CHAPTER

49

Auxiliary Power System

CHAPTER 49
AUXILIARY POWER SYSTEM

Subject/Page	Date	COC
49-EFFECTIVE PAGES		
1 thru 5	Oct 15/2023	
6	BLANK	
49-CONTENTS		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	BLANK	
49-00-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	Oct 15/2021	
7	Oct 15/2021	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	
11	Oct 15/2021	
12	Oct 15/2021	
13	Oct 15/2021	
14	Oct 15/2021	

Subject/Page	Date	COC
49-00-00 (cont.)		
15	Oct 15/2021	
16	Oct 15/2021	
17	Oct 15/2021	
18	Oct 15/2021	
19	Oct 15/2021	
20	Oct 15/2021	
21	Oct 15/2021	
22	Oct 15/2021	
23	Oct 15/2021	
24	Oct 15/2021	
25	Oct 15/2021	
26	BLANK	
49-10-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	Oct 15/2021	
7	Oct 15/2021	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

49-EFFECTIVE PAGES

CHAPTER 49
AUXILIARY POWER SYSTEM

Subject/Page	Date	COC
49-10-00 (cont.)		
11	Oct 15/2021	
12	Oct 15/2021	
13	Oct 15/2021	
14	Oct 15/2021	
15	Oct 15/2021	
16	Oct 15/2021	
17	Oct 15/2021	
18	Oct 15/2021	
19	Oct 15/2021	
20	Oct 15/2021	
21	Oct 15/2021	
22	Oct 15/2021	
23	Oct 15/2021	
24	Oct 15/2021	
25	Oct 15/2021	
26	Oct 15/2021	
27	Oct 15/2021	
28	BLANK	
49-20-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	

Subject/Page	Date	COC
49-20-00 (cont.)		
5	Oct 15/2021	
6	BLANK	
49-30-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	Oct 15/2021	
7	Oct 15/2021	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	
11	Oct 15/2021	
12	Oct 15/2021	
13	Oct 15/2021	
14	Oct 15/2021	
15	Oct 15/2021	
16	Oct 15/2021	
17	Oct 15/2021	
18	Oct 15/2021	
19	Oct 15/2021	
20	BLANK	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

49-EFFECTIVE PAGES

CHAPTER 49
AUXILIARY POWER SYSTEM

Subject/Page	Date	COC
49-40-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Feb 15/2022	
5	Oct 15/2021	
6	Oct 15/2021	
7	Oct 15/2021	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	
11	Oct 15/2021	
12	Oct 15/2021	
49-50-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	Jun 15/2022	
7	Jun 15/2022	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	
11	Oct 15/2021	
12	Oct 15/2021	

Subject/Page	Date	COC
49-50-00 (cont.)		
13	Oct 15/2021	
14	Oct 15/2021	
15	Oct 15/2021	
16	Oct 15/2021	
17	Oct 15/2021	
18	Oct 15/2021	
19	Oct 15/2021	
20	BLANK	
49-60-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	Oct 15/2021	
7	Oct 15/2021	
8	Oct 15/2021	
9	Oct 15/2021	
10	Oct 15/2021	
11	Oct 15/2021	
12	Oct 15/2021	
13	Oct 15/2021	
14	Oct 15/2021	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

49-EFFECTIVE PAGES

CHAPTER 49
AUXILIARY POWER SYSTEM

Subject/Page	Date	COC
49-60-00 (cont.)		
15	Oct 15/2021	
16	Oct 15/2021	
17	Oct 15/2021	
18	Oct 15/2021	
19	Oct 15/2021	
20	Oct 15/2021	
21	Oct 15/2021	
22	Oct 15/2021	
23	Oct 15/2021	
24	Oct 15/2021	
25	Oct 15/2021	
26	Oct 15/2021	
27	Oct 15/2021	
28	Jun 15/2023	
29	Oct 15/2021	
30	Oct 15/2021	
31	Oct 15/2021	
32	Oct 15/2021	
33	Oct 15/2021	
34	Oct 15/2021	
35	Oct 15/2021	
36	Oct 15/2021	
37	Oct 15/2021	
38	Oct 15/2021	
39	Oct 15/2021	
40	BLANK	
49-70-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	BLANK	
49-80-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Oct 15/2021	
5	Oct 15/2021	
6	BLANK	
49-90-00		
1	Oct 15/2021	
2	Oct 15/2021	
3	Oct 15/2021	
4	Jun 15/2022	
5	Oct 15/2021	
6	Jun 15/2022	
7	Oct 15/2021	
8	Oct 15/2021	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

49-EFFECTIVE PAGES

CHAPTER 49
AUXILIARY POWER SYSTEM

Subject/Page	Date	COC	Subject/Page	Date	COC
49-90-00 (cont.)					
9	Oct 15/2021				
10	Oct 15/2021				
11	Oct 15/2021				
12	Oct 15/2021				
13	Oct 15/2021				
14	Oct 15/2021				
15	Oct 15/2021				
16	Oct 15/2021				
17	Oct 15/2021				
18	Oct 15/2021				
19	Oct 15/2021				
20	BLANK				

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

49-EFFECTIVE PAGES

CHAPTER 49
AUXILIARY POWER SYSTEM

49-CONTENTS

CHAPTER 49
AUXILIARY POWER SYSTEM

49-CONTENTS

CHAPTER 49
AUXILIARY POWER SYSTEM

49-CONTENTS

CHAPTER 49
AUXILIARY POWER SYSTEM

49-CONTENTS

CHAPTER 49
AUXILIARY POWER SYSTEM

49-CONTENTS

THIS PAGE IS INTENTIONALLY LEFT BLANK

AIRBORNE AUXILIARY POWER - INTRODUCTION

Purpose

The AlliedSignal 131-9(B) auxiliary power unit (APU) supplies electrical and pneumatic power to other airplane systems. This permits these airplane systems to operate without the use of ground power sources or the engines. The APU can also supply electrical and pneumatic power in the air.

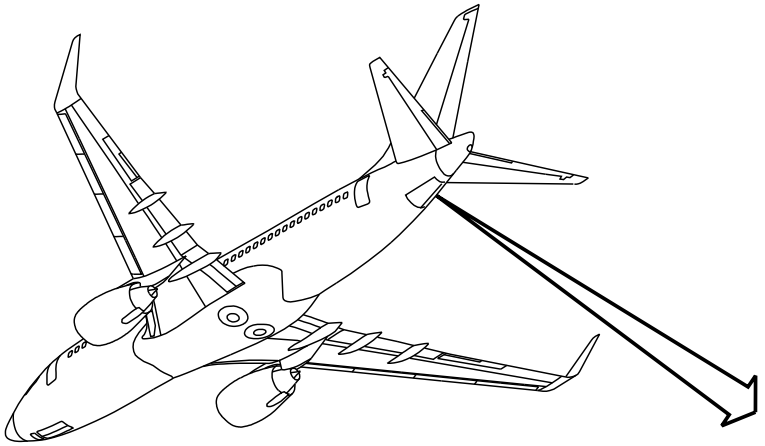
Altitude Operational Limits

The APU generator can supply 90 KVA electrical power up to 32,000 feet (9,754 meters) and 66 KVA to 41,000 feet (12,500 meters). Electrical and pneumatic power is available at the same time up to 15,000 feet (4,572 meters). Pneumatic power alone is available up to 17,000 feet (5,183 meters). The APU can be started at 41,000 feet or below.

Abbreviations and Acronyms

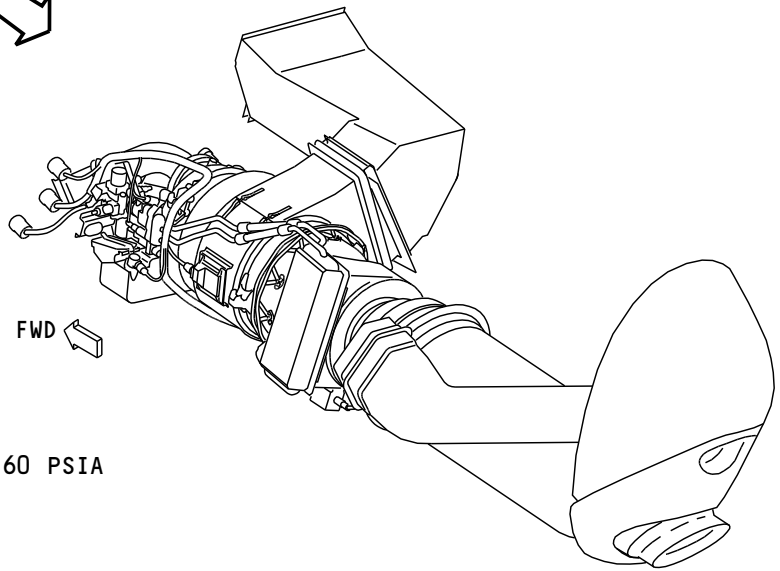
- APB - auxiliary power breaker
- APU - auxiliary power unit
- ACS - air conditioning system
- BAT - battery
- BAV - bleed air valve
- BPCU - bus power control unit
- CDU - control display unit
- DP - differential pressure
- DMM - data memory module
- DEU - display electronic unit
- DFDAU - digital flight data acquisition unit
- DU - display unit
- ECU - electronic control unit
- EGT - exhaust gas temperature
- FCU - fuel control unit
- FMV - fuel metering valve
- AGCU - APU generator control unit
- HOT - high oil temperature
- IGV - inlet guide vane
- KVA - kilovolt-ampere
- LOP - low oil pressure
- LVDT - linear variable differential transformer
- LRU - line replaceable unit
- MES - main engine start
- OLS - oil level sensor
- P2 - inlet pressure
- PPH - pounds per hour
- PPM - pounds per minute
- PSI - pounds per square inch
- PSIA - pounds per square inch absolute
- PSID - pounds per square inch differential
- PSIG - pounds per square inch gage
- PT - total pressure
- PWR - power
- RPM - revolutions per minute
- RTL - ready to load
- RVDT - rotary variable differential transformer
- SCU - starter converter unit
- SCV - surge control valve
- SHP - shaft horsepower
- SPU - start power unit
- sta - station
- T2 - inlet temperature
- T/M - torque motor

AIRBORNE AUXILIARY POWER - INTRODUCTION



PNEUMATIC POWER
(<17,000 FT)

ELECTRICAL POWER
(90 KVA <32,000 FT)
(66 KVA <41,000 FT)



DIMENSIONS
- LENGTH 56.76 IN (144 CM)
- WIDTH 34.33 IN (87 CM)
- HEIGHT 29.55 IN (75 CM)

DRY WEIGHT APPROX 390 LBS (177 KG)
(DOES NOT INCLUDE APU FLUIDS)

OPERATING LIMITS
- BLEED LOAD (SEA LEVEL, 60F) 160 PPM AT 60 PSIA
- ELECTRICAL LOAD (SEA LEVEL, 60F) 90 KVA

ENGINE SPEED
- NORMAL RATED SPEED 48,800 RPM = 100%
- OVERSPEED 51,728 RPM = 106%

M87494 S0004631401_V1

AIRBORNE AUXILIARY POWER - INTRODUCTION

THIS PAGE IS INTENTIONALLY LEFT BLANK

AIRBORNE AUXILIARY POWER - GENERAL DESCRIPTION

General

The APU system contains these subsystems:

- APU power plant (49-10)
- APU engine (49-20)
- APU fuel system (49-30)
- APU ignition and start system (49-40)
- APU bleed air system (49-50)
- APU controls (49-60)
- APU indicating system (49-70)
- APU exhaust system (49-80)
- APU lubrication system (49-90).

APU Power Plant

The APU is a gas turbine engine. It has a single shaft and operates at a constant speed. It drives an electric generator, pneumatic load compressor, and a reduction gearbox.

APU Engine

These are the primary APU engine components:

- The power section
- The load compressor
- The accessory gearbox.

The power section has a single stage centrifugal compressor. It has a reverse flow annular combustor with a two-stage axial turbine.

The load compressor turns on the same shaft with the power section compressor. The load compressor also uses the same air inlet as the power section compressor.

The gearbox provides gear reduction for the high speed torque of the power section to the accessories on the gearbox.

APU Fuel System

The APU fuel system supplies pressurized and metered fuel to the combustion chamber. It also supplies fuel to operate the inlet guide vane actuator and the surge control valve.

APU Ignition and Start System

The APU ignition and start system begins the rotation and acceleration of the APU. The starter-generator is used as a starter during APU starting. The start power unit (SPU) and start converter unit (SCU) change AC or dc power so it can be used for starting.

APU Bleed Air System

The APU bleed air system supplies pressurized air to the airplane pneumatic system. Inlet guide vanes control the quantity of air that goes to the load compressor. A surge control valve vents unnecessary bleed air overboard through the exhaust. A bleed air valve (BAV) isolates the APU air system from the airplane ducts.

APU Controls

An electronic control unit (ECU) controls the APU functions. The ECU interfaces with other airplane systems.

The ECU monitors APU functions using built in test equipment (BITE). The ECU shows unsatisfactory conditions found by BITE and the cause for protective shutdowns on the control display unit (CDU). The unsatisfactory conditions are called maintenance messages. Some of the maintenance messages and all the protective shutdowns cause one of these lights in the flight compartment to come on:

- Maintenance light (blue)
- Low oil pressure light (amber)
- Fault light (amber)
- Overspeed light (amber).

APU Indicating System

The APU indicating system consist of these components:

- EGT gauge
- Data Memory Module
- Control display unit (CDU).

The APU indications are on the P5-4 panel and the P9 panel.

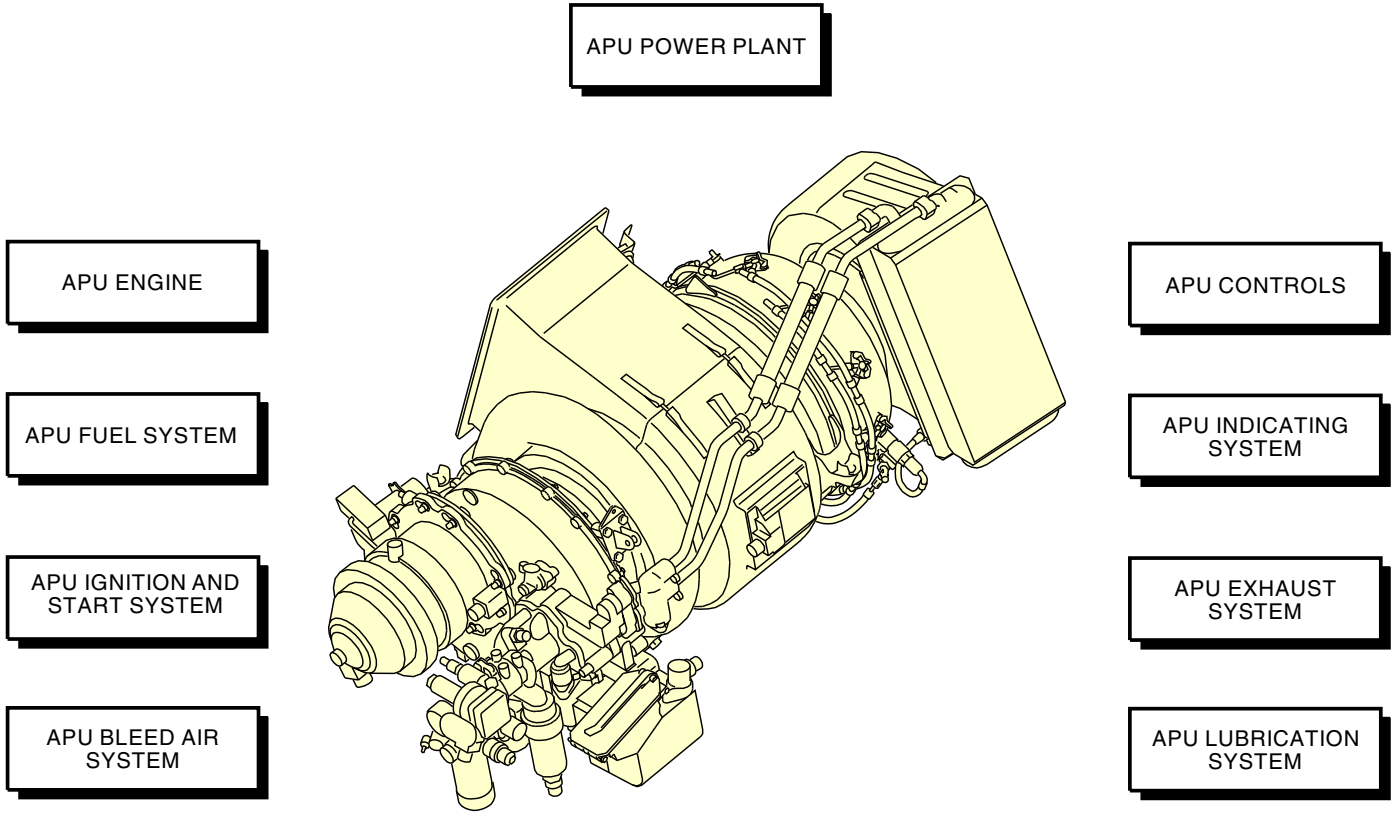
APU Exhaust System

The APU exhaust system sends the APU exhaust gases through the APU muffler. The muffler sends the APU exhaust out the tail cone.

APU Lubrication system

The APU lubrication system lubricates and cools the APU bearings, the gearbox, and the starter generator. An eductor moves air through the oil cooler to control oil temperature. It also takes in the ambient air to cool the APU compartment.

AIRBORNE AUXILIARY POWER - GENERAL DESCRIPTION



M87496 S0004631403_V2

AIRBORNE AUXILIARY POWER - GENERAL DESCRIPTION

AIRBORNE AUXILIARY POWER - COMPONENT LOCATION

General

The APU is in the aft fuselage of the airplane. A firewall isolates the APU compartment from the airplane fuselage and horizontal stabilizer assembly.

Air Inlet

The APU air inlet is on the right side of the aft fuselage. It is forward and below the horizontal stabilizer.

Doors

The APU access door at the bottom of the APU compartment is for servicing and maintenance.

Electronic Control Unit (ECU)

The APU electronic control unit (ECU) is in the aft cargo compartment. It is on the right side of the compartment, aft of the cargo door.

Electronic Equipment Compartment

These APU components are in the EE compartment:

- APU generator control unit (AGCU)
- Start power unit (SPU)
- Start converter unit (SCU).

Right Wheel Well

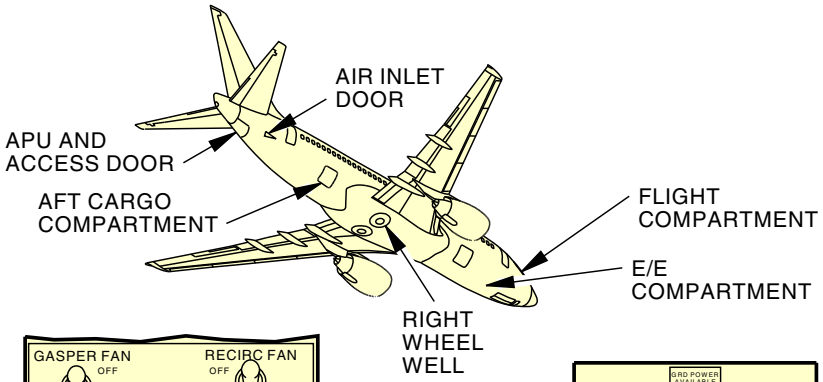
The APU ground control panel (P28) and fire alarm horn are in the right main wheel well, on the aft bulkhead.

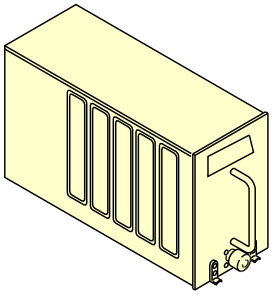
Flight Compartment

These APU components are in the flight compartment:

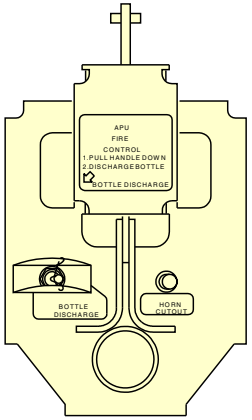
- APU switch - (APU/engine start panel) (P5) (not shown)
- APU bleed air switch - (air conditioning panel) (P5)
- APU generator switches - (AC system generator/APU control panel) (P5)
- APU EGT indicator and APU indication lights - (AC system generator/APU control panel) (P5)
- APU light - (system annunciator lights) (P7) (not shown)
- APU fire warning switch - (Engine and APU fire protection panel) (P8).

AIRBORNE AUXILIARY POWER - COMPONENT LOCATION

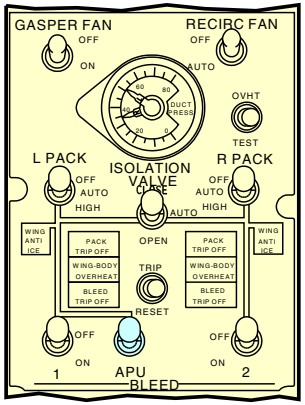




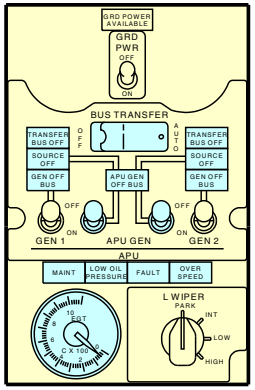
ELECTRONIC CONTROL UNIT (AFT CARGO)



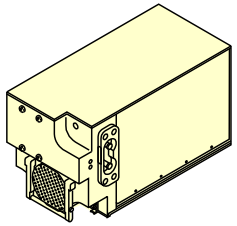
APU GROUND CONTROL PANEL (P28 RIGHT WHEEL WELL)



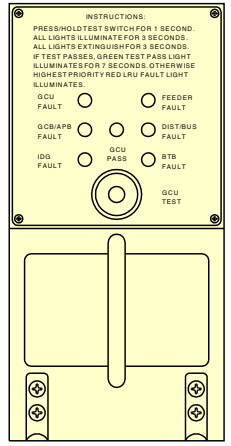
AIR CONDITIONING PANEL (P5) (TYPICAL)



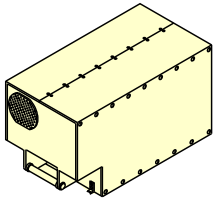
AC SYSTEM GENERATOR/ APU CONTROL PANEL (P5) (TYPICAL)



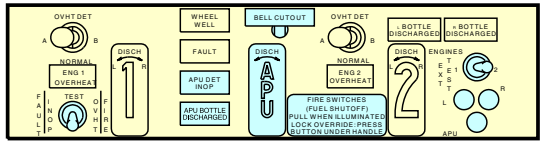
START POWER UNIT (E2-2)



APU GCU (E3-1)



START CONVERTER UNIT (E2-2) (TYPICAL)



ENGINE AND APU FIRE CONTROL PANEL (P8) (TYPICAL)

M87501 S0004631408_V2

AIRBORNE AUXILIARY POWER - COMPONENT LOCATION

APU Flight Compartment Controls

You use these switches to control the APU from the flight compartment:

- APU switch (P5)
- APU fire warning switch (P8)
- Battery switch (P5).

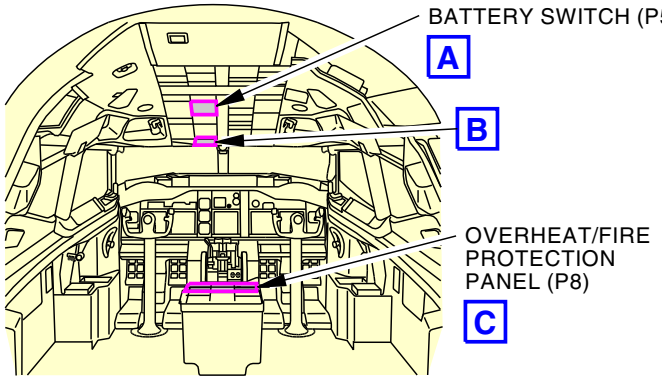
The APU switch starts and stops the APU.

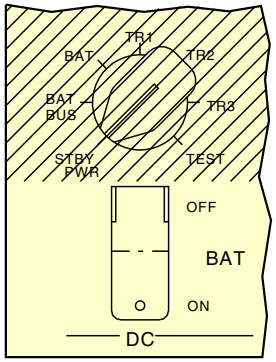
You can stop the APU with the APU fire warning switch on the engine and APU fire control module (P8) and the battery switch on the electric meters and galley power panel (P5).

APU Ground Control Panel (P28)

You can stop the APU from outside the airplane. You use the remote fire switch handle (P28) in the right wheel well aft bulkhead.

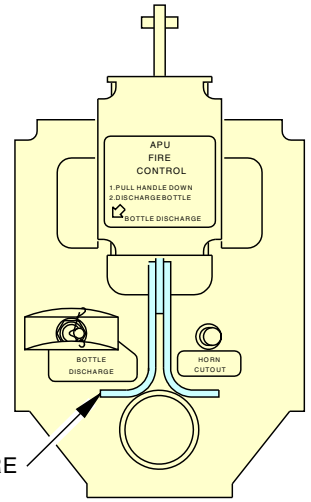
AIRBORNE AUXILIARY POWER - CONTROLS



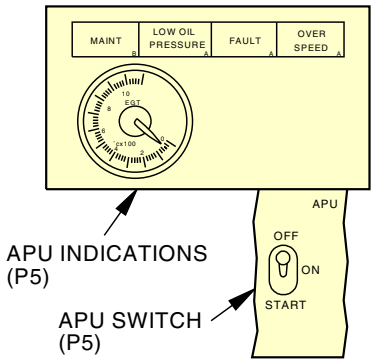


BATTERY SWITCH (P5)

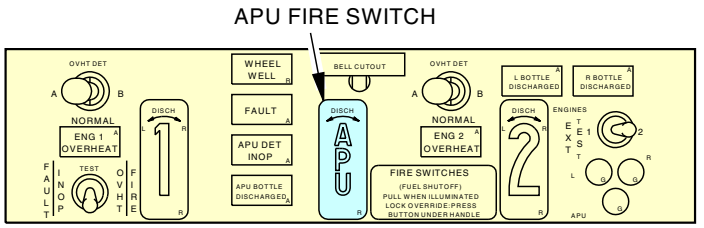
A



P28 GROUND CONTROL PANEL



B



OVERHEAT/FIRE PROTECTION PANEL (P8)

C

M87503 S0004631412_V2

AIRBORNE AUXILIARY POWER - CONTROLS

AIRBORNE AUXILIARY POWER - OPERATION - START

General

You can start the Auxiliary Power Unit (APU) up to an altitude of 41,000 feet (12,500 meters).

The APU Electronic Control Unit (ECU) controls these components during start:

- APU inlet door
- APU fuel shutoff valve
- APU fuel
- Ignition system
- APU start system.

Prestart

The battery switch must be ON before you can start and operate the APU.

If AC power is available, turn the aft number 1 fuel boost pump on. This gives pressurized fuel to the APU. Pressurized fuel makes the APU start better.

Starting the APU

When you move the APU switch to the START position and release it, the switch moves back to the ON position. This sends a signal to the ECU. The ECU then opens the APU fuel shut-off valve and the APU air inlet door. The ECU also causes the LOW OIL PRESSURE light to come on. When the air inlet door is fully open, the door switch closes. The door switch sends a door fully open signal to the ECU.

APU Start Sequence

The ECU controls the APU start sequence. This is the start sequence:

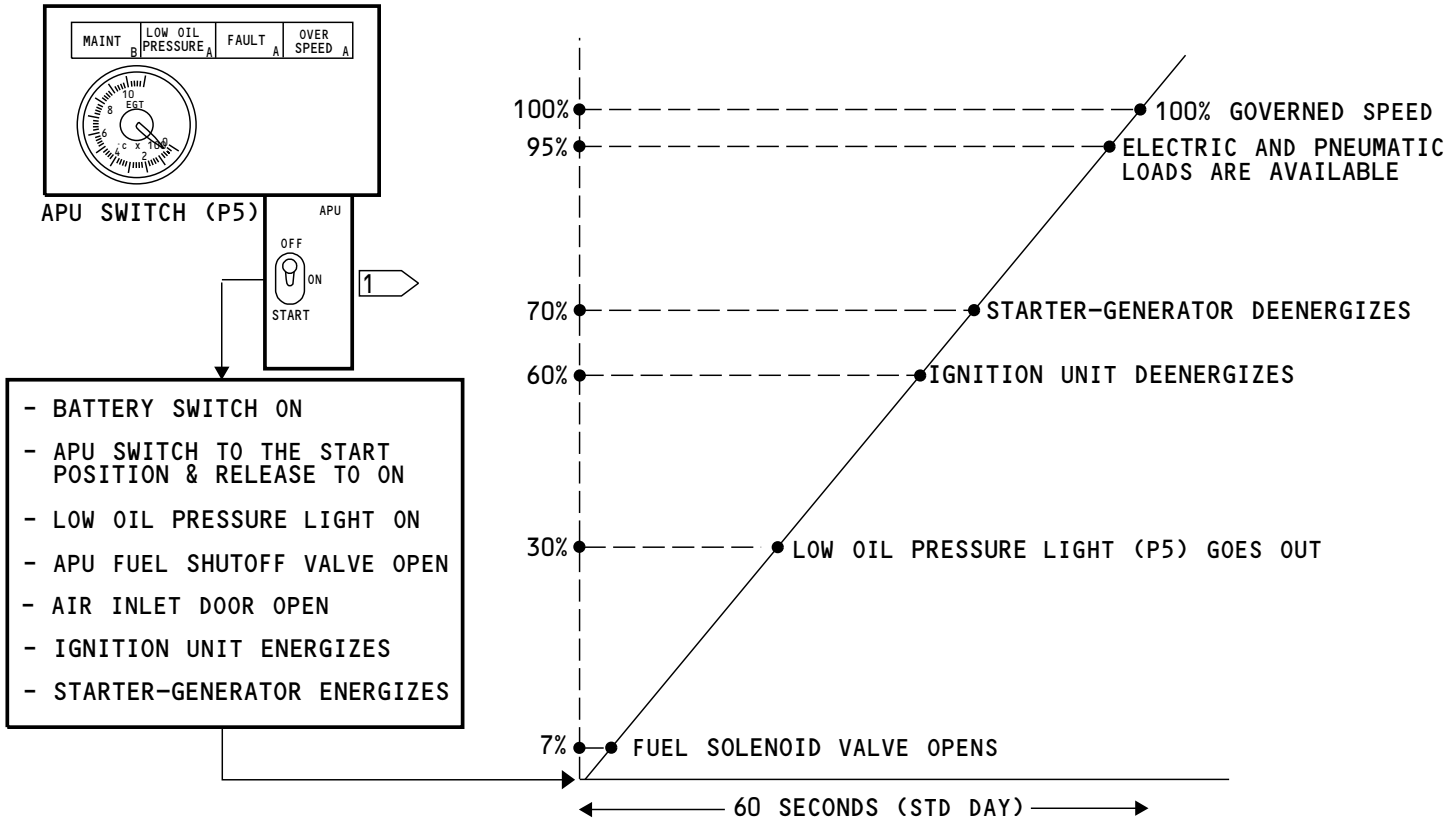
- At 0 percent speed and before the start system is energized, the ECU energizes the ignition unit
- At 0 percent speed for start or 7 percent speed for restart, the ECU energizes the starter-generator
- At 7 percent speed, the fuel solenoid valve opens
- At approximately 30 percent speed, the LOW OIL PRESSURE light (P5) goes out
- At 60 percent speed the ignition unit de-energizes
- At 70 percent speed, the starter-generator de-energizes
- At 95 percent speed, the APU can supply electrical power up to 41,000 feet (12,500 meters). The APU can also supply air up to 17,000 feet (5183 meters)
- The APU accelerates to 100 percent speed.

NOTE: The Inlet Guide Vanes (IGV) close to 20-24 degrees when the APU bleed air valve is closed. This will keep the load compressor cool when it does not have a load.

Training Information Point

The BAT DISCHARGE light on the electrical meters, battery, and galley power module comes on when the APU start uses DC power. The BAT DISCHARGE light does not come on when the APU uses AC power to start.

AIRBORNE AUXILIARY POWER - OPERATION - START



1 WHEN YOU PUT THE APU SWITCH TO ON OR START, THE APU FUEL SHUTOFF VALVE AND AIR INLET DOOR OPEN.

M87505 S0004631414_V1

AIRBORNE AUXILIARY POWER - OPERATION - START

AIRBORNE AUXILIARY POWER - OPERATION - SHUTDOWN

General

The ECU controls the APU shutdown. The APU has two types of shutdowns, normal shutdown and protective shutdown.

APU Switch to OFF

When you put the APU switch to OFF, it removes the 28v dc ON signal to the ECU and gives a 28v dc OFF signal to the ECU.

APU Cool Down

An APU shutdown causes a cool down cycle. The cool down cycle time is 60 seconds. The time starts when the APU switch is put to the OFF position.

The ECU does these steps for a cool down:

- Removes the ready-to-load signal
- Closes the bleed air valve
- Closes the inlet guide vanes (15 degrees)
- Opens the surge control valve
- De-energizes the starter-generator
- Starts the 60 second timer.

Completion of the Shutdown

During shutdown of the APU, these steps occur:

- At 30 percent speed, the APU air inlet door starts to close (closes immediately for APU fire)
- At less than 7 percent speed, an APU restart can be initiated.

Training Information Point

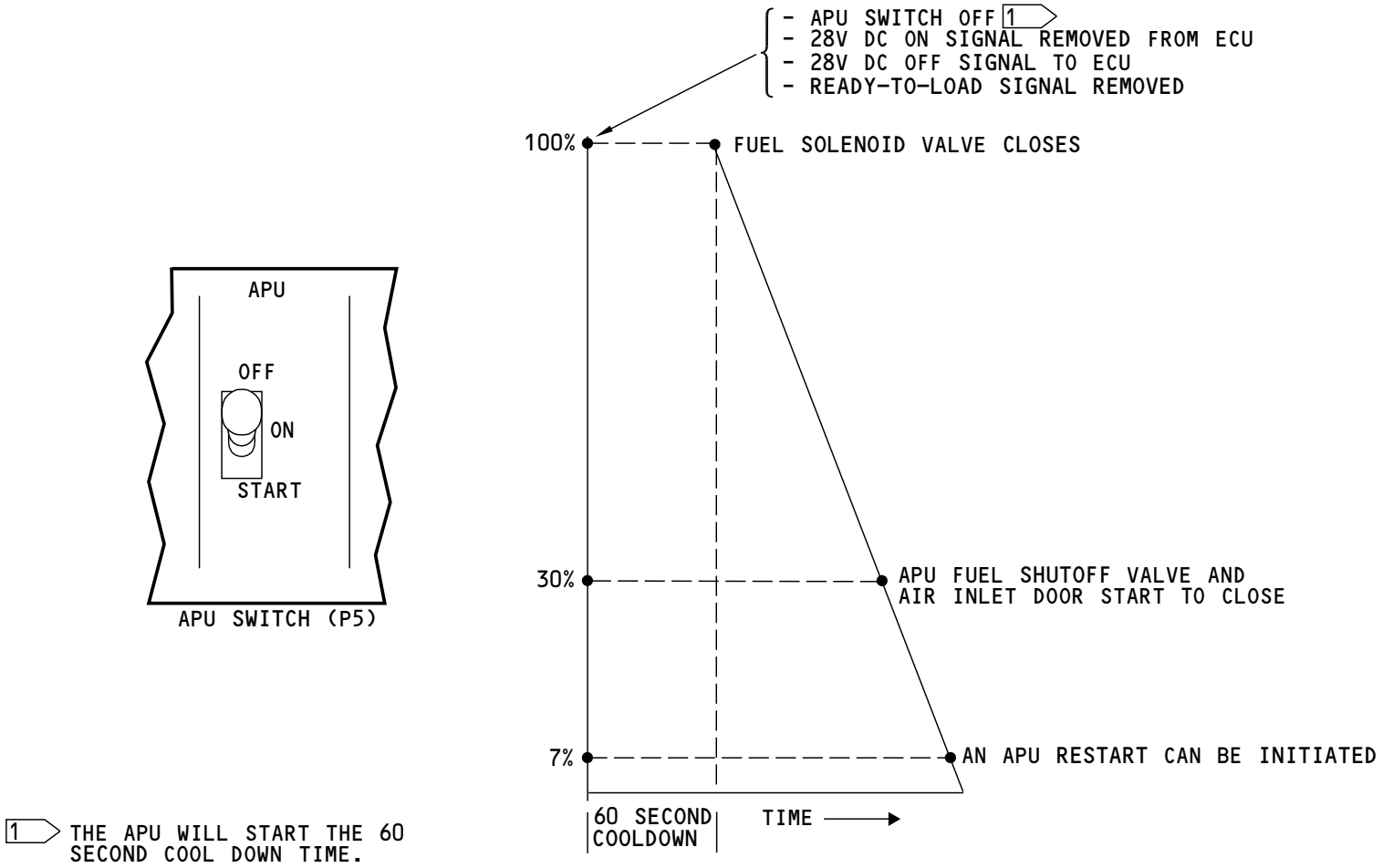
The APU fuel shutoff valve and air inlet door will close for a normal or protective shutdown. Wait 40 seconds after the EGT goes below 300 C for the inlet door and fuel shutoff valve to close before you move the battery switch to the OFF position.

Do not use the battery switch or fire switches to begin a normal APU shutdown. The 60 second cool down is required to prevent coke in the turbine bearing and fuel nozzles.

If the fuel shutoff valve does not close in the required time, the APU FAULT light will come on and stay on until the APU is started again or the battery switch is put in the off position.

See the APU engine controls section for more information on APU faults. (SECTION 49-60)

AIRBORNE AUXILIARY POWER - OPERATION - SHUTDOWN



M87506 S0004631416_V1

AIRBORNE AUXILIARY POWER - OPERATION - SHUTDOWN

AIRBORNE AUXILIARY POWER - PROTECTIVE SHUTDOWN

General

A protective shutdown prevents damage to the Auxiliary Power Unit (APU) or the airplane.

The Electronic Control Unit (ECU) controls an automatic protective shutdown of the APU. If the ECU finds a fault, it does a protective shutdown.

There are three different protective shutdown indications in the flight deck. These are the flight compartment protective shutdown indications:

- FAULT light
- OVER SPEED light
- LOW OIL PRESSURE light.

The cause for the shutdown shows on the Control Display Unit (CDU) on the P9 panel.

Protective Shutdown

These are the conditions that cause a protective shutdown and a FAULT light on:

- Fuel shutoff valve not in commanded position
- Loss of DC power
- ECU failure
- APU fire
- Inlet door not in command position
- APU inlet overheat
- Loss of both Exhaust Gas Temperature (EGT) signals
- No speed signal
- No acceleration
- No APU rotation
- No flame
- Generator filter clogged
- High oil temperature
- Overtemperature
- Reverse flow (load compressor)
- Oil temperature or inlet air temperature sensor failure
- Underspeed.

These are the conditions that cause a protective shutdown and an OVER SPEED light on:

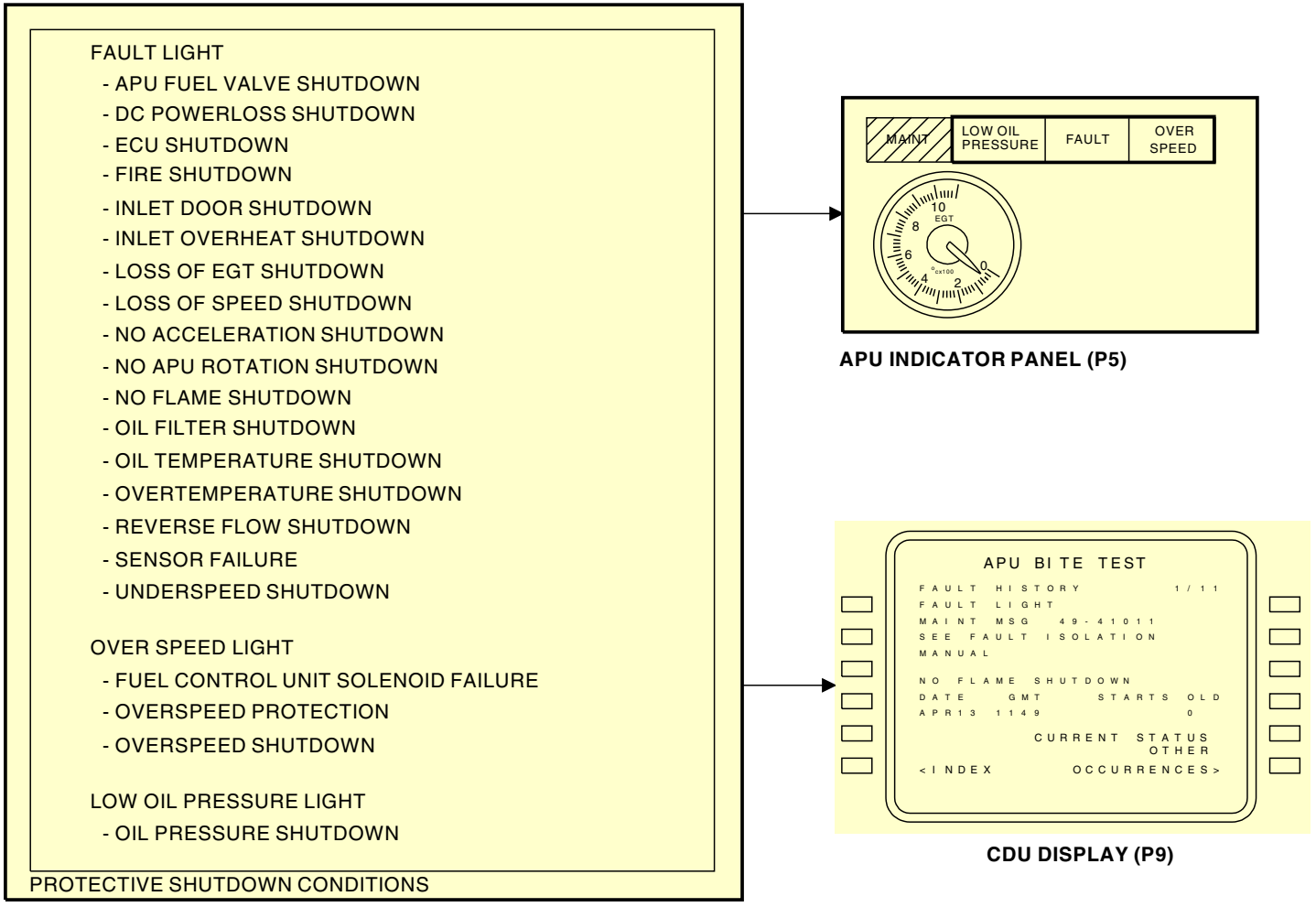
- Fuel control unit solenoid failure
- Loss of overspeed protection
- Overspeed.

Low oil pressure for 20 seconds causes a protective shutdown and a LOW OIL PRESSURE light on.

When a protective shutdown occurs, the ECU removes electrical power from these components:

- Fuel solenoid
- Ignitor
- SCU Start signal
- Bleed air valve (BAV)
- Fuel Control Unit (FCU) signal
- Surge control valve (SCV) signal.

AIRBORNE AUXILIARY POWER - PROTECTIVE SHUTDOWN



M87507 S0004631418_V2

AIRBORNE AUXILIARY POWER - PROTECTIVE SHUTDOWN

AIRBORNE AUXILIARY POWER - INDICATIONS

General

The APU has four indication lights and an EGT indicator on the APU indicator panel. These are the four lights:

- MAINTENANCE - no automatic shutdown (blue)
- LOW OIL PRESSURE - automatic shutdown (amber)
- FAULT - automatic shutdown (amber)
- OVER SPEED - automatic shutdown (amber).

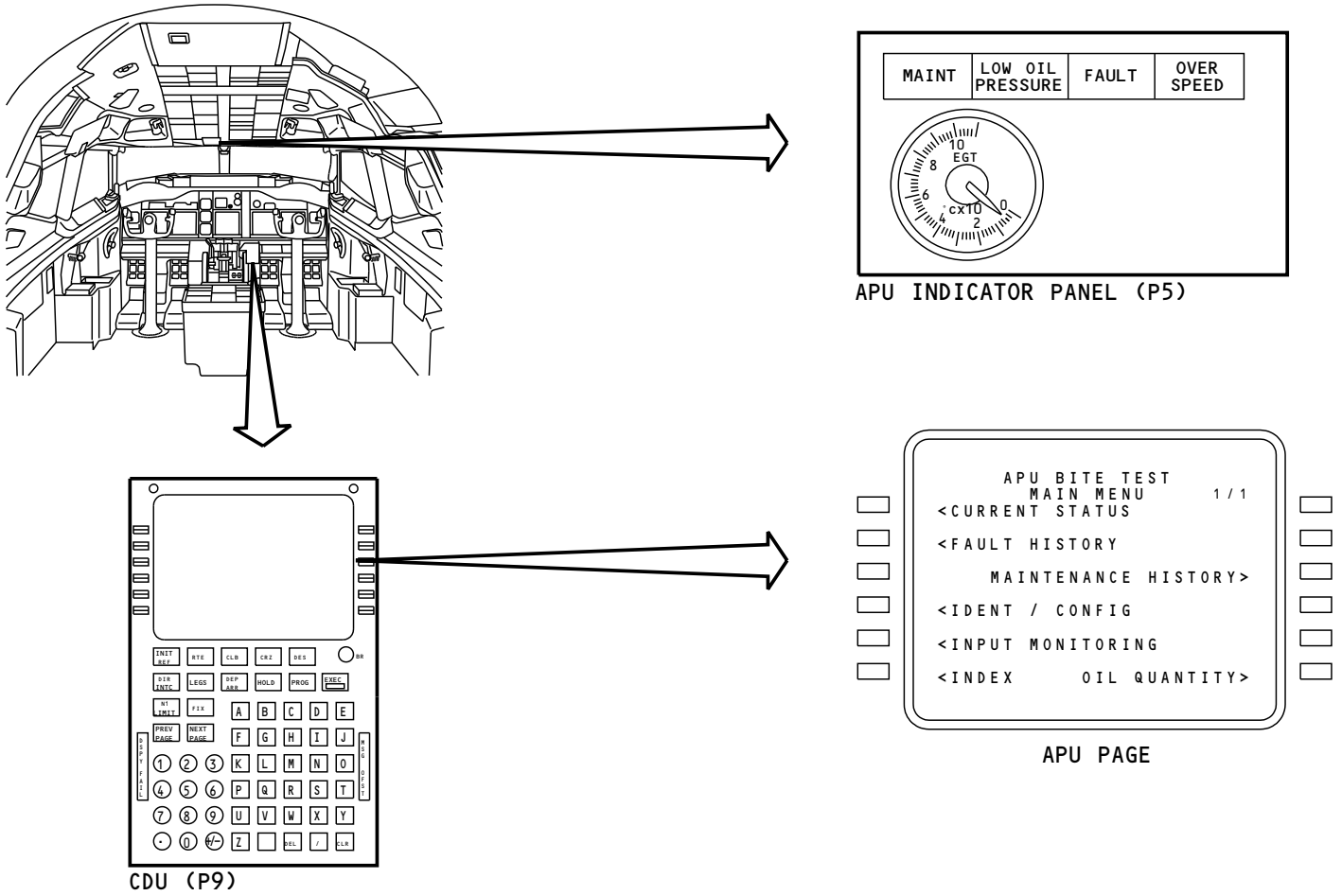
The control display unit (CDU) shows this APU system data:

- Current status
- Fault history
- Maintenance history
- Ident/config
- Input monitoring (real time data)
- Oil quantity.

Training Information Point

You must have 115v AC power from the transfer bus to operate the CDU. The APU indication lights operate on 28v DC power.

AIRBORNE AUXILIARY POWER - INDICATIONS



M87508 S0004631420_V1

AIRBORNE AUXILIARY POWER - INDICATIONS

APU Access

Open the APU cowl door on the bottom of the aft fuselage to get access to the APU compartment.

Release three latches on the left side to open the APU cowl door. The APU access door opens to the right on two hinges. Connect the hold open rods to keep the door open safely.

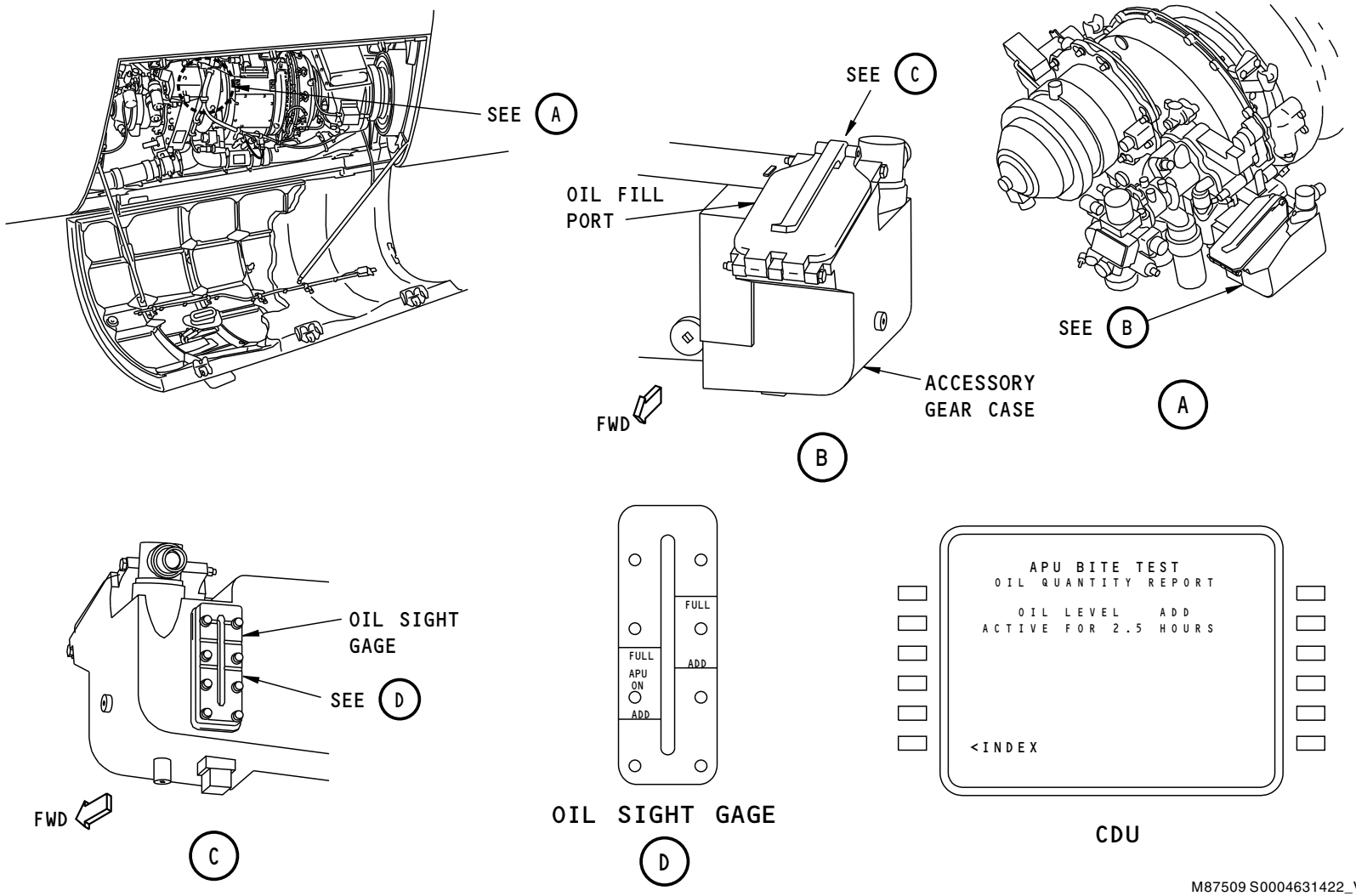
APU Oil Servicing

Add oil to the APU fill port on the left side of the accessory gear case. There are two FULL and ADD marks on the oil sight gage. The left side of the oil sight gage shows the oil level during APU operation. The right side of the oil sight gage shows the oil level for no APU operation (APU shutdown).

