POWERPLANT - REMOVAL/INSTALLATION

EFFECTIVITY: ALL

1. General

   A. This section gives the procedures to remove and install the engine. These procedures are applicable to the LH and RH engines.

   B. These engine installation procedures are applicable to the installation of an engine in the pre-installed condition (Refer to Powerplant Build-up Manual, PPBM-145/1139) or to the installation of an engine removed from the aircraft.

   C. The dry weight of the powerplant is approximately 977 kg (2154 lb) with the thrust reverser installed or 829 kg (1823.7 lb) without the thrust reverser.

   D. The procedures in this section are given in the sequence below. The tasks identified with (♦) are part of the Scheduled Maintenance Requirements Document (SMRD).

TASK NUMBER	*DESCRIPTION*	*EFFECTIVITY*
71-00-00-000-801-A	ENGINE - REMOVAL	ALL
71-00-00-400-801-A	ENGINE - INSTALLATION	ALL

TASK 71-00-00-000-801-A
EFFECTIVITY: ALL

2. ENGINE - REMOVAL

A. General

(1) This task gives the procedures to remove the engine.

B. References

REFERENCE	*DESIGNATION*
AMM TASK 29-10-00-860-801-A/200	HYDRAULIC SYSTEM - PRESSURIZATION WITH HTS
AMM TASK 45-45-00-970-802-A/200	CMC DOWNLOADING WITH THE PERSONAL COMPUTER
AMM TASK 71-11-01-000-801-A/400	ENGINE UPPER COWLING - REMOVAL
AMM TASK 71-13-01-000-801-A/400	NACELLE APRON - REMOVAL
AMM TASK 71-60-01-000-801-A/400	ENGINE AIR INTAKE - REMOVAL
AMM TASK 73-21-01-000-801-A/400	FPMU - REMOVAL
AMM TASK 78-11-01-000-801-A/400	ENGINE EXHAUST NOZZLE - REMOVAL
AMM TASK 78-31-01-000-801-A/400	THRUST REVERSER - REMOVAL
AMM TASK 78-31-01-980-801-A/200	LOCK/UNLOCK THE TR EXHAUST DOOR - STOWED POSITION
AMM TASK 78-33-01-980-801-A/200	ISOLATION CONTROL UNIT - INHIBITION PROCEDURES
Rolls-Royce Maintenance Manual CSP34022	-
S.B.145-24-0007	-
S.B.145-28-0016	-
S.B.145-45-0001	-

C. Zones and Accesses

ZONE	*PANEL/DOOR*	*LOCATION*
412		LH Engine upper cowling
413		LH Engine lower cowling
422		RH Engine upper cowling
423		RH Engine lower cowling

D. Tools and Equipment

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
GSE 159	Engine Maintenance Stand	To hold the engine after its removal	
GSE 164	Engine Assembly Lifting Adapter	To lift and remove the engine	
GSE 168	Aft Engine Handling Adapter	To handle the engine	
GSE 169	Aft Engine Lifting Adapter	To lift and remove the engine	
GSE 180	Hydraulic Crane	To remove the engine	

(Continued)

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
GSE 261	Forward Support Adapter	To permit you to store the engine	
GSE 262	Forward Lifting Adapter	To permit you to lift and remove the engine	
Commercially available	Crowfoot Wrench	To disconnect/connect fuel hose fitting	
Commercially available	Safety strap P/N 3383T531 from McMaster-Carr, made of nylon, with a length of 4.27 m (14 ft), or similar	To give a secondary device to prevent injury to personnel during the engine lifting.	
Commercially available	Shackle P/N 3663T42 from McMaster-Carr, or similar	To be used together with safety strap.	
Commercially available	Ring P/N 3769T47 from McMaster-Carr, or similar	To be used together with safety strap.	
Commercially available	Support Plate P/N 23055299 from Mid-west Tool, or similar	To be used together with safety strap.	

E. Auxiliary Items

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
Commercially available	Workstand	To get access to the engine	1
Commercially available	Containers	To collect fluids from the engine	AR
Commercially available	Blanking caps	To seal the lines disconnected	AR
Commercially available	Rubber Gloves, Phosphate Ester-Base, Fluid-Resistant	As a protection for your hands	1
Commercially available	Goggles, Phosphate Ester-Base, Fluid-Resistant	As a protection for your eyes	1

F. Consumable Materials

SPECIFICATION (BRAND)	*DESCRIPTION*	*QTY*
AMS 3160	Solvent, Petroleum	AR

G. Expandable Parts

Not Applicable

H. Persons Recommended

QTY	*FUNCTION*	*PLACE*
4	Do the task	Engine

I. Preparation

SUBTASK 843-002-A

NOTE: Preserve the engine according to Rolls-Royce Maintenance Manual CSP34022.

(1) On the circuit breaker panel, open the circuit breakers below and attach a DO-NOT-CLOSE tag to them:

- START 1/2.
- ENG AIR INLET 1/2.
- THRUST REVERSER 1/2.
- FADEC 1A/2A.
- FADEC 1B/2B.
- FUEL SOV 1/2.
- VIB IND.
- HYD ELEC PUMP 1/2.
- FUEL PUMP 1A/2A/1B/2B/1C/2C.

(2) Do a download and clean the CMC (AMM TASK 45-45-00-970-802-A/200).

(3) On the maintenance panel, set the CMC switch as follows:

(a) On aircraft PRE-MOD. S.B.145-45-0001, set the CMC switch to the INHIBIT position, refer to Figure 401.

(b) On aircraft POST-MOD. S.B.145-45-0001, make sure that the CMC switch is set at the normal position, refer to Figure 401.

(4) Fully release the pressure of the hydraulic system (AMM TASK 29-10-00-860-801-A/200).

(5) For aircraft with thrust reverser, inhibit the ICU (AMM TASK 78-33-01-980-801-A/200).

(6) Lock the thrust reverser doors (AMM TASK 78-31-01-980-801-A/200), if applicable.

(7) Remove the upper cowling (AMM TASK 71-11-01-000-801-A/400) to get access to the engine.

(8) Remove the apron (AMM TASK 71-13-01-000-801-A/400) to get access to the pylon firewall.

(9) Remove the pylon-to-nacelle fairings.

J. Removal (Figure 401) (Figure 402)

SUBTASK 020-002-A

WARNING:
- **USE APPLICABLE CONTAINERS TO COLLECT THE REMAINING FLUIDS FROM THE OPEN LINES AND KEEP THE WORK AREA CLEAN AND SAFE.**
- **KEEP THE ELECTRICAL POWER OFF WHEN YOU DISCONNECT OR CONNECT THE FUEL, HYDRAULIC, AND ELECTRICAL LINES. IF NOT, INJURIES TO PERSONS CAN OCCUR IF YOU ACCIDENTALLY APPLY PRESSURIZED FLUIDS, ENERGIZE ELECTRICAL CIRCUITS, OR THERE IS A FIRE.**
- **DO NOT REMOVE OR INSTALL THE ENGINES WITH THE AIRCRAFT ON JACKS.**

CAUTION: DURING THE TASK, OBEY THE PRECAUTIONS BELOW:
- CORRECTLY IDENTIFY ALL SUPPORTS AND COMPONENTS ATTACHED TO THE ENGINE/MOUNTING ASSEMBLY IF YOU MUST REMOVE THEM. MAKE MARKS TO SHOW THEIR POSITIONS. THIS WILL MAKE THE INSTALLATION PROCEDURE EASIER AND HELP YOU INSTALL THE POWERPLANT LINES AND WIRING CORRECTLY.
- DO NOT USE GRAPHITE AND/OR CHALK TO IDENTIFY THE POWERPLANT PARTS AND COMPONENTS. ALSO, DO NOT USE ADHESIVE TAPES: THEIR RESIDUES CAN CAUSE DAMAGE TO OR DECREASE THE STRENGTH OF THE SURFACES ON WHICH THEY ARE APPLIED, WHEN THE ENGINE OPERATION INCREASES THEIR TEMPERATURE. IF ADHESIVE TAPE IS USED, MAKE SURE THE TAPE AND ITS RESIDUES ARE FULLY REMOVED (USE SOLVENT AMS-3160) BEFORE YOU DO AN ENGINE START.
- CORRECTLY SEAL WITH CAPS ALL OPEN TUBES AND ELECTRICAL CONNECTIONS IMMEDIATELY AFTER YOU DISCONNECT THEM. USE PROTECTION PLUGS/CAPS WITH DIFFERENT FLANGES. THIS IS TO MAKE IT NOT POSSIBLE TO CONNECT UNITS BACK INTO POSITION WITH SUCH PLUGS AND COVERS INSTALLED.
- DO NOT LET ELECTRICAL CONNECTORS AND RECEPTACLES STAY OPEN. DAMAGE AND ENTRANCE OF MOISTURE AND DIRT CAN OCCUR.

(1) Release the screws (6) and washers (7) that attach the protective cap (5) of the generator electrical cables (2) to the two generators.

(2) NOTE: Each generator, in the same engine, has a specific position where to connect the electrical cables. Correctly identify the electrical cables (2) to make sure that they will be installed correctly.

Release and remove the nuts (4), and washers (3), and disconnect the electrical cables (2) from the two generators.

(3) Disconnect the electrical connectors (1) from the two generators.

(4) At the two engines, release the screws (15) and washers (14) that attach the clamp (16) of the FADEC A harness (47).

(5) At the two engines, release the screws (105) and washers (106) that attach the clamps (104) of the generator electrical harness (102) to the electrical cable support (8).

(6) At the left engine, release the screws (95), washers (96) and nut (93) that attach the clamp (94) of the generator electrical harness (102).

(7) (For hydraulic hoses with clamp P/N MS21919WCH13 installed) At the left engine, release the screws (99), washers (98) and nut (97) that attach the clamp (107) of the FADEC A harness to the hydraulic line.

NOTE: See Figure 402, sheet 2 for details.

(8) (For hydraulic hoses with clamp P/N MS21919WCH16 installed) At the left engine, release the screws (108), washers (109) and nut (111) that attach the clamp (110) of the FADEC A harness to the hydraulic line.

NOTE: See Figure 402, sheet 3 for details.

(9) At the right engine, release the tiedown straps that attach the FADEC A harness (47) to the generator electrical harness (102), and release screw (100) and washer (101) that attach the clamps (103) of the FADEC A and generator electrical harness (102) to the engine.

(10) Release the screws (9) and washers, as applicable, that attach the electrical cables supports (8) to the engine.

(11) Release the clamps (10) that connect the flexible ducts (11) between the air inlet and the generators.

(12) At the left engine, release the screws (19), washers (18), and nut (23) that attach the dampener support (17) to the engine.

(13) At the right engine, release the screws (25), washers (26) and nuts (27) that attach the dampener support (24) and the hose support (28) to the engine.

WARNING: THE PHOSPHATE-ESTER-BASE OIL CAUSES INJURY TO THE SKIN AND EYES: ITS VAPORS ARE HIGHLY CORROSIVE. BE CAREFUL NOT TO TOUCH THIS OIL. YOU MUST USE GLOVES AND GOGGLES.

CAUTION: ALWAYS CLEAN THE HYDRAULIC FLUID THAT FALLS FROM THE ENGINE. DAMAGE COULD COME FROM ITS CORROSIVE ACTION.

(14) At the left engine, release the nuts (20) and washers (21) that attach the hydraulic pump (22) to the engine.

(15) At the right engine, release the nuts (31) and washers (30) that attach the hydraulic pump (29) to the engine.

(16) Disconnect the hydraulic pump from the engine and let it hung with the hoses on the aircraft. Discard the O-rings and gasket.

NOTE: Be careful not to let the hydraulic pump shaft behind at the engine. It must be kept together with the hydraulic pump.

(17) At the left engine, release the screws (35), washers (34), and nuts (33) that attach the clamps (36) to the engine.

CAUTION: DRAIN THE FUEL BEFORE YOU DISCONNECT THE FUEL HOSE TO PREVENT FPMU HEATSHIELD CAVITY CONTAMINATION. (REFER TO ROLLS-ROYCE MAINTENANCE MANUAL 73-21-10).

(18) On aircraft PRE-MOD. S.B.145-28-0016, release the nut (32) and disconnect the fuel hose (37) from the FPMU.

(19) On aircraft POST-MOD. S.B.145-28-0016, disconnect the fuel hose (37) from de FPMU. Discard the gasket. Refer to AMM TASK 73-21-01-000-801-A/400.

(20) Install a cap on the FPMU fuel inlet.

(21) Remove the clamp (39) that attaches the engine bleed air system installation (38) to the tube assembly.

CAUTION: ALWAYS REMOVE THE CLAMP (43) AND NOT THE OUTER CUSTOMER SERVICE MANIFOLD (OCSM). THIS IS NOT CORRECT AND DAMAGE CAN OCCUR.

(22) Remove the clamp (43) that attaches the engine bleed tube assembly (42) to the precooler installation.

(23) Remove the clamp (41) to disconnect the engine bleed line (40).

(24) Disconnect the connector (44) of the fire detector sensor installed in the pylon.

(25) Disconnect the fire extinguishing hose (45) from the pylon.

CAUTION: BE CAREFUL NOT TO CAUSE DAMAGE TO THE HARNESS DURING THE REMOVAL OF THE HEAT-SHRINKABLE BOOTS.

(26) On aircraft POST-MOD. S.B.145-24-0007, cut and remove the forward heat-shrinkable boots (46) of FADEC A harness (47) and heat-shrinkable boots (48) and (49) of the indication harness (50).

(27) On aircraft POST-MOD. S.B.145-24-0007, cut and remove the aft heat-shrinkable boot (55) of the FADEC B harness (56) and fire extinguishing harness (54).

(28) On the aircraft with the thrust reverser installed and an aircraft POST-MOD. S.B. 145-24-0007, cut and remove the heat-shrinkable boots (52), (53), (51), and (55) of the thrust reverser harness.

(29) Disconnect the electrical connectors of FADEC A (47) and indication harness (50) installed in the pylon.

(30) Disconnect the electrical connectors of the fire extinguisher harness (54) and of the FADEC B harness (56) installed in the pylon.

