CHAPTER

79

OIL

CHAPTER 79 - LUBRICATION SYSTEM

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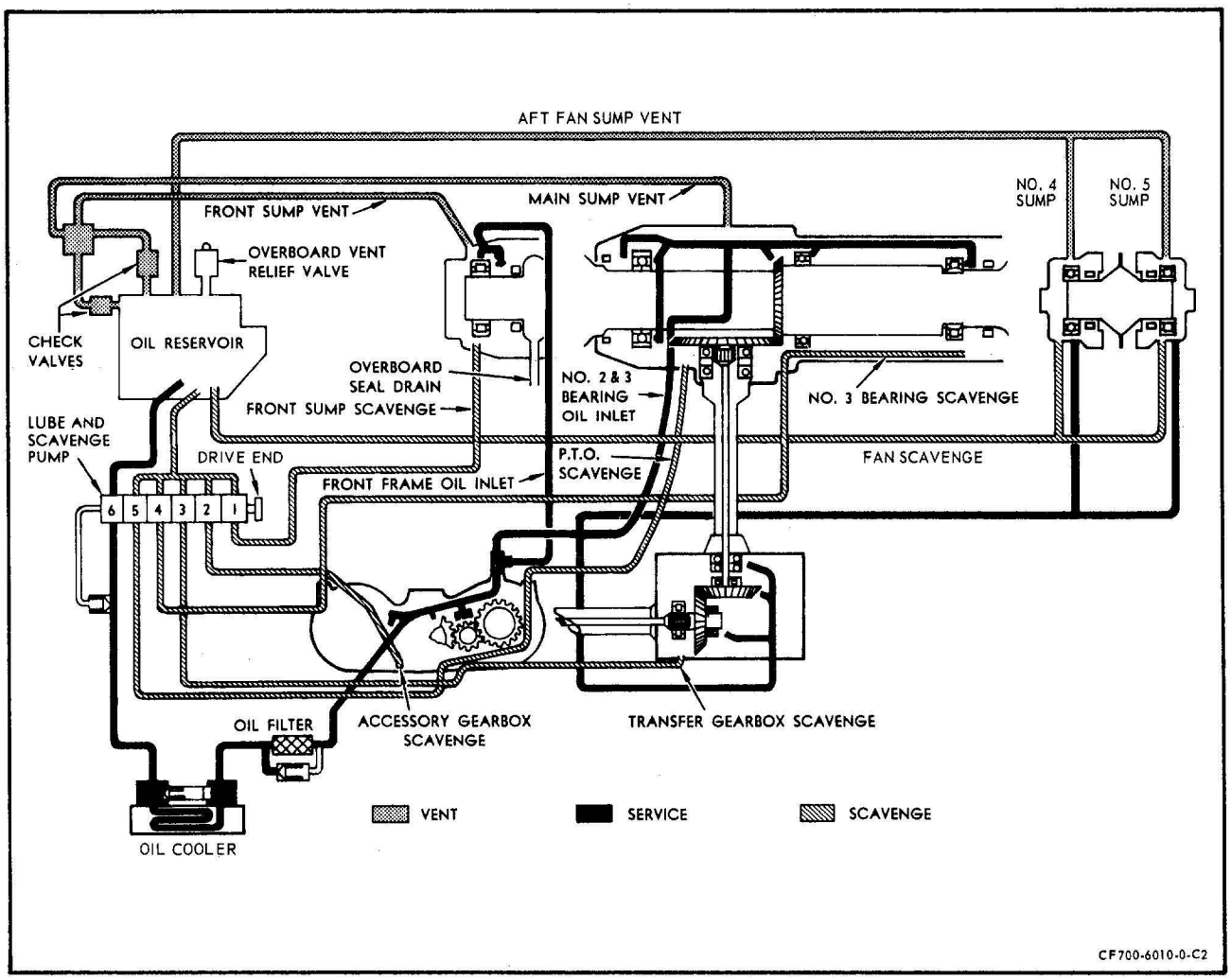
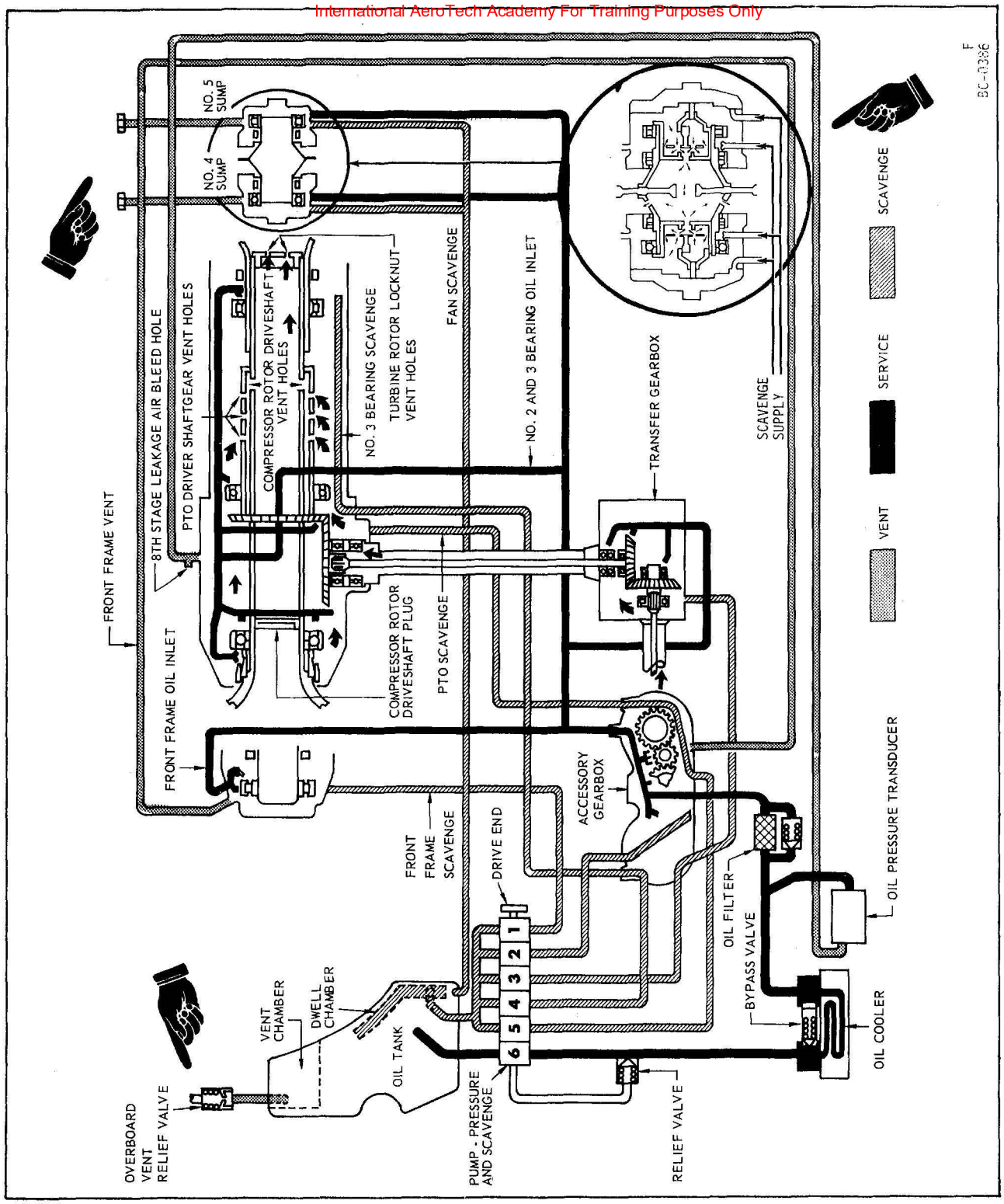
LUBRICATION SYSTEM - DESCRIPTION AND OPERATION

1. General. (See figures 1 and 2.) The engine has a pressurized closed-circuit lube system designed to furnish oil to parts which require lubrication during engine operation. After oil has been supplied to these parts it flows to the sumps where it is recovered and recirculated throughout the system. All system components are engine furnished and engine mounted. The main components of the lube system include:

Lube and scavenge pump mounted on the rear right-hand pad of the accessory gearbox.



Lubrication System (Non-Center-Vent)
Figure 1



Lubrication System (Center-Vent)
Figure 2

Oil tank attached to the lube and scavenge pump.

Oil cooler mounted to the oil tank.

Oil filter contained within the lube and scavenge pump casing.

Two scavenge pumps are located in the aft fan section, one mounted on the forward frame and the other mounted on the rear frame.

2. Operation.

A. Lube System Supply and Scavenging. Oil is drawn from the oil tank by the lube pump through a pendulum type pickup mounted on the pump. From the pump, oil is pumped through the oil cooler through the oil filter and into the accessory gearbox. Part of the oil services the gearbox and the remainder flows through internal passages in the gearbox to two outlet ports on the left side of the gearbox. Oil then flows from one port through an external line to service the front sump. Oil flows from the other port through an external line to a 4-way fitting on the left side of the engine. From the 4-way fitting, oil is supplied through external lines to the transfer gearbox, to the main sump and to the aft fan sumps.

At the transfer gearbox, the oil flows into the inlet port and flows through internal passages. As the oil flows from the internal passages, it services the transfer gearbox. Scavenge oil from the main sump also lubricates the transfer gearbox axis "A" bearings as the scavenge oil flows by gravity down into the transfer gearbox.

At the main frame oil flows through a tube located in the mainframe's 8 o'clock strut into the PTO housing. From the PTO housing the oil flows through a tube to the oil nozzles for the No. 2 and No. 3 bearings. The sumps for the No. 2 and No. 3 bearings are interconnected by the shaft shield to form one main sump.

To reach the aft fan section, the oil flows through a tube that runs from the 4-way fitting, along the engines left side, under and around the engine to the right lower side of the aft fan section. The tube then branches off into two paths so that it connects with the oil supply tubes in the No. 5 struts of the forward and rear frames. From the tubes, the oil flows through internal passages onto the No. 4 and 5 bearings housing and out through oil nozzles for the No. 4 and No. 5 bearings.

After the oil services the bearings, gears and seals, it drains down into the sumps and gearboxes. From the front sump, main sump, transfer gearbox and accessory gearbox, the oil is picked up by the scavenge elements of the lube and scavenge pump and returned to the oil reservoir.

From the aft fan sumps the oil is returned directly to the oil reservoir by the scavenge pumps mounted on the aft fan forward and rear frames. The aft fan scavenge pumps are driven by the aft fan rotor.

B. Sump Vent System Non-Center-Vent. (See figure 1.) The sump vent system is designed to maintain a controlled positive pressure in the front bearing sump, main sump, aft fan sumps, gear cases, and oil tank. The purpose of maintaining a positive pressure (above ambient) is to make the lube system insensitive to altitude. Controlled carbon seal leakage for the system is the source of pressurizing air, which is normally recirculated except for excessive air which is vented out of the system through the tank relief valve.

The scavenge pumps extract an air-oil mixture from the sumps and return it to the oil tank where the air is separated and carried to the air chamber of the tank. From the air chamber, the air is directed to the forward and main sumps. Under normal conditions, air is forced to flow from the tank to the sumps because the displacement of the scavenge pumps is greater than the combined carbon seal air leakage and oil flow from the oil supply pump, and hence would tend to evacuate the sumps if air were not allowed to return to the sumps. If a malfunction occurs in either sump, air may flow from the sump to the tank and is handled as referred to later in this description. Any excess of air not required to maintain equilibrium in the system is vented overboard through the vent relief valve located on the tank. The functions of the valves in the system are as follows:

(1) Only one check valve allows flow away from the air chamber of the tank. It is a swing or flapper type, used to allow the normal air flow to return from the tank to the sumps and yet check or prevent any back flow of oil from the sumps to the air chamber during maneuvers or malfunction such as excessive pressure in the sumps.

(2) The other check valve allows air (from the sumps) in excess of scavenge pump capacity to flow directly into the oil tank and be vented overboard. This valve in the check direction (away from the tank) does not permit oil to drain from the tank to the sumps during maneuvers or in the event of overservicing.

(3) Overboard Vent Relief Valve. The pressure relief valve is used to control the system pressure level to 2.0-3.0 psi above ambient. Excessive pressure buildup resulting from excessive air leakage into the system is prevented by this valve. The valve has a small vent orifice to allow depressurization of the pressure system at shutdown.

C. Sump Vent System - Center-Vent. (See figure 2.) The center vent system makes use of internal venting in the main sump through holes drilled in the Compressor Drive Shaft. The forward end of the Drive Shaft is plug-

ged to prevent compressor discharge leakage air from overpressurizing the main sump. Holes are also drilled in the turbine locknut (which screws into the aft end of the compressor shaft) to complete the airflow path out of the main sump and overboard via the turbine exhaust.

