

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

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OIL-TO-FUEL HEATER - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

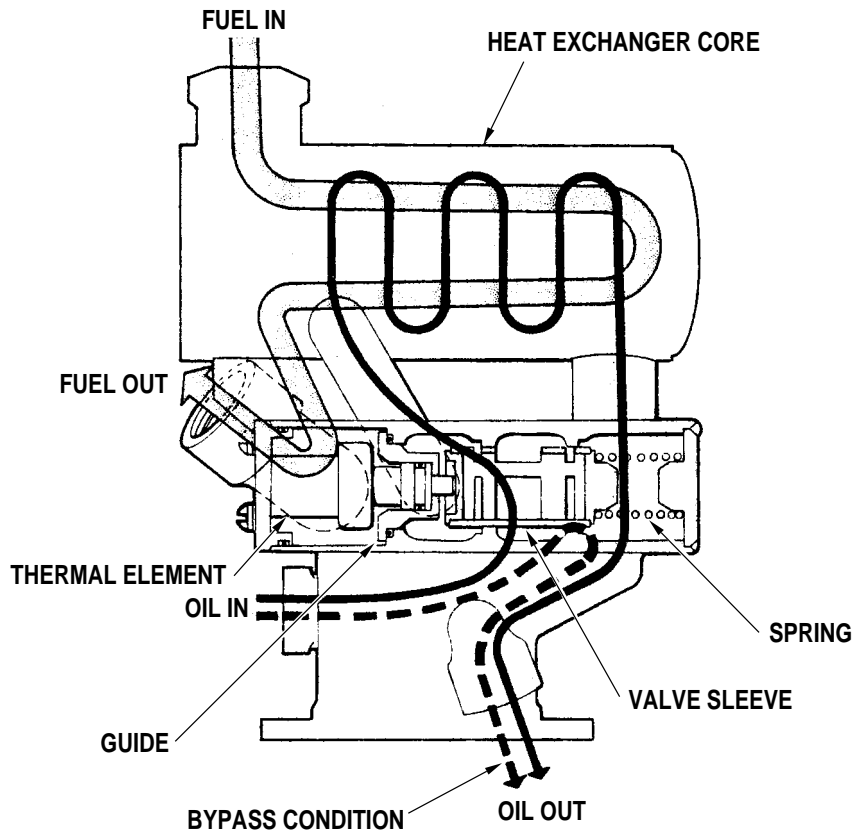
The oil-to-fuel heater, mounted at the top of the accessory gearbox at the rear of the engine and bolted to Flange G, is essentially a heat exchanger which utilizes heat from the engine lubricating oil system to preheat the fuel in the fuel system. The heater incorporates in honeycomb two-pass oil circuit and a two-pass fuel circuit. A fuel temperature-sensing oil bypass valve regulates the fuel temperature by either allowing oil to flow through the heater circuit, or to bypass it. Oil flow from the outlet passes through the oil return check valve and back to tank.

2. Operation

A minimum pressurizing valve (Ref. 79-20-03), fitted in a port at the 2 o'clock position on the compressor inlet case is connected by rigid tubing to the inlet side of the oil-to-fuel heater oil circuit. The valve closes at approximately 40 psig to prevent oil flow to the heater when the engine is shut down in flight when the compressor is windmilling. A check valve in the oil-to-fuel heater oil-return-to-tank prevents any oil from the airframe cooler being applied to the heater when the engine is shut down.

The temperature-sensing oil bypass (thermal element) valve consists of a highly expansive material sealed in a metallic chamber. The expansion force is transmitted through a diaphragm and plunger to a piston. Since the element only exerts an expansive force, it is counterbalanced by a return spring which provides a contracting force during decreases in temperature. The element senses the temperature of the outlet fuel and at temperatures above 21°C (70°F), starts to close the core valve and simultaneously open the bypass valve. At 32°C (90°F), the core valve is completely closed and oil bypasses the heater core.

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C429B

Oil-to-Fuel Heater Schematic
Figure 1

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OIL-TO-FUEL HEATER - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC01-001	Fuel, Engine
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Abrasive Coated
PWC11-021	Compound, Carbon Removing
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

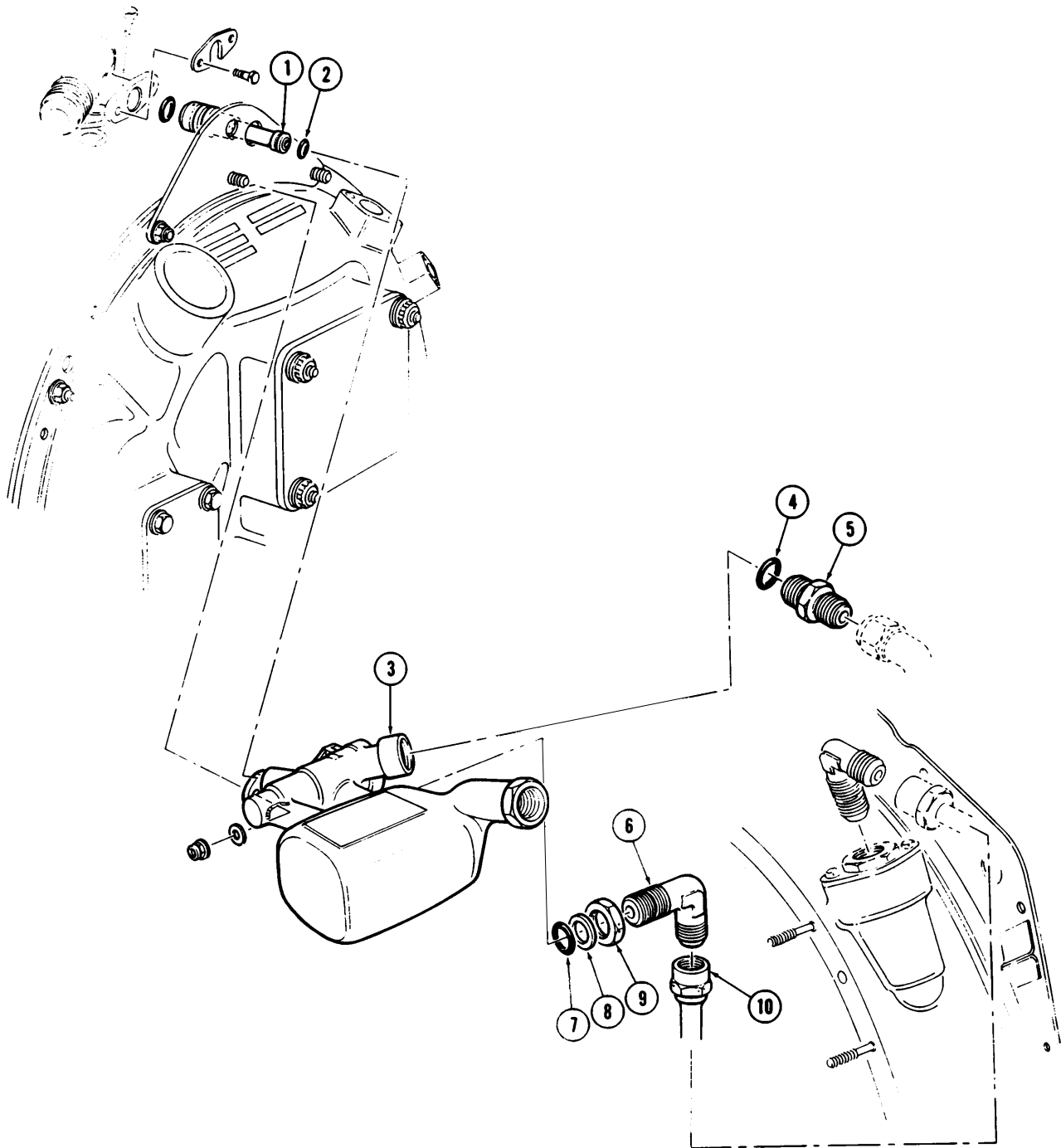
Not Applicable

5. Removal/Installation

CAUTION: OBSERVE ALL FIRE AND SAFETY PRECAUTIONS.

A. Removal of Oil-to-Fuel Heater (Ref. Fig. 201)

- (1) Drain oil tank (Ref. 72-00-00, SERVICING).
- (2) Provide suitable drip pans for residual oil and fuel spillage.
- (3) Disconnect the following lines from oil-to-fuel heater (3):
 - (a) Fuel inlet line (Ref.to airframe manufacturer's manual).
 - (b) Fuel outlet flexible hose from straight nipple (5).
 - (c) Oil inlet tube (10) from elbow (6).



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Removal/Installation of Oil-to-Fuel Heater
Figure 201

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Key to Figure 201

1. Oil Return Check Valve
2. Preformed Packing
3. Oil-to-fuel Heater
4. Preformed Packing
5. Straight Nipple
6. Elbow
7. Preformed Packing
8. Back-up Ring
9. Locknut
10. Oil Inlet Tube

(d) Cap all fuel lines.

- (4) Remove oil tube (10) by disconnecting from check valve elbow on air inlet case.
- (5) Remove two self-locking nuts and washers, and withdraw oil-to-fuel heater (3) from studs at flange G and from check valve (1).
- (6) Remove preformed packing (2) from check valve (1). Suitably cap open port of valve.
- (7) If oil-to-fuel heater is to be replaced, remove parts for reassembly on replacement unit:
 - (a) Airframe-supplied fitting at fuel inlet port.
 - (b) Elbow (6) and locknut (9). Discard preformed packing (7) and back-up ring (8).
 - (c) Straight nipple (5). Discard preformed packing (4).

B. Installation of Oil-to-Fuel Heater (Ref. Fig. 201)

- (1) If a replacement oil-to-fuel heater (3) is being installed, depressure prior to installation:
 - (a) Remove shipping plugs from oil ports and flush with engine oil (PWC03-001). Drain off surplus oil and reinstall shipping plugs until unit is required for installation.
 - (b) Remove shipping plugs from fuel ports and flush with engine fuel (PWC01-001). Drain off surplus fluid and reinstall shipping plugs until unit is required for installation.
- (2) If a new oil-to-fuel heater is to be installed, assemble parts removed at disassembly:
 - (a) Depressure unit as detailed in Subparagraph B.(1).

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- (b) Install airframe-supplied fitting in fuel inlet port. Tighten and torque to airframe manufacturer's recommendation
 - (c) Install straight nipple (5) with preformed packing (4). Tighten and torque to 200 to 225 lb.in.
 - (d) Install elbow (6) with locknut (9), back-up ring (8) and preformed packing (7) (Ref. 70-00-00, REMOVAL/INSTALLATION). Do not final torque locknut (9) until angle of elbow has been established. (Ref. Subpara. (5), following.)
- (3) Install preformed packing (2) on oil return check valve (1).
- (4) Locate oil-to-fuel heater (3) over studs at flange G and mate with oil return check valve (1). Secure with two washers and self-locking nuts. Tighten nuts and torque to 32 to 36 lb.in.
- (5) Connect oil inlet tube (10) to check valve elbow on inlet case and elbow (6) on heater unit:
- (a) Final torque locknut (9) on elbow (6) to 70 to 80 lb.in.
 - (b) Tighten tube coupling nut at elbow (6) and torque to 270 to 300 lb.in.
 - (c) Tighten tube coupling nut at check valve elbow and torque to 90 to 100 lb.in.
 - (d) Lockwire coupling nuts and locknut.
- (6) Connect fuel hose to straight nipple (5). Tighten coupling nut, torque to 450 to 500 lb.in., and lockwire.
- (7) Connect airframe fuel supply line to fitting at inlet port. Tighten coupling nut and torque to airframe manufacturer's recommendation, and lockwire.
- (8) Replenish oil tank (Ref. 72-00-00, SERVICING).

6. Cleaning/Painting

A. Cleaning

- (1) Soak the external oil tube in cold carbon remover (PWC11-021) for two hours at room temperature.
- (2) Remove the tube from the solvent and pull a suitable sized swab (or lint-free cloth) through the tube.

CAUTION: MAKE SURE NO PART OF THE SWAB OR CLOTH REMAINS IN THE OIL TUBE; OTHERWISE, THE OIL FLOW CAN BE RESTRICTED.

- (3) Rinse the tube exterior with petroleum solvent (PWC11-027) or (PWC11-031).
- (4) Pressure flush the tube interior with petroleum solvent and dry the interior and exterior with compressed air.

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- (5) Clean all components of the oil return check valve assembly with petroleum solvent (PWC11-027) or (PWC11-031). Make sure the check valve, spring, the spring seat and interior of the check valve housing are completely clean.

7. Inspection/Check

A. Oil-to-fuel Heater

- (1) Visually inspect the mounting lugs for cracks and other defects. Cracks are not permissible; minor defects may be repaired.
- (2) Inspect the bores of the oil inlet and outlet ports and the fuel outlet port for damage on the sealing surfaces.
- (3) Inspect the fuel inlet port for damage to the threads.
- (4) Check for security of the identification plate.
- (5) Oil inlet tube:
 - (a) Inspect the tube for damage.
 - (b) Cracks are not repairable.
 - (c) A dented tube must be replaced if any of the following conditions apply:
 - 1 Sharp cornered dent.
 - 2 Length and depth of the dent exceeds 10 percent of the tube outside diameter.
 - 3 More than one dent per 12-inch length.
 - 4 If the dent is within one inch of the ferrule scarf-welds or bend.
 - (d) Scratches, Nicks or Chafing. Light scratching of no appreciable depth can be ignored. Tubes must be replaced if scratches, nicks or chafing cannot be blended out within an area of one-half square inch to a maximum depth of one quarter of the original tube wall thickness. Any number of such blended areas are permitted, provided they are separated by at least one-half inch of undamaged material.
 - (e) Pitting. Tubes must be replaced if pitting cannot be blended out within an area of one-half square inch to a maximum depth of one quarter of the original tube wall thickness. Any number of such blended areas are permitted, provided they are separated by at least one-half inch of undamaged material.
 - (f) Corrosion. Rust and stains are acceptable if they can be removed by light polishing with a crocus cloth; otherwise, Step (e) applies.

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8. Approved Repairs

A. Oil-to-Fuel Heater

- (1) Minor damage such as burrs, scores, scratches, nicks and other similar defects on the sealing surfaces of oil and fuel ports may be cleaned up by blending with a fine grade crocus cloth (PWC05-061), making sure that all high spots are removed.
- (2) Blend out minor surface defects on the mounting lugs and other metal surfaces with a fine stone or swiss file.
- (3) Clean up minor thread damage in the fuel and oil ports or chase the threads.

9. Adjustment/Test

Check the function of the oil-to-fuel heater at the next engine run (Ref. 71-00-00, ADJUSTMENT/TEST).

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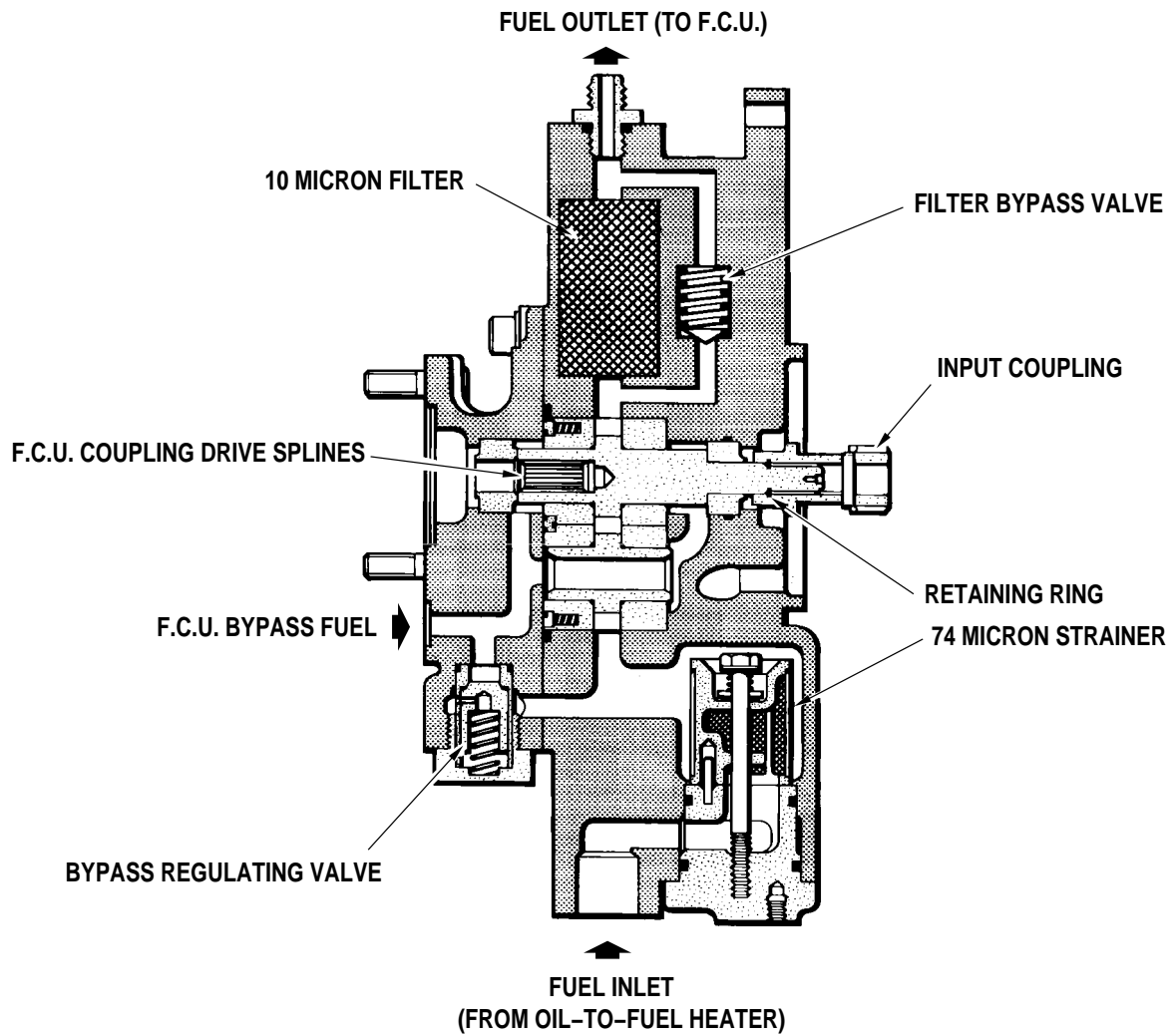
FUEL PUMP - DESCRIPTION AND OPERATION

1. Description Operation (Ref. Fig. 1)

The engine-driven fuel pump is a positive displacement gear-type pump, mounted on a pad at the 2 o'clock position on the rear face of the accessory gearbox. The pump incorporates spring and pressure loaded bushings and is shaft-driven off the accessory gearbox. A splined coupling is used to transmit the geartrain drive to the pump gears; the coupling splines are lubricated by oil mist from the gearbox via a hole in the associated gearshaft. Another coupling, on the other side of the pump gears, is used to transmit a speed signal to the fuel control unit (FCU).

Fuel from the oil-to-fuel heater enters the fuel pump chamber through a 74-micron (200-mesh) inlet screen. The inlet screen is spring-loaded and, should it become blocked, the increase in differential pressure overcomes the spring and allows unfiltered fuel to flow into the pump chamber. The pump gears increase the fuel pressure and deliver it to the FCU via a 10-micron filter in the pump outlet and an external transfer hose assembly. Seepage fuel drain connection points are provided to conduct fuel to an airframe collection point. A bypass valve, and cored passages in the pump body, enable unfiltered high pressure fuel to flow to the FCU in the event of the outlet filter becoming blocked. An internal passage originating at the mating face of the FCU returns bypass fuel from the FCU metering valve directly into the pump gears. A pressure regulating valve in the bypass line serves to pressurize the bearings and direct excess bypass fuel to the pump fuel inlet, downstream of the inlet screen.

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C3885B

Fuel Pump
Figure 1

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FUEL PUMP - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC01-001	Fuel, Engine
PWC03-001	Oil, Engine
PWC05-061	Cloth, Abrasive
PWC05-101	Cloth, Abrasive
PWC05-166	Solution Treatment
PWC05-168	Grit, Vapor Blasting
PWC11-027	Solvent, Cleaning
PWC11-031	Solvent, Cleaning
PWC11-038	Solvent, Cleaning

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

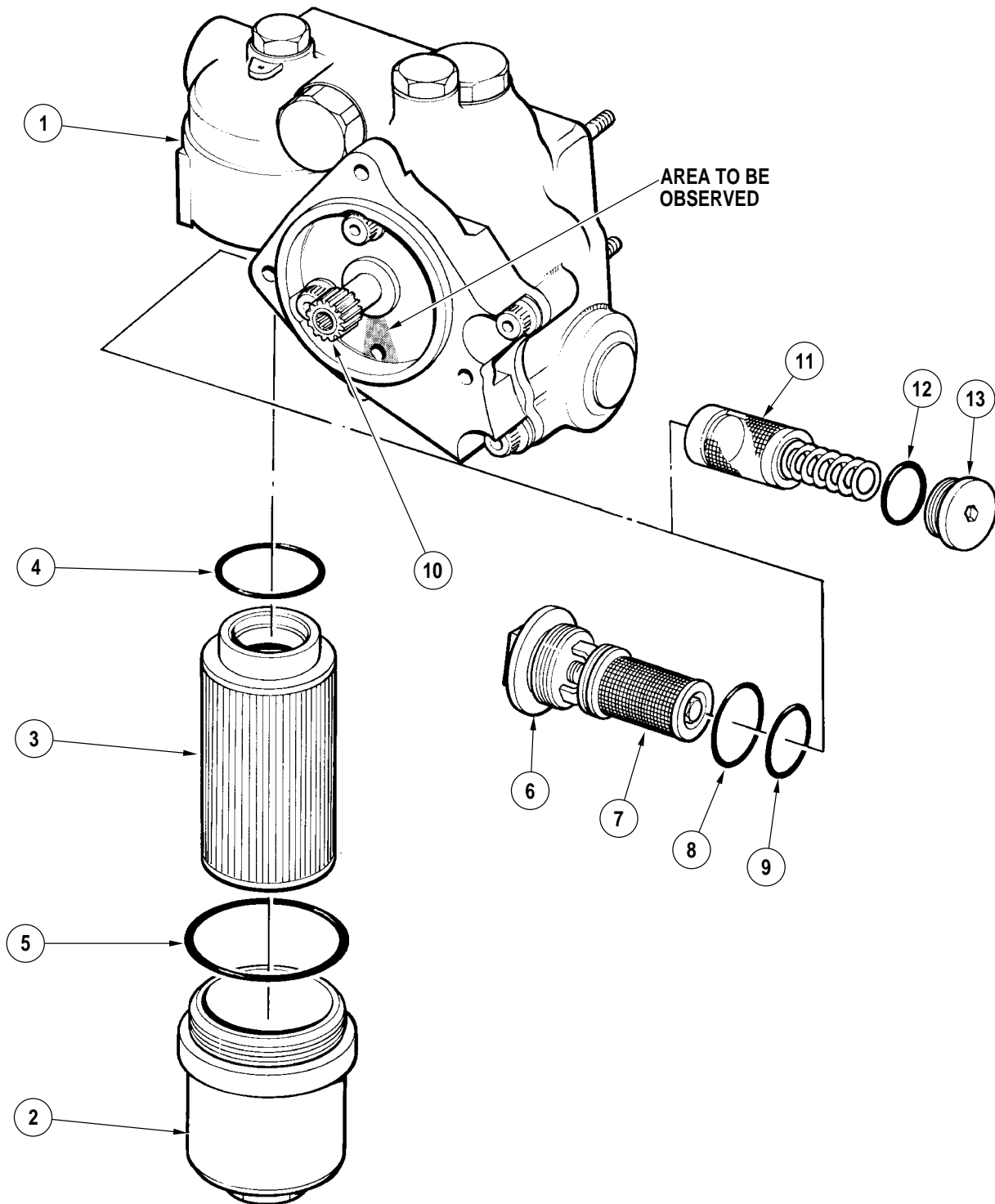
5. Servicing

NOTE: The fuel pump can be either Sundstrand or Argo-Tech manufacture (Ref. IPC).

A. Removal of Fuel Pump Filters (Ref. Fig. 201)

- (1) Remove the discharge filter cover (2) from the fuel pump (1). Withdraw the filter element (3) and preformed packing (4) and discard the packing. At the life limit, withdraw the element and packing and discard both items (Ref. 72-00-00, INSPECTION, Periodic Inspection).

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C13018A

Removal/Installation of Fuel Pump Filters
Figure 201

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Key to Figure 201

1. Fuel Pump (Sundstrand or Argo-Tech)
2. Discharge Filter Cover
3. Discharge Filter Element
4. Preformed Packing
5. Preformed Packing
6. Inlet Filter Cover (Sundstrand Pump Assembly)
7. Inlet Filter Element (Sundstrand Pump Assembly)
8. Preformed Packing (Sundstrand Pump Assembly)
9. Preformed Packing (Sundstrand Pump Assembly)
10. Drive Shaft
11. Inlet Filter Assembly (Argo-Tech Pump Assembly)
12. Preformed Packing (Argo-Tech Pump Assembly)
13. Inlet Filter Cover (Argo-Tech Pump Assembly)

CAUTION: THE DISCHARGE FILTER ELEMENT IS DISPOSABLE AND MUST BE DISCARDED. DO NOT CLEAN.

- (2) Remove the preformed packing (5) from the cover (2) and discard.
- (3) Remove Sundstrand pump inlet filter:
 - (a) Remove the inlet filter cover (6) with the attached filter element (7) from the fuel pump (1). Do not disassemble the parts.
 - (b) Remove and discard the preformed packings (8 and 9) from the inlet cover (6).
- (4) Remove Argo-Tech pump inlet filter:
 - (a) Using a $\frac{3}{8}$ inch Allen wrench, remove the inlet filter cover (13) with the attached filter assembly (11). Do not disassemble the parts.
 - (b) Remove and discard the preformed packing (12) from the inlet cover (13).

B. Installation of Fuel Pump Filters (Ref. Fig. 201)

NOTE: Lubricate all preformed packings with a light film of engine oil (PWC03-001) prior to assembly.

- (1) Install Sundstrand pump inlet filter: Make sure the inlet filter element (7) is clean, then:
 - (a) Install new preformed packings (8 and 9) under the head of the inlet filter cover (6) and in the groove of the filter.
 - (b) Insert the assembled inlet filter element and cover into the fuel pump (1) and screw the cover into the pump. Tighten the cover (6) 180 to 220 lb.in., and fasten with lockwire.

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- (2) Install Argo-Tech pump inlet filter:

CAUTION: WHEN INSTALLING THE INLET SCREEN ASSEMBLY INTO THE ARGO-TECH PUMP HOUSING ASSEMBLY, MAKE SURE THE SCREEN SEAT CONTACTS THE SEAT MACHINED IN THE HOUSING PRIOR TO COMPRESSING THE SPRING AND ENGAGING THE INLET SCREEN COVER THREADS. VERIFY PROPER INSTALLATION BY VISUALLY DETERMINING THAT THE UPPER EDGE OF THE SCREEN IS BELOW THE THREADS MACHINED IN THE PUMP HOUSING ASSEMBLY. IF IT IS NOT INSTALLED PROPERLY, THE SCREEN COULD GET HUNG UP ON THE SCREEN CENTERING LUGS AND THE UPPER EDGE OF THE SCREEN WOULD PROTRUDE INTO THE THREADED PORTION OF THE HOUSING.

- (a) Install the inlet filter assembly (11) into the pump housing (1).
- (b) Install a new preformed packing (12) in the groove on the inlet filter cover (13).
- (c) Position the cover (13) over the spring, and thread the cover into the pump housing. Tighten the cover above the run-in torque required to compress preformed packing (12), then, further tighten the cover 30 to 50 lb.in.

- (3) Install the new discharge filter element (3):

NOTE: Two service kits are available for the discharge filter. One kit covers consumable parts needed during discharge filter replacement; the other at discharge filter visual inspection (Ref. IPC).

- (a) Install a new preformed packing (5) in the seal groove around the discharge filter cover (2).
- (b) Install a new preformed packing (4) in the seal groove of the filter element (3).
- (c) Insert the element into the fuel pump (1).
- (d) Install the cover (2):
 - 1 Argo-Tech pump: Position the cover (2) over the end of the filter element (3) and screw the cover into the pump (1). Tighten the cover above the run-in torque required to compress the preformed packing (5), then, further tighten the cover 30 to 50 lb.in., and fasten with lockwire.
 - 2 Sunstrand pump: Position the cover (2) over the end of the filter element (3) and screw the cover into the fuel pump (1). Tighten the cover 180 to 220 lb.in., and fasten with lockwire.

6. Removal/Installation of Fuel Pump

A. Removal of Fuel Pump (Ref. Fig. 202)

- (1) Remove the fuel control unit (Ref. 73-20-00).

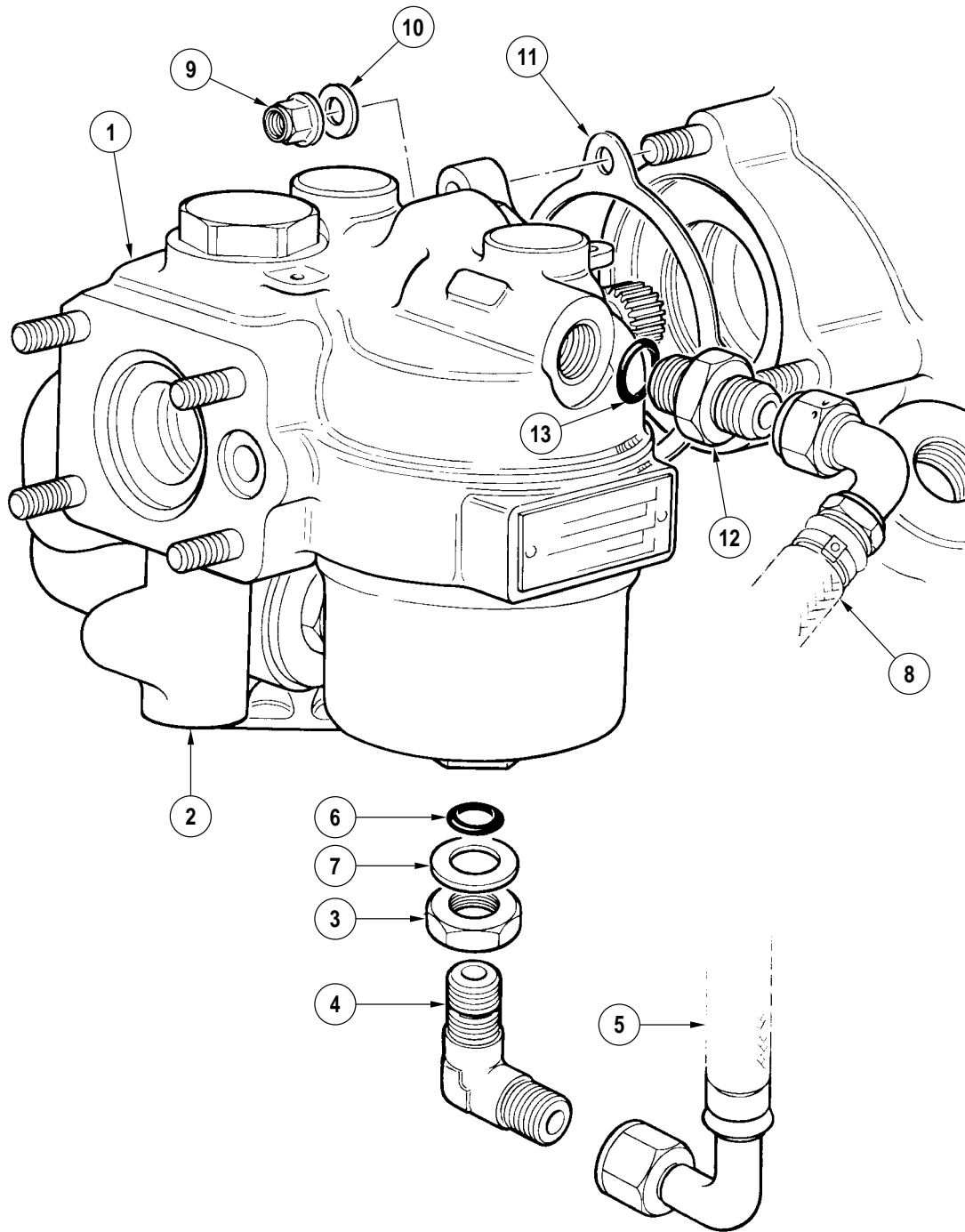
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- (2) If the fuel pump (1) is being removed with the engine installed, disconnect the line from the airframe-supplied fitting installed in the seal drain port (2). Suitably cap the line connection and pump fitting.
- (3) Disconnect the fuel hose (5) from the elbow (4) on the pump.
- (4) Disconnect and remove the fuel outlet interconnecting hose (8) and suitably cap the hose connections and straight nipple (12) in the fuel pump (1).
- (5) Support the fuel pump (1) and remove the self-locking nuts (9) and washers (10) that secure the pump to the accessory gearbox boss. Remove the pump and gasket (11).
- (6) If the fuel pump is being replaced, remove the following parts for installation on the replacement pump:
 - (a) Remove the straight nipple (12) and preformed packing (13) from the outlet port of fuel pump (1). Install the blanking plug in the outlet port.
 - (b) Remove the elbow (4) and locknut (3) from the bottom of the pump. Discard the preformed packing (6) and back-up ring (7).
 - (c) Remove the airframe-supplied fitting and preformed packing from the drain port (2) of the fuel pump (1) and install the blanking plug in the drain port. If the fitting is of the elbow type, note the angular position before removal.