(31) Disconnect the electrical connectors of the thrust reverser harness from the pylon, if applicable.

(32) Disconnect the aft and the forward bonding strap supports (57) from the engine.

WARNING: THE PHOSPHATE-ESTER-BASE OIL CAUSES INJURY TO THE SKIN AND EYES: ITS VAPORS ARE HIGHLY CORROSIVE. BE CAREFUL NOT TO TOUCH THIS OIL. YOU MUST USE GLOVES AND GOGGLES.

CAUTION: • ALWAYS CLEAN THE HYDRAULIC FLUID THAT FALLS FROM THE ENGINE. DAMAGE COULD COME FROM ITS CORROSIVE ACTION.

• CORRECTLY IDENTIFY THE THRUST REVERSER HYDRAULIC LINES IF YOU MUST REMOVE THEM. MAKE MARKS TO SHOW THEIR POSITIONS. THIS WILL MAKE THE INSTALLATION PROCEDURE EASIER AND HELP YOU INSTALL THE THRUST REVERSER LINES CORRECTLY.

(33) On aircraft with thrust reverser installed, release the screws (59) and washers (58) that attach the support (60) of the hydraulic lines to the thrust reverser and release the nuts (61).

CAUTION: • TO ADJUST THE ENGINE ASSEMBLY LIFTING ADAPTER, SEE THE ENGINE CONFIGURATION (WITH OR WITHOUT THRUST REVERSER AND AIR INTAKE).

• OBEY THE INSTRUCTIONS OF FIGURE 402, SHEET 14, FOR THE CORRECT INSTALLATION OF THE ENGINE ASSEMBLY LIFTING ADAPTER.

(34) Connect the engine assembly lifting adapter (62) to the hydraulic crane (63).

(35) Connect the aft engine lifting adapter (65) and the forward lifting adapter (64) to the engine assembly lifting adapter (62).

(36) Connect the aft engine lifting adapter (65) to the aft lifting points and the forward lifting adapter (64) to the forward lifting point.

CAUTION: • FOR ENGINES PRE-MOD SB ROLLS-ROYCE 72-289, PUT THE SAFETY STRAP, TOGETHER WITH THE SUPPORT PLATE, THE RING AND THE SHACKLE, AROUND THE FRONT FRAME OF THE ENGINE. THEY WILL SUPPORT THE ENGINE IF A HARDWARE FAILURE OCCURS. OBEY THE INSTRUCTIONS OF FIGURE 402, SHEET 14, FOR THE CORRECT INSTALLATION OF THE SAFETY STRAP AND ITS COMPONENTS.

• BE VERY CAREFUL WHEN YOU MOVE THE ENGINE BECAUSE OF ITS LARGE WEIGHT.

(37) Slowly and carefully operate the hydraulic crane (63) to keep the engine tightly held by the lifting adapters.

NOTE: Make sure that the engine is level while it is lowered.

(38) At the aft lower mount, remove the cotter pin (78), nut (77), washers (76), bolt (73), washer (74), and bushing (75). Discard the cotter pin (78).

(39) At the forward lower mount, remove the bolts (70) and (82), washers (71) and (81), lockplates (80) and (69), cotter pin (83), nut (66), washer (79), bolt (68), washer (72), and bushing (67). Discard the cotter pin (83).

(40) At the aft upper mount, remove the cotter pin (78), nut (77), washers (76), bolt (73), washer (74), and bushing (75). Discard the cotter pin (78).

(41) At the forward upper mount, remove the bolts (70) and (82), washers (71) and (81), lockplates (80) and (69), cotter pin (83), nut (66), washer (79), bolt (68), washer (72), and bushing (67). Discard the cotter pin (83).

CAUTION: WHEN YOU LIFT/REMOVE THE ENGINE, BE CAREFUL NOT TO LET CONNECTIONS, TUBES, AND ELECTRICAL WIRING STAY CONNECTED.

(42) Slowly and carefully operate the hydraulic crane (63) to lift the engine. Move the hydraulic crane as necessary to get the engine away from the pylon.

(43) If applicable, remove the thrust reverser assembly (AMM TASK 78-31-01-000-801-A/400) or the exhaust assembly (AMM TASK 78-11-01-000-801-A/400), as applicable, and the air intake assembly (AMM TASK 71-60-01-000-801-A/400).

(44) To install the engine on the maintenance stand (86), install the aft engine lifting adapter (85) and the forward support adapter (87) to the engine.

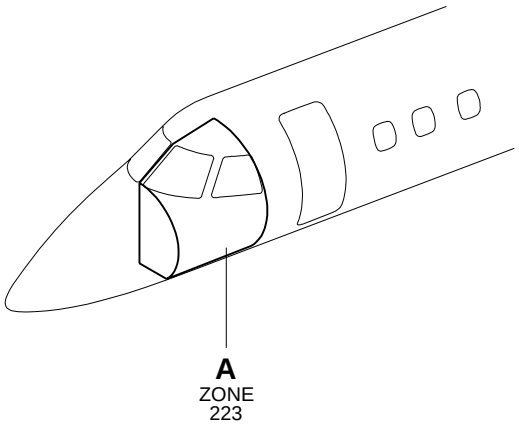
NOTE: To install the engine on the maintenance stand, first remove the thrust reverser assembly (AMM TASK 78-31-01-000-801-A/400) or the exhaust assembly (AMM TASK 78-11-01-000-801-A/400), as applicable, and the air intake assembly (AMM TASK 71-60-01-000-801-A/400).

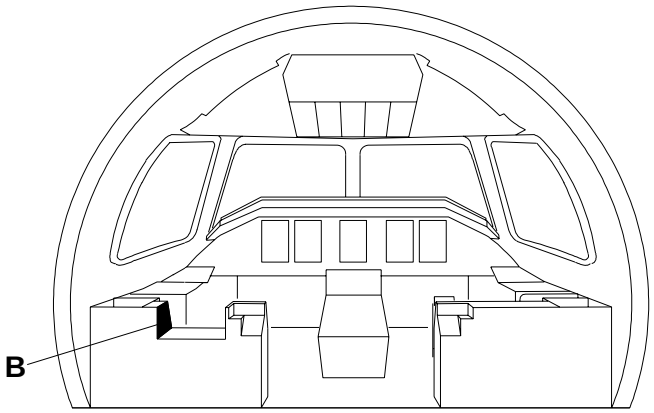
(45) Remove the hydraulic crane (63).

(46) Make sure that all open connections on the engine and in the pylon are sealed with protection plugs or caps.