To vent the forward sump through the compressor shaft it is necessary to connect the forward sump vent line externally to the Accessory Gearbox instead of the oil tank. Vent air then flows from the forward sump to the gearbox, to the transfer gearbox, through the gearbox Axis "A" radial drive shaft into the main sump, and then overboard through the compressor drive shaft. This system increases the vent capacity of the forward sump. Venting of the No. 4 and No. 5 sumps is now achieved by the gear locknuts, which at fan speeds act as an oil/air separator. Oil is centrifuged out, picked up by the individual scavenge pumps, which are driven by fan rotation, then returned to the oil tank. Vent air flows through the No. 4 and No. 5 gear locknuts to the center of the fan rotor assembly. The fan forward shaft, which has a pattern of 12 holes in it, then carries No. 4 and No. 5 sump vent air through the holes and across the forward side of the fan rotor and into the exhaust gas stream.

The center vent system eliminates the oil tank check valve as well as the main sump vent line and enables the oil tank to operate independently of the engine sumps. Therefore, the oil tank operating pressure is increased by changing the tank relief valve cracking pressure. The increased tank pressure suppresses the formation of vapor in the lube pump pressure inlet supply, thus eliminating cavitation and improving pump performance at altitude. This reduces the tendency for oil pressure to drop off at high altitude.

3. Lubrication System Components.

A. Oil Tank. The oil tank is a hydro-formed fabrication and is mounted on the aft flange of the lube and scavenge pump. There are both steel and aluminum tanks in service. Included within the oil tank is an air chamber (isolated from the remainder of the oil tank), a dwell chamber and a system of vent tubes. The oil tank filling port is located on the aft face and the oil level is indicated by a dip-stick graduated in pints (to be added). Oil that overflows during filling is collected in a scupper and drained overboard through a scupper drain port. A vent relief valve boss, a remote fill vent boss, and a series of check valve boss are located on the top or front of the oil tank. The lube and scavenge pump mounting flange, and oil cooler mounting flange, are located on the forward face. The oil tank has a drain plug on the bottom of the tank. A remote filling boss is located on the aft side of the oil tank. The aft fan scavenge line is connected to a boss located on the inboard side near the bottom of the tank. Beneath the oil tank is a deep well which forms a recess for the tachometer-generator-alternator unit which is driven from the rear pad of the lube and scavenge pump. The dwell chamber in the tank is adequate to limit the volume of entrained air to a maximum of 5%. The tank capacity is 4.0 quarts total with approximately 3.0 quarts usable.

B. Lube and Scavenge Pump. The combined lube and scavenge pump is a positive displacement pump consisting of six guided-vane type pump elements mounted along a common drive shaft and contained within a common housing. The pump elements that service the main engine sump are 3 GPM scavenge elements. The pump elements that service the gearbox and No. 1 bearing sump are 1 GPM elements. The pressure element is a 2.5 GPM element. The operating elements of the pump extend aft into the oil tank from the pump flange on which the oil tank is mounted.

The oil passes between the pump and the gearbox through six oil ports on the pump mounting flange which mate with six ports on the lube pump mounting pad on the gearbox. All scavenge oil from the pump is discharged into the oil tank dwell chamber. Lube oil from the oil tank enters the pressure element through a pendulum-type swivel pickup tube that extends out from the aft right-hand side of the pump body. It is delivered by the pressure element directly to the oil cooler, through the oil filter, into the gearbox where it is distributed throughout the system.

A pressure relief valve, mounted in parallel with the lube discharge passage, is included to prevent damage that might result from excessive oil pressure due to cold starting or restriction of normal oil flow. The relief valve is factory adjusted to open at a pressure differential of 85-95 psi (115-125 on center-vent-systems) across the valve. If this pressure differential is reached, the relief valve opens and oil from the pressure element is discharged directly into the oil tank.

C. Oil Cooler. The oil cooler is a liquid-to-liquid type heat exchanger mounted on the oil tank mounting flange and against the right-hand side of the oil tank. It consists of numerous longitudinal passages arranged in a honeycomb pattern. Both fuel and oil flow simultaneous through adjoining passages and an exchange of heat occurs between hot engine oil and cool fuel. Oil enters and leaves the cooler through ports located in the housing for the pressure bypass valve. When the pressure across the valve exceeds 16-24 psi due to clogging, the valve will open and the oil will bypass the heat exchanging elements.

D. Oil Filter. The oil filter assembly is mounted in the pump housing. It is a full-flow in-line filter with a corrosion-resistant screen element of corrugated steel. The screen filters out oil contaminants over 40 microns in size, and is removable for cleaning. A filter bypass valve is included in the core of the filter element. If the pressure difference between oil entering the filter and oil leaving the filter exceeds 21-23 psi, the valve opens to permit a direct flow of oil through the unit without filtration.

E. Eighth-Stage Air Leakage Valves. The eighth-stage air leakage valves are located at the 2 and 10 o'clock position on the mainframe. These valves maintain a controlled sump pressure by bleeding-off eighth-stage air leakage when the pressure exceeds the necessary value.

LUBRICATION SYSTEM - TROUBLESHOOTING

1. General. A malfunction within the lube system is usually quite obvious. Either the cockpit pressure indicator will display an abnormal reading or visual observation will establish the need for corrective action. The lubrication system is not complex, so little trouble may be anticipated in operation or service by the engine mechanic. Beyond obvious leaks the cockpit indicators provide the first symptoms of a system malfunction. Readings other than normal suggest the nature of the malfunction, but cannot isolate the cause. Various troubles may create similar indications, however, experience and forethought will indicate the most probable causes.

Trouble-Shooting information is furnished in Chapter 72-00.

LUBRICATION SYSTEM - MAINTENANCE MANUAL

1. General. The information presented under system maintenance applies to the system as a whole. Maintenance information which applies to an individual component is presented as part of the maintenance information for that component.

   WARNING: SYNTHETIC TURBINE LUBRICANTS, WHICH ARE EXTENSIVELY USED IN AIRCRAFT TURBINE ENGINES, CONTAIN ADDITIVES THAT ARE READILY ABSORBED THROUGH THE SKIN AND THAT ARE CONSIDERED HIGHLY TOXIC. EXCESSIVE AND/OR PROLONGED EXPOSURE OF THE SKIN TO THESE LUBRICANTS SHOULD BE AVOIDED.

   CAUTION: SILICONE OR SILICONE BASED OIL OR GREASE SHALL NOT BE USED ON LUBE SYSTEM COMPONENTS. SMALL AMOUNTS (SUCH AS THAT USED TO HOLD O-RINGS DURING ASSEMBLY) WILL CONTAMINATE THE OIL SYSTEM. SILICONE CONTAMINATION WILL CAUSE THE ENGINE OIL TO FOAM, THEREBY RESULTING IN OIL LOSS THROUGH THE OVERBOARD VENT, IN LOSS OF OIL PRESSURE, AND ULTIMATELY IN DAMAGE TO THE ENGINE.

2. Servicing.

   A. Approved Oils/Operating Requirements.

      (1) Approved oils. The following listed lubricating oils are approved for use in General Electric CF700 series engines and supersedes and cancels all previous information on this subject.

      CAUTION: THE INTERMIXING OF DIFFERENT APPROVED BRANDS OF TYPE 2 OR OF TYPE 1 OILS IS AUTHORIZED, HOWEVER, INTERMIXING OF OIL TYPES MUST BE AVOIDED. IF INTERMIXING OF OIL TYPES HAS OCCURRED, THE OIL SYSTEM MUST BE DRAINED, FLUSHED PER PARAGRAPH 2.E. AND REFILLED IMMEDIATELY.

(a) Type 1 Oils: (Conforming to General Electric Specification D50TF1 - current revision).

NOTE: Type 1 oils should be used in expected cold climates, -18° to -54°C (0° to -65°F). For best engine operation, it is recommended that engine oil be heated to -18°C (0°F) or above when in cold climates.

1. 2389 Turbo Oil	Humble Oil & Refining Company
2. RM 184A	Mobil Oil Company
3. Shell Aircraft Oil 307	Shell Oil Company

(b) Type 2 Oils: (Conforming to General Electric Specification D50TF1 - current revision): See Table I.

(2) Oil approval.

Operators desiring to use an oil not included in the approved lists must obtain specific approval from General Electric Company prior to its use. Approval will be granted upon submission by the operator, or the oil company involved, of valid evidence demonstrating that the particular oil conforms to the requirements of the current issue of General Electric Gas Turbine Oil Specification D50TF1.

(3) Operating requirements.

(a) Replace Type 1 oils with Type 2 at first opportunity using procedure outlined in paragraph E page 205.

(b) Change Type 2 oils at engine operating time intervals outlined in Table 601, Section 72-00. The engine lubrication system should be serviced with the approved oils. Type 2 oils should be used in this engine because they are capable of withstanding higher operating temperatures than Type 1 oils. Type 2 oils also have improved anti-coking characteristics. Use of Type 1 oil is limited to those occasions when Type 2 oil is unavailable.

TABLE I

TYPE 2 APPROVED OIL LIST

Brand Name	Oil Company
1. AeroShell Turbine Oil 500	Shell Oil Company
2. AeroShell Turbine Oil 555	Shell Oil Company
3. AeroShell Turbine Oil 560	Shell Oil Company
4. AVTUR Oil Synthetic	Dillons Chemical Company
5. Castrol 205	Stauffer Chemical Company Castrol, Ltd.
6. Caltex RPM Jet Engine Oil 5	Caltex Petroleum Corporation

TABLE I - Continued

TYPE 2 APPROVED OIL LIST

	Brand Name	Oil Company
7.	Caltex 7388	Caltex Petroleum Corporation
8.	Chevron Jet Engine Oil 5	Chevron International Oil Company
9.	Enco Turbo Oil 2380	Humble Oil & Refining Company
10.	Esso Turbo Oil 2380	Humble Oil & Refining Company
11.	Mobil Jet Engine Oil II	Mobil Oil Company
12.	Mobil Oil 254	Mobil Oil Company
13.	Royco Turbine Oil 566/560	Royal Lubricants
14.	Sinclair Turbo-S Type 2	Sinclair Refining Company
15.	Stauffer Jet II	Stauffer Chemical Company
16.	Texaco SATO 7388	Texaco, Incorporated
17.	Texaco Starjet 5	Texaco, Incorporated
18.	Caltex Starjet 5	Caltex Petroleum Corporation
19.	Exxon Turbo Oil 2380	Exxon Company

NOTE:
1. Stauffer Jet II, AVTUR Oil Synthetic, and Castrol 205 are identical oils.
2. Texaco SATO 7388 and Caltex 7388 are identical oils.
3. Chevron Jet Engine Oil 5 and Caltex RPM Jet Engine Oil 5 are identical oils.
4. Enco Turbo Oil 2380, Esso Turbo Oil 2380, and Exxon Turbo Oil 2380 are identical oils.
5. Texaco Starjet 5 and Caltex Starjet 5 are identical oils.
6. AeroShell Turbine Oil 560 and Royco Turbine Oil 560 are identical oils.

B. Oil Servicing During Postflight Inspection. The oil level should be checked immediately following engine shutdown because some oil will seep from the tank into the gearbox while the engine is inoperative. After an engine shutdown or during a postflight inspection, immediately check and add oil, if required, as follows:

(1) Remove the oil tank filler cap.

(2) Check oil level on the dipstick.

(3) If required, add oil until the oil level in the tank is at the full mark (4 quarts) or slightly below.

CAUTION: USE THE SAME OIL TYPE THAT IS ALREADY IN THE OIL SYSTEM.

NOTE: All approved oil that comes in containers of 1 quart or less is ready for use and has been filtered to 10 microns. Bulk oil must be filtered through a 10 micron paper or metalic filter. Paper filter shall be used only when the oil is at ambient temperature. Metallic filters can be used at ambient or elevated temperatures.

(4) Install the filler cap and lock it.

C. Oil Servicing During Preflight Inspection. After an engine has been inoperative (or during a preflight inspection), avoid overfilling the system by checking and adding oil, if required, as follows:

(1) Remove the oil tank filler cap.

(2) Check the oil level on the dipstick.

CAUTION: USE THE SAME OIL TYPE THAT IS ALREADY IN THE OIL SYSTEM.

NOTE: All approved oil that comes in containers of 1 quart or less is ready for use and has been filtered to 10 microns. Bulk oil must be filtered through a 10 micron paper or metalic filter. Paper filter shall be used only when the oil is at ambient temperature. Metallic filters can be used at ambient or elevated temperatures.

(a) If the oil level is low (but still visible on the dipstick), motor the engine for 30 seconds, recheck the oil level and add oil as required. Install filler cap and lock it.

(b) If there is NO oil level indication on the dipstick add oil until there is an indication on the dipstick. Motor the engine for 30 seconds, recheck the oil level and add oil as required. Install filler cap and lock it.

D. Oil Changes Using Same Type of Approved Oil. The procedure in this paragraph is only used to change oil when the lube system is to be refilled with the same type of approved oil that is presently being used in the lube system. If the lube system is to be refilled with a different type of oil, if the oil types have been mixed ,or if an unapproved oil has been used, the lube system should be drained, flushed, and the filter checked per paragraph 2.E. Change the oil as follows:

(1) Remove the oil tank filler cap.