B. Installation of Fuel Pump (Ref. Fig. 202)

- (1) On the Pre-SB1316 pump, make sure the drive coupling (10, Fig. 201) is secure on the pump internal splines by lightly pulling and pushing by hand. The coupling should be slightly loose, but should not move in or out. Check the protrusion of the coupling from the mounting face of the pump. Measurement should be 1.000 to 1.120 inches. Make sure the coupling is not displaced during assembly to the gearbox.

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Removal/Installation of Fuel Pump
Figure 202

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Key to Figure 202

1. Fuel Pump
2. Seal Seepage Drain Port
3. Locknut
4. Elbow
5. Fuel Inlet Hose (from heater)
6. Preformed Packing
7. Back-up Ring
8. Fuel Outlet Hose (to FCU)
9. Self-locking Nut
10. Washer
11. Gasket
12. Nipple
13. Preformed Packing

CAUTION: FOR PRE-SB1316 ENGINES: MAKE SURE DRIVE COUPLING (10, FIG. 201) IS CORRECTLY SECURED ON PUMP INTERNAL SPLINES BY LIGHTLY PULLING AND PUSHING BY HAND. COUPLING SHOULD BE SLIGHTLY LOOSE, BUT SHOULD NOT MOVE IN OR OUT. DO NOT REMOVE COUPLING FROM PUMP. CHECK PROTRUSION OF COUPLING FROM MOUNTING FACE OF PUMP. MEASUREMENT SHOULD BE 1.00 TO 1.12 INCHES. MAKE SURE COUPLING IS NOT DISPLACED DURING ASSEMBLY TO GEARBOX.

CAUTION: FOR POST-SB1316 ENGINES: PUMP COUPLINGS HAVE A STOP FLANGE AND MORE POSITIVE RETENTION. THERE SHOULD BE NO AXIAL MOVEMENT.

CAUTION: ALL TRACES OF GREASE MUST BE REMOVED FROM THE PUMP COUPLING SPLINES. ONLY ENGINE OIL IS TO BE USED AS A LUBRICANT. MAKE SURE THE OIL MIST LUBRICATION HOLE IS CLEAR.

- (2) If a new fuel pump (1) is installed, do an engine depreservation (Ref. Chap. 72-00-00, SERVICING):

NOTE: Depreservation is not required if removed fuel pump is being re-installed.

- (a) Remove the blanking plugs from the inlet and outlet ports of the fuel pump (1).
- (b) Connect the supply of filtered fuel (PWC01-001) at the inlet pressure of 5 to 15 psig to the inlet port of the pump.
- (c) Using a suitable turning device, rotate the drive shaft of the pump for approximately one minute until clear fuel is ejected from the outlet port.
- (d) Remove the rotation device, disconnect the fuel supply and blank off the inlet port.

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- (e) Install a preformed packing (13) on the straight nipple (12) and install the nipple in the fuel outlet port. Tighten the nipple 110 to 120 lb.in. Install a suitable blanking cap.
- (f) Install a preformed packing on the airframe-supplied fitting retained from the previous pump and install the fitting in the drain port (2) of the fuel pump (1). Tighten the fitting to the value recommended in the appropriate Aircraft Maintenance Manual. If the fitting is of the elbow-type, position at the same angle noted during removal (Ref. 70-00-00). Install a suitable blanking cap.
- (g) Install the elbow (4) with a locknut (3), back-up ring (7) and preformed packing (6) in the boss in the bottom of the pump (Ref. 70-00-00, REMOVAL/INSTALLATION). Do not final torque the locknut until the angle has been established per Step (5) following.

CAUTION: FAILURE TO COMPLY WITH STEP (3) REQUIREMENTS OR LUBRICATION OF SPLINE WITH OTHER THAN ENGINE OIL MAY RESULT IN ACCELERATED SPLINE WEAR AND POSSIBLE FUEL PUMP DECOUPLE.

- (3) Remove all traces of grease from the gearshaft bore and pump coupling. Make sure that the oil mist lubrication hole in the gearshaft restrictor is clear by manually inserting a No. 60 (0.040) drill into the restrictor hole, and turn the drill by hand. Make sure the teflon insert is installed, then liberally lubricate the splines with engine oil (PWC03-001).

NOTE: Operators may find it more convenient to install the FCU and fuel pump together as a unit after initial assembly of the two units on the bench. Refer to Chap. 73-20-00 for fuel control unit.

- (4) Place the gasket (11) over studs of the accessory gearbox boss, then carefully position the fuel pump (1) over the studs. As the pump is pushed on, carefully engage the splines of the driveshaft with the corresponding splines in the gearshaft in the accessory gearbox. Secure the pump to the gearbox with washers (10) and self-locking nuts (9). Tighten the nuts 75 to 85 lb.in.
- (5) Connect the fuel hose (5) to the elbow (4) on the pump. Final torque the locknut (3), as indicated in Step (2)(g) preceding, 145 to 155 lb.in. (Ref. 70-00-00, Table 401). Tighten the coupling nut of the hose 150 to 250 lb.in. Fasten the coupling nut and locknut with lockwire.
- (6) Remove the blanking caps from the connection on the fuel outlet interconnecting hose (8) and from the straight nipple (12). Connect the hose to the nipple, but do not tighten until the fuel control unit is installed; refer to Step (9), following.
- (7) If the installation of the fuel pump (1) has been done with the engine installed:
 - (a) Remove the blanking caps from the seal drain line and from the airframe-supplied fitting in the drain port (2) of the fuel pump (1).
 - (b) Connect the line to the drain fitting and tighten to the torque value recommended in the appropriate Aircraft Maintenance Manual.

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- (8) Install fuel control unit (Ref. 73-20-00) if not installed together with fuel pump (Ref. Step (3)).
- (9) Make sure the hose that interconnects the fuel pump outlet with the fuel control unit inlet is installed without twisting; tighten the connections at each end 270 to 300 lb.in. (Ref. 73-10-03).

7. Cleaning/Painting

A. General

- (1) Clean the exterior surface of the fuel pump with petroleum solvent (PWC11-027) or (PWC11-031). To prevent the cleaning agent from entering the unit, do not remove the blanking caps and/or plugs.
- (2) Wipe the surfaces dry with clean, lint-free cloths and/or compressed air to remove all residual solvent and contamination.

B. Inlet Filter Element

- (1) Supply the petroleum solvent (PWC11-027) or (PWC11-031) through a 10-micron filter at 30 psig, to the outside of the screen mesh. Rotate the element during cleaning to make sure all areas of the mesh screen are flushed.

NOTE: Contaminants will usually collect inside the screen mesh at the cone section where the attachment bolt head is located.

- (2) Reverse flush the inlet filter element with petroleum solvent to make sure all contamination is removed from the screen mesh.
- (3) Remove the residual contaminants and dry the screen mesh using a blast of dry, clean, low-pressure air.
- (4) Examine the inlet filter element for cleanliness and, if necessary, repeat the cleaning and reverse flushing operations until satisfactory.

8. Inspection/Check

A. General

- (1) Inspect the mounting lugs visually for cracks and other defects. Cracks are not permissible; minor surface damage may be repaired.
- (2) Inspect the machined mounting faces for gouges, nicks, scores, scratches, and similar surface defects which can damage the gasket between the pump and accessory gearbox and/or prevent proper mating of the fuel control unit to the pump. Particular attention should be paid to the seal recess at the bypass port between the studs in mounting face for the fuel control unit.
- (3) Inspect the bore of the inlet port for damage on the sealing surface.
- (4) Check the studs for security and for damage to the threads.

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- (5) Inspect the seal seepage drain port and fuel outlet port adapter for damage to the threads.
 - (6) Check for leakage from seal drain port:
 - (a) Coupling drive oil leaks from fuel pump drain should not exceed 3 cc per hour. If limits are exceeded, replace plain seal on accessory gearbox pad (Ref. 72-60-00, Removal/Installation). If leaks are still present and exceed limits, ship unit for overhaul.
 - (b) Fuel leaks should not exceed 20 cc per hour. If leakage exceeds limit, ship fuel pump for overhaul.
- NOTE: If limit is exceeded, inspect FCU driveshaft bearing area for fuel contamination (Ref. 73-20-00, Inspection/Check).
- (7) Inspect the splines on the drive coupling for nicks, gouges and chips.
 - (8) Examine the external surfaces of the pump for corrosion and for the general condition of the anodic treatment.
 - (9) Check for signs of leakage from the joint between the pump cover and pump housing. If leakage is evident, return the pump for overhaul.

B. Filter Elements

NOTE: Refer to Paras. 5.A. and B. for removal and installation of fuel pump filters.

- (1) Examine the inlet filter element for damage and/or breaks in the screen mesh.
- (2) The discharge filter is disposable and should be subjected only to visual examination for defects if the life of the part has not expired.

C. Flexible Hoses

- (1) Check that flexible hoses are fitted to avoid interference with the operation of the reversing linkage mechanism (Ref. 76-10-00).

D. Sundstrand Fuel Pump Coupling In-Situ Inspection

- (1) Remove the drain line and fitting from the fuel pump drain port (2, Fig. 202).

CAUTION: IF A COTTON SWAB OR SIMILAR DEVICE IS USED FOR THIS INSPECTION, CARE MUST BE TAKEN TO MAKE SURE NO FOREIGN MATTER REMAINS IN THE DRAIN PORT OR ASSOCIATED FITTINGS AND LINES.

- (2) Insert a cotton swab, or equivalent, 1.0 to 1.5 in. deep into the drain port of the fuel pump (Ref. Fig. 203).
- (3) Angle the cotton swab (Ref. Fig. 203) and roll it inside the drain port to collect evidence of a possible reddish-brown deposit (iron oxide).

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- (4) If no reddish-brown (iron oxide) stain is evident, the fuel pump may remain in service.
- (5) If a reddish-brown (iron oxide) stain is evident:
 - (a) Remove fuel pump (Ref. Para. 6.).
 - (b) Examine the input coupling shaft area of the pump face (Ref. Fig. 201) for residue from fretting corrosion (iron oxide deposit). If none is present, the pump may remain in service.
 - (c) Evidence of corrosion residue indicates possible spline wear. Return the fuel pump to an approved overhaul facility.
 - (d) Install a replacement fuel pump (Ref. Para. 6.).

9. Approved Repairs

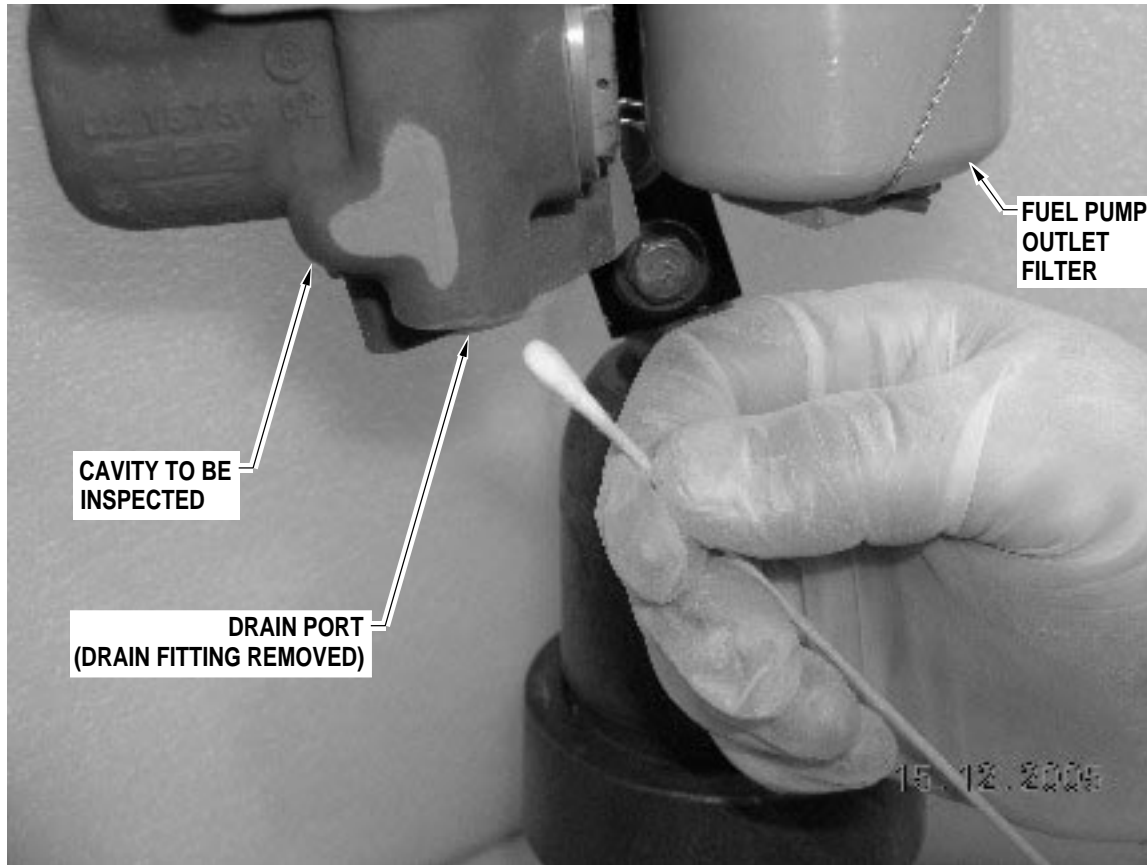
A. General

NOTE: After minor repairs are done, make sure that all areas are cleaned and corrosion preventive treatment is applied to aluminum surfaces. Do not allow filings to enter the unit.

- (1) Minor damage such as burrs, scores, scratches, nicks, and similar surface defects may be cleaned up by blending with a fine stone and/or crocus cloth (PWC05-061), making sure that all sharp edges and high spots are removed.
- (2) Clean up minor thread damage in the seal seepage drain port, and in the fuel inlet and outlet ports (when the nipple and elbow are removed) using a suitable swiss file or chase the threads using a suitable tap (Ref. IPC).
- (3) Clean up minor thread damage on studs with a suitable swiss file, or chase threads using a 1/4-28 UNF-3A die.
- (4) Blend out minor chips and nicks in the edges of splines, using a hard Arkansas stone, to remove rough edges and high spots that could damage mating splines and prevent proper meshing.

B. Corrosion Removal

- (1) Light surface corrosion may be removed from the pump housing and cover using one of the two methods outlined in following text. Severe corrosion, indicated by surface etching, is cause for rejection of the pump, which must be returned to an overhaul facility.
 - (a) Remove corrosion deposits by vapor blasting with No. 1200 grit (PWC05-168) or finer. Make sure that areas adjacent to the corrosion are masked to prevent damage to the surrounding parts.
 - (b) Remove corrosion deposits by local polishing with No. 44 grit abrasive cloth (PWC05-101), followed by crocus cloth (PWC05-061). Remove as little base metal as possible.



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Fuel Pump In-situ Inspection
Figure 203

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(c) Apply anti-corrosion treatment to the repaired area (Ref. Subpara. C.).

C. Application of Anodize Surface Treatment

(1) The anodic anti-corrosion finish on the pump housing and cover may be repaired by a local application of chemical treatment solution (PWC05-166). This treatment must be used on areas where minor repairs have been carried out by blending and/or polishing. To apply the treatment, proceed as follows:

(a) Prepare the surface by cleaning with a cleaning solution (PWC11-038). Keep the surface wetted with the cleaning agent for one to five minutes.

(b) Rinse with clean water to remove all traces of the cleaning agent.

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

WARNING: DURING THE USE OF ALODINE SOLUTION AVOID BREATHING VAPORS; USE ONLY WITH ADEQUATE VENTILATION. WEAR CHEMICAL SAFETY GOGGLES AND RUBBER GLOVES WHEN HANDLING. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER; IF IRRITATION APPEARS AND PERSISTS, CONSULT A PHYSICIAN (MEDICAL DOCTOR). IN CASE OF EYE CONTACT, FLUSH EXTENSIVELY WITH FRESH WATER AND CONSULT A PHYSICIAN IMMEDIATELY.

(c) Apply chemical treatment solution (PWC05-166) to prepared surface by brush, swab or spray method and allow three to five minutes setting time.

(d) Rinse with clean water to remove all traces of excess chemical treatment solution and allow surface to air dry.

(e) Examine treated surface and make sure that repair area is completely covered. Reapply treatment as necessary.

10. Adjustment/Test

Do a functional check of the fuel pump during the next engine test run (Ref. 71-00-00).

11. Fault Isolation

For detailed procedures refer to Chapter 72-00-00, FAULT ISOLATION.

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FUEL LINES - DESCRIPTION AND OPERATION

1. Description and Operation

The fuel supply to the engine is directed from the oil-to-fuel heater to the fuel pump, and from the fuel pump to the fuel control unit (FCU), through flexible hoses. Metered fuel from the FCU to the fuel manifold is through stainless steel line(s).

The fuel delivery hose assemblies each consist of a fluorocarbon plastic inner core with a stainless steel overbraiding and an asbestos and synthetic rubber outer covering. The outer covering acts as a fireshield. Stainless steel fittings are incorporated at each end of the assemblies.

The stainless steel delivery tube assemblies each consist of a preformed seamless tube with stainless steel end fittings.

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FUEL LINES - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Abrasive Coated
PWC05-101	Cloth, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

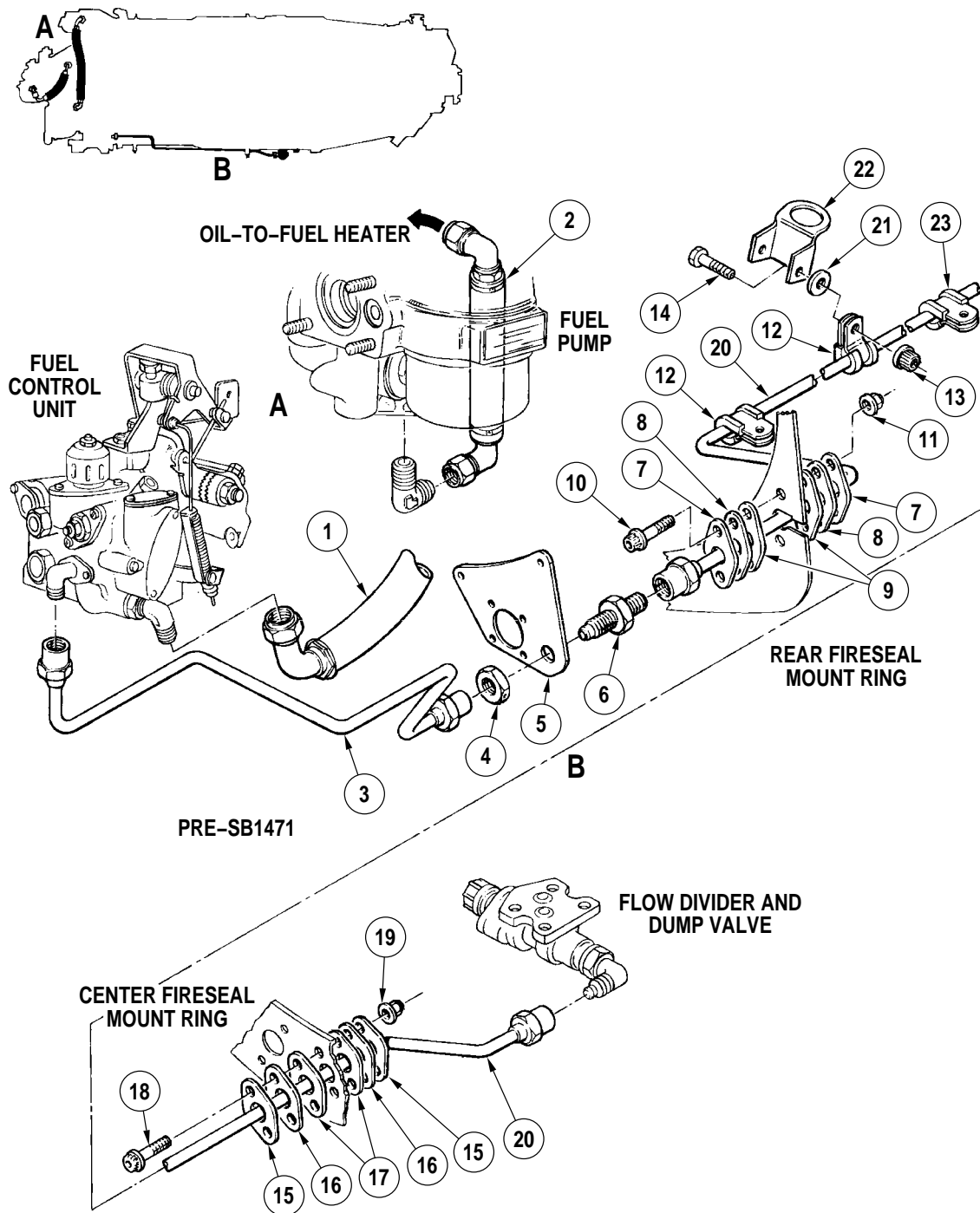
5. Removal/Installation

CAUTION: OBSERVE ALL FIRE AND SAFETY PRECAUTIONS.

A. Removal of Fuel Delivery Tubes (PT6A-21 Engines) (Ref. Fig. 201)

- (1) Disconnect coupling nuts at each end of flexible fuel hose (2) from oil-to-fuel heater and fuel pump. Remove hose and cap all openings.
- (2) Disconnect coupling nuts at each end of flexible fuel hose (1) from fuel pump and fuel control unit (FCU). Remove hose and cap all openings.
- (3) Disconnect coupling nuts at each end of fuel tube (3) from FCU and bulkhead coupling (6) at fuel pressure tube bracket (5). Remove tube and cap all openings.
- (4) Remove self-locking nuts (11) from bolts (10) at rear fireseal mount ring, and remove fuel line seals (9) and seal retaining plate insulation (8) from tube.

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PRE-SB1471

PT6A-21

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Removal/Installation of Fuel Delivery Tubes
 Figure 201 (Sheet 1 of 2)

73-10-03

FUEL LINES - MAINTENANCE PRACTICES

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Key to Figure 201

1. Fuel Hose (fuel pump FCU)
2. Fuel Hose (fuel pump fuel heater)
3. Fuel Tube
4. Jam Nut
5. Bracket
6. Coupling
7. Retaining Plate
8. Insulation
9. Seal
10. Bolt
11. Self-locking Nut
12. Loop Clamp
13. Self-locking Nut
14. Bolt
15. Retaining Plate
16. Insulation
17. Seal
18. Bolt
19. Self-locking Nut
20. Fuel Tube
21. Washer(s) (two max)
22. Support Bracket
23. Loop Clamp (glow plug installation only)
24. Bracket
25. Bolt
26. Washer
27. Fuel Tube Assembly
28. Fuel Flow Transmitter
29. Fuel Pressure Tube Assembly
30. Primary Fuel Tube Assembly
31. Clamp
32. Bolt
33. Nut

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- (5) Remove self-locking nuts (19) from bolts (18) at center fireseal mount ring, and remove fuel line seals (17) and seal retaining plate insulation (16) from tube.
- (6) Disconnect coupling nuts at each end of fuel tube (20) from bulkhead coupling (6) at fuel pressure tube bracket (5) and elbow fitting on flow divider and dump or purge valve.
- (7) Remove self-locking nut (13) and bolt (14) that secure loop clamp (12) and washer (21), if fitted, to support bracket (22) at rear fuel drain valve. Also, remove nuts and bolts securing fuel line loop clamps (12), and (23) if fitted, to similar loop clamps on ignition cable (Ref. 74-20-01). Remove fuel tube (20).

NOTE: Unless fuel tube is to be replaced, loop clamps (12) and seal retaining plates (7) and (15) may remain installed.

B. Removal of Fuel Delivery Tubes (PT6A-27 and PT6A-28 Engines) (Ref. Fig. 202)

- (1) Disconnect coupling nuts at each end of flexible fuel hose (2) from oil-to-fuel heater and fuel pump. Remove hose and cap all openings.
- (2) Disconnect coupling nuts at each end of flexible fuel hose (1) from fuel pump and fuel control unit (FCU). Remove hose and cap all openings.
- (3) Disconnect coupling nuts at each end of fuel tubes (3) and (4) from FCU and starting flow control. Remove tubes and cap all openings.
- (4) Remove self-locking nuts (10) and bolts (12) at center and rear fireseal mount rings, and remove fuel line seals (15) and seal retaining plate insulation (14) from tube.
- (5) Remove self-locking nuts (10), bolts (8) and washers (9) from loop clamps (7).
- (6) Disconnect coupling nuts at each end of fuel tubes (5) and (6) from starting flow control and fuel inlet adapter. Remove tubes and cap all openings.

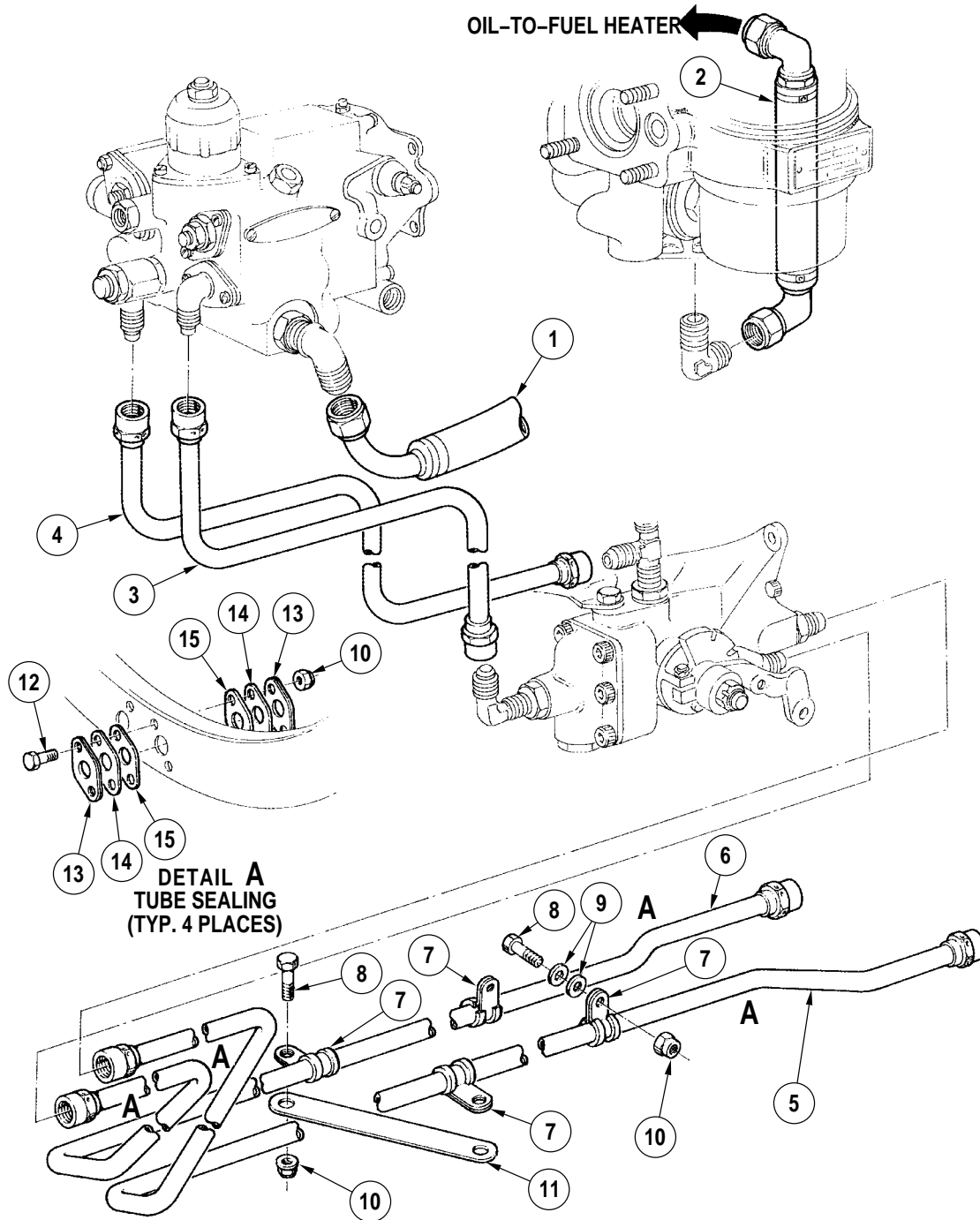
NOTE: Unless fuel tube(s) is to be replaced, loop clamps (7) and seal retaining plates (13) may remain installed.

C. Installation of Fuel Delivery Tubes (PT6A-21 Engines) (Ref. Fig. 201)

- (1) If replacement rear fuel tube (20) is being fitted, install four seal retaining plates (7) and (15) on tube; install two loop clamps (12), and (23) if fitted, on tube, clamps to be located between two center retaining plates.
- (2) Locate fuel tube (20) between bulkhead adapter and fuel inlet adapter, and secure coupling nuts. Do not torque nuts at this stage.
- (3) Secure front loop clamp (12) to support bracket (22) with bolt (14) and self-locking nut (13). Tighten nut and torque to 36 to 40 lb.in.

NOTE: Use washer(s) (21) between clamp and support bracket to prevent any misalignment. No side loading on tube is permissible.

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PT6A-27 and PT6A-28

C7921

Removal/Installation of Fuel Delivery Tubes
 Figure 202

73-10-03

FUEL LINES - MAINTENANCE PRACTICES

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Key to Figure 202

1. Fuel Inlet Hose
2. Fuel Hose
3. Fuel Pressure Rear Tube
4. Fuel Bypass Tube
5. Fuel Pressure Primary Tube
6. Fuel Pressure Secondary Tube
7. Loop Clamp
8. Bolt
9. Washer
10. Self-locking Nut
11. Back Plate
12. Bolt
13. Retaining Plate
14. Insulation
15. Seal

- (4) Secure rear loop clamp (12) to corresponding loop clamp on ignition cable with bolt and self-locking nut. Tighten nut and torque to 36 to 40 lb.in.
- (5) Install fuel line seals (9) and seal retaining plate insulations (8) on each side of rear fireseal mount ring and secure with seal retaining plates (7), nuts (11) and bolts (10). Tighten nuts and torque to firm contact plus 180 degrees.

NOTE: Bolt heads must be installed on air inlet side of mountring.

- (6) Similarly, install fuel line seals (17) and seal retaining plate insulations (16) on each side of center fireseal mount ring. Secure with seal retaining plates (15), nuts (19) and bolts (18). Tighten nuts until firm contact is made plus 180 degrees.
- (7) Install fuel tube (3) between elbow fitting on FCU and bulkhead adapter (6), and secure with coupling nuts. Torque nuts at each end of fuel tubes (3 and 20), 90 to 100 lb.in., and safety wire.
- (8) For Post-SB1471 Engines:

CAUTION: MAKE SURE THAT ALL BOLTS AND FUEL TUBE COUPLING NUTS ARE LOCKWIRED.

- (a) Install bracket (24) in aligned position on rear mounting hole of scavenge oil hose flange and secure with bolt (25) fingertight. Secure forward flange mount hole with washer (26) and bolt (25). Torque forward bolt 24 to 36 lb.in.
- (b) Locate fuel tube assembly (27) on coupling (6). Tighten nut and torque 90 to 100 lb.in.

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- (c) Install fuel flow transmitter (28) to fuel tube (27). Tighten nut fingertight.

NOTE: If fuel flow transmitter is unavailable, install fuel pressure tube assembly (29) in place of the transmitter, following the same instructions.

- (d) Locate primary fuel tube assembly (30) to fittings on fuel flow transmitter (28) and fuel control unit (FCU). Tighten coupling nut of flow transmitter fingertight. Torque coupling nut at FCU 90 to 100 lb.in.
- (e) Install clamp (31) on fuel tube (30) near flow transmitter. Align holes in clamp (31) and bracket (24), install bolt (32) and secure with nut (33). Torque nut 36 to 40 lb.in. Torque bolt (25) in rear mounting hole of scavenge oil hose flange 24 to 40 lb.in.
- (f) Ensure correct clearance angle maintained. Torque coupling nuts securing fuel flow transmitter 450 to 500 lb.in. and safety wire.

