Section V

STARTING AND IGNITION SYSTEMS

Contents *Page*

DESCRIPTION

5-1. GENERAL.

The engine starting and ignition systems are interrelated in that the operation of one system is dependent upon the other for completion of electrical circuits and starting of the engine. Switches for actuation of the starter and the ignition components are incorporated as a part of the pilot's throttle quadrant assembly. *On F-106B airplanes,* airplane starter actuation is accomplished from the front cockpit only. Ignition is used only during starts and functions only while the pilot depresses the ignition button, located on top of the throttle lever. The combustion starter is supplied with fuel from the airplane fuel system, and high-pressure compressed air from the airplane high-pressure pneumatic system or from an external compressed air source. A manual air selector valve, used for selection of either source of compressed air, and an adapter for attachment of an external air source are located in the left main wheel well. The fuel and air mixture is ignited by the starter ignition system. Either starter is actuated by holding the ignition button on the throttle lever depressed and moving the throttle lever to the "START" position. Engine ignition is supplied to spark-ignitors, located in number four and number five combustion chambers, by transformers located on the under side of the engine. Power for transformer operation is supplied from the airplane 28-volt, dc power system. The starting and ignition circuits are protected by the following fuses:

1. "ENG IGN," 15A	Main wheel well fuse panel
2. "START PWR," 10A	Main wheel well fuse panel
3. "START CONT," 5A	Main wheel well fuse panel

For illustration of the starting and ignition system, see figures 5-1 and 5-2.

5-2. COMBUSTION STARTER.

The combustion starter incorporates three systems, air, fuel, and ignition, and utilizes the combined pressure-energy of burning fuel to accelerate the starter turbine. The turbine is geared through a clutch to an output shaft which, in turn, engages the engine through the constant speed drive engine mounted gearbox. For a schematic illustration of the combustion starter, see figure 5-3.

5-3. Air System.

Compressed air at pressures between 1200 psi and 3500 psi must be provided either by an independently supplied ground source or by the airplane high-pressure pneumatic system, to support fuel combustion and to provide fuel pressure. The starter contains a dc powered shutoff valve to control this air pressure and a pressure regulating

valve to regulate it at 285 to 295 psi during the start. The 1200 psi to 3500 psi supply pressure is required to provide sufficient air volume for a complete starting cycle.

5-4. Fuel System.

Fuel for the starter is drawn from the airplane fuel system and is contained within an 18 to 20 cubic inch cylindrical accumulator on the starter. A piston in the accumulator separates fuel and air and is acted upon by regulated air pressure whenever the air solenoid is energized. A fuel solenoid in the outlet line of the accumulator prevents fuel entry into the combustion chamber until starter ignition is selected by throttle movement. When the fuel and air solenoids are energized, fuel is forced out of the accumulator by the air pressure acting on the accumulator piston and is sprayed through a nozzle into the combustion chamber. A check valve in the fuel inlet line to the accumulator prevents flowback into the airplane fuel system, yet provides for low flow pressure relief to prevent fuel thermal expansion pressure buildup in the accumulator. After the starting cycle is completed, both the fuel solenoid and air solenoid are deenergized. A spring on the fuel side of the accumulator piston then returns the piston to the full stroke position, drawing fuel in through the check valve to replenish the accumulator. A time delay switch is installed on the fuel accumulator which terminates starter ignition after a 1 to 3 second period. The switch, mounted on the side of the accumulator, is actuated by a pin which is pushed out by the accumulator piston movement after a predetermined quantity of fuel is displaced. *Applicable after incorporation of TCTO 1F-106-688,* a push-to-drain valve, located on bottom of fuselage at sta. 507.0, is provided to bleed the accumulator of entrapped air.

5-5. Ignition System.

The ignition system, consisting of an ignition box and sparkigniter, is similar to that used on the engine. The ignition box consists of a dc vibrator and step-up transformer. The secondary winding of the transformer is used to charge a storage capacitor. The storage capacitor is then discharged through the sparkigniter gap. Ignition is initiated by movement of the throttle inboard and, is terminated 1 to 3 seconds later by a signal from the time delay switch which is activated by displacement of the fuel accumulator piston.

5-6. Starter Components.

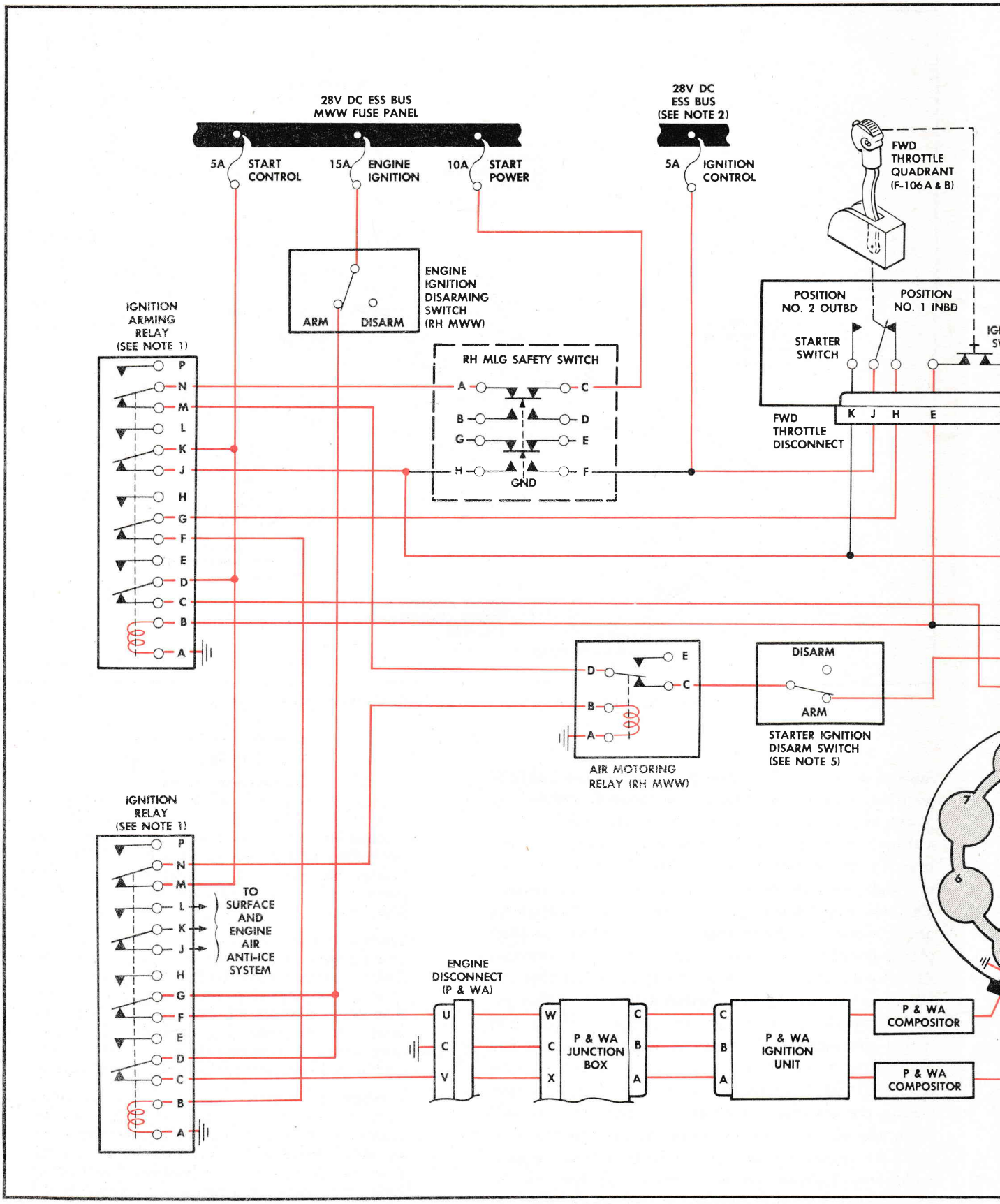
The basic starter consists of a combustion chamber; igniter; fuel nozzle; a turbine inlet nozzle assembly, to convert the combustion chamber high-pressure gas discharge into velocity energy; a turbine assembly, to convert this energy into starter output shaft torque; a planetary gear system of 17.17 to 1 gear ratio; a slip clutch assembly, to absorb the impact torque of the combustion start; and a one-way full phasing sprag clutch to transmit the energy from the starter gear train to the engine. The sprag clutch prevents the engine from driving the starter turbine at any time.

5-7. Starter Protective Devices.

A gear train centrifugal cutout switch is set at 2550 (±100) starter rpm (35% engine N_2 rpm) and is geared to the engine side of the starter output shaft. The purpose of the switch is to terminate starter operation after the starter has brought the engine up to the switch cutout rpm. The switch also acts to prevent accidental firing of the starter while the engine is operating above the cutout rpm setting of the switch. A turbine centrifugal cutout switch is set at 2850 (±100) starter rpm and is provided to terminate starter operation in the event the starter gear train centrifugal cutout switch failed to actuate. Actuation of this switch will require replacement of the starter. The actuator for this switch is located in the center of the starter turbine. The burner pressure switch is a two function switch located on the starter control box. After a time delay of 1 to 3 seconds, if the combustion chamber pressure has not reached 185 to 205 psi as a result of combustion, circuitry through the low-pressure contacts of the burner pressure switch will terminate starter operation. This is done to conserve the high-pressure air supply. Circuitry through the high-pressure contacts of the burner pressure switch will also terminate a start cycle whenever the combustion chamber pressure exceeds 325 to 345 psi. This feature is to protect the starter in the event that a malfunction has created excessive combustion chamber pressures. The high-pressure relief valve, located in the starter nozzle block shroud, vents regulated air through the starter exhaust if pressure exceeds 600 to 700 psi. The starter turbine is designed to minimize damage if a starter malfunction causes the turbine wheel to overspeed. In the event of an overspeed condition, the turbine buckets are designed to separate from the turbine wheel leaving the wheel intact. A shroud is provided around the outboard section of the turbine wheel to minimize external damage in the event of turbine wheel bucket separation. A friction clutch, located in the starter drive assembly between the sprag clutch and the starter output shaft, is provided to act in the initial stages of ignition to reduce the starting impact torque imposed on the engine. A shear coupling engages the engine starter drive and prevents damage to the engine drive should a starter gearbox drive malfunction occur.

5-8. Normal Starter Operation.

During normal operation (paragraph 5-10) with the throttle in "START" position, dc power is supplied to the starter air solenoid. Air at 285 to 295 psi pressure is then supplied to the air side of the fuel accumulator piston and to the combustion chamber from where it passes to the starter turbine, setting the turbine in motion. The output of the turbine is then transmitted through the starter gear train and through the engaged clutches of the starter to the engine. At this time an indication of engine N_2 rpm shall be observed on the tachometer to indicate that the starter has engaged with the engine starter drive. After obtaining an N_2 rpm indication, and while still holding the engine ignition button down, move the throttle


28V DC ESS BUS
MWW FUSE PANEL
5A START CONTROL
15A ENGINE IGNITION
10A START POWER
28V DC
ESS BUS
(SEE NOTE 2)
5A IGNITION CONTROL
FWD
THROTTLE
QUADRANT
(F-106 A & B)
ENGINE
IGNITION
DISARMING
SWITCH
(RH MWW)
ARM
DISARM
IGNITION
ARMING
RELAY
(SEE NOTE 1)
RH MLG SAFETY SWITCH
GND
POSITION
NO. 2 OUTBD
POSITION
NO. 1 INBD
STARTER
SWITCH
FWD
THROTTLE
DISCONNECT
K J H E
AIR MOTORING
RELAY (RH MWW)
DISARM
ARM
STARTER IGNITION
DISARM SWITCH
(SEE NOTE 5)
IGNITION
RELAY
(SEE NOTE 1)
TO
SURFACE
AND
ENGINE
AIR
ANTI-ICE
SYSTEM
ENGINE
DISCONNECT
(P & WA)
P & WA
JUNCTION
BOX
P & WA
IGNITION
UNIT
P & WA
COMPOSITOR
P & WA
COMPOSITOR

CONDITION

FWD IGNITION SWITCH ACTUATED, STARTER AND ENGINE IGNITION SYSTEMS ENERGIZED AT BEGINNING OF STARTER OPERATION CYCLE.

NOTES

1. *APPLICABLE TO F-106A AIRPLANES*, THE IGNITION RELAY AND IGNITION ARMING RELAY ARE LOCATED IN THE RH MISSILE BAY AT STATION 431.0. *APPLICABLE TO F-106B AIRPLANES*, THE IGNITION RELAY AND IGNITION ARMING RELAY ARE LOCATED IN THE RH MAIN WHEEL WELL AT STATION 380.0.
2. *APPLICABLE TO F-106A AIRPLANES*, IGNITION CONTROL FUSE IS LOCATED ON THE COCKPIT LEFT FUSE PANEL. *APPLICABLE TO F-106B AIRPLANES*, IGNITION CONTROL FUSE IS LOCATED ON THE NWW FUSE PANEL.
3. MALFUNCTION IN TURBINE CUT-OUT SWITCH REQUIRES STARTER REPLACEMENT AND BENCH RESET OF SWITCH.
4. NORMALLY OPEN "LOW" SWITCH CLOSES AT INTERMEDIATE AND HIGH PRESSURE. NORMALLY CLOSED "HI" SWITCH OPENS AT HIGH PRESSURE AND CLOSES AT INTERMEDIATE PRESSURE.
5. STARTER IGNITION DISARM SWITCH IS *APPLICABLE* AFTER INCORPORATION OF TCTO 1F-106-675.

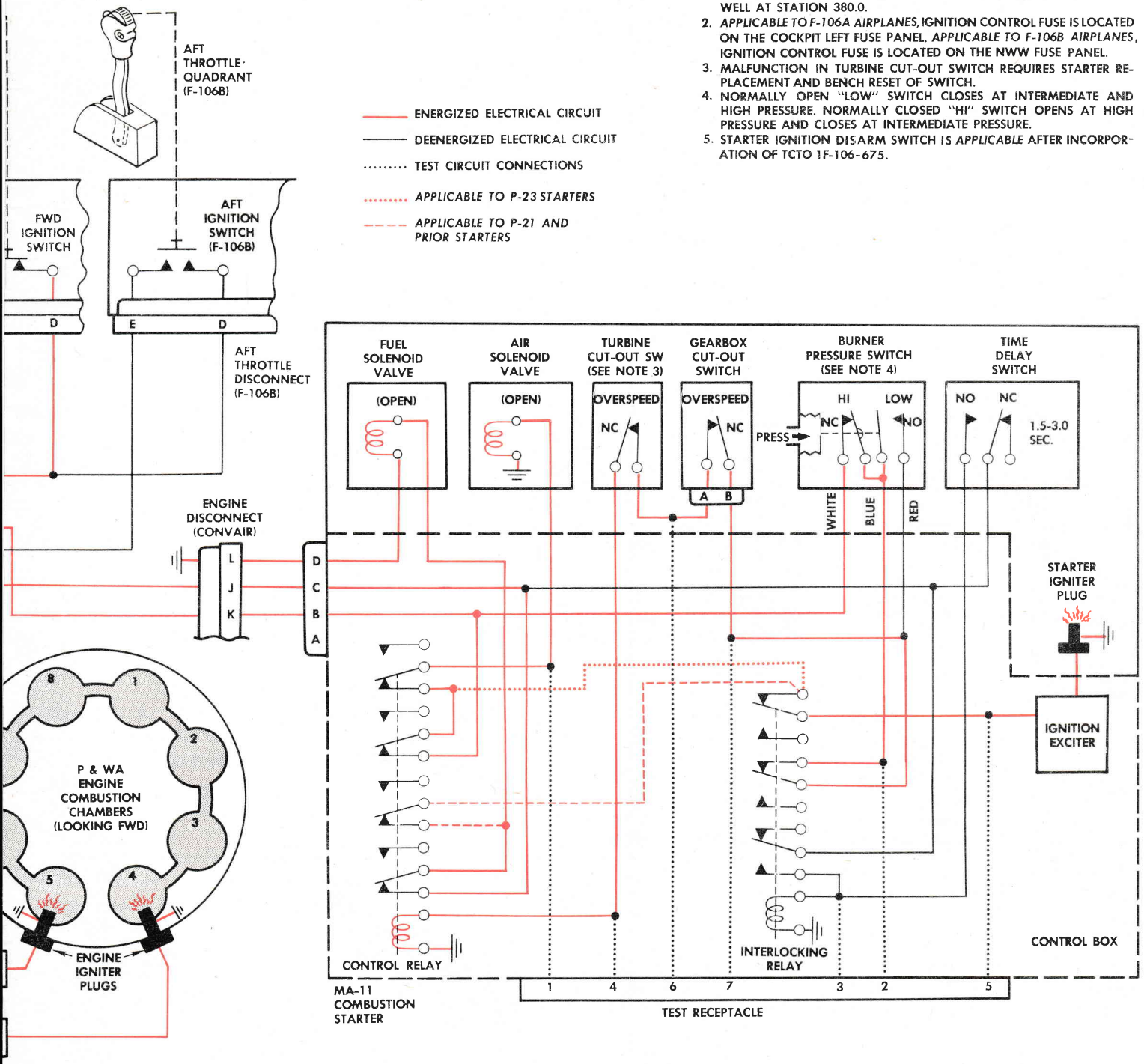


Figure 5-1. Starting and Ignition System Electrical Schematic

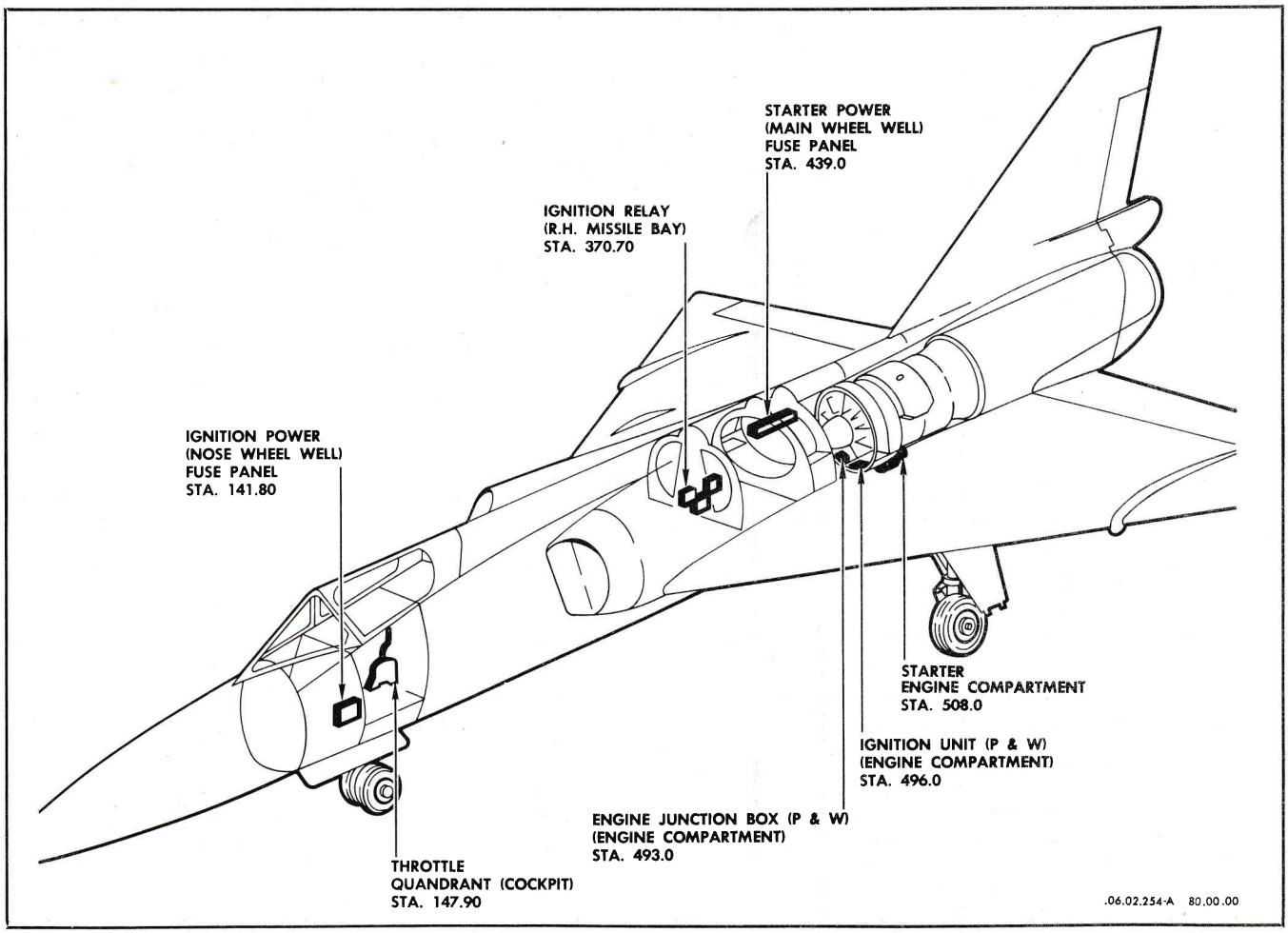


Figure 5-2. Starting and Ignition System, Component Locations

inboard to the "OFF" position and up to the "IDLE" position. With the throttle in the inboard position, dc power is supplied to actuate the starter fuel solenoid and ignition system. High-pressure fuel is then sprayed into the combustion chamber where it is mixed with the high-pressure air and ignited by the sparkigniter. The resulting burning gas is then ducted through the starter nozzle to the turbine. As the fuel accumulator piston moves during its delivery of fuel to the combustion chamber, it passes over the sparkigniter time delay switch actuating pin. Piston actuation of this pin will terminate starter ignition. Burning of the fuel within the starter will continue until the starter has reached cutout speed as signaled by the gear train centrifugal switch. This speed is approximately 35% N_2 rpm. During the starting procedure it is necessary to hold down the engine ignition button on the throttle lever until the engine instruments indicate a positive self-sustaining light-off, or until engine N_2 rpm reaches 35%. Release of the ignition button before this time will deenergize the starter electrical circuitry and result in a premature shutdown of the starter.

