GPA Group plc

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CHAPTER 80 - STARTING

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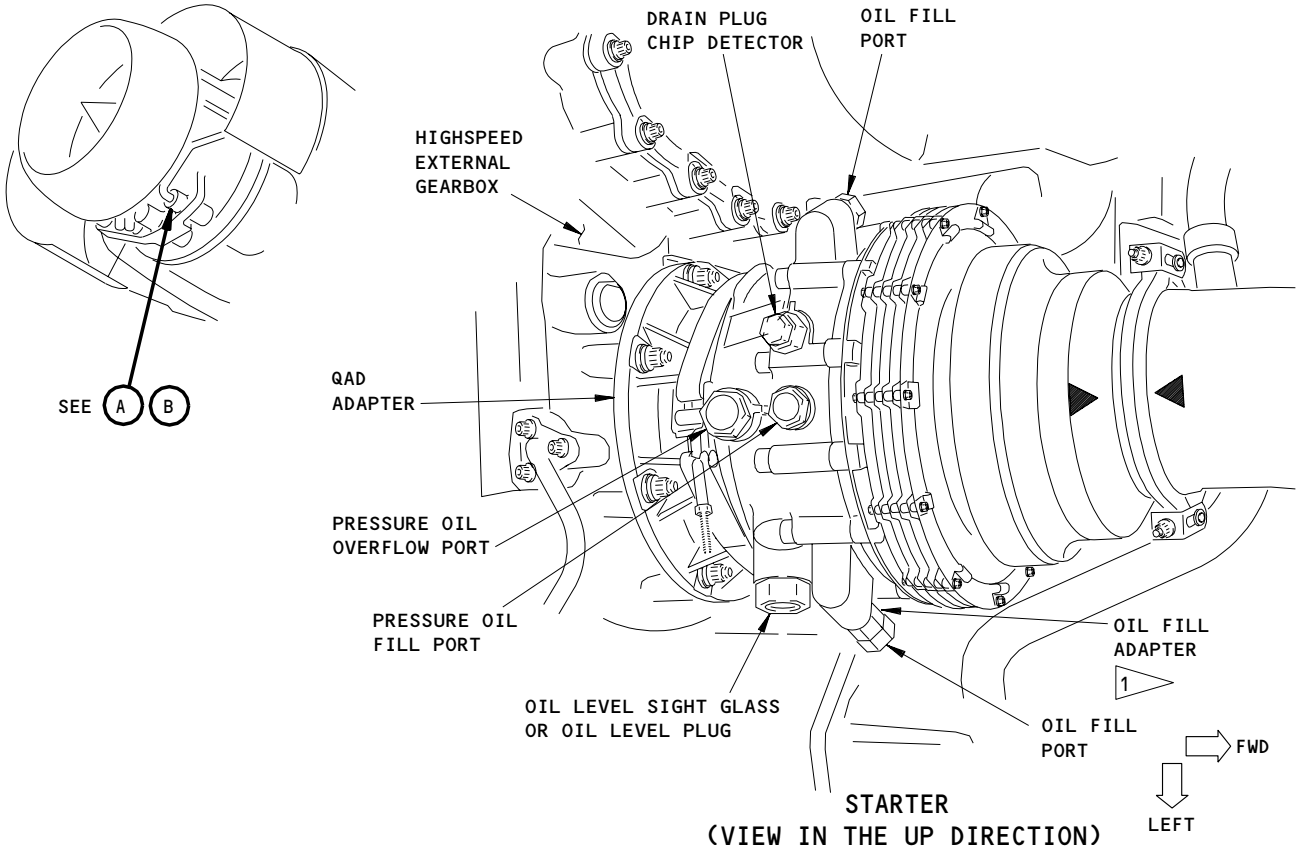
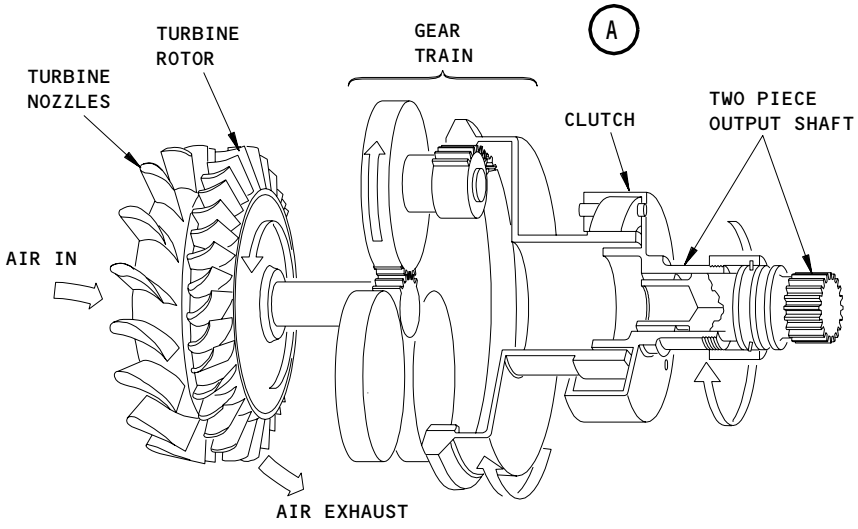
ENGINE STARTING SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The engine starting system supplies the input to turn the engine high pressure (HP) compressor rotor to a speed at which engine light-up can occur. The system is used for ground starts, and can also be used for in-flight starts.
   B. The start system includes the engine-mounted components that follow:
      (1) A pneumatic starter is installed on the forward face of the high-speed (HS) external gearbox.
      (2) A starter control valve is installed on the lower left side of the low pressure (LP) compressor (fan) case.
      (3) The related air ducting and electrical wiring.
   C. The HP compressor rotor assembly is turned by the starter through the HS external gearbox. The starter is a pneumatically driven motor, connected by ducts to the bleed air system of the aircraft. Air for the starter can be supplied by a ground supply, the Auxiliary Power Unit (APU) or from the other engine.
   D. The supply of air to the starter is controlled by the start valve which is a pneumatically operated, electrically controlled, butterfly valve. The start valve is electrically connected to the start switches on the pilots overhead instrument panel P5. In the flight compartment, a VALVE position indicator and the Engine Indication and Crew Alerting System (EICAS) show the position of the valve.
   E. All the ducting is designed for high pressures and temperatures, and gimbal joints are used to permit movement. Air leakage is prevented by E-type seals installed between all the mating flanges. The flanges are attached by coupling clamps. Supports attach the ducting to the LP compressor case.
2. Component Details
   A. Pneumatic Starter (Fig. 1)
      (1) The starter is a pneumatically driven turbine that accelerates the engine HP compressor rotor to the speed that is necessary to start the engine. The unit is mounted on the front face of the HS external gearbox.
      (2) The starter is a turbine, a reduction gear train, a clutch and an output drive shaft that is contained in a case. It has an air inlet and an exhaust.
      (3) The single-stage axial flow turbine is connected to the output drive shaft through a reduction gear train and a clutch. Pawls located on the output drive shaft engage with a ratchet ring on the rear face of the gear train hub. Leaf springs hold the pawls down to form a centrifugal clutch. The splined output drive shaft engages with the HS external gearbox which turns the engine HP compressor rotor assembly.
      (4) The starter case includes a containment ring which will contain a failure of the turbine assembly.



STARTER
(VIEW IN THE UP DIRECTION)

A



PNEUMATIC STARTER INTERNAL FUNCTION
(ELONGATED FOR CLARITY)

B

1 ADAPTER INSTALLED ON STARTERS POST-RR-SB 80-B009

Pneumatic Starter
Figure 1

(5) A plug in the starter case permits oil replenishment, and a sight glass allows oil level checking. A drain plug with a magnetic plug lets you do an inspection for signs of bearing failure.

B. Starter Control Valve (Fig. 2)

(1) The starter control valve is a pneumatically operated, electrically controlled, shut-off valve located on the lower left side of the LP compressor (fan) case.

(2) The start valve controls the air flow from the starter air duct to the starter motor. The start valve is a butterfly type valve that is contained in a cylindrical valve body. It has in-line flanged end connectors, an actuator, a solenoid valve and a pressure controller.

(3) The butterfly valve is held in the valve body by a shaft that turns in anti-seize bushings. An interlocking sealing ring is used on the butterfly valve to keep air leakage between the valve and the valve body to a minimum.

(4) The end of the valve shaft has a visual position indicator which also operates an electrical position switch.

(5) The actuator is two pistons of different areas installed on a common shaft in a cylinder. The assembly is held in the closed position by a spring. Movement of the valve shaft is transmitted through a linkage to the butterfly valve shaft.

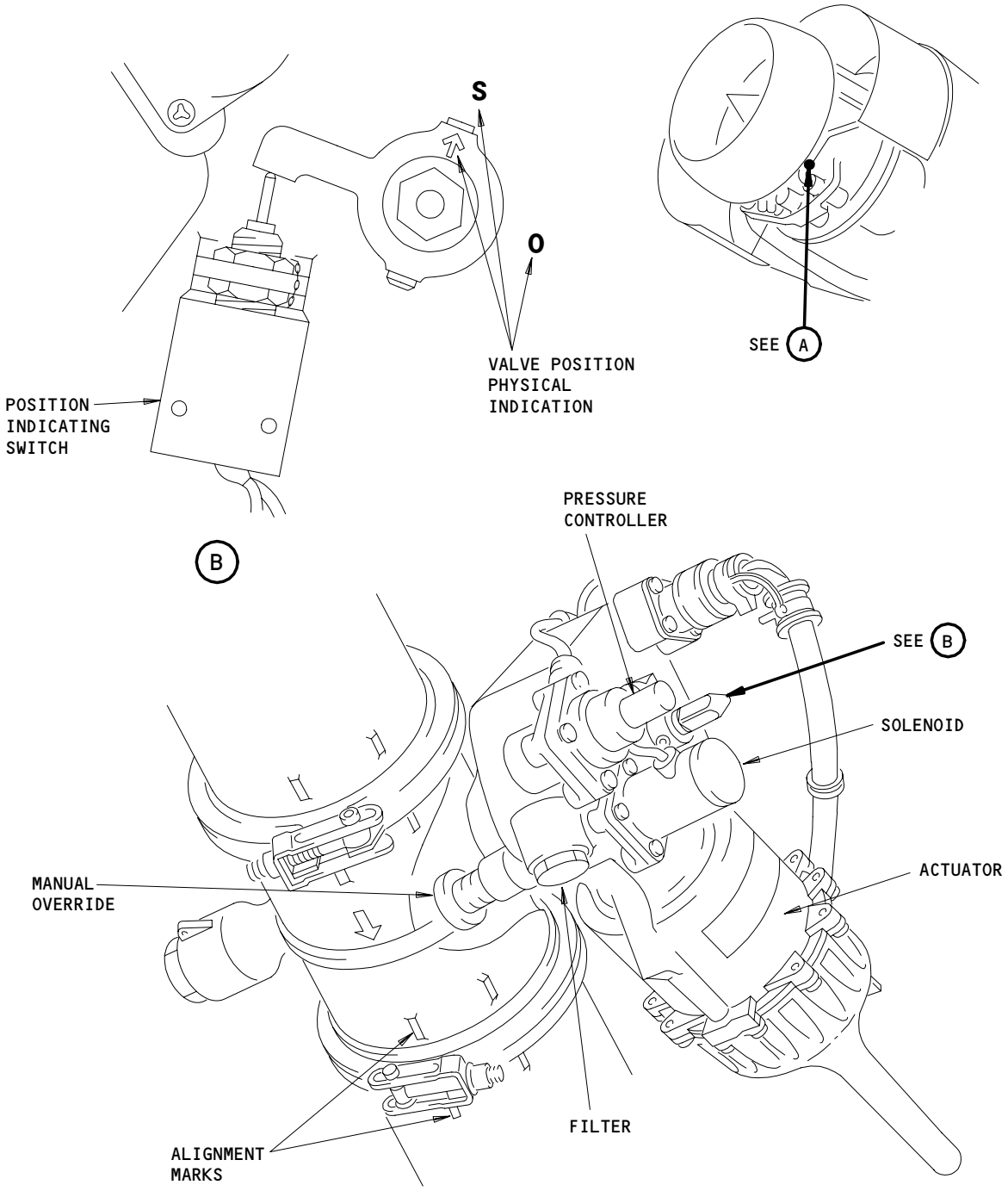
(6) The solenoid valve is a ball valve, a spring loaded plunger and an electrically operated solenoid. A manually operated override plunger is on the body at the opposite end of the solenoid.

(7) The pressure controller is a double-diaphragm piston, spring loaded, with a shaft that connects it to a ball-type servo relief valve.

(8) The electrical position switch sends a signal, open or closed, to the start relay circuit. If the position of the valve does not agree with the position of the engine start switch, the starter control VALVE light will come on.

C. Starter QAD (Quick Attach-Detach) Adapter

(1) The starter is installed to a quick attach-detach (QAD) adapter with a coupling clamp. The adapter is installed on the gearbox front face. A locating dowel is used to make sure the alignment of the adapter is correct.



