INDEX FOR FIGURE 72-1-2

1. Fuel Pump Assy
2. Elbow
3. Hose Assy
4. Nipple
5. Adapter
6. Fuel Drain Valve
7. Elbow
8. Fuel Drain Tube Assy
9. Tee
10. Nipple
11. Hose Assy
12. Clamp
13. Clamp
14. Clip
15. Primer Line Tube Assy
16. Clip
17. Clamp
18. Nipple
19. Coupling
20. Solenoid Valve
21. Clamp
22. Tee
23. Hose Assembly
24. Duct Drain Fitting
25. Hose Assembly
26. Hose Assembly
27. Union
28. Lower Carburetor Drain Tube Assy
29. Clamp
30. Fuel Drain Tube Assy
31. Spacer
32. Union
33. Washer
34. Hose
35. Clamp
36. Drain Line Tube
37. Grommet
38. Filler Unit Assy
39. Gasket
40. Gasket
41. Spacer

NOTE: The dual carburetor installation includes two Marvel-Schebler carburetors, Part No. 10-4401, which differ from the single Marvel-Schebler carburetor Part No. 10-4218 in both configuration and power setting. The dual carburetor installation cannot be assembled from two single installation carburetors (Part No. 10-4218). All dual installation carburetors (Part No. 10-4401) have the same setting and are interchangeable; either of these carburetors may be replaced separately without changing the other.

72-11-10. REMOVAL OF DUAL CARBURETOR INSTALLATION. (See figures 72-1-5 and 72-1-6.) Removal or replacement of parts in the dual carburetor installation can be accomplished most readily by first detaching and removing the carburetor adapter from the engine distribution chamber, and then detaching each carburetor as required. To remove the adapter and carburetors, proceed as follows.

a. Remove upper air intake duct (Section 76.)

b. Disconnect the throttle control cable from throttle control lever on left-hand carburetor and lower air intake duct.

c. Disconnect mixture control cable and interconnect mixture control cable from the right-hand carburetor mixture control lever by removing the cotter pin securing the fitting to the lever arm.

NOTE: Do not lose spacer washers between fitting and lever arm.

d. Disconnect mixture control cables from the cable supporting brackets adjacent to the right-hand carburetor.

e. Disconnect the fuel inlet hose, fuel instrument line, carburetor drain line and air intake duct drain line. Plug all openings in carburetor.

f. Remove carburetor heat air control cable and heated air intake flexible duct.

g. Remove carburetor air temperature bulb connector plug.

h. Remove nuts and washers securing carburetor adapter to engine distribution chamber. Lower both the carburetor and lower engine air intake duct to clear crankcase studs. Remove carburetors and adapter from engine.

i. Detach either or both carburetors from the adapter, as required.

72-11-11. INSTALLATION OF DUAL CARBURETOR INSTALLATION. (See figures 72-1-5 and 72-1-6.) Assemble the dual carburetors, carburetor adapter, lower air intake duct, interconnect throttle rod and interconnect fuel hose prior to installation on the engine distribution chamber.

a. Install gaskets between carburetors and engine air intake duct. Secure the bottom flange of the carburetors and the mixture control bracket to the air intake duct. Attach the mixture control bracket with two rear cap screws attaching the right-hand carburetor to the air intake duct.

b. Assemble gaskets, carburetor, and carburetor adapter and secure with nuts and washers. Safety with 0.032-inch diameter wire (Table 10-VI, item 6).

c. Install and adjust the interconnect throttle rod. (Refer to paragraph 72-11-31.)

d. Install fittings and interconnect fuel hose; and instrument line fitting in left-hand carburetor.

e. Install fuel drain valves in both carburetors.

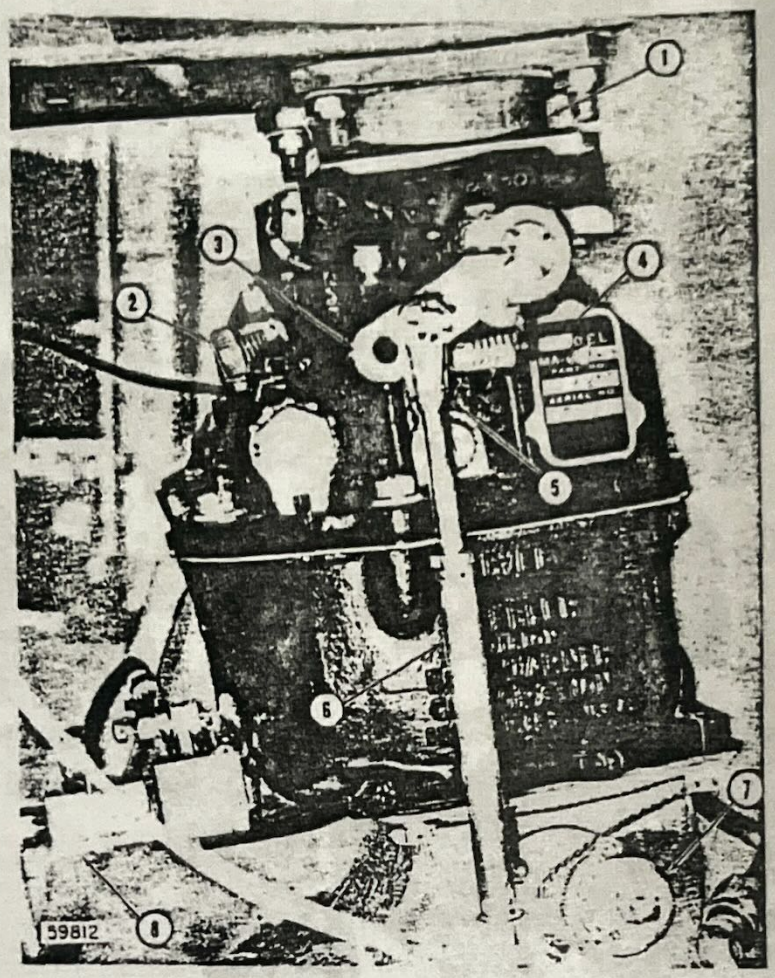
f. Install new gaskets on top of the carburetor adapter and between the engine air intake arm and engine distribution chamber.

g. Carefully install assembled parts over the four engine distribution chamber studs. Secure with nuts and washers. Safety with 0.032-inch diameter wire (Table 10-VI, item 6).

CAUTION: USE CARE IN INSTALLING THE CARBURETORS OVER THE MOUNTING STUDS. A SCRATCH ON THE MOUNTING FLANGE CAN CAUSE AN AIR LEAK.

h. Secure engine air intake support arm to engine air intake support bracket.

i. Connect and adjust throttle control cable to the carburetor. (Refer to Section 75.)



1. Carburetor Adapter
2. Adjusting Screw
3. Throttle Lever
4. Idle RPM Adjusting Screw
5. Throttle Control Clevis
6. Throttle Control Cable Protector Tube
7. Carburetor Air Temperature Bulb
8. Fuel Drain Valve

Figure 72-1-4. Right-Hand View of Single Carburetor Installation

j. Attach the fuel inlet hose, fuel pressure instrument lines and drain lines.

k. Install and adjust the mixture control cable, the interconnect mixture control cable, and the carburetor air heat control cable. (Refer to Section 75.)

l. Install heated air intake flexible duct and upper air intake duct.

m. Install carburetor air temperature bulb connector plug.

72-11-30. ENGINE IDLE ADJUSTMENT - DUAL CARBURETOR INSTALLATION. (See figures 72-1-5 and 72-1-6.)

a. Adjust the idle mixture adjustment screw on each carburetor by turning the screw (in the L direction indicated by the arrow) to the closed position, and back out the screw (in the R direction indicated by the arrow) approximately 3/4 turn.

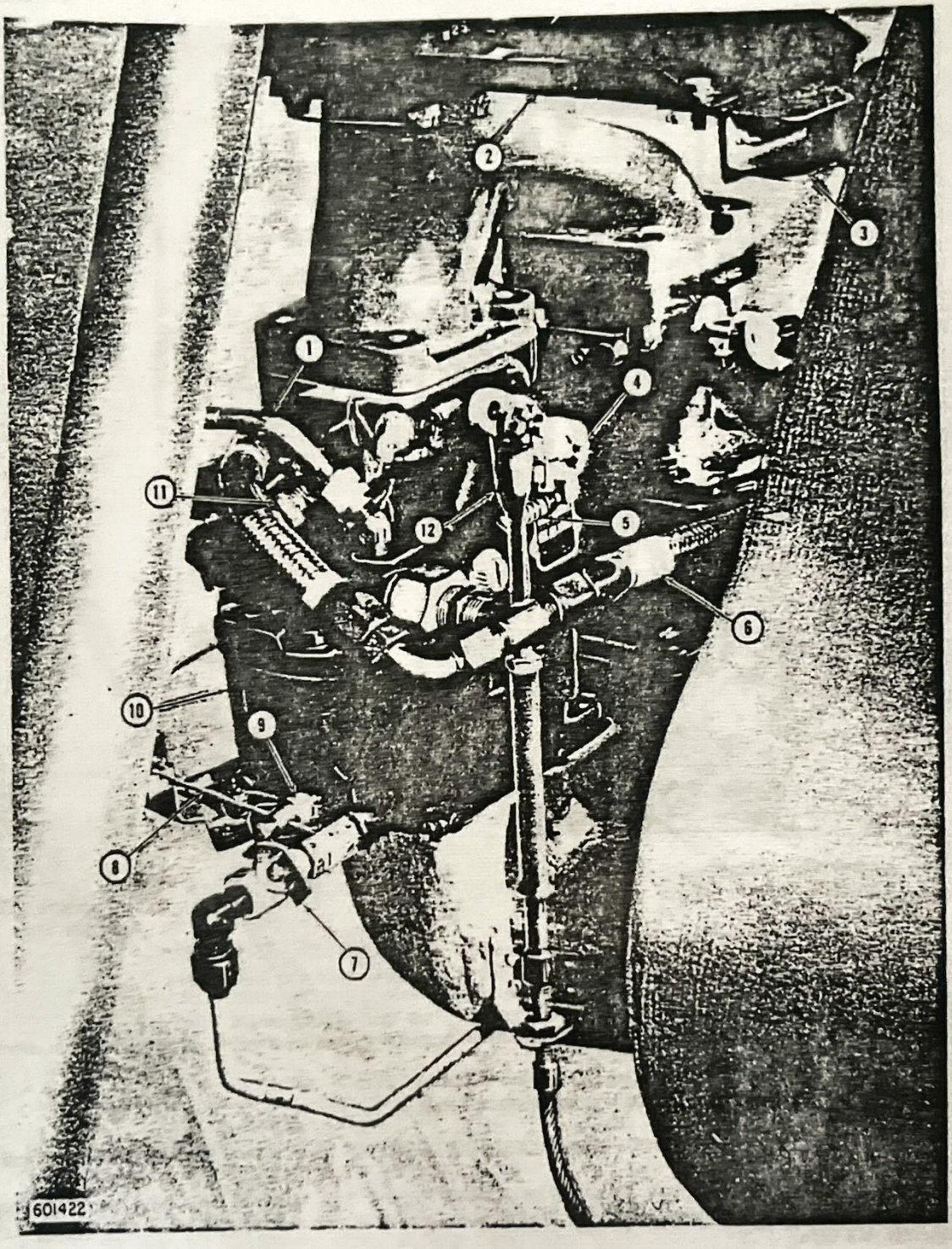
CAUTION: TURN THE SCREW UNTIL IT LIGHTLY TOUCHES THE SEAT OF THE VALVE. TIGHTENING THE SCREW MAY CAUSE DAMAGE TO THE NEEDLE VALVE AND SEAT.

b. Run the engine until normal operating temperatures are maintained and stabilized before further adjustment.

c. Adjust the idle rpm adjustment screw on the left-hand carburetor so that the engine idles at 1050 (± 50) rpm. Retract the idle rpm adjustment screw on the right-hand carburetor to make it ineffective.

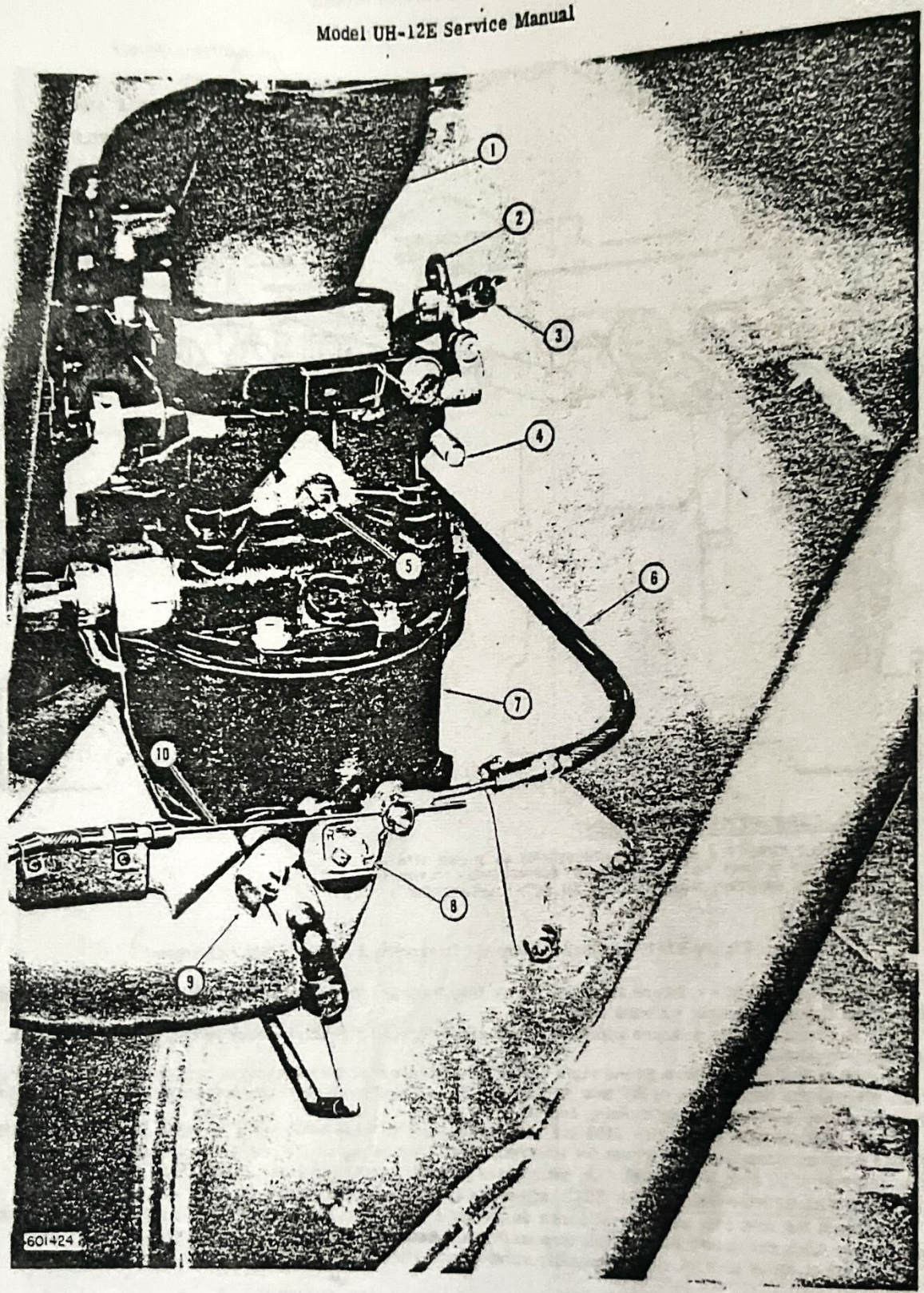
d. Adjust first the idle mixture on the left-hand carburetor as follows:

(1) Turn the idle mixture adjusting screw slowly toward the right position (R direction indicated by the arrow) until the engine runs unevenly.



1. Fuel Pressure Instrument Line
2. Engine Air Intake Support Arm
3. Engine Air Intake Support Bracket
4. Throttle Lever
5. Idle RPM Adjusting Screw
6. Interconnect Fuel Hose
7. Fuel Drain Valve
8. Interconnect Mixture Control Cable
9. Mixture Control Lever
10. Left-hand Carburetor
11. Idle Mixture Adjusting Screw
12. Control Cable Clevis Fitting

Figure 72-1-5. Left-Hand View of Dual Carburetor Installation



1. Carburetor Adapter
2. Throttle Lever
3. Interconnect Throttle Rod
4. Idle RPM Adjusting Screw
5. Idle Mixture Adjusting Screw
6. Interconnect Mixture Control Cable
7. Right-hand Carburetor
8. Mixture Control Lever
9. Fuel Drain Valve
10. Mixture Control Cable

Figure 72-1-6. Right-Hand View of Dual Carburetor Installation

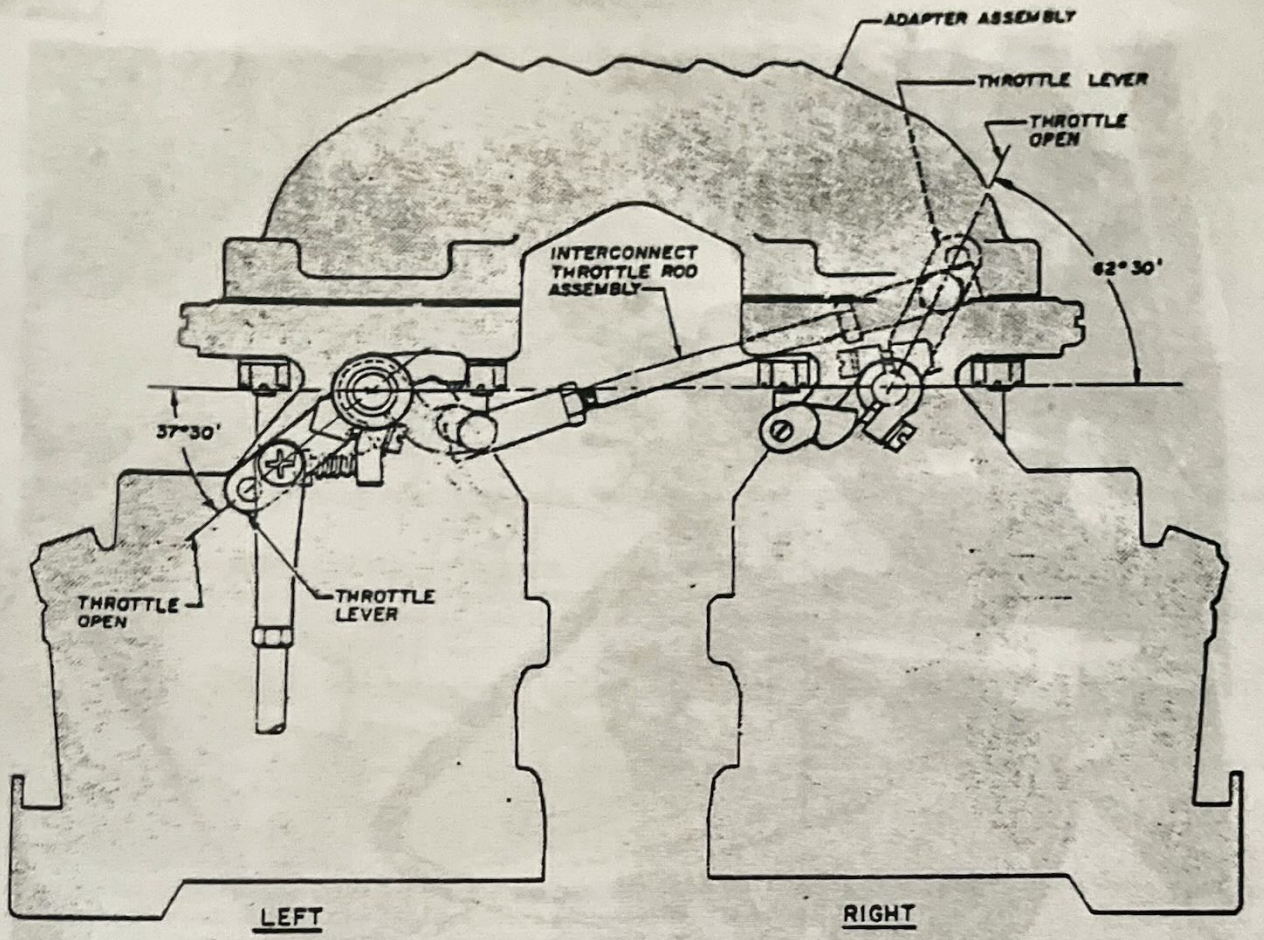


Figure 72-1-7. Dual Carburetor Interconnect Throttle Rod Adjustment

(2) Turn the idle mixture adjusting screw slowly toward the lean position (L direction indicated by the arrow) until the engine lags, or runs rough.

(3) Turn the idle mixture adjusting screw slowly toward a slightly richer setting to provide smooth, even engine operation.

e. Adjust the idle mixture on the right carburetor by repeating the procedures outlined above in paragraph d.

f. Repeat the adjustment of the idle mixture for the left and right-hand carburetors until the proper mixture setting provides a smooth, even running engine.

g. On helicopters, Serial No. 2199 and subsequent, and on those helicopters on which Service Bulletin No. 2027 has been accomplished, readjust the idle rpm adjustment screw on the left-hand carburetor so that the engine idles at 1750 rpm (± 50 rpm). On helicopters prior to Serial No. 2199, and on those not modified in accordance with Service Bulletin No. 2027, adjust the idle rpm to 1600 rpm (± 50 rpm).

h. Adjust the idle rpm adjustment screw on the right-hand carburetor so that it contacts the throttle control arm and then back the screw out one full turn so that it does not contact the arm at any time.

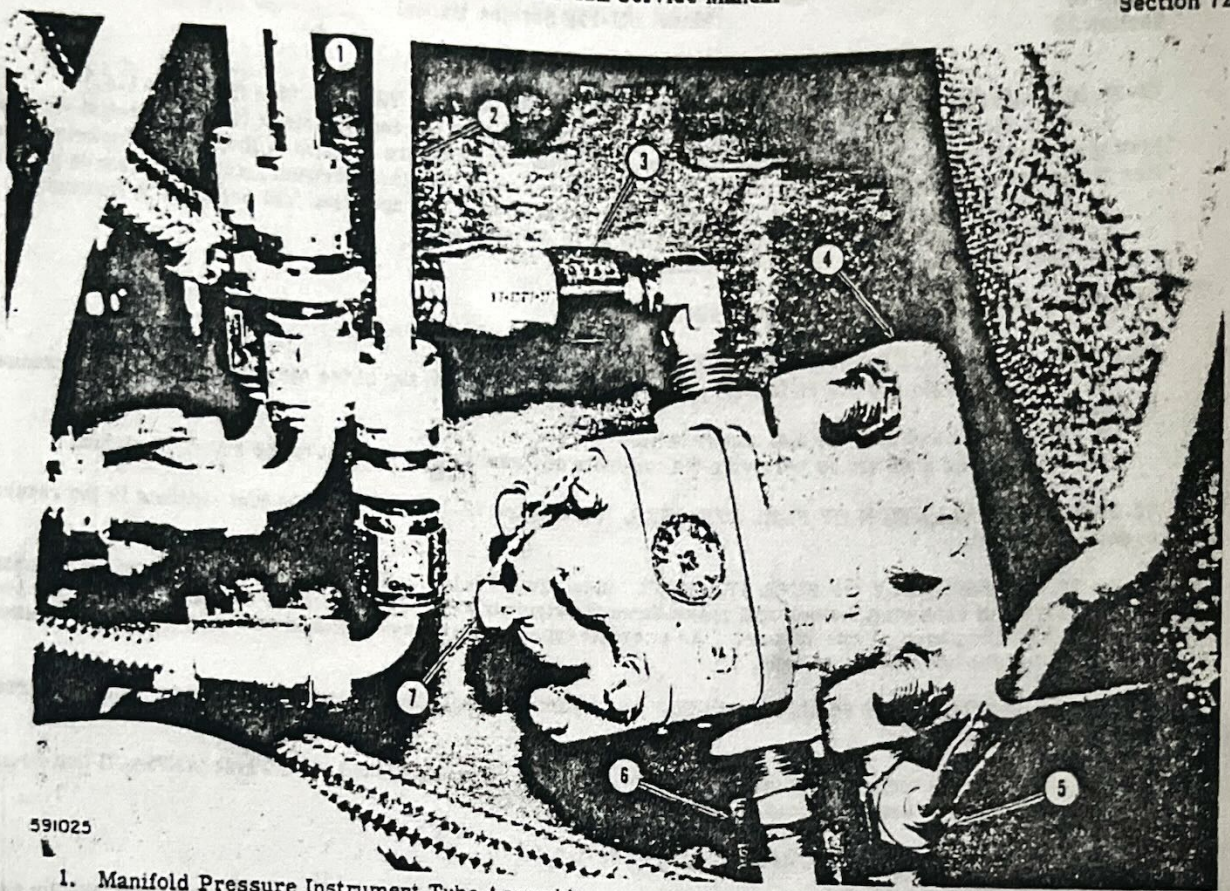
i. Check throttle control cable assembly adjustment. (Refer to Section 75.)

72-11-31. DUAL CARBURETOR INTERCONNECT THROTTLE ROD ADJUSTMENT. (See figure 72-1-7.)

a. Disconnect the interconnecting rod from the right-hand carburetor throttle lever.

b. Place throttles of both carburetors in full open position. Position the adjustable throttle levers in the angular positions specified in figure 72-1-7. Tighten the screws securing the throttle lever to the splined shaft on each carburetor. Safety with 0.032-inch diameter wire (table 10-VI, item 6).

c. With throttle levers properly positioned in full open throttle attitude, adjust interconnect rod to synchronize left and right-hand throttle control. Install the interconnect rod.



1. Manifold Pressure Instrument Tube Assembly
2. Fuel Pressure Instrument Tube Assembly
3. Fuel Pump to Primer Solenoid Hose Assembly
4. Fuel Pump Assembly
5. Fuel Pump Drain Tube Assembly
6. Auxiliary Fuel Pump to Engine Fuel Pump Hose Assembly
7. Fuel Pressure Adjustment Screw

Figure 72-1-8. Engine-Driven Fuel Pump

72-11-40. DEPRESERVATION AND FLUSHING OF DUAL CARBURETORS. Depreservation and flushing procedures for dual carburetors are the same as those for the single carburetor; refer to paragraph 72-10-40.

72-11-41. REPLACEMENT OF DUAL INSTALLATION CARBURETOR. To accomplish either replacement or interchange of a dual carburetor installation all that is required is correct orientation of the external fuel inlet fitting, fuel inlet screen, and the throttle control arms, in relationship to either the right or left position of the carburetor to be installed; refer to paragraphs 72-11-10 and 72-11-11 for removal and installation instructions.

NOTE: Whenever either or both carburetors, throttle levers or any of the throttle interconnect rod assembly components are replaced, the throttle levers will require adjustment. (Refer to paragraph 72-11-31 for throttle adjustment procedures.)

72-20-1. ENGINE-DRIVEN FUEL PUMP. (See figure 72-1-8.)

72-20-10. REMOVAL OF ENGINE-DRIVEN FUEL PUMP. (See figure 72-1-8.)

a. Disconnect and plug the fuel and drain lines at the pump.
b. Cap the inlet, outlet, and drain fittings of the pump.
c. Remove the pump from the engine by removing the four mounting nuts and washers.

72-20-11. INSTALLATION OF ENGINE-DRIVEN FUEL PUMP. (See figure 72-1-8.)

NOTE: The inlet, outlet and drain fittings must be installed on the pump before installation of the pump on the engine.

a. Install a new gasket before placing the pump in position on the engine.
b. Secure the pump with the four mounting nuts and washers.
c. Unplug the fuel and drain lines.
d. Uncap the inlet, outlet, and drain fittings on the pump.
e. Connect the fuel and drain lines to the pump.

72-20-30. ADJUSTMENT OF ENGINE-DRIVEN FUEL PUMP RELIEF VALVE. (See figure 72-1-8.)

a. With the engine idling at 1500 rpm (+ 100, -zero rpm) turn the engine-driven fuel pump relief valve adjusting screw in one-half to one turn increments to provide fuel pressure of three to four psi. Clockwise rotation of the relief valve adjusting screw increases pressure, while counterclockwise rotation decreases pressure.

b. With the engine operating at 3200 rpm check to make sure that specified fuel pressure is maintained.

c. If necessary, repeat adjustment and check as in steps a and b.

d. Safety the adjustment screw with lockwire.

72-30-1 FUEL STRAINER. (See figure 72-1-9.)

72-30-10. REMOVAL OF FUEL STRAINER. (See figure 72-1-9.)

a. Open the drain and air relief valves located just below and on top of the strainer and allow the strainer to drain.

b. Disconnect and plug the fuel supply lines.

c. Remove the strainer by removing the two bolts and washers securing it to the support bracket.

72-30-11. INSTALLATION OF FUEL STRAINER. (See figure 72-1-9.) Install the fuel strainer in the reverse order of removal.

72-30-20. DISASSEMBLY OF FUEL STRAINER. (See figure 72-1-9.) Disassemble the fuel strainer by cutting the lockwire and removing the bolt and gasket from the strainer cap. The cap, case and strainer may now be removed by lifting each off the strainer. An alternate type strainer may be disassembled by cutting the lockwire and removing the body from the base.

72-30-21. ASSEMBLY OF FUEL STRAINER. (See figure 72-1-9.) Assemble the fuel strainer in the reverse order of disassembly.

NOTE: A maximum torque value of 25/30 pound-inches has been established for the bolt (AN76A-7) that retains the fuel strainer (6-8) case.

72-40-1. AUXILIARY FUEL PUMP. (See figure 72-1-9.)

72-40-2. DESCRIPTION. The electrically operated auxiliary fuel pump is incorporated in the fuel system as a safeguard against fuel pressure drop or failure of the engine-driven fuel pump. The pump end assembly is a direct drive, positive displacement, cam-type metering pump. It is controlled by the FUEL PUMP-PRIME switch on the protection panel.

72-40-10. REMOVAL OF AUXILIARY FUEL PUMP. (See figure 72-1-9.)

a. Disconnect the plug and fuel lines from both the fuel strainer and the auxiliary fuel pump.

b. Cap the inlet, outlet, and drain fittings on the pump.

c. Remove the fuel strainer from the support bracket (refer to paragraph 72-30-10) to provide access to the pump mounting bolts.

d. Remove the pump by removing the four bolts and washers securing it to the support bracket.

72-40-11. INSTALLATION OF AUXILIARY FUEL PUMP. (See figure 72-1-9.) Install the auxiliary fuel pump in the reverse order of removal.

72-40-30. ADJUSTMENT OF AUXILIARY FUEL PUMP. (See figure 72-1-9.)

NOTE: Adjust the auxiliary fuel pump with engine stopped.

a. Open the carburetor drain valve while adjusting pressure.

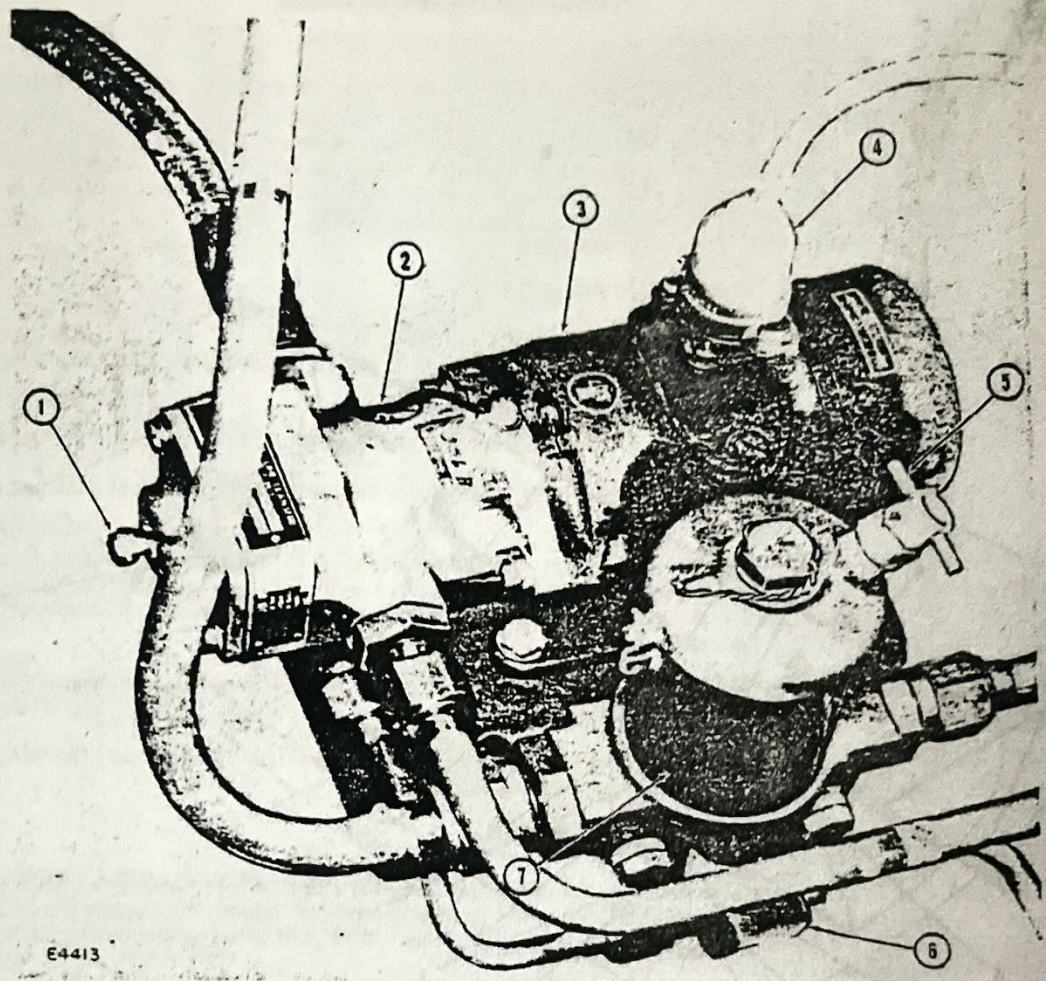
b. While the pump is operating, adjust the relief valve adjusting screw in one-half to one turn increments to an operating pressure of four to five psi. Clockwise rotation increases, and counterclockwise rotation decreases pressure.

c. Close the carburetor drain valve.

d. Safety the adjustment screw with lockwire.

72-50-1. FUEL CELL. (See figures 72-1-1 and 72-1-2.)

72-50-2. DESCRIPTION. The bladder type nylon fuel cell has a capacity of 46 U.S. gallons. The cell is installed in a tank cavity formed by the basic body section beneath the engine deck, and is retained at all sides by the tank cavity liner. The top of the fuel cell is held in place by eleven attaching tabs secured to snap fasteners which can be reached through access holes in the engine deck. The bottom and back end of the fuel cell are



1. Fuel Pressure Relief Valve Adjustment Screw
2. Line Transfer Fuel Pump
3. Line Transfer Fuel Pump Motor
4. Electrical Connector
5. Fuel Strainer Air Relief Valve
6. Fuel Pump and Strainer Drain Valve
7. Fuel Strainer

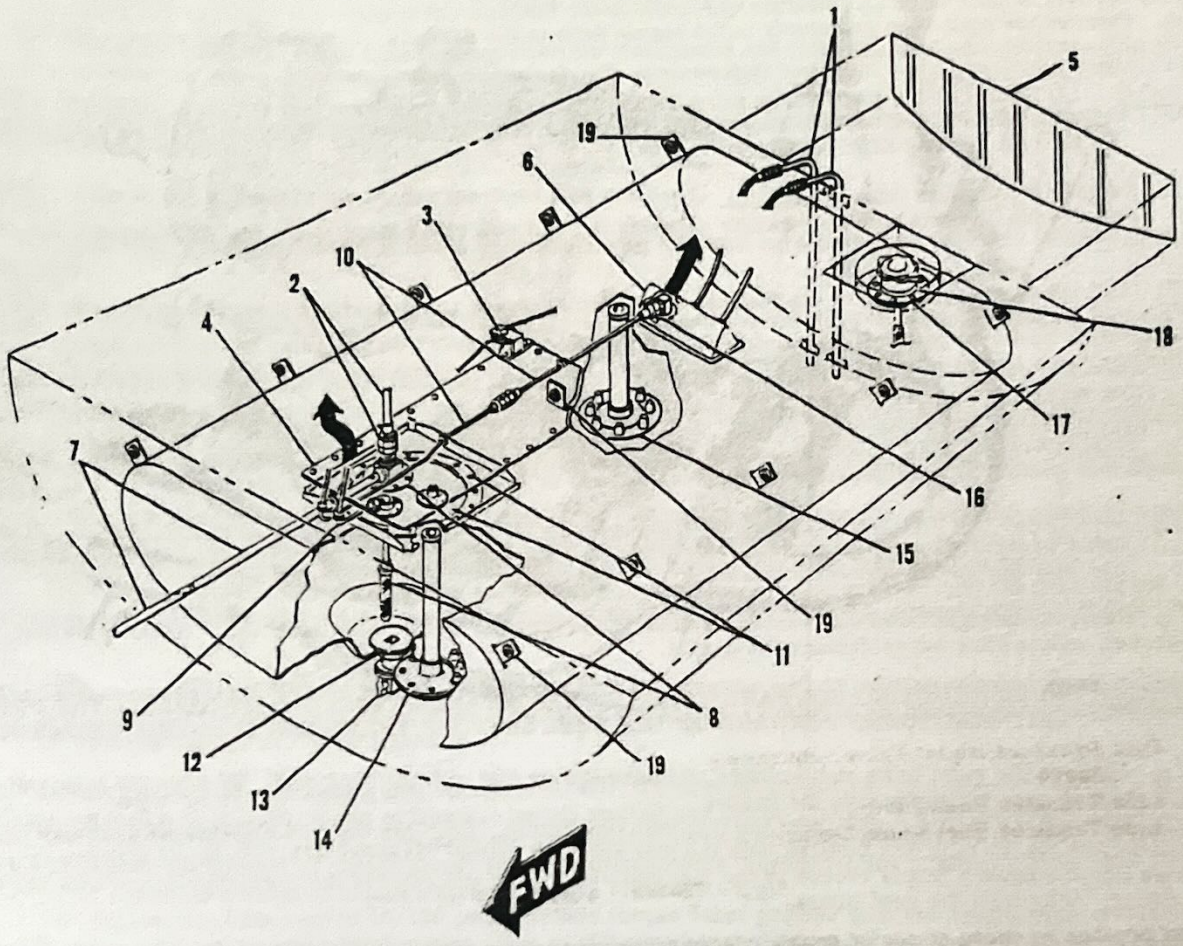
Figure 72-1-9. Auxiliary Fuel Pump

retained in place by three strips of double coated adhesive tape secured to the cell liner, or by two additional tabs secured to the basic body. The fuel cell interior is accessible through the removable fuel cell cover plate at the top of the cell, and the fuel cell sump and fuel quantity tank units are reached through access holes in the basic body underside.

72-50-10. REMOVAL OF FUEL CELL. (See figures 72-1-10 and 10-7.)

NOTE: Index numbers shown in figure 72-1-10 are arranged to indicate the proper sequence of removal.

a. Disconnect the battery. Remove the seat cushion, safety belts and seat deck from the right-hand side of the seat structure.
b. Drain the fuel cell according to instructions in Section 10.
c. Remove the tail boom in accordance with instructions in Section 62.
d. Remove the oil tank and oil cooler according to instructions in Section 73.
e. Remove the fuel pump and induction system drain tubes.
f. Remove the fuel supply line and fuel supply line cover plate nut.
g. Remove the bolts securing the two rudder control pulley bracket assemblies to the aft end of the large engine deck cover assembly.
h. Remove the access hole cover assemblies from the engine deck and the basic body bottom skin (left-hand forward and right-hand aft).
i. Remove the aft bulkhead fuel tank access door assembly.



1. Fuel Pump and Induction System Drain Tubes
2. Fuel Supply Line and Fuel Supply Line Cover Plate Nut
3. Rudder Control Pulley Bracket Assembly
4. Engine Deck Access Hole Cover Assembly
5. Aft Bulkhead Fuel Tank Access Door Assembly
6. Engine Deck Cable and Carburetor Vapor Vent Support Assembly
7. Forward and Aft Fuel Shutoff Valve Control Tube Assemblies
8. Fuel Shutoff Valve and Strainer Assembly
9. Fuel Cell Cover Plate Vent Tube Assembly
10. Aft Vent Tube Assemblies
11. Fuel Cell Cover Plate Assembly and Retainer
12. Fuel Cell Sump Drain Fitting
13. Drain Valve
14. Forward Fuel Quantity Tank Unit
15. Aft Fuel Quantity Tank Unit
16. Fuel Cell Vent Fitting
17. Fuel Filler Well Assembly
18. Filler Unit Assembly
19. Fuel Cell Attaching Tab

Figure 72-1-10. Fuel Cell Removal

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j. Loosen the locknuts securing the carburetor air heat and bypass cable assemblies to the engine deck cable support assembly. Remove the five screws, the throttle cable support bolt and spacer, and slide the cable support assembly aft and upward to provide access to the aft fuel cell vent fitting.

k. Remove the roll pins from the junction of the forward and aft fuel shutoff valve control tube assemblies located under the seat. It is not necessary to remove the fuel shutoff valve roll pin. Disengage the forward and aft control tube assemblies by moving the aft control tube assembly forward and then aft. Then slide the aft control tube assembly forward far enough to clear the edge of the large engine deck access hole.

l. Matchmark the fuel cell shutoff valve to shutoff valve plate and fuel cell cover plate. Remove the bolts securing the fuel shutoff valve and strainer assembly to the fuel cell cover plate and withdraw the assembly.

m. Remove the split-type grommets in the engine deck at the firewall. Disconnect and remove the fuel cell cover plate vent tube assembly.

CAUTION: DO NOT APPLY EXCESSIVE SIDE PRESSURE AGAINST THE FITTING WHEN LOOSENING THE TUBING NUT TO AVOID DAMAGING THE SEAL BETWEEN THE FITTING ADAPTER AND THE COVER PLATE SURFACES.

n. Remove the aft vent tube assemblies.

o. Remove the 16 bolts and the retainer securing the fuel cell cover plate to the fuel cell; remove the cover plate.

NOTE: Lift the right-hand side of the fuel cell cover plate upward and outward to clear the carburetor control cable assemblies.

p. Insert a tool, of local manufacture, into slot cut in top of fuel cell sump drain fitting to prevent the fitting from turning. Remove the drain valve and the nut securing the fuel cell sump drain fitting to the fuel cell liner. Withdraw the sump drain fitting.

q. Matchmark and disconnect the coaxial electrical connectors from the fuel quantity tank units. Tape the connectors to protect against possible mechanical damage or the entry of foreign material.

NOTE: Matchmark the fuel quantity tank unit flanges to the fuel cell liner to facilitate reinstallation. Electrical cable assembly length is adequate only when the tank unit flange and the fuel cell mounting hole pattern are matched in the correct position.

r. Remove the eight bolts and washers attaching the forward fuel quantity tank unit. Remove the tank unit and gasket, taking care not to damage the gasket.

CAUTION: WHEN REMOVING FORWARD TANK UNIT (RESISTANCE TYPE) DO NOT DAMAGE THE FLOAT UNIT POSITIONED FORWARD OF THE FUEL SHUTOFF VALVE AND STRAINER ASSEMBLY

s. Remove the eight bolts and washers attaching the aft fuel quantity tank unit. Remove the tank unit and gasket, taking care not to damage the gasket.

t. Remove the fitting nipple from the fuel cell vent fitting. Collapse the fuel cell upward at the aft end of the cell and aline the aft tank unit opening with the fuel cell vent fitting. Insert a 3/8-inch drive socket wrench extension into the square fitting recess of the fuel cell vent fitting and remove the securing nut and washers from the fitting. Withdraw the vent fitting.

CAUTION: THE FUEL CELL MAY BE EQUIPPED WITH TWO ADDITIONAL TIE-DOWN TABS AT THE REAR LOWER EDGE OF CELL; IF SO, REMOVE NUT, WASHER AND BOLT FROM EACH TAB TO RELEASE TAB.

u. Remove the eight bolts and washers located within the fuel filler well assembly.

NOTE: Matchmark the filler unit assembly to the filler well assembly. The filler unit assembly should be positioned so that the larger grip knobs on the filler unit cap are positioned laterally, with respect to the centerline of the helicopter, in the "closed" position.

v. Remove the filler unit assembly and gasket and withdraw the thick gasket from between the fuel cell liner and the filler well assembly.

w. Detach the eleven fuel cell attaching tabs from the studs on the basic body bulkheads by reaching through the engine deck access holes and depressing the spring-loaded locking key on each stud and withdrawing the tab from the stud.

x. Tie a length of cord or small gauge wire to each of the fuel cell attaching tabs prior to withdrawing the tabs through the liner slots. Carefully fold the fuel cell and remove it through the cell liner opening in the aft bulkhead of the basic body. Disconnect the eleven cord or wire lengths from each tab and leave them inserted through the slots. The cords can be used as guides to facilitate the reinstallation of the fuel cell.

CAUTION: USE EXTREME CARE TO AVOID SNAGGING OR TEARING THE FUEL CELL DURING ALL HANDLING OPERATIONS.

72-50-11. INSTALLATION OF THE FUEL CELL. (See figures 72-1-1 and 72-1-10.) Installation of the fuel cell is essentially the reverse of removal. In addition, accomplish the following steps.

NOTE: Do not remove replacement cell from storage until just prior to installation. If replacement cell is stiff, coat the interior surface with Goodyear (12946) Swabbing Solution (table 10-VI, item 7) or with a solution composed of equal parts of water and commercial glycerin.

a. Carefully check the metal tank support liner for cleanliness and freedom from sharp edges. Make certain that all interior edges, laps and joints are adequately covered with two-inch width pressure sensitive cloth tape.

b. Check condition of double-coated tape (table VI, item 29) used to secure bottom of cell in place. Replace deteriorated tape.

NOTE: Tape is not necessary when rear tie-down tabs are used.

c. Attach the previously inserted cords or wires to cell tabs and carefully place fuel cell in liner cavity in basic body.

NOTE: If fuel cell is equipped with two additional tie-down tabs at the rear lower edge of the cell, two additional slots in the cell liner are required to permit the tab attachment to the basic body. If the liner lacks the slots, fold the tabs under the cell and use the specified double-coated tape for cell retention.

d. (See figure 72-1-10.) Insert the thick gasket between the fuel cell and filler well assembly, and install gasket and fuel filler unit (18) in fuel filler well assembly (17). (Observe previously applied matchmarks.) Secure filler unit to filler well and fuel cell with self-locking screws. Install and tighten the self-locking screws as follows:

(1) Start each screw sufficiently to engage three or four threads, then use a torque wrench to measure the amount of torque (drag) required to overcome thread friction prior to clamp-up.

(2) Record the amount of torque measured in step (1) above, for each individual screw.

(3) Tighten each screw clamp-up to 15/25 pound-inches torque value greater than the drag torque recorded in step (2) above. Do not exceed a total torque value of 100 pound-inches (drag torque plus clamp-up torque).

NOTE: The sump and vent fittings must be alined during tightening the nuts to provide correct angular positioning of the nipple and drain valve when installed in the fitting. Transfer all matchmarking identification if new assemblies are to be installed.

e. Install the aft fuel vent fitting (16, figure 72-1-10). To prevent the fitting from turning, insert a 3/8-inch drive extension in square recess of fitting. Install washer and nut on fitting. Tighten nut as follows:

(1) Start the nut sufficiently to engage the self-locking device with the fitting threads; then use a torque wrench to measure the amount of torque (drag) required to overcome thread friction prior to clamp-up.

(2) Record the amount of torque required in step (1) above.