(2) Remove the drain plugs from the oil tank, accessory gearbox and transfer gearbox. (See figure 201.) Catch the draining oil in a clean container that will hold 4 or more quarts.

(3) Remove the oil filter per 79-22-0.

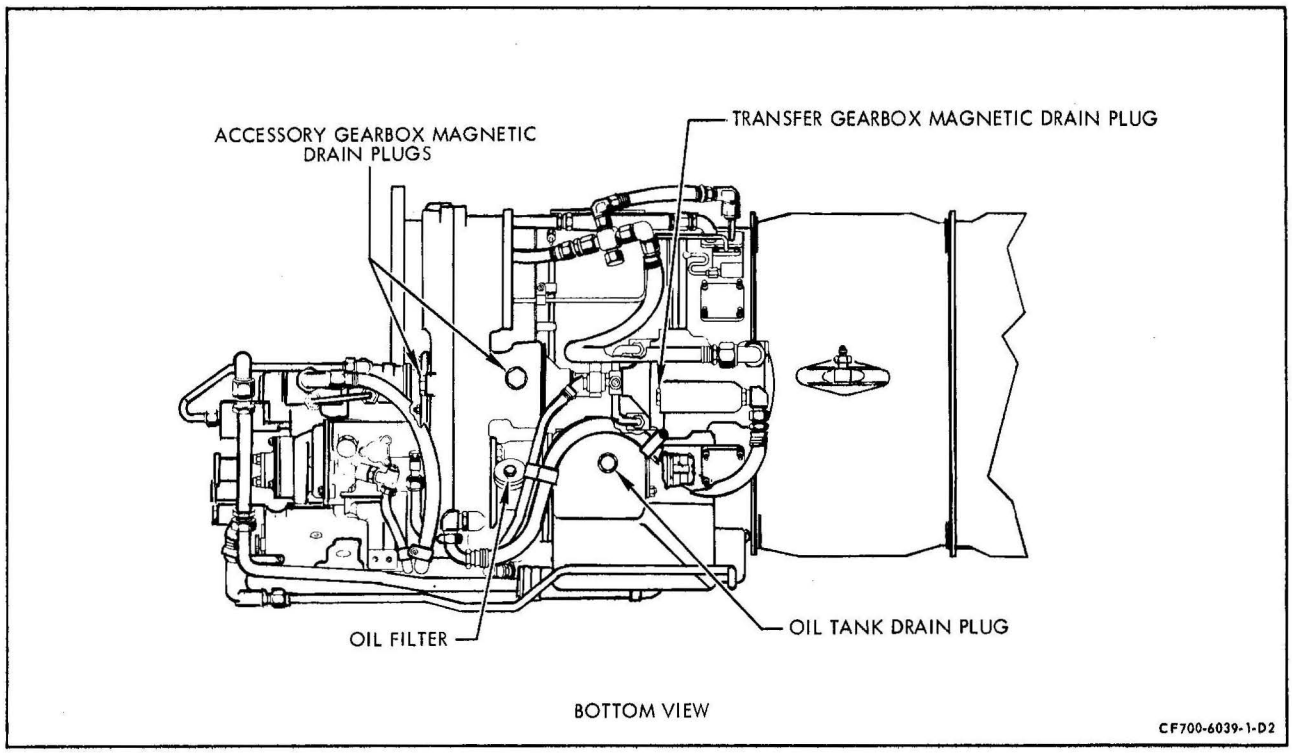
(4) Inspect the magnetic drain plugs, filter, and drained oil for metallic particles. If metallic particles are present, examine the particles per paragraph 3.A.

(5) Clean the oil filter per 79-22-0.

WARNING: TRICHLOROETHANE VAPORS ARE HARMFUL - DO NOT USE NEAR OPEN FLAMES, OR ON VERY HOT SURFACES. DO NOT USE NEAR WELDING AREAS, A SOURCE OF CONCENTRATED ULTRAVIOLET RAYS. INTENSE ULTRAVIOLET RAYS CAN CAUSE THE FORMATION OF PHOSGENE GAS, WHICH IS INJURIOUS TO THE LUNGS. USE ONLY WITH ADEQUATE VENTILATION. AVOID PROLONGED OR REPEATED BREATHING OF VAPORS. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. WEAR APPROVED GLOVES AND GOGGLES (OR FACE SHIELD) WHEN HANDLING AND WASH HANDS THOROUGHLY AFTER HANDLING. DO NOT TAKE INTERNALLY. DO NOT SMOKE WHEN USING IT. STORE IN APPROVED METAL SAFETY CONTAINERS.

(6) Clean the drain plugs with a suitable solvent, such as: carbon tetrachloride, trichloroethane fed. spec. O-T-620, or kerosene.

CAUTION: PERFORM THIS OPERATION IN AN APPROVED CLEANING CABINET OR IN A WELL-VENTILATED AREA. TAKE PRECAUTIONS TO PREVENT INHALATION OF VAPORS AND TO MINIMIZE FIRE HAZARDS. REPEATED OR PROLONGED CONTACT OF SOME CLEANING MATERIALS WITH THE SKIN WILL REMOVE SKIN OILS AND MAY CAUSE SEVERE DERMATITIS.



Location of Oil Drain Plugs and Filter
Figure 201

(7) Using new O-rings on the drain plugs and filter, install the plugs and filters to the torque values specified in the Engine Torque Chart in Section 72-01-3.

(8) Using the same type of oil that was in the lube system, fill the oil tank (passing the oil through a 10-micron filter) to the "FULL" mark, or slightly below, (4 quarts) on the dipstick. Install the filler cap and lock it.

NOTE: The engine will require additional oil, after the first run, to bring the level to the "FULL" mark on the dipstick because a small amount of oil remains in the sumps and in the oil lines after engine shutdown.

E. Oil Changes (Draining and Flushing Lube System). This procedure is used for changing the oil when the lube system will NOT be refilled with the same type of oil. This procedure should also be used as soon as possible after an unapproved oil has been used. Drain and flush lube system and check oil filter as follows:

(1) Drain oil; inspect plugs and filter; clean and install plugs and filter per paragraph 2.D, steps (1) through (7).

(2) Using an approved oil, fill the oil tank (passing the oil through a 10-micron filter) to the "FULL" mark, or slightly below, (4 quarts) on the dipstick. Install the filler cap and lock it.

(3) Operate the engine for 5 minutes.

(4) Drain oil tank and gearboxes. Install plugs per paragraph 2.D.(7).

(5) Refill oil tank with the same type of oil used in step (2).

(6) Attach a metal tag or other suitable device to the oil tank filler cap that designates the type of oil being used in the system.

(7) After the engine has been operated in service for 15-35 hours, check the oil filter and clean if necessary.

NOTE: It is important to establish a written record of findings during a filter inspection. This will allow detection of a buildup of contamination during subsequent filter inspections.

3. Inspection/Checks.

A. Metallic Particle Check.

The engine is manufactured and assembled with close tolerances. Therefore, metallic particles in the lubrication system are cause for investigation. Accumulation of particles may result from different causes; good judgment must be used before continuing to operate the engine. A review of previous filter inspection records and findings should be made.

When filter contamination by metal particles is less than ten percent of the total area, but is sufficient to be easily observed by the naked eye, the recommendations listed below are applicable. If contamination is greater than ten percent, (large metal chips, curls, heavily loaded, partially or completely filled valleys between pleats in filter) DO NOT OPERATE ENGINE until the source of metal particle generation is defined and corrected.

NOTE: A light deposit of minute silver particles may be found on the filter during the early stages of engine operation; this is considered normal. Silver particles can be generated from the normal seating of engine bearing cages that are silverplated during manufacture. In addition, a light accumulation of oxide "fuzz" (fine light particles) on the magnetic plugs may also be considered normal.

(1) Deleted.

(2) If metallic (magnetic and/or non-magnetic) particles are found in the filter or oil, they may have been externally introduced or caused by wear of engine rotating parts. These contaminants could contribute to faulty lube system operation and may damage lube system components or bearings. Contaminants may be in the form of metal curls, chips, flakes, etc. In either case proceed as follows:

(a) Drain oil from tank and gearbox(es).

(b) Clean and reinstall the filter and magnetic drain plugs per paragraph 2.D.(7).

(c) Re-service with approved oil.

(d) Run engine for 10 minutes at 85% RPM and then check filter.

(e) If filter is significantly contaminated DO NOT OPERATE THE ENGINE and DO NOT CLEAN THE OIL FILTER until a cause for contamination can be determined. This may require removal, disassembly and cleaning of engine. An analysis of filter contaminants may be helpful in determining source of contaminants.

(f) If filter is significantly cleaner than before, reclean and reinstall filter. Drain all oil from engine and reservice with approved oil.

(g) Continue to operate engine normally for two hours. During this period, monitor oil temperature and oil pressure for significant changes. Check filter and magnetic drain plug after this time. Record findings.

(h) If contaminants are found in excess of minute quantities DO NOT OPERATE THE ENGINE and DO NOT CLEAN THE OIL FILTER until a cause for contamination can be determined. This may require removal, disassembly and cleaning of engine. An analysis of filter contaminants may be helpful in determining source of contaminants.

(i) If contaminants are not found continue to operate engine normally and repeat step (g) every five hours for at least four times. DO NOT CLEAN FILTER. Record findings. Resume normal filter inspection periods when satisfied system is clean and not generating additional contaminants.

B. Postflight, Preflight Inspection/Checks. (Refer to Servicing.)

OIL TANK - MAINTENANCE PRACTICES

1. General. The maintenance practices for the oil tank are concerned with the removal/installation, inspection/check and cleaning of the component.

2. Servicing. (Refer to 79-00, Servicing.)

3. Removal/Installation.

   NOTE: The oil tank, lube pump and tachometer generator are mounted in tandem. The removal of the tank is simplified if all three units are removed as an assembly and then separated. (Refer to 79-21-0.)

4. Inspection/Check.

Inspect/Check	Maximum Serviceable Limits	Corrective Action
A. Dents on corners.	Any number, 1/8 inch deep.	Replace tank.
B. Dents on flat surfaces.	Any number, 1/4 inch deep.	Replace tank.
C. Sharp dents or creases.	None allowable.	Replace tank.
D. Leaks.	None allowable.	Replace tank.

5. Cleaning.

   If required the oil tank can be cleaned after it has been removed from the engine.

   A. Remove the oil tank from the engine.

   B. Slush the oil tank with a solvent, such as carbon tetrachloride or trichloroethylene, until all dirt and contamination is removed.

      WARNING: THESE SOLVENTS ARE TOXIC AND SHOULD BE USED WITH ADEQUATE VENTILATION. AVOID PROLONGED BREATHING OF VAPORS. REPEATED OR PROLONGED CONTACT WITH THE SKIN WILL REMOVE SKIN OILS AND CAUSE SEVERE DERMATITIS.

      NOTE: A discoloration may remain on the inside surface of the oil tank. This is normal and allowable.

   C. Inspect inside of tank with a light and dental mirror for evidence of contamination. Clean as necessary.

OIL TANK RELIEF VALVE - MAINTENANCE PRACTICES

1. General. The maintenance of the valve consists of the removal and replacement of defective valves.

2. Removal/Installation.

NOTE: Disconnect any aircraft line connected to the valve.

A. Removal.

(1) Remove the lockwire securing the valve to the side of the tank.

(2) Remove the valve by threading the valve from the tank.

(3) Remove and discard O-ring from the valve.

B. Installation.

(1) Install a new O-ring onto the valve.

(2) Assemble the valve to the oil tank.

(3) Tighten valve to 90-110 lb-in. and lockwire.