51106

Starter Control Valve
Figure 2

3. Operation

A. Functional Description (Fig. 3)

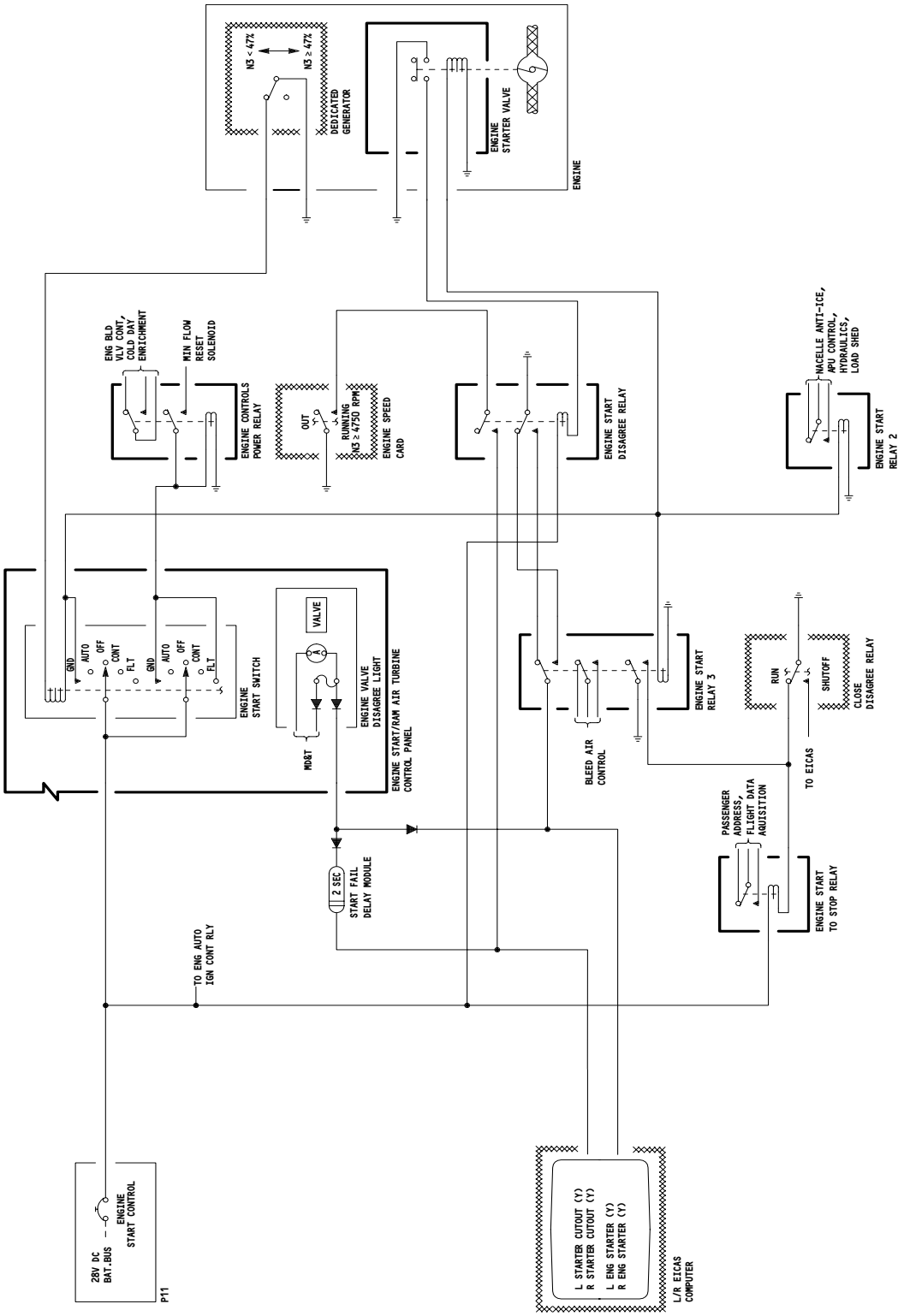
(1) Engine Start - Auxiliary Power Unit (APU)

(a) With the APU at a governed speed and the APU bleed air switch open (Ref 49-11-00), bleed air is supplied to pressurize the airplane pneumatic system. The isolation valve must be open, and the pack valve switches must be in the valve closed position (Ref 36-11-00). When the engine start switch is moved to GND, electrical power is supplied to the applicable starter control valve. The solenoid valve on the starter control valve opens. The starter control valve position indicator switch sends a valve open signal to the start relay circuit.

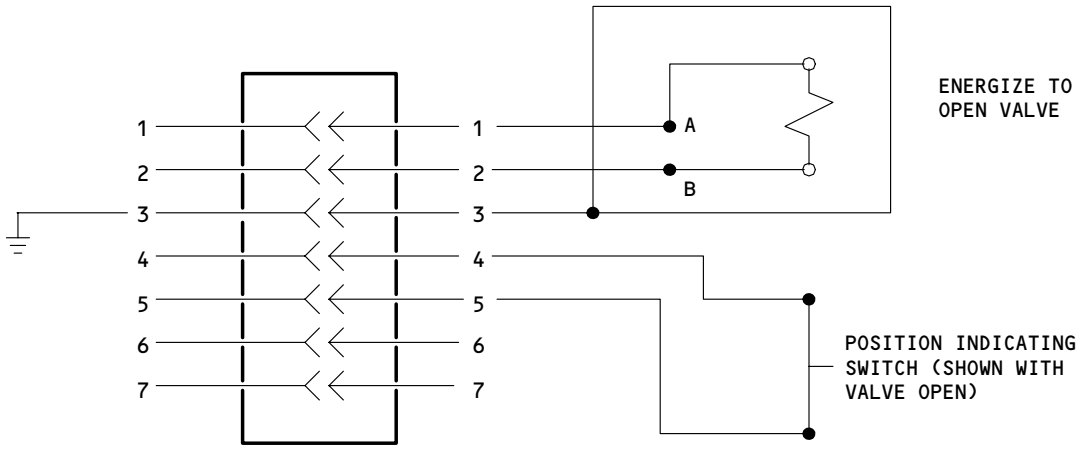
(b) Air, immediately upstream of the butterfly valve (Fig. 4), is filtered and pushed through an orifice in the solenoid valve. Air is also let in to the smaller piston of the double-acting actuator. When the solenoid is energized, the ball valve opens to let air into the larger piston while it closes the vent port. The air that pushes on the larger piston has more force then the combined force of the upstream air pressure that pushes on the smaller piston and the actuator spring. Movement of the actuator is transmitted through a linkage to turn the butterfly valve to the open position.

(c) Air, upstream of the pneumatic starter turbine nozzle area, gives the pressure controller a sensing pressure. As the sensed pressure increases to more than the spring load, the ball valve is unseated and lets some of the servo pressure air that pushes on the larger actuator piston vent. This causes the butterfly valve to close a small amount which reduces the pressure at the starter turbine nozzle.

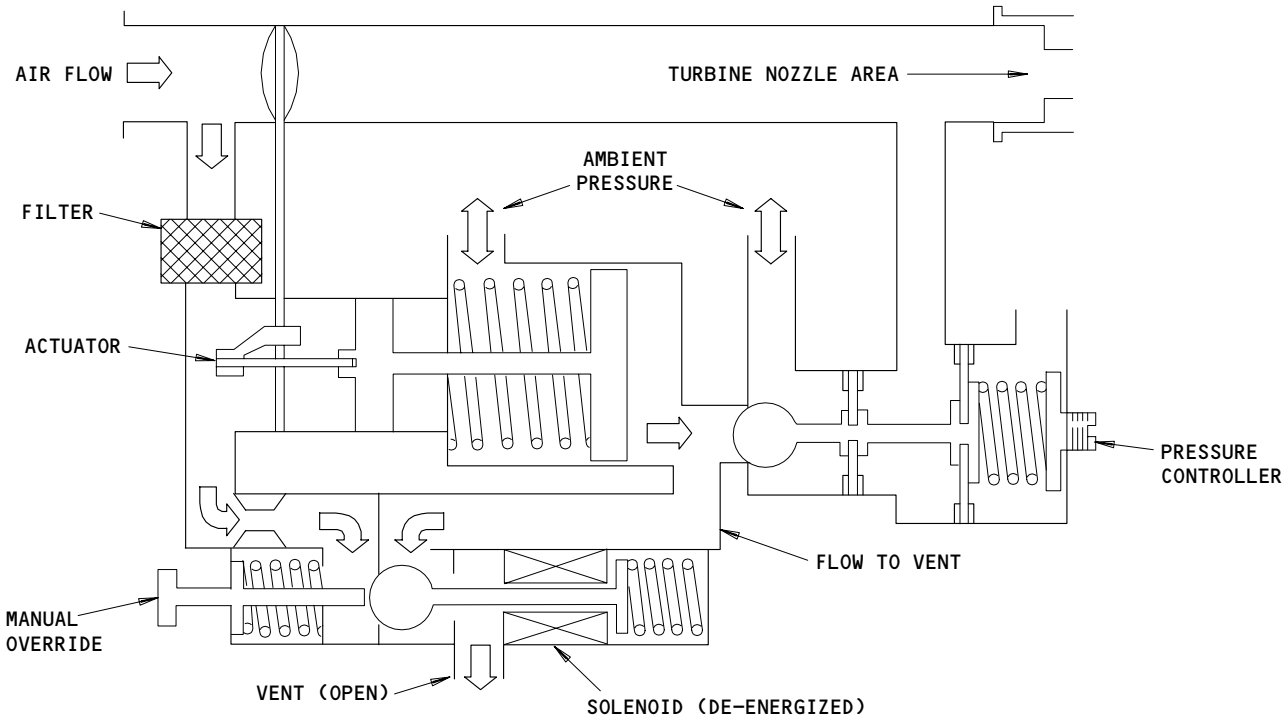
(d) When the starter control valve opens, compressed air enters the starter. The air goes in through the turbine and goes out of the starter through the air exhaust. The reduction gear train converts the high speed, low torque rotation of the turbine to low speed, high torque rotation of the gear train hub. The ratchet teeth of the gear hub engage the pawls of the output drive shaft to transmit drive to the HS external gearbox. This turns the engine HP compressor rotor assembly.



Engine Start Schematic (Typical)
Figure 3



ELECTRICAL SCHEMATIC



VALVE SHOWN IN CLOSED POSITION

51107

Starter Control Valve Schematic
Figure 4

(e) When the HP compressor speed is about 25% N3 RPM (minimum), the FUEL CONTROL switch is put to the RUN position to apply ignition and fuel flow.

(f) The starter continues to help the engine turn until the dedicated generator control unit removes the power to the engine start switch solenoid. The engine start switch returns to the AUTO position at about 47% N3 rpm. The solenoid valve is de-energized and the start control valve then closes. The air that pushes on the larger piston is then vented to the atmosphere through the vent. Air pressure and the actuator spring pressure that pushes on the smaller piston then closes the butterfly valve. A loss of air pressure will cause the butterfly valve to close because of the actuator spring.

(g) If the engine starter is still engaged above the engine RPM at which starter cutout should occur, a L(R) STARTER CUTOUT message will show on the upper EICAS display as a level B message.

(h) When the air supply to the starter is stopped, the pawls overrun the teeth on the gear train hub which lets the turbine turn until it stops. The engine HP compressor assembly, the HS external gearbox and the output drive shaft of the starter will continue to turn. When the output drive shaft of the starter gets to a given speed, the centrifugal force is more than the tension of the clutch leaf springs. This lets the pawls retract until they do not touch the teeth on the gear hub which disengages the output drive shaft from the starter turbine.

(i) ENGINES PRE SB 31-0035;
A position switch is used on the starter control valve to transmit the position of the valve. If the selected valve mode does not agree with the actual valve mode, an amber VALVE light on the overhead panel P5 will come on. L(R) ENG STARTER will show on the upper EICAS display as a level C message if the starter valve does not open in 6 seconds.

(j) ENGINES POST SB 31-0035;
A position switch is used on the starter control valve to transmit the position of the valve. If the selected valve mode does not agree with the actual valve mode, an amber VALVE light on the overhead panel P5 will come on. L(R) ENG STARTER will show on the upper EICAS display as a level C message if the starter valve does not open in 10 seconds.

(2) Engine Start - Manual

WARNING: WHEN YOU OPERATE THE STARTER CONTROL VALVE MANUALLY, HAND AND ARM COVERS MUST BE USED. HEAT AND HIGH SPEED AIR FROM THE STARTER CAN CAUSE INJURIES TO PERSONS.

CAUTION: IF THE VALVE IS NOT CLOSED WHEN N3 GETS TO 50% RPM, THE STARTER CAN BE DAMAGED.

MANUAL OPERATION OF THE STARTER CONTROL VALVE WITHOUT AIR PRESSURE IN THE INLET DUCT CAN DAMAGE THE VALVE.