CAUTION: IT MAY BE NECESSARY TO CHANGE ANGULAR POSITION OF FUEL CONTROL INLET ELBOW TO ACHIEVE CORRECT ALIGNMENT OF HOSE (1), IN WHICH EVENT INSTRUCTIONS IN STANDARD PRACTICES (REF. 70-00-00) MUST BE OBSERVED TO AVOID DAMAGE TO PREFORMED PACKING, WITH RESULTANT LEAKAGE.

- (9) Install fuel hose (1) between FCU and fuel pump, and secure coupling nuts. Torque nuts 170 to 200 lb.in., and safety wire.
- (10) Install fuel hose (2) between fuel pump and oil-to-fuel heater, and secure coupling nuts. Torque nuts 450 to 500 lb.in., and safety wire.

D. Installation of Fuel Delivery Tubes (PT6A-27 and PT6A-28 Engines) (Ref. Fig. 202)

- (1) If replacement of either/or both fuel tubes (5 and 6) is being carried out, install seal retaining plates (13) and loop clamps (7) on tube(s).
- (2) Locate fuel lines (5) and (6), through center and rear fireseal mount rings, and secure coupling nuts to respective fittings on fuel inlet adapter and starting flow control. Do not torque coupling nuts at this stage.
- (3) Install loop clamps (7) on fuel tubes (5) and (6) to respective arms of support bracket at rear fuel drain valve and install bolts (8) and self-locking nuts (10).

NOTE: Washers (9) (two max. each location) must be installed, as required, to prevent tube distortion due to side loading.

- (4) Torque coupling nuts 90 to 100 lb.in., and safety wire. Torque loop clamp self-locking nuts 36 to 40 lb.in.
- (5) Install fuel line seals (15) and seal retaining plate insulation (14) on fuel tubes (5) and (6). Secure seals, insulation and plates (13) to respective fireseal mount rings with bolts (8) and self-locking nuts (10). Torque nuts until firm contact is made plus 180 degrees.

NOTE: Bolt heads must be installed on air inlet side of mount rings.

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CAUTION: WHEN INSTALLING FUEL TUBE (3) ENSURE THAT SHORTER END IS DISCONNECTED TO FCU. INCORRECT INSTALLATION MAY RESULT IN CHAFING BETWEEN TUBE AND ADJACENT AIRFRAME EQUIPMENT.

- (6) Install fuel tubes (3) and (4) between respective fittings on FCU and starting flow control. Tighten coupling nuts, torque to 90 to 100 lb.in., and lockwire.

CAUTION: IT MAY BE NECESSARY TO CHANGE ANGULAR POSITION OF FUELCONTROL INLET ELBOW TO ACHIEVE CORRECT ALIGNMENT OF HOSE (1). IN THIS EVENT, OBSERVE INSTRUCTIONS IN STANDARD PRACTICES (REF. 70-00-00) TO AVOID DAMAGE TO PREFORMED PACKING WITH POSSIBLE RESULTANT LEAKAGE.

- (7) Install fuel hose (1) between FCU and fuel pump, and secure coupling nuts. Tighten nuts, torque to 270 to 300 lb.in., and lockwire.

- (8) Install fuel hose (2) between fuel pump and oil-to-fuel heater and secure coupling nuts. Tighten nuts, torque to 450 to 500 lb.in., and lockwire.

6. Cleaning/Painting

A. Clean Flexible Hoses and Fuel Line Tubing

- (1) Clean the exterior of tubing by spraying with petroleum solvent (PWC11-027) or (PWC11-031) and brushing with a soft bristle brush, as necessary. Dry using compressed air, observing all normal ventilation and fire safety precautions.
- (2) Clean tubing interior by pressure flushing with petroleum solvent. Dry using clean, filtered compressed air, taking particular care that no foreign matter remains in tubing.
- (3) Cap the tube ends immediately after cleaning and until the tube is to be installed on the engine to prevent ingress of foreign matter.

7. Inspection/Check

A. Flexible Fuel Hoses

- (1) Examine the hose for cuts, crimping or buckling. Hoses with such defects must be replaced.
- (2) Examine the coupling nuts for cracks. Replace the hoses as necessary.

B. Fuel Lines

- (1) Inspect tubing:
- (a) Scratches. Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tubing with scratches over 0.005 inch deep.

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- (b) Nicks. Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.
- (c) Dents. Round bottom dents on straight sections of tubing are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of the tube. No more than one dent to a maximum depth per 12 inch length of the tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.
- (d) Pitting. Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.
- (e) Corrosion. Staining on tubing and surface corrosion is acceptable if removable by light polishing with a crocus cloth and oil.

8. Approved Repairs

A. Repair of Fuel Tubes

- (1) Smooth out small nicks with abrasive cloth (PWC05-061).
- (2) Remove stains and/or corrosion by polishing with abrasive cloth (PWC05-101) and oil (PWC03-001).

9. Adjustment/Test

A. Procedure

- (1) Start engine, and do checks associated with Installation/Replacement of Fuel Lines (Ref. 71-00-00, ADJUSTMENT/TEST).

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FLOW DIVIDER AND STARTING CONTROL - DESCRIPTION AND OPERATION

1. Description and Operation

A. General (PT6A-21 Engines)

There are two alternative models of flow divider; one incorporating a dump valve and the other a purge valve.

The flow divider and dump valve or purge valve assembly is mounted on the fuel inlet manifold adapter located at the 6 o'clock position on the gas generator case. The flow divider schedules the metered fuel from the FCU between the primary and secondary fuel manifolds as a function of primary manifold pressure. During engine start-up, metered fuel is delivered initially by primary nozzles, with the secondary nozzles cutting in above a preset value. All nozzles are operative at idle and above.

(1) Flow Divider and (Pre-SB1406) Dump Valve (Ref. Fig. 1)

The flow divider and dump valve divides the fuel flow from the fuel control unit between the primary and secondary fuel manifolds during engine start-up and operation, and dumps residual fuel from the manifolds at engine shutdown.

The unit consists of a spring-loaded transfer valve operating within a spring-loaded, ported and slotted dump valve plunger. The transfer valve and plunger are housed in a single-unit body. Ports are provided for fuel inlet, primary and secondary fuel manifold flows, and residual fuel dump. The unit is fitted with two elbow connectors for the fuel inlet and dump lines.

When the fuel cutoff valve in the FCU closes during engine shutdown, an operating spring in the flow divider and dump valve overcomes the fuel inlet pressure and moves a piston within the unit body to block the fuel inlet port. This movement of the piston connects both primary and secondary manifolds to the dump valve port and allows residual fuel in the manifold to drain overboard, or to an airframe drain collection point, as applicable.

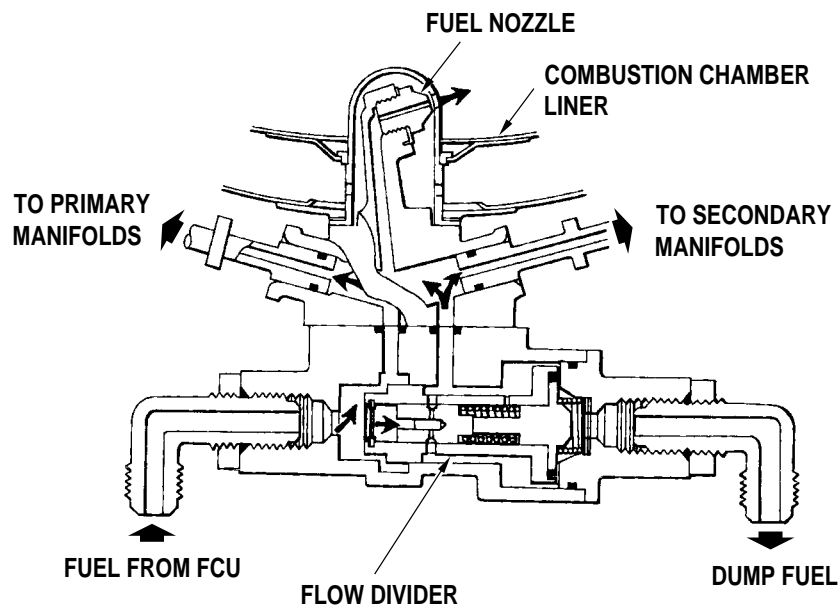
(2) Flow Divider and (Post-SB1406) Purge Valve (Ref. Fig. 2)

The flow divider and purge valve divides the fuel flow from the fuel control unit between the primary and secondary fuel manifolds during engine start-up and operation, and flushes residual fuel from the manifolds into the combustion chamber at engine shutdown.

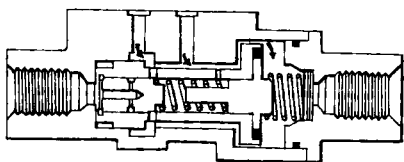
The unit consists of a primary valve, an independent secondary valve and an air purge valve. The primary valve is housed in the main body of the unit, and controls primary manifold fuel flow. The secondary valve is isolated within the primary valve, and controls secondary manifold fuel flow. Both the primary and secondary valves are spring-loaded and are shimmed to give precise cracking pressures.

A soft-seat check valve is located inside the purge valve to prevent fuel from entering the air purge accumulator, which is charged with compressed air. On engine shutdown, the valve opens and allows compressed air to flush the residual fuel from the manifolds into the combustion chamber where it is ignited and burned off.

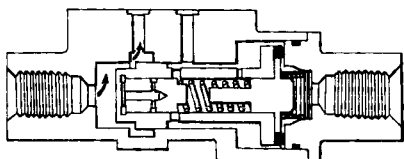
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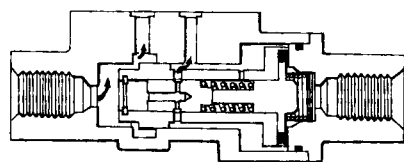
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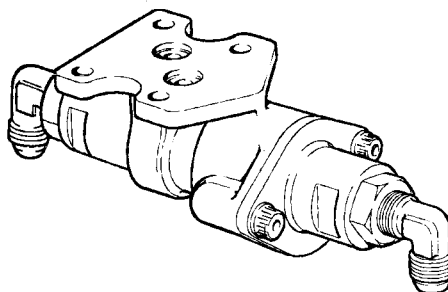
DUMP POSITION



PRIMARY FLOW POSITION



PRIMARY AND SECONDARY FLOW POSITION



Pre-SB1406, PT6A-21

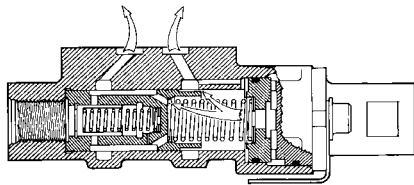
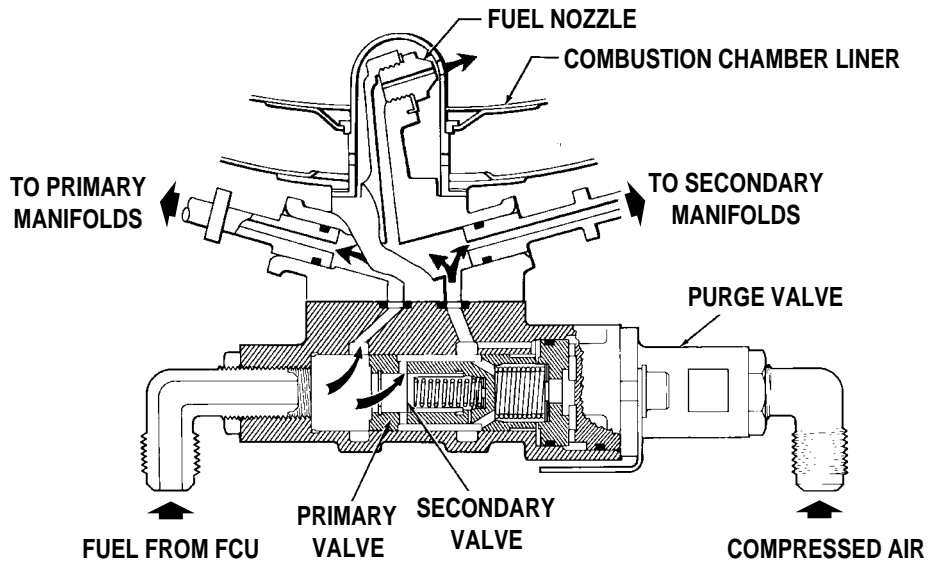
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Flow Divider and Dump Valve
 Figure 1

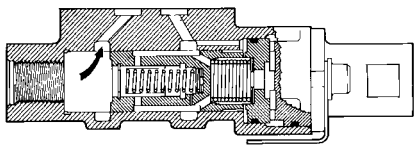
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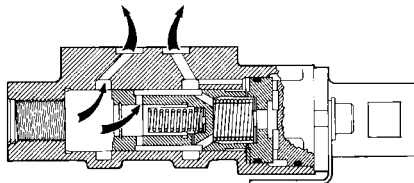
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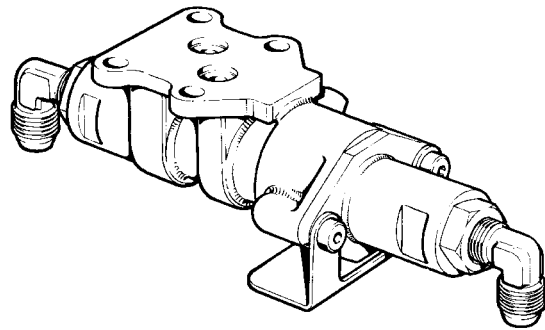
PURGE POSITION



PRIMARY FLOW POSITION



PRIMARY AND SECONDARY FLOW POSITION



Post-SB1406, PT6A-21

C13390A

Flow Divider and Purge Valve
 Figure 2

73-10-04

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Ports are provided for fuel inlet, primary and secondary fuel manifold flows and residual fuel purge. Two elbow connectors are fitted to the unit for the fuel inlet and purge lines.

B. Starting Flow Control (PT6A-27/-28 Engines) (Ref. Fig. 3)

The starting flow control is mounted at the 5 o'clock position on flange G of the accessory gearbox and connected by rigid stainless-steel fuel tubes to the FCU and fuel manifold.

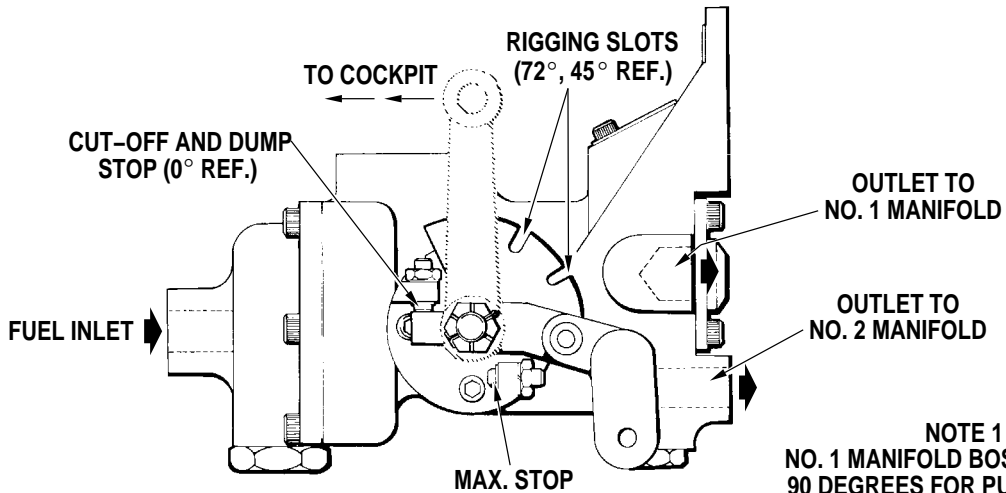
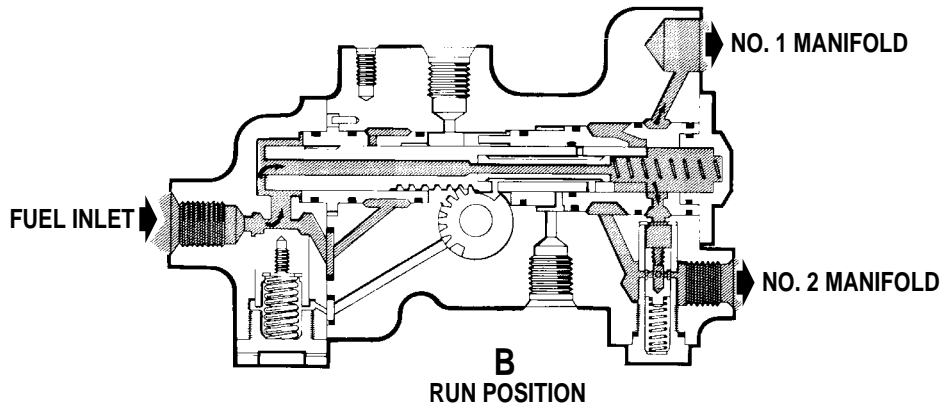
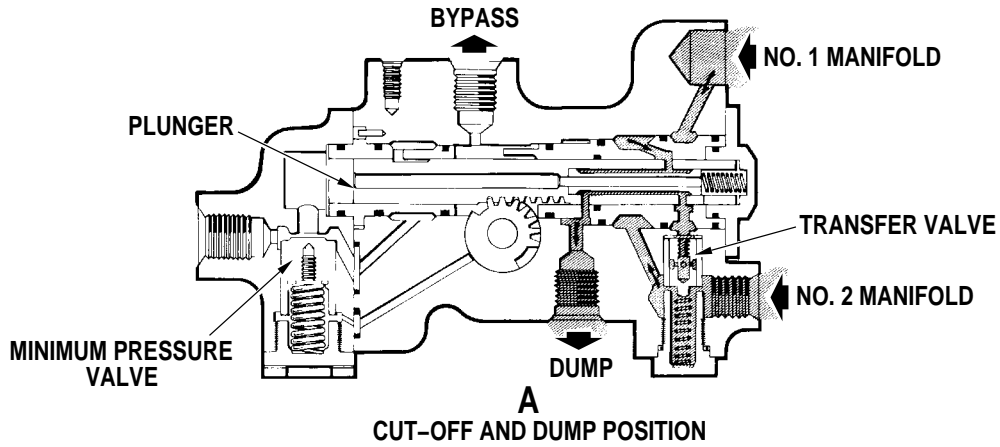
The control consists of a ported plunger sliding in a ported housing. Rotational movement of the input lever is converted to a linear plunger movement through a rack and pinion arrangement. A minimum pressurizing valve, in the control inlet, maintains a minimum pressure in the FCU to ensure correct fuel metering. Two outlet ports are provided, one for the primary manifold and the other for the secondary manifold; both ports are interconnected via a transfer valve. This valve allows the primary manifold to fill initially for engine lightup and, as pressure increases in the control, the valve opens allowing fuel into the secondary manifold.

When the input lever is in the cutoff and dump position (zero degree), the fuel supply to both fuel manifolds is blocked off and directed back to the FCU via bypass tubing; at the same time drain ports are aligned, via porting in the plunger, with the control dump port to allow residual fuel in both primary and secondary manifolds and lines to drain over board. This prevents fuel being coked in the system due to heat absorption. Fuel entering the starting control during engine rundown is diverted via the bypass port to the fuel pump inlet.

When the input lever is placed in the RUN position, the outlet port to the primary (No. 1) manifold is uncovered and the bypass port is covered. As the engine accelerates, both fuel flow and manifold pressure increase until the transfer valve opens and the secondary (No. 2) manifold fills. When the secondary manifold is filled, the total flow to the engine is increased by the amount now being delivered through the secondary manifold and the engine accelerates to idle. When the input lever is moved beyond the RUN position (45 degrees or 72 degrees, as applicable) towards the maximum stop (90 degrees) the starting flow control then has no further effect on fuel being metered to the engine. This range is overtravel and is utilized to actuate the engine high-idle requirement via a telescopic interconnecting linkage to the FCU on most airframe installations.

Rigging slots are provided on the input lever cam at the 45-degree and 72-degree RUN positions. One of these rig positions, depending on the airframe installation, is used to rig the system and to identify the cockpit lever position.

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PT6A-27 and PT6A-28

C650D

Starting Flow Control - Schematic
Figure 3

73-10-04

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FLOW DIVIDER AND STARTING CONTROL - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC01-001	Fuel, Engine
PWC05-061	Cloth, Abrasive Coated
PWC05-101	Cloth, Abrasive
PWC05-166	Solution, Chemical Treatment
PWC05-168	Compound, Polishing
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-038	Solvent, Cleaning

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

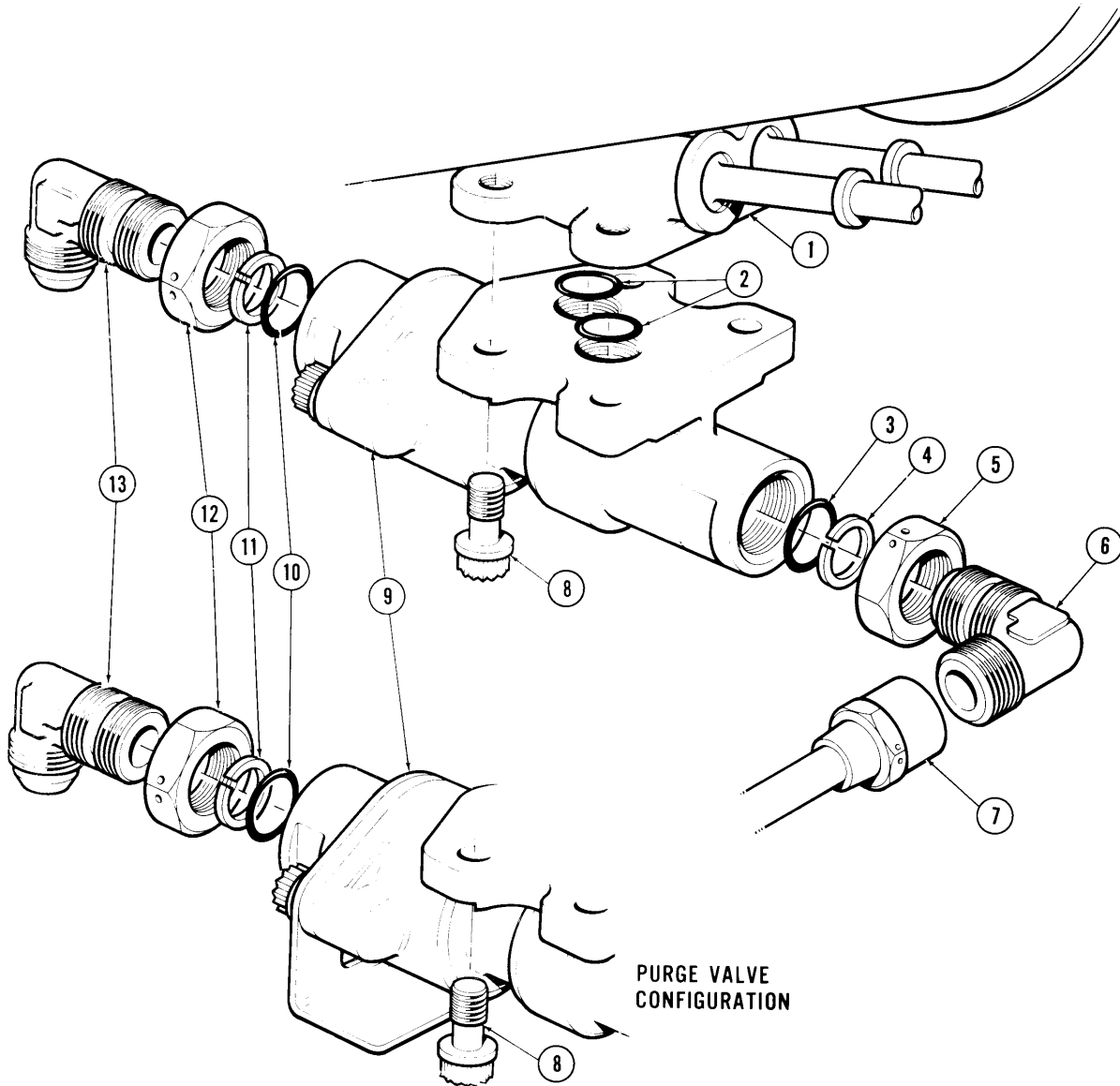
5. Removal/Installation

- A. Removal of Flow Divider and Dump (Pre-SB1406) or Purge (Post-SB1406) Valve (PT6A-21 Engines) (Ref. Fig. 201)

NOTE: 1. To avoid contamination of work area, use a container to catch fluid when disconnecting fuel lines, and during removal of flow divider and purge valve.

NOTE: 2. Smoky starts may be alleviated by replacing existing flow divider and purge valve with one having a larger diameter hole in the outlet fitting (P/N 3035229, 3036641, Ref. IPC).

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PT6A-21

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Removal/Installation of Flow Divider and Dump (Pre-SB1406) or Purge (Post-SB1406) Valve
Figure 201

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FLOW DIVIDER AND STARTING CONTROL - MAINTENANCE PRACTICES

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MAINTENANCE MANUAL
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Key to Figure 201

1. Inlet Adapter
2. Preformed Packing
3. Preformed Packing
4. Back-up Ring
5. Jam Nut
6. Elbow
7. Fuel Inlet Line
8. Bolt
9. Flow Divider and Dump or Purge Valve
10. Preformed Packing
11. Back-up Ring
12. Jam Nut
13. Elbow

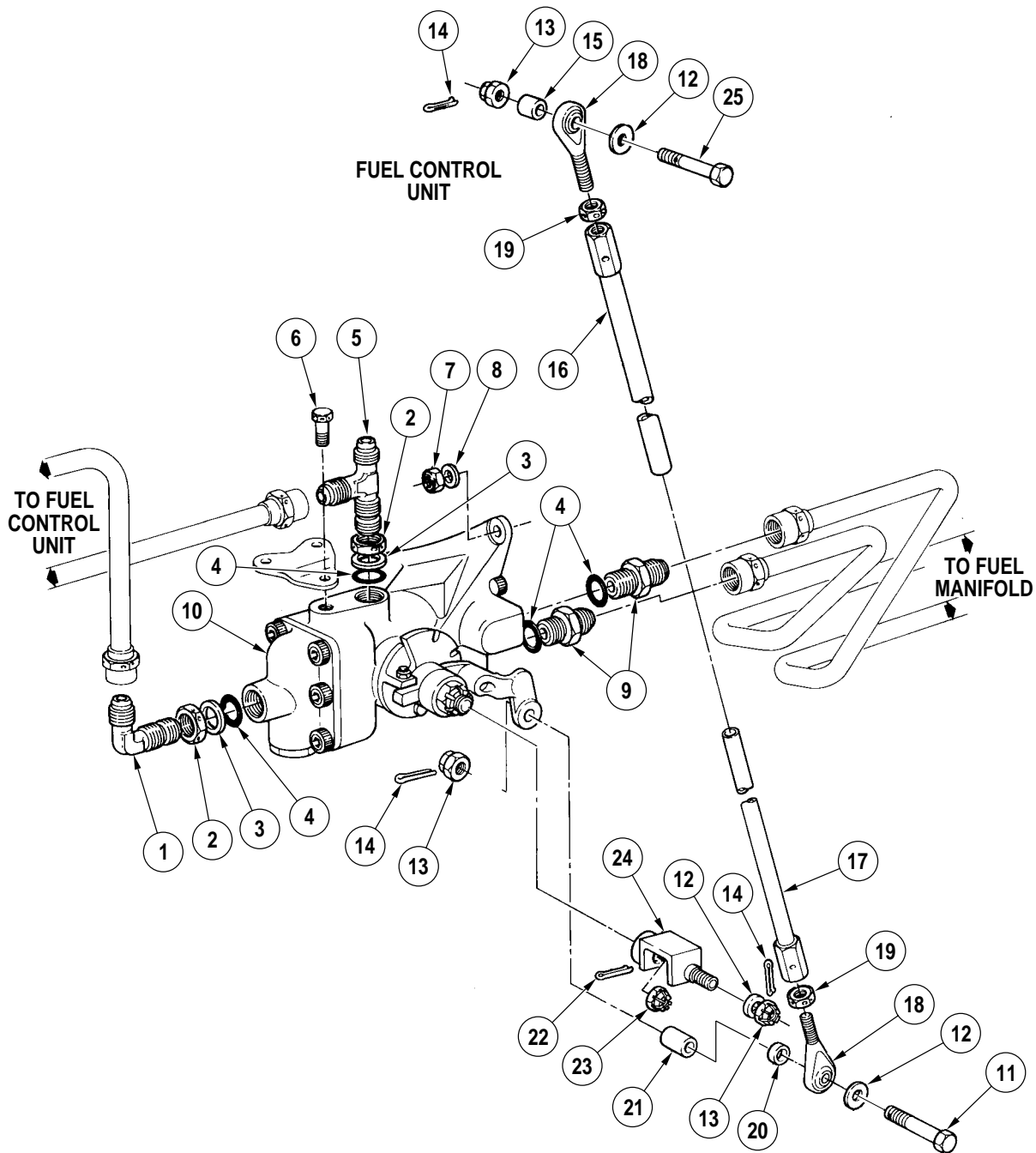
- (1) If flow divider and dump/purge valve (9) is being removed with engine installed, disconnect dump line or purge air line from elbow (13) on right side of engine. Cap line connection and elbow.
- (2) Disconnect coupling nut of fuel inlet tube (7) at elbow (6) on left side of engine. Cap line connection and elbow.
- (3) Support valve (9) and remove four bolts (8) that secure valve to fuel manifold inlet adapter (1). Remove valve and discard preformed packings (2).
- (4) If flow divider and dump/purge valve is being replaced, note angular position of elbows (6 and 13), then remove elbow fittings; discard preformed packings (3 and 10).

B. Removal of Starting Flow Control (PT6A-27 and PT6A-28 Engines) (Ref. Fig. 202)

NOTE: To prevent contamination of work area, use a container to catch spillage when disconnecting fuel lines and during removal of flow control.

- (1) Remove cotterpin (14), castellated nut (13), washer (12), spacers (20 and 21) and bolt (11) that secure lower end of starting flow control rod assembly to starting flow control (10).
- (2) Remove cotterpin (14), castellated nut (13), washer (12) and spacer (15) that secure upper end of starting flow control rod assembly to fuel control unit. Remove rod assembly.
- (3) Disconnect coupling nuts of fuel pressure and bypass tubes from elbow (1) and tee adapter (5) respectively. Cap all tubes and openings.
- (4) Disconnect coupling nuts of primary and secondary fuel tubes from nipples (9) on starting flow control. Cap all tubes and openings.

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Removal/Installation of Starting Flow Control
Figure 202

73-10-04

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Key to Figure 202

1. Elbow
2. Nut
3. Back-up Ring
4. Preformed Packing
5. Tee
6. Bolt
7. Nut
8. Washer
9. Straight Nipple
10. Starting Flow Control
11. Bolt
12. Washer
13. Castellated Nut
14. Cotterpin
15. Spacer
16. Upper Rod Assembly
17. Lower Rod Assembly
18. Rod End Connector
19. Nut
20. Sleeve Spacer
21. Sleeve Spacer
22. Cotterpin
23. Castellated Nut
24. Extension
25. Bolt

(5) Remove two self-locking nuts (7) and washers (8) that secure starting flow control to studs on flange G of engine, and remove single bolt (6) securing starting flow control to bracket attached to engine.

(6) If starting flow control is to be replaced, remove straight nipples (9), elbow (1), tee-adaptor (5) and bracket (24) from unit; discard preformed packings. Retain all other hardware for installation on replacement unit.

C. Installation of Flow Divider and Dump (Pre-SB1406) or Purge (Post-SB1406) Valve (PT6A-21 Engines) (Ref. Fig. 201)

(1) When a replacement flow divider and dump/purge valve (9) is being installed, depressure unit and assemble elbows (6 and 13) prior to installation:

NOTE: Depreservation is not required when original flow divider and dump/purge valve is being installed.

(a) Remove shipping plugs from inlet and dump line or purge air ports of replacement valve, and drain as much preservation oil as possible from unit.