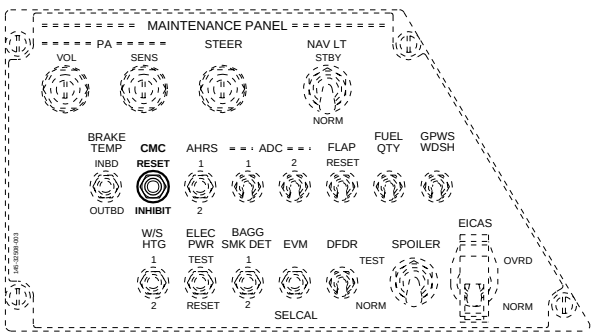
EFFECTIVITY: ALL

Maintenance Panel - Component Locations
Figure 401



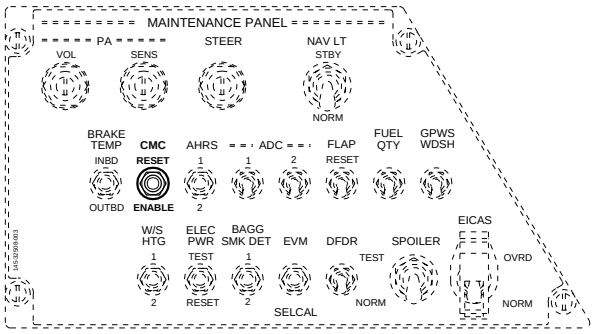


DET. A



DET. B

PRE-MOD SB 145-45-0001

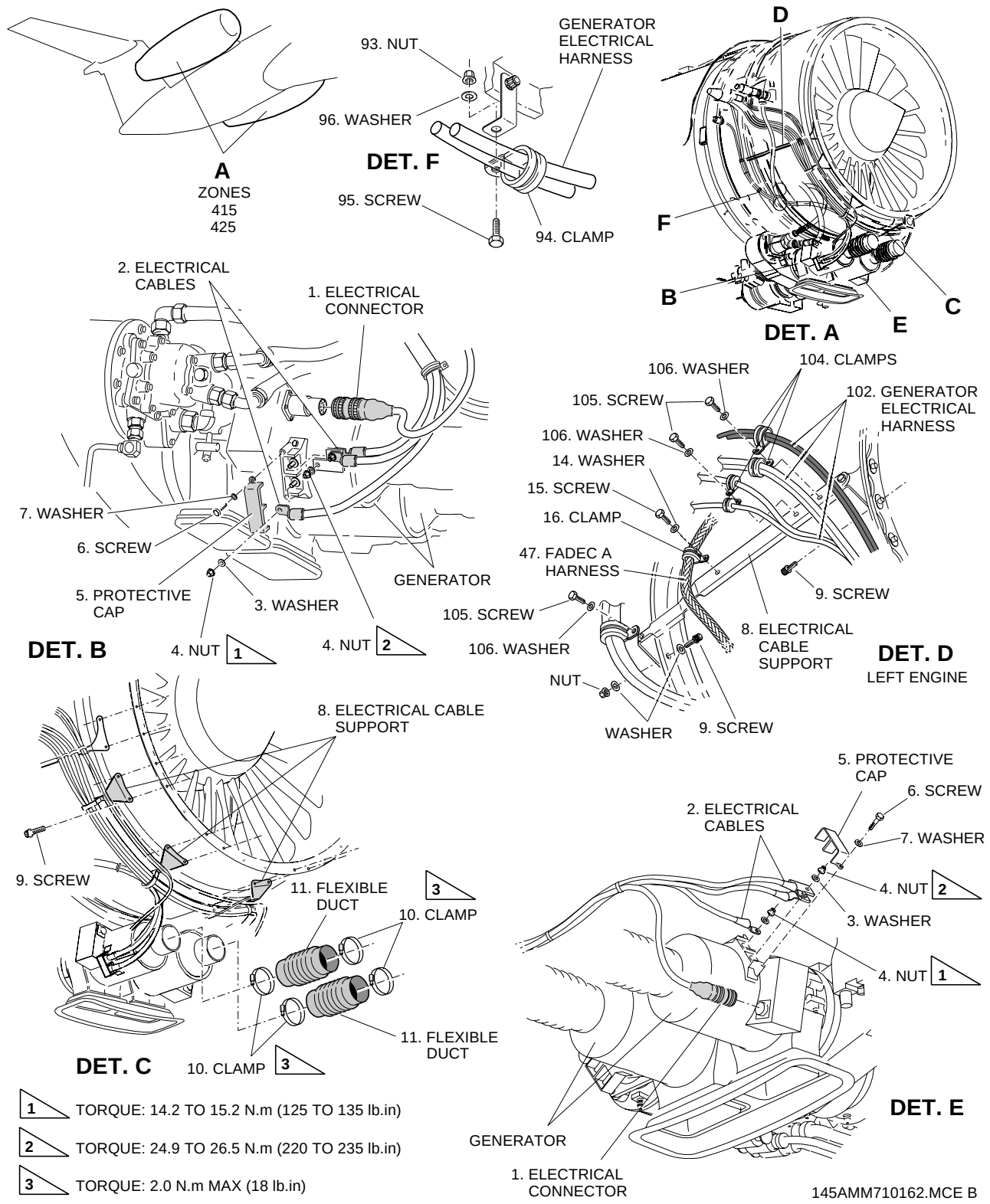


DET. B

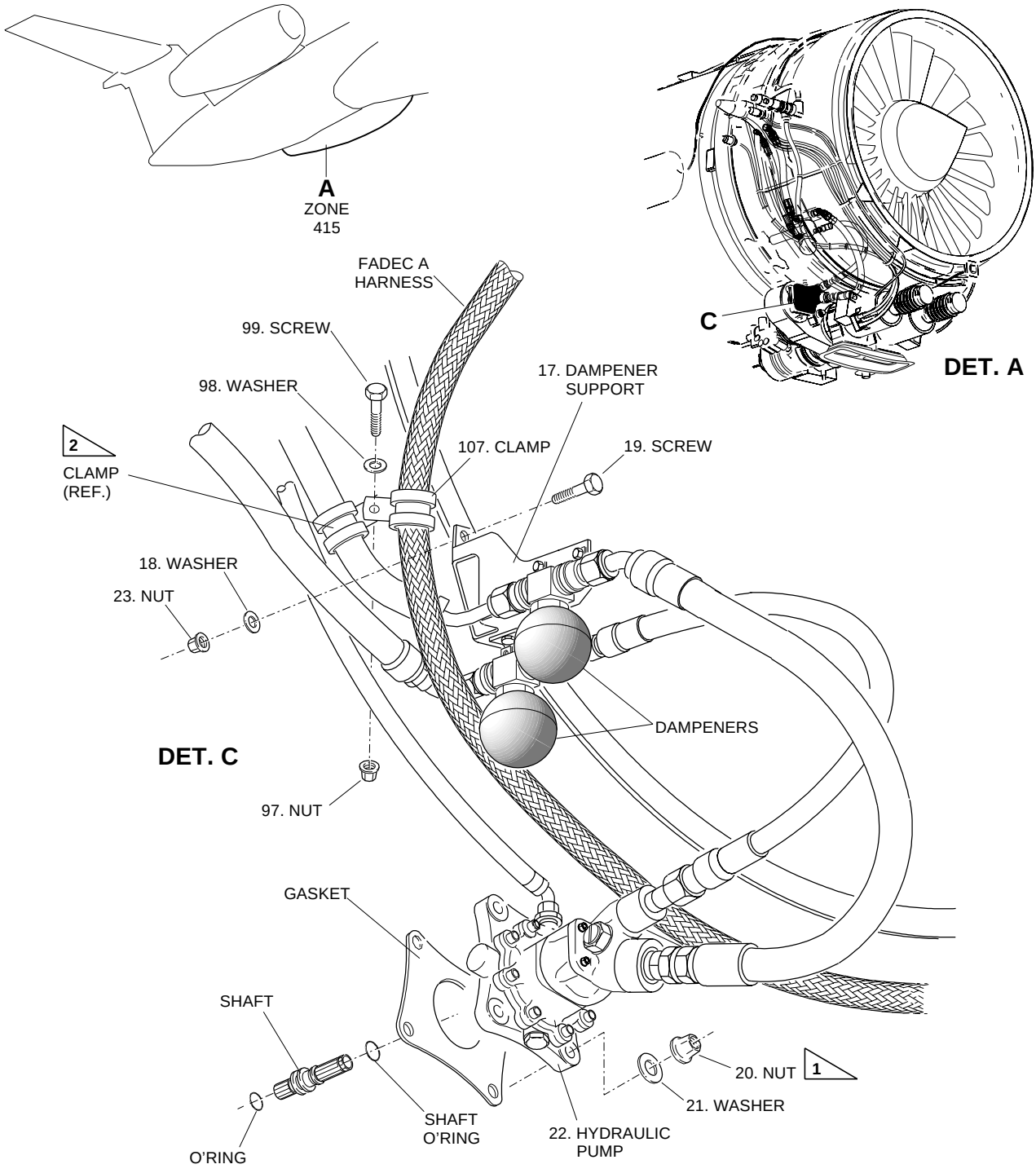
POST-MOD SB 145-45-0001

145AMM710186.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 1



EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 2

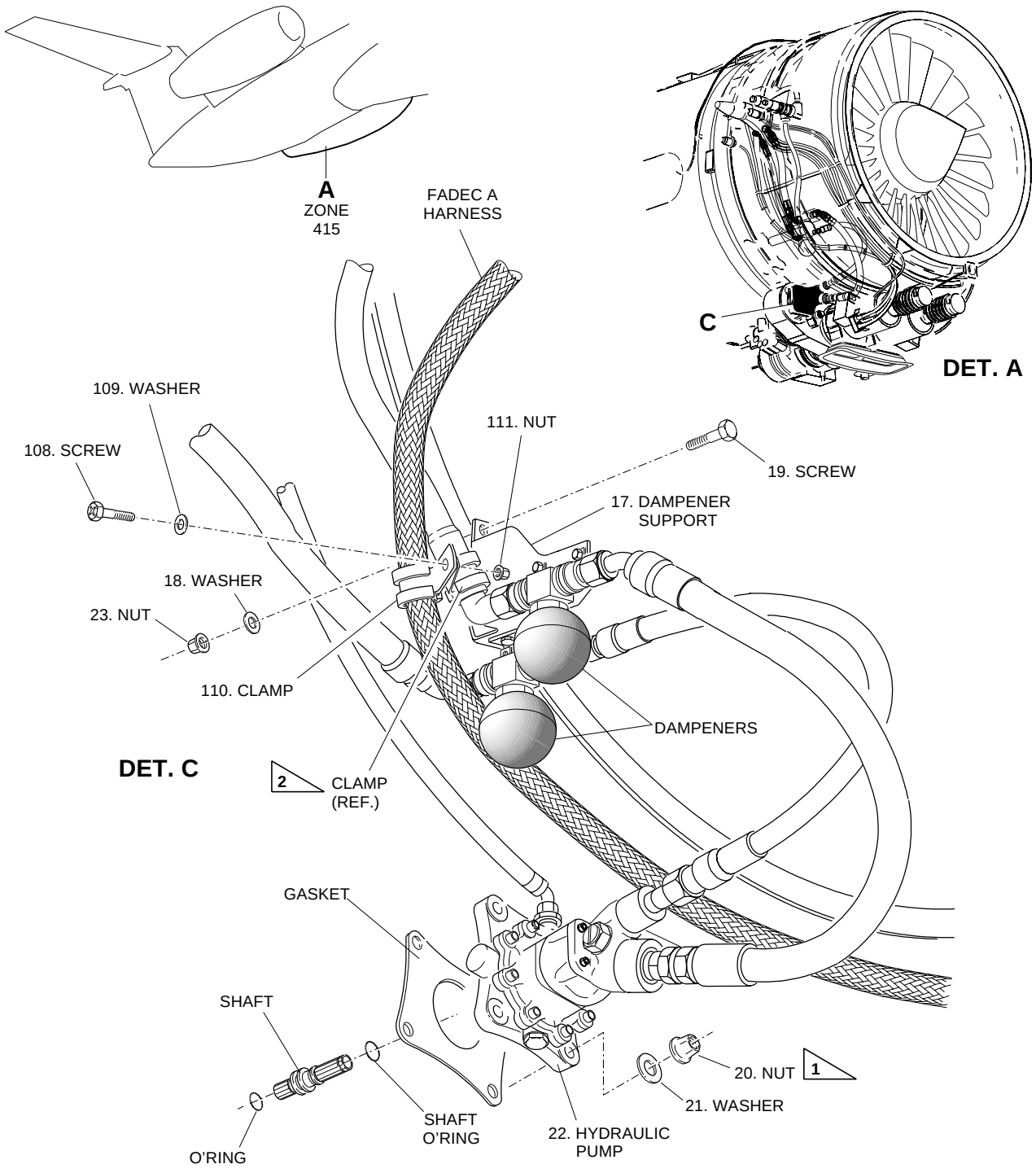


1 TORQUE VALUE: 16.9 TO 19.2 N.m (150 TO 170 lb.in)

2 CLAMP P/N MS21919WCH13

EM145AMM710171B.DGN

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 3

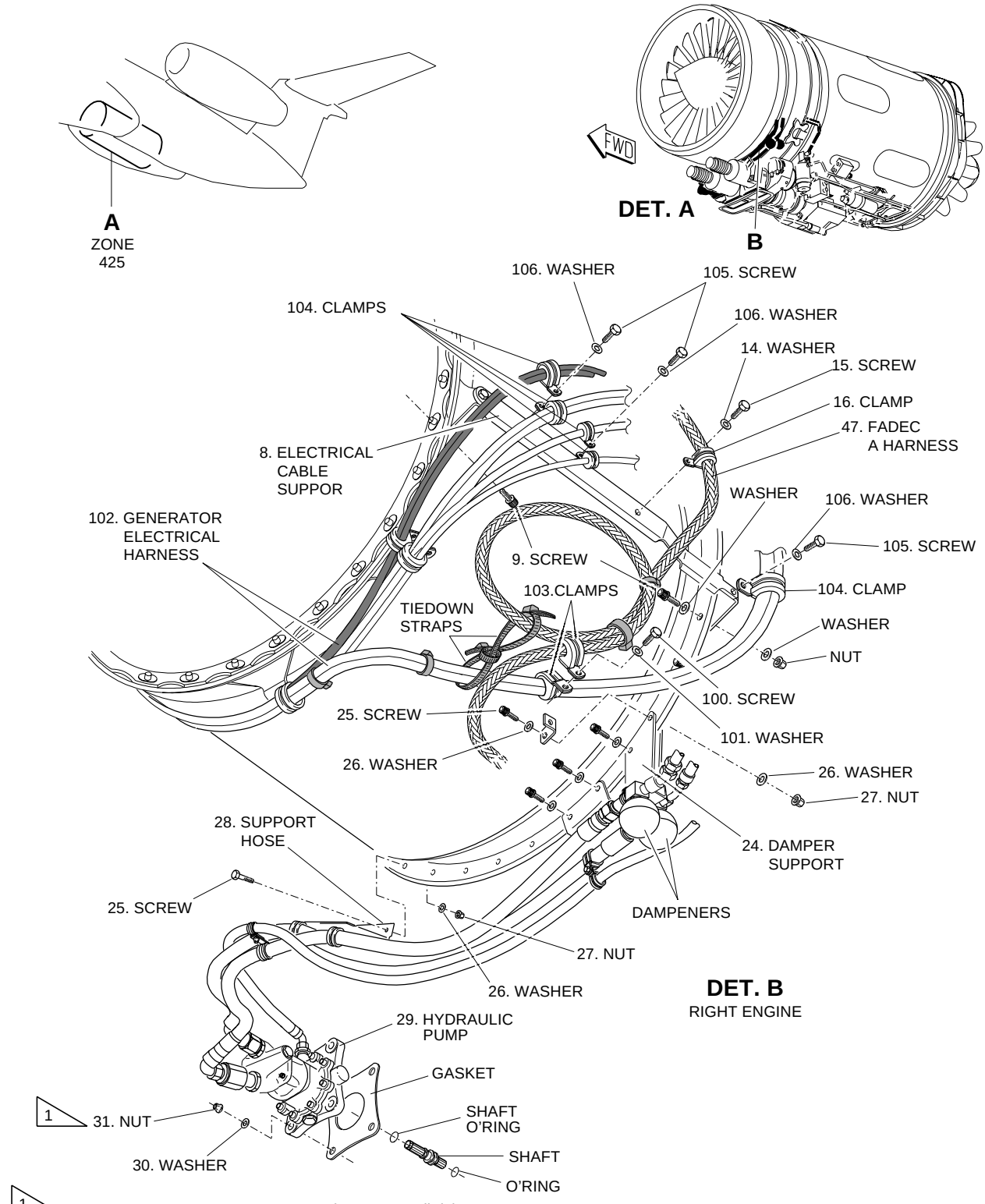


1 TORQUE VALUE: 16.9 TO 19.2 N.m (150 TO 170 lb.in)

2 CLAMP P/N MS21919WCH16

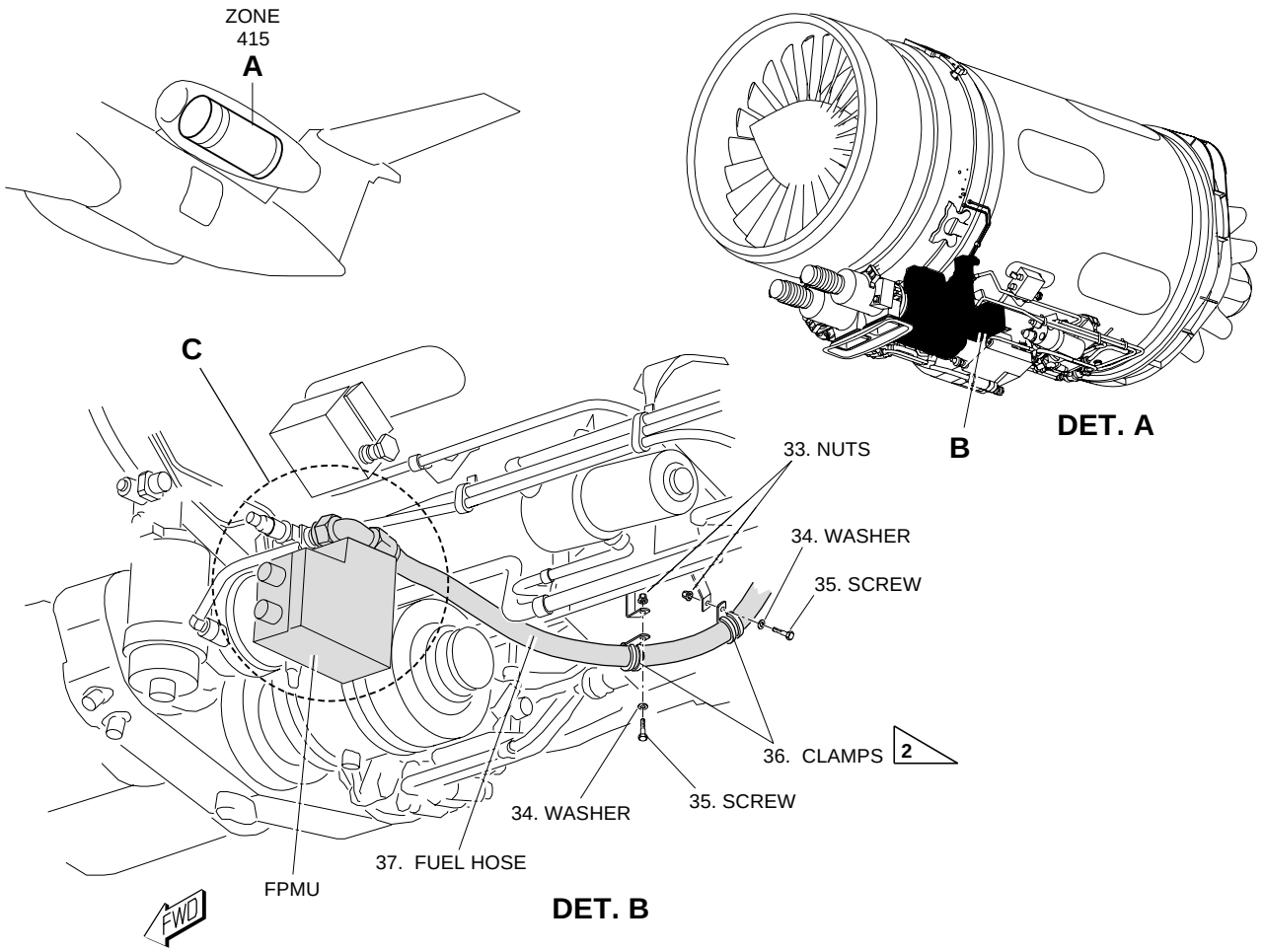
EM145AMM710236A.DGN

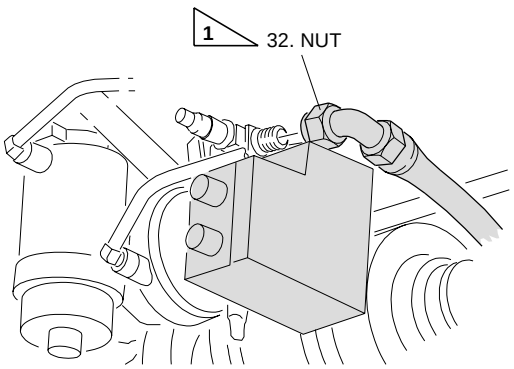
EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 4