CAUTION

During the starting cycle, temperatures as high as 954°C (1750°F) can be reached in the combustion chamber. For this reason it is necessary that proper cooling periods for the starter be observed in order to insure that parts are not damaged as a result of excessive heat.

Combustion starter duty cycle, at ambient temperatures up to 32°C (90°F), must be limited to two consecutive combustion runs in rapid succession followed by a cooling time of 30 minutes minimum. Succeeding runs must then be spaced a minimum of 25 minutes apart. If combustion starter duty cycle limitations are exceeded, replace the starter.

Combustion starter duty cycle, at ambient temperature above 32°C (90°F), must be limited to two consecutive combustion runs in rapid succession followed by a cooling time of 45 minutes minimum. Succeeding runs must then be spaced a minimum of 40 minutes apart. If combustion starter duty cycle limitations are exceeded, replace the starter.

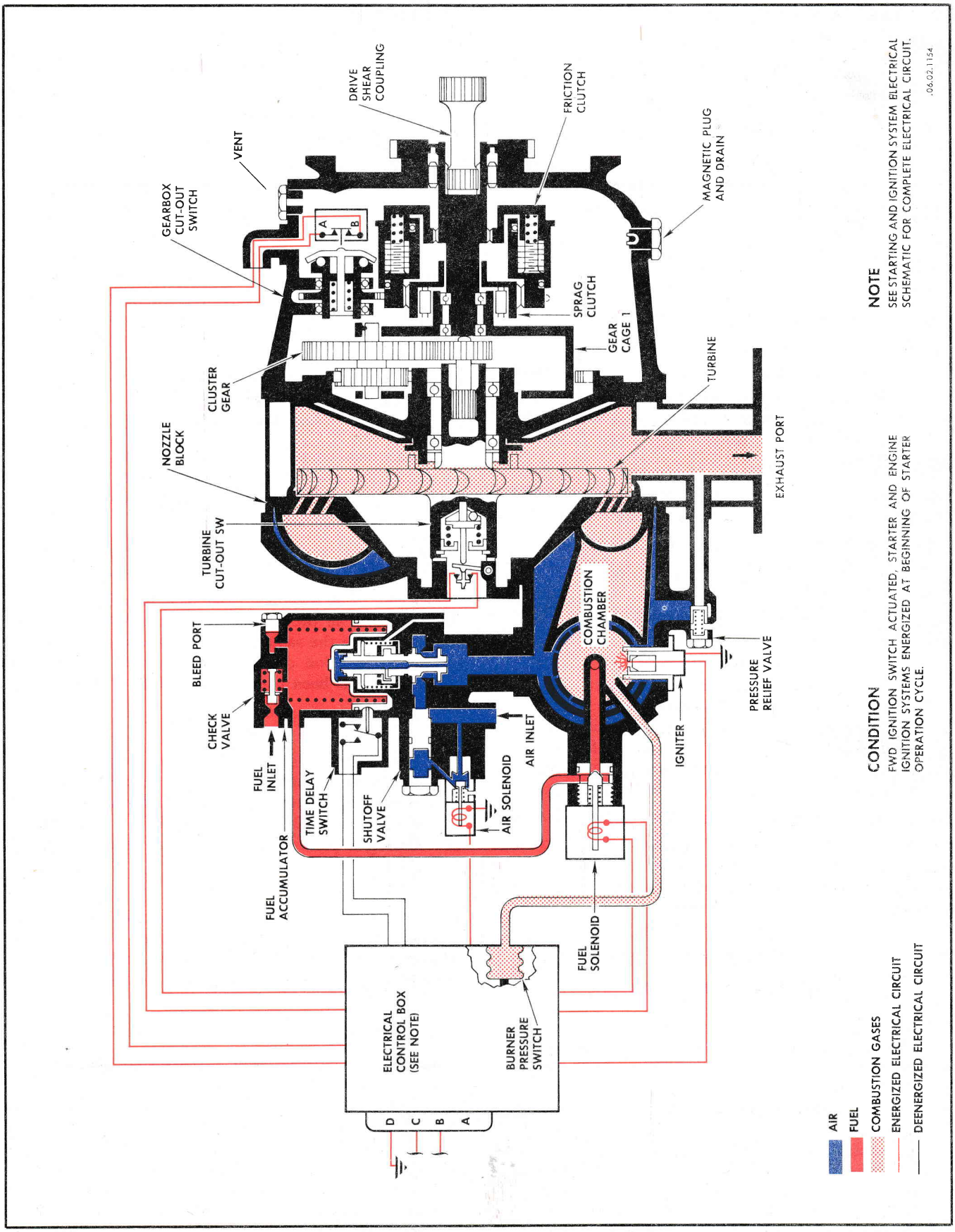


Figure 5-3. Combustion Starter Schematic

5-9. STARTER IGNITION DISARM SWITCH.

Applicable to all airplanes after incorporation of TCTO 1F-106-675. The starter ignition disarm switch is located in the right main wheel well. The switch has two positions, "ON" and "OFF," and is used to interrupt power to the starter ignition system. The "OFF" position is used during the air motor start procedure to prevent firing of the combustion portion of the starter system. The switch receives power from the dc essential bus.

5-10. COMBUSTION STARTER OPERATION.

Operation of the combustion starter will be conducted as follows:

a. Prepare airplane and engine for ground run. Refer to Section I of this manual for this information.

b. Provide source of high-pressure compressed air for starter operation. If external air source is used, starter manual air selector valve, in left main wheel well, must be in the "CLOSED" position. If airplane pneumatic system is to be used, manual air valve must be in the "OPEN" position.

c. Turn on airplane fuel supply system boost pumps. This provides fuel to the starter fuel accumulator.

d. *Applicable to all airplanes after incorporation of TCTO 1F-106-675.* Check that starter ignition disarm switch is in the "ON" position.

CAUTION

The starter ignition switch is to be used only for an air motor start subsequent to an unsuccessful attempt at starting engine utilizing the combustion capabilities of the starter. During the air motor start procedure the starter ignition switch must be in the "OFF" position.

e. Depress the ignition button and hold; move the throttle outboard to "START" position. Check tachometer for positive rpm indication, then move the throttle inboard to "OFF," then forward to "IDLE."

WARNING

Release ignition button immediately if no "RPM" reading is evident on the tachometer. Do not move the throttle inboard to the "OFF" position with the ignition button depressed if there is no "RPM" indication. This could result in disintegration of the combustion starter. No "RPM" reading indicates the starter failed to engage the engine. A maximum of two attempts should be made, but if still unsuccessful, the operation should be discontinued until the cause of malfunction has been established and correction made.

This procedure is accomplished by a continuous movement of the throttle. Do not hesitate at any point.

CAUTION

Do not jockey the throttle. The starting fuel schedule is automatically controlled by the fuel control unit. Jockeying the throttle will interrupt this schedule.

f. Continue holding ignition button depressed until engine rpm reaches 30% and the engine instruments indicate a positive light-off; release ignition button. Refer to paragraph 1-26 for the complete engine starting procedure.

CAUTION

Adequate combustion starter cooling periods must be observed between starts to prevent damage from overheating. Refer to Section I for starter duty cycle limitations.

5-11. PNEUMATIC START OPERATION.

Applicable to all airplanes after incorporation of TCTO 1F-106-675. The procedures for accomplishing a pneumatic start are the same as for a combustion start after the starter ignition disarm switch, located in the right wheel well, has been placed in the "OFF" position.

NOTE

Pneumatic starts will be used only after failure to obtain a combustion start. An external compressed air source must be used for all pneumatic starts. The maximum EGT observed during a pneumatic start will be recorded on AFTO Form 781.

After the engine ignition button is released and exhaust gas temperature has stabilized, return the starter ignition disarm switch to the "ON" position before external compressed air and electrical power are disconnected.

5-12. ENGINE IGNITION SPARKIGNITERS.

Two ceramic type ignition sparkigniters are used for engine starting ignition. One sparkigniter is installed in No. 4 combustion chamber, the other is installed in No. 5 combustion chamber. Other than checking of the condition of the sparkigniters at specified periods, no maintenance is required. If the sparkigniters are found to have a brown stain on the ceramic surrounding the center electrode, insulation breakdown is indicated and the sparkigniters should be replaced. The sparkigniters must also be replaced when the electrodes are burned

more than 0.225 inch below the surface of the ceramic insulation.

WARNING

When performing maintenance on sparkigniters or other components of the ignition system, be sure that electrical power has been removed from the ignition system.

5-13. AIR MOTORING OF ENGINE WITH COMBUSTION STARTER (AIR ONLY).

During engine maintenance procedures, it may be necessary to rotate the engine using the combustion starter. This procedure will be conducted as follows:

a. Position engine ignition disarming switch in main wheel well to the disarmed position.

CAUTION

Refer to system test procedure requiring engine air motoring before performing the motoring procedure.

b. Remove starter "START PWR" fuse from main wheel well fuse panel.

c. *Applicable to all airplanes after incorporation of TCTO 1F-106-675.* Position starter ignition disarm switch to the "OFF" position.

CAUTION

The starter ignition disarm switch is to be used only for an air motor start subsequent to an unsuccessful attempt at starting engine utilizing the combustion capabilities of the starter. During the air motor start procedure the starter ignition switch must be in the "OFF" position.

d. Connect external high-pressure air source to filler fitting in left main wheel well; starter air selector valve in left wheel well in "CLOSED" position.

e. Depress throttle ignition button and move throttle to "START" position. Allow starter to accelerate engine to a minimum of 14% N_2 rpm. The starter will continue to air motor the engine until the ignition button is released, or until the air supply is shut off or depleted.

OPERATIONAL CHECKOUT

5-14. TEST, ENGINE STARTER AND IGNITION CIRCUIT.

5-15. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T. O. 1F-106A-2-10.	Test Light, 28-volt dc (3).			To test circuit continuity.
	Generator Set (Gas).	8-9026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF/ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-620-6468)	

5-15. Equipment Requirements (Cont).

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
	Generator Set.		MC-1 (6125-500-1190)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
			MD-3 (6115-635-5595)	
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.

5-16. Procedure.

a. With electrical power removed from airplane, disconnect plug from P&W engine junction box.

b. Disconnect electrical plug from starter.

c. Install 28-volt dc test lights as follows:

1. Between pin W of P & W plug and ground.
2. Between pin X of P & W plug and ground.
3. Between pin B of starter plug and ground.
4. Between pin C of starter plug and ground.

d. The following fuses are to be installed:

1.	"ENG IGN"	Main wheel well fuse panel
2.	"START CONT"	Main wheel well fuse panel
3.	"START PWR"	Main wheel well fuse panel
4.	"IGN CONT"	Nose wheel well fuse panel

e. Connect 28-volt dc power to external power receptacle.

NOTE

Applicable to all airplanes after incorporation of TCTO 1F-106-675. Check that starter ignition disarm switch is in "ON" position.

f. Move throttle lever to "START" and depress ignition button. Test light at pin B of the starter plug shall illuminate.

g. With ignition button still depressed, move throttle to the "OFF" position. Lights at the P & W plug and pins B and C at starter plug shall illuminate.

h. Release ignition button; lights shall extinguish.

i. Actuate right main landing gear safety switch to the up (actuated) position.

j. With throttle lever in "OFF" position, depress ignition button. Light at pin C of starter plug shall not illuminate. Light at pin B of starter plug and both lights at P & W plug shall illuminate.

k. Position engine ignition disarming switch in main wheel well to the "DISARMED" position. Light at P & W plug shall extinguish.

l. Reposition right landing gear up-position switch to the gear-down position. Remove electrical power from airplane. Remove test lights and reconnect electrical plugs. Reposition engine ignition disarming switch to the "ARMED" position.

5-17. LEAK CHECK, ENGINE STARTER ACCUMULATOR CHECK VALVE AND FUEL SOLENOID.

The following procedure is to be used to detect a leaking check valve or fuel solenoid while the starter is installed in the airplane:

5-18. Procedure.

a. Bleed all air from the starter fuel system; refer to paragraph 5-29 for this procedure.

b. Disconnect fuel supply line at starter fuel accumulator inlet fitting.

c. Connect external source of dry compressed air (0-350 psig) to bleed port of fuel accumulator.

d. Turn on 300 (±10) psig air pressure.

NOTE

The 300 (±10) psig pressure may be applied directly to the accumulator bleed port or to any adapter hose used for remote bleeding of the accumulator.

e. Check for leakage from the accumulator fuel inlet port. There shall be no evidence of leakage from the inlet port, except during the instant of pressure application. At this time a small amount of fuel may be forced out during seating operation of check value. This leakage shall cease immediately.

f. Check the fuel solenoid for external leakage while the accumulator is charged.

g. Replace the starter if leakage is detected during test.

h. Connect fuel supply line to starter; disconnect external air pressure.

i. Bleed the starter fuel system; refer to paragraph 5-29 for procedure.

j. visually check the starter fuel solenoid for leakage under the following conditions:

1. During pressure checking of the fuel accumulator as outlined in the preceding steps, there shall be no external leakage around the fuel solenoid.
2. There shall be no indication of leakage from the starter exhaust after the starter has been idle for any period of time following a combustion start.
3. During the air motoring portion of the starting cycle, the discharge from the starter exhaust shall be clear. A white vapor is an indication of a leaking solenoid.

5-19. AUDIBLE OPERATION CHECK, STARTER IGNITION.

a. Check that the starter air supply source is in the "OFF" position.

b. Position switches and controls as follows:

1. Master power switch "OFF"
2. AC and dc generator control switches "OFF"
3. Engine ignition arming switch (right MWW) "DISARMED"
4. Throttle lever "OFF"
5. All other switches and controls in the nonoperating position.

c. Check that the following fuses are installed:

1. "START CONTROL" Main wheel well fuse panel
2. "START POWER" Main wheel well fuse panel

d. Connect external ac and dc power to the airplane external power receptacle.

e. Depress and hold ignition button on throttle lever. Move throttle lever to "START," then to "OFF" position. Place ear near the starter ignition transformer and listen for audible operation. Release ignition button; transformer operation shall cease.

f. Reposition engine ignition arming switch to the "ARMED" position.

g. Disconnect external electrical power.

SYSTEM ANALYSIS

5-20. SYSTEM ANALYSIS, STARTER AND IGNITION SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STARTER OPERATING BUT NOT ENGAGING.		
Faulty starter engagement jaw assembly.	Remove starter for bench test.	Install replacement item.
Starter clutch malfunctioning.		
WITH IGNITION BUTTON DEPRESSED, STARTER DOES NOT REMAIN ENERGIZED WHEN THROTTLE IS MOVED TO "OFF" POSITION.		
Ignition switch on throttle not actuating.	Check for electrical continuity through switch.	Replace switch if found to be faulty.

5-20. SYSTEM ANALYSIS, STARTER AND IGNITION SYSTEM (CONT).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
STARTER INOPERATIVE.		
Loose or faulty electrical connections.	Check physical condition of electrical system.	Repair as required.
Starter turbine cutout switch tripped.	Check for electrical continuity between pins 4 and 6 of starter test receptacle.	Remove starter for overhaul of cutout switch if continuity cannot be obtained. Install replacement starter.
Starter air solenoid valve not opening.	Apply 28-volt dc power through a test switch to pin 1 of the starter test receptacle. Listen for valve operation as power is applied.	Replace starter if valve action is not obtained.
Starter igniter plug inoperative.	Remove plug for bench check.	Install replacement item.
	"Buzz" the starter sparkigniter using the procedure given in paragraph 5-19.	If engine still will not start, replace the sparkigniter.
Starter fuel accumulator malfunctioning.	Remove starter for bench test.	
Air lock in starter fuel system.		Bleed starter fuel system. Refer to paragraph 5-29 for this procedure.
Starter ignition disarm switch in "OFF" position.		Position switch to "ON."
STARTER DOES NOT TURN ENGINE FAST ENOUGH FOR START.		
Starter fuel accumulator malfunctioning.	Remove starter for bench test.	Install replacement item.
Insufficient air supply.	Check air source for volume and unrestricted flow.	Repair as required.
STARTER OPERATION CYCLE OF SHORT DURATION; OR BACKFIRING OCCURS.		
Air in starter fuel system.		Bleed starter fuel system. Refer to paragraph 5-29 for this procedure. If system bleeding does not eliminate malfunction, go to next probable cause.
Starter fuel accumulator piston binding.	Remove starter for bench test.	Install replacement item. Bleed fuel system.
STARTER MISFIRES OR BACKFIRES.		
Preservative oil in starter combustion chamber.	Make a minimum of six engine starts, or attempted starts, to clear up condition.	If condition persists, replace starter.

5-20. SYSTEM ANALYSIS, STARTER AND IGNITION SYSTEM (CONT).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
SLOW LIGHT-OFF OF ENGINE.		
Half of engine ignition system inoperative.	Remove sparkigniters. Check for condition.	Replace defective unit.
	Operate ignition system without energizing starter. Listen for operation of ignition exciters and sparkigniters.	
	WARNING The electrical energy produced by the engine ignition system is sufficient to produce a shock that can be fatal to personnel. Be sure that electrical power has been removed from the ignition system before performing system maintenance.	

REPLACEMENT

5-21. REPLACEMENT, ENGINE STARTER.

See figure 5-4 for the removal and installation procedures for the combustion starter.

5-22. REPLACEMENT, STARTER EXHAUST DUCT.

See figure 5-5 for the combustion starter exhaust duct replacement procedure.

5-23. REMOVAL, ENGINE IGNITION EXCITER UNIT.

Replacement of the engine ignition exciter unit may be accomplished with the engine installed in the airplane. Access is gained through the constant-speed drive unit access doors.

CAUTION

Do not allow hardware or foreign material to fall into the flight control mixer assembly when replacing ignition assemblies.

a. Disconnect and lower constant-speed remote gearbox to the hanging position. See figure 9-3 for this procedure.

b. Remove fiberglass cover from flight control mixer assembly.

WARNING

Be sure that electrical power has been removed from the ignition circuit before performing maintenance on the system. Ignition must be inoperative for 2 minutes before disconnecting leads.

c. Disconnect leads from the exciter assemblies. Cover leads and openings with polyethylene sheet.

d. Remove bolts (4 each); remove exciter assemblies.

5-24. INSTALLATION, ENGINE IGNITION EXCITER UNIT.

a. Install the engine ignition exciter assembly in essentially the reverse of the removal procedure.

b. Conduct engine start. Refer to Section I for this procedure.

5-25. REMOVAL, ENGINE IGNITION COMPOSITORS.

Removal of the engine ignition compositors may be accomplished with the engine installed in the airplane. Access is gained to the necessary work areas through the engine accessory compartment access doors. Compositors are located on the left and right sides of the engine accessory section.

WARNING

Be sure that electrical power has been removed from the ignition circuit before performing maintenance on the system. Ignition must be inoperative for 2 minutes before disconnecting electrical leads.

a. Disconnect leads from compositors. Cover lead and openings with polyethylene sheet.

