



CHAPTER 71

POWER PLANT - GENERAL

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# CHAPTER

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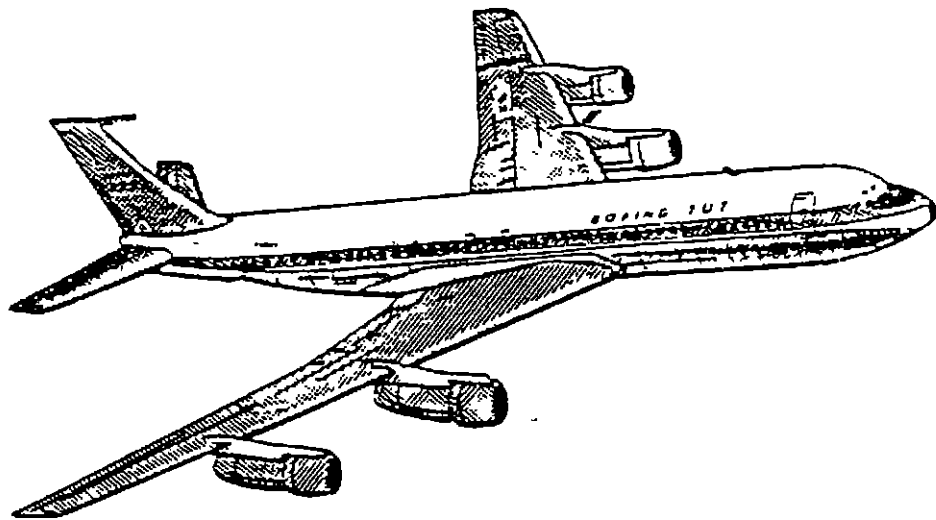
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# **BOEING 707**



## **MAINTENANCE MANUAL FOR NATO TRAINER CARGO AIRCRAFT**

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## MAINTENANCE MANUAL

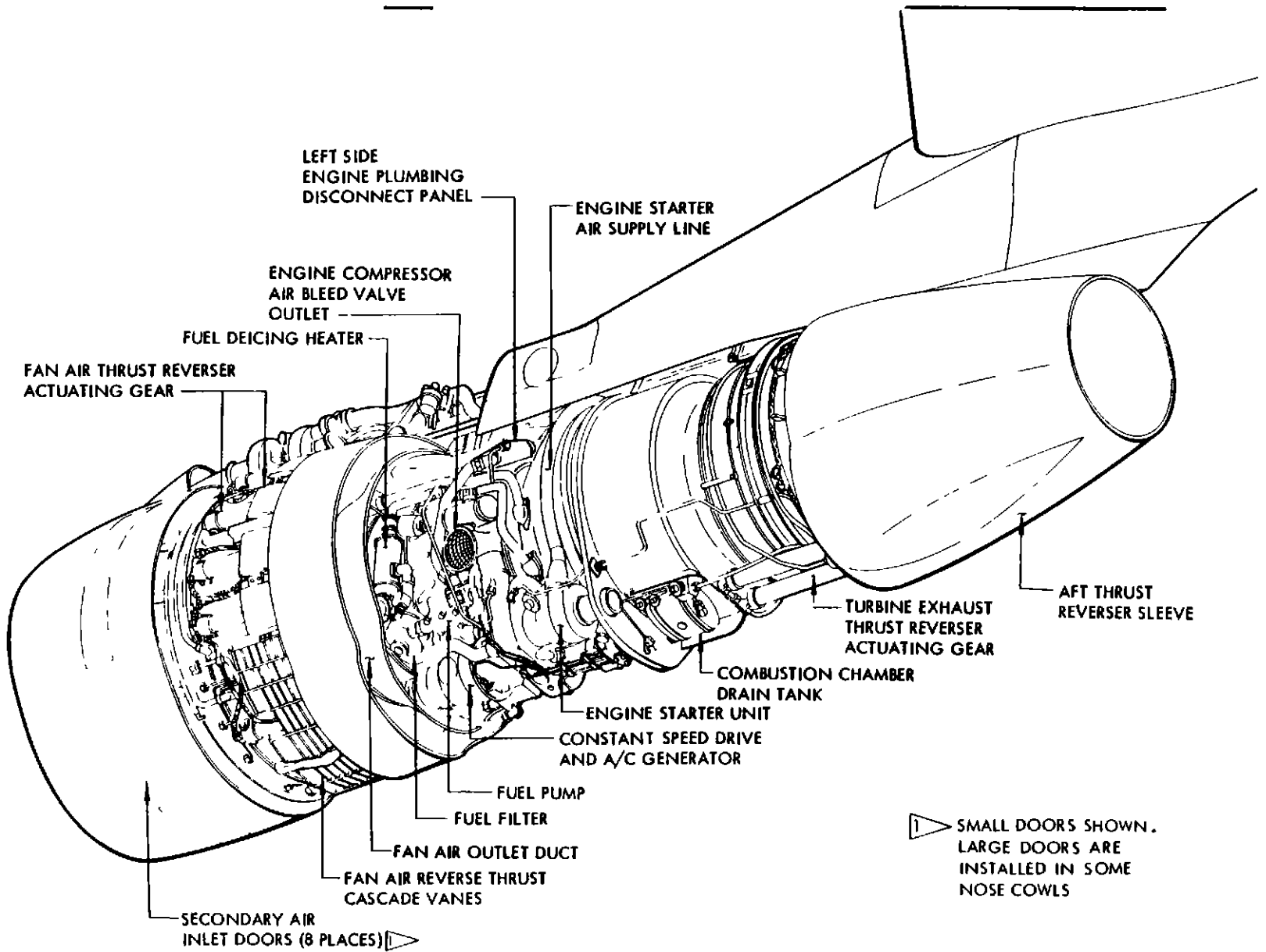
### POWER PLANT (JT3D) - DESCRIPTION AND OPERATION

#### 1. General

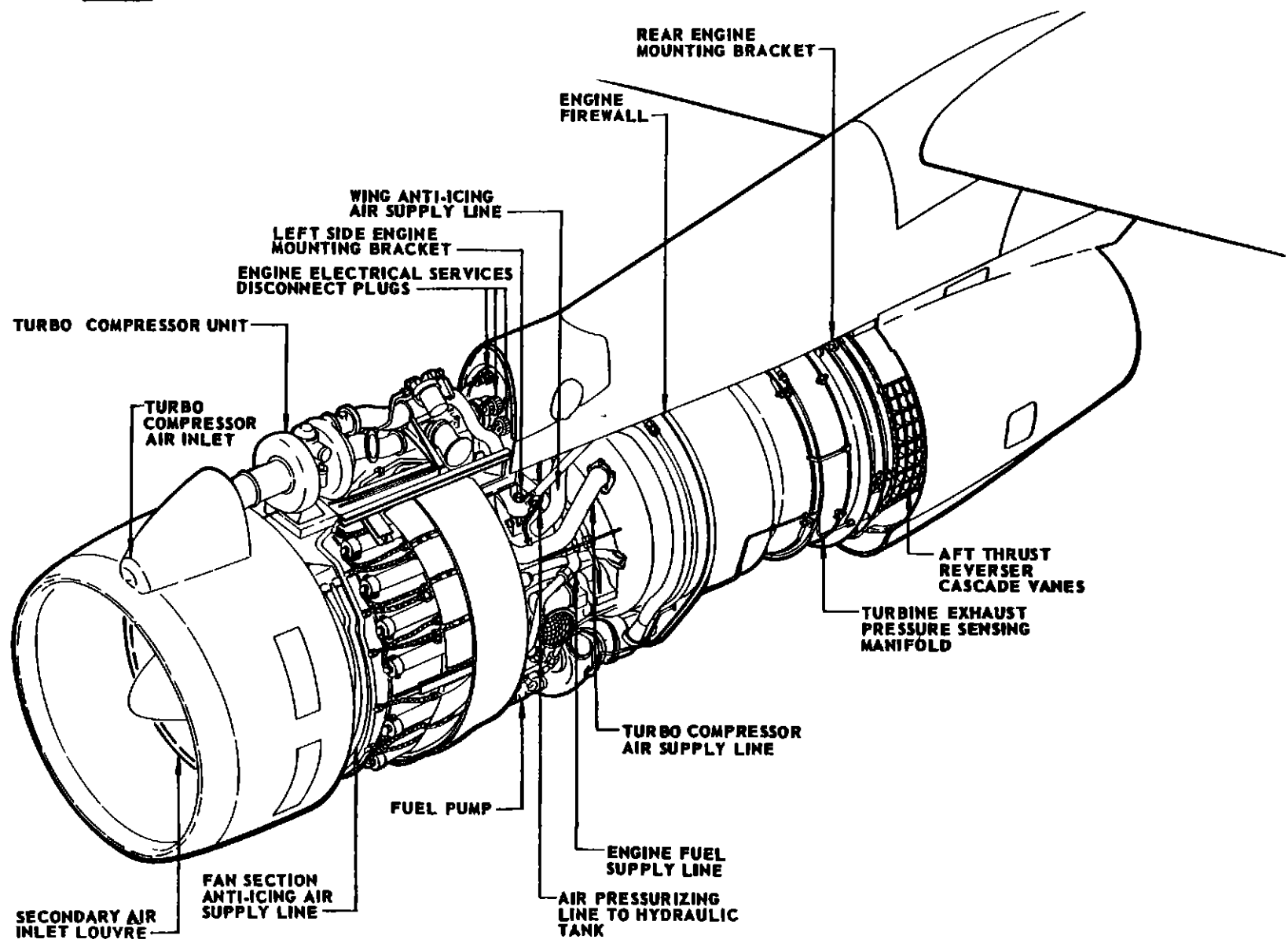
- A. Four JT3D twin spool axial flow, turbofan engines provide thrust for the aircraft propulsion. (See figures 1 and 2.) The engines are supported individually in two strut-mounted nacelles beneath each wing and are attached to the struts by mountings designed to take thrust and side loads and allow for thermal expansion. Removable hinged side cowl panels permit access to any part of the engine exterior. Each engine is equipped with a thrust reverser bolted to the engine exhaust case flange. The forward fan duct is also fitted with a thrust reverser. The major accessories fitted to each engine in addition to basic components are a pneumatic starter, a-c generator with constant speed drive unit, hydraulic pump (engines No. 2 and 3) and a turbocompressor on engines No. 2, 3 and 4.

#### 2. Engine

- A. The JT3D engine is an axial gas flow turbofan with a fifteen stage twin spool compressor, an eight can combustion chamber and a four-stage twin spool turbine. Refer to Chapter 72, "Engine." The engine is divided into five functional zones. (See figure 3.) At the forward end is the first compressor spool comprising a two-stage fan section and the low pressure (N1) compressor. This discharges into a second high pressure (N2) compressor. A diffuser section immediately aft of the N2 compressor reduces the air flow to a suitable velocity for mixing with fuel in the combustion section. High temperature gases leaving the combustion chambers pass through two turbine spools which drive the N1 and N2 compressors respectively. Combustion gases leave the turbines, pass into the engine exhaust section then out to atmosphere through the aft reverser sleeve section. Each compressor and its turbine is supported by a combination of ball and roller bearings. These bearings are supported from the engine outer casing by struts which contain passages for bearing oil and cooling air supply.
- B. A main accessory component drive gearbox is mounted beneath the engine and secured to the diffuser case front flange. Other accessories are mounted on the cover of the front compressor bearing assembly and are geared to the N1 compressor shaft.

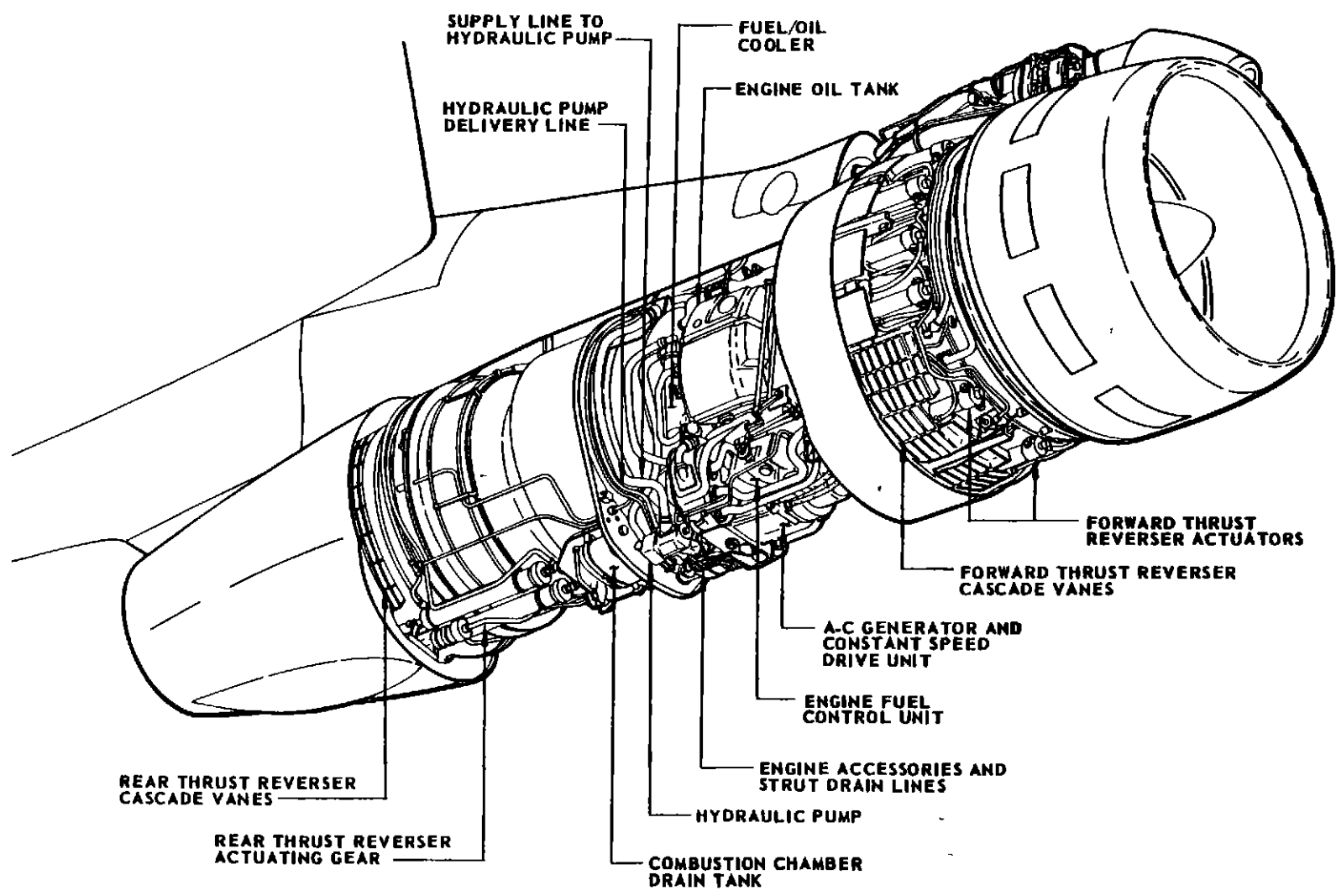


Engine Left Side View  
 Figure 1 (Sheet 1)



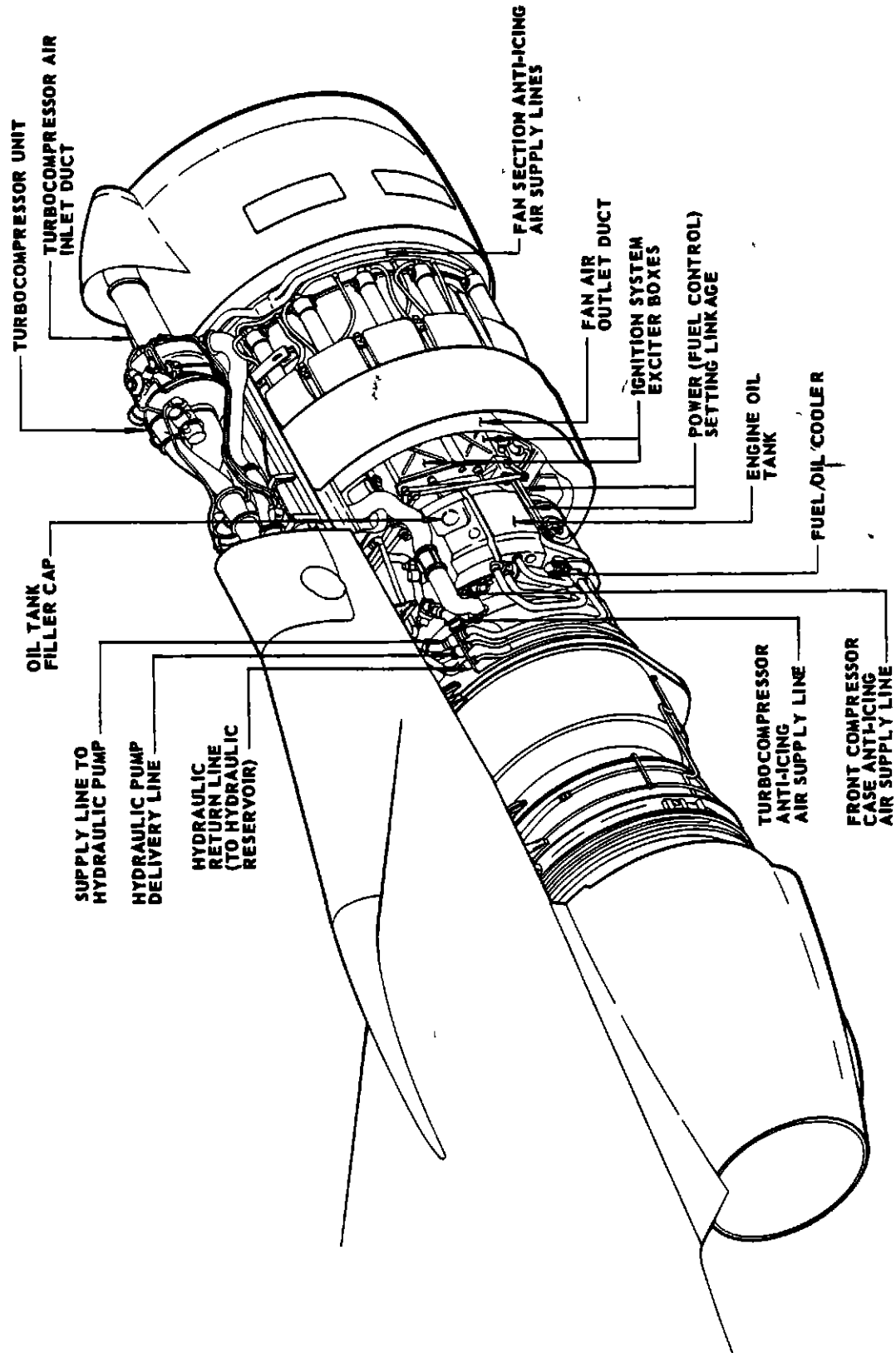
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Engine Left Side View  
Figure 1 (Sheet 2 of 2)



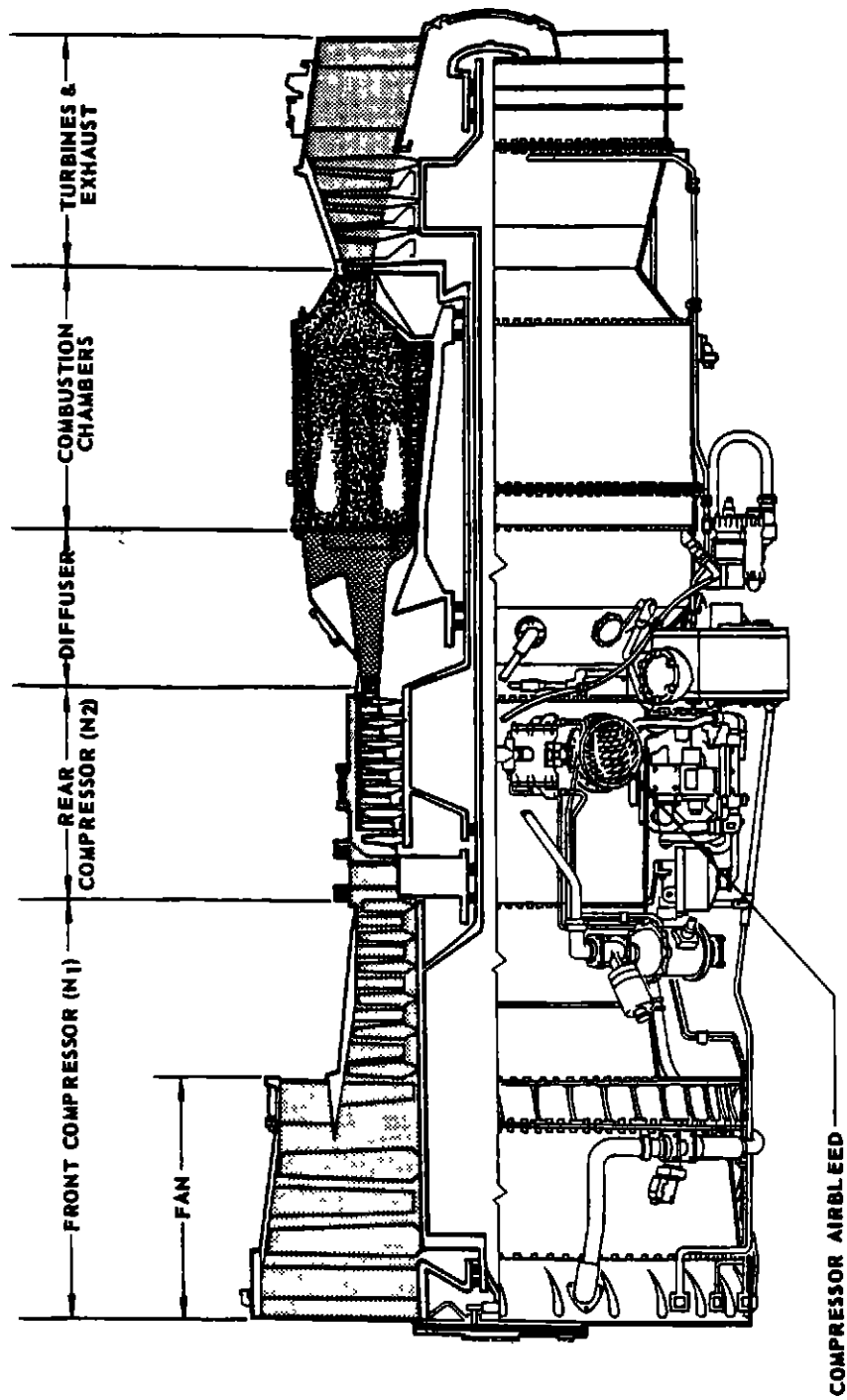


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Engine Right Side View  
Figure 2 (Sheet 2 of 2)



Engine Air (Gas) Flow  
Figure 3

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- C. The front two stages of the  $N_1$  compressor are comprised of longer vanes and blades than the other stages. These two stages initiate an airstream which divides into a primary and secondary flow. The secondary (outer) air stream is ducted to the outside of the engine and provides propulsive force in the same manner as a propeller. A thrust reversing arrangement, whereby the direction of this air stream may be changed and diverted forward, is incorporated in the fan ducting outlet. The primary flow feeds the remaining stages of the  $N_1$  compressor. After passing through the  $N_1$  compressor the air stream enters an intermediate case provided with vanes which give a correct air flow to the  $N_2$  compressor. The intermediate case is constructed with a double wall into which part of the  $N_1$  compressor output backs up. This pressure is bled overboard through an automatic valve during certain changes of engine speed. Release of these pressure changes improves the characteristics of engine performance. Refer to Chapter 75, "Air."
- D. Seven-stages in the  $N_2$  compressor further increase pressure and velocity of the air which leaves the compressor with a high tangential swirl. Guide vanes at the entrance of the diffuser case straighten the air flow and convert the swirl into pressure energy. An increase in size of the diffuser passages reduces the airflow velocity so that proper mixing with the fuel spray and efficient burning can take place in the combustion chambers.
- E. The combustion section houses eight combustion chambers. The outer case of this section consists of two units of the same diameter. The front flange of the shorter unit bolts to the diffuser case. Attached to the rear flange is the longer second unit. A titanium firewall extending around the engine is bolted to the jointing flange between these two units. Each of the eight combustion chambers have six fuel nozzles protruding through the forward face. The chambers are provided with holes in their forward end and sides which allow the passage of air for combustion and cooling purposes. Spark igniters are fitted to No 4 and 5 chambers (clockwise viewed from rear). Interconnecting flame tubes allow the transfer of burning gases for ignition in the other chambers. The main gas flow leaves the combustion chambers through guide vanes and passes to the turbine spools.
- F. The first turbine spool has a single high pressure stage and is connected by a hollow shaft to the  $N_2$  compressor. The second spool is a three-stage low pressure turbine and drives the  $N_1$  compressor/fan combination. Combustion gases leaving the turbines are discharged through the exhaust housing.



- G. Bolted to the rear of the exhaust housing is a thrust reverser which operates simultaneously with the fan section thrust reverser. These two thrust reversers are controlled from engine thrust levers.

### 3. Engine Mounts

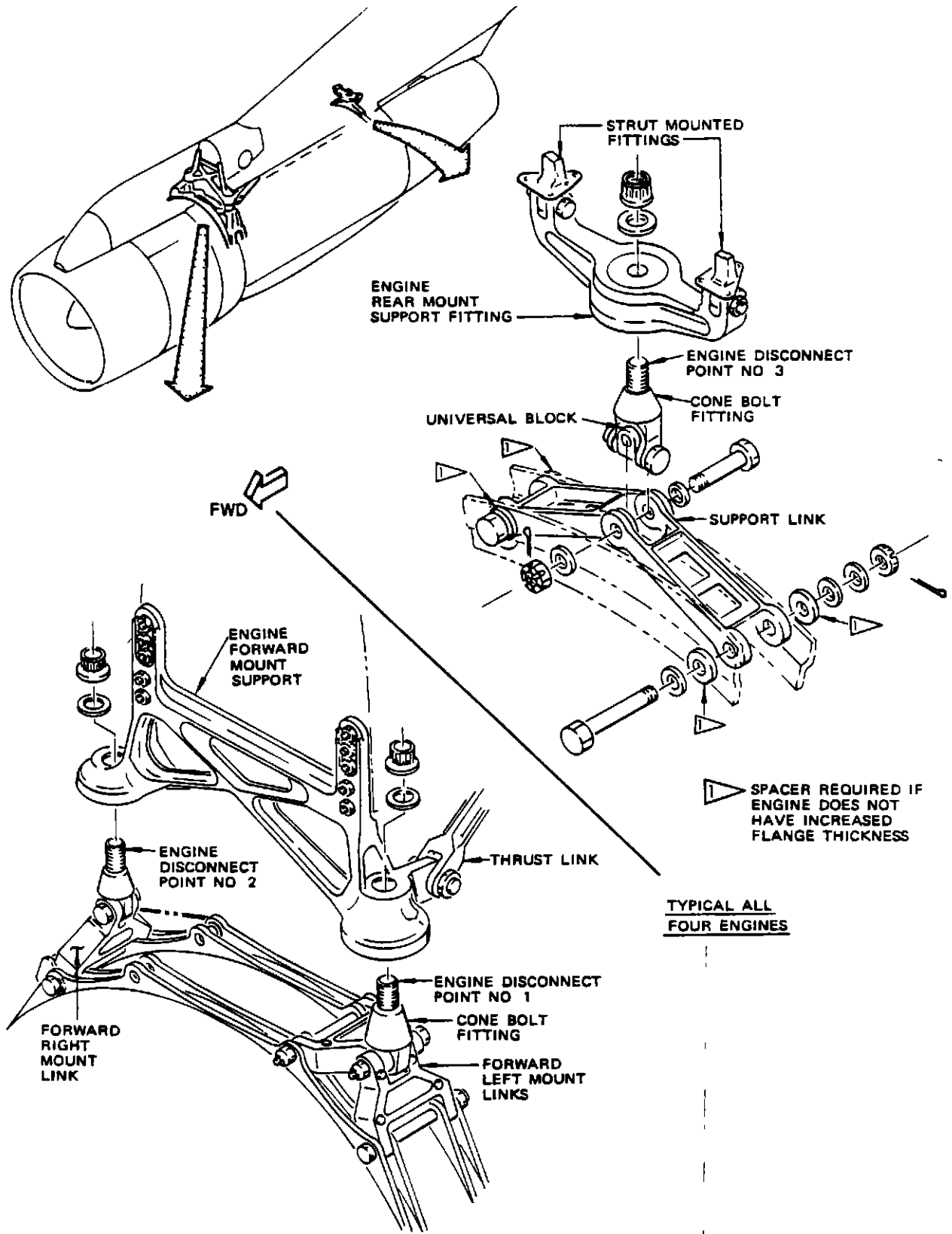
- A. The engine is secured to the strut at three points. The forward mounting position has an arrangement of links bolted to the forward flange of the diffuser case and terminating in two cone bolts which are rigidly secured into the strut fitting. The aft engine mount is comprised of two links bolted to the top of a double flange running around the exhaust section. These terminate in a single cone bolt secured into a strut mounted bracket arranged to compensate for changes in engine length due to thermal expansion. (See figure 4.)

### 4. Engine Anti-icing

- A. High pressure sixteenth-stage air from the diffuser case is used for engine, nose dome, nose cowl and turbo-compressor anti-icing. Refer to Chapter 75, "Air." The engine inlet guide vane assembly consists of twenty-eight hollow steel vanes welded between hollow inner and outer shrouds. Anti-icing air is introduced into the outer shroud ring then flows through the struts to the inner shroud ring and discharges into the engine nose dome. It exhausts through a louvre around the aft end of the nose dome. A secondary supply of sixteenth-stage air is circulated through the fan section of the front compressor case. This air is bled through to the outer shroud ring and mixes with inlet guide vane anti-icing air.
- B. The inlet vane anti-icing air supply is taken from a pad located approximately at the 9 o'clock position on the left side of the engine diffuser case. The air is conveyed forward by a duct that divides into a pair of valves just aft of the fan outlet duct. Tubing from these valves is routed forward across the top side of the fan compressor case. Each line is then branched left and right around the periphery of the inlet shroud to feed the hot air into the bottom segment of the shroud.

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Engine Mounts  
Figure 4



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- C. A pad to supply air to the fan section of the front compressor case is located approximately at the 2 o'clock position right side of engine. The air is ducted through a valve and forward to its inlet pad located between the 12 and 1 o'clock position on the front compressor case.
- D. The nose cowl and turbocompressor anti-icing air bleed pad is located slightly above the front compressor anti-icing air supply pad. A tube routed through a valve and along the top of the engine carries the anti-icing air to the turbocompressor, turbocompressor inlet scoop and nose cowl

### 5. Engine Driven Accessories

- A. The front accessory drive gearbox is located on the axis of the engine immediately in front of the N1 compressor. The casing for this gearbox is bolted to the No. 1 bearing housing which is supported from the outer shroud case by the twenty-eight inlet guide vanes. A spur gear on the N1 compressor shaft drives the N1 tachometer generator and the No. 1 bearing oil scavenge pump. (See figure 5.) These accessories are covered by the engine nose dome which is secured with captive nuts to studs on the accessory case.
- B. The main accessory drive gearbox is mounted beneath the engine and secured to the diffuser case front flange. Power is supplied to the gearbox assembly through a bevel gear on the N2 compressor shaft and an accessory drive extension shaft. On the front face, as viewed from forward, the fuel pump is located in the right hand position. A generator drive occupies the location under the center line of the engine. The fuel control drive is on the left of the gearbox. Viewed from the rear, the N2 tachometer is in the extreme right position, the pneumatic starter on the left side and a hydraulic pump (engines No. 2 and 3 only) in the right-center location. On engines fitted with water injection, a water injection pump is mounted on the top drive pad at the left side of the gearbox
- C. The generator is connected into the accessory drive gearbox through a constant speed drive unit. This drive unit has a variable speed input from the engine and self-governs its output at a constant 6000 rpm. An electrically operated clutch is incorporated on the constant speed drive input. If a fault develops in the generator or drive unit this clutch may be disengaged by operating a switch at the flight engineer's station. Once disengaged the clutch may be re-engaged only when the plane is on the ground and the engine shut down.

6. Engine Electrical and Plumbing Disconnects

- A. All electrical services to the engine have quick-disconnects mounted on the strut firewalls. The disconnect which carries the generator output is separated from the other wiring and is located near the forward end of the strut horizontal firewall. The oil quantity indicating system disconnect is on the vertical firewall and is separated from the general wiring to minimize interference from extraneous magnetic fields. Three disconnect plugs for the remaining electrical systems are located near the top of the vertical firewall at the front end of the strut. (See figure 6.)
- B. Engine plumbing disconnects are mounted along a panel located at the 10 o'clock position on the left side of the engine, forward of the diffuser case, and also on a bracket mounted on the diffuser case flange at the 1 o'clock position on the right side of the engine. These services include hydraulic supply, pressure and return, main engine fuel feed and, if installed, a high pressure air supply line for the starter.
- C. Large diameter ducting for wing anti-icing air and high pressure air from the turbocompressor pass into the strut area through the horizontal firewall. These ducts are not fitted with quick disconnects but have removable sections located between the engine and strut firewall.

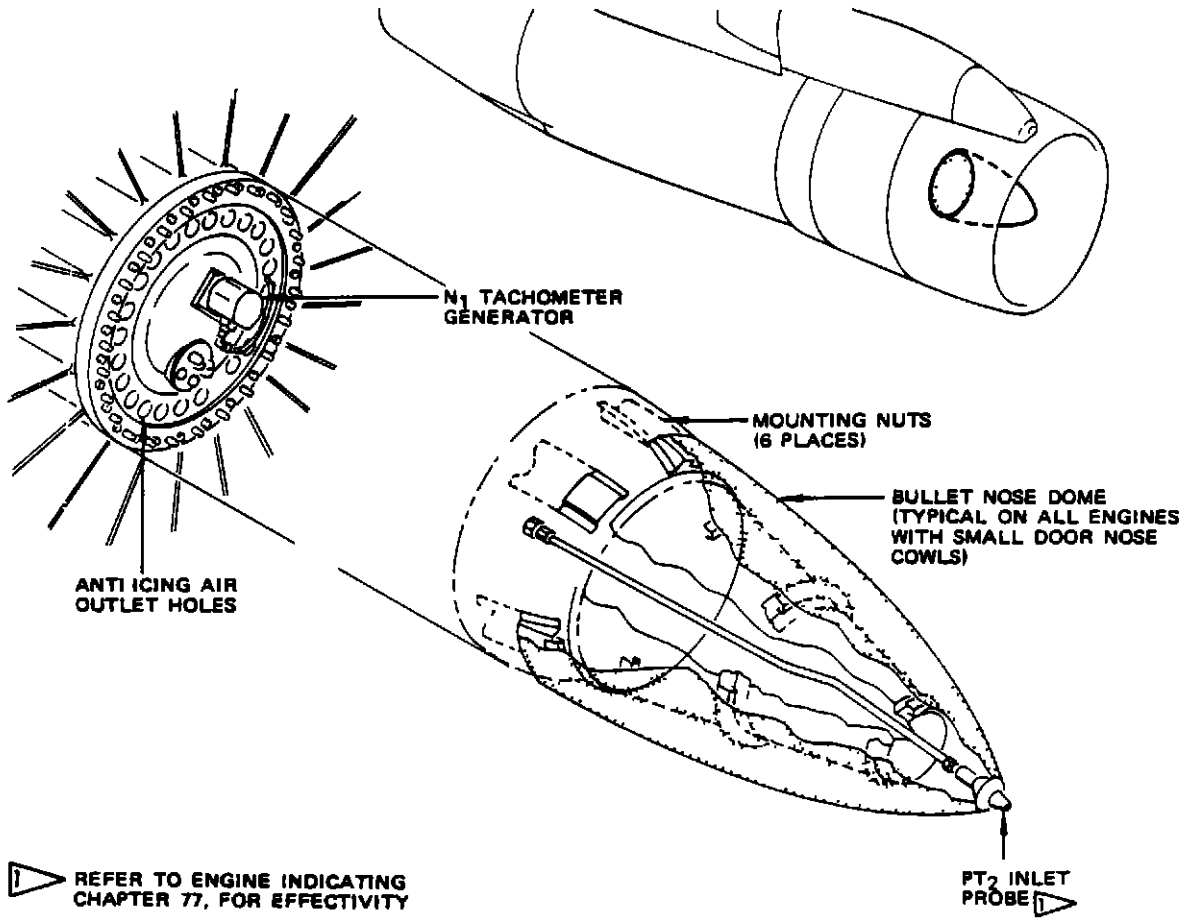
7. Engine Vent and Drain Lines

- A. The accessories vent lines are open to atmosphere through ports on the lower side of the engine side cowl panels. Drains from the combustion chambers and fuel pressurizing and dump valve discharge into a collector tank beneath the engine. This tank is automatically exhausted overboard during flight. (See figures 1 and 2.)

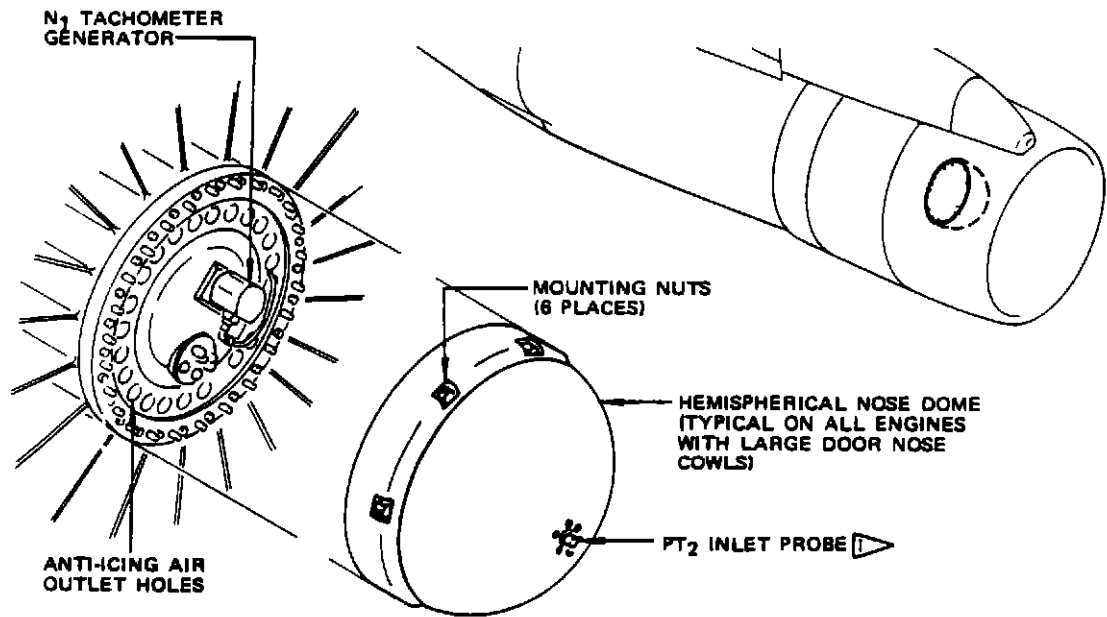
8. Engine Fireseal

- A. The engine fireseal forms a barrier between the rear (hot section) and forward (cold section) of the engine exterior surface. (See figure 7.) The periphery of the fireseal section is contoured to the inside of the side cowl panels. A hat section extends around the fireseal and interlocks with a similar section riveted inside each of the side cowl panels. With the side cowl panels closed, any fire hazard is prevented from spreading between the forward and aft sections of the engine.

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REFER TO ENGINE INDICATING CHAPTER 77, FOR EFFECTIVITY

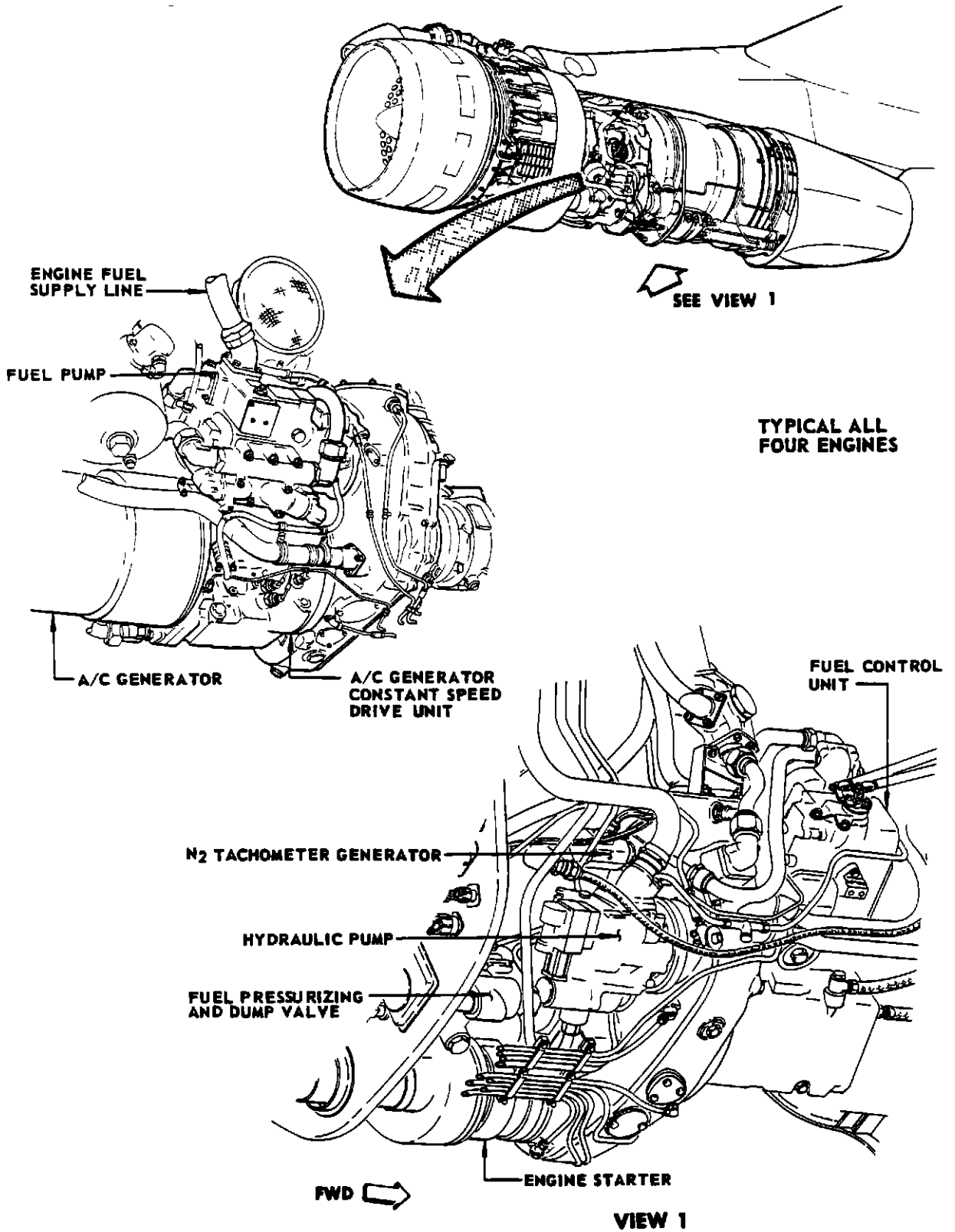


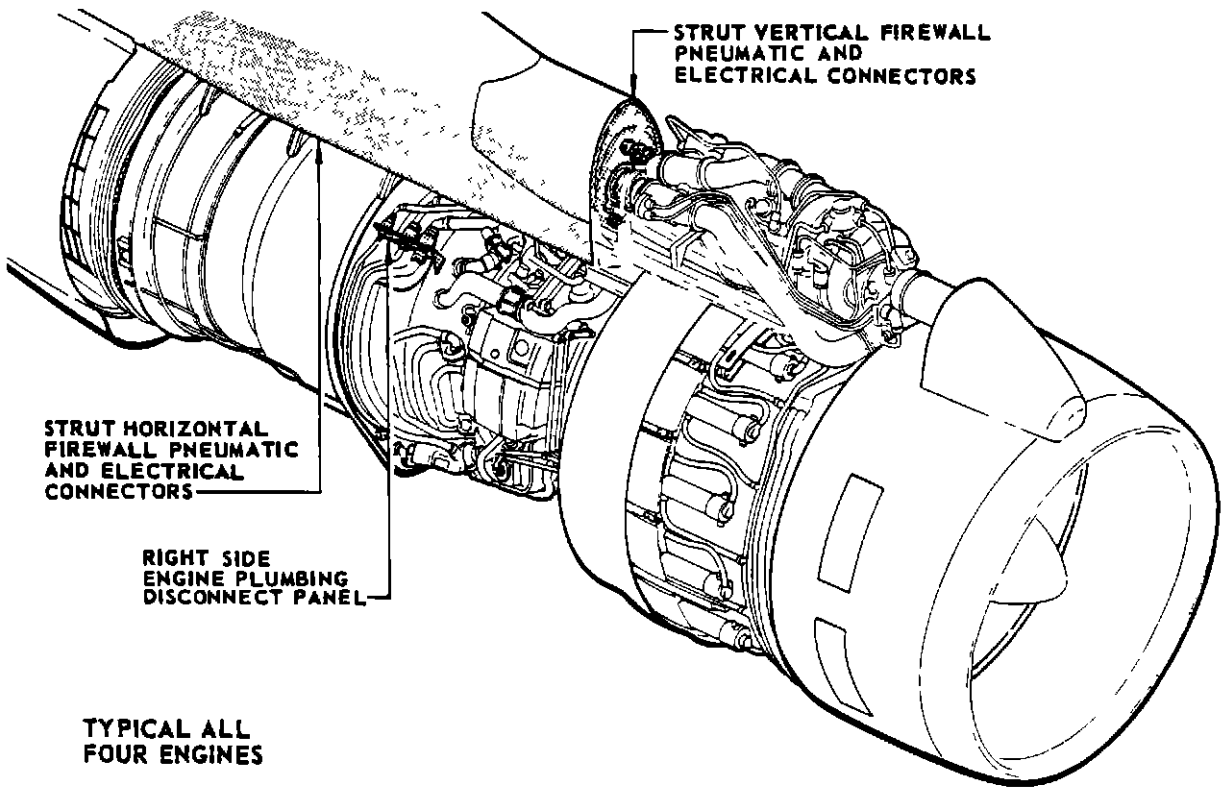
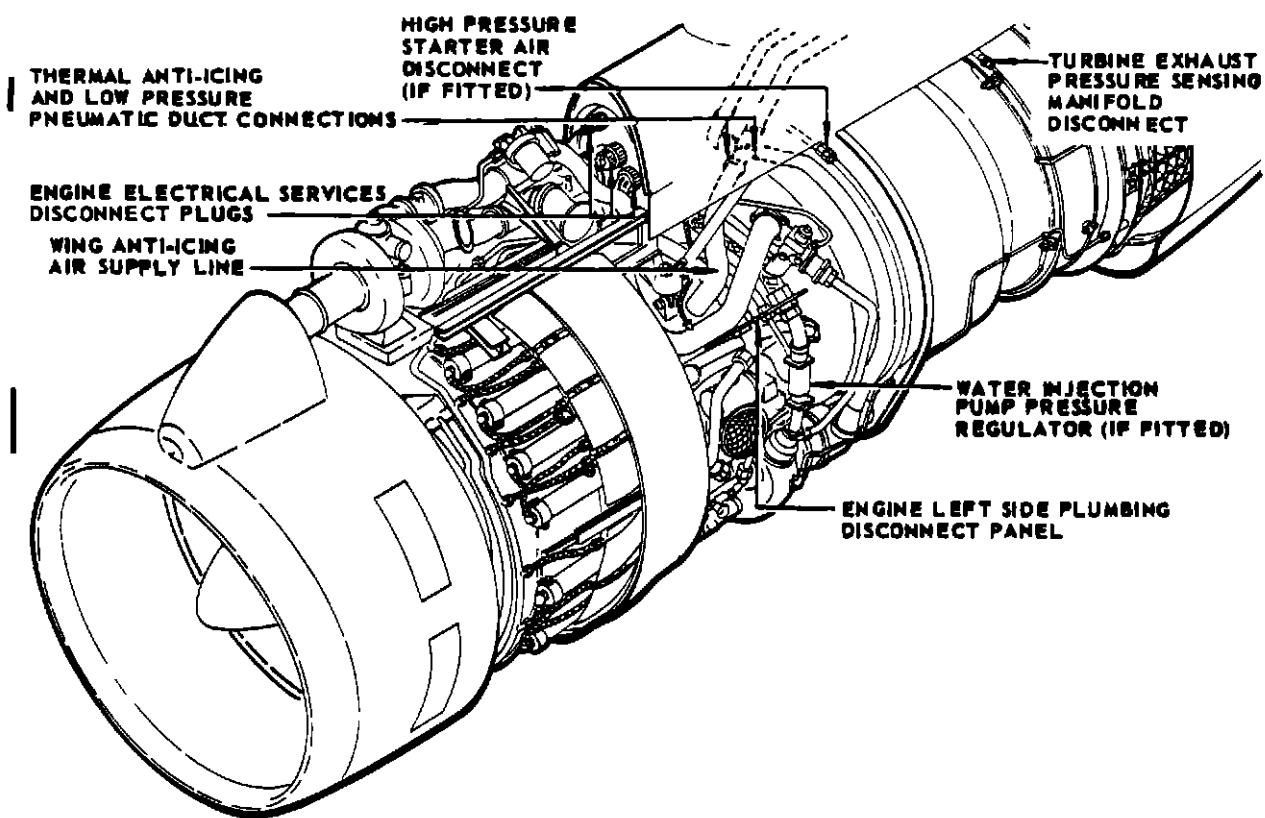
Engine-Driven Accessories  
Figure 5 (Sheet 1)

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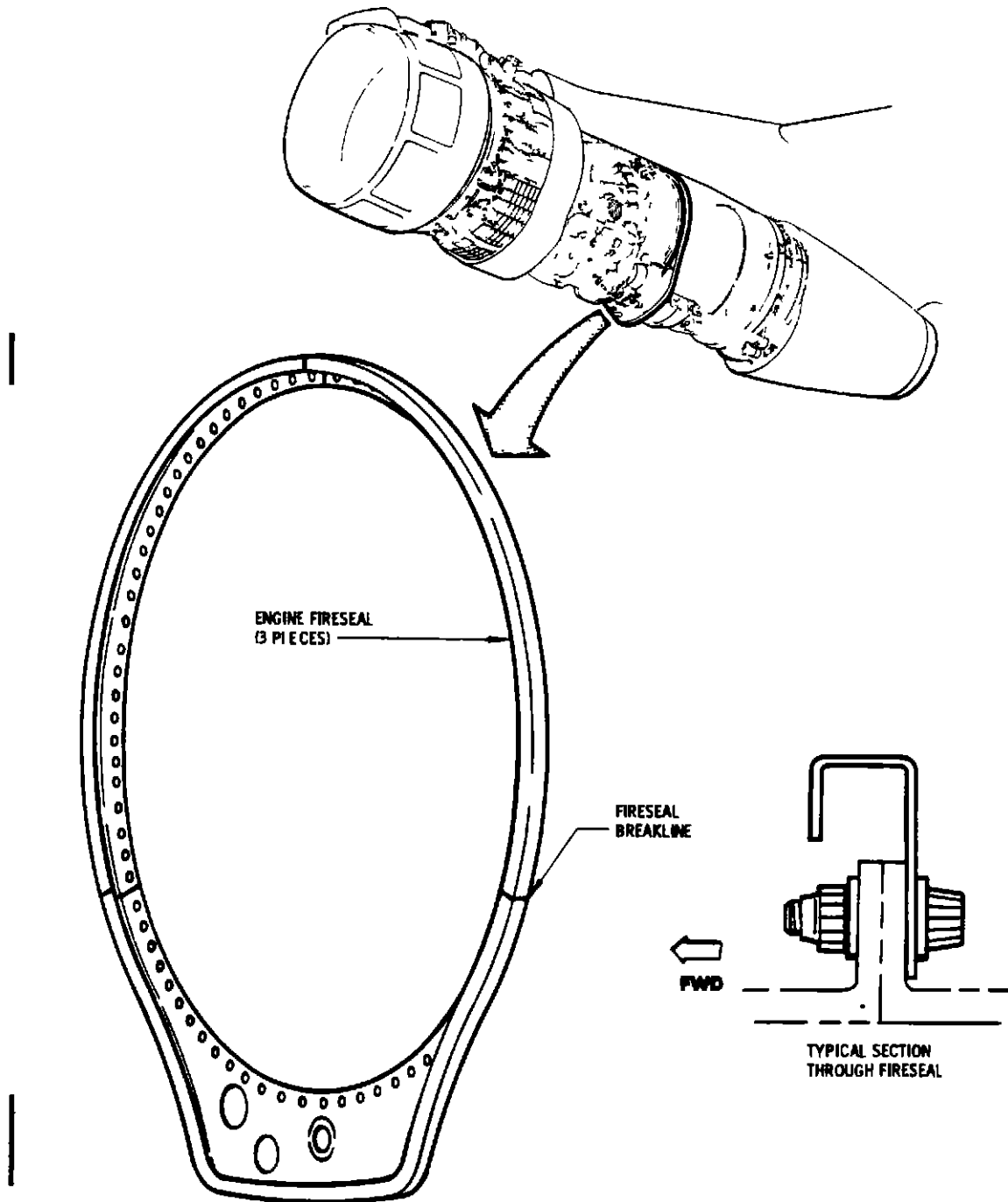
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Engine Electrical and Plumbing Disconnects  
 Figure 6



9. Engine Oil System

- A. The engine oil system is regulated to operate at a pressure of 40 to 55 psig at normal engine speeds. The overall system performs three functions; the supply of lubricating oil, scavenging of the oil after circulation, and the breathing or venting of excessive vapor pressure. Refer to Chapter 72, Engine.
- B. The engine oil tank is located between the 1 o'clock and 3 o'clock position on the right side of the engine slightly forward of the diffuser case. (See figure 2.) The oil pump in the main accessory drive gearbox, a scavenge pump is located at both No. 1 and No. 6 bearings and a dual scavenge pump clears No. 4, 4-1/2 and 5 bearings. Bearings No. 2, 2-1/2 and 3 drain into an oil gallery which is cleared by the main scavenge pump. This pump returns the oil to the main tank. A thermostatically controlled fuel/oil heat exchanger in the main scavenge pump outlet line cools the oil before it re-enters the tank. A full flow filter unit is on the downstream side of the oil pressure pump. The filter is fitted with a bypass which permits continued oil circulation in the event of filter blockage.
- C. All breathing passages from the oil tank and main bearings lead into the main accessory gearbox. Inside the gearbox is a centrifugal separator which removes oil droplets from the air/vapor mixture. The separator allows the oil to drain back to the gearbox sump and discharges the air to atmosphere.
- D. The engine oil tank is fitted with a volume measuring system which shows the amount of usable engine oil on an indicator at the flight engineers' station. Each engine oil system comprises a capacitance type probe in the oil tank and an indicator calibrated in gallons on the flight engineer's lower panel. A PUSH TO TEST GAGES switch is close to the four oil quantity indicators and may be used to check their operation. Refer to Chapter 79, Oil.
- E. An oil temperature sensing bulb is located at the inlet side of the oil filter. This bulb controls an indicator gage mounted on the flight engineer's lower panel. The four gages, one for each engine, are adjacent to the engine oil quantity indicators.
- F. An oil pressure indicating system shows effective oil pressure in psig on an indicator at the flight engineers station. Engine oil pressure is sensed at the main oil pump outlet. This pressure actuates a transmitter which sends an electrical signal to the indicator. The transmitter also senses engine vent pressure which works in opposition to main pump output, thus the indicator shows differential or effective pressure available through the engine oil system.