The CDU shows the APU oil quantity with a FULL, ADD, or LOW indication.

Training Information Point

Servicing of the APU should only be done with the APU shutdown.



M87509 S0004631422_V2

AIRBORNE AUXILIARY POWER - INTERFACE

General

The ECU sends and receives data with airplane systems. The data is digital and analog. The ARINC 429 data bus transmits the digital data.

ARINC 429 Interfaces

Display electronic unit (DEU) 1 transmits ARINC 429 data to the ECU.

These components receive ARINC 429 data from the ECU:

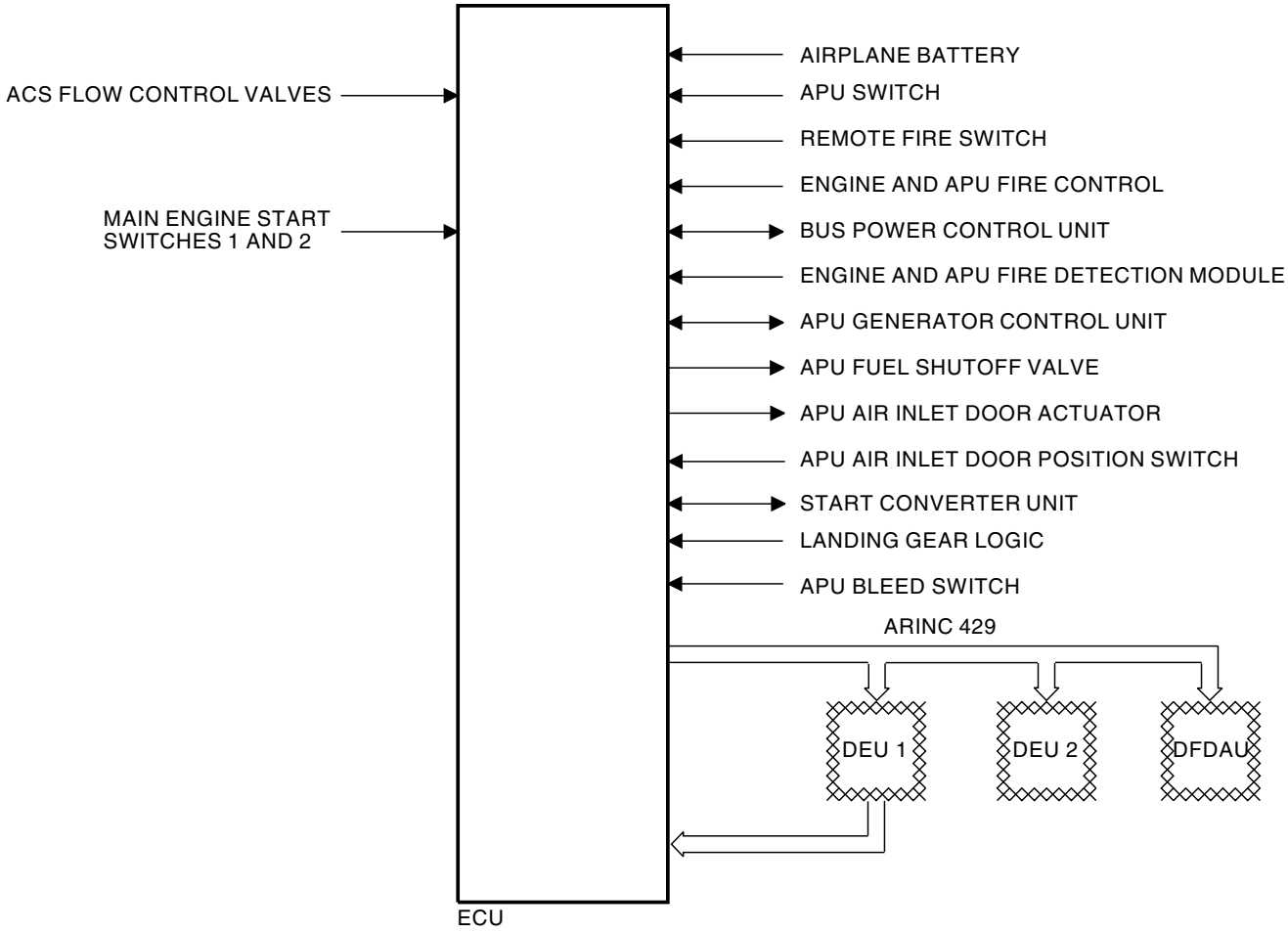
- Display electronic unit (DEU) 1
- Display electronic unit (DEU) 2
- Digital flight data acquisition unit (DFDAU).

Other interfaces

The ECU also has analog interfaces with these systems and components:

- APU switch
- APU bleed switch
- Remote fire switch
- Engine and APU fire control
- Bus power control unit
- Engine and APU fire detection module
- APU generator control unit
- APU fuel shutoff valve
- APU air inlet door actuator
- Air inlet door position switch
- Start converter unit
- Landing gear logic
- Airplane battery
- Air conditioning system (ACS) flow control valves
- Main engine start switches 1 and 2.

AIRBORNE AUXILIARY POWER - INTERFACE



M87510 S0004631424_V2

AIRBORNE AUXILIARY POWER - INTERFACE

AIRBORNE AUXILIARY POWER - APU COOLING

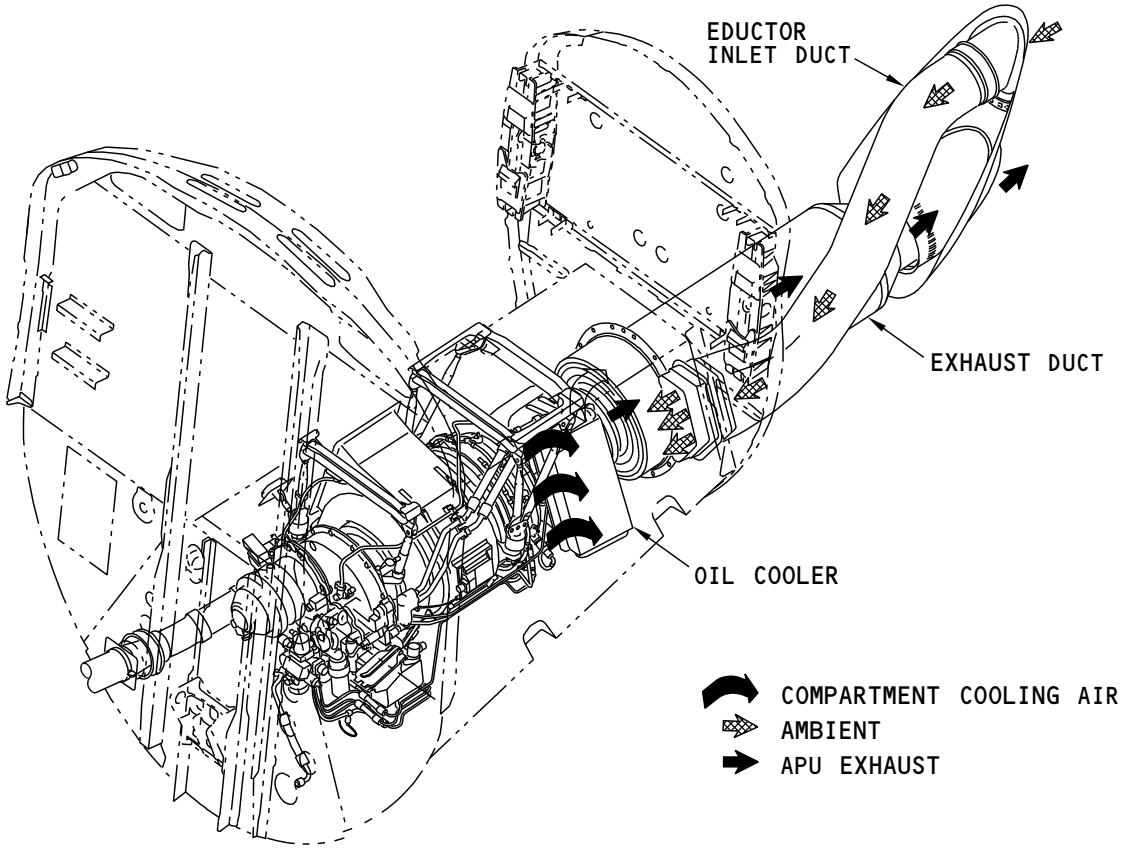
General

The APU cooling air system cools the APU compartment and the APU engine oil.

Compartment Cooling

APU compartment cooling uses an eductor to pull outside air through the APU compartment. The high speed flow of the APU exhaust forms a low pressure area. This low pressure pulls outside air through the eductor inlet duct to the APU compartment. The cooling air then goes through the oil cooler and out the APU exhaust duct.

See the APU oil section for more information on the oil cooler. (SECTION 49-90)



APU COMPARTMENT

M87490 S0004631426_V1

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU POWER PLANT - INTRODUCTION

Purpose

The APU power plant supplies electrical and pneumatic power to the airplane systems. This permits the airplane systems to operate without engine or ground power when necessary.

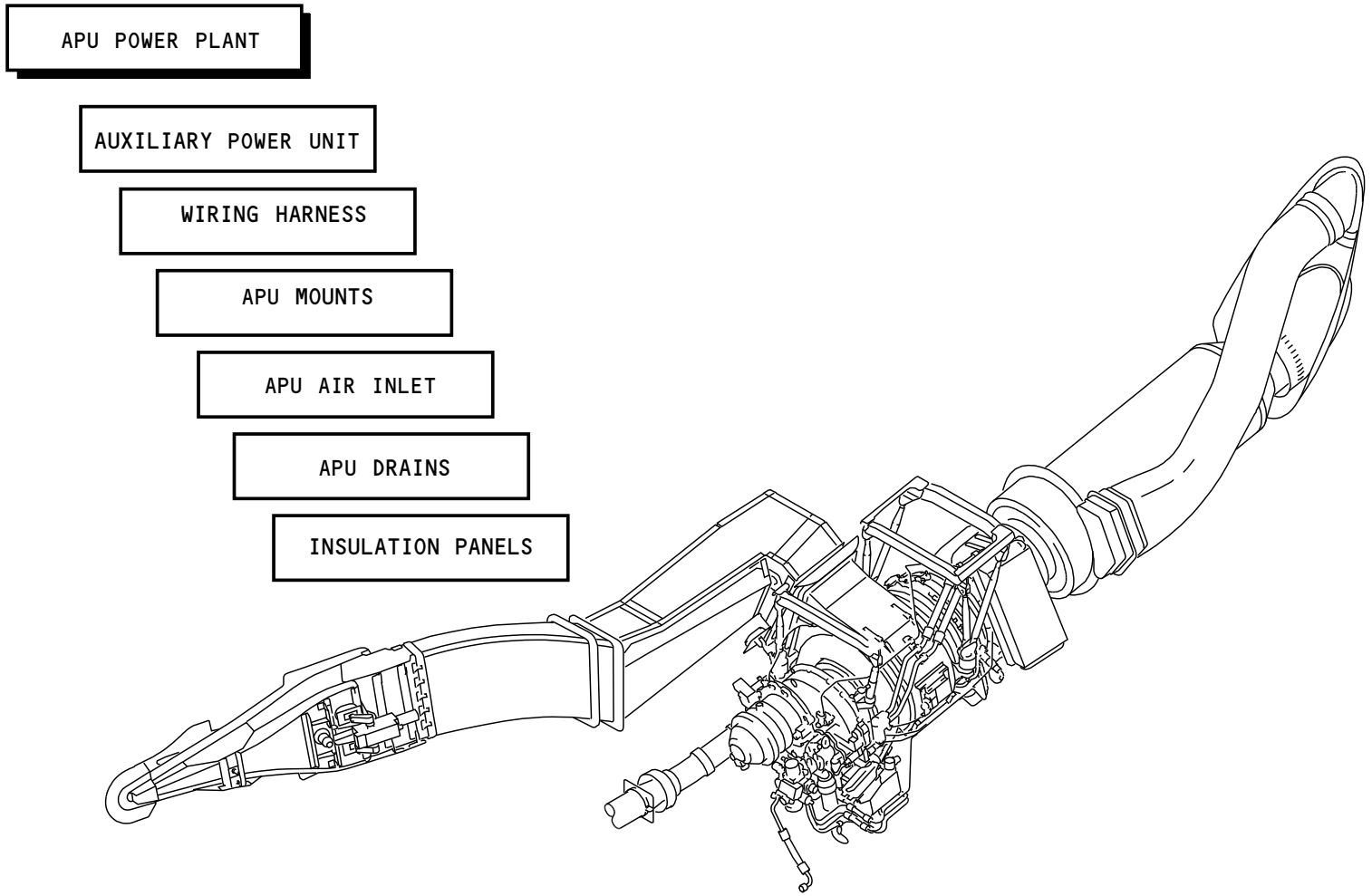
General

These are the APU power plant systems and components:

- Auxiliary Power Unit
- APU wire harness
- APU mounts
- APU air inlet
- APU drains
- Insulation panels.

See the APU engine section for more information. (SECTION 49-20)

APU POWER PLANT - INTRODUCTION



M87512 S0004631430_V1

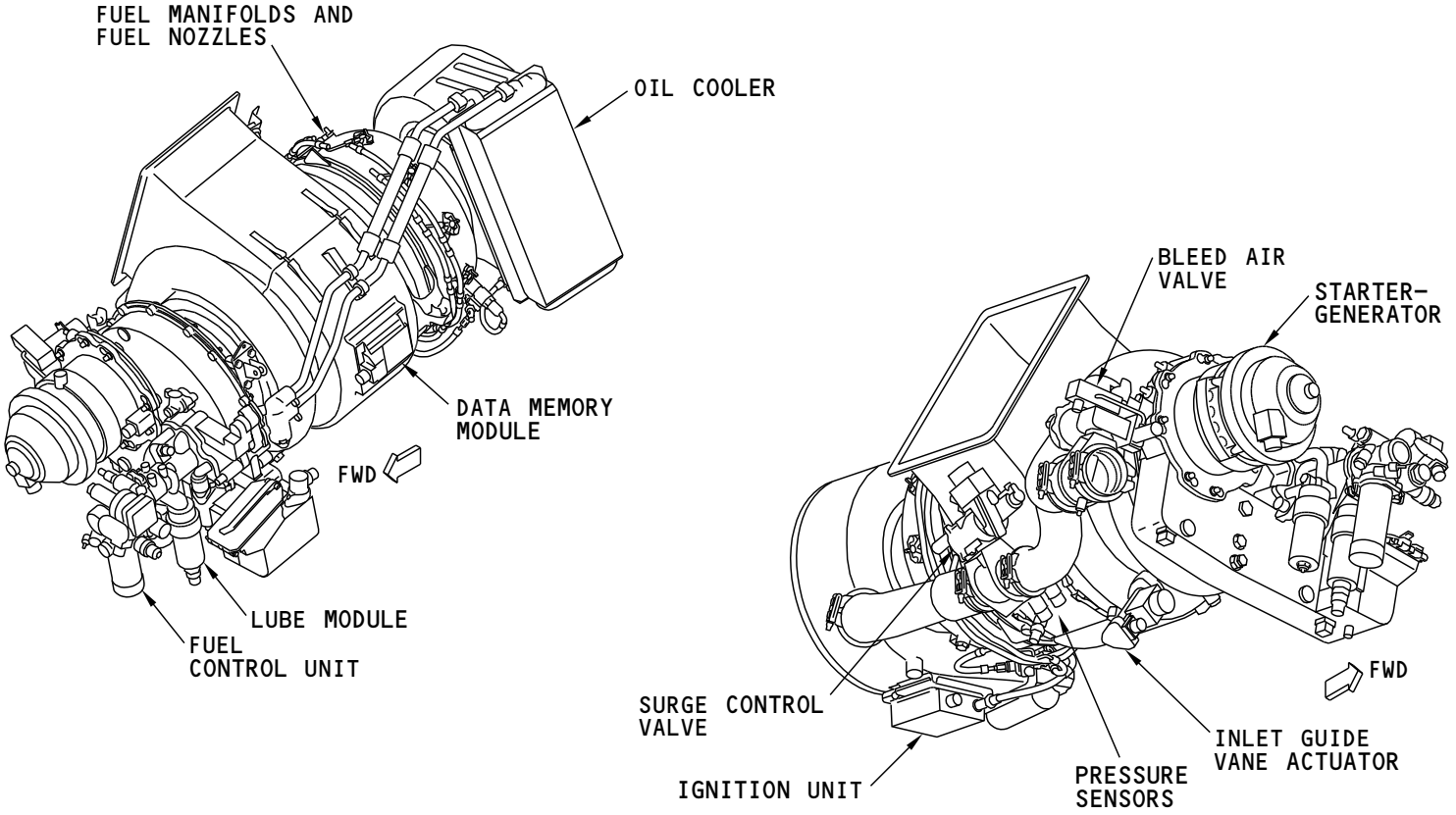
APU POWER PLANT - INTRODUCTION

APU POWER PLANT - AUXILIARY POWER UNIT - INTRODUCTION

General

These are the major components for the auxiliary power unit:

- Fuel manifolds
- Fuel nozzles
- Oil cooler
- Starter-generator
- Bleed air valve (BAV)
- Inlet guide vane actuator (IGVA)
- Pressure sensors
- Ignition unit
- Surge control valve (SCV)
- Data memory module (DMM)
- Lube module
- Fuel control unit (FCU)
- APU engine.



M87513 S0004631432_V1

APU POWER PLANT - WIRING HARNESS

Purpose

The APU wiring harness holds all the electrical wires in one assembly.

Location

The APU wiring harness goes from the firewall connector to the front of the APU. From the front of the APU it goes in different directions to connect all electrical components.

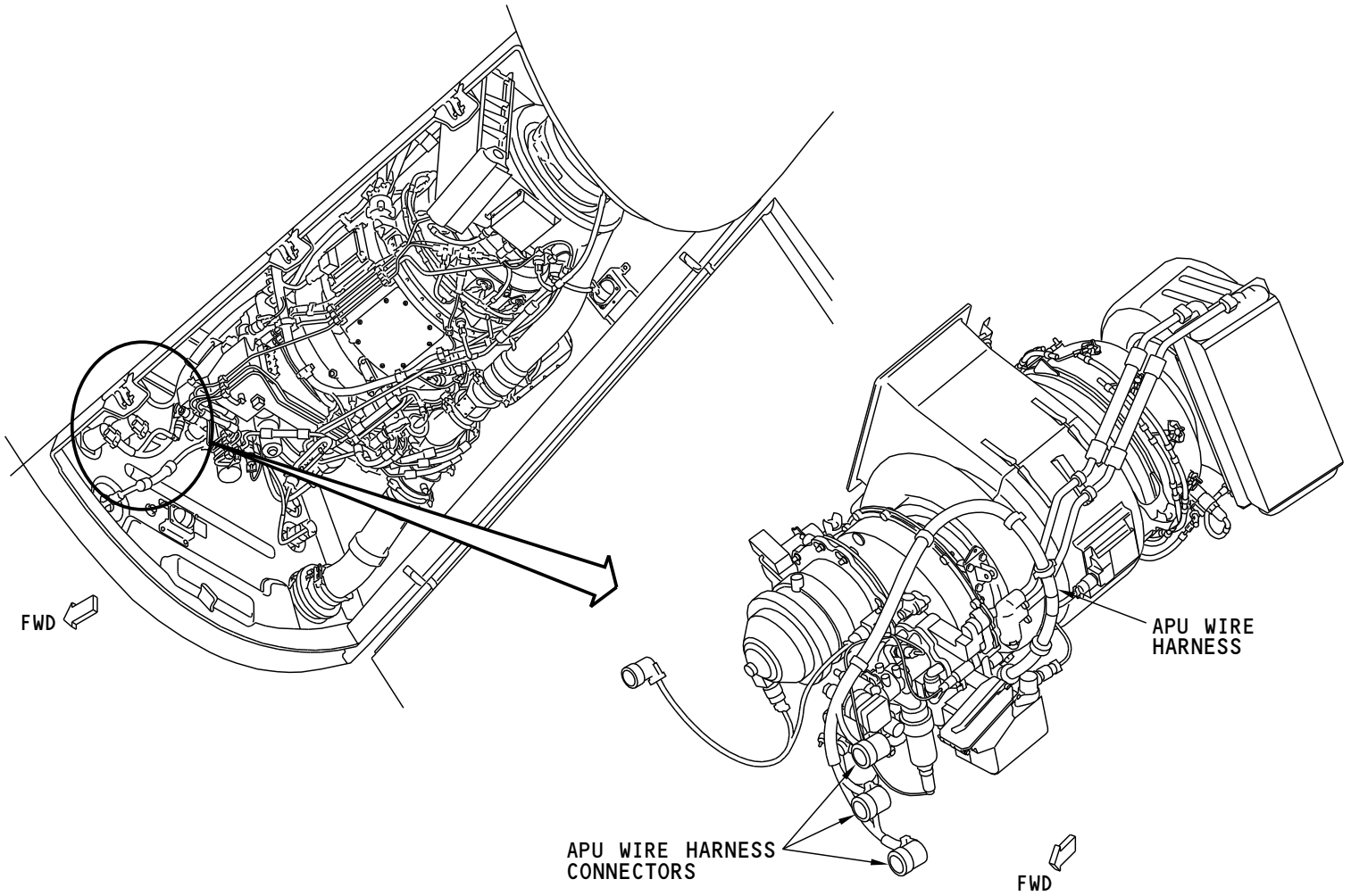
Physical Description

The wires have shields with twisted pair conductors to keep electromagnetic interference to a minimum. The harness connectors are stainless steel and have a self-lock connection.

Training information point

The harness connectors have an index to prevent improper connections.

APU POWER PLANT - WIRING HARNESS



M87515 S0004631434_V1

APU POWER PLANT - WIRING HARNESS

APU POWER PLANT - APU MOUNTS

Purpose

Three primary APU engine mounts hold the APU in its compartment. The mounts isolate the airplane structure from APU vibration. The primary APU engine mounts use a cone bolt type interface.

The forward left mount is a redundant vertical strut. This mount is not vibration isolated. The forward right side strut is also redundant. If there is a mount failure, these redundant struts, with the remaining primary mounts, hold the APU.

Location

The two forward mounts attach to a single crossbeam. The crossbeam attaches to the upper structure of the APU compartment.

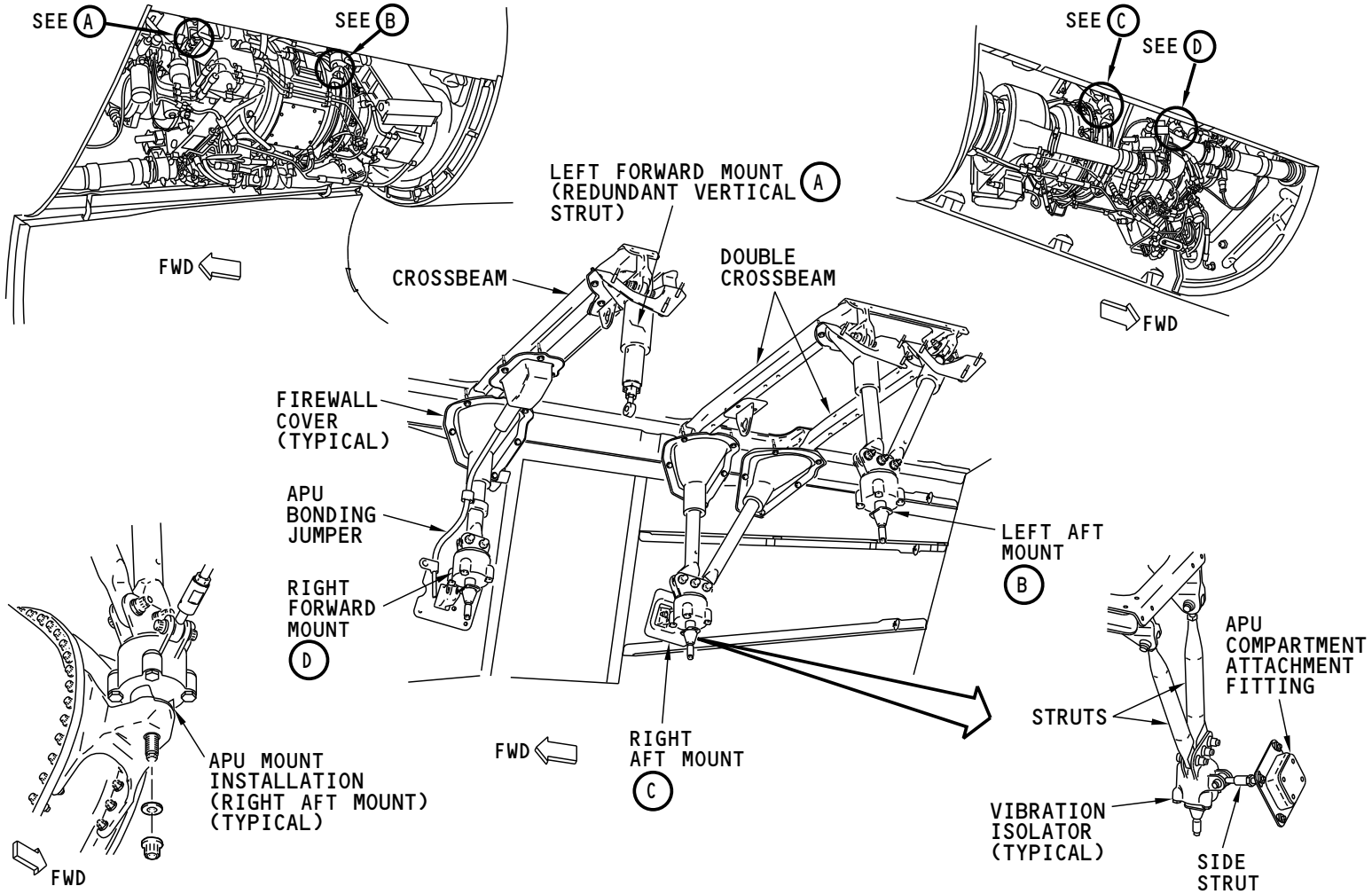
The two aft mounts attach to a double crossbeam. These crossbeams attach to the upper structure of the APU compartment.

The right forward and right aft mounts attach to the side wall of the APU compartment.

Training Information Point

All of the vertical primary mount struts are adjustable at the top. However, adjustments to the primary mount struts are not required unless a strut is repaired or replaced. The redundant vertical strut (forward left) and the redundant side strut (forward right) may require adjustment during APU replacement. To gain access to the upper jam nut on the mount strut it is necessary to remove the firewall cover. Care must be taken not to damage the firewall cover.

APU POWER PLANT - APU MOUNTS



M87514 S0004631436_V1

APU POWER PLANT - APU MOUNTS

APU POWER PLANT - APU AIR INLET - INTRODUCTION

Purpose

The APU air inlet supplies air to the APU for APU engine and load compressor operation.

Location

These are the air inlet components on the lower right side of the tail section:

- Inlet door housing
- Air inlet door
- Air inlet door vortex generator and flap
- Air inlet door actuator and actuator rods
- Air inlet door switch
- Diffuser ducts
- Elevator cable housing
- Inlet liner plenum
- Inlet duct
- Inlet adapter.

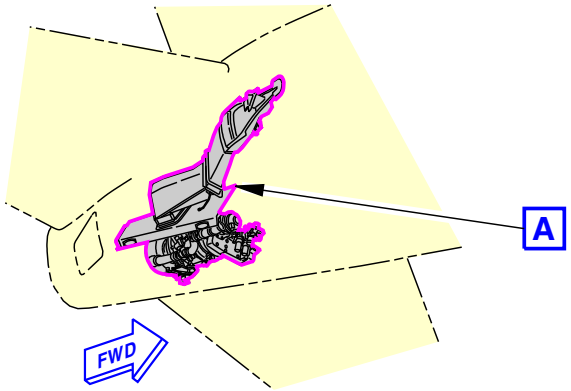
Interface

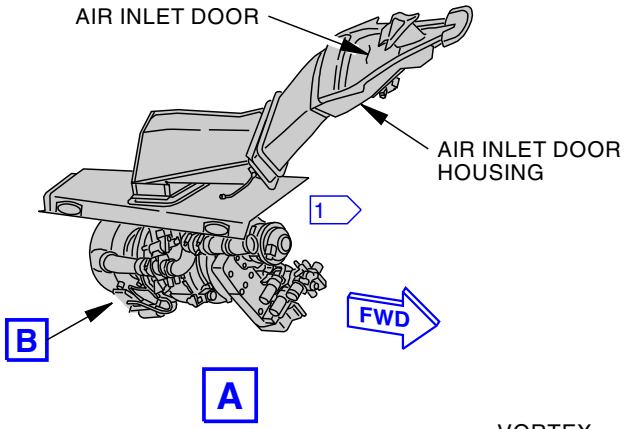
The APU switch and the APU electronic control unit (ECU) control the air inlet door operation.

Training Information Point

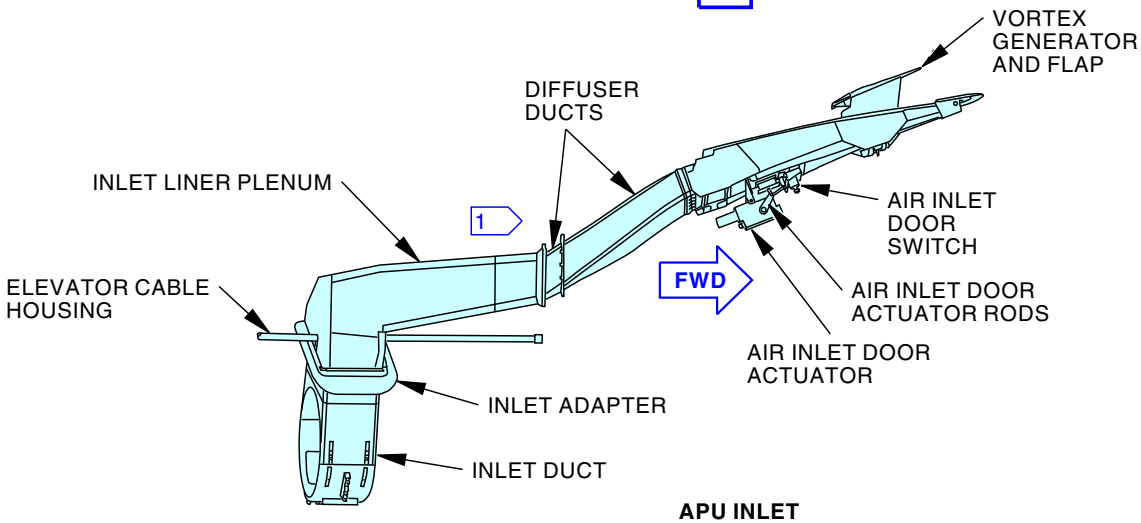
The air inlet door actuator for the 737-600/700/800/900 is different than the inlet door actuator for the 737-100/200/300/400/500. These actuators are not inter-changeable.

APU POWER PLANT - APU AIR INLET - INTRODUCTION





A



APU INLET
(VIEW IN THE UP DIRECTION)

B

1 AIR INLET REPOSITIONED FOR CLARITY

M87516 S0004631438_V2

APU POWER PLANT - APU AIR INLET - INTRODUCTION

APU POWER PLANT - AIR INLET DOOR COMPONENTS

Purpose

The air inlet door opens to let air into the engine and load compressor. The air inlet door closes at shutdown.

The air inlet door is on the right forward side of the aft fuselage.

Air Inlet Door Actuator

The air inlet door actuator is a rotary electric actuator that opens and closes the air inlet door. The air inlet door actuator is on the inboard side of the inlet door housing forward of the APU compartment.

Air Inlet Door Switch

The air inlet door switch supplies a door open and door not open signal to the ECU. The switch is on the inboard side of the inlet door housing.

Training Information Point

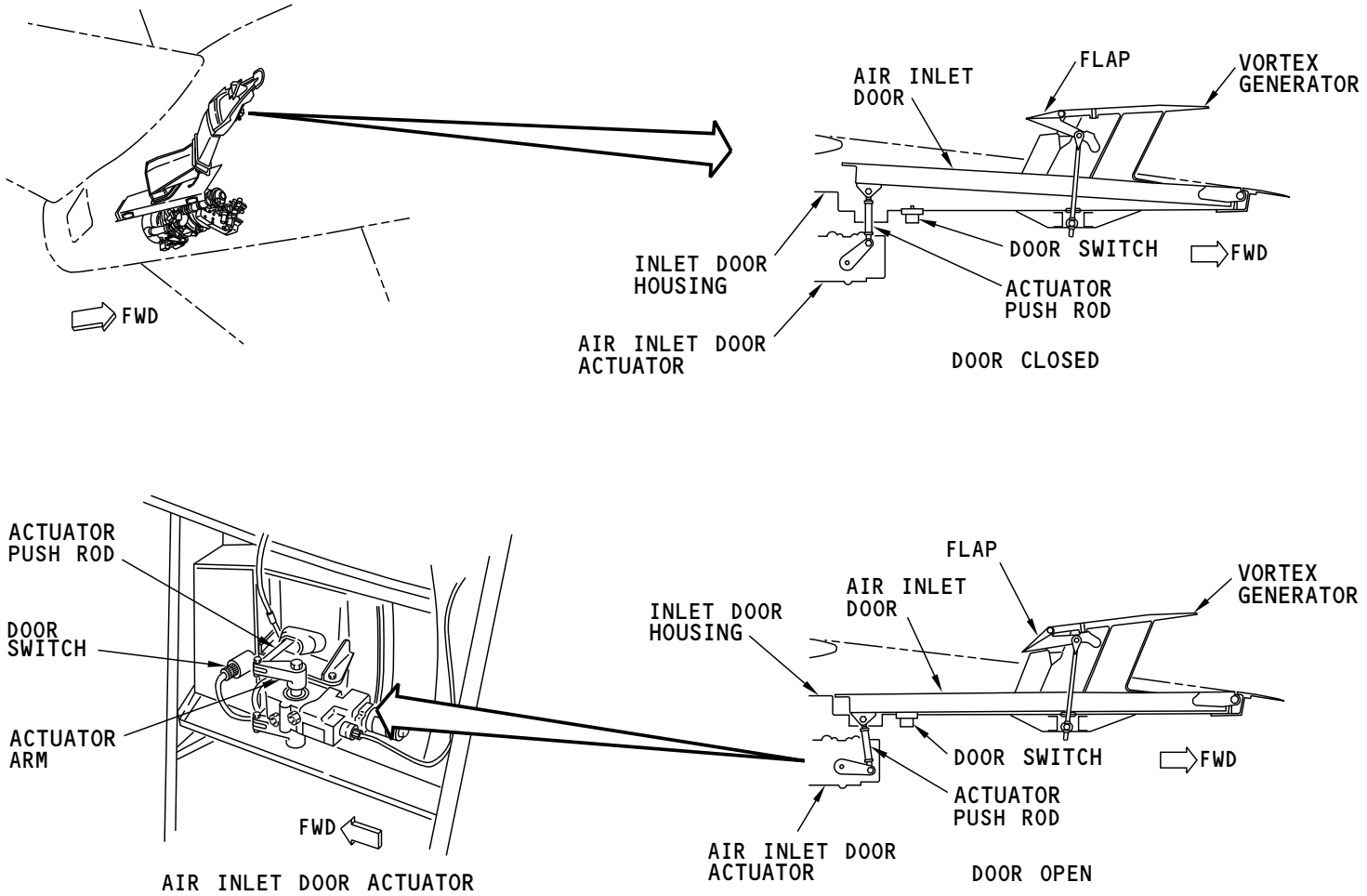
You can open the air inlet door without a start cycle on the APU. To open the door, put the APU switch to the ON position.

The air inlet door does not fully close. This prevents APU rotation during flight when the APU air inlet door is in the closed position.

NOTE: If there is a pressure differential from the inlet of the APU, and the outlet of the APU, then air will flow. If air flows in sufficient quantities, the APU will rotate or 'windmill' during flight. Therefore, there is a need to neutralize that pressure differential. When the door is closed, the pressure on the back side of the APU is higher than on the inlet side causing the differential to be in the opposite direction. So, the APU inlet door is left slightly open to neutralize the pressure differential across the APU during flight to prevent 'windmilling'.

The air inlet door and actuator are adjustable.

APU POWER PLANT - AIR INLET DOOR COMPONENTS



M87517 S0004631440_V1

APU POWER PLANT - AIR INLET DOOR COMPONENTS

APU POWER PLANT - APU AIR INLET FUNCTIONAL DESCRIPTION

General

The APU air inlet door opens for APU operations. It is in the closed position when the APU is not in operation. The ECU and APU switch control the APU air inlet door.

APU Start

When you put the APU switch in the ON or START position, this sequence occurs:

- ECU sends an open signal to the fuel shutoff valve
- When the fuel shutoff valve opens, the fuel shutoff valve open limit switch changes position
- Open signal goes to the ECU
- ECU sends the open signal to the air inlet door actuator
- Air inlet door actuator opens the air inlet door
- When the air inlet door is fully open, the air inlet door switch sends a signal to the ECU.

Normal Operation

During normal operation, the air inlet door and fuel shutoff valve stay open until they get a signal to go to the closed position.

APU Shutdown

When you put the APU switch to the OFF position, it causes these conditions:

- APU shuts down
- APU fuel shutoff valve closes
- APU air inlet door closes.

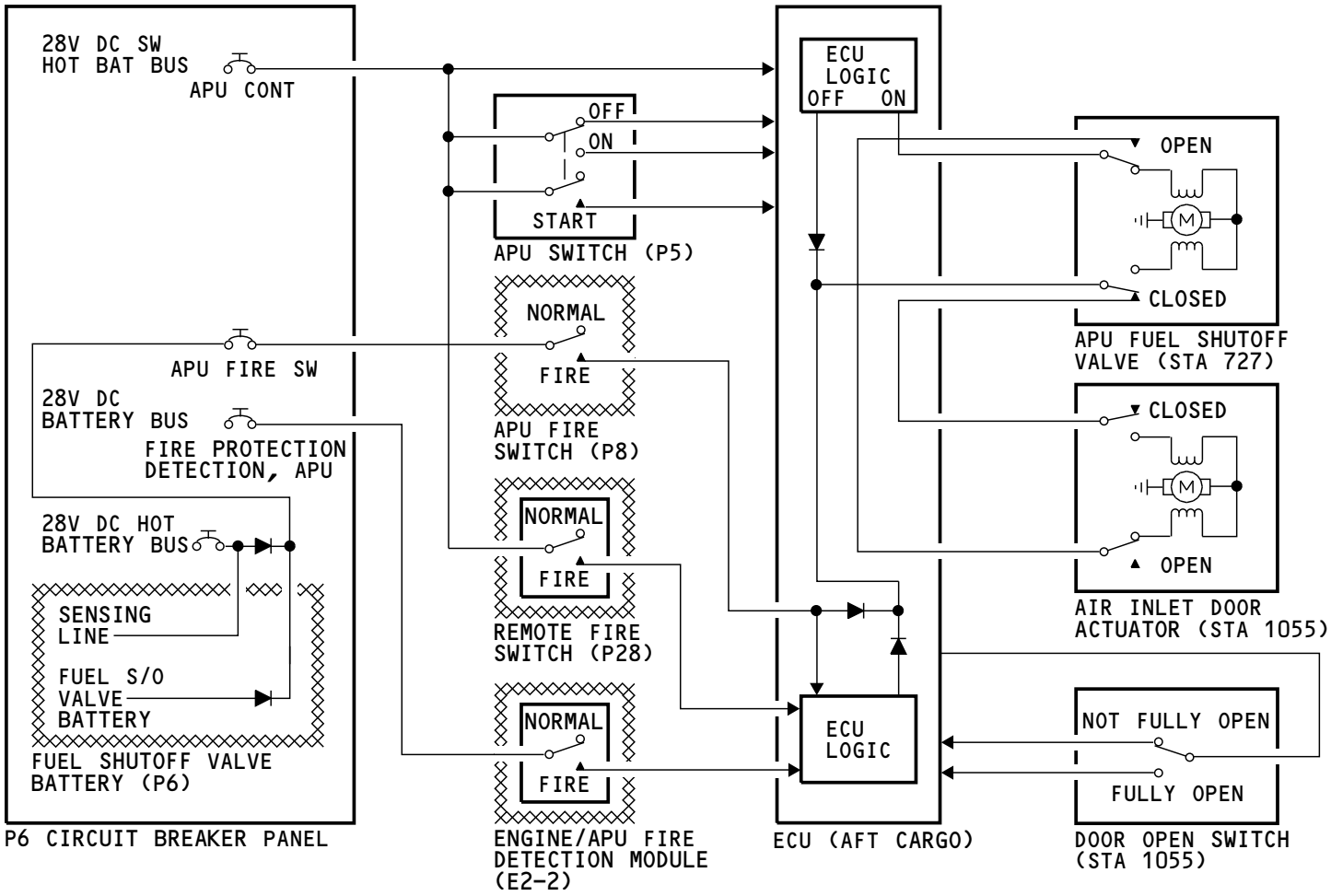
These signals shutdown the APU and close the air inlet door and the fuel shutoff valve:

- APU switch to the OFF position (P5)
- APU fire switch in close position (P8)
- APU remote fire switch in close position (P28)
- Engine/APU fire detection module detects a fire
- Automatic protective shutdown (ECU logic).

EFFECTIVITY

SIA ALL

APU POWER PLANT - APU AIR INLET FUNCTIONAL DESCRIPTION



M87518 S0004631442_V1

APU POWER PLANT - APU AIR INLET FUNCTIONAL DESCRIPTION

APU POWER PLANT - APU DRAINS - INTRODUCTION

Purpose

The Auxiliary Power Unit (APU) engine drain system drains flammable fluid overboard through a drain mast.

The APU compartment drain system drains flammable and nonflammable fluids overboard through a drain hole on the APU cowl door.

APU Engine Drain System

These drains come together at the forward drain collector tube:

- Fuel Control Unit (FCU) seal
- Surge Control Valve (SCV) seal
- Inlet Guide Vane Actuator (IGVA) seal.

The APU load compressor seal connects to the middle drain collector tube.

These drains come together at the aft drain collector tube:

- Combustor case
- Eductor
- Muffler.

The drain collector cup contacts the drain seal when the APU cowl door is closed.

Compartment Drain System

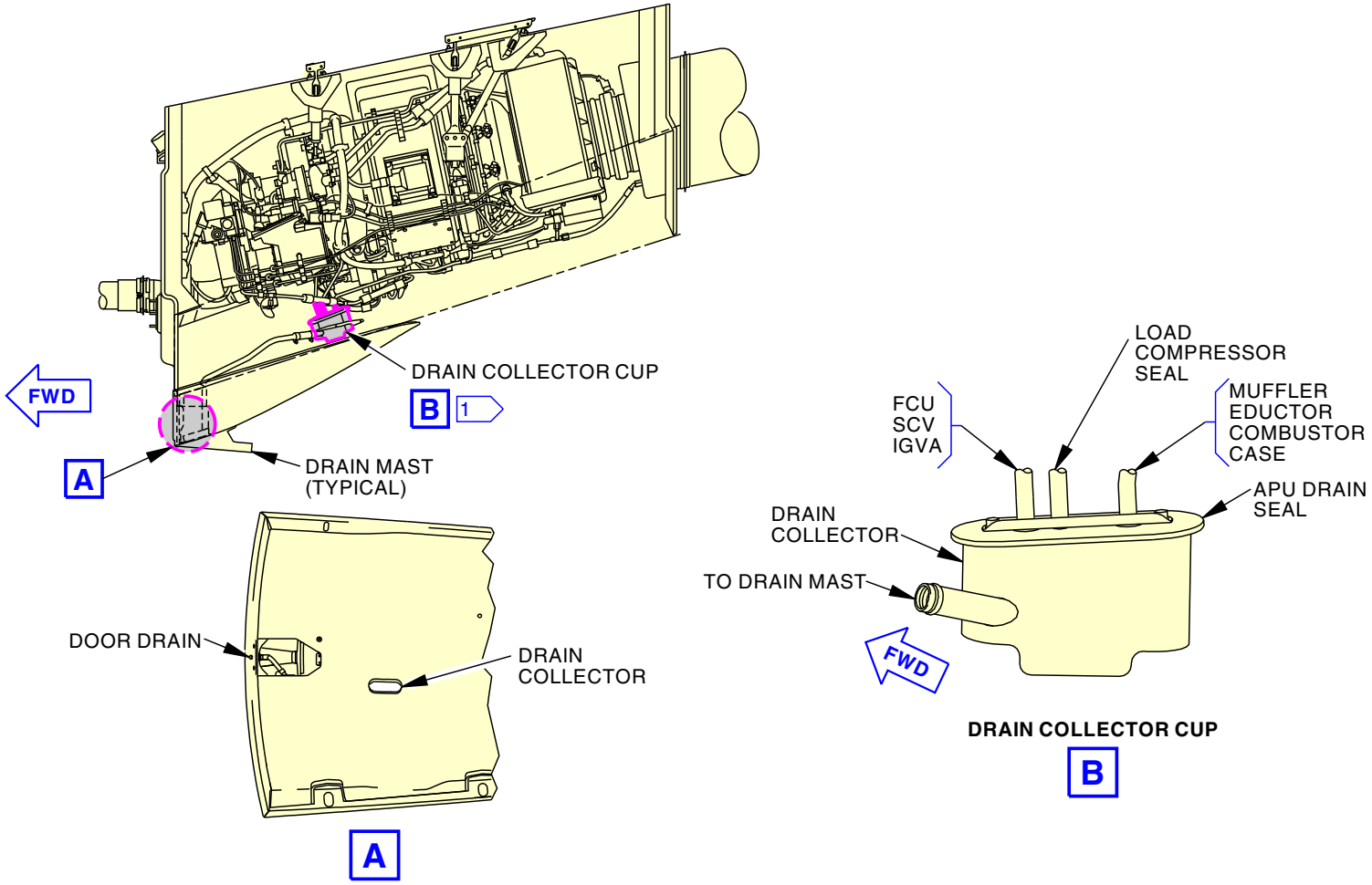
The compartment drain system collects external APU engine leakage and fluids that enter the APU compartment through the eductor inlet. This fluid drains through the APU cowl door. The drain extends past the cowl door to keep fluid off the airplane skin.

Training Information Point

Fluid drainage from the drain mast must be investigated to determine the source of the leak. Fuel or oil leakage from the FCU, SCV, or IGVA is an indication of an APU failure.

Fluid leakage from the door drains through the door drain. The door drain connects to the drain mast. Oil or fuel leakage from the compartment drain shows a loose connection on the APU. You should correct the cause of the leakage. Water leakage from the drain mast is usual.

APU POWER PLANT - APU DRAINS - INTRODUCTION



1 THE DOOR INSULATION PANEL IS NOT SHOWN FOR CLARITY.

M87520 S0004631445_V2

APU POWER PLANT - APU DRAINS - INTRODUCTION

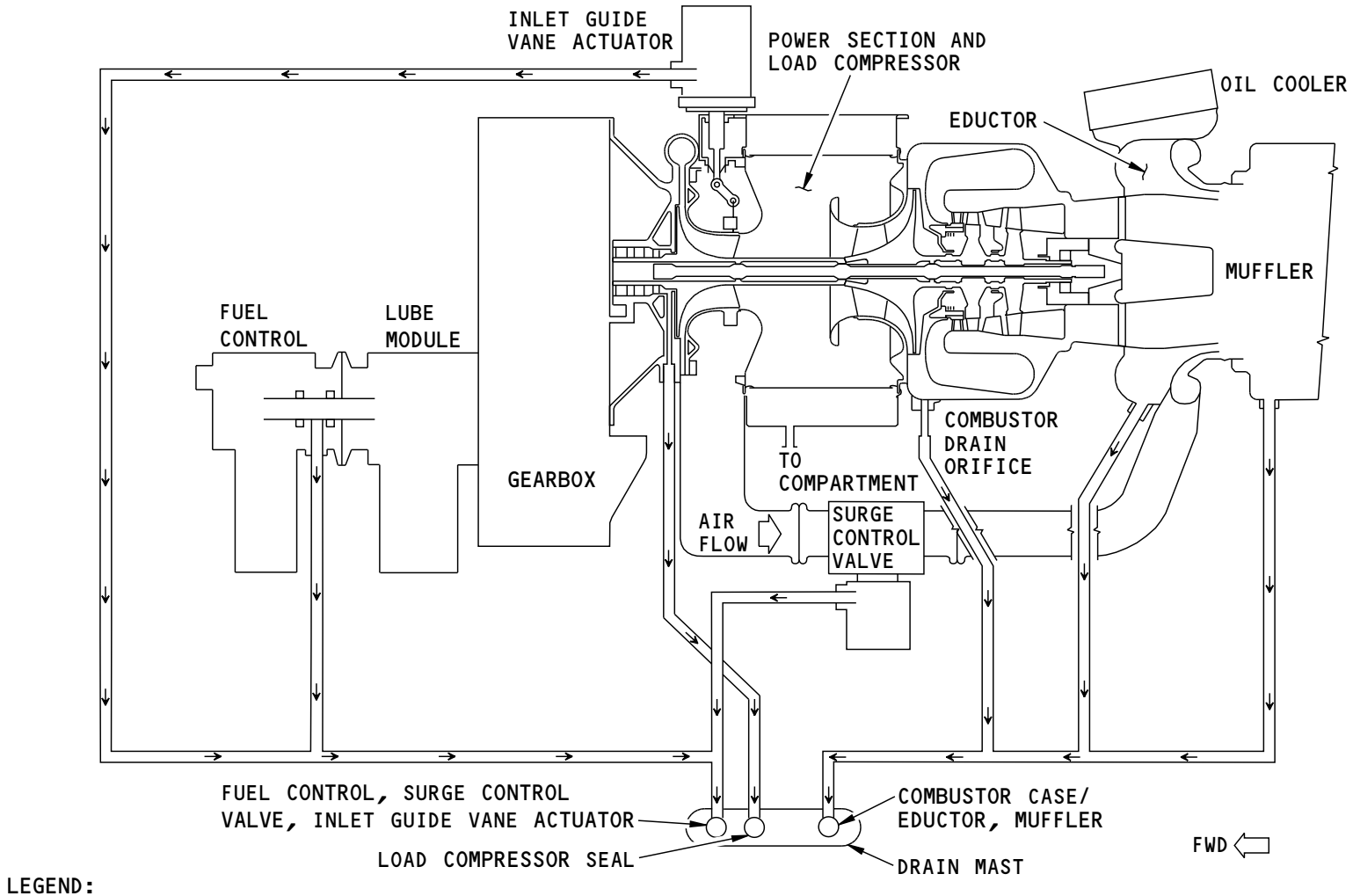
APU POWER PLANT - APU DRAINS - FUNCTIONAL DESCRIPTION

General

These APU components send fuel and oil to the drain mast on the APU access door:

- Combustion chamber fuel
- Eductor/muffler
- Load compressor seal
- Surge control valve (SCV) actuator seal
- Inlet guide vane (IGV) actuator seal
- Fuel control unit seal.

