# CHAPTER 7

# FUEL SYSTEM

## LIST OF CONTENTS


| | |
|---|---|
| GENERAL | 7-1-1 |
| 1. TANK INSTALLATION | 7-1-1 |
| 2. REFUEL AND DEFUEL | 7-2-1 |
| A. Pressure Refuel | 7-2-1 |
| B. Suction Defuel | 7-2-1 |
| C. Gravity Refuel | 7-2-1 |
| D. Gravity Defuel | 7-2-1 |
| 3. FUEL SUPPLY SUB-SYSTEM | 7-3-1 |
| A. Normal Operation | 7-3-1 |
| B. Scavenge, Collector and Negative "G" Tanks | 7-3-1 |
| C. Low Pressure Valves | 7-3-1 |
| D. Motive Flow Shut-Off Valve | 7-3-1 |
| E. Fuel Standby Pump | 7-3-2 |
| F. Crossfeed System | 7-3-2 |
| 4. FUEL QUANTITY MEASUREMENT SUB-SYSTEM | 7-4-1 |
| A. Capacitance Fuel Management System | 7-4-1 |
| B. Magnetic Fuel Level Indicators | 7-4-1 |
| C. Low Fuel Level Warning | 7-4-1 |

5. FUEL SYSTEM INDICATION 7-5-1
A. Fuel Contents 7-5-1
B. FuelFlow/Fuel Used 7-5-1
C. Fuel Pressure 7-5-1
D. Fuel Filter Blockage 7-5-1
E. Low Fuel Level Warning 7-5-1
F. Low Fuel Temperature 7-5-1
G. Refuel Control Panel 7-5-3
H. Master Caution 7-5-3
I. LP Valve Position 7-5-3
J. Crossfeed Shut-Off Valve 7-5-3
6. FUEL SYSTEM CONTROL 7-6-1
A. LP Valves 7-6-1
B. Standby Pumps 7-6-1
C. Crossfeed Shut-Off Valve 7-6-1

Printed in the U.K.

# CHAPTER 7 FUEL SYSTEM

## LIST OF EFFECTIVE PAGES

| Page | | Date | Page | Date |
|---|---|---|---|---|
| 7 CONTENTS | 1 | Jul 15/94 | | |
| | 2 | Aug 31/92 | | |
| LIST OF EFFECTIVE PAGES | 1/2 | Apr 15/96 | | |
| 7-1-1 | | Jul 15/94 | | |
| 7-1-2 | | Aug 31/92 | | |
| 7-2-1 | | Jul 15/94 | | |
| 7-2-2 | | Aug 31/92 | | |
| 7-2-3 | | Mar 1/93 | | |
| 7-2-4 | | Mar 1/93 | | |
| 7-3-1 | | Nov 15/93 | | |
| 7-3-2 | | Aug 31/92 | | |
| 7-3-3 | | Aug 1/92 | | |
| 7-3-4 | | Aug 31/92 | | |
| 7-3-5 | | Aug 1/92 | | |
| 7-3-6 | | Jul 15/94 | | |
| 7-3-7 | | Jul 15/94 | | |
| 7-3-8 | | Jul 15/94 | | |
| 7-4-1 | | Apr 15/93 | | |
| 7-4-2 | | Mar 1/93 | | |
| 7-4-3 | | Aug 31/92 | | |
| 7-4-4 | | Apr 15/96 | | |
| 7-5-1 | | Apr 15/93 | | |
| 7-5-2 | | Aug 1/94 | | |
| 7-5-3 | | Aug 1/92 | | |
| 7-5-4 | | Aug 1/92 | | |
| 7-6-1 | | Aug 1/92 | | |
| 7-6-2 | | Apr 15/96 | | |

CHAPTER 7

# FUEL SYSTEM

## General Description

The aircraft fuel system has two integral fuel tanks, one installed in each wing. Each wing tank has a fuel supply sub-system, a fuel quantity sub-system, and a refuel/defuel sub-system.

