Aerolineas Argentinas

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CHAPTER 36 - PNEUMATIC

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CHAPTER 36 – PNEUMATIC

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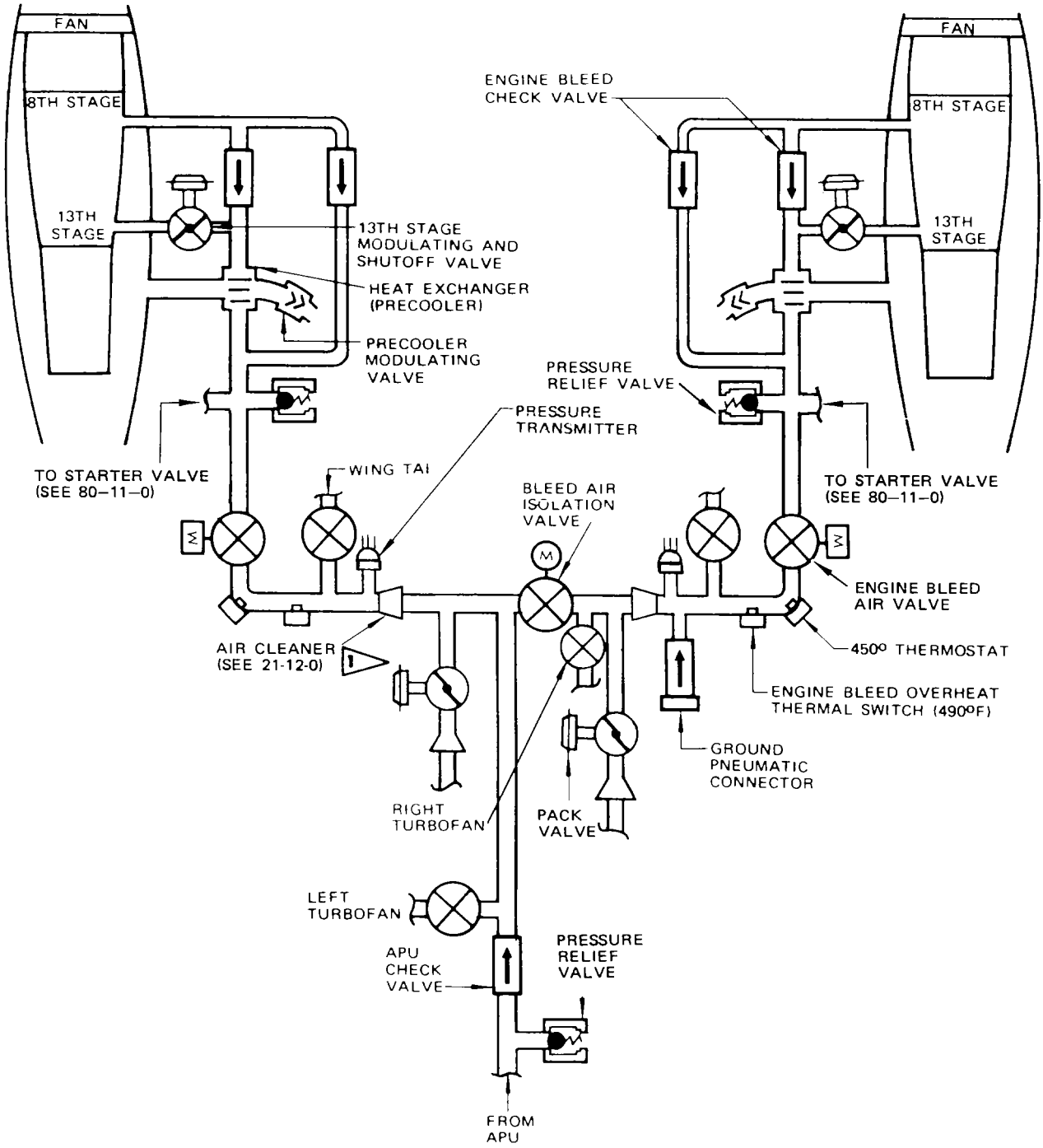
PNEUMATIC - DESCRIPTION AND OPERATION

1. General
   A. The purpose of the pneumatic system is to supply compressed air from the 8th- and 13th-stage engine compressor bleeds or from the APU or from a ground cart to a pneumatic manifold for air conditioning and pressurization, engine starting, and for the thermal anti-icing system. The controlling valves of the systems drawing compressed air from the pneumatic manifold are covered in their respective chapters. For air conditioning and pressurization, refer to Chapter 21, Engine Bleed Air Compression Control System; for engine starting, refer to Chapter 80, Pneumatic Starting System; for thermal anti-icing, refer to Chapter 30, Wing Thermal Anti-Icing System.
   B. The main supply of compressed air to the manifold is obtained from 8th-stage compressor bleeds. When the supply of air of 8th-stage bleed is not adequate to meet air conditioning system demands, the 13th-stage bleed air is used. Air from the engine compressor bleeds is directed through precoolers (heat exchangers) to the pneumatic manifold (Fig. 1). A high pressure bleed control system is provided in order to regulate the airflow and supply the air demand for the air conditioning system. Refer to Chapter 21, Air Conditioning for full information on high pressure bleed control system. For pressure and temperature indication of the bleed air, pressure transmitters and temperature switches are provided.
   C. The engine bleed air distribution system interconnects the engine bleeds of the engines and APU and contains the necessary valves to shut off bleed air at each engine and isolate various ducts.
   D. The bleed air precooler system consists of the two similar subsystems which provide the precooling of bleed air. One subsystem is the left side, which cools the air supplied by engine No. 1 and the other is the right side which cools the air supplied by engine No. 2. Each subsystem functions automatically as long as the engine is running. Each subsystem consists of a thermostatically controlled precooler valve and an air-to-air heat exchanger. The cooling air for the heat exchanger is engine fan air bleed. The precooler valve is attached to the discharge port of the heat exchanger and the valve position is controlled by cooling air exit temperature.
   E. Two pressure transmitters are provided for pressure indication of the bleed air. One transmitter is used for each engine. Both pressure transmitters are connected to a dual pressure indicator on the overhead panel. The engine bleed temperature indication consists of overtemperature switches on the ducting system, which are connected to the overhead panel trip lights. The temperature switches illuminate the trip lights and the corresponding engine bleed valve closes when the bleed air temperature exceeds approximately 490°F.



1
AR ALL EXCEPT LV-JMW THRU LV-JMY
ND ALL EXCEPT CF-NAB, CF-NAH, CF-NAQ
PV ALL EXCEPT CF-EPL, CF-EPO, CF-EPR
VP ALL EXCEPT PP-SMA THRU PP-SME
PW ALL EXCEPT CP-PWD, CF-PWE

Pneumatic System Schematic
Figure 1

F. The bleed air cleaner system on some airplanes consists of two similar independent subsystems, which purge the bleed air of impurities. Each subsystem functions automatically whenever engine bleed air is used from its respective engine for air conditioning, and the airplane is on the ground or the flaps are extended. Each subsystem consists of an inertial type air cleaner and an electrically controlled pneumatically operated purge valve. The air cleaner is located in the pneumatic manifold outboard of the air conditioning duct for the respective engine. For a more detailed description of the air cleaner system, refer to Chapter 21 Air Cleaner System.

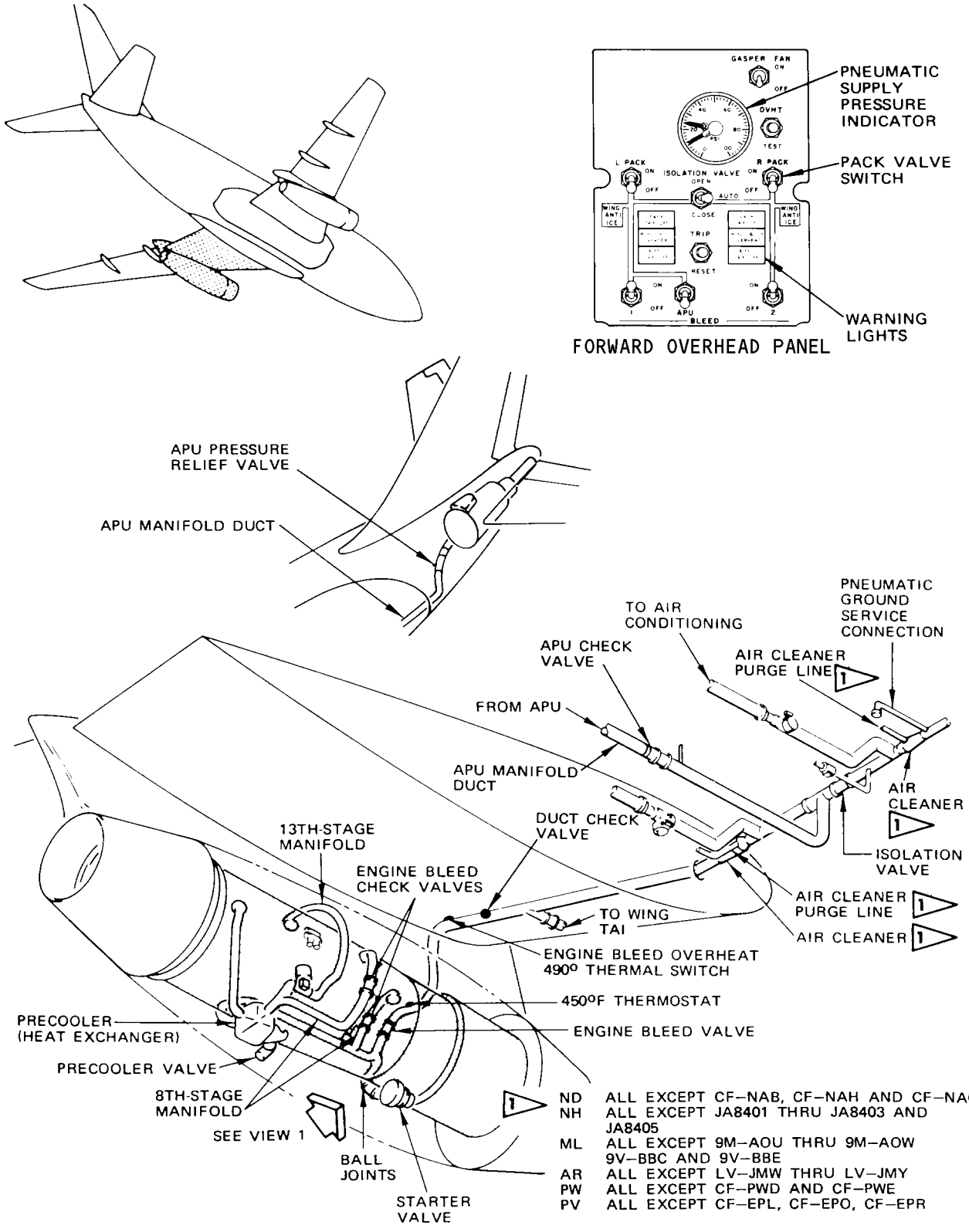
ENGINE BLEED AIR DISTRIBUTION SYSTEM - DESCRIPTION AND OPERATION

1. General

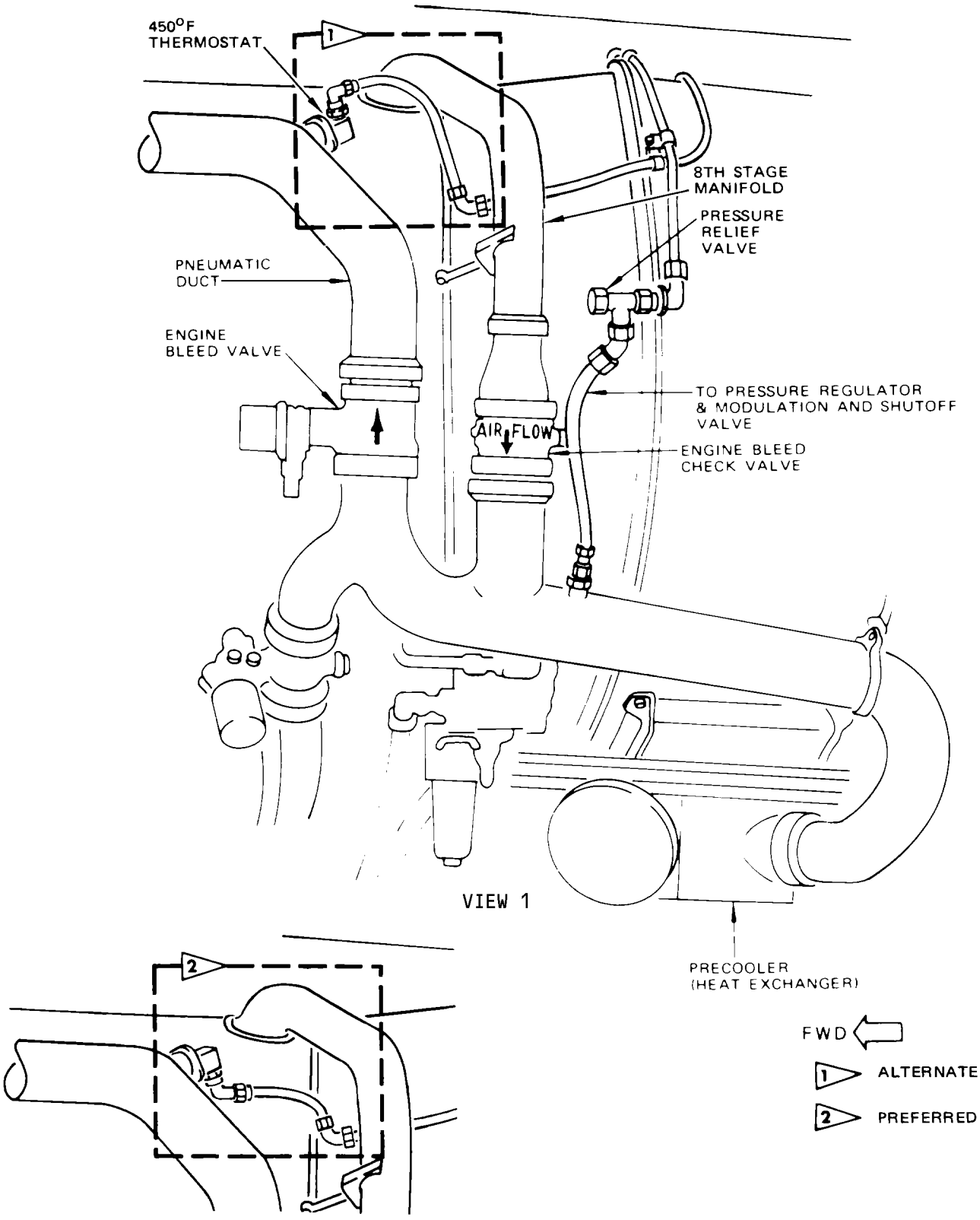
A. The purpose of the engine bleed air distribution system is to direct high temperature compressed air from the engine bleeds to the air conditioning system, to the engine starting system, and to the thermal anti-icing system. The engine bleed system consists of ducts that interconnect the two engines, an isolation valve, and engine bleed valves to isolate each engine and deliver air as required. Bleed air from the eighth stage is delivered to the main manifold through two separate ducts. The main duct delivers the air through the precooler system heat exchanger, the second duct bypasses the heat exchanger and delivers the increased flow of air through the bleed valve directly to the manifold. Bleed air from the 13th stage, after passing through the modulating and shutoff valve in the air conditioning compression control system merges with the main ducting system prior to entering the precooler. (See figure 1.) A check valve on each eighth stage bleed duct prevents reverse flow of the high spool bleed air into the eighth stage engine ports. Relief valves are installed in the main manifold (figure 2) to prevent excess pressure from rupturing the ducts. A pneumatic ground service connector and check valve is provided for the connection of a ground pneumatic cart.

B. The right air conditioning system takes air from the No. 2 engine and the left air conditioning system from the No. 1 engine. (See figure 2.) One isolation valve is provided for the isolation of the systems. The isolation valve is automatic in operation and electrically controlled. Bleed air can be directed from one system to the other by opening of the isolation valve.

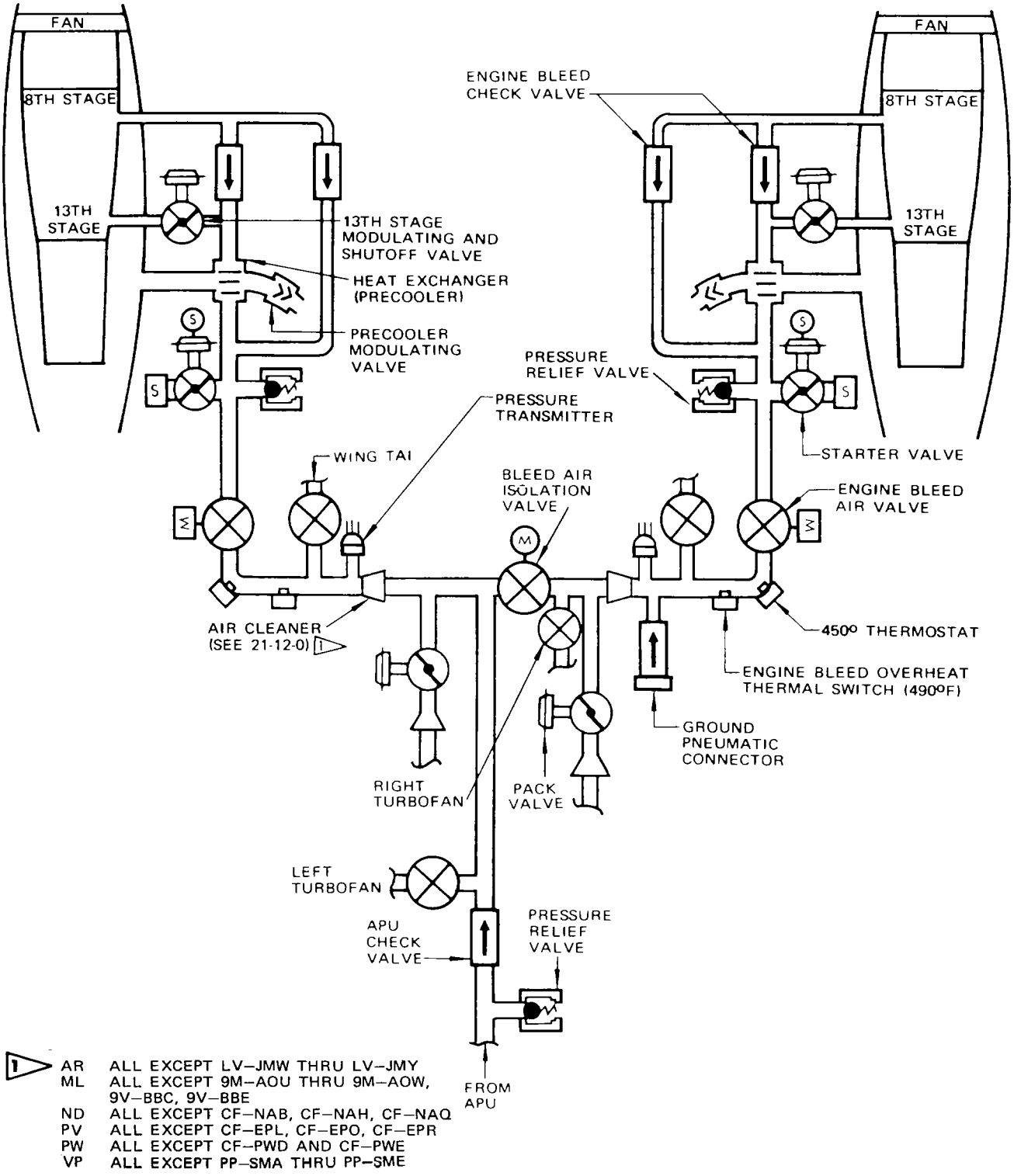
C. Normally the APU check valve prevents engine bleed pressure from backing into the APU bleed system. Should the check valve fail open, with the APU bleed valve open, engine bleed pressure could be detrimental to the APU. The DUAL BLEED light on the overhead panel illuminates when the APU bleed valve is open and either engine No. 1 bleed valve or engine No. 2 bleed valve and isolation valve are open. The light would be on during an APU engine start. After engine start and the APU bleed valve switch is placed to OFF the light goes out indicating that the APU bleed valve has closed. (See figure 5.)