(a) Make sure you have interphone communication between the person on the ramp and the person in the flight compartment.
(b) Open the access door in the left fan cowl to get access to the starter control valve.
(c) Do the normal engine start procedure along with these steps:
    1) If the starter control valve has an electrical failure to the solenoid, the valve may be opened manually with the manual override knob. When you push the knob in, it unseats the ball valve which lets air flow to the larger piston while it closes the vent.
    2) If the starter control valve has a mechanical failure to the actuator, put the start switch for the engine with the inoperative starter control valve in the GND position and tell the ground personnel to open and hold the manual override valve with a 1/2 inch deep socket and wrench.
        a) When the N3 RPM gets to 50%, tell the ground personnel to close the valve.
        b) Make sure the start switch moves to the AUTO position.

(3) Engine Start - External Air Source
    (a) Ground carts connected to the ground air source are used to run the starters. The procedure to start the engine is the same as when you use the APU as the air source.
(4) Engine Start - Cross-Bleed Air
    (a) Use the bleed air from the other engine to start the engine. The air supply pressure regulating and shut-off valve for the air source engine must be in the open position to supply bleed air to the pneumatic distribution system. The switches that control the air supply pressure regulating and shut-off valves are located on the overhead panel P5. The procedure to start the engine is the same as when you use the APU as the air source.
(5) Engine Motoring
    (a) The starter can be used to motor the engine. The engine may need to be motored to clear the engine gas path of remaining fuel or for other ground maintenence tasks. To motor an engine, the ignition circuit breakers must be open and the FUEL CONTROL switch put to the CUTOFF position. Put the engine start switch to the GND position.

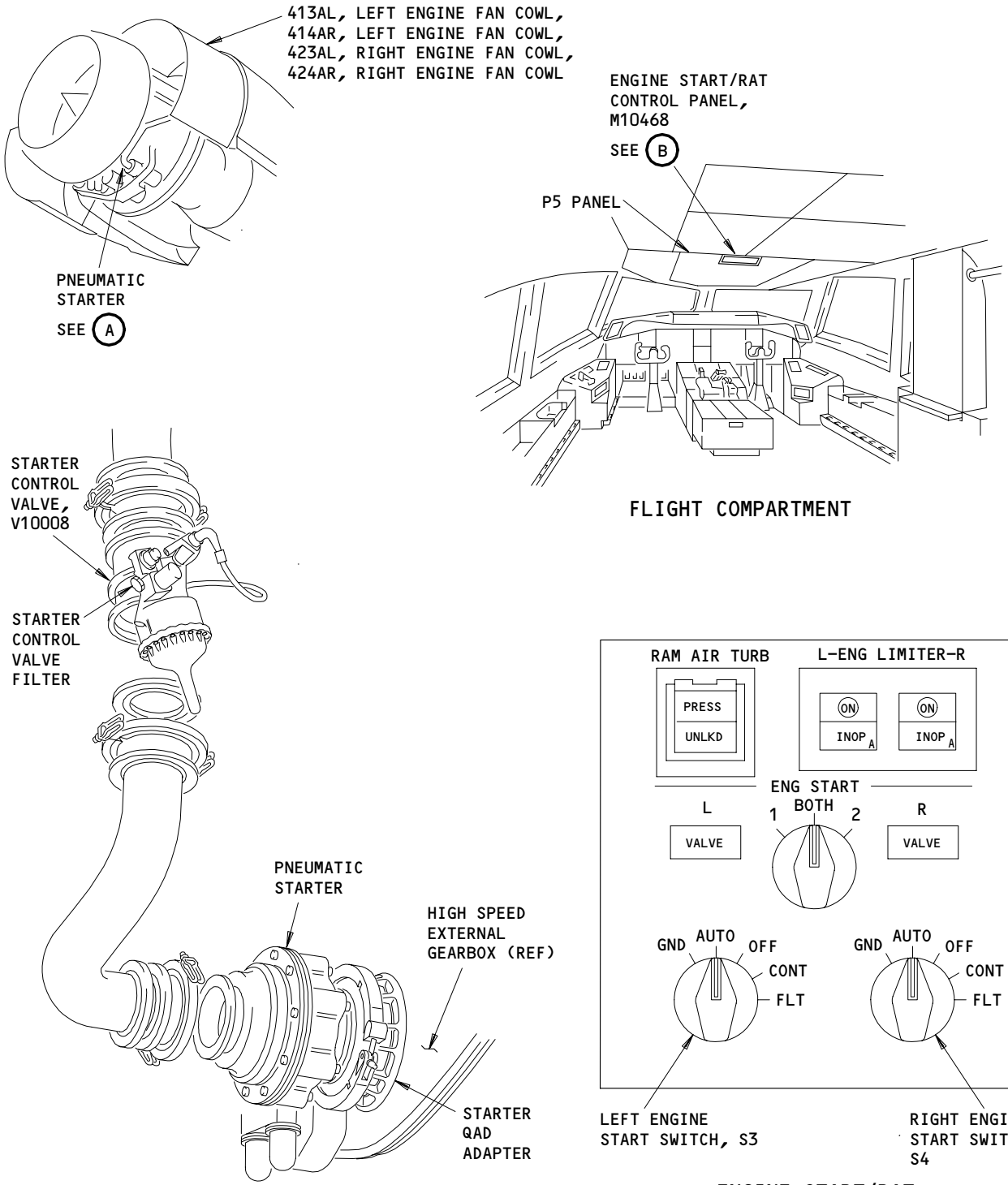
B. Control
   (1) Make sure the applicable ENGINE START CONTROL and circuit breakers for the ignition system, on the overhead panel P11, are in the closed position.
   (2) Make sure the switch for the applicable isolation valve, on the overhead panel P5, is in the open position.
   (3) Make sure the valve switches for the air conditioning packs, on the overhead panel P5, are in the closed position.
   (4) Put the engine start switch, on the overhead panel P5, to the GND position.
      (a) Make sure the starter control VALVE light goes on and then goes off.
      (b) Make sure the N3 tachometer shows that the N3 RPM increases.
   (5) When N3 gets to 25% RPM, put the FUEL CONTROL switch to the RUN position.
   (6) When the N3 gets to 50% RPM make sure the engine start switch goes to the AUTO position.
   (7) Make sure the starter control VALVE light comes on and then goes off.

ENGINE STARTING SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
ADAPTER - STARTER QAD	--	2	413AL,414AR, LEFT ENGINE FAN COWL, 423AL,424AR, RIGHT ENGINE FAN COWL	80-11-07
FILTER - STARTER CONTROL VALVE	--	2	413AL,414AR, LEFT ENGINE FAN COWL, 423AL,424AR, RIGHT ENGINE FAN COWL	80-11-08
PANEL - ENG START/RAT CONT, M10468		1	FLIGHT COMPARTMENT, P5	*
RELAYS - (31-01-36/101) LEFT ENGINE CONTROLS POWER, K10208 LEFT ENGINE START DISAGREE, K10209 LEFT ENGINE START 2, K10247 LEFT ENGINE START 3, K10248 LEFT ENGINE START TO STOP, K10212 RELAYS - (31-01-37/101) RIGHT ENGINE CONTROLS POWER, K10220 RIGHT ENGINE START DISAGREE, K10221 RIGHT ENGINE START 2, K10250 RIGHT ENGINE START 3, K10251 RIGHT ENGINE START TO STOP, K10224				
STARTER - PNEUMATIC	--	2	413AL,414AR, LEFT ENGINE FAN COWL, 423AL,424AR, RIGHT ENGINE FAN COWL	80-11-01
SWITCH - LEFT ENGINE START, S3	--	1	FLIGHT COMPARTMENT, P5, ENGINE START/RAT CONTROL PANEL, M10468	*
SWITCH - RIGHT ENGINE START, S4	--	1	FLIGHT COMPARTMENT, P5, ENGINE START/RAT CONTROL PANEL, M10468	*
VALVE - STARTER CONTROL, V10008	--	2	413AL,414AR, LEFT ENGINE FAN COWL, 423AL,424AR, RIGHT ENGINE FAN COWL	80-11-08

* SEE THE WDM EQUIPMENT LIST

Engine Starting System - Component Index
Figure 101



Engine Starting System - Component Location
Figure 102

ENGINE STARTING SYSTEM - ADJUSTMENT/TEST

1. General
   A. An operational test and a system test are given for the engine starting system.
   B. The operational test can be done when there is pneumatic and electrical power on the airplane.

      NOTE: It makes sure that the system operates correctly.

   C. The system test makes sure that the fault indication and the manual override is satisfactory.

TASK 80-11-00-715-001-R00

2. Operational Test - Engine Starting System
   A. References
      (1) AMM 12-13-02/301, Engine Starter
      (2) AMM 24-22-00/201, Control
      (3) AMM 36-00-00/201, Pneumatic - General
   B. Access
      (1) Location Zones
          210 Control cabin
   C. Prepare for Test

      S 615-002-R00
      (1) Do the Engine Starter Oil Servicing procedure (AMM 12-13-02/301).

      S 865-003-R00
      (2) Supply the electrical power (AMM 24-22-00/201).

      S 865-004-R00
      (3) Supply the pneumatic power (AMM 36-00-00/201).

      S 865-005-R00
      (4) For the left engine, make sure this circuit breaker is closed:
          (a) P11 Overhead Circuit Breaker Panel
              1) 11D19, ENGINE START CONT LEFT

S 865-006-R00

(5) For the right engine, make sure this circuit breaker is closed:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11D20, ENGINE START CONT RIGHT

S 865-007-R00

(6) Make sure that the six EICAS circuit breakers on the P11 panel are closed.

D. Test Engine Starting System

S 615-008-R00

WARNING: BEFORE YOU DO THIS TEST, MAKE SURE ALL PERSONS, TOOLS, AND UNWANTED OBJECTS ARE REMOVED FROM THE ENGINE INLET AREA. MAKE A SAFETY AREA AROUND THE ENGINE INLET. IF YOU DO NOT FOLLOW THESE INSTRUCTIONS, YOU CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(1) Make sure that the FUEL CONTROL switch is in the CUTOFF position and attach a DO-NOT-OPERATE tag.

S 615-060-R00

(2) Obey the starter operation limits when starting engine (AMM 71-00-00/201).

S 615-010-R00

CAUTION: DO NOT OPERATE THE STARTER MORE THAN THE STARTER OPERATION LIMITS. THE STARTER CAN BE DAMAGED IF THE STARTER IS OPERATED MORE THAN THE STARTER OPERATION LIMITS.

(3) Move the ENGINE START switch to the GND position and let the starter turn the engine to approximately 25% N3.

NOTE: The ENGINE START VALVE light should come on momentarily and then go off.

S 865-062-R00
(4) Move the ENGINE START switch to the AUTO position.

NOTE: The ENGINE START VALVE light should come on momentarily and then go off.

E. Put the Airplane Back to its Usual Condition

S 865-011-R00
(1) Remove the pneumatic power, if it is not necessary (AMM 36-00-00/201).

S 865-012-R00
(2) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 80-11-00-735-013-R00

3. System Test - Engine Starting System

A. Equipment
(1) Voltmeter/Continuity Indicator capable of reading 28 Vdc (commercially available).

B. References
(1) AMM 12-13-02/301, Engine Starter
(2) AMM 24-22-00/201, Control
(3) AMM 36-00-00/201, Pneumatic - General
(4) AMM 71-11-04/201, Fan Cowl Panels

C. Access
(1) Location Zones
210 Control Cabin
413/423 Fan Cowl Panel (left)

(2) Access Panels
413AL/423AL Fanl cowl panel (left)
413BL/423BL Starter control valve access door

D. Prepare for Test

S 865-014-R00
(1) Supply the electrical power (AMM 24-22-00/201).