NOTE

On airplanes equipped with the engine fuel supply inlet strainer, removal of the strainer will be required before removal of the right compositors can be accomplished. Refer to Section II for removal procedures.

b. Remove bolts (4); remove compositor.

5-26. INSTALLATION, ENGINE IGNITION COMPOSITORS.

a. Install the engine ignition compositors in essentially the reverse of the removal procedure.

b. Apply Molykote powder type "Z," Military Specification MIL-M-7866, to sparkigniter lead coupling nuts on installation.

c. Conduct engine start. Refer to Section I for this procedure.

5-27. REPLACEMENT, ENGINE IGNITION SPARKIGNITERS.

a. Remove ignition sparkigniters as follows:

1. Remove engine ignition fuse located on the main wheel well fuse panel.
2. Open engine accessory compartment access door.

WARNING

Be sure electrical power has been removed from the ignition circuit before performing maintenance on the system.

3. Remove ignition leads from sparkigniters. Cover leads with polyethylene sheet.
4. Remove sparkigniters.

b. Install ignition sparkigniters as follows:

1. Installation is essentially the reverse of removal.
2. Use new gasket when installing sparkigniters. Apply anti-seize compound, Military Specification MIL-T-5544, sparingly on the sparkigniter shell threads.

NOTE

Do not apply compound to the first thread as the material may run down and ground the electrode.

3. Torque sparkigniters 300 to 360 inch-pounds.
4. Apply Molykote powder type "Z," Military Specification MIL-M-7866, to the sparkigniter lead coupling nut threads. Connect the sparkigniter leads to the sparkigniters.

NOTE

Make certain lead is properly positioned as coupling nut is tightened. Safety-wire coupling nuts.

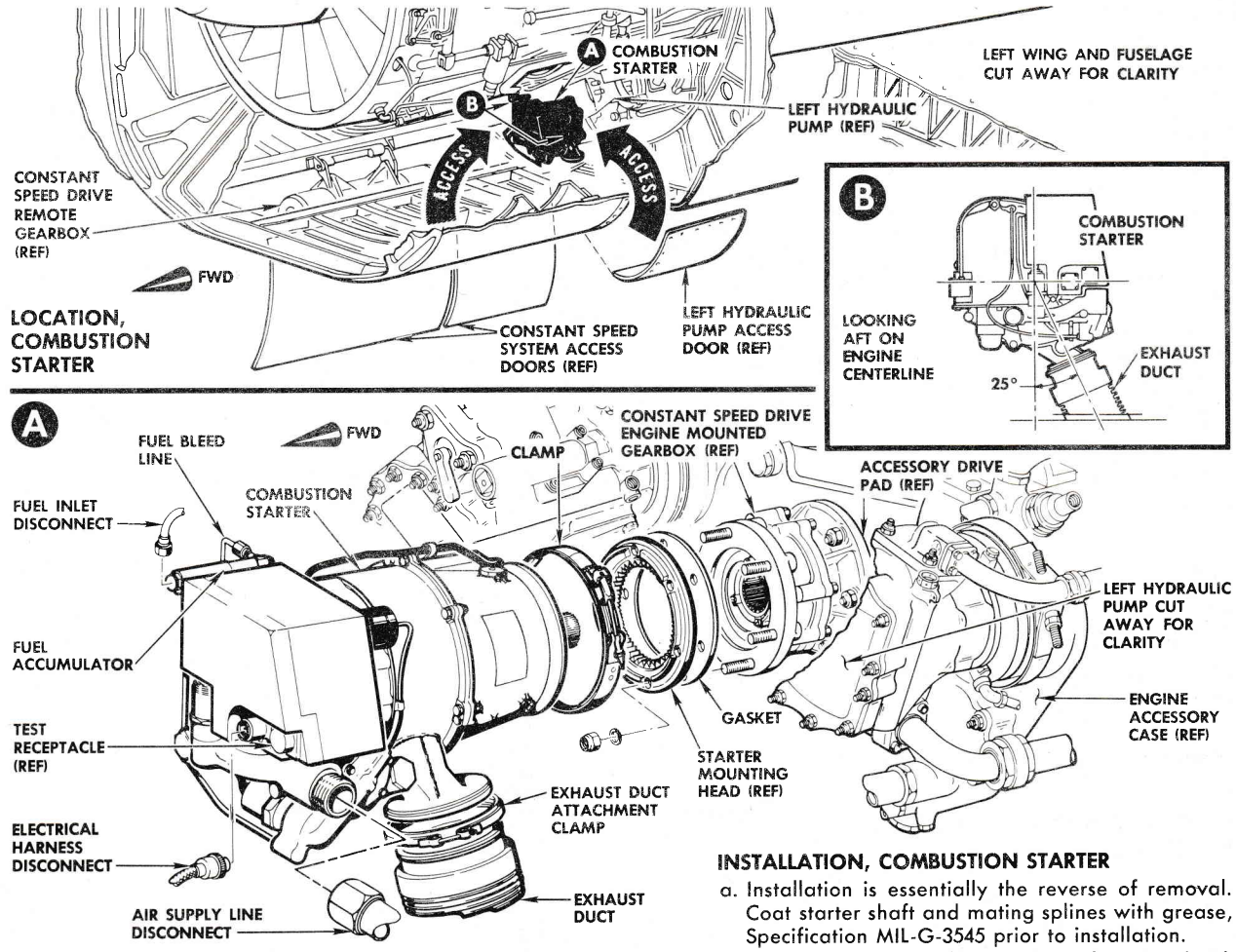
SERVICING

5-28. SERVICING COMBUSTION STARTER.

Servicing the combustion starter consists of checking the oil level and changing the oil at specified periods. Check oil level by removing filler plug on left-hand side of starter; oil should be level with the bottom of the oil filler hole. Oil drainage is accomplished by removing drain plug from bottom centerline of the starter. Service starter with oil, Military Specification MIL-L-7808, to bottom of oil filler hole. See figure 5-6 for illustration of combustion starter oil servicing points.

5-29. COMBUSTION STARTER, FUEL SYSTEM BLEEDING.

Upon completion of a combustion starter replacement, or completion of maintenance on the starter where the fuel system has been opened, the following bleeding procedure will be accomplished.



REMOVAL, COMBUSTION STARTER

a. Open constant speed system access door.
b. Lower remote gearbox out of fuselage; do not detach from fuselage.
c. Disconnect electrical harness from starter.
d. Disconnect exhaust duct and mounting clamp.
e. Disconnect fuel drain line from fuel accumulator.

NOTE

APPLICABLE TO ALL AIRPLANES AFTER INCORPORATION OF TCTO 1F-106-688, STARTER FUEL ACCUMULATOR BLEED LINE EXTENDS TO A PUSH TO DRAIN VALVE LOCATED NEAR BOTTOM CENTER LINE OF FUSELAGE AT STATION 506.90.

f. Disconnect fuel inlet line.
g. Disconnect air supply line from front of starter.
h. With the starter fully supported, loosen starter-to-mounting head clamp. Remove starter.
i. Remove attachment nuts (6); remove starter mounting head.

CAUTION

DO NOT LEAVE STARTER UNSUPPORTED ON MOUNTING HEAD WHEN MOUNTING CLAMP IS LOOSE.

INSTALLATION, COMBUSTION STARTER

a. Installation is essentially the reverse of removal. Coat starter shaft and mating splines with grease, Specification MIL-G-3545 prior to installation.
b. Install mounting head using new gasket coated with oil, Specification MIL-L-7808. Torque mounting head attachment nuts 120 to 144 inch-pounds.
c. Torque starter mounting clamp 15 to 25 inch-pounds. Make certain that starter is seated evenly on mounting head before clamp is torqued. Tap clamp lightly as it is torqued to insure that tension is uniformly distributed in the clamp.

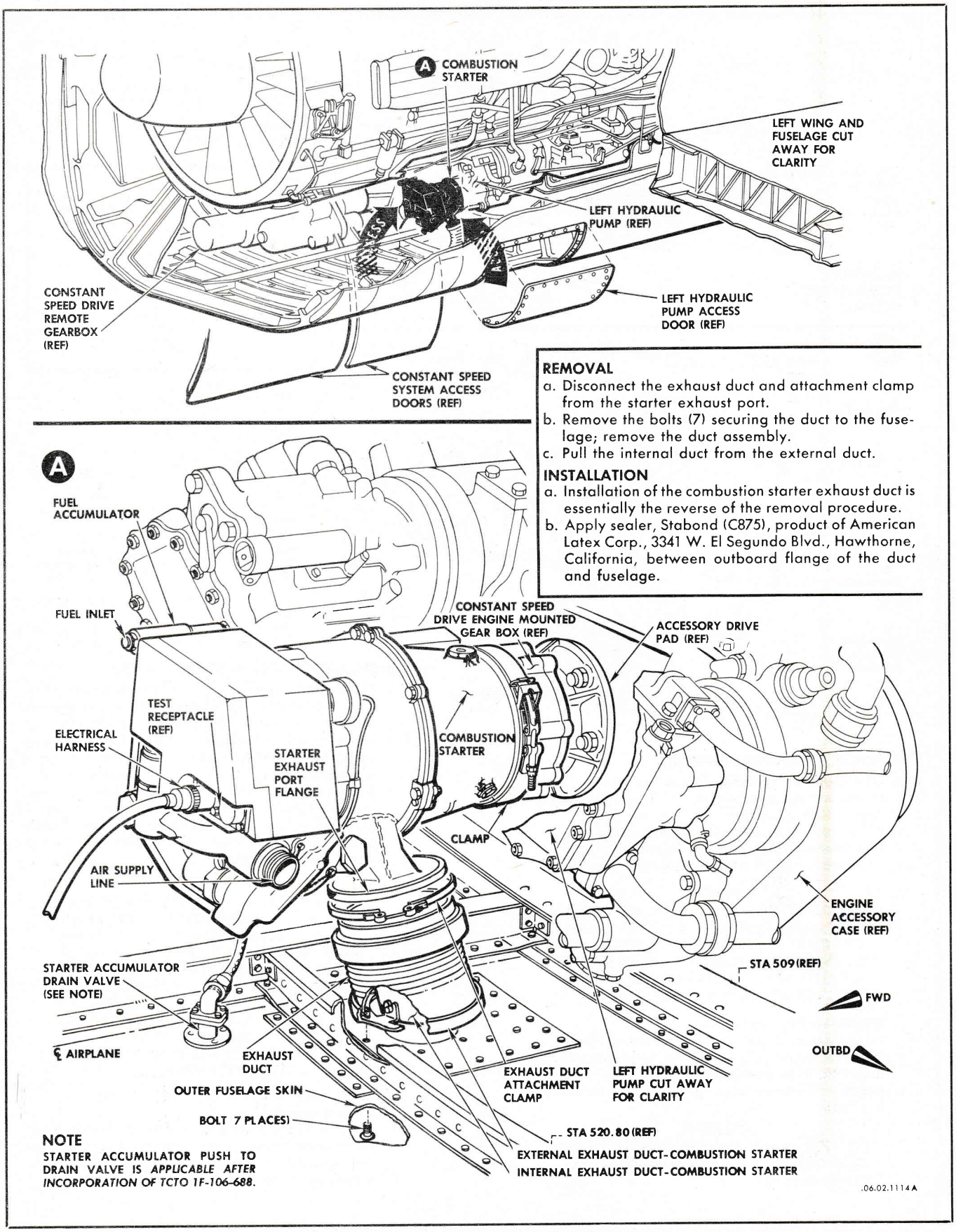
NOTE

WHEN INSTALLING STARTER, CHECK THAT STARTER EXHAUST PORT IS PROPERLY ALIGNED WITH EXHAUST DUCT. ALIGNMENT (INDEXING) IS EFFECTED BY LOOSENING BOLTS (6) JUST AFT OF THE EXHAUST PORT AND ROTATING STARTER HOUSING UNTIL PROPER ANGLE IS OBTAINED. DO NOT LOOSEN SCREWS (3) ADJACENT TO BOLT LOCATIONS. SEE DETAIL B FOR PROPER ANGLE OF ALIGNMENT. TORQUE BOLTS 50 TO 70 INCH-POUNDS.

d. Safety-wire fittings and mounting clamp.
e. Bleed starter fuel system.
f. Perform engine start procedure and visually check starter installation for fuel leakage during first engine ground run idle rpm. Refer to Section 1 for engine start and ground run procedures.

.06.02.615H

Figure 5-4. Replacement, Combustion Starter



REMOVAL

a. Disconnect the exhaust duct and attachment clamp from the starter exhaust port.
b. Remove the bolts (7) securing the duct to the fuselage; remove the duct assembly.
c. Pull the internal duct from the external duct.

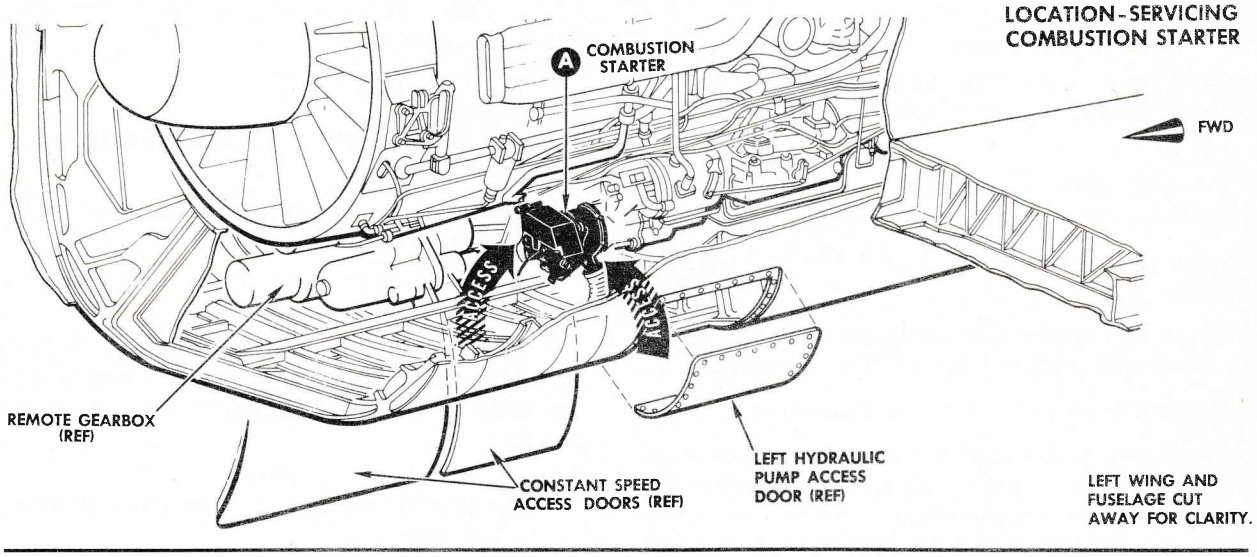
INSTALLATION

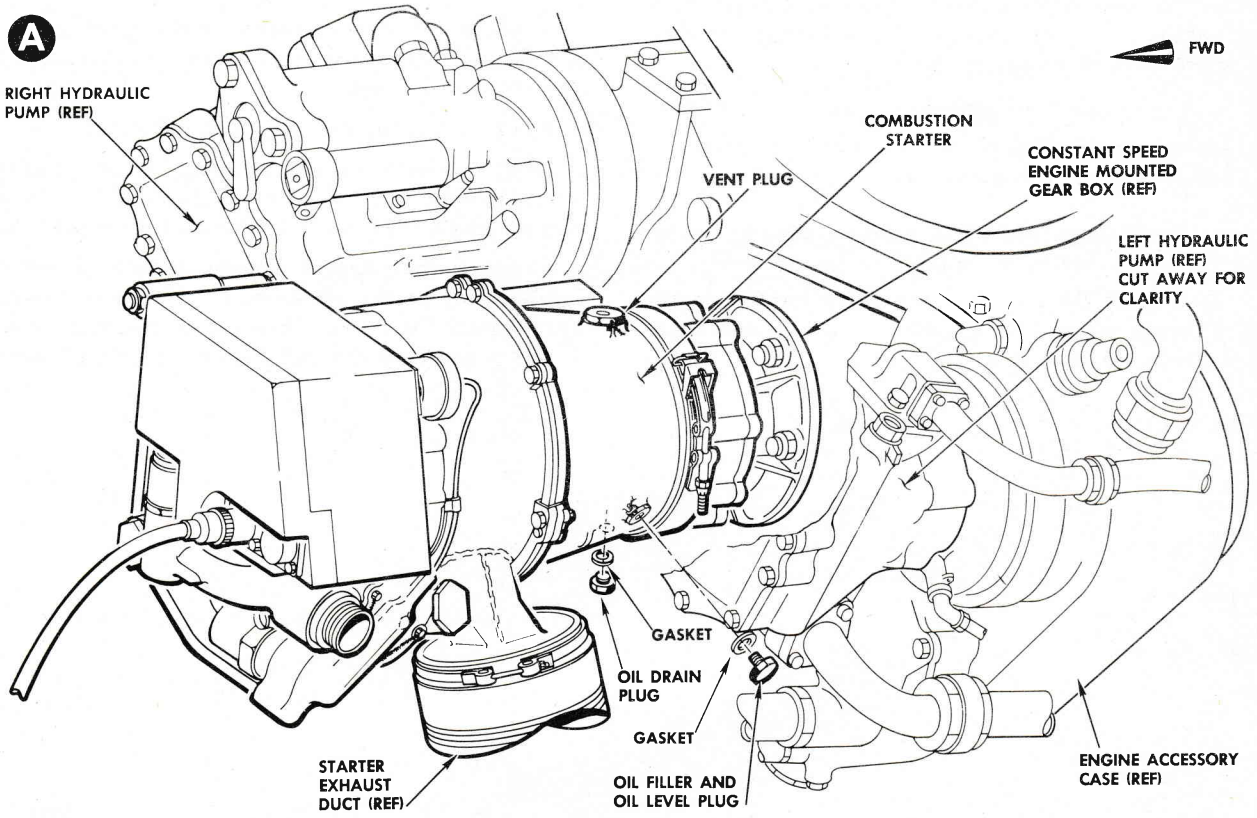
a. Installation of the combustion starter exhaust duct is essentially the reverse of the removal procedure.
b. Apply sealer, Stabond (C875), product of American Latex Corp., 3341 W. El Segundo Blvd., Hawthorne, California, between outboard flange of the duct and fuselage.

NOTE

STARTER ACCUMULATOR PUSH TO DRAIN VALVE IS *APPLICABLE AFTER INCORPORATION OF TCTO 1F-106-688.*

Figure 5-5. Replacement, Combustion Starter Exhaust Duct





COMBUSTION STARTER SERVICING

a. Open left hydraulic pump access door and accessory drive access door.
b. Remove oil filler plug.
c. Check for oil level at bottom of oil filler hole. Service as required with oil, Specification MIL-L-7808. Recheck in a few minutes and top-off if necessary.
d. Install filler plug using new gasket; close access doors.

NOTE

AFTER COMPLETION OF AN ENGINE REPLACEMENT OR REINSTALLATION, OR AFTER STARTER REPLACEMENT OR MAINTENANCE, BLEED ENTRAPPED AIR FROM THE STARTER FUEL SYSTEM.

.06.02.616C .12.03.00

Figure 5-6. Servicing, Combustion Starter

a. Open constant-speed drive unit access door.

NOTE

Check that fire extinguishers are provided before starting the procedure.

b. Pressurize airplane fuel supply system by actuating one fuel boost pump.

c. Open fuel bleed line at plugged tube at right side of starter.

d. Allow fuel to flow out tube into a container until a solid stream of fuel issues from the tube; cap tube.

e. Turn off boost pump and close access door.

f. *Applicable to all airplanes after incorporation of TCTO 1F-106-688.* Upon completion of combustion starter replacement, completion of maintenance on the starter where the fuel system has been opened, or when difficulty has been experienced in obtaining a combustion start on the preceding attempt, the following bleeding procedure shall be accomplished:

NOTE

Make sure that fire extinguishers are provided before starting this procedure.

1. Pressurize airplane fuel supply system by actuating one fuel boost pump.
2. Actuate the push-to-bleed valve located on the lower side of fuselage, forward of starter exhaust duct outlet.
3. Allow fuel to flow out of the push-to-bleed valve into a container until air is bled from the starter accumulator.
4. Turn off boost pump.

5-30. CLEANING AND TESTING, IGNITION SPARKIGNITERS.

a. Degrease the sparkigniter, using hot trichlorethylene solvent, Military Specification MIL-T-7003.

b. Clean the outer shell of the sparkigniter using a wire brush.

c. Using hot trichlorethylene solvent and a nonmetallic brush, remove deposits from the external surface of the firing end of the sparkigniter. Do not use abrasive cleaner.

