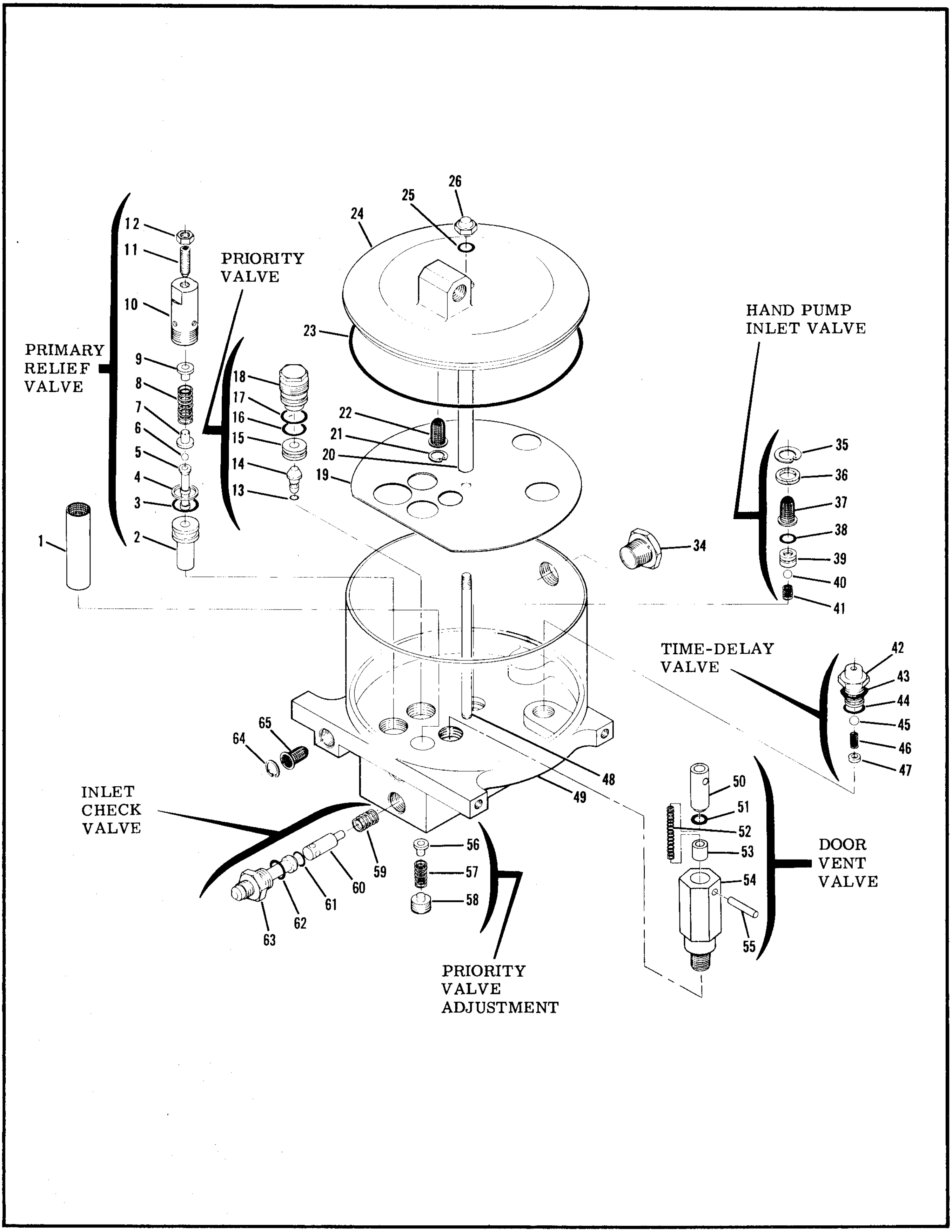


Figure A2-1. Reservoir and Main Body Components

References for Figure A2-1

1. Standpipe and Filter

PRIMARY RELIEF VALVE

2. Poppet Seat
3. O-Ring
4. Back-Up Ring
5. Poppet
6. Ball
7. Button
8. Spring
9. Button
10. Retainer
11. Adjusting Screw
12. Lock Nut

PRIORITY VALVE

13. Poppet O-Ring
14. Poppet
15. Poppet Seat
16. Poppet Seat O-Ring
17. Retainer O-Ring
18. Retainer

19. Baffle
20. Spacer
21. Snap Ring
22. Vent Filter
23. Reservoir Cover O-Ring
24. Reservoir Cover
25. O-Ring
26. Cap Nut
27. Sight Gage

HANDPUMP INLET VALVE

28. Snap Ring
29. Spacer
30. Filter
31. Seat O-Ring
32. Seat
33. Ball
34. Spring

TIME-DELAY VALVE

35. Retainer
36. Retainer Hex O-Ring
37. Retainer Body O-Ring
38. Ball
39. Spring
40. Spacer
41. Center Bolt
42. Reservoir and Body Assembly

DOOR VENT VALVE

43. Retainer
44. O-Ring
45. Spring
46. Poppet
47. Body
48. Pin

PRIORITY VALVE ADJUSTMENT

49. Button
50. Spring
51. Retainer (Adjusting Plug)

INLET CHECK VALVE

52. Spring
53. Plunger
54. O-Ring
55. Fitting O-Ring
56. Pressure Inlet Fitting

57. Snap Ring
58. Filler Line Filter

SHOP NOTES:

k. Remove time-delay valve ball, spring, spacer, and spring by removing time-delay valve retainer.

NOTE

Do not remove time-delay valve plunger until after manifold assembly has been removed.

l. Cut safety wire and remove screws attaching gear and rack protective cover. Remove cover.
m. Remove clamp attaching electrical wires to door solenoid valve and remove safety wire from door solenoid valve.
n. Cut safety wire and remove four screws attaching manifold assembly. Work manifold assembly from Power Pack, taking care to prevent loss of transfer tubes between manifold and Power Pack.
o. Remove the seven transfer tubes from manifold or Power Pack.

CAUTION

As the manifold is separated from the Power Pack body, the rack on the landing gear selector spool becomes disengaged from the gear on the handle. This will permit the selector spool to move. Do NOT move the selector spool from its position. Never move it to a position that is more than flush with the manifold body at the end opposite the selector spool rack. If moved beyond this position, an O-ring will become caught and the selector spool will then be extremely difficult to remove.

A2-2. DISASSEMBLY OF MANIFOLD.
a. Remove door solenoid by unscrewing from manifold. This solenoid is hand tightened. Use strap wrench or strip of sandpaper to grip door solenoid for removal. Remove plunger return spring.
b. Remove plunger and spool by carefully pulling from manifold.
c. Using a hook formed from brass welding rod and inserted into oil hole in transfer sleeve, withdraw sleeve from manifold.

NOTE

Be sure that end of hook is not over 1/16-inch long, and use with care to prevent scratching the bore in manifold. The sleeve will be hard to withdraw due to O-ring friction.

d. Remove time-delay valve plunger, using a small wooden dowel inserted in center of plunger. The plunger should slide out of manifold easily.
e. Remove landing gear selector spool by grasping rack end of spool and carefully pulling from manifold.

NOTE

Do not bend selector spool. Pull straight out. Do not remove gear rack from selector spool unless it is necessary to replace selector spool and manifold. The landing gear selector spool, time-delay plunger, and manifold are matched, lapped parts. If it is necessary to replace any one of these three parts, replace them as an assembly only.

f. Remove landing gear handle-release retainer (adjusting plug), spring, and poppet from manifold. The end of the poppet has a ball which should remain in the poppet. If it doesn't, remove ball from manifold.
g. Remove caps from fittings and wash manifold in cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air. Be sure internal passages are clean, then reinstall caps on fittings.

A2-3. COMPONENTS DISASSEMBLY.

A2-4. HAND PUMP VALVES.
a. Pull hand pump plunger from Power Pack body.
b. Using snap ring pliers, remove snap ring at inboard end of hand pump plunger.
c. Remove gland and scraper from plunger.
d. Inside reservoir, remove snap ring, spacer, and filter screen. Use a brass hook to remove seat, ball, and spring.

A2-5. PRIMARY RELIEF VALVE.
a. Loosen lock nut at top of primary relief valve.
b. Remove adjusting screw and lock nut from top of relief valve.
c. Unscrew retainer.
d. Remove two buttons, spring, and ball.
e. Remove poppet from poppet seat by lifting out of poppet assembly. The poppet and poppet seat are matched parts.
f. Using a brass hook not over 1/8-inch long, pull poppet seat up out of body. Hook through holes in side of seat and use care not to damage bore in body.

A2-6. PRIORITY VALVE.
a. Remove priority retainer from reservoir.
b. Turn Power Pack upside down and remove retainer (adjusting plug), spring, and button from bottom of Power Pack.
c. While Power Pack is upside down, push poppet and poppet seat into reservoir, using a punch of 1/8 inch maximum diameter. Make sure that face of punch is square and flat.

A2-7. SYSTEM INLET CHECK VALVE.
a. Remove system pressure port fitting.
b. Remove O-ring, plunger, and spring. Spring and plunger should fall out of Power Pack after O-ring is removed. Use hook, if necessary, to remove O-ring.

A2-8. STANDPIPE AND FILTER.
a. The standpipe and filter assembly should not be removed unless it is damaged, since it is a press fit in the reservoir.
b. Remove vent filter by removing the snap ring.
c. Remove fill line filter by removing the fitting and snap ring.

A2-9. DOOR VENT VALVE.
a. Remove door vent valve from reservoir. The door vent valve should not be disassembled except for replacement of parts.
b. Remove pin from valve body and retainer. Use care when removing pin, as the spring is under a slight load.
c. Remove retainer, O-ring, and poppet from valve body.