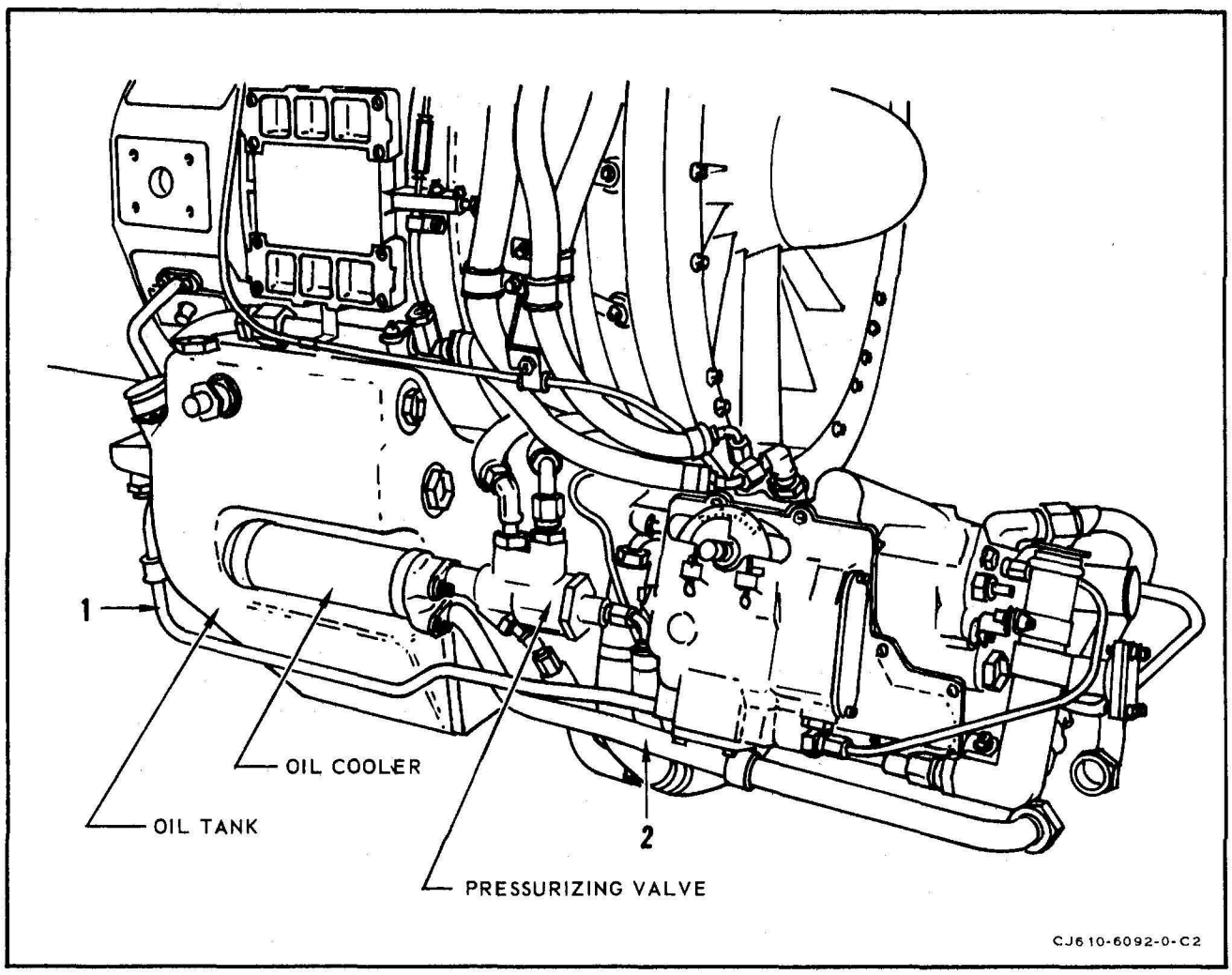
NOTE: Connect any aircraft lines that were removed.

LUBE AND SCAVENGE PUMP - MAINTENANCE PRACTICES

1. General. The following procedures cover the maintenance that may be performed on the pump.

2. Removal/Installation.

NOTE: Refer to figure 201.



Lube and Scavenge Pump Removal/Installation
Figure 201

A. Removal.

(1) Drain the lubrication tank by removing the tank drain plug.

(2) Disconnect the 2 vent lines from the oil tank check valves. (On engines without center vent only.)

(3) Remove the oil cooler and fuel-pressurizing valve as follows:

(a) Remove the tube (1) that runs from the mainframe pad (at 4 o'clock) to the fuel control compressor inlet temperature aspirator.

(b) Disconnect 4 lines from the fuel-pressurizing valve.

(c) Remove the tube (2) that runs from the fuel flowmeter to the oil cooler.

(d) Remove the 2 bolts that secure the oil cooler to the oil tank. Remove the oil cooler-fuel pressurizing valve assembly.

(e) Remove three O-rings and the O-ring adapter from the oil cooler ports.

(4) Disconnect the oil pressure transducer line at the lube pump, oil filter ports (if applicable).

(5) Remove the lube pump, oil tank and tachometer from the accessory gearbox as follows:

(a) Remove 3 mounting nuts and washers at the gearbox pad.

(b) Carefully move the lube pump aft until it clears the 3 mounting studs on the accessory gearbox. Remove seven O-rings.

CAUTION: PROTECT THE LUBE PUMP AND ACCESSORY GEARBOX FROM DAMAGE AND CONTAMINATION.

(6) Separate the lube pump, oil tank, and tachometer-generator as follows:

(a) Remove 4 nuts and washers and remove the airframe tachometer-generator.

(b) Remove bolts and washers, and separate the lube pump from the oil tank. Remove two O-rings from the grooves in the face of the oil tank, and one O-ring from the groove in the aft OD of the lube pump.

B. Installation.

NOTE: Prior to installation, prime the elements of the lube and scavenge pump with engine oil by filling all of the inlet and outlet ports and then rotating the drive gear by hand.

(1) Install 1 new O-ring in the groove in the aft OD of the lube pump and 2 new O-rings in the grooves in the forward face of the oil tank. Use O-ring lubricant and holding grease A.1 or A.2 of Section 72-01-1.

(2) Carefully insert the lube pump vertically into the oil tank and visually check alignment. Secure pump and oil tank together with 2 opposite bolts and washers and tighten to 24-27 lb-in. to seat pump. Install remaining 13 bolts and tighten to 24-27 lb-in. and lockwire all bolts.

NOTE: Some earlier configuration pumps and tanks have only 13 bolt holes. When either tanks or pumps are interchanged, 2 bolts may be omitted and the holes left open.

(3) Check the lube pump oil tank assembly for free movement of pick-up tube as follows:

(a) Disconnect and restrict this movement of the oil tank filler cap and chain.

(b) Hand-hold the subassembly upright with the pump in the 12 o'clock position.

(c) Gently tilt the oil tank back and forth, check for audible free movement, from stop to stop, of the lube pick-up tube.

NOTE: If unable to substantiate the free movement, remove the lube pump and check for hang-up. Repeat until free movement is obtained.

(4) Install the air frame tachometer-generator on the 4 studs that protrude through the rear of the oil tank. Secure it with nuts and washers. Tighten the nuts to 28-35 lb-in.

(5) Install 7 new O-rings in the grooves on the face of the lube pump mounting flange. Use O-ring lubricant and holding grease A.1 or A.2 of Section 72-01-1. Install the lube pump, oil tank and tachometer on the right, rear pad of the accessory gearbox and secure it with the nuts and washers. Tighten the nuts to 120-150 lb-in.

(6) Connect the oil pressure transducer line to the lube pump. Tighten to 30-50 lb-in.

(7) Install the oil cooler-fuel-pressurizing valve assembly as follows:

(a) Assemble 2 new O-rings on the O-ring adapter and 1 new O-ring on the oil cooler lube-OUT port. Install the O-ring adapter in the lube-IN port of the oil cooler.

(b) Align the lube-IN and lube-OUT ports of the oil cooler to the ports in the lube pump and install the oil cooler. Secure the oil cooler to the front face of the oil tank with 2 bolts. Tighten the bolts to 24-27 lb-in. and lockwire them.

(c) Connect 4 hoses to the fuel-pressurizing valve.

(d) Install 1 new O-ring and install the fuel tube (2) that connects the flowmeter to the oil cooler. Tighten the 2 screws to 24-27 lb-in. and lockwire them.

(8) Install the tube (1) (with a new gasket) that runs from the main-frame pad (at 4 o'clock) to the fuel control compressor inlet temperature aspirator. Tighten the 2 screws to 24-27 lb-in. and lockwire them. Adjust and tighten the support clamps.

(9) Connect the 2 vent lines to the oil tank check valves. (On engines without center vent only.)

(10) Reservice the lubrication system per 79-00, Maintenance Practices, paragraph 2.D.

CAUTION: WHEN REPLACING THE LUBE PUMP, BE SURE THE LUBE FILTER IS INSTALLED.

3. Inspection/Check.

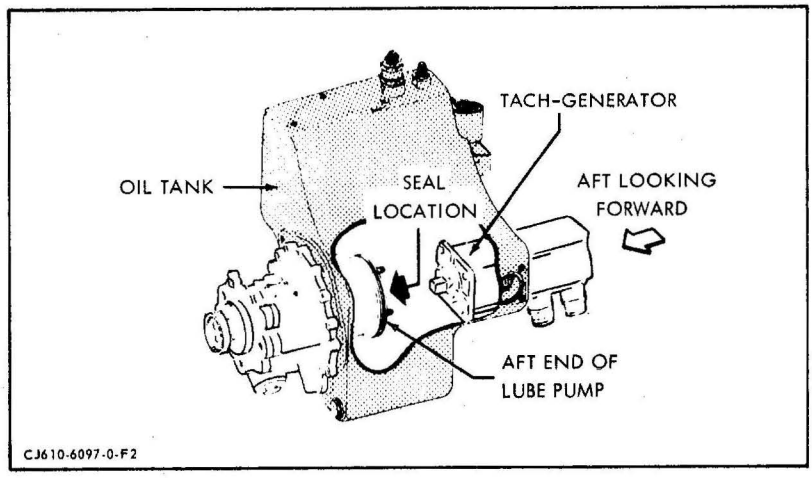
Check the lube pump, while installed, for leakage. No leakage allowable. If leakage is from lube pump-tachometer generator drive shaft seal, replace seal per repair paragraph. If leakage is from non-repairable area, replace pump.

4. Approved Repair.

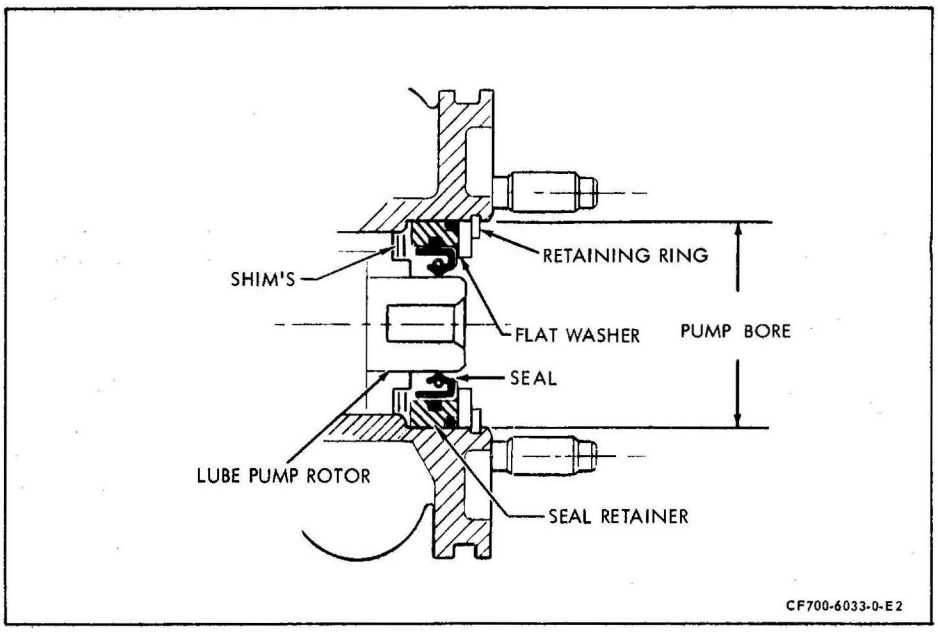
A. Replacement Procedure for Lube Pump Tachometer-Generator Drive Shaft Plain Encased Lip Seal (Without Removing Lube Pump from Engine). (See figure 203.)

(1) Drain the oil from the oil tank.

(2) Disconnect the electrical leads from the tachometer-generator. Remove the 4 nuts and washers, then remove the tachometer-generator from the lube pump.



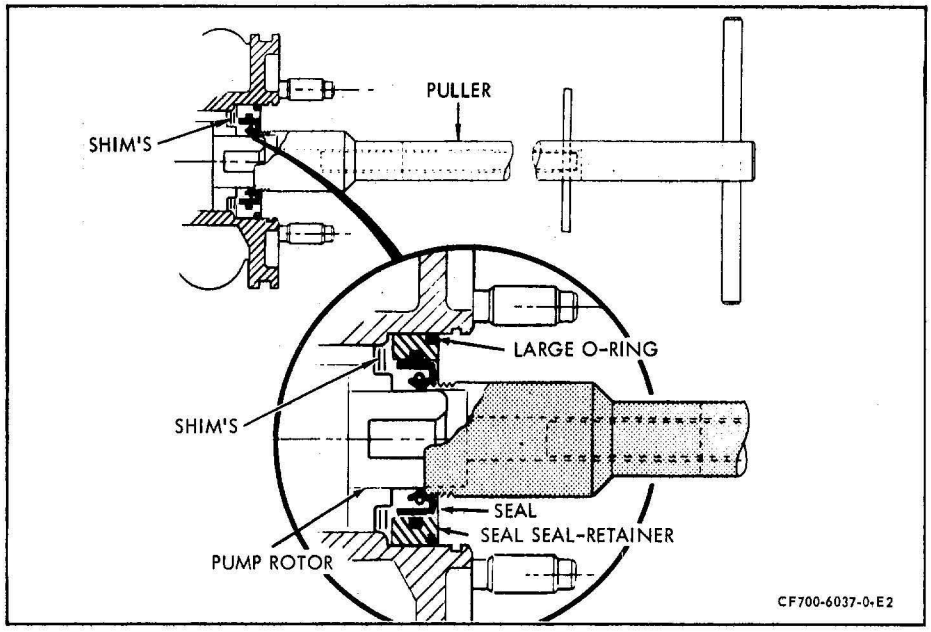
Replacement Lube-Pump Seal
Figure 202



Seal Retainer
Figure 203

(3) Remove the retainer ring, using a small screwdriver or scriber. Be careful not to scratch or damage the surface of the seal retainer or the lube pump bore. Carefully lift out the flat washer. (See figure 203.)