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- (b) Using fuel (PWC01-001), flush out valve from dump line or purge air port end to remove all residual preservation oil from this area of the valve. Continue flushing until clear fuel flows from primary and secondary manifold ports. Temporarily reinstall plug in dump or air port.
 - (c) Flush out valve at area of fuel inlet port with fuel, and ensure all residual preservation oil is removed. Temporarily reinstall plug in inlet port.
 - (d) Assemble nuts (5 and 12), and back-up rings (4 and 11) followed by preformed packings (3 and 10) on each elbow (6 and 13) (Ref. 70-00-00, REMOVAL/INSTALLATION).
 - (e) Remove plugs from inlet and dump or purge air ports, install elbows (6 and 13) in valve (9), and position each elbow at same angle noted during removal. Tighten nuts (5 and 12), torque 38 to 42 lb.in. and safety wire.
 - (f) To prevent ingress of foreign material, cap elbows (6 and 13) until valve (9) is ready for installation.
- (2) Press two preformed packings (2) into recesses at primary and secondary manifold ports in mounting face of valve (9).
 - (3) Position valve (9) on base of fuel manifold inlet adapter (1), align attachment holes in each part, and secure valve to adapter with four bolts (8). Tighten bolts, torque 32 to 36 lb.in. and safety wire bolts together in pairs.
 - (4) Remove blanking caps from fuel pressure tube (7) and elbow (6), and connect coupling nut to elbow. Tighten coupling nut, torque 90 to 100 lb.in. and install safety wire.
 - (5) If installation of flow divider and dump/purge valve has been carried out with engine installed, remove blanking caps from dump line or purge air line and from elbow (13) and connect line to elbow. Tighten line connection to torque value recommended in relevant Aircraft Maintenance Manual.
- D. Installation of Starting Flow Control (PT6A-27 and PT6A-28 Engines) (Ref. Fig. 202)
- (1) When a replacement starting flow control (10) is being installed, depreserve unit and assemble elbows, tee and nipples prior to installation:

NOTE: Depreservation is not required when original starting flow control (10) is being installed.
 - (a) Remove shipping plugs from inlet and dump ports of replacement unit and drain as much preservation oil as possible from unit.
 - (b) Using fuel (PWC01-001), flush out unit from dump port end to remove all residual preservation oil from this area of the unit. Continue flushing until clear fuel flows from primary and secondary manifold ports. Temporarily reinstall plug in dump port.
 - (c) Flush out valve at area of inlet port with fuel and ensure all residual preservation oil is removed. Temporarily reinstall plug in inlet port.

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- (d) Assemble nuts (2) and back-up rings (3) followed by preformed packings (4) on elbow (1) and tee (5) fittings.
 - (e) Remove plugs from inlet and dump ports, install elbow (1) and tee (5) in control (10), and position each fitting at same angle noted during removal. Tighten nuts (2) torque 38 to 42 lb.in., and install safety wire.
 - (f) Remove plugs from primary and secondary fuel ports and install straight nipples (9) and preformed packings (4) in ports. Tighten nipples and torque 65 to 75 lb.in.
 - (g) To prevent ingress of foreign material, cap elbows, tee and nipples until control (10) is ready for installation.
- (2) Install starting flow control (10) on studs at flange G of accessory gearbox and secure with two self-locking nuts (7) and washers (8). Tighten nuts and torque 36 to 40 lb.in.
 - (3) Secure bracket on accessory gearbox to upper face of starting flow control with single bolt (6). Tighten bolt, torque 32 to 36 lb.in., and safety wire.
 - (4) Connect coupling nuts of primary and secondary fuel tubes to respective nipples (9) on starting flow control. Tighten nuts, torque 90 to 100 lb.in., and safety wire.
 - (5) Connect coupling nuts of pressure and bypass fuel tubes to elbow and tee fittings (1) and (5) respectively. Tighten nuts, torque 90 to 100 lb.in., and safety wire.
 - (6) If engine is mounted in airframe, connect fuel dump line to tee fitting (5). Tighten and torque line fitting as detailed in relevant Aircraft Maintenance Manual.
 - (7) Install upper end of starting flow control rod at fuel control unit and secure to lever with bolt (25), spacer (15), washer (12) and castellated nut (13). Tighten nut and torque 12 to 18 lb.in.; do not lock with cotterpin (14) at this stage.
 - (8) Install lower end of starting flow control rod at starting flow control (10) lever, and secure with bolt (11), spacers (21 and 20), washer (12) and castellated nut (13). Tighten nut and torque 12 to 18 lb.in.; do not lock with cotterpin (14) at this stage.
 - (9) Adjust length of control rod (Ref. 76-10-00), retighten and torque castellated nuts 12 to 18 lb.in.; lock with cotterpins (14).

6. Cleaning/Painting

A. Cleaning of Flow Divider

- (1) Clean exterior surfaces of the flow divider and dump/ purge valve or starting control with petroleum solvent (PWC11-027) or (PWC11-031). To prevent cleaning agent from entering valve, do not remove blanking caps.
- (2) Wipe surfaces dry with clean, lint-free cloths to remove all residual solvent and contamination.

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7. Inspection/Check

A. General Inspection

- (1) Examine the mounting flange for cracks and other defects. Cracks are not permissible; minor surface damage may be repaired.
- (2) Examine machined face of mounting flange for gouges, nicks, scores, scratches, and similar defects which can prevent correct mating of flange surface with fuel manifold inlet adapter. Particular attention should be paid to the two recesses for primary and secondary manifold port seals.
- (3) If elbows have been removed from inlet and dump ports, examine each port for thread damage.
- (4) Check for signs of leakage at joint between valve housing and main body. If leakage is evident, return valve to supplier (Ref. IPC).
- (5) Examine surfaces of valve for corrosion and for general condition of anodic treatment.
- (6) On the flow divider and dump or purge valve, check for signs of leakage at the spigot joint between the dump spring housing or purge valve housing and main body. If leakage is evident, return the valve to an approved overhaul facility.
- (7) On the starting control, check the lever for freedom of movement. Suspect units should be returned to an approved overhaul facility.
- (8) Inspect the surfaces of the valve or starting control for corrosion and for the general condition of the anodic treatment.

8. Approved Repairs

A. General Repair

NOTE: Make sure that all areas are cleaned and corrosion preventive treatment applied to surfaces after carrying out minor repairs. Do not allow filings to enter the valve.

- (1) Minor damage such as burrs, nicks, scores, scratches and other similar defects, may be cleaned up by blending with a fine stone or crocus cloth (PWC05-061), making sure that all high spots and sharp edges are removed.
- (2) Minor defects on the machined face of the flow divider mounting flange may be cleaned up by lightly dressing with crocus cloth (PWC05-061) held to a true, flat plate.
- (3) Clean up minor thread damage in the fuel inlet and dump or air inlet ports, as applicable, or chase the threads 7/16-20 UNJF-3B.
- (4) Clean up minor thread damage on the elbow fittings or chase the threads using the appropriate die.

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B. Corrosion Removal

- (1) Light surface corrosion on the units may be removed from the main body and from the dump spring or purge valve housing (as applicable) using one of the following methods:

NOTE: Apply anti-corrosion treatment to the repaired area in accordance with the procedure given in Subpara. C.

- (a) Remove corrosion deposits by vapor blasting with 1200 grit (PWC05-168) or finer. Make sure that the areas around the corrosion are masked to prevent damage to the surrounding parts.
- (b) Remove corrosion deposits by careful polishing with No. 400 grit abrasive cloth (PWC05-101) followed by crocus cloth (PWC05-061).

C. Application of Anodize Surface Treatment

- (1) The anodic anti-corrosion finish on the unit surfaces of the main body and dump spring or purge valve housing (as applicable) may be repaired by local application of the chemical treatment solution (PWC05-166). This treatment must be used on areas where minor repairs have been carried out by local blending and/or polishing. To apply the treatment, proceed as follows:

- (a) Prepare the surface by cleaning with the cleaning solution (PWC11-038). Keep the surface wetted with the cleaning solution for one to five minutes.
- (b) Rinse with clean water to remove all traces of the cleaning solution.

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

WARNING: DURING THE USE OF ALODINE SOLUTION, AVOID BREATHING VAPORS; USE ONLY WITH ADEQUATE VENTILATION. WEAR CHEMICAL SAFETY GOGGLES AND RUBBER GLOVES WHEN HANDLING. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER; IF IRRITATION APPEARS AND PERSISTS, CONSULT A PHYSICIAN (MEDICAL DOCTOR). IN CASE OF EYE CONTACT, FLUSH EXTENSIVELY WITH FRESH WATER AND CONSULT A PHYSICIAN IMMEDIATELY.

- (c) Apply the chemical treatment solution to the prepared surface by brush, swab, or spray method and allow three to five minutes setting time.
- (d) Rinse with clean water to remove all excess chemical treatment solution and allow the surface to air dry.
- (e) Examine the coating and make sure the repaired area is completely covered. Reapply the treatment as necessary.

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9. Adjustment/Test

Check the function of the flow divider and dump or purge valve or starting control, as applicable, during the next engine test run (Ref. 71-00-00).

A. Procedure

- (1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST), and do checks associated with Installation/Replacement of Flow Divider (Ref. 71-00-00, ADJUSTMENT/TEST).

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FUEL MANIFOLD AND NOZZLES - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

A. Fuel Manifold

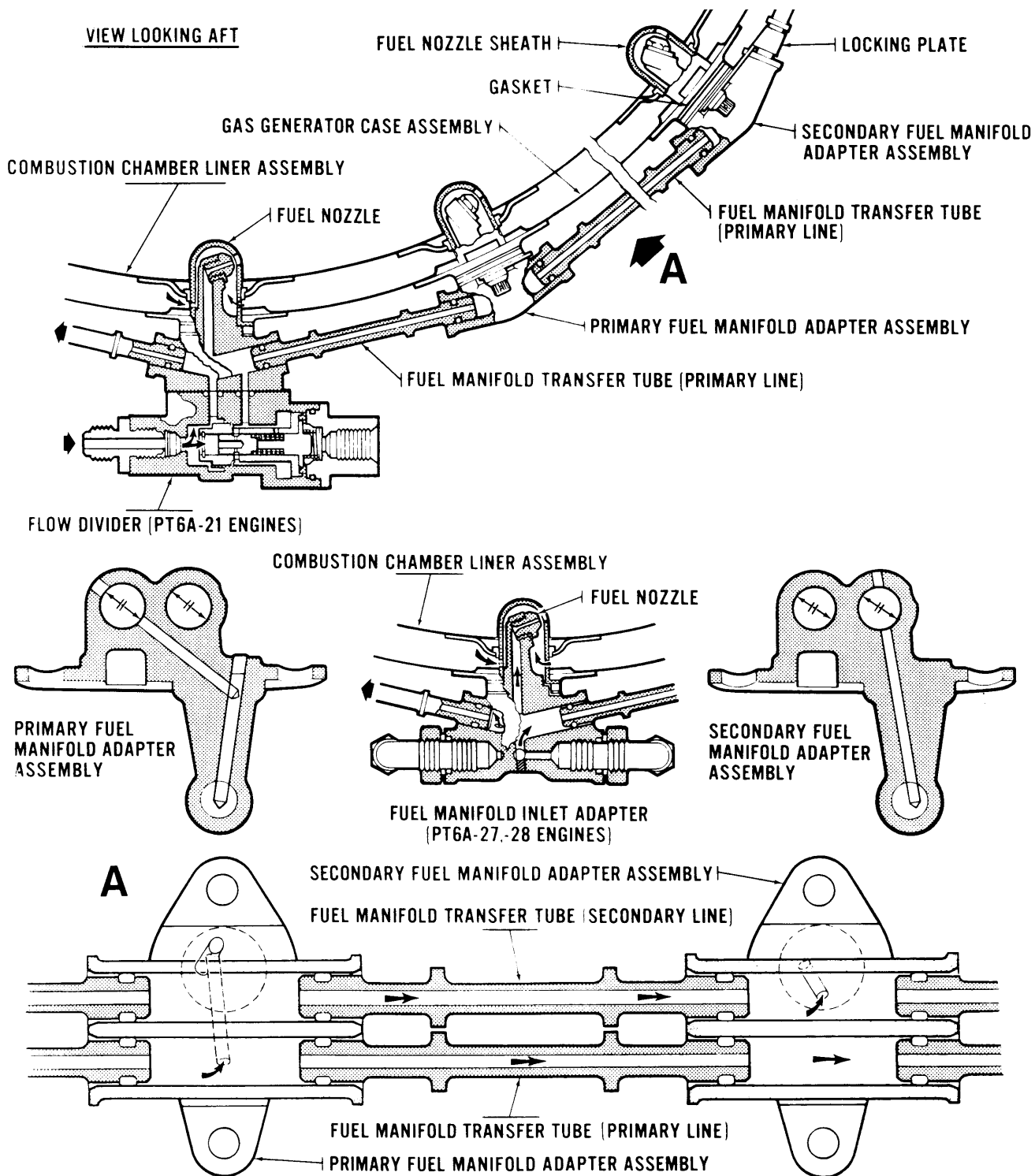
The dual fuel manifold delivers metered fuel from the flow divider (PT6A-21) or starting flow control (PT6A-27 and PT6A-28), as applicable, to the primary and secondary fuel nozzles. The manifold consists of 14 adapter assemblies (Pre-SB1372 - seven primary, six secondary and a secondary inlet adapter; for Post-SB1372 engines - ten primary, three secondary and a secondary inlet adapter). The adapters are interconnected by pairs of fuel transfer tubes and are each secured to their respective bosses on the gas generator case by same two bolts. Locking plates, secured by the same two bolts, maintain the transfer tubes in position. The adapters and transfer tubes are sealed with gaskets and preformed packings, respectively.

B. Fuel Manifold Adapter Assemblies

Each fuel manifold adapter assembly incorporates a simplex, single orifice fuel nozzle, with swirl-type tip, and a sheath. The swirl-type tips provide a fine atomized fuel spray in the annular combustion chamber liner. The sheath fits over the fuel nozzle and internal section of the manifold adapter. Each fuel nozzle assembly, which incorporates a fine strainer adjacent to the tip, is threaded into the internal section of the adapter. An internal passageway connects the nozzle to its respective primary or secondary bore in the adapter body. The sheath and nozzles extend through the gas generator case and combustion chamber liner, and are positioned so that they produce a tangential spray from one nozzle to the next in the liner. Holes in the sheath allow cooling air, from the space between the gas generator case and liner, to pass within the sheath and out through the nozzle aperture; this air, in addition to cooling the tip of the nozzle, also assists in fuel atomization.

The combustion chamber liner is located and supported within the gas generator case by the fuel nozzle sheaths. The sheaths act as spigots and pass through suspension brackets welded to the outer wall of the liner.

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C7954

Fuel Manifold Assembly - Cross-Section
 Figure 1

73-10-05

Page 2

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FUEL MANIFOLD AND NOZZLES - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC01-001	Fuel, Engine
PWC05-007	Fluid, Check
PWC05-027	Ink, Marking
PWC05-046	Marker, Ink
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-145	(See PWC05-019)
PWC09-003	Compound, Sealing
PWC11-013	Compound, Carbon Removing
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-049	Remover, Rust

3. Special Tools

The special tools listed below are used in the following procedures.

<u>Tool No.</u>	<u>Name</u>
PWC30405	Fixture, Leak test
PWC30416	Puller, Fuel Nozzle Sheath
PWC30506	Rig, Fuel Manifold Adapters - Flow Test
PWC30530	Plug, Blanking
PWC32366	Pusher, Fuel Transfer Tubes
PWC32811	Fixture, Flow Test

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4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

<u>Name</u>	<u>Remarks</u>
Pressure Tester	P/N 2311F
Flushing Fixture	
Stainless Steel Container, Perforated	
Ultrasonic Cleaner	

5. Removal/Installation

A. Procedure Before Removal

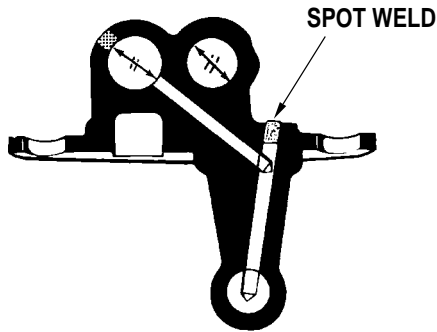
- (1) To ease accessibility to the transfer tubes and manifold adapters adjacent to the glow plugs or spark igniters, disconnect the ignition leads (Ref. 74-20-00/74-20-01). Release the ignition lead loop clamps from the support brackets at the center fireseal lower attachment brackets and move the leads clear. Install blanking caps on the glow plugs or spark igniters and lead connectors.
- (2) Disconnect both lines from the fuel inlet adapter (PT6A-27/-28) or flow divider (PT6A-21) and install blanking caps.
- (3) If the engine is not separated at Flange C and it is intended to remove all manifold adapters, make sure glow plugs or spark igniters remain installed; otherwise, alignment problems with the combustion chamber outer liner might be encountered during reinstallation.

B. Removal of Fuel Manifold Adapters

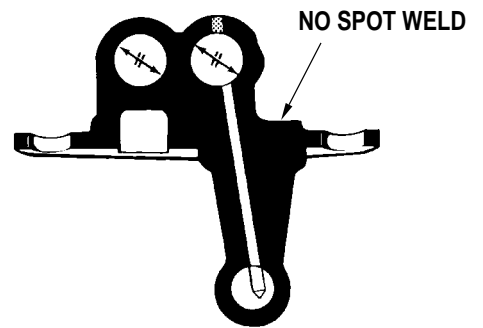
NOTE: The following procedure itemizes a removal sequence commencing with the No. 8 fuel manifold inlet adapter, and which is best achieved by consideration of the Nos. 7, 8 and 9 adapters as a group. The procedural sequence may be modified by the operator as convenient for adapters at other locations.

- (1) Using a suitable dye marker (PWC05-027) or (PWC05-046), number the position of each manifold adapter to identify its original location for reinstallation (Ref. Fig. 201) and to aid detecting hot section damage.
- (2) Remove bolts securing transfer tube locking plate (6, Fig. 202) and inlet manifold adapter (2) to gas generator case. Remove locking plate (6).
- (3) Remove bolts securing locking plates (6) to the primary and secondary manifold adapters (5) adjacent to inlet manifold adapter (2). Remove locking plates (6).
- (4) Support all three adapters and slide interconnecting fuel transfer tubes (1) into the bores of the adapters (5). Using pusher (PWC32366), move fuel transfer tubes, in a clockwise direction, away from inlet manifold adapter bores.

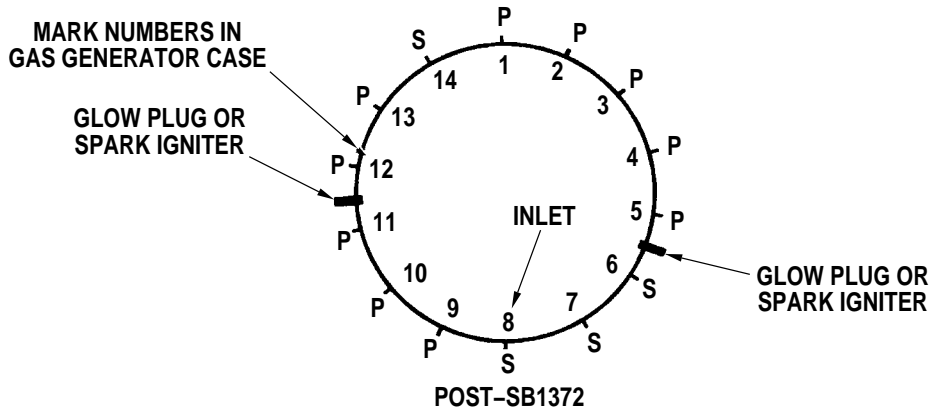
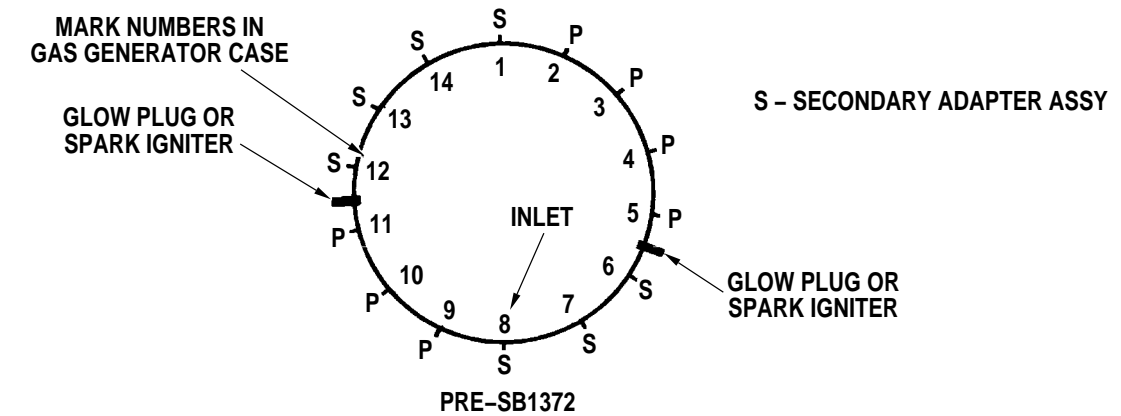
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**PRIMARY FUEL MANIFOLD
ADAPTER ASSEMBLY**



**SECONDARY FUEL MANIFOLD
ADAPTER ASSEMBLY**

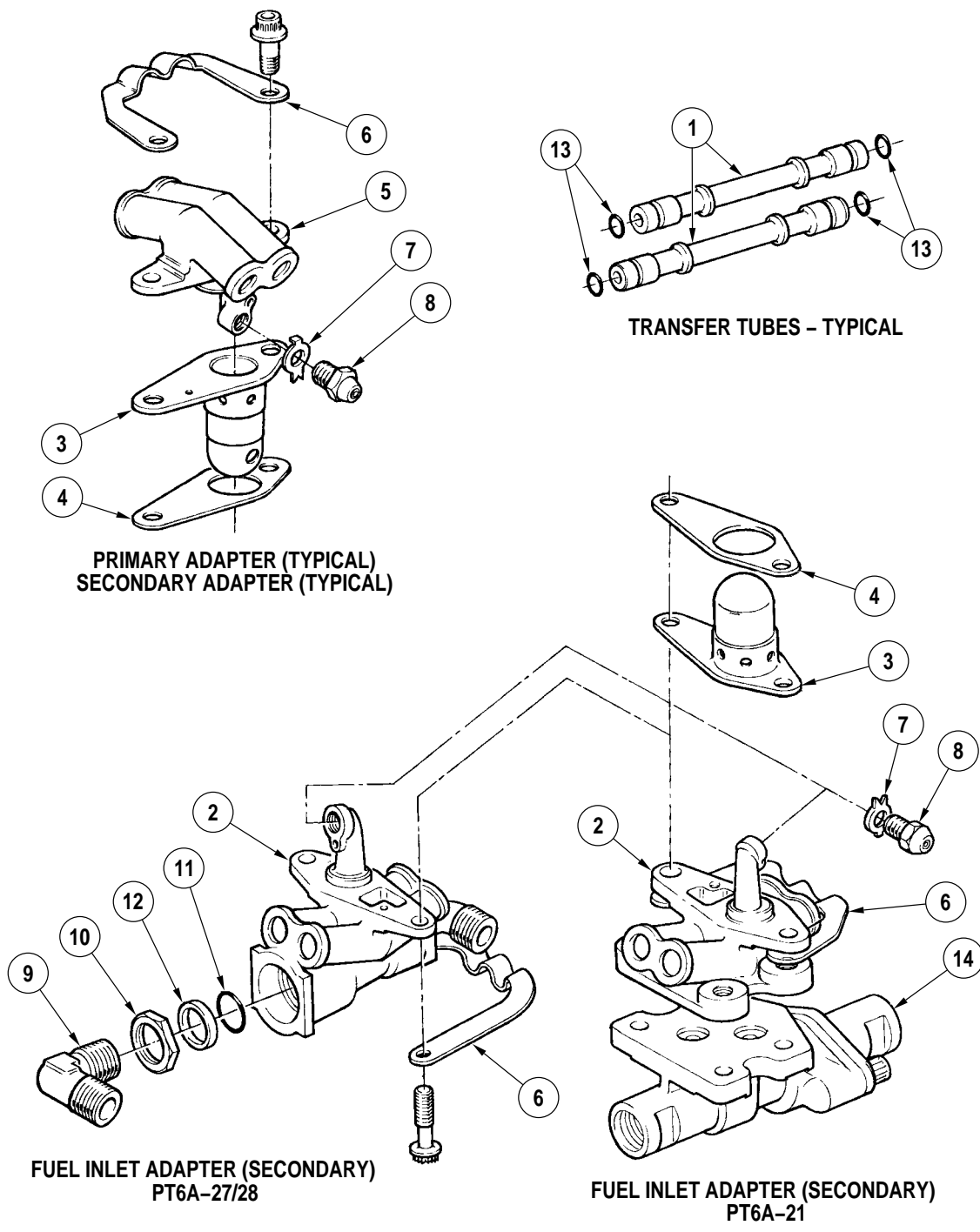


FUEL MANIFOLDS AS VIEWED FROM REAR OF ENGINE

C7919C

Identification and Location of Fuel Manifold Adapters
Figure 201

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C7918A

Removal/Installation of Fuel Manifold Adapters and Nozzle Assemblies
 Figure 202

73-10-05

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Key to Figure 202

1. Fuel Transfer Tube
2. Fuel Manifold Inlet Adapter
3. Sheath
4. Gasket
5. Fuel Manifold Adapter
6. Lockplate
7. Keywasher
8. Fuel Nozzle
9. Elbow
10. Locknut
11. Preformed Packing
12. Back-up ring
13. Preformed Packing
14. Flow Divider and Dump or Purge Valve

- (5) Remove the inlet manifold adapter (2) (with attached flow divider and dump valve (14) where fitted). Remove the fuel transfer tubes (1) from the adjoining secondary adapters (5). Remove and discard preformed packings (13) from transfer tubes.

NOTE: Do not remove the flow divider and dump or purge valve (where fitted) from the inlet manifold adapter except for cleaning (Ref. Cleaning/Painting). Inspection and testing procedures outlined in following text can be accomplished with parts remaining attached as an assembly.

- (6) Remove the gasket (4) from the sheath (3) on the inlet manifold adapter (2).
- (7) Remove the remaining manifold adapters (5) progressively from the gas generator case by removing bolts and locking plates (6). As each adapter is removed, withdraw interconnecting fuel transfer tubes (1). Remove and discard preformed packings (13). Remove metal gaskets (4) from sheaths (3) on the adapters.

CAUTION: DO NOT PRY THE SHEATHS OFF WITH A SCREWDRIVER.

- (8) Remove the sheaths (3) from the manifold adapters using puller (PWC30416) if sheath is tight fitting on adapter boss.

CAUTION: EXTREME CARE MUST BE EXERCISED WHEN HANDLING THE FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT-FREE COTTON GLOVES OR SURGICAL GLOVES SHOULD BE WORN AT ALL TIMES WHEN HANDLING THESE PARTS.

CAUTION: MAKE SURE WRENCH SOCKET IS CORRECTLY ENGAGED ON NOZZLE DURING INSTALLATION. FUEL NOZZLE OUTLET MAY BE DAMAGED IF WRENCH SLIPS.

- (9) Straighten the lugs on the keywashers (7) and remove the nozzle assemblies (8) from the adapters (2) and (5). Discard the keywashers.

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- (10) Note the relative angle of each elbow to the inlet manifold adapter (2) (starting control installation only) and remove the elbows (9) and locknuts (10). Discard preformed packings (11) and back-up rings (12).
- (11) To prevent exposure to dust and dirt, place the manifold components in clean, covered containers or polyethylene bags until required for use.
- (12) Send rejected assemblies for repair or overhaul in original packaging to prevent parts contacting each other during shipment.

C. Installation of Fuel Manifold Adapters

CAUTION: EXTREME CARE MUST BE EXERCISED WHEN HANDLING THE FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT-FREE COTTON GLOVES OR SURGICAL GLOVES SHOULD BE WORN AT ALL TIMES WHEN HANDLING THESE PARTS.

CAUTION: MAKE SURE WRENCH SOCKET IS CORRECTLY ENGAGED ON NOZZLE DURING INSTALLATION. FUEL NOZZLE OUTLET MAY BE DAMAGED IF WRENCH SLIPS.

- (1) With a 10X magnifying glass verify that each manifold adapter assembly carries the correct detail fuel nozzle assembly tip part number (Ref. Illustrated Parts Catalog).
- (2) Install the elbows (9) on the inlet adapter (starting control installation only) (Ref. 70-00-00, REMOVAL/INSTALLATION) in the same positions as noted on removal (Ref. Subpara. B.(10)).
- (3) Install new nozzle assemblies (8, Fig. 202) in adapters (2 and 5) using new keywashers (7) at each location. Tighten nozzle assemblies 45 to 50 lb. in. DO NOT lock keywashers until testing is completed. Use of fuel (PWC01-001) as a lubricant while tightening is permitted.
- (4) Leak test each nozzle and adapter assembly (Ref. Adjustment/Test). Repair or replace nozzles that leak (Ref. Repair).
- (5) Function test each nozzle and adapter assembly (Ref. Adjustment/Test).
- (6) On completion of satisfactory tests, lock each keywasher on respective nozzle assembly. Do NOT exceed specified torque to align flat on tip with keywasher.
- (7) Install the manifold adapters and fuel transfer tubes as follows:

NOTE: Primary fuel manifold adapters are identified by a single weld blob on the larger mounting flange. Other weld blobs appearing on the knuckle section of the adapters should be ignored

- (a) Assemble sheaths (3) on all adapters (2 and 5). Make sure each locating pin engages hole in each sheath.

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- (b) With nozzle adapter and sheath pressed together by hand, check clearance between adapter and sheath flanges. Maximum gap allowed is 0.003 inch (Ref. Fig. 203). Larger gap suggests either or both parts are distorted. Send parts to P&WC (Ref. INTRODUCTION, Customer Support) for repair.
- (c) Carefully check gap between fuel nozzle tip and side of hole in sheath; clearance of 0.020 inch is required (Ref. Fig. 203). If clearance is less at any point, either or both parts are distorted. Send parts to P&WC (Ref. INTRODUCTION, Customer Support) for repair.
- (d) Assemble preformed packings (13, Fig. 202) on all fuel transfer tubes (1). Position fuel transfer tubes into ports on one side of manifold adapters (2 and 5). Fully insert fuel transfer tubes in their respective ports until the bottom of manifold adapter is reached.

CAUTION: TO AVOID POSSIBLE FAILURE OF THE STAINLESS STEEL GASKETS, IT IS ADVISABLE TO SLIDE THE GASKET OVER THE SHEATH, CAREFULLY ALIGN THE HOLES AND INSERT BOTH BOLTS. THE WHOLE ASSEMBLY CAN THEN BE MATED WITH THE PADS ON THE GAS GENERATOR CASE, THUS AVOIDING ANY ATTEMPT TO LEVER THE GASKETS INTO ALIGNMENT WITH THE BOLTS.

- (e) Position the Pre-SB1276/Post-SB1276 gasket (4) over the sheath (3) on the inlet manifold adapter (2) and align the bolt holes. The sheath flange must be flat.

NOTE: 1. The gasket may be put on either side. For consistency, all gaskets should be installed with the flat side against the gas generator.

NOTE: 2. Post-SB1167: For engines with the conversion coated gas generator case only, lightly coat both faces of the gasket (4) with corrosion-preventive compound (PWC09-003).

- (f) Position the gaskets (4) over the sheaths (3) on the primary and secondary manifold adapters (5) and align on the bolt holes.
- (g) Install remaining manifold adapters (5) and sheaths (3) on the gas generator case, at previously marked locations, starting on each side of inlet manifold adapter (2). As each adapter and sheath is positioned, using pusher (PWC32366), insert the fuel transfer tubes (1) to interconnect with the adjacent adapter at each location.

NOTE: In order to easily detect hot section damage, replacement nozzle should be installed at original locations from which unserviceable item was removed. Nozzles should be reinstalled at original locations if not cleaned after flow test (Ref. Fig. 201).

- (h) Install locking plate (6) and bolts to the gas generator case . Torque bolts fingertight.
- (8) When all remaining manifold adapters (5) are positioned, remove bolts from inlet manifold adapter (2). Assemble the locking plate (6) and reinstall the bolts.

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CAUTION: MAKE SURE ALL 14 MANIFOLD ADAPTER LOCKING PLATES ARE CORRECTLY INSTALLED.

CAUTION: PRIOR TO TIGHTENING BOLTS OR LOCKNUTS, CHECK SEATING OF METAL GASKET RELATIVE TO SHEATH AND BOSS. TIGHTENING SHOULD BE DONE EVENLY ON EACH ADAPTER TO PROVIDE FULL SEATING POTENTIAL OF METAL GASKET.

- (9) Tighten all adapter mounting bolts, in a sequence, 15 to 20 lb.in. Retighten 32 to 36 lb. in. in the same sequence. Secure bolts with lockwire.