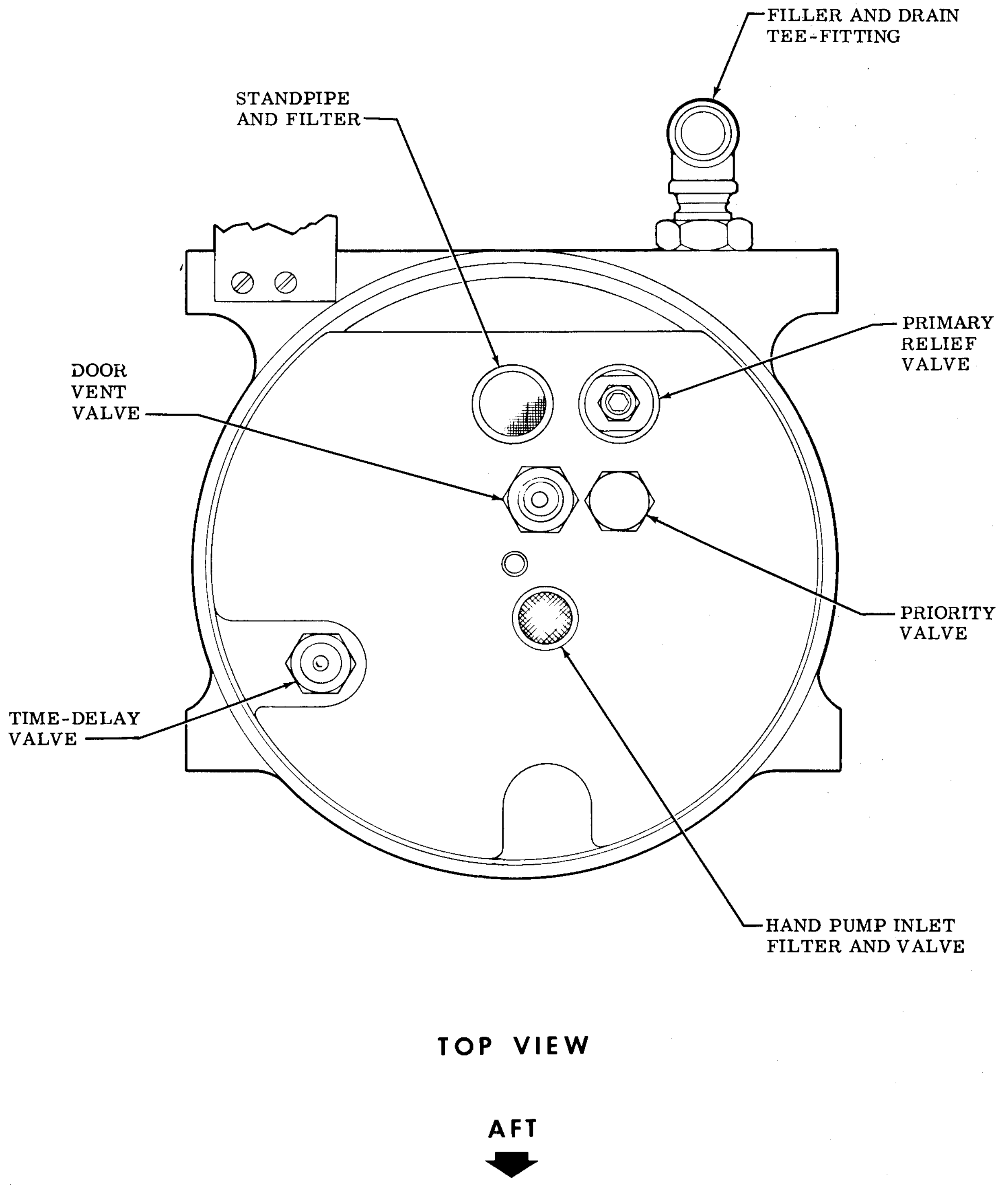
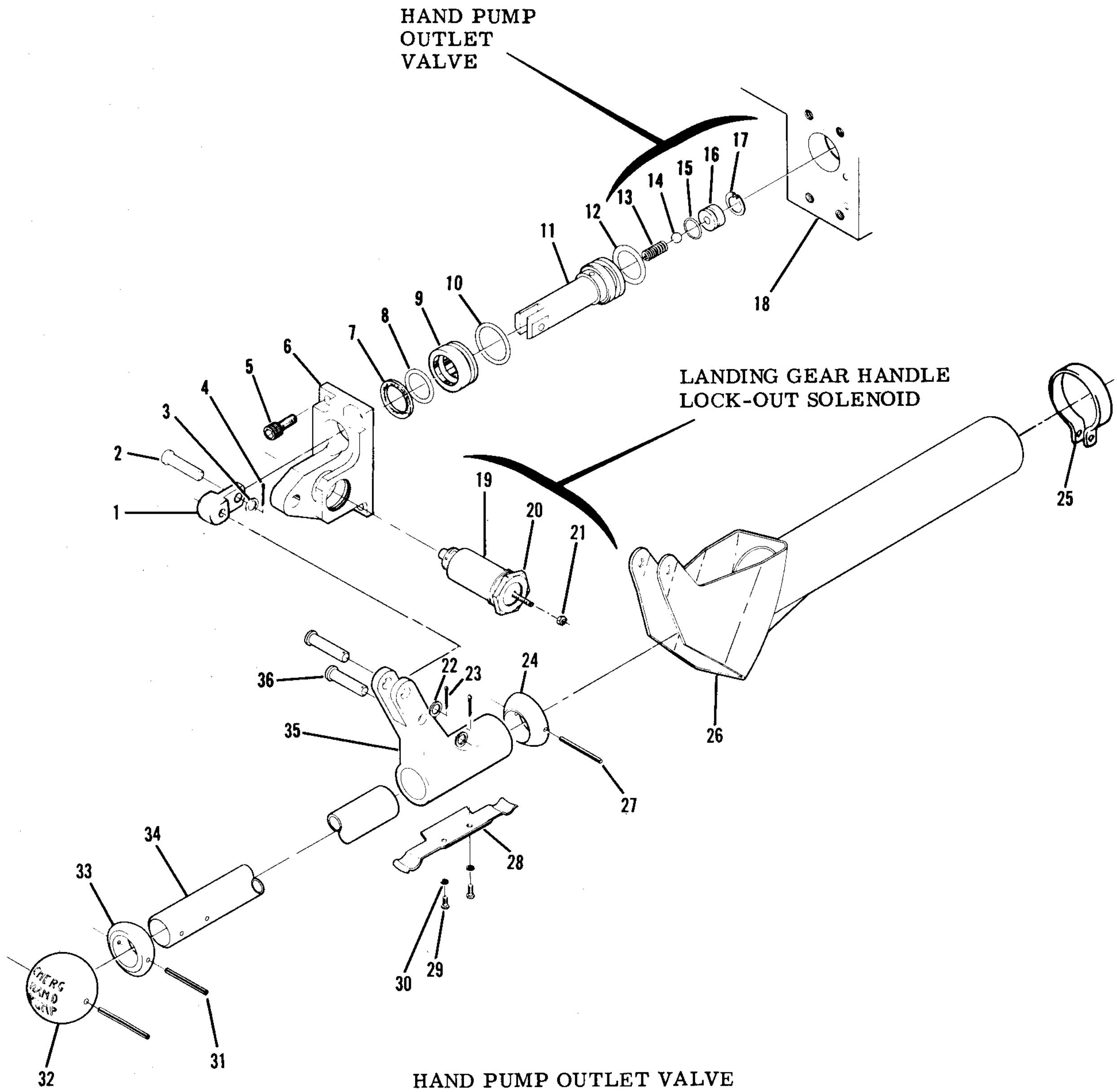


Figure A2-2. Center Section Components



1. Link
2. Pin
3. Washer
4. Cotter Pin
5. Allen Screw
6. Hand Pump Bracket
7. Scraper
8. Gland O-Ring (Internal)
9. Gland
10. Gland O-Ring (External)
11. Hand Pump Plunger
12. Plunger O-Ring

HAND PUMP OUTLET VALVE

13. Spring
14. Ball
15. Seat O-Ring
16. Seat
17. Snap Ring

18. Power Pack Body

LANDING GEAR HANDLE
LOCK-OUT SOLENOID

19. Solenoid
20. Retaining Nut
21. Stroke Adjusting Nut

22. Washer
23. Cotter Pin
24. Handle Stop
25. Clamp
26. Handle Guard
27. Pin
28. Handle Latch Spring
29. Screw
30. Washer
31. Pin
32. Handle Knob
33. Handle Stop
34. Handle
35. Lever Assembly
36. Pin

Figure A2-3. Emergency Hand Pump

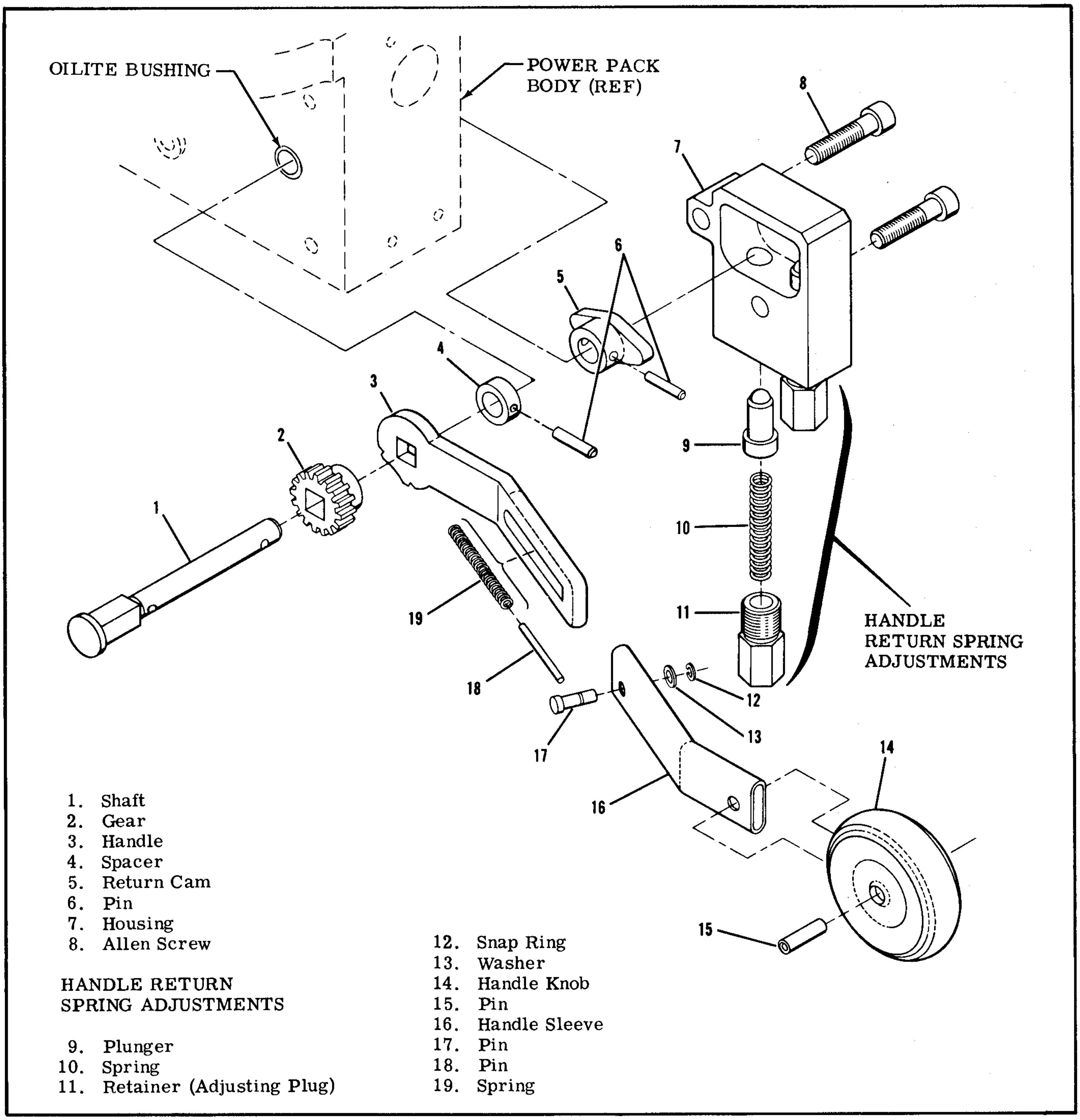


Figure A2-4. Handle and Handle-Release Mechanism

A2-10. LANDING GEAR HANDLE AND HANDLE-RELEASE MECHANISM.

a. Remove two hex-head retainers (adjusting plugs), springs, and plungers from handle return housing.

b. Cut safety wire and remove two screws attaching handle release housing to Power Pack, and remove the housing.

