CHAPTER

28

Fuel

CHAPTER 28
FUEL

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

28-EFFECTIVE PAGES

CHAPTER 28
FUEL

Subject/Page	Date	COC
28-21-00 (cont.)		
16	Sep 05/2016	
17	May 05/2015	
18	May 05/2015	
19	May 05/2015	
20	May 05/2015	
21	May 05/2015	
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23	May 05/2015	
24	May 05/2015	
25	May 05/2015	
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32	May 05/2015	
33	Sep 05/2016	
34	Sep 05/2016	
35	May 05/2015	
36	Sep 05/2016	
37	Sep 05/2016	
38	Sep 05/2016	
28-21-00 (cont.)		
39	May 05/2015	
40	May 05/2015	
28-22-00		
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2	May 05/2015	
3	May 05/2015	
4	May 05/2015	
5	May 05/2015	
6	May 05/2015	
7	Jul 25/2018	
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12	May 05/2018	
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14	May 05/2018	
15	May 05/2018	
16	May 05/2018	
17	May 05/2018	
18	May 05/2018	
19	May 05/2018	
20	May 05/2018	
21	May 05/2018	

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28-EFFECTIVE PAGES

CHAPTER 28
FUEL

Subject/Page	Date	COC	Subject/Page	Date	COC
28-22-00 (cont.)			28-22-00 (cont.)		
22	May 05/2018		45	May 05/2018	
23	May 05/2018		46	May 05/2018	
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44	May 05/2018		10	May 05/2015	

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28-EFFECTIVE PAGES

CHAPTER 28
FUEL

Subject/Page	Date	COC
28-25-00 (cont.)		
11	May 05/2015	
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13	May 05/2015	
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14	May 05/2018	
15	May 05/2018	
16	Sep 05/2016	

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28-EFFECTIVE PAGES

CHAPTER 28
FUEL

Subject/Page	Date	COC
28-31-00 (cont.)		
17	Sep 05/2016	
18	Sep 05/2016	
19	Sep 05/2016	
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21	Sep 05/2016	
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9	May 05/2015	
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Subject/Page	Date	COC
28-40-00 (cont.)		
11	May 05/2015	
12	May 05/2015	
13	May 05/2015	
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16	May 05/2015	
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28-EFFECTIVE PAGES

CHAPTER 28
FUEL

28-CONTENTS

CHAPTER 28
FUEL

28-CONTENTS

CHAPTER 28
FUEL

28-CONTENTS

CHAPTER 28
FUEL

28-CONTENTS

CHAPTER 28
FUEL

28-CONTENTS

FUEL SYSTEM - INTRODUCTION

General

The fuel system has these subsystems:

- Fuel storage
- Fuel indicating
- Pressure refuel
- Engine fuel feed
- APU fuel feed
- Jettison
- Defuel.

Fuel Storage

The fuel storage system has three fuel tanks: left and right main tanks, and a center tank.

Fuel Indicating

The fuel indicating system measures fuel quantity in the tanks. The primary display system (PDS) and the integrated refuel panel (IRP) indicators show fuel quantity. The fuel indicating system also measures fuel temperature and senses fuel pump outlet pressure.

Pressure Refuel

The pressure refuel system transfers fuel from the refuel adapters to the main and center tanks. You operate the refuel system with the integrated refuel panel.

Engine Fuel Feed

The engine fuel feed system supplies fuel to the engines from the main and center tanks. You operate the engine feed system from the fuel panel on the P5 overhead panel.

APU Fuel Feed

The APU fuel feed system normally supplies fuel to the APU. It can also supply fuel to the left engine feed manifold during an in-flight flameout.

Jettison

The fuel jettison system dumps fuel overboard to reduce the landing weight. You operate the jettison system from the fuel panel on the P5 overhead panel.

Defuel

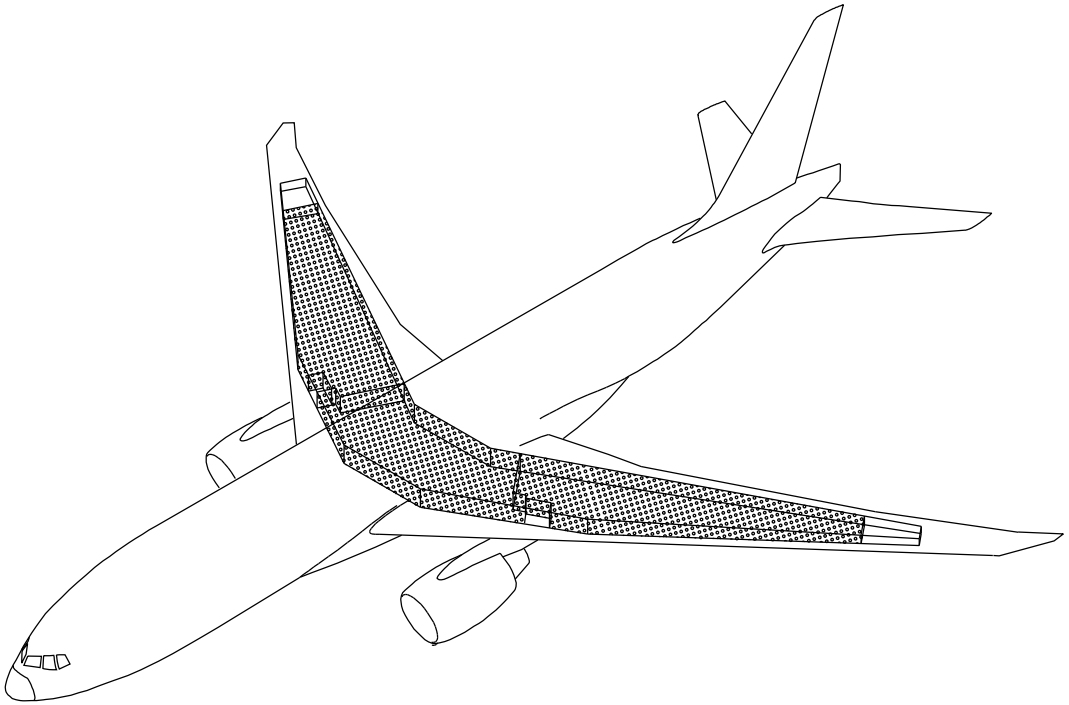
The defuel system moves fuel from the airplane tanks to ground tanks or from one airplane tank into another. You operate the defuel system at the IRP and the P5 overhead panel.

Abbreviations and Acronyms

- AIMS - airplane information management system
- APU - auxiliary power unit
- ARINC - Aeronautical Radio, Inc.
- bat - battery
- C - celsius
- CCU - Computing and Communications Unit (ELMS)
- ccw - counterclockwise
- chan - channel
- ctr - center
- ctrl - control
- EICAS - engine indication and crew alerting system
- ELCU - electrical load control unit
- ELMS - electrical load management system
- FTR - fuel-to-remain
- FQIS - fuel quantity indicating system
- FQPU - fuel quantity processor unit

FUEL SYSTEM - INTRODUCTION

- fwd - forward
- gnd - ground
- hdlg - handling
- I/O - input/output
- inbd - inboard
- ind - indicator
- IRP - integrated refuel panel
- isln - isolation
- jett - jettison
- kg - kilogram
- l - left
- lb - pound
- man - manual
- mgmt - management
- min - minimum
- MLW - maximum landing weight
- O/J - override/jettison
- OPAS - overhead panel ARINC 629 system
- outbd - outboard
- PDS - primary display system
- pwr - power
- qty - quantity
- r - right
- rly - relay
- sel - select
- SOV - shutoff valve
- svc - service
- sw - switch
- temp - temperature
- vlv - valve
- VOS - velocity of sound
- VTO - volumetric top-off



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FUEL SYSTEM - INTRODUCTION

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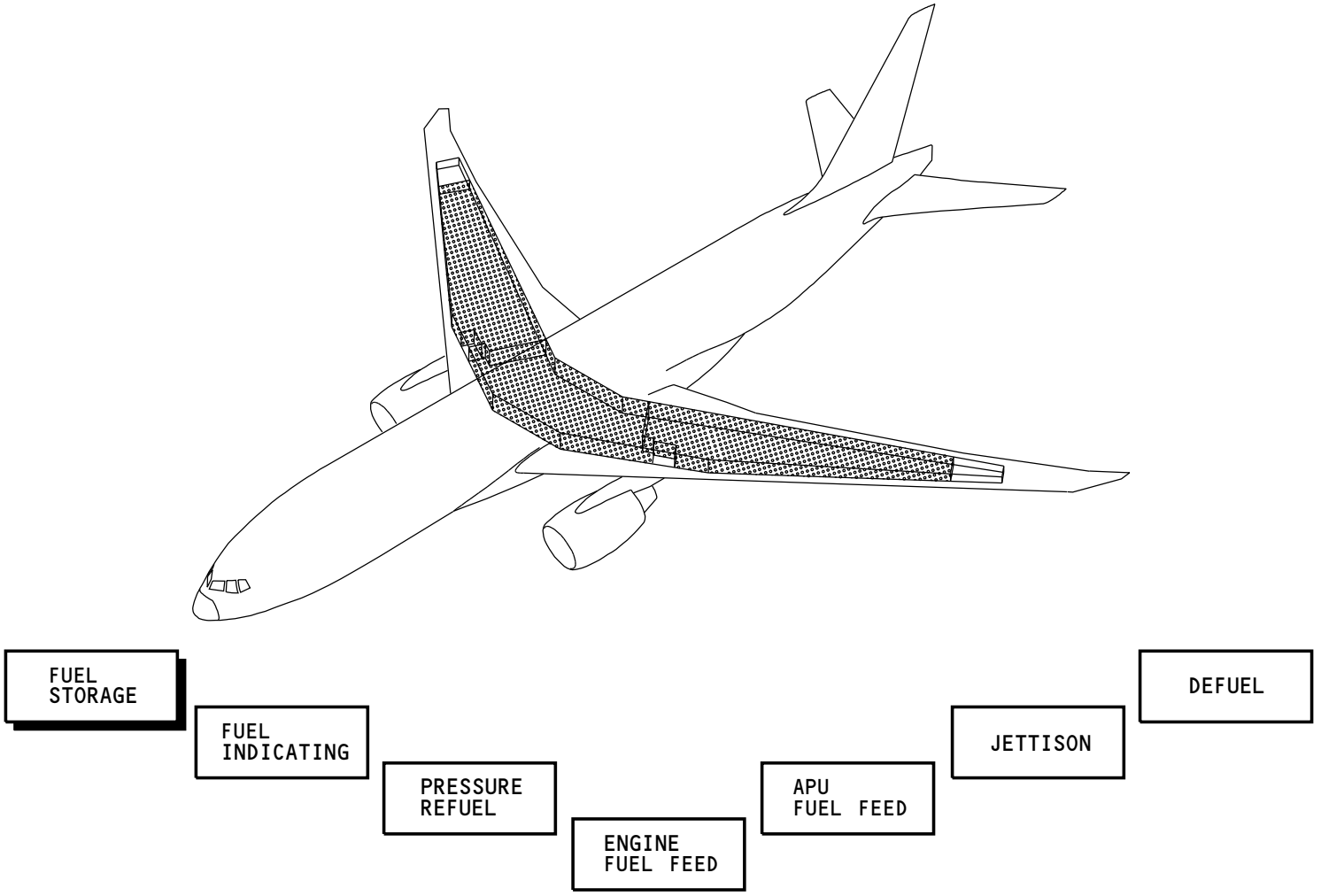
FUEL STORAGE - INTRODUCTION

General

The fuel storage system holds the fuel necessary for engine and APU operation.

The fuel storage system also does these functions:

- Gives maintenance access
- Prevents large pressure differences
- Helps drain the fuel tanks.



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FUEL STORAGE - INTRODUCTION

Fuel Tank Arrangement

These are the fuel storage tanks:

- Left main tank
- Center tank
- Right main tank.

Surge tanks collect fuel overflow. The fuel overflow drains into the main tanks. Each main tank has a dry bay that does not hold fuel.

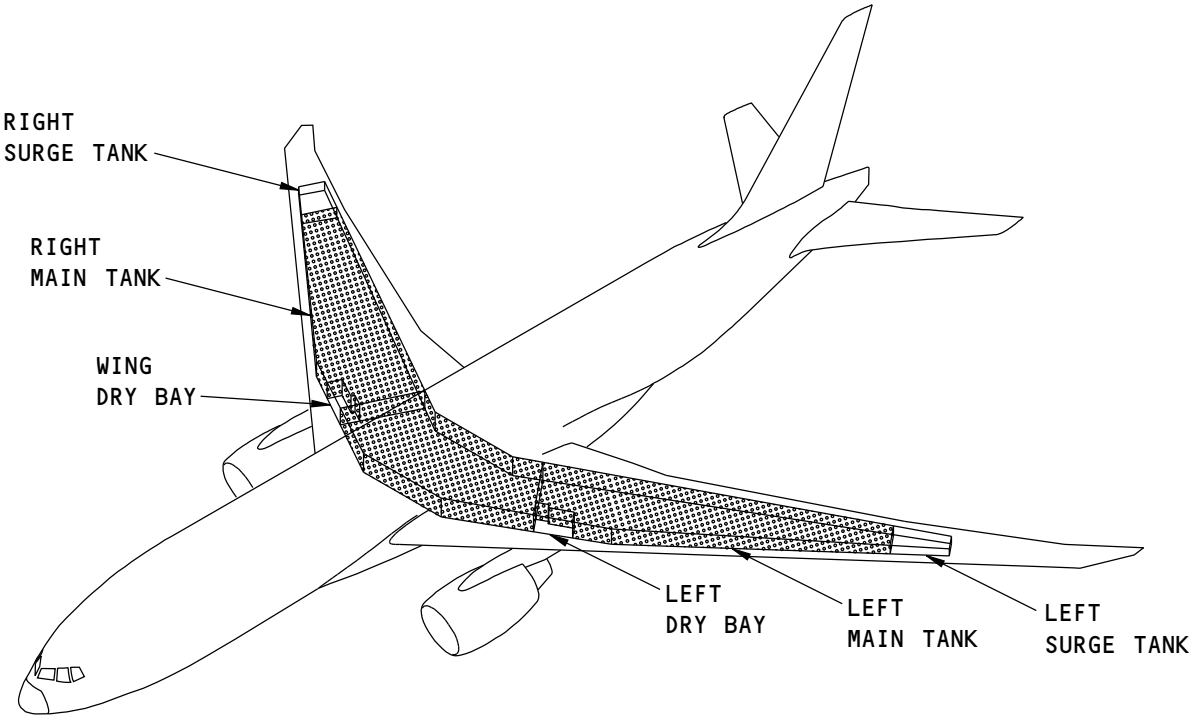
Component Locations

The left main tank is in the wing box of the left wing. The right main tank is in the wing box of the right wing. An adjacent surge tank is outboard of each main tank. The wing dry bays are above each engine strut.

The center tank is in the center wing section and in the inboard wing box of the left and right wings.

Capacity

The capacity of each main tank is approximately 69,630 lb (31 590 kg) of fuel. The capacity of the center tank is approximately 184,480 lb (83,670 kg).



TANKS	GALS	LITERS	LB *	KG *
MAIN TANKS	10,300 EA	39 000 EA	69,628 EA	31 590 EA
CENTER TANK	27,290	103 300	184,480	83 673
TOTALS	47,890	181 300	323,736	146 853

* DENSITY = 6.76 LB/GAL (0.81 KG/L)

777 FUEL TANK CAPACITIES

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FUEL STORAGE - GENERAL DESCRIPTION - TANK ARRANGEMENT

FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 1

General

The fuel tanks are sealed parts of the wing structure. These are the parts of the fuel tanks:

- Upper wing skin
- Lower wing skin
- Front spar
- Rear spar
- Wing ribs.

Wing ribs divide the fuel tanks into bays, and reduce the movement of fuel during airplane maneuvers. Access doors and cutouts are entrances into the airplane fuel tanks for inspection or component repair.

Fuel Tank Locations

The center fuel tank is between rib 8 of the left wing and rib 8 of the right wing. Wing ribs divide each side of the center tank into seven fuel bays. The center wing section between the left and right side-of-body ribs (rib 1) is also a part of the center fuel tank. Three spanwise beams between the left and right side-of-body ribs divide the center wing section into four fuel bays. A purge door for the fuel bays in the center wing section is on the rear spar.

The main tanks are between rib 8 and rib 37 in each wing. Wing ribs divide each main tank into 29 fuel bays. The forward parts of the bays between rib 9 and rib 11 are dry. These wing dry bays prevent a fuel spill on the engine if an engine burst occurs.

The surge tanks are between rib 37 and rib 41 in each wing. The wing ribs divide each surge tank into four fuel bays.

Wing Ribs

Standard wing ribs have upper and lower openings between the stringers that let fuel and air flow through them.

Tank-end ribs close the ends of each fuel tank. Tank-end ribs are sealed. No fuel can flow through them.

Rib 18 is a baffle rib. The rib is sealed, but has check valves between each lower stringer. The check valves let fuel flow inboard at a slow rate. One hole at the bottom of the rib lets fuel flow outboard. This keeps the fuel level on the two sides of the rib the same. Two large holes and six smaller holes at the top of the rib let air through it.

Rib 10 is a fuel dam rib. The lower section is the same as the baffle rib, but the upper section is the same as a standard rib. The fuel dams of rib 10 prevent fuel from flowing away from the fuel pump inlets.

Fuel Tank Access Doors

The access doors fit in fuel bays over openings in the airplane skin. A clamp ring and knitted aluminum gasket bolt to the access door from outside the airplane to hold the access door in its position. Thus, no bolt holes are in the skin. The gasket makes an electrical bond between the access door and the airplane skin. A rubber seal in the access door prevents fuel leaks around the access door.

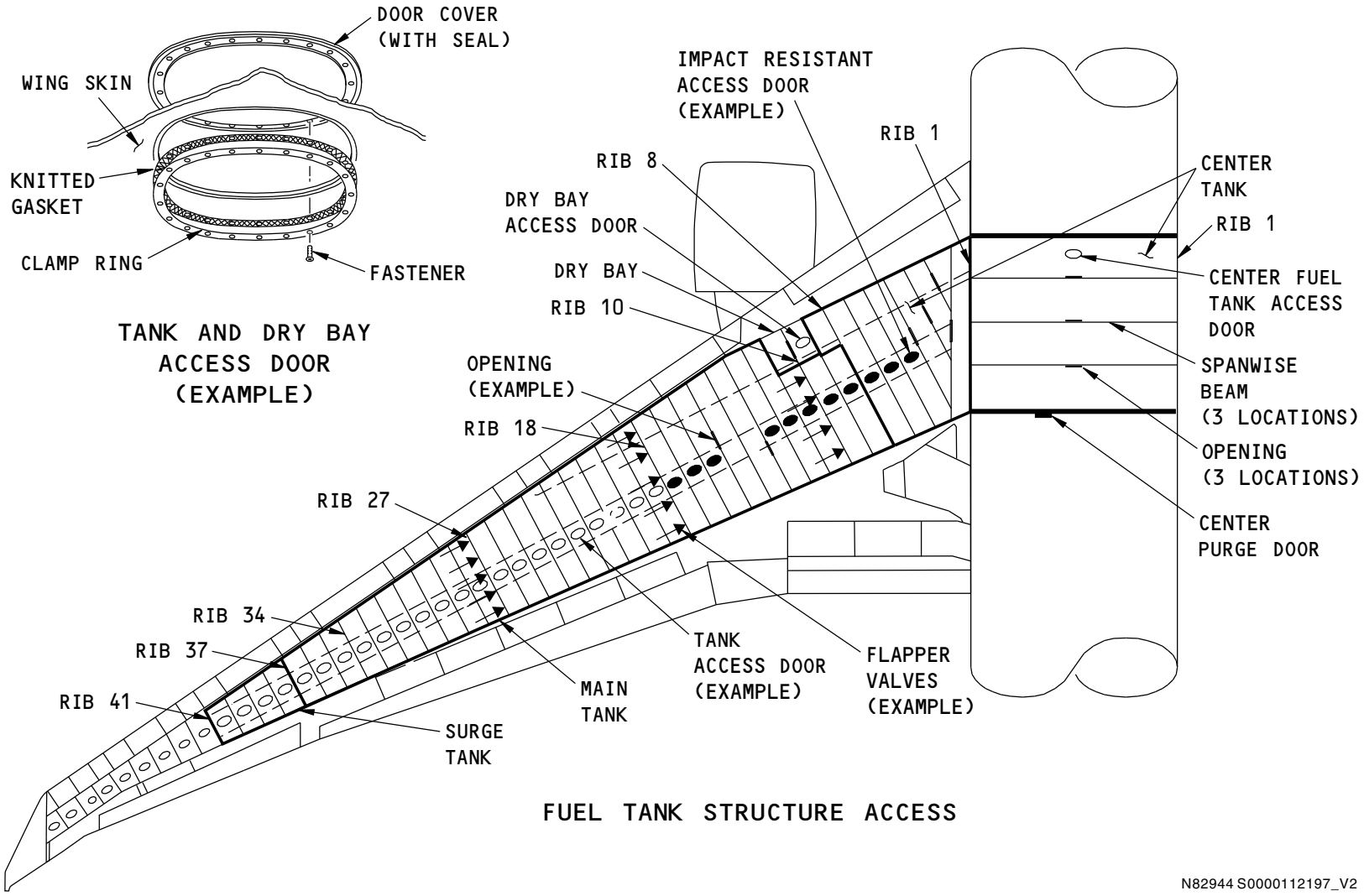
Eight of the access doors in each main fuel tank have fuel quantity measuring stick assemblies.

The eleven inboard access doors of each wing have impact-resistant access doors.

Rib and Spanwise Beam Cutouts

Some of the bays do not have an access door. You can get access to these bays from adjacent bays. Access openings in wing ribs and spanwise beams let you go in from an adjacent bay.

The purge door is in the left main wheel well. It supplies an opening for airflow when you purge the fuel bays in the center wing section.



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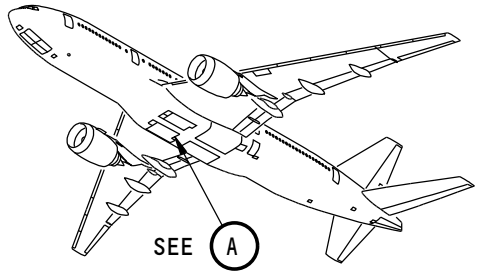
General

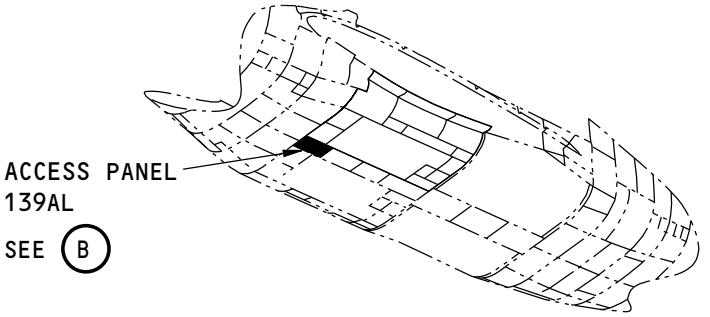
You remove access doors on the bottom of the tanks and dry bays to get access inside the tanks.

Center Wing Section Access

You get access into the center wing section fuel bays through a single access door. The access door (139AZ) is on the forward, center, lower skin of the center wing section. You must open panel 139AL on the wing- body fairing to get to access door 139AZ.

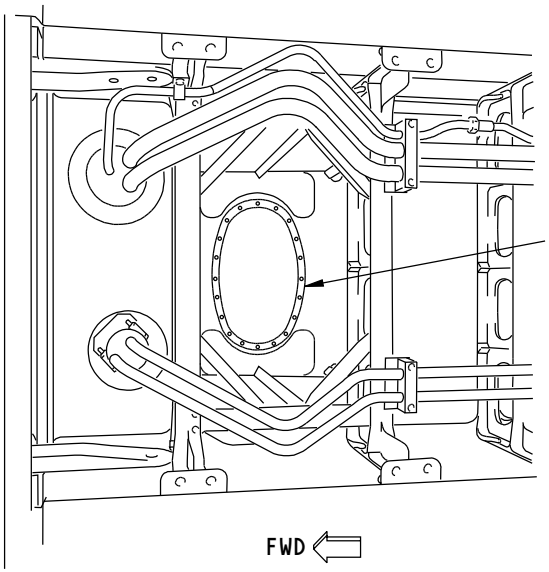
Spanwise beams in the center wing section have baffle doors. To get access to each bay, you must remove the baffle door for that bay.





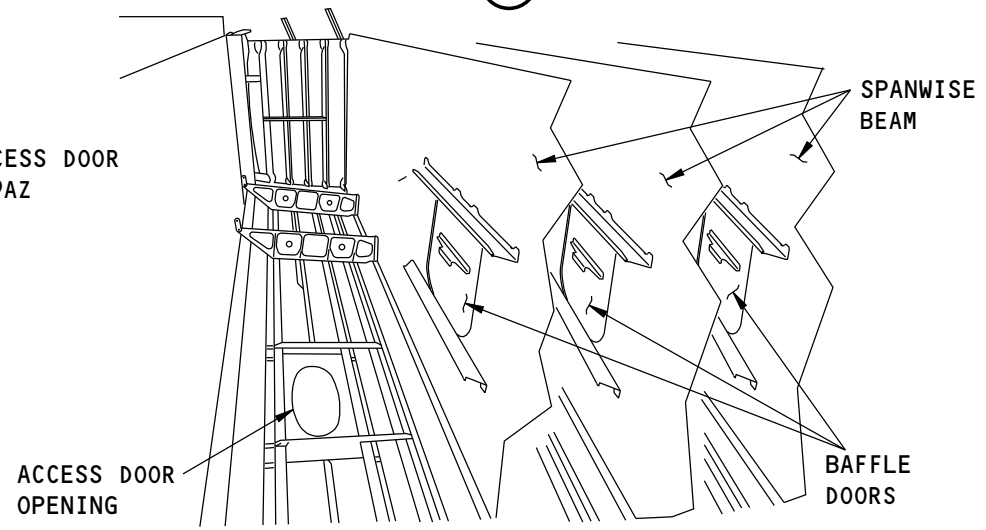
WING-BODY FAIRING AREA

A



CENTER WING SECTION ACCESS
(VIEW LOOKING UP)

B



CENTER WING SECTION
(VIEW INSIDE)

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FUEL STORAGE - SUMP DRAIN VALVES

General

Sump drain valves are at the low point of each fuel tank.

You use the sump drain valves to these functions:

- Get fuel samples
- Remove water and contaminants from the fuel tanks
- Drain all the fuel that remains after the defuel procedure
- Check for fuel in a surge tank before you open an access door.

Component Locations

The center tank has two sump drain valves. The valves are at the low points of the center wing section next to the side of body ribs. You get access to each valve through an access door in the wing-to-body fairing. A flexible hose connects the valve to a drain hole in the fairing.

Each main tank has one sump drain valve. The sump drain valve is in the lower wing skin near the fourth access door from the fuselage (between rib 8 and rib 9).

A sump drain valve for each surge tank is between rib 37 and rib 38 (31 access doors away from the fuselage).

Functional Description

Each sump drain valve in the main tank and the surge tank has a primary poppet and a secondary poppet (not shown). The secondary poppet lets you remove the primary poppet without defueling.

The sump drain valve in the center tank has a poppet valve in the valve body. A flapper valve lets you remove the valve body without defueling.

Operation

To drain fluid from the center tank, push up on the flexible hose connection on the sump drain valve. This opens the valve and lets the fuel sample drain through the hose. Use a container to collect the sample at the drain hole in the wing-to-body fairing. You must hold the valve in the open position.

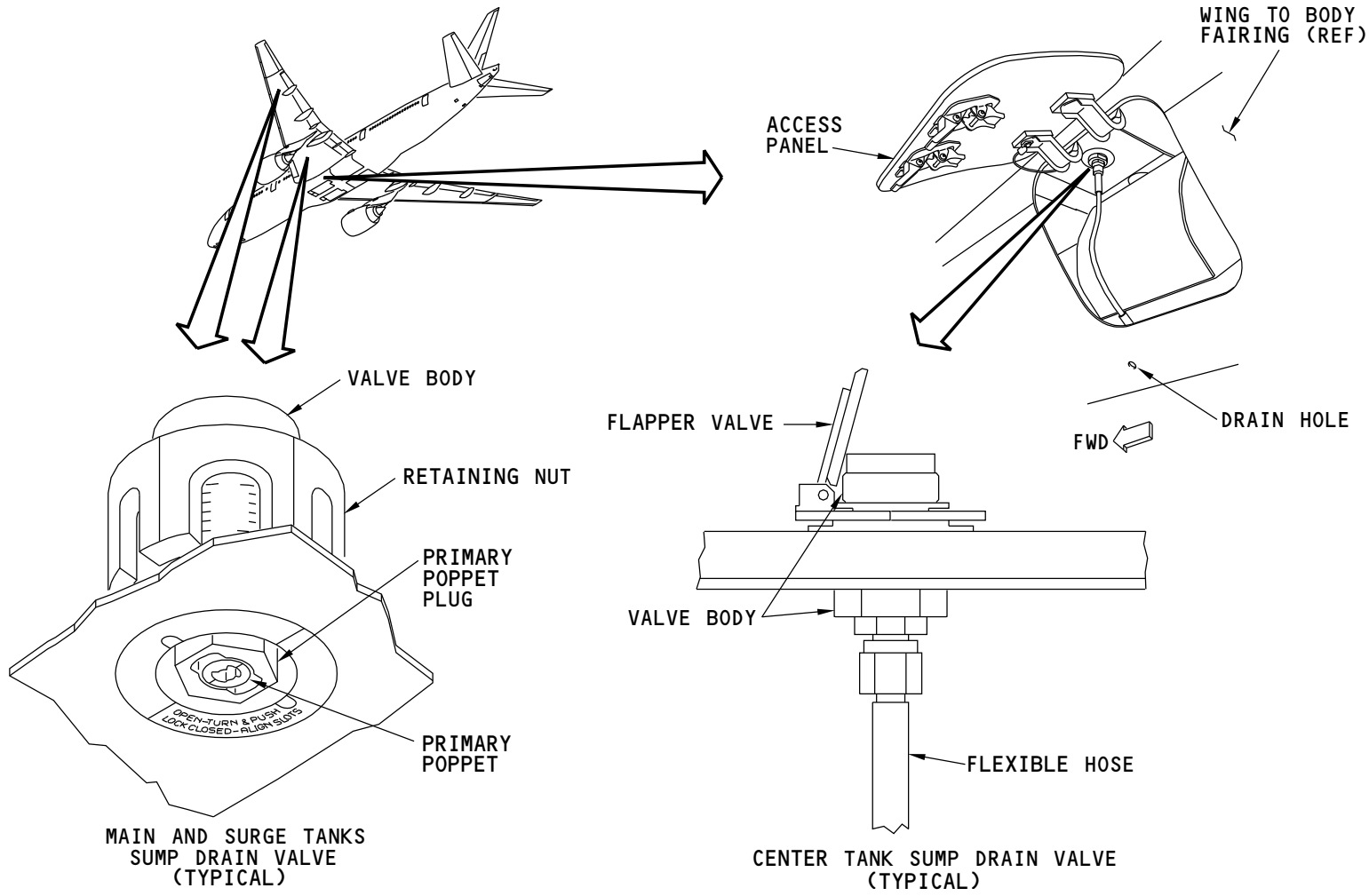
To drain fluid from a main tank or to check for fuel in a surge tank, turn and push up on the primary poppet with a fuel sampling tool. You must hold the poppet in the open position.

To drain the fuel that remains after you do the defuel procedure, you can remove the primary poppet plug and primary poppet. Then install the sump drain fitting/tool to hold the secondary poppet open. This lets all the fuel drain through the sump drain/fitting tool.

Training Information Point

You should get a fuel sample from the sump drain valves before and after you do the refuel procedure. A large quantity of water in a fuel sample that you drain from a tank before refueling is an indication of a blocked water scavenge jet pump.

Cold weather can freeze the water in the fuel tanks. This can prevent the drain valves from opening.



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FUEL STORAGE - SUMP DRAIN VALVES

FUEL STORAGE - TANK VENT SYSTEM

General

The fuel vent system keeps the pressure of the fuel tanks near the pressure of the outside atmosphere. A large pressure difference can damage the wing structure.

Drains let fuel in the vent system return to the fuel tanks so the engines or APU can use it.

Flame arrestors make sure that a flame does not come inside the fuel tanks through the vent system. If a flame arrestor becomes blocked, pressure relief valves in the surge tank open to make a vent.

Component Locations

Hat-section upper stringers and the upper wing skin make vent channels. A vent tube that has a drain valve at the low point attaches to each vent channel.

Each main tank has a forward and an aft vent channel. A fuel vent float valve attaches to the outboard end of each forward vent channel.

The center tank has three vent channels. Two float actuated drain valves attach to the low points on each vent channel.

There is a vent scoop access door in each surge tank. Each vent scoop contains a flame arrestor.

There is a pressure relief valve in the inboard access door of each surge tank.

A check valve in the inboard rib of each surge tank lets any fuel in the surge tank drain back into the main tank.

Functional Description

Vent channels and vent tubes keep the pressure of all the fuel tanks near the pressure in the surge tanks. The surge tanks are open to outside air through the vent scoops. The shape of the vent scoops keep positive pressure inside the surge tanks during flight.

Vent tube drain valves let fuel in the vent tubes drain back into the tank when the fuel level is below the level of the valve.

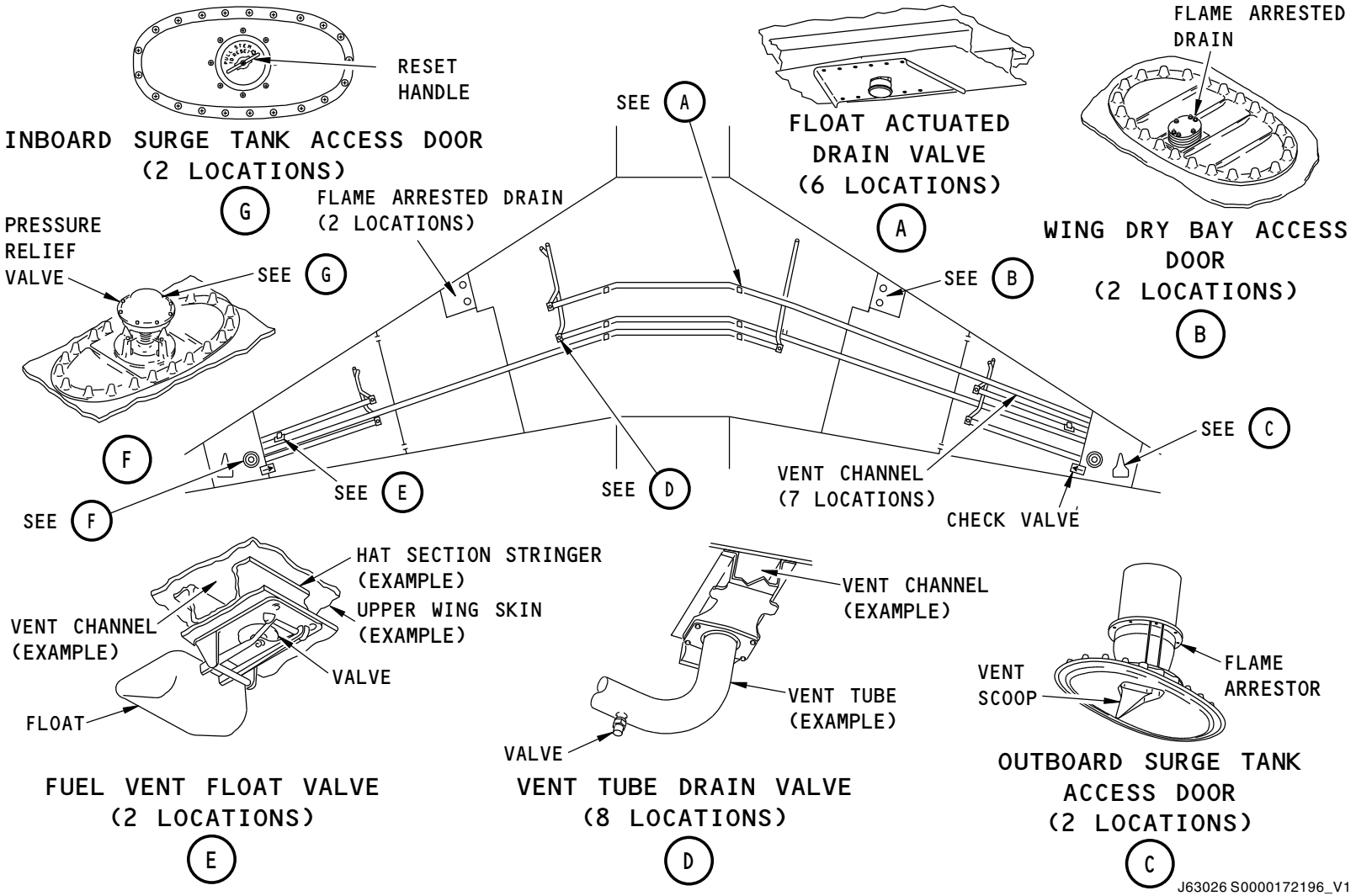
Fuel in the center tank vent channels drains through the float-actuated drain valves when the drain valves are not covered by fuel. Float-actuated drain valves close when the fuel level is above them. Thus, fuel does not get into the vent channels through the drain valves.

When the fuel level is higher than the outboard end of the main tank vent channels, the fuel vent float valves close to keep fuel out of the vent channels. When the fuel level is below these valves, the floats open them.

The pressure relief valve is normally closed. When it is closed, the valve is in line with the bottom of the wing. If a pressure difference opens the valve, it moves up as it opens. A spring holds the valve open until you close it. Pull the reset handle to move the valve back to the closed position.

Training Information Point

When you do an inspection, you must look at the pressure relief valves. Make sure they are closed. An open pressure relief valve is a symptom of a blocked vent scoop or flame arrestor. The pressure relief valve can also open to relieve air or fuel pressure if there is too much pressure during refueling.



FUEL STORAGE - TANK VENT SYSTEM

FUEL STORAGE - TANK ENTRY - TRAINING INFORMATION POINTS

Fuel Tank Entry

The fumes from fuel in a fuel tank are explosive and poisonous.

Before you go into a fuel tank, you must defuel the fuel tank and decrease the fuel fumes to a safe level. You do the purging and fuel tank entry procedure to remove fuel fumes.

A spark in the fuel tank can cause an explosion. When you are in a fuel tank you must do these things to prevent sparks:

- Put on approved clothing
- Obey the fuel fume concentration limits
- Have good air flow through the tank
- Obey instructions for use of tools.

Clothing

You must put on approved clothing, and rubber gloves. Nylon, rayon, silk, or wool clothing can cause sparks and are not approved.

Fuel Fume Concentration

The air in the fuel tank must be fire-safe or, health-safe. The limits for the fire-safe condition and the health-safe condition are in the purging and fuel tank entry procedure.

A fuel tank in the fire-safe condition is safe to work in if you use respirator equipment. A fuel tank in the health-safe condition is safe to work in without respirator equipment.

You use a combustible gas indicator to measure the fuel fume concentration in a fuel tank.

Air Flow

The fuel tank must have a good flow of air to keep it fire-safe or health-safe.

Install an air mover in an access door at one end of the tank. Remove an access door at the opposite end of the tank, so the air mover can pull a good flow of air through the fuel tank.

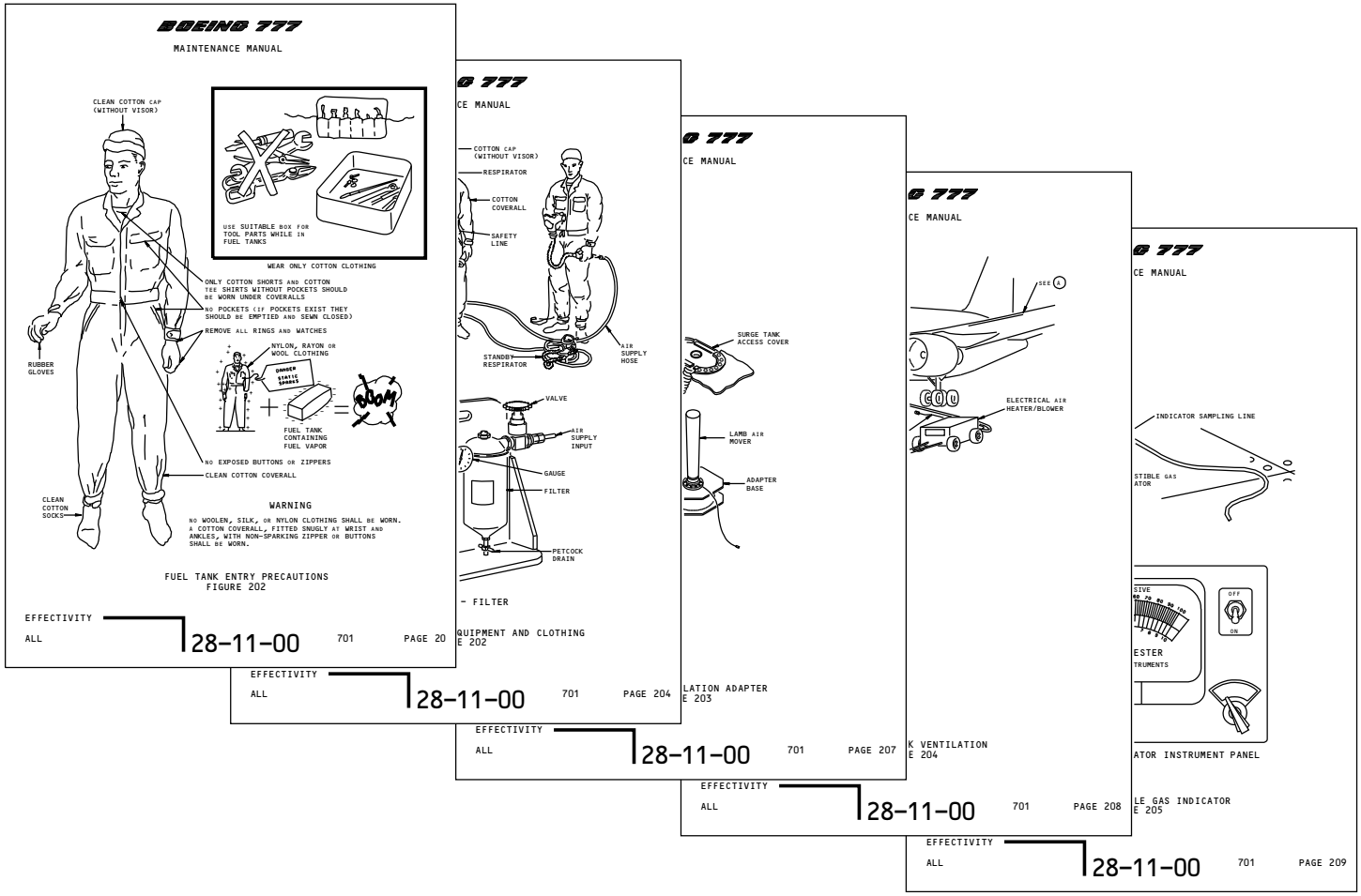
In the main tanks, make sure that the air mover pulls the air inboard. This lets a good flow of air go through the baffle rib.

Tools

Keep tools in non-static containers that have rounded corners while you do not use them.

Use only explosion-proof electrical equipment.

Make sure to remove all the equipment you bring into the fuel tank.



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FUEL STORAGE - TANK ENTRY - TRAINING INFORMATION POINTS

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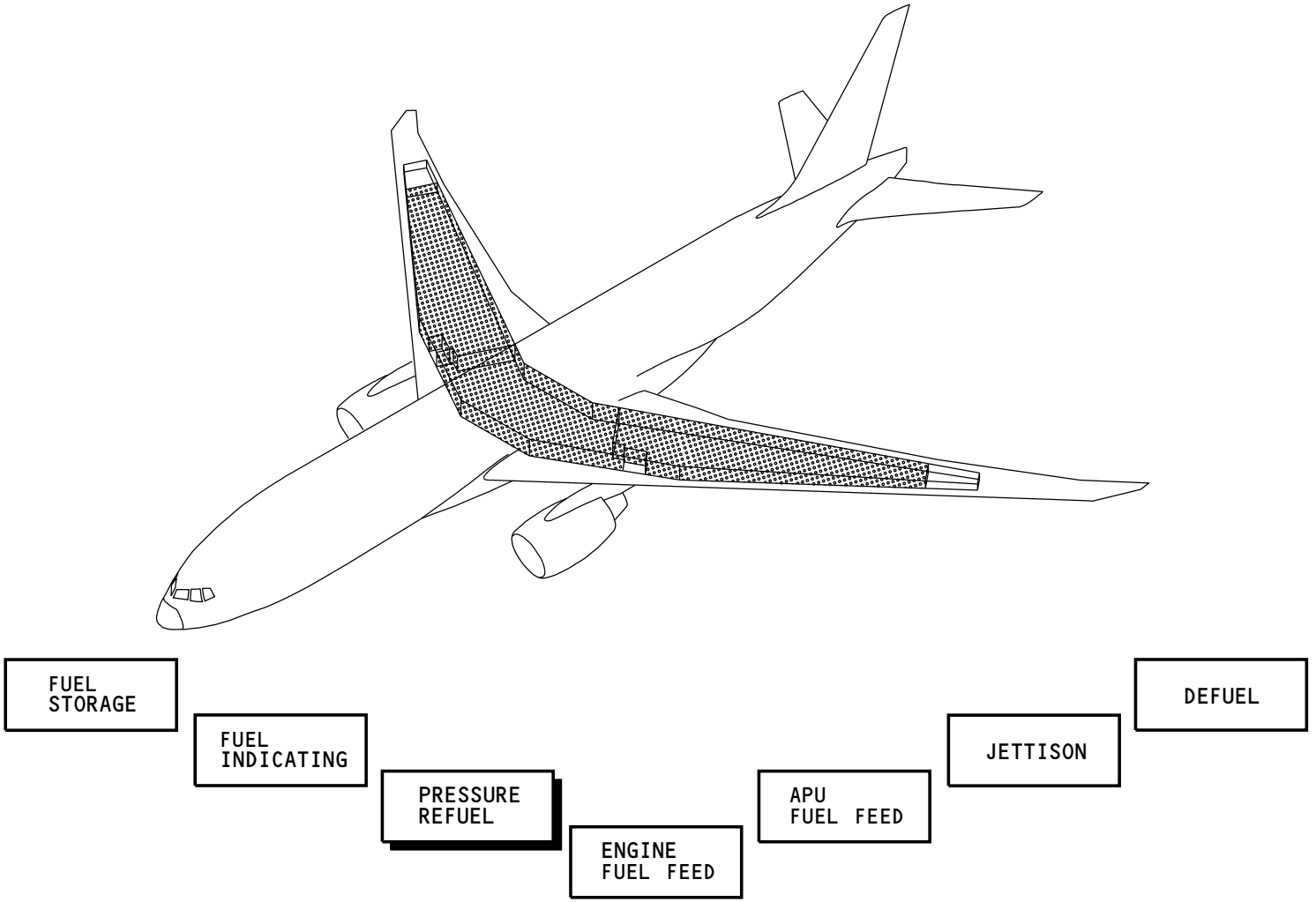
PRESSURE REFUEL - INTRODUCTION

General

The pressure refuel system transfers fuel from the refuel adapters to the main and center tanks. You operate the pressure refuel system with an integrated refuel panel (IRP).



PRESSURE REFUEL - INTRODUCTION

PRESSURE REFUEL - GENERAL DESCRIPTION

General

The pressure refuel system transfers fuel from the refuel adapters to the airplane tanks. You operate the pressure refuel system with the IRP on the left wing. The FQPU and the ELMS control the system.

Fault information goes to the AIMS.

Control

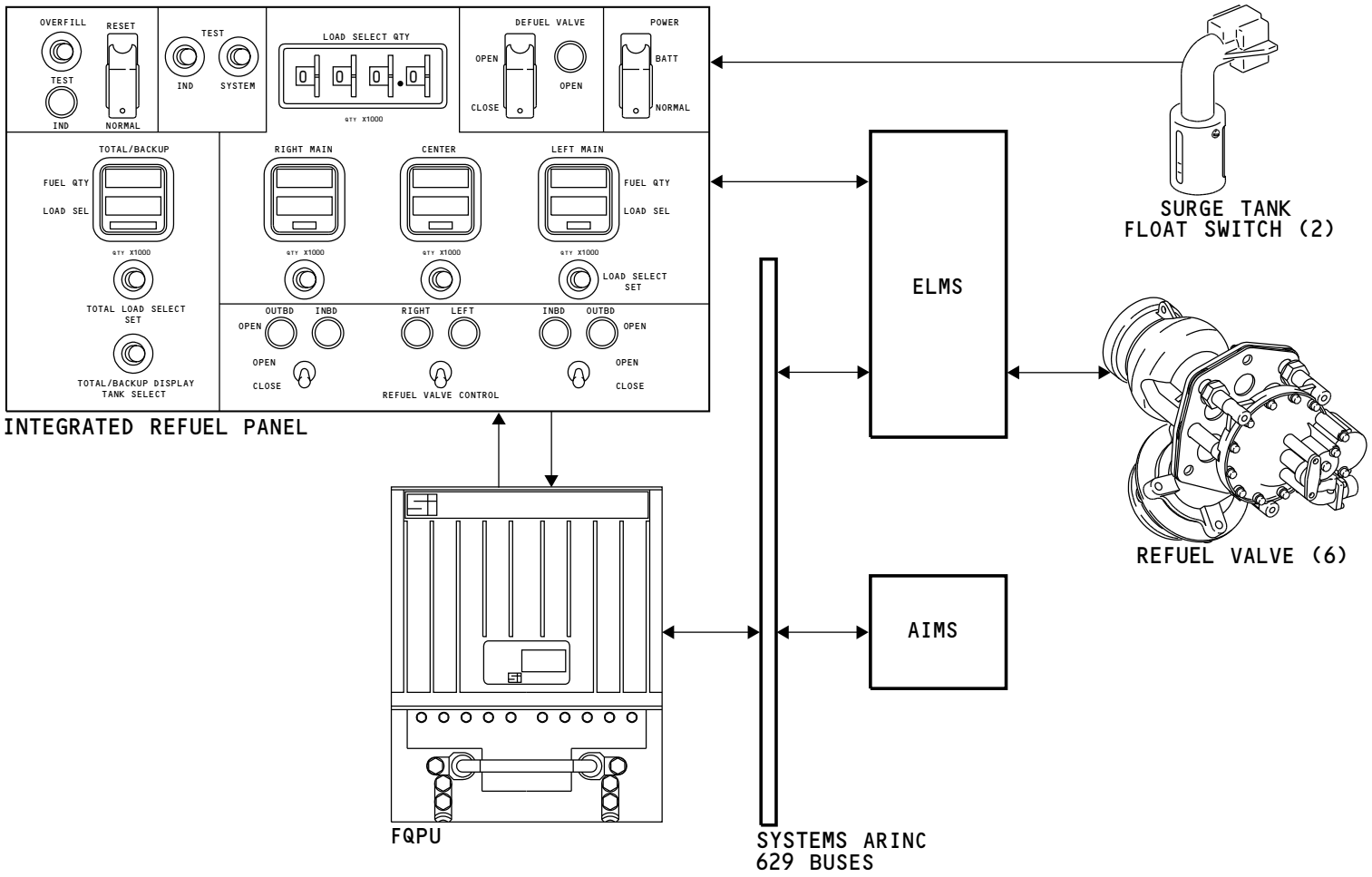
The IRP sends fuel load data and refuel valve switch positions to the FQPU through an ARINC 429 data bus. The processor sends the switch positions to the ELMS through the systems ARINC 629 buses. The ELMS supplies power to open and close the refuel valves.

Indication

The ELMS monitors refuel valve positions. When a refuel valve is open, the ELMS sends a signal to the FQPU on the systems ARINC 629 buses. The FQPU makes the related valve-open light come on.

Overfill Protection

There is a surge tank float switch in each surge tank. If fuel enters the surge tank, the surge tank float switch sends a signal through the IRP to the ELMS. This causes the ELMS to remove power from all the refuel valves so the valves close.



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PRESSURE REFUEL - GENERAL DESCRIPTION

PRESSURE REFUEL - COMPONENT LOCATIONS

General

The components for the pressure refuel system are:

- Refuel stations
- Refuel valves
- Secondary refuel valves.
- Refuel/jettison manifold
- Refuel/jettison manifold drain valves
- Refuel/jettison manifold vacuum relief valves.

Refuel Stations

There is a refuel station on the leading edge of each wing, outboard of the engines. The left refuel station has an access door, two refuel adapters, and an IRP. The right wing refuel station is the same except it does not have an IRP.

Refuel Valves

There are six refuel valves; two in each tank. The valve bodies are on the rear spar, inside the tanks. The valve actuators are on the rear spar, outside the tanks.

The refuel valve in the left side of the center tank is aft of the second fuel tank access door. The refuel valve in the right side of the center tank is in a similar position.

The inboard refuel valve in the left main tank is aft of the fourth fuel tank access door. The outboard refuel valve in the main tank is aft of the eighteenth fuel tank access door. The refuel valves in the right main tank are in similar positions.

Secondary Refuel Valves

There are two secondary refuel valves; one on each side of the center tank. The valve bodies are on the inboard side of rib 7.

The secondary refuel valve float valve is installed on the outboard side of rib 6 on each side of the center tank.

Refuel/Jettison Manifold

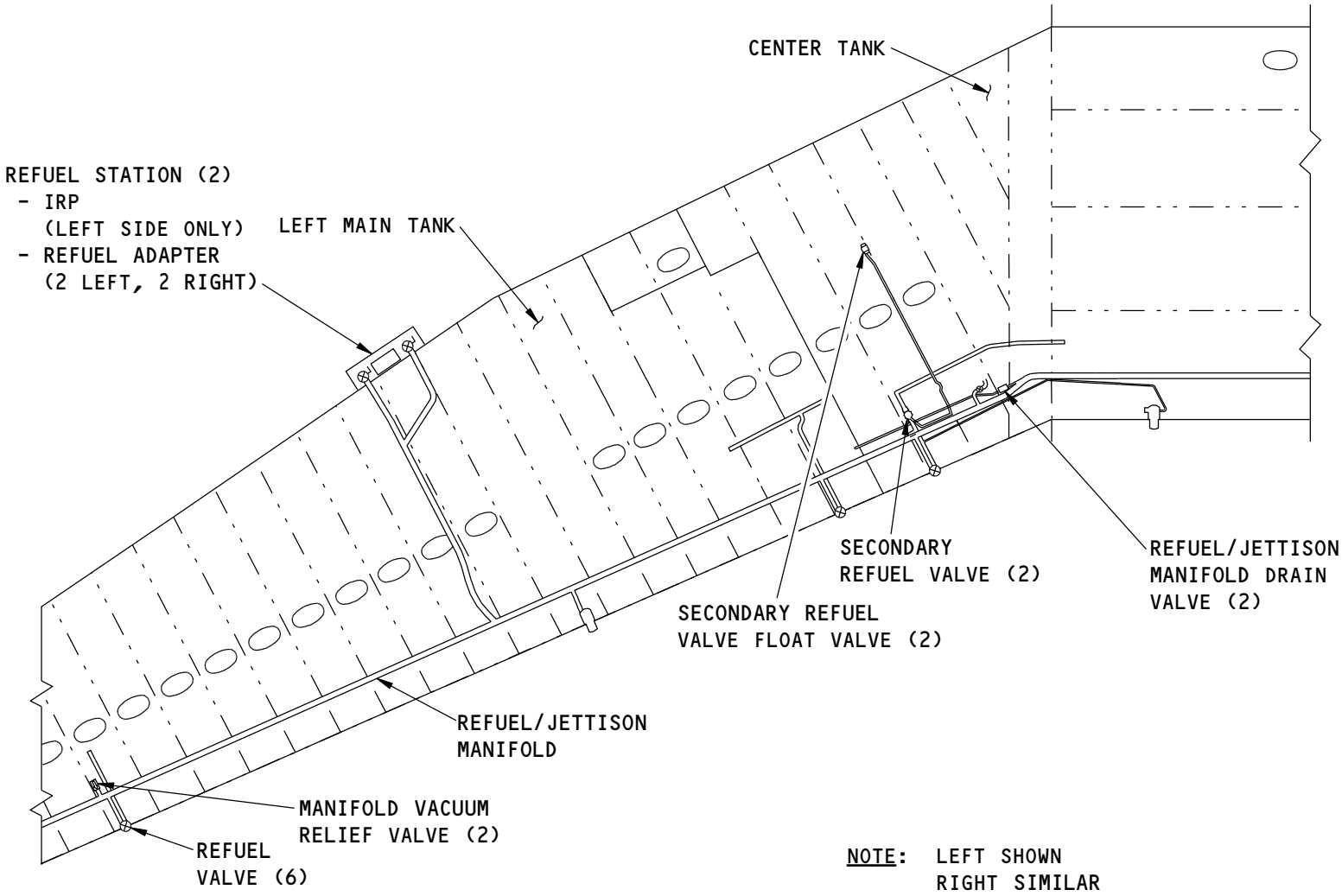
The refuel/jettison manifold connects the two refuel stations to all the refuel valves. It supplies fuel from the refuel adapters to each tank.

Refuel/Jettison Manifold Drain Valves

There are two refuel/jettison manifold drain valves. One is in each half of the center tank. You get access to them through the first fuel tank access door.

Refuel/Jettison Manifold Vacuum Relief Valves

There are two refuel/jettison manifold vacuum relief valves. They are on the refuel/jettison manifold, near the outboard refuel valve in each main tank. You get access to them through the eighteenth fuel tank access door.