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- G. A warning light on the engine instrument panel illuminates when either oil system pressure falls below a safe level or when the main oil strainer becomes clogged. A differential pressure type switch senses pressure at the engine oil pump outlet and either accessory drive gearbox vent pressure or ambient pressure. Another differential pressure type switch senses pressures at the main oil strainer inlet and outlet. When the differential pressures at either switch reach a preset level, the switch will close, illuminating the warning light.

10. Engine Fuel Supply and Fuel Control

- A. The boost pumps mounted in the wing tanks transfer engine fuel through a shutoff valve in the wing dry bay area, then through plumbing which leads from the wing area down each strut, to the engine fuel pump (left side of engine). A fuel flow meter is located in each fuel line where it passes down the strut. Refer to Chapter 73, "Engine Fuel and Control" and Chapter 28, "Fuel."
- B. The two-stage engine driven fuel pump delivers fuel under pressure to the fuel control unit. (See figure 1.) A fuel filter and a fuel deicing heater (sixteenth stage air) are located between the first and second stages of the pump. Refer to Chapter 28, "Fuel." The fuel control unit automatically determines engine requirements and meters fuel according to the power setting selected by the thrust control levers.
- C. Metered fuel leaving the fuel control passes through a fuel/oil heat exchanger which removes excess heat from the engine lubricating oil. After discharge from the heat exchanger, the metered fuel builds up in a pressurizing and dump valve to a suitable pressure for use in the burner cans. At engine shut down, fuel remaining in the burner manifold lines drains back through the pressurizing and dump valve into a drain tank located behind the fireseal on the underside of the engine. This tank has drain lines extending overboard and during flight the tank discharges the waste fuel to atmosphere.

11. Ignition System

- A. The ignition system consists of two spark ignitors, electrical harnesses, and two exciter units. The ignitors are located in burner cans No. 4 and 5, and the two exciter units are at the 2 o'clock position on the right side of the engine under the fan air outlet fairing. Controls are on the pilot's overhead panel and control stand.
- B. Refer to 71-5-0, "Power Plant - Adjustment/Test" for ignition system switching sequence. For a detailed description of the ignition system, refer to Chapter 74, "Ignition."



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### 12. Starting System

- A. The starting system provides a means of rotating the N2 compressor and turbine. The compressor is rotated fast enough to establish a flow of air through the engine and allow safe ignition of the fuel/air mixture in the combustion section.
- B. A pneumatically operated starter is fitted to each engine. The starter may be operated by low pressure air (approximately 22 to 46 psi) supplied by a turbocompressor on an operating engine or a low pressure ground cart source. On engines equipped with a high/low pressure starter, the starter can also be operated by high pressure air (when supplied) from the airplane starter air bottle(s) or a high pressure ground source. Refer to Chapter 80, "Starting."

### 13. Engine Controls

- A. Engine power output is selected by means of four thrust levers located on the engine control stand. Each thrust lever is fitted with an additional lever which controls the operation of the thrust reverser. Refer to Chapter 76, "Engine Controls."
- B. Four start levers are provided on the control stand. Movement of the start levers is approximately 32°, extending from "CUTOFF" to "START" positions, with an additional small advance to "IDLE" detent. As the start levers are advanced the ignition system is energized. The system is cut off once a start lever is moved into the "IDLE" detent. The start levers remain in "IDLE" position during all engine running.
- C. The engine thrust levers actuate the fuel control unit through the range from idle to maximum thrust. When reverse thrust is required the thrust levers are placed in the idle position and the reversing lever, which is pivoted near the top of the thrust lever, is pulled to the rear and upwards. With reversers operating, the thrust levers can not be advanced beyond a position equivalent to approximately 80% normal engine thrust. Indicator lights, on the engine instrument panel, illuminate whenever the forward or aft thrust reverser sleeves depart from the forward thrust position.

### 14. Thrust Reverser

- A. The thrust reverser provides a means of retarding the forward speed of the airplane after touchdown by directing the engine fan discharge air and exhaust gases forward. Reverse thrust is accomplished through a combination of two simultaneously operated independent systems.

- (1) An aft thrust reverser is attached to the aft flange of the engine turbine exhaust section. Actuators on the reverser move the reverser sleeve aft exposing a ring of cascade vanes around the periphery of the thrust reverser. As the sleeve moves aft a pair of clamshell doors are closed blocking the exhaust gases and diverting them forward through the cascade vanes.
- (2) A forward thrust reverser, attached around the engine fan section, provides reverse thrust by utilizing actuators to move the forward reverser cowl ring aft to close off the fan air exhaust duct. A number of blocker doors, cascade vanes, and baffle plates are positioned by the aft motion of the cowl ring to discharge the air in a forward direction. Refer to Chapter 78 "Exhaust."

#### 15 Engine Indicating Systems

- A. The engine is fitted with indicating systems which show engine performance. The indicators are located at the flight engineer's and pilot's panels. Warning indicators are incorporated on some of the engine systems to give advance notice of possible engine malfunction.
- B. The engine oil system has indicators, located on the flight engineer's lower panel, for pressure, temperature and quantity. A test switch for the oil quantity indicating system is located adjacent to this group of indicator gages. Engine low oil pressure warning lights are on the pilot's engine instrument panel. Refer to Chapter 79, "Oil."
- C. Indications of engine performance are provided in the control cabin by turbine exhaust gas temperature indicators, engine exhaust/inlet pressure ratio indicators and tachometers for both the low pressure ( $N_1$ ) compressor and the high pressure ( $N_2$ ) compressor. A fuel flow indicator is also provided for each engine. Refer to Chapter 77, "Engine Indicating" and 28-9-0, "Fuel Flow Indicating System."

#### 16 Air Bleed System

- A. In addition to air required for engine anti-icing, on engines equipped with turbocompressors sixteenth stage air is taken from a pad at the 3 o'clock position on the diffuser case to operate the turbocompressor. On the inboard engines this air supply line has a small diameter pipe branched off to provide air pressurization of the hydraulic tank. (See figure 1.) A hot air supply for the fuel heating and de-icing unit is also taken from the left side of the diffuser case.

- B. A large diameter duct takes air from the intermediate case at a point just aft of the left-hand forward engine mount. This duct transfers the bleed air into the wing anti-icing system. (See figure 6.) A check valve is placed in the strut area of each wing anti-icing duct to prevent reverse air flow should the engine be shut down. Refer to Chapter 75, "Air."

17. Fire Protection

- A. A fire outbreak in the strut or engine nacelle areas is sensed by a continuous wire loop detection system. The detecting loop consists of a wire core enclosed in a metal sheath, these two conductors are separated by a semi-conducting material. If the temperature of this separating material is raised it allows a greater current flow between the wire and the sheath. This current triggers a circuit which controls a warning light and bell in the control cabin. Refer to Chapter 26, "Overheat and Fire Detection System."
- B. A fire outbreak is extinguished by flooding the strut and engine enclosures with inert gas. Each wing has two gas bottles stowed in the inboard strut. A distribution manifold and two selector control valves permit discharge of the gas to either engine. Bottle discharge is controlled from switches on the pilot's lightshield panel.

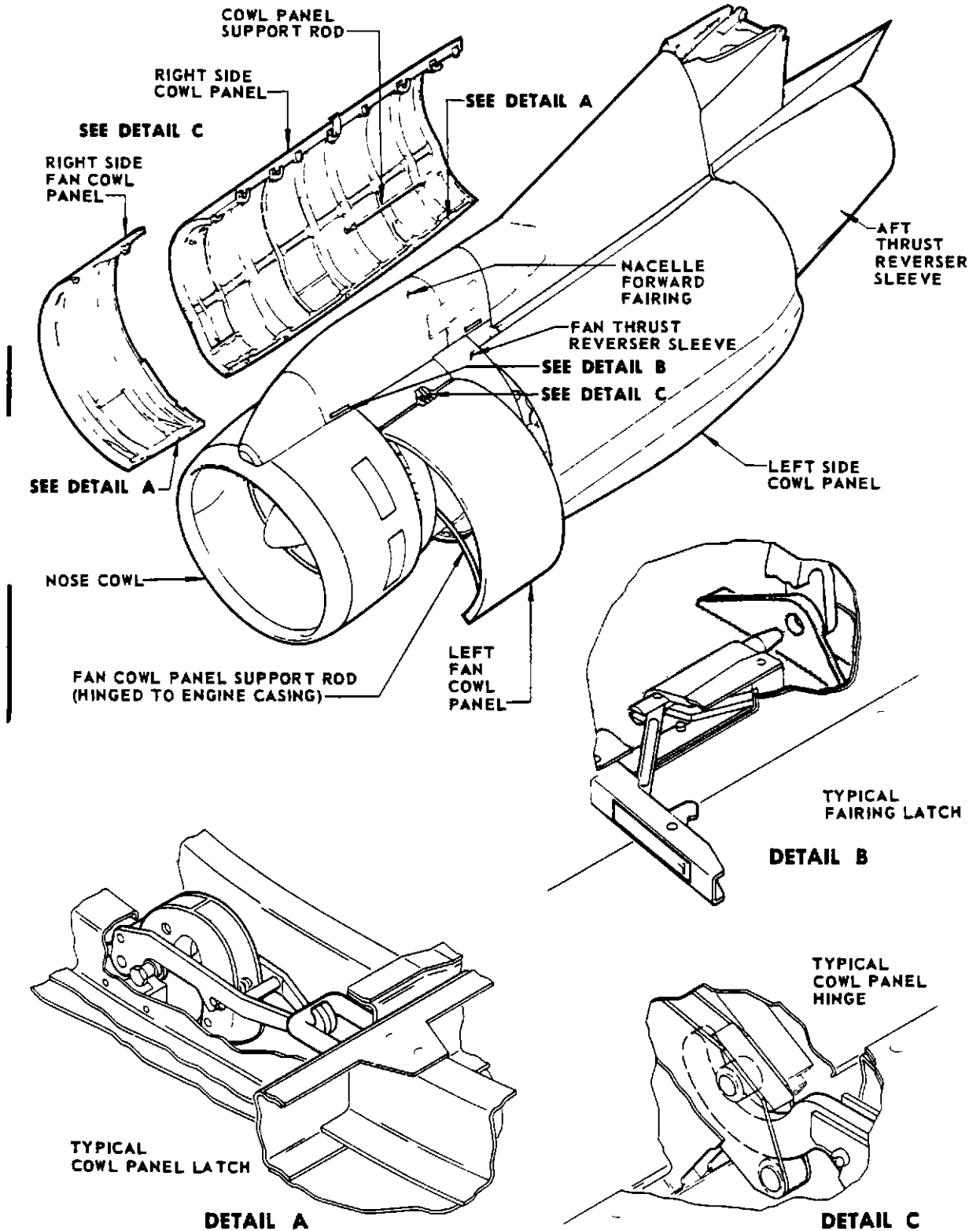
18. Engine Cowls

- A. The engine has removable cowlings to cover its exterior. (See figure 8.) These provide a smooth surface for the air stream passing over the engine and protect engine exterior components from damage. The nose cowl provides a passage for proper entry of the inlet air stream to the front compressor. The aft thrust reverser outer sleeve normally fairs up to the side cowl panels and covers the thrust reverser cascade vanes. When the engine is operating in reverse thrust this outer sleeve is moved aft, thus exposing the cascade vanes and allowing the exhaust gases to escape in a forward direction. The fan thrust reverser sleeve normally fairs with the fan cowl panels and is moved aft to expose the fan thrust reverser cascade vanes and panels during thrust reverser operation.
- B. Access to a majority of the engine exterior mounted accessories can be gained by opening the engine side cowl panels. Each panel is hinged by its top edge to the nacelle and fastened to its opposite cowl along the underside of the engine with a series of hook latch fasteners. The hinges are designed so that panels may be removed by raising them to a fully open position and lifting them clear of the nacelle and strut. A cowl support rod is stowed along the inner surface of each side cowl panel enabling it to be propped in the open position. Safety pins are provided to lock the rods in either the stowed or open position. Both

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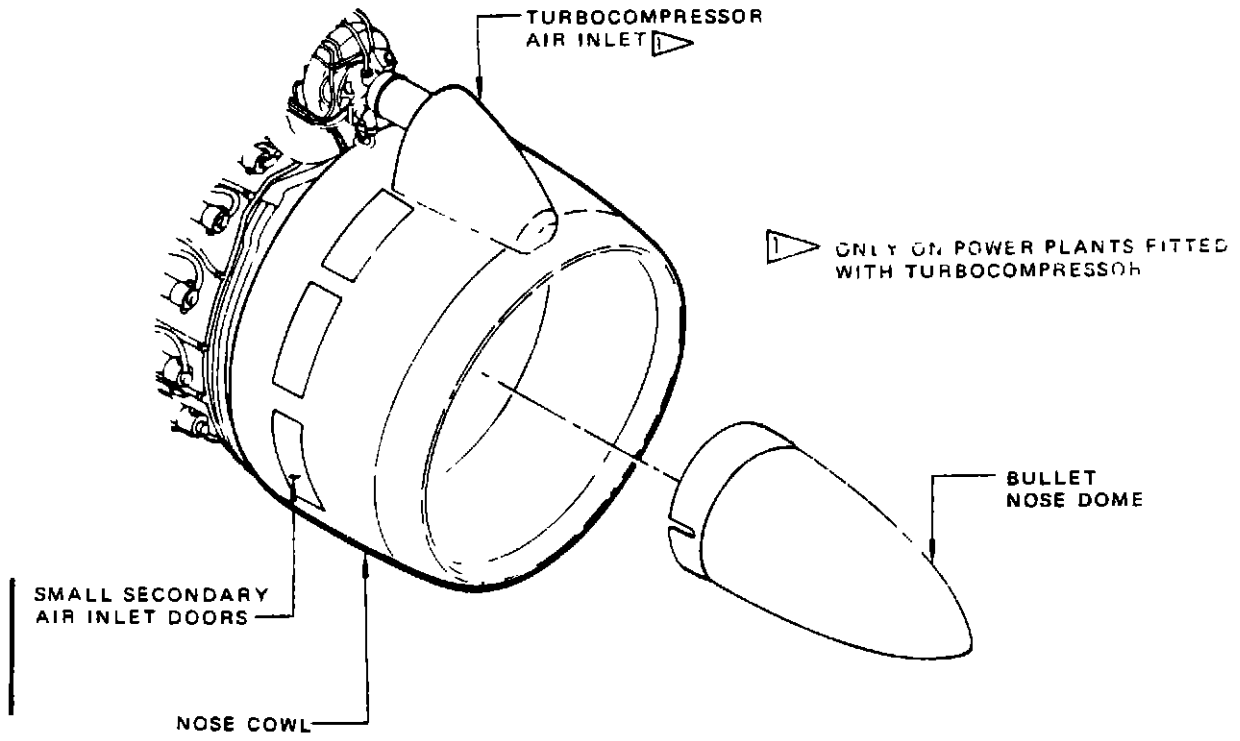
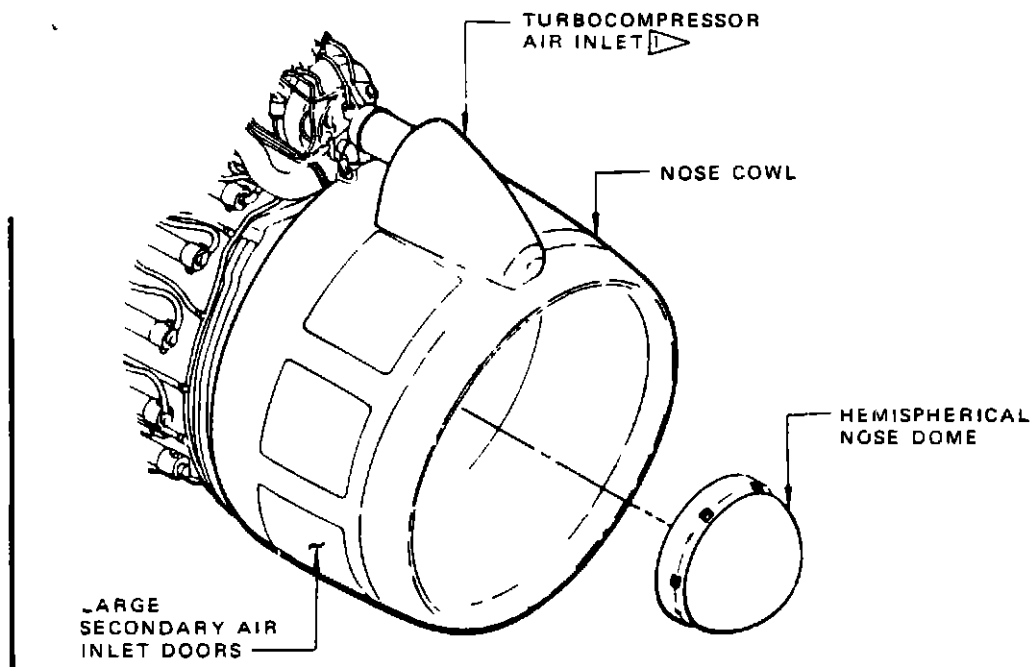
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engine side cowl panels have port openings to correspond with the various engine and strut drains. All drain tubes are fitted with spring-loaded sealing plates which provide a close fit with the side cowl panels when these are closed. An access panel is provided near the top forward end of the right side cowl panel to give access to the engine oil tank filler cap. A hat section rib is riveted to the inside of the cowl panels. This mates with a similar section around the engine fireseal and prevents fire from spreading between the combustion compressor sections of the engine. An access panel is provided in the lower front end of the right-hand cowl panel which allows fitting a remotely operated trim mechanism on the fuel control unit. A pressure relief door in the left side cowl panel opens automatically to relieve excessive pressure.

- C. The engine fan section and the thrust reversing mechanism for the fan exhaust are covered by a left and right side fan section cowling. These are hinged to the forward reverser slot seal and fitted with mating hook latch fasteners on their underside. The panels may be removed in the same manner as the engine main side cowl panels. The fan section cowls can be supported by rods stowed on the aft face of the nose cowl.
- D. The nose cowl is bolted to the engine inlet guide vane and shroud assembly. It is shaped to provide a smooth air flow over the engine exterior and a passage for inlet air to the engine compressors. On engines fitted with a turbocompressor, a fairing on the top of the nose cowl provides an air passage to the engine driven turbocompressor. The nose cowl has an anti-icing air inlet at the 12 o'clock position on its rear face immediately under the turbocompressor air inlet fairing. Eight spring-loaded doors are arranged around the aft outer face of the nose cowl. When the airplane has no forward motion these doors are opened inwards by engine suction and allow additional air to pass through the side of the nose cowl to the engine inlet. Once the airplane is in motion ram air entering the front of the nose cowl is able to supply all engine needs, thus engine suction on the eight doors diminishes and the doors close. (See figure 9.)
- E. The nose dome is bolted to the front accessory drive gearbox and covers the N1 tachometer. Anti-icing air from the inlet guide vanes enters the nose dome through passages in the front of the accessory drive gear case and discharges via a louver around the aft end of the nose dome. Either of two nose dome configurations may be installed. The long (31 inch) bullet shaped nose dome must be installed with nose cowls having small (4 x 14 inch) secondary air inlet doors. The short (10 inch) hemispherically shaped nose dome must be installed with nose cowls having large (13 x 16 inch) secondary air inlet doors.

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F. The nacelle forward fairing is located above the fan section of the engine, forward of the strut vertical firewall. On engines equipped with a turbocompressor, the nacelle forward fairing covers the turbocompressor and fairings with the turbocompressor inlet fairing as well as the engine strut. (See figure 8) Two types of fairing latch arrangements are used. Some fairings are equipped with six latches which fasten to fittings on the nose cowl and on the forward reverser slot seal, an improved fairing configuration uses four latches which secure the fairings to fittings on the nose cowl and on the forward end of the engine strut. Engines equipped with turbocompressors and four latch fairings have a shear pin, installed on the left beam of the forward reverser slot seal, which mates with a receptacle on the fairing, to provide additional security. Fairings with either latch configuration may be interchanged by replacing the attach fittings on the nose cowl, the forward reverser slot seal and the forward bulkhead of the nacelle strut as required. Refer to Service Bulletin No. 1922 for specific convertibility details.

19. Power Plant Interchangeability

A. Each power plant is built up for its specific airplane position and is not suitable for installation at another engine station. The basic engine is the same for all power plants and the external equipment and accessories are varied as described in the preceding paragraphs.

POWER PLANT - THREE ENGINE FERRY FLIGHT PREPARATION

1. General

- A A three engine ferry flight may be performed when an engine change at a remote location is undesirable or inconvenient. When performing this type of flight, care should be taken to prevent possible damage to the inoperative engine due to windmilling of the N1 and N2 compressor rotors.

NOTE. If the engine received only minor damage prior to shutdown, ferrying the airplane without controlling windmilling could increase internal damage and result in more expensive rework or overhaul.

- B To prevent an inoperative engine from windmilling, it is necessary to block the engine inlet and either the primary exhaust or the fan air exhaust. Plugging the engine inlet is not sufficient to prevent reverse engine rotation since the airflow past the fan air exhaust area creates a negative pressure which causes air to flow forward through the primary exhaust and out the fan air exhaust. This air circulation results in reverse rotation of the N2 compressor rotor.
- C. Blocking the inlet of an inoperative engine may cause the fan sleeve to move to the reverse thrust position due to normal in flight vibration and the absence of air loads that hold the sleeve in the forward thrust position during normal engine operation. To prevent this occurrence the fan sleeve should be locked in the cruise position by inserting an aluminum alloy bar between the stop lug on the track and the carriage stop bolt inside the two main carriages.
- D. To prevent inadvertant starting of an inoperative engine after installing the engine air inlet cover and fan exhaust cover, the IGNITION and ENGINE IGNITOR circuit breakers must be opened.
- E. The recommended and easiest method for preparing an inoperative engine for a three engine ferry flight is by using Boeing developed tool F70163-1 and F70163-4. These tools enable an engine to be prepared for ferry without removing or disconnecting any of the power plant components except for the removal and reinstallation of the fan reverser stop bolts during installation of the lock-out bars.
- F. An alternate method may be used whereby the engine inlet is blocked with a metal or plywood inlet cover (Fig. 201), the aft thrust reverser clamshell doors are secured in the reverse thrust position, and the fan reverser sleeve is locked in the cruise position.

2. Equipment and Materials

A. Items (1) and (2) are used for the preferred ferry configuration; items (5), (6) and (7) are used for the alternate ferry configuration; items (3) and (4) are used for both configurations.

- (1) Engine Inlet Cover - F70163-1
- (2) Fan Exhaust Cover - F70163-4
- (3) Forward Reverser Lock-out Bar, 2 required (Aluminum Alloy 2024-T3, 0.250 x 0.60 x 7.10 inches)

NOTE This item is included with the F70163-4 fan exhaust cover

- (4) Circuit Breaker Collar - G57NB-5, Nylon Molding Corp., Garwood, N J.
- (5) Plywood or Metal Inlet Cover, fabricate per Fig. 201
- (6) Clamshell Door Restrainer (Aluminum Alloy 0 08 x 1.5 x 14.74 inches), Contoured to Fit Lower Portion of Clamshell Doors
- (7) Follow-up Rods Lock (Aluminum Alloy 0.08 x 1.75 x 7.75 inches)

3 Prepare Inoperative Power Plant for Three Engine Ferry - Preferred Method

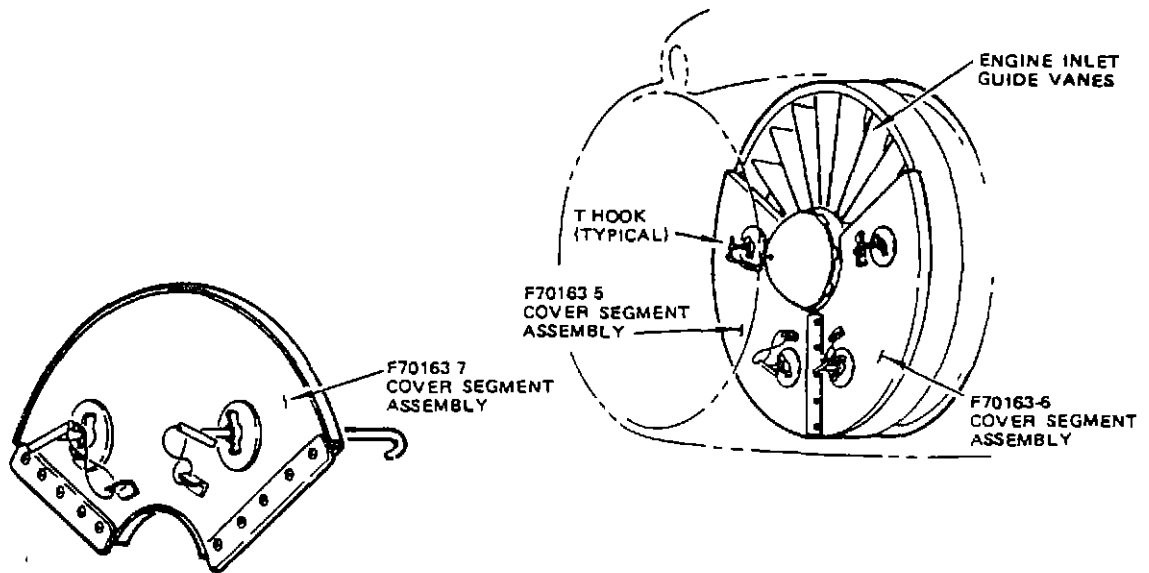
A Install engine air inlet cover, F70163-1, as follows

- (1) Insert F70163-5 cover segment assembly into engine nose cowl and engage each T-hook with aft end of engine inlet guide vanes (Fig. 201).
- (2) Insert F70163-6 and F70163-7 cover segment assemblies, in that order, into engine nose cowl Engage T-hooks with engine inlet guide vanes.
- (3) Tighten all T-hook wing nuts finger tight and lockwire to adjacent angle.

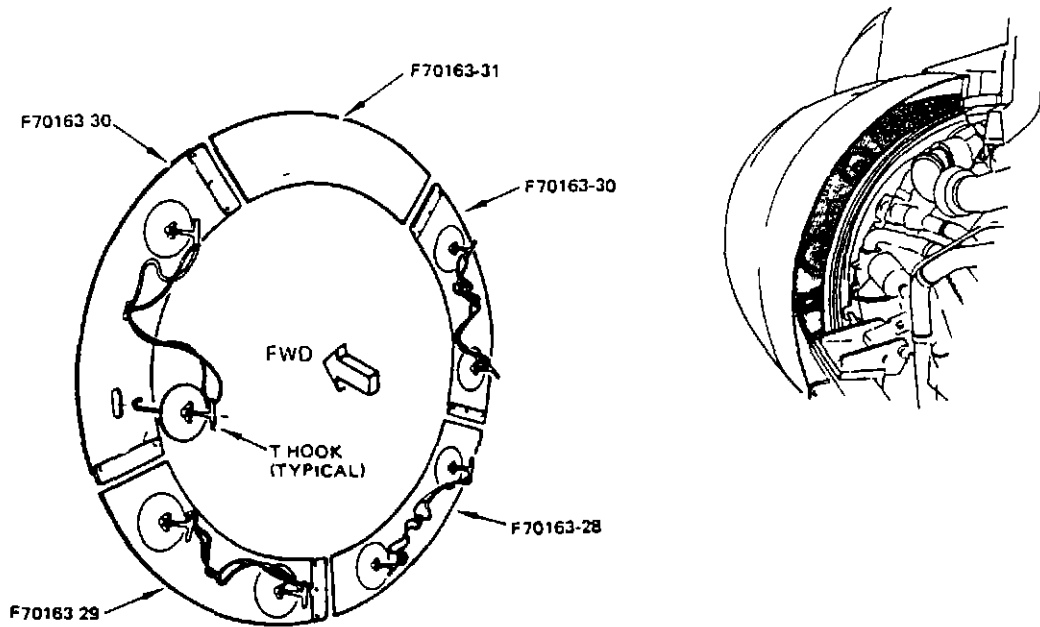
B. Install F70163-4 fan exhaust cover as follows.

- (1) Remove engine side cowl panels and fan cowl panels (71-5-21).
- (2) Position F70163-31 cover segment at top of fan exhaust duct forward of fan air exhaust diaphragm. Position F70163-30, -28, -29 and -30 cover segments, in that order, in fan air exhaust duct (Fig. 203).

NOTE. Two -30 segments are included in the -4 fan exhaust cover.

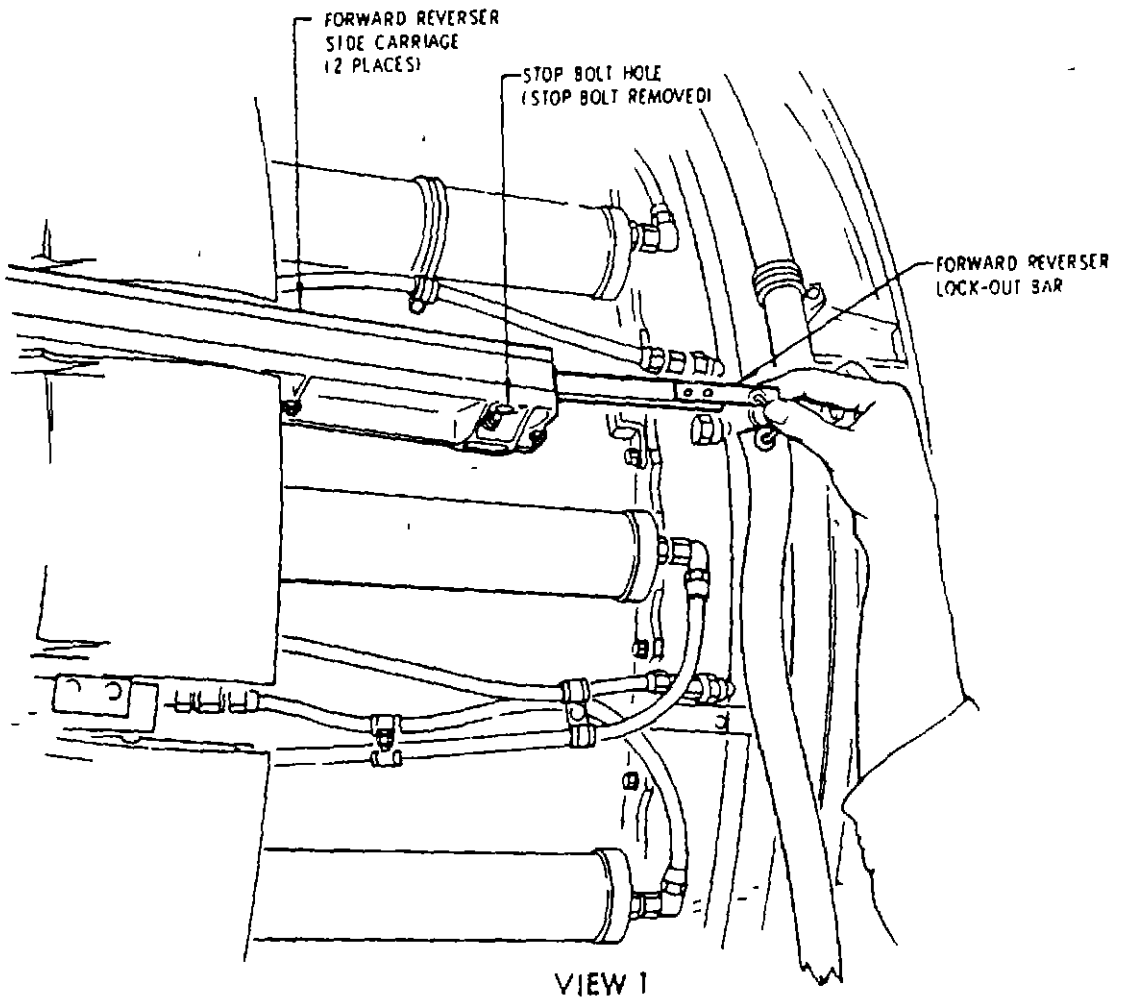
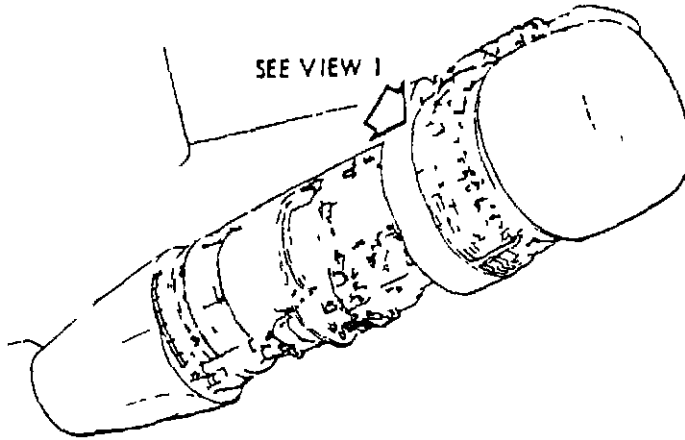


Engine Inlet Cover Installation  
 Figure 201



Fan Exhaust Cover Installation  
 Figure 202  
 TR 71-78

- (3) Engage each T-hook with forward end of fan exhaust guide vanes. Tighten T-hook wing nuts finger-tight and lockwire
  - (4) With thrust reverser in cruise position, remove forward thrust reverser carriage stop bolts at the two side carriages; insert a F70163-42 lock-out bar between the track stop lug and the carriage stop bolt hole at each side carriage and reinstall carriage stop bolts (Fig. 203).
  - (5) Install left and right side cowl panels and fan cowl panels
- C. Open Ignition circuit breaker and ENGINE IGNITORS IGN1 and IGN2 circuit breakers on circuit breaker panel P-6 for inoperative engine. Install circuit breaker collars on opened breakers.
- 4 Prepare Inoperative Power Plant for Three Engine Ferry Flight - Alternate Method
- A. Open left and right fan cowl panels (Ref 71-5-21).
  - B. With thrust reverser in cruise position, remove forward thrust reverser carriage stop bolts at the two side carriages, insert locally fabricated lock-out bars between the track stop lug and the carriage stop bolt hole, and reinstall carriage stop bolts (Fig 203).
- CAUTION ATTACH RED STREAMER TO LOCK-OUT BAR OR TO REVERSER CARRIAGE TO ENSURE REMOVAL OF LOCK-OUT BARS AT AIRPLANE DESTINATION.
- C. Close left and right fan cowl panels.
  - D. Install either the following compressor inlet covers (Fig. 204).
- (1) One Piece Cover Installation
    - (a) Remove engine nose cowl (Ref 71-5-11)



- (b) Attach cover between nose cowl and nose cowl mounting flange using fasteners that normally mount nose cowl to engine.

NOTE: The mounting ring of a one piece cover should have a maximum thickness of 0.064. If a thicker plate is used, the nose cowl may move forward so far that it is impossible to close the forward latch of the nacelle forward fairing.

(2) Three Piece Cover Installation

- (a) Remove nose dome and N1 tachometer generator.
- (b) Attach the cover pieces to the engine front accessory drive housing using the studs to which the nose dome normally attaches.
- (c) Install aluminum strips between adjacent sections to provide an air-tight seal and splice the sections together.

E. Secure thrust reverser clamshell doors in reverse thrust position as follows:

- (1) Remove side cowl panels (Ref 71-5-21).
- (2) Move aft thrust reverser sleeve to reverse thrust position.
- (3) Disconnect hinge drive drag links (4 places) from hinge drive idler links and aft thrust reverser sleeve. Store links in airplane for later installation.
- (4) Secure clamshell doors in the reverse thrust position by bolting clamshell door restrainer between the two hinge drive idler links at bottom of reverser (Fig. 205).

NOTE: Clamshell door restrainer hole centers are 13.125 inches apart.

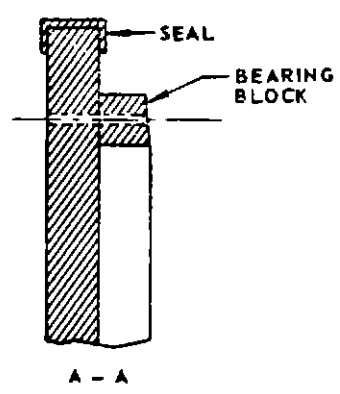
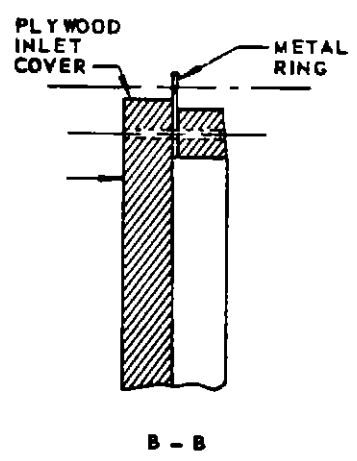
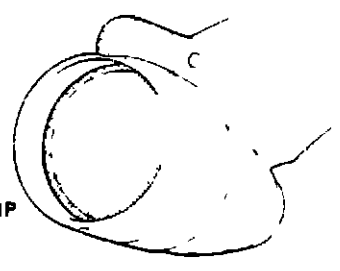
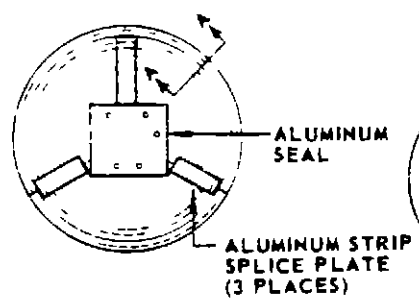
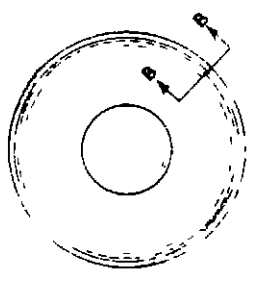
- (5) Remove bolts securing clamshell door upper hinge arms to aft follow-up rods, align follow-up rods lock and reinstall bolts.

NOTE: Follow-up rod lock centers are 6.125 inches apart.

- (6) Move aft reverser sleeve to forward thrust position and ensure that locks have engaged by exerting aft force on sleeve.
- (7) Install side cowl panels (Ref 71-5-21).

F. Open IGNITION circuit breaker and ENGINE IGNITORS IGN1 and IGN2 circuit breakers on circuit breaker panel P-6 for inoperative engine. Install circuit breaker collars on opened breakers.

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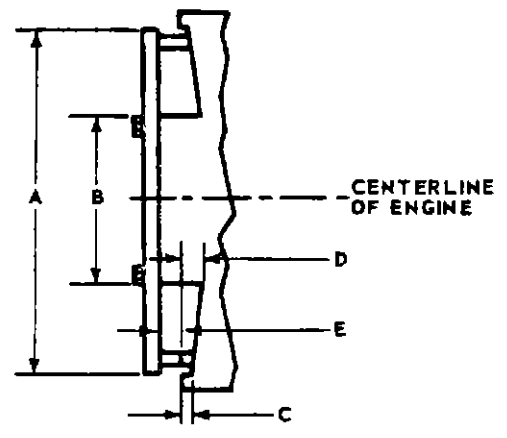


NOTES

- 1 ATTACH BEARING BLOCK TO COVER TO COMPENSATE FOR SWEEPBACK OF INLET GUIDE VANE LEADING EDGES
- 2 FABRICATE FROM .05 - .06 IN ALUMINUM OR STEEL ALLOY SHEET OR .05 IN PLYWOOD (IF PLYWOOD IS USED ON THE ONE PIECE COVER CUT UNDER SIZE AND ATTACH .05 - .06 METAL RING FOR USE AS MOUNTING SURFACE)
- 3 SEAL OUTER EDGE OF THREE PIECE COVER AND NOSE DOME CUTOUT OF ONE PIECE COVER WITH RUBBER OR FELT MATERIAL
- 4 SEAL JOINTS OF THREE PIECE COVER WITH STRIPS OF ALUMINUM SHEET

DIMENSIONS (INCHES) FOR LAYOUT OF INLET COVER				
A	B	C	D	E
NOSE COWL ID	NOSE DOME OD	COWL PLANE TO GUIDE VANES (OUTER)	COWL PLANE TO GUIDE VANES (INNER)	COWL BOLT FLANGE LEVEL TO NOSE DOME LEVEL
51	18	0.35	0.751	1.00

TABLE I

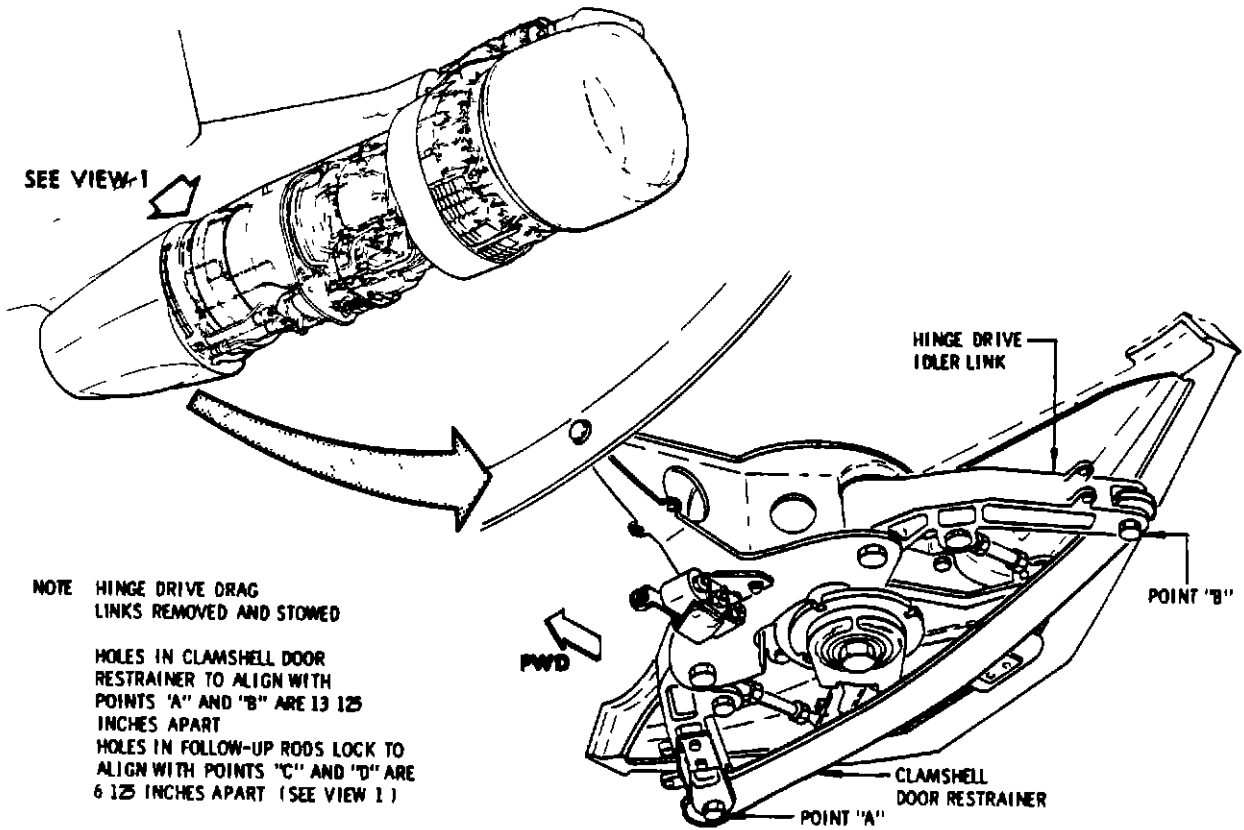


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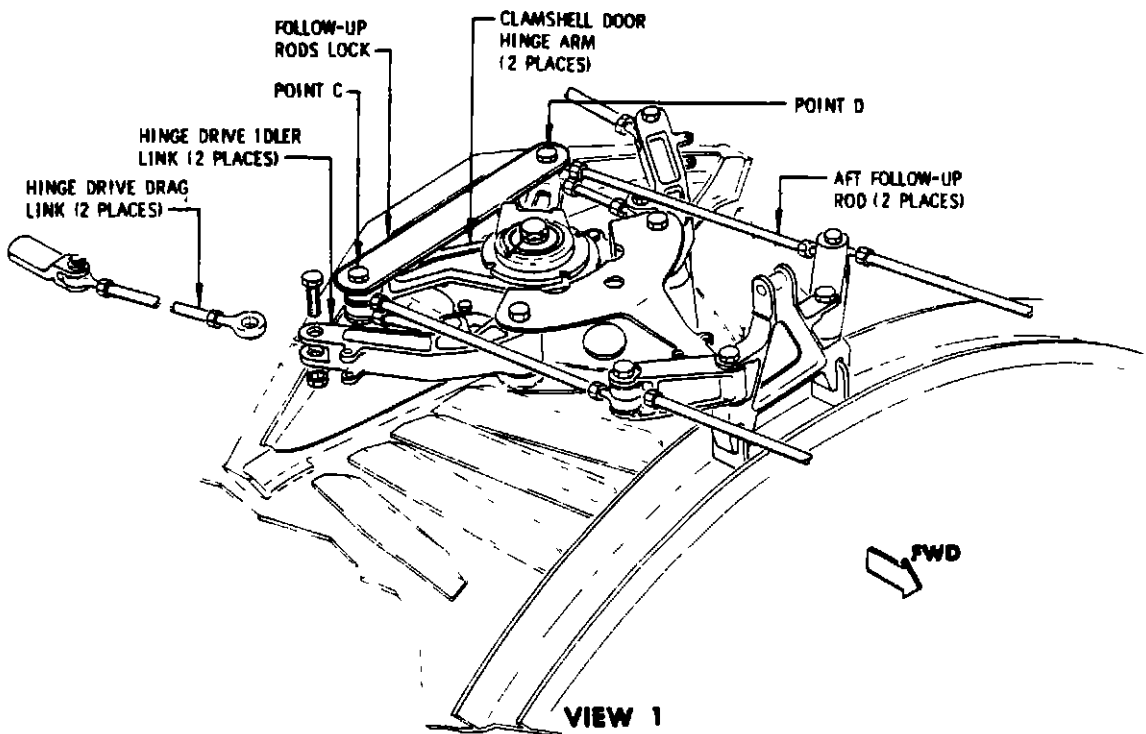


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NOTE HINGE DRIVE DRAG LINKS REMOVED AND STOWED

HOLES IN CLAMSHELL DOOR RESTRAINER TO ALIGN WITH POINTS "A" AND "B" ARE 13 1/2 INCHES APART  
 HOLES IN FOLLOW-UP RODS LOCK TO ALIGN WITH POINTS "C" AND "D" ARE 6 1/2 INCHES APART (SEE VIEW 1)



Clamshell Door Restraint Figure 205



## MAINTENANCE MANUAL

TEMPORARY REVISION NR. DFW 71-01

INSERT FACING TO SUBCHAPTER 71-05-0, PAGE 401

REASON FOR CHANGE: Engine Removal / Installation - Alternate Procedure.

INSTRUCTION: Insert updated page.

NOTE: The insertion of this TR has to be listed in the Record of Temporary Revisions at the beginning of Volume 1.

TCA: LX-N20199

RTCA: LX-N19997, LX-N20000

# 71-5-0

TR-Nr. 71-01

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## MAINTENANCE MANUAL

### POWER PLANT (JT3D) - REMOVAL/INSTALLATION ALTERNATE PROCEDURE

#### 1. General

- A. Any one engine may be removed without employing an aft fuselage jack. When more than one engine is to be removed it is recommended that an aft fuselage jack is to be installed in order to prevent the possible tipping of the airplane. See Chapter 7 for airplane jacking procedure.

**CAUTION** MAIN GEAR OLEOS MUST BE DEFLATED WHEN USING AFT FUSELAGE JACK TO PRECLUDE AIRPLANE WEIGHT FROM SETTLING ON NOSE GEAR AND AFT FUSELAGE JACK

- B. The engine aft trailer may be used for lowering and lifting the engine. An engine may not be lowered or lifted unless extreme care is used to ensure that engine components do not strike strut, that all tubes and wire bundles are clear during movement and electrical harnesses are positioned so as not get trapped.
- C. During engine removal all apertures must be blanked off with approved plugs and shields. Similarly all tube ends and electrical connectors must be covered and plugged as soon as possible after disconnection. Conversely, during installation, covers and plugs should be left in place until the connections are made.

#### 7. Equipment and Materials

- A. Engine Lift Trailer Model 4100B
- B. Engine Mount Bolts Thread Protector F70010-4, -5, -6 or equivalent.
- C. Engine Handling Kit - F70142 or equivalent.
- D. Anti-Seize Compound - EASE-OFF 990 or equivalent (if required).
- E. Engine Mount Nut (Rear) Reversible Ratchet Wrench - F71418 or equivalent.

#### 4. Remove Power Plant

**CAUTION** THE "FUEL FLOWMETER" CIRCUIT BREAKERS MUST BE PULLED (OPEN) WHENEVER THE ENGINE FUEL SUPPLY LINE IS DRAINED OR THE AIRPLANE IS OUT OF SERVICE FOR MAINTENANCE THIS WILL PREVENT DRY OPERATION DAMAGE TO THE TRANSMITTER

- A. Disconnect external electrical power and ground airplane to an approved ground connection. Position the battery switch on the flight engineer's upper panel to OFF.

**CAUTION** THE EXTERNAL ELECTRICAL POWER RECEPTACLE MUST BE TAGGED TO PREVENT USE DURING REMOVAL AND INSTALLATION OF AN ENGINE



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- B. Check that start levers are in CUTOFF position
- C. Depressurize utility hydraulic supply system.

**NOTE:** Utility hydraulic system is depressurized by positioning the handle on the manual bypass valve located in the right hand wheel well, to BYPASS. Unscrew cap on hydraulic reservoir, located in left wheel well, 3 turns to allow depressurization.

- D. Check that applicable engine fuel shutoff valve, located in inboard dry bay is closed and disconnect electrical plug from valve. Install dummy plug into valve receptacle.
- E. Remove main side cowl panels. Refer to 71-5-21.
- F. Drain fuel supply line to engine.
  - (1) Place container, minimum capacity five gallons, under engine fuel pump, right side of engine.
  - (2) Remove drain plug on fuel pump and allow fuel to drain out, replace and tighten drain plug (see detail E., Fig. 406).
- G. Unlatch and remove nacelle forward fairing. Refer to 71-5-31.
- H. Disconnect engine start control rod (1, Fig. 406) from start control shaft lever arm, disconnect power control rod (2) from power control shaft lever arm and install four rig pins to hold linkage in position.
- I. Remove bolts from both ends of fan reserver control rod (18., Fig. 406) and remove rod. Tag for identification.
- J. Remove duct clamps (14 and 15, Fig. 406) from thermal anti-icing duct and pneumatic duct to engine starter. When fitted to airplane, disconnect starter high pressure air supply line (16). Disconnect electrical plug on pneumatic duct motor operated valve
- K. Disconnect two large electrical connectors (9, Fig. 406), and exhaust gas temperature disconnect plug (8), at horizontal fire wall. When fitted to airplane, disconnect two single wire fire detection system electrical connectors located aft of plug (8). Undo clamp supporting wiring harness from engine forward mount brace.
- L. Disconnect two large electrical connectors (3, Fig. 406), oil quantity indicating system and interphone connectors (5 and 2) from strut vertical bulkhead. Unbolt two generator ground leads (1) and conduit grounding lead (4) from right side of bulkhead (see detail A). Unclamp electrical raceway duct on vertical bulkhead.



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- M. Uncouple pneumatic hose (6, Fig 406) at right side of strut vertical bulkhead (see detail A.)
- N. On engines fitted with turbocompressor, remove clamp (7, Fig. 406) on turbocompressor output duct and disconnect turbocompressor pressure sensing line (26) at T-fitting.
- O. Uncouple fan reverser actuator pneumatic supply line (10, Fig. 406) at control valve and at fitting slightly forward of strut vertical bulkhead. Disconnect thrust reverser control valve pneumatic supply line (27) at flex hose (see detail B.).
- P. When removing engines No. 2 or 3, uncouple hydraulic reservoir pressurizing line (left side of engine) (see detail C., Fig. 406). Also at disconnect panel, right side of engines No. 2 or 3 uncouple hydraulic pump return line (11), delivery line (12) and pump inlet supply line (13) (see detail B.). Remove clamps that support hoses from engine casing.
- Q. At disconnect panel (left side of engine) uncouple fuel supply line (23, Fig. 406) and strut drain line (24). When fitted to airplane, disconnect water injection line (25) (see detail F.). Unfasten clamps holding flexible lines to engine casing.
- R. Uncouple and remove two aft thrust reverser follow-up control rods (18 and 19, Fig. 406). Tag for identification.
- S. Uncouple exhaust pressure sensing line (17, Fig. 406) at horizontal firewall and two thrust reverser pneumatic lines (22) at bracket mounted on firewall above engine diffuser section. Uncouple combustor chamber drain tank pressurizing line (see view 2.)
- T. Disconnect two aft thrust reverser actuator lines (21, Fig. 406) at brackets mounted on horizontal firewall (see view 2).

