KSSU Group

KSSU Group

PAGE	DATE	CODE
75-26-03		
401	JUN 10/94	J02
402	FEB 10/94	J01
403	FEB 10/94	J01
404	FEB 18/00	J02
405	FEB 18/00	J02
406	FEB 18/00	J02
407	OCT 10/95	J02
408	BLANK	
75-30-00		
F 1	DEC 10/88	J01
F 2	DEC 10/88	J01
75-31-00		
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2	DEC 10/88	J01
3	DEC 10/88	J01
4	FEB 10/89	J01
5	FEB 10/89	J02
6	FEB 10/89	J02
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410	FEB 18/00	J02
411	FEB 18/00	J02
412	FEB 15/98	J02
413	FEB 10/95	J02
414	FEB 18/00	J02
75-31-02		
601	FEB 18/00	J02
602	DEC 10/88	J01
603	FEB 18/00	J02
604	FEB 18/00	J02
75-32-00		
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PAGE	DATE	CODE
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75-32-01		
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404	JUN 10/92	J01
405	JUN 18/00	J02
R 406	OCT 18/00	J02.1
R 407	OCT 18/00	J02.101
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406	JUN 10/91	J02
75-32-03		
601	OCT 10/91	J02
602	JUN 10/88	J01
603	OCT 10/91	J02
604	BLANK	

PAGE	DATE	CODE

CHAPTER 75 - AIR

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[*] ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123

CHAPTER 75 - AIR

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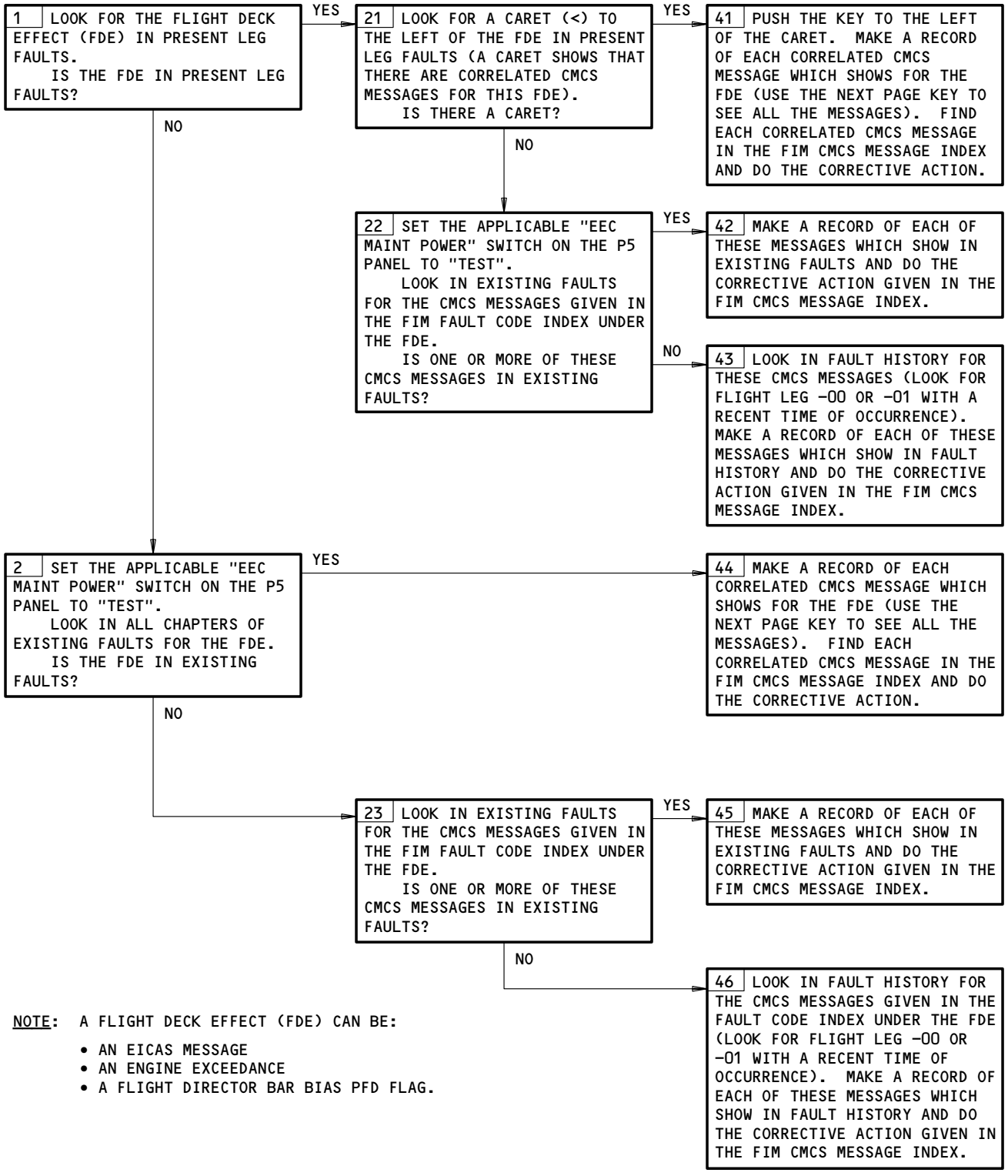
FAULT CODE INDEX

1. General
   A. The Fault Code Index includes fault isolation or corrective action for each fault code in the Fault Reporting Manual (FRM). The fault codes for each chapter are in numerical order.
      (1) The first paragraph given with each fault code is the log book report from the FRM. The log book report is a short description of the fault.
      (2) The numbered paragraphs after the log book report contain the fault isolation or the corrective action.
   B. The fault isolation for most EICAS messages, engine exceedances, or PFD flags includes a list of one or more possible correlated CMCS messages.
      (1) For each CMCS message in the list, there is the message number and an ATA number. The ATA number is the prompt under which you can find the message in Existing Faults or Fault History on the CDU.
      (2) The corrective action refers to the procedure in Figure 1 of this section. Figure 1 shows how to use the Present Leg Faults, Existing Faults, and Fault History functions of the CMC to isolate the fault to a specific CMCS message.
   C. For those EICAS status messages which latch into EIU memory when they occur, this index includes the letters NVM, NVM-A, or NVM-G to the right of the log book report.
      (1) NVM indicates that the message latches if it occurs in the air or on the ground.
      (2) NVM-A indicates that the message latches only if it occurs in the air.
      (3) NVM-G indicates that the message latches only if it occurs on the ground.
      (4) To remove the latched message from the EICAS after you correct the fault, you must use the ERASE function of the CMC.

          NOTE: Do not erase a latched EICAS message until you are sure that you have corrected the fault.

D. When the CDU shows a large number of Flight Deck Effects (FDEs) or CMCS messages, it is possible that there is a bus failure. Do these steps to isolate the cause of the failure:
   (1) Look at the CMCS messages to determine which system or LRU is related to all the messages.
   (2) Look at the wiring diagram for each system and determine if the suspect LRUs are on a common bus.
   (3) Do a check of the wiring between each of the suspect LRUs and the common bus.
   (4) Repair any problems that you find.
   (5) If the problem continues, remove each LRU individually to determine which LRU is the cause of the fault.
   (6) Replace the LRU which caused the fault.



Fault Isolation Procedure with the CMCS
Figure 1

EFFECTIVITY
ALL

A04391

FAULT CODE	LOG BOOK REPORT/ CORRECTIVE ACTION

75 03 01 00 The EICAS message ENG 1 ESCV (STATUS) shows. (NVM)

1. Look for one or more of these CMCS messages (Fig. 1):

71368 (71-00) 71392 (71-00) 71468 (71-00) 71492 (71-00)
74487 (71-00)

75 03 02 00 The EICAS message ENG 2 ESCV (STATUS) shows. (NVM)

1. Look for one or more of these CMCS messages (Fig. 1):

72368 (71-00) 72392 (71-00) 72468 (71-00) 72492 (71-00)

75 03 03 00 The EICAS message ENG 3 ESCV (STATUS) shows. (NVM)

1. Look for one or more of these CMCS messages (Fig. 1):

73368 (71-00) 73392 (71-00) 73468 (71-00) 73492 (71-00)

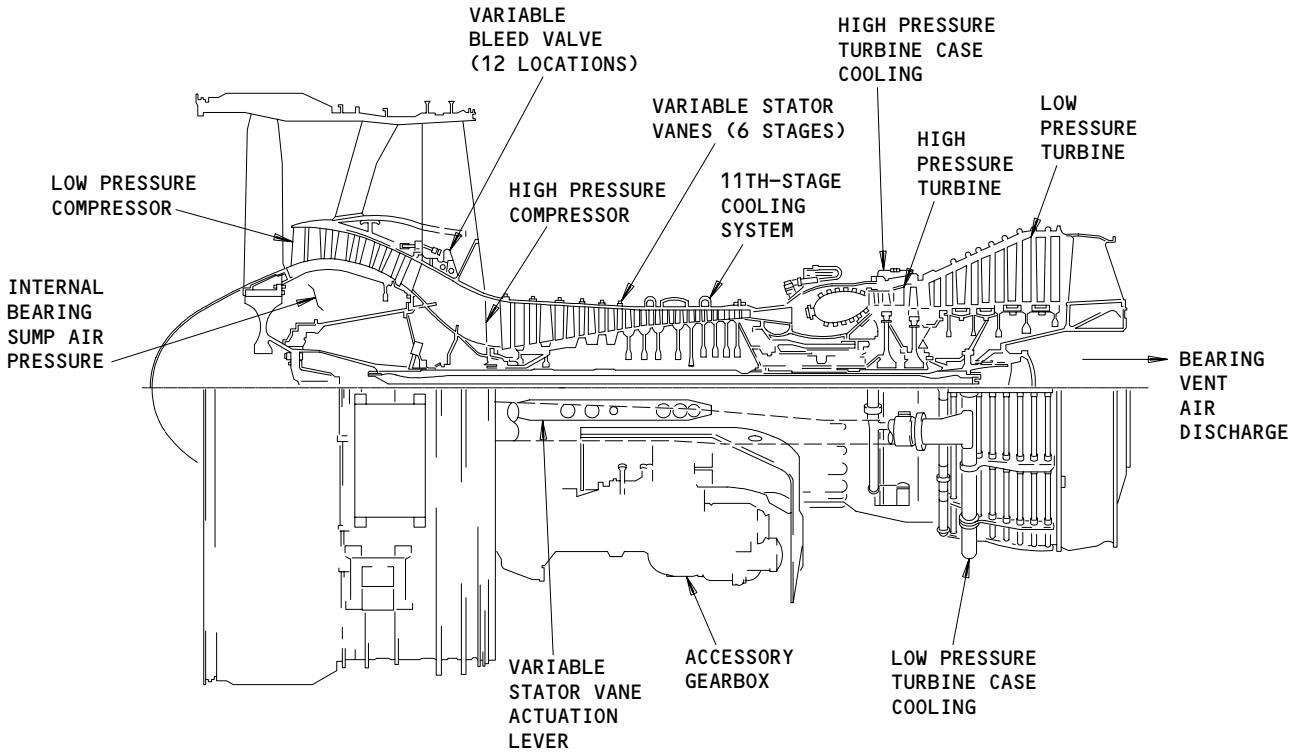
75 03 04 00 The EICAS message ENG 4 ESCV (STATUS) shows. (NVM)

1. Look for one or more of these CMCS messages (Fig. 1):

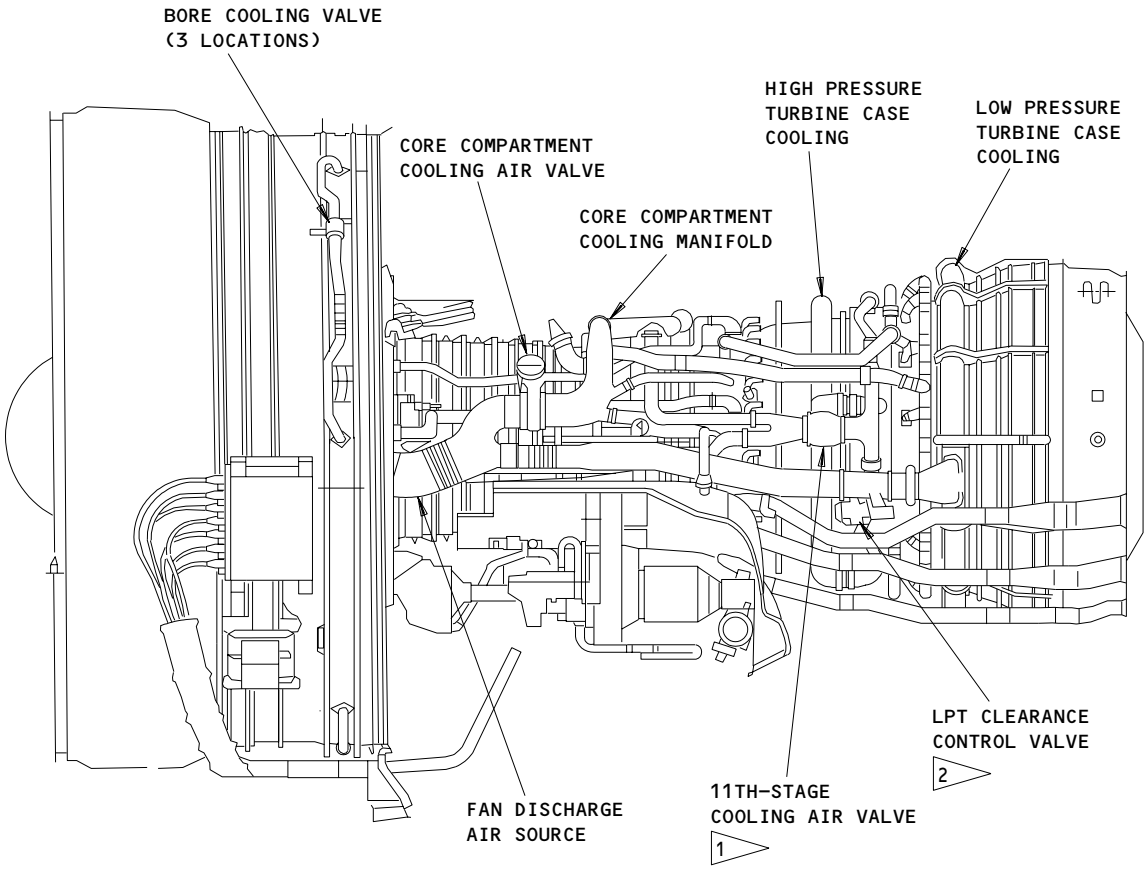
74368 (71-00) 74392 (71-00) 74468 (71-00) 74492 (71-00)

AIR - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The engine air systems regulate air throughout the engine for cooling and controlling purposes.
   B. The air system is comprised of the following systems:
      - HPC Bore Cooling System, AMM 75-21-00/001
      - Engine External Accessories Cooling, AMM 75-23-00/001
      - Turbine Clearance Control System, AMM 75-24-00/001
      - 11th-Stage Cooling Air System, AMM 75-26-00/001
      - Variable Stator Vane System, AMM 75-31-00/001
      - Variable Bypass Valve System, AMM 75-32-00/001.
2. Engine Cooling (Fig. 2)
   A. A small amount of low pressure compressor discharge air is used to supply internal bearing sump pressure and to cool the high pressure compressor (HPC) bore. This air enters through the leading edges of five fan struts.
   B. Fan discharge air is used to cool the engine external accessories and the core compartment. Air enters the core compartment cooling manifold on the left side of the engine. The manifold distributes the air to the various engine accessories.
   C. The integrated drive generator (IDG), ignition leads, and igniter plugs are also cooled with fan discharge air.
   D. ENGINES WITHOUT GE SB 75-159, 75-161 OR 75-165;
      The turbine clearance control (TCC) system regulates the amount of cooling air flow to the turbine cases to maintain satisfactory turbine blade tip clearances and to improve engine efficiency. Fan discharge cooling air enters the low pressure turbine case cooling manifold on the left side of the engine and the high pressure turbine case cooling manifold on the right side. There is a TCC valve installed in each turbine case cooling manifold.
   E. ENGINES WITH GE SB 75-159, 75-161 OR 75-165;
      The turbine clearance control (TCC) system regulates the amount of cooling air flow to the turbine cases to maintain satisfactory turbine blade tip clearances and to improve engine efficiency. Fan discharge cooling air enters the high pressure turbine case cooling manifold on the right side of the engine. The TCC valve is installed on the high pressure turbine case cooling manifold.
   F. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
      Two 11th-stage cooling air valves regulate the amount of air that flows to the HPT second stage nozzle. The 11th-stage cooling valve solenoid is used to send a pneumatic signal to the valves. The pneumatic signal will cause the valves to move to the reduced-flow position.
   G. ENGINES WITHOUT 11TH-STAGE COOLING VALVES OR WITH GE SB 75-123;
      The 11th-stage cooling air system supplies bleed air to cool the high pressure turbine (HPT) second stage nozzle. The 11th-stage bleed air enters the manifold from the left and right side of the engine.



Engine Air System
Figure 1



LEFT SIDE

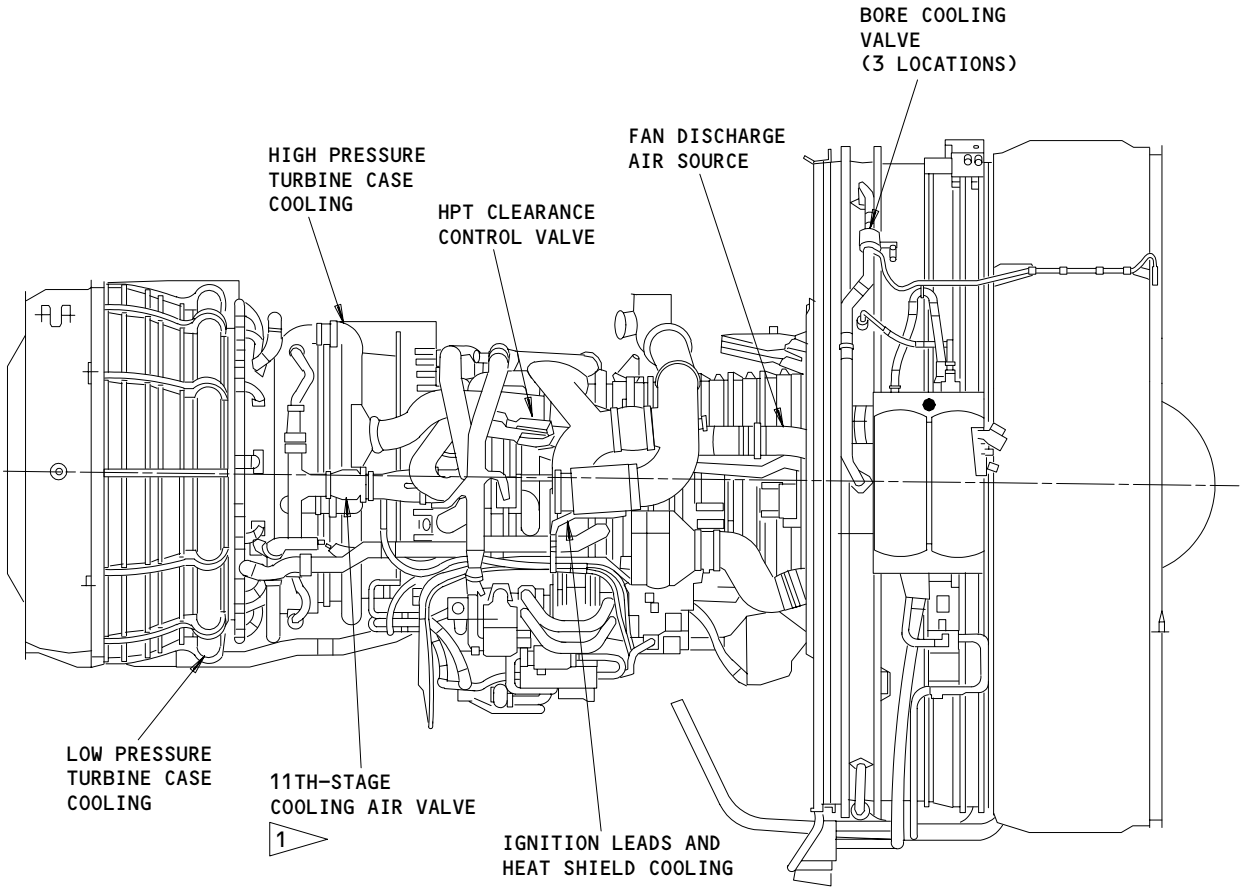
NOTE: ENGINE SHOWN WITHOUT QEC FOR CLARITY.

1 ENGINES WITH GE SB 75-123; THIS VALVE IS DEACTIVATED. ON SUBSEQUENT ENGINES AND ENGINES WITH GE SB 75-135; THERE IS A DUCT HERE.

2 ENGINES WITH GE SB 75-159; THERE IS NO VALVE HERE.

CF8-8258-00-A2A

Cooling Air System
Figure 2 (Sheet 1)



RIGHT SIDE

CF8-8257-00-A2A

Cooling Air System
Figure 2 (Sheet 2)

3. Compressor Control
   A. The compressor control system controls the air flow to and through the HPC to maintain efficient engine performance. The variable stator vane (VSV) system controls the primary air flow through the HPC. Some of the air flow is extracted from the 7th-, 8th-, and the 11th-stages of the HPC to cool and pressurize other systems. The variable bypass valve (VBV) system controls the amount of air flow to the HPC.
4. Operation
   A. Functional Description
      (1) The operation of the engine air systems is automatic. There are no operator actions required during engine operation. Refer to the individual section Description and Operation's listed in paragraph 1.B. for complete information.

AIR

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
ACTUATOR - ENGINE 1 VARIABLE BYPASS VALVE	3	2	415, LEFT THRUST REVERSER HALF 416, RIGHT THRUST REVERSER HALF	75-32-01
ACTUATOR - ENGINE 2 VARIABLE BYPASS VALVE	3	2	425, LEFT THRUST REVERSER HALF 426, RIGHT THRUST REVERSER HALF	75-32-01
ACTUATOR - ENGINE 3 VARIABLE BYPASS VALVE	3	2	435, LEFT THRUST REVERSER HALF 436, RIGHT THRUST REVERSER HALF	75-32-01
ACTUATOR - ENGINE 4 VARIABLE BYPASS VALVE	3	2	445, LEFT THRUST REVERSER HALF 446, RIGHT THRUST REVERSER HALF	75-32-01
ACTUATOR - ENGINE 1 VARIABLE STATOR VANE	3	2	415, LEFT THRUST REVERSER HALF 416, RIGHT THRUST REVERSER HALF	75-31-02
ACTUATOR - ENGINE 2 VARIABLE STATOR VANE	3	2	425, LEFT THRUST REVERSER HALF 426, RIGHT THRUST REVERSER HALF	75-31-02
ACTUATOR - ENGINE 3 VARIABLE STATOR VANE	3	2	435, LEFT THRUST REVERSER HALF 436, RIGHT THRUST REVERSER HALF	75-31-02
ACTUATOR - ENGINE 4 VARIABLE STATOR VANE	3	2	445, LEFT THRUST REVERSER HALF 446, RIGHT THRUST REVERSER HALF	75-31-02
CIRCUIT BREAKERS -	1		117A, MAIN EQUIP CENTER, P18O	
ENG 1 EEC PWR CH A, C10373		1	18OJ5	*
ENG 1 EEC PWR CH B, C10374		1	18OJ5	*
ENG 2 EEC PWR CH A, C10375		1	18OF5	*
ENG 2 EEC PWR CH B, C10376		1	18OF6	*
ENG 3 EEC PWR CH A, C10377		1	18OG2O	*
ENG 3 EEC PWR CH B, C10378		1	18OG21	*
ENG 4 EEC PWR CH A, C10379		1	18OD2O	*
ENG 4 EEC PWR CH B, C10380		1		*
SOLENOID - ENGINE 1 11TH-STAGE COOLING VALVE	2	1	415, LEFT THRUST REVERSER HALF	75-24-12
SOLENOID - ENGINE 2 11TH-STAGE COOLING VALVE	2	1	425, LEFT THRUST REVERSER HALF	75-24-12
SOLENOID - ENGINE 3 11TH-STAGE COOLING VALVE	2	1	435, LEFT THRUST REVERSER HALF	75-24-12
SOLENOID - ENGINE 4 11TH-STAGE COOLING VALVE	2	1	445, LEFT THRUST REVERSER HALF	75-24-12
UNIT - (73-00-00/101) ELECTRONIC CONTROL, M7198 HYDROMECHANICAL				
VALVE - ENGINE 1 BORE COOLING	3	3	413, LEFT FAN COWL PANEL 414, RIGHT FAN COWL PANEL	75-21-01
VALVE - ENGINE 2 BORE COOLING	3	3	423, LEFT FAN COWL PANEL 424, RIGHT FAN COWL PANEL	75-21-01
VALVE - ENGINE 3 BORE COOLING	3	3	433, LEFT FAN COWL PANEL 434, RIGHT FAN COWL PANEL	75-21-01
VALVE - ENGINE 4 BORE COOLING	3	3	443, LEFT FAN COWL PANEL 444, RIGHT FAN COWL PANEL	75-21-01

* SEE THE WDM EQUIPMENT LIST

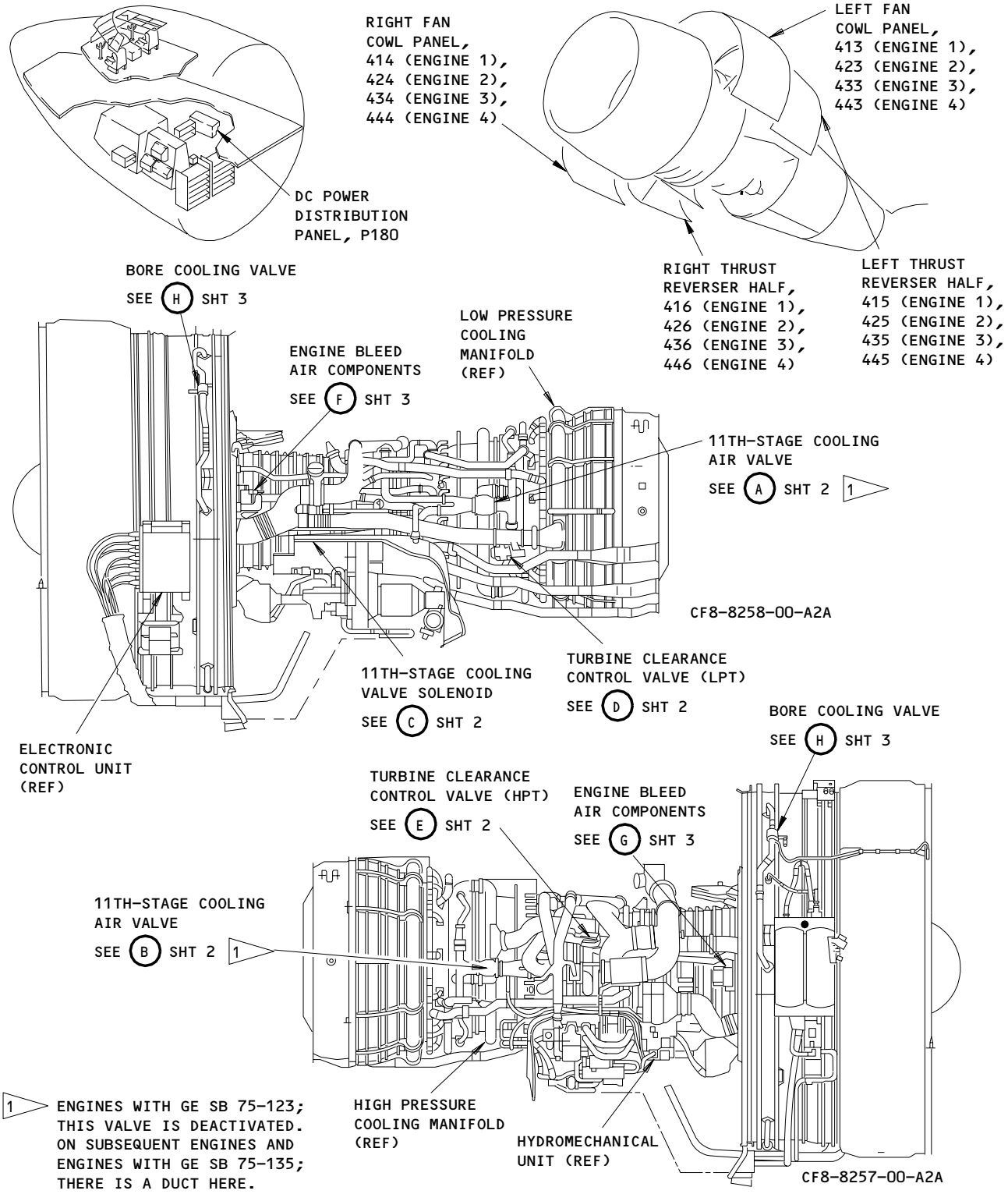
Air - Component Index
Figure 101 (Sheet 1)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
VALVE - ENGINE 1 CORE COMPARTMENT COOLING	3	1	415, LEFT THRUST REVERSER HALF	75-23-01
VALVE - ENGINE 2 CORE COMPARTMENT COOLING	3	1	425, LEFT THRUST REVERSER HALF	75-23-01
VALVE - ENINEG 3 CORE COMPARTMENT COOLING	3	1	435, LEFT THRUST REVERSER HALF	75-23-01
VALVE - ENGINE 4 CORE COMPARTMENT COOLING	3	1	445, LEFT THRUST REVERSER HALF	75-23-01
VALVE - ENGINE 1 11TH-STAGE COOLING AIR 1	2	2	415, LEFT THRUST REVERSER HALF 416, RIGHT THRUST REVERSER HALF	75-24-11
VALVE - ENGINE 2 11TH-STAGE COOLING AIR 1	2	2	425, LEFT THRUST REVERSER HALF 426, RIGHT THRUST REVERSER HALF	75-24-11
VALVE - ENGINE 3 11TH-STAGE COOLING AIR 1	2	2	435, LEFT THRUST REVERSER HALF 436, RIGHT THRUST REVERSER HALF	75-24-11
VALVE - ENGINE 4 11TH-STAGE COOLING AIR 1	2	2	445, LEFT THRUST REVERSER HALF 446, RIGHT THRUST REVERSER HALF	75-24-11
VALVE - ENGINE 1 TURBINE CLEARANCE CONTROL	2	2	415, LEFT THRUST REVERSER HALF 416, RIGHT THRUST REVERSER HALF	75-24-01
VALVE - ENGINE 2 TURBINE CLEARANCE CONTROL	2	2	425, LEFT THRUST REVERSER HALF 426, RIGHT THRUST REVERSER HALF	75-24-01
VALVE - ENGINE 3 TURBINE CLEARANCE CONTROL	2	2	435, LEFT THRUST REVERSER HALF 436, RIGHT THRUST REVERSER HALF	75-24-01
VALVE - ENGINE 4 TURBINE CLEARANCE CONTROL	2	2	445, LEFT THRUST REVERSER HALF 446, RIGHT THRUST REVERSER HALF	75-24-01
VALVE - ENGINE 1 VARIABLE BYPASS	3	12	415, LEFT THRUST REVERSER HALF 416, RIGHT THRUST REVERSER HALF	75-32-02
VALVE - ENGINE 2 VARIABLE BYPASS	3	12	425, LEFT THRUST REVERSER HALF 426, RIGHT THRUST REVERSER HALF	75-32-02
VALVE - ENGINE 3 VARIABLE BYPASS	3	12	435, LEFT THRUST REVERSER HALF 436, RIGHT THRUST REVERSER HALF	75-32-02
VALVE - ENGINE 4 VARIABLE BYPASS	3	12	445, LEFT THRUST REVERSER HALF 446, RIGHT THRUST REVERSER HALF	75-32-02

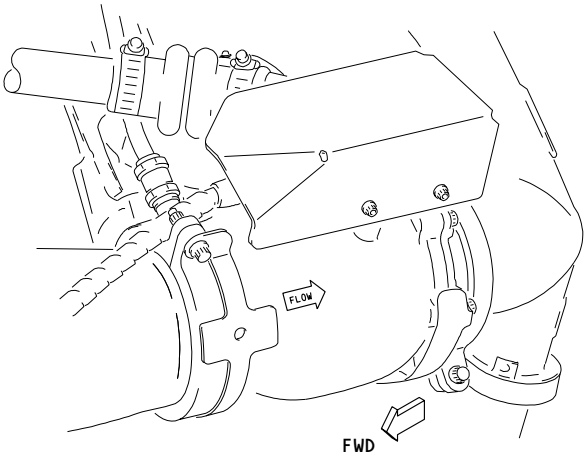
1 ENGINES WITH GE SB 75-123;
THIS VALVE IS DEACTIVATED.

ON SUBSEQUENT ENGINES AND
ENGINES WITH GE SB 75-135;
THERE IS A DUCT HERE.

Air - Component Index
Figure 101 (Sheet 2)

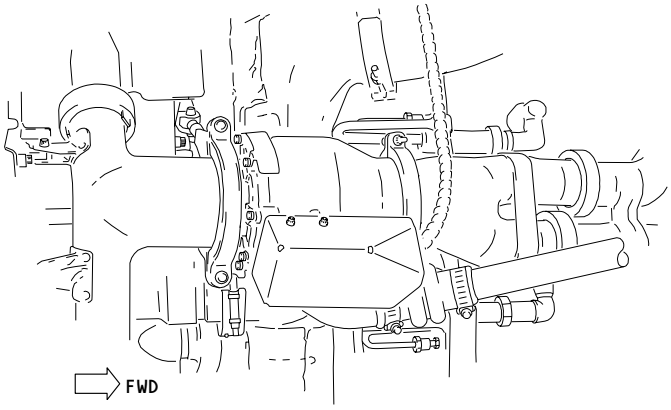


Air - Component Location
Figure 102 (Sheet 1)



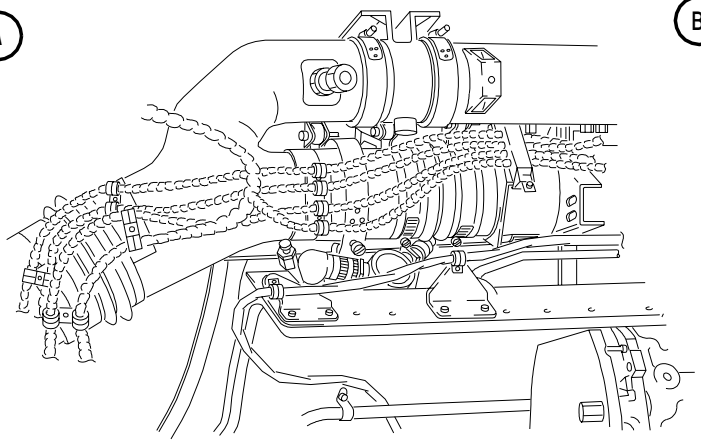
11TH-STAGE COOLING AIR VALVE, LEFT

A



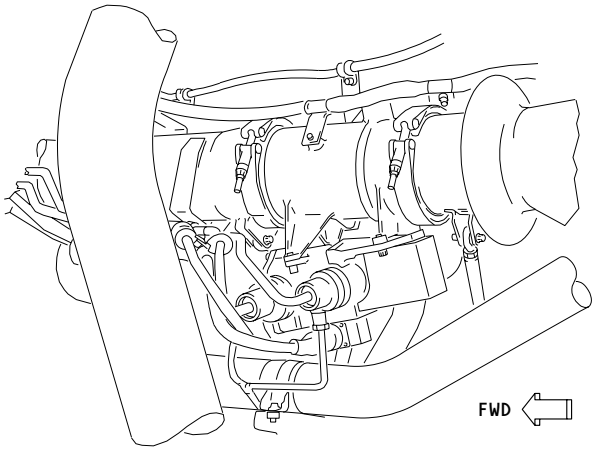
11TH-STAGE COOLING AIR VALVE, RIGHT

B



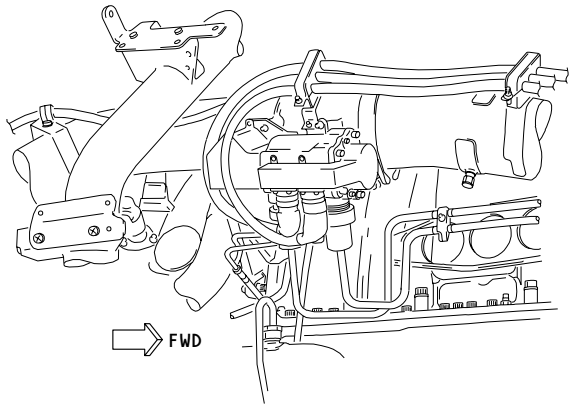
11TH-STAGE COOLING VALVE SOLENOID

C



TURBINE CLEARANCE CONTROL VALVE (LPT)

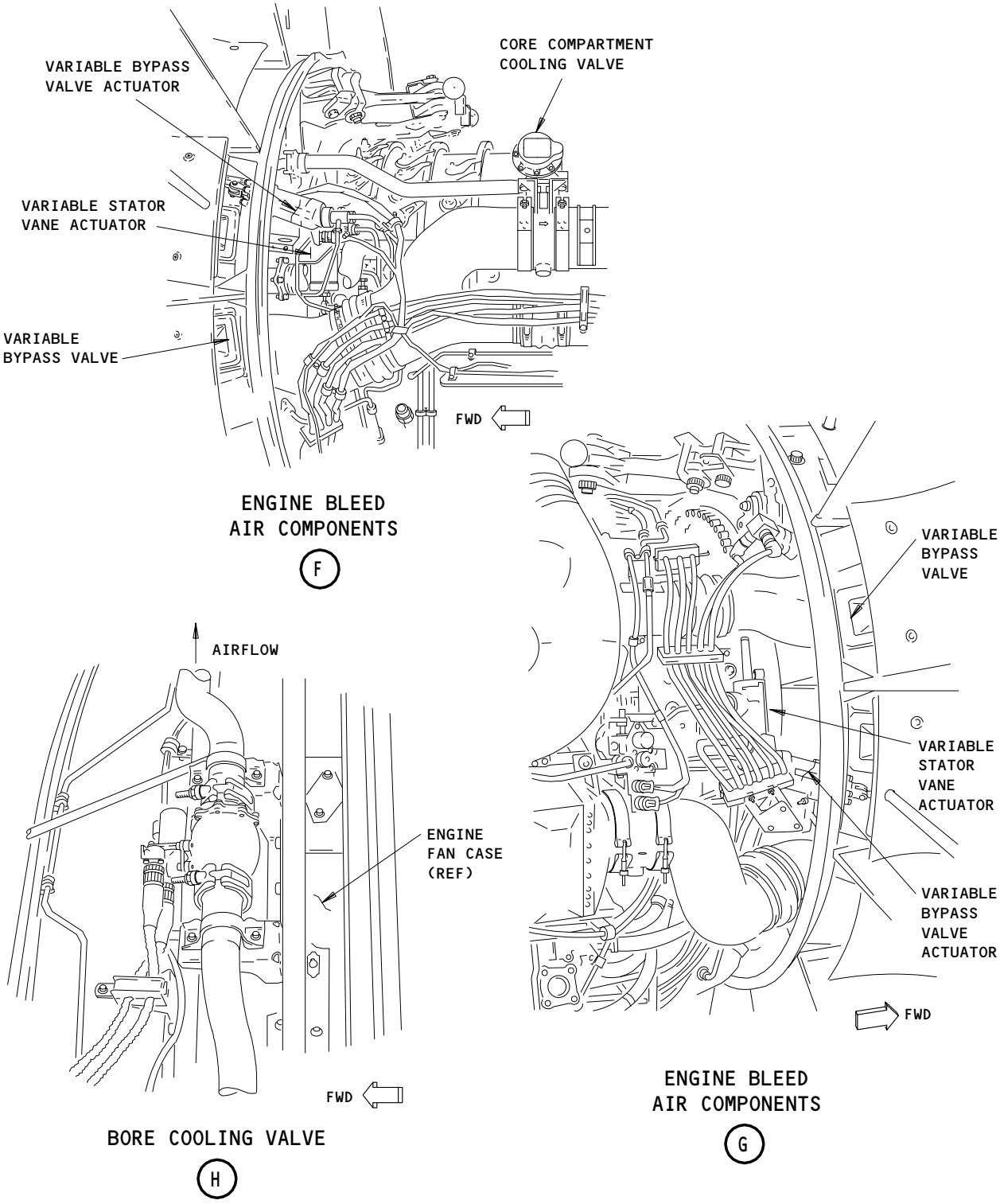
D



TURBINE CLEARANCE CONTROL VALVE (HPT)

E

Air - Component Location (Details from Sht 1)
Figure 102 (Sheet 2)



Air - Component Location
Figure 102 (Sheet 3)

AIR - ADJUSTMENT/TEST

1. General
   A. This section contains the steps necessary to do a test of the pneumatic ducts for leaks.
   B. You must operate the engine to do this test.

TASK 75-00-00-795-001-J00

2. Pneumatic Duct Leak Check
   A. Consumable Materials
      (1) Aluminum Foil - heavy duty
   B. References
      (1) 71-00-00/501, Power Plant
      (2) 71-11-06/201, Core Cowl Panels
   C. Access
      (1) Location Zone

412	Engine 1
422	Engine 2
432	Engine 3
442	Engine 4

      (2) Access Panel

413 and 414	Fan Cowl Panels - Engine 1
415 and 416	Thrust Reverser Halves - Engine 1
417 and 418	Core Cowl Panels - Engine 1
423 and 424	Fan Cowl Panels - Engine 2
425 and 426	Thrust Reverser Halves - Engine 2
427 and 428	Core Cowl Panels - Engine 2
433 and 434	Fan Cowl Panels - Engine 3
435 and 436	Thrust Reverser Halves - Engine 3
437 and 438	Core Cowl Panels - Engine 3
443 and 444	Fan Cowl Panels - Engine 4
445 and 446	Thrust Reverser Halves - Engine 4
447 and 448	Core Cowl Panels - Engine 4

   D. Procedure

      S 865-002-J00
      (1) Open the core cowl panels (Ref 71-11-06/201).

      S 215-003-J00
      (2) Do a visual check of the pneumatic tube connections.
         (a) Look for gaps between the tube connections.

      S 225-004-J00
      (3) If you removed and installed a tube or if you see a tube connection that may have a gap or a leak, do these steps:
         (a) Put 2 to 4 layers of aluminum foil on the tube connection.
            1) Cut the foil into rectangles with a length that will cover half of the duct connections plus approximately 3-4 inches at each end.

2) Put a piece of foil on each side of the connection and twist the ends together.
3) Make sure all of the tube connection you will test is covered completely.

(b) Install lockwire on the ends of the twisted foil halves.

S 865-005-J00

(4) Close the core cowl panel (Ref 71-11-06/201).

S 725-006-J00

(5) Do the Power Assurance Check Procedure (Ref 71-00-00/501, Test # 10).

S 865-009-J00

(6) Open the core cowl panels (Ref 71-11-06/201).

S 215-007-J00

(7) Do a visual check of the foil for signs of a leak:
(a) Look for holes in the foil.
(b) Look for connections where a leak has pushed the foil away from the connection.
(c) If you see signs of a leak, repair, tighten, or replace the connection as it is necessary.
(d) Do the pneumatic tube leak check procedure again.

S 865-008-J00

(8) Close the core cowl panels (Ref 71-11-06/201).

ENGINE COOLING - DESCRIPTION AND OPERATION

1. General
   A. The purpose of the engine cooling systems is to maintain the temperature of the engine (core) compartment and engine external accessories at acceptable levels. The engine also incorporates internal cooling of the compressor rotor bore, the high pressure turbine (HPT) second-stage nozzle, and the turbine cases.
   B. Engine cooling consists of the following systems:
      - HPC Bore Cooling System, AMM 75-21-00/001 *[1]
      - Engine External Accessories Cooling, AMM 75-23-00/001
      - Turbine Clearance Control System, AMM 75-24-00/001
      - 11th-Stage Cooling Air System, AMM 75-26-00/001. *[2]

      *[1] ENGINES WITHOUT GE SB 75-157 (WITH BORE COOLING VALVES)
      *[2] ENGINES WITHOUT GE SB 73-156 (WITH 11TH STAGE COOLING AIR SYSTEM)
   C. The integrated drive generator (IDG), ignition leads, and igniter plugs are also cooled by the engine accessories cooling system.
2. ENGINES WITHOUT GE SB 75-157;
   HPC Bore Cooling System
   A. The high pressure compressor (HPC) bore cooling system uses fan discharge booster air to remove heat from the HPC center bore. The system controls the amount of air that flows through the bore to regulate compressor blade tip clearances.
   B. The system consists of the fan frame, three bore cooling valves, and the electronic control unit (ECU).
3. Engine External Accessories Cooling
   A. The engine external accessories cooling system uses fan discharge air to cool the various engine components and thus the engine core compartment. The air enters the cooling duct on the left side of the engine, goes through the core compartment cooling air valve, and is distributed by the core compartment cooling manifold.
   B. The IDG is cooled with an air/oil heat exchanger and a fuel/oil heat exchanger. The air/oil heat exchanger is installed on the right side of the engine. Hot oil from the IDG is cooled in the heat exchanger with fan discharge air (AMM 24-11-00/001).
   C. The core compartment cooling manifold directs fan discharge air to the ignition leads. A cooling jacket covers the hot section of the ignition leads. Fan air enters the cooling jacket and flows to the igniter plugs (AMM 74-00-00/001).
4. Turbine Clearance Control System
   A. ENGINES WITHOUT GE SB 75-159, 75-161 OR 75-165 (WITH THE LPT TCC);
      The turbine clearance control (TCC) system uses fan discharge air to cool the low pressure and high pressure turbine cases. The system controls the amount of air that flows to the LPT and HPT manifolds to decrease the turbine blade tip to shroud clearances.

      The system consists of two TCC valves, the ECU, and the hydromechanical unit (HMU). The HMU supplies fuel pressure to operate the valves.

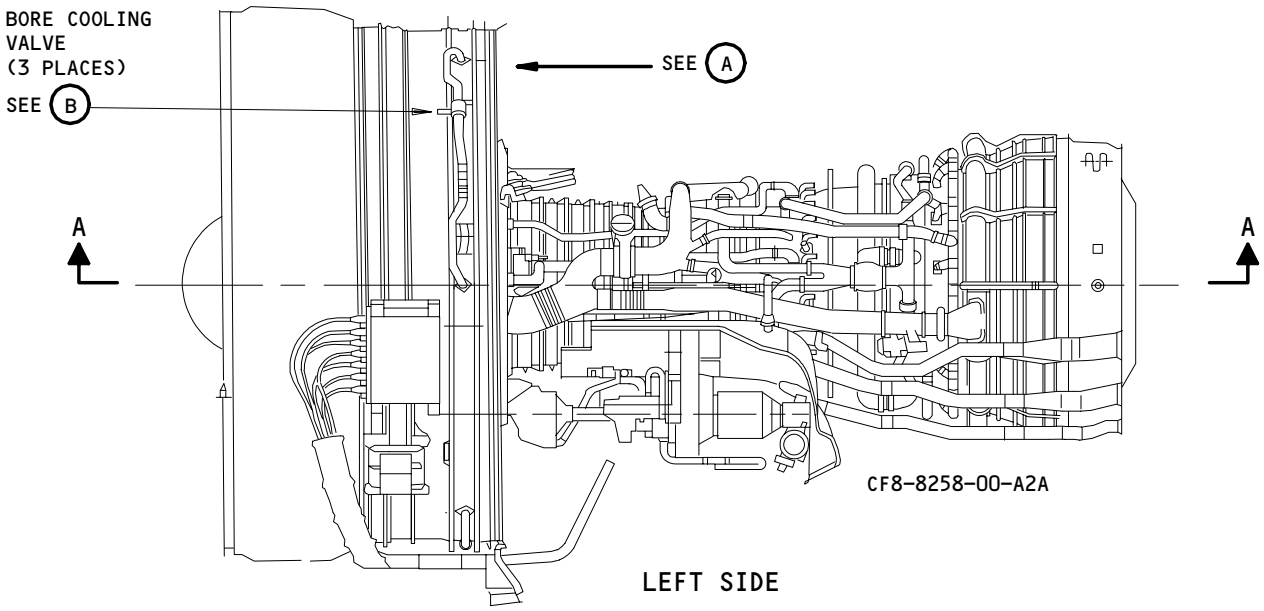
B. ENGINES WITH GE SB 75-159, 75-161 OR 75-165 (WITHOUT THE LPT TCC);
The turbine clearance control (TCC) system uses fan discharge air to cool the high pressure turbine case. The system controls the amount of air that flows to the HPT manifolds to decrease the turbine blade tip to shroud clearances.

The system consists of one TCC valve, the ECU, and the hydromechanical unit (HMU). The HMU supplies fuel pressure to operate the valve.

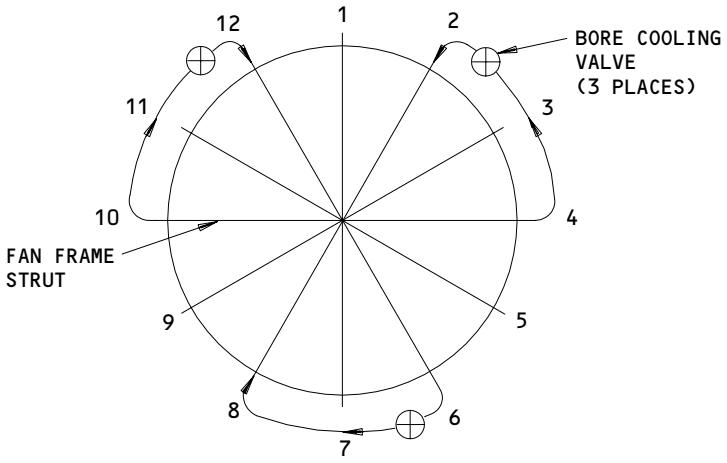
5. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
11th-Stage Cooling Air System
   A. The 11th-stage cooling air system uses 11th-stage bleed air to cool the HPT second stage nozzle. The system consists of two 11th-stage cooling air valves, an 11th-stage cooling valve solenoid, and the ECU.
   B. During low temperature engine operation, the solenoid sends a pneumatic signal to the valves. This will cause the valves to close and reduce the amount of bleed air that flows to the HPT second-stage nozzle. During high temperature engine operation, the valves open and supply the maximum amount of bleed air to the HPT second-stage nozzle.
6. ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES OR WITH GE SB 75-123;
11th-Stage Cooling Air System
   A. The 11th-stage cooling air system uses 11th-stage bleed air to cool the HPT second stage nozzle and controls the core compartment cooling valve through the solenoid. The system consists of an 11th-stage cooling valve solenoid, and the ECU.
   B. The electronic control unit (ECU) monitors the engine operating conditions and transmits electrical signals to the 11th-stage cooling valve solenoid. The solenoid sends a pneumatic signal to the core compartment cooling air valve.

HPC BORE COOLING SYSTEM - DESCRIPTION AND OPERATION

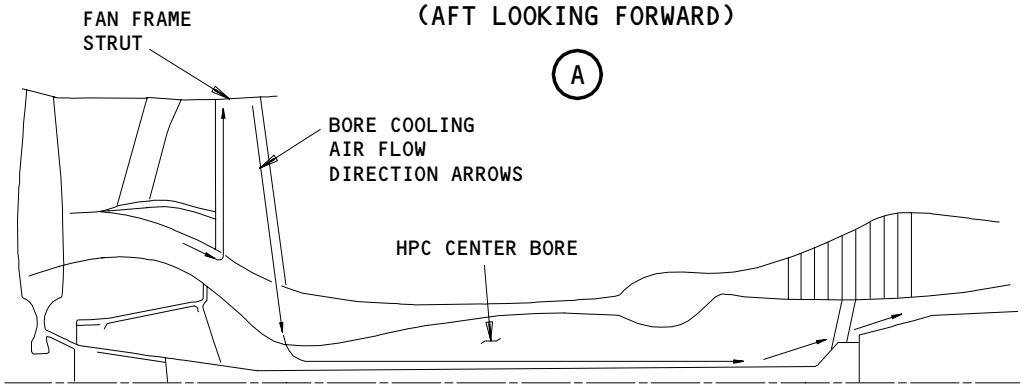
1. General (Fig. 1)
   A. The high pressure compressor (HPC) bore cooling system supplies additional cooling air to the HPC center bore. The system consists of the fan frame, three bore cooling valves, and the electronic control unit (ECU).
   B. The purpose of the system is to regulate compressor blade tip clearances by controlling the amount and the temperature of the air that flows through the center bore. The fan frame struts 1, 4, 6, 9, and 10 act as collection and distribution points for the booster discharge cooling air. The cooling air from struts 1 and 9 flows radially inward and directly to the HPC center bore. The cooling air from struts 4, 6, and 10 flows radially outward and through the bore cooling valves.
   C. The bore cooling valves are spring loaded in the open position for maximum air flow during high power/high temperature engine operation. The ECU monitors engine operating conditions and transmits independent electrical position command signals to the solenoids on the bore cooling valves. Depending upon the conditions there may be any combination of valves open or closed. The solenoid changes the electrical signal into a pneumatic signal to close the valve and decrease the air flow to the HPC center bore.
   D. The bore cooling valves are closed during low power engine operation to conserve booster discharge air and improve engine efficiency.
2. Bore Cooling Valve (Fig. 1, Sheet 2)
   A. The three bore cooling valves are installed on the fan case at the 2:00, 5:30, and 10:00 o'clock positions. The valves are the same and are individually controlled by the ECU.
   B. The valve is a two position, pneumatically operated, sleeve-type valve assembly. Each valve has a translating sleeve, an actuation chamber, and a solenoid controlled ball valve.
      (1) The translating sleeve is spring loaded to the open position.
      (2) The solenoid controlled ball valve is an integral part of the bore cooling valve. The solenoid can be energized by either channel A or channel B.
      (3) When the solenoid is energized, the ball valve opens and the valve inlet pneumatic signal pressure is sent to the actuation chamber. This causes the translating sleeve to move to the closed position.
      (4) When the solenoid is de-energized, the ball valve cuts off the pneumatic signal pressure to the actuation chamber. This will permit the spring to open the translating sleeve.
      (5) There is no valve position feedback provided.