NOTE: Inspect the pump housing bore at the retainer ring groove and bench out any nicks, dents, etc.



Seal Puller Installed
Figure 204

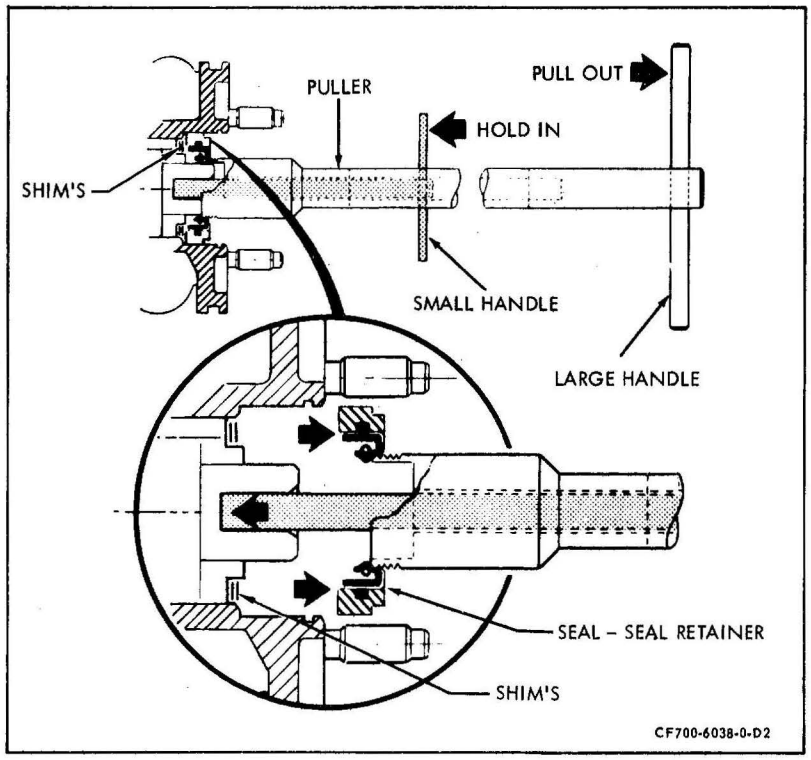
(4) Lubricate the counterbore at the threaded end of puller, 2C5331. Insert the threaded end into the rubber of the seal and turn the puller 1 or 2 turns clockwise to engage seal. Do not pull seal at this time. (See figure 204.)

NOTE: Do not remove the large O-ring until after the puller is engaged. This is to keep the seal retainer from rotating with the puller. If O-ring does not prevent rotation insert a small screwdriver or scriber into O-ring to prevent rotation.

(5) After the puller is engaged, use a small scriber or equivalent tool to remove the large O-ring from in front of the seal retainer. Make sure the seal retainer does not move outward with the O-ring.

CAUTION: AFTER THE O-RING IS REMOVED, BE CERTAIN THAT THE PUMP ROTOR DOES NOT MOVE OUTWARD WITH THE SEAL AND RETAINER ASSEMBLY, AS THIS WILL UNSTACK THE PUMP. IF THIS SHOULD HAPPEN, THE LUBE PUMP MUST BE REPLACED.

(6) Push the plunger towards the threaded end of the puller with the small T-handle and hold it in this position. The plunger should engage in the bottom of the female square in the lube pump drive shaft and hold the internal parts of the pump in place during the removal of the seal retainer and the seal.



Removing Seal
Figure 205

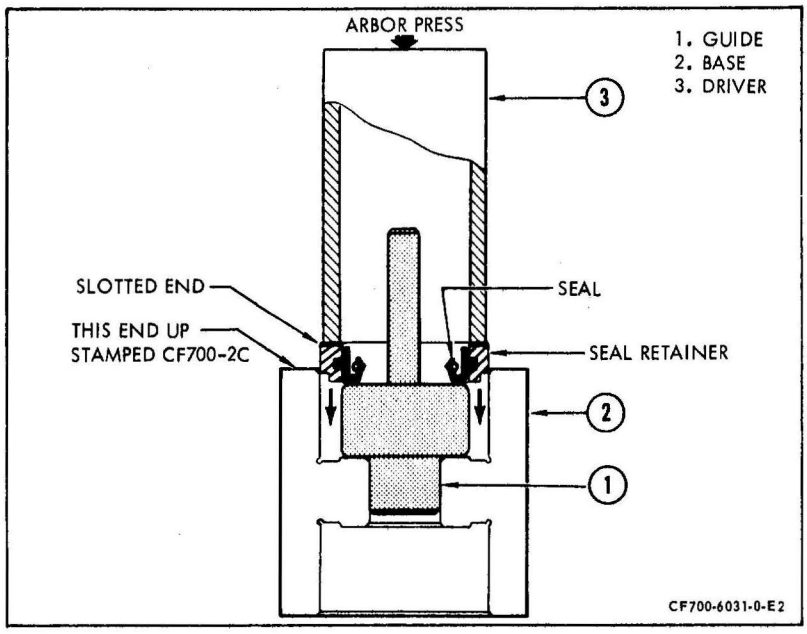
(7) While holding the small T-handle in, pull the large T-handle out to remove the seal retainer and the seal. (See figure 205.)

CAUTION: IF ANY INTERNAL PARTS OF THE LUBE PUMP ARE INADVERTENTLY REMOVED, (EXCEPT SHIM/S) MISPLACED OR DAMAGED DURING REMOVAL OF THE SEAL RETAINER AND SEAL, THE LUBE PUMP MUST BE REPLACED.

NOTE: Re-install original shim/s if removed. Shim thickness is a predetermined value and original shim/s must be used or replace lube pump.

(8) Insert the guide (1, figure 205A) into base (2). Place seal retainer and seal assembly onto guide (1) with slotted side of seal retainer facing up. Position driver (3) on top of seal retainer.

(9) Using an arbor press, push seal retainer down to separate it from the seal. Remove the seal, guide (1), and seal retainer from the base (2).



Removal of Seal from Seal Retainer
Figure 205A

(10) Remove the square seal O-ring from the inside diameter groove of the seal retainer.

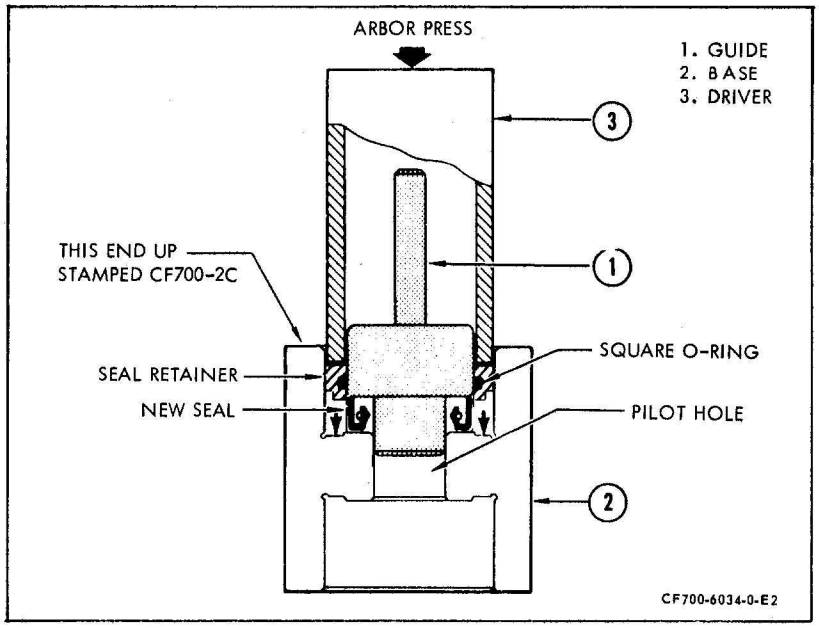
(11) Install a new square seal O-ring into the groove on the inside diameter of the seal retainer.

(12) Place the new seal (metal surface down) into the base (2, figure 206) and using petrolatum or equivalent, lubricate the outside diameter of the seal. Insert the guide (1) through the inside diameter of the seal and into the pilot hole of the base (3).

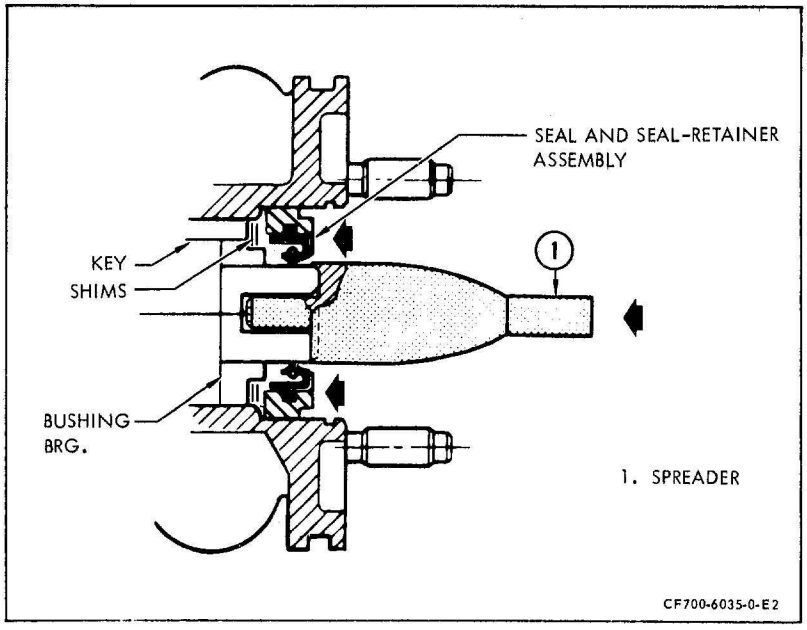
(13) Lubricate the inside diameter of the seal retainer and square seal O-ring. Install the seal retainer (slotted side up) onto the guide (1). Position driver (3) on top of seal retainer.

(14) Using an arbor press, carefully push the seal retainer down over the seal until it bottoms in the base (2). Remove the seal retainer and seal assembly.

CAUTION: CHECK THE SEAL AND SEAL RETAINER ASSEMBLY TO BE CERTAIN THAT EACH END OF THE SEAL IS BELOW THE SURFACES OF THE SEAL RETAINER. THE SEAL RETAINER SLOTS MUST BE OPEN AT THE INSIDE DIAMETER TO PERMIT OIL PASSAGE WHEN INSTALLED IN THE PUMP.



Assembly of Seal
Figure 206



Seal Spreader Installed
Figure 207

(15) Lubricate with petrolatum the outside diameters of the seal retainer and the spreader (1, figure 207). Position the spreader against the lube pump rotor as shown, push seal and seal retainer assembly over the spreader (1) and into the lube pump until it bottoms against the shim/s. Remove spreader (1).

(16) Lubricate a new O-ring and install between the outside diameter of the seal retainer and the ID of the lube pump bore. Coat the washer with petrolatum and assemble into the lube pump bore. Work the retaining ring into the pump bore and push it against the washer. (See figure 208.)

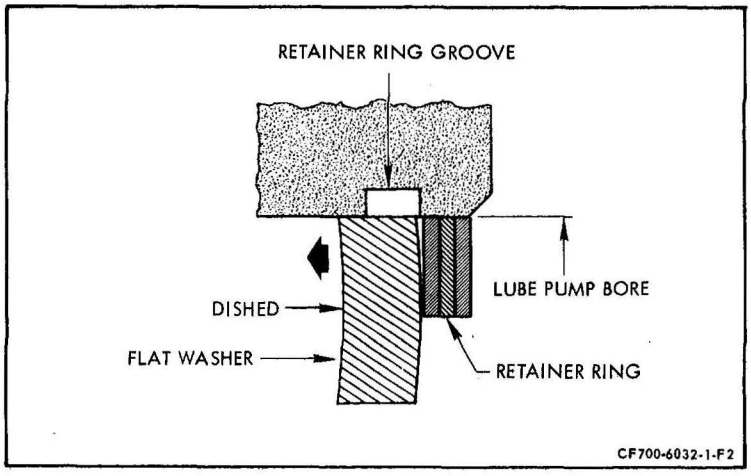
(17) Assemble the pusher of 2C5331 over 2 of the studs in the lube pump mounting flange and against the flat washer, then assemble 2 nuts to the studs. (See figure 209.)