**CAUTION** CAREFULLY USE ENGINE LIFT TRAILER TO FACILITATE ENGINE REMOVAL/INSTALLATION AND AVOID ANY DAMAGE TO STRUT AND/OR ENGINE

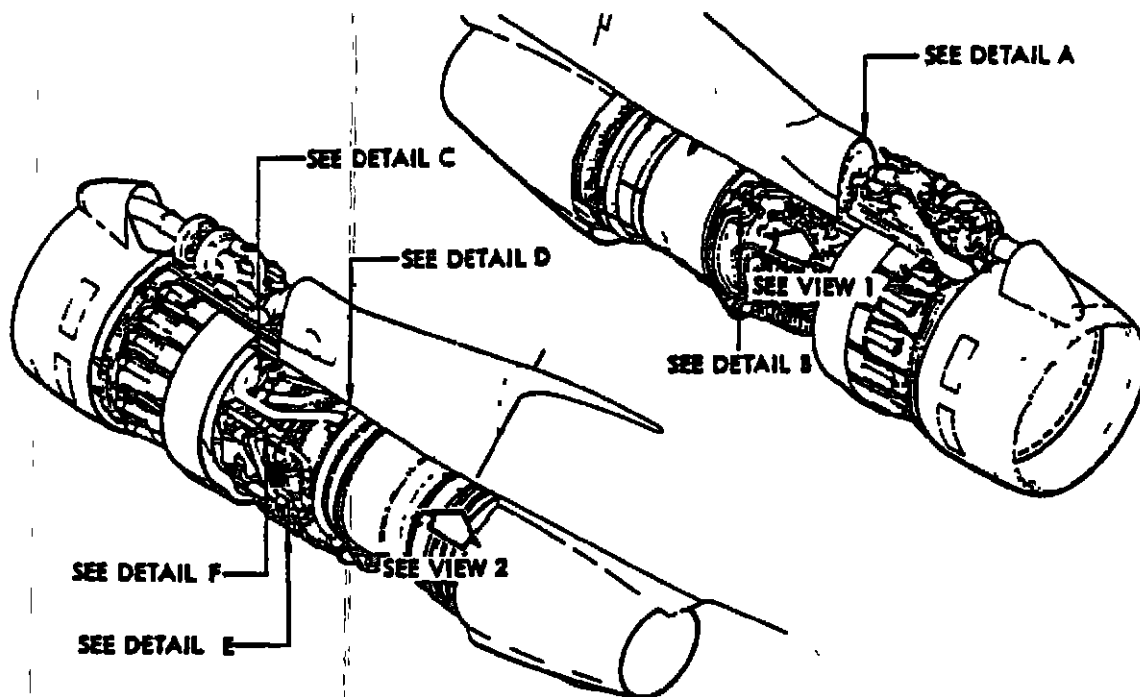
- U. Carefully position engine lift trailer below engine.
- V. Attach forward mount assembly to engine mount lugs (1, Fig. 409 Sheet 2 of 2) on left-hand side of engine using ball lockpins (2ea). Fwd lock pin is installed from forward side of lugs, aft lockpin is installed from aft side of lugs.
- W. Attach forward mount assembly to engine mount lugs on right-hand side of engine using ball lockpins (2ea.). Ball lockpins are installed from aft side of lugs.
- X. Install aft support assembly, with roller assemblies, on positioning trailer rails.



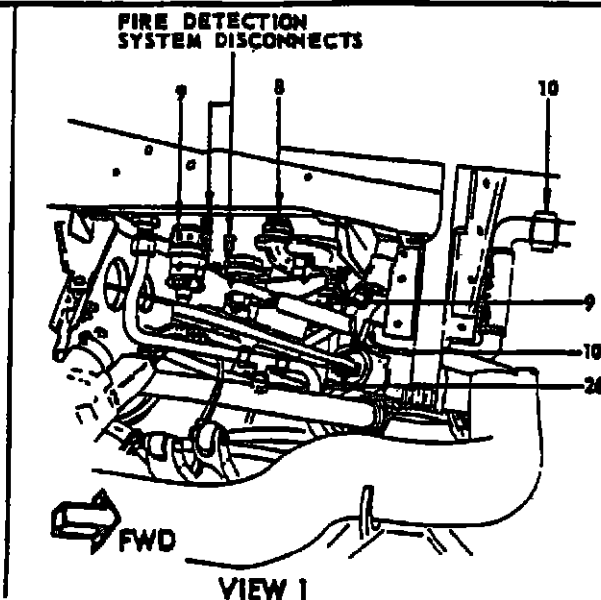
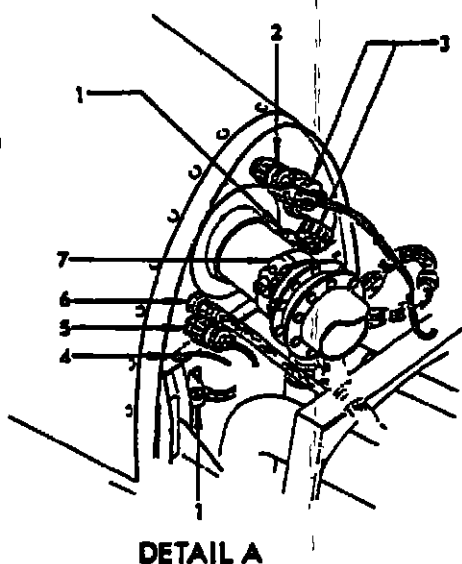
## MAINTENANCE MANUAL

- Y. Install fwd support assembly, with roller assemblies, on positioning trailer rails.
- Z. Raise rails until ball lockpins can be inserted in turbine case flange mount ring holes on aft support assembly on both sides of engine.
- AA. Align holes of fwd support assembly and fwd mount assembly and insert ball lockpins on each side of engine.
- AB. Extend safety feet from positioning trailer and release weight from wheels. Extend stabilizing jacks of trailer until snug.
- AC. Extend stabilizing jacks of trailer until snug.
- AD. Continue to raise until weight is supported by trailer. After engine is positioned on rails, lock roller assemblies in place with locking knobs.
- AE. Loosen cone bolt nuts on the three engine mount fittings and fwd lateral bolt.
- AF. Visually check all disconnected points to ensure all tubes and harnesses are free of strut.
- AG. Remove and discard engine mount nuts and washers and install thread protectors (Engine Mount Bolts Thread Protector F70010-4, -5, -6 according to location).
- AH. Carefully lower engine. Check that all disconnect points are free and that tubing and wiring are not fouled.

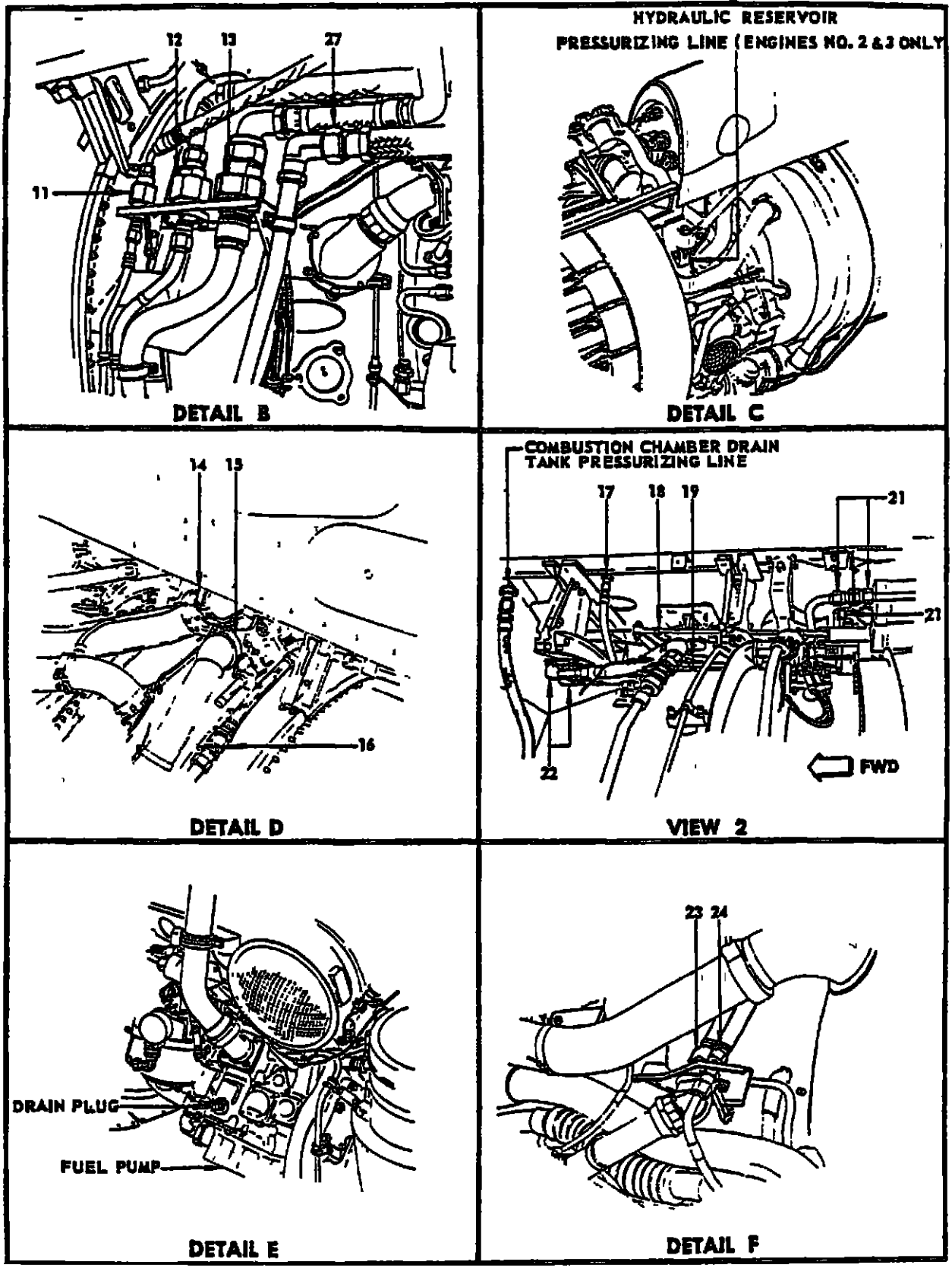
**CAUTION** USE EXTREME CARE TO ENSURE THAT ENGINE DUCTS AND CONE BOLTS DO NOT STRIKE STRUT



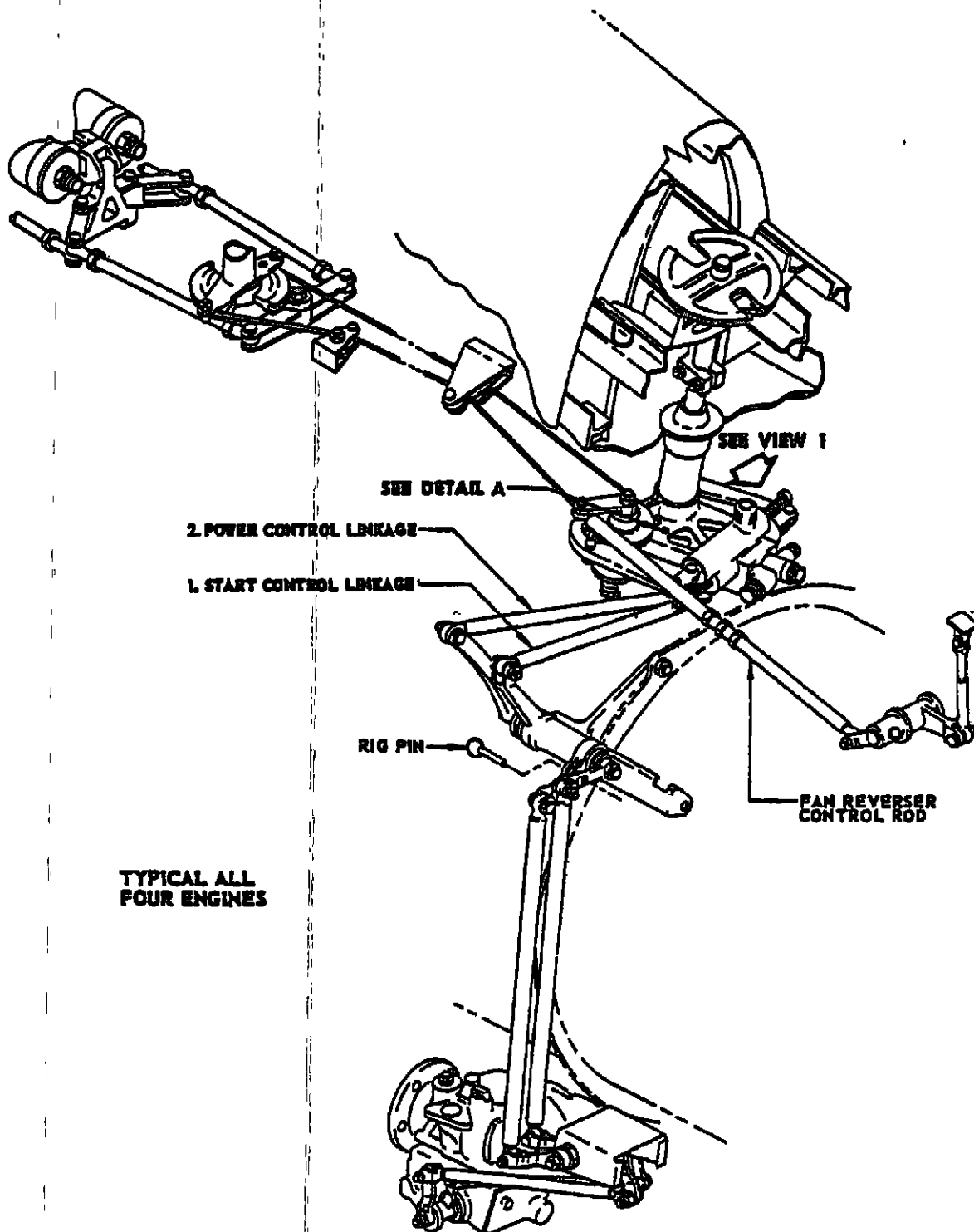
- |  |   |   |
|--|---|---|
| 1 GENERATOR GROUND LEAD                    | 10 REVERSER PNEUMATIC LINE                        | 19 REVERSER CONTROL ROD                         |
| 2 INTERPHONE CONNECTOR                     | 11 HYDRAULIC RETURN LINE                          | 20 DELETED                                      |
| 3 ELECTRICAL CONNECTOR                     | 12 HYDRAULIC DELIVERY LINE                        | 21 REVERSER PNEUMATIC LINE                      |
| 4 GROUND LEAD                              | 13 HYDRAULIC SUPPLY LINE                          | 22 REVERSER PNEUMATIC LINE                      |
| 5 OIL QUANTITY SYSTEM ELECTRICAL CONNECTOR | 14 DUCT CLAMP                                     | 23 FUEL SUPPLY LINE                             |
| 6 PNEUMATIC LINE                           | 15 DUCT CLAMP                                     | 24 STRUT DRAIN LINE                             |
| 7 DUCT CLAMP                               | 16 HIGH PRESSURE AIR LINE (WHEN FITTED TO ENGINE) | 25 WATER INJECTION LINE (WHEN FITTED TO ENGINE) |
| 8 EXHAUST GAS TEMPERATURE DISCONNECT PLUG  | 17 EXHAUST PRESSURE LINE                          | 26 PRESSURE SENSING LINE                        |
| 9 ELECTRICAL CONNECTOR                     | 18 REVERSER CONTROL ROD                           | 27 REVERSER PNEUMATIC LINE                      |



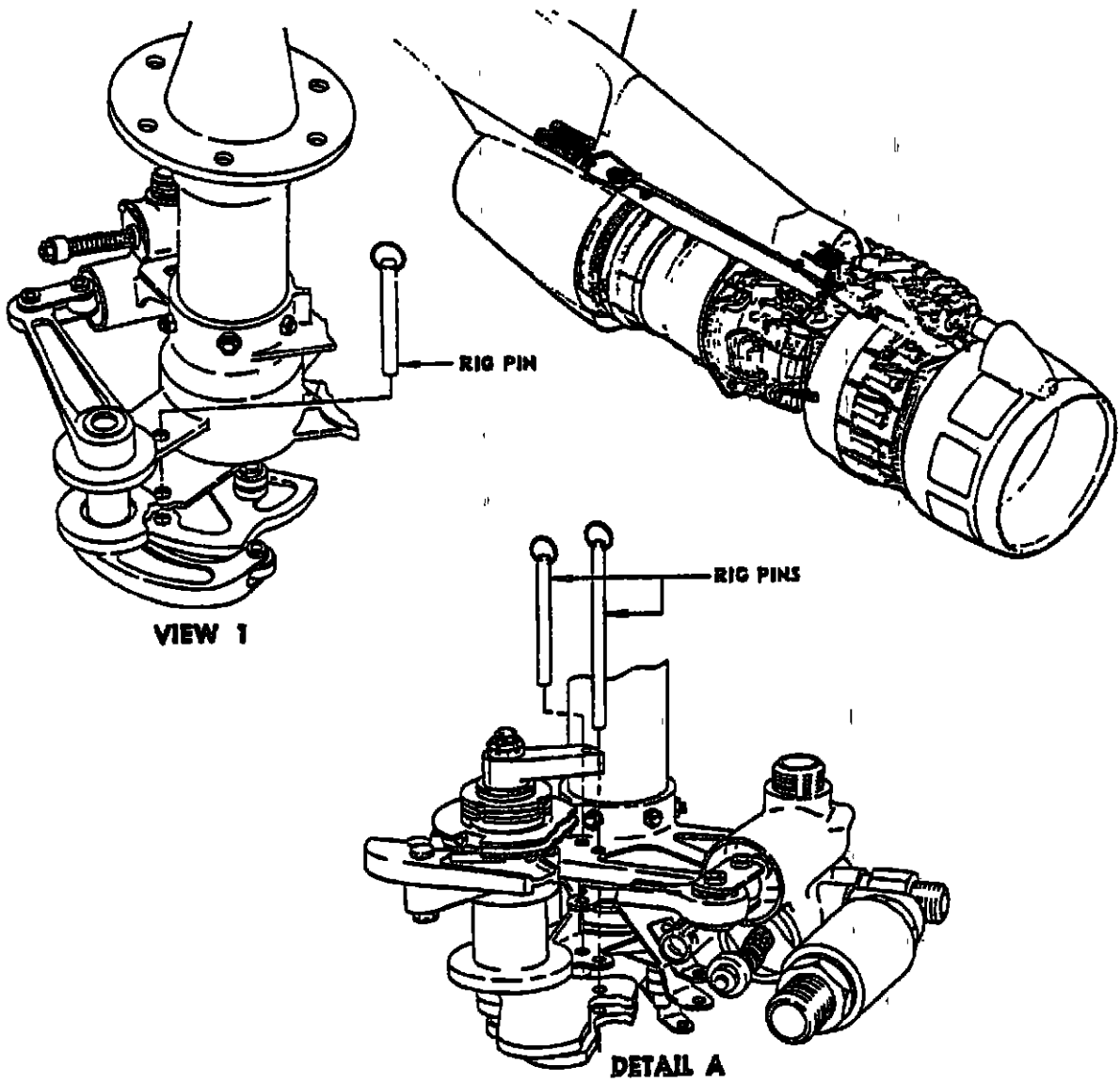
Engine Plumbing and Electrical Disconnects  
 Fig. 406 (Sheet 1 of 2)



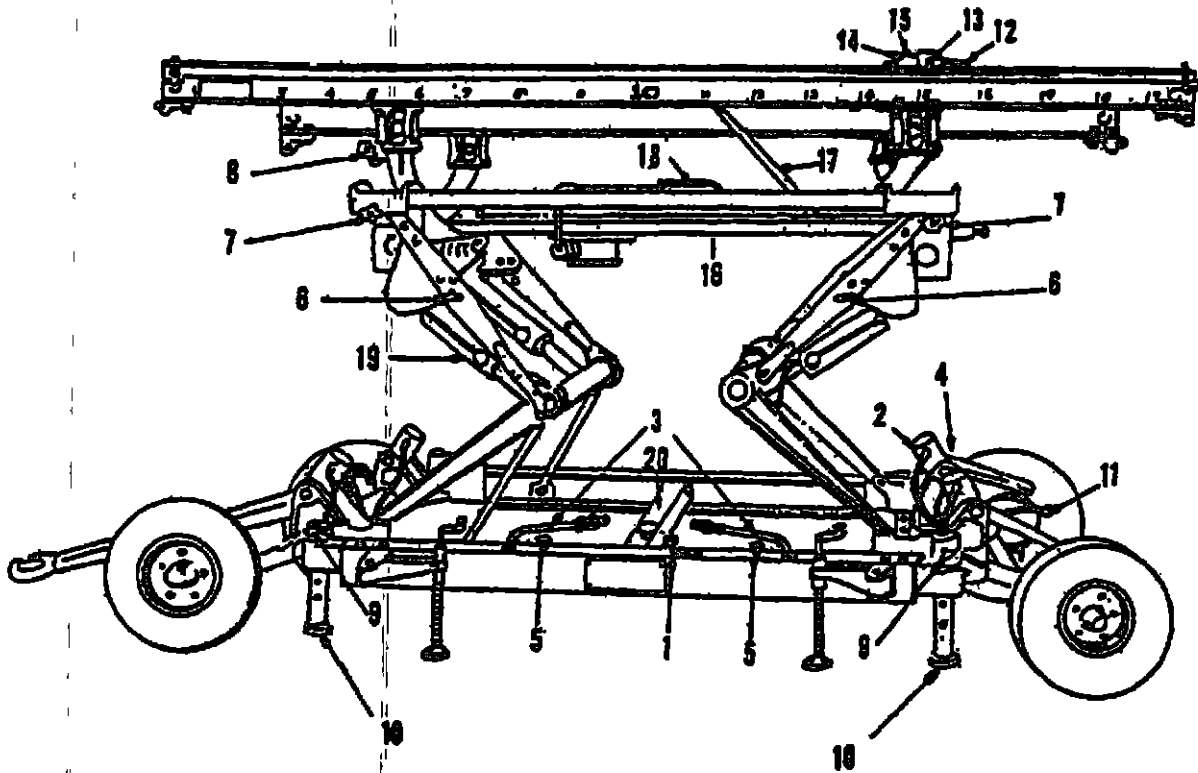
Engine Plumbing and Electrical Disconnects  
Fig. 406 (Sheet 2 of 2)



Power and Start Lever Linkage Connections  
Fig. 407 (Sheet 1 of 2)

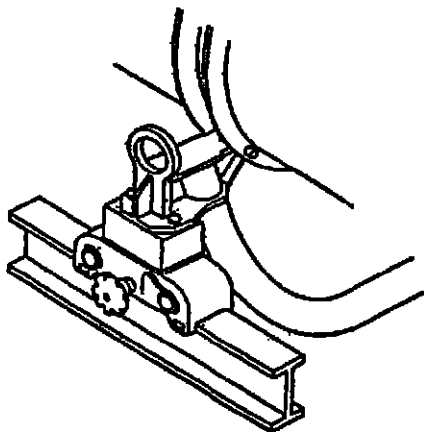
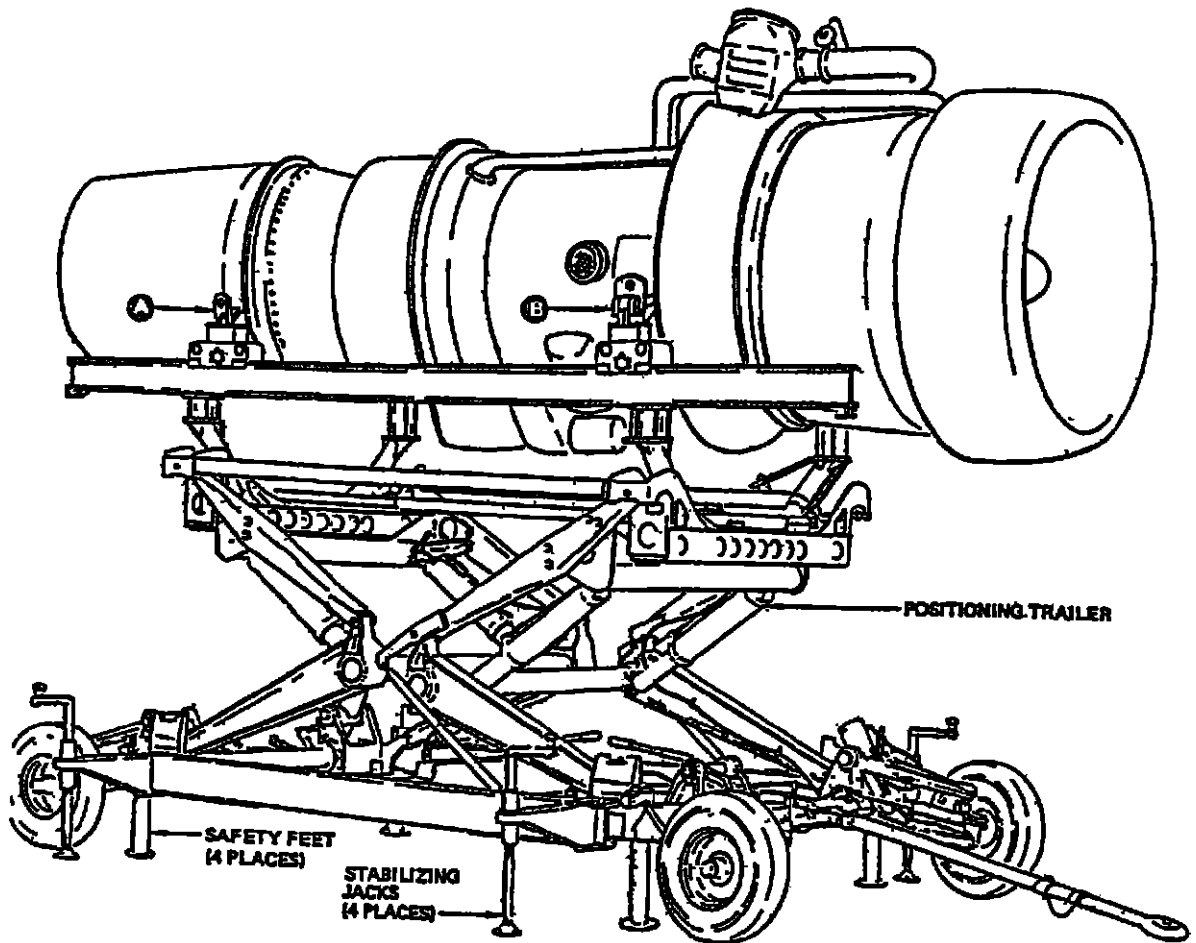


Power and Start Lever Linkage Connections  
Fig 407 (Sheet 2 of 2)

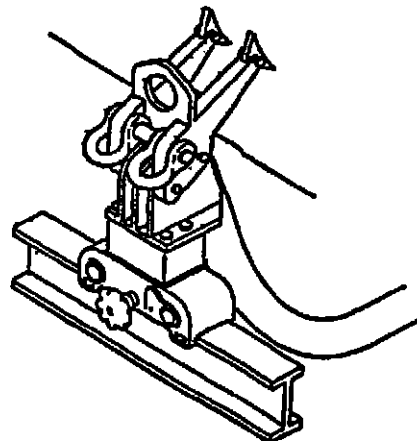


- 1 Selector Valve
- 2 Wheel lift cylinder
- 3 Hand pump
- 4 Handle
- 5 Release Valve
- 6 Knob
- 7 Traverse adjustment
- 8 Rotation adjustment
- 9 Pin
- 10 Foot assembly
- 11 Foot brakes
- 12 Roller adapter
- 13 Drive Location
- 14 Jaw
- 15 Drive Location
- 16 Winch assembly
- 17 Draw bar tube
- 18 Winch drive
- 19 Upper lift cylinder
- 20 Reservoir

Lift Trailer Operation  
 Fig. 408



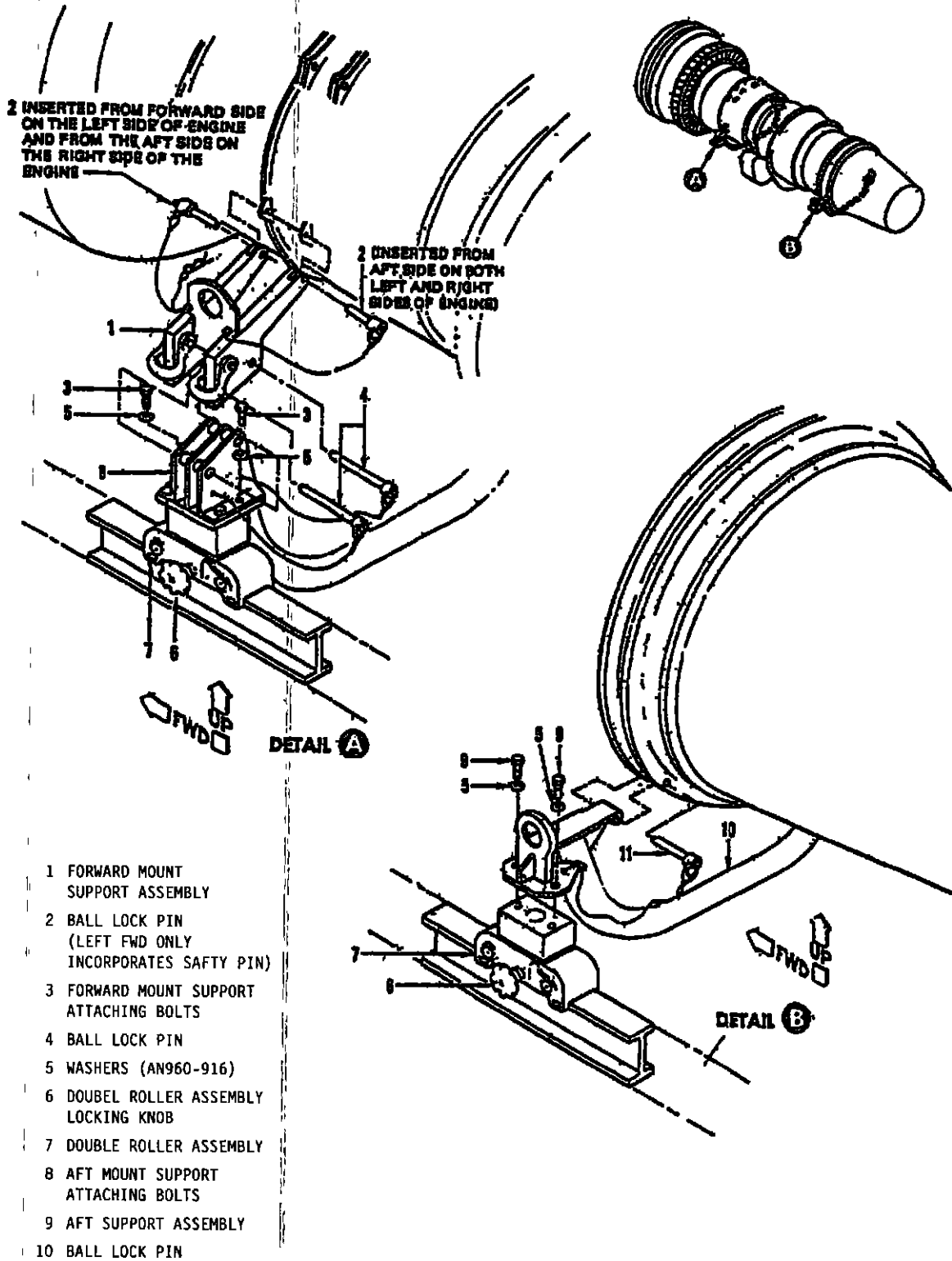
**AFT ADAPTER  
DETAIL A**



**FORWARD ADAPTER  
DETAIL B**

Installation of Engine Using Positioning Trailer  
and Engine Handling Adapter Kit

Fig. 409 (Sheet 1 of 2)



Engine Lift Adapter Set Installation  
 Fig. 409 (Sheet 2 of 2)



## MAINTENANCE MANUAL

### 5 Install Power Plant

- A Ground airplane to an approved ground connection.
- (1) Check fwd and aft engine mounts and related support structure incl. strut to wing attachments at the front spar, mid spar, diagonal brace fittings and engine hoist attach points for evidence of loose fasteners, nicks, cracks, gouges, chipped finish and/or signs of visible damage.
- B. Make sure external electrical power is disconnected and attach warning placard to external power connections. Position battery switch, located on flight engineer's panel, to OFF.
- C. Align positioning trailer under strut as accurately as possible to facilitate installation.

**CAUTION** UNSTABLE CONDITIONS MAY EXIST IF THE FOLLOWING PRECAUTIONS ARE NOT TAKEN

- SAFETY FEET EXTENDED TO SUPPORT TRAILER LOAD
  - TRAILER STABILIZING JACKS MUST MAKE FIRM CONTACT WITH GROUND
  - DO NOT ATTEMPT TO LIFT TRAILER WITH JACKS
- D. Extend safety feet and lower trailer until weight of trailer is supported on feet.
- E Extend stabilizing jacks to make firm contact with the ground
- F. Rotate and raise engine as required until fwd mount cones are approx. 3 inches from being seated.

**CAUTION** WHILE RAISING ENGINE, USE EXTREME CARE TO ENSURE THAT ENGINE DUCTS AND CONE BOLTS DO NOT STRIKE STRUT ENSURE THAT ALL TUBES AND WIRE BUNDLES ARE CLEAR AS ENGINE IS BEING RAISED CHECK THAT ELECTRICAL HARNESSSES ARE POSITIONED SO AS NOT TO GET TRAPPED ON WRONG SIDE OF FRONT ENGINE MOUNT STRUT BRACKET

- G. Raise engine into place. Adjust positioning of trailer rails and engine as necessary to obtain proper mating of engine mount cones and strut hangers
- H. Remove thread protectors
- I. Apply antiseize compound, Ease-off 990, to engine mount fittings

**CAUTION** STRESS CORROSION CAN RESULT IF ANTISEIZE COMPOUND IS NOT USE

- J Install correct washer and nut on all three mount fittings. Snug up all three nuts before making final torque.



## MAINTENANCE MANUAL

**CAUTION** CHECK ENGINE REAR MOUNT NUT FOR CONFORMITY ON POWER PLANTS INCORPORATING SAB 707/823, NUT MATERIAL IS NON-MAGNETIC AND HAS A 15/16 INCH EXTERNAL WRENCHING ON PREVIOUS INSTALLATIONS, NUT MATERIAL IS MAGNETIC AND MAY HAVE EITHER A 7/8 OR 15/16 INCH EXTERNAL WRENCHING IN CASE OF MAGNETIC 15/16 INCH NUT, USE ONLY NEW NUT WHICH IS PROPERLY TAGGED 65-10600-49 OR PAINTED WITH A GREEN VARNISH NO OTHER NUT ALLOWED

- K. Tighten aft fitting nut, forward left fitting nut and forward right fitting nut to torques given in Fig. 410.
- L. Lower positioning trailer rails until weight of engine is no longer on trailer.

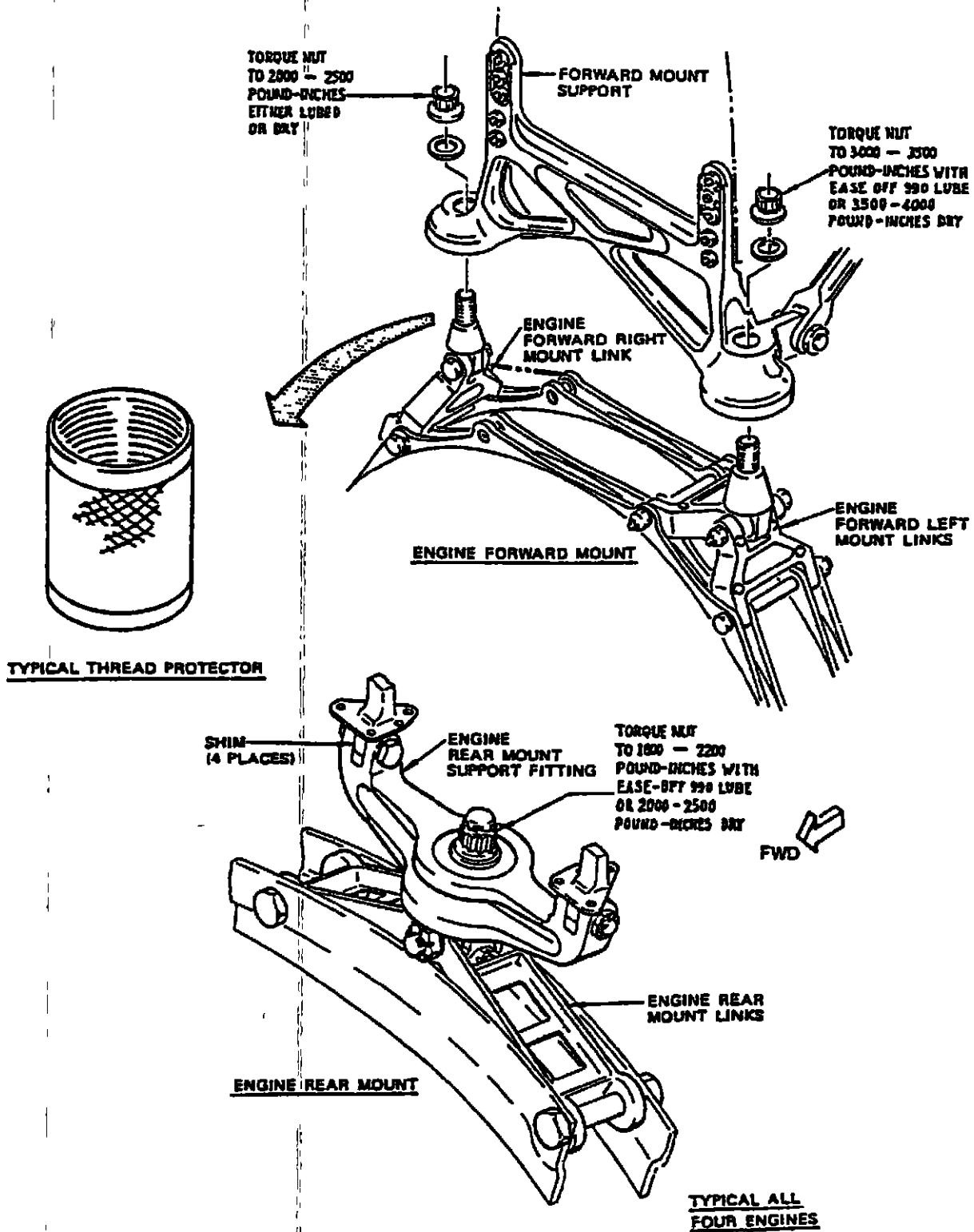
**CAUTION** SUPPORT OR HOLD LEFT- AND RIGHT-HAND FWD SUPPORT ASSEMBLIES (1, FIG 409, SHEET 2 OF 2) TO PREVENT DAMAGE TO ENGINE COMPONENTS WHEN LOCKING PINS (4 AND 11, FIG 409, SHEET 2 OF 2) ARE REMOVED AND TRAILER IS LOWERED

- M. Remove lockpins (4 and 11, Fig. 409, Sheet 2 of 2) from both sides of fwd support assembly (8 and 10, Fig. 409, Sheet 2 of 2) and lower rails.
- N. Retract and stow stabilizing jacks of trailer.
- O. Retract trailer safety feet and remove trailer.
- P. Remove locking pins (2, Fig. 409, Sheet 2 of 2) and remove fwd support assemblies (1, Fig. 409, Sheet 2 of 2) from both sides of engine and reinstall fwd mount support assemblies on fwd support assembly (8, Fig. 409, Sheet 2 of 2) with locking pins (4, Fig 409, Sheet 2 of 2).
- Q. Move positioning trailer away from engine.
- R. Connect fan reverser actuator pneumatic supply line (10, Fig. 406) to control valve and to fitting slightly forward of strut vertical bulkhead. Connect thrust reverser control valve pneumatic supply line to flex hose (See 27, Fig. 406).
- S. On engine fitted with turbocompressor install turbocompressor output duct (7, Fig. 406). Connect turbocompressor pressure sensing line (26) to T-fitting.
- T. Bolt two generator ground leads (1, Fig. 406) and conduit grounding lead (4) to brackets on strut vertical bulkhead. Connect pneumatic line (6) on right side of bulkhead. Install electrical raceway duct in clamps on vertical bulkhead.



## MAINTENANCE MANUAL

- U. Connect two large electrical connectors (3, Fig. 406), oil quantity indicating system connector (5) and interphone plugs (2) at strut vertical bulkhead.
- V. Install fan reverser control rod (see Fig. 407). Refer to AMM Chapter 78.
- W. Bolt engine start control rod (1, Fig. 407) to start control shaft lever arm, bolt power control rod (2) to power control shaft lever arm. Refer to AMM Chapter 76 for rigging details
- X. Install duct clamps on wing anti-icing air duct (14, Fig. 406) and engine starter low pressure air duct (15) located between horizontal firewall and engine diffuser case. Connect electrical plug on engine wiring bundle to starter air valve. If high pressure start system is used on airplane, connect starter high pressure air supply line (16) (see detail D., Fig. 406).
- Y. Connect two large electrical connectors (9, Fig. 406) and exhaust gas temperature electrical plug (8) at horizontal firewall (see view 1.). When fitted to airplane, connect two single wire fire detection system electrical plugs passing through horizontal firewall aft of exhaust gas temperature system plug.
- Z. Couple exhaust pressure sensing line (17, Fig. 406) to horizontal firewall connection located above diffuser section. Couple two aft thrust reverser pneumatic lines (22) to engine thrust reverser system at bracket mounted on underside firewall. Couple combustion chamber drain tank pressurizing line (see view 2.).
- AA. Connect two aft thrust reverser follow-up control rods (18 and 19, Fig. 406).
- AB. Connect two aft thrust reverser pneumatic lines (21, Fig. 406).
- AC. When installing engines No. 2 or 3 connect hydraulic reservoir pressurizing line on left side of engine (see detail C., Fig. 406).
- AD. At disconnect panel on left side of engine, connect fuel supply line (23, Fig. 406) and strut drain line (24). If fitted, on airplane, connect water injection line (25) (see detail F.). Install clamps holding flexible lines to engine casing.
- AE. With all rig pins removed, check for free working of power and start control linkage by moving power and start levers on pilot's control stand through working range.

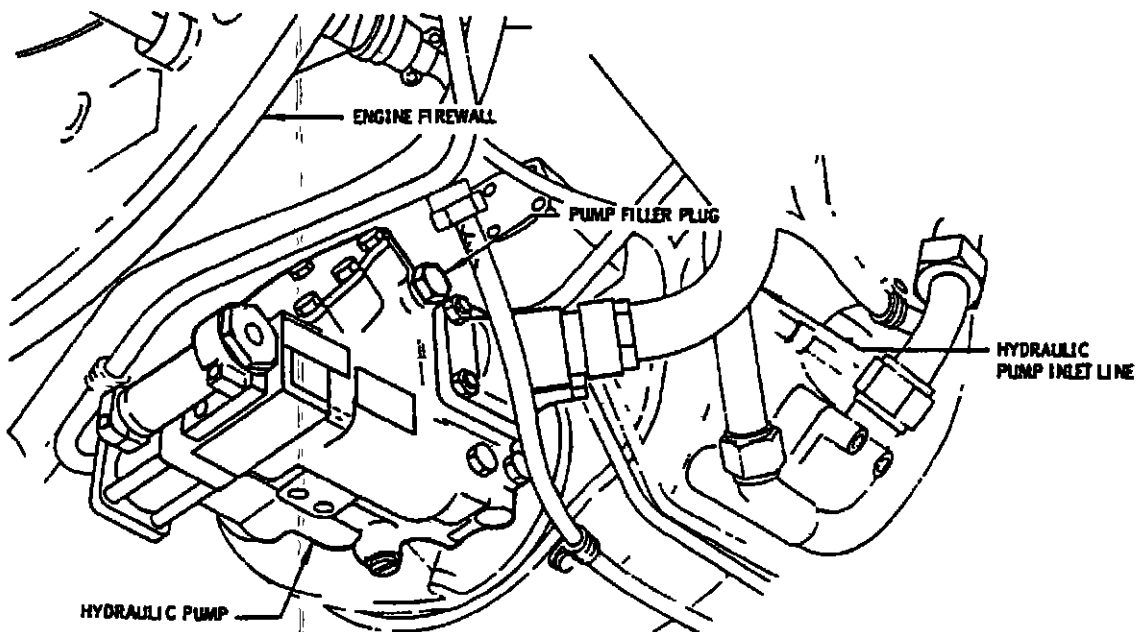
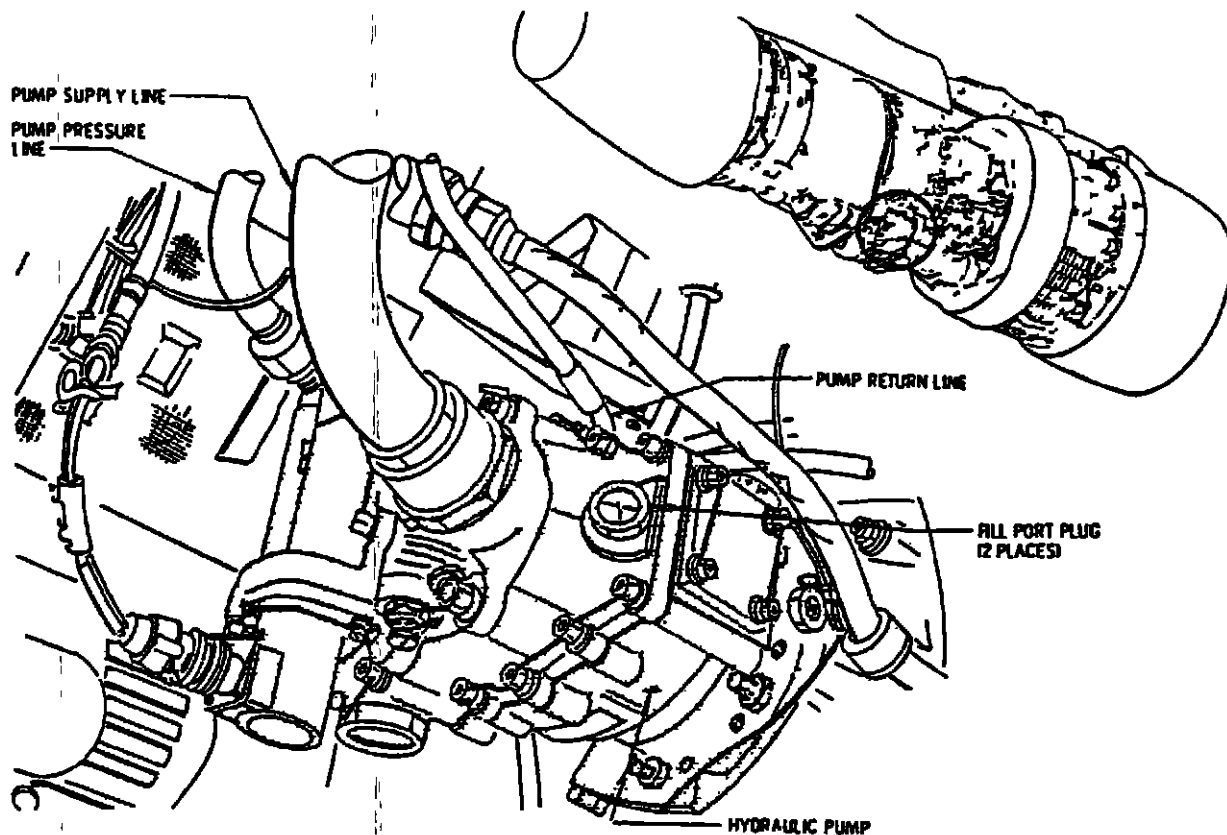


Engine Mounts Installation  
Fig. 410



## MAINTENANCE MANUAL

- AF. On engine No.2 or 3 reconnect hydraulic system as follows:
- (1) Completely fill hydraulic pump with Hydraulic Fluid, Fire Resistant, BMS 3-11, by removing plug from filler port and filling case of pump (see Fig 411).
  - (2) Depress valve in hydraulic supply self-sealing coupling and fill hydraulic supply line (13, Fig. 406) with Hydraulic Fluid, Fire Resistant, BMS 3-11.
  - (3) Connect hydraulic supply line (13, Fig. 406) at disconnect panel.
  - (4) Connect hydraulic delivery line (12, Fig. 406) at disconnect panel.
  - (5) Connect hydraulic return line (11, Fig. 406) at disconnect panel.
- AG. Install nacelle forward fairing. Refer to 71-5-31.
- AH. At engine fuel shutoff valve in applicable dry bay, remove dummy plug from airplane wiring. Connect airplane wiring to fuel shutoff valve and manually open valve.
- AI. Reposition utility hydraulic bypass valve in right-hand wheel well to CLOSED and retighten utility hydraulic reservoir filler cap in left-hand wheel well.
- AJ Position and install left and right engine side cowl panels Refer to 71-5-21.



Hydraulic Pump Filler Plug  
Fig. 411

END



**MAINTENANCE MANUAL**

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POWER PLANT (JT3D) - REMOVAL/INSTALLATION

1. General

- A. Any one engine may be removed without employing an aft fuselage jack. When more than one engine is to be removed it is recommended that an aft fuselage jack be installed in order to prevent the possible tipping of the airplane. See Chapter 7 for airplane jacking procedure.

CAUTION· MAIN GEAR OLEOS MUST BE DEFLATED WHEN USING AFT FUSELAGE JACK TO PRECLUDE AIRPLANE WEIGHT FROM SETTLING ON NOSE GEAR AND AFT FUSELAGE JACK.

- B. The engine installation sling has adjustable load centering features and may be used for hoisting or lowering the engine. An engine may not be handled using sling fittings unless a dolly is installed on these fittings after their attachment to the engine case. Alternatively, the engine and dolly may be raised or lowered with the engine installation sling using a forklift as an overhead hoist in place of a crane.
- C. During engine removal all apertures must be blanked off with approved plugs and shields. Similarly all tube ends and electrical connectors must be covered and plugged as soon as possible after disconnection. Conversely, during installation, covers and plugs should be left in place until the connections are made.

2. Equipment and Materials

- A. Engine Installation Sling Assembly - F71141-501 or equivalent
- B. Engine Mount Bolts Thread Protector F70010-4, -5, -6 or equivalent
- C. Engine Handling Kit - F70142 or equivalent
- D. Anti-seize compound - EASE-OFF 990 or equivalent (if required)
- E. Engine Mount Nut (Rear) Reversible Ratchet Wrench - F71418 or equivalent

3. Remove Power Plant

CAUTION: THE "FUEL FLOWMETER" CIRCUIT BREAKERS MUST BE PULLED (OPEN) WHENEVER THE ENGINE FUEL SUPPLY LINE IS DRAINED OR THE AIRPLANE IS OUT OF SERVICE FOR MAINTENANCE. THIS WILL PREVENT DRY OPERATION DAMAGE TO THE TRANSMITTER.



## MAINTENANCE MANUAL

EFFECTIVITY

TURBOFAN

- A. Disconnect external electrical power and ground airplane to an approved ground lug. Position the battery switch on the flight engineer's upper panel to "OFF."

**CAUTION:** THE EXTERNAL ELECTRICAL POWER RECEPTACLE MUST BE TAGGED TO PREVENT USE DURING REMOVAL AND INSTALLATION OF AN ENGINE.

- B. Check that start levers are in "CUTOFF" position.  
C. Depressurize utility hydraulic supply system.

**NOTE:** Utility hydraulic system is depressurized by positioning the handle on the manual bypass valve located in the right hand wheel well, to "BYPASS." Unscrew cap on hydraulic reservoir, located in left wheel well, 3 turns to allow depressurization.

- D. Check that applicable engine fuel shutoff valve located in inboard dry bay is closed and disconnect electrical plug from valve. Install dummy plug into valve receptacle.  
E. Remove main side cowl panels. Refer to 71-5-21.  
F. Drain fuel supply line to engine.  
(1) Place container, minimum capacity five gallons, under engine fuel pump, right side of engine.  
(2) Remove drain plug on fuel pump (see detail E, figure 401) and allow fuel to drain out, replace and tighten drain plug.  
G. Unlatch and remove nacelle forward fairing. Refer to 71-5-31.  
H. Disconnect engine start control rod (1, figure 402) from start control shaft lever arm, disconnect power control rod (2) from power control shaft lever arm and install four rig pins to hold linkage in position.  
I. Remove bolts from both ends of fan reverser control rod (figure 402) and remove rod. Tag for identification.  
J. Remove duct clamps (14 and 15, figure 401) from thermal anti-icing duct and pneumatic duct to engine starter. When fitted to airplane, disconnect starter high pressure air supply line (16). Disconnect electrical plug on pneumatic duct motor operated valve.  
K. Disconnect two large electrical connectors (9) and exhaust gas temperature disconnect plug (8), at horizontal fire wall. When fitted to airplane, disconnect two single wire fire detection system electrical connectors located aft of plug (8). Undo clamp supporting wiring harness from engine forward mount brace.  
L. Disconnect two large electrical connectors (3), oil quantity indicating system and interphone connectors (5 and 2) from strut vertical bulkhead. Unbolt two generator ground leads (1) and conduit grounding lead (4) from right side of bulkhead. (See detail A.) Unclamp electrical raceway duct on vertical bulkhead.