2115656 S0000453376_V1

PRESSURE REFUEL - COMPONENT LOCATIONS

PRESSURE REFUEL - COMPONENT LOCATIONS - FRONT SPAR

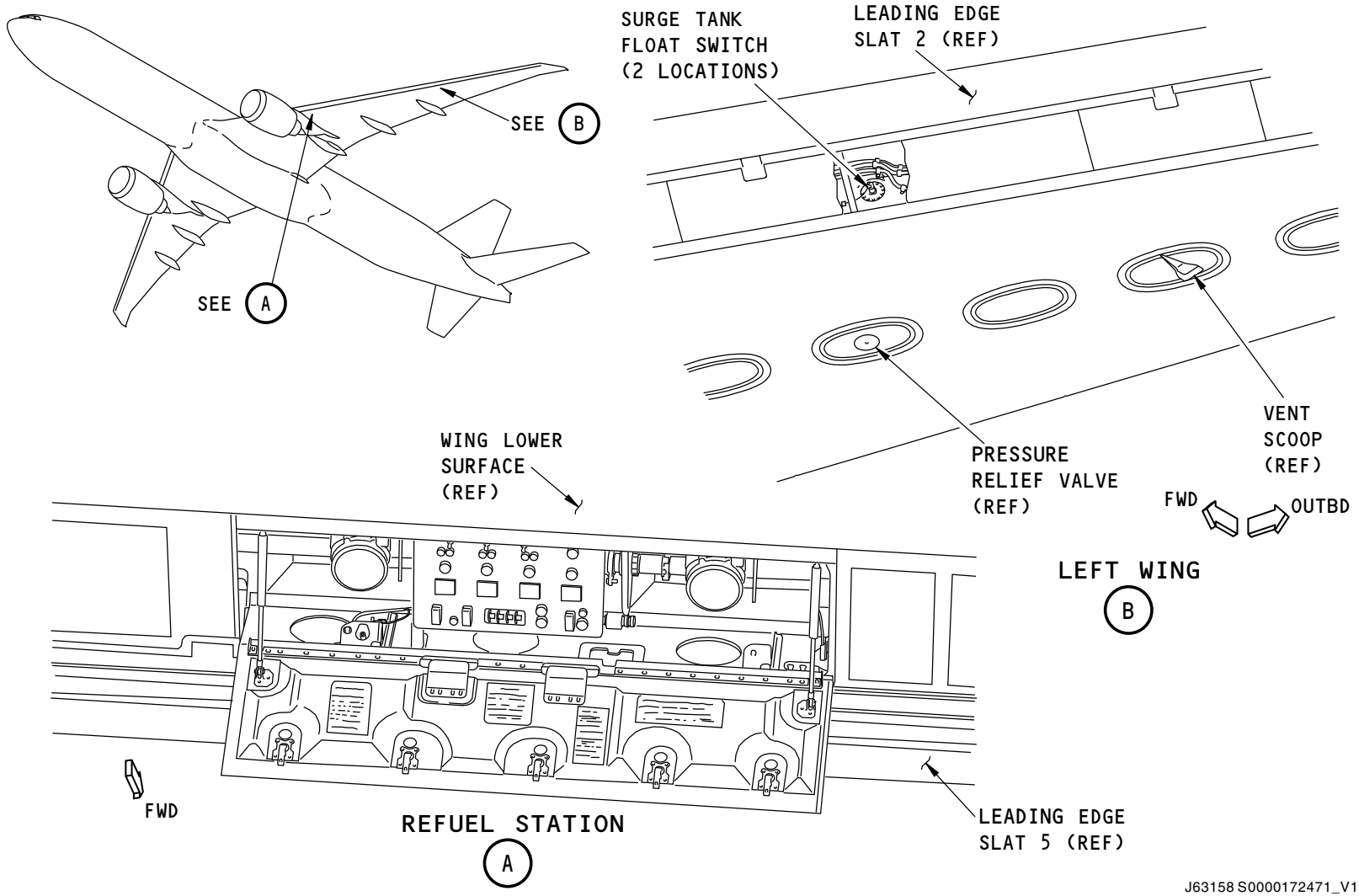
Refuel Station

There is a refuel station on the left wing aft of leading edge slat 5. This refuel station contains two refuel adapters and an IRP.

There is also a refuel station on the right wing, aft of leading edge slat 10. The right refuel station contains two refuel adapters. It does not contain an IRP.

Surge Tank Float Switches

There is one surge tank float switch on each wing, near the pressure relief valve and vent scoop. The left switch is on the front spar, aft of leading edge slat 2. The right switch is on the front spar, aft of leading edge slat 13.



J63158 S0000172471_V1

PRESSURE REFUEL - COMPONENT LOCATIONS - FRONT SPAR

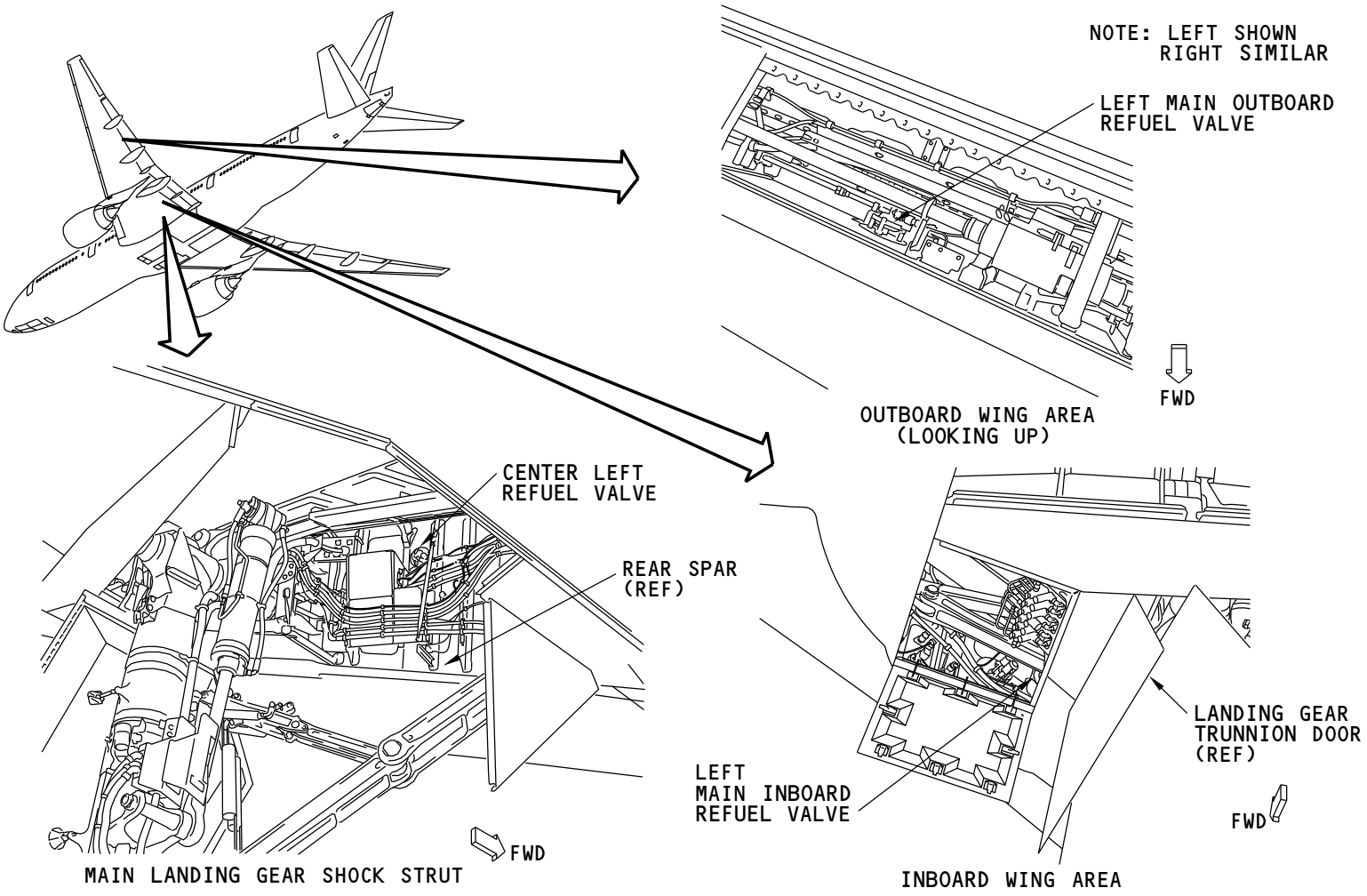
PRESSURE REFUEL - COMPONENT LOCATIONS - REAR SPAR

General

There are two refuel valves in each fuel tank.

In the left main fuel tank, the inboard refuel valve actuator is outboard of the main landing gear shock strut. The outboard refuel valve is between the fairings of the outboard flap. The refuel valve actuators are in similar locations in the right main fuel tank.

In the center tank, the left refuel valve actuator is on the rear spar, inboard of the main landing gear shock strut. The right refuel valve actuator is in a similar location in the right side of the center tank.



M41278 S000617626_V1

PRESSURE REFUEL - COMPONENT LOCATIONS - REAR SPAR

PRESSURE REFUEL - REFUEL STATION

General

There is one refuel station on the leading edge of each wing. Each refuel station has these components:

- Access door
- Access door switch
- Refuel adapter (2)
- Bonding point (2).

The refuel station on the left wing also has an IRP. You use the IRP to control refuel and defuel operations. When you refuel from the right refuel station, you must still use the IRP on the left refuel station.

Access Door

Two hold-open rods keep the access door in the full-open position. To close the access door, you must move a collar on each hold-open rod. There are four placards on the access door. They tell you about refuel and defuel procedures.

When the access door is open, the access door switch permits power to go to the IRP and the FQIS processor unit. The switch also controls the panel lights.

Integrated Refuel Panel

The IRP has these parts:

- Front panel
- Fuel quantity indicators in an electronics module
- Switches and lights
- Load select module.

The electronics module has two channels.

Refuel Adapters

The refuel adapters connect the fueling nozzles to the refuel system. There are two adapters at each refuel station. The adapters attach to the front spar of the wing.

Each adapter has these parts:

- Break-away flange
- Check valve (not shown)
- Refuel/defuel handle.

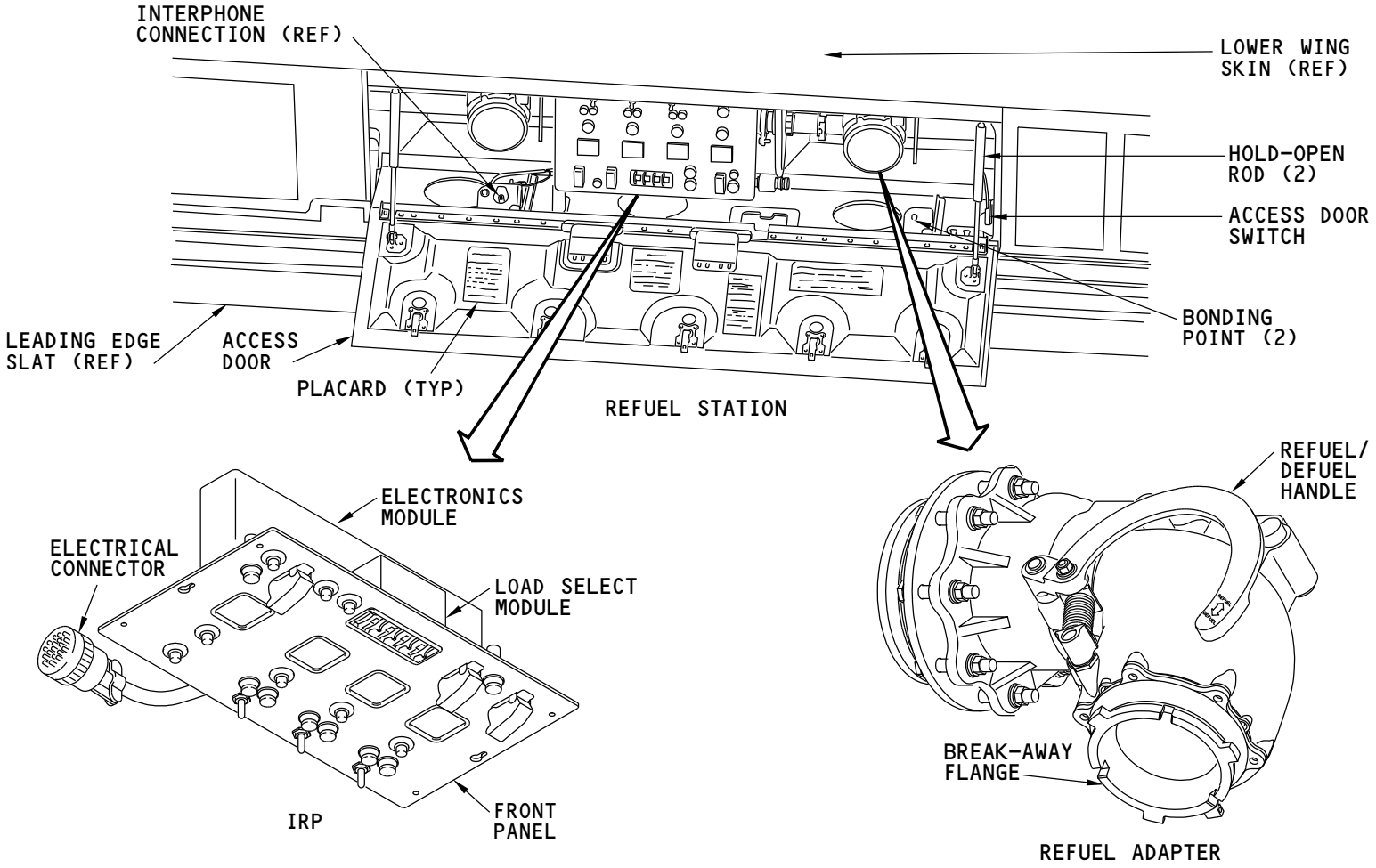
The adapter check valve prevents fuel in the refuel/jettison manifold from flowing back through the adapters.

Training Information Point

The adapter grounds the fueling nozzles to the airplane. If there is electrical continuity between the fueling source and the fueling nozzle, it is not necessary to attach a bonding cable.

Caps are not required on the adapters.

The IRP is an LRU.



M41260 S000617608_V1

PRESSURE REFUEL - REFUEL STATION

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PRESSURE REFUEL - INTEGRATED REFUEL PANEL

Overfill Test Switches

The overfill test switch starts the overfill test. This causes the overfill protection to immediately close all the refuel valves. You do the overfill test during refueling.

The overfill indication light is a red light that comes on when there is fuel in a surge tank, or when you do the overfill test. It stays on until the surge tanks are empty and the overfill reset switch is in the RESET position.

The overfill reset switch disables the overfill protection. It has two positions: NORMAL and RESET. The NORMAL position arms the overfill protection. The RESET position turns off the overfill protection.

Indicator Test Switch

The indicator test switch does a test of these indicators:

- Fuel quantity indicators
- Refuel valve position indication lights
- Defuel valve position indication light.

During the test, a test pattern shows in the fuel quantity indicators, and the valve position indication lights come on. If a fuel quantity indicator fails the test, all of its LEDs go off.

The IRP also does the indicator test when it initially gets power.

System Test Switch

You push the system test switch during refueling to do a test of the refuel system. During the test all the refuel valves close in sequence and the refuel valve position indication lights go off. Then, the valves automatically open and the lights come on again.

Load Select Quantity Selectors

The load select quantity selectors permit you to select fuel load quantity. There are four selectors. Each selector has a thumbwheel and shows a number. You turn the thumbwheel to set the related number of the fuel load quantity.

Defuel Valve Switch and Light

The defuel valve switch opens and closes the defuel valve.

The defuel valve open light is a blue light that shows the position of the defuel valve. It comes on when the defuel valve opens.

Power Switch

The power switch permits you to refuel the airplane when the ground handling bus does not have power. When you move the power switch to the battery (BATT) position, it causes the hot battery bus to send power to the refuel system.

Fuel Quantity Indicators

There are four fuel quantity indicators:

- Total/backup
- Right main
- Center
- Left main.

The fuel quantity indicators have two LED displays. The upper display shows actual fuel quantity. The lower display shows load select quantity.

The total fuel quantity indicator can show indications for one of the other tanks if its indicator fails.

Load Select Set Switches

There are four load select switches, one below each fuel quantity indicator. Load select set switches move the load select quantity from the selector to the related load select display. These switches permit you to set the total fuel load or the fuel load for each tank.

Refuel Valve Switches and Lights

Refuel valve control switches send command signals to the FQPU to control the refuel valves.

Each refuel valve open light is a blue light that shows the position of the related refuel valve. The light comes on when the valve opens.

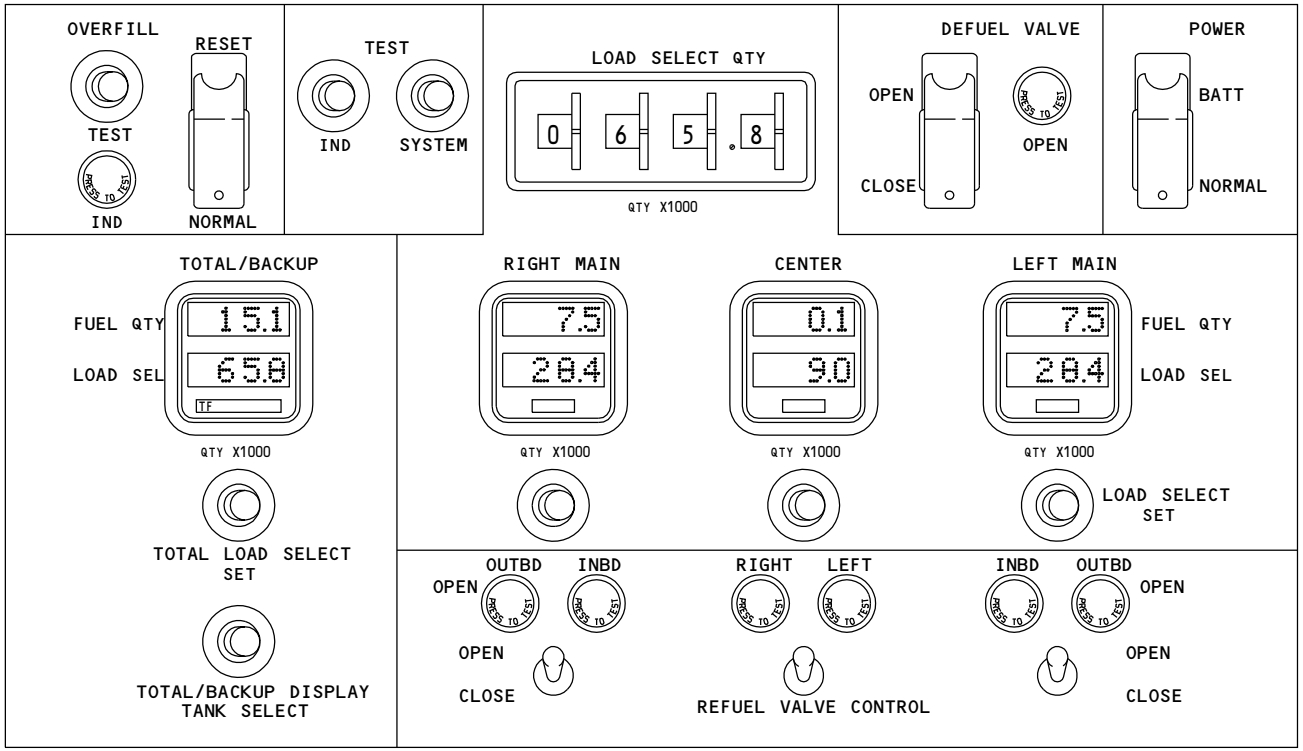
Total/Backup Display Tank Select Switch

The display tank select switch permits you to use the total fuel quantity indicator as a backup for the left, right, or center tank indicator. Each time you push the switch, a different tank quantity and identifier show on the total/backup display. This is the sequence of the identifiers:

- TF - total fuel quantity
- RM - right main tank quantity
- CT - center tank quantity
- LM - left main tank quantity.

Training Information Point

The IRP also does the indicator test when it initially gets power.



M41262 S000617610_V3

PRESSURE REFUEL - INTEGRATED REFUEL PANEL

PRESSURE REFUEL - REFUEL VALVE

General

The refuel valves permit fuel to flow from the refuel/jettison manifold into the fuel tanks. Each valve has a valve body and a control unit.

Valve Body

The valve body has a poppet-type valve. The valve body is on the rear spar, inside the fuel tank.

Control Unit

The control unit opens and closes the valve. The control unit is on the rear spar, outside the fuel tank. It has these parts:

- Solenoid
- Actuator
- Manual override knob
- Position switch.

When the solenoid energizes, it supplies pressurized fuel into the actuator. This causes the valve to open.

If the valve does not open, you can use the manual override knob to manually open and close it.

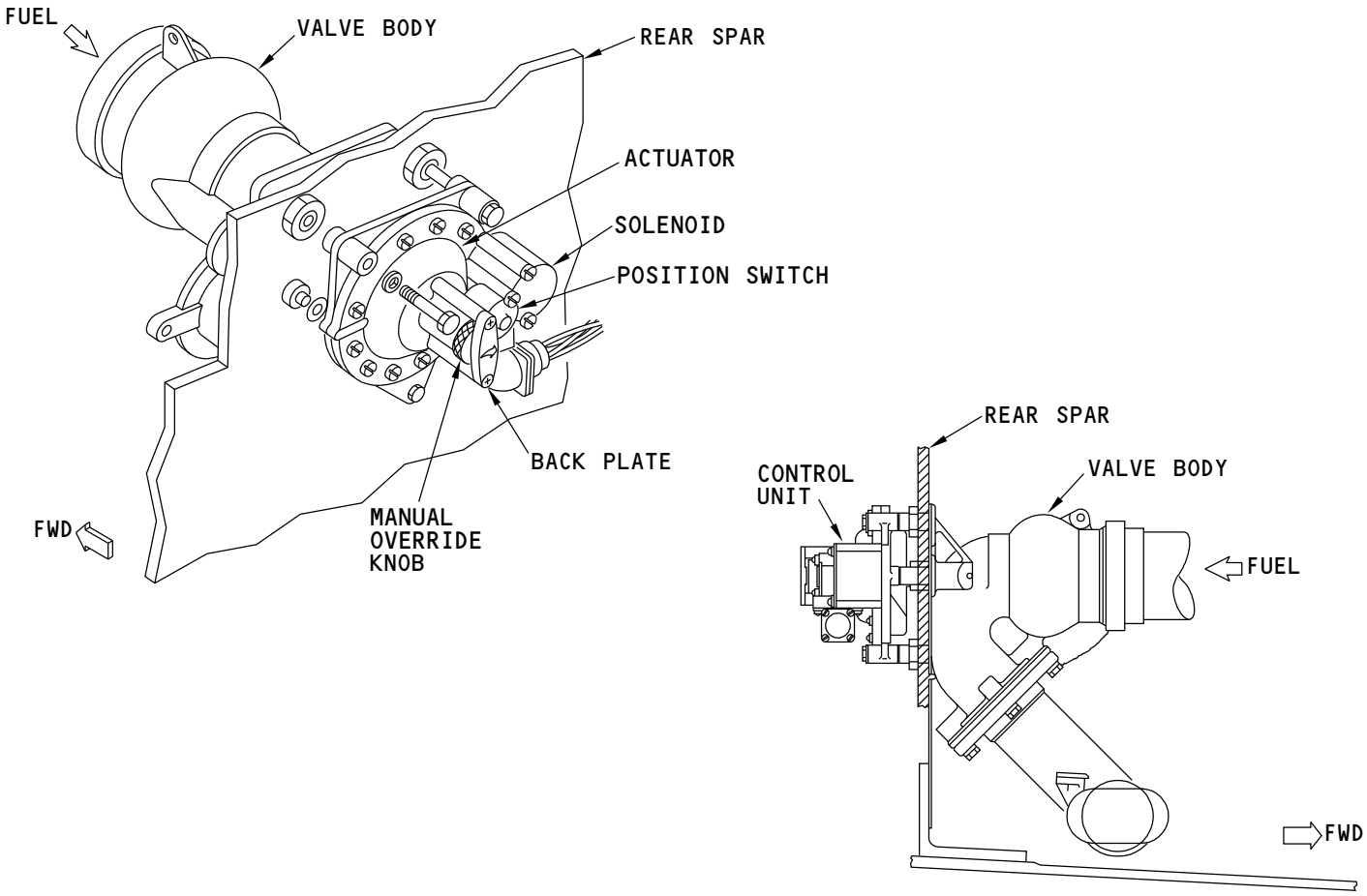
The valve position switch sends a signal to the ELMS when the valve is open. This causes the valve position light on the IRP to come on.

You can remove the control unit without defueling. A removal check valve in the valve body prevents fuel from coming out.

Do not remove or loosen the back plate when you open the valve manually.

Training Information Point

Keep manual operation of the valve to a minimum. Damage to an O-ring inside the valve can occur if you manually operate the valve many times.



M41263 S000617611_V1

PRESSURE REFUEL - REFUEL VALVE

PRESSURE REFUEL - SURGE TANK FLOAT SWITCH

Purpose

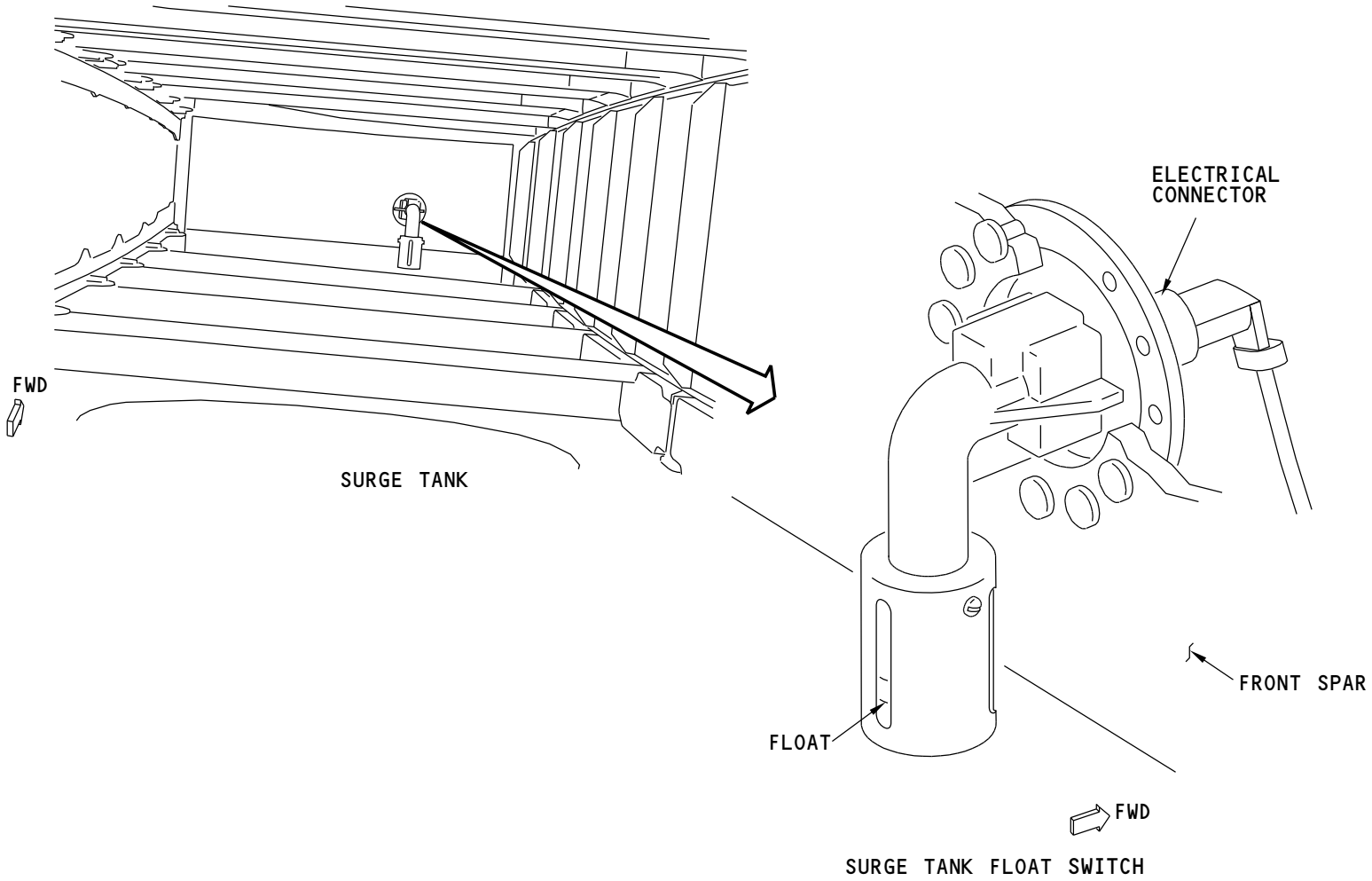
The surge tank float switch sends a signal to close all the refuel valves if there is fuel in the surge tank.

Location

One surge tank float switch is on the front spar in each surge tank.

Functional Description

Each surge tank float switch contains a magnetic reed float switch. The switch closes when fuel in the surge tank gets above a specified level.



M41264 S000617612_V1

PRESSURE REFUEL - SURGE TANK FLOAT SWITCH

PRESSURE REFUEL - REFUEL MANIFOLD VALVES

Purpose

There are two types of refuel manifold valves: refuel manifold drain valves and refuel manifold vacuum relief valves.

The refuel manifold drain valves drain fuel from the refuel/jettison manifold into the main tanks. This increases the amount of fuel that the airplane can use.

The refuel manifold vacuum relief valves prevent a vacuum in the manifold, so fuel can drain.

Location

Two refuel manifold drain valves are in each refuel manifold drain line. You get access to the inboard drain valves through the first fuel tank access door. You get access to the outboard drain valves through the eighteenth fuel tank access door (between ribs 24 and 25).

One manifold vacuum relief valve is on the refuel manifold near the outboard refuel valve in each main tank. You get access to the vacuum relief valve through the eighteenth fuel tank access door (between ribs 24 and 25).

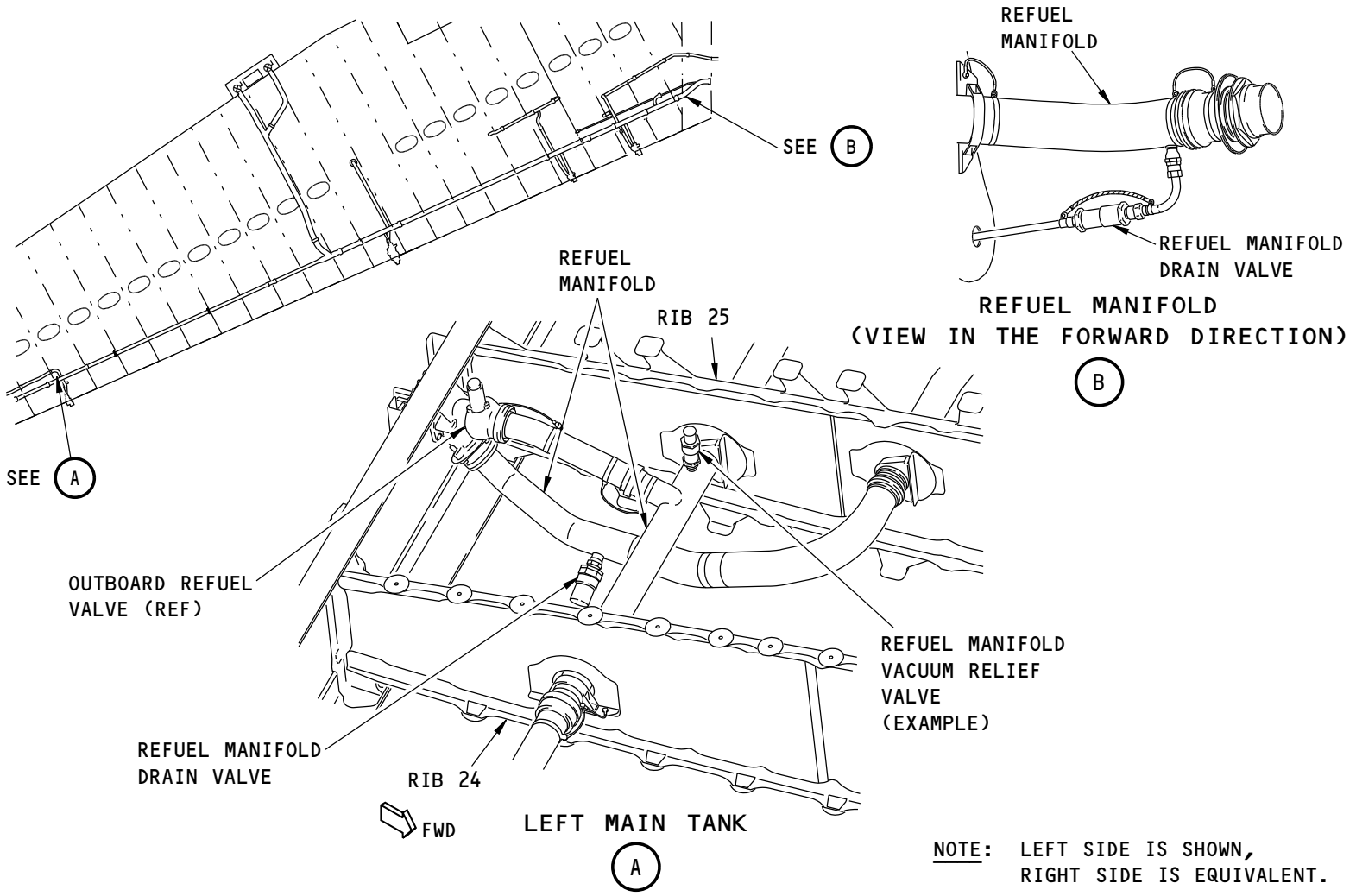
Refuel Manifold Drain Valve - Functional Description

When the manifold has pressure, the valve prevents fuel from flowing into the main tanks.

When the main tank is full, the drain valve prevents fuel from flowing from the tank into the manifold. When the main tank is not full, fuel drains from the refuel/jettison manifold into the main tank.

Refuel Manifold Vacuum Relief Valve - Functional Description

When fuel drains through a refuel manifold drain valve, the pressure in the refuel manifold becomes less than the pressure inside the fuel tank. This causes the refuel manifold vacuum relief valve(s) to open. The open valve permits air to enter the refuel manifold and increase the pressure. Then fuel can continue to drain from the refuel manifold.



J63358 S0000172502_V1

PRESSURE REFUEL - REFUEL MANIFOLD VALVES

CENTER TANK CHECK VALVES

Purpose

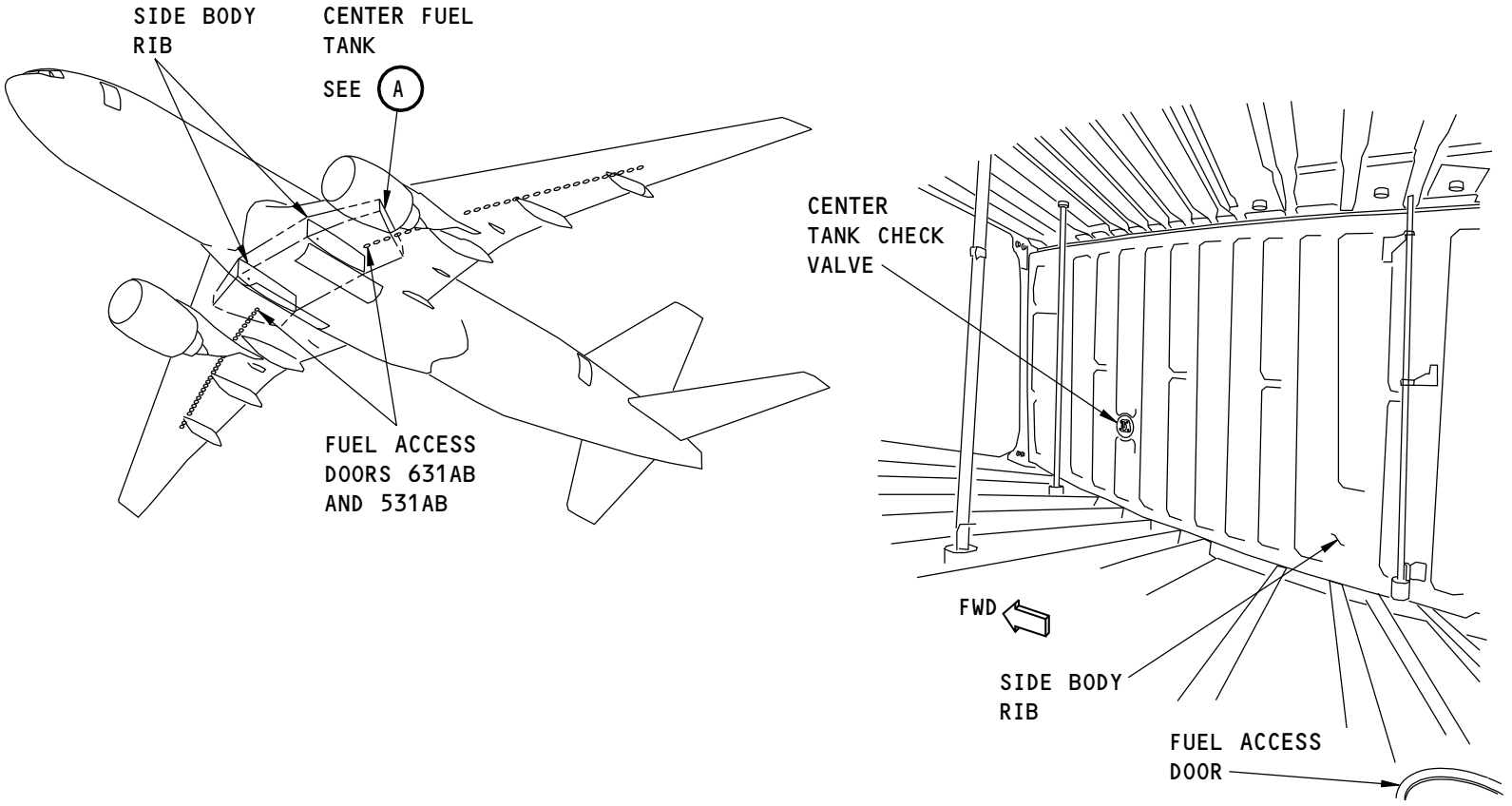
The center tank check valves help to make a more even distribution of fuel between the center tank wing stub bays and cheek bays during refueling.

Location

One center tank check valves is installed on each of the side of body ribs. Access to the center tank check valves is through the cheek tanks.

Functional Description

The center tank check valve is a flapper valve that permits fuel to flow from the wing center section into the cheek tank. The check valve prevents the flow of fuel from the cheek tank to the wing center section.



CENTER FUEL TANK
(LEFT SIDE IS SHOWN, RIGHT SIDE IS OPPOSITE)

A

W56442 S0000126341_V1

PRESSURE REFUEL - CENTER TANK CHECK VALVE

PRESSURE REFUEL - SECONDARY REFUEL VALVE

General

The secondary refuel valve increases the rate at which the center tank can be refueled.

Location

The secondary refuel valve is located on the inboard side of rib number 7 in the center tank. There is one secondary refuel valve on each side of the center tank.

The secondary refuel valve float valve is located on the outboard side of rib number 6 in the center tank. There is one secondary refuel valve float valve on each side of the center tank.

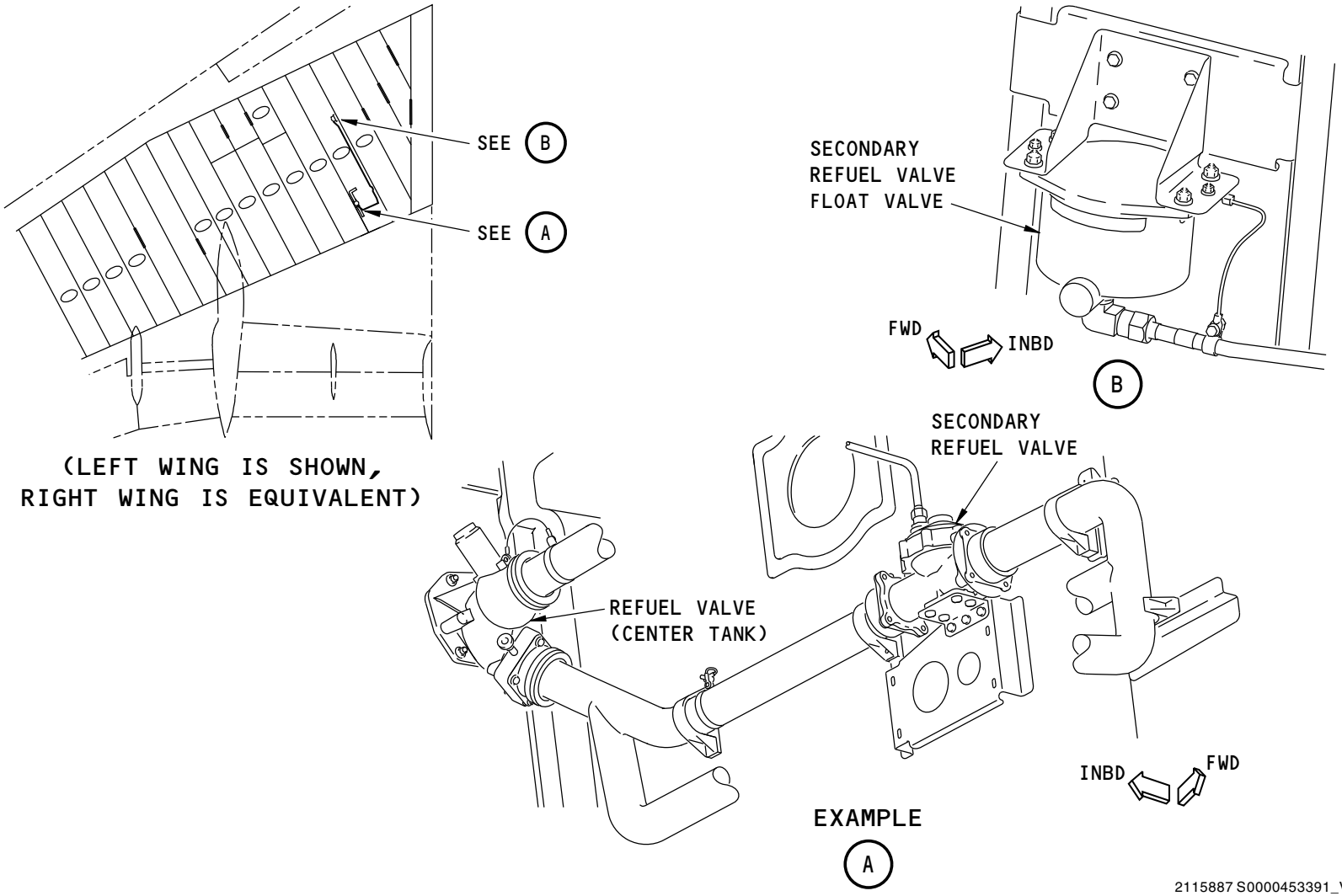
Control

The secondary refuel valve is controlled by the secondary refuel valve float valve. When the fuel level is below the secondary refuel valve float valve, the secondary refuel valve is open. When fuel reaches the secondary refuel valve float valve, the pilot valve closes the secondary refuel valve.

Functional Description

The secondary refuel valve opens a secondary fuel path after fuel passes through the center tank refuel valve. The secondary path increases the rate at which the center tank can be refueled.

A spring loaded diaphragm usually keeps the flapper in the secondary refuel valve closed. Pressurized fuel comes in the valve and pushes against the flapper. This causes the flapper to open and let fuel go through the valve. Fuel also bleeds into the upper diaphragm compartment. Pressure on the upper diaphragm can not increase while fuel goes out of the pilot port and through the sensing line and pilot float valve. The flow through the sensing line stops when the pilot float valve float moves up with an increase in fuel level. This causes the pressure to increase on the diaphragm until the pressure is equal to the fuel pressure in the main distribution manifold. This balance in fuel pressure lets the flapper and the diaphragm close the valve.



PRESSURE REFUEL - SECONDARY REFUEL VALVE

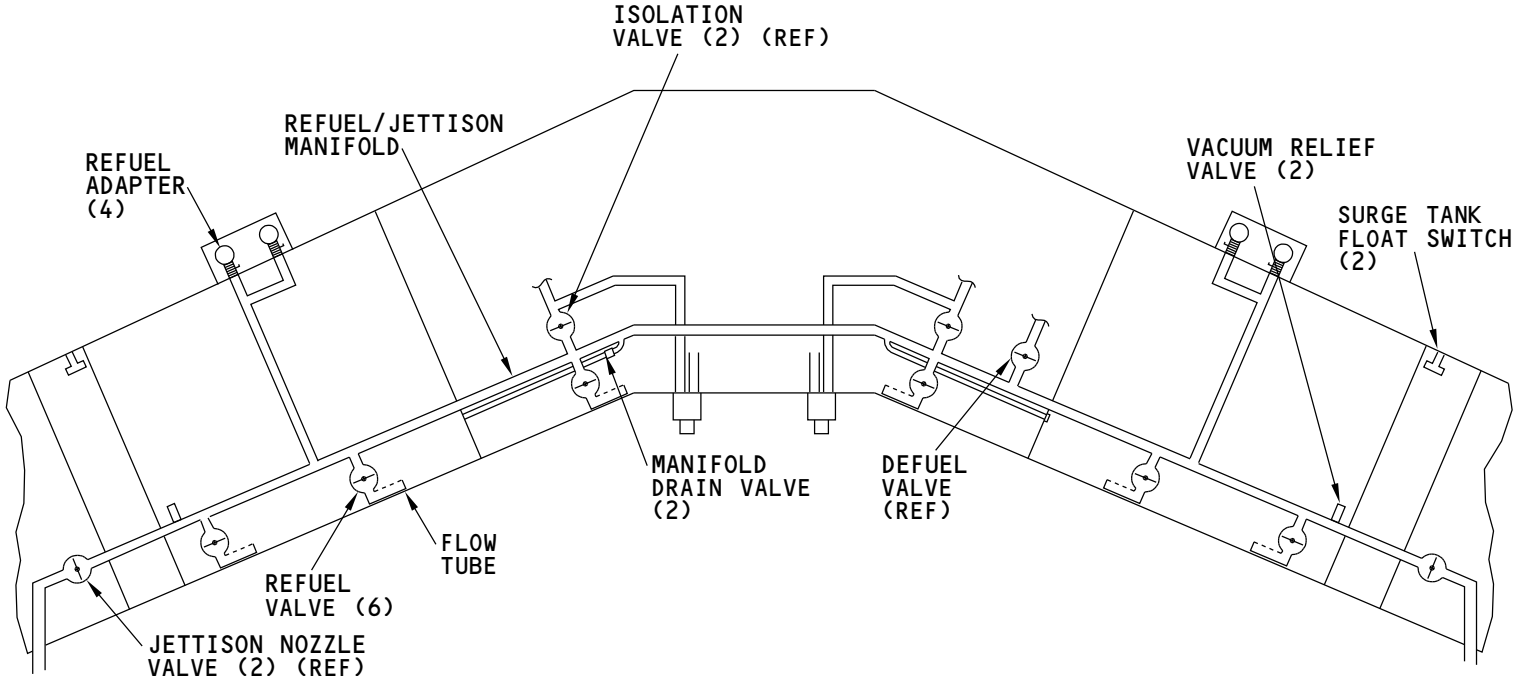
PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

Fuel flows from the refuel adapters into the refuel/jettison manifold. When the refuel valves open, fuel flows from the manifold into the fuel tanks. A flow tube at the end of each refuel valve decreases the exit force of the fuel. The flow tube also puts the fuel in different parts of the tank.

The refuel valves close to stop fuel flow. Fuel that is left in the refuel/jettison manifold goes through the manifold drain valves and into the main tanks. The manifold has two vacuum relief valves. These valves permit air to go into the manifold when the fuel goes out of the manifold drain valves.

If a refuel system failure prevents the refuel valves from closing, fuel goes into the surge tanks. If the fuel gets to the level of the surge tank float switches, the switches close. When one of the two switches close, the ELMS closes all refuel valves.



M41270 S000617618_V1

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - POWER

General

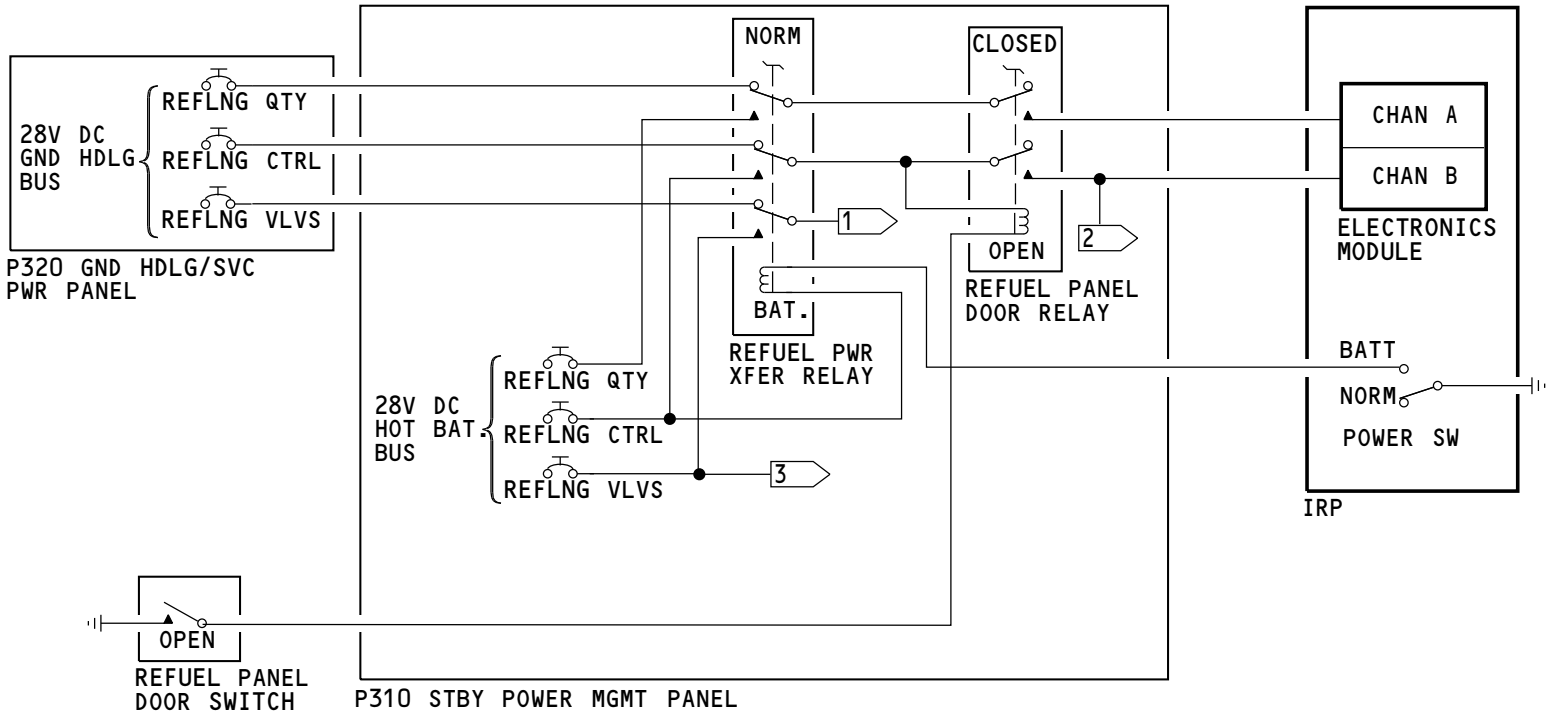
Power for the refuel system comes from the ground handling bus or the hot battery bus. Power control relays for the refuel system are in the standby power management panel.

Ground Handling Power

When the refuel panel door opens, the refuel panel door relay energizes. This permits power to go from the ground handling bus to the IRP.

Battery Bus Power

If the ground handling bus has no power, you close the refuel power (POWER) switch. This energizes the refuel power transfer relay and permits power to go from the hot battery bus to the IRP and the overfill control relay.



1 OVERFILL CONTROL RELAY

2 OVERFILL CONTROL RELAY COIL

3 REFUEL VALVE CONTROL RELAYS (6)

M41271 S000617619_V1

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - POWER

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PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - CONTROL

General

During automatic refueling, you use the IRP to set the fuel load and to open the refuel valves. The FQPU closes the refuel valves.

During manual refueling, you use refuel valve control switches on the IRP to open and close the refuel valves

Refuel Valve Open Control

The refuel valves open when they get a refuel-valve-open command from the FQPU. The IRP sends refuel valve switch position signals to the FQPU on an ARINC 429 data bus. The FQPU sends refuel-valve-open commands on the systems ARINC 629 buses to the CCU in the P310 standby power management panel. The CCU supplies a ground to close each refuel valve control relay. This permits power to go to the related refuel valve solenoid. Fuel pressure opens the refuel valve.

Refuel Valve Close Control

Each refuel valve closes when the FQPU removes the related refuel-valve-open command.

When you put the refuel valve control switches in the close position, the FQPU removes the refuel-valve-open commands.

The FQPU automatically removes the refuel-valve-open commands for these conditions:

- Tank quantity reaches the load select value
- Tank quantity reaches the volumetric top-off (VTO) value
- System test switch is in (test position).

You set the load select value at the IRP. The refueling operation section describes this.

The FQPU memory has the VTO values for each tank. When a tank quantity equals the VTO value, the tank is full. The FQPU removes the refuel-valve-open commands for that tank.

Refuel Valve Indication

The refuel valve position switch closes when the valve opens. This sends a signal to the CCU. The CCU sends an ARINC 629 signal to the FQPU. The FQPU sends an ARINC 429 signal to the IRP. The IRP turns on the valve open light (not shown).

Overfill Protection

If fuel flows into a surge tank, the related surge tank float switch closes. This supplies a ground to energize the overfill control relay. The relay removes power from all the refuel valves. Immediately, all the refuel valves close at the same time.

The overfill control relay has a latching ground. After the fuel in the surge tank drains out, the relay stays energized. You must operate the overfill reset switch to remove the latching ground.

The overfill reset switch disables the overfill protection. When the overfill reset switch is in the reset position, the surge tank float switches and the overfill test switch can not energize the overfill control relay.

Overfill Test

You use the overfill test switch to do a test of the overfill protection. The switch supplies a ground, similar to a closed surge tank float switch, to energize the overfill control relay. Immediately, all the refuel valves close at the same time.

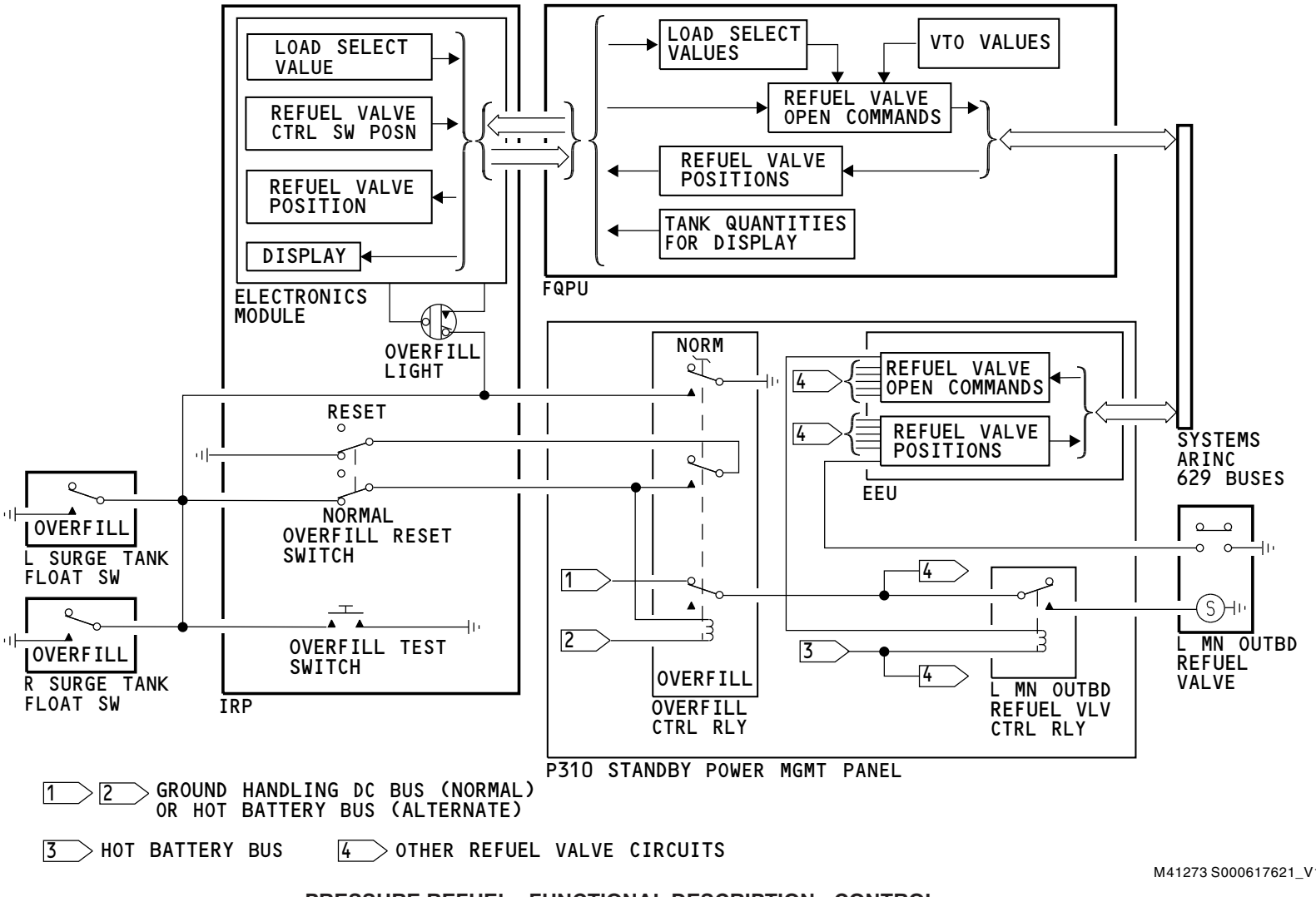
Overfill Indication

The overfill indication light on the IRP comes on for these conditions:

- A surge tank float switch is closed
- The overfill control relay is energized
- The overfill test switch is in (test position).

Training Information Point

When you set the total fuel load, the FQPU calculates the fuel load quantities for each tank two times. It calculates when you set the total fuel load, and when the main tanks are almost full. When the main tanks are almost full, the FQPU usually opens the center tank refuel valves again.



M41273 S000617621_V1

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - CONTROL

PRESSURE REFUEL - OPERATION

General

The refuel station gets power when the refuel station door opens. The quantity indications take 60 seconds to show after the door opens. The station has bonding points and an interphone jack. There is a placard on the refuel station door with the refuel procedure.