APU POWER PLANT - APU DRAINS - FUNCTIONAL DESCRIPTION



2067716 S0000429419_V1

APU POWER PLANT - APU DRAINS - FUNCTIONAL DESCRIPTION

APU POWER PLANT - APU INSULATION PANELS

Purpose

The APU insulation panels provide thermal and fire insulation between the APU and APU compartment structure.

Physical Description

There are seven different insulation panels. Each panel fits in a particular area of the APU compartment.

The panels are made of stainless steel face sheets with insulation between the face sheets.

Training Information Point

The APU insulation panels are not easily damaged, however, if the panels are punctured, you should repair the damaged panel as soon as possible. If you do not repair a puncture immediately, the panel can store fluids in the insulation. If fluids get into the insulation material, you must replace the panel. The air inlet scoop replaces the foam and support insulation (egg crate) that were installed between the APU insulation panels and the bulkhead. During an airplane operation, the air inlet scoop supplies forced outside air through the empty space between the APU insulation panels and the bulkhead for ventilation and for the removal of flammable or unwanted fluids. The location of the air inlet scoop is behind the forward insulation panel and adjacent to the forward right side of the APU cowl door.

See Part II of the Airplane Maintenance Manual for the repair procedure.

Location

The insulation panels are around the inside of the APU compartment. The name of the panel is also the location of the panel in the compartment.

These are the seven insulation panels:

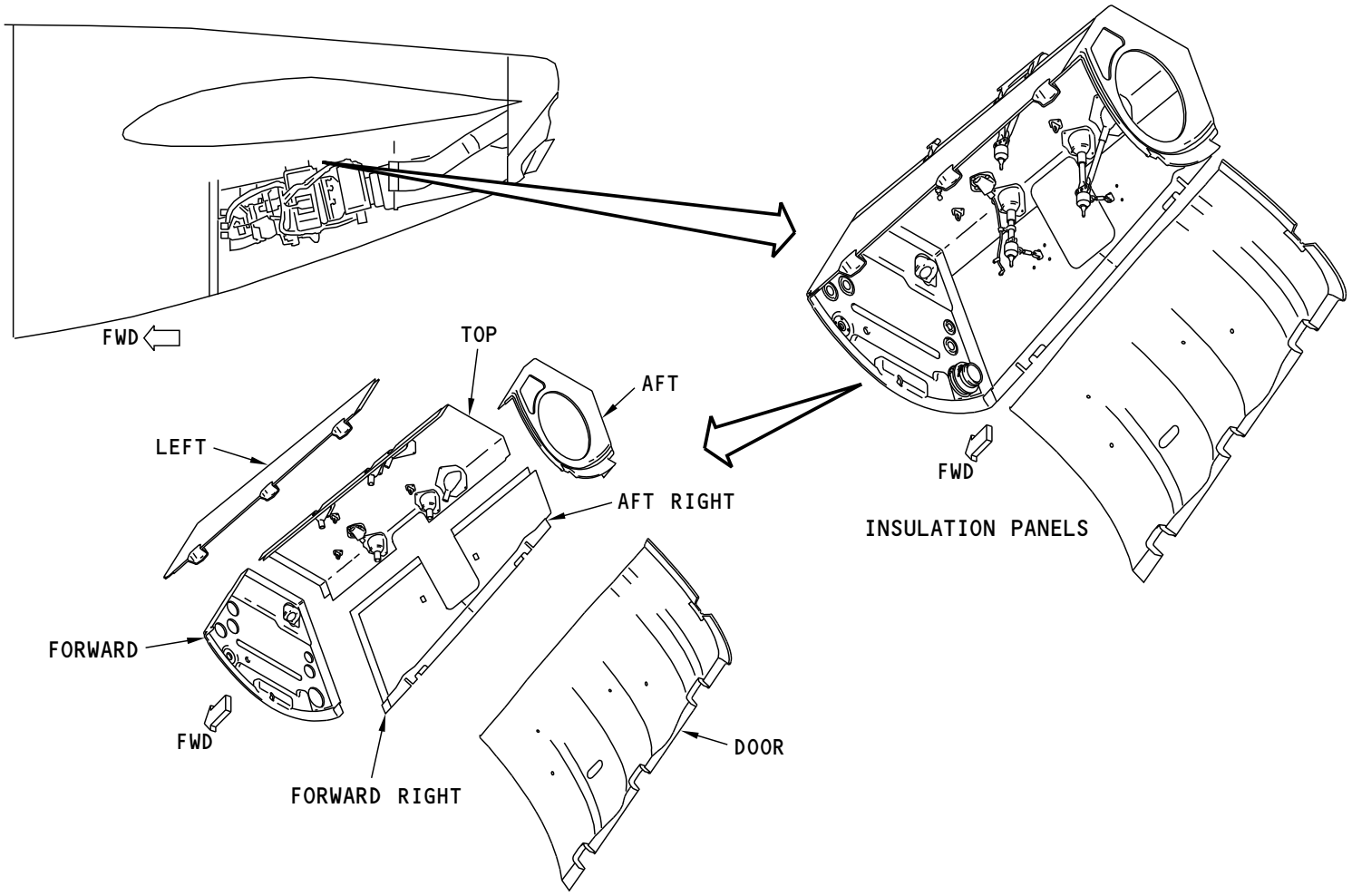
- Forward
- Forward right
- Aft right
- Aft
- Left
- Top
- Door.

Training Information Point

The insulation panels in the APU compartment are installed in a specified order because of the insulation panel over laps. The APU cowl door insulation panel is installed independently.

See Part II of the maintenance manual for APU insulation panel removal/installation procedures.

APU POWER PLANT - APU INSULATION PANELS



M87522 S0004631449_V1

APU POWER PLANT - APU INSULATION PANELS

APU POWER PLANT - APU INSULATION PANELS - INSTALLATION

Purpose

Six of the seven insulation panels have holes for APU systems interface connections with the airplane.

These are the six insulation panels with holes:

- Forward
- Forward right
- Aft right
- Aft
- Top
- Door.

Forward Insulation Panel

These are the holes in the forward insulation panel:

- Starter-generator wiring
- Fire detector and compartment light connector
- Generator control connector
- ECS duct
- Fire extinguisher nozzle
- Fuel line
- Three electrical connectors for APU harness.

Forward Right Insulation Panel

The forward right insulation panel has a hole for the APU right forward mount.

AFT Right Insulation Panel

The aft right insulation panel has a hole for the APU right aft side mount.

Aft Insulation Panel

Two holes are in the aft insulation panel. One is for the eductor duct and the other is for the APU exhaust duct.

Top Insulation Panel

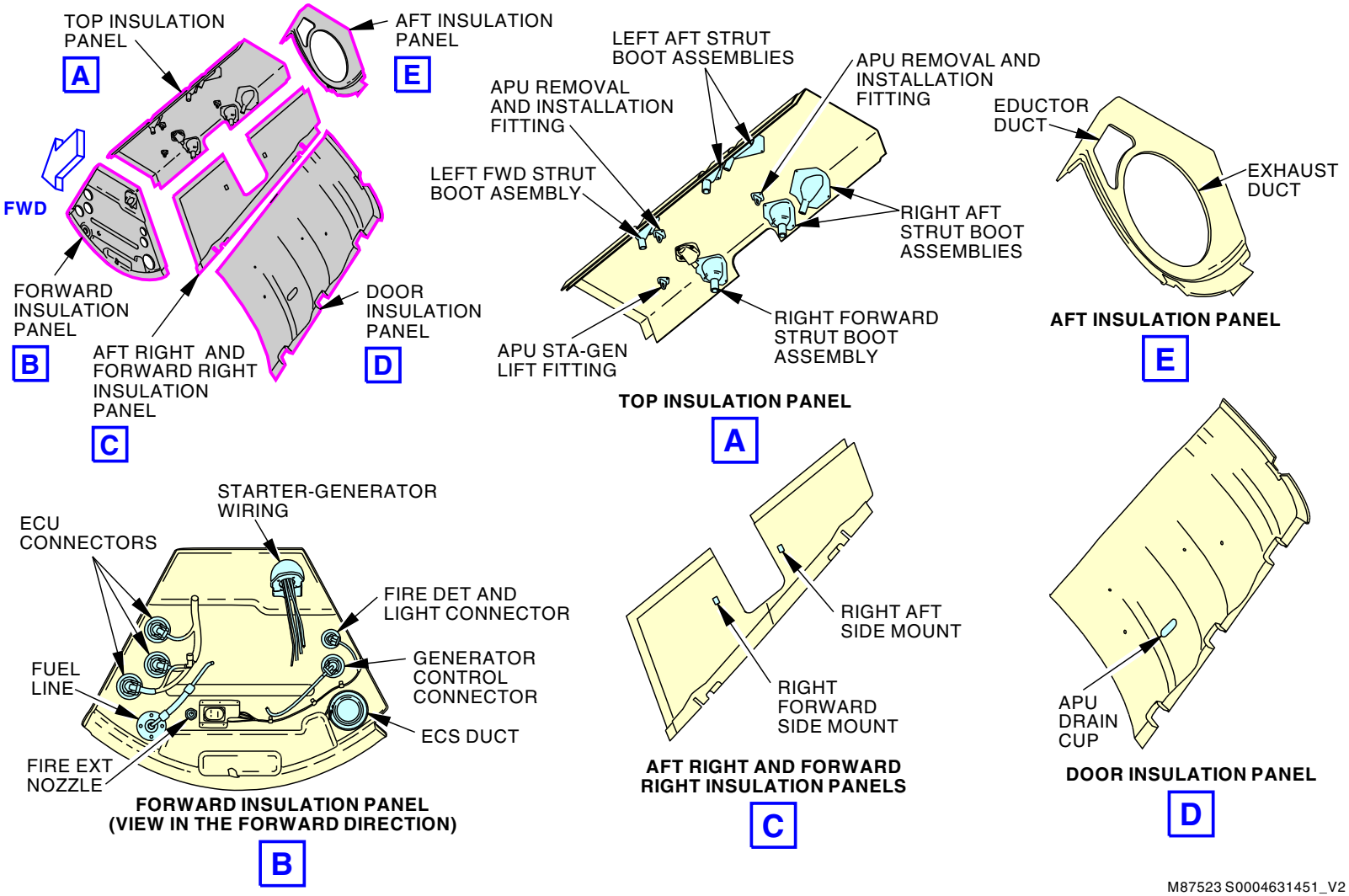
These are the holes in the top insulation panel:

- Right forward mount strut and boot assembly
- Two right aft mount struts and boot assemblies
- Two left aft mount struts and boot assemblies
- Left forward mount strut and boot assembly
- APU starter-generator lift fitting
- Two APU lift fittings
- APU electrical ground bracket (not shown).

Door Insulation Panel

The door insulation panel has one hole for the APU drains.

APU POWER PLANT - APU INSULATION PANELS - INSTALLATION



M87523 S0004631451_V2

APU POWER PLANT - APU INSULATION PANELS - INSTALLATION

APU POWER PLANT - INSTALLATION

General

The auxiliary power unit is removed or installed from the airplane by one of these two methods:

- Fishpole hoist
- Hydraulic jack.

The fishpole hoist method uses two fishpole hoists and APU hoist equipment to lift and lower the APU. The APU hoist equipment has three parts:

- Forward arm assembly
- Center beam assembly
- Aft arm assembly.

The APU hoist equipment attaches to the two APU lift fittings in the APU compartment. The two fishpole hoists attach to the APU hoist equipment and the APU. The two fishpole hoists are used to move the APU up and down in the APU compartment.

The hydraulic jack method uses a hydraulic jack assembly, an adapter, and a maintenance stand to lift and lower the APU. The adapter attaches to the hydraulic jack assembly. The maintenance stand is used to lift the APU, adapter and hydraulic jack assembly to the APU compartment. The hydraulic jack assembly then moves the APU up and down in the APU compartment.

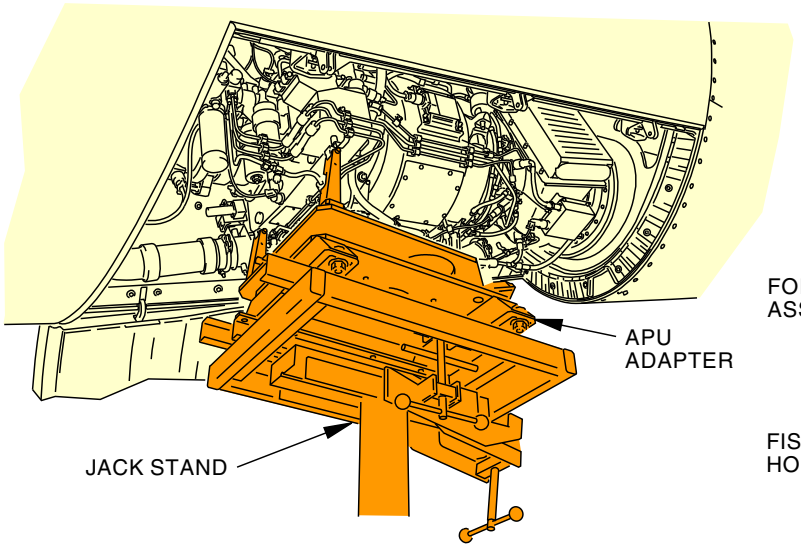
WARNING MAKE SURE THAT THE FISHPOLE HOIST IS IN A SERVICEABLE CONDITION. MAKE SURE THAT THERE ARE NO SIGNS OF DAMAGE ON THE CABLES OR CHAINS. IF THERE IS DAMAGE, INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION MAKE SURE THAT THE TWO CABLES OF THE TWO FISHPOLE HOISTS ARE EQUALLY WOUND AROUND THE DRUM BEFORE YOU OPERATE. IF YOU DO NOT HAVE THE CABLE EQUALLY WOUND BEFORE OPERATION, THE APU CAN FALL SUDDENLY.

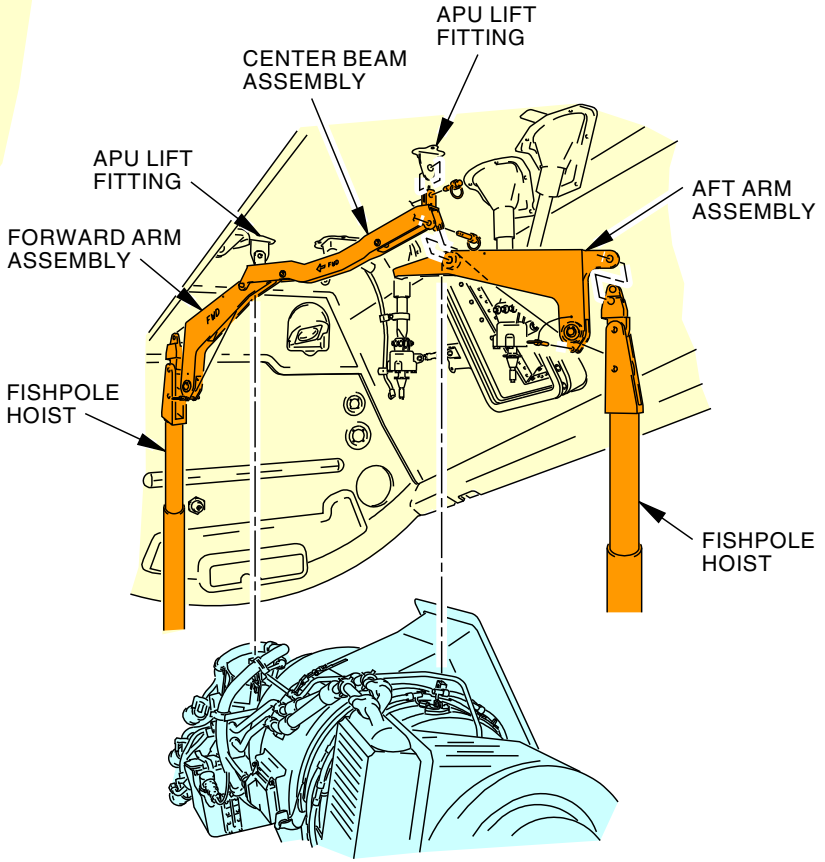
CAUTION BE CAREFUL WHEN YOU MOVE THE APU IN THE APU COMPARTMENT. YOU MUST TILT THE APU APPROXIMATELY 10-15 DEGREES IN THE FORWARD-END-DOWN POSITION WHILE THE APU IS IN THE APU COMPARTMENT. IF YOU DO NOT TILT THE APU CORRECTLY, DAMAGE TO THE FUEL SUPPLY LINE, STARTER-GENERATOR WIRE HARNESS AND ENGINE WIRE HARNESS CAN OCCUR.

CAUTION CAREFULLY LIFT THE APU SO THAT YOU DO NOT DAMAGE THE CONED SURFACES OF THE APU MOUNTS. IF YOU DO NOT, IT CAN CAUSE DAMAGE.

APU POWER PLANT - INSTALLATION



HYDRAULIC JACK



FISHPOLE HOIST

M87524 S0004631453_V2

APU POWER PLANT - PRESERVATION

General

The factors that control the APU preservation and storage are:

- Where the aircraft or vehicle will be parked or stored.
- How long the aircraft or vehicle will be parked or stored.
- If the APU can be periodically motored.
- If the APU can be periodically operated.
- If the aircraft or vehicle fuel system have been preserved.

A mild environment is where the ambient temperature is between 30°F (-1°C) to 125°F (52°C), the humidity is below 40%, and there is no salt air present. A severe environment is where the ambient temperature is not between 30°F (-1°C) to 125°F (52°C), or the humidity is above 40%, or there is salt air present.

In a mild environment, the APU should be preserved within two months of the last APU operation when the APU will not be used. If the APU is sent to engine shop, continue the preservation until it goes to the shop.

In a severe environment, the APU should be preserved within three days of the last APU operation when the APU will not be used. If the APU is sent to the engine shop, continue the preservation until it goes to the shop.

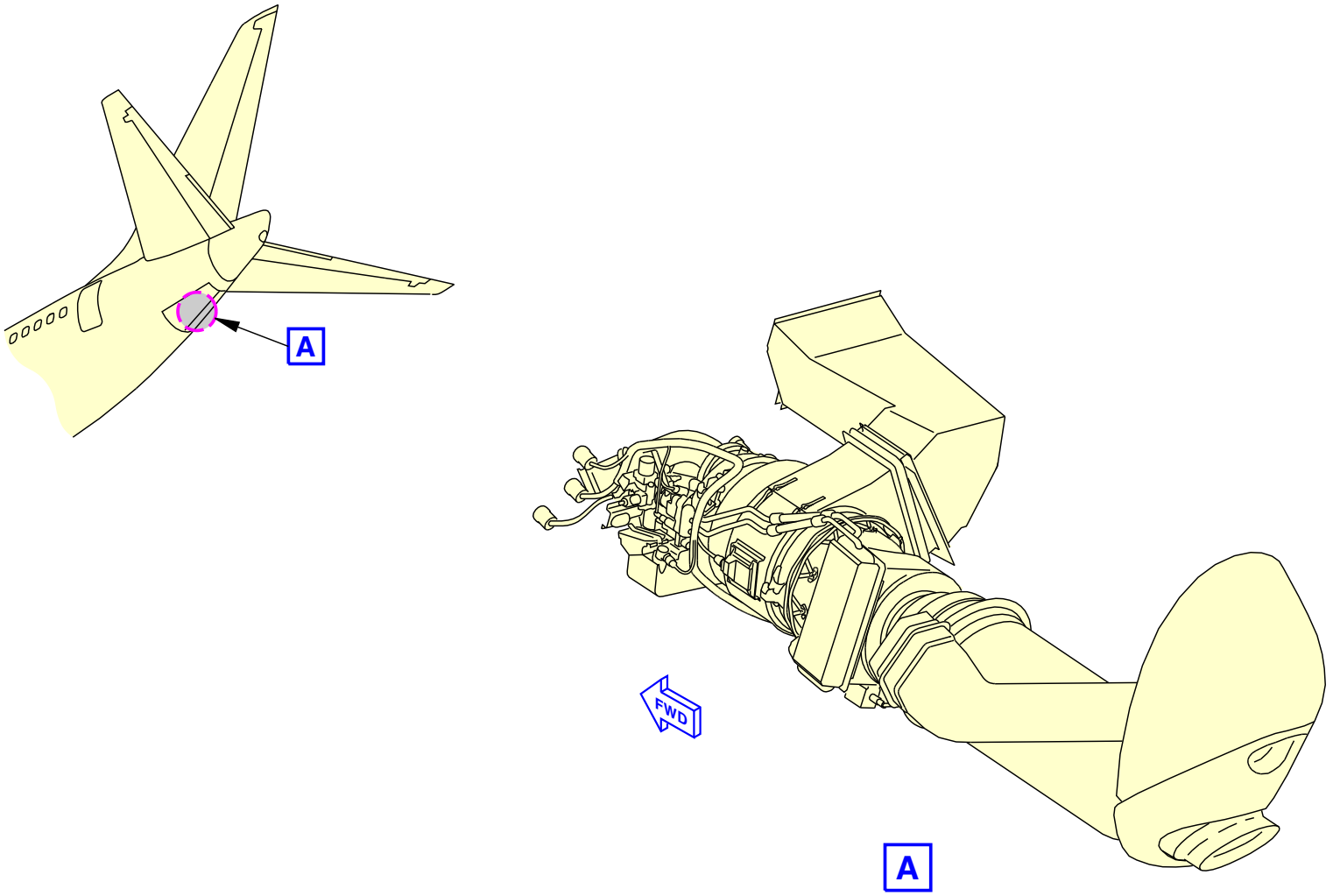
Desiccant in the APU inlet and exhaust can help reduce corrosion, fungus and humidity in the sealed APU area. Desiccant can be put in the APU air inlet and/or exhaust. If space is limited, the desiccant can be distributed between the air inlet and the exhaust. DO NOT put the desiccant in the bleed air ducts.

The best general practices are:

- Operate the APU a minimum of five minutes before the preservation procedure to dry out the APU and APU compartment.
- It is recommended to use the APU supply bleed to operate both packs during the APU operation. Pack operation will raise the temperature of the load compressor and provide better dry out conditions.
- In high humidity environments, it is recommended to operate the APU for 20 to 30 minutes.
- Operate the APU periodically, the interval will depend on the storage environment.
- For severe environments, it is recommended to operate the APU every three days for a minimum of five minutes, and up to 30 minutes to make sure that the APU and APU compartment are dried out.
- If the APU is not operable during storage, motor the APU periodically. The interval will depend on the storage environment.
- If the APU cannot be motored or started, put desiccant in the gas path and seal the fuselage openings. Periodically check the desiccant and the seal on the fuselage openings.

The preservation of the APU fuel control unit with preservation oil is not necessary if the APU stays in the airplane and the APU fuel control unit is not removed or replaced. The low pressure fuel filter replacement is permitted. If the fuel control unit is replaced, the fuel system can be preserved by motoring or operating the APU at no load for one minute.

APU POWER PLANT - PRESERVATION



2957215 S0000734997_V1

APU POWER PLANT - PRESERVATION

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU ENGINE - INTRODUCTION

Purpose

The APU engine supplies power to operate the load compressor and the APU starter-generator.

General Description

The APU engine has these main sections:

- Accessory gear box
- Single stage load compressor
- Single stage engine compressor
- Combustor chamber
- Two stage axial flow turbine.

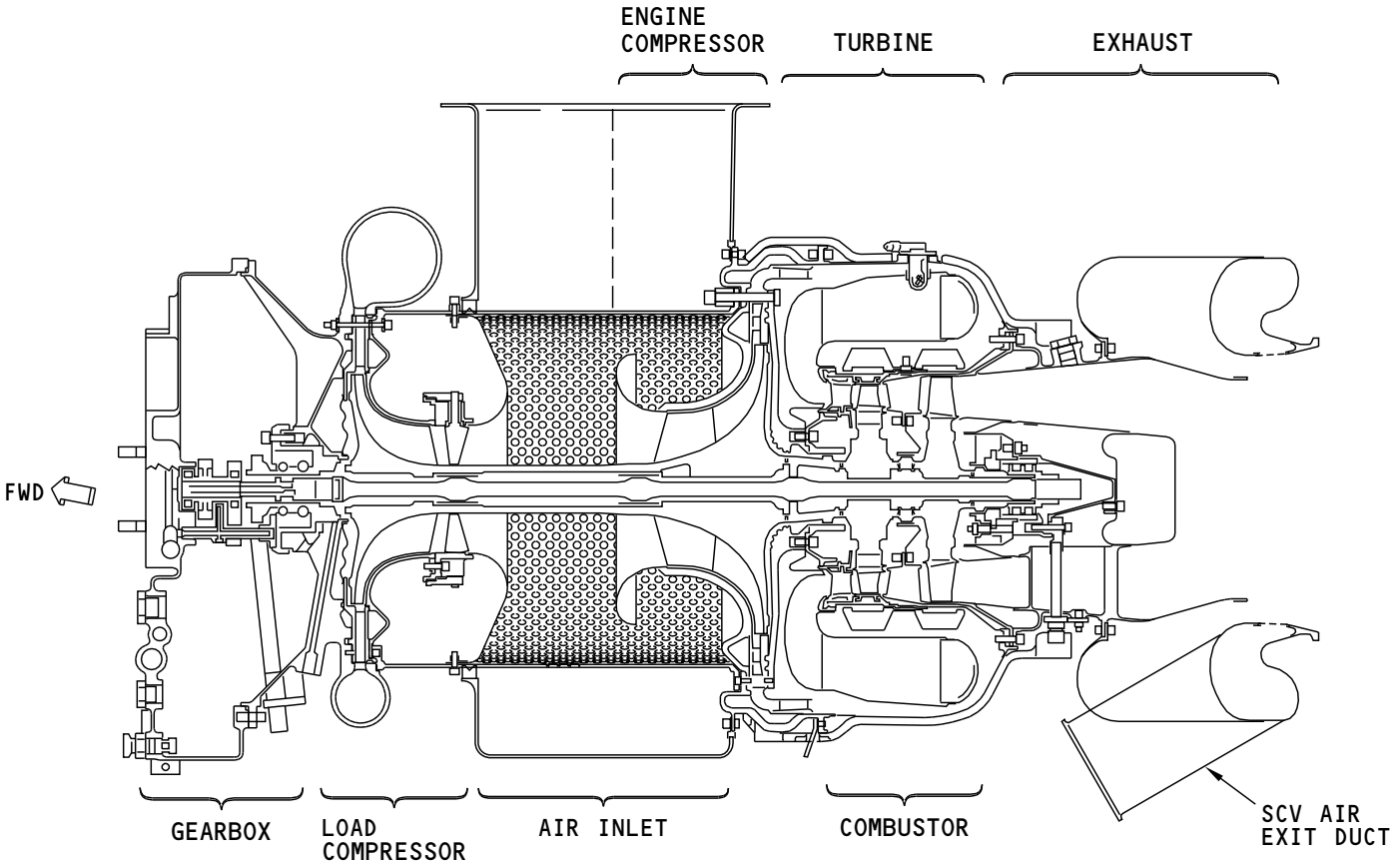
All the components in the engine that turn are on a common shaft.

The shaft turns the accessory gearbox and the load compressor. The accessory gear box turns the APU generator and other components.

The engine operates at a constant speed to provide 400 Hz generator output. The APU engine also supplies air for airplane systems.

An inlet screen prevents foreign object damage (FOD) to the APU compressors.

APU ENGINE - INTRODUCTION



M87525 S0004631457_V1

APU ENGINE - INTRODUCTION

APU ENGINE - TRAINING INFORMATION POINT - APU BORESCOPE

Borescope Inspection Ports

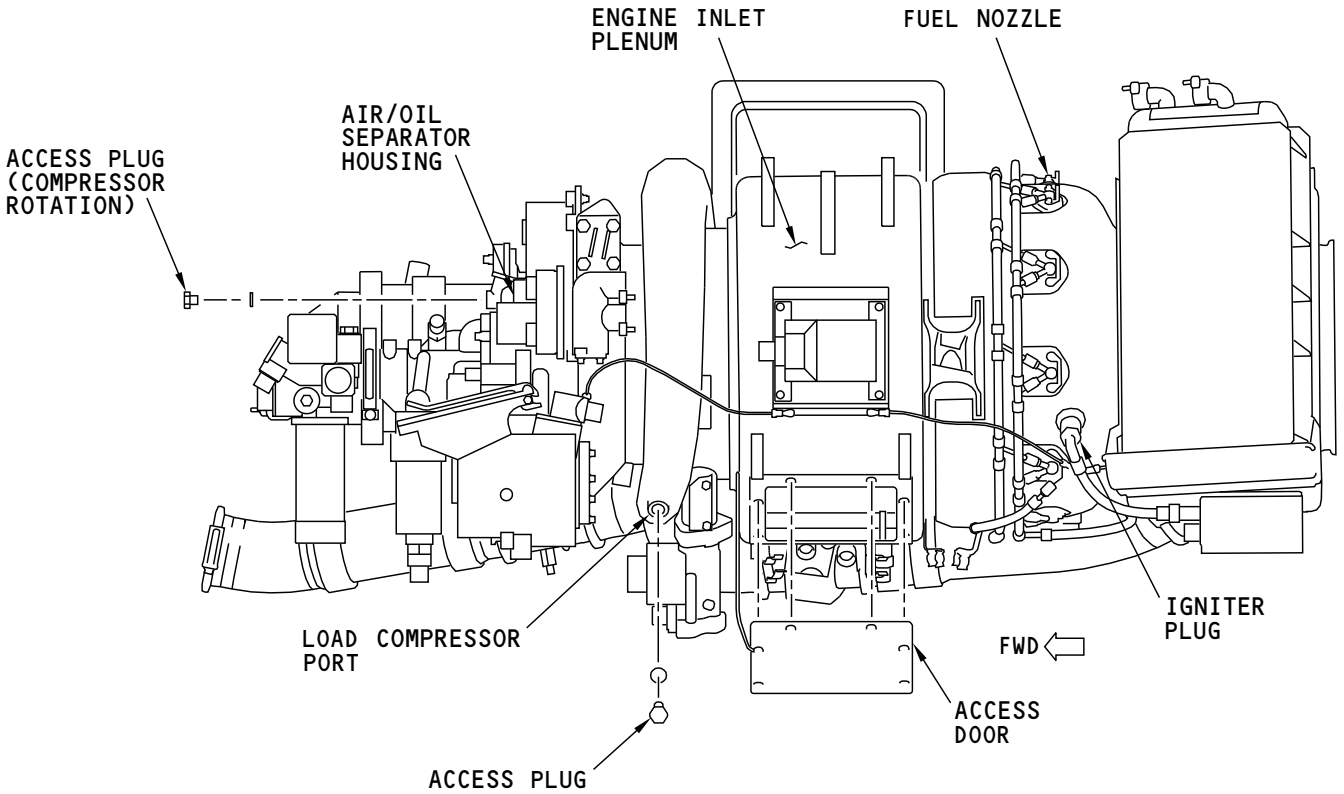
These components have borescope inspection access:

- Load compressor
- Engine compressor
- Combustor chamber
- Turbine section.

Engine Manual Rotation

To borescope the compressor and turbine, you turn the APU engine main shaft. To do this, remove the access plug in the air-oil separator housing on the front of the gearbox and insert a 1/4-inch hex drive with a 6-inch extension.

APU ENGINE - TRAINING INFORMATION POINT - APU BORESCOPE



M87526 S0004631459_V1

APU ENGINE - TRAINING INFORMATION POINT - APU BORESCOPE

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU FUEL SYSTEM - INTRODUCTION

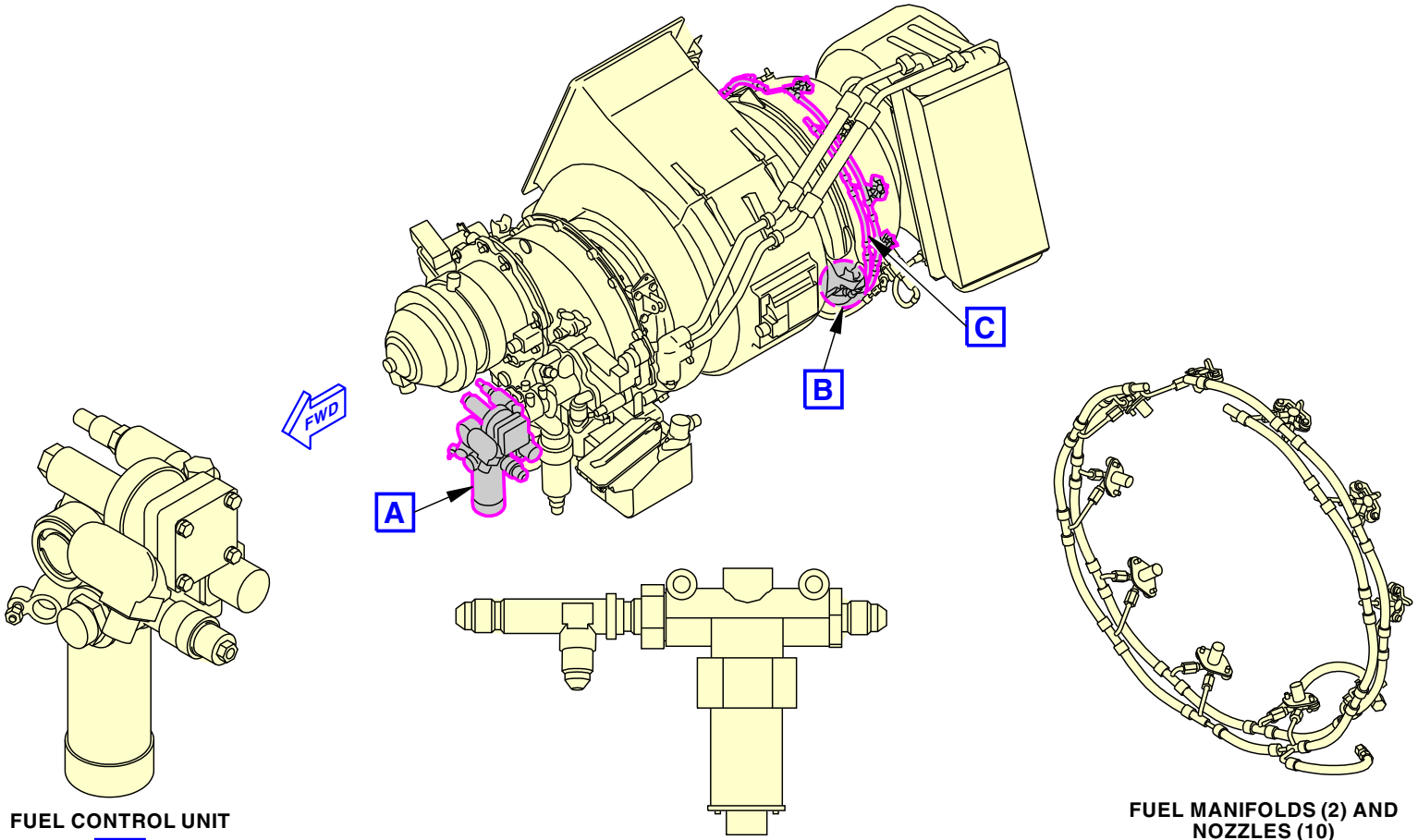
Purpose

The APU fuel system pressurizes and supplies metered fuel to the APU combustion chamber. It also supplies pressurized fuel to the APU inlet guide vane and surge control valve actuators.

These are the APU fuel system components:

- Fuel control unit (FCU)
- Flow divider solenoid
- Flow divider
- Primary fuel manifold
- Secondary fuel manifold
- Fuel nozzles.

APU FUEL SYSTEM - INTRODUCTION



APU FUEL SYSTEM - INTRODUCTION

APU FUEL SYSTEM - GENERAL DESCRIPTION

General Description

The airplane fuel system AC boost pumps supply fuel for APU operation. The fuel goes through the APU fuel shutoff valve on the left wing rear spar. The AC boost pumps can supply fuel from any tank.

If the AC boost pumps do not supply fuel, the APU suction feeds from the left main tank.

See the APU fuel feed system for more information. (SECTION 28-25)

The ECU calculates the correct fuel flow for APU start and run. The ECU uses these values to calculate the correct fuel flow:

- APU speed
- APU exhaust gas temperature (EGT)
- Inlet temperature (T2)
- Inlet pressure (P2)
- Fuel temperature.

The ECU sends the fuel flow command signal to the fuel control unit (FCU) on the APU. The FCU sends the correct fuel flow to the flow divider and flow divider solenoid.

The flow divider solenoid gets a signal from the ECU to inhibit fuel flow to the secondary fuel manifold. The flow divider and flow divider solenoid send the metered fuel from the FCU to the primary and secondary fuel manifolds.

The fuel manifolds give primary and secondary fuel to ten dual tipped fuel nozzles. The nozzles give the metered fuel to the APU combustor.

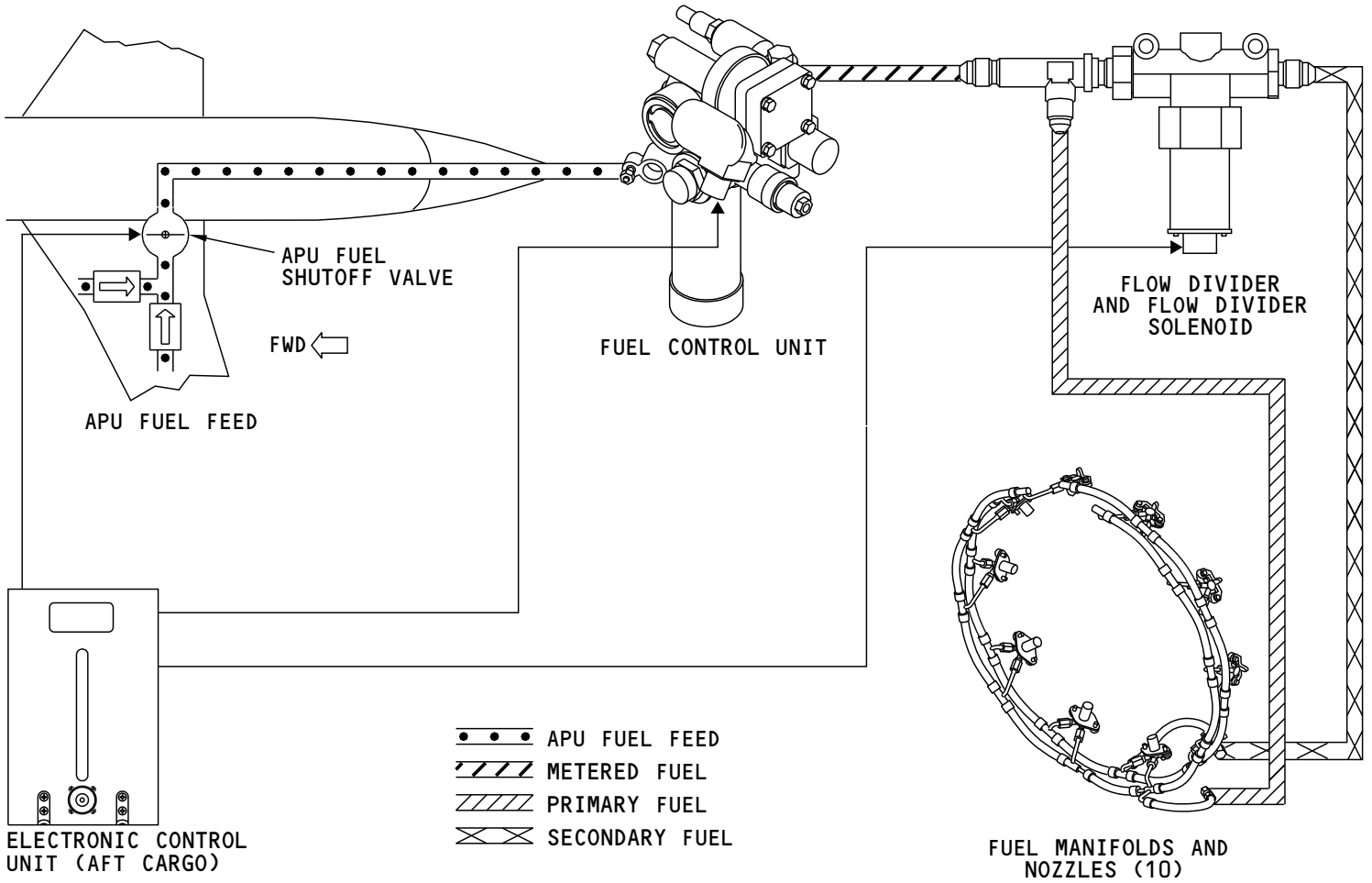
Component Location

Most fuel system components are part of the fuel control unit. The fuel control unit attaches to the lube module.

These are the APU fuel system components not in the fuel control unit:

- Flow divider
- Flow divider solenoid
- Primary fuel manifold
- Secondary fuel manifold
- Fuel nozzles.

APU FUEL SYSTEM - GENERAL DESCRIPTION



M87528 S0004631465_V1

APU FUEL SYSTEM - GENERAL DESCRIPTION

APU FUEL SYSTEM - FUEL CONTROL UNIT

Purpose

The APU fuel control unit (FCU) supplies the correct metered fuel for these APU operations:

- Start
- Acceleration
- On speed.

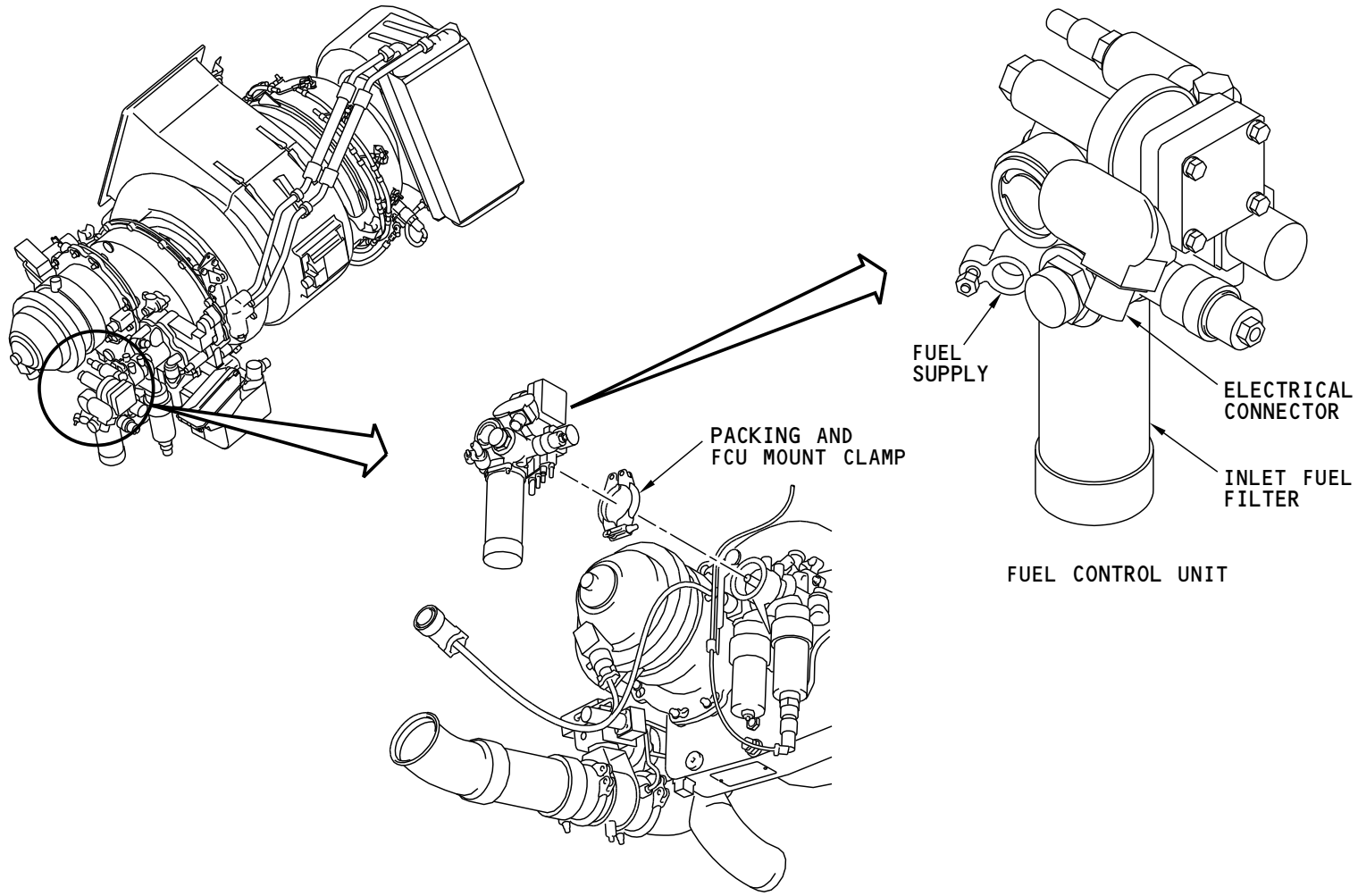
General

The FCU mounts to the front of the lube module by a V band clamp. The lube module drives the FCU.

Training Information Point

The FCU and the inlet fuel filter are line replaceable units (LRU).

APU FUEL SYSTEM - FUEL CONTROL UNIT



M87530 S0004631468_V1

APU FUEL SYSTEM - FUEL CONTROL UNIT

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU FUEL SYSTEM - FUEL CONTROL UNIT - FUNCTIONAL DESCRIPTION

General

Fuel for the APU fuel control unit (FCU) comes from the airplane fuel system. The APU FCU supplies fuel for combustion and servo fuel to operate the inlet guide vane actuator (IGVA) and the surge control valve (SCV).

The FCU includes these components:

- Inlet filter
- High pressure fuel pump
- Pump relief valve
- High pressure filter
- Differential pressure regulator
- Bypass bleed orifice
- Torque motor metering valve
- Pressurizing valve and flowmeter
- Actuator pressure regulator
- Fuel solenoid valve
- Fuel temperature sensor.

Inlet Filter

The inlet filter removes contamination before the fuel goes into the high pressure gear pump.

High Pressure Fuel Pump and Pump Relief Valve

A shaft from the lube module turns the high pressure fuel pump. The pump gives high pressure fuel for use in the FCU. The pump relief valve keeps fuel pressure below 950 psi.

High Pressure Filter

The high pressure filter removes contamination caused by the gear pump.

Actuator Pressure Regulator

The actuator pressure regulator keeps actuator fuel pressure at 250 psid. The FCU uses actuator fuel pressure to operate the inlet guide vane actuator and surge control valve.

Differential Pressure Regulator

The differential pressure regulator holds a constant differential pressure of 50 psid across the metering valve.

Bypass Bleed Orifice

The bypass bleed orifice is installed between the torque motor metering valve and the input shaft of the high pressure fuel pump. Metered valve discharged fuel from the torque motor flows to the delta-P regulator and bypassed fuel goes through the bypass bleed orifice and into the input shaft of the high pressure fuel pump.

Fuel Metering Valve

The torque motor metering valve is an electrohydraulic servo valve. It controls the amount of fuel to the combustion chamber.

Flowmeter Pressurizing Valve and Flowmeter

The flowmeter pressurizing valve keeps a 50 psi decrease in fuel pressure from the fuel metering valve to the fuel shutoff solenoid. A resolver attaches to the valve to measure valve position. The ECU uses this signal to find the fuel flow to the APU combustor.

Fuel Solenoid Valve

The fuel solenoid valve controls the fuel flow from the fuel control unit. The fuel solenoid valve is spring loaded closed.

During APU start, the ECU energizes the solenoid at 7 percent speed. This opens the fuel solenoid valve.