(18) Tighten the nuts evenly and drive the pusher against the flat washer until the retainer ring groove is accessible. Using a small screwdriver, work the retaining ring into its groove.

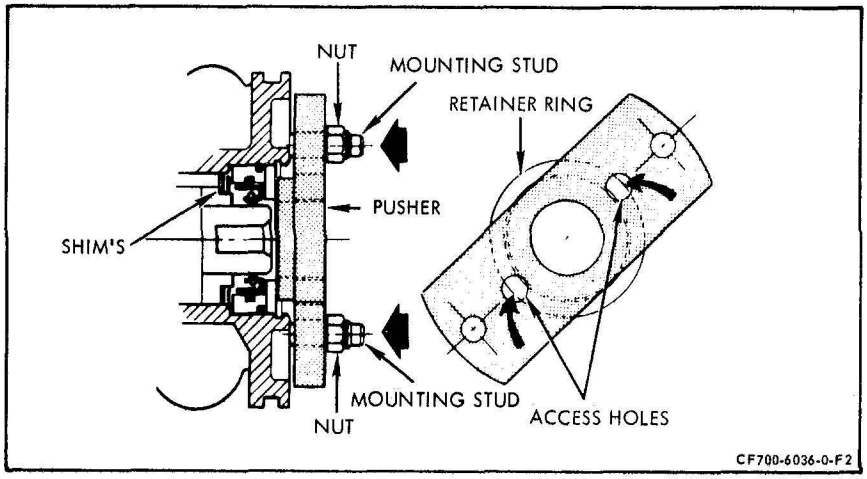
NOTE: Use the space on each side of the pusher and the 2 access holes in the pusher to work the retaining ring into place.

(19) Remove the 2 nuts and the pusher from the lube pump.

NOTE: The retaining ring must be thoroughly checked to make certain it is properly seated in the groove in the inside diameter of the lube pump bore. It must be properly seated or the performance of the lube pump will be greatly reduced affecting the lubrication system.



Installation of Retainer
Figure 208



Pushing Retainer into Place
Figure 209

(20) Assemble the tachometer-generator to the lube pump with the 4 nuts and washers. Tighten the nuts to 28-35 lb-in.

(21) Connect the electrical leads to the tachometer generator.

(22) Refill the lube tank with oil.

B. Replacement Procedure for Lube Pump Tachometer-Generator Drive Shaft Carbon Seal (Without Removing Lube Pump from Engine). (See figure 210.)

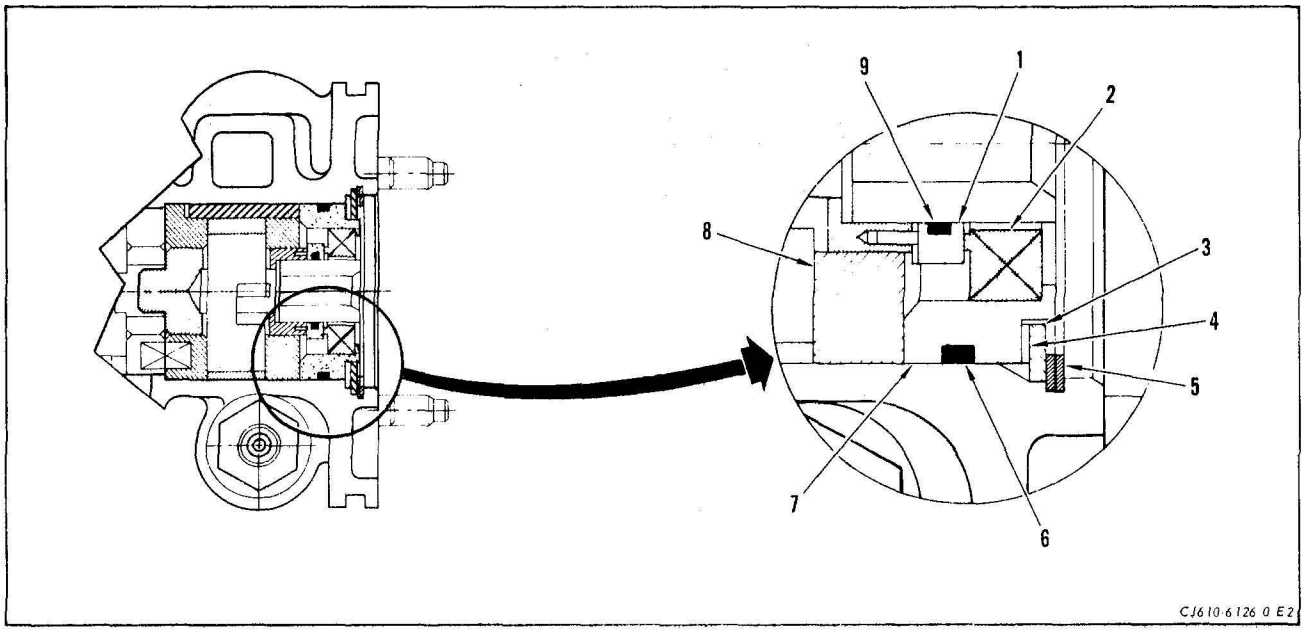
(1) Drain the oil from the oil tank.

(2) Disconnect the electrical leads from the tachometer-generator. Remove the 4 nuts and washers, then remove the tachometer-generator from the lube pump.

(3) Remove the retainer ring (5), using a small screwdriver or scriber. Be careful not to scratch or damage the surface of the seal retainer or the lube pump bore. Carefully lift out the flat washer (3) and shims (4).

NOTE: Retain shims and washer for reinstallation. Inspect the pump housing bore at the retainer ring groove and bench out any nicks, dents, etc.

(4) Install puller 2C5436P02 on shoulder of seal retainer (7) and remove with a straight pull. Remove O-ring (6) from seal retainer and discard.



Lube and Scavenge Pump Rear Seal - Replacement
Figure 210

CAUTION: AS THE SEAL AND SEAL RETAINER IS REMOVED, BE CERTAIN THAT THE PUMP ROTOR DOES NOT MOVE OUTWARD WITH THE SEAL AND SEAL RETAINER ASSEMBLY AS THIS WILL UNSTACK THE PUMP. IF THIS SHOULD HAPPEN, THE LUBE PUMP MUST BE REPLACED.

(5) Remove mating ring (1) using puller 2C5484. Remove O-ring (9) from mating ring and discard.

CAUTION: DO NOT PERMIT PUMP ROTOR TO MOVE OUTWARD WITH THE MATING RING AS THIS WILL UNSTACK THE PUMP AND LUBE PUMP MUST THEN BE REPLACED.

(6) Place seal retainer (7) in guide 2C5436P04 and press out carbon seal using pusher 2C5436P07.

(7) Place seal retainer (7) in base 2C5436P05 and position guide 2C5436P04. Install a new carbon seal (2) into seal retainer using pilot 2C5436P03.

(8) Install a new O-ring (9) into a new or reconditioned mating ring (1). Lubricate O-ring with Mobile Assembly Fluid RT403C or an approved equivalent and install mating ring on rotor shaft using puller 2C5484 as a pusher.

CAUTION: ALIGN SLOTS ON MATING RING WITH THE PINS ON THE ROTOR SHAFT.

NOTE: With the pins on the rotor shaft in the slots of the mating ring there will be approximately a 1/32 inch gap between the mating ring and the bearing (8).

(9) Install a new O-ring (6) onto the seal retainer (7). Lubricate O-ring with Mobile Assembly Fluid RT403C or an approved equivalent. Insert seal retainer into guide 2C5436P06. Wipe mating ring and carbon seal face with a clean lint free cloth dampened with clean trichloroethylene. Mount guide onto lube pump housing and press seal retainer into pump housing until it seats against the bearing using guide 2C5436P04 as a pusher. Remove guide and pusher.

WARNING: TRICHLOROETHYLENE IS TOXIC AND SHOULD BE USED WITH ADEQUATE VENTILATION. AVOID PROLONGED BREATHING OF VAPORS. REPEATED OR PROLONGED CONTACT WITH THE SKIN WILL REMOVE SKIN OILS AND CAUSE SEVERE DERMATITIS.

(10) Install shims (4) and flat washer (3).

CAUTION: CENTER WASHER AND SHIMS SO THAT THEY DO NOT CATCH IN RETAINING RING GROOVE AS STACK IS COMPRESSED.

(11) Assemble retaining ring (5) into housing bore and install pusher 2C5436P08 to compress stack and ease installation of retaining ring.

NOTE: It may be necessary to use pusher first to compress the stack of pump rotating parts below the retaining ring groove.

(12) Using a small screwdriver and/or scribe, work the retaining ring into its groove. Remove pusher.

(13) Assemble the tachometer-generator to the lube pump with the 4 nuts and washers. Tighten the nuts to 28-35 lb-in.

(14) Connect the electrical leads to the tachometer-generator.

(15) Refill the lube tank with oil.

OIL FILTER - MAINTENANCE PRACTICES

1. General. The following procedures cover the maintenance procedures for the filter.

2. Removal/Installation.

A. Removal. (See figure 201.)

(1) Cut the lockwire securing filter cap to the pump.

(2) Thread the cap out of the pump.

NOTE: A small container (approximately 1/2 pint) should be used to catch the small amount of oil that will drain from this pump housing.

(3) Remove the cap and the filter element from the pump.

NOTE: On some filters the cap and the element are separate, on others, they are held together by a pin.

(4) Discard the O-rings.

B. Disassembly of Filter.

(1) Re-useable filters.

NOTE: On filters that are pinned to the cap, the pin must be removed and the cap and protective shield removed for cleaning.

(a) Type A and B.

1. Cut the lockwire and remove the valve seat from the bottom of the filter.

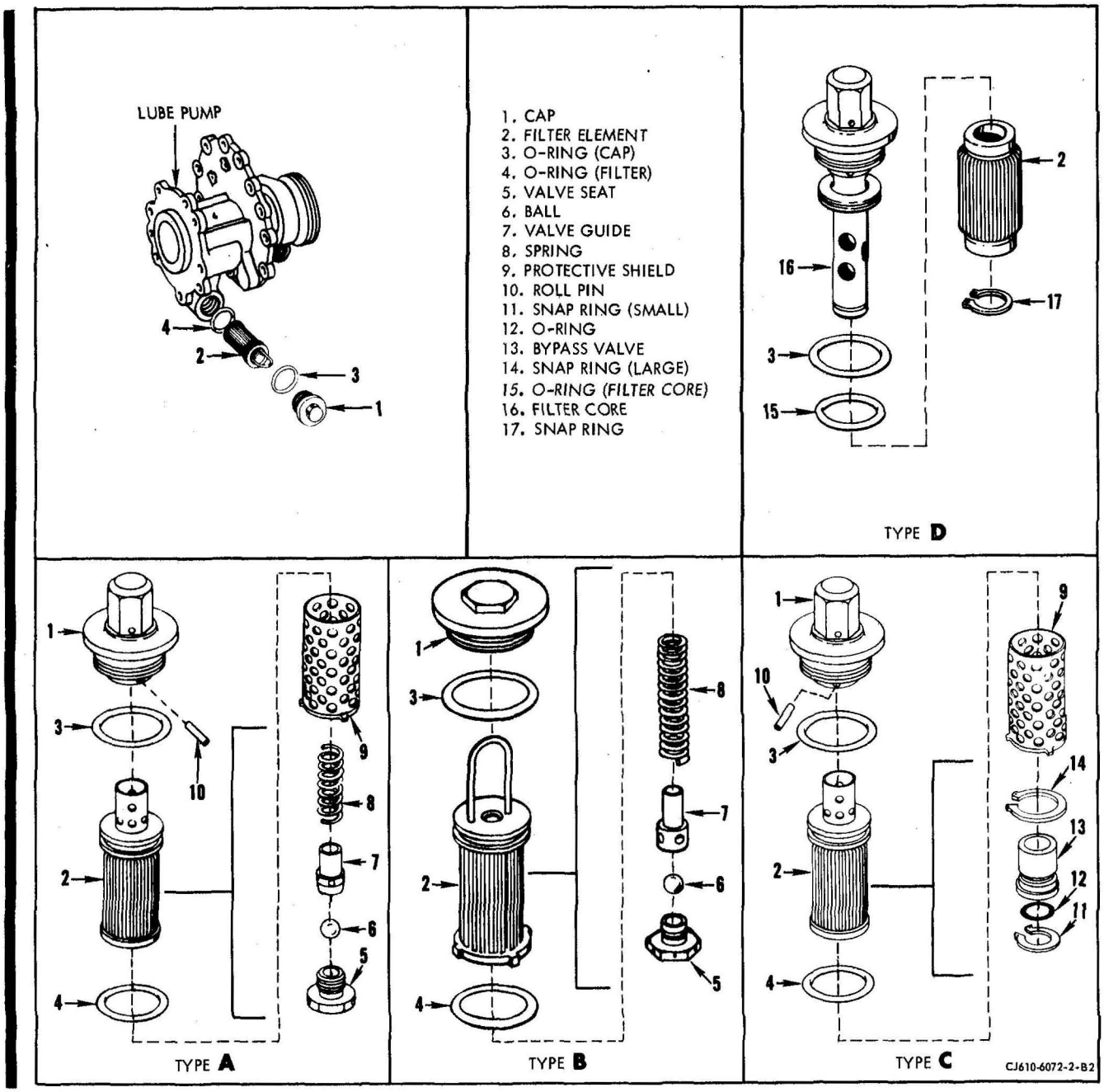
2. Remove the ball, valve guide, spring and protective shield (Type A) from the element.