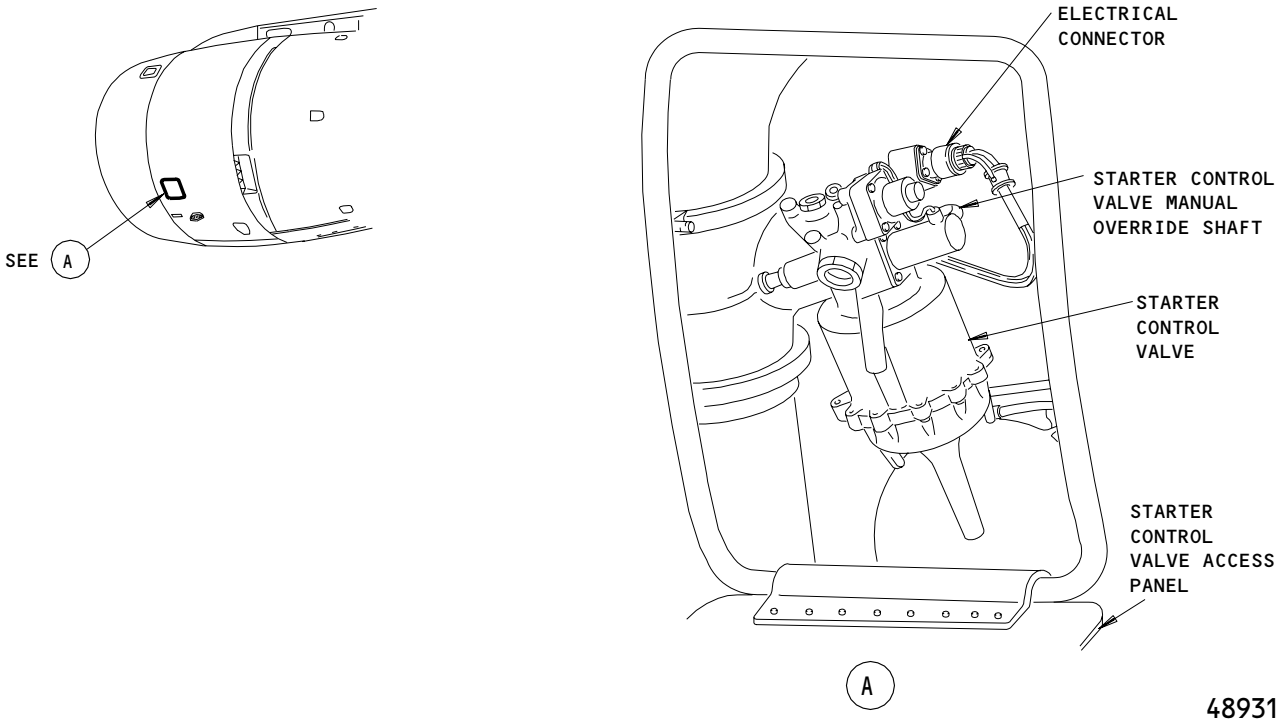
S 865-015-R00
(2) Make sure that the six EICAS circuit breakers are closed.

S 865-017-R00
(3) For the left engine, make sure this circuit breaker is closed:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11D19, ENGINE START CONT LEFT

S 865-018-R00
(4) For the right engine, make sure this circuit breaker is closed:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11D20, ENGINE START CONT RIGHT

E. Starter Valve Position Indication System Test

S 015-019-R00
(1) Open the starter control valve access door.



Starter Control Valve Access
Figure 501

S 735-020-R00
(2) Disconnect the electrical connector from the starter control valve.

S 735-021-R00
(3) Move the ENGINE START switch to the GND position.

S 735-022-R00
(4) Make sure that the START VALVE light comes on and stays on.

S 735-023-R00
(5) Make sure that the L (R) ENG STARTER message is shown on the upper EICAS display after approximately 5 seconds.

S 735-024-R00
(6) Make sure that the voltage between pins 1+ and 2- on the electrical connector for the starter control valve measures 28V dc.

S 735-025-R00
(7) Connect pins 4 and 5 on the electrical connector (D13006) for the starter control valve with a jumper wire.

S 735-026-R00
(8) Make sure that the START VALVE light goes off and the EICAS message L (R) ENG STARTER is not shown on the EICAS display.

S 735-027-R00
(9) Move the ENGINE START switch to the AUTO position.

S 735-028-R00
(10) Make sure that the START VALVE light goes on.

S 735-029-R00
(11) Make sure that the L (R) ENG STARTER message is shown on the EICAS display after approximately 5 seconds.

S 735-030-R00
(12) Remove the wire between the pins 4 and 5 on the electrical connector for the starter control valve.

S 735-031-R00
(13) Make sure that the START VALVE light goes off and the EICAS message L (R) ENG STARTER is not shown on the EICAS display.

S 735-032-R00
(14) Connect the electrical connector to the starter control valve.

S 415-033-R00
(15) Close the starter control valve access door.

S 865-034-R00
(16) For the left engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:
(a) P11 Overhead Circuit Breaker Panel
1) 11D19, ENGINE START CONT LEFT

S 865-035-R00
(17) For the right engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:
(a) P11 Overhead Circuit Breaker Panel
1) 11D20, ENGINE START CONT RIGHT

S 015-057-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU OPEN THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(18) Open the right fan cowl panel (AMM 71-11-04/201).

S 735-037-R00
(19) Disconnect the connector from the dedicated generator (Fig. 502).

S 865-038-R00
(20) For the left engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
(a) P11 Overhead Circuit Breaker Panel
1) 11D19, ENGINE START CONT LEFT

S 865-039-R00
(21) For the right engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
(a) P11 Overhead Circuit Breaker Panel
1) 11D20, ENGINE START CONT RIGHT

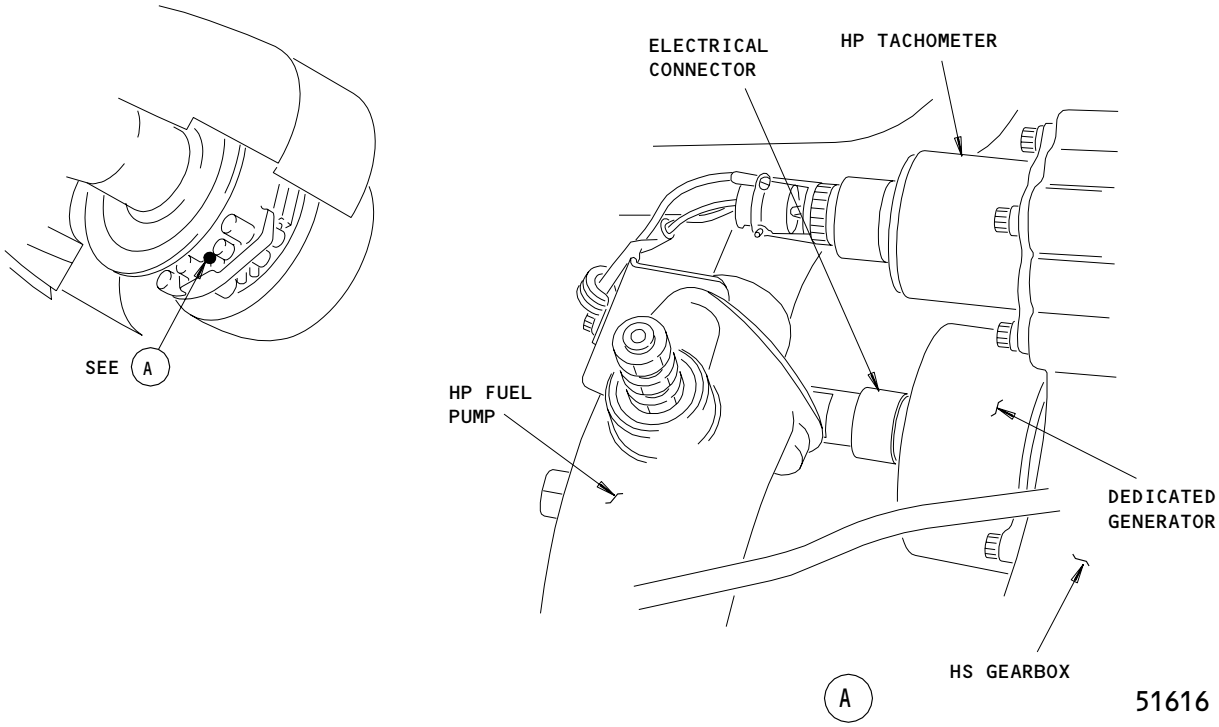
S 735-040-R00
(22) Move the START switch to the GND position and hold.

S 735-041-R00
(23) Make sure that the START VALVE light comes on and the L (R) ENG STARTER message is shown on EICAS.

S 735-042-R00
(24) Make sure that the N3 rotor does not turn.

S 735-043-R00
(25) Move the START switch to the AUTO position.

S 735-044-R00
(26) Connect the electrical connector to the dedicated generator.



Dedicated Generator Location
Figure 502

S 415-058-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU CLOSE THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(27) Close the right fan cowl panel (AMM 71-11-04/201).

F. Starter Control Valve Manual Override Test (Fig. 501)

S 615-046-R00

(1) Do the Engine Starter Oil Servicing procedure (AMM 12-13-02/301).

S 865-047-R00

(2) Supply the pneumatic power (AMM 36-00-00/201).

S 015-048-R00

(3) Open the starter control valve access door.

S 865-049-R00

(4) Make sure that the FUEL CONTROL switch is in the CUTOFF position and attach DO-NOT-OPERATE tag.

S 735-050-R00

WARNING: BEFORE YOU DO THIS TEST, MAKE SURE ALL PERSONS, TOOLS, AND UNWANTED OBJECTS ARE REMOVED FROM THE ENGINE INLET AREA. MAKE A SAFETY AREA AROUND THE ENGINE INLET. IF YOU DO NOT FOLLOW THESE INSTRUCTIONS, YOU CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(5) Turn the manual override shaft on the starter control valve to the OPEN position and let the engine turn to 20 ±2% N3.

S 735-051-R00

(6) Close the engine starter control valve when the engine turns at 20 ±2% N3.

S 735-052-R00
(7) Make sure that the starter control valve closed and that air flow to the engine starter has stopped.

S 415-053-R00
(8) Close the starter control valve access door.

S 865-054-R00
(9) Remove the DO-NOT-OPERATE tag from the FUEL CONTROL switch.

S 865-055-R00
(10) Remove the pneumatic power, if it is not necessary (AMM 36-00-00/201).

S 865-056-R00
(11) Remove the electrical power, if it is not necessary (AMM 24-22-00/201).

ENGINE STARTING SYSTEM - INSPECTION/CHECK

TASK 80-11-00-206-001-R00

1. Engine Starting System Inspection

A. References

(1) AMM 12-13-02/301, Engine Starter-Oil Replenishing

(2) AMM 71-11-04/201, Fan Cowl Panels

B. Access

(1) Location Zones

413 Fan cowl panel (Left)
414 Fan cowl panel (Right)
423 Fan cowl panel (Left)
424 Fan cowl panel (Right)

(2) Access Panels

413 Fan cowl panel (Left)
414 Fan cowl panel (Right)
423 Fan cowl panel (Left)
424 Fan cowl panel (Right)

C. Engine Starting System Inspection

S 866-002-R00

(1) For the left engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:

(a) P11 Overhead Circuit Breaker Panel

1) 11D19, ENGINE START CONT LEFT

S 866-003-R00

(2) For the right engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:

(a) P11 Overhead Circuit Breaker Panel

1) 11D20, ENGINE START CONT RIGHT

S 016-004-R00

(3) Open the fan cowl panels (AMM 71-11-04/201).

S 216-005-R00

(4) Examine the engine starter duct for cracks, holes or other damage.

S 216-006-R00

(5) Examine the engine starter duct to make sure it is aligned correctly.

S 216-007-R00

(6) Examine the engine starter duct coupling clamps to make sure they are tight.

S 616-008-R00
(7) Look into the sight glass to see if you need to add oil.
  (a) Do the Engine Starter Oil Servicing procedure, if it is neccessary (AMM 12-13-02/301).

S 416-009-R00
(8) Close the fan cowl panels (AMM 71-11-04/201).

S 866-010-R00
(9) For the left engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11D19, ENGINE START CONT LEFT

S 866-011-R00
(10) For the right engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11D20, ENGINE START CONT RIGHT

PNEUMATIC STARTER - REMOVAL/INSTALLATION

1. General
   A. Two tasks are given in this procedure. The first is the removal of the pneumatic starter and the second is the installation of the starter.
   B. In this procedure the pneumatic starter will be referred to as the starter.