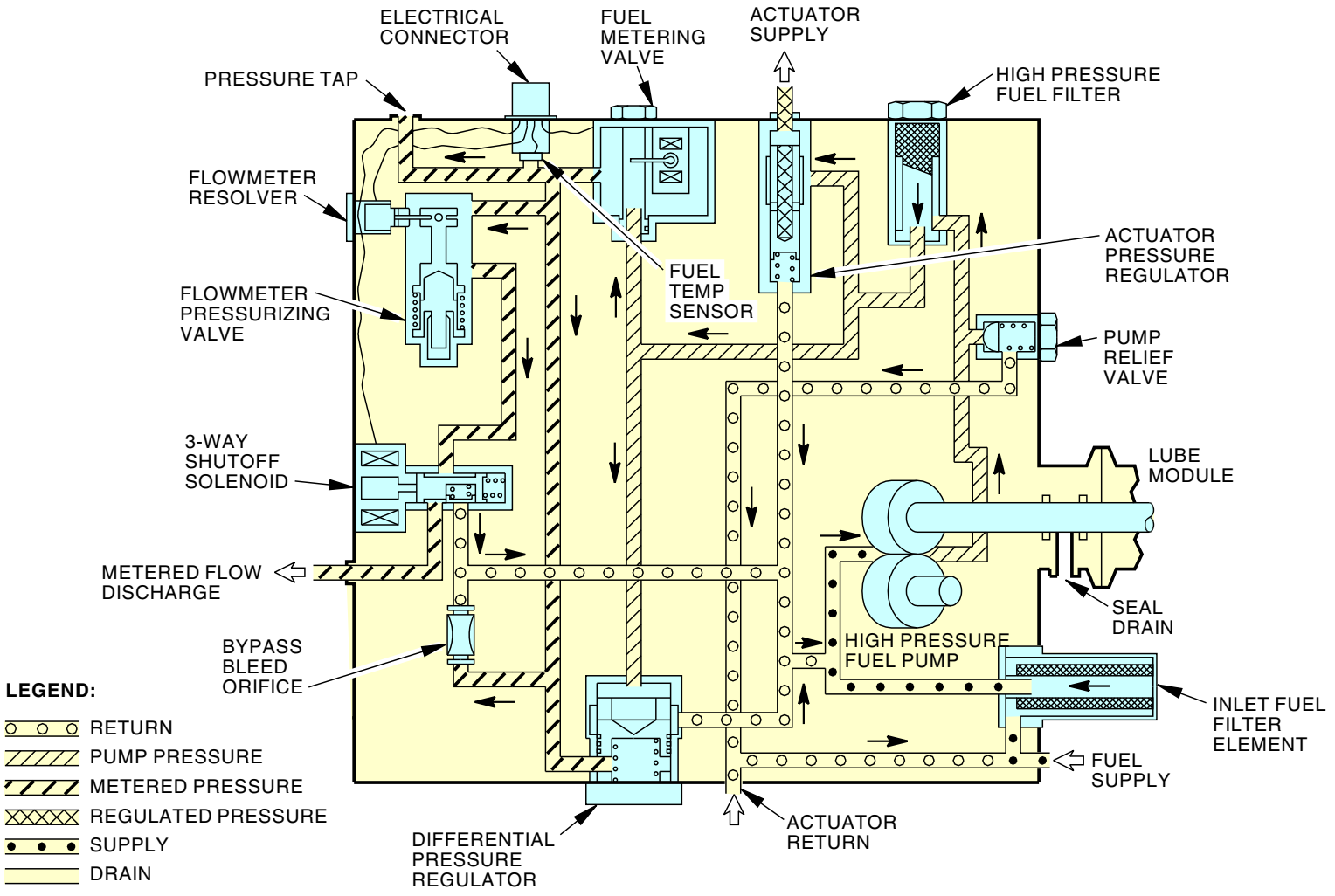
During shutdown, the ECU de-energizes the solenoid. The fuel solenoid valve closes. This shutdown sequence is the same for normal or protective shutdown.

APU FUEL SYSTEM - FUEL CONTROL UNIT - FUNCTIONAL DESCRIPTION

Fuel Temperature Sensor

The fuel temperature sensor is a resistive temperature device (RTD). The fuel temperature sensor gives a fuel temperature signal to the ECU.

APU FUEL SYSTEM - FUEL CONTROL UNIT - FUNCTIONAL DESCRIPTION



M87532 S0004631470_V3

APU FUEL SYSTEM - FUEL CONTROL UNIT - FUNCTIONAL DESCRIPTION

APU FUEL SYSTEM - FUEL FLOW DIVIDER AND FLOW DIVIDER SOLENOID

Purpose

The fuel flow divider directs fuel to the primary and secondary manifolds.

Location

The fuel flow divider is on the lower left side of the APU engine near the combustion chamber.

Fuel Flow Divider and Flow Divider Solenoid Components

These are the main fuel flow divider components:

- Ball check valve
- Inlet filter
- Flow divider solenoid.

Functional Description

When the fuel solenoid valve opens, fuel flows to the fuel flow divider through the inlet filter in the flow divider.

The fuel flow divider directs fuel to the primary fuel manifold for initial start and acceleration.

The flow divider solenoid makes sure fuel does not go to the secondary manifold at the incorrect time. When the flow divider first sends fuel to the secondary manifold, the fuel pressure in the primary manifold momentarily decreases while the secondary manifold fills with fuel. If the primary fuel pressure decreases at the incorrect time, the APU flames out or goes under speed.

A spring holds the flow divider solenoid in the open position. The flow divider solenoid closes when the ECU energizes the solenoid.

The ECU energizes the flow divider solenoid closed from 7 percent to 30 percent speed. This prevents APU flame out and shutdown during a start.

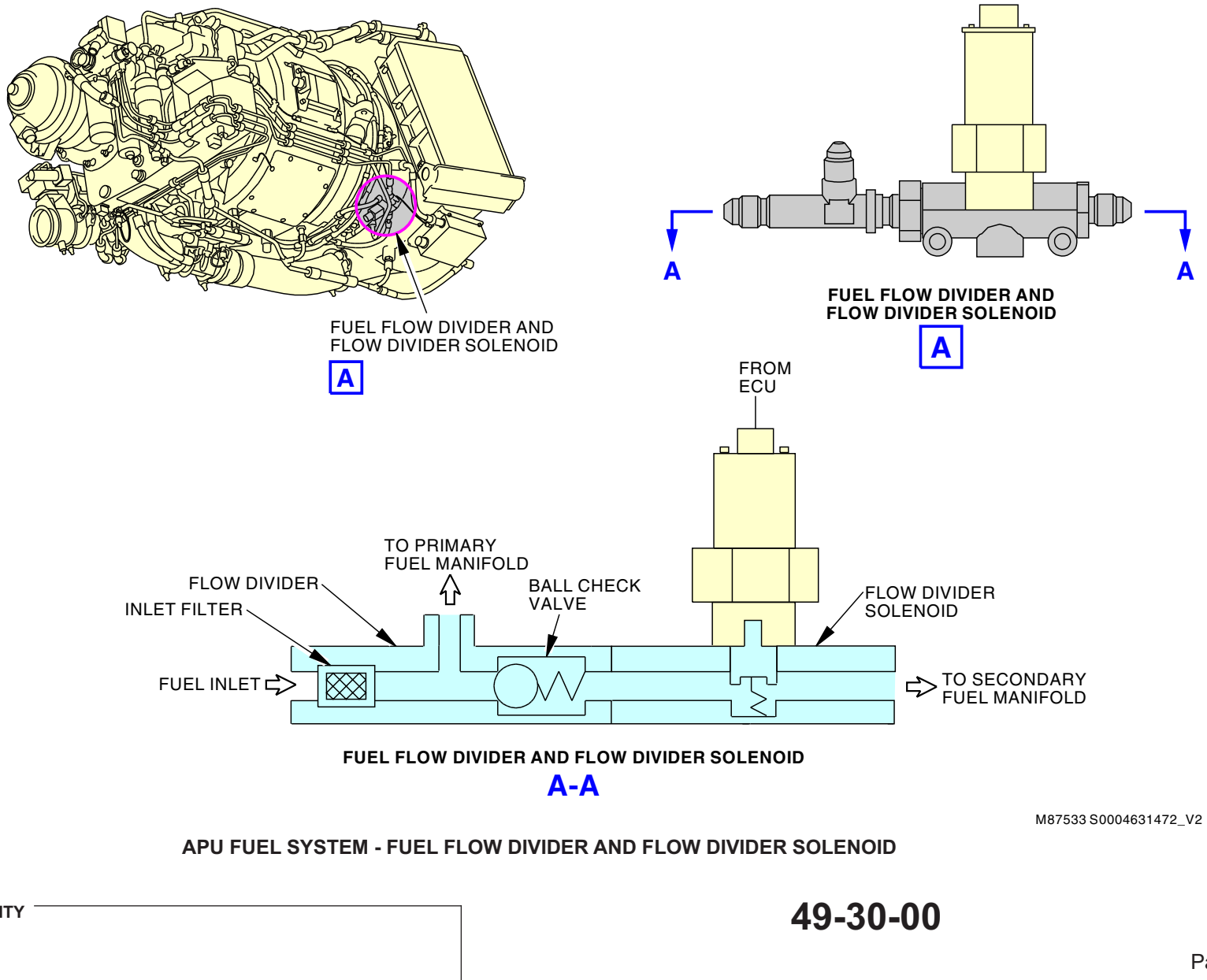
At 25-40 percent speed (approximately 120 psi), the check valve inside the flow divider T fitting opens and supplies fuel to the secondary manifold unless the fuel flow divider solenoid valve is in the closed position.

The ECU again energizes the flow divider solenoid at higher altitudes. This prevents an APU under speed and shutdown with the addition of electrical load above 25,000 feet.

The ECU uses these values to find when the flow divider solenoid should be energized:

- Inlet pressure (P2)
- Inlet temperature (T2)
- APU speed.

APU FUEL SYSTEM - FUEL FLOW DIVIDER AND FLOW DIVIDER SOLENOID



M87533 S0004631472_V2

APU FUEL SYSTEM - FUEL FLOW DIVIDER AND FLOW DIVIDER SOLENOID

APU FUEL SYSTEM - MANIFOLDS AND NOZZLES

Fuel Manifolds

A primary fuel manifold and a secondary fuel manifold supply fuel from the fuel control unit to the fuel nozzles.

The manifolds are around the Auxiliary Power Unit (APU) combustion chamber.

Both manifolds supply fuel when the APU is on speed below 25,000 feet. Only the primary manifold supplies fuel up to 30 percent speed during APU start and above 25,000 feet for all APU operation.

Fuel Nozzles

Ten fuel nozzles atomize and inject fuel into the combustion chamber. The fuel nozzles are installed around the combustion section.

The 10 fuel nozzles have these components:

- Primary and secondary screen
- Locating pin
- Air shroud
- Nozzle tip.

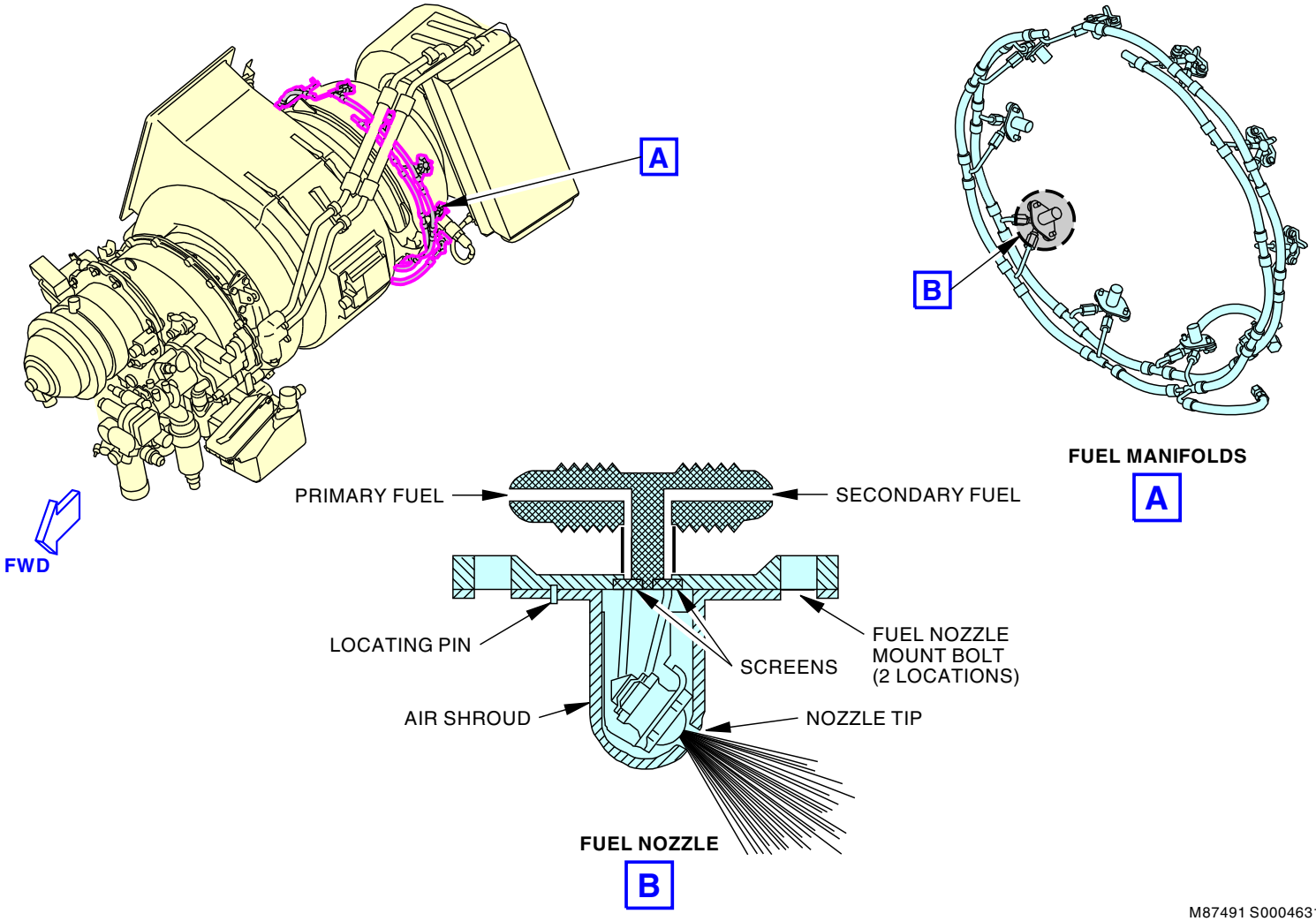
Training Information Point

NOTE: Do not remove all fuel nozzles at the same time. The fuel nozzles put the combustor in position. If you remove all nozzles at the same time the combustor can move out of position. If the combustor moves out of position, you can not install the replacement fuel nozzles.

You can remove and install both the fuel manifolds and fuel nozzles without removal of the APU.

The fuel nozzles have a locating pin to make sure installation is correct.

APU FUEL SYSTEM - MANIFOLDS AND NOZZLES



M87491 S0004631474_V2

APU FUEL SYSTEM - MANIFOLDS AND NOZZLES

APU FUEL SYSTEM - APU COMBUSTOR DRAIN ORIFICE

Purpose

The APU combustor drain provides a drain for fuel that may accumulate in the combustor after an unsuccessful start. This prevents a possible hot start on the next start.

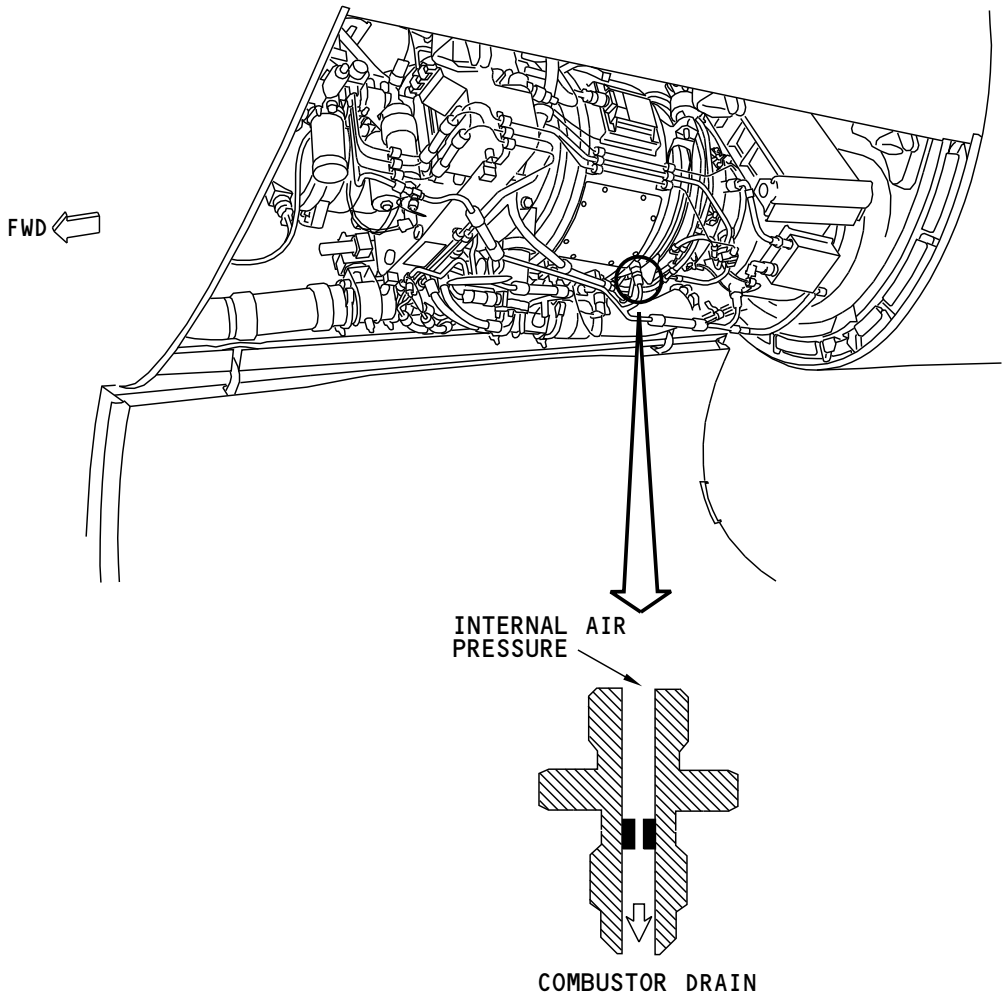
Location

The combustor drain is at the lowest point of the combustor case.

Functional Description

The combustor drain is a 0.060 inch diameter orifice that drains fluid. During APU operation, the orifice lets a small quantity of air go out from the combustor.

APU FUEL SYSTEM - APU COMBUSTOR DRAIN ORIFICE



M87534 S0004631476_V1

APU FUEL SYSTEM - APU COMBUSTOR DRAIN ORIFICE

APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION

General

The APU fuel system supplies fuel for combustion. The fuel control unit also provides regulated fuel pressure for the inlet guide vane actuator(IGVA) and the surge control valve (SCV) operation. The APU electronic control unit (ECU) controls the APU fuel system.

Fuel Supply

The fuel system boost pumps supply pressurized fuel or the APU fuel control unit suction supplies fuel through the fuel shutoff valve to the APU. The shutoff valve opens when the APU switch is put in the ON or the START position.

Fuel Control Unit

The fuel control unit (FCU) has these functions:

- Pressurizes the fuel
- Cleans the fuel
- Controls the fuel pressure
- Controls fuel flow.

ECU Control

The ECU logic controls the following fuel feed components:

- Fuel shutoff valve
- Fuel solenoid valve
- Fuel metering valve
- Flow divider solenoid.

The fuel shutoff valve opens when the APU switch is in the ON or START position. During the APU start, the ECU sends a signal to the fuel solenoid valve to open when the APU RPM is more than 7 percent. The ECU controls the fuel metering valve when the APU speed is more than 7 percent. The ECU also controls the flow divider solenoid valve on the fuel flow divider.

The ECU uses start-up control logic to control the fuel metering valve when the speed is less than 95 percent. This logic schedules fuel flow to start the APU quickly and to keep the EGT low. Start-up fuel flow logic uses these inputs:

- APU speed (N)
- Inlet pressure (P2)
- Inlet temperature (T2)
- Exhaust gas temperature (EGT).

The ECU uses the same inputs for the on-speed logic above 95 percent speed.

The flow meter in the FCU sends a fuel-flow feedback signal to the ECU. The ECU uses this signal to make sure the APU gets the necessary fuel.

Fuel Flow Divider

The fuel flow divider gives fuel to the primary manifold during start of the APU. At 25-40 percent speed or approximately 120 psi, the fuel flow divider gives fuel to both the primary and secondary fuel manifolds for APU operation.

The fuel flow divider has a normally open flow divider solenoid. The ECU signals the flow divider solenoid closed above approximately 25,000 feet (7,620 meters) altitude to make sure the internal check valve for secondary fuel does not open and cause the APU speed to decrease.

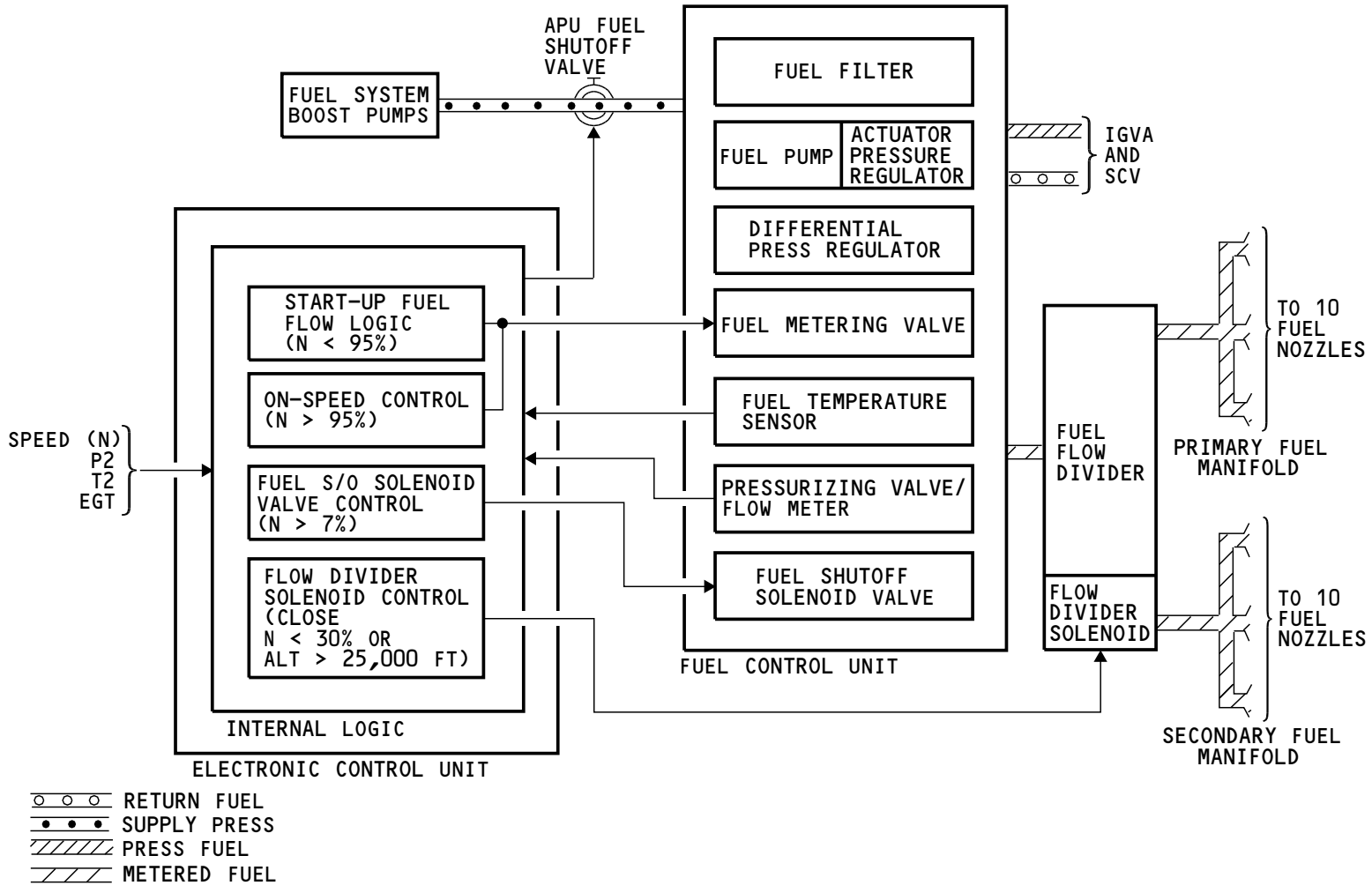
The flow divider solenoid also improves start capability in cold weather.

The ECU uses P2, T2, and speed signals to control the fuel flow divider solenoid valve.

Actuator Pressure Regulator

The FCU also supplies pressurized fuel to operate the IGVA and the SCV. The pressure is regulated at 225 to 275 psi. Return fuel from these valves goes back to the pump inlet.

APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION



M87535 S0004631478_V1

APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU IGNITION AND START SYSTEM - INTRODUCTION

Purpose

The APU ignition and start system gives the initial rotation of the engine and ignition.

General

The APU ignition and start system consists of these components:

- Ignition unit
- Igniter plug lead
- Igniter plug
- Start power unit (SPU)
- Start converter unit (SCU)
- Starter-generator.

The APU electronic control unit (ECU) controls the APU start sequence.

See the APU engine controls section for more information on the ECU. (SECTION 49-60)

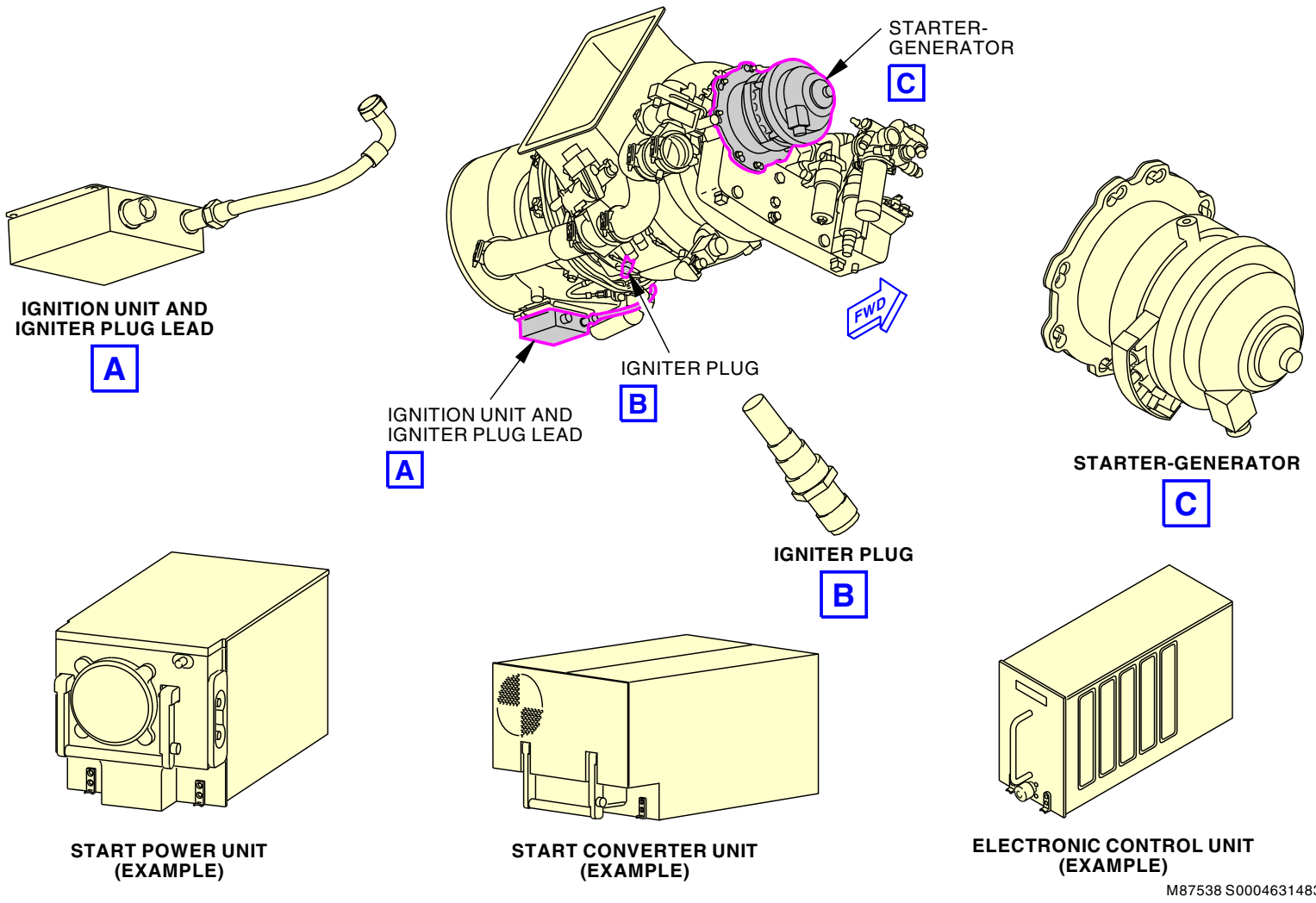
Ignition System

The ignition system supplies sparks to start APU combustion during the APU start. The ECU energizes the ignition unit at 0 percent speed and de-energizes the ignition unit at 60 percent speed.

Start System

The starter-generator, SPU, and SCU together supply initial rotation of the APU. The start power sources are 28v DC from the battery or 115v AC transfer bus number 1.

APU IGNITION AND START SYSTEM - INTRODUCTION



M87538 S0004631483_V3

APU IGNITION AND START SYSTEM - INTRODUCTION

EFFECTIVITY

SIA ALL

Start Power Unit

The start power unit changes 115v AC or 28v DC electrical power to 270v DC power. Transfer bus 1 or the battery supplies power to the start power unit (SPU).

The SPU gives fault data to the ECU through the SCU for display on the CDU.

The SPU is in the EE compartment on the E2-2 shelf.

Start Converter Unit

The start converter unit (SCU) changes the 270v DC power to AC and sends it to the starter-generator.

The SCU gives fault data to the ECU for display on the CDU.

The SCU is in the EE compartment on the E2-2 shelf.

See the electrical chapter for more information about the APU starter-generator generate function. (CHAPTER 24)

Start Control

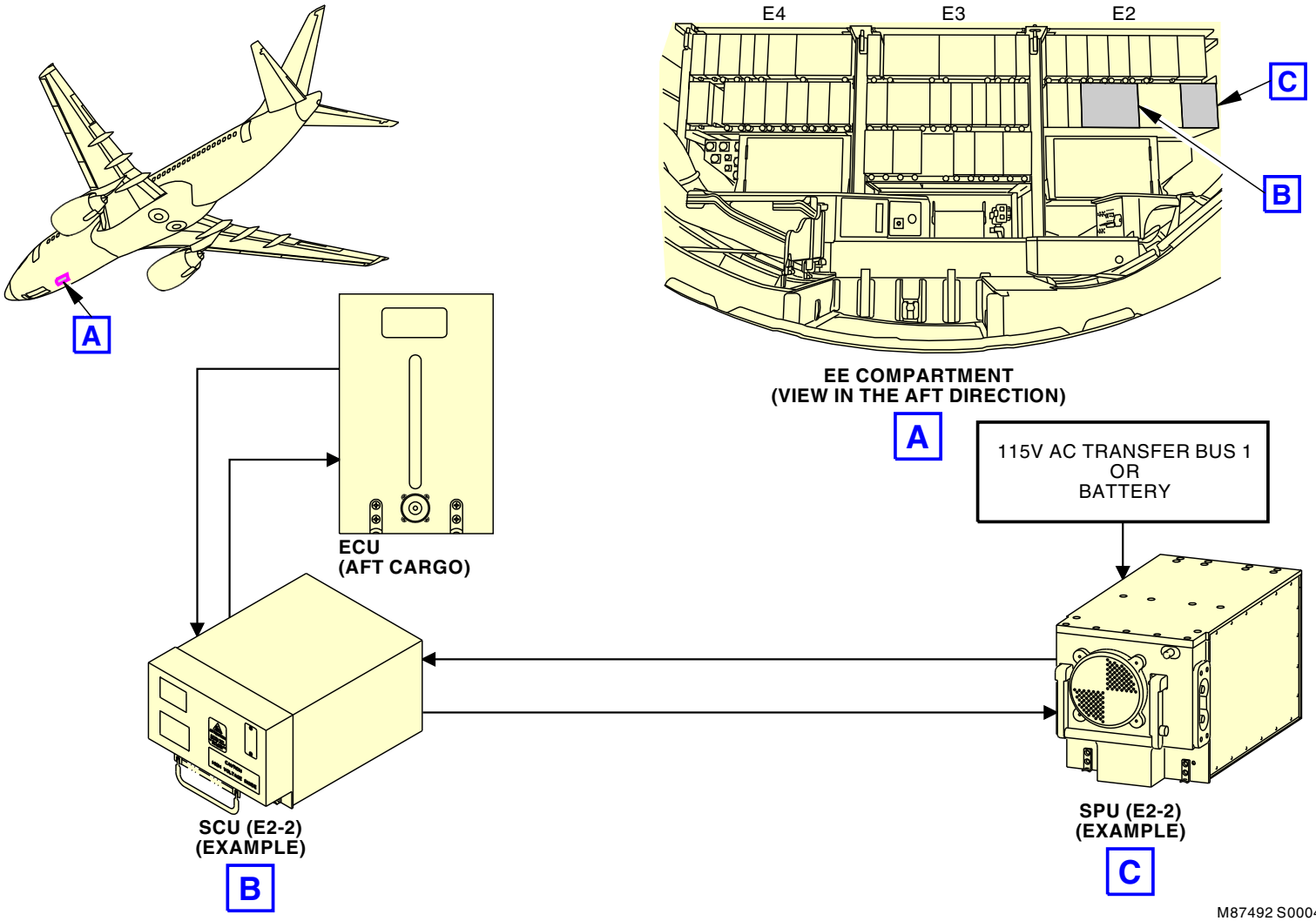
The electronic control unit sends a signal to the start converter unit when the air inlet door is fully open. The start converter unit tells the start power unit to supply the 270v DC. The start converter unit changes the 270v DC to AC power for the operation of the starter-generator. At 70 percent speed, the electronic control unit removes the start signal from the start converter unit. With the start signal off, the SCU and the SPU removes power from the starter-generator.

Training Information Point

The maximum duty cycle for the SPU and SCU is three starts, one after the other, followed by a 15-minute cool down period. If you do too many starts one after the other, the SCU and SPU will get too hot and stop the APU start. More starts are possible after the SCU and SPU cool.

You get access to the SCU terminal block for the AC power feeder wires from the back of the SCU. Remove the panel behind the E2 rack from the forward cargo compartment to get access to the back of the SCU.

APU IGNITION AND START SYSTEM - SPU AND SCU GENERAL DESCRIPTION



M87492 S0004631486_V4

APU IGNITION AND START SYSTEM - SPU AND SCU GENERAL DESCRIPTION

APU IGNITION AND START SYSTEM - APU STARTER-GENERATOR

Purpose

The starter-generator supplies the initial rotation of the APU for the start cycle.

The starter-generator is also a source of electrical power for the airplane systems. It supplies 90 kVA of AC electrical power on ground and in flight.

See the electrical chapter for more information about the generate function of the starter-generator. (CHAPTER 24)

Location

The starter-generator is on the upper right side of the APU gearbox. Eight bolts hold the starter-generator to the gearbox.

General Description

The APU starter-generator has a terminal block and a electrical connector.

The starter-generator has three rotors mounted on the same shaft. For each rotor there is a stater winding installed in the starter-generator case. These are the rotor-stator pairs:

- Permanent magnet generator (PMG)
- Exciter
- Main generator.

The starter-generator also has 6 rotating diodes attached to the shaft.

A resolver mounted on the starter-generator shaft sends rotor position to the SCU. The SCU uses the rotor position signal to synchronize the AC power to the rotor position.

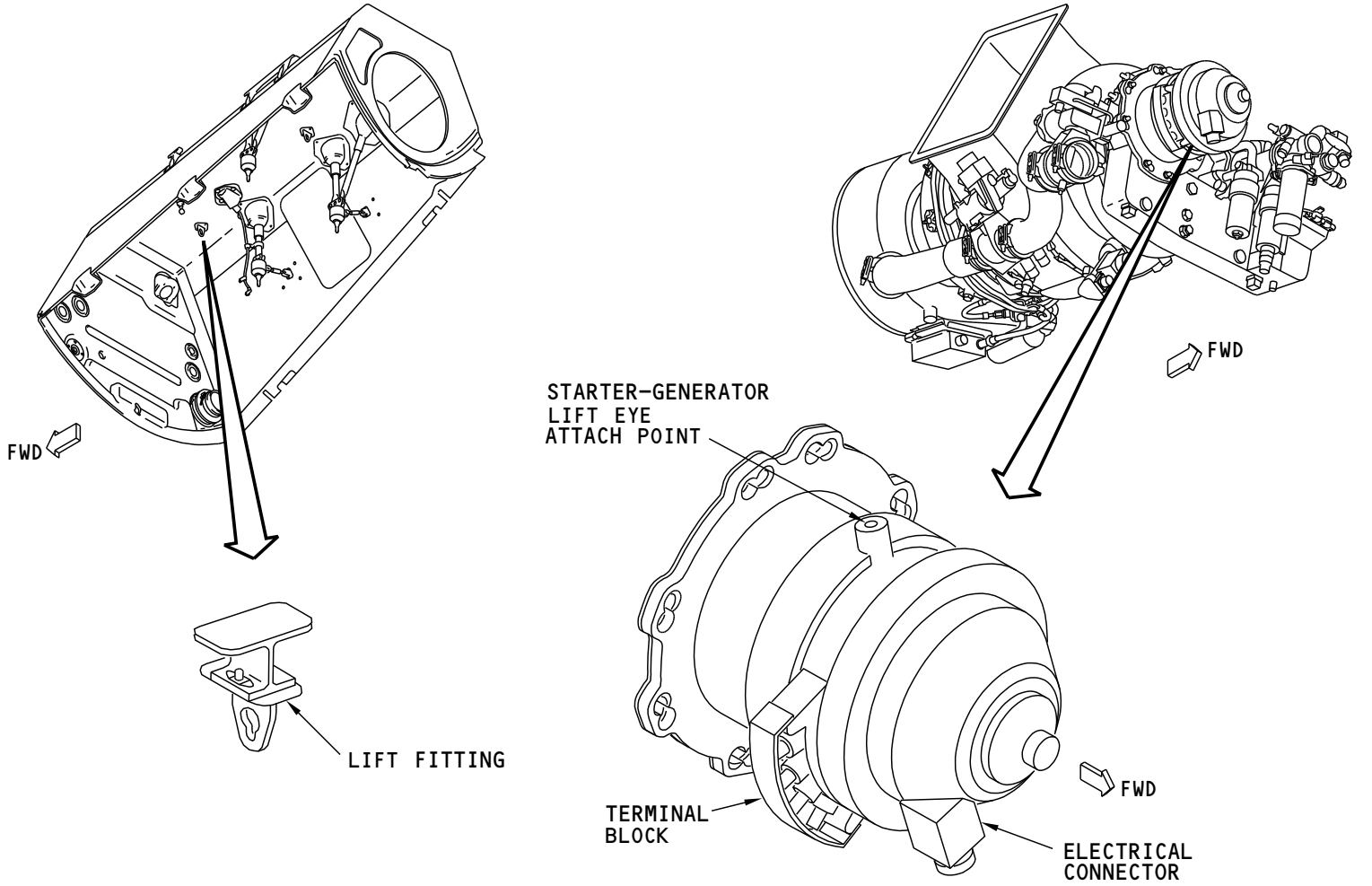
The APU oil system cools the starter-generator.

The weight of the starter-generator is 54.5 pounds (24.7kg).

Training Information Point

A ground support lift fitting on the top of the APU compartment and the starter-generator helps remove and replace the starter-generator.

APU IGNITION AND START SYSTEM - APU STARTER-GENERATOR



M87540 S0004631489_V1

APU IGNITION AND START SYSTEM - APU STARTER-GENERATOR

General

The ignition system starts the combustion of the fuel-air mixture during engine start. The APU electronic control unit controls the ignition system.

The ignition system components are on the bottom of the engine.

Ignition Unit

The ignition unit changes 28v DC power to a high voltage pulsed current that goes to the igniter plug. The ignition unit has one channel for one igniter plug lead and igniter plug. The ignition unit supplies one spark per second to the igniter plug.

WARNING MAKE SURE THAT THE IGNITION SYSTEM IS OFF FOR FIVE MINUTES BEFORE YOU TOUCH THE COMPONENT. IGNITION VOLTAGE IS HIGH WHICH MAKES IT DANGEROUS. IGNITION VOLTAGE CAN CAUSE INJURIES TO PERSONNEL.

Igniter Plug Lead

The igniter plug lead connects the ignition unit to the igniter plug. The igniter plug lead insulation prevents radio interference.

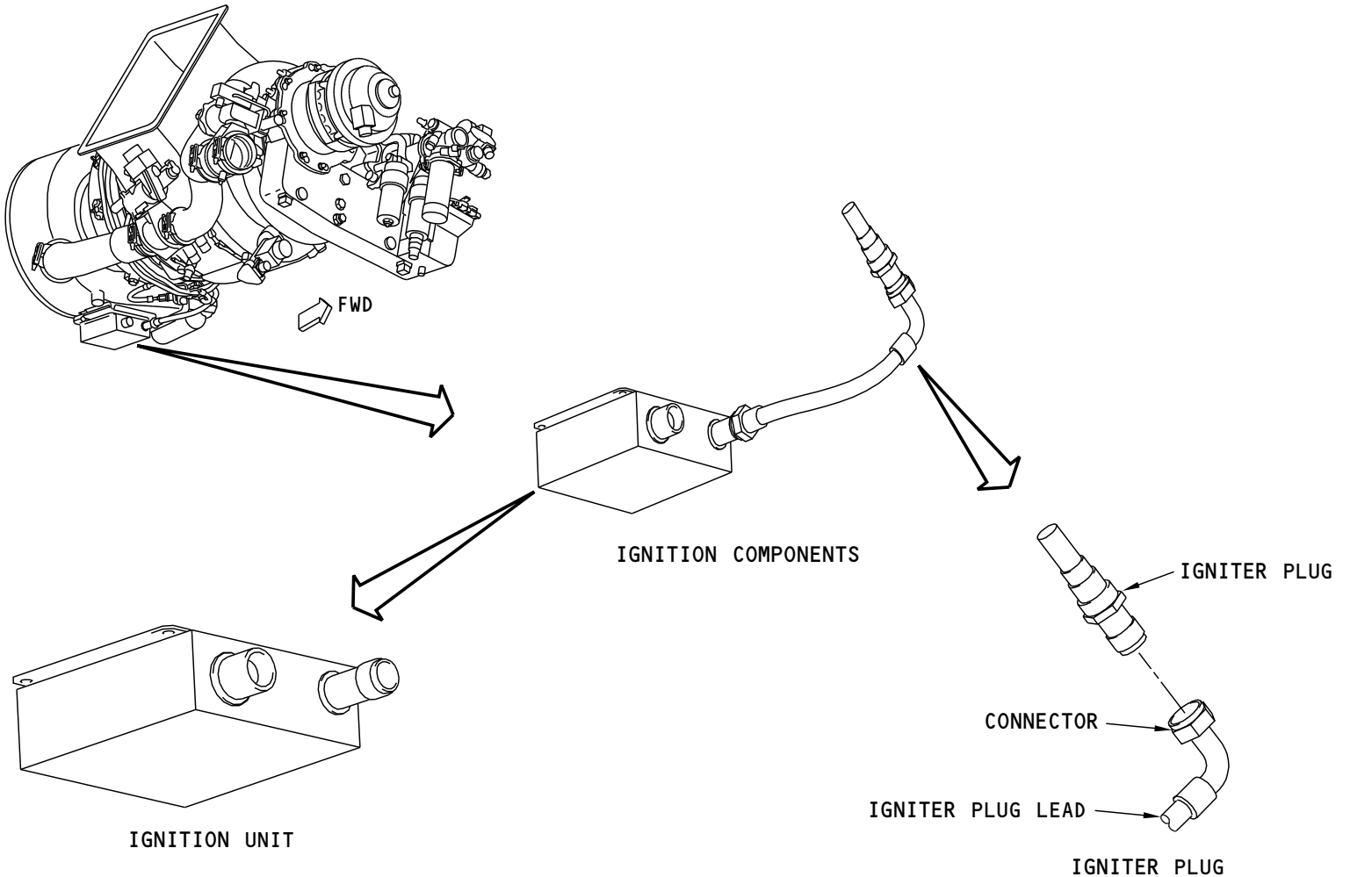
Igniter Plug

There is one igniter plug. It supplies the high energy spark for fuel-air ignition.

Functional Description

The ECU energizes the ignition system at 0 percent speed during APU start. The ECU de-energizes the ignition system at 60 percent speed.

The ECU energizes the ignition system if the APU engine speed goes below 95 percent speed during APU operation (speed droop).



M87541 S0004631491_V1

APU IGNITION AND START SYSTEM - FUNCTIONAL DESCRIPTION

General

To start the APU, put the APU switch to the START position and release the switch to the ON position. This signals the ECU to begin the start cycle.

Electrical Power

These are the electrical power sources for the ignition and start system function:

- 24/28v DC battery
- 24/28v DC switched hot battery bus

SIA ALL PRE SB 737-49-1150 AND POST SB 737-49-1150 REV 1; AIRPLANES WITH INTERCHANGEABLE SCU

- 115v AC standby bus

SIA ALL

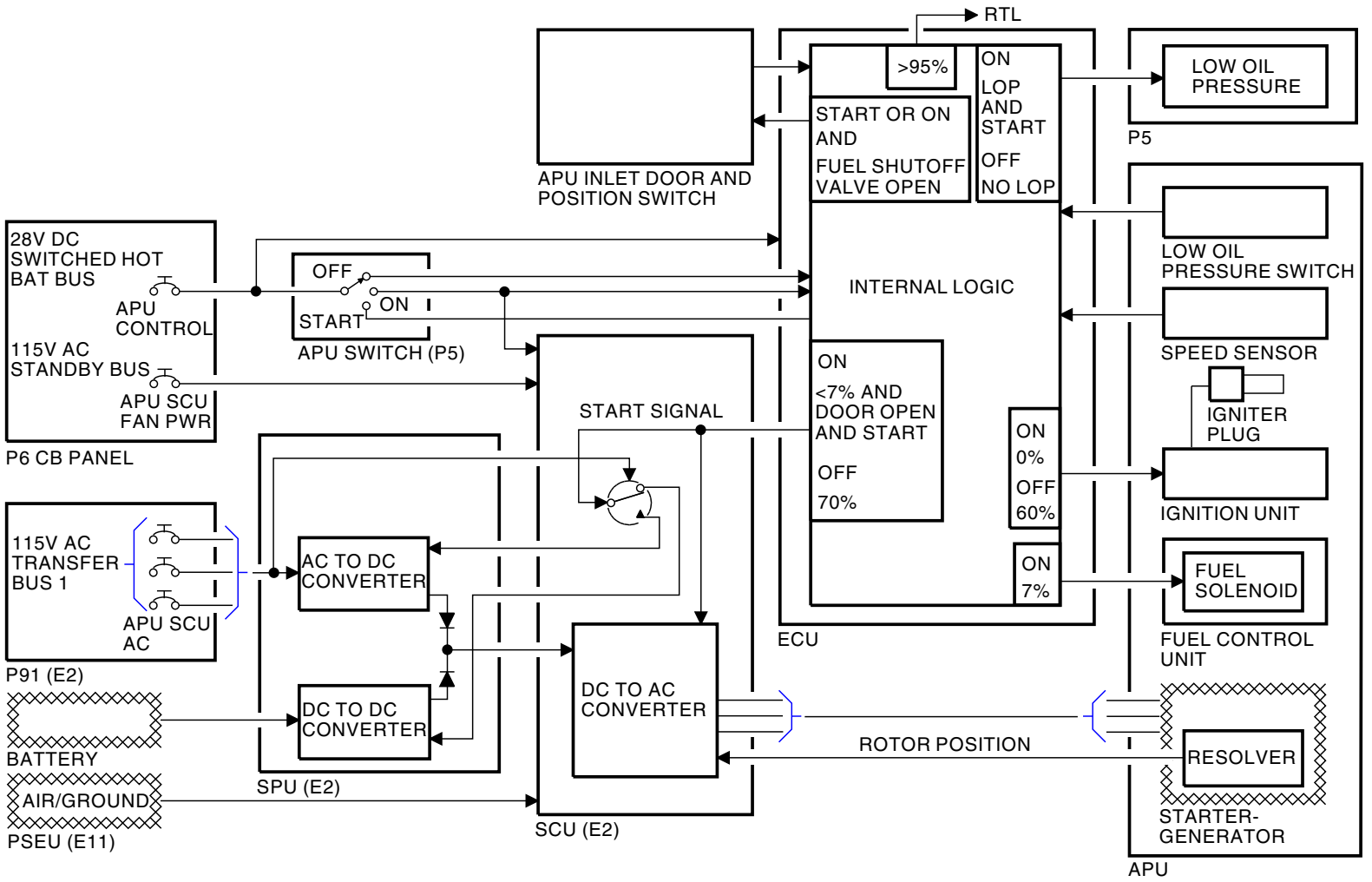
- 115v AC transfer bus 1.

Ignition/Starting Function Sequence

This is the APU start sequence:

- The start sequence starts when the APU switch is put to the START position and released to the ON position.
- The ECU turns on the oil pressure light on the P5 panel when the ECU receives the start signal. The LOW OIL PRESSURE light goes out at 30-40 psi oil pressure.
- The ECU opens the APU fuel shutoff valve and air inlet door. The inlet door switch sends a door open signal to the ECU when the air inlet door is open.
- At 0 percent speed and before the start system is energized, the ECU energizes the ignition unit.
- If the air inlet door is open and the APU speed is less than 7 percent, the ECU sends a start signal to the SCU. If the APU speed is more than 7 percent, the ECU waits until the speed is less than 7 percent.
- If 115v AC is available on transfer bus 1, the SCU sends a start signal to the AC to DC converter in the SPU. The AC to DC converter gives 270v DC power to the SCU.
- If 115v AC is not available on transfer bus 1, the SCU sends a start signal to the DC to DC converter in the SPU. The DC to DC converter gives 270v DC to the SCU. The SCU also has a control function to prevent the DC to DC converter from depleting the battery below limits (18v DC on ground, 20v DC in air) during a DC start attempt. The Proximity Switch Electronics Unit (PSEU) provides the air/ground input.
- The DC to AC converter in the SCU changes the 270v DC power from the SPU into three-phase start power. This power goes to the starter-generator. The starter-generator turns the APU turbine shaft. The SCU receives starter-generator rotor position from the starter-generator resolver. The SCU uses this signal to synchronize the three-phase start power to the starter-generator rotor position.
- At 7 percent speed, the ECU energizes the fuel solenoid which supplies fuel for combustion.
- At approximately 30 percent speed, oil pressure goes above 30-40 psi. The oil pressure switch removes the low oil pressure signal. The ECU turns off the LOW OIL PRESSURE light.
- At 60 percent speed, the ECU de-energizes the ignition unit.
- At 70 percent speed, the ECU removes the start signal from the SCU. The SCU removes the start signal from the SPU AC to DC and DC to DC converters. This de-energizes the starter-generator.
- At 95 percent speed, plus two seconds, the ECU gives the ready to load (RTL) signal to other airplane systems. This signals the airplane systems that the APU is ready to accept pneumatic and electrical loads.