### 1. Tank Installation

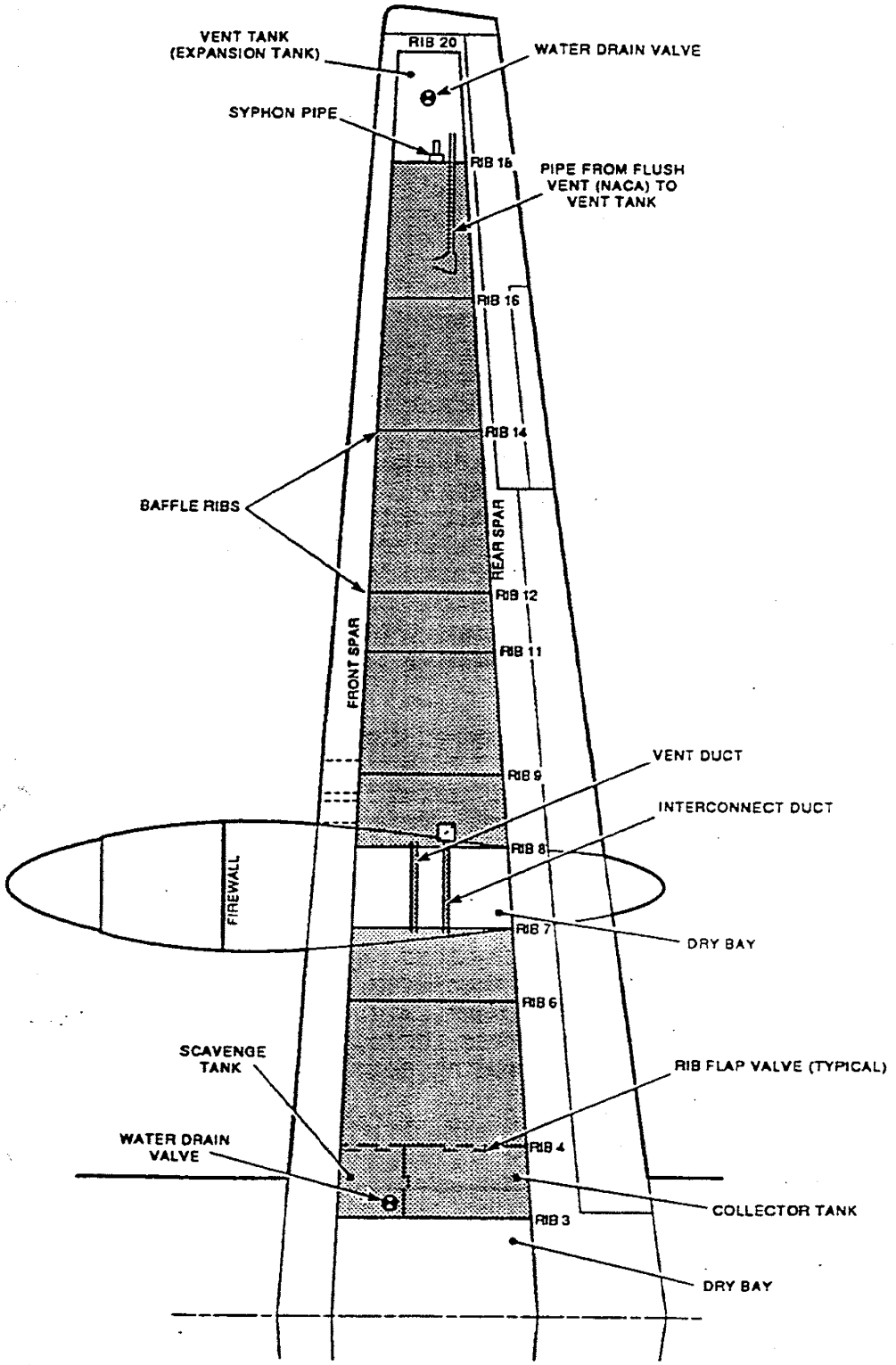
Each engine has its own independent fuel tank and supply system. The total available fuel is divided equally between the two tanks. The tanks are integral with the wings, installed between the front and rear spars and the upper and lower skins. Each tank has two main compartments; one inboard and one outboard of the nacelle. The two compartments are connected by a fuel interconnect duct, and a fuel vent duct. To prevent blockage, a strainer is installed on the outboard end of the interconnect duct. Two of the wing ribs act as baffle ribs, and prevent the bulk movement of fuel during manoeuvres. Each rib has vent spaces and drain holes. Other wing ribs have rib flap valves which permit the fuel to flow to the lower part of the wing and prevent fuel surge back along the wing. The inner bay of each tank is divided to form a scavenge tank at the front and a collector tank at the rear.

At the tip of each wing is a vent tank (expansion tank) which has a capacity of approximately 12 US gals. This tank is not filled during refuelling. The vent tank is vented to atmosphere, through a pipe, to a NACA inlet installed on the underside of the aircraft wing. During flight the vent tank is slightly pressurized and any fuel that spills into the vent tank is returned to the main tank through the syphon pipe.

Two water drain valves are located in each wing; in the vent tank and in the scavenge tank. The inner-wing dry bay is drained and ventilated through four holes in the lower skin. The area forward of the front spar is drained and ventilated through a stub pipe and two holes in the lower surface of the leading edge.

The total fuel capacity will be as follows, equally divided between each tank (the average density is assumed as 6.66 lb/US gal).

| FUEL CAPACITY | IMP GAL | US GAL | LITRES | KG | LB |
|---|---|---|---|---|---|
| USABLE | 727.4 | 873.5 | 3306.8 | 2639 | 5818 |
| UNUSABLE | 4.1 | 4.9 | 18.6 | 15 | 33 |
| TOTAL | 731.5 | 878.4 | 3325.4 | 2654 | 5851 |




Fuel Tank Installation

2. Refuel and Defuel

A single point refuel/defuel connecter is installed in the leading edge of the right wing. Both wings also have a gravity refuel/defuel facility.

A. Pressure Refuel

Both tanks can be pressure refuelled through the single refuel/defuel connector. The connector is located in the leading edge of the right wing, outboard of the engine. The connector contains a non-return valve to prevent the escape of fuel overboard. Access to the connector and its control panel is through a door in the right wing leading edge.

The flow of fuel to each tank is controlled by the left and right refuel valves. Fuel from the connector flows along pipework to each valve. Restrictors in the pipework of the right tank, limit the total flow rate and ensure an equal flow rate to both tanks. The refuel valves include a thermal relief valve. Using a refuelling nozzle pressure of 50 psig, the tanks are filled at a total rate of approximately 72 US gals per minute.

The control panel, located with the connector, provides the control and indication for automatic pressure refuel, the panel also has a total FUEL QUANTITY display. If the automatic system becomes unserviceable, a MANUAL pressure refuel facility is available.

The right battery busbar supplies the power for the pressure refuel system. When either the GPU or BATT switch is set to ON, the 28V dc emergency busbar supplies the power for the system.

B. Suction Defuel

Suction defuel is through the same connector and pipework as for pressure refuel, but through the right and left hand defuel shut-off valves in the scavenge tank. Electrical power is not necessary for this operation but the lever on the connector must be set to DEFUEL.