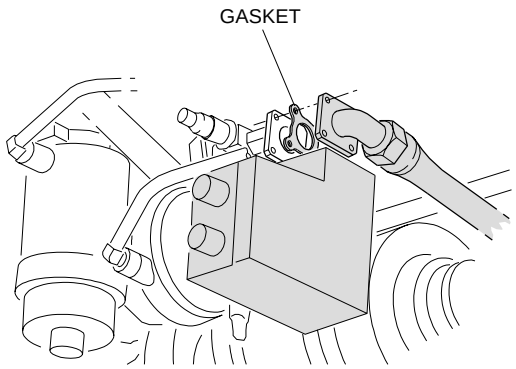
EM145AMM710172C.DGN

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 5





DET. C
PRE−MOD SB 145−28−0016



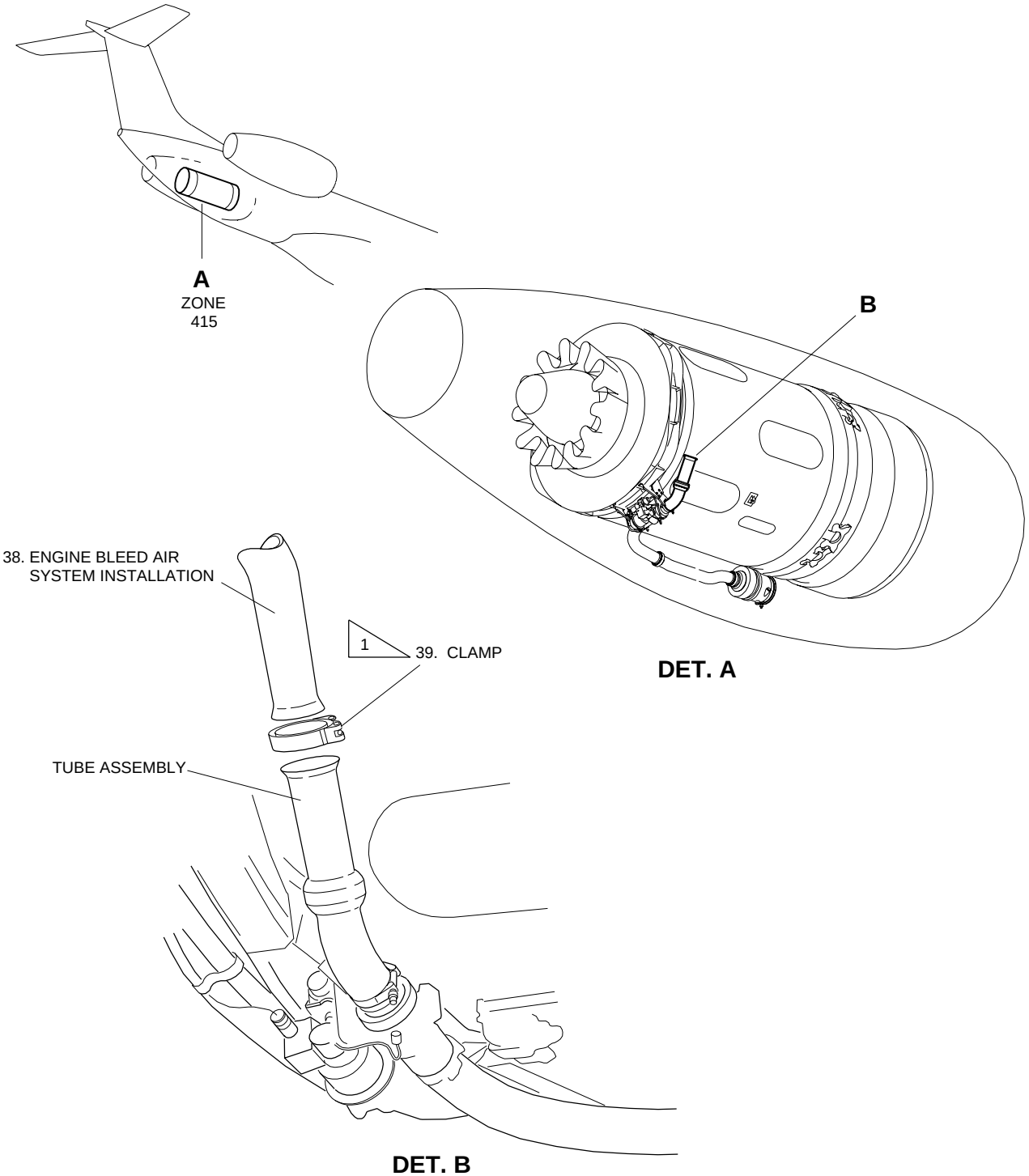
DET. C
POST−MOD SB 145−28−0016

1 TORQUE VALUE: 56,5 TO 79 N.m (500 TO 700 lb.in).

2 APPLICABLE ONLY TO LEFT ENGINE.

EM145AMM710173B.DGN

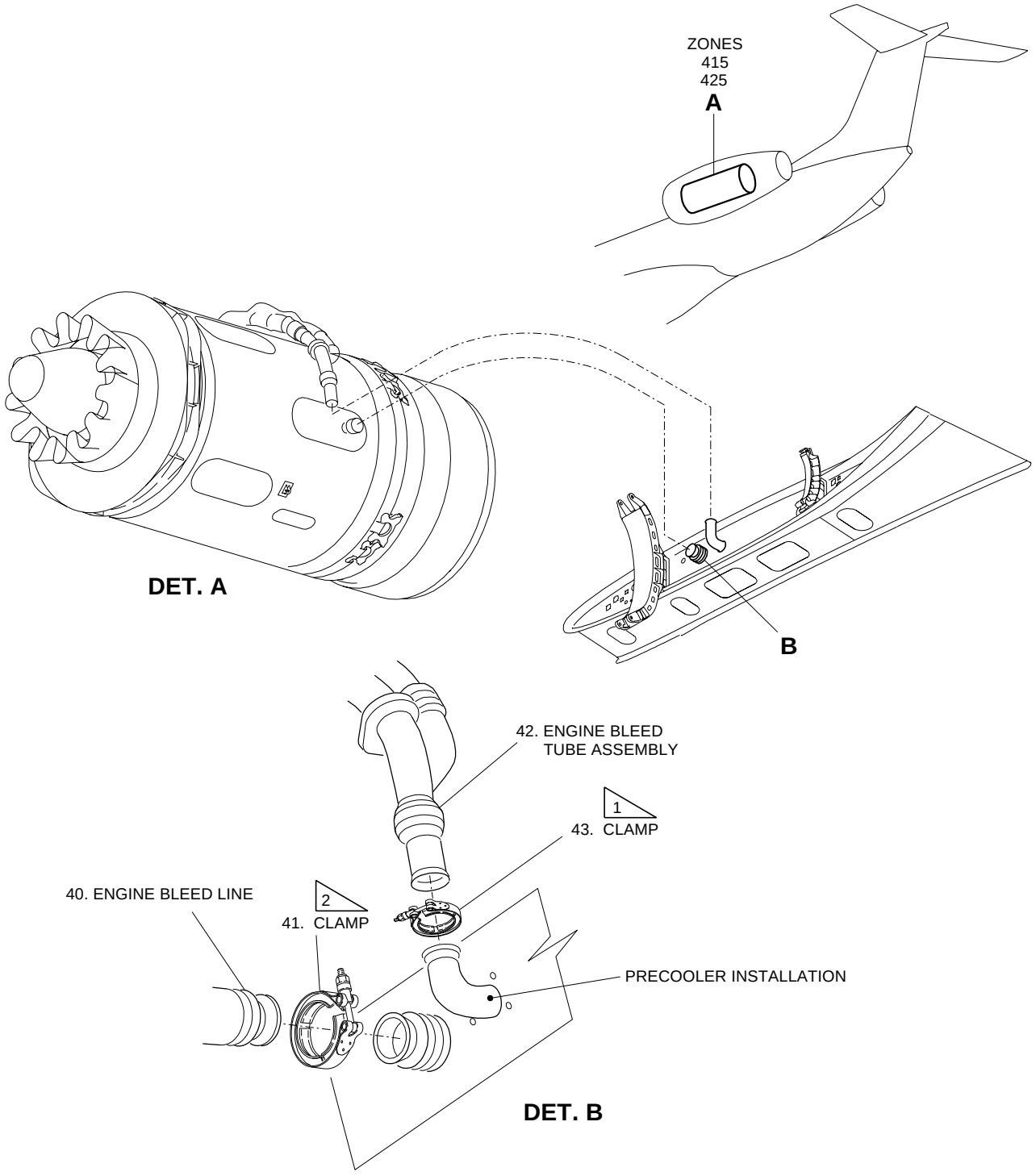
EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 6



1 TORQUE: 5.0 TO 5.3 Nm (45 TO 47 lb.in)

145AMM710174.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 7

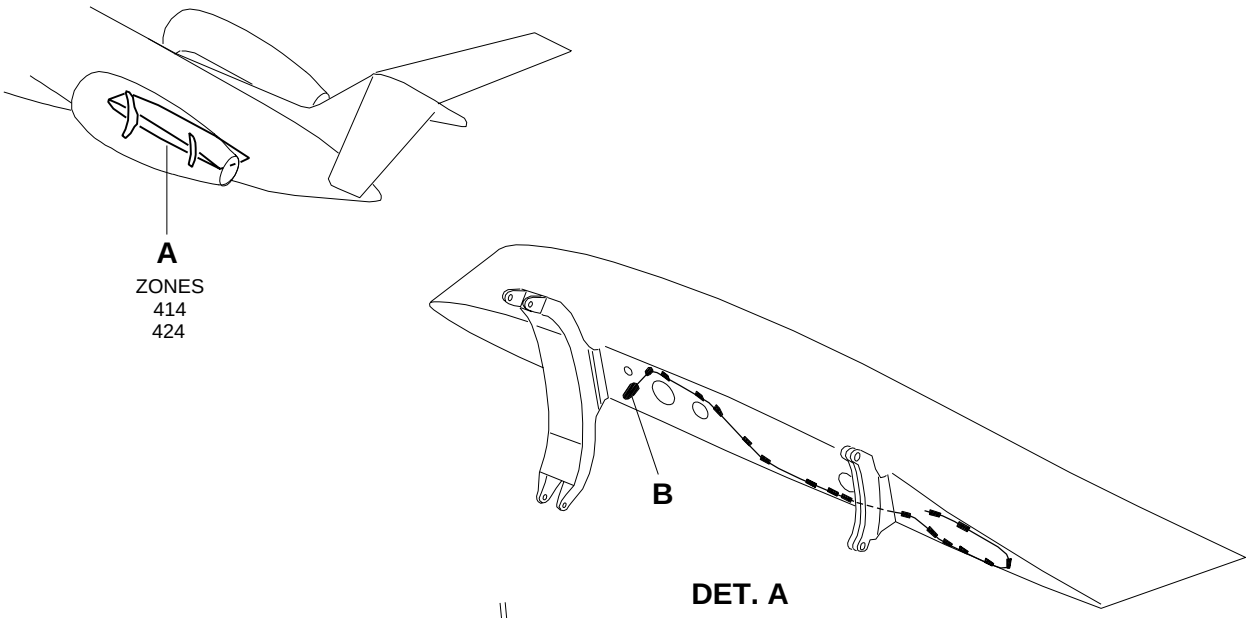


1 TORQUE: 5.7 TO 6.2 N.m (50 TO 55 lb.in)

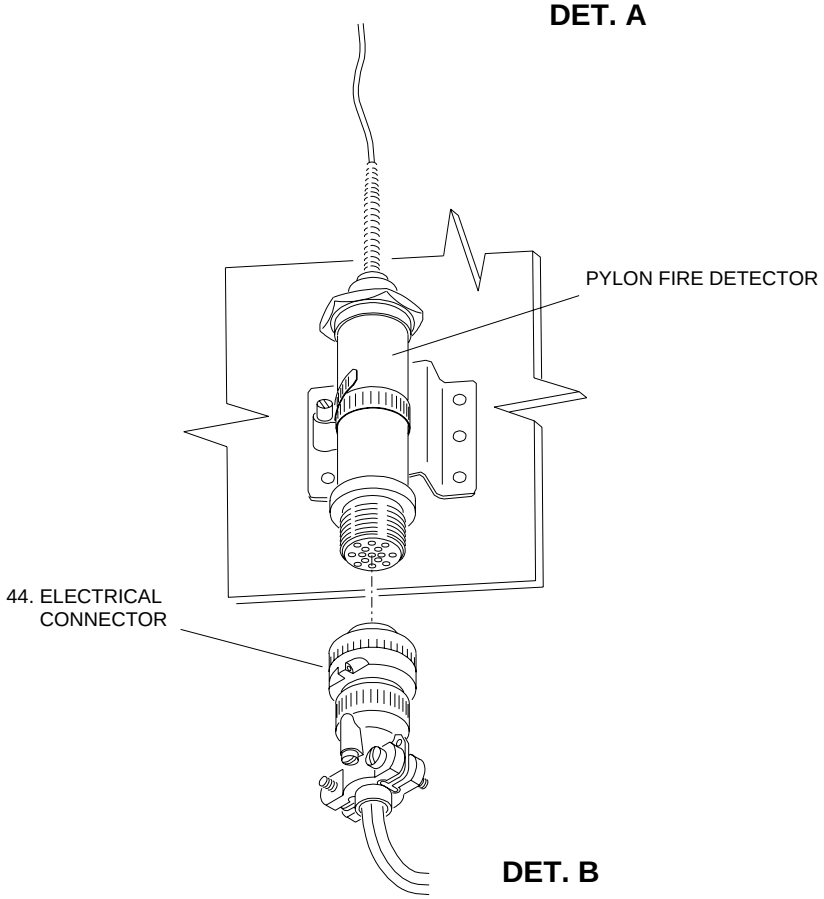
2 TORQUE: 3.95 TO 4.5 N.m (35 TO 40 lb.in)