The refuel procedure is also in the maintenance manual. It includes warnings and cautions. The procedure has these tasks:

- Pressure refueling with a set fuel quantity
- Pressure refueling with a no set fuel quantity
- Pressure refueling with inoperative fuel valves
- Pressure refueling with inoperative fuel quantity display.

Normal Refuel Procedure

This is a brief summary of the refuel procedure when you do the set or no set fuel quantity tasks:

- Make sure you use approved electrical grounding or bonding
- Connect the refuel nozzles
- Do the indicator test
- Set the fuel load as necessary
- Put the refuel valve control switches in the OPEN position
- Start the fueling source
- Put the refuel valve control switches in the CLOSED position after automatic shutoff, or when the required fuel load is in the tanks
- Stop the fueling source
- Remove the fuel nozzles
- Make sure all refuel valves and switches are in the CLOSE position.

When you use the total load select set switch to set the fuel load, do not operate the refuel valve switches until all of the refuel valves close automatically. The FQPU makes corrections to the fuel distribution when refueling is 95 percent complete. If you operate refuel valve switches before refueling is complete, the fuel distribution may be incorrect.

When you do not set a quantity, valves close when the tanks are full. You can also put a refuel valve control switch to the close position to stop fuel flow into a tank at a specific quantity that shows on the fuel quantity display.

The fuel quantity to be loaded is entered in the LOAD SELECT QTY control and will show on the LOAD SEL display when you push the LOAD SELECT SET switch. During pressure refueling with a SET fuel quantity in the LOAD SEL display, the fuel quantity indicating system (FQIS) operates with the pressure refueling system. The fuel quantity processor unit (FQPU) closes the refuel valves when the SET fuel quantity is the same as the FQIS fuel quantity.

NOTE: The refueling operator can operate the refuel valve control switches at the integrated refuel panel (IRP) to stop the refuel operation.

NOTE: With a LOAD SELECT QTY entered for each main tank, the FQIS will automatically keep the main tank fuel level balanced during the refuel operation. If the quantity of one main tank becomes 1000 LB (400 KG) more than the other main tank, the inboard refuel valve for the tank with the higher quantity will be closed. When the main tank quantities become equal, the valve will open.

The total fuel quantity is the sum of all the fuel tanks. If the total quantity selected is more than the main fuel tanks capacity, the main tanks will fill to full and the center fuel tank will fill with the remaining fuel. All fuel tanks are filled with fuel at the same time. If the center tank fills to its LOAD SELECT value before the main tanks reach VSO, the center tank refuel valves will close until the 95% point of main tank capacity. At this point the LOAD SELECT values for the three tanks will be updated and the center tank refuel valves will reopen and fueling will continue to the updated LOAD SELECT value.

The examples below will show the final tank values for TOTAL LOAD SELECT quantities of 12,600 LB (5700 KG), 15,000 LB (6800 KG), 90,100 LB (41,000 KG) and 132,500 LB (60,100 KG)

- TOTAL LOAD SELECT = 12,600 LB (5700 KG)

NOTE: Left main tank load selects = 6,300 LB (2800 KG)
Right main tank load selects = 6,300 LB (2800 KG)

Center load select = 0.0

- TOTAL LOAD SELECT = 90,100 LB (41,000 KG)

NOTE: Left main load select = 45,100 LB (20,400 KG)
Right tank load select = 45,000 LB (20,400 KG)
Center load select = 0.0
Notice that the odd 100 LB (45 KG) of fuel was put in the left tank.

- TOTAL LOAD SELECT = 132,500 LB (60,100 KG)

NOTE: Left main load select = 66,300 LB (30,100 KG)
Right tank load select = 66,200 LB (30,000 KG)
Center load select = 0.0

For the first three totals, the load select values are never recalculated since 95% of main tank VSO is never reached. For the last total, at 95% of main tank VSO, assuming the average density is 6.78 lb/gal, the load select values are recalculated. The left and right main load selects will change to 63,000 LB (28,600 KG), and the center load select will change to 6,500 LB (2,900 KG). Also, the above examples assume that the center tank quantity starts at zero. If there is fuel in the center tank before you do the TOTAL LOAD SELECT the center tank quantity of fuel will be used to determine the final main tank quantities. For example:

MAIN TANK LOAD SELECT=(TOTAL LOAD SELECT-CENTER QUANTITY)/2

Refuel Procedure With Inoperative Fuel Valves

When the valve control is set to the open position and a valve light does not come on, it shows that the valve is not open. This is a brief summary of the refuel procedure you can use:

- Depressurize the fueling source
- Get access to the failed valve
- Use the manual override knob to open the valve
- Start the fueling source
- Look at the fuel quantity display
- Release the deadman switch on the fueling source to stop refueling when you get to the correct tank quantity
- Return the airplane to its normal condition.

Refuel Procedure With Inoperative Fuel Quantity Display

This is a brief summary of the refuel procedure you can use if fuel quantity for a tank does not show on the refuel panel:

- Move the power switch to BATT
- If the quantity does not to show after 60 seconds, use the measuring sticks
- Use the conversion tables to find the fuel quantity in the tank
- Use the conversion tables to find what the stick indication should be for the refuel quantity
- Start the fueling source
- Close the tank valves when the stick indications show the required fuel quantity.

System Test

The system test is not necessary for refueling. To do the test, push the system test switch during refueling. During the system test, the refuel valves close in sequence. The refuel valve indicator light goes out when each valve closes. Then the valves automatically open and each indicator light comes on again. The system test takes less than 20 seconds.

If one or more of the refuel valve indicator lights does not go out, the FQIS processor unit has a fault. The processor can not automatically close the valve when the refuel procedure is done. You must close the valve with the refuel valve control switch on the IRP, or with the manual override knob on the refuel valve control unit.

Overfill Test

The overfill test is not necessary for refueling. To do this test, push the overfill test switch during refueling. During the test, all refuel valves close immediately and the refuel valve indicator lights go out. Move the overfill reset switch to the RESET position to open the valves again. You must move the overfill reset switch to the NORMAL position to arm the overfill protection again.

If the refuel valve indicator lights do not go out, the overfill system has a fault. The overfill system can not automatically close the refuel valves if fuel flows into the surge tank. You must close the valves with the refuel valve control switches or with the manual override knobs on the refuel valve control units.

Training Information Point

During refueling, if the FQPU can not make a good fuel quantity calculation, the message PUSH SET comes on in the FUEL QTY display. Also, the refuel valves for the applicable tank close. Push the load select set switch to continue refueling. The display will go off and only one refuel valve will open. If the failure is in a main tank, the inboard refuel valve opens. If the failure is in the center tank, the left center refuel valve opens.

When the display is off, there is no volumetric shutoff for that tank. You must use the refuel valve switch to close the refuel valve.

A STOP indication can show in a LOAD SELECT window on the IRP for a tank. This means that the VSO has been exceeded by 100 gallons or more. The refueler should stop refueling. The STOP indication stays until the quantity in the tank is decreased to at or below the VSO level for that tank.

The FQPU can command the refuel valves to the close position if there is failure of tank unit 10, 17, 18, or 19. The FQPU software will decrease the shutoff level to 1% to 3.2% below VSO depending on failure condition. Below are the shutoff values for individual tank unit failures.

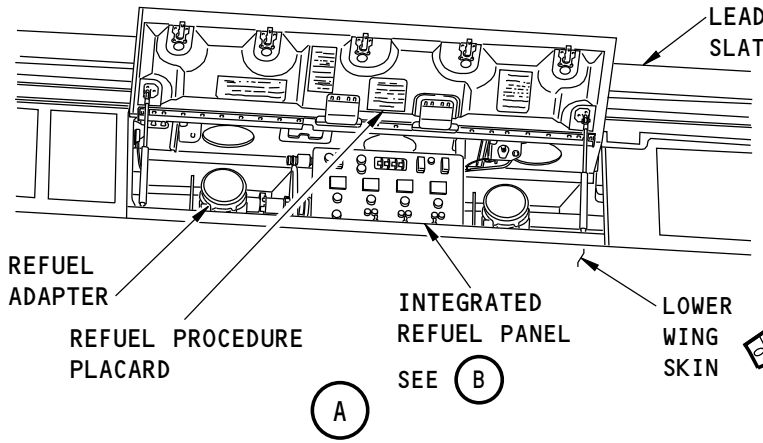
- Tank Unit 10 Fault: Maint Message: 28-20060, 28-20061, 28-20108, 28-20109

  (163 Gallons Below VSO; or 1.7% Below VSO)
- Tank Unit 17 Fault: Maint Message: 28-20074, 28-20075, 28-20122, 28-20123

  (112 Gallons Below VSO; or 1.2% Below VSO)
- Tank Unit 18 Fault: Maint Message: 28-20076, 28-20077, 28-20124, 28-20125

  (165 Gallons Below VSO; or 1.7% Below VSO)
- Tank Unit 19 Fault: Maint Message: 28-20078, 28-20079, 28-20126, 28-20127

  (99 Gallons Below VSO; or 1.0% Below VSO)
- Other Failed Units can cause shutoff of 3.2% Below VSO



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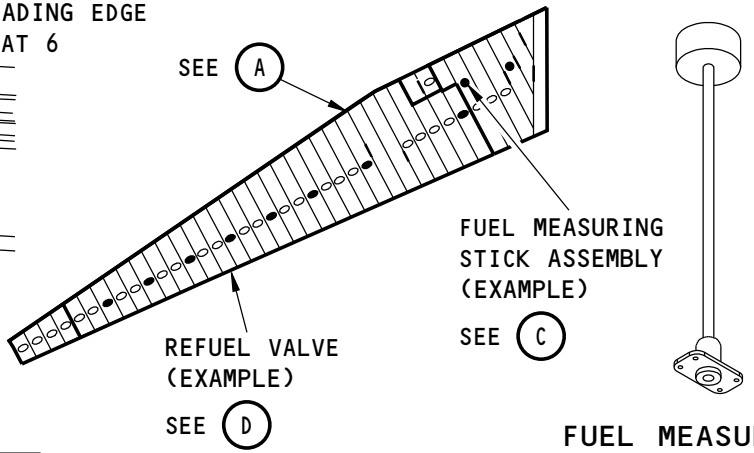
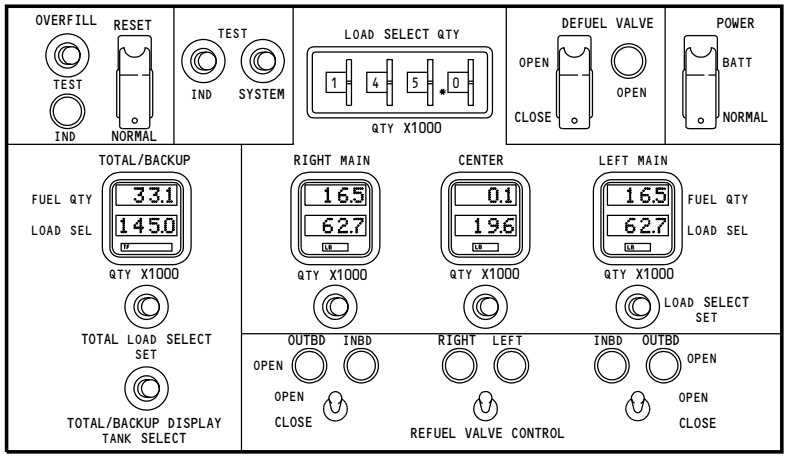


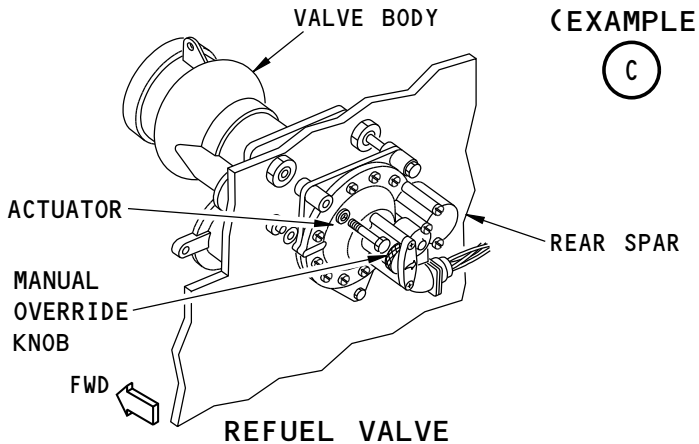
FUEL MEASURING STICK ASSEMBLY (EXAMPLE)

C



INTEGRATED REFUEL PANEL

B



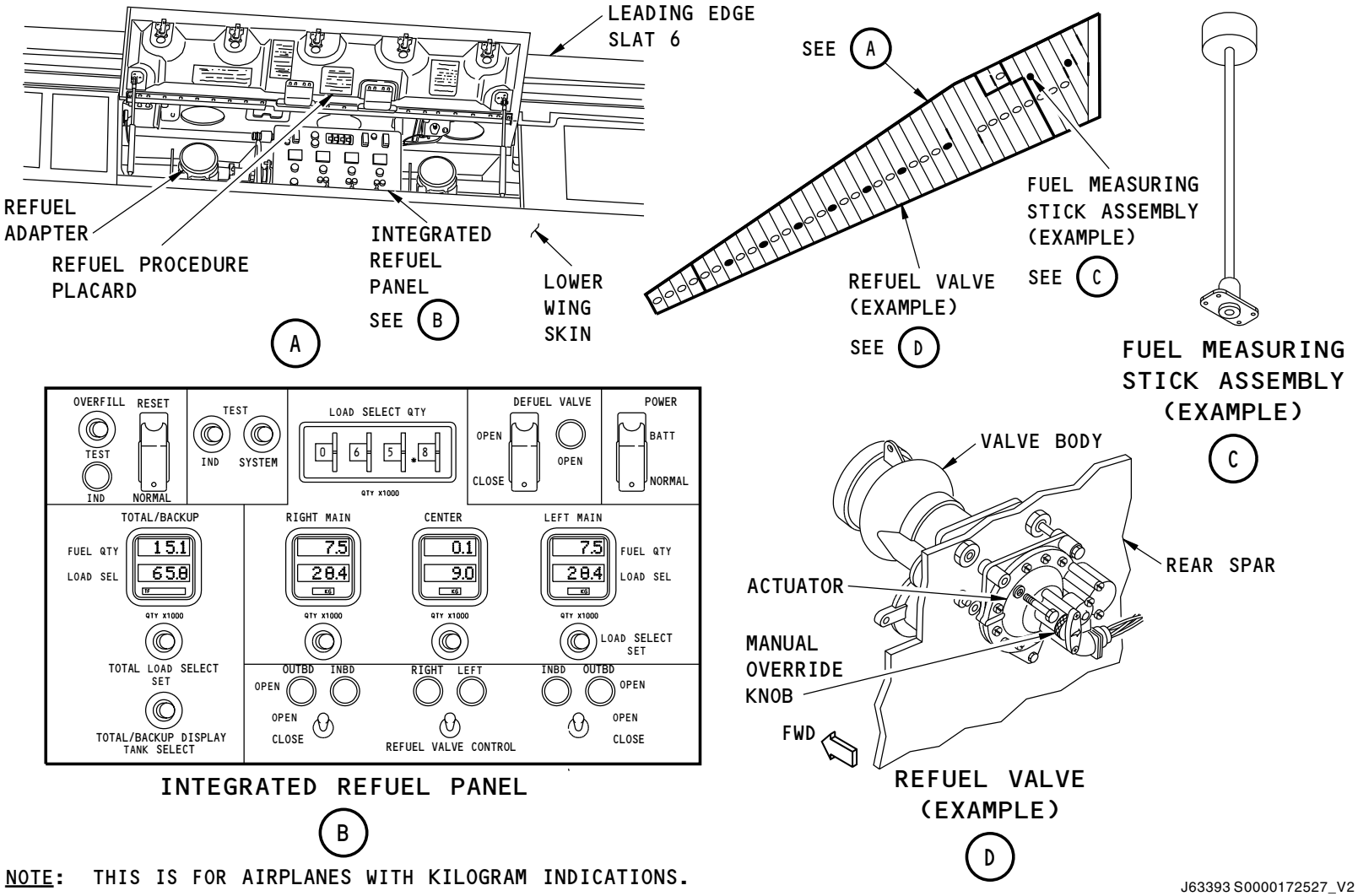
REFUEL VALVE (EXAMPLE)

D

NOTE: THIS IS FOR AIRPLANES WITH POUND INDICATIONS.

J63882 S0000172526_V2

PRESSURE REFUEL - OPERATION



NOTE: THIS IS FOR AIRPLANES WITH KILOGRAM INDICATIONS.

J63393 S0000172527_V2

PRESSURE REFUEL - OPERATION

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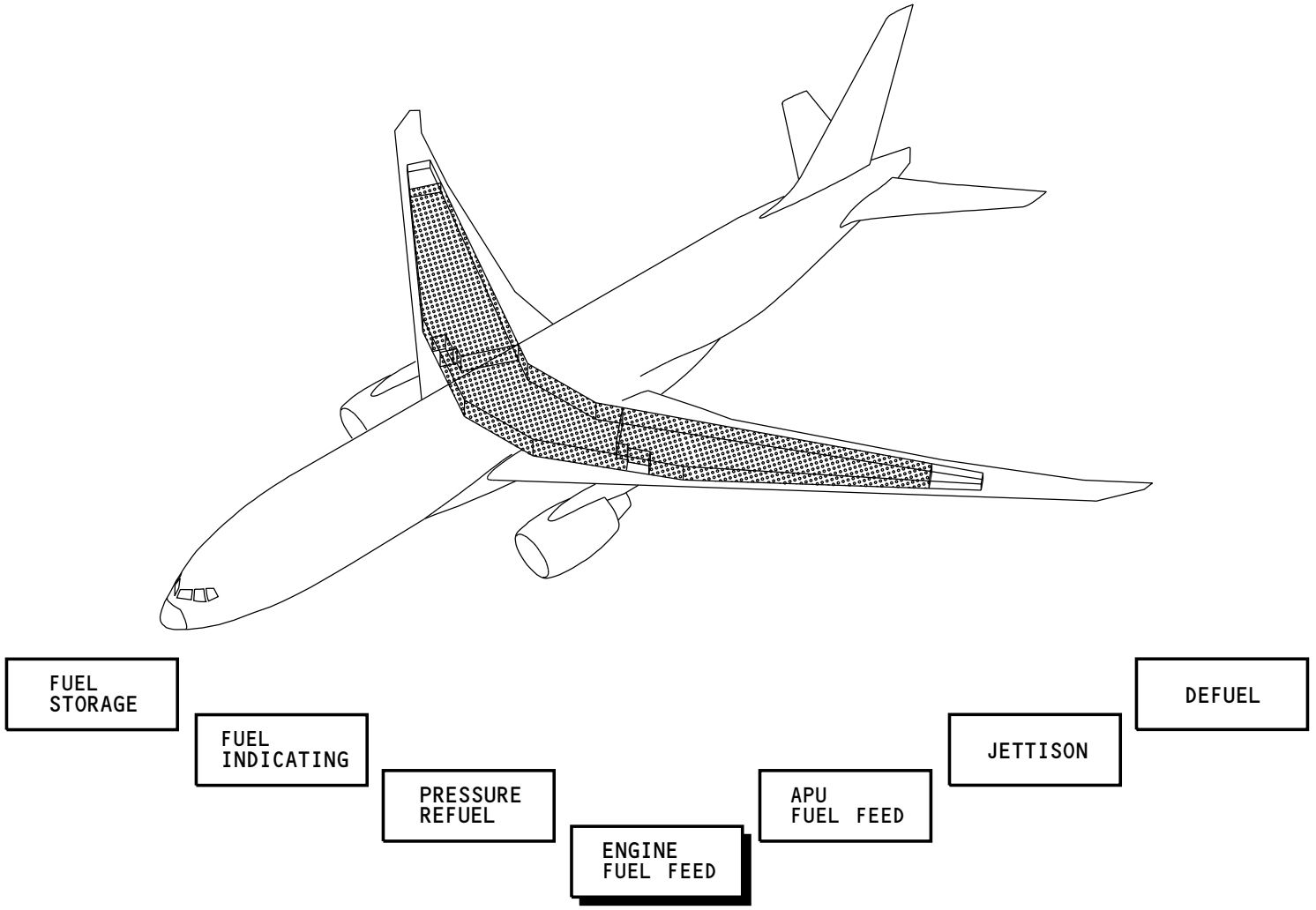
ENGINE FUEL FEED - INTRODUCTION

Purpose

The engine fuel feed system supplies fuel to the engines from the main and center tanks. You operate the engine feed system from the fuel panel on the P5 overhead panel.



W43418 S0000123525_V1

ENGINE FUEL FEED - INTRODUCTION

ENGINE FUEL FEED - GENERAL DESCRIPTION

General

The engine fuel feed system controls and supplies fuel to the engines. It uses these inputs:

- Fuel panel
- Fuel control switches
- Engine fire switches
- The ELMS.

The engine fuel feed system uses these components to supply fuel to the engines:

- Fuel pumps
- Fuel pump pressure switches
- Crossfeed valves
- Spar valves

The engine fuel feed system uses power from the ELMS and the engine fuel spar valve battery.

Fuel Pump Control

Each fuel pump has a switch on the fuel panel. The switches control relays in the ELMS to supply power to the pumps.

Fuel Pump Pressure Switches

Pump pressure switches send low pressure signals to the ELMS. The ELMS sends the signals through OPAS to turn on the low pressure lights on the pump switches.

Crossfeed Valves Control

The crossfeed valve switches on the fuel panel directly control the crossfeed valves. The ELMS supplies the power that opens or closes the valves.

Spar Valve Control

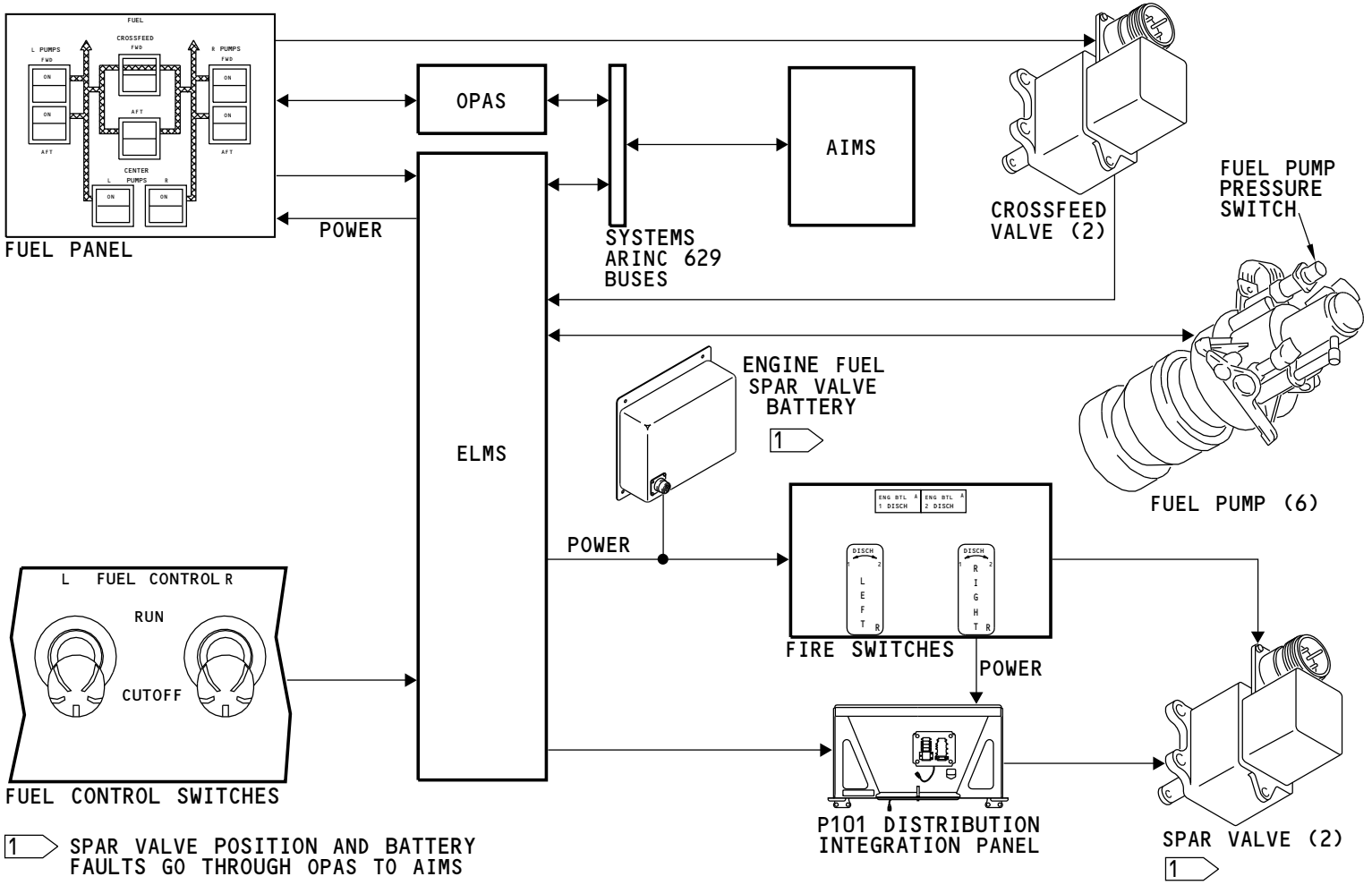
The fuel control switches control relays to open and close the spar valves. The engine fire switch must be down to permit the power to get through the relays to the spar valve.

The fire switch also has a direct circuit to the spar valve. This closes the valve when you pull the fire switch.

The hot battery bus (ELMS) or the engine fuel spar valve battery supply the power to open or close the spar valve.

Fault Indication

The ELMS compares fuel panel switch positions with crossfeed valve and fuel pump relay positions to look for disagreements. The ELMS receives switch positions on the systems ARINC 629 buses. The OPAS reports faults of the spar valves and the engine fuel spar valve battery. Faults go to the AIMS for indication.



M41360 S000617629_V1

ENGINE FUEL FEED - GENERAL DESCRIPTION

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ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

General

The engine fuel feed system has these components:

- Fuel suction bypass valve (2)

ARO 001-004 PRE SB 777-28-0078

- Outlet float-operated shutoff valve (2)

ARO ALL

- Crossfeed valve (2)
- Engine feed manifold
- Override/jettison pump (2)

ARO 007-999

- Scavenge jet pump (4)

ARO 001-006

- Scavenge jet pump (6)

ARO 001-004 PRE SB 777-28-0078

- Inlet float-operated shutoff valve (2)

ARO ALL

- Boost Pump (4)
- Spar valve (2).

Main Tank Fuel Suction Bypass Valves

There is one fuel suction bypass valve in each main tank. It attaches to the engine feed manifold. You get access to the bypass valve through the fourth fuel tank access door.

Fuel Crossfeed Valves

The forward and aft crossfeed valves isolate the left and right sides of the engine feed manifold. Both valve bodies are in the left side of the center tank. You get access to the valve bodies through the first fuel tank access door in the left wing. The valve actuators are on the rear spar aft of the first fuel tank access door.

Engine Feed Manifold

The engine feed manifold connects the output of the fuel pumps to the engine fuel main supply line. Sections of the manifold are in the center tank and the main tanks.

Center Fuel Tank Override/Jettison Pumps

There are two override/jettison pumps that attach to the rear spar of the center tank. You get access to the pumps in the main wheel wells.

Scavenge Jet Pumps

ARO 001-006

There are four water scavenge jet pumps and two center tank fuel scavenge jet pumps. Each main tank has one water scavenge jet pump on the rear spar aft of access door 533AB or 633AB.

ARO 007-999

There are two water scavenge jet pumps and two center tank fuel scavenge jet pumps. Each main tank has one water scavenge jet pump on the rear spar aft of access door 533AB or 633AB.

ARO 001-004 PRE SB 777-28-0078

Each side of the center tank has a water scavenge jet pump and a fuel scavenge jet pump. The water scavenge jet pumps are on the rear spar of the center tank. The fuel scavenge jet pumps are on the rear spars of the wings.

ARO 005, 006; ARO 001-004 POST SB 777-28-0078

Each side of the center tank has a water scavenge jet pump and a fuel scavenge jet pump. The water scavenge jet pumps are on the rear spar of the center fuel tank. The fuel scavenge jet pumps are on the forward side of spanwise beam no. 1, inside the center tank.

ARO 007-999

Each side of the center tank has a fuel scavenge jet pump. The fuel scavenge jet pumps are on the forward side of spanwise beam no. 1, inside the center tank.

ARO 001-004 PRE SB 777-28-0078

Float-Operated Shutoff valves

Each center tank fuel scavenge jet pump has an inlet and an outlet float-operated shutoff valve. You get access to the inlet valve through access door 531AB or 631AB. You get access to the outlet valve through access door 541DB or 641DB.

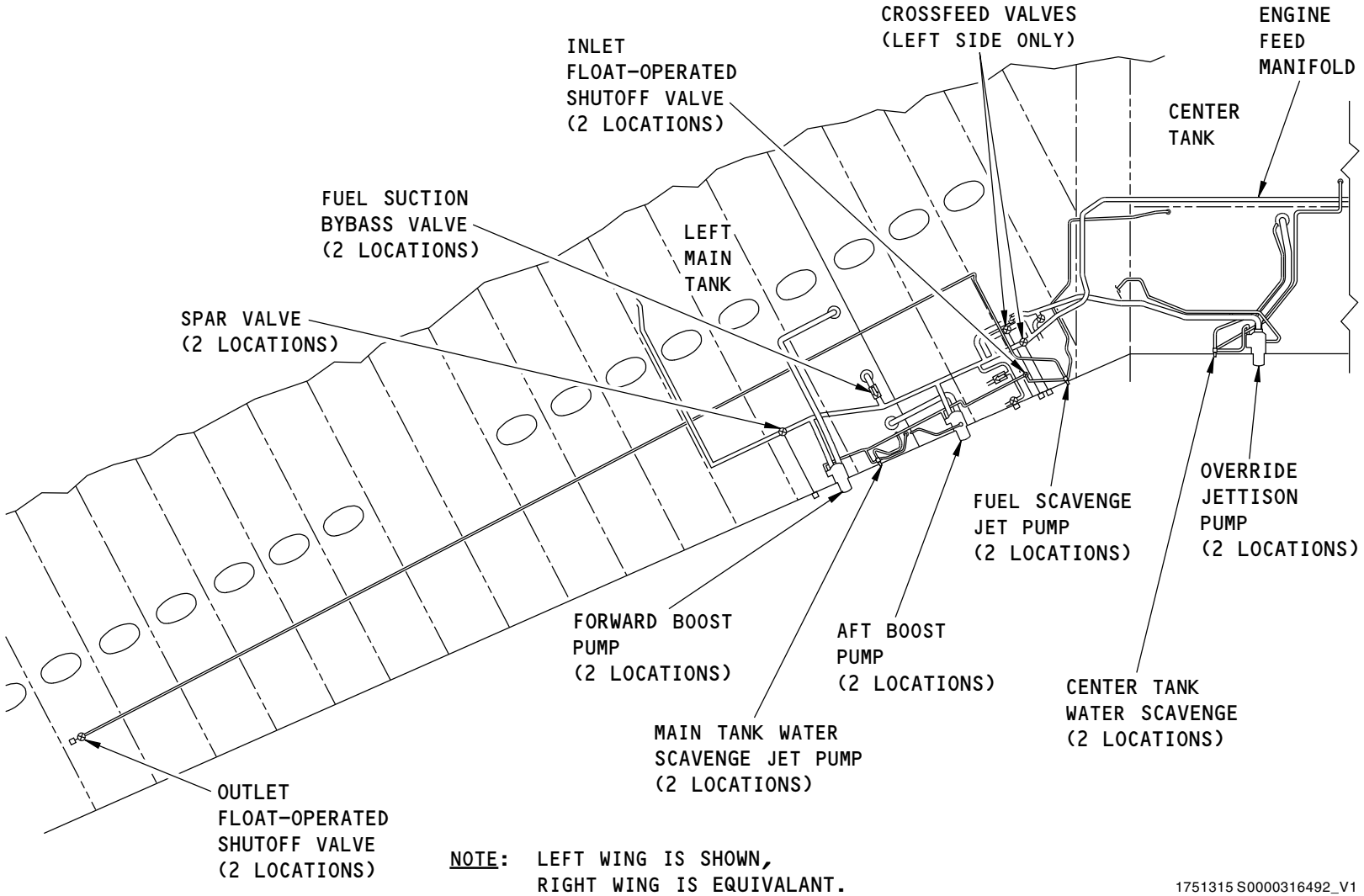
ARO ALL

Main Fuel Tank Fuel Boost Pumps

Each main tank has a forward and an aft boost pump. The boost pumps are on the rear spar. The left forward boost pump is outboard of main tank rib no. 9. The left aft boost pump is inboard of the main tank end rib no. 8. The right tank boost pumps are in a similar position on the right rear spar.

Engine Fuel Spar Valves

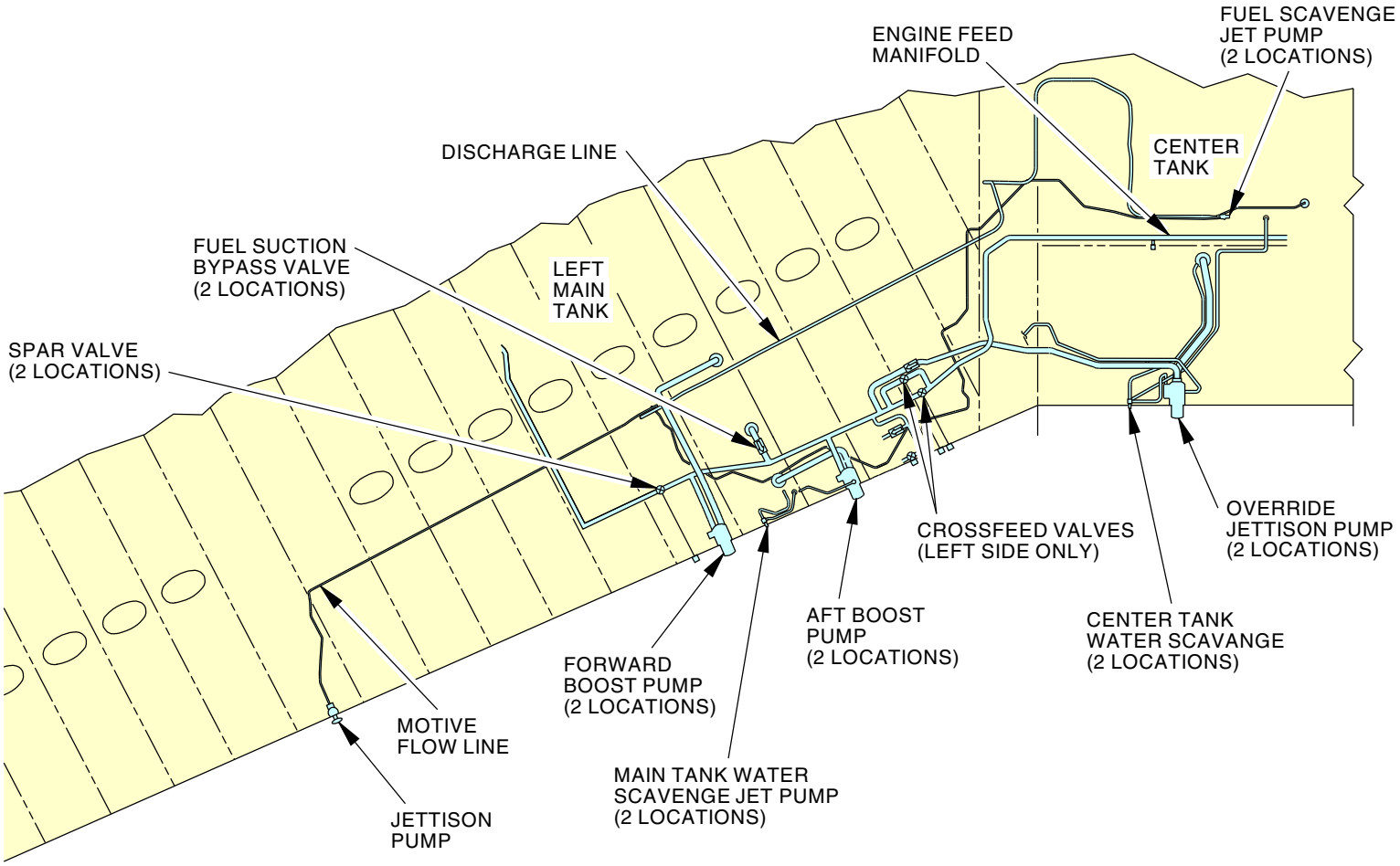
There is one spar valve in each main tank. You get access to the valve bodies through access door 533BB or 633BB. The valve actuators are on the rear spar and are accessed through access panel 551DB or 651DB.



NOTE: LEFT WING IS SHOWN,
RIGHT WING IS EQUIVALANT.

1751315 S0000316492_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

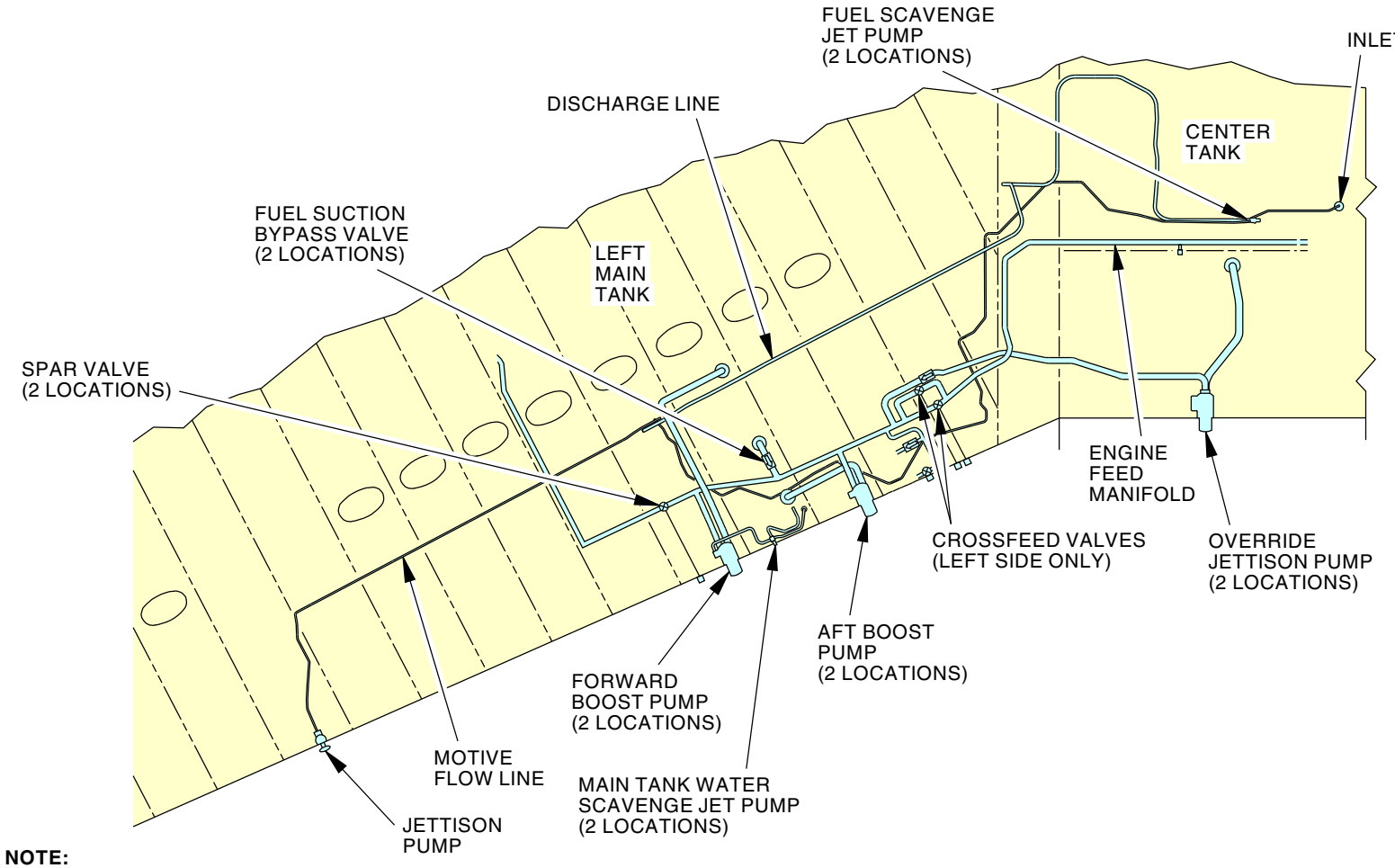


NOTE:

LEFT WING IS SHOWN,
RIGHT WING IS OPPOSITE.

2478413 S0000580481_V2

ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS



NOTE:

LEFT WING IS SHOWN,
RIGHT WING IS OPPOSITE.

2235994 S0000499356_V2

ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

Override/Jettison Pumps

The engine fuel feed system has two override/jettison pumps. One pump is for each half of the center tank. They attach to the rear spar of the center wing section. You get access to the pumps in the main wheel wells.

ARO 001-006

Center Tank Water Scavenge Jet Pumps

Each half of the center tank has a water scavenge jet pump. The pumps attach to the rear spar of the center tank wing section, outboard of the override/jettison pumps.

ARO 001-004 PRE SB 777-28-0078

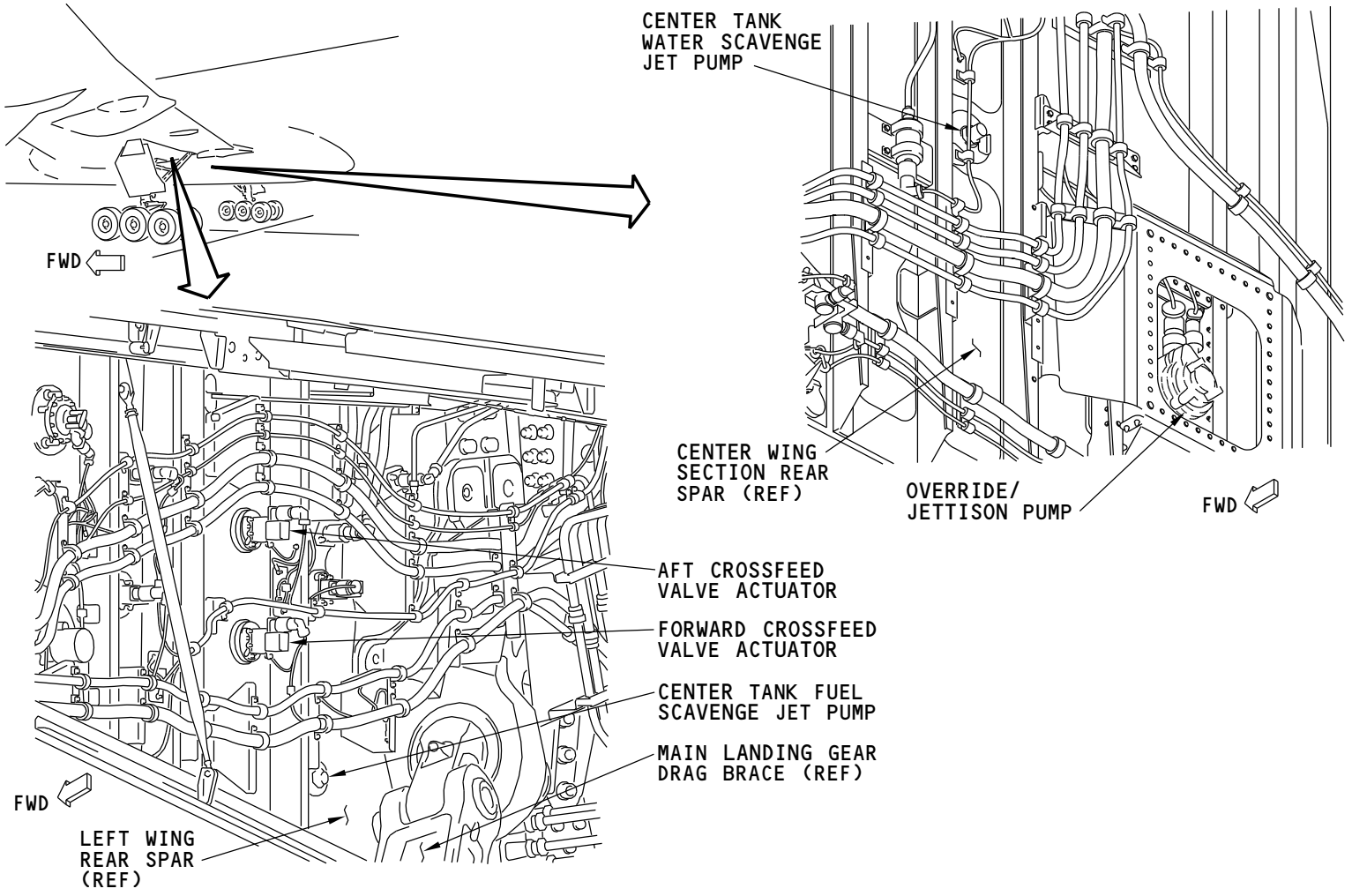
Center Tank Fuel Scavenge Jet Pumps

Each half of the center tank has a fuel scavenge jet pump. The pumps attach to the rear spar of each wing, outboard of the main landing gear drag brace.

ARO ALL

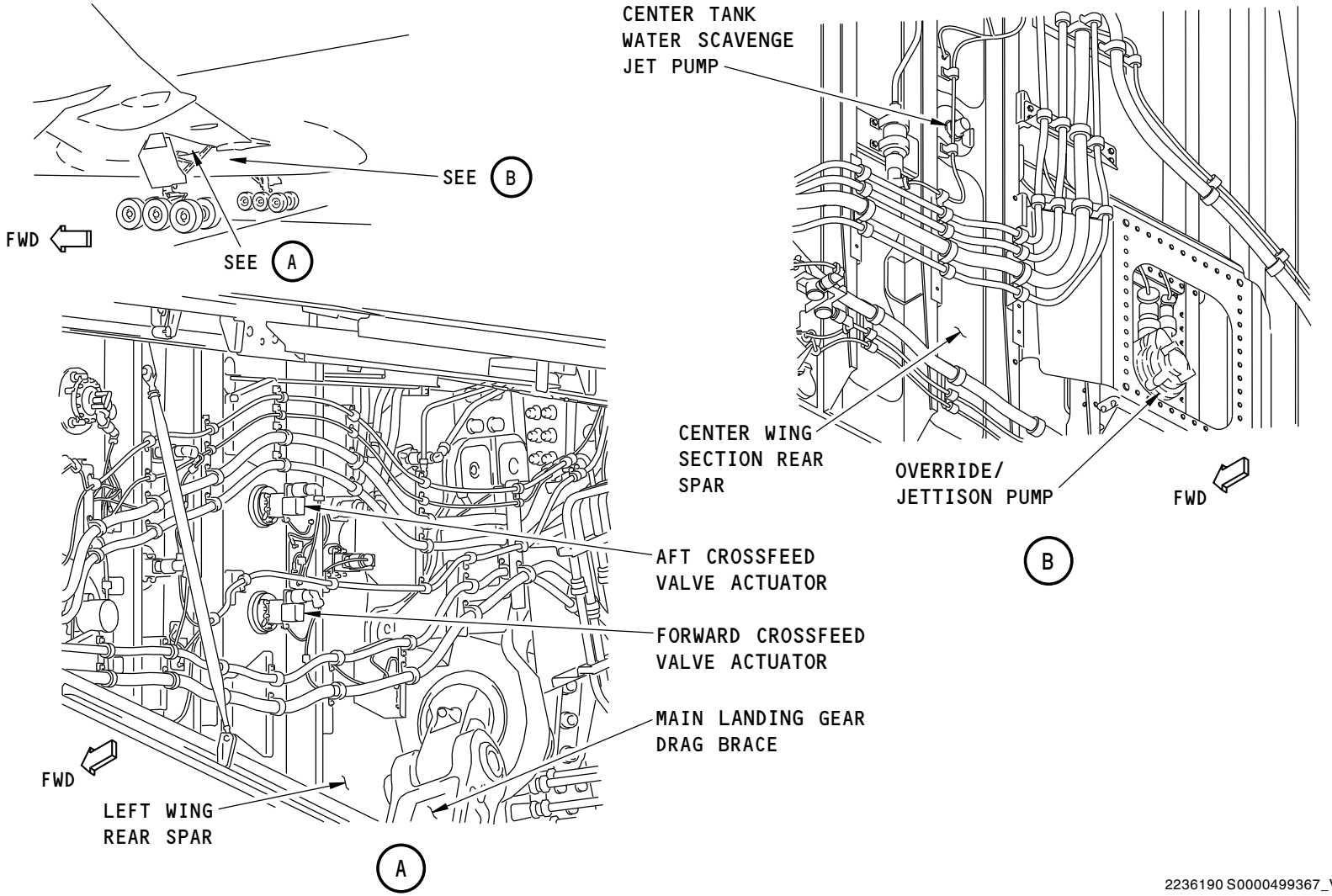
Crossfeed Valves

The engine fuel feed system has two crossfeed valves. The crossfeed valve actuators attach to the rear spar of the left wing, outboard of the main landing gear drag brace.



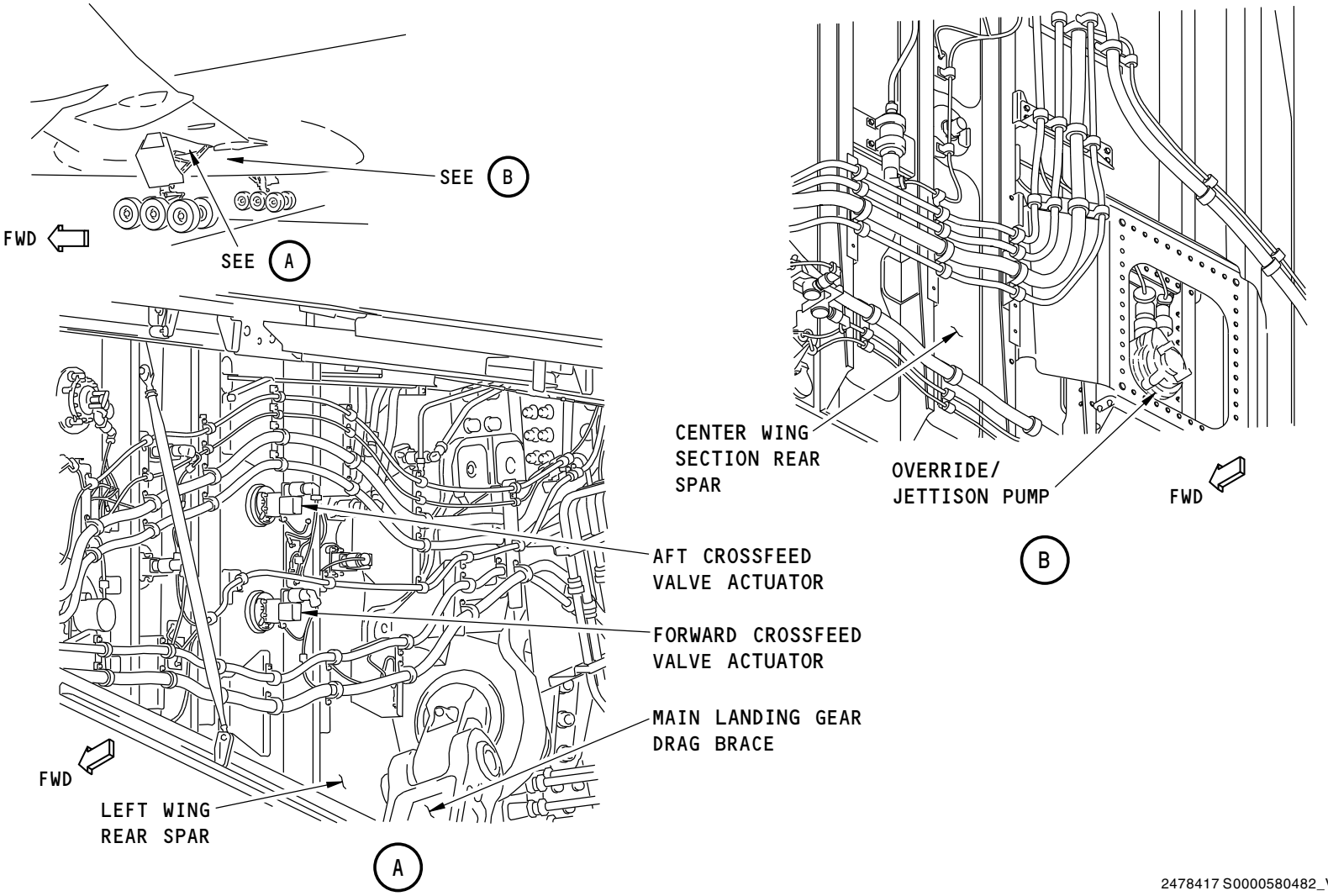
M41295 S000617652_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 1



2236190 S0000499367_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 1



2478417 S0000580482_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 2

Boost Pumps

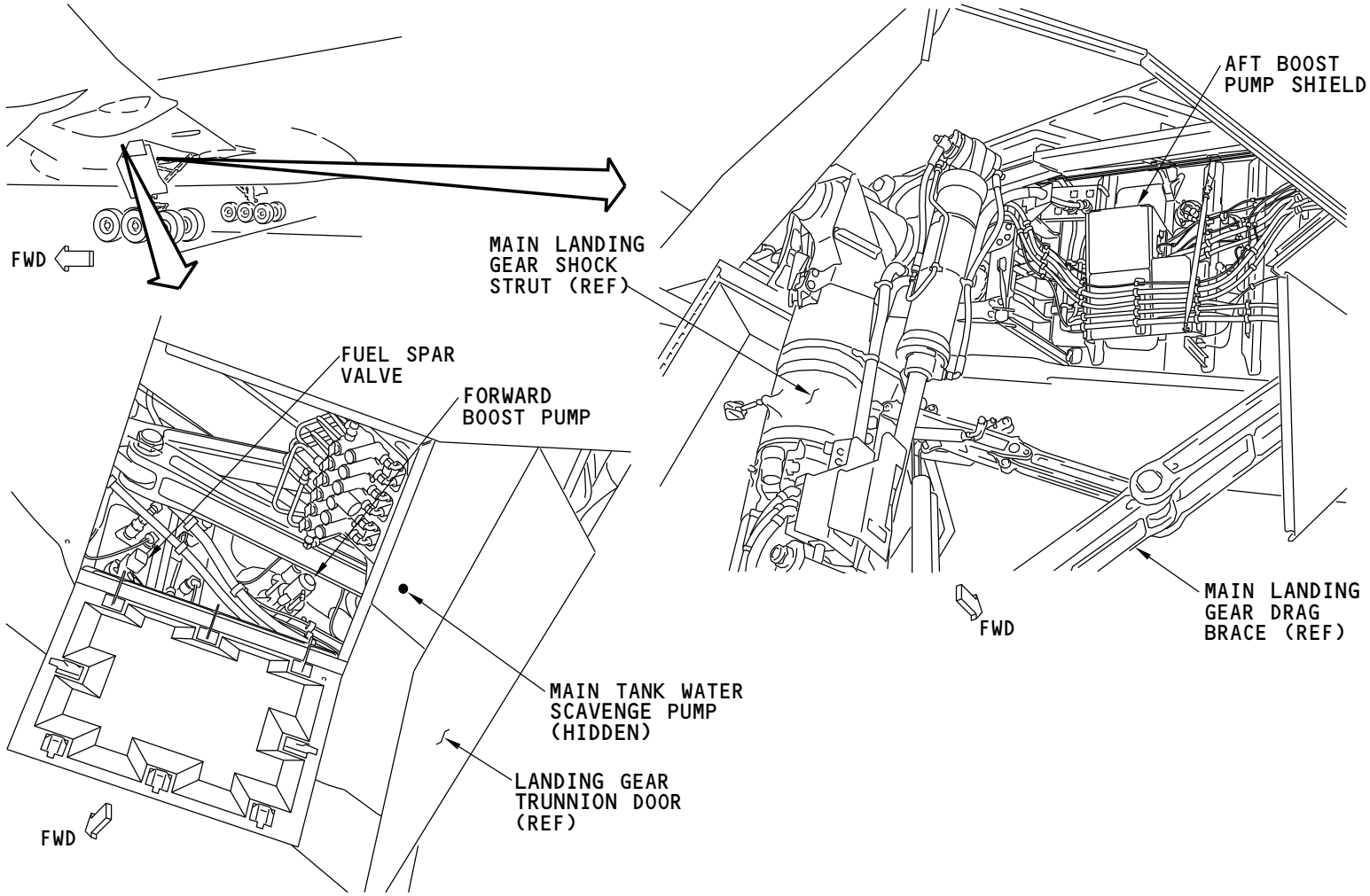
The engine fuel feed system has four boost pumps. Two pumps are for each main tank. They attach to the rear spar of each wing. The forward boost pumps are outboard of each main landing gear shock strut. The aft boost pumps are inboard of each main landing gear shock strut. The aft boost pump has a shield that protects it.

Main Tank Water Scavenge Jet Pumps

Each main tank has a water scavenge jet pump. The pumps attach to the rear spar of each wing, inboard of the forward boost pumps, near the landing gear trunnion door.

Engine Fuel Spar Valves

The engine fuel feed system has two fuel spar valves. The spar valve actuators attach to the rear spar of each wing, outboard of the forward boost pumps.



M41296 S000617653_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 2

Engine Fuel Spar Valve Battery

The engine fuel spar valve battery is in the flight deck. Four fasteners attach the battery to the outboard side of the right side stowage bin.