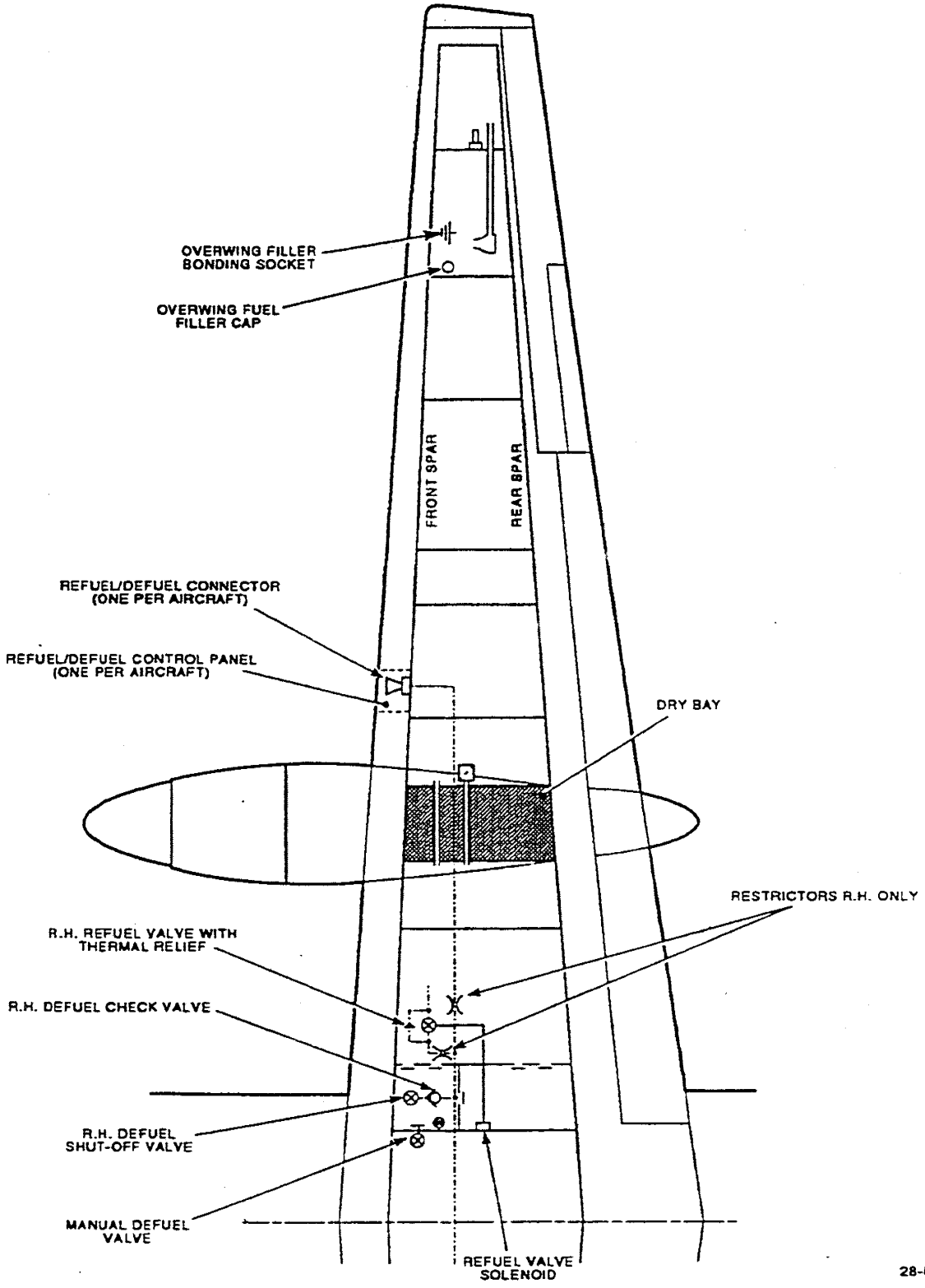
The suction defuel system will not fully drain the fuel tanks, to do this, the water drain valves must be opened.

C. Gravity Refuel

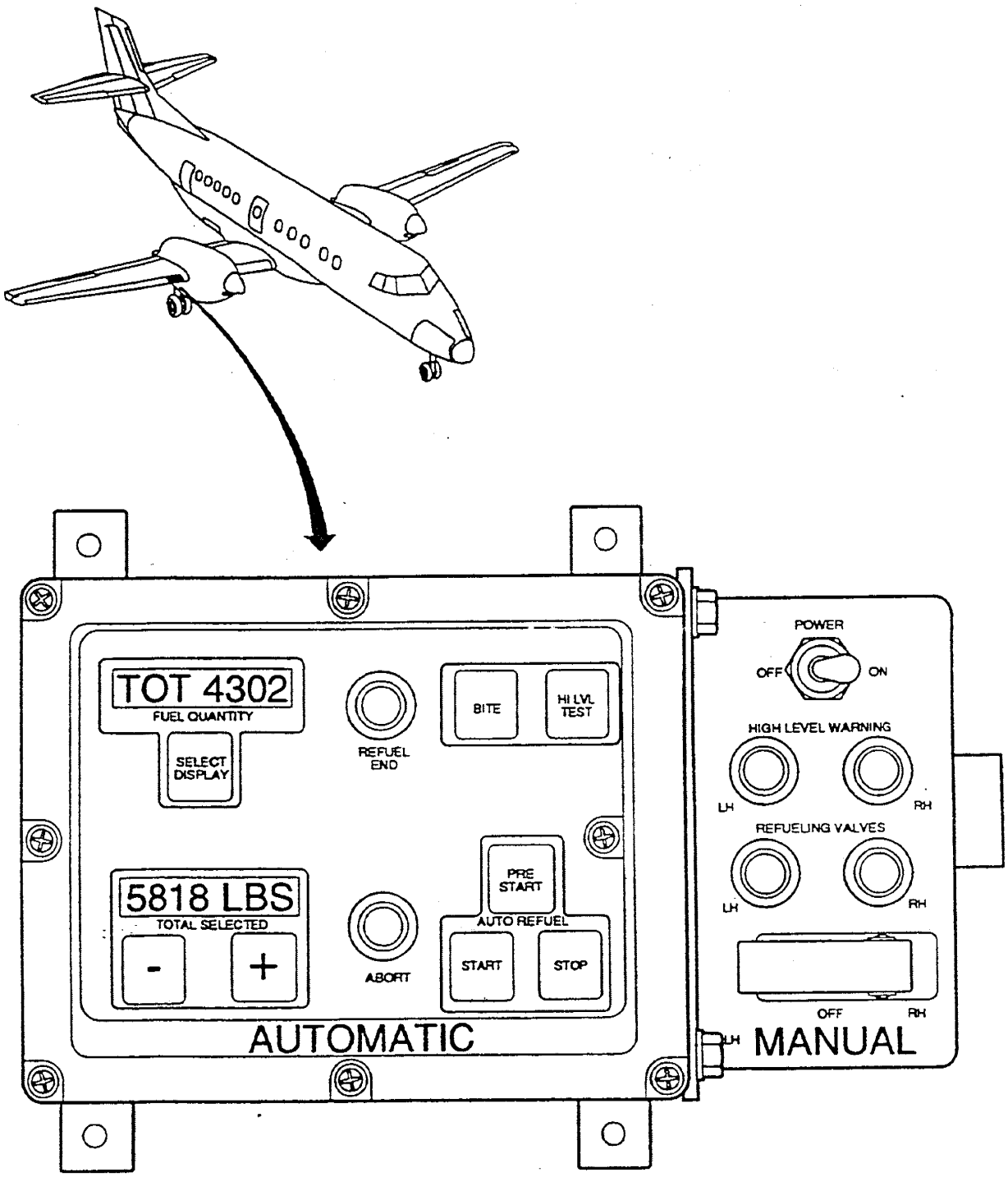
If a ground pressure refuel is not available the wing tank can be refuelled through the overwing fuel filler cap. An overwing filler bonding socket is provided and must be used during a gravity refuel.