NOTE: After torquing, a 0.001 in. gap is allowed between the adapter and sheath flanges (Ref. Fig. 203).

- (10) Remove the blanking caps from the fuel delivery lines and connect the lines to the elbows. Tighten the coupling nuts 90 to 100 lb.in. and fasten with lockwire.
- (11) Remove the blanking caps from the spark igniters and from harness leads and connect the leads to the igniters. Tighten the connections fingertight, plus 45 degrees and fasten with lockwire. Secure the ignition lead loop clamps to the support brackets at the center fireseal lower mounts and tighten the nuts 32 to 36 lb.in.
- (12) Check function of fuel manifold installation (Ref. Adjustment/Test).

6. Cleaning/Painting

WARNING: CARBON REMOVING COMPOUND IS TOXIC AND CAUSTIC, AND MUST BE HANDLED WITH EXTREME CARE. AVOID ALL DIRECT CONTACT WITH SKIN OR CLOTHING. PREVENT CONTACT WITH EYES AND AVOID INHALATION OF THE VAPORS. COMPOUNDS CAN BE FATAL IF SWALLOWED. IF CONTACT WITH EYES OR SKIN IS MADE, WASH AFFECTED AREAS THOROUGHLY FOR 15 MINUTES WITH WATER AND RINSE WITH SATURATED BORIC ACID SOLUTION. IF ACCIDENTALLY SWALLOWED, GET MEDICAL ATTENTION IMMEDIATELY. CONSULT WITH PHYSICIAN AS RAPIDLY AS POSSIBLE FOR ALL CONTACT CASES.

CAUTION: ONLY USE RECOMMENDED ALKALINE CLEANING SOLUTION WITH A PH GREATER THAN 7. SOLUTIONS WITH A PH VALUE LOWER THAN 7 (ACIDIC) MAY CAUSE FUEL NOZZLE DAMAGE.

CAUTION: OBSERVE ALL FIRE AND SAFETY PRECAUTIONS WHEN FUELS OR SIMILAR COMBUSTIBLES ARE USED.

A. Cleaning of Fuel Manifold Adapter Assemblies

- (1) Remove fuel flow divider from inlet adapter (Ref. 73-10-04, Removal/Installation).
- (2) Remove fuel manifold sheaths from adapter assemblies.

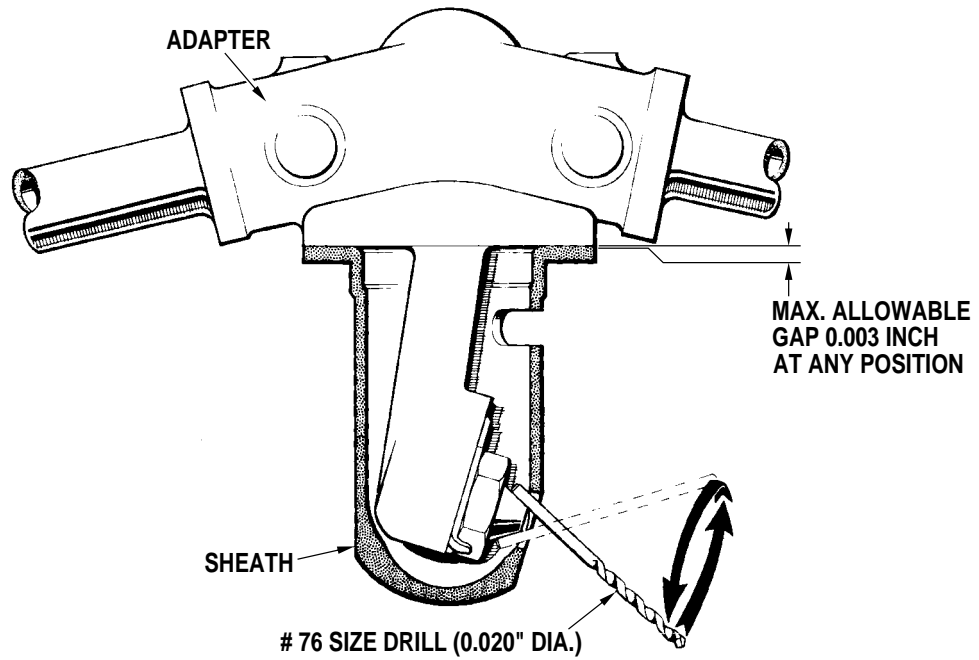
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CAUTION: MAKE SURE ADAPTERS ARE SEPARATED FROM EACH OTHER TO PREVENT DAMAGE DURING CLEANING.

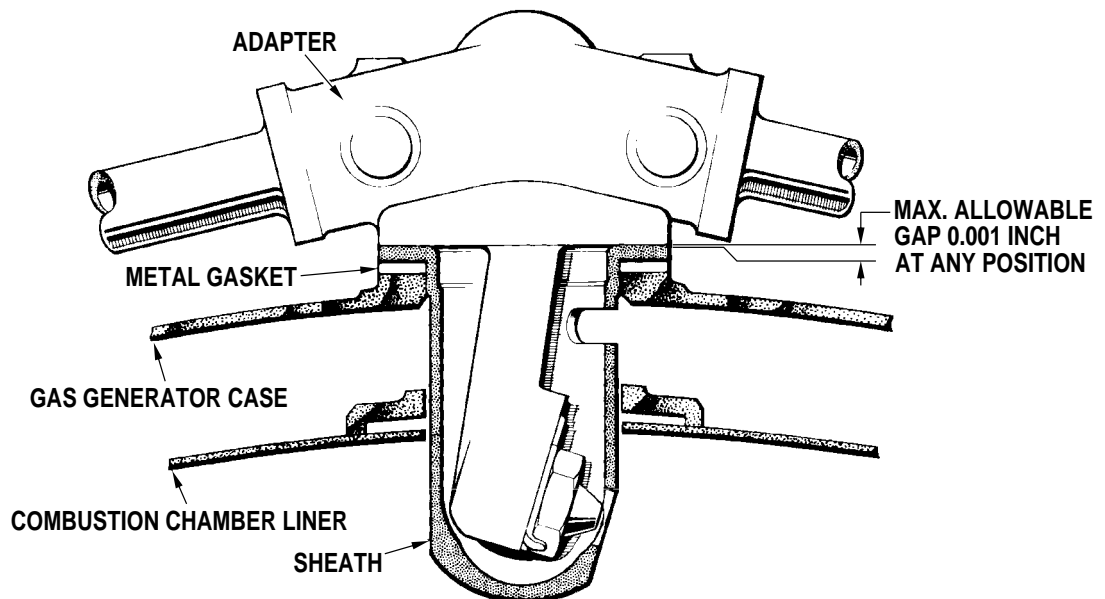
- (3) Place as many manifold adapter assemblies as possible in a perforated stainless steel container constructed to prevent contact between parts.

NOTE: Wires may be used to suspend parts in cleaning solution to prevent contact during cleaning.

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SECTION THROUGH FUEL MANIFOLD ADAPTER AND SHEATH HAND HELD



SECTION THROUGH FUEL MANIFOLD ADAPTER AND SHEATH
INSTALLED ON GAS GENERATOR CASE

C41914

Fuel Manifold Installation - Clearance Checks
Figure 203

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- (4) Prepare caustic solution by diluting 2 to 3 pounds of carbon removing compound (PWC11-013) or (PWC11-049) in one (1) U.S. gallon of water (3.8 liters) and heat to approximately 90°C (200°F). Pour caustic solution/cleaner into a tank of ultrasonic cleaner.

NOTE: 2 to 3 lb. carbon removing compound (PWC11-013) or (PWC11-049) per (US) gallon produces 24 to 36 % solution.

- (5) Suspend the perforated stainless steel container containing manifold adapter assemblies in the cleaner tank solution. Make sure that all manifold adapters are completely immersed.
- (6) Cover tank and activate ultrasonic cleaner for approximately one hour.
- (7) After cleaning, immediately wash assemblies thoroughly in very hot water.

CAUTION: FLUSHING MUST BE DONE IMMEDIATELY FOLLOWING CLEANING PROCESS TO AVOID DAMAGE TO ASSEMBLIES BY RESIDUAL CLEANING SOLUTION.

- (8) Rinse parts again in warm water at 82°C (180°F) for 2 to 3 minutes.
- (9) Install blanking plate (Ref. Fig. 204) and preformed packings on mounting face of inlet manifold adapter to block flow through flow divider transfer ports at base of adapter.
- (10) To remove residual cleaning solution from inside adapter assemblies, install adapters in fixture (PWC32811). Using appropriate blanking tubes, flow clean, very hot water at normal tap pressure, 30 psig max., for at least one minute through passageways of adapters.
- (11) Remove blanking plate from inlet manifold adapter.
- (12) Immediately dry assemblies thoroughly using clean, filtered compressed air or nitrogen.
- (13) Do leak and functional test (Ref. Para. 9.B. and C.).

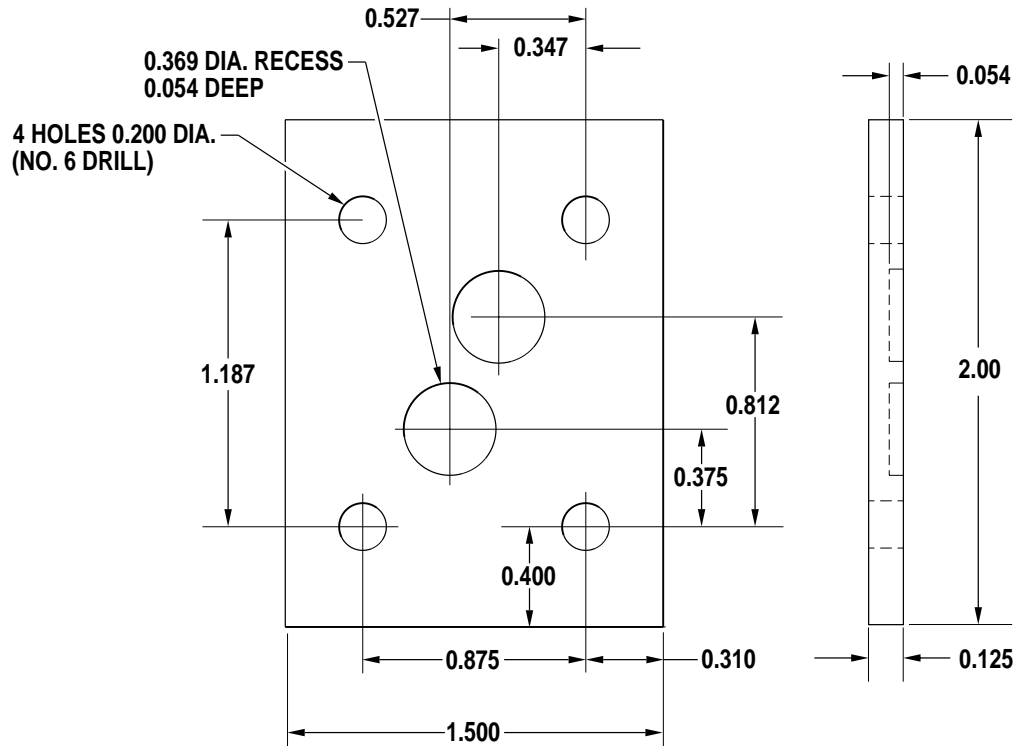
NOTE: Before commencing the tests as described, allow fuel to flow through the nozzle and manifold adapter assembly for at least one minute at 30 psig.

B. Cleaning of Fuel Nozzles (Removed from Fuel Manifold Adapters)

CAUTION: EXTREME CARE MUST BE USED WHEN THE FUEL NOZZLE ASSEMBLIES ARE HANDLED SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT-FREE COTTON GLOVES OR SURGICAL GLOVES SHOULD BE WORN AT ALL TIMES WHEN THESE PARTS ARE HANDLED.

- (1) Place fuel nozzles in perforated steel container, and clean using same procedures as that for fuel manifold adapter assemblies (Ref. Subpara. A.).

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MATERIAL: MILD STEEL OR ALUMINUM SHEET 0.125 THICK (MIN.)

LOCAL MANUFACTURE

C3790D

Inlet Adapter Blanking Plate
Figure 204

73-10-05

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CAUTION: FLUSHING MUST BE DONE IMMEDIATELY AFTER THE CLEANING PROCESS TO AVOID DAMAGE TO THE NOZZLES BY RESIDUAL CARBON REMOVER SOLUTION.

- (2) Install nozzles in flushing fixture (Ref. Fig. 205).

NOTE: Use suitable blanking plugs if all 14 positions are not filled.

- (3) Connect the hot water supply to the flushing fixture and flow clean, very hot water through the nozzles for one minute at normal tap water pressure up to 30 psig.
- (4) Disconnect the flushing fixture from the hot water supply, connect to a supply of clean filtered compressed air or nitrogen and dry thoroughly. Disconnect the flushing fixture from the air supply.
- (5) Connect the flushing fixture to the fuel manifold adapter assembly test rig and flow fuel through the nozzles for one minute at 30 psig.
- (6) Remove the nozzles from the flushing fixture and store in a clean container until required for reinstallation and test in the adapter assemblies.

C. Cleaning Fuel Manifold Adapter (Nozzles Removed) and Adapter Sheaths

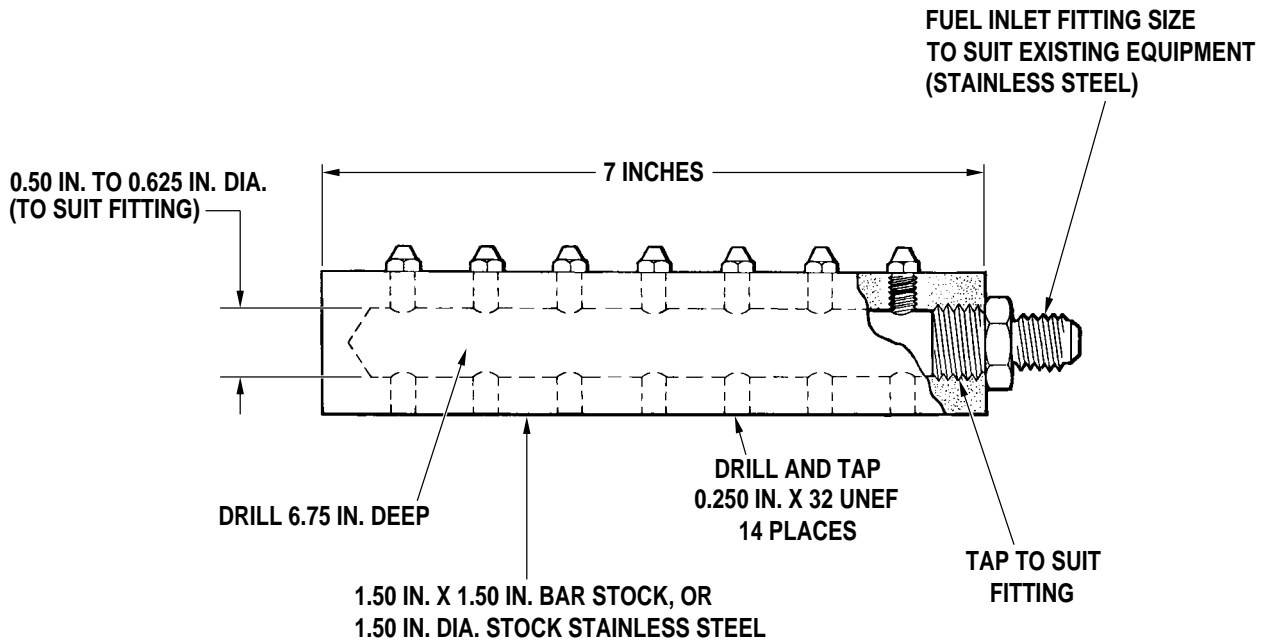
CAUTION: EXTREME CARE MUST BE USED WHEN THE FUEL NOZZLE ASSEMBLIES ARE HANDLED SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT-FREE COTTON GLOVES OR SURGICAL GLOVES SHOULD BE WORN AT ALL TIMES WHEN THESE PARTS ARE HANDLED.

- (1) Place the fuel manifold adapters and sheaths in the perforated stainless steel container, and proceed as described in Subpara. A., steps (4) through (7). Reduce cleaning time to 30 minutes.

CAUTION: FLUSH WASHING MUST BE DONE IMMEDIATELY AFTER THE CLEANING PROCESS.

- (2) Pressure wash parts thoroughly to remove residual compound under very hot, running water for at least one minute. Make sure that adequate water flow is maintained through the internal bores of the adapters. Remove any remaining loose carbon build-up on the sheaths by scrubbing with a non-metallic bristle brush.
- (3) Immediately dry parts thoroughly using clean, filter compressed air.
- (4) Install the fuel nozzles in the manifold adapters (Ref. Removal/Installation) and test (Ref. Adjustment/Test).

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LOCAL MANUFACTURE

C3812A

Fuel Nozzle Flushing Fixture
Figure 205

73-10-05

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7. Inspection/Check

CAUTION: USE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT FREE GLOVES SHOULD BE WORN AT ALL TIMES WHEN HANDLING PARTS.

A. Fuel Nozzle Assembly

- (1) Check the nozzle assembly for burrs and similar defects. Threads and hexagon may be lightly stoned to remove nicks and burrs.

B. Nozzle Sheath (Ref. Fig. 206)

- (1) Erosion, any loss of coating is acceptable provided any loose coating is removed by light buffing and 0.040 inch minimum dome thickness is retained .
- (2) Fretting wear, maximum permissible depth is 0.010 inch; deburr raised material.

C. Manifold Adapter

- (1) Check the locating pin for security in the adapter and for burrs and similar defects. Check threads for damage.

8. Approved Repairs

CAUTION: REPAIRS ARE NOT PERMITTED ON NOZZLE ORIFICE FACE.

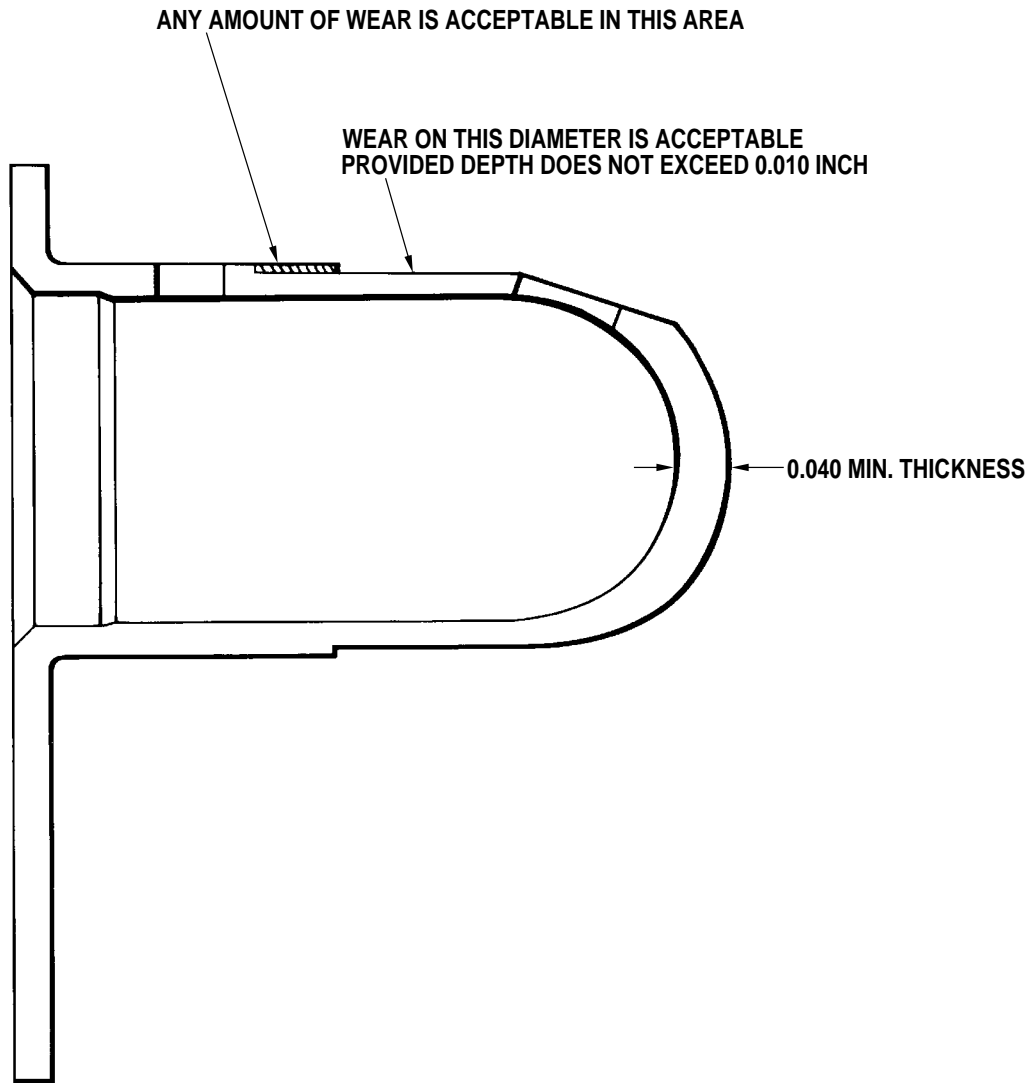
A. Procedure

CAUTION: DAMAGE MAY OCCUR TO THE ADAPTER SEALING FACE IF USING TOO COARSE A GRIT OF ABRASIVE CLOTH OR APPLICATION OF UNEQUAL PRESSURE ON ADAPTER FACE DURING LAPPING. THIS PROCEDURE IS ONLY RECOMMENDED FOR ADAPTERS THAT ARE FOUND TO BE LEAKING AFTER INSTALLATION OF A NOZZLE TIP.

CAUTION: IF LEAKAGE CANNOT BE STOPPED BY LAPPING OF THE ADAPTER SEALING FACE, DO NOT OVERTORQUE NOZZLE TIP TO ACHIEVE CORRECT SEALING. RETURN DEFECTIVE NOZZLE ASSEMBLY TO AN AUTHORIZED OVERHAUL SHOP FOR REPAIR.

- (1) Repair of adapters, sheaths and nozzle assemblies is limited to local blending of minor defects such as scores, nicks, scratches and gouges on exterior surfaces.
- (2) Clean up minor defects by blending with a fine stone or file and/or by polishing with crocus cloth (PWC05-061). Thread damage on adapters may be repaired with a suitable Swiss file, thread chaser or appropriate die.
- (3) Remove all sharp edges and high spots. Lap adapter sealing surfaces (Ref. Fig. 207) against a flat base (± 0.0002 inch flatness). Use compound (PWC05-145) or an abrasive cloth (PWC05-061) lubricated with a drop of fuel.
- (4) Clean all parts after repair by pressure washing in petroleum solvent (PWC11-027) or (PWC11-031).

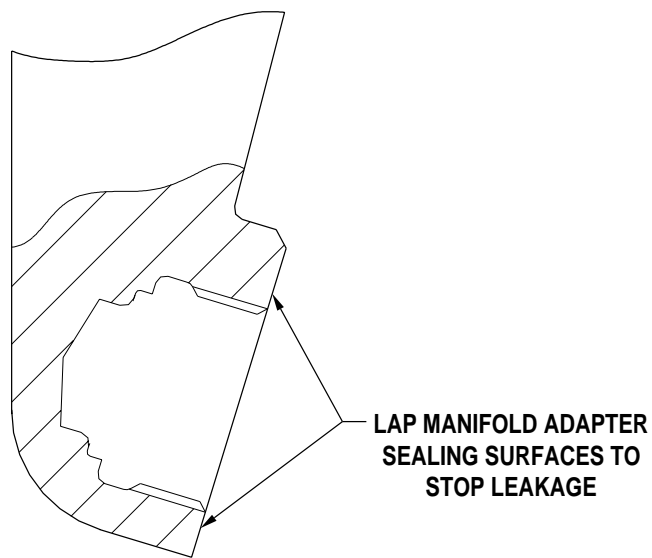
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MAINTENANCE MANUAL
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C8403

Nozzle Sheath Wear Limits
Figure 206

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C67072

Manifold Adapter Sealing Surfaces
Figure 207

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9. Adjustment/Test

CAUTION: OBSERVE FIRE SAFETY PRECAUTIONS AT ALL TIMES WHEN PROCEDURES INVOLVE THE USE OF FUELS OR SIMILAR COMBUSTIBLES.

CAUTION: DAMAGE TO THE HOT SECTION MAY BE CAUSED BY DEFECTIVE FUEL NOZZLES. REGULAR NOZZLE INSPECTION AND CLEANING IS RECOMMENDED TO EXTEND HOT SECTION LIFE.

A. General

- (1) Definitions of terms used in the text to describe specified test conditions for nozzles (Ref. Fig. 208):
 - (a) "Streakiness" is defined as variation in spray quantity between different parts of spray cone and appearing as lighter or darker streaks in spray.
 - 1 A total of 20% of fuel spray may show light streaks.
 - 2 Caused by carbon deposit at nozzle face.
 - 3 Brush nozzle surface during flow test.
 - (b) "Spitting" is a condition which exists when large drops of unatomized fuel occur intermittently and usually on outside of spray cone.
 - 1 No spitting allowed.
 - 2 Caused by carbon deposit at nozzle face.
 - 3 Brush nozzle during flow test.
 - (c) "Drooling" is a condition which occurs when large drops of unatomized fuel form on nozzle face.
 - 1 No drooling allowed.
 - 2 Caused by carbon deposit at nozzle orifice or by partial obstruction of fuel nozzle distributor.
 - 3 Brush nozzle surface during flow test and ultrasonically clean.
 - (d) "Void" area of fuel spray showing discontinuity in fuel flow (air gap).
 - 1 No void allowed.
 - 2 Caused by obstruction on internal fuel passage.
 - 3 Ultrasonically clean.
 - (e) "Skewness" describes a spray condition that is not centered.
 - 1 No skewness allowed.

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- 2 Caused by damage to nozzle orifice.
- 3 Not repairable at field level.

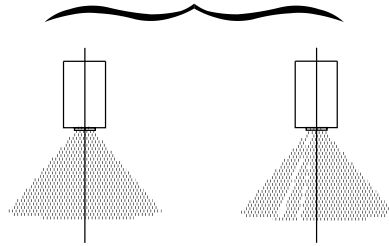
B. Leakage Test of Fuel Manifold Adapters (Ref. Fig. 209)

CAUTION: USE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT FREE COTTON GLOVES OR SURGICAL GLOVES SHOULD BE WORN AT ALL TIMES WHEN HANDLING PARTS.

- (1) Loosen screws (8, 6 and 4) of test fixture (2) and remove pivot block (7).
- (2) Insert plugs of pivot block (7) into ports in the nozzle assembly. Make sure the preformed packings are not pinched during nozzle installation.
- (3) With plugs fully inserted into adapter ports, hold parts firmly and tighten pivot screw (8).
- (4) Blank off nozzle orifice:
 - (a) Turn setscrew (4) until it just makes contact with rear of adapter behind nozzle.
 - (b) Turn torque screw (6) until plastic pad (5) seats on nozzle face.
 - (c) Tighten setscrew (4) and screw (6), simultaneously, to make sure that plastic pad (5) closes nozzle orifice without distortion of adapter.
 - (d) Tighten locknut on setscrew (4).
- (5) When inlet manifold adapter and nozzle assembly (9) with attached flow divider (10) are to be tested, do the following additional steps:
 - (a) Blank off elbow on flow divider (10) with caps (11). Tighten caps 40 to 45 lb.in. (Ref. View A).
 - (b) If elbows are not installed, blank off ports in flow divider (10) with plugs (12, PWC30530) (Ref. View B).
- (6) Check for external leaks between nozzle and adapter using one of the following methods:
 - (a) Method A: Connect hose assembly (1) to a supply of clean, dry compressed air or nitrogen and apply 200 psig to test fixture (2). Check for leaks using leak check fluid (PWC05-007) or by immersing in solvent (PWC11-027) or (PWC11-031). No leaks are permitted.
 - (b) Method B: Fill hose assembly (1) with fuel (PWC01-001). Apply 500 psig of compressed air or nitrogen to hose to pressurize the fuel. Hold hose assembly vertical and check fuel nozzle for leakage of fuel. No leaks are permitted.

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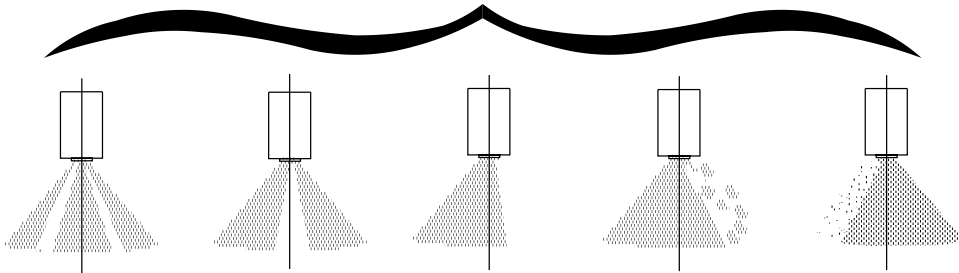
ACCEPTABLE



**GOOD UNIFORM
 SPRAY QUALITY**

**LIGHT STREAKS
 (20%) MAX.**

NOT ACCEPTABLE



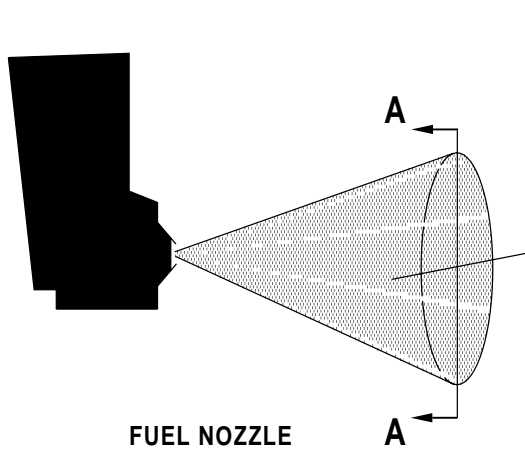
**ONE OR MORE
 HEAVY STREAKS**

**ONE OR MORE
 VOIDS**

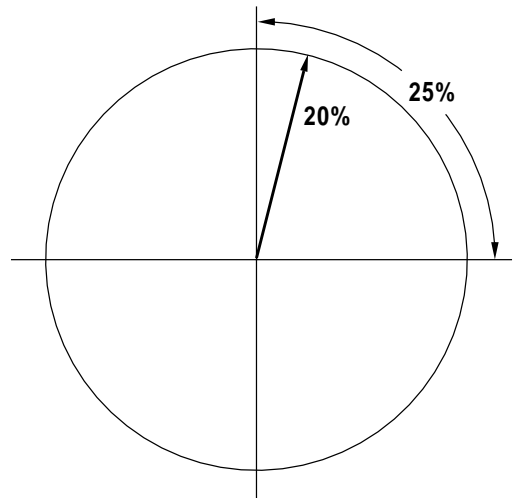
SKEWNESS

DROOLING

SPITTING



FUEL NOZZLE



**FUEL SPRAY UNDER VIEW
 VIEW A**

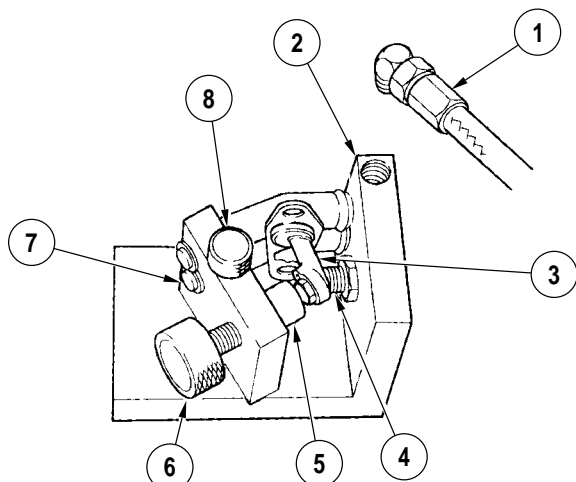
**THE ADDITION OF THE STREAKS MUST NOT
 EXCEED 20% OF THE TOTAL FUEL SPRAY.**

C67153A

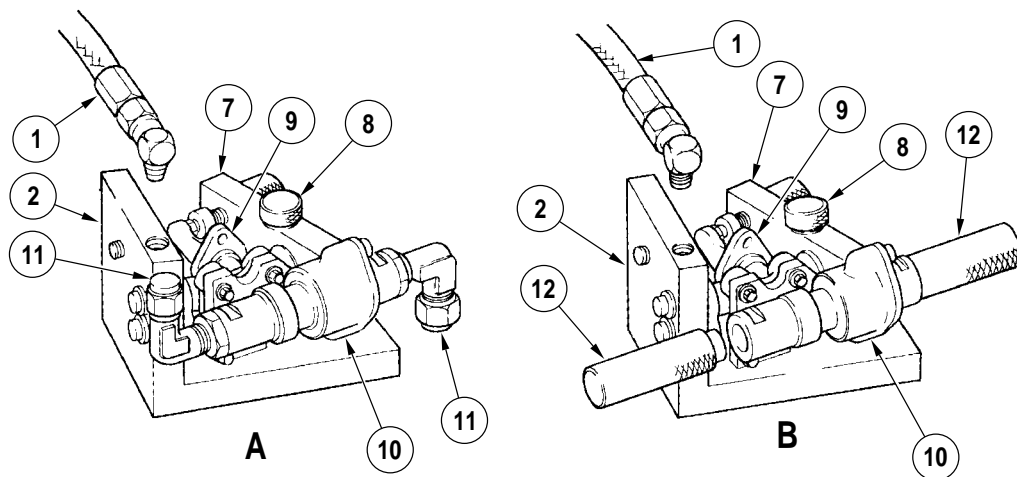
Fuel Nozzle Spray Conditions
 Figure 208

73-10-05

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PRIMARY AND SECONDARY MANIFOLD ADAPTERS



**INLET MANIFOLD ADAPTER WITH
 FLOW DIVIDER AND DUMP / PURGE VALVE**

C1881

Manifold Adapter and Nozzle Assembly Leakage Test
 Figure 209

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Key to Figure 209

1. Hose Assembly
2. Test Fixture (PWC30405)
3. Primary or Secondary Manifold Adapter and Nozzle Assembly
4. Setscrew (Part of Fixture)
5. Plastic Pad (Part of Fixture)
6. Torque Screw (Part of Fixture)
7. Pivot Block (Part of Fixture)
8. Pivot Screw (Part of Fixture)
9. Inlet Manifold Adapter and Nozzle Assembly
10. Flow Divider and Dump Valve
11. Blanking Cap
12. Plug

- (7) Reduce pressure to fixture (2) to zero, disconnect hose assembly (1), and remove adapter assembly from fixture.