LEFT SIDE

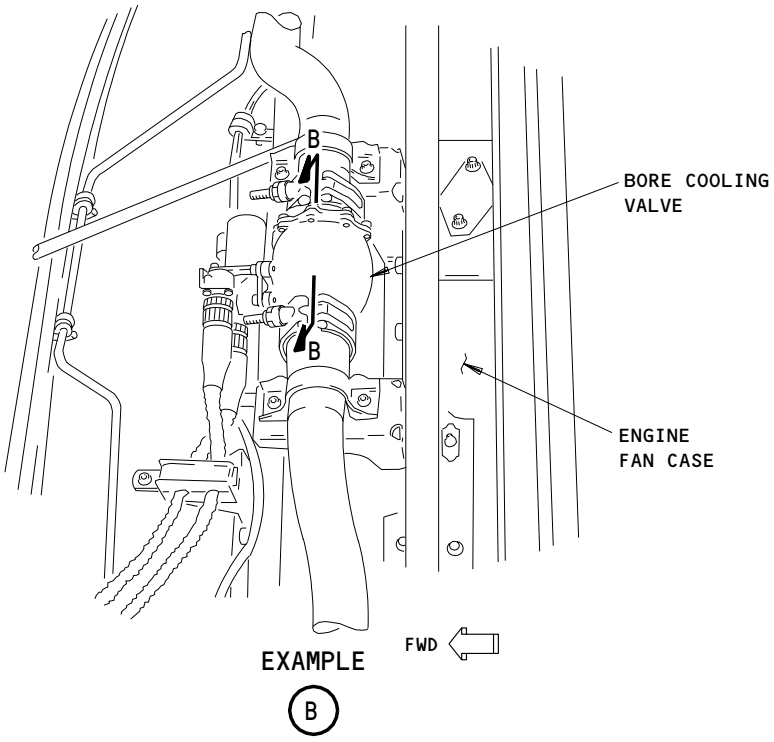


AIRFLOW DIRECTION
(AFT LOOKING FORWARD)



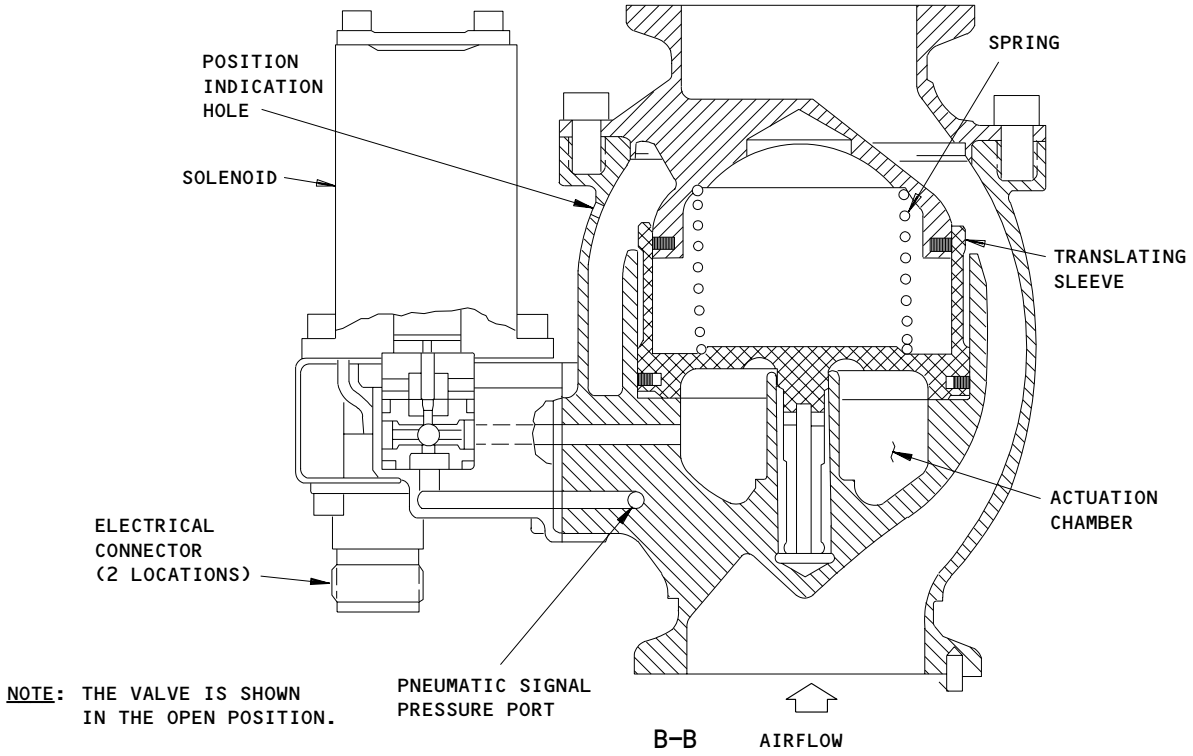
A-A

Bore Cooling System
Figure 1 (Sheet 1)



EXAMPLE

B



NOTE: THE VALVE IS SHOWN IN THE OPEN POSITION.

Bore Cooling System
Figure 1 (Sheet 2)

596639

(6) The valve has a position indication hole on the outlet flange. This hole is used to do a check of the valve position and make sure that it is not stuck in the closed position.

3. Operation

A. Functional Description

(1) The fan booster discharge air enters the leading edge slots of the fan frame struts 1, 4, 6, 9, and 10. The air from struts 1 and 9 flows directly to the center bore. The air from struts 4, 6, and 10 flows into individual cooling tubes and then into the bore cooling valves. The air from strut 4 flows to strut 2, strut 6 to strut 8, and strut 10 to strut 12. After the air enters struts 2, 8, and 12, it flows radially inward and into the center bore.

(2) The ECU measures fan speed (N1), altitude, core speed (N2), compressor inlet temperature (T2.5), and compressor discharge temperature (T3). The ECU will calculate bore temperature and send individual 16 volt dc command signals to the bore cooling valves.

(3) When the airplane is at high altitude and N1 is less than 86%, the ECU will energize one, two, or all three of the bore cooling valve solenoids. The pneumatic signal pressure is then sent to the actuation chamber. This will cause the translating sleeve to close the valve(s) and decrease the amount of cooling air that flows to the center bore.

(4) When the ECU determines that the bore temperature is too high, or when N1 is greater than 86%, it will de-energize one, two, or three of the solenoids. When the solenoid is de-energized, the pneumatic signal pressure to the actuation chamber is cut off. This will cause the spring to move the translating sleeve to the open position and increase the amount of cooling air flow to the center bore.

BORE COOLING VALVE - REMOVAL/INSTALLATION

1. General
   A. This procedure contains two tasks:
      - Remove the bore cooling valve
      - Install the bore cooling valve.
   B. To remove the bore cooling valve, you must do these steps:
      - Open the applicable fan cowl panel
      - Disconnect the electrical connectors
      - Remove the V-band clamp that attaches the bore cooling valve.
   C. To install the bore cooling valve, you must do these steps:
      - Attach the valve with the V-band clamp
      - Connect the electrical connectors
      - Close the applicable fan cowl panel.
   D. Three bore cooling valves are installed on the fan case at the 2:00, 5:30 and 10:00 o'clock positions. The removal and the installation procedures are the same for each of the three valves.

TASK 75-21-01-004-001-J00

2. Remove the Bore Cooling Valve (Fig. 401)
   A. References
      (1) 71-11-04/201, Fan Cowl Panels
      (2) IPC 75-21-01 Fig. 1 and 5
   B. Access
      (1) Location Zone

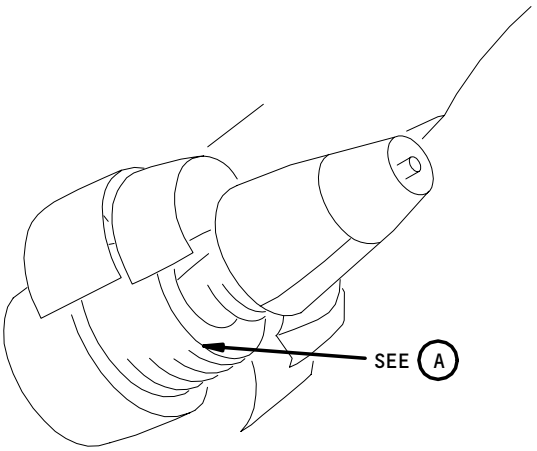
412	Engine 1 - Fan Case 2:00, 5:30 and 10:00 o'clock
422	Engine 2 - Fan Case 2:00, 5:30 and 10:00 o'clock
432	Engine 3 - Fan Case 2:00, 5:30 and 10:00 o'clock
442	Engine 4 - Fan Case 2:00, 5:30 and 10:00 o'clock

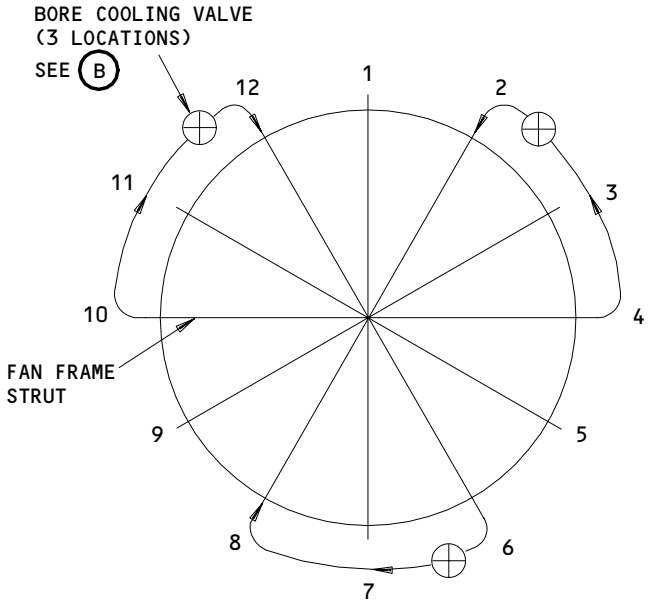
      (2) Access Panel

413 and 414	Fan Cowl Panels - Engine 1
423 and 424	Fan Cowl Panels - Engine 2
433 and 434	Fan Cowl Panels - Engine 3
443 and 444	Fan Cowl Panels - Engine 4

   C. Procedure

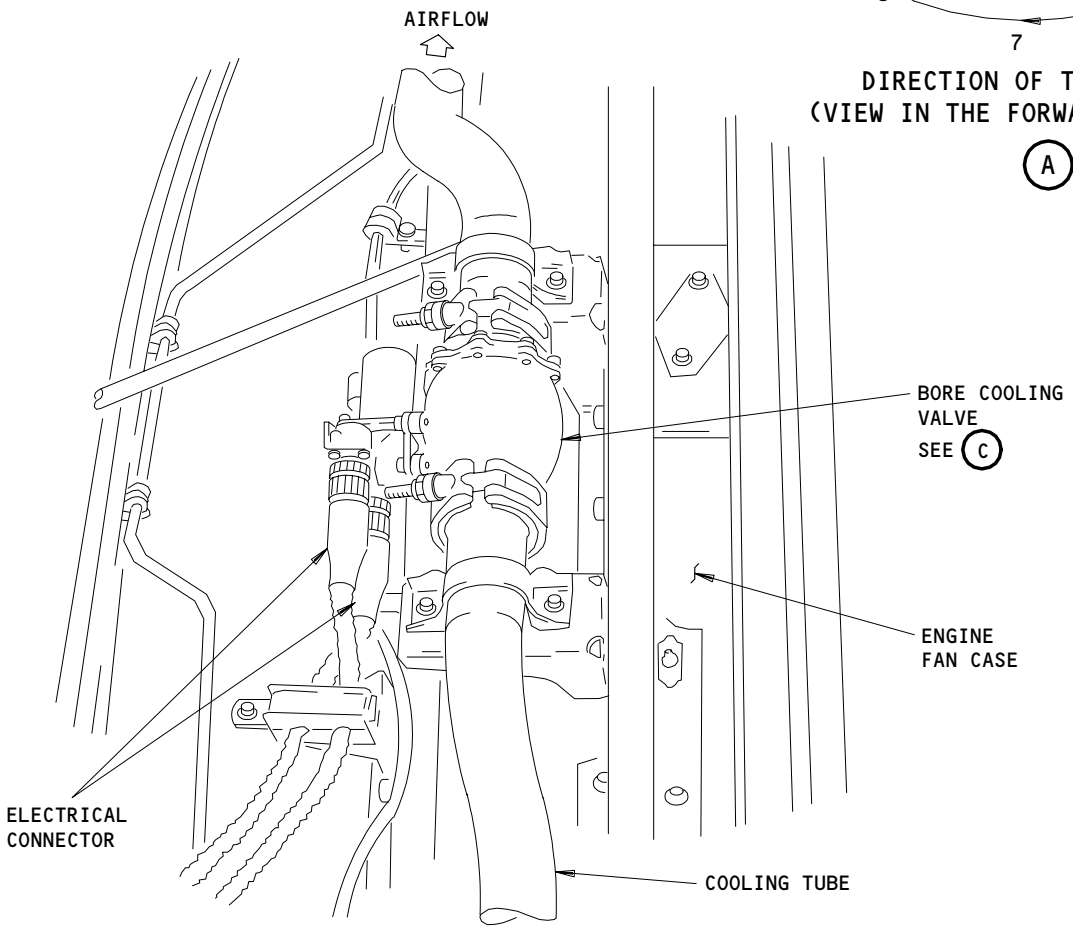
      S 014-002-J00
      (1) Open the left fan cowl panel to get access to the valve at the 10:00 o'clock position (Ref 71-11-04/201).





DIRECTION OF THE AIRFLOW
(VIEW IN THE FORWARD DIRECTION)

A



3 LOCATIONS (EXAMPLE)

B

Bore Cooling Valve Installation
Figure 401 (Sheet 1)

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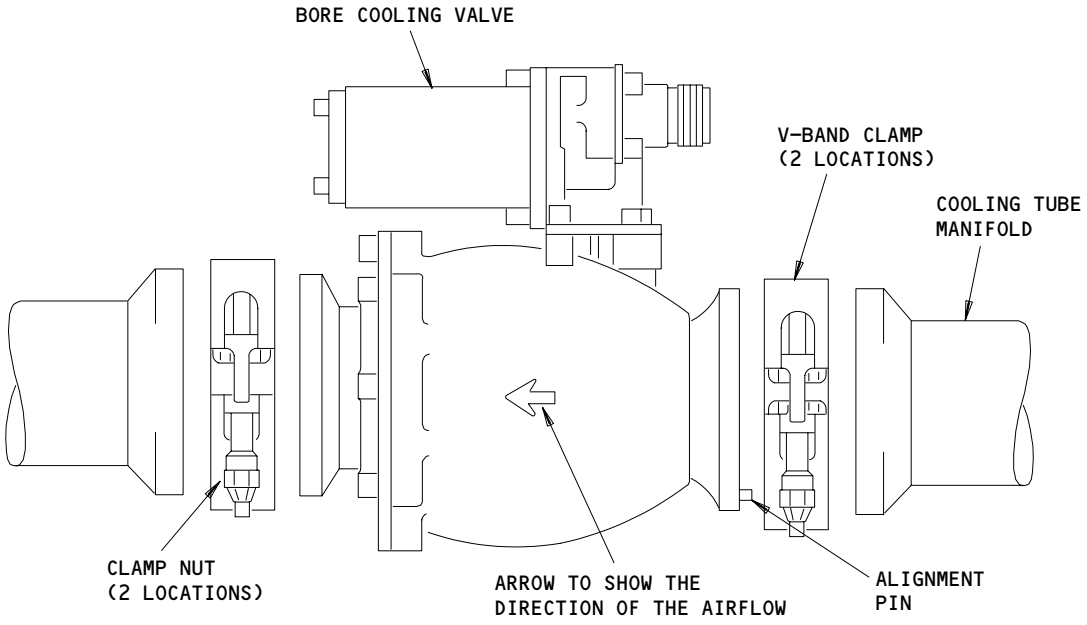


Bore Cooling Valve Installation
Figure 401 (Sheet 2)

S 014-007-J00
(2) Open the right fan cowl panel to get access to the valve at the 2:00 or the 5:30 o'clock position (Ref 71-11-04/201).

S 034-004-J00
(3) Disconnect two electrical connectors from the bore cooling valve.

S 034-005-J00
(4) Loosen the clamp nut on the V-band clamp.

S 034-006-J00
(5) Remove the V-band clamp at each end of the bore cooling valve.

S 024-014-J00
(6) Remove the bore cooling valve from the fan case.

S 034-009-J00
(7) Install a cover on each tube opening.

TASK 75-21-01-404-007-J00

3. Install the Bore Cooling Valve (Fig. 401)

A. References
(1) AMM 70-50-00/201, Tightening Techniques and Torque Values
(2) AMM 71-11-04/201, Fan Cowl Panels
(3) AIPC 75-21-01, Fig. 1 and 5

B. Access
(1) Location Zone

412	Engine 1 - Fan Case 2:00, 5:30 and 10:00 o'clock
422	Engine 2 - Fan Case 2:00, 5:30 and 10:00 o'clock
432	Engine 3 - Fan Case 2:00, 5:30 and 10:00 o'clock
442	Engine 4 - Fan Case 2:00, 5:30 and 10:00 o'clock

(2) Access Panel

413 and 414	Fan Cowl Panels - Engine 1
423 and 424	Fan Cowl Panels - Engine 2
433 and 434	Fan Cowl Panels - Engine 3
443 and 444	Fan Cowl Panels - Engine 4

C. Procedure

S 434-008-J00
(1) Remove the cover from each tube opening.

S 424-009-J00
(2) Put the bore cooling valve in the correct position between the cooling tubes.

NOTE: Make sure that the airflow direction arrow on the valve points in the direction of the airflow. Refer to Fig. 401 (The arrow must point from fan frame strut 4 to strut 2, from strut 6 to strut 8, or from strut 10 to strut 12, for the applicable valve).

Make sure that the alignment pin is engaged in the cooling tube.

S 434-010-J00
(3) Install two V-band clamps around the valve and the cooling tube flanges.

S 414-008-J00
(4) Tighten the clamp nuts to 45-55 pound-inches (5.1-6.2 N.m) with the tighten procedure for V-band clamps (AMM 70-50-00/201).

S 434-011-J00
(5) Connect two electrical connectors to the bore cooling valve.

S 414-013-J00
(6) Close the applicable fan cowl panel (AMM 71-11-04/201).

BORE COOLING VALVE - INSPECTION/CHECK

1. General
   A. This procedure provides one task: a check of the position of the bore cooling valve.
   B. To do a check of the bore cooling valve, you must do these steps:
      - Open the fan cowl panels
      - Make sure the bore cooling valve is in the open position
      - Close the fan cowl panels.
   C. Do this check to make sure that the three bore cooling valves will move freely from the closed position.

      NOTE: The bore cooling valves must move freely to the open position from the force of a spring.

TASK 75-21-01-206-001-J00

2. Do a Check of the Bore Cooling Valve
   A. Standard Tools and Equipment
      (1) Pin - 0.075 inch (1.91 mm) diameter
      (2) Pin - 0.055 inch (1.40 mm) diameter
   B. References
      (1) 71-11-04/201, Fan Cowl Panels
      (2) 75-21-01/401, Bore Cooling Valve
   C. Access
      (1) Location Zone

412	Engine 1 - Fan Case 2:00, 5:30 and 10:00 o'clock
422	Engine 2 - Fan Case 2:00, 5:30 and 10:00 o'clock
432	Engine 3 - Fan Case 2:00, 5:30 and 10:00 o'clock
442	Engine 4 - Fan Case 2:00, 5:30 and 10:00 o'clock

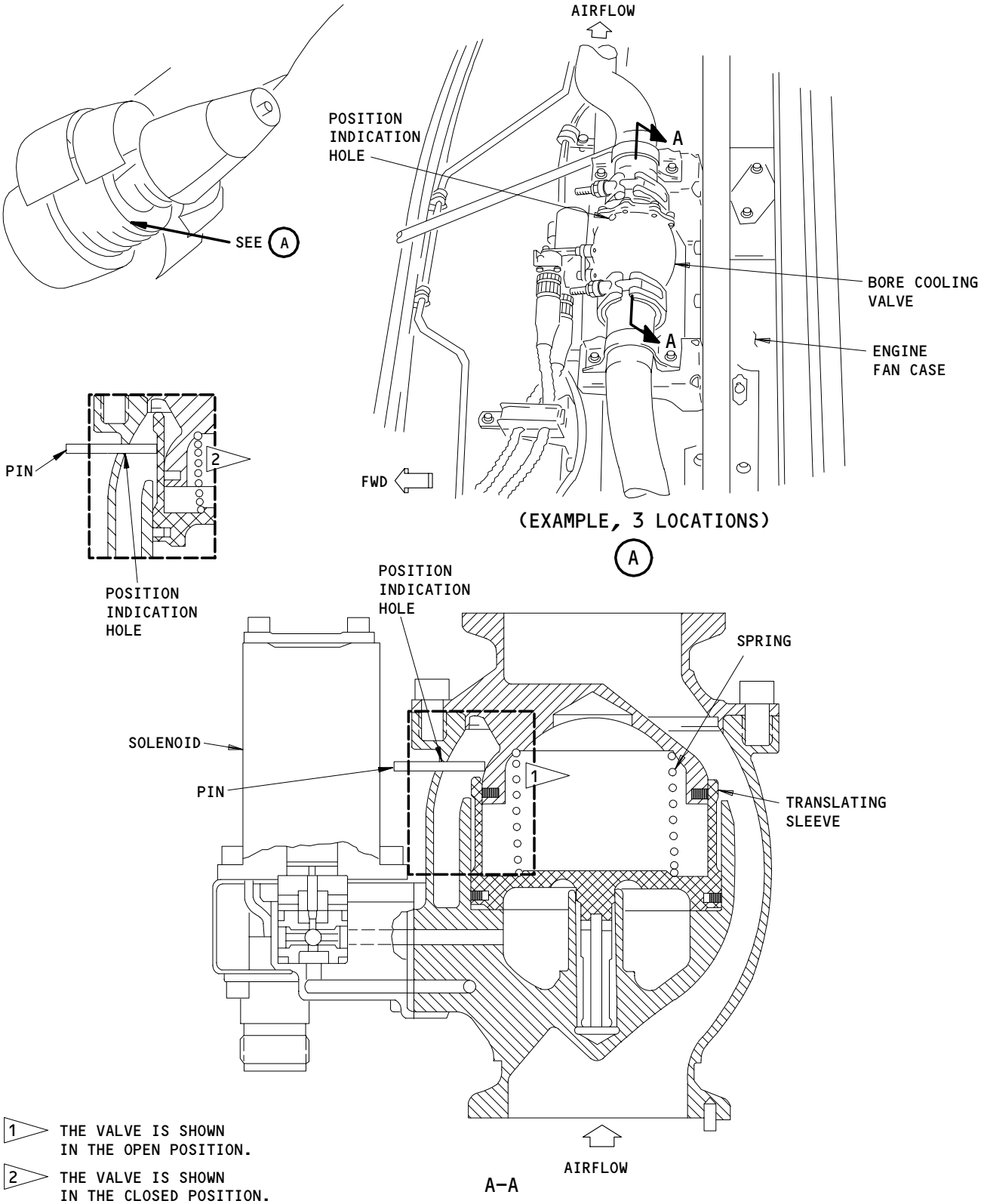
      (2) Access Panel

413 and 414	Fan Cowl Panels - Engine 1
423 and 424	Fan Cowl Panels - Engine 2
433 and 434	Fan Cowl Panels - Engine 3
443 and 444	Fan Cowl Panels - Engine 4

   D. Procedure

      S 016-002-J00
      (1) Open the fan cowl panels (Ref 71-11-04/201).

      S 226-005-J00
      (2) ENGINES PRE GE SB 72-722;
      Do a check of the position of the bore cooling valve (Fig. 601):
      (a) Put a 0.075 inch (1.91 mm) pin into the position indication hole on the outlet flange of the valve.
      1) You must be able to insert the pin a minimum distance of 0.32 inch (0.81 cm).



Bore Cooling Valve Inspection
Figure 601

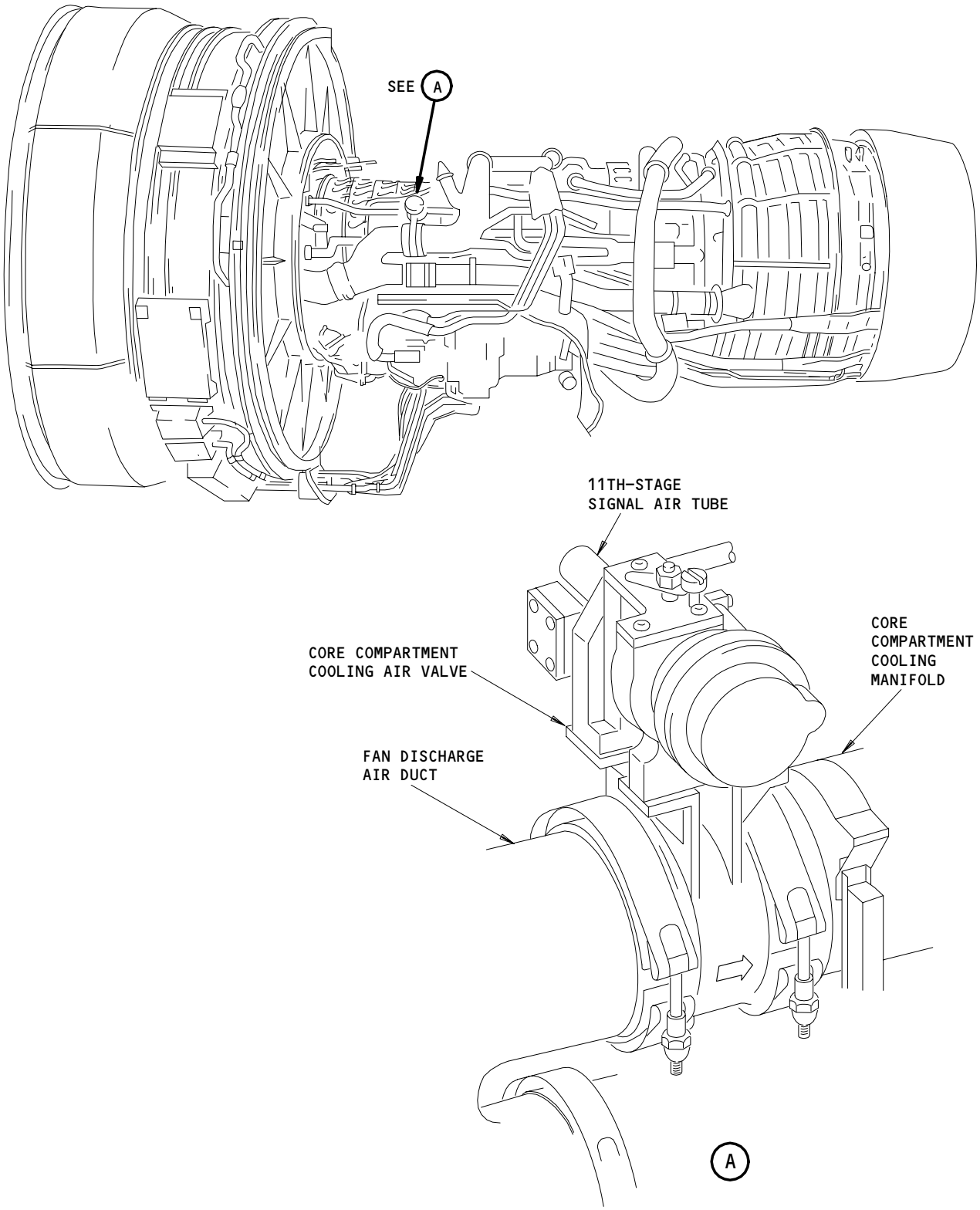
S 226-009-J00
(3) ENGINES POST GE SB 72-722;
Do a check of the position of the bore cooling valve (Fig. 601):
(a) Put a 0.055 inch (1.40 mm) pin into the position indication hole on the outlet flange of the valve.
1) You must be able to insert the pin a minimum distance of 0.30 inch (0.76 cm).

S 426-010-J00
(4) Replace the bore cooling valve (AMM 75-21-01/401) if the pin can not be inserted the minimum distance.
(a) This shows that the valve will not move freely from the closed position.

S 416-007-J00
(5) Close the fan cowl panels (Ref 71-11-04/201).

ENGINE EXTERNAL ACCESSORIES COOLING - DESCRIPTION AND OPERATION

1. General
   A. The engine external accessories and the core compartment are cooled with fan discharge air. The cooling air enters the fan discharge air duct on the left side of the engine. The core compartment cooling air valve controls the amount of air flow.
   B. The purpose of this cooling system is to maintain the core compartment air temperatures at acceptable values with the use of a minimum amount of fan air.
   C. ENGINES WITHOUT GE SB 75-156;
      The electronic control unit (ECU) monitors the engine operating conditions and transmits electrical signals to the 11th-stage cooling valve solenoid. The solenoid sends a pneumatic signal to the core compartment cooling air valve.
   D. ENGINES WITH GE SB 75-156;
      The electronic control unit (ECU) monitors the engine operating conditions and transmits electrical signals to the CCCV (core compartment cooling valve).
   E. During takeoff thrust and climb thrust operating conditions, the core engine develops higher temperatures. The cooling air valve supplies most of the fan discharge air to the core compartment cooling manifold. The cooling air is then directed to the various external accessories in the core compartment.
   F. During cruise condition, the cooling air valve will reduce the amount of cooling air to the core compartment cooling manifold. The cooling air is then directed to the low pressure turbine (LPT) cooling manifold.
2. ENGINES WITHOUT GE SB 75-156;
   Core Compartment Cooling Air Valve (Fig. 1)
   A. The core compartment cooling air valve is installed on the high pressure compressor case at the 10 o'clock position. The valve is pneumatically operated by 11th-stage signal air.
   B. The valve assembly consists of a butterfly valve, an actuation mechanism, a translational lever, a positioning spring, and a manual override handle.
      (1) The positioning spring holds the valve in the open position when there is no 11th-stage signal air supplied.
      (2) When 11th-stage signal air is supplied to the valve assembly, the actuation mechanism will turn the translational lever. This will cause the valve to move to the closed position.
      (3) The manual override handle gives a visual indication of the valve position. It is also used to lock the valve in the closed or open position.
   C. ENGINES WITHOUT GE SB 75-116;
      The valve assembly has an air flow direction arrow and alignment pins on the inlet mounting flange to prevent incorrect installation.

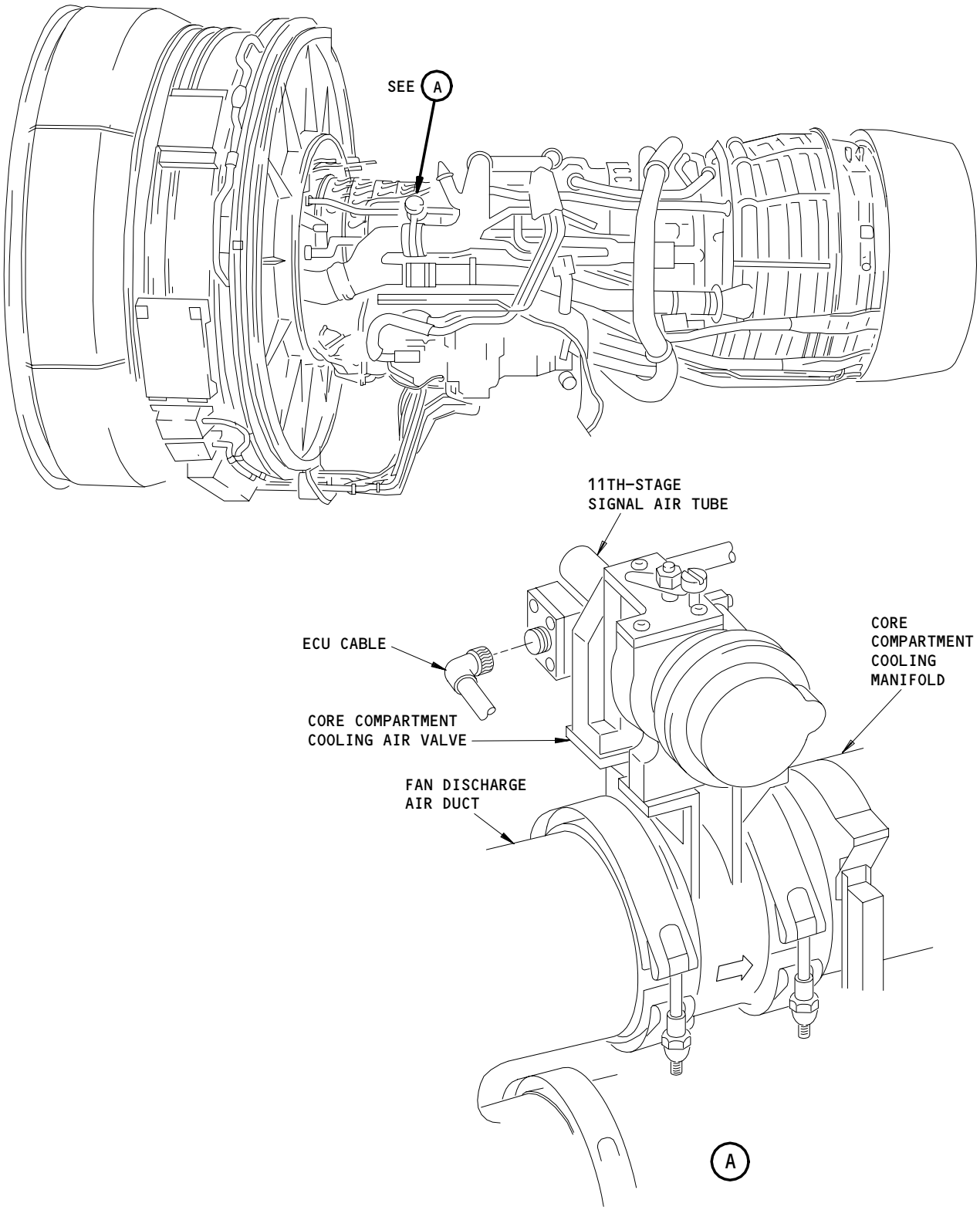


Core Compartment Cooling Air Valve
Figure 1

D. ENGINES WITH GE SB 75-116;
The valve assembly has an air flow direction arrow and an alignment mark on the inlet duct to prevent incorrect installation.

3. ENGINES WITH GE SB 75-156;
Core Compartment Cooling Air Valve (Fig. 1A)
A. The core compartment cooling air valve is installed on the high pressure compressor case at the 10 o'clock position. The valve is electrically operated by the EEC.
B. The valve assembly consists of a butterfly valve, an actuation mechanism, a translational lever, a positioning spring, and a manual override handle.
(1) The positioning spring holds the valve in the open position when there is no electrical signal supplied.
(2) When an electrical signal from the EEC is supplied to the valve assembly, the actuation mechanism will turn the translational lever. This will cause the valve to move to the closed position.
(3) The manual override handle gives a visual indication of the valve position. It is also used to lock the valve in the closed or open position.

4. ENGINES WITHOUT GE SB 75-156;
Operation
A. Functional Description
(1) The fan discharge cooling air enters the cooling duct at the aft end of the fan frame. The air is then divided into core compartment cooling air and LPT cooling air.
(2) At takeoff and low altitudes the cooling air valve is in the spring loaded open position. This will permit maximum air flow to the engine external accessories and the core compartment.
(3) When an altitude of approximately 20,000 feet (6096 m) is reached, the ECU will send a 16 volt dc signal to the 11th-stage cooling valve solenoid. The energized solenoid will send a pneumatic signal to the cooling air valve. This will cause the valve to move to the closed position. The cooling air will then be directed to the LPT cooling manifold.
(4) When the airplane descends, the ECU will de-energize the solenoid and cut off the 11th-stage signal air. The positioning spring will return the valve to the normal open position.



Core Compartment Cooling Air Valve
Figure 1A

5. ENGINES WITH GE SB 75-156;
   Operation
   A. Functional Description
      (1) The fan discharge cooling air enters the cooling duct at the aft end of the fan frame. The air is then divided into core compartment cooling air and LPT cooling air.
      (2) At takeoff and low altitudes the cooling air valve is in the spring loaded open position. This will permit maximum air flow to the engine external accessories and the core compartment.
      (3) When an altitude of approximately 20,000 feet (6096 m) is reached, the ECU will send a 16 volt dc signal to the CCCV. This will cause the valve to move to the closed position. The cooling air will then be directed to the LPT cooling manifold.

          When the airplane descends, the ECU will signal the CCCV to cut off the 11th-stage signal air. The positioning spring will return the valve to the normal open position.

CORE COMPARTMENT COOLING AIR VALVE - REMOVAL/INSTALLATION

1. General
   A. This procedure contains two tasks:
      - Remove the core compartment cooling air valve (CCC air valve)
      - Install the core compartment cooling air valve (CCC air valve).
      (1) To remove the CCC air valve, you must do the following:
         - Open the left thrust reverser half
         - Disconnect the air tube and the coupling from the CCC air valve
         - Lock the CCC air valve in the closed position
         - Disconnect the V-band clamp and remove the CCC air valve.
      (2) To install the CCC air valve, you must do the following:
         - Connect the coupling and the air tube to the CCC air valve
         - Make sure the CCC air valve is locked in the closed position
         - Install the CCC air valve and connect the V-band clamp
         - Release the CCC air valve to the open position
         - Close the left thrust reverser half.

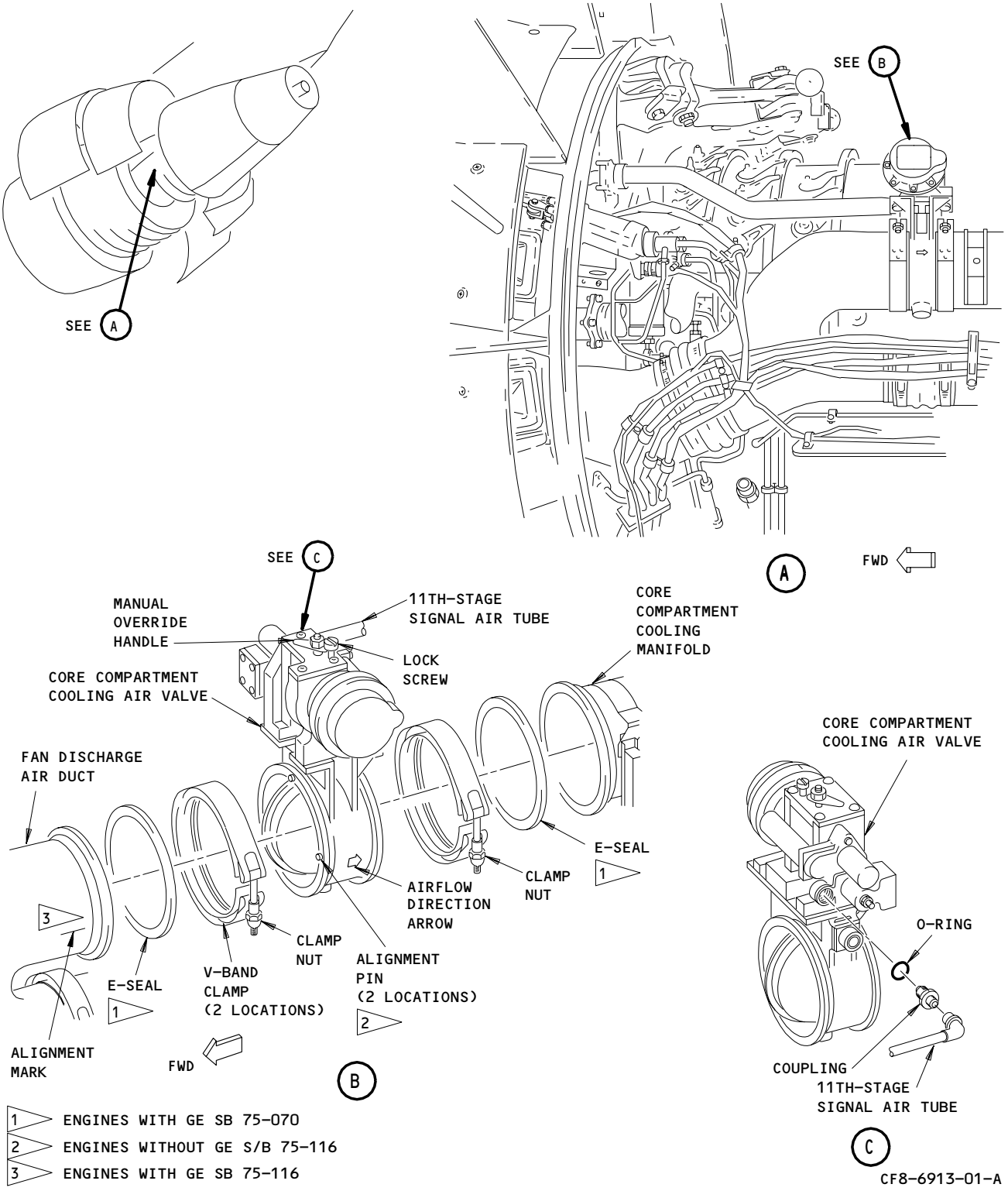
TASK 75-23-01-004-001-J00

2. Remove the Core Compartment Cooling Air Valve (Fig. 401, Fig. 401A)
   A. References
      (1) AMM 78-31-00/201, Thrust Reverser System
      (2) AIPC 75-20-51 Fig. 1
   B. Access
      (1) Location Zone
         412 Engine 1 - Compressor Case 10 o'clock
         422 Engine 2 - Compressor Case 10 o'clock
         432 Engine 3 - Compressor Case 10 o'clock
         442 Engine 4 - Compressor Case 10 o'clock

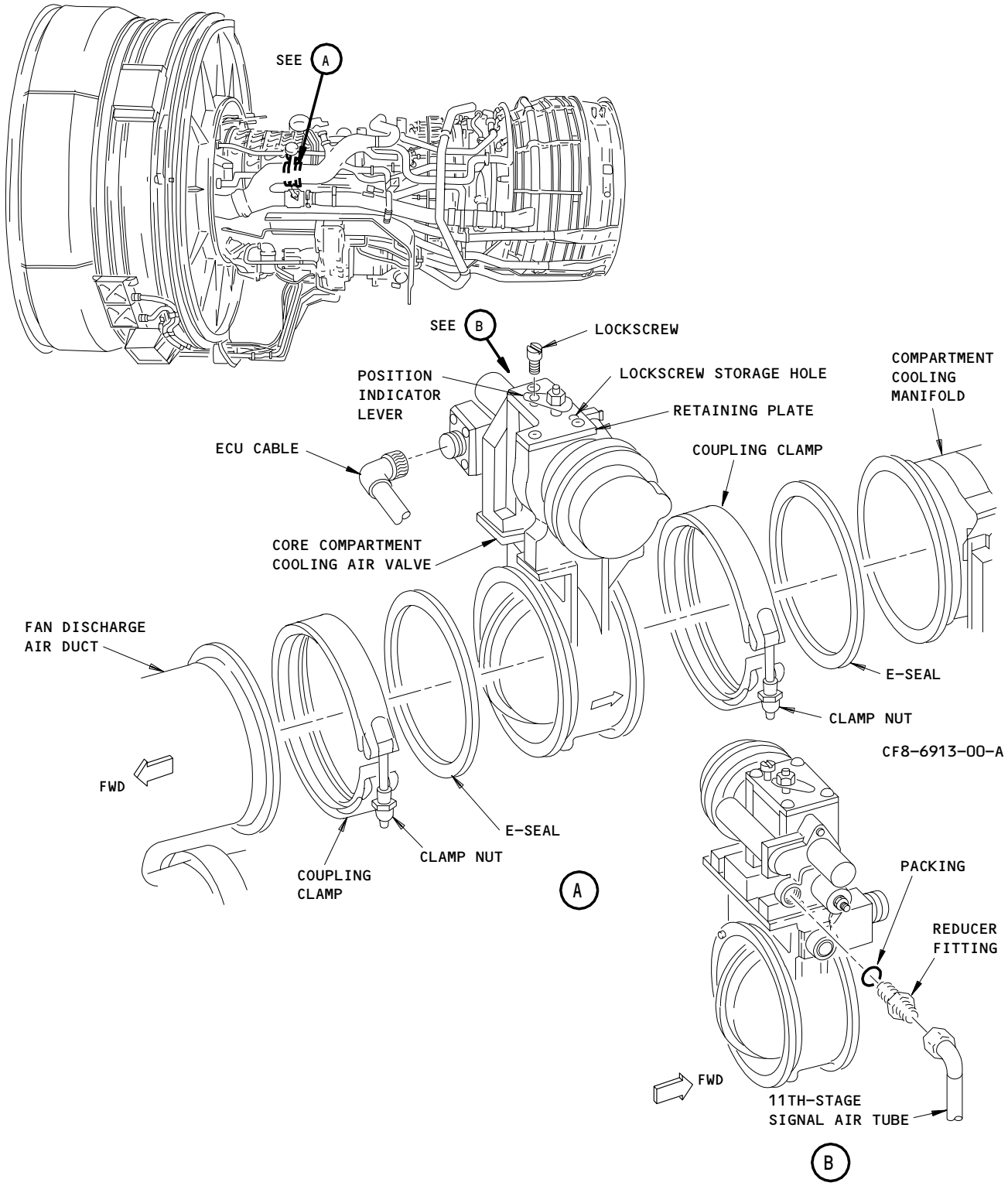
      (2) Access Panel
         415 Left Thrust Reverser Half - Engine 1
         425 Left Thrust Reverser Half - Engine 2
         435 Left Thrust Reverser Half - Engine 3
         445 Left Thrust Reverser Half - Engine 4

   C. Procedure

      S 014-002-J00
      (1) Open the left thrust reverser half (AMM 78-31-00/201).



Core Compartment Cooling Air Valve Installation
Figure 401



Core Compartment Cooling Air Valve
Figure 401A

EFFECTIVITY
ENGINES POST-GE-SB 75-158
(WITH THE ECU CABLE CONNECTION TO THE CCC AIR VALVE)

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S 034-003-J00
(2) ENGINES PRE-GE-SB 75-158;
Disconnect the signal air tube from the CCC air valve.

S 024-020-J00
(3) ENGINES POST-GE-SB 75-158;
Disconnect the ECU cable connector from the CCC air valve (Fig. 401A).

S 034-017-J00
(4) Remove the coupling and the O-ring from the CCC air valve. Discard the O-ring.

S 984-004-J00
(5) Lock the CCC air valve in the closed position, to prevent damage to the edge of the valve butterfly.
(a) Remove the set screw and the lock screw from the CCC air valve.
(b) Turn the manual override handle to the closed position.
(c) Install the lock screw in the manual override handle and into the set screw storage hole. Hand-tighten the lock screw.

S 024-005-J00
(6) Remove the CCC air valve.
(a) Loosen the clamp nuts and remove the V-band clamps. The V-band clamps attach each end of the valve to the air duct of the fan discharge and the cooling manifold of the core compartment.
(b) ENGINES PRE-GE-SB 75-116;
Remove the alignment pins at the forward (inlet) end of the CCC air valve from the fan duct.
(c) Remove the CCC air valve from the engine.
(d) ENGINES POST-GE-SB 75-070;
Remove the E-seals from two sides of the valve.

S 034-007-J00
(7) Install protective covers on all openings in the CCC air valve, the fan duct, and the cooling manifold.

TASK 75-23-01-404-008-J00

3. Install the Core Compartment Cooling Air Valve (Fig. 401, Fig. 401A)

A. Consumable Materials
(1) D00389 Oil - Lubricating, GE Spec D50TF1 (GE C02-019)

B. References
(1) AMM 70-50-00/201, Tightening Techniques and Torque Values
(2) AMM 78-31-00/201, Thrust Reverser System
(3) AIPC 75-20-51, Fig. 1

C. Access
(1) Location Zone
412 Engine 1 - Compressor Case 10 o'clock
422 Engine 2 - Compressor Case 10 o'clock
432 Engine 3 - Compressor Case 10 o'clock
442 Engine 4 - Compressor Case 10 o'clock

(2) Access Panel
415 Left Thrust Reverser Half - Engine 1
425 Left Thrust Reverser Half - Engine 2
435 Left Thrust Reverser Half - Engine 3
445 Left Thrust Reverser Half - Engine 4

D. Procedure

S 434-009-J00
(1) Remove protective covers from the cooling ducts.

S 434-010-J00
(2) Lubricate a new O-ring with engine oil and install the O-ring on the coupling. Install the coupling in the CCC air valve. Torque the coupling to 155-175 pound-inches (17.5-19.8 N.m).

S 984-011-J00
(3) Make sure that the CCC air valve is locked in the closed position. Turn the manual override handle to the closed position and hold with the lock screw.

S 424-019-J00
(4) Install the CCC air valve.
(a) ENGINES POST-GE-SB 75-070;
Install the E-seals on two sides of the valve.

(b) Put the CCC air valve between the air duct of the fan discharge and the cooling manifold of the core compartment.

(c) ENGINES PRE-GE-SB 75-116;
Make sure the alignment pins at the forward (inlet) end of the CCC air valve engage with the alignment holes in the fan duct.

NOTE: Make sure the airflow direction arrow on the CCC air valve points in the direction of the airflow. The air flows from the air duct of the fan discharge to the cooling manifold of the core compartment.

(d) ENGINES POST-GE-SB 75-116;
Align the arrow on the CCC air valve with line on the fan discharge air duct.

NOTE: Make sure the airflow direction arrow on the CCC air valve points in the direction of the airflow. The air flows from the air duct of the fan discharge to the cooling manifold of the core compartment.

(e) Put two V-band clamps around the mating flanges of the CCC air valve and the duct flange. Torque the clamp nuts to an end torque of 50 pound-inches (5.6 N.m) with the procedure to torque V-band clamps (AMM 70-50-00/201).

S 434-014-J00

(5) ENGINES PRE-GE-SB 75-158;
Connect the signal air tube to the coupling in the CCC air valve. Torque the tube nut to 180-200 pound-inches (20.3-22.6 N.m).

S 984-015-J00

(6) Return the valve butterfly to the spring-loaded open position:
(a) Remove the lock screw from the manual override handle and let the valve return to the open position.
(b) Install the lock screw and set screw in their storage holes. Hand-tighten the lock screw and install a lockwire.

S 424-021-J00
(7) ENGINES POST-GE-SB 75-158;
Connect the ECU cable connector to the CCC air valve.

S 414-016-J00
(8) Close the left thrust reverser half (AMM 78-31-00/201).

TURBINE CLEARANCE CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. ENGINES WITHOUT GE SBs 75-159, 75-161, 75-165;
   General
   A. The turbine clearance control (TCC) system supplies cooling air flow to the high pressure turbine (HPT) and the low pressure turbine (LPT) cases. The system consists of two TCC valves, the electronic control unit (ECU), and the hydromechanical unit (HMU).
   B. The purpose of the system is to decrease the turbine blade tip to shroud clearances by regulating the amount of cooling air flow to the turbine cases. The fan discharge cooling air enters the LPT case on the left side of the engine and enters the HPT case on the right side of the engine. The cooling air is blown against the turbine cases through small holes in the inboard side of the HPT and LPT cooling manifolds.
   C. The ECU monitors the position of the TCC valves and the engine operating conditions. The ECU transmits electrical signals to the HMU. The HMU converts the electrical signals into hydraulic command signals. The hydraulic command signals send pressurized fuel to the TCC valves.
   D. During low altitude operations, the HPT and LPT cooling manifolds are supplied with a minimum amount of cooling air. At high altitude operations, the amount of cooling air is increased; this causes the turbine cases to cool and shrink which closes blade tip to shroud clearances, and improves engine efficiency.
2. ENGINES WITH GE SBs 75-159, 75-161, 75-165;
   General
   A. The turbine clearance control (TCC) system supplies cooling air flow to the high pressure turbine (HPT) and the low pressure turbine (LPT) cases. The system consists a HPT TCC valve, the electronic engine control (EEC (ECU)), and the hydromechanical unit (HMU).

      NOTE: GE SBs 75-159, 75-161, and 75-165 remove the LPT (low pressure turbine) active TCC (turbine clearance control) valve. The valve is replaced by a tube and a spoolie.

   B. The purpose of the system is to decrease the turbine blade tip to shroud clearances be regulating the amount of cooling air flow to the turbine cases. The fan discharge cooling air enters the LPT case on the left side of the engine and enters the HPT case on the right side of the engine. The cooling air is blown against the turbine cases through small holes on the inboard side of the HPT and LPT cooling manifolds.

C. The EEC (ECU) monitors the position of the TCC valve and the engine operating conditions. The EEC (ECU) transmits electrical signals to the HMU. The HMU converts the electrical signals into hydraulic command signals. The hydraulic command signals send pressurized fuel to the TCC valve.

D. During low altitude operations, the HPT cooling manifold is supplied with a minimum amount of cooling air. At high altitude operations, the amount of cooling air is increased; this causes the turbine case to cool and shrink which closes blade tip to shroud clearances, and improves engine efficiency.

3. Turbine Clearance Control Valve (Fig. 1)

A. ENGINES WITHOUT GE SBs 75-159, 75-161, 75-165;
There are two identical TCC Valves. The HPTCC valve is installed on the high pressure compressor (HPC) case at the 1 o'clock position. The LPTCC valve is installed on the HPT case at the 8 o'clock position. The valves are individually controlled by the HMU.

B. ENGINES WITH GE SBs 75-159, 75-161, 75-165;
The HPTCC valve is installed on the high pressure compressor (HPC) case at the 1 o'clock position.

C. The TCC valve assembly consists of a two-way continuously-variable butterfly valve, a fuel powered hydraulic actuator, and two position feedback sensors.

(1) The valve has manual stops to prevent it from opening beyond 90 degrees.

(2) The actuator is an integral part of the valve assembly. It has a single ended hydraulic piston which applies a force to open or close the valve. The actuator is spring loaded to the closed position.

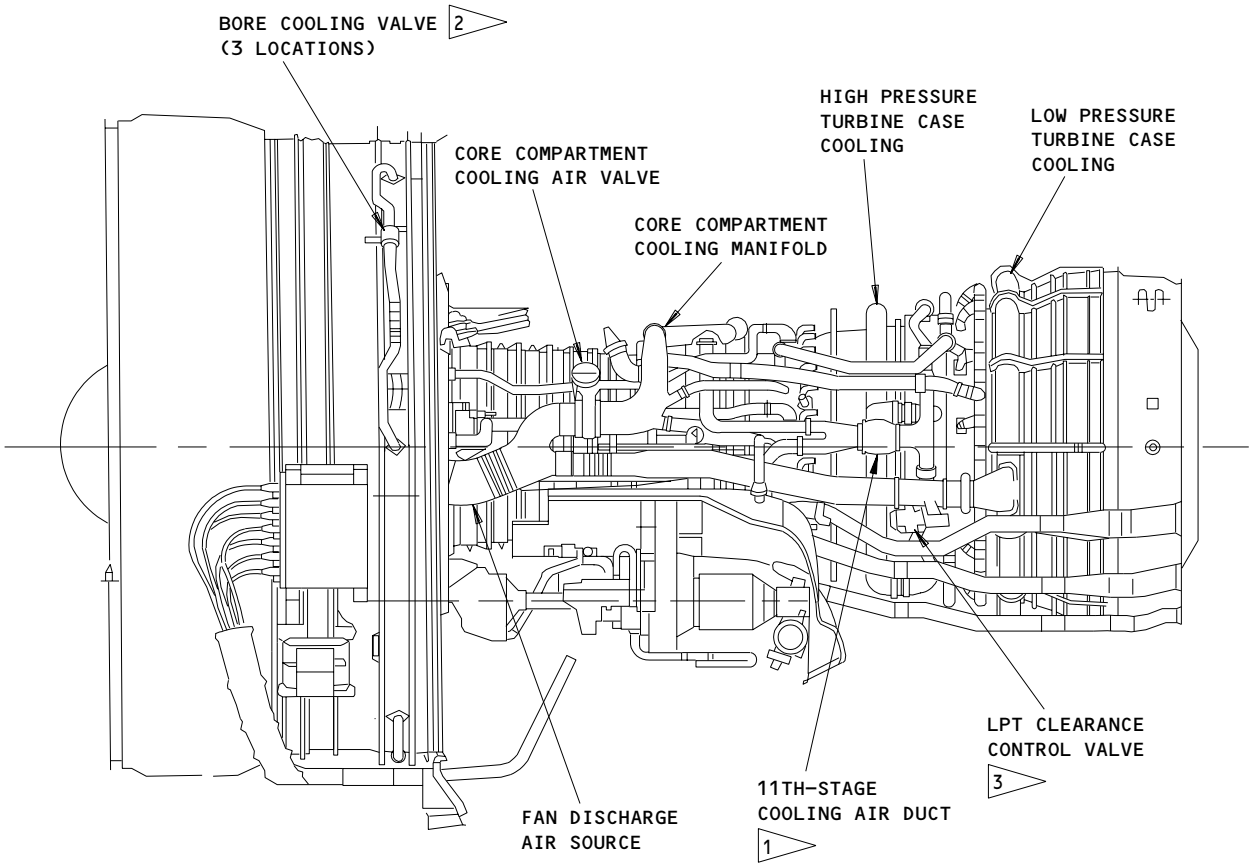
(3) The two position feedback sensors are fuel cooled and transmit redundant electrical signals. The signals are sent to the ECU and are proportional to the valve position. The sensors are electronically isolated.