D. Gravity Defuel

If a ground suction defuel is not available then the tanks can be emptied with the manual defuel valve. The valve is operated with a handle located in the inner-wing dry bay.



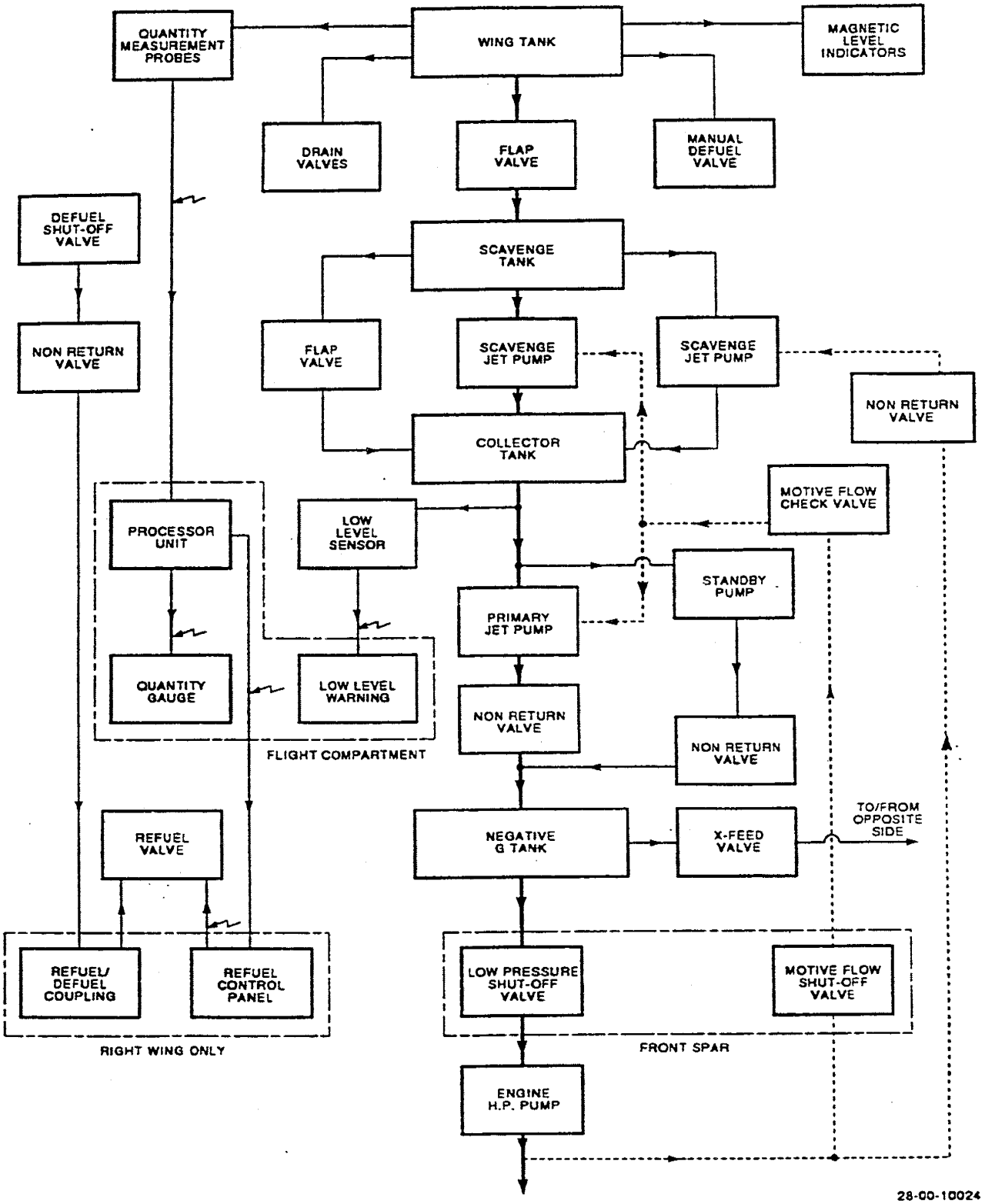

Refuel/Defuel Sub-System




28-00-10025

Fuel System-Schematic

00002487




Fuel System-Schematic

3. Fuel Supply Sub-System

A. Normal Operation

During normal operation, motive flow from the engine HP fuel pump is used to drive three jet pumps; A primary jet pump and two scavenge jet pumps.

The primary jet pump is mounted in the base of the collector tank. This pump delivers fuel from the collector tank through a non-return valve, to a negative 'g' tank. The fuel is then supplied to the engine through a low pressure (LP) valve, which incorporates an integral thermal relief valve.

Two scavenge jet pumps send fuel from the scavenge tank into the collector tank. There is a constant motive flow supply to one scavenge jet pump provided by a tapping off the main motive flow line.