NOTE: If one or more unacceptable nozzle (s) is/are found, it is highly recommended that the hot section be inspected for damage by a direct visual inspection or borescope inspection.

C. Functional Test of Fuel Manifold Adapters (Ref. Figs. 208 and 210)

CAUTION: USE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT FREE GLOVES SHOULD BE WORN AT ALL TIMES WHEN HANDLING PARTS.

NOTE: Although cleaning is recommended, nozzles can be reinstalled without cleaning provided that function test is within limits.

- (1) Partially fill reservoir (5, Fig. 210) of test rig (1) with clean fuel (PWC01-001).

CAUTION: CONNECT GROUND CABLE ON TEST RIG TO ELIMINATE DANGER OF ELECTROSTATIC DISCHARGE.

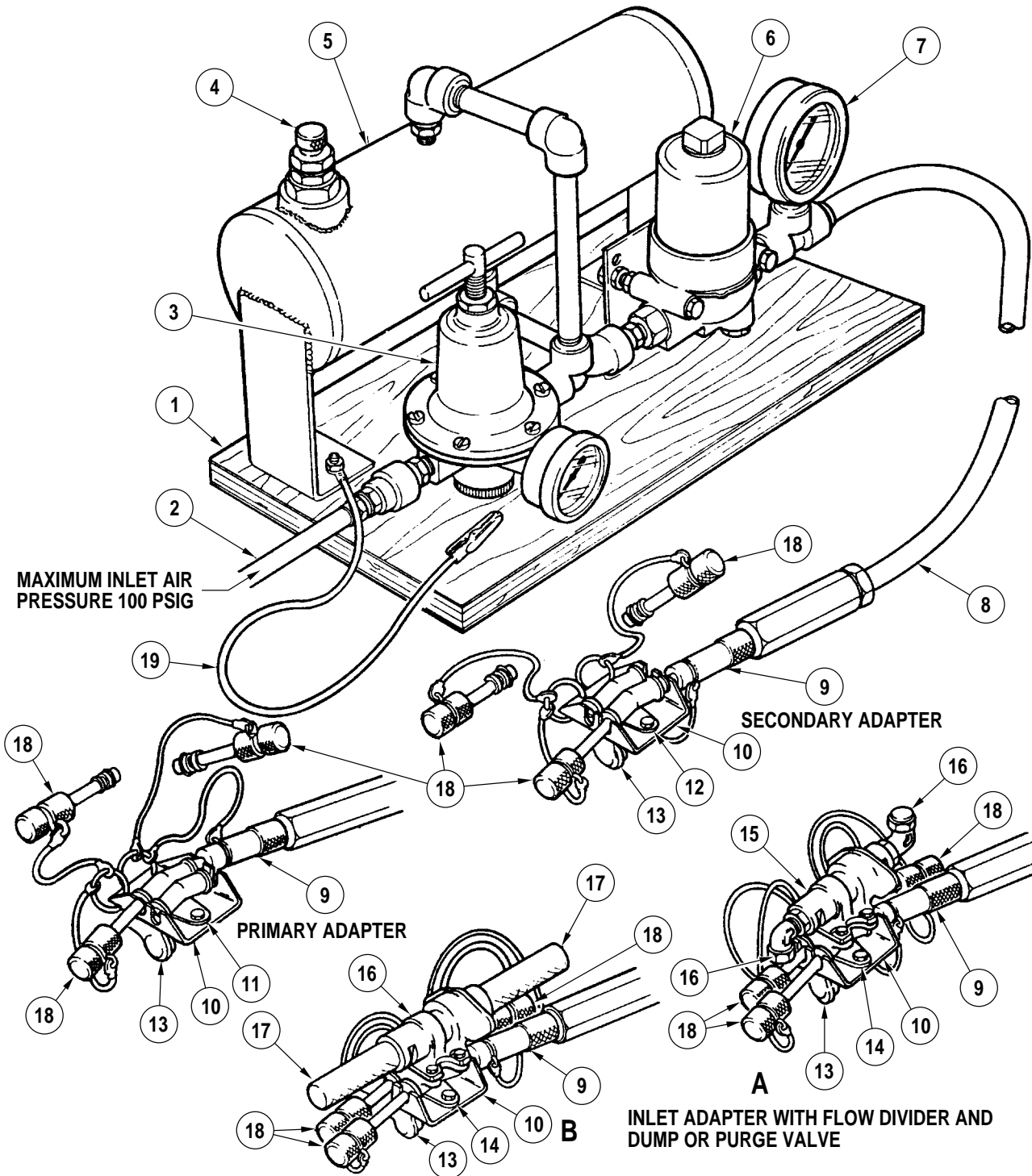
CAUTION: AVOID BREATHING FUEL VAPOUR DURING FUNCTIONAL TEST. MAKE SURE OF ADEQUATE VENTILATION DURING TEST OR USE AN EXPLOSION PROOF VENTILATION HOOD.

- (2) Functionally test the primary and secondary nozzle assemblies (13):

- (a) Insert one blanking tube assembly (18) and connecting tube assembly (9) of fixture (10) into ports of the manifold adapter (11 and 12) as shown. The two remaining blanking tube assemblies (18) are not required.

NOTE: Primary adapters are identified by a black stripe, weld spot or the letter P on the adapter.

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C1882H

Manifold Adapter and Nozzle Assembly Functional Test
 Figure 210

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Key to Figure 210

1. Test Rig (PWC30506)
2. Air Supply Line
3. Pressure Regulator (0 to 250 psig)
4. Relief Valve (150 psig)
5. Reservoir
6. Filter (10 micron nominal)
7. Pressure Gage (0 to 100 psig)
8. Hose Assembly
9. Connecting Tube Assembly
10. Nozzle Flow Fixture (PWC32811)
11. Primary Manifold Adapter
12. Secondary Manifold Adapter
13. Nozzle Assembly
14. Inlet Manifold Adapter
15. Flow Divider
16. Blanking Cap
17. Plug
18. Blanking Tube Assembly
19. Electrostatic Ground Cable

- (b) Place manifold adapters (11 and 12) in fixture (10). Make sure the collars of tube assemblies (18 and 9) are located on the inside of fixture flanges with the tubes in the appropriate slots. Fasten adapter to fixture with screws and nuts.
- (c) Connect hose assembly (8) to the tube assembly (9) and tighten coupling nuts securely to prevent leaks.
- (d) Connect air supply line (2) with 100 psig maximum to pressure regulator (3) on test rig (1).
- (e) Slowly adjust pressure regulator (3) to 20 psig. With the nozzle pointing downward, observe the spray pattern at the nozzle. An open spray must be observed, free from spitting or drooling.
- (f) Adjust pressure regulator (3) to increase pressure to 60 psig as indicated on gage (7). Volume of spray should increase and be spread evenly about the center axis of nozzle orifice. If streakiness of more than 20% is evident, reject nozzle (Ref. Fig. 208).

NOTE: Spitting, drooling and streakiness may be caused by external carbon deposits around nozzle orifice. Remove deposits by lightly brushing nozzle face with cotton swab or non-metallic bristle brush while fuel is flowing through orifice.

- (g) Return nozzles to an authorized accessories overhaul shop if satisfactory spray cannot be achieved after repeated cleaning.

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- (h) Reduce pressure to zero, as indicated on gage (7), by adjusting pressure regulator (3). When fuel flow from nozzle stops, disconnect and blank off hose assembly (8) from connecting tube assembly (10).
 - (i) Disconnect air supply line (2) from pressure regulator (3) on test rig (1).
 - (j) Remove manifold adapters (11 and 12) and nozzle assemblies (13) from flow fixture (11). Withdraw connecting tube assembly (10) and blanking tube assembly (19) from ports in adapter.
- (3) Place manifold adapters (11 and 12) and nozzle assemblies (13) in a clean, dust-proof container until ready for installation on engine.
- (4) Function test inlet manifold adapter (14) and nozzle assembly (13) :
- (a) Blank off elbow connection on flow divider (15) with caps (16). Tighten caps 40 to 45 lb. in. (Ref. View A). Alternatively, if elbow connections are not installed, use plugs (17) to blank off ports (Ref. View B).
 - (b) Insert connecting tube assembly (9) of fixture (10) into port of inlet adapter (14) at same location as that used on secondary adapter (12).
 - (c) Insert three blanking tube assemblies (19) into remaining ports of adapter (14).
 - (d) Install adapter (14) in fixture (10) and test following Steps (2)(a) through (j).
 - (e) Remove plugs (17) or blanking caps (16) from flow divider (15). Place inlet manifold adapter and nozzle assembly with attached flow divider in a clean, dust proof container until required for installation.
- (5) If one or more nozzles are found unacceptable during the test, examine the hot section for evidence of heat damage by direct visual or borescope inspection.

NOTE: Return unserviceable nozzles to an authorized accessories overhaul shop for repair.

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FUEL DRAIN VALVES - DESCRIPTION AND OPERATION

1. Description and Operation

The drain valves installation comprises two valves and gaskets installed in the gas generator case at the 6 o'clock position, one to the rear of the engine mounts and the other adjacent to Flange C. The valves let all residual fuel accumulated in the bottom of the gas generator case to drain to an airframe collection point when the engine is shut down. The forward valve also accommodates any residual drainage from the bottom of the exhaust duct via a small hole in the bottom of the duct rear cone immediately in front of the valve. Both drains are closed during engine operation by the action of P3 air pressure against the spring-loaded valves.

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FUEL DRAIN VALVES - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire used shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC05-061	Cloth, Abrasive Coated
PWC06-003	Compound, Anti-galling
PWC06-015	Beeswax
PWC06-032A	Compound, Anti-galling
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

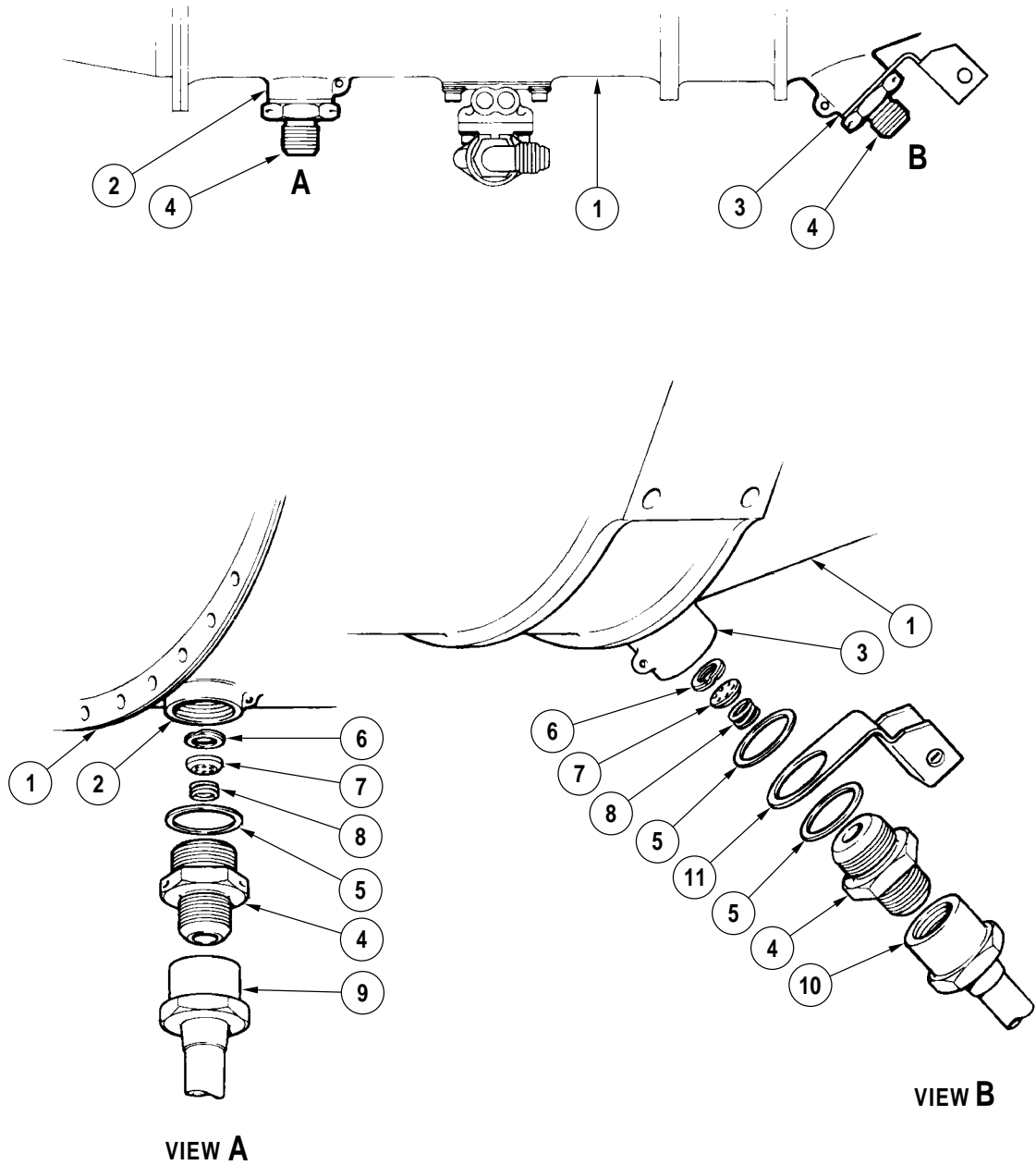
Not Applicable

5. Removal/Installation

A. Removal of Fuel Drain Valves (Ref. Fig. 201)

- (1) If the drain valve is being removed with the engine installed, disconnect the appropriate airframe drain line (9 or 10) from the adapter (4) and install a suitable blanking cap on the line connection.
- (2) Disconnect and remove the primary and secondary fuel lines (Ref. 73-10-03).
- (3) Unscrew each adapter (4) from the boss (2) on the gas generator case (1) and remove the gasket (5) from the adapter. At the rear valve (View B), remove the additional gasket (5) and support bracket (11).
- (4) Remove the retaining ring (6) from the groove in the bore of each adapter (4) and withdraw the valve (7) and spring (8).

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C7052A

Removal/Installation of Fuel Drain Valves
 Figure 201

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Key to Figure 201

1. Gas Generator Case
2. Front Drain Valve Boss
3. Rear Drain Valve Boss
4. Drain Valve Adapter
5. Gasket
6. Retaining Ring
7. Drain Valve
8. Spring
9. Front Drain Tube
10. Rear Drain Tube
11. Support Bracket

B. Installation of Fuel Drain Valves (Ref. Fig. 201)

- (1) Insert the spring (8) into the bore of the adapter (4).
- (2) Position the valve (7), flat side out, over the spring (8). Press the valve into the bore of the adapter (4) and install the retaining ring (6).
- (3) For the front drain valve (View A), assemble the gasket (5) on the large diameter end of the adapter (4); apply a thin film of anti-galling compound (PWC06-003) or (PWC06-032A) or (PWC06-015) to the threads at the large diameter end of the adapter (4) and screw the adapter into the boss (2) on the gas generator case (1). Tighten the adapter 450 to 550 lb.in., but do not fasten with lockwire.
- (4) For the rear drain valve (View B), assemble two gaskets (5) and the support bracket (11) on the large diameter end of the adapter (4); apply a thin film of anti-galling compound (PWC06-003) or (PWC06-032A) or (PWC06-015) to the threads at the large diameter end of the adapter (4) and screw the adapter into the boss (3) on the gas generator case (1). Tighten the adapter 450 to 550 lb.in., but do not fasten with lockwire.

NOTE: The adapters (4) must be retightened and fastened with lockwire after the engine test run.

- (5) Install the primary and secondary fuel lines (Ref. 73-10-03).
- (6) If installation of the drain valves has been carried out with the engine installed, remove the blanking caps from the line connections and connect the drain lines (9 and 10) to the adapters. Tighten the coupling nuts (Ref. Aircraft Maintenance Manual).

6. Cleaning/Painting

Clean all parts with solvent (PWC11-027) or (PWC11-031) and dry with filtered compressed air and/or clean, lint-free cloths.

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7. Inspection/Check

A. General

- (1) Examine the valve surface for nicks, gouges, scores, scratches and burrs. Particular attention must be given to the sealing surface around the counterbore in the spring side of the valve.
- (2) Check for blockage in the six drain holes of the valve. Holes which are blocked may be cleared by passing through a 0.042 in. (No. 58) drill by hand.
- (3) Examine the adapter for thread damage.
- (4) Check for blockage in the centerbore of the adapter. Blockage may be cleared by passing through a 0.246 in. (letter D) drill by hand.
- (5) Examine the large bore of the adapter for surface defects, especially on the sealing surface of projection.
- (6) Examine the support for surface damage. A bent or distorted bracket should be replaced.

B. Drain Valve Spring Inspection Requirements

- (1) Check the drain valve spring for distortion. The spring must pass freely over a 0.530 in. diameter gage rod and through a 0.600 in. diameter gage tube. Reject if distorted.
- (2) Check the compression loading of the spring. The load required to compress the spring to 0.250 in. length should be 4 oz. to 8 oz. Reject the spring if the load is not within the limits.
- (3) Examine the spring for uniformity of the coil spacing. Check that the surfaces are free from imperfections such as pits, scratches, nicks and other defects which may be detrimental to the fatigue resistance of the spring.

8. Approved Repairs

A. Procedure

- (1) Repair of the component parts of the drain valves is limited to local blending of minor surface defects such as nicks, burrs, scratches, scores and gouges.
- (2) Clean up these defects by blending with a fine stone and/or polishing with crocus cloth (PWC05-061).
- (3) Remove all sharp edges and high spots.
- (4) Thread damage on the adapter may be cleaned up with a suitable Swiss file or by chasing with an appropriately sized die.
- (5) Prior to the installation of the adapters, make sure that the threads in the bosses on the gas generator case are not damaged; repair as necessary.

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9. Adjustment/Test

A. Operation

- (1) During the next engine test, do a wet motoring run (Ref. 71-00-00) and check the operation of the drain valves. The proper functioning of the valves will be indicated by the fuel flow from the drain lines.
- (2) If fuel does not flow from one or both drain valves, remove the suspect valve, clean and reinstall. Repeat the wet motoring run and check the operation of the valves.

B. Procedure after Test (Ref. Fig. 201)

- (1) Disconnect the drain lines (9 and 10) from the adapter (4).
- (2) Loosen the adapters (4) two or three turns, and retighten 450 to 550 lb.in.
- (3) Lockwire the adapter (4) to the lug on the appropriate boss (2 or 3) on the gas generator case (1) and reconnect the drain lines (9 and 10).

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PNEUMATIC LINE (P3) - DESCRIPTION AND OPERATION

1. Description and Operation

Compressor discharge air (P3), derived from the diffuser section of the gas generator case, is routed to the metering section of the fuel control unit (FCU) through external lines and, depending on the installation, engine model configuration, through a fine-screen filter.

One configuration utilizes a single heated line, connected directly from a boss on the gas generator case to a metered elbow on the FCU; the line incorporates a flanged elbow at its front end.

A second configuration utilizes two lines with a in-line filter, the body of which is mounted on a bracket at Flange G of the engine; the rear line from the elbow on the FCU to the filter, being of the heated type; the front tube is insulated and has a flanged elbow at its front end.

The third configuration utilizes three lines and a filter, the housing of which is mounted on a bracket at Flange G; the rear heated line from the FCU and the center, unheated line are connected to ports in the filter housing; the front unheated line is interconnected to the center unheated line via a plate mounted on the rear fireseal. Similar to other configurations, the front line has a flanged elbow for connection to a boss on the gas generator case.

All lines, except the flexible ones, are of stainless-steel tubing encased in shrunk-on rubber sheaths. The heated lines incorporates a heater element interposed between the tube and the sheath; a twin-lead cable provides electrical supply from a receptacle mounted on a bracket at Flange G.

The in-line type filter arrangement comprises a ported threaded body and a ported hexagon head, encasing a non-cleanable, life limited 3-micron filter element.

The alternate filter arrangement comprises a manifold-type housing with a removable threaded cover encasing a cleanable, life limited 3-micron or 10-micron filter element. Discharge air enters the housing and is routed via a cored passage to the outer core of the element; filtered air from the inner core of the element is then routed via an internal transfer tube and second cored passage, through a heated tube, to the FCU. Some engine models may have housing with reverse air flow paths (Ref. Post-SB1387 / SB1448).

The Post-SB1495 air filter cover has a P3 air pressure sensitive drain valve. During compressor wash, P3 air pressure is low, and the valve is spring loaded open to allow cleaning fluid to drain. As engine speed increases, P3 air pressure increases and closes the valve.

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PNEUMATIC LINE (P3) - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC03-001	Oil, Engine Lubricating
PWC05-007	Fluid, Check
PWC05-031	Flux, Resin
PWC05-052	Sheathing, Heat-Shrinkable
PWC08-002	Adhesive, Fluorosilicone
PWC09-001	Sealant, Silicone Rubber
PWC11-002	(Use PWC11-014)
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

<u>Name</u>	<u>Remarks</u>
Cleaner, Electrosonic	
Turbine Temperature Indicating System Test Set	TT1000A

5. Servicing

A. Procedure

- (1) Servicing of the pneumatic system consists of cleaning or replacement of the disposable air filter element.

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- (2) Replacement of element is in accordance with Chapter 72-00-00, Table 601 or 602.
- (3) Indications of need to change the element are no, or slow, response to power control lever movements during engine run, when it is known there are no leaks in the pneumatic system.
- (4) It is recommended, therefore, that operators monitor engine response characteristics and derive their own cleaning/replacement schedules.

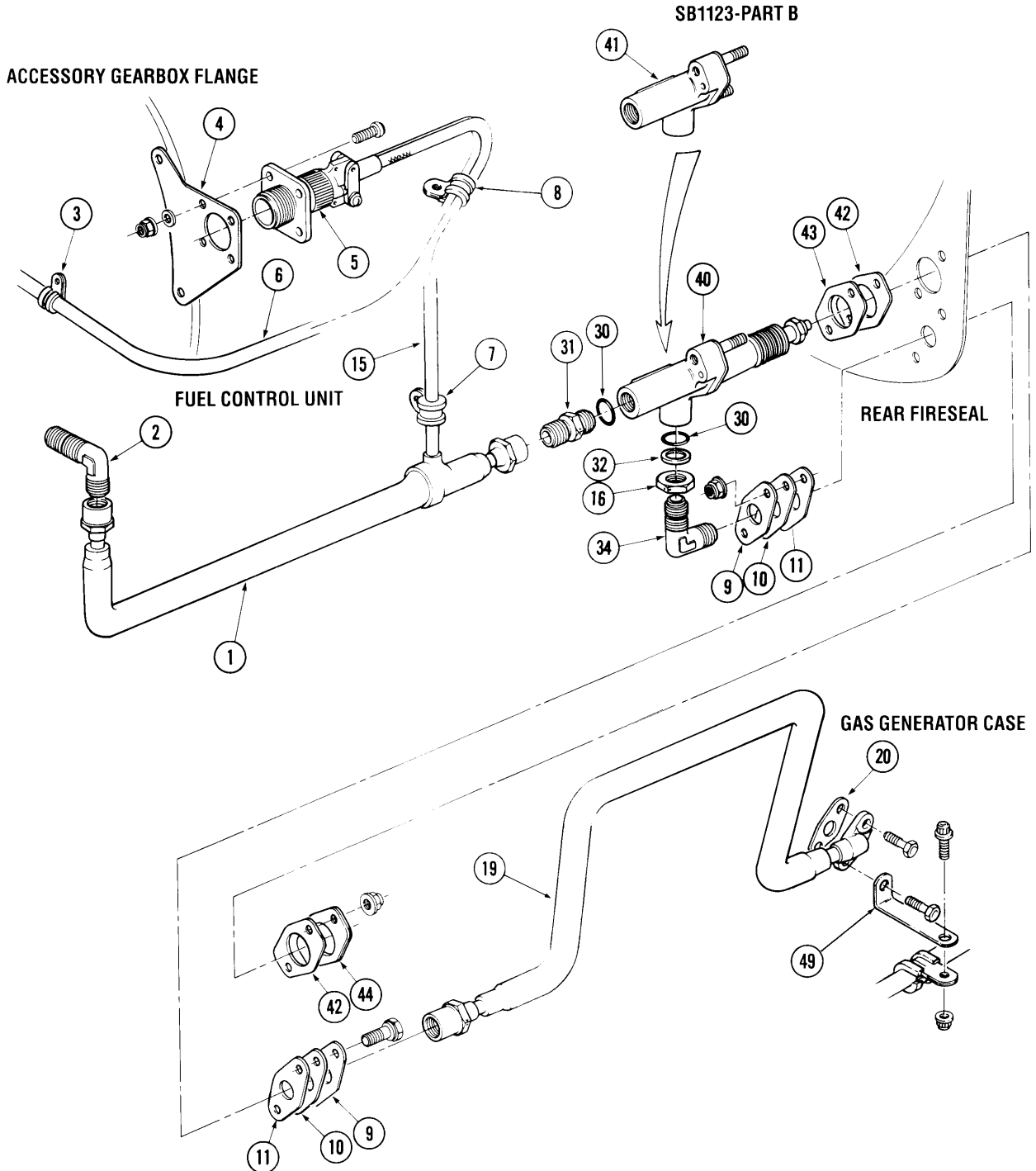
6. Removal/Installation

NOTE: It is important to make sure that all solid P3 lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any pipe brackets should not distort the pipe in any way.

A. Removal of Air Pressure Lines (Ref. Fig. 201)

- (1) Disconnect electrical cable (15 or 38) of relevant heated line (1, 21, 33 or 35) from electrical connector (5):
 - (a) Detach and remove clamps (7 and 8) from their respective locations.
 - (b) Disconnect cables (15 and 38) from connector (Ref. Subpara. D.).
- (2) For PT6A-27 and PT6A-28 Engines: Remove air pressure lines (1 and 19):
 - (a) Disconnect and remove heated rear line (1) from elbow (2) on FCU and from straight nipple (31) on temperature compensator (40) or compensator body (41).
 - (b) Loosen coupling nut of insulated front line (19) at elbow (34) on temperature compensator or compensator body.
 - (c) Remove two bolts and bracket (49, Post-SB1196) if fitted, securing flanged elbow of front line (19) to boss on gas generator case. Discard gasket (20).
 - (d) Remove insulated front line (19) by disconnecting from elbow (34).
- (3) For PT6A-27 and PT6A-28 Pre-SB1205 Engines and all PT6A-21 Engines: Remove heated air pressure line (21):
 - (a) Detach and remove clamp (13) from bracket (14) by removing self-locking nut and bolt.
 - (b) Remove two self-locking nuts, bolts and sealing components (9, 10, 11 and 12) from rear fireseal mount ring.
 - (c) Remove bolts and bracket (49, Post-SB1196) if fitted, securing flanged elbow of line (21) to boss on gas generator case. Discard gasket (20).
 - (d) Disconnect line from metered elbow (2) on FCU. Remove line complete with sealing components from slot in rear fireseal.