Engine Bleed Air Distribution System Component Location
Figure 1 (Sheet 1)



Engine Bleed Air Distribution System Component Location
Figure 1 (Sheet 2)



1 AR ALL EXCEPT LV–JMW THRU LV–JMY
ML ALL EXCEPT 9M–AOU THRU 9M–AOW, 9V–BBC, 9V–BBE
ND ALL EXCEPT CF–NAB, CF–NAH, CF–NAQ
PV ALL EXCEPT CF–EPL, CF–EPO, CF–EPR
PW ALL EXCEPT CF–PWD AND CF–PWE
VP ALL EXCEPT PP–SMA THRU PP–SME

Engine Bleed Air Distribution System Schematic
Figure 2

2. Bleed Valves
   A. The engine bleed valves are motor-driven and electrically controlled. Each valve is located downstream of the heat exchanger (precooler) (Fig. 2 and 3). Control switches for the engine bleed valves are on the forward overhead panel. The engine bleed valves are provided to shut off bleed air from the respective engine bleeds to the main manifold. The control circuit includes an overtemperature switch downstream of the heat exchanger. The engine bleed overheat switch will cause the valve to close if the bleed air temperature exceeds 490° ±10°F. An indicator light on the forward overhead panel is illuminated concurrently with closure of the engine bleed valve and may be reset in flight after having been closed by the overtemperature switch, but only after the air temperature in the duct cools by approximately 20° to 30°F. Cooling of the duct air allows the overtemperature switch to cool and reopen. A reset switch is provided for the bleed valves, and is located on the forward overhead panel. (Fig. 1). This reset switch is also used for the air conditioning pack valves.
   B. A manual override is provided to permit positioning the valve manually. On some valves the manual override includes a lock out feature which disengages the valve motor. A decal on the actuator housing provides instructions for engaging and disengaging motor.
3. Isolation Valve
   A. The right air conditioning system takes air from the No. 2 engine and the left air conditioning system takes air from the No. 1 engine. (See figure 2.) This separation of bleed air is accomplished by the isolation valve. The isolation valve remains closed unless a cross-feed of bleed air is required. The isolation valve is motor-driven and electrically controlled by a three-position switch on the forward overhead panel.
   B. The isolation valve may be manually controlled by the flight crew or it may be left in the automatic mode. In the automatic mode the isolation valve will be closed so long as both engine bleed switches and both pack switches are selected ON; this is the normal flight operating mode for the system. If any other combination of switch positions is selected the isolation valve will open. The isolation valve position is controlled by the position of the bleed and pack switches and not by the position of the bleed and pack valves themselves. In the event of an engine shutdown, or a 490°F overheat trip, the system will not automatically allow the remaining air source to supply both sides of the airplane. (See figure 4.)
4. APU Check Valve
   A. An APU supply duct directs APU air to the pneumatic manifold. A check valve in the duct prevents engine bleed air from entering the APU when an engine is running.

2. Bleed Valves

A. The engine bleed valves are motor-driven and electrically controlled. Each valve is located downstream of the heat exchanger (precooler) (Fig. 2 and 3). Control switches for the engine bleed valves are on the forward overhead panel. The engine bleed valves are provided to shut off bleed air from the respective engine bleeds to the main manifold. The control circuit includes an overtemperature switch downstream of the heat exchanger. The engine bleed overheat switch will cause the valve to close if the bleed air temperature exceeds 490 ±10°F. An indicator light on the forward overhead panel is illuminated concurrently with closure of the engine bleed valve and may be reset in flight after having been closed by the overtemperature switch, but only after the air temperature in the duct cools by approximately 20 to 30°F. Cooling of the duct air allows the overtemperature switch to cool and reopen. A reset switch is provided for the bleed valves, and is located on the forward overhead panel (Fig. 1). This reset switch is also used for the air conditioning pack valves.

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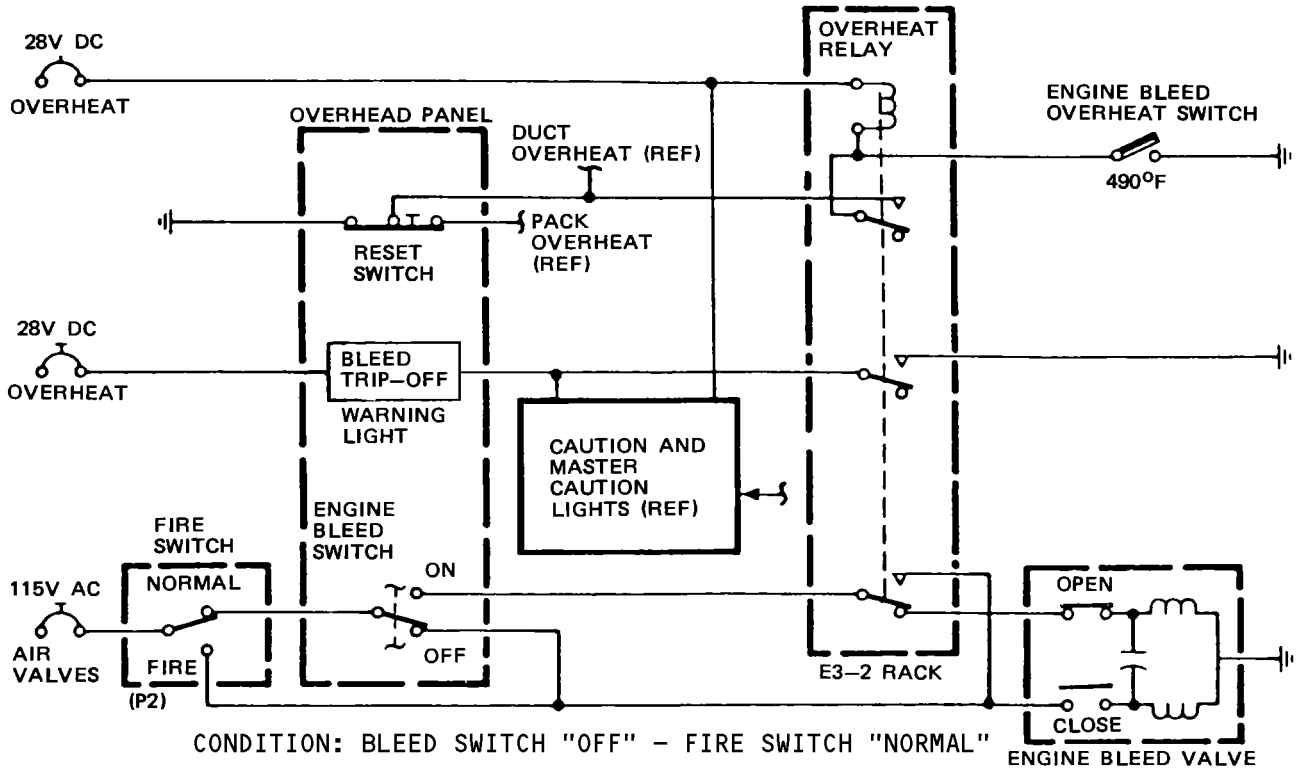


Bleed Valve Control Circuit
Figure 3

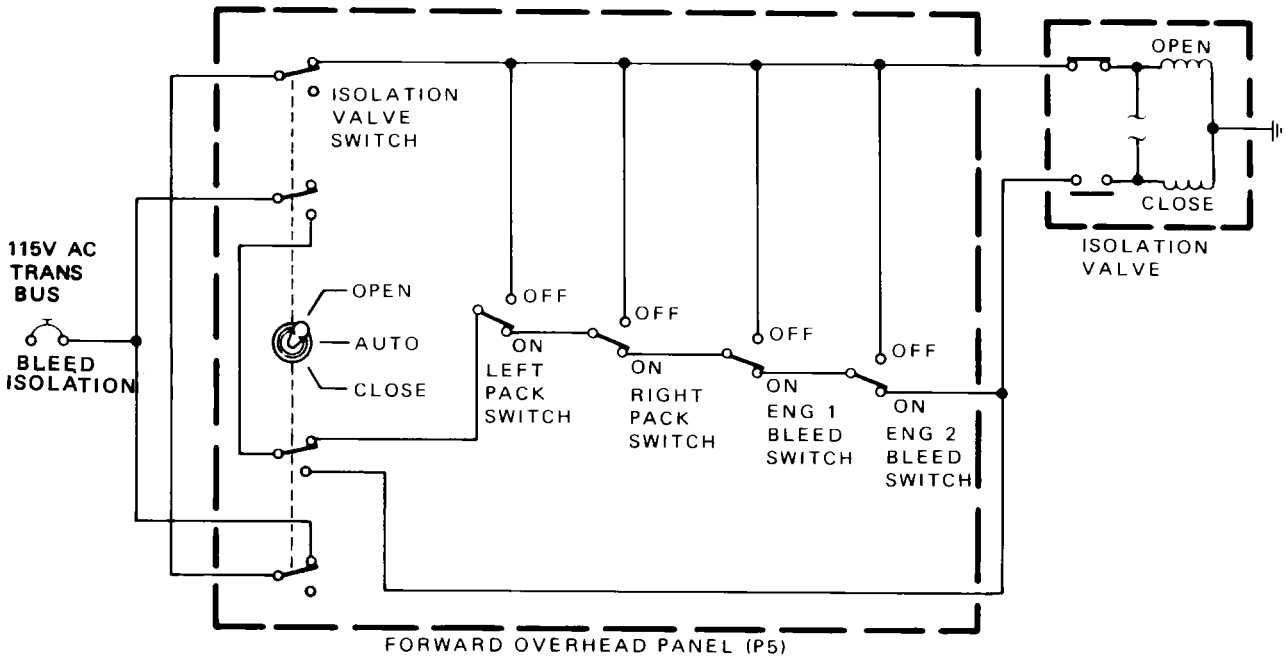
3. Isolation Valve

A. The right air conditioning system takes air from the No. 2 engine and the left air conditioning system takes air from the No. 1 engine. (See figure 2.) This separation of bleed air is accomplished by the isolation valve. The isolation valve remains closed unless a cross-feed of bleed air is required. The isolation valve is motor driven and electrically controlled by a three-position switch on the forward overhead panel.

B. The isolation valve may be manually controlled by the flight crew or it may be left in the automatic mode. In the automatic mode the isolation valve will be closed so long as both engine bleed switches and both pack switches are selected ON; this is the normal flight operating mode for the system. If any other combination of switch positions is selected the isolation valve will open. The isolation valve position is controlled by the position of the bleed and pack switches and not by the position of the bleed and pack valves themselves. In the event of an engine shutdown, or a 490°F overheat trip, the system will not automatically allow the remaining air source to supply both sides of the airplane. (See figure 4.)

4. APU Check Valve

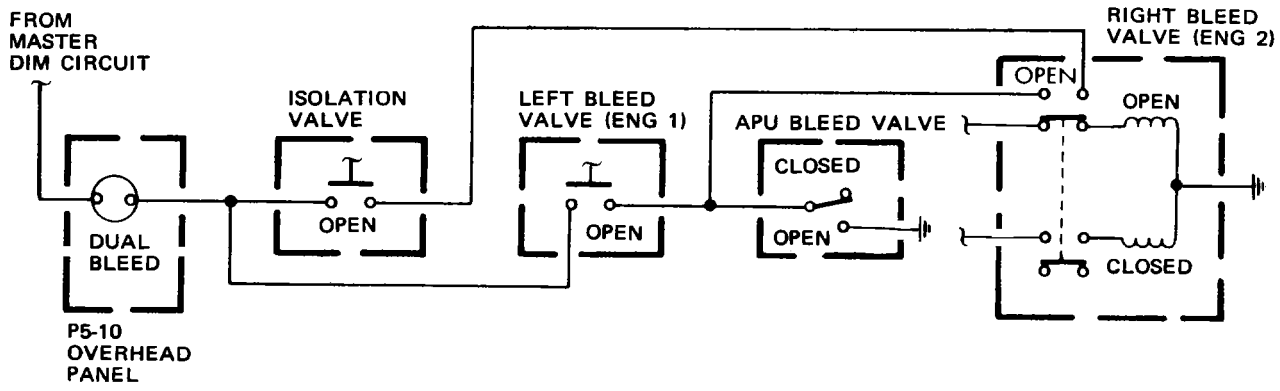
A. An APU supply duct directs APU air to the pneumatic manifold. A check valve in the duct prevents engine bleed air from entering the APU when an engine is running.



CONDITION: ISOLATION VALVE SWITCH "OPEN"

Isolation Valve Control Circuit
Figure 4

5. Pneumatic Ground Service Connector
   A. A pneumatic ground service connector and check valve is provided for the connection of a ground pneumatic cart. The connector is located in the right pack bay area on the underside of the fuselage (Fig. 1). Pressurized air from the cart can be supplied for starting. However, before air is supplied for starting, the battery power must be turned on and the air conditioning pack valves switched off. Although maximum pressure and temperature limit of air at ground connector is 60 psig and 450°F respectively, starter limits may be different. For limits of pneumatic starting system, Ref 80-11-0.
   B. Pressurized air from the cart can also be used for the air conditioning system during ground operation with no engines running, provided ac power is available on the airplane.
6. Ducts
   A. The ducts located in the engine sections are joined to the bleed manifolds by duct ball joints to allow limited motion during operation.
   B. The duct sections of the pneumatic system are designed and manufactured slightly short in length in order to compensate for thermal expansion when hot air flows through them.
7. Pressure Relief Valves (Fig. 1 and 2)
   A. Pressure relief valves are provided to protect pneumatic ducts from excessive pressure. One relief valve is located in the titanium portion of the APU supply duct and relieves at pressures above approximately 80 psi. Two other relief valves, one on the left side of each engine, are located in the downstream sense line for each 13th-stage modulating and shutoff valve. These valves relieve at approximately 106 psi.
8. Engine Bleed Check Valves (Fig. 1)
   A. Five check valves are provided in the engine bleed air distribution system. Two check valves are provided at each engine, one in each 8th-stage manifold, to keep air from entering the 8th-stage engine ports during engine start or from high spool bleed. The fifth check valve is located in the APU supply duct to prevent engine bleed air from entering APU.



Dual Bleed Indicating System Circuit
Figure 5

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ENGINE BLEED AIR DISTRIBUTION SYSTEM - TROUBLESHOOTING

1. General
   A. The Engine Bleed Air Distribution System directs high temperature compressed air from the engine bleeds to the air conditioning system, to the engine starting system and to the thermal anti-icing system. The system consists of engine bleed valves, an isolation valve, check valves, pressure relief valves, temperature sensing switch and associated ducting.
   B. The compression control system comprised of the 13-stage modulating and shutoff valve, high pressure regulator and pack valves is covered in AMM 21-11-0. Refer to AMM 21-11-0/101 for troubleshooting of these components.
   C. Prior to accomplishing troubleshooting on the distribution system, perform the Engine Bleed Air Compression Control System - Adjustment/Test, troubleshooting as necessary including closing of circuit breakers (AMM 21-11-0).
   D. Perform engine bleed air distribution system test (AMM 36-11-0/501) to isolate problems in the system. Then perform the procedures on the following troubleshooting chart to isolate system and component faults.
   E. Engine bleed air precooler leakage has been eliminated as a possible fault since any leakage at the precooler great enough to cause system problems should be obvious.
   F. Leakage from ducts may be determined by accomplishing duct leakage tests shown in AMM 36-11-0/501.
   G. All troubleshooting procedures are based on the assumption that wiring is ok and that electrical power is available. If the corrective action in the procedure does not correct the problem, check wiring using the wiring diagram. Prior to troubleshooting, check master Dim and Test circuits to ensure panel lights are operable.

2. Engine Bleed Air Distribution System Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Bleed air shutoff valve does not operate	Valve jammed motor failed	Turn applicable bleed air switch on and make sure that shutoff valve opens and motor stops.	Replace shutoff valve (AMM 36-11-11)
Bleed air overheat switch (490°F)	Defective switch	Remove switch from duct and heat switch probe to 500°F (use controlled heat). CAUTION: DO NOT HEAT PROBE ABOVE 550°F OR UNIT MAY BE DAMAGED. CHECK THAT BLEED AIR VALVE CLOSES AND BLEED TRIPOFF LIGHT (ON AIR COND MODULE) AND MASTER CAUTION AND AIR COND ANNUNCIATOR LIGHTS (PILOTS LIGHT SHIELD) ILLUMINATE. ALLOW PROBE TO COOL, PUSH TRIP BUTTON & CHECK THAT VALVE OPENS, MOTOR STOPS, LIGHTS EXTINGUISH. NOTE: Allow 2 minutes heating at setting temperature to enable switch to heat soak.	Replace overheat switch (AMM 36-11-71) Check Indicator lights circuitry (Ref Wiring Diagram)
Fire indicating circuit malfunction	Circuitry	Place engine fire switch on aft electronics panel to fire. Check that bleed air valve closes and motor stops. Reposition fire switch to normal, check that valve returns to open and motor stops.	Check and repair circuitry as required (Wiring Diagram)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Bleed air isolation valve does not operate	Valve jammed, motor failed	Test bleed air isolation valve (AMM 36-11-0/501), if valve positions are incorrect, make sure that valve is receiving power.	If valve received power, replace valve (AMM 36-11-21) If no power, check circuitry (Wiring Diagram)
Ground pneumatic system check valve malfunctions	Poppet stuck	Pressurize system from engines or APU. With isolation valve and bleed air valve(s) which control source, open, check for pressure loss, pressurize system through ground pneumatic connector. Make sure that system pressurizes.	Replace valve (AMM 36-11-41)
APU system check valve malfunctions	Poppet stuck	Pressurize system from engines or from ground pneumatic system having isolation valve and bleed air valve which controls pressure source open. Check for system pressure loss. Pressurize system using APU. Check that system pressurizes. IF NOT -	Replace check valve (AMM 36-11-51)
Engine bleed check valves malfunction	Poppet stuck	Pressurize system from ground pneumatic connection with: - 13th stage modulating & shutoff valve closed - Starter valve closed - Pack valves closed - Wing TAI valves closed - Engine bleed air valve on engine being checked open. valve on other engine closed - Isolation valve open when checking engine #1 valves closed when checking engine #2. Check to make sure system pressurizes. IF NOT -	Replace engine bleed check valve indicated open (by sound of rushing air at valve) (AMM 36-11-31)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Indication system malfunction	Limit switches inoperative	Position air conditioning switches as follows: - Isolation valve switch on - Engine bleed air switches off - Pack switches on with APU running and APU bleed switch on. Check no dual bleed on overhead panel.	Replace overheat switch (AMM 36-11-71)
		Turn pack switches off and #2 bleed switch on. With APU providing pressure to system, dual bleed, master caution & air condit annunciator lights illuminate.	
	Zener diodes malfunction	Check lights dim. Check reset and recall.	(AMM Chap 33)
		Close isolation valve. Warning lights extinguish.	Check power at applicable valve
		Turn #2 engine bleed off and turn #1 engine bleed on warning lights illuminate. Open isolation valve, turn #2 bleed switch on and turn off APU bleed switch, lights extinguish	Replace valve if power is available

ENGINE BLEED AIR DISTRIBUTION SYSTEM - ADJUSTMENT/TEST

1. Engine Bleed Air Distribution System Test
   A. General
      (1) The engine bleed air distribution system test is separated into six tests: two operational tests, and four duct leakage tests.
      (2) The operational tests are intended to ensure correct functioning of the electrical control components, circuit continuity and valve motor operation. Running engines is not necessary if ground electrical power is provided. Two operational tests are included. They may be accomplished concurrently or separately.
         (a) The bleed shutoff valves and bleed air overheat switch (490°F) test covers the operation of the valves and relationship between the valve and the 490°F switch.
         (b) The bleed air isolation valve test covers only the operational testing of the valves.
      (3) The duct leakage test is intended to establish integrity and leakage limits of pneumatic ducts and associated components of the engine bleed air distribution system which are subject to pneumatic pressure.
         (a) Time Pressure Drop Method
            1) This leakage test, which requires no special equipment, measures the leakage on the right and left sides of the isolation valve. The leakage is measured by pressurizing the applicable side of the manifold with an APU and timing the pressure drop on the pneumatic supply indicator.
               a) The bleed air system test covers ducts from the APU shutoff valve to the pack valve and through the engine bleed valve to the thirteenth stage modulating and shutoff valve, starter valve, precooler and eighth stage check valves. This test does not cover the ducts downstream of the pack valve.
         (b) Flow Rate Method
            1) These three leakage tests, which require special equipment, each check a separate section of the system. Each section of the system is isolated by closure of the appropriate valves and then pressurized using an air source equipped with a flow measuring indicator.
               a) The engine supply duct leakage test covers ducts between the modulating and shutoff valve, starter valve, engine bleed valve and the eighth stage check valves.

b) The pneumatic ducts downstream from engine bleed valves leakage test includes the ducts downstream of the engine bleed valves to the pack valve and APU bleed air valve. The test requires only the addition of one blocking plate and may be preferred if suspected leakage or questionable duct joints are located in these ducts. If ducts or components downstream of the pack valve are questionable, accomplish the pack installation pneumatic ducts leakage test.

c) The pack installation pneumatic ducts leakage test includes the ducts downstream of the engine and APU bleed valves and the ducts in the air conditioning equipment bay. Unless cargo compartment lining has been removed, it may be desirable to accomplish leakage test per (3)(b)1)b) before doing this test. If leakage per (3)(b)1)b) is within limits excessive leakage would be isolated to equipment bay ducts.

B. Bleed Air Shutoff Valves and Bleed Air Overheat Switch Test

(1) Equipment and Materials

(a) Controlled Heat Source - Temp. Cal probe heater (Attachment to Jet Cal engine analyzer), P/N BH3884-40, Howell Instruments Inc., 3479 W. Vickery Blvd., Ft. Worth, Texas 76107

(b) TEMPCAL Tester, H394 Series, Howell Instruments Inc., 3479 W. Vickery Blvd.,
Ft. Worth, Texas 76107

(2) Prepare to Test Bleed Air Distribution System

(a) Open right engine cowl.

(b) Connect external power and energize 115-volt ac transfer bus No. 1 and 2.

(c) Check that the following circuit breakers are closed (P6).

1) MASTER CAUTION (ALL EXCEPT FUEL, if installed)
2) INDICATOR LTS, MASTER DIM BUS (9 places)
3) DIM & TEST (1 place)
4) BLEED AIR VALVE (2 places)

(3) Test Bleed Air Shutoff Valves and Bleed Air Overheat Switch (490°F).

(a) On forward overhead panel, press BLEED TRIP OFF light for operation.

(b) On lightshield, press MASTER CAUTION light.

NOTE: Each annunciator and master caution light will go on when pressed, and off when released.

(c) On forward overhead panel, position engine 1 BLEED switch to ON.

(d) Check that bleed air valve from engine 1 opens as shown by valve external position indicator and that, after opening, valve motor stops.