TASK 80-11-01-024-001-R00

2. Remove the Pneumatic Starter
   A. References
      (1) AMM 71-11-04/201, Fan Cowl Panels
   B. Access
      (1) Location Zone

413	Fan Cowl Panel (Left)
414	Fan Cowl Panel (Right)
423	Fan Cowl Panel (Left)
424	Fan Cowl Panel (Right)

      (2) Access Zone

413AL	Fan Cowl Panel (Left)
414AR	Fan Cowl Panel (Right)
423AL	Fan Cowl Panel (Left)
424AR	Fan Cowl Panel (Right)

   C. Prepare to Remove the Starter

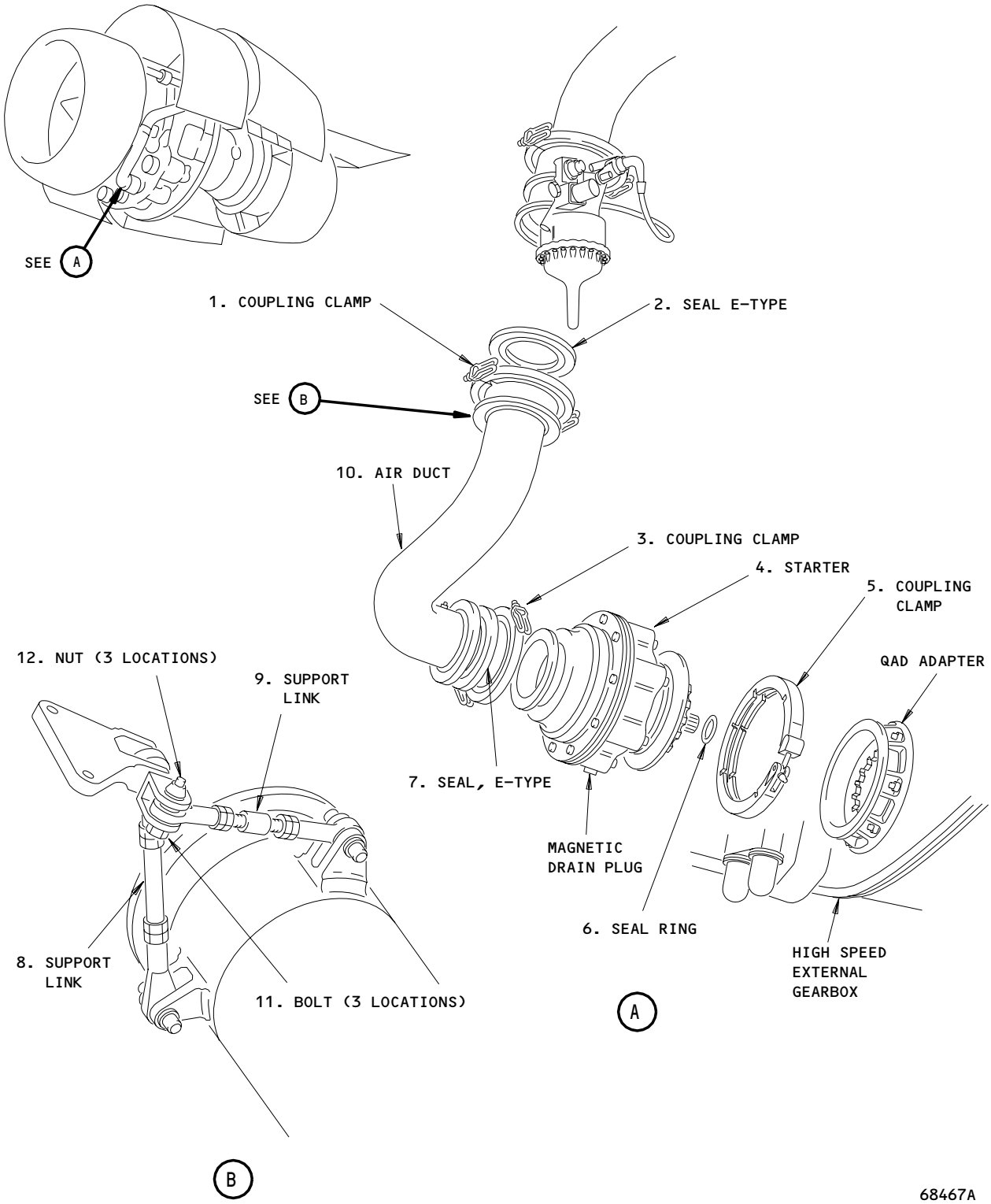
      S 864-002-R00
      (1) For the left engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:
         (a) P11 Overhead Circuit Breaker Panel
            1) 11D19, ENGINE START CONT LEFT

      S 864-003-R00
      (2) For the right engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:
         (a) P11 Overhead Circuit Breaker Panel
            1) 11D20, ENGINE START CONT RIGHT

      S 014-017-R00

      CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU OPEN THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

      (3) Open the fan cowl panels (AMM 71-11-04/201).
   D. Remove the Starter (Fig. 401)



Pneumatic Starter Installation
Figure 401

S 024-005-R00

(1) Remove the air duct.
  (a) Remove the nuts (12) and the bolts (11) from each end of the support link (9) and remove the link.
  (b) Remove the nut (12) and the bolt (11) from the support link (8) at the air duct connection.
    1) Move the support link away from the duct.
  (c) Hold the air duct (10) and remove the coupling clamps (1, 3).

    NOTE: E-type seals (2, 7) can be left in their positions.

  (d) Remove the air duct (10).

S 024-022-R00

WARNING: BE CAREFUL WHEN YOU MOVE THE PNEUMATIC STARTER. BECAUSE THE STARTER WEIGHS 38 POUNDS (17.2 KG), INJURY TO YOU CAN OCCUR.

CAUTION: DO NOT LIFT THE STARTER BY THE DRIVESHAFT. INTERNAL DAMAGE TO THE STARTER CAN OCCUR.

(2) Remove the starter.
  (a) Release the coupling clamp (5) from the QAD adapter flange.
  (b) Move the starter (4) forward to disengage the adapter splines and the drive shaft splines for the starter (4).
  (c) Remove the starter (4).
  (d) Remove and discard the seal (6) from the driveshaft.
  (e) Put caps on all open duct ends.

TASK 80-11-01-424-007-R00

3. Install the Pneumatic Starter

A. Parts

AMM		NOMENCLATURE	AIPC		
FIG	ITEM		SUBJECT	FIG	ITEM
401	1	Clamp - Vee	80-11-02	01	45
	2	Gasket			15
	3	Coupling	80-11-53	01	149
	4	Starter - Air	80-11-01	01	5
	5	Coupling Clamp			20
	6	Packing			25
	7	Gasket			180
	8	Support Link	80-11-53	01	255,260, 270,275
	9	Support Link			255,260, 265
	10	Duct Assy - Air Starter Lwr			135
	11	Bolt			90
	12	Nut			95

B. Consumable Material
   (1) Clean Engine Oil, OMat No. 1011
C. References
   (1) AMM 12-13-02/301, Engine Starter - Oil Replenishing
   (2) AMM 71-00-00/201, Power Plant
   (3) AMM 71-11-04/201, Fan Cowl Panels
D. Access
   (1) Location Zone
       413 Fan Cowl Panel (Left)
       414 Fan Cowl Panel (Right)
       423 Fan Cowl Panel (Left)
       424 Fan Cowl Panel (Right)

   (2) Access Zone
       413AL Fan Cowl Panel (Left)
       414AR Fan Cowl Panel (Right)
       423AL Fan Cowl Panel (Left)
       424AR Fan Cowl Panel (Right)

E. Procedure (Fig. 401)

   S 434-008-R00
   (1) Remove the caps from the ducts.

   S 424-015-R00
   (2) Install the starter.
      (a) Lubricate the new seal ring with clean engine oil OMat No. 1011.
      (b) Put the seal ring (6) onto the drive shaft.

(c) Make sure the flanges of the starter (4) and the QAD adapter are clean and not damaged.
(d) Put the starter (4) on the QAD adapter.
(e) Make sure the magnetic drain plug is at bottom center.
(f) Align the master splines on the starter (4) and the adapter.
(g) Push the starter (4) to the gearbox until it stops.
(h) Install the coupling clamp (5), that connects the starter to the QAD adapter.
1) Tighten the clamp to 60-65 pound-inches (6.8-7.3 Newton meters).

S 424-009-R00

(3) Install the air duct.
(a) Examine the E-type seals (2, 7) in the air duct (10) flanges.
(b) Engage the flanges and align the yellow marks on the ducts.
(c) Install the coupling clamps (1, 3).

S 434-016-R00

(4) Install the support link assembly.
(a) Put the free end of the support link (8) in the forked connection on the air duct.
(b) Adjust the link to align the bolt holes.
(c) Adjust the support link (9), to align the bolt holes.
(d) Install the bolts (11) and the nuts (12).
(e) Tighten the nuts (12).
(f) Examine the safety holes in the support links (8, 9) to make sure the threads are engaged correctly.
(g) Tighten the locknuts for the support link.

F. Put the airplane back to its usual condition.

S 614-010-R00

(1) Fill the starter (4) with oil (AMM 12-13-02/301).

S 414-018-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU CLOSE THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(2) Close the fan cowl panels (AMM 71-11-04/201).

S 864-012-R00

(3) For the left engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
(a) P11 Overhead Circuit Breaker Panel
1) 11D19, ENGINE START CONT LEFT

S 864-013-R00

(4) For the right engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
   (a) P11 Overhead Circuit Breaker Panel
      1) 11D20, ENGINE START CONT RIGHT

S 714-019-R00

WARNING: USE AMM 71-00-00/201 TO OPERATE THE POWER PLANT. IF YOU DO NOT USE THIS PROCEDURE, YOU CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

(5) Use the Power Plant Dry-Motor procedure to motor the engine (AMM 71-00-00/201).

STARTER - INSPECTION/CHECK

1. General
   A. This procedure contains steps to do the visual inspections that follow:
      (1) Visual inspection of the magnetic chip detector for signs of starter damage.
      (2) Visual inspection for oil leakage from the starter.
      (3) Visual inspection to make sure that the starter is correctly attached to the engine and the pneumatic duct.

   TASK 80-11-01-206-001-R00

2. Pneumatic Starter Inspection
   A. References
      (1) AMM 12-13-02/301, Starter Servicing
      (2) AMM 71-11-04/201, Fan Cowl Panels
      (3) AMM 78-31-00/201, Thrust Reverser System
      (4) AMM 80-11-01/401, Pneumatic Starter
   B. Access
      (1) Location Zones
          410 Left Engine
          420 Right Engine

      (2) Access Panels
          413AL Fan Cowl Panel (Left)
          414AR Fan Cowl Panel (Right)
          415AL Thrust Reverser (Left)
          416AR Thrust Reverser (Right)
          423AL Fan Cowl Panel (Left)
          424AR Fan Cowl Panel (Right)
          425AL Thrust Reverser (Left)
          426AR Thrust Reverser (Right)

   C. Prepare for inspection

      S 866-002-R00

      WARNING: DO THE THRUST REVERSER DEACTIVATION PROCEDURE TO PREVENT THE OPERATION OF THE THRUST REVERSER. ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURY TO YOU OR DAMAGE TO EQUIPMENT.

      (1) Do this procedure: Thrust Reverser Deactivation for Ground Maintenance (AMM 78-31-00/201).

S 016-017-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU OPEN THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(2) Open the fan cowl panels (AMM 71-11-04/201).

D. Magnetic Chip Detector Inspection (Fig. 601)

S 216-004-R00

(1) Remove and examine the magnetic chip detector as follows:
  (a) Remove the magnetic chip detector from the drain plug in the starter.
  (b) Examine the magnetic chip detector for an unusually large quantity of metal particles.
    1) Also look for large metal pieces such as pins, lockwire, and casting chips.
    2) Metal pieces should not be larger that 0.1 inch (2.5 mm) in length.

S 906-005-R00

(2) If large metal chips or large quantities of metal particles are found, replace the starter (AMM 80-11-01/401).

NOTE: The drain plug has a two part base which permits the magnetic chip detector to be removed without any oil leakage. A spring-loaded seal closes the opening as the magnetic chip detector is removed.

S 436-006-R00

(3) Install a new O-ring on the magnetic chip detector.

S 436-007-R00

(4) Install the magnetic chip detector in the starter oil drain plug.
  (a) Tighten the plug to 5-15 inch-pounds (0.56-1.69 newton-meters).
  (b) Install lockwire to the plug.

E. Starter Oil Leak Inspection

S 216-008-R00

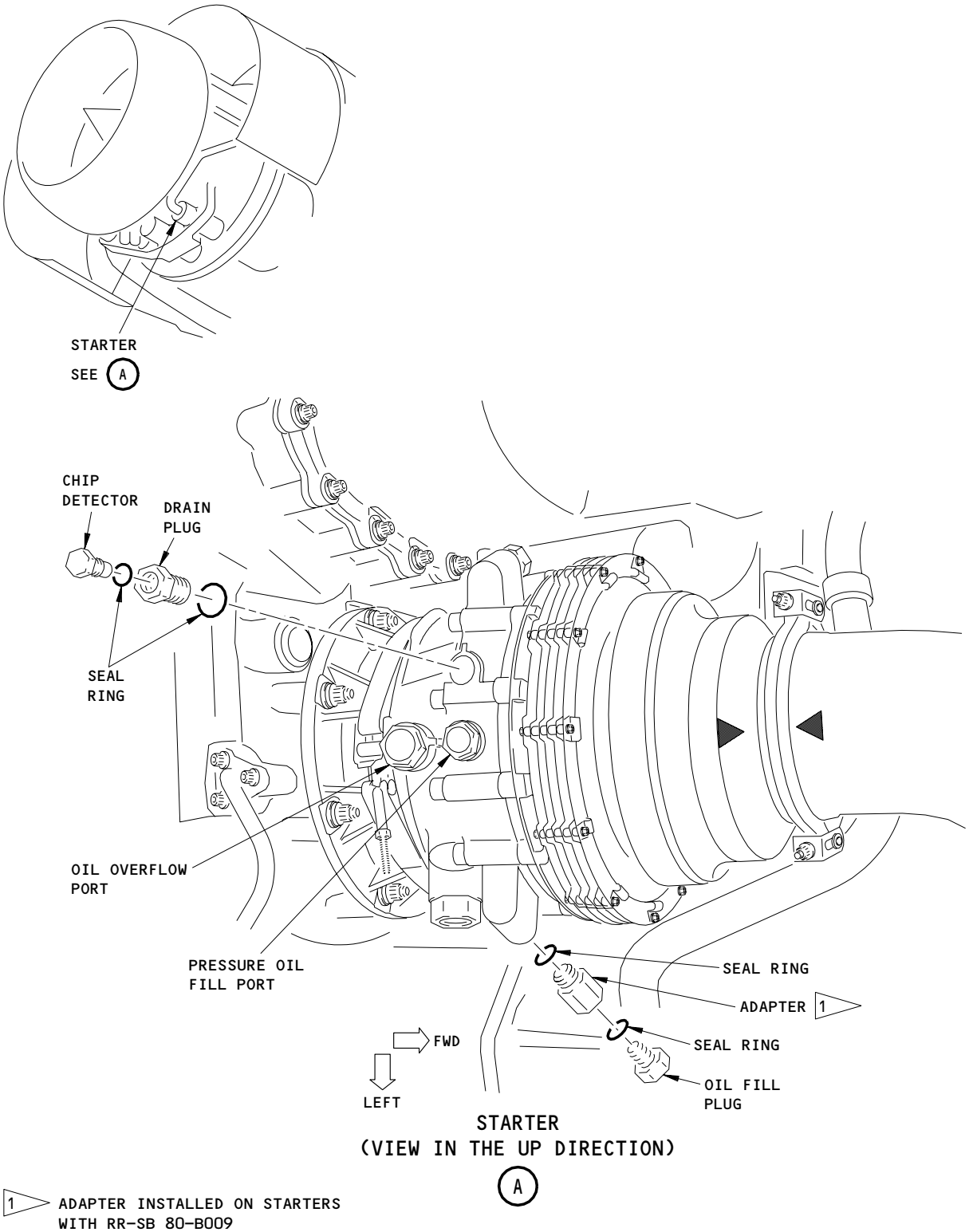
(1) Examine the starter for oil leakage.