B. Scavenge, Collector and Negative "G" Tanks

Fuel is fed towards the wing root under gravity. Four flap valves in the inboard wing ribs retain fuel within the scavenge and collector tanks. A further flap valve is situated between the collector/scavenge tank to retain fuel within the collector tank.

The negative "g" tank is an inline reservoir that prevents fuel starvation during manoeuvres. It gives approximately 10 seconds supply in a negative "g" condition. A vent valve on top of the negative "g" tank ensures the fuel supply is free of air.

C. Low Pressure Valves

An LP valve is installed between each engine and negative 'g' tank. Each valve is controlled by a guarded LP VALVE switch installed on the flight deck roof panel. Power is supplied from the 28V dc battery busbar to SHUT and emergency busbar to OPEN the valve.

The valve condition is shown on a caption above each switch. When engine shut-down occurs, movement of the related engine CONDITION lever to the FEATHER position closes the LP valve. Power to close the LP valve comes from the 28V dc emergency busbar through the CONDITION lever microswitch.

D. Motive Flow Shut-off Valve

A shut-off valve is installed in the main motive flow line. This shut-off valve controls the supply to one of the jet pumps, and is normally in the open position. When the valve is closed the jet pump is inoperative. The valve is located in the same area as the LP valve.

E. Fuel Standby Pump

An electrically operated standby pump is installed on the base of the collector tank. The standby pump is used:

- To supply fuel to the engine for start-up until the motive flow system is operational
- As a standby pump to cater for failure of the motive flow system
- To pump fuel during crossfeed operations.

Non-return valves are fitted downstream of the standby pump and in the outlet line of the primary jet pump. These non-return valves prevent reverse fuel flow when either the jet or standby pumps are in operation. The standby pumps are controlled by STBY PUMP switches in the flight deck roof panel. Electrical power is 28V dc supplied from the emergency busbar or the related essential busbar.

When a standby pump is selected ON the applicable motive flow shut-off valve is automatically closed. When the standby pump is selected OFF the motive flow shut-off valve re-opens and an increase in fuel pressure will be noticed.

F. Crossfeed System

The two fuel tanks are connected by a crossfeed line and a crossfeed valve. This crossfeed valve is controlled by a two-position X-FEED switch installed in the flight deck roof panel.

The crossfeed system allows both engines to be supplied from one tank. The crossfeed system also allows one engine to be supplied from both tanks. When an engine is shutdown, fuel can be provided to the remaining engine by alternately feeding from each tank. Fuel cannot be transferred from one tank to the other. To operate the crossfeed system:

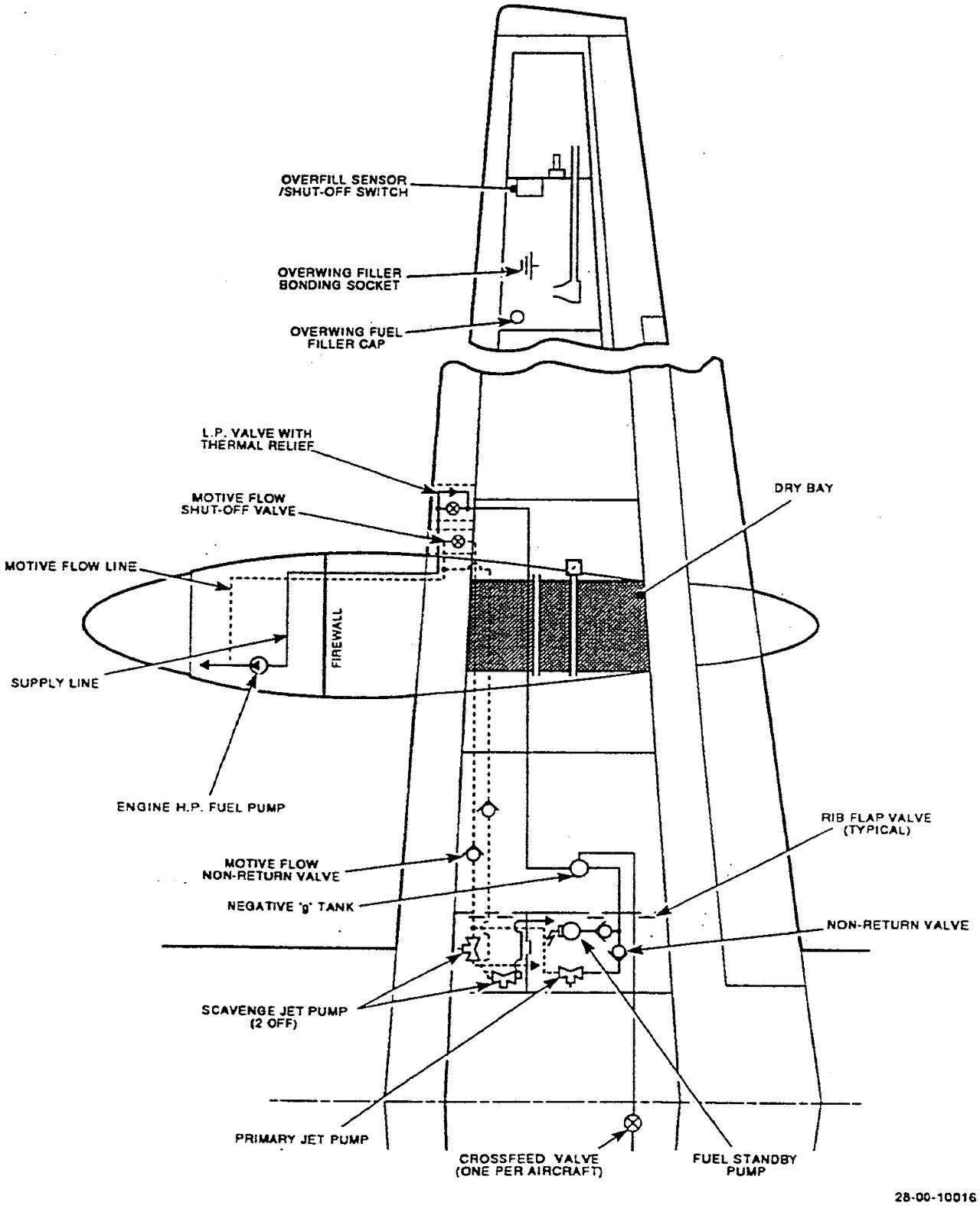
- Select the applicable STBY PUMP to ON (this causes the related motive flow shut-off valve to close and the standby pump to operate)
- Select the X-FEED switch to OPEN (this causes the crossfeed valve to open and the motive flow shut-off valve on the opposite side to close).