EM145AMM710175A.DGN

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 8



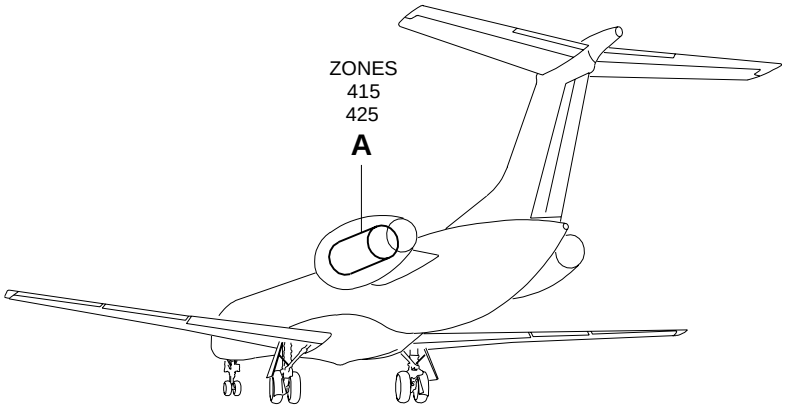
DET. A

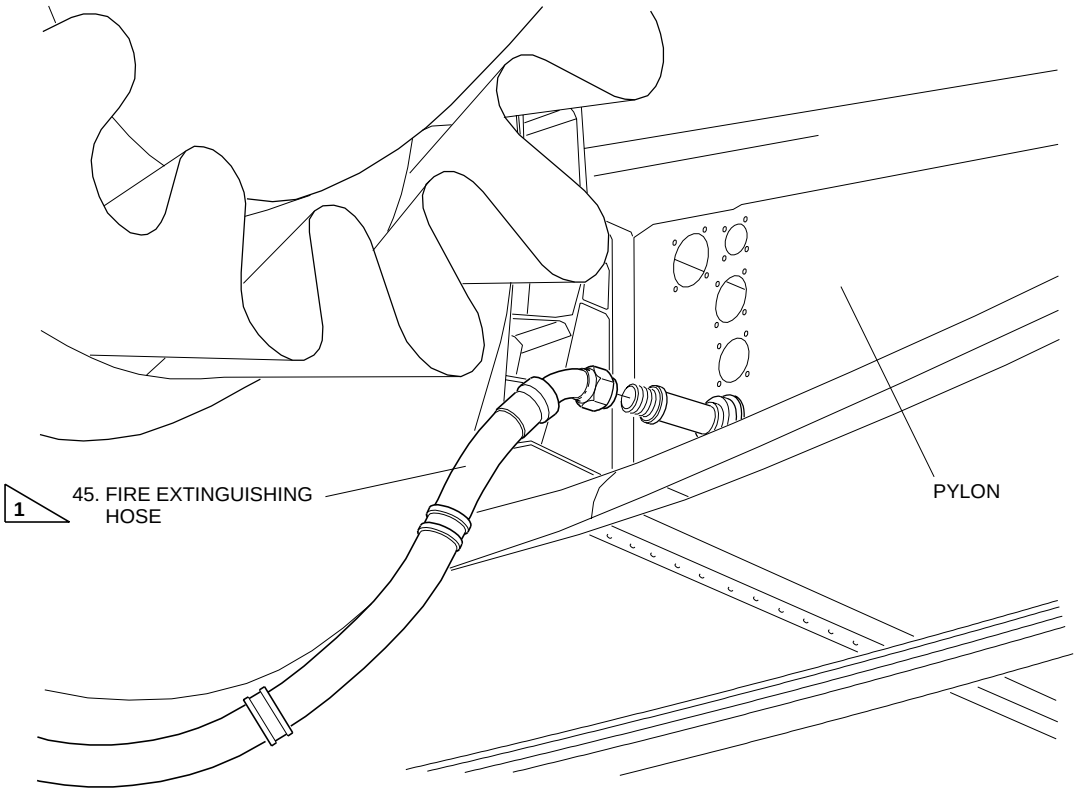


DET. B

145AMM710176.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 9



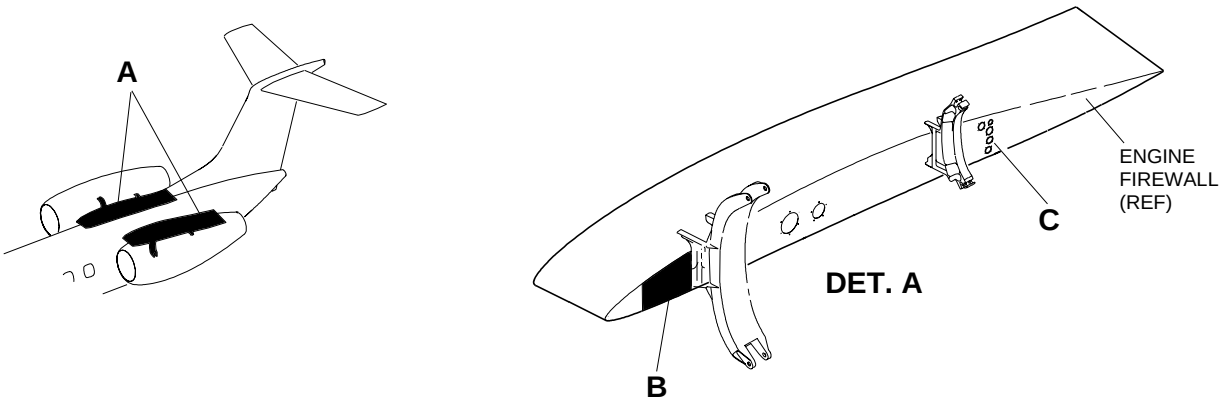


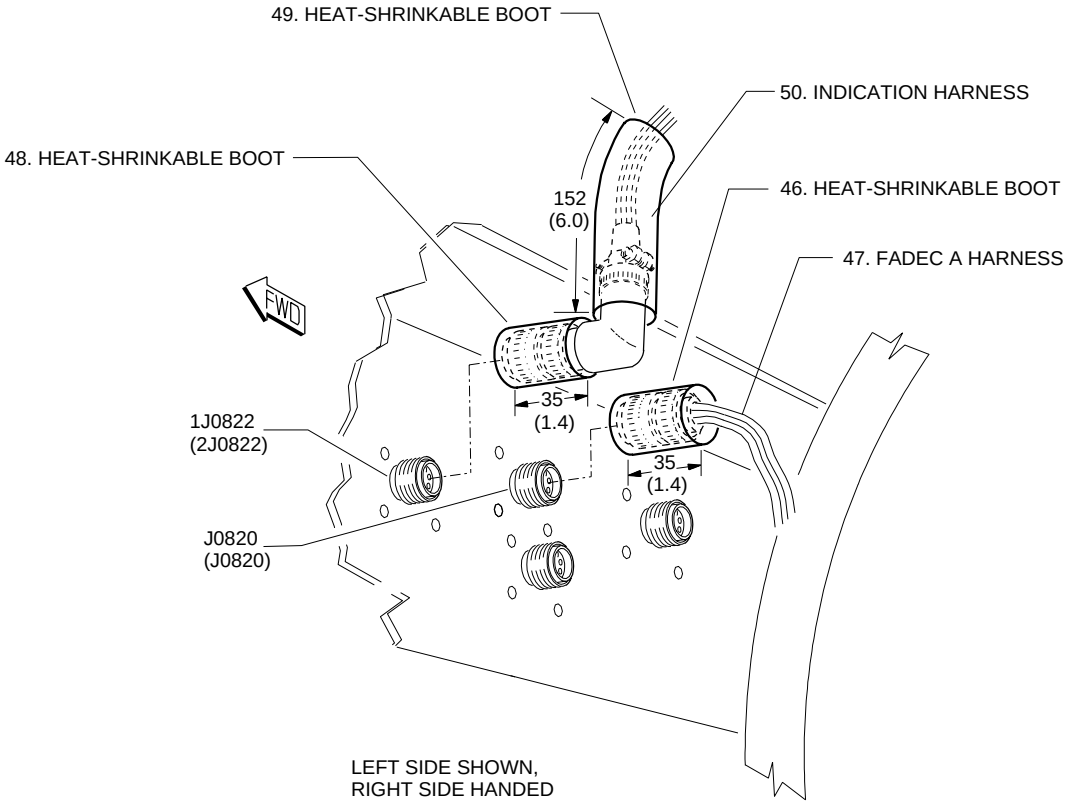
DET. A

1 TORQUE: 45.2 TO 67.8 N.m (400 to 600 lb.in)

145AMM710177.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 10



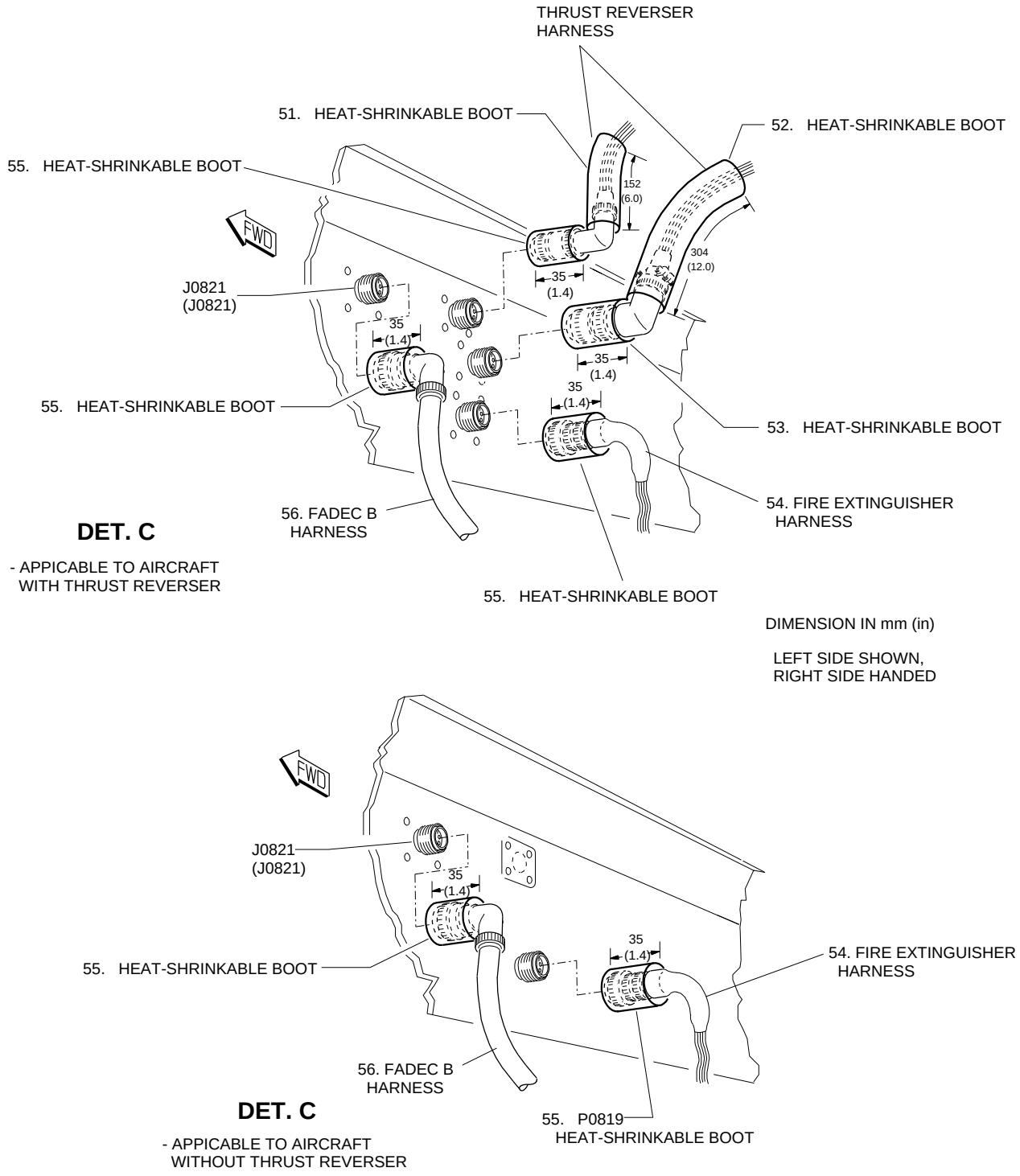


DET. B

DIMENSION IN mm (in)

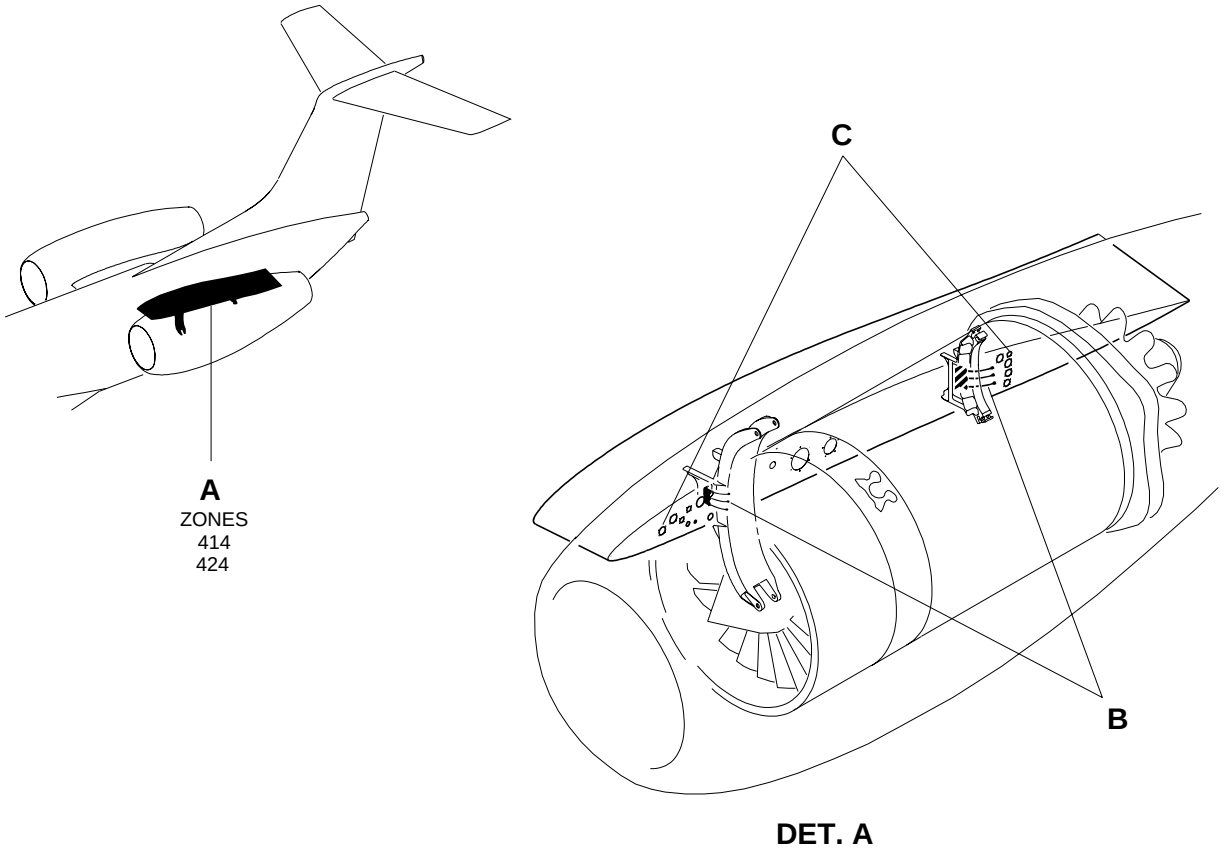
145AMM710178.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 11