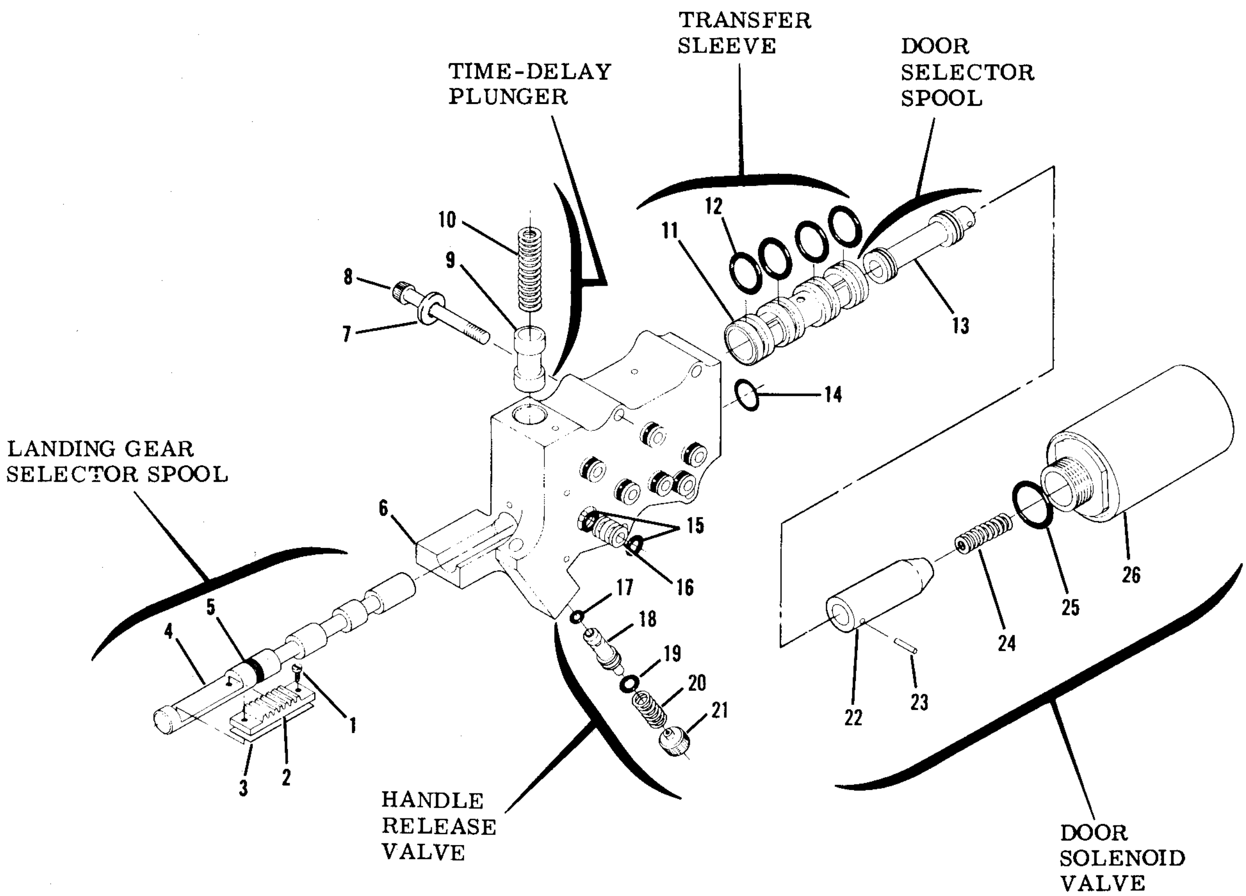
c. Using a punch, drive roll pin from cam, and remove cam from landing gear handle shaft.

d. Pull handle assembly from Power Pack.

NOTE

Do not remove spacer, handle, or gear from handle shaft except for replacement of parts.

e. Landing gear handle may be disassembled as illustrated in figure A2-4.



LANDING GEAR SELECTOR SPOOL

1. Screw
2. Rack
3. Laminated Shim
4. Spool
5. Spool O-Ring

6. Manifold
7. Washer
8. Allen Screw

TIME-DELAY PLUNGER

9. Plunger
10. Spring

TRANSFER SLEEVE

11. Sleeve
12. Sleeve O-Ring

13. Spool
14. O-Ring

15. Transfer Tube O-Rings
16. Transfer Tubes

HANDLE RELEASE VALVE

17. O-Ring
18. Poppet
19. Poppet O-Ring
20. Spring
21. Retainer (Adjusting Plug)

DOOR SOLENOID VALVE

22. Plunger
23. Pin
24. Spring
25. Solenoid O-Ring
26. Solenoid

Figure A2-5. Manifold Assembly

NOTE

On the 1968 models, an oilite bushing is added to the Power Pack housing to support the landing gear control shaft through the Power Pack. Do not remove bushing except for replacement.

f. Emergency hydraulic hand pump handle may be disassembled as illustrated in figure A2-3.

A2-11. POWER PACK REASSEMBLY. After Power Pack has been completely disassembled, remove and discard all O-rings and gaskets. Wash all parts in dry cleaning solvent (Federal Specification P-S-661, or equivalent) and dry with filtered compressed air. Inspect all threaded surfaces for serviceable condition and cleanliness. Inspect all parts for scratches, scores, chips, cracks, and indications of excessive wear. Use new O-rings and gaskets during reassembly. Lubricate all O-rings with Dow-Corning DC-4 compound during reassembly. Lubricate all threaded surfaces on the various valves in the Power Pack with MIL-G-7711 grease (or equivalent) before installing.

A2-12. DOOR VENT VALVE.
a. Install poppet in body and insert spring in body. Be sure that spring enters poppet.
b. Lubricate and install O-ring on retainer and insert retainer in valve body. Align holes in retainer with holes in valve body.
c. Install pin through valve body and retainer.
d. Lubricate threads on valve body (MIL-G-7711) and install assembly in reservoir. Tighten securely.

A2-13. STANDPIPE AND FILTER.
a. If standpipe and filter assembly was removed, press into body until standpipe bottoms.
b. Replace vent filter and snap ring.
c. Install filler line filter and secure with snap ring.
d. Install back-up ring and O-ring on fill and drain tee, and install tee as shown in figure 5-9.

A2-14. SYSTEM INLET CHECK VALVE.
a. With pressure port up, drop spring into port.
b. Drop in plunger, making sure that small end of plunger goes into spring. Check freeness of plunger in body by depressing plunger against spring. Use small wood dowel or plastic rod to depress plunger when checking freedom of movement. Plunger must move freely in body bore.
c. Lubricate and install O-rings on flange of fitting and at end of fitting. Lubricate threads (MIL-G-7711), insert fitting, start the threads, and tighten securely.

A2-15. PRIORITY VALVE.
a. Lubricate and install O-ring on poppet and insert poppet in body through reservoir. Push poppet down firmly. Either surface may be used as seating surface.
b. Inspect poppet seat for sharp seating edge. Lap as necessary to obtain a sharp seating edge. Lubricate and install O-ring on poppet seat.
c. Install poppet seat in body through reservoir, with sharp seating edge toward poppet. Push poppet seat down firmly against poppet.
d. Lubricate and install O-ring on retainer assembly, lubricate retainer threads (MIL-G-7711), and install retainer. Tighten securely.
e. Turn Power Pack upside down, lubricate spring and button (MIL-G-7711) and install body. Apply lubricant to hold button in spring and install with button in hole first.
f. Lubricate (MIL-G-7711) threads on retainer (adjusting plug) and install. This plug provides adjustment for the priority valve. Install flush at this time.

A2-16. PRIMARY RELIEF VALVE.
a. Inspect poppet and poppet seat for pitting or scoring. Since they are matched parts, if either or both are pitted or scored, replace as an assembly only.
b. Lubricate and install O-ring and back-up ring on seat, insert poppet in seat, and install assembly in body.
c. Lubricate ball, buttons, and spring (MIL-G-7711). Install with ball entering hole first. Be sure that ball enters cavity at top of poppet.
d. Lubricate threads on retainer (MIL-G-7711) and install over button and spring. Tighten securely.
e. Lubricate threads of adjusting screw (MIL-G-7711) and install at top of retainer. Turn adjusting screw full down to lock primary relief valve closed, but do not tighten lock nut. This is done so that the secondary relief valve, which opens at a higher pressure, can be adjusted before the primary relief valve is adjusted.

A2-17. HAND PUMP VALVES.
a. Insert spring and ball in body through reservoir.
b. Inspect seating surface of seat. It should have a very sharp edge. Seat may be lapped if necessary to obtain a sharp edge.
c. Lubricate and install O-ring on seat and install seat in body through reservoir.
d. Install filter screen, spacer, and snap ring in body through reservoir.
e. Install spring and ball in hand pump plunger.
f. Inspect seating surface. It should have a very sharp edge. Seat may be lapped if necessary to obtain a sharp edge.
g. Lubricate and install O-ring on seat and install seat in hand pump plunger. Secure with snap ring.
h. Lubricate and install O-ring on plunger, and internal and external O-rings on bronze gland.
i. Install gland on plunger, and insert plunger and gland into body.
j. Install scraper ring in counterbore of gland. Install so that flat surface of scraper is in counterbore of gland and inner protruding part of scraper faces outward.
k. Thread lock-out solenoid wires through hand pump bracket, position solenoid, and install retainer nut. Do not tighten lock-out solenoid retainer nut at this time.
l. Attach hand pump bracket to Power Pack. Shift bracket so that lock-out solenoid plunger does not bind in any way with the landing gear handle barrier, then tighten bracket attaching screws, but do not safety at this time.
m. Install hand pump handle with pivot and linkage pins. Secure with cotter pins.