Fuel is then supplied to both engines from the fuel tank of the selected standby pump. Closing the crossfeed shut-off valve will reverse the process and switching OFF the STBY PUMP will re-open the associated motive flow valve.

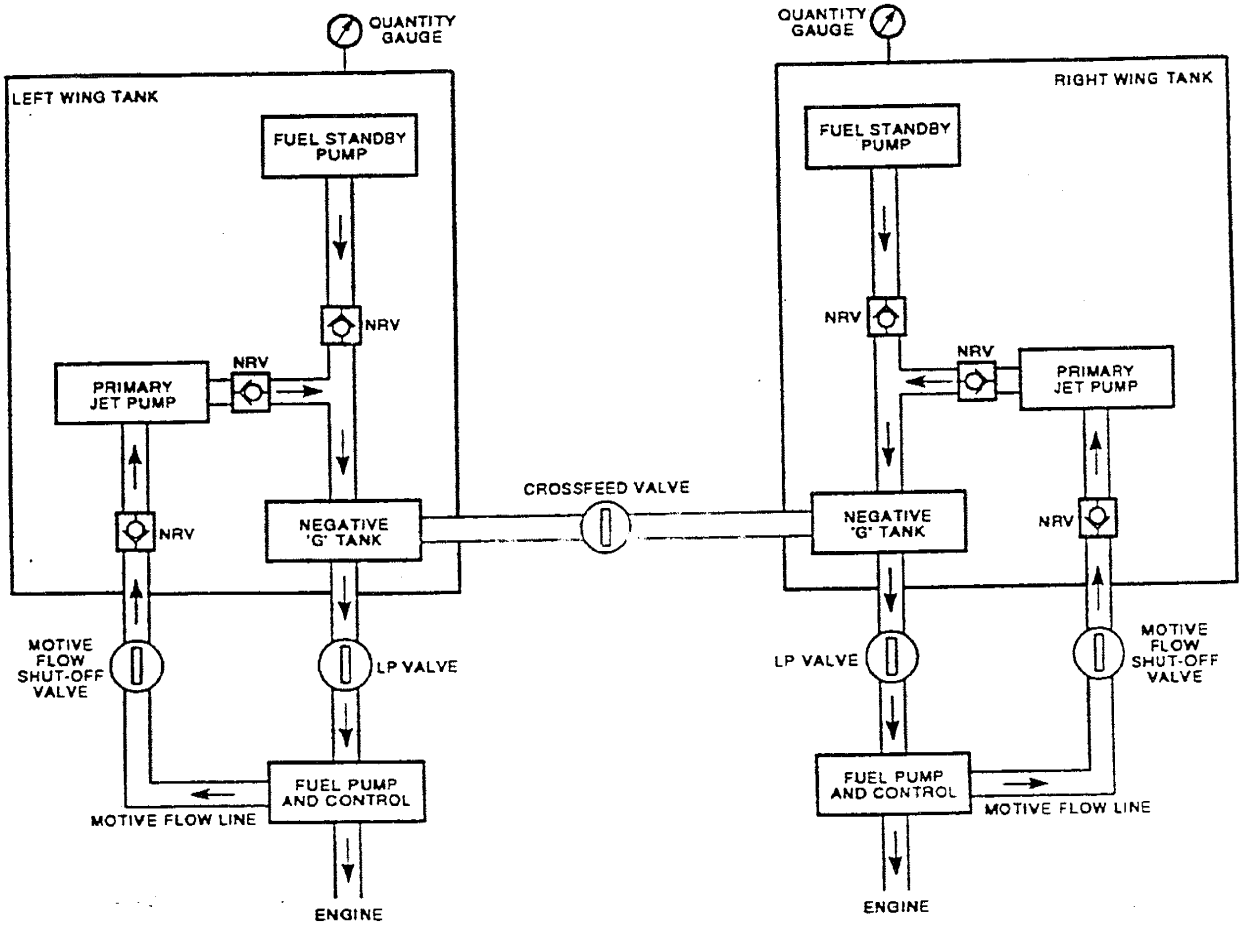
The crossfeed valve cannot open until a standby pump has been switched ON. A crossfeed open condition is shown by a CAP 

(green) caption. While the crossfeed valve changes from the open and closed positions, an amber and black cross-hatch indicator, above the X-FEED switch, will come on.

The crossfeed shut-off valve must be closed during normal conditions.