D. The TCC valve assembly has an air flow direction arrow on the housing. On engines before GE SB 75-032, the TCC valve also has an alignment pin on the inlet mounting flange to prevent incorrect installation.

4. ENGINES WITHOUT GE SBs 75-159, 75-161, 75-165;
Operation (Fig. 1)

A. Functional Description

(1) The fan discharge cooling air enters the cooling ducts at the aft end of the fan frame. The right side cooling duct goes aft to the HPTCC valve and then to the HPT cooling manifold. The left side cooling duct goes aft to the LPTCC valve and then to the LPT cooling manifold.



NOTE: ENGINE SHOWN WITHOUT QEC FOR CLARITY

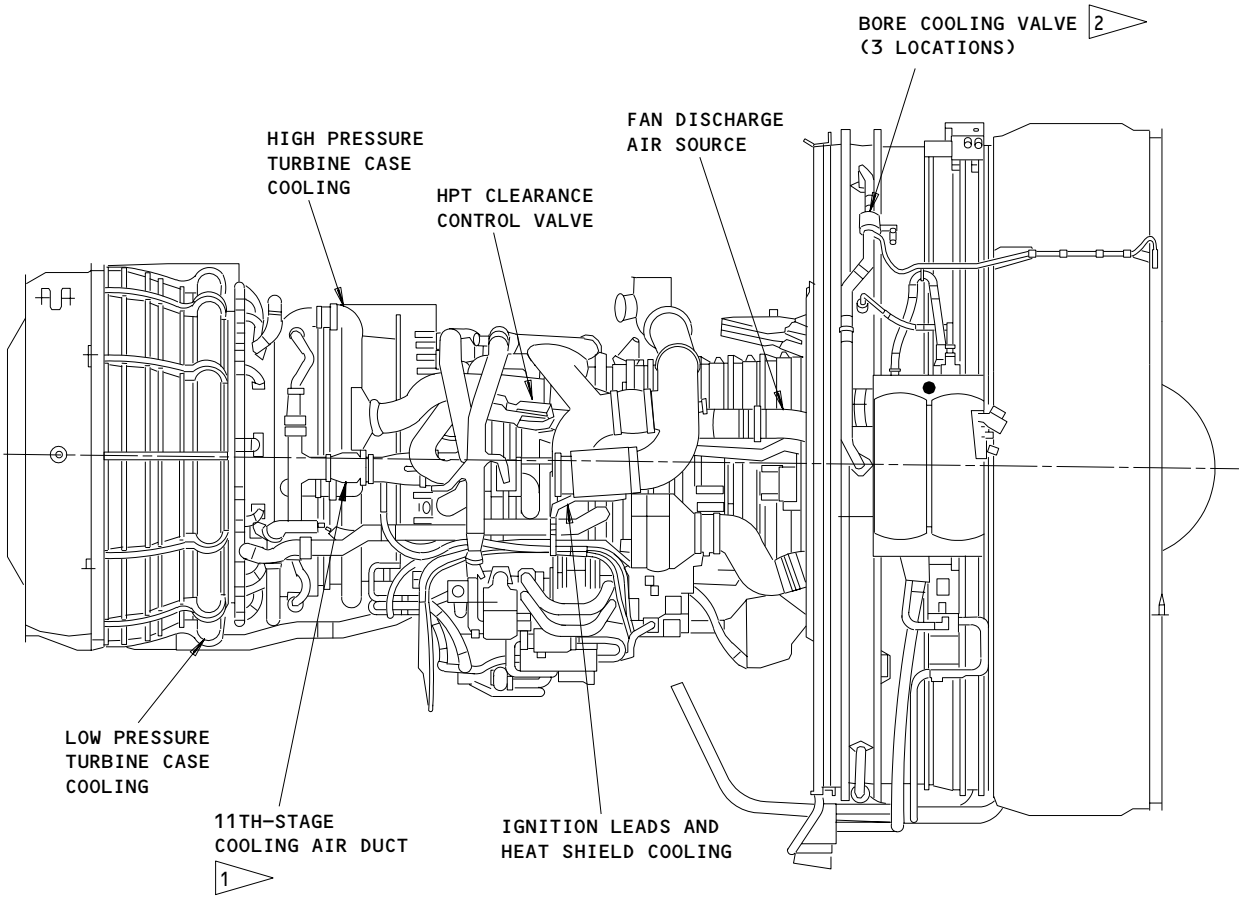
LEFT SIDE

1 ENGINES WITH GE SB 75-156 (WITHOUT THE 11TH-STAGE COOLING AIR SYSTEM); THERE ARE TWO SEPERATE TUBES HERE.

2 ENGINES WITH GE SB 75-157 (WITHOUT THE BORE COOLING SYSTEM); THERE ARE NO BORE COOLING VANES HERE.

3 ENGINES WITH GE SB 75-159; THERE IS NO VALVE HERE.

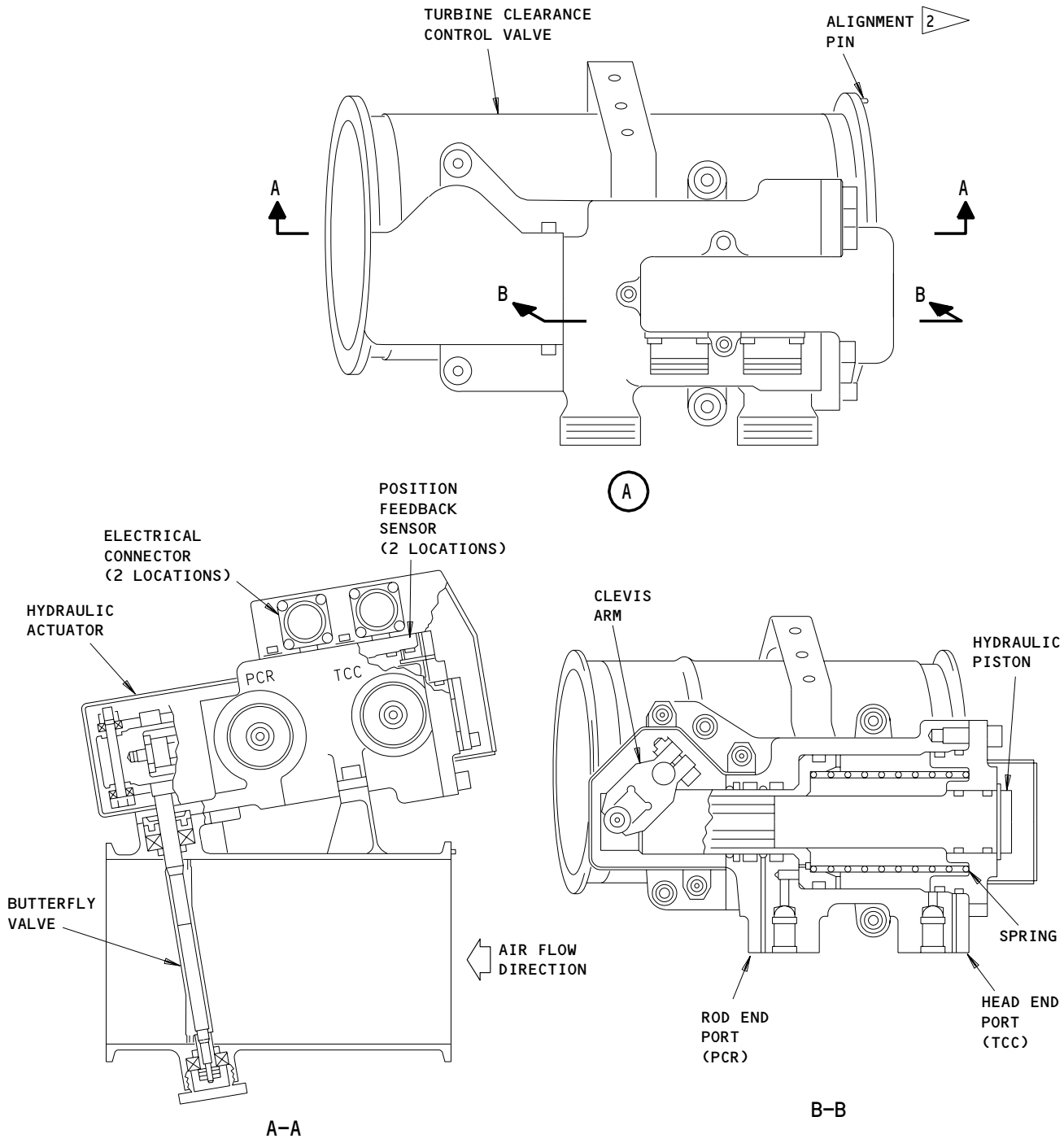
Turbine Clearance Control System
Figure 1 (Sheet 1)



RIGHT SIDE

CF8-8257-00-A2A

Turbine Clearance Control System
Figure 1 (Sheet 2)



NOTE: VALVE SHOWN IN CLOSED POSITION.

2 INSTALLED ON ENGINES WITHOUT GE SB 75-032

Turbine Clearance Control System
Figure 1 (Sheet 3)

(2) The ECU measures fan inlet temperature (T12), core speed (N2), compressor discharge pressure (PS3), compressor discharge temperature (T3), and the position of each TCC valve. The ECU will determine if it is necessary to change the position of the TCC valves to maintain a constant HPT and LPT pressure. The ECU will then send individual signals to the HMU.

(3) The HMU supplies fuel at the regulated reference pressure (PCR) to the rod end of the TCC valve actuators. It also supplies a modulated fuel servo pressure (TCC) to the head end of the actuators.

(a) The PCR pressure to the rod end is constant.

(b) The TCC pressure to the head end is changed by the HMU in response to the command signals from the ECU. When TCC pressure is larger than PCR pressure, the valve will open. When TCC pressure is less than PCR pressure, the valve will close.

(4) The two position feedback sensors monitor the position of the actuator piston. They transmit the valve position signal to the ECU. The sensors receive electrical power from the ECU. One sensor is dedicated to channel A and the other is dedicated to channel B.

5. ENGINES WITH GE SBs 75-159, 75-161, 75-165;

Operation (Fig. 1)

A. Functional Description

(1) The fan discharge cooling air enters the cooling ducts at the aft end of the fan frame. The right side cooling duct goes aft to the HPTCC valve and then to the HPT cooling manifold. The left side cooling duct goes aft (through an orifice and a spoolie) to the LPT cooling manifold.

(2) The EEC (ECU) measures fan inlet temperature (T12), core speed (N2), compressor discharge pressure (PS3), compressor discharge temperature (T3), and the position of the TCC valve. The EEC (ECU) will determine if it is necessary to change the position of the TCC valve to maintain a constant HPT pressure. The EEC (ECU) will then send individual signals to the HMU.

(3) The HMU supplies fuel at the regulated reference pressure (PCR) to the rod end of the TCC valve actuator. It also supplies a modulated fuel servo pressure (TCC) to the head end of the actuator.

(a) The PCR pressure to the rod end is constant.

(b) The TCC pressure to the head end is changed by the HMU in response to the command signals from the EEC (ECU). When TCC pressure is larger than PCR pressure, the valve will open. When the TCC pressure is less than PCR pressure, the valve will close.

(4) The two position feedback sensors monitor the position of the actuator piston. They transmit the valve position signal to the EEC (ECU). The sensors receive electrical power from the EEC (ECU). One sensor is dedicated to channel A and the other is dedicated to channel B.

TURBINE CLEARANCE CONTROL VALVE - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks:
      (1) The turbine clearance control valve (TCC valve) removal
      (2) The turbine clearance control valve (TCC valve) installation.
   B. ENGINES PRE-GE-SBs 75-159, 75-161, 75-165;
      (WITH THE LOW PRESSURE TURBINE CLEARANCE CONTROL VALVE);
      The TCC valves are the low (LPT) and the high (HPT) pressure turbine clearance control valves.
      (1) The procedures to remove and install the LPT and the HPT valves are the same for each valve.
   C. ENGINES POST-GE-SBs 75-159, 75-161, 75-165;
      (WITHOUT THE LOW PRESSURE TURBINE CLEARANCE CONTROL VALVE);
      The TCC valve is the high pressure turbine (HPT) clearance control valve.
      (1) GE SBs 75-159, 75-161, and 75-165 remove the low pressure turbine clearance control valve.

TASK 75-24-01-004-001-J00

2. TCC Valve Removal (Fig. 401)
   A. Standard Tools and Equipment
      (1) Container - 1 gallon (4 liter) capacity, for fuel
   B. References
      (1) 78-31-00/201, Thrust Reverser System
      (2) IPC 75-24-01 Figs. 5 and 10
   C. Access
      (1) Location Zone

412	Engine 1 - Compressor Case 1 and 8 o'clock
422	Engine 2 - Compressor Case 1 and 8 o'clock
432	Engine 3 - Compressor Case 1 and 8 o'clock
442	Engine 4 - Compressor Case 1 and 8 o'clock

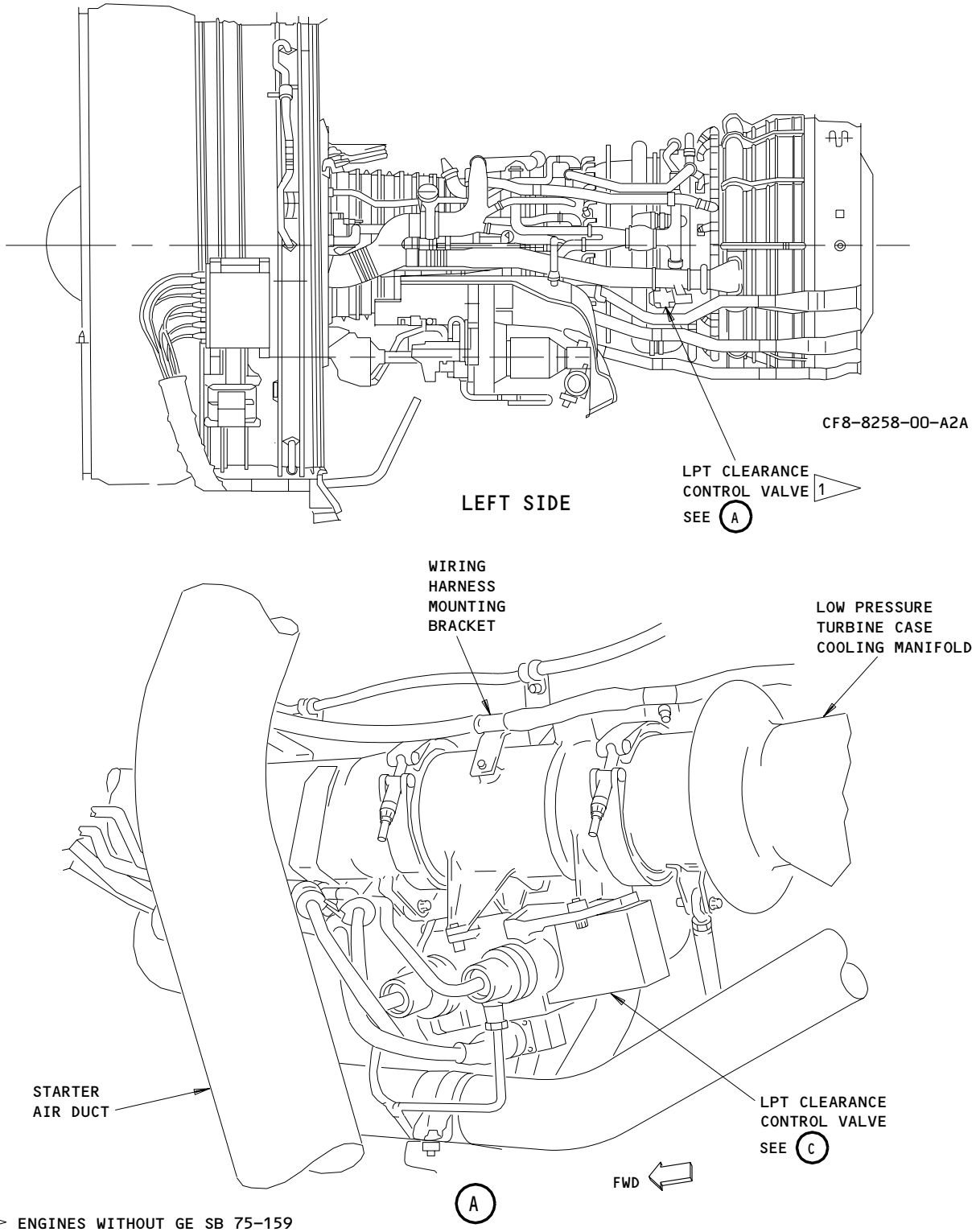
      (2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

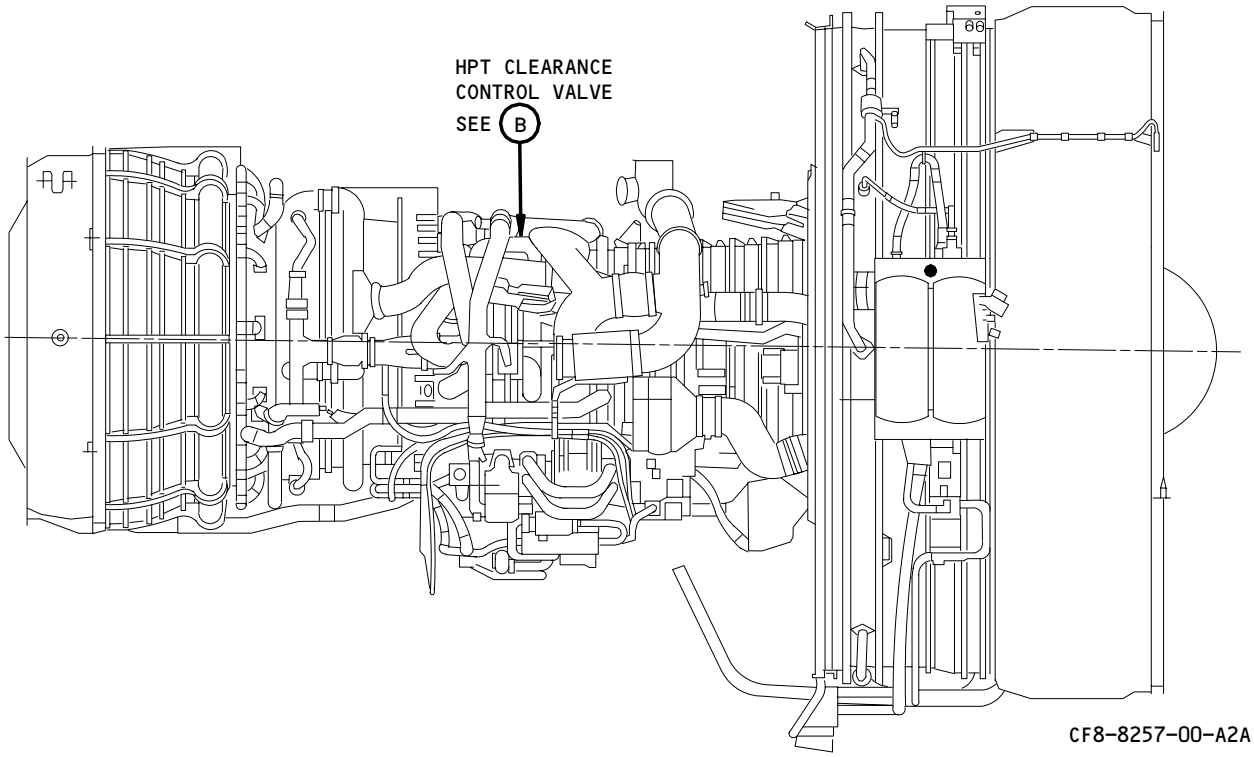
   D. Procedure

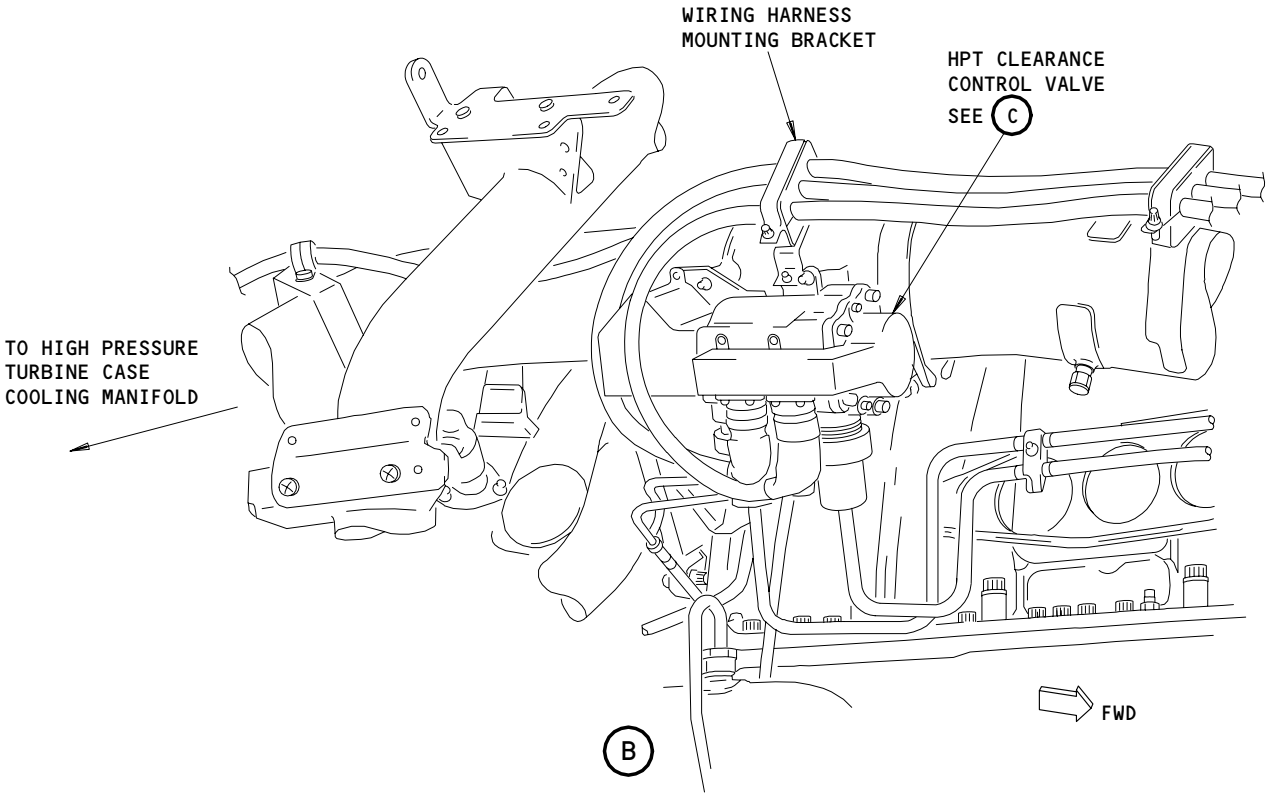
      S 014-002-J00
      (1) Open each thrust reverser half (Ref 78-31-00/201).

      S 864-003-J00
      (2) Open these circuit breakers, for the applicable engine, and attach the DO-NOT-CLOSE tags:
         (a) P18 DC Power Distribution Panel
            1) 18QJ5 ENG 1 EEC PWR CH A

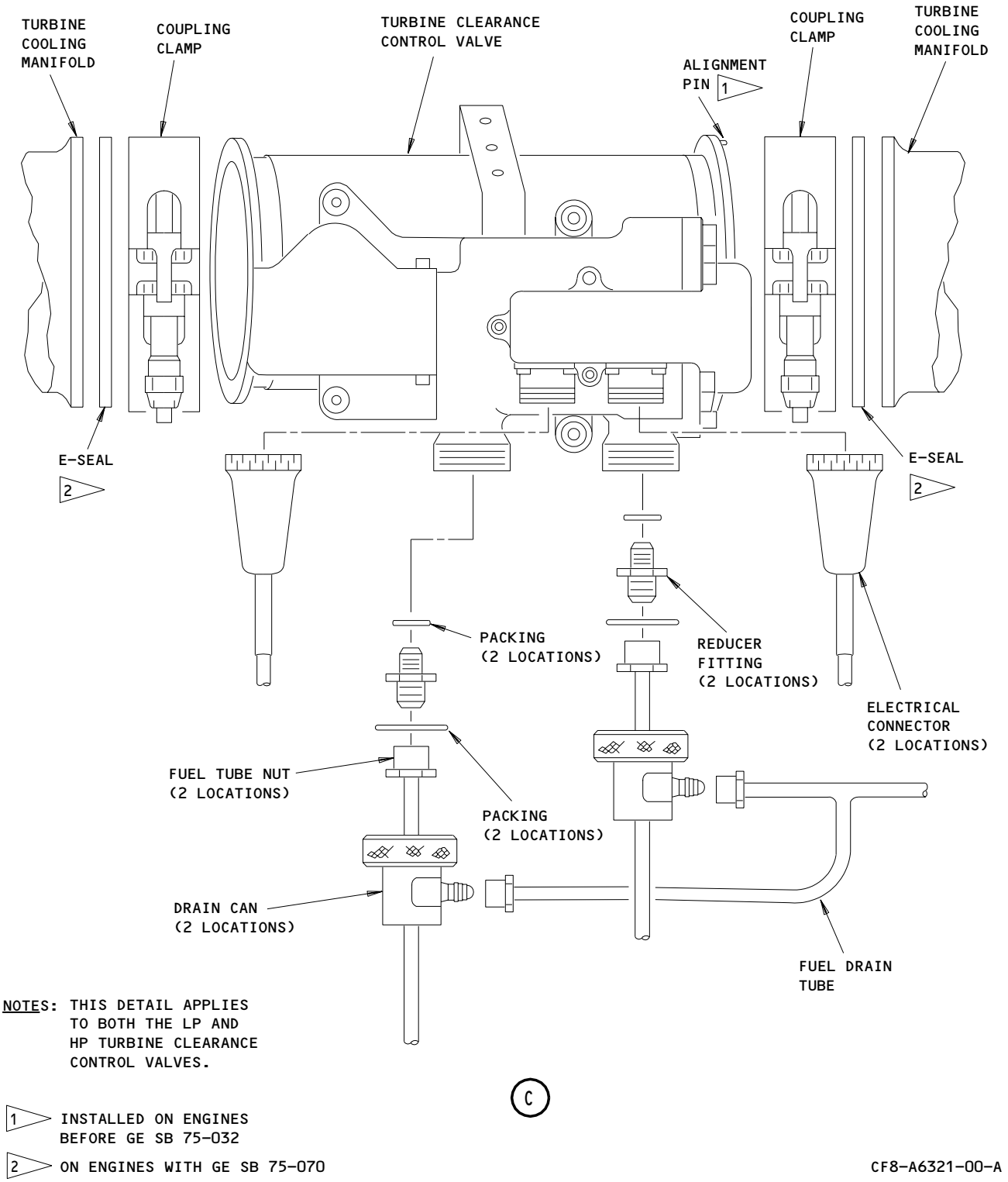


Turbine Clearance Control Valve Installation
Figure 401 (Sheet 1)





Turbine Clearance Control Valve Installation
Figure 401 (Sheet 2)



Turbine Clearance Control Valve Installation
Figure 401 (Sheet 3)

2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 034-004-J00
(3) Disconnect the two electrical connectors from the TCC valve.

S 034-005-J00
(4) Remove two bolts and washers that attach the wire bundle bracket for the wires to the TCC valve.

S 034-006-J00
(5) Disconnect the fuel tubes, and drain fuel in a container:
(a) Disconnect the nuts on the fuel drain tube from the drain cans.
(b) Disconnect the knurled nuts on the drain cans.
(c) Move the drain cans from the valve to let the fuel tube nuts show.
(d) Disconnect the fuel tube nuts from the valve.
(e) Remove and discard the O-rings from the knurled nuts.

S 024-011-J00
(6) Disconnect the clamps:
(a) Loosen the clamp nuts.
(b) Remove the coupling clamps that attach each end of the TCC valve to the turbine cooling manifolds.

S 024-029-J00
(7) Remove the valve from the engine.
(a) ENGINES PRE-GE-SB 75-032;
Disengage the alignment pin.

(b) ENGINES POST-GE-SB 75-070;
Remove the E-seals on two sides of the valve.

S 034-013-J00

(8) Remove the parts from the valve:
(a) Remove the couplings from the TCC valve and keep them for the installation.
(b) Remove and discard the O-rings.

S 034-014-J00

(9) Install protective covers on the openings in the valve and the cooling manifolds.

TASK 75-24-01-404-015-J00

3. TCC Valve Installation (Fig. 401)

A. General

CAUTION: ENGINES WITH GE SB 73-079 (WITH FLUOROCARBON (VITON) SEALS): YOU MUST NOT OPERATE THE ENGINE WITH OIL TEMPERATURES BELOW -30 DEGREES F (-34 DEGREES C). REFER TO AMM 71-00-00/201 FOR SPECIAL PRECAUTIONS FOR OPERATION OF THE ENGINE AT VERY LOW TEMPERATURES. ENGINE DAMAGE CAN OCCUR IF VITON SEALS ARE USED AT VERY LOW TEMPERATURES.

(1) If you operate the engine at very low temperatures, make sure you follow the instuctions in AMM 71-00-00/201 for special precautions.

B. Consumable Materials
(1) D00096 Oil - MIL-L-6081, Grade 1005
(2) G00095 Chemical-leak detecting, Leak-tek 160X

C. References
(1) 71-00-00/501, Power Plant
(2) 78-31-00/201, Thrust Reverser System
(3) IPC 75-24-01 Figs. 5 and 10

D. Access
(1) Location Zone

412	Engine 1 - Compressor Case 1 and 8 o'clock
422	Engine 2 - Compressor Case 1 and 8 o'clock
432	Engine 3 - Compressor Case 1 and 8 o'clock
442	Engine 4 - Compressor Case 1 and 8 o'clock

(2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

E. Procedure

S 434-016-J00

(1) Remove the protective covers from the valve and the cooling manifolds.

S 434-030-J00

(2) Install the couplings:
  (a) Lubricate two new O-rings with oil.
  (b) Install an O-ring on each coupling.
  (c) Install the couplings in the TCC valve.
  (d) Tighten the couplings to 135-150 pound-inches (15.3-16.9 N.m).

S 424-018-J00

(3) Put the valve in the correct position between the turbine cooling manifolds.

  NOTE: Make sure the arrow on the valve points in the direction of the flow of air.

  (a) ENGINES PRE-GE-SB 75-032;
  Make sure the alignment pin engages with the hole in the manifold.
  (b) ENGINES POST-GE-SB 75-032;
  Make sure the fuel tubes align with the openings on the TCC valve.
  (c) ENGINES POST-GE-SB 75-070;
  Install the E-seals on two sides of the valve.

S 424-019-J00

(4) Install the coupling clamps:
  (a) Put the two coupling clamps around the flanges of the valve and the duct.
  (b) Tighten the clamp nuts to 55-70 pound-inches (6.2-7.9 N.m).

S 434-020-J00

(5) Connect the fuel tubes:
  (a) Lubricate two new O-rings with oil.
  (b) Install the O-rings in the grooves of each knurled nut.
  (c) Connect the fuel tubes to the couplings on the valve.
  (d) Tighten the fuel tube nuts to 270-300 pound-inches (30.5-33.9 N.m).

S 434-023-J00

(6) Install the wire bundle bracket with two bolts and two washers.

S 864-024-J00

(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:
  (a) P180 DC Power Distribution Panel
    1) 180J5 ENG 1 EEC PWR CH A
    2) 180J6 ENG 1 EEC PWR CH B
    3) 180F5 ENG 2 EEC PWR CH A
    4) 180F6 ENG 2 EEC PWR CH B
    5) 180G20 ENG 3 EEC PWR CH A
    6) 180G21 ENG 3 EEC PWR CH B

7) 18OD20 ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 794-025-J00
(8) Do the ECU Actuators Ground Test task (AMM 71-00-00/501, Test No. 12).
(a) Make sure that there are no leaks at the fuel tube nuts.

S 434-026-J00
(9) Connect the fuel drain tubes:
(a) Connect the knurled nuts to the valve actuator.
(b) Tighten the knurled nuts with your hand.
(c) Install lockwire on the nuts.
(d) Connect the nuts on the fuel drain tubes to the drain cans.
(e) Tighten the nuts to 135-150 pound-inches (15.3-16.9 N.m).

S 784-032-J00
(10) ENGINES PRE-GE-SBs 75-159, 75-161, 75-165;
(WITH THE LOW PRESSURE TURBINE CLEARANCE CONTROL VALVE);
Do a pressure test of the HPTC and the LPTC drain shrouds system as follows:

S 784-033-J00
(11) ENGINES POST-GE-SBs 75-159, 75-161, 75-165;
(WITHOUT THE LOW PRESSURE TURBINE CLEARANCE CONTROL VALVE);
Do a pressure test of the HPTC drain shrouds system as follows:
(a) Connect an air source to the drain fittings on the bottom of the drain cans.
(b) Close the vent valve from the air source.
(c) Open the shutoff valve from the air source.
(d) Supply pressure of 50-55 psig (345-379 kpag) to the drain fitting.
(e) Close the shutoff valve from the air source.
(f) Monitor the pressure for 2 minutes.
1) A maximum of 10 psig (69 kpag) decrease in pressure is permitted.
(g) If the decrease in pressure is more than the limits, do the steps that follows:
1) Apply a soap solution or leak-tek to show leakage at the shroud connections.
2) Tighten the knurled nut by hand to stop the leaks.
3) Make sure the hex nuts are tightened to the correct torque value.

NOTE: Do not over-tighten the connections.

4) If the leakage continues, replace the packings at the connections where the leakage occurs.
5) Do the pressure test of the drain shrouds again.

S 414-028-J00

(12) Close each thrust reverser half (Ref 78-31-00/201).

LPT COOLING AIR MANIFOLD - REMOVAL/INSTALLATION

1. General
   A. This procedure has four tasks.
   B. ENGINES PRE GE SB 75-148;
      The LPT cooling air manifold (LPT manifold) has 12 segments. The LPT manifold segments are installed radially on the low pressure turbine case.
   C. ENGINES POST GE SB 75-148;
      The LPT cooling air manifold (LPT manifold) has 6 segments. The LPT manifold segments are installed radially on the low pressure turbine case.
   D. You can remove or replace each of the segments individually.
   E. You must open the thrust reversers to get access to the LPT manifold.

   TASK 75-24-03-004-021-J00

2. ENGINES POST GE SB 75-148;
   Six-Segment LPT Cooling Air Manifold Removal
   A. References
      (1) AMM 78-31-00/201, Thrust Reverser System
   B. Access
      (1) Location Zones

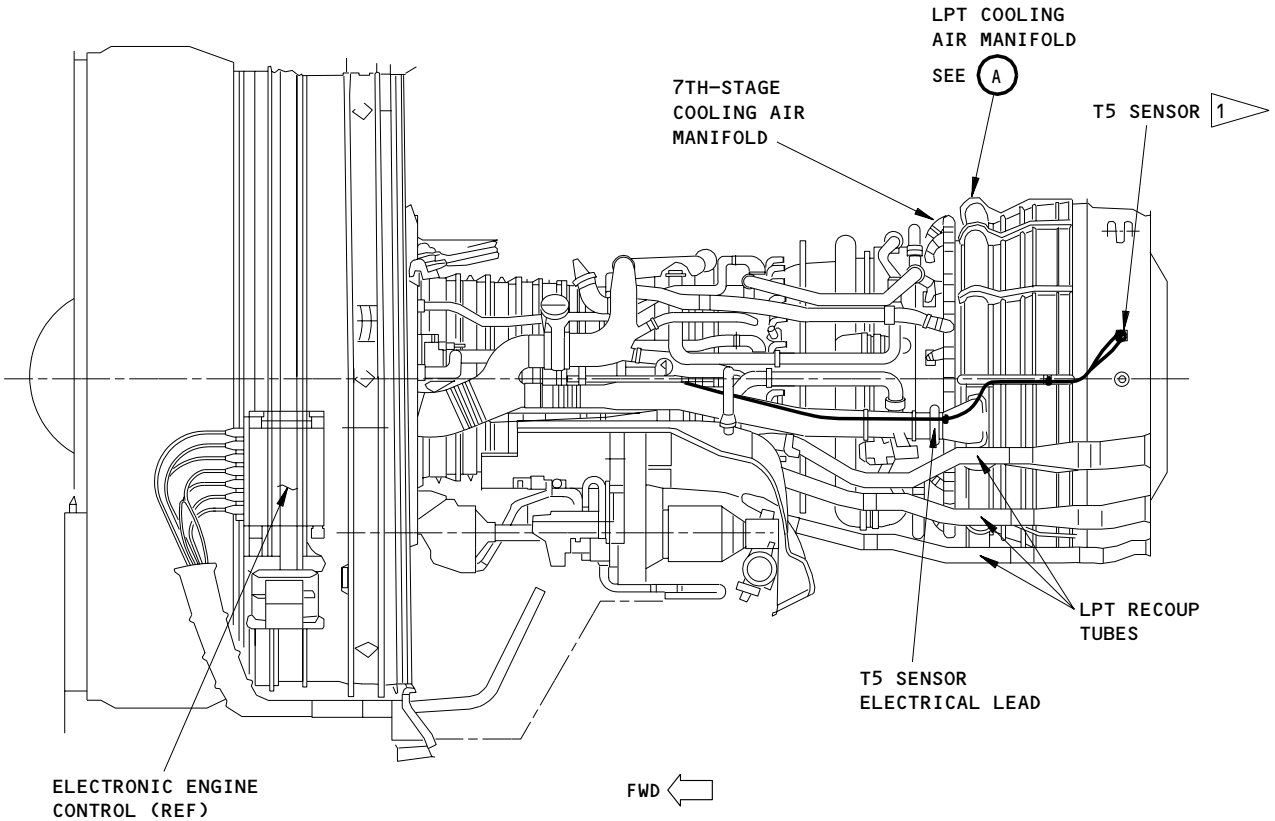
412	Engine 1
422	Engine 2
432	Engine 3
442	Engine 4

      (2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

   C. Prepare for the Removal

      S 864-022-J00
      (1) Open the thrust reversers (AMM 78-31-00/201).

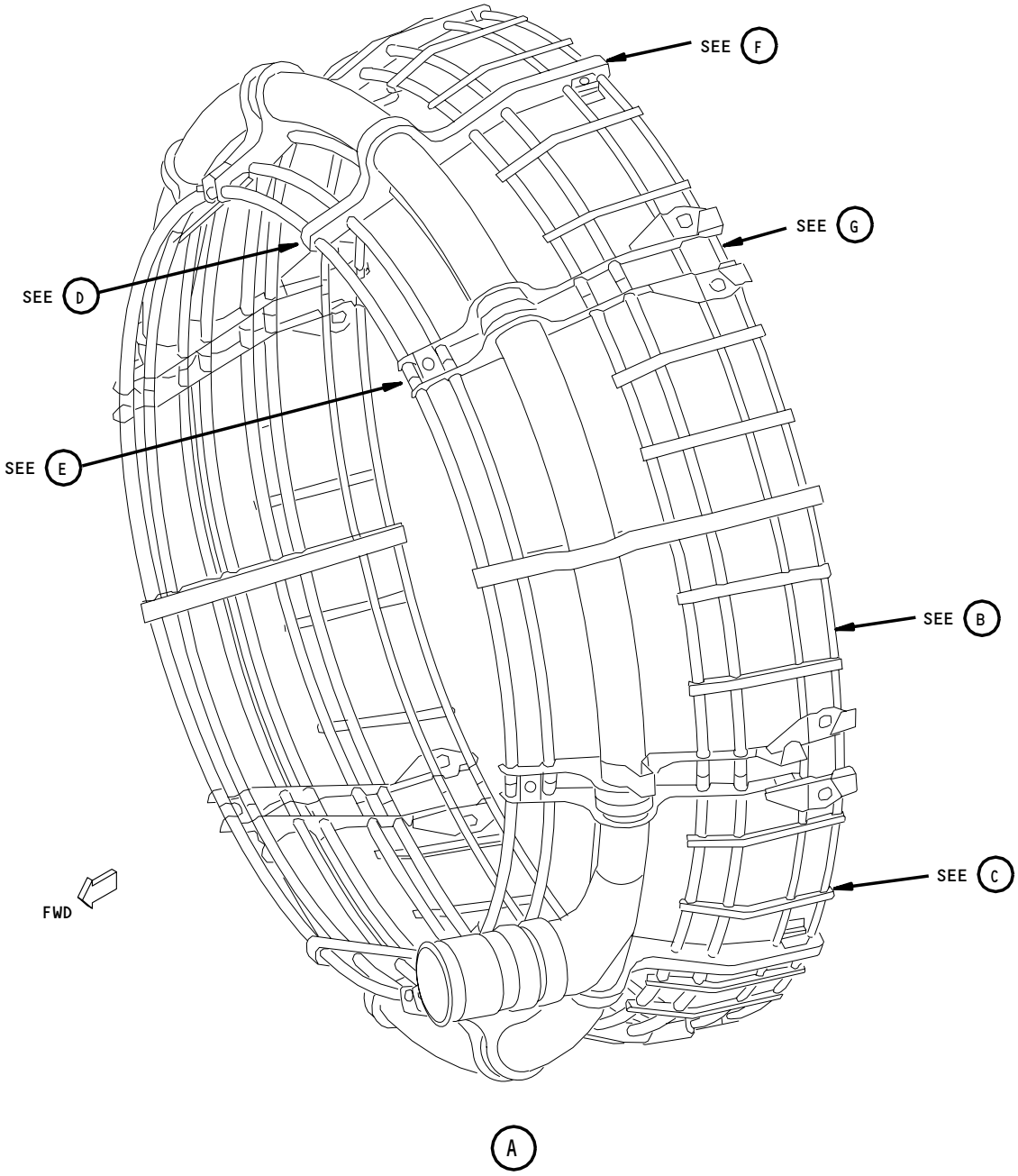


LEFT SIDE

1 ENGINES WITH ACMS

CF8-8258-00-A2A

Six Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401 (Sheet 1)



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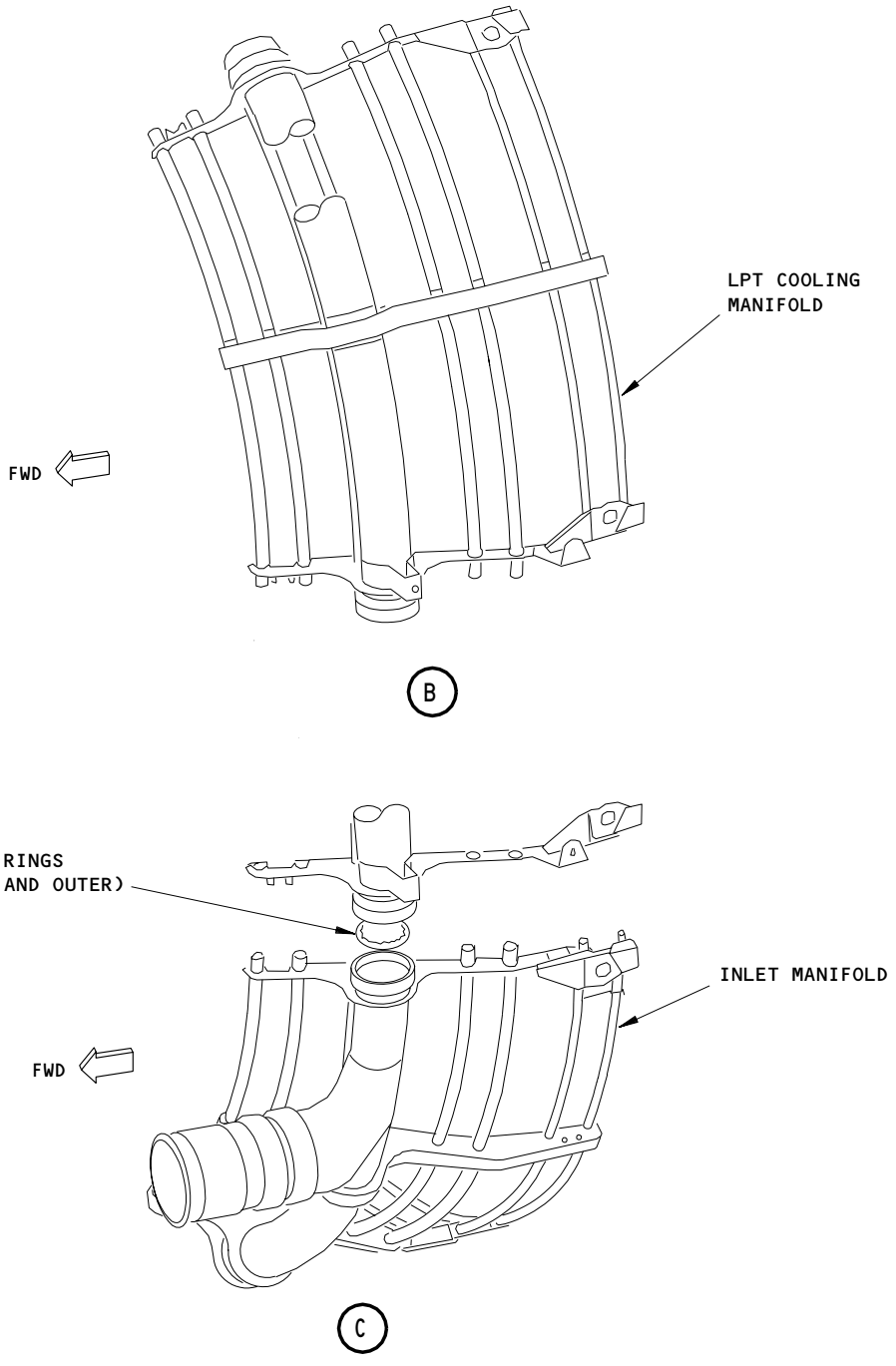
Six Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401 (Sheet 2)

EFFECTIVITY
ENGINES POST GE SB 75-148

G58824



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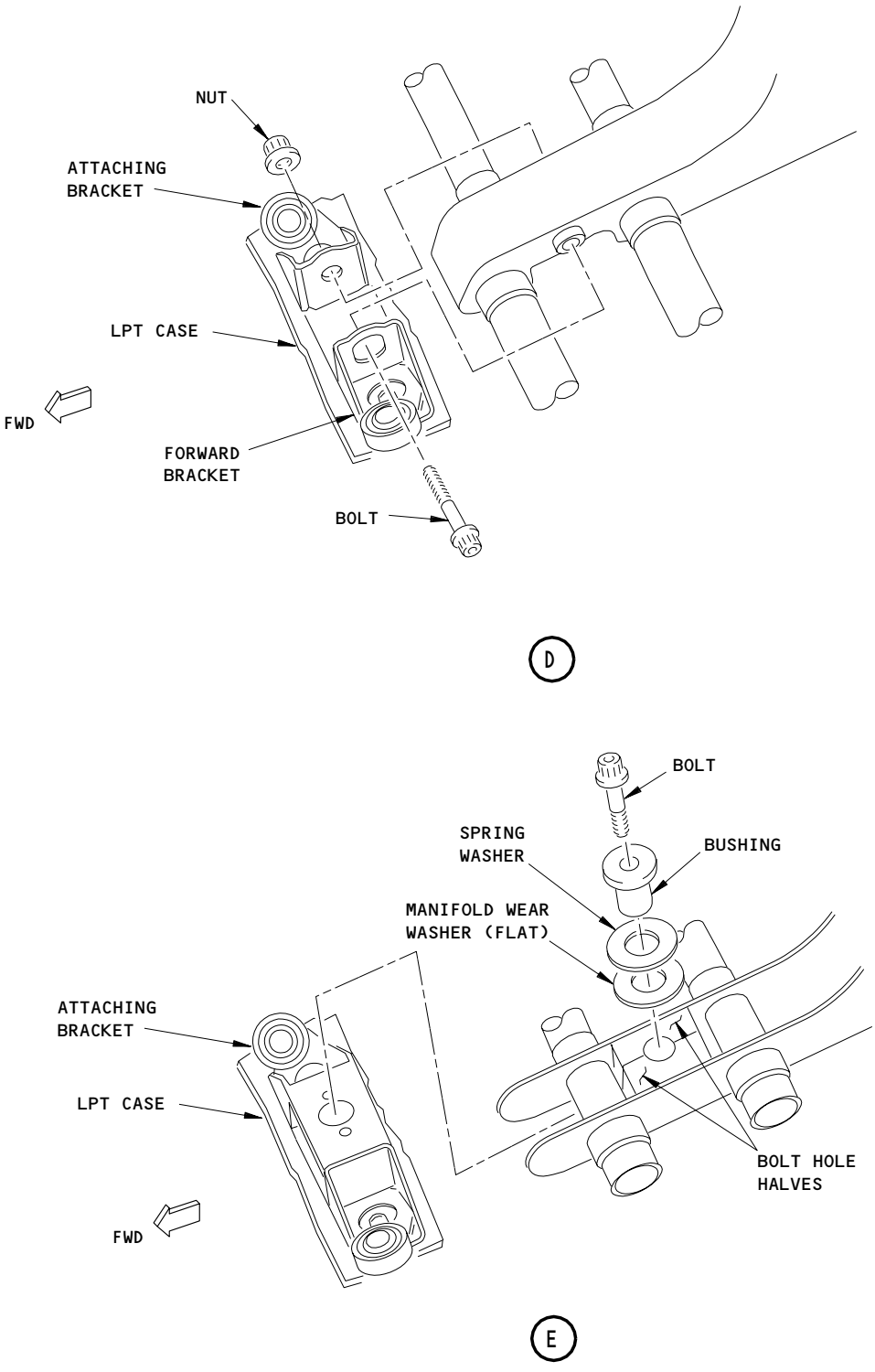
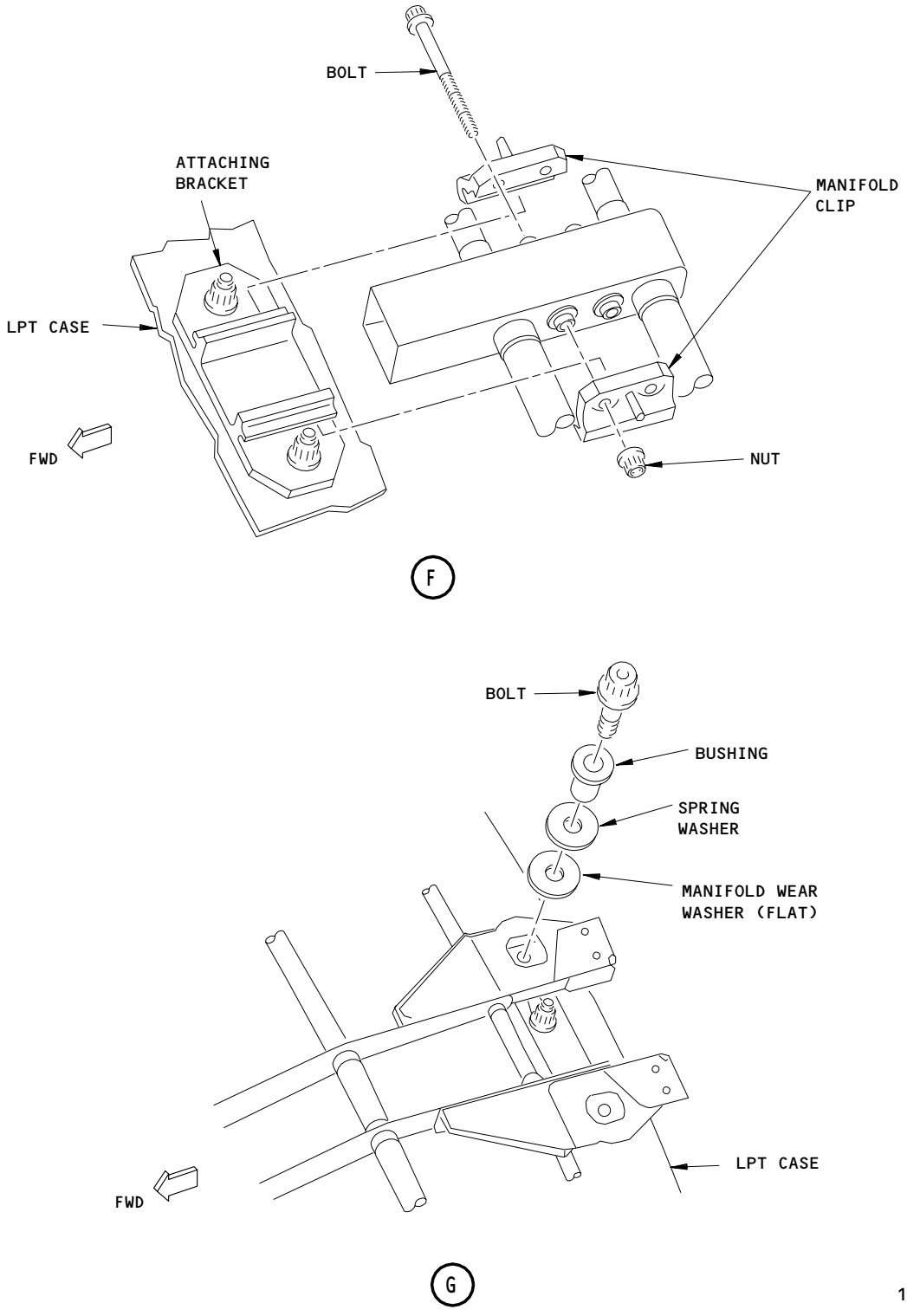
Six Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401 (Sheet 3)



Six Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401 (Sheet 4)



Six Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401 (Sheet 5)

S 864-023-J00

(2) Open these circuit breakers, for the applicable engine, and attach the DO-NOT-CLOSE tags:

(a) P18O DC Power Distribution Panel

1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

D. Procedure (Fig. 401)

S O24-O53-J00

(1) ENGINES WITH ACMS (AIRCRAFT CONDITION MONITORING SYSTEM); Remove the two nuts that attach the T5 elctrical harnes to the T5 probe and disconnect the harness from the probe.

(a) Remove the nuts, washers, and bolts that attach the T5 harness to the two brackets welded to the cooling segment located at the 2 o'clock position (forward looking aft) on the LPT stator case and the bracket attached to the LPT/TRF mating flange.

S O24-O25-J00

(2) Remove the V-band clamp, nuts, bolts, and the links from the forward end of the inlet cooling segment.

S O24-O4O-J00

(3) Remove all the links, bolts and nuts that support the 7th-stage stage cooling air manifold from the forward brackets at the 1 - 12 o'clock positions on the LPT stator case.