**EFFECTIVITY**

**TURBOFAN**

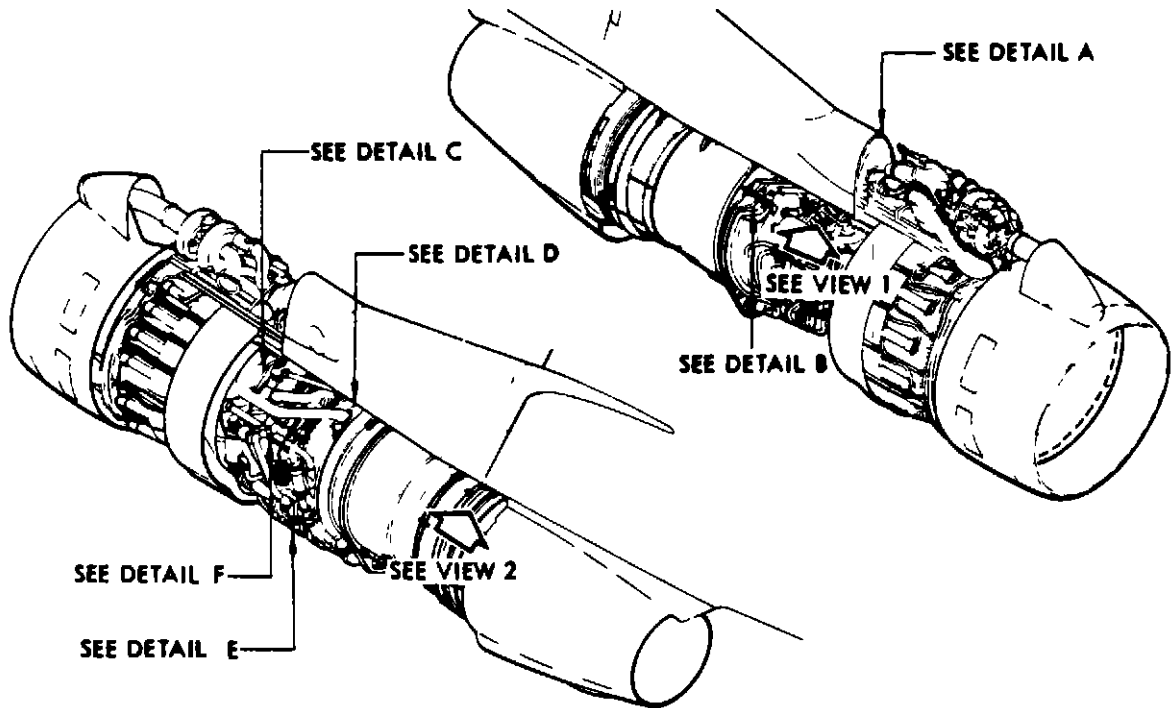


**MAINTENANCE MANUAL**

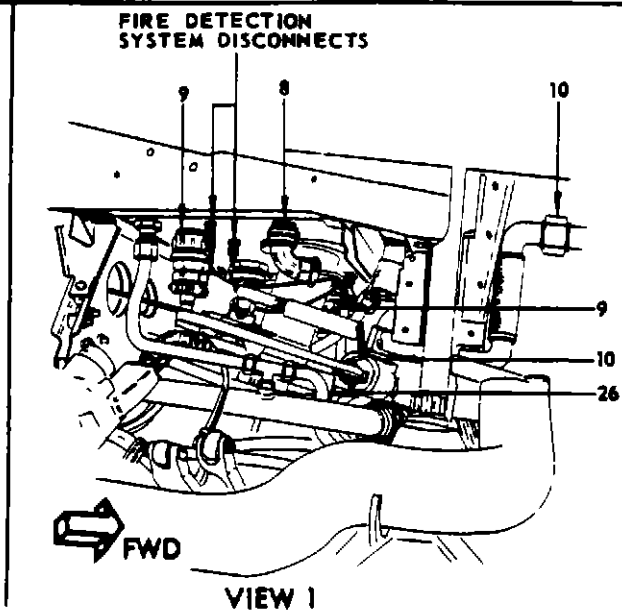
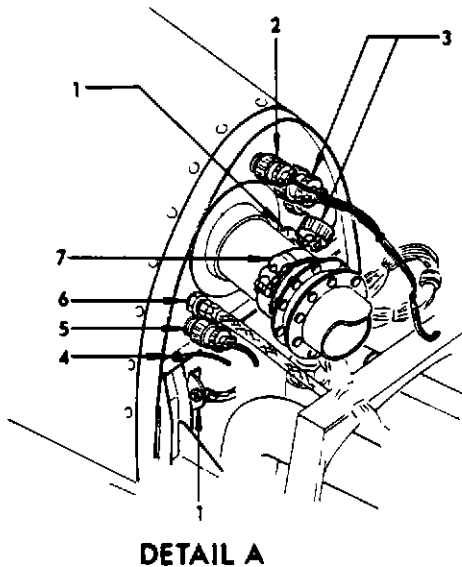
- M Uncouple pneumatic hose (6) at right side of strut vertical bulkhead, see detail A
- N On engines fitted with turbocompressor, remove clamp (7) on turbocompressor output duct and disconnect turbocompressor pressure sensing line (26) at T-fitting.
- O Uncouple fan reverser actuator pneumatic supply line (10) at control valve and at fitting slightly forward of strut vertical bulkhead. Disconnect thrust reverser control valve pneumatic supply line (27) at flex hose (See detail B )
- P When removing engines No. 2 or 3, uncouple hydraulic reservoir pressurizing line (left side of engine). (See detail C.) Also at disconnect panel, right side of engines No. 2 or 3, uncouple hydraulic pump return line (11), delivery line (12) and pump inlet supply line (13) (See detail B ) Remove clamps that support hoses from engine casing.
- Q At disconnect panel (left side of engine) uncouple fuel supply line (23) and strut drain line (24). When fitted to airplane, disconnect water injection line (25) (See detail F ) Unfasten clamps holding flexible lines to engine casing
- R. Uncouple and remove two aft thrust reverser follow-up control rods (18 and 19). Tag for identification.
- S. Uncouple exhaust pressure sensing line (17) at horizontal firewall and two thrust reverser pneumatic lines (22) at bracket mounted on firewall above engine diffuser section. Uncouple combustor chamber drain tank pressurizing line (See view 2 )
- T Disconnect two aft thrust reverser actuator lines (21) at brackets mounted on horizontal firewall. (See view 2.)
- U Install engine hoisting fitting on each side of engine at forward and aft mount rings (See figure 403.)
- V. Install sling attaching shackles on engine hoisting fittings
- W Position dolly under engine. Raise dolly to level of engine hoisting fittings, locate engine fittings in fixtures on each dolly post and insert locking pins
- X Attach hoisting sling to shackles and take up slack in cables. Adjust forward cables with hand hoist until taut (See figure 403.)

**WARNING : LIGHTLY LOADED LEVER CHAIN HOISTS MAY RELEASE LOAD IF CONTROL LEVER OR KNOB IS FORCED INTO NEUTRAL OR FREE CHAIN POSITION. ONLY PERSONNEL INSTRUCTED IN PROPER USAGE SHOULD OPERATE LEVER CHAIN HOISTS.**

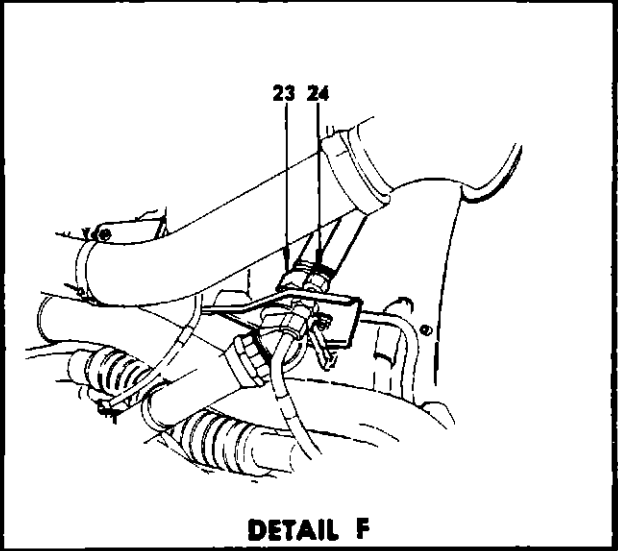
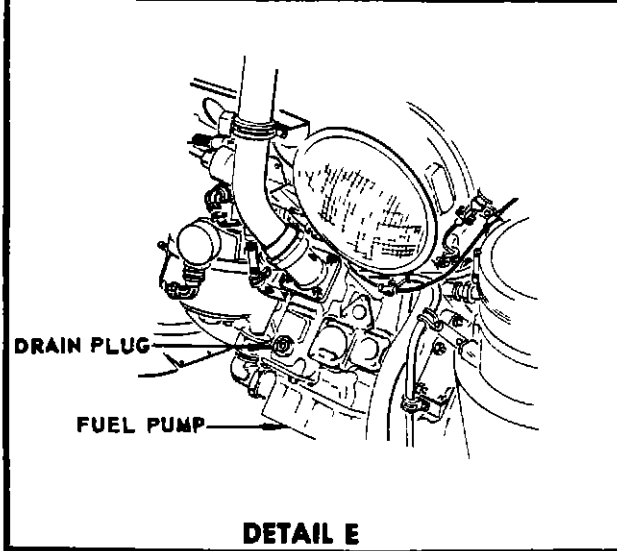
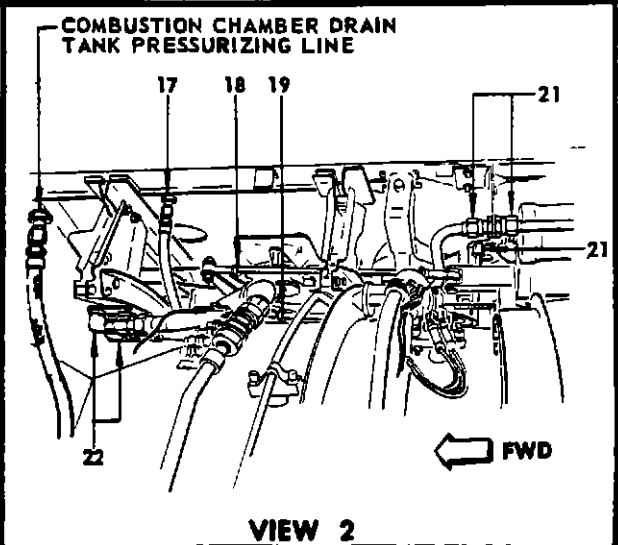
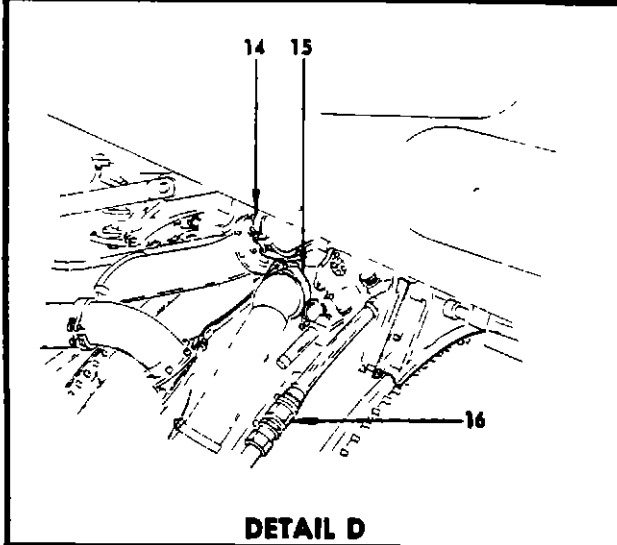
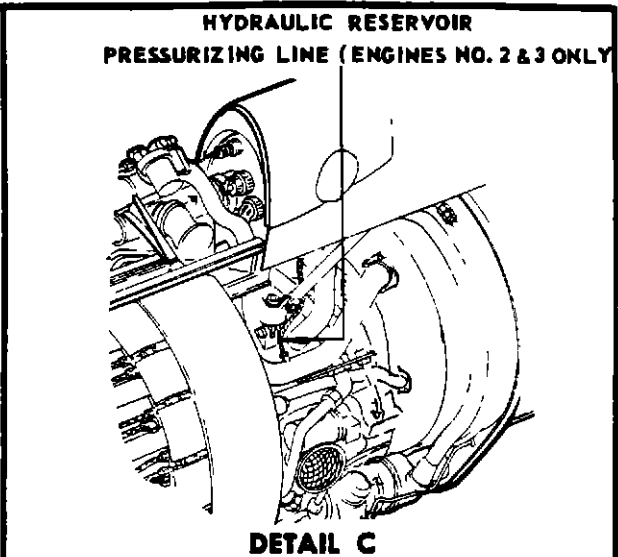
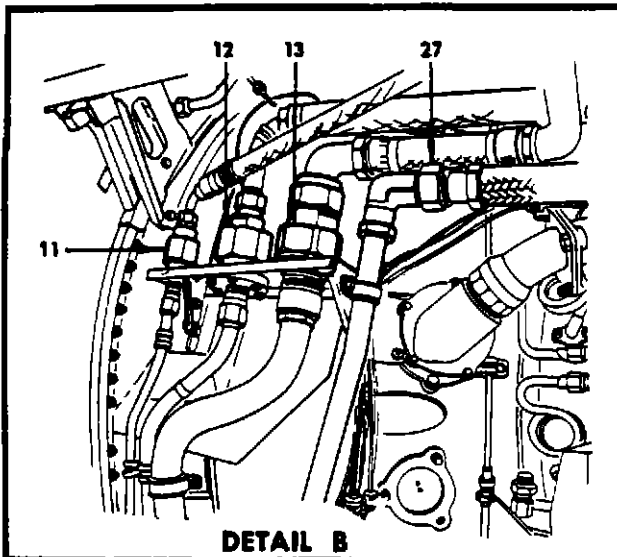
MAINTENANCE MANUAL

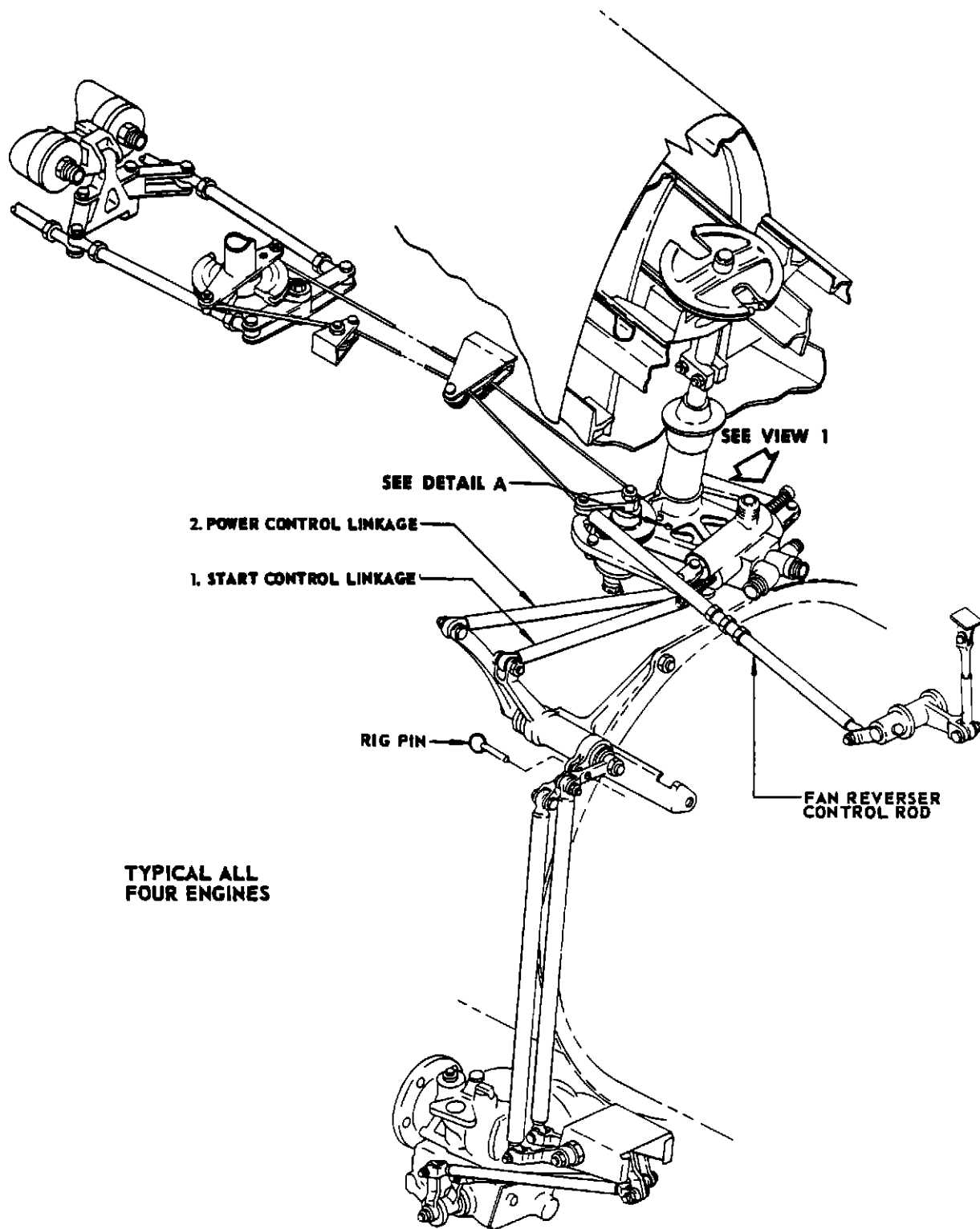


- |                           |                            |                            |
|---------------------------|----------------------------|----------------------------|
| 1 GENERATOR GROUND LEAD   | 10 REVERSER PNEUMATIC LINE | 19 REVERSER CONTROL ROD    |
| 2 INTERPHONE CONNECTOR    | 11 HYDRAULIC RETURN LINE   | 20 DELETED                 |
| 3 ELECTRICAL CONNECTOR    | 12 HYDRAULIC DELIVERY LINE | 21 REVERSER PNEUMATIC LINE |
| 4 GROUND LEAD             | 13 HYDRAULIC SUPPLY LINE   | 22 REVERSER PNEUMATIC LINE |
| 5 OIL QUANTITY SYSTEM     | 14 DUCT CLAMP              | 23 FUEL SUPPLY LINE        |
| 6 ELECTRICAL CONNECTOR    | 15 DUCT CLAMP              | 24 STRUT DRAIN LINE        |
| 7 PNEUMATIC LINE          | 16 HIGH PRESSURE AIR LINE  | 25 WATER INJECTION LINE    |
| 8 DUCT CLAMP              | (WHEN FITTED TO ENGINE)    | (WHEN FITTED TO ENGINE)    |
| 9 EXHAUST GAS TEMPERATURE | 17 EXHAUST PRESSURE LINE   | 26 PRESSURE SENSING LINE   |
| DISCONNECT PLUG           | 18 REVERSER CONTROL ROD    | 27 REVERSER PNEUMATIC LINE |
| 9 ELECTRICAL CONNECTOR    |                            |                            |



Engine Plumbing and Electrical Disconnects  
Figure 401 (Sheet 1)





Power and Start Lever Linkage Connections  
Figure 402 (Sheet 1 of 2)

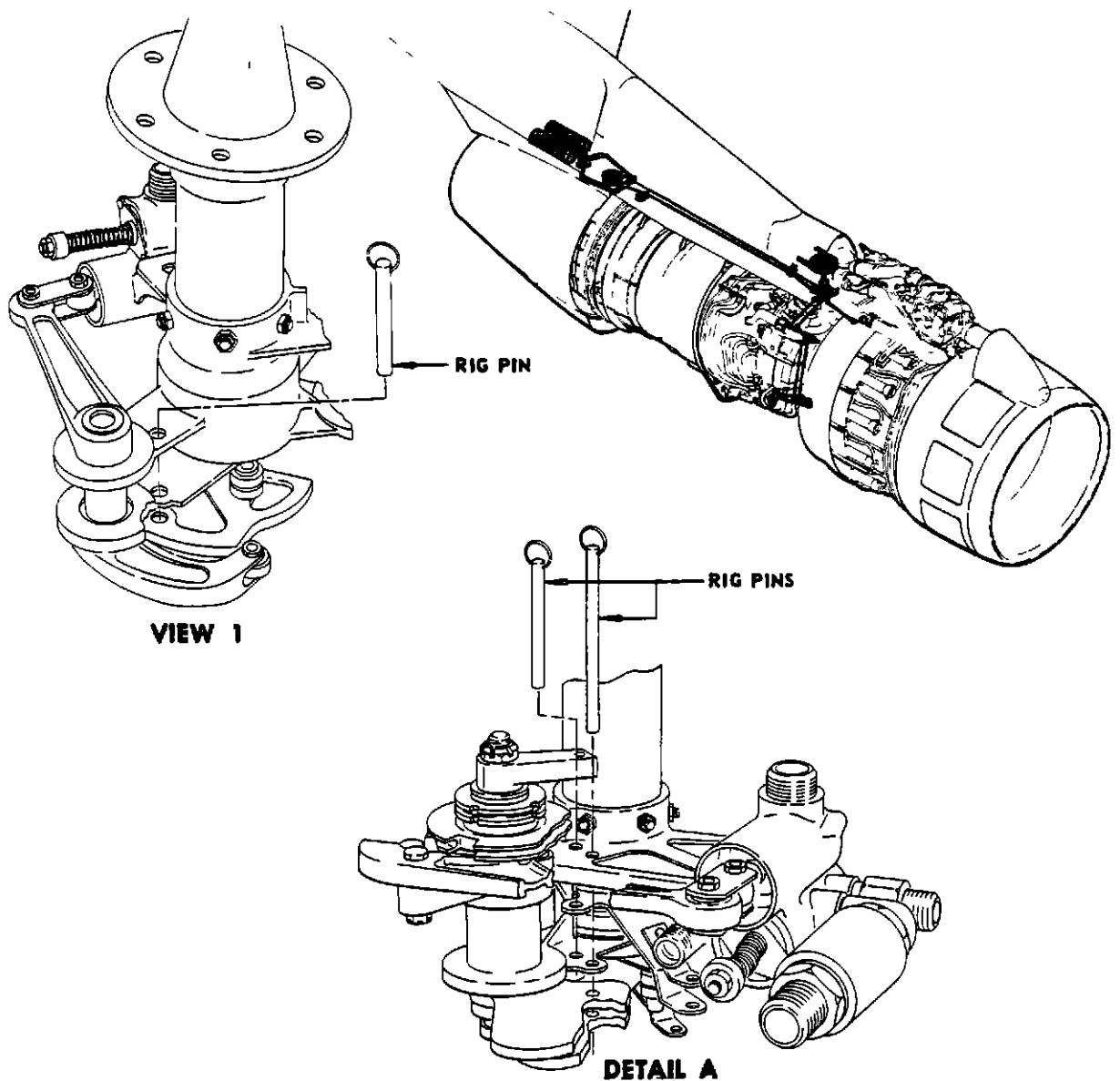
**EFFECTIVITY**

**TURBOFAN**



**MAINTENANCE MANUAL**

- Y Loosen nuts on three engine mount fittings.
- Z. Adjust hoist cables until engine is supported.
- AA. Remove nuts from engine mount fitting, install thread protectors (F70010-4, -5 or -6 according to location) and lower engine and dolly from strut.
- AB. Remove hoisting sling from engine dolly.

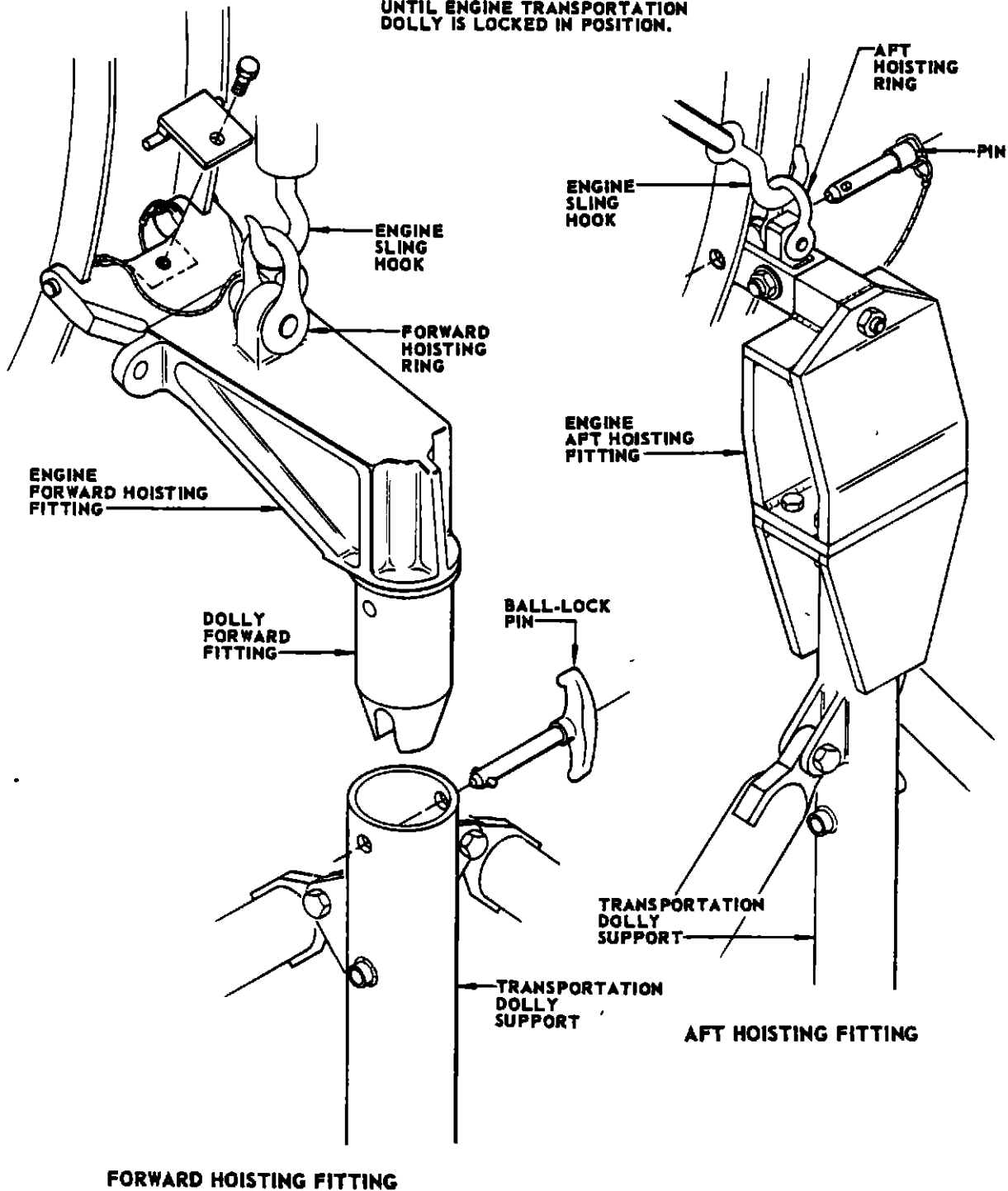


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Power and Start Lever Linkage Connections  
Figure 402 (Sheet 2 of 2)

71-5-0  
Page 407

**NOTE: ENGINE SLING HOOKS  
MUST NOT TAKE LOAD  
UNTIL ENGINE TRANSPORTATION  
DOLLY IS LOCKED IN POSITION.**



**FORWARD HOISTING FITTING**

**Engine Hoisting Sling Fittings Installation  
Figure 403 (Sheet 1 of 2)**

4. Install Power Plant

A. Ground airplane to an approved ground lug.

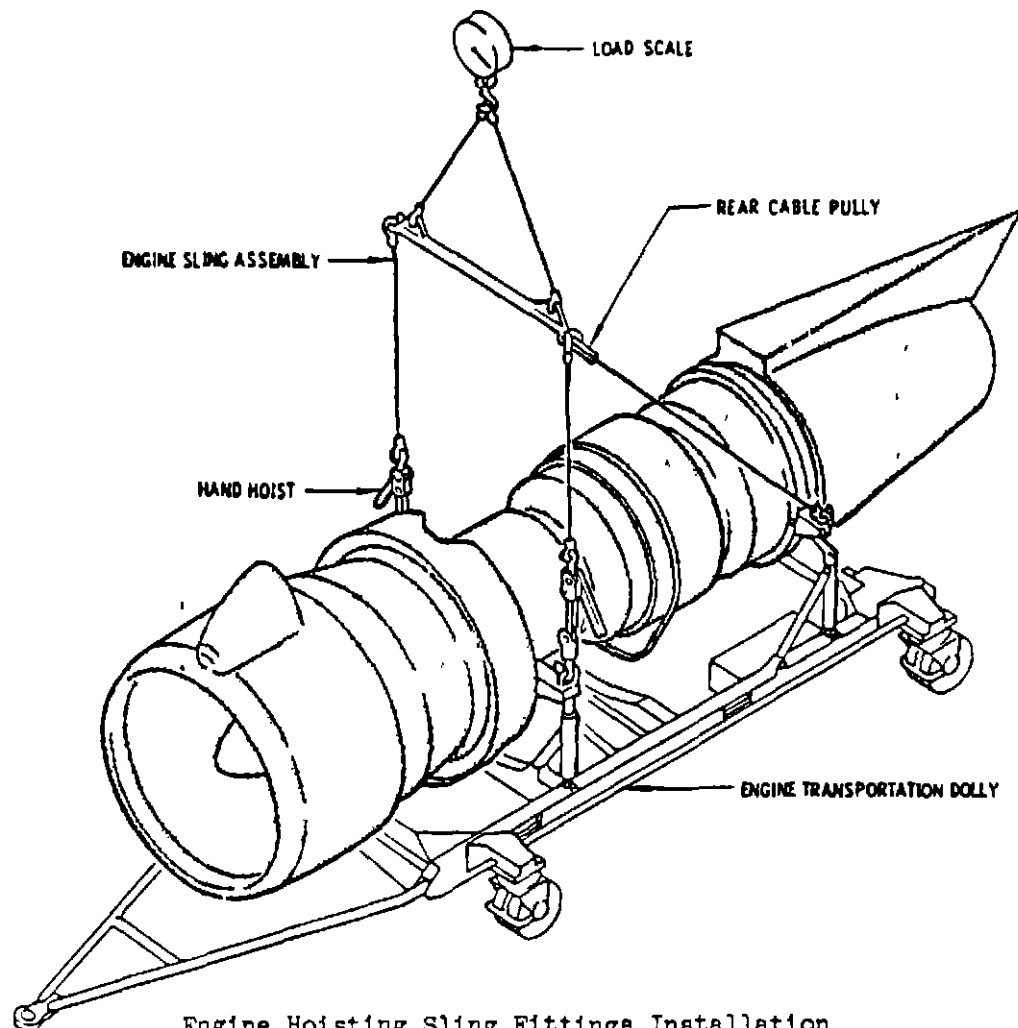
(1) Check forward and aft engine mounts and related support structure including strut to wing attachments at the front spar, mid spar, diagonal brace fittings and engine hoist attach points for evidence of loose fasteners, nicks, cracks, gouges, chipped finish and/or signs of visible damage.

B. Make sure external electrical power is disconnected and attach warning placard to external power connections. Position battery switch, located on flight engineer's panel, to "OFF."

C. Attach engine sling to crane and attach sling hooks to engine hoisting rings. A suitable load scale should be interposed between the sling and crane. (See figure 403.)

**WARNING :** LIGHTLY LOADED LEVER CHAIN HOISTS MAY RELEASE LOAD IF CONTROL LEVER OR KNOB IS FORCED INTO NEUTRAL OR FREE CHAIN POSITION. ONLY PERSONNEL INSTRUCTED IN PROPER USAGE SHOULD OPERATE LEVER CHAIN HOISTS.

**CAUTION :** EXERCISE CARE WHEN HANDLING AN ENGINE FITTED WITH NOSE COWL AND AFT THRUST REVERSER SLEEVE AS THESE ITEMS ARE DAMAGED IF BUMPED.





EFFECTIVITY  
TURBOFAN

## MAINTENANCE MANUAL

- D. Adjust hoist and sling until all cables are taut. Forward cables are adjusted with hand hoist. Raise hoist until weight of engine and dolly are taken on sling.
- E. Install thread protectors (F70010-4, -5 or -6 according to location) on engine mount fitting. Ensure that the three engine mounting bolts and the mounting bolt holes in the strut fittings are clean.
- F. Hoist engine into place, guiding the two forward and single aft mount fittings into the mount supports (Fig. 403 and 404). Ensure correct mating of starter air duct and thermal anti-icing air duct, turbocompressor output duct (when fitted to engine) and guide tracks for aft thrust reverser sleeve.

**CAUTION.** IT IS IMPERATIVE THAT BOTH FORWARD BOLTS AND REAR MOUNT BOLT ARE ENGAGED SIMULTANEOUSLY TO PREVENT ANY POSSIBILITY OF THE ENGINE YAWING DURING INSTALLATION AND CONSEQUENT TWISTING OF THE SUPPORT LINKS. OBSERVE LOAD SCALE AT ALL TIMES ENGINE MOUNTS ENGAGE WITH STRUT, AND AVOID LOAD INCREASES EXCEEDING 5% OF ENGINE WEIGHT.

IF UNDUE STRESS IS APPLIED TO FORWARD AND/OR AFT ENGINE MOUNTS, CHECK FORWARD AND AFT ENGINE MOUNTS AND RELATED SUPPORT STRUCTURE INCLUDING STRUT TO WING ATTACHMENTS AT THE FRONT SPAR, MID SPAR, DIAGONAL BRACE FITTINGS AND ENGINE HOIST ATTACH POINTS FOR EVIDENCE OF LOOSE FASTENERS, NICKS, CRACKS, GOUGES, CHIPPED FINISH AND/OR SIGNS OF VISIBLE DAMAGE.

- G. Remove thread protectors.
- H. Apply antiseize compound, Ease-off 990, to engine mount fittings.

**CAUTION:** STRESS CORROSION CAN RESULT IF ANTISEIZE COMPOUND IS NOT USED.

- I. Install correct washer and nut on all three mount fittings. Snug up all three nuts before making final torque.

**CAUTION:** CHECK ENGINE REAR MOUNT NUT FOR CONFORMITY. ON POWER PLANTS INCORPORATING SAB 707/823, NUT MATERIAL IS NON-MAGNETIC AND HAS A 15/16 INCH EXTERNAL WRENCHING. ON PREVIOUS INSTALLATIONS, NUT MATERIAL IS MAGNETIC AND MAY HAVE EITHER A 7/8 OR 15/16 INCH EXTERNAL WRENCHING. IN CASE OF MAGNETIC 15/16 INCH NUT, USE ONLY NEW NUT WHICH IS PROPERLY TAGGED 65-10600-49 OR PAINTED WITH A GREEN VARNISH. NO OTHER NUT ALLOWED.

- J. Tighten aft fitting nut, forward left fitting nut and forward right fitting nut to torques given in figure 404.
- K. Remove pins locking engine hoist fittings into dolly posts.
- L. Slack off hoist and remove dolly assembly from engine.
- M. Remove the forward and aft engine hoisting fittings from engine. (See figure 403.)

**NOTE:** Stow engine hoisting fittings on engine transportation dolly. Keep pins with fittings.

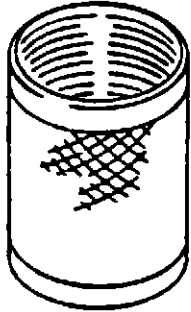
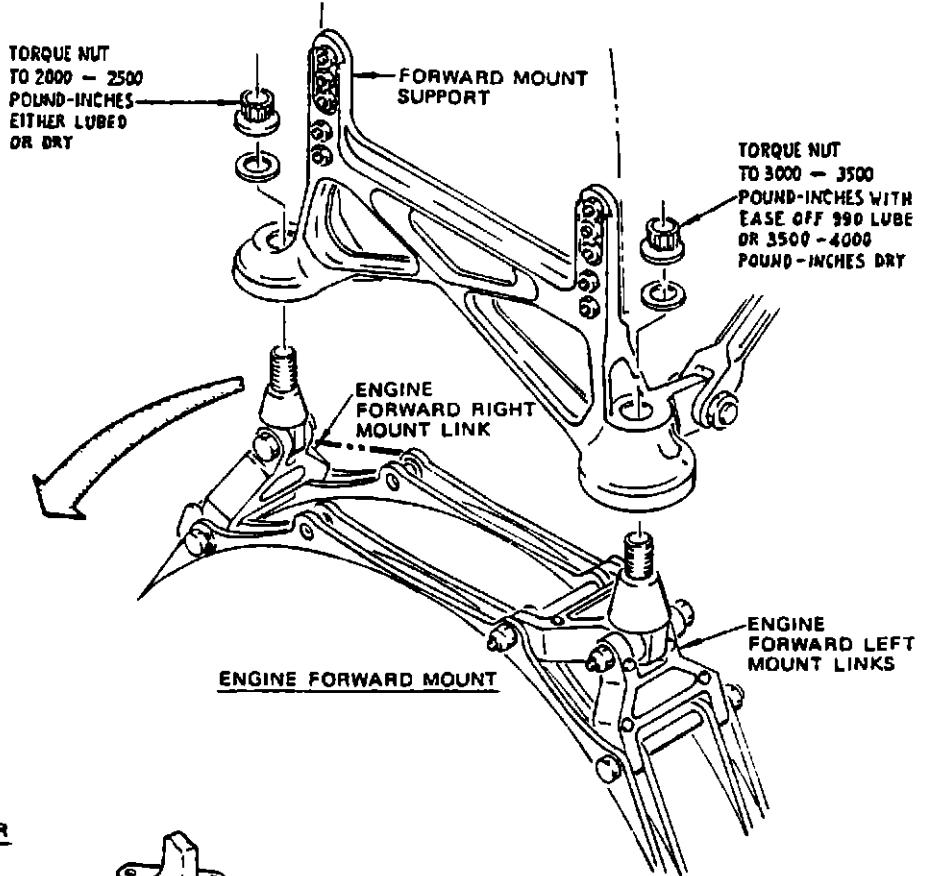
- N. Connect fan reverser actuator pneumatic supply line (10) to control valve and to fitting slightly forward of strut vertical bulkhead. Connect thrust reverser control valve pneumatic supply line (27) to flex hose. 2  
(See figure 401.)

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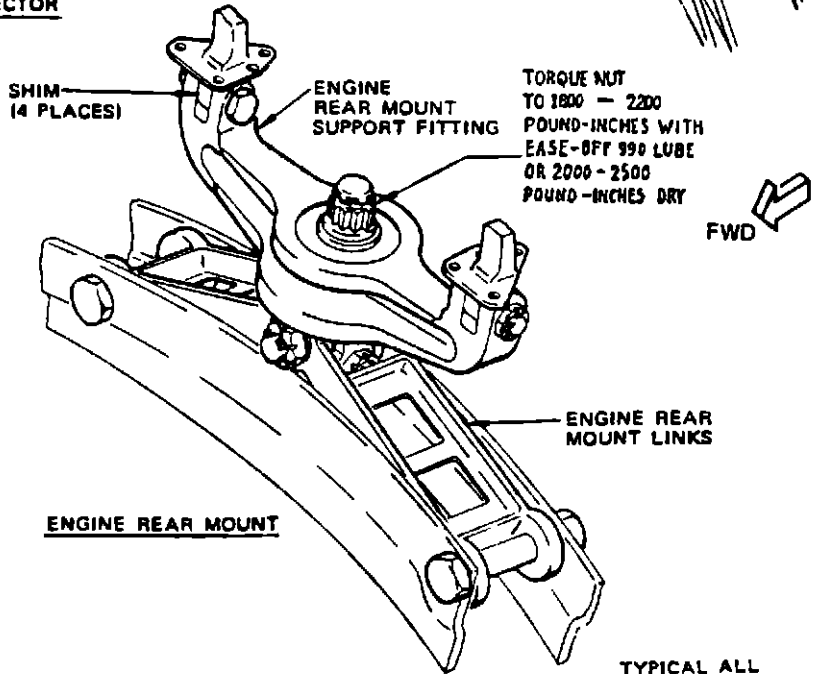
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MAINTENANCE MANUAL



TYPICAL THREAD PROTECTOR



TYPICAL ALL FOUR ENGINES

A: Boe1. Airgram 6-7134-4231 dated June 27, 1967  
B: Boe1. Airgram of November 9, 1966 (I.T.Fg. ATA 71/8)

2  
Oct 15/69  
SAB REV. 17 NOV. 1969

Engine Mounts Installation  
Figure 404



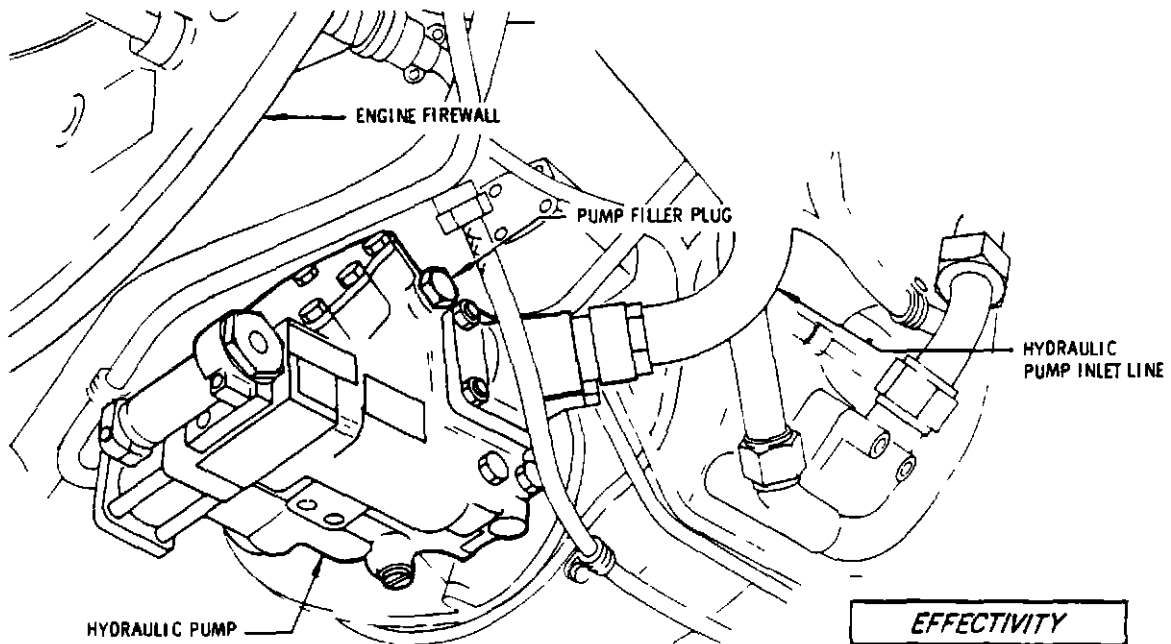
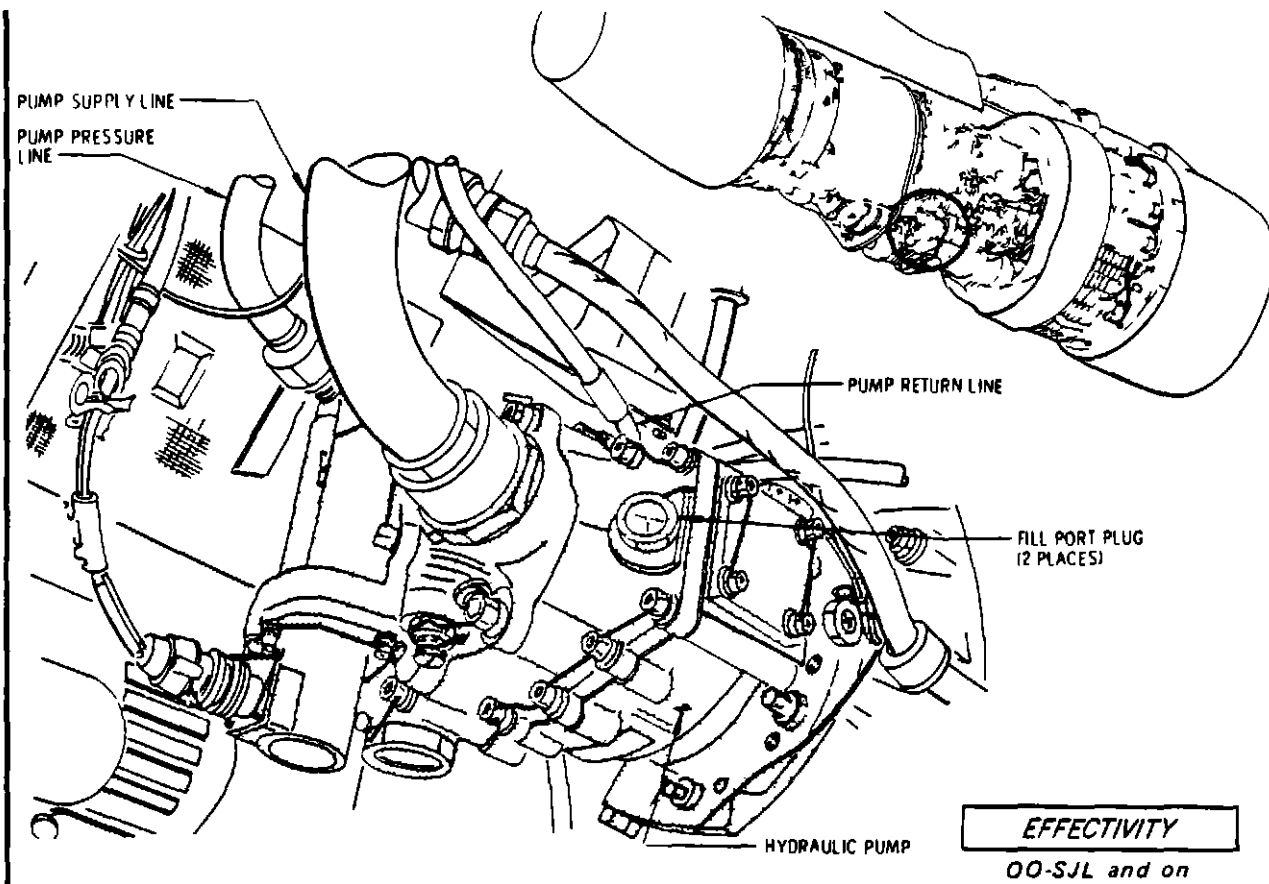
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## MAINTENANCE MANUAL

- O. On engines fitted with turbocompressors install turbocompressor output duct (7). Connect turbocompressor pressure sensing line (26) to T-fitting.
- P. Bolt two generator ground leads (1) and conduit grounding lead (4) to brackets on strut vertical bulkhead. Connect pneumatic line (6) on right side of bulkhead. Install electrical raceway duct in clamps on vertical bulkhead.
- Q. Connect two large electrical connectors (3), oil quantity indicating system connector (5) and interphone plugs (2) at strut vertical bulkhead.
- R. Install fan reverser control rod. (See figure 402.) Refer to Chapter 78.
- S. Bolt engine start control rod (1, figure 402) to start control shaft lever arm, bolt power control rod (2) to power control shaft lever arm. Refer to Chapter 76 for rigging details.
- T. Install duct clamps on wing anti-icing air duct (14) and engine starter low pressure air duct (15) located between horizontal firewall and engine diffuser case. Connect electrical plug on engine wiring bundle to starter air valve. If high pressure start system is used on airplane, connect starter high pressure air supply line (16). (See detail D, figure 401.)
- U. Connect two large electrical plugs (9) and exhaust gas temperature electrical plug (8) at horizontal firewall. (See view 1.) When fitted to airplane, connect two single wire fire detection system electrical plugs passing through horizontal firewall aft of exhaust gas temperature system plug.
- V. Couple exhaust pressure sensing line (17) to horizontal firewall connection located above diffuser section. Couple two aft thrust reverser pneumatic lines (22) to engine thrust reverser system at bracket mounted on underside firewall. Couple combustion chamber drain tank pressurizing line. (See view 2.)
- W. Connect two aft thrust reverser follow-up control rods (18 and 19).
- X. Connect two aft thrust reverser pneumatic lines (21).
- Y. When installing engines No. 2 or 3, connect hydraulic reservoir pressurizing line on left side of engine. (See detail C )
- Z. At disconnect panel on left side of engine, connect fuel supply line (23) and strut drain line (24). If fitted on airplane, connect water injection line (25). (See detail F.) Install clamps holding flexible lines to engine casing.
- AA. With all rig pins removed, check for free working of power and start control linkage by moving power and start levers or pilot's control stand through working range.

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- AB On engine No. 2 or 3 reconnect hydraulic system as follows
- (1) Completely fill hydraulic pump with Hydraulic Fluid, Fire Resistant, BMS 3-11, by removing plug from filler port and filling case of pump. (See figure 405.)
  - (2) Depress valve in hydraulic supply self-sealing coupling and fill hydraulic supply line (13, figure 401) with Hydraulic Fluid, Fire Resistant, BMS 3-11.
  - (3) Connect hydraulic supply line (13) at disconnect panel.
  - (4) Connect hydraulic pressure line (12) at disconnect panel.
  - (5) Connect hydraulic pump return line (11) at disconnect panel.
- AC Install nacelle forward fairing. Refer to 71-5-31.
- AD At engine fuel shutoff valve in applicable dry bay, remove dummy plug from airplane wiring. Connect airplane wiring to fuel shutoff valve and manually open valve.
- AE Reposition utility hydraulic bypass valve in right-hand wheel well to CLOSED and retighten utility hydraulic reservoir filler cap in left-hand wheel well.
- AF Position and install left and right engine side cowl panels. Refer to 71-5-21.



Hydraulic Pump Filler Plug  
Figure 405



## MAINTENANCE MANUAL

### POWER PLANT (JT3D) - ADJUSTMENT TEST

#### EFFECTIVITY

##### Turbofan

#### 1. General

- A. This section contains specific instructions required to satisfactorily start, operate, and shut down the engine under normal and emergency conditions. The section also outlines a step-by-step sequence of tests and checks to be performed to ensure that the engine is operating correctly prior to adjusting engine trim for peak performance of the engine and related systems. For additional information on a specific power plant system or component not covered in this section, refer to the applicable page block and/or chapter.
- B. Ensure that the following general maintenance instructions are reviewed and complied with, as applicable, when performing maintenance and/or operational procedures.
- (1) Ensure that engine compartment is clean as mass airflow tends to draw foreign objects into the engine. Thoroughly clean and check area after completion of any work. Engine inlet area shall be free of dirt, oil, grease, and unused parts such as nuts, washers, and lockwire.
  - (2) Ensure that openings and disconnected hose and tubing are covered with proper caps and plugs to prevent entry of foreign matter into the system. Use external caps on all openings, not internal plugs.
  - (3) To prevent corrosion in the compressor stages and damage to the second stage fan disc and blades, the engine inlet and exhaust shall be covered if engine is to be left inoperative for more than 6 hours. If there is freezing precipitation and sufficient wind to rotate engine compressor, engine inlet and exhaust shall be covered immediately.
  - (4) Before disconnecting fluid lines for draining, provide suitable containers to catch drainage.
  - (5) When a removed component is to be replaced, install gaskets, O-rings, fittings, brackets, etc., on replacement components in same relative position as located on replaced component.
  - (6) Lockwire nuts, bolts, fittings, and connectors in accordance with standard lockwiring procedures. Lockwire shall be stainless steel corrosion-resistance wire.



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### C Engine Ground Safety Precautions

#### (1) General

- (a) The operating characteristics of jet engines requires that all engine operating parameters and ground safety precautions be closely observed. All engine danger areas, particularly engine inlet and exhaust, should be avoided. The following paragraphs outline safety requirements that shall be observed to prevent possible injury to personnel and damage to property or equipment.

### D. The Air Intake (Fig. 501)

**WARNING:** ALL PERSONNEL MUST AVOID DANGER AREAS IN FRONT AND REAR OF POWER PLANT AND REMAIN OUTSIDE OF ENGINE SAFETY BARRIER, IF USED, DURING GROUND RUNNING OPERATIONS. THE ENGINE IS CAPABLE OF DEVELOPING ENOUGH SUCTION AT THE INLET DUCT TO PULL A MAN UP TO OR PARTIALLY INTO THE DUCT WITH POSSIBLE FATAL RESULTS. THEREFORE, WHEN APPROACHING ANY TYPE OF JET ENGINE, PRECAUTIONS MUST BE TAKEN TO KEEP CLEAR OF THE INTAKE AIR STREAM. THE SUCTION NEAR THE INTAKE CAN ALSO PULL IN HATS, GLASSES, LOOSE CLOTHING AND WIPE-RAGS FROM POCKETS. ANY LOOSE ARTICLES MUST BE MADE SECURE OR REMOVED BEFORE WORKING AROUND THE ENGINE.

DO NOT USE ENGINE NACELLE SERVICE INTERPHONE JACK ON ENGINE WHICH IS TO BE STARTED OR IS IN OPERATION. PERSONNEL MAY BE INJURED BY ENGINE INLET SUCTION OR EXHAUST BLASTS.

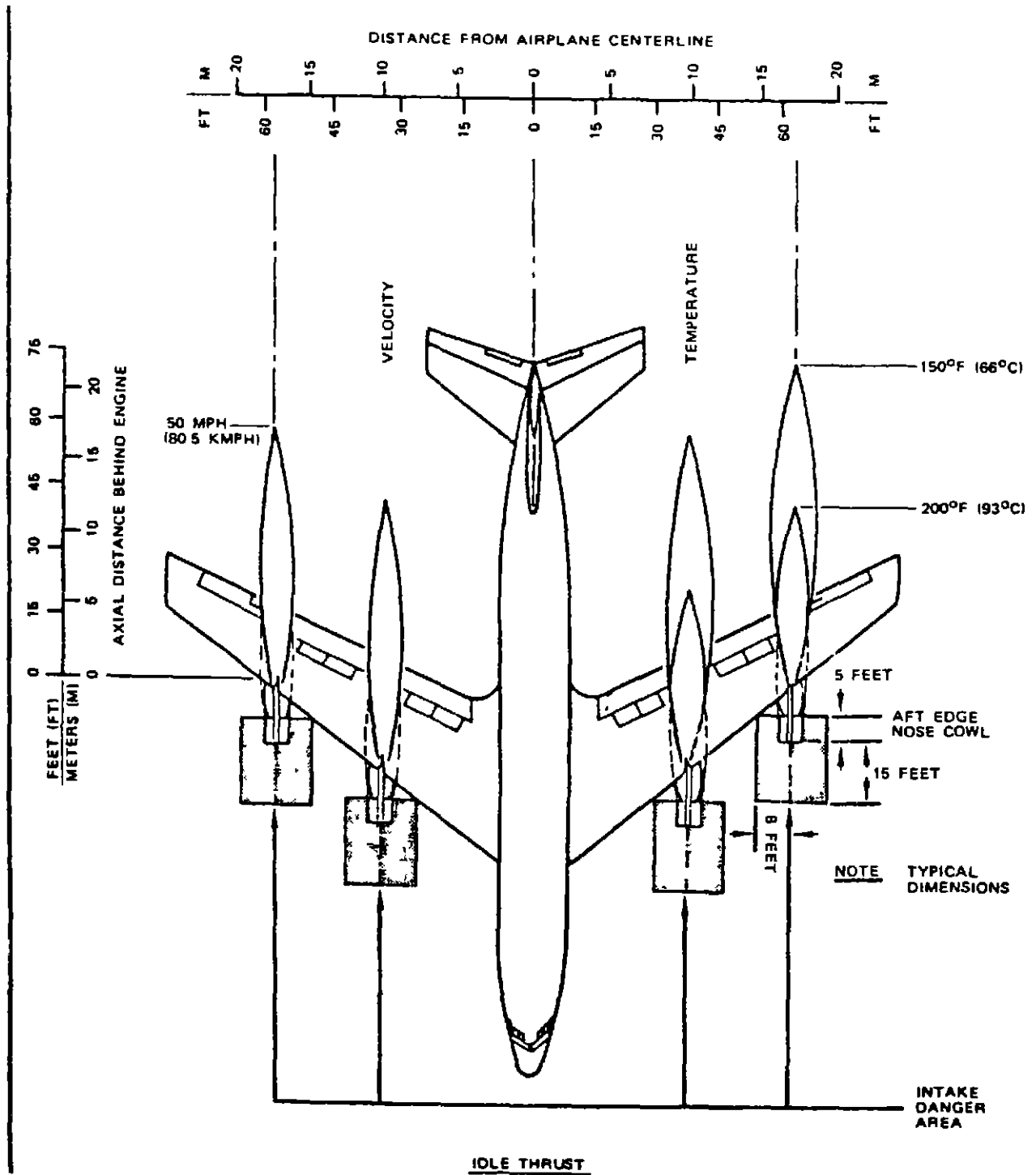
**CAUTION.** PERSONNEL SHALL EXERCISE CARE TO ENSURE THAT HELMET, HEADSET, HATS, GLASSES, WIPE-RAGS, AND ARTICLES OF CLOTHING ARE STRAPPED SECURELY IN POSITION OR REMOVED BEFORE WORKING AROUND THE ENGINE. NO EFFORT SHALL BE MADE TO RETRIEVE EQUIPMENT DROPPED NEAR THE ENGINE INTAKE BUT THE THRUST LEVER SHALL BE RETURNED TO THE FULLY RETARDED POSITION AND THE START LEVER IMMEDIATELY MOVED TO CUTOFF POSITION.