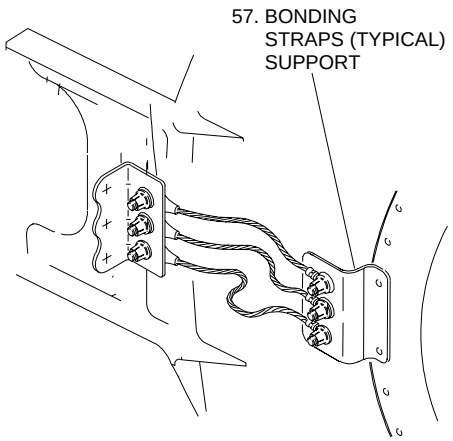


145AMM710179.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 12



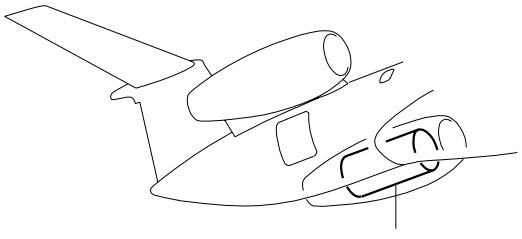
DET. A

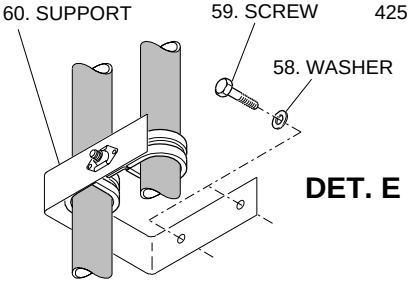


DET. B

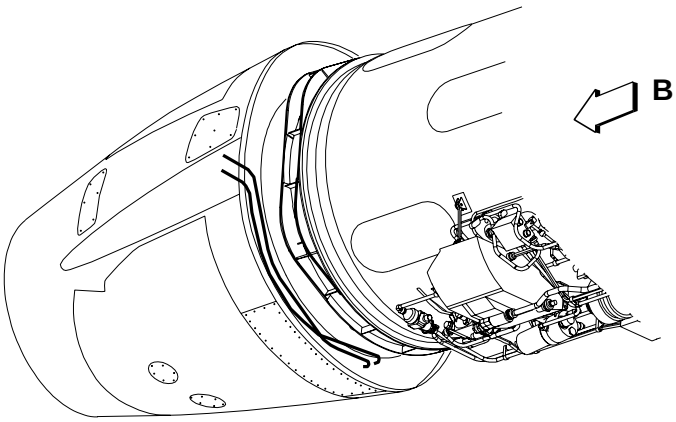
145AMM710180.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 13

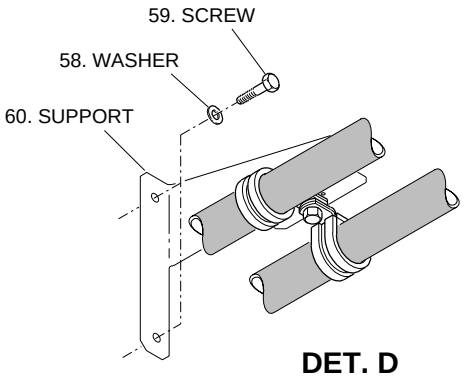




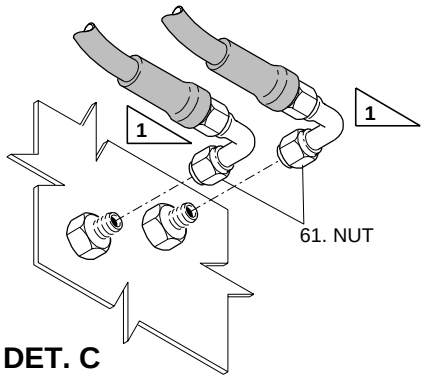
DET. E



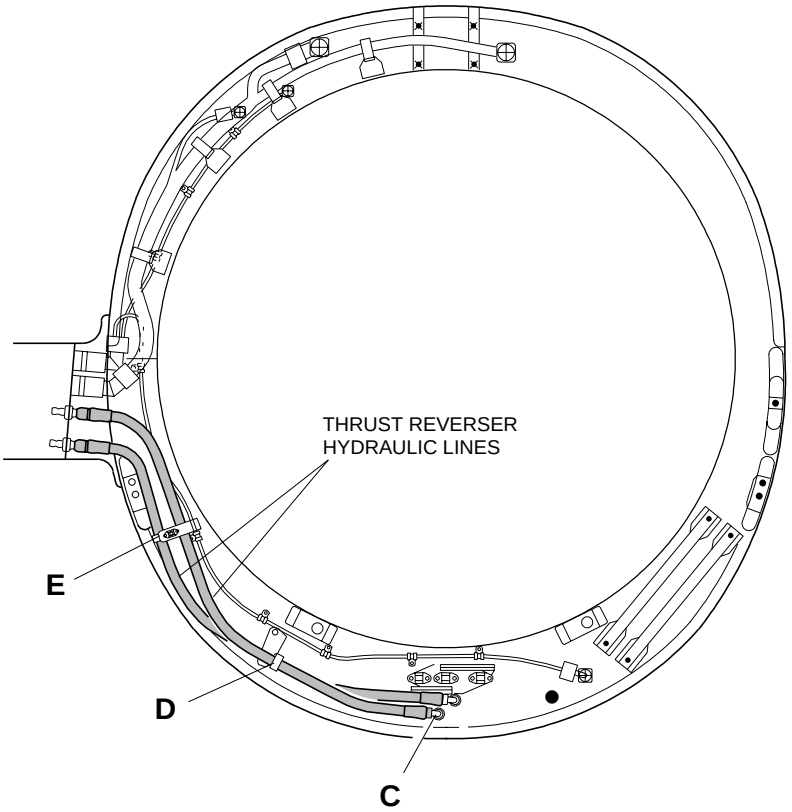
DET. A



DET. D



DET. C

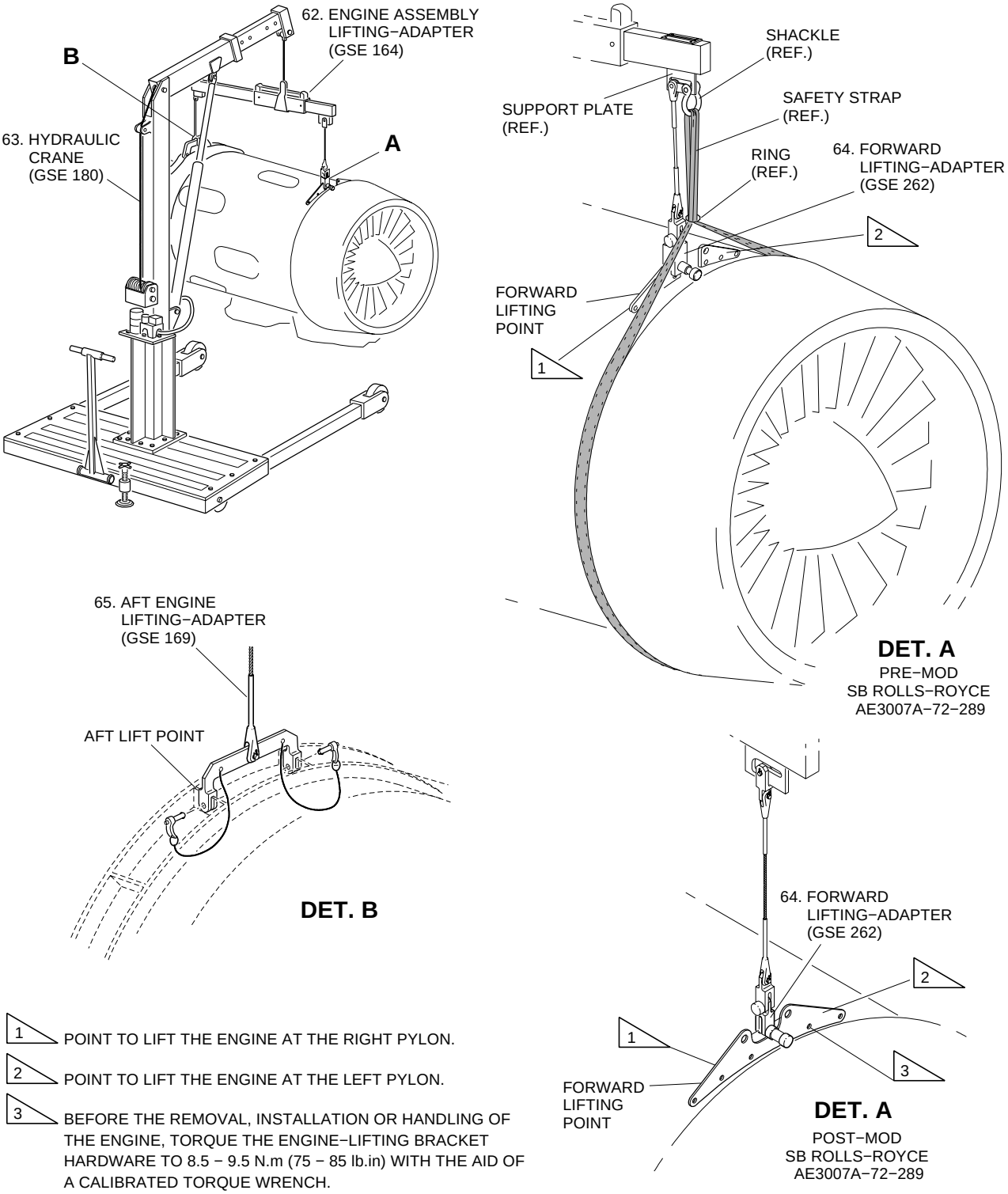


VIEW B

1 TORQUE: 30.5 N.m (270 lb.in)

145AMM710181.MCE A

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 14



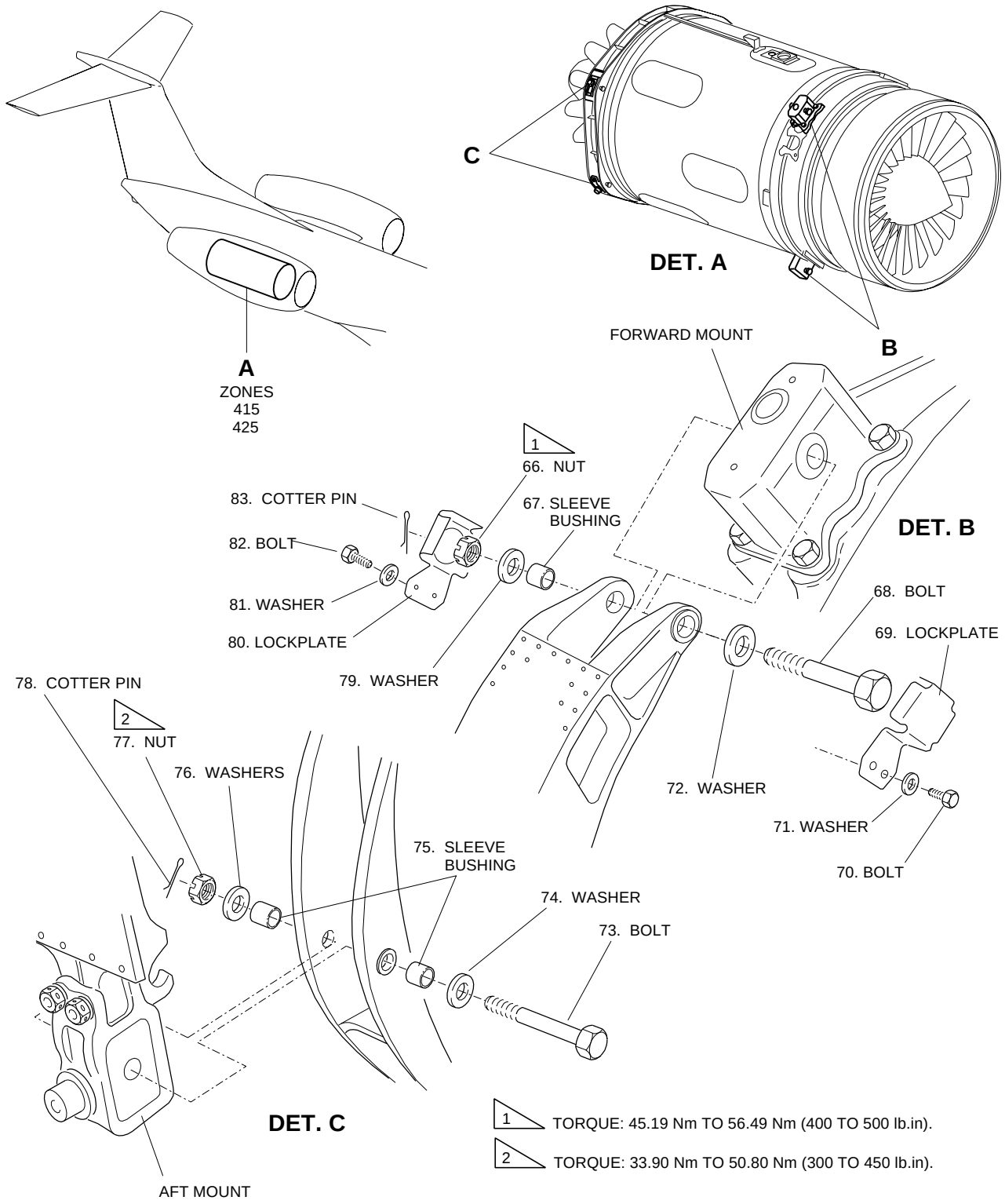
1 POINT TO LIFT THE ENGINE AT THE RIGHT PYLON.