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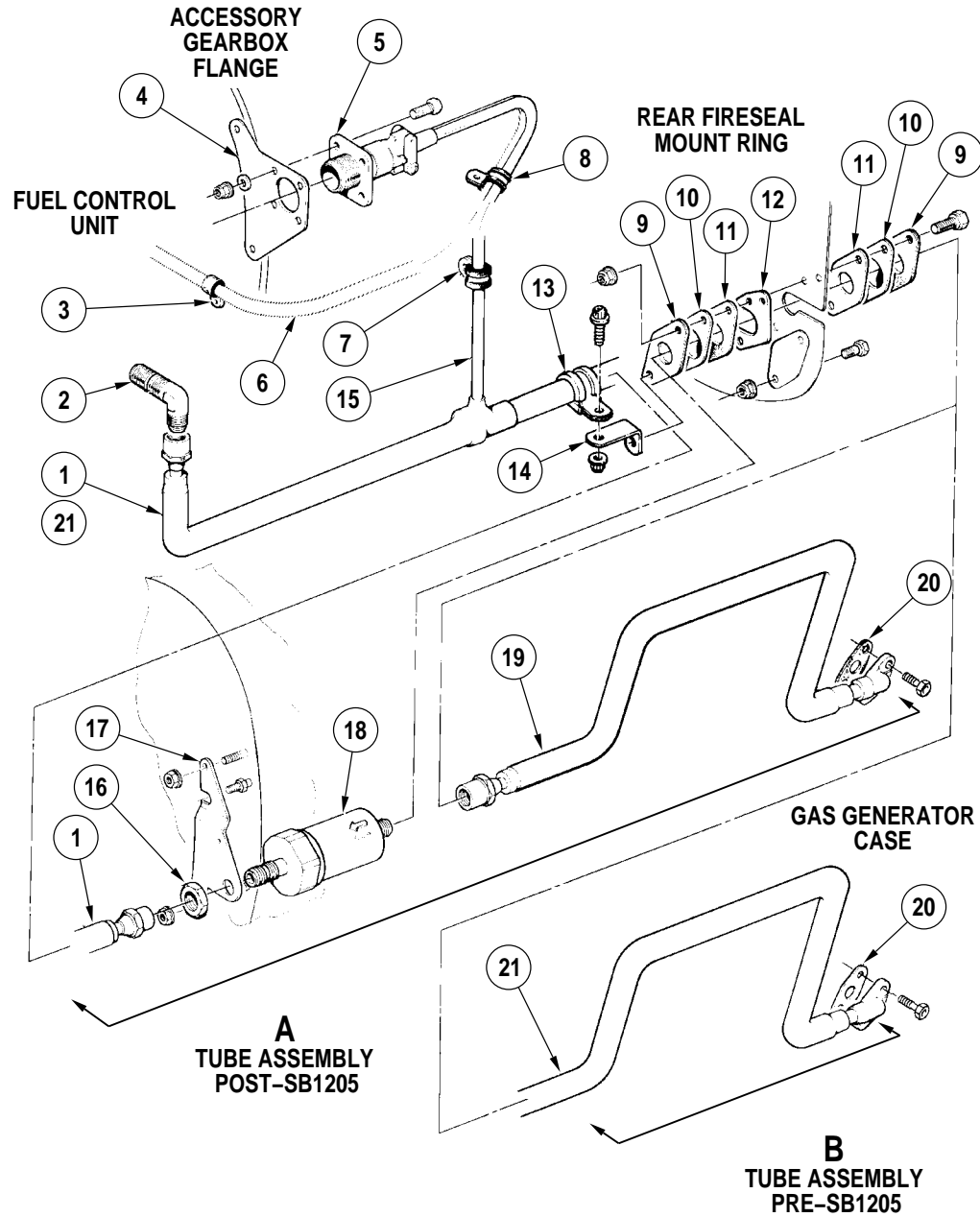
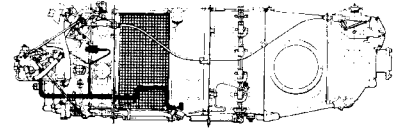
Removal/Installation of P3 Air Pressure Lines
 Figure 201 (Sheet 1 of 5)

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Key to Figure 201

- | | |
|--|--|
| 1. Heated Air Pressure Line (P3 Rear) | 27. Element (3-micron) |
| 2. Metered Elbow (on FCU) (Except unmetered Pre-SB1123) | 28. Preformed Packing |
| 3. Clamp | 29. Air Filter Cover |
| 4. Support Bracket | 30. Preformed Packing |
| 5. Electrical Connector | 31. Straight Nipple |
| 6. Electrical Cable (Py Line) | 32. Back-up Ring |
| 7. Clamp | 33. Heated Air Pressure Hose (P3 Rear) (Post-SB1330/Post-SB1343/Post-SB1448) |
| 8. Clamp | 34. Elbow |
| 9. Retaining Plate | 35. Heated Air Pressure Tube (P3 Center) (Post-SB1330/Post-SB1378) |
| 10. Insulation | Heated Air Pressure Hose (Post-SB1343/Post-SB1448) |
| 11. Seal | 36. Support Bracket |
| 12. Slotted Retaining Plate | 37. Not Used |
| 13. Clamp | 38. Electrical Cable (P3 Line Center) |
| 14. Bracket | 39. Elbow |
| 15. Electrical Cable (P3 Line) | 40. Temperature Compensator (Pre-SB1123) |
| 16. Locknut | 41. Compensator Body (Post-SB1123, Part B) |
| 17. Support Bracket | 42. Seal |
| 18. Air Filter (Post-SB1205) | 43. Insulation |
| 19. Insulated Air Pressure Line (P3 Front) (Post-SB1205) | 44. Retaining Plate and Insulation Assembly |
| 20. Gasket | 45. Elbow Tube (Post-SB1448) |
| 21. Heated Air Pressure Line (P3) (Pre-SB1205) | 46. Washer (Post-SB1448) |
| 22. Insulated Air Pressure Line (P3 Front) | 47. Retaining Plate (Post-SB1448) |
| 23. Support Plate | 48. Support Bracket Assembly (Post-SB1448) |
| 24. Air Filter Housing | 49. Bracket (Post-SB1196/Post-SB1448) |
| 25. Transfer Tube (Ref.) | |
| 26. Preformed Packing | |

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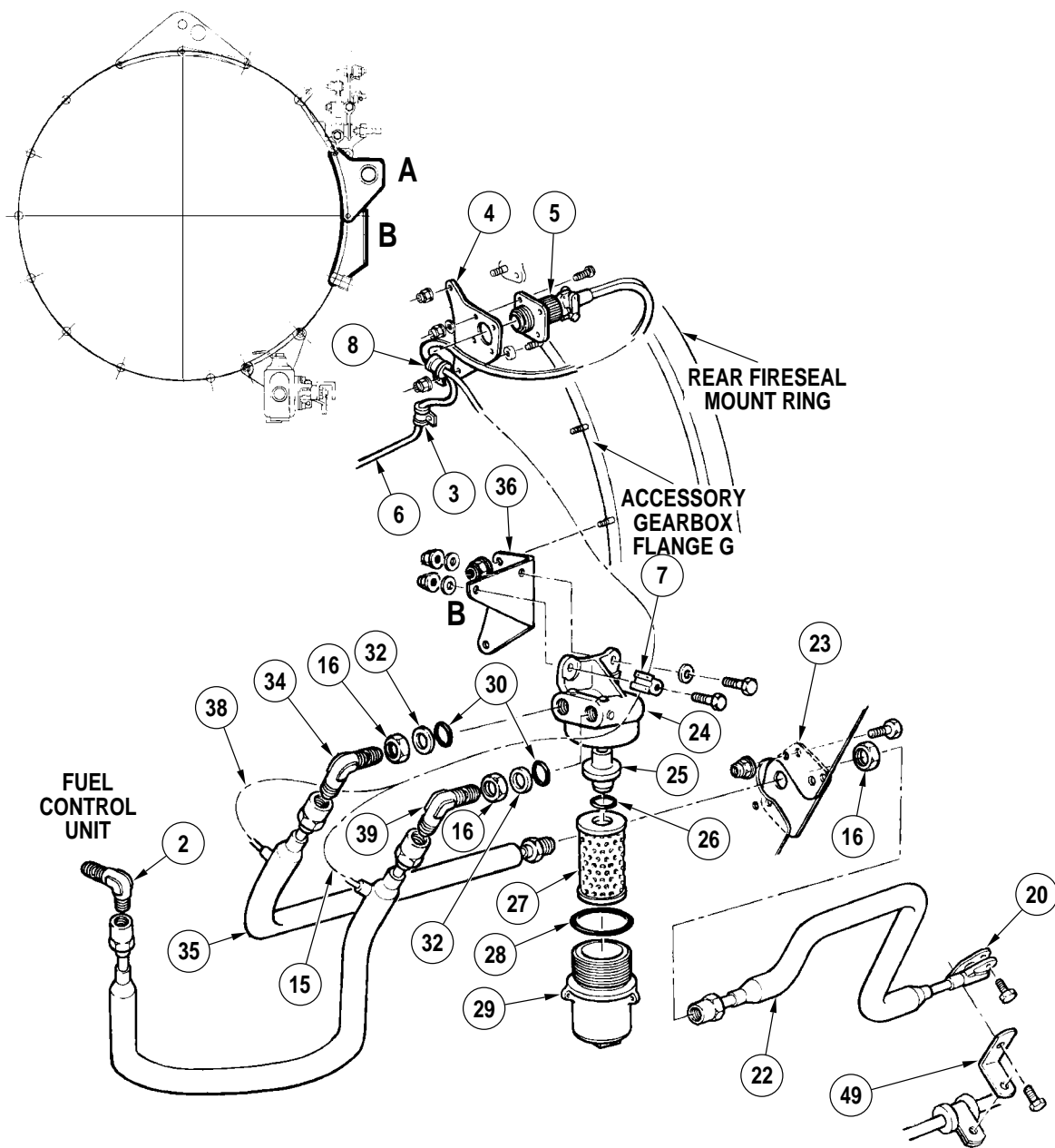
Removal/Installation of P3 Air Pressure Lines
 Figure 201 (Sheet 2)

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PNEUMATIC LINE (P3) - MAINTENANCE PRACTICES

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Post-SB1378

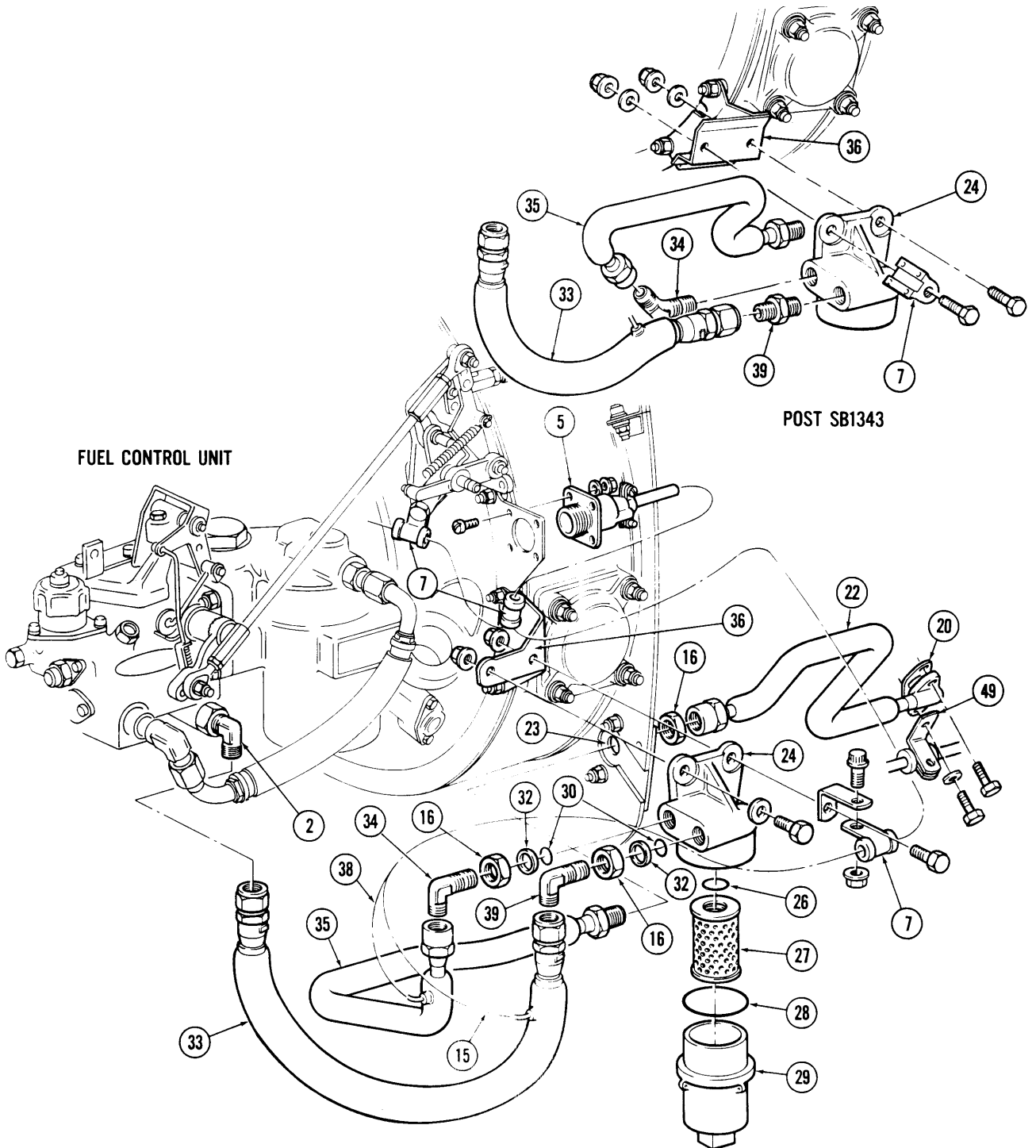
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Removal/Installation of P3 Air Pressure Lines
 Figure 201 (Sheet 3)

73-10-07

PNEUMATIC LINE (P3) - MAINTENANCE PRACTICES

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Post-SB1330 and Post-SB1343

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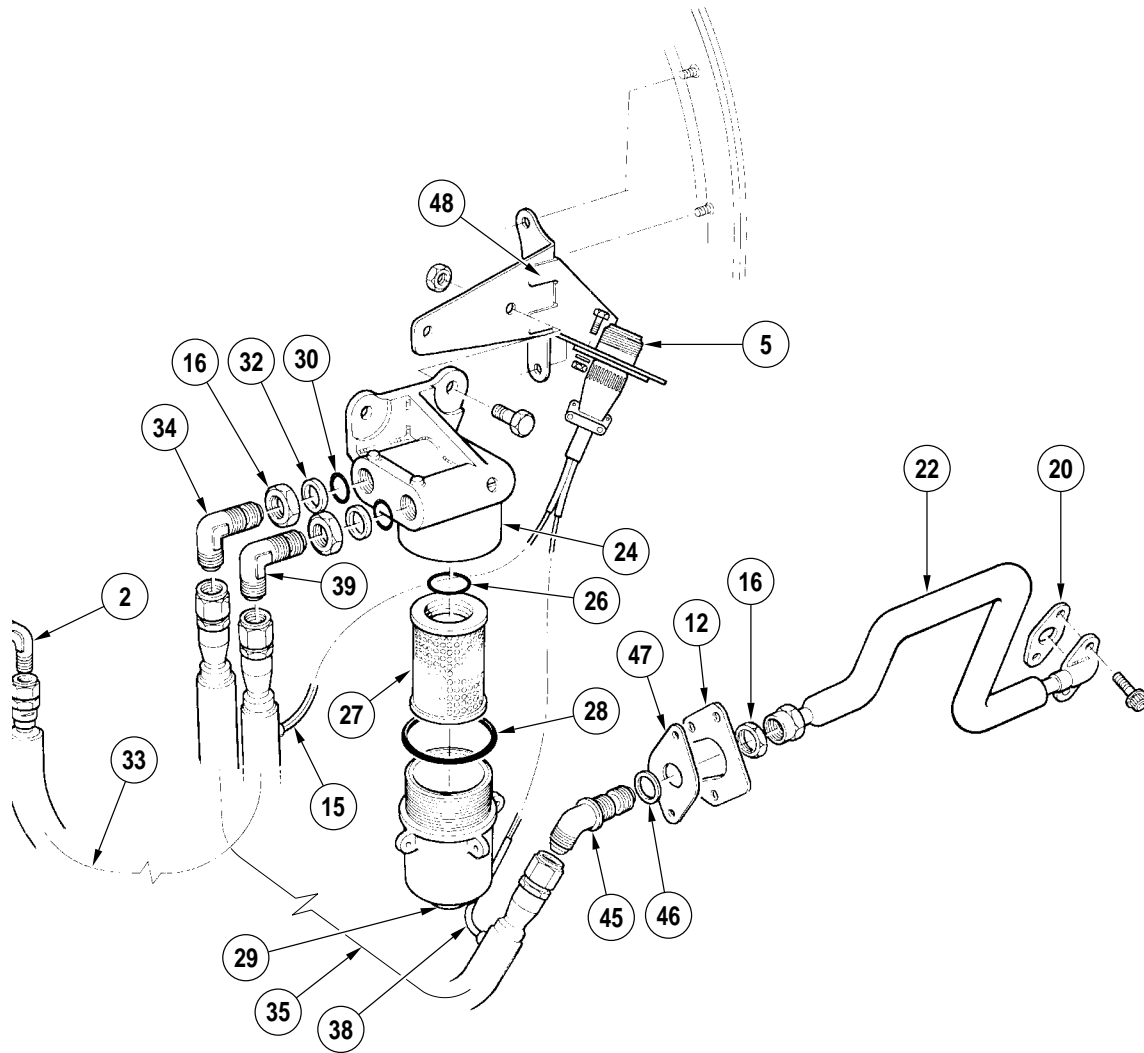
Removal/Installation of P3 Air Pressure Lines
Figure 201 (Sheet 4)

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PNEUMATIC LINE (P3) - MAINTENANCE PRACTICES

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Post-SB1448

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Removal/Installation of P3 Air Pressure Lines
Figure 201 (Sheet 5)

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PNEUMATIC LINE (P3) - MAINTENANCE PRACTICES

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- (e) Remove sealing components (9, 10 and 11) from line.
- (4) For PT6A-27 and PT6A-28 Post-SB1205 Engines:
- (a) Disconnect and remove heated rear line (1) from metered elbow (2) on FCU and from fitting on body of air filter (18).
 - (b) Loosen coupling nut of insulated front line (19).
 - (c) Remove bolts securing flanged elbow and bracket (Post-SB1196) if fitted, to boss on gas generator case. Discard gasket (20).
 - (d) Remove insulated front line by disconnecting from fitting on air filter (18).
- (5) For PT6A-28 Post-SB1290, PT6A-21/-27/-28 Post-SB1330/Post-SB1343/Post-SB1378 Engines:
- (a) Disconnect and remove heated rear line (33) from metered elbow (2) on FCU and elbow (39) on air filter housing (24).

NOTE: To improve resistance to cracking or fracture, the heated and insulated compressor delivery tubes (33 and 35) (Post-SB1290, Pre-SB1314) are removed and replaced (Post-SB1314) with tubes having increased wall thickness.
 - (b) Loosen coupling nut of insulated front line (22).
 - (c) Remove two bolts securing flanged elbow of line (22) and bracket (49, Post-SB1196) if fitted, to boss on gas generator case. Discard gasket (20).
 - (d) Remove front line (22) by disconnecting from center line (35) at rear fireseal.
 - (e) Remove locknut (16) securing fitting of heated center line (35) to support plate (23) at rear fireseal.
 - (f) Remove line (35) by disconnecting from elbow (34) on air filter housing (24) and withdrawing from plate (23).
- (6) For PT6A-27 and PT6A-28 Post-SB1448 Engines:
- (a) Disconnect coupling nuts of heated rear hose (33) from elbow (2) in FCU and elbow (39) in filter housing (24).
 - (b) Disconnect coupling nuts of heated center hose (33) from elbow (34) in filter housing (24) and elbow tube (45) through rear fireseal mount ring.
 - (c) With electrical cables disconnected (Ref. Subpara. B.(1)) remove heated center and rear hoses (33 and 35).
 - (d) Loosen insulated tube (22) coupling nut at rear fireseal mount ring, and remove bolts and flanged elbow. Disconnect coupling nut and remove insulated tube. Discard gasket (20).

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- (e) If necessary to remove elbow (45), remove locknut (16) and remove elbow rearward through rear fireseal mount ring. Remove and retain washer (46) from elbow tube.

B. Removal of Air Filter (Ref. Fig. 201)

(1) For PT6A-27 and PT6A-28 Post-SB1205 Engines:

- (a) Remove locknut (16) and remove air filter (18) from support bracket (17) at flange G of accessory gearbox.
- (b) Remove hexagon head from housing of filter (18) and remove filter element. Discard preformed packing from groove in hexagon head and small preformed packing from inner, flanged diameter of element.

(2) For PT6A-28 Post-SB1290, and PT6A-21/-27/-28 Post-SB1330/Post-SB1343/Post-SB1378 Engines:

CAUTION: USE EXTREME CARE WHEN P3 FILTER COVER IS REMOVED IN ORDER TO AVOID DAMAGE TO FCU/START CONTROL TELESCOPIC ROD. DAMAGE TO THIS ROD CAN CAUSE HANG-UP AT HIGH POWERS. EXCESS TORQUE OR UNTORQUING LOADS CAN BEND FILTER BRACKET, THUS CAUSING INTERFERENCE WITH CONTROL ROD.

- (a) Remove assembly of air filter from support bracket (36) at flange G, by removing two bolts and clamp (7).

NOTE: Step (a) may be omitted if filter element only is being serviced.

- (b) Remove cover (29) from housing (24). Discard preformed packing (28).
- (c) Remove filter element (27).

NOTE: Transfer tube (25, Post-SB1290) should remain in-situ.

- (d) Remove and discard preformed packing (26) from inner, flanged diameter of element.
- (e) If a new filter housing is to be assembled at installation, remove elbow (34), elbow (39) and locknuts (16). Discard preformed packings (30) and back-up rings (32).

NOTE: For Post-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), complete steps (f) through (h) as follows in addition to (a) through (e) above:

- (f) Remove filter cover (6), and discard preformed packing (7).
- (g) Remove drain valve adapter (1), and discard preformed packing (2).
- (h) Remove retaining ring (5), drain valve (4), and spring (3).

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(3) For PT6A-27 and PT6A-28 Post-SB1448 Engines:

- (a) Remove filter cover (29) from housing assembly (24). Discard preformed packing (28).
- (b) Remove filter element (27) from housing assembly (24). Discard preformed packing (26) from inner flanged diameter of filter element.
- (c) If new filter housing is to be installed, loosen locknuts (16) on elbows (34 and 39) and remove elbows from filter housing (24). Remove preformed packings (30), back-up ring (32) and locknuts from elbows. Discard preformed packings.
- (d) Remove bolts and filter housing (24) from bracket (48).

NOTE: For Post-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), complete steps (e) through (g) as follows in addition to (a) through (d) above:

- (e) Remove filter cover (6), and discard preformed packing (7).
- (f) Remove drain valve adapter (1), and discard preformed packing (2).
- (g) Remove retaining ring (5), drain valve (4), and spring (3).

C. Removal of Temperature Compensator (PT6A-27 and PT6A-28) (Ref. Fig. 201)

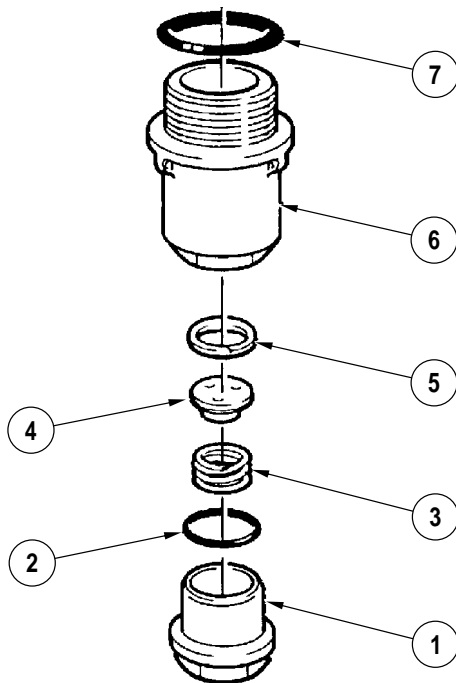
- (1) Disconnect heated line (1) from straight nipple (31) on compensator.
- (2) Disconnect insulated line (19) from elbow (34) on compensator.
- (3) Remove two self-locking nuts, compensator (40 or 41), seals (42), insulation (43) and retaining plate assembly (44) from rear fireseal mount ring.
- (4) If replacement compensator is to be fitted, remove straight nipple (31) and elbow (34) from compensator. Discard preformed packings (30).
- (5) Remove self-locking nuts, bolts, seals (11), insulation (10) and retaining plates (9) from rear fireseal mount ring, if insulation or seals are damaged.

D. Removal of Electrical Connection of Heated Lines (Ref. Fig. 203)

- (1) Disconnect leads of cable, of relevant heated air pressure line from connector:
 - (a) Remove two clamp screws (5) and remove clamp halves from bell end fitting (4).

CAUTION: MAKE SURE LEADS OF CABLES DO NOT TURN WHEN UNSCREWING BELL END FITTING FROM SHELL.

- (b) Remove bell end fitting (4) from connector shell (1) and slide fitting and cable sleeve (6) back along cables.



Post-SB1495

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Removal/Installation of Air Filter Housing Drain Valve
Figure 202

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Key to Figure 202

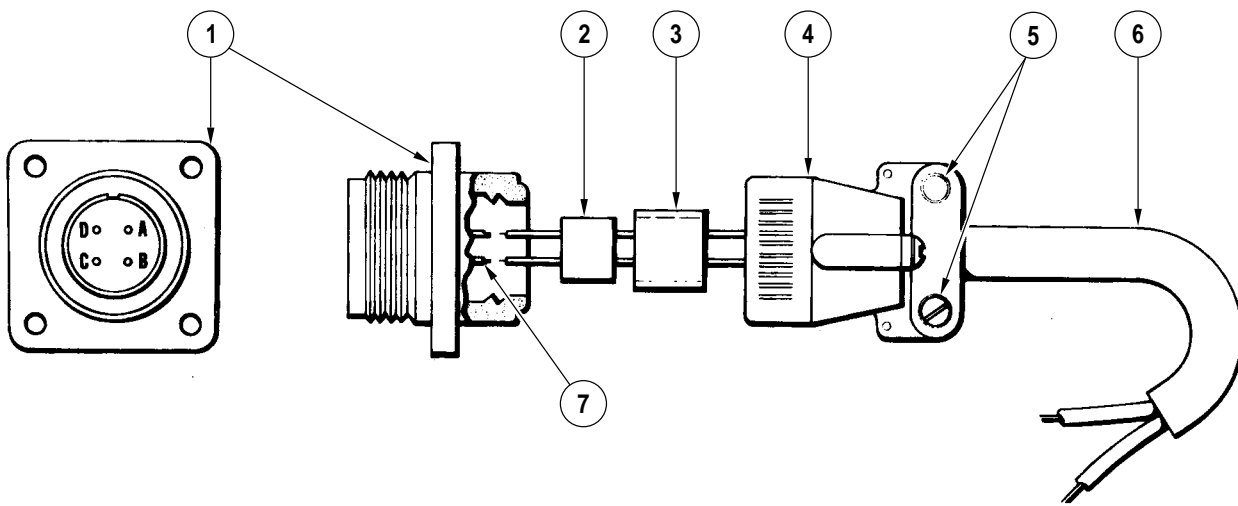
1. Drain Valve Adapter
2. Preformed Packing
3. Spring
4. Compressor Air Drain Valve
5. Retaining Ring
6. Filter Cover
7. Preformed Packing

- (c) Slide nylon sleeve (3) and rubber insulator (2) back on cables to expose terminal pins (7).
 - (d) Using a suitable soldering iron, disconnect leads of compressor discharge air pressure line(s) from pins B and D; disconnect leads of propeller governor air pressure line from pins A and C.
 - (e) If all cables are being disconnected, remove connector components from electrical cables.
- (2) Connect leads of cable, of relevant heated air pressure line to connector:
- (a) If all cables were disconnected, reassemble connector components on cables:
 - 1 Insert cables through sleeve (6), bell end fitting (4) and nylon sleeve (3). Slide components back along cables.
 - 2 Pass each lead of cable(s) through relevant holes in rubber insulator (2).
 - (b) Using a suitable soldering iron, with solder (PWC05-205) and resin flux (PWC05-031), solder leads of compressor discharge air pressure line(s) to pins B and D; solder leads of propeller governor air pressure line to pins A and C.

CAUTION: DO NOT ALLOW LEADS TO TURN WHEN TIGHTENING BELL END FITTING.

- (c) Slide rubber insulator (2) and nylon sleeve (3) over soldered connections. Slide bell end fitting (4) with sleeve (6), over sleeve (3) and attach to connector; screw on fingertight.
 - (d) Attach cables and sleeve (6) with cable clamp; attach clamp halves with screws (5).
 - (e) Do conductivity and resistance checks (Ref. Inspection/Check).
- E. Installation of Air Pressure Lines (Ref. Fig. 201)
- (1) For PT6A-27 and PT6A-28 Engines: Install air pressure lines (1) and (19):

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Heated Lines - Wiring Details
Figure 203

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Key to Figure 203

1. Connector Shell
2. Rubber Insulator
3. Nylon Sleeve
4. Bell End Fitting
5. Clamp Screws
6. Cable Sleeve
7. Terminal Pins

- (a) Install heated line (1) by connecting to elbow (2) on FCU and straight nipple (31) on temperature compensator (40) or compensator body (41). Torque coupling nuts 90 to 100 lb.in.

NOTE: Elbow (2) is metered Post-SB1123, and unmetered Pre-SB1123.

- (b) Loosely connect coupling nut of insulated line (19) to elbow (34) on temperature compensator, attach flanged elbow of line and gasket (20) to boss on gas generator case with bolts. Do not tighten bolts.

NOTE: Fit bracket (49, Post-SB1196) if required.

- (c) Coupling nut of insulated line (19) is to be torqued and lockwired after pressure check (Ref. Para. Adjustment/Test).
- (d) Connect leads of electrical cable (15) to relevant pins of connector (5).
- (e) Install electrical cable (15) to stud at flange G with clamps (7) and self-locking nut. Torque nut 36 to 40 lb.in.
- (f) Using self-locking nut, attach cables (15 and 6) together with clamp (8) to stud at lower mounting of support bracket (4). Torque 36 to 40 lb.in.
- (2) For PT6A-27 and PT6A-28 Pre-SB1205 and PT6A-21 Engines:
- (a) Sequentially install retaining plates (9), insulation (10) and seals (11) on heated line (21); locate line as shown in slot in rear fireseal mount ring.
- (b) Install flanged elbow of line (21), gasket (20) and bracket (49) if fitted, on gas generator case with bolts. Do not tighten bolts.
- (c) Connect heated line to metered elbow (2) on FCU. Coupling nut is to be fingertight only. Nut must be torqued and lockwired after pressure check (Ref. Para. Adjustment/Test).
- (d) Attach line to bracket (14) with clamp (13), bolt and self-locking nut. Torque bolt 36 to 40 lb.in.
- (e) Install slotted plate (12) on line and fasten sealing components (9, 10 and 11) together with slotted plate to rear fireseal mount ring with bolts and self-locking nuts. Tighten nuts until firm contact is obtained, plus 180 degrees.

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- (f) Connect leads of electrical cable (15) to relevant pins of connector (5).
- (3) For PT6A-27 and PT6A-28 Post-SB1205 Engines: Install air pressure lines (1 and 19):
- (a) Install heated line (1) by connecting to metered elbow (2) on FCU and fitting on air filter (18) at bracket (17). Torque coupling nuts 90 to 100 lb.in.
 - (b) Connect leads of electrical cable (15) and secure cable.
 - (c) Loosely connect coupling nut of insulated line (19) to fitting on air filter (18). Attach flanged elbow of line, gasket (20) and bracket (49) if fitted, to boss on gas generator case with two bolts. Do not tighten bolts.
 - (d) Coupling nut of insulated line (19) is to be torqued and lockwired after pressure check (Ref. Para. Adjustment/Test).
- (4) For PT6A-28 Post-SB1290, PT6A-21/-27/-28 Post-SB1330 Engines: Install air pressure lines (33, 35 and 22):
- (a) Install heated line (33) by connecting to metered elbow (2) on FCU and elbow (39) on filter housing (24). Torque coupling nuts 90 to 100 lb.in.

NOTE: To improve resistance to cracking or fracture, the heated and insulated compressor delivery tubes (33 and 35) (Post-SB1290, Pre-SB1314) are replaced (Post-SB1314) by tubes having increased wall thickness.
 - (b) Install heated center line (35) by inserting front end through support plate (23) at rear fireseal mount ring and connecting rear end to elbow (34) on filter housing (24). Final torque locknut (16) 38 to 42 lb.in., and torque coupling nut 90 to 100 lb.in. Secure fitting at front end of line to plate (23) with locknut (16). Torque locknut 38 to 42 lb.in.
 - (c) Connect leads of cables (15 and 38) and secure cables. Secure cables at air filter with clamp (7). Tighten nut and torque 36 to 40 lb.in.
 - (d) Loosely connect coupling nut of insulated front line (22) to center line (35) at support plate (23); secure flanged elbow of line, gasket (20) and bracket if fitted, to boss on gas generator case with two bolts. Do not tighten bolts.
 - (e) Coupling nut of insulated line (22) is to be torqued and lockwired after pressure check (Ref. Para. Adjustment/Test).
- (5) For PT6A-27 and PT6A-28 Post-SB1448 Engines:
- (a) If applicable, install washer (46) on elbow (45) and insert elbow forward through retaining plates (47 and 12) mounted on rear fireseal mount ring and fasten in position with locknut (16) torqued 38 to 42 lb.in.
 - (b) Install heated center hose (35), with electrical cable (38) forward, by connecting coupling nuts to inside elbow (34) on filter housing (24) and elbow (45) through rear fireseal mount ring. Torque coupling nuts 90 to 100 lb.in.

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- (c) Install heated rear hose (35), with electrical cable (15) forward, by connecting coupling nuts to outside elbow (34) on filter housing (24) and elbow (2) on FCU. Torque coupling nuts 90 to 100 lb.in.
- (d) Connect electrical cables (15 and 38) to connector (5) mounted on support bracket (48).
- (e) Install insulated tube (22) by connecting coupling nut to elbow (45) through rear fireseal mount ring and with gasket (20) in place on gas generator case boss, attach flanged end of insulated tube and bracket, if fitted, with bolts through bracket and gasket into case boss.

NOTE: Coupling nut and flange bolts on insulated tube (22) will be torqued and lockwired after pressure check (Ref. Adjustment/Test).

F. Installation of Air Filter (Ref. Fig. 201)

(1) For PT6A-27 and PT6A-28 Post-SB1205/Pre-SB1290 Engines:

- (a) If element was removed for inspection purposes, install small preformed packing in flanged inner diameter of existing or new element.
- (b) Install large preformed packing in groove in hexagon head of filter.
- (c) Insert filter element into housing and press until fully bottomed.
- (d) Install housing on hexagon head; screw on until metal-to-metal contact is obtained.
- (e) Install assembly of air filter (18) on support bracket (17) at flange G with locknut (16). Torque locknut 38 to 42 lb.in.

(2) For PT6A-28 Post-SB1290, and PT6A-21/-27/-28 Post-SB1330/Post-SB1343/Post-SB1378 Engines:

CAUTION: USE EXTREME CARE WHEN P3 FILTER COVER IS INSTALLED IN ORDER TO AVOID DAMAGE TO FCU/START CONTROL TELESCOPIC ROD. DAMAGE TO THIS ROD CAN CAUSE HANG-UP AT HIGH POWERS. EXCESS TORQUE OR UNTORQUING LOADS CAN BEND FILTER BRACKET, THUS CAUSING INTERFERENCE WITH CONTROL ROD.

- (a) Install spring (3) and drain valve (4) into adapter (1); install retaining ring (5). Make sure that valve moves smoothly and freely and that retaining ring is installed properly.

NOTE: 1. For Pre-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), omits steps (a) through (c) and commence assembly of air filter assembly with step (d).

NOTE: 2. For Post-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), complete steps (a) through (c) in the sequence shown and then do (d) through (i).