PERSONNEL DANGER AREAS SHALL RECEIVE SPECIAL CONSIDERATION WHEN POSITIONING PERSONNEL, EQUIPMENT, VEHICLES, OR OTHER AIRCRAFT IN PROXIMITY OF OPERATING ENGINE.

BEFORE OPERATING ENGINE, CHECK THAT ENGINE INLET, UPPER SURFACE OF WING AND FUSELAGE, AND RUNUP AREAS ARE FREE OF SAND, GRAVEL, LOOSE OBJECTS, OR EQUIPMENT THAT COULD BE DRAWN INTO THE ENGINE INLET OR THROWN AFTS BY THE EXHAUST BLAST.

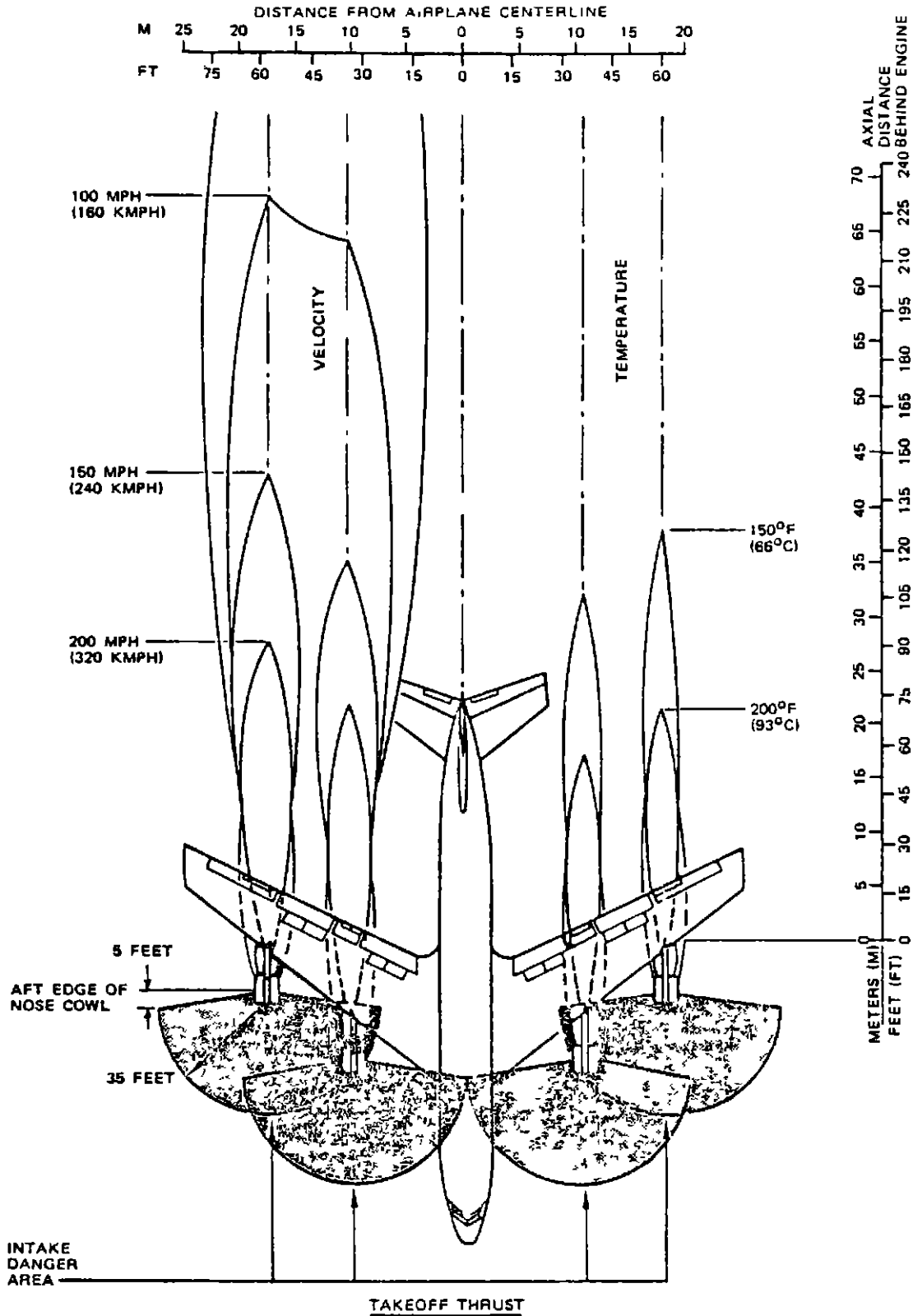
CLEAR AREA SURROUNDING ENGINE OR ALL SNOW AND ICE. EXTENSIVE DAMAGE TO COMPRESSOR BLADES CAN BE CAUSED BY THE ENTRANCE INTO THE ENGINE OF RELATIVELY SMALL PIECES OF ICE.

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Turbofan Engine Hazard Areas  
Figure 501 (Sheet 1)

MAINTENANCE MANUAL



Turbofan Engine Hazard Areas  
Figure 501 (Sheet 2)



## MAINTENANCE MANUAL

### E. Exhaust Characteristics (Fig. 501)

- (1) Velocity. Extreme caution must be exercised when parking the aircraft for runup to avoid possible injury to personnel or damage to property or other aircraft. At high engine rpm the exhaust blast may pick up and blow loose dirt, sizeable stones, or sand and debris a distance of several hundred feet. A blast fence is recommended if the engines are to be operated at high power settings in an area not sufficient for dissipation of the exhaust blast.
- (2) Temperature. High temperature will be found up to several hundred feet from the exhaust nozzle depending on wind conditions. Concrete aprons are recommended for runup areas as exhaust temperature close to the engine is high enough to deteriorate bituminous pavement. Occasionally when an engine is started, excess fuel accumulation in the tailpipe ignites and long flames are blown out of the exhaust nozzle. Stand clear of tailpipe during engine starting and remove all flammable materials from vicinity of engine and aircraft.
- (3) Toxicity. Tests have indicated that the carbon monoxide content of exhaust gases is low but other gases are present which have a disagreeable odor and are irritating in effect. Exposure will usually cause watering or a burning sensation of the eyes. Less noticeable but important is the respiratory irritation which may be caused. For these reasons exposure shall be avoided, particularly in confined areas where the concentration of gases may increase.

### F. Engine Ignition

**WARNING:** THE ENGINE IGNITION SYSTEM IS CHARACTERISTICALLY HIGH IN ENERGY. THE NATURE OF THE SYSTEM IS SUCH AS TO RENDER IT A HAZARDOUS, POSSIBLY FATAL, SOURCE OF ELECTRICAL SHOCK UNLESS THE NECESSARY PRECAUTIONS ARE EXERCISED. DO NOT TOUCH IGNITER PLUGS WHEN THE IGNITION IS ON. DO NOT TEST THE IGNITION SYSTEM WHEN PERSONNEL MAY BE IN CONTACT WITH IGNITER PLUGS OR WHEN FLAMMABLE MATERIALS ARE NEARBY.

### G. Compressor Bleed Valve

- (1) When checking the compressor bleed valve for operation or performing work on, or adjacent to, the bleed valve while the engine is running, exercise extreme caution to stand clear during bleed valve open operation.

**WARNING:** WHEN THE BLEED VALVE FIRST OPENS DURING DECELERATION FROM HIGH RPM, HIGH PRESSURE AIR IS DUMPED OVERBOARD AT VERY HIGH VELOCITY. THE FORCE OF THIS AIR IS SUFFICIENT TO KNOCK A PERSON OFF HIS FEET RESULTING IN POSSIBLE INJURY.

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## MAINTENANCE MANUAL

### H. Engine Noise

- (1) The noise intensity levels produced by an operating jet engine are capable of causing temporary, as well as permanent, loss of hearing. Even short exposures to extreme noise may result in damage to the ears and all personnel shall use some type of ear protection. Noise can affect the ear mechanism in such a way as to cause unsteadiness or inability to walk or stand without reeling. Therefore, the use of cup type ear protection is recommended. If engines are to be serviced from aero-stands or platforms these shall be equipped with protective railing to prevent falls.

### I. Engine Cooldown

- (1) After engine operation, care must be taken to ensure that the tailpipe has cooled before any work is performed in that area. All other parts usually may be worked on without danger of burn.

### J. Fuel and Lubricating Oils

- (1) All fuel and lubricating oils tend to dry the skin. Precautions should be taken to avoid contact with these fluids as much as possible.

## 2. Operate Engine

### A. General

- (1) Before operating engines, main landing gear wheels must be chocked, engine inlet and exhaust plugs removed, and engine inlet checked for freedom from foreign objects. The engine and its associated systems must be depreserved and serviced before attempting to start. During cold weather it may be necessary to preheat the engine using an air heater until the compressor rotates freely.

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- (2) All engines are started by low pressure air from a ground air source through the ground service connection, or by an operating turbocompressor through the pneumatic crossover manifold. On airplanes with hi/lo starters, high pressure air from the airplane self-contained source or from a ground high pressure source may be used to start the engine. Refer to Starting, Chapter 80. Initial starts on newly installed engines and motoring runs should be made using a ground low pressure air source.
- (3) After three consecutive shutdowns following ground runups, the combustion chamber drain tank must be emptied to prevent fuel from spilling over the hot engine from the tank pressurizing line in strut. Following a misstart or whenever it is desired to clear engine of fuel or vapor, perform Clear Engine procedure.
- (4) After the start has been accomplished, the engine and its associated systems must be tested for normal operation. On completion of tests, the engine should be shut down in accordance with the Normal Engine Shutdown procedure. If abnormal conditions arise during start or run, the engine may be shut down in accordance with the Emergency Engine Shutdown procedure.
- (5) To eliminate overservicing, the engine oil tank must be serviced within 30 minutes after engine shutdown. Refer to Servicing, Chapter 12.

**B. Equipment and Materials**

- (1) Ground Service Electrical Power Unit (60 KVA, 210 volt, 400 cps) - Louis Allis or equivalent
- (2) Ground Low Pressure Air Supply Unit (35 psig minimum delivery) - Boeing Model 502 or equivalent
- (3) Ground High Pressure Air Supply Unit (3000 psig delivery) - starter air bottle or equivalent
- (4) Thermometer (-20 to 120°F)
- (5) Shutoff valve fitted with adapter tube and nut to mate with No. 4 nipple. Valve outlet to have drain hose connection suitable for coupling of 1/2-inch bore hose. (See figure 504.)



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- (6) Length of hose fitted with adapter to suit pressurizing and dump valve drain port (See figure 504 )

### C. Motor Engine

- (1) Remove engine inlet, fan and exhaust duct covers
- (2) Check that engine fuel system has been bled and depreserved. Refer to paragraph D.
- (3) Connect external electrical power and ground low pressure air supply to airplane. (See figure 502.)
- (4) Place thrust levers in fully retarded position and start levers in "CUTOFF" position. (See figure 503.)
- (5) Turn off all unnecessary system switches and pull (open) applicable engine igniter circuit breakers

**CAUTION:** TO AVOID POSSIBILITY OF INADVERTENT START DURING MOTORING, PULL (OPEN) APPLICABLE ENGINE IGNITER CIRCUIT BREAKERS LOCATED ON BATTERY AND ESSENTIAL 28V CIRCUIT BREAKER PANEL (P6)

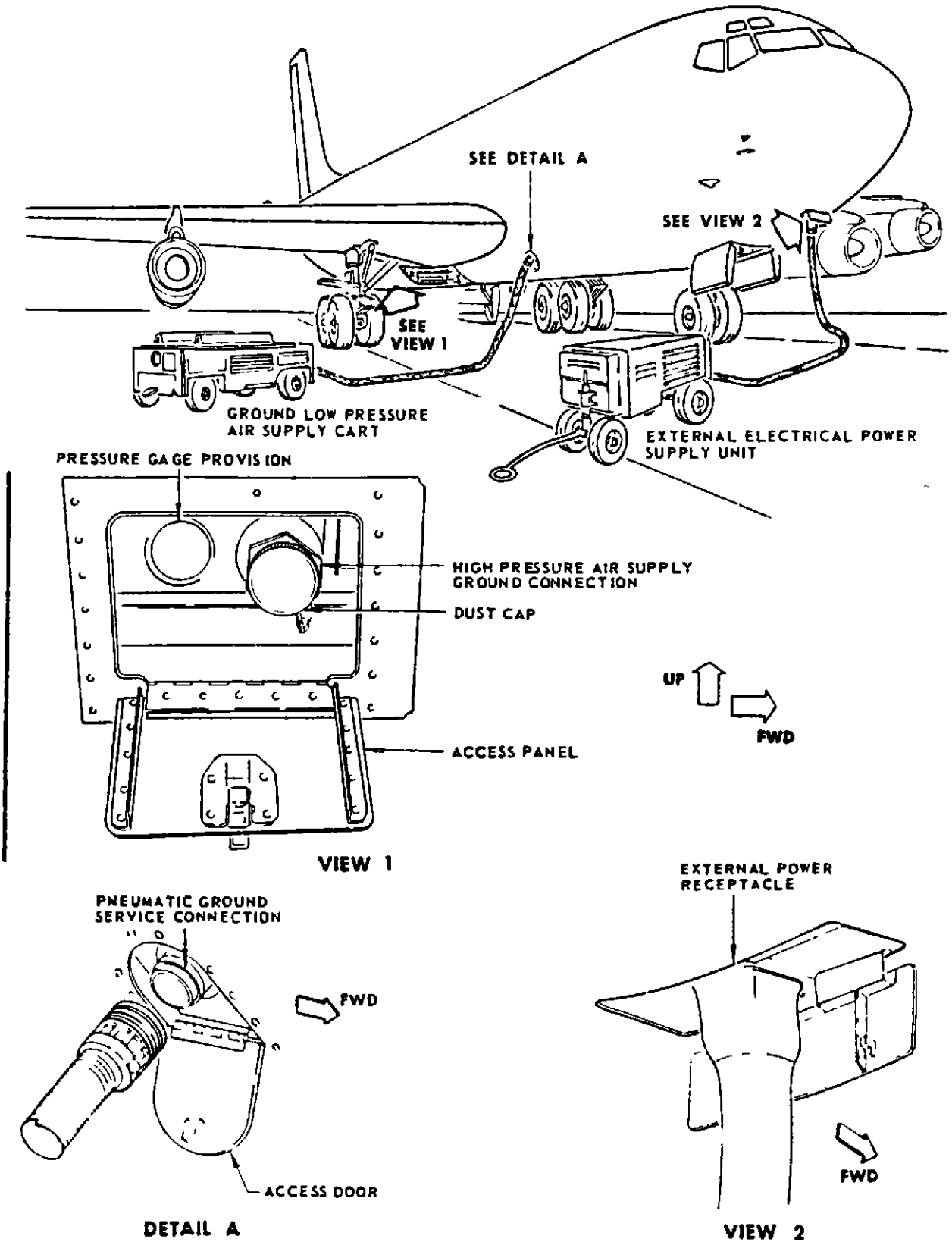
- (6) Check that fire switch is in "NORMAL" position.
- (7) When motoring inboard engines check following:
  - (a) Utility hydraulic reservoir is serviced
  - (b) Hydraulic lines are connected at engine disconnect panel.
  - (c) Hydraulic supply shutoff valve positioned to "OPEN," if applicable
- (8) With alternate low pressure start switch at "OFF," position pressure selector switch to "MANIFOLD," ("LOW PRESSURE")
- (9) Position engine start control switch to "GROUND START" and observe  $N_2$  rpm increase.

**CAUTION:** THIS IS A MOMENTARY TYPE SWITCH AND IF INADVERTENTLY RELEASED PRIOR TO END OF MOTORING RUN, SWITCH MUST NOT BE RE-ENGAGED UNTIL 30 SECONDS AFTER ENGINE AND STARTER HAVE STOPPED ROTATING.

DO NOT MOTOR ENGINE LONGER THAN NECESSARY STARTER UNIT DUTY CYCLE ALLOWS A MAXIMUM OF 2 MINUTES ON AND 5 MINUTES OFF. REFER TO CHAPTER 80, "STARTING."

- (10) Discontinue motoring by placing engine start control and pressure selector switches to "OFF" position

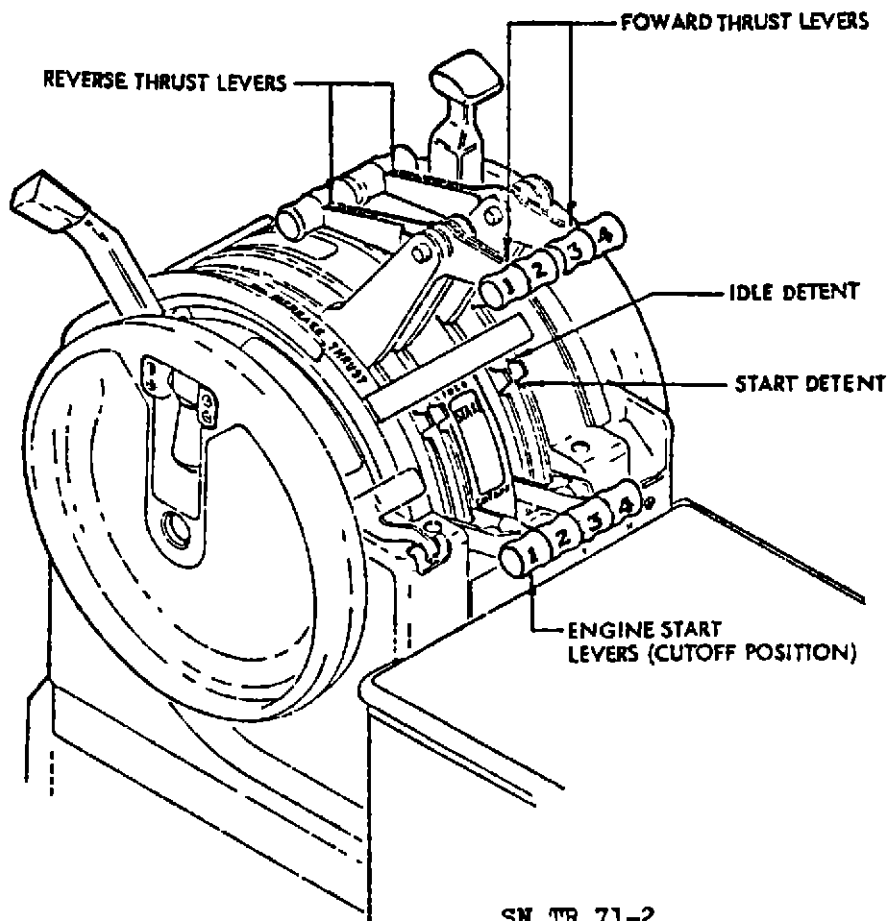
**EFFECTIVITY**  
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D. Bleed and Depreserve Engine Fuel System.

(1) General

- (a) Bleeding and depreserving of engine fuel system is necessary following installation of new engine which has been preserved in accordance with PWA Overhaul Manual or Maintenance Manual procedure (storage period exceeding 28 days). The applicable depreservation procedure is described in paragraph (2).
- (b) Bleeding only is necessary following new engine installation which does not have fuel system preserved as per PWA instructions or following change of fuel control, fuel pump or fuel heater, or after removal of engine fuel strainers or fuel flowmeter, as air trapped in the fuel system can be removed by exercising the throttle during engine running, until normal operation and throttle response is obtained. Bleeding procedure is described in paragraph (3).



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Throttle Control Stand  
 Figure 503  
 T.MAT.PR.



## MAINTENANCE MANUAL

- (2) Bleeding and depreservation procedure (preserved engine).
- (a) Remove pressurizing and dump valve drain plug, insert hose with adapter into drain hole and place hose end into five gallon capacity container.
  - (b) Connect external power to airplane and place engine fuel shutoff valve switch to OPEN.
  - (c) Position fuel boost pump switches to ON and check that fuel inlet pressure indicator light goes out.
  - (d) Move start lever to START position. (See figure 503).
  - (e) Motor engine (paragraph C) at 20 to 25% N2 rpm, until approximately two gallons of fuel have discharged from fuel pressurizing and dump valve drain port or traces of preservative oil disappear.
  - (f) Move start lever to CUTOFF position and turn fuel boost pump switches to OFF.
  - (g) Replace fuel pressurizing and dump valve drain plug. (figure 504).
  - (h) Perform bleeding procedure as per paragraph (3).

(3) Bleeding Procedure ( non-preserved engine or accessories).

**NOTE:** Bleeding of the fuel system may be performed simultaneously with initial engine run up before trim, as described in paragraph 2 I (4) or 3 C (13).

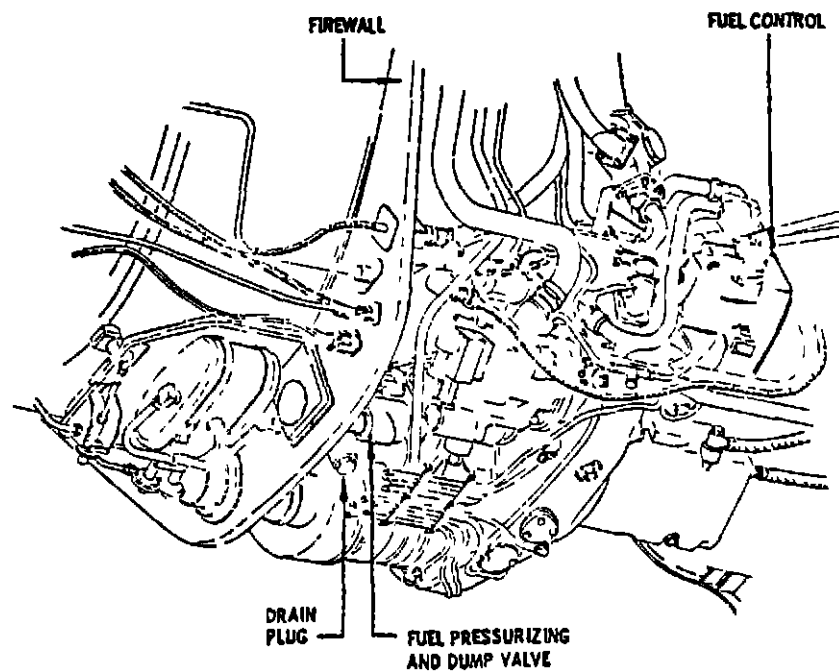
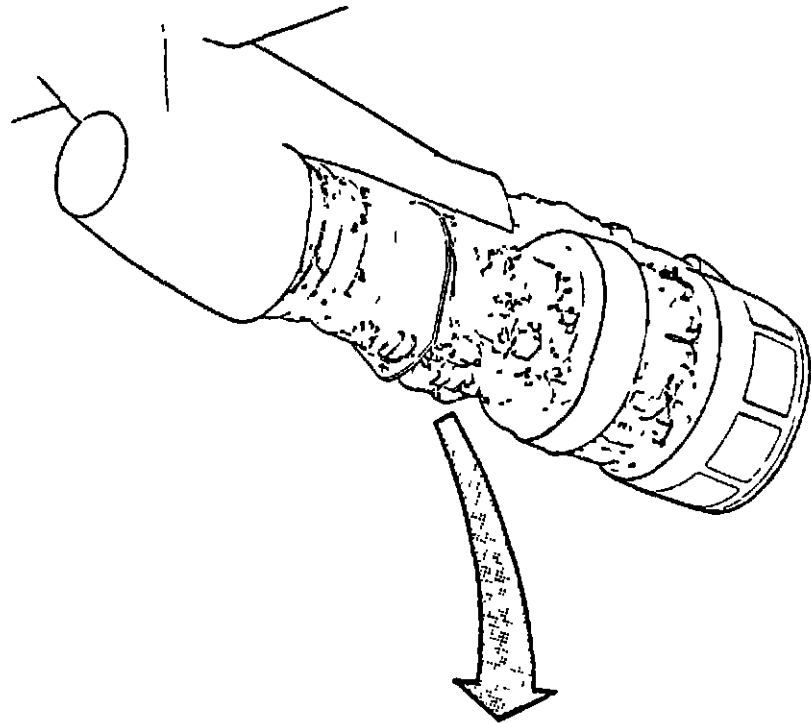
- (a) Start engine as outlined in paragraph 2 H.

**NOTE:** Closely monitor the EGT after light-up for evidence of possible hot start.

- (b) After engine has stabilized for five minutes at idle rpm, purge air from fuel control system by cycling the thrust lever several times FWD and AFT, without exceeding 85% N2 rpm.

**NOTE:** Continue bleeding until stable fuel flow indication and normal engine operation with throttle response is obtained.

- (c) Perform engine trim, or if not required, stop engine following paragraph 2 J.



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Engine Fuel Dump and Pressurizing Valve Test Connections  
Figure 504

E. Clear Engine

- (1) Following any unsatisfactory start, an engine motoring run must be performed to clear engine of trapped fuel or vapor.
  - (a) Motor engine at 20 to 25% N2 rpm for 10 to 20 seconds as outlined in paragraph C.

F. Prepare to Start Engine

- (1) Check and clean area around airplane and insure that engine inlet and exhaust ducts are free of foreign objects. Position personnel guards around plane at correct distance from engine.
- (2) Check that wing flaps are fully up, main landing gear wheels are chocked, nose wheel steering linkage is engaged and all gear locks are installed.
- (3) Remove side cowl panels. Refer to 71-5-21.
- (4) Depreserve and service engine and associated systems if necessary.
- (5) Carefully check engine. Insure that all connections are tight and free from leaks and that lines, tubing and controls are secure and properly locked.

CAUTION: DURING FREEZING CONDITIONS CHECK FOR ICE IN ENGINE COMPRESSOR INLET AND EXHAUST UNIT. TURN ENGINE COMPRESSOR BY HAND IN COUNTERCLOCKWISE DIRECTION AND CHECK FOR FREE ROTATION. IF ICE IS PRESENT, PREHEAT ENGINE WITH AIR HEATER. FOR ENGINE STARTING PRECAUTIONS DURING EXTREME WEATHER CONDITIONS, REFER TO CHAPTER 72, "ENGINE".

- (6) Install side cowl panels.
- (7) Check position of following switches:
  - (a) Fuel Heater, "OFF".
  - (b) Turbocompressor, "STOP".
  - (c) Wing and Nacell Anti-Icing, "OFF".
  - (d) Low Pressure Bleed Air, "OFF".
  - (e) Air Conditioning Packs, "OFF".

G Engine Starting and Operating Limitations

**CAUTION:** GROUND RUNNING OF THE ENGINE AT TAKEOFF POWER SHALL BE RESTRICTED TO 5 MINUTES DRY AND 2 1/2 MINUTES WET THIS WILL PREVENT CERTAIN COMPONENTS OF THE POWER PLANT INSTALLATION FROM EXCEEDING THEIR TEMPERATURE LIMITATION

**CAUTION:** THE ENGINES SHOULD BE OPERATED ONLY WITH SIDE COWL PANELS LOCKED IN PLACE. THIS WILL AVOID DAMAGE TO ENGINE WIRING AND COMPONENTS CAUSED BY THE FAN AIR BLAST. AN EXCEPTION TO THIS PROCEDURE CAN BE MADE IF THE FAN REVERSER ONLY IS POSITIONED TO REVERSE THRUST. REFER TO PARAGRAPH 4.A.

- (1) The recommended start limitations for air turbine starters are as follows:
  - (a) For normal starting using low or high pressure (if high pressure starters installed) the duty cycle is 30 seconds on and 60 seconds off for first start.
  - (b) For a slow starting engine using low pressure air, the duty cycle may be extended to 60 seconds on at speeds up to starter-cutout-speed and 60 seconds off. This extended duty cycle may be repeated once and then a 5 minute cooling period observed between extended duty starts.
  - (c) Deleted.
- (2) Recommended engine operating conditions and limits are outlined in figure 505. Operating conditions are described as follows:
  - (a) TAKEOFF - Maximum thrust available. Rating is obtained by positioning thrust lever to obtain computed TAKEOFF Pt7 or Pt7/Pt2 (EPR) for existing ambient conditions.

**NOTE:** During static engine running conditions inlet pressure (Pt2) sensing probe senses only barometric pressure (Pamb). During takeoff and in flight, inlet pressure probe senses both ram air and altitude pressure variables.
  - (b) MAX. CONTINUOUS - Maximum thrust which may be used continuously. Rating is primarily intended for emergency use during flight and is obtained by positioning thrust lever to predetermined PT7 or EPR.
  - (c) NORMAL RATED - Maximum approved for normal climb during flight operation. Rating is obtained by positioning thrust lever in same manner as for MAX. CONTINUOUS.
  - (d) MAX CRUISE - Maximum thrust approved for cruising.
  - (e) IDLE - This is not an engine rating, but a thrust lever position suitable for minimum thrust operation on the ground or in flight. It is obtained by fully retarding thrust lever.



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## H. Start Engine

- (1) Start engine (ground low pressure air source).

**CAUTION** DURING FREEZING CONDITIONS CHECK FOR ICE IN ENGINE COMPRESSOR INLET AND EXHAUST UNIT. TURN ENGINE COMPRESSOR BY HAND IN NORMAL DIRECTION OF ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE) AND CHECK FOR FREE ROTATION. IF ICE IS PRESENT, PREHEAT ENGINE WITH AIR HEATER. FOR ENGINE STARTING PRECAUTIONS DURING EXTREME WEATHER CONDITIONS, REFER TO ENGINE, CHAPTER 72.

- (a) Prepare check sheet to record engine data during start and ground running operation.
- (b) Provide electrical power and connect ground low pressure air supply to airplane.
- (c) Place thrust levers in fully retarded position and start levers in CUTOFF position. Turn off all unnecessary system switches.
- (d) Check that adequate fuel is present in tanks and position fuel shutoff valve switch to OPEN.
- (e) Position fuel boost pump switches to ON and check that fuel inlet pressure indicator light goes out.
- (f) Position ground start selector switch, if fitted, to LOW PRESS (MANIFOLD) and position left and right wing air conditioning manifold isolation valve switches to OPEN.
- (g) Hold engine start control switch on GROUND START (GND). When N2 rpm reaches 15% and some positive N1 rotation is indicated, move engine start lever to START detent.

**CAUTION:** ADVANCING START LEVER PREMATURELY CAN RESULT IN A HOT START.





## MAINTENANCE MANUAL

- (h) Move engine start lever to IDLE detent when N2 rpm reaches approximately 50%.

**CAUTION:** IF STARTER DOES NOT CUT OUT BY 40% N2 RPM, RETURN ENGINE START CONTROL SWITCH TO "OFF" POSITION.

**NOTE:** Light-up will be evidenced first by rise in exhaust gas temperature (EGT) and should take place within 20 seconds after step (g) is accomplished. N2 rpm and EGT should be monitored immediately after light-up to ascertain that engine accelerates normally and the EGT does not exceed specified limits in Engine Starting and Operating Limitations, figure 505. Observe starter limitations.

**CAUTION:** WHENEVER THE ENGINE FAILS TO LIGHT WITHIN 20 SECONDS OR THE EGT IS CLIMBING RAPIDLY THRU 400°C DURING A START, RETURN START LEVER TO CUTOFF TO AVOID EXCEEDING THE 450°C MOMENTARY LIMITATION. CONTINUE TO MOTOR ENGINE FOR 10 TO 15 SECONDS TO REMOVE FUEL AND VAPOR OR EVIDENCE OF FIRE FROM WITHIN THE ENGINE, OR UNTIL EGT BECOMES NORMAL. AFTER SATISFACTORY CLEARING OF ENGINE, RETURN START SWITCH TO OFF. AFTER ENGINE ROTATION CEASES, AND BEFORE ANOTHER START ATTEMPT DETERMINE AND RECTIFY CAUSE OF UNSATISFACTORY START.

**NOTE:** Following the above procedure during a developing hot start can usually prevent exceeding the temperature limits.

- (i) Check that engine accelerates normally to idle rpm, and that oil low pressure warning light goes out.
- (j) Place pressure selector switch, if fitted, to OFF, after engine has attained idle rpm.



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- (k) Allow engine to stabilize at idle rpm and check the following.
- 1) EPR Approximately 1.06
  - 2) EGT: 260°C normal (340°C maximum)
  - 3) N2 rpm: 58% (+0/-2%)
  - 4) Fuel Flow: Approximately 900-1000 pounds per hour
  - 5) Oil Pressure 35 psig minimum (41 to 43 psig normal)
  - 6) Oil Temperature: 40 to 132°C
  - 7) Engine fuel filter temperature for applicable engine Fuel filter temperature should read approximately 10°C higher than indicated temperature of fuel in No 1 main fuel tank.

(2) Start Engine (Low Pressure Air, Turbocompressor Source)

**CAUTION** DURING FREEZING CONDITIONS CHECK FOR ICE IN ENGINE COMPRESSOR INLET AND EXHAUST UNIT. TURN ENGINE COMPRESSOR BY HAND IN NORMAL DIRECTION OF ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE) AND CHECK FOR FREE ROTATION IF ICE IS PRESENT, PREHEAT ENGINE WITH AIR HEATER. FOR ENGINE STARTING PRECAUTIONS DURING EXTREME WEATHER CONDITIONS, REFER TO ENGINE, CHAPTER 72.

- (a) For pneumatic crossover starts between engines on opposite sides of airplane, position right and left wing manifold isolation valve switches to OPEN
- (b) Start engine equipped with turbocompressor per paragraph (1), and operate at idle rpm
- (c) Place turbocompressor control switch for this engine to START
- (d) Check turbocompressor, on engine just started, for satisfactory operation.
- (e) Increase power on this engine until pneumatic duct pressure reaches 35 psi. (This requires 85 to 86% N2 rpm.)
- (f) Place fuel shutoff valve switch to OPEN and fuel boost pump switches to ON, for engine to be started
- (g) Continue start procedure as outlined in paragraph (1) steps (g) through (k)
- (h) Reduce power on engine used for cross-starting once second engine attains idle speed



## MAINTENANCE MANUAL

### (3) Start Engine (Ground High Pressure Air Source, Engine 3)

**CAUTION:** DURING FREEZING CONDITIONS CHECK FOR ICE IN ENGINE INLET AND EXHAUST. TURN ENGINE COMPRESSOR BY HAND IN NORMAL DIRECTION OF ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE) AND CHECK FOR FREE ROTATION. IF ICE IS PRESENT, PREHEAT ENGINE WITH AIR HEATER FOR ENGINE STARTING. PRECAUTIONS DURING EXTREME WEATHER CONDITIONS, REFER TO ENGINE, CHAPTER 72.

- (a) Provide electrical power and close starter air bottle isolation valve. Refer to Starting, Chapter 80.
- (b) Connect high pressure air supply to ground connection of high pressure air system. (See figure 502 )

**NOTE:** High pressure air can be an external air bottle or from an air compressor, capable of 3000 psig delivery.

- (c) Place thrust levers in retarded position and start levers in CUTOFF position. Turn off all unnecessary systems switches.
- (d) Check that adequate fuel is present in tank, and then position fuel shutoff valve switch to OPEN.
- (e) Place appropriate fuel boost pump switches to ON and check that fuel inlet pressure indicator light goes out
- (f) Position ground start selector switch to HIGH PRESS (BOTTLE)



## MAINTENANCE MANUAL

- (g) Hold engine start control switch to GROUND START (GND). Advance the engine start lever to START detent at first indication of N2 rotor rpm. Additionally for JT3D-7 engines, monitor the N1 tachometer for indication of N1 rotation.

CAUTION: IF THE ENGINE IS ALLOWED TO TURN TO 15% N2 OR GREATER BEFORE MOVING THE START LEVER FROM CUTOFF, THE STARTER TORQUE WILL HAVE DECREASED SO MUCH AT LIGHT-OFF THAT THERE WILL BE INSUFFICIENT TORQUE FOR NORMAL ACCELERATION TO IDLE. THE RESULT MAY BE A HOT OR HUNG START.

CAUTION: FOR JT3D-7 ENGINES, IF N1 ROTATION IS NOT OBSERVED DURING THE INITIAL PHASE OF THE START, THE START SHOULD BE DISCONTINUED IMMEDIATELY

CAUTION: THE ENGINE START CONTROL SWITCH IS A MOMENTARY TYPE SWITCH. PREMATURE RELEASE FROM GROUND POSITION BEFORE STARTER CUTOFF CAN CAUSE A HOT START.

NOTE: Light-up will be evidenced first by a rise in exhaust gas temperature (EGT) N2 rpm, EGT, fuel flow and oil pressure should be monitored immediately after light-up to ascertain that engine accelerates normally and EGT does not exceed the limits specified in Engine Starting and Operating Limitations, figure 505.

- (h) Return engine start control switch to OFF position at starter cutout or 40% N2 rpm, whichever comes first.
- (i) Move engine start lever to IDLE detent when N2 rpm reaches approximately 50%.
- (j) Return ground start selector switch (when fitted) to OFF position when engine reaches idle.



## MAINTENANCE MANUAL

- (4) Start engine (airplane high pressure air source engines 2 and 3).

**CAUTION:** DURING FREEZING CONDITIONS CHECK FOR ICE IN ENGINE INLET AND EXHAUST. TURN ENGINE COMPRESSOR BY HAND IN NORMAL DIRECTION OF ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE) AND CHECK FOR FREE ROTATION. IF ICE IS PRESENT, PREHEAT ENGINE WITH AIR HEATER. FOR ENGINE STARTING PRECAUTIONS DURING EXTREME WEATHER CONDITIONS, REFER TO ENGINE, CHAPTER 72

- (a) Provide electrical power and check that starter system air bottles are fully charged. Minimum bottle pressure for high pressure starts is 2700 psig.
- (b) Place thrust levers in retarded position and start levers in CUTOFF position. Turn off all unnecessary systems switches
- (c) Check that adequate fuel is present in tank, and then position fuel shutoff valve switch to OPEN.
- (d) Place appropriate fuel boost pump switches to ON and check that fuel inlet pressure indicator light goes out.
- (e) Position ground start selector switch to HIGH PRESS (BOTTLE).
- (f) Hold engine start control switch to GROUND START (GND). Advance the engine start lever to START detent at first indication of N2 rotor rpm. Additionally for JT3D-7 engines, monitor N1 tachometer for indication of N1 rotation.

**CAUTION:** IF THE ENGINE IS ALLOWED TO TURN TO 15% N2 OR GREATER BEFORE MOVING THE START LEVER FROM CUTOFF, THE STARTER TORQUE WILL HAVE DECREASED SO MUCH AT LIGHT-OFF THAT THERE WILL BE INSUFFICIENT TORQUE FOR NORMAL ACCELERATION TO IDLE. THE RESULT MAY BE A HOT OR HUNG START

FOR JT3D-7 ENGINES, IF N1 ROTATION IS NOT OBSERVED DURING THE INITIAL PHASE OF THE START, THE START SHOULD BE DISCONTINUED IMMEDIATELY.

THE ENGINE START CONTROL SWITCH IS A MOMENTARY TYPE SWITCH. PREMATURE RELEASE FROM GROUND POSITION BEFORE STARTER CUTOFF CAN CAUSE A HOT START.

**NOTE:** Light-up will be evidenced first by a rise in exhaust gas temperature (EGT). N2 rpm, EGT, fuel flow and oil pressure should be monitored immediately after light-up to ascertain that engine accelerates normally and EGT does not exceed the limits specified in Engine Starting and Operating Limitations, figure 505.



## MAINTENANCE MANUAL

- (g) Return engine start control switch to OFF position at starter cutout or 40% N2 rpm, whichever comes first.
- (h) Move engine start lever to IDLE detent when N2 rpm reaches approximately 50%.
- (i) Return ground start selector switch to OFF position when engine reaches idle.



## MAINTENANCE MANUAL

## I. Operate Engine and Associated Systems

- (1) Operate engine at idle rpm for 5 minutes and check instruments for proper engine operation.
- (2) Deleted
- (3) Adjust engine oil pressure to within specified range Refer to "Adjust Engine Oil Pressure."
- (4) Accelerate engine four or five times to approximately 85% N2 rpm to purge all air from fuel system

NOTE: Stable fuel flow indication with normal throttle response is considered to be satisfactory indication that air has been purged from engine fuel system

- (5) With engine at idle, check thrust reverser operation Refer to Chapter 78, "Exhaust "
- (6) Slowly increase power from approximately 50% N1 rpm and check surge bleed valve operation with the assistance of a ground crewman. The surge bleed valve may be observed through the port on the left side cowl panel. Compare surge bleed valve operation for the prevailing ambient temperature against the values of N1 rotor speed as given in figure 505A.
- (7) Increase power to approximately 90% N2 rpm, stabilize EPR (or Pt7) and check engine and nose cowl anti-icing system operation.

CAUTION. TO PREVENT DAMAGE TO THE FOAM RUBBER MATERIAL IN THE CENTER BAY OF THE INLET GUIDE VANES, LIMIT USE OF THE ENGINE AND NACELLE ANTI-ICING SYSTEM TO 10 SECONDS AT AMBIENT TEMPERATURES ABOVE 50°F (10°C).

- (8) Place nacelle anti-ice switch "ON" and check for decrease in EPR. EPR value should decrease approximately 0.04 units Position nacelle anti-ice switch to "OFF "



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- (9) Retard thrust lever to idle position.
- (10) Check wing anti-ice system. Refer to Chapter 30, "Ice and Rain Protection."
- (11) Check constant speed drive operation. Refer to Chapter 24, "Electrical Power "
- (12) On engines No. 2 and 3 check hydraulic system operation. Refer to Chapter 29, "Hydraulic "

### J. Stop Engine

#### (1) General

- (a) If an engine has been above 85% N2 rpm for more than one minute during the five minutes prior to shut-down, engine must be operated at idle rpm for an additional five minutes to ensure uniform cooling.
- (b) Emergency shut-down procedure will only be used when abnormal conditions arise or to prevent damage to engine. If an emergency stop from high power is necessary, both compressor rotors must be checked for freedom of rotation when engine has cooled.

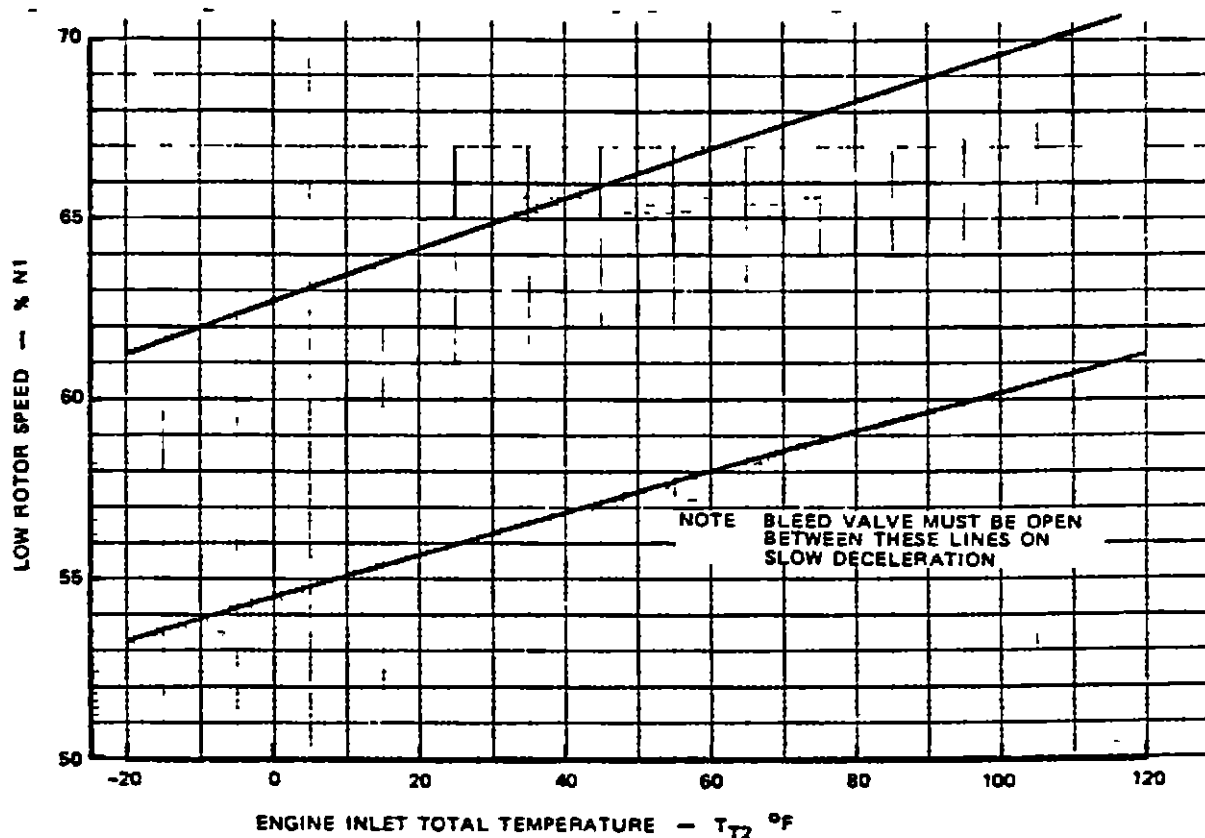
#### (2) Engine Shutdown Procedure (Normal)

- (a) Allow engine to run at idle rpm for five minutes
- (b) During last 30 seconds prior to engine cutoff advance power to 75 to 80%. This assures complete scavenging of the oil sumps
- (c) Move start lever to "CUTOFF" position and check that engine decelerates freely. Listen for any unusual rubbing or scraping noises on rundown.
- (d) Position fuel boost pump switches to "OFF" and fuel shutoff valve switch to "CLOSE."

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NOTE: Present curve is compatible to engines having bleed valve with or without PWA SB 5209 incorporated.



APPLICABLE TO JT3D-1, JT3D-1-MC6 JT3D-1-MC7 JT3D-3 JT3D-3B, AND JT3D-7 ENGINES

Compressor Surge Bleed Valve Schedule  
Figure 505A

- (e) After three consecutive engine shutdowns, actuate the combustion chamber drain tank jiffy valve.

CAUTION: FAILURE TO DRAIN TANK WILL RESULT IN A HAZARD IF FUEL DISCHARGED FROM STRUT PORT DRIPS ON ENGINE.

- (f) Service engine oil tank within 30 minutes of engine shutdown.
- (3) Engine Shutdown Procedure (Emergency)

- (a) Fully retard thrust lever and move start lever to CUTOFF in quick succession.

CAUTION: DO NOT PLACE START LEVER IN "CUTOFF" POSITION WITH ENGINE OPERATING IN THE HIGH RPM RANGE WITHOUT FIRST RETARDING THRUST LEVER TO IDLE POSITION. RESULTANT HIGH FUEL PRESSURES MAY CAUSE INTERNAL DAMAGE TO FUEL CONTROL UNIT OR TURBINE WHEEL SEIZURE MAY OCCUR DUE TO SUDDEN CONTRACTION OF ENGINE CASE.

- (b) Pull appropriate fireswitch on pilot's lightshield.
- (c) Position applicable fuel boost pump switches to OFF.
- (d) If engine is cowed, actuate appropriate fire extinguisher switch as required.

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## (4) Internal Engine Fire During or After Shutdown

NOTE: Internal or tailpipe fires are not detected by cockpit fire alarm but reported by ground crew.

## (a) With external electrical power and ground low pressure air supply connected to the airplane:

- (1) Place engine fuel shutoff valve in "CLOSE" position.
- (2) On battery and essential bus circuit breaker panel P6, open (pull) applicable "ENG IGNITION" circuit breakers.
- (3) Open appropriate wing air conditioning isolation valve.
- (4) Engage starter at any speed up to 15% N2 rpm.

NOTE: If possible, engage starter only after engine has stopped rotating. If starter has been engaged with engine running, inspect the starter for sheared shaft or other damage before using the starter again.

- (5) Motor engine to clear out all evidence of internal fire or tailpipe fire without regard for starter limitations.
- (6) After fire is cleared, complete shutdown.

CAUTION: GROUND CREW IS REQUESTED NOT TO USE EXTINGUISHER AGENTS ON INTERNAL ENGINE FIRE OR TAILPIPE FIRE UNLESS MOTORING FAILS TO BRING FIRE UNDER CONTROL. HOT SECTION OF ENGINE CAN WITHSTAND VERY HIGH TEMPERATURE. NORMALLY, IF AN INTERNAL FIRE OR TAILPIPE FIRE IS PERMITTED TO BURN UNTIL ENGINE CAN BE MOTORED, ENGINE WILL EXPERIENCE FAR LESS DAMAGE THAN THAT WHICH WOULD BE CAUSED BY SPRAYING A CORROSIVE OR CHILLING AGENT INTO TURBINE EXHAUST DUCT. ENGINE REMOVAL IS MANDATORY AFTER USE OF LATTER METHOD.

## (b) With only external electrical power connected to the airplane:

- (1) Ground crew observes fire dies out by itself.
- (2) If fire intensifies, ask cockpit for pulling the respective fire switch, without discharging A/C fire extinguisher bottle.
- (3) Ground crew discharges fire extinguisher bottle into the turbine exhaust duct.
- (4) Engine removal is mandatory after use of any corrosive or chilling agent.



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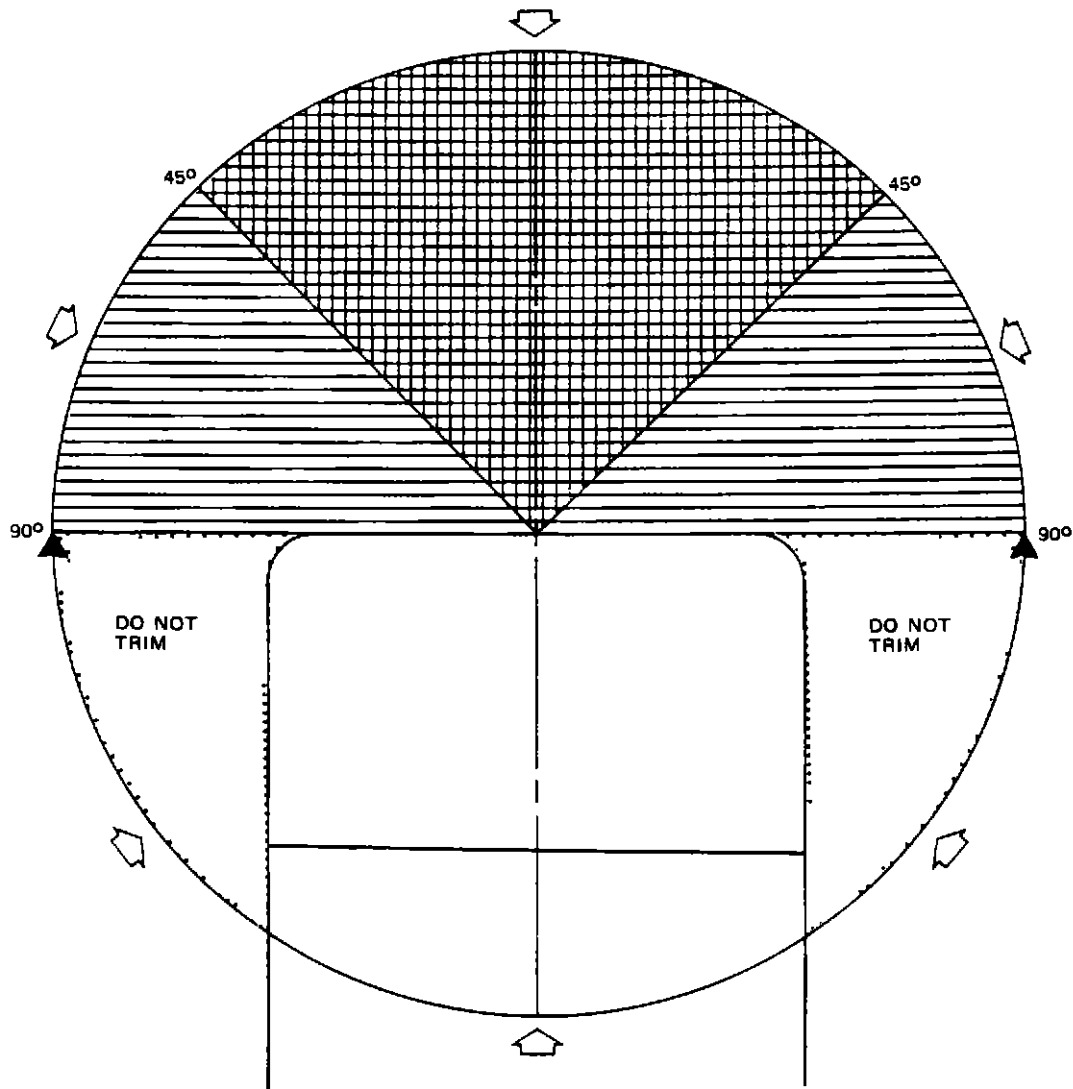
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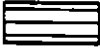




3. Adjust (Trim) Engine

A. General

- (1) Engine trimming is performed at part power setting and is a necessary requirement on newly installed engines or following a change of fuel control unit. Periodic trim adjustments may also be necessary during the life of the engine, to restore normal "cushion" between take-off and full throttle position. Since the fuel control is fuel density sensitive, some change will occur in engine trim when switching from one fuel to another. An engine trimmed with JP-4 fuel will be "overtrimmed" when operated with kerosene while a kerosene trimmed engine will be "undertrimmed" when operated with JP-4 fuel. The amount of throttle cushion available is sufficient to absorb such changes and permit use of either fuel without having to retrim the engines.
- (2) Engine trim is affected by wind velocity and direction. Trim adjustment loses its effectiveness as the angle of wind direction increases toward 90° from the engine inlet. Engines that are trimmed in a cross-wind will be "overtrimmed" when checked in a no wind condition while engines checked in a head wind will be in an "undertrimmed" condition. Tailwind conditions (beyond 90°) tend to direct engine exhaust gases forward to the engine inlet. Since target values of turbine discharge pressure (Pt7) are corrected for ambient air temperature, exhaust gases ingested by the engine will produce an inaccurate trim adjustment. (See figure 506.) Relative wind velocity may be disregarded providing the velocity is under 10 mph and a blast fence is employed. Otherwise, the airplane should be headed into the wind. Engines should not be trimmed when wind velocity exceeds 25 mph or when icing conditions prevail.
- (3) A check sheet should be prepared to record engine operation data during the trim run. See figure 507 for sample check sheet layout. Ambient temperature, true barometric pressure, and idle and Pt7 targets should be recorded before commencing the engine trim run. The idle and Pt7 target values are determined from the tabulated trim charts (figure 511). The EPR (Pt7/Pt2) reading which corresponds to the target Pt7 value should also be noted to provide a check between the control cabin EPR indicator and the engine Pt7 test indicator.