NOTE

Cleaning of the recessed center electrode cavity is not recommended.

d. Clean the ceramic barrel of the sparkigniter with a soft cloth dampened in a cleaning naphtha, Federal Specification P-S-661.

e. Blow sparkigniter dry using air blast.

f. If necessary to aid cleaning, chase sparkigniter threads using a 1.000 inch -20 NS die for the barrel threads, and a 15/16 inch -16 NS die for the shell threads.

g. Check the exposed ceramic section of the sparkigniter. Any cracks are cause for rejection. Inspect the sparkigniter for erosion. Erosion of the center electrode is not to exceed 0.225 inch below the ceramic surface.

Section VI

LUBRICATION SYSTEM

Contents *Page*

DESCRIPTION

6-1. LUBRICATION SYSTEM.

The engine lubrication is provided by a hot tank type oil pressure system. The hot tank system increases altitude performance by providing better de-aeration of the oil, since air escapes more readily from hot oil. This is accomplished by routing oil, Military Specification MIL-L-7808, from the engine scavenge pumps, directly to the oil tank where de-aeration occurs. From the tank, the oil is gravity fed to an engine driven boost pump which forces the oil through the air-oil cooler, and in to the main oil pressure pump. This system provides a positive inlet pressure for the main pump under all operating conditions. The oil passes through the pump and is routed through the bypass equipped main oil strainer to the pressure distribution system. The oil is then routed through the engine bearings and accessory drive section where it is picked up by the scavenge pumps and returned to the oil tank. An integral breather pressurizing system regulates air pressure in the system to maintain proper oil flow at all altitudes. An engine oil low-pressure warning system is provided to warn the pilot of engine low oil pressure. For a schematic illustration of the engine lubrication system, see figure 6-1.

WARNING

Engine oil, Military Specification MIL-L-7808, is detrimental to paint and rubber materials. Spilled oil should be immediately wiped up. This oil has an irritating effect on human skin and prolonged contact should be avoided.

6-2. OIL BREATHER PRESSURIZING SYSTEM.

The oil breather pressurizing system is provided to insure proper oil flow, at altitude, from the main bearing oil jets. Pressurizing air is provided by air leakage through the compressor seal and into the inner case of the engine. The breather system connects all of the bearing compartments and oil tank by means of internal passages and external tubing on the right side of the engine. From the tubing, air enters the oil pump and accessory drive housing. In the accessory drive housing, the air is routed to the breather pressurizing valve. Pressurization is provided by action of the valve in retarding the free venting of the air in the system. At sea level pressure, the valve is open. The valve gradually closes with increasing altitude, and maintains a pressure sufficient to insure oil flow at the main bearing jets similar to that provided

at sea level. A spring-loaded blowoff valve acts as a pressure relief for the breather system, and will open to relieve excessive pressure in the event of pressurizing valve malfunctions.

6-3. ENGINE OIL TANK.

The engine oil tank is installed on the forward left-hand side of the engine compressor section. The tank, of 4½ gallons minimum usable capacity, is equipped with an internal oil de-aerator. The de-aerator removes entrained air from the oil as it is returned to the tank. The tank is equipped with a filler cap and attached dipstick which is accessible through a door in the upper left side of the fuselage. This door is secured by 12 quick-opening type fasteners. The oil tank scupper is equipped with an adapter to which an overboard drain line is attached.

6-4. OIL BOOST PUMP.

The oil boost pump is an engine driven gear-type pump installed in the lower section of the main oil pump housing. Oil is gravity fed from the oil tank to the boost pump. The pump is provided to force oil through the air-oil and fuel-oil coolers, and provides the main oil pump with a constant oil inlet pressure.

6-5. PRESSURE OIL PUMP.

The single-section gear-type pressure oil pump is located in the upper left-hand section of the oil pump and accessory drive housing. Oil enters the pump inlet by pressure flow from the oil boost pump. Pump discharge pressure is regulated by a pressure relief valve provided downstream of the pump and strainer. The pressure relief valve is set to maintain a normal operating pressure of 45 psi.

6-6. FUEL-OIL COOLER.

The fuel-oil cooler is a heat exchanger employing fuel as coolant for engine oil. The cooler is installed on the upper left side of the engine compressor case and operates in conjunction with the air-oil cooler in cooling engine oil. The cooler is equipped with a thermal relief-bypass valve, and two pressure-relief bypass valves. The pressure relief-bypass valve, on the oil side of the cooler, is set for a differential pressure of 40 psi. A similar valve on the fuel side of the cooler is set for 30 psi.

6-7. PRESSURE OIL STRAINER.

An oil strainer assembly, equipped with a bypass valve, is located on the lower right side of the oil pump and accessory drive housing. The strainer is provided to supply the engine lubricating system with a clean supply of oil. The valve permits the oil to bypass the strainer in the event the strainer becomes clogged. The strainer assembly consists of a series of screens in disc form, separated alternately by inlet and outlet spacers, assembled around a perforated tube.

6-8. OIL BREATHER PRESSURIZING VALVE.

The oil breather pressurizing valve is installed on the upper right side of engine accessory section. This assembly employs an aneroid valve and a pressure relief valve to regulate pressure in the engine bearing compartments. The aneroid valve is open at sea level and is fully closed at 6 to 9 inches Hg. The pressure relief valve is set to relieve system pressurization in excess of 5 psi.

6-9. ENGINE AIR-OIL COOLER.

The engine air-oil cooler is a fuselage mounted, aluminum fin-plate type cooler, using ram air from the engine air inlet duct as its cooling agent. The cooler is installed on the upper left side of the fuselage adjacent to the engine inlet guide vane assembly. The cooler is provided with a spring-loaded push-to-drain assembly. Access to the drain is gained through the left main wheel well. Cooling air, which has passed through the cooler, is discharged into the engine accessory compartment as a cooling aid for that area. Refer to Section IV of this manual for complete information regarding air flow control. Cooling air for the cooler is controlled by the air-oil cooler air inlet valve. A fuel temperature sensing probe, located in the main fuel line at the inlet of the fuel pressurizing and dump valve, transmits fuel temperatures to the fuel temperature control box in the left main wheel well. The fuel temperature control box provides the engine air-oil cooler air valve with an opening signal at 107.2°C (225°F) and a closing signal at 101.7°C (215°F). The fuel temperature sensing system thereby restricts engine air-oil cooler action until the engine fuel-oil cooler function becomes insufficient. On airplanes with J75-P17 engine (S/N 610494 and subsequent) installed, an engine oil pressure reduction orifice plate must be installed at the oil "OUT" elbow connection on the engine air-oil cooler. Engine air-oil coolers on airplanes with J75-P17 engines (S/N 610493 and prior), do not require installation of the oil pressure reduction orifice plate. Refer to Replacement, Oil Pressure Reduction Orifice Plate in this section for pertinent installation instructions.

6-10. OIL LOW-PRESSURE WARNING SYSTEM.

The oil low-pressure warning system is provided to give the pilot an indication of low engine oil pressure. The system consists of a warning light located on the cockpit master warning panel, and a pressure switch located on the engine accessory section oil pressure port. The oil low-pressure warning switch is set to extinguish the warning light on an increasing pressure of 40 psi maximum and to illuminate the light on a decreasing pressure of 37 (±2) psi. This provides a warning of undesirable oil pressure. The switch is vented to the accessory case cavity by a tube to permit sensing of differential pressure between oil and engine internal pressure. The system is protected electrically by a 5 amp fuse located on the main wheel well fuse panel.

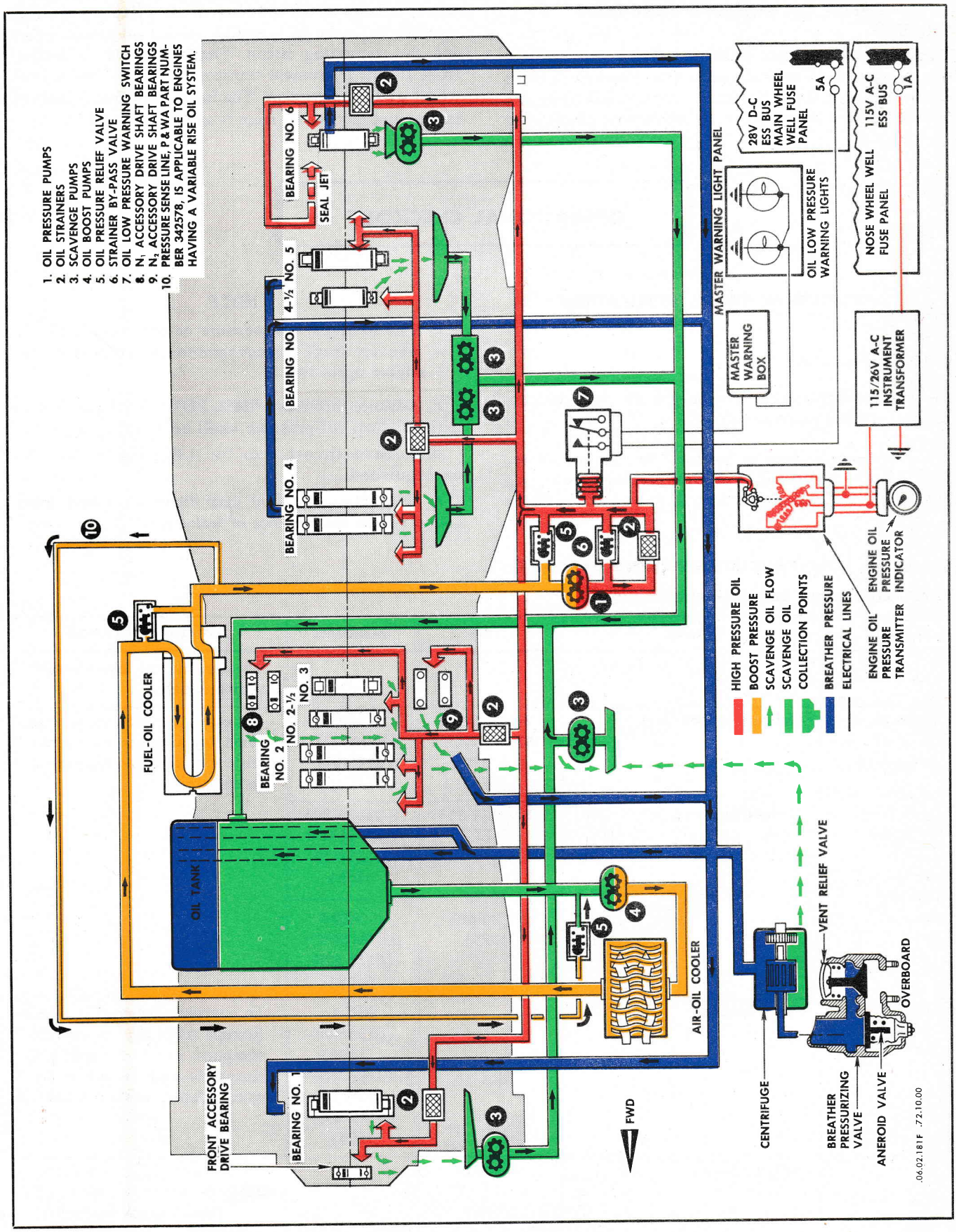


Figure 6-1. Engine Lubrication System, Schematic

6-11. ENGINE OIL PRESSURE INDICATING SYSTEM.

The engine oil pressure indicating system consists of a single indicator on the main instrument panel *for F-106A airplanes. On F-106B airplanes,* separate indicators are installed on the forward and aft instrument panels. The system consists of the indicator in the cockpit, a pressure transmitter on the N_2 accessory section oil pressure port and the connecting circuit. Electrical power is derived from 26-volt irstrument transformer located in the nose wheel well compartment. The instrument face is marked in 5 pound increments from 0 to 100 psi.

OPERATIONAL CHECKOUT

6-12. OPERATIONAL CHECK, LUBRICATION SYSTEM.

6-13. Procedure.

a. Prepare airplane for engine ground run; refer to Section I for this procedure.

b. Start engine; refer to Section I for this procedure. With throttle at "IDLE," oil low-pressure warning light shall be extinguished. Oil pressure will be 45 (±5) psi.

NOTE

A 40 to 50 psi oil pressure on the cockpit oil pressure gage is acceptable for continuous engine operation.

c. Advance throttle to "MIL POWER"; light shall be extinguished. Oil pressure shall be 45 (±5) psi.

d. Return throttle to "IDLE"; light shall be extinguished.

e. Shut off engine; light shall illuminate. Check lubrication system for evidence of leakage.

6-14. OIL LOW-PRESSURE WARNING SYSTEM TEST.

6-15. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
	Two Position Test Switch.			To simulate oil low-pressure switch action.
Refer to T.O. 1F-106A-2-10	Generator Set (Gas).	8-96026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF-ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-628-6468)	
	Generator Set.		MC-1 (6125-500-1190)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
			MD-3 (6115-635-5595)	
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.

6-16. Procedure.

a. Remove oil low-pressure warning fuse from main wheel well fuse panel.

b. Gain access to oil low-pressure warning switch through the engine accessory compartment access door.

c. Slide outer sleeve from oil low-pressure warning switch permanent splice connectors and connect test switch to the two splice connectors.

d. Install oil low-pressure warning fuse in main wheel well fuse panel. Install master warning control fuse in cockpit right fuse panel. Connect external 28-volt dc electrical power to airplane receptacle.

e. Actuate test switch to "ON"; master warning light and oil low-pressure warning light shall illuminate.

f. Momentarily actuate "WARN LIGHT TEST" switch to "RESET"; master warning light shall extinguish. Oil low-pressure warning light shall remain illuminated.

g. Actuate test switch to "OFF"; oil low-pressure warning light shall extinguish.

h. Remove test switch from splice connectors. Position and secure outer sleeve over permanent splice connectors.

6-17. ENGINE OIL PRESSURE INDICATING SYSTEM TEST.

For testing of the engine oil pressure indicating system, refer to paragraph 1-23. The indicating system is checked during engine operation.

SYSTEM ANALYSIS

6-18. SYSTEM ANALYSIS. LUBRICATION SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
EXCESSIVE OIL IN TANK.		
Internal leak in fuel-oil cooler. Fuel entering oil system.	Remove cooler for test.	Install replacement item.
OIL FOUND BLACK IN COLOR OR CONTAINING CARBON PARTICLES.		
Carbon seals in engine deteriorating.	Check oil filters for evidence of carbon particles.	Replace component having suspected carbon seal deterioration.
LOW OIL PRESSURE INDICATION.		
Oil tank empty.	Check oil level.	
Oil breather pressurizing valve not closing at altitude.	Remove valve for bench test.	Install replacement item.
Oil low-pressure warning light malfunctioning.	Remove switch for bench test.	
OIL LOW-PRESSURE WARNING LIGHT FLUCTUATING OFF AND ON.		
Loose connection in electrical circuit.	Check circuit for condition and security of attachment of components.	
Low-pressure warning light switch malfunctioning.	Remove switch for bench test.	Install replacement item.
Oil pressure fluctuating.	Check oil level in tank.	

6-18. SYSTEM ANALYSIS, LUBRICATION SYSTEM (CONT).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
OIL LOW-PRESSURE WARNING LIGHT FLUCTUATING OFF AND ON (CONT).		
Oil pressure fluctuating (cont).	Check engine oil strainer for metal particles indicating engine failure. **NOTE** If fluctuation occurs only at altitude, check oil breather pressurizing valve.	
	Remove oil pressure indicator and transmitter for bench test.	Install replacement item.

REPLACEMENT

6-19. REPLACEMENT, ELECTRICAL COMPONENTS GENERAL.

When removing components equipped with pigtail electrical leads, always cut leads at existing splices. This is necessary to preserve the component lead identity and to provide sufficient length for reinstallation.

6-20. REMOVAL, ENGINE OIL TANK.

a. Remove engine from airplane. Refer to Section I for this procedure.

b. Drain oil tank by opening tank drain valve. Drainage may be facilitated by removing oil tank filler cap (see figure 6-4).

c. Disconnect lines from tank.

d. Disconnect tank attachment straps; remove tank.

e. Cover all lines and openings with plugs or polyethylene sheet.

6-21. INSTALLATION, ENGINE OIL TANK.

a. Install the engine oil tank in essentially the reverse of the removal procedure.

b. Check that tank support bracket cushions maintain proper positioning during installation.

c. Fill oil tank, see figure 6-4 for procedure. Conduct lubrication system leak check at first engine run.

6-22. REPLACEMENT, FUEL-OIL COOLER.

For the fuel-oil cooler replacement procedure, refer to paragraph 2-23.

6-23. REPLACEMENT, ENGINE AIR-OIL COOLER.

For removal and installation of the air-oil cooler, see figure 6-2.

6-24. REMOVAL, ENGINE BREATHER PRESSURIZING VALVE.

a. Gain access to the engine oil breather pressurizing valve through the engine accessory compartment access door.

b. Remove lines attached to pressurizing valve.

c. Remove bolts (4); remove pressurizing valve.

d. Remove pressurizing valve ferrule from the engine accessory case port, and retain for new installation. Cover openings with plugs or polyethylene sheet.

6-25. INSTALLATION, ENGINE BREATHER PRESSURIZING VALVE.

a. Install the engine breather pressurizing valve in essentially the reverse of the valve removal procedure. Use new seals.

b. Conduct lubrication system leak check at first engine run.

6-26. REPLACEMENT, ENGINE OIL LOW-PRESSURE WARNING SWITCH AND TRANSMITTER.

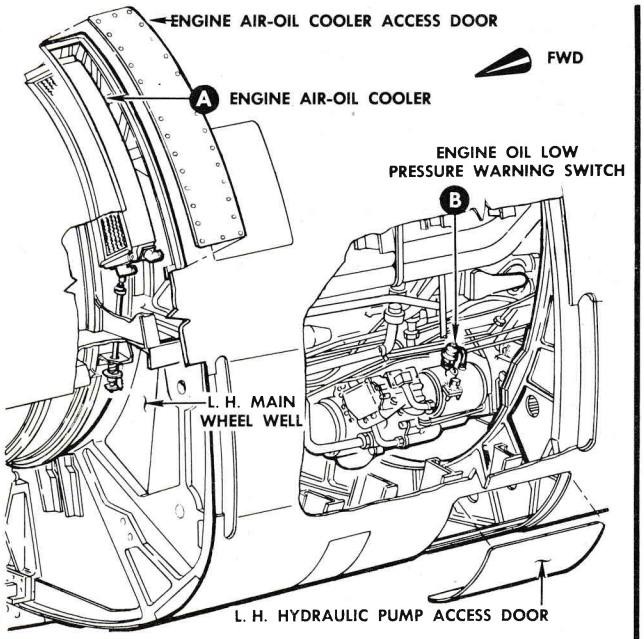
For removal and installation of the oil low-pressure warning switch and transmitter, see figure 6-2.

6-27. REPLACEMENT, MAIN FUEL CONTROL DRIVE SHAFT GEAR OIL SEAL.

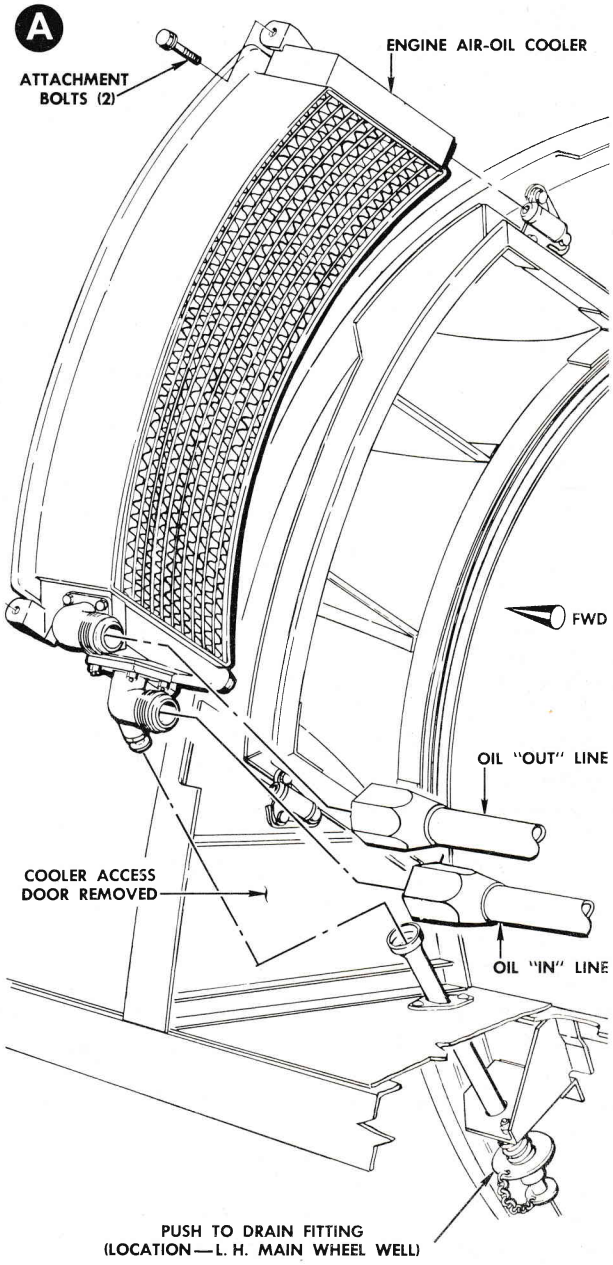
a. Drain oil from engine N_2 accessory case. Refer to paragraph 6-39 for this procedure.

b. Remove main fuel control unit. Refer to paragraph 2-17 for this procedure.

c. Remove fuel control shaft seal housing using puller, P & W A tool No. 10008.