(3) Tighten nut clamp-up to 90/130 pound-inches torque value greater than the drag torque recorded in step (2) above. Do not exceed a total torque value of 600 pound-inches (drag torque plus clamp-up torque).

f. Install the fuel cell sump drain fitting (12, figure 72-1-10), gasket, washer and nut. To prevent fitting from turning, insert a tool of local manufacture in slot in top of fitting. Tighten the nut as outlined in step e above.

g. Check that matchmarked assemblies have been properly alined.

h. Check that vent tube assembly grommets and the forward and aft fuel shutoff tube assembly nylon guide bushings are properly installed.

i. Install the forward and aft fuel quantity transmitter units. (Refer to Section 81 for installation procedure.)

j. (See figure 72-1-1.) Make certain that fuel cell interior is clean and free of foreign matter. Check alinement of the fuel shutoff valve (29) and the aft shutoff valve tube assembly (7) prior to the final installation in the fuel cell cover plate assembly (38). (Refer to paragraph 72-60-11 for installation of fuel shutoff valve and strainer assembly.)

k. Position cover plate gasket (41) on fuel cell liner, position cover plate assembly (38) in place. Secure plate to structure with bolts and washers. Install retainer (37) and secure retainer and cover plate to cell liner and cell with close tolerance self-locking bolts (33) and washers. Tighten the sixteen bolts in accordance with the procedure outlined in step d above.

l. Install the fuel cell vent tube assemblies; engage the aft fuel shutoff control tube with the fuel shutoff valve and install the aft bulkhead fuel tank access door assembly.

m. Service the fuel cell as specified in table 10-VI and check all assembly parting surfaces for leaks. If leaks are detected, drain the cell and make necessary corrections.

n. Add shim washers as required to adjust the clamping surface height of the engine deck access hole cover

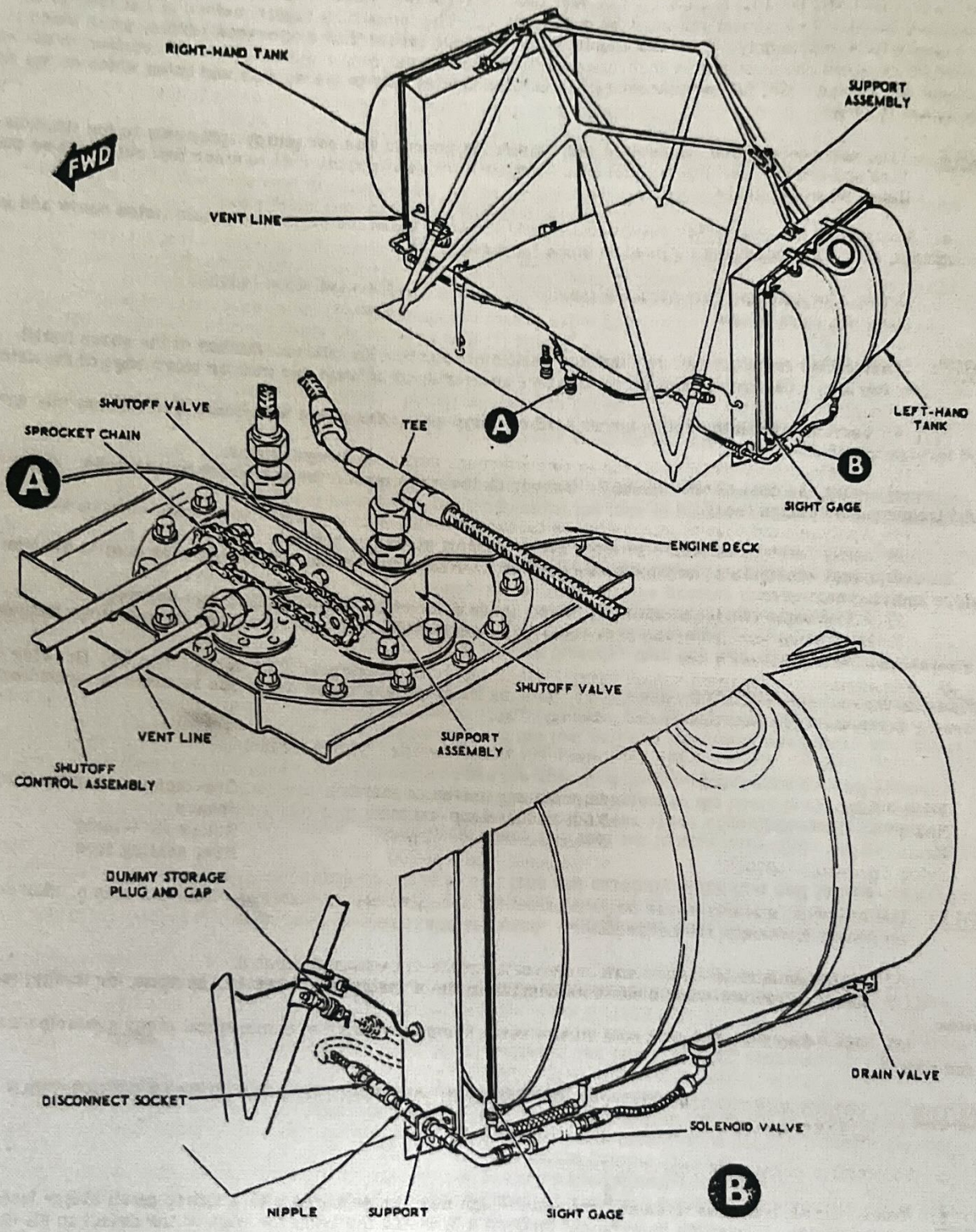


Figure 72-101-1. Auxiliary Fuel System Kit Installation

assembly (4, figure 72-1-10). Hold the fuel shutoff valve body while tightening the fuel supply line cover plate nut and fuel supply line (2, figure 72-1-10) to prevent loss of valve assembly torque at nut (26, figure 72-1-1).

o. Continue installation of removed items in any convenient sequence.

72-50-50. REPAIR OF FUEL CELL. Two methods for repairing tears, cuts and holes in the fuel cell are described below. Two limitations must be observed: (1) The temporary repair method is intended as an emergency field repair only. The cell should not be used for longer than a one-week period, after which it should be removed and repaired in accordance with the permanent repair method, or else returned to the manufacturer for repair. (2) The permanent repair method applies only to tears, cuts and holes which do not exceed six inches in length.

NOTE: The repair techniques, materials and limitations given in this paragraph apply only to the Goodyear Tire and Rubber Co. Pliocel fuel cell. Repair information applicable to other fuel cells will be published when available.

a. Accomplish the temporary repair (one-week duration) using the repair materials listed below and in accordance with the procedures outlined in steps (1) through (8):

Grade A or intermediate airplane fabric	Nitrocellulose lacquer
One-inch paint brush	shears

NOTE: Defects that result in fuel cell leakage must be repaired with internal patches of the above listed materials. The patch must be cut to allow an overlap of at least one inch or more edge of the defect.

(1) Carefully wash the cell internal surface surrounding the defect with benzine to remove oil, grease, and foreign materials.

(2) Carefully trim defective area to remove rough edges or irregularities.

(3) Paint one coat of nitrocellulose lacquer on the patch and on the section to be repaired. Allow to dry until lacquer is no longer tacky.

(4) Apply second coat of nitrocellulose lacquer on same surfaces and allow to dry until tacky.

(5) Apply patch to defective section; avoid trapping air under patch.

(6) Apply six coats of nitrocellulose lacquer over the entire repair, allowing each coat to dry thoroughly before applying next coat.

(7) Allow repair to set a minimum of two hours before handling or putting into service.

(8) If external surface of the repaired area is accessible, paint two coats of nitrocellulose lacquer on the repaired area and allow to dry.

b. Accomplish a permanent repair using Pliocel Repair Kit (Goodyear Tire and Rubber Co. Drawing No. 2FL-2-12456) which includes the following repair materials. Any of these items can be ordered individually from the Goodyear Tire and Rubber Co., Akron, Ohio.

Pliocel Repair Kit Materials (No. 2FL-2-12456)

Pliocel fabric	Chemigum paint-black (5070C)	One-inch paint brush (two)
Nedine	Kick-accelerator (1408C)	Shears
Mekol	Swabbing solution (1294C)	Roller (3/4-inch)
Nylon paint-blue (5073C)	Cellophane type Apt-600	Heat sealing iron

NOTE: The following materials may be substituted for specified repair materials listed in step b, above whenever such materials are not available:

(1) Nedine substitute - any clean commercial grade of denatured alcohol.

(2) Mekol substitute - any clean commercial grade of methyl ethyl ketone, acetone, or methyl isobutyl ketone.

(3) 1294C Swabbing Solution substitute - equal parts by volume of commercial clear glycerine and clean water.

CAUTION: THERE ARE NO SUBSTITUTES AUTHORIZED FOR SPECIFIED MATERIALS OTHER THAN THOSE LISTED ABOVE.

c. Accomplish permanent repair as follows:

NOTE: Tears, holes, and cuts up to six inches in length must be repaired with a fabric patch either internally or externally. The patch must be cut to allow a 3/4-inch lap from the edge of the defect in all directions. Any cell with a rupture more than six inches in length should be returned to the manufacturer for repair.

(1) Use Mekol to remove the black Chemigum paint from the exterior surface of the cell in an area extending approximately three inches beyond the defect in all directions.

(2) Carefully wash the internal surface of the cell surrounding the defect with Mekol to remove all oil, grease, or foreign materials.

(3) Carefully trim the defect to remove rough edges or irregularities.

(4) Center defective area over smooth wood block covered with closely woven cloth or Penciltex. If wood block and material are not available, use any smooth material with a stiff, hard finish which will not be affected by the heat and to which the cell will not stick when heated (test with scrap piece of material).

(5) Wash the patch and the section of the cell to be repaired with Nedine.

(6) Center patch over defect and cover with cellophane. Make certain cellophane is between hot iron and Pliocel material.

(7) To be effective, the heat sealing operation requires penetration of heat through the material. Prior to application of patch with heat-sealing iron, test temperature of iron by making small heat seal strip test as follows:

(a) Cut a one-inch fabric strip approximately four inches long. Fold strip in half. Heat-seal approximately one inch of strip according to steps (b), and (c) as follows.

(b) Pull the sealed pieces apart and check the appearance of sealed surface for loose, shiny spots; such spots indicate that the iron was not hot enough or was not applied long enough.

(c) If, when applying the iron, the fabric blisters immediately or turns dark brown, the iron is too hot.

(8) Place cellophane on patch and fabric area to be heated. Make certain cellophane is placed between hot iron and heated area.

(9) Apply heat to a small area of patch or seam until the area is completely blistered. Without pressing on heating iron, roll it lightly over entire repair area until blistered. Press and roll down blistered area with the cold roller.

(10) Apply heat continuously to patch or seam during heat-sealing operation; do not lift the iron from the area until effectively sealed.

(11) Remove cellophane with a cloth moistened with clean water. If, after a few seconds soaking, the cellophane is still tight, apply a wet cloth until cellophane becomes loose.

(12) If repair is loose, repeat heating operation.

(13) After application of the patch, apply three coats of nylon blue (5073C) to the internal surface of the repaired area and two coats of nylon blue (5073C) to the external surface of the repaired area.

NOTE: Each coat of nylon paint should extend one inch beyond the edge of the patch or repaired area. Allow 20 minutes drying time between applications of each coat.

(14) Apply one coat of Chemigum black paint (5071C) to the external surface of the repaired area. To make Chemigum black paint (5071C), add Kick-accelerator (1408C) to Chemigum black paint (5073C) in the following proportions:

(a) 12-1/2 cc (1/2-oz) bottle of Kick-accelerator (1408C) to one pint of Chemigum black paint (5070C) or

(b) 25 cc (1 oz) bottle of Kick-accelerator (1408C) to one quart of Chemigum black paint (5070C).

NOTE: Do not mix any more 5071C than is immediately required. The 5071C is air-curing and will gel in six to eight hours.

d. Wash brushes used for applying 5071C in Mekol.

e. Remove a defective patch and support hangers as follows:

NOTE: Nedine is a solvent for nylon and will open or loosen any heat-sealed area.

(1) Work a small amount of Nedine under the edge of the patch, lifting up the patch during the removal operation.

(2) Apply two coats of nylon paint over area that has been damaged by separating the fabric with Nedine.

(3) Apply a new repair patch in accordance with the repair instructions described in step c above.

f. A loose seam or support hanger is repaired as outlined in step c, except that no trimming is required unless a patch is necessary.

72-60-1. FUEL SHUTOFF VALVE AND STRAINER ASSEMBLY. (See figure 72-1-10.)

72-60-10. REMOVAL OF FUEL SHUTOFF VALVE AND STRAINER ASSEMBLY. Refer to paragraph 72-50-10 for fuel shutoff valve and strainer assembly removal instructions.

72-60-11. INSTALLATION OF FUEL SHUTOFF VALVE AND STRAINER ASSEMBLY. (See figure 72-1-1.)

a. Assemble fuel cell shutoff valve (29), gasket (28), shutoff valve plate (39), gasket (40), thin washer (27), nut (26) and fuel strainer (43). Aline matchmarks and tighten nut (26) in accordance with paragraph 72-50-11, step e (1) through (3).

b. Insert the fuel shutoff valve and strainer assembly into fuel cell cover plate (38) into position so that the shutoff valve stem and roll pin engage with slot in aft control tube assembly (7). Check alinement of valve stem

and aft shutoff tube with shutoff valve plate partially secured in place.

NOTE: A maximum of one thick washer and an extra gasket (same as gasket 28) may be added under the shutoff valve to obtain the best stem-to-tube alinement.

c. Secure shutoff valve plate gasket, shutoff valve plate, valve and strainer assembly to fuel cell cover plate assembly with bolts and washers.

d. Install fuel cell cover plate. (Refer to paragraph 72-50-11.)

72-70-1. FUEL QUANTITY TANK UNITS. (See figure 72-1-10.)

72-70-10. REMOVAL OF FUEL QUANTITY TANK UNITS. Refer to Section 81 for fuel quantity tank unit removal instructions.

72-70-11. INSTALLATION OF FUEL QUANTITY TANK UNITS. Refer to Section 81 for fuel quantity tank unit installation instructions.

72-101-1. AUXILIARY FUEL SYSTEM KIT INSTALLATION. (See figure 72-101-1.)

72-101-2. DESCRIPTION. The auxiliary fuel system kit installation is installed either in the form of a 20-gallon capacity left-hand auxiliary tank or as a 40-gallon auxiliary fuel tank installation. The left-hand auxiliary tank installation consists of: a single aluminum alloy tank secured to a stainless steel tank support assembly that attaches to the accessory attachment fittings on the left-hand side of the helicopter and to the engine mount frame; an auxiliary fuel shutoff valve installation which mounts to the fuel cell cover plate and is mechanically activated "on" and "off" in unison with the standard fuel shutoff valve; an electrically actuated solenoid valve for fuel flow control from the auxiliary tank to the main tank; and the electrical controls, associated wire harness, tubing and hose assemblies used for interconnection of the auxiliary fuel system with the standard fuel system. Quick release fittings are used for mechanical attachment of the tank and support assembly to the helicopter structure, and quick-disconnect couplings are used for fuel hose and electrical harness connections to permit fast, simple removal and installation of the auxiliary tank assembly. A dummy plug and cap are located on the left-hand engine mount frame to provide a means for securing the disconnected end of the fuel hose assembly and for capping the fuel tank nipple during the time that the auxiliary fuel tank is removed from the helicopter.

a. The auxiliary fuel tank installation consists of a complete left-hand auxiliary fuel tank installation, plus an additional right-hand tank and tank support assembly fitted with parallel connecting hose and harness assemblies that are essentially the same as the left-hand assemblies. Each auxiliary fuel tank assembly includes a drain valve, and a sight indicator assembly which is attached to the forward end of the fuel tank. The fuel level sight indicator utilizes a red-colored float ball contained in a clear plastic tube which permits instant observation of the actual fuel level in the tank at all times. When either the single or dual auxiliary tanks are installed, operation of the fuel solenoid valve or valves is controlled by the AUXILIARY FUEL TRANSFER ON-OFF switch located in the lower section of the instrument panel; circuit protection is provided by a 5-ampere AUX circuit breaker located at the forward end of the circuit protection panel.

72-101-3. TROUBLESHOOTING THE AUXILIARY FUEL SYSTEM. Refer to table 72-101-I for troubleshooting information.

Table 72-101-I. Troubleshooting the Auxiliary Fuel System

TROUBLE	PROBABLE CAUSE	REMEDY
Fuel will not drain into main cell, or drains too slowly	Solenoid valve defective	Replace solenoid valve (see solenoid valve inoperative below).
	Shutoff valve not completely open	Adjust valve rigging.
	Defective electrical circuit	(See below).
	Fuel vent line plugged	Remove material plugging vent line.
Solenoid valve inoperative	Electrical circuit defective or "open".	Repair or replace broken wires, knife-splice or disconnect coupling.
	Defective valve	Replace solenoid valve.
Shutoff valve not opening	Valve improperly rigged	Rerig valve to correct position.
	Chain assembly detached	Attach chain assembly.
	Broken or separated chain assembly or master link	Replace chain assembly or master link.
Electrical circuit inoperative	Defective AUX circuit breaker	Replace circuit breaker
	Defective TRANSFER SWITCH	Replace transfer switch.
	Solenoid "ground" connection loose, corroded or open	Tighten, repair or replace pump ground terminal at firewall.

72-110-1. AUXILIARY FUEL TANK INSTALLATION. (See figure 72-101-1.)

72-110-10. REMOVAL OF AUXILIARY FUEL TANK INSTALLATION. (See figure 72-101-1.)

NOTE: Removal and installation of the left-hand auxiliary fuel tank components shall be accomplished in accordance with the instructions provided in paragraphs 72-110-10 and 72-110-11. Removal and installation procedures for the right-hand auxiliary fuel tank components are essentially the same as those for the left-hand fuel tank.

a. Open the drain valve and drain all fuel from the tank.
b. Disengage the inlet hose assembly disconnect-socket from the support assembly nipple by sliding the knurled ring of the fitting toward the helicopter to release the clamping dogs. Remove the cap from the dummy stowage plug attached to the engine mount frame. Cap the support assembly nipple.
c. Stow the fuel hose assembly for security by engaging the hose socket to the dummy plug.
d. Disconnect the solenoid valve harness plug from the receptacle mounted on the engine frame.
e. Withdraw the quick-release pins and remove the fuel tank and support assembly from the helicopter.

72-110-11. INSTALLATION OF THE AUXILIARY FUEL TANK AND TANK SUPPORT ASSEMBLY. (See figure 72-101-1.)

a. Place the auxiliary fuel tank and tank support assembly in position on the helicopter and install the quick-release pins.
b. Connect the solenoid valve harness plug to the frame-mounted bracket assembly.
c. Disengage the inlet hose assembly from the dummy stowage plug; remove the cap from the support assembly nipple and place the cap on the dummy stowage plug. Connect the inlet hose quick disconnect to the support assembly nipple.

72-110-50. REPAIR OF AUXILIARY FUEL TANK ASSEMBLY. (See figure 72-101-1.)

NOTE: Repair of cracks and holes in the auxiliary fuel tanks are permitted, provided that such repairs are accomplished in accordance with repair procedures authorized in Federal Aviation Regulation 43.

a. Following repair of fuel tank, thoroughly purge tank to remove any loose foreign particles from the tank interior.
b. Pressure test the repaired fuel tank for a minimum period of five minutes at pressures of 0.50 to 1.00 psi.

72-120-1. AUXILIARY FUEL SHUTOFF VALVE ASSEMBLY. (See figure 72-101-1.)

72-120-2. DESCRIPTION. The auxiliary fuel shutoff valve assembly is essentially identical to the standard fuel shutoff valve and is synchronized with the standard fuel shutoff valve to provide positive, simultaneous operation.

72-120-10. REMOVAL OF AUXILIARY FUEL SHUTOFF VALVE ASSEMBLY. (See figure 72-101-1.) Removal procedure for the auxiliary fuel shutoff valve is essentially the same as those for the standard fuel shutoff valve: refer to paragraph 72-60-10 for standard fuel shutoff valve removal procedure.

72-120-11. INSTALLATION OF AUXILIARY FUEL SHUTOFF VALVE ASSEMBLY. (See figure 72-101-1.) Installation procedure for the auxiliary fuel shutoff valve is essentially the same as those for the standard fuel shutoff valve assembly; refer to paragraph 72-60-11 for standard fuel shutoff valve installation procedure.

72-120-30. RIGGING PROCEDURE FOR AUXILIARY FUEL SHUTOFF VALVE ASSEMBLY. (See figure 72-101-1.)

a. Disconnect the fuel hose assembly from the top of each fuel shutoff valve so that the valve opening and closing may be observed.
b. Loosen the bolts attaching the auxiliary fuel shutoff valve to the fuel cell cover plate and remove the chain assembly.
c. Rotate both valves to full closed position and reinstall the chain assembly. Adjust the support assembly so that the chain is taut; retighten the bolts attaching the auxiliary fuel shutoff valve to the fuel cell cover plate.
d. Place the fuel shutoff valve handle in the full open position. The standard fuel shutoff valve should be full open and the fuel passage in the internal plug of the auxiliary fuel safety shutoff valve within 0.10-inch of full open.

LUBRICATION SYSTEM

73-1-1. LUBRICATION SYSTEM.

73-1-2. DESCRIPTION. (See figures 73-1-1 and 73-1-1B.) One of two different lubrication systems may be installed on the UH-12E Helicopter. The engine and transmission oil systems are independent of each other on the late configuration helicopters (Serial No. 2199 and subsequent, or prior S/N's modified in accordance with both Service Bulletins No. 2026 and 2027). The engine and transmission share a single oil system in common on the early configuration helicopters (prior to Serial No. 2199, and those modified in accordance with Service Bulletin No. 2026 only). Details of the differences between the two configurations are discussed in subsequent paragraphs.

73-1-2A. EARLY CONFIGURATION LUBRICATION SYSTEM. (See figures 73-1-1 and 73-1-1A.) The early configuration engine-transmission lubrication system comprises an oil tank; radiator type cooler; integral engine oil pump; an engine oil filter; and an engine breather and outlet manifold assembly. The system also includes a special transmission oil filter, transmission vent and oil drain manifold; and pressure and drain lines. A thermostat and a pressure relief valve are included in the oil cooler, and the transmission oil outlet temperature warning system operates from a temperature activated switch mounted within the transmission oil drain cross. The one-way check valve located on the transmission upper housing includes an air breather vent that prevents a possible vacuum lock of transmission drain oil. An additional oil filter is optional (paragraph 73-101-1).

a. Oil is drawn from the tank to the engine oil pump, from which it is distributed under pressure through the engine, and through the transmission oil filter directly into the one-way clutch inlet and a pressure cross. Pressure oil is supplied from this cross to the inlets for the transmission upper and center housings, and to the tachometer and fan drive inlet.

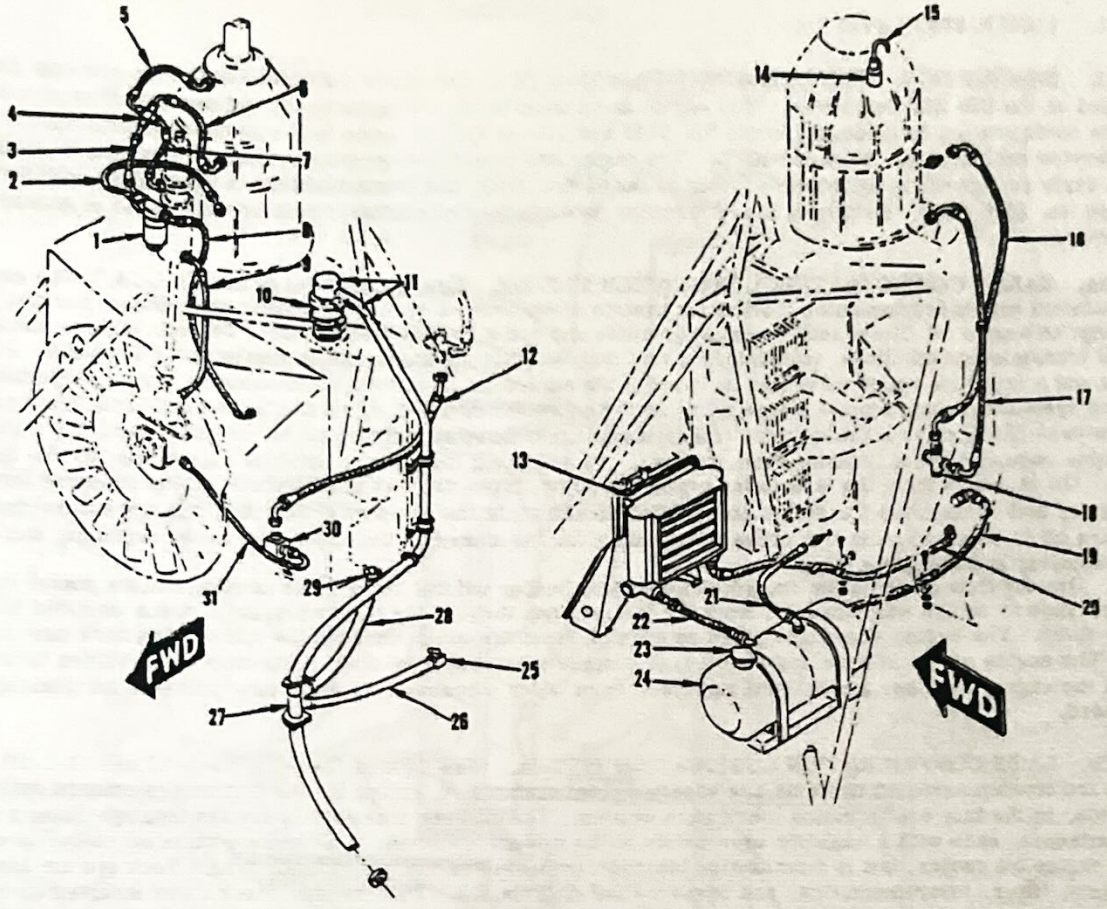
b. Gravity flow oil from the transmission lower housing and tail rotor drive housing outlets passes through a drain cross to return with drain oil from the fan gear box through the transmission oil drain manifold into the engine sump. The engine scavenger pump returns oil from the sump, through the cooler, and back into the tank. The engine oil drain hose and the oil tank drain hose extend from their respective drain valves to terminate in the engine breather and oil line manifold, from which a common oil drain tube provides for drainage overboard.

73-1-2B. LATE CONFIGURATION LUBRICATION SYSTEM. (See figures 73-1-1B, 73-1-1C and 73-1-1D.) The engine and transmission oil systems are separate from each other, except for the common overboard drain tube provision, in the late configuration lubrication system. The oil tank assembly is divided into two distinct tank compartments, each with a capacity appropriate to the system it serves. The transmission oil cooler is mounted on the engine oil cooler, but is functionally separate; both coolers are the radiator type. Each system has its own pump, filter, instrumentation, and pressure and drain hoses. The one-way check valve mounted on the transmission upper housing includes an air breather vent to prevent possible vacuum lock in its drain system, and the engine oil tank is vented to the engine crankcase.

a. In the separate transmission oil system (figures 73-1-1B and 73-1-1C), oil is pumped from the transmission oil tank through the cooler into an instrument and fitting assembly that contains the transmission oil pressure warning switch and temperature bulb. The oil flows under pressure through the transmission oil filter to the one-way clutch inlet and also through a pressure cross into inlets for the upper and center housings, and to the tachometer and fan drive inlet. From the tachometer and fan drive outlet, oil is gravity fed to the fan gear box. The fan gear box outlet fitting is turned upward to ensure an adequate supply of residual oil for gear lubrication at low engine speeds and during engine starting. Drain oil from the fan gear box and from the lower housing and tail rotor drive outlets flows through the tank inlet manifold into the tank. The oil temperature warning switch, located inside the manifold, remains open (warning light off) as long as transmission oil temperature remains below 275°F (135°C). Transmission inlet oil temperature, transmitted from a temperature bulb, is indicated on the engine gage unit.

b. In the separate engine oil system (figures 73-1-1B and 73-1-1D), oil is pumped through the engine internal oil provisions and returned by the scavenger pump from the oil sump through the oil cooler and into the tank. Engine oil and tank oil drainage lines combine in an oil drain manifold from which a tube extends for drainage overboard. The oil pressure gage is connected by instrument plumbing to the engine oil pump, and the engine oil temperature bulb is mounted in the lower section of the engine case.

73-1-3. TROUBLESHOOTING LUBRICATION SYSTEM. Refer to table 70-1-I for engine lubrication troubleshooting information, and to table 73-1-I for transmission lubrication troubleshooting data. Note that items identified by an asterisk (*) in table 73-1-I are applicable to both the early and late configuration transmission oil systems, and items with no asterisk pertain to the late configuration only.



1. Transmission Oil Filter
2. One-way Clutch Inlet Hose
3. Oil Distribution Hose
4. Transmission Oil Pressure Cross
5. Upper Housing Inlet Hose
6. Center Housing Inlet Hose
7. Tachometer and Fan Drive Inlet Hose
8. Transmission Oil Line Hose
9. Cooling Fan Gear Box Inlet Hose
10. Engine Breather Hose
11. Engine Breather Tube
12. Transmission Oil Drain Hose
13. Oil Cooler
14. Check Valve
15. Transmission Vent
16. Lower Housing Outlet Hose
17. Tail Rotor Drive Housing Outlet Hose
18. Transmission Oil Drain Cross
19. Engine Oil Pump Inlet Hose
20. Oil Cooler Inlet Hose
21. Oil Tank Vent Hose
22. Oil Cooler Outlet Hose
23. Oil Tank Filler Cap
24. Oil Tank
25. Oil Tank Drain Valve
26. Oil Tank Drain Hose
27. Engine Breather and Oil Line Manifold
28. Engine Oil Drain Hose
29. Oil Sump Drain Valve
30. Transmission Oil Drain Manifold
31. Cooling Fan Gear Box Outlet Hose

Figure 73-1-1. Oil System,Early Configuration

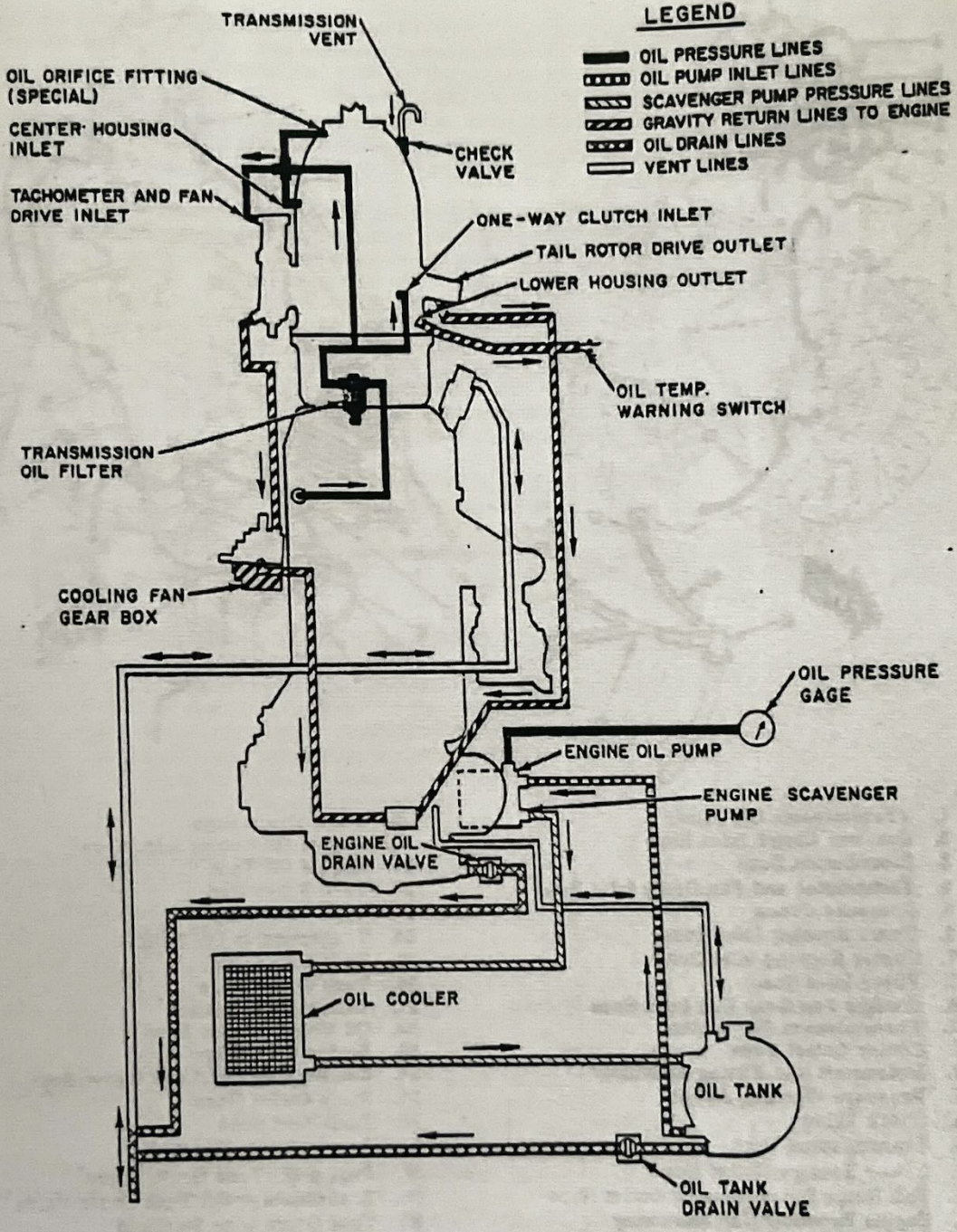
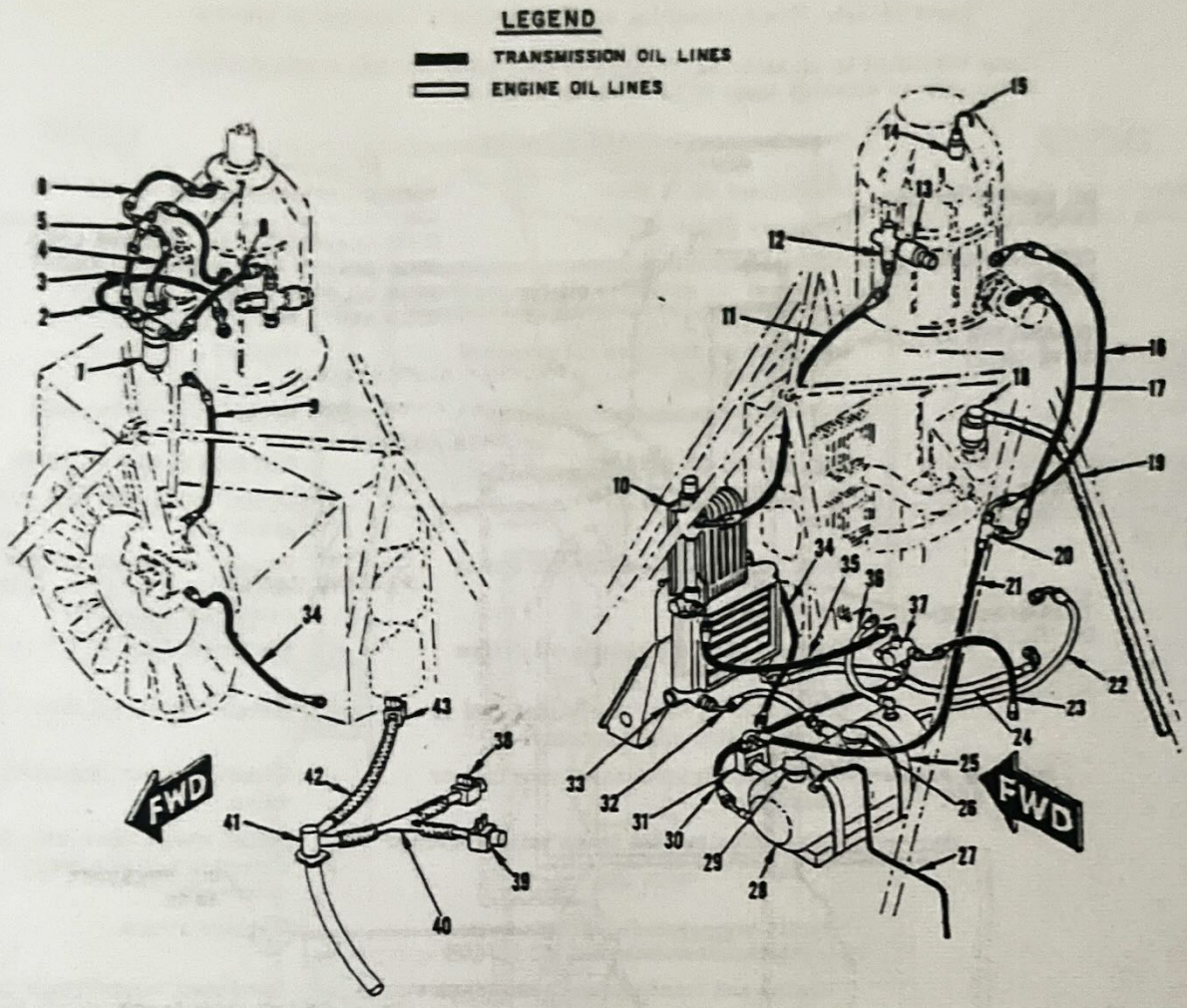


Figure 73-1-1A. Oil System Schematic, Early Configuration



1. Transmission Oil Filter
2. One-way Clutch Inlet Hose
3. Distribution Hose
4. Tachometer and Fan Drive Inlet Hose
5. Pressure Cross
6. Upper Housing Inlet Hose
7. Center Housing Inlet Hose
8. Filter Inlet Hose
9. Cooling Fan Gear Box Inlet Hose
10. Transmission Oil Cooler
11. Cooler Outlet Hose
12. Instrument and Fitting Assembly
13. Pressure Warning Switch
14. Check Valve
15. Transmission Vent
16. Lower Housing Outlet Hose
17. Tail Rotor Drive Housing Outlet Hose
18. Engine Breather Cap Assembly
19. Engine Breather Hose
20. Drain Tee
21. Drain Hose
22. Engine Oil Pump Inlet Hose
23. Pump Drain Hose
24. Engine Oil Cooler Inlet Hose
25. Engine Oil Tank
26. Tank Filler Cap
27. Tank Vent Tube
28. Transmission Oil Tank
29. Tank Filler Cap
30. Tank Outlet Hose
31. Tank Inlet Manifold
32. Oil Cooler Outlet Hose
33. Engine Oil Cooler
34. Cooling Fan Gear Box Outlet Hose
35. Pump Outlet Hose
36. Tank Vent Hose
37. Transmission Oil Pump
38. Engine Oil Tank Drain Valve
39. Transmission Oil Tank Drain Valve
40. Tank Drain Line Manifold
41. Drain Line Manifold
42. Drain Hose
43. Engine Drain Valve

Figure 73-1-1B. Oil System, Late Configuration

Table 73-1-1. Troubleshooting the Transmission Lubrication System

Items identified by an asterisk (*) apply to both early and late configurations.
Items with no asterisk apply to late configuration only.

TROUBLE	PROBABLE CAUSE	REMEDY
Transmission oil pressure warning light ON	Insufficient oil in tank	Fill tank to correct level.
	Improper grade oil	Drain, refill tank with correct grade oil.
	Incorrect or defective oil temperature warning switch	Replace switch.
	Incorrect or defective oil pressure warning switch	Replace switch.
	Defective transmission oil pump	Repair or replace pump.
* Oil temperature warning light ON, or transmission oil temperature gage reading high.	Insufficient oil in tank	Fill tank to correct level.
	*Incorrect grade of oil	Drain, refill tank with correct grade oil.
	*Insufficient air flow through cooler	Repair or replace leaking cooler inlet air duct. Clean cooler air passages.
	*Restricted transmission oil return lines	Remove, clean return oil lines.
	*Incorrect oil inlet fitting installed in transmission upper housing	Install correct oil inlet fitting.
	*Restricted transmission vent tube or vent valve	Remove, clean vent tube and valve.
	*Transmission vent check valve reversed	Install check valve with flow direction arrow pointing downward.
	*Faulty temperature warning switch (contacts close below 135°C (275°F)	Replace switch.
	Engine and transmission temperature bulb connections reversed at selector switch	Reconnect temperature gage selector switch wiring (wiring diagrams, Section 83).
	Defective oil cooler regulator valve	Repair or replace oil cooler.
	Faulty transmission	Inspect transmission interior: repair or overhaul.
Low oil temperature	Oil cooler air baffle omitted during installation of cooler	Install specified baffle plate at air inlet side of oil cooler.
	Defective oil cooler regulator valve	Repair or replace oil cooler.
*Metal particles in transmission oil filter	*Faulty cooling fan gear box	Inspect gear box interior; repair or overhaul.
	*Faulty transmission	Inspect transmission interior: repair or overhaul.

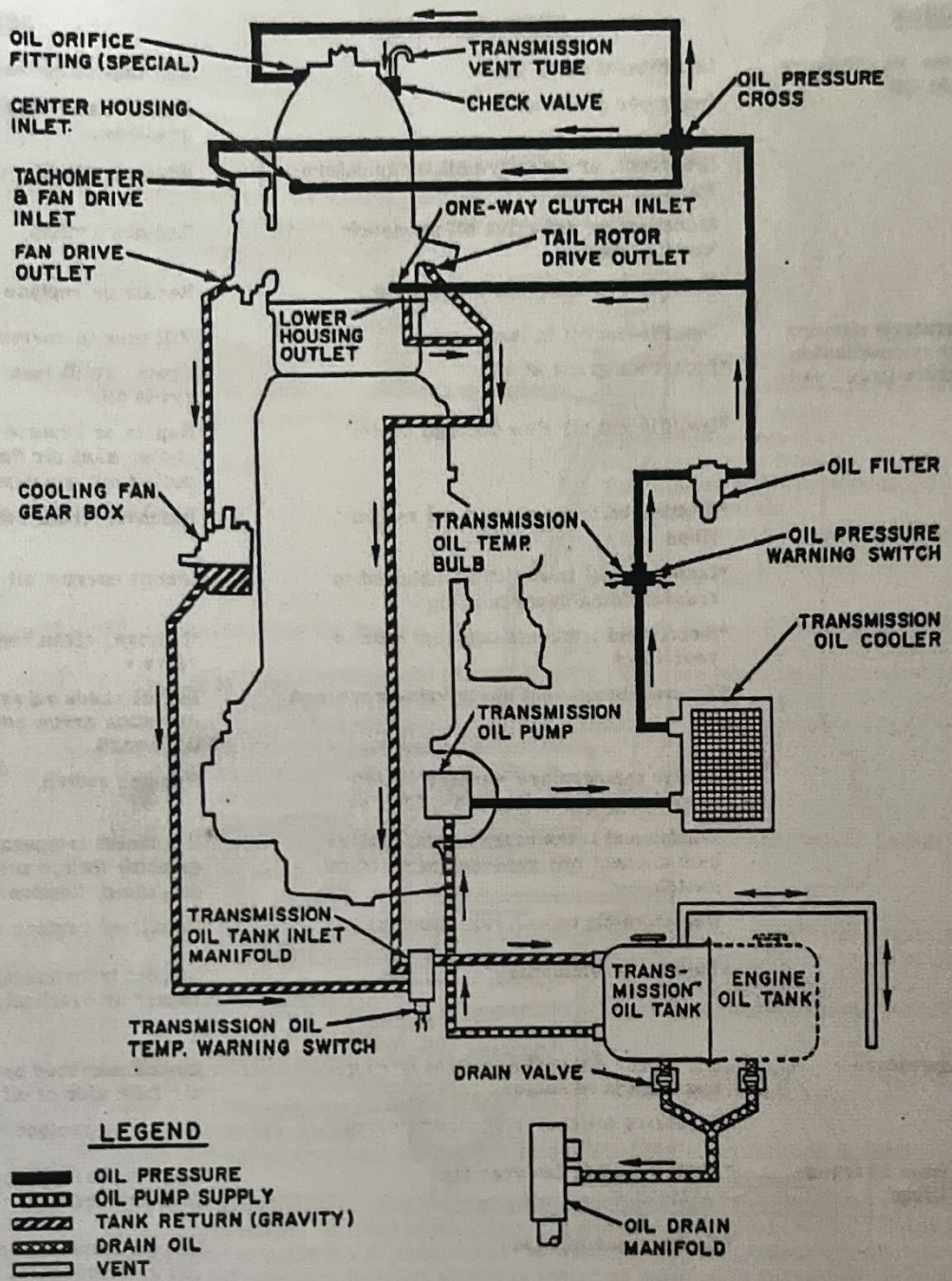


Figure 73-1-1C. Transmission Oil System Schematic, Late Configuration

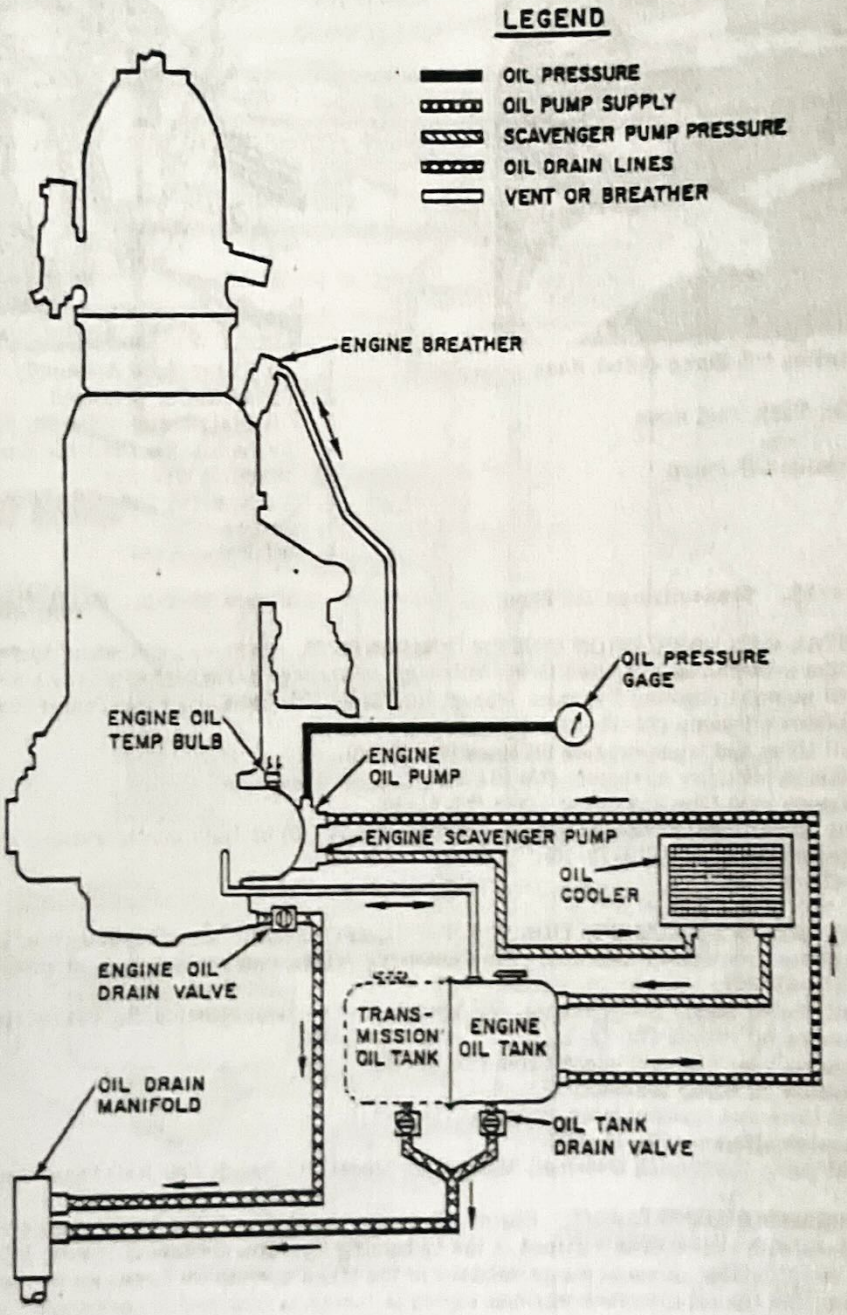
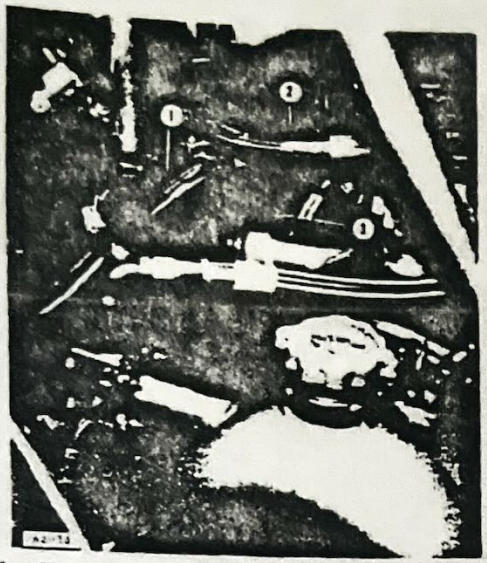
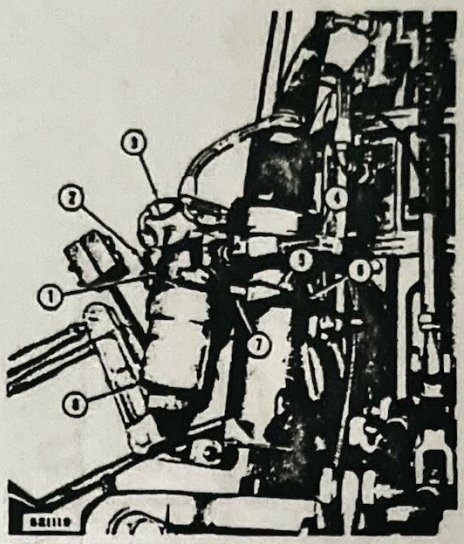


Figure 73-1-1D. Engine Oil System Schematic, Late Configuration



1. Transmission Oil Pump Outlet Hose
2. Engine Oil Tank Vent Hose
3. Transmission Oil Pump

Figure 73-1-1E. Transmission Oil Pump



1. Oil Filter Head Assembly
2. Filter Outlet Manifold
3. Oil Distribution Hose
4. Transmission Oil Line Hose
5. Mounting Bracket
6. Tachometer and Cooling Fan Drive Housing
7. Spacer
8. Oil Filter Case

Figure 73-1-2. Transmission Oil Filter

73-1-10. REMOVAL OF LUBRICATION SYSTEM COMPONENTS. Remove lubrication system components in accordance with the procedures indicated in the following referenced paragraphs, in any convenient sequence.

a. Engine oil pump (Lycoming Overhaul Manual for Model VO-540 Series Helicopter Engines).
b. Transmission oil pump (73-11-10).
c. Engine oil lines and transmission oil lines (73-30-10).
d. Transmission oil filter assembly (73-40-10).
e. Transmission vent tube and check valve (73-41-10).
f. Engine oil cooler (early configuration, paragraph 73-71-10) or (late configuration, paragraph 73-72-10).
g. Transmission oil cooler (73-72-10).
h. Oil tank (73-80-10).