CAUTION: VALVE MOTOR MUST STOP DRIVING AFTER VALVE IS OPEN. IF FAULTY LIMIT SWITCH ALLOWS MOTOR TO CONTINUE DRIVING (REBOUNDING) AFTER VALVE STOPS THE MOTOR MAY BE RUINED.

(e) Remove bleed air overheat switch (490°F) from engine 1 pneumatic duct.
(f) Apply 500°F controlled heat to switch probe.

CAUTION: DO NOT HEAT PROBE ABOVE 550°F. IF PROBE IS HEATED ABOVE 550°F, IT MAY BE DAMAGED.

(g) Check that bleed air valve closes and after closing that valve motor stops; that BLEED TRIP OFF light on forward overhead panel, and MASTER CAUTION and AIR COND annunciation lights on lightshield panel illuminate.

CAUTION: VALVE MOTOR MUST STOP DRIVING AFTER VALVE CLOSES. IF FAULTY LIMIT SWITCH ALLOWS MOTOR TO CONTINUE DRIVING (REBOUNDING) AFTER VALVE STOPS THE MOTOR MAY BE RUINED.

(h) Remove controlled heat source from switch probe.
(i) Position LIGHTS switch on P2 panel to DIM and check that lights noted in step (g) dim.
(j) Position switch to BRT position and check that lights return to original brightness.
(k) Depress either MASTER CAUTION light and check that both MASTER CAUTION lights and the AIR COND annunciator light extinguish but the applicable BLEED TRIP OFF light on the P-5 panel remains illuminated.
(l) Depress either MASTER CAUTION annunciator and check that both MASTER CAUTION lights and all MASTER CAUTION annunciator lights illuminate, but when released only the MASTER CAUTION lights, and AIR COND annunciator light on lightshield panel remain illuminated
(m) Allow sufficient time for thermal switch probe to cool. Push TRIP RESET button on control panel, and check that BLEED TRIP OFF annunciator and all MASTER CAUTION annunciator lights extinguish and bleed air valve opens.
(n) Reinstall bleed air overheat switch (490°F) on duct.

(o) Position ENGINE 1 FIRE switch on aft electronic panel (P8) to FIRE and check that bleed air shutoff valve closes.
(p) Reposition FIRE SWITCH to NORMAL. Check that bleed air shutoff valve opens.
(q) Position ENGINE 1 BLEED SWITCH to OFF and check that valve closes.
(r) Repeat test for engine 2.

(4) Restore Airplane to Normal
(a) Remove electrical power if no longer required.
(b) Close right engine cowl.

C. Bleed Air Isolation Valve Test

(1) Prepare to Test Bleed Air Isolation Valve
(a) Open air conditioning bay doors.
(b) Provide electrical power.
(c) Check that the following circuit breakers are closed (P6).
1) MASTER CAUTION (all except FUEL, if installed)
2) INDICATOR LTS, MASTER DIM BUS (9 places)
3) DIM & TEST (1 place)

(2) Test Bleed Air Isolation Valve
(a) Position ISOLATION VALVE switch to AUTO and move pack switches and bleed switches to positions listed in the following table. Check that isolation valve moves to or stays in position noted.
(b) Position L. PACK, R. PACK and both BLEED switches to OFF and ISOLATION VALVE switch to CLOSE and check that isolation valve closes.
(c) Position L. PACK, R. PACK and both BLEED SWITCHES to ON and ISOLATION VALVE switch to OPEN and check that isolation valve opens.

(3) Restore Airplane to Normal Configuration
(a) Remove electrical power if no longer required.
(b) Close air conditioning equipment bay doors.

D. Bleed Air System Leakage Test - Time Pressure Drop Method

(1) General
(a) This task does not use any special equipment. The APU is used to supply pneumatic pressure to test whether the level of leakage from the bleed air system and precooler ducting are within acceptable limits.

(2) Prepare to Leak Test Bleed Air System
  (a) Provide electrical power.
  (b) Check that the following switches on the forward overhead panel are OFF:
    1) WING ANTI-ICE
    2) BLEED 1
    3) BLEED 2
    4) L PACK
    5) R PACK
    6) ENGINE START 1
    7) ENGINE START 2
  (c) Check that indicators on turbofan control valves are at CLOSE.
(3) Leak Test the Right Bleed Air System
  (a) On the forward overhead panel, position the APU BLEED switch to ON.
  (b) Check that the ISOLATION VALVE switch on the forward overhead panel is in the OPEN position.
  (c) Position the BLEED 2 switch on the forward overhead panel to ON.
  (d) Pressurize the pneumatic system with the APU.
  (e) When the bleed air duct pressure is stable, record the right duct pressure shown on the forward overhead panel.
  (f) Check that the right manifold is pressurized to a minimum of 20 psig.
  (g) At the same time on the forward overhead panel, position the ISOLATION VALVE switch to CLOSE and the APU BLEED switch to OFF.
  (h) Measure the time necessary for the right manifold duct pressure to decrease to 5 psi (INDICATOR END value) from one of the Duct Pressure Start values shown in the chart below.

PACK SWITCH POSITION	BLEED SWITCH POSITION	VALVE POSITION
L – R ON	1 – 2 ON	CLOSED
L OFF – R ON	1 – 2 ON	OPEN
L ON – R OFF	1 – 2 ON	OPEN
L – R ON	1 – 2 OFF	OPEN
L – R ON	1 – OFF – 2 ON	OPEN
L – R OFF	1 – 2 OFF	OPEN

(i) If the decay time is more than the MINIMUM PASS TIME, then the right bleed air system and precooler is satisfactory.
(j) If the decay time is less than the MINIMUM PASS TIME, then the right bleed air system and precooler is not satisfactory. Check all joints by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.
(k) Position the BLEED 2 switch on the forward overhead panel to OFF.

(4) Leak Test the Left Bleed Air System
(a) On the forward overhead panel, position the APU BLEED switch to ON.
(b) Position the ISOLATION VALVE switch on the forward overhead panel to OPEN.
(c) Position the BLEED 1 switch on the forward overhead panel to ON.
(d) Pressurize the pneumatic system with the APU.
(e) Position the ISOLATION VALVE switch on the forward overhead panel to CLOSE.
(f) When the bleed air duct pressure is stable, record the left duct pressure shown on the forward overhead panel.
(g) Check that the left manifold is pressurized to a minimum of 20 psig.
(h) At the same time on the forward overhead panel, stop the APU and position the APU BLEED switch to OFF.
(i) Measure the time necessary for the left manifold duct pressure to decrease to 5 psi (INDICATOR END value) from one of the Duct Pressure Start values shown in the chart below.

DUCT PRESSURE START (PSI)	INDICATOR END (PSI)	MINIMUM PASS TIME (SEC)
50	5	17
40	5	14
30	5	11
20	5	8

(j) If the decay time is more than the MINIMUM PASS TIME, then the left bleed air system and precooler is satisfactory.

(k) If the decay time is less than the MINIMUM PASS TIME, then the left bleed air system and precooler is not satisfactory. Check all joints by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.

(l) Position the BLEED 1 switch on the forward overhead panel to OFF.

(m) Position the ISOLATION VALVE switch on the forward overhead panel to AUTO.

(5) Restore the Airplane to Normal

(a) Stop the APU if necessary.

(b) Remove the pressure from the pneumatic system

(c) Remove electrical power if no longer required.

E. Engine Supply Ducts Leakage Test - Flow Rate Method

(1) Equipment and Materials

(a) Air source capable of delivering 10 pounds per minute at 120 +5 psig

NOTE: If there is no requirement to test pneumatic manifold pressure relief valve, an air source delivering four pounds per minute at 40 psig is sufficient.

(b) Pneumatic Duct Pressurization Plug Set, F80211-( )

(2) Prepare to Test Engine Supply Ducts

(a) Open engine cowl.

(b) Open ENGINES START VALVES circuit breaker (P6).

(c) Open AIR CONDITIONING BLEED AIR VALVE - L and R circuit breakers (P6).

(d) Remove engine bleed valve and insert fitting to apply air pressure into duct (Ref 36-11-11 R/I).

(e) Deleted.

(f) Provide electrical power (Ref 24-22-0 MP).

(3) Test Engine Supply Ducts
(a) Apply and maintain air pressure on system and check that leakage rate does not exceed rate corresponding to pressure applied (Fig. 501).

WARNING: SUDDEN PARTING OF VESSELS HIGHLY PRESSURIZED WITH AIR CAN ENDANGER LIFE AND PROPERTY.

(b) While pressure is applied, check all joints by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.
(c) Slowly increase pressure until pneumatic manifold pressure relief valve opens and check that pressure is not less than 85 psig.
(4) Restore Airplane to Normal
(a) Release pressure; disconnect air supply; and install engine bleed valve (Ref 36-11-11 R/I).
(b) Close circuit breakers opened in steps (2)(b) and (2)(c).

NOTE: Install engine bleed valve with special consideration given to proper mating due to the fact that individual tests may not be accomplished prior to airplane operation.

(c) Close engine cowl.
(d) Remove electrical power if no longer required.

F. Pneumatic Ducts Downstream from Engine Bleed Valves Leakage Test - Flow Rate Method
(1) General
(a) This test determines leakage rates between the APU and engine bleed valves and the pack valves. The pack installation leakage check determines leakage rates between the pack valves and both, the warm air supply duct check valve upstream of the main distribution manifold and just downstream of the ACM water separator.
(b) The air pressure source is common for both tests as are the closures of engine bleed valves, wing anti-ice valves and turbofan valves. The difference is that the pack valves are open for the pack installation leak check.
(2) Equipment and Materials
(a) Air source capable of delivering a minimum of 40 psig at 7.2 pounds per minute flow
(b) Pneumatic Duct Pressurization Plug Set, F80211-( )

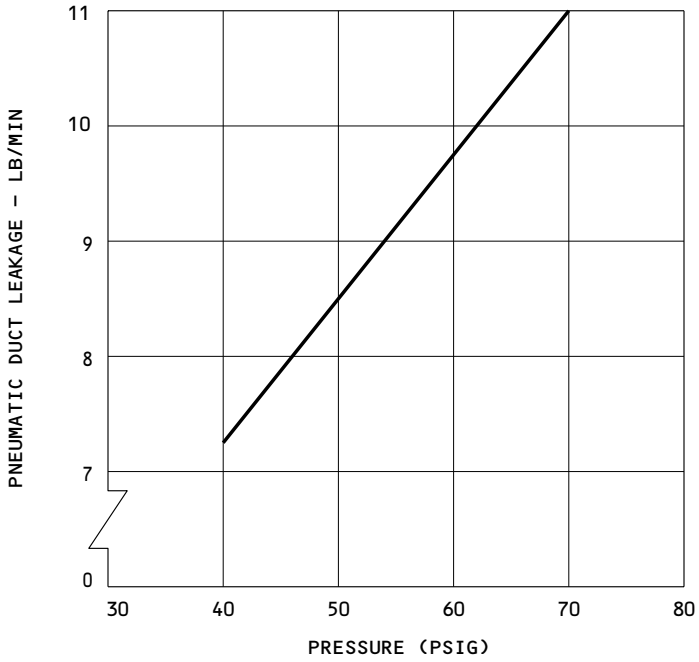
(3) Prepare to Test Pneumatic Ducts Downstream from Engine Bleed Valves
  (a) Provide electrical power.
  (b) Check that the following switches on the forward overhead panel are OFF:
    1) WING ANTI-ICE
    2) NO. 1 BLEED
    3) NO. 2 BLEED
    4) L PACK
    5) R PACK
    6) APU BLEED
  (c) On forward overhead panel, position ISOLATION VALVE switch to OPEN.
  (d) Check that turbofan control valve indicator is in CLOSE.
  (e) Install closure plates between right and left turbofan and turbofan supply ducts.
  (f) Gain access to APU relief valve by opening access panel 3701.
  (g) Remove APU duct relief valve and insert closure plug in duct boss.
  (h) Remove APU bleed air valve and cap upstream duct.
  (i) Install closure plug with air source fitting on inlet of APU bleed air duct.
(4) Test Pneumatic Ducts Downstream from Engine Bleed Valves
  (a) Apply and maintain air pressure on system and check that leakage rate does not exceed rate corresponding to pressure applied as shown on Fig. 501.

    WARNING: SUDDEN PARTING OF VESSELS HIGHLY PRESSURIZED WITH AIR CAN ENDANGER LIFE AND PROPERTY.

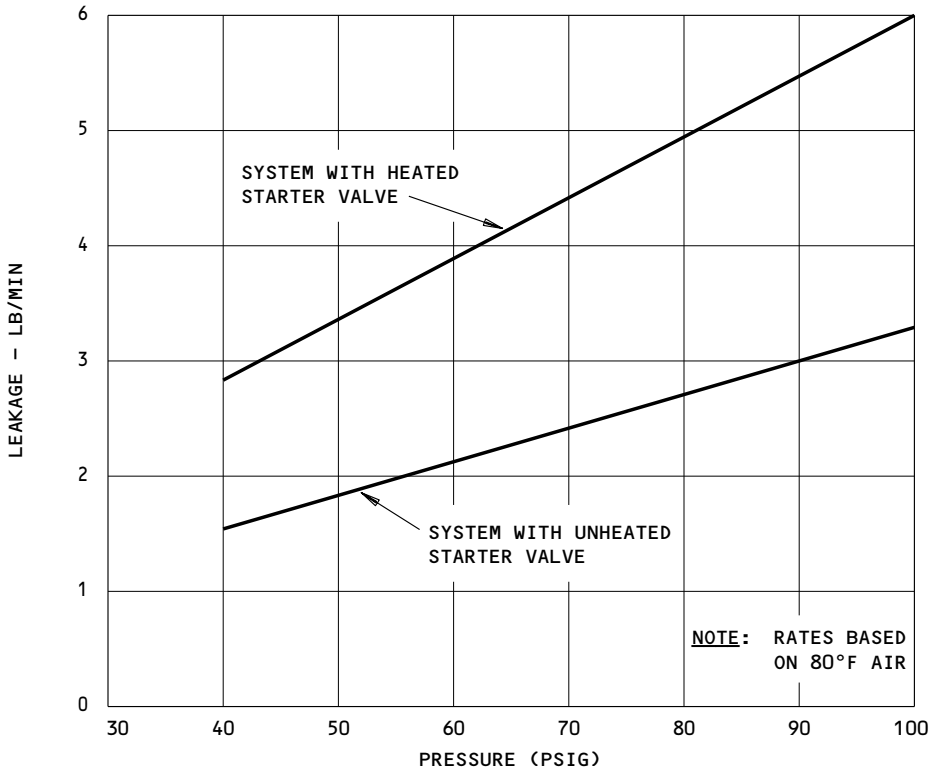
  (b) While pressure is applied, check all joints and connections by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.
(5) Restore Airplane to Normal
  (a) Release pressure, disconnect air supply, remove duct closure plates and connect turbofan supply ducts to turbofans.

    NOTE: All joints disturbed for testing shall be reassembled with special consideration given to mating and seals due to the fact that individual tests may not be accomplished prior to airplane operation.

  (b) Position isolation valve switch to AUTO.
  (c) Install access panel 3701.
  (d) Remove electrical power if no longer required.



Pneumatic Ducts Downstream from Engine Bleed Valve
Leakage Rate Chart
Figure 501



Engine Supply Ducts Leakage Rate Chart
Figure 501

G. Pack Installation Pneumatic Ducts Leakage Test - Flow Rate Method

(1) General

(a) This test will check leakage between the APU and engine bleed valves and both the warm air supply duct check valve upstream of the main distribution manifold and just downstream of the water separator.

(b) The air pressure source and the closures of engine bleed valves, wing anti-ice valves and turbofan valves is the same for this test as the previous test. The differences are that the pack valves will be opened and different blocking plates will be installed for the pack installation leak check.

(c) The allowable leakage rate for this test will be approximately 5.4 lb/min at 45 psig and 70° F with isolation valve closed, and 8.4 lb/min at 45 psig and 70°F with isolation valve open.

(2) Equipment and Materials

(a) Air source capable of delivering pressure to 50 psig at 10 pounds per minute flow

(b) Pneumatic Duct Pressurization Plug Set, F80211-( )

(3) Prepare to test pack installation pneumatic ducts.

(a) Open air conditioning equipment bay doors.

(b) Provide electrical power.

(c) Check that switches listed in 1.E.(3)(b) on overhead panel are OFF.

(d) On forward overhead panel, position ISOLATION VALVE switch to CLOSE.

(e) Check that indicators on turbofan control valves are at CLOSE.

(f) Check that pack flow control and shutoff valves indicators are at CLOSE.

(g) Remove turbofan valves electrical connectors and purge valve electrical connectors.

(h) Install closure plates on end flanges of check valves common to warm air supply ducts.

(i) Install closure plates at joints downstream of water separators.

(j) Open OVERHEAT circuit breaker (P6).

CAUTION: DO NOT OPEN CIRCUIT BREAKER UNTIL AFTER CLOSURE PLATES ARE INSTALLED AT WATER SEPARATOR AND HOT AIR DUCTS. HOT AIR ENTERING AIR CONDITIONING SYSTEM WITH AIR CONDITIONING SYSTEM OVERHEAT PROTECTION CIRCUIT DEACTIVATED COULD DAMAGE AIR CONDITIONING SYSTEM EQUIPMENT.

(k) Check that both air conditioning temperature selectors are at OFF.

(l) Position both PACK switches to ON.

(m) Hold each cabin temperature selector to MANUAL WARM until respective AIR MIX VALVE position indictor shows mix valve at approximately mid-position then release selector to OFF.
(n) Open access panel 3701. Remove APU relief valve from APU bleed air supply duct and insert closure plug in duct boss.
(o) Remove APU bleed air valve and install closure plug in upstream duct.
(p) Install closure plug, with air pressure fitting in APU bleed air duct.

(4) Test pack installation pneumatic ducts.
(a) Slowly pressurize ducts to 45 +3 psig and record leakage rate at 45 +3 psig.

WARNING: DO NOT INCREASE PRESSURE TOO FAST AND STAND CLEAR OF JOINTS AS PRESSURE IS APPLIED. SUDDEN PARTING OF PRESSURIZED VESSELS CAN ENDANGER PERSONNEL AND DAMAGE EQUIPMENT.

(b) Check that leakage rate does not exceed 5.4 pounds per minute.
(c) While pressure is applied, check all joints and connections by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.
(d) Repeat test for ducting of remaining pack.
(e) Position ISOLATION VALVE switch to OPEN.
(f) Check that leakage rate does not exceed 8.4 pounds per minute.
(g) While pressure is applied, check all joints and connections by feeling and listening. Diffused leakage is allowed at any joint; however, jet blasts are not permissible. Entire leakage allowed for duct joints should not be concentrated at one joint.

(5) Restore airplane to normal.
(a) Release pressure and disconnect air supply.
(b) Remove duct closure plates.
(c) Connect warm air supply ducts to check valves and water separators to their outlet ducts.
(d) Install APU relief valve and APU bleed air valve.

NOTE: All joints disturbed for testing shall be reassembled with special consideration given to mating and seals due to the fact that individual tests may not be accomplished prior to airplane operation.

(e) Install turbofan valve electrical connectors and purge valve electrical connectors.

(f) Close OVERHEAT circuit breaker and check that mix valve drives to full cold position.
(g) Position PACK switches to OFF.
(h) Install access panel 3701.
(i) Operate air conditioning packs and check disturbed joints for jet blast type leakage.
(j) Close air conditioning equipment bay doors.
(k) On airplanes with wheel well seal, place GEAR SEAL switch on panel P2 to NORMAL.
(l) Remove electrical power if no longer required.

PNEUMATIC DUCT INSULATION – APPROVED REPAIR

1. General
   A. CFR 14 Part 121.312 mandates that insulation material installed in the fuselage as a replacement after September 2, 2005 must meet the flame propagation requirements of CFR Part 25.856, effective September 2, 2003.
   B. Existing insulation material can be removed and re-installed if it is not damaged. Replacement insulation material must meet the flame propagation requirement.

      NOTE: Do not use BMS8-39 polyurethane foam insulation for repairs due to the degradation in flammability properties over time.

   C. Existing tape that does not meet the flame propagation requirement must be removed or completely covered with tape that meets the requirement.

2. Material
   A. Heat Resistant Fiberglass Batt - BMS 8-48 or ASTM-C800 (20-30-51)
   B. Film (Reinforced Heat Resistant Fiberglass) - AN4C (20-30-51) - Preferred
   C. Film (Reinforced Heat Resistant Fiberglass) - BMS 8-142 Type XI Grade 1 (20-30-51) - Alternate
   D. G50327, Tape - Insulation Blanket, BMS5-157, Type 1 (AMM 20-30-51).
   E. Mild Detergent (20-30-41)
3. Repair Damaged Duct
   A. Clean area to be repaired with clean cloths and solution of mild detergent and water. Rinse with cloths saturated with clean water and wipe dry.
   B. Cut insulation batt to extend beyond damaged area a minimum of 1.5 inches.
   C. Cut fiberglass film approximately 0.25 inch larger than insulation batt.
   D. Secure the insulation batt covered by the fiberglass film over the damaged area with insulation blanket tape. Apply tape around the duct, but do not crush repair insulation or existing insulation.

ENGINE BLEED AIR VALVE - REMOVAL/INSTALLATION

1. General
   A. The engine bleed air valve is provided to shut off bleed air from engine bleed to the main manifold.
   B. An engine bleed air valve is installed on the left side of each engine, downstream of the heat exchanger. The following procedure is applicable to each with any difference noted in the applicable step.
2. Remove Engine Bleed Air Valve (Fig. 401)
   A. Gain access to valve by opening left engine cowl.
   B. Open L or R BLEED AIR VALVES circuit breaker (P6-4).
   C. Remove electrical connector and bonding jumper from valve.
   D. Remove valve clamps.