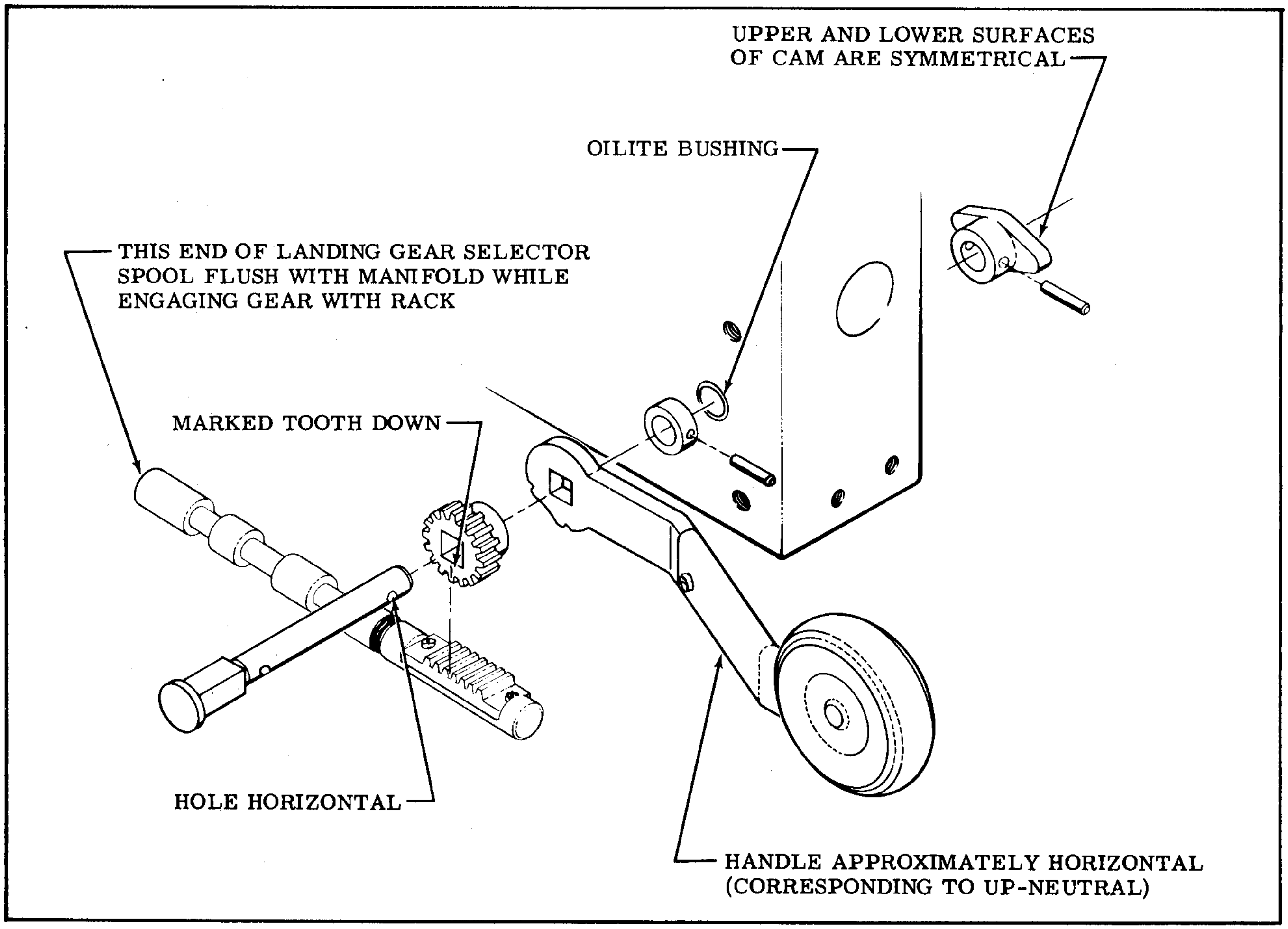


Figure A2-6. Timing of Handle and Selector Spool

A2-18. MANIFOLD ASSEMBLY.

a. Lubricate and install the O-ring on landing gear selector spool, and the O-ring in manifold at the opposite end.

NOTE

If landing gear selector spool, manifold, and time-delay plunger are being replaced, install rack with a new laminated shim on selector spool. The landing gear selector spool, time-delay valve plunger, and manifold are matched, lapped parts. If necessary to replace, replace as an assembly only.

b. Insert selector spool in manifold from landing gear handle end of manifold. Insert only until end of selector spool is flush with solenoid end of manifold.

CAUTION

If the selector spool is moved much more than flush with the manifold at the end opposite the rack (before the manifold is installed and the rack engaged properly with the gear on the landing gear handle), an O-ring will become caught. The selector spool will then have to be removed, the manifold cleaned to remove all O-ring particles, and a new O-ring installed. The selector spool then must be reinstalled correctly.

c. Check that spool slides freely.

d. Inspect door solenoid spool for freedom of movement within the transfer sleeve assembly.

NOTE

Spool and sleeve are matched parts. If necessary to replace, replace as an assembly only.

e. Lubricate and install O-rings on transfer sleeve and install sleeve in manifold.

f. Attach plunger to door selector spool with pin.

g. Lubricate and install O-ring on solenoid.

h. Lubricate solenoid threads and spring (MIL-G-7711) and insert into plunger, then install solenoid over spring and plunger. Screw solenoid into manifold. Do not overtighten solenoid, but tighten securely by hand. Safety the solenoid to adjacent Power Pack mounting lug.

A2-19. LANDING GEAR HANDLE AND HANDLE-RELEASE MECHANISM.

a. Assemble emergency hydraulic hand pump handle as illustrated in figure A2-3.

b. If the landing gear handle was disassembled, assemble as illustrated in figure A2-4. When

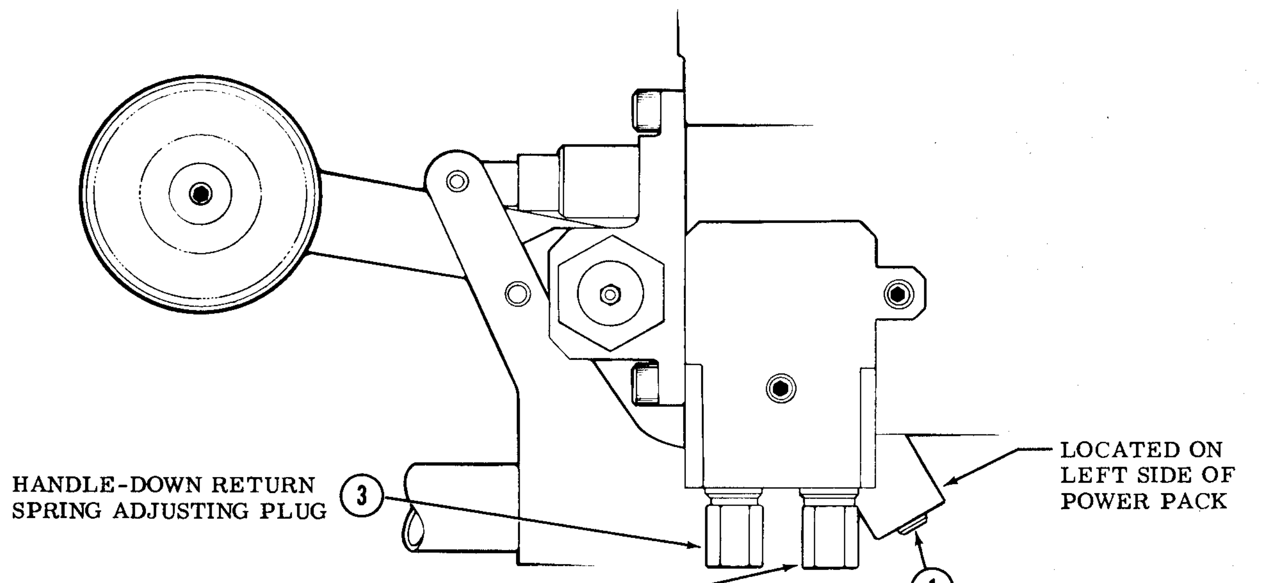


Figure A2-7. Handle Release Adjustment

assembling gear handle, insert pin in spring and place in slot of handle. Using a small punch, compress spring slightly to install clevis pin.

c. If the landing gear handle shaft or gear was removed, the parts must be indexed and assembled as shown in figure A2-6.

d. Lubricate shaft (MIL-G-7711), install spacer on shaft with roll pin, and insert shaft into Power Pack.

e. Install cam with roll pin. Both sides of cam surfaces are identical. Check landing gear handle for freedom of movement in Power Pack. Check for slight end play in shaft. If handle binds, remove cam and lap inside boss of cam to obtain slight end play in shaft with cam installed.

f. Install handle-release housing and safety attaching screws. Check landing gear handle for freedom of movement.

NOTE

Do not install plungers, springs, and hex-head retainers (adjusting plugs) at this time.

A2-20. MANIFOLD INSTALLATION.

a. Lubricate and install O-rings on the seven transfer tubes.

b. Insert transfer tubes into Power Pack body.

c. Install time-delay valve plunger in manifold. Plunger must move freely in manifold without binding.

d. Mate manifold to Power Pack body, using care to prevent damage to O-rings on transfer tubes. Align dowel pin in Power Pack with dowel hole in manifold.

NOTE

When installing manifold, time the landing gear handle assembly to rack on selector spool as shown in figure A2-6. Refer to the following steps if binding exists.

e. Install four manifold attaching screws and washers. Torque screws to 35 pound-inches and safety. Do not over-torque screws, as this will cause binding in the movement of landing gear handle.

NOTE

If a new landing gear selector spool, time-delay plunger, and manifold (a matched assembly) are being installed, the rack on the selector spool must be shimmed properly to provide a slight backlash (free movement) between the teeth of the rack and the teeth of the gear on the handle. This adjustment is provided by a laminated shim. If excessive backlash exists, a new shim must be used. If no backlash exists, or if a new shim is being installed, the "trial-and-error" method should be used, since the backlash is determined after manifold attaching screws are installed and torqued. Remove one lamination at a time until backlash exists when screws are torqued properly, then do not remove any more laminations. Apply Loctite to rack retainer screws only after final adjustment of shim has been determined and screws are being installed for the last time.

f. Lubricate and install two O-rings on time-delay valve retainer.
g. Lubricate (MIL-G-7711) and insert larger spring and spacer in body through reservoir.
h. Lubricate (MIL-G-7711) and insert ball and smaller spring in time-delay valve retainer (ball next to top of retainer).
i. Lubricate threads on time-delay valve retainer (MIL-G-7711) and install retainer in body through reservoir. Do not overtighten time-delay valve retainer as this will cause the landing gear selector to bind in the manifold. After tightening time-delay valve retainer, check for freedom of movement of landing gear handle and selector spool.
j. Thoroughly lubricate handle return springs and plungers (MIL-G-7711) and install in housing with hex-head retainers. Do not tighten retainers at this time.
k. Lubricate and install two O-rings on landing gear handle release plunger and insert plunger in body.
l. Lubricate landing gear handle release spring and retainer (MIL-G-7711) and install in body. Tighten retainer (adjusting plug) until almost flush with body.
m. Install gear and rack protective cover. Safety attaching screws.
n. Install landing gear up-down switch and the switch attaching bracket. Note that washers are used between the bracket and Power Pack. Switch bracket has slotted holes for switch adjustment.

NOTE

With landing gear handle at centerline of barrier, adjust up-down switch so that switch clicks at an equal distance up and down from centerline of barrier as landing gear handle is moved up and down.

o. Install terminal strip and place capacitor alongside the strip. Connect electrical wires to terminal strip and ground, clamping wires to door solenoid valve. If the wires from the handle lock-out solenoid are not long enough, rotate the lock-out solenoid until the wires will reach their connections. Tighten the lock-out solenoid retainer nut, and safety the retainer nut and hand pump bracket attaching screws together.