73-1-11. INSTALLATION OF LUBRICATION SYSTEM COMPONENTS. Install lubrication system components in accordance with the procedures indicated in the following referenced paragraphs, in any convenient sequence.

a. Oil tank (73-80-11).
b. Engine oil cooler (early configuration, paragraph 73-71-11) or (late configuration, paragraph 73-72-11).
c. Transmission oil cooler (73-72-11).
d. Transmission vent tube and check valve (73-41-11).
e. Transmission oil filter assembly (73-40-11).
f. Engine oil lines and transmission oil lines (73-30-11).
g. Transmission oil pump (73-11-11).
h. Engine oil pump (Lycoming Overhaul Manual for Model VO-540 Series Helicopter Engines).

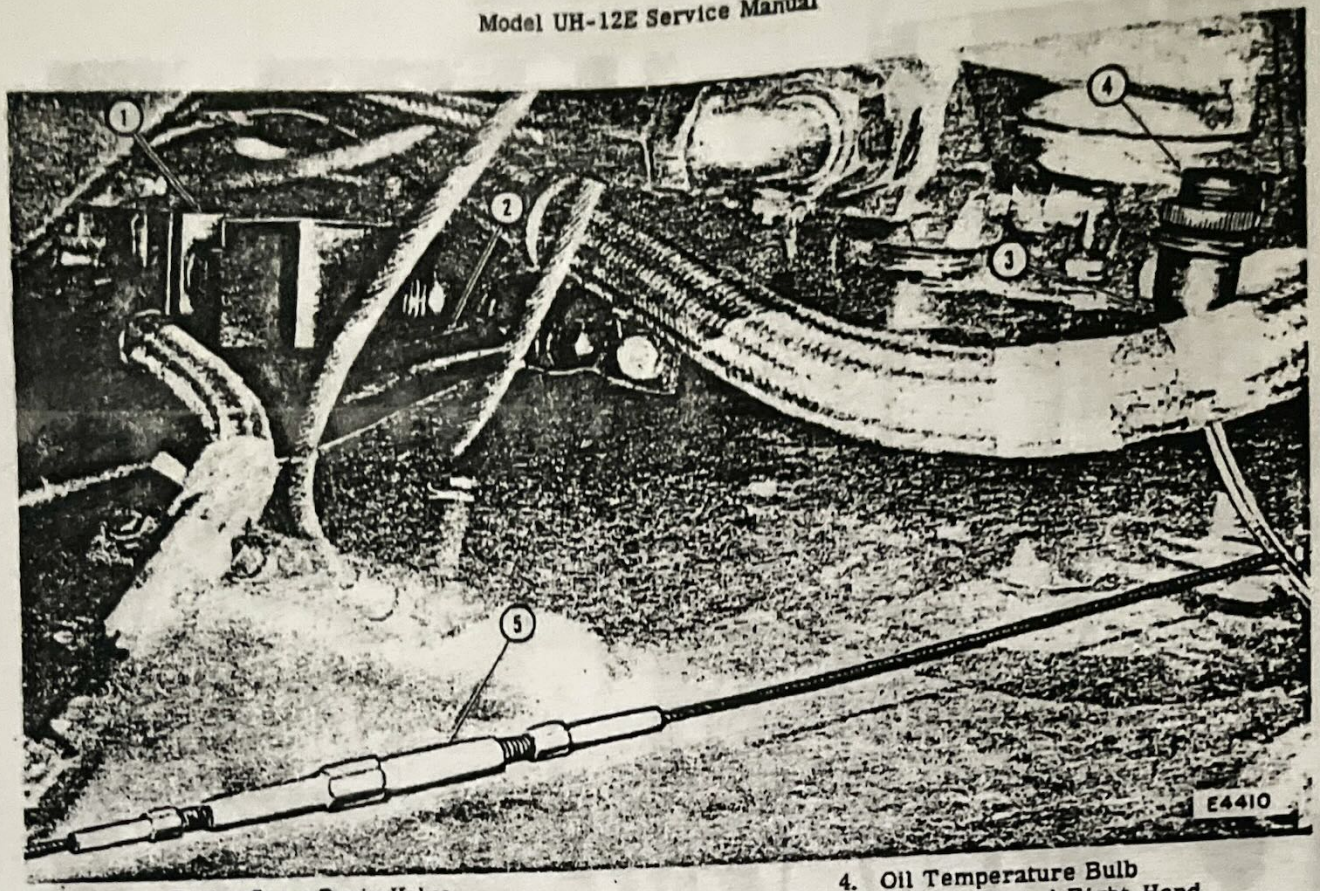
73-1-30. OIL PRESSURE ADJUSTMENT. Engine oil pressure (early or late lubrication configuration) is adjusted in accordance with procedures outlined in the Lycoming Operator's Manual (Model VO-540 Series Helicopter Engine). No provision is made for adjustment of the transmission oil pressure in the late configuration lubrication system, but the oil pressure warning switch is tested as outlined in paragraph 73-1-60.

73-1-40. SERVICING LUBRICATION SYSTEM. Refer to Section 10 for lubrication requirements.

73-1-41. DRAINING LUBRICATION SYSTEM. Refer to Section 10 for lubrication system draining.

73-1-42. DECONTAMINATION OF LUBRICATION SYSTEM. Whenever the engine and/or transmission require replacement due to internal failure decontaminate the affected lubrication system as follows.

a. Drain the lubrication system (Section 10)
b. Remove the oil cooler(s) for flushing (73-71-10 and 73-72-10).



1. Engine Sump Drain Valve
2. Engine Aft Snubber Assembly
3. Oil Temperature Bulb Electrical Plug Connector
4. Oil Temperature Bulb
5. Rudder Control Right-Hand Cable Assembly

Figure 73-1-2A. Location of Oil Sump Drain Valve

c. Clean the system and its components with a flushing solution prepared as follows:
(1) Eight parts kerosene (table 10-VI, item 19).
One part cleaning solvent (table 10-VI, item 25).
One part preservative lubricating oil (table 10-VI, item 2).
(2) Temperature of solution must not exceed 26.5°C (80°F). In cold weather, the solution must be kept in warm by flashproof, thermostatically-controlled, electric heating elements.

CAUTION: USE ADEQUATE PRECAUTION AGAINST FIRE WHEN USING FLUSHING SOLUTION.

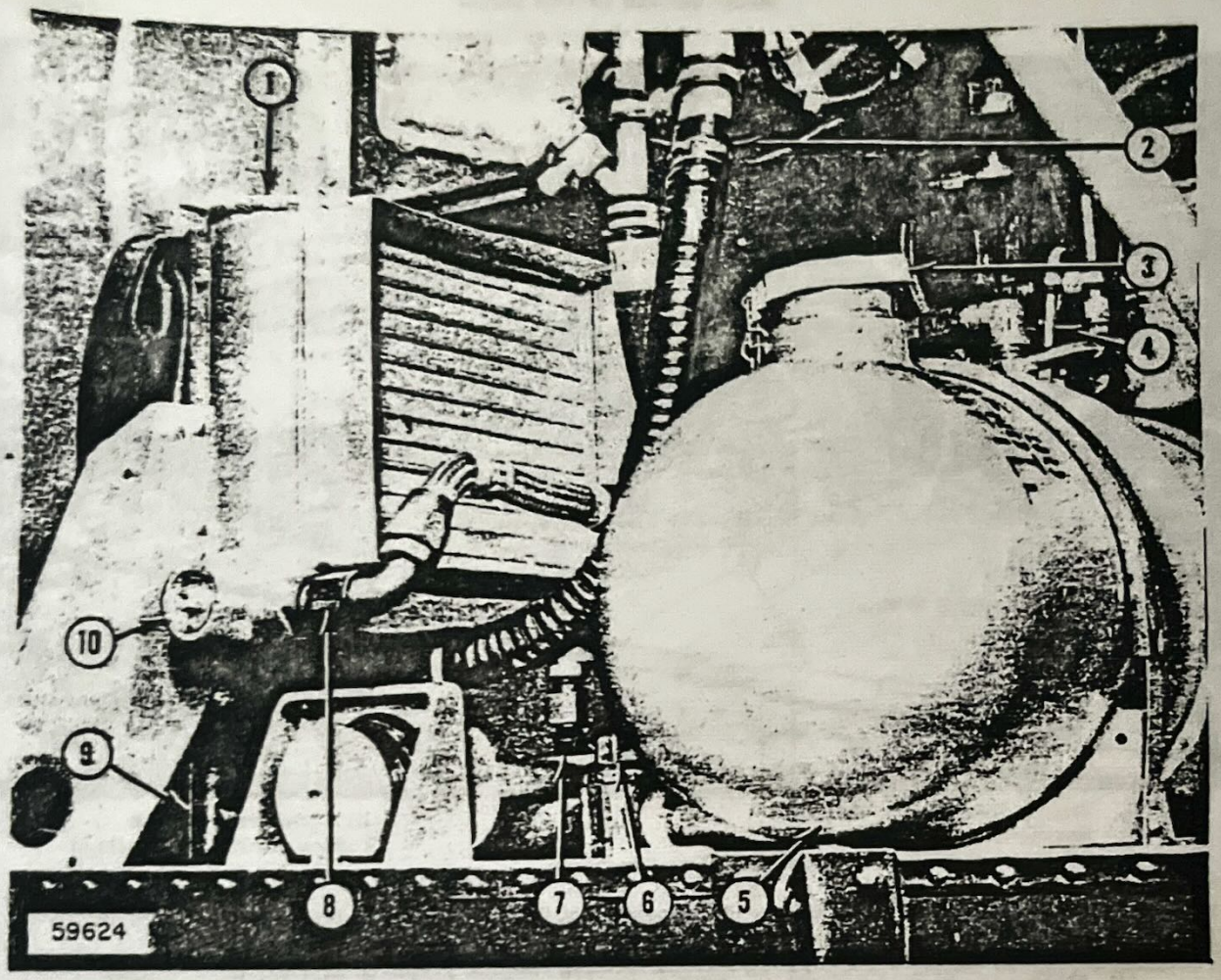
d. Clean oil lines by circulating the flushing solution through the system under pressure. Oil lines that cannot be satisfactorily cleaned in the installed position shall be removed for cleaning.
e. After flushing, reinstall oil cooler(s) (73-71-11 and 73-72-11).

73-1-43. Deleted.

73-1-60. TESTING TRANSMISSION OIL PRESSURE WARNING SWITCH. The transmission oil pressure warning light switch contacts must close (warning light on) at a pressure of 12 psi (± 1 psi), and must open (warning light off) at one to three psi above the contact closing pressure. Regardless of pressure differential, the switch contacts must be open at pressures of 17 psi and higher. Although it is usually more practical to remove the switch for bench testing, an installed switch can be tested as follows.
a. Install a tee connection and test pressure gage in the oil system, locating them as close as possible to the switch.
b. Vary oil system pressure by gradually increasing and decreasing engine rpm, observing the test gage and pressure warning light to determine the pressures at which the switch contacts open and close.
c. If necessary, engine idle rpm may be temporarily lowered below normal to reduce system oil pressure sufficiently to close the switch contacts.

73-10-1. ENGINE OIL PUMP.

73-10-2. DESCRIPTION. The engine oil pump comprises a pressure pump, a scavenger pump, an oil pump



1. Oil Cooler
2. Engine Breather Hose
3. Filler Cap
4. Oil Pressure Instrument Tube
5. Oil Tank
6. Oil Tank Drain Valve
7. Oil Cooler Inlet Hose
8. Oil Cooler Outlet Hose
9. Oil Drain Manifold
10. Thermostat and Pressure Relief Valve

Figure 73-1-3. Oil Cooler and Oil Tank, Early Configuration

relief valve, and a filtering screen. Pump removal and installation shall be accomplished in accordance with the procedures specified in the Lycoming Overhaul Manual for Model VO-540 Series Helicopter Engines.

73-11-1. TRANSMISSION OIL PUMP.

73-11-2. DESCRIPTION. (See figure 73-1-1E.) The transmission oil pump, used in the late configuration lubrication system only, is a vane type rotary pump installed on the vacuum pump drive on the lower left side of the engine accessory housing. The pump relief valve, which incorporates a valve cap and washer, is set to crack at 55/65 psi. The pump includes in inlet port, a discharge (outlet) port, and two drain ports. The front drain port, on the relief valve side of the pump, is fitted with a threaded pipe plug; the rear drain port is connected by a flexible drain hose to a tee in the fuel system drain line.

73-11-10. REMOVAL OF TRANSMISSION OIL PUMP.

a. Disconnect and cap inlet, outlet and drain hoses. Cap inlet, outlet and drain fittings on pump.
b. Remove the four nuts and washers securing pump to engine vacuum pump drive pad, and remove pump.

73-11-11. INSTALLATION OF TRANSMISSION OIL PUMP.

a. Install new gasket on engine vacuum pump drive pad.
b. Install inlet, outlet and drain fittings on pump. Lubricate drive shaft cavity (Section 10).
c. Position pump on drive pad so that the outlet port is on top. Secure with the four washers and nuts.

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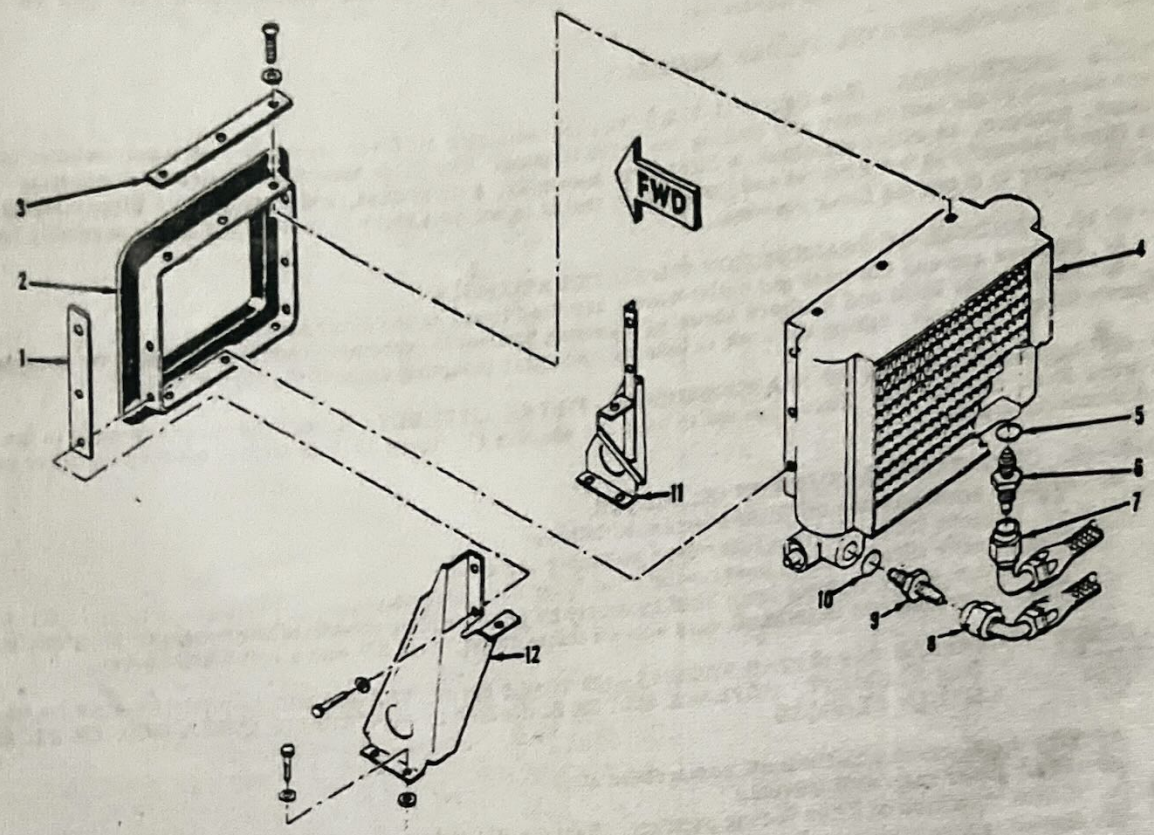


1. Strip
2. Oil Cooler Rubber Duct
3. Strip
4. Oil Cooler
5. Packing
6. Union
7. Hose Assembly
8. Hose Assembly
9. Union
10. Packing
11. Oil Cooler Inboard Support
12. Oil Cooler Outboard Support

Figure 73-1-3A. Oil Cooler, Early Configuration, Exploded View

d. Connect inlet, outlet, and drain hoses to corresponding pump fittings.

73-20-1. ENGINE OIL FILTER.

73-20-40. ENGINE OIL FILTER MAINTENANCE. The engine oil filter shall be inspected and cleaned at the time intervals specified in the applicable Lycoming Operator's Manual.

73-30-1. OIL LINES.

73-30-2. DESCRIPTION. (See figures 73-1-1 and 73-1-1B.) Pressure, oil return, and drain hose lines are included in the oil line system. The lines are cleaned as outlined in paragraph 73-1-42, and are removed and installed in accordance with the procedures presented in the following paragraphs.

73-30-10. REMOVAL OF OIL LINES.

a. Drain the lubrication system (Section 10).
b. Disconnect upper end of hose assembly and allow oil in line to drain for a few seconds.
c. Disconnect hose lower end and remove hose assembly.
d. Cap all open fittings and hose assemblies.

73-30-11. INSTALLATION OF OIL LINES.

a. Check that threads of all orifices and hose fittings are undamaged, and that orifices, inlets, fittings and hose passages are clean and unobstructed.

b. Apply a thin coating of lubricant to all threaded connections.
c. Connect lower end of hose assembly, and then the upper end to the fittings.
d. Check hose for kinks, uniformity of diameter, and interference with other components or with the helicopter structure.
e. Tighten both ends of hose assembly.

73-40-1. TRANSMISSION OIL FILTER ASSEMBLY.

73-40-2. DESCRIPTION. (See figure 73-1-2.) The transmission oil filter assembly is bracket-mounted on the lower section of the tachometer and cooling fan drive housing. The filter assembly consists of a mounting bracket, spacers, an outlet manifold, a filter head assembly, a filter case, and a metal-edge filter element. The filter assembly is constructed and installed so that it is not necessary to remove the entire assembly from the helicopter to clean the filter element.

73-40-10. REMOVAL OF TRANSMISSION OIL FILTER ASSEMBLY.
a. Remove and cap the inlet and outlet hoses; cap the fittings on the filter assembly.
b. Remove the bolts and washers securing mounting bracket to tachometer and cooling fan drive housing; remove filter assembly, taking care not to lose the two filter mounting spacers (7, figure 73-1-2).

73-40-11. INSTALLATION OF TRANSMISSION OIL FILTER ASSEMBLY. Install the filter assembly in the reverse order of removal. Take care not to omit the spacers (7, figure 73-1-2) located between the filter head and mounting bracket.

73-40-40. CLEANING TRANSMISSION OIL FILTER.
a. Remove transmission oil filter element as follows:
(1) Remove lockwire from filter head assembly and case.
(2) Remove filter case by unscrewing from filter head assembly.
(3) Detach filter element from head assembly by gently sliding downward with slight twisting motion.
b. Clean filter element in mineral base solvent (table 10-VI, item 25) with a soft bristle brush.

CAUTION: DO NOT USE METAL BRUSHES AND TOOLS ON FILTER ELEMENT, AS THEY MAY DAMAGE THE ELEMENT. REPLACE FILTER ELEMENT IF PUNCTURED, COLLAPSED, OR EXCESSIVELY CLOGGED.

c. Dry the element with filtered, compressed air.
d. Flush filter case with solvent.
e. Check condition of filter O-ring packings. Replace if damaged.
f. Install transmission oil filter element as follows:
(1) Carefully slide filter element upward, over internal oil outlet flange in center of filter head assembly.
(2) Coat threads at top of filter case with petrolatum (table 10-VI, item 26).
(3) Tilt filter case to clear engine mount; install filter case on filter head assembly; tighten hand-tight.
(4) Secure filter case to filter head assembly with lockwire.

73-41-1. TRANSMISSION VENT.

73-41-2. DESCRIPTION. (See figures 73-1-1 and 73-1-1B.) The transmission vent, installed in the upper housing of the main transmission, comprises a vent tube assembly and a one-way check valve. The vent tube assembly is U-shaped, with the opening of the tube pointing down to prevent accumulation of foreign matter. The one-way check valve permits air to be drawn into the transmission to equalize internal and external pressure and promote the gravity flow of drain oil from the transmission.

73-41-10. REMOVAL OF TRANSMISSION VENT ONE-WAY CHECK VALVE.
a. Remove vent tube assembly from one-way check valve.
b. Remove check valve from transmission upper housing.
c. Remove O-ring packing from transmission vent port.

73-41-11. INSTALLATION OF TRANSMISSION VENT ONE-WAY CHECK VALVE.
a. Check condition of transmission vent port O-ring packing; replace if damaged.
b. Install the one-way check valve with the flow direction arrow pointing downward.
c. Install vent tube assembly on the valve so that the tube open end is toward the right-hand side of the helicopter.

73-41-40. CLEANING TRANSMISSION VENT ONE-WAY CHECK VALVE.
a. Remove one-way check valve (73-41-10).
b. Clean the valve by flushing with mineral base solvent (table 10-VI, item 25). Dry with filtered, compressed air.

CAUTION: DO NOT ATTEMPT TO DISASSEMBLE THE ONE-WAY CHECK VALVE.

c. Install one-way check valve (73-41-11).

73-50-1. ENGINE BREATHER INSTALLATION.

73-50-2. DESCRIPTION. One of two different engine breather configurations may be installed on the helicopter.

73-50-2A. On helicopters Serial No. 2199 and subsequent, and on those modified in accordance with Service Bulletin No. 2023, the breather hose is routed and vented to reduce possible ice formation within the engine breather assembly and thereby improve cold weather service. (See figure 73-1-1B.) An engine breather cap is installed on the engine breather outlet at the crankcase cover assembly. The hose assembly, attached to the breather cap, is clamped along the aft right-hand engine mount tube, extending downward to pass through the tail boom transition section. The lower end of the hose is retained by a bracket and shield to the transition section underside, and discharges overboard. On aircraft fitted with the cargo compartment, the hose is contained within a protector tube where it passes through the baggage liner and compartment.

73-50-2B. On helicopters prior to Serial No. 2199 that are not modified in accordance with Service Bulletin No. 2023, the breather hose line is connected directly to the engine breather outlet at the crankcase cover assembly, with no breather cap assembly installed. The hose is routed downward where it connects to, and discharges into the oil line manifold, as shown in figure 73-1-1.

NOTE: In both configurations, the engine breather hoses and connections are removed and installed as outlined in paragraphs 73-30-10 and 73-30-11.

73-60-1. LUBRICATION SYSTEM DRAIN VALVES.

73-60-2. DESCRIPTION. Two different oil drain valve installations are used on the helicopter, corresponding to the requirements of the early or of the late configuration lubrication systems, as described in paragraph 73-1-2. On the early configuration, one drain valve serves the engine oil sump, and the other serves the engine oil tank (figures 73-1-1 and 73-1-2A). On the late configuration, a third valve is installed, to drain the transmission oil tank (figures 73-1-1B and 73-1-2A).

73-70-1. OIL COOLER.

73-70A-1. EARLY CONFIGURATION OIL COOLER.

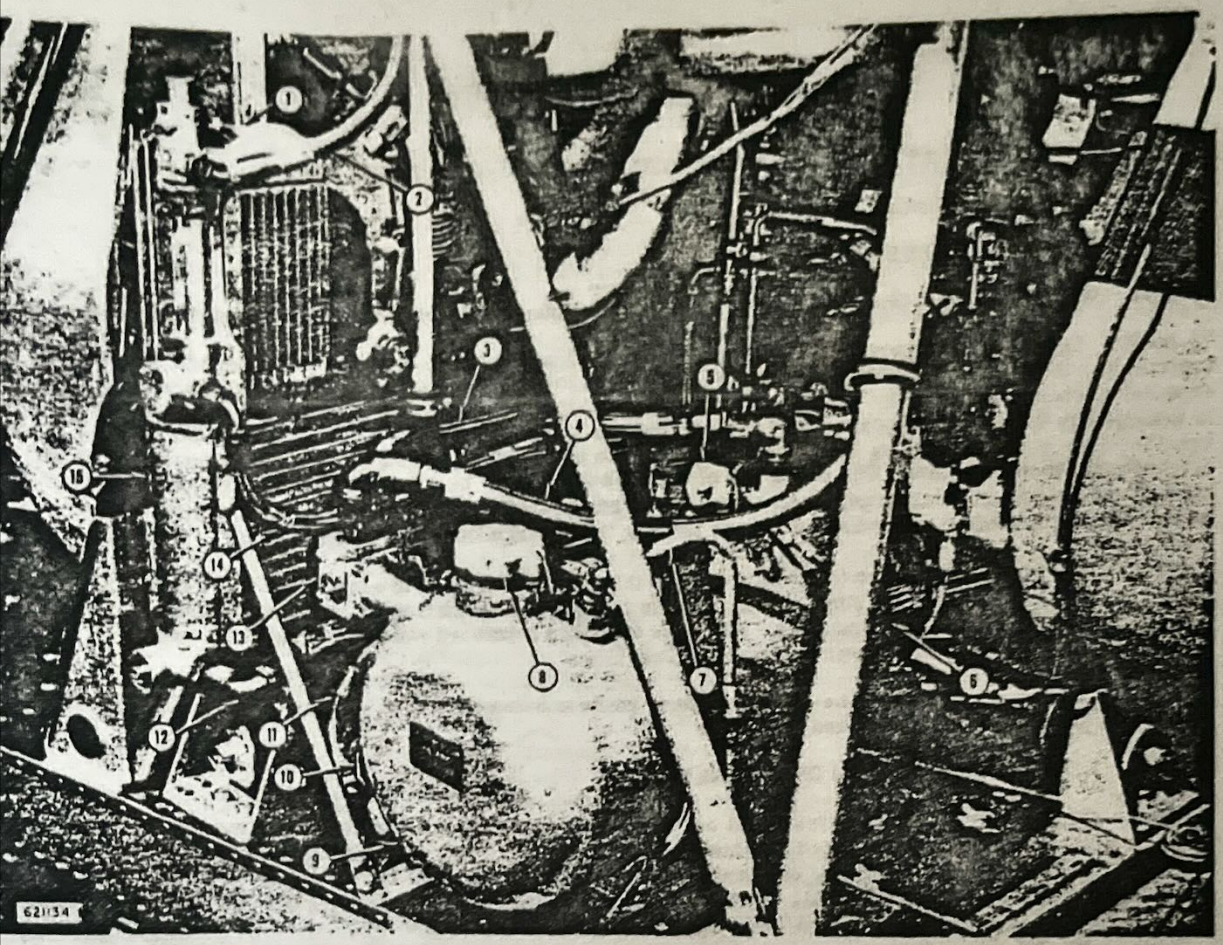
73-70A-2. DESCRIPTION. (See figures 73-1-1, 73-1-3, and 73-1-3A.) The oil cooler used in the early configuration lubrication system (described in paragraph 73-1-2A) is a flat, radiator type cooler with a thermostatic and pressure relief valve to control oil flow through the cooler. When oil is cold, or if pressure exceeds 65 psi, the bypass port is open to permit oil flow through the bypass tube of the cooler. When oil temperature rises, the thermostat expands, causing the bypass port to begin closing at approximately 52°C (125°F). When the bypass port is closed, oil circulates through the oil cooler core.

73-70A-10. REMOVAL OF OIL COOLER. (See figures 73-1-1 and 73-1-3A.)

a. Disconnect oil cooler inlet hose from lower right-hand corner of oil cooler. Cap the hose and cooler inlet.
b. Remove the large rectangular clamp securing the rubber duct to the fiberglas duct.
c. Remove the four bolts securing the cooler supports to the engine deck.
d. Loosen outlet hose at cooler outlet fitting and raise cooler (with outlet hose attached) so that oil remaining in cooler will drain into the oil tank.
e. Remove outlet hose from cooler, and cooler from helicopter. Cap the hose and cooler fittings.

73-70A-11. INSTALLATION OF OIL COOLER. (See figures 73-1-1 and 73-1-3A.)

a. Assemble oil cooler, rubber duct, retaining strips and mounting brackets. Tighten bolts and screws evenly to minimize distortion of retaining strips.
b. Apply a thin coat of lubricant to threaded portions of fittings. Install fittings in cooler inlet and outlet ports.
c. Install assembled cooler, attaching the mounting supports to engine deck with bolts and washers. Install washers at four places between engine deck and supports.
d. Connect inlet and outlet hoses to fittings on cooler.
e. Attach rubber duct to fiberglas duct with large rectangular clamp.
f. Fill oil system with specified grade oil (Section 10).



1. Transmission Oil Cooler
2. Transmission Oil Cooler Outlet Hose
3. Cooling Fan Gear Box Drain Hose
4. Transmission Drain Hose
5. Engine Oil Tank Filler Cap
6. Engine Oil Tank
7. Transmission Oil Tank Vent Tube
8. Transmission Oil Tank Filler Cap
9. Transmission Oil Tank
10. Transmission Oil Tank Drain Valve
11. Transmission Oil Tank Outlet Hose
12. Engine Oil Cooler Outlet Hose
13. Transmission Oil Tank Inlet Manifold
14. Transmission Oil Cooler Inlet Hose
15. Engine Oil Cooler

Figure 73-1-4. Oil Tanks and Coolers, Late Configuration

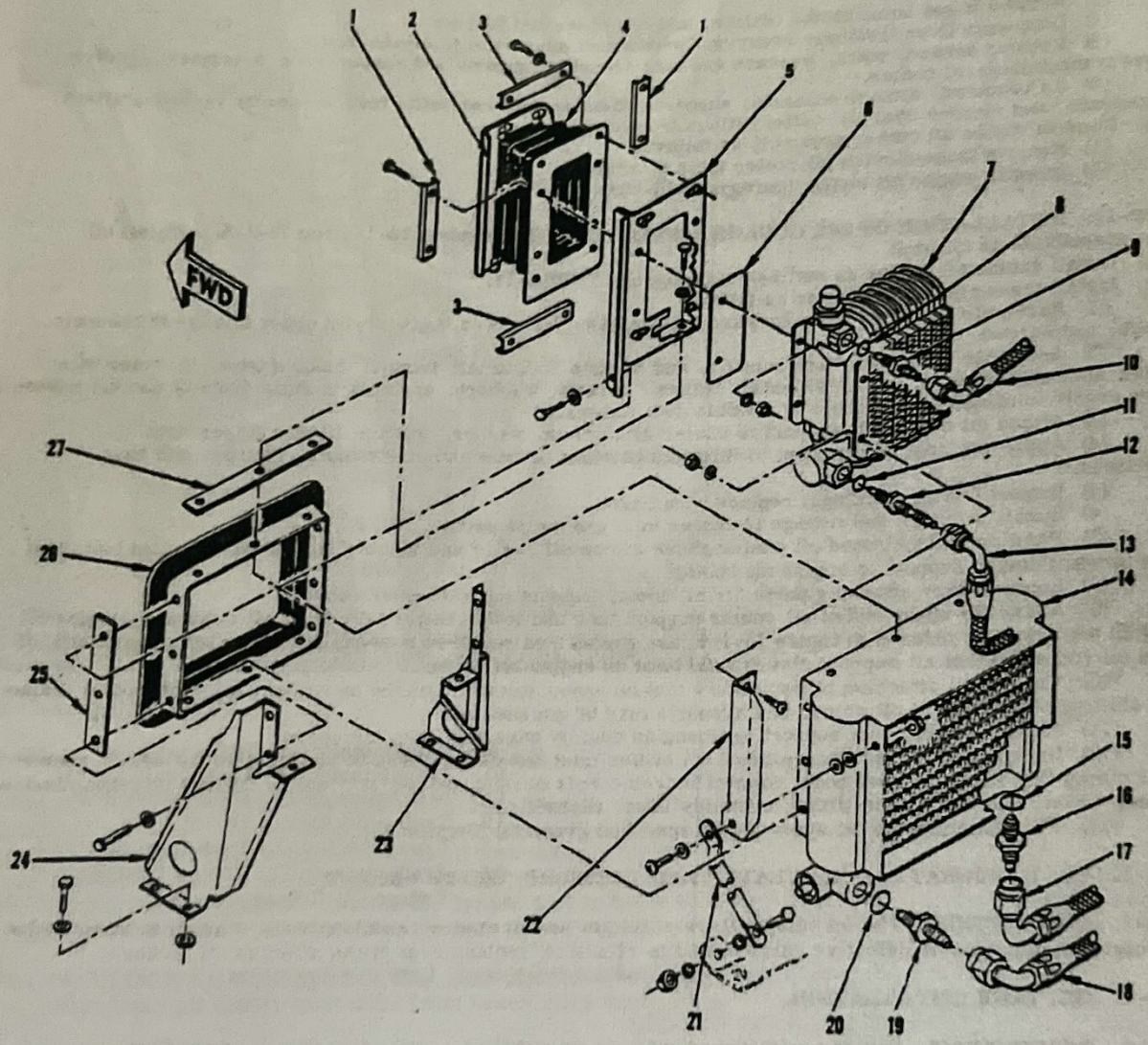
73-70B-1. LATE CONFIGURATION OIL COOLER.

73-70B-2. DESCRIPTION. (See figures 73-1-1B, 73-1-4 and 73-1-5.) Two oil coolers are used in the late configuration lubrication system (described in paragraph 73-1-2B). The same oil cooler described in paragraph 73-1-2B). The same oil cooler described in paragraph 73-70A-2 is installed for the engine oil system, with some difference in mounting provisions. The transmission oil cooler is bracket-mounted on the engine oil cooler. The engine and transmission coolers are similar in construction, but the latter requires an external baffle to reduce air flow to slightly more than half of the cooler area to prevent excessive cooling of transmission oil.

73-70B-10. REMOVAL OF OIL COOLER ASSEMBLIES. (See figures 73-1-4 and 73-1-5.) Remove the engine and transmission oil cooler assemblies in the following sequence.

a. Remove the transmission oil cooler assembly as follows:

(1) Disconnect transmission oil cooler outlet hose from the instrument and fitting assembly (12, figure 73-1-1B). Cap the fitting, but not the hose. Remove clamp supporting the hose.



1. Flexible Duct Channel
2. Flexible Duct Support
3. Flexible Duct Channel
4. Duct
5. Transmission Oil Cooler Forward Support Assy
6. Transmission Oil Cooler Baffle
7. Transmission Oil Cooler
8. O-ring Packing
9. Union
10. Transmission Oil Cooler Outlet Hose
11. O-ring Packing
12. Union
13. Transmission Oil Cooler Inlet Hose
14. Engine Oil Cooler
15. O-ring Packing
16. Union
17. Engine Oil Cooler Outlet Hose
18. Engine Oil Cooler Inlet Hose
19. Union
20. O-ring Packing
21. Support Tube
22. Transmission Oil Cooler Aft Support
23. Oil Cooler Inboard Support
24. Oil Cooler Outboard Support
25. Oil Cooler Duct Retaining Strip
26. Oil Cooler Rubber Duct
27. Oil Cooler Duct Retaining Strip

Figure 73-1-5. Transmission and Engine Oil Coolers, Late Configuration, Exploded View

(2) Drain oil from cooler by removing the cooler inlet hose from the transmission oil pump outlet fitting, and draining oil into a suitable container. Cap the pump fitting. Allow a few minutes for oil to drain from cooler and hoses.

(3) Remove hoses from cooler fittings, and cap hoses and fittings.

(4) Disengage Dzus fasteners securing flexible duct support to fiberglas duct.

(5) Remove screws, bolts, washers and nuts securing supports and support tube to engine oil cooler. Remove transmission oil cooler.

(6) As required, remove channels, supports, flexible duct and baffle from cooler by removing attaching hardware, and remove inlet and outlet fittings from cooler.

b. Remove engine oil cooler assembly as follows:

(1) Remove transmission oil cooler (step a, above).

(2) Remove engine oil cooler (paragraph 73-70A-10).

73-70B-11. INSTALLATION OF OIL COOLER ASSEMBLIES. (See figures 73-1-4 and 73-1-5.) Install oil cooler assemblies as follows:

a. Install engine oil cooler as outlined in paragraph 73-70A-11.

b. Install transmission oil cooler as follows:

(1) Assemble flexible duct to forward transmission oil cooler support with upper and lower channels, washers, and screws.

(2) Assemble baffle, forward support, and flexible duct to left-front of transmission oil cooler with channel, screws, washers, and nuts; install channel, screws, washers, and nuts in right-front of cooler; tighten screws evenly to minimize distortion of flexible duct flanges.

(3) Attach oil cooler aft support to cooler with screw, washer, and nut; tighten finger tight.

(4) Apply thin coat of lubricant to threaded portions of inlet and outlet ports, fittings, and hose connections.

(5) Inspect O-ring packings; replace if damaged.

(6) Install packings and fittings in cooler inlet and outlet ports.

(7) Position transmission oil cooler above engine oil cooler and loosely install washers and bolts that attach forward cooler support to engine oil cooler.

(8) Loosen lower attaching parts for oil cooler support tube; do not remove.

(9) Assemble upper end of oil cooler support tube and lower end of oil cooler aft support to engine oil cooler in the sequence indexed in figure 73-1-5; use washers as required between oil cooler aft support and engine oil cooler so that aft support clears weld bead on engine oil cooler.

(10) Tighten all attaching parts; ensure that no undue stress is placed on transmission oil cooler frame. Some shifting of position of oil cooler and supports may be necessary.

(11) Secure flexible duct support to fiberglas duct by engaging Dzus fasteners.

(12) Uncap and connect transmission oil cooler inlet and outlet hoses to appropriate fittings on cooler; install clamp that supports inlet hose; connect extreme ends of inlet and outlet hoses to fittings on transmission oil pump outlet, and instrument fitting assembly inlet, respectively.

(13) Fill transmission oil system with specified grade oil (Section 10).

73-71-1. OIL TEMPERATURE REGULATOR AND PRESSURE RELIEF VALVES.

73-71-2. DESCRIPTION. The oil temperature regulator and pressure relief valves are integral parts of the oil cooler. A damaged or defective valve requires repair or replacement of the affected oil cooler.

73-80-1. OIL TANK INSTALLATION.

73-80-2. DESCRIPTION. One of two different oil tank assemblies may be installed on the helicopter, corresponding to the requirements of the early or of the late configuration lubrication system (paragraph 73-1-2).

a. The oil tank used with the early configuration lubrication system (figures 73-1-1 and 73-1-3) is an aluminum alloy cylinder with a capacity of 12.3 US quarts. The tank is located on the left-hand side of the engine deck, and is secured by two tank retaining clamps that are part of the tank support assembly.

b. The late configuration oil tank (figures 73-1-1B and 73-1-4) is a welded assembly of two aluminum alloy tanks with a divider wall between the two tanks. The transmission oil tank has a capcity of 6.5 US quarts, and the engine oil tank capacity is 13-1/8 US quarts. The location and mounting are similar to the early configuration tank installation.

73-80-10. REMOVAL OF OIL TANK ASSEMBLY. Removal of either the early or the late configuration oil tank assembly is accomplished as follows.

a. Drain engine and transmission oil systems (Section 10).

b. Disconnect all hose and tube assemblies (and inlet manifold, in the late configuration) from the oil tank. Cap all open fittings and hoses.

c. Release the two tank retaining clamps and remove tank from support.

73-80-11. INSTALLATION OF OIL TANK ASSEMBLY. Installation of either the early or the late configuration oil tank assembly is accomplished as follows.

a. Place tank in support and secure with the two tank retaining clamps.
b. Ensure that all hoses, tube assemblies, and fittings are clean and unobstructed; apply a thin coat of lubricant to all threaded portions.
c. Install fittings in oil tank ports, and connect hose and tube assemblies to fittings.

73-101-1. WINSLOW OIL FILTER KIT INSTALLATION (HILLER DRAWING 73100).

73-101-2. DESCRIPTION. (See figures 10-6 and 73-101-1.) The Winslow Oil Filter Kit installation provides more adequate filtering of engine oil under operating conditions where unusual amounts of dust, dirt and other possible sources of contamination are present. The Winslow Oil Filter Kit Installation includes an oil filter assembly, an oil filter support, attaching clamps and interconnecting hose assemblies. The oil filter assembly includes a bypass valve designed to bypass all oil if the filter becomes clogged, or when during the engine warm-up period in cold weather, the oil pressures are high. The oil filter assembly contains a throw-away filter element that may be discarded and replaced with a new element every 50 hours, or more frequently if the engine oil becomes excessively dirty or contaminated.

73-101-10. REMOVAL OF WINSLOW OIL FILTER KIT INSTALLATION. (See figure 73-101-10.)
a. Disconnect oil hose assemblies from the side and bottom of the oil filter assembly shell.
b. Remove the attaching bolts from the two large clamps securing the filter assembly to the filter support: remove the filter assembly.
c. Remove four clamps attaching the filter support to the engine mount assembly; remove the filter support.
d. Disconnect and remove the oil filter assembly and hoses from the helicopter.

NOTE: If the helicopter is to be operated without the Winslow Oil Filter Kit Installation, install Removal Kit Part No. 73100-3.

73-101-11. INSTALLATION OF WINSLOW OIL FILTER KIT INSTALLATION. (See figure 73-101-1.)
a. Clamp the oil filter support assembly on the engine mount assembly frame (right-rear leg) with four attaching clamps.
b. Place the oil filter assembly on the filter support and position the two large clamps around the oil filter assembly; install the two attaching bolts but do not tighten.
c. Connect the oil inlet hose assembly to the fitting on the scavenge side of the oil pump fitting and to the inlet fitting on side of the oil filter assembly.
d. Connect the oil outlet hose assembly to the inlet fitting on the oil cooler and to the bottom fitting on the oil filter assembly.
e. Tighten the two large clamps securing the oil filter assembly to the support.

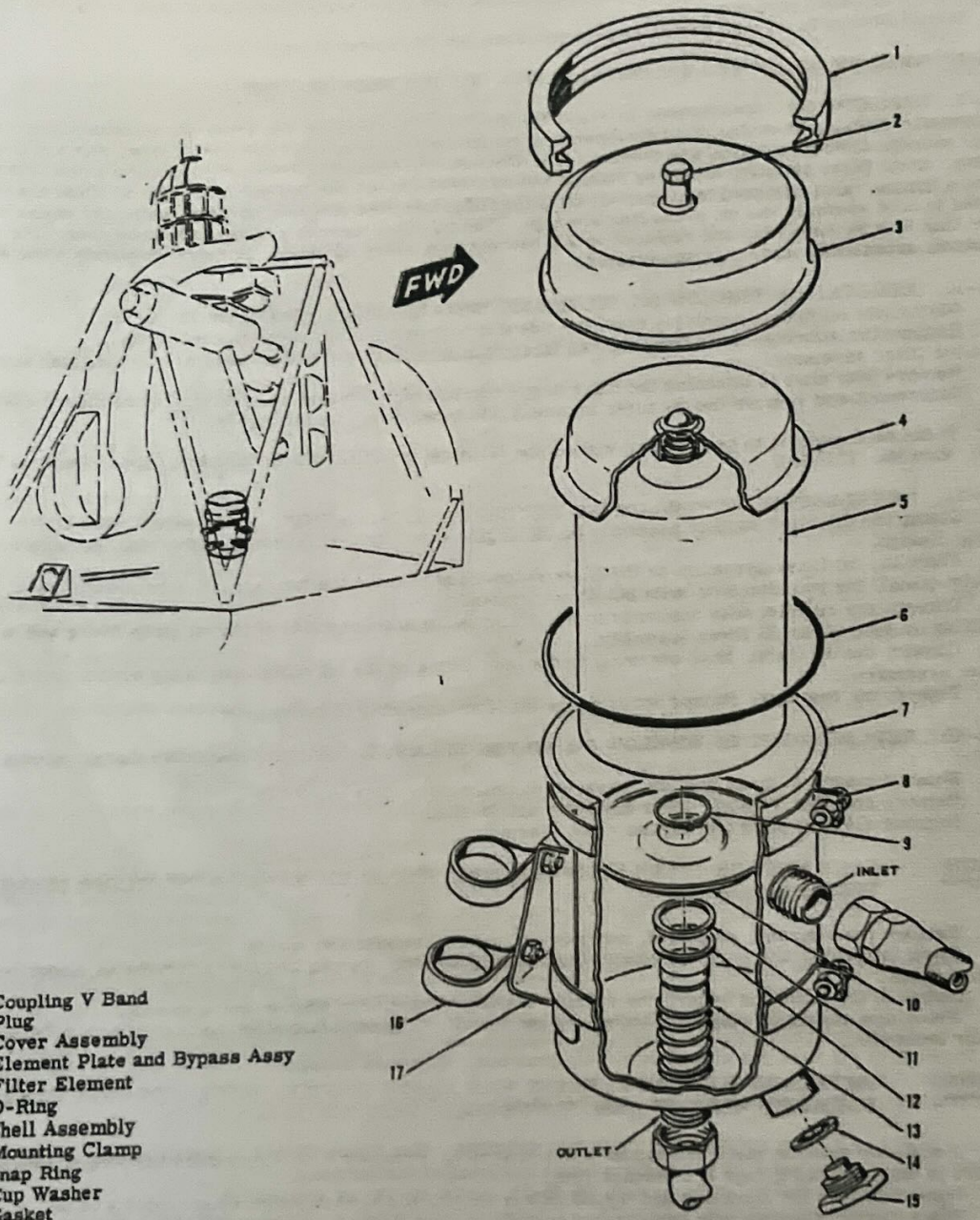
73-101-40. REPLACEMENT OF WINSLOW OIL FILTER ELEMENT. (Winslow Aerofilter Corp. Part No. 1A0286.)
a. Remove magnetic drain plug and allow oil to drain from filter assembly.
b. Remove coupling V-band, cover assembly and O-ring.
c. Remove element plate and bypass valve assembly.

CAUTION: CARE MUST BE TAKEN WHEN REMOVING FILTER ELEMENT AS THE FILTER ELEMENT IS SPRING-LOADED.

d. Remove the element, snap ring, cup washer, gasket, washer and spring.
e. Clean and flush the shell assembly with cleaning solvent, making certain to remove all sludge from bottom of shell.
f. Install in the following order: the spring, washer, gasket, cup washer and snap ring.
g. Place new gasket on magnetic drain plug and install. Tighten drain plug, and safety with 0.041-inch diameter lockwire.

CAUTION: INSTALL NEW FILTER ELEMENT WITH ARROW POINTING DOWN. USE ONLY FILTER ELEMENT, WINSLOW AEROFILTER CORP. PART NO. 1A0286.

h. Install top element plate and bypass valve assembly, pressing down into place until locking lugs clear; then turn to engage locking lugs and release filter.
i. Inspect O-ring for condition and install tightly against top of shell using a light coating of oil.
j. Place cover assembly into position and install coupling V-band. Tighten latching bolt to 35/50 pound-inch torque value.
k. Ground-run engine and check filter assembly for leaks.



1. Coupling V Band
2. Plug
3. Cover Assembly
4. Element Plate and Bypass Assy
5. Filter Element
6. O-Ring
7. Shell Assembly
8. Mounting Clamp
9. Snap Ring
10. Cup Washer
11. Gasket
12. Washer
13. Spring
14. Magnetic Drain Plug Washer
15. Magnetic Drain Plug
16. Support Clamp
17. Support

Figure 73-101-1. Winslow Oil Filter Kit Installation

ENGINE COOLING SYSTEM

74-1-1. ENGINE COOLING SYSTEM.

74-1-2. DESCRIPTION. (See figure 74-1-1.) The engine cooling system includes the cooling fan drive, gear box, fan and segmented shroud assembly. The shroud is fitted with doors having quick opening fasteners to permit ready access (figure 74-1-2). Forced draft air from the cooling fan is directed over the engine cylinder cooling fins by the fiberglas shroud assembly. Cooling air is also directed via duct assemblies to the generator, oil cooler(s), and to the cabin heat flexible duct. Driving power for the fan is supplied from the transmission through the drive coupling to the gear box, mounted on supports at the front of the engine.

74-1-3. TROUBLESHOOTING THE ENGINE COOLING SYSTEM. Refer to table 74-1-I for engine cooling system troubleshooting information.