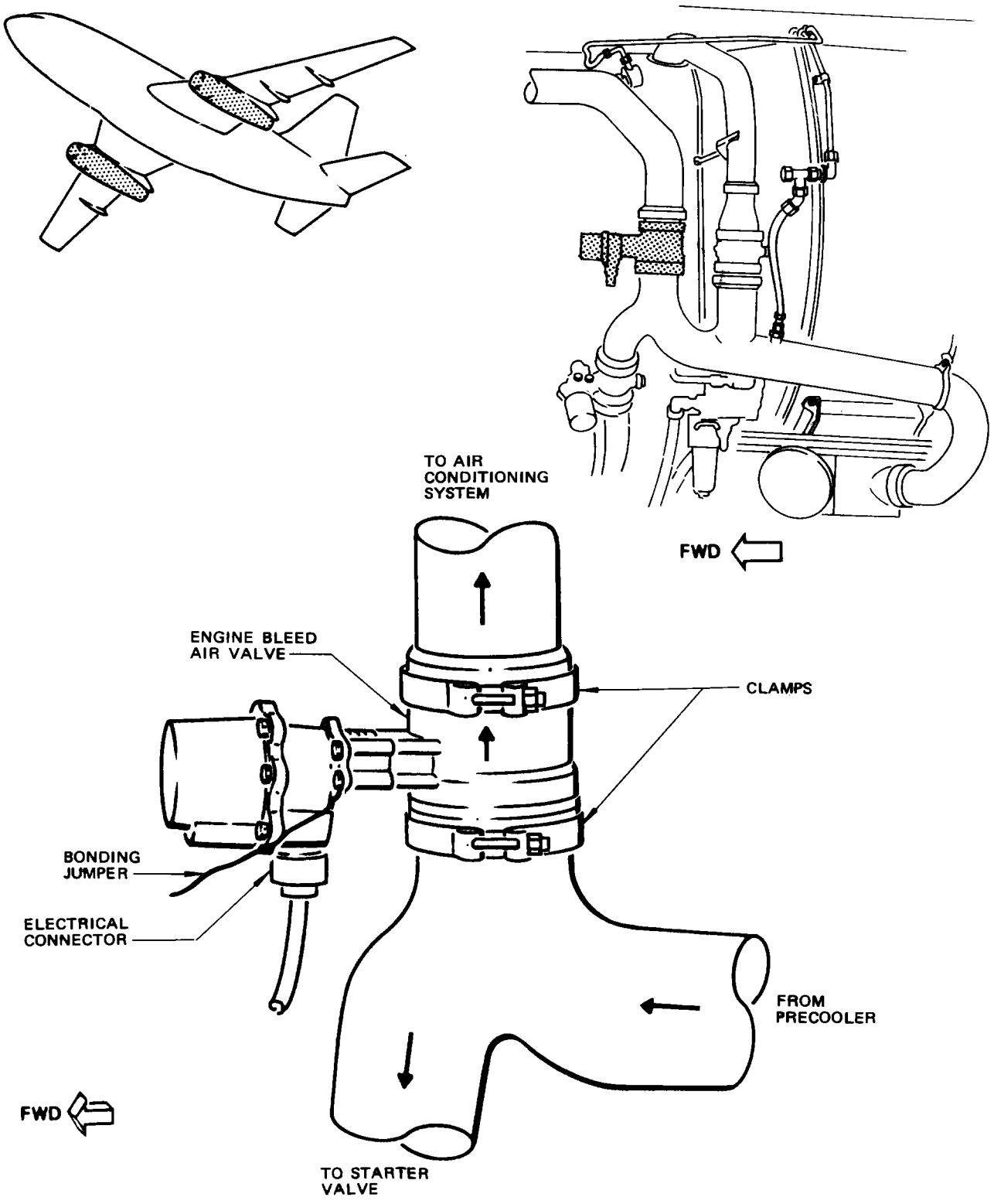
      WARNING: REMOVING DUCT CLAMPS WHILE AIR DUCTING IS PRESSURIZED MAY CAUSE PERSONNEL INJURY AND/OR EQUIPMENT DAMAGE.

   E. Remove valve.
3. Install Engine Bleed Air Valve (Fig. 401)
   A. Position valve in line with duct with flow arrow pointing upward. Loosely install clamps.
   B. Rotate valve as necessary to provide clearance with cowling, then tighten clamps.
   C. Check that bonding surfaces are clean then install bonding jumper.
   D. Install electrical connector.
   E. On valves with manual lock out feature, check that manual override knob is in the unlock position.

      NOTE: Some valves are equipped with a manual lockout feature associated with the manual override. On these valves the manual override knob must be rotated until the cross pin fits into the unlock groove to engage the valve motor (Ref manual override decal on valve actuator),

   F. Close circuit breaker opened in 2.B.
   G. Provide electrical power.
   H. Check that applicable engine fire switch is in NORMAL position.
   I. While observing position indicator at valve, move applicable engine BLEED switch to ON and check that valve opens.
   J. Move switch to OFF and check that valve closes.
   K. Pressurize pneumatic system by a ground pneumatic cart, an APU (Ref Chapter 49) or by engines (Ref Chapter 80).
   L. Move ISOLATION VALVE switch to OPEN.
   M. Move applicable engine BLEED switch to ON and check for leakage at engine bleed air valve duct clamps.
   N. Remove pneumatic system pressure if no longer required.

O. Remove electrical power if no longer required.
P. Close left engine cowl.



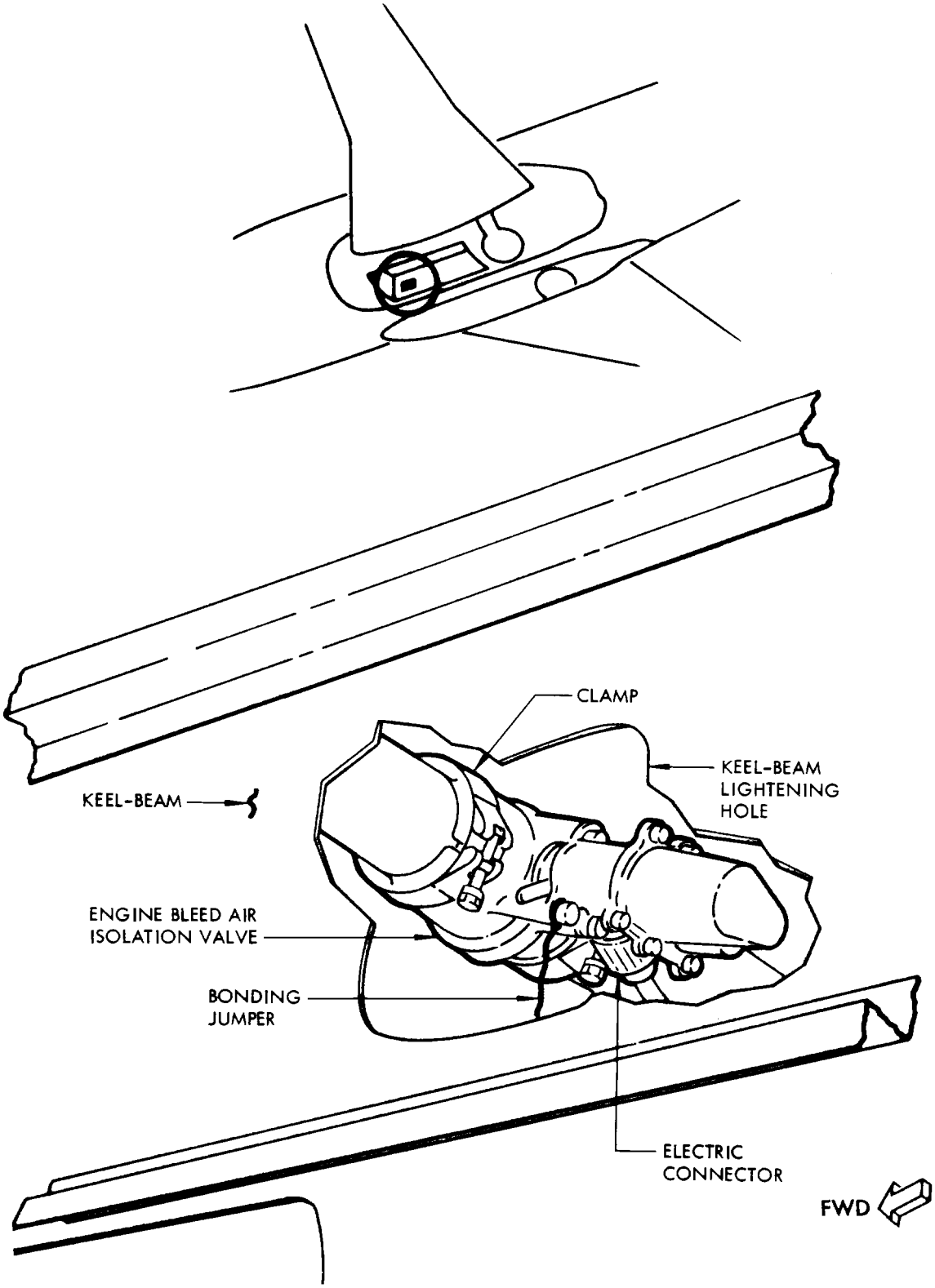
Engine Bleed Air Valve Installation
Figure 401

ENGINE BLEED AIR ISOLATION VALVE - REMOVAL/INSTALLATION

1. General
   A. The engine bleed air isolation valve is located in the pneumatic manifold position inside the keel-beam. Lightening holes are provided on the left and right side of the keel-beam to facilitate removal and installation of the valve (Fig. 401).
2. Remove Engine Bleed Air Isolation Valve (Fig. 401)
   A. Open air conditioning equipment bay doors to gain access to valve.
   B. Open BLEED AIR VALVES - ISOLATION circuit breaker (P6-4).
   C. Remove electrical connector and bonding jumper from valve.
   D. Remove duct clamps.

      WARNING: REMOVING DUCT CLAMPS WHILE AIR DUCTING IS PRESSURIZED MAY CAUSE PERSONNEL INJURY AND/OR EQUIPMENT DAMAGE.

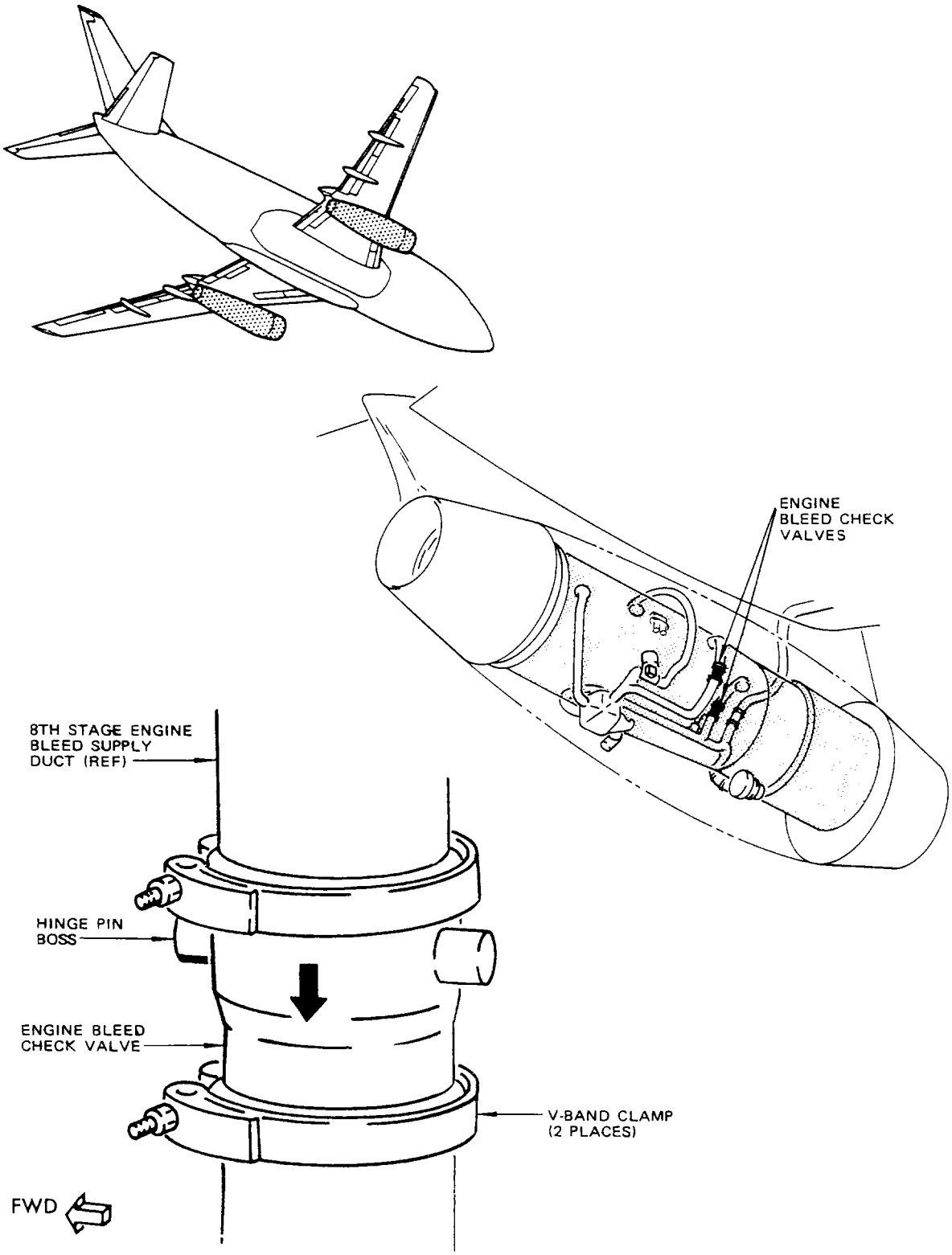
   E. Remove valve through lightening hole left side of keel-beam by rotating valve until flanges are horizontal, then work out with actuator trailing.
3. Install Engine Bleed Isolation Valve
   A. Check that valve bonding surface is clean then insert valve through left keel-beam lightening hole while observing through right keel-beam lightening hole. Locate valve between ducts so flow arrow is pointing to the right and rotate to position approximately as shown in Fig. 401.
   B. Tighten duct clamps.
   C. Check that bonding strap bonding surface is clean then install bonding strap.
   D. Install valve electrical connector.
   E. Close BLEED AIR VALVES - ISOLATION circuit breaker.
   F. Provide electrical power.
   G. Move ISOLATION VALVE switch to OPEN and check that isolation valve opens.
   H. Move ISOLATION VALVE switch to CLOSE and check that valve drives closed.
   I. Pressurize pneumatic system by a ground pneumatic cart, an APU (Ref. Chapter 49) or by engines (Ref Chapter 80).
   J. Check that both PACK switches are in OFF position.
   K. Move ISOLATION VALVE switch to AUTO and check for leakage at isolation valve duct clamps.
   L. Remove pneumatic system pressure if no longer required.
   M. Remove electrical power if no longer required.
   N. Close air conditioning equipment bay doors.



Engine BLeed Isolation Valve Installation
Figure 401

ENGINE BLEED CHECK VALVE - REMOVAL/INSTALLATION

1. General
   A. The engine bleed check valves prevents reverse flow of the high spool bleed air into the eighth stage engine port.
   B. The engine bleed check valves are mounted on the left and right side of each engine.
2. Remove Engine Bleed Check Valve
   A. Gain access to check valve by opening respective engine cowl.
   B. Remove V-band clamp from each end of valve body (Fig. 401).
   C. Remove check valve.
3. Install Engine Bleed Check Valve
   A. Deleted
   B. Position check valve between duct flanges with flow direction arrow pointing downstream and hinge pin bosses pointing forward and aft (Fig. 401).
   C. Install and tighten V-band clamps.
   D. Close engine cowl.



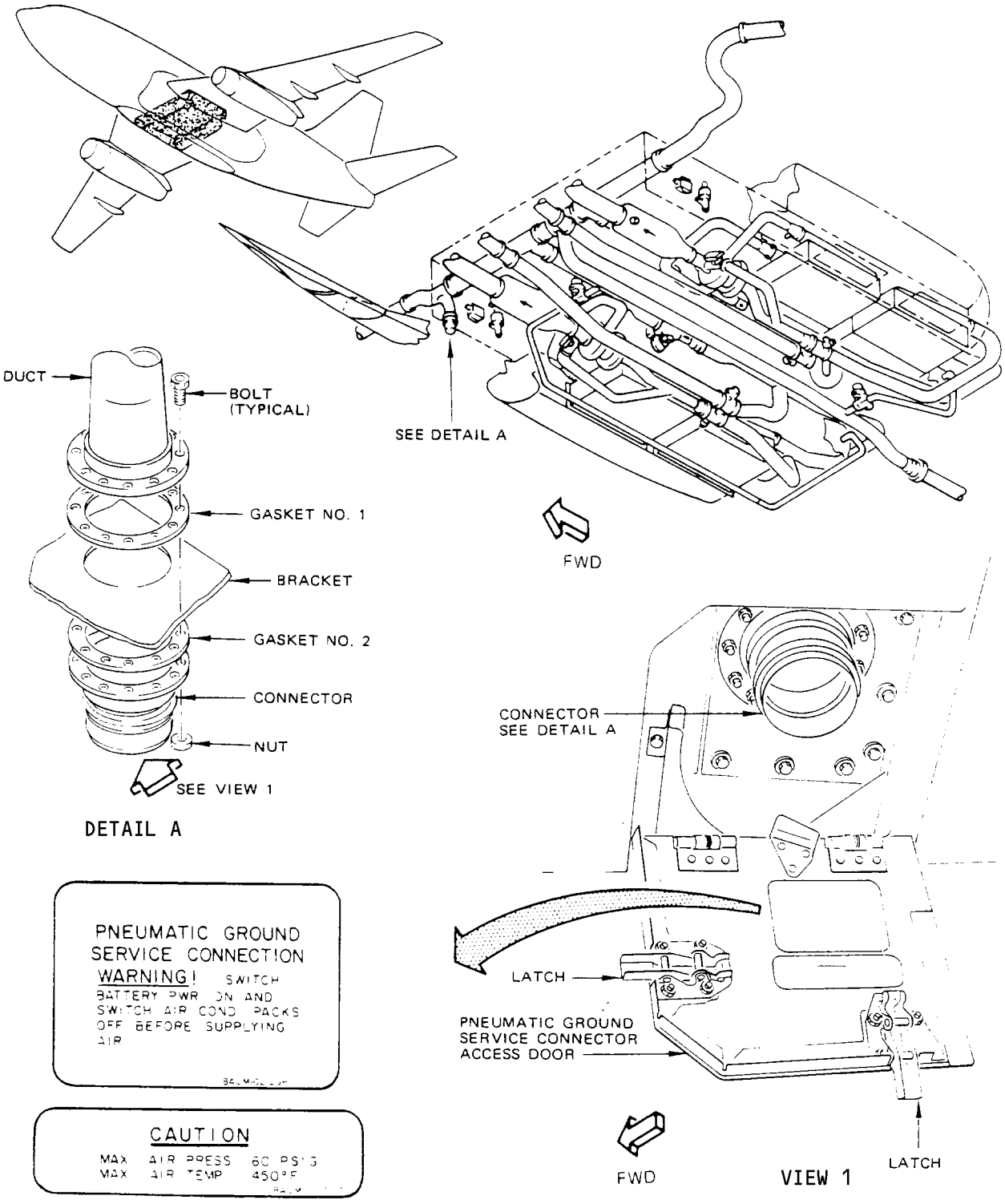
Engine Bleed Check Valve Installation
Figure 401

PNEUMATIC GROUND SERVICE CONNECTOR - REMOVAL/INSTALLATION

1. Remove Pneumatic Ground Service Connector
   A. Open pneumatic ground service connector access door. (See figure 401.)
   B. Remove attaching nuts.

      NOTE: Keep bolts in place to avoid misplacement or damage to gasket No. 1.