NOTE

Electrical wires are coded with color stripes. Disregard color of wire terminals or plastic sleeving. If color codes are matched when wires are installed, the wires will be connected correctly.

p. A small nut is provided at the handle lock-out solenoid to adjust the stroke of the solenoid plunger. Adjust the nut so that the solenoid plunger fully engages the handle detent when released, but clears the handle when it is actuated, even when slight side-pressure is exerted manually on the handle.
q. Continue reassembly of Power Pack after pressure adjustments have been completed.

A2-21. PRESSURE ADJUSTMENTS.

NOTE

This procedure requires a minimum of test equipment and is intended for bench-testing the Power Pack after field repair.

TEST EQUIPMENT.
a. One hydraulic hand pump of 2000 psi capacity.
b. One hydraulic pressure gage of 2000 psi capacity.
c. One hydraulic pressure gage of 150 psi capacity.
d. High pressure hose to attach hand pump to Power Pack inlet fitting.
e. Drain hose to connect to Power Pack reservoir drain fitting.

A2-22. GENERAL CONDITIONS. Use only clean hydraulic fluid (MIL-H-5606). Install a tee at the hand pump pressure outlet, and attach the 2000 psi pressure gage and the pressure hose to the tee. Connect the hose from the hand pump to the Power Pack pressure inlet fitting, labeled "PUMP." Connect drain hose to Power Pack reservoir fill and drain tee. Cap all other fittings with high-pressure caps.

NOTE

Some Hydro Test units are equipped with a hand pump, and others are provided with a pressure jack and provisions to install a hand pump.

A2-23. HANDLE-RELEASE MECHANISM. (See figure A2-7.) The following procedure outlines preliminary adjustments to set the handle-release detent spring load and the handle-return spring load adjusting plugs in approximately their correct positions before installing the Power Pack in the airplane. After it has been installed, the system must be checked and final adjustments, if needed, made at that time.
a. With handle-return spring adjusting plugs (2 and 3) not tightened, screw in detent spring adjusting plug (1) until it is approximately flush. The spring, however, must not bottom out.
b. Place handle in up-detent position, then hold it beyond this position (in overtravel).
c. Tighten forward handle-return spring adjusting plug (2) until handle just starts to move out of overtravel, then loosen the adjusting plug one turn.
d. Place handle in down-detent position, then hold it beyond this position (in overtravel).
e. Tighten aft handle-return spring adjusting plug (3) until handle just starts to move out of overtravel, then loosen the adjusting plug one turn.
f. Place handle in up-detent position and tighten handle-release detent spring adjusting plug (1) until the spring bottoms out, then back the adjusting plug out two turns.
g. Handle must hold in both detent positions, but must return with a positive snap when manually released from either detent position. Handle-release detent spring adjusting plug (1) may be readjusted slightly more or slightly less than the two turns specified in the preceding step if necessary.

A2-24. PRIMARY RELIEF VALVE.

a. Loosen lock nut and back adjusting screw at top of valve out until very little load is left on spring.

b. With landing gear handle in neutral, apply pressure until fluid flows from primary relief valve.

c. Adjust primary relief valve until valve cracks at 1700 psi. Adjusting this valve to 1700 psi cracking pressure will give approximately 1800 psi when valve is in a flow condition. Bleed pressure after each adjustment by cracking cap on door-open fitting. Tighten lock nut on adjusting screw after obtaining correct adjustment.

A2-25. PRIORITY VALVE.

a. Place landing gear handle in up position and remove cap from gear-up fitting.

b. Apply pressure and note priority valve cracking pressure by observing pressure gage when fluid first starts to flow from gear-up port.

c. Adjust priority valve to crack at 750 psi. Bleed pressure after each adjustment by cracking cap on door-open fitting.

d. Disconnect test pump and cap all open fittings.

A2-26. DOOR SOLENOID VALVE.

a. Remove caps from door-open and door-close fittings on Power Pack.

b. Connect Test Harness as shown in figure 5A-23.

c. With Test Harness switch in OFF position, and landing gear handle in either up or down neutral, apply pressure and note that fluid flows from door-open fitting.

d. With Test Harness switch in either gear up or down position, landing gear handle in either up or down neutral, apply pressure and note that fluid flows from door-close fitting.

e. Disconnect test equipment and cap all open fittings.

A2-27. DOOR VENT VALVE.

a. Remove cap from door-open fitting on Power Pack, and attach pressure hose from hand pump with 150 psi pressure gage to door-open fitting.

b. Slowly apply 50 psi pressure and check to see that fluid flows from door vent valve.

c. Increase pressure to 100 psi minimum and check to see that door vent valve shuts off fluid flow, except for slight fluid seepage through the valve.

d. Relieve pressure by cracking hose fitting from hand pump.

e. Disconnect test pump and cap all open fittings.

A2-28. EMERGENCY HAND PUMP TEST.

a. Fill reservoir with clean MIL-H-5606 hydraulic fluid to the top of the standpipe in reservoir.

b. Remove cap from door-open port and operate emergency hand pump until fluid flows from port with no evidence of air in the system. Replenish reservoir with clean hydraulic fluid as necessary to maintain fluid level.

c. After pump is primed and bled of all air, remove fitting and install 2000 psi gage at door-open port.

d. Operate emergency hand pump very slowly until pressure on gage stops increasing, indicating that the secondary relief valve has opened.

CAUTION

It is very important that the hand pump be operated very slowly as pressure is being increased to bleed the secondary relief valve. If the hand pump is operated rapidly, damage to the valve can occur as air permits parts to "slam" against each other.

Maximum indication on the gage should be 1900 to 1950 psi. During the pumping operation, the emergency hand pump should not feel spongy in either the up or down stroke.

e. Crack gage in door-open port to release pressure, remove gage, reinstall and cap door-open fitting, and drain fluid from reservoir.

To complete the reassembly of the Power Pack, proceed as follows:

a. Install reservoir cover attaching stud. Install with longer threaded end down, and screw in until stud bottoms in reservoir.

b. Install baffle and center stud spacer. Safety wire primary relief valve lock nut to screened standpipe.

c. Lubricate and install O-ring in groove of reservoir cover.

d. Position reservoir cover on reservoir, aligning index marks on reservoir and cover. Vent fitting in cover points to the left with Power Pack in airplane.

CAUTION

Be sure that the large O-ring is positioned properly in the groove of the reservoir cover and that the O-ring is not pinched as the cover is installed.

e. Lubricate and install O-ring at top of cover around center stud.

f. Install cover retaining nut (cap nut), tighten, and safety.

A2-29. RESERVOIR LEAKAGE TEST.

a. Remove filler and drain tee, and attach hand test pump and 150 psi gage to filler port.

b. Remove cap from reservoir vent fitting at top of reservoir and operate test hand pump until reservoir is completely full, indicated by fluid coming out of the fitting.

c. Cap reservoir vent fitting.

d. Operate test hand pump very slowly until pressure gage indicates 15 psi maximum.

e. Check for leaks. There should be no external leakage.

f. Crack vent fitting to release pressure, remove test equipment, drain reservoir, and cap fittings.

g. Hydraulic Power Pack is now ready to be installed in the airplane.

NOTE

After Power Pack is installed in airplane, refill reservoir.

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SECTION A3

REPAIR OF HYDRAULIC PUMP

A3-1. DISASSEMBLY. (See figure A3-1.)
a. Plug all ports and clean outside of pump with solvent.
b. Clamp pump in vise, shaft down and remove cap screws and washers (1 and 2).
c. Remove rear housing (3) by rocking from side to side and sliding it off the gear shafts and dowel pins. In case of sticking, gently tap, with either plastic or rubber hammer, from side to side. Do not pry sections apart with a screwdriver. Scratches caused by pry tool will prevent sealing of mating surfaces.

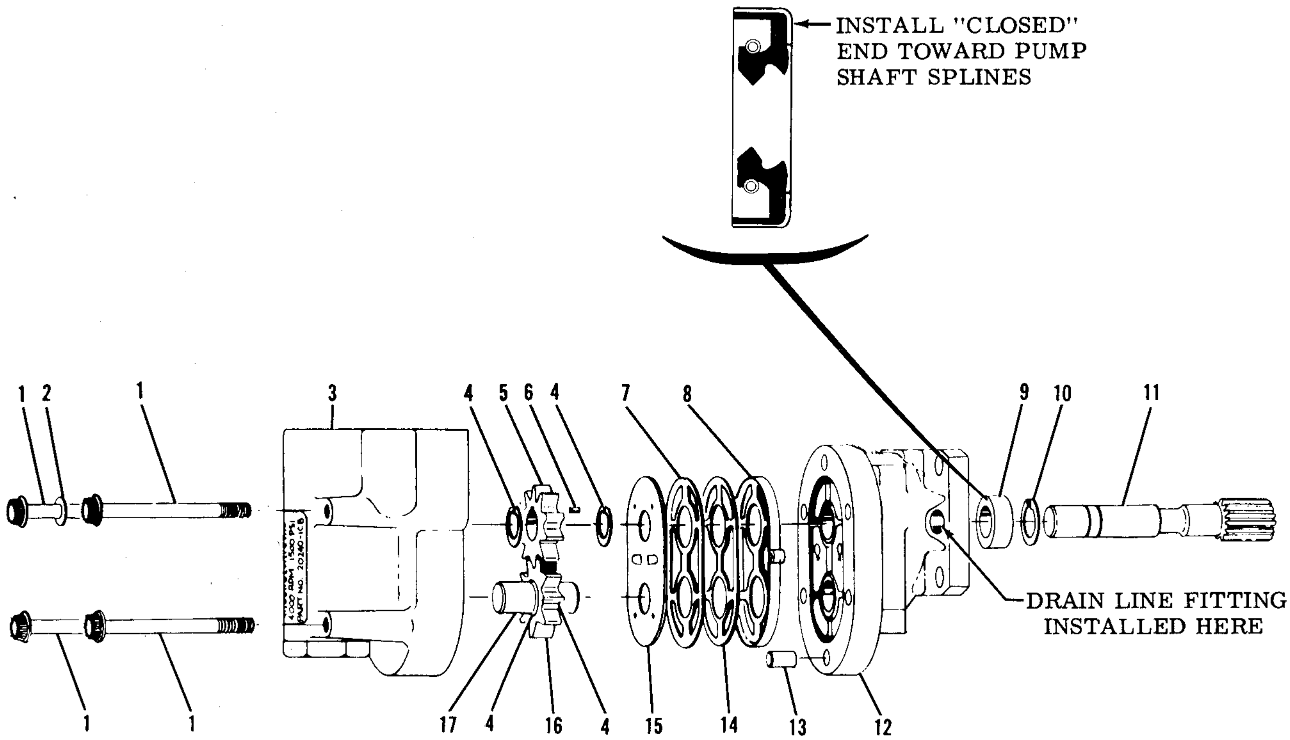
NOTE

Do not disassemble rear housing (3).

d. Remove idler gear assembly (16).
e. Remove snap ring (4) from drive shaft, being careful not to scratch bearing surface of drive shaft.
f. Remove gear (5) and key (6) from drive shaft (11).
g. Remove remaining snap ring (4) from drive shaft (11).
h. Remove drive shaft (11) from front housing (12) by pulling it out of housing by splined end.
i. Remove diaphragm (15) from front plate (12) by prying with a sharp tool.
j. Remove phenolic back-up gasket (7) and protector gasket (14) from front plate (12).
k. Remove diaphragm seal (8) from front plate (12).
l. Remove snap ring (10) and drive shaft seal (9) from bore in front plate (12).