2 POINT TO LIFT THE ENGINE AT THE LEFT PYLON.

3 BEFORE THE REMOVAL, INSTALLATION OR HANDLING OF THE ENGINE, TORQUE THE ENGINE−LIFTING BRACKET HARDWARE TO 8.5 − 9.5 N.m (75 − 85 lb.in) WITH THE AID OF A CALIBRATED TORQUE WRENCH.
TO MAKE SURE THAT THE TORQUE IS CORRECT, MOVE THE NUT 3 TURNS BACK AND THEN APPLY THE TORQUE REQUIREMENTS.

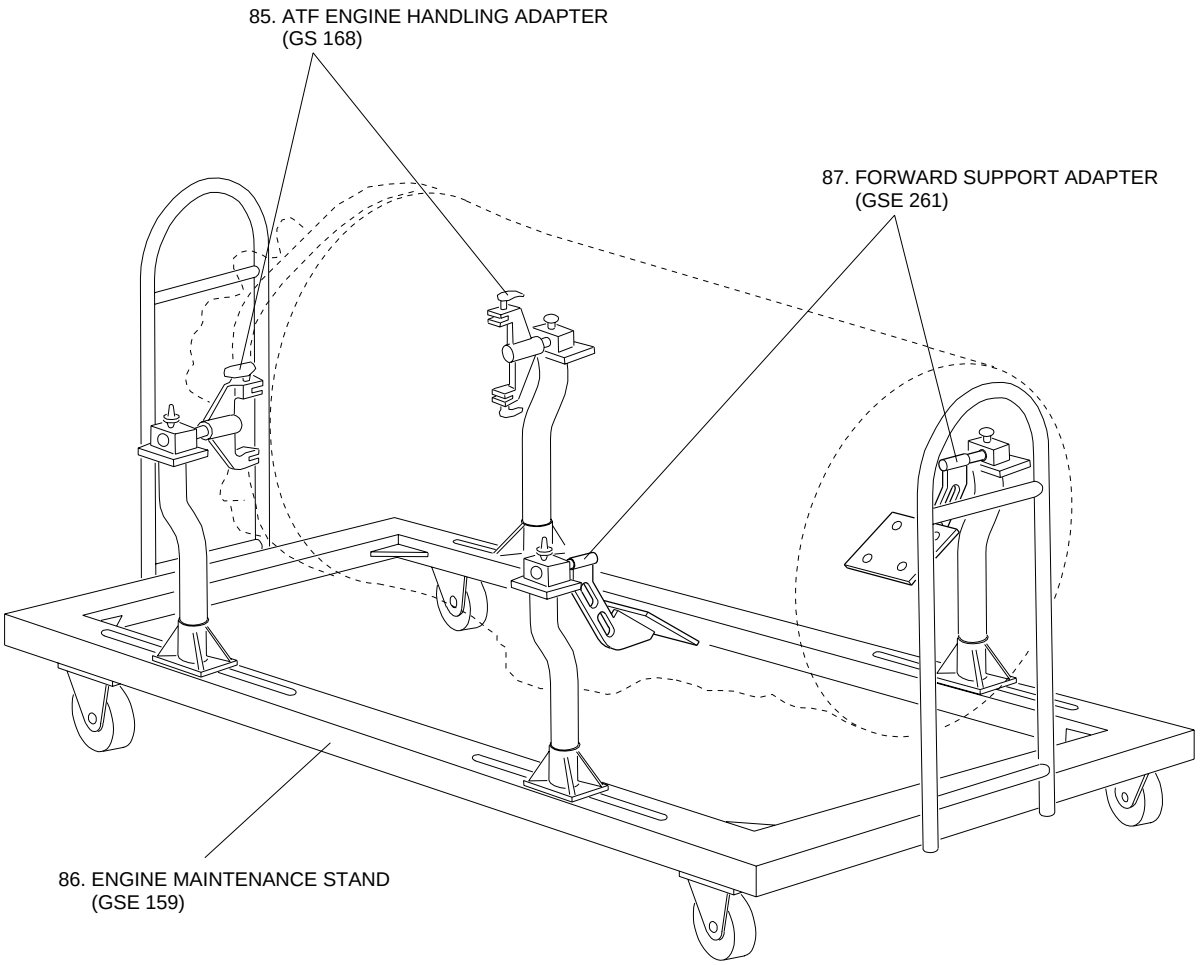
EM145AMM710234B.DGN

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 15



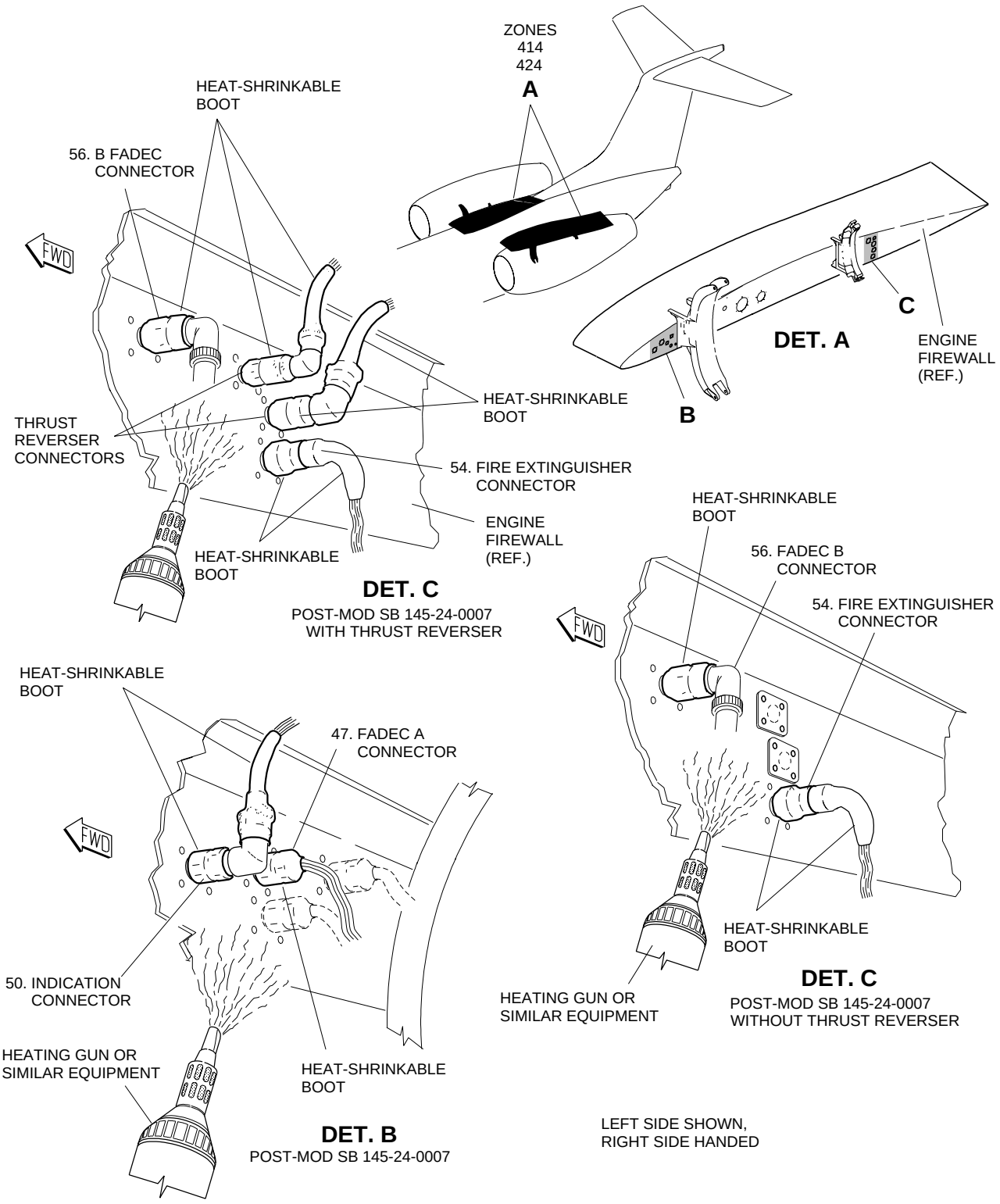
145AMM710183C.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 16



145AMM710184.MCE

EFFECTIVITY: ALL
Engine - Removal/Installation
Figure 402 - Sheet 17



145AMM710185.MCE A

TASK 71-00-00-400-801-A
EFFECTIVITY: ALL

3. ENGINE - INSTALLATION

A. General

(1) This task gives the procedures to install the engine.

B. References

REFERENCE	*DESIGNATION*
AMM TASK 20-10-10-910-801-A/200	V-BAND CLAMPS - INSTALLATION
AMM TASK 20-13-21-700-801-A/200	ELECTRICAL BONDING TEST - STANDARD PROCEDURES
AMM TASK 20-13-21-910-801-A/200	TYPES OF ELECTRICAL BONDING AND SURFACE PREPARATION - STANDARD PROCEDURES
AMM TASK 20-13-21-910-802-A/200	ELECTRICAL BONDING PROTECTION - STANDARD PROCEDURES
AMM TASK 71-00-00-700-801-A/500	ENGINE DYNAMIC CHECKS
AMM TASK 71-11-01-400-801-A/400	ENGINE UPPER COWLING - INSTALLATION
AMM TASK 71-13-01-400-801-A/400	APRON - INSTALLATION
AMM TASK 71-51-01-200-801-A/600	ENGINE HARNESS - VISUAL INSPECTION
AMM TASK 71-60-01-400-801-A/400	ENGINE AIR INTAKE - INSTALLATION
AMM TASK 71-71-01-100-801-A/700	ENGINE DRAIN LINES - CLEANING
AMM TASK 73-21-01-400-801-A/400	FPMU - INSTALLATION
AMM TASK 78-11-01-400-801-A/400	ENGINE EXHAUST NOZZLE - INSTALLATION
AMM TASK 78-31-01-400-801-A/400	THRUST REVERSER - INSTALLATION
AMM TASK 78-31-01-980-801-A/200	LOCK/UNLOCK THE TR EXHAUST DOOR - STOWED POSITION
AMM TASK 78-33-01-980-801-A/200	ISOLATION CONTROL UNIT - INHIBITION PROCEDURES
IPC 28-21-00	SUPPLY SYSTEM
IPC 29-10-03	ENGINE DRIVEN PUMP
IPC 71-20-00	ENGINE MOUNTS
IPC 71-50-00	ENGINE HARNESS
IPC ADDITIONAL CROSS-REFERENCE TABLE	-
Rolls-Royce Maintenance Manual CSP34022	-
S.B.145-24-0007	-
S.B.145-28-0016	-
S.B.145-45-0001	-
WM 20-10-00	-
WM 34-90-00	-

C. Zones and Accesses

Not Applicable

D. Tools and Equipment

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
GSE 164	Engine Assembly Lifting Adapter	To lift and install the engine	
GSE 169	Aft Engine Handling Adapter	To lift and remove the engine	
GSE 180	Hydraulic crane	To remove the engine	
GSE 262	Forward Lifting Adapter	To lift and remove the engine	
Commercially available	Torque Wrench (For the torque range, refer to Figure 402)	To apply torque	
Commercially available	Crowfoot Wrench	To disconnect/connect fuel hose fitting	
Commercially available	Heating gun	To shrink the original heat-shrinkable boot size	
Commercially available	Safety strap P/N 3383T531 from McMaster-Carr, made of nylon, with a length of 4.27 m (14 ft), or similar	To give a secondary device to prevent injury to personnel during the engine lifting.	
Commercially available	Shackle P/N 3663T42 from McMaster-Carr, or similar	To be used together with safety strap.	
Commercially available	Ring P/N 3769T47 from McMaster-Carr, or similar	To be used together with safety strap.	
Commercially available	Support Plate P/N 23055299 from Mid-west Tool, or similar	To be used together with safety strap.	

E. Auxiliary Items

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
Commercially available	Workstand	To get access to the engine	1
Commercially available	Rubber Gloves, Phosphate Ester-Base, Fluid-Resistant	As a protection for your hands	1
Commercially available	Goggles, Phosphate Ester-Base, Fluid-Resistant	As a protection for your eyes	1

F. Consumable Materials

SPECIFICATION (BRAND)	*DESCRIPTION*	*QTY*
MS20995-C32	Lockwire	AR
MEP 09-060	Corrosion Inhibiting Compound (CA-1000)	AR
FIT-621-2 or CFHR-TW-2000	Heat-shrinkable boot	AR
FIT-621-3, HRNF-300-S or CFHR-TW-3000	Heat-shrinkable boot	AR
AMS-2518	Molykote 321	AR

G. Expendable Parts

ITEM	*IPC REFERENCE (VENDOR REFERENCE)*	*QTY*
Tiedown strap (cable tie)	IPC 71-50-00	AR
Cotter pin	IPC 71-20-00	04
O-ring	IPC 29-10-03	02
Gasket	IPC 29-10-03	01
Gasket	IPC 28-21-00	01

H. Persons Recommended

QTY	*FUNCTION*	*PLACE*
4	Do the task	Engine

I. Installation (Figure 401) (Figure 402)

SUBTASK 420-002-A

WARNING:
- **BEFORE THE INSTALLATION OF THE ENGINE, MAKE SURE THAT THE P/NS OF THE FADECS ARE THE SAME AND AGREE WITH THE P/N OF THE ENGINE ACCORDING TO IPC ADDITIONAL CROSS-REFERENCE TABLE.**
- **DO NOT REMOVE OR INSTALL THE ENGINES WITH THE AIRCRAFT ON JACKS.**

CAUTION: IF THE ENGINE YOU REMOVED WAS MODIFIED AS PER SB AE3007A-79-025/ AE3007A-79-026, MAKE SURE THAT THE ENGINE YOU WILL INSTALL IN ITS PLACE ALSO INCLUDES THE SAME MODIFICATION.