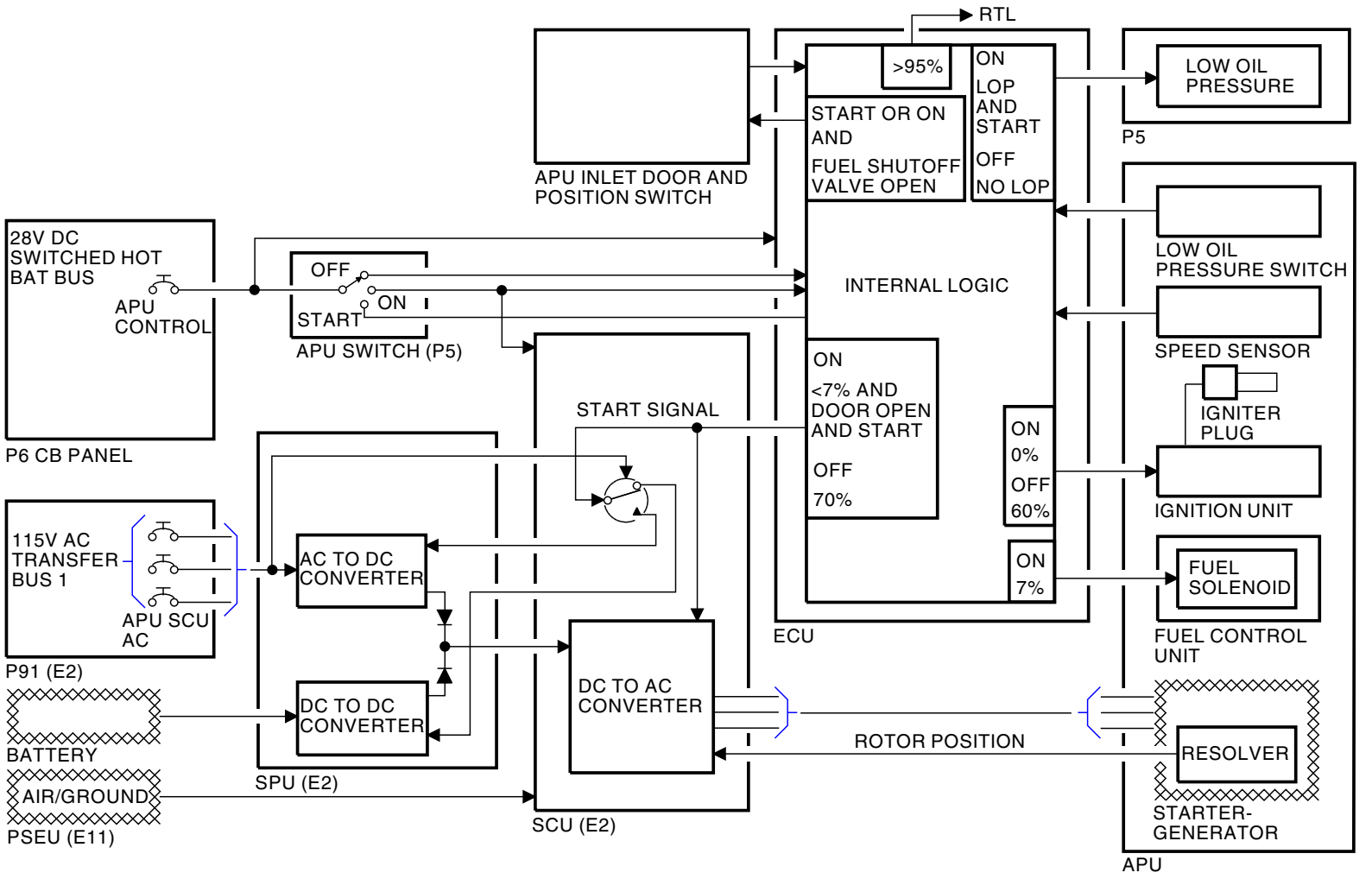
APU IGNITION AND START SYSTEM - FUNCTIONAL DESCRIPTION



M87542 S0004631493_V1

APU IGNITION AND START SYSTEM - FUNCTIONAL DESCRIPTION

APU IGNITION AND START SYSTEM - FUNCTIONAL DESCRIPTION



2551611 S0000608010_V1

APU IGNITION AND START SYSTEM - FUNCTIONAL DESCRIPTION

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU BLEED AIR SYSTEM - INTRODUCTION

Purpose

The Auxiliary Power Unit (APU) bleed air system supplies pressurized air for these airplane pneumatic operations:

- Main engine start
- Air conditioning
- Pressurization.

Components

These are the APU bleed air system components:

- Load compressor (not shown)
- Inlet guide vanes (IGVs) (not shown)
- Inlet Guide Vane Actuator (IGVA)
- Bleed Air Valve (BAV)
- Pressure sensors (PT, DP, P2)
- Surge Control Valve (SCV).

All bleed air system components, except the load compressor and inlet guide vanes, are line replaceable.

Controls

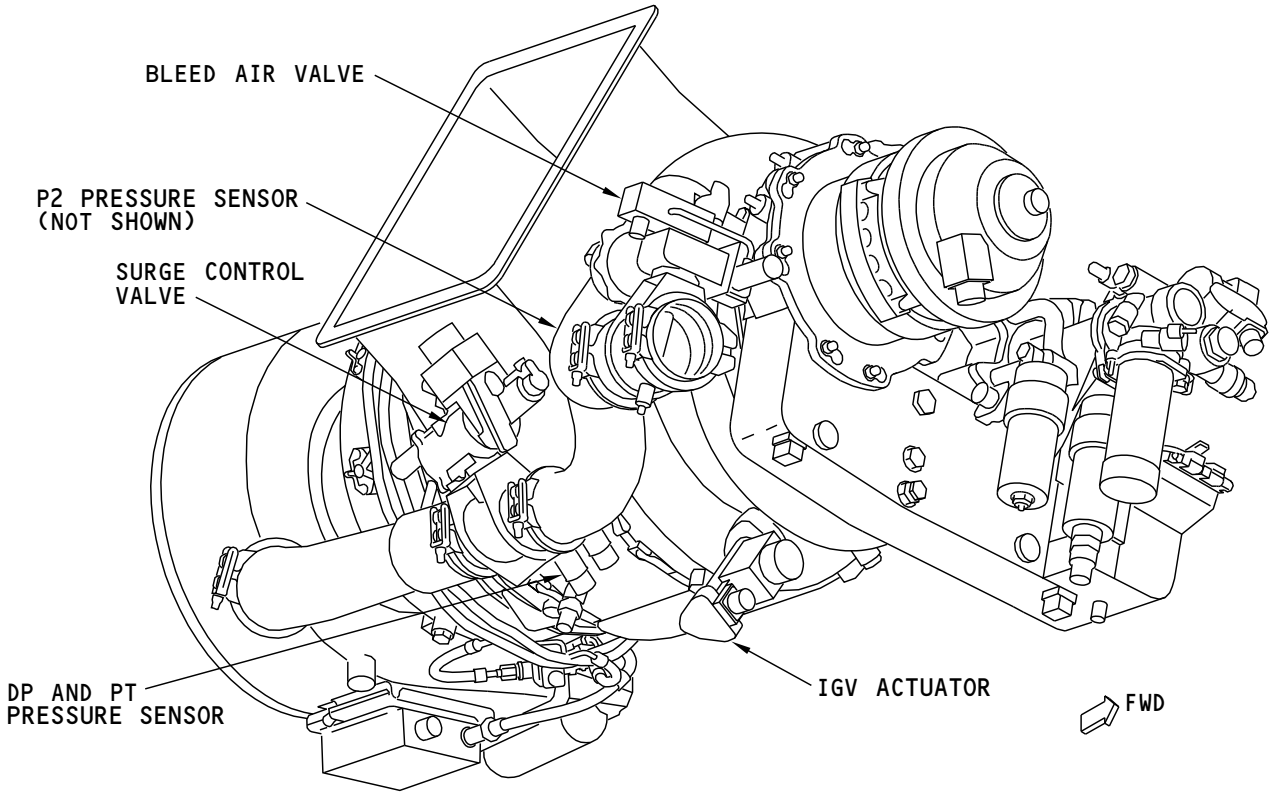
The Electronic Control Unit (ECU) sends signals to the IGVA to control the Inlet Guide Vane (IGV) position. With the APU bleed switch in the ON position and APU speed above 95 percent, the ECU sends a signal to open the BAV. The ECU sends signals to the SCV to make sure sufficient air flows through the load compressor to prevent a surge.

Training Information Point

ECU Built-In-Test Equipment (BITE) checks these bleed air system components:

- BAV
- IGVA
- SCV
- Pressure sensors.

APU BLEED AIR SYSTEM - INTRODUCTION



M87543 S0004631497_V1

APU BLEED AIR SYSTEM - INTRODUCTION

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE

Purpose

The APU bleed air valve (BAV) isolates the APU bleed air system from the airplane pneumatic manifold.

Physical Description

The APU bleed air valve has these components:

- Valve flow body with butterfly plate
- Spring-loaded pneumatic actuator
- Control solenoid and electrical connector
- Position indicator (visual)
- Limit switch assembly.

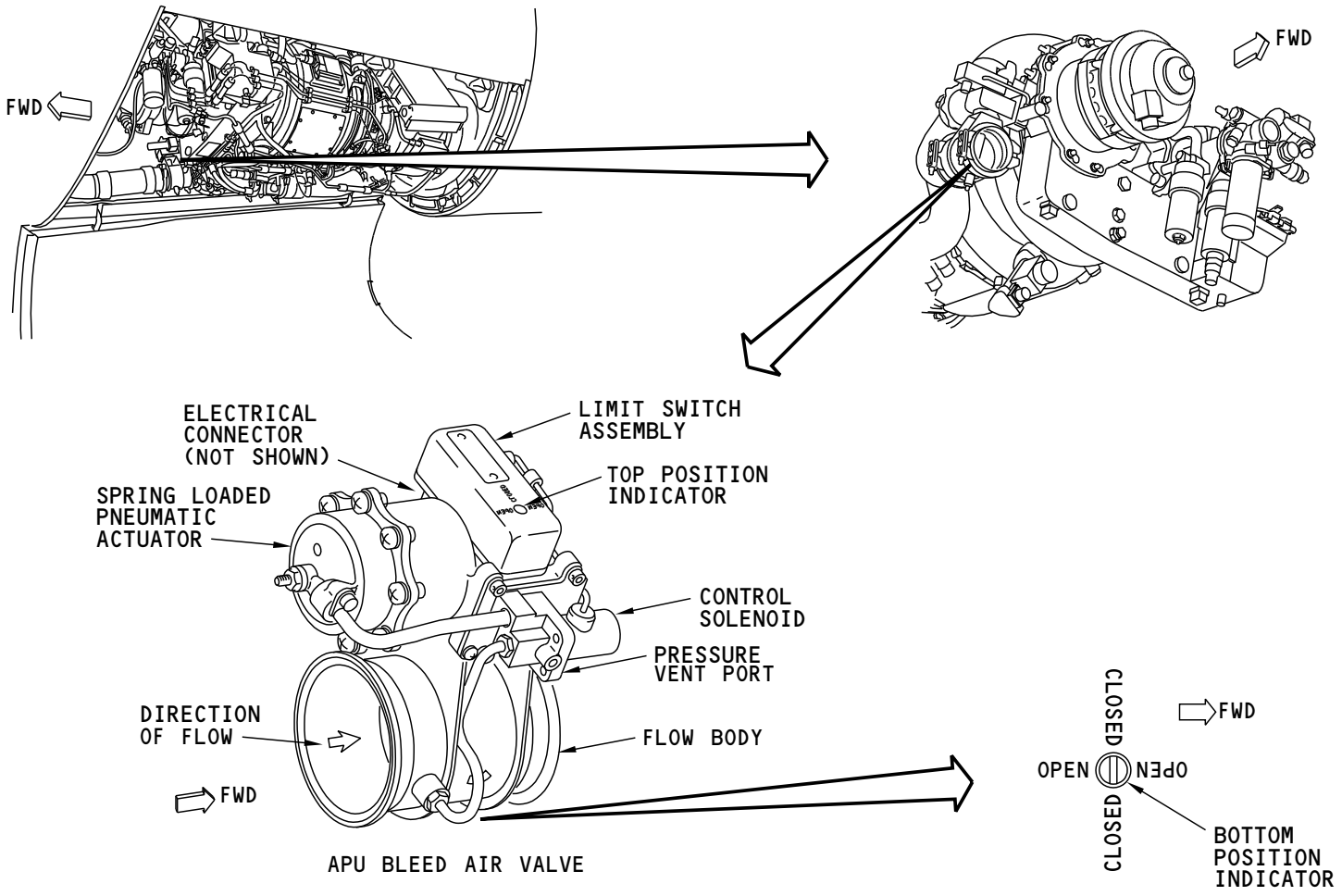
Location

The APU bleed air valve is in the forward right side of the APU. Access is through the APU cowl door.

Mechanical Valve Position Indication

The APU bleed air valve has a visual position indicator on the bottom of the BAV flow body. The APU BAV also has a visual position indicator on the top of the limit switch assembly.

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE



M87544 S0004631499_V1

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE - FUNCTIONAL DESCRIPTION

General

The Bleed Air Valve (BAV) is a butterfly type valve that isolates the APU load compressor from the airplane bleed air system.

Operational Indications

These are the indications in the flight compartment:

- EGT indicator
- Duct pressure gage
- Dual bleed light.

Exhaust Gas Temperature (EGT) increases when the BAV opens. As the Inlet Guide Vanes (IGV) open, more air goes to the load compressor (L/C). As more air enters the L/C duct, the pressure increases. The EGT increase is less than for APUs on previous 737s because air is from the L/C and not from the engine compressor.

The duct pressure gage gives the left and right bleed manifold pressures. You know if the BAV is open if the duct pressure is more than 0 when the APU is the only source of bleed air.

See the pneumatic system for more information on duct pressure indication (SECTION 36-20).

The dual bleed light comes on when these conditions occur:

- APU bleed air valve is open
- Engine 1 or 2 bleed switch is ON and the isolation valve is open.

See the pneumatic system for more information on the dual bleed light (SECTION 36-20).

Control

The APU bleed air switch sends a signal to the ECU. The APU bleed air switch is on the air conditioning/bleed air controls panel. The switch positions are OFF and ON.

The APU ECU controls the ON and OFF signal to the APU bleed valve solenoid. The BAV opens when the solenoid is energized from the ECU and pneumatic power is available from the load compressor.

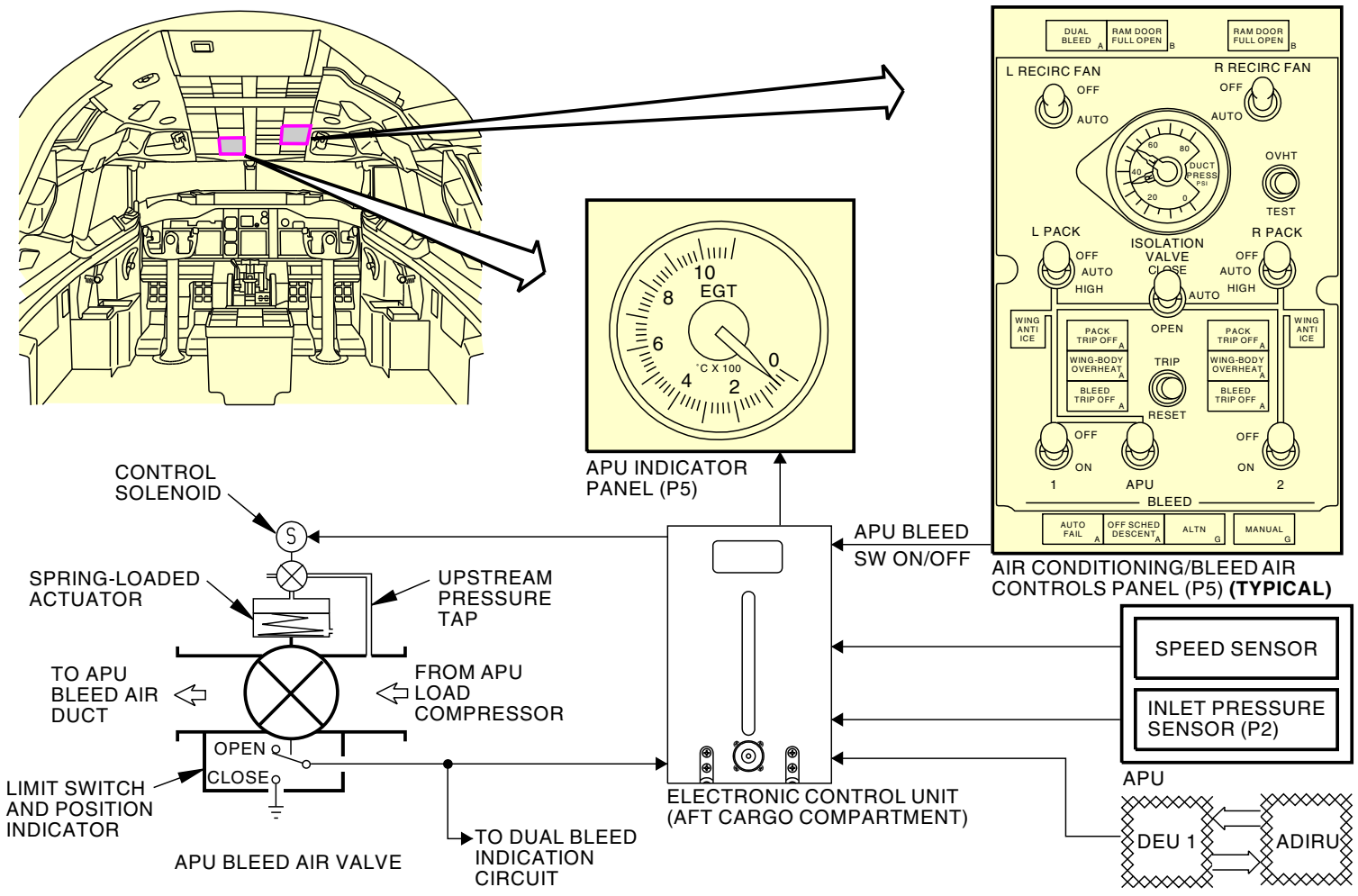
The APU ECU energizes the solenoid when these conditions occur:

- APU bleed air switch is in the ON position
- APU is not in cool down cycle
- APU speed is more than 95 percent
- Altitude is less than 18,000 ft (5486 m), if altitude comes from the ADIRU
- Altitude is less than 21,000 ft (6401 m), if increasing altitude and altitude comes from inlet pressure sensor (P2)
- Altitude is less than 19,000 ft (5791 m), if descending and altitude comes from inlet pressure sensor (P2).

The bleed air valve has a spring to hold it in the closed position. Air from the APU load compressor moves the valve open when the ECU energizes the solenoid.

NOTE: Bleed duct pressure will be 0 psig (0 kPa)-6 psig (41 kPa) when the APU bleed air switch is in the OFF position.

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE - FUNCTIONAL DESCRIPTION



M87547 S0004631503_V2

APU BLEED AIR SYSTEM - APU BLEED AIR VALVE - FUNCTIONAL DESCRIPTION

APU BLEED AIR SYSTEM - INLET GUIDE VANES AND ACTUATOR

Purpose

The inlet guide vanes control the air flow to the load compressor. The IGV actuator controls the IGV position.

Physical Description

Sixteen inlet guide vanes (IGVs) are inside the APU around the load compressor inlet. These are the parts in the inlet guide vane assembly:

- Inlet guide vanes (16)
- Ring gear
- Support assembly
- Segment gears (16).

The inlet guide vane actuator (IGVA) is on the right side of the compressor. These are the actuator components:

- Electrical connector
- Linear variable differential transformer (LVDT)
- Actuator rod
- Fuel inlet line
- Fuel return line
- Drain line.

Functional Description

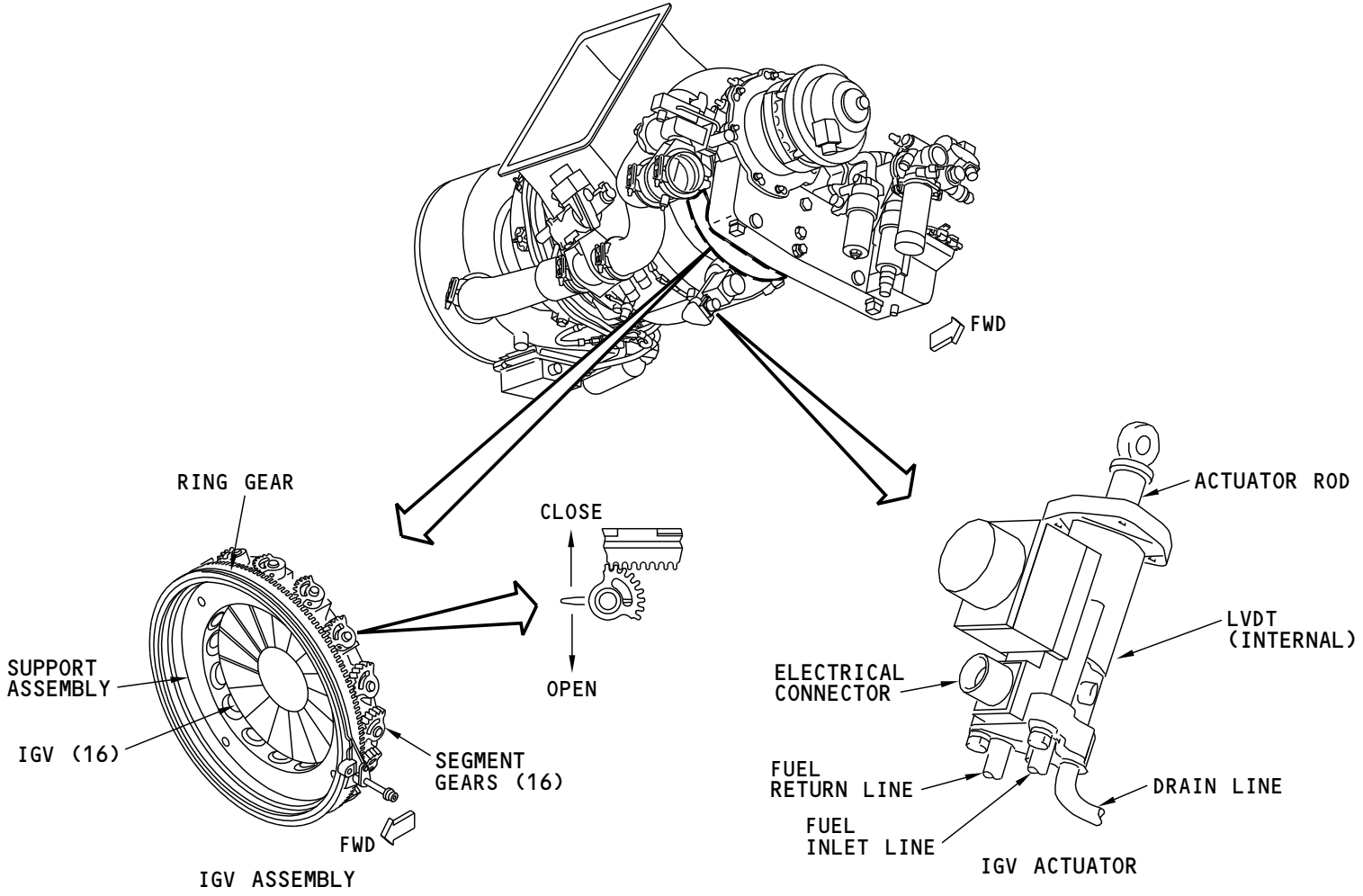
The inlet guide vanes turn between 15 degrees (fully closed) to 115 degrees (fully open). The vanes do not fully close. The vanes are set to stop at the 15 degrees position to cool the load compressor.

The actuator receives signals from the ECU and uses fuel pressure from the FCU to move the vanes. The ECU controls the inlet guide vanes to the correct angle by the air demand from the airplane.

Training Information Point

The IGV position shows on the CDU in the flight compartment.

APU BLEED AIR SYSTEM - INLET GUIDE VANES AND ACTUATOR



M87548 S0004631505_V1

APU BLEED AIR SYSTEM - INLET GUIDE VANES AND ACTUATOR

APU BLEED AIR SYSTEM - INLET GUIDE VANES - FUNCTIONAL DESCRIPTION

General

The ECU receives airplane systems inputs and selects from four bleed air modes. These are the bleed air modes:

- No bleed
- Duct pressurization
- Main engine start
- Air conditioning system (ACS).

The ECU sends a signal to the IGV actuator to change the angle of the IGVs. The angle of the IGVs changes to control the air supply.

The ECU puts the IGVs at 15 degrees when the APU bleed air valve closes.

No Bleed Mode

The no bleed mode occurs when the ECU closes the IGVs to 15 degrees, the APU bleed valve closes, and there is no pneumatic system demand.

Duct Pressurization Mode

The ECU selects the duct pressurization mode when the APU bleed air valve opens and there is no air system demand. The IGVs open to let the load compressor pressurize the air ducts.

Main Engine Start Mode

In main engine start mode, the ECU opens the IGVs to meet the increased airflow requirements. This mode has priority over all other modes.

ACS Mode

In each ACS mode, the ECU opens the IGVs as necessary to supply air to the air conditioning system. These are the four ACS modes:

- One pack inflight
- One pack ground
- Two pack normal
- Two pack high.

The IGV positions in the ACS modes are different for each airplane model. The ECU finds the airplane model from two signature pins on the airplane ECU connector.

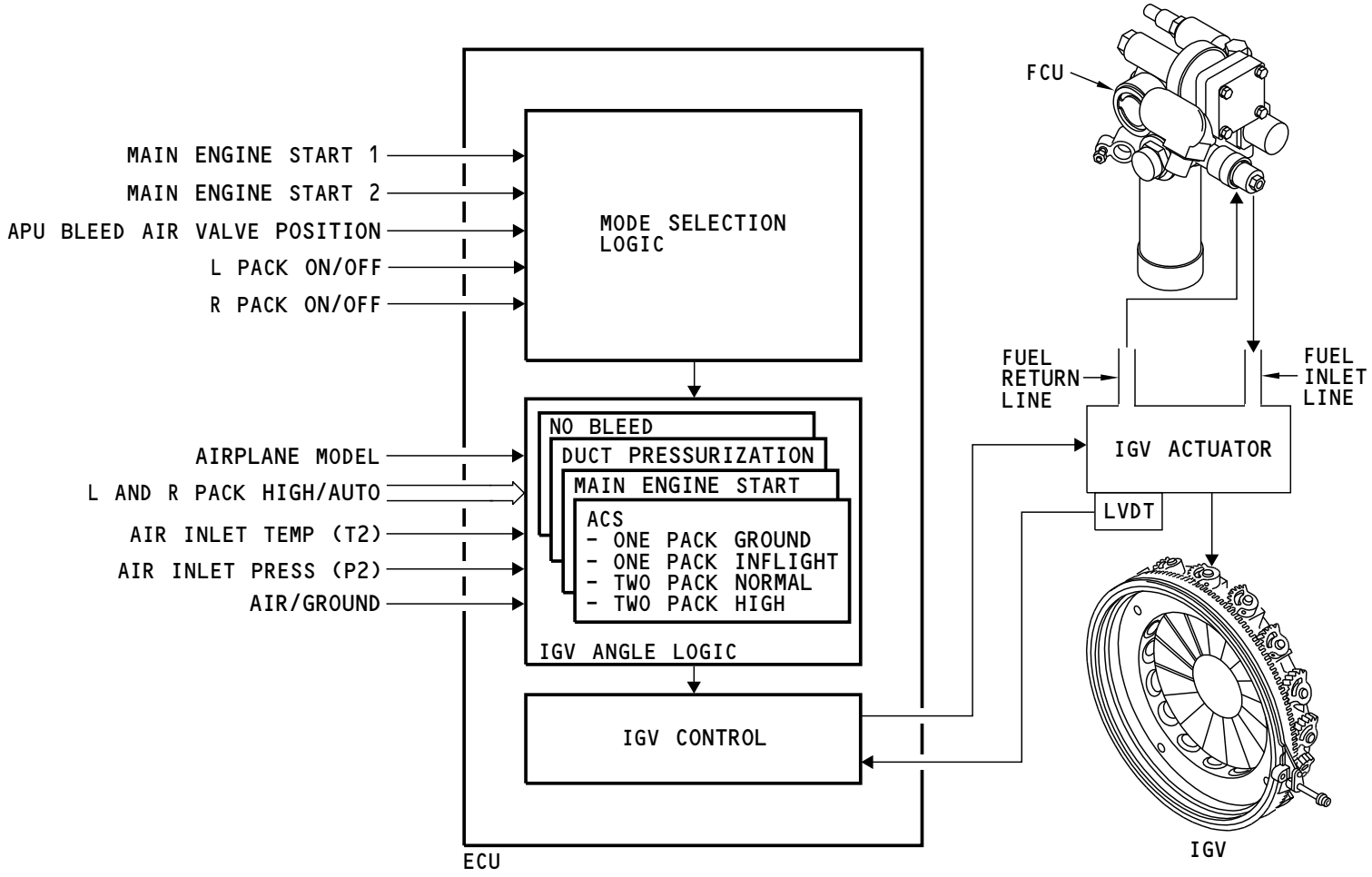
It is recommended that you operate the APU with the two air conditioning packs when maximum cabin cooling is necessary. Use the two air conditioning packs as an alternative to the one air conditioning pack operation. The results of the operation of two air conditioning packs will be cooler cabin temperatures, lower APU fuel burn, better APU hot section life and lower APU noise. Refer to Service Letter 737-SL-49-060 for more data on these results.

Control

After the mode selection, the ECU uses inlet temperature, inlet pressure, and airplane specific data (flight or ground conditions) to find the commanded IGV angle.

The ECU sends control signals to the servo valve on the IGV actuator to open or close the guide vanes. The LVDT in the IGV actuator supplies vane position feedback to the ECU.

APU BLEED AIR SYSTEM - INLET GUIDE VANES - FUNCTIONAL DESCRIPTION



M87549 S0004631507_V1

APU BLEED AIR SYSTEM - INLET GUIDE VANES - FUNCTIONAL DESCRIPTION

APU BLEED AIR SYSTEM - P2, PT, AND DP PRESSURE SENSORS

Purpose

The three pressure sensors measure load compressor pressures and convert these pressures into a electric signals. The electric signals are sent to the ECU.

These are the three pressure sensors:

- Inlet pressure (P2) sensor
- Total pressure (PT) sensor
- Differential pressure (DP) sensor.

Location

The P2 sensor is attached to the APU inlet. The PT and DP sensors are above the surge control valve (SCV) on the APU inlet.

Functional Description

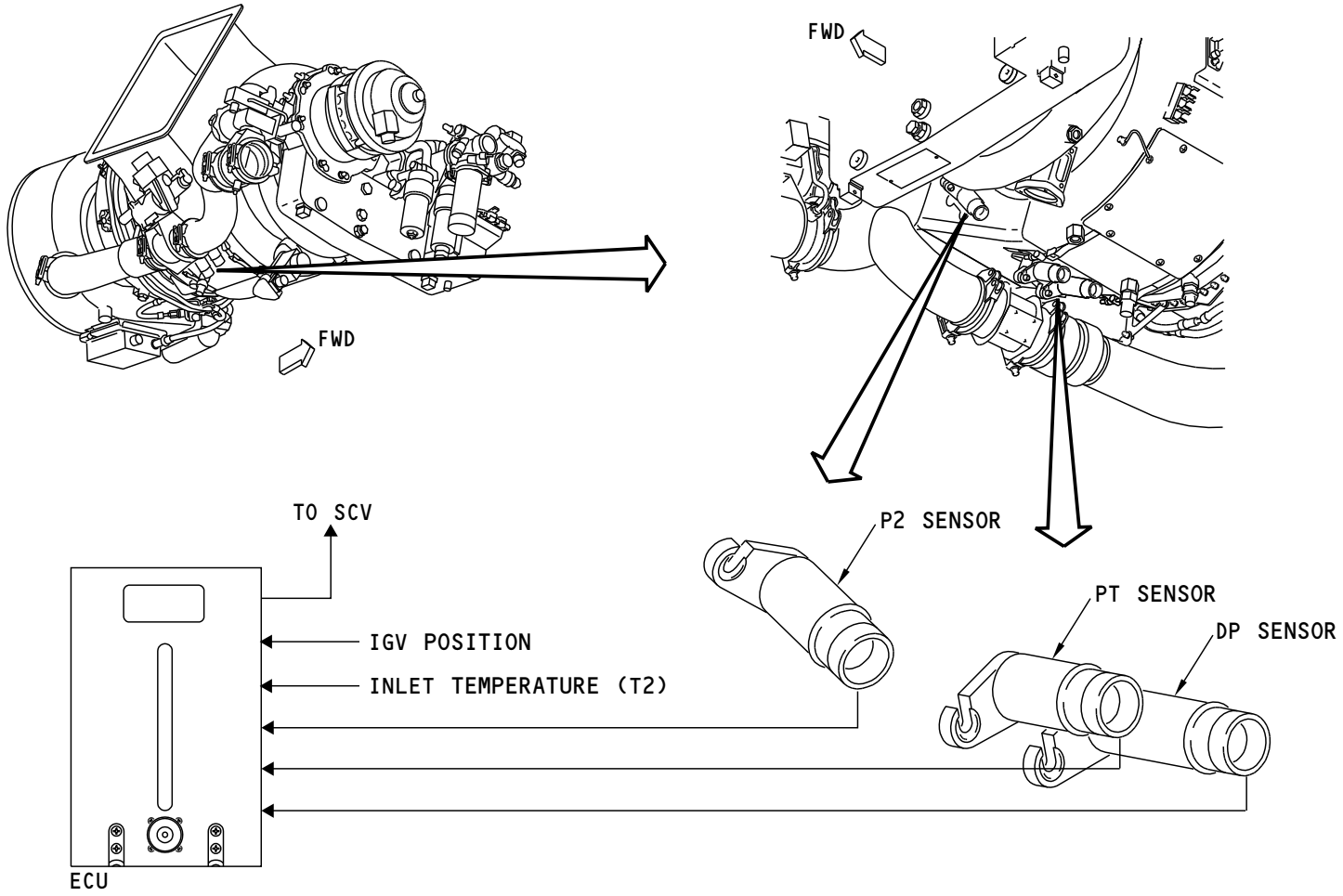
The P2 sensor measures the APU inlet pressure of the load compressor. The ECU uses this data to control APU functions.

The PT sensor measures load compressor total discharge pressure.

A DP sensor measures the difference between the total discharge pressure and the static pressure in the diffuser. Differential pressure equals total pressure minus static pressure.

The ECU uses PT and DP to calculate load compressor airflow. The ECU uses load compressor airflow, inlet temperature, and IGV position to operate the surge control valve.

APU BLEED AIR SYSTEM - P2, PT, AND DP PRESSURE SENSORS



M87550 S0004631509_V1

APU BLEED AIR SYSTEM - P2, PT, AND DP PRESSURE SENSORS

APU BLEED AIR SYSTEM - SURGE CONTROL VALVE

Purpose

The surge control valve (SCV) releases air from the load compressor. The SCV makes sure there is a minimum flow of air through the load compressor. This prevents a surge. If a surge does occur, the SCV opens to help the load compressor recover.

Physical Description

The SCV is a butterfly type valve. The surge control valve actuator is on the top of the valve. A two-stage servo valve controls the actuator. A visual indicator on the valve gives the position of the valve.

Location

The valve is in the surge bleed duct on the right side of the APU.

Functional Description

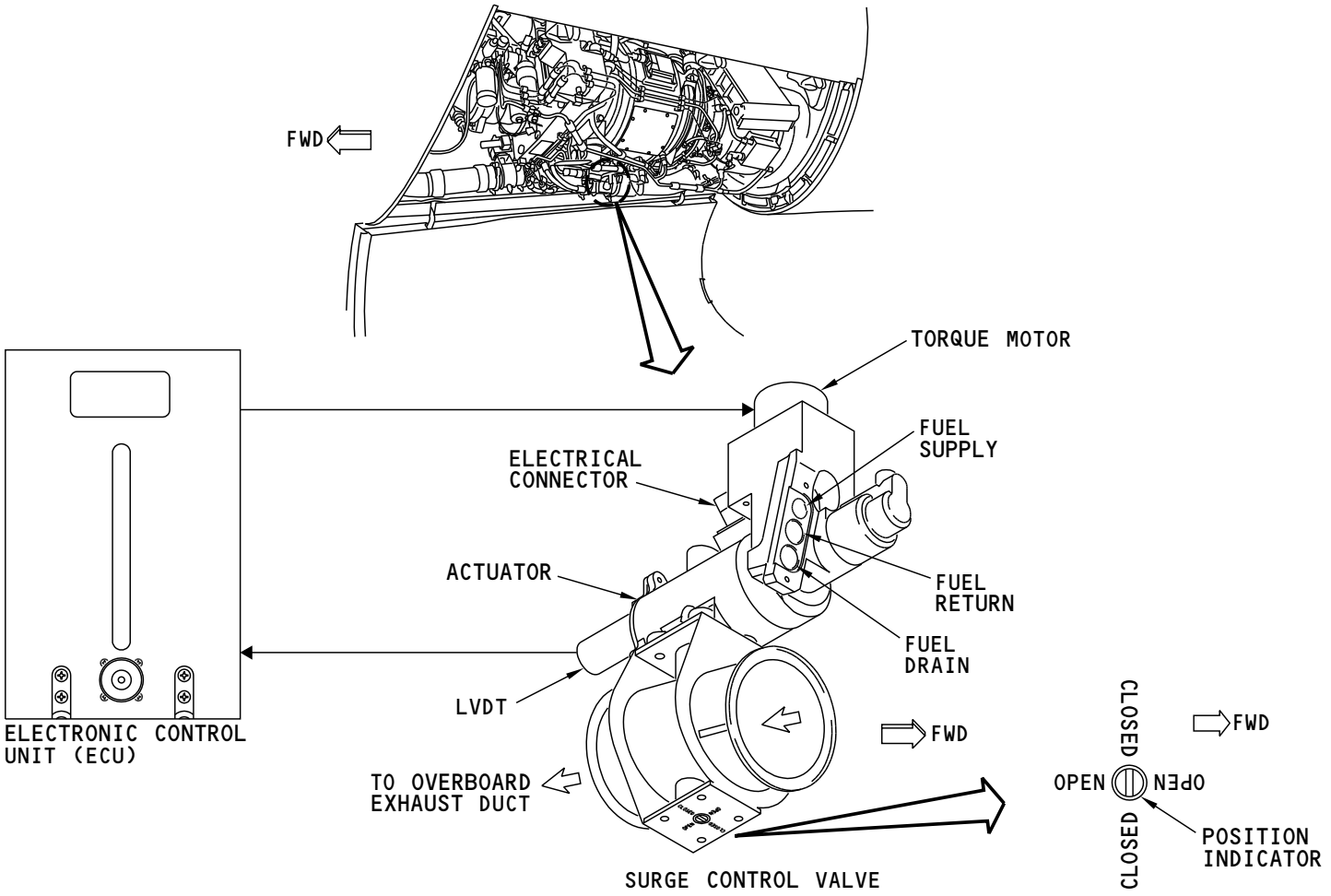
The ECU controls a torque motor on the servo valve. This motor sends high pressure fuel from the APU fuel system to open or close the surge control valve. The valve moves between 10 degrees (open) and 90 degrees (closed). A linear variable differential transformer (LVDT) supplies valve position feedback to the ECU.

Air that flows through the surge control valve goes overboard through the exhaust duct.

Training Information Point

The SCV has a visual position indicator. This indicator is on the bottom of the SCV flow body.

APU BLEED AIR SYSTEM - SURGE CONTROL VALVE



M87551 S0004631511_V1

APU BLEED AIR SYSTEM - SURGE CONTROL VALVE

APU BLEED AIR SYSTEM - SURGE BLEED - FUNCTIONAL DESCRIPTION

General

The APU uses surge bleed to prevent load compressor surges. If there is not sufficient flow through the load compressor, the surge control valve (SCV) releases bleed air into the APU exhaust. The bleed air flow into the exhaust is the surge bleed.

Corrected Air Flow and Surge Margin Setpoint

The ECU calculates the corrected airflow and the surge margin setpoint.

The corrected airflow is the quantity of air that flows through the load compressor. The ECU uses total pressure (PT) and differential pressure (DP) to calculate the corrected airflow.

The surge margin setpoint is the minimum quantity of corrected air that should flow through the load compressor to prevent load compressor surge.

The ECU uses these inputs to calculate the surge margin set point:

- Inlet temperature (T2)
- IGV position
- Bleed mode
- Air/ground.

If the corrected air flow is less than the surge margin set point, the ECU opens the surge control valve. When the SCV is open, the SCV releases air into the APU exhaust. This surge bleed keeps the airflow through the load compressor at or more than the minimum level.

SCV Actuator Control

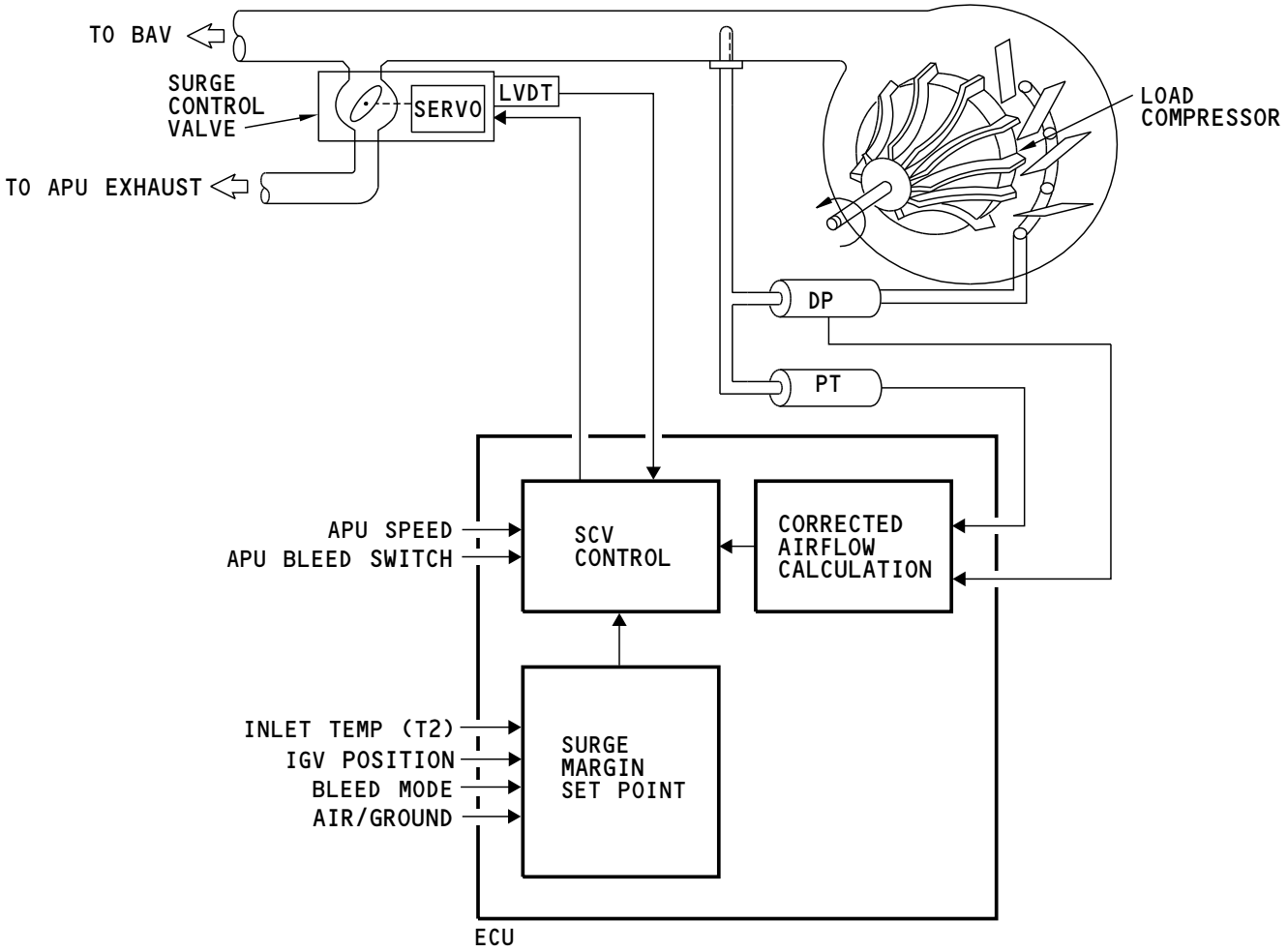
The ECU sends control signals to the servo valve on the SCV actuator to open or close the valve. The LVDT in the surge control valve supplies valve position feedback to the ECU.

APU Start and Shutdown

When you start the APU, the surge control valve stays in the full open position. The valve butterfly closes when the APU speed is more than 95 percent speed and the APU bleed switch is in the ON position. This helps prevent stall conditions during a start.

The surge control valve opens when the APU shuts down.

APU BLEED AIR SYSTEM - SURGE BLEED - FUNCTIONAL DESCRIPTION



M87552 S0004631513_V1

APU BLEED AIR SYSTEM - SURGE BLEED - FUNCTIONAL DESCRIPTION

APU BLEED AIR SYSTEM - FUNCTIONAL DESCRIPTION

Purpose

The APU bleed air system supplies air to the airplane pneumatic system. The APU uses surge bleed to prevent load compressor surges.

APU Bleed Air System

The ECU controls the APU bleed air system.

These are the components of the bleed air system:

- Load compressor
- Inlet guide vanes
- Inlet guide vane actuator
- Bleed air valve
- Pressure sensors
- Surge control valve.

The load compressor supplies airflow to the airplane pneumatic system. The inlet guide vanes control the amount of air to the load compressor. The inlet guide vane actuator operates the inlet guide vanes.

The inlet guide vane actuator receives commands from the ECU and uses fuel pressure for operation.

The ECU sends a open signal to the APU bleed air valve when the APU is at 95 percent speed and the APU bleed switch is in the ON position.

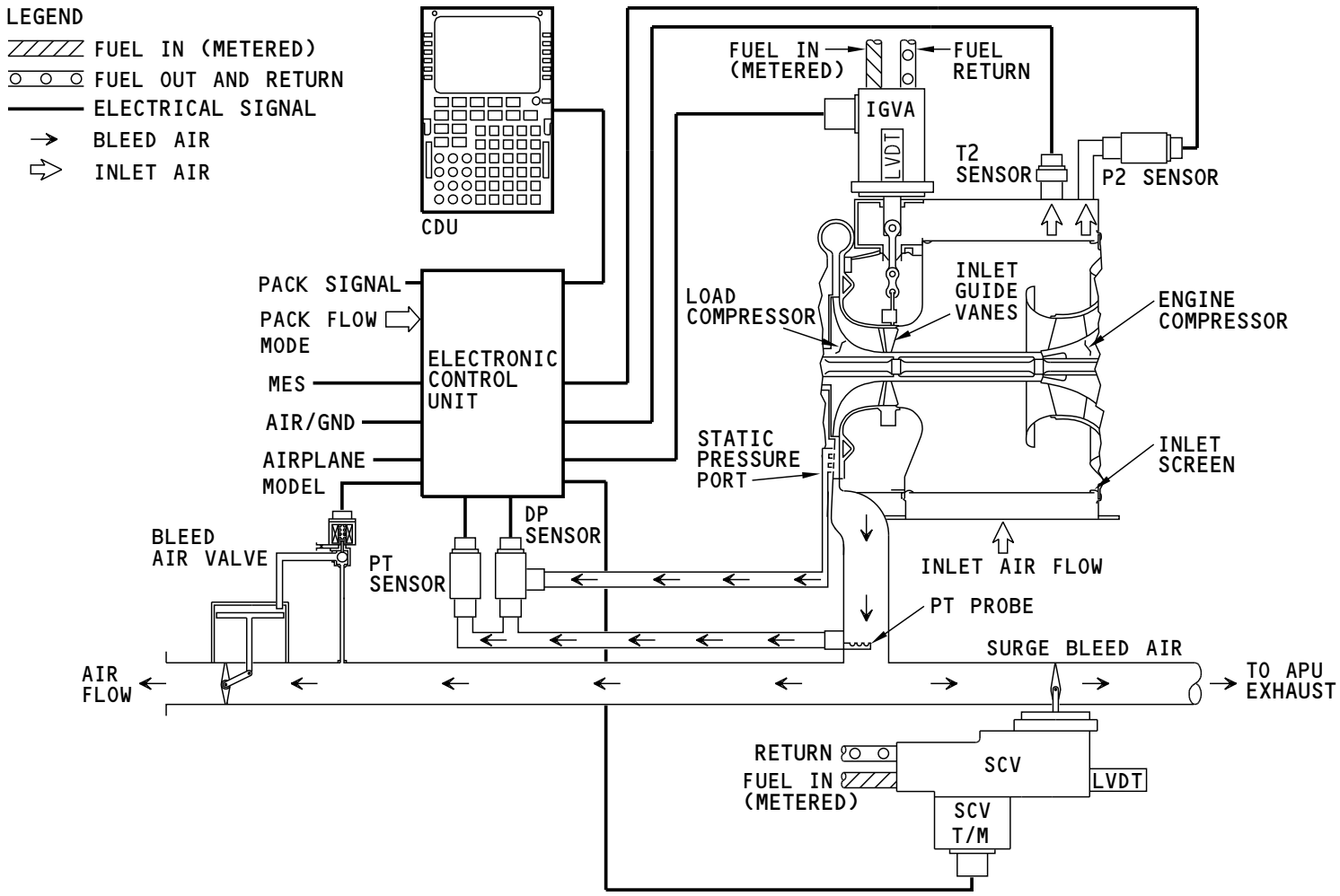
Electric power controls the bleed air valve and air pressure operates it.

APU Surge Bleed

Load compressor surge protection is on during all APU operations. The surge control valve gives this protection.

The ECU controls the surge control valve by a torque motor. The ECU calculates the correct position of the surge control valve with APU and airplane operating parameters.

APU BLEED AIR SYSTEM - FUNCTIONAL DESCRIPTION



M87553 S0004631515_V1

APU BLEED AIR SYSTEM - FUNCTIONAL DESCRIPTION

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU CONTROLS - INTRODUCTION

Purpose

The APU controls provide control for the APU for all operating conditions.