Table 74-1-I. Troubleshooting the Engine Cooling System

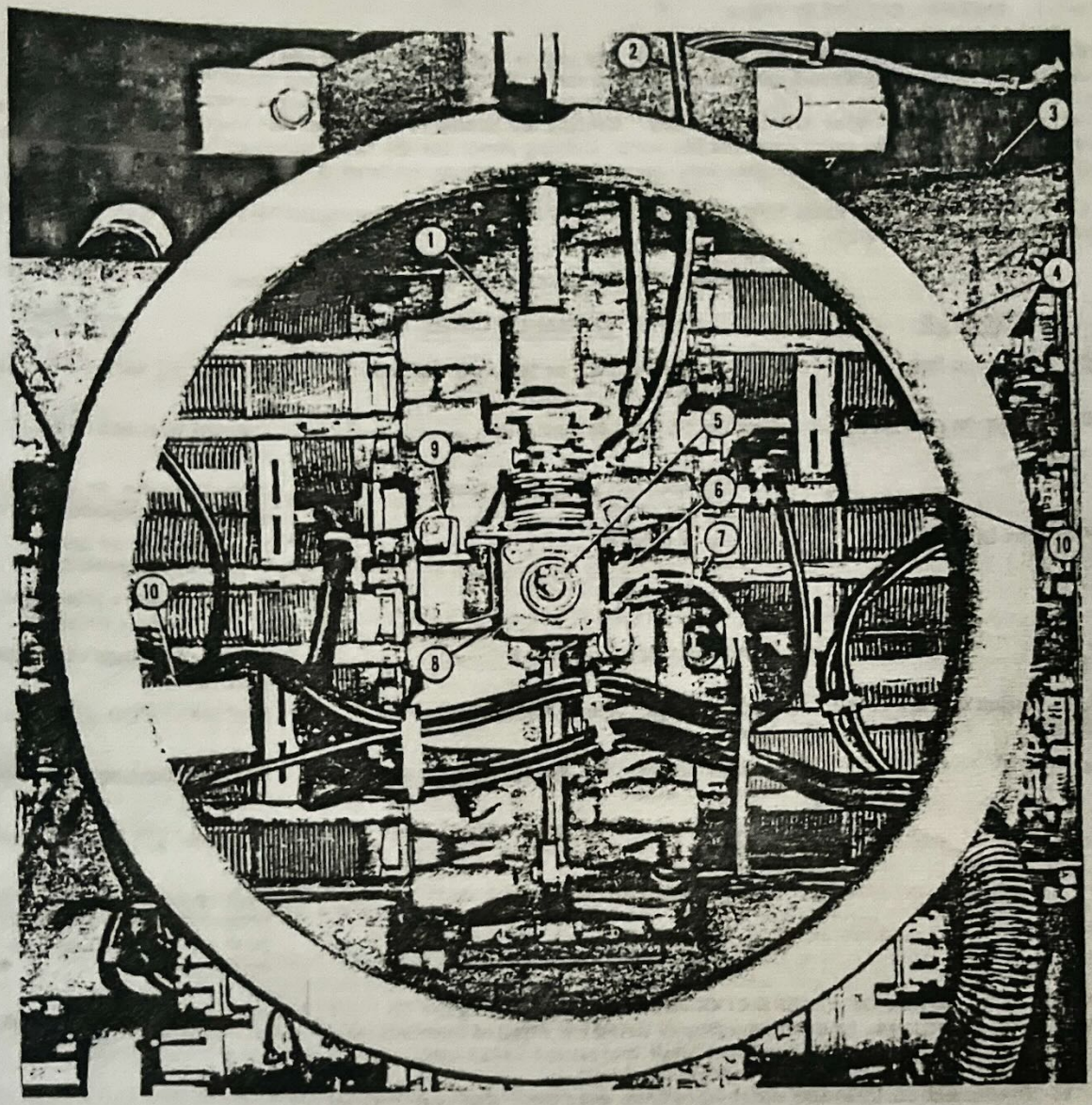
TROUBLE	PROBABLE CAUSE	REMEDY
Oil leakage on fan	Gear box drive shaft or fan shaft oil seal leaking	Replace oil seal(s) or replace gear box.
Oil leakage on gear box	Leaking oil hose connections	Tighten inlet and outlet connections.
	Leaking gear box parting surface	Replace gasket or O-ring packing, or replace gear box.
Vibration in fan drive	Fan out of balance	Rebalance fan or install correctly balanced fan.
	Drive misalined	Check fan drive alinement. Aline fan drive coupling.
	Rough bearings in gear box	Replace bearings or replace gear box.
Lost motion or play in fan drive	Gear box input or drive shaft splines worn in excess of limits	Replace shaft(s) or gear box.
	Drive coupling shaft splined fittings worn in excess of limits	Replace coupling splined fittings.
	Coupling spiders (if used) worn in excess of limits	Replace worn coupling spiders.
	Cooling fan loose on gear box shaft	Tighten fan retaining nut to proper torque of 160/190 pound-inches. Safety with cotter pin.

74-1-10. REMOVAL OF ENGINE COOLING SYSTEM. (See figure 74-1-1.) Remove engine cooling system components as follows; refer to paragraphs listed for detailed instructions.

a. Remove fan from gear box drive shaft (paragraph 74-10-10).
b. Remove shroud assemblies (paragraph 74-20-10).
c. Disconnect oil inlet and outlet lines from gear box. Cap open fittings.
d. Remove gear box (paragraph 74-30-10).
e. Remove fan drive coupling (paragraph 74-40-10).

74-1-11. INSTALLATION OF ENGINE COOLING SYSTEM. (See figure 74-1-1.) Install engine cooling system components as follows; refer to paragraphs listed for detailed instructions.

a. Install coupling assembly (paragraph 74-40-11, or 74-40-12, as applicable).
b. Install gear box (paragraph 74-30-11).
c. Connect oil inlet and outlet lines to gear box.
d. Install shroud assemblies (paragraph 74-20-11).
e. Install fan on gear box drive shaft (paragraph 74-10-11).



1. Cooling Fan Drive Coupling (bonded rubber type)
2. Transmission-to-Fan Gear Box Oil Hose Assembly
3. Engine Cooling Shroud Assembly
4. Cooling Shroud Ring Assembly
5. Fan Gear Box Fan Shaft
6. Fan Gear Box Support, Left-Hand
7. Fan Gear Box Drain Hose Assembly
8. Fan Gear Box
9. Fan Gear Box Support, Right-Hand
10. Baffle

Figure 74-1-1. Engine Cooling System, Front View (Fan Removed)

74-30-1. COOLING FAN GEAR BOX.

74-30-2. DESCRIPTION. (See figures 74-1-1 and 74-1-4.) The cooling fan gear box is a 90-degree, direct drive gear box containing a splined drive (input) shaft, a splined fan (output) shaft, and a pair of matched bevel pinion gears. Driving force from the transmission, transmitted through the fan drive coupling, turns the fan shaft in a clockwise direction, as viewed from the front of the engine. Continuous, gravity flow lubricant enters through the pinion housing cap inlet oil fitting, and discharges from the drain fitting in the side of the gear housing. Replaceable oil seals at the drive and fan shafts retain the lubricant.

74-30-3. TROUBLESHOOTING THE COOLING FAN GEAR BOX. Refer to table 74-1-I for fan gear box troubleshooting information.

NOTE: Misalinement (bend) of either the drive (input) or fan (output) shaft is limited to 0.002-inch TIR. Measure runout in the shaft area next to the oil seal.

74-30-10. REMOVAL OF COOLING FAN GEAR BOX. (See figure 74-1-4.)

a. Remove cooling fan (paragraph 74-10-10).
b. Disconnect oil inlet and outlet lines from gear box. Cap all open fittings.
c. Detach gear box from the mounting supports by removing attaching hardware.

NOTE: If the bonded rubber type fan drive coupling is installed, remove the right-hand support (16, figure 74-1-4). Take care to identify all shims and washers for correct reinstallation.

d. Carefully slip gear box forward until it is free of the supports. Remove and retain gear box flange mounting shims.

CAUTION: USE CARE IN REMOVING GEAR BOX FROM MOUNTING SUPPORTS TO AVOID IMPOSING BENDING LOADS ON THE GEAR BOX DRIVE (INPUT) AND FAN (OUTPUT) SHAFTS.

e. Lower gear box until drive shaft is free of the coupling. If the coupling disengages at the transmission end, disengage coupling from drive shaft, and allow coupling to remain supported by the shroud.
f. Remove gear box through shroud forward end.

74-30-11. INSTALLATION OF FAN GEAR BOX. (See figure 74-1-4.) Install fan gear box in accordance with the following procedure.

a. Install fan drive coupling on the transmission fan drive shaft as outlined in paragraph 74-40-11 or 74-40-12, as applicable.

NOTE: If installing either the spider type coupling (View C, figure 74-1-4) or the early bonded rubber coupling (View A), make certain that retainer ring (1) is in place on the gear box drive shaft.

b. Engage splines of lower coupling body (fitting) with splines of gear box drive shaft and slide gear box into position on the supports.
c. Install gear box right-hand support (if removed).
d. Position the laminated shims between each gear box support and the mounting flanges, and secure with the four bolts, washers and nuts. Tighten nuts to 40/50 pound-inches.
e. Check drive coupling alinement in accordance with procedures outlined in paragraph 74-40-30.
f. Install cooling fan and check fan blade tip clearance as outlined in paragraph 74-10-11.
g. Fill gear box and input seal cavity with lubricant as specified in table 10-II and figure 10-19.
h. Connect gear box oil inlet line. Make certain that gear box outlet fitting elbow is positioned vertically (± 45 degrees) and connect the oil outlet line.

74-30-40. REPLACEMENT OF FAN GEAR BOX OIL SEALS. Replace the fan (output) shaft oil seal or the drive (input) shaft oil seal as outlined below.

a. Replace the fan (output) shaft oil seal as follows:
(1) Remove fan gear box (paragraph 74-30-10).
(2) Remove the four attaching bolts and washers and slide the fan shaft housing cap and seal from the fan shaft.

CAUTION: WHEN REMOVING FAN SHAFT CAP, BE SURE TO RETAIN THE LAMINATED SHIMS LOCATED BETWEEN THE CAP AND THE HOUSING. LOSS OR ALTERATION OF LAMINATED SHIM THICKNESS CAN RESULT IN FAILURE OF BOTH GEARS AND BEARINGS.

(3) Remove the O-ring packing. Support the cap at the seal bore perimeter and tap out the seal. Discard both seal and O-ring.
(4) Apply a coat of primer (table 10-VI, Item 3) around the outside diameter of the new seal, and install while primer is still wet.

CAUTION: THE SEAL LIP MUST FACE HOUSING INTERIOR. THE SEAL OUTER FACE MUST NOT EXTEND BEYOND THE EXTERIOR SURFACE OF THE HOUSING CAP, NOR BE DEPRESSED MORE THAN 0.030-INCH BELOW THE CAP EXTERIOR SURFACE.

(5) Coat new O-ring packing with Lubriplate 630-AA (table 10-VI, item 16) and install on the housing cap.
(6) Place a billet (table 92-1-I, item 48) over the fan shaft splines to protect the oil seal lip from damage. Position the laminated shims on the cap flange and install cap on housing with the bolts and washers. Tighten bolts to 50/70 pound-inches, and safety in pairs with 0.032-inch diameter wire (table 10-VI, item 6).
(7) Install fan gear box (paragraph 74-30-11).

b. Replace the drive (input) shaft oil seals as follows:
(1) Remove the fan gear box (paragraph 74-30-10).
(2) Remove the four bolts and washers and lift the small pinion housing cap from input housing. Remove gasket from cap and press out the oil seal. Discard both seal and gasket.
(3) Apply a coat of primer (table 10-VI, item 3) around the outside diameter of the replacement oil seal, and press it into cap while primer is still wet.

NOTE: Install a double lipped seal so that the spring loaded lip faces the gear box interior.

(4) Place the billet (table 92-1-I, item 48) over the drive shaft splines to protect seal lip from damage. (If desired, a wrapping of cellophane tape may be used to protect the seal lip in lieu of the billet.) Position the gasket on the cap flange and install cap on input housing. Check that the oil inlet boss of the drive shaft cap is located so that the boss faces toward the rear and to the left-hand side with respect to the normal installed position of the gear box. Secure cap with bolts and washers. Safety the bolts in pairs with 0.032-inch diameter wire (table 10-VI, item 6).
(5) Install fan gear box (paragraph 74-30-11).

74-40-1. COOLING FAN DRIVE COUPLING.

74-40-2. DESCRIPTION. (See figure 74-1-4.) The flexible cooling fan drive coupling transmits drive force from the transmission to the fan gear box, and also reduces loads in the fan drive system. Any of three coupling types may be installed.

a. In the two most recent types (Views A and B, figure 74-1-4), the coupling shaft assembly (4) comprises a 2024-T3 aluminum alloy tube bonded within an absorber unit at each end of the shaft. Each absorber unit is a 4130 steel housing containing a special antiozodent, water and grease resistant elastomer, which is the bonding agent. The major difference between the two bonded type couplings lies in the method of mounting attachment. In the earlier type (View A), retainer rings (1) are used in support of the installed coupling. In the later type (View B), the coupling weight is supported principally by the upper coupling fitting (5) which is secured to the transmission by the bolt (7) and washer (6); this method of attachment reduces the load sustained by the lower coupling fitting (8) attached to the gear box drive shaft.

b. In the earliest configuration (View C), hard rubber spiders (11) are used at each end of the shaft (12) together with retainer rings (1 and 10) to mount the coupling. The coupling shaft and body units are not bonded to the end fittings (9).

74-40-3. TROUBLESHOOTING THE COOLING FAN DRIVE COUPLING. Refer to table 74-1-I for fan drive coupling troubleshooting information.

74-40-10. REMOVAL OF COOLING FAN DRIVE COUPLING. (See figure 74-1-4.) Remove the cooling fan drive coupling (either bonded or spider type) as follows.

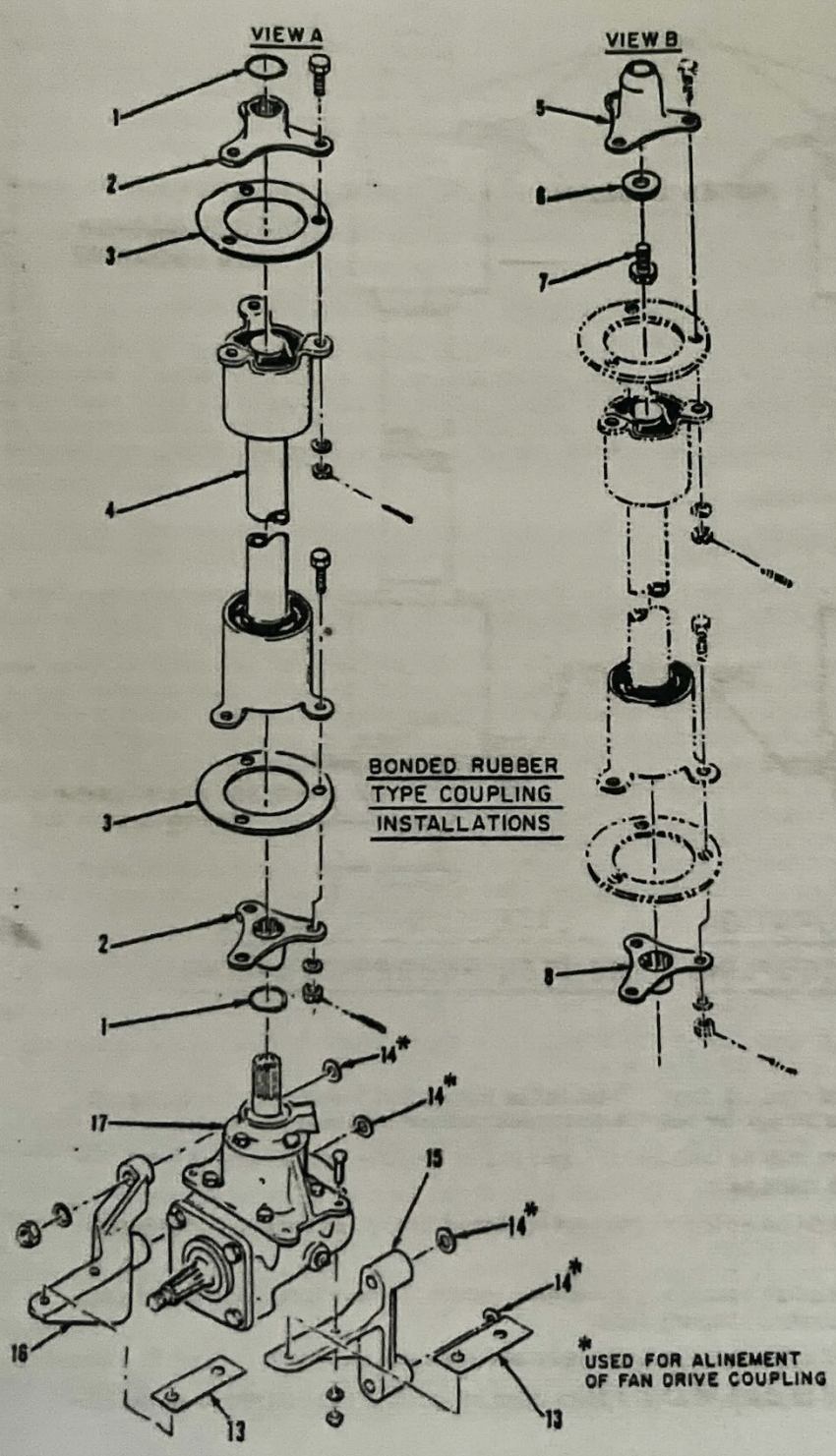
NOTE: Prior to removal of bonded rubber type coupling, use paint or other suitable marking material to matchmark the coupling shaft, shims and end fittings to facilitate coupling alinement at reinstallation.

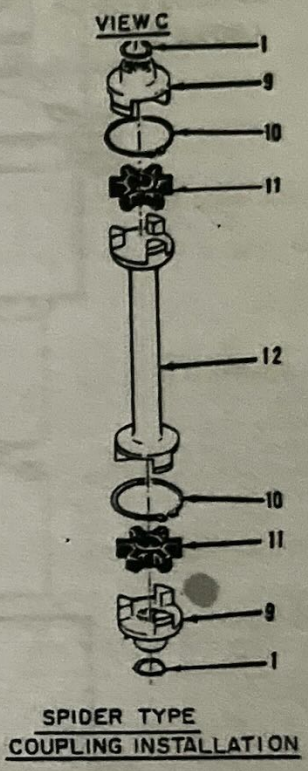
a. Remove cooling fan gear box (17) and the right-hand support (16) as outlined in paragraph 74-30-10.
b. Remove the shroud ring stiffener and half-covers (figure 74-1-2) located on the upper forward section of the shroud assembly, as outlined in paragraph 74-20-10.
c. Disengage the coupling from the transmission fan drive shaft, and remove it through the shroud forward end.

NOTE: When removing the bonded rubber type (late configuration) coupling shown in View B, remove the three bolts, washers and nuts to separate the coupling from the upper fitting (5). Remove bolt (7) and washer (6) and slide the fitting (5) from the transmission fan drive shaft.

74-40-11. INSTALLATION OF COOLING FAN DRIVE BONDED RUBBER TYPE COUPLING. (See figures 74-1-4 and 74-1-5.) Install either of the fan drive bonded rubber type couplings (View A or B, figure 74-1-4) in accordance with the following procedure.

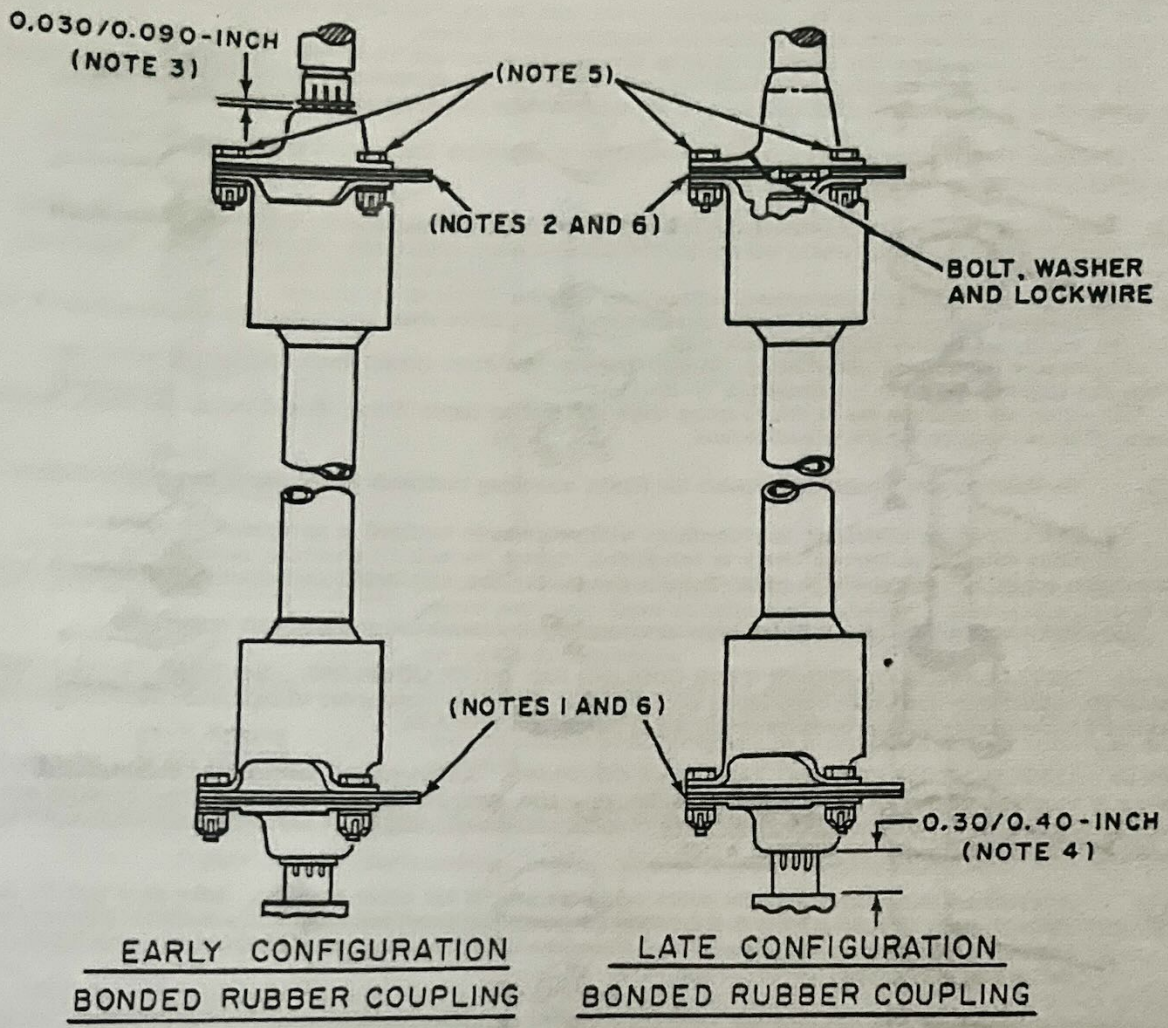
a. Install the earlier type bonded rubber type coupling (View A) as follows:





1. Retainer Ring
2. Coupling Fitting
3. Coupling Shim
4. Coupling Shaft
5. Coupling Fitting
6. Washer
7. Bolt
8. Coupling Fitting
9. Coupling Body (End)
10. Retainer Ring
11. Coupling Spider
12. Coupling Body (Shaft)
13. Laminated Shim
14. Washer (AN960-516, AN960-516L, AN960PD516L)
15. Left-hand Support
16. Right-hand Support
17. Fan Gear Box

Figure 74-1-4. Fan Drive Coupling Configurations



NOTES:

1. Install shims at lower end of coupling first. Total shims installed at lower end of coupling not to exceed two 1/8-inch thick shims, or one 1/8-inch thick and one 1/16-inch thick shim.
2. If required, additional shims may be installed at upper end of coupling, not to exceed one 1/8-inch thick and one 1/16-inch thick shim.
3. Adjust shim thickness to establish specified gap between top of fitting and retaining ring (early configuration coupling).
4. Adjust shim thickness to establish specified gap between bottom of lower fitting and top of gear box housing cap (late configuration coupling only).
5. No washers may be installed under bolt heads at upper end of coupling.
6. AN4-6 bolts may be installed in place of AN4-5 bolts when longer bolt is required to accommodate shim thickness.

Figure 74-1-5. Shim Installation Requirements, Bonded Rubber Type Fan Drive Couplings

(1) Make certain that the retainer ring (1) is installed on both the transmission fan drive shaft, and on the drive (input)shaft of the fan gear box (17).

(2) Engage the fitting (2) at the coupling lower end with the gear box drive shaft splines, and the fitting (2) at the coupling upper end with the transmission fan drive shaft splines.

(3) Check alinement of the drive coupling as directed in paragraph 74-40-30.

(4) After the drive coupling is correctly alined, check the gap dimension between the top surface of the upper fitting (2) and the retainer ring installed on the transmission fan drive shaft, as illustrated in figure 74-1-5.

(5) Adjust the coupling shim thickness as required to establish the correct gap dimension within the limits specified in figure 74-1-5.

NOTE: No washers are permissible under the fitting attaching boltheads at the upper end of the coupling. Tighten all fitting attaching nuts to 70/100 pound-inches, and safety with cotter pins.

b. Install the later configuration bonded rubber type coupling (View B) as follows:

(1) Position the upper fitting (5) on the transmission fan drive shaft and install the attaching bolt (7) and washer (6), but do not tighten the bolt at this time.

(2) Engage the splined lower fitting (8) with the gear box drive (input) shaft splines and install the gear box and supports as given in paragraph 74-30-11.

(3) Aline the matchmarks of the coupling shaft and mating upper fitting (5) and install the bolts, washers and nuts. Tighten nuts to 70/100 pound-inches.

NOTE: No washers are permissible under the fitting attaching boltheads at the upper end of the coupling.

(4) Check coupling alinement in accordance with procedures outlined in paragraph 74-40-30.

(5) After coupling alinement check is completed, tighten the bolt (7) attaching upper fitting (5) to the transmission fan drive shaft to 50/70 pound-inches. Secure the bolt with 0.032-inch diameter wire (table 10-VI, item 6).

(6) Make sure all fitting attaching bolts are properly tightened and safetied with cotter pins.

74-40-12. INSTALLATION OF SPIDER TYPE COOLING FAN DRIVE COUPLING. (See figure 74-1-4.) Installation of the spider type fan drive coupling is accomplished in the reverse order of removal. Check coupling alinement in accordance with procedures outlined in paragraph 74-40-30.

74-40-30. ALINEMENT OF COOLING FAN DRIVE COUPLING. An alinement check of the cooling fan drive coupling is required whenever the transmission, fan gear box, gear box supports, or fan drive coupling are reinstalled or replaced. Check cooling fan drive coupling alinement, and make any necessary adjustments in accordance with the following procedure.

NOTE: After completing any alinement check or adjustment of fan drive coupling, make sure that all fan drive system attaching bolts and nuts are properly tightened and safetied, and that clearance between fan blade tips and the shroud, and between the blades and shroud baffles is within limits, as defined in paragraphs 74-10-11 and 74-30-11.

a. Observe the following practices and precautions when checking fan drive coupling alinement:

(1) Make sure that the fan gear box is securely mounted on its supports, and that the nuts attaching the supports to the engine crankcase studs are correctly tightened (paragraph 74-30-11).

(2) When checking alinement of the late configuration (figure 74-1-4, View B) bonded rubber type coupling, loosen and back off the bolt (7) attaching the coupling upper fitting (5) to the transmission fan drive shaft.

(3) When checking alinement of the spider type drive coupling (View C), it is necessary to clamp the lower coupling body (9) to the coupling shaft (12) with two C-clamps positioned 180 degrees apart. The combined weight of both clamps must not exceed three pounds; the total weight of two standard C-clamps with two-inch jaw openings falls well within this limitation.

b. Check fan drive coupling alinement as follows:

(1) Lift the coupling to the limit of its upward travel, and release it. If the coupling slides by its own weight down the splined drive shaft of the gear box, it is alined, and no further adjustment is required.

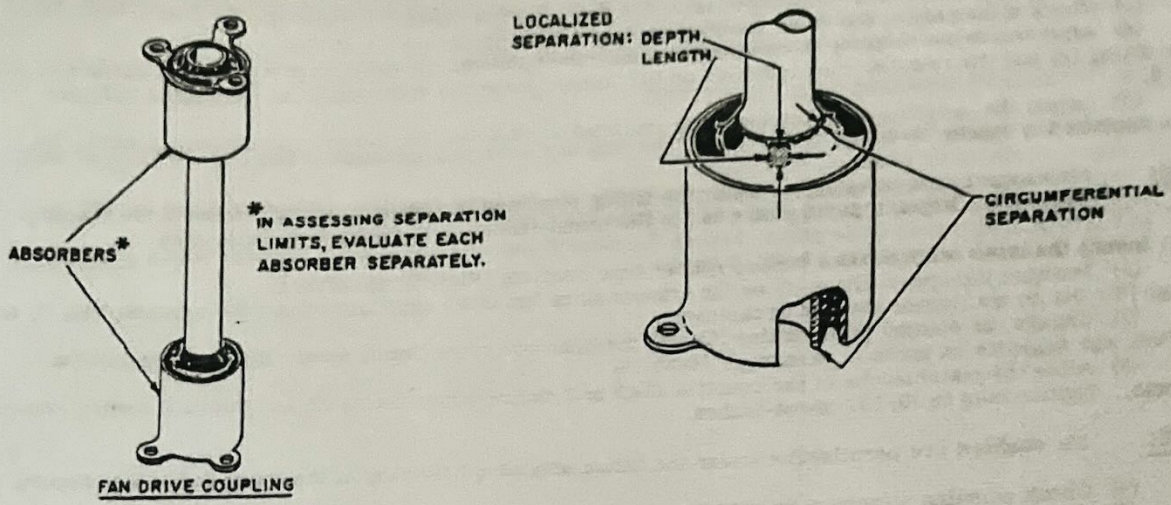
(2) If the coupling does not slide down the shaft by its own weight, adjust the alinement as given in c, immediately following.

c. Alinement of the fan drive coupling is accomplished as follows:

(1) Vary the thickness of the shims (13) located between the fan gear box mounting flanges and the gear box supports (15 and 16) to obtain lateral alinement of the gear box drive shaft with the drive coupling.

(2) Install washers (AN960-516, AN960-516L and/or AN960PD516L) between the gear box supports and the engine crankcase studs to obtain fore and aft alinement of the gear box drive shaft with the coupling.

NOTE: The maximum permissible difference in the number of washers installed between the upper and lower legs of either gear box support (15 and 16) is one AN960PD516L washer.



CIRCUMFERENTIAL SEPARATION: Combined separation depth limited to total of 0.19-inch for both upper and lower faces of individual absorber. Circumferential separation that does not extend completely around shaft is treated as localized separation.

LOCALIZED SEPARATION: Separations, cracks, cuts and rubber deterioration other than complete circumferential separation around the inner member shall be limited to 0.62-square inch combined total area for either absorber.

LOCALIZED AND CIRCUMFERENTIAL SEPARATION: Combined total limited to 0.62-square inch area.

Figure 74-1-6. Serviceability Limits, Bonded Rubber Coupling Absorbers

74-40-40. SERVICEABILITY CHECK AND MINOR REPAIR OF COOLING FAN DRIVE BONDED RUBBER TYPE COUPLING. (See figures 74-1-4 and 74-1-6.) Check the bonded rubber type coupling for serviceability as follows:

a. Check for excessive play between the splines of coupling fitting (2, figure 74-1-4) and the splines of either the transmission fan drive shaft or the gear box drive (input) shaft by blocking the affected shaft against movement, and using a dial indicator to measure the backlash (rotational play) at the bolt circle of the coupling fitting. Maximum backlash is limited to 0.026-inch. If this limit is exceeded, remove coupling (paragraph 74-40-10) and check individual coupling and shaft splines for wear as outlined in the following steps.

(1) Measure the coupling fitting splines between 0.0600-inch diameter pins. The maximum allowable dimension between pins is 0.6440 inch.

(2) Measure the mating transmission fan drive shaft or gear box drive shaft splines over 0.0800-inch diameter pins. The minimum allowable over pin dimension is 0.8160 inch.

(3) Replace any parts worn beyond the above specified limits.

CAUTION: NO SPLINE REPAIRS ARE PERMITTED.

b. Check the bonded rubber absorbers for extent of separation between the elastomer bond and the shaft and/or metal shell, as illustrated in figure 74-1-6. Separation beyond limits requires replacement of the coupling shaft (4, figure 74-1-4).

74-40-41. SERVICEABILITY CHECK AND MINOR REPAIR OF COOLING FAN DRIVE SPIDER TYPE COUPLING. (See figure 74-1-4.) Check the serviceability of the fan drive spider type coupling as follows:

a. Check for excessive play between the splines of the coupling body (9, View C, figure 74-1-4) and the mating splines of the transmission fan drive shaft or the gear box drive (input) shaft by blocking the affected shaft against movement, and measuring for backlash (rotational movement) at the larger (outer) diameter of the coupling body (9). Maximum backlash is limited to 0.023-inch. If this limit is exceeded, remove and disassemble the coupling components (paragraph 74-40-10) and check individual coupling and shaft splines for wear as out-

lined in the following steps.

(1) Measure the coupling fitting splines between 0.0600-inch diameter pins. The maximum allowable dimension is 0.6440-inch.

(2) Measure the mating transmission fan drive shaft or gear box drive shaft splines over 0.0800-inch diameter pins. The minimum allowable dimension is 0.8160-inch.

(3) Replace any parts worn beyond the above specified limits.

CAUTION: NO SPLINE REPAIRS ARE PERMITTED.

b. Replace any rubber coupling spider (11) if the legs are worn to a minimum width of 0.360-inch or less, or if excessive checking or cracking is evident.

c. Check for wear in the coupling body (9) groove for the retainer ring (1). Groove width is limited to 0.157-inch maximum. Replace parts with wear beyond the limit.

d. In reassembling serviceable parts, secure the ears of the retainer ring (1) together with a double wrap of 0.041-inch diameter wire (table 10-VI, item 6).

ENGINE CONTROLS

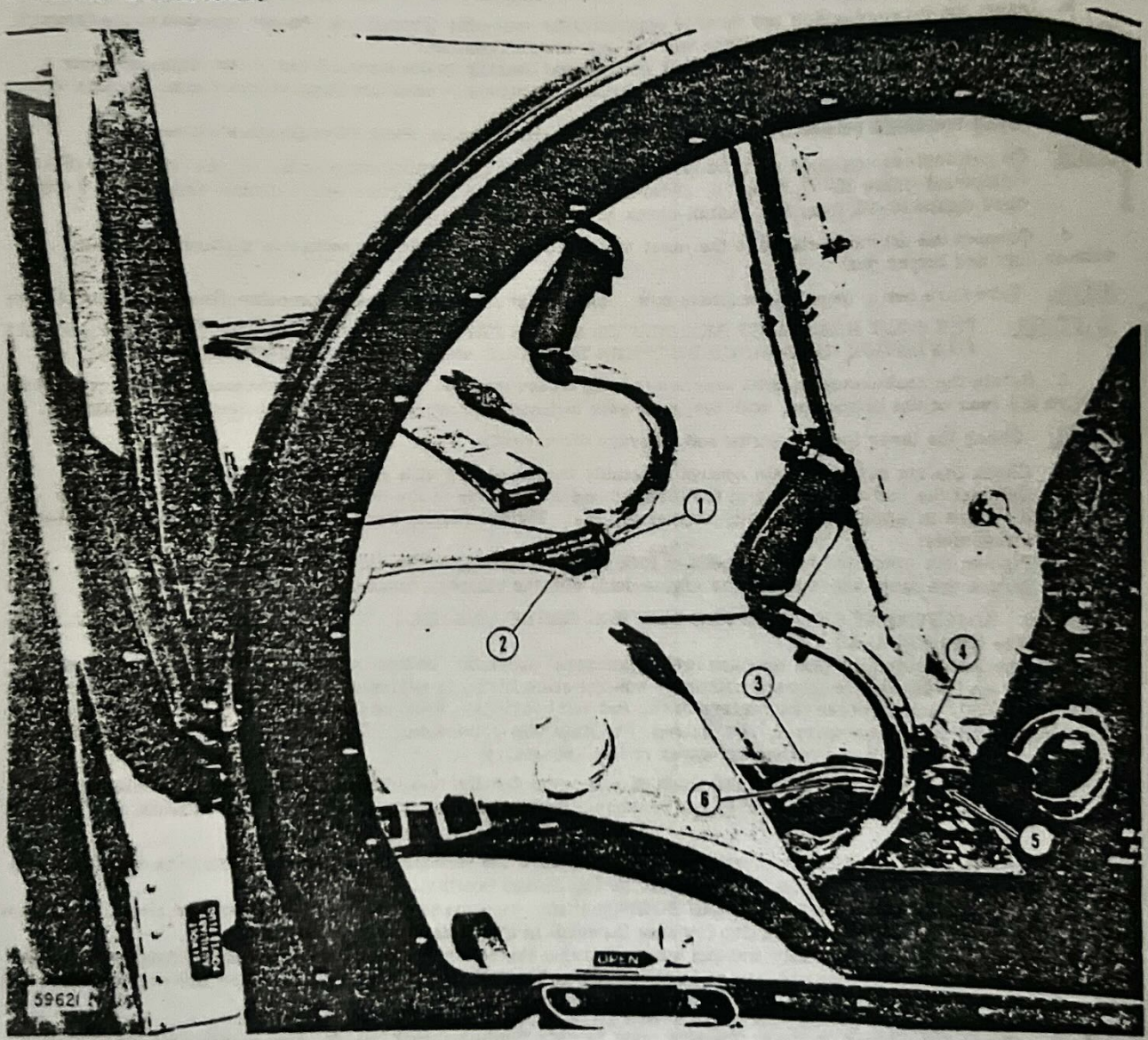
75-1-1. ENGINE CONTROLS. (See figures 75-1-1 and 75-1-2.)

75-1-2. DESCRIPTION. The engine controls include the throttle, idle cut-off mixture control and carburetor air heat controls. Figure 75-1-1 shows the location of the engine controls.

75-10-1. THROTTLE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. (See figure 72-1-2.)

75-10-10. REMOVAL OF THROTTLE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. (See figure 75-1-2.)

a. Remove the cotter pin, nut, washer and bolt used to attach the aft throttle control clevis fitting to the carburetor throttle lever.



1. Starter Switch
2. Throttle Grip
3. Control Quadrant
4. Carburetor Air Heat Control
5. Mixture Control
6. Mixture Lever Safety Stop

Figure 75-1-1. Engine Controls

b. Remove the nut, washer and bolt used to secure the rod end bearing at the forward end of the throttle cable assembly to the cam follower lever.

c. Remove the rod end bearing, nut, two rubber boots, cable housing attaching nut and lockwasher from the forward end of the throttle cable assembly.

d. Remove the clevis fitting, protector tube, small rubber boot and the cable housing attaching nut and lockwasher from the throttle cable aft end.

NOTE: On helicopters equipped with the large rubber boots, remove the clevis fitting and check nuts. Clip the cord securing boots to control cable.

e. Remove the screw, spacer, washer and clamp used to secure the throttle cable assembly to the engine deck.

f. Remove the cable assembly from the helicopter.

75-10-11. INSTALLATION OF THROTTLE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. (See figure 75-1-2.)

a. Insert the forward end of the throttle control cable assembly through the bracket mounted at the forward end of the engine deck and secure in place with the nut and lockwasher.

b. Install the two rubber boots, checknut and rod end bearing on the forward end of the cable assembly.

c. Insert the aft end of the cable assembly through the aft cable mounting bracket and secure in place with the nut and lockwasher.

d. Install the small rubber boot, protector tube and clevis fitting on the throttle cable aft end.

NOTE: On helicopters equipped with the large rubber boots at the control cable ends, fill the boots with DC-4 Compound (table 10-VI, Item 20). Secure boots at both top and bottom with a double wrap of No. 6 waxed cord (table 10-VI, Item 21). Install check nuts and clevis fittings.

e. Connect the aft cable clevis to the inner hole of the throttle lever and secure in place with the bolt, washer, nut and cotter pin.

NOTE: Take care not to overtighten clevis bolt. Some axial play must exist between the clevis and throttle lever.

CAUTION: THE BOLT HEAD MUST BE LOCATED AT THE CARBURETOR SIDE OF THE THROTTLE LEVER TO PROVIDE CLEARANCE BETWEEN THE BOLT AND IDLE RPM ADJUSTMENT SCREW.

f. Rotate the carburetor throttle lever to the full closed position and check to determine that the lever faces toward the rear of the helicopter, with the lever axis inclined approximately 36 degrees above the horizontal.

NOTE: Check the lever locking screw and lockwire for security.

g. Check the rig of the throttle control assembly in accordance with paragraph 75-10-30.

h. Connect the rod end bearing at the forward end of the cable to the throttle coordination cam follower lever and secure in place with the bolt, washer and nut. Tighten the checknut used to lock the rod end bearing to the cable assembly.

i. Tighten the protector tube nut used to lock the clevis fitting to the cable.

j. Secure the cable assembly to the engine deck with the clamps, spacers and bolts.

75-10-30. ADJUSTMENT OF THROTTLE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. (See figure 75-1-2.)

a. Check to determine that the cam lever turnbarrel assembly located between the throttle coordination assembly cam lever and the inboard collective control stick fitting is adjusted to establish a dimension of 4.53 inches (± 0.030-inch) between the centers of the rod end bearings. Remove the turnbarrel assembly to check the distance and adjust the turnbarrel, if required, to obtain this dimension. (Take care to reinstall the small spacer between the stick end fitting and lower rod end bearing.)

NOTE: Operate the collective pitch stick and throttle grip through their full range of travel to check that the rod end bearings do not bind in any position. Reposition the rod end bearings, if required, to eliminate binding.

b. Disconnect the rod end bearing at the forward end of the throttle cable assembly from the cam follower lever and move the carburetor throttle lever to the full closed position.

c. With the collective stick in the full DOWN position, turn the throttle grip at the forward end of the collective pitch stick in a clockwise direction (looking forward) to the limit of its travel (full closed).

d. Adjust the cable assembly rod end bearing so that the bolt hole through the rod end bearing and the bolt holes through the cam follower lever are in alinement and install the bolt through the lever and rod end bearing. Secure the rod end bearing in place with the bolt, washer and nut.

NOTE: The throttle lever on the carburetor must be held firmly against the idle rpm adjustment screw during the forward rod end bearing adjustment step.

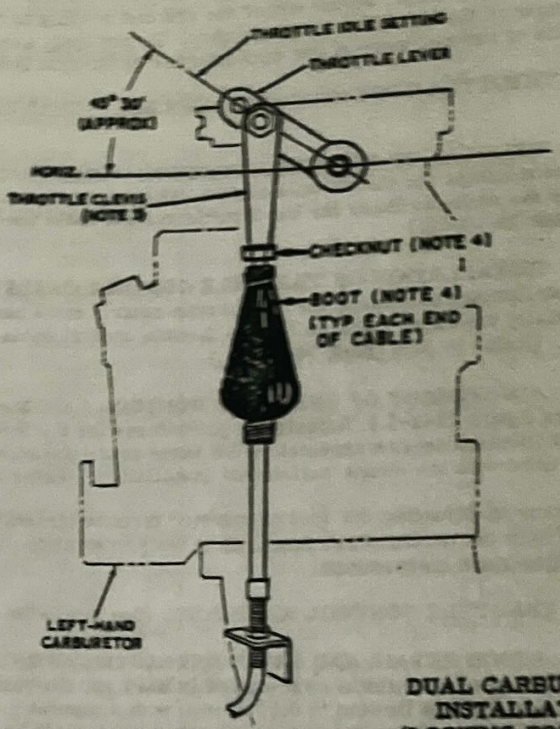
e. Check to determine that there is from 1/16 to 1/8-inch clearance between the lever arm of the collective stick end fitting and the overtravel stop while the throttle grip is held in the full closed position. Loosen the stop clamp bolt and rotate the overtravel stop to obtain the required clearance. (See figure 75-1-2.)

f. Check for full travel and freedom of movement of the throttle control system.

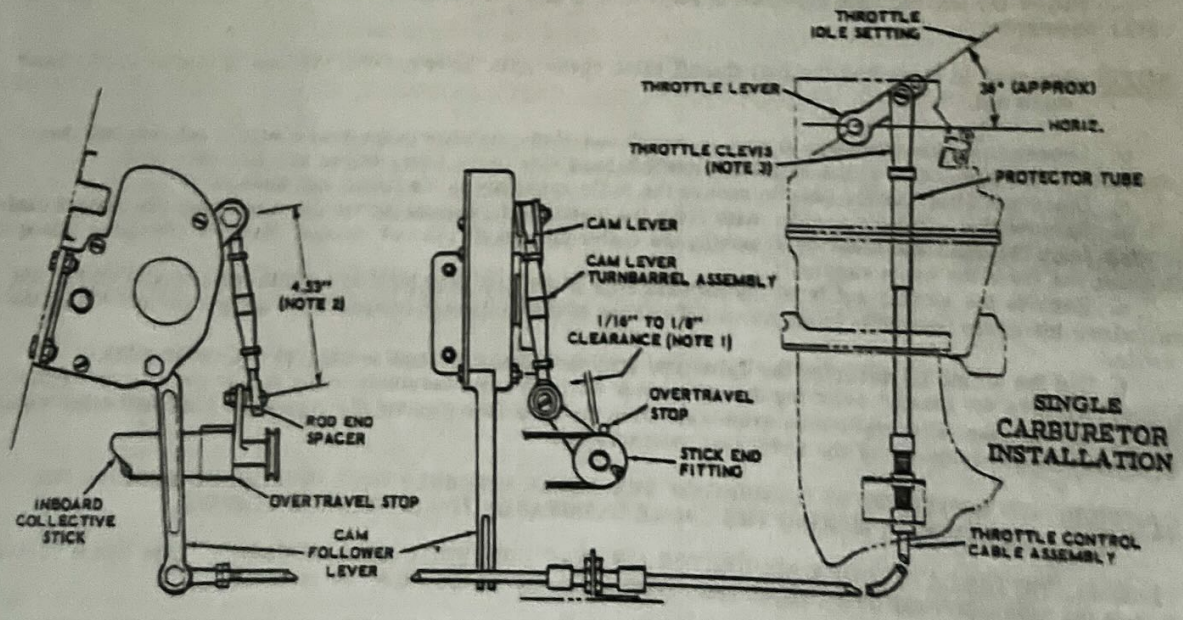
g. Check that all of the system parts are properly safetied.

NOTES:

1. Inboard collective control stick at 0 degrees with throttle grip fully "closed".
2. Remove either end of the cam lever turnbarrel assy to check this dimension - rod end bearings must be centered (not swiveled) in races.
3. Attach throttle clevis to inner hole of throttle lever.
4. Boot and checknut provided on helicopter Serial No. 2149 and subsequent.



DUAL CARBURETOR INSTALLATION (LOOKING FORWARD)



SINGLE CARBURETOR INSTALLATION

Figure 75-1-2. Adjustment, Throttle Control Cable Assembly

NOTE: In the event of pilot request for an increase in detent "feel", preload the cam follower lever. To preload the lever, adjust either the rod end bearing or the throttle lever clevis to INCREASE the length of the throttle cable assembly. Do not apply excessive preload as doing so may accelerate the rate of normal wear at the cam follower or throttle lever pivot surfaces.

75-11-1. THROTTLE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. (See figure 75-1-2.)

75-11-10. REMOVAL OF THROTTLE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. Removal procedures for the throttle control cable assembly used with the dual carburetor installation are essentially the same as those for the throttle control cable used with the single carburetor installation. (Refer to paragraph 75-10-10.)

75-11-11. INSTALLATION OF THROTTLE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. Installation procedures for the throttle control cable assembly used with the dual carburetor installation are essentially the same as those for the throttle control cable assembly used with the single carburetor assembly. (Refer to paragraph 75-10-11.)

75-11-30. ADJUSTMENT OF THROTTLE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. (See figure 75-1-2.) Adjustment procedures for the throttle control cable assembly used with the dual carburetor installation are essentially the same as the adjustment procedures for the throttle control cable assembly used with the single carburetor installation. (Refer to paragraph 75-10-30.)

NOTE: Prior to adjusting the dual carburetor throttle control cable assembly make certain the throttle levers of both carburetors are installed at the proper angle; refer to paragraph 72-11-31 for dual carburetor adjustment instructions.

75-20-1. THROTTLE CONTROL ASSEMBLY. (See figure 75-1-2.)

75-20-30. MINOR REPAIR AND PARTS REPLACEMENT OF THROTTLE CONTROL ASSEMBLY. Check the clearance between the throttle cam assembly shaft and the bushings of the throttle control housing. Maximum allowable clearance is limited to 0.0095-inch with a minimum cam assembly shaft diameter of 0.347-inch. Reduction of excessive clearance to a serviceable limit might be accomplished by replacing the bushings in the housing, using new bushings with the low tolerance limit ID (0.376-inch ID).