S O24-O89-J00

(4) Remove the 3 LP recoup tubes from the engine as follows:

(a) ENGINES PRE GE SB 75-O71; Remove the six bolts, washers and nuts which attach the three LP recoup tubes to the low pressure turbine brackets.

(b) ENGINES POST GE SB 75-071;
Remove the six bolts, spacers, washers and nuts which attach the three LP recoup tubes to the low pressure turbine brackets.
(c) Remove the twelve bolts which attach the three LP recoup tubes to the exhaust sleeve.

S 024-091-J00

(5) If necessary, remove the D-sump oil supply, D-sump oil scavenge and combustor drain lines as follows (Fig. 401):
(a) Remove the spray shields and loosen the B-nuts at each end of the lines, as necessary.
(b) Remove any necessary bolts, nuts and clamps that attach the lines to the turbine rear frame.
(c) Remove any necessary bolts, nuts and clamps that attach the lines to the LPT cooling air manifold.
(d) Remove the D-sump oil supply, D-sump oil scavenge and combustor drain lines as necessary.

S 024-041-J00

(6) Remove the hardware that attaches the aft end of the LPT cooling manifold segment to the LPT stator case:
(a) Remove the manifold clips, bolts and nuts from the aft brackets at the 2, 4, 6, 8, 10, and 12 o'clock positions.
(b) Remove the bolts, bushings, spring washers, and wear washers from the aft brackets at the 1, 3, 5, 7, 9, and 11 o'clock positions.

S 024-042-J00

(7) Remove the bolts, bushings, spring washers, and wear washers from the forward brackets at the 1, 3, 5, 7, 9, and 11 o'clock positions.

S 024-057-J00

(8) Remove the nuts and bolts from the the forward brackets at the 2, 4, 6, 8, 10, and 12 o'clock positions to remove each segment from the engine.

S 024-081-J00

(9) Remove the piston ring from the large tube on all LPT cooling air manifold segments.
(a) Discard the piston ring.

TASK 75-24-03-404-068-J00

3. ENGINES POST GE SB 75-148;
Six-Segment LPT Cooling Air Manifold Installation

A. References
(1) 78-31-00/201, Thrust Reverser System

B. Equipment
(1) Soft (or non-metallic) mallet

C. Consumable Materials
(1) D01062 Never-Seez, Pure Nickel Special (Anti-seize compound)
(2) D00250 Lubricant - Petrolatum, Soft White Fonoline

D. Access

(1) Location Zones

412	Engine 1
422	Engine 2
432	Engine 3
442	Engine 4

(2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

E. Procedure (Fig. 401)

S 644-070-J00

(1) Apply a light coat of soft petrolatum to the thick outer ring of the six piston rings.

NOTE: Each piston ring consists of a thin inner ring and a thick outer ring.

S 424-071-J00

(2) Install one piston ring into each groove on the male end of the largest tube of each new manifold segment.
   (a) Wrap the thin inner ring around and into the groove on the male end and hold it in position until the thick outer ring is installed.
   (b) Install the thick outer ring into the groove and over the thin inner ring and make sure the gaps of each ring are not aligned.

S 424-072-J00

(3) Install one non-inlet segment at the 2 o'clock position as follows:
   (a) Use the non-inlet segment that has two brackets welded to the plenum.
   (b) Put the middle section of the segment into the forward bracket at the 2 o'clock position.
   (c) Align the forward bolt hole half at the 1 o'clock position in the segment with the bolt hole in the forward bracket.
   (d) Loosely install the flat washer, spring washer, bushing and bolt.

S 424-073-J00

(4) Install a non-inlet segment counterclockwise from the installed segment as follows:

CAUTION: DO NOT FORCE THE SEGMENTS TOGETHER. IF THE ASSEMBLY IS DIFFICULT, MAKE SURE THE PISTON RING IS ALIGNED IN THE GROOVE OF THE LARGE TUBE. DAMAGE TO THE SEGMENTS CAN OCCUR.

(a) Align the tubes and gently push the large tube until the segment is aligned with the brackets on the LPT stator case.
    1) Make sure the forward bolt hole half slides under the washer installed with the previous segment.
(b) Loosen the bolt as necessary and then tighten hand-tight.
(c) Put the middle section of the segment into the forward bracket.
(d) Align the other forward bolt hole in the segment with the bolt hole in the forward bracket.
(e) Loosely install the washer, spring washer, bushing and bolt.

S 424-074-J00

(5) Repeat the above steps to install the remaining non-inlet segments.

S 424-075-J00

(6) Install the inlet segment to the air supply tube as follows:
    (a) Install the forward hardware.
        1) Install the flat washer, spring washer, bushing and bolt in the forward holes at the 1, 3, 5, 7, 9 and 11 o'clock positions.
            a) Tighten the bolts with your fingers.
    (b) Install one bolt and one nut in the forward holes at the 2, 4, 6, 8, 10 and 12 o'clock positions.
        1) Tighten the bolts hand-tight.
    (c) Install the aft hardware:
        1) Install the two manifold clips, two bolts and two nuts in the aft holes at the 2, 4, 6, 8, 10, and 12 o'clock positions.
            a) Make sure the manifold clips straddle the case bracket and engage the bracket tabs with the slots in the clips.
        2) Install the two wear washers, two spring washers, two bushings, and bolts in the aft holes at the 1, 3, 5, 7, 9, and 11 o'clock positions.
        3) Torque the 12 nuts at the 2, 4, 6, 8, 10 and 12 o'clock positions to 33-37 pound-inches (3.7-4.2 Newton meters).
        4) Torque the 12 bolts at the 1, 3, 5, 7, 9 and 11 o'clock positions to 55-70 pound-inches (6.2-7.9 Newton meters).
    (d) Torque the six bolts at the forward 1, 3, 5, 7, 9 and 11 o'clock positions to 55-70 pound-inches (6.2-7.9 Newton meters).
    (e) Torque the six nuts at the 2, 4, 6, 8, 10 and 12 o'clock positions to 55-70 pound inches (6.2-7.9 Newton meters).
    (f) Coat the bolts for the links for the 7th stage cooling air manifold with anti-seize compound.

(g) Install the links, bolts, and nuts for the 7th stage cooling air manifolds at the forward brackets at the 1, 3, 5, 7, 9 and 11 o'clock positions.
1) Torque the nuts to 33-37 pound-inches (3.7-4.2 Newton meters).

S 424-076-J00

(7) Install the V-band clamp on the inlet segment as follows:
(a) Install the V-band clamp and torque the nut to 35 pound inches (4.0 Newton meter).
(b) Tap with a plastic mallet, tighten, and check the torque again until the proper torque is maintained.
(c) Use a plastic (or non-metallic) mallet and tap around the circumference of the coupling to make the band tension even.
(d) Increase the torque, and at the same time continue tapping around the circumference.
(e) When the torque is 70 pound-inches (7.9 Newton meters) tap around the circumference once more.
(f) Tighten again to 70 pound-inches (7.9 Newton meters).
(g) Connect the inlet manifold support links with the two bolts and two nuts.
1) Tighten the bolts to 55-70 pound-inches (6.2-7.9 Newton meters).

S 424-093-J00

(8) Install the three LP recoup tubes on the low pressure turbine brackets as follows:
(a) Lubricate the bolts with antiseize compound (C02-002).
(b) ENGINES PRE GE SB 75-071;
Install the six bolts, washers and nuts that attach the three LP recoup tubes on the low pressure turbine brackets.
1) Tighten the bolts to 33-37 pound-inches (3.7-4.2 N.m).
(c) ENGINES POST GE SB 75-071;
Install the six bolts, spacers, washers and nuts that attach the three LP recoup tubes on the low pressure turbine brackets.
1) Tighten the bolts to 33-37 pound-inches (3.7-4.2 N.m).

S 424-094-J00

(9) Install the three LP recoup tubes on the exhaust sleeve as follows:
    (a) Lubricate the bolts with antiseize compound (C02-002).
    (b) Tighten the bolts to 33-37 pound-inches (3.7-4.2 N.m).

S 424-095-J00

(10) If removed, install the D-sump oil scavenge line as follows:
    (a) Install the aft end of the D-sump oil scavenge line to the turbine rear frame fitting at the 5 o'clock position.
        1) Install the forward end to the D-sump oil scavenge line.
        2) Tighten the coupling nuts with your fingers.
    (b) Install any removed clamps, bolts and nuts.
        1) Tighten the nuts with your fingers.
    (c) Tighten the D-sump oil scavenge line forward and aft B-nuts to 650-770 pound-inches (73.4-87.0 N.m).
    (d) Tighten the loop clamps nuts to 33-37 pound-inches (3.7-4.2 N.m).

S 424-096-J00

(11) If removed, install the D-sump oil supply line as follows:
    (a) Install the aft end of the D-sump oil supply line to the turbine rear frame fitting at the 7 o'clock position.
        1) Install the forward end to the D-sump oil supply line.
        2) Tighten the coupling nuts with your fingers.
    (b) Install any removed clamps, bolts and nuts.
        1) Tighten the nuts with your fingers.
    (c) Tighten the D-sump oil supply line forward and aft B-nuts to 450-550 pound-inches (50.8-62.1 N.m).
    (d) Tighten the loop clamps nuts to 33-37 pound-inches (3.7-4.2 N.m).
    (e) Install the spray shields.

S 424-097-J00

(12) If removed, install the combustor drain line as follows:
    (a) Install the aft end of the combustor drain tube to the compressor rear frame port at the 7 o'clock position.
        1) Install the forward end to the D-sump oil supply line.
        2) Tighten the coupling nuts with your fingers.
    (b) Install any removed clamps, bolts and nuts.
        1) Tighten the nuts with your fingers.
    (c) Tighten the loop clamps nuts to 33-37 pound-inches (3.7-4.2 N.m).
    (d) Tighten the combustor drain line forward and aft B-nuts to 180-200 pound-inches (20.3-22.6 N.m).

S 424-077-J00

(13) ENGINES WITH ACMS (AIRCRAFT CONDITION MONITORING SYSTEM); Attach the T5 thermocouple harness as follows:

(a) Install the T5 thermocouple harness to the two brackets on the manifold with two, bolts and washers.

1) Torque the nuts to 33-37 pound-inches (3.7-4.2 Newton meters).

(b) Connect the T5 sensor electrical leads to the T5 sensor.

1) Tighten the smaller lead nut to 33-37 pound-inches (3.7-4.2 newton-meters).

2) Tighten the larger lead nut to 55-70 pound inches (6.2-7.9 newton-meters).

F. Put the Airplane Back to Its Usual Condition

S 864-079-J00

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:

(a) P18O DC Power Distribution Panel

1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 414-08O-J00

(2) Close the thrust reversers (Ref 78-31-00/201).

TASK 75-24-03-004-061-J00

4. ENGINES PRE GE SB 75-148;
<u>Twelve-Segment LPT Cooling Air Manifold Removal</u>

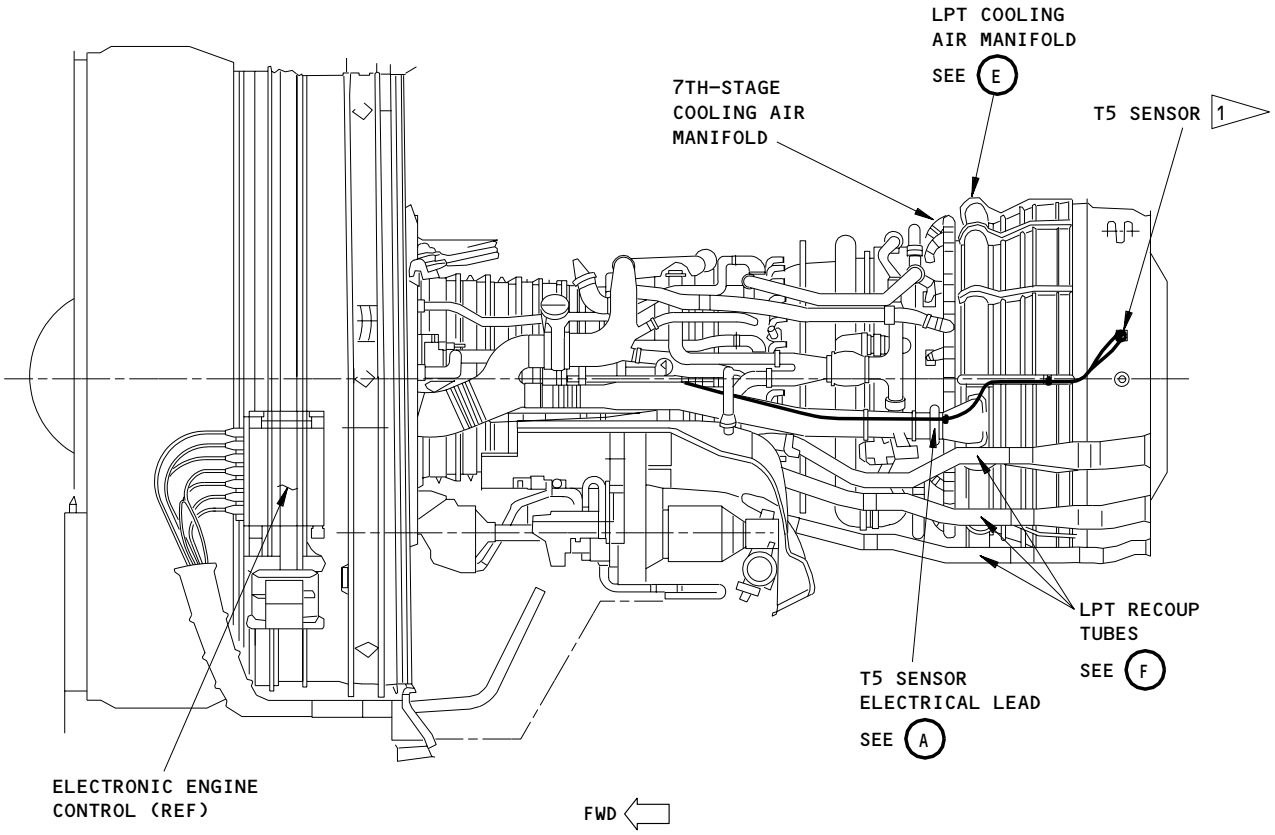
A. References

(1) 78-31-00/201, Thrust Reverser System

B. Access

(1) Location Zones

412 Engine 1
422 Engine 2
432 Engine 3
442 Engine 4



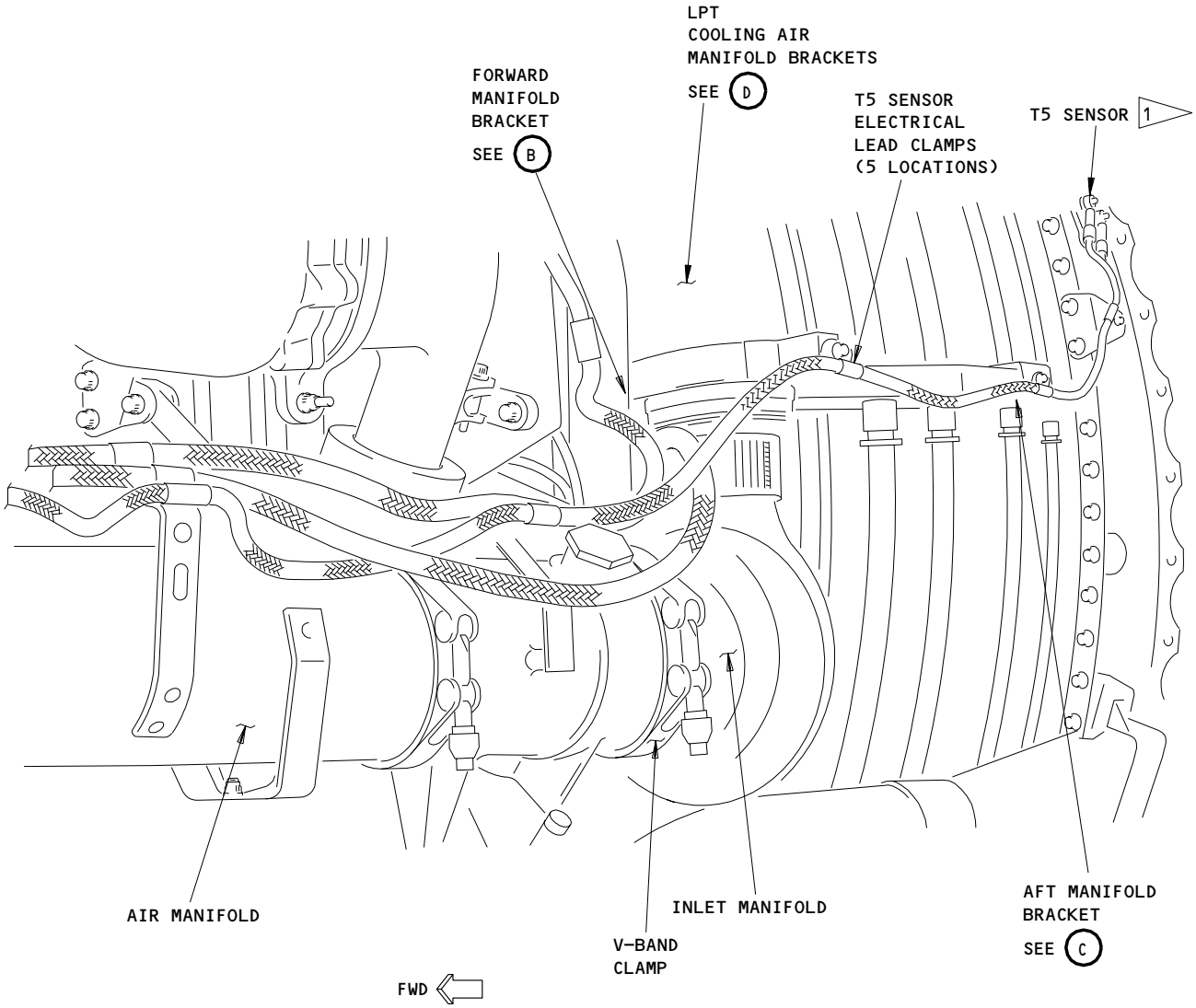
LEFT SIDE

1 ENGINES WITH ACMS

CF8-8258-00-A2A

Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 1)

G58819



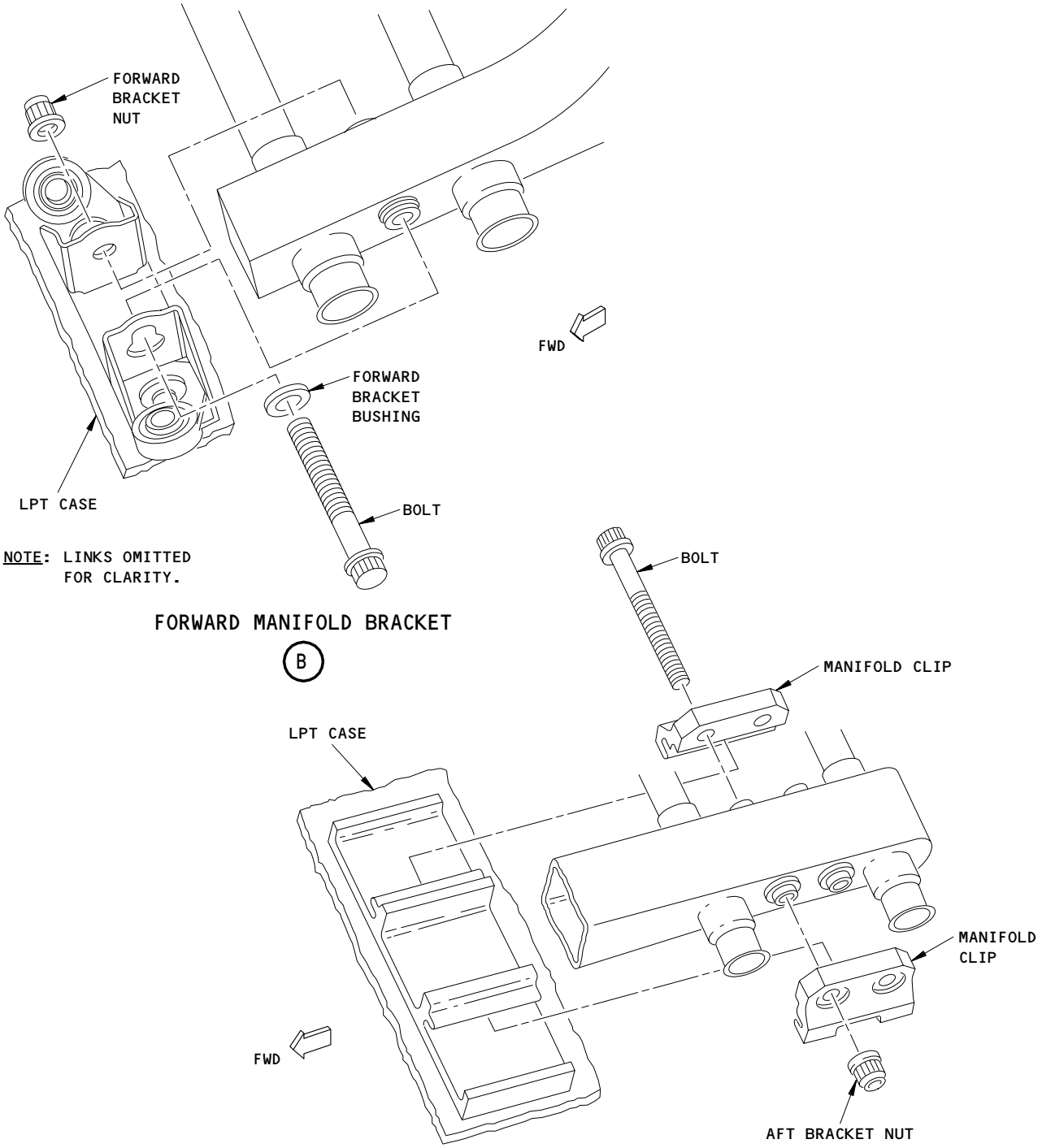
T5 SENSOR ELECTRICAL LEAD
A

CF8-A6273-00-A

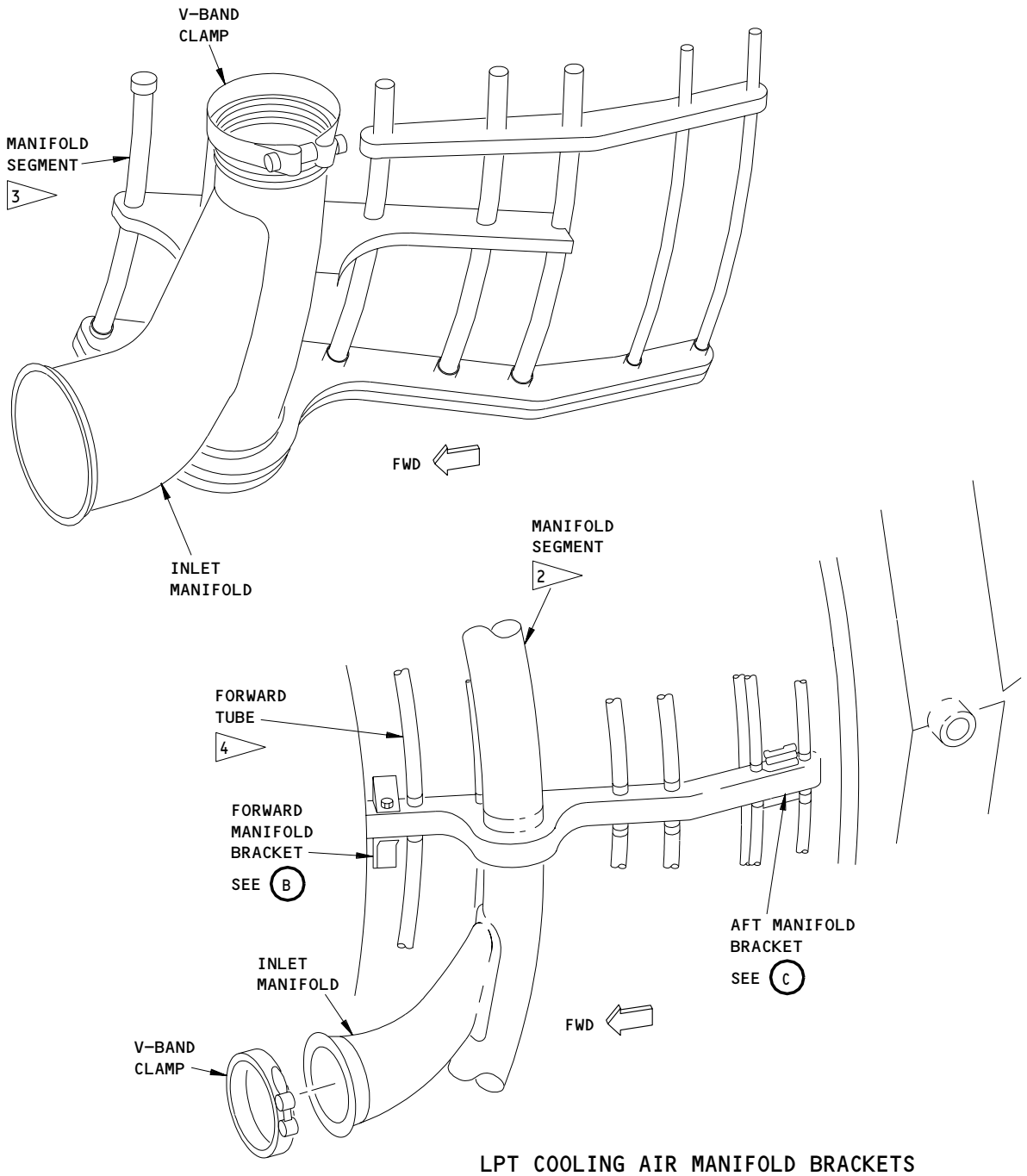
Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 2)

EFFECTIVITY
ENGINES PRE GE SB 75-148

G59057



Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 3)



LPT COOLING AIR MANIFOLD BRACKETS

D

2 ENGINES PRE-GE-SB 75-122.

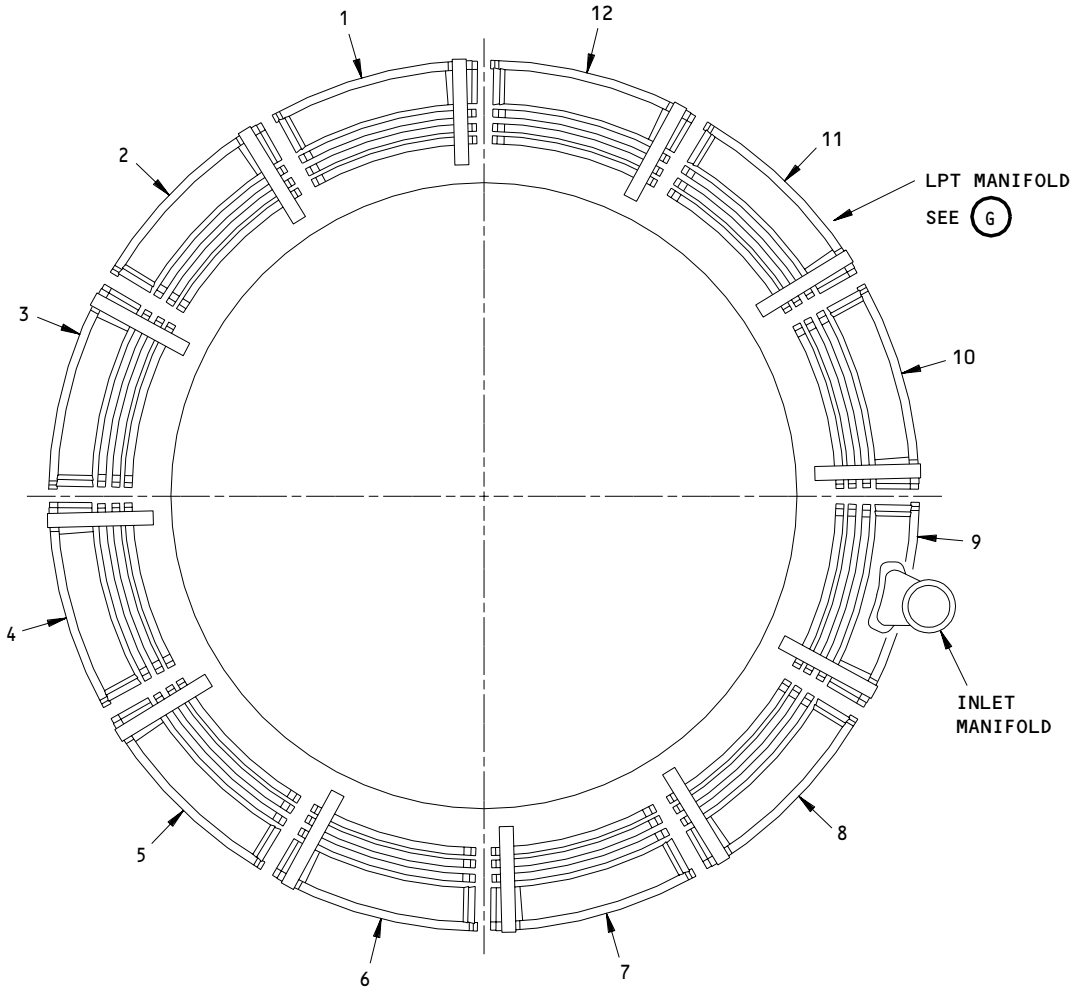
3 ENGINES POST-GE-SB 75-122.

4 ENGINES POST-GE-SB 72-202 HAVE FORWARD TUBE REMOVED ON ALL MANIFOLD SEGMENTS.

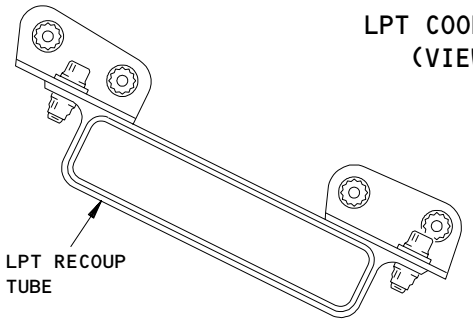
1176293-00-A

Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 4)

L27630



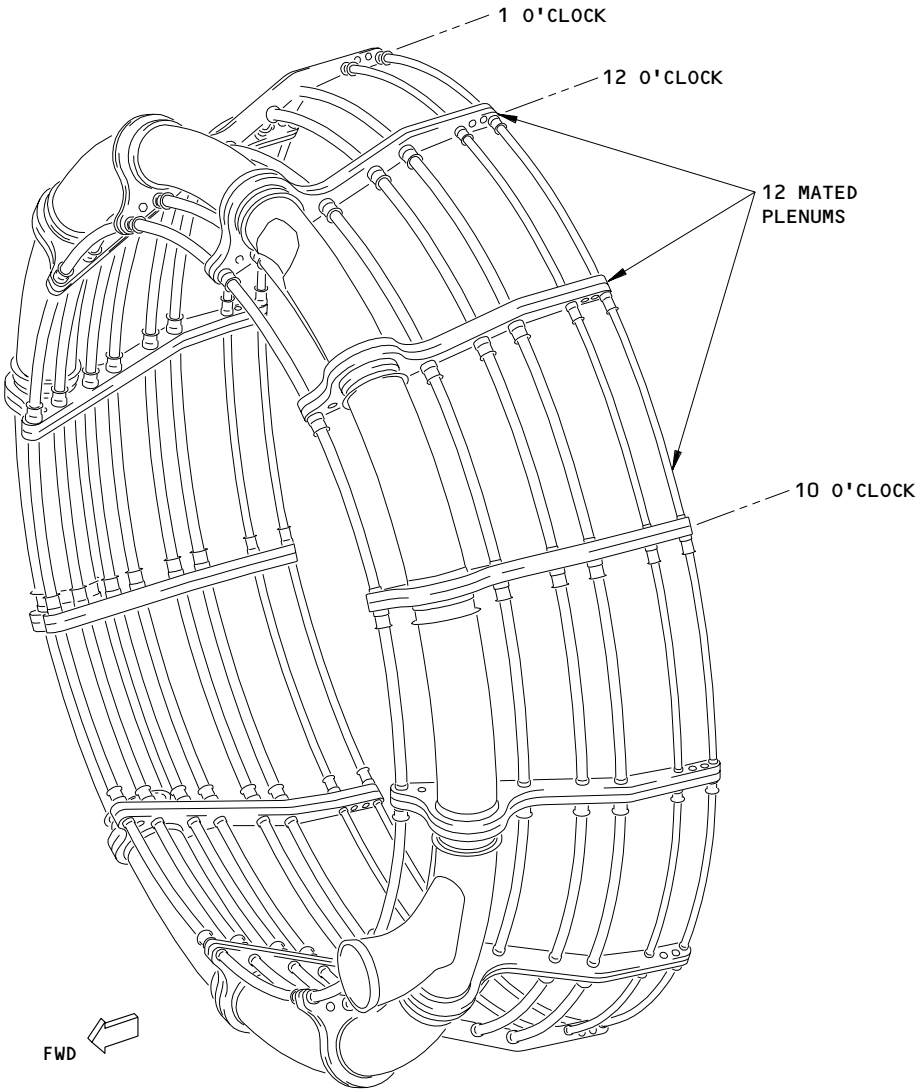
LPT COOLING AIR MANIFOLD SEGMENTS
(VIEW IN THE AFT DIRECTION)
E



LPT RECOUP TUBE
(VIEW IN THE FORWARD DIRECTION)
F

CF8-A6275-00-A

Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 5)



LPT MANIFOLD

G

1122374-00

Twelve Segment LPT Cooling Air Manifold - Removal/Installation
Figure 401A (Sheet 6)

EFFECTIVITY
ENGINES PRE GE SB 75-148

L31218

(2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

C. Prepare for the Removal

S 864-062-J00

(1) Open the thrust reversers (Ref 78-31-00/201).

S 864-063-J00

(2) Open these circuit breakers, for the applicable engine, and attach the DO-NOT-CLOSE tags:
   (a) P18 DC Power Distribution Panel
      1) 18J5 ENG 1 EEC PWR CH A
      2) 18J6 ENG 1 EEC PWR CH B
      3) 18F5 ENG 2 EEC PWR CH A
      4) 18F6 ENG 2 EEC PWR CH B
      5) 18G20 ENG 3 EEC PWR CH A
      6) 18G21 ENG 3 EEC PWR CH B
      7) 18D20 ENG 4 EEC PWR CH A
      8) 18D21 ENG 4 EEC PWR CH B

D. Procedure (Fig. 401A)

S 034-064-J00

(1) ENGINES WITH ACMS (AIRCRAFT CONDITION MONITORING SYSTEM); Disconnect the T5 electrical leads from the engine as follows:
   (a) Disconnect the T5 electrical leads from the T5 sensor.
   (b) Remove the bolts, washers, and nuts which attach the lead to the LPT cooling manifold (5 locations).

      NOTE: Do the work from the forward sensor. Carefully put the T5 sensor electrical lead to one side.

S 024-066-J00

(2) Remove the LPT cooling manifold segments as follows:

   NOTE: From the 2 o'clock position (forward looking aft), work in a counterclockwise direction. Make sure you number the manifold segments in sequence.

   (a) ENGINES PRE GE SB 75-098; Remove the tie down straps and insulation blankets.
   (b) Disconnect the aft end of the manifold segment (No. 11) from the aft bracket of the LPT stator case.
      1) Remove the two nuts, bolts, and manifolds clips from the aft manifold bracket.
   (c) If necessary, remove the bolts and nuts from the 7th-stage cooling air manifold support links at the LPT forward brackets.

CAUTION: DO NOT REMOVE THE NUTS THAT HOLD THE LPT COOLING MANIFOLD BRACKET TO THE LPT CASE. THE RETAINER BOLT WILL FALL INTO THE LPT CASE.

(d) ENGINES PRE GE SB 75-122;
Disconnect the forward end of the manifold segment (No. 11) from the forward bracket of the LPT stator case.
1) Remove the nut, bushing, and bolt from the forward manifold bracket.

(e) ENGINES PRE GE SB 75-122;
Loosen the V-band clamp on the large tube of each manifold segment.

(f) Loosen the aft manifold clips of the adjacent LPT manifold segments (No. 10 and 12).

(g) Disconnect the cooling air feeder tubes of the manifold segment No. 11 from the adjacent manifold segments (No. 10 and 12).

(h) Remove the manifold segment No. 11

NOTE: Carefully pull the manifold segment No. 11 outward, then move it aft until clear of the 7th-stage cooling air manifold.

(i) Disconnect the aft end of the remaining manifold segments from the brackets (11 locations).
1) Remove the nuts, bolts, and manifold clips from the aft manifold bracket.

(j) ENGINES PRE GE SB 75-122;
Disconnect the forward end of the remaining manifold segments from the brackets (11 locations).
1) Remove the nuts, bushings, and bolts from the forward manifold brackets.

(k) Disconnect the cooling air feeder tubes from the segments.

NOTE: When you disconnect the cooling air tubes, do it one manifold segment at a time.

(l) Remove the remaining manifold segments.

NOTE: Removal of the manifold segments No. 7 and 8 requires removal of the three LP recoup tubes.

(m) Remove the three LP recoup tubes from the engine as follows:
1) ENGINES PRE GE SB 75-071;
Remove the six bolts, washers and nuts which attach the three LP recoup tubes to the low pressure turbine brackets.
2) ENGINES POST GE SB 75-071;
Remove six bolts, spacers, washers, and nuts which attach the three LP recoup tubes to the low pressure turbine brackets.

3) Remove the twelve bolts which attach the three LP recoup tubes to the pads of the exhaust sleeve.

(n) If necessary, remove the D-sump oil supply, D-sump oil scavenge and combustor drain lines as follows (Fig. 401A):

1) Remove the spray shields and loosen the B-nuts at each end of the lines, as necessary.
2) Remove any necessary bolts, nuts and clamps that attach the lines to the turbine rear frame.
3) Remove any necessary bolts, nuts and clamps that attach the lines to the LPT cooling air manifold.
4) Remove the D-sump oil supply, D-sump oil scavenge, and combustor drain lines, as necessary.

(o) Remove the LPT inlet manifold (segment 9) from the air manifold as follows:

1) Loosen the V-band clamp that connects the air manifold with the LPT cooling air inlet manifold.
2) Disconnect the air manifold from the inlet manifold.
3) Disconnect the inlet manifold from the manifold support linkage.
a) Remove the bolt and nut from the linkage joint of the manifold bracket.

S 024-083-J00

(3) ENGINES PRE GE SB 75-122;
Remove the piston rings from all the LPT manifold segments.
(a) Discard the piston rings.

TASK 75-24-03-404-014-J00

5. ENGINES PRE GE SB 75-148;
Twelve Segment LPT Cooling Air Manifold Installation

A. Consumable Materials
(1) D01062 Never-Seez, Pure Nickel Special (Anti-seize compound)
(2) Lubricant - Petrolatum, Soft White Fonoline

B. References
(1) 78-31-00/201, Thrust Reverser System

C. Access
(1) Location Zones

412	Engine 1
422	Engine 2
432	Engine 3
442	Engine 4

(2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

D. Procedure (Fig. 401A)

S 424-006-J00

(1) Install the LPT inlet manifold on the air manifold as follows:
  (a) Align the LPT cooling air inlet manifold segment (segment 9) with the air manifold.
    1) Install the V-band clamp around the tube joint.
    2) Connect the inlet manifold to the manifold support linkage.
      a) Tighten the linkage to the manifold bracket with the bolt and nut.
      b) Tighten the bolt and nut to 55-70 pound-inches (6.2-7.9 Newton meters).
    3) Align the manifold segment aft end to the LPT stator case aft bracket.

S 424-007-J00

(2) Install the LPT cooling manifold segments.
  (a) ENGINES PRE GE SB 75-122;
    Do the steps that follow:
    1) Lubricate the assorted piston rings with white fonoline.
    2) Install the applicable piston ring on the feeder tubes and the main tube of the segment.
  (b) Connect each feeder tubes and stator case brackets.
  (c) Connect the aft end of the manifold segment (No. 11) to the bracket of the LPT stator case.
    1) Install the two bolts, nuts and manifold clips on the aft manifold bracket.

      NOTE: Do not tighten the bolts at this time.

  (d) ENGINES PRE GE SB 75-122;
    Connect the forward end of the manifold segment (No. 11) to the bracket of the LPT stator case.
    1) Install the bolt, bushing, and nut on the forward manifold bracket.

      NOTE: Do not tighten the bolt at this time.

  (e) Install the adjacent LPT manifold segment (No. 10).

S 424-019-J00

(3) Do the steps above for the remaining LPT manifold segments installation.

  NOTE: Work in the clockwise rotation until it reaches manifold segment No. 12.

S 434-008-J00
(4) Tighten the V-band clamp at (inlet manifold/air manifold) junction to 50 pound-inches (5.6 newton-meters).
  (a) At the same time, tap the circumference of the junction with a non-metallic mallet.

S 434-009-J00
(5) ENGINES PRE GE SB 75-122;
Tighten the nuts on the forward stator case to the segment brackets to 65 pound-inches (7.3 newton-meters).

S 434-010-J00
(6) Tighten the aft bracket nuts to 25 pound-inches (2.8 newton-meters).

S 434-082-J00
(7) ENGINES POST GE SB 75-122;
Tighten all the V-band clamps that connect the LPT cooling air segments to 33-37 pound-inches (3.7-4.2 Newton meters).

S 424-011-J00
(8) Install the three LP recoup tubes on the low pressure turbine brackets as follows:
  (a) Lubricate the bolts with the antiseize compound.
  (b) ENGINES PRE GE SB 75-071;
  Install the six bolts, washers and nuts which attach the three LP recoup tubes on the low pressure turbine brackets.
    1) Tighten the bolts to 33-37 pound-inches (3.7-4.2 newton-meters).
  (c) ENGINES POST GE SB 75-071;
  Install six bolts, spacers, washers, and nuts which attach the three LP recoup tubes on the low pressure turbine brackets.
    1) Tighten the nuts to 33-37 pound-inches (3.7-4.2 newton-meters).

S 424-012-J00
(9) Install the three LP recoup tubes on the exhaust sleeve as follows.
  (a) Lubricate the bolts with the antiseize compound.
  (b) Tighten the bolts to 33-34 pound-inches (3.7-4.2 newton-meters).

S 424-084-J00
(10) If removed, install the D-sump oil scavenge line as follows:
  (a) Install the aft end of the D-sump oil scavenge line to the turbine rear frame fitting at the 5 o'clock position (Fig. 401A).
    1) Install the forward end to the D-sump oil scavenge line.

2) Tighten the coupling nuts with your fingers.
(b) Install any removed clamps, bolts and nuts.
1) Tighten the nuts with your fingers.
(c) Tighten the D-sump oil scavange line forward and aft B-nuts to 650-770 pound-inches (73.4-87.0 N.m).
(d) Tighten the loop clamp nuts to 33-37 pound-inches (3.7-4.2 N.m).

S 424-085-J00
(11) If removed, install the D-sump oil supply line as follows:
(a) Install the aft end of the D-sump oil supply line to the turbine rear frame fitting at the 7 o'clock position (Fig. 401).
1) Install the forward end to the D-sump oil supply line.
2) Tighten the coupling nuts with your fingers.
(b) Install any removed clamps, bolts and nuts.
1) Tighten the nuts with your fingers.
(c) Tighten the D-sump oil supply line forward and aft B-nuts to 450-550 pound-inches (50.8-62.1 N.m).
(d) Tighten the loop clamp nuts to 33-37 pound-inches (3.7-4.2 N.m).
(e) Install the spray shields.

S 424-086-J00
(12) If removed, install the combustor drain line as follows:
(a) Install the forward end of the combustor drain tube to the comprssor rear frame port at the 7 o'clock position (Fig. 401).
1) Install the aft end to the combustor drain valve.
2) Tighten the coupling nuts with your fingers.
(b) Install any removed clamps, bolts and nuts.
1) Tighten the nuts with your fingers.
(c) Tighten the loop clamp nuts to 33-37 pound-inches (3.7-4.2 N.m).
(d) Tighten the combustor drain line forward and aft B-nuts to 180-200 pound-inches (20.3-22.6 N.m).

S 424-087-J00
(13) If removed, install the 7th-stage cooling air manifold support links as follows:
(a) Lubricate the bolts with antiseize compound (C02-002).
(b) Install the 7th-stage cooling air manifold support links to the LPT forward brackets.
(c) Install the bolts and nuts.
1) Tighten the bolts to 33-37 pound-inches (3.7-4.2 N.m).

S 424-088-J00
(14) ENGINES PRE GE SB 75-098;
Install the insulation brackets and tie-down straps.

S 424-098-J00

(15) ENGINES WITH ACMS (AIRCRAFT CONDITION MONITORING SYSTEM);
Attach the T5 thermocouple harness as follows:

(a) Install the T5 thermocouple harness to the two brackets on the manifold with two, bolts and washers.

1) Torque the nuts to 33-37 pound-inches (3.7-4.2 Newton meters).

(b) Connect the T5 sensor electrical leads to the T5 sensor.

1) Tighten the smaller lead nut to 33-37 pound-inches (3.7-4.2 newton-meters).

2) Tighten the larger lead nut to 55-70 pound inches (6.2-7.9 newton-meters).

E. Put the Airplane Back to Its Usual Condition

S 864-016-J00

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:

(a) P18O DC Power Distribution Panel

1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 414-015-J00

(2) Close the thrust reversers (Ref 78-31-00/201).

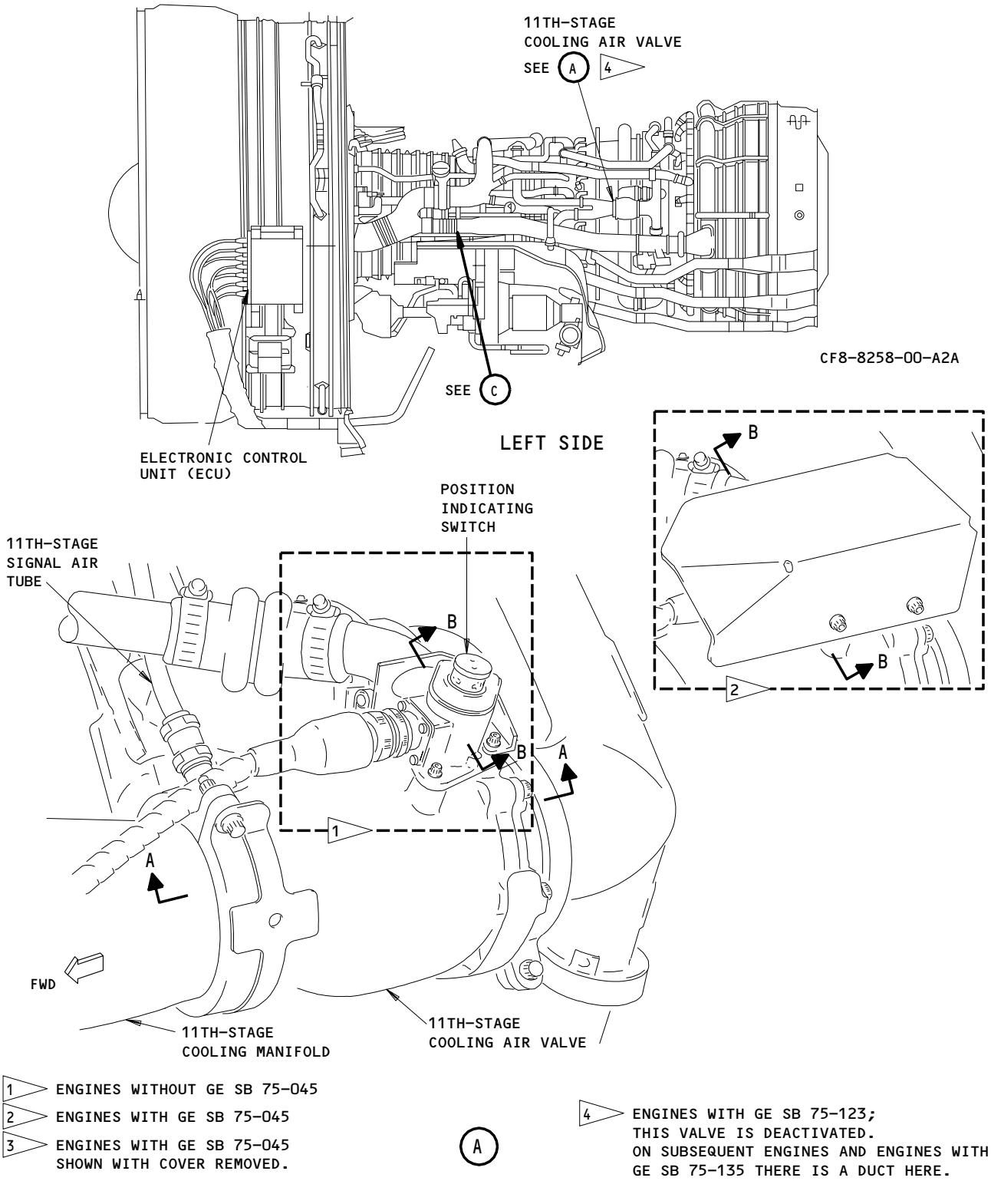
11TH-STAGE COOLING AIR SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The 11th-stage cooling air system supplies 11th-stage bleed air to cool the high pressure turbine (HPT) second-stage nozzle.
   B. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
      The system consists of two 11th-stage cooling air valves, an 11th-stage cooling valve solenoid, and the electronic control unit (ECU).
   C. ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES;
      The system consists of an 11th-stage cooling valve solenoid, and the electronic control unit (ECU). Ducts are installed in the locations where the 11th-stage cooling air valves are installed on other engines.
   D. ENGINES WITH GE SB 75-123;
      The system consists of an 11th-stage cooling valve solenoid and the electronic control unit (ECU). The 11th-stage cooling air valves are deactivated.
   E. The bleed air enters the 11th-stage cooling manifold at the high pressure compressor (HPC) 11th-stage.
   F. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
      The air goes through the two 11th-stage cooling air valves and to the HPT second-stage nozzle cooling manifold.
   G. ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES;
      The air goes through ducts to the HPT second-stage nozzle cooling manifold.
   H. ENGINES WITH GE SB 75-123;
      The air goes through the deactivated 11th-stage cooling air valves to the HPT second-stage nozzle cooling manifold. The 11th-stage cooling air valves allow constant air flow.
   I. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
      The 11th-stage cooling air valves are in the full-flow position during takeoff thrust, climb thrust, and high power engine operation. The maximum amount of cooling air is supplied to the HPT second-stage nozzle during these high temperature conditions.
   J. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123;
      When the engine is operating at low power and during a cruise condition, the ECU sends an electrical signal to the 11th-stage cooling valve solenoid. The solenoid changes the electrical signal into a pneumatic signal and sends it to the valves. The pneumatic signal causes the valves to go to the reduced-flow position. This will decrease the amount of cooling air to the HPT second-stage nozzle and improve engine efficiency during low power operation.

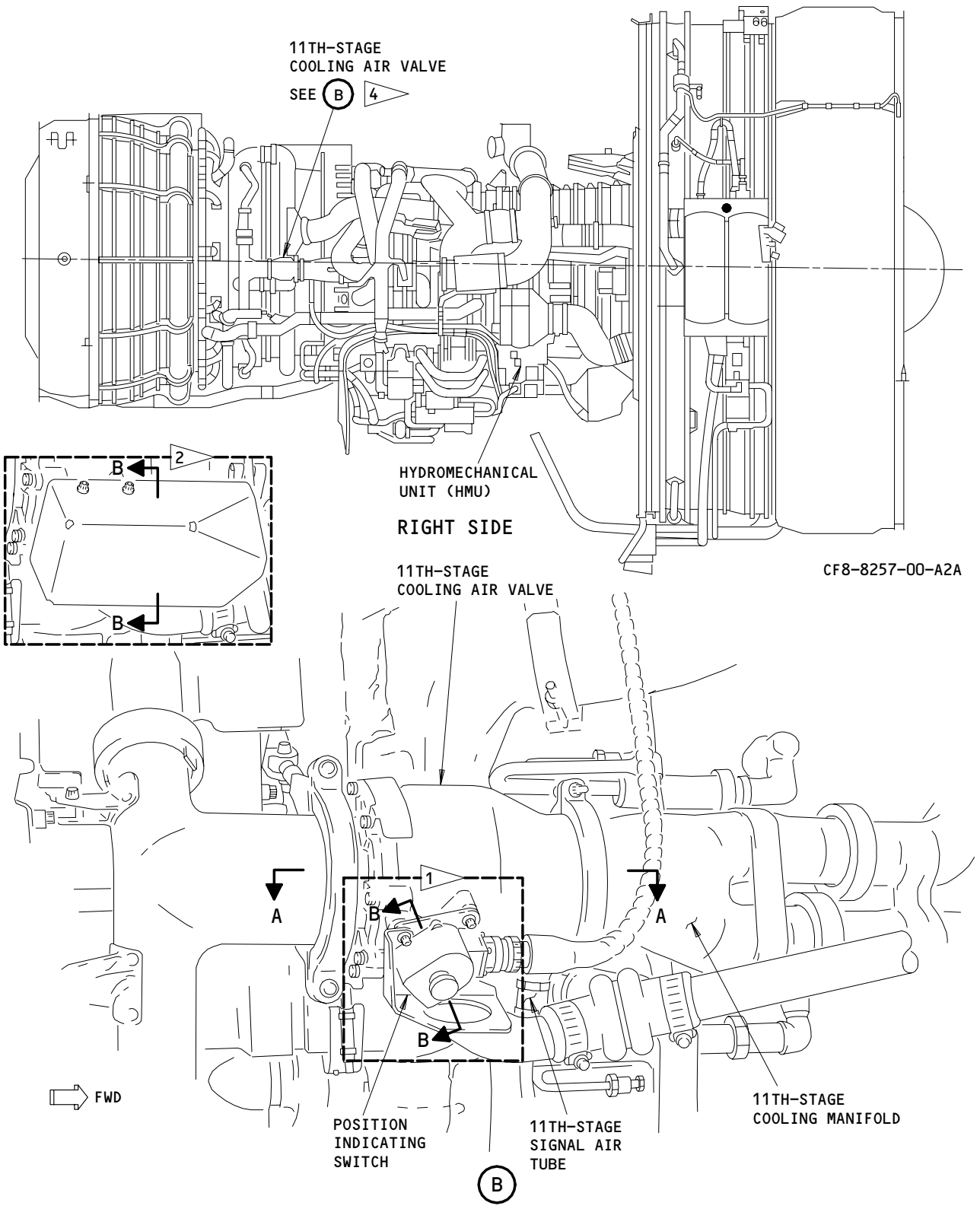
K. ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES OR WITH GE SB 75-123; When the engine is operating at low power and during a cruise condition, the ECU sends an electrical signal to the 11th-stage cooling valve solenoid. The solenoid changes the electrical signal into a pneumatic signal and sends it to the core compartment cooling valve.