-  PREFERRED
-  ACCEPTABLE
-  UNACCEPTABLE
-  WIND DIRECTION

**NOTE**

TYPICAL FOR ALL ENGINES

TO ACHIEVE CONSISTENTLY GOOD TRIM RESULTS THE AIRPLANE SHOULD BE HEADED INTO THE WIND AND TRIMMED WHEN WIND VELOCITY (STEADY OR GUSTS) IS NOT MORE THAN 25 MPH

WHEN WIND VELOCITY IS LESS THAN 10 MPH WIND DIRECTION MAY BE DISREGARDED IF A BLAST FENCE IS USED DURING ENGINE TRIM

TRIMS ARE NOT RECOMMENDED WHEN WIND VELOCITY EXCEEDS 25 MPH OR WHEN ICING CONDITIONS PREVAIL

Wind Direction and Velocity Limits  
 Figure 506

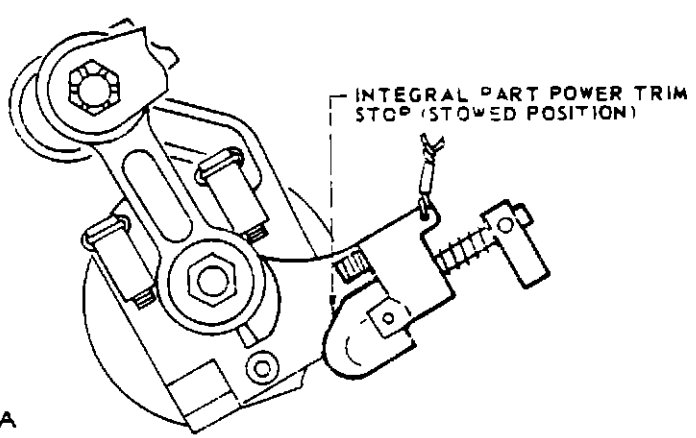
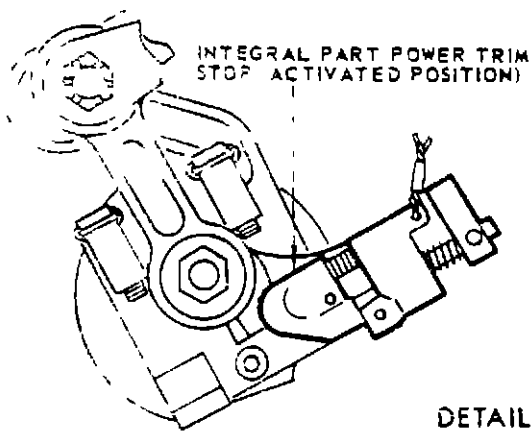
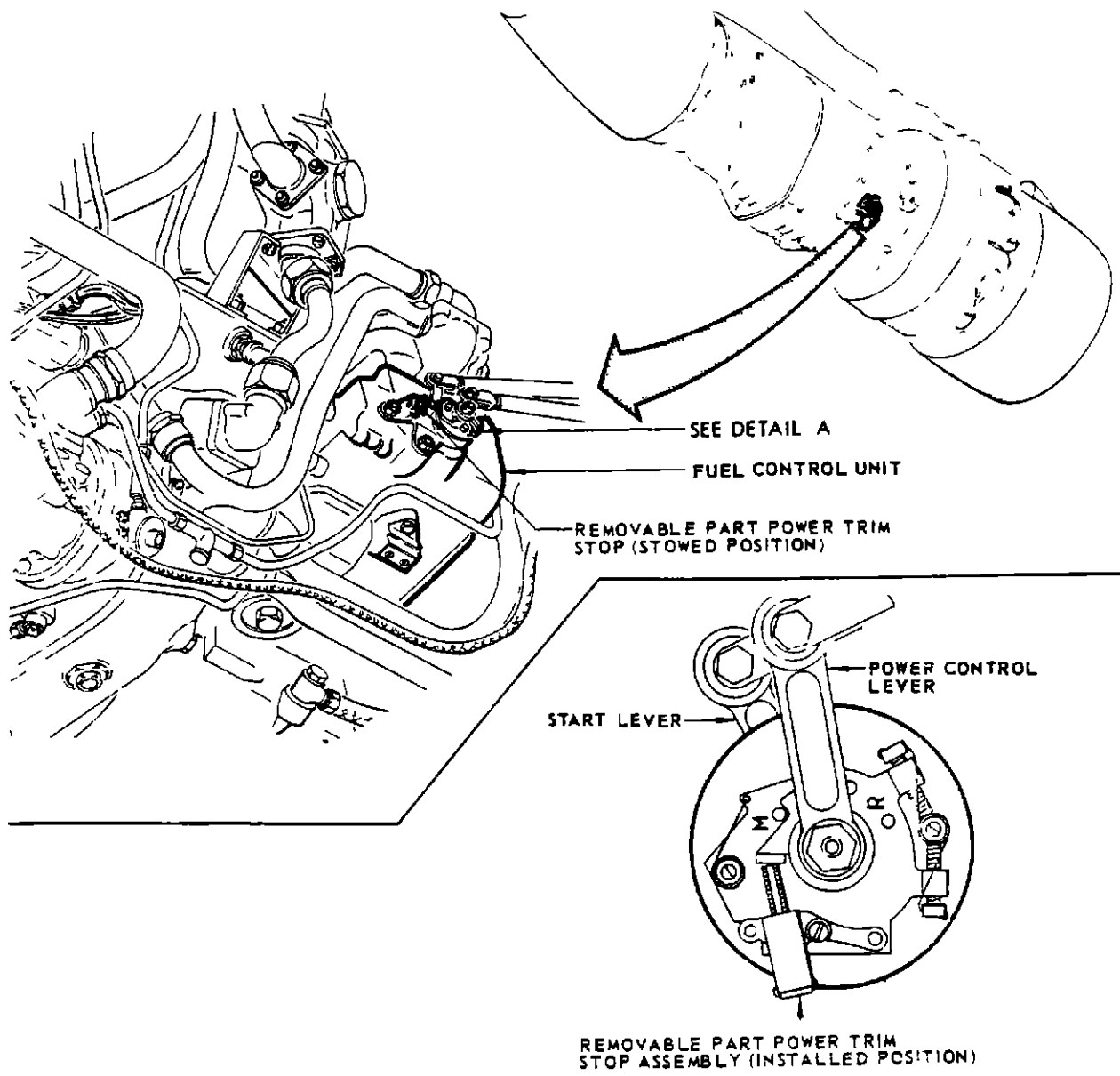
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A/F Serial No		RATING		NEXT FLIGHT NO		FUEL GRADE		WEATHER		DATE					
ENG POS	ENGINE SERIAL NO	ENGINE DATA PLATE SPEED		OAT °F	BARO INS HG ABS	TAILPIPE CONFIGURATION		FUEL QUANTITY POUNDS		SBV	TIME RUN				
1								#1 Main							
2								#2 Main							
3								#3 Main							
4								#4 Main							
<p>Activate or install part power trim stops. Start and run at idle for 5 minutes. Check fuel heater <input type="checkbox"/> turbocompressor <input type="checkbox"/> anti-icing <input type="checkbox"/> and LP bleed <input type="checkbox"/> off. Increase to part power trim stop for 15 - 20 seconds. Adjust MAX trim screw to part power Pt7 target. Reduce power to idle and adjust idle trim screw to give 58% N2 idle rpm. Then trim as follows: Increase power to part power trim stop for 2 minutes. Adjust MAX trim screw to part power Pt7 target during final 30 seconds.</p>															
ENG POS	POWER SETTING	Tam	Pam	EPR OF Pt7 (Pilot's)			Pt7 (Test Gage)			N1RPM %	EGT °C	N2RPM %	Wf Lb/Hr	OIL PF T	
1	PART			ORIGNL	TARGET	ACTUAL	ORIGNL	TARGET	ACTUAL						
2	POWER														
3	TRIM														
4	STOP														
Adjust power to data plate Pt7 - Stabilize for 30 seconds															
ENG POS	POWER SETTING	TARGET Pt7	PILOTS EPR	N2 %	RPM	ADJ DATA PLATE SPEED									
1	DATA														
2	PLATE														
3	CHECK														
4															
Reduce power to idle. Shut down and deactivate or stow part power trim stop. Start and run at idle for 5 minutes, then increase power to take-off rating.															
ENG POS	POWER SETTING	EPR OF Pt7		N1 %RPM	EGT °C	N2 RPM %	Wf Lbs/Hr	INS LEFT AT PILOT'S QUAD	OIL TEMP	OIL PRESS	REMARKS				
1	T.O. Dry	TARGET	ACTUAL												
2	15 Secs.														
3															
4															
Reduce power to idle for 5 minutes. Adjust idle rpm and oil pressure as required. Shut down.										WEATHER					
ENG POS	POWER SETTING	N2 RPM %	OIL PRESS	REMARKS											
1	IDLE														
2	58 <sup>+0</sup> / <sub>-2</sub> %														
4	N2 RPM														



DETAIL A

Fuel Control Unit Part Power Trim Stops  
 Figure 508

- (4) Trimming the engine is accomplished by adjusting the IDLE and MIL (Maximum) trim screws, on the forward end of the fuel control, with the part power trim stop in the activated position to limit throttle cross-shaft angle. Identification and direction for adjustment is stamped on the pad adjacent to the trim screws. (See figure 508.) On engines fitted with water injection, a water injection trim screw is located on the forward face of the fuel control (See figure 508.)
- (5) After a satisfactory trim run has been accomplished, it is necessary to run the engine at takeoff power to ensure that the TAKEOFF rating and adequate throttle "cushion" are obtainable. An engine acceleration and deceleration check should also be performed

#### B Equipment and Materials

- (1) Manifold Pressure Gage - Kollsman Type 838K-3-05 or equivalent (with current calibration chart) and adapter hose with suitable end fittings to connect pressure gage to Pt7 test fitting.
- (2) Tachometer Indicator - Takcal Model BHL50B (Howell Instruments, Inc., Ft. Worth, Texas) or equivalent (with current calibration chart) and adapter harness with four position selector switch - to enable both pilots tachometer indicators and test indicator to be used simultaneously. Adapter harness plug must mate with the Amphenol connector 69-OR20-27S (100), located below the copilot's waste container. (See figure 509.)  
  
NOTE: The tachometer gear ratio for JT3D engines is 0 435:1 (N2)
- (3) Thermometer - calibrated in degrees Fahrenheit (-20° to +120°F)
- (4) Ground Low Pressure Air Supply Unit - (35 psig minimum delivery, 450°F maximum temperature, 95 lbs/min. minimum flow) - Boeing Model 502 or equivalent.
- (5) Ground Service Electrical Power Unit - (60 KVA, 210 volt, 400 cps) - Louis Allis or equivalent.
- (6) Interphone Service Equipment



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- (7) Flex Cable Assembly - Lear Inc. Part Number C3939C for dry engines or C3939D for engines equipped with water injection.
- (8) Water Injection Trim Adapter - Lear Inc. Part Number C3944A or equivalent for engines equipped with water injection.
- (9) Blast Shield - Lear Inc. Part Number C3942A
- (10) Power Assembly - Lear Inc. Part Number 4734A (includes actuator control box and two cable assemblies)
- (11) Holding Frame - Lear Inc. Model Number 3927B
- (12) Spacer (0.048 inch thick for JT3D-1 engines; 0.099 inch thick for JT3D-3, JT3D-3B, and JT3D-7 engines) to serve as shim between part power trim stop and fuel control power lever arm at temperatures of 0°F and below.

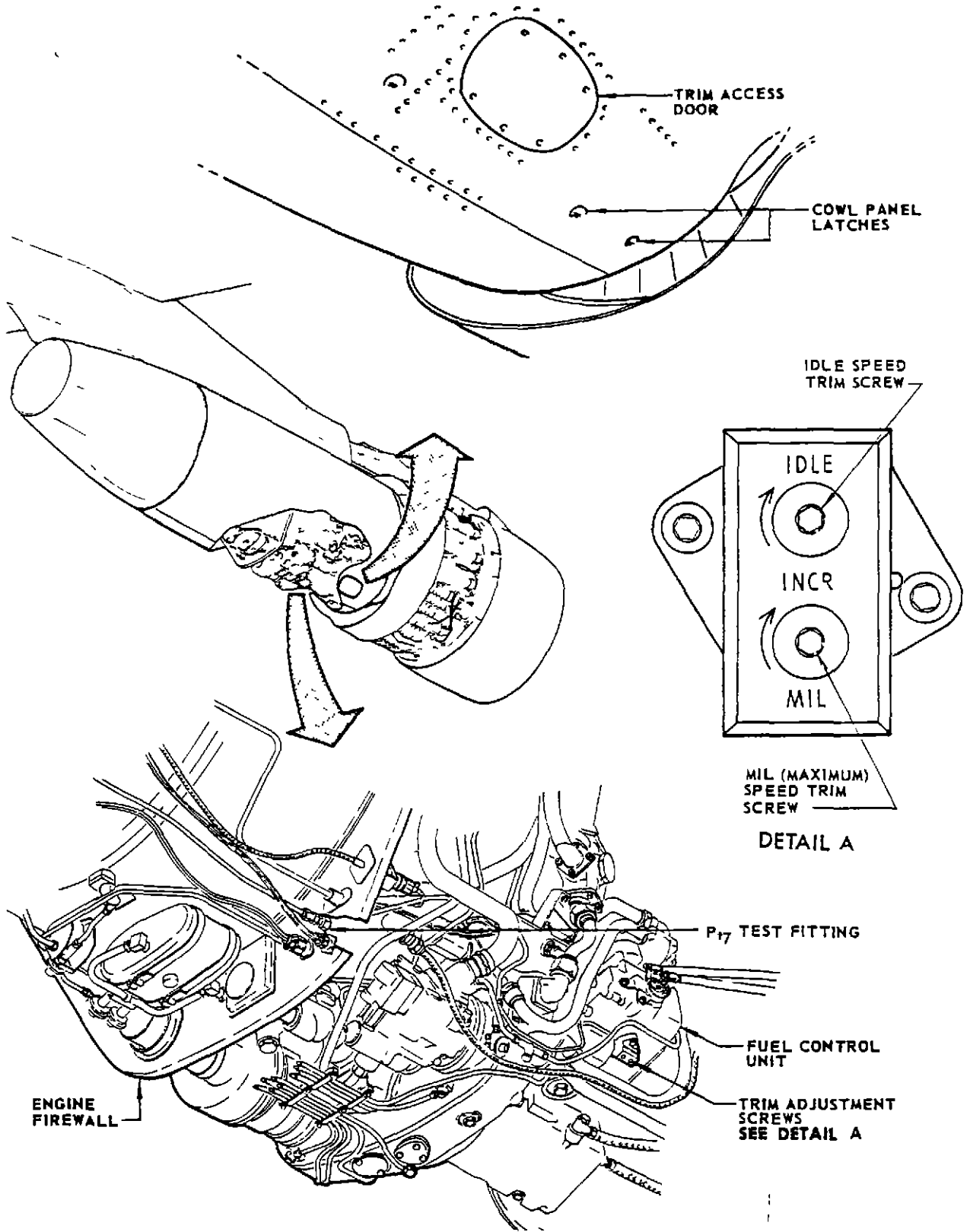
### C. Prepare to Trim Engine

NOTE: An observer, with interphone to airplane control cabin, should be located at a safe distance from an engine undergoing trim operations.

- (1) Open side cowl panels. Refer to 71-5-21
- (2) Remove trim access door from the right side cowl panel (See figure 509 )
- (3) Check and clean up area, engine and engine mounted accessories.
- (4) Install or activate part power trim stop at fuel control (See figure 508.)

NOTE: Some fuel controls have a flip-lock type part power trim stop while others have a removable type. Ensure that retaining screw of removable type part power trim stop is fully tightened so that trim stop will not work loose during engine trim run.

CAUTION· PART POWER TRIM STOP IS SELECTIVE TO PROVIDE CORRECT POWER LEVER POSITION FOR RESPECTIVE FUEL CONTROL UNIT. STOPS ARE NOT INTERCHANGEABLE BETWEEN FUEL CONTROL UNITS

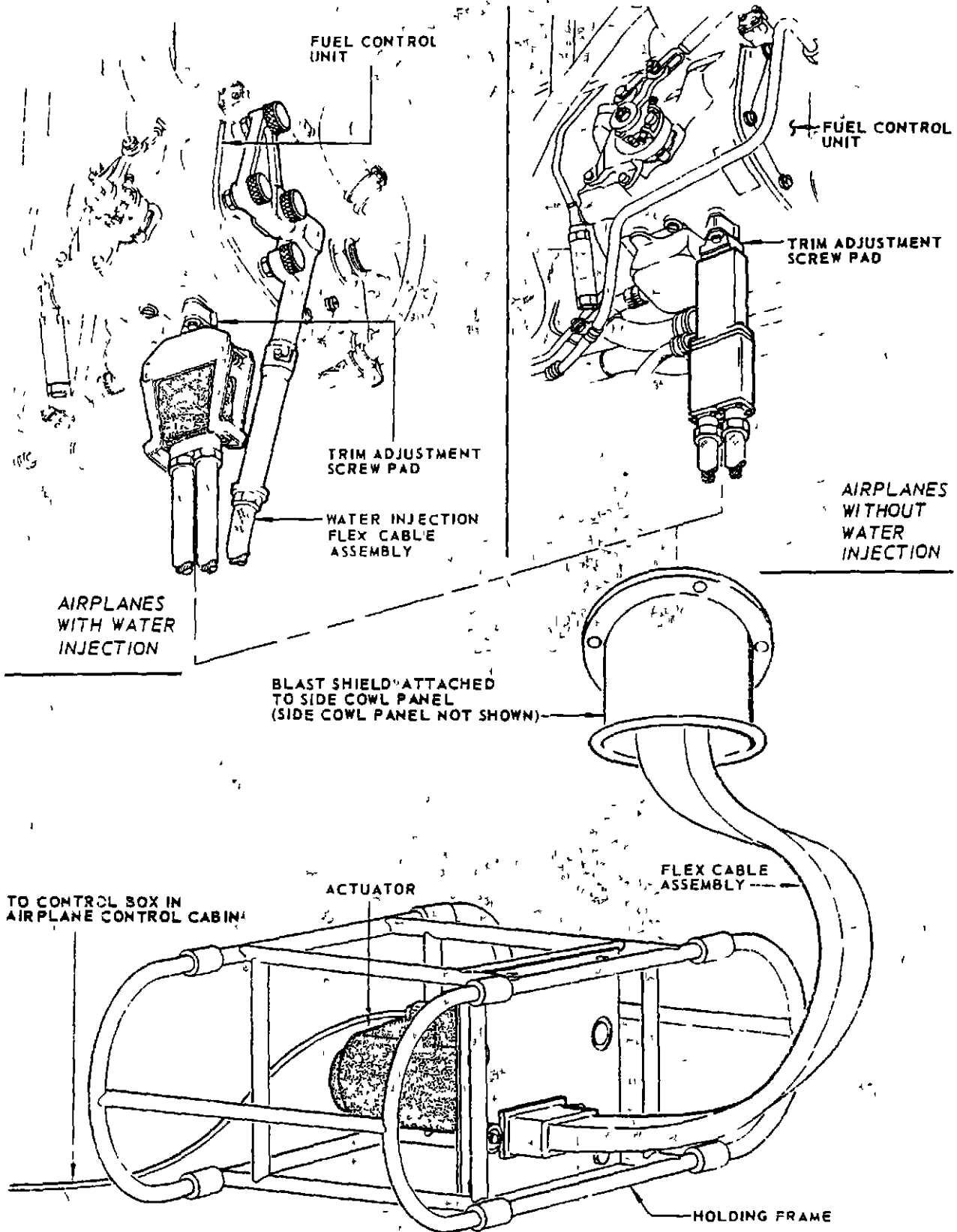


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*Intercontinental*  
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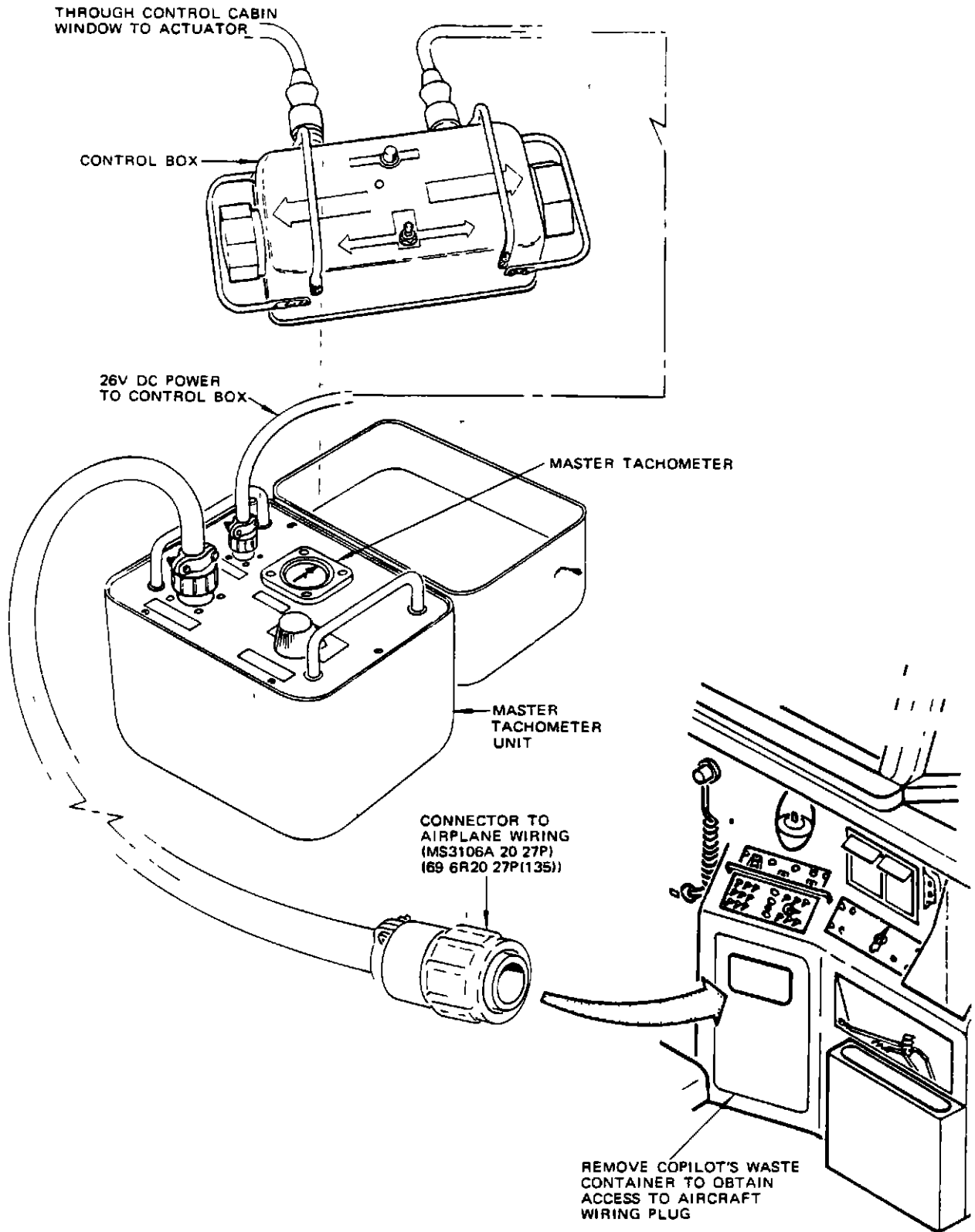
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Engine Remote Trim Equipment Arrangement  
Figure 509 (Sheet 2)

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- (5) Thread Pt7 adapter hose through the blast shield then through the cowl panel trim access door and connect to Pt7 test branch located at engine firewall. (See figure 509.)
- (6) Close and latch cowl panels.  

CAUTION ENSURE Pt7 ADAPTER HOSE IS NOT TRAPPED OR PINCHED BETWEEN COWLING AND ENGINE COMPONENTS.
- (7) Thread the flex cable assembly through the blast shield and insert it up through the trim access door. Remove trim screw seals and attach cable assembly to fuel control trim adjustment block. If engine is to be trimmed with water injection (if fitted), attach water injection trim adapter cable. (See figure 509.)
- (8) Install blast shield over trim access door opening.  

CAUTION THE BLAST SHIELD MUST BE INSTALLED TO PROTECT REMOTE TRIM EQUIPMENT FROM DAMAGE BY THE FAN AIR BLAST. WHEN TRIMMING PROCEDURE IS FINISHED COWL PANEL TRIM ACCESS DOOR MUST BE REPLACED.
- (9) Attach free end of flex cable to power assembly mounted in holding frame. (See Detail B.) Locate control box (detail C) in airplane control cabin and route electrical cable from power assembly through control cabin sliding window to control box. Also route Pt7 pressure line through cabin window to a convenient location for observing manifold pressure test gage.
- (10) Connect manifold pressure gage to Pt7 pressure line, also connect cable from power assembly to control box.
- (11) Remove copilots waste container to gain access to fourteen-pin electrical plug located on forward face of airplane frame.
- (12) Connect fourteen-conductor cable between airplane plug and master tachometer selector box. (See detail D.) Connect two-conductor cable between master tachometer selector box and control box.
- (13) Close "ENGINE TRIM" circuit breaker on circuit breaker panel P5.
- (14) Connect external electrical power and ground low pressure air supply to airplane.

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- (15) Accurately determine and record ambient temperature and local barometric pressure.

CAUTION. DO NOT USE AIRPLANE OUTSIDE AIR TEMPERATURE (OAT) INDICATOR TO OBTAIN AMBIENT AIR TEMPERATURE. DO NOT APPLY BAROMETRIC PRESSURE CORRECTED TO SEA LEVEL, NORMALLY REPORTED BY CONTROL TOWER.

- (16) Determine part power trim target Pt7 for ambient temperature and true local barometric pressure using figure 511. Note equivalent EPR value for check of pilot's indicating system.

CAUTION. DIFFERENT TRIM AND TAKE-OFF POWER SETTING CHARTS ARE USED ACCORDING TO THE TYPE OF ENGINE AND NOSE COWL INSTALLED. CARE MUST BE TAKEN TO ENSURE THAT THE CHARTS USED ARE APPLICABLE TO THE TYPE OF ENGINE AND NOSE COWL INSTALLED.

NOTE. Once the engine has been trimmed with either the large or small secondary inlet door the nose cowl may be changed to the other type without retrimming the engine.

- (17) Determine engine data plate speed power setting target Pt7, data plate rpm correction, and data plate percent rpm correction for ambient temperature and true local barometric pressure using figure 511.
- (18) Record engine data plate N2 speed and adjusted data plate N2 speed to check actual engine performance during trim run.

NOTE Engine data plate N2 speed reference is stamped on data plate tag located on forward side of engine firewall.



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- (19) Start engine.

**CAUTION:** OBSERVE NORMAL ENGINE OPERATING LIMITATIONS WHILE TRIMMING ENGINE. PROMPT THRUST LEVER ACTION MAY BE REQUIRED TO PREVENT OVERSPEEDING ENGINE IF THERE IS AN AIR LEAK IN Pt7 SYSTEM OR IF MIL (MAXIMUM) SPEED TRIM SCREW IS INCORRECTLY ADJUSTED ON NEW ENGINE.

**NOTE:** Turbocompressor (cabin air compressor), fuel heater, air conditioning units, anti-icing valves and low pressure bleed air (outboard engines only) must be off during engine part power trimming. The engine trim data charts (figure 511) are based on NO AIR BLEED.

- (20) Allow five minutes for engine to stabilize at idle rpm, then perform the following checks:

- (a) EGT: 340°C maximum
- (b) N2 rpm: 58% (+0/-2%)
- (c) Fuel Flow: Approximately 900-1000 pph
- (d) Oil Pressure: 35 psig minimum (41 to 43 psig normal)
- (e) Oil Temperature: 40° to 132°C

**NOTE:** The utility hydraulic system pump and the generator drive need not be disconnected during engine power adjustment since the no load power requirement of these items is negligible.

- (21) If new fuel control unit has been installed, ensure all air is purged from fuel system by exercising throttle four or five times from idle to approximately 85% N2 rpm.

### D. Trim Engine, Part Power

- (1) Preset idle rpm.

- (a) At ambient temperatures of 0°F and below, install a shim between the part power trim stop and the power lever arm of the fuel control. Use a 0.048 inch shim for JT3D-1 engines and a 0.099 inch shim for JT3D-3, JT3D-3B, and JT3D-7 engines.

**NOTE:** Reduced part power trim targets are used at temperatures of 0°F and below to prevent exceeding take-off EPR. Use of the trim shim and the reduced Pt7 targets may result in some power lever misalignment, therefore, retrimming to the normal (above 0°F) part power trim targets is recommended as soon as the ambient temperature permits.

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- (b) Advance thrust lever until contact is made with part power trim stop. Stabilize for two minutes.

**CAUTION:** DO NOT USE EXCESSIVE FORCE WHEN ADVANCING THRUST LEVER AGAINST PART POWER TRIM STOP AS DAMAGE MAY RESULT TO TRIM STOP ASSEMBLY. A DAMAGED TRIM STOP IS CAUSE FOR REJECTION OF THE FUEL CONTROL.

- (c) Operate remote trim controls to adjust MIL (maximum) speed trim screw at fuel control to obtain Pt7 part power target.

**NOTE:** Adjustment of maximum speed trim screw one-quarter turn will change Pt7 value approximately 1.0 in. Hg.

- (d) Retard thrust lever to idle position and adjust IDLE speed trim screw to obtain idle rpm of 58% (+0/-2%) N2 rpm. Engines equipped with turbocompressors must be adjusted to idle with the turbocompressors operating.

**NOTE:** Good engine acceleration is dependent on a high idle rpm. Adjust idle rpm toward the high side of the tolerance.

The above idle rpm adjustment procedure is recommended since there is interaction between IDLE and MIL speed trim screws. Idle rpm should be rechecked after final part power trim adjustment is accomplished.

- (2) Make final part power trim adjustment. (No water injection.)

- (a) With turbocompressor turned off, advance thrust lever until contact is made with part power trim stop, stabilize at part power setting for two minutes. During last 30 seconds adjust MIL speed trim screw to obtain trim target Pt7 (+0.5/-0 in. Hg Abs) and take complete set of engine instrument readings.

**NOTE:** When making trim screw adjustments, always adjust Pt7 upwards to target. This may require adjusting to a value below target and then adjusting upward until target is reached.

- (b) Retard thrust lever to obtain data plate speed power setting target Pt7 obtained in paragraph 3.C.(17). Pilot's EPR indicator should read 1.36 units on power plants with small secondary air inlet doors, or 1.37 units on power plants with large secondary air inlet doors. After 30 seconds, record N2 rpm, Pt7 and EPR readings at pilot's instrument panel and test indicators.

**NOTE:** When trimming JT3D-1 engines at ambient temperatures above 76°F and JT3D-3 or JT3D-3B engines at ambient



## MAINTENANCE MANUAL

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temperatures above 110°F, or JT3D-7 engines at ambient temperatures where part power trim Pt7 is lower than data plate power setting target Pt7, perform check of data plate power setting target in conjunction with the takeoff thrust setting check.

- (c) Retard thrust lever to idle position, stabilize three minutes and recheck idle rpm with turbocompressor operating. If idle rpm is not satisfactory adjust idle speed trim screw and repeat trim procedure.
- (d) The precision tachometer N2 rpm reading, after calibration correction is applied, should be approximately equal to adjusted data plate speed of the engine. If a new engine exceeds 1.0% N2 rpm over adjusted data plate speed, check for an open air bleed, faulty instrumentation, leaking Pt7 system probes and/or manifold, or wrong target. Retrim engine if necessary.

NOTE. If indicated N2 rpm exceeds adjusted data plate speed by more than 2.1%, investigate and correct cause of performance deterioration. This upper limit of 2.1% N2 rpm has been established to allow for performance deterioration over the entire service life of the engine between overhauls.

If indicated N2 rpm is 1.0% or more under adjusted data plate speed, engine hot section distress should be suspected and further investigation should take place.

- (e) Compare EPR recorded at pilot's instrument panel with EPR equivalent of target Pt7 determined in paragraph C.(16). Difference should not be greater than 0.015 units. If difference is greater, check EPR system and transmitter for leaks and instrument errors.
- (f) The pilot's N2 tachometer indicator should read within  $\pm 0.5\%$  rpm ( $\pm 50$  rpm) of the trim kit calibrated tachometer indicator. If not within this tolerance, the pilot's indicator should be changed and a check run with the new indicator.
- (g) If engine is not fitted with water injection, reduce power to idle, stabilize for 5 minutes and shut down. If engine is fitted with water injection proceed to paragraph (3) or (4).
- (h) Open right side cowl panel. Remove and stow part power trim stop assembly on fuel control unit. (See figure 508.) Close right side cowl panel.

- (3) Check takeoff thrust setting.
- (a) Start engine and stabilize at idle rpm for 3 minutes.
  - (b) If check of data plate power setting target Pt7 could not be performed during engine trim run because of high ambient temperature proceed as follows:
    - 1) Advance thrust lever to obtain 1.36 EPR (if nose cowl with small secondary air inlet doors is installed) or 1.37 EPR (if nose cowl with large secondary air inlet doors is installed) Adjust EPR reading for system error, as determined during engine trim run, and stabilize for 30 seconds. Record N2 rpm, Pt7 and EPR readings at pilot's instrument panel and at test indicators.
  - (c) Advance thrust lever to takeoff setting. Refer to figure 511
- CAUTION** THERE IS NO THRUST LEVER STOP AT "TAKEOFF" POWER SETTING, HENCE EXHAUST GAS TEMPERATURE AND N2 SPEED MUST BE CAREFULLY MONITORED TO INSURE THAT OPERATING LIMITATIONS ARE NOT EXCEEDED.
- (d) Stabilize at takeoff power setting for 15 to 20 seconds and record pilot's engine instrument readings.
  - (e) Mark position of forward edge of thrust lever on control stand using grease pencil, tape, or other temporary marking method.
  - (f) Retard thrust lever to idle position.
- (4) Acceleration and deceleration check
- (a) Advance thrust lever in one to two seconds from idle to the takeoff mark on the throttle stand determined in (3)(e) above.
  - (b) Record engine acceleration time; the time elapsed from initial advancement of the thrust lever until the engine has reached 95% of the takeoff N2 rpm recorded in paragraph 3.D.(3)(d) above.
  - (c) Remain at takeoff power setting for 2 to 3 seconds and decelerate engine to idle by retarding the thrust lever to idle in 1 to 2 seconds. The engine should decelerate smoothly and stabilize at idle. Any "flameout" is cause for rejection of the fuel control
  - (d) Only if engine acceleration time is greater than 7 seconds, repeat steps (a), (b) and (c) until three satisfactory accelerations have been completed. Allow the engine to stabilize at idle rpm prior to repeating each acceleration check.



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- (e) The normal acceleration time for the JT3D engine is 5.0 to 8.0 seconds under no air bleed conditions. If the engine cannot be accelerated within 8 seconds, the engine and/or fuel control are considered to be faulty and should be investigated.
  - (f) Retard thrust lever to idle position and stabilize for five minutes.
  - (g) With turbocompressor switch in ON position, check idle speed for 58% (+0%/-0.5%) N2 rpm.
  - (h) Shut down engine.
- (5) Determine throttle cushion after final shutdown by pushing thrust lever to full throttle and allowing it to spring back. Measure and record the distance between takeoff thrust mark, step (3) (e), on control stand and forward edge of thrust lever. Return thrust lever to idle. At sea level standard day conditions, the throttle cushion will normally be between 1.00 and 1.75 inches.
  - (6) Remove all engine test instrumentation and restore engine to normal configuration.
  - (7) Seal IDLE and maximum speed trimmers with approved sealing wax.
  - (8) Remove and clean engine fuel and oil filter screens and elements. Change applicable screens and elements if necessary.
  - (9) Check engine and engine mounted accessories for fuel and oil leaks.
  - (10) Install side cowl panels. Refer to 71-5-21.

#### 4. Engine Operation With Side Cowl Panels Removed

##### A. General

- (1) The turbofan engine must normally be run fully cowled due to the high velocity air discharging from the fan exhaust. On newly installed engines the following special run should be accomplished to check for fluid leaks and perform necessary engine adjustments before the side cowl panels are installed.

##### B. Leak Check Run - Uncowled

- (1) Remove side cowl panels, if installed. See 71-5-21.
- (2) With the thrust reversers in the cruise position, disconnect the upper metal flex line at the left side of the thrust reverser. (See figure 510.) Cap the line on the pressure side. (This will

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## MAINTENANCE MANUAL

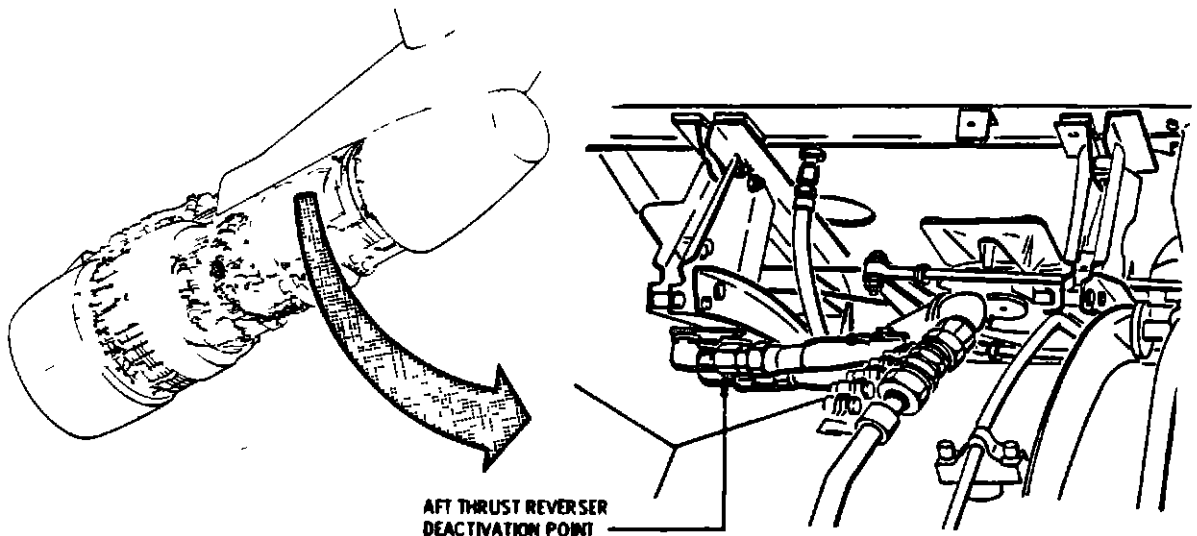
permit actuation of the forward thrust reverser only so that an inspection and necessary adjustments can be performed on the engine.)

- (3) Start Engine.
- (4) Slowly move reverse thrust lever into reverse thrust position and set  $N_2$  rpm to 58%.
- (5) If engine oil pressure is not in desired range adjust oil pressure relief valve. See paragraph 4-C.
- (6) Increase power in reverse thrust to the interlock stop and have a ground crewman check engine for fluid leaks.
- (7) Operate turbocompressor, if installed, and check for fluid leaks.
- (8) When fluid leaks have been rectified retard reverse thrust lever to idle and check that reverser has returned to cruise position.
- (9) Shut down engine and return reverser plumbing to normal configuration.
- (10) Install side cowl panels. See 71-5-21.

### C. Adjust Engine Oil Pressure

- (1) Operate engine as in paragraph B above.
- (2) Remove oil pressure relief valve cover plugs, located on underside of accessory drive gear box, holding outer hex fitting with suitable wrench. (See figure 510A.)

**CAUTION:** IF THE OUTER HEX HEAD FITTING IS REMOVED PRESSURE RELIEF VALVE PARTS WILL BE RELEASED AND WILL FALL TO THE GROUND



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Aft Thrust Reverser Deactivation Point  
Figure 510

- (3) Carefully loosen the adjusting screw locknut.
- (4) While the oil pressure indicator on the flight engineer's lower panel is monitored, turn the adjusting screw to obtain an oil pressure of 41 to 43 psig at 58 (+0/-2)% N2 rpm (idle).

NOTE. On a cold engine (oil temperature below 40°C) adjust oil pressure to 43 psig at idle rpm.

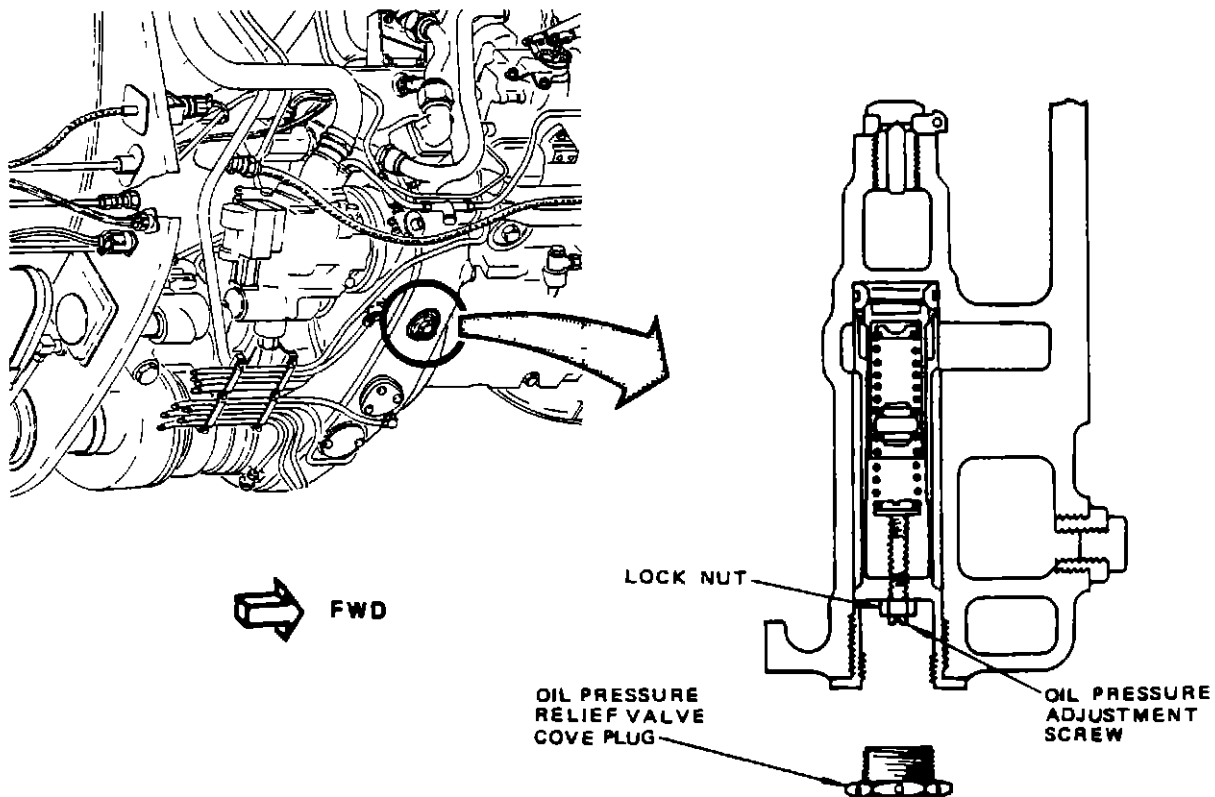
One full turn on the adjustment screw results in approximately a 2 psig change in engine oil pressure. Turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.

- (5) Tighten the locknut and recheck the pressure on the oil pressure indicator.

NOTE: For consistent readings hold a screwdriver on the adjusting screw while tightening the locknut.

- (6) Place a serviceable gasket on the relief valve liner and install the cover plug.

- (7) Shut down engine and restore to normal configuration.



Engine Oil Pressure Adjustment  
Figure 510A

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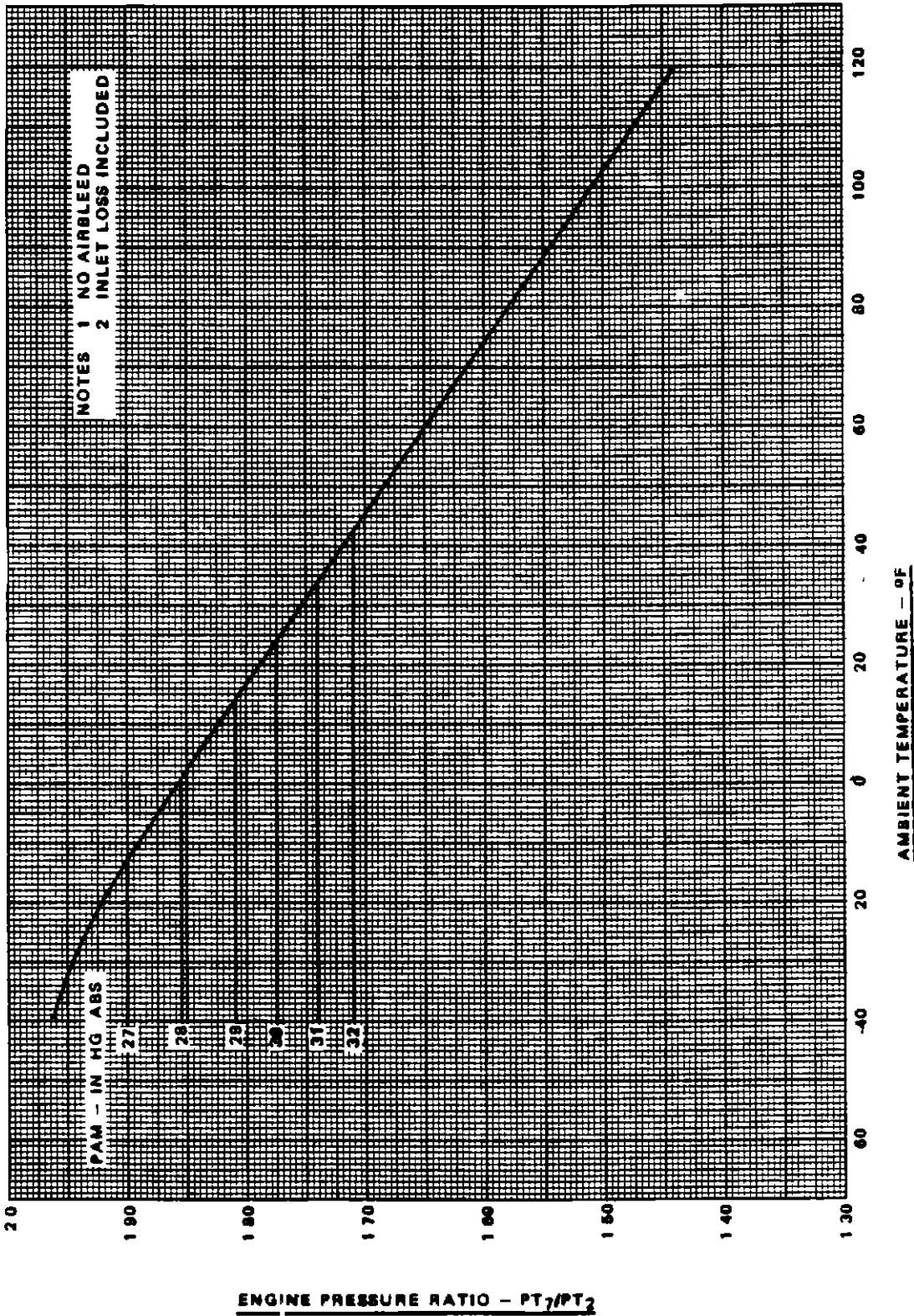


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5. Test Engine After Repair or Replacement of Engine Components

A. General

- (1) The extent of repair and replacement will vary with each engine; therefore, the degree of test necessary to demonstrate satisfactory repair will vary also. When maintenance affecting the engine fuel system has been accomplished, perform the applicable P&WA test procedure utilizing the TAKEOFF EPR setting specified in figure 511. If maintenance accomplished does not affect the engine fuel system, perform the applicable P&WA test procedure, utilizing the MAXIMUM CONTINUOUS EPR setting from figure 510B. To determine the test required for any given repair, refer to Repair Test Reference Table, Engine, Chapter 72.



APPLICABLE TO JT3D 3 AND JT3D 3B ENGINES  
 WITH 4 x 14 INCH SECONDARY AIR INLET DOORS

Maximum Continuous Thrust Curve (Static)  
 Figure 510B (Sheet 1)



## MAINTENANCE MANUAL

- (5) Breather pressurizing valve housing for loose connections and mounting bolts; vent for obstructions.
- (6) Tubing and hoses for loose or broken clamps, and loose or leaking connections, hoses for chafing.
- (7) Pressure transmitter and tubing connections for evidence of leakage, mounting bracket for cracks and loose mounting bolts.

C. Check combustion case and turbine case as follows:

- (1) Check exhaust cone, nozzle and struts for visible evidence of cracks, dents, buckling, distortion, and localized overheating.
- (2) Check last stage turbine blades and trailing edge of nozzle guide vanes for warpage, cracks, and foreign object damage.

CAUTION. ALWAYS TURN ENGINE TURBINE OR N1 COMPRESSOR IN DIRECTION OF NORMAL ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE).

- (3) Check exhaust section for oil accumulation
- (4) Combustion chamber case, turbine exhaust case, and exhaust cone for local burnt spots and cracks.
- (5) Thermocouples for insecurity, leads for chafing and loose clamps.

D. Check compressor section for following:

- (1) Inlet guide vanes, front bearing support, and visible compressor blades for cracks and evidence of foreign material having entered the engine.

CAUTION: ALWAYS TURN ENGINE TURBINE OR N1 COMPRESSOR IN DIRECTION OF NORMAL ROTATION (CLOCKWISE AS VIEWED FROM REAR OF ENGINE).

- (2) Inlet pressure probe and temperature sensing elements loose, dented or blocked.
- (3) Compressor case exterior for cracks.
- (4) Fan air outlet duct for cracks or damage.

E Check fuel components for following.

- (1) Control, filter and heater, pump unit and connections for leaks; screens for foreign matter, mounting clamps for loose check nuts and broken or missing lockwire; control unit electrical connection for broken or missing lockwire.

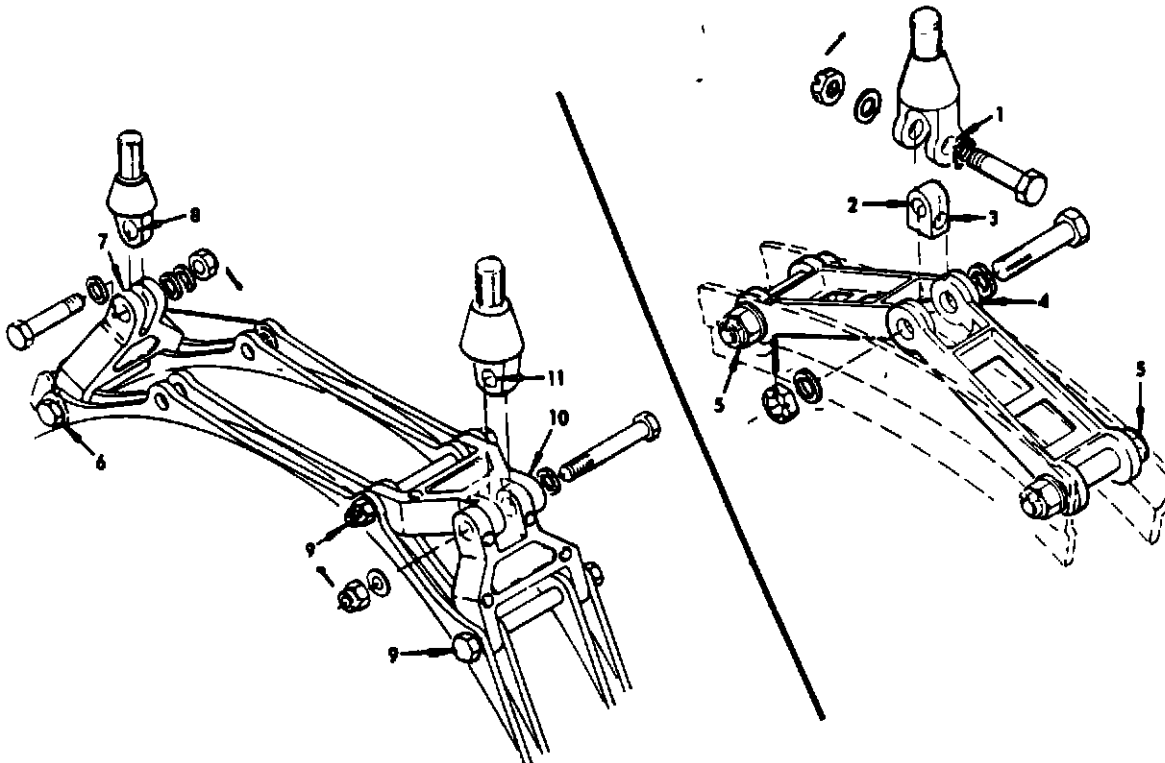
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- (2) Pressurizing and dump valve for loose mounting bolts, valve connections for leaks, screens for foreign matter and weld separations.
  - (3) Tubing for loose or broken clamps and loose or leaking connections; flex lines for chafing.
  - (4) Fuel flowmeter transmitters for evidence of leakage and loose mounting bolts; electrical connectors for broken or missing lockwire.
- F Check ignition components for following:
- (1) Units for cracked mounts, loose mount bolts and loose connections.
  - (2) Ignition harness for loose or broken clamps, shielding crushed or frayed.
  - (3) Igniter for eroded electrodes, improper gap clearance, cracked insulators and loose leads.
- G. Check pneumatic components for following:
- (1) Engine and nose cowl anti-ice valve fittings for broken or missing lockwire; anti-ice ducting for loose or broken clamps; duct joints for loose bolts.
  - (2) Engine pneumatic ducts for loose clamps; clamps and mounting bolts for broken or missing lockwire; ducts and flexible couplings for cracks or abrasions.
  - (3) Pneumatic starters for specified oil level; ducting, joints, and clamps for cracks and loose bolts; starter for loose mounting bolts; low pressure air shutoff valve for loose or cracked mounting clamps and frayed cables to electrical connector.
- H. Check engine controls for following:
- (1) Cables for specified tension, corrosion and fraying, turnbuckles for broken safety wire.
  - (2) Pulleys for misalignment with cable runs.
  - (3) Linkage terminal bolts for broken or missing cotter pins, linkage for excessive play and binding
  - (4) Levers for full travel.



**TYPICAL ALL  
FOUR ENGINES**

- ▽ Joint may be reworked by either of two methods. 1.) Use oversize bolt, BAC-B30AJ12-55 or equivalent, and enlarge bores in fittings to regain design clearance. 2.) Install 17-4PH bushings in fitting bores.
- ▽ 17-4PH stainless steel bushings allowed. Ream to size after installation.
- ▽ 17-4PH stainless steel bushing allowed. Cadmium plate bushing O.D. before installation. Ream I.D. to size after installation.
- ▽ Joint may be reworked by either of two methods. 1.) Use oversize bolt NAS2910-E25DW or NAS3010-E25DW and enlarge bores in fittings to regain design clearance. 2.) Install 17-4PH stainless steel bushings in fitting bores.