75-30-1. CARBURETOR AIR HEAT CONTROL CABLE ASSEMBLY. (See figures 75-1-1 and 76-1-2.)

75-30-10. REMOVAL OF CARBURETOR AIR HEAT CONTROL CABLE ASSEMBLY. (See figure 76-1-2.)

a. Follow the instructions provided in steps a, d, f, and g of paragraph 72-50-10. Remove the engine deck cover assembly.

NOTE: Use care in loosening the fuel shutoff valve cover plate nut to prevent the loss of torque at the lower valve nut.

b. Loosen the setscrew used to secure the aft end of the carburetor air heat control cable wire to the carburetor air heat valve crank located at the left-hand side of the lower intake air duct assembly.

c. Disconnect the clamps used to secure the cable assembly to the lower duct assembly.

d. Remove the left-hand access plate from the instrument pedestal tunnel and disconnect the control cable clevis from the quadrant lever by removing the cotter pin, clevis pin and washer. Remove the clevis fitting and locking nut from the cable assembly.

e. Remove the locking nut from the forward side of the seat deck bulkhead within the pedestal tunnel and withdraw the cable assembly from the tunnel and out of the underseat compartment using care not to kink the cable.

f. Cut the string tie securing the split-type grommet located alongside the fuel cell cover plate.

g. Remove the locknut securing the carburetor air heat cable assembly to the engine deck cable support.

h. Remove the three split-type grommets from the bulkheads beneath the engine deck and withdraw the cable assembly forward and out of the underseat compartment.

CAUTION: EXCESSIVE SHARP BENDING OF THE CABLE ASSEMBLY WILL INTRODUCE KINKS IN THE WIRE SHAFT, MAKING THE CABLE UNSUITABLE FOR CONTINUED SERVICE.

75-30-11. INSTALLATION OF CARBURETOR AIR HEAT CONTROL CABLE ASSEMBLY. (See figure 76-1-2.) Install the carburetor air heat control cable assembly in the reverse order of removal.

NOTE: Take care not to omit the split-type cable grommets located beneath the engine deck. Adjust the carburetor air heat control upon completion of the installation steps. (Refer to paragraph 75-30-30.)

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75-30-30. ADJUSTMENT OF CARBURETOR AIR HEAT CONTROL CABLE ASSEMBLY. (See figure 76-1-2.)

a. Place the carburetor air heat quadrant control lever approximately 1/8 to 3/16-inch aft of the full forward or COLD position.

b. Loosen the setscrew used to secure the control cable wire to the fitting on the valve door crank.

c. Place the carburetor air heat valve door in the full COLD position and tighten the setscrew on the valve crank fitting.

d. Operate carburetor air heat control lever through its full range of travel and check to determine that the valve door operates satisfactorily. Increase valve door travel in either direction by loosening the valve crank setscrew and repositioning the crank on the cable wire as required to obtain full travel of the valve door.

e. Safety the setscrew with lockwire when the valve door adjustment is completed.

75-40-1. MIXTURE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. (See figure 75-1-1.)

75-40-10. REMOVAL OF MIXTURE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. Removal instructions for the mixture control cable are essentially the same as for the carburetor air heat control cable. (Refer to paragraph 75-30-10.)

75-40-11. INSTALLATION OF MIXTURE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION. Installation procedures for the mixture control cable are essentially the same as for the carburetor air heat control cable. (Refer to paragraph 75-30-11.)

NOTE: Use AN960PD10 or AN960PD10L washers as required between the cable clamps and the carburetor mixture control bracket to aline the cable with the mixture control arm.

75-40-30. ADJUSTMENT OF MIXTURE CONTROL CABLE ASSEMBLY, SINGLE CARBURETOR INSTALLATION.

a. Place the quadrant control lever in the ICO position and insert the cable end into the control arm fitting at the carburetor.

b. Move the carburetor control arm to the full lean stop (note the L and arrow on the arm) and tighten the setscrew.

c. Check the full throw of the quadrant control lever to the ALT COMP (forward) position and observe the lever position. Check that the mixture control arm is at full rich stop (note the R and arrow on the arm).

d. Loosen the setscrew at the control arm fitting and set the quadrant lever half way between the preliminary forward full throw position and the limit of quadrant travel. Retighten the setscrew and safety the screw to the fitting with lockwire.

75-41-1. MIXTURE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. (See figures 72-1-5 and 72-1-6.)

75-41-10. REMOVAL OF MIXTURE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. Removal procedures for the mixture control cable assembly used with dual carburetor installation are essentially the same as those for the mixture control cable used with the single carburetor installation. (Refer to paragraph 75-40-10.)

75-41-11. INSTALLATION OF MIXTURE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. Installation procedures for the mixture control cable used with the dual carburetor installation are essentially the same as those for the mixture control cable used with the single carburetor install. (Refer to paragraph 75-40-11.)

75-41-30. ADJUSTMENT OF MIXTURE CONTROL CABLE ASSEMBLY, DUAL CARBURETOR INSTALLATION. (See figures 72-1-5 and 72-1-6.)

a. Place the quadrant control lever in the ICO position and insert the end of the mixture control cable into the control arm fitting of the right-hand carburetor.

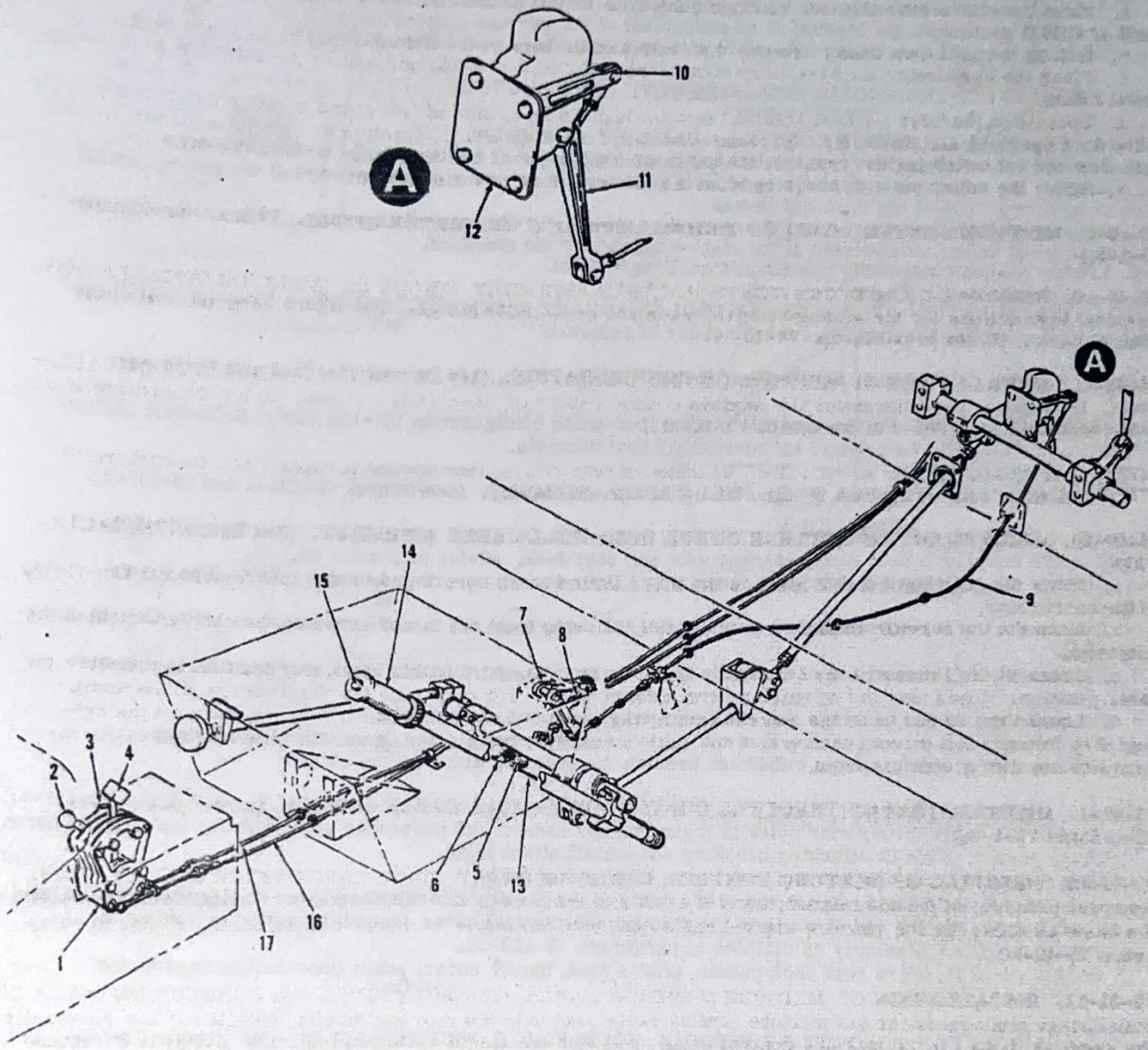
b. Place two AN960PD10 washers on the shank of the control arm fitting and insert the fitting through the terminal end of the interconnect mixture control cable. Attach the fitting and terminal end of mixture control cable to the right-hand carburetor mixture control arm. Install a washer and cotter pin on control arm fitting.

NOTE: Install AN960PD10 washers on the control arm fittings, as required, to eliminate excessive end play and provide proper alinement of the mixture control cables.

c. Move the right-hand carburetor mixture control arm to the L position and tighten the control arm fitting setscrew.

d. Insert the interconnect mixture control cable into the control arm fitting attached to the left-hand carburetor mixture control arm. Place the mixture control arm in the L position and tighten the fitting setscrew.

e. Operate the quadrant control lever forward to the ALT COMP position. Make certain that the mixture control arm of each carburetor touches the stop in the R position.



1. Control Quadrant
2. Mixture Control
3. Mixture Lever Safety Stop
4. Carburetor Air Heat Control
5. End Fitting
6. Overtravel Stop
7. Throttle Coordination Lever Assembly
8. Turnbarrel Assembly
9. Throttle Control Push-pull Cable Assembly
10. Throttle Coordination Lever
11. Cam Follower Lever
12. Throttle Coordination Control Assembly
13. Throttle Cable Assembly
14. Throttle Grip
15. Starter Switch
16. Carburetor Air Heat Control Cable Assembly
17. Mixture Control Cable Assembly

Figure 75-101-1. Engine Controls, Four-Place Configuration

f. Move the quadrant control lever from the ALT COMP to the ICO position. Check to make certain that the mixture control operates smoothly and no binding occurs. Install AN960PD10 washers, as required, on the control arm fitting to eliminate binding or misalinement of the mixture control cable.

g. Safety the control arm fitting setscrews on both carburetors with lockwire.

75-50-1. ENGINE CONTROL QUADRANT ASSEMBLY. (See figure 75-1-1.)

75-50-10. REMOVAL OF ENGINE CONTROL QUADRANT ASSEMBLY.

a. Remove the cover plates from the left and right-hand sides of the instrument pedestal tunnel.

b. Remove the cotter pins, washers and clevis pins used to secure the forward ends of the engine control cables to the lower ends of the quadrant levers.

c. Remove the bolts used to secure the quadrant assembly to the support assembly. Take care not to lose the mixture lever safety stop located at the right-hand side of the quadrant.

d. Lift the quadrant assembly upward and out of the tunnel.

75-50-11. INSTALLATION OF ENGINE CONTROL QUADRANT ASSEMBLY. (See figure 75-1-1.) Install the engine control quadrant assembly in reverse order of removal.

75-101-1. ENGINE CONTROLS, FOUR-PLACE CONFIGURATION. (See figures 75-101-1 and 75-101-2.)

75-101-2. DESCRIPTION. Engine controls for the four-place configuration UH-12E Model Helicopter include the throttle, idle cut-off mixture and carburetor air heat controls.

75-110-1. THROTTLE CONTROL PUSH-PULL CABLE ASSEMBLY. (See figures 75-101-1 and 75-101-2.)

75-110-10. REMOVAL OF THROTTLE CONTROL PUSH-PULL CABLE ASSEMBLY. (See figure 75-101-1.)

a. Remove the pilot's seat and passenger seat and seat deck. (Refer to Section 85.)

b. Remove the collective torque tube cover, cabin floor access covers and tunnel cover. (See figure 85-101-2.)

c. Disconnect the forward throttle control push-pull cable from the throttle coordination lever located on the firewall.

d. Disconnect the forward end of the cable from the throttle coordination lever assembly located in the tunnel.

e. Remove the rod end bearings and checknuts from each end of the cable.

f. Remove attach nut from each end of the cable housing; remove cable from attaching brackets.

g. Remove two grommets from bulkheads beneath the seat and withdraw the cable.

75-110-11. INSTALLATION OF THROTTLE CONTROL PUSH-PULL CABLE ASSEMBLY. (See figure 75-101-1.)

a. Thread the cable through the holes in the bulkheads beneath the passenger seat deck and install grommets.

b. Place ends of cable in attaching brackets and install attach nuts.

c. Install the checknut and rod end bearing on each end of cable.

d. Connect rod end bearing on aft end of the cable to the throttle coordination lever on firewall; connect the rod end bearing on forward end of cable to the throttle coordination lever assembly located in the tunnel.

e. Adjust the cable assembly as outlined in paragraph 75-120-30.

f. Install the passengers seat deck panels, pilot's seat, tunnel cover, cabin floor access covers and collective torque tube cover.

75-120-30. RIGGING OF THROTTLE CONTROLS, FOUR-PLACE CONFIGURATION. (See figures 75-101-1 and 75-101-2.)

a. Adjust turnbarrel assembly, to establish length between rod end bearing centers of approximately 4.05 inches. Install turnbarrel assembly.

NOTE: Take care to install one spacer on either side of the lower rod end bearing of turnbarrel assembly.

b. Move the throttle coordination lever (located on the firewall), upward until it stops; attach aft rod end bearing of throttle control push-pull cable assembly.

c. Attach forward rod end bearing of throttle control push-pull cable assembly to the throttle coordination lever located in tunnel.

d. Place the collective control stick in full "down" position; rotate the throttle grip to closed position; adjust length of throttle control push-pull cable assembly, as required, to establish throttle coordination lever angle at 53 to 57 degrees from a horizontal position. (See figure 75-101-2.)

e. Adjust throttle overtravel stop clamp to provide 1/16 to 1/8-inch clearance between overtravel stop and end fitting arm when the throttle grip is in full closed position and the collective stick is held in a full "down" position.

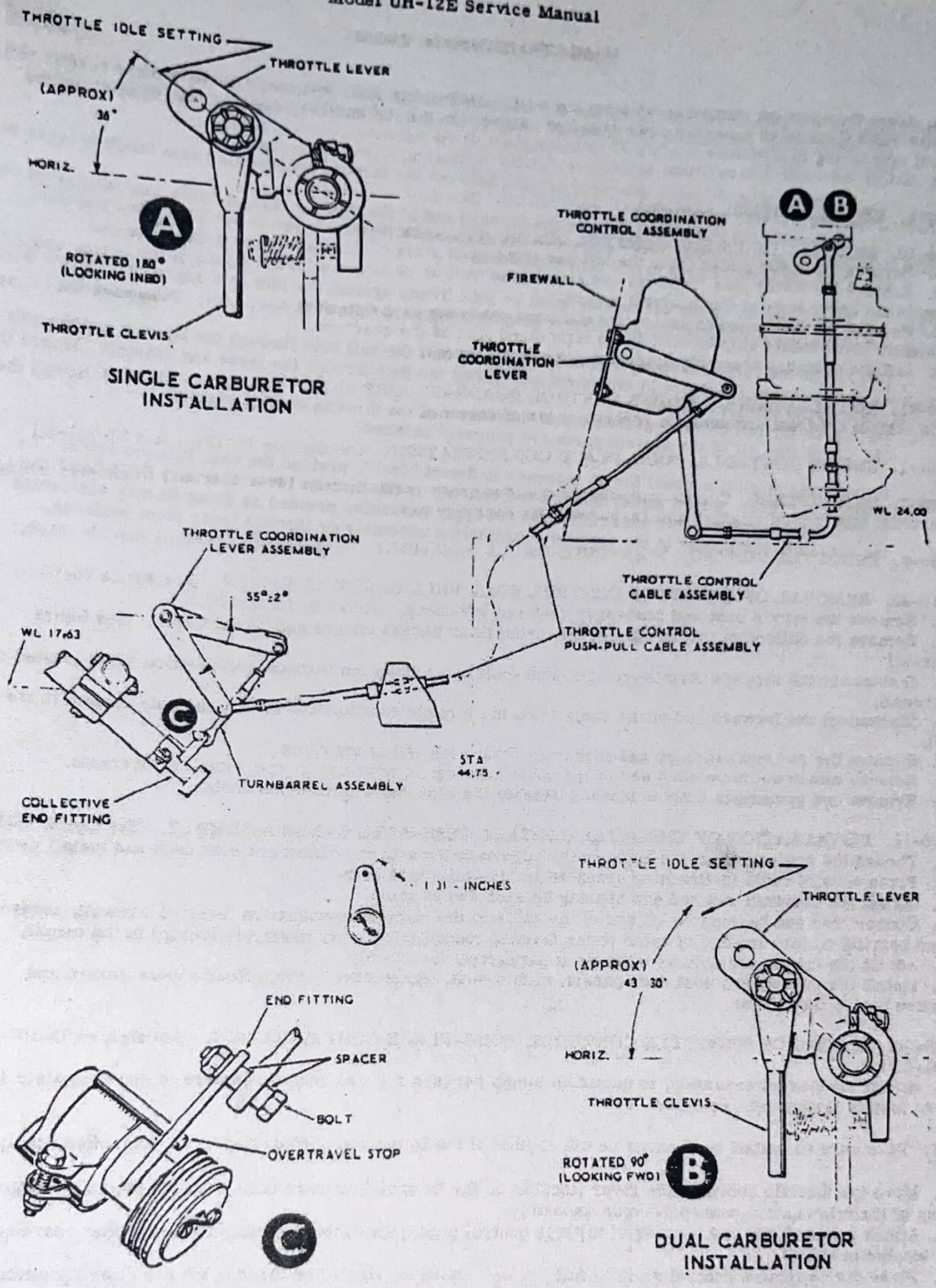


Figure 75-101-2. Adjustment of Throttle Controls, Four-Place Configuration

NOTE: Operate the collective pitch stick and throttle grip through their full range of travel to check that the rod end bearings do not bind in any position. Reposition the rod end bearings as required to eliminate bearing binding.

f. Adjust throttle control cable assembly located between the throttle coordination cam follower lever on the firewall and carburetor as follows:

(1) Disconnect the rod end bearing at the forward end of the throttle control cable assembly from the throttle coordination cam follower lever and move the carburetor throttle lever to the full closed position.

(2) Turn the throttle grip to full closed position.

NOTE: The throttle lever on the carburetor must be held firmly against the idle rpm adjustment screw during the forward rod end bearing adjustment step, immediately following.

(3) Adjust the cable assembly rod end bearing so that the bolt hole through the bearing and the bolt holes through the cam follower lever are in alinement and install the bolt through the lever and bearing. Secure the bolt in place with the washer and nut.

(4) Check for full travel and freedom of movement of the throttle control system.

(5) Check that all of the system parts are properly safetied.

NOTE: In the event of pilot request for an increase in detent "feel", preload the cam follower lever. To preload the lever, adjust either the rod end bearing or the throttle lever clevis to INCREASE the length of the throttle cable assembly. Do not apply excessive preload as doing so may accelerate the rate of normal wear in the throttle coordination assembly or throttle lever pivot surfaces.

AIR INTAKE AND EXHAUST SYSTEMS

76-1-1. ENGINE AIR INDUCTION AND EXHAUST SYSTEM. (See figures 76-1-1, 76-1-2 and 76-1-3.)

76-1-2. DESCRIPTION. The engine exhaust system consists of a left and a right exhaust manifold assembly. Each assembly includes three exhaust stacks leading from the cylinder exhaust ports into the manifold core. A wrap-around shroud clampes to the left-hand manifold core to provide carburetor heat and a second wrap-around shroud on the right-hand manifold core provides cabin heat. Carburetor air enters the engine intake air upper duct assembly and is directed to the circular drum of the lower duct assembly. The air passes from the lower duct through the dual filter assembly installation, the duct assembly elbow and to the carburetor. Carburetor air heat is provided, as required, from the left-hand muffler shroud assembly. The heated air is drawn through the flexible duct connecting the shroud port to the lower duct assembly heated air elbow; a manually operated intake air valve door assembly is located in the lower duct assembly to provide heat control.

76-10-1. ENGINE AIR INTAKE DUCT ASSEMBLY. (See figure 76-1-1.)

76-10-10. REMOVAL OF ENGINE AIR INTAKE DUCT ASSEMBLY, SINGLE CARBURETOR INSTALLATION.

a. Disconnect upper duct assembly from transmission by removing two intake air inlet support attaching nuts and washers from studs on the lower transmission housing.
b. Remove clamp securing upper duct assembly to lower duct assembly and remove upper duct.
c. Disconnect flexible heated air intake duct from lower duct assembly elbow by removing attaching clamp.
d. Disconnect the electrical connector from carburetor air temperature bulb, and remove bulb. Tape the electrical connector to prevent damage and entry of foreign material.
e. Disconnect control cables from lower duct and throttle push-pull cable support bracket.
f. Disconnect fuel system drain line from fitting on underside of lower duct assembly.
g. Remove lower duct cover plate and filter elements. Then remove screw, nut, washer, and clamp securing the carburetor air heat control cable to the lower duct.
h. Remove engine air intake lower duct assembly by removing attaching bolts and washers from engine air intake support assembly located between the carburetor and intake manifold. Remove bolts and washers from duct flange at the intake side of the carburetor. Take care not to damage the gasket during removal.

76-10-11. INSTALLATION OF ENGINE AIR INTAKE DUCT ASSEMBLY, SINGLE CARBURETOR INSTALLATION. Installation of engine air intake duct assembly is the reverse of removal.

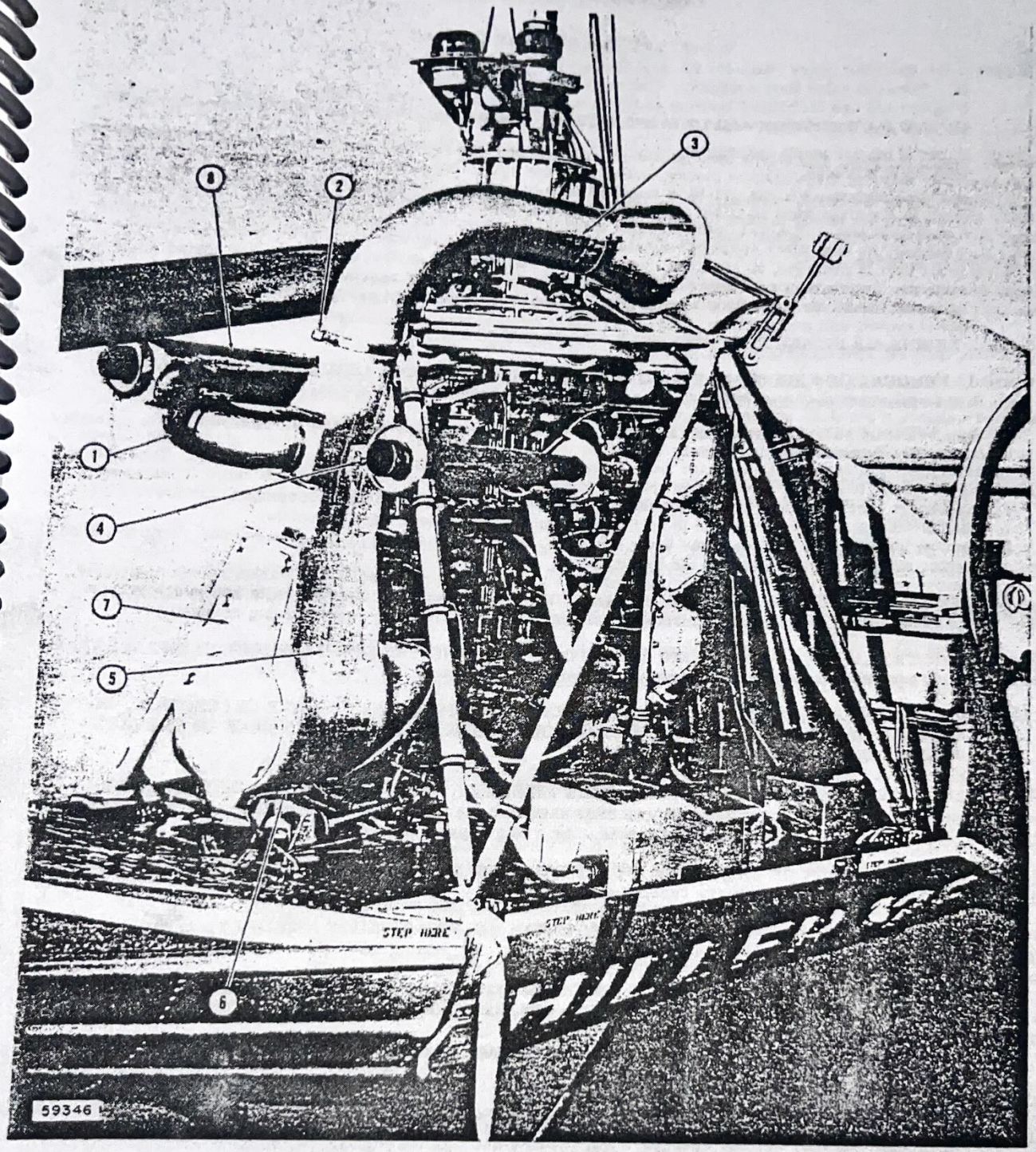
CAUTION: CHECK THE AIR INTAKE INLET SUPPORT CLAMP LUGS FOR EXCESSIVE DEFLECTION. INSTALL AN960PD-10L OR AN960PD-10 WASHERS BETWEEN THE CLAMP LUGS TO PREVENT EXCESSIVE BENDING.

76-10-12. REMOVAL OF ENGINE AIR INTAKE DUCT ASSEMBLY, DUAL CARBURETOR INSTALLATION. Removal procedures for the air intake duct assembly used with the dual carburetor installation are essentially the same as those for the single carburetor installation; refer to paragraph 76-10-10.

76-10-13. INSTALLATION OF ENGINE AIR INTAKE DUCT ASSEMBLY, DUAL CARBURETOR INSTALLATION. Installation of the air intake duct is the reverse of removal.

76-10-40. REPAIRS AND PARTS REPLACEMENT, ENGINE AIR INTAKE DUCT ASSEMBLY. Accomplish the following maintenance, as applicable. Certain repairs, other than those listed below, are beyond the intended scope of the handbook and are given in the Structural Repair Manual.

a. Check the heated-air door assembly for wear of the valve shaft in the pivot holes. When total side play of a valve shaft exceeds 0.020-inch the worn bushings or elongated holes must be repaired. Repair this condition in accordance with the subparagraphs which follow.
b. Install valve shaft nylon bearings at the heated-air intake valve of the intake duct assembly as follows:
(1) Remove the heated-air door assembly (Refer to paragraph 76-30-10); remove the inner crank assembly.
(2) Using a 3/8-inch drill for the 0.250-inch ID bushing (bearing) and a 1/2-inch drill for the 0.375-inch ID bushing (bearing), drill out the existing bushings (bearings) taking care to avoid elongation of the holes in the fiberglas duct. Remove any remaining flange material by filling until the surface is flush.
(3) Check the nylon bearings for correct length and proper alinement by installing the bearings (flanges outside) and inserting the valve shaft. Mark the bearing shank excess length using any suitable method. Check the shaft for rotational freedom which would indicate satisfactory alinement of the bearings.
(4) Remove the shaft and nylon bearings and cut off excess bearing length. Prepare a suitable amount of adhesive, (item 13, table 10-VI) to be used for bonding the bearings in place. If Metalfil-F is used, prepare in accordance with the instructions in subparagraph c, below, otherwise follow instructions provided by the adhesive manufacturer.
(5) Bond the bearings to the duct assembly using the valve shaft to establish and maintain alinement.



1. Heated Air Intake Flex Duct
2. Duct Clamp
3. Engine Air Intake Upper Duct Assembly
4. Carburetor Heat Control Valve Shaft
5. Engine Air Intake Lower Duct Assembly
6. Engine Air Intake Duct Drain
7. Cover Plate Assembly
8. Exhaust Shroud

Figure 76-1-1. Air Induction System

(Observe the specified "cure" time for the adhesive; subparagraph c, below.)

(6) Reinstall valve door assembly. (Refer to paragraph 76-30-11.)

c. Prepare and use Metalfil-F bonding epoxy composition in the following manner:

(1) Add 3-1/2 parts-by-weight of Part B to 10 parts-by-weight of Part A and mix together thoroughly.

NOTE: Working life for small quantities (one pound or less) is approximately 1-1/2 hours; for larger quantities, working life is less.

(2) Apply the mixed compound to the repair area by using any convenient applicant (putty knife, etc).

(3) Allow the repair to cure (harden) in a location where surrounding air temperature is at least 16°C (60°F). At 24°C (75°F) or more, handling (part useability) strength is produced in 16 hours, with full cure produced in 72 hours.

NOTE: Full cure (hardening) time may be reduced to one hour by placing repaired part in an oven or similar device which can produce an assembly surface temperature of 93°C (200°F). Caution must be used to never exceed this temperature because excessive temperature will damage the duct assembly.

76-20-1. AIR FILTER ELEMENT ASSEMBLY.

76-20-10. REMOVAL OF AIR FILTER ELEMENT ASSEMBLY. Remove the lower duct cover plate assembly. Remove the element assemblies from the filter support in the engine air intake lower duct assembly.

76-20-11. INSTALLATION OF AIR FILTER ELEMENT ASSEMBLY. Installation of the filter elements assembly are the reverse of removal.

NOTE: Replace the cover assembly sponge neoprene gasket and seal if they are deteriorated or compressed to the point where the cover plate fasteners do not adequately seal the cover assembly to the lower duct assembly.

76-20-40. CLEANING OF AIR FILTER. Clean air intake filter elements as follows:

a. Clean filters by simultaneous light tapping of the two metal end caps on a firm surface.

CAUTION: DO NOT ATTEMPT TO BLOW OFF DIRT WITH COMPRESSED AIR. DO NOT WASH FILTER ELEMENT IN ANY LIQUID OR SOAK IN OIL.

b. Wipe inside of fiberglas intake duct with a cloth moistened with dry cleaning solvent.

76-30-1. CARBURETOR HEAT VALVE DOOR ASSEMBLY. (See figure 76-1-2.)

76-30-10. REMOVAL OF CARBURETOR HEAT VALVE DOOR ASSEMBLY.

a. Remove engine air intake upper duct assembly. (Refer to paragraph 76-10-10.)

b. Remove lower duct cover plate assembly.

c. Remove carburetor heat air control cable and roll pin from valve crank. Detach the valve crank.

d. Remove bolt and washer attaching inner crank assembly to valve door assembly, withdraw valve shaft and remove door assembly. It is not necessary to remove the inner crank assembly.

76-30-11. INSTALLATION OF CARBURETOR HEAT VALVE DOOR ASSEMBLY. (See figure 76-1-2.) Installation of the carburetor heat air intake valve door assembly is the reverse of removal. In addition, accomplish the following:

a. Check control cable assembly for proper rig. (Refer to paragraph 75-30-30.)

b. Check valve door assembly seal for proper seating with the door assembly in cold position.

76-40-1. LEFT AND RIGHT-HAND EXHAUST MANIFOLDS. (See figure 76-1-3.)

76-40-10. REMOVAL OF LEFT AND RIGHT-HAND EXHAUST MANIFOLDS. (See figure 76-1-3.)

a. Disconnect the flexible hot air duct from left-hand exhaust shroud outlet.

b. Disconnect flexible duct and control cable assembly, if installed, from right-hand exhaust manifold.

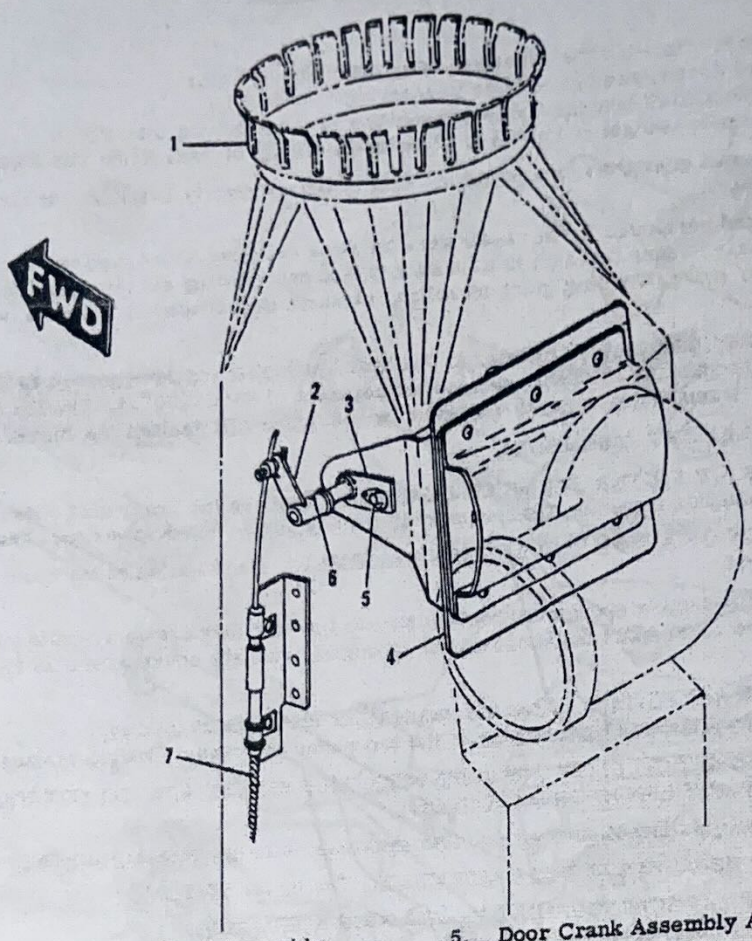
c. Remove nuts securing the exhaust manifolds to cylinder exhaust ports and remove the manifolds.

76-40-11. INSTALLATION OF LEFT AND RIGHT-HAND EXHAUST MANIFOLDS. (See figure 76-1-3.)

NOTE: Prior to installing manifolds, place a straight edge between the two outer exhaust flange faces to determine that they are not warped. Flanges should be flat and parallel within 0.010-inch.

a. Install exhaust manifolds and secure with washers and nuts. Nuts should be tightened evenly to prevent distortion of the flanges.

NOTE: The short center stack must be retained as a matched assembly with its associated exhaust manifold.



1. Engine Air Intake Lower Duct Assembly
2. Carburetor Heat Control Valve Crank
3. Inner Crank Assembly
4. Carburetor Heat Intake Air Valve Door Assembly
5. Door Crank Assembly Attach Bolt
6. Valve Crank Roll Pin
7. Carburetor Heat Control Cable Assembly

Figure 76-1-2. Carburetor Heat Valve Door Assembly

b. Connect flexible ducts to exhaust shrouds and secure with clamps.

NOTE: If excessive exhaust gas blowby is detected between the cylinder ports and flanges install exhaust gaskets (Lycoming Part No. 67196.) Take care not to distort the gaskets by overtightening the attach nuts.

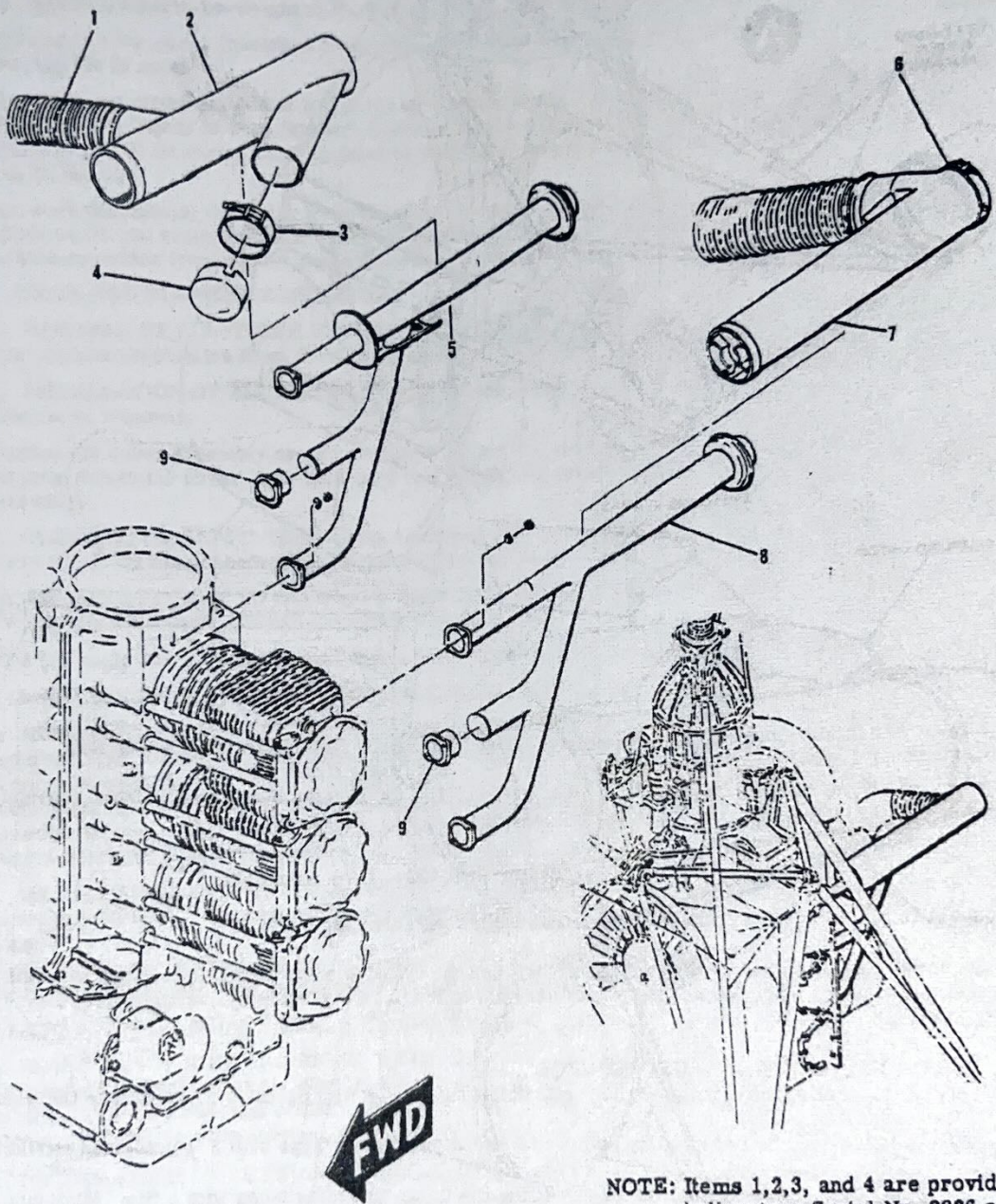
76-40-40. MINOR REPAIR OF EXHAUST MANIFOLD.

a. At regular intervals, inspect the exhaust manifolds for cracks with particular attention to the welded areas.

b. Cracks or holes may be repaired by standard welding practices. Type 310C8 welding rod should be used during the welding operations.

c. Repair warped exhaust manifold flanges by filing the flange mounting faces with a file. Minimum flange thickness after resurfacing is 0.10-inch; replace the exhaust manifold assembly if flange thickness is reduced below this dimension.

NOTE: After filing the flange mounting surfaces, place a straight edge between the two outer exhaust stack flange faces to determine that they lie on a common plane. Determine that a minimum of 0.050-inch gap exists between the end of the center flange tube and its mating tube inside the expansion sleeve.



NOTE: Items 1,2,3, and 4 are provided on helicopters Serial No. 2026 and subsequent

1. Flexible Duct
2. Right-hand Shroud Assembly
3. Clamp
4. Cover
5. Right-hand Manifold Assembly
6. Screw
7. Left-hand Shroud Assembly
8. Left-hand Manifold Assembly
9. Flange

Figure 76-1-3. Engine Exhaust System

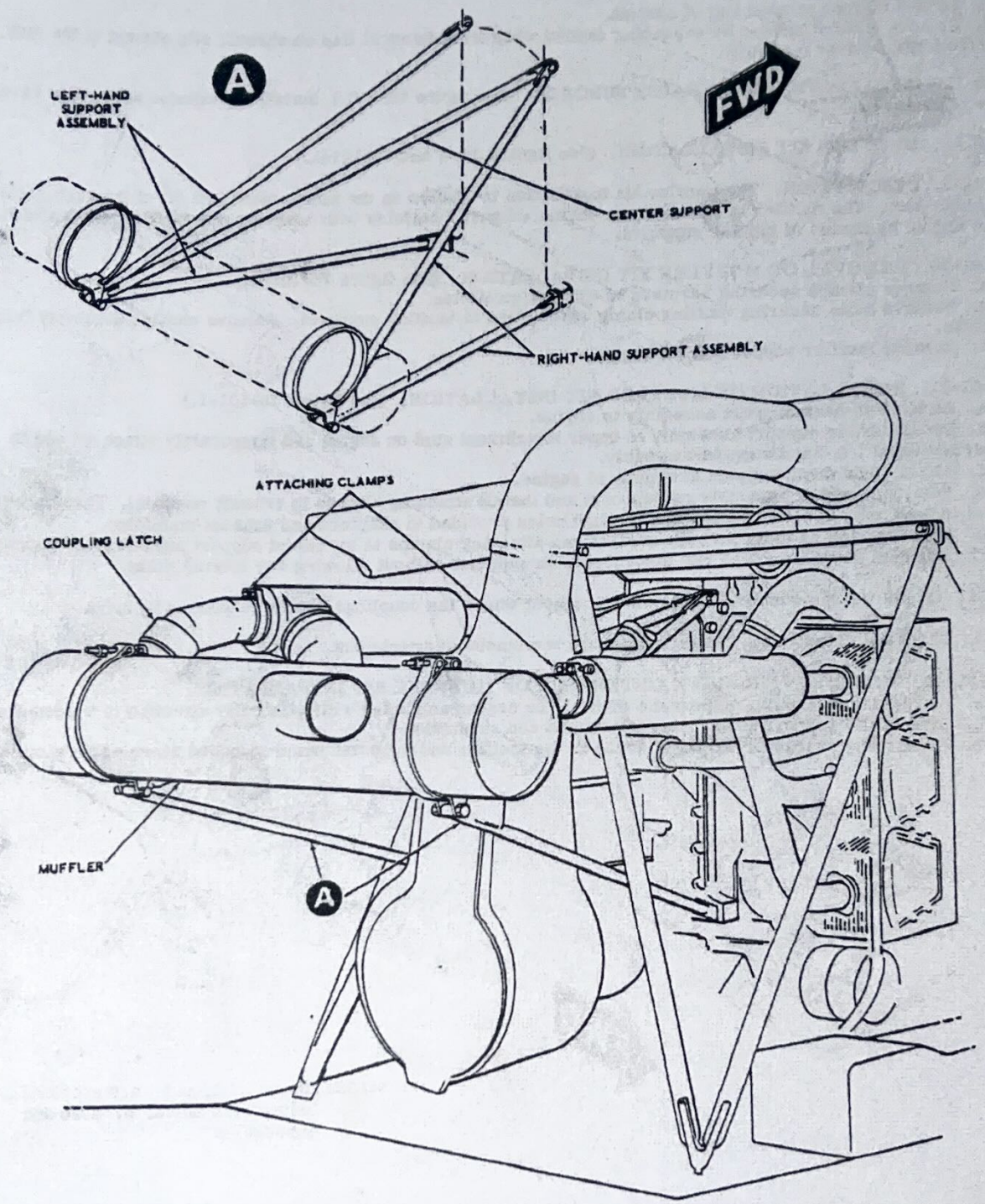


Figure 76-101-1. Muffler Kit Installation

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76-50-10. REMOVAL OF EXHAUST SHROUDS. (See figure 76-1-3.)

a. Disconnect flexible ducts from exhaust shroud outlet and remove sheet metal screws from aft end of shroud assembly.

b. Loosen clamps at each end of shroud.

c. Remove exhaust shroud by expanding shroud wrap from integral flap on shroud; slip shroud to the side away from the exhaust manifold.

76-50-11. INSTALLATION OF EXHAUST SHROUDS. (See figure 76-1-3.) Install the exhaust shrouds in reverse order of removal.

76-101-1. MUFFLER KIT INSTALLATION. (See figures 10-6 and 76-101-1.)

76-101-2. DESCRIPTION. The muffler kit installation is located on the power plant just aft of the carburetor air intake duct. The muffler is joined to the engine exhaust manifolds with adapters and clamps and is attached to the engine by means of tubular supports.

76-101-10. REMOVAL OF MUFFLER KIT INSTALLATION. (See figure 76-101-1.)

a. Remove clamps securing adapters to exhaust manifolds.

b. Remove bolts securing muffler clamp assemblies to muffler supports. Remove muffler assembly from supports.

c. Remove muffler supports from engine.

76-101-11. INSTALLATION OF MUFFLER KIT INSTALLATION. (See figure 76-101-1.)

a. Attach left-hand support assembly to engine.

b. Install center support assembly to upper attachment stud on engine and temporarily attach aft end to center fitting of left-hand support assembly.

c. Attach right-hand support assembly to engine.

d. Position muffler assembly on supports and install attaching clamps to exhaust manifold. Take care to insert locking pins of attaching clamps through holes provided in adapters and exhaust manifolds.

e. Install attaching bolts through muffler and attaching clamps at aft end of support assemblies. Tighten attachment nuts so that muffler can pivot freely on supports without allowing any lateral shake.

NOTE: Do not tighten coupling latches to the extent where the couplings cannot be rotated by hand.

f. Check all components for security and correctness of attachment.

76-101-40. MINOR REPAIR AND MAINTENANCE OF MUFFLER KIT INSTALLATION.

a. At regular intervals, inspect the muffler for cracks and holes with particular attention to welded areas.

b. Inspect the support assemblies for cracks and scratches.

c. Repair any cracks or damaged areas in the muffler and supports using standard acceptable practices.

81-1-1. INSTRUMENTS. (See figure 81-1-1.)

81-1-2. DESCRIPTION. The helicopter is equipped with flight, engine and several miscellaneous instruments. These instruments include direct reading and transmitting-remote indicating types. All flight and engine instruments (except the compass) are mounted in the instrument panel. The instrument panel is located on the instrument pedestal forward of the cabin seats on the helicopter centerline. The instrument panel has removable upper and lower plastic panels which distribute light to the instruments during night flying. A glare shield is installed on top of the instrument panel of four-place helicopters equipped with position lights.

a. The instrument panel is hinged at the bottom and secured to the pedestal with attaching studs through the face of the instrument panel. Metal tubing and flexible hoses provide the plumbing for the pressure-operated instrument systems. Flexible hoses are used to connect the instruments to the terminations of the metal tubing in the pedestal behind the instrument panel. Flexible hoses are also used at other points in the system where some freedom of movement between adjacent sections of metal tubing is needed. All lines are identified by conventional color banding codes. Cables provide the wiring for the electrically-operated instrument systems. Plug connectors are used to connect each instrument to a cable.

CAUTION: INSTRUMENTS MUST NOT BE DISASSEMBLED BY ANY PERSON UNTRAINED IN INSTRUMENT SERVICES.

81-1-10. REMOVAL OF INSTRUMENTS.

NOTE: The removal procedure for all instruments is relatively the same, except that it is necessary to disconnect wiring from one type of instrument or disconnect a tube or hose from another type of instrument. A single removal procedure will suffice for any instrument. Before removing any instrument, be sure that the cause of trouble is actually traceable to that instrument.

a. Turn the MASTER SWITCH and the IGNITION switch to the OFF position. Disconnect the battery and/or external power source.

b. Remove the plastic panel from the face of the instrument panel to gain access to the instrument mounting screws. Remove the plastic panel by removing the INSTRUMENT LIGHTS knob and the screws and washers which attach the plastic panel to the instrument panel. Remove the caps from the 11 panel lights uppermost in the instrument panel. Then pull the plastic panel away from the instrument panel. Take care not to pry against the upper plastic panel.

c. Open the instrument panel by loosening the seven studs which secure the instrument panel to the pedestal. The studs can be disengaged by approximately 1 4 turn counterclockwise. Pull the top of the panel aft for access to the instruments. Protect the face of the panel from frontal damage. Make sure that the wiring and flexible hoses behind the panel are not twisted or strained.

d. Disconnect the flexible hose or the electrical connector from the rear of the instrument case of the individual instrument being removed. Identify connections if necessary.

e. When flexible hose connections are disconnected, plug the open fitting in the instrument case and the open end of the hose. Use every precaution to prevent dirt and moisture from entering the system.

f. Remove the mounting screws, nuts, and washers from the instrument and instrument panel. Remove the instrument from the instrument panel.

g. Removal of metal tubing or flexible hose sections of the plumbing lines, if necessary for repair or replacement, is conventional. Adjacent sections can be disconnected at the couplings.

81-1-11. INSTALLATION OF INSTRUMENTS.

a. Insert the instrument from the rear into the proper position in the instrument panel. Install the attaching screws, washers, and nuts.