2. ENGINES WITH 11TH-STAGE COOLING AIR VALVE AND WITHOUT GE SB 75-123;
11th-Stage Cooling Air Valve (Fig. 1)
   A. There are two identical 11th-stage cooling air valves installed on the HPT case at the 3 and 9 o'clock positions.
   B. The valve assembly is pneumatically operated and has two positions: full-flow and reduced-flow. The valve assembly consists of a translating sleeve, an actuation chamber, and a position indicating switch.
      (1) The translating sleeve is spring loaded to the open position. The sleeve has slots cut into it which permit a reduced-flow of 11th-stage cooling air when the valve is in the closed position. The sleeve also has a cam to operate the position indicating switch.
      (2) When 11th-stage signal air is supplied to the actuation chamber, the valve will move to the closed position.
      (3) The position indicating switch senses the position of the translating sleeve. It has a cam follower which contacts the cam on the sleeve. The position of the sleeve is sent to the ECU. When the sleeve is in the open position, a rod attached to the cam follower can be seen through the observation window. When the sleeve is in the closed position, the observation window will be clear.
   C. The valve assembly has an air flow direction arrow to prevent incorrect installation.

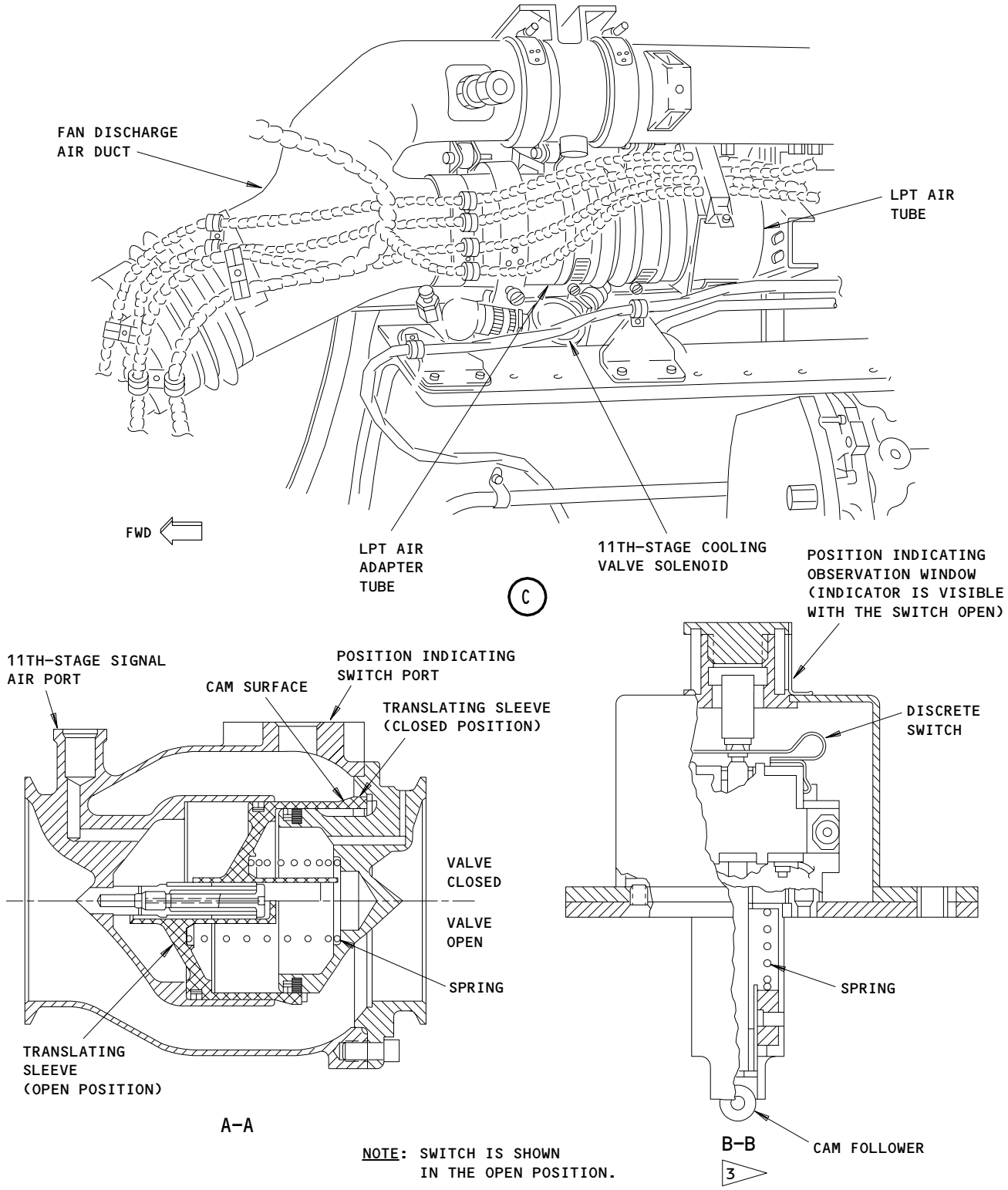
3. 11th-Stage Cooling Valve Solenoid (Fig. 1)
   A. The 11th-stage cooling valve solenoid is installed on the upper left side of the accessory gearbox (AGB) heatshield in the 8 o'clock position.
   B. The dual coil solenoid is attached to a three-port valve. The solenoid has two electrical connectors. The valve has a bleed air port, a signal air port, a vent port, and a manual override.
      (1) ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123; The bleed air port is connected directly to 11th-stage bleed air. The signal air port is connected to the two 11th-stage cooling air valves and the core compartment cooling air valve (AMM 75-23-00/001).



11th-Stage Cooling Air System
Figure 1 (Sheet 1)



11th-Stage Cooling Air System
Figure 1 (Sheet 2)



11th-Stage Cooling Air System
Figure 1 (Sheet 3)

(2) ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES OR WITH GE SB 75-123; The bleed air port is connected directly to 11th-stage bleed air. The signal air port is connected to the core compartment cooling air valve (AMM 75-23-00/001).

(3) When the ECU energizes the solenoid, the valve will open and permit 11th-stage signal air to go to the core compartment cooling air valve.

(4) When the solenoid is not energized, the spring will move the valve to the closed position and the bleed air port will be blocked.

(5) The manual override can be locked in the closed position. When the override is locked in the closed position, it will prevent 11th-stage bleed air flow to the signal air port.

4. Operation

A. ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123; Functional Description

(1) The ECU measures fan speed (N1), low pressure turbine inlet temperature (T4.9), ambient pressure (P0), core speed (N2), and the position of the 11th-stage cooling air valves.

(2) When N1 is equal to or larger than 86 percent, T4.9 is less than 699°C, and P0 is less than 7.95 psi (55 KPa); the ECU transmits a 16 volt dc signal to the solenoid. The energized solenoid will open the bleed air port and cause the 11th-stage valves to move to the reduced-flow position, and the core compartment cooling valve to move to the reduced-flow position.

(3) When N1 is less than 86 percent, T4.9 is greater than 704°C, and P0 is equal to or greater than 8.20 psi (57 KPa); the ECU will not transmit an electrical signal to the solenoid. The de-energized solenoid will close the bleed air port and permit the 11th-stage valves to move to the spring loaded full-flow position, and the core compartment cooling valve to the full-flow position.

(4) When the translating sleeve moves, the cam follower on the position indicating switch will move along the cam surface. The switch will send a signal to the ECU. This signal is used for position feedback and fault detection.

B. ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES OR WITH GE SB 75-123; Functional Description

(1) The electronic control unit (ECU) monitors the engine operating conditions as described above and transmits electrical signals to the 11th-stage cooling valve solenoid. The solenoid sends a pneumatic signal to the core compartment cooling air valve , as described above.

11TH-STAGE COOLING AIR SYSTEM - MAINTENANCE PRACTICES

1. General
   A. This section contains two tasks. One task is for the deactivation of the 11th-stage cooling air valve. The other task is for the reactivation of the 11th-stage cooling air valve.
   B. An 11th-stage cooling valve that does not operate must be deactivated in the open position. You can deactivate the 11th-stage cooling valve open if you disconnect the signal air tube from the valve. You must keep the signal air port on the 11th-stage cooling air valves open.
   C. The procedure to deactivate/reactivate the left and the right 11th-stage valves are the same for each valve.
   D. Both left and right 11th-stage cooling air valves should be deactivated/reactivated at the same time.

TASK 75-26-00-862-001-J00

2. 11th-Stage Cooling Air Valve Deactivation (Fig. 201)
   A. General
      (1) This task contains steps to deactivate the 11th-stage cooling air valve.
      (2) To do a deactivation of the 11th-stage cooling valve, you must disconnect and plug the signal air tubes at the 11th-stage cooling valves.
   B. Equipment
      (1) Plug, AN-806-6
   C. References
      (1) AMM 78-31-00/201, Thrust Reverser System
   D. Access
      (1) Location Zones

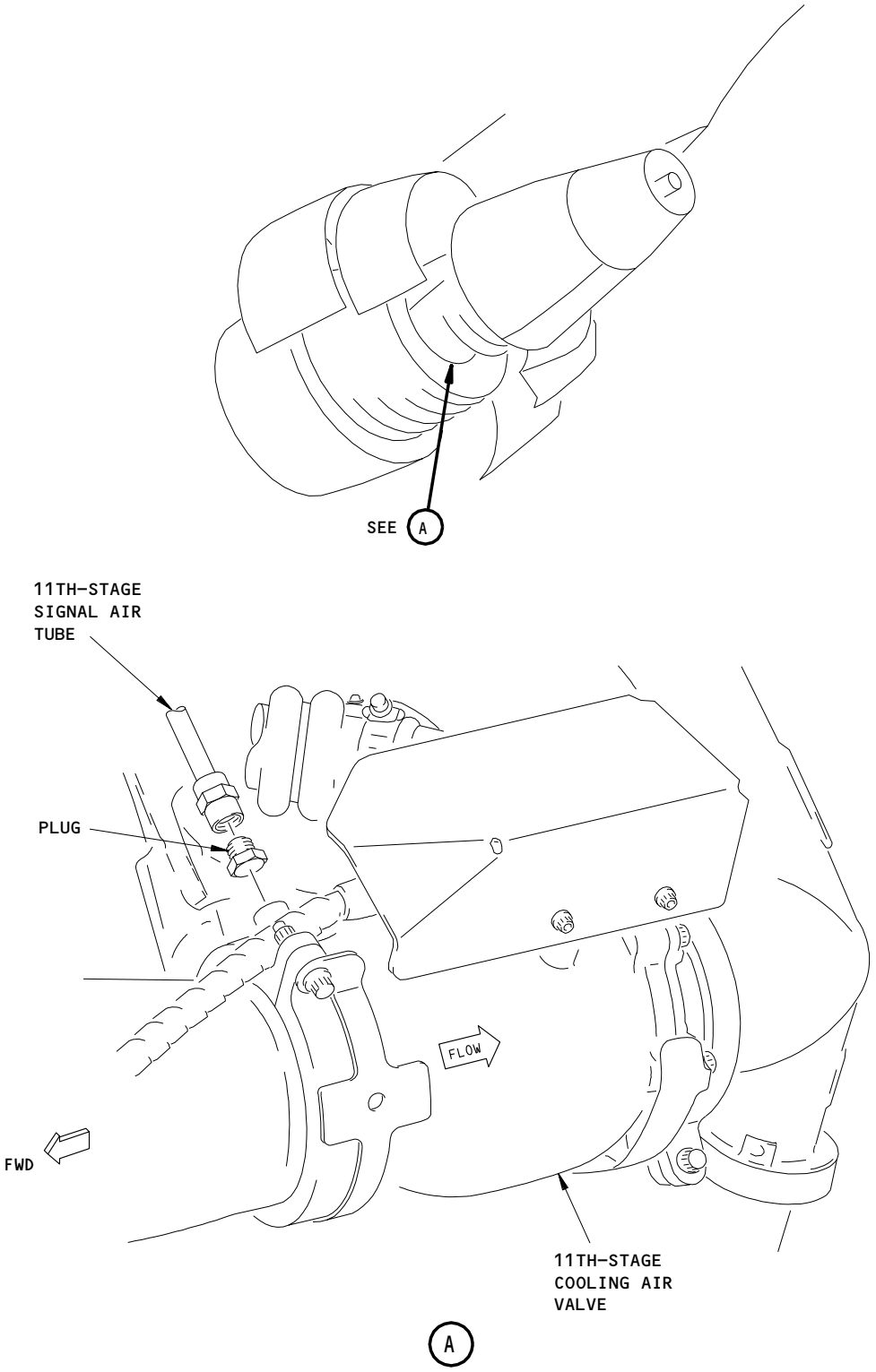
412	No. 1 - HPT Case 3 and 9 o'clock
422	No. 2 - HPT Case 3 and 9 o'clock
432	No. 3 - HPT Case 3 and 9 o'clock
442	No. 4 - HPT Case 3 and 9 o'clock

      (2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

   E. Procedure

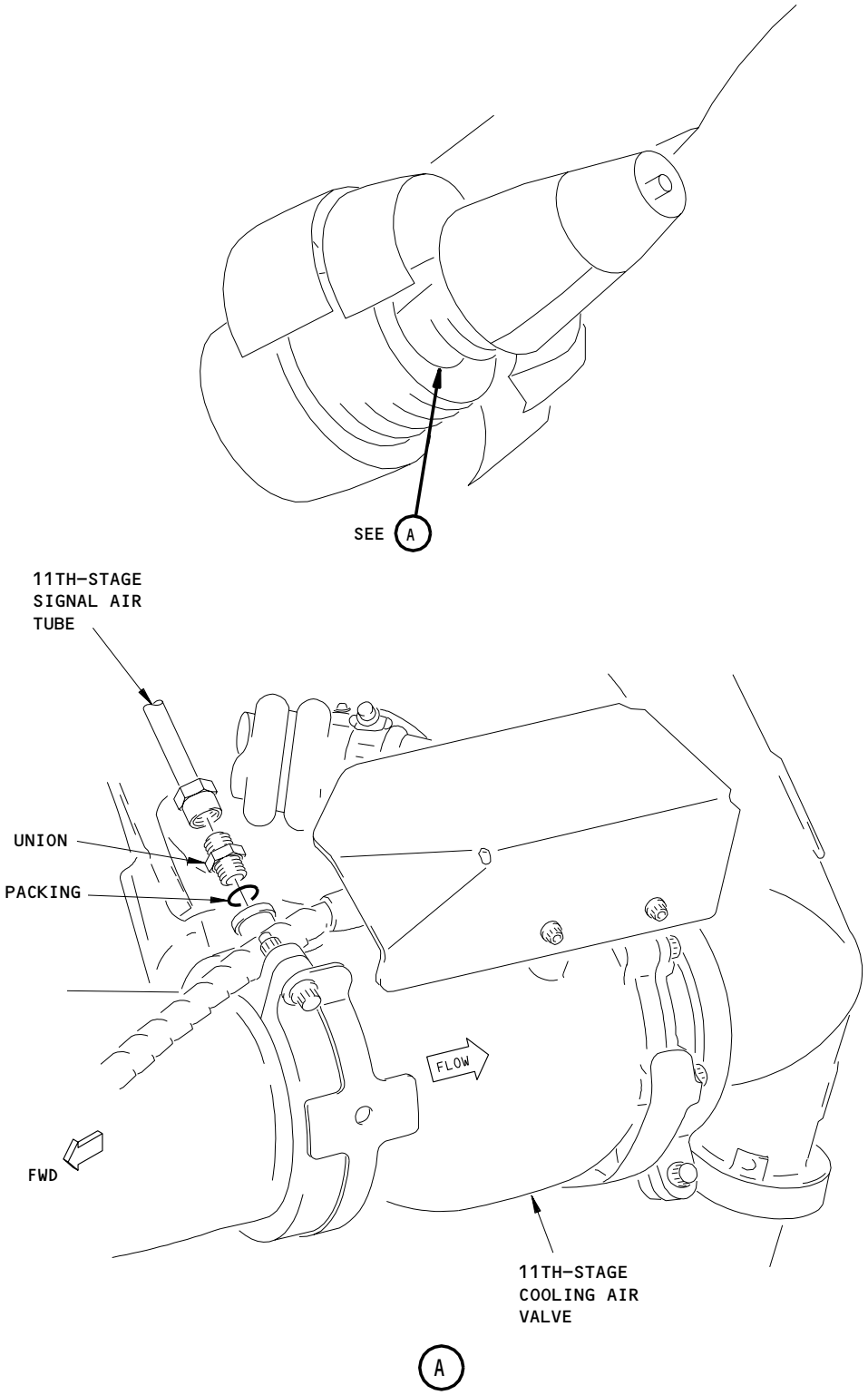
      S 012-006-J00
      (1) Open the thrust reversers (AMM 78-31-00/201).



11th-Stage Cooling Valve Deactivation/Reactivation
Figure 201 (Sheet 1)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR
VALVES AND WITHOUT GE SB 75-123

C77840



11th-Stage Cooling Valve Deactivation/Reactivation
Figure 201 (Sheet 2)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR VALVES AND WITHOUT GE SB 75-123

C77841

S 862-009-J00

CAUTION: DO NOT PLUG OR COVER THE SIGNAL AIR PORT ON THE 11TH-STAGE COOLING AIR VALVE. DAMAGE TO THE ENGINE TURBINE COMPONENTS WILL OCCUR IF YOU DO THIS INCORRECTLY.

(2) Deactivate the 11th-stage cooling air valve.
  (a) Disconnect the signal air tube from the union in the valve.
  (b) Remove the union from the opening for the signal air tube.
    1) Remove and discard the packing.
  (c) Install a plug in the 11th-stage signal air tube.
  (d) Tighten the plug to 270-300 pound-inches (30.5-33.9 N.m.).
  (e) Secure the 11th-stage signal air tube.

S 412-007-J00

(3) Close the thrust reversers (AMM 78-31-00/201).

TASK 75-26-00-862-005-J00

3. 11th-Stage Cooling Air Valve Reactivation (Fig. 201)

A. General
  (1) This task contains steps to reactivate the 11th-stage cooling air valve.
  (2) To do a reactivation of the 11th-stage cooling valve, you must connect the signal air tubes to the 11th-stage cooling valves.

B. Consumable Materials
  (1) D00558 Compound - Antiseize (C02-001)

C. References
  (1) AMM 78-31-00/201, Thrust Reverser System

D. Access
  (1) Location Zones

412	No. 1 - HPT Case 3 and 9 o'clock
422	No. 2 - HPT Case 3 and 9 o'clock
432	No. 3 - HPT Case 3 and 9 o'clock
442	No. 4 - HPT Case 3 and 9 o'clock

  (2) Access Panels

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

E. Procedure

S 012-008-J00

(1) Open the thrust reversers (AMM 78-31-00/201).

S 862-011-J00

(2) Reactivate the 11th-stage cooling air valve.
  (a) Remove the plug from the 11th-stage signal air tube.
  (b) Install the union in the opening for the signal air tube.
    1) Put lubricant on the packing.
    2) Put the packing on the union.
    3) Tighten the union to 180-200 pound-inches (20.3-22.6 N.m.).
  (c) Connect the signal air tube to the union.
    1) Tighten the tube nut to 270-300 pound-inches (30.5-33.9 N.m.).

S 412-010-J00

(3) Close the thrust reversers (AMM 78-31-00/201).

11TH-STAGE COOLING AIR SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure supplies the data to do a test of the 11th-stage cooling system. You use the EEC MAINT ENG POWER switch to do this test while the engine is at approach idle. During the test the ECU drives the eleventh stage cooling valves fully closed (minimum flow) and fully open (maximum flow).

   TASK 75-26-00-715-009-J00

2. Operational Test - 11th-Stage Cooling System
   A. References
      (1) 24-22-00/201, Electrical Power - Control
      (2) 45-10-00/201, Central Maintenance Computer System
      (3) 71-00-00/201, Power Plant
      (4) FIM 71-CMCS MESSAGE INDEX
   B. Access
      (1) Location Zones
          221 and 222 Control Cabin

   C. Preconditions

      S 865-013-J00
      (1) Electrical Power on (AMM 24-22-00/201).

      S 865-014-J00
      (2) Integrated Display System (IDS) serviceable (AMM 31-61-00/501).
   D. Procedure

      S 865-001-J00
      (1) Supply electrical power (Ref 24-22-00/201).

      S 865-002-J00
      (2) Make sure the applicable EEC MAINT ENG POWER switch on the P461 pilot overhead panel is in the NORM position.

      S 865-011-J00
      (3) Use the Power Plant Operation (Normal) procedure to start the engine (AMM 71-00-00/501).

      NOTE: The engine should be run at approach idle for the operational test of the 11th-stage cooling system.

S 865-003-J00

(4) Do the test of the ECU as follows:

(a) On the P461 pilot's overhead maintenance panel, operate the EEC MAINT ENG POWER switch as follows:

1) Move the applicable EEC MAINT ENG POWER switch to the TEST position.

NOTE: Use CMCS input monitoring to read the octal label 275 bit 29 from either EEC (ECU) channel for the applicable engine (Ref 45-10-00/201). Bit 29 is "1" when EEC (ECU) commands the ESCV valves closed. Bit 29 is "0" when EEC (ECU) commands the ESCV valves open.

NOTE: The following table shows the input monitoring EEC port address numbers for the octal 275 bit 29.

ENG	EEC	PORT LOCATION/PORT NUMBER/LABEL/SDI BITS 9,10
1	CH-A	E/082/275/10
1	CH-B	E/090/275/10
2	CH-A	E/084/275/01
2	CH-B	E/092/275/01
3	CH-A	E/083/275/11
3	CH-B	E/091/275/11
4	CH-A	E/085/275/00
4	CH-B	E/093/275/00

2) After 30 seconds, move the applicable EEC MAINT ENG POWER switch to the NORM position.

(b) After 5 seconds, operate the EEC MAINT ENG POWER switch as of the above steps again.

S 865-004-J00

(5) Read the CMCS Existing Faults as follows:

(a) Go to the CMCS Existing Fault menu.

(b) Find and select the <73 ENGINE-FUEL & CONT prompt.

(c) Print all the CMCS fault messages that you have found.

S 865-010-J00

(6) Use the Power Plant Operation (Normal) procedure to do the engine shutdown (Ref 71-00-00/201).

S 715-008-J00

(7) Do a check of the 11th-stage cooling air system on the CMCS Existing Faults.

(a) Look on the list of the CMCS messages for one or more of the messages that follows:

7X367	ENG-X 11TH-STAGE POSITION DISAGREE 'DMD CLOSED' (CH A)
7X392	ENG-X 11TH-STAGE COOLING VALVE SWITCH DISAGREE (CH A)
7X328	ENG-X ESCV SOL W/A (CH A)
7X368	ENG-X 11TH-STAGE POSITION DISAGREE 'DMD OPEN' (CH A)
7X467	ENG-X 11TH-STAGE POSITION DISAGREE 'DMD CLOSED' (CH B)
7X492	ENG-X 11TH-STAGE COOLING VALVE SWITCH DISAGREE (CH B)
7X428	ENG-X ESCV SOL W/A (CH B)
7X468	ENG-X 11TH-STAGE POSITION DISAGREE 'DMD OPEN' (CH B)

(b) Do the corrections for any CMCS messages that are found from the list above (Ref 71-CMCS MESSAGE INDEX).

(c) If no more CMCS messages are found, the 11th-stage cooling air system is serviceable.

S 865-009-J00

(8) Remove electrical power, if it is not necessary (Ref 24-22-00/201).

11TH-STAGE COOLING AIR VALVE - REMOVAL/INSTALLATION

1. General
   A. ENGINES POST-GE-SB 75-123;
      The 11th-Stage Cooling Air Valves are deactivated and cannot cause a failure. They are still installed on the engine.
   B. ENGINES POST-GE-SB 75-135;
      The 11th-Stage Cooling Air Valves are deactivated by removal from the engine. They are replaced by an air duct.
   C. This procedure contains two tasks, remove the 11th-stage cooling air valve and install the 11th-stage cooling air valve (11th-stage valve).
   D. Two 11th-stage valves are installed on the high pressure turbine case at the 3 and the 9 o'clock locations.
   E. The procedure to remove and install the left and the right 11th-stage valves are the same for each valve.

TASK 75-26-01-004-001-J00

2. 11th-Stage Valve Removal (Fig. 401)
   A. References
      (1) 75-26-03/401, 11th Stage Cooling Air Valve Position Indicating Switch
      (2) 78-31-00/201, Thrust Reverser System
      (3) IPC 75-24-01 Figs. 5 and 10
   B. Access
      (1) Location Zone

412	Engine 1 - HPT Case 3 and 9 o'clock
422	Engine 2 - HPT Case 3 and 9 o'clock
432	Engine 3 - HPT Case 3 and 9 o'clock
442	Engine 4 - HPT Case 3 and 9 o'clock

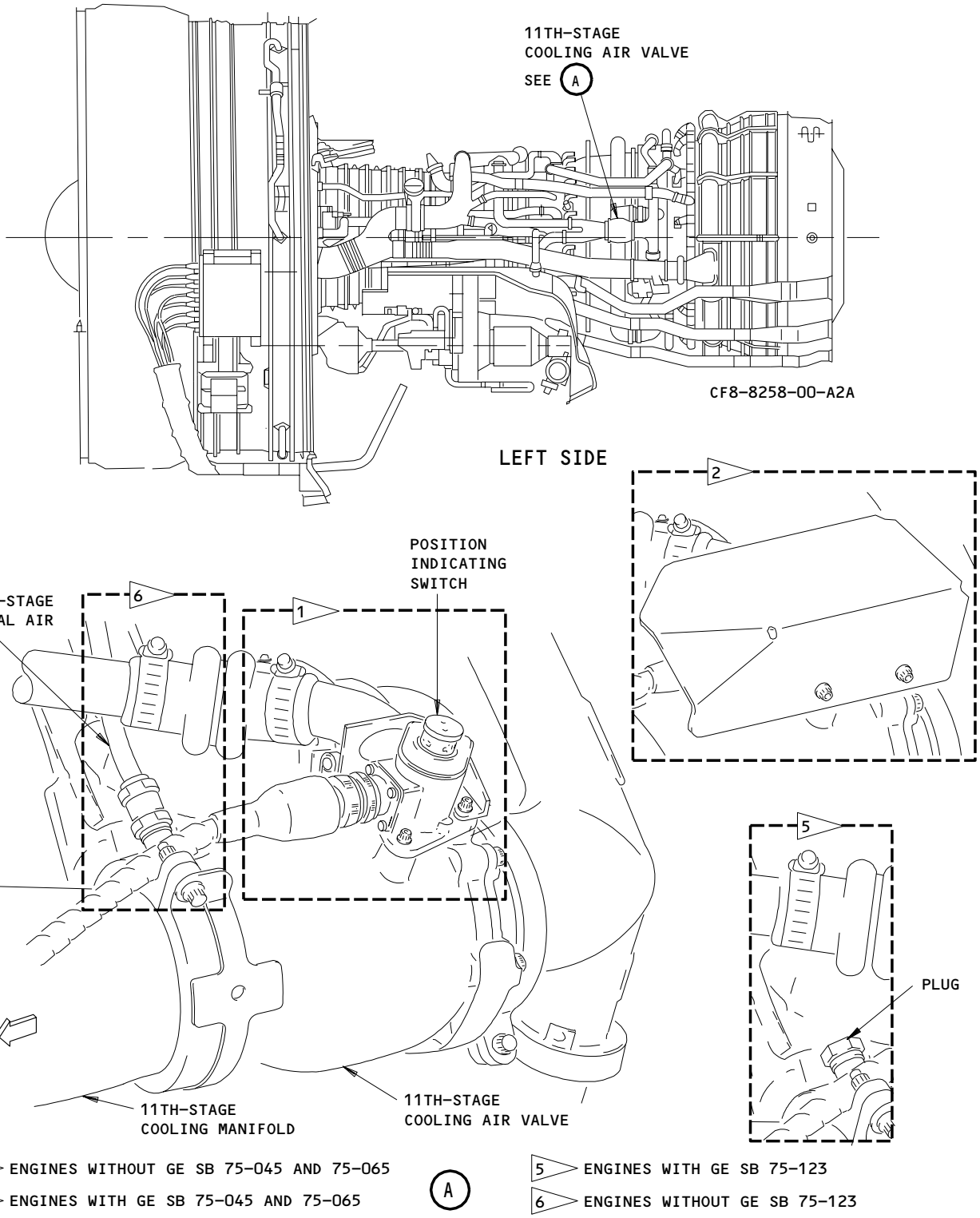
      (2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

   C. Procedure

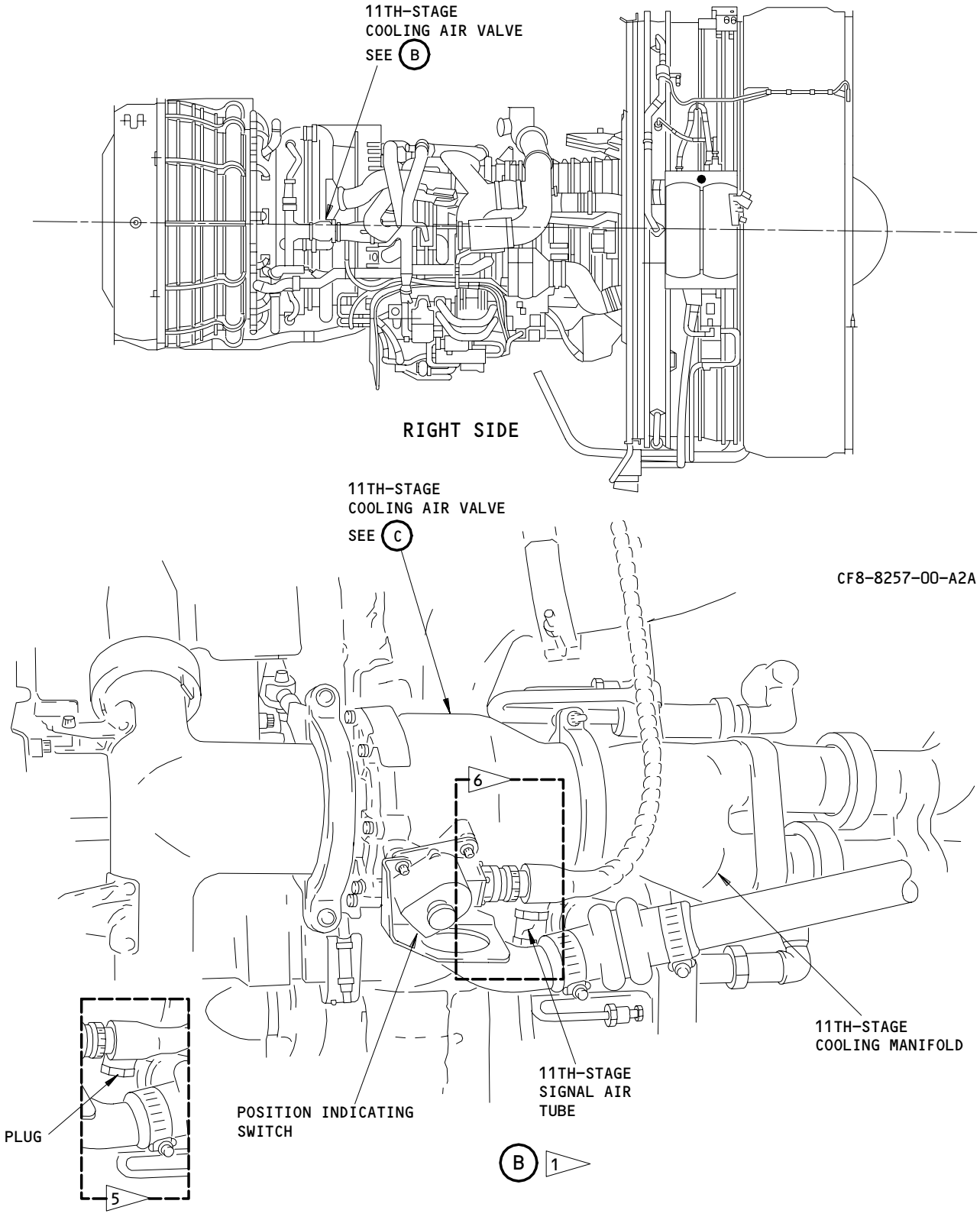
      S 014-002-J00
      (1) Open the applicable thrust reverser half (Ref 78-31-00/201).

      S 864-003-J00
      (2) Open these circuit breakers, for the applicable engine, and install the DO-NOT-CLOSE tags:
          (a) P18 DC Power Distribution Panel
              1) 18QJ5 ENG 1 EEC PWR CH A



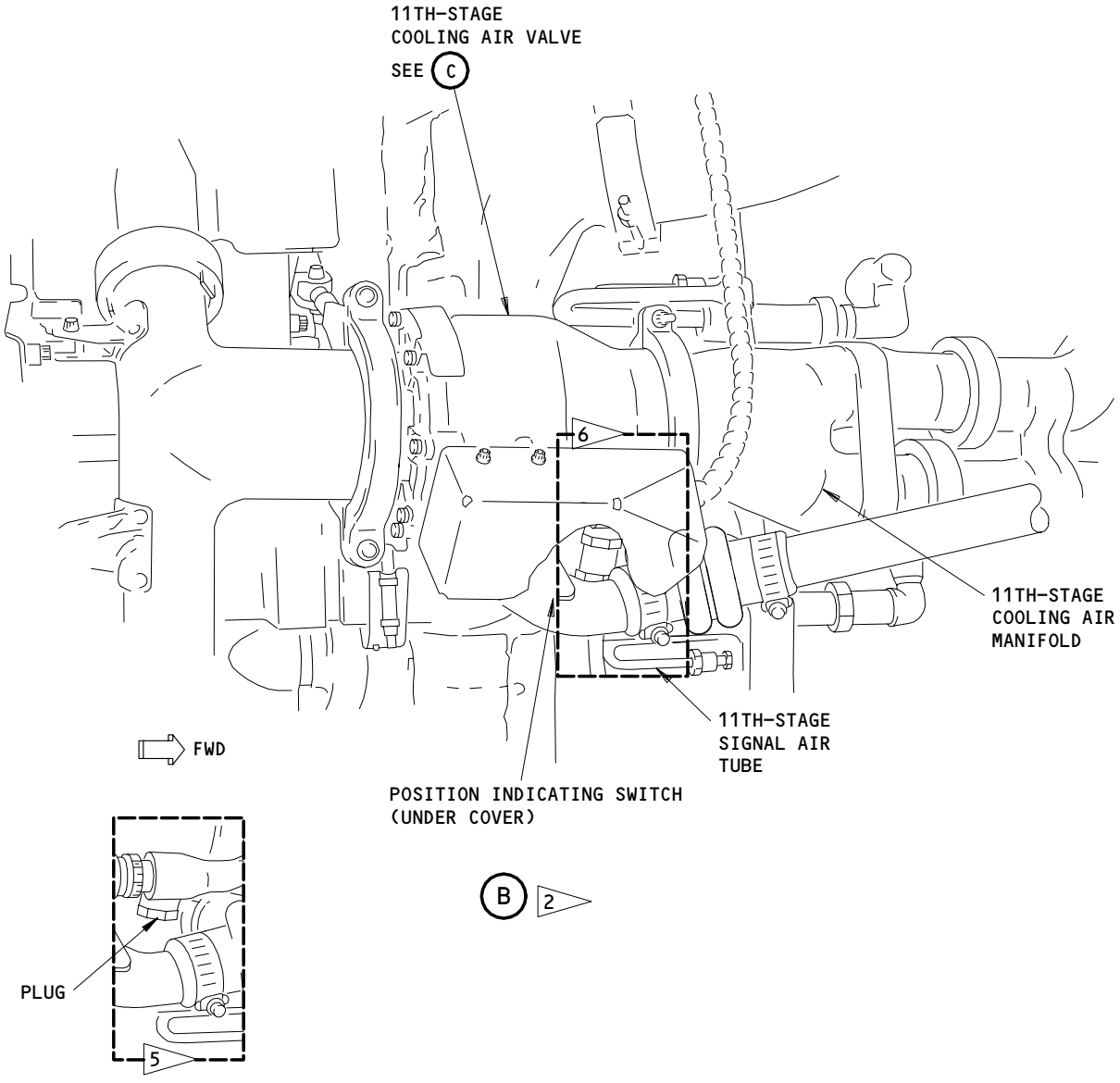
11th-Stage Cooling Air Valve Installation
Figure 401 (Sheet 1)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR VALVES

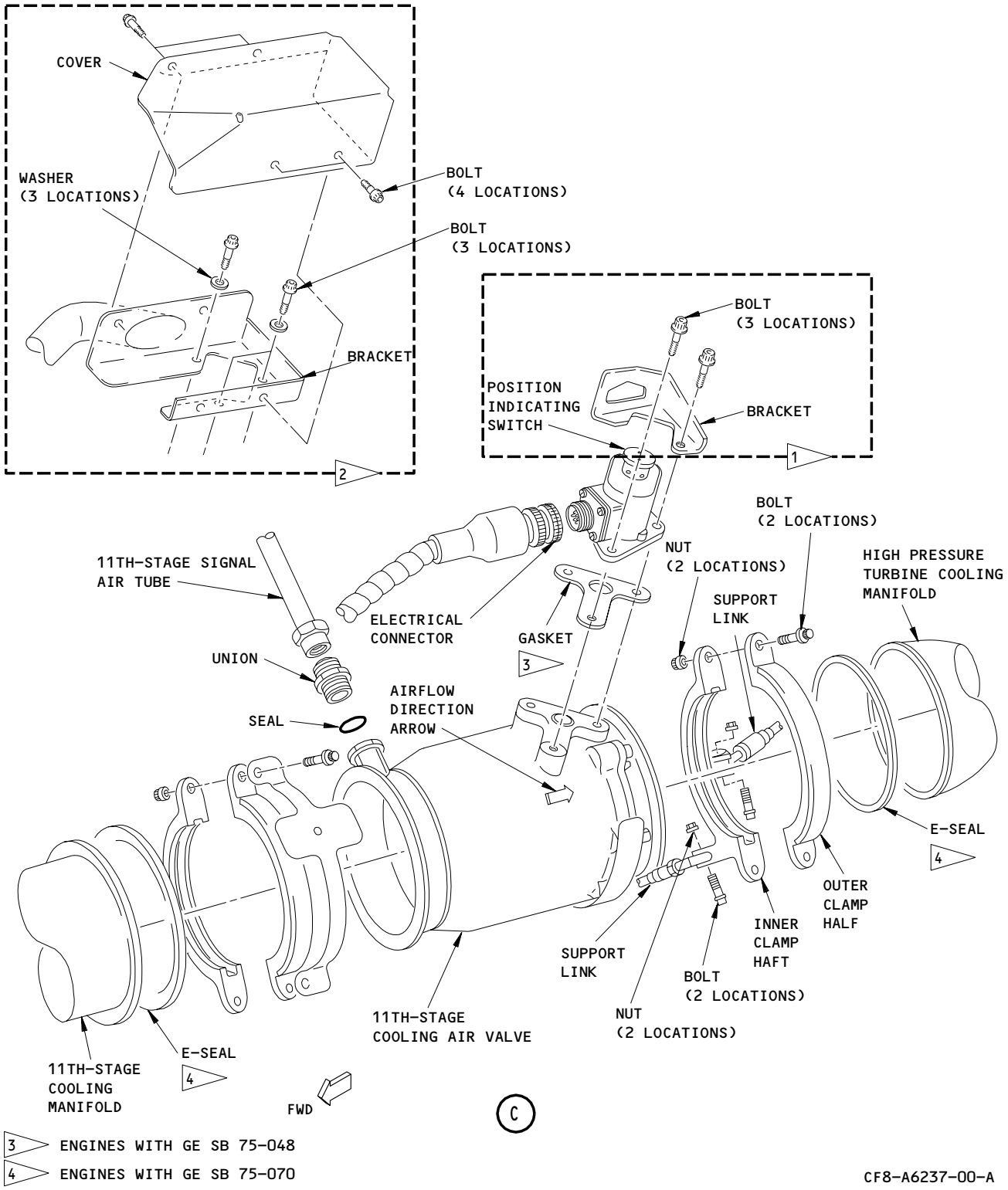


11th-Stage Cooling Air Valve Installation
Figure 401 (Sheet 2)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR VALVES



11th-Stage Cooling Air Valve Installation
Figure 401 (Sheet 3)



11th-Stage Cooling Air Valve Installation
Figure 401 (Sheet 4)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR VALVES

2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 034-004-JOO
(3) Remove the 11th-stage cooling air valve switch (Ref 75-26-03/401).

S 034-005-JOO
(4) ENGINES PRE-GE-SB 75-123;
Disconnect the signal air tube from the coupling in the valve.

S 024-034-JOO
(5) ENGINES PRE-GE-SB 75-123;
Remove the plug from the signal tube opening on the 11th-stage cooling air valve.

S 034-030-JOO
(6) Remove the clamps and the support links:
(a) Remove the two nuts and bolts that attach the clamp half on the forward end of the valve.
(b) Remove the outer and inner clamp half.
(c) Remove the two nuts and two bolts that attach each clamp half on the aft end of the valve.
(d) Remove the outer clamp half.
(e) Remove the two nuts and bolts that attach the support links to the inner clamp half.
(f) Move the support links to one side.
(g) Remove the inner clamp half.

S 024-009-JOO
(7) Remove the 11th-stage valve from the engine.
(a) ENGINES POST-GE-SB 75-07O;
Remove the E-seals on two sides of the valve.

S 034-010-JOO
(8) ENGINES PRE-GE-SB 75-123;
Remove the coupling from the opening for the signal air tube.
(a) Remove the seal.

S 034-012-JOO
(9) Install protective covers on the openings in the valve and the manifolds.

TASK 75-26-01-404-013-J00

3. 11th-Stage Valve Installation (Fig. 401)

A. References

(1) 75-26-03/401, 11th Stage Cooling Air Valve Position Indicating Switch

(2) 78-31-00/201, Thrust Reverser System

(3) IPC 75-24-01 Figs. 5 and 10

B. Access

(1) Location Zone

412 Engine 1 - HPT Case 3 and 9 o'clock
422 Engine 2 - HPT Case 3 and 9 o'clock
432 Engine 3 - HPT Case 3 and 9 o'clock
442 Engine 4 - HPT Case 3 and 9 o'clock

(2) Access Panel

415 and 416 Thrust Reverser Halves - Engine 1
425 and 426 Thrust Reverser Halves - Engine 2
435 and 436 Thrust Reverser Halves - Engine 3
445 and 446 Thrust Reverser Halves - Engine 4

C. Procedure

S 434-014-J00

(1) Remove the protective covers from the openings on the valve and the manifolds.

S 434-016-J00

(2) ENGINES PRE-GE-SB 75-123;
Install the coupling in the opening for the signal air tube.
(a) Put seal on the coupling.
(b) Tighten the coupling to 180-200 pound-inches (20.3-22.6 N.m).

S 424-035-J00

(3) ENGINES PRE-GE-SB 75-123;
Install the plug in the signal port on the ESCV.
(a) Put lubricant on the packing.
(b) Install the packing on the plug.
(c) Tighten the plug to 180-200 pound-inches (20.3-22.6 N.m).

S 424-027-J00

CAUTION: DO NOT PUT TOO MUCH FORCE ON THE SIGNAL AIR TUBE WHEN YOU INSTALL THE VALVE. IF YOU DO NOT INSTALL THE VALVE CORRECTLY, YOU CAN CAUSE AIR LEAKS AND DAMAGE TO THE TUBE.

(4) Put the valve in the correct position between the cooling manifolds.
(a) Make sure the arrow points in the aft direction.
(b) Turn the valve to align the signal air tube with the coupling.

S 424-018-J00

(5) Install the clamps and the support links:
  (a) ENGINES POST-GE-SB 75-070;
  Install the E-seals on two sides of the valve.
  (b) Attach the inner and outer clamp half to the forward end of the valve with two nuts and bolts (Do not tighten).
  (c) Install the inner clamp half around the inboard aft end of the valve.
  (d) Attach the clamp half to the support links with two bolts and two nuts (Do not tighten).
  (e) Attach the outer clamp half to the inner clamp half with the two bolts and two nuts (Do not tighten).

S 434-021-J00

(6) ENGINES PRE-GE-SB 75-123;
Connect the signal air tube to the coupling.
  (a) Tighten the two nuts that attach the support links to the aft inner clamp half to 55-70 pound-inches (6.2-7.9 N.m.)
  (b) Tighten the tube nut to 270-300 pound-inches (30.5-33.9 N.m).
  (c) Tighten the four nuts attaching the clamp halves to the forward and aft ends of the valve to 55-70 pound-inches (6.2-7.9 N.m.).

S 434-028-J00

(7) Install the 11th-stage cooling air valve switch (AMM 75-26-03/401).

S 864-023-J00

(8) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:
  (a) P180 DC Power Distribution Panel
    1) 180J5 ENG 1 EEC PWR CH A
    2) 180J6 ENG 1 EEC PWR CH B
    3) 180F5 ENG 2 EEC PWR CH A
    4) 180F6 ENG 2 EEC PWR CH B
    5) 180G20 ENG 3 EEC PWR CH A
    6) 180G21 ENG 3 EEC PWR CH B
    7) 180D20 ENG 4 EEC PWR CH A
    8) 180D21 ENG 4 EEC PWR CH B

S 414-024-J00

(9) Close the applicable thrust reverser half (Ref 78-31-00/201).

11TH-STAGE COOLING VALVE SOLENOID - REMOVAL/INSTALLATION

1. General
   A. This procedure contains two tasks, remove the 11th-stage cooling valve solenoid and install the 11th-stage cooling valve solenoid (11th-stage valve solenoid).

   TASK 75-26-02-004-001-J00

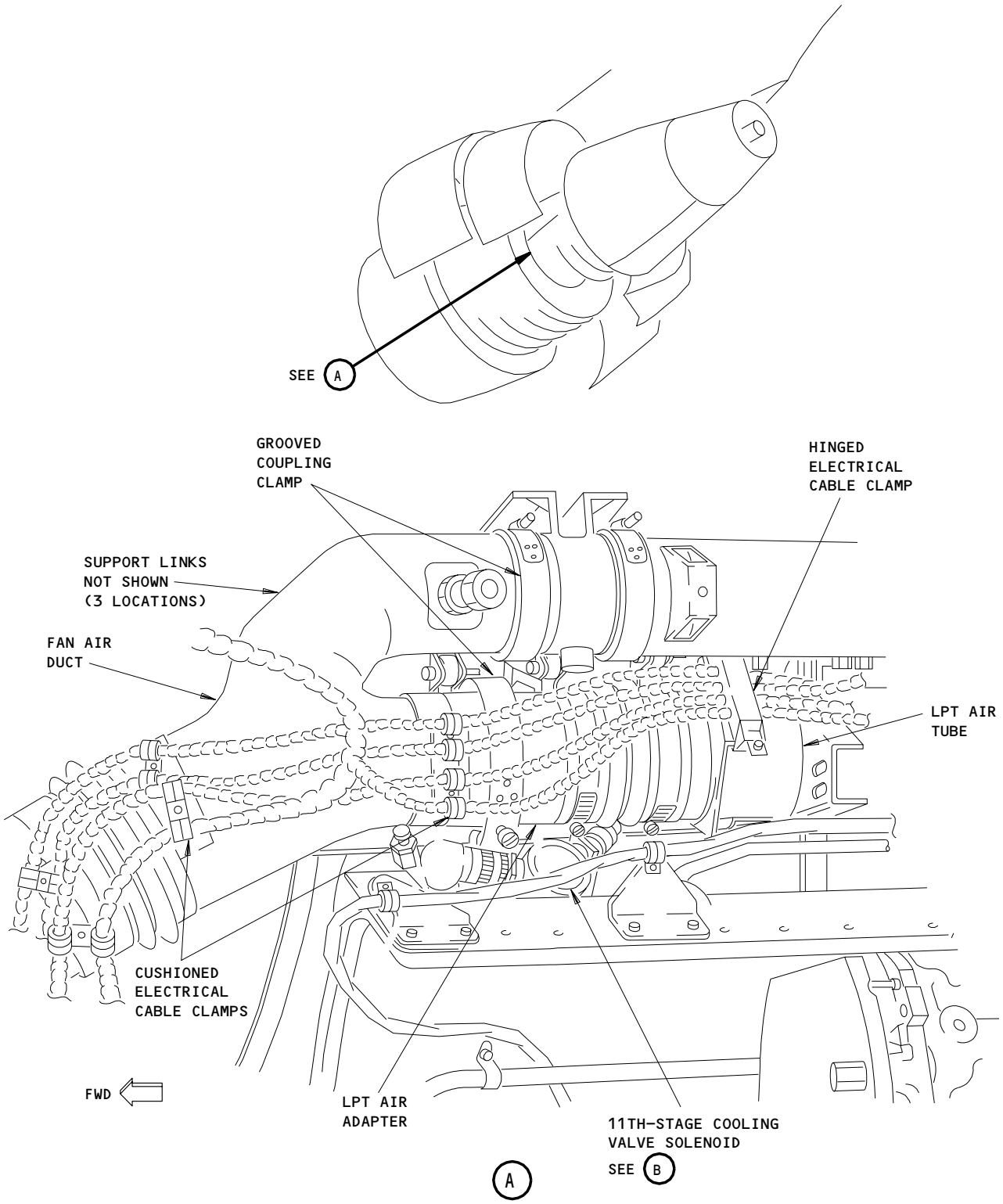
2. 11th-Stage Valve Solenoid Removal (Fig. 401)
   A. References
      (1) 78-31-00/201, Thrust Reverser System
      (2) IPC 75-24-02 Fig. 1
   B. Access
      (1) Location Zone
          412 Engine 1 - Compressor Case 8 o'clock
          422 Engine 2 - Compressor Case 8 o'clock
          432 Engine 3 - Compressor Case 8 o'clock
          442 Engine 4 - Compressor Case 8 o'clock

      (2) Access Panel
          415 Left Thrust Reverser Half - Engine 1
          425 Left Thrust Reverser Half - Engine 2
          435 Left Thrust Reverser Half - Engine 3
          445 Left Thrust Reverser Half - Engine 4

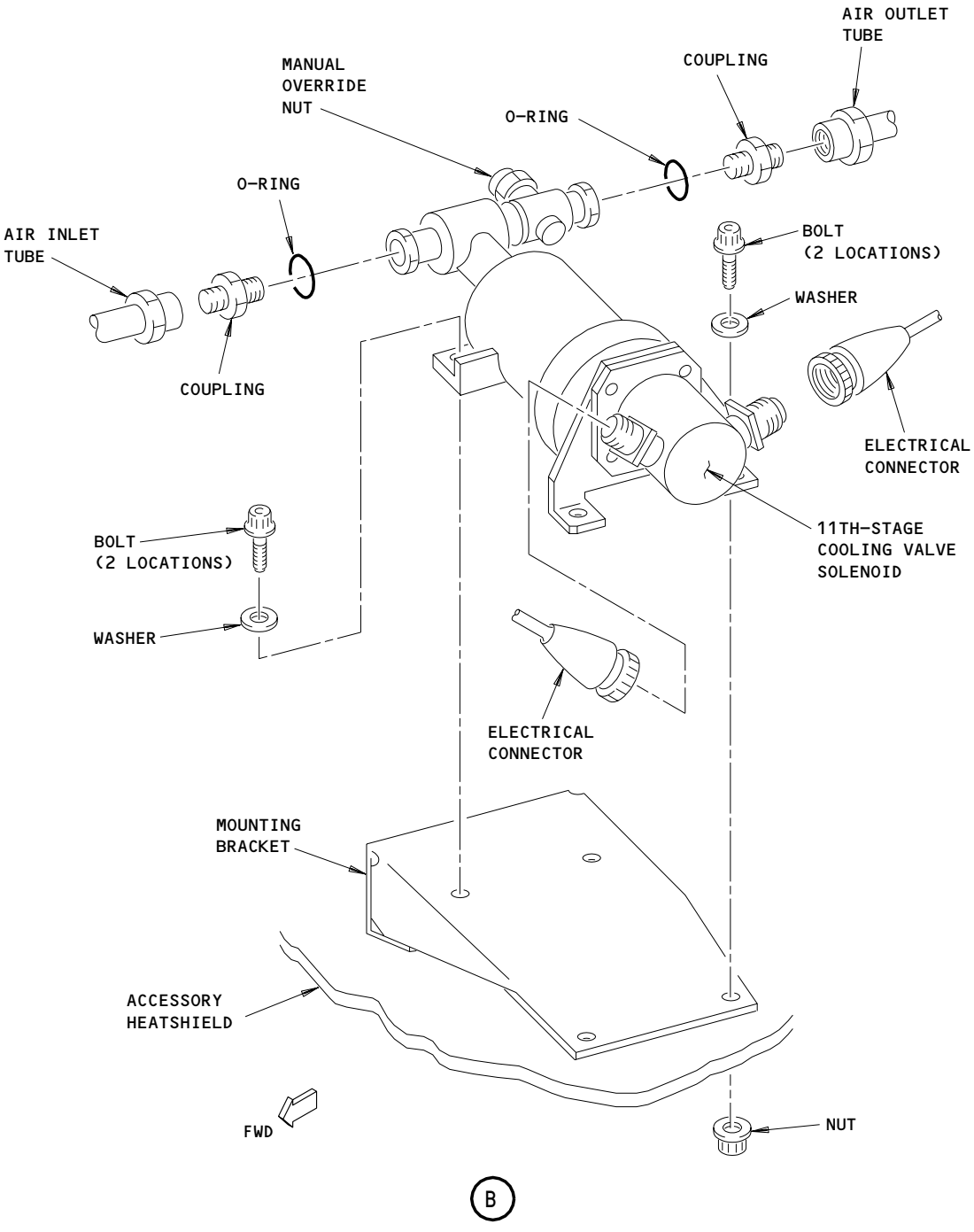
   C. Procedure

      S 014-002-J00
      (1) Open the left thrust reverser half (Ref 78-31-00/201).

      S 864-003-J00
      (2) Open these circuit breaker, for the applicable engine, and install DO-NOT-CLOSE tags.
          (a) P18 DC Power Distribution Panel
              1) 18QJ5 ENG 1 EEC PWR CH A



11th-Stage Cooling Valve Solenoid Installation
Figure 401 (Sheet 1)



11th-Stage Cooling Valve Solenoid Installation
Figure 401 (Sheet 2)

2) 180J6 ENG 1 EEC PWR CH B
3) 180F5 ENG 2 EEC PWR CH A
4) 180F6 ENG 2 EEC PWR CH B
5) 180G20 ENG 3 EEC PWR CH A
6) 180G21 ENG 3 EEC PWR CH B
7) 180D20 ENG 4 EEC PWR CH A
8) 180D21 ENG 4 EEC PWR CH B

S 034-018-J00
(3) Remove the fan air duct:
(a) Disconnect the electrical cables from the ducts:
1) Remove four bolts, four washers, and two clamps that attach the electrical cables to the fan air duct.
2) Disconnect the clamp that attaches the electrical cable to the LPT air tube.
(b) Move the electrical cables away from the duct couplings on the fan air duct and the LPT air tube.
(c) Remove the hose clamp from the duct coupling on the forward side of the fan air duct.
(d) Remove two coupling clamps from the aft side of the fan air duct.
(e) Remove the bolts, the nuts, and three support links between the engine and the air duct.
(f) Remove the fan air duct.
(g) Remove the hose clamp from the duct coupling on the aft side of the LPT air adapter.

S 034-004-J00
(4) Disconnect two electrical connectors from the 11th-stage valve solenoid.

S 034-005-J00
(5) Disconnect the bleed air tube and the signal air tube from the 11th-stage valve solenoid.

S 034-006-J00
(6) Remove four bolts, washers, and nuts that attach the 11th-stage valve solenoid to the bracket on the AGB heat shield.

S 024-020-J00
(7) Remove the 11th-stage valve solenoid from the engine.