(b) Type C.

1. Remove large snap ring and slide protective shield off filter element.

2. Remove small snap ring, carefully push bypass valve out from filter element.

3. Remove O-ring from bypass valve. Discard O-ring.



Oil Filter Removal/Installation
Figure 201

(2) Disposable filters.

(a) Type D.

1. Remove large snap ring from filter core.

2. Slide filter element off filter core, and discard snap ring.

3. Discard filter element.

C. Assembly of Filter.

(1) Type A and B.

(a) Install the protective shield over the filter element (Type A).

(b) Install the spring, valve guide and ball into the filter element.

NOTE: Position the valve guide by inserting the smaller diameter inside the spring.

(c) Install the valve seat and tighten to 30-60 lb-in. torque value.

(d) Safety wire the valve seat to the element.

CAUTION: THE PIGTAIL AT THE END OF THE WIRING SHOULD CONSIST OF A MINIMUM OF THREE TWISTS AND MUST BE FLUSH OR BELOW VALVE SEAT SURFACE (5/8 INCH HEXAGON) AND MUST BE BENT BACK TO WITHIN THE OUTER EDGE OF THE THREE ANTI-ROTATION LUGS.

(e) Assemble filter element to filter cap with roll pin. Push roll pin into cap until it is flush with cap (Type A).

(2) Type C.

(a) Assemble new O-ring to bypass valve.

(b) Push bypass valve, small end first into filter element until it seats.

(c) Install new small snapring into groove in filter element to secure bypass valve.

(d) Slide protective shield over filter element and secure with large snapring.

NOTE: The large snapring may be reused if undamaged.

(e) Assemble filter element into filter cap using roll pin. Push roll pin into cap until it is flush with cap.

(3) Type D.

(a) Slide new filter element onto filter core.

NOTE: Disposable filter elements from different vendors may differ slightly in appearance and construction but are physically and functionally interchangeable.

(b) Install large snap ring into groove in filter core to secure filter element.

D. Installation.

(1) Install the filter with new O-rings, into the lube pump housing.

CAUTION: ON THE FREE CAP TYPE FILTER BE SURE THE BYPASS END OF THE FILTER GOES INTO THE HOUSING LAST.

(2) Tighten the filter cap to 40-60 lb-in. and lockwire it.

3. Inspection/Checks.

If magnetic particles are found in the filter, refer to Inspection/Checks, 79-00.

4. Cleaning.

A. Re-useable filters.

(1) Ultrasonic Procedure. (Refer to SEI-154 for filter cleaning.) This method of cleaning is the recommended method for cleaning the filter.

(2) Alternate Procedure. When ultrasonic cleaning equipment is not available the following procedure can be used.

(a) Clean the filter body by immersing it in carbon tetrachloride, trichloroethylene, kerosene or equivalent. While continually agitating the filter, use a suitably contoured soft bristled brush to dislodge contaminants from the filter convolutions.

NOTE: Only clean, filtered solvents should be used. Assure that containers used during cleaning procedure are clean and free from contaminants.

WARNING: CLEANING OPERATION SHALL BE PERFORMED IN AN APPROVED CLEANING CABINET OR WELL VENTILATED AREA. PRECAUTIONS SHALL BE EXERCISED TO PREVENT INHALATION OF VAPOR EMITTED BY VOLATILE CLEANING MATERIALS, AND TO MINIMIZE DANGER OF EXPLOSION AND FIRE HAZARDS.

(b) Visually inspect the filter using a magnifying glass (10X minimum) and a strong light. If the filter is not completely clean, repeat step (a), above.

NOTE: If some dark colored stains remain at the bottom of the convolutions these are not harmful, and the filter is serviceable. If any doubt exists as to the cleanliness of the filter, repeat the cleaning procedure.

CAUTION: DO NOT ATTEMPT TO PROBE THE FILTER CONVOLUTIONS WITH A SHARP TOOL, AS THIS MAY DAMAGE THE FILTER AND RENDER THE FILTER NOT SERVICEABLE.

B. Disposable Filters.

(1) Clean the filter core per paragraph 4.A.(1) and (2).

NOTE: Disposable filters can be cleaned once and then must be replaced at the next inspection period.

OIL COOLER - MAINTENANCE PRACTICES

1. General. The following procedures cover the maintenance that may be performed on the oil cooler.

2. Removal/Installation.

NOTE: See figure 201, 79-21-0.

A. Removal.

(1) Separate the fuel-pressurizing valve from the oil cooler. Remove and discard the O-ring.

(2) Separate the fuel inlet tube from the front of the oil cooler. Remove and discard the O-ring.

(3) Remove the 2 bolts that secure the oil cooler to the front face of the oil tank.

(4) Carefully lift the oil cooler up and away from the lube pump. Remove the O-ring adapter; remove and discard three O-rings.

B. Installation.

(1) Assemble 1 new O-ring in the groove on the OD of the lube-OUT (bottom) port of the oil cooler. Assemble 2 new O-rings on the O-ring adapter; install the O-ring adapter in the lube-IN (top) port of the oil cooler.

(2) Carefully align the lube-IN and lube-OUT ports to the mating ports of the lube pump.

(3) Secure the oil cooler to the forward face of the oil tank with 2 bolts. Torque the bolts to 24-27 lb-in. and lockwire them.

(4) Install a new O-ring on the fuel-pressurizing valve. Secure the valve to the top port of the oil cooler with 2 screws and washers. Torque the screws to 12-14 lb-in. and lockwire them.

(5) Install a new O-ring on the fuel tube. Secure the tube and clamp bracket to the bottom port of the oil cooler with 2 screws and washers. Torque the screws to 12-14 lb-in. and lockwire them.

(6) Readjust the clamps that were disturbed during the oil cooler removal. Torque the clamp bolts to 20-25 lb-in.

FAN SCAVENGE PUMP - MAINTENANCE PRACTICES

1. General. This section covers the maintenance that can be performed on the fan scavenge pump.

2. Removal/Installation.

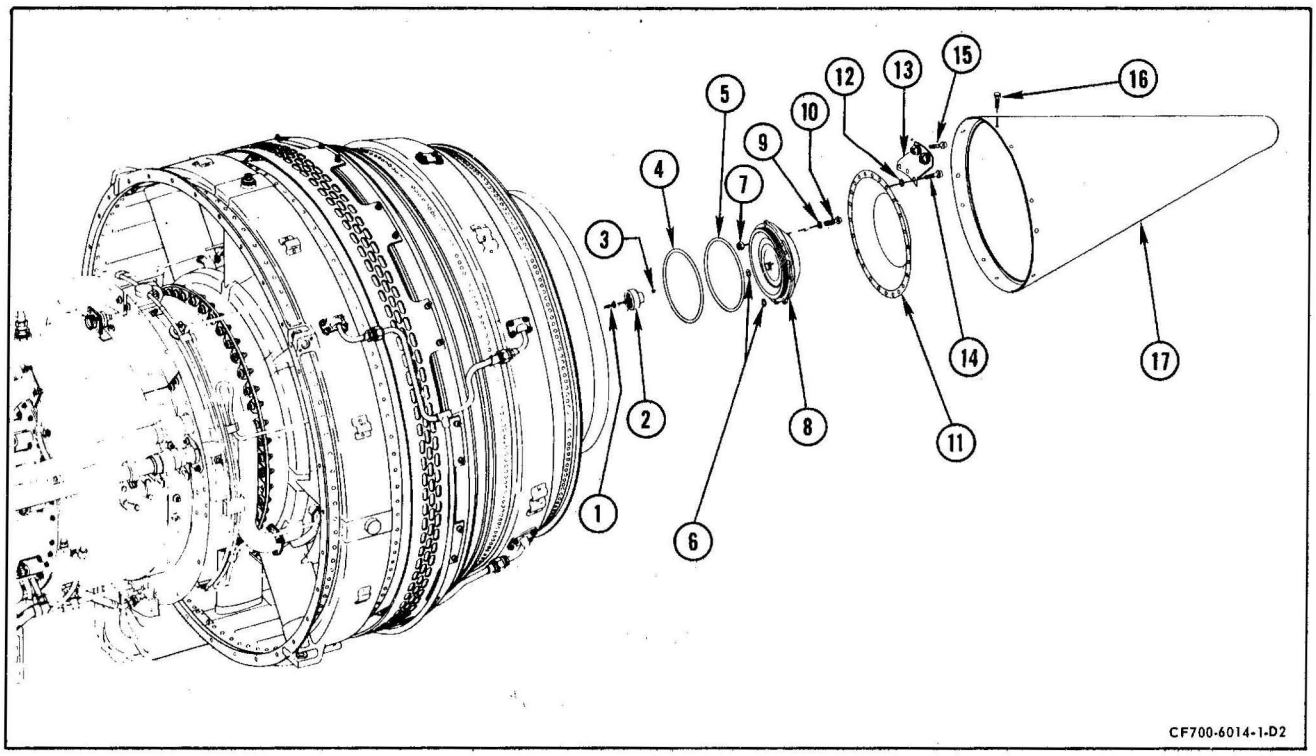
   A. Removal.

      (1) Remove the rear scavenge pump as follows: (See figure 201.)

         (a) Remove the bolts (16), extension cone (17), bolts (15), (14), bracket (13), washers (12) and the rear shield (11).

            NOTE: Do not lose the washers when removing the brackets.

         (b) Remove the nuts (7), bolts (10) and washers (9) securing the pump (8). Free the speed sensor conduit from the pump and push aside.



Rear Scavenge Pump Removal/Installation
Figure 201

(c) Remove the pump (8) from the bearing housing with 2 jacking screws (1/4-28 thread).

(d) Remove the O-ring (15) and O-ring retainer (4). Remove the O-rings (6) from the in and out ports. Discard O-rings.

(e) Remove the drive gear (2) by removing the retainer (1) and using puller, 2C5358. Remove the key (3).

NOTE: It is not necessary to remove the drive gear unless it is damaged.

(2) Remove the front scavenge pump as follows: (See figure 202.)

(a) Remove fan assembly from the engine per 72-70.

(b) Remove the bolts (1), cover (2), bolts (3), rim clamps (4) and front shield (5).

(c) Remove the bolts (6), washers (7) and nuts (9). Remove the pump (8) from the bearing housing with 2 jacking screws (1/4-28 thread).

(d) Remove the O-rings (10, 12) and O-ring retainer (11). Discard O-rings.

(e) Remove the drive gear (14) by removing the retainer (15) and using puller 2C5358. Remove key (13).

NOTE: It is not necessary to remove the drive gear unless it is damaged.

B. Installation.

(1) Install the rear scavenge pump as follows: (See figure 201.)

(a) Install the gear (2) on the pump (8) as follows:

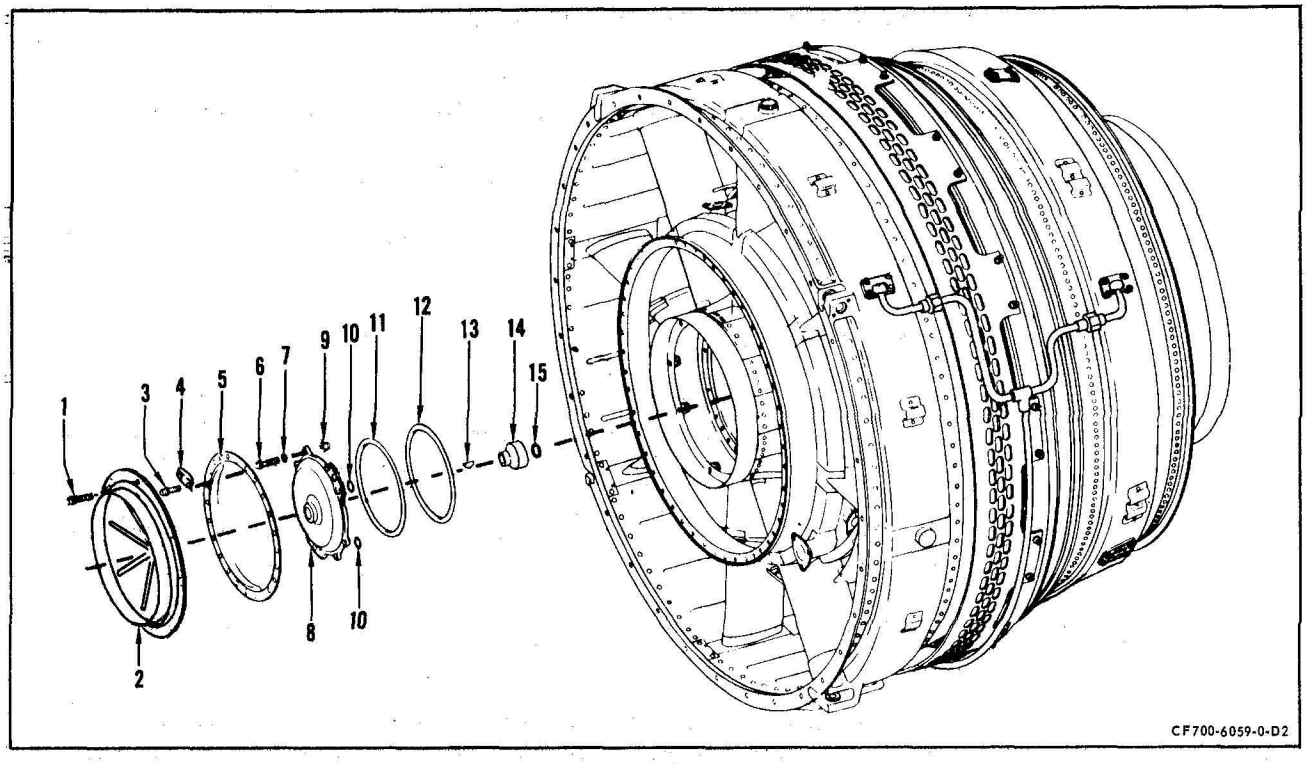
1 Place the key (3) in the shaft keyway.