A3-2. INSPECTION OF PUMP. Clean all metal parts with cleaning solvent and dry with filtered compressed air. Prior to reassembly of the pump, inspect all parts as follows:

ITEM	INSPECTION	REPAIR
Gears and Shafts.	Inspect drive gear shaft for broken splines.	Replace shaft if damaged.
Gears and Shafts.	Inspect both the drive gear and idler gear shaft at bearing points and shaft seal areas for rough surfaces and excessive wear. If shafts measure less than .4360 in bearing area, they should be replaced.	Replace drive gear shaft. Replace idler gear shaft.
	Inspect gear face for scoring and excessive wear. If gear width is below .1950, drive gear or idler gear should be replaced.	Replace drive gear. Replace idler gear.
	Visually inspect snap rings on idler gear shaft. They should be in grooves.	Replace if necessary.
	Visually inspect edges of gear teeth to see if they are too sharp.	Break sharp edge with emery cloth.
Front Plate.	Visually inspect bearings for scratches or scoring. Measure I.D. bearings. If I.D. measures more than .4400, front plate should be replaced.	Replace front plate assembly (Bearings are not available as separate items).
	Visually inspect bearings for proper positioning. Bearings should be flush with islands in groove pattern. Splits in bearings should be in line with dowel pin holes and in position closest to the respective dowel pin hole.	Replace front plate assembly if bearings are out of position. (Bearings are not available as separate items).



1. Cap Screw
2. Copper Crush Gasket
3. Rear Housing Assembly
4. Snap Ring
5. Gear
6. Key
7. Phenolic Back-Up Gasket
8. Diaphragm Seal
9. Shaft Seal
10. Snap Ring
11. Drive Shaft
12. Front Plate Assembly
13. Dowel Pin
14. Protector Gasket
15. Diaphragm
16. Idler Gear
17. Idler Gear Shaft

Figure A3-1. Engine-Driven Hydraulic Pump

Rear Housing.	Visually inspect inside gear pockets for excessive scoring or wear. Also measure I. D. and depth of gear pockets. I. D. should not exceed 1.691 and depth should not exceed .1972.	If badly scored or wear exceeds dimensions given, replace rear housing assembly.
	Visually inspect bearings for scratches or scoring. I. D. should not exceed .4400.	If I. D. of bearing exceeds dimensions given, replace rear housing assembly.
	Visually inspect bearings for proper positioning. Splits in bearings should be in line with dowel pins and in position closest to the respective dowel pin.	If bearings are out of position, replace rear housing. (Bearings are not available as separate items).

A3-3. REASSEMBLY.

NOTE

The diaphragm (15), phenolic gasket (7), protector gasket (14), diaphragm seal (8), drive gear snap rings (4), shaft seal (9), snap ring (10), copper crush washer (2), and key (6) should be replaced with new parts when reassembling hydraulic pump. Major Seal Repair Kit No. 20240-36 consisting of the above parts is available from the Cessna Service Parts Center.

a. Install new shaft seal (9) in front plate with flat metal side of seal in front plate and the tapered internal part of seal toward pump shaft splines. Install snap ring (10) in groove in front plate with sharp edge of snap ring toward shaft splines.

b. Place diaphragm seal (8) on front plate (12) with flat side of seal down (cup side of seal up). Using a dull pointed tool, work diaphragm seal to bottom of grooves in front plate. Be sure that seal is all the way down in grooves of front plate.

c. Press protector gasket (14) and phenolic back-up gasket (7) into cup of diaphragm seal.

d. Place diaphragm (15) on top of phenolic back-up gasket with bronze face of diaphragm up, next to the gears. The two small depressions on the bronze face must match the two depressed areas in the rear housing.

NOTE

Protector gasket (14), phenolic back-up gasket (7), and diaphragm (15) must fit inside cup of diaphragm seal (8).

e. Coat drive shaft (12) with grease to prevent damage to seal (9) as drive shaft is installed.

f. Work drive shaft (12) through shaft seal (9) and into position.

g. Install snap ring (4) in groove on shaft next to diaphragm.

h. Place key (6) in slot in drive shaft and install gear (5) over key in shaft.

i. Install snap ring (4) in groove of shaft (11) next to gear (5).

j. Install idler gear assembly (16).

k. Slide rear housing assembly (3) over gear shafts until dowel pins (13) are engaged.

l. Install cap screws (1) with copper crush washer (2) on the 1-3/4 inch long screw which passes through the suction port of the pump. Tighten cap screws evenly to torque value of 7-10 lb ft.

m. Rotate pump shaft by hand. Pump will have small amount of drag, but should turn freely after short period of use.

SHOP NOTES:

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SECTION A4

REPAIR OF MAIN GEAR ACTUATOR

A4-1. LEADING PARTICULARS.

Cylinder Bore Diameter	2.125 in.
Piston Diameter	2.122 in.
Piston Rod Diameter	0.934 in.
Cylinder Stroke	2.937 in.
Shaft Rotation - Loaded	161°(min)
Shaft Rotation - Unloaded	167°(max)

A4-2. DISASSEMBLY. (See figure A4-1.)

a. Remove screw (11) and remove end gland (10) and metering pin (13) by unscrewing end gland from cylinder body (2).

b. Remove cap plug (24) and rotate shaft (1) to remove piston (5). Using a small rod push piston from cylinder body.

c. Cut safety wire and remove cap (18) by removing screws (20) and washers (19).

d. Remove set screw (21) from sector (16) and remove sector and shaft (1) from cylinder body. Retain washers (15).

NOTE

Unless defective, do not remove helicoils, name plate, bearings (14, 17 and 22), or roller (23).

e. Remove O-ring (4) from cylinder body (2).

f. Remove snap ring (8) and remove metering pin (13) from end gland (10). Remove and discard O-rings (7 and 9) from end gland.

g. Thoroughly clean all parts in solvent (Federal Specification P-S-661, or equivalent).

A4-3. INSPECTION OF PARTS. Perform the following inspections to ascertain that all parts are in serviceable condition.

a. Inspect all threaded surfaces for cleanliness and freedom from cracks and wear.

b. Inspect cap (18), washers (15), sector (16), shaft (1), piston (5), roller (23) and cylinder body (2) for cracks, chips, scratches, scoring, wear, or surface irregularities which may affect their function or the overall operation of the actuator.

c. Inspect bearings (14, 17 and 22) for freeness of motion, scores, scratches and Brinnel marks.

A4-4. REPLACEMENT/REPAIR OF PARTS.

a. Repair of small parts of the main gear actuator is impractical. Replace all defective parts with serviceable parts. Minor scratches or score may be removed by polishing with abrasive crocus cloth (Federal Specifications P-C-458) providing their removal does not affect the operation of the unit.

b. During reassembly install all new O-rings.

A4-5. ASSEMBLY (See figure A4-1.)

NOTE

Use MIL-G-3278 lubricant on roller (23), bearings (14, 17 and 22), and sector (16), when installing parts in cylinder body.

a. Press one bearing (22) into cylinder body until flush. Install roller (23) and press other bearing (22) in place to hold roller. Use care to prevent damage to bearings and roller.

b. Press bearing (14) in until seated against retaining base in cylinder body. Press bearing (17) in until flush in cap (18).

c. Place shaft (1) in cylinder body and place one washer (15) over shaft in cylinder body.

d. Position sector (16) on splines of shaft so that index marks on shaft and sector are aligned, with teeth of sector toward cylinder end of actuator. Install and tighten set screw (21). Be sure end of set screw enters depression in shaft.

e. Install new O-ring (4) in cylinder body bore and install new O-ring (6) on piston (5).

f. Slide piston (5) into cylinder body, rotating shaft as necessary to engage first tooth on sector with first tooth on piston rack. Use care to prevent damage to O-rings in cylinder body bore and on piston.

NOTE

Lubricate sector and piston rack gears with MIL-G-3278 lubricant. Apply grease sparingly. Overgreasing may cause contamination of the hydraulic cylinder with grease, which may work past O-ring (4).

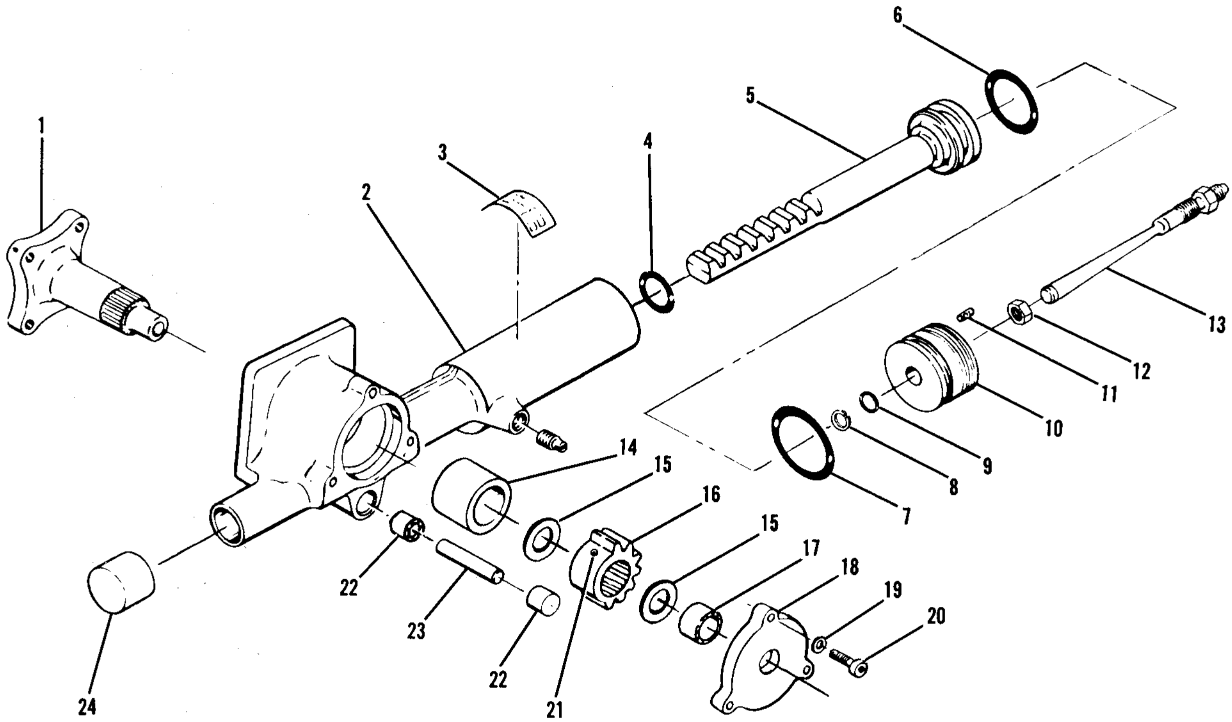
g. Install washer (15) on shaft next to sector and install cap (18), washers (19) and screws (20). Tighten screws evenly to a torque value of 90-100 lbs-in. and install lockwire.

h. Install new O-ring (9) in end gland (10) and install a new O-ring (7) on end gland.

i. Install metering pin (13) in end gland (10) and install snap ring (8) on metering pin.

j. Install end gland and metering pin assembly in cylinder and tighten until end of end gland is flush with end of cylinder. Install and tighten set screw (11).

k. Install cap plug (24) at end of actuator assembly.