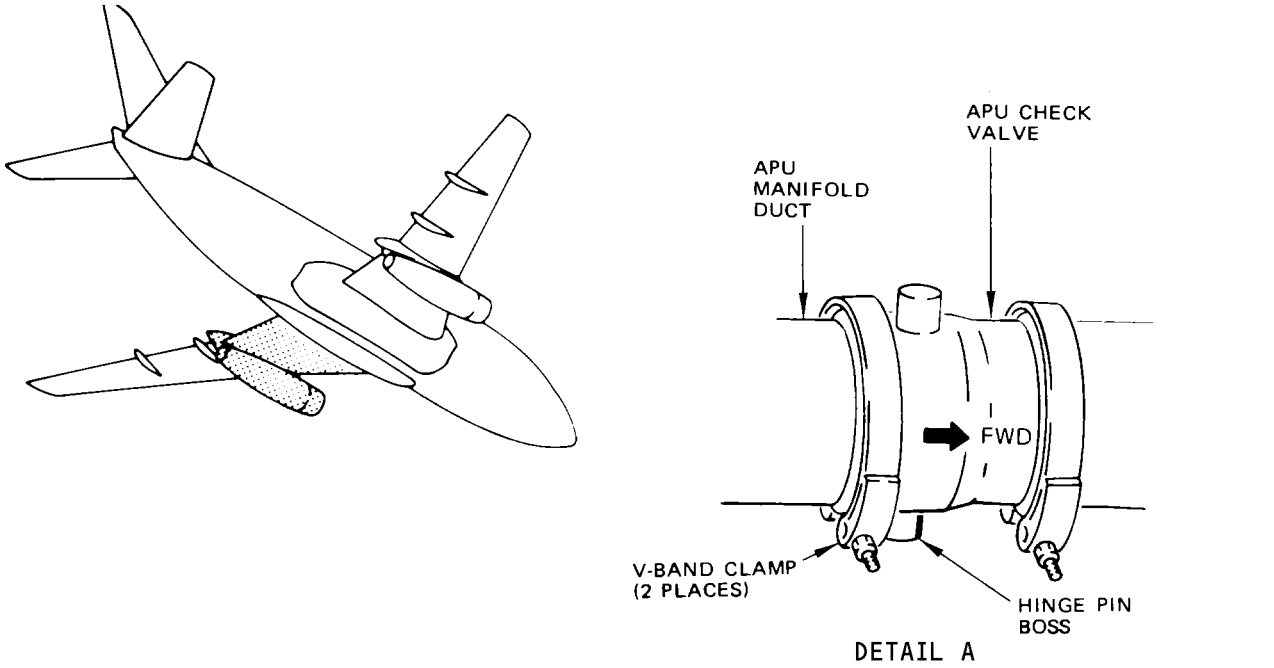
   C. Remove connector and gasket No. 2.
   D. Reinstall nuts loosely.
   E. Retain gasket No. 2 for installation.
2. Install Pneumatic Ground Service Connector
   A. Remove nuts, keeping bolts in place.
   B. Position gasket No. 2 and connector.
   C. Install and tighten nuts.
   D. Close access door.



Pneumatic Ground Service Connector Installation
Figure 401

APU CHECK VALVE - REMOVAL/INSTALLATION

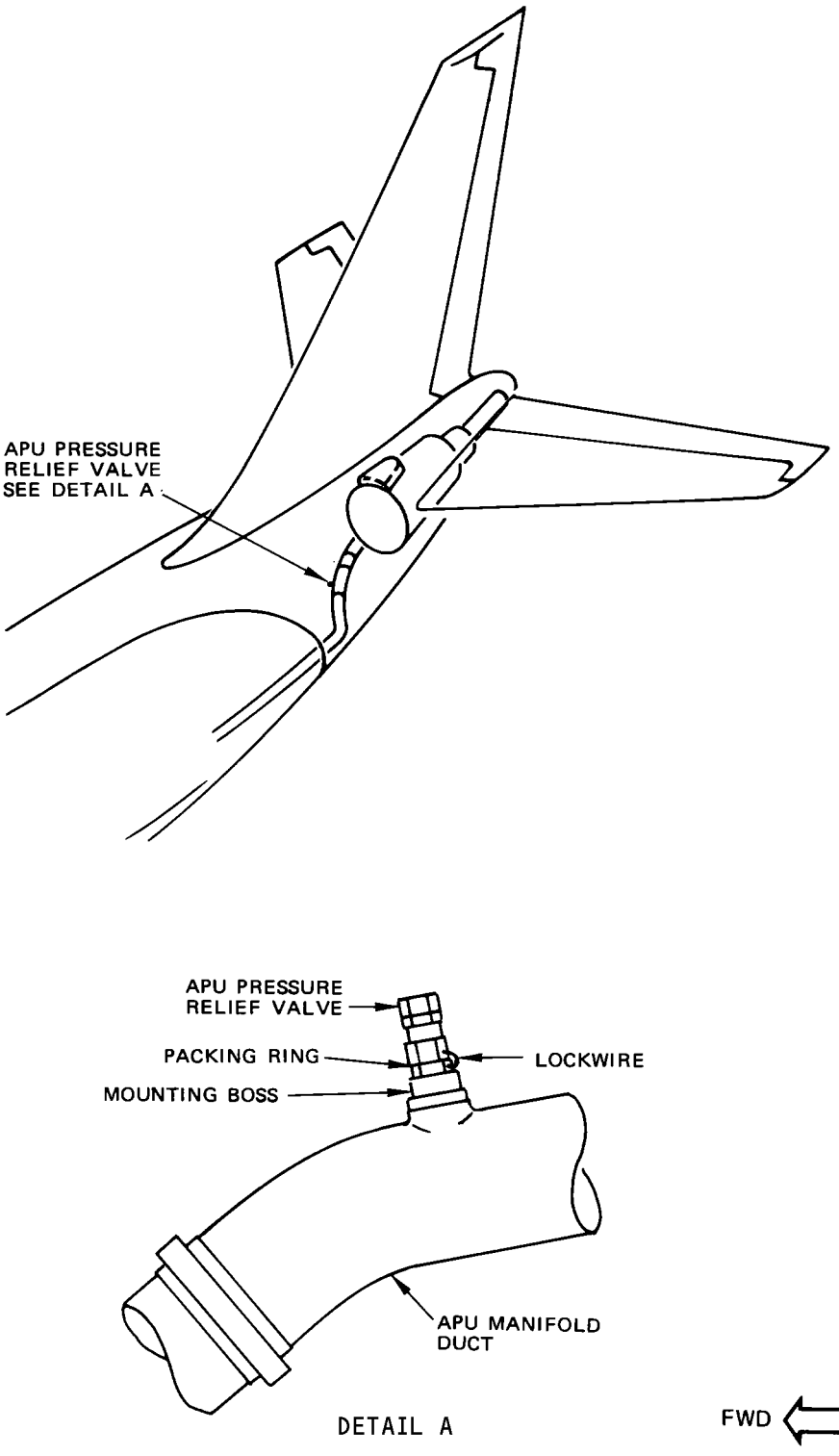
1. Remove Valve (Fig. 401)
   A. Open air conditioning equipment bay doors to gain access to APU check valve.
   B. Remove both V-band clamps and check valve from APU manifold duct.
2. Install Valve (Fig. 401)
   A. Position APU check valve on duct with flow arrow pointing downstream.
   B. Install V-band clamps and torque nuts from 45 to 55 pound-inches.
   C. Close air conditioning equipment bay doors.



APU Check Valve Installation
Figure 401

APU PRESSURE RELIEF VALVE - REMOVAL/INSTALLATION

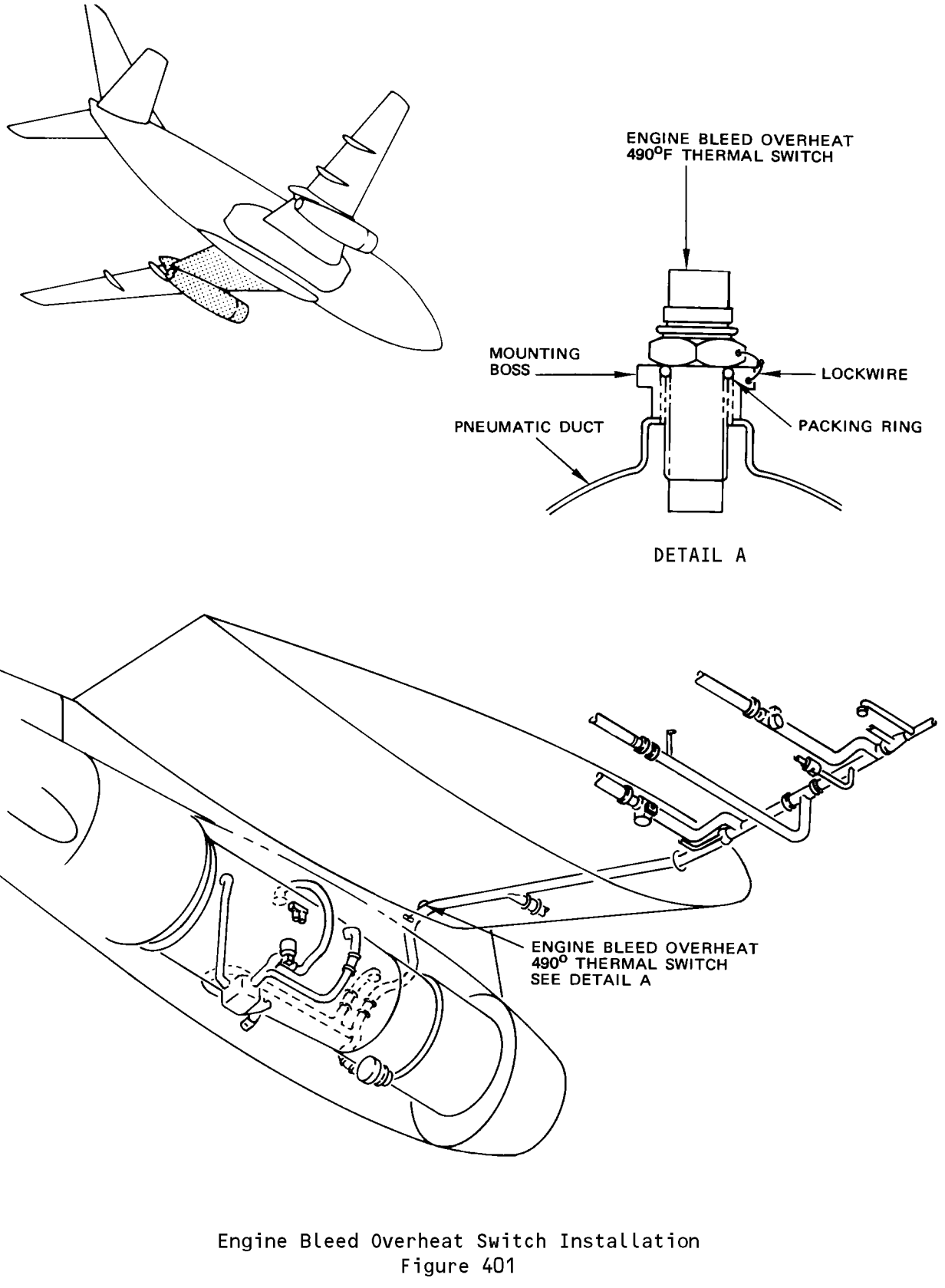
1. Remove Valve (Fig. 401)
   A. Open access panel 3701 to gain access to APU pressure relief valve.
   B. Remove lockwire.
   C. Unscrew valve and remove with packing ring from mounting boss on APU manifold duct.
2. Install Valve (Fig. 401)
   A. Replace packing ring on APU pressure relief valve.
   B. Screw valve into mounting boss on duct, tighten and lockwire.
   C. Close access panel.



APU Pressure Relief Valve Installation
Figure 401

ENGINE BLEED OVERHEAT SWITCH - REMOVAL/INSTALLATION

1. General
   A. The engine bleed overheat 490°F thermal switch is located on a pneumatic duct downstream of the engine bleed air valve. Access to the switch is through a wing upper surface access door.
2. Prepare for Removal of Switch
   A. Open OVERHEAT circuit breaker on load control center circuit breaker panel P6.
   B. Open access door 6301 to gain access to overheat switch.
3. Remove Switch (Fig. 401)
   A. Disconnect electrical connector from overheat switch.
   B. Remove lockwire.
   C. Unscrew switch and remove with packing ring from mounting boss on duct.
4. Install Switch (Fig. 401)
   A. Replace packing ring on overheat switch.
   B. Screw switch into mounting boss on duct, tighten and lockwire.
   C. Connect electrical connector to 490°F overheat switch.
   D. Close access door.



Engine Bleed Overheat Switch Installation
Figure 401

ENGINE BLEED OVERHEAT SWITCH - ADJUSTMENT/TEST

1. General
   A. The engine bleed overheat 490°F thermal switch is located on a pneumatic duct downstream of the engine bleed air valve. A temperature calibrated heat source is required to operationally test the bleed overheat switch.
2. Equipment and Materials
   A. Controlled Heat Source - Temp Cal probe heater (attachment to Jet Cal engine analyzer) or equivalent
3. Prepare to Test Overheat Switch
   A. Open OVERHEAT circuit breaker on load control center circuit breaker panel P6.
   B. Open access door 6301 to gain access to overheat switch.
   C. Disconnect electrical connector from overheat switch.
   D. Remove lockwire.
   E. Unscrew switch and remove with packing ring from mounting boss on duct.
   F. Connect electrical connector to 490°F overheat switch.
4. Test Overheat Switch Operation
   A. Connect external electrical power.
   B. Close OVERHEAT circuit breaker on load control center circuit breaker panel P6.
   C. Push-to-test BLEED TRIP OFF light for the 490°F overheat switch.
   D. Apply controlled heat of approximately 500°F to thermal switch probe and observe that the BLEED TRIP OFF light on forward overhead panel, and MASTER CAUTION and AIR COND annunciator lights on lightshield panel come on.

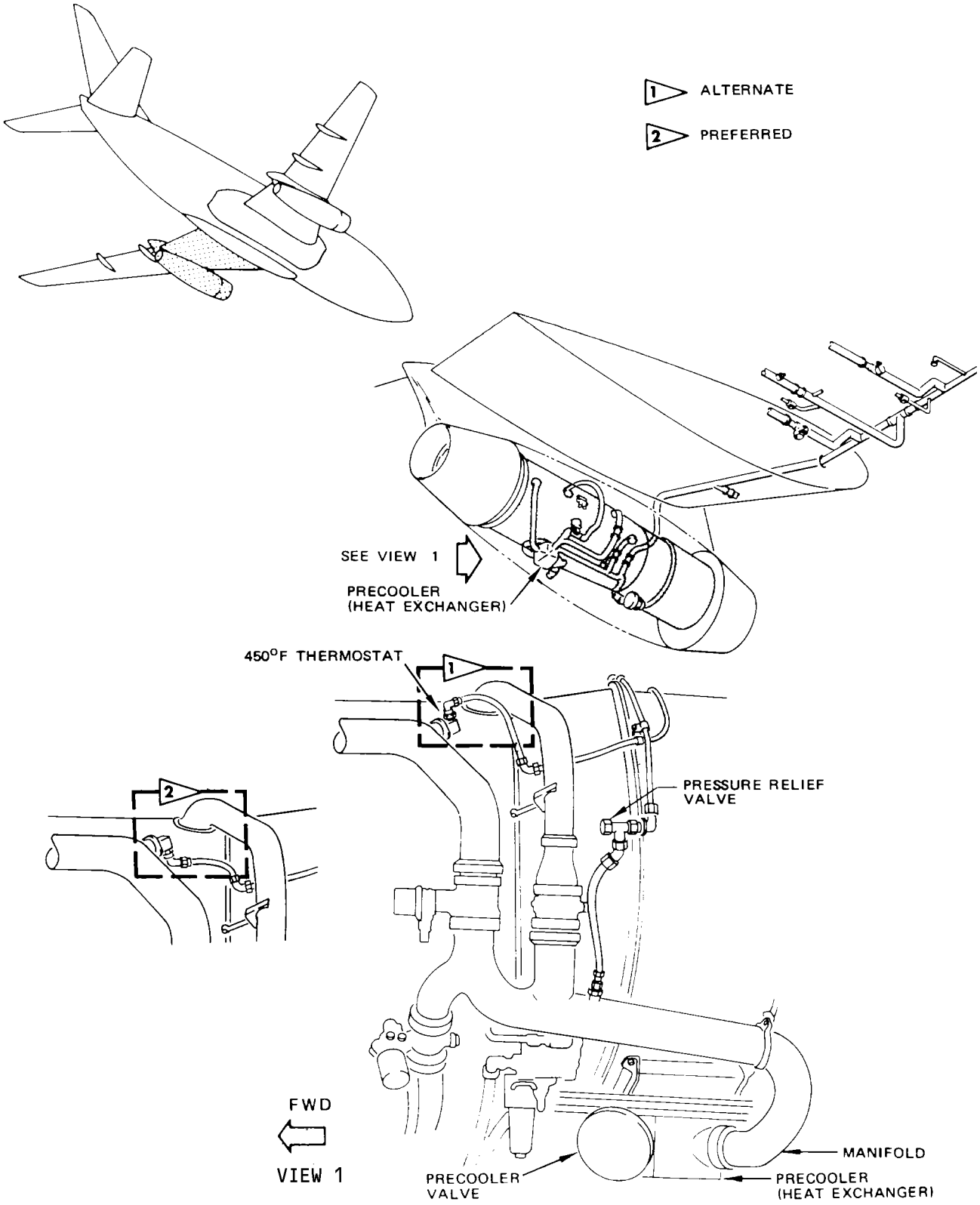
      CAUTION: DO NOT HEAT PROBE ABOVE 550°F. TEMPERATURE ABOVE 550°F MAY RUIN THE SWITCH.

      NOTE: Duct overheat lights should illuminate at a probe temperature of approximately 490°F.

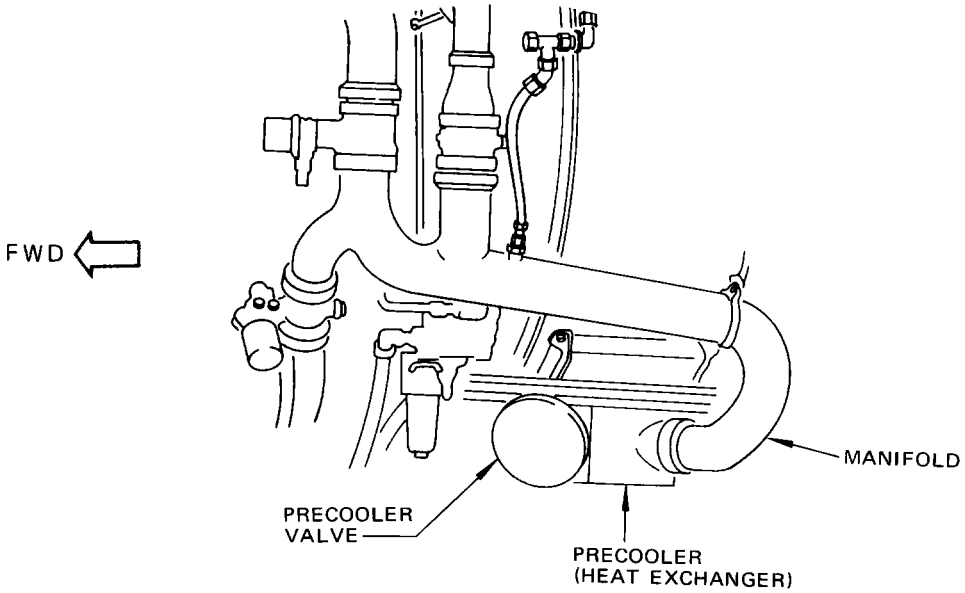
   E. Remove the heat source.
   F. Allow sufficient time for the switch probe to cool, then push the TRIP RESET button.
      (1) Check that BLEED TRIP OFF light and all MASTER CAUTION annunciator lights go out.
   G. If no longer required, remove electrical power from airplane.
   H. Install packing ring on overheat switch.
   I. Screw switch into mounting boss on duct, tighten and lockwire.
   J. Close access door.

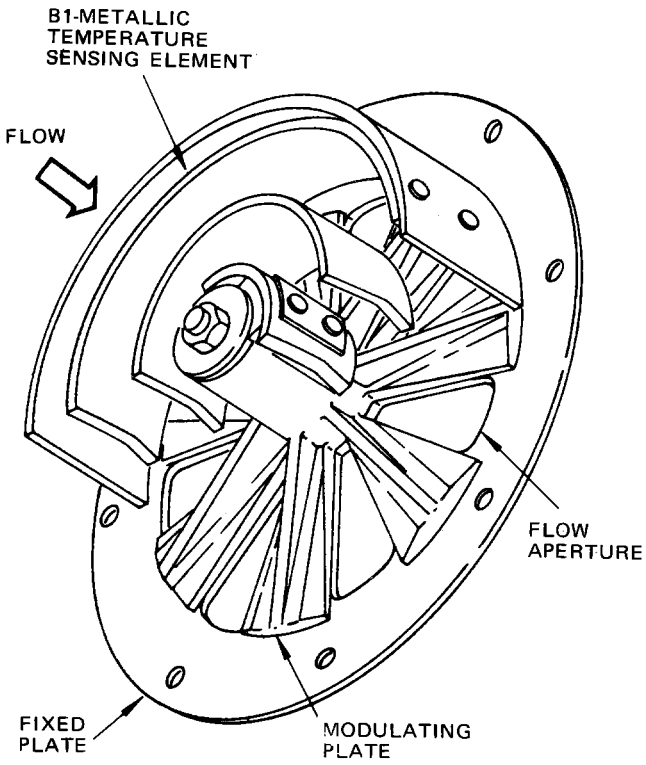
BLEED AIR PRECOOLER SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The purpose of the bleed air precooler system is to reduce the temperature of the high pressure bleed air which is supplied to the manifold system to approximately 370°F. Two precooler systems are provided, one for engine No. 1 and one for engine No. 2. Each precooler system consists of an air-to-air heat exchanger, and a five-inch-diameter precooler valve. (See figure 1.)
2. Heat Exchanger
   A. The air-to-air heat exchanger located below each engine is of the plate-fin single pass crossflow type. The heat collected from the hot air ducted from the engine, is absorbed by the cool air ducted from the fan. The cooling air is then discharged overboard after passing through the precooler valve.
3. Precooler Valve
   A. The precooler valve is attached to the discharge port of the heat exchanger. (See figure 2.) The purpose of the valve is to control the flow of cooling air through the heat exchanger to regulate the temperature of the bleed air. The unit modulates the area as a function of temperature. Temperature modulation is obtained through a fixed plate containing several apertures, and a moving plate of similar construction. The moving plate is positioned by a bi-metalic element so that the openings in the modulating plate coincide with those in the fixed plate at high temperature and the solid portions cover the holes at low temperature. The area changes linearly between open and closed as the temperature decreases.
4. Operation
   A. Temperature control of the bleed air is accomplished with an air-to-air heat exchanger, which uses engine fan bleed air as a cooling medium. A precooler valve limits the temperature of the air in the downstream ducts to approximately 450°F. A large part of the 8th-stage bleed air bypasses the heat exchanger in order to keep the bleed air pressure drop to a minimum. The 8th-stage air cannot completely bypass the heat exchanger because there may be times when 8th-stage bleed air temperature exceeds 450°F and can reach a maximum of 520°F (Fig. 3).