CAUTION: BEFORE THE INSTALLATION OF THE ENGINE, MAKE SURE THAT THE CORRECT ITT TRIMMER IS INSTALLED IN ACCORDANCE WITH ROLLS-ROYCE MAINTENANCE MANUAL TASK 77-21-25-400-801.

NOTE: Make sure that the indicating system straps related to the engine models are configured correctly (WM 34-90-00), to prevent incorrect engine indication on the EICAS.

(1) Clean the engine drain lines (AMM TASK 71-71-01-100-801-A/700).

(2) Put the engine in the configuration for left-side or right-side installation, as applicable. Refer to Powerplant Build-up Manual, PPBM-145/1139.

(3) At the pylons, clean the pads which attach the engine forward mounts.

CAUTION:
- TO ADJUST THE ENGINE ASSEMBLY LIFTING ADAPTER, SEE THE ENGINE CONFIGURATION (WITH OR WITHOUT THRUST REVERSER).
- OBEY THE INSTRUCTIONS OF FIGURE 402, SHEET 14, FOR THE CORRECT INSTALLATION OF THE SLING.

(4) Connect the engine assembly lifting adapter (62) to the hydraulic crane (63).

(5) Connect the aft engine lifting adapter (65) and the forward lifting adapter (64) to the engine assembly lifting adapter (62).

(6) Connect the aft engine lifting adapter (65) to the aft lifting points and the forward lifting-adapter (64) to the forward lifting point.

CAUTION: FOR ENGINES PRE-MOD SB ROLLS-ROYCE 72-289, PUT THE SAFETY STRAP, TOGETHER WITH THE SUPPORT PLATE, THE RING AND THE SHACKLE, AROUND THE FRONT FRAME OF THE ENGINE. THEY WILL SUPPORT THE ENGINE IF A HARDWARE FAILURE OCCURS. OBEY THE INSTRUCTIONS OF FIGURE 402, SHEET 14, FOR THE CORRECT INSTALLATION OF THE SAFETY STRAP AND ITS COMPONENTS.

(7) Remove all protection plugs from the engine and pylon open lines and connections.

CAUTION: BE VERY CAREFUL WHEN YOU MOVE THE ENGINE BECAUSE OF ITS LARGE WEIGHT.

(8) Remove the engine from the maintenance stand (86), as applicable, and carefully put it in the pylon.

NOTE: Make sure that the engine is level while it is lifted.

(9) If applicable, install the thrust reverser assembly (AMM TASK 78-31-01-400-801-A/400) or exhaust assembly (AMM TASK 78-11-01-400-801-A/400), as applicable, and the air intake assembly (AMM TASK 71-60-01-400-801-A/400).

WARNING: CA-1000 CORROSION-INHIBITING COMPOUND IS TOXIC TO SKIN, EYES AND RESPIRATORY TRACT. USE PVC GLOVES AND EYE PROTECTION. USE ONLY IN WELL VENTILATED AREAS. OBEY THE MANUFACTURERS' HEALTH AND SAFETY INSTRUCTIONS.

(10) Apply Molykote 321 lubricant over the bushings (67). Protect the bolts (68), (73) and the bushings (75) with CA-1000 corrosion-inhibiting compound.

CAUTION:
- MAKE SURE THAT THE HOLES OF THE FORWARD MOUNTS AND THE AIRFRAME YOKES ARE CORRECTLY ALIGNED. THIS IS TO MAKE THE BOLTS (68) INSTALLATION EASIER AND TO PREVENT INCORRECT TORQUE TO THE NUTS (66) AND DAMAGE TO THE ENGINE.
- MAKE SURE THAT THE HOLES OF THE AFT MOUNTS AND THE ENGINE STRUCTURE ARE CORRECTLY ALIGNED. THIS IS TO MAKE THE BOLTS (73) INSTALLATION EASIER AND TO PREVENT INCORRECT TORQUE TO THE NUTS (77) AND DAMAGE TO THE ENGINE.

(11) At the aft lower mount, install the bushings (75), washer (74), bolt (73), washer (76), and nut (77).

(12) At the forward upper mount, install the bushing (67), washer (72), bolt (68), washer (79), and nut (66).

(13) At the aft upper mount, install the bushings (75), washer (74), bolt (73), washer (76), and nut (77).

(14) At the forward lower mount, install the bushing (67), washer (72), bolt (68), washer (79), and nut (66).

(15) At all mounts, apply torque to the nuts (66) and (77). Refer to figure 402, sheet 15 for torque values.

(16) At the forward mounts, install lockplates (80) and (69) with washers (81) and (71), bolts (70) and (82) and cotter pin (83).

(17) At the aft mounts, install the cotter pins (78).

(18) For engines pre-mod SB Rolls-Royce 72-289, remove the safety strap, together with the support plate, the ring and the shackle, around the front frame of the engine.

(19) Disconnect the aft engine lifting adapter (65) from the aft lifting points and the forward lifting adapter (64) from the forward lifting point.

(20) Disconnect the aft engine lifting adapter (65) and the forward lifting adapter (64) from the engine assembly lifting adapter (62). Disconnect the engine assembly lifting adapter (62) from the hydraulic crane (63).

WARNING: THE PHOSPHATE-ESTER-BASE OIL CAUSES INJURY TO THE SKIN AND EYES: ITS VAPORS ARE HIGHLY CORROSIVE. BE CAREFUL NOT TO TOUCH THIS OIL. YOU MUST USE GLOVES AND GOGGLES.

CAUTION: ALWAYS CLEAN THE HYDRAULIC FLUID THAT FALLS FROM THE ENGINE. DAMAGE COULD COME FROM ITS CORROSIVE ACTION.

(21) On aircraft with thrust reverser, connect the nuts (61) to the thrust reverser and apply the torque.

(22) Attach the supports (60) of the hydraulic lines to the thrust reverser with the washers (58) and screws (59).

(23) Prepare the aft and forward bonding strap supports surface (57) for bonding. Do the bonding procedure method 3 (AMM TASK 20-13-21-910-801-A/200).

(24) Install the aft and forward bonding strap supports (57).

(25) On aircraft POST-MOD. S.B.145-24-0007, cover the electrical connectors as shown below:

(a) Cover the indication harness (50) with the heat-shrinkable boots (49) and (48).

(b) Cover the FADEC A harness (47) with the heat-shrinkable boots (46).

(c) Cover the fire extinguisher harness (54) and the FADEC B harness (56) with the heat-shrinkable boots (55).

(d) If applicable, cover the thrust reverser harness with the heat-shrinkable boots (51), (55), (52), and (53).

(26) Connect the electrical connectors of the indication harness (50) and the FADEC A harness (47) to the pylon.

(27) Connect the electrical connectors of the thrust reverser harness, if applicable, to the pylon.

(28) Connect the electrical connectors of the fire extinguisher harness (54) to the pylon and safety it with wire.

(29) Connect the electrical connectors of the FADEC B harness (56) to the pylon.

(30) Connect the fire extinguishing hose (45) to the pylon. Apply torque to the nut.

WARNING: IF YOU MUST DO TASKS WITH A HEATING GUN, OBEY THE SAFETY PRECAUTIONS GIVEN IN (WM 20-10-00). EXPLOSION CAN OCCUR IF YOU USE AN INCORRECT HEATING GUN NEAR FLAMMABLE MATERIAL OR FUEL VENT.

(31) On aircraft POST-MOD. S.B.145-24-0007, heat the heat-shrinkable boots with a heating gun or a similar equipment.

(32) Connect the electrical connector (44) to the pylon fire detector.

CAUTION:
- MAKE SURE THAT THE DUCTS ARE ALIGNED AND ASSEMBLED WITHOUT TENSION.
- MAKE SURE THAT THE BALL JOINTS ARE IN THE NEUTRAL POSITION.

(33) Connect the engine bleed line (40) and install the clamp (41). Apply torque to the clamp (41).

NOTE: Refer to AMM TASK 20-10-10-910-801-A/200 for correct installation of V-band clamps.

(34) Connect the engine bleed tube assembly (42) to the precooler and install the clamp (43). Apply torque to the clamp.

(35) Connect the engine bleed air system installation (38) of the starting system to the tube assembly and install the clamp (39). Apply torque to the clamp (39).

(36) At the left engine, attach the fuel hose clamps (36) with washer (34), screws (35), and nuts (33).

(37) On aircraft PRE-MOD. S.B.145-28-0016, connect the fuel hose (37) to the FPMU. Apply torque to the nut (32).

(38) On aircraft POST-MOD. S.B.145-28-0016, position the gasket and connect the fuel hose (37) to the FPMU. Refer to AMM TASK 73-21-01-400-801-A/400.

(39) At the right engine, install the gasket and O-rings in the hydraulic pump (29) , and connect it with the washers (30) and nuts (31) to the engine. Apply torque to the nuts.

(40) At the right engine, attach the dampener support (24) and support hose (28) with nuts (27), washers (26), and screws (25) to the engine.

(41) At the left engine, install the gasket and O-rings in the hydraulic pump (22), and connect it with the washers (21) and nuts (20) to the engine. Apply torque to the nuts.

(42) At the left engine, connect the dampener support (17) with the nuts (23), washers (18), and screws (19) to the engine.

(43) Connect the electrical connectors (1) to the two generators of each engine.

CAUTION: REFER TO THE IDENTIFICATIONS MADE BEFORE TO MAKE SURE THAT THE ELECTRICAL CABLES ARE INSTALLED CORRECTLY. THE INCORRECT INSTALLATION OF THESE CABLES WILL CAUSE IMPORTANT PROBLEMS TO THE DC GENERATING SYSTEM.

(44) Attach the electrical cables (2) with washers (3) and nuts (4) to the two generators of each engine. Apply torque to the nuts.

(45) Attach the electrical cable supports (8) with the screws (9) and washers, as applicable, to the engine.

(46) Install the protective cap (5) with washers (7) and screws (6) to the two generators of each engine.

(47) Install the flexible ducts (11) with the clamps (10) between the air inlet and the generators. Apply torque to the clamps (10).

(48) At the right engine, attach clamp (103) of the FADEC A (47) and generator electrical harness (102) with screw (100) and washer (101) to the engine.

(49) Attach the FADEC A harness (47) with the new tiedown straps (cable ties) to the generator electrical harness (102).

NOTE:
- For the correct tiedown straps (cable ties), see IPC 71-50-00.
- At the right engine, make sure that the FADEC A harness (47) is correctly routed as shown in (Figure 402), sheet 4.

(50) (For hydraulic hoses with clamp P/N MS21919WC13 installed) At the left engine, attach the clamp (107) of the electrical harness with screws (99), washers (98) and nuts (97) to the hydraulic line.

NOTE: See (Figure 402), sheet 2 for details.

(51) (For hydraulic hoses with clamp P/N MS21919WC16 installed) At the left engine, attach the clamp (110) of the electrical harness with screws (108), washers (109) and nuts (111) to the hydraulic line.

NOTE: See (Figure 402), sheet 3 for details.

(52) At the left engine, attach the clamp (94) with screws (95), washers (96), and nut (93) of the generator electrical harness (102).

(53) At the two engines attach the clamp (16) of the FADEC A harness (47) with screws (15) and washers (14).

(54) At the two engines, attach the screws (105) and washers (106) that connect the clamps (104) of the generator electrical harness (102) to the electrical cable support (8).

J. Follow-on

SUBTASK 844-002-A

(1) Do the bonding test procedure (AMM TASK 20-13-21-700-801-A/200) on the aft and forward bonding strap supports (57).

(2) Do the bonding protection procedure (AMM TASK 20-13-21-910-802-A/200) for the aft and forward bonding strap supports (57).

(3) Do an inspection procedure on the engine harness system (AMM TASK 71-51-01-200-801-A/600).

(4) Install the apron (AMM TASK 71-13-01-400-801-A/400).

(5) Install the pylon-to-nacelle fairings.

(6) Install the upper cowling (AMM TASK 71-11-01-400-801-A/400).

(7) Unlock the thrust reverser doors (AMM TASK 78-31-01-980-801-A/200), if applicable.

(8) For aircraft with thrust reverser, put the ICU back to its normal condition (AMM TASK 78-33-01-980-801-A/200).

(9) On the circuit breaker panel, close the circuit breakers below and remove the DO-NOT-CLOSE tag from them:

- START 1/2.
- ENG AIR INLET 1/2.
- THRUST REVERSER 1/2.
- FADEC 1A/2A.
- FUEL SOV 1/2
- FADEC 1B/2B.
- VIB IND.
- HYD ELEC PUMP 1/2.
- FUEL PUMPS 1A/2A/1B/2B/1C/2C.

(10) On the maintenance panel, set the CMC switch as follows:

(a) On the aircraft PRE-MOD. S.B.145-45-0001 and POST-MOD. S.B. 145-45-0001, set the CMC switch to the normal position, refer to (Figure 401).

(11) On the circuit breaker panel, cycle the circuit breakers below, two times.

- FADEC 1A/2A.
- FADEC 1B/2B.

(12) Reset the FADECs with the reset switch, on the overhead panel.

NOTE: Depreserve the engine according to the Rolls-Royce Maintenance Manual CSP34022.

(13) Do the applicable tasks to make sure that the engine operates correctly after its installation (AMM TASK 71-00-00-700-801-A/500).