LOCATION—ENGINE OIL SYSTEM COMPONENTS



ENGINE AIR-OIL COOLER, REMOVAL

a. Drain cooler at push-to-drain fitting in LH main wheel well.
b. Open cooler access door on upper LH side of fuselage.
c. Disconnect cooler oil lines (2).
d. Remove cooler attachment bolts (2); slide cooler out of fuselage. Cover line openings.

INSTALLATION.

a. Installation of the air-oil cooler is essentially the reverse of removal.

NOTE

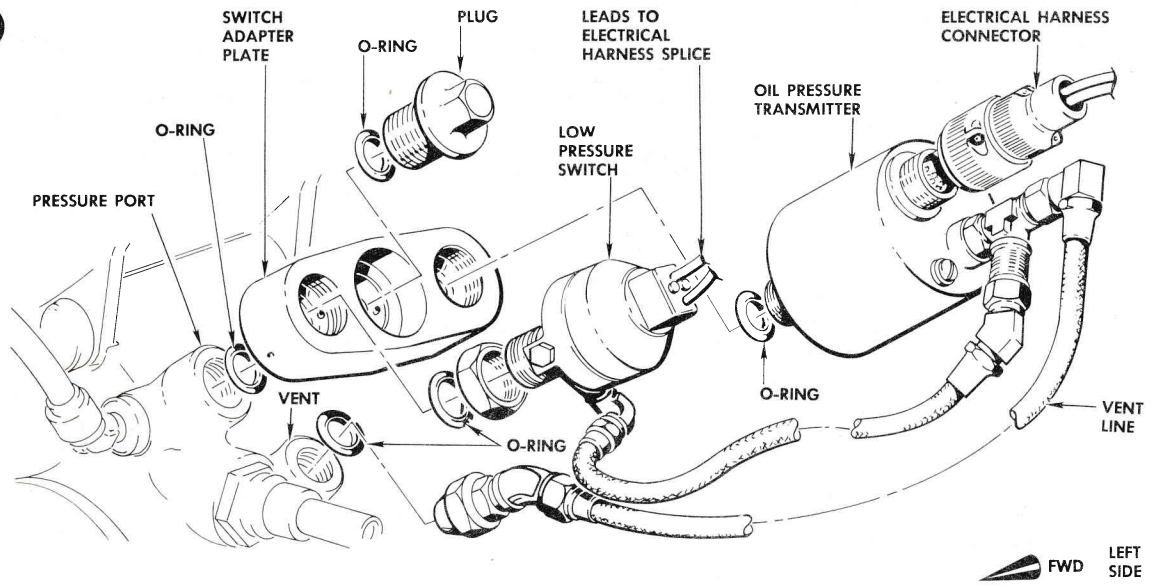
WHEN INSTALLING REPLACEMENT AIR-OIL COOLER IN AIRPLANE HAVING AN ENGINE EQUIPPED WITH A CONSTANT RISE OIL PRESSURE SYSTEM, AN ENGINE OIL PRESSURE REDUCTION ORIFICE PLATE, PART NO. 8-27544-27, MUST BE INSTALLED AT THE AIR-OIL COOLER OIL "OUT" LINE ELBOW. J75-P17 ENGINES, S/N 610494 AND SUBSEQUENT (WITH MAIN OIL PUMP P&WA PART NO. 384830), HAVE THE CONSTANT RISE OIL PRESSURE SYSTEM. AIRPLANES HAVING J75-P17 ENGINES, S/N 610493 AND PRIOR, INSTALLED, DO NOT REQUIRE THE ORIFICE PLATE INSTALLATION. REFER TO REPLACEMENT, ENGINE OIL PRESSURE REDUCTION ORIFICE PLATE, IN THIS SECTION.

COOLER-TO-DUCT SEAL STRIPS ARE ATTACHED, USING SEALER A-4000, MANUFACTURED BY DOW-CORNING CORP., MIDLAND, MICHIGAN.

b. Safety-wire elbow and drain valve.
c. Visually check installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

.06.02.280-1C .72-11-00

Figure 6-2. Replacement, Engine Lubrication System Components (Sheet 1 of 2)



ENGINE OIL PRESSURE SWITCH AND TRANSMITTER, REMOVAL

a. Open LH hydraulic pump access door.
b. Remove oil low pressure warning system fuse located on the main wheel well fuse panel. Remove electrical leads from the switch and transmitter.
c. Provide container for oil drainage.
d. Remove lines attached to switch and transmitter.
e. Remove plug securing switch adapter plate to pressure port and remove switch and transmitter assembly from engine.
f. Loosen switch to adapter plate retaining nut and remove switch from plate. Remove transmitter from plate.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Use new O-rings and safety wire at installation.
c. Visually check installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

.06.02.280-2B

Figure 6-2. Replacement, Engine Lubrication System Components (Sheet 2 of 2)

d. Remove oil seal from housing using drift, P & W A tool No. 10017.

e. Place seal housing on base, P & W A tool No. 10018.

f. Drift new seal into seal housing.

g. Insert guide in splined end of shaftgear.

h. Install seal housing and new O-ring seal over end of guide.

i. Secure with 4 screws and safety-wire.

j. Reinstall fuel control unit.

k. Service engine oil tank. Refer to paragraph 6-39 for this procedure.

l. Visually check fuel control installation for fuel leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

6-28. REPLACEMENT, ENGINE FUEL PUMP DRIVE SHAFTGEAR OIL SEAL.

a. Drain oil from engine N_2 accessory case. Refer to paragraph 6-39 for this procedure.

b. Remove engine fuel pump.

c. Remove fuel pump shaft seal housing using P & W A tool No. 10008.

d. Remove oil seal from housing using drift, P & W A tool No. 10017.

e. Place seal housing on base, P & W A tool No. 10018.

f. Drift new seal into housing.

g. Place guide in splined end of shaftgear.

h. Install seal housing and new O-ring seal over end of guide.

i. Secure with 4 screws and safety-wire.

j. Reinstall fuel pump.

k. Service engine oil tank. Refer to paragraph 6-39 for this procedure.

l. Visually check fuel pump installation for fuel leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

6-29. REPLACEMENT, ENGINE STARTER DRIVE SHAFTGEAR OIL SEAL.

a. Drain oil from engine N_2 accessory case. Refer to paragraph 6-39 for this procedure.

b. Remove starter and constant-speed drive engine mounted gearbox.

c. Remove snapring securing shaftgear oil seal housing in accessory section.

d. Remove starter shaftgear seal housing from accessory section using puller, P & W A tool No. 10008.

e. Remove oil seal from seal housing using drift, P & W A tool No. 10228.

f. Install new seal in seal housing using drift, P & W A tool No. 10226.

g. Install seal housing and new O-ring seal over end of shaftgear. Secure seal housing with snapring.

h. Service engine oil tank. Refer to paragraph 6-39 for this procedure.

i. Perform engine start procedure and visually check combustion starter installation for fuel leakage during first engine ground run idle rpm. Refer to Section I for engine start and ground run procedures.

6-30. REPLACEMENT, HYDRAULIC PUMP DRIVE SHAFTGEAR OIL SEAL.

a. Drain oil from engine N_2 accessory section.

b. Remove hydraulic pump from N_2 accessory section. Refer to T.O. 1F-106A-2-3 for this procedure.

c. Remove hydraulic pump shaftgear oil seal housing using puller, P & W A tool No. 10008.

d. Remove seal from housing using drift, P & W A tool No. 10228.

e. Install new seal in housing using drift, P & W A tool No. 6676.

f. Install seal housing and new O-ring seal over end of shaftgear. Secure with 4 screws and safety-wire.

g. Install hydraulic pump. Refer to T. O. 1F-106A-2-3 for this procedure.

h. Service engine oil tank. Refer to paragraph 6-39 for this procedure.

i. Bleed hydraulic system. Refer to T. O. 1F-106A-2-3 for this procedure.

j. Visually check installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

6-31. REPLACEMENT, ENGINE COMPRESSOR BLEED VALVE GOVERNOR DRIVE SHAFTGEAR OIL SEAL (N_1 ACCESSORY SECTION).

a. Remove bleed governor from N_1 accessory section.

b. Remove governor shaftgear oil seal housing from accessory section using puller, P & W A tool No. 7146.

c. Remove oil seal from housing using drift, P & W A tool No. 10375.

d. Position seal housing on base, P & W A tool No. 10376 and install new seal in housing using drift.

CAUTION

When the oil seal is positioned on the drift, be sure the exposed spring side of the seal enters the seal housing first.

e. Insert guide, P & W A tool No. 10016, in end of shaftgear. Install seal housing and new O-ring seal over end of shaftgear.

f. Install bleed governor.

g. Perform system operational checkout if system is activated. It will be necessary to check the engine historical record for each engine to determine the operational status of the system.

6-32. Replacement, N_2 Tachometer Drive Shaft Oil Seal.

a. Remove electrical lead from tachometer generator.

b. Remove generator from N_2 accessory section.

c. Remove seal housing from N_2 accessory section.

d. Remove old seal from housing using drift, P&WA tool No. 10035.

e. Position new seal on pilot of drift so that exposed spring side of seal will enter seal housing first.

f. Place seal housing on base, P&WA tool No. 10034 and press new seal into housing.

g. Insert guide, P&WA tool No. 10016 in end of shaftgear.

h. Install seal housing and new gasket over end of shaftgear.

i. Install tachometer generator or accessory case.

j. Install electrical lead on generator.

k. Perform system operational checkout and visually check tachometer installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

6-33. REMOVAL, ENGINE OIL PUMP.

a. Drain oil from engine oil tank.

b. Gain access to the engine oil pump through the engine accessory compartment left access door.

NOTE

A suitable container shall be placed under main oil pump to catch residual oil when disconnecting tubes from pump and removing pump from gearbox.

c. Disconnect tubes attached to the main oil pump.

NOTE

The presence of a pressure sense tube, P&WA part No. 342578, identifies engines that have a variable rise oil system. The main oil pump for this system will have one of the following P&WA part No. 331946, 334716 or 339642. Engines that do not have the sense tube have a constant rise oil system. The main oil pump for this system is P&WA part No. 384830. It is preferable that a pump be replaced by one of the same configuration. If it is necessary to use part No. 384830 for any of the variable rise system pumps the sense tube must be capped. If it is necessary to use a variable rise pump in place of part No. 384830, the sense tube port on the pump must be uncapped and a sense line installed.

d. Remove oil pump retaining nuts and position the puller, P&WA tool No. 10322, so that the fixed jaws engage the lugs on the pump body. Engage and secure the adjustable jaw to the pump body. Use the knocker action to remove the pump.

e. Remove and discard all seals. Cover openings with plugs or polyethylene sheet.

6-34. INSTALLATION, ENGINE OIL PUMP.

a. Place two new seals in the grooves in the pump housing bore and a new seal in the groove of the pump mounting pad. Coat the pump shaft and mating spline with grease, Military Specification MIL-G-3545, prior to installation.

b. Install the pump into the gearbox and secure with the washers and locknuts.

c. Using new seals, connect the tubes to the main oil pump.

d. Service the engine oil tank.

e. Conduct engine ground run check procedure. Check lubrication system for leaks.

6-35. REPLACEMENT, ENGINE OIL PRESSURE REDUCTION ORIFICE PLATE.

For removal and installation of the engine oil pressure reduction orifice plate, see figure 6-3.

ADJUSTMENT

6-36. ADJUSTMENT, ENGINE OIL PRESSURE.

Access to the engine oil pressure adjustment (oil pressure relief valve) is gained through the engine accessory compartment left access door. The valve is located on the left side of the engine N_2 accessory drive housing, aft of the left hydraulic pump. Adjust engine oil pressure as follows:

a. Remove cap from adjustment screw.

b. Using slot type screw driver, hold adjustment screw and loosen locknut.

c. Turn adjustment screw clockwise to increase oil pressure or counterclockwise to decrease oil pressure. Adjust oil pressure to 45 (+5, −0) psi with the engine operating at idle. Tighten locknut holding adjustment screw with slot type screw driver.

d. Check oil pressure with engine operating at military power. Pressure shall be 45 (+5, −0) psi.

e. Install cap on adjustment screw.

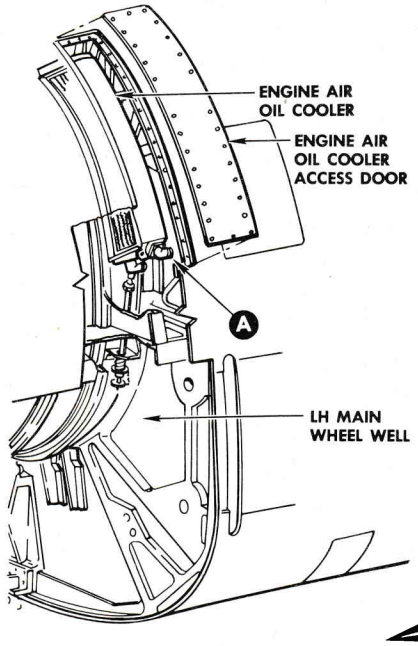
SERVICING

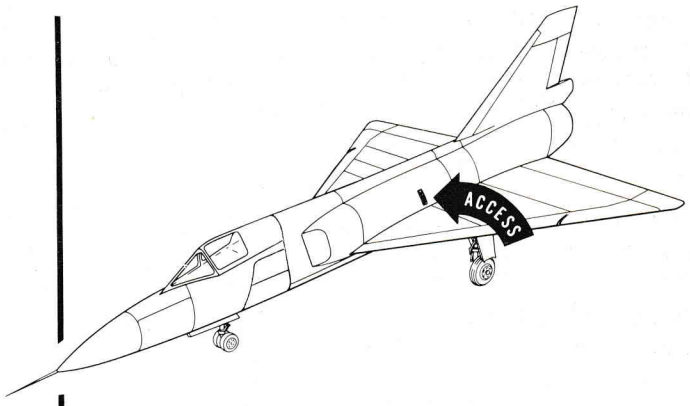
6-37. PRESERVATION, ENGINE OIL SYSTEM.

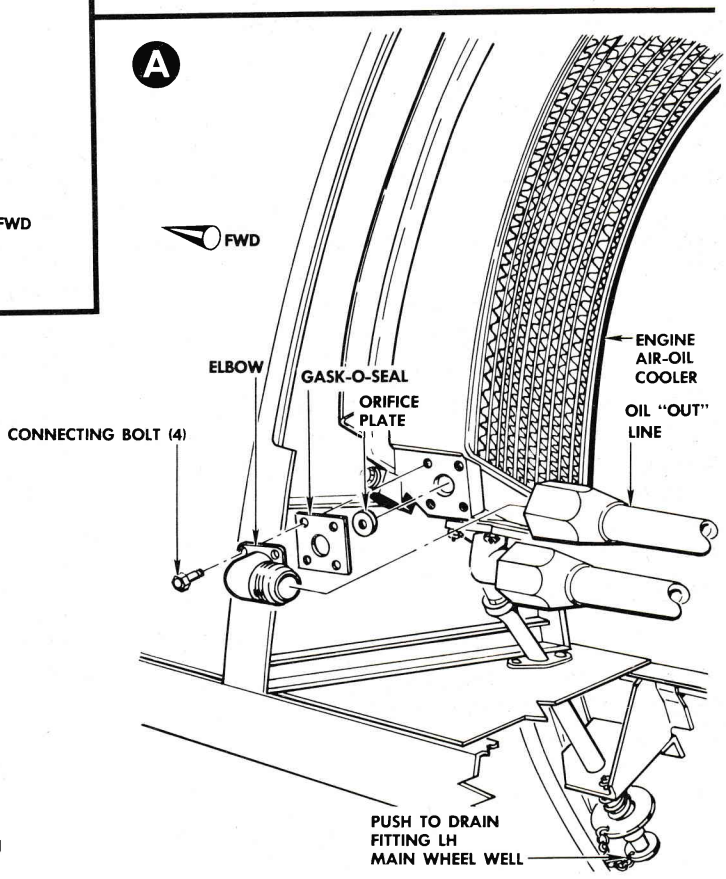
For preservation information for the engine oil system, refer to Servicing in Section I.

6-38. DEPRESERVATION, ENGINE OIL SYSTEM.

For depreservation information for the engine oil system, refer to Servicing in Section I.







ENGINE OIL PRESSURE REDUCTION ORIFICE, PLATE REMOVAL.

NOTE

THE ENGINE OIL PRESSURE REDUCTION ORIFICE PLATE, PART NO. 8-27544-27 (WITH GASK-O-SEAL PART NO. 8-27544-19), MUST BE INSTALLED ON ALL AIRPLANES HAVING AN ENGINE EQUIPPED WITH A CONSTANT RISE OIL PRESSURE SYSTEM. J75-P17 ENGINES, S/N 610494 AND SUBSEQUENT, WITH MAIN OIL PUMP P & WA PART NO. 384830, HAVE THE CONSTANT RISE OIL PRESSURE SYSTEM.

a. Drain engine air-oil cooler at push-to-drain fitting in LH main wheel well.
b. Open engine air-oil cooler access door on upper LH side of the fuselage.
c. Disconnect oil "OUT" line from the elbow on cooler.
d. Remove bolts (4) securing elbow to cooler; then remove elbow, gask-O-seal, and orifice plate from the cooler. Cover line openings.

INSTALLATION

a. Installation of the engine oil pressure reduction orifice is essentially the reverse of removal.
b. Use new gask-O-seal, Part No. 8-27544-19, when installing the orifice plate, Part No. 8-27544-27.
c. Safety-wire bolts and line connection.
d. Visually check installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

.06.02.1083

Figure 6-3. Replacement, Engine Oil Pressure Reduction Orifice Plate

6-39. DRAINING AND SERVICING.

The engine lubrication system shall be drained and serviced at specified periods. See figure 6-4 for an illustration of the lubrication system servicing. The following procedure is recommended:

a. Drain oil tank through drain valve at bottom of tank.

b. Drain air-oil cooler at push-to-drain fitting in left main wheel well by removing fitting cap, then depressing fitting.

c. Remove N_2 accessory section drain plugs. Drain oil from fuel-oil cooler.

NOTE

Engine oil found black in color or containing particles of carbon does not indicate high temperature breakdown of the oil. When this condition is found, look for other sources of contamination. Engine oil, Military Specification MIL-L-7808 is not a hydro-carbon but a synthetic oil usually having a silicone base.

d. Replace all plugs, and safety-wire; close oil tank drain valve.

CAUTION

When installing engine oil drain plug in the N_2 accessory drive gear box, torque plug to maximum of 75 to 100 inch-pounds to prevent stripping of gear box threads.

e. Service oil tank to full mark on dip stick with oil, Military Specification MIL-L-7808.

NOTE

Oil tank filler cap must be properly installed before oil filler door in fuselage can be installed and secured.

f. Prepare engine and airplane for engine run.

g. Start engine, and run until oil temperature is high enough to circulate oil through fuel-oil cooler.

CAUTION

Watch closely for oil low warning indication, and for leaks at strainer and drain points.

h. Stop engine, and service tank to full mark on dip stick. Check system for oil leaks.

6-40. CHECKING OF ENGINE OIL LEVEL.