Flight Compartment Controls and Panels

These are the APU controls and panels in the flight compartment:

- APU switch (P5)
- APU bleed air switch (P5)
- APU generator switch (P5)
- APU fire warning switch (P8).

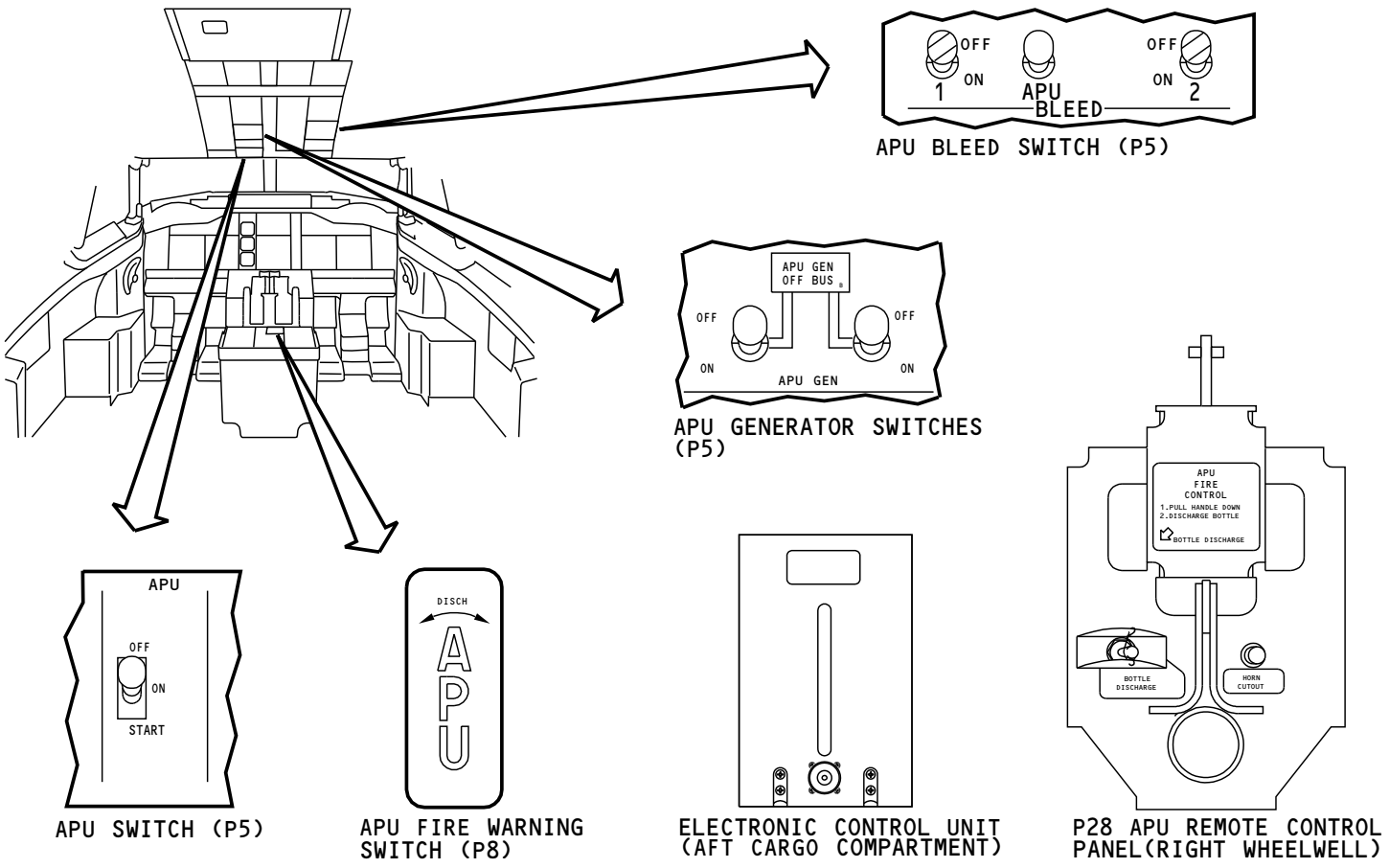
Other Control Components

The P28 APU remote control panel is on the right wheel well aft bulkhead.

The electronic control unit (ECU) controls the APU operation when the ECU receives a signal from the controls in the flight compartment. The ECU is in the aft cargo compartment right side.

The ECU also uses signals from certain APU and airplane systems for correct operation of the APU.

APU CONTROLS - INTRODUCTION



M87554 S0004631519_V1

APU CONTROLS - INTRODUCTION

APU CONTROLS - ELECTRONIC CONTROL UNIT - INTRODUCTION

Purpose

The ECU controls APU functions. The ECU also contains circuits for fault detection and isolation.

Location

The ECU is on a shelf in the aft cargo compartment near the aft cargo door.

Training Information Point

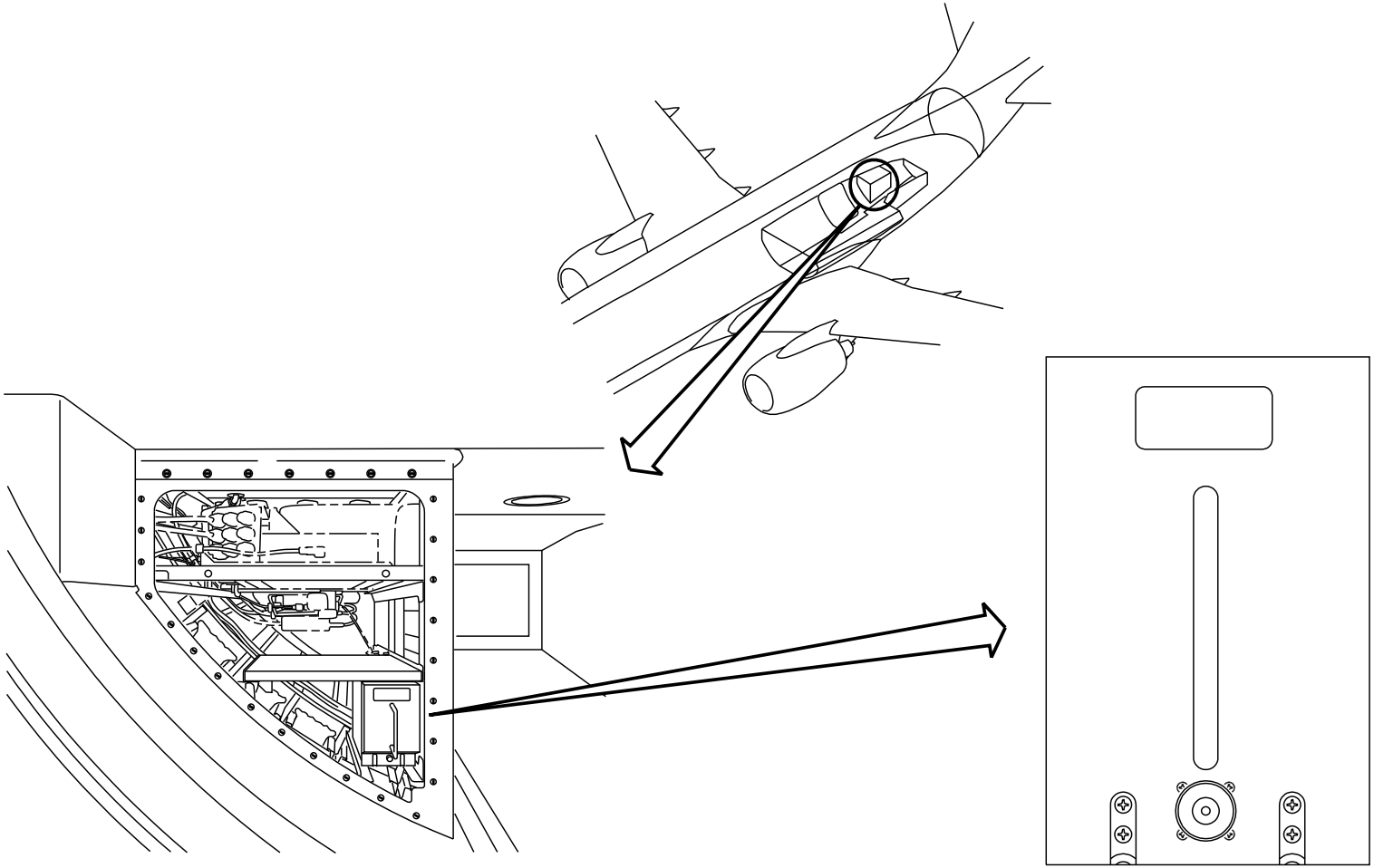
The ECU is a line replaceable unit (LRU). The circuit cards in the ECU are not LRUs.

To get access to the ECU, you must open the aft cargo door and remove the panel that protects the ECU front face.

Training Information Point

If you remove the ECU for maintenance, do not remove the data memory module from the APU at the same time. Lose of APU memory data will result.

APU CONTROLS - ELECTRONIC CONTROL UNIT - INTRODUCTION



M87556 S0004631522_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - INTRODUCTION

APU CONTROLS - ELECTRONIC CONTROL UNIT - INPUTS

General

The ECU gets inputs from airplane systems and from the APU.

The ECU receives 28v dc power from the 28v dc switched hot battery bus.

Airplane System ARINC 429 Data Bus

The ECU receives airplane data from the display electronic unit (DEU). The ARINC 429 bus transmits this information. You use the CDU to get APU BITE data from the ECU.

Operational Software Loading

Maintenance personnel can install operation software in the ECU with the data loader. See the data loader section for more information on the data loader. (SECTION 34-61)

Airplane Systems Discrete Inputs

The ECU receives these airplane system inputs:

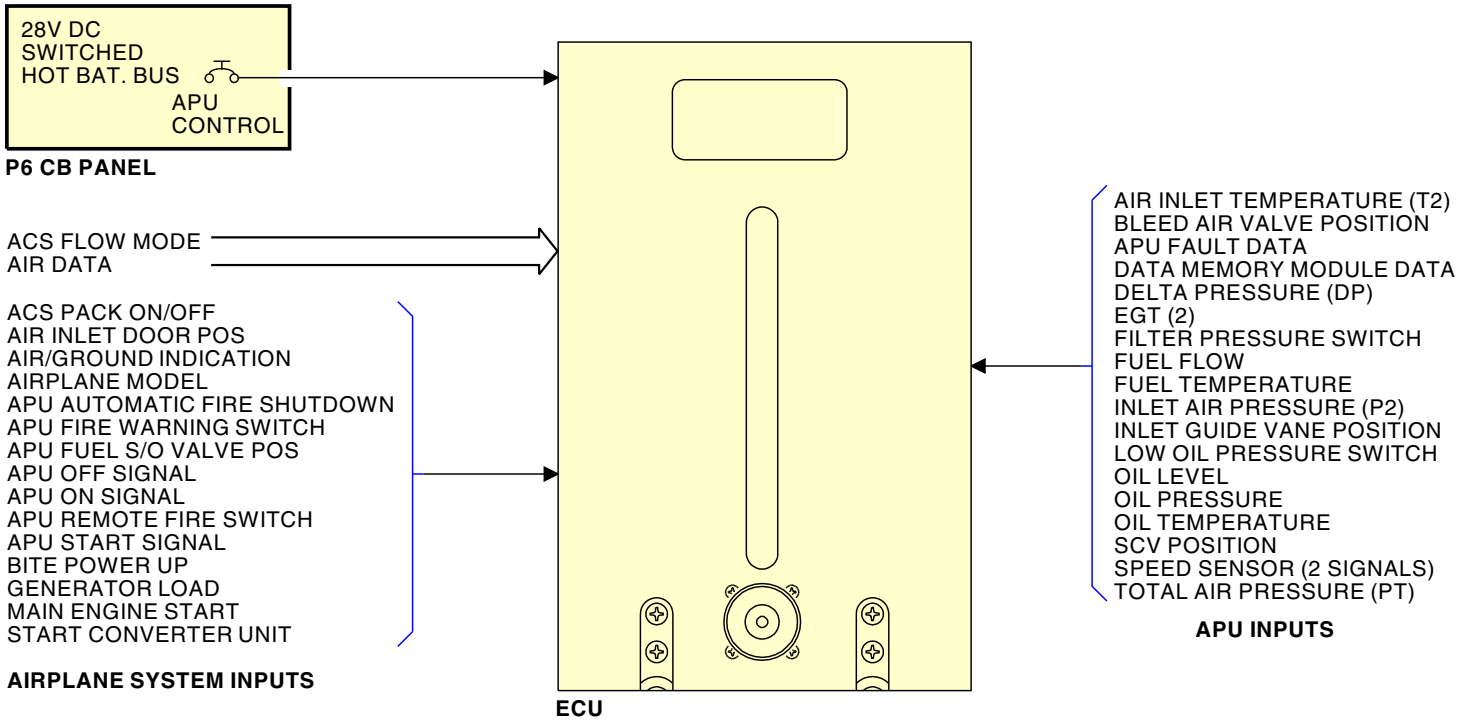
- ACS pack ON/OFF
- Air/ground indication
- Airplane model
- APU automatic fire shutdown
- APU BITE power up
- APU bleed command
- APU fire warning switch
- APU fuel shutoff valve position
- Air inlet door position
- APU OFF signal
- APU ON signal
- APU remote fire switch
- APU START signal
- Generator load
- Main engine start/run
- Start converter BITE data.

APU Inputs

These inputs are from the APU to the ECU:

- Air inlet temperature
- APU bleed air valve position
- APU fault data
- Data memory module (DMM)
- Delta pressure (DP)
- EGT (2)
- Filter pressure switch
- Fuel flow
- Fuel temperature
- IGV position
- Inlet air pressure (P2)
- Low oil pressure switch
- Oil level
- Oil pressure
- Oil temperature
- SCV position
- Speed sensor with 2 signals
- Total air pressure (PT).

APU CONTROLS - ELECTRONIC CONTROL UNIT - INPUTS



M87557 S0004631524_V3

APU CONTROLS - ELECTRONIC CONTROL UNIT - INPUTS

APU CONTROLS - ELECTRONIC CONTROL UNIT - OUTPUTS

General

The ECU supplies APU data to airplane systems and it controls APU functions.

ECU ARINC 429 Outputs

The ECU supplies this APU data to the flight management computer (FMC) through the ARINC 429 bus. The FMC system shows this information on the control display unit (CDU):

- APU and ECU part numbers and serial numbers
- APU fault data
- APU maintenance data
- APU running status (over 40 indications, 4 pages of status when you select Input Monitoring on the CDU)
- Oil quantity.

ECU Outputs to the APU

The ECU sends signals to control these APU components:

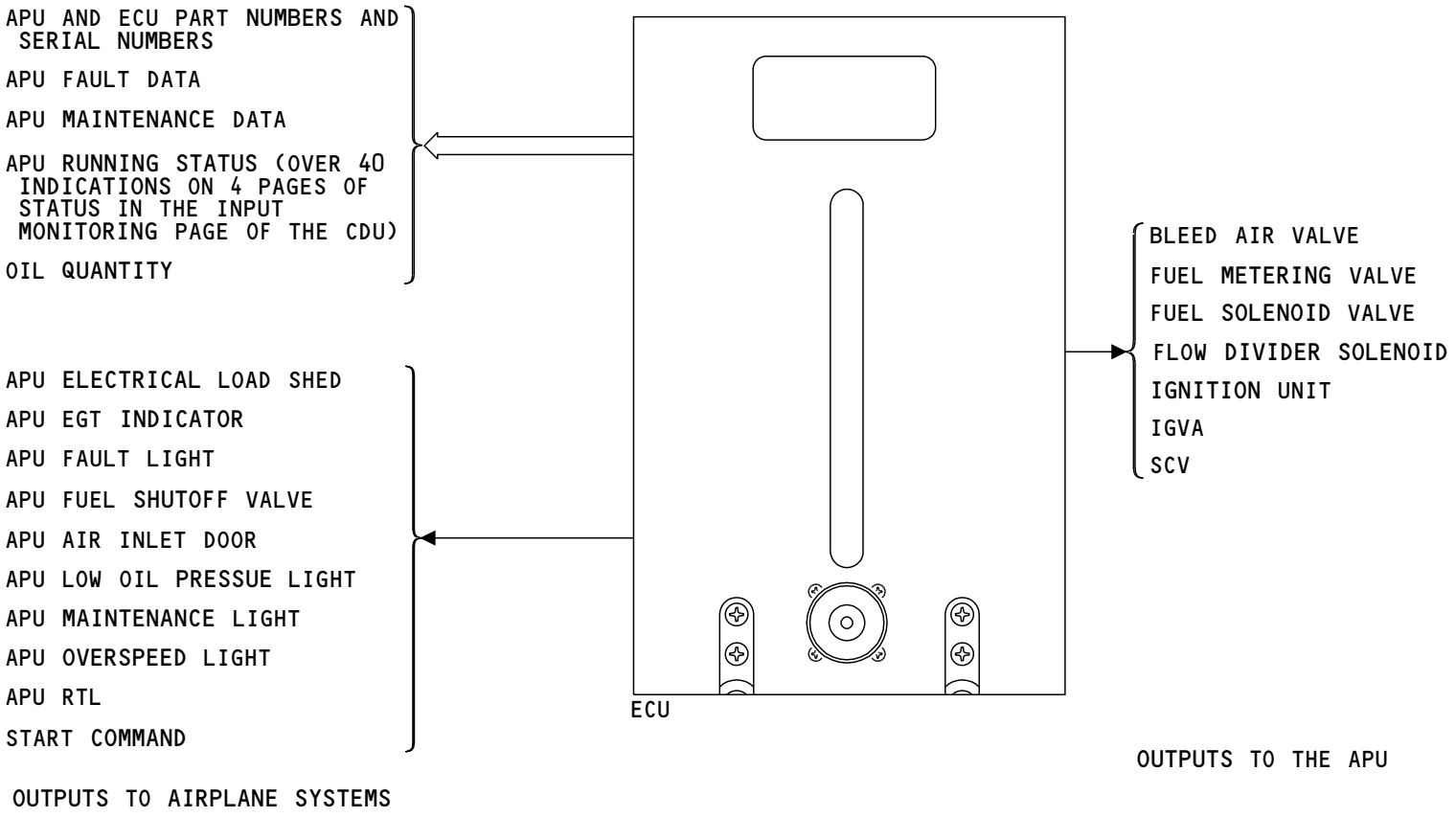
- Bleed air valve (BAV)
- Fuel metering valve
- Fuel solenoid valve
- Flow divider solenoid
- Ignition unit
- Inlet guide vane actuator (IGVA)
- Surge control valve (SCV).

ECU Outputs to Other Airplane Systems

The ECU also sends these analog signals:

- APU EGT indicator
- APU electrical load shed command
- APU fault light (amber)
- APU fuel shutoff valve
- APU air inlet door
- APU low oil pressure light (amber)
- APU maintenance light (blue)
- APU overspeed light (amber)
- Ready to load APU GEN OFF BUS light on at 95 percent speed (blue)
- Start command.

APU CONTROLS - ELECTRONIC CONTROL UNIT - OUTPUTS



M87558 S0004631526_V2

APU CONTROLS - ELECTRONIC CONTROL UNIT - OUTPUTS

General

The ECU does tests of the APU components and its internal functions. The ECU does some component tests continuously and others only when the APU is in a specific mode.

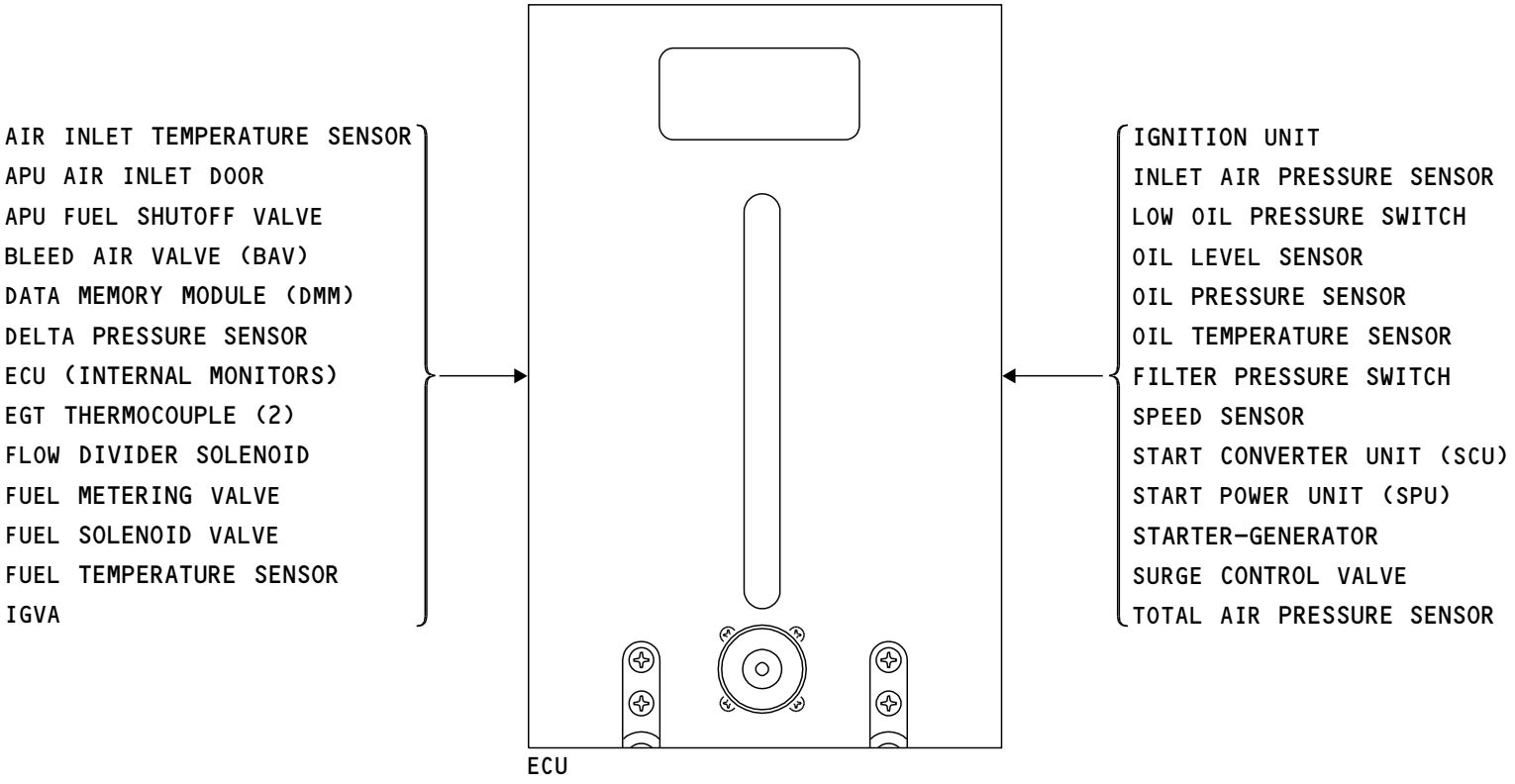
The ECU memory holds up to 99 faults. When the memory is full, new faults record over the oldest faults.

Monitored Components

The ECU monitors these components:

- Air inlet temperature (T2) sensor
- APU air inlet door
- APU fuel shutoff valve
- Bleed air valve (BAV)
- Data memory module (DMM)
- Delta pressure (DP) sensor
- ECU (internal monitors)
- EGT thermocouple (2)
- Flow divider solenoid
- Fuel metering valve
- Fuel solenoid valve
- Fuel temperature sensor
- IGVA
- Ignition unit
- Inlet air pressure (P2) sensor
- Low oil pressure switch
- Oil level sensor
- Oil pressure sensor
- Oil temperature sensor
- Filter pressure switch for starter-generator filter
- Speed sensor
- Start converter unit (SCU)
- Start power unit (SPU)
- Starter-generator
- Surge control valve (SCV)
- Total air pressure (PT) sensor.

APU CONTROLS - ELECTRONIC CONTROL UNIT - FAULT MONITORING



M87559 S0004631528_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - FAULT MONITORING

General

The ECU makes sure the APU operates correctly. If the ECU senses APU operation that could cause damage, the ECU shuts down the APU. This is a protective shutdown. A protective shutdown can occur anytime during APU start and operation. The ECU keeps protective shutdown data in memory. You use the CDU to get this data.

The ECU makes the maintenance light on the AC systems, generator and APU module come on if the APU requires servicing or maintenance. You can use the APU with the maintenance light on.

Protective Shutdown

The ECU uses protective shutdown logic to automatically shutdown the APU. You know the ECU did a protective shutdown if the fault or overspeed lights come on. The ECU also does a protective shutdown and the low oil pressure (LOP) light comes on if oil pressure is too low when the APU speed is more than 95%. These lights are on the AC systems, generator, and APU module. When the ECU does a protective shutdown, the master caution and APU annunciator light on the P7 panel also come on.

The APU protective shutdown lights go off when you move the APU switch to OFF and back to ON with APU speed less than 7 percent or when the ECU de-energizes. The ECU de-energizes five minutes after these condition occur:

- APU switch in OFF position
- APU CDU BITE is off
- APU fuel shutoff valve is closed.

If the fuel shutoff valve fails in the open position, the ECU will not de-energize. This causes the FAULT light to be on until you move the battery switch to the off position.

These are the protective shutdowns that cause a fault light:

- APU fuel valve shutdown
- DC powerloss shutdown
- ECU shutdown
- Fire shutdown
- Inlet door shutdown
- Inlet overheat shutdown
- Loss of EGT shutdown
- Loss of speed shutdown
- No acceleration shutdown
- No APU rotation shutdown
- No flame shutdown
- Oil filter shutdown
- Oil temperature shutdown
- Overtemperature shutdown
- Reverse flow shutdown
- Sensor failure
- Underspeed shutdown
- Shorted rotating diode.

These are the protective shutdowns that cause an overspeed light:

- Overspeed shutdown
- Overspeed protection.

A low oil pressure protective shutdown causes the low oil pressure light to come on.

During a protective shutdown, these APU and airplane system changes occur:

- Fuel solenoid valve closes
- Fuel control unit metering valve closes
- APU light comes on
- Remove ready to load signal (RTL)
- Igniter de-energizes, if energized
- IGVs close
- SCV opens

- APU fuel shutoff valve closes
- APU inlet door closes.

The fuel shutoff valve and inlet door start to close when the APU speed decreases to 30 percent on all shutdowns except FIRE and OVERSPEED. The fuel shutoff valve and inlet door begin to close as soon as a FIRE or OVERSPEED shutdown begins.

Protective Shutdown Logic

An APU fuel valve shutdown occurs if the ECU commands the fuel shutoff valve closed and the ECU does not get a closed signal 29 seconds after the command. This fault makes the FAULT light come on and stay on until the fuel valve closes or you put the battery switch to the OFF position.

A DC powerloss shutdown occurs if ECU power is lost for more than 50 milliseconds and APU speed is more than 7 percent.

An ECU shutdown occurs when a failure of any ECU component that does not let the ECU detect or control APU operations. An example of this is a failure of the fuel torque motor driver.

A fire shutdown occurs if you pull one of the APU fire handles or if the fire detection system detects a fire.

An inlet door shutdown occurs if the ECU commands inlet door open and the ECU does not get an open signal from the inlet door position switch in 30 seconds. An inlet door shutdown also occurs if the door open signal is lost for 1 second after APU speed is more than 7 percent.

An inlet overheat shutdown occurs if the compressor inlet temperature is more than 350F (180C) for 3 seconds.

A loss of EGT shutdown occurs if both EGT thermocouples fail. Loss of one EGT thermocouple does not shutdown the APU.

A loss of speed shutdown occurs if both speed sensing circuits fail. Loss of one speed circuit does not shutdown the APU. A speed circuit includes the speed sensor, aircraft wiring and the ECU.

A no acceleration shutdown occurs if, after ignition and before 95 percent, acceleration is less than 0.2 percent per second for 12.5 seconds.

A no APU rotation shutdown occurs if speed is less than 7 percent 20 seconds after the ECU gives the start command to the SCU.

A no flame shutdown occurs if EGT change is less than 100F (38C) 23 seconds after the ECU commands the fuel solenoid valve open.

An oil filter shutdown occurs if these conditions occur:

- Oil temperature is more than 100F (38C)
- Both main engines are off for more than 90 seconds
- Airplane is on ground
- Starter-Generator Oil filter is clogged for more than 5 seconds.

A oil temperature shutdown occurs if the oil temperature is more than 300°F (149°C) for 10 seconds and the sensor is good.

An overtemperature shutdown occurs if the turbine inlet temperature or exhaust gas temperature goes too high. When APU speed is above 95 percent, the maximum turbine inlet temperature is 2200F (1204C). The ECU uses exhaust gas temperature to calculate turbine inlet temperature. When APU speed is less than 95 percent, the ECU uses these values to find the maximum exhaust gas temperature:

- APU speed
- Inlet temperature (T2)
- Inlet pressure (P2).

A reverse flow shutdown occurs if load compressor air flow decreases to approximately zero for 6 seconds. The ECU commands the BAV closed when the air flow decreases to approximately zero for one second. With the BAV closed, bleed air can not reverse flow from the airplane to the APU load compressor. This prevents most reverse flow shutdowns.

A sensor failure shutdown occurs if the inlet temperature (T2) or the oil temperature sensor fails and the airplane is on the ground.

An underspeed shutdown occurs if these conditions occur for 10 seconds:

- APU acceleration is less than 0.5 percent per second
- APU speed is less than 85 percent

- APU is not starting.
- The starter has a shorted rotating diode.

An overspeed protection shutdown occurs if the APU fails the overspeed circuit test. The ECU does the overspeed circuit test during APU shutdown.

An overspeed protection shutdown also occurs if the fuel solenoid valve fails in the open position. The fuel solenoid valve fails in the open position if these conditions occur:

- Power is removed from fuel solenoid valve for 10 seconds
- APU speed is more than 90 percent.

An overspeed shutdown occurs if the APU speed is more than 106 percent.

An oil pressure shutdown occurs if the APU is on speed and oil pressure is low for 20 seconds.

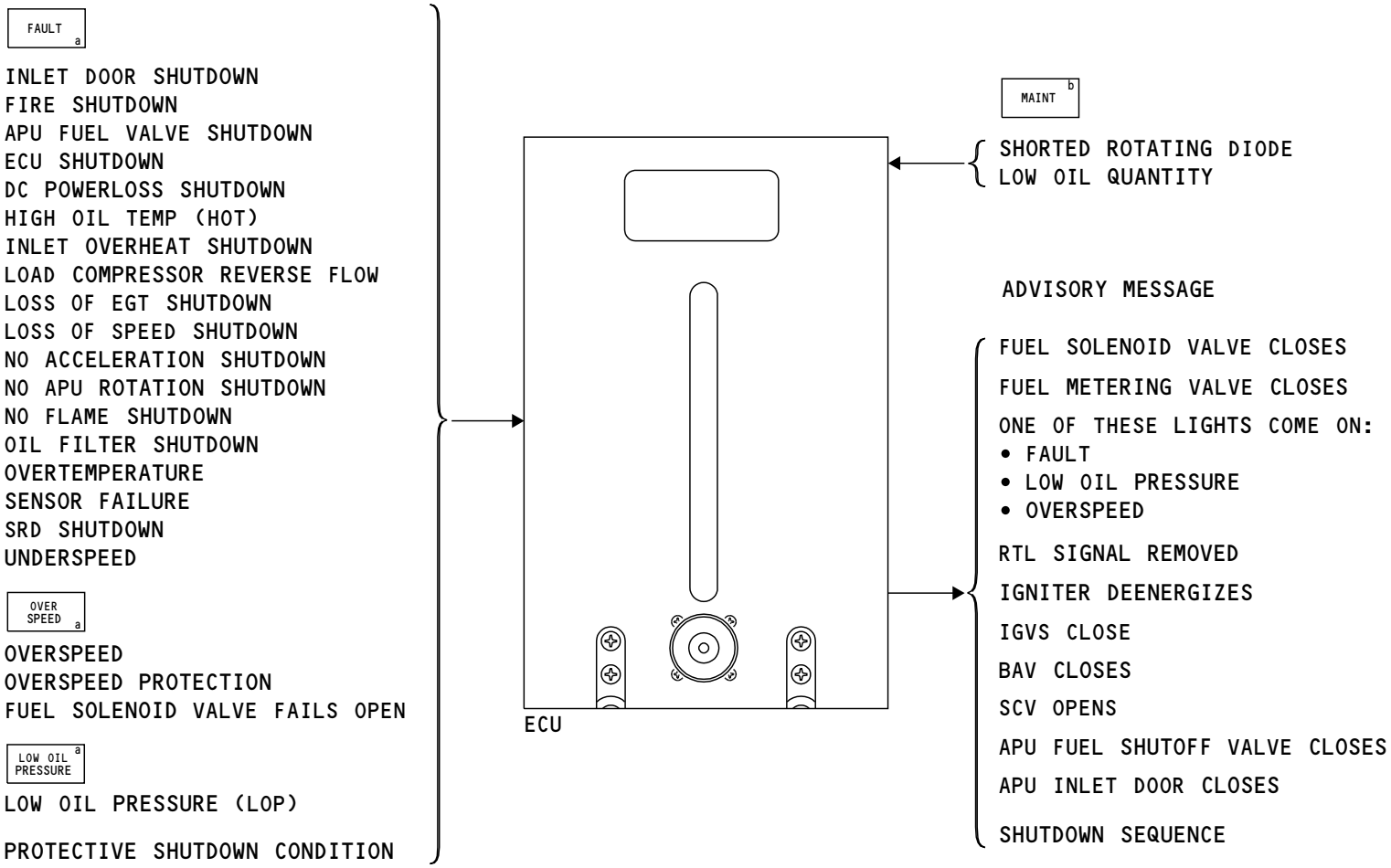
MAINT Light

The ECU uses the MAINT light to tell you when the starter-generator has a shorted rotating diode. Repair the starter-generator as soon as possible. You will not be able to start the APU until you enter STARTOK on the current status page scratch pad.

The ECU also uses the MAINT light to tell you the APU oil level is at low oil quantity (LOQ). When the oil level is at LOQ, there is enough oil in the APU for 30 - 50 hours of operation at the maximum oil consumption rate before the APU will shutdown because of low oil pressure. However, if there is an oil leak, the APU will not operate the 30 - 50 hours before a low oil pressure shutdown occurs. Add oil to the APU as soon as possible.

You can also use the ECU to deactivate the MAINT light because of incorrect low oil quantity (LOQ) indication. It is possible to deactivate the MAINT light.

APU CONTROLS - ELECTRONIC CONTROL UNIT - PROTECTION SYSTEM



1551468 S0000285323_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - PROTECTION SYSTEM

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - MAIN MENU

General

The APU built in test equipment (BITE) data shows on the control display unit (CDU).

To see the APU BITE TEST page you select the line select key next to APU on the MAINT BITE INDEX. To return to the MAINT BITE INDEX, you select the line select key next to INDEX. You also can select the INIT/REF key from any screen in APU CDU BITE to return to the MAINT BITE INDEX.

It can take up to 10 seconds for the first APU screen to show on the CDU. This delay occurs because the ECU does a power-up test each time it is energized.

APU Display on the CDU

APU data shows on one of these six pages:

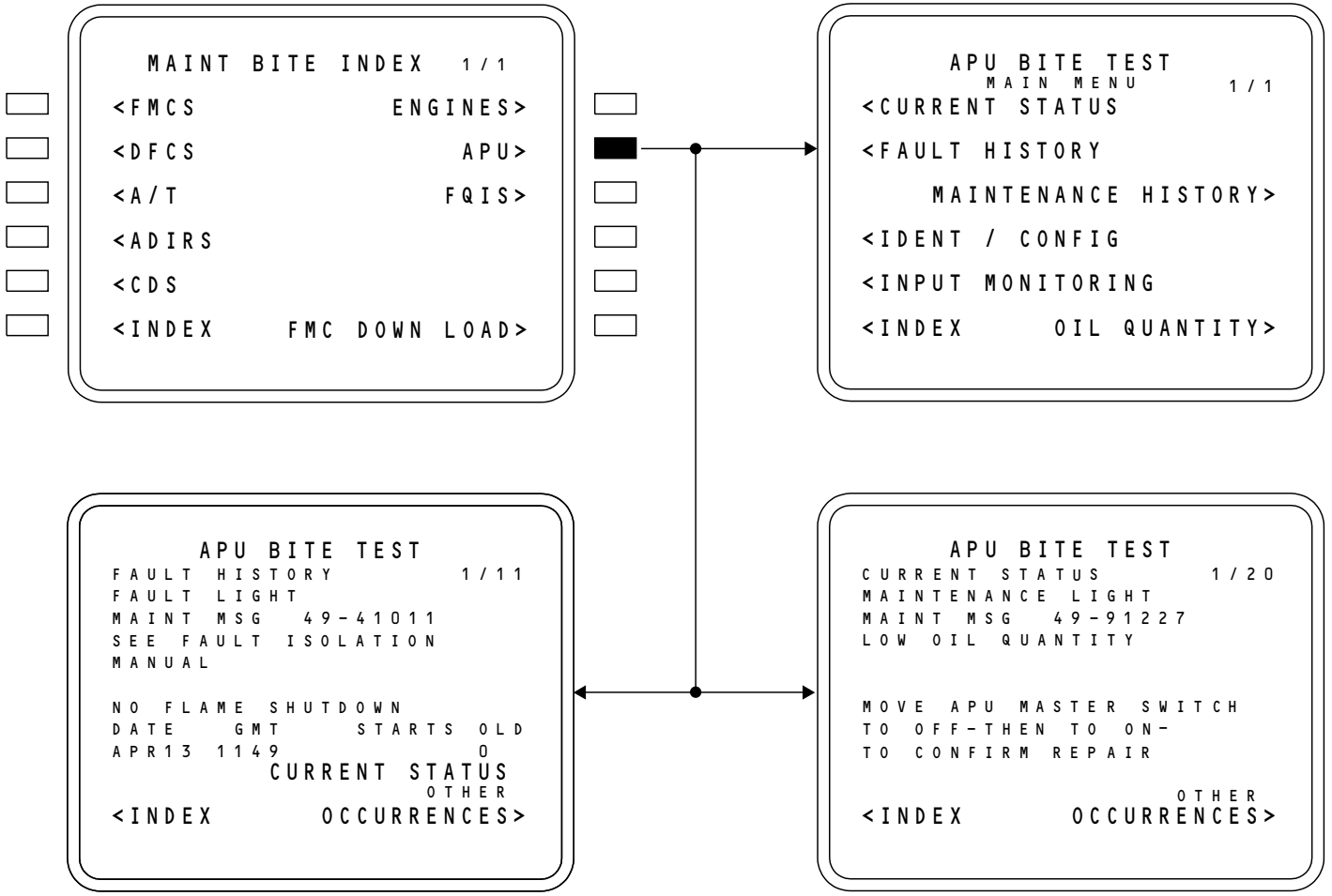
- CURRENT STATUS
- FAULT HISTORY
- MAINTENANCE HISTORY
- IDENT/CONFIG
- INPUT MONITORING
- OIL QUANTITY.

You see the MAIN MENU when you select APU from the MAINT BITE INDEX if the last APU shutdown was normal and the APU MAINT light is off.

You see the FAULT HISTORY page in place of the MAIN MENU if the last APU shutdown was a protective shutdown. FAULT HISTORY page gives the cause for the protective shutdown.

You see the CURRENT STATUS page in place of the MAIN MENU if the APU MAINT light is on and the last APU shutdown was normal. The CURRENT STATUS page gives the cause of the MAINT light.

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - MAIN MENU



M87563 S0004631532_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - MAIN MENU

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - CURRENT STATUS

General

The CURRENT STATUS page of APU CDU BITE shows the maintenance message the ECU finds for the last APU cycle. The maintenance message stays in the current status until the ECU tests the condition again and finds that it is satisfactory. There are over 200 possible maintenance messages.

The scratch pad is used to enter STARTOK to allow an APU start after any fault that inhibits the next APU start. The faults that inhibit the next APU start are:

- Shorted rotating diode
- Fuel control unit shows solenoid failed on
- ECU internal failure

One maintenance message shows on each page. The CDU shows the page number of the maintenance message in the upper right corner of the display followed by the total number of pages in CURRENT STATUS.

Select the line select key next to OTHER OCCURRENCES to see a list of other APU start attempts with the same maintenance message. If there are no other APU start attempts with the same maintenance message, the ECU shows NO OTHER OCCURRENCES when you select the OTHER OCCURRENCES line select key.

Select the line select key next to INDEX to go to the APU MAIN MENU.

The CURRENT STATUS page gives the following information about the maintenance message:

- Flight deck effect
- Maintenance message number
- Description of the maintenance message
- Instructions for how to verify the repair if the ECU can not test the condition in the current mode.

These are the possible flight deck effects:

- APU GEN OFF BUS LIGHT
- FAULT LIGHT
- LOW OIL PRESSURE LIGHT
- MAINT LIGHT
- NO BLEED
- NO FLIGHT DECK EFFECT
- OVERSPEED LIGHT
- UNKNOWN FLT DECK EFFECT

APU GEN OFF BUS LIGHT

The flight deck effect shows APU GEN OFF BUS LIGHT if the maintenance message causes the APU GEN OFF BUS light to come on.

FAULT LIGHT

The flight deck effect shows FAULT LIGHT if the maintenance message causes the FAULT light to come on.

LOW OIL PRESSURE LIGHT

The flight deck effect shows LOW OIL PRESSURE LIGHT if the maintenance message causes the LOW OIL PRESSURE light to come on. During start the LOW OIL PRESSURE light is on.

MAINT LIGHT

The flight deck effect shows MAINT LIGHT if the maintenance message causes the MAINT light to come on.

NO BLEED

The flight deck effect shows NO BLEED if the ECU disables APU bleed.

NO FLIGHT DECK EFFECT

The flight deck effect shows NO FLIGHT DECK EFFECT if the maintenance message does not cause a flight deck effect.

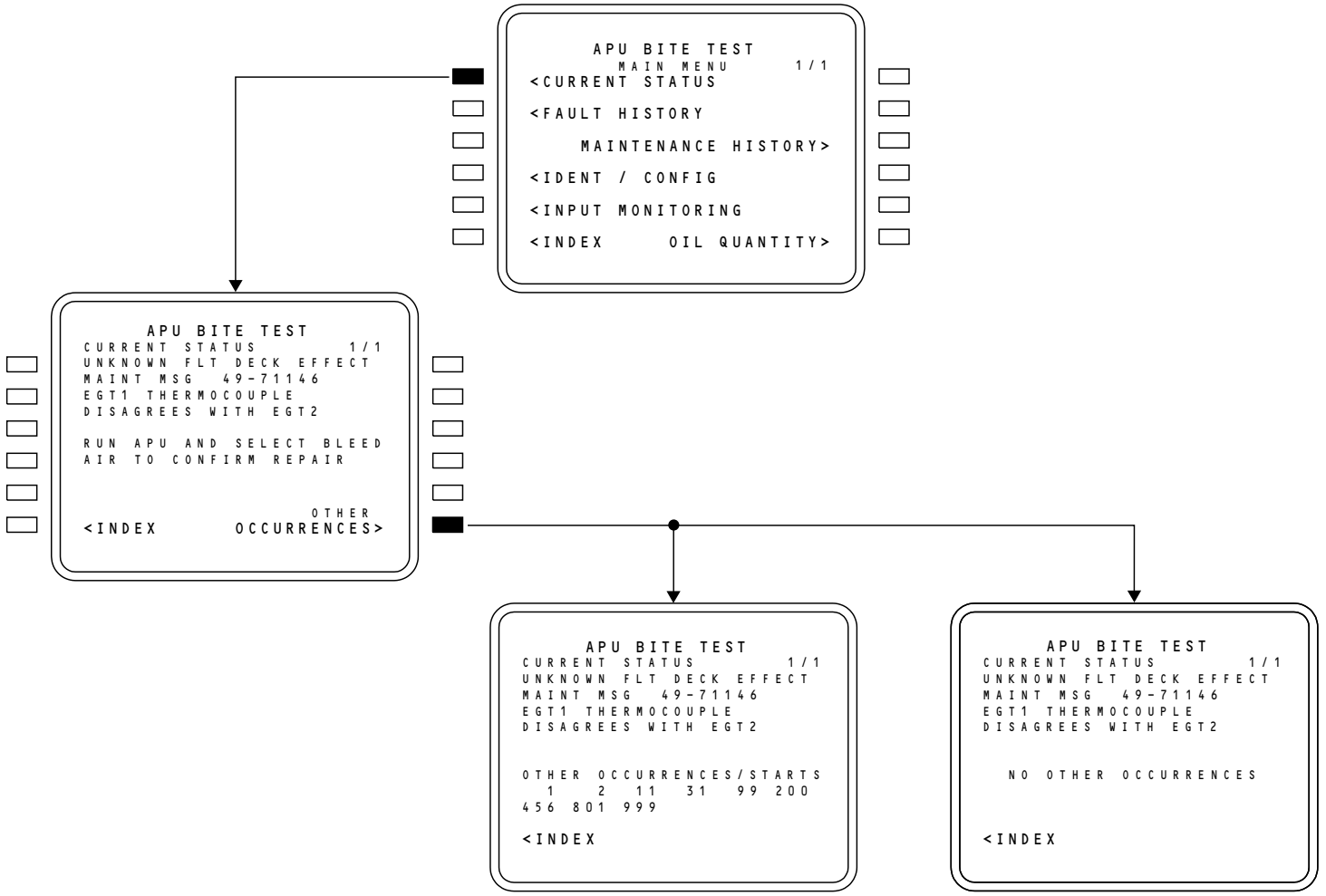
OVERSPEED LIGHT

The flight deck effect shows OVER SPEED LIGHT if the maintenance message causes the OVER SPEED light to come on.

UNKNOWN FLT DECK EFFECT

The flight deck effect shows UNKNOWN FLT DECK EFFECT if the maintenance message does not always cause a flight deck effect.

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - CURRENT STATUS



M87564 S0004631534_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - CURRENT STATUS

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - FAULT HISTORY

General

The FAULT HISTORY page of APU CDU BITE shows the cause for an APU protective shutdown. THE ECU stores up to 30 protective shutdowns that are up to 999 starts old.

Each occurrence of a protective shutdown shows on a page. The CDU shows the page number of the protective shutdown in the upper right corner of the display followed by the total number of pages in FAULT HISTORY.

Select the NEXT PAGE button on the CDU key pad to go to the next page. Select the PREV PAGE on the CDU key pad to go to the previous page.

If you see > next to CURRENT STATUS the ECU found the maintenance message that causes this shutdown on a CURRENT STATUS page. To see the current status page select CURRENT STATUS.

Select OTHER OCCURRENCES to see a list of other APU start attempts with the same protective shutdown. If there are no other APU start attempts with the same protective shutdown, the ECU shows NO OTHER OCCURRENCES when you select the OTHER OCCURRENCES line select key.

Select INDEX to go to the MAIN MENU.

The FAULT HISTORY page gives the following information about the protective shutdown:

- Flight deck effect
- Maintenance message number(s)
- Description of up to two maintenance messages that the ECU found causes the protective shutdown
- Protective shutdown name
- Date of the shutdown
- Time of the shutdown in Greenwich mean time
- Start attempts old.

These are the possible flight deck effects:

- FAULT LIGHT
- LOW OIL PRESSURE LIGHT
- OVERSPEED LIGHT.

FAULT LIGHT

The flight deck effect shows FAULT LIGHT if the maintenance message causes the FAULT light to come on.

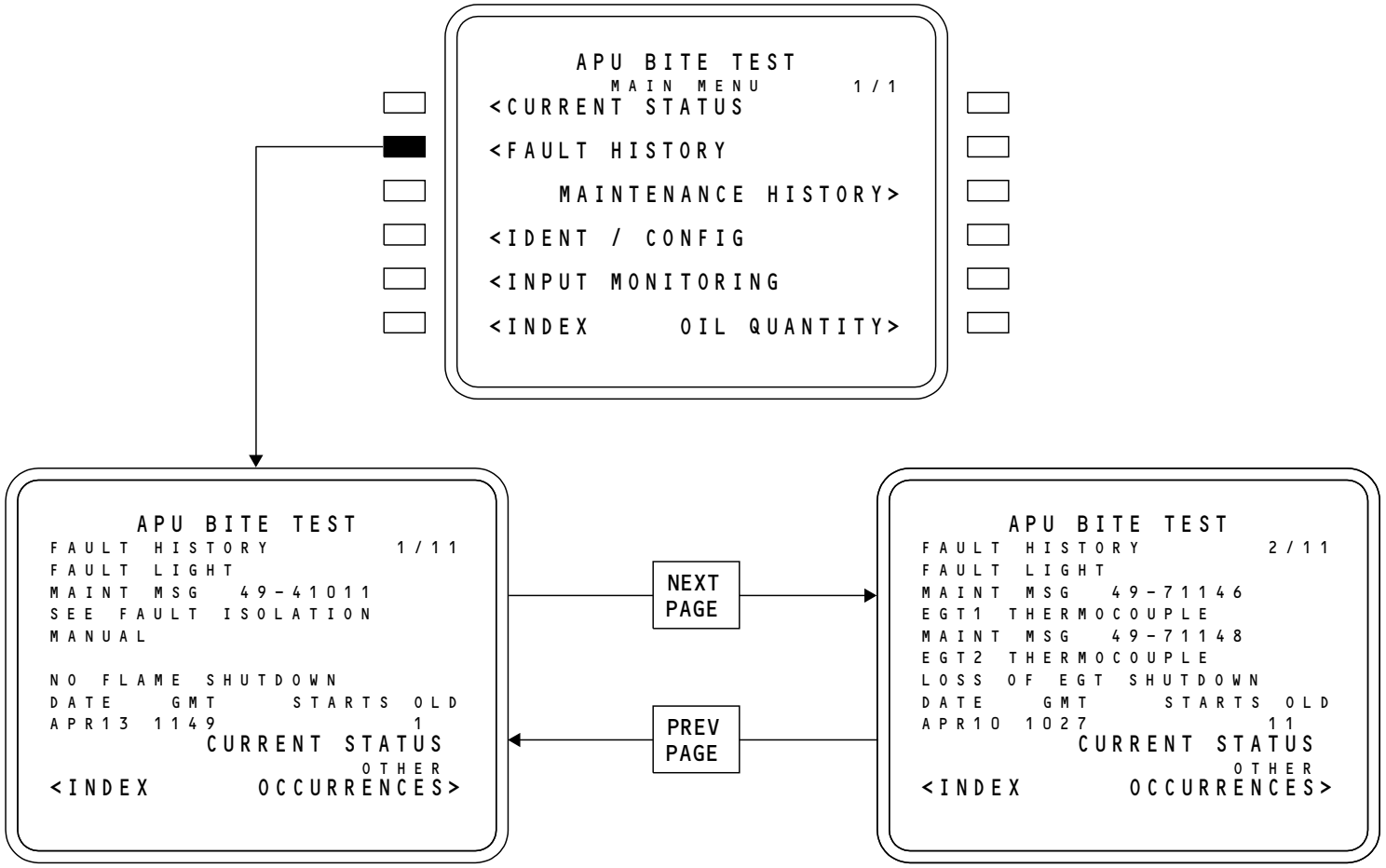
LOW OIL PRESSURE LIGHT

The flight deck effect shows LOW OIL PRESSURE LIGHT if the maintenance message causes the LOW OIL PRESSURE light to come on.