Relays

These relays are in the P101 distribution integration panel:

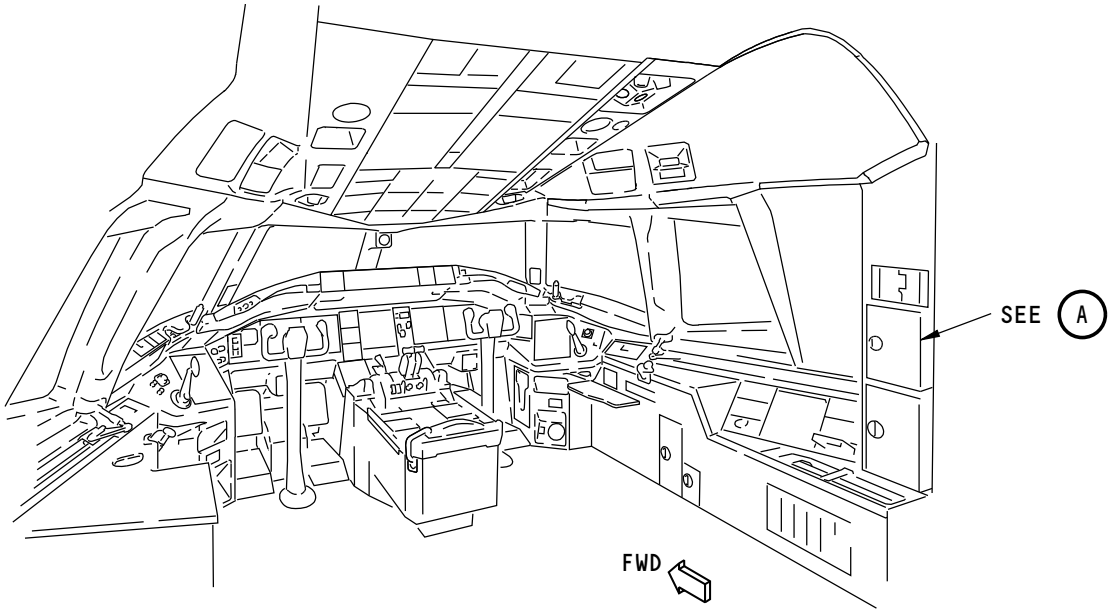
- Right engine fuel spar valve control
- APU shutoff valve control
- APU remote shutdown.

The P101 panel is in the passenger compartment. It is above the center stowage bins, near door 1L.

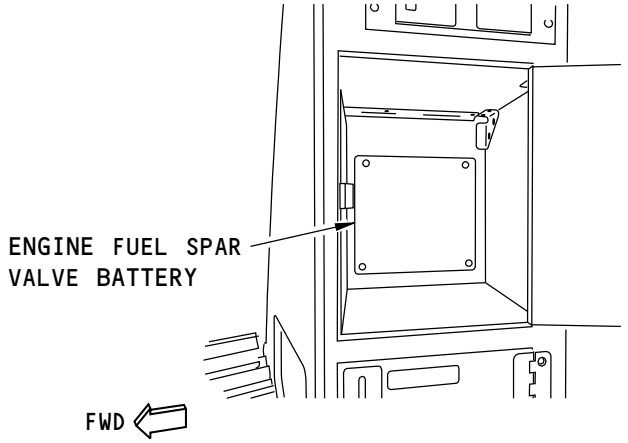
This relay is in the E1–4 Shelf.

- Left engine fuel spar valve control

The E1–4 Shelf is in the Electronic Equipment Bay



FLIGHT COMPARTMENT

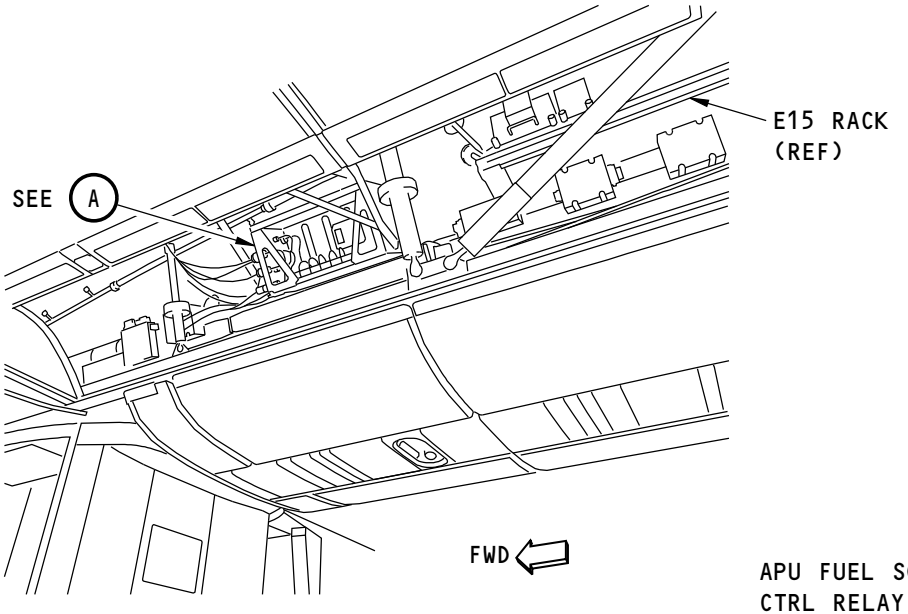


RIGHT SIDE STOWAGE BIN
(DOOR OPEN)

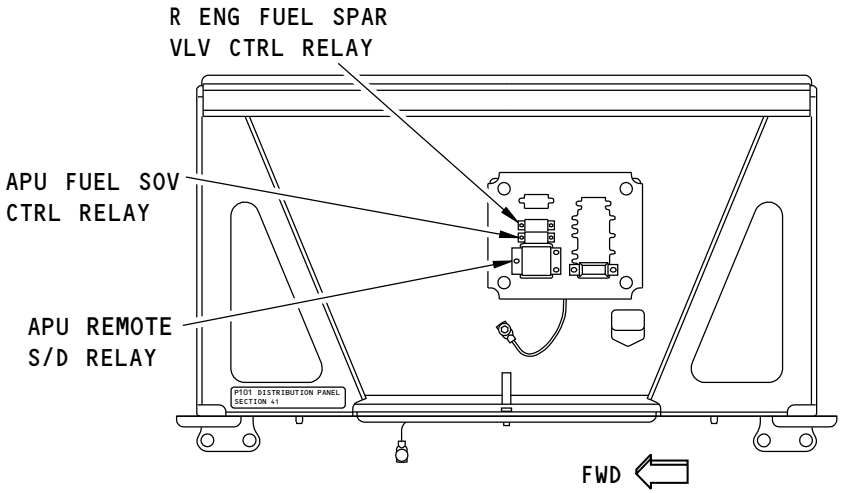
A

1613491 S0000299132_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - FLIGHT DECK AND PASSENGER COMPARTMENT



OVERHEAD PASSENGER COMPARTMENT
(LEFT SIDE)
(VIEW IN THE INBOARD DIRECTION)

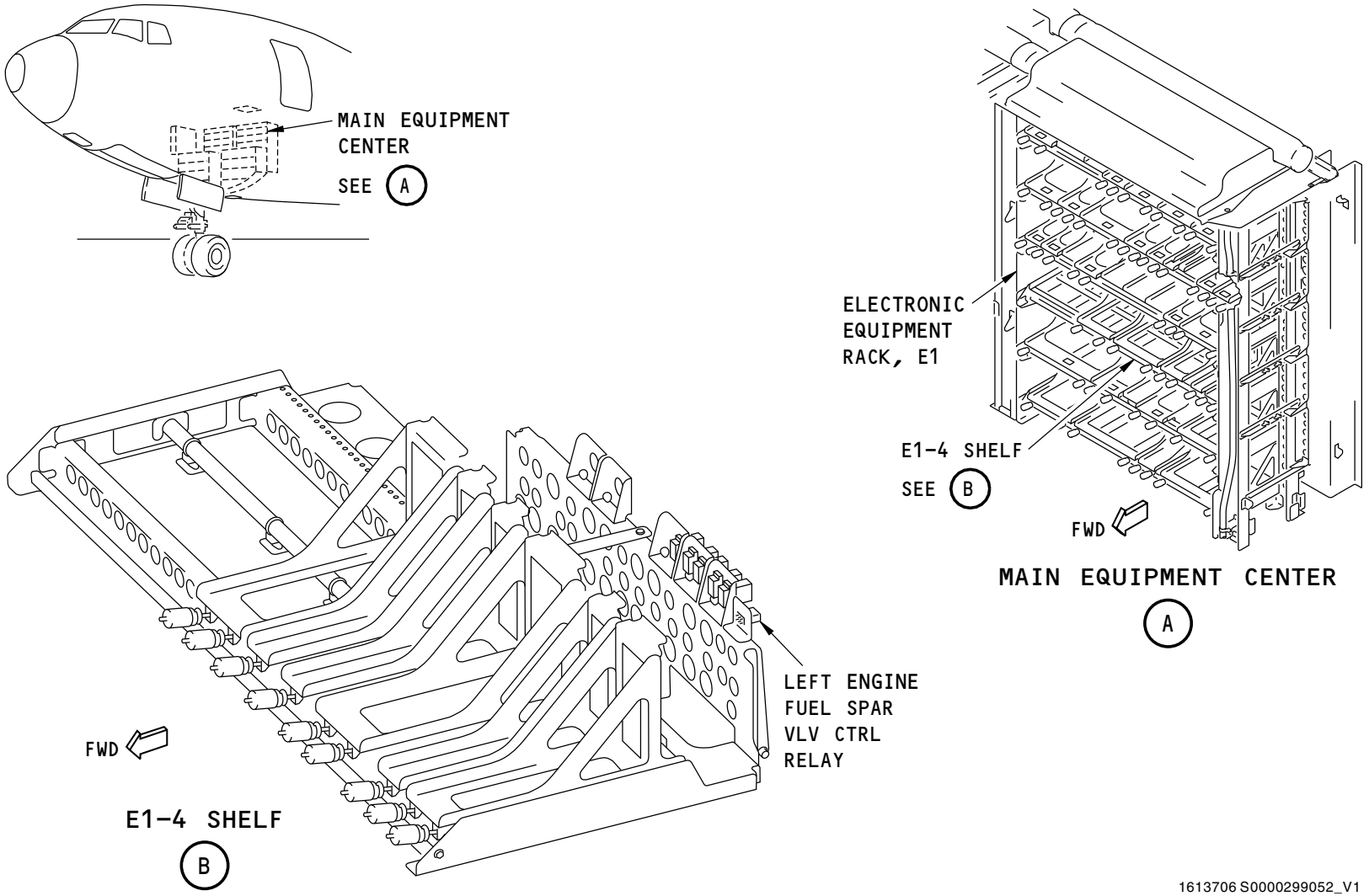


P101 DISTRIBUTION INTEGRATION
PANEL (DOOR 1L)

A

1616411 S0000299928_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - FLIGHT DECK AND PASSENGER COMPARTMENT



1613706 S0000299052_V1

ENGINE FUEL FEED - COMPONENT LOCATIONS - FLIGHT DECK AND PASSENGER COMPARTMENT

ENGINE FUEL FEED - OVERRIDE/JETTISON PUMP

General

The override/jettison pumps supply fuel from the center tank to the engine feed manifold. They also supply fuel to the refuel/jettison manifold during fuel jettison.

The override/jettison pumps can supply fuel at a pressure of 36 psi and a flow rate of 70,000 pounds (31,750 kgs) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There is one override/jettison pump in each main landing gear wheel well, at the rear spar. The housings are inside the center wing section, on the rear spar. The motor-impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve
- Motive flow check valve
- Vapor vent valve
- Inlet valve.

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks have fuel in them.

Motor-Impeller

The motor-impeller uses 115v ac power. Each pump has these parts:

- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

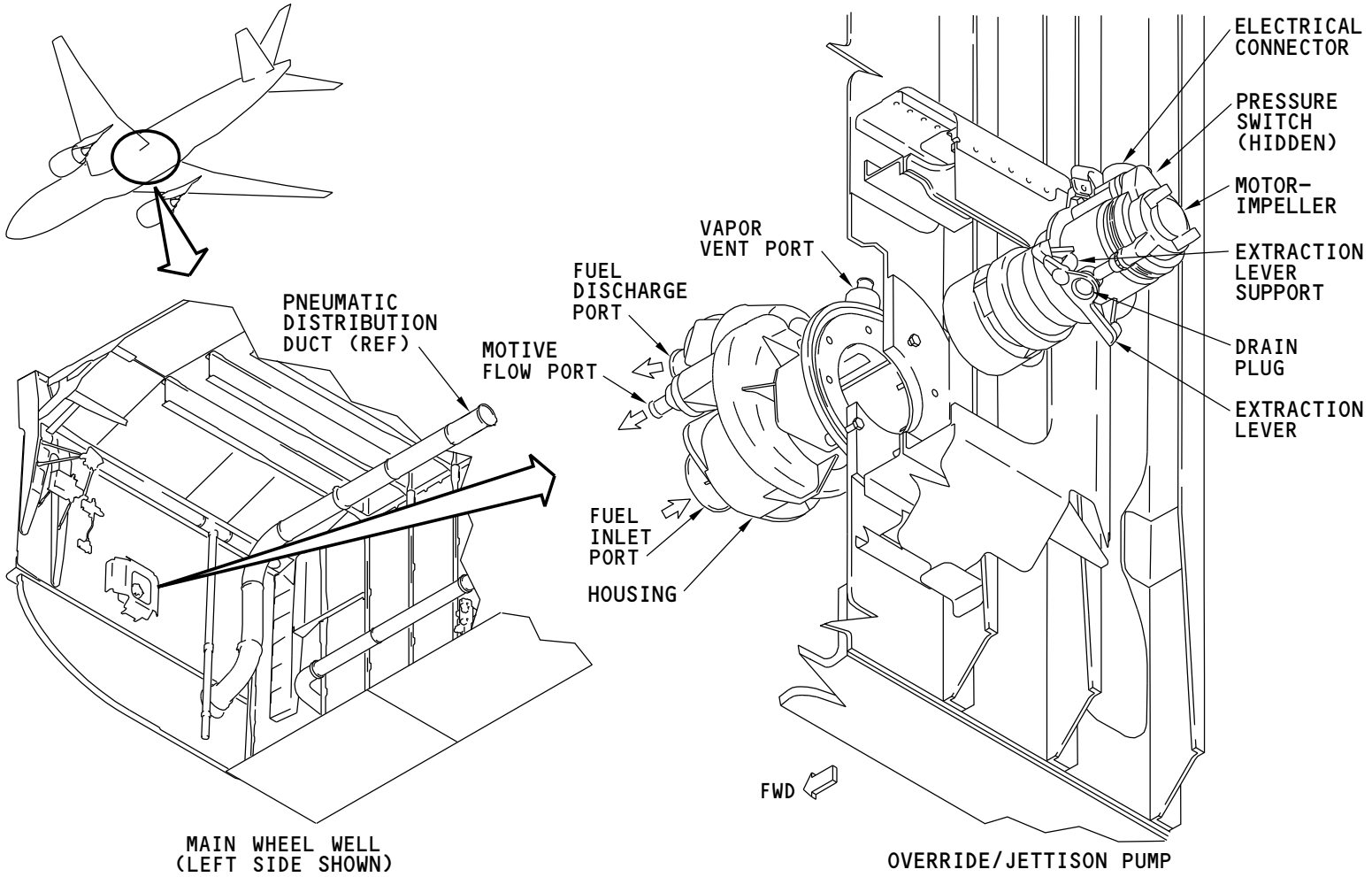
Training Information Point

The override/jettison pump motor-impellers are interchangeable with the jettison pump motor-impellers.

To remove the motor-impeller, you rotate it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

You can remove the discharge, motive flow, and vapor vent valves through the housing from outside the tank.



M41281 S000617632_V1

ENGINE FUEL FEED - OVERRIDE/JETTISON PUMP

ENGINE FUEL FEED - CENTER TANK FUEL SCAVENGE JET PUMP

Purpose

ARO 001-004 PRE SB 777-28-0078

The fuel scavenge jet pumps take fuel from the low points in the center tank and send it to the main tanks. This increases the amount of usable fuel in the center tank. Float-operated shutoff valves prevent fuel scavenge when the main tanks are full.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

The fuel scavenge jet pumps take fuel from the low points in the center tank and send it to the main tanks. This increases the amount of usable fuel in the center tank. Swing check valves near the center tank fuel scavenge inlets prevent fuel backflow when the main tanks are full.

ARO ALL

Location

ARO 001-004 PRE SB 777-28-0078

There is one fuel scavenge jet pump in each side of the center tank. They are in the left and right wheel wells on the rear spar.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

There is one fuel scavenge jet pump in each side of the center tank. They are on the forward side of spanwise beam No. 1 in the center tank.

ARO 001-004 PRE SB 777-28-0078

There is an outlet float-operated shutoff valve in each main tank. You get access to these valves through the fourteenth fuel tank access door.

There is an inlet float-operated shutoff valve in each side of the center tank. You get access to these valves through the first fuel tank access door.

ARO ALL

Functional Description

ARO 001-004 PRE SB 777-28-0078

The jet pumps operate automatically when the boost pumps are on. They use fuel from the boost pumps as motive fuel. The flow of the motive fuel through the jet pump causes suction that takes fuel from the center tanks. The fuel goes through the jet pump discharge lines to the main tanks. When the main tanks are full, the outlet float-operated shutoff valve closes to stop fuel flow through the discharge line.

The inlet float-operated shutoff valve prevents motive flow to the jet pump until the center tank is almost empty. This prevents the fuel from flowing into the main tank too early if the outlet float-operated shutoff valve fails. A check valve in the jet pump prevents fuel movement from the main tank to the center tank.

ARO 007-999

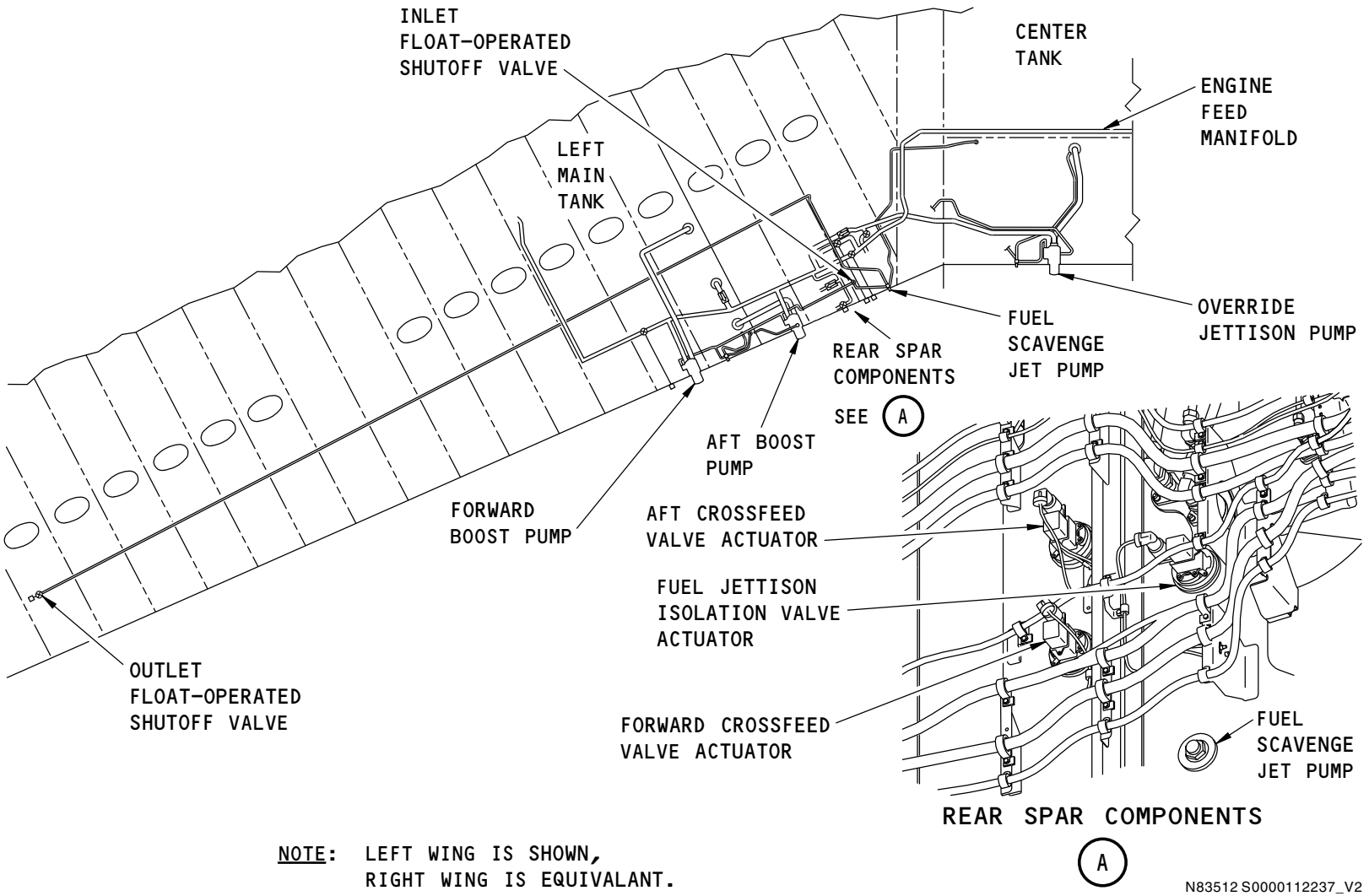
A check valve in the jet pump prevents fuel movement from the main tank to the center tank.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

The jet pumps operate automatically when the main tank jettison pumps are on. They use fuel from the main tank jettison pumps as motive fuel. The flow of the motive fuel through the jet pump causes suction that takes fuel from the center tanks. The fuel goes through the jet pump discharge lines to the main tanks.

The electrical load management system controls the operation of the main tank jettison pumps in flight to automatically scavenge fuel. A check valve in fuel scavenge inlet line prevents fuel movement from the main tank to the center tank.

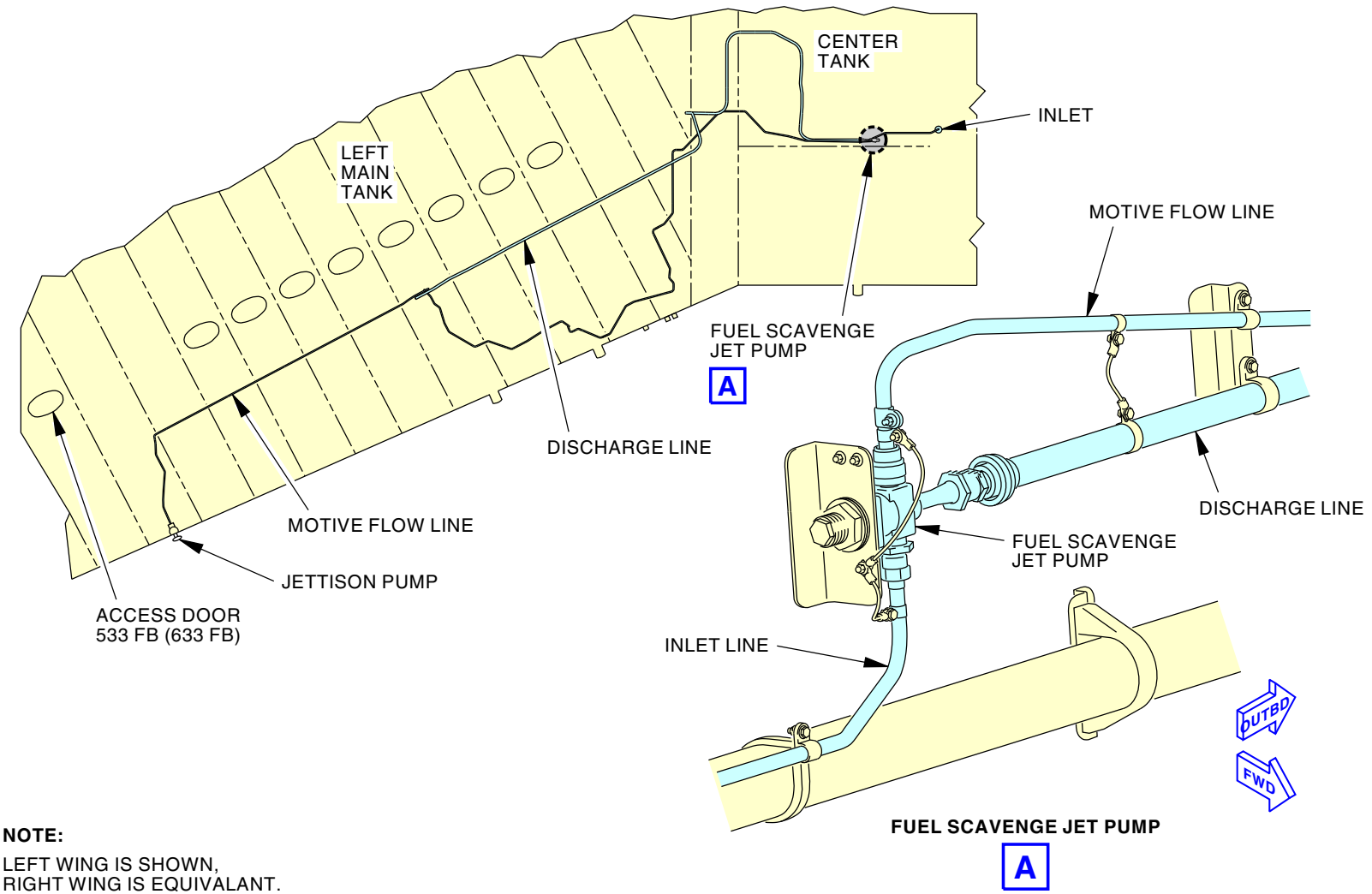
ARO ALL



NOTE: LEFT WING IS SHOWN,
RIGHT WING IS EQUIVALANT.

N83512 S0000112237_V2

ENGINE FUEL FEED - CENTER TANK FUEL SCAVENGE JET PUMP



NOTE:

LEFT WING IS SHOWN,
RIGHT WING IS EQUIVALANT.

2231633 S0000497112_V2

ENGINE FUEL FEED - CENTER TANK FUEL SCAVENGE JET PUMP

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ENGINE FUEL FEED - BOOST PUMP

General

The boost pumps supply main tank fuel to the engine feed manifold.

The boost pumps can supply fuel at a pressure of 12 psi and a flow rate of 43,500 pounds (19,730 kgs) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There are two boost pumps in each main tank. The forward boost pumps are on the rear spar, outboard of each main landing gear shock strut. The aft boost pumps are on the rear spar, inboard of each main landing gear shock strut. The housings are inside the tanks, on the rear spar. The motor/impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve

ARO 001-004 PRE SB 777-28-0078

- Motive flow check valve

ARO 005-999; ARO 001-004 POST SB 777-28-0078

- The forward fuel boost pumps contain a motive flow check valve.

ARO ALL

- Vapor vent valve
- Inlet valve.

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks are full.

Motor-Impeller Unit

The motor-impeller uses 115v ac power. Each pump has these parts:

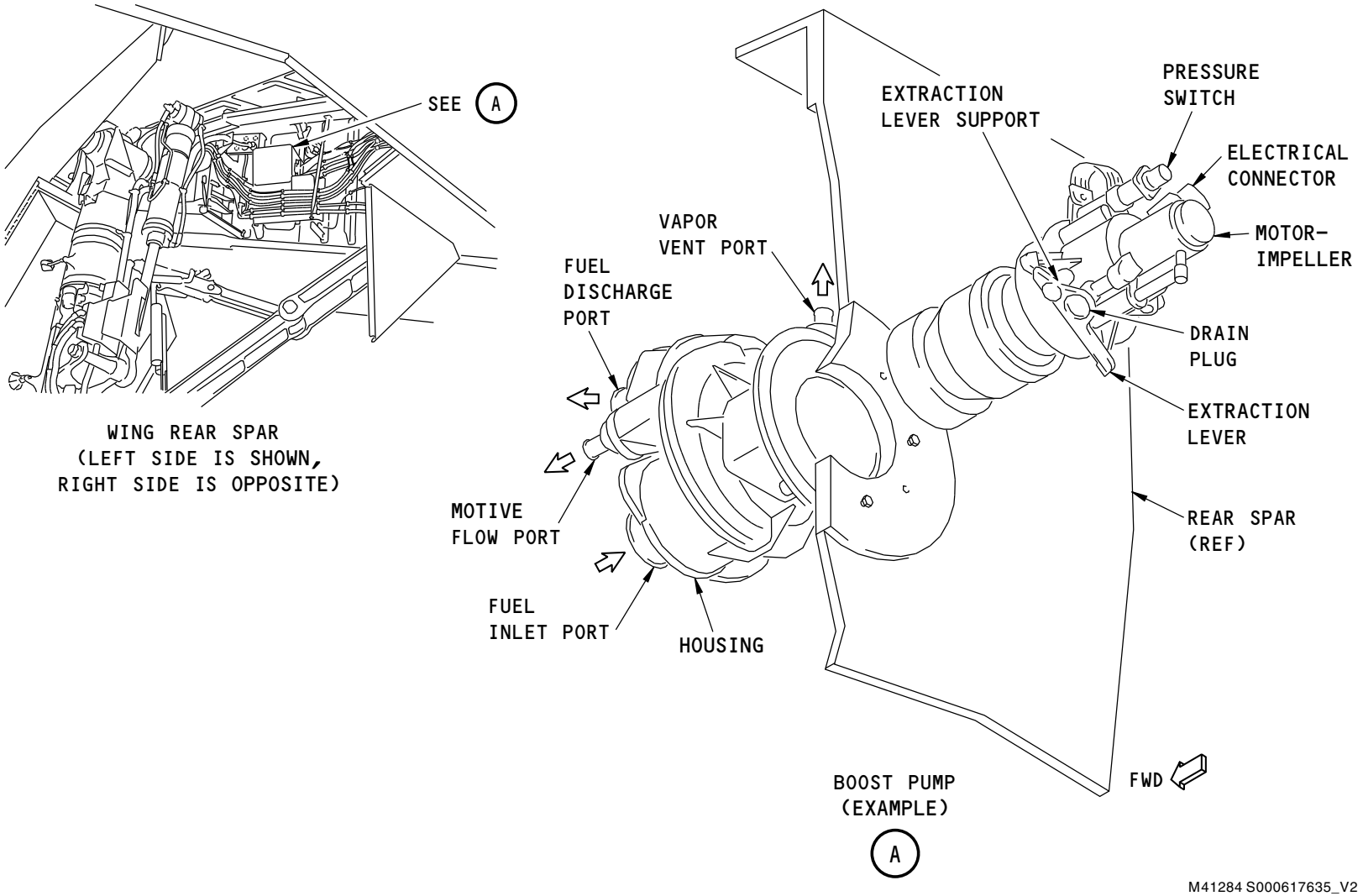
- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

Training Information Point

To remove the motor-impeller, you turn it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

You can remove the discharge, motive flow, and vapor vent valves through the housing from outside the tank.



M41284 S000617635_V2

ENGINE FUEL FEED - BOOST PUMP

ENGINE FUEL FEED - WATER SCAVENGE JET PUMP

General

The water scavenge jet pumps take fluid from the low points in the tanks and send it to the pump inlets. This prevents water from collecting in the bottom of the tanks.

Location

ARO 001-006

The water scavenge jet pumps are on the rear spar. There is one jet pump in each side of the center tank and one in each main tank.

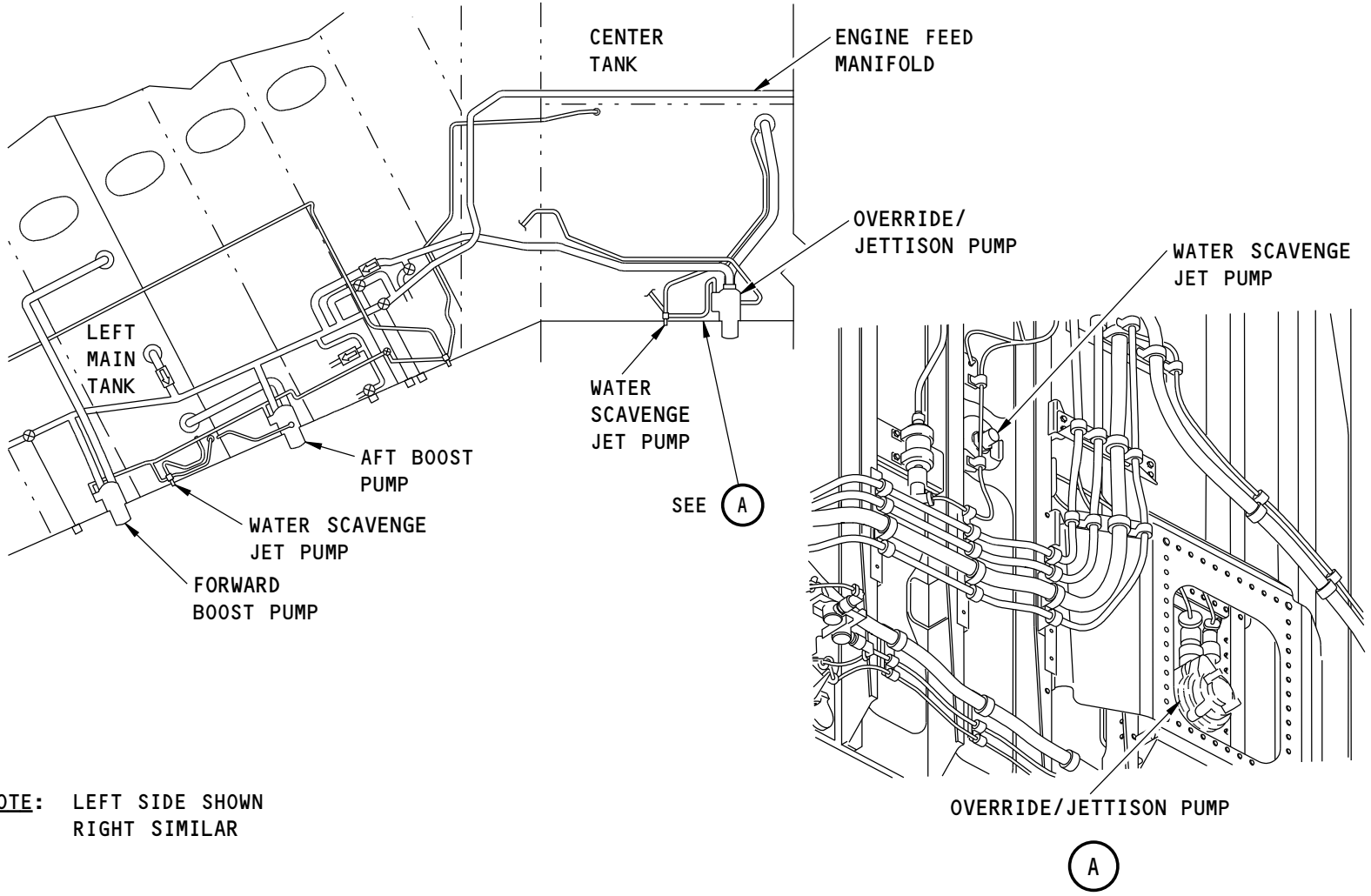
ARO 007-999

The water scavenge jet pumps are on the rear spar. There is one jet pump in each main tank.

ARO ALL

Functional Description

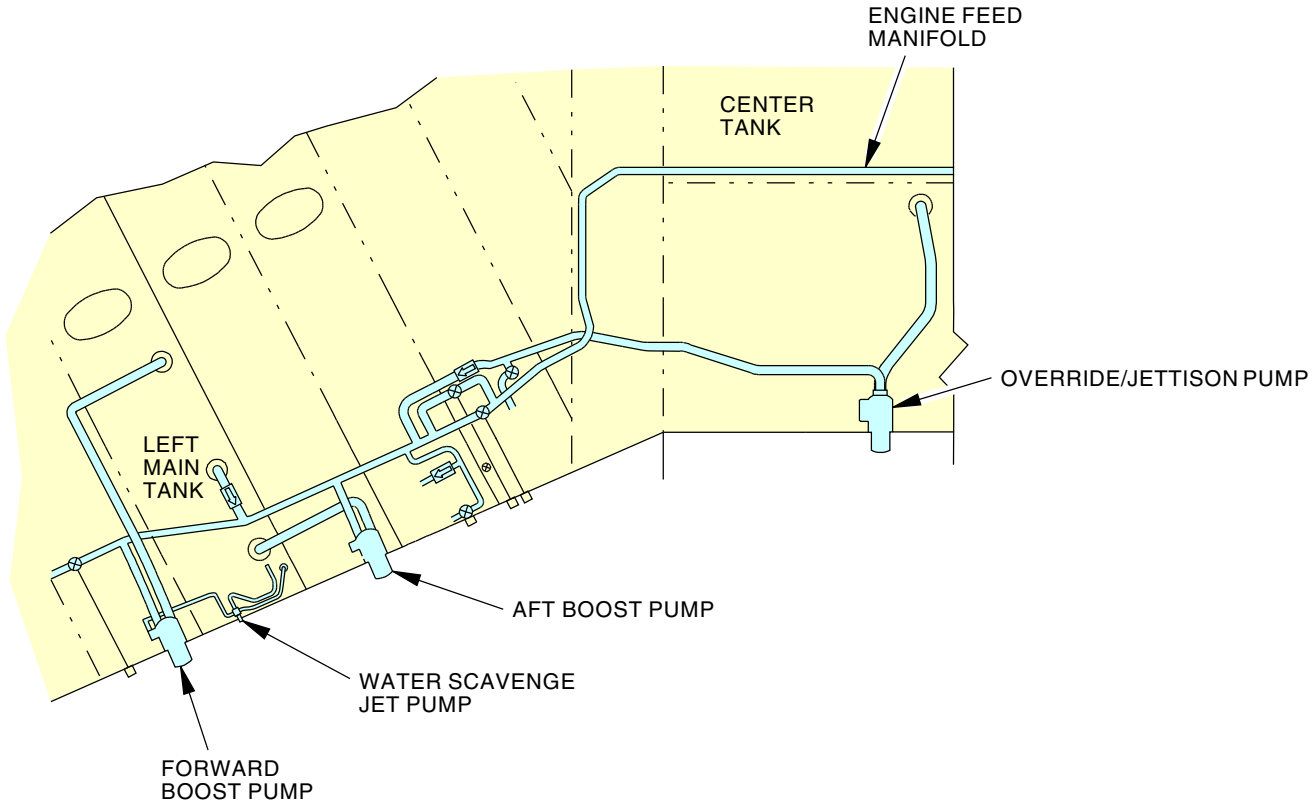
The jet pumps operate automatically when the fuel pumps are on. They use fuel from the fuel pumps as motive fuel. The flow of the motive fuel through the jet pump causes suction that takes fluid from the low points in the tanks.



NOTE: LEFT SIDE SHOWN
RIGHT SIMILAR

M41285 S000617636_V2

ENGINE FUEL FEED - WATER SCAVENGE JET PUMP



NOTE:

LEFT SIDE SHOWN RIGHT SIMILAR

2478587 S0000580483_V2

ENGINE FUEL FEED - WATER SCAVENGE JET PUMP

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ENGINE FUEL FEED - MOTOR-ACTUATED VALVES

General

The fuel system has 11 motor-actuated valves. These seven valves have a valve body, an adapter/shaft and an actuator:

- Engine fuel spar valves (2)
- Fuel crossfeed valves (2)
- Fuel jettison isolation valves (2)
- Defuel valve.

These four valves have the same actuator, a different valve body, but no adapter/shaft:

- APU fuel shutoff valve
- APU fuel isolation valve
- Fuel jettison nozzle valves (2).

Valve Body

The valve body connects two fuel lines. It has these parts:

- Butterfly valve (not shown)
- Operating shaft
- Thermal relief valve.

There are no hard stops for the valve body. You look at alignment marks to find out if the valve is closed.

Adapter

The adapter/shaft mounts through the rear spar. It has these parts:

- Mount plate
- Index plate
- Adapter shaft.

The adapter shaft connects the adapter to the operating shaft on the valve body.

The index plate attaches to the mount plate with three screws. You loosen these screws to rotate the index plate when you align the valve. You must get access to the valve body to check the valve position when you align it.

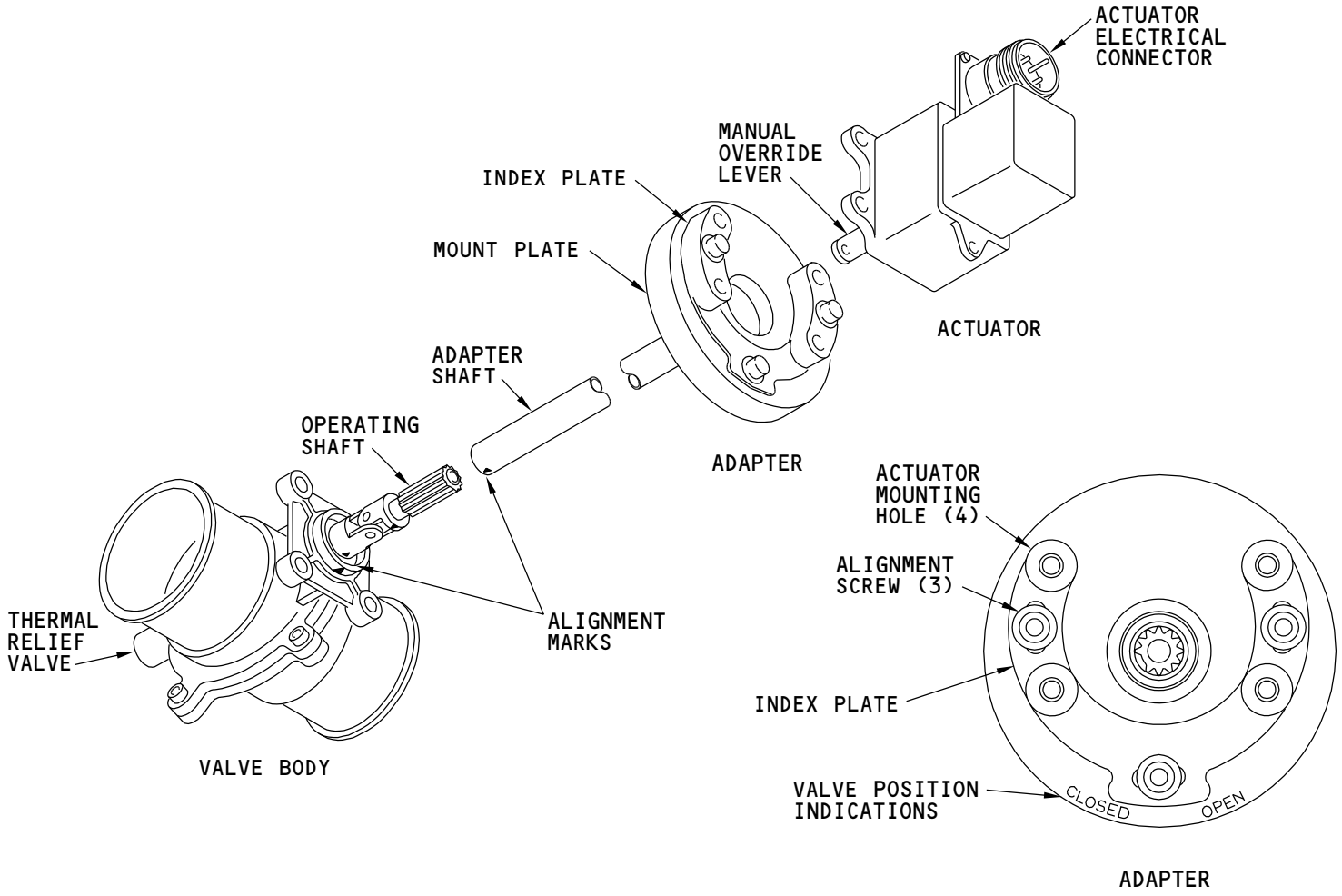
Actuator

The actuator is a 28v dc motor. It has a manual override lever that permits you to operate the actuator without electrical power. The lever aligns with marks on the adapter. This shows you the valve position.

You can remove the actuator without defueling the airplane.

Training Information Point

The valves use interchangeable actuators.



M41287 S000617638_V1

ENGINE FUEL FEED - MOTOR-ACTUATED VALVES

ENGINE FUEL FEED - SPAR VALVE BATTERY

Purpose

The engine fuel spar valve battery makes sure that the fuel system always has power to close these shutoff valves:

- Engine fuel spar valves
- APU fuel shutoff valve.

Components

The engine fuel spar valve battery has these components:

- Aluminum case
- Battery pack
- Printed circuit board assembly
- Electrical connector.

Battery Assembly

The battery pack contains rechargeable nickel-cadmium batteries. They supply 28v dc power to the valve actuators.

Printed Circuit Board Assembly

The printed circuit board assembly has these functions:

- Switching
- Charging
- Testing.

The switch circuit monitors the voltage of the hot battery bus. If the voltage becomes less than 22v, the switch circuit supplies power from the spar valve battery to the valve actuator circuits.

The charge circuit uses power from the right main dc bus to charge the batteries.

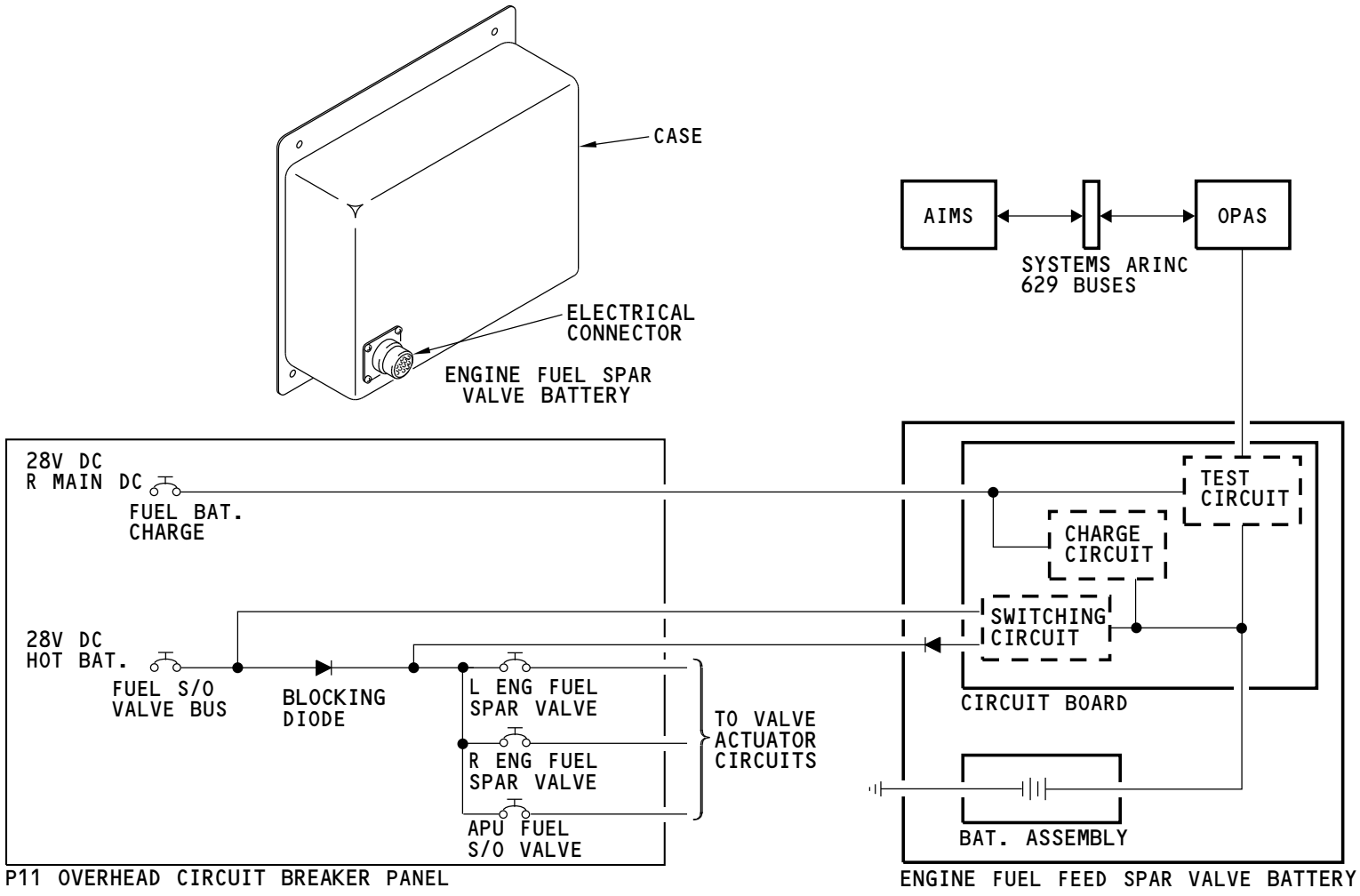
The test circuit does automatic tests of the spar valve battery. It also continuously monitors the battery for these faults:

- Voltage
- Shorted cell
- Open cell
- One battery section has lower voltage than the other battery section.

The test circuit sends a status signal to OPAS that tells the AIMS if the batteries have sufficient capacity. It sends a health signal to OPAS that tells the AIMS if a fault is found. The AIMS shows the EICAS status message FUEL SOV BATTERY when there is a fault.

Training Information Point

There is a airplane maintenance manual (AMM) test of the blocking diode for the fuel shutoff valve bus. The blocking diode is in the P11 panel.



M41294 S000617650_V1

ENGINE FUEL FEED - SPAR VALVE BATTERY

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

The normal procedure for engine fuel feed operation is to supply fuel from the center tank first. When the center tank is empty, you supply fuel from the main tanks.

If you open a crossfeed valve, you can feed an engine from the opposite main tank to correct a fuel imbalance between the main tanks.

The engines can also use suction feed from a main tank.

Center Tank Engine Feed

When the override/jettison pumps are on and there is fuel in the center tank, fuel goes from the center tank into the engine feed manifold. When the spar valves open, fuel goes from the engine feed manifold to the engines.

Main Tank Engine Feed

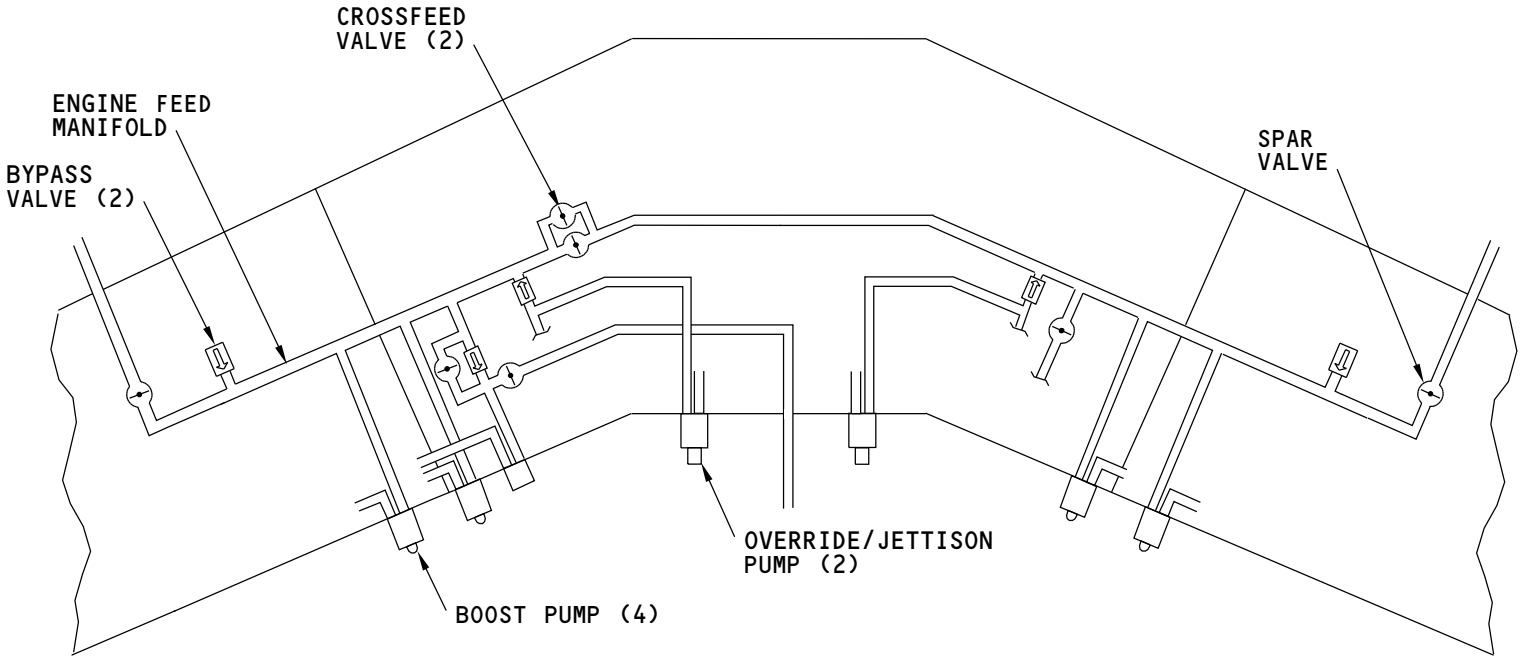
When the center tank is empty and the boost pumps are on, fuel goes from the main tanks into the engine feed manifold.

Cross Feed

The crossfeed valves isolate the left and right sides of the engine feed manifold. If a crossfeed valve is open, an engine can receive fuel from the fuel pumps on the opposite side.

Suction Feed

Suction (gravity) feed occurs when all the pumps on one side are off and the crossfeed valves are closed. During suction feed, the engine gets fuel through the suction bypass valve. The engines can only suction feed from the main tanks.



M41289 S000617640_V1

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT FORWARD BOOST PUMP CONTROL

General

The left forward boost pump receives 115v ac power from two sources: the ground service bus or the left transfer bus.

The boost pump control switch controls power to the pump. A light on the switch shows when there is low pressure at the pump outlet.

Ground Service Bus Power

The usual power source for the boost pump is the ground service bus. Power goes through the boost pump switching and control relays to the pump.

Power from the ground service bus automatically closes the boost pump switching relay.

Left Transfer Bus Power

The left transfer bus is an alternative power source for the left forward boost pump. The left aft boost pump switch must be off for the forward boost pump to receive power from the left transfer bus. This prevents both boost pumps from operating when the backup generator is the power source.

Boost Pump Power Control

The boost pump control switch supplies a ground to close the boost pump control relay.

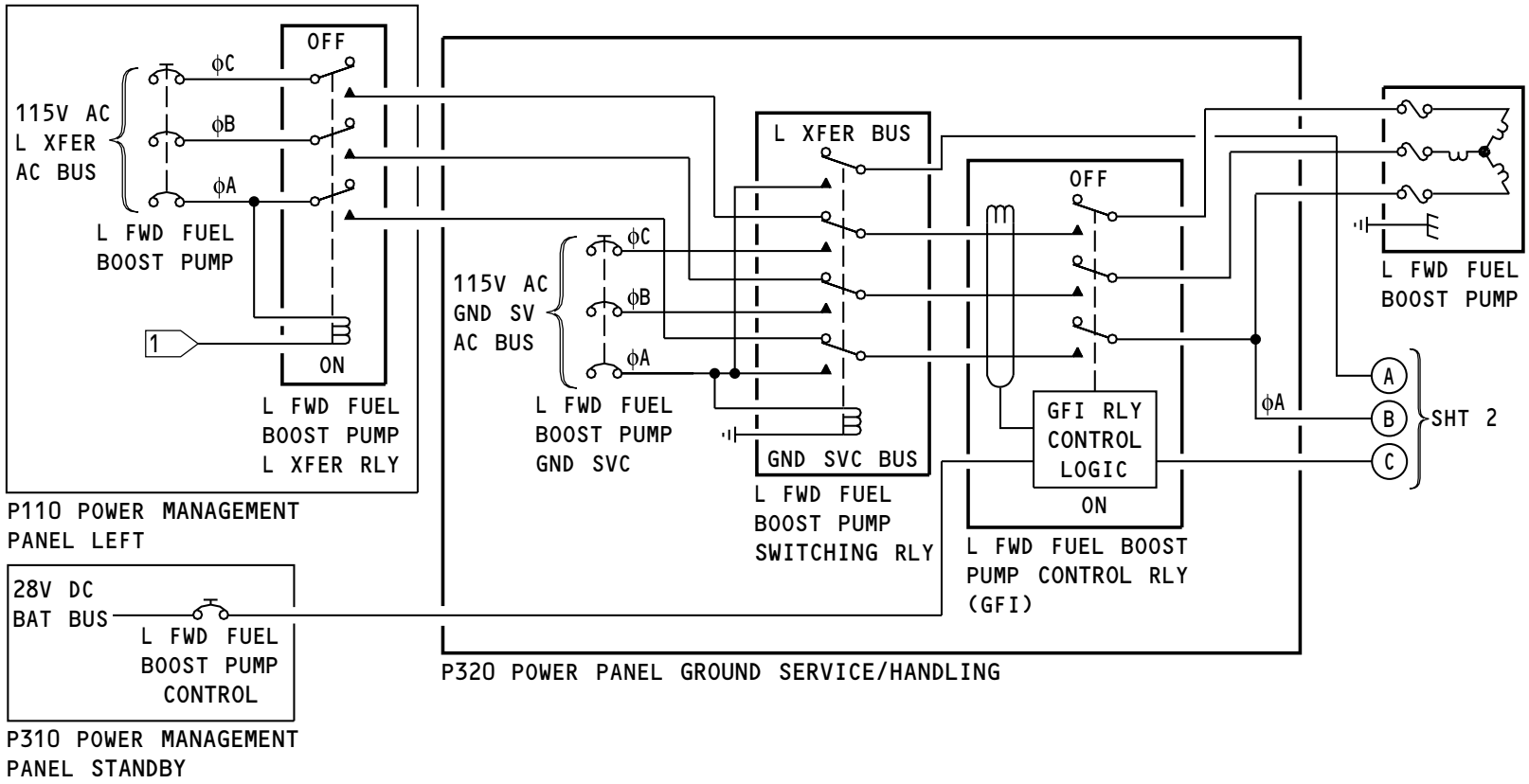
The ELMS logic can also supply a ground to close the boost pump control relay. It does this when the airplane is on the ground and the APU selector is on or the APU is running. This permits the APU to get fuel when the boost pump switches are off.

Ground Fault Protection

The boost pump control relay contains a ground fault protection circuit. It removes power to the boost pump if there is a short circuit or a phase anomaly in the ac power supply.

Pressure Indication

The pressure light on the boost pump control switch shows low pump pressure. The boost pump pressure switch closes when there is low pressure at the pump outlet. The ELMS sends a signal through OPAS to turn on the low pressure light.