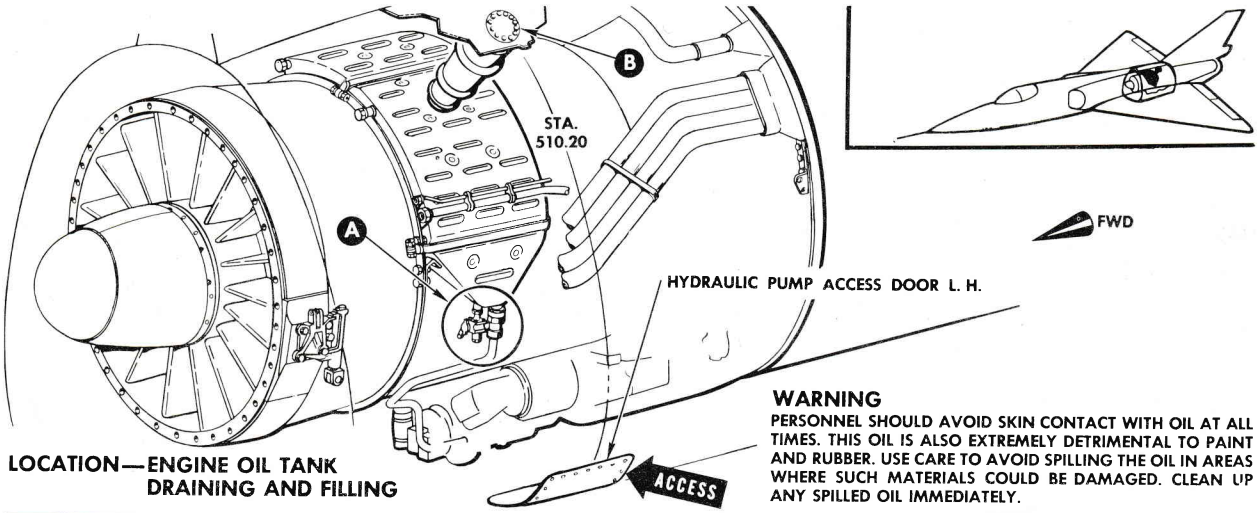
When the engine oil level is to be checked, it should be done immediately after engine shutdown after a flight, or engine ground run. If the oil level is to be checked after an extended shutdown period, the engine shall be run at least 2 minutes prior to checking the oil level. These precautions must be taken since the oil will drain into the engine bearings and sump when the engine is not running. This accumulation of oil, in the low points of the system, will overfill the tank if oil is added and the engine is then started. This will result in the excess oil being discharged overboard through the oil breather-pressurizing valve vent. See figure 6-4 for the oil tank servicing procedure.

6-41. CLEANING, ENGINE OIL STRAINER.

For removal and cleaning of the engine oil strainer, see figure 6-5.

6-42. CLEANING, ENGINE NO. 6 BEARING OIL STRAINERS.

For removal and cleaning of the engine No. 6 bearing oil strainers, see figure 6-6.



LOCATION—ENGINE OIL TANK DRAINING AND FILLING

WARNING

PERSONNEL SHOULD AVOID SKIN CONTACT WITH OIL AT ALL TIMES. THIS OIL IS ALSO EXTREMELY DETRIMENTAL TO PAINT AND RUBBER. USE CARE TO AVOID SPILLING THE OIL IN AREAS WHERE SUCH MATERIALS COULD BE DAMAGED. CLEAN UP ANY SPILLED OIL IMMEDIATELY.

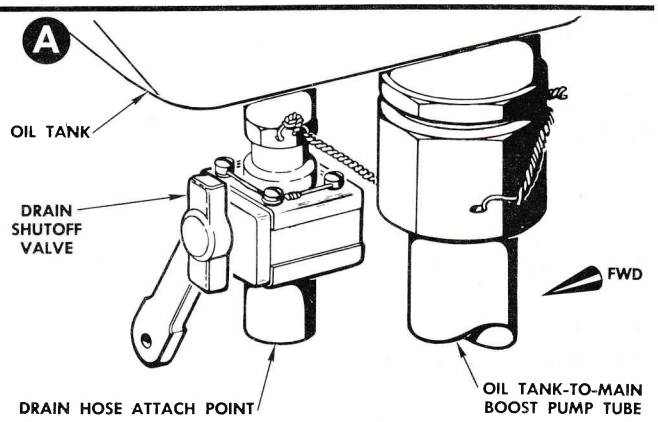
DRAINING OIL TANK

a. Open hydraulic pump access door on left side of fuselage.

NOTE

DRAIN TANK IMMEDIATELY AFTER ENGINE SHUTDOWN. IF TANK IS TO BE DRAINED AFTER EXTENDED ENGINE SHUTDOWN PERIOD, RUN ENGINE TWO MINUTES PRIOR TO DRAINING, TO PUMP RESIDUAL OIL OUT OF THE ACCESSORY CASE.

b. Attach a drain hose to tank drain valve.
c. Place a container under drain hose.
d. Open drain shutoff valve and drain tank.
e. When draining is completed, close drain shutoff valve and remove drain hose; install door.

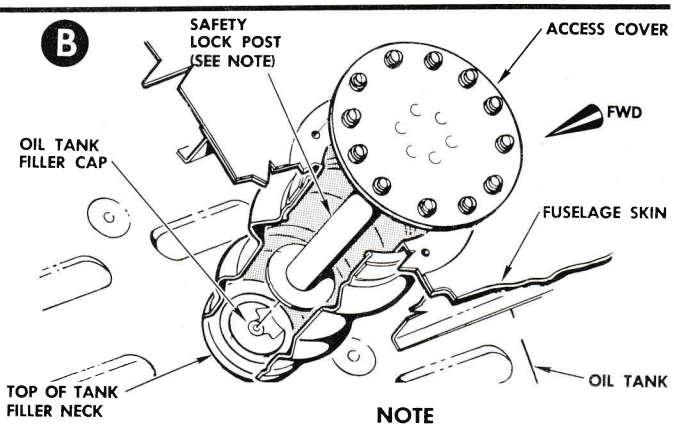


FILLING OIL TANK

NOTE

THE OIL TANK SHOULD BE CHECKED AND FILLED WITHIN 15 MINUTES AFTER ENGINE SHUTDOWN, AS OIL WILL DRAIN FROM THE TANK INTO THE ACCESSORY GEAR CASE IN SUFFICIENT QUANTITIES TO PREVENT AN ACCURATE QUANTITY CHECK. IF ENGINE HAS NOT BEEN OPERATED, CHECK OIL QUANTITY AND REPLENISH AS NECESSARY AFTER FIRST ENGINE RUN-UP AND PRIOR TO FLIGHT.

a. Place protective mat on wing during servicing of oil tank.
b. Open access cover on top left side of fuselage and remove filler cap.
c. Fill tank with oil, Specification MIL-L-7808, until oil level is 2 inches below top of tank filler neck.
d. Replace tank cap and install the fuselage access cover. If the access cover will not fit flush with the fuselage the tank cap is not secured.

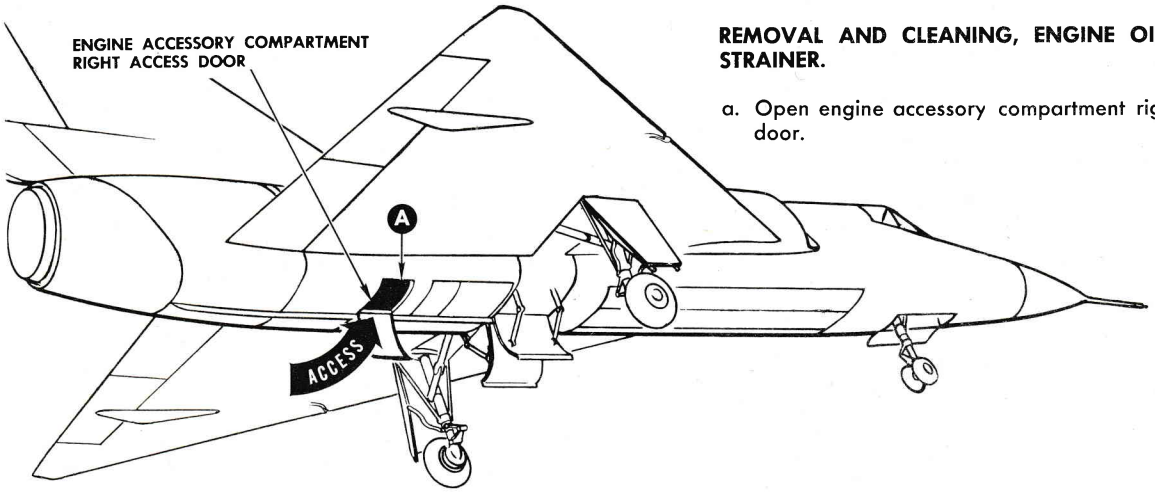


NOTE

THE SAFETY LOCK POST CONFIGURATION OF THE ACCESS COVER IS *APPLICABLE TO F-106A AIRPLANES 56-453, 56-454, 56-456 THRU 57-245, 58-759 AND SUBSEQUENT; AND 57-246 THRU 57-2506 AFTER INCORPORATION OF TCTO 1F-106-706. APPLICABLE TO F-106B AIRPLANES 57-2508 THRU 57-2515, 57-2532 AND SUBSEQUENT; AND 57-2516 THRU 57-2531 AFTER INCORPORATION OF TCTO 1F-106-706.*

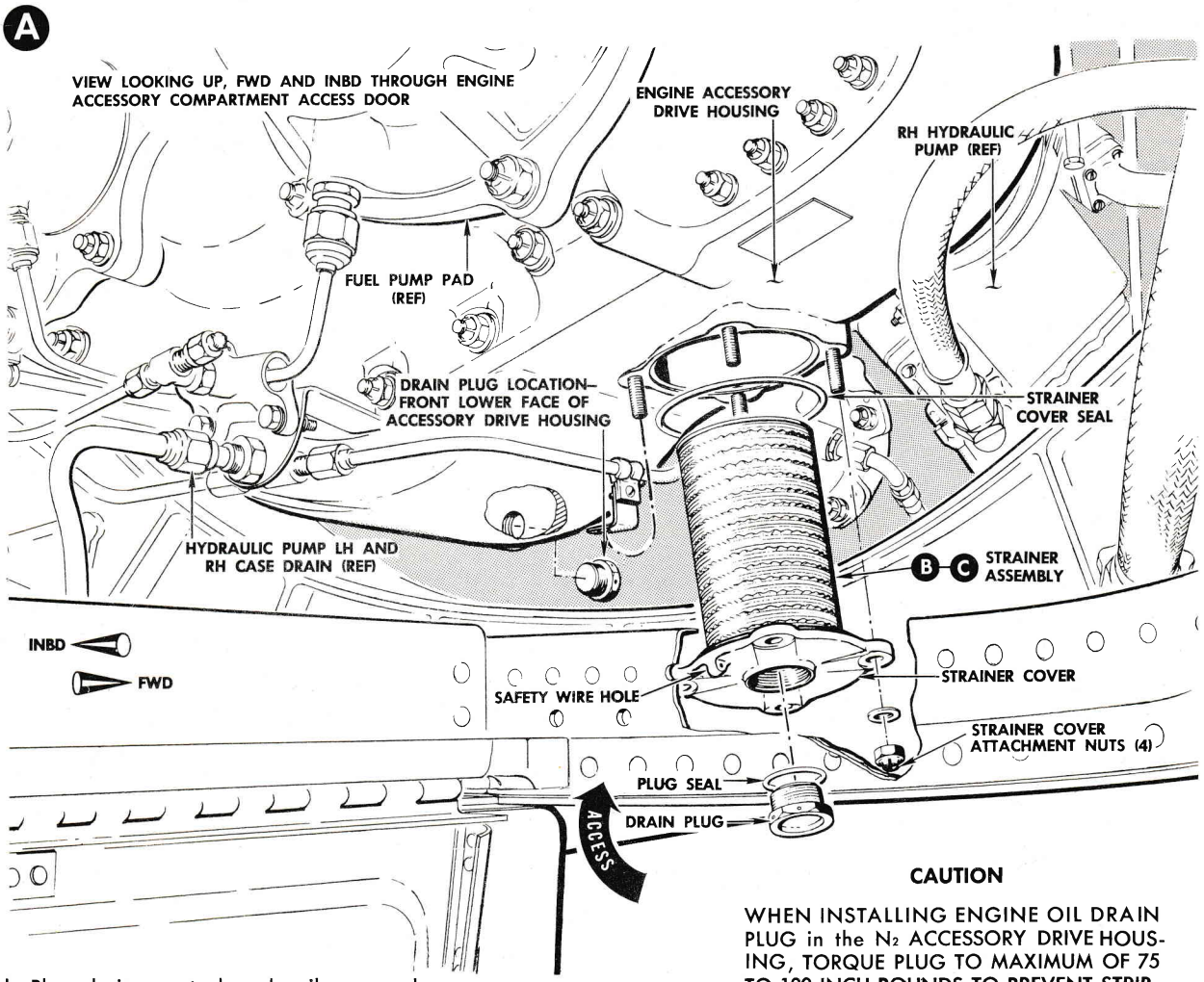
.06.02.283 H

Figure 6-4. Draining and Servicing, Engine Lubrication System



REMOVAL AND CLEANING, ENGINE OIL STRAINER.

a. Open engine accessory compartment right access door.



b. Place drain receptacle under oil pump and accessory drive housing. Remove drain plug from front face of housing and from oil strainer cover; drain oil. Install drain plug in accessory housing and safety-wire.

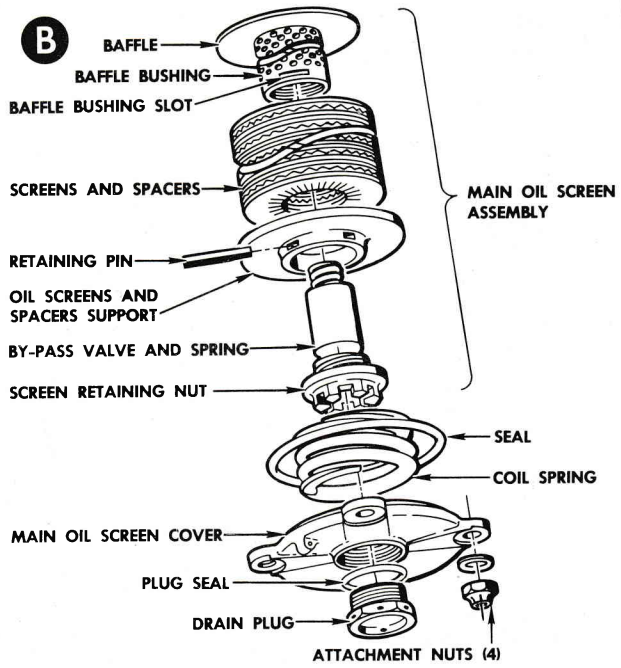
.06.02.463-1B .72.13.00

CAUTION

WHEN INSTALLING ENGINE OIL DRAIN PLUG in the N_2 ACCESSORY DRIVE HOUSING, TORQUE PLUG TO MAXIMUM OF 75 TO 100 INCH-POUNDS TO PREVENT STRIPPING OF HOUSING THREADS.

c. Remove strainer attachment nuts (4); remove strainer assembly. Discard strainer cover seal.

Figure 6-5. Cleaning, Engine Oil Strainer (Sheet 1 of 2)

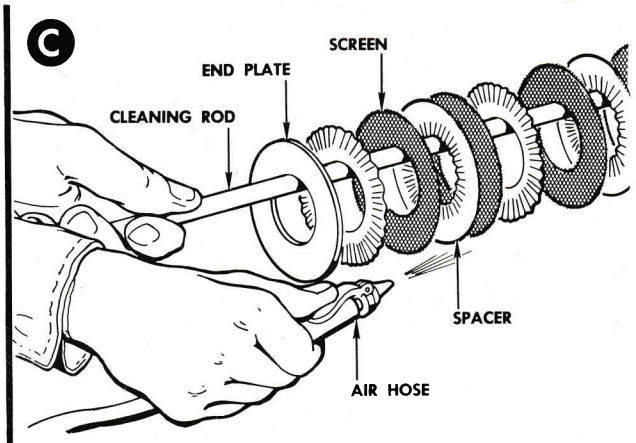


d. Holding the screen assembly compressed, remove retaining pin and screen retaining nut.

CAUTION

SCREEN ASSEMBLY MUST BE CAREFULLY HELD TOGETHER DURING THIS PROCEDURE TO PREVENT STRAINER SCREENS AND SPACERS FROM FLYING APART.

e. Remove bypass valve and spring. Remove strainer baffle.



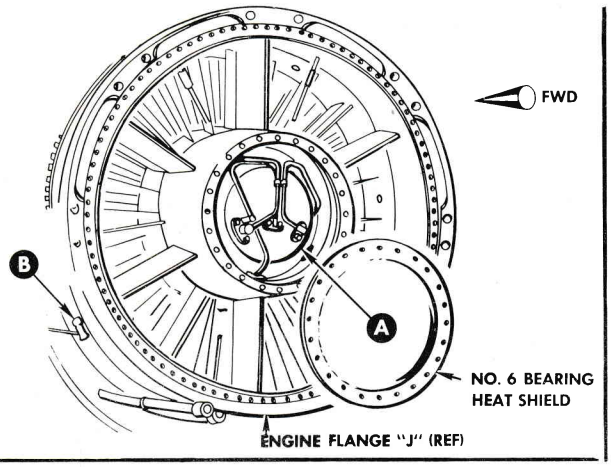
f. Slide screens and spacers on a rod, keeping them in their proper assembly order.
g. Separate screens and spacers by sliding parts along rod. Examine parts for foreign materials that would indicate an unsatisfactory engine condition.
h. Clean screens and spacers by immersing in cleaning compound, Specification MIL-C-5546. Rinse in degreasing fluid or naphtha, Federal Specification P-S-661; blow dry with air jet.

ASSEMBLY AND INSTALLATION

a. Assembly and installation of the oil strainer is essentially the reverse of removal. Use new strainer cover seal when installing strainer assembly on engine.
b. Visually check strainer installation for oil leakage during first engine ground run idle rpm. Refer to Section I for engine ground run procedures.

.06.02.463-2A

Figure 6-5. Cleaning, Engine Oil Strainer (Sheet 2 of 2)



PROCEDURE

a. Remove engine from airplane. Refer to Section I for this procedure.
b. Remove engine shroud. Refer to Section IV for this procedure.
c. Remove afterburner. Refer to Section III for this procedure.
d. Remove No. 6 bearing heat shield.
e. Remove No. 6 bearing oil inlet line and strainer.
f. Soak oil line and strainer in solvent, Specification MIL-C-5546, to remove carbon deposits. Blow dry using compressed air.
g. Inspect strainer for damage. Replace strainer if damaged.
h. Install strainer and oil line using new seals. Safety-wire attachment bolts. Install tube clipping.
i. Install bearing heat shield and engine afterburner assembly. Install engine in airplane. Refer to Section I for these procedures.