NOTE

Lubricate sector, piston rack gears, and all bearings with MIL-G-3278 grease during assembly of the main gear actuator.

1. Shaft
2. Cylinder Body
3. Name Plate
4. O-Ring
5. Piston
6. O-Ring
7. O-Ring
8. Snap Ring
9. O-Ring
10. End Gland
11. Set Screw
12. Locknut
13. Metering Pin
14. Bearing
15. Washer
16. Sector
17. Bearing
18. Cap
19. Washer
20. Screw
21. Set Screw
22. Bearing
23. Roller
24. Cap Plug

Figure A4-1. Main Gear Actuator

SECTION A5

REPAIR OF NOSE GEAR ACTUATOR

A5-1. LEADING PARTICULARS.

Cylinder Bore Diameter	0.740 in.
Piston Rod Diameter	0.437 in.
Stroke	8.238±0.065 in.
Length (C/L bushing to C/L of hook pins) (retracted)	11.580±0.031 in.
Ball Lock (unlocking pressure)	100±25 psi
Ball Lock (locking pressure)	275 psi (max)
Hook Lock (unlocking pressure)	250 psi (max)

A5-2. DISASSEMBLY (See figure A5-1.)

a. Unlock cylinder by applying hydraulic pressure to port in head (25).

b. Loosen locknut (12) at end of piston rod and unscrew parts (1 thru 11) as an assembly from piston rod. Remove locknut (12) from piston rod.

c. Mark barrel (33) and head (25) so that same end of barrel may be reinstalled in head (25) when reassembling actuator. Remove safety wire from locknuts (32 and 35).

d. Remove setscrew (18) in bearing end (17) and loosen locknut (35). While using a strap wrench on barrel (33), remove bearing end (17) from barrel.

e. Pull piston (20) from barrel using care to prevent loss of balls (23) as piston is removed from barrel.

f. Remove setscrew (18) from head (25) and loosen locknut (32). Using a strap wrench on barrel (33), remove head (25) from barrel.

g. Remove O-ring (19) from head (25) and remove plunger (29) and parts (26 thru 31) by applying a sharp blast of air in the vent hole located in head (25).

h. Remove all O-rings and backup rings.

i. Disassemble hook assembly.

A5-3. INSPECTION OF PARTS. Make the following inspections to ascertain that all parts are in a serviceable condition.

a. Inspect all threaded surfaces for cleanliness and for freedom from cracks and excessive wear.

b. Inspect spring (6) for evidence of breaks and distortion. The free length of the spring must be 2.460±.080 inches and compress to 2.00 inches under a 19.5±1.95 pound load.

c. Inspect spring (26) for evidence of breaks and distortion. The free length of the spring must be 1.055 inches and compress to .875 inch under a 35±3.5 pound load.

d. Inspect hooks (4 and 10), spring guide (7), bearing end (17), piston and stop assembly (20), barrel (33), head (25) and bushing (24) for cracks, chips, scratches, scoring, wear, or surface irregularities which may affect their function or the overall function of the nose landing gear actuator.

A5-4. REASSEMBLY. Repair of most parts of the nose gear actuator assembly is impractical. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new O-rings and backup rings during reassembly of the actuator.

a. Install O-ring (28) and backup ring (27) in groove on plunger (29).

b. Insert spring (26) and plunger (29) into head (25). Install stop washer (30) and race (31) over end of plunger (29) and install O-ring (19) in groove in head (25).

c. With locknut (32) on barrel, screw barrel (33) into head (25) until tapped hole in head is aligned with hole in barrel.

NOTE

Be sure that marked end of barrel is installed in head (25). Barrel should tighten against race to prevent any movement between stop washer and race.

d. Install and tighten set screw (18) in head (25). Tighten locknut (32).

e. Install O-ring (22) and backup rings (21) in groove on piston and install balls (23) in holes of piston.

f. Insert piston into barrel. Be sure all six balls are in place in piston.

g. Install O-rings (19 and 14) and backup rings (13) in grooves in bearing end (17).

h. With locknut (35) on barrel, screw bearing end (17) on barrel until tapped hole in bearing end is aligned with hole in barrel. Install and tighten setscrew in bearing head (17). Tighten locknut (35).

NOTE

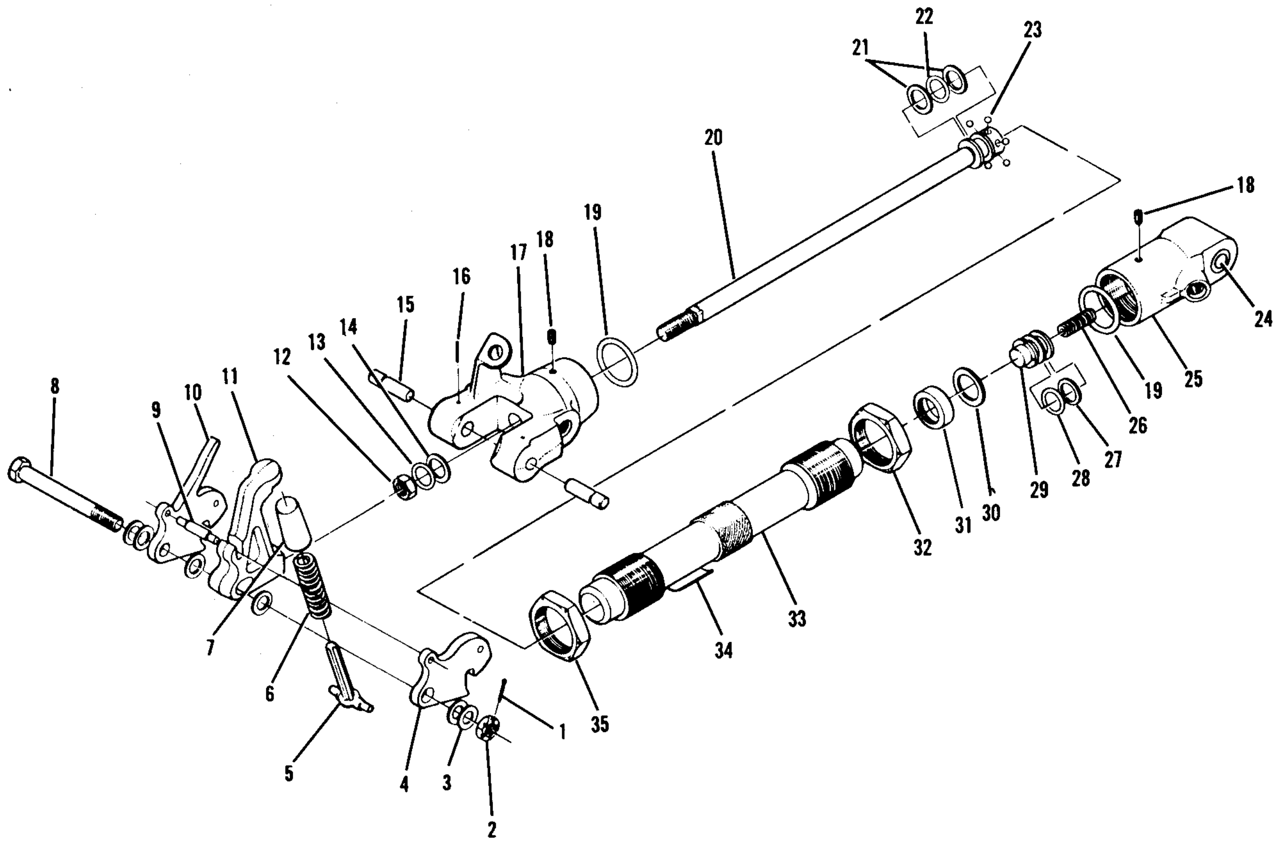
Centerline of hook pins and centerline of bushing hole must align within .005 inch with cylinder locked at a length of 11.580 ±.031 inches from centerline of hookpins to centerline of bushing (24) in head (25).

i. Install locknut (12) on end of piston. Assemble and install hook assembly on piston.

NOTE

When assembling hook assembly, lubricate as shown in Section 2.

j. After repair, rig nose gear actuator as shown in Section 5A.



1. Cotter Pin	13. Back-Up Ring	24. Bushing
2. Nut	14. O-Ring	25. Head
3. Washers	15. Pin	26. Spring
4. Hook	16. Pin	27. Back-Up Ring
5. Spring Guide	17. Bearing End	28. O-Ring
6. Spring	18. Setscrew	29. Plunger
7. Shield	19. O-Ring	30. Washer
8. Bolt	20. Piston	31. Race
9. Crossbar	21. Back-Up Rings	32. Nut
10. Hook	22. O-Ring	33. Barrel
11. Rod End	23. Balls	34. Nameplate
12. Nut		35. Nut

Figure A5-1. Nose Gear Actuator

SECTION A6

REPAIR OF LOCK, UNLOCK, & SEQUENCE CYLINDERS

A6-1. LEADING PARTICULARS.

Cylinder Bore Diameter	1.00 + .002, -.000 in.
Rod Diameter	.343 + .001, -.002 in.
Piston Stroke (total)	.812 in.
Piston Stroke (to unseat valve)	.719±.031 in.

A6-2. DISASSEMBLY (See figure A6-1.)

a. Remove fitting (13), spring (11), and balls (10) and (9).

b. Cut safety wire and unscrew end plug (1) from barrel and valve body (8).

c. Remove springs (2 and 3) and push piston (5) from barrel and valve body.

d. Remove and discard O-rings (4, 6, and 14) and remove and discard back-up rings (7 and 15).

A6-3. INSPECTION OF PARTS. Make the following inspections to ascertain that all parts are in a serviceable condition.

a. Inspect all threaded surfaces for cleanliness and for freedom from cracks and excessive wear.

b. Inspect spring (3) for evidence of breaks and distortion. The free length of the spring must be 2.95±.09 inches and compress to 1.969 inches under a 22.5±2.2 pound load.

c. Inspect spring (2) for evidence of breaks and distortion. The free length of the spring must be 2.98±.09 inches and compress to 1.969 inches under a 10.6±1.1 pound load.

d. Inspect spring (11) for evidence of breaks and distortion. The free length of the spring must be .446±.015 and compress to .359 inches under a .18 ±.02 pound load.

e. Inspect plug (1), piston and rod (5), barrel and valve body (8), balls and ball seats for cracks, chips, scratches, scoring, wear, or surface irregularities which may affect their function or the overall function of the unit.