2 Align the gear with the shaft and key and push onto shaft.

3 Install the retainer (1) and seat in shaft groove.

(b) Install the O-ring retainer (4) into the recess on the pump housing.

NOTE: Place the flat side of the retainer against the pump housing.



Front Scavenge Pump Removal/Installation
Figure 202

(c) Install the O-ring (5) against the O-ring retainer (4).

(d) Install the 2 O-rings (6) into the oil-IN and oil-OUT ports.

(e) Install the pump (8) to the bearing housing and secure with 4 bolts (10), washer (9) and nuts (7). Cross-tighten until seated.

NOTE: If the O-ring retainer shears, remove the sheared section and re-install the pump assembly.

(f) Align the speed sensor conduit with the bolt holes at the 3 and 5 o'clock positions.

(g) Install the remaining bolts (10), washers (9) and nuts (7) to secure the speed sensor conduit and scavenge pump. Torque the bolts to 30-35 lb-in. and lockwire.

(h) Check the No. 5 bearing housing sump as follows: (See figure 202.)

1 Attach a hose from a vacuum pump to the No. 5 bearing scavenge tube.

2 Cap off the No. 5 bearing oil tube, vent tube and air tube.

NOTE: Make certain all tube flange bolts are tight.

3 Open the vacuum line valve until vacuum reading is 26.5-28.0 inches of mercury.

4 Close the vacuum line and stop the pump.

5 Starting when the vacuum reading drops to 25 inches of mercury, record the time in seconds. Time of decay to zero inches of mercury should not be less than 60 seconds.

6 If the decay time is not within limits, check for leaking O-ring and replace before checking carbon seals.

(i) Install the rear shield (11) and secure in position with 2 bolts (14).

(j) Install the brackets (13) and secure with bolts (15) to the rear of the inner casing. Torque the bolts to 30-35 lb-in.

NOTE: Equally space the brackets around the OD of the casing.

(k) Remove the 2 bolts securing the rear shield and install washers (12) between the rear shield and the brackets; secure both to the rear frame with bolts (14). Torque the bolts to 18-22 lb-in. and lockwire.

(l) Install the tailcone (17) to the inner casing of the rear frame and secure with bolts (16).

(2) Install the front scavenge pump (8) as follows: (See figure 202.)

(a) Install the gear (14) on the pump (8) as follows:

1 Place the key (13) in the shaft keyway.

2 Align the gear with the shaft and key and push onto shaft.

3 Install the retainer (15) and seat in shaft groove.

(b) Install the O-ring retainer (11) into the recess on the pump housing.

NOTE: Place the flat side of the retainer against the pump housing.

(c) Install the O-ring (12) against the O-ring retainer (11).

(d) Install the 2 O-rings (10) into the oil-in and oil-out ports.

(e) Install the pump (8) to the bearing housing and secure with 4 bolts (6), washers (7) and nuts (9). Cross-tighten until the pump is seated. Install the remaining bolts, nuts and washers. Torque the bolts to 30-35 lb-in. and lockwire.

NOTE: If the O-ring retainer (11) shears, remove the sheared section and re-install the pump assembly.

(f) Check the No. 4 bearing housing sump as follows: (See figure 202.)

NOTE: To properly locate the fan rotor, position fan package with aft end up.

1 Attach a hose from a vacuum pump to the No. 4 bearing oil scavenge tube.

2 Cap off the No. 4 bearing oil tube, vent tube and air tube.

NOTE: Make sure all tube flange bolts are tight.

3 Open the vacuum line valve until vacuum reading is 26.5-28.0 inches of mercury.

4 Close the vacuum line and stop the pump.

5 Starting when the vacuum reading drops to 25 inches of mercury, record the time in seconds. Time of decay to zero inches of mercury should not be less than 60 seconds.

6 If the decay time is not within limits, check for leaking O-ring and replace before checking carbon seals.

(g) Install the front shield (5) and rim clamps (4) to the front frame and secure with the bolts (3). Torque the bolts to 18-22 lb-in. and lockwire.

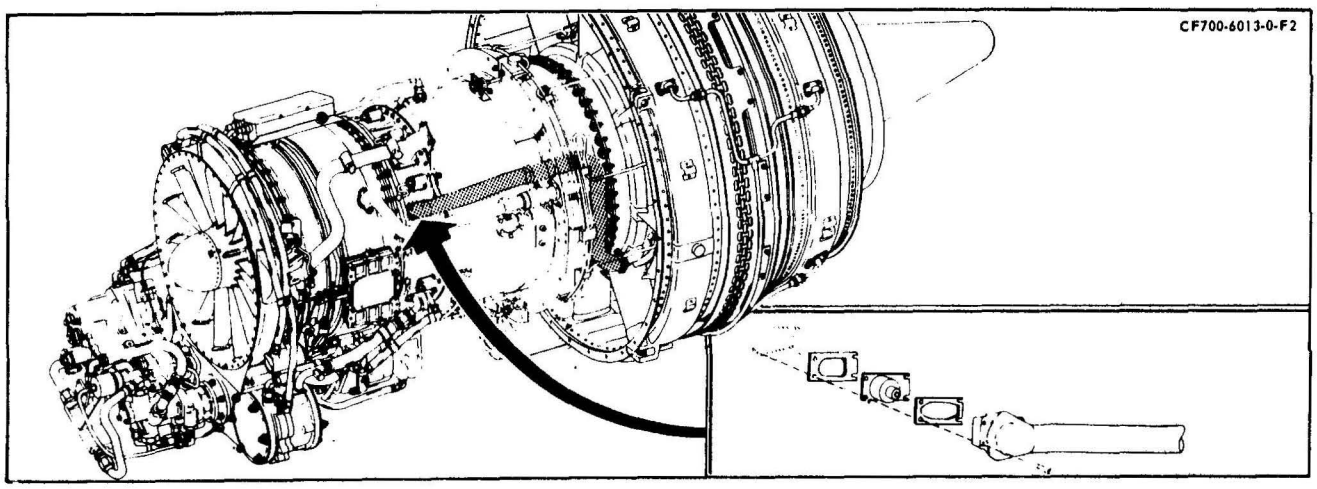
NOTE: Equally space the 6 rim clamps, using the 12 o'clock position as the starting point.

(h) Install the cover (2) and secure with the bolts (1). Torque the bolts to 22-27 lb-in. and lockwire.

(i) Assemble fan assembly to engine per 72-70.

EIGHTH-STAGE AIR LEAKAGE VALVES - MAINTENANCE MANUAL

1. General. This section covers the maintenance that can be performed on these valves.



Eighth-Stage Air Leakage Valve
Figure 201

2. Removal/Installation. (See figure 201.)

A. Removal.

(1) Remove the eighth-stage air leakage ducts by removing the bolts that secure the ducts and valves to the mainframe at the 2 and 10 o'clock position. Use penetrating oil if bolts are seized.

(2) Lift the valves from the mainframe pads.

B. Installation.

(1) Install the air leakage valves and new gaskets onto the mainframe.

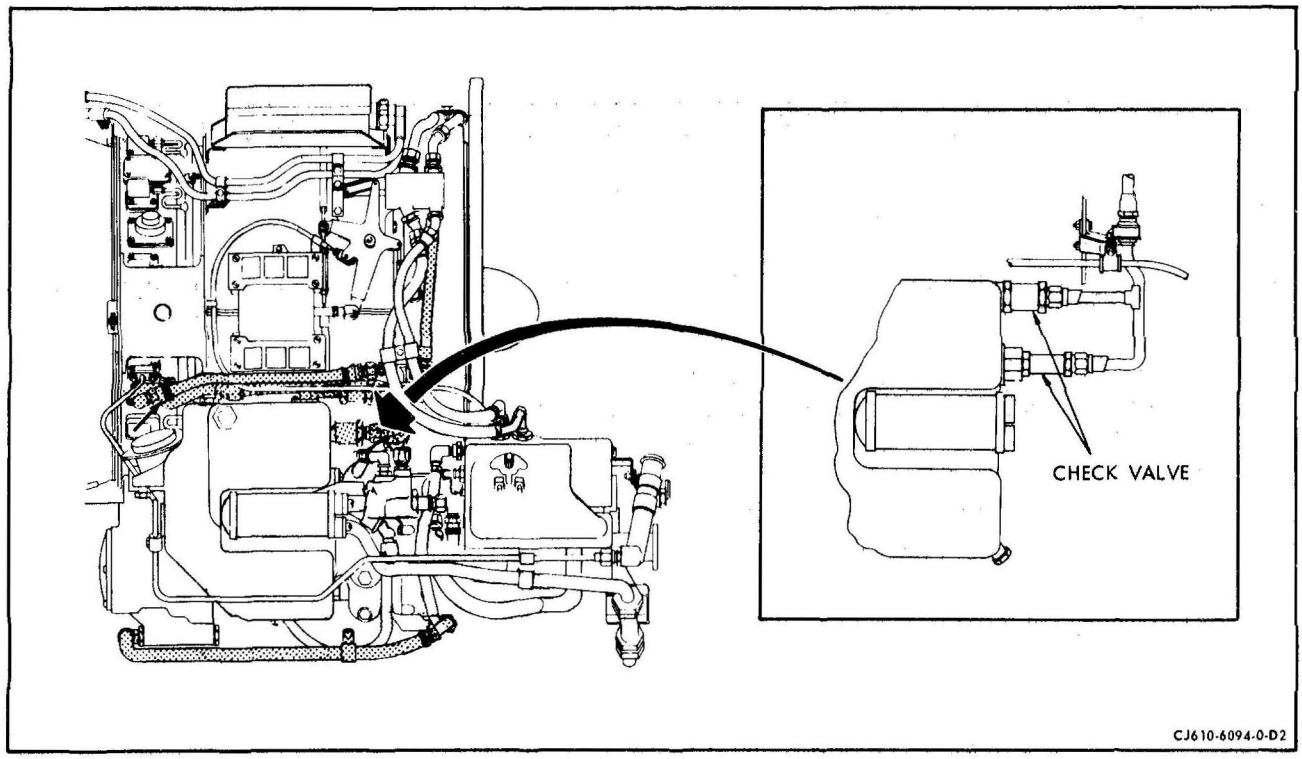
(2) Lubricate the 4 bolts with Ease-Off 990 (Texacone Co., Box 4236, Dallas, Texas) or G-392 Versilube (G.E. Products Co., Waterford, N.Y.). Install the air leakage ducts and secure the valves and ducts with the 4 bolts. Tighten the bolts to 16-19 Lb-in. and lockwire.

3. Inspection/Check.

Inspect	Maximum Serviceable Limits	Remarks
A. Housing, cap and valve for cracks.	Not serviceable.	
B. Gap between valve stem and cap.	0.060 inch.	

OIL TANK CHECK VALVES - MAINTENANCE PRACTICES
(Non-center vent only)

1. General. The following covers the maintenance that can be performed on these valves.



Oil Tank Check Valves
Figure 201

2. Removal/Installation. (See figure 201.)

A. Removal.

(1) Disconnect the vent lines from the valves.

(2) Thread the valves out of the fittings on the oil tank.

NOTE: Discard O-rings.

B. Installation.

(1) Place new O-rings on the valves and install on the fittings on the tank. Tighten and lockwire.

(2) Connect the vent lines to the valves.

3. Inspection/Check.

Inspect	Maximum Serviceable Limits	Remarks
A. Entire valve for cracks.	Not serviceable.	
B. Threads for damage.	One entrance thread.	Clean-up and chase threads.
C. Free movement and seating of swing seat.	No binding that keeps swing seat from seating.	