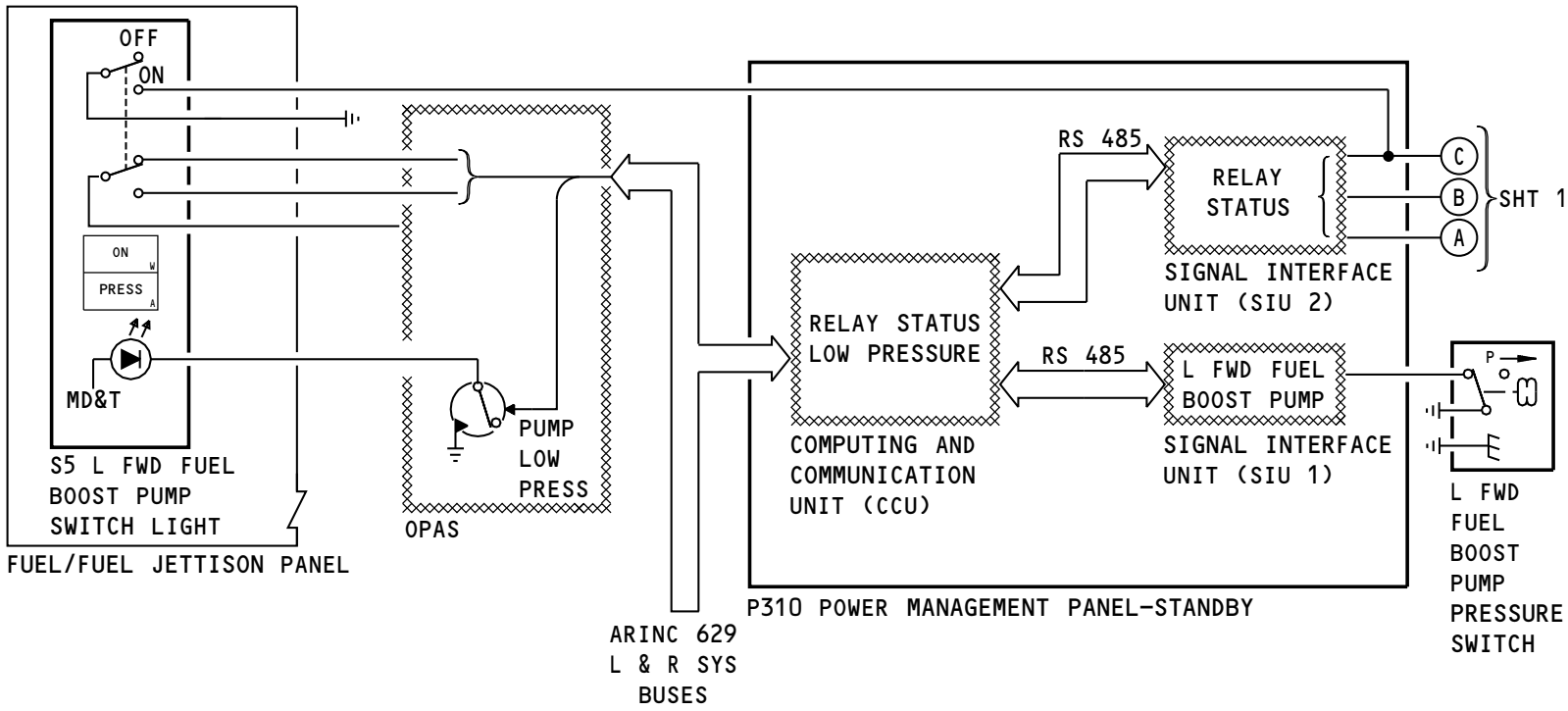


NOTE: RIGHT FORWARD BOOST PUMP ALMOST THE SAME.

1 TO GND IF LEFT AFT FUEL BOOST PUMP RELAY IS DE-ENERGIZED.

U40695 S0000195372_V1

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT FORWARD BOOST PUMP CO



NOTE: RIGHT FORWARD BOOST PUMP ALMOST THE SAME.

U41815 S0000195604_V1

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT FORWARD BOOST PUMP -2

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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT AFT BOOST PUMP CONTROL

General

This page shows control for the left aft boost pump. Control of the right aft boost pump is almost the same.

The left aft boost pump receives 115v ac power from the left transfer bus.

Left Aft Boost Pump Control

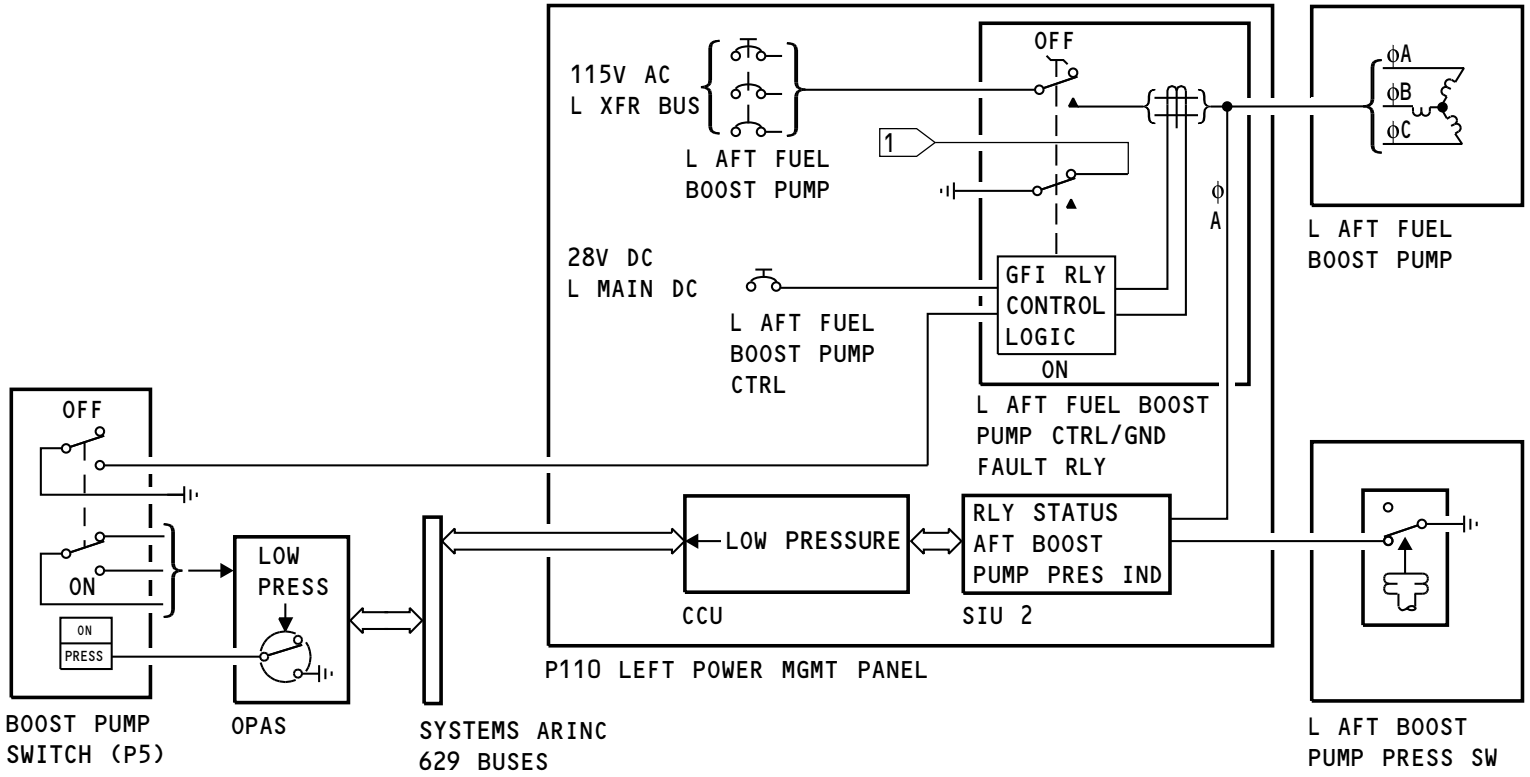
When you close the boost pump switch on the P-5 panel, you operate the boost pump control relay. The relay is in the left power management panel (P110). This lets power go from the left transfer bus to the boost pump.

Ground Fault Protection

The boost pump control relay contains a ground fault protection circuit. It removes power to the boost pump if there is a short circuit or a phase anomaly in the ac power supply.

Pressure Indication

The boost pump control switch has a light to show when there is low pressure at the pump outlet. The boost pump pressure switch closes when there is low pressure. The ELMS logic sends a signal through OPAS to turn on the low pressure light in the switch.



NOTE: L AFT BOOST PUMP IS SHOWN,
R AFT IS ALMOST THE SAME.

1 TO L FWD FUEL BOOST PUMP XFER RELAY

488628 S0000145781_V2

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT AFT BOOST PUMP CONTROL

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT CENTER OVERRIDE/JETTISON PUMP CONTROL

General

The left center override/jettison pump receives 115v ac power from the left main bus. Control of the right center override/jettison pump is almost the same.

Left Center Override/Jettison Pump Control

The center left fuel pump switch supplies a ground to an electrical load control unit (ELCU) in the left power panel. The ELCU uses a control relay to close an internal contactor. This permits power to go from the left main bus to the pump.

The override/jettison pump control relay contains a ground fault protection circuit. It removes power to the pump if there is a short circuit or a phase anomaly in the ac power supply.

The left override pump control relay does not let the pump operate while the switch is in the OFF position. If this relay is closed and the switch is in the OFF position, ELMS energizes the inhibit relay. This removes power from the pump.

The ELCU receives power from the left main dc bus. When the airplane is on the ground and has only one external power source, the ELMS removes the dc power to the ELCU. The right override/jettison pump operates the same. This inhibits the pump and prevents an electrical power overload. During the inhibit no EICAS message shows.

If the APU generator is the single power source, you can operate the left override/jettison pump. You cannot operate the right override/jettison pump if the APU generator is the only power source.

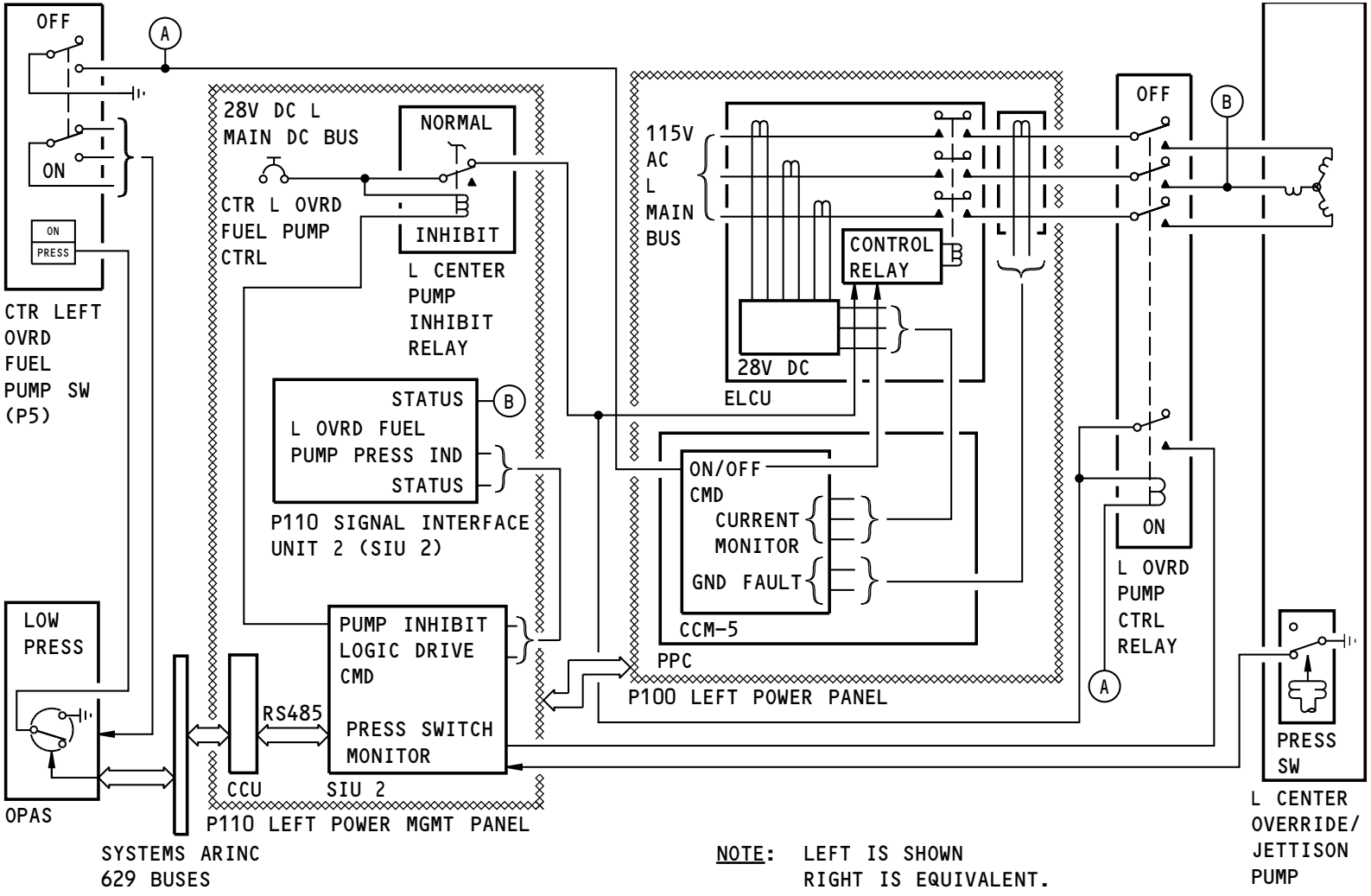
If an IDG is the single power source, you can operate the related override/jettison pump.

The pump inhibit logic does not operate during these conditions:

- The air/ground system is set to air mode
- A refuel panel door is open
- The fuel jettison arm switch is in the armed position.

Pressure Indication

The pressure light on the switch shows low pump pressure. The override/jettison pump pressure switch closes when there is low pressure at the pump outlet. The ELMS sends a signal through the OPAS to turn on the pressure light on the switch. The pressure light will come on only when the pump is commanded on.



U35320 S0000193335_V2

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT CENTER OVERRIDE/JETTISON PUMP CONTROL

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - ENGINE FUEL SPAR VALVE

General

The engine fuel spar valves get power to operate from the hot battery bus or the spar valve battery. The fuel control switches control relays to operate the spar valves. The engine fire switch must be down to permit the spar valve to open.

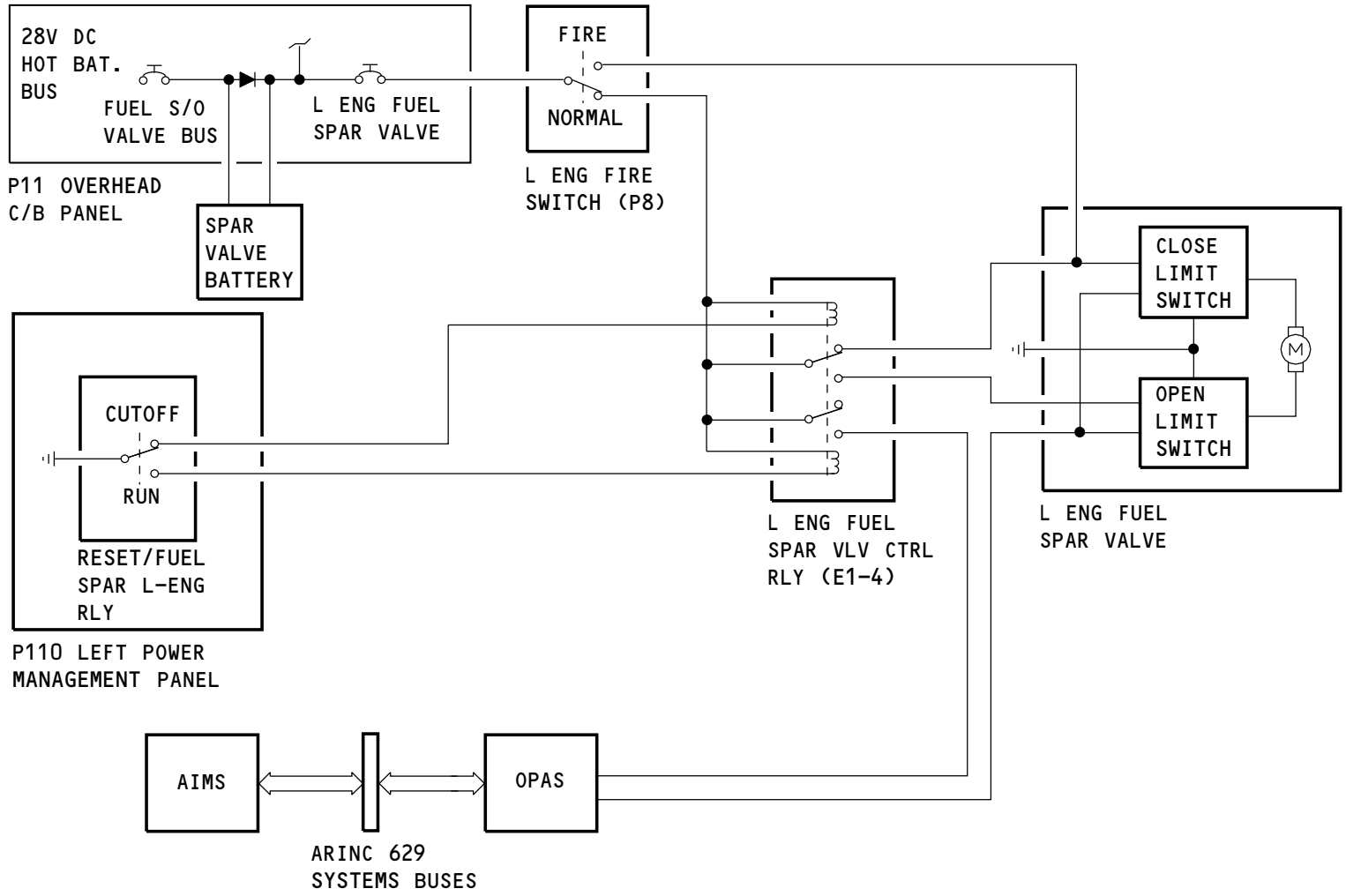
Control

Power goes through engine fuel spar valve control relay to the spar valve. The fuel control switch controls the reset/fuel spar relay to move the control relay. When the fuel control switch is in the RUN position, the open coil in the control relay energizes. This sends power to open the spar valve. When the fuel control switch is in the CUTOFF position, the close coil in the control relay energizes. This sends power to close the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator.

Fault Indications

The OPAS monitors the spar valve control relay position and the spar valve position. If there is a disagreement between the relay position and valve position, the OPAS sends a fault message to the AIMS. The fault messages cause an EICAS status message.



NOTE: LEFT SHOWN, RIGHT SIMILAR

1614109 S0000299925_V1

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - ENGINE FUEL SPAR VALVE

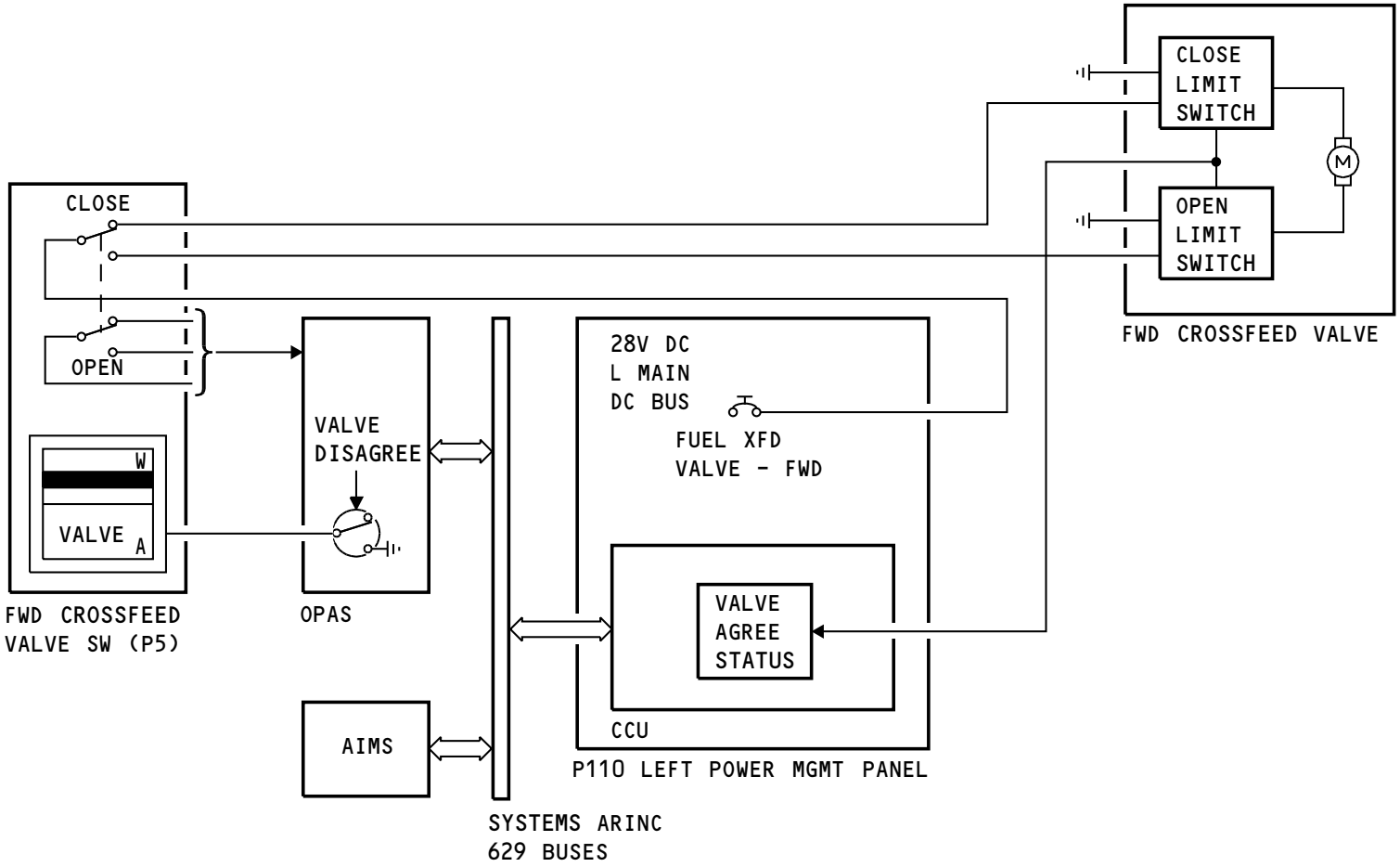
Control

The crossfeed valve switches on the P5 directly control the crossfeed valves. A 28v dc bus supplies power to the crossfeed valve actuator. When you push the switch, you supply power through the limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve agree status logic.

Fault Indications

The VALVE light comes on to show the related valve is in transit, or a valve disagree fault exists. The light comes on when the valve position disagrees with the switch position. The ELMS controls the light. A CCU sends a valve disagree message to the OPAS to cause the OPAS to turn on the light.

If the valve disagree condition exists for more than 10 seconds, the ELMS sends a fault signal to the AIMS. The AIMS shows the related EICAS advisory and status messages.



NOTE: FORWARD SHOWN,
AFT SIMILAR

488648 S0000145777_V1

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CROSSFEED VALVE CONTROL

ENGINE FUEL FEED - OPERATION

Fuel Panel

The fuel panel is on the P5 overhead panel. It has alternate-action switches that control the fuel pumps and the crossfeed valves.

Each fuel pump switch has two indication lights. The ON light is on when the switch is on. The pressure light comes on when there is low pressure at the pump outlet.

Crossfeed Valve Switches

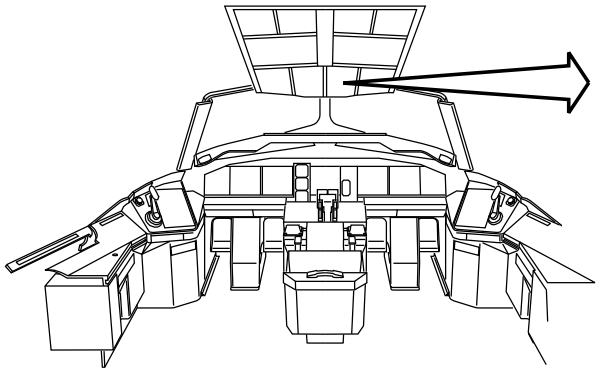
Each crossfeed valve switch has two indication lights. The flowbar light is on when the switch is on. The VALVE light comes on when there is disagreement between switch and valve positions.

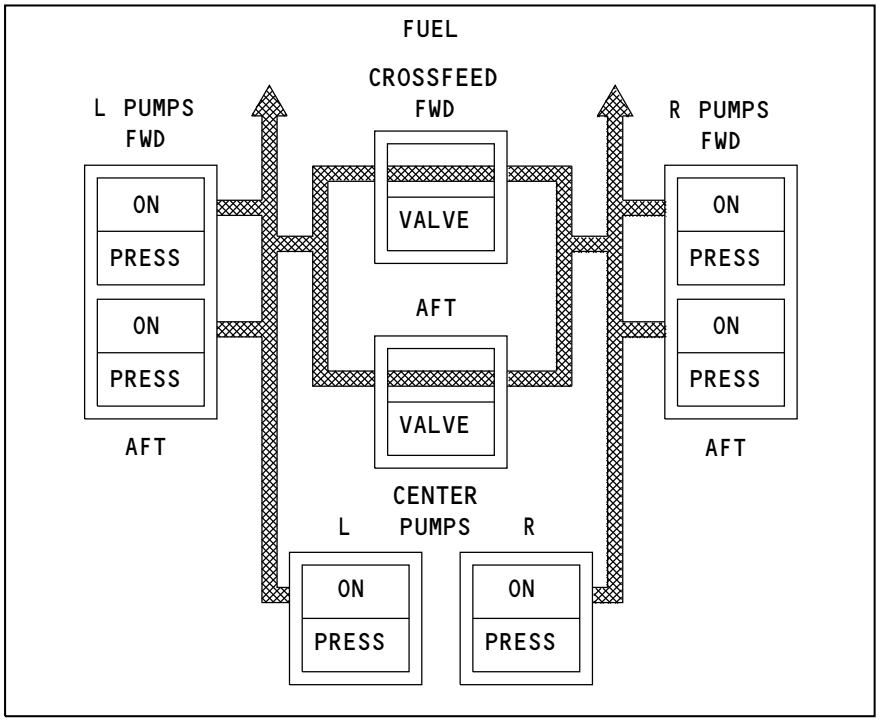
Normal Operation

Normally all pump switches are on at the beginning of a flight. The center tank supplies fuel to the engines. When the center tank is empty, you turn off the override/jettison pumps.

Crossfeed

You supply fuel to an engine from the opposite tank through the crossfeed valve(s) to correct an imbalance between the main tanks. You open a crossfeed valve and turn off the boost pumps in the tank that has less fuel.





FUEL PANEL (P5)

M41361 S000617644_V1

ENGINE FUEL FEED - OPERATION

Fuel Synoptic Display

The fuel synoptic display is a simplified schematic of the fuel system. It shows the system configuration for these components:

- Override/jettison pumps
- Boost pumps
- Spar valves
- Crossfeed valves

The fuel synoptic display also shows fuel quantity.

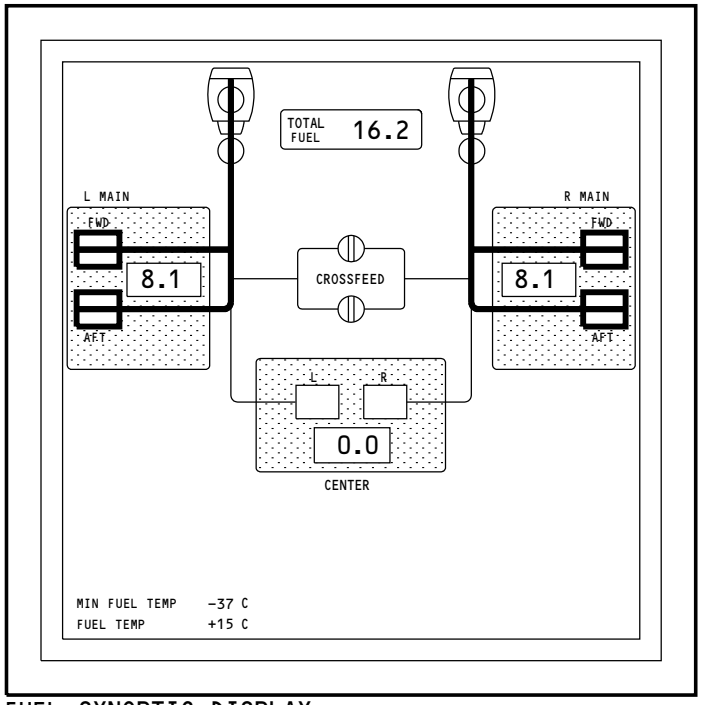
The configuration in the fuel synoptic display below shows the center tank empty and the boost pumps feeding the engines from the main tanks. The crossfeed valves are closed and the spar valves are open.

Fuel Management Maintenance Page

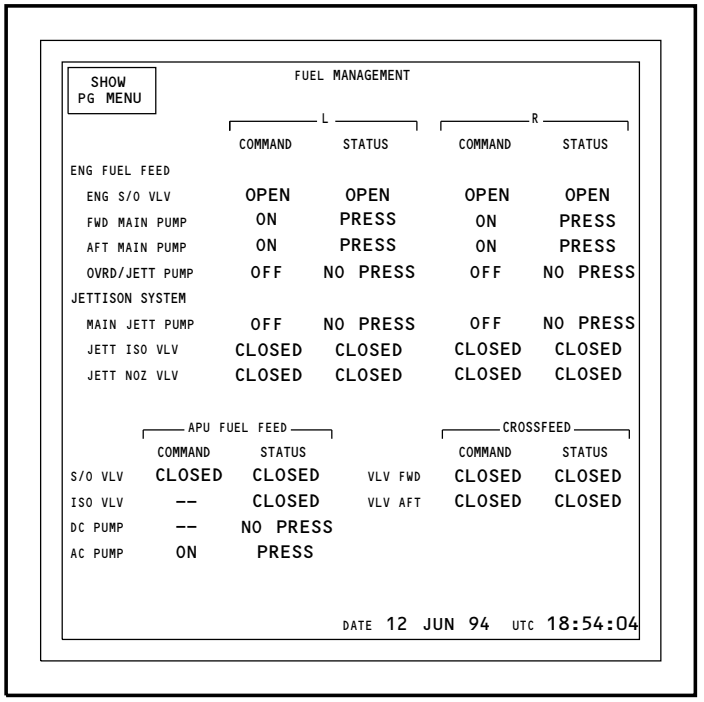
The fuel management maintenance page shows the commanded and actual status for the fuel system components.

Training Information Point

The ENG S/O VLV data tell you about the spar valves. The AC PUMP data tell you about the left forward boost pump. The VLV FWD data tell you about the forward crossfeed valve. The VLV AFT data tell you about the aft crossfeed valve.



FUEL SYNOPTIC DISPLAY



FUEL MANAGEMENT MAINTENANCE PAGE

M41365 S000617648_V3

ENGINE FUEL FEED - INDICATIONS

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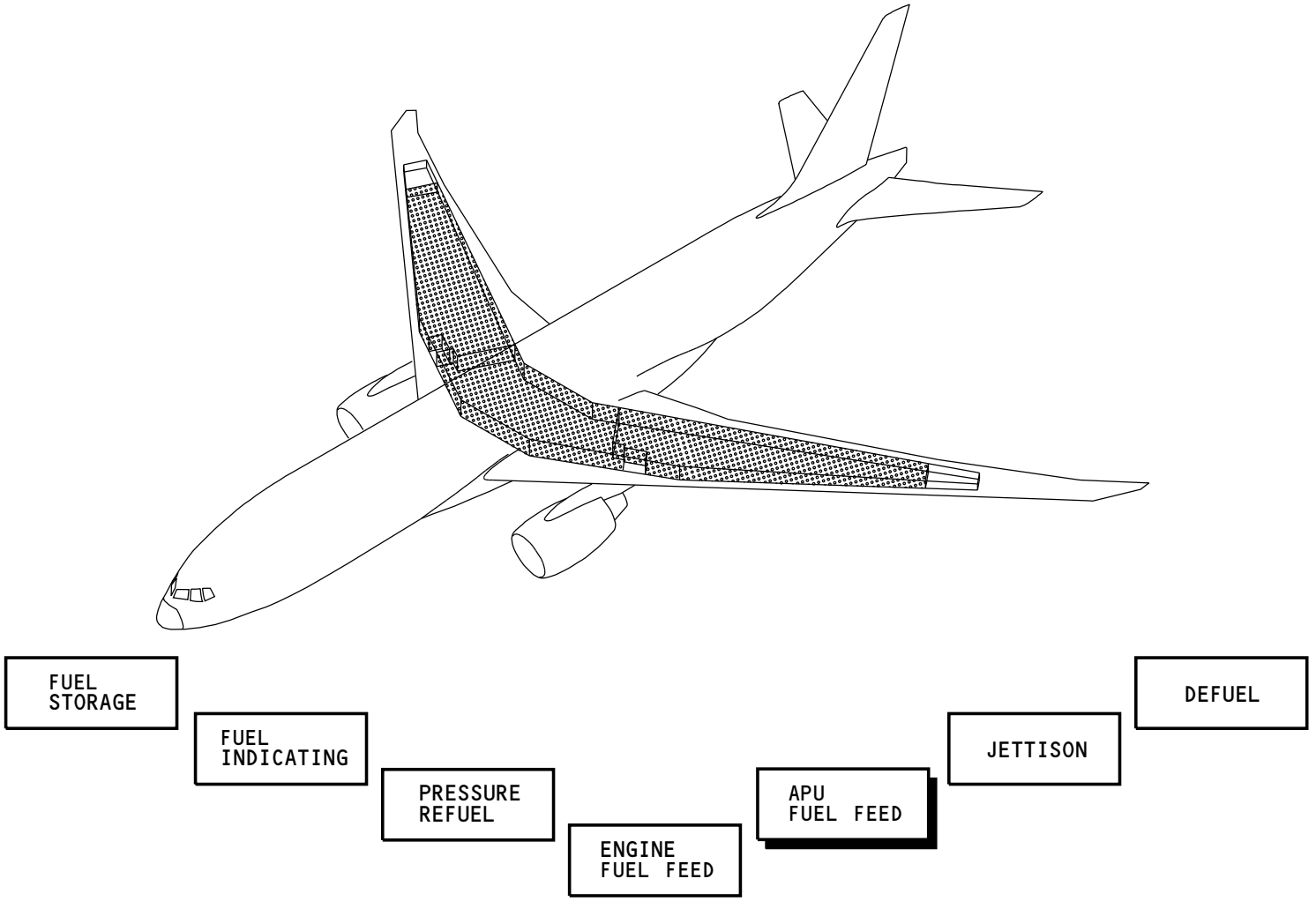
APU FUEL FEED - INTRODUCTION

Purpose

The APU fuel feed system normally supplies fuel to the APU. It can also supply fuel to the left engine when there is no pressure in the left engine feed manifold and the left engine is not operating.



W43420 S0000123526_V1

APU FUEL FEED - INTRODUCTION

APU FUEL FEED - GENERAL DESCRIPTION

General

The APU fuel feed system supplies fuel to the APU during APU operation. Fuel comes from the fuel pumps (not shown) or the APU dc fuel pump. Power and control come from the ELMS.

APU Feed

The ELMS supplies power to the APU dc fuel pump and APU fuel shutoff valve. The pump operates automatically when the APU selector is in the ON position and there is no pressure in the left engine feed manifold. When there is pressure in the left engine feed manifold, the pump does not operate.

The ELMS uses crossfeed valve position and pump pressure switch signals to find if there is pressure in the manifold. The ELMS uses the dc pump pressure switch to monitor pump operation.

The APU fuel shutoff valve opens to permit fuel to go to the APU. In normal operation, the ELMS controls the valve through the a relay in the P101 panel. The ELMS opens the APU fuel shutoff valve when the APU selector is in the ON position or when the APU is running. The APU controller tells the ELMS when the APU is running.

The hot battery bus or the engine fuel spar valve battery supplies the power to open or close the APU fuel shutoff valve. The APU fire switch must be down to open the valve.

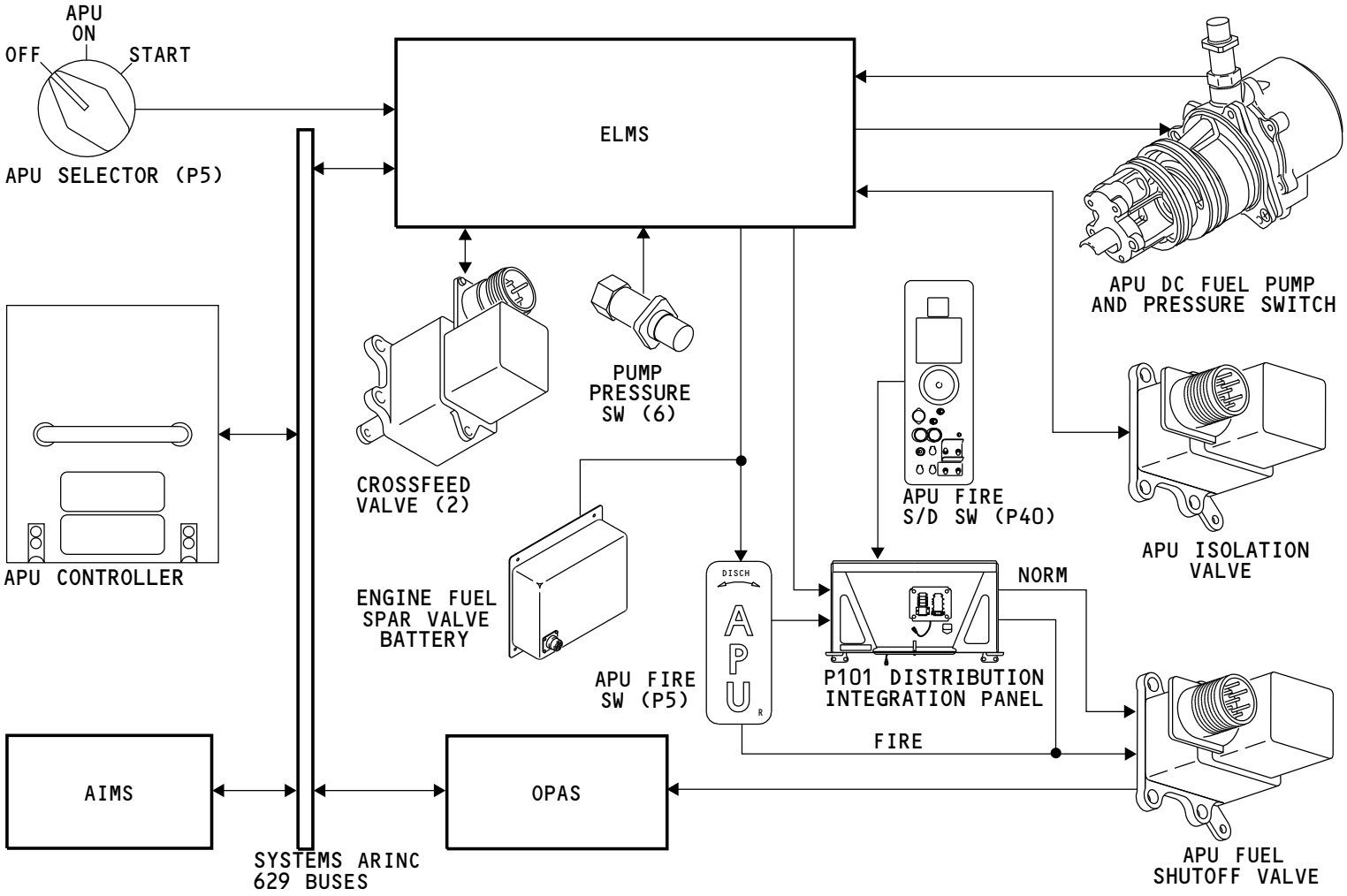
The APU fire switch and the APU fire shutdown switch close the APU fuel shutoff valve. The APU fire switch has a direct circuit to the valve. The APU fire shutdown switch controls a relay in the P101 panel to close the valve.

Engine Feed

The APU fuel feed system can supply fuel to the left engine in the air when there is no pressure in the left engine feed manifold and the left engine is not operating. The ELMS opens the APU isolation valve and turns on the APU dc fuel pump to permit this.

Fault and Indicating Information

APU fuel feed faults and indication information goes to the AIMS on the systems ARINC 629 buses.



M41298 S000617657_V1

APU FUEL FEED - GENERAL DESCRIPTION

APU FUEL FEED - COMPONENT LOCATIONS - FUEL TANKS

General

The APU fuel feed system has these components:

- APU DC fuel pump
- APU isolation valve
- APU fuel shutoff valve
- APU isolation check valve.

The APU fuel supply line goes through the center tank, then aft to the APU. The fuel supply line has a shroud around it. The shroud has a drain line that goes to the APU shroud drain mast on the bottom of the airplane.

APU DC Fuel Pump

The APU dc fuel pump is on the rear spar of the left wing, aft of the second fuel tank access door. The pump housing is inside the center tank. The pump inlet is in the left main tank.

APU Fuel Shutoff Valve

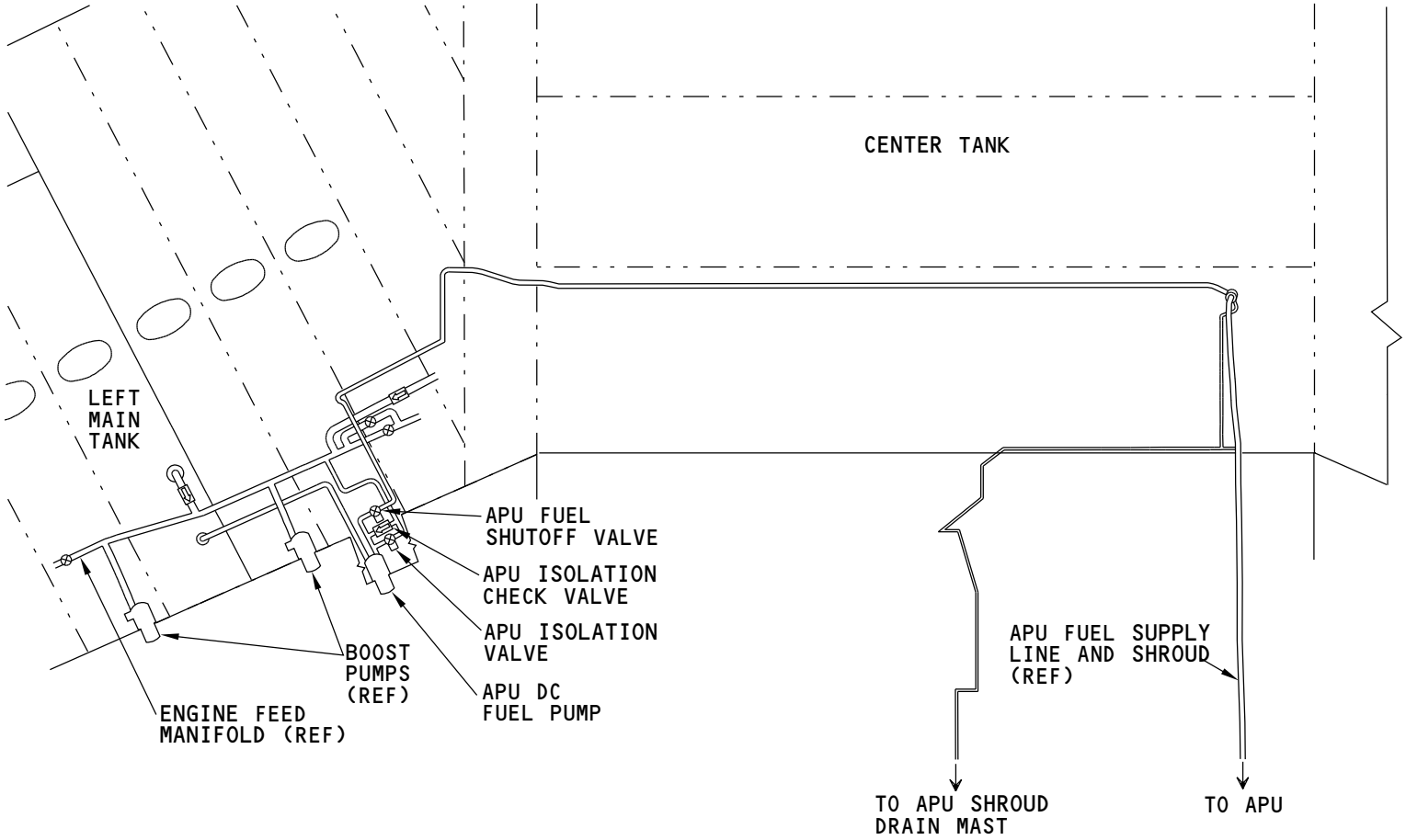
The APU fuel shutoff valve body is high in the left side of the center tank, above the APU isolation valve. You get access to the fuel shutoff valve through the second fuel tank access door. The valve actuator is on the rear spar of the left wing, inboard of the dc fuel pump.

APU Isolation Valve

The APU isolation valve body is in the left side of the center tank, below the APU fuel shutoff valve. You get access to the isolation valve through the second fuel tank access door. The valve actuator is on the rear spar of the left wing, inboard of the dc fuel pump.

APU Isolation Check Valve

The APU isolation check valve is in the left side of the center tank, between the APU fuel shutoff valve and isolation valve. You get access to the isolation check valve through the second fuel tank access door.



M41299 S000617658_V1

APU FUEL FEED - COMPONENT LOCATIONS - FUEL TANKS

APU FUEL FEED - COMPONENTS

APU DC Fuel Pump

The APU dc fuel pump supplies fuel to the APU and to the engine feed manifold. It uses 28v dc power. It supplies fuel at a pressure of 24 psi and a flow rate of 3150 pounds per hour (1430 kilograms per hour).

The pump has a pressure switch that sends a signal to the ELMS when the pump is operating.

APU Fuel Shutoff Valve

The APU fuel shutoff valve opens to permit fuel to flow to the APU. Fuel comes from the left engine feed manifold, or from the dc pump.

The APU fuel shutoff valve actuator is the same as the other 28v dc motor actuators on other fuel system valves. See the engine fuel feed section for more information about motor actuated fuel valves (SECTION 28-22).

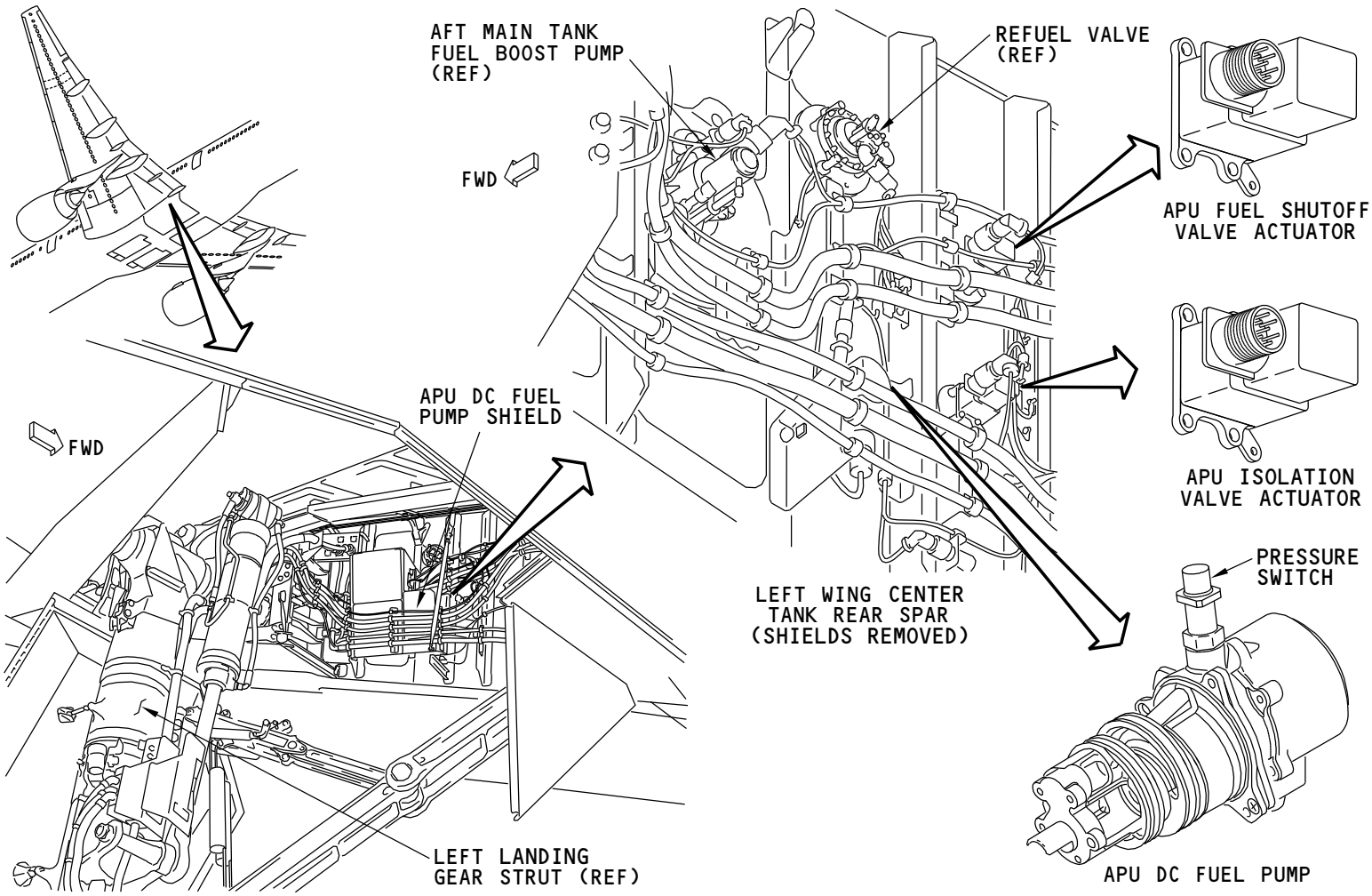
APU Isolation Valve

The APU isolation valve opens to let fuel flow from the APU dc fuel pump to the left engine feed manifold. The isolation valve is normally closed. The valve opens when there is no pressure in the left engine feed manifold and the left engine is not operating.

The APU isolation valve actuator is the same as the other 28v dc motor actuators on other fuel system valves. See the engine fuel feed section for more information about motor actuated fuel valves (SECTION 28-22).

Training Information Point

The APU dc fuel pump has a shield that protects it from thrown tire treads. You must remove the shield to get access to the pump.



M41301 S000617660_V1

APU FUEL FEED - COMPONENTS

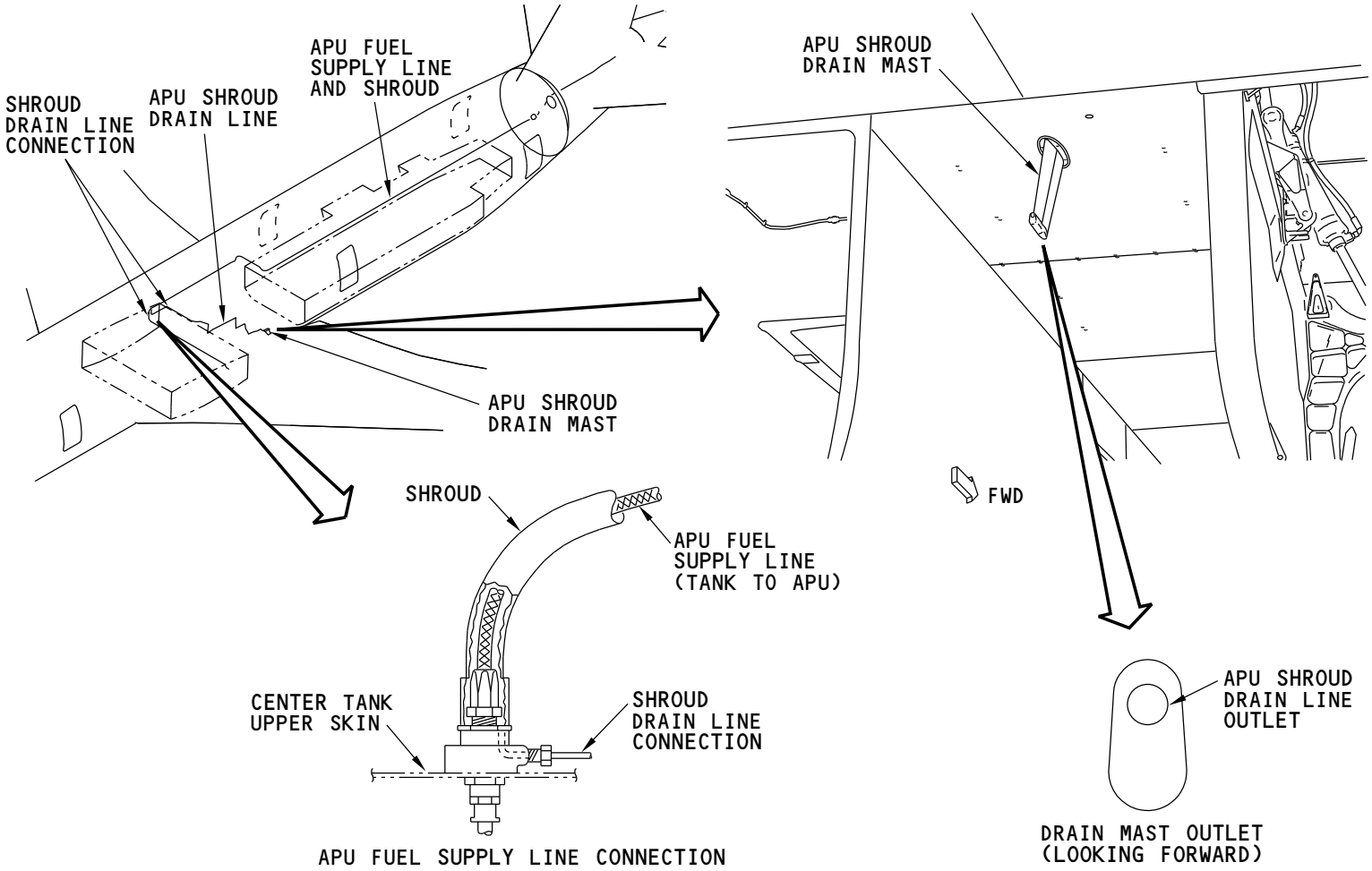
APU FUEL FEED - FUEL SUPPLY LINE AND SHROUD

APU Fuel Supply Line and Shroud

The APU fuel supply line is flexible rubber and kevlar. It has an aluminum shroud. The fuel supply line exits from the center fuel tank. It passes through the right wheel well, and goes under the floor to the APU.

Shroud Drain Line

The shroud drain line connects the fuel line shroud to the APU shroud drain mast. If there is a leak in the fuel supply line, the fuel is contained by the shroud and flows overboard through the drain mast.



M41302 S000617661_V1

APU FUEL FEED - FUEL SUPPLY LINE AND SHROUD

APU FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

The APU fuel feed system uses the main pumps or the DC pump to supply fuel to the APU. The system can also supply fuel to the left engine feed manifold.

APU Fuel Feed From Main Pumps

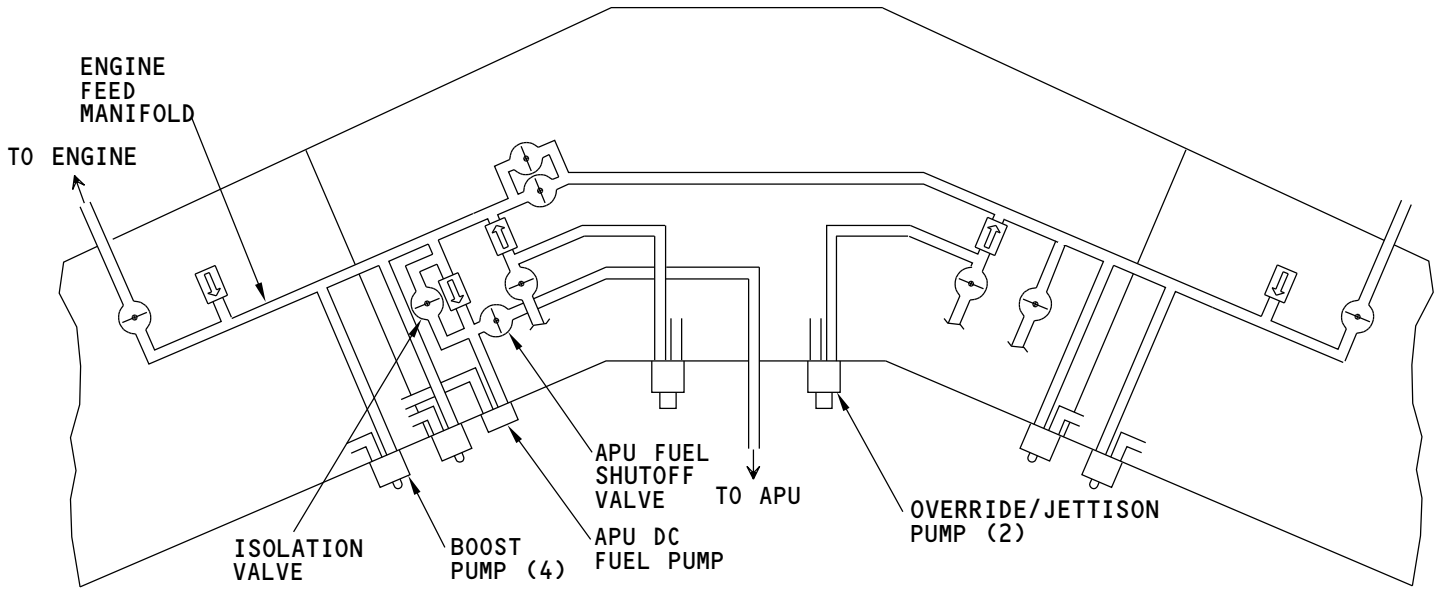
The APU normally receives fuel from the left engine feed manifold. The engine feed manifold receives fuel from any of the main or center tank fuel pumps. The fuel flows through a check valve and the APU fuel shutoff valve to the APU fuel line.

APU Fuel Feed From DC Fuel Pump

During APU starts and operation, if there is no fuel pressure in the left engine feed manifold, the APU dc fuel pump automatically turns on. This supplies fuel through the APU fuel valve to the APU fuel line.

Main Engine Feed From DC Fuel Pump

The APU dc fuel pump also turns on when there is no pressure in the left engine feed manifold and the left engine is not operating. Fuel flows through the APU isolation valve into the left engine feed manifold.