S 906-009-R00

(2) If an unusual quantity of oil leakage is found around the starter housing, replace the starter (AMM 80-11-01/401).

S 906-010-R00

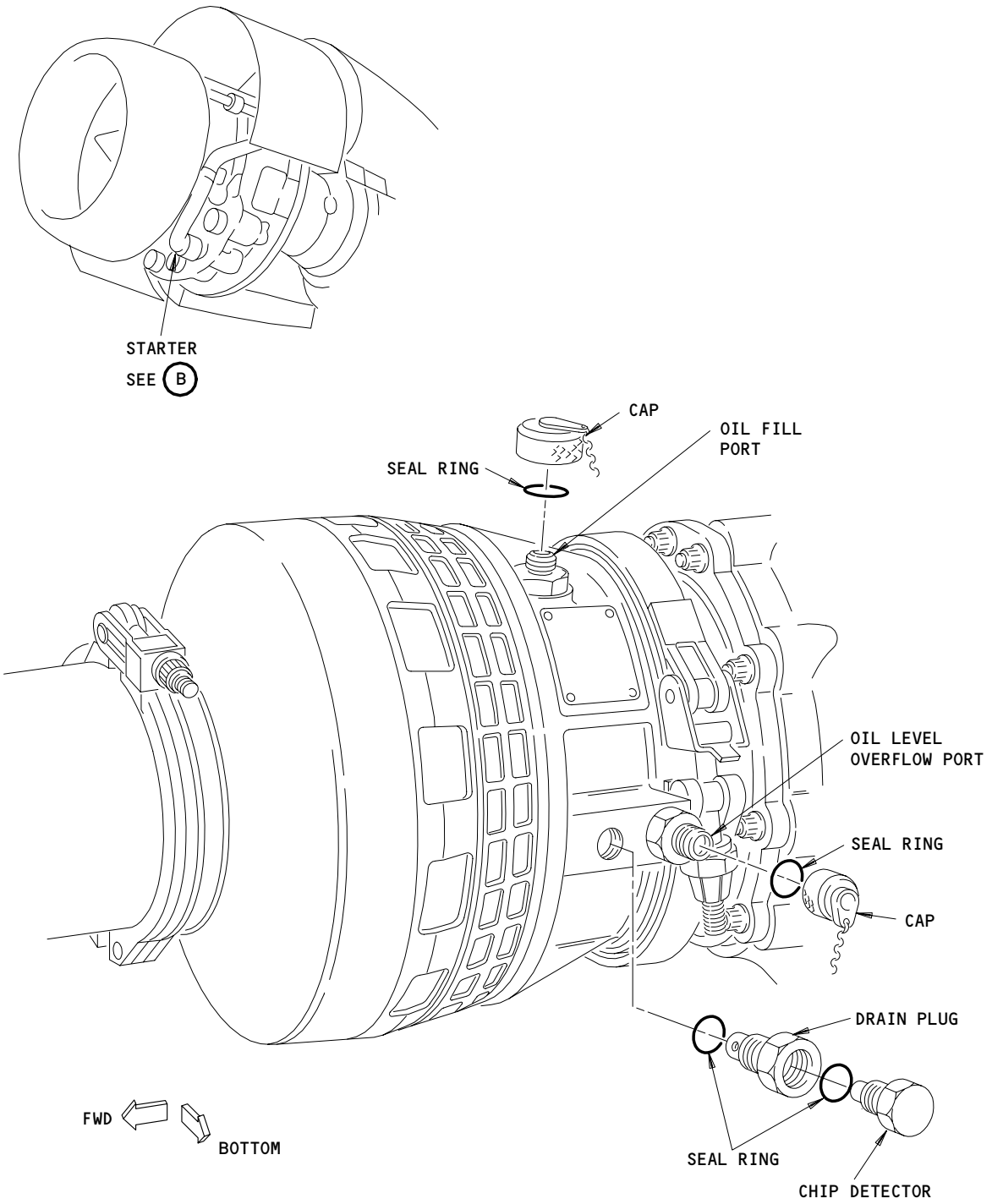
(3) If an unusual quantity of oil leakage is found around the fill plug or overfill plug, replace the packing.



Engine Starter – Oil Change and Chip Detector Inspection
Figure 601 (Sheet 1)

EFFECTIVITY
ENGINES WITH HAMILTON STANDARD STARTER

M01623



STARTER
B

A3995

Engine Starter – Oil Change and Chip Detector Inspection
Figure 601 (Sheet 2)

S 906-011-R00

(4) If an unusual quantity of oil leakage is found around the oil drain plug, do the steps that follow:

WARNING: DO NOT KEEP THE OIL ON YOUR SKIN FOR A LONG TIME. IF YOU DO NOT CLEAN THE OIL OFF, THE OIL CAN CAUSE INJURY. THE OIL CAN ALSO STAIN CLOTHING AND DAMAGE PAINT.

(a) Remove the fill plug and the drain plug and let the oil drain fully.
(b) Install a new packing on the drain plug.
(c) Install the drain plug in the starter.
1) Tighten the drain plug to 10-25 inch-pounds (1.13-2.82 newton-meters).
2) Install lockwire to the plug.

S 616-012-R00

(5) Do the oil servicing procedure for the engine starter (AMM 12-13-02/301).

S 216-013-R00

(6) Make sure that the starter is correctly attached to the engine and the pneumatic duct.

F. Put the airplane back to its usual condition

S 416-018-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU CLOSE THE FAN COWL PANEL. IF THE PRECAUTIONS ARE NOT OBEYED, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(1) Close the fan cowl panels (AMM 71-11-04/401).

S 866-015-R00

(2) Do the activation procedure for the thrust reverser (AMM 78-31-00/201).

STARTER CONTROL VALVE - REMOVAL/INSTALLATION

TASK 80-11-02-004-008-R00

1. Remove the Starter Control Valve

A. References

(1) AMM 71-11-04/201, Fan Cowl Panels

B. Access

(1) Location Zones

413	Fan cowl panel (left)
414	Fan cowl panel (right)
423	Fan cowl panel (left)
424	Fan cowl panel (right)

(2) Access Panels

413AL	Fan cowl panel (left)
414AR	Fan cowl panel (right)
423AL	Fan cowl panel (left)
424AR	Fan cowl panel (right)

C. Prepare for the Removal

S 864-001-R00

(1) For the left engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:

(a) P11 Overhead Circuit Breaker Panel

1) 11D19, ENGINE START CONT LEFT

S 864-002-R00

(2) For the right engine, open this circuit breaker and attach a DO-NOT-CLOSE tag:

(a) P11 Overhead Circuit Breaker Panel

1) 11D20, ENGINE START CONT RIGHT

S 864-003-R00

WARNING: MAKE SURE THERE IS NO AIR PRESSURE IN THE STARTER DUCT. PRESSURIZED AIR IN THE STARTER DUCT CAN CAUSE INJURY TO PERSONS WHEN YOU REMOVE THE STARTER CONTROL VALVE.

(3) Make sure the external air supply is not connected to the bleed air system and the APU is off.

S 014-004-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVLAR WRAPPING WHEN YOU OPEN THE FAN COWL PANEL. IF YOU DO NOT OBEY THE PRECAUTIONS, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(4) Open the fan cowl panels (AMM 71-11-04/201).

D. Procedure (Fig. 401)

S 034-018-R00

(1) Disconnect the electrical connector from the starter control valve (3).

S 034-005-R00

(2) Do the steps that follow to remove the support links (9, 12) from the starter air duct (6):
  (a) Remove the nuts (11) and the bolts (10) from each end of the support link (12).
  (b) Remove the support link (12).
  (c) Remove the nut (11) and the bolt (10) from the support link (9) until you can move the support link away from the duct.

S 034-019-R00

(3) Do the steps that follow to remove the starter air duct (6):
  (a) Hold the air duct (6) and remove the coupling clamps (5) and (8).
  (b) Remove the air duct (6).

S 024-006-R00

(4) Do the steps that follow to remove the starter control valve (3):

WARNING: BE CAREFUL WHEN YOU MOVE THE STARTER CONTROL VALVE. BECAUSE THE VALVE WEIGHS 16 POUNDS (7.2 KG), INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

  (a) Hold the starter control valve (3) and remove the coupling clamp (1).
  (b) Remove the starter control valve (3).
  (c) Remove the E-type seal (4) from the valve outlet.

NOTE: The E-type seals (2, 7) can be left in their position.

1) Keep the seal.

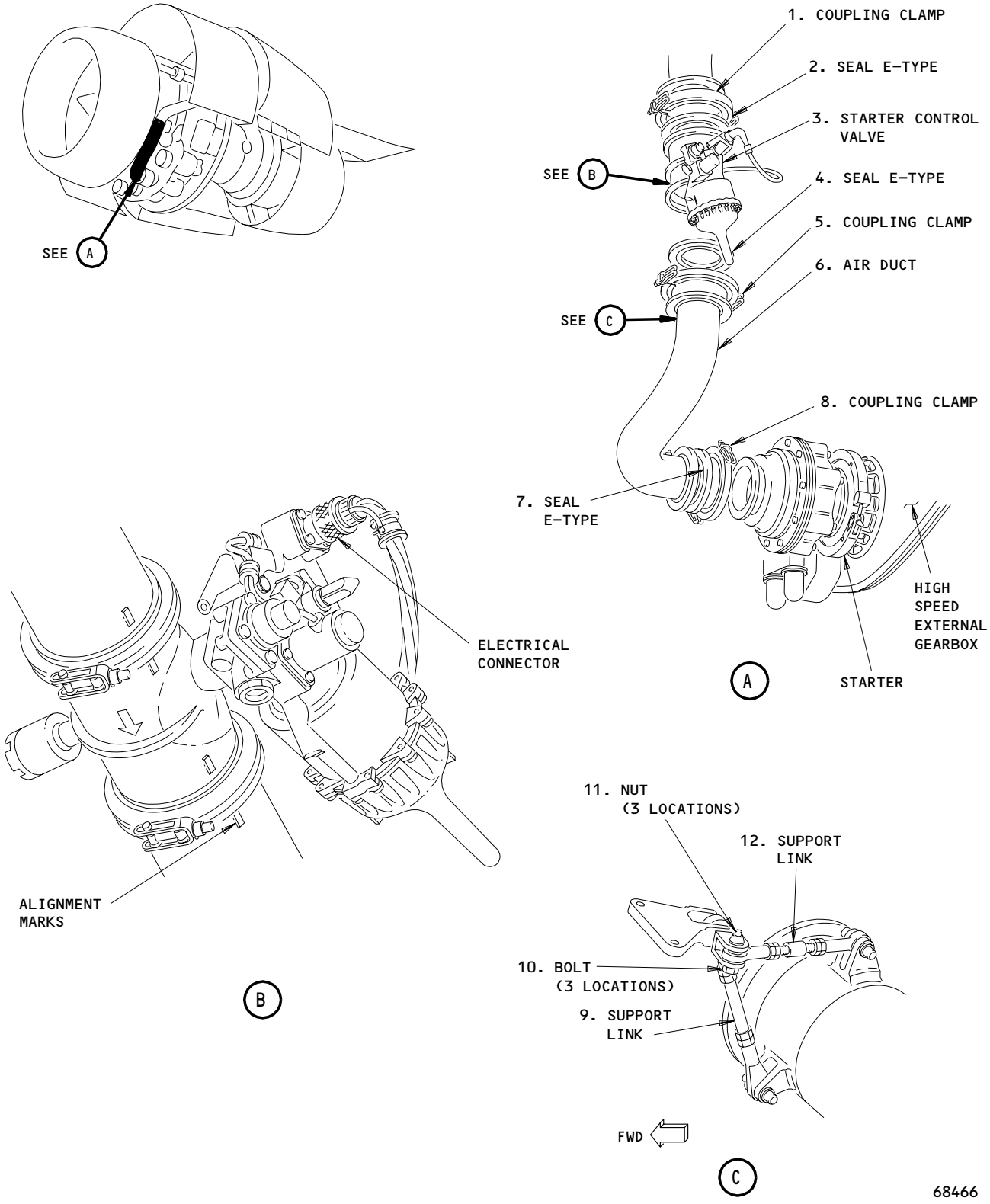
  (d) Put dust caps on all the ducts and connectors that are open.