S 034-022-J00
(8) Remove the couplings from the 11th-stage valve solenoid:
(a) Remove two couplings.
(b) Remove and discard the O-ring from each coupling.

S 434-008-J00
(9) Install protective covers on the openings.

TASK 75-26-02-404-009-J00

3. 11th-Stage Valve Solenoid Installation (Fig. 401)

A. Consumable Materials

(1) D00389 Oil - Lubricating, GE Spec D50TF1 (GE C02-019)

B. References

(1) 78-31-00/201, Thrust Reverser System

(2) IPC 75-24-02 Fig. 1

C. Access

(1) Location Zone

412 Engine 1 - Compressor Case 8 o'clock
422 Engine 2 - Compressor Case 8 o'clock
432 Engine 3 - Compressor Case 8 o'clock
442 Engine 4 - Compressor Case 8 o'clock

(2) Access Panel

415 Left Thrust Reverser Half - Engine 1
425 Left Thrust Reverser Half - Engine 2
435 Left Thrust Reverser Half - Engine 3
445 Left Thrust Reverser Half - Engine 4

D. Procedure

S 434-010-J00

(1) Remove the protective covers from the openings.

S 434-023-J00

(2) Install the couplings on the 11th-stage valve solenoid:
(a) Lubricate two new O-rings with oil.
(b) Install an O-ring on each coupling.
(c) Install the couplings in the 11th-stage valve solenoid.
(d) Tighten the couplings to 180-200 pound-inches (20.3-22.6 N.m).

S 424-013-J00

(3) Install the 11th-stage valve solenoid:
(a) Make sure that the solenoid manual override is in the OPEN position.

NOTE: Make sure the indicator pin aligns with the override nut.

(b) Put the solenoid in the correct location on the bracket.
(c) Attach the solenoid with four bolts, washers, and nuts.
(d) Tighten the bolts to 33-37 pound-inches (3.7-4.2 N.m).

S 434-014-J00

(4) Connect the signal air tube and the bleed air tube to the 11th-stage valve solenoid.
(a) Tighten the tube nuts to 270-300 pound-inches (30.5-33.9 N.m).

S 434-015-J00

(5) Connect the two electrical connectors to the 11th-stage cooling valve solenoid.

S 434-019-J00

(6) Install the fan air duct.
  (a) Attach the LPT air adapter to the LPT air tube with the hose clamp.
    1) Tighten the hose clamp.
  (b) Attach the forward side of the fan air duct to the duct coupling with the hose clamp.
    1) Tighten the hose clamp.
  (c) Attach the lower aft side of the fan air duct to the LPT air adapter with the duct coupling.
  (d) Attach the top aft side of the fan air duct to the CCC air valve with the duct coupling.
    1) Tighten the duct couplings to 50 pound-inches (5.6 N.m).
  (e) Install three support links between the fan air duct and the engine, with the bolts and the nuts.
    1) Tighten the nuts to 24-27 pound-inches (2.7-3.1 N.m).
    2) Install lockwire on the nuts.
  (f) Attach the electrical cables:
    1) Attach the electrical cables to the LPT air tube with the clamp.
      a) Turn the screw 1/4 turn clockwise to engage the clamp.
    2) Install two clamps that attach the electrical cables to the fan air duct, with bolts and nuts.
      a) Tighten the nuts to 33-37 pound-inches (3.7-4.2 N.m).

S 864-016-J00

(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:
  (a) P18O DC Power Distribution Panel
    1) 18OJ5 ENG 1 EEC PWR CH A
    2) 18OJ6 ENG 1 EEC PWR CH B
    3) 18OF5 ENG 2 EEC PWR CH A
    4) 18OF6 ENG 2 EEC PWR CH B
    5) 18OG2O ENG 3 EEC PWR CH A
    6) 18OG21 ENG 3 EEC PWR CH B
    7) 18OD2O ENG 4 EEC PWR CH A
    8) 18OD21 ENG 4 EEC PWR CH B

S 414-017-J00

(8) Close the left thrust reverser half (Ref 78-31-00/201).

S 714-012-J00
(9) ENGINES WITH 11TH-STAGE COOLING AIR VALVES
AND WITHOUT GE SB 75-123 OR 75-135;
Do the test of the 11th-stage cooling air system (AMM 75-26-00/501).

S 864-013-J00
(10) ENGINES WITHOUT 11TH-STAGE COOLING AIR VALVES;
OR
ENGINES WITH 11TH-STAGE COOLING AIR VALVES
WITH GE SB 75-123 OR 75-135;
Optional: To verify the 11th-stage solenoid is operational, make sure the CMCS messages '7X328 ENG-X ESCV SOL W/A (CH-A)' and '7X428 ENG-X ESCV SOL W/A (CH-B)' do not appear during the next flight above 25,000 feet.

11TH-STAGE COOLING AIR VALVE POSITION INDICATING SWITCH - REMOVAL/INSTALLATION

1. General
   A. ENGINES WITH GE SB 75-135;
      The 11th-stage cooling air valve (ESCV) position indicating switches are removed from the engine. They are replaced by an air duct with a dummy connector.
   B. This procedure contains two tasks: the removal and the installation of the 11th-stage cooling air valve position indicating switch.

TASK 75-26-03-004-001-J00

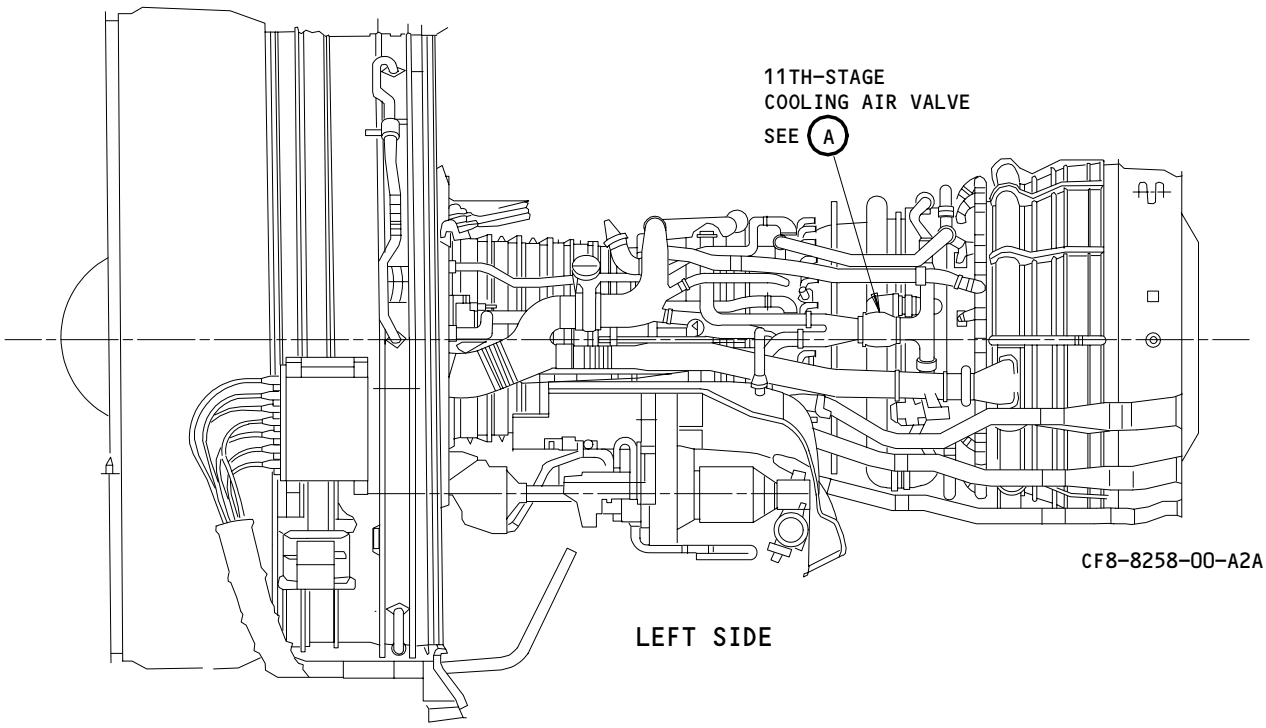
2. 11th-Stage Cooling Air Valve Position Indicating Switch Removal (Fig. 401)
   A. References
      (1) 78-31-00/201, Thrust Reverser System
      (2) IPC 75-24-01 Figs. 5 and 10
   B. Access
      (1) Location Zone
          412 Engine 1 - HPT Case 3 and 9 o'clock
          422 Engine 2 - HPT Case 3 and 9 o'clock
          432 Engine 3 - HPT Case 3 and 9 o'clock
          442 Engine 4 - HPT Case 3 and 9 o'clock

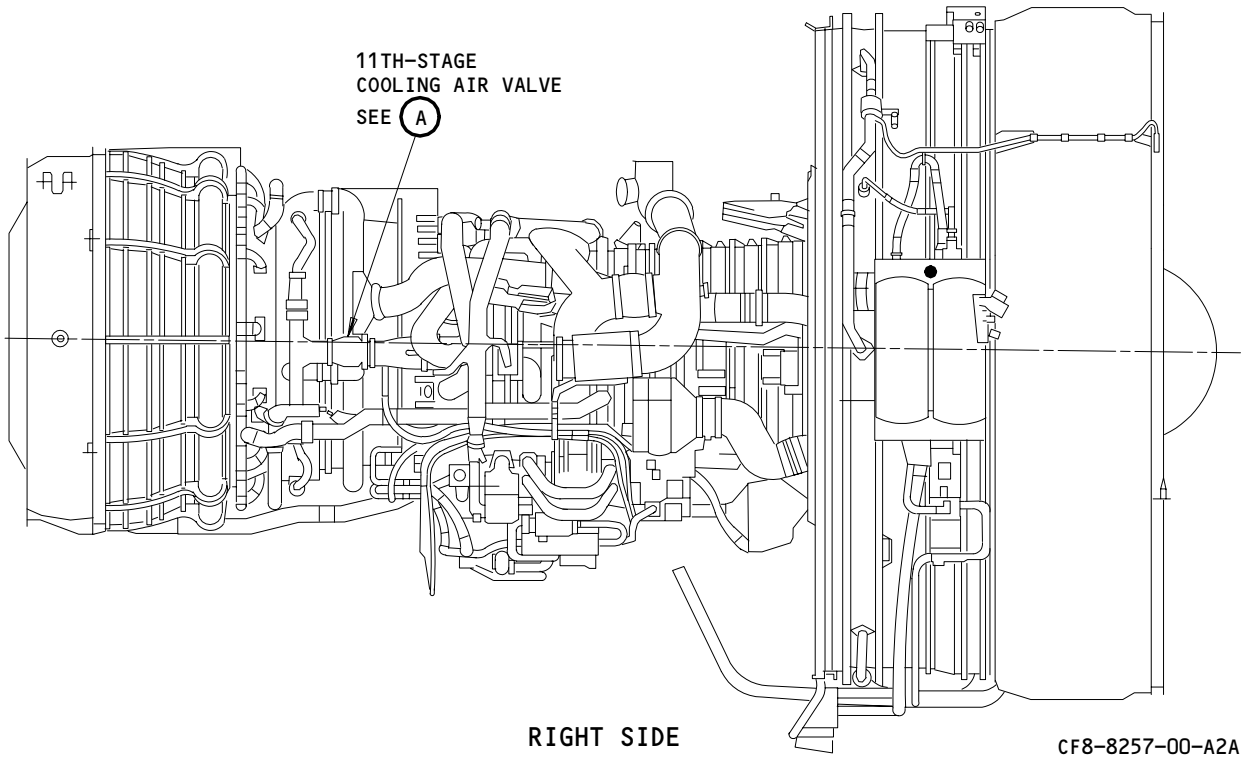
      (2) Access Panel
          415 Left Thrust Reverser Half - Engine 1
          416 Right Thrust Reverser Half - Engine 1
          425 Left Thrust Reverser Half - Engine 2
          426 Right Thrust Reverser Half - Engine 2
          435 Left Thrust Reverser Half - Engine 3
          436 Right Thrust Reverser Half - Engine 3
          445 Left Thrust Reverser Half - Engine 4
          446 Right Thrust Reverser Half - Engine 4

   C. Procedure

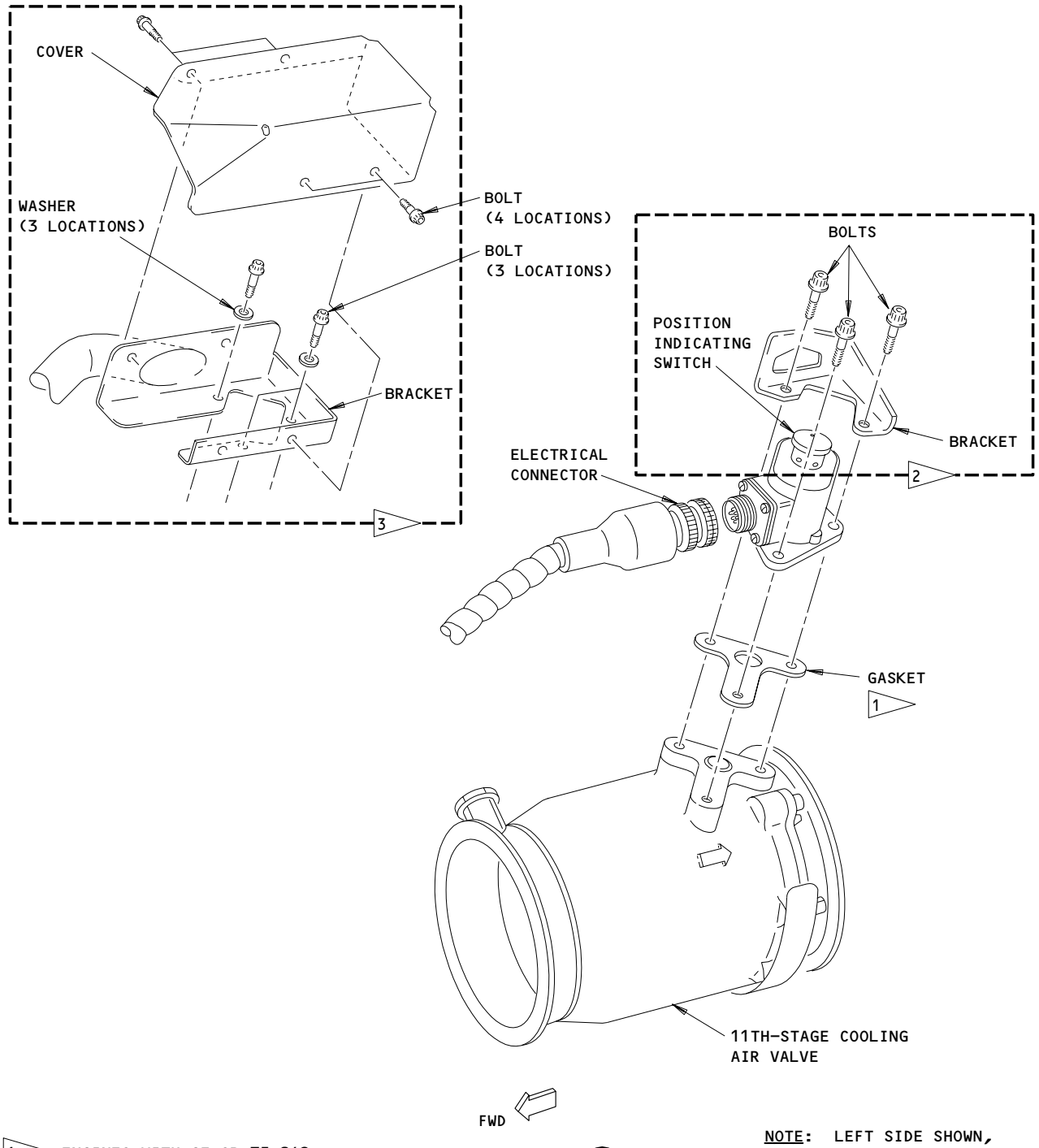
      S 014-002-J00
      (1) Do this task: "Open the Thrust Reverser" (Ref 78-31-00/201) to open the applicable thrust reverser half.

      S 864-003-J00
      (2) Open these circuit breakers, for the applicable engine, and attach DO-NOT-CLOSE tags:
          (a) P18O DC Power Distribution Panel
              1) 18OJ5 ENG 1 EEC PWR CH A





11th-Stage Cooling Air Valve Position Indications Switch Installation
Figure 401 (Sheet 1)



1 ENGINES WITH GE SB 75-048

2 ENGINES WITHOUT GE SB 75-045 AND 75-065

3 ENGINES WITH GE SB 75-045 AND 75-065

NOTE: LEFT SIDE SHOWN, RIGHT SIDE EQUIVALENT.

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11th-Stage Cooling Air Valve Position Indicating Switch Installation
Figure 401 (Sheet 2)

EFFECTIVITY
ENGINES WITH 11TH-STAGE COOLING AIR VALVE

685632

2) 180J6 ENG 1 EEC PWR CH B
3) 180F5 ENG 2 EEC PWR CH A
4) 180F6 ENG 2 EEC PWR CH B
5) 180G20 ENG 3 EEC PWR CH A
6) 180G21 ENG 3 EEC PWR CH B
7) 180D20 ENG 4 EEC PWR CH A
8) 180D21 ENG 4 EEC PWR CH B

S 034-004-J00
(3) ENGINES PRE-GE-SB 75-045 AND PRE-GE-SB 75-065;
Disconnect the electrical connector from the 11th-stage cooling air valve position indicating switch (switch).

S 434-016-J00
(4) Install a protective cover on the connector.

S 034-005-J00
(5) ENGINES PRE-GE-SB 75-045 AND PRE-GE-SB 75-065;
Remove two bolts that attach the cooling air tube bracket to the switch.
(a) Move the bracket to the side.

S 034-006-J00
(6) ENGINES PRE-GE-SB 75-065;
Remove the bolt that attach the switch to the valve.

S 024-028-J00
(7) ENGINES POST-GE-SB 75-045;
Remove the three bolts that attach the enclosure box cover to the enclosure base.

S 024-033-J00
(8) ENGINES POST-GE-SB 75-045;
Remove two bolts and two washers that attach the enclosure box base to the switch.
(a) Move the enclosure box base to the side.

S 024-024-J00
(9) ENGINES POST-GE-SB 75-065;
Remove the four bolts that attach the enclosure box cover to the enclosure base.

S 024-031-J00
(10) ENGINES POST-GE-SB 75-045 AND POST-GE-SB 75-065;
Disconnect the electrical connector from the 11th-stage cooling air valve position indicating switch (switch).
(a) Install a protective cover on the connector.

S 024-032-J00
(11) ENGINES POST-GE-SB 75-065;
Remove three bolts and three washers that attach the enclosure box base to the switch.
(a) Move the enclosure box base to the side.

S 024-015-J00
(12) Remove the switch from the valve.
(a) ENGINES POST-GE-SB 75-048;
Remove the gasket from the valve.

S 034-007-J00
(13) Install a protective cover on the opening on the valve.

TASK 75-26-03-404-008-J00

3. 11th-Stage Cooling Air Valve Position Indicating Switch Installation
(Fig. 401)

A. Consumable Materials
(1) Compound - Antiseize, MIL-T-5544 (C02-001), alternate to (C02-058)
(2) Compound - Antiseize, GE SPEC A50TF201, Class A (C02-058)

B. References
(1) 78-31-00/201, Thrust Reverser System
(2) IPC 75-24-01 Figs. 5 and 10

C. Access
(1) Location Zone

412	Engine 1 - HPT Case 3 and 9 o'clock
422	Engine 2 - HPT Case 3 and 9 o'clock
432	Engine 3 - HPT Case 3 and 9 o'clock
442	Engine 4 - HPT Case 3 and 9 o'clock

(2) Access Panel

415	Left Thrust Reverser Half - Engine 1
416	Right Thrust Reverser Half - Engine 1
425	Left Thrust Reverser Half - Engine 2
426	Right Thrust Reverser Half - Engine 2
435	Left Thrust Reverser Half - Engine 3
436	Right Thrust Reverser Half - Engine 3
445	Left Thrust Reverser Half - Engine 4
446	Right Thrust Reverser Half - Engine 4

D. Procedure

S 434-009-J00
(1) Remove the protective cover from the valve.

S 424-010-J00
(2) Install the 11th-stage cooling air valve position indicating switch as follows:

NOTE: On engines without GE SB 75-048, position indicating switch does not have the gasket.

(a) ENGINES POST-GE-SB 75-048;
Put the gasket below the 11th-stage cooling air valve position indicating switch.
(b) Lubricate the threads on all three bolts with the antiseize compound.
(c) ENGINES PRE-GE SB 75-065;
Install the bolt that attach the position indicating switch on the 11th-stage cooling air valve.
(d) Do not tighten the bolt.
(e) ENGINES PRE-GE-SB 75-045 AND PRE-GE-SB 75-065;
Install two bolts that attach the cooling air tube bracket to the switch.
(f) ENGINES POST-GE-SB 75-045;
Install two bolts and two washers that attach the enclosure box base to the switch.
(g) ENGINES POST-GE-SB 75-065;
Install three bolts and three washers that attach the enclosure box base to the switch.
(h) Tighten the three bolts to 33-37 pound-inches (3.7-4.2 N.m).

S 034-014-J00
(3) Remove the protective cover from the electrical connector.

S 434-017-J00
(4) Connect the electrical connector to the switch.

S 414-029-J00
(5) ENGINES POST-GE-SB 75-045;
Install three bolts that attach the enclosure box cover to the enclosure base.

S 414-030-J00
(6) ENGINES POST-GE-SB 75-065;
Install four bolts that attach the enclosure box cover to the enclosure base.

S 864-012-J00
(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:
(a) P18 DC Power Distribution Panel
1) 18J5 ENG 1 EEC PWR CH A
2) 18J6 ENG 1 EEC PWR CH B
3) 18F5 ENG 2 EEC PWR CH A

4) 180F6 ENG 2 EEC PWR CH B
5) 180G20 ENG 3 EEC PWR CH A
6) 180G21 ENG 3 EEC PWR CH B
7) 180D20 ENG 4 EEC PWR CH A
8) 180D21 ENG 4 EEC PWR CH B

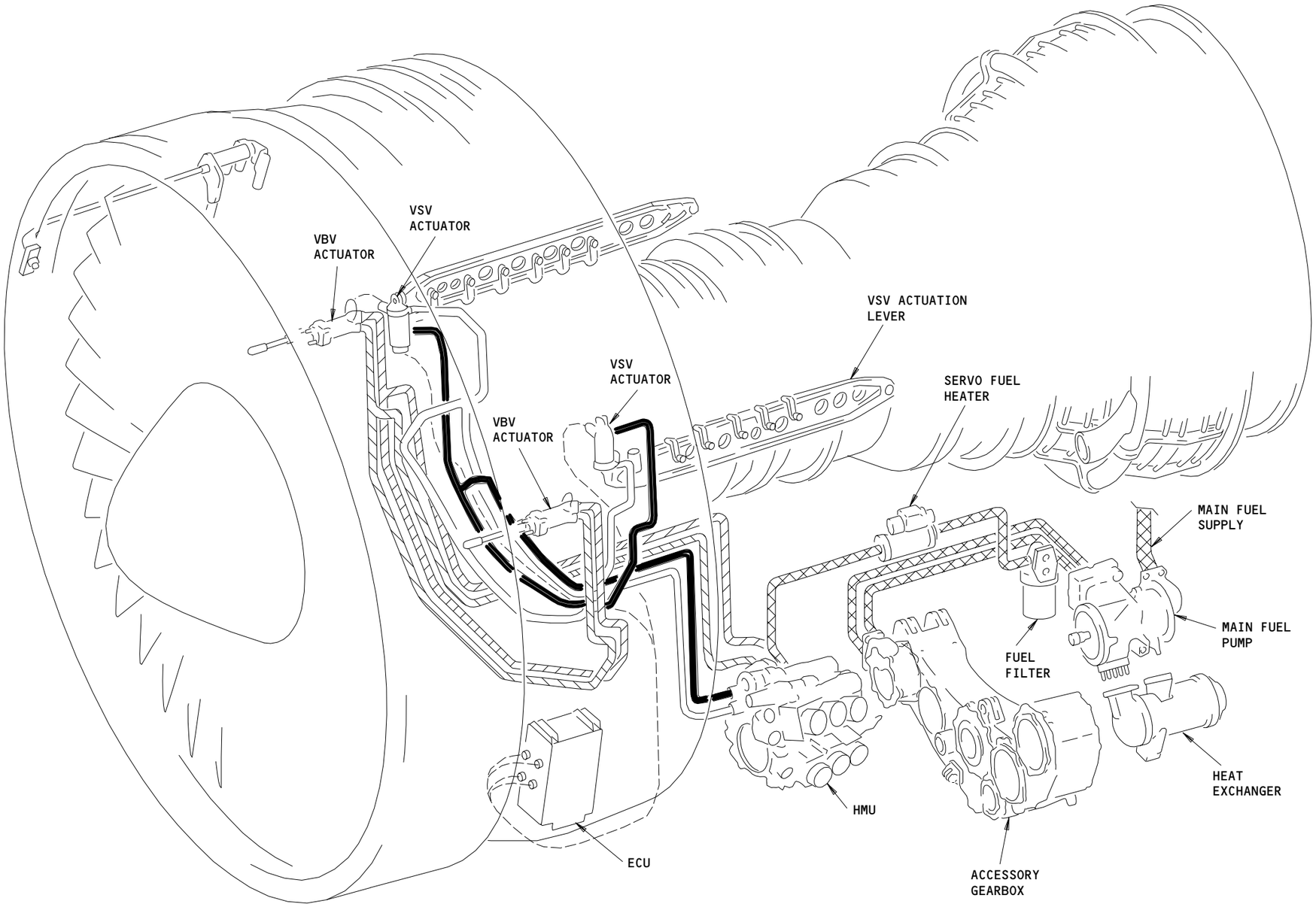
S 414-013-J00
(8) Close the Thrust Reverser (Ref 78-31-00/201).

S 714-021-J00
(9) ENGINES WITHOUT GE SB 75-123;
Do the test of the 11th-stage cooling air system (AMM 75-26-00/501).

S 864-034-J00
(10) ENGINES WITH GE SB 75-123;
To verify the 11th-stage cooling air system is operational, make sure that no CMCS messages for the ESCV system appear during the next flight above 25,000 feet.

COMPRESSOR CONTROL - DESCRIPTION AND OPERATION

1. General
   A. The compressor control system maintains efficient compressor performance during all the engine operating conditions. The system controls the low pressure air that flows to and through the high pressure compressor (HPC). The system consists of the variable stator vane (VSV) system, the variable bypass valve (VBV) system, the electronic control unit (ECU), and the hydromechanical unit (HMU).
2. Variable Stator Vane System (Fig. 1)
   A. The VSV system controls the primary air flow through the HPC. The system consists of two VSV actuators, two linear variable differential transformers (LVDT's), and two actuation levers and linkages.
   B. The VSV actuators are hydraulically operated by fuel pump discharge pressure from the HMU. The actuators are connected to the actuation levers. The linkages transmit the motion to the inlet guide vanes (IGV's) and the five stages of stator vanes.
   C. The LVDT's, within the actuators, send a signal that is proportional to the position of the stator vanes to the ECU. The ECU determines if the VSV's are in the proper position and sends a signal to the HMU. For more information on the VSV system, refer to 75-31-00/001.
3. Variable Bypass Valve System (Fig. 1)
   A. The VBV system controls the amount of air flow to the HPC. The system consists of two VBV actuators, two LVDT's, 12 bypass valves, a unison ring, and bellcrank linkages.
   B. The VBV actuators are hydraulically operated by fuel pump discharge pressure from the HMU. The actuators are connected to bellcranks which cause the unison ring to rotate. As the unison ring rotates, all 12 bypass valves move to the same position.
   C. The LVDT's, within the actuators, send a signal that is proportional to the position of the bypass valves to the ECU. The ECU determines if the VBV's are in the proper position and sends a signal to the HMU. For more information on the VBV system, refer to 75-32-00/001.



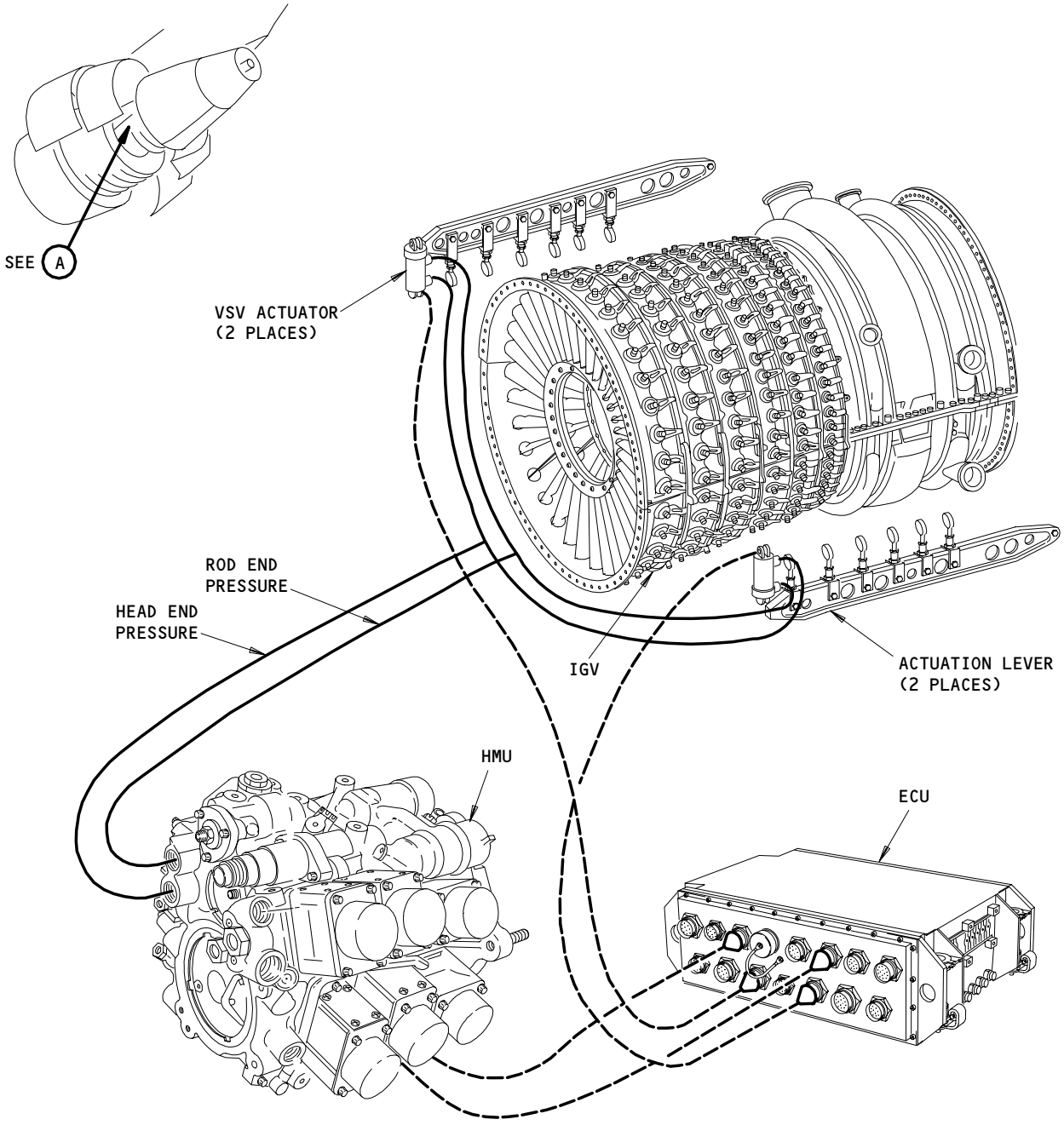
Compressor Control
Figure 1

599300

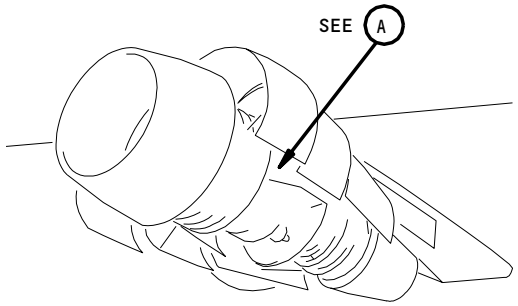
EFFECTIVITY
ALL

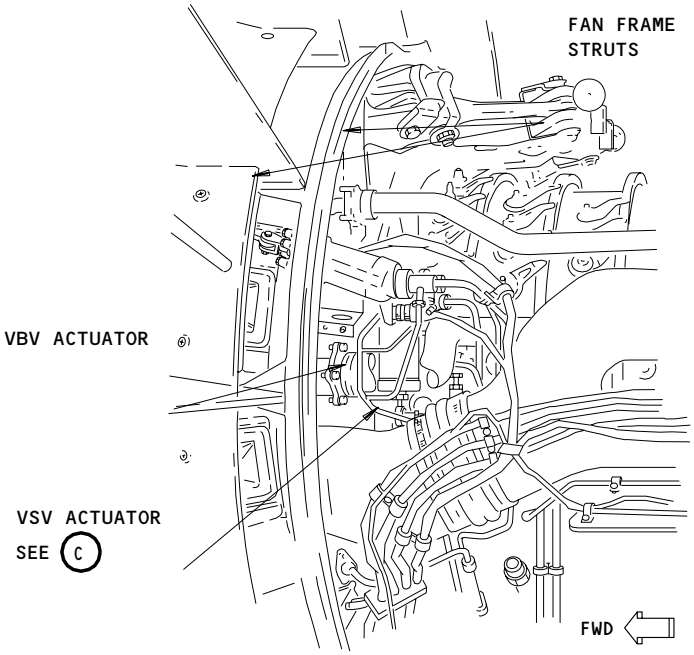
VARIABLE STATOR VANE SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The variable stator vane (VSV) system controls the primary air flow through the high pressure compressor (HPC). The system consists of:
      - Two fuel powered hydraulic actuators
      - Two VSV actuation levers and linkages
      - The electronic control unit (ECU) and the hydromechanical unit (HMU).
   B. The VSV system maintains satisfactory compressor performance over a wide range of operating conditions. The system varies the angle of the inlet guide vanes (IGV) and the five stages of variable stator vanes to aerodynamically match the low pressure stages of compression with the high pressure stages. This variation of vane position changes the effective angle at which air flows across the rotor blades.
   C. The HMU has a two stage torque motor/servo valve for VSV actuator positioning. The torque motor contains two electrically isolated and independent coils with one dedicated to channel A and the other to channel B of the ECU. The servo valve supplies pressurized fuel to the VSV actuators. A mechanical bias in the VSV torque motor causes the variable stator vanes to move towards the closed position for the no electrical input condition.
   D. The VSV actuation system is designed to position the stator vanes at an angle which will determine the compression characteristics (direction and velocity) for any particular stage of compression. The position of the stator vanes is determined as a function of those conditions affecting compressor performance (compressor inlet temperature [CIT] and core engine speed [N2]). Through this predetermined schedule, the critical low pressure stages are automatically realigned or rematched to maintain satisfactory air flow and compressor performance during all engine operating conditions.
   E. The position of the VSV actuators is sent to the ECU by position feedback sensors. The sensors are an integral part of the actuators.
2. Variable Stator Vane Actuator (Fig. 2)
   A. The VSV actuators are installed on either side of the HPC forward stator case at the 3 and 9 o'clock positions. Each VSV actuator is connected to a mounting bracket bolted to the fan frame and to the actuation lever.

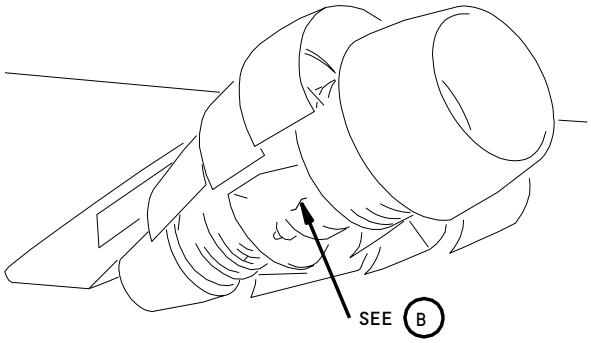


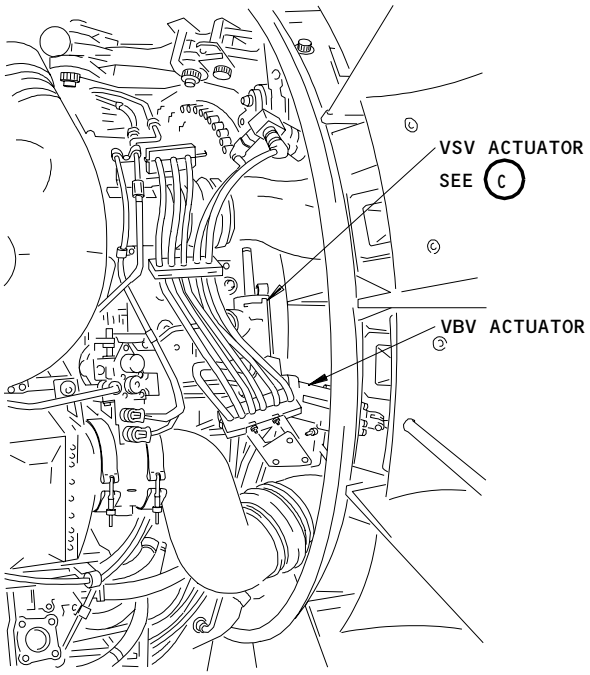
Variable Stator Vane (VSV) System
Figure 1





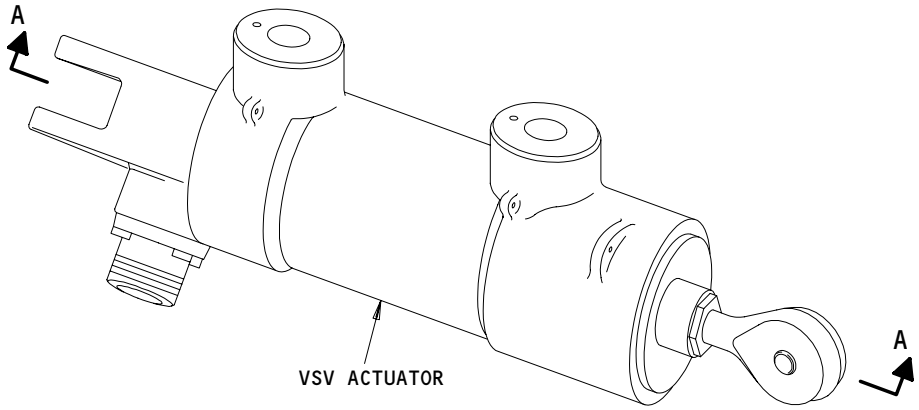
LEFT SIDE OF ENGINE
A



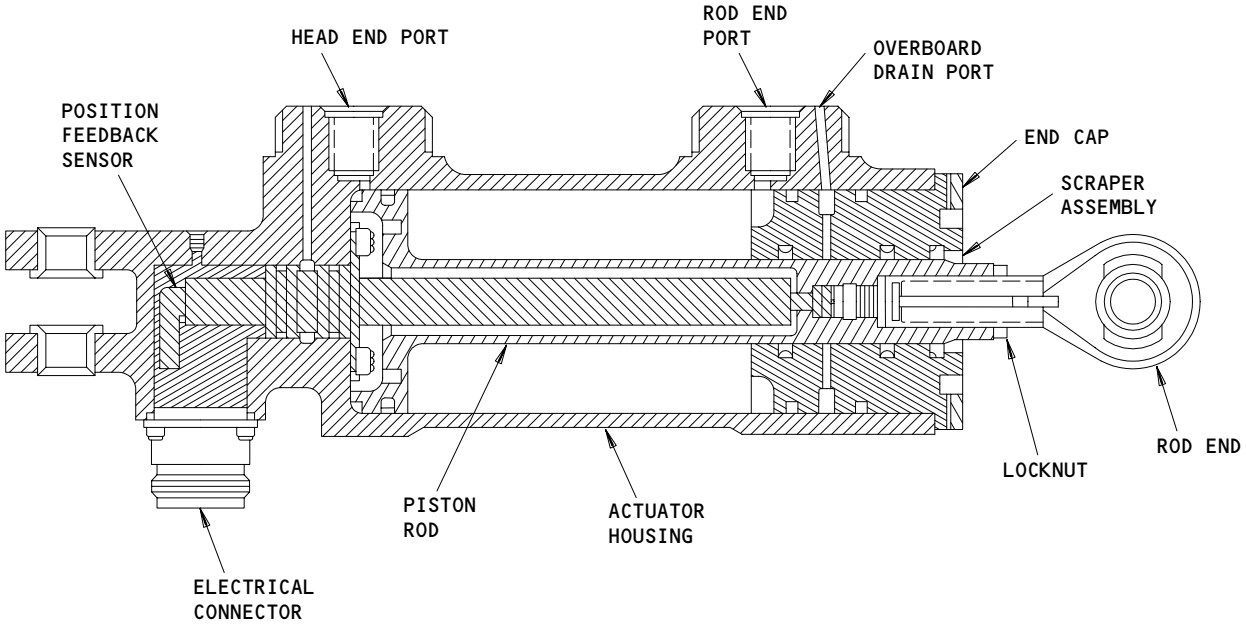


RIGHT SIDE OF ENGINE
B

Variable Stator Vane (VSV) Actuators
Figure 2 (Sheet 1)



C



A-A

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Variable Stator Vane (VSV) Actuators
Figure 2 (Sheet 2)

B. The VSV actuators are single-ended, uncushioned hydraulic cylinders, which are driven in either direction by high pressure fuel. The actuator rod end is sealed against fuel leakage by dual-stage preformed seals. Fuel, which leaks past the preformed seals, is drained overboard through the drain mast. The piston has a capped preformed packing to prevent leakage across the piston. It also has internal stops to control the stroke. To make sure of dirt-free operation, the piston has a wiper which cleans the rod as it retracts past the dual-stage seals. The rod end is internally threaded and fitted with an adjustable extension that includes a spherical seat bearing for connection to the VSV actuation lever.

3. Variable Stator Vane Actuation Linkage (Fig. 1 and 2)
   A. The VSV actuation levers are installed on either side of the engine with the aft ends mounted on a pivot post located opposite the 10th-stage stator vanes. The forward ends terminate in a pin which inserts through the rod end bearing of the VSV actuator. The six adjustable interstage linkages connect each actuation lever directly to the actuation rings. The two piece actuation rings, which are linked at the horizontal splitline of the compressor casing, rotate circumferentially about the horizontal axis of the compressor. Movement of the rings is transmitted to the individual vanes through vane actuating lever arms.
4. Variable Stator Vane Position Feedback
   A. The six-wire position feedback sensors, within the VSV actuators, are energized by the ECU. The two isolated output signals, one from each actuator, are monitored by the feedback sensor's dedicated channel. The sensor in the left side actuator uses channel A to send the feedback signal and the sensor in the right side actuator uses channel B.
5. Operation
   A. Functional Description
      (1) The VSV's are positioned by two VSV actuators which are hydraulically activated by pressurized fuel. The HMU supplies a pressure signal from a single port to the rod end of both actuators. This pressure is between fuel pump discharge and HMU regulated body pressure (PCB which is 5-15 psi [34-103 KPa] above fuel bypass pressure). The HMU also supplies fuel pressure from another single port to the head end of each actuator at a pressure between fuel pump discharge and PCB. The pressures are varied by the HMU in response to commands from the ECU.
      (2) A higher fuel pressure supplied to the head end port of the VSV actuators causes the piston rod to extend, which in turn drives the left actuation lever in a vertical downward motion and the right lever in a vertical upward motion. Movement of the levers is transmitted to the actuation rings and thus to the individual vanes. This will cause the vanes to open.

(3) A higher fuel pressure supplied to the rod end port causes the piston rod to retract, which in turn drives the left actuation lever in a vertical upward motion and the the right lever in a vertical downward motion. Movement of the levers is transmitted to the actuation rings and thus to the individual vanes. This will cause the vanes to close.

(4) The two position feedback sensors monitor the position of the actuator pistons. The output signals, which vary in amplitude as a function of actuator stroke, are sent to the ECU. If the ECU senses any error between the scheduled VSV position and actual VSV position, it will send a signal to the HMU. The HMU will vary the fuel pressure to the head and rod ends of the actuators until the position of the stator vanes agrees with the schedule.

VARIABLE STATOR VANE SYSTEM - MAINTENANCE PRACTICES

1. General
   A. This section contains the task to operate the variable stator vane (VSV) system.
   B. You must open the right thrust reverser half to get access to do this task.

TASK 75-31-00-862-001-J00

2. Variable Stator Vane (VSV) Operation
   A. Standard Tools and Equipment
      (1) Actuator - Hydraulic (2C6395), General Electric Co., 111 Merchant Street, Room 425, Cincinnati, OH 45246

          NOTE: Dry air, nitrogen, or argon source (capable of providing 300 psig (2100 kPa gage) pressure) may be used if hydraulic actuator is not available.

   B. Consumable Materials
      (1) D00124 Oil - Grade 1010
      (2) B00722 Solvent - Stoddard, P-D-680
   C. References
      (1) 71-00-00/501, Power Plant
      (2) 78-31-00/201, Thrust Reverser System
   D. Access
      (1) Location Zone

          412 Engine 1 - Compressor Case 5 o'clock
          422 Engine 2 - Compressor Case 5 o'clock
          432 Engine 3 - Compressor Case 5 o'clock
          442 Engine 4 - Compressor Case 5 o'clock

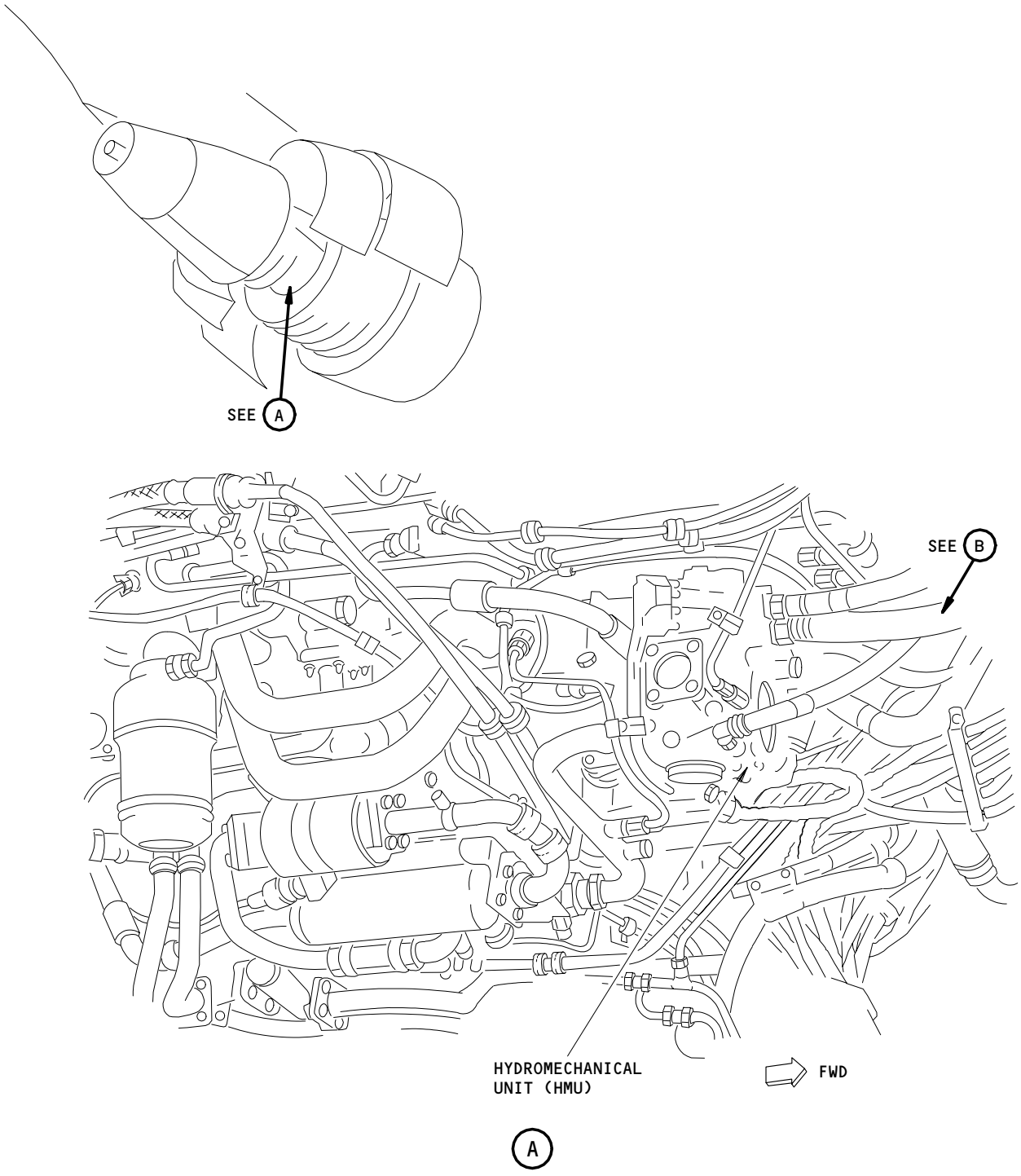
      (2) Access Panel

          416 Right Thrust Reverser Half - Engine 1
          426 Right Thrust Reverser Half - Engine 2
          436 Right Thrust Reverser Half - Engine 3
          446 Right Thrust Reverser Half - Engine 4

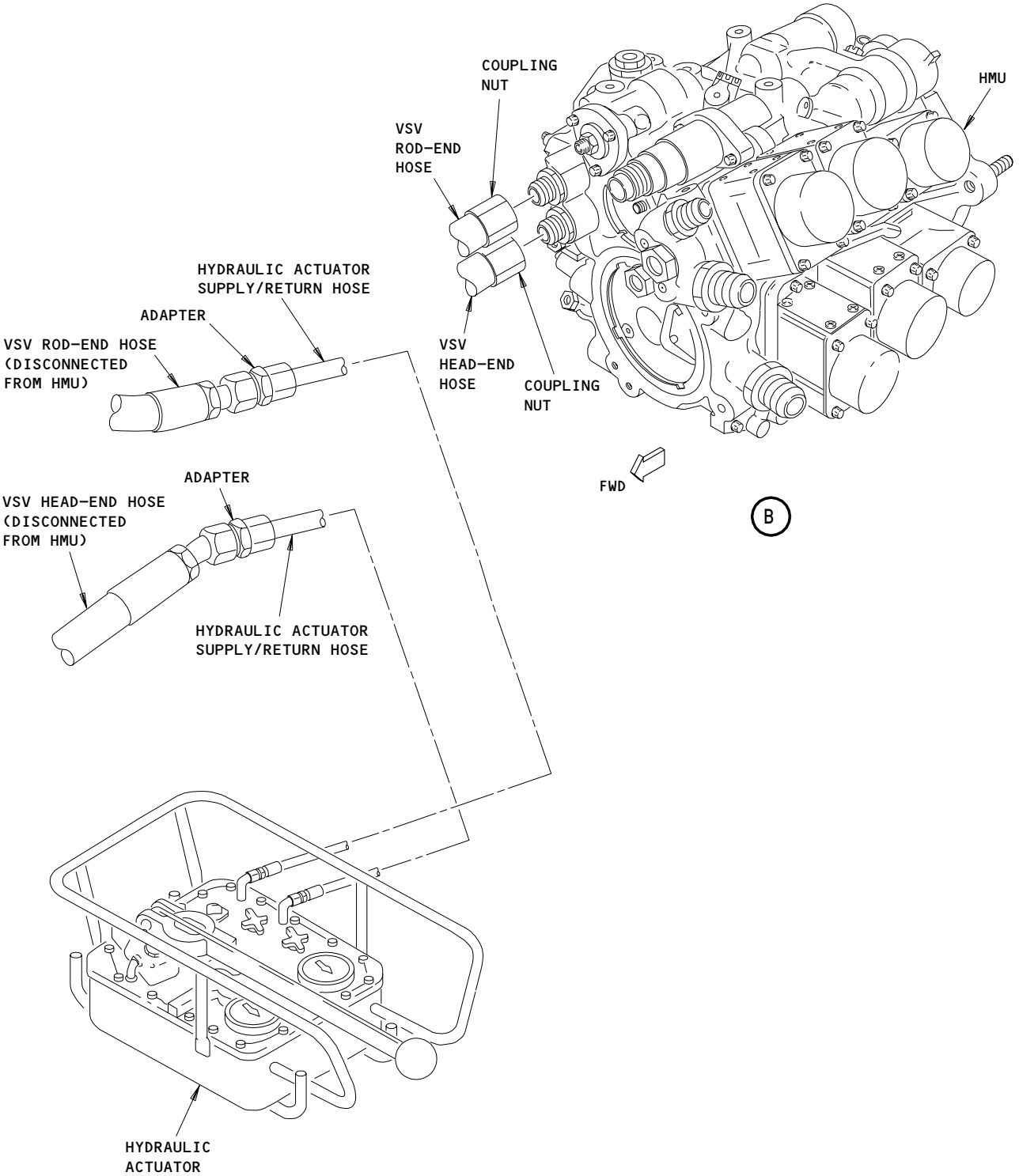
   E. Procedure

      S 862-002-J00
      (1) Make sure the applicable FUEL CONTROL switch on the aisle control stand is in the CUTOFF postion and install DO-NOT-CLOSE identifier(s).

      S 012-003-J00
      (2) Open the right thrust reverser half (Ref 78-31-00/201).



Variable Stator Vane (VSV) System Actuation
Figure 201 (Sheet 1)



Variable Stator Vane (VSV) System Actuation
Figure 201 (Sheet 2)

S 032-004-J00

(3) Disconnect the VSV head and rod end tubes from the hydromechanical unit (HMU).

S 432-005-J00

(4) Install the protective covers on the HMU fittings.

S 492-006-J00

(5) Connect the hydraulic actuator supply and return hoses to the VSV head and rod end tubes.

S 862-007-J00

(6) Put the VSV system in the closed position (VSV actuator rod retracted):

CAUTION: DO NOT SUPPLY A PRESSURE OF MORE THAN 300 PSIG (2100 KPA GAGE). TOO MUCH PRESSURE CAN CAUSE DAMAGE TO THE VSV SYSTEM.

(a) Supply and keep a pressure of 200-300 psig (1400-2100 kPa gage) to the VSV rod end tube.

NOTE: Use oil or solvent, if you use the hydraulic actuator.

NOTE: ENGINES POST GE SB 75-154
(WITH COOLING HOLES IN THE ACTUATOR PISTON);
The pressure will slowly bleed down during the pressurization of the actuator. The cooling holes provide a cooling flow of 30-50 lbs/hour, so the pressure will slowly bleed down.

S 862-008-J00

(7) Put the VSV system in the open position (VSV actuator rod extended).

CAUTION: DO NOT SUPPLY A PRESSURE OF MORE THAN 300 PSIG (2100 KPA GAGE). TOO MUCH PRESSURE CAN CAUSE DAMAGE TO THE VSV SYSTEM.

(a) Supply and keep a pressure of 200-300 psig (1400-2100 kPa gage) to the VSV head end tube.

NOTE: Use oil or solvent, if you use the hydraulic actuator.

NOTE: ENGINES POST GE SB 75-154
(WITH COOLING HOLES IN THE ACTUATOR PISTON);
The pressure will slowly bleed down during the pressurization of the actuator. The cooling holes provide a cooling flow of 30-50 lbs/hour, so the pressure will slowly bleed down.