A6-4. REASSEMBLY. Repair of most parts of the lock cylinder is impractical. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new O-rings and back-up rings during reassembly of the lock cylinder.

a. Install new O-rings (4 and 6) and back-up ring (8) in grooves on piston and rod (5).

b. Install new O-ring (14) and back-up ring (15) in groove of barrel and valve body (8).

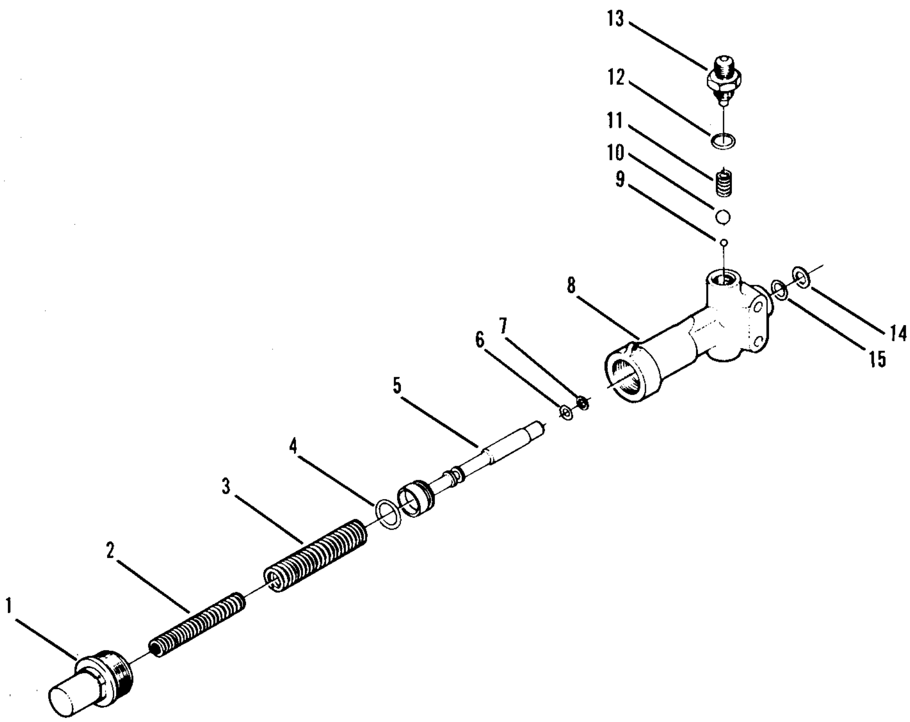
c. Slide piston and rod (5) into barrel and valve body (8). Use care to prevent damage to O-rings and back-up rings.

d. Insert springs (2 and 3), then install and safety end plug to barrel and valve body.

e. Insert balls (9 and 10) and spring (11) in barrel and valve body.

f. Install a new O-ring (12) on fitting (13), install and tighten fitting.

SHOP NOTES:



1. End Plug
2. Spring
3. Spring
4. O-Ring
5. Piston and Rod
6. O-Ring
7. Back-Up Ring
8. Barrel and Valve Body
9. Ball
10. Ball
11. Spring
12. O-Ring
13. Fitting
14. O-Ring
15. Back-Up Ring

Figure A6-1. Lock, Unlock, and Sequence Cylinders

SHOP NOTES:

SECTION A7

REPAIR OF DOOR ACTUATORS

A7-1. LEADING PARTICULARS.

Cylinder Bore Diameter	0.625 in.
Piston Rod Diameter	0.3125 in.
Stroke (nose gear and main gear strut)	5.75 + .06, -.03 in.
Stroke (main gear wheel)	5.35 + .06, -.03 in.
Length - extended (nose gear and main gear strut)	17.50 + .06, -.03 in.
Length - extended (main gear wheel)	17.11 + .06, -.03 in.
Length - retracted (all)	11.75 + .06, -.03 in.
Ball lock (unlocking pressure)	100±25 psi
Ball lock (locking pressure)	275 psi(max)

A7-2. DISASSEMBLY. (See figure A7-1.)

a. Unlock cylinder by applying hydraulic pressure to port in clevis end (22) of actuator.

b. Loosen locknut (2) and remove rod end (1) from piston rod. Remove locknut from piston.

c. Remove safety wire from knurled nuts (13) and loosen knurled nuts.

d. Remove gland end (5) from barrel (17), using a strap wrench on barrel.

e. Remove clevis end (22) from barrel, then push piston (7) from barrel. Use care when pushing piston from barrel, to prevent loss of balls (12).

f. Remove spacer (6) from barrel. Spacer (6) is used only in the main landing gear wheel door actuator.

g. Remove O-ring (4) and back-up ring (3) from gland end (5).

h. Apply a sharp blast of air to hydraulic port of clevis end (22) to remove plunger (18), washer (11), and race (10). Remove spring (21) from clevis end.

j. Remove and discard O-rings and back-up rings from barrel, piston, and plunger.

A7-3. INSPECTION OF PARTS. Make the following inspections to ascertain that all parts are in a serviceable condition.

a. Inspect all threaded surfaces for cleanliness and for freedom from cracks and excessive wear.

b. Inspect spring (21) for evidence of breaks and distortion. The free length of the spring must be 1.055 inches and compress to .875 inch under a 35 ±3.5 pound load.

c. Inspect gland end (5), spacer (6), piston (7), barrel (17), plunger (18) and clevis end (22) for cracks, chips, scratches, scoring, wear or surface irregularities which may affect their function or the overall function of the door actuator cylinder.

A7-4. REASSEMBLY. Repair of most parts of the landing gear door actuator assembly is impractical. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new O-rings and back-up rings during reassembly of the actuator.

a. Install O-ring (19) and back-up ring (20) in groove on plunger (18).

b. Insert spring (21) and plunger (18) into clevis end (22). Install washer (11) and race (10) over end of plunger (18).

c. With knurled nuts (13) on barrel (17), install O-rings (14) and back-up rings (15) in grooves on barrel.

d. Install O-ring (9) and back-up rings (8) in groove on piston (7) and install balls (12) in holes of piston.

e. Insert piston into barrel. Be sure that all six balls are in place in piston as piston is inserted in barrel.

f. Screw barrel (17) into clevis end (22). Tighten barrel down snugly against race, then tighten knurled nut.

g. Insert spacer (6) in barrel (17). Spacer (6) is used only in main landing gear wheel door actuator.

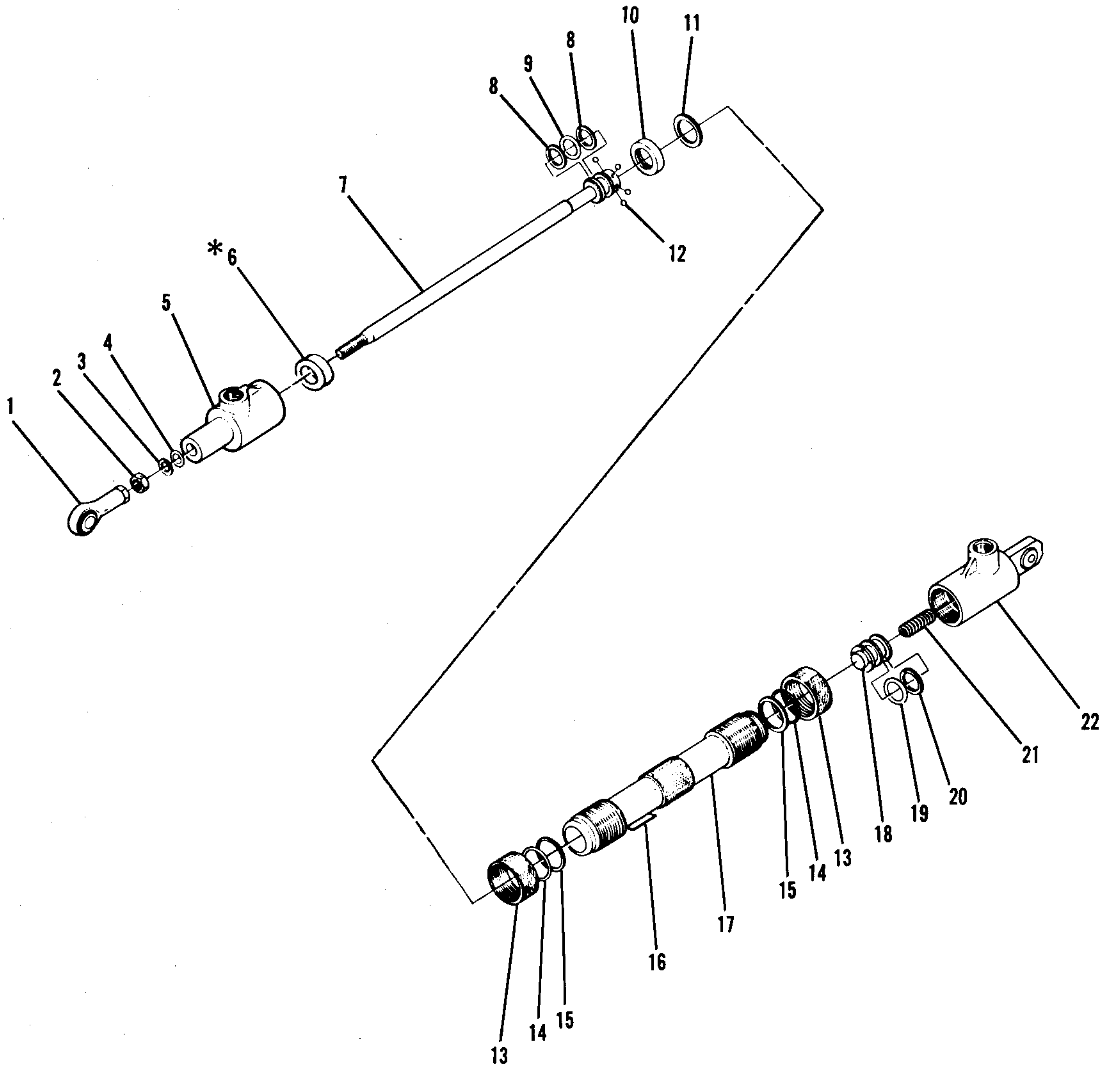
h. Install O-ring (4) and back-up ring (3) in bore groove of gland end (5), lubricate piston rod and slide gland end over rod. Tighten gland end on barrel, aligning hydraulic port fittings of the gland end with the port fitting in the clevis end.

i. Tighten knurled nuts (13) to a torque value of 130±10 lb.in. Install lockwire on both knurled nuts.

j. Install locknut (2) and rod end (1).

k. Check actuator per paragraph A7-1 specifications.

* Spacer (6) used only in the main landing gear wheel door actuator.



1. Rod End
2. Nut
3. Back-Up Ring
4. O-Ring
5. Gland End
*6. Spacer
7. Piston and Plug
8. Back-Up Ring
9. O-Ring
10. Race
11. Washer
12. Balls
13. Nut
14. O-Ring
15. Back-Up Ring
16. Nameplate
17. Barrel
18. Plunger
19. O-Ring
20. Back-Up Ring
21. Spring
22. Clevis End

Figure A7-1. Door Actuator