M41304 S000617663_V1

APU FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU DC FUEL PUMP & ISOLATION VALVE

General

The ELMS automatically controls the APU dc fuel pump and the APU isolation valve. When you start the APU on the ground and ac power is not available, the ELMS starts the APU dc fuel pump. During flight, if there is an engine flameout, the ELMS can start the APU dc fuel pump and open the APU isolation valve. This lets the dc fuel pump supply fuel to the left engine when the ac boost pumps do not operate.

APU DC Fuel Pump

The APU dc fuel pump gets power from battery bus #2. The P310 CCU sends a signal to turn on the pump. This energizes the APU dc pump control relay to supply power to the pump.

Isolation Valve

The APU isolation valve gets power to open or close from the captain's flight instrument bus. The P310 EEU sends a signal to open the valve. This energizes the APU isolation valve relay to supply power to open the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve agree status logic.

Control

For APU fuel feed, the P310 CCU sends the dc pump command signal when these conditions occur:

- No pressure in the left engine feed manifold
- APU running, or APU selector in START or ON position.

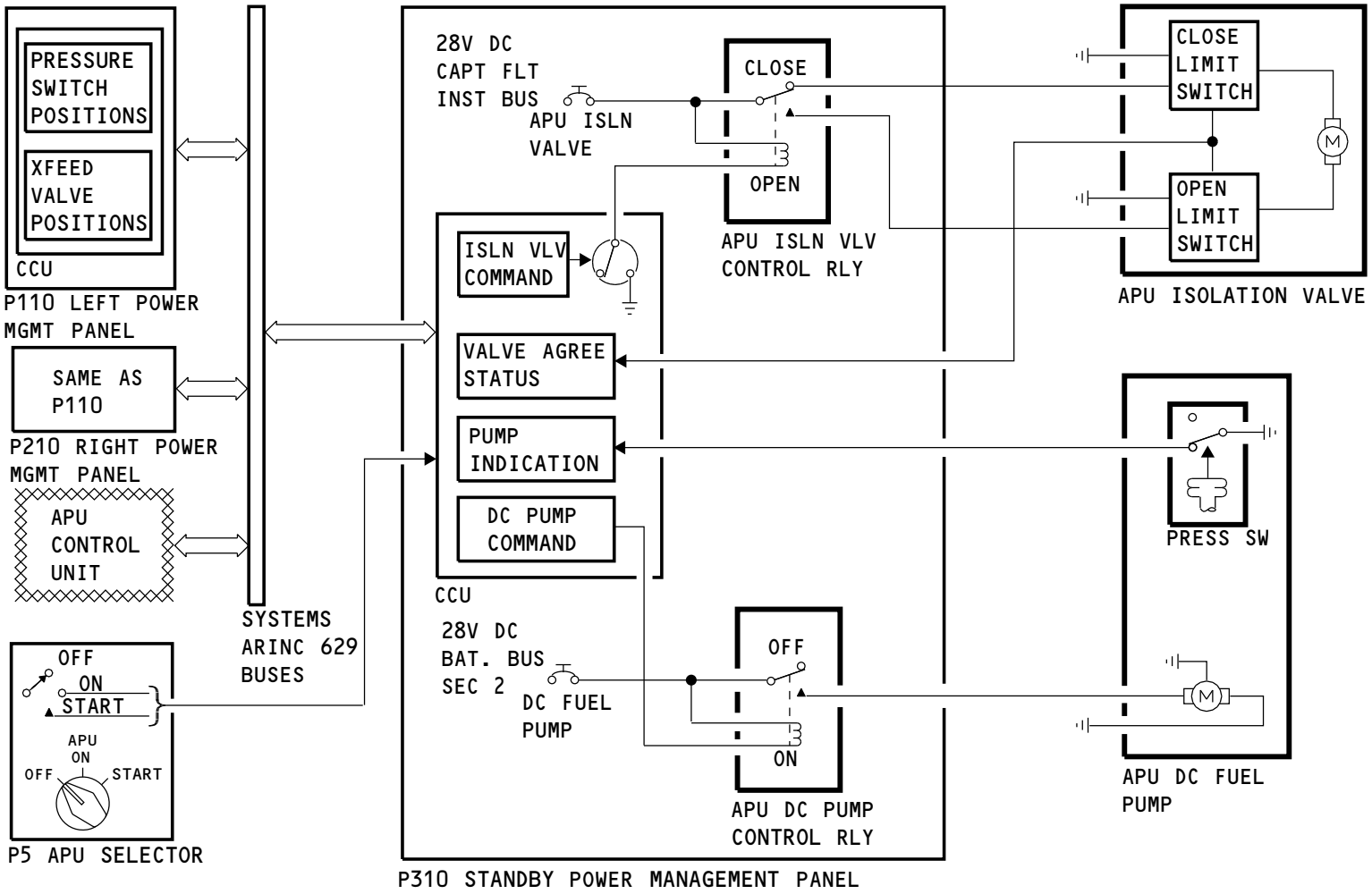
For left engine fuel feed, the P310 CCU sends the dc pump command signal and the isolation valve command signal when these conditions occur:

- No pressure in the left engine feed manifold
- left engine N2 is less than the engine run speed
- Left engine fuel control switch is in the RUN position
- The airplane is in the air.

The ELMS uses signals from the ac fuel pump pressure switches and the crossfeed valves to find if there is pressure in the left engine feed manifold. The P110 and P210 CCUs send the signals on the systems ARINC 629 buses to the P310 CCU. The APU signals come from the APU control unit and the APU selector.

Fault Indications

The P310 CCU monitors the status of the APU dc pump pressure switch and the APU isolation valve position. If the pressure switch does not agree with the dc pump command status, the CCU sends a fault message to the systems ARINC 629 buses. If the APU isolation valve position does not agree with the isolation valve command status, the CCU sends a fault message to the systems ARINC 629 buses. The fault messages cause EICAS advisory and status messages.



439061 S0000142205_V1

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU DC FUEL PUMP & ISOLATION VALVE

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU FUEL SHUTOFF VALVE

General

The ELMS automatically controls the APU fuel shutoff valve. The CCU in the P310 panel uses inputs from the APU controller and the APU selector to control the valve.

Control

The P310 CCU sends a valve open command when any of these conditions occur:

- APU is running
- APU selector is in the ON or START position.

It sends a valve close command when any of these conditions occur:

- APU is not running
- APU fire switch closes
- APU fire shutdown switch closes
- APU fire.

The APU running signal comes from the APU controller.

Power

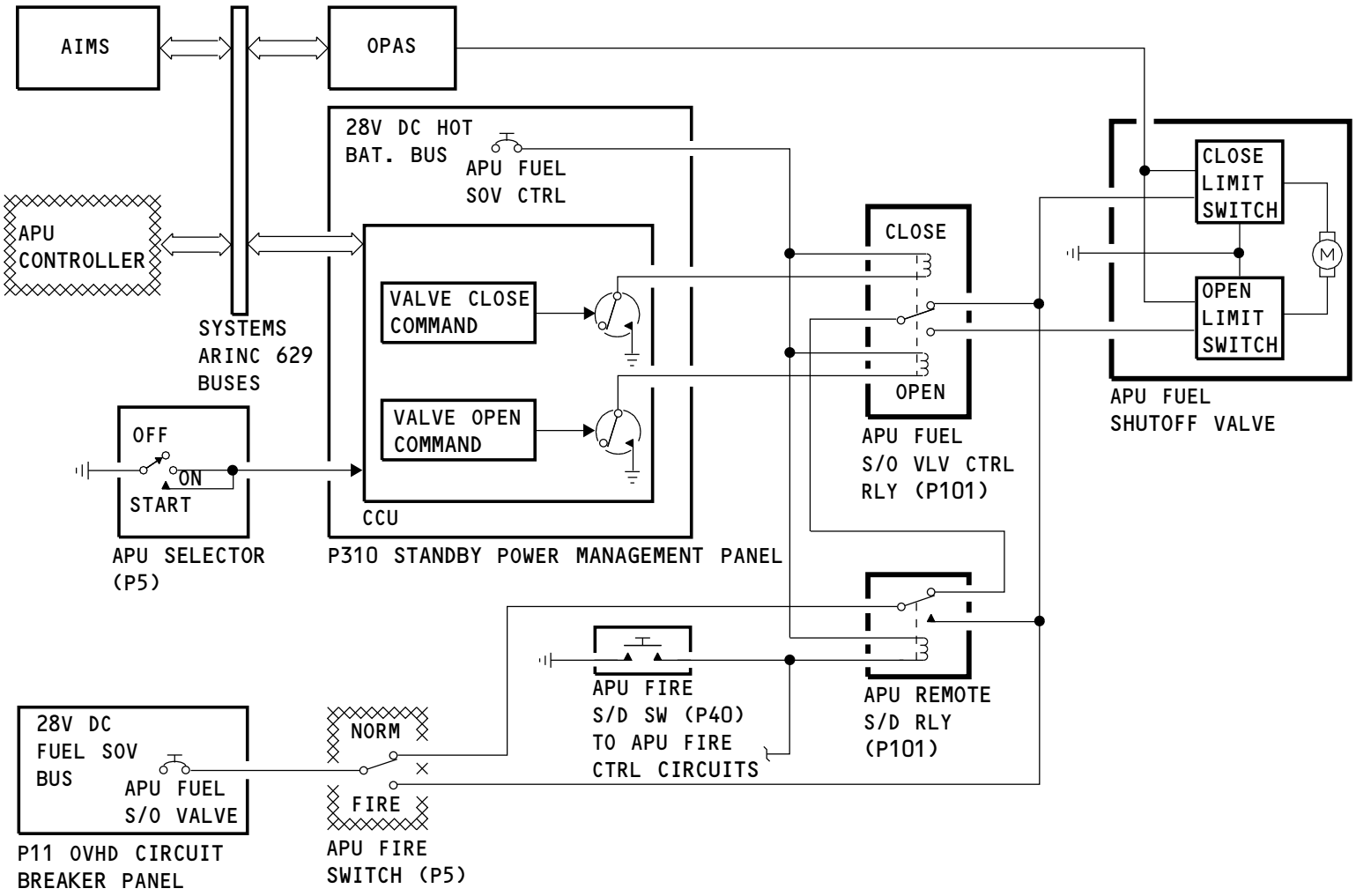
The APU fuel shutoff valve gets power to open or close from the fuel shutoff valve bus. The P310 CCU sends a command to operate the valve. This energizes the open or close coil of the APU fuel shutoff valve control relay and permits power to go to the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator.

If you pull the APU fire switch or push the APU fire shutdown switch, power goes directly to the APU fuel shutoff valve to close it. Pushing the APU fire shutdown switch energizes the APU remote shutdown relay. APU fire control circuits keep it energized.

Fault Indications

The P310 CCU monitors the positions of the APU fuel shutoff valve control relay and the APU remote shutdown relay. The CCU gets the APU fuel shutoff valve position from the OPAS on the systems ARINC 629 buses. If there is a disagreement between the valve position and the relay positions, the CCU sends a fault message to the AIMS. The fault message causes EICAS advisory and status messages.



439084 S0000142209_V1

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU FUEL SHUTOFF VALVE

APU FUEL FEED - INDICATIONS

Fuel Synoptic Display

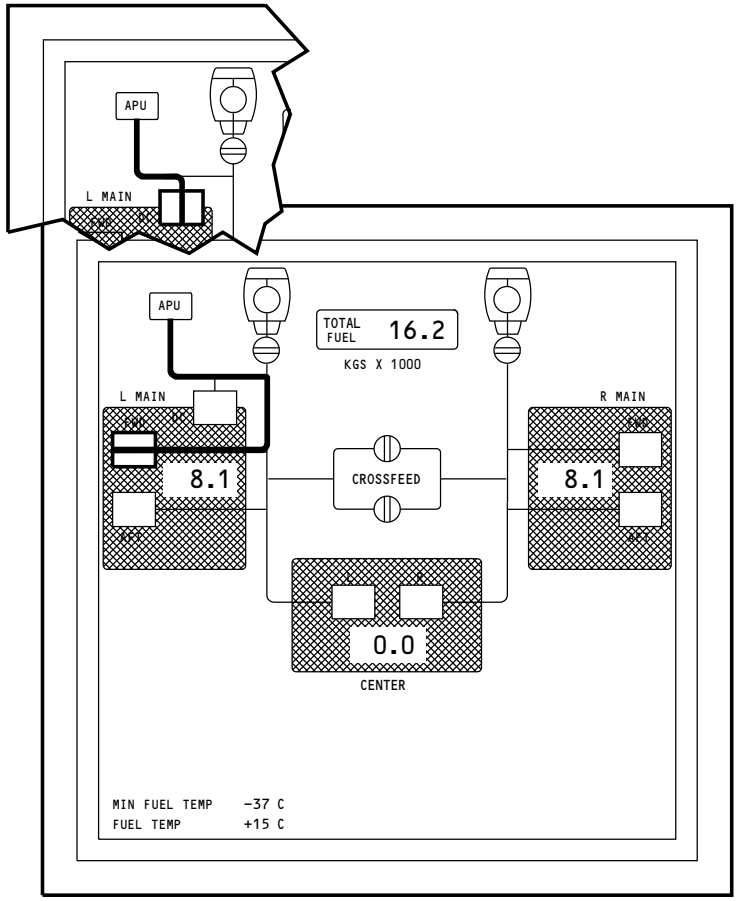
The fuel synoptic display is a simplified schematic of the fuel system. It shows the system configuration for the APU fuel feed system.

The configuration in the fuel synoptic display below shows the left forward boost pump feeding the APU. The inset display shows the APU dc fuel pump feeding the APU.

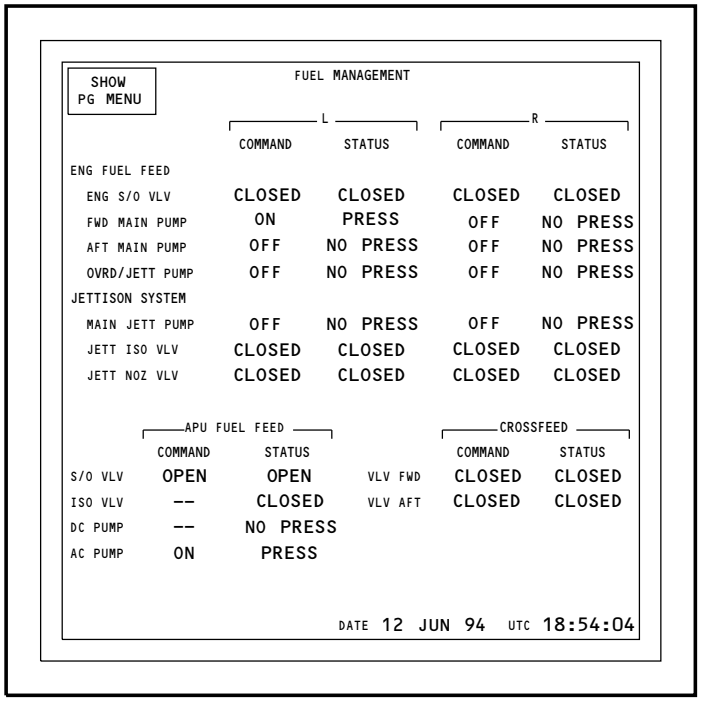
Fuel Management Maintenance Page

The fuel management maintenance page shows commanded and actual status for the APU fuel feed system components.

The AC PUMP data tell you about the left forward boost pump.



FUEL SYNOPTIC DISPLAY



FUEL MANAGEMENT MAINTENANCE PAGE

M41369 S000617667_V1

APU FUEL FEED - INDICATIONS

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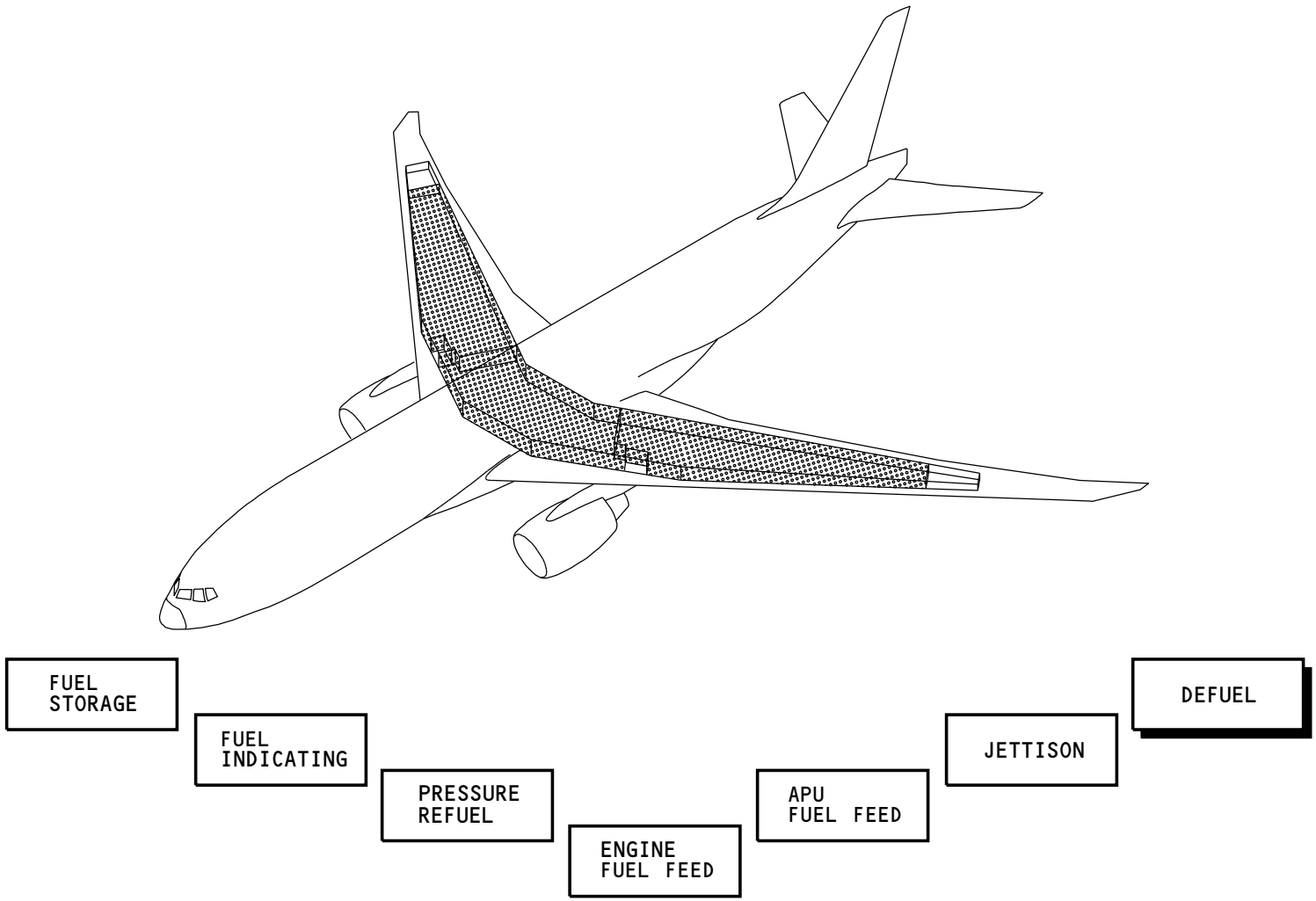
DEFUEL - INTRODUCTION

General

The defuel system moves fuel from the airplane tanks to the refuel station, or from one airplane tank into another. You operate the defuel system with the refuel station controls.



W43421 S0000123527_V1

DEFUEL - INTRODUCTION

DEFUEL - GENERAL DESCRIPTION

General

The defuel system moves fuel from the airplane tanks to refuel station. It also moves fuel from one airplane tank into another (tank-to-tank transfer). There are two ways to get fuel out of the tanks:

- Use the airplane fuel pumps (pressure-defuel)
- Use ground pumps (suction-defuel).

You must open the defuel valve to move fuel to the refuel station. Refuel hoses transfer fuel to ground tanks or a defuel truck.

You do these things for a tank-to-tank transfer:

- Open the defuel valve
- Open the applicable refuel valves
- Operate the applicable fuel pumps.

You must open a crossfeed valve to remove fuel from the left main tank through the engine feed manifold.

Control and Indication

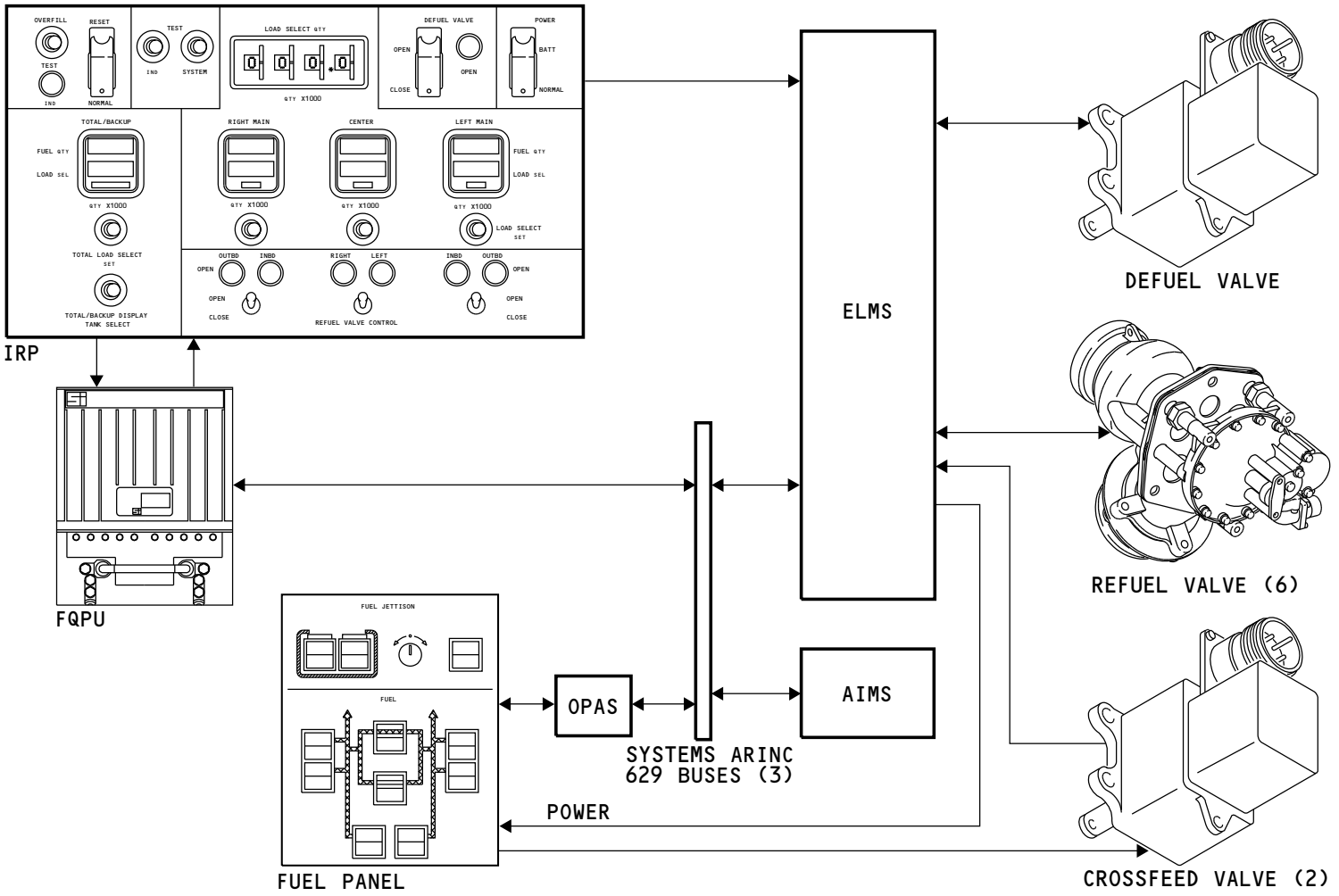
You use the IRP to open and close the defuel valve and refuel valves. The ELMS supplies power to open and close the valves.

The defuel valve switch controls relays in the ELMS to open and close the defuel valve. The refuel valve switches send valve position signals to the FQPU. The FQPU controls relays in the ELMS to open and close the refuel valves. The FQPU controls the refuel and defuel valve position lights on the IRP.

The FQPU supplies fuel quantity data to the IRP.

You use the fuel panel switches on the P5 panel to operate the fuel pumps.

The refuel section describes the refuel valves. The engine fuel feed section describes the fuel pumps and the crossfeed valves.



M41375 S000617673_V1

DEFUEL - GENERAL DESCRIPTION

DEFUEL - COMPONENT LOCATIONS - CENTER FUEL TANK

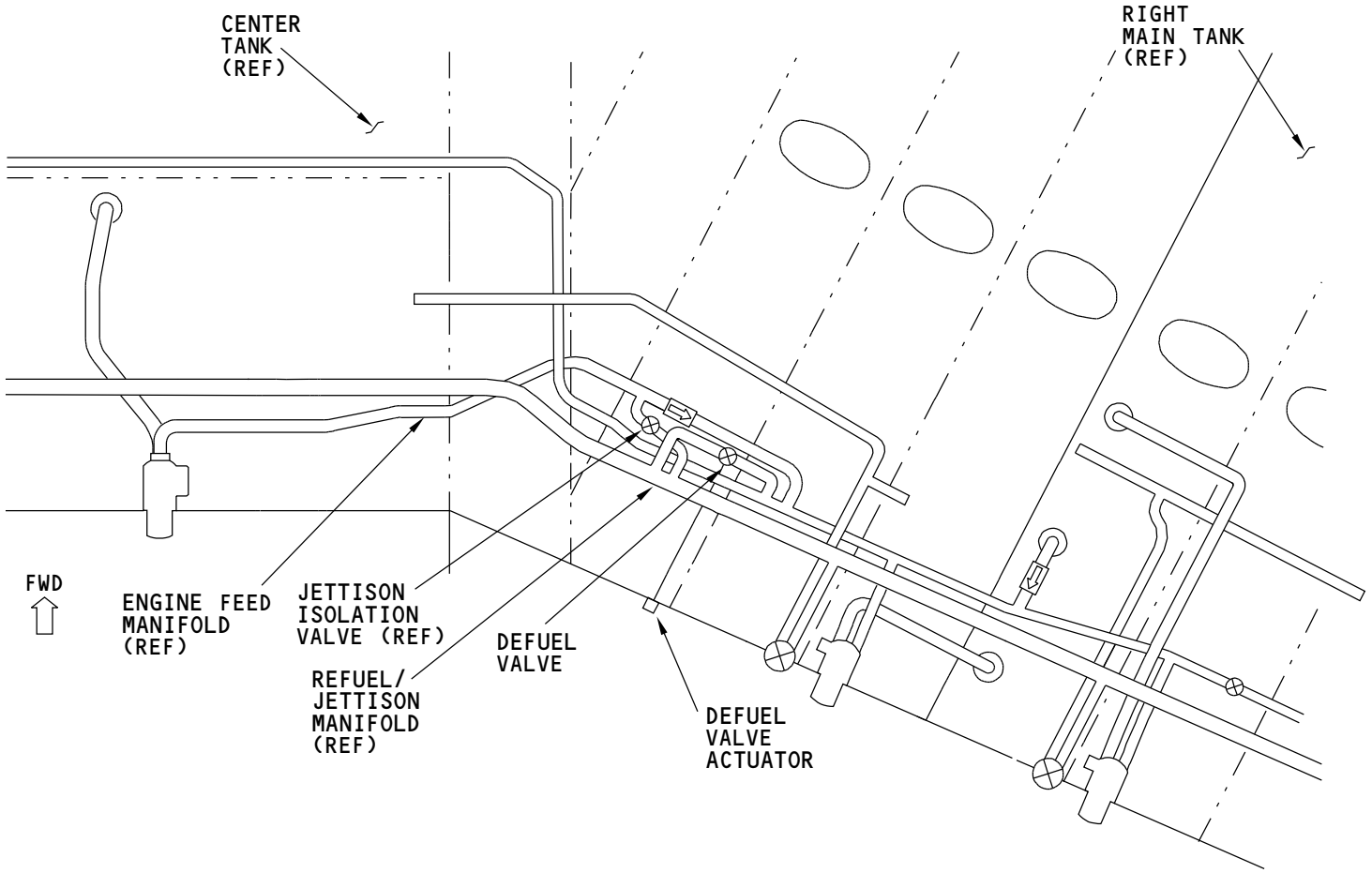
Purpose

The defuel valve connects the engine feed manifold to the refuel/jettison manifold.

Location

There is one defuel valve. It is in the right side of the center tank. You get access to the defuel valve though the first fuel tank access door in the right wing.

The defuel valve actuator is on the rear spar. It is aft of the first fuel tank access door in the right wing.



M41308 S000617675_V1

DEFUEL - COMPONENT LOCATIONS - CENTER FUEL TANK

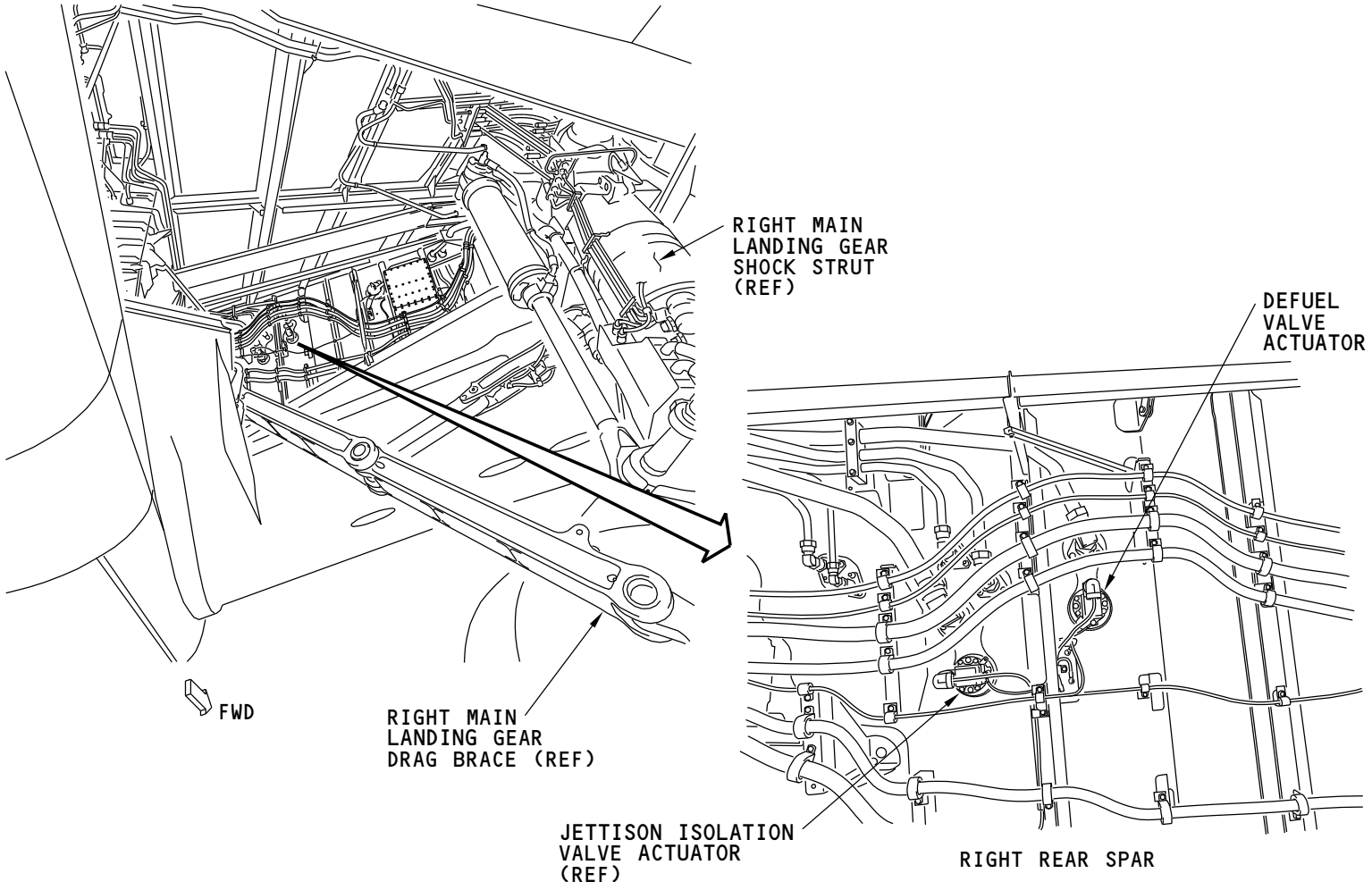
DEFUEL - DEFUEL VALVE

Purpose

The defuel valve connects the engine feed manifold to the refuel/jettison manifold so you can remove fuel from the fuel tanks.

Description

The defuel valve is a motor-actuated valve. The valve body is in tubing in the right side of the center tank. The tubing connects to the right engine feed manifold and the refuel/jettison manifold. The valve actuator is on the right rear spar. See the engine fuel feed section for more information about motor-actuated fuel valves (SECTION 28-22).



M41315 S000617683_V1

DEFUEL - DEFUEL VALVE

DEFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

You can pressure-defuel the fuel tanks with the engine feed system. You can also suction defuel the main tanks through the bypass valve.

Pressure-Defueling With Engine Feed System

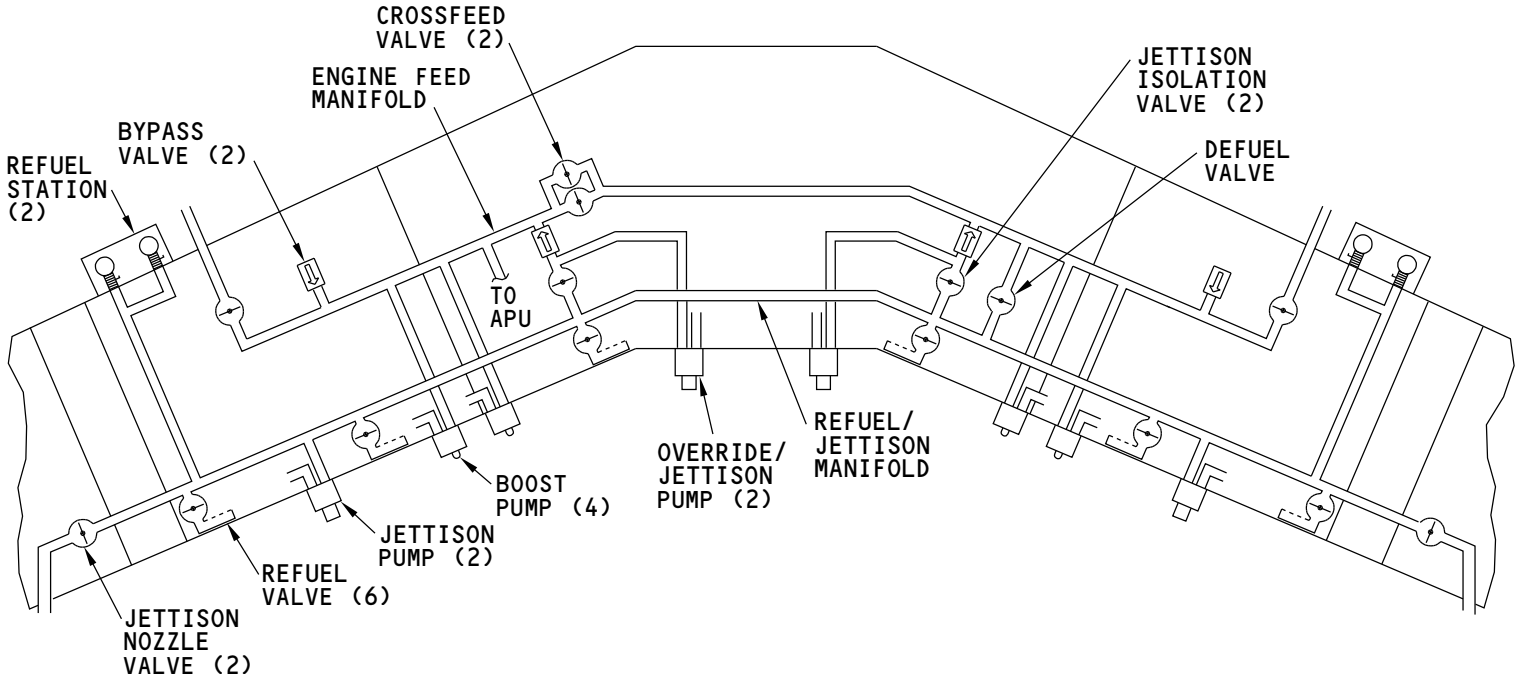
When you use the boost pumps to pressure-defuel the airplane, the pumps put fuel into the engine feed manifold. When you open the defuel valve the fuel goes into the refuel/jettison manifold and out the refuel station adapters. One of the crossfeed valves must be open for fuel from the left side to get to the defuel valve.

Suction-Defueling

You suction-defuel the main tanks through the bypass valves. You must open the defuel valve to get fuel from the engine feed manifold into the refuel/jettison manifold. Suction-defuel will remove fuel until the fuel level is below one of the two bypass valves. Then you must use another method to defuel the tanks.

Tank-to-Tank Transfer

You can also defuel a tank by moving fuel into another tank. In this case, instead of removing fuel through the refuel adapters at the refuel station, you open the refuel valves for the tank in which you want to put the fuel.



M41313 S000617680_V1

DEFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

DEFUEL - FUNCTIONAL DESCRIPTION - ELECTRICAL

General

The hot battery bus supplies power to the defuel valves. Power goes through the refuel panel door relay and defuel valve control relay in the P310 standby power management panel.

Defuel Valve Control

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve disagree logic.

The defuel valve control relay energizes when you put the defuel valve switch in the open position.

You can open the defuel valve only when the refuel panel door is open. When the refuel panel door closes, the defuel valve automatically closes. When the door closes, it also moves the defuel valve switch to the closed position.

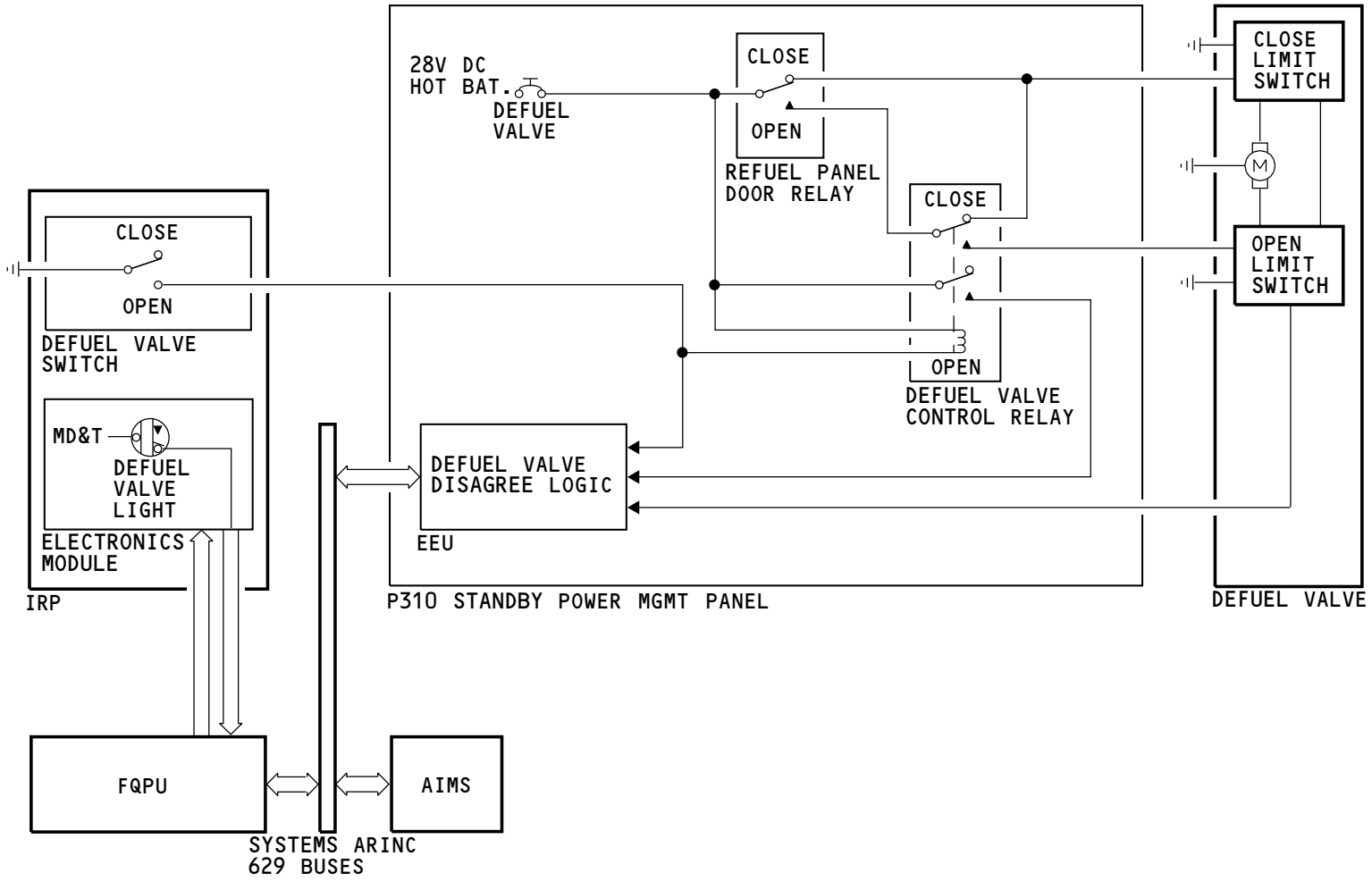
Indication

The P310 EEU monitors the position of these components:

- Defuel valve switch
- Defuel valve control relay
- Defuel valve.

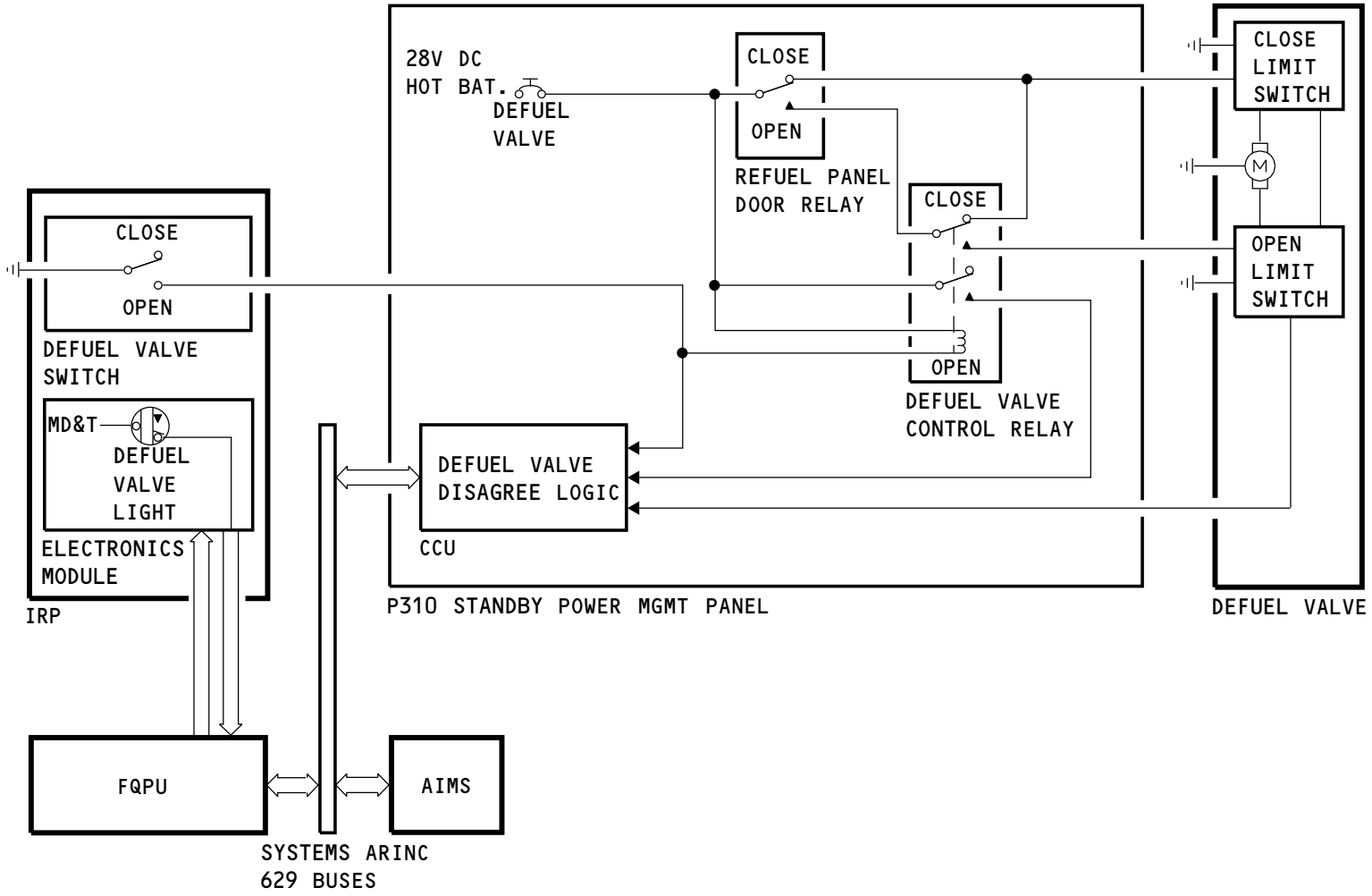
The CCU sends the position signals to the FQIS processor unit (FQPU) on the ARINC 629 system buses. When the valve is open, the FQPU turns on the blue defuel valve light. You push the defuel valve light to do a test of it.

If there is a disagreement between the switch position and the defuel valve control relay, the FQPU sends a fault signal to the AIMS.



M41314 S000617681_V1

DEFUEL - FUNCTIONAL DESCRIPTION - ELECTRICAL



439038 S0000142210_V1

DEFUEL - FUNCTIONAL DESCRIPTION - ELECTRICAL

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DEFUEL - OPERATION

General

The defuel procedure is on a placard on the refuel station door. The procedure is also in the maintenance manual.

Defuel Procedure

This is a brief summary of the pressure-defuel procedure:

- Connect the fueling nozzles
- Move the defuel lever on refuel adapter to the defuel position
- Move the defuel valve switch to OPEN
- Turn on the fuel pumps in each tank that you want to defuel
- Open crossfeed valve if necessary
- Move the defuel valve switch to CLOSE when the tanks are empty
- Turn off the fuel pumps
- Move the defuel lever on the refuel adapter to the refuel position
- Remove the fueling nozzles
- Do a test of the defuel valve open light.

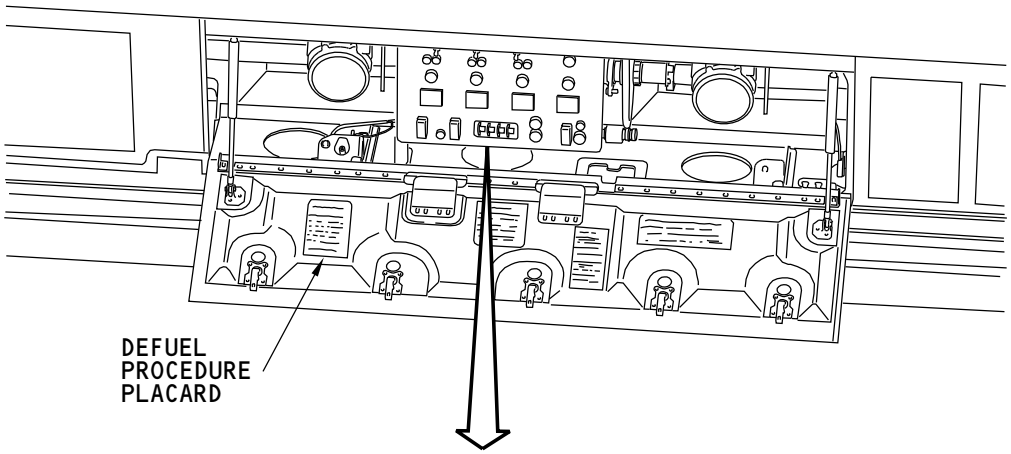
The suction-defuel procedure is the same as the pressure-defuel procedure except you do not turn on the fuel pumps. Suction defueling stops when one of the bypass valve inlets is uncovered. Thus, if the tanks do not become empty at the same time, there may be fuel remaining in one of the tanks.

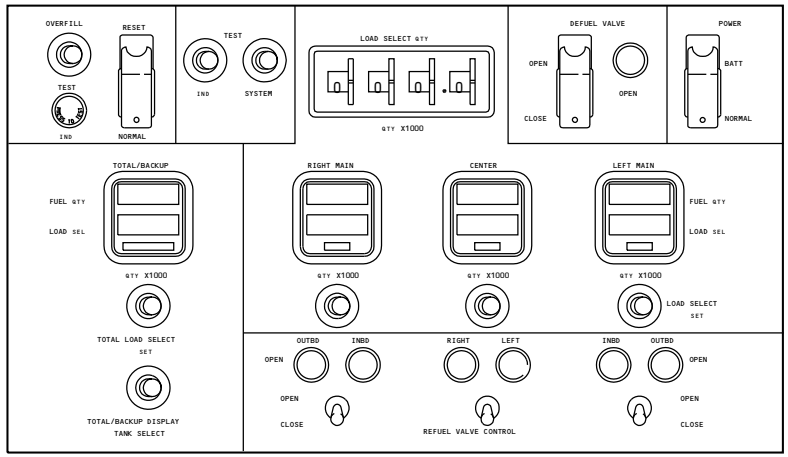
Tank-to-Tank Transfer

To move fuel from one tank to another you must use the engine feed, defuel, and refuel systems. These steps are necessary for tank-to-tank transfer:

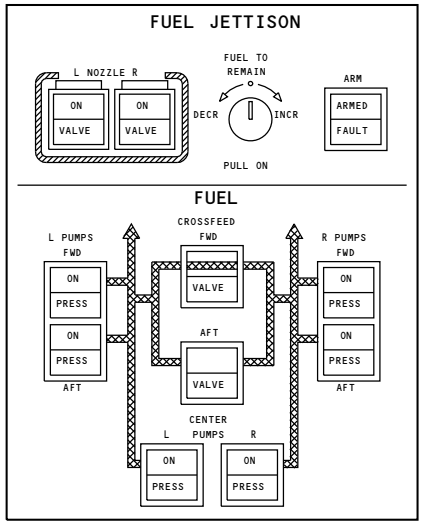
- Do a test of the indicators and defuel valve open light
- Move the defuel valve switch to OPEN
- Turn on the fuel pumps in the tank you want to defuel
- Open crossfeed valve if necessary
- Move the refuel valve switches to OPEN in the tank you want to put the fuel into.

If you want to defuel the tank, let the pump operate until the tank is empty. If you want to move only part of the fuel, use the refuel valve control switches to stop the fuel flow.





P28 INTEGRATED REFUEL PANEL



FUEL PANEL (P5)

M41377 S000617682_V1

DEFUEL - OPERATION

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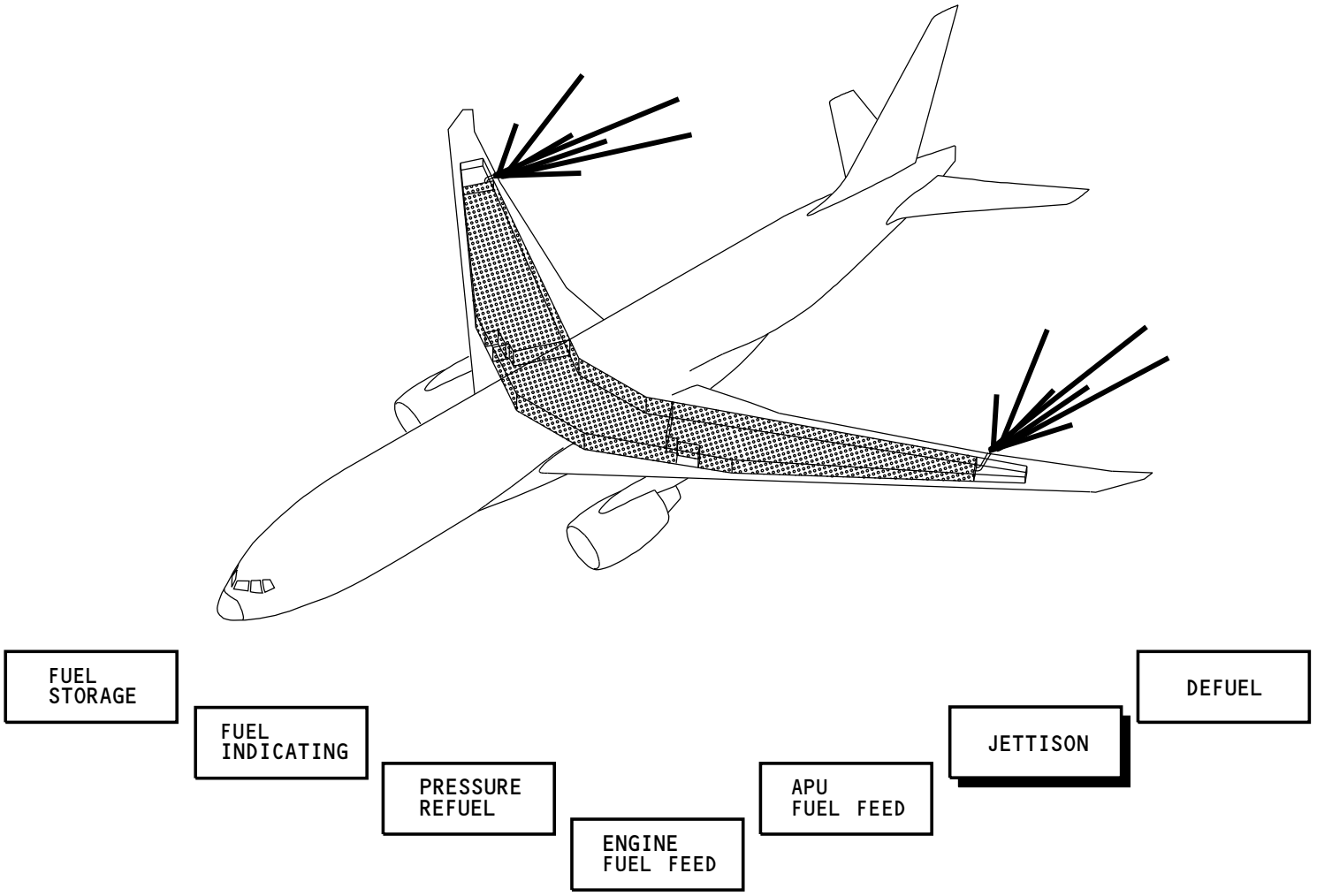
FUEL JETTISON - INTRODUCTION

Purpose

The fuel jettison system dumps fuel overboard to reduce the landing weight. You operate the jettison system from the fuel panel on the P5 overhead panel.



W43442 S0000123528_V1

FUEL JETTISON - INTRODUCTION

FUEL JETTISON - GENERAL DESCRIPTION

General

The fuel jettison system dumps fuel overboard to reduce the landing weight. You operate the jettison system from the fuel jettison panel (P5). The ELMS controls the fuel jettison system.

Jettison Pumps

There are two override/jettison pumps in the center tank and one fuel jettison pump in each main tank.

Each pump has a pressure switch that sends a signal through the ELMS to the systems ARINC 629 buses. The signal goes to the jettison panel and the AIMS for fault indication.

Jettison Isolation Valves

These valves let the override/jettison pumps put fuel into the refuel/jettison manifold (not shown). A signal goes to the AIMS for valve fault indication.

Jettison Nozzle Valves

In the air, the nozzle valves let fuel in the refuel/jettison manifold go overboard. This reduces the landing weight.

On the ground, you cannot open the nozzle valves. The power to close the valves goes directly from the ELMS to the nozzle valve actuators.

A signal for valve fault indication goes to the fuel jettison panel and the AIMS.

General Operation

In the air, you push the arm switch to operate the fuel jettison system. The arm switch sends a signal through the systems ARINC 629 buses to the ELMS.

The jettison system has two operating modes:

- Maximum landing weight (MLW) mode
- Manual (MAN) mode.

When you arm the jettison system, it is in the MLW mode. The ELMS calculates the quantity of fuel to remain after it jettisons fuel to the MLW. The ELMS subtracts zero fuel weight (ZFW) from MLW to get the fuel to remain. It gets the MLW and ZFW from the AIMS. The quantity of fuel to remain in the airplane shows on the EICAS display.