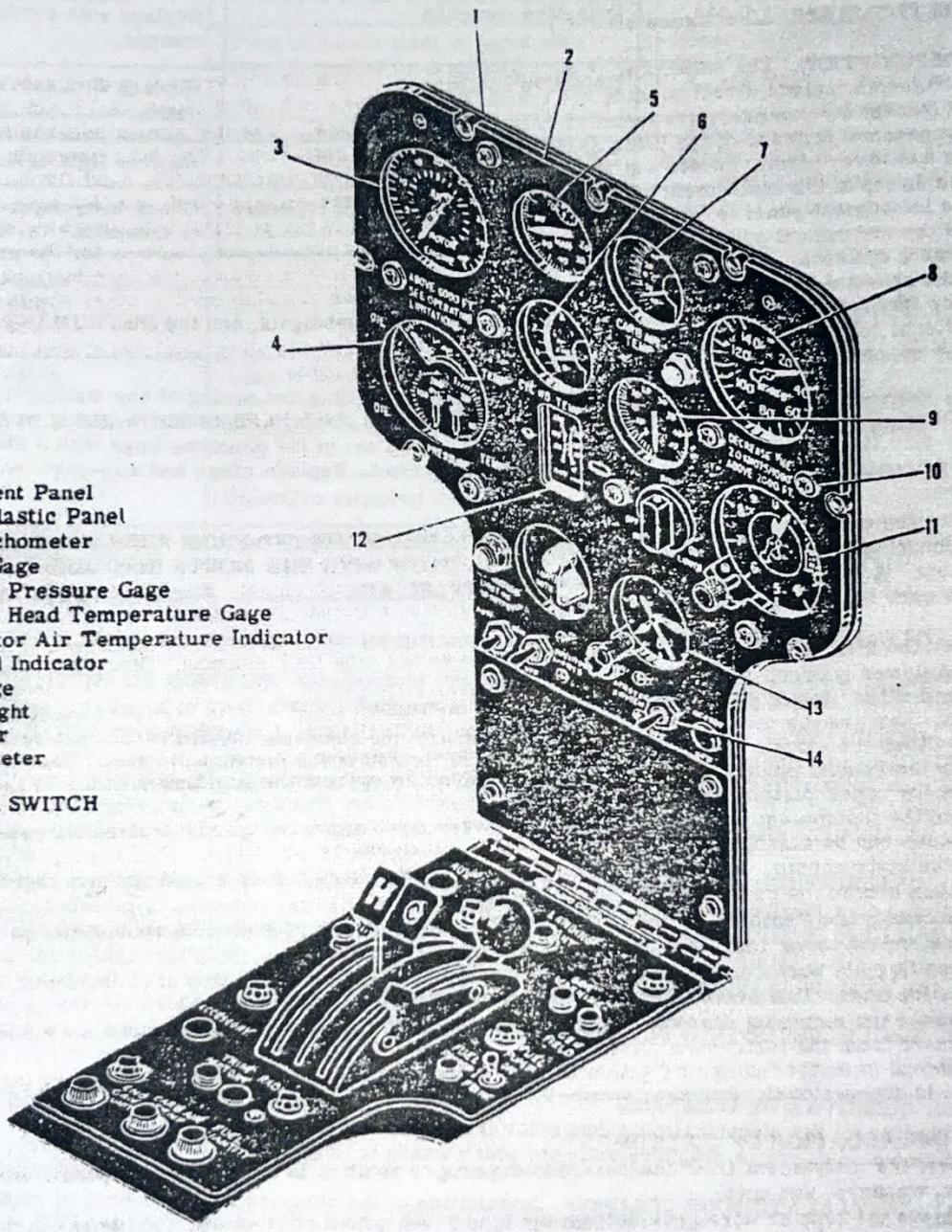
b. Remove the tape or wire covers from the tubing, electrical connectors, and fittings in the instrument case. Connect the tubing or electrical connectors to the instrument, checking identification to make sure that correct connections are made.

CAUTION: DO NOT FORCE OR TWIST THE TUBING INTO ALINEMENT.

c. Install any flared fittings by hand and secure them finger-tight. Check the alinement of the fittings. Use a wrench for final tightening of the nuts to the proper torque value.

d. Install range markings on the replacement instruments, as necessary, to conform with the range markings on the instrument units they replace.

e. Carefully tilt the instrument panel forward into position against the instrument pedestal, making certain that wiring and tubing stow without twisting or interference. Secure the instrument panel to the instrument pedestal by engaging the seven studs and turning them clockwise.



1. Instrument Panel
2. Upper Plastic Panel
3. Dual Tachometer
4. Engine Gage
5. Manifold Pressure Gage
6. Cylinder Head Temperature Gage
7. Carburetor Air Temperature Indicator
8. Airspeed Indicator
9. Fuel Gage
10. Panel Light
11. Altimeter
12. Voltammeter
13. Clock
14. MASTER SWITCH

Figure 81-1-1. Instrument Panel Installation

Table 81-1-I. Troubleshooting the Compass

TROUBLE	PROBABLE CAUSE	REMEDY
Compass card sticks or binds when attempting to move	Defective compass	Replace with serviceable compass.
Compass liquid contains air bubbles or clouding	Defective compass	Replace with serviceable compass.
Compass light bulb does not light with other instrument lights	Defective compass light bulb	Replace light bulb.
	Defective instrument light circuitry	Check instrument light circuit to compass.

f. Reinstall the upper plastic panel, the 11 caps for the panel lights, and the INSTRUMENT LIGHTS knob. Take care not to damage the upper plastic panel.

81-1-40. MINOR REPAIR OF INSTRUMENTS. Check all plumbing and wiring of any malfunctioning instrument system. Inspect the wiring and hoses for deterioration. Replace all defective wiring with new wiring of the same wire type, gage and length. Blow any obstructions out of the plumbing lines with a mild air blast. Replace the instrument if its cover glass is loose or cracked. Replace range and slip-page markings if necessary.

CAUTION: BE SURE THAT THE FLEXIBLE HOSE IS DISCONNECTED FROM THE INSTRUMENT WHEN BLOWING THE LINES CLEAN. NEVER BLOW WITH THE MOUTH INTO THE TUBING BECAUSE OF THE MOISTURE CONTENT OF EXHALED AIR.

81-1-41. CLEANING THE INSTRUMENTS. Clean instrument cover glasses with a soft, clean, lint-free cloth.

81-10-1. FLIGHT INSTRUMENTS. (See figure 81-1-1.)

81-10-2. DESCRIPTION. The flight instruments include the compass, the altimeter, and the airspeed indicator. All flight instruments except the compass are located in the instrument panel. The compass is mounted on the tube support assembly, centered just above the level of the instrument panel.

81-11-1. COMPASS. (See figure 84-401-1.)

81-11-2. DESCRIPTION. The compass is a direct reading, magnetic type instrument containing a compass card mounted on a magnetic element within a liquid-filled bowl. The compass is mounted in a bracket in the location described in paragraph 81-10-2. The compass bowl has an expansion chamber to permit liquid volume to change with variations in temperature. Provisions are incorporated for making compensation adjustments. The compass is equipped with a built-in light to provide illumination at night.

81-11-3. TROUBLESHOOTING THE COMPASS. Table 83-1-1 contains instructions for troubleshooting the compass.

81-11-10. REMOVAL OF COMPASS.

a. Disconnect the electrical plug connector from the rear of the compass housing.
b. Remove the screws, washers and nuts which attach it to its mounting bracket.

81-11-11. INSTALLATION OF COMPASS. Installation of the compass is the reverse of removal.

Table 81-1-II. Troubleshooting the Altimeter

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer indicates incorrectly	Static line or static source fitting plugged	Blow the static pressure line clear. (Refer to paragraph 81-20-40.)
	Defective altimeter	Replace with serviceable altimeter.

Table 81-1-III. Troubleshooting the Airspeed Indicator

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer fails to respond	Pressure lines not connected properly	Make proper connections.
	Pitot or static lines clogged with foreign matter or moisture	Blow the pitot and static pressure lines clear (refer to paragraph 81-20-40).
Pointer indicates incorrectly	Leak in pressure line	Repair or replace pressure line.
	Defective or leaky instrument	Replace instrument.
	Pitot tube obstructed or damaged	Clean or replace pitot tube.
Pointer vibrates	Instrument loose on panel	Tighten instrument mounting screws.
Pointer oscillates	Leak in pressure line	Repair or replace pressure line.
	Airspeed is underdamped	Adjust damping (refer to paragraph 81-13-30).
	Defective airspeed indicator	Replace airspeed indicator.
Pointer responds sluggishly	Airspeed is overdamped	Adjust damping (refer to paragraph 81-13-30).

81-11-30. ADJUSTMENT OF COMPASS. Compensate the compass using the N-S and E-W compensating screws, at any time it is found to be in error. Compensate the compass using methods described in Civil Aeronautics Manual 18, Volume III.

81-11-60. TESTING OF COMPASS. Test the compass after any change in the electrical system or in any helicopter main component which might affect the compass, and at any other time it is suspected of being in error. Compensate the compass as described in paragraph 81-11-30, if necessary.

81-12-1. ALTIMETER. (See figure 81-1-1.)

81-12-2. DESCRIPTION. The altimeter is mounted in the center right-hand area of the instrument panel. The altimeter is connected to the static (atmospheric) line of the pitot static pressure system. The altimeter is a conventional barometric type which indicates the height of the helicopter in feet above sea level under normal conditions. The altimeter can be adjusted to compensate for various barometric pressure conditions by turning the small knob on the lower left edge of its instrument case. The barometric pressure selected is indicated by a dial on the right face of the instrument.

81-12-3. TROUBLESHOOTING THE ALTIMETER. Table 81-1-II contains instructions for troubleshooting the altimeter.

81-12-10. REMOVAL OF THE ALTIMETER. Refer to paragraph 81-1-10.

81-12-11. INSTALLATION OF THE ALTIMETER. Refer to paragraph 81-1-11.

81-13-1. AIRSPEED INDICATOR. (See figure 81-1-1.)

81-13-2. DESCRIPTION. The airspeed indicator is located in the upper right-hand area of the instrument panel. Pitot (dynamic) and static (atmospheric) pressures are provided to the airspeed indicator by the pressure and static lines of the pitot static pressure system. A differential pressure-measuring mechanism inside the indicator converts these pressures into airspeed indication (in knots) or miles-per-hour.

81-13-3. TROUBLESHOOTING THE AIRSPEED INDICATOR. Table 81-1-III contains instructions for troubleshooting the airspeed indicator.

81-13-10. REMOVAL OF AIRSPEED INDICATOR. Refer to paragraph 81-1-10.

81-13-11. INSTALLATION OF AIRSPEED INDICATOR. Refer to paragraph 81-1-11.

81-13-30. ADJUSTMENT OF AIRSPEED INDICATOR. If the airspeed indicator response is improperly damped, adjust the damping as follows:

a. Open the instrument panel as in steps a through c, paragraph 81-1-10.

b. Disconnect the flexible hose of the pressure line from the inboard elbow at the airspeed indicator.

c. Remove the inboard elbow from the airspeed indicator.

d. Use a screwdriver to turn the airspeed indicator adjusting screw which is located inside the threaded opening from which the inboard elbow was removed. The adjusting screw should be turned clockwise to increase the damping, and counterclockwise to decrease the damping to improve the sensitivity of response. Do not rotate the adjusting screw more than one-half turn at one time. Smaller amounts of rotation will correct minor damping errors.

e. Install the inboard elbow on the airspeed indicator.

f. Connect the flexible hose of the pressure line to the inboard elbow at the airspeed indicator.

g. Close instrument panel as given in steps e and f, paragraph 81-1-11.

h. The action of the airspeed indicator should be checked the next time the helicopter is in flight. Further adjustment can then be made if necessary.

81-20-1. PITOT STATIC PRESSURE SYSTEM.

81-20-2. DESCRIPTION. The pitot static pressure system is composed of the pitot tube, the static source fitting and the pressure and static lines which supply pressure to the airspeed indicator and altimeter. The pressure line is connected to the pitot tube which is located below the forward end of the basic body to the left of the landing light recess. The static line is connected to the static source fitting which is located flush with the bottom of the basic body, to the right of center. The pressure and static lines are provided with drainage tees and caps, which protrude from the bottom of the basic body. The pressure line drainage tee is located at the aft end of the pitot tube. This tee also connects the pitot tube to the pressure line. The static line drainage tee is located adjacent to the static source fitting in the bottom of the basic body just to the right of center.

CAUTION: THE SMALL HOLES IN THE LOWER END OF THE STATIC SOURCE FITTING MUST BE KEPT OPEN FOR ACCURATE AIRSPEED AND ALTITUDE INDICATION.

81-20-3. TROUBLESHOOTING PITOT STATIC PRESSURE SYSTEM. Malfunctioning of this system will be apparent through trouble in the altimeter or airspeed indicator. (Refer to Tables 81-1-II and 81-1-III.)

81-20-10. REMOVAL OF PITOT TUBE.

a. On three-place configuration helicopters, remove the pitot tube by disconnecting it from the tee at the aft end of the pitot tube. Release the clamp which secures the pitot tube to the standoff spacer, and remove the pitot tube.

b. On four-place configuration helicopters, remove the pitot tube by loosening the tube fitting nut.

81-20-11. INSTALLATION OF PITOT TUBE. Installation of the pitot tube is the reverse of removal.

CAUTION: DO NOT BEND THE PITOT TUBE AWAY FROM PARALLEL ALINEMENT WITH THE LONGITUDINAL AXIS OF THE HELICOPTER.

81-20-40. MINOR REPAIR OF PITOT STATIC PRESSURE SYSTEM. If necessary, blow the pressure and static lines clear as follows:

CAUTION: BE SURE THAT PRESSURE AND STATIC FLEXIBLE HOSES ARE DISCONNECTED FROM THE AIRSPEED INDICATOR AND FROM THE ALTIMETER.

a. Remove the drain caps from the drainage tees of the pressure and static lines.

b. Blow the pressure and static lines clear with a mild blast of filtered compressed air. It will usually be sufficient to blow into the lines from the instrument end of the system. If, however, this is not sufficient, blow into the lines from the pitot tube and static source fitting end of the system also.

NOTE: The three holes in the static source fitting may be cleared with fine gage wire or a No. 70 drill shank.

c. Replace the drain caps on the drainage tees of the pressure and static lines.

81-20-41. CLEANING OF PITOT TUBE. Clean the pitot tube with a clean cloth dampened with dry-cleaning solvent. Dry with filtered compressed air. Blow the pitot tube clear of any obstructions.

81-20-60. PRESSURE TEST OF PRESSURE LINE. Test the pressure line of the pitot static pressure system as follows:

CAUTION: DO NOT APPLY SUCTION TO THE PRESSURE LINE.

a. Loosen the spacer and disconnect the pitot tube from the tee at its aft end. Connect a regulated pressure source to the disconnected opening of the tee, making sure that the connection is tight.

b. Apply pressure very slowly from the regulated source to the pressure line. This action simulates the increase of ram pressure as airspeed is increased. Increase the applied pressure until the airspeed indicator indicates 70 knots. Close the input line from the regulated pressure source to the pressure line, thereby holding the pressure constant.

c. Tap the instrument panel lightly near the airspeed indicator to overcome the effect of any friction that might cause an untrue registering of the airspeed indicator pointer. Observe the drop of the airspeed indicator pointer during a one-minute period.

d. If the airspeed indicator pointer drops more than five knots during one minute, correct excessive leakage of the pressure line and repeat the test.

81-20-61. SUCTION TEST OF STATIC LINE. Test the static line of the pitot static system as follows:

CAUTION: DO NOT APPLY GREATER THAN AMBIENT PRESSURE TO THE STATIC LINE.

a. Remove the cap from the static line drainage tee. Place a piece of tape securely over the openings in the static source fitting to prevent leakage through this fitting during the test. Connect a regulated vacuum source to the open end of the static line drainage tee, making sure that the connection is tight.

b. Apply suction very slowly from the regulated vacuum source to the static line. This action simulates the decrease in pressure as altitude is increased. Apply the suction until the altimeter indicates a height of 5,000 feet. Close the input line from the regulated vacuum source to the static line, thereby holding the suction constant.

c. Tap the instrument panel lightly near the altimeter to overcome the effect of any friction that might cause an untrue registering of the altimeter pointer. After the initial drop-off, observe the drop of the altimeter pointer during a one-minute interval.

d. If altimeter drops more than 50 feet in one minute, correct excessive leakage of static line and repeat the test.

e. Disconnect the regulated vacuum source and replace the cap on the static line drainage tee. Remove the tape from the static source fitting. Make certain that no bits of tape have clogged the static source fitting.

81-30-1. POWER PLANT INSTRUMENTS.

80-30-2. DESCRIPTION. All power plant instruments are located in the instrument panel. The power plant instruments consist of the dual tachometer, manifold pressure gage, carburetor air temperature indicator, cyclinder head temperature indicator, and the engine gage (combination oil temperature and oil and fuel pressure gage), and the voltammeter. The instruments are mounted in the instrument panel in the locations shown in figures 81-1-1 and 81-1-2.

81-31-1. DUAL TACHOMETER. (See figure 81-1-1.)

81-31-2. DESCRIPTION. The dual tachometer is mounted in the upper left-hand area of the instrument panel. The dual tachometer indicates the main rotor and engine rpm by means of two separate concentric scales with an indicating hand for each. The main rotor and engine tachometer systems are independent of each other in operation. The tachometer generators generate current in varying amounts proportional to the speed at which they are driven. The tachometer generators are connected by wiring cables to the dual tachometer at the instrument panel. Each indicating hand of the dual tachometer provides an indication proportional to the current generated by the associated tachometer generator. Refer to Section 83 for electrical wiring data. The engine tachometer generator is mounted horizontally on the right-hand side of the engine accessory housing between the starter and the magneto. The rotor tachometer generator is mounted vertically on the top of the cooling fan drive housing.

81-31-3. TROUBLESHOOTING THE DUAL TACHOMETER. Table 81-1-IV contains instructions for troubleshooting the dual tachometer.

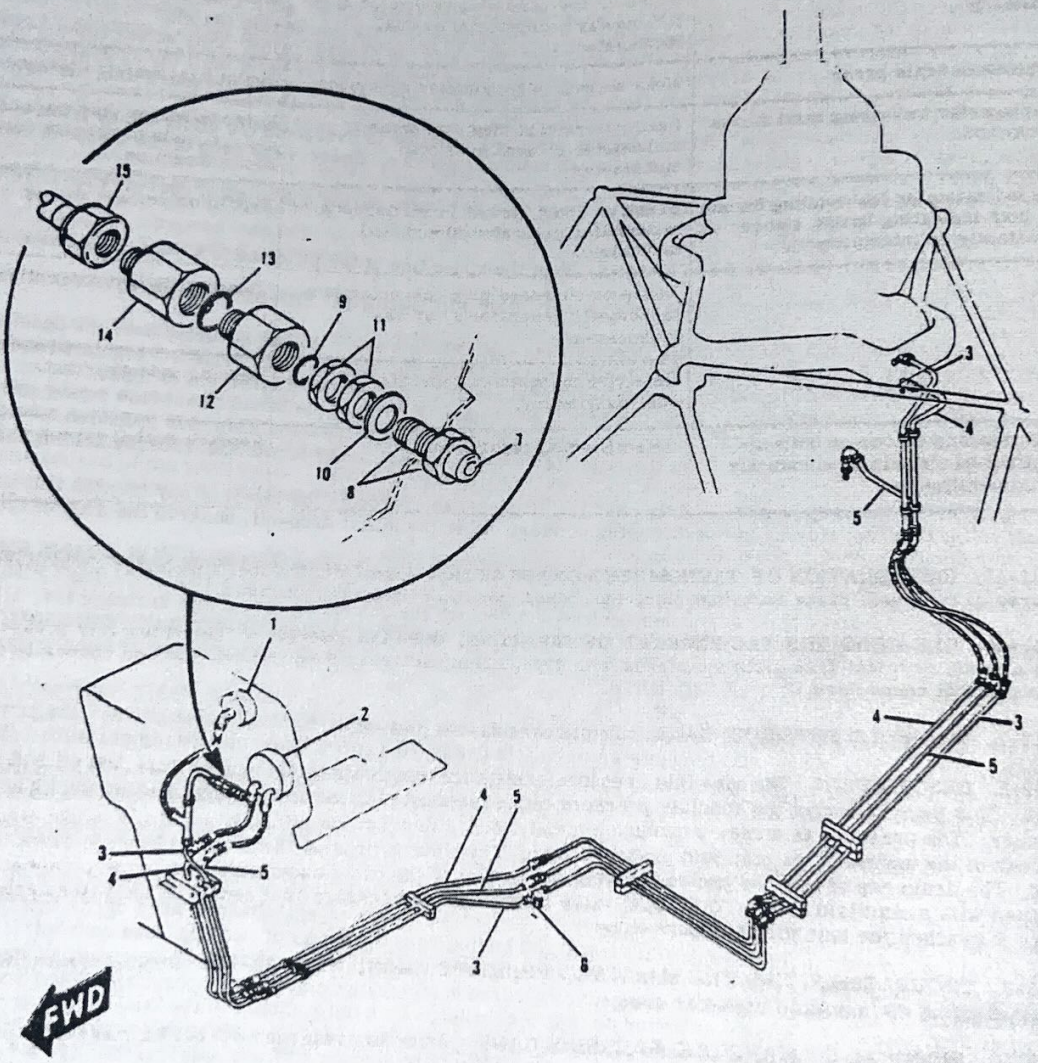
81-31-10. REMOVAL OF DUAL TACHOMETER. Refer to paragraph 81-1-10.

81-31-11. INSTALLATION OF DUAL TACHOMETER. Refer to paragraph 81-1-11.

81-31-12. REMOVAL OF TACHOMETER GENERATORS.

a. Disconnect the electrical plug connectors and cover the connectors to prevent entrance of dirt.

b. Remove generators by removing the four mounting nuts.



1. Manifold Pressure Gage
2. Engine Gage
3. Manifold Pressure Line
4. Fuel Pressure Line
5. Oil Pressure Line
6. Manifold Pressure Line Drainage Tee
7. Push Button
8. Push to Purge Valve
9. O-Ring
10. Washer
11. Nut
12. Reducer
13. O-Ring
14. Expander
15. Manifold Pressure Tube Assy

Figure 81-1-2. Pressure Operated Engine Instruments

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Table 81-1-IV. Troubleshooting the Dual Tachometer

TROUBLE	PROBABLE CAUSE	REMEDY
One or both indicating hands unsteady	Loose or corroded plug connector at tachometer generator(s) or dual tachometer.	Clean or tighten connections.
Excessive scale error	Weak magnet in tachometer generator	Replace tachometer generator.
Tachometer indicating hand moves backward	Lead reversed at plug connector at tachometer generator or dual tachometer	Refer to wiring diagram and change leads to provide correct connection.
No indication or low reading by one or both indicating hands, either constantly or intermittently	Break or short circuit in wiring between tachometer generator(s) and dual tachometer	Repair or replace wiring.
	Loose or corroded plug connector at tachometer generator(s) or dual tachometer	Clean or tighten connections.
	Defective tachometer generator(s) or dual tachometer.	Replace defective unit.
High reading on one or both indicating hands, either constantly or intermittently	Defective dual tachometer	Replace dual tachometer.

81-31-13. INSTALLATION OF TACHOMETER GENERATORS. Installation of the tachometer generators is the reverse of removal. Make sure that electrical connections are tight and lockwired.

81-31-40. CLEANING THE TACHOMETER GENERATORS. Wipe the exterior of the tachometer generators with a clean, dry, lint-free cloth moistened with dry-cleaning solvent. Remove any dust and corrosion from the electrical connectors.

81-32-1. MANIFOLD PRESSURE GAGE. (See figures 81-1-1 and -2.)

81-32-2. DESCRIPTION. The manifold pressure gage is located in the upper center area of the instrument panel. This gage indicates the absolute pressure of the fuel-air mixture in the intake manifold in inches of mercury. The pressure is directed through a metal tubing line from the diffuser box of the intake manifold at the rear of the engine to the manifold pressure gage. This line is provided with a drainage tee at its low point. The drain cap of this tee protrudes from the bottom of the basic body of the helicopter. On helicopters equipped with a manifold PUSH TO PURGE valve assembly, the pressure is directed to the valve assembly before it reaches the manifold pressure gage.

81-32-3. TROUBLESHOOTING THE MANIFOLD PRESSURE GAGE. Table 81-1-V contains instructions for troubleshooting the manifold pressure gage.

81-32-10. REMOVAL OF MANIFOLD PRESSURE GAGE. Refer to paragraph 81-1-10 for removal procedure.

81-32-11. INSTALLATION OF MANIFOLD PRESSURE GAGE. Refer to paragraph 81-1-11 for installation procedure.

81-32-12. REMOVAL OF MANIFOLD PUSH TO PURGE VALVE ASSEMBLY.

a. Open the instrument panel. (Refer to paragraph 81-1-10, step c.)
b. Loosen the two hex nuts securing the valve in the reducer and the instrument pedestal.
c. Hold the reducer and nuts in position and loosen and remove the valve from the reducer by turning the valve body at the hexagonal end. (Take care to avoid dropping the two nuts and the washer.)

81-32-13. INSTALLATION OF MANIFOLD PUSH TO PURGE VALVE ASSEMBLY. Installation of the PUSH TO PURGE valve assembly is essentially the reverse of removal.

81-32-30. MINOR REPAIR OF MANIFOLD PRESSURE GAGE. If necessary, blow the line to the manifold pressure gage clear as follows:

CAUTION: THIS PROCEDURE SHOULD NOT BE NECESSARY ON HELICOPTERS EQUIPPED WITH A PUSH TO PURGE VALVE; HOWEVER, MAKE CERTAIN THAT THE FLEXIBLE HOSE IS DISCONNECTED FROM THE MANIFOLD PRESSURE GAGE WHENEVER COMPRESSED AIR IS USED.

a. Remove the drain cap from the drainage tee of the line to the manifold pressure gage (see figure 10-17).
b. Blow the line clear from the manifold pressure gage end with a mild blast of filtered compressed air.
c. Replace the drain cap on the drainage tee of the line to the manifold pressure gage.

81-32-31. MINOR REPAIR OF MANIFOLD PUSH TO PURGE VALVE ASSEMBLY. Replace the rubber seal if it becomes defective (refer to Table 81-1-V) by removing the valve and depressing the valve plunger. Replace the seal with an equivalent part.

81-32-60. TESTING THE MANIFOLD PRESSURE GAGE. Compare the absolute reading of the manifold pressure gage with that of a barometer.

81-32-61. TESTING THE MANIFOLD PUSH TO PURGE VALVE ASSEMBLY. (See figure 81-1-2.) Test a purge valve installation after repair or replacement of the valve, or for suspected leakage, as follows:

a. Disconnect the tubing line from the intake manifold and connect a regulated vacuum source to the open end of the tubing line.
b. Apply suction very slowly from the regulated vacuum source to the tubing line until the manifold pressure gage indicates a pressure of 20 inches of mercury. Close the input line from the vacuum source to hold the suction constant.
c. Tap the instrument panel lightly near the manifold pressure gage to eliminate instrument pointer friction. After the pointer is stabilized, observe the pointer for drop during a one minute interval.
d. If the manifold pressure gage shows any drop the pressure system must be checked for the source of the leakage. (Refer to Table 81-1-V.)
e. Repeat the test. If no drop is indicated, disconnect the vacuum source and reinstall the tubing line at the intake manifold.

81-33-1. CARBURETOR AIR TEMPERATURE INDICATOR. (See figure 81-1-1.)

81-33-2. DESCRIPTION. The CARB AIR TEMP indicator is located in the upper center area of the instrument panel. This instrument operates as an electrical resistance thermometer, measuring the current which flows through a temperature-sensitive electrical resistance bulb mounted on the engine intake air lower duct assembly (see figure 72-1-4). This electrical resistance bulb is a threaded type which is screwed to the air intake duct assembly below the carburetor and secured with lockwire. An increase in temperature increases the resistance of the variable resistance bulb, as indicated on the CARB AIR TEMP indicator, which is calibrated in degrees centigrade. The resistance element is hermetically sealed within the electrical resistance bulb. The electrical resistance bulb is connected by electric cable to the CARB AIR TEMP indicator.

81-33-3. TROUBLESHOOTING THE CARBURETOR AIR TEMPERATURE INDICATOR. Table 81-1-VI contains instructions for troubleshooting the carburetor air temperature indicator.

81-33-10. REMOVAL OF CARBURETOR AIR TEMPERATURE INDICATOR. Refer to paragraph 81-1-10 for removal procedure.

81-33-11. INSTALLATION OF CARBURETOR AIR TEMPERATURE INDICATOR. Refer to paragraph 81-1-11 for installation procedure.

81-33-12. REMOVAL OF ELECTRICAL RESISTANCE BULB FOR CARBURETOR AIR TEMPERATURE INDICATOR. To remove this unit, disconnect the electrical plug connector and cover it to prevent the entrance

Table 81-1-V. Troubleshooting the Manifold Pressure Gage

TROUBLE	PROBABLE CAUSE	REMEDY
Manifold pressure gage will not zero at 29.92 inches of mercury with corrections applied for existing barometric pressure	Fuel in line to manifold pressure gage	Drain line at tee or purge.
	Defective instrument	Replace instrument.
Excessive error when engine is running	Leak in line to manifold pressure gage	Tighten tubing, purge valve and drain connections or repair line. Replace purge valve seal.

of dirt. Cut the lockwire and unscrew the electrical resistance bulb from the air intake duct temperature probe flange.

NOTE: Take care not to lose the crush-washer from the variable resistance bulb.

81-33-13. INSTALLATION OF ELECTRICAL RESISTANCE BULB FOR CARBURETOR AIR TEMPERATURE INDICATOR. Apply a light coating of general-purpose white-lead-base antiseize-compound (item 1, Table 10-VI) to the threads of the electrical resistance bulb. Insert the unit into the probe flange and tighten it. Reinstall the lockwire. Remove the tape from the electrical plug connector, make a tight connection, and lockwire.

81-34-1. CYLINDER HEAD TEMPERATURE INDICATOR. (See figure 81-1-1.)

81-34-2. DESCRIPTION. The CYL HD TEMP indicator is located in the center area of the instrument panel. This instrument operates as a resistance thermometer and is similar to the CARB AIR TEMP indicator except for a greater indicating range. The electrical resistance bulb for the CYL HD TEMP indicator is installed in the cylinder head of number three cylinder on the left-hand side of the helicopter (see figure 10-16). This electrical resistance bulb is a bayonet lock type, which mates with a fitting in the cylinder head. The electric cable from the CYL HD TEMP indicator is connected to the leads from the electrical resistance bulb with knife connectors.

NOTE: On helicopters equipped with dual carburetors, the electrical resistance bulb is installed in number 5 cylinder.

81-34-3. TROUBLESHOOTING THE CYLINDER HEAD TEMPERATURE INDICATOR. Table 81-1-VII contains instructions for troubleshooting the cylinder head temperature indicator.

81-34-10. REMOVAL OF CYLINDER HEAD TEMPERATURE INDICATOR. Refer to paragraph 81-1-10 for removal procedure.

81-34-11. INSTALLATION OF CYLINDER HEAD TEMPERATURE INDICATOR. Refer to paragraph 81-1-11 for installation procedure.

81-34-12. REMOVAL OF ELECTRICAL RESISTANCE BULB FOR CYLINDER HEAD TEMPERATURE INDICATOR. Disconnect the knife connectors at the output leads of the unit. Depress the cap of the unit slightly, and turn counterclockwise slightly to release the bayonet locking cap from the pin in the cylinder head fitting. Remove the electrical resistance bulb.

Table 81-1-VI. Troubleshooting the Carburetor Air Temperature Indicator

TROUBLE	PROBABLE CAUSE	REMEDY
No reading (with MASTER SWITCH in the on position), either constant or intermittently	Loose or corroded plug connector at electrical resistance bulb or CARB AIR TEMP indicator	Clean or tighten connections.
	Break in wiring	Repair or replace wiring.
	Blown CARB AIR TEMP fuse	Replace fuse.
	Defective CARB AIR TEMP indicator	Replace CARB AIR TEMP indicator.
Reading off scale at low temperature end of low reading, either constantly or intermittently	Short circuit in wiring to electrical resistance bulb	Repair or replace wiring.
	Short circuit in electrical resistance bulb	Replace electrical resistance bulb.
	Defective CARB AIR TEMP indicator	Replace CARB AIR TEMP indicator.
Reading off scale at high temperature end, or high reading, either constantly or intermittently	Break in wiring	Repair or replace wiring.
	Defective CARB AIR TEMP indicator	Replace CARB AIR TEMP indicator.

Table 81-1-VII. Troubleshooting the Cylinder Head Temperature Indicator

TROUBLE	PROBABLE CAUSE	REMEDY
No reading (with MASTER SWITCH in the on position) either constantly or intermittently	Loose or corroded plug connector at CYL HD TEMP indicator or at knife connector at electrical resistance bulb	Clean or tighten connections.
	Break in wiring	Repair or replace wiring
	GEN WARNING circuit breaker tripped	Eliminate short or overload in circuit and turn circuit breaker on.
	Defective CYL HD TEMP indicator	Replace CYL HD TEMP indicator.
Reading off scale at low temperature end or low reading, either constantly or intermittently	Short circuit in wiring to electrical resistance bulb.	Repair or replace wiring.
	Short circuit in electrical resistance bulb	Replace electrical resistance bulb.
	Defective CYL HD TEMP indicator	Replace CYL HD TEMP indicator.
Reading off scale at high temperature end, or high reading, either constantly or intermittently	Break in wiring	Repair or replace wiring.
	Defective CYL HD TEMP indicator	Replace CYL HD TEMP indicator.

81-34-13. INSTALLATION OF ELECTRICAL RESISTANCE BULB FOR CYLINDER HEAD TEMPERATURE INDICATOR. The installation of this unit is the reverse of removal.

81-35-1. ENGINE GAGE. (See figures 81-1-1 and -2.)

81-35-2. DESCRIPTION. The engine gage is a combination unit that indicates oil temperature, oil pressure, and fuel pressure, using three operating mechanisms and three indicating pointers. The engine gage is located in the center left-hand area of the instrument panel. Oil temperature is indicated in degrees centigrade, and fuel and oil pressures are indicated in pounds per square inch (psi). The OIL TEMP indicator part of the engine gage operates as a resistance thermometer and is similar to the CARB AIR TEMP indicator, except that it has a greater range. The electrical resistance bulb for engine OIL TEMP readings is mounted on the oil pump housing on the right-hand side of the engine accessory section (See Section 73). Helicopters on which the separated transmission oil system has been installed have an OIL TEMP ENG-XMSN toggle switch located on the lower right-hand side of the instrument panel, next to the MASTER SWITCH, to permit indication of either engine oil or transmission oil temperature by the engine gage. The switch is spring-loaded in the ENG position, so that the engine gage normally indicates engine oil temperature. The electrical resistance bulb for transmission OIL TEMP indications is mounted in an instrument and fitting assembly between the transmission oil cooler and the transmission oil filter (See Section 73). The FUEL PRESSURE indicator part of the engine gage indicates the fuel pump output pressure at the carburetor fuel inlet. The pressure is directed through a fuel-filled metal tubing line from the carburetor. This line is connected to the aft left-hand side of the carburetor. The OIL PRESSURE indicator part of the engine gage indicates the forced lubrication system pressure within the engine. The pressure is directed through an oil-filled metal tubing line from the engine oil pump. This line is connected to the engine oil pump output gallery at the engine oil pump housing at the rear of the engine.

81-35-3. TROUBLESHOOTING THE ENGINE GAGE. Table 81-1-VIII contains instructions for troubleshooting the engine gage.

81-35-10. REMOVAL OF ENGINE GAGE. Refer to paragraph 81-1-10 for removal procedure.

81-35-11. INSTALLATION OF ENGINE GAGE. Refer to paragraph 81-1-11 for installation procedure.

81-35-40. BLEEDING THE LINE TO THE FUEL PRESSURE INDICATOR.

a. Disconnect the flexible hose form the FUEL PRESSURE part of the engine gage. Place the end of the line in a small container.

b. Station an assistant at the container to observe when bubble-free flow of clean fuel has been established

Table 81-1-VIII. Troubleshooting the Engine Gage

TROUBLE	PROBABLE CAUSE	REMEDY
No reading of OIL TEMP indicator (with MASTER SWITCH in the on position) either constantly or intermittently	Loose or corroded plug connector at OIL TEMP indicator or at electrical resistance bulb	Clean or tighten connections.
	Break in wiring	Repair or replace wiring.
	Blown ENG GAGE UNIT fuse	Replace fuse.
	Defective OIL TEMP indicator	Replace engine gage unit.
OIL TEMP indicator reads off scale at the low temperature end, or gives low reading, either constantly or intermittently	Short circuit in wiring to electrical resistance bulb	Repair or replace wiring.
	Short circuit in electrical resistance bulb	Replace electrical resistance bulb.
	Defective OIL TEMP indicator	Replace engine gage unit.
OIL TEMP indicator reads off scale at the high temperature end, or gives high reading, either constantly or intermittently	Break in wiring	Repair or replace wiring.
	Defective OIL TEMP indicator	Replace engine gage unit.
FUEL PRESSURE indicator gives low reading	Leak in line	Tighten all couplings and flexible hose connections.
	Kinked metal tubing	Replace metal tubing.
	Weak or leaky flexible hoses	Replace flexible hoses.
FUEL PRESSURE indicator gives inaccurate or sluggish readings	Fuel in line	Blow line clear.
	Defective FUEL PRESSURE indicator	Replace engine gage.
OIL PRESSURE indicator gives low reading	Kinked metal tubing	Replace metal tubing.
OIL PRESSURE indicator gives inaccurate or sluggish readings	Sludge or heavy oil in line	Bleed line and fill with proper fluid (table 10-II).
	Defective OIL PRESSURE indicator	Replace engine gage.

through the line.

c. Apply pressure slowly with the auxiliary fuel pump to displace the fluid in the line with clean fuel, while at the same time forcing air bubbles out of the line. Continue to force fuel through the line until a steady, bubble-free flow of clean fuel is established at the end of the line.

d. When bleeding has been completed satisfactorily, immediately connect the line to the instrument. Take care to hold fuel loss from the line to an absolute minimum, so that no air enters the line while the connection is being made to the instrument. Tighten the connection.

81-35-41. BLEEDING THE LINE TO THE OIL PRESSURE INDICATOR.

a. Disconnect the flexible hose from the OIL PRESSURE part of the engine gage.

b. Disconnect the aft end of the line from the oil pump. Cover the open connection to the oil pump to prevent the entrance of dirt. Place the aft end of the line in a container.

c. Connect a low pressure filler device to the instrument end of the line. See that the device is filled with SAE 10 lubricating oil (normal operation) or kerosene (cold weather operation). Refer to Table 10-II.

d. Station an assistant at the container to observe when bubble-free flow of clean lubricating oil has been established through the line.

e. Apply pressure slowly with the filler device to displace the fluid in the line with clean oil, while at the same time forcing air bubbles out of the line. Continue to force oil into the line until a steady, bubble-free flow of of clean oil is established at the aft end of the line.

f. When bleeding has been completed satisfactorily, disconnect the filler device and immediately connect the line to the instrument. Take care to hold oil loss from the line to an absolute minimum, so that no air enters the line while the connection is being made to the instrument. Tighten the connection.

g. Remove the covering from the connection at the oil pump and reconnect the line to the oil pump, making sure the connection is tight.

Table 81-1-VIIIA. Fuel Quantity Indicator Summary

SYSTEM NO.	FUEL QUANTITY INDICATOR PART NUMBER AND REMARKS	TRANSMITTER PART NO. 381094-07049	TRANSMITTER PART NO. 381094-08050	TRANSMITTER PART NO. 391061-03232	TRANSMITTER PART NO. 391061-03233	USED ON HELICOPTER SERIAL NUMBER	DISTINGUISHING FEATURES: Dial Graduation	DISTINGUISHING FEATURES: Capacitance Type System	DISTINGUISHING FEATURES: Float Type Tank Units
1	Simmonds 393029-01412 (Adjustments required after component replacement)	X	X			954 thru 2098	lb	X	
2	Simmonds 393000-01412 (No adjustment required)	X	X			2099 thru 2100, 2102 thru 2121, 2123 thru 2130, 2133 thru 2134, 2137 thru 2141, 2144 thru 2146	lb	X	
3	Simmonds 393000-01961 (No adjustment required)			X	X	2101, 2122, 2131, 2132, 2135, 2136, 2143, 2147, and 2148 thru 2198	lb	X	
4.	Liquidometer EA102ANH-146 (Adjustments required after component replacement)	EA1015B-2374 and either EA1028B-2375 or EA1028N-2375M				2199 and subsequent	gal		X

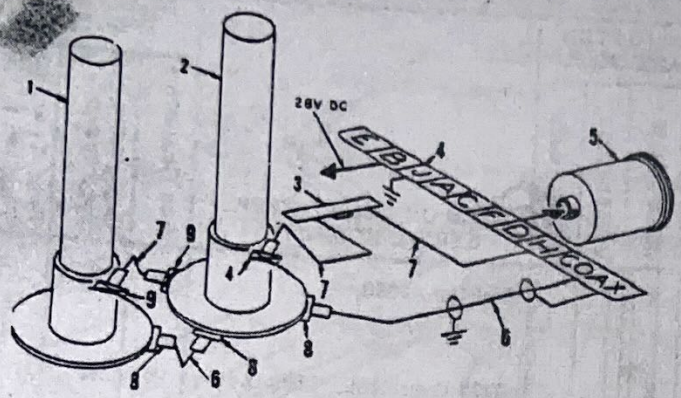
81-40-1. FUEL QUANTITY SYSTEM.

81-40-2. DESCRIPTION. (See figures 81-1-1, 81-1-3, and 81-1-3A.) Two basically different fuel quantity systems are used in Model UH-12E Helicopters. Three early configuration fuel quantity systems are capacitance type systems (Simmonds). The latest configuration fuel quantity system is a resistance type system (Liquidometer). Each system consists basically of a fuel quantity indicator (fuel gage) that is mounted in approximately the center of the instrument panel (see figure 81-1-1), and two transmitters that are mounted in the bottom of the fuel tank. Systems 1, 2, and 3, shown in figure 81-1-3 and table 81-1-VIIIA, are capacitance type systems. System 4, shown in figure 81-1-3A and table 81-1-VIIIA is a resistance type system. Aircraft Serial Number application data for the various fuel quantity systems are shown in table 81-1-VIIIA.

a. The capacitance type fuel quantity system consists of a fuel gage that is a combination indicator-oscillator-amplifier-bridge assembly; two tank units; a FUEL GAGE TEST pushbutton switch; and associated wiring and hardware. The system is an electronic device that measures the mass or weight of fuel in the fuel tank. The basic circuit of the capacitance type fuel quantity system is a continually rebalanced, or null balancing, capacitance bridge circuit in which the tank units act as the variable capacitor. See figure 83-1-3 for a simplified wiring diagram of the system. Of the three capacitance type fuel quantity systems, only the earliest requires adjustment after component replacement.

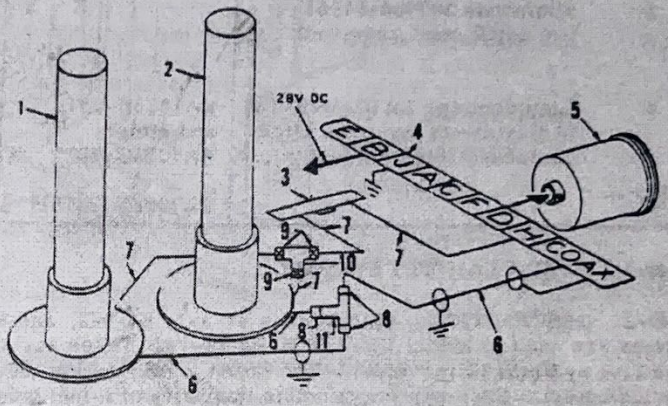
(1) The tank units are two conductive units separated by an air gap. Insulation between the electrodes is so arranged that leakage paths across solid dielectric insulation occur to ground and not between the two conductive tubes. The capacitance of the tank units changes as the quantity of fuel within the tank changes, because of the difference in the dielectric (insulating) qualities of fuel and air in the gap between the two conductive tubes.

(2) The fuel gage includes an indicator assembly, a transistor oscillator, and an amplifier-bridge assembly which are electrically and mechanically joined in a single case. The indicator assembly is hermetically sealed and should not be opened without proper tools and testing equipment. It is basically a servo motor that responds to signals from the amplifier-bridge, operating both a rebalancing variable resistor in the bridge circuit and the fuel gage indicator pointer through a reduction gear train. The bridge section of the amplifier-bridge contains a conventional capacitance bridge in which voltages of opposite phase are supplied to the bridge arms by a transformer. One arm of the bridge is a reference capacitor; the other capacitance arm of the bridge is the tank unit circuit. When the quantity of fuel in the fuel tank changes, resulting in a capacitance change in one arm of the bridge, an error signal is generated by the bridge. The error signal is amplified by the amplifier section of the amplifier-bridge, and is applied to the control winding of the servo motor. The servo motor turns sufficiently to adjust the rebalancing variable resistor, again balancing the bridge circuit and reducing the error signal to zero. This action moves the indicator pointer, producing an indication of the quantity of fuel remaining in the fuel tank.



VIEW A Refer to Systems 1 and 2, Table 81-1-X

INDEX NO.	DESCRIPTION
1.	Aft Tank Unit
2.	Forward Tank Unit
3.	FUEL GAGE TEST switch
4.	Plug Connector
5.	Fuel Gage
6.	Coaxial Cable (ref)
7.	400-cycle Cable (ref)
8.	Coaxial Plug Connector
9.	400-cycle Plug Connector
10.	Connector (Tee)
11.	Coaxial Connector (Tee)



VIEW B Refer to System 3, Table 81-1-X

Figure 81-1-3. Capacitance Type Fuel Quantity System , Simplified Wiring Diagram

(3) A d-c input of 27. 5 volts is applied to the fuel gage through a FUEL QUANTITY fuse in the protection panel. The transistor oscillator generates an a-c output of 115 volts at a frequency of 400 cycles per second for operation of the tank units and the bridge circuit.

(4) A FUEL GAGE TEST pushbutton switch on the instrument panel is used to test fuel quantity system operation.

b. The resistance type fuel quantity system comprises a fuel gage, two tank units, a stroke adjustment panel. a FUEL GAGE TEST pushbutton switch. and associated wiring and hardware. The system is an electrical device that measures the physical level of fuel in the fuel tank. and indicates the level on the fuel gage, which is graduated in US gallons. Major components of the resistance type fuel quantity system are shown in figure 81-1-3A and in table 81-1-VIIIA.

(1) The fuel gage used in the resistance type fuel quantity system is a d-c operated ratiometer that that indicates, in US gallons, the quantity of fuel remaining in the fuel tank. Battery current is applied to the fuel gage through the FUEL QUANTITY fuse in the protection panel. The fuel gage distributes battery current to the coils of three internal electromagnets, and to the tank units. A permanent magnet, to which a pointer is attached, is positioned so that current flow through the three electromagnets influences its position, thus moving the pointer. Return current from the tank units is applied to the fuel gage through the stroke adjustment panel, located beneath the left-hand seat deck.

(2) The aft tank unit incorporates a float arm that rises and falls with changes of fuel level in the fuel tank. The float arm is mechanically connected to the sliding contact of a variable resistor mounted in the tank unit. The sliding contact is electrically connected to the fuel gage, and the extreme ends of the resistance element of the variable resistor are electrically connected to the forward tank unit.