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INDEX NO.	DIM.	DESIGN LIMITS		WEAR LIMITS		REWORK LIMITS					
		DIAMETER		MAX WEAR DIM.	MAX. DIAM. CLEARANCE	BUSHING OR PLATING PERMITTED			OVERSIZE HOLE OR PLATING BUILD-UP MAX.	BUSHING INTERFERENCE	
		MIN.	MAX.			YES	NO	MTL.		MIN	MAX.
1	ID	0.6241	0.6261	0.6290	0.0050	X		▽	0.7441	0.0005	0.0025
	OD	0.6234	0.6240	0.6191				X			
2	ID	0.6245	0.6255	0.6280	0.0040			X			
	OD	0.6234	0.6240	0.6205				X			
3	ID	0.6245	0.6255	0.6280	0.0040			X			
	OD	0.6234	0.6240	0.6205				X			
4	ID	0.6245	0.6255	0.6280	0.0040	X		▽	0.7445	0.0005	0.0025
	OD	0.6234	0.6240	0.6205				X			
5	ID	0.6245	0.6255	0.6280	0.0045	X		▽	0.7445	0.0005	0.0025
	OD	0.6234	0.6240	0.6205				X			
6	ID	0.6245	0.6258	0.6290	0.0050	X		▽	0.7445	0.0005	0.0025
	OD	0.6230	0.6240	0.6195				X			
7	ID	0.6245	0.6258	0.6290	0.0050	X		▽	0.7445	0.0005	0.0025
	OD	0.6230	0.6240	0.6195				X			
8	ID	0.6238	0.6258	0.6290	0.0050	X		▽	0.7438	0.0005	0.0025
	OD	0.6230	0.6240	0.6188				X	▽		
9	ID	0.6245	0.6255	0.6290	0.0050	X		▽	0.7445	0.0005	0.0025
	OD	0.6230	0.6240	0.6195				X			
10	ID	0.7495	0.7505	0.7558	0.0070	X		▽	0.8686	0.0005	0.0025
	OD	0.7468	0.7488	0.7425				X	▽		
11	ID	0.7486	0.7506	0.7558	0.0070	X		▽	0.8686	0.0005	0.0025
	OD	0.7468	0.7488	0.7416				X	▽		

I. Check electrical wiring for chafing, loose or broken clamps, loose connectors.

(1) Specific Check

(a) Perform a grip check of the hydraulic pump valve connector D135. Open connector and check:

- 1) Grip of each plug pin socket with a new pin size 16 P/N 030-1154-000 or equivalent.
- 2) Grip of each receptacle pin with a new socket size 16 P/N 031-0731-000 or equivalent.

NOTE: The grip force must be above 100 grams. Replace plug not meeting this limit. Replace and send hydraulic pump to overhaul facility when receptacle is faulty.

J. Check engine mount linkage and support brackets for cracks and loose nuts.

K. Examine nacelle strut for following:

- (1) Engine forward mount fitting attaching bolts for looseness; engine mount right hand side fitting and left hand side cone fitting holes for corrosion (boroscope); engine mount fitting and bulkhead for cracks; thrust link fitting and terminal bolts for cracks, corrosion and wear; connecting bolt holes for wear and corrosion (boroscope); thrust link fitting connection and lower spar in this area for cracks and loose fasteners. Magnetic inspect forward engine mount right hand side fitting and left hand side cone fitting holes for cracks at each aircraft overhaul. (See figure 601.)
- (2) Engine rear mount support bracket and universal block for cracks; connecting bolts for cracks, corrosion and wear; connecting bolt holes for wear and corrosion (boroscope). Magnetic inspect rear engine mount fitting hole for cracks at each aircraft overhaul.
- (3) Skin and doublers around access openings for cracks and loose fastenings.
- (4) Access opening and gap covers for cracks and loose or missing fasteners.
- (5) Nacelle forward fairing latches and guide pins for loose fasteners, cracks and corrosion.

L. Check engine vents, breather openings and drains for obstructions.

M. Check engine combustion chamber drain tank for loose support straps, lines for kinks or loose connections.

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**707**  
**MAINTENANCE MANUAL**

NOSE COWL (SMALL SECONDARY AIR INLET DOORS) - MAINTENANCE PRACTICES

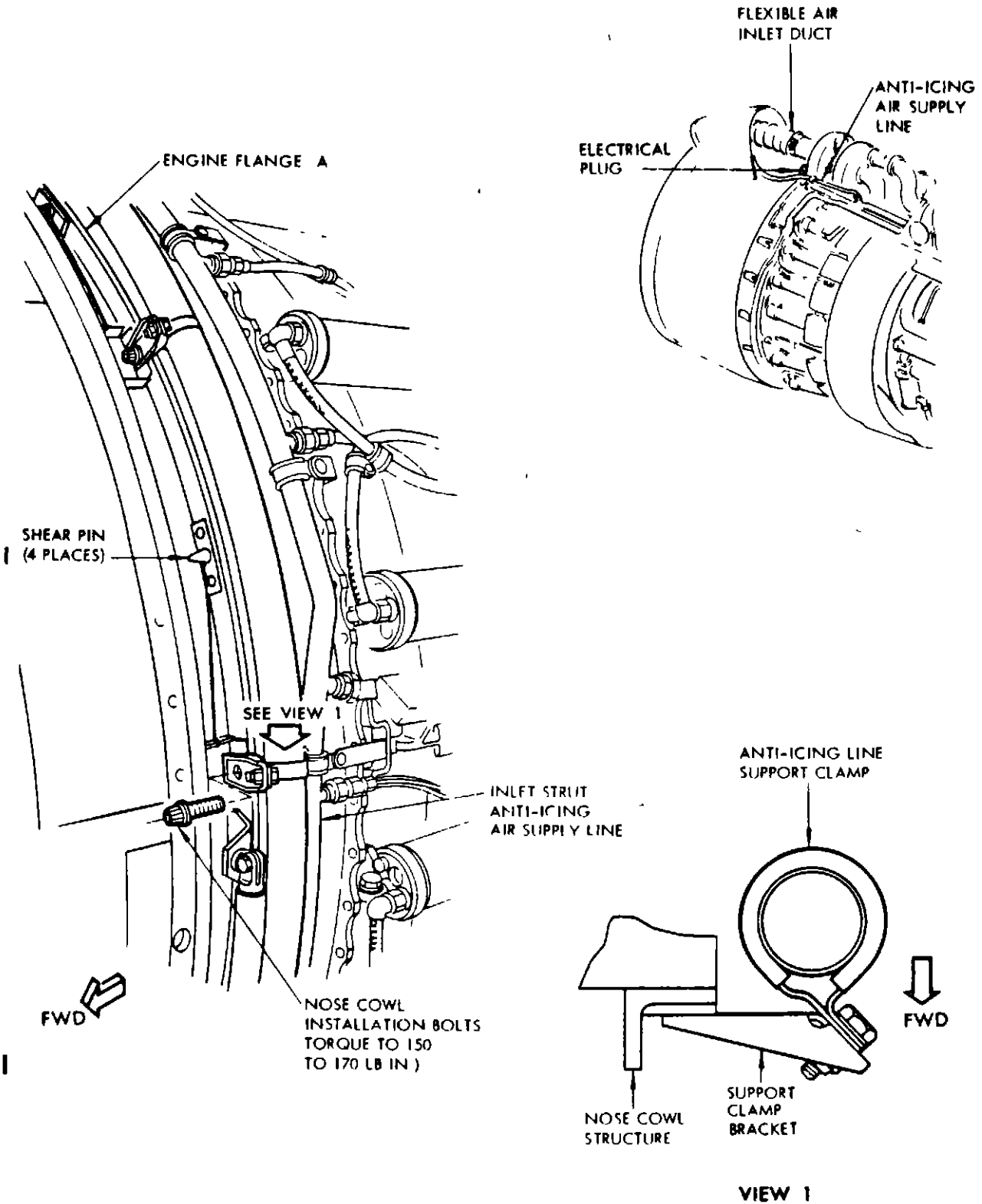
1. Removal/Installation Nose Cowl

A. Remove Nose Cowl (See figure 201.)

- (1) Remove left and right fan cowl panels. See 71-5-21.
- (2) Remove nacelle forward fairing. See 71-5-31.

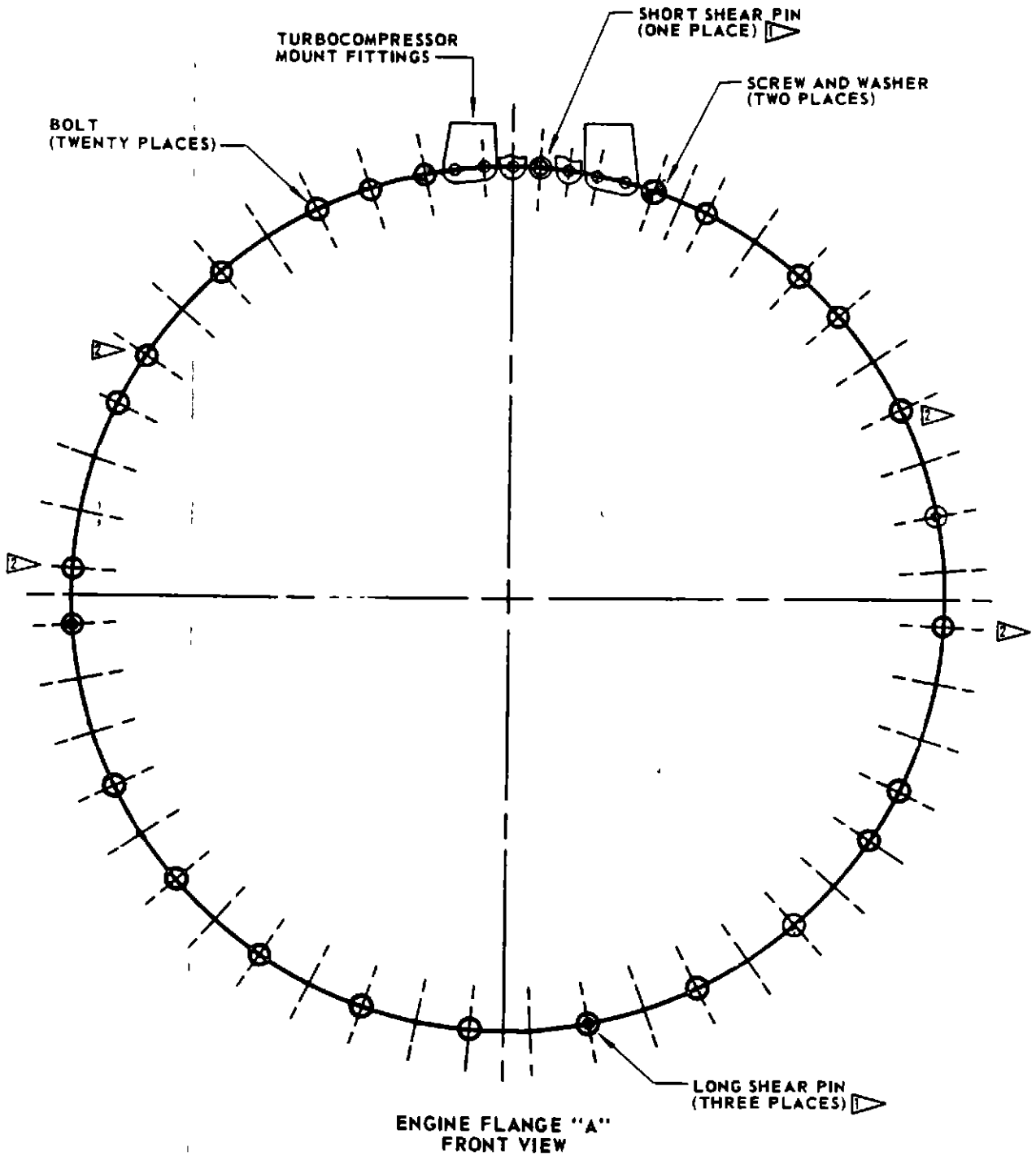
**CAUTION:** REMOVE AND INSTALL FORWARD FAIRING CAREFULLY TO AVOID DAMAGE TO SEALING SURFACES BETWEEN TURBOCOMPRESSOR EXHAUST DUCT AND PORT IN FAIRING.

- (3) On engines equipped with turbocompressor, loosen clamps and remove turbocompressor flexible air inlet duct. Uncouple turbocompressor air inlet scoop anti-icing air supply line.
- (4) Disconnect clamps retaining turbocompressor wiring bundle at top of nose cowl and uncouple ground interphone electrical plug.
- (5) Remove lockwire from nose cowl installation bolts and shear pins.
- (6) Loosen clamps retaining inlet strut anti-icing air supply line to engine (four places). (View 1, figure 201.)
- (7) Remove four nose cowl support bolts holding inlet strut anti-icing air supply line clamp brackets.
- (8) Rotate brackets and clamps out of the way for nose cowl removal.
- (9) Support nose cowl and remove remaining installation bolts. Remove nose cowl taking care to avoid bumping or stressing the inlet strut anti-icing air supply line.



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- 1 INSTALL ON ENGINE PRIOR TO NOSE COWL INSTALLATION
- 2 ENGINE INLET CASE ANTI-ICING AIR SUPPLY LINE SUPPORT BRACKET LOCATION

Nose Cowl Bolt and Shear Pin Installation  
Figure 202

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### B. Install Nose Cowl

- (1) If nose cowl is to be installed on a new or overhauled engine, install shear pins (four places) in engine flange A. Tighten within torque range of 150 to 170 pound-inches. Install washers and screws (two places) through aft side of engine flange A. See figure 202 for flange hole locations.
- (2) Taking care to avoid bumping or stressing the engine inlet strut anti-icing air supply line, align nose cowl on engine flange A.
- (3) Insert and start a sufficient number of bolts to retain nose cowl in position.
- (4) Reposition inlet strut anti-icing line support clamps and tighten bolts retaining clamps to brackets.
- (5) Insert remaining nose cowl bolts and tighten all nose cowl retaining bolts to 150 to 170 pound-inches. Lockwire bolts and shear pins to adjacent boltheads or to adjacent splice channel flanges.
- (6) On engines equipped with turbocompressors, align anti-icing air supply line coupling and connect to turbocompressor air inlet scoop. Fit flexible duct over turbocompressor inlet and secure clamp.
- (7) Connect ground interphone electrical plug at 12 o'clock position on nose cowl. Secure clamps retaining turbocompressor wiring bundle to top of nose cowl.
- (8) Install nacelle forward fairing and latch in position. See 71-5-31.
- (9) Replace left and right side cowl panels. See 71-5-21.

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NOSE COWL (LARGE SECONDARY AIR INLET DOORS) - MAINTENANCE PRACTICES

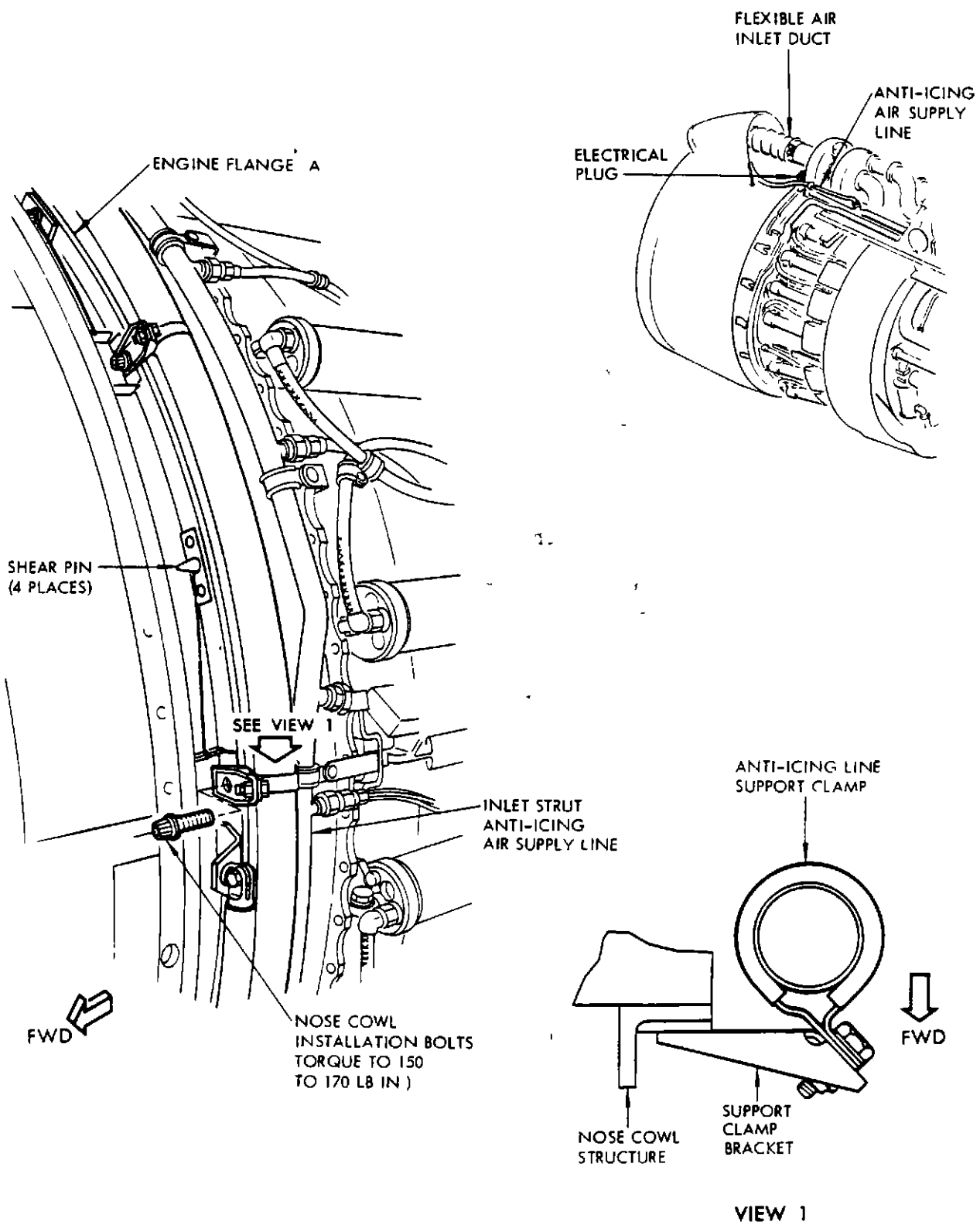
1. Removal/Installation Nose Cowl

A. Remove Nose Cowl (See figure 201.)

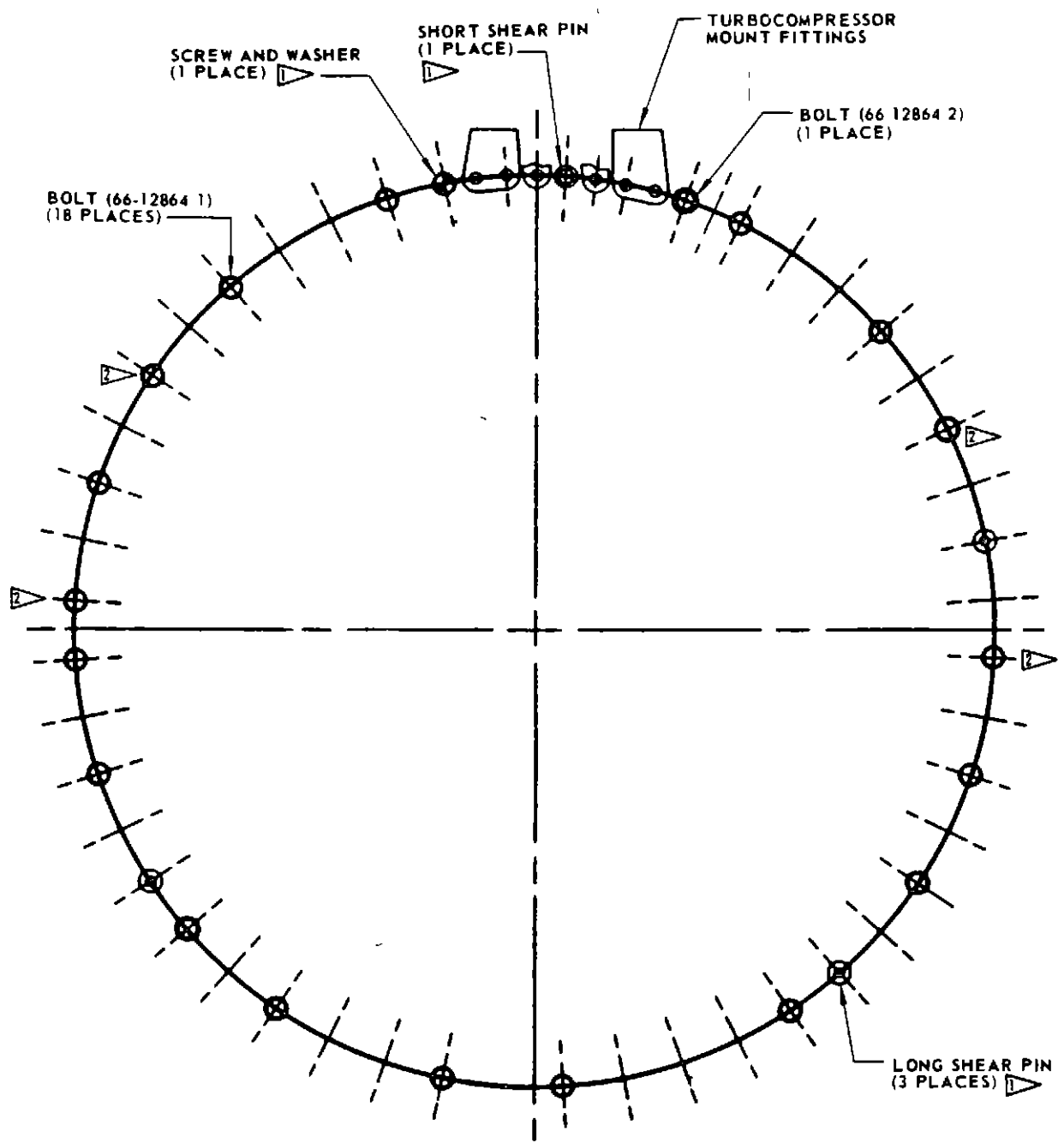
- (1) Remove left and right fan cowl panels. See 71-5-21.
- (2) Remove nacelle forward fairing. See 71-5-31.

CAUTION. REMOVE AND INSTALL FORWARD FAIRING CAREFULLY TO AVOID DAMAGE TO SEALING SURFACES BETWEEN TURBOCOMPRESSOR EXHAUST DUCT AND PORT IN FAIRING.

- (3) On engines equipped with turbocompressor, loosen clamps and remove turbocompressor flexible air inlet duct. Uncouple turbocompressor air inlet scoop anti-icing air supply line.
- (4) Disconnect clamps retaining turbocompressor wiring bundle at top of nose cowl and uncouple ground interphone electrical plug.
- (5) Remove lockwire from nose cowl installation bolts and shear pins.
- (6) Loosen clamps retaining inlet strut anti-icing air supply line to engine (four places). (View 1, figure 201.)
- (7) Remove four nose cowl support bolts holding inlet strut anti-icing air supply line clamp brackets.
- (8) Rotate brackets and clamps out of the way for nose cowl removal.
- (9) Support nose cowl and remove remaining installation bolts. Remove nose cowl taking care to avoid bumping or stressing the inlet strut anti-icing air supply line.



**Nose Cowl Installation**  
**Figure 201**



ENGINE FLANGE "A"  
FRONT VIEW

- 1 INSTALL ON ENGINE PRIOR TO NOSE COWL INSTALLATION
- 2 ENGINE INLET CASE ANTI-ICING AIR SUPPLY LINE SUPPORT BRACKET LOCATION

B. Install Nose Cowl

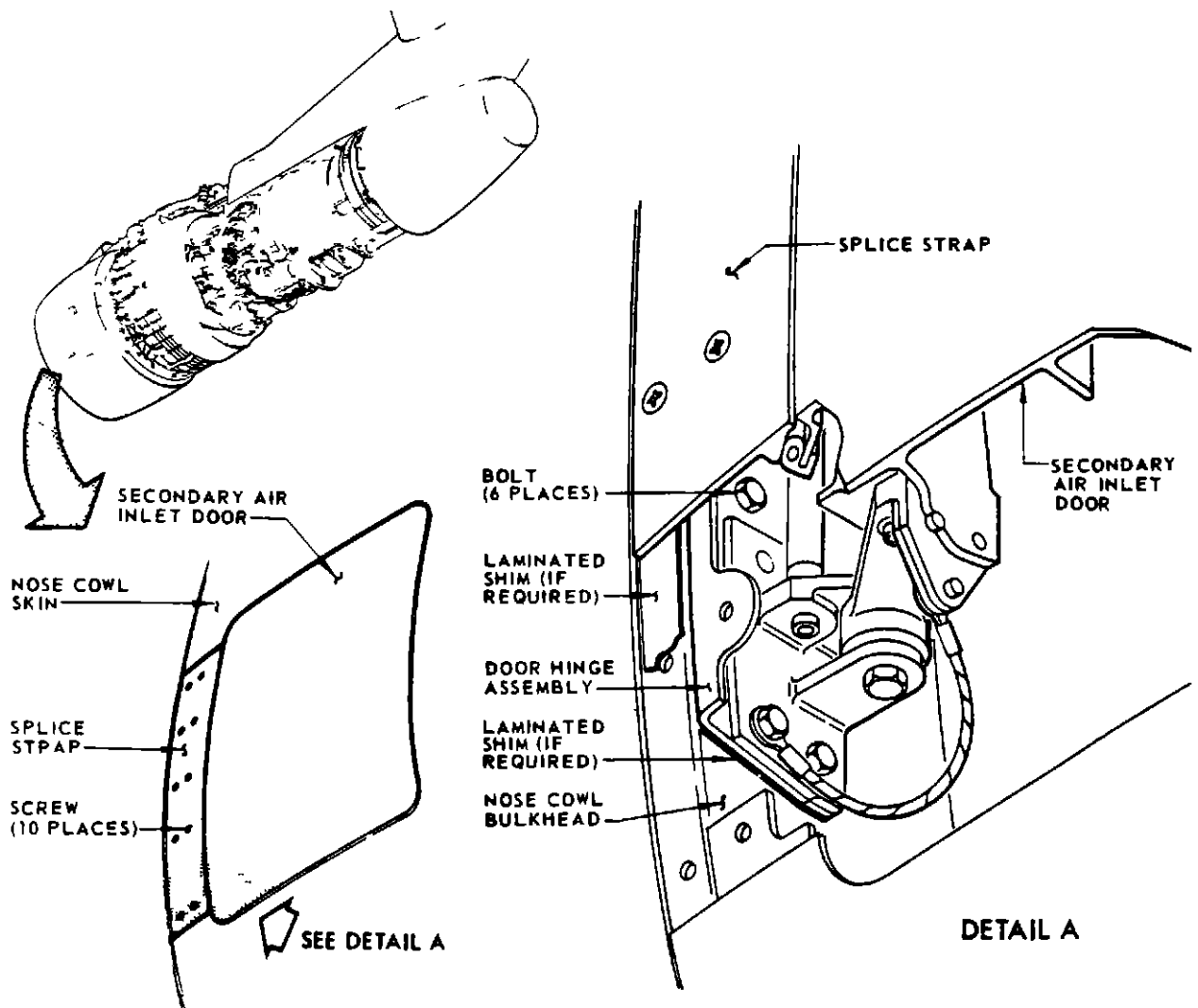
- (1) If nose cowl is being installed on a new or newly overhauled engine, install shear pins (four places) in engine flange A. Tighten within torque range of 150 to 170 pound-inches. Install washer and screw through aft side of engine flange A. See figure 202 for flange hole locations.
- (2) Taking care to avoid bumping or stressing the engine inlet strut anti-icing air supply line, align nose cowl on engine flange A.
- (3) Insert and start a sufficient number of bolts to retain nose cowl in position.
- (4) Reposition inlet strut anti-icing line support clamps and tighten bolts retaining clamps to brackets.
- (5) Insert remaining nose cowl bolts and tighten all nose cowl retaining bolts to 150 to 170 pound-inches. Lockwire bolts and shear pins to adjacent boltheads or to adjacent splice channel flanges.
- (6) On engines equipped with turbocompressors, align anti-icing air supply line coupling and connect to turbocompressor air inlet scoop. Fit flexible duct over turbocompressor inlet and secure clamp.
- (7) Connect ground interphone electrical plug at 12 o'clock position on nose cowl. Secure clamps retaining turbocompressor wiring bundle to top of nose cowl.
- (8) Install nacelle forward fairing and latch in position. See 71-5-31.
- (9) Replace left and right side cowl panels. See 71-5-21.

SECONDARY AIR INLET DOORS, 13 x 16 INCH (LARGE) - MAINTENANCE PRACTICES

1. Removal/Installation Secondary Air Inlet Doors

A. Remove Secondary Air Inlet Doors

- (1) Remove screws (10 places) securing splice strap to nose cowl and door hinge assembly. (See figure 201.)
- (2) Remove splice strap and shims (if installed).
- (3) Remove bolts (6 places) securing door hinge assembly to nose cowl bulkhead.
- (4) Remove secondary air inlet door and also shims (if installed).





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B. Install Secondary Air Inlet Doors.

- (1) Position secondary air inlet door into nose cowl skin cutout and align holes in door hinge assembly with mating holes in nose cowl bulkhead.
- (2) With door bonding jumper positioned as shown, install, but do not tighten, bolts securing door hinge assembly to nose cowl bulkhead. (See detail A, figure 201.)
- (3) Measure distance between aft edge of door and nose cowl skin. Gap should be within tolerance indicated in section B-B, figure 202. If adjustment of door position is required, remove bolts installed in paragraph B. (2) and install laminated shims between door hinge assembly and nose cowl bulkhead. Reinstall, but do not tighten bolts removed.
- (4) Measure gaps between upper and lower edges of door and nose cowl skin. Adjust door position until gaps are within tolerance indicated in section B-B, figure 202 and tighten bolts through door hinge assembly.
- (5) Position splice strap on nose cowl and install screws (10 places) fastening splice strap to nose cowl and door hinge assembly. Install the two longer screws at each end of the aft row of holes.
- (6) Measure distance between aft edge of splice strap and forward edge of secondary air inlet door. If gap is not within tolerance indicated in section A-A, figure 202, remove splice strap and bolts through door hinge assembly. Install or remove laminated shims between door hinge assembly and nose cowl bulkhead. Reinstall bolts securing door hinge assembly and reinstall splice strap.  
  
NOTE: Ensure that gaps between secondary air inlet door and nose cowl skin are within tolerance before tightening bolts through door hinge assembly.
- (7) Check for fairing between secondary air inlet door and splice strap. If outer surfaces do not fair within tolerance indicated in section A-A, figure 202, remove splice strap and loosen bolts through door hinge assembly. Adjust door position inboard or outboard as required. Tighten and lockwire bolts through door hinge assembly. Reinstall splice strap.

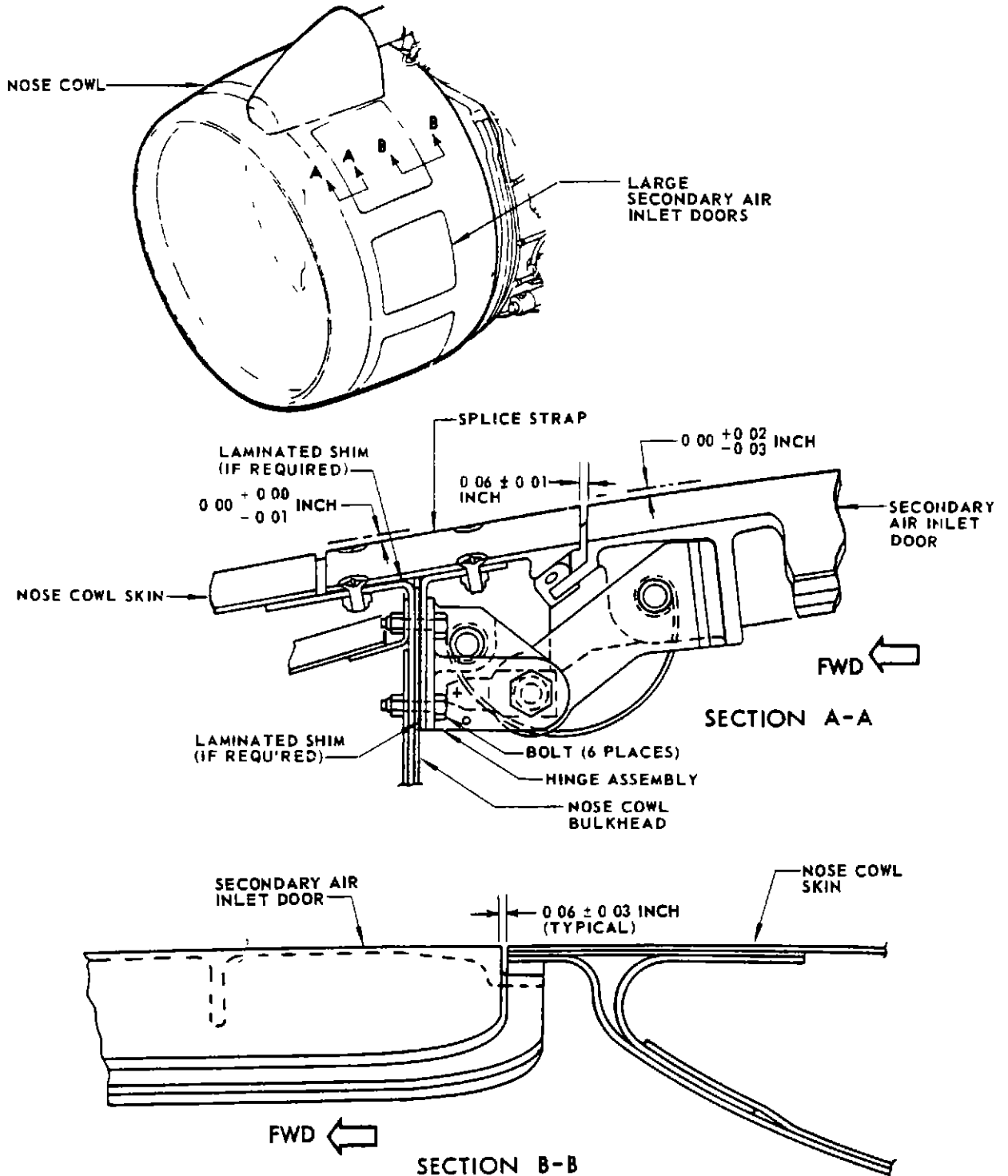
EFFECTIVITY

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- (8) Check for fairing between nose cowl skin and splice strap. If outer surfaces do not fair within tolerance indicated in section A-A, figure 202, remove screws through splice strap and install laminated shims under forward edge of splice strap. Reinstall screws through splice strap when required fair is achieved.



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COWL PANELS - MAINTENANCE PRACTICES

1. Removal/Installation Fan Cowl Panels

A. Remove Fan Cowl Panel (See figure 201.)

- (1) Insert screwdriver into opening of forward fan cowl latch. Pull handle of tool away from center line of engine. Repeat for remaining two latches.
- (2) Grasp lower edge of left or right fan cowl and open away from engine. When panel is approximately 40 degrees out from engine lift clear of hinge pivots and remove panel.
- (3) Repeat for other panel.

B. Install Fan Cowl Panel

- (1) Support fan cowl panel in fully open position and engage panel hinge hooks between hinge rollers. See figure 201.
- (2) Lower panel into closed position.
- (3) Install other fan cowl panel similarly.
- (4) Ensure that two alignment pins between bottom edges of the cowl panels are correctly positioned and close latches.

2. Servicing (Lubricate) Side Cowl Panel Surge Bleed Door

NOTE: This procedure is only applicable to cowl panels with a fabricated sheet metal surge bleed door. Cowl panels equipped with a die-cast aluminum surge bleed door have self lubricating bearings which require no periodic lubrication.

A. Remove left side cowl panel. See "Removal/Installation Side Cowl Panels."

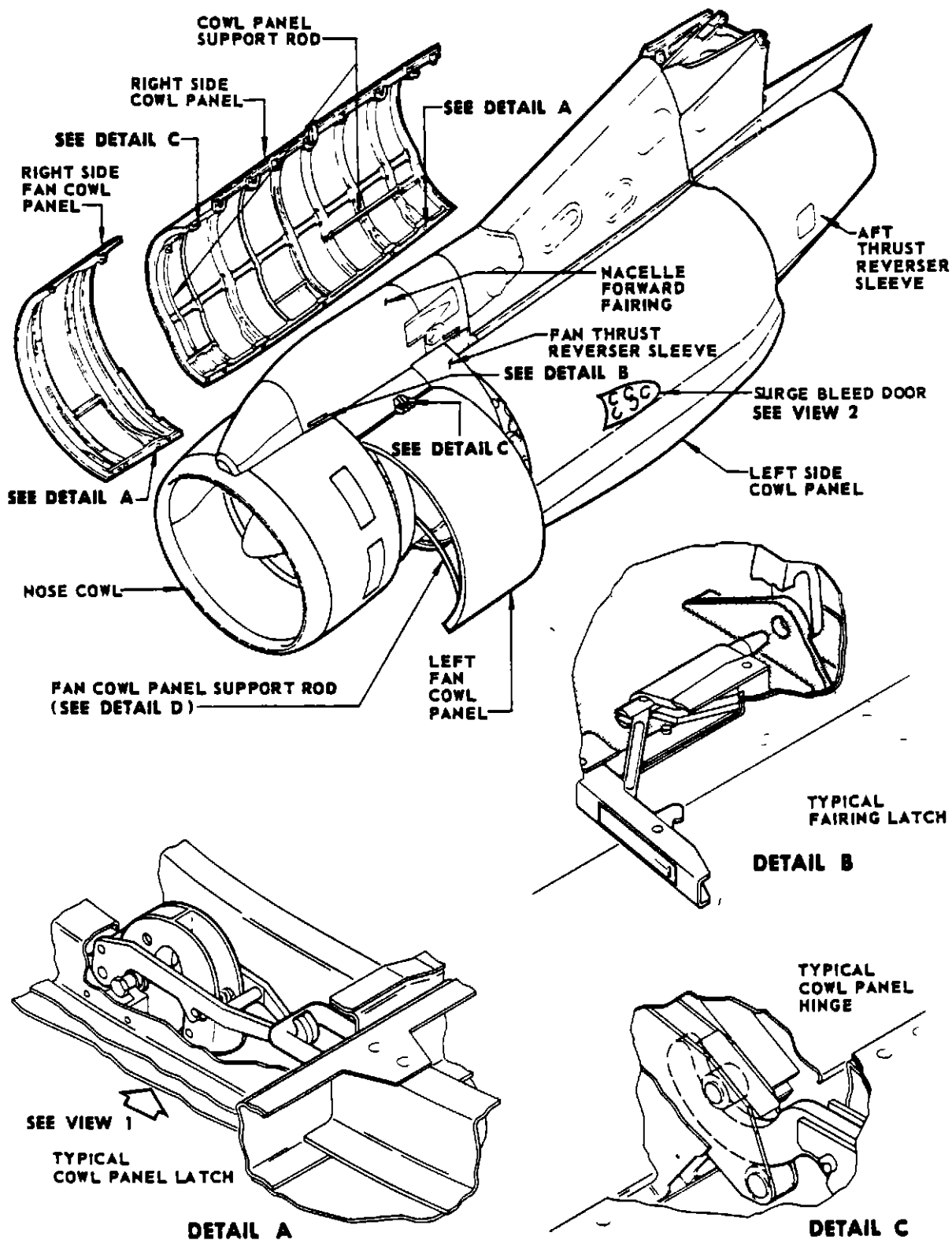
B. At upper end of surge bleed door, remove cotter pin securing surge bleed door pivot tube to bearing block and remove pivot tube. (See figure 201.)

NOTE: If corrosion exists between the tube and bushings it may be necessary to tap the tube loose.

C. At lower end of door, remove cotter pins securing spring retainer pin bushings and remove spring retainer pins.

D. Remove any corrosion on pivot tube, spring retainer pins, or bushings.

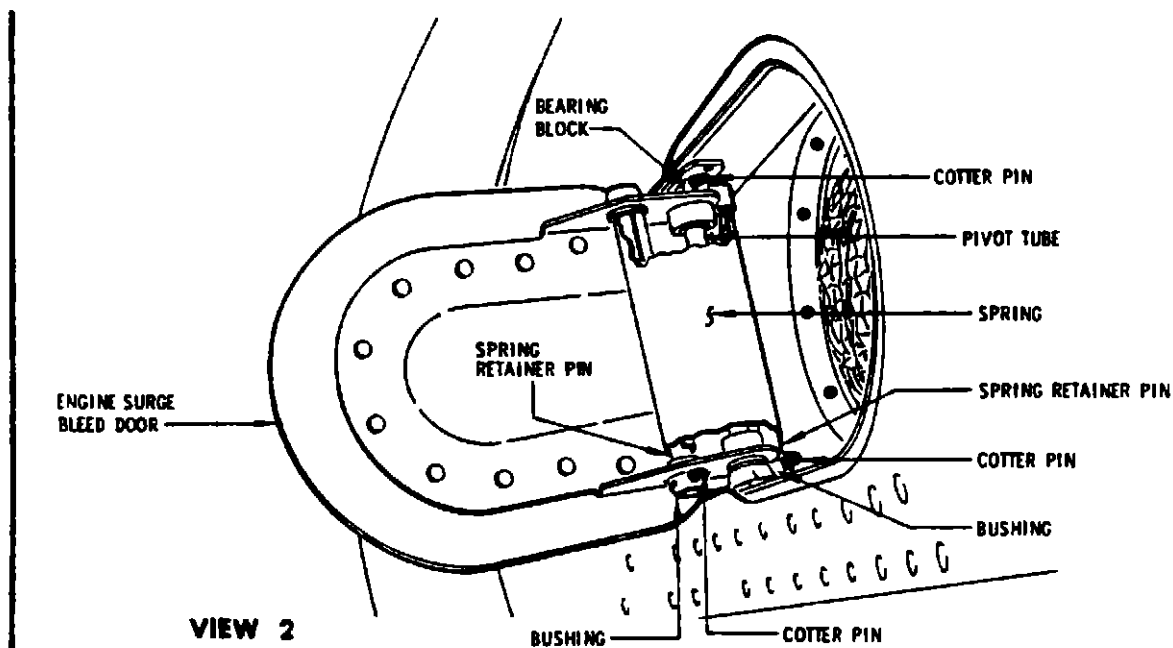
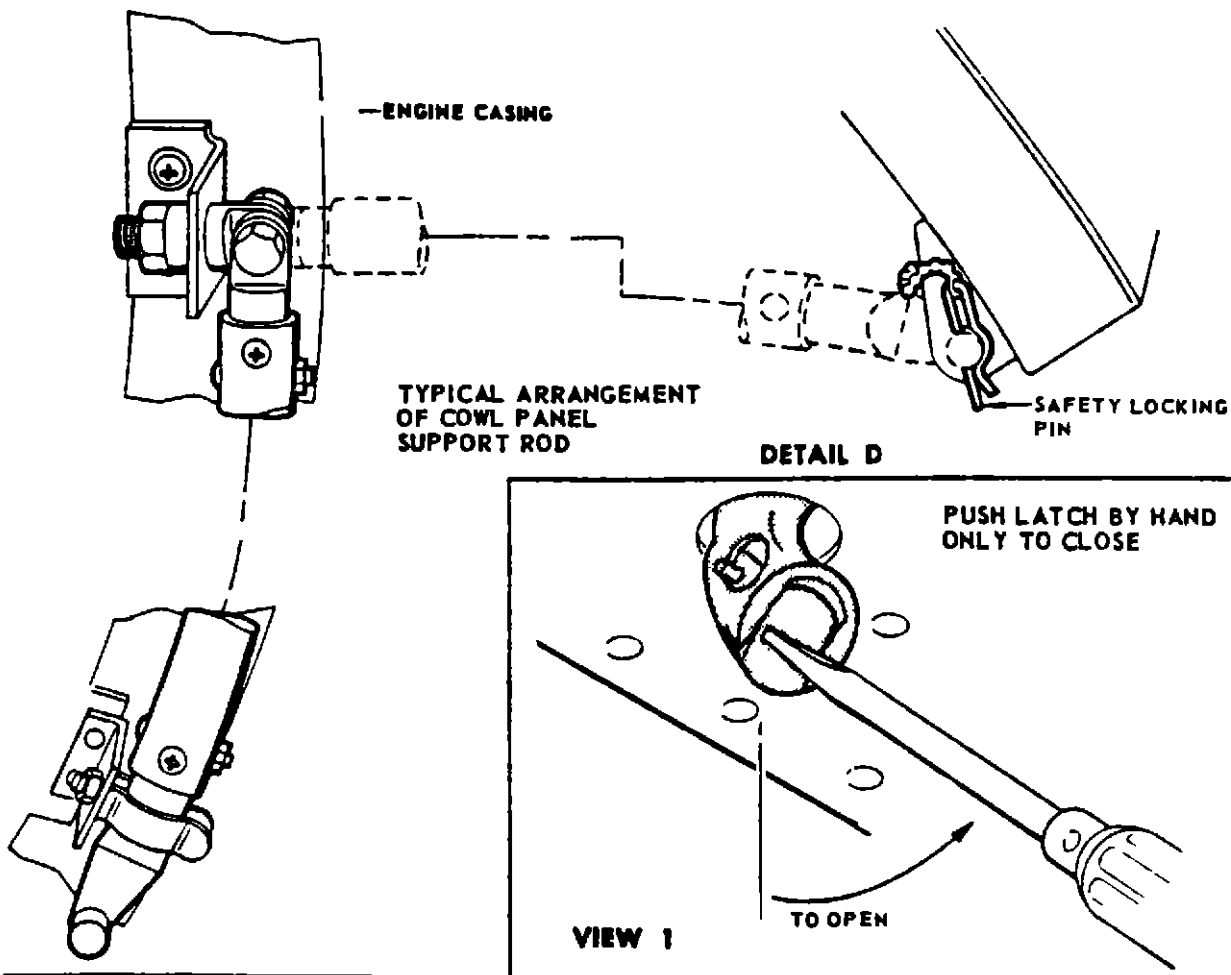
E. Apply a light coat of grease, MIL-G-23827, on areas of pivot tube that mate with door bushings and on surfaces of spring retainer pins that contact spring.



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Engine Cowls Installation  
Figure 201 (Sheet 2 of 2)

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- F. Install pivot tube between bearing blocks and secure to upper bearing block with cotter pin.
- G. Insert spring retainer pins through bushings and spring. Install cotter pins through bushings and lower end of spring retainer pins.
- H. Check operation of surge bleed door by manually opening and closing door several times. Door should operate freely with no binding of spring or door pivot points.
- I. Install left side cowl panel.

3. Removal/Installation Side Cowl Panels

A. Remove Side Cowl Panel (See figure 201.)

- (1) To unlock this type of latch a flat screwdriver should be used; standing at the right side of the engine, introduce the screwdriver into the provided slot of the latch-head and bring it upwards till the latch completely emerges from its housing. As a rule the unlocking of a cowling should begin with the first latch at the front side of the engine and be ended with the last one situated at the rear side.
- (2) Support each end of left or right side cowl panel and open away from engine. When panel is approximately 40 degrees out from engine lift clear of hinge pivots and removal panel.
- (3) Repeat for other panel.

B. Install Side Cowl Panels

**CAUTION:** ON ENGINES WITH OPERABLE P&D VALVE DRAIN SYSTEM, DO NOT INSTALL SIDE COWL WITH P&D VALVE DRAIN HOLE PLUGGED IN COWL. INSTALLATION OF PLUGGED COWL ON ENGINE WITH OPERABLE P&D VALVE DRAIN SYSTEM WILL RESULT IN FUEL COLLECTING IN THE COWL.

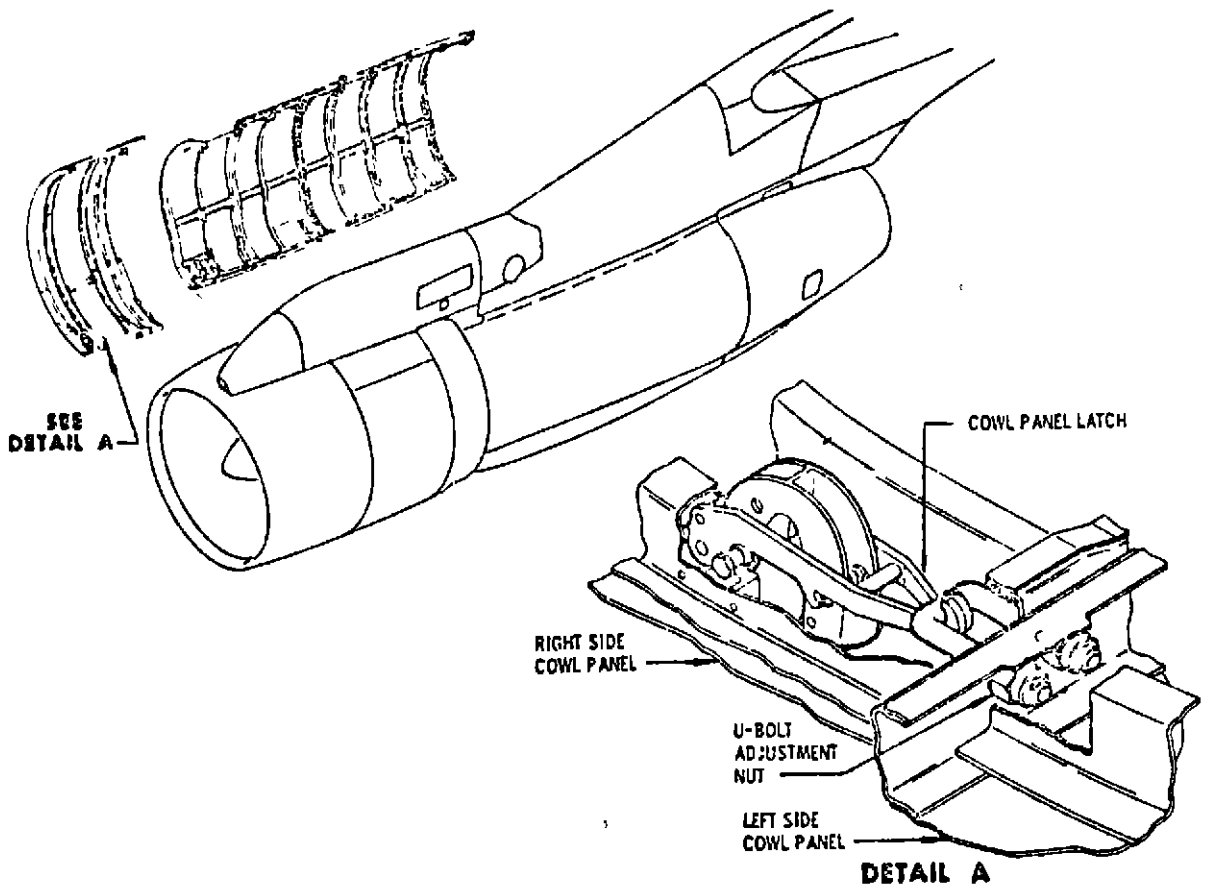
- (1) Support side cowl panel in fully open position and engage panel hinge hooks between hinge rollers. (See figure 201.)
- (2) Lower panel into closed position.
- (3) Install other side cowl panel.
- (4) To lock the cowling it is recommended to operate as follows:
  - (a) Make sure the alignment pins, on the inferior edges are located correctly.

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Cowl Panel Adjustment  
Figure 202

- (b) Fasten the six latches beginning with the first at the front side of the engine (ascertain the cowlings at both sides of the engine are flush with the diaphragm) and ending with the last one at the rear side.

A  $50 \pm 20$  pounds force is required to fasten each latch. It should be noted that, for the fastening of the latches no screwdriver should be used, to avoid any deterioration of the locking system. This operation should be done manually only.

When the latch-lock is not engaged into the corresponding "U" bolt the latch-handle must, on principle, protrude a few millimeters from the cowling.

To make sure the latch-hooks are correctly engaged, it is strongly recommended to feel by finger if they don't recede. The right cowlings are provided with inspection holes, which permit, in case of doubt, to verify if the hook is correctly engaged into the "U" bolt.

- (5) The maximum allowable gap between the edges of the cowl panels is 0.08 inch. An excessive gap indicates an improperly latched installation.
- (6) On right cowl panels with inspection holes, visually inspect each latch to ensure that the hook is properly engaging the U-bolt.

**CAUTION:** FAILURE TO POSITIVELY LATCH THE COWL PANELS CAN RESULT IN LOSS OF PANELS IN FLIGHT.

#### 4. Adjustment/Test Cowl Panel Latch

A. Both the fan cowl panel and side cowl panel latches require a closing force of  $50 (\pm 20)$  pounds to close the handle when adjacent latches are engaged. The required closing force should be applied by hand pressure only. Latches for fan cowls should be adjusted with the forward thrust reverser ring in the cruise operation. Latches on the side cowls should be adjusted with the aft reverser in the reverse position.

#### B. Adjust Cowl Panel Latch

- (1) The length of U-bolts located in lower left edge of cowl panels should be adjusted until the correct closing force on any latch handle is obtained. When testing any latch closing pressure the adjacent latch must be closed.
- (2) Adjust length of U-bolt by shifting position of nuts holding U-bolt into cowl panel structure. (See figure 202).

NACELLE FORWARD FAIRING - MAINTENANCE PRACTICES

 1 Removal/Installation Nacelle Forward Fairing

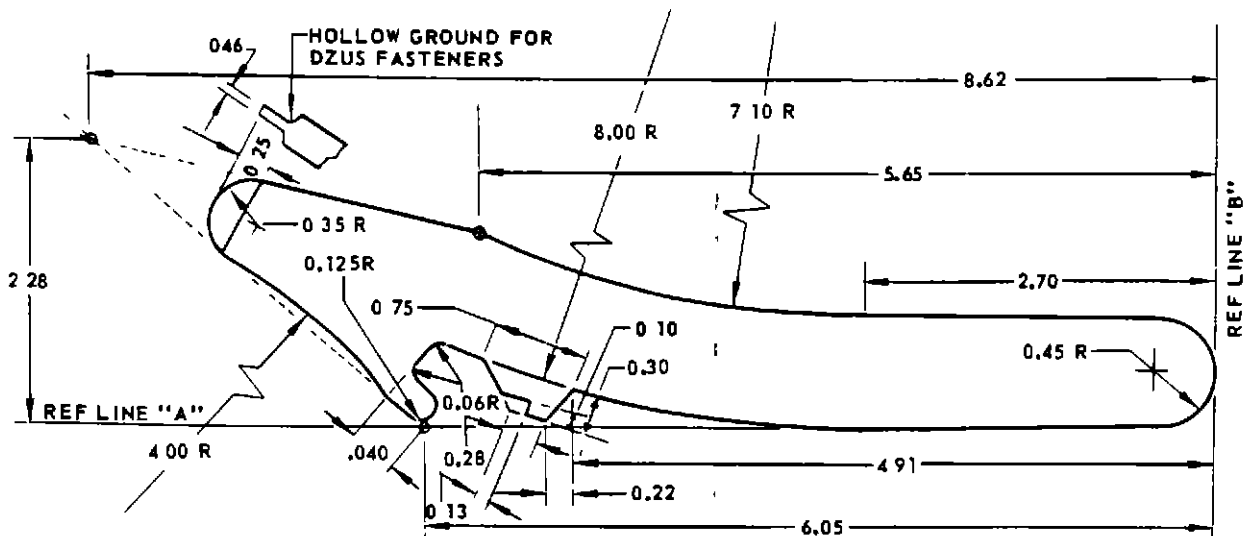
**CAUTION:** REMOVE AND INSTALL FORWARD FAIRING CAREFULLY TO AVOID DAMAGE TO SEALING SURFACES BETWEEN TURBOCOMPRESSOR EXHAUST DUCT AND PORT IN FAIRING.