Fuel Supply System

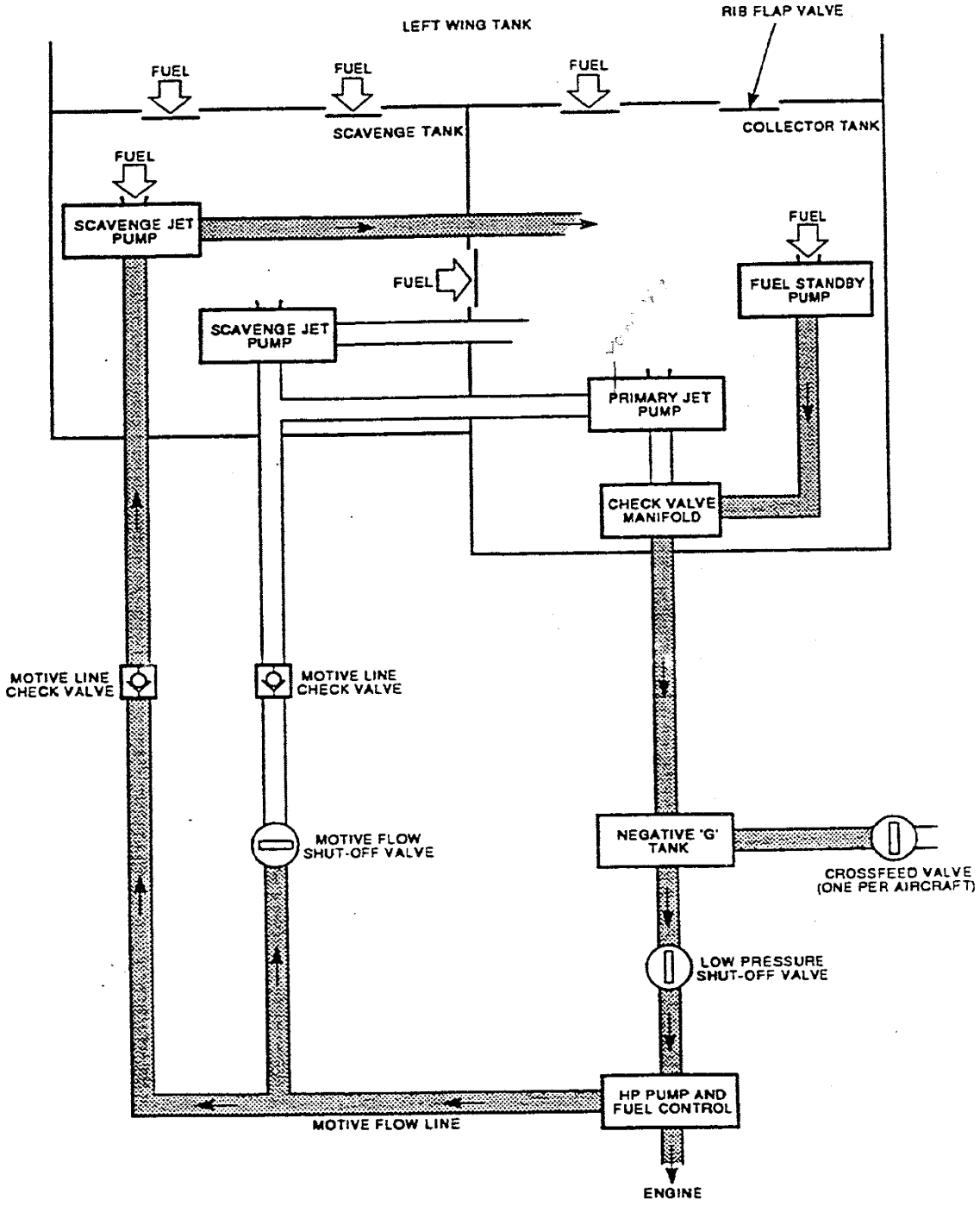



SIMPLIFIED AIRCRAFT FUEL SYSTEM

28-00-10010

00000368

Simplified Aircraft Fuel System



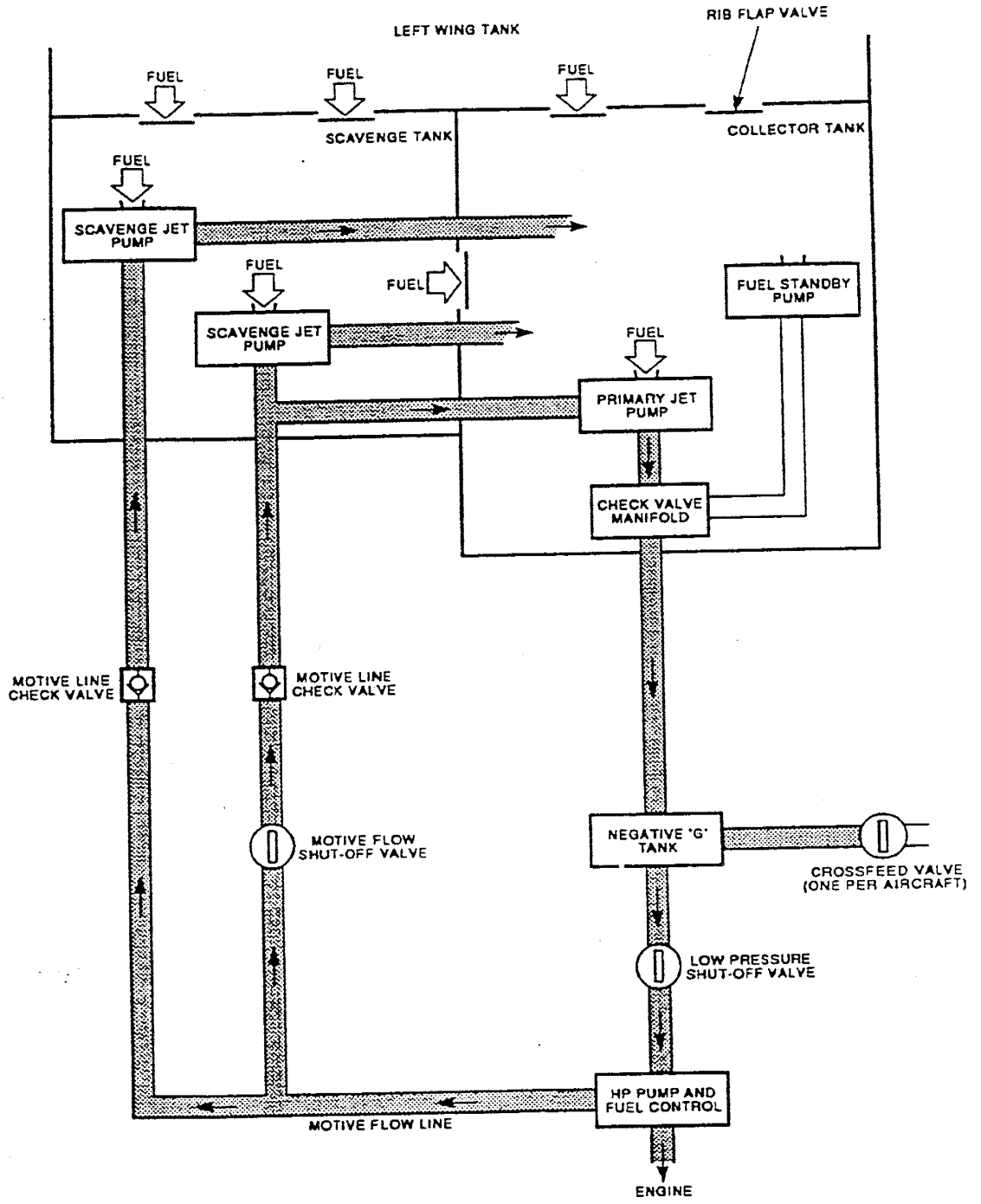

FUEL FLOW DURING ENGINE START-UP

28-00-10029

Fuel Flow During Engine Start-Up

Printed in the U.K.

00004139




FUEL FLOW AT STABLE RPM

28-00-10030

Fuel Flow At Stable RPM

00004140

4. Fuel Quantity Measurement Sub-System

A. Capacitance Fuel Measurement System

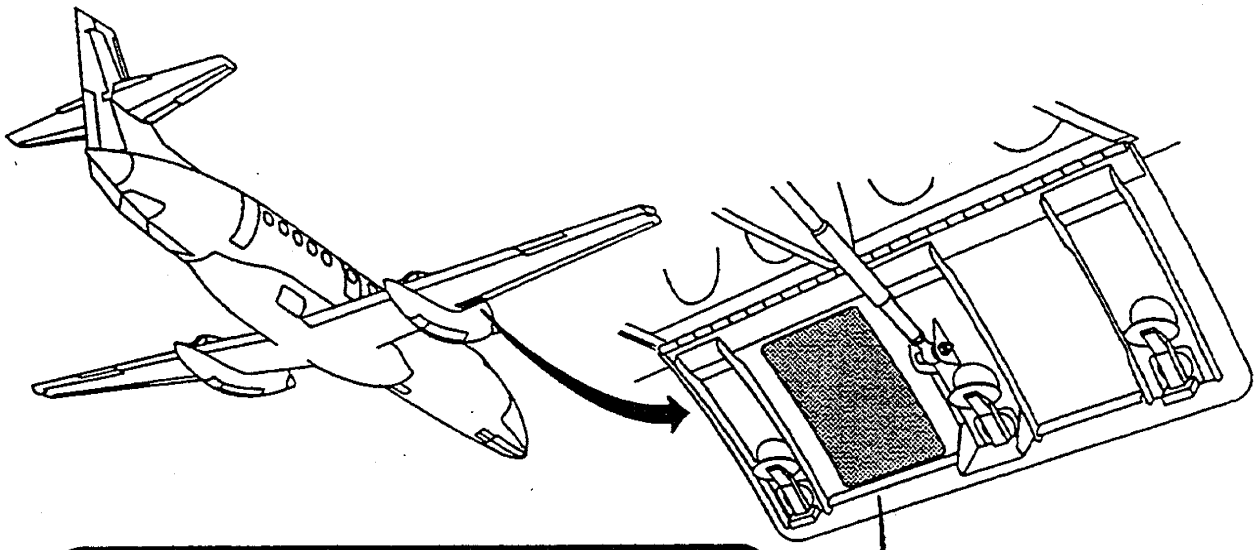
Each of the tanks have a dc capacitance fuel measurement system. Seven quantity measurement probes are installed along the length of each tank. The total signal from the probes is sent to a processor unit installed behind the roof panel. A processor unit and fuel quantity display are supplied for each tank. The FUEL QTY digital display is installed in the engine instrument panel. Electrical power is supplied from the 28V dc emergency busbar. A FUEL CONTS test switch is provided on the maintenance test panel.

B. Magnetic Fuel Level Indicators