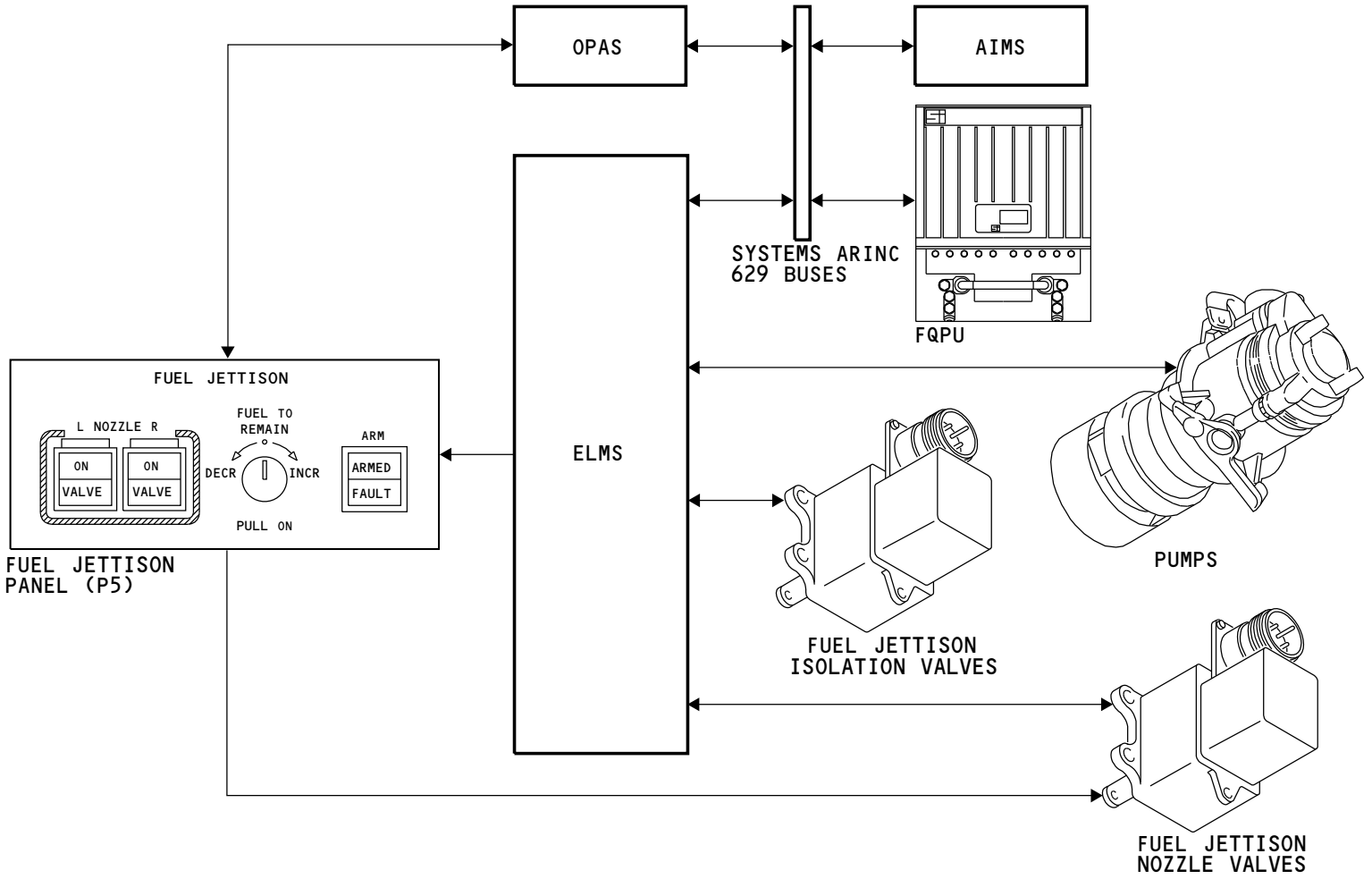
The ELMS gets actual fuel quantity from the FQPU. It uses this information to calculate the time to jettison.

When you pull out the fuel-to-remain selector, the jettison system is in the MAN mode. You can use the fuel-to-remain selector to increase or decrease the quantity of fuel to remain.

In the air, the jettison nozzle valve switches cause the ELMS to open the nozzle valves. Each switch also causes the ELMS to open the isolation valves and start the fuel jettison pumps. You must use the center tank pump switches to start the override/jettison pumps.

Fuel jettison can cause the airplane center of gravity to be forward of the center of gravity limit. If the ELMS calculates that this will happen, it stops the main tank jettison pumps for 7.5 minutes.

On the ground, the arm switch causes the ELMS to open the two jettison isolation valves and start the fuel jettison pumps.



M41316 S000617686_V1

FUEL JETTISON - GENERAL DESCRIPTION

FUEL JETTISON - COMPONENT LOCATIONS - FUEL TANKS

General

The jettison system has these components:

- Override/jettison pumps
- Jettison pumps
- Jettison isolation valves
- Isolation check valves
- Refuel/jettison manifold
- Jettison nozzle valves.

Override/Jettison Pumps

There are two override/jettison pumps in the center tank. They are in the left and right wheel wells on the rear spar. The engine feed section describes these pumps.

Fuel Jettison Pumps

There is one fuel jettison pump in each main tank. They are on the rear spar forward of the flaperons. These pumps are interchangeable with the override/jettison pumps.

Fuel Jettison Isolation Valves

There is one fuel jettison isolation valve in each section of the center tank. The valve actuators are on the rear spar just outboard from the fuselage.

These are the same kind of valve as the other motor-actuated valves in the fuel system.

Jettison Isolation Check Valve

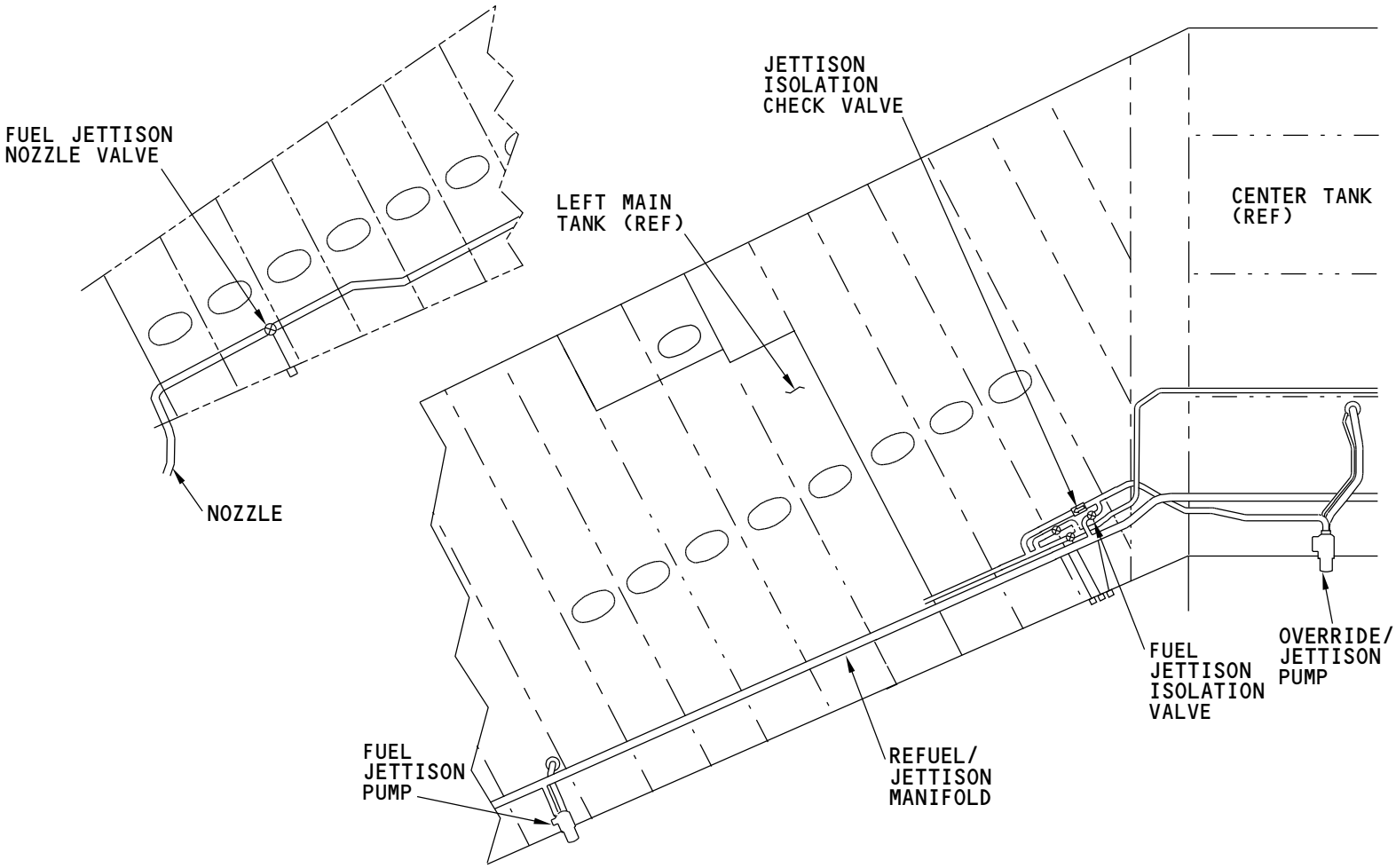
There is a jettison isolation check valve in each section of the center tank. The valve prevents fuel jettison by the left and right main tank fuel boost pumps.

Refuel/Jettison Manifold

The refuel/jettison manifold is in both wings and goes through the end of the main tank and surge tank. The end of the refuel/jettison manifold has a nozzle. The nozzle comes out of the trailing edge of each wing between the outboard flap and the aileron.

Fuel Jettison Nozzle Valves

There is one jettison nozzle valve near each end of the refuel/jettison manifold. They attach to the refuel/jettison manifold.



W43627 S0000112252_V2

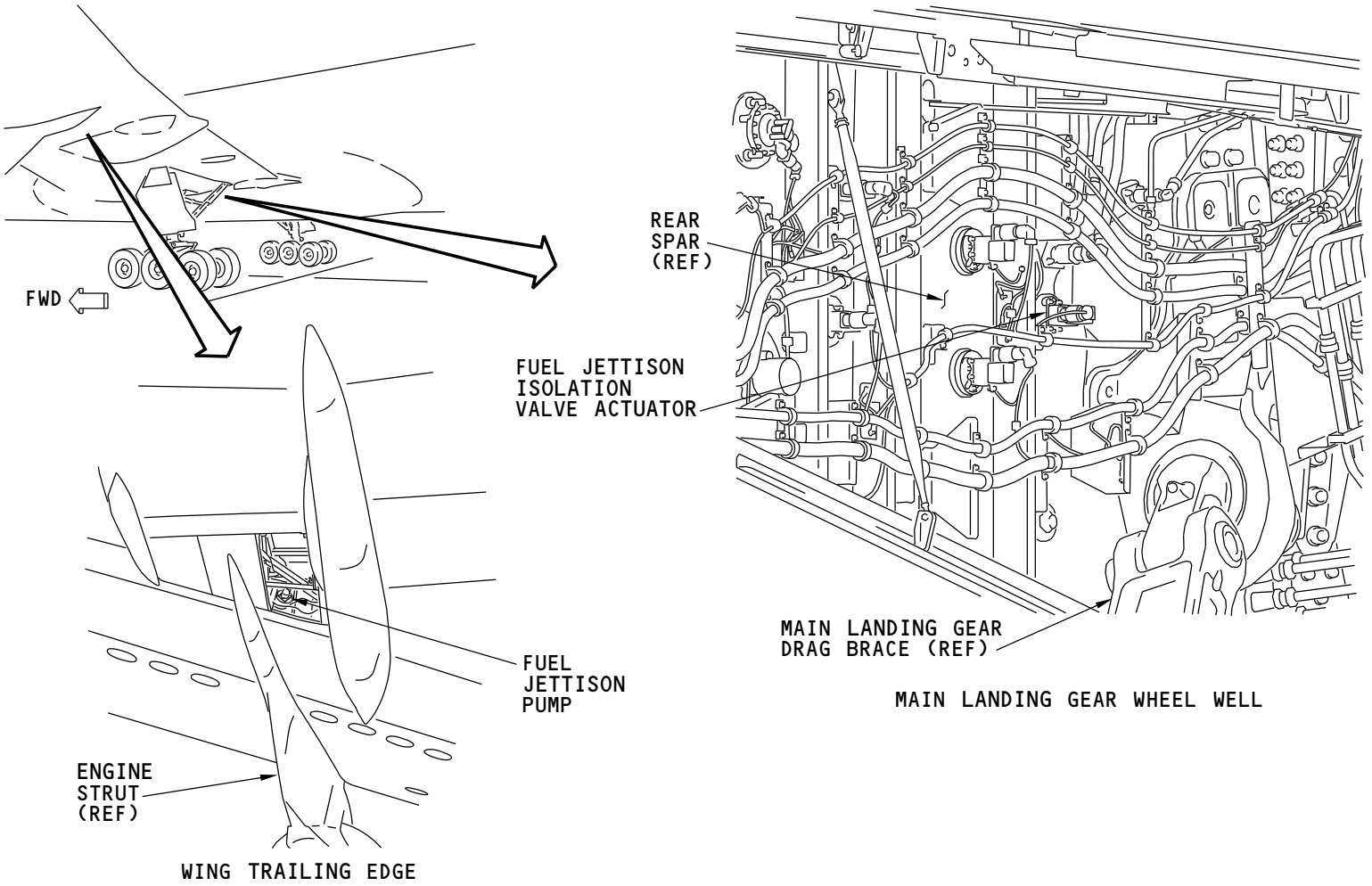
FUEL JETTISON - COMPONENT LOCATIONS - FUEL TANK

FUEL JETTISON - COMPONENT LOCATIONS - REAR SPAR

General

The fuel jettison pumps are on the rear spar, aft of each engine.

There are two fuel jettison isolation valves. The valve actuators are on the rear spar. There is an actuator in each main landing gear wheel well.



M41328 S000617700_V1

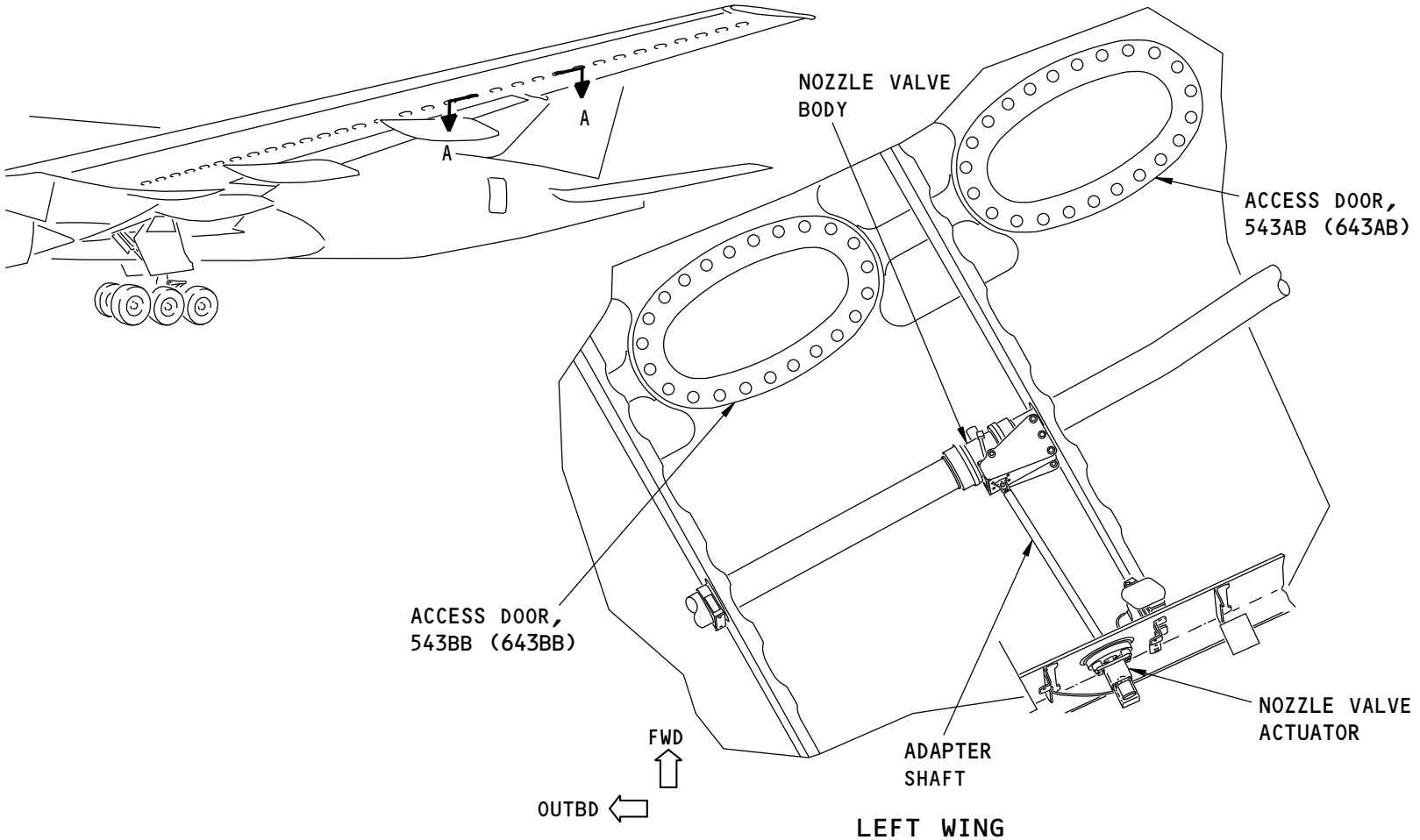
FUEL JETTISON - COMPONENT LOCATIONS - REAR SPAR

FUEL JETTISON - COMPONENT LOCATIONS - WINGS

General

There is a jettison nozzle on each wing. The nozzles are on the wing trailing edges, near the ailerons.

There is a jettison nozzle valve and actuator on each wing. Each nozzle valve is in the main fuel tank immediately outboard of rib 35. The valve attaches to the refuel/jettison manifold.



LEFT WING
(TOP VIEW)
(RIGHT WING IS EQUIVALENT)
A–A

N83336 S0000112253_V1

FUEL JETTISON - COMPONENT LOCATIONS - WINGS

FUEL JETTISON - FUEL JETTISON PUMP

General

The jettison pumps supply fuel from the main tank to the refuel/jettison manifold during fuel jettison.

The jettison pumps can supply fuel at a pressure of 36 psi and a flow rate of 70,000 pounds (31750 kg) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There is one jettison pump in each main tank. They are on the rear spar, aft of the engine strut. The housings are inside the tanks, on the rear spar. The motor-impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve
- Vapor vent valve
- Inlet valve.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

- Motive flow check valve

ARO ALL

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks have fuel in them.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

ARO ALL

Motor-Impeller

The motor-impeller uses 115v ac power. Each pump has these parts:

- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

Training Information Point

The jettison pump motor-impellers are interchangeable with the override/jettison pump motor-impellers.

To remove the motor-impeller, you rotate it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

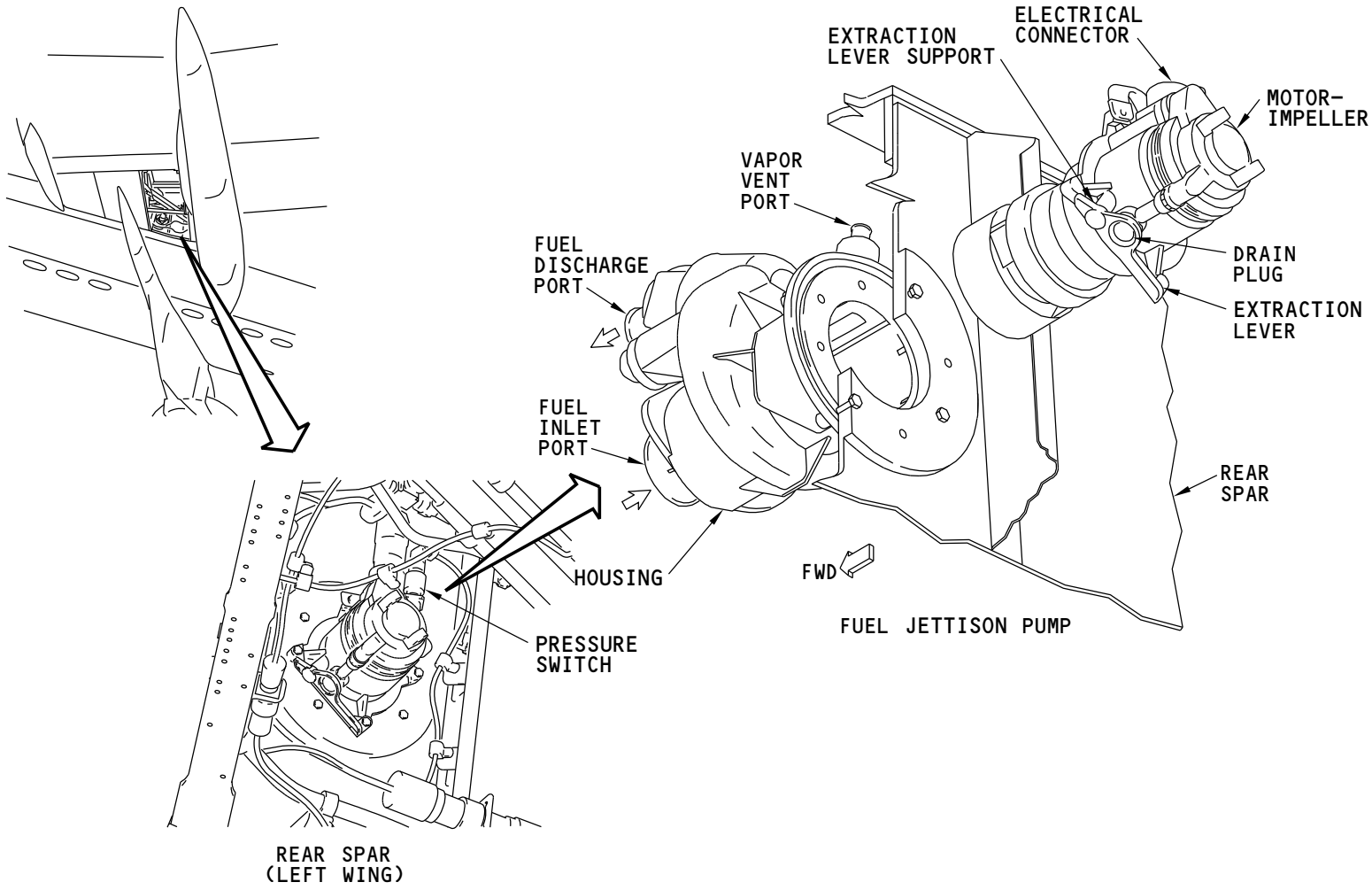
ARO 001-004 PRE SB 777-28-0078

You can remove the discharge and vapor vent valves through the housing from outside the tank.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

You can remove the discharge, vapor vent and motive flow check valves through the housing from outside the tank.

ARO ALL



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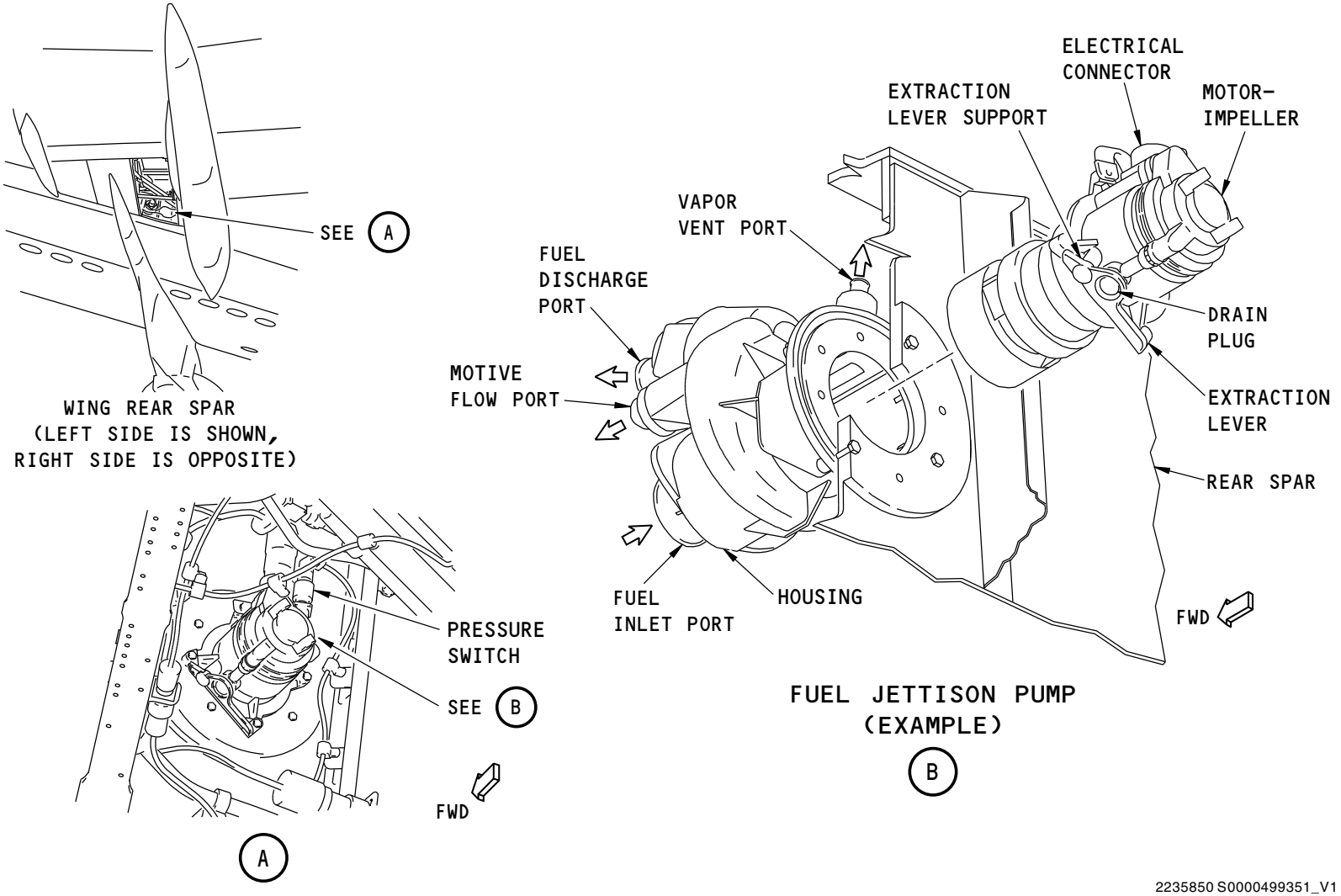
FUEL JETTISON - FUEL JETTISON PUMP



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FUEL JETTISON - FUEL JETTISON PUMP

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FUEL JETTISON - ISOLATION VALVE

Purpose

The fuel jettison isolation valves open during fuel jettison operation. The open isolation valve lets override/jettison pump fuel go to the refuel/jettison manifold.

Location

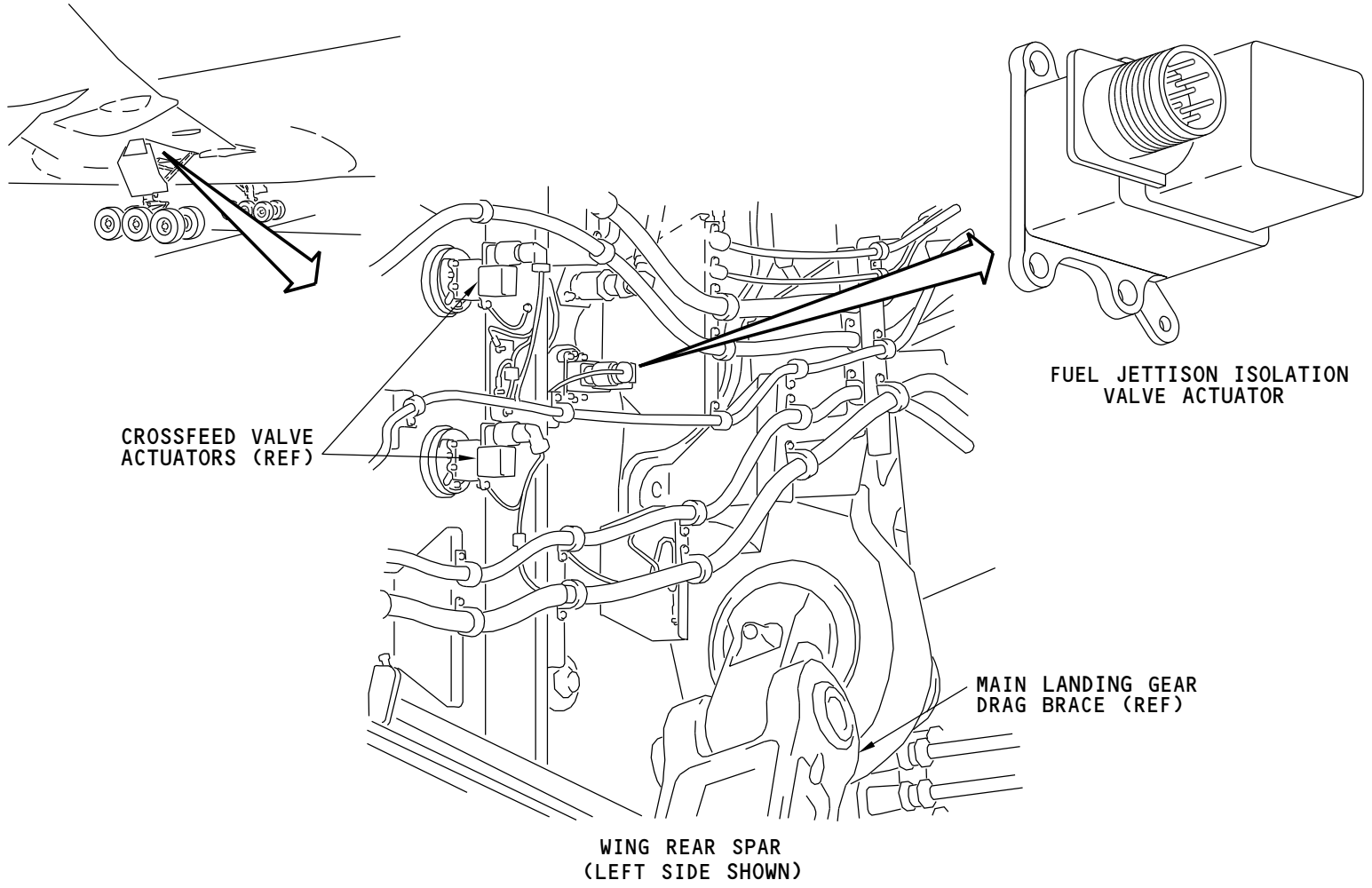
There is one fuel jettison isolation valve in each section of the center tank. The valve actuators are on the rear spar in the wheel wells.

Isolation Valve Description

The fuel jettison isolation valve is the same type of valve as the other motor-actuated valves in the fuel system.

Actuator

The actuator is a 28v dc motor. It has a manual override lever so you can operate the actuator without electrical power. The lever also shows valve position.



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FUEL JETTISON - ISOLATION VALVE

FUEL JETTISON - JETTISON NOZZLE VALVE

Purpose

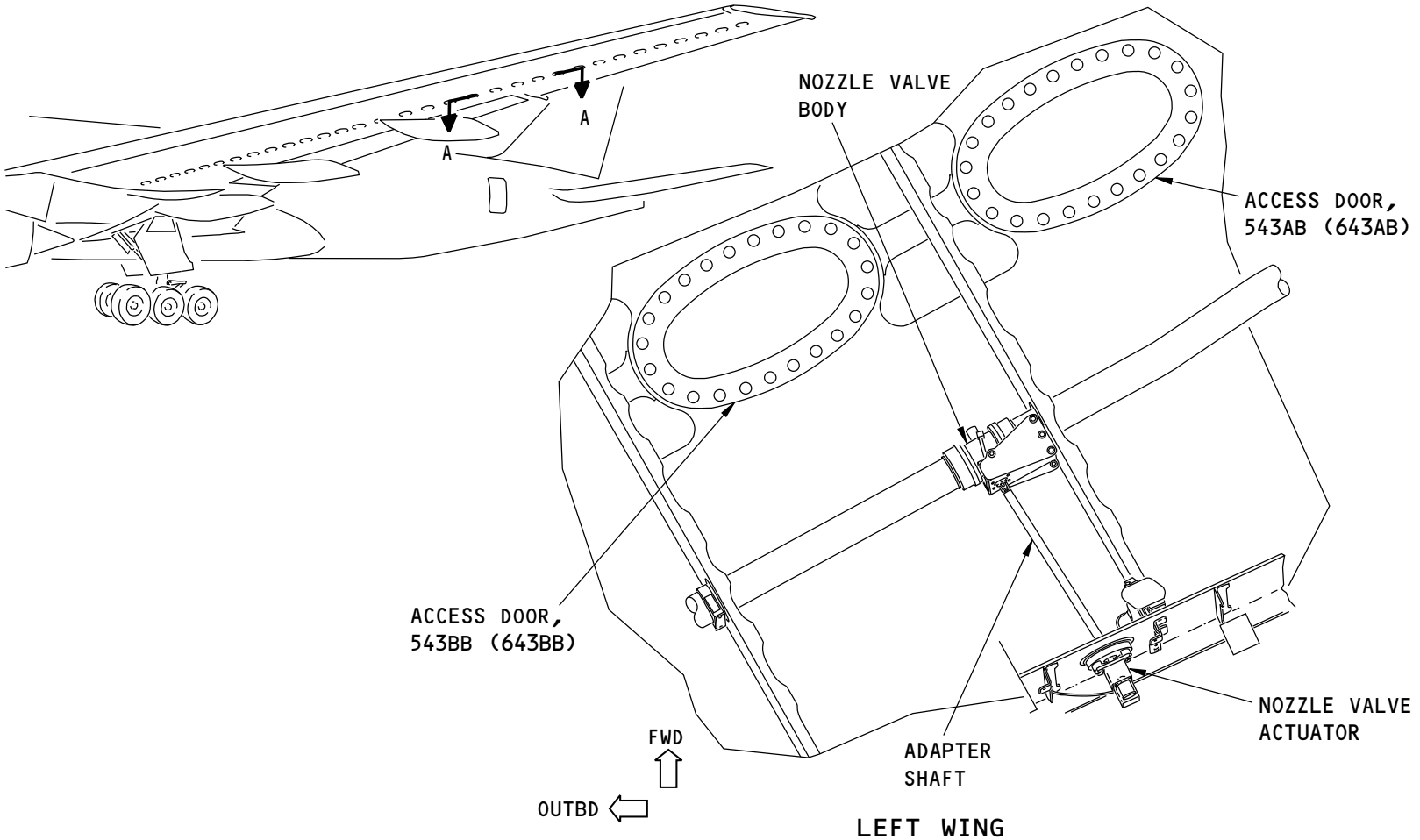
The fuel jettison nozzle valves open during fuel jettison operation. When the valve opens, fuel goes out of the jettison nozzle near the wing tip.

Location

There is one fuel jettison nozzle valve at each end of the refuel/jettison manifold. They are found in the main fuel tank outboard of rib 35.

Jettison Valve Description

The fuel jettison nozzle valves are the same type of valve as the other motor-actuated valves in the fuel system.



LEFT WING
(TOP VIEW)
(RIGHT WING IS EQUIVALENT)
A-A

N83336 S0000112253_V1

FUEL JETTISON - JETTISON NOZZLE VALVE

FUEL JETTISON - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

Jettison can occur from the center tank or the main tanks. Fuel from the tank flows through the refuel/jettison manifold.

Center Tank Jettison

The center tank uses the override/jettison pumps as engine feed pumps and jettison pumps. When the jettison system operates, the pumps put fuel through the fuel jettison isolation valves into the refuel/jettison manifold. The fuel goes out of the manifold through the fuel jettison nozzle valves and jettison nozzles.

ARO 001-004 PRE SB 777-28-0078

Main Tank Jettison

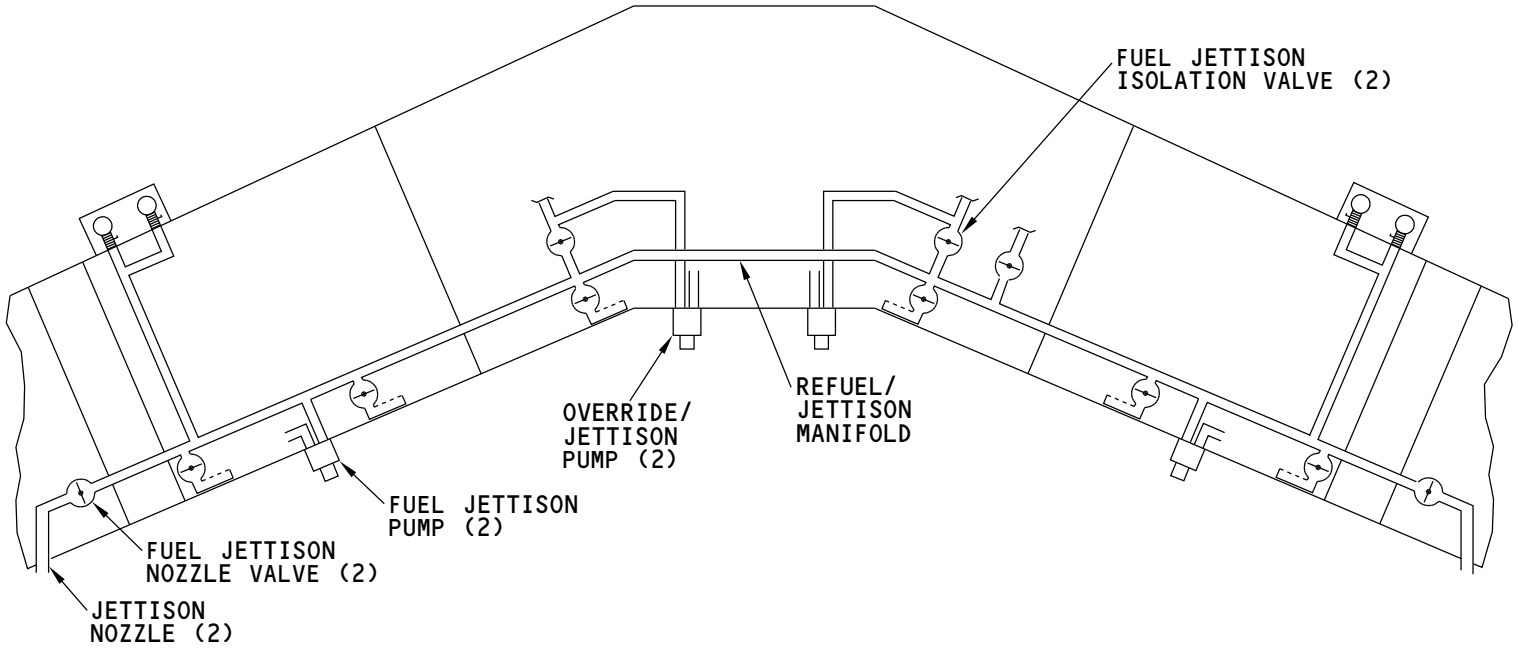
The main tanks have pumps that operate only during fuel jettison. These pumps deliver fuel directly into the refuel/jettison manifold. This fuel also leaves the manifold through the fuel jettison nozzle valves and jettison nozzles.

ARO 005-999; ARO 001-004 POST SB 777-28-0078

Main Tank Jettison

The main tanks have pumps that operate only during fuel jettison. These pumps deliver fuel directly into the refuel/jettison manifold. This fuel also leaves the manifold through the fuel jettison nozzle valves and jettison nozzles. The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

ARO ALL



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FUEL JETTISON - FUNCTIONAL DESCRIPTION - FUEL FLOW

FUEL JETTISON - FUNCTIONAL DESCRIPTION - POWER & CONTROL

Power

The left fuel jettison pump receives 115v ac power from the left main bus.

Jettison Pump Control - Ground

When the airplane is on the ground, the ELMS puts the fuel jettison pumps on when you put the jettison ARM switch in the ARM position.

The jettison arm switch sends a signal on the systems ARINC 629 buses to the Computing and Communications Unit (CCU) in the left power management panel. Digital pump logic in the CCU goes to the Signal Interface Unit 1 (SIU1) through the A & B RS485 buses. The SIU1 transmits the command to the P100 Power Panel Controller. More pump data is sent to the P100 Power Panel Controller (PPC) from the CCU through the A & B RS485 buses. If the conditions are applicable for jettison, the Power Panel Controller sends a command to an ELCU in the left power panel to turn on the left fuel jettison pump. The SIU1 also sends a signal to the P210 Power Panel Controller to turn on the right fuel jettison pump. The ELCU closes a contactor to permit power to go from the left main bus to the pump. The ELCU receives power from the left main dc bus.

The left fuel jettison pump control relay supplies redundant control of the power to the pump. This relay does not let the pump operate while the jettison arm switch is in the OFF position.

The pump control logic in the P210 panel can also turn on the left fuel jettison pump.

Jettison Pump Control - Air

ARO 005-999; ARO 001-004 POST SB 777-28-0078

When the airplane is in the air and the fuel jettison system is off, ELMS turns on the fuel jettison pumps to operate the fuel scavenge system. The fuel jettison pumps will turn on 45 minutes after the center override pumps have been turned off. The jettison pumps will turn off after 4 hours, if the fuel transfer rate from the main tanks is more than expected, or if the jettison pumps have low pressure.

If the fuel jettison system is operated, the fuel scavenge will not automatically continue. The center override pumps must be cycled on and turned off before the normal operation of the jettison pumps for center tank fuel scavenge continues.

ARO ALL

When the airplane is in the air, the ELMS turns on the fuel jettison pumps, when all of these conditions occur:

- Jettison arm switch is in the ARM position
- Left or right jettison nozzle valve is open
- Fuel quantity is more than the fuel-to-remain value.

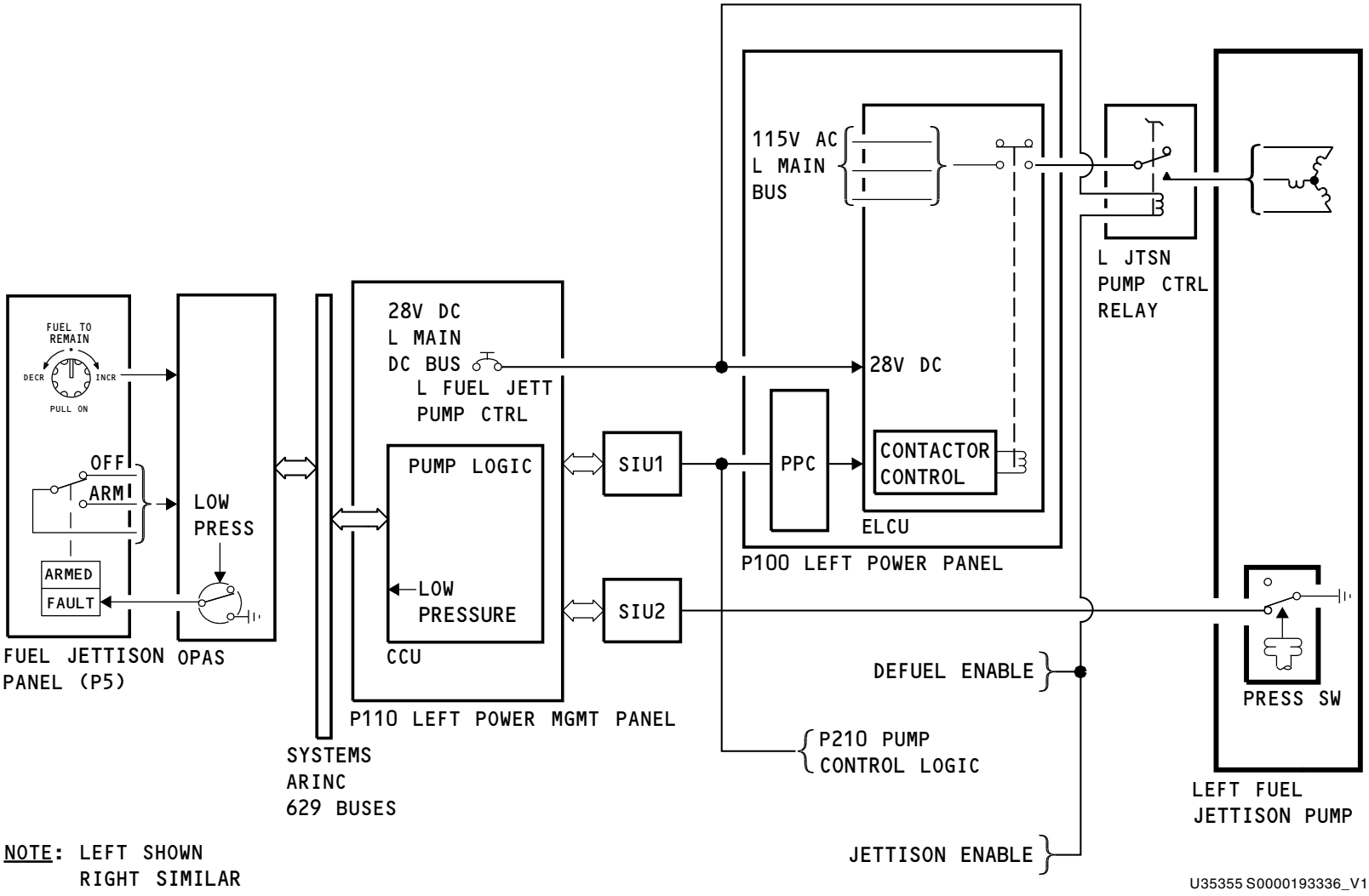
Fuel jettison can cause the airplane center of gravity to be forward of the center of gravity limit. If the ELMS calculates that this will happen, it stops the main tank jettison pumps for 7.5 minutes. The ELMS monitors these parameters to see if it is necessary to stop the main tank jettison pumps:

- Airplane center of gravity
- Airplane gross weight
- Center tank fuel weight.

Fault Indication

The Fuel/Fuel Jettison panel ARM switch has a fault light. The fault light can come on only when the system is armed. The ELMS logic sends a signal through OPAS to turn on the fault light in the ARM switch. The ARM switch fault light comes on when one of these conditions exist:

- Jettison pump is commanded ON and low pressure continues after 30 seconds. This can occur if the pump is inoperative, or if the jettison pump low pressure delay senses low fuel pressure. An EICAS message tells you which jettison pump is defective.
- Nozzle valve position disagree. An EICAS message tells you which nozzle valve disagrees with the command.
- ELCU status disagrees with command, caused by a loss of ARINC 629 data in the jettison system. The ELMS will command the jettison pumps OFF when ARINC 629 data is lost.



FUEL JETTISON - FUNCTIONAL DESCRIPTION - POWER AND CONTROL

FUEL JETTISON - FUNCTIONAL DESCRIPTION - ISOLATION AND NOZZLE VALVE CONTROL

Fuel Jettison Isolation Valve

The left main dc bus supplies power to open and close the left fuel jettison isolation valve. Valve logic in two ELMS Computing and Communications Units (CCU) (P110 or P210) controls the left and right jettison isolation valve control relays. The relay energizes to open the isolation valve.

When the airplane is on the ground, the ELMS CCUs open the isolation valves when the jettison arm switch is on.

The ELMS CCUs open the isolation valves in the air when these conditions are met:

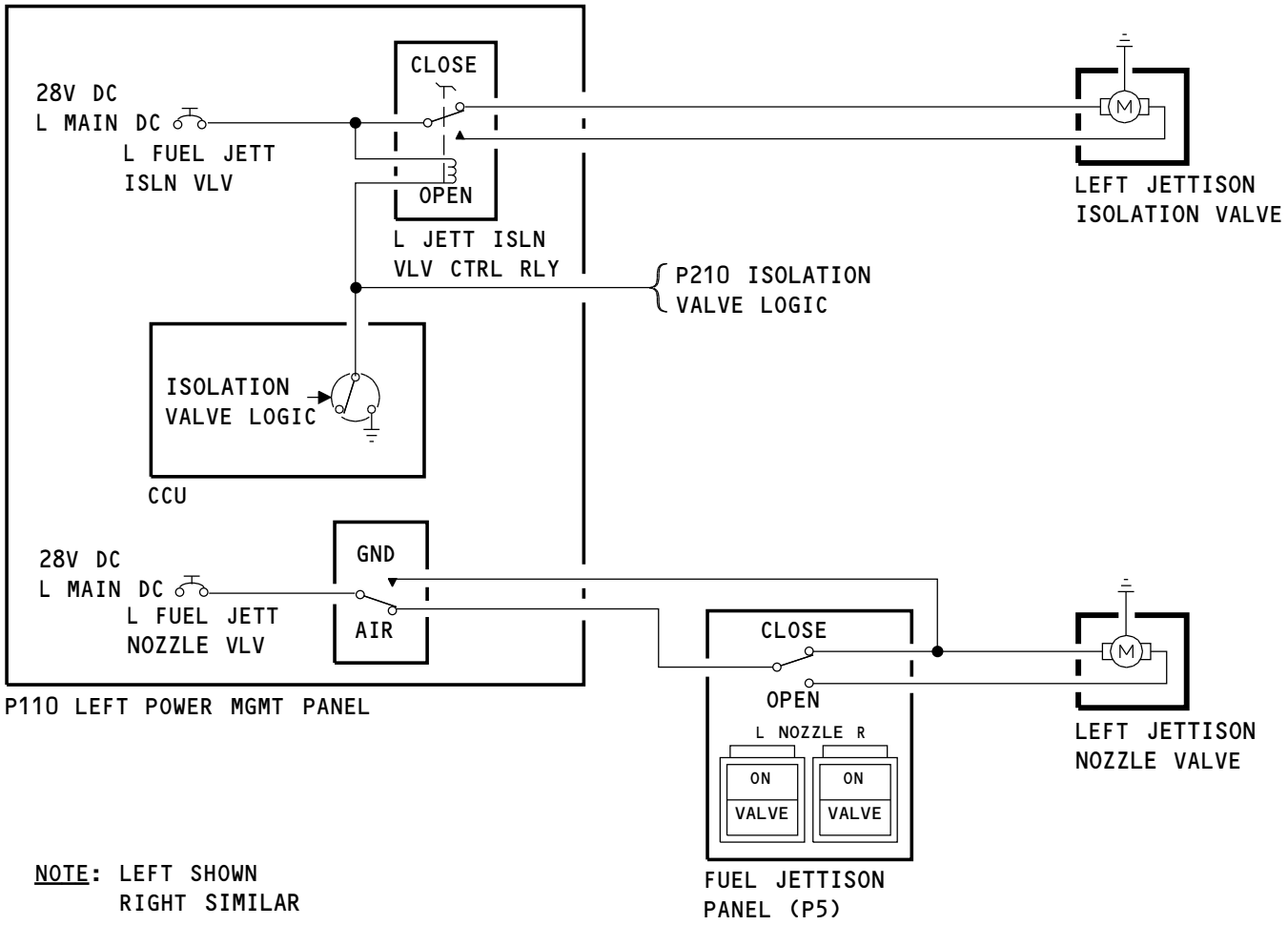
- Jettison arm switch is on
- Left or right jettison nozzle valve is open
- Fuel quantity is greater than fuel-to-remain.

Fuel Jettison Nozzle Valve

The left main dc bus supplies power to open and close the nozzle valve. Power goes through an air/ground relay.

The nozzle valve does not open when the airplane is on the ground.

When the airplane is in the air, the nozzle valve opens when you push the nozzle switch.



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FUEL JETTISON - FUNCTIONAL DESCRIPTION - ISOLATION AND NOZZLE VALVE CONTROL

FUEL JETTISON - OPERATION

General

You can use the jettison system in the air to dump fuel overboard. The airplane must be in air mode for the jettison nozzle valves to open. If the airplane is in ground mode when you arm the jettison system, the main tank fuel jettison pumps and the jettison isolation valves operate immediately.

Jettison

This is a brief description of jettison system operation when the airplane is in the air mode:

- Push the ARM switch
- Increase or decrease the fuel to remain with the FUEL TO REMAIN selector
- Push the NOZZLE switches to open the jettison nozzle valves, start the jettison pumps, and open the jettison isolation valves
- Turn off the NOZZLE switches when the EICAS display shows the jettison complete advisory message
- Turn off the ARM switch.

When you arm the jettison system, it is in the maximum landing weight mode. In this mode, the jettison system automatically sets the quantity of fuel to remain that will make the airplane weight equal to the maximum landing weight.

If you pull the FUEL TO REMAIN selector, the jettison system changes to the manual mode. Then you turn the FUEL TO REMAIN selector to change the quantity of fuel to remain. Turn the selector left to decrease or right to increase the fuel to remain.

You use the override/jettison pump switches to control the center tank override/jettison pumps. The jettison system does not control the override/jettison pumps.

The fuel jettison rate with one nozzle valve open is 2700 lbs/min (1224 kg/min) with the operation of the jettison pumps only, and 3500 lbs/min (1587 kg/min) with the jettison and the override/jettison pumps.

The fuel jettison rate with two nozzle valves open is 3100 lbs/min (1406 kg/min) with the operation of the jettison pumps only, and 5400 lbs/min (2449 kg/min) with the jettison and the override/jettison pumps.

Indications

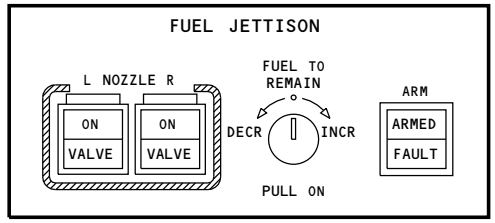
The EICAS display shows these jettison system indications:

- Total fuel quantity
- Fuel to remain
- Jettison mode.

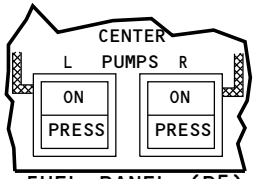
The jettison mode shows adjacent to the fuel to remain quantity. MLW shows if the jettison system is in the maximum landing weight mode. MAN shows if the jettison system is in the manual mode.

The fuel synoptic display shows these jettison system indications:

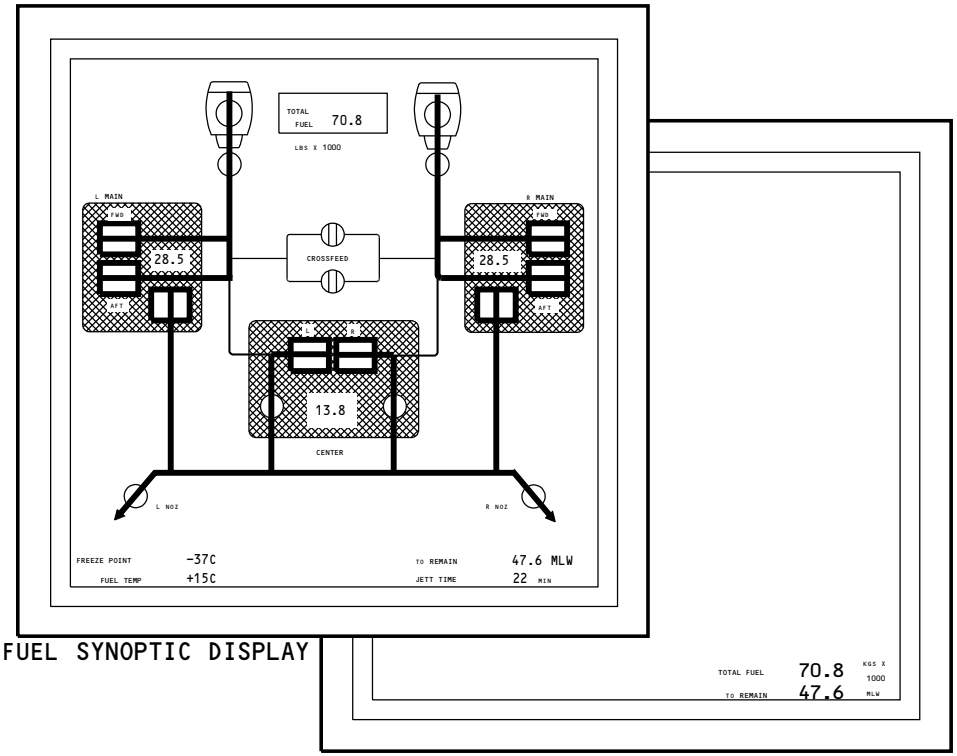
- Override/jettison pump operation
- Jettison isolation valve position
- Jettison pump operation
- Jettison nozzle valve position
- Fuel to remain
- Jettison mode
- Time until jettison complete.



FUEL JETTISON PANEL (P5)



FUEL PANEL (P5)



FUEL SYNOPTIC DISPLAY

EICAS DISPLAY

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FUEL JETTISON - OPERATION

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FUEL INDICATING - INTRODUCTION

General

The fuel indicating system has these subsystems:

- Fuel quantity indicating system
- Fuel measuring sticks
- Fuel temperature indicating
- Fuel pressure indicating.

Fuel Quantity Indicating System (FQIS)

The FQIS measures fuel quantity in the tanks. The primary display system (PDS) and the IRP indicators show fuel quantity.

Fuel Measuring Sticks

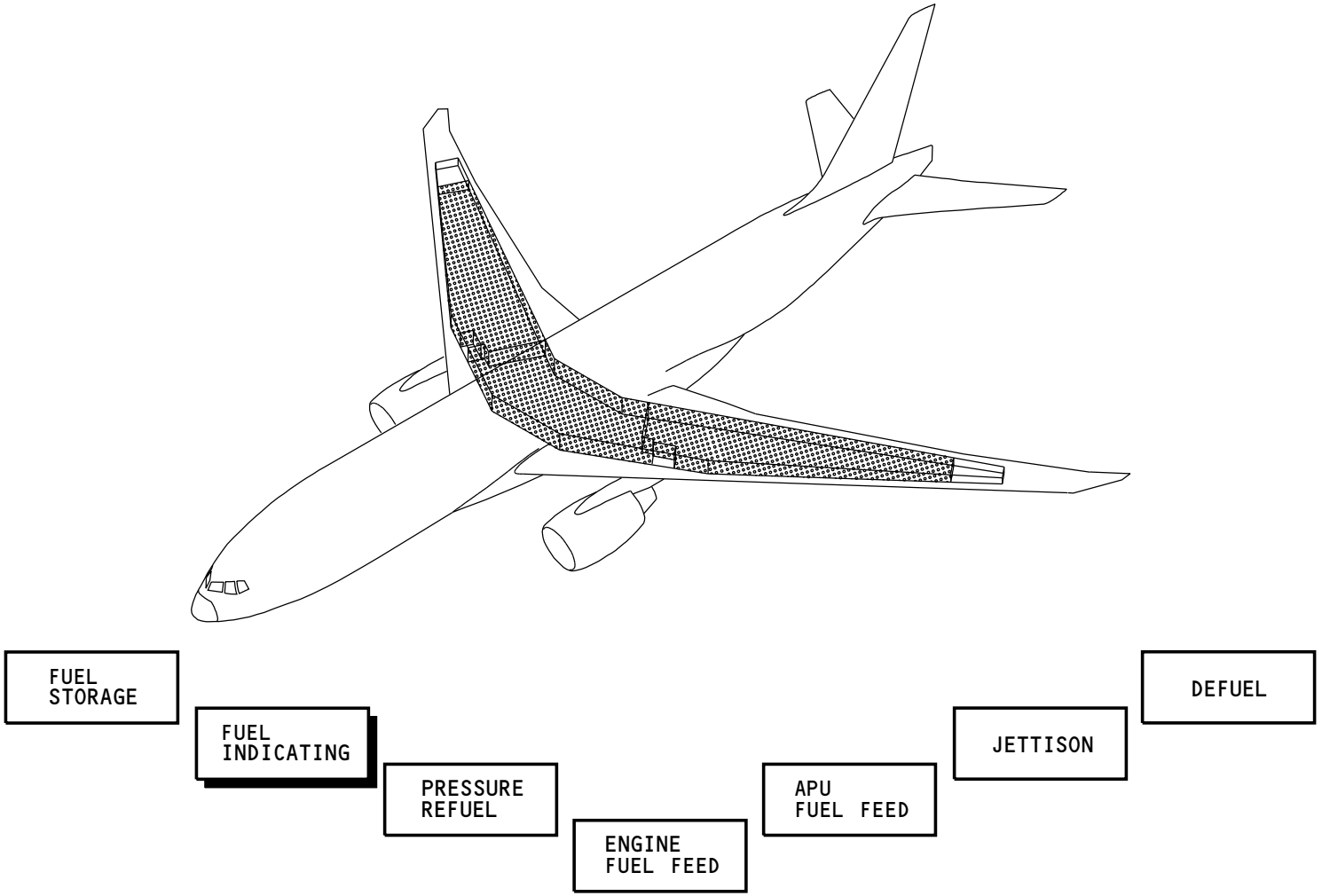
The fuel measuring sticks permit you to manually measure fuel quantity in each tank.