OVERSPEED LIGHT

The flight deck effect shows OVERSPEED LIGHT if the maintenance message causes the OVERSPEED light to come on.

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - FAULT HISTORY



M87565 S0004631536_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - FAULT HISTORY

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - MAINTENANCE HISTORY

General

The MAINTENANCE HISTORY page of Auxiliary Power Unit (APU) Built-In-Test Equipment (BITE) TEST shows maintenance messages that are current or have occurred in the past. The Electronic Control Unit (ECU) stores up to 99 maintenance messages that are up to 999 start attempts old.

Each occurrence of a maintenance message shows on a page. The Control Display Unit (CDU) shows the current page number in the upper right corner of the display. After this number you see the total number of pages in MAINTENANCE HISTORY.

If you see > next to CURRENT STATUS the ECU found the maintenance message on a CURRENT STATUS page. To see the current status page select the line select key next to CURRENT STATUS.

The MAINTENANCE HISTORY page gives the following information about the maintenance messages:

- Flight deck effect
- Maintenance message number
- Description of the maintenance message
- Date maintenance message occurred
- Time maintenance message occurred in Greenwich Mean Time
- Start attempts old.

These are the possible flight deck effects:

- APU GEN OFF BUS LIGHT
- FAULT LIGHT
- LOW OIL PRESSURE LIGHT
- MAINT LIGHT
- NO BLEED
- NO FLIGHT DECK EFFECT
- OVERSPEED LIGHT
- UNKNOWN FLT DECK EFFECT.

Select the line select key next to OTHER OCCURRENCES to see a list of other APU start attempts with the same maintenance message. If there are no other APU start attempts with the same condition, the ECU shows NO OTHER OCCURRENCES when you select the OTHER OCCURRENCES line select key.

APU GEN OFF BUS LIGHT

The flight deck effect shows APU GEN OFF BUS LIGHT if the maintenance message causes the APU GEN OFF BUS light to come on.

FAULT LIGHT

The flight deck effect shows FAULT LIGHT if the maintenance message causes the FAULT light to come on.

LOW OIL PRESSURE LIGHT

The flight deck effect shows LOW OIL PRESSURE LIGHT if the maintenance message causes the LOW OIL PRESSURE light to come on.

MAINT LIGHT

The flight deck effect shows MAINT LIGHT if the maintenance message causes the MAINT light to come on.

NO BLEED

The flight deck effect shows NO BLEED if APU bleed is not available because of a failure sensed by the ECU.

NO FLIGHT DECK EFFECT

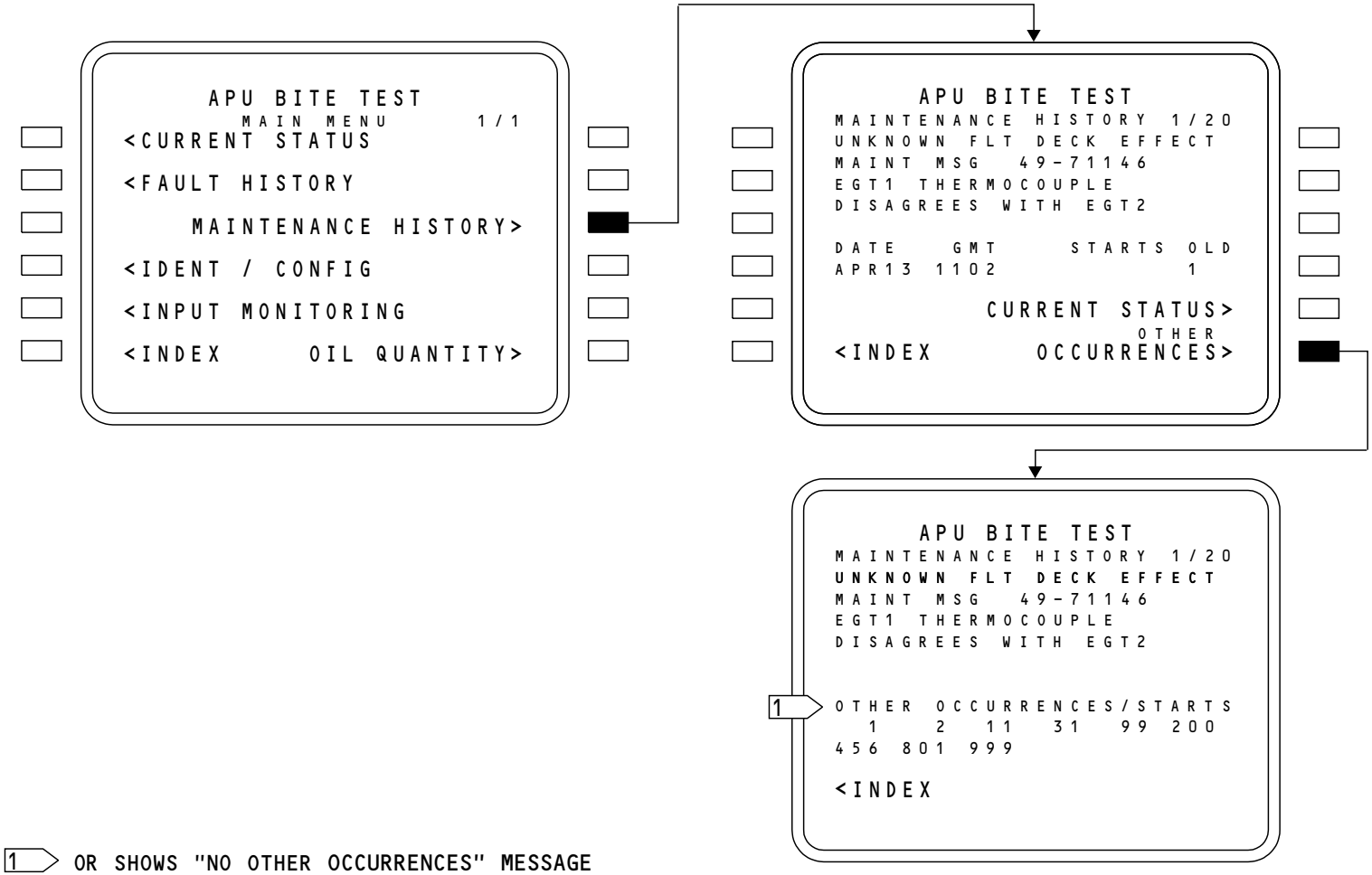
The flight deck effect shows NO FLIGHT DECK EFFECT if the maintenance message does not cause a flight deck effect.

OVERSPEED LIGHT

The flight deck effect shows OVERSPEED LIGHT if the maintenance message causes the OVER SPEED light to come on.

UNKNOWN FLT DECK EFFECT

The flight deck effect shows UNKNOWN FLT DECK EFFECT if the maintenance message does not always cause a flight deck effect.



1 OR SHOWS "NO OTHER OCCURRENCES" MESSAGE

M87566 S0004631538_V1

General

The IDENT/CONFIG page of APU BITE TEST shows APU and ECU configuration and identification data. There are two pages of this data. Page one shows the APU data. Page two shows ECU data.

The CDU shows the page number in the upper right corner of the display. Next to this number you see the total number of pages in IDENT/CONFIG.

IDENT/CONFIG Page 1

The IDENT/CONFIG page 1 gives this APU identification and configuration data:

- APU serial number
- APU hours
- APU cycles
- APU hours since installation on airplane.

You reset the APU hours since installation on the airplane when you select the line select key next to RESET HOURS SINCE INSTALLATION. You should reset the hours since installation when you replace the APU.

APU Hours and APU Cycles have a maximum value of 65,535. When at the maximum value, the value shows zero and will start to count from zero, or show 65,535. If the value starts at zero, to get an accurate count, you must add the value shown to 65,535 for the total value.

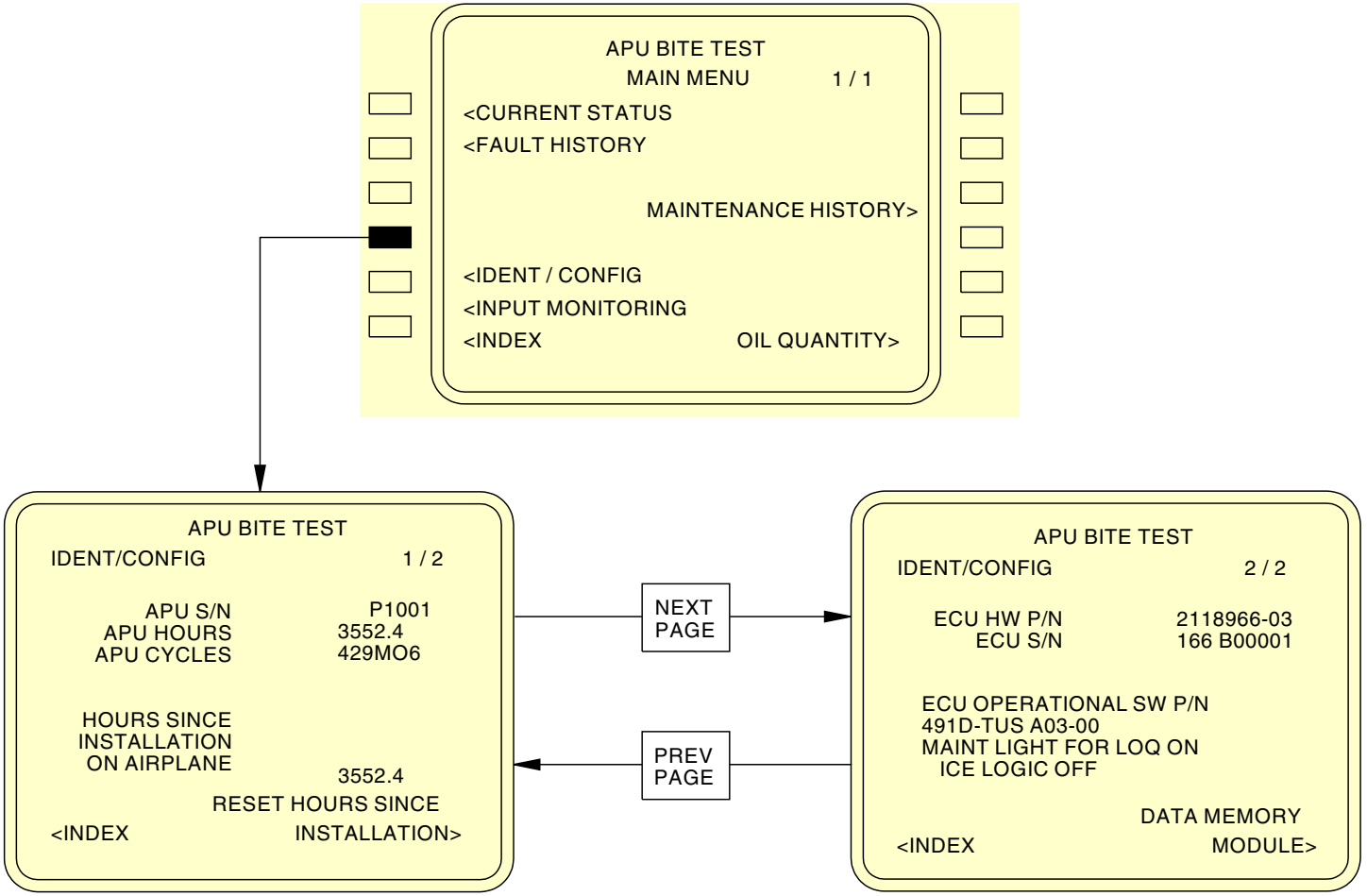
IDENT/CONFIG Page 2

The IDENT/CONFIG page 2 gives this data about the ECU:

- ECU part number
- ECU serial number
- ECU operational software part number
- Maintenance light for low oil quantity on/off
- Ice logic on/off

You select the line select key next to DATA MEMORY MODULE to see the data stored in the data memory module (DMM). There are 12 pages of DMM data. The DMM records data about the health of the APU. This data is used during overhaul and is not needed for line maintenance. The DMM data is not shown here.

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - IDENT CONFIG



1551469 S0000285325_V2

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - IDENT CONFIG

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - INPUT MONITORING

General

The INPUT MONITORING page of APU BITE TEST shows APU and airplane interface data. You use this data for troubleshooting of the APU and APU interfaces.

The CDU shows the page number in the upper right corner of the display. The second number is the total number of pages in INPUT MONITORING.

INPUT MONITORING Page 1

INPUT MONITORING page 1 shows this APU data:

- SPEED (the speed the APU turns)
- EGT (exhaust gas temperature)
- IGV POSITION (inlet guide vane position with 90 degrees as open)
- SCV POSITION (surge control valve position with 90 degrees as full closed)
- DELTA PRESS (differential pressure in bleed duct)
- TOTAL PRESS (total pressure in bleed duct)
- INLET PRESS (APU air inlet pressure)
- INLET TEMP (APU air inlet temperature)
- FUEL TMC (fuel control unit metering valve torque motor current)
- FUEL FLOW.

INPUT MONITORING Page 2

INPUT MONITORING page 2 shows this APU data:

- OIL TEMP (APU oil temperature)
- FUEL TEMP (APU fuel temperature)
- GENERATOR LOAD (starter-generator load)
- START SWITCH (APU switch in START position, YES/NO)
- APU ON SWITCH (APU switch in ON position, YES/NO)
- APU OFF SWITCH (APU switch in OFF position, YES/NO)
- MES SWITCH(S) (main engine start switch positions, OFF/1/2/BOTH)
- AIR/GROUND (airplane in air or on ground, AIR/GRD)
- LEFT PACK (left pack mode, OFF/LOW/HIGH)
- RIGHT PACK (right pack mode, OFF/LOW/HIGH).

INPUT MONITORING Page 3

INPUT MONITORING page 3 shows this APU data:

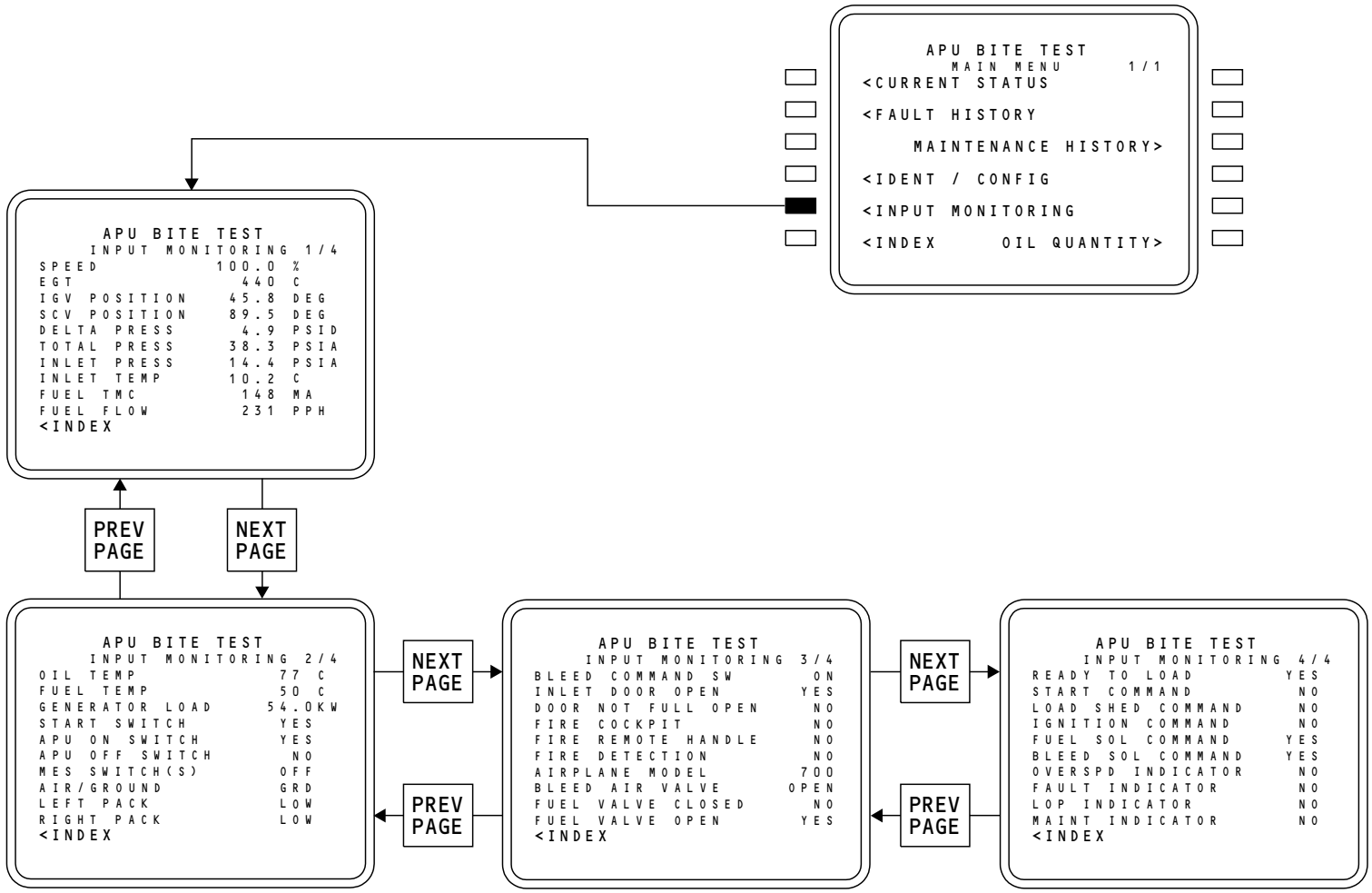
- BLEED COMMAND SW (APU bleed switch position, ON/OFF)
- INLET DOOR OPEN (APU air inlet door open, YES/NO)
- DOOR NOT FULL OPEN (APU air inlet door not full open, YES/NO)
- FIRE COCKPIT (flight compartment fire handle pulled, YES/NO)
- FIRE REMOTE HANDLE (remote fire handle pulled, YES/NO)
- FIRE DETECTION (fire detected by fire detection system, YES/NO)
- AIRPLANE MODEL (600/700/800/900)
- BLEED AIR VALVE (bleed air valve position, OPEN/CLOSE)
- FUEL VALVE CLOSED (fuel shutoff valve in closed position, YES/NO)
- FUEL VALVE OPEN (fuel shutoff valve in open position, YES/NO).

INPUT MONITORING Page 4

INPUT MONITORING page 4 shows this APU data:

- READY TO LOAD (APU ready to load, YES/NO)
- START COMMAND (start command to SCU on, YES/NO)
- LOAD SHED COMMAND (load shed command on, YES/NO)
- IGNITION COMMAND (ignition command on, YES/NO)
- FUEL SOL COMMAND (fuel solenoid valve command on, YES/NO)
- BLEED SOL COMMAND (bleed air valve command on, YES/NO)
- OVERSPD INDICATOR (OVER SPEED light on, YES/NO)
- FAULT INDICATOR (FAULT light on, YES/NO)
- LOP INDICATOR (LOW OIL PRESSURE light on, YES/NO)
- MAINT INDICATOR (MAINT light on, YES/NO).

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - INPUT MONITORING



M87568 S0004631542_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - INPUT MONITORING

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - OIL QUANTITY

General

The OIL QUANTITY page of APU BITE TEST shows the APU oil quantity. The oil quantity page shows three APU oil levels. These levels are:

- FULL
- ADD
- LOW.

The OIL QUANTITY page of APU BITE TEST shows two status messages for the APU oil quantity. These messages are:

- WAIT
- UNKNOWN.

There is approximately 171 APU hours at normal oil consumption rate from full on the oil level sight glass until ADD is displayed on the CDU. There is approximately 9 hours of APU operation at the maximum oil consumption rate from full on the oil level sight glass until ADD is displayed on the CDU.

ADD level first shows when the APU has approximately 60 hours of APU operation at normal oil consumption rate until the APU MAINT light comes on. At the maximum oil consumption rate, there is approximately 3 hours of APU operation from ADD until the APU MAINT light comes on.

LOW level first shows when there is approximately 365 hours of APU operation at normal oil consumption rate until the APU does a protective shutdown caused by low oil pressure. At the maximum oil consumption rate, there is approximately 19 hours of APU operation from when LOW first shows until the APU does a low oil pressure protective shutdown.

NOTE: The low oil quantity (LOQ) maintenance light will come on when there is enough oil in the APU for 30-50 hours of operation at the maximum oil consumption rate before the APU will shutdown because of low oil pressure.

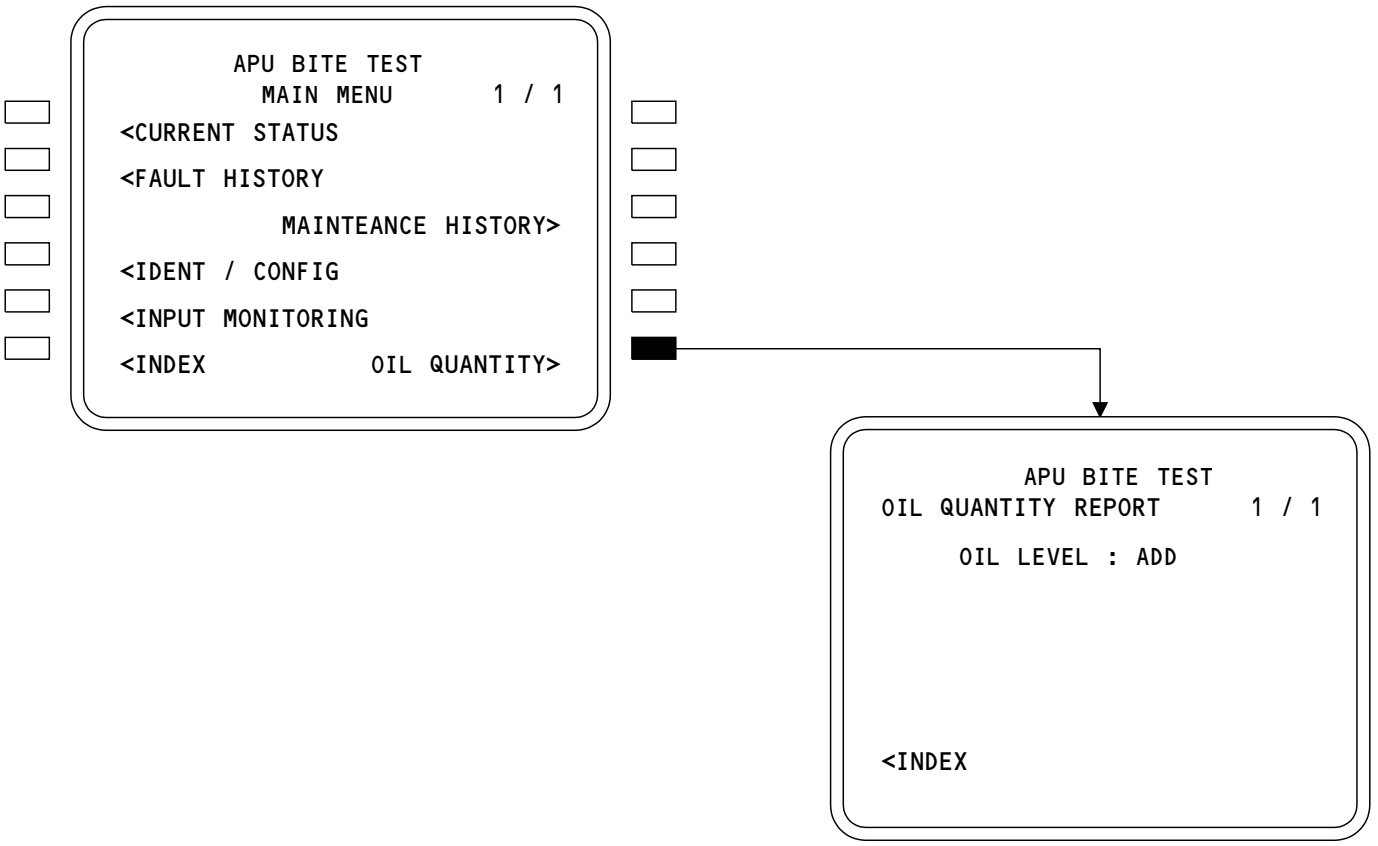
NOTE: The maximum oil consumption rate is calculated with the APU oil quantity from full on the oil level sight glass to ADD on the CDU, and the longest flight possible.

The ECU checks the APU oil level when the ECU is energized or when a you begin a start and when the airplane is on the ground. The oil quantity check is done before the APU begins to rotate.

WAIT will show with a countdown from 120 seconds after the APU is shutdown. When the countdown is over or the oil quantity becomes measurable, the oil quantity will be displayed.

UNKNOWN will show when the oil quantity can't be determined. These conditions are:

- After the APU has operated for one hour
- When in flight
- When the APU is started in flight
- During a sensor failure
- When main engines and APU are operating on the ground.



1551466 S0000285328_V1

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINT - ICE LOGIC

General

The IDENT/CONFIG page 2 shows the status of the ICE LOGIC for the ECU. The status messages are:

- ICE LOGIC ON
- ICE LOGIC OFF.

When the ice logic is selected on, the inlet guide vanes are swept at a regular interval when the temperature is near freezing to prevent ice from forming and freezing the vanes in place. During the sweep of the inlet guide vanes, it is normal to hear a change in the APU sound.

ICE CONFIG

NOTE: The ICE CONFIG is also known as the APU ECU Ice Breaker Logic (IBL).

Transition (when the APU is moving from one mode to another, for example RTL to ECS):

- When T2 < 52°F (11°C) and when position error is detected which keeps the IGVs from moving, there will be no noticeable effects, but the IGVs will be commanded partially open and closed indefinitely unless APU is shutdown, or until the IGVs move to their commanded position.

Ready to Load (APU on, APU Bleed Switch off):

- When T2 < 52°F (11°C) there will be a small noise increase for 2 seconds every 60 seconds due to small IGV commanded movements. This noise is due to a small sweep (+7 degrees and back to RTL position) that serves to detect if vanes are stuck.

Duct Pressurization and ECS modes (APU on, APU Bleed Switch on, R&L Packs on or off):

- When T2 < 52°F (11°C) and when ice is accumulating on the IGVs, there will be an audible “whoosh” for 3 seconds every 60 seconds noticeable in and around the aircraft. This noise is due to the IGVs being commanded full open and back to original position under this weather and ice condition. Correspondingly, the additional air flowing through the load compressor goes downstream to the Air Cycle Machine (ACM), and the resulting spooling up and down of the ACM creates the audible difference. This feature will automatically turn off when the APU is shutdown or when MES is attempted.

MES mode will not be affected. In-flight operations will not be affected.

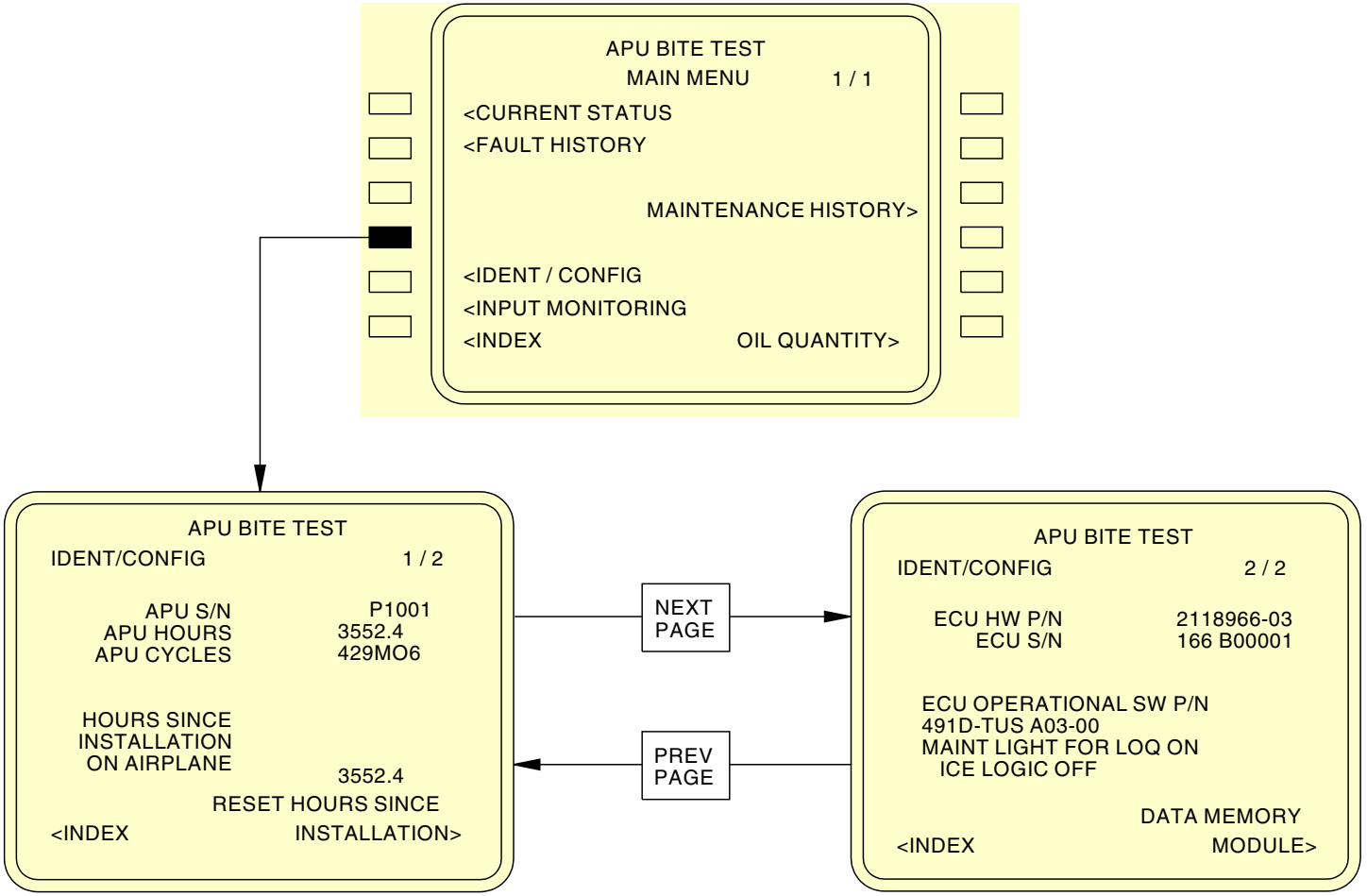
The IBL option may be turned on and off from the CDU Ident./Config. page 2. The on/off toggle will be shown at all times on Line 11 of the CDU. Line 11 will read one of the following messages:

- ICE LOGIC ON
- ICE LOGIC OFF

The IBL Scratch Pad Entries for turning this feature on and off will be typed into Line 14 with wording as follows:

- ICELOGICON
- ICELOGICOFF

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINT - ICE LOGIC



1551469 S0000285325_V2

APU CONTROLS - ELECTRONIC CONTROL UNIT - TRAINING INFORMATION POINTS - ICE LOGIC

APU CONTROLS - SPEED SENSOR

Purpose

A dual-coil speed sensor measures APU shaft speed and supplies two independent speed signals to the ECU.

Location

The speed sensor is on the right side of the compressor case.

Functional Description

The speed sensor is a variable reluctance motion sensor. The sensor sends a signal with a frequency proportional to engine speed. The ECU selects the higher of the two signals for control and display functions.

Control

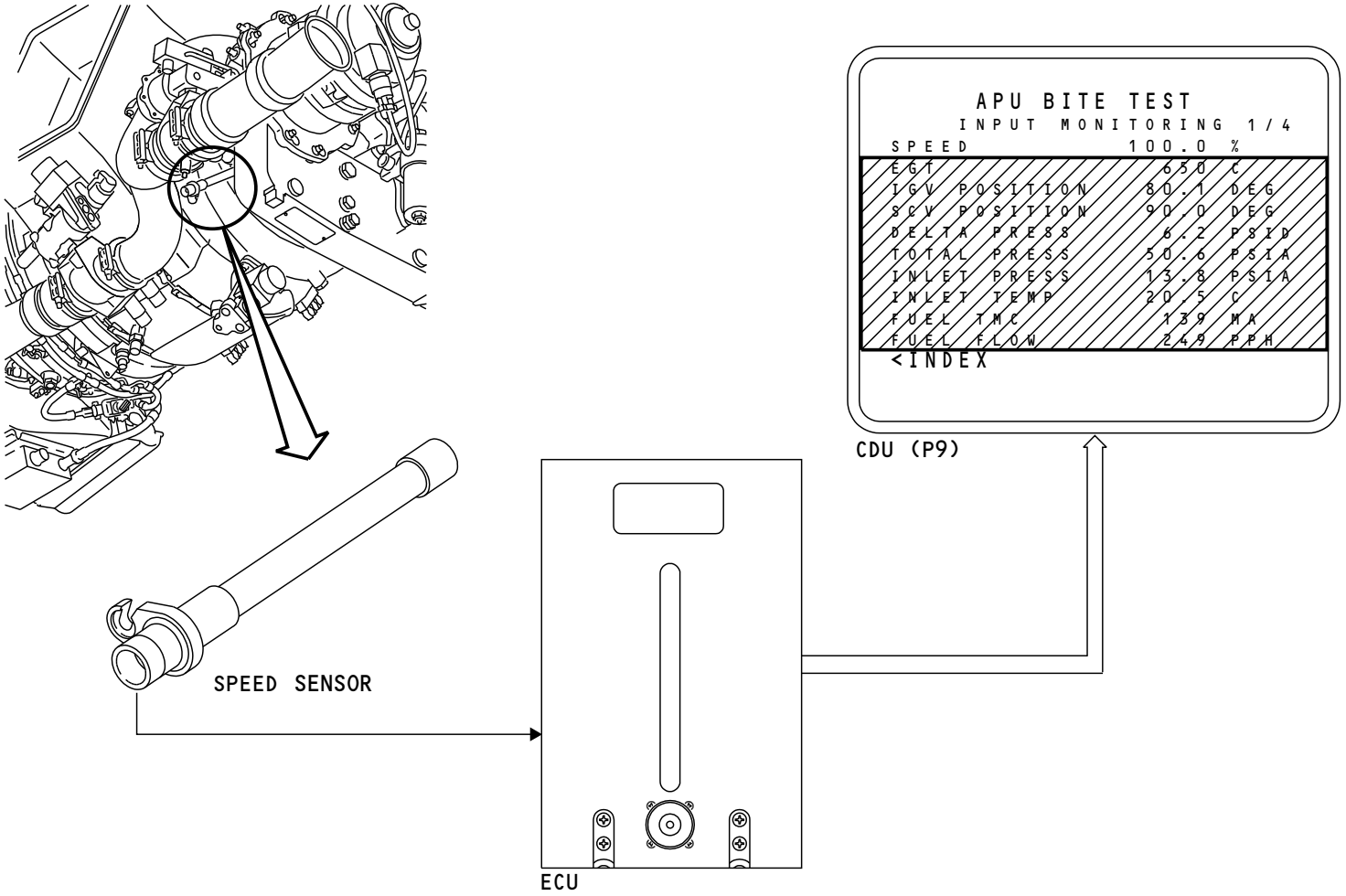
The ECU uses engine speed to control these functions:

- Ignition system control
- Starter system control
- Fuel system control
- APU speed control
- Overspeed automatic shutdown protection
- No-acceleration automatic shutdown protection.
- APU ready-to-load (RTL).

Indications

APU engine speed shows on the control display unit (CDU) input monitoring.

APU CONTROLS - SPEED SENSOR



M87561 S0004631546_V1

APU CONTROLS - SPEED SENSOR

Inlet Temperature Sensor

The inlet temperature sensor supplies inlet air temperature data (T2). The ECU uses this data for these functions:

- Fuel control
- IGV control
- SCV control
- EGT trim schedule (ECS and MES modes)
- Inlet overheat.

Location

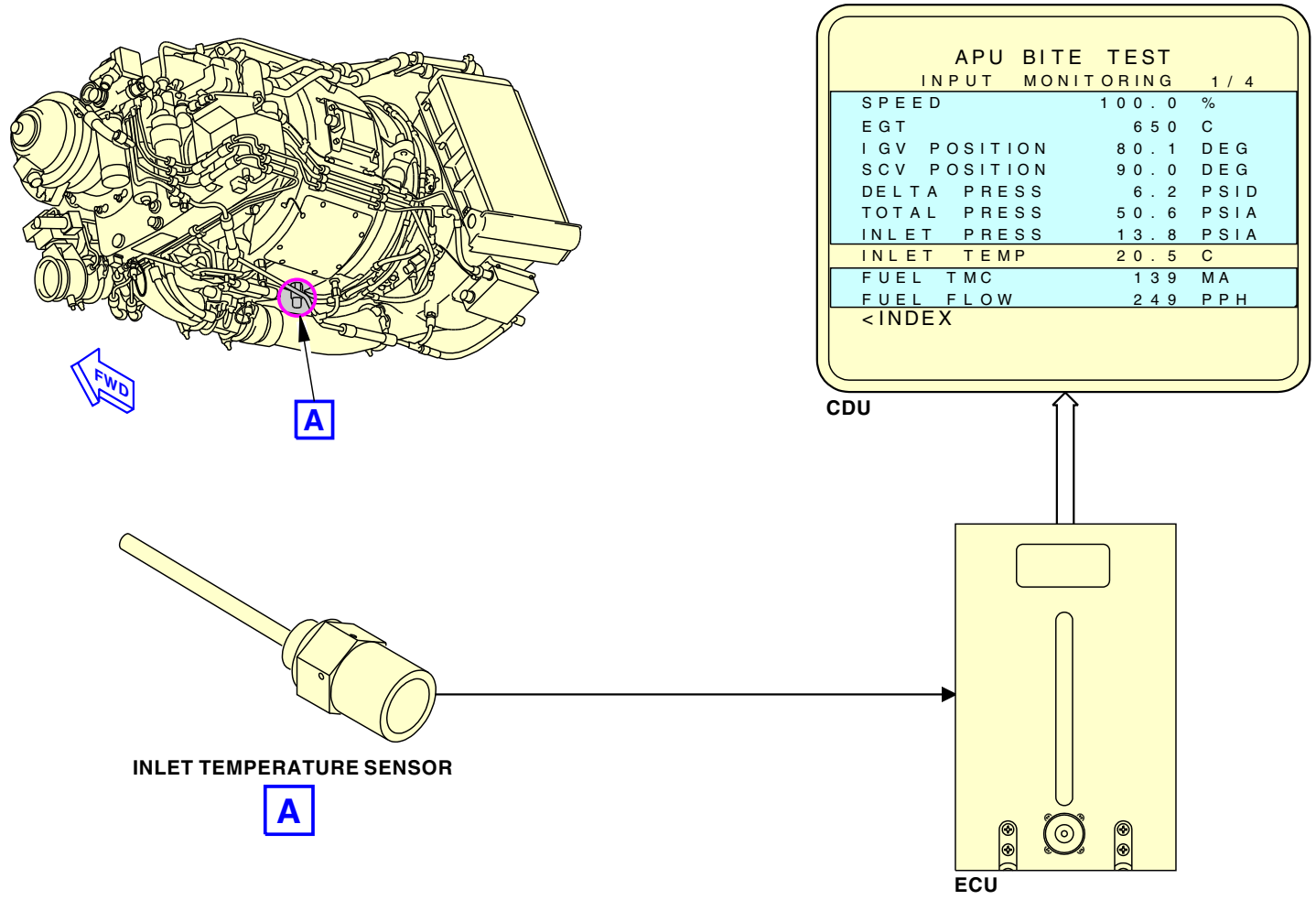
The inlet temperature sensor is on the bottom of the APU compressor plenum.

Functional Description

The inlet temperature sensor is a resistive temperature device (RTD). When the air temperature into the inlet of the compressor changes, the resistance changes in the sensor. The ECU senses this change in resistance. The ECU adjusts the APU operation due to that temperature change.

The ECU also sends the temperature to the control display unit (CDU) in the flight compartment.

APU CONTROLS - INLET TEMPERATURE SENSOR T2



M87562 S0004631548_V2

APU CONTROLS - INLET TEMPERATURE SENSOR T2

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU INDICATING SYSTEM - EGT INDICATION

Purpose

The Auxiliary Power Unit (APU) exhaust gas temperature indicating system supplies APU exhaust gas temperature data for flight compartment indication and APU control.

Location

Two chromel/alumel thermocouples are on the bottom of the exhaust section. Each thermocouple has two temperature sensing junctions. The thermocouples are close together, but the tips in the exhaust stream are 60 degrees apart.

Functional Description

The Electronic Control Unit (ECU) receives temperature inputs from the two thermocouples. The ECU uses the highest temperature for indication and control.

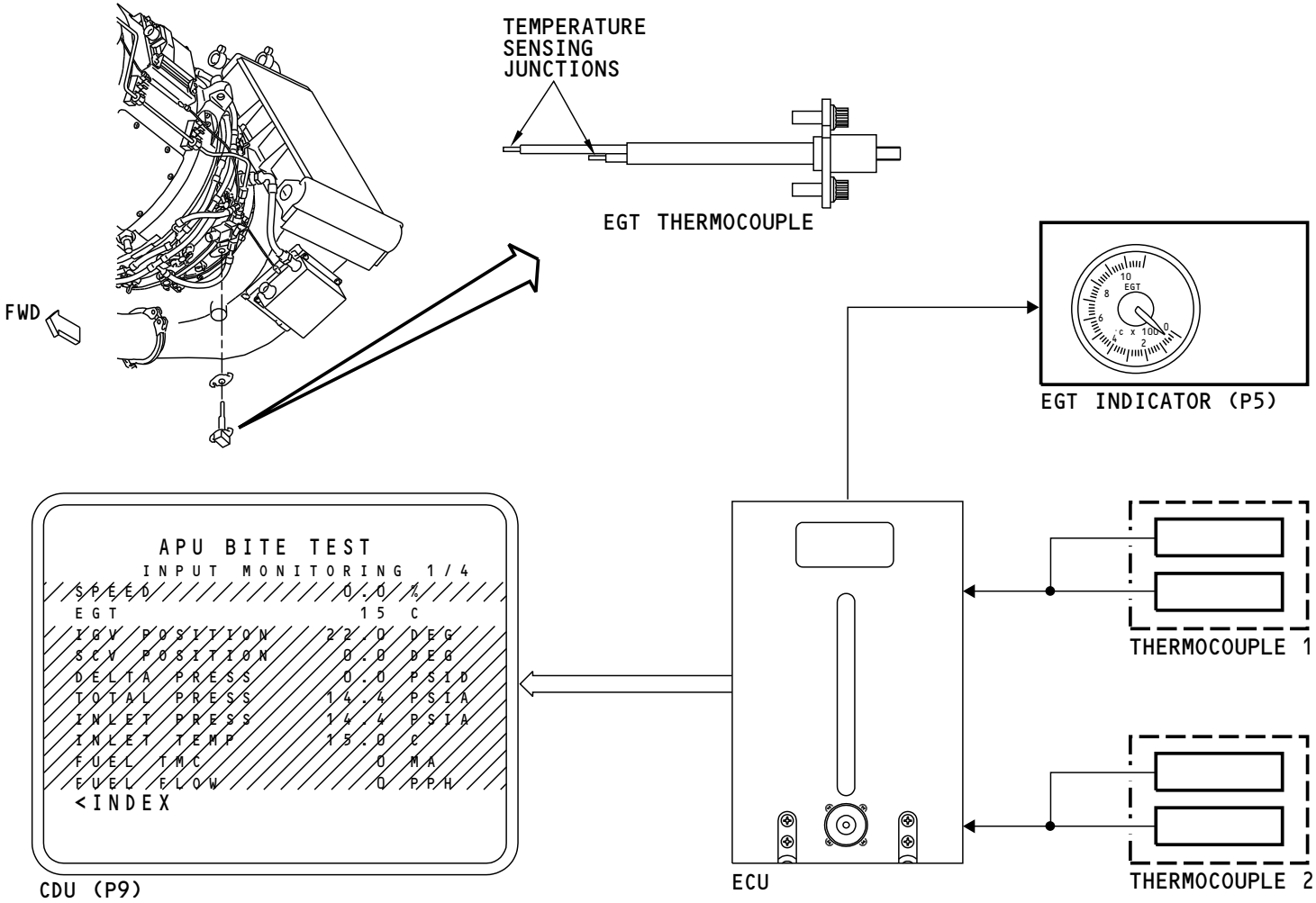
Indication

The APU Exhaust Gas Temperature (EGT) is on the EGT indicator on the P5 panel and on the Control Display Unit (CDU).

Training Information Point

Loss of input from one thermocouple does not cause the loss of EGT indication. Loss of EGT input from both thermocouples causes loss of indication. EGT overtemperature or loss of EGT from both thermocouples cause an APU protective shutdown.

APU INDICATING SYSTEM - EGT INDICATION



M87570 S0004631552_V1

APU INDICATING SYSTEM - EGT INDICATION

APU INDICATING SYSTEM - DATA MEMORY MODULE (DMM)

Purpose

The data memory module (DMM) keeps this APU data in non-volatile memory:

- APU health data
- APU operating hours
- APU serial number
- APU turbine life used
- Number of APU starts
- Shutdown data
- Start data.

The DMM keeps this APU data so that APU engine data stays with the APU engine.

General Description

The ECU controls the data that goes in the DMM. The ECU reads the DMM memory during the APU start sequence and gives updated information to the DMM during APU shutdown. The control display unit (CDU) shows APU parameters that are in the DMM.

Location

The DMM is on the left side of the APU.

Training Information Point

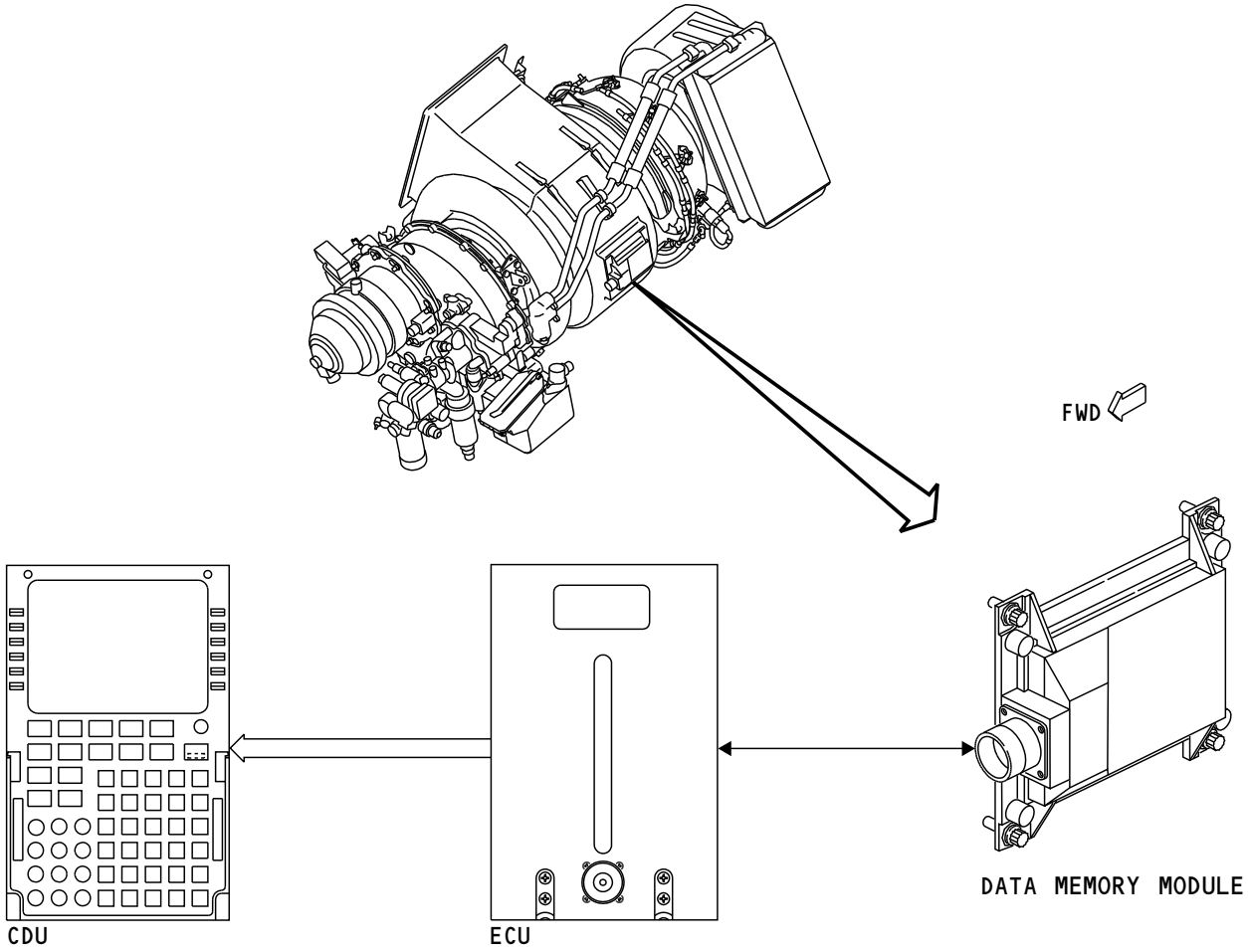
You read DMM data with special test equipment or with the CDU.

Replacement of the ECU does not cause loss of the data that is in the DMM.

Do not remove the data memory module at the same time you remove the ECU. Loss of data will result.

If you replace the data memory module, you must replace it with a blank module (a module with no data in memory). If you replace it with one that has data, loss of data and incorrect data can occur.

APU INDICATING SYSTEM - DATA MEMORY MODULE (DMM)



M87571 S0004631554_V1

APU INDICATING SYSTEM - DATA MEMORY MODULE (DMM)

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU EXHAUST SYSTEM - EXHAUST DUCT

Purpose

The APU exhaust system sends the APU exhaust overboard through the exhaust duct. The exhaust system prevents APU compartment damage from high exhaust gas temperatures and decreases exhaust noise levels.