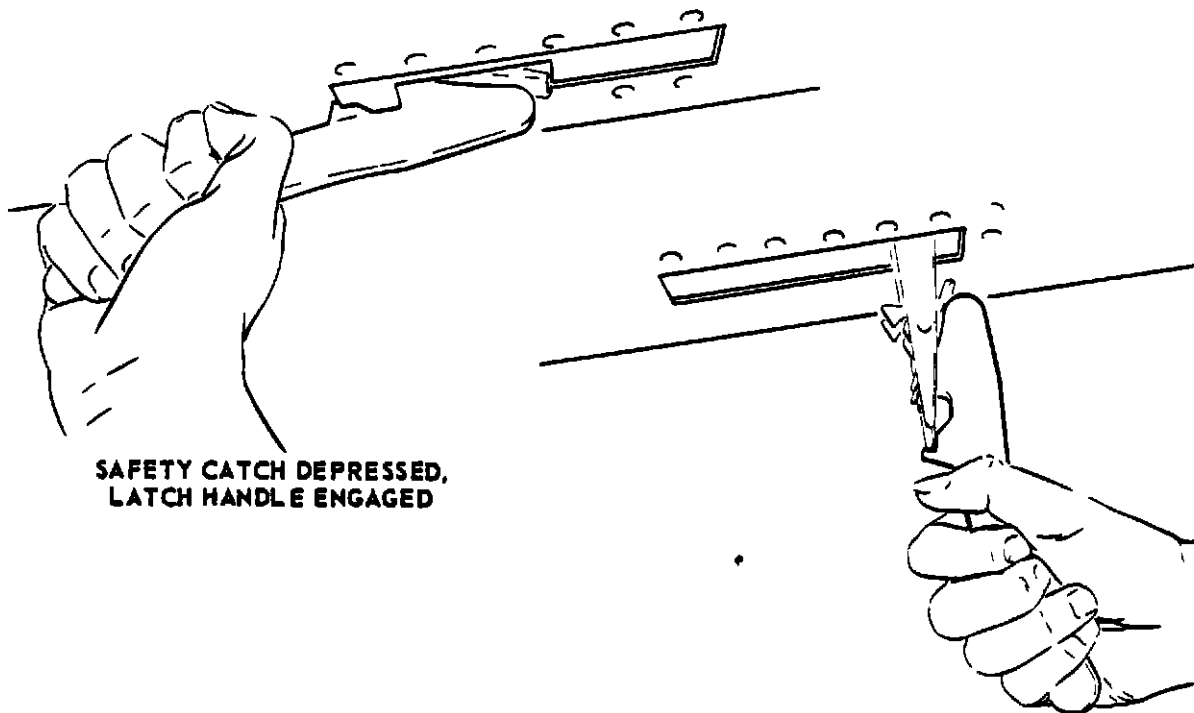
## A. Remove Nacelle Forward Fairing:

- (1) Release two latches on each side of nacelle forward fairing by inserting latch tool (figure 201) and carefully opening latch. (See figure 202.)
- (2) Lift fairing up to clear shear pin on left rail of forward reverser slot seal and remove from engine.

## B. Install Nacelle Forward Fairing (See figure 202.)

- (1) Position nacelle forward fairing on forward reverser slot seal. Ensure that fairing is properly aligned with strut vertical bulkhead and that shear pin on left rail of slot seal mates with receptacle on forward fairing.
- (2) Carefully close four latches.
- (3) Deleted



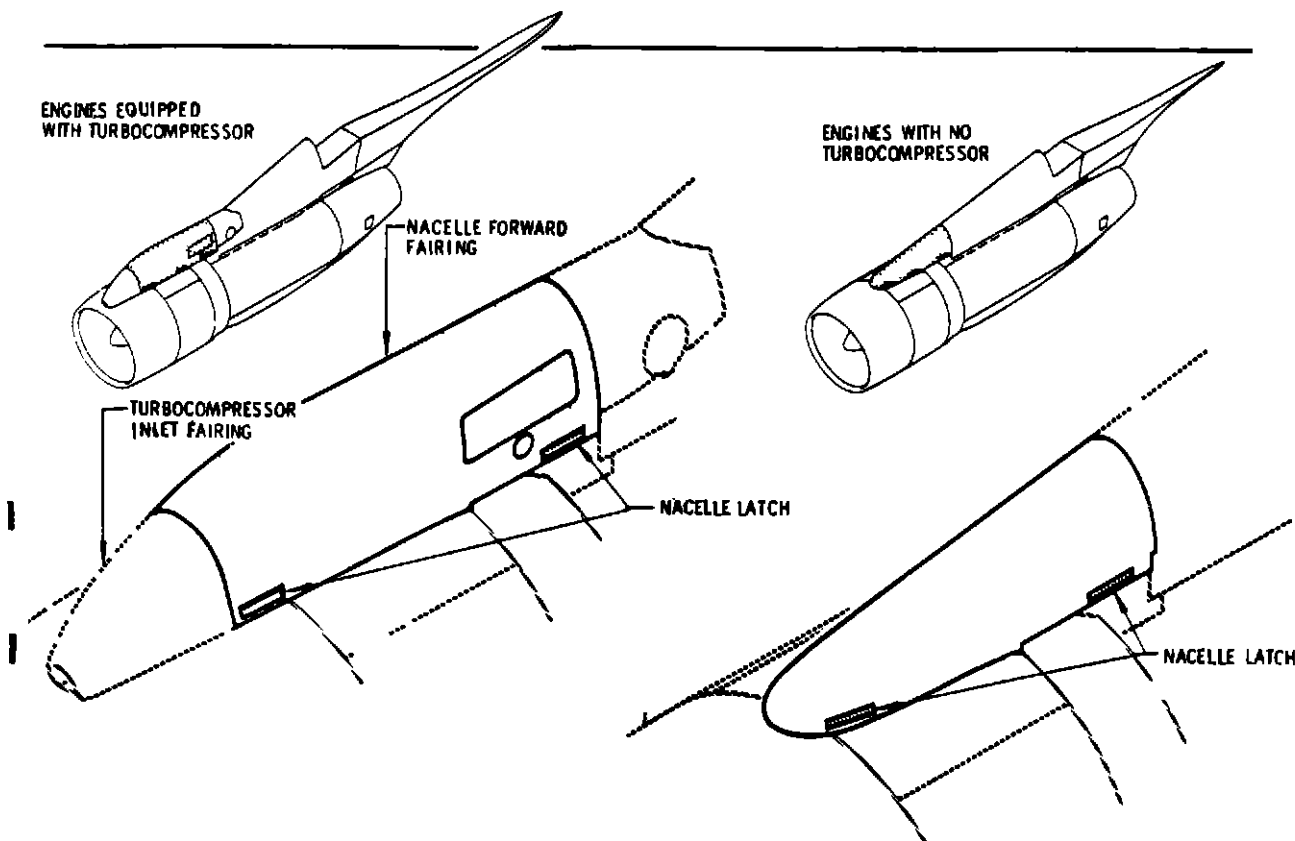


SAFETY CATCH DEPRESSED,  
LATCH HANDLE ENGAGED

LATCH HANDLE PULLED OPEN

ENGINES EQUIPPED  
WITH TURBOCOMPRESSOR

ENGINES WITH NO  
TURBOCOMPRESSOR

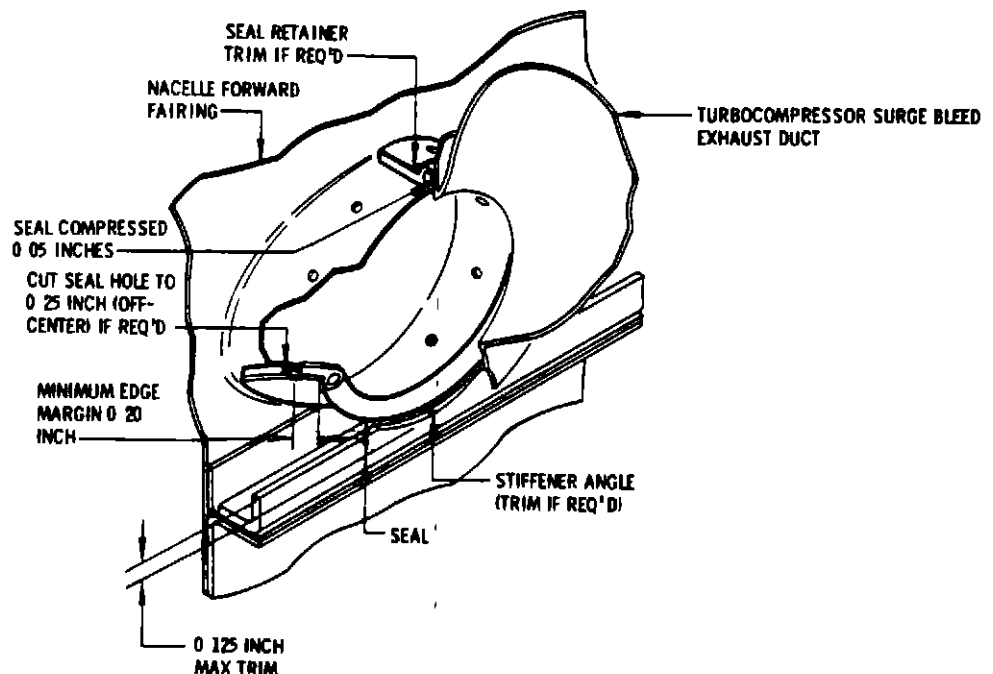


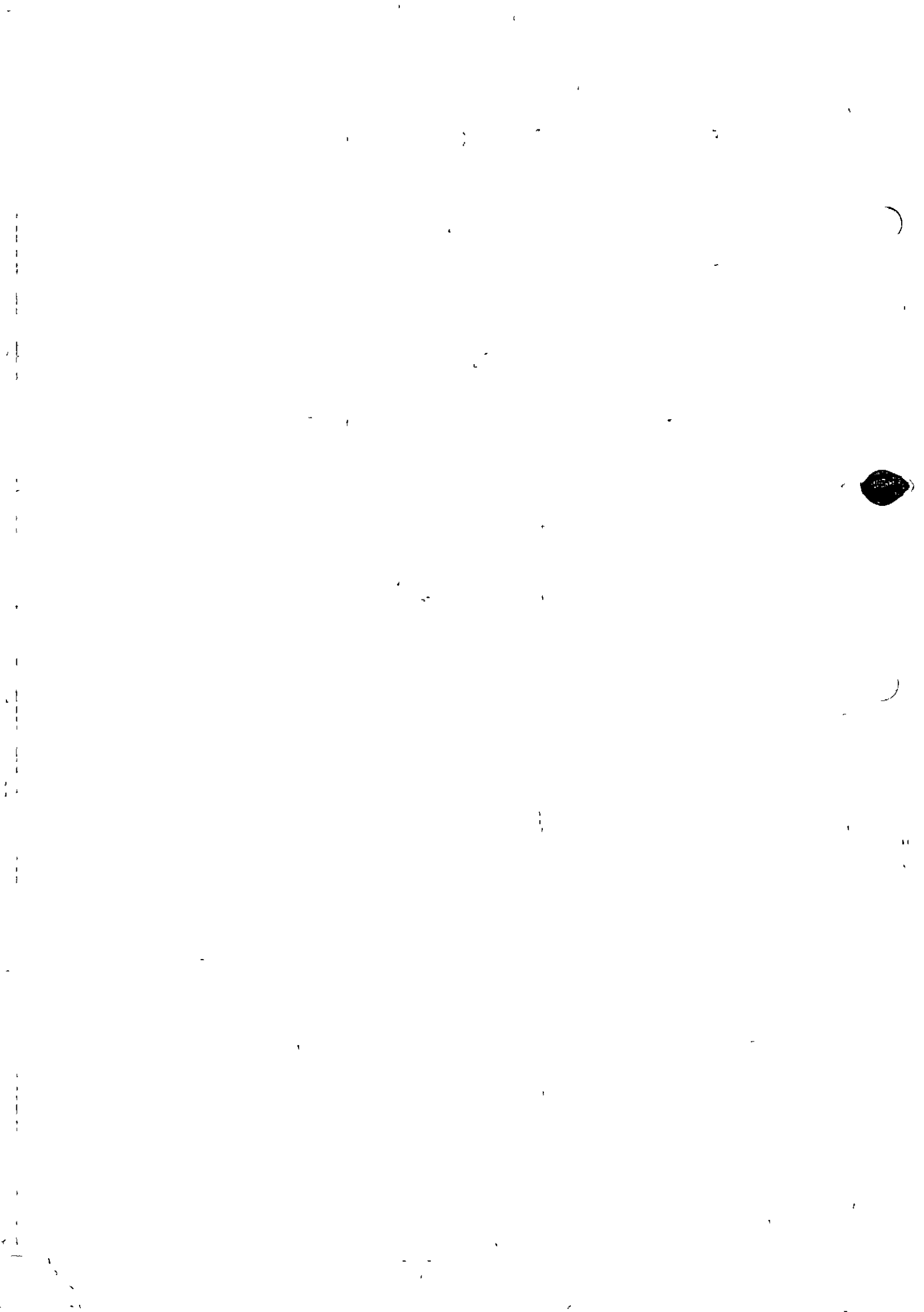
2. Adjustment/Test of Turbocompressor Surge Bleed Exhaust Duct Seal

A. Adjust Turbocompressor Surge Bleed Exhaust Duct Seal

- (1) Loosen retaining fasteners and slide seal in or out between turbocompressor surge bleed exhaust duct and port in fairing.
- (2) If the size of the hole in the seal does not permit adjustment, remove the seal and rework by cutting off-center 0.250 inch holes in seal at fastener locations. If necessary trim seal retainers to prevent retainer from cutting seal. Maintain a minimum of 0.20 inches edge margin for fasteners through seal retainers.
- (3) Trim stiffener angle (figure 203) to a maximum of 0.125 inch if necessary to clear the seal.
- (4) Adjust seal for 0.05 inch compression all around upon installation of fairing. Suggested method as follows:
  - (a) Install fairing with the seal omitted or retracted and obtain the gap distance all around between the exhaust duct and fairing port flange. Use wire gage inserted through fairing exhaust port.
  - (b) Remove fairing and adjust the seal so that the outer edge of the seal is a distance of 0.05 inch plus the gap distance from the edge of the fairing port flange.

**CAUTION:** EXCESSIVE AMOUNT OF SEAL COMPRESSION MAY RESULT IN PINCHING AND POSSIBLE CUTTING OF SEAL.





NOSE DOME - REMOVAL/INSTALLATION1. General

- A To obtain optimum engine performance, the correct nose dome shall be used in conjunction with the appropriate nose cowl. The short (10 inch hemispherical shaped nose dome shall be used in conjunction with a nose cowl having large (13 x 16 inch) forward hinged secondary air inlet doors. The long (31 inch) bullet shaped nose dome shall be used in conjunction with a nose cowl having small (4 x 14 inch) aft hinged secondary air inlet doors.

2. Equipment and Materials

- A Grease - MIL-L-4343

3. Remove Nose Dome

- A. Loosen six captive self-locking nuts securing nose dome to engine. (See figure 401.)
- B If applicable, disconnect nose dome Pt2 coupler from engine Pt2 fitting. Slide nose dome forward and off engine.

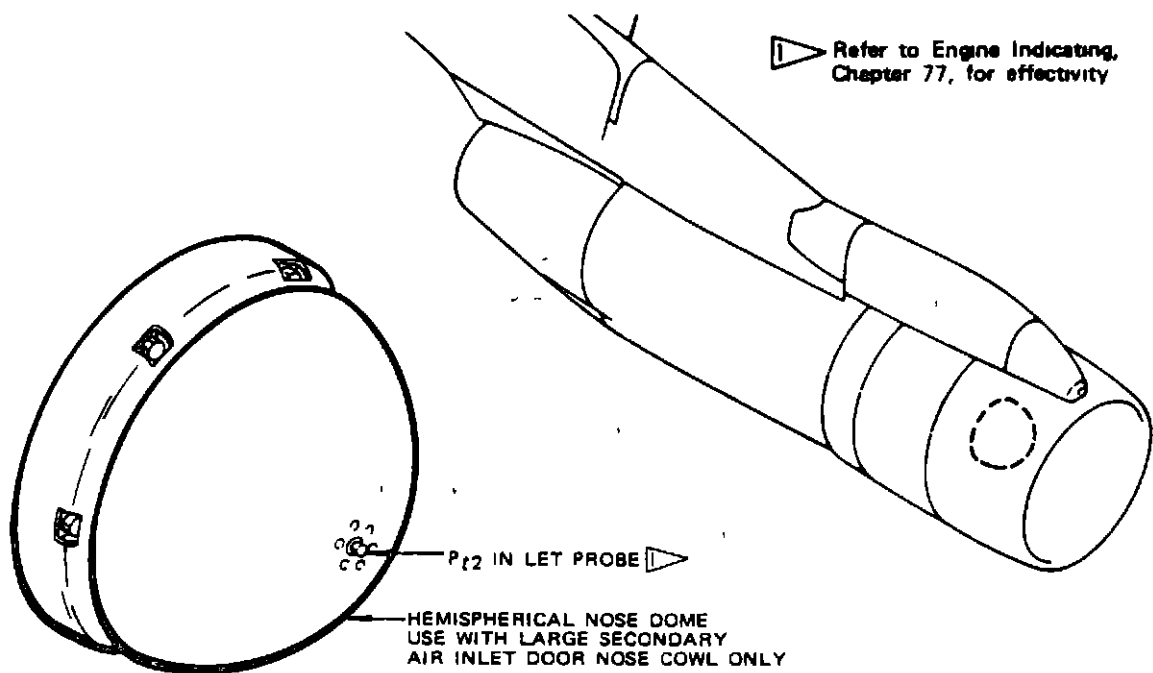
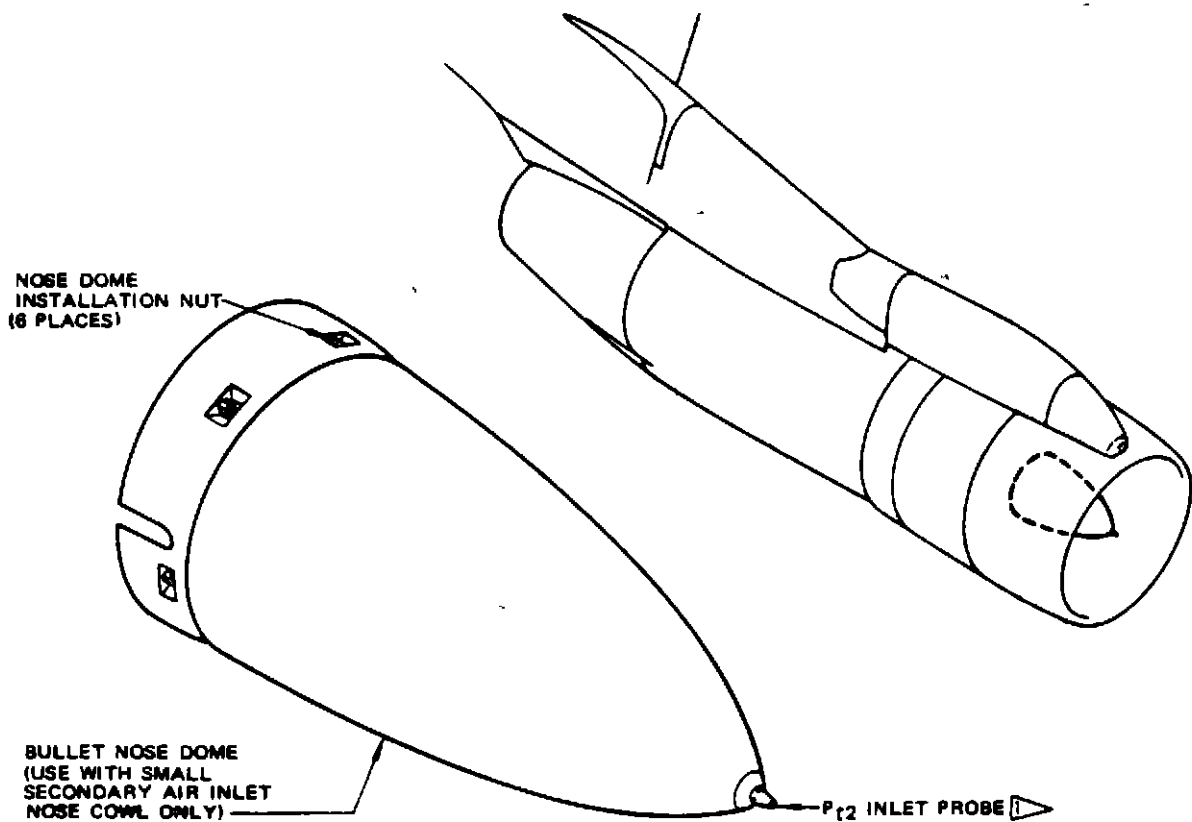
CAUTION. EXERCISE CARE WHEN HANDLING NOSE DOME TO AVOID DENTING THE EXTERIOR SURFACES AND TO PREVENT DAMAGE TO THE PT2 PROBE

- C. If nose dome has Pt2 probe, remove O-rings from Pt2 coupler and discard.

4. Install Nose Dome

- A If applicable, install new O-rings, lightly lubricated with grease, MIL-L-4343 on Pt2 probe coupler.
- B If installing hemispherical nose dome, remove indexing patch, if installed, at engine front accessory drive housing.
- C. Align captive nuts in nose dome with six mounting studs on engine front accessory drive housing. If nose dome has Pt2 probe, mate probe receptacle with Pt2 coupler.
- D. Torque captive nose dome installation nuts in diametrically opposite pairs to 100 to 140 pound-inches.

NOTE. The P&WA indexing patch is required for the bullet shaped nose dome because of its drooped configuration. The indexing patch is not required for the short hemispherical nose dome because the patch would interfere with the symmetrical contour of the nose dome.



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COMBUSTION CHAMBER DRAIN TANK - MAINTENANCE PRACTICES

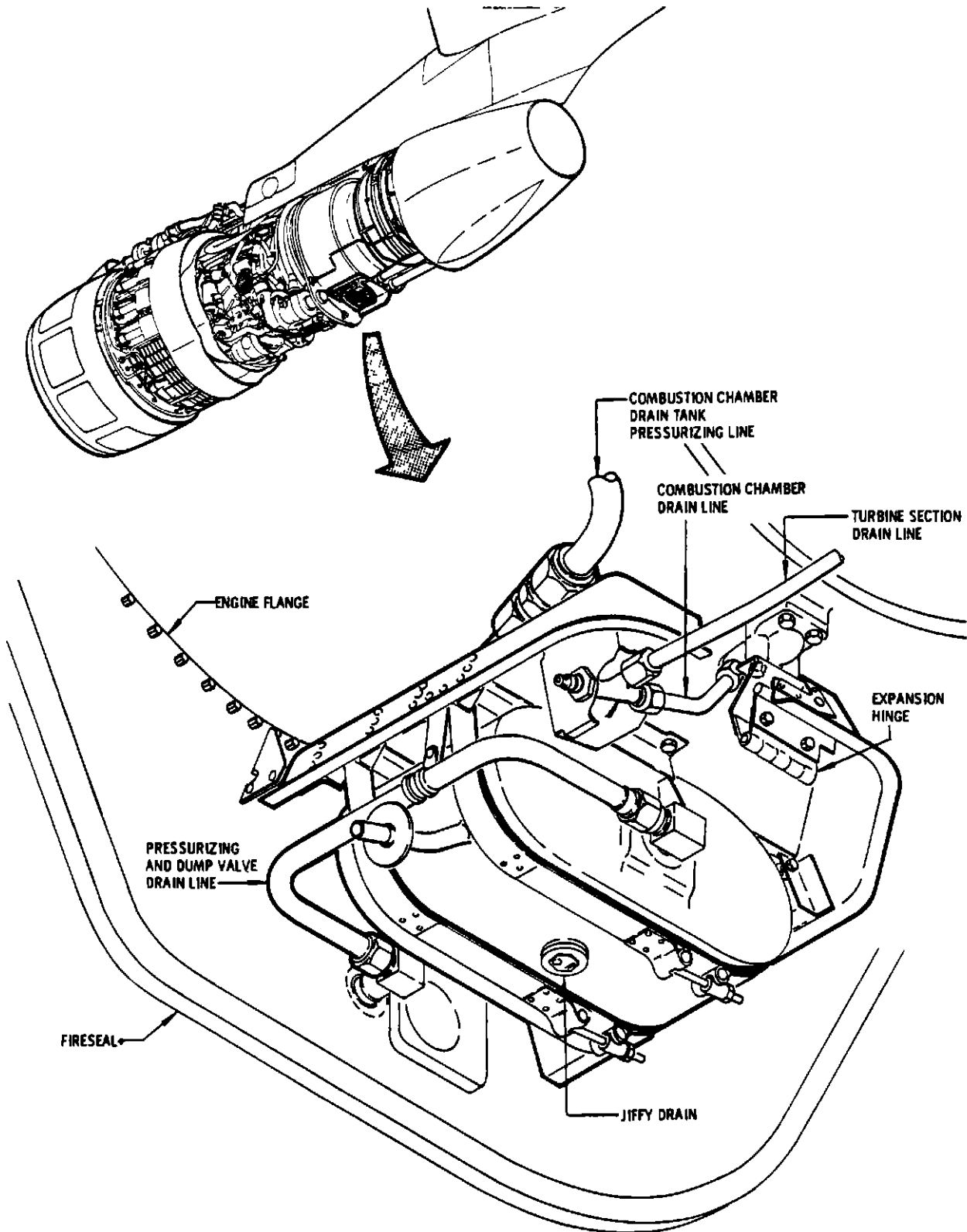
1. Removal/Installation Combustion Chamber Drain Tank

A. Remove Combustion Chamber Drain Tank (See figure 201.)

- (1) Open side cowl panels.
- (2) At underside of engine, aft of fireseal, locate combustion chamber drain tank. Drain fuel from tank using jiffy drain.
- (3) Disconnect and remove clamps securing electrical wiring to tank pan.
- (4) Disconnect pressurizing and dump valve drain line, combustion chamber drain line, turbine section drain line, and combustion chamber drain tank pressurizing line.
- (5) At fireseal, remove seven bolts securing drain tank pan brackets on engine flange.
- (6) Remove two screws securing tank expansion hinge to engine bracket.
- (7) Remove drain tank and pan.

B. Install Combustion Chamber Drain Tank (See figure 201.)

- (1) Position combustion chamber drain tank on underside of engine aft of fireseal.
- (2) Connect two screws securing drain tank expansion hinge to engine bracket
- (3) At fireseal connect seven bolts securing drain tank pan to engine flange bracket.
- (4) Connect pressurizing and dump valve drain line, combustion chamber drain line, turbine section drain line, and combustion chamber drain tank pressurizing line.
- (5) Install clamps securing electrical wiring to drain tank pan.
- (6) Close side cowl panels.



Combustion Chamber Drain Tank Installation  
Figure 201

ENGINE MOUNT FITTINGS - MAINTENANCE PRACTICES

1. General

A. This section contains procedures for the removal and installation of the engine mount links and cone bolts. Since the bolt retaining the right forward mount link also serves as one attachment point for the engine throttle and start control bracket, the installation of this bracket is also included in this section.

2. Removal/Installation Engine Mount Fittings

A. Remove Engine Mount Fittings

- (1) At top of engine forward mount ring, unbolt and remove two cone bolts (14 and 18). See figure 201.
- (2) Unbolt and remove three engine mount links (11 and 17).
- (3) At top of engine exhaust case, unbolt and remove universal block (22) and attached cone bolt (24). Remove bolt (21) securing cone bolt to universal block.
- (4) Unbolt and remove two engine mount links (23).

B. Install Engine Mount Fittings

- (1) At upper right side of engine forward mount flange, position throttle and start control bracket (33) so that bracket holes align with first and second engine mounting lugs from the vertical centerline of the engine. The hole in the extended arm of the bracket should align with the first lug from the engine vertical centerline. (See figure 201.)
- (2) Insert bushing (29) in engine lug hole adjacent to hole in extended arm of bracket. Flange of bushing must be on forward side of lug.
- (3) Install clip (28) under head of bolt (27) with bracket facing aft and insert bolt through bushing, bracket arm and lug hole. Place clip (30) on end of bolt, with bracket facing forward. Install washer (31) and nut (32). Do not tighten nut.
- (4) Insert engine mount link (17) between faces of second engine mount lugs on right side of engine centerline and install link attach bolt (15) and countersunk washer (2) with bolt head facing forward.



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## MAINTENANCE MANUAL

- (5) Check gap between engine mount link and engine lug. Shim if necessary to obtain maximum total gap of 0.002 inch.

**CAUTION:** TO PREVENT FORE AND AFT LOADING OF ENGINE MOUNT FLANGES, INSTALL SHIMS (4) BETWEEN MOUNT LINKS AND INSIDE FACE OF ENGINE MOUNT LUGS ONLY. OUTSIDE FACE OF MOUNT LINKS MUST NOT CONTACT ENGINE LUGS UNDER ANY CONDITIONS.

- (6) Install one or two washers (25) as required, and nut (5). Tighten nut to allow 0.01 to 0.03 inch end play of bolt and install cotter pin (26).
- (7) Tighten nut (32) under extended arm of throttle and start control bracket.
- (8) Position cone bolt (18) between faces of mount link. With countersunk washer (2) under head of attach bolt (16), insert bolt through holes in link and cone bolt. Install two washers (25) and nut (5). Tighten nut within 660 to 780 pound-inches to seat bolt; back off nut and retighten finger tight; back off to first castellation and install cotter pin (26).
- (9) Position two engine mount links (11) between faces of first and second engine mount lugs on left side of engine vertical centerline. Raised bosses on links must either both face outwards or both face inwards.
- (10) With countersunk washer (2) installed on each link attach bolt (1), insert bolts through engine lugs and mount links. Check gap between mount links and engine lugs. Shim if necessary to obtain maximum total gap of 0.002 inch.

**CAUTION:** TO PREVENT FORE AND AFT LOADING OF ENGINE MOUNT FLANGES, INSTALL SHIMS (4) BETWEEN MOUNT LINKS AND INSIDE ENGINE MOUNT LUGS ONLY.

- (11) Install two washers (25) and nut (5) on each bolt. Tighten nuts to allow 0.01 to 0.03 inch end play of bolt and install cotter pins (26).
- (12) Position cone bolt (14) between faces of mount links. With countersunk washer (7) under head of attach bolt (6), insert bolt through holes in links and cone bolt. Check gap between cone bolt and links and install shims (9) if necessary to obtain 0.002 maximum gap.
- (13) Install washer (8) and nut (10). Tighten nut within 2400 to 3100 pound-inches.

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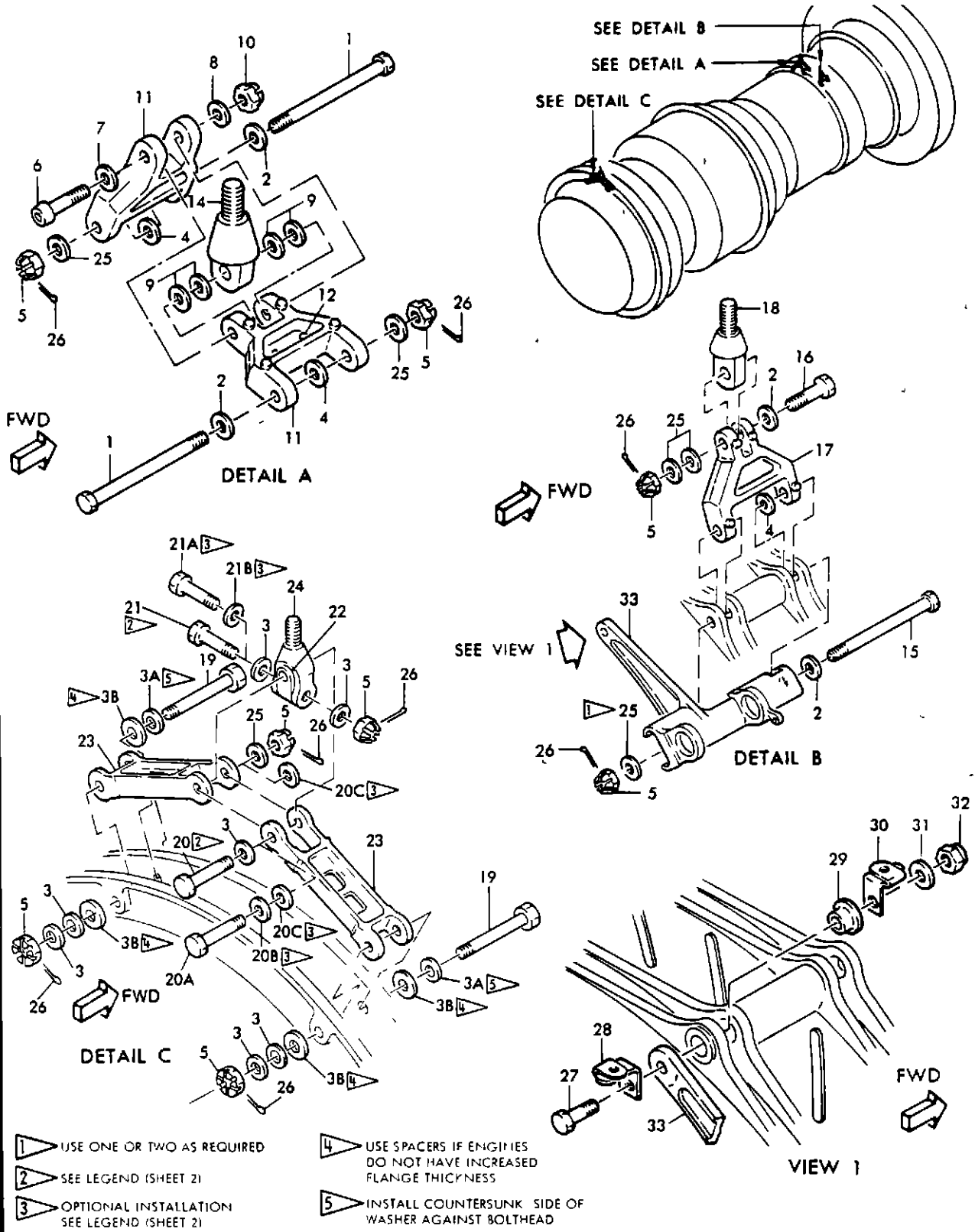
(14) At engine aft mount flange, position a support link (23) between flange faces at the first hole to the right of the vertical centerline. Position a second support link (23) at the first hole to the left of the vertical centerline. Install links using bolt (19), two washers (3) and nut (5) at each link. Tighten nuts within 660 to 780 pound-inches to seat bolt, back off nut and retighten finger-tight only, back off to first castellation and install cotter pin (26).

(15) Position universal block (22) between lugs of aft cone bolt (24). Secure block to cone bolt using bolt (21) two washers (3), and nut (5), or optional bolt (21A) with countersunk washer (21B) under bolthead, two washers (3), and nut (5). Tighten nut within 660 to 780 pound-inches to seat bolt, back off nut and retighten finger-tight, back off to first castellation and install cotter pin (26).

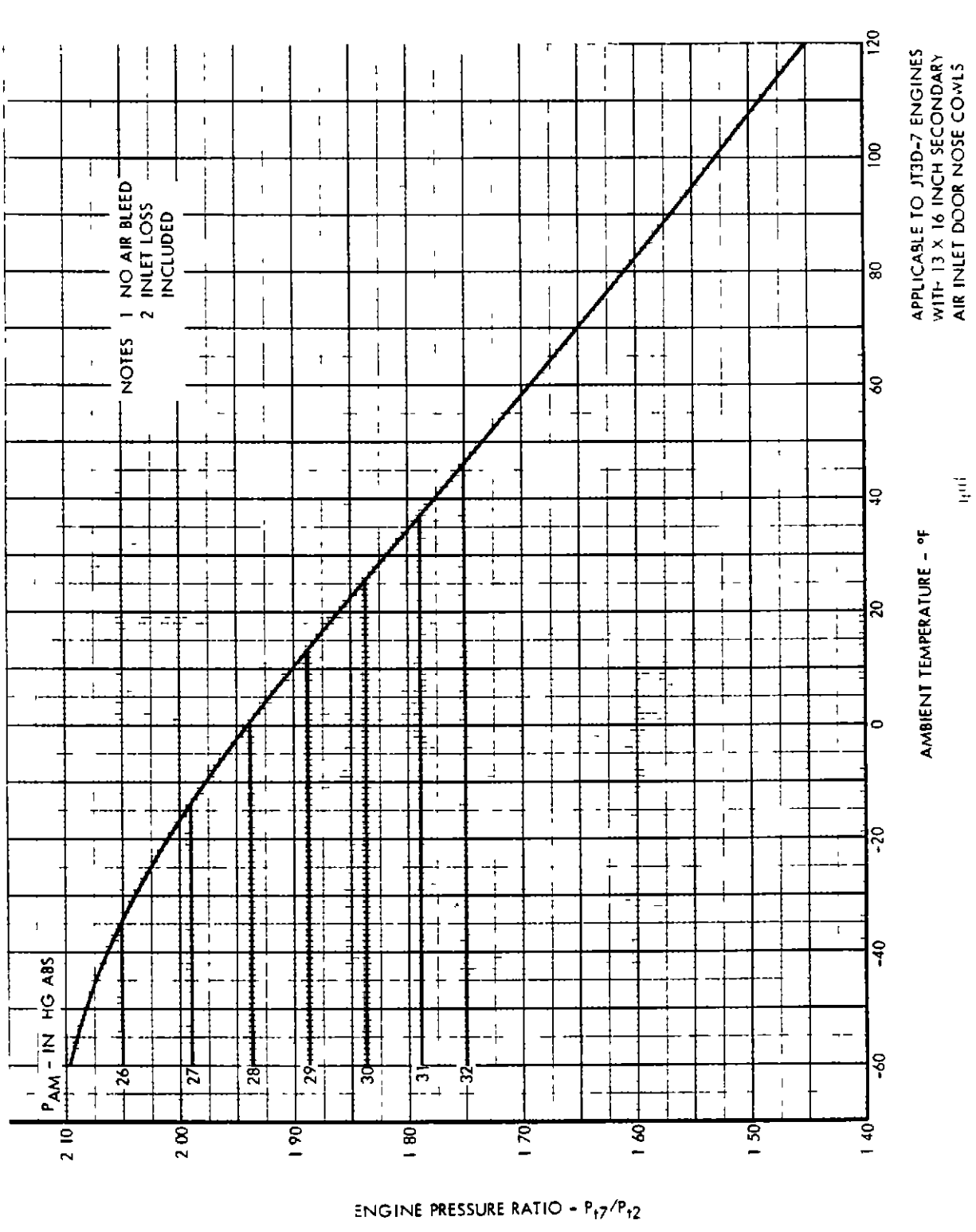
CAUTION: BOLTS (21) AND (21A) ONLY ARE ALLOWED FOR USE AT THIS LOCATION. USE OF A BOEING STANDARD BACB30LJ BOLT, WHICH SUPERSEDES BACB30BH BOLT, CAN RESULT IN INTERFERENCE BETWEEN BOLT END AND LINK (23).

(16) Position cone bolt and universal block assembly between faces of aft support links. Align holes through links and universal block and install bolt (20) with washer (3) under bolthead, or optional bolt (20A) with countersunk washer (20B) under bolthead and washer (20C) under countersunk washer. Secure bolt with nut (5) and washer (20C). Tighten nut within 660 to 780 pound-inches to seat bolt, back off nut and retighten finger-tight; back off to first castellation and install cotter pin (26).

CAUTION: ON OPTIONAL BOLT INSTALLATION, BOTH WASHERS (20C) MUST BE AS SPECIFIED TO ENSURE THAT NUT REACHES COTTER PIN HOLE IN BOLT.



Engine Mount Fittings Installation  
Figure 201 (Sheet 1)



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GENERAL INSTRUCTIONS FOR USE OF ENGINE TRIM DATA

Determine page on which data for ambient temperature and barometric pressure is located from page 534 or 534A as applicable. If ambient temperature or barometric pressure is found to fall between values given in the chart, correct data can be obtained by interpolation (finding midpoint of difference in this case)

Using the appropriate page, determine the target values (defined below) corresponding to the ambient temperature and/or barometric pressure:

DATA - Correction factor added to, or subtracted from, engine data plate  
PLATE percent rpm to compensate for nonstandard day conditions.  
CORR  
% N2

DATA - Engine data plate power setting target This target is used during part  
PLATE power trim operation to check engine performance deterioration  
PT7

PP - Pt7 target, to which MIL trim screw is adjusted during part power trim  
Pt7 operation.

PP - Part power EPR reference for personnel in control cabin. This value  
EPR gives an indication of the accuracy of the airplanes EPR indicating system. Do not use this value for engine trim unless precision trim instrumentation is not available and airplane instruments are known to be accurate.

NOTE: If control cabin instruments are used for engine trim, a complete trim run must be accomplished as soon as calibrated trim instruments become available.

TO - EPR target to which engine is operated, after part power trim operation,  
EPR to check availability of TAKEOFF power and amount of throttle cushion.

BAROMETRIC PRESSURE - INCHES OF MERCURY ABSOLUTE

	20.9 to 22.6	22.7 to 24.4	24.5 to 26.2	26.3 to 28.0	28.1 to 29.8	29.9 to 31.6
-48 to -22	PAGE 549	PAGE 550E	PAGE 550K	PAGE 550Q	PAGE 550W	PAGE 552A
-20 to 6	550	550F	550L	550R	550X	552B
8 to 34	550A	550G	550M	550B	550Y	552C
36 to 62	550B	550H	550N	550T	550Z	552D
64 to 90	550C	550I	550O	550U	551	552E
92 to 118	550D	550J	550P	550V	552	552F

APPLICABLE TO JT3D-3B ENGINES WITH SMALL (4x14 INCH) AFT HINGED SECONDARY AIR INLET DOOR NOSE COWLS.



## MAINTENANCE MANUAL

BAROMETRIC PRESSURE - INCHES OF MERCURY ABSOLUTE

	20.7 TO 22.2	22.3 TO 23.8	23.9 TO 25.4	25.5 TO 27.0	27.1 TO 28.6	28.7 TO 30.2	30.3 TO 31.8
	PAGE	PAGE	PAGE	PAGE	PAGE	PAGE	PAGE
-36 TO -30	535	536T	538M	540F	541	542T	544M
-28 TO -22	536	536U	538N	540G	542	542U	544N
-20 TO -14	536A	536V	538O	540H	542A	542V	544O
-12 TO -6	536B	536W	538P	540I	542B	542W	544P
-4 TO +2	536C	536X	538Q	540J	542C	542X	544Q
4 TO 10	536D	536Y	538R	540K	542D	542Y	544R
12 TO 16	536E	536Z	538S	540L	542E	542Z	544S
18 TO 22	536F	537	538T	540M	542F	543	544T
24 TO 28	536G	538	538U	540N	542G	544	544U
30 TO 34	536H	538A	538V	540O	542H	544A	544V
36 TO 40	536I	538B	538W	540P	542I	544B	544W
42 TO 48	536J	538C	538X	540Q	542J	544C	544X
50 TO 56	536K	538D	538Y	540R	542K	544D	544Y
58 TO 64	536L	538E	538Z	540S	542L	544E	544Z
66 TO 72	536M	538F	539	540T	542M	544F	545
74 TO 80	536N	538G	540	540U	542N	544G	546
82 TO 88	536O	538H	540A	540V	542O	544H	546A
90 TO 96	536P	538I	540B	540W	542P	544I	546B
98 TO 104	536Q	538J	540C	540X	542Q	544J	546C
106 TO 112	536R	538K	540D	540Y	542R	544K	546D
114 TO 120	536S	538L	540E	540Z	542S	544L	546E

AMBIENT TEMPERATURE °F

APPLICABLE TO JT3D-7 ENGINES

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POWER PLANT (JT3D) - INSPECTION/CHECK

1. Examine Power Plant

A. Check cowling for following:

- (1) Latches for cracks, strained links and pins, ease of latching and positive engagement.
- (2) Nose cowl, nose dome and leading edge of struts for cracks, loose rivets and dents or gaps affecting aerodynamic smoothness beyond permissible limits. Check nose cowl secondary air inlet doors for damage or sticking.

(2') Check nose cowl particularly for :

- (a) Leading edge anti-icing duct ring inspection.

Check integrity of the duct ring attachment as follows:

- Remove the nose cowl from the engine.
- Shake the nose cowl by hand.
- If shindy during shaking, the duct attachment may be defective and the nose cowl must be sent to repair.

- (b) Support structure  $V_{ee}$  section radials to  $Z_{ee}$  section rib rings.

- At each of the three  $Z_{ee}$  rings to the  $V_{ee}$  section radial joints, check lockbolt looseness by hand from cowl inside through the secondary air inlet channels.
- To avoid additional loading on/and possibility of remaining fasteners loosening, any loose or missing lockbolt must be replaced.

In such a case, the nose cowl must be sent to repair and defective installation corrected by use of NAS 1103 bolts and NAS 679 nuts (or equivalents). Before tightening, gap between  $Z_{ee}$  and  $V_{ee}$  sections may not exceed .002 inch. Shim as necessary.

NOTE: If required, repair may be postponed to the next equalized service (B check), provided there is only one loose or missing fastener per any  $Z_{ee}$  section rib or  $V_{ee}$  section radial with a maximum of three per nose cowl.

- (c) Forward bulkhead cracking at secondary air inlet door attaching points.

NOTE: Applicable if SAB. 707/621 not incorporated.

- Proceed by spot check on two inlet doors.

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- Remove doors and hinge assembly.
- Visually check the bulkhead for cracks around hinge support bolt plate nuts. If cracked, send nose cowl to repair shop.

NOTE: If required, repair may be postponed to the next equalized service (B check).

- (3) Fireseals for loose rivets, misalignment and damage.
  - (4) Fuel and oil drain cowl seals for cuts and wear.
  - (5) Hinge spacers and brackets for corrosion and loose mounting bolts.
  - (6) Cowl panel hinge fittings, latches and U-bolts for wear, cracks, corrosion and loose fasteners; cowl panel skin at frame and longeron attachments for cracks, loose fasteners and broken spot welds.
  - (7) Cowl panel skin, covers, doublers, and frames at duct outlets for cracks and loose fasteners; access doors for cracks and loose fasteners.
  - (8) Cowl panel support rods (if fitted) for correct functioning of hinge bolts, stowage clips and safety pins.
  - (9) Nacelle forward fairing attach fittings for wear.
- B. Check oil system for following:
- (1) Strainer for carbon, metal, or other foreign material.
  - (2) Oil cooler for leaks and loose mounting bolts; oil temperature regulating and pressure relief valves, tubing, and connections for leakage.
  - (3) Turbocompressor, constant speed drive, accessory drive gear box oil connections, drain plugs and banjo fittings for loose, broken or missing lockwire.
  - (4) Tank for specified servicing, evidence of leakage, loose or cracked mount straps, sump for water accumulation; connections for leaks; filler cap for positive locking, deteriorated seals, or broken chain.

INDEX NO	NOMENCLATURE
1	BOLT
2	WASHER
3	WASHER
3A	WASHER, Countersunk (Countersunk side against bolthead)
3B	SPACER
4	SHIM, Forward engine mount thrust fitting
5	NUT
6	BOLT
7	WASHER
8	WASHER
9	SHIM, Forward engine mount thrust fitting
10	NUT
11	LINK ASSY, Forward engine mount LH side
12	NAMEPLATE
13	LINK, Forward engine mount
14	FITTING, Forward engine mount LH side cone
15	BOLT
16	BOLT
17	LINK, Forward engine mount RH side
18	FITTING, Forward engine mount RH side cone
19	BOLT, BAC69-60892-1
20	BOLT, BACB30BH10C38
20A	BOLT, BACB30LJ10DU37 (Optional to INDEX NO 20)
20B	WASHER, Countersunk (Use only with INDEX NO. 20A)
20C	WASHER, AN960C1016 (Two required with INDEX NO 20A)
21	BOLT, BACB30BH10C29
21A	BOLT, BAC69-56963-1 (Optional to INDEX NO 21)
21B	WASHER, Countersunk (Use only with INDEX NO 21A)
22	BLOCK, Rear engine mount universal
23	LINK, Rear engine mount support
24	BOLT, Rear engine mount cone
25	WASHER
26	COTTER PIN
27	BOLT
28	CLIP, Electrical harness NUT
29	BUSHING, Throttle control
30	CLIP, Plumbing support NUT
31	WASHER
32	NUT
33	BRACKET

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FIRE BARRIER - REMOVAL/INSTALLATION1. General

- A. The procedure in this section is designed to be accomplished with the engine installed on the airplane.
- B. Removal of a section of the nacelle vertical fire barrier will be necessary if a burner can or hot section inspection is to be performed with the engine installed on the airplane. Refer to Chapter 72 for burner can inspection and replacement, hot section inspection, and fuel manifold maintenance procedures.

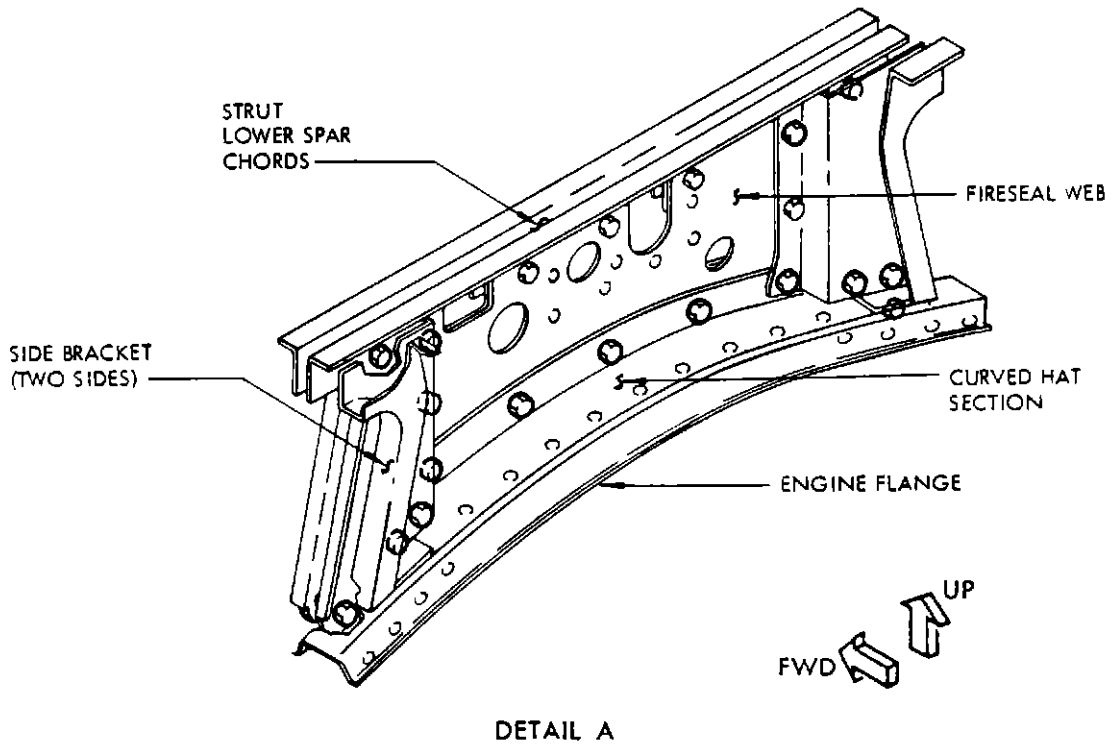
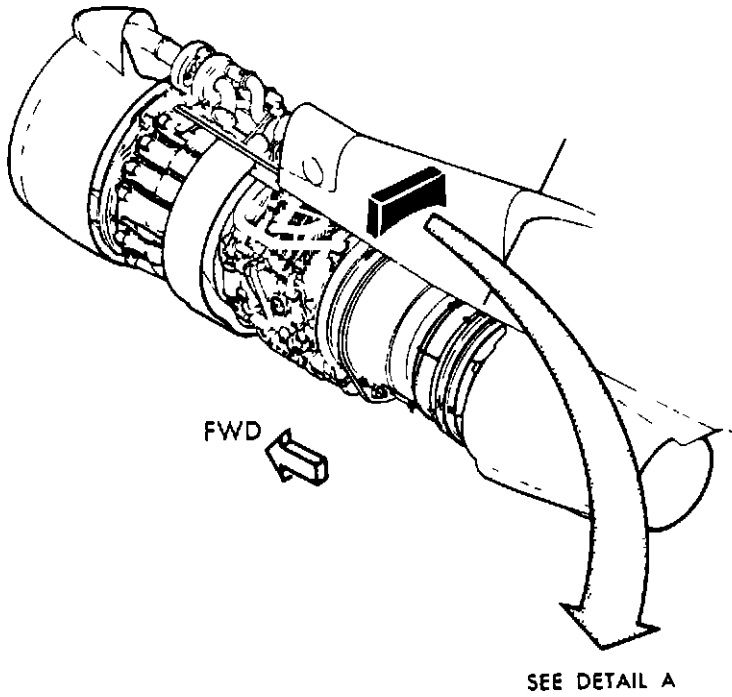
2. Remove Fire Barrier Section

- A. Strip sealant between the curved hat section, two side brackets, fireseal web, and strut lower spar chords, if sealant is present. (See figure 401.)
- B. Remove eleven bolts which attach curved hat section to fireseal web and two side brackets.
- C. Remove three bolts which attach each side bracket to the strut lower spar chords and fireseal web.
- D. Separate curved hat section from two side brackets and remove all three components from airplane.

3. Install Fire Barrier Section

- A. Position two side brackets and curved hat section on fireseal web. (See figure 401.)
- B. Install three bolts holding each side bracket to strut lower spar chords and fireseal web.
- C. Install eleven bolts holding curved hat section to fireseal web and two side brackets.

NOTE. If sealant was stripped during removal of the fire barrier, it need not be reapplied.



Fire Barrier Installation  
Figure 401