TASK 80-11-02-404-007-R00

2. Install the Starter Control Valve

A. General

(1) Use the procedure in AMM 70-51-00/201 to tighten the fasteners.



Starter Control Valve Installation
Figure 401

(2) Tighten the fasteners to the torque values in AMM 70-51-00/201 unless a torque value is specified in this procedure.

B. Parts

AMM		NOMENCLATURE	AIPC		
FIG	ITEM		SUBJECT	FIG	ITEM
401	1	Clamp - Vee	80-11-02	01	45
	2	Gasket			15
	3	Valve - Starter Cont	80-11-01	02	150
	4	Gasket	80-11-02		15
	5	Clamp - Vee			45
	6	Duct Assy - Air Starter Lwr	80-11-53	01	135
	7	Gasket	80-11-01	02	180
	8	Coupling	80-11-53	01	149
	9	Support Link			255,260,
	10	Bolt			90
	11	Nut			95
	12	Support Link			255,260,

C. References

(1) AMM 71-00-00/201, Power Plant

(2) AMM 71-11-04/201, Fan Cowl Panels

D. Access

(1) Location Zones

413 Fan cowl panel (left)
414 Fan cowl panel (right)
423 Fan cowl panel (left)
424 Fan cowl panel (right)

(2) Access Panels

413AL Fan cowl panel (left)
414AR Fan cowl panel (right)
423AL Fan cowl panel (left)
424AR Fan cowl panel (right)

E. Procedure (Fig. 401)

S 424-009-R00

(1) Do the steps that follow to install the starter control valve (3):

(a) Remove the dust caps from the ducts and connectors.

(b) Make sure the E-type seal (4) for the valve outlet flange and the E-type seals (2, 7) for the duct flanges are not damaged.

(c) Install the E-type seal (4) in the valve outlet flange (AMM 70-12-02/201).

(d) Prepare the coupling clamps (1, 5, 8), the valve inlet and outlet flanges and duct flanges for installation (AMM 70-12-02/201).

WARNING: BE CAREFUL WHEN YOU MOVE THE STARTER CONTROL VALVE. BECAUSE THE VALVE WEIGHS 16 POUNDS (7.2 KG), INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

(e) Install the starter control valve (3) on the duct.
1) Make sure the arrow on the valve body points in the direction of the airflow.
2) Make sure the alignment marks on valve body are aligned with the alignment marks on the duct.

(f) Install the top coupling clamp (1).
1) Make sure there is sufficient clearance between the clamp bolt and adjacent structure.
2) Adjust the top coupling clamp (1), if it is necessary.
3) Tighten the coupling clamp (1) (AMM 70-12-02/201).

S 434-010-R00

(2) Do the steps that follow to install the starter air duct (6):
(a) Install the air duct (6).
(b) Engage the mating flanges.
(c) Make sure the yellow alignment marks on the ducts are aligned.

S 434-011-R00

(3) Do the steps that follow to install the support links (9, 12) for the starter air duct (6):
(a) Put the free end of the support link (9) in the forked connection on the air duct.
1) Adjust the link to align the bolt holes, if it is necessary.
2) Install the bolts (10) and the nuts (11).
3) Tighten the bolts (10) and the nuts (11) (AMM 70-51-00/201).

(b) Install the support link (12).
1) Adjust the link to align the bolt holes, if it is necessary.
2) Install the bolts (10) and the nuts (11).
3) Tighten the bolts (10) and the nuts (11) (AMM 70-51-00/201).

(c) Look in the safety holes in the support links (9, 12) to make sure the threads are engaged correctly.
(d) Tighten the locknuts on the support links (9, 12) (AMM 70-51-00/201).
(e) Install the middle coupling clamp (5).
1) Make sure there is sufficient clearance between the clamp bolt and adjacent structure.
2) Adjust the middle coupling clamp (5), if it is necessary.
3) Tighten the middle coupling clamp (5) (AMM 70-12-02/201).

(f) Install the bottom coupling clamp (8).
1) Make sure there is sufficient clearance between the clamp bolt and adjacent structure.
2) Adjust the bottom coupling clamp (8), if it is necessary.
3) Tighten the bottom coupling clamp (8) (AMM 70-12-02/201).

S 434-012-R00

(4) Connect the electrical connector to the starter control valve (AMM 70-12-02/201).

S 414-013-R00

CAUTION: OBEY THE PRECAUTION FOR THE KEVLAR WRAPPING WHEN YOU CLOSE THE FAN COWL PANEL. IF YOU DO NOT OBEY THE PRECAUTIONS, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(5) Close the fan cowl panels (AMM 71-11-04/401).

S 864-014-R00

(6) For the left engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
(a) P11 Overhead Circuit Breaker Panel
1) 11D19, ENGINE START CONT LEFT

S 864-015-R00

(7) For the right engine, remove the DO-NOT-CLOSE tag and close this circuit breaker:
(a) P11 Overhead Circuit Breaker Panel
1) 11D20, ENGINE START CONT RIGHT

S 864-017-R00

WARNING: USE AMM 71-00-00/201 TO OPERATE THE POWER PLANT. IF YOU DO NOT USE THIS PROCEDURE, YOU CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

(8) Use the Power Plant Dry-Motor procedure to motor the engine (AMM 71-00-00/201).

STARTER QAD ADAPTER - REMOVAL/INSTALLATION

1. General
   A. The quick attach detach (QAD) adapter for the starter helps to change starters quickly. This section gives the removal and the installation procedures for the QAD adapter. The engine starter must be removed to get access to the QAD adapter.

   TASK 80-11-07-024-001-R00

2. Remove the Starter QAD Adapter
   A. Equipment
      (1) HU34316 - Socket, Rolls-Royce
   B. References
      (1) AMM 71-11-04/201, Fan Cowl Panels
      (2) AMM 78-31-00/201, Thrust Reversers
      (3) AMM 80-11-01/401, Pneumatic Starter
   C. Access
      (1) Location Zones
          413 Fan Cowl Panel (Left)
          414 Fan Cowl Panel (Right)

      (2) Access Panels
          423 Fan Cowl Panel (Left)
          424 Fan Cowl Panel (Right)

   D. Procedure

      S 044-016-R00

      WARNING: DO THE THRUST REVERSER DEACTIVATION PROCEDURE TO PREVENT THE OPERATION OF THE THRUST REVERSER. ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

      (1) Do this procedure: Thrust Reverser Deactivation for Ground Maintenance (AMM 78-31-00/201).

      S 014-017-R00
      (2) Open the fan cowl panels (AMM 71-11-04/201).

S 014-018-R00
(3) Remove the pneumatic starter (AMM 80-11-01/401).

S 024-015-R00
(4) Do the steps that follow to remove the QAD adapter (Fig. 401):
(a) Remove the nuts (1) from the QAD adapter (2) with the HU34316 socket.
(b) Remove the QAD adapter from the high speed (HS) external gearbox.
(c) Remove the seal ring (3) from the flange of the QAD adapter.
1) Discard the used seal ring.

TASK 80-11-07-424-005-R00

3. Install the Starter QAD Adapter

A. Equipment
(1) HU34316 - Socket, Rolls-Royce

B. Consumable Materials
(1) G00535 Jointing Compound
British Spec - DTD.900/4586 Hylomar (Light)
OMat No. - 4/46
(2) B00090 Degreasing fluid
(Inhibited and stabilized 1.1.1. trichloroethane)
British Spec - B.S.4487:1969
American Spec - MIL-T-81533
OMat No. - 1/21

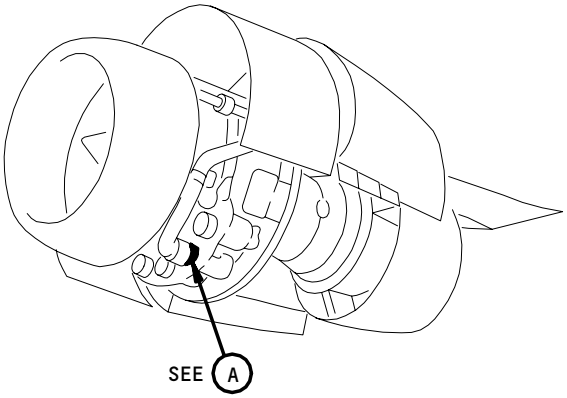
C. References
(1) AMM 70-02-01/201, Identification, Lubrication and Fitting of Rubber Sealing Rings
(2) AMM 70-51-00/201, Torque Tightening Technique
(3) AMM 71-11-04/201, Fan Cowl Panels
(4) AMM 78-31-00/201, Thrust Reversers
(5) AMM 80-11-01/401, Pneumatic Starter

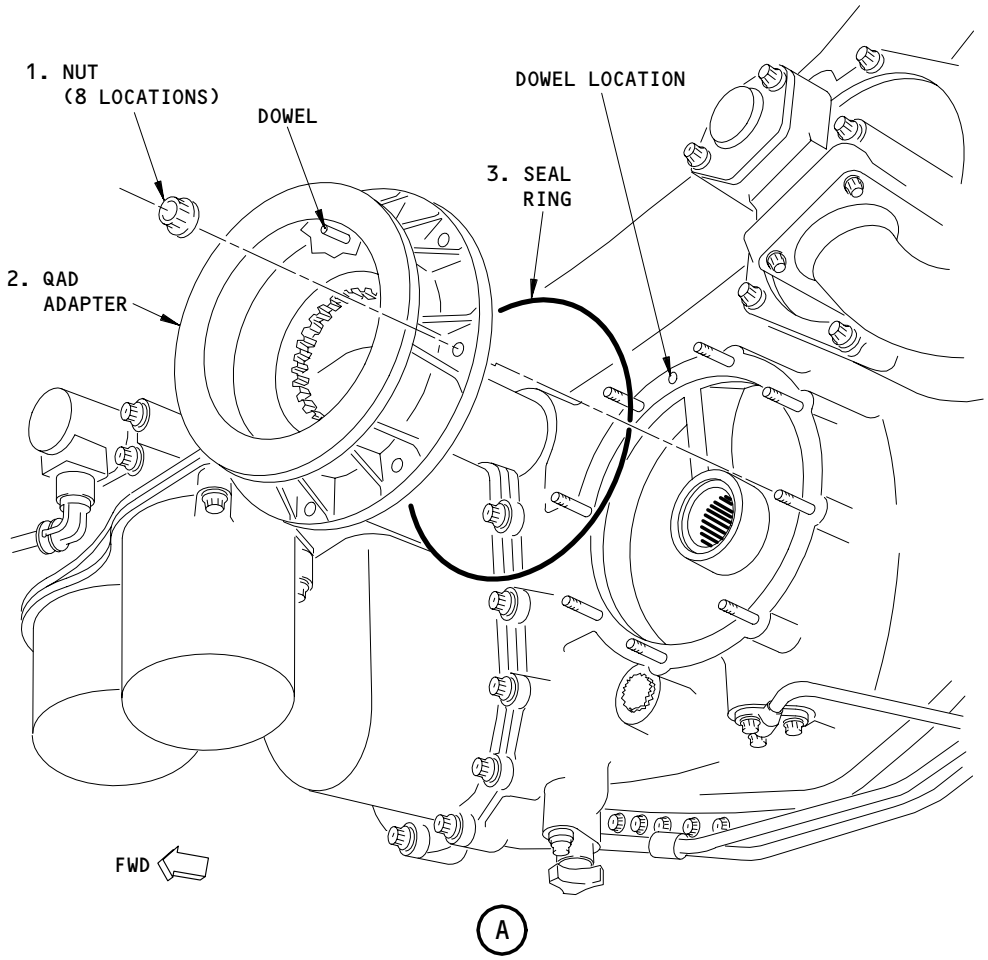
D. Access
(1) Location Zones
413 Fan Cowl Panel (Left)
414 Fan Cowl Panel (Right)

(2) Access Panels
423 Fan Cowl Panel (Left)
424 Fan Cowl Panel (Right)

E. Procedure

S 414-013-R00
(1) Do the steps that follow to install the starter QAD adapter (Fig. 401):





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Starter QAD Adapter Installation
Figure 401

WARNING: DO NOT GET DEGREASING FLUID IN YOUR MOUTH, OR EYES, OR ON YOUR SKIN. PUT ON A PROTECTIVE SPLASH GOGGLE AND GLOVES WHEN YOU USE DEGREASING FLUID. DO NOT BREATH THE FUMES. DEGREASING FLUID IS A DANGEROUS SOLVENT WHICH CAN CAUSE INJURY OR DAMAGE.