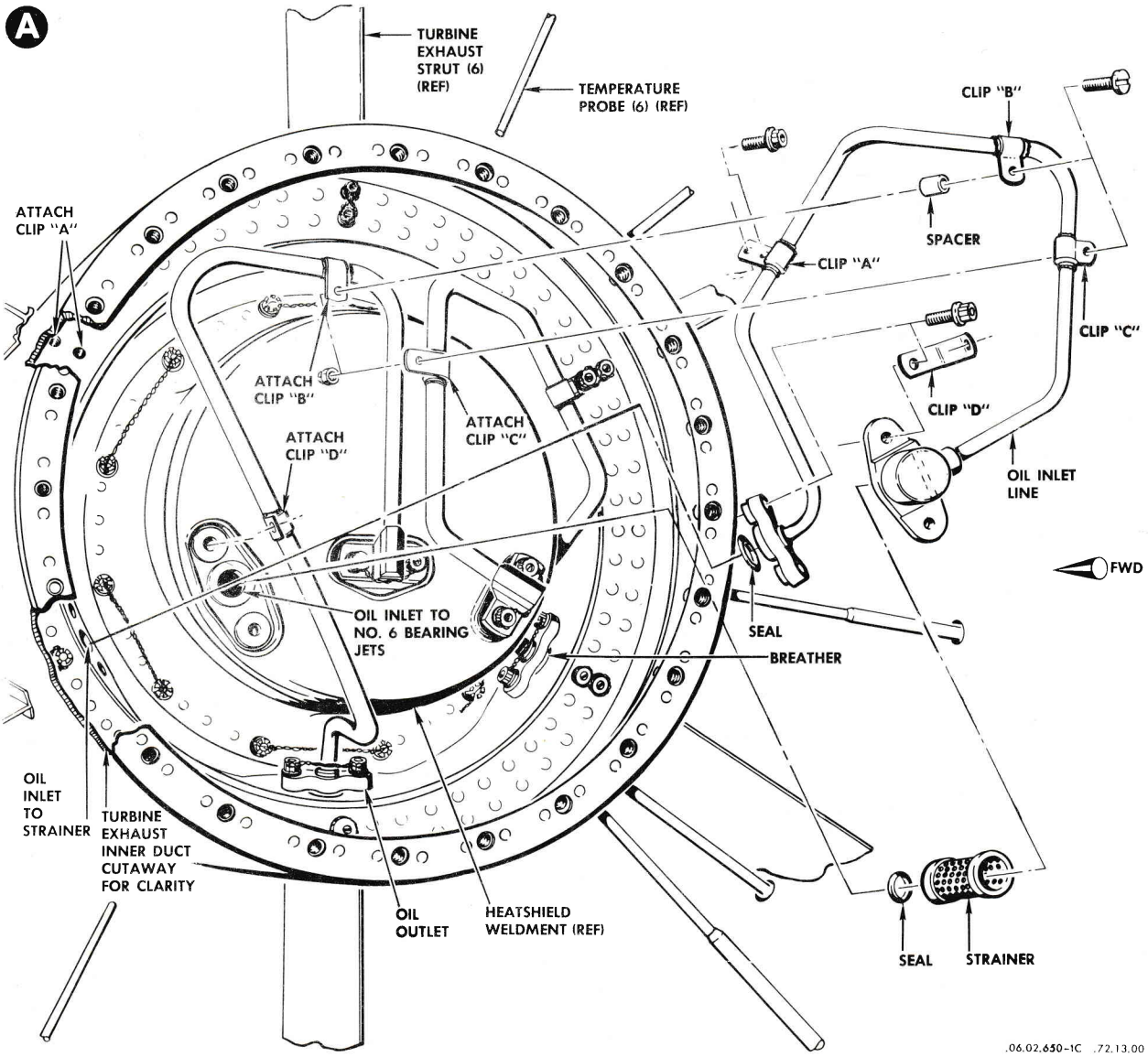
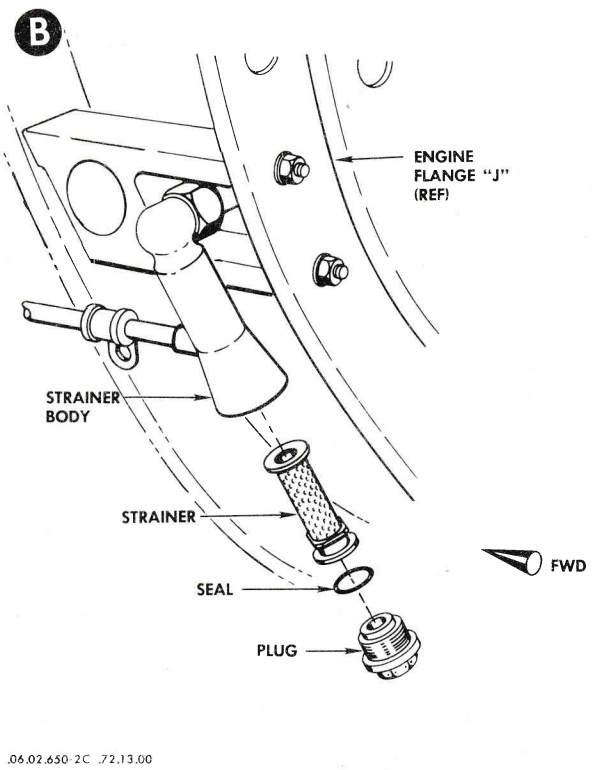


Figure 6-6. Cleaning, Engine No. 6 Bearing Oil Strainers (Sheet 1 of 2)



PROCEDURE

a. Remove engine from airplane. Refer to Section I for this procedure.
b. Remove engine shroud. Refer to Section IV for this procedure.
c. Remove the plug from the strainer body.
d. Pull the strainer from the body.
e. Inspect strainer for contamination, replacing the strainer if it is clogged, bent, or otherwise damaged.
f. Clean the strainer by flushing with solvent, Specification PS-661. Blow dry using compressed air.
g. Install strainer in strainer body; then install plug with new seal. Safety-wire the plug.

Figure 6-6. Cleaning, Engine No. 6 Bearing Oil Strainers (Sheet 2 of 2)

Section VII

ANTI-SURGE BLEED SYSTEM

Contents *Page*

DESCRIPTION

7-1. DESCRIPTION.

The engine anti-surge system is provided to prevent surging, pulsating, and possible compressor stalling during engine operation. During acceleration or rapid engine speed changes, the forward or N_1 compressor supplies a greater volume of air than can be readily used by the aft or N_2 compressor. The anti-surge system operates at such times, bleeding off excess air until the compressors are balanced. The system consists essentially of a bleed governor, two bleed valves and actuators, screen assemblies, and ducting. In operation, the compressor bleed governor, driven by the N_1 compressor, senses changes in rpm, air pressure, and temperature in the engine compressor inlet. This intelligence is transmitted to the bleed valve actuators in the form of a pneumatic pressure signal. The pressure signal in turn, actuates the valves to the desired open or closed position. Openings in the fuselage skin vent the bleed air to atmosphere. The bleed governor temperature bulb is located in the right-hand side of the engine air inlet guide vane assembly, and is an integral part of the bleed governor assembly. For an illustration of the anti-surge system, see figure 7-1.

7-2. OPERATION OF ANTI-SURGE BLEED SYSTEM.

The operation of the anti-surge bleed system is automatic with the operation of the engine, and is controlled by the bleed system governor. Power to operate the bleed system valve is provided by N_2 compressor discharge air. On low engine power settings, both bleed valves are open, to permit a portion of the N_1 compressor output to be vented to atmosphere. As the engine is accelerated, the valves close. As the engine decelerates, the valves open and again vent excess N_1 compressor air to atmosphere. The bleed governor senses N_1 compressor speed, inlet air temperature, and inlet air pressure. These factors are interpreted by the governor, which signals for proper positioning of the bleed valves.

7-3. ANTI-SURGE BLEED GOVERNOR.

The compressor bleed governor is a bench-calibrated unit that controls the function of the bleed valves. The governor is installed on the forward side of the engine N_1 compressor accessory drive adaptor and is driven at N_1 compressor speed. The governor is equipped to sense compressor speed, inlet air pressure, and inlet air temperature. These signals are used to establish the time for action of the bleed valves. A temperature sensing probe, installed in the engine air inlet, is connected to the bleed governor by a capillary tube. The temperature probe and tube are calibrated to, and cannot be removed from the governor.

7-4. ANTI-SURGE BLEED VALVE AND ACTUATOR.

Two butterfly-type bleed valve-and-actuator assemblies are installed, one on each side of the engine compressor section. These assemblies bleed air from the area between the N_1 and N_2 compressors. The actuator is a cylinder and piston assembly actuated by N_2 compressor discharge air controlled by the bleed governor. The action of the piston opens and closes the bleed valve. Action of the bleed valves is very rapid; less than one-half second is required. The valves are equipped with wire mesh screens, to prevent entry of foreign materials into the valves and engine. Each valve assembly is equipped with a bellows-type collar that forms a flex coupling between the engine and the bleed air vent attached to the fuselage. During engine installation or removal, the seals slide free from or to the fuselage duct flange, and automatically connect the valve assemblies and ducting.

OPERATIONAL CHECKOUT

7-5. OPERATIONAL CHECKOUT, ANTI-SURGE SYSTEM.

a. Prepare airplane and engine for ground run. Refer to Section I for this procedure and the equipment required.

b. Start engine and position throttle at idle. Refer to Section I for the engine start and run procedure.

c. Station a man on each wing to check for opening and closing of bleed valves.

WARNING

Keep face and hands away from direct blast of anti-surge bleed air to prevent possible injury.

d. Advance throttle and check for valve closing at 88% to 90% engine rpm.

e. Retard throttle to idle; check for valve opening at 90% to 88% rpm.

f. Shutdown engine.

SYSTEM ANALYSIS

7-6. SYSTEM ANALYSIS, ANTI-SURGE SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ONE BLEED VALVE FAILS TO CLOSE.		
Bleed governor malfunctioning.	Remove governor for bench test.	Install replacement governor.
Defective valve actuator.	Remove actuator for bench test.	Install replacement item.
Excessive friction in valve action.	Remove valve for bench test.	
BOTH BLEED VALVES FAIL TO CLOSE DURING THROTTLE ADVANCE.		
Loose connection in N_2 compressor discharge line to bleed governor.	Check line and fittings for condition and security of attachment.	Repair or replace components as necessary.
Bleed governor malfunctioning.	Remove governor for bench test.	Install replacement item.

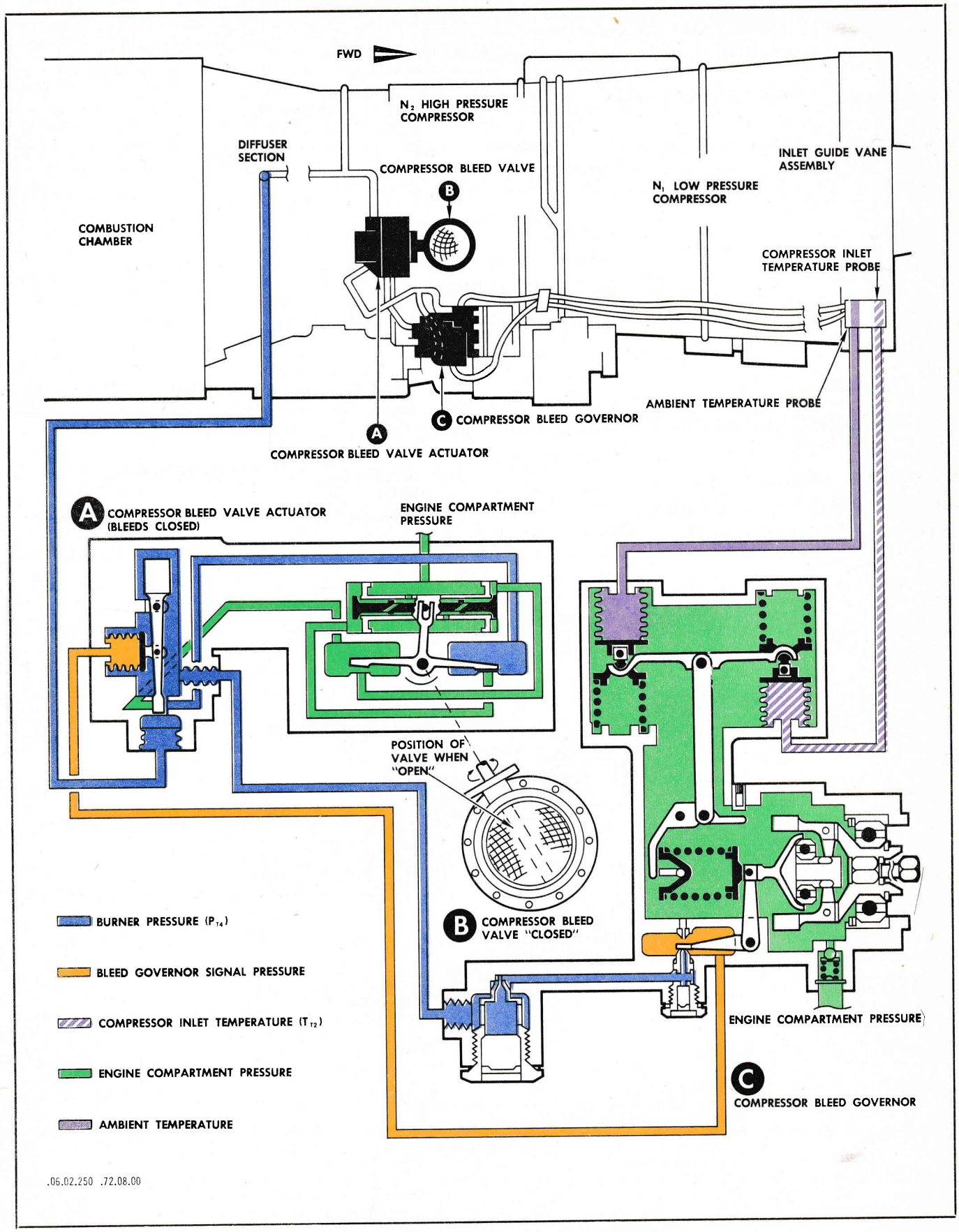


Figure 7-1. Anti-Surge Bleed System, Schematic

7-6. SYSTEM ANALYSIS, ANTI-SURGE SYSTEM (CONT).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
BLEED VALVES OPERATE INTERMITTENTLY THROUGHOUT POWER RANGE.		
Bleed governor malfunctioning.	Remove governor for bench test.	Install replacement item.

REPLACEMENT

7-7. GENERAL.

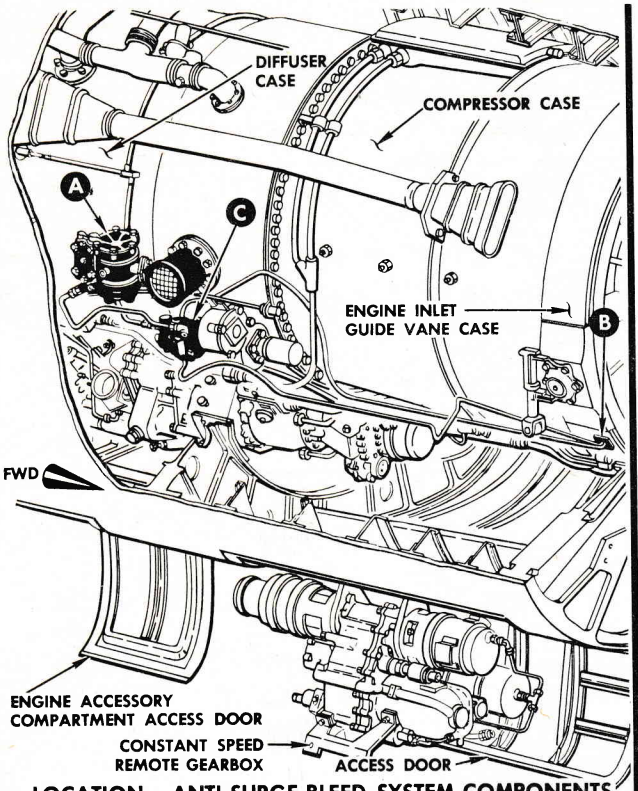
Other than periodic inspection and operational checks, maintenance of the anti-surge system will consist mainly of replacement of damaged or malfunctioning components. Component repair or adjustment should not be attempted without special bench testing facilities.

7-8. REMOVAL, ANTI-SURGE BLEED GOVERNOR.

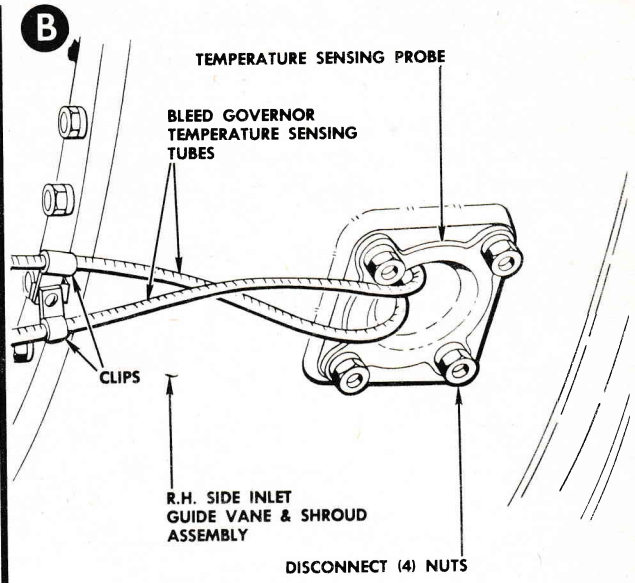
For removal and installation of the bleed governor, see figure 7-2.

7-9. REMOVAL, ANTI-SURGE BLEED VALVE ACTUATOR.

For removal and installation of the bleed valve actuator, see figure 7-2.

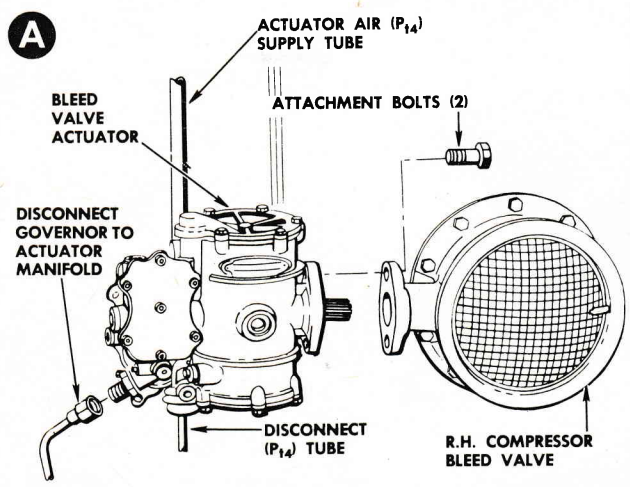


LOCATION—ANTI-SURGE BLEED SYSTEM COMPONENTS



ANTI-SURGE BLEED GOVERNOR, REMOVAL

a. Open the constant speed system access door.
b. Extend remote gearbox out of fuselage.
c. Disconnect temperature sensing probe from engine inlet guide vane case. Remove clipping from temperature sensing lines.



ANTI-SURGE BLEED VALVE ACTUATOR, REMOVAL

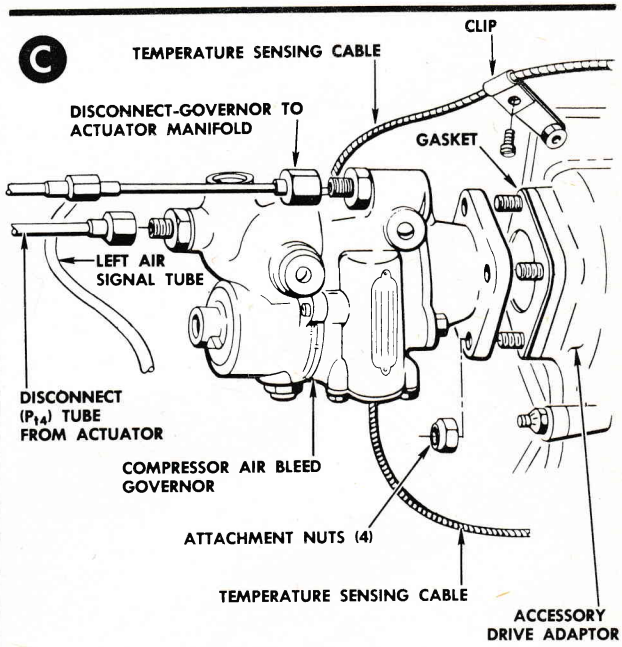
NOTE

RIGHT HAND VALVE SHOWN; LEFT HAND OPPOSITE.

a. Open engine accessory compartment access door.
b. Disconnect lines attached to actuator.
c. Remove attachment bolts holding actuator to valve; remove actuator.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Perform system operational checkout.



d. Disconnect tubing from governor.
e. Remove governor to engine attachment nuts; remove governor

INSTALLATION.

a. Installation is essentially the reverse of removal.
b. Perform system operational checkout.

.06.02.269 B .72.08.00

Figure 7-2. Replacement, Anti-Surge Bleed System Components

Section VIII

ENGINE ANTI-ICING SYSTEM

Contents *Page*

DESCRIPTION

8-1. ENGINE ANTI-ICING SYSTEM.

The engine anti-icing system consists of a bleed air transfer line on the left side of the engine, and an electrically actuated valve. For an illustration of the system, see figures 8-1, 8-2, and 8-3. The air line routes N_2 compressor bleed air, heated by compression, from the engine diffuser section, forward to the engine inlet guide vanes. Control of the air flow is accomplished by an electrically actuated valve installed in this line. The valve operates in conjunction with the airplane anti-icing system. When the valve is open, the heated air flows into the engine inlet guide vane manifold at approximately the nine o'clock position on the inlet case. The air passes inward through the guide vanes and is routed forward into the engine nose cone. The cone then vents the air into the engine intake air stream.

8-2. ENGINE INLET DUCT LIP ANTI-ICE SYSTEM.

The engine inlet duct lip anti-ice system is provided to prevent formation of ice on the leading edges of the engine air inlet ducts. Hot engine bleed air is routed from the bleed air duct at the cockpit air conditioning system heat exchanger. Flow of the air to the duct leading edges is controlled by a solenoid-controlled, pneumatically-actuated pressure regulator and shutoff valve. From the valve the heated air is routed through tubing to the duct leading edges. The system is controlled by the anti-ice switch located above the cockpit left-hand console panel. For further information and illustrations on this system, refer to T. O. 1F-106A-2-6.