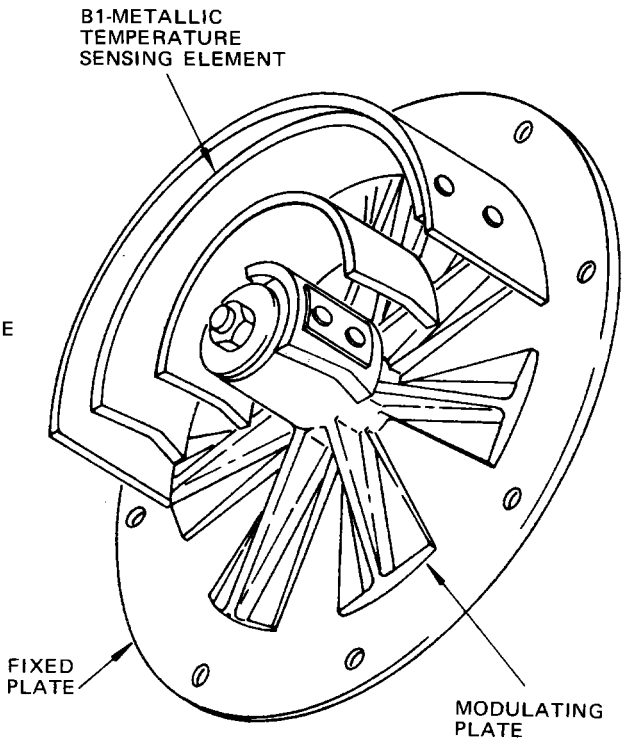


Bleed Air Precooler System Component Location
Figure 1





VALVE - OPEN

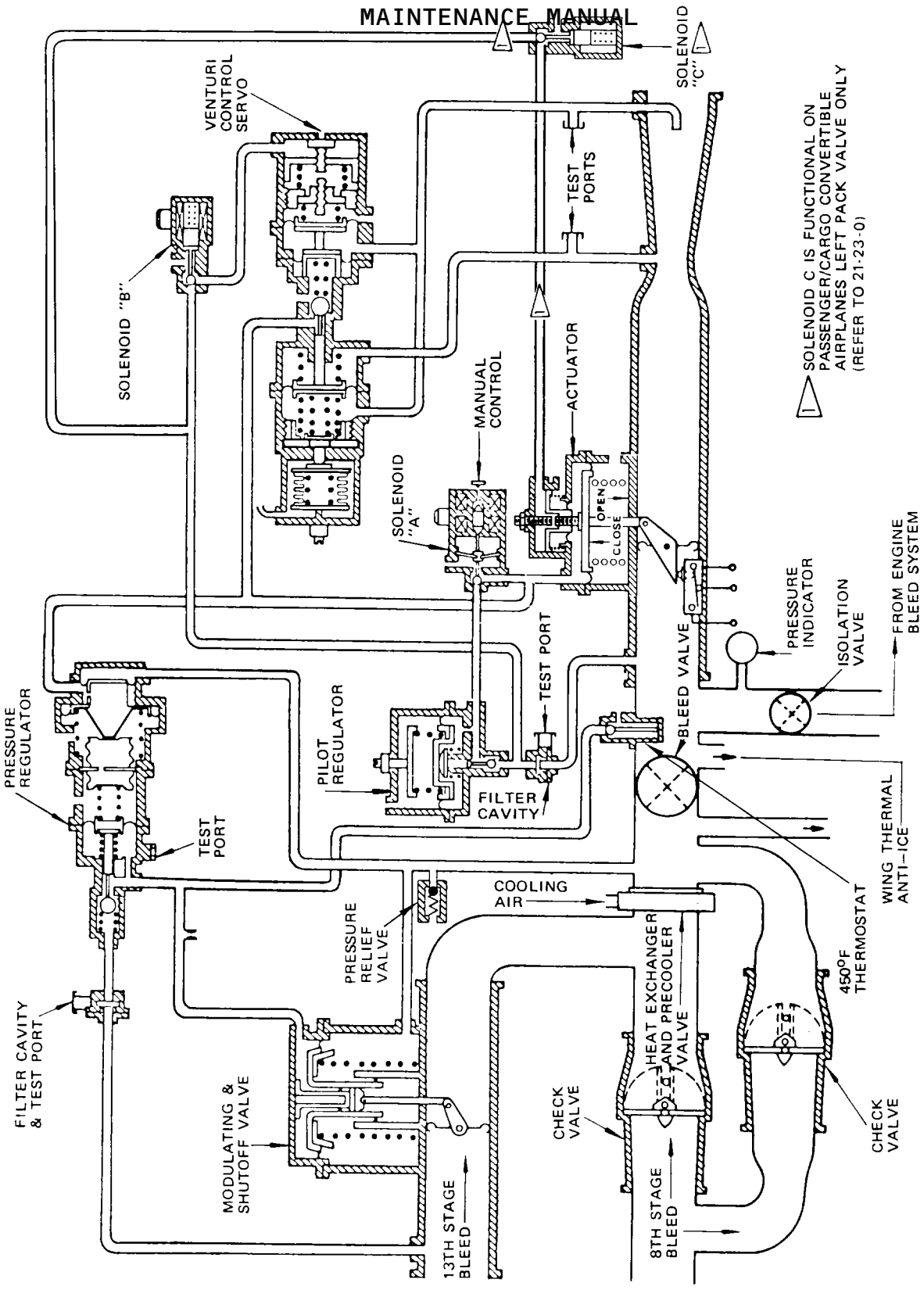


VALVE - CLOSE

Precooler Valve
Figure 2

B. Regulation of the cooling airflow through the precooler valve is provided by a self-contained thermostatic valve in the air discharge duct. This valve is actuated by a bimetallic strip which positions the moving element in response to the sensed temperature. The precooler valve is fully closed at a temperature of 365°F or less and fully open at a temperature of 440°F or more. Under some conditions of high airflow demand when both the air conditioning and wing TAI systems are using 13th-stage bleed air the capacity of the precooler valve is exceeded and duct air temperatures could reach as much as 550°F. The overheat trip system is set at 490°F. A 450°F limit control is provided to avoid tripouts. This thermostat is located in the bleed air duct downstream of the precooler valve. Whenever the temperature sensed by the thermostat exceeds 450°F it starts to bleed off the control pressure in the sense line to the 13th-stage modulating and shutoff valve and the 13th-stage pressure regulator. The reduction in control pressure causes the 13th-stage modulating and shutoff valve to modulate towards the closed position thereby reducing the total bleed airflow through the precooler. For detailed description and location of 450°F thermostat refer to Engine Bleed Air Compression Control System, 21-00-0.

C. Duct overheat protection is provided by a thermal switch located downstream of the precooler. If the sensed temperature at the switch exceeds 490 +10°F for more than 15 seconds the switch closes, causing the bleed valve to close and energizing the appropriate trip-off light on the flight crew's panel. The bleed air shutoff valve is also controllable from the flight deck and may be reset in flight after a trip-off, once the thermal switch has cooled and reopened.



Bleed Air Precooler System Schematic
Figure 3

BLEED AIR PRECOOLER SYSTEM - TROUBLESHOOTING

1. Bleed Air Precooler System Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Bleed air temperature above 450°F	Bleed air precooler valve failure	With engine idle and PACK switch OFF, visually make sure that precooler valve is closed. With engine speed increased to 1.5 EPR and PACK switch ON, visually make sure that precooler valve is full open.	Replace bleed air precooler valve (AMM 36-12-31)
	Bleed air heat exchanger airflow blocked	With precooler valve full open, make sure that bleed air temperature is below 450°F.	Replace bleed air heat exchanger (AMM 36-12-21)

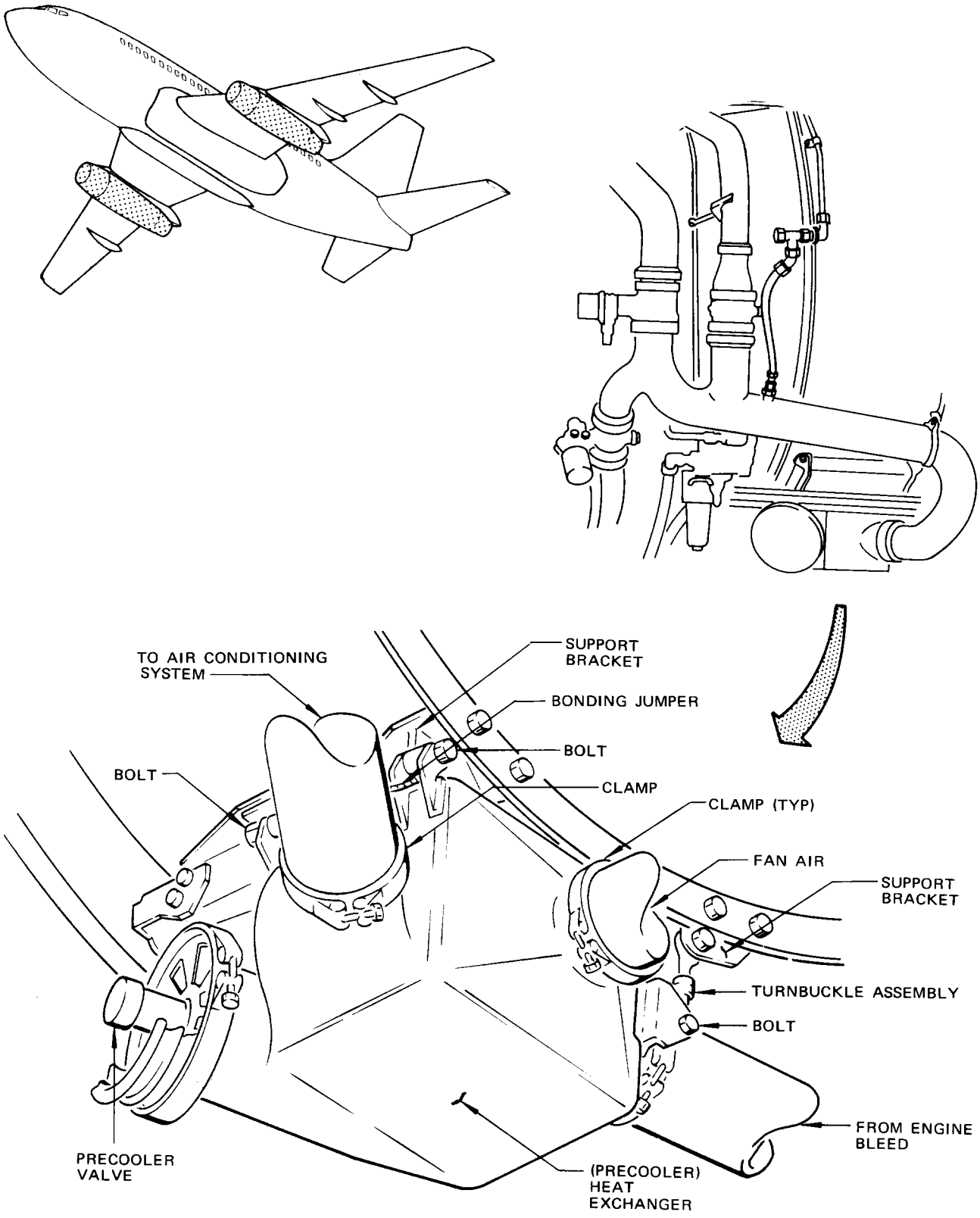
1. Bleed Air Precooler System Test
   A. General
      (1) The bleed air precooler system reduces temperature of high pressure bleed air supplied to the main pneumatic manifold. During ground operation, the bleed air precooler valve is not likely to open without operating the respective engine to near takeoff thrust. Since the precooler valve has proven to be extremely reliable in service and to minimize fuel consumption during testing it is recommended that valve be removed from airplane and be bench checked if a malfunction is suspected.
      (2) A visual check that the valve does close while performing the Bleed Air Compression Control System - Adjustment/Test (21-11-0) should verify that precooler system is functioning normally.
      (3) A bench check of the valve after a report of bleed air overheat will confirm or eliminate the precooler valve as cause of overheat.
      (4) The bleed air precooler system leakage test requires only an original inspection of the duct joints and support clamps for proper installation due to the low duct pressure involved.

BLEED AIR HEAT EXCHANGER - REMOVAL/INSTALLATION

1. General
   A. The heat exchanger reduces the temperature of bleed air supplied to the main manifold and is located below each engine.
2. Prepare Bleed Air Heat Exchanger for Removal (See figure 401.)
   A. Gain access to heat exchanger by opening left and right engine cowls.
   B. Remove bleed air precooler valve from discharge port of heat exchanger. See Bleed Air Precooler Valve Removal/Installation, 36-12-31.
   C. Retain precooler valve and cowl seal for installation on new heat exchanger.
3. Remove Bleed Air Heat Exchanger (See figure 401.)
   A. Disconnect bonding jumper.
   B. Remove the three clamps that connect heat exchanger to ducts.
   C. Disconnect two turnbuckle assemblies from brackets by removing lower bolts.
   D. Disconnect two bolts from supporting brackets.
   E. Remove heat exchanger.
4. Install Bleed Air Heat Exchanger (See figure 401.)
   A. Position heat exchanger on support brackets.

      NOTE: Adjust turnbuckles, if required, to align ducts with heat exchanger.

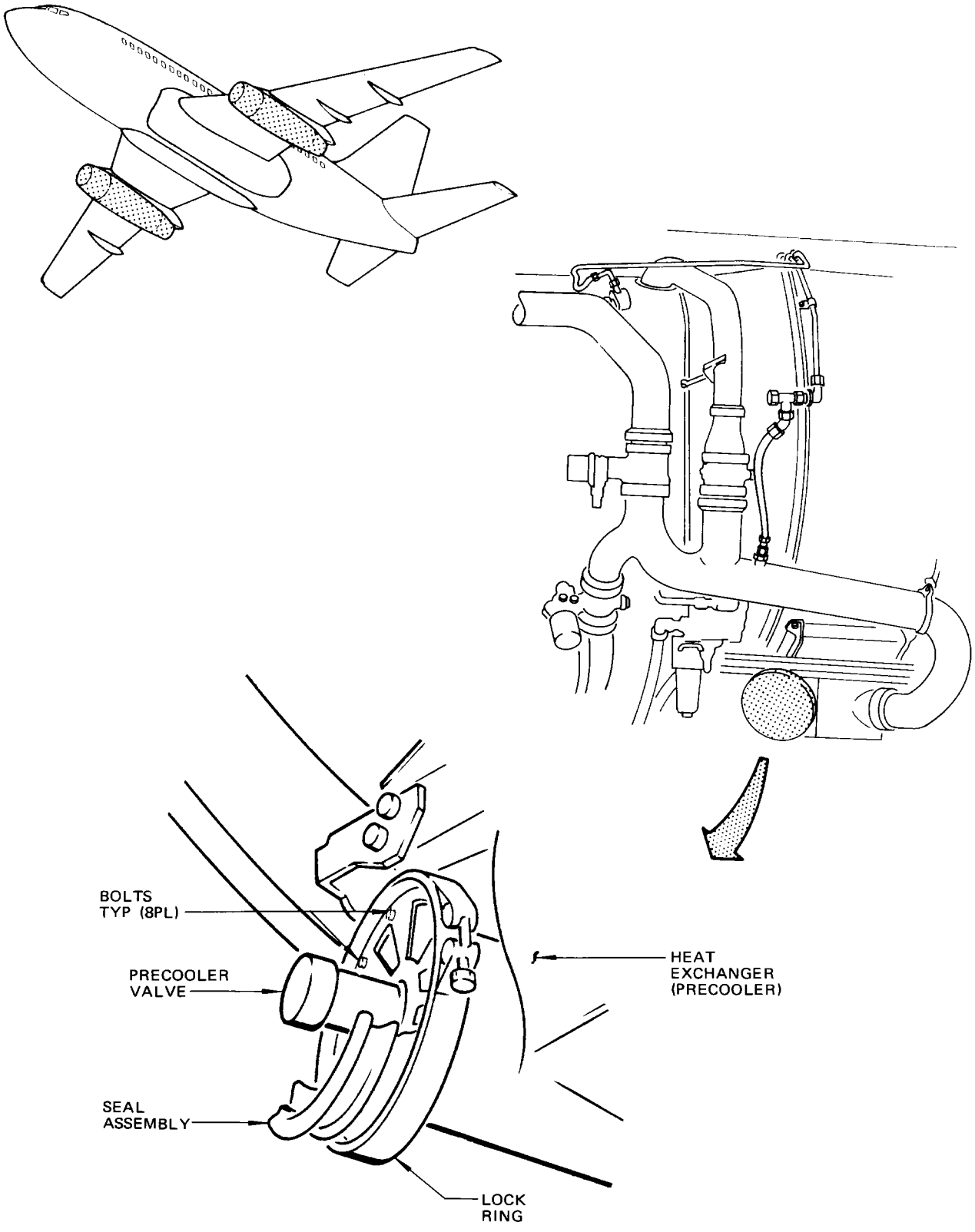
   B. Install two bolts through support brackets.
   C. Install two bolts through brackets and turnbuckle assemblies.
   D. Fasten the three clamps that connect heat exchanger to ducts.
   E. Install bonding jumper.
5. Restore Airplane to Normal Configuration
   A. Reinstall bleed air precooler valve and seal assembly. See Bleed Air Precooler Valve Removal/Installation, 36-12-31.
   B. Close left and right engine cowls.



Bleed Air Heat Exchanger Precooler Installation
Figure 401

BLEED AIR PRECOOLER VALVE - REMOVAL/INSTALLATION

1. General
   A. The precooler valve controls the flow of cooling air through the heat exchanger to regulate bleed air temperature.
   B. The precooler valve is attached to the discharge port of the heat exchanger.
2. Remove Precooler Valve (See figure 401.)
   A. Gain access to valve by opening left engine cowl.
   B. Remove seal assembly by removing lockring and retain for installation.
   C. Remove eight bolts from valve.
   D. Remove valve.
3. Install Precooler Valve (See figure 401.)
   A. Locate valve such that bolt holes align with gasket and discharge port of heat exchanger.
   B. Install eight bolts.
   C. Install seal assembly.
   D. Install lockring.
   E. Test valve operation. Refer to Bleed Air Precooler System - Adjustment/Test, 36-12-0.
   F. Close left engine cowl.



Bleed Air Precooler Valve Installation
Figure 401

450°F THERMOSTAT - REMOVAL/INSTALLATION

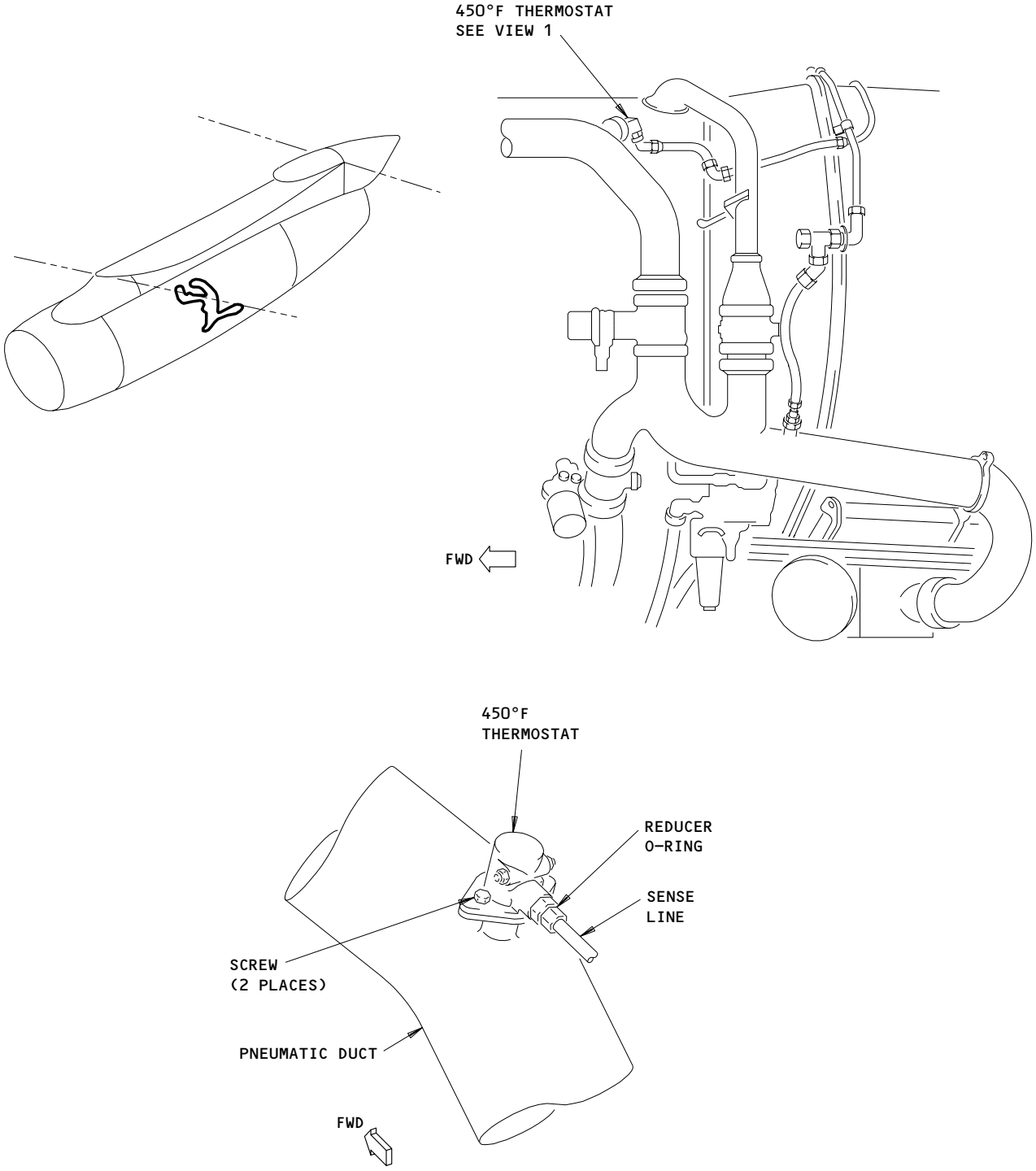
1. General
   A. The 450°F thermostat is mounted on the left side of each engine in the manifold duct, adjacent to the 8th-stage engine port. Access is through the left engine cowling panel.
2. Prepare to Remove the 450°F Thermostat
   A. Remove the pressure from the pneumatic system.
   B. Open the BLEED AIR VALVES circuit breaker on the P6 panel and attach a DO-NOT-CLOSE tag.
   C. Attach a DO-NOT-OPERATE tag to the following switches on the P5 panel:
      (1) BLEED 1
      (2) BLEED 2
      (3) APU BLEED
   D. Remove the side removable cowl panels (AMM 71-11-11/401).
   E. Remove the engine-to-wing forward fairing (AMM 54-51-11/401).
   F. Remove the fixed fairing (AMM 71-11-21/401).
3. Remove the 450°F Thermostat (Fig. 401)
   A. Disconnect the sense line and the reducer from the thermostat, and discard the O-ring.
   B. Remove the screws (2 locations) which hold the thermostat to the duct.
   C. Remove the thermostat from the duct.
   D. Put a cover over the opening on the duct to keep out unwanted material.
4. Install the 450°F Thermostat (Fig. 401)
   A. Install the O-ring and the reducer on the thermostat.
   B. Remove the cap from the sense line.
   C. Remove the cover from the opening on the duct.
   D. Make sure there is packing on the thermostat.
   E. Use the screws (2 locations) to attach the thermostat to the pneumatic duct.