1. Aft Tank Unit
2. Forward Tank Unit
3. Terminal Strip
4. Fuel Gage Test Pushbutton Switch
5. Plug Connector (6 pin)
6. Fuel Gage
7. Stroke Adjustment Panel
8. Connector (5 pin), Forward Tank Unit
9. Connector (4 pin), Aft Tank Unit

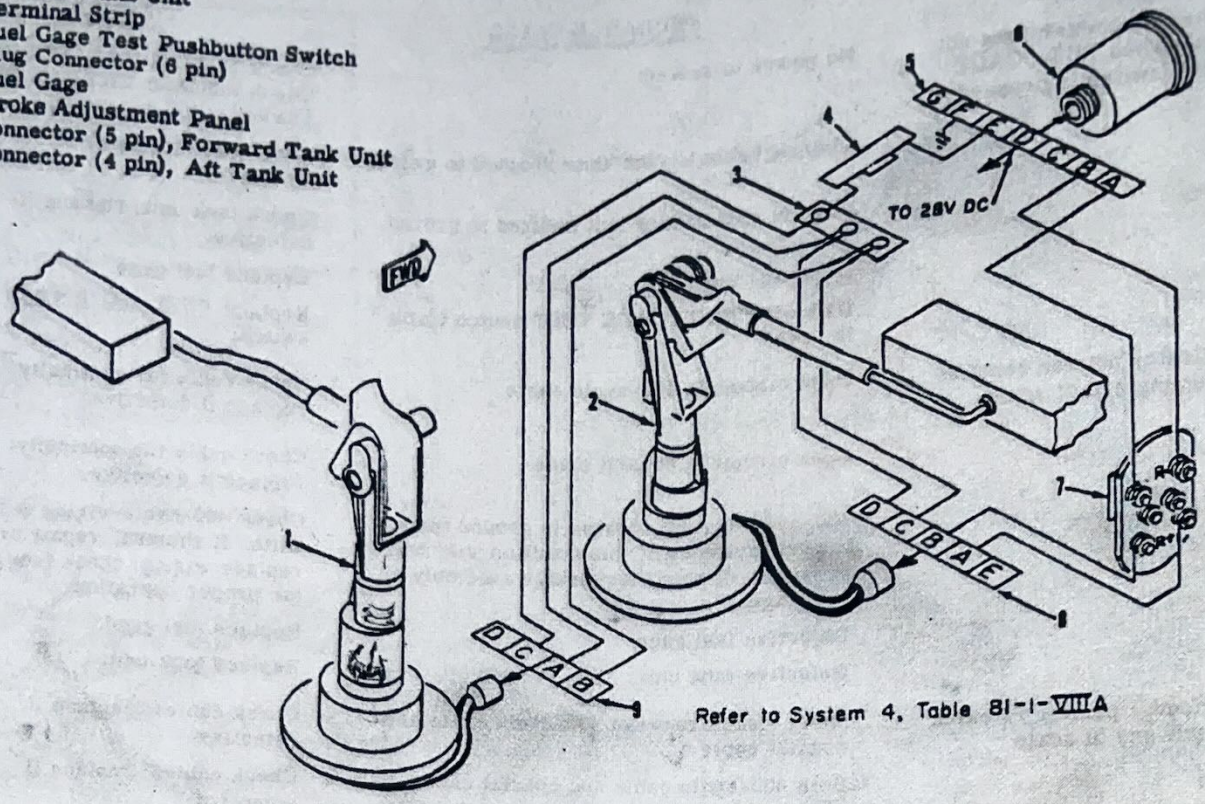


Figure 81-1-3A. Resistance Type Fuel Quantity System, Simplified Wiring Diagram

(3) The forward tank unit contains two variable resistors. The sliding contacts of the variable resistors are mechanically connected to a float arm that rises and falls with changes of fuel level in the fuel tank, and are electrically connected to the aft tank unit. One end of each resistance element is electrically connected, through variable resistors in the stroke adjustment panel, to the fuel gage. The forward tank unit is a system balancing device that compensates for variations in fuel level resulting from changes in the pitch and roll attitudes of the helicopter. For example: when the helicopter is in a nose-down attitude, the aft tank unit float arm is in a lower-than-normal position and the forward tank unit float arm is simultaneously in a higher-than-normal position, thus compensating for the off level tank attitude.

81-40-3. TROUBLESHOOTING FUEL QUANTITY SYSTEM. Fuel quantity system troubles are evidenced by an inoperative or inaccurate fuel gage. In either case the following troubleshooting operations should be performed, in the sequence listed, to isolate and correct the difficulty. Because all subsequent troubleshooting steps depend upon proper tank venting and satisfactory electrical connections, take care not to omit or minimize the importance of steps a and b below.

NOTE: To determine whether the fuel gage is actually inaccurate or within its normal accuracy tolerances, refer to the fuel gage serviceability standards discussed in paragraphs 81-40-30 and 81-40-31.

a. Check the fuel tank vent system for freedom from obstructions. Negative air pressure inside the fuel cell can result in partial collapse of the cell and an abnormal fuel level indication on the gage.

b. Check all fuel quantity system electrical connections for security and absence of corrosion; clean and tighten connections as necessary.

c. If the system fails to operate satisfactorily after completing steps a and b above, attempt to adjust the system in accordance with instructions provided in paragraph 81-40-30 (capacitance type system) or paragraph 81-40-31 (resistance type system).

d. If system adjustment is unsuccessful or ineffective, refer to table 81-1-IX or 81-1-X, whichever is applicable, for more detailed troubleshooting procedures. If any system component (including electrical connectors or wiring) is replaced during the troubleshooting procedure it will be necessary to readjust the system as directed in step c above.

Table 81-1-IX. Troubleshooting the Capacitance Type Fuel Quantity System

TROUBLE	PROBABLE CAUSE	REMEDY
Indicator pointer does not move when FUEL GAGE TEST switch is pressed	No power to system	Check FUEL QUANTITY fuse. Check indicator oscillator for 115 volts, 400 cps output.
	Coaxial cable to tank units shorted to ground	Check cable; replace if defective.
	Coaxial side of tank unit shorted to ground	Check tank unit; replace if defective.
	Defective fuel gage	Replace fuel gage.
	Defective FUEL GAGE TEST switch (fails to open)	Replace FUEL GAGE TEST switch.
Indicator pointer remains at empty end of scale	Open circuit in 400-cycle cable	Check cable for continuity; replace if defective.
	Open circuit in coaxial cable	Check cable for continuity; replace if defective.
	400-cycle circuit shorted to ground (prolonged existence of this conditon will result in failure of amplifier-bridge assembly of fuel gage.)	Check 400-cycle wiring to tank units. If shorted, repair or replace wiring; check fuel gage for proper operation.
	Defective fuel gage	Replace fuel gage.
	Defective tank unit	Replace tank unit.
Indicator pointer remains at full end of scale	Short circuit between 400-cycle cable and coaxial cable	Check cables; replace if defective
	Both 400-cycle cable and coaxial cable shorted to ground	Check cables; replace if defective
	Tank unit internally shorted	Replace tank unit.
Indicator pointer operation is sluggish	Low resistance between 400-cycle cable and coaxial cable, or between coaxial cable and ground	Check insulation resistance of cables and tank units (paragraph 81-40-60).
Indicator pointer shows higher than known quantity of fuel in tank	Fuel quantity system not properly adjusted	Adjust system (paragraph 81-40-30).
	Low d-c resistance between coaxial cable and ground	Check insulation resistance of coaxial cable (paragraph 81-40-60).
	Low d-c resistance between coaxial cable and 400-cycle cable	Check insulation resistance between coaxial cable and 400-cycle cable (paragraph 81-40-60).
Indicator pointer shows lower than known quantity of fuel in tank	Fuel quantity system not properly adjusted	Adjust system (paragraph 81-40-30).
	Open circuit in cables between tank units	Check cables; replace if defective.
	Defective tank unit	Replace tank unit.

81-40-10. REMOVAL OF FUEL GAGE. Refer to paragraph 81-1-10 for instrument removal instructions.

81-40-11. INSTALLATION OF FUEL GAGE. Refer to paragraph 81-1-11 for instrument installation instructions.

Figure 81-1-4. Deleted.

Table 81-1-X. Troubleshooting the Resistance Type Fuel Quantity System

TROUBLE	PROBABLE CAUSE	REMEDY
Indicator pointer remains at empty end of scale	No power to system	Check FUEL QUANTITY fuse.
	Loose or corroded connection at fuel gage	Clean or tighten connector.
	Loose or corroded connector at tank unit	Clean or tighten connector.
	Defective fuel gage	Replace fuel gage.
	Defective tank unit	Test tank unit (paragraph 81-40-61); replace if defective.
Indicator pointer does not move when FUEL GAGE TEST pushbutton switch is pressed	Defective fuel gage	Replace fuel gage.
	Defective FUEL GAGE TEST pushbutton switch	Replace switch.
Indicator pointer moves to full end of scale when FUEL GAGE TEST pushbutton switch is pressed	Short to ground in FUEL GAGE TEST pushbutton switch circuit	Repair circuit or replace switch.
Indication on fuel gage below zero with empty fuel tank	System out of adjustment	Adjust system (paragraph 81-40-31).
	Defective fuel gage	Replace fuel gage.
	Open circuit between pin A of fuel gage and pin B of aft tank unit	Repair open circuit.
	Open circuit between pin E of fuel gage and pin C of aft tank unit	Repair open circuit.
Fuel gage indicates more than 34 gallons when fuel tank is empty	Open circuit between pin A of fuel gage and pin C of aft tank unit	Repair open circuit.
Fuel gage indicates less than 12 gallons when fuel tank is half full	Defective fuel gage	Replace fuel gage.
	Open circuit between pin B of fuel gage and pin A of aft tank unit	Repair open circuit.
	Open circuit between pin E of fuel gage and pin C of aft tank unit	Repair open circuit.
Fuel gage indicates more than 34 gallons when fuel tank half full	Defective fuel gage	Replace fuel gage.
	Open circuit between pin A of fuel gage and pin B of tank unit	Repair open circuit.
Fuel gage indicates less than 12 gallons when fuel tank is full	Defective fuel gage	Replace fuel gage.
	Open circuit between pin B of fuel gage and pin A of aft tank unit	Repair open circuit
	Open circuit between pin E of fuel gage and pin C of aft tank unit	Repair open circuit
Fuel gage indication above 46 gallons when tank is full (46 US gallons)	System out of adjustment	Adjust system (paragraph 81-40-31).
	Defective fuel gage	Replace fuel gage.
	Open circuit between pin A of fuel gage and pin B of aft tank unit	Repair open circuit.
	Short to ground in FUEL GAGE TEST push-button switch circuit	Repair circuit or replace switch.
Fuel gage indications are extremely erratic in flight	Defective forward tank unit.	Test forward tank unit (paragraph 81-40-61); replace if defective.

1-40-12. REMOVAL OF TANK UNITS. Remove tank units as follows.
a. Disconnect all electrical power and drain fuel system as directed in Section 10.
b. Remove forward left-hand access cover (forward tank unit) or center right-hand access cover (aft tank unit) from body skin below fuel tank, and disconnect electrical connectors from receptacles on tank unit.
c. Matchmark capacitance type tank units to tank liner.
d. Remove tank unit by removing the eight bolts and washers securing tank unit to tank and tank liner.
e. Remove gasket; clean all gasket residue from tank unit flange and fuel tank liner lower surface.

81-40-13. INSTALLATION OF TANK UNITS. Install tank units as follows.
a. Install new gasket on tank unit flange.
b. Position tank unit in opening in fuel tank and tank liner.
(1) Aline matchmarks on capacitance type tank units with matchmarks on tank liner, or position a new tank unit to permit mating or existing cable end connectors to tank unit receptacles without changing position of cables.
(2) Position resistance type tank units so that arrow on bottom of tank unit points forward.

CAUTION: INSTALL RESISTANCE TYPE FORWARD TANK UNIT WITH FLOAT ARM FORWARD OF FUEL STRAINER ASSEMBLY, WHICH EXTENDS DOWNWARD FROM FUEL CELL COVER PLATE INTO FUEL TANK SUMP. DO NOT FORCE TANK UNIT INTO POSITION; TO DO SO MAY DAMAGE FUEL STRAINER ASSEMBLY, TANK UNIT FLOAT ARM, OR FLOAT.

c. Install and tighten the eight close tolerance, self-locking attaching bolts as follows; use from one to three washers under bolt heads to obtain proper thread engagement.
(1) Start each bolt sufficiently to engage three or four threads, then use a torque wrench to measure the amount of torque required to overcome thread friction (drag torque) prior to clamp-up.
(2) Record, adjacent to each bolt, the amount of torque measured in step (1) above.
(3) Tighten each bolt by applying clamp-up torque of 15 to 25 pound-inches greater than drag torque recorded in step (2) above; do not exceed total torque value of 100 pound-inches (drag torque plus clamp-up torque).
(4) After 30 minute interval, loosen each bolt slightly and repeat step (3) above to compensate for gasket compression.
d. Connect electrical connectors to appropriate receptacles on tank units (see figure 81-1-3 or 81-1-3A).
e. Install tank unit access cover(s); secure with attaching hardware.

81-40-14. REMOVAL OF STROKE ADJUSTMENT PANEL. Remove stroke adjustment panel as follows.
a. Turn MASTER SWITCH to OFF position.
b. Remove left-hand seat cushion and seat deck assembly.
c. Tag and remove the four electrical wires attached to the stroke adjustment panel.
d. Remove stroke adjustment panel by removing the two attaching screws, spacers, washers, and nuts.

81-40-15. INSTALLATION OF STROKE ADJUSTMENT PANEL. Installation of the stroke adjustment panel is the reverse of removal.

81-40-30. ADJUSTMENT OF CAPACITANCE TYPE FUEL QUANTITY SYSTEM. System Number 1, table 81-1-VIIIA, is the only one of the three capacitance type fuel quantity systems that requires adjustment after replacement of a system component, or if the fuel gage indications are inaccurate. Either of two alternate adjustment methods may be employed. The method described in step a below utilizes a Simmonds 387019 tester unit, which permits the fuel gage to be adjusted in the minimum amount of time and with the least effort. The alternate method described in step b below provides instructions for adjusting the gage without any special tools or test equipment. Regardless of the adjustment method employed, the fuel gage indications should fall within the limit ranges provided in table 81-1-XI after adjustment.
a. In instances where the Simmonds 387019 Tester is available, proceed as follows to adjust the fuel gage.
(1) Drain the fuel tank completely. Refer to Section 10 for draining instructions.
(2) Turn the MASTER SWITCH to the ON position.
(3) Open the face of the instrument panel and turn the FULL adjustment screw (located at the rear of the fuel gage) to its midtravel position.
(4) Turn the gage EMPTY adjustment screw until the gage pointer reads zero.
(5) Turn the MASTER SWITCH to the OFF position and disconnect the plug connector from the rear of the fuel gage.
(6) Reconnect the gage plug connector through the harness of the Simmonds 387019 Tester.
(7) Set the switch on the tester to the EMPTY position; then turn the tester knob as necessary to set the gage pointer to zero. Take care not to move the knob again during any of the following steps.
(8) Set the switch on tester to FULL, and adjust the FULL adjustment screw on rear of gage as necessary to set gage pointer to the 276-pound position on the gage dial.
(9) Set tester switch to EMPTY and note gage reading. If pointer reads zero, no further adjustments are required; if pointer does not read zero, repeat steps (4) through (8) above.

Table 81-1-XI. Fuel Quantity System Serviceability Standards

MEASURED FUEL IN TANK Basis: 1 gal = 5.95 lb		ACCEPTABLE INDICATOR READINGS INDICATOR PART NO.			
GALLONS	(POUNDS)	393029-01412 (lb)	393000-01412 (lb)	393000-01961 (lb)	EA102ANH-146 (gal)
5	(29.75)	21 - 29	19 - 24	16 - 21	3.5 - 4.5
10	(59.50)	49 - 60	49 - 54	50 - 60	8.0 - 10.0
15	(89.25)	76 - 90	78 - 83	78 - 83	15.0 - 17.0
20	(119.00)	109 - 120	108 - 118	99 - 104	19.0 - 21.0
25	(148.75)	148 - 158	120 - 130	120 - 130	24.0 - 26.0
30	(178.50)	171 - 189	174 - 184	149 - 153	29.0 - 31.0
35	(208.25)	201 - 220	205 - 216	173 - 183	36.0 - 37.0
40	(238.00)	230 - 250	238 - 250	219 - 229	39.0 - 41.0
45	(267.75)	251 - 273	249 - 265	241 - 251	45.0 - 46.0
46	(273.70)	273 .7	273 .7	273 .7	46.0

NOTES:
1. Test conditions: Electrical system voltage, 24v; helicopter laterally level; nose two degrees below horizontal.
2. The apparent discrepancies between measured fuel in tank and indicator readings result from: (1) the difference between the average helicopter flight attitude (8 deg. nose-down) and parked attitude (2 deg. nose-down); and (2), table limits based on the extremes experienced on a relatively large number of different helicopters rather than a single aircraft. In most instances the fuel quantity indicator of a given helicopter will fall well inside the limit ranges given above at all but one or two points on the dial.

(10) After the preceding steps have been satisfactorily completed, turn the MASTER SWITCH to the OFF position, remove the tester from the system, and reinstall the electrical plug connector at the rear of the fuel gage.

(11) Place the helicopter in a two-degree nose down, laterally level attitude. If the aircraft is parked on a smooth level surface with the ground handling wheels extended it may not be necessary to support the helicopter on jacks.

(12) Verify fuel gage accuracy by filling the fuel tank in accurately measured five US gallon increments, recording the gage reading after each increment is added, and comparing the results with the serviceability standards given in table 81-1-XI.

b. In instances where the Simmonds 387019 Tester is not available, proceed as follows to adjust the fuel gage.

(1) Drain the fuel tank completely. Refer to Section 10 for draining instructions.

(2) Place the helicopter in the attitude described in step a (11) above.

(3) Open the face of the instrument panel to obtain access to the rear of the fuel gage.

(4) Turn the MASTER SWITCH to the ON position and turn the EMPTY adjustment screw on the rear of the fuel gage until the gage pointer is alined with the zero point on the dial.

(5) Completely fill the fuel tank.

(6) Set the FULL adjustment screw at the rear of the gage to obtain a gage reading of 273.7 pounds.

(7) Completely drain the fuel tank and verify gage accuracy by performing the accuracy check described in step a (12) above.

81-40-31. ADJUSTMENT OF RESISTANCE TYPE FUEL QUANTITY SYSTEM. When any component of the resistance type fuel quantity system is replaced, or if the fuel gage indications are inaccurate, adjust the system according to the following procedures. After adjustment, the fuel gage indications should fall within the limit ranges shown in table 81-1-XI, Fuel Quantity System Serviceability Standards.

NOTE: The fuel tank must be empty to begin adjustment procedures. Drain fuel tank as directed in Section 10.

a. Assure that helicopter is laterally level and nose is two degrees below horizontal.
b. Remove left-hand seat cushion and seat deck assembly.
c. Turn MASTER SWITCH to ON position.
d. Release locking nut on R plus (+) adjusting screw on stroke adjustment panel, which is located below left-hand seat deck, and adjust screw to produce an "empty" indication on the fuel gage.
e. Tighten locking nut while holding adjusting screw to prevent screw from turning with locking nut.

NOTE: Check fuel gage to assure that adjusted indication remains accurate after tightening locking nut. If indication is inaccurate, adjusting screw might have rotated during tightening of locking nut; if so, repeat steps d and e.

f. Turn MASTER SWITCH to OFF position and fill fuel tank with accurately measured 46 US gallons of fuel as directed in Section 10.
g. Turn MASTER SWITCH to ON position.
h. Release locking nut on R minus (-) adjusting screw on stroke adjustment panel, and adjust screw to produce a "full" indication on fuel gage.
i. Tighten locking nut while holding adjusting screw to prevent its turning with locking nut.

NOTE: Check fuel gage to assure that adjusted indication remains accurate after tightening locking nut. If indication is inaccurate, adjusting screw might have rotated during tightening of locking nut; if so, repeat steps h and i.

81-40-60. TESTING INSULATION RESISTANCE OF CAPACITANCE TYPE FUEL QUANTITY SYSTEMS. Insulation resistance tests of the capacitance type fuel quantity system require use of an insulation resistance tester (Model 799, Weston Electrical Instrument Corp., Newark, N. J., or equivalent) to measure the insulation resistances given in table 81-1-XII. The first three tests in table 81-1-XII are tests of system insulation resistance. Disconnect the electrical connector plug from the fuel gage receptacle, and conduct all tests at this plug with all other connectors installed in their tank unit receptacles. Test numbers 4, 5, and 6 are tests of tank unit insulation resistance, and may be conducted on individual tank units either installed or removed from the helicopter, but in either case, with all cable connectors removed. Measurements are made at tank unit receptacles. Item numbers appearing in table 81-1-XII refer to items shown in figure 83-1-21, Capacitance Type Fuel Quantity System Wiring Diagram.

Table 81-1-XII. Insulation Resistance Limits, Capacitance Type Fuel Quantity System

NOTE: Item numbers refer to items shown in figure 83-1-21, Fuel Quantity System Wiring Diagram.

TEST NO.	MEASURE FROM	MEASURE TO	MINIMUM INSULATION RESISTANCE IN MEGOHMS
1	Pin A of connector (item 91 or 95)	Pin X of connector (item 91) or pin B of connector (item 95)	20
2	Pin H of connector (item 91), or pin E of connector (item 95)	Pin X of connector (item 91), or pin B of connector (item 95)	20
3	Pin A of connector (item 91 or 95)	Pin H of connector (item 91) or pin E of connector (item 95)	100
4	Center pin of tank unit coaxial receptacle	Flange of tank unit	100
5	Center pin of tank unit 400-cycle receptacle	Flange of tank unit	100
6	Center pin of tank unit coaxial receptacle	Center pin of tank unit 400-cycle receptacle	5000

81-40-61. TESTING TANK UNITS, RESISTANCE TYPE FUEL QUANTITY SYSTEM. The tank units in the resistance type fuel quantity system may be tested according to Table 81-1-XIII. Resistance measurements are made at the pins of the electrical connector that is part of the tank unit. Resistance measurements may be made with the tank unit installed in the helicopter, or on the bench. Replace a tank unit in which resistances differ from those shown in Table 81-1-XIII.

Table 81-1-XIII. Resistance Chart, Resistance Type Tank Units

	MEASURE BETWEEN Pin	and Pin	RESISTANCE IN OHMS Float Arm Down (Tank Empty)	Float Arm Up (Tank Full)
FORWARD TANK UNIT EA10288-2375	A	D	84 ± 3	0 to 2
	B	C	0 to 2	84 ± 3
AFT TANK UNIT EA10158-2374	A	B	84 ± 3	0 to 2
	A	C	84 ± 3	84 ± 3
	B	C	0 to 2	

81-40-62. OPERATIONAL TEST, FUEL QUANTITY SYSTEMS. An operational test of either the capacitance type or the resistance type fuel quantity system may be made as follows.

a. Test the capacitance type fuel quantity system as follows:
(1) Turn MASTER SWITCH to ON position.
(2) Observe indication on fuel gage.
(3) Press FUEL GAGE TEST pushbutton switch; hold switch down long enough to permit indicator pointer to move toward empty end of indicator scale.
(4) Release FUEL GAGE TEST pushbutton switch and observe indication on fuel gage at which pointer stops; this should be the same as the indication observed in step (2) above.

b. Test the resistance type fuel quantity system as follows:
(1) Turn MASTER SWITCH to ON position.
(2) Observe indication on fuel gage.
(3) Press FUEL GAGE TEST pushbutton switch. Indicator pointer will move to approximately 20 gallons if system is operating properly.

NOTE: Little or no movement of indicator pointer will be observed if fuel tank contains approximately 20 gallons.

(4) Release FUEL GAGE TEST pushbutton switch and observe indication on fuel gage at which pointer stops; this should be the same as the indication observed in step (2) above.

81-50-1. MISCELLANEOUS INSTRUMENTS. Miscellaneous instruments are described in the following paragraphs.

81-51-1. CLOCK.

81-51-2. DESCRIPTION. (See figure 81-1-1.) The clock is located in the lower center area of the instrument panel. The clock is an aircraft type eight-day clock equipped with a winding knob.

81-51-3. TROUBLESHOOTING THE CLOCK. If the clock does not operate when wound, or does not keep correct time, it is defective and must be replaced.

81-51-10. REMOVAL OF CLOCK. (Refer to paragraph 81-1-10.)

81-51-11. INSTALLATION OF CLOCK. (Refer to paragraph 81-1-11.)

81-52-1. VOLTAMMETER. This instrument and the associated electrical systems are described in Section 83.

81-53-1. FREE AIR TEMPERATURE INDICATOR.

81-53-2. DESCRIPTION. (See figure 84-401-1.) The free air temperature indicator is mounted in a bracket on the cabin enclosure support tube assembly near the compass. The free air temperature indicator is a direct-reading type with a bimetallic sensing element. The free air temperature indicator consists of two units: the sensing-indicating element and the sunshield. The sensing-indicating element extends forward through the windshield inside the sunshield.

81-53-3. TROUBLESHOOTING THE FREE AIR TEMPERATURE INDICATOR. Should the free air temperature indicator give incorrect readings, it is defective and must be replaced.

81-53-10. REMOVAL OF THE FREE AIR TEMPERATURE INDICATOR.

a. Turn the indicating element counterclockwise to unscrew the sensing-indicating element from the sunshield.

b. Pull the sensing-indicating element aft out of the sunshield, thereby separating the sensing-indicating element and the sunshield from the bracket on the cabin enclosure support tube assembly.

c. Remove the sunshield from the windshield by removing the bracket to allow the sunshield to be pulled aft.

81-53-11. INSTALLATION OF FREE AIR TEMPERATURE INDICATOR. Installation of the free air temperature indicator is the reverse of removal.

ELECTRICAL SYSTEMS

83-1-1. ELECTRICAL SYSTEM.

83-1-2. DESCRIPTION. The helicopter is provided with a single-wire d-c electrical system, using the helicoper structure as a ground return line. Electrical power is supplied by an engine-driven generator and a storage battery. The electrical system includes provisions for the use of an external power source. All wiring, including the various kits that may be installed on the helicopter, is numbered in conformance with MIL-STD-15 and is shown in the wiring diagrams at the end of this section. Except where color coding is used, all wiring is identified by number.

83-1-3. TROUBLESHOOTING THE ELECTRICAL SYSTEM. Refer to appropriate tables in this section for troubleshooting information.

83-1-4. ELECTRICAL SYSTEM EQUIPMENT. The equipment of the electrical system is listed in Table 83-1-VI. Each item of equipment is assigned an index number which is used to identify that item of equipment.

83-1-5. ELECTRICAL CONNECTORS. Standard electrical connectors are used throughout the electrical systems to connect the various wiring harnesses and electrical components. For installation and maintenance instructions applicable to the connectors, refer to paragraphs 83-1-40 and -41. Type and identification of sealants used are included in the list of consumable materials (item 9, Table 10-VI).

83-1-40. MINOR REPAIR AND MAINTENANCE OF THE ELECTRICAL SYSTEM. Replace any wiring or wiring shielding which shows evidence of deterioration, chafing, fraying, overheating, corrosion, or other damage. Replace damaged or corroded terminal strips and electrical connectors. Test all wiring in malfunctioning circuits for continuity with an ohmmeter to check terminal by terminal through the circuit. Refer to the wiring diagrams at the end of this section. Make any necessary wiring repairs or replacement of defective connectors. Check that all wire harness clamps are positioned properly and installed tightly to prevent strain or vibration of wiring or connections.

83-1-41. REPAIR OR REPLACEMENT OF SEALED (POTTED) AN ELECTRICAL CONNECTORS. (See figures 83-1-1, 83-1-2 and -3.)

a. Repair or replace wires or sealing compound in the sealed AN electrical connectors according to the procedures outlined below. If it is necessary to replace only a wire, refer to subparagraph f. During preparation, application or storage of the sealing compound, observe the following general precautions:

(1) Do not remove the accelerator and base material containers from the carton for separate storage purposes. Any switching of the two materials may result in a sealing compound with substandard electrical properties.

(2) The work life of the sealing compound can be extended appreciably by chilling the base and accelerator in ice water or in a refrigerator for approximately 10 hours prior to mixing.

(3) Avoid direct skin contact with the leadbearing accelerator. Wear gloves and wash hands thoroughly after working with accelerator.

(4) Provide adequate ventilation, and observe fire precautions, as the sealing compound contains inflammable solvent. Do not apply heat in excess of 135° F to facilitate curing.

(5) The viscosity of the mixed compound increases with time and temperature. At a room temperature of 75°F and 50 percent relative humidity, the work life of the mixed compound expires in 90 minutes. For each 10°F increase in temperature, the work life is reduced approximately 50 percent. Conversely, each 10°F reduction in temperature will double the work life.

(6) For storage purposes, the mixed compound can be stored at -20°F, which will maintain working life for as long as 36 hours. In calculating the work life of stored sealing compound, the time required to cool the sealing compound plus the time required to bring it to application temperature must be subtracted from the work life. If the sealing compound is to be stored, cool it immediately after acceleration. Bring it back to working temperature by warming the container with compressed air. Do not use heat to raise the sealing compound temperature to working condition.

b. Clean connectors fitted with hard plastic inserts, and having no wires attached, by tumbling them in Turco High Flash Penetrol for a period of not less than 40 minutes. Follow with a thorough rinsing in dry cleaning solvent, naphtha or mineral spirits. Vapor degrease the connectors.

CAUTION: UNDER NO CIRCUMSTANCES SHALL CONNECTORS WITH RUBBER INSERTS OR ASSEMBLED CABLES AND WIRE BUNDLES BE CLEANED BY THE METHOD INDICATED IN STEP b, IMMEDIATELY PRECEDING. IT IS PERMISSIBLE TO CLEAN CONNECTORS FITTED WITH HARD RUBBER INSERTS OR WIRES BY THE METHOD PRESCRIBED IN STEP c, FOLLOWING.

c. Clean connectors fitted with hard rubber inserts or those with wires attached, as follows:

(1) Remove all sleeving from wires and bundles.

Figure 83-1-1. Checking Connector Sealing Compound

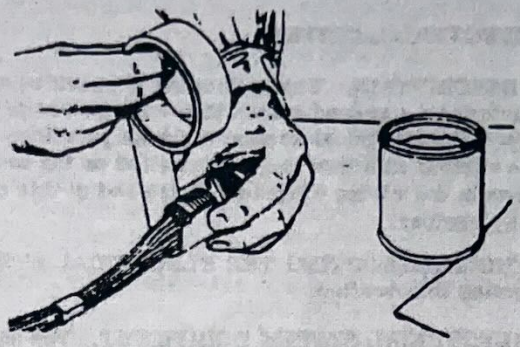


Figure 83-1-2. Preparing Connector for Sealing Compound

(2) Remove loose resin and flux by using a small stiff bristle brush and safety solvent, mineral spirits, naphtha or dry cleaning solvent; clean thoroughly around all wires, lugs, pins and internal surfaces of the shells. Repeat the operation at least twice to insure a clean, silicone-free back shell area.

(3) Rinse the area to be sealed with a small amount of methylene chloride and allow to dry. Use a hand-operated laboratory wash-bottle, atomizer or similar device to apply the methylene chloride.

WARNING: DO NOT BREATHE METHYLENE CHLORIDE FUMES. APPLY ONLY IN A WELL VENTILATED AREA.

(4) Check that there is no foreign matter in the connector which might prevent adherence of sealing compound to the wires or connector.

d. Prepare the sealing compound according to the following procedure:

NOTE: Observe the precautions and working conditions described in step a. above, while preparing sealing compound.

(1) Use either hand mixing or mechanical mixing methods (such as a paint shaker) to mix the accelerator and the base compound separately, before blending the two together. Use a clean spatula, tongue depressor or similar instrument to stir the materials by hand.

(2) After each material is thoroughly mixed, add the accelerator to the base compound and mix slowly for a period of five to seven minutes to obtain a smooth, creamy compound. It is permissible to use mechanical means for blending. If a wire mixing paddle secured to a drill press (geared from 50 to 90 rpm) is used, secure the container so that it remains fixed during mixing.

NOTE: Avoid fast or excessive mixing action to prevent formation of air bubbles.

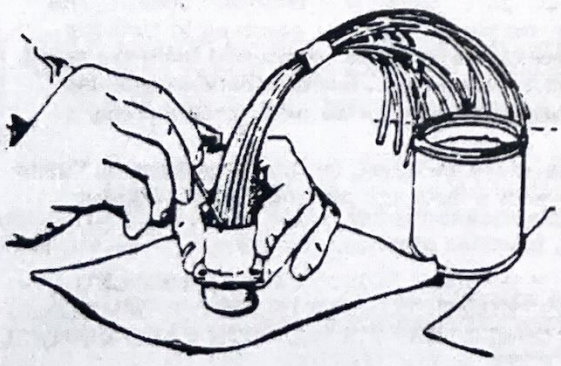


Figure 83-1-3. Tamping Sealing Compound to Remove Air Bubbles

(3) Determine that the blending is thoroughly accomplished by spreading a drop of the mixture thinly on a clean white paper. (See figure 83-1-1.) Examine the material closely to make sure that no traces or streaks of accelerator are visible. If necessary, continue mixing by hand; if using a mechanical mixer, mix in two-minute cycles, until no traces of nonblended material are visible. Do not mix beyond the point where tests indicate that the materials are completely blended.

e. Apply the sealing compound according to the following procedure:

NOTE: If it is desirable to have the back shell easily removable for repair or inspection, coat the inner surfaces of the shell very lightly with oil, which will act as a parting compound. Make sure that the quantity and application of the oil is such that it does not make contact with the inserts, pins or wires.

(1) Seal box-type connectors without back shells with a mold from masking or cellophane tape, vinyl tubing, or similar material to retain the sealing compound in place during curing. (See figure 83-1-2.) Place the plugs in position so that the sealing compound will flow to the bottom during application. Make certain that the shell is clean, and free from foreign material which might prevent proper adherence of the sealing compound.

(2) Apply the sealing compound to the connector with a spatula or sealant gun. Pack the sealing compound around the base of the pins by tapping the connector sharply on a block of wood or other resilient surface. Tamping with a small dowel or welding rod will aid in removal of air bubbles. (See figure 83-1-3.) Fill the connector to its brim, or to a point where the sealing compound will cover 1/4-inch of the wire insulation. Group and secure the wires in the desired position, and allow the sealing compound to cure.

(3) To provide a satisfactory cure, allow the sealed connector to set for 24 hours in an ambient temperature of 70°F. To expedite curing, it is permissible to heat a sealed connector to a maximum of 135°F. after allowing a minimum one-hour air drying period.

NOTE: Do NOT apply heat in excess of 135°F. The sealing compound will become very porous if curing temperature exceed this limit.

f. If a wire in a previously sealed connector requires repair or replacement, remove the back shell by sliding a knife blade around the outside edge of the sealing compound and unscrew the shell. Cut the sealing compound away from the affected wire and solder cup. Use long nose pliers to facilitate removal of sealing compound around the center of tightly grouped wires. Use a small soldering iron or gun when resoldering wires in such confined places. After repair or replacement of the necessary wires is accomplished, reseal the connector in accordance with paragraph e preceding.

NOTE: It is not necessary to remove all sealing compound from the connector during removal of only one wire. Sealing of the replacement wire will seal or vulcanize the new sealing compound to that remaining in the connector.

83-1-42. EXTREME WEATHER MAINTENANCE OF ELECTRICAL SYSTEM. Inspect the components of the electrical system frequently during cold weather operations. Guard against the accumulation of moisture in the electrical accessories and junction boxes by frequent cleaning with a clean, dry, lint-free cloth. Exposed insulation may freeze and split at extremely low temperatures, and must be inspected frequently and replaced if necessary. Cables and wire harnesses may become stiff and will therefore be difficult to manipulate when being disconnected. When disconnecting these cables exercise care not to damage the insulation.

83-10-1. BATTERY. (See figures 83-1-4 and -5.)

83-10-2. DESCRIPTION. The 24-volt, 13-amp-hr nickel-cadmium type battery is mounted in the battery rack on the forward side of the instrument pedestal in the UH-12E standard configuration, and in a metal enclosure at the aft end of the tail boom on the four-place configuration. The battery is mounted in a removable stainless steel drip pan which contains a felt pad impregnated with boric acid crystals to neutralize any electrolyte spillage. The battery is clamped to the rack with two side rods which bolt to the hold-down cross member on top of the sunshield cover and the battery. The battery does not require external venting as there is no gassing effect during discharge. The battery output terminals are fitted with a receptacle adapter. The battery disconnect assembly attaches to this receptacle adapter to connect the battery to the electrical system. The cable from the battery disconnect assembly runs to the external power receptacle where the negative lead is grounded to the helicopter structure. The positive lead continues to the battery relay in the engine junction box.

83-10-3. TROUBLESHOOTING THE BATTERY. Table 83-1-I contains instructions for troubleshooting the battery.

83-10-10. REMOVAL OF BATTERY.

CAUTION: IF BATTERY ELECTROLYTE IS SPILLED ON THE SKIN, CLOTHING, OTHER MATERIAL, OR ON THE HELICOPTER, WASH THE AFFECTED AREA WITH COLD WATER OR A BORIC ACID SOLUTION, IF ANY PAINT HAS BEEN REMOVED, CLEAN AND SPRAY THE AREA WITH TYGON, K-23 BLACK PAINT.

a. Turn the MASTER SWITCH to the OFF position.
b. Remove the lockwire from the wing nuts which attach the side rods to the hold-down cross member on top of the battery and sunshield cover. In the four-place configuration installed position, remove both access covers from the battery enclosure.
c. Detach the battery disconnect assembly from the receptacle adapter.
d. Cut the lockwire and unscrew the wing nuts from the side rods and remove the sunshield.
e. Lift the battery up and out of the rack.

83-10-11. INSTALLATION OF BATTERY.
a. Place the battery on the battery rack with the receptacle adapter positioned to the left (three-place

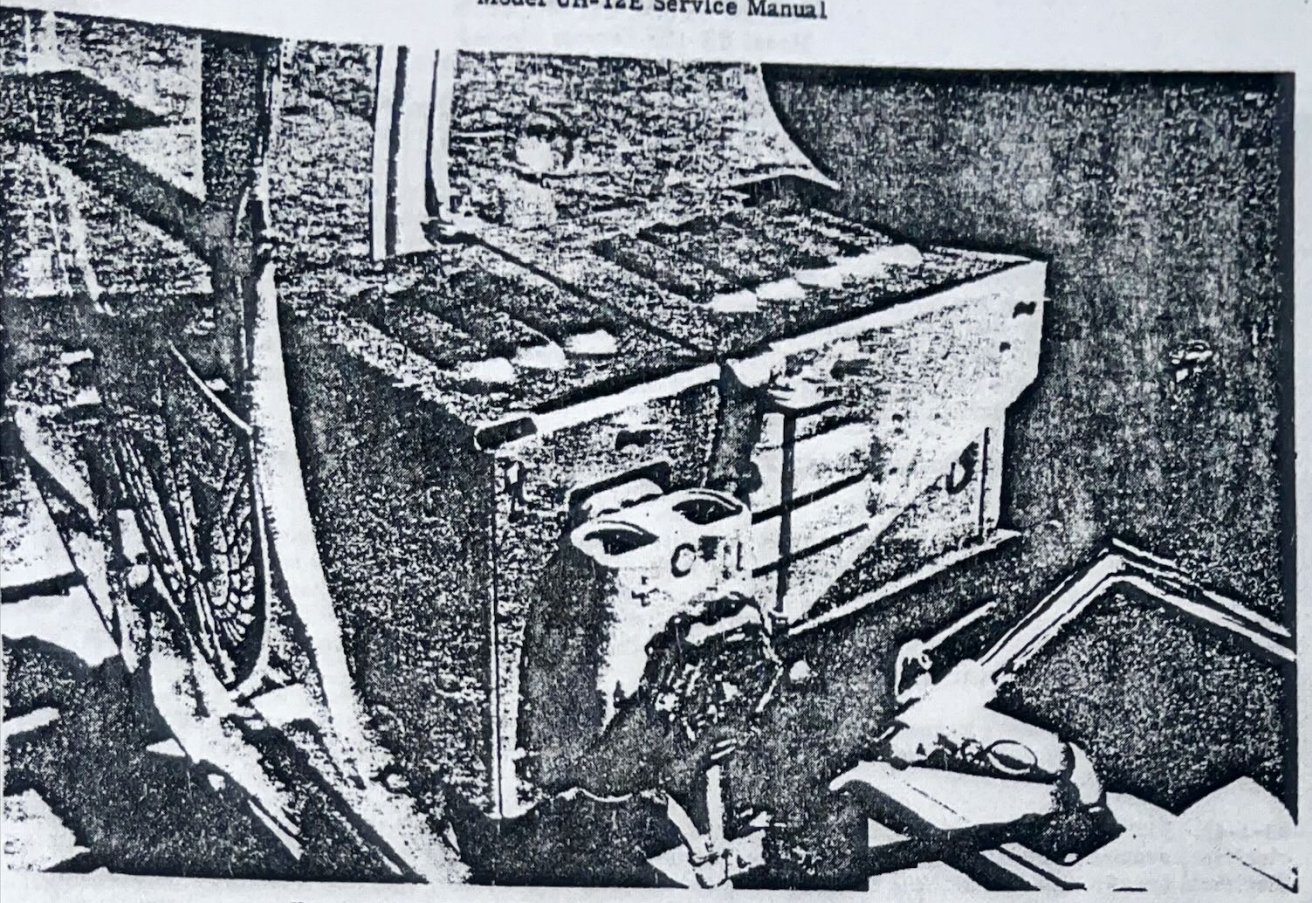


Figure 83-1-4. Battery Installation (Three-Place Configuration)

configuration) and install the sunshield. Engage the side rods with the slots in the hold-down cross member on the top of the battery and the sunshield cover.

b. Put the wing nuts on the side rods, and tighten finger-tight only.

CAUTION: OVER-TIGHTENING THE WING NUTS WILL DISTORT THE BATTERY COVER, DAMAGING THE SEAL.

c. Safety the wing nuts with lockwire.
d. On the four-place configuration, install access covers on battery enclosure.
e. Connect the battery disconnect assembly to the receptacle adapter.

83-10-40. CLEANING THE BATTERY. Clean potassium carbonate from the battery or battery drip pan as follows:

a. If the battery shows formation of a white substance on top of the cells or elsewhere, remove the substance by brushing the terminals with a stiff brush and washing with cold water.

CAUTION: BE CAREFUL NOT TO SHORT CIRCUIT THE BATTERY TERMINALS WHEN CLEANING THEM WITH A WIRE BRUSH.

b. Remove the battery drip pan and thoroughly wash the felt pad in clear water. Allow the pad to dry and then saturate the pad in a 15 percent weight aqueous solution of boric acid. Allow the saturated pad to dry in a horizontal position---do not dripdry the pad.

83-10-41. MAINTENANCE OF BATTERY. Maintain the battery in serviceable condition as follows:

a. Keep the electrolyte level in the battery adjusted as necessary by removing the filler caps and adding only enough distilled water to bring the electrolyte level in each cell to the level lines indicated on battery case. Then install the filler caps.

NOTE: Service with distilled water ONLY.

b. When the electrolyte level drops below the lower level line, (battery fully charged) add distilled water ONLY. Do not check the specific gravity immediately after the addition of distilled water, and do not check the electrolyte level immediately after the battery has been charged, as at that time the level is normally high.

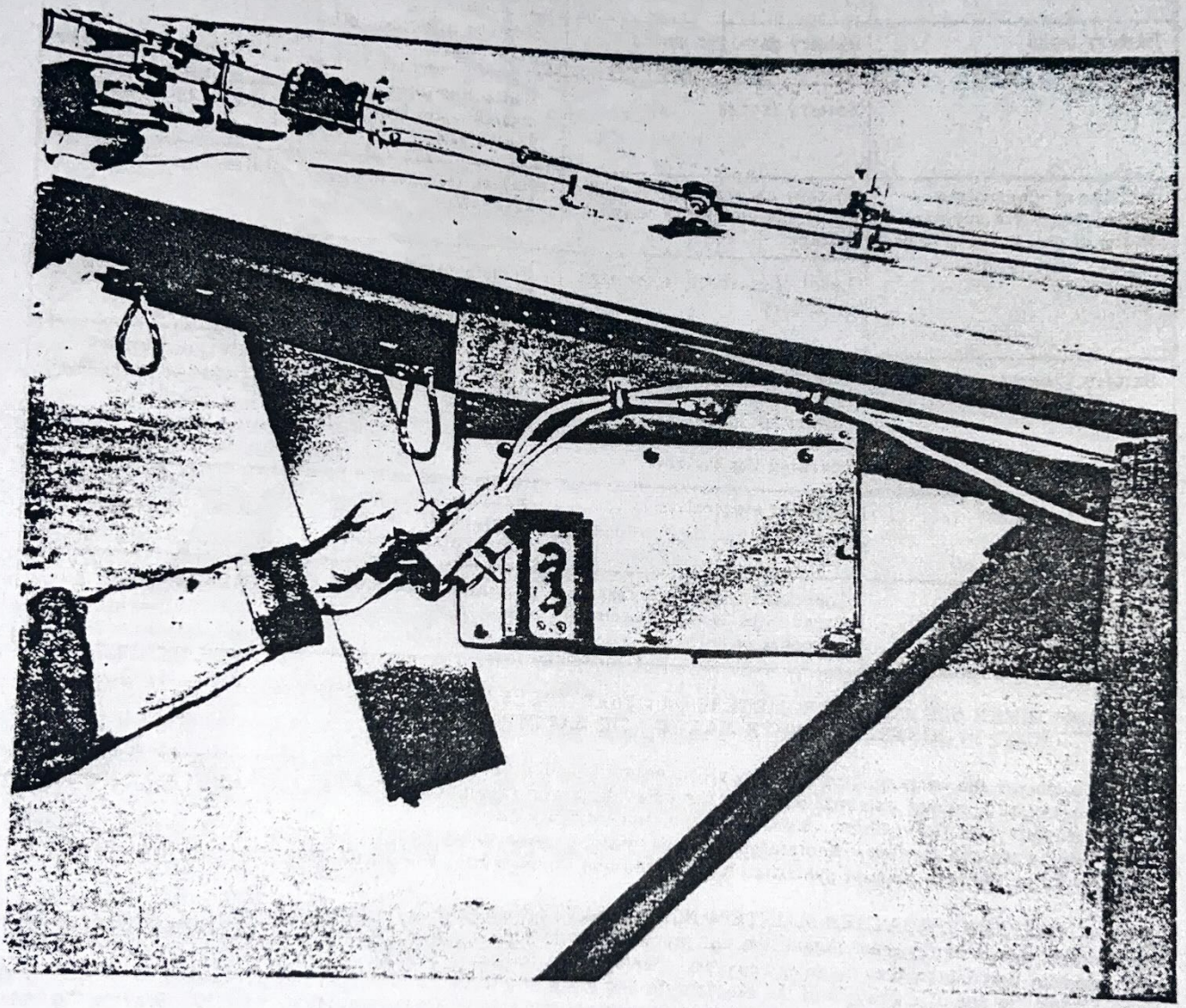


Figure 83-1-5. Battery Installation (Four-Place Configuration)

Table 83-1-L. Troubleshooting the Battery

TROUBLE	PROBABLE CAUSE	REMEDY
Battery will not hold charge	Battery cell(s) worn out or defective	Replace defective cell(s).
	Internal short circuit	Replace defective cell(s).
	Excessive power demands on battery	Reduce use of starter. Use external power whenever possible. Turn the MASTER SWITCH to the OFF position when the helicopter is idle. Check wiring for short circuits.
Battery leaks	Battery damaged due to excessive overcharging.	Replace affected cells.
	Battery frozen	Replace battery. Observe extreme weather maintenance instructions. (Refer to paragraph 83-10-42.)
Spillage of electrolyte (excessive white substance on top of cell or in drip pan)	Battery charging too fast due to excess generator output voltage	Adjust voltage regulator. (Refer to paragraph 83-31-30.)
	Level of electrolyte too high in battery	Reduce battery electrolyte level. Add electrolyte to new battery only as required. (Refer to paragraph 83-10-41.)
Battery freezes	Low specific gravity of electrolyte due to discharge of battery or to addition of water to the battery without charging the battery	Replace battery. Observe extreme weather maintenance instructions. (Refer to paragraph 83-10-42.)
Short battery life	Level of electrolyte is low	Raise battery electrolyte level. Keep battery properly filled with electrolyte. (Refer to paragraph 83-10-41.)
Low battery output (battery known to be fully charged)	Corrosion between nickel plated buss bars and terminal posts of cells	Remove corrosion. Replace nickel plated buss bars.

CAUTION: NEVER USE ANY HYDROMETERS OR OTHER TOOLS ON THE BATTERY WHICH HAVE BEEN USED IN CONNECTION WITH A LEAD ACID BATTERY.

c. To charge the battery, remove it to a convenient location for charging, or the battery can be charged in the helicopter by applying external power to the external power receptacle. The external power source should be capable of supplying 27.5v(+0.5v, -0.0v)under the current drain used.

d. For additional service and maintenance information, refer to the Sonotone Battery (Sintered-Plate Nickel-Cadmium Type) Service Manual published by the Sonotone Corporation, Elmsford, New York.

83-10-42. EXTREME WEATHER MAINTENANCE OF BATTERY. Satisfactory performance of the battery in cold weather requires frequent inspection and maintenance to prevent freezing and to give satisfactory operation. It is essential that the battery be fully charged. Perform the following steps:

a. Check the specific gravity of the electrolyte and state of charge as described in paragraph 83-10-60. The minimum specific gravity reading (temperature corrected) for cold weather operation is 1.250. Service the battery if the above reading decreases below this value.

b. Batteries in a partially or completely discharged state will freeze at comparatively high temperatures. If the helicopter is to be idle and exposed to low temperatures for more than a day, remove the battery from the helicopter and store it in a warm place.

83-10-60. TESTING THE SPECIFIC GRAVITY OF BATTERY ELECTROLYTE.

CAUTION: NEVER USE ANY HYDROMETERS OR OTHER TOOLS ON THE BATTERY WHICH HAVE BEEN USED IN CONNECTION WITH A LEAD ACID BATTERY.

To check the specific gravity of the battery electrolyte, remove the filler caps and insert a hydrometer. If the reading (temperature corrected) is below 1.250, add 1.320 specific gravity potassium hydroxide (HOH), reagent grade, to bring the liquid level to the "normal" area indicated on the side of battery case.