8-3. CONTROL SYSTEM.

The anti-icing system is controlled electrically by the three-position anti-ice switch located above the pilot's right console panel. When the switch is in the "MANUAL" position, the valves are open to allow flow of hot air without the monitoring action of the ice detection system. When the switch is in the "AUTO" position, the system operates only when icing conditions exist. An ice detector is installed in the engine air inlet stub duct, to sense icing condition. This intelligence is relayed to the ice detector interpreter, which is a part of the airplane surface and anti-ice system. Refer to T.O. 1F-106A-2-6 for information in regard to this system.

8-4. ANTI-ICE AIR VALVE.

The anti-ice air valve is an electrically-actuated butterfly-type valve installed on the leftside of the engine. The valve actuates to either the full open or full closed position, as dictated by the anti-icing control system. The actuator is a sealed unit. Any malfunction or misadjustment is cause for replacement of the assembly.

OPERATIONAL CHECKOUT

8-5. OPERATIONAL CHECKOUT, ENGINE ANTI-ICING SYSTEM.

Operational checking of the engine anti-icing system consists of actuating the anti-ice switch in the cockpit to the "MANUAL ON" position and listening for the operation of the valve motor.

a. Install anti-ice control and anti-ice power fuses in the cockpit left fuse panel.

b. Connect outside source of 28-volt dc power to the external dc power receptacle.

c. Actuate anti-ice control switch to "MANUAL ON" position.

d. Listen for actuation of the anti-ice valve to the open position.

e. Actuate switch to the "OFF" position; listen for valve to actuate to the closed position.

f. Remove electrical power.

SYSTEM ANALYSIS

8-6. SYSTEM ANALYSIS, ENGINE ANTI-ICING SYSTEM.

The engine anti-icing system is a portion of the complete airplane anti-icing system. System analysis of the anti-icing system will be found in T.O. 1F-106A-2-6.

REPLACEMENT

8-7. REPLACEMENT, ANTI-ICE AIR VALVE.

For removal and installation of the anti-ice air valve, see figure 8-4.

8-8. REPLACEMENT, ENGINE NOSE CONE.

a. Remove engine from airplane. Refer to Section I for engine replacement procedures.

b. Cover compressor inlet to prevent entry of foreign materials into the engine.

c. Remove attachment bolts (10) securing nose cone to cone adapter ring; remove cone.

d. Position nose cone on cone adapter ring with cone short seam splice at top centerline of adapter ring.

e. Install attachment bolts (10); safety-wire bolts to nose cone.

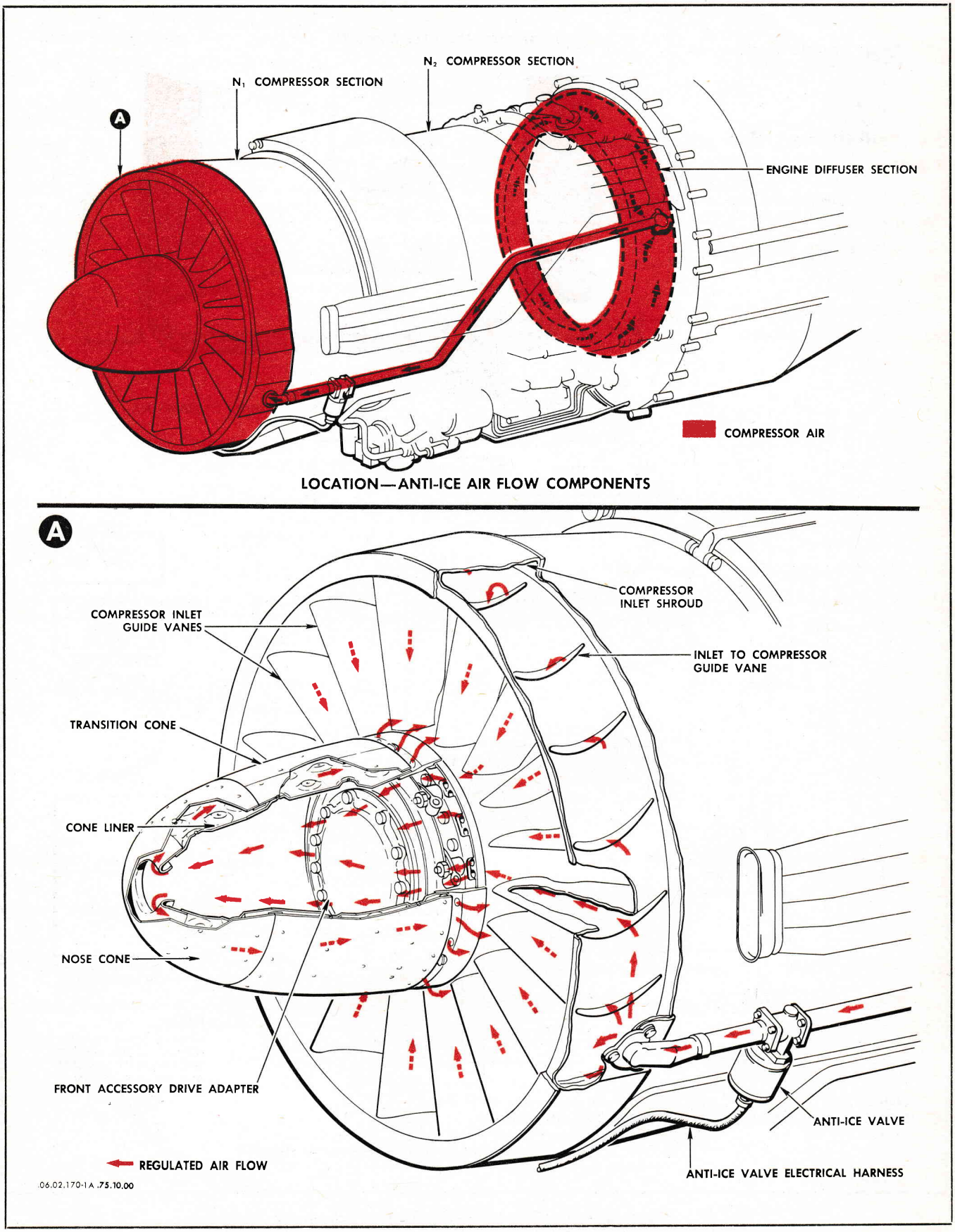


Figure 8-1. Engine Anti-Icing System Air Flow Diagram

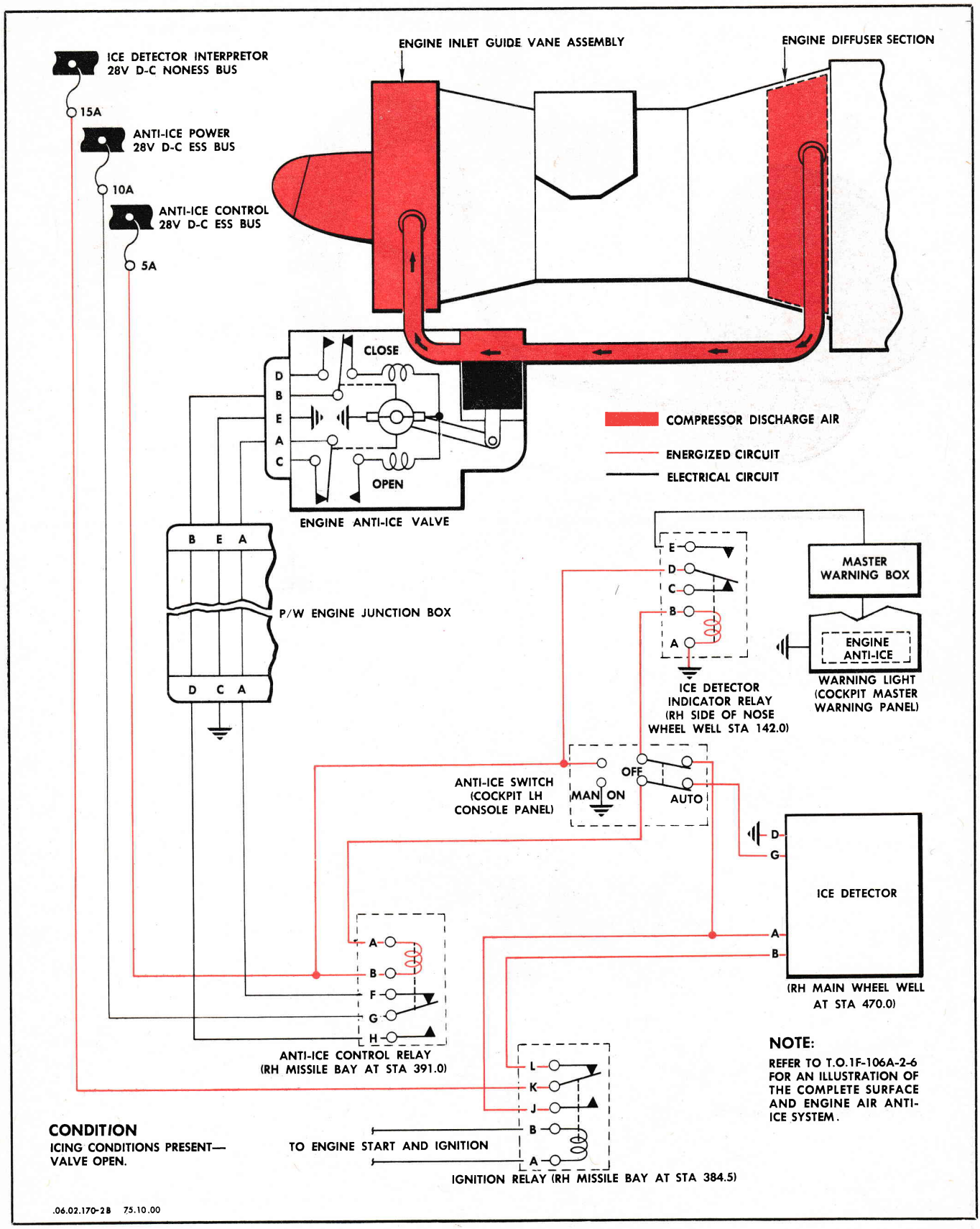


Figure 8-2. Engine Anti-Icing System Schematic

Applicable to F-106A airplanes 57-246 thru 57-2506 and F-106B airplanes 57-2516 thru 57-2541 prior to incorporation of TCTO 1F-106-537

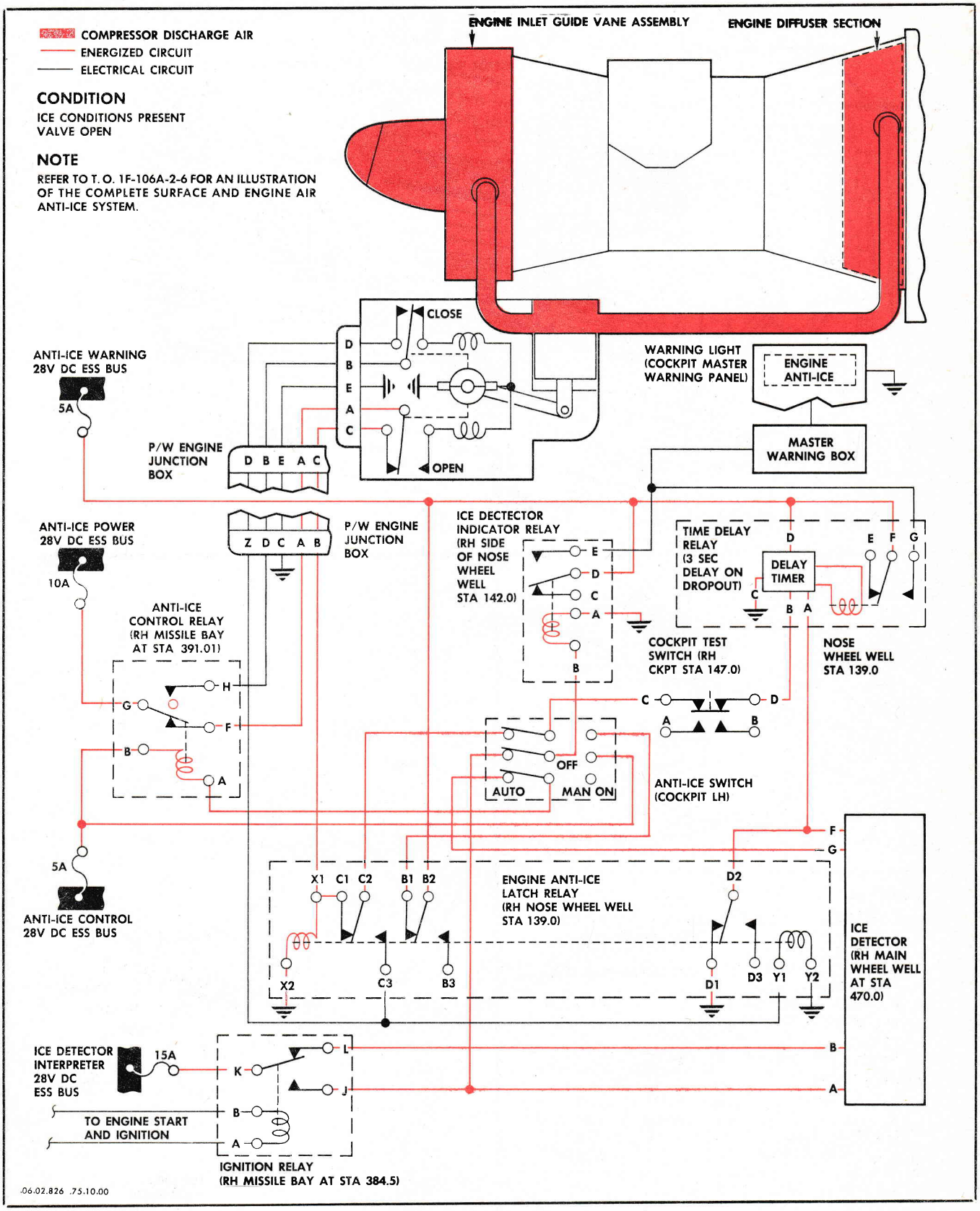
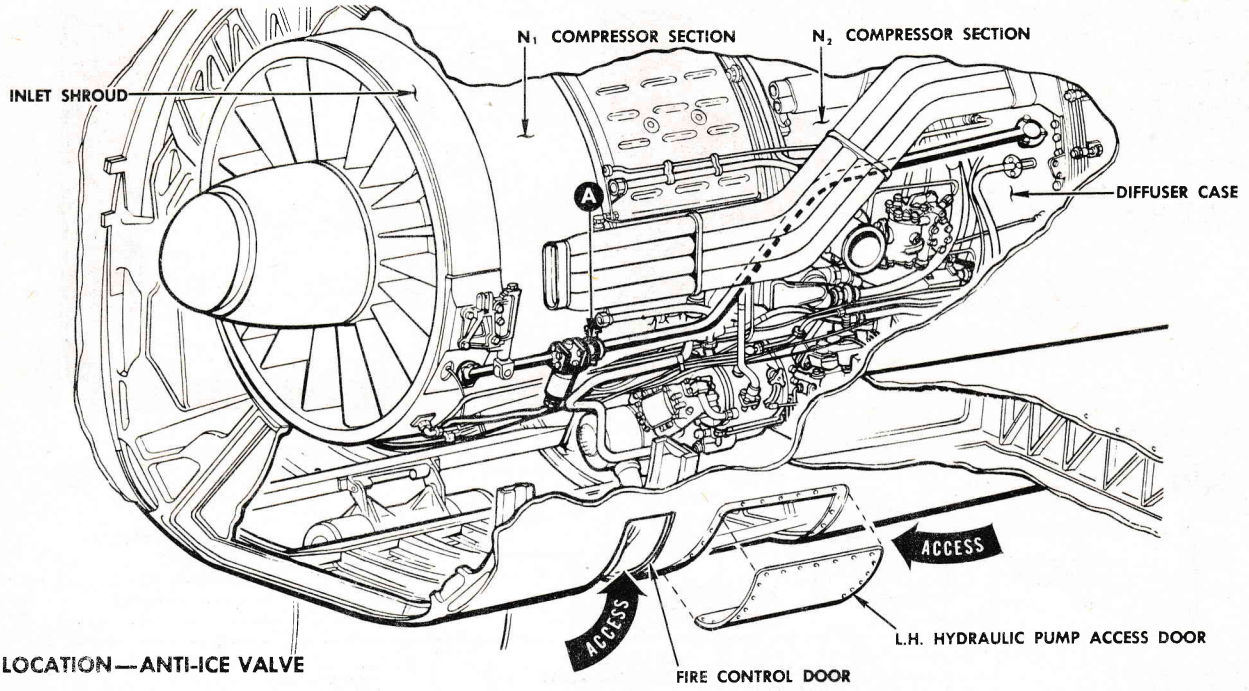
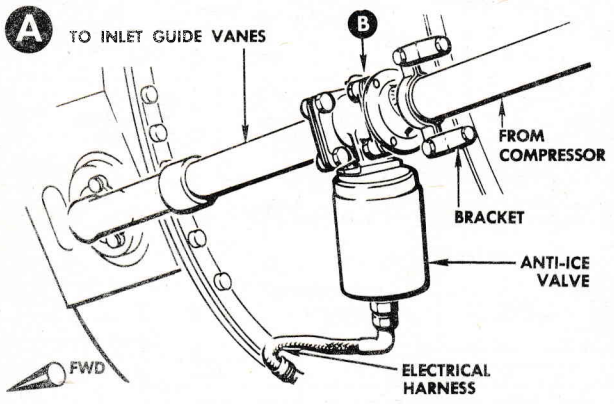


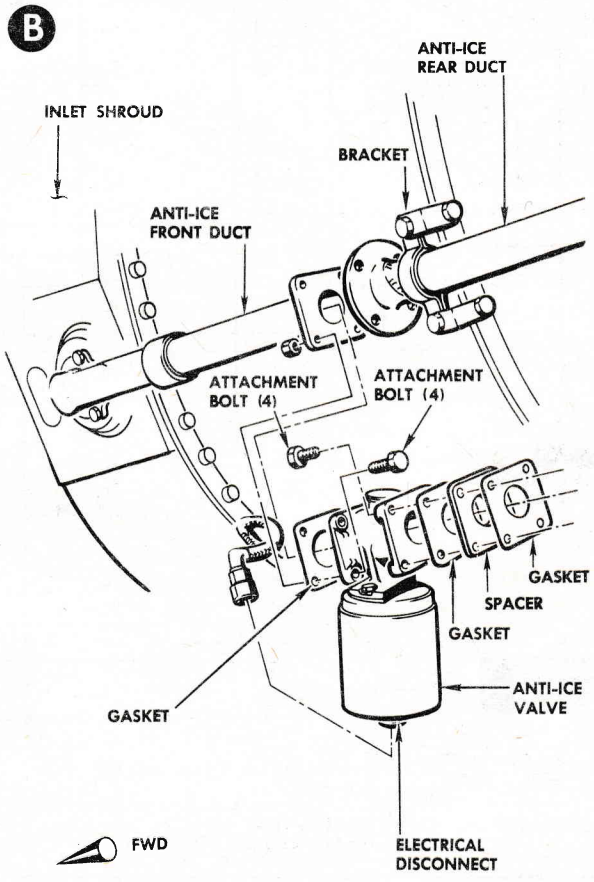
Figure 8-3. Engine Anti-Icing System Schematic

Applicable to F-106A airplanes 56-453, -454, 56-456 thru 57-245, 58-759 and subsequent; and 57-246 thru 57-2506 after incorporation of TCTO 1F-106-537. Applicable to F-106B airplanes 57-2508 thru 57-2515, 57-2542 and subsequent; and 57-2516 thru 57-2541 after incorporation of TCTO 1F-106-537



LOCATION—ANTI-ICE VALVE





REMOVAL

a. Gain access to the anti-ice valve through the LH fire control door and the LH hydraulic pump access door.
b. Cut safety and remove electrical harness connector from lower side of anti-ice valve.
c. Cut safety and remove attachment bolts (8) attaching valve to anti-ice duct; remove valve, spacer, and gaskets.
d. Cover valve and duct openings.

INSTALLATION

a. Installation of the anti-ice valve is essentially the reverse of removal. Make certain the spacer is installed between the valve and the rear duct.
b. Use new gaskets when making valve installation.
c. Perform system operational checkout as directed in this manual and in T.O. 1F-106A-2-6.

.06.02.165D .75.11.00

Figure 8-4. Replacement, Anti-Icing Air Valve