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CAUTION: THE P3 FILTER COVER IS MADE FROM ALUMINUM ALLOY. TAKE CARE NOT TO DAMAGE THE COVER ASSEMBLY WHEN LOCKWIRING THE DRAIN VALVE ASSEMBLY TO THE COVER ASSEMBLY. BEFORE LOCKWIRING, EXAMINE THE LOCKWIRE ATTACHMENT HOLES ON THE COVER ASSEMBLY FOR EVIDENCE OF TEARING. IF TEARING IS EVIDENT, SECURE LOCKWIRE TO AN ALTERNATE SERVICEABLE LOCATION (REF. 70-00-00, STANDARD PRACTICES - MAINTENANCE PRACTICES).

- (b) Install preformed packing (2) on adapter (1), and install valve assembly in cover. Tighten 225 to 250 lb.in., and lockwire adapter to cover.
- (c) Install preformed packing (7) on filter cover (6). Lubricate threads of cover with oil, and install in filter housing. Tighten 60 to 70 lb.in., and lockwire.

CAUTION: IT IS IMPORTANT THAT THE INSTALLATION OF THE DRAIN VALVE BE IN THE EXACT SEQUENCE PROVIDED ABOVE. FAILURE TO OBSERVE THIS SEQUENCE WILL RESULT IN OVERTORQUE OF THE P3 FILTER CASE.

- (d) If elbows (34 and 39) were removed from filter housing (24), reinstall (Ref. 70-00-00, REMOVAL/INSTALLATION). Do not final torque locknuts (16) until angle of elbow has been established.
- (e) Install preformed packing (26) in flanged inner diameter of existing or new filter element (27).
- (f) Install preformed packing (28) on grooved shoulder of cover (29).
- (g) Install filter element (27) and preformed packing (26) over transfer tube (25, Post-SB1290) and press in until fully bottomed in housing (24).
- (h) Apply engine oil (PWC03-001) on threads of cover (29) and install on housing (24). Torque 60 to 70 lb.in. and lockwire.

NOTE: Step (i) following may be omitted if filter element only has been serviced.

- (i) Install assembly of air filter on support bracket (36) and attach with bolts, clamp (7), washers and self-locking nuts. Tighten nut at right-hand mounting and torque 36 to 40 lb.in., left-hand nut to be fingertight as clamp (7) is used to attach electrical cable of heated line at a later stage of assembly.
- (3) For PT6A-27 and PT6A-28 Post-SB1448 Engines:

NOTE: 1. For Pre-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), omit steps (a) through (c) and commence assembly of air filter assembly with step (d).

NOTE: 2. For Post-SB1495 Engines: Installation of air filter drain valve (Ref. Fig. 202), complete steps (a) through (c) in the sequence shown and then do (d) through (g).

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- (a) Install spring (3) and drain valve (4) into adapter (1); install retaining ring (5). Make sure that valve moves smoothly and freely and that retaining ring is installed properly.

CAUTION: THE P3 FILTER COVER IS MADE FROM ALUMINUM ALLOY. TAKE CARE NOT TO DAMAGE THE COVER ASSEMBLY WHEN LOCKWIRING THE DRAIN VALVE ASSEMBLY TO THE COVER ASSEMBLY. BEFORE LOCKWIRING, EXAMINE THE LOCKWIRE ATTACHMENT HOLES ON THE COVER ASSEMBLY FOR EVIDENCE OF TEARING. IF TEARING IS EVIDENT, SECURE LOCKWIRE TO AN ALTERNATE SERVICEABLE LOCATION (REF. 70-00-00, STANDARD PRACTICES - MAINTENANCE PRACTICES).

- (b) Install preformed packing (2) on adapter (1), and install valve assembly in cover. Tighten 225 to 250 lb.in., and lockwire adapter to cover.
- (c) Install preformed packing (7) on filter cover (6). Lubricate threads of cover with oil (SB1001), and install in filter housing. Tighten 60 to 70 lb.in., and lockwire.

CAUTION: IT IS IMPORTANT THAT THE INSTALLATION OF THE DRAIN VALVE BE IN THE EXACT SEQUENCE PROVIDED ABOVE. FAILURE TO OBSERVE THIS SEQUENCE WILL RESULT IN OVERTORQUE OF THE P3 FILTER CASE.

- (d) If applicable install locknuts (16), new back-up rings (32) and new lubricated preformed packings on elbows (34 and 39). Install elbows in filter housing (24), do not torque locknuts until elbow angle is established.
- (e) Install new lubricated preformed packing (26) in flanged inner diameter of cleaned or new filter element (27). Insert element over center tube in filter housing (24) and press by hand until fully bottomed in housing.
- (f) Install new lubricated preformed packing (28) in grooved shoulder of cover (29) and apply engine oil to threads on cover. Install cover in filter housing (24), torque 60 to 70 lb.in. and lockwire.

NOTE: Step (vii) following may be omitted if filter element only has been serviced.

- (g) If applicable install filter housing assembly (24) on bracket (48) and attach with bolts and self-locking nuts torqued 36 to 40 lb.in.

G. Installation of Temperature Compensator (PT6A-27 and PT6A-28) (Ref. Fig. 201)

- (1) If replacement compensator is to be installed, install straight nipple (31) and elbow (34) (Ref. 70-00-00). Torque locknut on elbow 38 to 42 lb.in. and lockwire.
- (2) Install seals (11), insulation (10) and retaining plates (9), on rear fireseal mount ring and fasten with bolts and self-locking nuts. Bolt heads must be on air inlet side of fireseal.
- (3) Install insulation (43) and seal (42) on studs at front end of compensator. Locate compensator on rear face of rear fireseal mount ring, install seal (42) and retaining plate and insulation assembly (44) on compensator studs at front of rear fireseal.

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- (4) Fasten compensator and seals to fireseal mount ring with self-locking nuts. Torque 36 to 40 lb.in.
- (5) Connect heated line (1) to straight nipple (31). Torque 90 to 100 lb.in. and lockwire.
- (6) Do pressure leak check (Ref. Adjustment/Test).

7. Cleaning/Painting

A. Cleaning

(1) Air Pressure Lines

CAUTION: DURING CLEANING, MAKE SURE THAT THE SOLVENT DOES NOT CONTACT THE RUBBER SECTIONS OF THE INSULATED AIR PRESSURE LINE ASSEMBLIES.

- (a) Pressure flush the lines with petroleum solvent (PWC11-027) or (PWC11-031).
- (b) Dry the interior and exterior of the lines using clean, dry compressed air.
- (c) Cap the ends of the lines to prevent the ingress of dirt, oil, or other contaminants until the lines are required for installation.

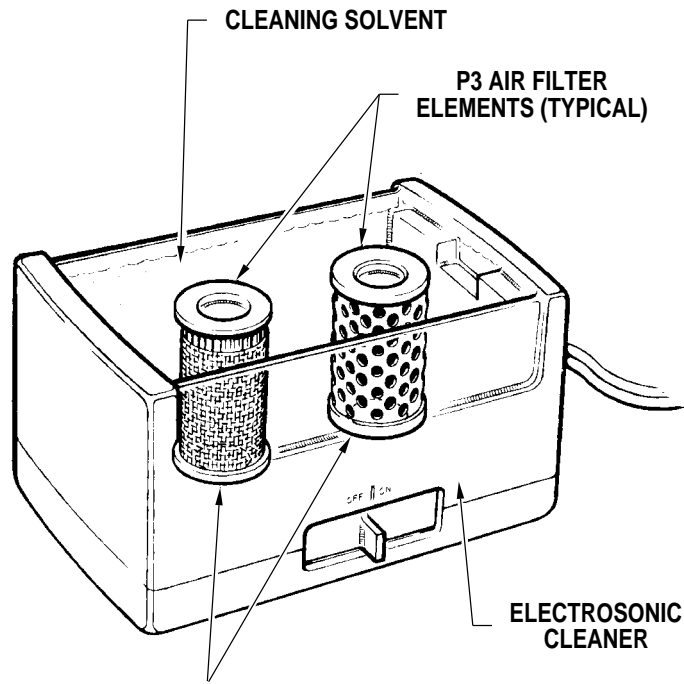
(2) Air Filter Element (Ref. Fig. 204)

NOTE: Inspect the filter element at the intervals recommended in Chapter 72-00-00, Table 601, and clean as required.

- (a) For Post-SB1387 Engines: Plug the opening at the end of the filter element with a suitable plastic or rubber plug.
- (b) Place the P3 filter element vertically in the cleaning tank electrosonic cleaner with the open or plugged end of the element at the bottom position.
- (c) Pour a sufficient quantity of cleaning solvent (PWC11-002) or (PWC11-014) into the tank to a level approximately 1/4 inch below the top.
- (d) Operate the cleaner for ten minutes.
- (e) Turn the element 180 degrees (with the open or plugged end of the element at the top).
- (f) Operate the cleaner for five minutes.
- (g) Turn the element to the original position in the tank (Ref. Step (b)).
- (h) Operate the cleaner for five minutes.

NOTE: The cleaning duration should be adjusted to suit the condition of the filter element. However, for optimum results, the cleaning solvent should be replaced every 20 minutes.

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**THROUGH HOLES DO NOT PLUG (PRE-SB1387)
INSTALL PLASTIC OR RUBBER PLUG (POST-SB1387)**

C13130A

Electrosonic Cleaner - P3 Air Filter Element
Figure 204

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- (i) Wear clean, lint-free gloves, and remove the element from the tank. Remove the plug if installed.
- (j) Dry the element with clean, dry compressed air (30 psi max.).
- (k) Inspect the filter element for condition.

NOTE: If repeated cleaning using an electrosonic cleaner does not clean the elements to the required condition, the following procedures apply:

- A disposable element must be replaced with a new element.
 - A permanent element may be shipped to an approved facility equipped with ultrasonic cleaning and pressure testing equipment and cleaned in accordance with the overhaul manual.
- (l) Vibropeen cleaning date on end cap.
 - (m) Store cleaned filter elements in clean plastic bags until required for installation.
- (3) Air Filter Housing (Post-SB1495):
- (a) Clean cover (1, Fig. 202), spring (3), valve (4) and filter cover (6) with solvent (PWC11-027) or (PWC11-031) and non-metallic bristle brush.
 - (b) Dry with clean dry compressor air and/or clean with a lint-free cloth.

8. Inspection/Check

A. Inspection

- (1) Insulated Tube Assemblies
 - (a) Examine flanged end fitting for elongated holes.
 - (b) Examine tube assemblies (Ref. 70-00-00, STANDARD PRACTICES - INSPECTION, Inspection of Fuel, Oil and Air Tubes).
 - (c) Blend out damage that does not exceed specified limits. Replace tube assemblies damaged beyond limits.
 - (d) Examine the insulation on the pneumatic tube assemblies for cuts in the outer rubber sheath. Surface cuts up to three inches long may be repaired (Ref. Para. 9.).
 - (e) If surface damage exceeds specified limits above, but depth is superficial, sheathing may be repaired by replacement of damaged portion (Ref. Para. 9.).
 - (f) Examine the metal braid and electrical lead on heated tubes for cuts. Up to three broken wires per plait, or six broken wires per linear foot, are acceptable. Replace the tube assemblies where metal braid is chafed or worn through to the lead conductors.

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- (2) For Pre-SB1495 Engines P3 Filter Cover:
 - (a) Make sure vent hole in cover is clear of all obstructions (hole size 0.029 to 0.034 in. dia.).
- (3) For Post-SB1495 Engines Air Filter Housing Drain Valve Assembly (Fig. 202)
 - (a) Filter Cover (6):
 - 1 Check lockwire holes for damage (tearing, cracks).
 - 2 Check threads for damage.
 - 3 Check that contact area is free of nicks and/or scratches.
 - (b) Retaining Ring (5):
 - 1 Check for distortion. Replace if distorted.
 - (c) Drain Valve (4):
 - 1 Check that contact area is free of nicks and/or scratches.
 - 2 Make sure drain holes are clear and unobstructed.
 - (d) Valve Spring (3):
 - 1 Check for corrosion and/or damage. Reject if unsatisfactory.
 - (e) Drain Valve Adapter (1):
 - 1 Check threads for damage.
 - 2 Check that contact area is free of nicks and/or scratches.
 - 3 Check flats and lockwire holes are free of damage.
 - 4 Check retaining ring groove. Reject if damaged or worn.

B. Check

- (1) Heated Tubes
 - (a) Using the turbine temperature indicating system test set, measure the resistance of the tube heating element and input lead. Resistance should be as noted in Table 201.

NOTE: 1. Resistance values are at 20°C (68°F).

NOTE: 2. For engine model applicability refer to IPC.

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TABLE 201, Heated Tube Inspection

TUBE ASSEMBLY P/N	RESISTANCE VALUE (IN OHMS)	TOLERANCE (IN OHMS)
3011853	20	± 1.4
3014216	20	± 1.4
3021964	13	± 1.0
3028907	20	± 1.4
3030517 *	35	± 2.0
3030522 *	40	± 2.0
3031445 **	40	± 2.0
3031448 **	35	± 2.0
3031850	18	± 0.9
3011843	8	± 0.4
3027974	8	± 0.4
3032097	26	± 2.0
3032309	39	± 2.0
* Paralleled	18.5	± 1.5
** Paralleled	18.5	± 1.5

9. Approved Repairs

A. Cuts in Insulated and Heated Air Pressure Lines

- (1) Apply adhesive sealant (PWC08-002) or (PWC09-001) to the damaged area of the tube in accordance with the manufacturer's instructions.

NOTE: If the cut is near the maximum allowable, it may be necessary to bind the area lightly with plastic covered wire after an application of adhesive. Remove the wire after the adhesive has cured.

- (2) Allow the adhesive sealant to cure at least two hours at room temperature. Full bond strength will be obtained in 72 hours.
- (3) After curing, trim the excess adhesive if necessary.

B. Repair of Damaged Silicone Rubber Sheath

- (1) Remove damaged portion of sheath, taking care not to penetrate to tape or insulation.
- (2) Cut a length of silicone rubber sheath (PWC05-052) one inch longer than part to be covered.

NOTE: If a heated tube is damaged in the proximity of the electrical input lead, cut the repair sheath to allow for a minimum of $\frac{3}{8}$ inch overlap.

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- (3) Put sheath over tube assembly until overlap is equal at both ends.

NOTE: If damage is near pigtail lead on heated tube, make end of repair sheath flush with pigtail lead.

CAUTION: AVOID APPLYING EXCESS HEAT TO SHEATH AT EXISTING BOOT. FURTHER HEATING OF BOOT COULD HAVE ADVERSE EFFECT.

- (4) Heat sheath all over with a hot air blower at 177 to 204°C (350 to 400°F). Sheath will immediately contract and should be smoothed out for a uniform fit.
- (5) Trim sheath, as applicable, to 0.65 to 0.90 inch from end of ferrule. Seal ends of repair sheath with adhesive sealant (PWC08-002) or (PWC09-001).
- (6) Allow sealant to cure for two hours at room temperature. Full bond strength will be obtained in 72 hours.
- (7) After curing, trim excess sealant as necessary.

C. Replacement of Electrical Connector

- (1) If replacement of the electrical connector is necessary, remove the tube wiring. Refer to Subpara. 6. for Removal/Installation of associated wiring.

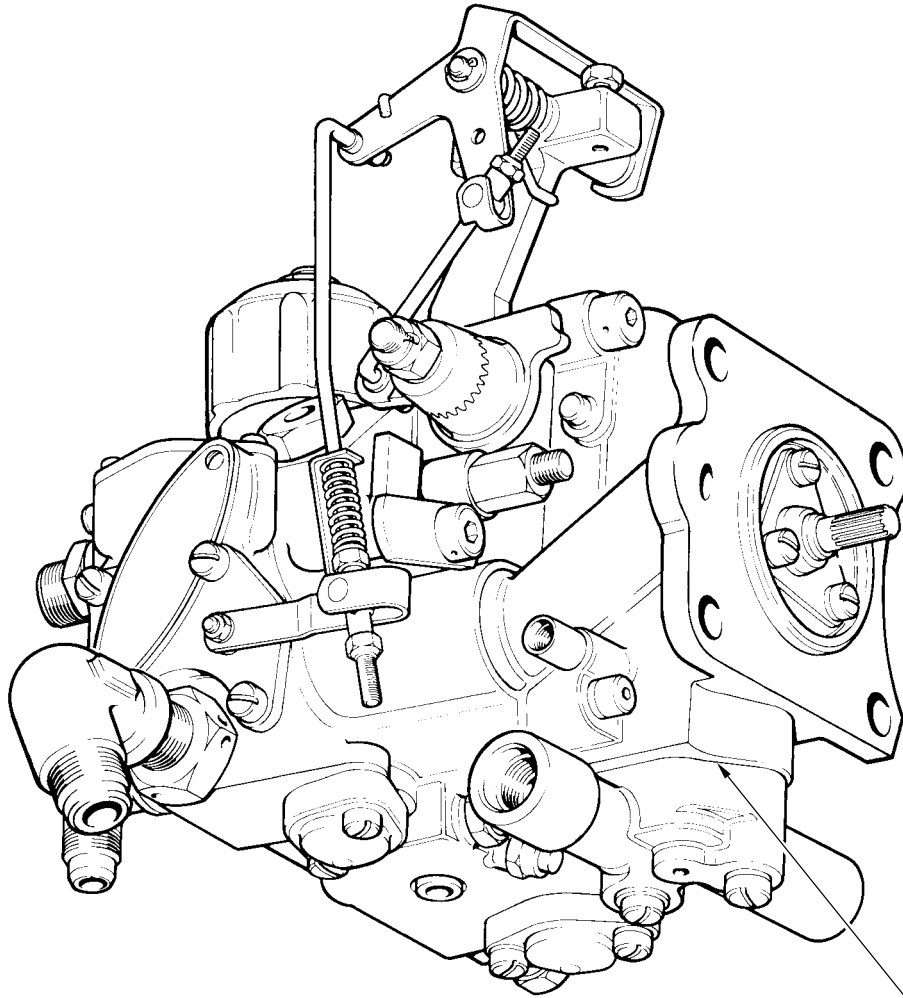
10. Adjustment/Test

A. System Test (Ref. Fig. 206)

NOTE: After pneumatic lines are installed, and individual components within lines or components associated with lines are installed, pressure test the system.

- (1) Dependent on engine configuration, disconnect compressor discharge air pressure line at appropriate connection.
- (2) Connect a supply of clean, dry compressed air regulated to 80 ± 5 psig:
- (a) For PT6A-27 and PT6A-28 Engines: Connect to elbow on compensator.
 - (b) For PT6A-27 and PT6A-28 Pre-SB1205 and PT6A-21 Engines: Connect to metered elbow on FCU.
 - (c) For PT6A-27 and PT6A-28 Post-SB1205 Engines: Connect to fitting at inlet of air filter.
 - (d) For PT6A-28 Post-SB1290 Engines: Connect to insulated center line at rear fireseal.
 - (e) For PT6A-21/-27/-28 Post-SB1330 Engines: Connect to insulated center line at rear fireseal.
 - (f) For PT6A-27 and PT6A-28 Post-SB1448 Engines: Connect to insulated center line at rear fireseal mount ring.

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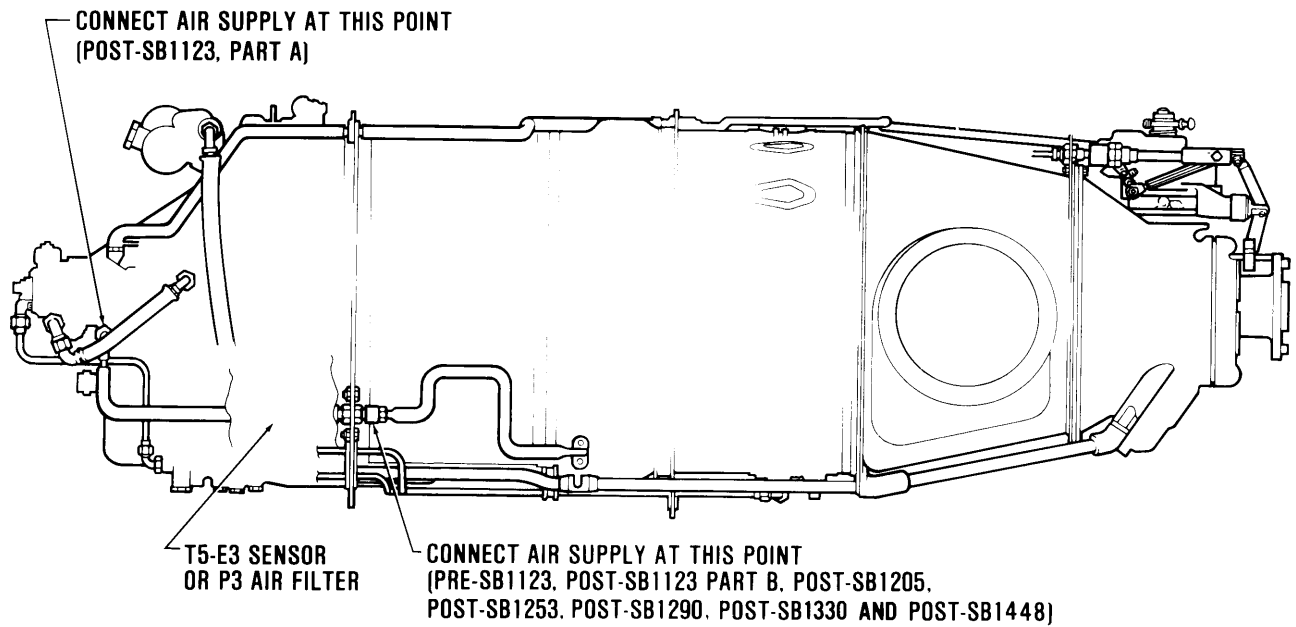


**SLOW BUBBLING PERMITTED
IN THIS AREA**

C71006

Leak Check at Drive Body and Adapter Junction
Figure 205

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C7916B

Fuel Control Pneumatic System Pressure Test
Figure 206

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- (3) Apply leak checking fluid (PWC05-007) to entire surface of all connecting points throughout pneumatic system. No leaks are permitted other than from one bleed hole underneath the fuel control unit.

NOTE: 1. For Pre-SB1495 engines, and one bleed hole in the P3 filter cover.

NOTE: 2. For Post-SB1495 engines, and minor leakage (Ref. NOTE 3) through the drain hole in the P3 filter drain adapter.

NOTE: 3. Excessive leakage at the P3 drain valve port (Post-SB1495) may result in unacceptable engine starting or acceleration characteristics.

NOTE: 4. Slow bubbling is permitted at junction of drive body and adapter (Ref. Fig. 205), provided that the engine accelerates normally (Ref. 71-00-00, Power Plant Adjustment/Test). Ship FCU to an approved facility for repair if leak is causing acceleration problems.

- (4) If leaks are detected, affected parts must be inspected for defects before retorquing. Replace defective parts. If no defects are found, retorque connection and repeat pressure leak test.
- (5) When no leaks are detected, wipe all leak checking fluid from connecting parts throughout system.
- (6) Disconnect air supply from appropriate connection (Ref. Fig. 206).
- (7) If front section of P3 line was disconnected at gas generator case, install new Post-SB1276 gasket (20, Fig. 201) flanged fitting and gasket to gas generator case using bolts, torque sequentially 15 to 20 lb.in., then continue torquing in same sequence 32 to 36 lb.in., and lockwire.

NOTE: 1. For Pre-SB1276 Engines: Do not lockwire bolts at flanged fitting end of line at this time.

NOTE: 2. For Post-SB1276 Engines: Do not loosen bolts to zero torque after applying initial torque.

- (8) Connect coupling nut at rear end of tube (19 or 22), as applicable, tighten nut, torque 90 to 100 lb.in., and lockwire. Complete safety wiring of all connections throughout pneumatic system.
- (9) Do engine start and ground run (Ref. 71-00-00).
- (10) For Pre-SB1276 Engines: After ground run, retorque flange bolts at gas generator case boss and lockwire.

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PNEUMATIC LINE (PY) - DESCRIPTION AND OPERATION

1. Description and Operation

The Nf section of the propeller governor derives Py pneumatic pressure from the metering section of the fuel control unit (FCU) through external lines.

The rear line, routed from the FCU to a bulkhead coupling at the center fireseal, is of stainless steel tubing encased in a shrunk-on rubber sheath insulation; a heater element is interposed between the tube and the sheath. A twin-lead cable provides electrical supply from a receptacle mounted on a bracket at Flange G of the engine.

The front line, routed from the coupling at the center fireseal to the propeller governor, is of stainless steel tubing, unheated and uninsulated.

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PNEUMATIC LINE (PY) - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

Not Applicable

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

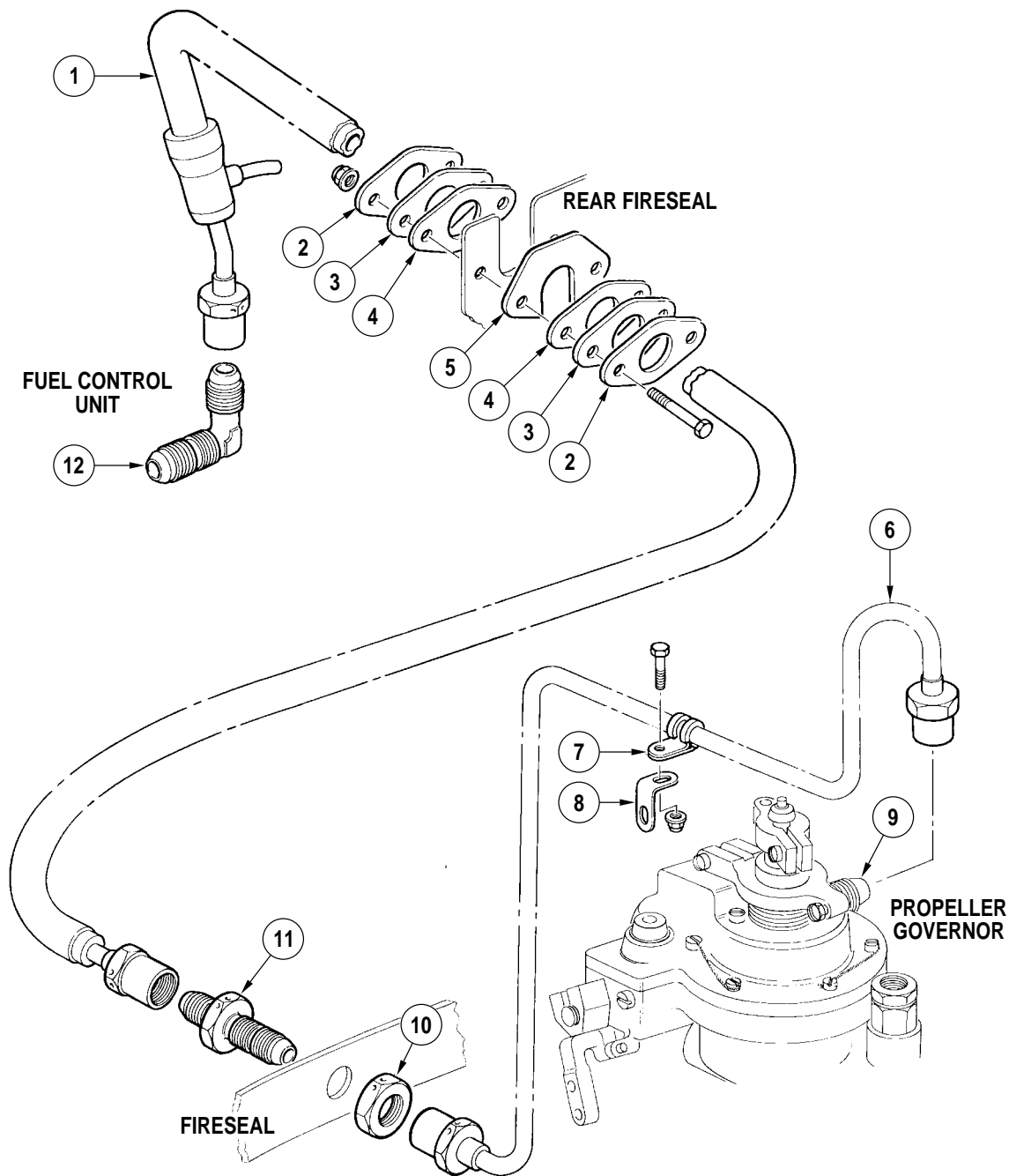
5. Removal/Installation

NOTE: It is important to make sure that all solid P3 lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any pipe brackets should not distort the pipe in any way.

A. Removal (Ref. Fig. 201)

- (1) Detach the electrical cable of the heated rear line (1) and disconnect the leads from the connector at Flange G (Ref. 73-10-07).
- (2) Remove the two self-locking nuts and bolts, and detach the sealing components (2), (3) and (4) from the rear fireseal. Remove the slotted retaining plate (5).
- (3) Disconnect the heated line (1) from the elbow (12) on the FCU and bulkhead coupling (11) at the center fireseal.
- (4) Remove the heated line from the slot in the rear fireseal and remove the sealing components from the line.
- (5) Remove the self-locking nut and bolt securing the clamp (7) on the front line (6) to the bracket (8).
- (6) Disconnect the front line (6) from the straight nipple (9) on the propeller governor and the bulkhead coupling (11) at the center fireseal and remove the line. Remove the clamp (7) from the line.

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Removal/Installation of Py Air Pressure Lines
Figure 201

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Key to Figure 201

1. Pneumatic Heated Rear Line
2. Retaining Plate
3. Insulation
4. Seal
5. Slotted Retaining Plate
6. Pneumatic Front Line
7. Clamp
8. Bracket
9. Straight Nipple
10. Locknut
11. Bulkhead Coupling
12. Elbow (Ref.)

- (7) If on visual inspection, the bulkhead coupling (11) appears to be damaged, remove the coupling from the center fireseal by removing the locknut (10).

B. Installation of Pneumatic Line (Ref. Fig. 201)

NOTE: It is important to make sure that all solid P3 lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any pipe brackets should not distort the pipe in any way.

- (1) If the bulkhead coupling (11) was removed, reinstall the coupling on the center fireseal and secure it with the locknut (10). Tighten the locknut 38 to 42 lb.in.

NOTE: Do not lockwire connections of pneumatic lines; lockwiring must be accomplished after the system pressure check.

- (2) Install the front line (6) by connecting the line to the straight nipple (9) on the propeller governor and the bulkhead coupling (11). Tighten the coupling nuts 90 to 100 lb.in.
- (3) Secure the line to the bracket (8) with a clamp (7), bolt and self-locking nut. Tighten the nut 36 to 40 lb.in.
- (4) Sequentially install the seals (4), insulation (3) and retaining plates (2) on the heated rear line (1).
- (5) Install the line (1) by locating the line in the slot of the rear fireseal with sealing components disposed as shown, on each side of the fireseal; connect the line to the elbow (12) on the FCU and the bulkhead coupling (11) at the center fireseal. Tighten the coupling nuts 90 to 100 lb.in.
- (6) Install the slotted retaining plate (5) on the line on the front face of the rear fireseal. Secure the slotted plate and sealing components with two bolts and self-locking nuts. Tighten the nuts until firm contact is obtained, plus 180 degrees.

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- (7) Connect the leads of the electrical cable of the heated line (1) to the connector at Flange G, and secure the cable (Ref. 73-10-07).

6. Cleaning/Painting

A. Cleaning of Air Tube(s)

- (1) Clean air tube(s) (Ref. 73-10-07, MAINTENANCE PRACTICES, Cleaning/Painting).

7. Inspection/Check

A. Inspection

(1) Insulated Tube Assemblies

- (a) Examine tube assemblies (Ref. 70-00-00, STANDARD PRACTICES - INSPECTION).
- (b) Blend out minor damage that does not exceed specified limits.
- (c) Replace the tube assemblies damaged beyond specified limits.
- (d) Inspect heated rear pneumatic line (Ref. 73-10-07, Inspection/Check).
- (e) Examine insulation on pneumatic tube assemblies for cuts in the outer rubber sheath. Cuts up to three inches long may be repaired (Ref. 73-10-17, Approved Repairs).
- (f) If surface damage exceeds specified limits above, but depth is superficial, sheathing may be repaired by replacement of the damaged portion (Ref. 73-10-07, Approved Repairs).

8. Approved Repairs

A. General Repairs

- (1) Repair damaged insulation on the heated rear line (Ref. 73-10-07).
- (2) Damaged threads of the bulkhead coupling may be repaired by chasing. Raised metal on the hexagon flats may be removed by light stoning.
- (3) Damaged electrical connector may be replaced (Ref. 73-10-07).

9. Adjustment/Test

Do a pressure test of the pneumatic system (Ref. 73-10-07).