NOTE: The specific gravity of the electrolyte does not change sufficiently between the charged and uncharged condition to indicate the state of charge. To determine the state of charge, place the battery on a constant voltage charger at 1.55 volts per cell. If it needs charge, it will accept current at a high rate. If it is fully charged, it will accept very little current.

83-20-1. GENERATOR. (See figure 63-1-2.)

83-20-2. DESCRIPTION. The generator is mounted horizontally on the left-hand side of the helicopter engine. As viewed from the outboard end, the generator is driven in a clockwise direction at a speed of 6246 rpm when the engine is turning at 3200 rpm. The generator is rated at 50 amperes at 28vdc, with the output controlled by the voltage regulator to 27.5v (+0.5v, -0.0v). The generator circuit to the electrical system is opened by the reverse current cutout relay when the MASTER SWITCH is turned to the OFF position. The field circuit of the generator is protected by the 10-amp GEN FIELD circuit breaker. A 1.0 ufd capacitor is connected across the armature output terminals of the generator to smooth out the ripple voltage in the d-c output and prevent generator interference within the radio set. When the generator is operating, the MASTER SWITCH turned to the on position, the GEN WARNING LIGHT on the instrument panel glows if the generator is not producing satisfactory output. This operation of the GEN WARNING LIGHT is controlled by the reverse cutout relay as follows:

a. One terminal of the GEN WARNING LIGHT receives power through the GEN WARNING circuit breaker. This circuit through the light is completed through an 80-ohm resistor to ground. The terminal of the light which is connected to the 80-ohm resistor is also connected to the reverse current cutout relay.

b. When the generator is working properly, the reverse current relay provides this terminal of the light with a voltage equal to that provided the other terminal of the light through the GEN WARNING circuit breaker. These equal voltages at each terminal of the light cancel, extinguishing the light.

c. If the generator output fails or drops to an abnormally low voltage, or if current attempts to flow into the generator from the battery, the generator is disconnected from the rest of the power supply system by the reverse current cutout relay. At the same time the reverse current cutout relay removes the generator voltage from the terminal of the GEN WARNING LIGHT which is connected to the 80-ohm resistor. The GEN WARNING LIGHT receives battery voltage through the GEN WARNING circuit breaker and will be lighted with the circuit completed to ground through the 80-ohm resistor.

d. The GEN WARNING LIGHT can be tested by pushing it on the lens cap thereby grounding the terminal normally connected to the reverse current cutout relay. The generator output current and voltage are indicated on the volt-ammeter at the instrument panel, as described in paragraph 83-66-1. The generator is cooled by air from the cooling system. The air passes through the blast tube from the cooling fan shroud to the end of the generator housing, and is expelled through openings in the generator housing.

83-20-3. TROUBLESHOOTING THE GENERATOR. In the event of functional failure of the generator, voltage regulator, or reverse current cutout, pull the GEN FIELD circuit breaker up to the off position. This action removes the generator from the power circuit without disconnecting the battery. Evidence of failure of the generator or of some unit in the generator circuit will be provided by the GEN WARNING LIGHT, or by an abnormally high voltage indication. Refer to Table 83-1-II for troubleshooting procedures for the generator.

83-20-10. REMOVAL OF GENERATOR.

a. Disconnect the three wires from the generator terminals, and identify if necessary. Disconnect the blast tube from the generator by releasing the hose clamp at the generator housing.

b. Remove the nuts and washers from the generator mounting studs.

c. Remove the generator by pulling outward until its shaft is free of the accessory housing pad. Remove the generator mounting gasket.

83-20-11. INSTALLATION OF GENERATOR.

a. Place the generator mounting gasket on the generator mounting studs of the accessory housing pad.

b. Carefully position the generator on the generator mounting studs, engaging the splines of the generator shaft with the splines of the generator drive adapter. The generator housing should be oriented so that the three generator terminals line up pointing downward, approximately parallel to the vertical centerline. The connection for the blast tube should face forward. (The blast tube connection can be rotated if necessary by loosening the brush cover on the generator to which the blast tube connection attaches.)

c. Connect the three wires to the generator terminals, making sure that the correct terminal connections are made. Connect the blast tube to the generator housing, routing the blast tube forward to the cooling fan shroud duct.

83-20-30. ADJUSTMENT OF GENERATOR. If the generator fails to build up voltage because of loss of residual magnetism or reversed polarity in the field, flash the generator field as follows:

a. Remove the cover from the engine junction box.

b. Connect a length of cable to the F+terminal of the voltage regulator.

c. Turn the MASTER SWITCH to the on position and push the GEN FIELD circuit breaker down to the on position.

d. Momentarily touch the free end of the cable to the output terminal, A1, of the battery relay several times.

e. Start the engine and note the voltage reading on the voltammeter.

f. If no voltage is indicated, repeat step d above several times, with the engine running, as required for adequate flashing.

g. If no voltage is indicated and the voltage regulator is known to be working properly, replace the generator.

h. Stop the engine. Disconnect the cable from the F+ terminal of the voltage regulator.

83-20-40. CLEANING THE GENERATOR. Clean the exterior of the generator with a cloth slightly moistened with dry cleaning solvent.

83-20-41. MINOR REPAIR OF THE GENERATOR. If it is necessary to perform minor repair on the generator (i.e., replacement of brushes, etc.) instead of replacing the unit, refer to the applicable handbook of service instructions for the generator. Replace the generator if service instructions are not available.

83-20-60. TESTING THE GENERATOR. Normally the generator output voltage can be checked by reading the voltammeter. To test the generator output voltage independently of the operation of the voltammeter and the generator reverse current cutout, a test voltammeter can be used. Connect the voltmeter to the test jacks on the outside of the engine junction box. When the helicopter engine is turning at 3200 rpm, the generator output voltage measured at the test jacks or at the voltammeter should be 27.5v (+0.5v, -0.0v), if the generator and voltage regulator are operating properly. (Be sure the GEN FIELD circuit breaker is pushed down to the on position.)

83-30-1. ENGINE JUNCTION BOX. (See figure 83-1-6.)

83-30-2. DESCRIPTION. The engine junction box is located on the right-hand side of the engine deck. The engine junction box houses the voltage regulator, the generator reverse current cutout relay, the ammeter shunt and ammeter fuses, the battery relay, the starter relay, and a terminal block. The engine junction box is provided with a cover which can be easily removed for access to the components inside. All wiring to and from the engine junction box (except the power wire from the battery and the power wire to the protection panel) is connected by means of the receptacle connector mounted on the engine junction box and the engine deck plug connector just forward of the engine junction box.

83-30-10. REMOVAL OF ENGINE JUNCTION BOX. When removing the engine junction box, detach the battery disconnect assembly from the battery to prevent an accidental short circuit. Remove engine junction box as follows:

a. Disconnect the aft plug connector from the engine junction box.

b. Disconnect the engine deck plug connector. Place a protective covering over the electrical connectors to prevent the entrance of dirt.

c. Disconnect the power wire P6A6 from the battery at terminal A2 of the battery relay, which is located just aft of the reverse current cutout relay in the engine junction box. Also disconnect the power wire PSD10 to the protection panel at terminal A1 of the battery relay.

d. Remove the screws which secure the engine junction box to the engine deck.

e. Lift the engine junction box slowly, carefully pulling the two disconnected wires through the grommets and out of the engine junction box. Place an insulating covering over the disconnected terminal end of wire P6A6 to prevent an accidental short circuit.

f. When removing one of the units from the engine junction box, detach the battery disconnect assembly from the battery to prevent an accidental short circuit.

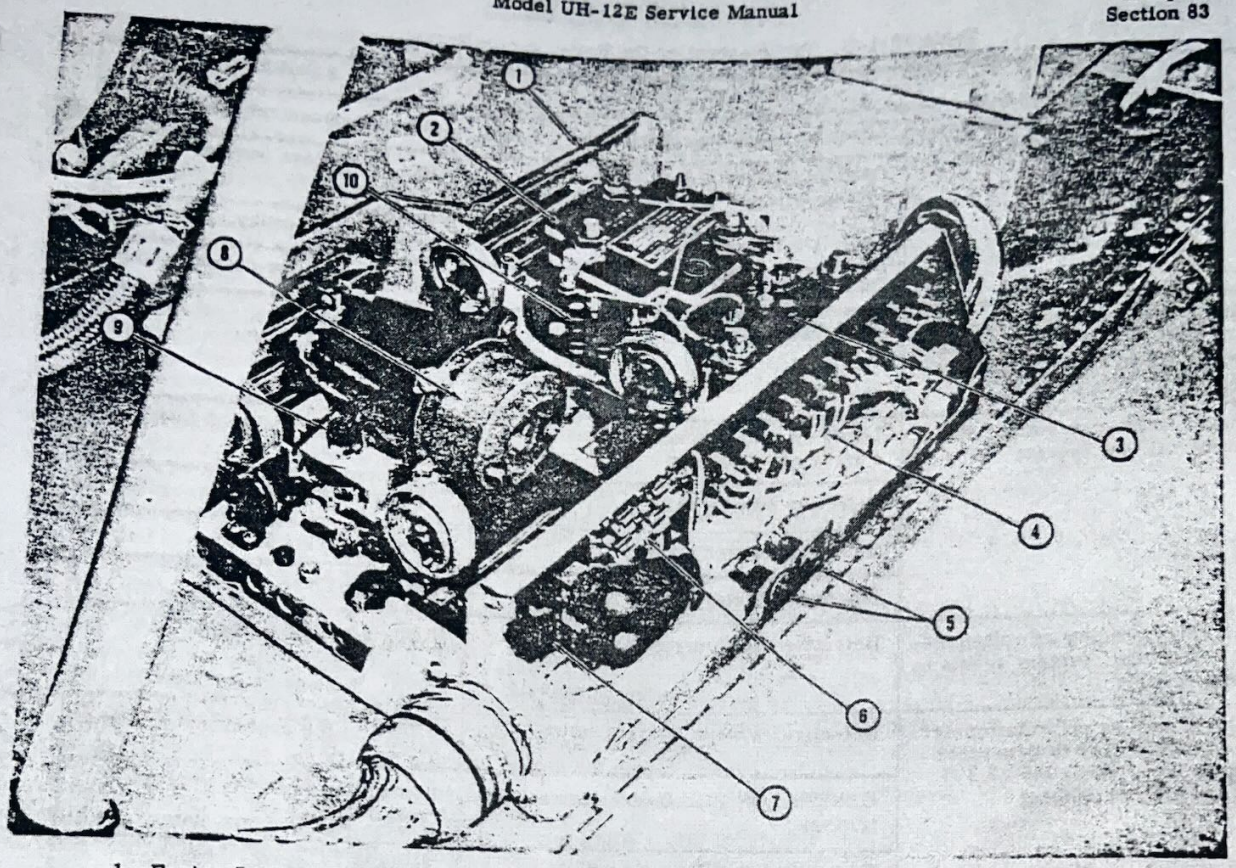
g. Disconnect the wiring from the terminals of the unit which is to be removed. Identify the wires as necessary. Remove the screws or bolts which attach the unit to its mounting in the engine junction box.

CAUTION: WHEN EITHER THE ENGINE JUNCTION BOX OR ONE OF THE UNITS CONTAINED IN IT IS REMOVED, LEAVE THE BATTERY DISCONNECT ASSEMBLY DETACHED UNTIL THE PART REMOVED HAS BEEN REINSTALLED OR REPLACED. PLACE A WARNING NOTE ON THE BATTERY DISCONNECT ASSEMBLY AND ON THE EXTERNAL POWER RECEPTACLE INDICATING THE WORK BEING PERFORMED.

83-30-11. INSTALLATION OF ENGINE JUNCTION BOX. Installation of the engine junction box is the reverse of removal.

83-30-40. CLEANING THE ENGINE JUNCTION BOX. Blow any accumulated dust or dirt from the engine junction box with a mild blast of filtered low pressure air. Wipe the exterior of the individual units with a clean, lint-free cloth.

83-31-1. VOLTAGE REGULATOR. (See figure 83-1-6.)



1. Engine Junction Box
2. Reverse Current Cutout Relay
3. Starter Relay
4. Engine Junction Box Terminal Strip
5. Test Jack
6. Ammeter Fuses
7. Ammeter Shunt
8. Voltage Regulator
9. Voltage Regulator Adjustment Screw
10. Battery Relay

Figure 83-1-6. Engine Junction Box Installation

83-31-2. DESCRIPTION. The voltage regulator is mounted in the aft end of the engine junction box, and is secured to its mounting base with screws. The voltage regulator contains a variable resistance in the form of a carbon pile. This variable resistance is connected in series with the generator field winding which is supplied by the generator armature output. The carbon pile adjusts the voltage applied to the generator field winding, thereby keeping the armature output voltage constant within ±2.5 percent of regulator voltage setting. A manually adjustable variable resistance located in the voltage regulator support permits adjustment of the regulated voltage to the required 27.5 volts (+0.5v, -0.0v). The generator armature negative output terminal is grounded to the helicopter structure through a ground terminal in the junction box.

83-31-3. TROUBLESHOOTING THE VOLTAGE REGULATOR. Refer to Table 83-1-II for troubleshooting procedures.

83-31-10. REMOVAL OF VOLTAGE REGULATOR. Refer to paragraph 83-30-10 for removal procedure.

83-31-11. INSTALLATION OF VOLTAGE REGULATOR. Refer to paragraph 83-30-11 for installation procedure.

83-31-30. ADJUSTMENT OF VOLTAGE REGULATOR. Adjust the voltage regulator as follows:

a. Start the helicopter engine. Operate the engine at its normal speed. Turn the MASTER SWITCH to the on position and push the GEN FIELD circuit breaker down to the on position. Allow approximately 15 minutes for the voltage regulator to reach operating temperature.

b. Read the generator output voltage on the voltammeter, or connect a test d-c voltmeter to the test jacks on the engine junction box as described in paragraph 83-20-60.

Table 83-1-II. Troubleshooting the Power Supply System

TROUBLE	PROBABLE CAUSE	REMEDY
No voltage reading on voltammeter. Starter will not operate	Loose or corroded connections	Clean and tighten connections.
	Open or short in power supply system wiring	Repair or replace wiring.
	Defective battery relay	Replace battery relay.
	Defective battery	Replace battery or defective cells.
Voltage reading on voltammeter. Starter will not operate. Voltage reading drops significantly when starter button is pressed	Weak battery	Recharge battery.
Voltage reading on voltammeter. Starter will not operate	Loose or corroded connections in starter power circuit	Clean and tighten connections.
	Defective starter relay	Replace starter relay.
	Defective starter button	Replace starter button.
	Defective starter	Replace starter.
No voltage reading on voltammeter. Electrical system seems to work properly	Defective voltammeter	Replace voltammeter.
Voltage reading on voltammeter does not increase to generator voltage (approximately 27.5V) when engine is running	Defective reverse current cutout relay	Replace reverse current cutout relay.
	GENERATOR FIELD circuit breaker tripped	Reset GENERATOR FIELD circuit breaker.
	Generator capacitor shorted	Replace generator capacitor.
	Generator inoperative	Replace generator.
Fluctuating generator output voltage	Loose or corroded wiring connections	Clean and tighten connections.
	Generator brushes worn or restricted in brush holders	Replace brushes.
	Brush springs weak	Replace springs.
	Generator commutator dirty, glazed, or pitted	Refer to paragraph 83-20-41.
	Voltage regulator improperly adjusted	Adjust voltage regulator.
	Voltage regulator unstable	Replace voltage regulator.
No amperage reading or erratic amperage reading on voltammeter, with generator operating	Loose or corroded connections at ammeter shunt	Clean or tighten connections.
	Ammeter shunt shorted	Replace ammeter shunt.
	Defective voltammeter	Replace voltammeter.
	Blown AMMETER FUSE(S)	Replace fuse(s).
GEN WARNING LIGHT glows when voltammeter indicates proper generator output voltage	Socket of GEN WARNING LIGHT defective, or stuck in the depressed test position	Replace GEN WARNING LIGHT socket.

Table 83-1-II. Troubleshooting the Power Supply System (cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
Generator output voltage too high or too low	Voltage regulator improperly adjusted	Adjust voltage regulator.
	Voltage regulator defective	Replace voltage regulator.
	Voltammeter defective	Replace voltammeter.
Generator output voltage too low	Weak generator field	Flash generator field.(Refer to paragraph 83-20-30.)
	Defective generator	Replace generator.
Adjustment of voltage regulator fails to affect generator output voltage	Defective voltage regulator	Replace voltage regulator.

c. Turn the landing light switch on cyclic control stick grip to the ON position and then to the OFF position several times. This action will repeatedly load and unload the electrical system. Observe the effect of the changing load on the regulated voltage.

d. The regulated voltage should remain between 27.5 and 28 volts under all load conditions. If the voltage is not in this range, remove the cover from the engine junction box. Use a screwdriver to turn the voltage regulator adjustment screw as necessary to produce the correct generator output voltage (see figure 83-1-6.) Turn the adjustment screw, clockwise to increase the voltage and counterclockwise to decrease the voltage, one notch at a time, allowing several seconds for the voltage to stabilize before making additional corrections.

e. If the voltage cannot be adjusted to within the correct range, check the voltage regulator for malfunction by replacing it with a unit known to be serviceable. Internal adjustment of a defective voltage regulator should be performed by an approved repair station only.

f. Replace the cover on the engine junction box and shut down the engine.

83-31-60. TESTING THE VOLTAGE REGULATOR. If the generator output voltage is correct, as measured or as adjusted in paragraph 83-31-30, the voltage regulator is working properly. If the generator output voltage is not correct, and adjustment of the variable resistance as in paragraph 83-31-30 has no effect on the output voltage, the voltage regulator is defective.

83-32-1. REVERSE CURRENT CUTOUT RELAY. (See figure 83-1-6.)

83-32-2. DESCRIPTION. The reverse current cutout relay is mounted in the forward end of the engine junction box, and is secured to its mounting base with screws. These screws furnish the ground connection for the unit. The operation of the reverse current cutout relay is described in paragraph 83-20-2.

83-32-3. TROUBLESHOOTING THE REVERSE CURRENT CUTOUT RELAY. Refer to Table 83-1-II for troubleshooting procedure.

83-32-10. REMOVAL OF REVERSE CURRENT CUTOUT RELAY. Refer to paragraph 83-30-10 for removal procedure.

83-32-11. INSTALLATION OF REVERSE CURRENT CUTOUT RELAY. Refer to paragraph 83-30-11 for installation procedure.

83-32-30. ADJUSTMENT OF REVERSE CURRENT CUTOUT RELAY. The reverse current cutout relay should be adjusted by an approved repair station only.

83-32-60. TESTING THE REVERSE CURRENT CUTOUT RELAY. To test the reverse current cutout relay, its operation must be checked when the generator is not producing voltage, and also when the generator is producing sufficient output voltage to operate the reverse current cutout relay. The procedure for these steps is given below:

a. Turn the MASTER SWITCH to the on position. The GEN WARNING LIGHT should come on.

b. Start the engine. If the GEN WARNING LIGHT goes out and the generator output voltage measured at the voltammeter is correct (paragraph 83-31-30), the reverse current cutout relay is operating properly.

83-33-1. AMMETER SHUNT AND AMMETER FUSES. (See figure 83-1-6.)

83-33-2. DESCRIPTION. The ammeter shunt is mounted inside the engine junction box, near the aft end of the

terminal block support. The ammeter shunt is connected in series with the generator output circuit to the reverse current cutout relay. The ammeter shunt provides a low resistance path for the main portion of the generator output current while a very small proportion of the current is bypassed from the shunt to the ammeter indicator through the ammeter fuses which are mounted just forward of the ammeter shunt. One fuse is provided for each of the two leads to the ammeter.

83-33-3. TROUBLESHOOTING THE AMMETER SHUNT AND AMMETER FUSES. Refer to Table 83-1-II for troubleshooting procedure.

83-34-1. BATTERY RELAY. (See figure 83-1-6.)

83-34-2. DESCRIPTION. The battery relay is mounted just aft of the reverse current cutout in the engine junction box. The contacts of this relay connect power from the battery (or from the external power relay) to the remainder of the power supply system. The power input contact of the battery relay is connected to the terminal of the battery relay coil. The circuit through the coil is completed through the MASTER SWITCH to energize the battery relay when the MASTER SWITCH is turned to the on position.

83-34-3. TROUBLESHOOTING THE BATTERY RELAY. Refer to Table 83-1-II for troubleshooting procedure.

83-34-10. REMOVAL OF BATTERY RELAY. Refer to paragraph 83-30-10 for removal procedure.

83-34-11. INSTALLATION OF BATTERY RELAY. Refer to paragraph 83-30-11 for installation procedure.

83-34-60. TESTING THE BATTERY RELAY. With the engine stopped, observe the voltage indication at the voltammeter when the MASTER SWITCH is turned to the OFF position and then to the on position. If the voltammeter indicates battery voltage (approximately 24 v) and zero voltage respectively, for the on and OFF positions of the MASTER SWITCH, the battery relay is operating properly.

83-35-1. STARTER RELAY. (See figure 83-1-6.)

83-35-2. DESCRIPTION. The starter relay is mounted inside the engine junction box in the forward right-hand area, outboard of the reverse current cutout. The contacts of this relay connect power from the battery relay to the starter. The starter relay is energized through a jumper wire from its input power when the circuit through its coil is completed to ground through the starter button. The starter button is located in the end of the throttle grip of the collective stick.

83-35-3. TROUBLESHOOTING THE STARTER RELAY. Refer to Table 83-1-II for troubleshooting procedure.

83-35-10. REMOVAL OF STARTER RELAY. Refer to paragraph 83-30-10 for removal procedure.

83-35-11. INSTALLATION OF STARTER RELAY. Refer to paragraph 83-30-11 for installation procedure.

83-35-60. TESTING THE STARTER RELAY. If the starter operates when the starter push button is released, the starter relay is operating properly.

83-40-1. EXTERNAL POWER RECEPTACLE AND EXTERNAL POWER RELAY. (See figure 10-15.)

83-40-2. DESCRIPTION. The external power receptacle and the external power relay are attached to the right-hand aft side of the firewall, enclosed by the external power receptacle cover assembly. The external power receptacle is the connection point for attaching external power to the helicopter. The external power relay connects the positive input terminal of the external power receptacle to the input terminal of the battery relay, in parallel with the battery. The negative terminal of the external power receptacle and the negative power wire from the battery disconnect assembly are grounded to the helicopter structure at the external power receptacle. The external power relay is operated by the external power input through the short pin of the external power receptacle.

83-40-3. TROUBLESHOOTING THE EXTERNAL POWER RECEPTACLE AND EXTERNAL POWER RELAY. Table 83-1-III contains instructions for troubleshooting the external power receptacle and external power relay.

83-40-10. REMOVAL OF EXTERNAL POWER RECEPTACLE AND EXTERNAL POWER RELAY.

a. Detach the battery disconnect assembly from the battery to prevent an accidental short circuit.
b. Remove the external power receptacle cover assembly by releasing the three studs at the top, bottom, and aft surfaces.
c. Disconnect the wiring from the terminals of the unit to be removed.
d. Remove the unit by removing its attaching screws or bolts.

CAUTION: DO NOT CONNECT THE BATTERY DISCONNECT ASSEMBLY TO THE BATTERY UNTIL THE PART REMOVED HAS BEEN REINSTALLED OR REPLACED.

83-40-11. INSTALLATION OF EXTERNAL POWER RECEPTACLE AND EXTERNAL POWER RELAY. Installation of these units is the reverse of removal.

83-40-40. MINOR REPAIR OF EXTERNAL POWER RECEPTACLE. Replace the external power receptacle if its insulator is cracked or if the receptacle is excessively burned or corroded.

83-40-41. CLEANING THE EXTERNAL POWER RECEPTACLE. Wipe accumulated dust from the external power receptacle and the external power receptacle cover assembly with a clean, dry, lint-free cloth.

83-50-1. POWER DISTRIBUTION SYSTEM.

83-50-2. DESCRIPTION. The power distribution system is centered at the lower section of the instrument panel and in the protection panel. This system provides power to all instrument, equipment and lighting circuits, except for the starter and the engine ignition system. Power for the starter is provided directly by the power supply system, as described in paragraph 83-62-1. Power for the engine ignition system is provided by magnetos on the engine. The ignition system is controlled by the IGNITION switch which is located on the instrument panel. The MASTER SWITCH, three fuses, and seven push-type circuit breakers are provided on the instrument and the protection panels. These circuit breakers distribute the power from the main bus at the protection panel and protect the circuits against overload. Wiring to the protection panel is connected through the protection panel electrical connector in the instrument tunnel at the forward end of the panel. Wiring to the instruments, switches and lights of the instrument panel is connected through the instrument panel electrical connector below the instrument panel on the upper surface of the instrument tunnel. Wiring on the cyclic control grip switch on the cyclic sticks is connected through the cyclic control stick electrical connectors in the seat deck structure. Wiring to the various units mounted on the basic body structure under the seat is connected through the underseat terminal block. Spare wiring for radio, auxiliary and accessory equipment is installed in the instrument panel and protection panel electrical connectors to provide simplified wiring installation when additional circuit provisions are required in conjunction with accessory equipment installation.

83-50-3. TROUBLESHOOTING THE POWER DISTRIBUTION SYSTEM. Failure of any of the electrically operated units of the helicopter may be due to failure of some element of the power distribution system. A blown fuse, loose or corroded connections, or defective wiring are the probable causes of power distribution system trouble. A test d-c voltmeter can be used to check that each unit is supplied with its correct power requirements.

83-50-40. MINOR REPAIR AND MAINTENANCE OF THE POWER DISTRIBUTION SYSTEM. Refer to paragraph 83-1-40 for repair and maintenance procedures.

83-51-1. PROTECTION PANEL ASSEMBLY. (See figure 83-1-7.)

83-51-2. DESCRIPTION. The protection panel is mounted on the pedestal tunnel aft of the bottom of the instrument panel. The protection panel has a removable plastic panel which distributes light without causing cabin glare during night flying.

Table 83-1-III. Troubleshooting the External Power Receptacle and External Power Relay

TROUBLE	PROBABLE CAUSE	REMEDY
No power when external power is connected to external power receptacle	External power relay contacts corroded or pitted	Replace external power relay.
	External power relay coil not energized	Be sure + voltage is applied to the short pin of the external power receptacle to energize the external power relay.
	Loose or corroded connections at external power relay or external power receptacle	Clean and tighten connections.
	Insufficient power from external power source	Check output of external power source.

1. Instrument Panel
2. Panel Light
3. INSTRUMENT LIGHTS Knob
4. MASTER SWITCH
5. OIL TEMP INDIC ENG-XMSN Switch
6. XMISSION OIL TEMP Warning Light
7. Hinge Pin
8. LANDING LIGHT Circuit Breaker
9. GEN FIELD Circuit Breaker
10. XMSN & GEN WARNING Circuit Breaker
11. MIXTURE Control Lever
12. FUEL PUMP Toggle Switch
13. FUEL PUMP Circuit Breaker
14. Protection Panel
15. Plastic Panel
16. TRIM MOTORS Circuit Breaker
17. RADIO Circuit Breaker
18. FUEL QUANTITY Fuse
19. CARB AIR TEMP Fuse
20. ENG GAGE UNIT Fuse
21. ACCESSORY Circuit Breaker
22. UTILITY OUTLET Circuit Breaker
23. Carburetor Air Temperature Control Lever
24. AUX Circuit Breaker
24A. Lighting Circuit, Circuit Breaker
25. XMISSION OIL PRESS Warning Light
26. POSITION LIGHTS Switch
27. ANTI COLL Light Switch
28. IGNITION Switch
29. GEN WARNING LIGHT
30. Voltammeter

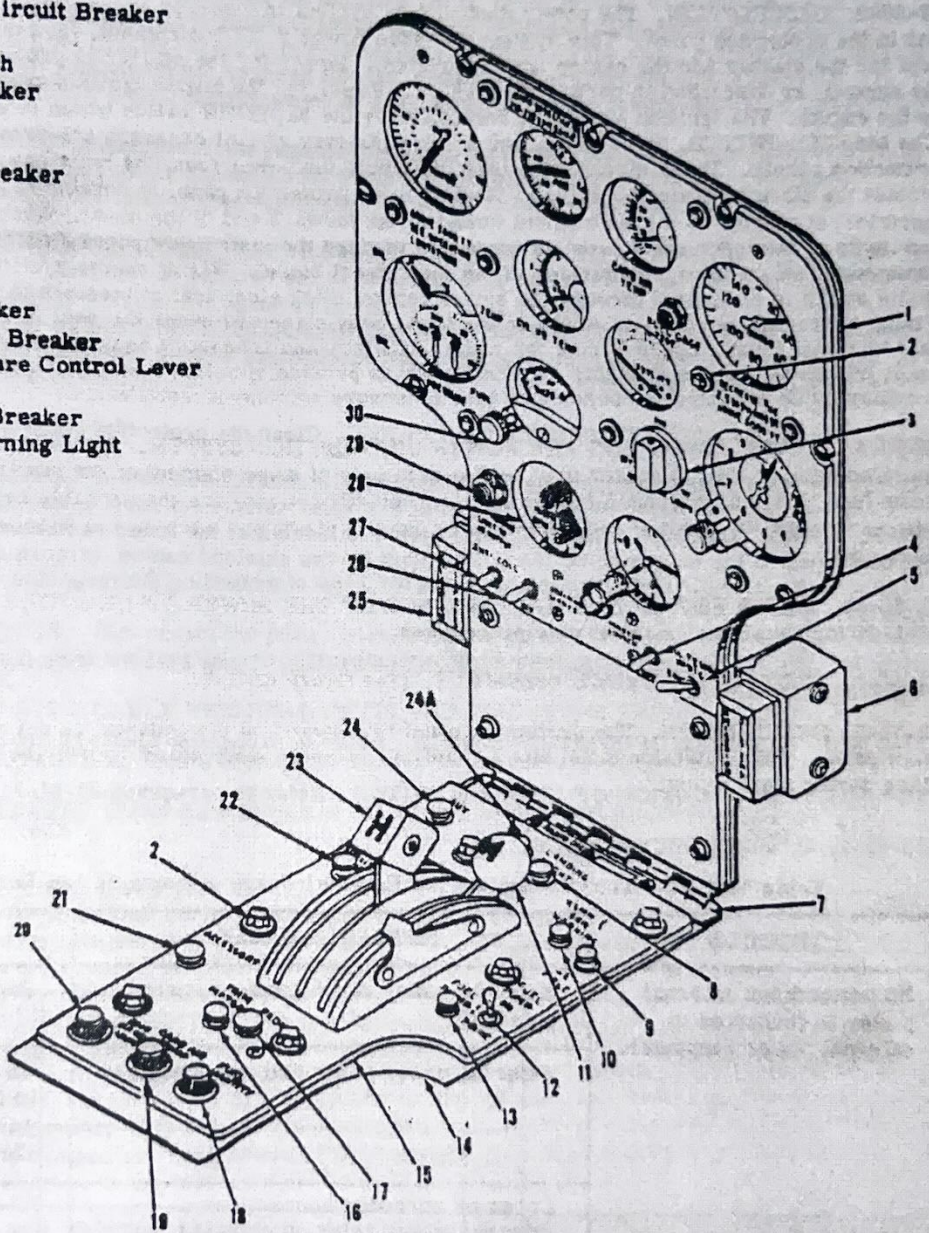


Figure 83-1-7. Electrical Controls and Indicators

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83-51-10. REMOVAL OF SWITCHES, CIRCUIT BREAKERS, FUSEHOLDERS AND PANEL LIGHTS FROM THE PROTECTION PANEL ASSEMBLY. Use the following procedure for removal of any of the units from the protection panel:

a. Turn the MASTER SWITCH to the OFF position.
b. Remove the screws from the access panel on the left-hand side of the pedestal tunnel, and remove the panel.
c. Disconnect the protection panel plug connector inside the pedestal tunnel at the forward end of the protection panel.
d. Remove the two screws attaching the plastic panel to the protection panel. Remove the caps from the six panel lights and remove the six lights from the protection panel. Remove the attaching screw from the mixture control knob and remove the knob from the lever. Then lift the plastic panel away from the protection panel, taking care not to pry against the plastic panel.
e. Remove the ten screws attaching the protection panel to the pedestal tunnel.
f. Remove the pin from the hinge at the forward end of the protection panel.
g. Move the mixture control lever to the extreme aft position.
h. Remove the protection panel by lifting it upward, tilting it as necessary to clear the engine quadrant levers in the center.
i. Disconnect the wiring from the switch, circuit breaker, or fuseholder to be replaced. Identify the wires as necessary. Replacement of any of these units is conventional.

NOTE: Access to some of the switches, circuit breakers, and fuseholders at the edges of the protection panel may be obtained without removing the protection panel from the helicopter by removing the access panels from the left and right-hand sides of the pedestal tunnel.

83-51-11. INSTALLATION OF SWITCHES, CIRCUIT BREAKERS, FUSEHOLDERS AND PANEL LIGHTS IN THE PROTECTION PANEL. Installation of these units is the reverse of removal.

83-51-40. MINOR REPAIR AND MAINTENANCE OF PROTECTION PANEL. With all power disconnected, check the operation of switches, circuit breakers, and fuseholders with an ohmmeter. Replace any defective unit or units with corroded terminals.

83-51-41. CLEANING THE PROTECTION PANEL. Clean the protection panel with a clean, dry, lint-free cloth.

83-52-1. IGNITION SWITCH. (See figure 83-1-7.)

83-52-2. DESCRIPTION. The IGNITION switch is located at the lower center area of the instrument panel. It is connected to the magnetos on the power plant by two shielded cables, through an electrical connector at the engine deck. The IGNITION switch provides a means of grounding the magnetos which de-energizes the ignition system.

83-52-3. TROUBLESHOOTING THE IGNITION SWITCH. Table 83-1-IV contains instructions for troubleshooting the IGNITION switch.

83-52-10. REMOVAL OF IGNITION SWITCH. Refer to paragraph 83-51-10 for removal procedure.

83-52-11. INSTALLATION OF IGNITION SWITCH. Refer to paragraph 83-51-11 for installation procedure.

83-53-1. UTILITY RECEPTACLE.

Table 83-1-IV. Troubleshooting the Ignition Switch

TROUBLE	PROBABLE CAUSE	REMEDY
IGNITION switch does not turn ignition system on	Grounded cable from IGNITION switch to magneto(s)	Check resistance between each cable and ground with ohmmeter. Repair or replace cable if defective.
	Defective IGNITION switch	Replace with serviceable IGNITION switch.
IGNITION switch does not turn either or both magnetos off	Open circuit in cable from IGNITION switch to magneto(s)	Repair or replace cable.
	Defective IGNITION switch	Replace with serviceable IGNITION switch.

83-53-2. DESCRIPTION. The utility receptacle is mounted on the forward face of the seat structure. The utility receptacle provides a 28 vdc outlet for auxiliary electrical equipment. Power for the utility receptacle is provided by the 15-ampere UTILITY OUTLET circuit breaker on the protection panel.

83-54-1. GROUNDING PROVISIONS. (See figure 10-16.)

83-54-2. DESCRIPTION. An engine ground strap is installed between the engine support assembly and the engine. The engine ground strap is attached to a stud at the upper aft right-hand corner of the engine crankcase, and is bolted to an engine mount fitting at the adjacent corner of the engine support assembly. The engine ground strap provides an electrical connection between the engine crankcase and the helicopter structure. This connection serves as a ground return path for the units mounted on the engine housing and grounded to the engine crankcase. The engine ground strap also prevents the accumulation of electrostatic charge on the engine.

a. An additional ground strap is attached between the lower left-hand aft corner of the engine support assembly and the corresponding engine support assembly mount.

b. A receptacle for grounding fuel nozzles to the helicopter is located in the skin on the left-hand side of the tail boom transition section.

83-54-40. MINOR REPAIR OF ENGINE GROUND STRAP. Make sure the nuts which secure the engine ground straps are kept tight to achieve a good ground return path for the units mounted on the engine crankcase.

83-60-1. ELECTRICALLY OPERATED EQUIPMENT.

83-60-2. DESCRIPTION. The electrically operated equipment includes the starter, starting vibrator, trim motors, auxiliary fuel pump, fuel primer solenoid, voltammeter, lighting and the engine instruments. Electrically operated units are described in the following paragraphs.

83-61-1. ELECTRICALLY OPERATED INSTRUMENTS. (See figure 83-1-7.)

83-61-2. DESCRIPTION. The engine instruments powered by the electrical system include the carburetor air temperature indicator, the cylinder head temperature indicator and the oil temperature indicator of the engine gage. The fuel gage is also electrically operated. The electrical systems associated with these instruments are described with the instruments in Section 81.

83-62-1. STARTER. (See figure 70-1-1.)

83-62-2. DESCRIPTION. The starter is mounted horizontally on the right-hand side of the accessory section of the engine. The starter receives power from the starter relay and is controlled by the starter button as described in paragraph 83-35-1.

83-62-3. TROUBLESHOOTING THE STARTER. Refer to Table 70-1-I for troubleshooting procedure.

83-62-10. REMOVAL OF STARTER. Disconnect the power wire from the starter terminal, and on later models, disconnect the ground wire from the ground terminal. Remove the nuts from the starter mounting studs and detach the starter from the engine.

CAUTION: INSULATE THE STARTER CABLE TERMINAL UNTIL THE STARTER IS REINSTALLED.

83-62-11. INSTALLATION OF STARTER. Installation of the starter is the reverse of removal.

83-62-40. CLEANING THE STARTER. Clean the exterior of the starter with a cloth slightly moistened with dry cleaning solvent.

83-63-1. TRIM ACTUATOR MOTORS. (See figure 38-1-1.)

83-63-2. DESCRIPTION. The trim actuator motors of the trim control system are located underneath the seat deck structure. The motors are the reversible, dual winding type, controlled by a five-position, momentary contact switch mounted on top of the cyclic control stick grip (see figure 33-1-5). The motor wiring connects to the underseat terminal block. Power is supplied through the TRIM MOTORS circuit breaker on the protection panel and a connector on each actuator motor. The momentary contact switches (with dual controls installed) are connected in parallel, with the terminals corresponding to the forward and aft switch positions connected to the longitudinal trim actuator motor; the terminals corresponding to the left and right switch positions are connected to the lateral trim actuator motor. One side of one winding of each motor is grounded at the electrical plug conector of each motor. The momentary contact switch grounds one side of an additional winding in the appropriate motor, which then operates in the desired direction.

83-63-2. TROUBLESHOOTING THE TRIM ACTUATOR MOTORS CIRCUIT. Refer to Tables 38-1-I and 83-1-V for troubleshooting information.

Table 83-1-V. Troubleshooting the Trim Actuator Motors Circuit

TROUBLE	PROBABLE CAUSE	REMEDY
One or both trim actuator motors will not turn in one or both directions	Loose or corroded wiring connections	Clean and tighten connections.
	Defective wiring	Repair or replace wiring.
	Defective trim actuator motor(s)	Replace with serviceable trim actuator motor(s).
One momentary contact switch will not properly operate trim motor(s)	Loose or corroded wiring connections	Clean and tighten connections.
	Defective wiring	Repair or replace wiring.
	Defective cyclic control stick grip	Replace with serviceable cyclic control stick grip.

83-63-10. REMOVAL OF TRIM ACTUATOR MOTORS. Refer to Section 38 for removal procedure.

83-63-11. INSTALLATION OF TRIM ACTUATOR MOTORS. Refer to Section 38 for installation procedures.

83-64-1. AUXILIARY FUEL PUMP. (See figure 72-1-9.)

83-64-2. DESCRIPTION. The auxiliary fuel pump is mounted on the engine deck near the firewall on the right-hand side of the helicopter centerline. The auxiliary fuel pump receives power through the FUEL PUMP circuit breaker. The double throw FUEL PUMP PRIME SWITCH operates the auxiliary fuel pump only, or the auxiliary fuel pump and fuel primer solenoid simultaneously when the switch is turned to the PRIME position. Refer to Section 72 for further information regarding the auxiliary fuel pump including removal, installation and trouble-shooting.

83-65-1. FUEL PRIMER SOLENOID. (See figure 72-1-2.)

83-65-2. DESCRIPTION. The fuel primer solenoid is mounted on the crankcase adjacent to the left-hand side of the carburetor on the aft side of the engine. The fuel primer solenoid receives power through the FUEL PUMP circuit breaker, and is controlled by the momentary contact pole of the FUEL PUMP-PRIME switch mounted on the right-hand side of the protection panel.

83-65-2. TROUBLESHOOTING THE FUEL PRIMER SOLENOID. If the fuel primer solenoid does not function, the trouble is probably in the external electrical circuit. Check that the wire to the fuel primer solenoid has not been strained and broken at the point where it enters the fuel primer solenoid. Check for other possible open circuits in the wiring and for a defective switch. The fuel primer solenoid is case-grounded through its attachment to the engine. If the wiring is not found faulty, check for improper grounding due to dirt or corrosion at the point where the fuel primer solenoid support clamp contacts the crankcase and the solenoid support clamp contacts the crankcase and the solenoid valve body. If dirt or corrosion is found, remove the fuel primer solenoid and clean both surfaces. Replace a nonfunctioning fuel primer solenoid when there is no defect in the external electrical circuit.

83-65-10. REMOVAL OF THE FUEL PRIMER SOLENOID. (See figure 72-1-2.) Remove the fuel primer solenoid as follows:

a. Disconnect the wire to the fuel primer solenoid at the adjacent knife disconnect.
b. Disconnect the primer line tube assembly at the coupling just above the fuel primer solenoid.
c. Remove the clamp attaching the fuel primer solenoid to the crankcase.
d. Unscrew the fuel primer solenoid from the tee below it.

83-65-11. INSTALLATION OF FUEL PRIMER SOLENOID. Installation of the fuel primer solenoid is the reverse of removal.

83-66-1. VOLTAMMETER. (See figures 81-1-1 and 83-1-7.)

83-66-2. DESCRIPTION. The voltammeter installed on the helicopter, Serial No. 954 through 2158, comprises two separate meters in one instrument; one meter is graduated in volts, and the other is graduated in amperes. On helicopters, Serial No. 2159 and subsequent, and those modified in accordance with Service Bulletin No. 2028, the single-movement meter has two scales: one for volts and one for amperes. The single-movement voltammeter indicates current at all times, unless the knob at the lower left of the meter is pressed, in which case the meter indicates voltage.

a. External connections to both voltammeters are the same. The ammeter section of the voltammeter is connected in parallel with the ammeter shunt, as described in paragraph 83-33-2, and indicates the output current of the generator.

b. The positive (+) terminal of the voltmeter section is connected to a power distribution bus in the protection panel through the GEN WARNING circuit breaker, and the negative terminal is connected to ground in the instrument panel. The voltmeter indicates operating voltage of the aircraft electrical power distribution system.

83-66-3. TROUBLESHOOTING THE VOLTAMMETER. Refer to Table 83-1-II for troubleshooting procedure.

83-66-10. REMOVAL OF VOLTAMMETER. Refer to paragraph 81-1-10 for removal procedure.

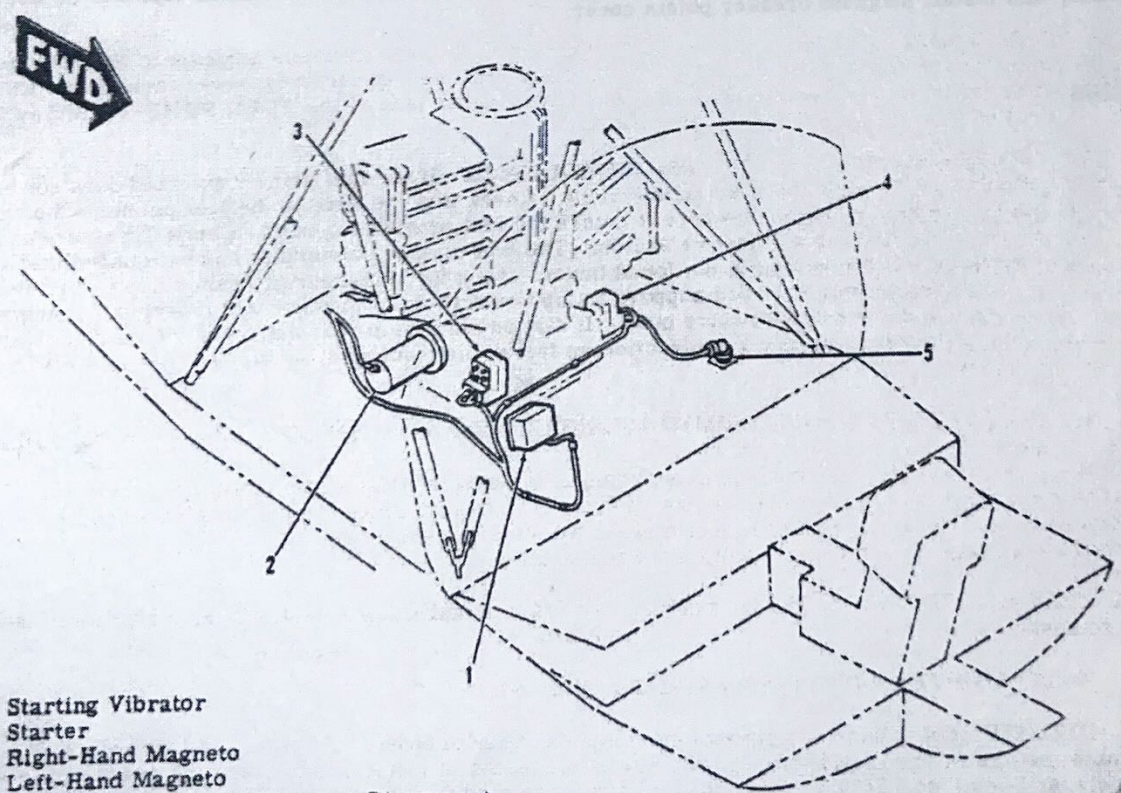
83-66-11. INSTALLATION OF VOLTAMMETER. Refer to paragraph 81-1-11 for installation procedure.

83-66-60. TESTING THE VOLTAMMETER. The ammeter instrument of the voltammeter can be assumed to be operating properly if it indicates a positive current when the generator is operating.

NOTE: When making voltage readings with the voltammeter on the instrument panel or with a test voltmeter, the MASTER SWITCH must be turned to the ON position unless otherwise noted. When performing continuity checks of wiring with an ohmmeter, or when disconnecting or connecting components or wiring, the MASTER SWITCH must be turned to the OFF position.

83-67-1. STARTING VIBRATOR INSTALLATION. (See figure 83-1-8.)

83-67-2. DESCRIPTION. The starting vibrator installation includes a starting vibrator, mount assembly, aft magneto harness assembly and attaching hardware. The starting vibrator, used in conjunction with the retard breaker (right) magneto, provides improved engine starting characteristics, especially during cold weather operation. Retarded spark is provided by the vibrator by means of an additional set of breaker points timed to open after the main breaker points open. Power is supplied to the magneto primary circuit by the vibrator while the starter button is depressed and a "shower of hot sparks" occur at the spark plugs. When the starter button is released, the starting vibrator and retard breaker points automatically become inoperative and advance ignition is immediately provided.



1. Starting Vibrator
2. Starter
3. Right-Hand Magneto
4. Left-Hand Magneto
5. Engine Deck Magneto Harness Disconnect

Figure 83-1-8. Starting Vibrator Installation

83-67-3. TROUBLESHOOTING THE STARTING VIBRATOR. Refer to paragraph 83-67-60 for testing procedure.

83-67-10. REMOVAL OF STARTING VIBRATOR INSTALLATION.

a. Disconnect the aft magneto harness at the engine deck receptacle.
b. Disconnect lead from retard terminal on right magneto.
c. Disconnect the leads from switch terminal on both magnetos.
d. Remove vibrator cover and disconnect leads from vibrator.
e. Disconnect lead from starter terminal, remove harness attaching clamps, and remove harness from helicopter.
f. Remove attaching bolts and vibrator from the mount assembly on firewall.

83-67-11. INSTALLATION OF STARTING VIBRATOR. Installation procedures for the starting vibrator installation are the reverse of removal.

83-67-60. TESTING THE STARTING VIBRATOR. Test the starting vibrator as follows:

a. Disconnect right magneto spark plug leads from spark plugs and remove right magneto breaker points cover.
b. Rotate the engine until No. One cylinder is in its retard firing position. Check that both right magneto breaker points are open.
c. Disconnect both electrical connections from the positive (+) terminal of the engine starter. Fasten these two leads together while testing.
d. Place IGNITION switch in R position and turn on MASTER SWITCH. Press starter button to energize starting vibrator.
e. A buzzing sound will be heard if the vibrator is operating properly.
f. When No. One spark plug lead is held approximately 3/16 to 1/4-inch away from a good ground, a shower of sparks should occur.
g. Should step f fail to produce a shower of sparks, check the voltage applied to the starting vibrator; voltage should be 13 to 24 volts. If the vibrator voltage is below 13 volts, check the battery output voltage for 24 volts, or check the electrical wiring for defects.
h. Should the correct voltage be present at vibrator, check that both right-hand sets of breaker points are open.
i. Turn off MASTER SWITCH and IGNITION switch; reconnect starter electrical connections and spark plug leads, and install magneto breaker points cover.