Components

The APU exhaust duct attaches to the APU turbine section with a V-band clamp.

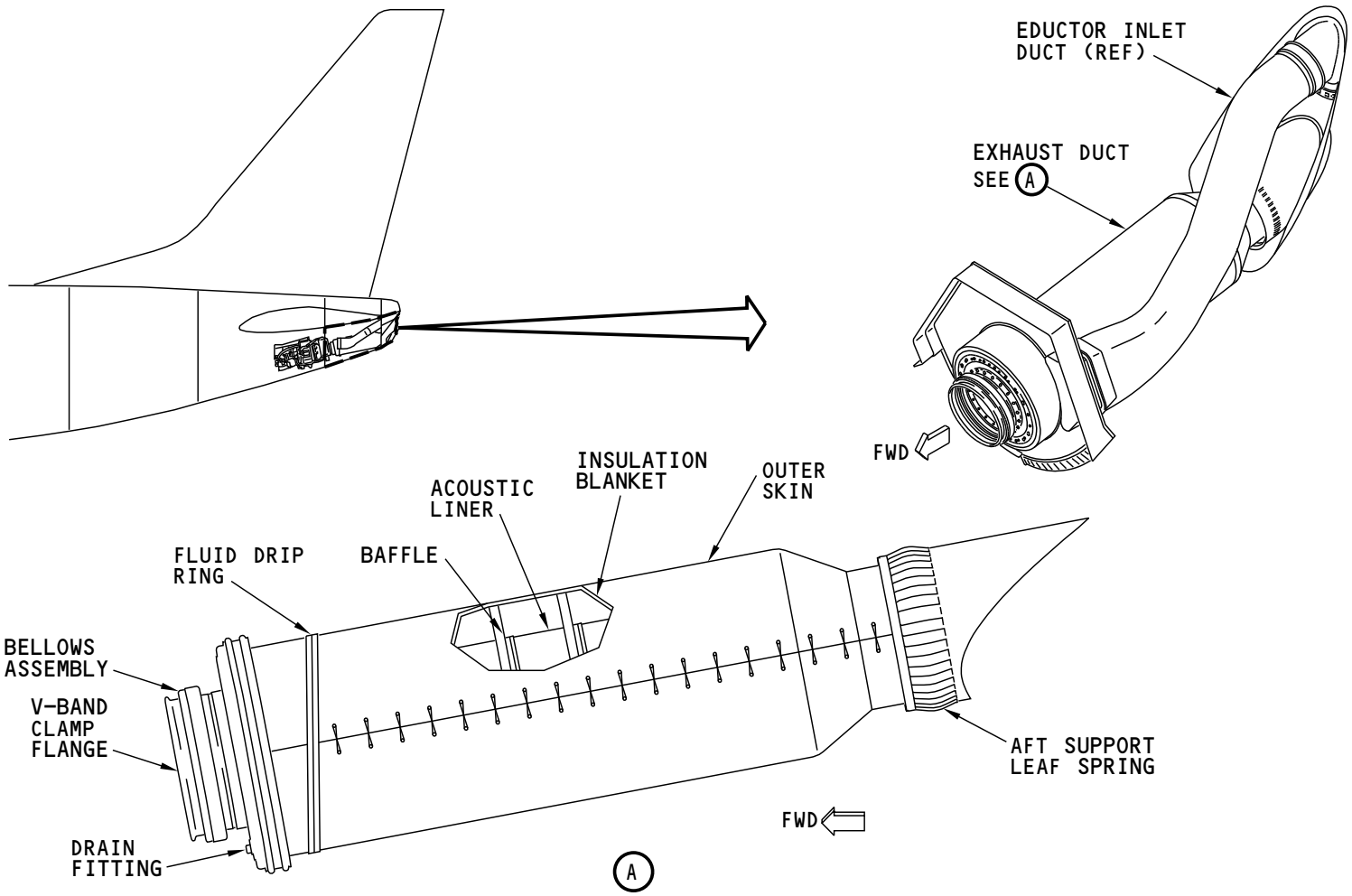
These are the major components of the exhaust duct:

- Drain fitting
- V-band clamp flange
- Bellows assembly
- Fluid drip ring
- Baffle
- Acoustic liner
- Outer skin
- Insulation blanket
- Aft support leaf spring.

Training Information Point

You remove the exhaust duct from the tail section to do maintenance on the duct.

APU EXHAUST SYSTEM - EXHAUST DUCT



M87572 S0004631558_V1

APU EXHAUST SYSTEM - EXHAUST DUCT

APU EXHAUST SYSTEM - AFT FAIRING

Purpose

The aft fairing supports the aft end of the exhaust duct and eductor inlet duct.

Location

The aft fairing is at the aft end of the fuselage.

Functional Description

The aft fairing is superplastic formed titanium that aligns with the airplane tail cone. The aft fairing has two openings. One opening is for the APU compartment and eductor inlet. The other opening is for the APU turbine exhaust.

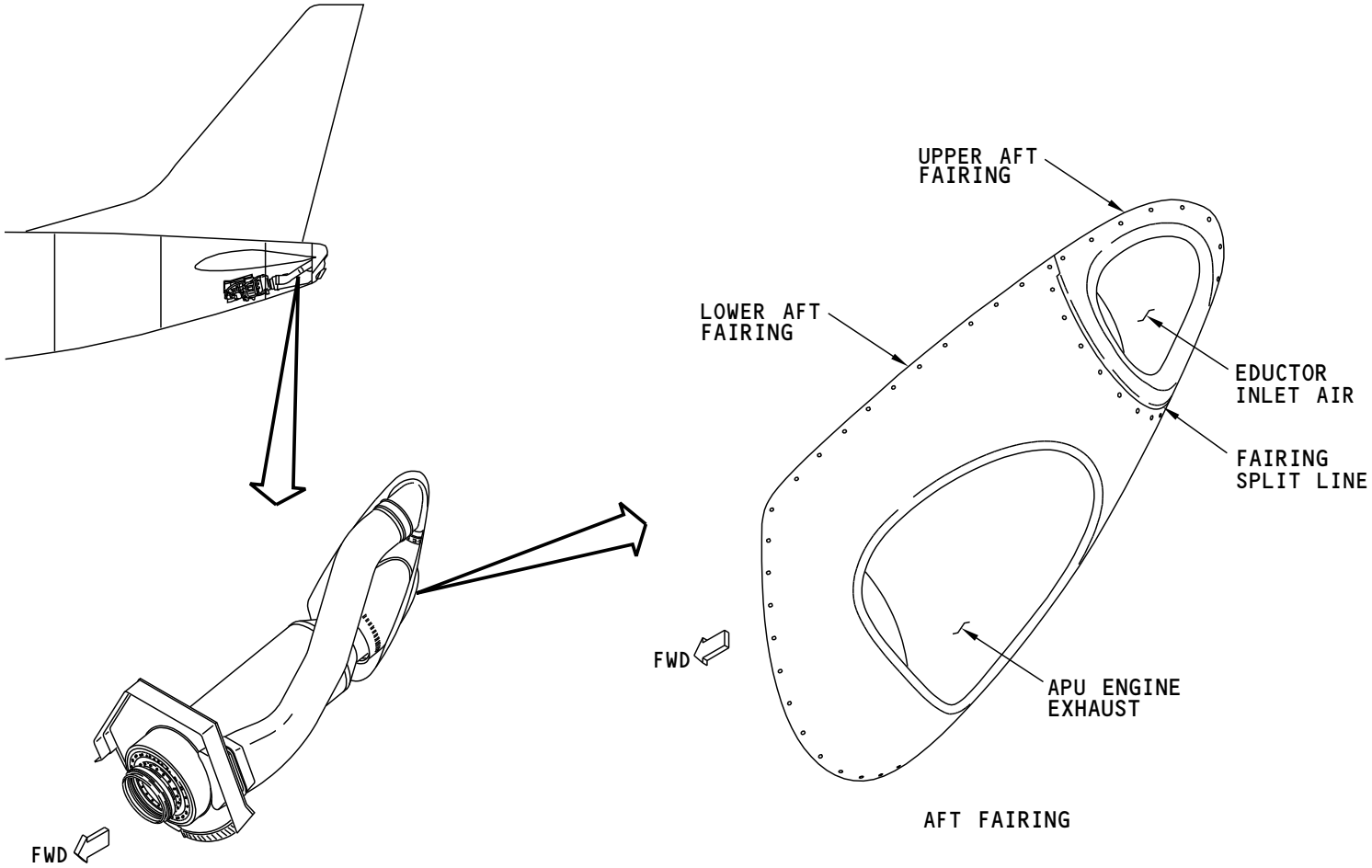
These are the components of the aft fairing:

- Upper aft fairing
- Lower aft fairing.

Training Information Point

For ease of removal and installation, the aft fairing has an upper and lower section. To remove the muffler, you remove only the lower aft fairing.

APU EXHAUST SYSTEM - AFT FAIRING



M87573 S0004631560_V1

APU EXHAUST SYSTEM - AFT FAIRING

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU LUBRICATION SYSTEM - INTRODUCTION

Purpose

The APU lubrication system lubricates, cleans, and cools these components:

- APU starter-generator
- APU bearings
- APU gearbox.

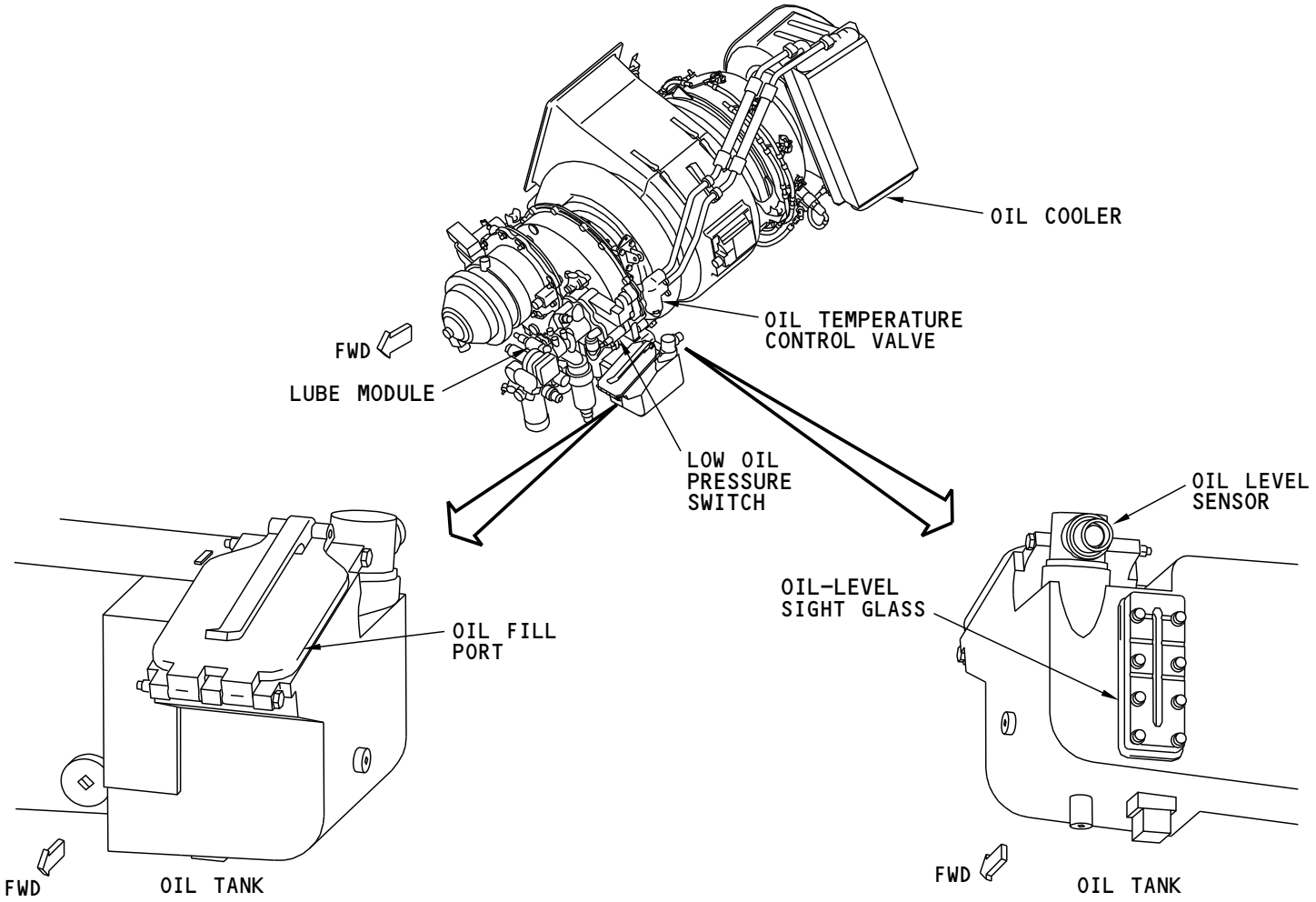
Components

Some lubrication system components are on a common lube module on the front of the APU. These lubrication system components are not on the lube module:

- Magnetic drain plug (not shown)
- Low oil pressure switch
- Oil level sensor
- Oil cooler
- Temperature control valve
- Oil-level sight glass and an oil fill port.

A 5.7 quart (5.4 liter) oil sump is inside the gearbox. The APU oil cooler and oil lines hold approximately 3 quarts (2.9 liters) of oil. The total oil quantity of oil in an APU at full is 8.7 quarts (8.3 liters). An oil-level sight glass shows the oil level. An oil fill port is adjacent to the oil-level sight glass.

APU LUBRICATION SYSTEM - INTRODUCTION



M87574 S0004631564_V1

APU LUBRICATION SYSTEM - INTRODUCTION

APU LUBRICATION SYSTEM - LUBE MODULE

General

The lube module contains many of the lubrication system components. The lube module is on the front of the Auxiliary Power Unit (APU) gearbox.

Components

The lube module contains lube and scavenge pump elements. A shaft from the gearbox turns the pump elements. A pressure regulating/relief valve is also internal to the lube module.

These components are on the outside of the lube module and are LRUs:

- Filter indicator
- Filter bypass switch
- Oil filter
- Generator filter
- Oil temperature sensor.

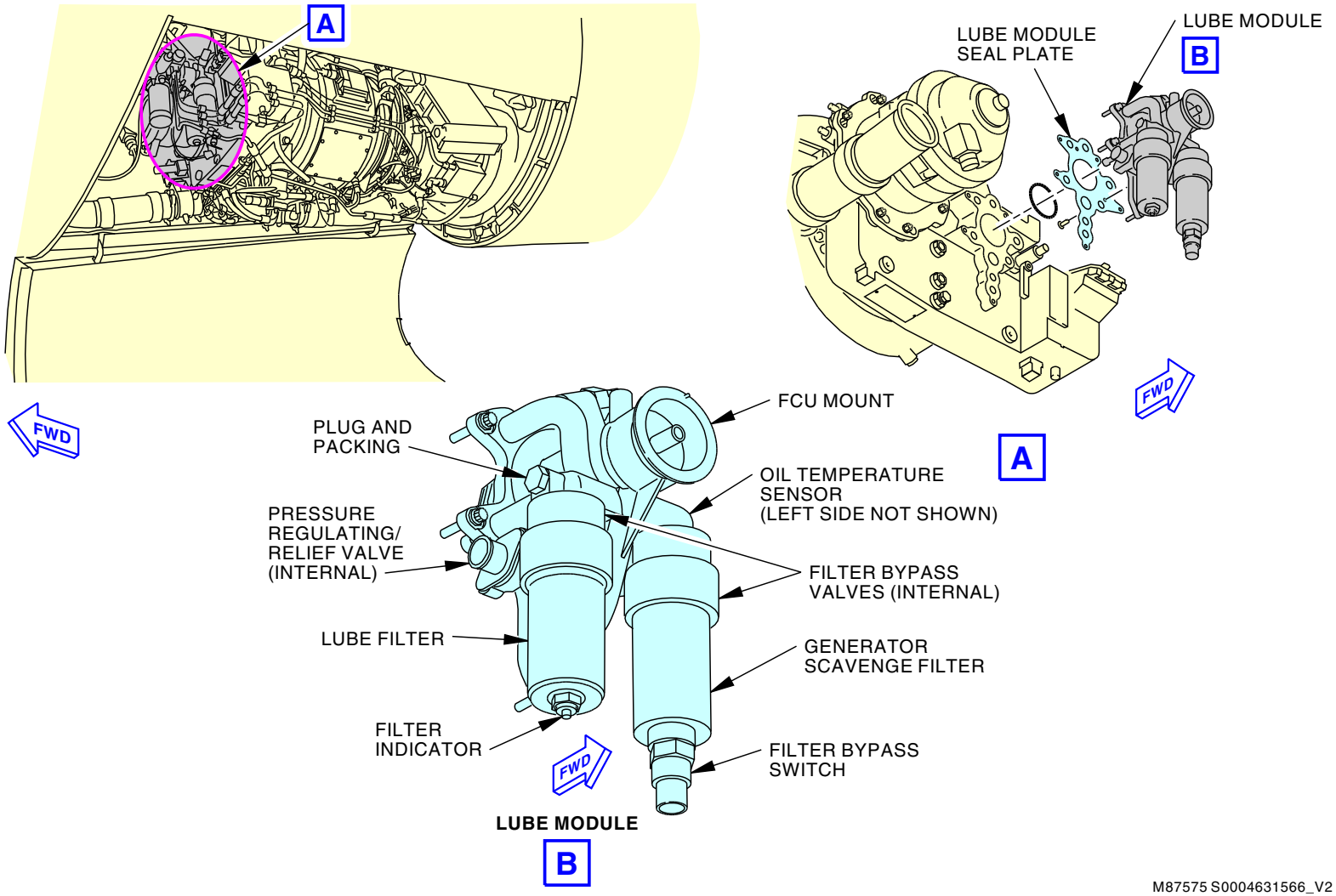
Training Information Point

The Fuel Control Unit (FCU) attaches to the lube module. You must first remove the FCU to remove the lube module.

You must remove the FCU and the lube module to replace the lube module seal plate.

Replace the seal plate only if you believe there is a leak due to a failed seal plate or when you replace the lube module.

APU LUBRICATION SYSTEM - LUBE MODULE



M87575 S0004631566_V2

APU LUBRICATION SYSTEM - LUBE MODULE

APU LUBRICATION SYSTEM - LUBE MODULE - FUNCTIONAL DESCRIPTION

Lube and Scavenge Pumps

The lube and scavenge pumps are on a common shaft. Three of the pumps are lube pumps. Three elements are starter-generator scavenge pumps and one is a turbine bearing scavenge pump.

Pressure Regulating/Relief Valve

The pressure regulating/relief valve keeps the oil pressure at 67 ±7 psi (462 ±48 kPa). If the pressure is more than this, the valve returns the oil to the oil pump inlet. The relief valve is set at 240 ±40 psi (1655 ±276 kPa).

Temperature Control Valve

The temperature control valve controls the oil flow to the oil cooler to control oil temperature and to bypass the oil cooler when the oil is cold.

When the oil temperature is 140°F (60°C) or less, the valve is fully open and the oil does not go to the oil cooler. When the oil temperature is 170°F (77°C) or more, the valve is fully closed and the oil goes to the oil cooler. Between temperatures of 140°F (60°C) and 170°F (77°C), the valve is not fully open.

A pressure difference of 50 psid (345 kPa) also opens the valve to permit the oil to continue to flow if the oil cooler clogs.

Oil Filters

There are two interchangeable oil filters. The oil from the Auxiliary Power Unit (APU) generator goes through the generator filter. Pressurized oil goes through the oil filter after it goes through the oil cooler. The filters are throw-away type elements. They both have a 10 micron rating.

Oil Filter Bypass Valve and Indicator Button

The oil filter has an indicator button to monitor for filter clogs. When there is a pressure difference of more than 33 ±7 psid (228 ±49 kPa) across the filter and the oil temperature is more than 90F (32C), the indicator button extends.

The oil filter also has a bypass valve that allows the oil to flow if there is a clog or the oil is cold. The filter bypasses oil at 60 ±10 psid (414 ±69 kPa).

Generator Filter Bypass Valve and Filter Pressure Switch

The generator filter has a filter pressure switch to monitor for filter clogs. When there is a pressure difference of more than 35 ±5 psid (241 ±35 kPa) across the filter, for 5 seconds, the switch sends a signal to the Electronic Control Unit (ECU). The ECU shuts down the APU if these occur:

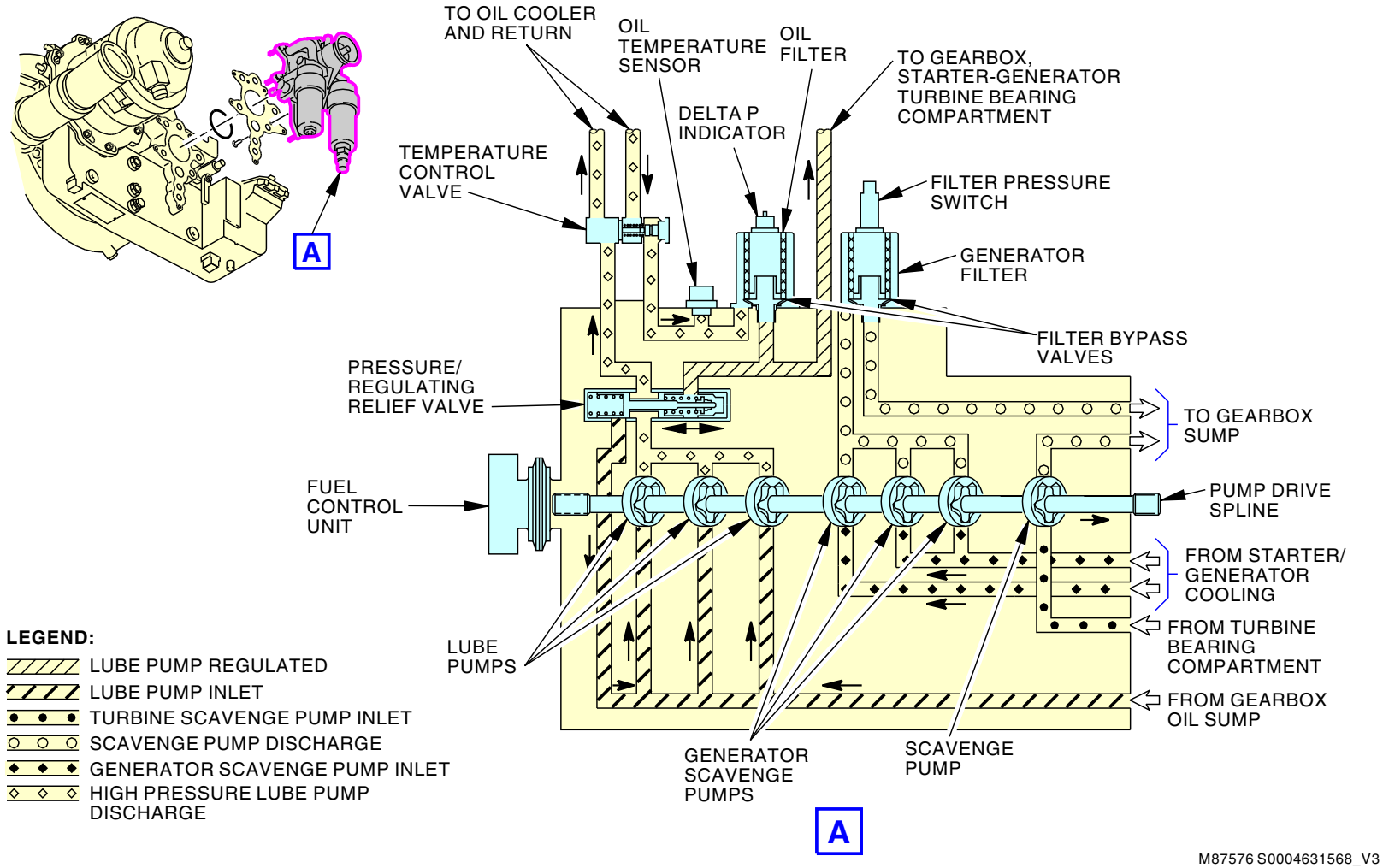
- High filter delta pressure
- Oil temperature is more than 100°F (38°C)
- Main engines not running for 90 seconds
- Airplane on ground.

The generator filter also has a bypass valve to let the oil flow if there is a clog or the oil is cold. The bypass valve bypasses oil at 60 ±10 psid (414 ±69 kPa).

Oil Temperature Sensor

The oil temperature sensor sends lube oil temperature data to the ECU. The ECU shuts down the APU if the APU speed is more than 95 percent and the oil temperature is 300°F (149°C) or more for 10 seconds.

APU LUBRICATION SYSTEM - LUBE MODULE - FUNCTIONAL DESCRIPTION



M87576 S0004631568_V3

APU LUBRICATION SYSTEM - LUBE MODULE - FUNCTIONAL DESCRIPTION

APU LUBRICATION SYSTEM - OIL COOLER AND TEMPERATURE CONTROL VALVE

General

The oil cooler is an air/oil heat exchanger. Compartment and outside air cool the pressurized oil after it leaves the oil pump.

The oil cooler is on the upper left side of the APU turbine case. It is part of the eductor cooling system.

The temperature control valve is on the APU gearbox behind the lube module. The valve controls the oil flow to and from the oil cooler.

Functional Description

The APU exhaust causes a suction of air from outside through the eductor inlet duct. This causes the APU compartment and outside air to move through the oil cooler to cool the APU oil. The cooling air then flows overboard through the exhaust duct.

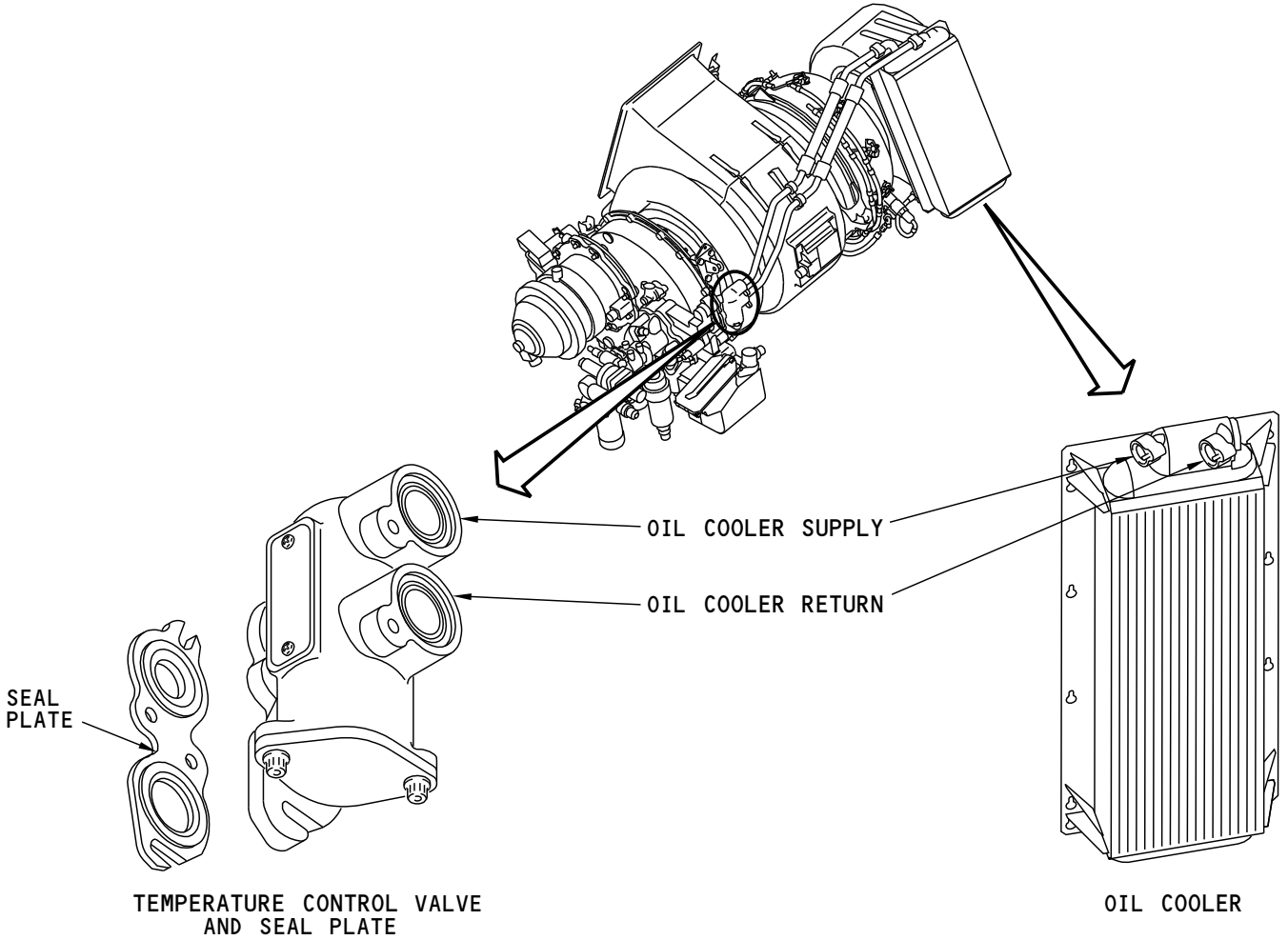
The temperature control valve allows oil to bypass the oil cooler if the oil temperature is less than 140F (60C). The valve lets oil flow through the cooler if the oil temperature is more than 170F (78C). If the oil pressure is more than 50 psid across the temperature control valve, the oil bypasses the cooler.

The temperature control valve uses a seal plate for attachment to the gearbox.

Training Information Point

Replace the seal plate only if you believe there is a leak due to a seal plate failure.

APU LUBRICATION SYSTEM - OIL COOLER AND TEMPERATURE CONTROL VALVE



M87577 S0004631570_V1

APU LUBRICATION SYSTEM - OIL COOLER AND TEMPERATURE CONTROL VALVE

APU LUBRICATION SYSTEM - MAGNETIC DRAIN PLUG

Purpose

The magnetic drain plug collects metallic particles that are in the engine oil. It has two parts, the magnetic chip collector and the drain plug. You remove the drain plug to drain the oil out of the gearbox.

Location

There is one magnetic drain plug. It is on the bottom front of the gearbox.

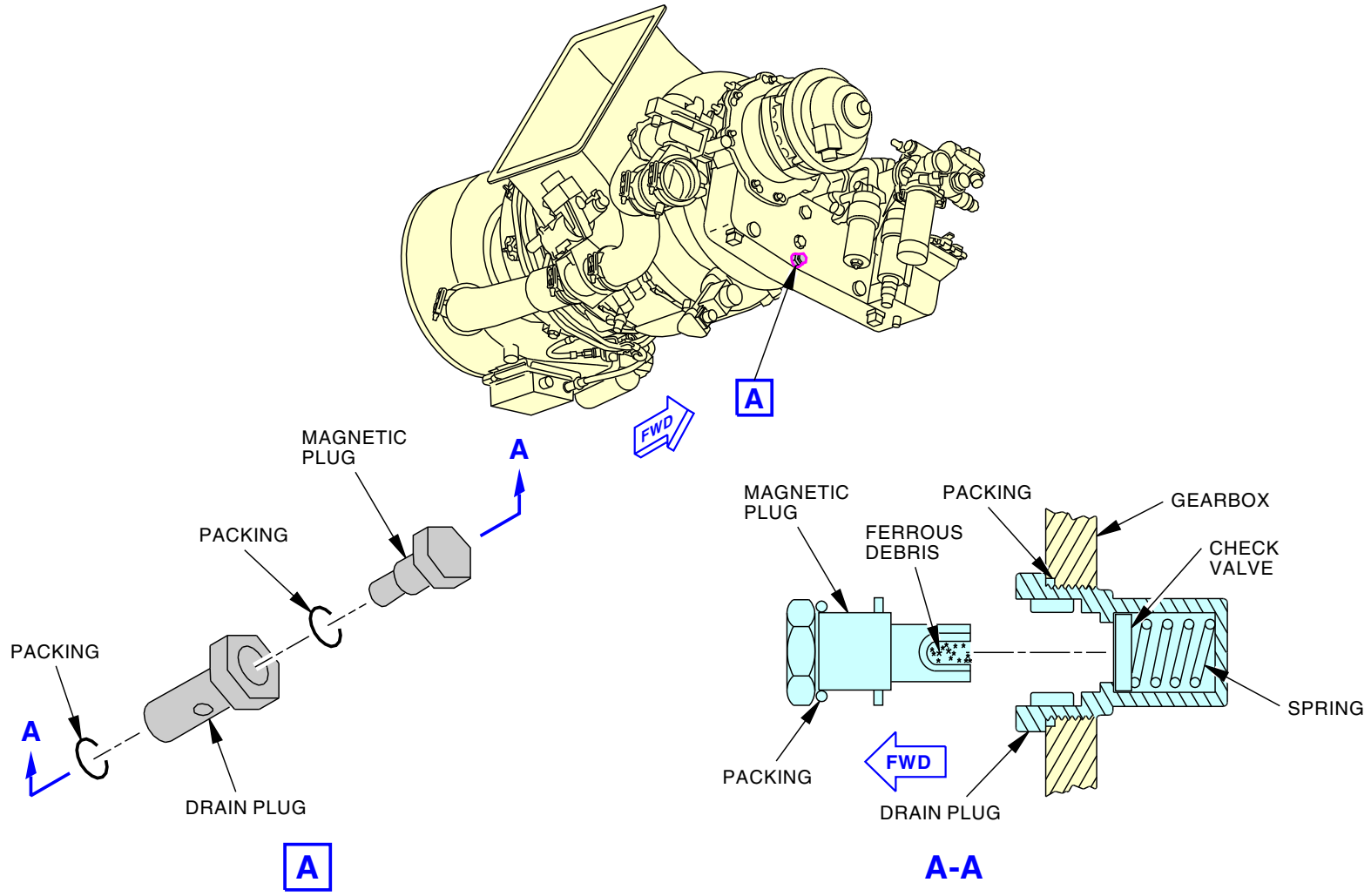
Components

These are the components of the magnetic drain plug:

- Magnet plug
- Drain plug
- Magnet
- Packings
- Check valve
- Spring.

The check valve closes to prevent oil loss when you remove the magnetic chip detector from the magnetic drain plug.

APU LUBRICATION SYSTEM - MAGNETIC DRAIN PLUG



M87578 S0004631572_V2

APU LUBRICATION SYSTEM - MAGNETIC DRAIN PLUG

APU LUBRICATION SYSTEM - FUNCTIONAL DESCRIPTION

General

The APU lubrication system supplies pressurized oil to cool, clean, and lubricate APU components and the APU generator. A scavenge system returns the oil to the reservoir in the gearbox.

Supply

Oil pumps in the lube module, pump oil from the reservoir in the gearbox. Pressurized oil from the lube module goes to the oil cooler and then returns to the lube module.

The lube module cleans the oil and controls the oil pressure. These components supply data to the ECU:

- Low oil pressure switch
- Oil level sensor
- Oil temperature sensor
- Generator filter pressure switch.

The oil goes to these areas:

- APU starter-generator
- Gearbox bearings and gears
- Turbine bearing compartment.

Scavenge

A scavenge pump in the lube module sends the oil from the turbine bearing compartment back to the gear box reservoir. Other scavenge pump elements send the scavenge oil from the APU starter-generator through the scavenge filter and back to the gearbox reservoir.

Vent

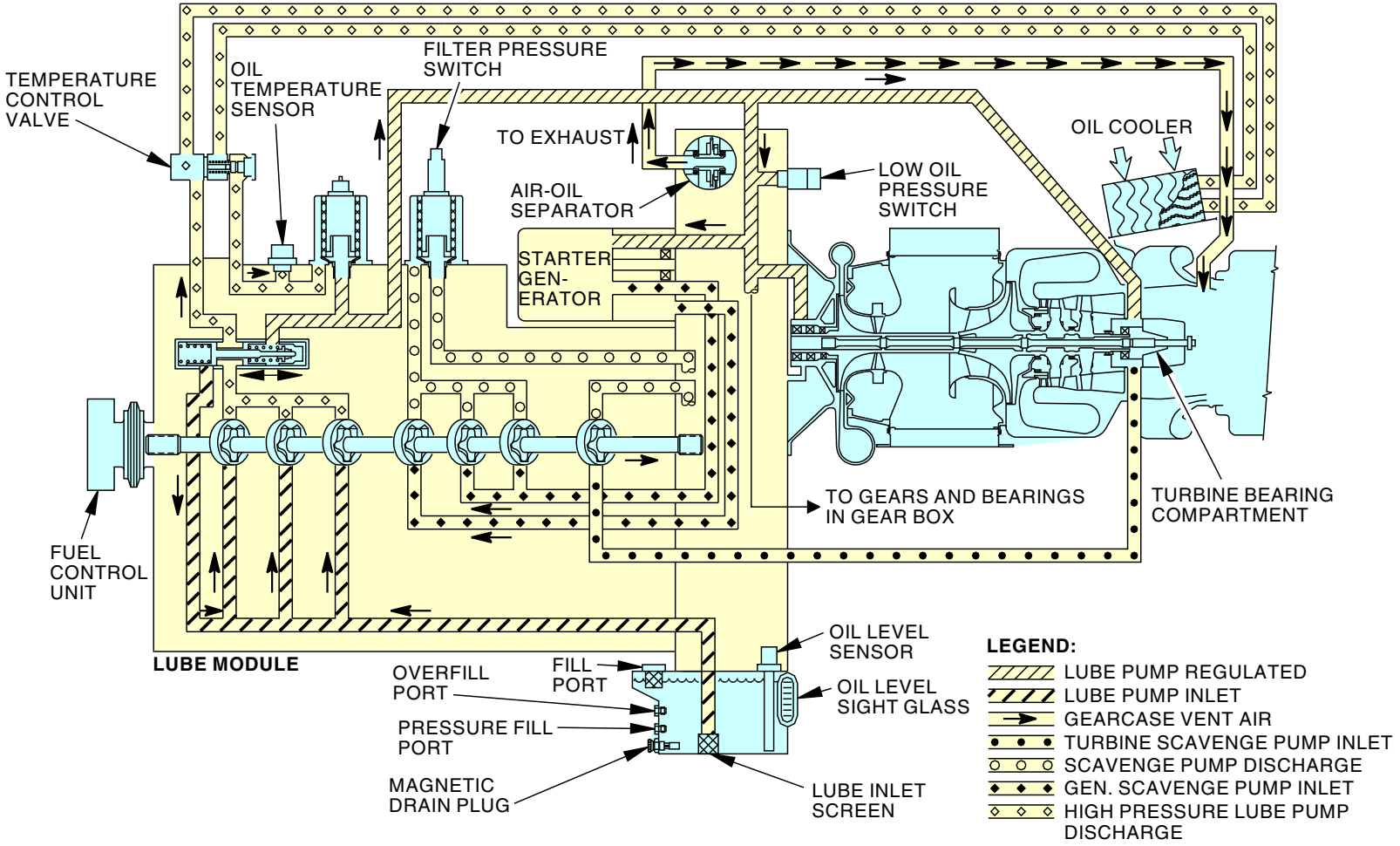
An air-oil separator separates the air that mixes with the oil in the scavenge system. The air-oil separator is on the right side of the lube module on the gearbox.

Air that goes by the bearing cavities and mixes with the scavenge oil goes through the air-oil separator. Through centrifugal action, the air-oil separator returns the oil to the sump in the gearbox and the air vents overboard. The air vents overboard through the APU exhaust duct.

Training Information Point

The air-oil separator is not a line replaceable component.

APU LUBRICATION SYSTEM - FUNCTIONAL DESCRIPTION



M87579 S0004631574_V3

APU LUBRICATION SYSTEM - FUNCTIONAL DESCRIPTION

THIS PAGE IS INTENTIONALLY LEFT BLANK

APU LUBRICATION SYSTEM - OIL INDICATING - GENERAL DESCRIPTION

Purpose

The APU oil indicating system supplies this data for the flight compartment:

- Oil temperature (P5 panel amber FAULT light only)
- Oil pressure (P5 panel amber LOW OIL PRESSURE light only)
- Oil level (P5 panel blue MAINT light and CDU display)
- Starter-generator scavenge filter clogged (P5 panel amber FAULT light only).

General Description

The ECU receives APU oil indicating system inputs and supplies this data to the airplane flight compartment.

The oil level indication only shows on the control display unit (CDU). The blue MAINT light comes on at a specified oil quantity.

Components

These are the APU oil indicating system components:

- Low oil pressure switch
- Oil temperature sensor
- Oil level sensor
- Filter pressure switch.

Low Oil Pressure Switch

The low oil pressure switch sends a signal to the ECU when the oil pressure is less than 30-40 psi. If the APU speed is more than 95 percent, the ECU shuts down the APU after 20 seconds. These amber lights come on for a low oil pressure indication:

- LOW OIL PRESSURE (P5)
- MASTER CAUTION (P7)
- APU annunciator (P7).

Oil Temperature Sensor

The oil temperature sensor sends lube oil temperature data to the ECU. The ECU shuts down the APU if the APU speed is more than 95 percent and oil temperature is 300°F (149°C) or more for 10 seconds. The CDU shows the oil temperature.

These amber lights come on for a high oil temperature indication:

- FAULT (P5)
- MASTER CAUTION (P7)
- APU annunciator (P7).

Oil Level Sensor

The oil level sensor sends the oil level data in the gearbox sump to the ECU. The ECU sends this data to the CDU for display.

The ADD message shows on the APU oil quantity page of the CDU when approximately 4.3 quarts (4.1 liters) of oil remains in the APU sump.

The blue MAINT light on the P5 panel comes on and the LOW message shows on the APU oil quantity page of the CDU when approximately 3.8 quarts (3.6 liters) of oil remains in the APU sump.

The APU sump holds 5.7 quarts (5.4 liters) of oil when full.

Filter Pressure Switch

The filter pressure switch monitors the differential pressure between the inlet and outlet of the starter-generator scavenge filter. If the pressure is greater than 30-40 psid, the filter switch sends a signal to the ECU.

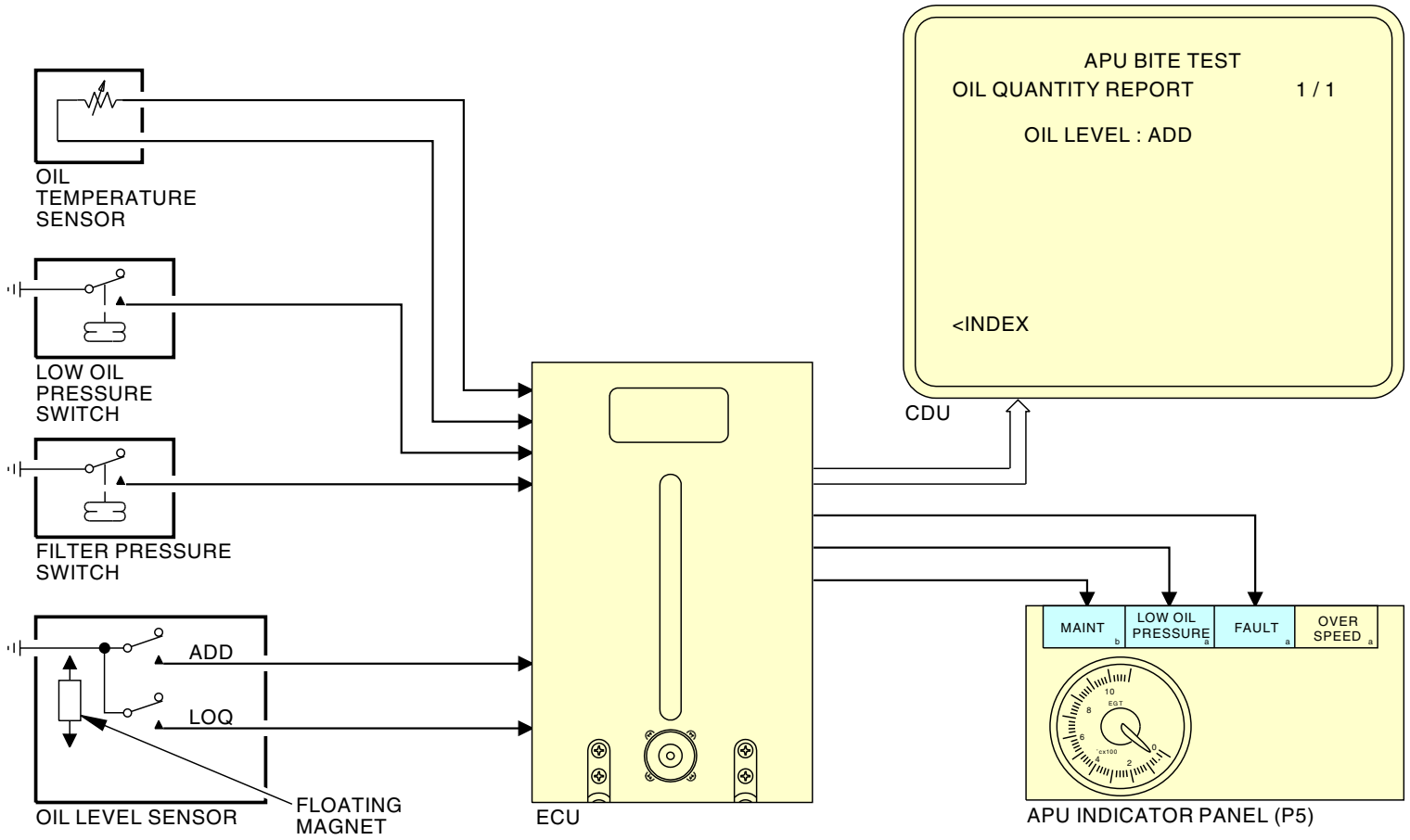
Protective Shutdowns

Low oil pressure, high oil temperature or starter-generator filter clogged causes the ECU to do a protective shutdown when the APU is above 95 percent speed.

The low oil pressure switch causes the amber LOW OIL PRESSURE light on the P5 panel to come on.

High oil temperature and filter clogged causes the amber FAULT light on the P5 panel to come on.

APU LUBRICATION SYSTEM - OIL INDICATING - GENERAL DESCRIPTION



1551460 S0000285330_V2

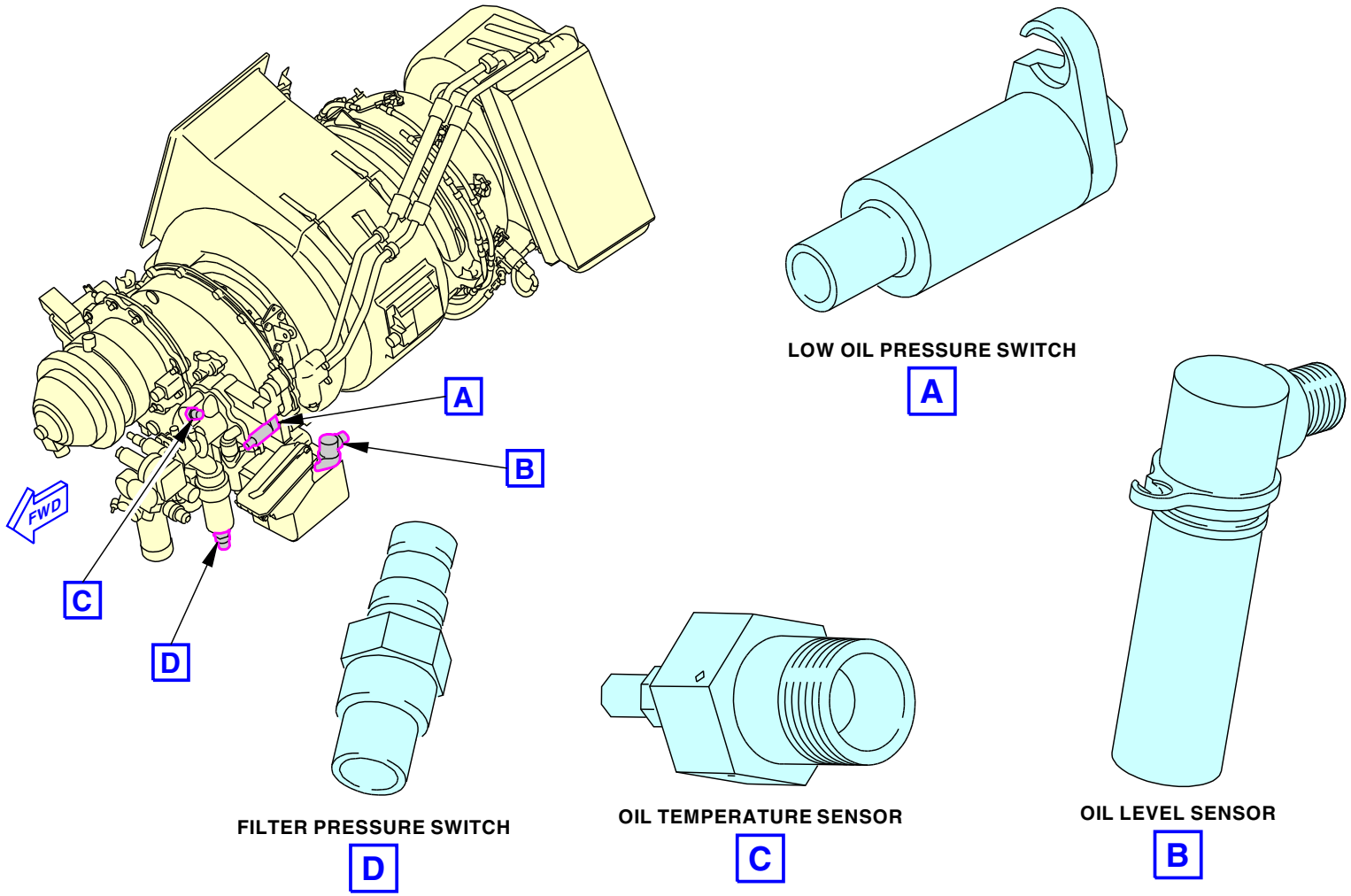
APU LUBRICATION SYSTEM - OIL INDICATING - GENERAL DESCRIPTION

APU LUBRICATION SYSTEM - OIL INDICATING - COMPONENTS

Location

The low oil pressure switch is on the upper left side of the gearbox. The oil temperature sensor and filter pressure switch are on the lube module. The oil level sensor is on the gearbox.

APU LUBRICATION SYSTEM - OIL INDICATING - COMPONENTS



M87581 S0004631578_V2

APU LUBRICATION SYSTEM - OIL INDICATING - COMPONENTS