Fuel Temperature Indicating System

The fuel temperature indicating system measures the fuel temperature in the left main tank. The PDS shows the temperature.

Fuel Pressure Indicating System

The fuel pressure indicating system shows low pressure at the fuel pump outlets. See the engine fuel feed section for more information about fuel pressure indicating (SECTION 28-22).



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FUEL INDICATING - INTRODUCTION

FUEL INDICATING - FQIS - GENERAL DESCRIPTION

General

The fuel quantity indicating system (FQIS) does these functions:

- Measures the fuel volume
- Calculates the fuel quantity
- Controls refuel operations
- Shows when there is water in the tanks.

These are the FQIS components:

- Tank units
- Densitometers
- Water detectors
- Fuel temperature sensor
- Wiring harnesses
- Fuel quantity processor unit (FQPU).

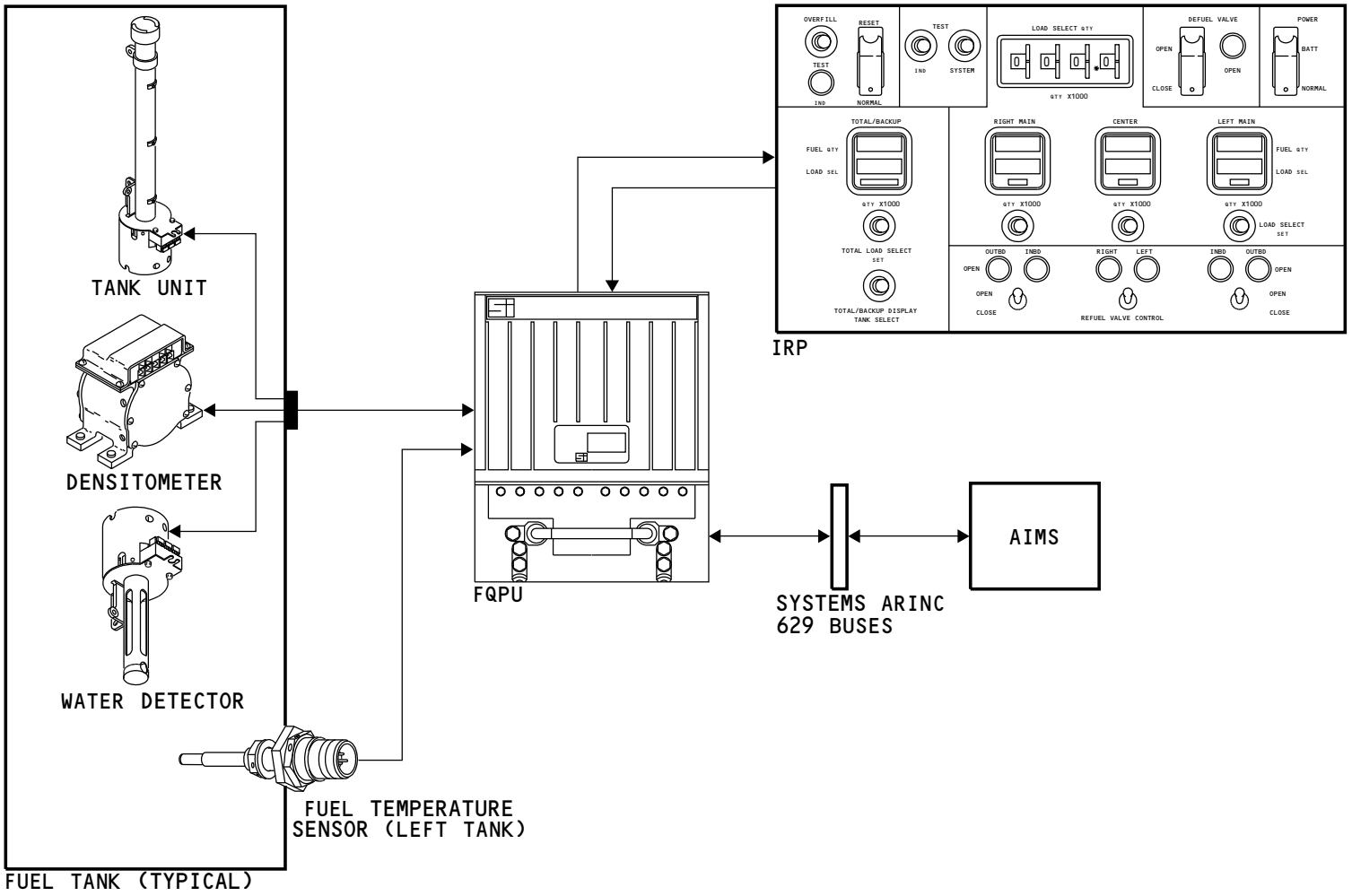
Operation

The FQPU sends signals to and gets signals from the fuel tank sensors. The FQPU uses the signals to calculate these data:

- Fuel height
- Fuel quantity in each tank
- Total fuel quantity.

The FQPU shows fuel quantity data on the EICAS display and on the integrated refuel panel (IRP) indicators.

Fuel weights go to the IRP on ARINC 429. Fuel weights, and FQIS data and fault information go to the AIMS on the systems ARINC 629 buses.



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FUEL INDICATING - FQIS - GENERAL DESCRIPTION

FUEL INDICATING - FQIS - FUEL TANK SENSORS

General

These are the sensors in the fuel tanks:

- Tank units
- Densitometers
- Water detectors
- Temperature sensor.

Tank Units

The tank units measure fuel height. There are 76 tank units in the three tanks: 28 in each main tank and 20 in the center tank.

Each tank unit position has a number. In the main tanks, tank unit 1 is at the inboard end of the tank. Tank unit 28 is at the outboard end of the tank. In the center tank, the left and right side tank unit numbers are from 1 to 10. The left tank unit 1 is at the left outboard end of the center tank. The right tank unit 1 is at the right outboard end of the center tank.

Each tank unit has an ultrasonic transmitter/receiver and a stillwell. Ten of the tank units also have calibration targets.

The fuel quantity processor unit (FQPU) sends a signal to the ultrasonic transmitter/receiver. This causes a sonic pulse to go through the fuel in the stillwell to the fuel surface, and back to the receiver. The FQPU measures the travel time of the pulse and uses it to find the fuel height.

The sonic pulse also reflects from the targets back to the receiver. The FQPU uses these pulses to measure the velocity of sound (VOS)in the fuel.

Densitometers

Each fuel tank has one densitometer. Densitometers use a vibrating cylinder transducer to measure the fuel density in each tank. The frequency of the vibrations is proportional to the fuel density. The densitometers are energized and monitored by the FQPU.

Water Detectors

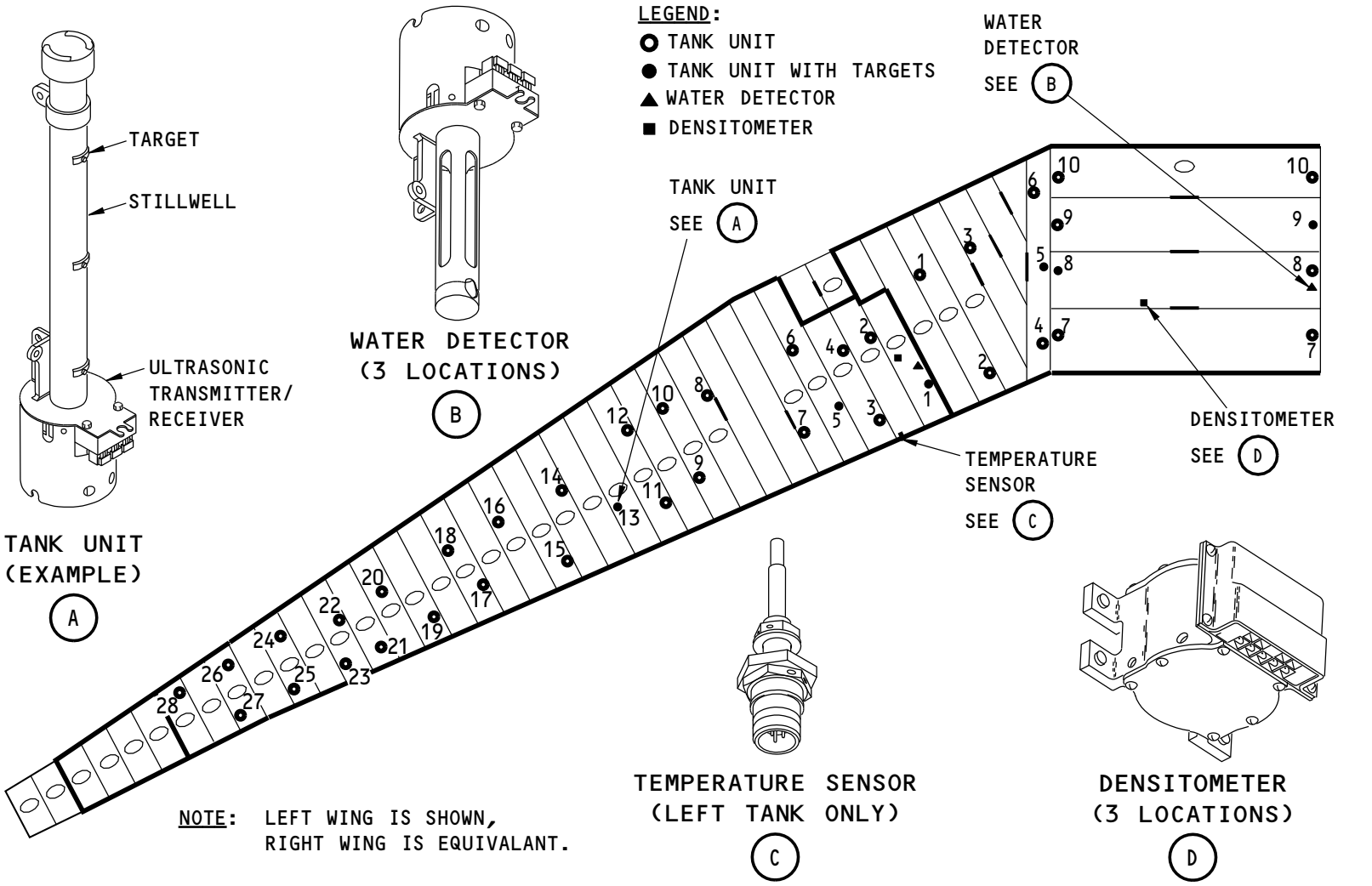
Water detectors are at the low point in each fuel tank in the tank sump area. The FQPU uses water detector signals to see if there is water in the tank sump area. Each fuel tank has one water detector. The fuel quantity maintenance page shows a message when there is water in the fuel tank.

The water detectors are ultrasonic devices like the tank units. The FQPU sends a signal to the water detectors. The water detectors send a pulse to the bottom of the tank. If there is water in the bottom of the tank, the pulse reflects off the interface between the water and fuel.

Temperature Sensor

There is only one fuel temperature sensor. It measures the fuel temperature in the left main tank. The temperature sensor is a resistance-type sensor that fits inside a sleeve.

The sleeve is on the rear spar of the left wing, aft of the fifth fuel tank access door (between ribs 9 and 10).



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FUEL INDICATING - FQIS - FUEL TANK SENSORS

FUEL INDICATING - FQIS - WIRING HARNESS

General

Tank wiring includes internal harnesses, external harnesses, and connectors. Internal harnesses connect the fuel tank sensors to connectors on the spars. External harnesses go from the spar connectors to the FQPU.

Internal Harness

Each main tank has two internal harnesses. The inboard harness connects eight tank units, one densitometer, and one water detector to one connector on the rear spar. The inboard harness connector is aft of the fifth fuel tank access door (between ribs 9 and 10). The outboard harness (not shown) connects twenty tank units to another connector on the rear spar. The outboard harness connector is aft of the sixth fuel tank access door (between ribs 10 and 11).

The center tank has two internal harnesses. The left center tank harness connects ten tank units and the densitometer to a connector on the left front spar. The right center tank harness connects ten tank units and the water detector to a connector on the right front spar. The connectors are between ribs 2 and 3.

The internal wire harnesses connect to fuel tank sensors with Faston connectors. The Faston connectors have a terminal and insulator on the wire, and a tab on the sensor. The insulator is around the terminal.

External Harness

There are two external harnesses for each tank. The main tank external harnesses go from the connectors on the rear spar to the FQPU.

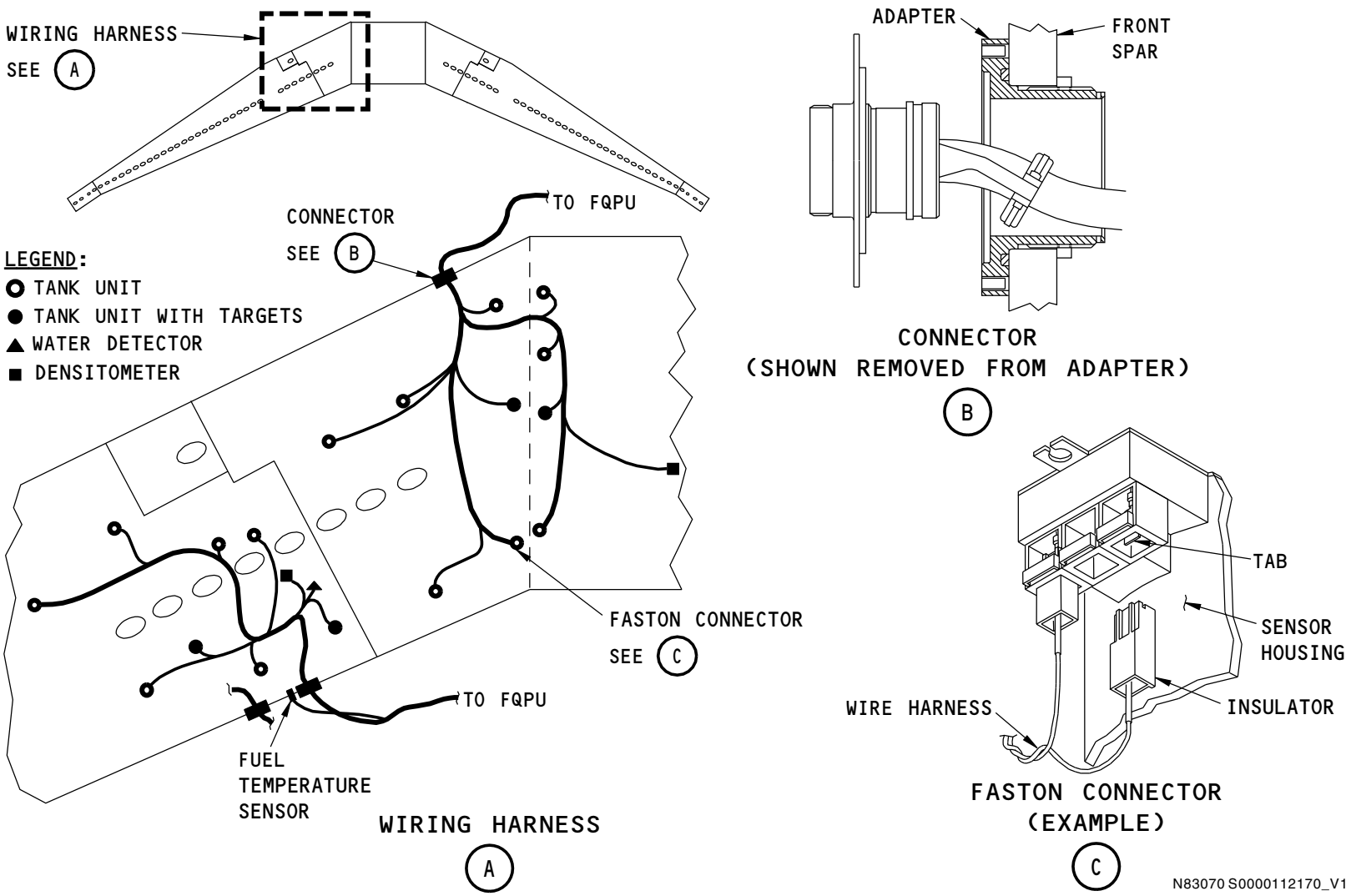
The center tank harnesses go from the connectors on the front spar to the FQPU.

Each connector attaches to the spar with an adapter. You can remove and repair the connectors without entering the tank.

Training Information Point

Each fuel tank sensor has a separate twisted wire pair. Thus, a single wire failure does not affect the whole tank. You can make splices in the wire harnesses only with limited conditions. These conditions are specified in the wire harness repair procedure in part II of the airplane maintenance manual (AMM).

You pull the insulator to disconnect the Faston connector. You push the insulator onto the tab to install the Faston connector. The shape of the insulator does not let you put a wire on the wrong tab.



FUEL INDICATING - FQIS - WIRING HARNESS

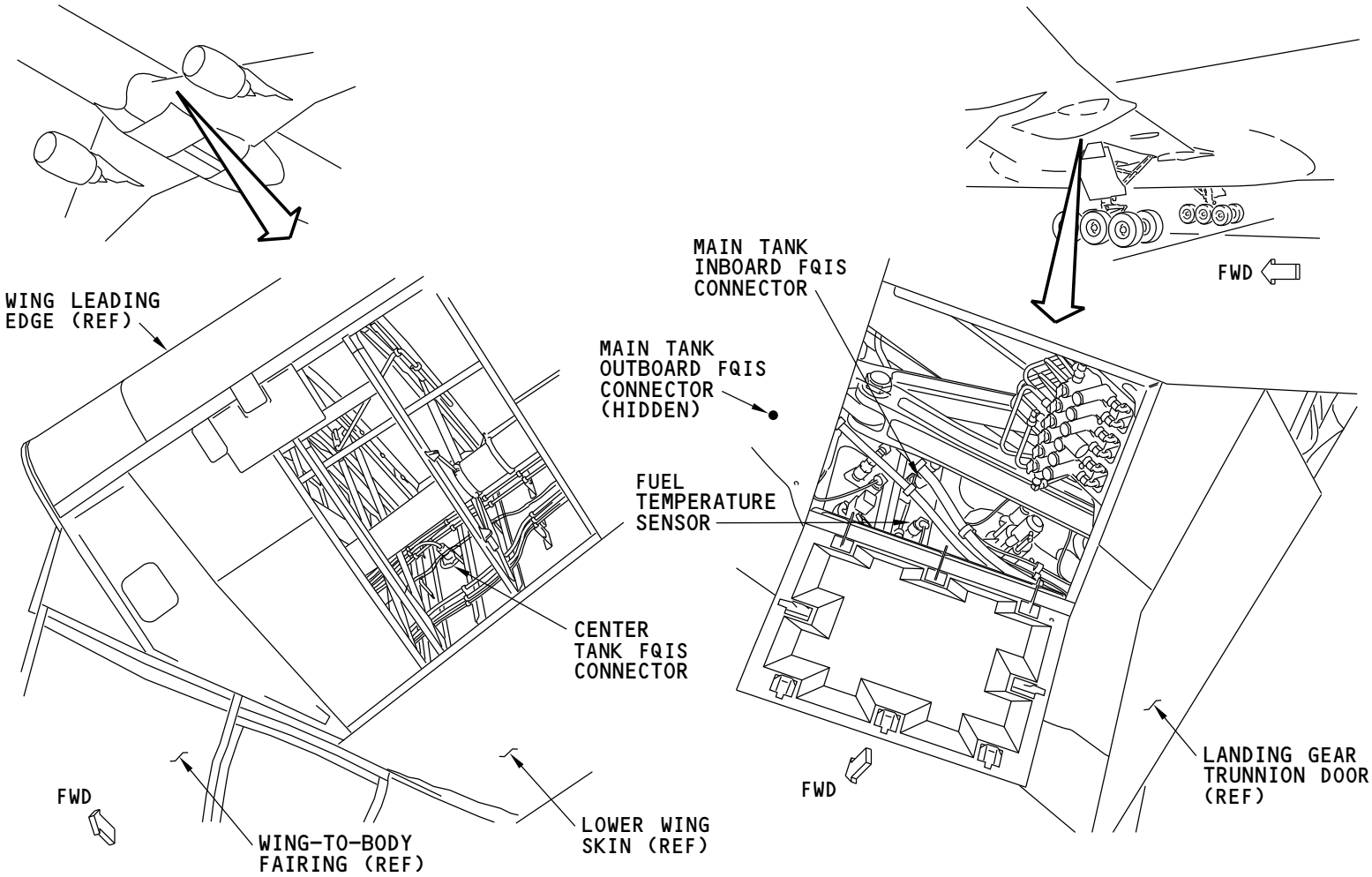
FQIS Connectors

Each half of the center tank has one FQIS connector. It is on the front wing spar near the wing-to-body fairing.

Each main tank has two FQIS connectors. They are on the rear wing spar, outboard of the main landing gear shock strut, near the landing gear trunnion door.

Fuel Temperature Sensor

There is one fuel temperature sensor in the left main tank. It attaches to the rear spar of the left wing, below the main tank inboard FQIS connector.



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FUEL INDICATING - FQIS - COMPONENT LOCATIONS - WINGS

FUEL INDICATING - FQIS - FUEL QUANTITY PROCESSOR UNIT

Purpose

The fuel quantity processor unit (FQPU) does these functions:

- Calculates the fuel weight for each tank
- Calculates the total fuel weight
- Shows the weights on the IRP indicators
- Sends the weights to the AIMS
- Causes the refuel valves to close
- Monitors the FQIS for faults
- Sends fault data to the CMCS.

Location

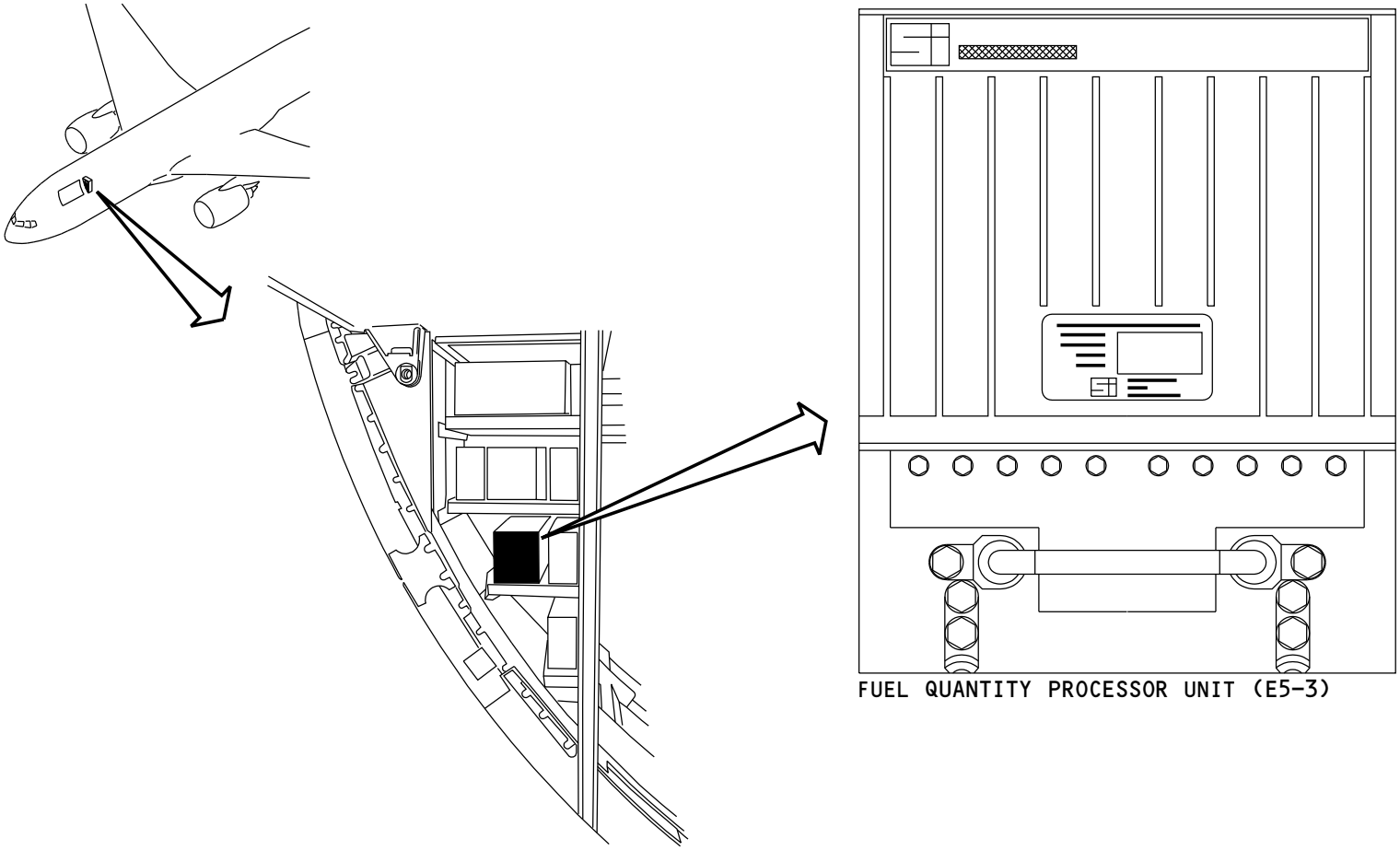
The FQPU is on the E5-3 shelf.

Physical Description

The FQPU is in a 5 MCU ARINC 600 container. The container has twelve printed circuit boards. The FQPU connects to airplane wiring.

Training Information Point

The FQPU has software that is data-loadable.



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FUEL INDICATING - FQIS - FUEL QUANTITY PROCESSOR UNIT

FUEL INDICATING - FQIS - POWER

General

The FQPU connects to two isolated 28v dc power sources at one time. The FQPU operates when one or both of the sources have power.

Power Sources

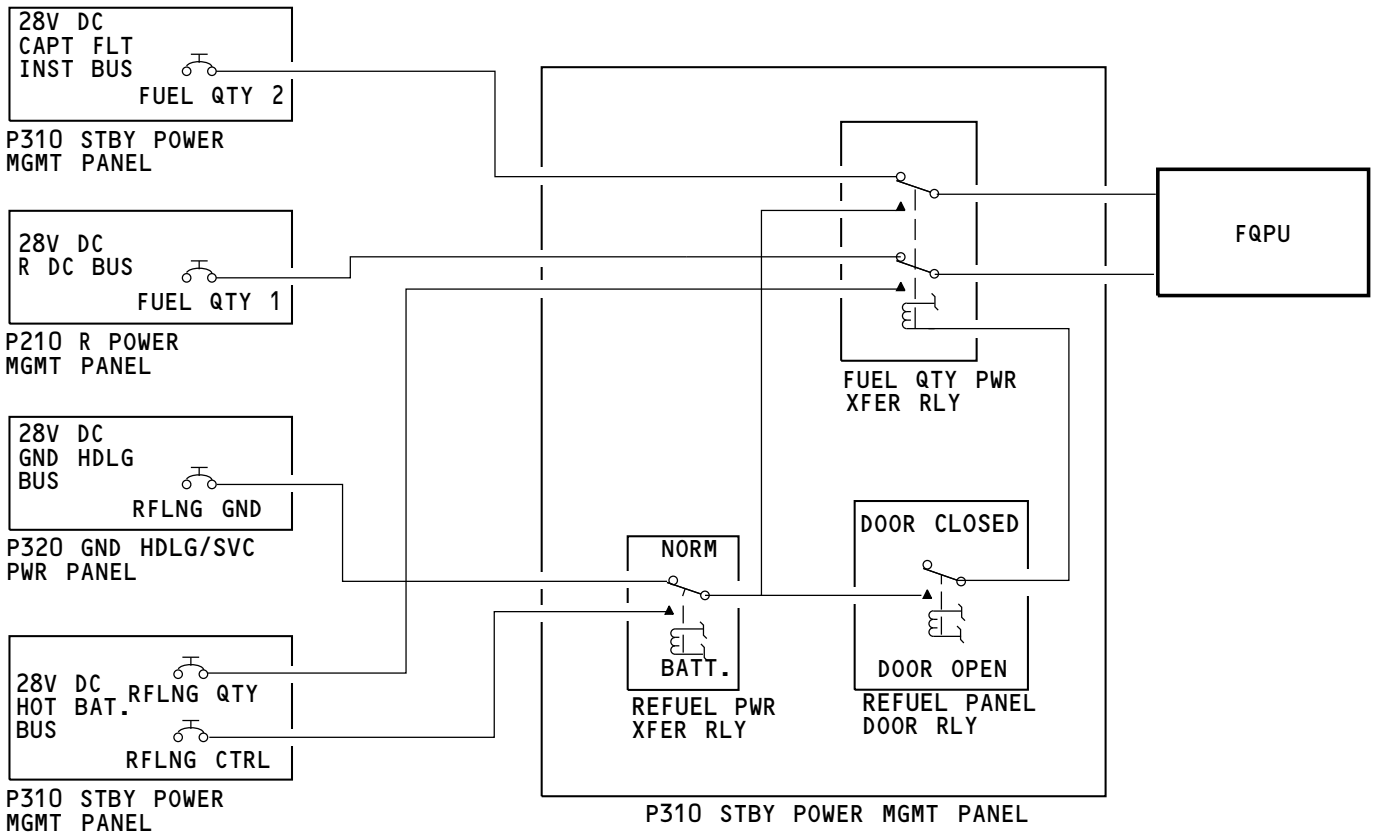
The FQPU gets power from four different sources:

- Captain's flight instrument bus
- Right dc bus
- Ground handling bus
- Hot battery bus.

During normal operation, the refuel station door is closed. The FQPU gets power from the captain's flight instrument bus and the right dc bus. The two power sources are connected together inside the FQPU. Whichever has the higher voltage supplies power to the two FQPU channels.

When the refuel station door is open and the ground handling bus has power, the fuel quantity power transfer relay energizes. This causes the FQPU to get power from different sources. The FQPU gets power from the ground handling bus and the hot battery bus.

If ground handling power is not available, you put the refuel station power switch in the battery position (BATT). This causes the hot battery bus to energize the refuel power transfer relay and the fuel quantity power transfer relay. When the two relays energize, the FQPU gets power from the hot battery bus only.



M41335 S000617712_V1

FUEL INDICATING - FQIS - POWER

FUEL INDICATING - FQIS - FUNCTIONAL DESCRIPTION

General

The FQPU has two channels, 1 and 2, that operate independently. Each channel includes an input/output (I/O) circuit card and an ARINC 629/429 card.

The FQPU uses separate and independent tank circuits for each tank. Each tank circuit has a data concentrator card and a tank circuit card.

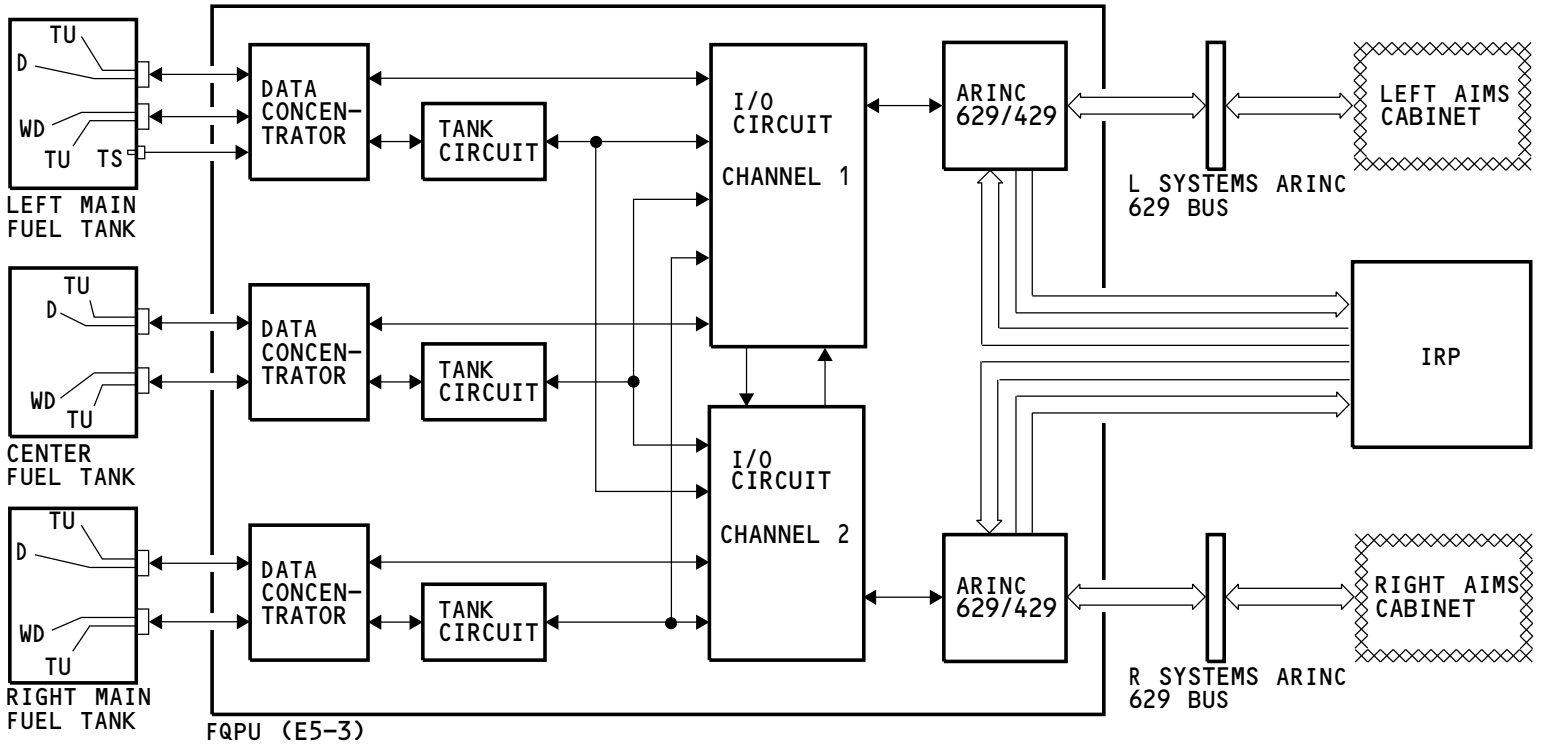
FQIS Channels

The I/O circuit cards calculate total fuel weight and send the individual tank weights and the total weight to the AIMS and the IRP.

The ARINC 629/429 card transmits and receives ARINC 629 and ARINC 429 data.

FQIS Tank Circuits

The data concentrator cards supply excitation to, and get data from, the fuel tank sensors. The tank circuit cards calculate fuel volume and weight. The calculations for each tank are independent. A fault that causes loss of indication for one tank does not affect indication for the other tanks.



M41338 S000617714_V1

FUEL INDICATING - FQIS - FUNCTIONAL DESCRIPTION

FUEL INDICATING - FQIS - INDICATIONS

General

The EICAS display shows total fuel quantity and fuel temperature in the lower right corner of the EICAS display.

The fuel synoptic display shows individual tank quantities and the total fuel quantity. It also shows the fuel temperature and the minimum fuel temperature. The minimum temperature is 3C more than the freeze temperature.

Non-Normal EICAS Displays

The EICAS display also shows the fuel quantity for each tank for these non-normal conditions:

- Low fuel in the main tanks
- Fuel is in the center tank and the center tank pumps are off
- Forward or aft crossfeed valve is open
- You select the fuel synoptic display and the MFD does not work
- Fuel imbalance between the left and right main tanks.

When the airplane is on the ground and one or both engine(s) are off, the AIMS software will prompt the Expanded Fuel Indication to appear on the EICAS display. This display helps inform the crew about fuel loading conditions before engine start.

The EICAS display also shows a fuel imbalance pointer under these conditions:

- There is a fuel imbalance more than 3000 lb (1361 kg), or
- The FUEL IMBALANCE EICAS advisory message shows, or
- The fuel imbalance between the left and right main tanks is 1000 lb (454 kg) or more, or
- The fuel imbalance between the left and right main tanks is 200 lb (91 kg) or more and either fuel crossfeed valve is open.

The fuel imbalance pointer shows adjacent to the main tank quantity that is the lowest.

The fuel imbalance pointer shows as solid white if the main tank fuel quantity difference is more than 1000 lb (454 kg), but will change to amber when the FUEL IMBALANCE EICAS advisory message shows.

The FUEL IMBALANCE EICAS advisory message will be set when the difference between the main tanks is more than the allowable quantity for more than 30 seconds.

The allowable quantity is 4000 lb (1814 kg) when total main tank fuel is 90,000 lb (40,823 kg) or less, with a linear reduction to 2000 lb (907 kg) when total main tank fuel is 123,000 lb (55,792 kg), and 2000 lb (907 kg) when total main tank fuel exceeds 123,000 lb (55,792 kg).

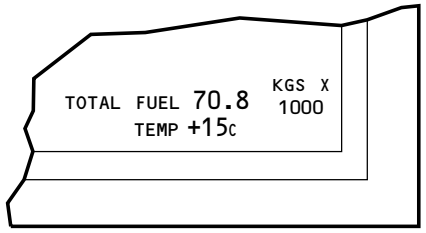
The FUEL IMBALANCE EICAS advisory message signal will remain set until the fuel imbalance decreases 200 lb (91 kg) below the set quantity for a period more than 15 seconds.

The fuel temperature data on the EICAS display and the fuel synoptic display can change from white to amber. This occurs when the fuel temperature equals or becomes less than the minimum fuel temperature.

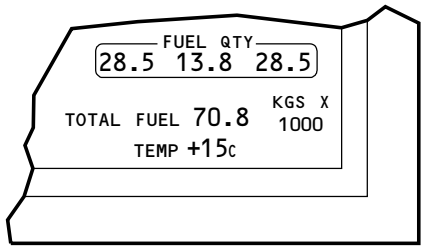
Normal EICAS Fuel Quantity Display Disagreement

AIRPLANES WITH METRIC UNITS;

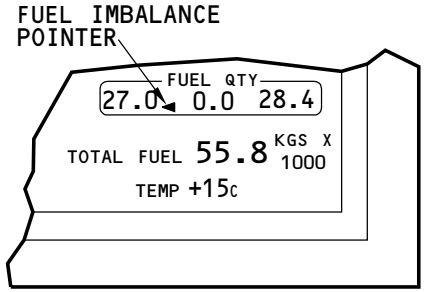
- The EICAS display indicated center tank volumetric top off (VTO) display does not match the actual VTO. The EICAS display has a maximum display of 99999. The center tank VTO measured in liters is more than the maximum EICAS display quantity.



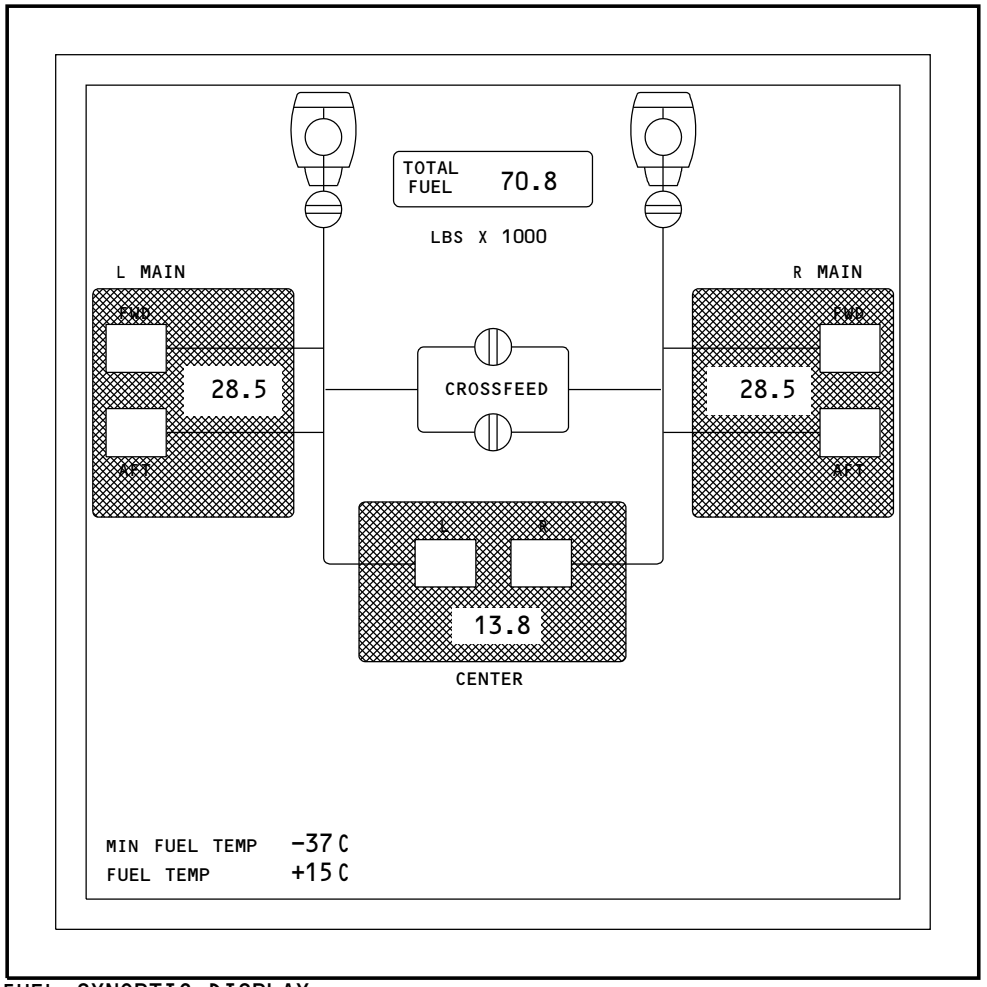
EICAS DISPLAY



EICAS DISPLAY



EICAS DISPLAY



FUEL SYNOPTIC DISPLAY

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FUEL INDICATING - FQIS - INDICATIONS

FUEL INDICATING - FQIS - MAINTENANCE PAGES

General

Fuel quantity data shows on the fuel quantity maintenance pages 1 and 2. Page 1 shows data for the left and right main tanks. Page 2 shows similar data for the center tank.

The maintenance page shows this data:

- Fuel quantities
- Fuel temperature
- Fuel densities
- Height of fuel at each tank unit
- Velocity of sound (VOS) at each tank unit
- Volumetric top-off (VTO) values
- Water detection status.

Uplift Quantity

The uplift quantity is the change in the total quantity from the time that the refuel station door opens to the time that the last refuel valve closes.

Uplift Density

The uplift density is the average density of the fuel added from the time that the refuel station door opens to the time that the last refuel valve closes.

Volumetric Top-Off

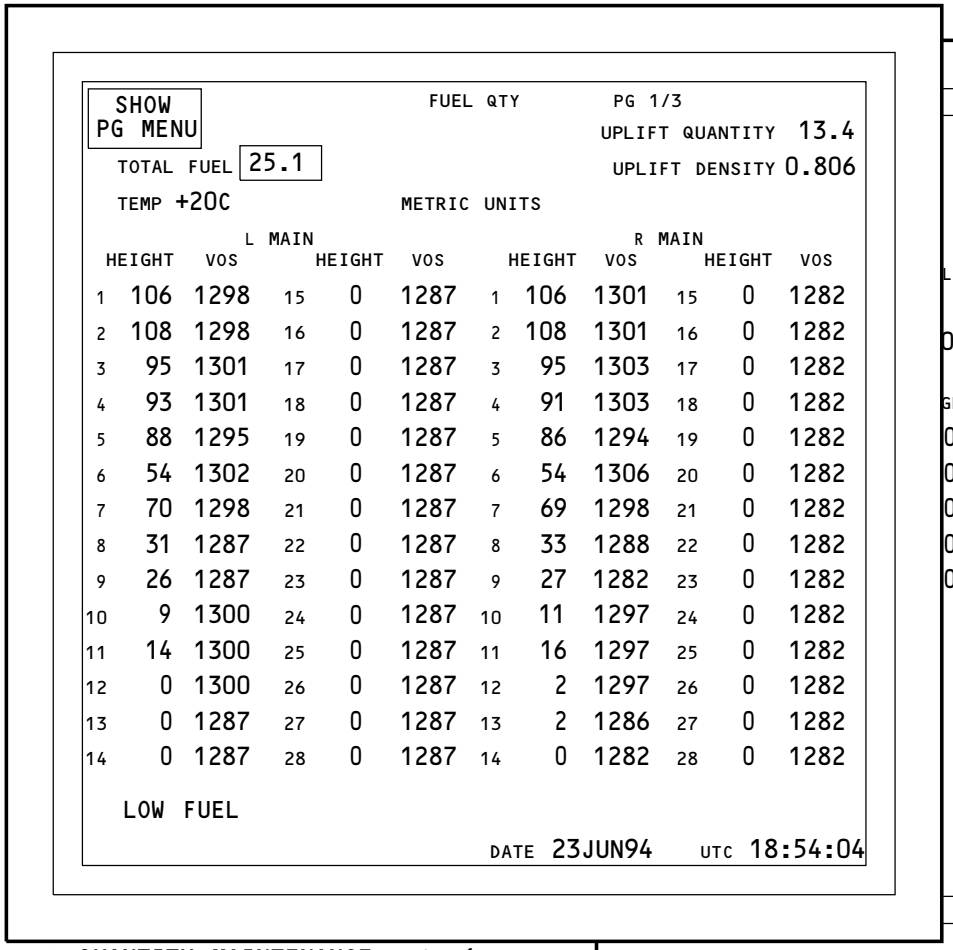
The VTO for a tank is the volume of fuel the tank can hold. The FQPU uses VTO values to calculate the load select set values for the main tanks when you do a total load select set for automatic refueling. The FQPU also uses the VTO value to close the refuel valves when the tank is full.

Water Detection Status

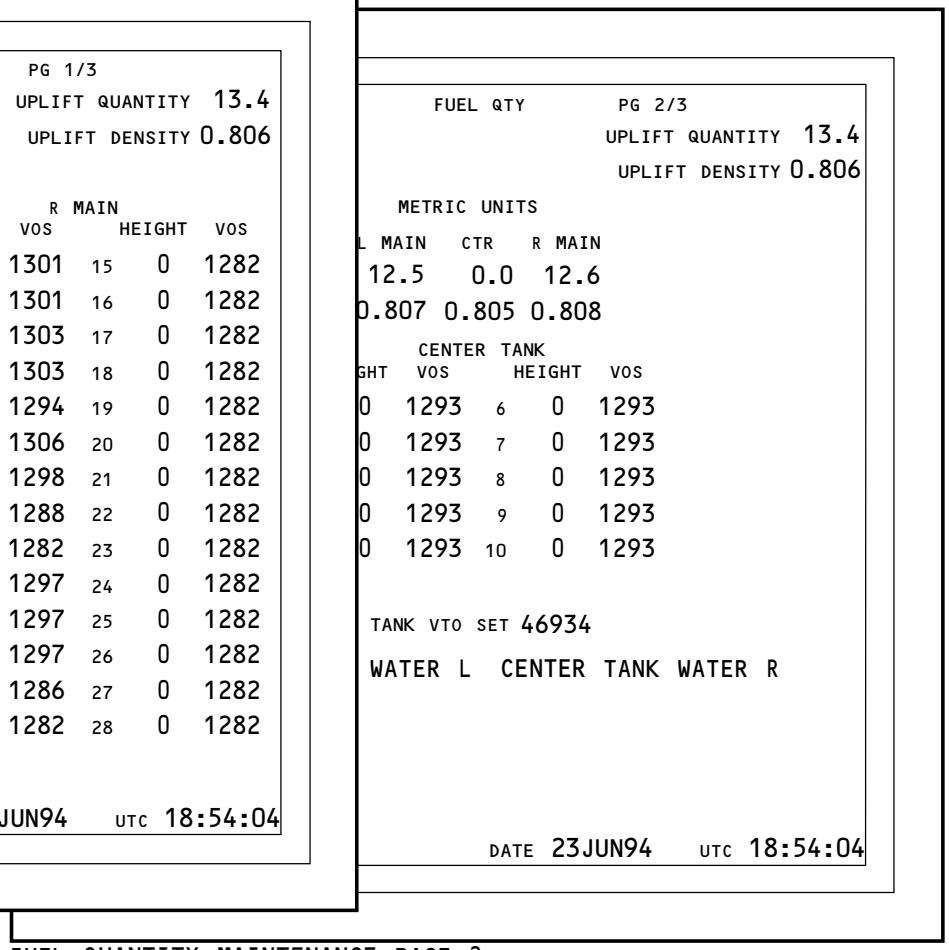
If a water detector finds water in a tank, the FQPU causes the water detection message for that tank to show. The main tank water detection messages show at the bottom of maintenance page 1. The center tank water detection messages show at the bottom of maintenance page 2. The amount of water required to set the L MAIN WATER or R MAIN WATER message is approximately 7 gallons (31.8 liters). The amount of water for the center tank water message is approximately 138 gallons (627 liters).

Training Information Point

Fuel quantity maintenance page 3 shows airplane pitch and roll data. When you use the fuel measuring sticks to find fuel quantity, you can use the pitch and roll data from the maintenance page.



FUEL QUANTITY MAINTENANCE PAGE 1



FUEL QUANTITY MAINTENANCE PAGE 2

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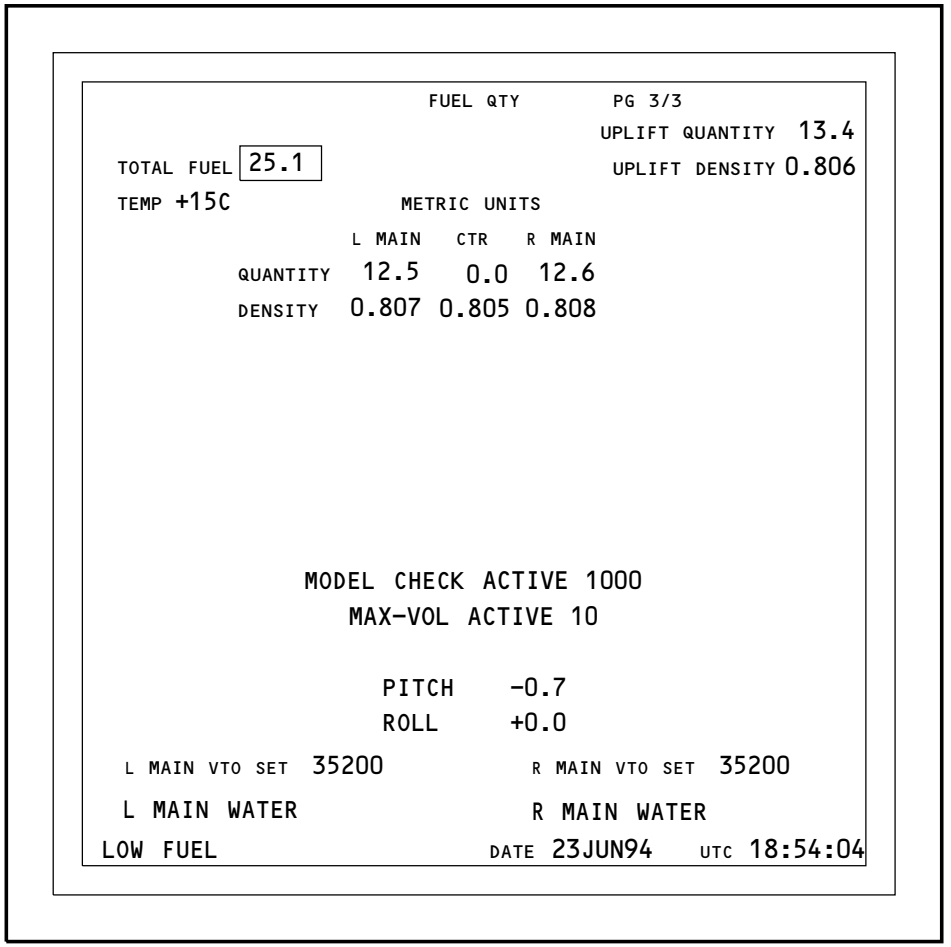
FUEL INDICATING - FQIS - MAINTENANCE PAGES



FUEL QUANTITY MAINTENANCE PAGE 3

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FUEL INDICATING - FUEL QUANTITY MEASURING STICK ASSEMBLY

General

You can manually measure fuel quantity with the fuel measuring stick assemblies.

Ten measuring stick assemblies install through the bottom of each wing. Eight are in each main tank and two are in each section of the center tank. They are numbered from inboard to outboard.

The measuring sticks in the main tanks are installed in the fuel tank access doors. The measuring sticks in the center tank are installed in the lower wing skin.

Physical Description

The fuel measuring stick assemblies have these parts:

- Base
- Housing
- Magnetic float
- Measuring stick.

The base and housing are inside the tank. There is a red retainer in the base. The magnetic float surrounds the housing and moves up and down the housing as the fuel level changes. There is a float stop at the top of the housing to keep the float on the housing when the tanks are full.

The measuring stick is inside the housing. The measuring stick is flexible. It has a latch assembly at the bottom and a steel armature at the top. The stick has graduation marks to show the fuel level. The graduation marks are non-dimensional linear units.

You can remove the fuel measuring sticks from the assembly without defueling the airplane.

Operation

You use airplane attitude (pitch and roll) and fuel height to manually measure fuel quantity. The nose wheel well has inclinometers. The right main wheel well has a leveling scale and plumb bob attachment. You use the inclinometers or the leveling scale to measure airplane pitch and roll.

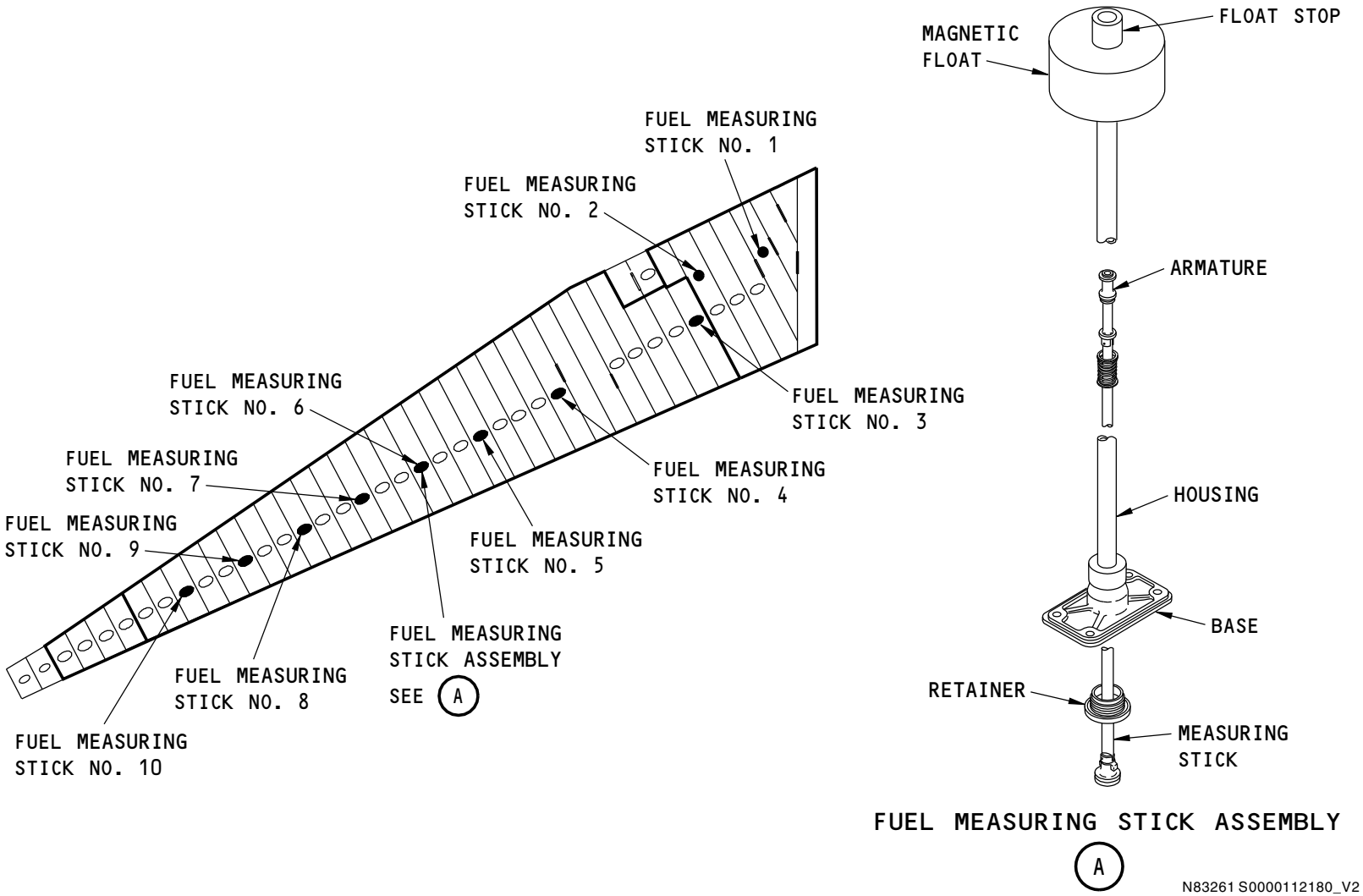
Use a screwdriver to unlock and release the measuring stick latch. Lower the stick to its fully extended length. Raise the stick slowly until you feel the magnetic float catch the stick. Read the graduation mark at the bottom of the stick to get the fuel level. You do this procedure three times to make sure you accurately read the fuel level.

You use airplane attitude, fuel density, and the fuel level from the sticks to find the fuel quantity in the fuel measuring stick conversion tables.

You can find the fuel measuring stick conversion tables in the Fuel Measuring Stick Manual (FMSM).

Training Information Point

Because it is flexible, move the measuring stick slowly when you stow it.



FUEL INDICATING - FUEL QUANTITY MEASURING STICK ASSEMBLY