      NOTE: Do not tighten the screws at this time.

   F. Apply a thin layer of antiseize compound to the external threads of the sense line/450°F thermostat coupling.
   G. Connect the sense line to the thermostat.

      NOTE: Do not tighten the sense line at this time.

   H. Tighten the screws (2 locations) which connect the thermostat to the pneumatic duct.
   I. Tighten the sense line.
5. Restore Airplane to Normal Configuration
   A. Install the fixed fairing (AMM 71-11-21/.401).
   B. Install the engine-to-wing forward fairing (AMM 54-51-11/401).
   C. Install the side removable cowl panels (AMM 71-11-11/401).

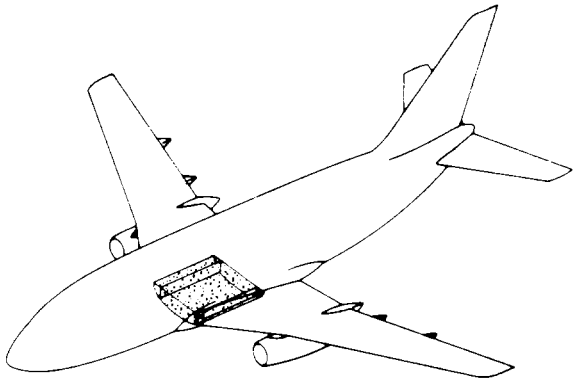


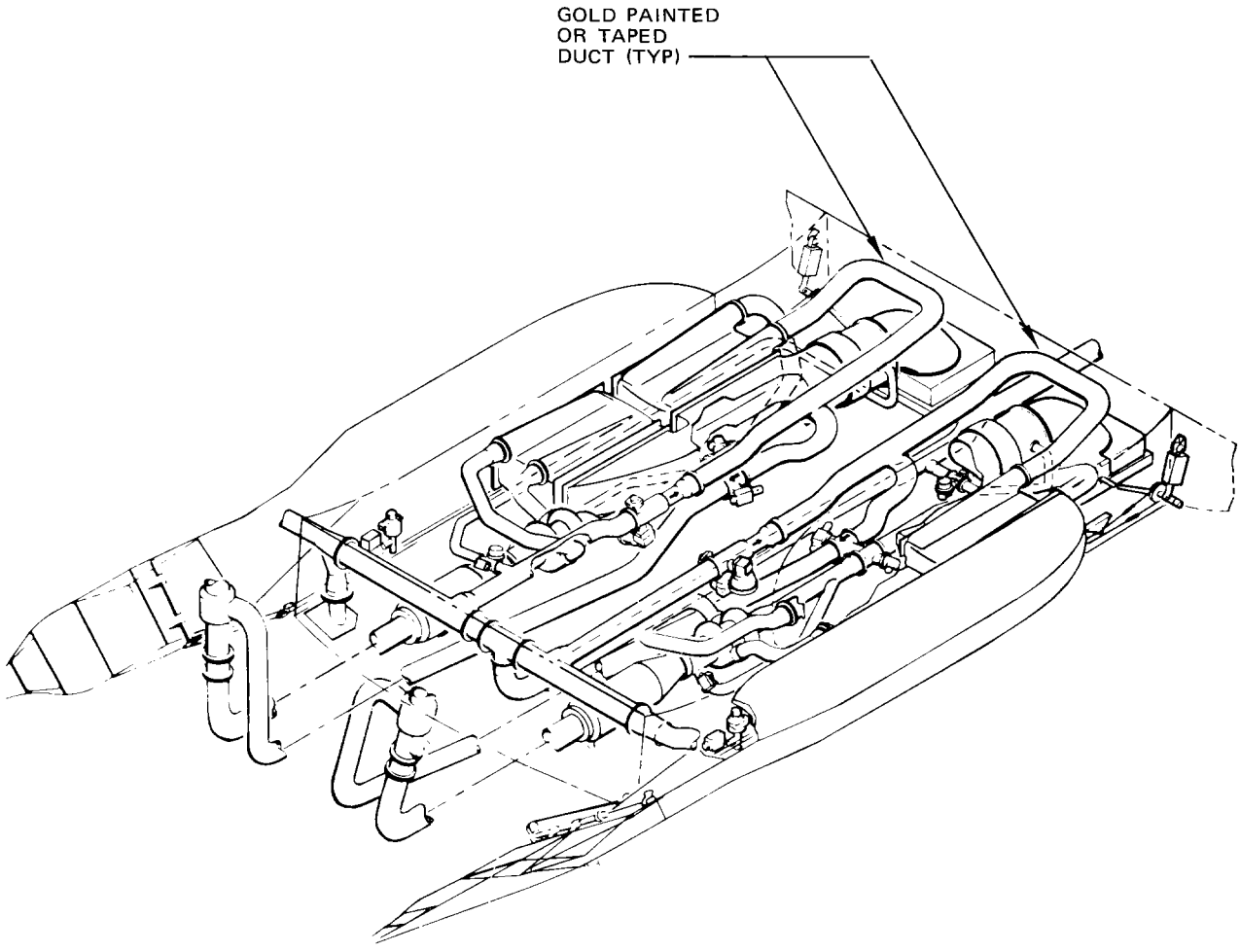
450°F Thermostat Installation
Figure 401

D. Remove the DO-NOT-OPERATE tag from the following switches on the P5 panel:
   (1) BLEED 1
   (2) BLEED 2
   (3) APU BLEED
E. Remove the DO-NOT-CLOSE tag and close the BLEED AIR VALVES circuit breaker on the P6 panel.

DUCTS - MAINTENANCE PRACTICES

1. General
   A. On newer airplanes, gold paint or tape insulation has been added on air conditioning ducts in the underwing left and right-hand pack bays. With air conditioning pacts using APU bleed air during ground operation in hot weather, the gold paint or tape insulation reduces radiation and eliminates possible overheat nuisance warnings. Gold painted or taped ducts should be cleaned periodically to prevent duct surfaces from becoming coated with contaminants.
2. Cleaning Gold Painted Or Taped Ducts (Fig. 201)
   A. Clean with BMS 3-2 Type 1 or 2 or naphtha.
   B. Wipe with a damp cloth.



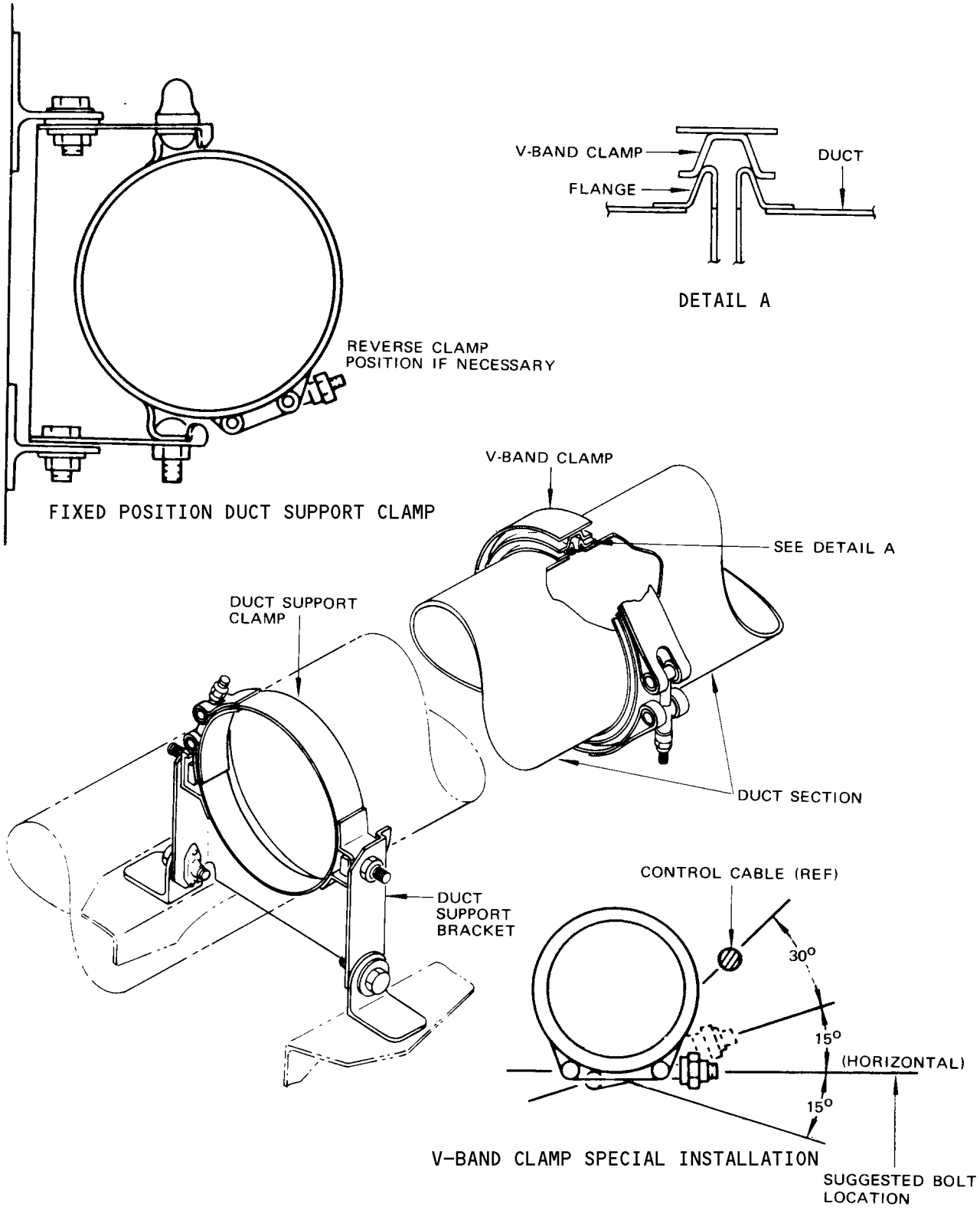


Gold Painted or Taped Ducts Location
Figure 201

DUCTS AND CLAMPS - REMOVAL/INSTALLATION

1. General
   A. The ducts for the air conditioning, thermal anti-icing and pneumatics systems are all held in place by support clamps and joined together by V-band clamps. Some of the duct sections are designed and manufactured slightly short in length, in order to compensate for thermal expansion when hot air flows through the ducts. When ducts are installed the systems are inoperative therefore the ducts are cold and must be slightly prestressed by the clamps at the duct joints. Some V-band clamps are installed in areas containing control cables and special attention must be taken to ensure against interference with control cables.
2. Remove Ducts and Clamps
   A. Gain access to the duct by removing the appropriate access panels.
   B. Loosen V-band clamps at either end of duct section. (See figure 401.)
   C. Unfasten duct support clamps which secure duct section to support brackets.
   D. Remove duct support clamps, V-band clamps, and duct section.
3. Install Ducts and Clamps (See figure 401.)
   A. Check that duct section is clean and undamaged. If a new duct section is being installed, be certain the new section is the correct part for the section being replaced.
   B. Place new duct section in position and support loosely in duct support clamps.
   C. Install duct V-band clamps
      (1) Arrange loose duct sections so as to evenly space gap between ducts. Normal gap in 0.03 inch or less. If gap is in excess of 0.03 inch, loosen adjoining duct sections as required. If 0.03-inch maximum gap for all joints in work is not obtainable, equalize the gaps and proceed.
      (2) Position V-band clamps and tighten.
         (a) Do not apply any lubricant to the clamping area or clamp bolt.
         (b) Tighten all clamps in work evenly so as to load each joint equally.
         (c) Tighten clamp nuts. Tap clamps with a soft mallet while tightening.

            NOTE: If V-band clamps are being installed in areas adjacent to control cables, align clamp in a position so that the clamp tee bolt is a minimum of 30 degrees circumferentially from the control cable (Fig. 401, Detail B). Test the clearance by physically deflecting the cable towards the clamp to check that cable slack will not interfere under any flight conditions.



Typical Duct Section Installation
Figure 401

D. Tighten duct support clamps. If duct support clamps were removed to obtain alignment for V-band clamp alignment, deflect the assembled tubing sufficiently to engage the support clamps in a manner that will not physically damage tubing. Do not loosen V-band clamps in order to align support clamps.

NOTE: Installation torque range for 0.016 inch titanium ducts on TAI system support clamps shall be 10 to 15 pound-inches or 10 pound-inches over the nut threading torque, whichever is greater.

E. Pressurize system as required and check for leakage at all joints involved in the repair.
F. Install access panels.

TITANIUM DUCTS - INSPECTION/CHECK

1. Ducts Inspection
   A. Titanium Ducts Inspection
      (1) General
         (a) At normal ambient temperatures fire resistant hydraulic fluid is compatible with titanium. Above 170°F, however, the fluid becomes acidic and attacks titanium causing it to corrode and become brittle.
         (b) Titanium ducts are found in the air condition equipment bay area, wing leading edge TAI system, and on the pneumatic system aft of the APU check valve.
         (c) When it is suspected that titanium ducts have been contaminated with fire resistant hydraulic fluid an inspection of the applicable ducts should be accomplished. Refer to Chapter 5, Hydraulic Fluid Reaction with Titanium - Conditional Inspection, for duct inspection and check.

TITANIUM DUCTS - CLEANING/PAINTING

1. General
   A. Titanium ducts in some airplanes may not be painted with preservative and even those that are painted may corrode and become brittle if they come in contact with fire resistant hydraulic fluid at temperature above 270°F. On either painted or unpainted ducts, contamination is evidenced by a bright glossy brown film, dull black residue, or a bare surface on painted ducts.
   B. Contamination can be removed by cleaning, either removing the ducts or as installed, provided caution is exercised to avoid cleaning solution coming in contact with other airplane components or structure.
2. Duct Cleaning
   A. References
      (1) OHM 20-30-03, Standard Overhaul Practices Manual, General Cleaning Procedures
      OHM 20-41-01, Standard Overhaul Practices Manual, Application of Corrosion Preventives to Interior of Closed End Tubes
      OHM 20-44-01, Standard Overhaul Practices Manual, Application of Special Purpose Coating and Finishes
   B. Clean the Ducts
      (1) If the ducts are touched with the fire-resistant hydraulic fluid, clean the ducts (Ref Standard Overhaul Practices Manual 20-30-03, Section 8, Manual Cleaning).
      (2) Titanium ducts that require the removal of hydraulic fluid contamination while installed on the airplane may be cleaned as follows:
         (a) Clean the duct with the use solvents such as cold alkaline, solvent emulsion, and foam cleaners (Ref SOPM 20-30-03, Section 8, Manual Cleaning).
         (b) Soak ducts with thick hydraulic fluid residues with alkaline solvent for 20 to 40 minutes, then scrape it off the duct with a soft piece of wood (tongue depressor).

            NOTE: Do not remove hydraulic fluid residues on titanium ducts with power wire brush or abrasive air blast materials. Aluminized steel wool or scotch brite pads may be used. The ducts may be stained as many times as you want after it has been cleaned and provided that all the hydraulic fluid residues has been removed and the surface of the duct is smooth.

(3) After you clean the ducts, you can paint them with BMS 10-82 low emissitivity gold coating (Ref SOPM 20-44-01) or B-2000 high temperature coating (Ref SOPM 20-41-01, SRF-14.87) to provide a protective coating for the duct.

NOTE: B-2000 high temperature coating may be applied over worn or scarred BMS 10-82 gold coating or to bare titanium ducting.

DUCTS - APPROVED REPAIRS

1. General
   A. Thin wall ducts are subject to damage as a result of improper removal or installation, mishandling or abnormal operating conditions. Extremes of pressures or temperatures may in some cases, make complete replacement of components more desirable than local repair or partial replacement.
2. Duct Repair (Fig. 801)
   A. Smooth dents do not require rework if they are not so deep as to restrict the airflow substantially. Smooth dents of greater depth may be removed by pulling a ball mandrell through the dented area or by the use of any applicable hydraulically or mechanically actuated expansion device. Hydrostatic pressure within the allowable pressure for the particular system used in conjunction with moderate tapping with a nonmetallic hammer around the edge of the dent from the outside is an effective method for removal of some dents.
   B. Shallow scratches, gouges and corrosion having a depth not in excess of 10% of the duct wall thickness do not require rework provided the transition from base metal thickness is smooth and rounded and the bottom of the crack or gouge is also smooth and rounded.
   C. Sharp scratches, gouges and corrosion can be reworked by removal of adjacent metal subject to the following restrictions:
      (1) Minimum wall thickness at the bottom of a scratch, gouge or corrosion after rework shall not be less than 90% of the minimum material gauge.
      (2) The surface roughness of the reworked area shall not exceed 40 RMS.
      (3) The slope of the reworked area shall not exceed a rise of 1 to 10.
      (4) Internal and external radii of the reworked area shall not be less than 0.12 inch.
      (5) When these defects are within 0.25 inch of a primary fusion welded joint they shall be as per par. D. below.
   D. Ducts with damage which cannot be repaired within the above limits must be replaced. For repair of extensively damaged ducts, see Overhaul Manual.
3. Temporary Repair of Cracked Ducts (Fig. 801)
   A. General
      (1) You can temporarily repair ducts that have a crack along the longitudinal axis.

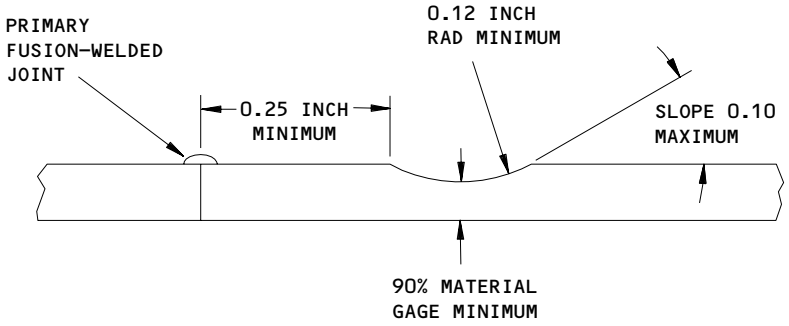
          NOTE: This repair procedure is only permitted for ducts that have a crack along the longitudinal axis. Replace ducts that have a crack along the circumference or have multiple cracks.

      (2) A duct with a longitudinal crack that is less than three inches for a flange or pullout also cannot be repaired by this procedure. It must be replaced or repaired in accordance with the Overhaul Manual.