(a) Use cold liquid degreasing fluid to clean the mating faces of the QAD adapter and the HS external gearbox.
(b) Use a brush and apply a thin film of jointing compound to the mating faces of the QAD adapter and the HS external gearbox.
(c) Let the compound dry for a minimum of 10 minutes.
(d) Lubricate a new ring seal (3) for the flange of the QAD adapter (AMM 70-02-01/201).
    1) Install the seal ring to the flange of the QAD adapter.
    2) Put the QAD adapter (2) on the HS external gearbox mating face.
    3) Make sure the location dowel is correctly engaged.
    4) Make sure the seal ring (3) is installed correctly.
(e) Install and tighten the nuts (1) that attach the QAD adapter to the gearbox with the HU34316 socket (AMM 70-51-00/201).

S 414-019-R00

(2) Install the starter (AMM 80-11-01/401).

S 444-020-R00

(3) Do the activation procedure for the thrust reverser (AMM 78-31-00/201).

S 414-021-R00

(4) Close the fan cowl panels (AMM 71-11-04/201).

STARTER CONTROL VALVE FILTER - MAINTENANCE PRACTICES

1. General
   A. This procedure gives three tasks. These tasks are a removal, cleaning, and an installation of the filter.
   B. In this procedure the filter for the starter control valve will be referred to as the filter.

TASK 80-11-08-002-001-R00

2. Remove the Filter
   A. References
      (1) AMM 24-22-00/201, Electrical Power
      (2) AMM 71-11-04/201, Fan Cowl Panels
   B. Access
      (1) Location Zones
          413 Fan Cowl Panel (Left)
          423 Fan Cowl Panel (Left)
      (2) Access Panels
          413AL Fan Cowl Panel (Left)
          423AL Fan Cowl Panel (Left)
   C. Procedure (Fig. 201)

      S 862-002-R00
      (1) Remove the electrical power (AMM 24-22-00/201).

      S 012-003-R00

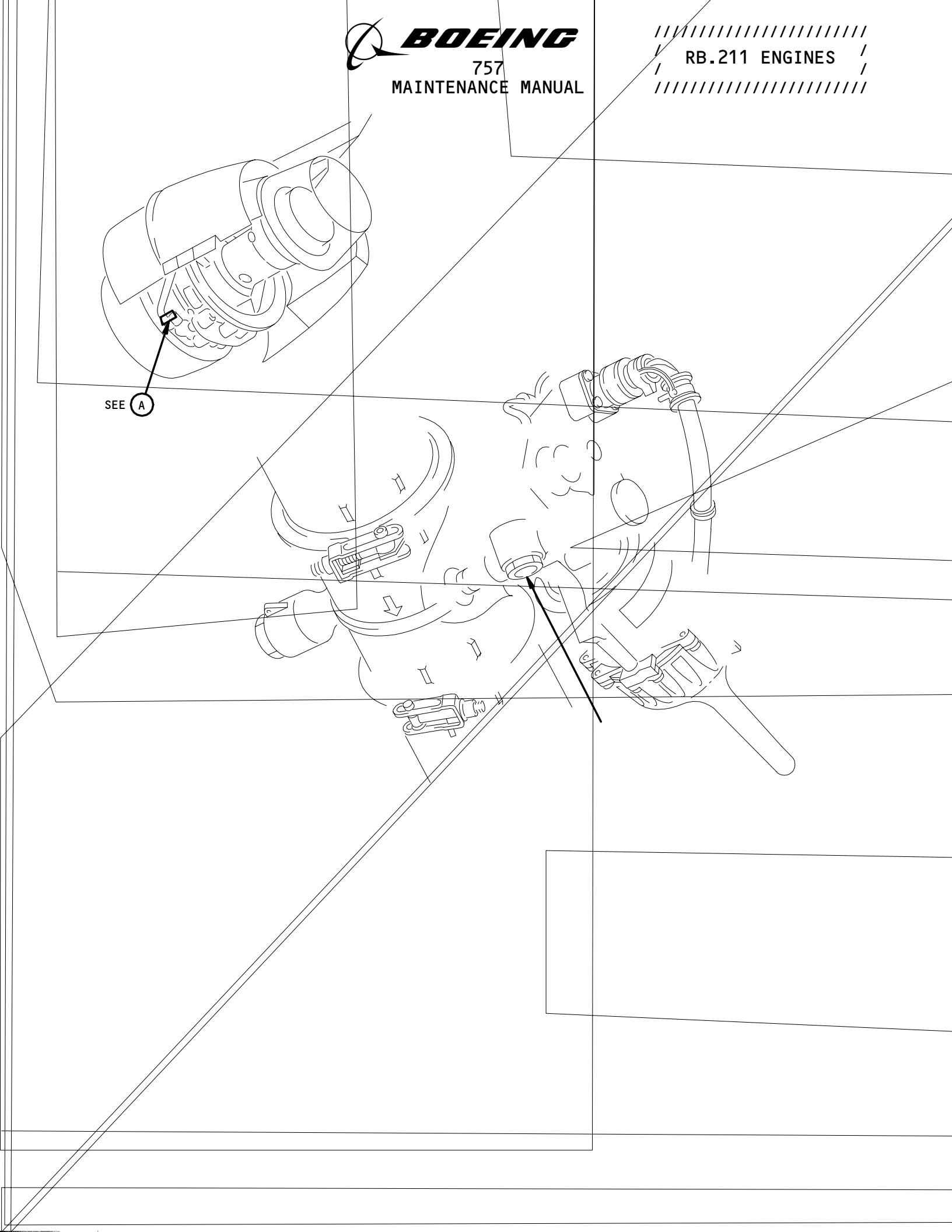
      CAUTION: OBEY THE PRECAUTIONS FOR THE KEVAR WRAPPING WHEN YOU OPEN THE FAN COWL PANEL. IF YOU DO NOT OBEY THE PRECAUTIONS, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

      (2) Open the left fan cowl panel (AMM 71-11-04/201).

      S 022-019-R00
      (3) Do these steps to remove the filter (Fig. 201):
          (a) Remove the plug (4).
          (b) Discard the seal ring (3).
          (c) Remove the filter (1) and the spring (2).

TASK 80-11-08-102-007-R00

3. Clean the Filter
   A. Equipment
      (1) Compressed air supply
   B. Consumable Materials
      (1) Turco Liquid Sprayeze


SEE A

(2) Fine Organics, F02085 or F02085M
(3) B00148 Solvent - Methyl Ethyl Ketone (MEK), TT-M-261

C. References
(1) AMM 70-42-12/201, Local Surface Protection

D. Access
(1) Location Zones
413 Fan Cowl Panel (Left)
423 Fan Cowl Panel (Left)
(2) Access Panels
413AL Fan Cowl Panel (Left)
423AL Fan Cowl Panel (Left)

E. Procedure

S 022-008-R00
(1) Do the steps in the procedure to remove the filter element.

S 112-009-R00

WARNING: DO NOT GET METHYLETHYLKEYTONE (MEK) IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM MEK. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE MEK. KEEP MEK AWAY FROM SPARKS, FLAMES AND HEAT. MEK IS A POISONOUS AND FLAMMABLE SOLVENT WHICH CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

CAUTION: THE SOLVENT CAN CAUSE DAMAGE TO SURFACE PROTECTION. DAMAGED AREAS MUST BE REPAIRED (AMM 70-42-12/201).

(2) Do these steps to clean the filter element:
(a) Clean the filter with the solvent.
(b) Dry the filter with low pressure compressed air.
(c) Look at the filter for signs of damage or contamination.
(d) Replace the filter if you find any damage or contamination.

S 422-010-R00
(3) Do the steps in the procedure to install the filter.

TASK 80-11-08-402-011-R00

4. Install the Filter
A. Consumable Materials
(1) Lockwire
British Spec./Ref - DTD 189A 22 S.W.G.
American Spec./Ref - 21 A.W.G.
OMat Item No. - 238

B. References
(1) AMM 24-22-00/201, Electrical Power
(2) AMM 70-02-01/201, Identification, Lubrication and Fitting of Rubber Sealing Rings
(3) AMM 70-51-00/201, Torque Tightening Technique
(4) AMM 71-11-04/201, Fan Cowl Panels

C. Access
(1) Location Zones
413 Fan Cowl Panel (Left)
423 Fan Cowl Panel (Left)
(2) Access Panels
413AL Fan Cowl Panel (Left)
423AL Fan Cowl Panel (Left)

D. Procedure

S 422-020-R00

(1) Do these steps to install the filter:
(a) Install the filter (1) and the spring (2) with the flanged end of the filter first.
(b) Install the new preformed packing (3) on to the plug (4) (AMM 70-02-01/201).
(c) Install the plug (4) and make sure the spring (2) and the filter (1) are in the correct position.
1) Tighten the plug (4) to 20-25 pound-inches (2.3-2.8 Newton meters) (AMM 70-51-00/201).
(d) Install lockwire to the plug (4).

S 412-017-R00

CAUTION: OBEY THE PRECAUTIONS FOR THE KEVAR WRAPPING WHEN YOU CLOSE THE FAN COWL PANEL. IF YOU DO NOT OBEY THE PRECAUTIONS, DAMAGE TO THE KEVLAR WRAPPING CAN OCCUR.

(2) Close the left fan cowl panel (AMM 71-11-04/201).

ENGINE START/RAT CONTROL PANEL - REMOVAL/INSTALLATION

1. General
   A. The engine start/ram air turbine (RAT) control panel M10468 is located on the pilots' overhead panel P5. This section gives the engine start/RAT control panel removal and installation procedures.

   TASK 80-11-09-024-002-R00

2. Remove the Engine Start/RAT Control Panel

   A. Access
      (1) Location Zones
          210 Control Cabin
   B. Procedure

      S 864-015-R00
      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
          (a) P11 Overhead Circuit Breaker Panel
              1) 11A33, IND LIGHTS 2
              2) 11A35, IND LIGHTS 4
              3) 11D7, ENGINES STBY IGN LEFT 1
              4) 11D8, ENGINES STBY IGN LEFT 2
              5) 11D9, ENGINES STBY IGN RIGHT 1
              6) 11D10, ENGINES STBY IGN RIGHT 2
              7) 11D19, ENGINE START CONT LEFT
              8) 11D20, ENGINE START CONT RIGHT
              9) 11D26, HYDRAULICS RAT AUTO CONT
              10) 11D27, HYDRAULIC RAT AUTO PWR
              11) 11L1, LEFT ENGINE IGN 1
              12) 11L28, RIGHT ENGINE IGN 1
              13) 11N4, INSTRUMENT & PANEL OVHD
          (b) P6 Circuit Breaker Panel
              1) 6C1, FUEL COND CONT L
              2) 6C2, FUEL COND CONT R
              3) 6F1, RAT MAN

S 024-016-R00
(2) Remove the control panel from the P5 panel.

TASK 80-11-09-424-005-R00

3. Install the Engine Start/RAT Control Panel

A. References
(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 33-16-00/501, Master Dim and Test
B. Access
(1) Location Zones
210 Control Cabin
C. Procedure

S 424-006-R00
(1) Install the control panel in the P5 panel.

S 864-014-R00
(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
(a) P11 Overhead Circuit Breaker Panel
1) 11A33, IND LIGHTS 2
2) 11A35, IND LIGHTS 4
3) 11D7, ENGINES STBY IGN LEFT 1
4) 11D8, ENGINES STBY IGN LEFT 2
5) 11D9, ENGINES STBY IGN RIGHT 1
6) 11D10, ENGINES STBY IGN RIGHT 2
7) 11D19, ENGINE START CONT LEFT
8) 11D20, ENGINE START CONT RIGHT
9) 11D26, HYDRAULICS RAT AUTO CONT
10) 11D27, HYDRAULIC RAT AUTO PWR
11) 11L1, LEFT ENGINE IGN 1
12) 11L28, RIGHT ENGINE IGN 1
13) 11N4, INSTRUMENT & PANEL OVHD
(b) P6 Circuit Breaker Panel
1) 6C1, FUEL COND CONT L
2) 6C2, FUEL COND CONT R
3) 6F1, RAT MAN

S 864-016-R00
(3) Supply the electrical power (AMM 24-22-00/201).

S 714-017-R00
(4) Do these steps to make sure the control panel installation is correct:
  (a) Push the master dim and test (MD&T) switch on the overhead P5 panel (AMM 33-16-00/501).
  (b) Make sure the engine start VALVE light on the control panel comes on.
  (c) Release the MD&T switch on P5 panel to the off position.

S 864-018-R00
(5) Remove the electrical power if it is not necessary (AMM 24-22-00/201).