S 842-009-J00
(8) When it is no longer necessary, release the pressure from the system.

S 092-010-J00
(9) Disconnect the hydraulic actuator supply and return hoses from the VSV head and rod end tubes.

S 032-011-J00
(10) Remove the protective covers from the HMU fittings.

S 432-012-J00
(11) Connect the VSV head end tube to the HMU.
(a) Tighten the tube nut to 450-550 pound-inches (50.8-62.2 N.m).

S 432-013-J00
(12) Connect the VSV rod end tube to the HMU.
(a) Tighten the tube nut to 270-300 pound-inches (30.5-33.9 N.m).

S 862-014-J00
(13) Remove the DO-NOT-CLOSE identifier from the FUEL CONTROL switch.

S 792-015-J00
(14) Do the Idle Leak Test - Test No. 3 (Ref 71-00-00/501).

S 412-016-J00
(15) Close the right thrust reverser half (Ref 78-31-00/201).

VARIABLE STATOR VANE ACTUATOR - REMOVAL/INSTALLATION

1. General
   A. This procedure contains two tasks: a removal and an installation of the variable stator vane (VSV) actuators.
   B. To remove the VSV actuator, you must do these steps:
      (1) Open the thrust reverser halves
      (2) Remove the VSV actuator.
   C. To install the VSV actuator, you must do these steps:
      (1) Install the VSV actuator
      (2) Do a pressure test of the fuel tubes and the drain shroud
      (3) Do the ECU (EEC) Actuators Ground Test
      (4) Close the thrust reverser halves.
   D. The steps to remove or install each VSV actuator are the same for the left and for the right VSV actuator.

TASK 75-31-02-004-001-J00

2. Variable Stator Vane Actuator Removal
   A. Standard Tools and Equipment
      (1) Container - 1 gallon (4 liter) capacity, for fuel
   B. References
      (1) AMM 78-31-00/201, Thrust Reverser System
      (2) AIPC 73-11-07 Fig. 5
      (3) AIPC 75-31-02 Fig. 1
   C. Access
      (1) Location Zone
          412 Engine 1 - Compressor Case 3 and 9 o'clock
          422 Engine 2 - Compressor Case 3 and 9 o'clock
          432 Engine 3 - Compressor Case 3 and 9 o'clock
          442 Engine 4 - Compressor Case 3 and 9 o'clock

      (2) Access Panel
          415 Left Thrust Reverser Half - Engine 1
          416 Right Thrust Reverser Half - Engine 1
          425 Left Thrust Reverser Half - Engine 2
          426 Right Thrust Reverser Half - Engine 2
          435 Left Thrust Reverser Half - Engine 3
          436 Right Thrust Reverser Half - Engine 3
          445 Left Thrust Reverser Half - Engine 4
          446 Right Thrust Reverser Half - Engine 4

   D. Prepare for the Removal

      S 014-002-J00
      (1) Do this task: "Open the Thrust Reverser" (AMM 78-31-00/201) to open the applicable thrust reverser half.

S 864-003-J00
(2) Open these circuit breakers for the applicable engine, and attach DO-NOT-CLOSE tags:
(a) P18O DC Power Distribution Panel
1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

E. Procedure (Figs. 401, 402)

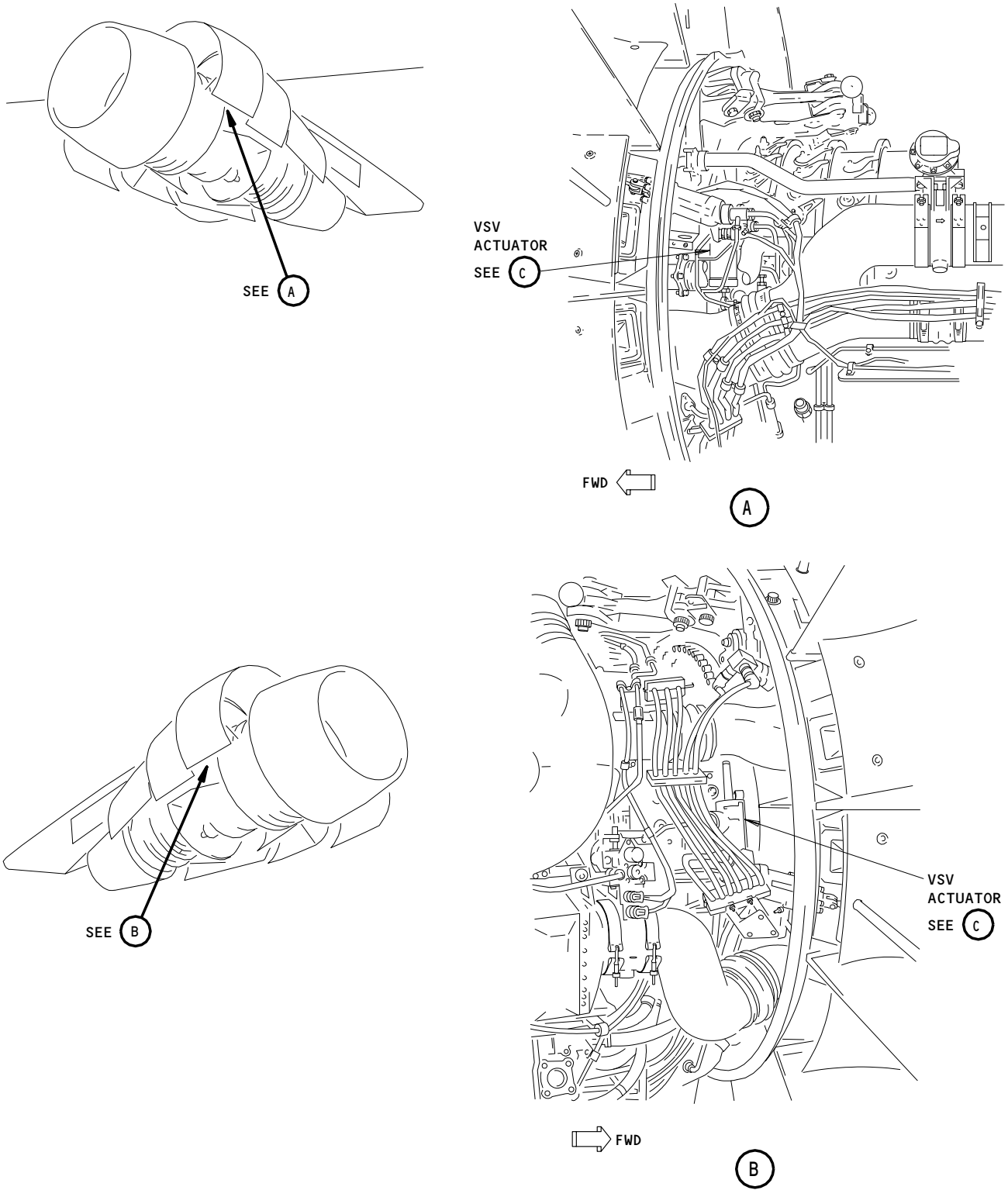
S 034-004-J00
(1) Disconnect the electrical connector (14, Fig. 401) from the VSV actuator (13).
(a) Install protective covers on the open ends of the connectors.

S 034-005-J00
(2) Disconnect the fuel tubes (Fig. 401), and drain the fuel into a container:
(a) Disconnect the drain tubes (1O) from the two drain cans (9).
(b) Loosen the knurled nuts that attach two drain cans (9) to the VSV actuator (13).
(c) Move the drain cans back to get access to the fuel tube nuts (11).
(d) Disconnect the fuel tube nuts (11) from the couplings (7).
(e) Pull the fuel tubes away from the actuator.

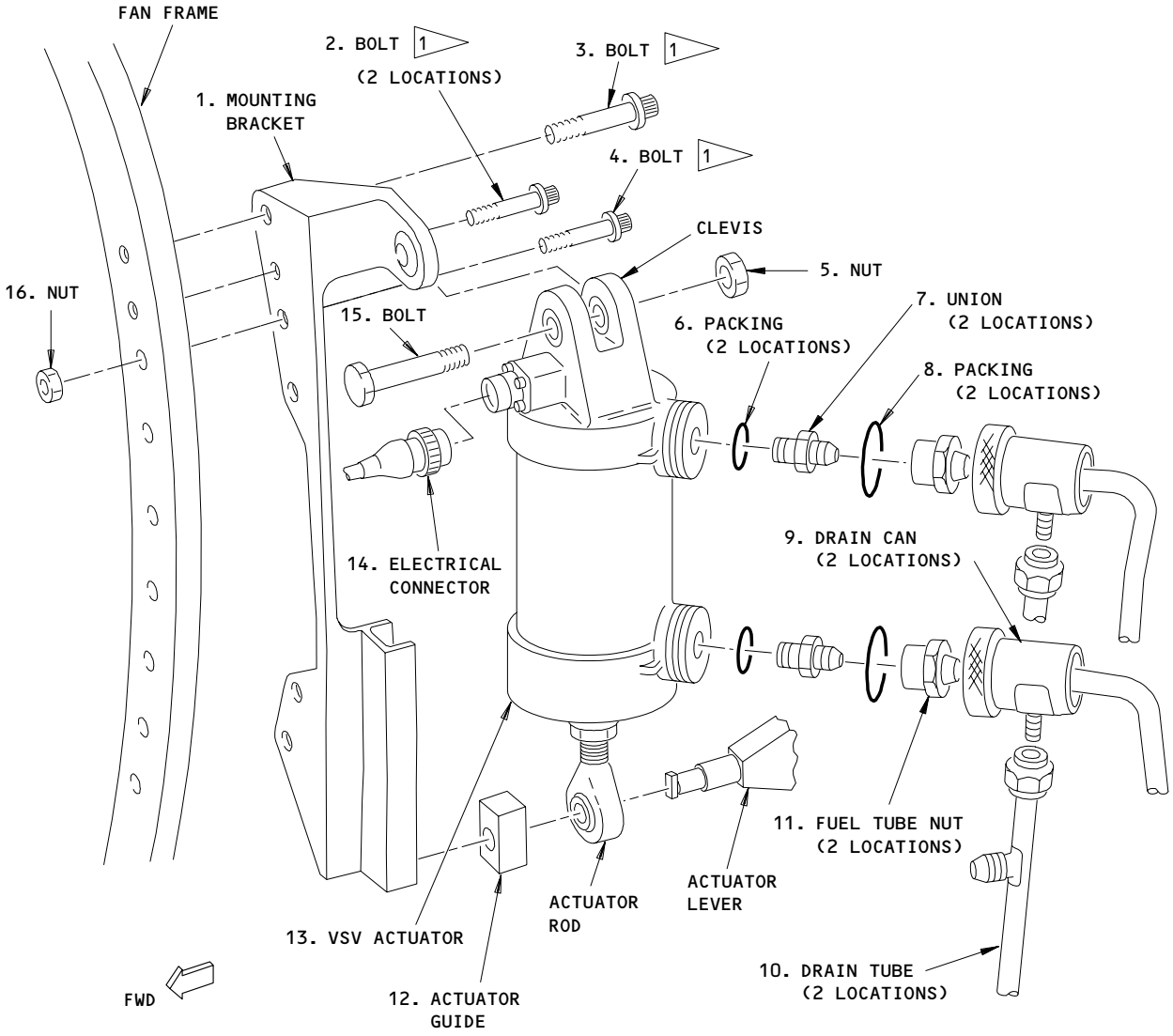
NOTE: Loosen the clamps on the fuel tubes near the VSV actuator, if it is necessary. This can make it easier to remove the VSV actuator.

(f) Remove and discard an O-ring (8) from each of the two knurled nuts.

S 024-037-J00
(3) Remove the VSV actuator (Fig. 401):
(a) Remove the nut (5) and the bolt (15) that attach the actuator clevis to the bracket (1).
(b) Move the actuator (13) away from the engine.
(c) Remove six bolts (2, 3 and 4) and the nut (16) that attach the bracket (1) to the fan frame flange.



Variable Stator Vane (VSV) Actuator Installation
Figure 401 (Sheet 1)



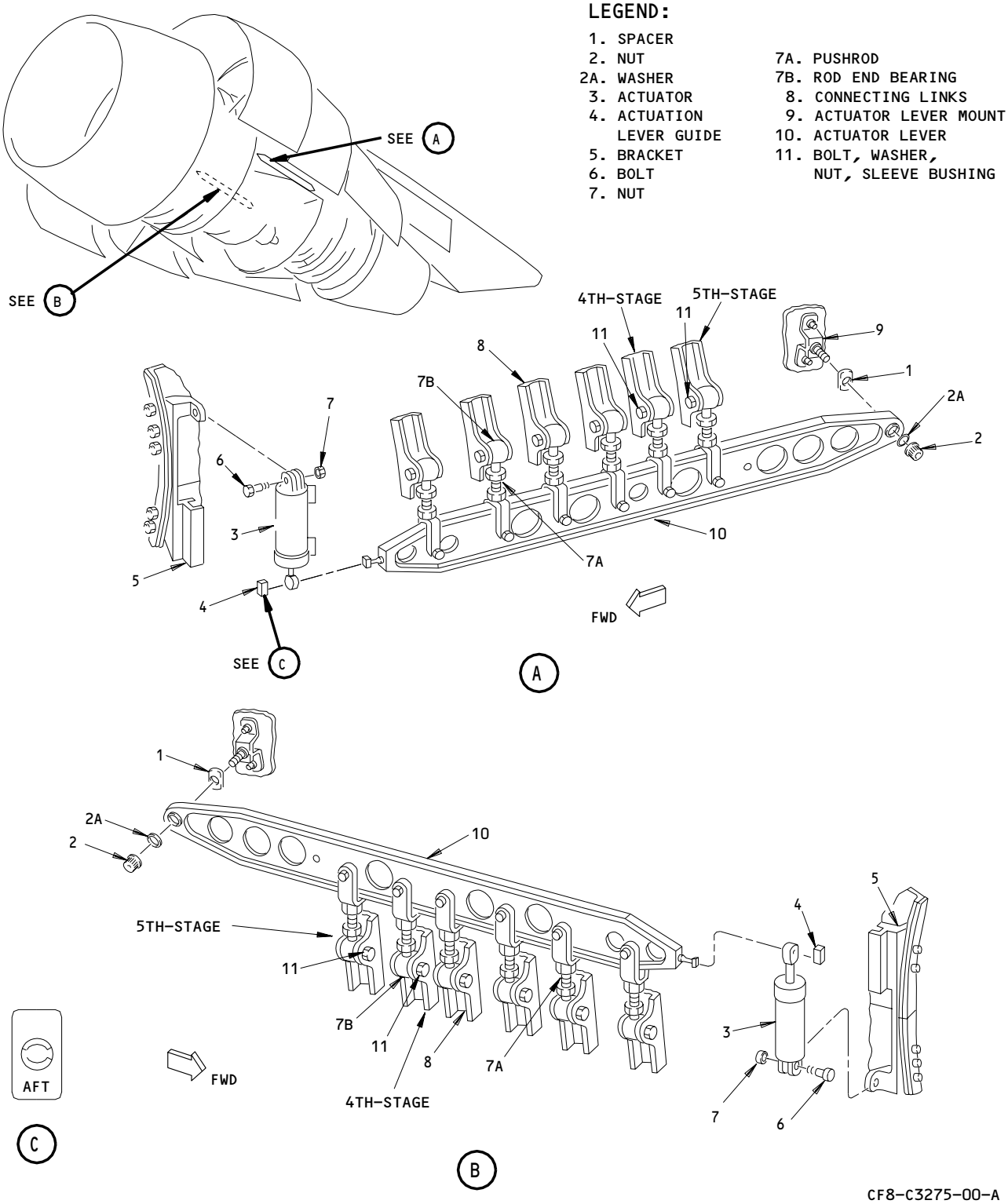
NOTE: LEFT SIDE SHOWN,
RIGHT SIDE IS ALMOST THE SAME.

(C)

1 DO NOT REMOVE IF THE ALTERNATE METHOD IS USED.

CF8-A6236-00-A

Variable Stator Vane (VSV) Actuator Installation
Figure 401 (Sheet 2)



VSV Actuator Lever Installation - Alternate Method
Figure 402

(d) Move the bracket (1) off the actuator guide (12).
(e) Turn the actuator guide (12) 90 degrees and remove it from the actuator lever.
(f) Remove the VSV actuator (13) from the actuator lever.
(g) Remove the couplings (7) and the O-rings (6) from the rod end and the head end openings of the VSV actuator (13).
1) Discard the O-rings.
(h) Install protective caps on the actuator openings and the tube ends.

S 024-045-J00
(4) Remove the VSV actuator (alternative method) (Figs. 401,402)
(a) Remove the aft mount nut (2, Fig. 402) and the washer (2A) from the actuator lever mount (9).
(b) Move the aft end of the actuator lever (10) away from the actuator lever mount (9).
(c) Remove the spacer (1).
1) Keep the spacer for installation.

CAUTION: KEEP THE PUSHROD-ROD END BEARING LOCKWIRE ATTACHED. MAKE SURE THAT YOU DO NOT MOVE OR ADJUST THE LENGTH OF THE PUSHROD-ROD END BEARING. DAMAGE TO THE ENGINE CAN OCCUR.

(d) Remove the bolt, nut, two washers, and the sleeve bushing (11) that attach the 4th and 5th stage rod-end bearing (7B) to the connecting links (8).
(e) Move the actuator lever (10) aft to disengage it from the VSV actuator rod end actuator lever guide (4).
1) Catch the actuator lever guide when the actuator lever is disengaged.
(f) Remove the VSV actuator (3) from the actuator lever (10).
(g) Remove the couplings (7, Fig. 401) and the O-rings (6) from the rod end and the head end openings of the VSV actuator (13).
1) Install protective caps on the actuator openings and the tube ends.

TASK 75-31-02-404-015-J00
3. Variable Stator Vane Actuator Installation
A. General

CAUTION: ENGINES WITH GE SB 73-079 (WITH FLUOROCARBON (VITON) SEALS): YOU MUST NOT OPERATE THE ENGINE WITH OIL TEMPERATURES BELOW -30 DEGREES F (-34 DEGREES C). REFER TO AMM 71-00-00/201 FOR SPECIAL PRECAUTIONS FOR OPERATION OF THE ENGINE AT VERY LOW TEMPERATURES. ENGINE DAMAGE CAN OCCUR IF VITON SEALS ARE USED AT VERY LOW TEMPERATURES.

(1) If you operate the engine at very low temperatures, make sure you follow the instuctions in AMM 71-00-00/201 for special precautions.

B. Standard Tools and Equipment
   (1) Air Source - Compressed Dry Filtered, 0-60 psig (0-420 kPag)
   (2) Gage - Pressure, 0-60 psig (0-420 kPag)
   (3) Valves - Vent and Shutoff

C. Consumable Materials
   (1) D00096 Oil - MIL-L-6081, Grade 1005
   (2) G00095 Leak-Tek, 160X (soap solution is optional)

D. Parts

AMM		NOMENCLATURE	AIPC		
FIG	ITEM		SUBJECT	FIG	ITEM
401	1	Bracket	75-31-02	01	40
	2	Bolt			50
	3	Bolt			55
	4	Bolt			60
	5	Nut			15
	6	Packing (O-ring)			30
	7	Fitting (Coupling)			25
	8	Packing (O-ring)	73-11-07	05	16
	12	Actuator Guide	75-31-02	01	20
	13	VSV Actuator			5
	15	Bolt			10
	16	Nut			75

AMM		NOMENCLATURE	AIPC		
FIG	ITEM		SUBJECT	FIG	ITEM
402	1	Spacer		TBD	
	2	Nut			
	2A	Washer			
	3	Actuator			
	4	Actuation Lever Guide			
	5	Bracket			
	6	Bolt			
	7	Nut			
	7A	Pushrod			
	7B	Pushrod End Bearing			
	8	Connecting Links			
	8	Connecting Links			
	9	Actuator Lever Mount			
	11	Bolt			
		Nut			
		Washer			
		Sleeve Bushing			

E. References
(1) 71-00-00/501, Power Plant
(2) 78-31-00/201, Thrust Reverser System

F. Access
(1) Location Zone
412 Engine 1 - Compressor Case 3 and 9 o'clock
422 Engine 2 - Compressor Case 3 and 9 o'clock
432 Engine 3 - Compressor Case 3 and 9 o'clock
442 Engine 4 - Compressor Case 3 and 9 o'clock

(2) Access Panel
415 Left Thrust Reverser Half - Engine 1
416 Right Thrust Reverser Half - Engine 1
425 Left Thrust Reverser Half - Engine 2
426 Right Thrust Reverser Half - Engine 2
435 Left Thrust Reverser Half - Engine 3
436 Right Thrust Reverser Half - Engine 3
445 Left Thrust Reverser Half - Engine 4
446 Right Thrust Reverser Half - Engine 4

G. Procedure

S 434-016-J00
(1) Remove the protective covers from the actuator openings and the tube ends.

S 434-017-J00

(2) Install the couplings (Fig. 401):
  (a) Lubricate two new O-rings (6) with oil.
  (b) Install an O-ring (6) on each coupling (7).
  (c) Install the couplings (7) in the rod end and the head end openings on the VSV actuator (13).
    1) Tighten each coupling to 135-150 pound-inches (15.3-16.9 N.m).

S 424-039-J00

(3) Install the VSV actuator (Fig. 401):

CAUTION: MAKE SURE THE SIDE OF THE ACTUATOR GUIDE THAT HAS THE MOST DEPTH OF COUNTERBORE IS FORWARD WHEN YOU INSTALL IT. IF YOU DO NOT INSTALL IT CORRECTLY, THE SYSTEM CAN NOT MOVE EASILY.

  (a) Put the actuator rod and the actuator guide on the actuator lever and turn the guide 90 degrees to attach the parts.
  (b) Move the bracket (1) on the guide (12).
  (c) Install the bracket on the fan frame flange with bolts (2, 3, 4) and nut (16) as follows:
    1) Bolts (2, 3) go through the mounting bracket holes and are installed in the fan flange.
    2) Bolt (4) goes through both the mounting bracket and the fan flange and is attached with nut (9).
    3) Make sure the heads of the bolts are in the aft direction.
    4) Tighten the bolt (3) to 580-620 pound-inches (65.5-70.0 N.m).
    5) Tighten bolts (2) and (4) to 380-420 pound-inches (42.9-47.5 N.m).
    6) Tighten the nut (16) to 210-230 pound-inches (23.7-26.0 N.m).
  (d) Install the bolt (15) and the nut (5) that attach the clevis on the VSV actuator (13) to the bracket (1).
    1) Make sure the head of the bolt is in the forward direction.
    2) Tighten the nut to 65-75 pound-inches (7.3-8.5 N.m).

S 424-046-J00

(4) Install the VSV actuator (alternative method) (Fig. 402):
  (a) Move the actuator lever (10) forward to engage the VSV actuator rod and the actuation lever guide (4) with the track on the mounting bracket (5).
  (b) Install the 4th and 5th stage rod-end bearings (7B) to the connecting links (8) with the bolt, nut, two washers, and the sleeve bushing (11).
    1) Tighten finger-tight.
  (c) Install the spacer (1) on the actuator lever mount (9).
  (d) Put the aft end of the actuator lever (10) on the actuator lever mount (9).

(e) Install the washer (2A) and the aft mount nut (2) on the actuator lever mount (9).
1) Tighten the nut (2) to 190-230 pound-inches (21.5-26.0 N.m).
(f) Tighten the nut on the 4th and 5th stage rod-end bearings (7B) to 55-70 pound-inches (6.2-7.9 N.m).
(g) Install the bolt (6) and the nut (7) that attach the clevis on the VSV actuator (3) to the bracket (5).
1) Tighten the nut (7) to 65-75 pound-inches (7.3-8.5 N.m).

S 434-038-J00
(5) Attach the fuel tubes (Fig. 401):
(a) Lubricate two new O-rings (8) with oil.
(b) Install an O-ring (8) in the groove of each knurled nut on the drain can.
(c) Connect the tube nuts (11) from the rod end and the head end fuel tubes to the couplings (7).
1) Tighten the tube nuts to 270-300 pound-inches (30.5-33.9 N.m).

S 434-042-J00
(6) Connect the electrical connectors (Fig. 401):
(a) Remove the protective covers from the electrical connectors.
(b) Connect the electrical connector (14) to the VSV actuator (13).

S 784-029-J00
(7) Do a pressure test of the fuel tube connections:
(a) Do this task: "ECU (EEC) Actuators Ground Test" (AMM 71-00-00/501) to do an activation of the VSV system.
(b) If you see leaks in the VSV system,
Repair the leak.
1) Replace the O-ring if the leak is between the coupling and the actuator.
2) Do the pressure test of the fuel tube connections again.
3) If the tube fitting or the coupling has damage, and the leak is at the tube fitting:
Replace the tube fitting or the coupling.
4) Do the pressure test again.

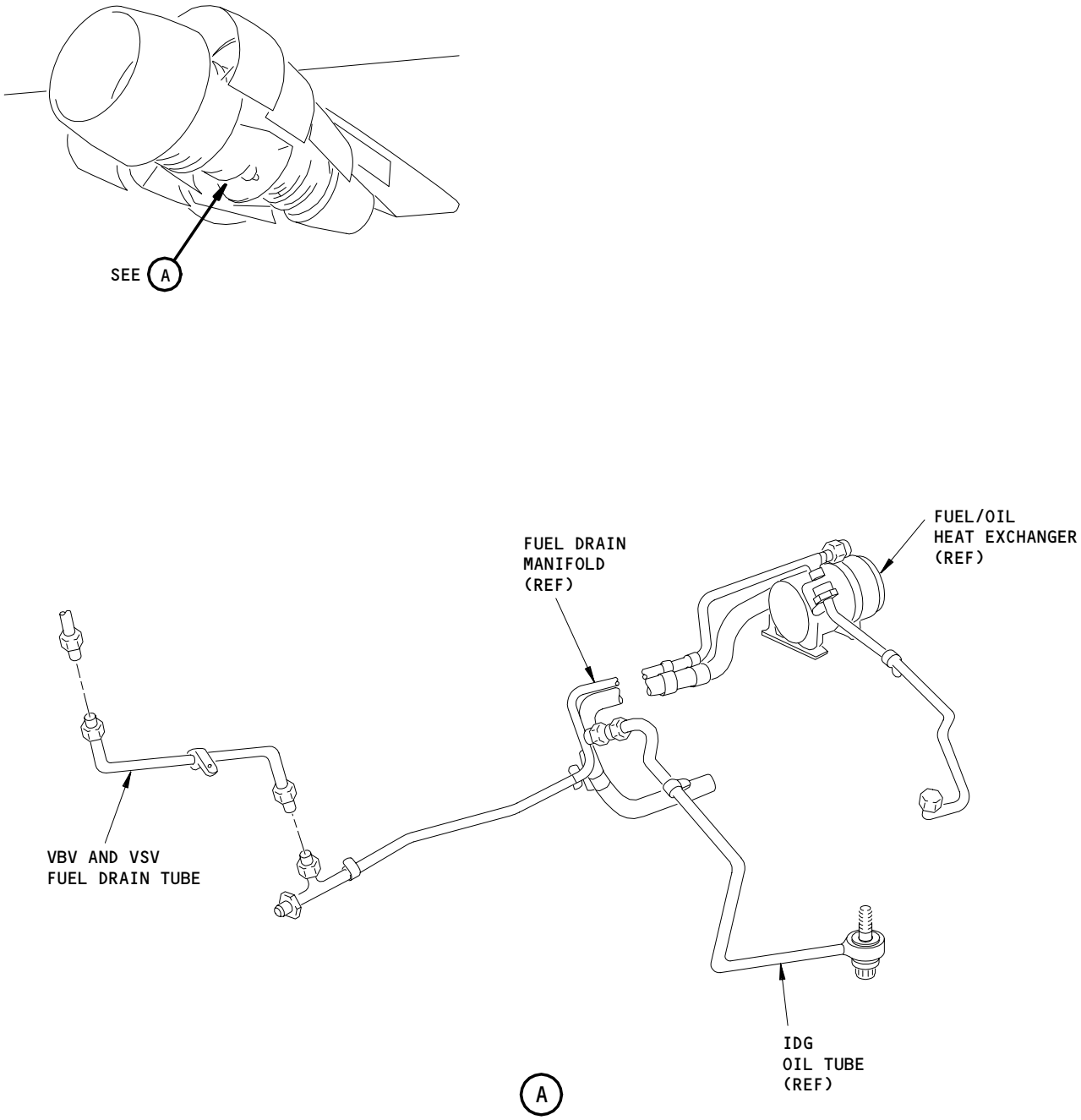
S 434-031-J00
(8) Attach the drain cans to the VSV actuator:
(a) Attach the drain cans (9) to the VSV actuator with the knurled nuts.
(b) Tighten the knurled nuts with your hand.
(c) Install lockwire on the nuts.
(d) If you loosened the fuel tube clamps when you disconnected the fuel tubes,
Tighten the fuel tube clamps.

S 784-044-J00

(9) Do a pressure test for leaks as follows (Fig. 403):
   (a) Supply dry air, nitrogen or argon at a pressure of 50-55 psig (345-380 kPa gage) to the fitting at the 6 o'clock position on the VBV and VSV fuel drain tube.
      1) Connect the pressure gage to the fittting at the 8 o'clock position.
   (b) Turn off the pressure supply when you have the correct pressure.
   (c) Monitor the pressure for 2 minutes.
      1) A maximum of 10 psig (70 kPa gage) decrease in pressure is permitted.

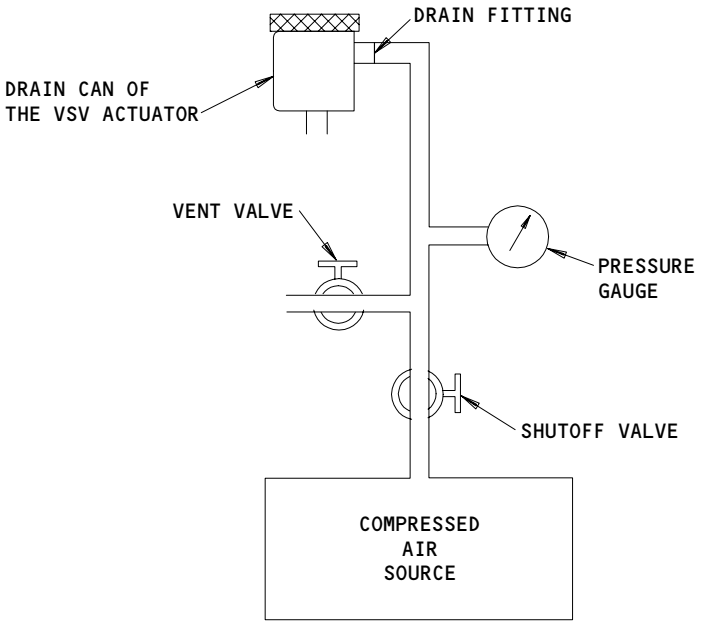
S 784-043-J00

(10) If the decrease in pressure is more than the limit, do the steps that follow to individually pressure test the shrouds for leaks (Fig. 404):
   (a) Connect the air source to the drain fitting on the bottom of the drain can.
      1) Close the vent valve.
      2) Open the shutoff valve.
   (b) Apply 50-55 psig (345-380 kPag) of pressure to the drain fitting.
   (c) Close the valve from the air source.
   (d) A maximum decrease in pressure of 10 psig (70 kPag) in two minutes is allowed.
   (e) If the decrease in pressure is more than the limits, Repair the leaks:
      1) Apply a soap solution or Leak-Tek to the shroud connections.
      2) If the leaks are at the knurled nuts, Tighten the knurled nuts with your hand to stop the leaks.
      3) If the leaks are at the hexagonal nuts, Make sure the hexagonal nuts are tightened to the correct torque value.
         a) Do not tighten the connections more than the correct torque value, to stop the leaks.



Variable Stator Vane (VSV) Actuator Pressure Test
Figure 403

E82264



Pressure Test of the Drain Shrouds on the VSV Actuators
Figure 404

4) If there are remaining leaks,
Replace the O-rings at the leaks.
5) Do the pressure test to individually test the drain shrouds again.

S 424-047-J00
(11) Remove the pressure source and connect two drain tubes (10, Fig. 401)) to the drain cans (9).
(a) Tighten the tube nuts to 270-300 pound-inches (30.5-33.9 N.m).

S 864-024-J00
(12) Remove the DO-NOT-CLOSE tags and close these circuit breakers, for the applicable engine:
(a) P18O DC Power Distribution Panel
1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S 714-048-J00
(13) Do the test shown in the Power Plant Test Reference Table (AMM 71-00-00/501).

S 414-028-J00
(14) Do this task: "Close the Thrust Reverser" (Ref 78-31-00/201).

VARIABLE STATOR VANE ACTUATOR - INSPECTION/CHECK

1. General
   A. This procedure contains a task to visually examine the variable stator vane (VSV) actuator.
   B. You must remove the VSV actuator to visually examine it.

   TASK 75-31-02-206-001-J00

2. Variable Stator Vane Actuator Visual Examination (Fig. 601)
   A. Standard Tools and Equipment
      (1) Brush - Stiff Bristle
   B. Consumable Materials
      (1) B00722 Solvent - Stoddard, P-D-680
   C. References
      (1) AMM 75-31-02/401, Variable Stator Vane Actuator
   D. Access
      (1) Location Zone

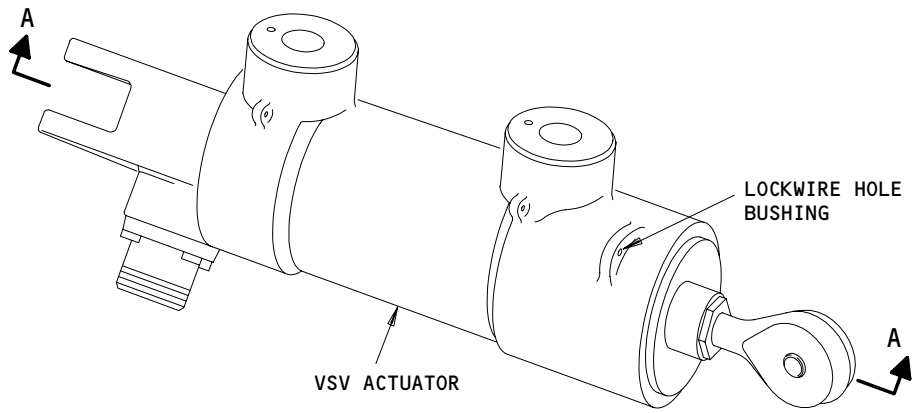
412	Engine 1 - Compressor Case 3 and 9 o'clock
422	Engine 2 - Compressor Case 3 and 9 o'clock
432	Engine 3 - Compressor Case 3 and 9 o'clock
442	Engine 4 - Compressor Case 3 and 9 o'clock

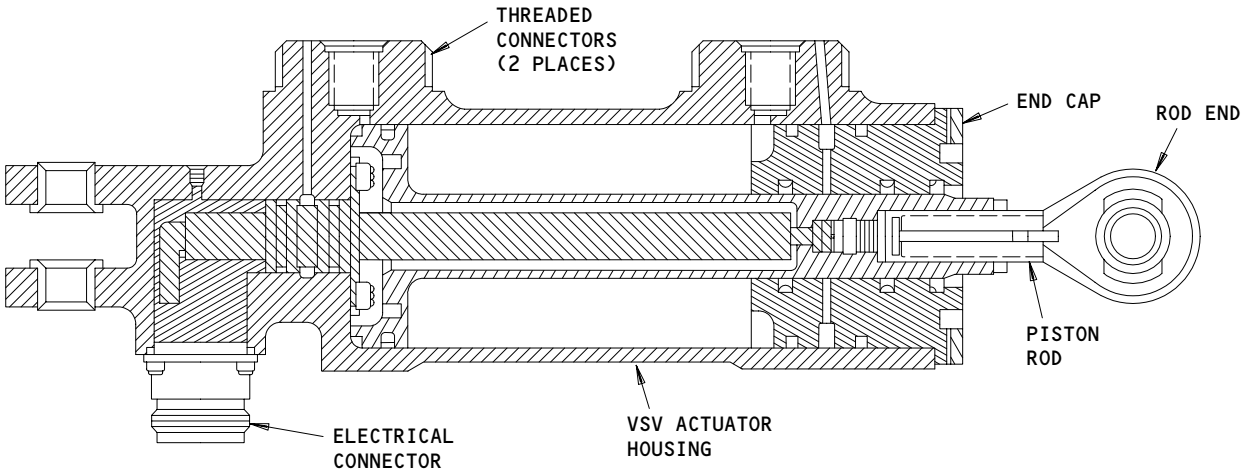
      (2) Access Panel

415	Left Thrust Reverser Half - Engine 1
416	Right Thrust Reverser Half - Engine 1
425	Left Thrust Reverser Half - Engine 2
426	Right Thrust Reverser Half - Engine 2
435	Left Thrust Reverser Half - Engine 3
436	Right Thrust Reverser Half - Engine 3
445	Left Thrust Reverser Half - Engine 4
446	Right Thrust Reverser Half - Engine 4

   E. Procedure

      S 026-002-J00
      (1) Do this task: "Variable Stator Vane Actuator Removal" (AMM 75-31-02/401).





A-A

CF8-A6239-00-A

Variable Stator Vane (VSV) Actuator Inspection
Figure 601

S 216-011-J00
(2) Visually examine the end cap on the VSV actuator:
(a) Examine the end cap for fuel leaks.
(b) If there are fuel leaks at the end caps,
Replace the VSV actuator.

S 216-012-J00
(3) Visually examine the VSV actuator housing:
(a) Examine the VSV actuator housing for these types of damage:
1) Different color from too much heat
2) Deformation
3) Dents.
4) Loose or torn lockwire hole bushing
5) Locations where lockwire hole bushings are not there.
(b) If you find these types of damage,
Replace the VSV actuator.

S 216-013-J00
(4) Visually examine the tube connections on the VSV actuator:
(a) Examine the openings with threads for these types of damage:
1) Threads that are stripped
2) Nicks or dents that are the full depth of the thread.
(b) If you find these types of damage,
Replace the VSV actuator.
(c) If the nicks or the dents are not the full depth of the threads,
Chase the threads.

S 216-014-J00
(5) Visually examine the piston rod on the VSV actuator:
(a) Examine the piston rod for these types of damage:
1) Scores or bent parts
2) Threads that are stripped.
(b) If you find these types of damage,
Replace the VSV actuator.

S 216-015-J00
(6) Visually examine the rod end on the VSV actuator:
(a) Examine the rod end for these types of damage:
1) The spherical rod end bearing does not move easily.
2) Nicks or worn areas in the spherical rod end bearing
(b) If you find these types of damage,
Replace the VSV actuator.

S 216-016-J00

(7) Visually examine the electrical connectors on the VSV actuator:
  (a) Examine the electrical connector for these types of damage:
    1) Bent, broken, or loose pins
    2) Burns or other signs of arcing
    3) Cracks or crossed threads
    4) Nicks or dents to the full depth of the thread
  (b) If the nicks or the dents are not to the complete depth, Chase the threads.

WARNING: DO NOT BREATHE THE FUMES FROM THE SOLVENT. KEEP THE SOLVENT AWAY FROM SPARKS, FLAME, AND HEAT. THE SOLVENT CAN CAUSE INJURY TO PERSONS.

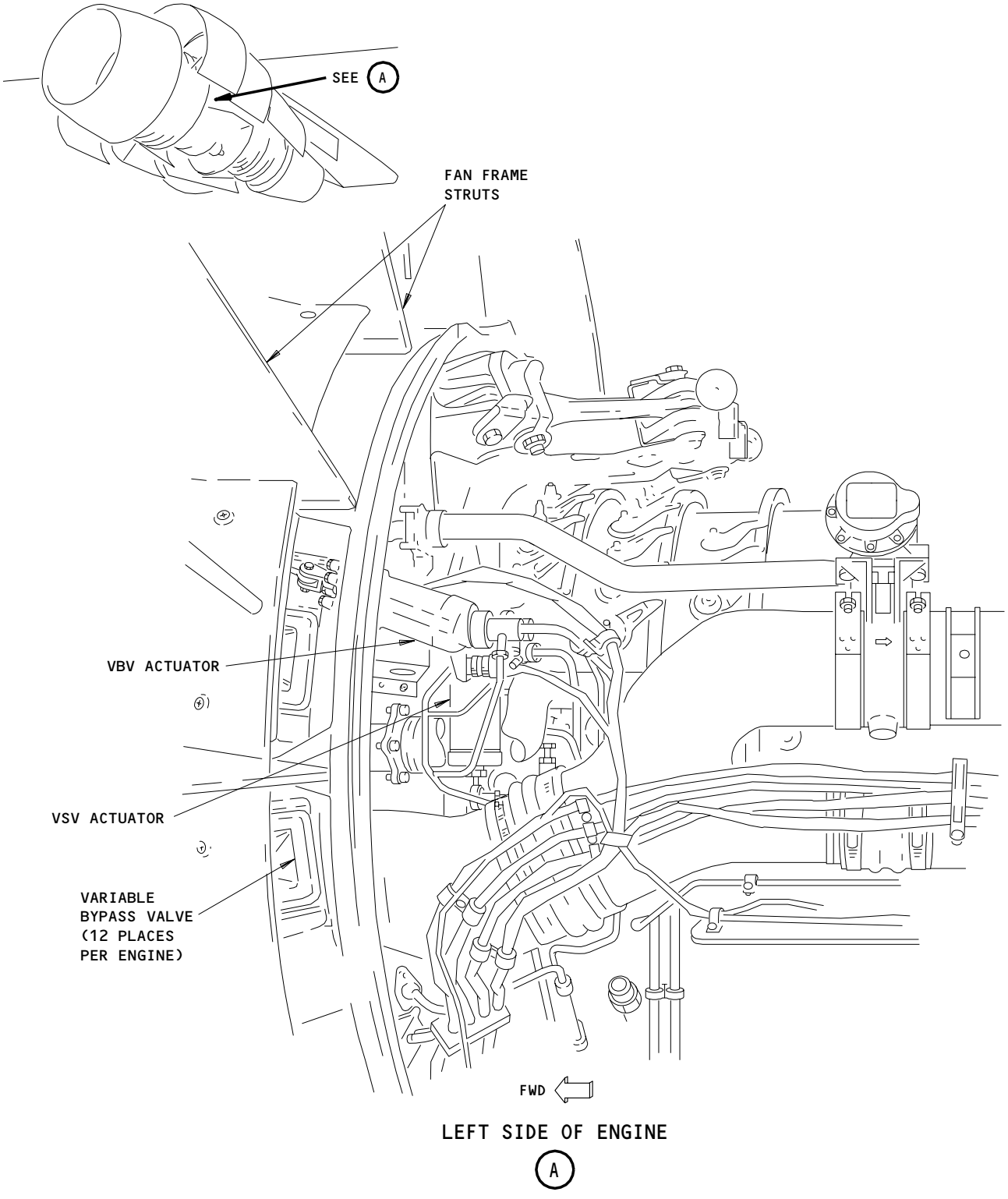
  (c) If there is dirt or contamination on the electrical connector, Clean the electrical connector with a soft bristle brush and solvent.
  (d) If you find these types of damage, Replace the VSV actuator.

S 426-010-J00

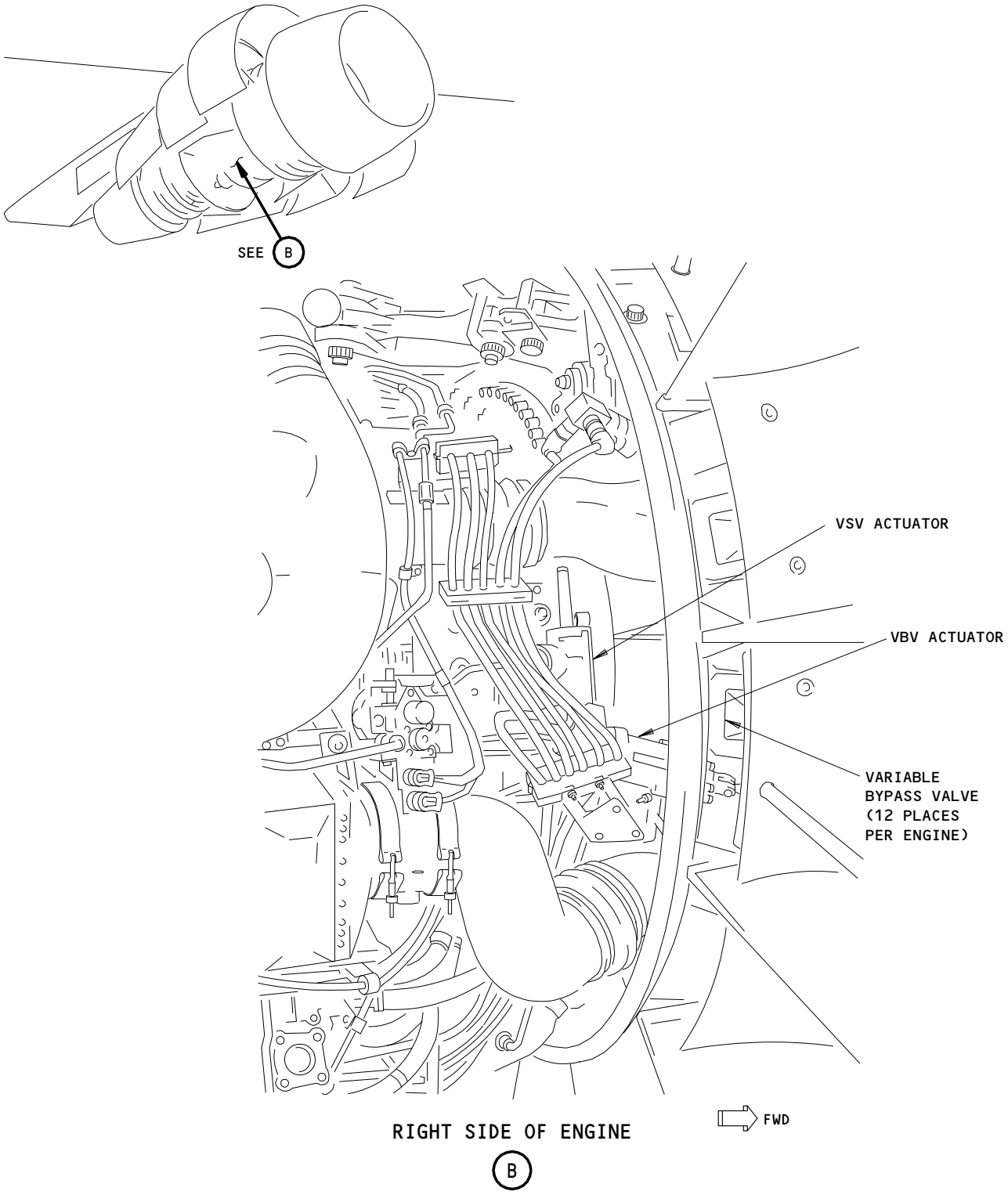
(8) Do this task: "Variable Stator Vane Actuator Installation" (AMM 75-31-02/401).

VARIABLE BYPASS VALVE SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The variable bypass valve (VBV) system controls the air flow quantity to the high pressure compressor (HPC). The system consists of:
      - Two fuel powered hydraulic actuators
      - A 360 degree unison ring
      - Two actuator pushrods and bellcranks which are linked to the unison ring
      - 12 bypass valves and bellcranks which are linked to the unison ring
      - The electronic control unit (ECU) and the hydromechanical unit (HMU).
   B. The VBV system improves the stability between the high pressure and low pressure compressors by opening the 12 bypass valves, located between the fan frame struts. This will permit a portion of the primary air flow to pass through the fan frame and enter the secondary air flow.
   C. The VBV system automatically moves the bypass valves to the proper position as a function of core engine speed and compressor inlet temperature. The bypass valves become partially opened during low and transient operations and become fully opened during rapid decelerations and thrust reverser operation. The bypass valves are closed during takeoff and cruise operations.
   D. The HMU contains a two stage torque motor/servo valve for VBV actuator positioning. The torque motor contains two electrically isolated and independent coils with one dedicated to channel A and the other to channel B of the ECU. The four-way second stage servo valve supplies pressurized fuel to the VBV actuators. A mechanical bias in the VBV torque motor causes the VBV's to open for the no electrical input condition.
   E. The VBV actuation is designed to open, close or vary the position of the 12 bypass valves in response to an input command signal. The VBV's are connected to the unison ring. As the unison ring rotates, all of the bypass valves move to the same position. High pressure fuel hydraulically activates the VBV system.
   F. The position of the VBV actuators is sent to the ECU by position feedback sensors. The sensors are an integral part of the actuators.
2. Variable Bypass Valve Actuator
   A. The two VBV actuators are installed on the fan frame between the 4th- and 5th-struts and the 10th- and 11th-struts. The actuators are single-ended, hydraulic cylinders driven in either direction by high pressure fuel. The piston has internal stops to control the stroke. The rod end of the actuator is threaded and fitted with an adjustable extension containing a clevis end fitting. The actuator pushrod transmits motion from the clevis to the actuator bellcrank.



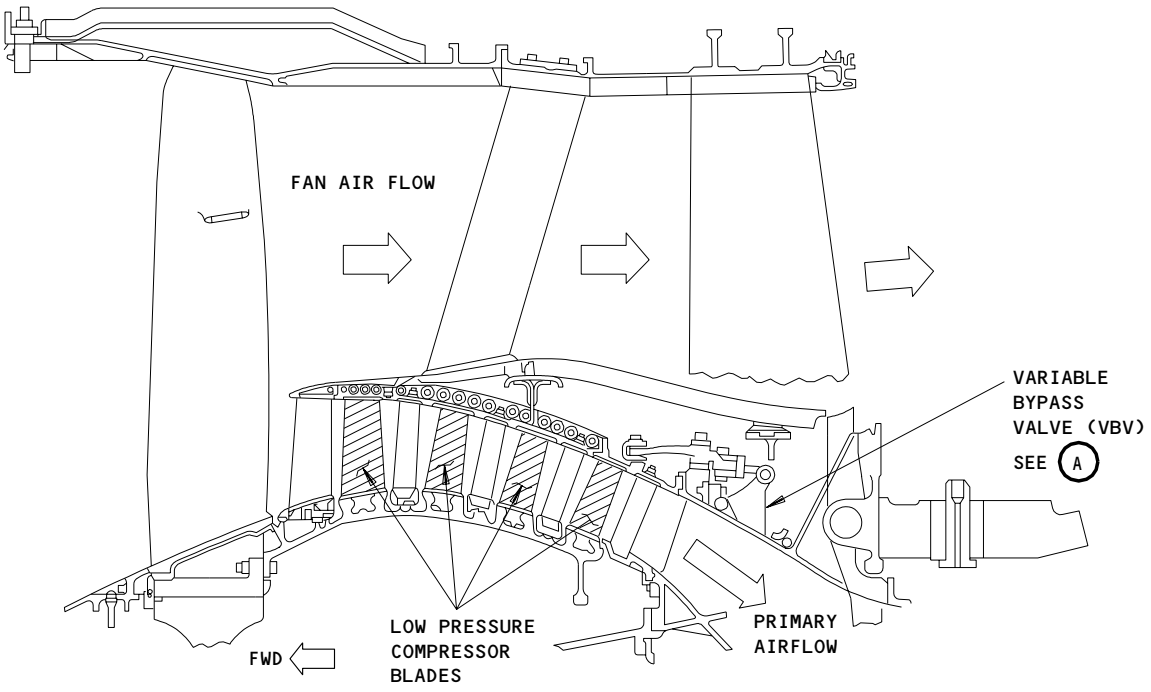
Variable Bypass Valve System
Figure 1 (Sheet 1)



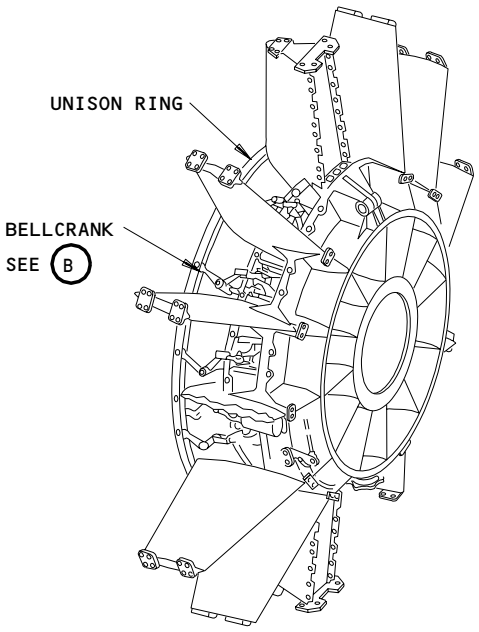
Variable Bypass Valve System
Figure 1 (Sheet 2)

B. The rod end of the actuator is protected against leakage by dual-stage preformed seals. A capped preformed seal prevents cross piston leakage. Fuel, which leaks past the different sealing provisions, is drained overboard through the drain mast.

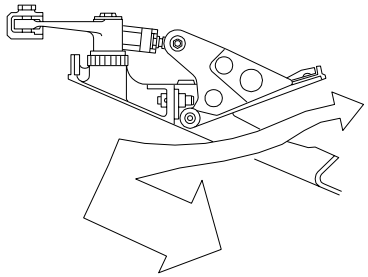
3. Variable Bypass Valve Position Feedback
   A. The six-wire position feedback sensor, within the VBV actuator, is energized by the ECU. The two isolated output signals from each actuator are monitored by the feedback sensor's dedicated channel. The sensor in the left side actuator uses channel A to send the feedback signal and the sensor in the right side actuator uses channel B.
4. Operation (Fig. 2)
   A. Functional Description
      (1) The bypass valves are positioned by two VBV actuators which are hydraulically activated by pressurized fuel. The HMU supplies a pressure signal from a single port to the rod end of both actuators. This pressure is between fuel pump discharge and HMU regulated body pressure (PCB which is 5-15 psi [34-103 KPa] above fuel bypass pressure). The HMU also supplies fuel pressure from another single port to the head end of each actuator at a pressure between fuel pump discharge and PCB. The pressures are varied by the HMU in response to commands from the ECU.
      (2) A higher fuel pressure supplied to the head end port of the VBV actuators causes the piston rods to extend. The piston rods are connected to bellcranks which cause the unison ring to rotate counterclockwise (aft looking forward). The motion is then transmitted through bellcranks to the bypass valves. This will cause the bypass valves to open.
      (3) A higher fuel pressure supplied to the rod end port causes the piston rod to retract. This will cause the unison ring to rotate clockwise (aft looking forward). The motion is then transmitted through bellcranks to the bypass valves. This will cause the bypass valves to close.
      (4) The two position feedback sensors monitor the position of the actuator pistons. The output signals, which vary in amplitude as a function of actuator stroke, are sent to the ECU. If the ECU senses any error between the scheduled VBV position and actual VBV position, it will send a signal to the HMU. The HMU will vary the fuel pressure to the head and rod ends of the actuators until the position of the bypass valves agrees with the schedule.