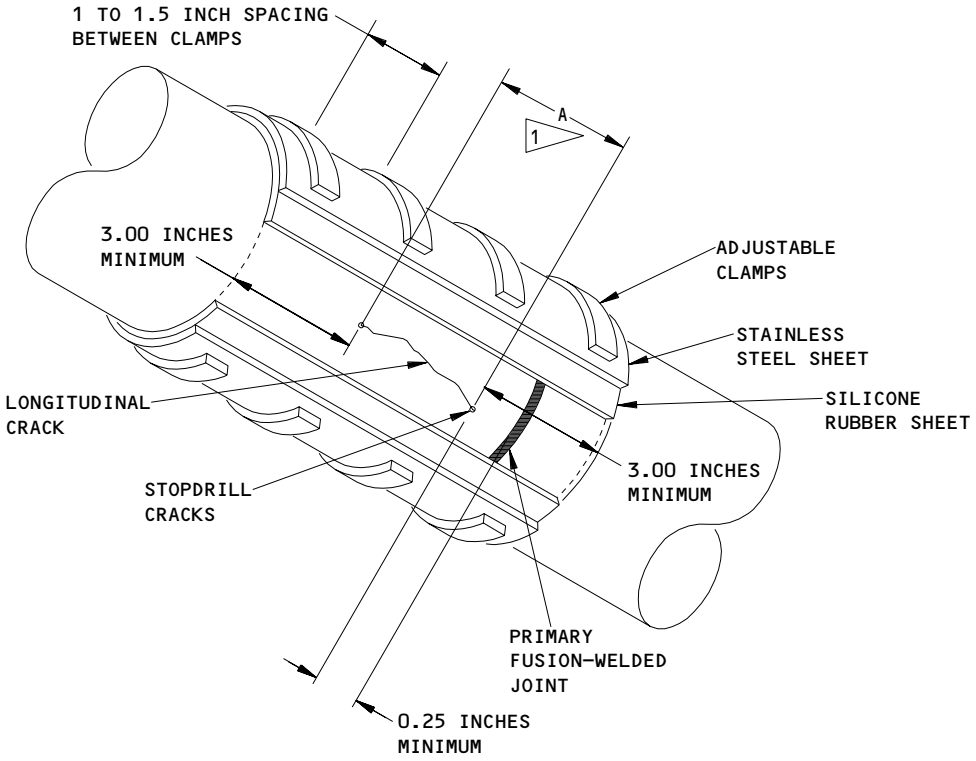
(3) The repair is temporary and you must replace the duct as soon as possible.

B. Repair the duct with the crack
(1) Stopdrill the crack.
(2) Put the silicone rubber sheet on the crack and extend it three inches beyond the crack.
(3) Put the stainless steel sheet on the rubber sheet.
(4) Put the clamps on the duct every 1 to 1 1/2 inches and tighten the clamps.

4. Duct Flange Repair
A. Equipment
(1) Flange Reforming Tool, Adams Flange Spider
Adams - Bird, Inc.
5296 Pebbletree Way
San Jose, CA 95111
U.S.A.
B. Consumable Materials
(1) D60068 Penetrant - Fluorescent, Zyglo ZL67 or equivalent
C. Procedure
(1) Get access to the duct flange that you will repair.
(2) Use the flange reforming tool and repair the duct flange.
(3) If you cannot repair the duct while the flange is installed, remove the duct to get access to the damaged flange (Ref 36-19-11/401).
(a) Repair the flange with the flange reforming tool.
(4) Inspect the duct flange for cracks after the repair.
(a) For metallic and nonmetallic ducts, use the fluorescent penetrant inspection, using water washable penetrant (refer to the applicable vendor's instructions).
(b) If the flange has any cracks, replace the duct or repair off of aircraft.
(5) Install the duct, if removed (AMM 36-19-11/401).



DUCT REWORK (EXAMPLE)



1 MAXIMUM CRACK LENGTH MUST NOT BE MORE THAN THE DUCT DIAMETER.

DUCT REPAIR (EXAMPLE)

Pneumatic Duct Approved Repair
Figure 801

BALL JOINT - MAINTENANCE PRACTICES

1. General
   A. The duct ball joints are located in the engine section of engines No. 1 and 2, and connect the 8th- and 13th-stage bleed manifolds to engine bleed air system and thermal anti-ice (TAI) system ducts. The ball joints consist of an inner bearing and bearing nut fixed to one of the ducts being joined, a retainer fixed to the other duct, a split or solid replaceable wear ring, and adjustment shims (Fig. 201).
   B. Maintenance practices for the duct ball joints consist of a removal/installation procedure for the wear ring which includes adjustment, a ball joint leakage test, and a ball joint approved repairs.
2. Ball Joint Wear Ring Removal/Installation
   A. Equipment and Materials
      (1) Antiseize Compound - MIL-T-5544 (Ref 20-30-21/201)
      (2) Torque Wrench - 50 to 400 pound-inches
      (3) Oversize Wear Ring - METAL FORM, Kent, Wash., or JET PRODUCTS CORP., San Diego, Calif.
      (4) Ball Joint Bearing Nut Wrench
         (a) Perferred: F72999-( )
         (b) Optional: ST2580-153-( )
      (5) Pneumatic System Ball Joint Retainer Wrench - ST2580-163-( )
   B. Remove Wear Ring (Fig. 201)
      (1) While holding retainer with retainer wrench unscrew bearing nut from retainer with bearing nut wrench.
      (2) Move nut away from joint and remove wear ring (if wear ring is solid, cut to enable removal).
      (3) Remove shims.
   C. Install Wear Ring (Fig. 201)
      (1) Install split wear ring in bearing nut and check that gap in split wear ring does not exceed 0.030 inch.

         NOTE: Wear ring gap may be filed if necessary to facilitate installation in bearing nut but not to exceed 0.030-inch gap.

      (2) Assemble joint without shims and using ball joint and torque wrenches, tighten nut to 70-90 pound-inches torque.
      (3) Measure clearance between nut and retainer rim with feeler gage.
      (4) Record amount of clearance and add 0.012 to 0.014 inch to obtain total shim thickness.
      (5) Disassemble joint.
      (6) Apply coating of antiseize compound to threads of nut and retainer.

(7) Reassemble joint using the combination of solid and laminated shims determined in step (4).

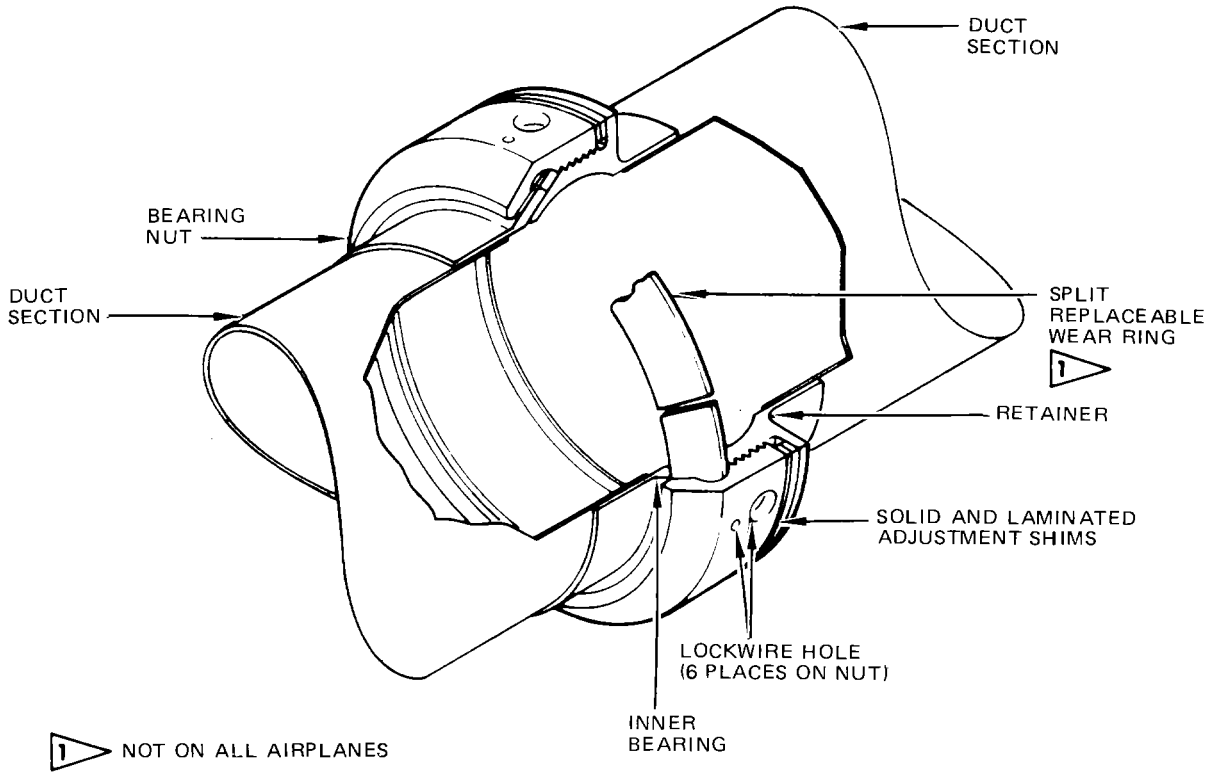
NOTE: Shims must not protrude beyond periphery of nut.

(8) Hold retainer with retainer wrench and using bearing nut and torque wrenches, tighten nut to 380-400 pound-inches torque.
(9) Check joint to ensure freedom of movement by hand.
(10) Lockwire nut to retainer using two holes in nut closest to hole in retainer.

3. Ball Joint Leakage Test
A. General
(1) All ball joints will leak as design requirements in the assembly of the joint requires 0.005 clearance.

NOTE: Leakage from a cold ball joint will usually be greater than that of a warm joint. If leakage rate is questionable, establish a flow through the duct to obtain normal operating temperatures. If the leakage rate is acceptable during normal temperatures, no corrective action is required.

B. The following leakage definitions are based on duct pressures experienced when bleed air system is being pressurized with auxiliary power unit (APU). If engines are operating for check, engine power should be advanced as required to provide an equivalent duct pressure.
(1) Diffused leakage.
(a) Air that is leaking around most of the circumference of the joint.
(2) Concentrated air blast leakage.
(a) Leakage resulting from: flat area on the joint face, nick, burr, or deep scratch, damaged shims, or excessive wear ring end gap.
C. Check Ball Joint Leakage
(1) Check that all air conditioning and pneumatic system circuit breakers are closed.
(2) Check that L and R PACK switches are OFF.
(3) Operate APU (Ref 49-11-0, APU Power Plant Operating Procedure) or run engine(s) (Ref 71-09-100, Power Plant (JT8D) - Operating Procedure).
(4) Position engine BLEED switches and ISOLATION VALVE switch as required to pressurize ducts which include ball joint being checked.
(5) Check for leakage at ball joint.
(a) If diffused leakage is observed, check that fire warning and overheat detectors are not in leak area and that leakage cannot be felt on the hand approximately 12 inches from joint.



Duct Ball Joint
Figure 201

(b) If jet blast (concentrated air blast) is observed, check that blast is away from any fire warning or overheat detectors and that air blast is not felt on the hand 12 inches from joint.

4. Ball Joint Approved Repairs

A. General

(1) Excessive leakage as identified in par. 3 may be eliminated by accomplishing the following repairs.

B. Repair Ball Joint

(1) Remove wear ring per par. 2.B.

(2) Remove burr or other interference observed on wear ring, threads or shims.

(3) Either rework wear ring or replace with oversize wear ring to reduce end gap.

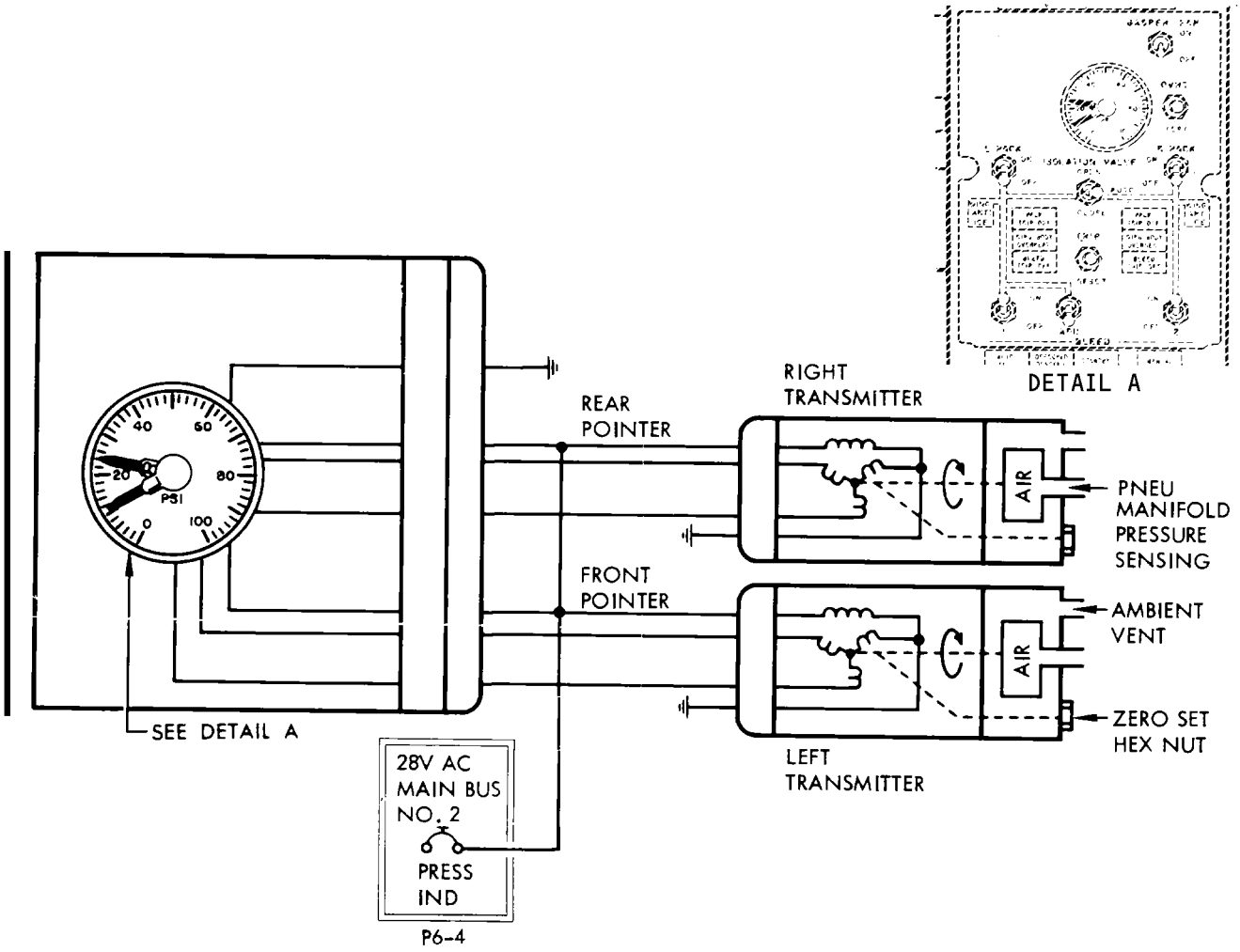
(a) Spring the wear ring in at the gap to about 1-inch overlap and release. Repeat as necessary until natural butt is assumed by the ring at the split.

(b) Carefully reinstall wear ring in the nut. Avoid spreading by installing the ring on the duct at the ring split and "peeling" it on.

(c) Install wear ring per par. 2.C.

ENGINE BLEED PRESSURE INDICATING SYSTEM - DESCRIPTION AND OPERATION

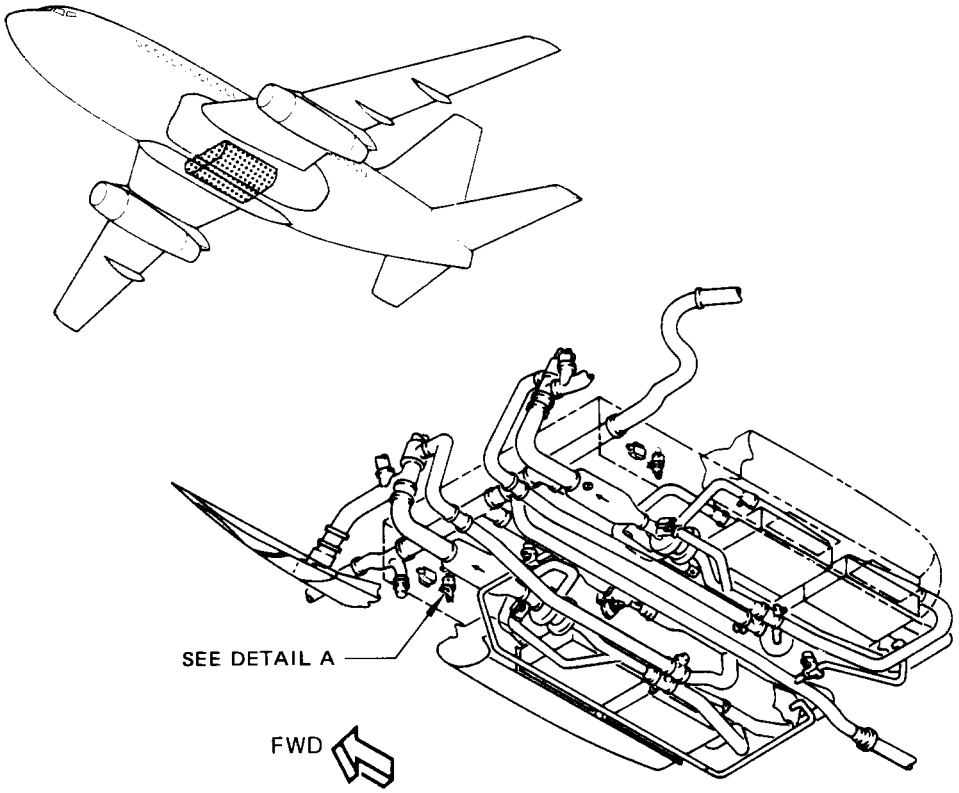
1. General
   A. A pressure indication system, consisting of two transmitters and a dual pressure indicator, is provided for the pressure indication of the engine bleed system. Each transmitter is connected to a sensing line which is connected to the pneumatic manifold downstream from the bleed air heat exchanger. Both transmitters are electrically connected to the dual pressure indicator on the overhead panel which has two pointers marked L and R for the left and right system respectively. One transmitter is sensing engine No. 1 bleed air pressure and the other senses engine No. 2 bleed air pressure. (See figure 1.)
   B. Each transmitter has two ports. One port is for the pressure sensing line from the pneumatic manifold and the other port is the vent to atmosphere. Next to the ports there is a zero set hex nut. The zero set hex nut is used to adjust the transmitter to obtain a zero indication on the indicator with no pressure in the ducts.

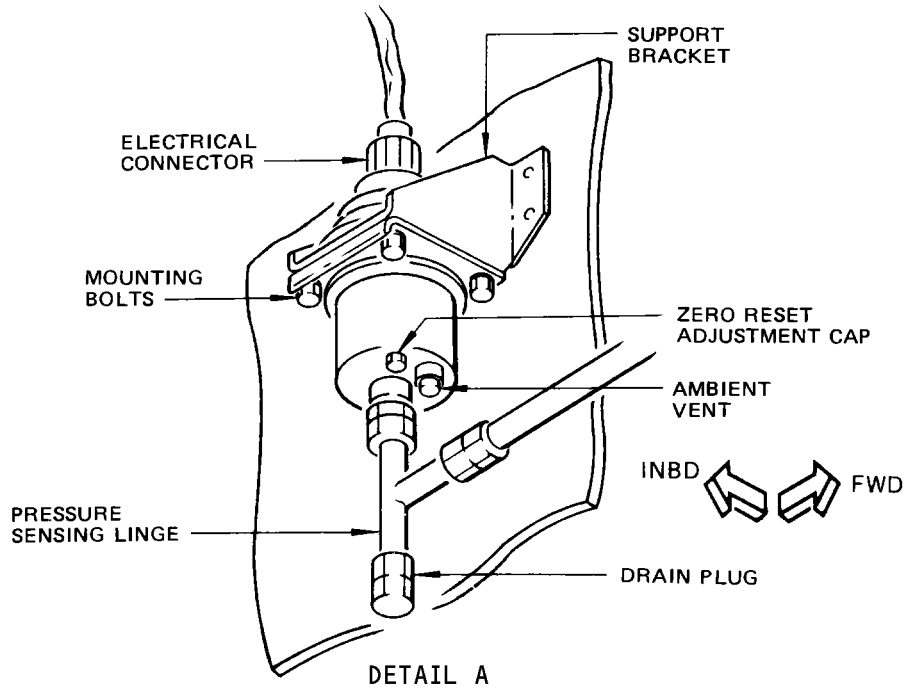


Engine Bleed Pressure Indicating Circuit
Figure 1

DUCT PRESSURE TRANSMITTER - REMOVAL/INSTALLATION

1. General
   A. Two duct pressure transmitters are provided to transmit and indicate engine bleed pressure to the forward overhead panel.
   B. The pressure transmitters are installed in the outboard side of the forward air conditioning equipment bay. (See figure 401.)
   C. The removal/installation procedure is identical for both transmitters.
2. Remove Duct Pressure Transmitter (See figure 401.)
   A. Open applicable air conditioning equipment bay door to gain access to transmitter.
   B. Disconnect pressure sensing line from transmitter.
   C. Disconnect electrical connector.
   D. Remove mounting bolts from support bracket.
   E. Remove transmitter.
3. Install Duct Pressure Transmitter
   A. Position pressure transmitter on support bracket with electrical connector facing up.
   B. Fasten to support bracket with mounting bolts.
   C. Check that ambient vent marked V is not plugged.
   D. Connect pressure sensing line to pressure port of transmitter marked P.
   E. Connect electrical connector.
   F. Check that circuit breaker, PRESSURE IND, on panel P6-4 is closed.
   G. Adjust zero reset on pressure transmitter so the pressure gage on forward overhead panel reads zero pressure with no pressure in ducts.
   H. Close air conditioning equipment bay doors.





Duct Pressure Transmitter Installation
Figure 401