LOW PRESSURE COMPRESSOR ASSEMBLY

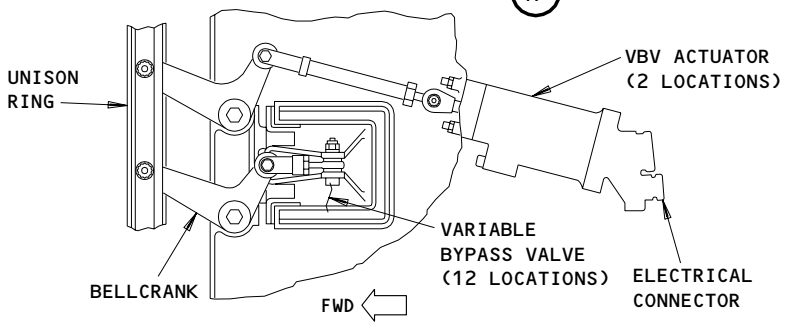


VBV MECHANICAL SYSTEM



DOOR OPEN

A



VBV ACTUATOR AND VALVE

B

CF8-6663-00-C

Variable Bypass Valve System Details
Figure 2

VARIABLE BYPASS VALVE SYSTEM - MAINTENANCE PRACTICES

1. General
   A. This section contains the task to operate the variable bypass valve (VBV) system.
   B. You must open the right thrust reverser half to get access to do this task.

TASK 75-32-00-862-001-J00

2. Variable Bypass Valve (VBV) Operation (Fig. 201)
   A. Standard Tools and Equipment
      (1) Actuator - Hydraulic (2C6395), General Electric Co., 111 Merchant Street, Room 425, Cincinnati, OH 45246

          NOTE: Dry air, nitrogen, or argon source (capable of providing 300 psig (2100 kPa gage) pressure) may be used if hydraulic actuator is not available.

   B. Consumable Materials
      (1) D00124 Oil - Grade 1010
      (2) B00722 Solvent - Stoddard, P-D-680
   C. References
      (1) 71-00-00/501, Power Plant
      (2) 78-31-00/201, Thrust Reverser System
   D. Access
      (1) Location Zone

412	Engine 1 - Compressor Case 5 o'clock
422	Engine 2 - Compressor Case 5 o'clock
432	Engine 3 - Compressor Case 5 o'clock
442	Engine 4 - Compressor Case 5 o'clock

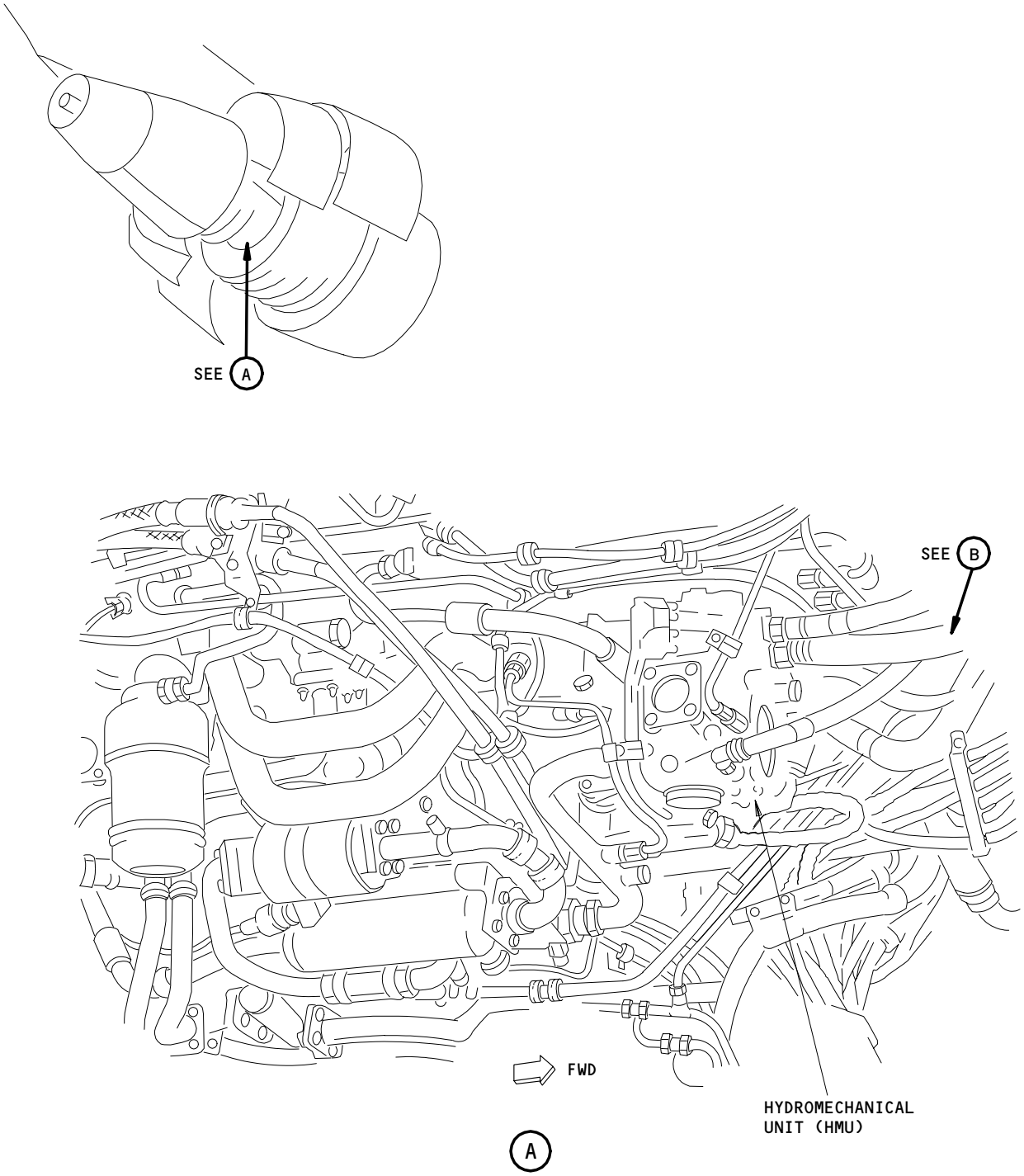
      (2) Access Panel

416	Right Thrust Reverser Half - Engine 1
426	Right Thrust Reverser Half - Engine 2
436	Right Thrust Reverser Half - Engine 3
446	Right Thrust Reverser Half - Engine 4

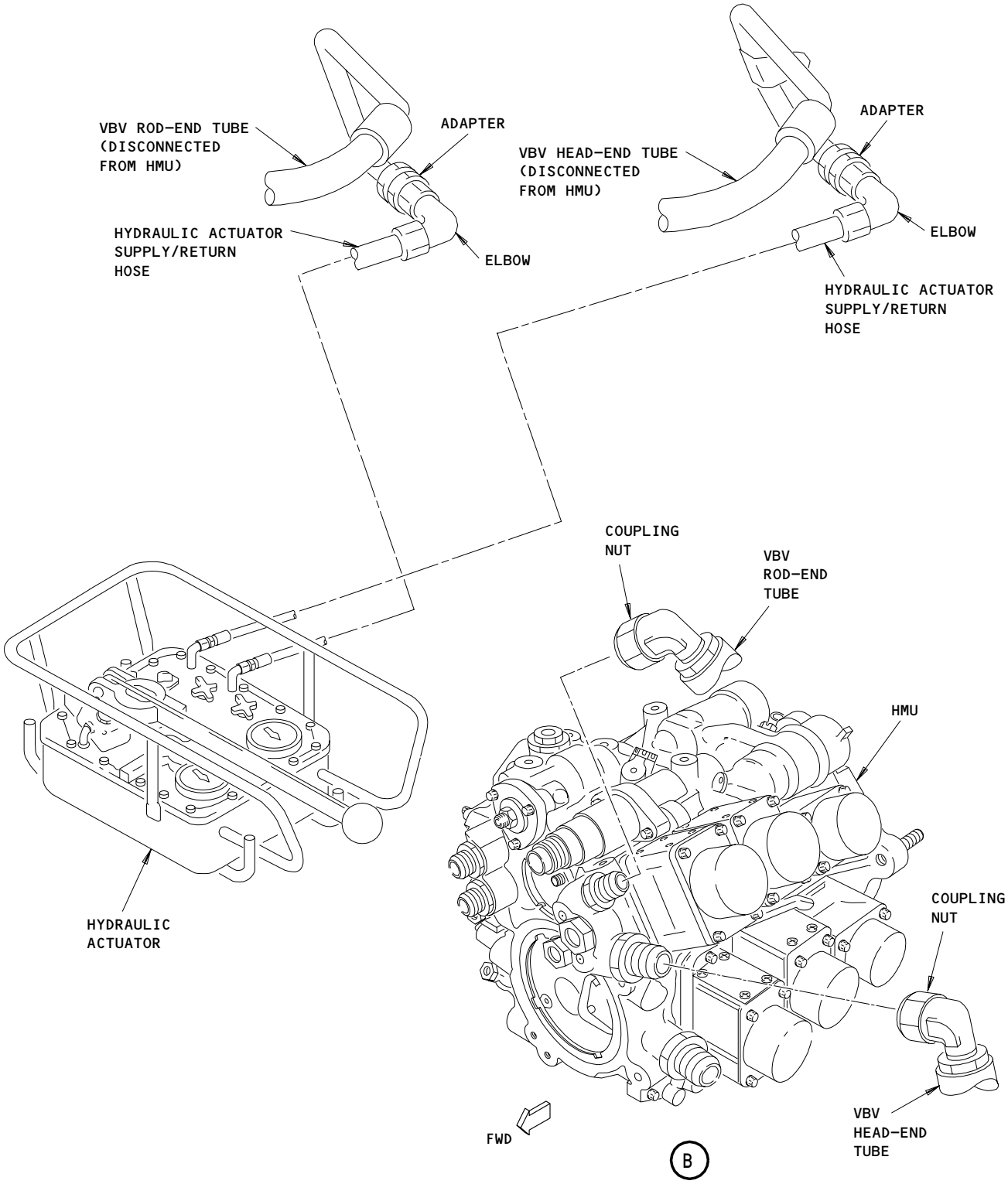
   E. Procedure

      S 862-002-J00
      (1) Make sure the applicable FUEL CONTROL switch on the aisle control stand is in the CUTOFF position and install DO-NOT-CLOSE identifier(s).

      S 012-003-J00
      (2) Open the right thrust reverser half (Ref 78-31-00/201).



Variable Bypass Valve (VBV) System Actuation
Figure 201 (Sheet 1)



Variable Bypass Valve (VBV) System Actuation
Figure 201 (Sheet 2)

S 032-004-J00

(3) Disconnect the VBV head and rod end tubes from the hydromechanical unit (HMU).

S 432-005-J00

(4) Install the protective covers on the HMU fittings.

S 492-006-J00

(5) Connect the hydraulic actuator supply and return hoses to the VBV head and rod end tubes.

S 862-007-J00

(6) Put the VBV system in the closed position (VBV actuator rod retracted):

CAUTION: DO NOT SUPPLY A PRESSURE OF MORE THAN 300 PSIG (2100 KPA GAGE). TOO MUCH PRESSURE CAN CAUSE DAMAGE TO THE VBV SYSTEM.

(a) Supply and keep a pressure of 200-300 psig (1400-2100 kPa gage) to the VBV rod end tube.

NOTE: Use oil or solvent, if you use the hydraulic actuator.

NOTE: ENGINES POST GE SB 75-154
(WITH COOLING HOLES IN THE ACTUATOR PISTON);
The pressure will slowly bleed down during the pressurization of the actuator. The cooling holes provide a cooling flow of 30-50 lbs/hour, so the pressure will slowly bleed down.

S 862-008-J00

(7) Put the VBV system in the open position (VBV actuator rod extended).

CAUTION: DO NOT SUPPLY A PRESSURE OF MORE THAN 300 PSIG (2100 KPA GAGE). TOO MUCH PRESSURE CAN CAUSE DAMAGE TO THE VBV SYSTEM.

(a) Supply and keep a pressure of 200-300 psig (1400-2100 kPa gage) to the VBV head end tube.

NOTE: Use oil or solvent, if you use the hydraulic actuator.

NOTE: ENGINES POST GE SB 75-154
(WITH COOLING HOLES IN THE ACTUATOR PISTON);
The pressure will slowly bleed down during the pressurization of the actuator. The cooling holes provide a cooling flow of 30-50 lbs/hour, so the pressure will slowly bleed down.

S 842-009-J00
(8) When it is no longer necessary, release the pressure from the system.

S 092-010-J00
(9) Disconnect the hydraulic actuator supply and return hoses from the VBV head and rod end tubes.

S 032-011-J00
(10) Remove the protective covers from the HMU fittings.

S 432-012-J00
(11) Connect the VBV head end tube to the HMU.
(a) Tighten the tube nut to 450-550 pound-inches (50.8-62.2 N.m).

S 432-013-J00
(12) Connect the VBV rod end tube to the HMU.
(a) Tighten the tube nut to 270-300 pound-inches (30.5-33.9 N.m).

S 862-014-J00
(13) Remove the DO-NOT-CLOSE identifier from the FUEL CONTROL switch.

S 792-015-J00
(14) Do the Idle Leak Test - Test No. 3 (Ref 71-00-00/501).

S 412-016-J00
(15) Close the right thrust reverser half (Ref 78-31-00/201).

VARIABLE BYPASS VALVE ACTUATOR - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One task is for the removal of the variable bypass valve (VBV) actuator. The other task is for the installation of the variable bypass valve (VBV) actuator.
   B. There are two VBV actuators on the engine. The right actuator is installed on the fan frame between the 4th- and 5th-struts (3:30 o'clock position). The left actuator is installed on the fan frame between the 10th- and the 11th-struts (9:30 o'clock position).
   C. To replace the VBV actuators, you must do the steps that follow:
      - Open the thrust reverser halves
      - Remove the fan frame liner segment
      - Replace the VBV actuator
      - Do the Test of the ECU (EEC) Actuators
      - Install the fan frame liner segment
      - Close the thrust reverser halves.

TASK 75-32-01-004-001-J00

2. Variable Bypass Valve Actuator Removal (Fig. 401)
   A. Standard Tools and Equipment
      (1) Container - 1 gallon (4 liter) capacity, for fuel
   B. References
      (1) 72-33-01/401, Acoustical Liner Segment
      (2) 78-31-00/201, Thrust Reverser System
      (3) AIPC 75-11-07, Fig. 5
      (4) AIPC 75-32-01, Fig. 1
   C. Access
      (1) Location Zone

412	Engine 1 - Fan Frame 3:30 and 9:30 o'clock
422	Engine 2 - Fan Frame 3:30 and 9:30 o'clock
432	Engine 3 - Fan Frame 3:30 and 9:30 o'clock
442	Engine 4 - Fan Frame 3:30 and 9:30 o'clock

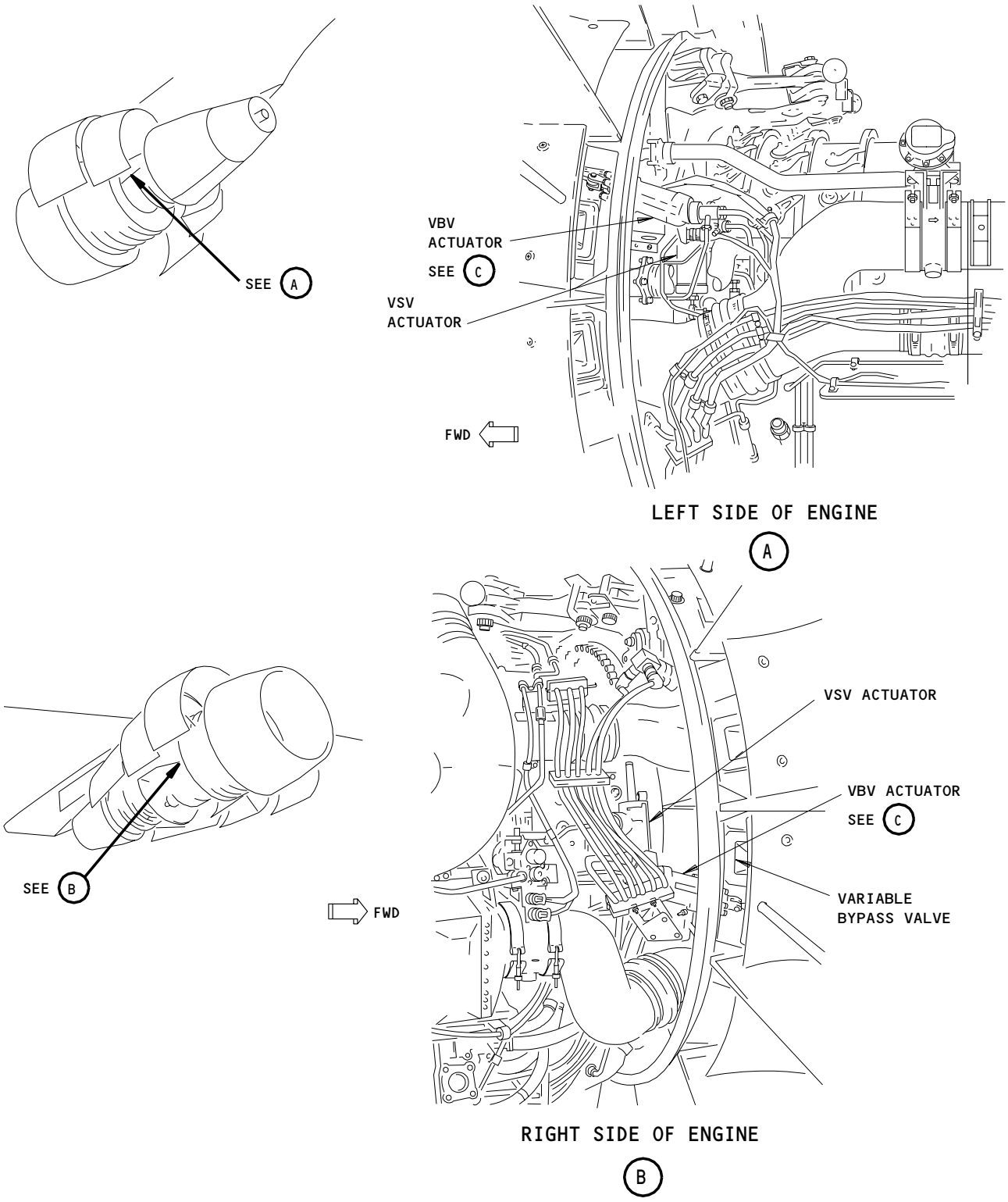
      (2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

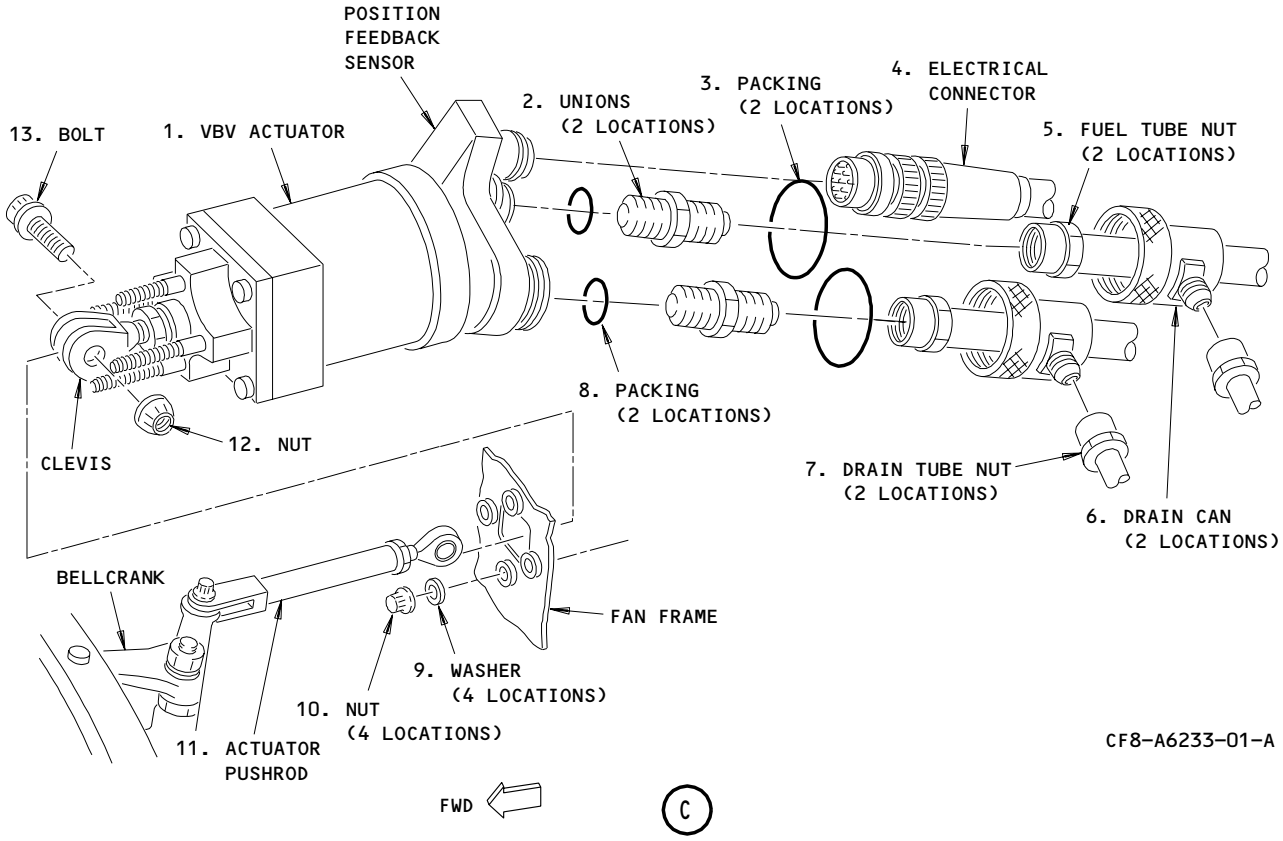
   D. Procedure

      S 014-002-J00
      (1) Open the thrust reversers (Ref 78-31-00/201).

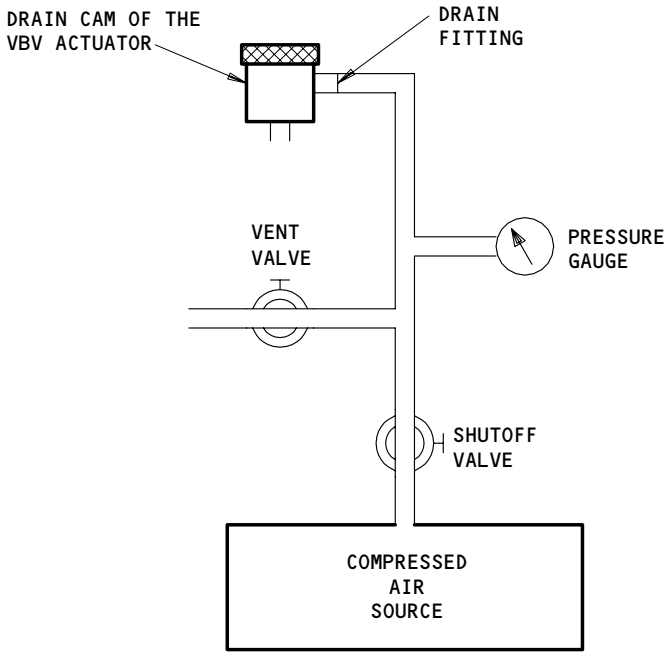
      S 014-003-J00
      (2) Remove the applicable liner segment to get access to the VBV actuator clevis (Ref 72-33-01/401).



Variable Bypass Valve (VBV) Actuator Installation
Figure 401 (Sheet 1)



Variable Bypass Valve (VBV) Actuator Installation
Figure 401 (Sheet 2)



Pressure Test of the Drain Shrouds on the VBV Drain Shroud System
Figure 402

S 864-004-J00
(3) For the applicable engine, open these circuit breakers and attach DO-NOT-CLOSE tags:
(a) P18O DC Power Distribution Panel
1) 18OJ5 ENG 1 EEC PWR CH A
2) 18OJ6 ENG 1 EEC PWR CH B
3) 18OF5 ENG 2 EEC PWR CH A
4) 18OF6 ENG 2 EEC PWR CH B
5) 18OG2O ENG 3 EEC PWR CH A
6) 18OG21 ENG 3 EEC PWR CH B
7) 18OD2O ENG 4 EEC PWR CH A
8) 18OD21 ENG 4 EEC PWR CH B

S O34-005-J00
(4) Disconnect the electrical connector (4) from the VBV actuator (1).

S 494-006-J00
(5) Put a container below the VBV actuator (1) to catch the remaining fuel when you disconnect the fuel tubes.

S O34-007-J00
(6) Disconnect the fuel drain tubes (7) from the drain cans (6).

S O34-008-J00
(7) Loosen the knurled nuts that attach the drain cans (6) to the VBV actuator (1).
(a) Move the drain cans back to get access to the fuel tube nuts (5).

S O34-009-J00
(8) Disconnect the fuel tube nuts (5) from the unions (2).

S O34-010-J00
(9) Remove and discard the packings (3) from the drain can knurled nuts.

S O34-011-J00
(10) Remove the nut (12) and the bolt (13) from the VBV actuator rod end clevis and move the actuator pushrod (11) to the side.

S O24-012-J00
(11) Remove the four nuts (10) and the washers (9) from the actuator mounting studs.
(a) Remove the actuator (1) from the fan frame.

S O34-013-J00
(12) Remove the unions (2) and the packings (8) from the VBV actuator (1).
(a) Discard the packings (8).

S 034-014-J00

(13) Install protective caps on all the openings.

TASK 75-32-01-404-015-J00

3. Variable Bypass Valve Actuator Installation (Fig. 401)

A. General

CAUTION: ENGINES WITH GE SB 73-079 (WITH FLUOROCARBON (VITRON) SEALS): YOU MUST NOT OPERATE THE ENGINE WITH OIL TEMPERATURES BELOW -30 DEGREES F (-34 DEGREES C). REFER TO AMM 71-00-00/201 FOR SPECIAL PRECAUTIONS FOR OPERATION OF THE ENGINE AT VERY LOW TEMPERATURES. ENGINE DAMAGE CAN OCCUR IF VITRON SEALS ARE USED AT VERY LOW TEMPERATURES.

(1) If you operate the engine at very low temperatures, make sure you follow the instuctions in AMM 71-00-00/201 for special precautions.

B. Standard Tools and Equipment

(1) Pressure Source - Gas, Dry air, nitrogen or argon source (capable of providing 200 psig [1378 KPa gage])

C. Consumable Materials

(1) D00096 Oil - MIL-L-6081, Grade 1005

(2) G00095 Chemical-leak detecting, Leak-tek 160X

D. Parts

AMM			AIPC		
FIG	ITEM	NOMENCLATURE	SUBJECT	FIG	ITEM
401	1	VBV Actuator	75-32-01	01	25
	2	Union			40
	3	Packing	73-11-07	05	16
	8	Packing	75-32-01	01	45
	9	Washer			15
	10	Nut			20
	12	Nut			10
	13	Bolt			5

E. References

(1) 71-00-00/501, Power Plant

(2) 72-33-01/401, Acoustical Liner Segment

(3) 78-31-00/201, Thrust Reverser System

F. Access

(1) Location Zone

412 Engine 1 - Fan Frame 3:30 and 9:30 o'clock
422 Engine 2 - Fan Frame 3:30 and 9:30 o'clock
432 Engine 3 - Fan Frame 3:30 and 9:30 o'clock
442 Engine 4 - Fan Frame 3:30 and 9:30 o'clock

(2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

G. Procedure

S 424-033-J00
(1) Remove the protective caps from all the openings.

S 434-017-J00
(2) Install the unions (2) on the VBV actuator (1).
(a) Put oil on the packings (8).
(b) Install the packings (8) on the unions (2).
(c) Install the unions on the VBV actuator (1).
(d) Tighten the unions to 135-150 pound-inches (15.3-16.9 N.m).

S 424-018-J00
(3) Install the nuts (10) and washers (9) that secure the VBV actuator (1) to the fan frame.
(a) Tighten the nuts to 55-70 pound-inches (6.2-7.9 N.m).

S 434-019-J00
(4) Attach the actuator pushrod (11) to the rod end clevis with the bolt (13) and the nut (12).
(a) Tighten the nut to 100-130 pound-inches (11.3-14.7 N.m).

S 644-030-J00
(5) Put oil on the packings (3).

S 434-020-J00
(6) Install the packings (3) in the grooves of the drain can knurled nuts.

S 434-021-J00
(7) Connect the fuel tube nuts (5) to the unions (2).
(a) Tighten the nuts (5) to 270-300 pound-inches (30.5-33.9 N.m).

S 434-029-J00
(8) Connect the electrical connector (4) to the VBV actuator (1).

S 864-023-J00
(9) For the applicable engine, remove the DO-NOT-CLOSE tags and close these circuit breakers.
(a) P180 DC Power Distribution Panel
1) 180J5 ENG 1 EEC PWR CH A
2) 180J6 ENG 1 EEC PWR CH B
3) 180F5 ENG 2 EEC PWR CH A
4) 180F6 ENG 2 EEC PWR CH B

5) 180G20 ENG 3 EEC PWR CH A
6) 180G21 ENG 3 EEC PWR CH B
7) 180D20 ENG 4 EEC PWR CH A
8) 180D21 ENG 4 EEC PWR CH B

S 794-024-J00
(10) Do the test shown in the Power Plant Test Reference Table (AMM 71-00-00/501).
(a) Make sure that there are no leaks at the fuel tube nuts (5).

S 434-025-J00
(11) Connect the drain can knurled nuts to the VBV actuator (1) fuel port bosses.
(a) Tighten the knurled nuts by hand only.
(b) Install the lockwire.

S 434-026-J00
(12) Connect the two drain tubes (7) to the drain cans (6).
(a) Tighten to 135-150 pound-inches (15.3-16.9 N.m).

S 784-031-J00
(13) Do a pressure test of the VBV drain shroud system as follows (Fig. 402):
(a) Connect an air source to the drain fitting on the bottom of the drain can.
(b) Close the vent valve from the air source.
(c) Open the shutoff valve from the air source.
(d) Apply pressure of 50-55 psig (345-379 kpag) to the drain fitting.
(e) Close the shutoff valve from the air source.
(f) Monitor the pressure for 2 minutes.
1) A maximum of 10 psig (69 kpag) decrease in pressure is permitted.
(g) If the decrease in pressure is more than the limits, do the steps that follows:
1) Apply a soap solution or leak-tek to show leakage at the shroud connections.
2) Tighten the knurled nut by hand to stop the leaks.
3) Make sure the hex nuts are tightened to the correct torque value.

NOTE: Do not over-tighten the connections.

4) If the leakage continues, replace the packings at the connections where the leakage occurs.
5) Do the pressure test of the drain shrouds again.

S 414-027-J00
(14) Install the applicable liner segment (Ref 72-33-01/401).

S 414-028-J00
(15) Close the thrust reverser (Ref 78-31-00/201).

VARIABLE BYPASS VALVE ACTUATOR - INSPECTION/CHECK

1. General
   A. This procedure contains the task to do a visual inspection of the variable bypass valve (VBV) actuator.
   B. To do the task, you must remove the VBV actuator.

TASK 75-32-01-206-001-J00

2. Variable Bypass Valve (VBV) Actuator Inspection (Fig. 601)
   A. Standard Tools and Equipment
      (1) Brush - Stiff Bristle
   B. Consumable Materials
      (1) B00722 Solvent - Stoddard, P-D-680
   C. References
      (1) 75-32-01/401, Variable Bypass Valve Actuator
   D. Access
      (1) Location Zone

412	Engine 1 - Fan Frame 3:30 and 9:30 o'clock
422	Engine 2 - Fan Frame 3:30 and 9:30 o'clock
432	Engine 3 - Fan Frame 3:30 and 9:30 o'clock
442	Engine 4 - Fan Frame 3:30 and 9:30 o'clock

      (2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

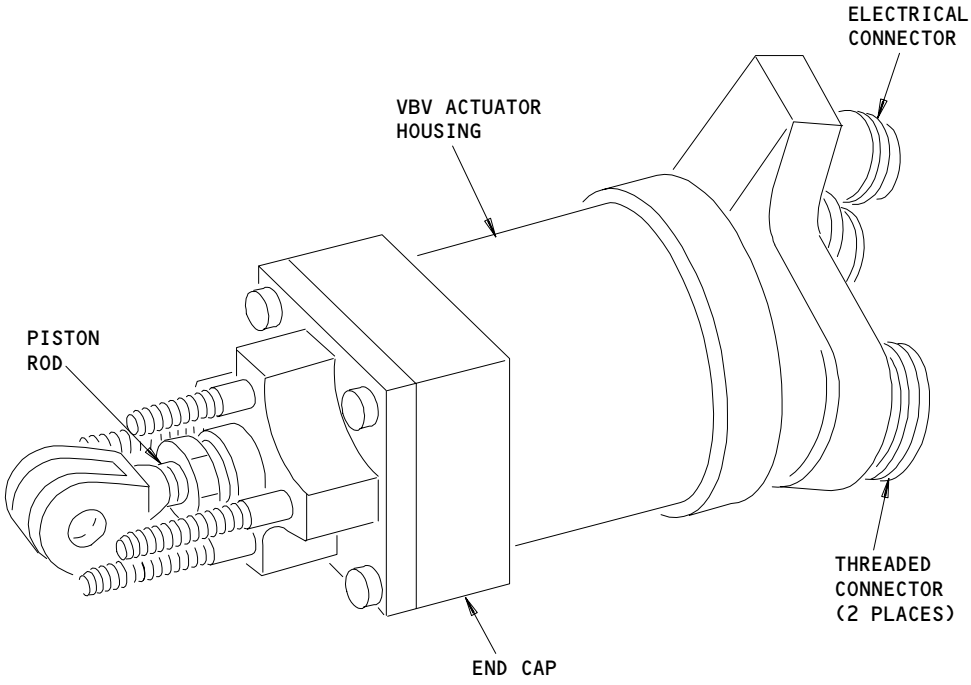
   E. Procedure

      S 026-002-J00
      (1) Remove the VBV actuator (Ref 75-32-01/401).

      S 216-003-J00
      (2) Visually examine the end cap for damage.
         (a) Fuel leakage is not permitted.

      S 216-004-J00
      (3) Visually examine the VBV actuator housing for damage.
         (a) Heat discoloration, deformation, or dents is not permitted.
         (b) A surface with nicks or scratches is not permitted, if the housing is damaged.

      S 216-005-J00
      (4) Visually examine the connector threads for the damage.
         (a) Stripped threads are not permitted.



Variable Bypass Valve (VBV) Actuator Inspection
Figure 601

(b) Threads with nicks or dents to the full depth (into the shank) are not permitted.

NOTE: You can chase the threads if the nicks or dents are not to the full depth of thread.

S 216-006-J00

(5) Visually examine the piston rod for damage.
(a) A marked or bent piston rod is not permitted.
(b) Damaged threads are not permitted.

S 216-007-J00

(6) Visually examine the electrical connector for damage.
(a) Bent, broken, or loose pins are not permitted.
(b) Burns or evidence of arcing is not permitted.
(c) Cracks or damaged threads are not permitted.
(d) Threads with nicks or dents to the full depth (into the shank) are not permitted.

NOTE: You can chase the threads if the nicks or dents are not to the full depth of thread.

WARNING: SOLVENTS USED TO CLEAN ARE HIGHLY FLAMMABLE, VOLATILE, AND POISONOUS. THEY CAN ONLY BE USED WITH A SUFFICIENT AIR FLOW. DO NOT GET THE SOLVENTS IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM THE SOLVENTS. THE SOLVENTS CAN CAUSE INJURY TO PERSONS.

(e) If it is necessary, clean the electrical connector with a soft bristle brush and solvent.

S 426-008-J00

(7) Replace the VBV actuator, if the damage is more than the limits.

S 426-009-J00

(8) Install the VBV actuator (Ref 75-32-01/401).

VARIABLE BYPASS VALVE - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One task is the removal of the variable bypass valves (VBV). The other task is the installation of the VBVs.
   B. There is a VBV installed between each pair of fan frame radial struts (12 total). You must open a thrust reverser half and remove a liner segment from the aft fan frame to get access to a VBV.

TASK 75-32-03-004-001-J00

2. Variable Bypass Valve Removal (Fig. 401)
   A. References
      (1) 72-33-01/401, Acoustical Liner Segments
      (2) 78-31-00/201, Thrust Reverser System
      (3) IPC 75-32-01 Fig. 1
   B. Access
      (1) Location Zone

412	Engine 1 - Fan Frame
422	Engine 2 - Fan Frame
432	Engine 3 - Fan Frame
442	Engine 4 - Fan Frame

      (2) Access Panel

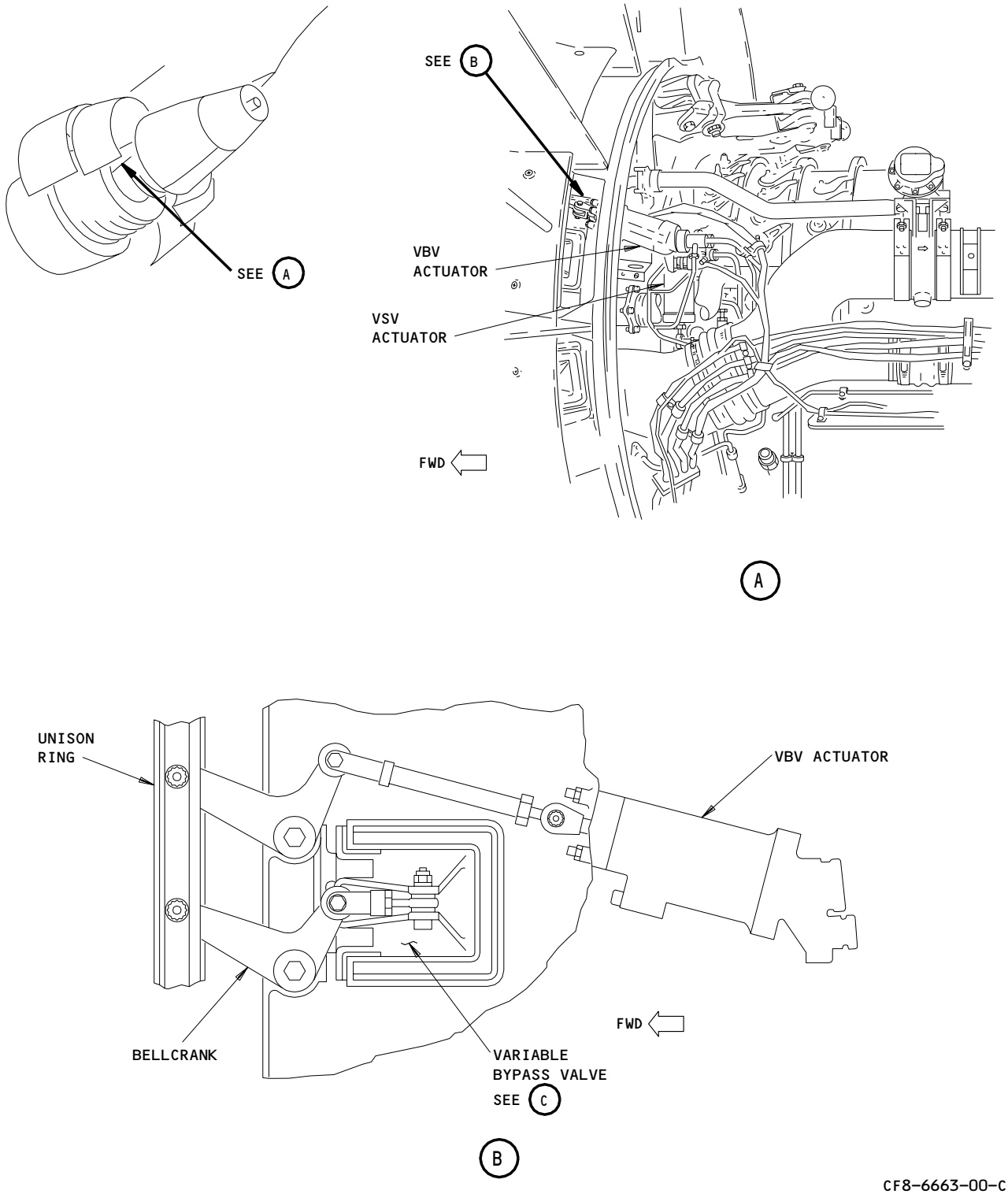
415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

   C. Procedure

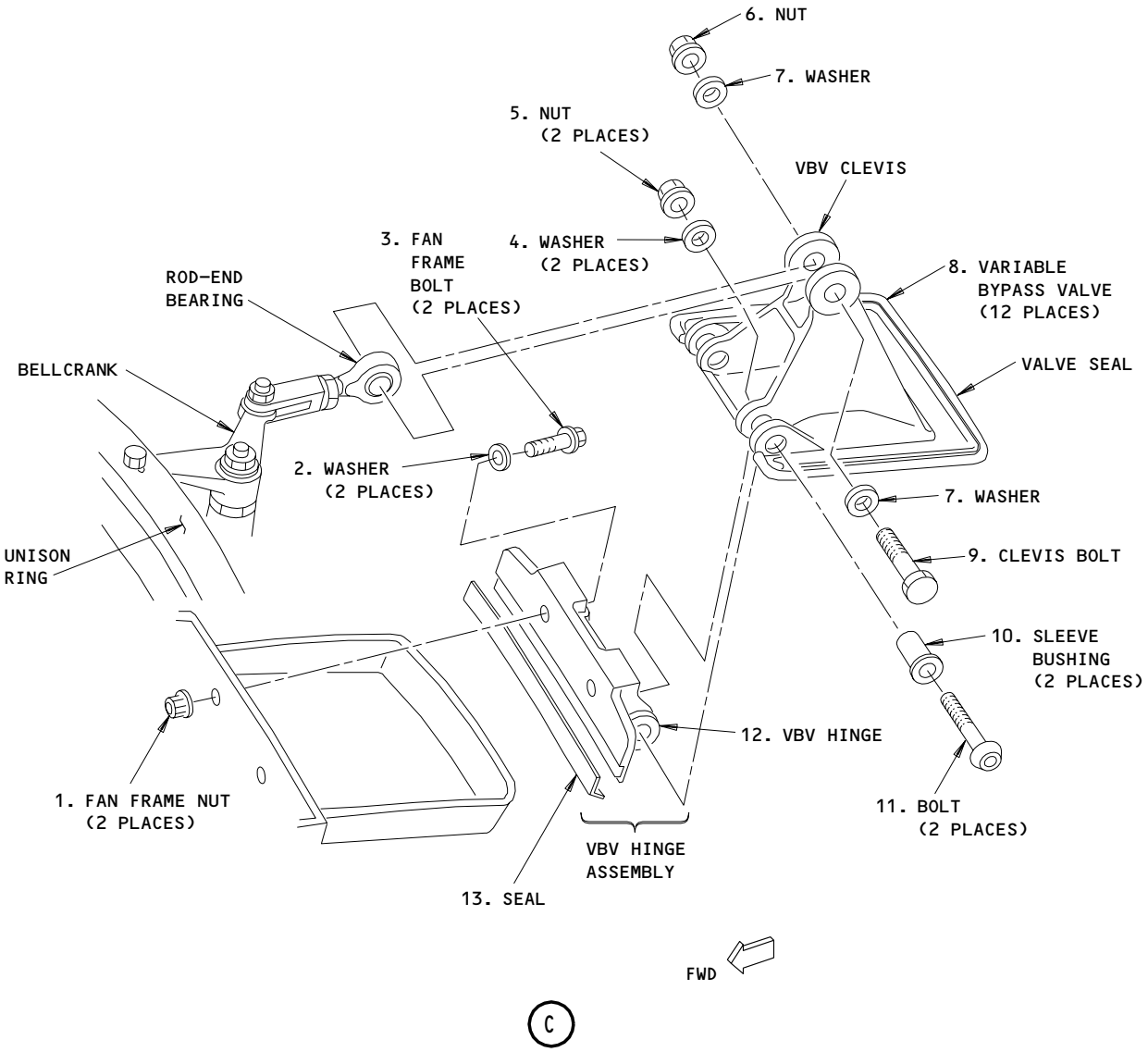
      S 014-002-J00
      (1) Open the applicable thrust reverser half (Ref 78-31-00/201).

      S 014-022-J00
      (2) Remove the applicable liner segment from the fan frame (Ref 72-33-01/401).

      S 934-021-J00
      (3) If you will remove two or more VBVs, write the same number on every part that you remove (except the bolts and nuts) for each VBV. This will make sure that you install the correct parts for each VBV.



Variable Bypass Valve Installation
Figure 401 (Sheet 1)



Variable Bypass Valve Installation
Figure 401 (Sheet 2)

S 034-018-J00

(4) Remove the nut (6), washers (7), and clevis bolt (9) that attach the VBV (8) to the bellcrank.

S 024-019-J00

(5) Remove the VBV (8):

(a) Remove the fan frame nuts (1), washers (2), and fan frame bolts (3) that attach the VBV hinge (12) to the fan frame.

CAUTION: DO NOT DROP THE SEAL INTO THE ENGINE. IT CAN CAUSE DAMAGE TO THE ENGINE DURING A SUBSEQUENT ENGINE OPERATION.

BE CAREFUL WHEN YOU MOVE THE VBV AWAY FROM THE ROD END BEARING. IF YOU CHANGE THE ADJUSTMENT OF THE BEARING, YOU CAN MISALIGN THE VBV.

(b) Remove the VBV (8), VBV hinge (12), and seal (13) from the fan frame as an assembly.

S 034-007-J00

(6) Remove the nuts (5), washers (4), bolts (11), and sleeve bushings (10) that attach the VBV (8) to the VBV hinge (12).

TASK 75-32-03-404-008-J00

3. Variable Bypass Valve Installation (Fig. 401)

A. Consumable Materials

(1) G00803 Release - Mold

(2) D00031 Lubricant - Everlube, ESNA 382 (GE C02-006)

B. Parts

AMM			AIPC		
FIG	ITEM	NOMEMCLATURE	SUBJECT	FIG	ITEM
401	1	Fan Frame Nut	75-32-01	01	95
	2	Washer			90
	3	Fan Frame Bolt			85
	4	Washer			70
	5	Nut			75
	6	Nut			60
	7	Washer			55
	8	Variable Bypass Valve			120
	9	Clevis Bolt			50
	10	Sleeve Bushing			80
	11	Bolt			65
	12	VBV Hinge			105 & 110
	13	Seal			115

C. References
(1) 72-33-01/401, Acoustical Liner Segments
(2) 78-31-00/201, Thrust Reverser System

D. Access
(1) Location Zone

412	Engine 1 - Fan Frame
422	Engine 2 - Fan Frame
432	Engine 3 - Fan Frame
442	Engine 4 - Fan Frame

(2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

E. Procedure

S 434-015-J00
(1) Attach the VBV (8) to the VBV hinge (12):
(a) Apply lubricant to the bolts (11) that attach the VBV to the hinge.
(b) Install a sleeve bushing (10) on each bolt (11), with the bushing flange against the bolt head.
(c) Put the hinge and the VBV together to align the bolt holes in the hinge and the VBV.
(d) Install the bolts (11), washers (4), and nuts (5) to attach the hinge to the VBV.

NOTE: The bolts are installed with the bolt heads pointed out.

(e) Tighten the nuts to 24-27 pound-inches (2.7-3.0 N.m).

S 424-016-J00
(2) Attach the VBV hinge (12) to the fan frame:
(a) Apply mold release to the valve seal and the mating surface on the fan frame.
(b) Apply lubricant to the threads of the fan frame bolts (3).

(c) Put the seal (13) on the VBV hinge (12).

CAUTION: BE CAREFUL WHEN YOU PUT THE ROD END BEARING IN THE BELLCRANK BETWEEN THE TANGS OF THE VBV CLEVIS. IF YOU CHANGE THE ADJUSTMENT OF THE BEARING, YOU CAN MISALIGN THE VBV.

(d) Put the VBV hinge (12) and the seal (13) in their position on the edge of the opening in the fan frame.

NOTE: You must put the VBV so the rod end bearing in the bellcrank is between the VBV clevis tangs.

(e) Install the two fan frame bolts (3), washers (2), and fan frame nuts (1) that attach the hinge to the fan frame.

NOTE: The nuts are installed forward of the fan frame opening.

(f) Tighten the nuts to 55-70 pound-inches (6.2-7.9 N.m).
(g) Install lockwire on the nuts.

S 434-023-J00

(3) Attach the VBV (8) to the bellcrank:
(a) Install the clevis bolt (9), washers (7), and nut (6) that attach the VBV (8) to the bellcrank.
(b) Tighten the nut to 55-70 pound-inches (6.2-7.9 N.m).

S 414-013-J00

(4) Install the applicable liner segment on the fan frame (Ref 72-33-01/401).

S 414-014-J00

(5) Close the applicable thrust reverser half (Ref 78-31-00/201).

VARIABLE BYPASS VALVE - INSPECTION/CHECK

1. General
   A. This procedure has one task, a visual inspection of the variable bypass valve.
   B. To do the task, you must remove the aft fan frame liner segment.

   TASK 75-32-03-206-001-J00

2. Variable Bypass Valve Inpection (Fig. 601)
   A. References
      (1) 72-33-01/401, Acoustical Liner Segments
      (2) 75-32-03/401, Variable Bypass Valve
      (3) 78-31-00/201, Thrust Reverser System
   B. Access
      (1) Location Zone

412	Engine 1 - Fan Frame
422	Engine 2 - Fan Frame
432	Engine 3 - Fan Frame
442	Engine 4 - Fan Frame

      (2) Access Panel

415 and 416	Thrust Reverser Halves - Engine 1
425 and 426	Thrust Reverser Halves - Engine 2
435 and 436	Thrust Reverser Halves - Engine 3
445 and 446	Thrust Reverser Halves - Engine 4

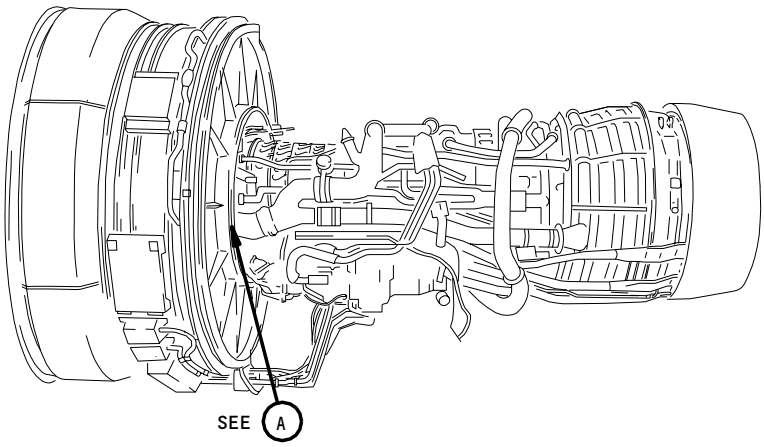
   C. Procedure

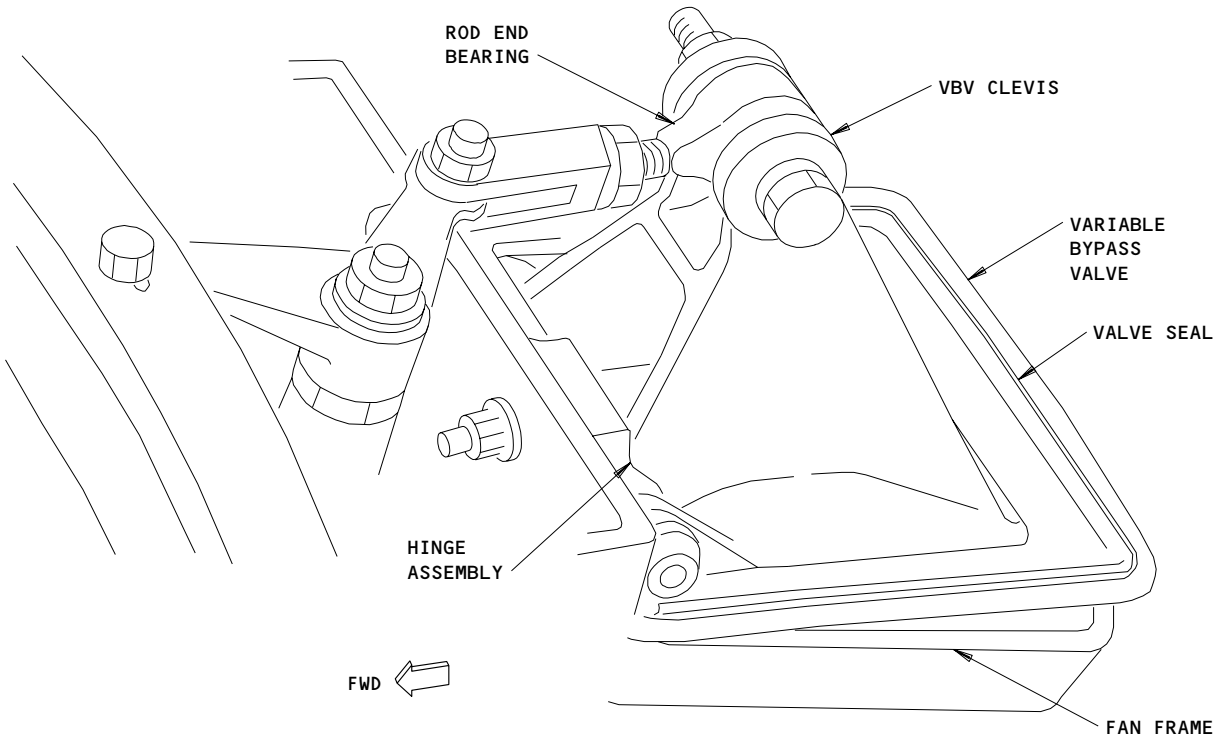
      S 016-002-J00
      (1) Open the thrust reverser halves (Ref 78-31-00/201).

      S 016-003-J00

      CAUTION: AFTER THE ENGINE SHUTDOWN, THE BYPASS VALVES ARE IN THE OPEN POSITIONS. WHEN YOU WORK IN THE FAN AREA, MAKE SURE THAT NO OBJECTS HAVE FALLEN THROUGH THE VALVE OPENING. IF OBJECTS HAVE FALLEN INTO THE VALVE OPENING, YOU CAN CAUSE DAMAGE TO THE ENGINE.

      (2) Remove the applicable fan frame liner segment (Ref 72-33-01/401).





Variable Bypass Valve Inspection
Figure 601

S 226-004-J00
(3) Examine the variable bypass valve for damage:
  (a) Cracks are not permitted.
  (b) Nicks or scratched surface are permitted up to 0.02 inch (0.5 mm) in depth and at least 0.25 inch (6.4 mm) apart.
  (c) Rivets that are gone, are permitted up to five flights or 50 hours.
  (d) Cuts or tears in the valve are not permitted.
  (e) If the bolts or nuts at the VBV clevis or hinge are gone, Install the new bolts or nuts.
    1) Tighten the clevis nuts to 55-70 pound-inches (6.2-7.8 N.m).
    2) Tighten the hinge nuts to 24-27 pound-inches (2.7-3.0 N.m).
  (f) If the bolts or nuts at the VBV clevis or hinge are loose, do the following:
    1) Tighten the clevis nuts to 55-70 pound-inches (6.2-7.8 N.m).
    2) Tighten the hinge nuts to 24-27 pound-inches (2.7-3.0 N.m).

S 416-005-J00
(4) Install the applicable fan frame liner segment (Ref 72-33-01/401).

S 416-006-J00
(5) Close the thrust reverser halves (Ref 78-31-00/201).