A magnetic fuel level indicator is an external device that is not electrically operated. The indicators give a visual means of checking the fuel quantity of each tank. Four magnetic fuel level indicators are installed along the bottom of each wing, on access panels.

C. Low Fuel Level Warning

A low fuel level warning system is fitted to each tank. The system is operated when the amount of fuel that can be used (in either tank) falls below 269 lb. When operated the system signals a warning on the flight deck.



USABLE FUEL CONTENTS - U/WING INDICATORS

| INDICATOR | | POUNDS | INDICATOR | | POUNDS |
|---|---|---|---|---|---|
| INDICATOR 1 | 0 | 453 | INDICATOR 3 | 0 | 1758 |
| | 1 | 567 | | 1 | 1841 |
| | 2 | 679 | | 2 | 1924 |
| | 3 | 790 | | 3 | 2008 |
| | 4 | 901 | | 4 | 2093 |
| | 5 | 1014 | | 5 | 2176 |
| | 6 | 1127 | | 6 | 2259 |
| | 6.75 | 1218 | | 6.25 | 2276 |
| INDICATOR 2 | 0 | 1179 | INDICATOR 4 | 0 | 2209 |
| | 1 | 1303 | | 1 | 2284 |
| | 2 | 1416 | | 2 | 2352 |
| | 3 | 1520 | | 3 | 2421 |
| | 4 | 1615 | | 4 | 2492 |
| | 5 | 1703 | | 4.75 | 2541 |
| | 6 | 1783 | | FULL | 2916 |
| | 6.75 | 1836 | CHECK VIA FILLER CAP | | |

FIGURES ARE PER WING AND FOR AVTUR ONLY

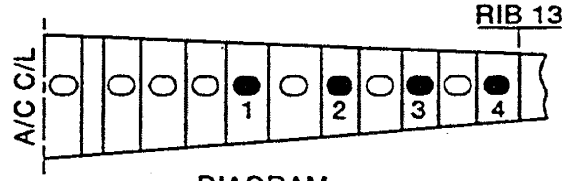
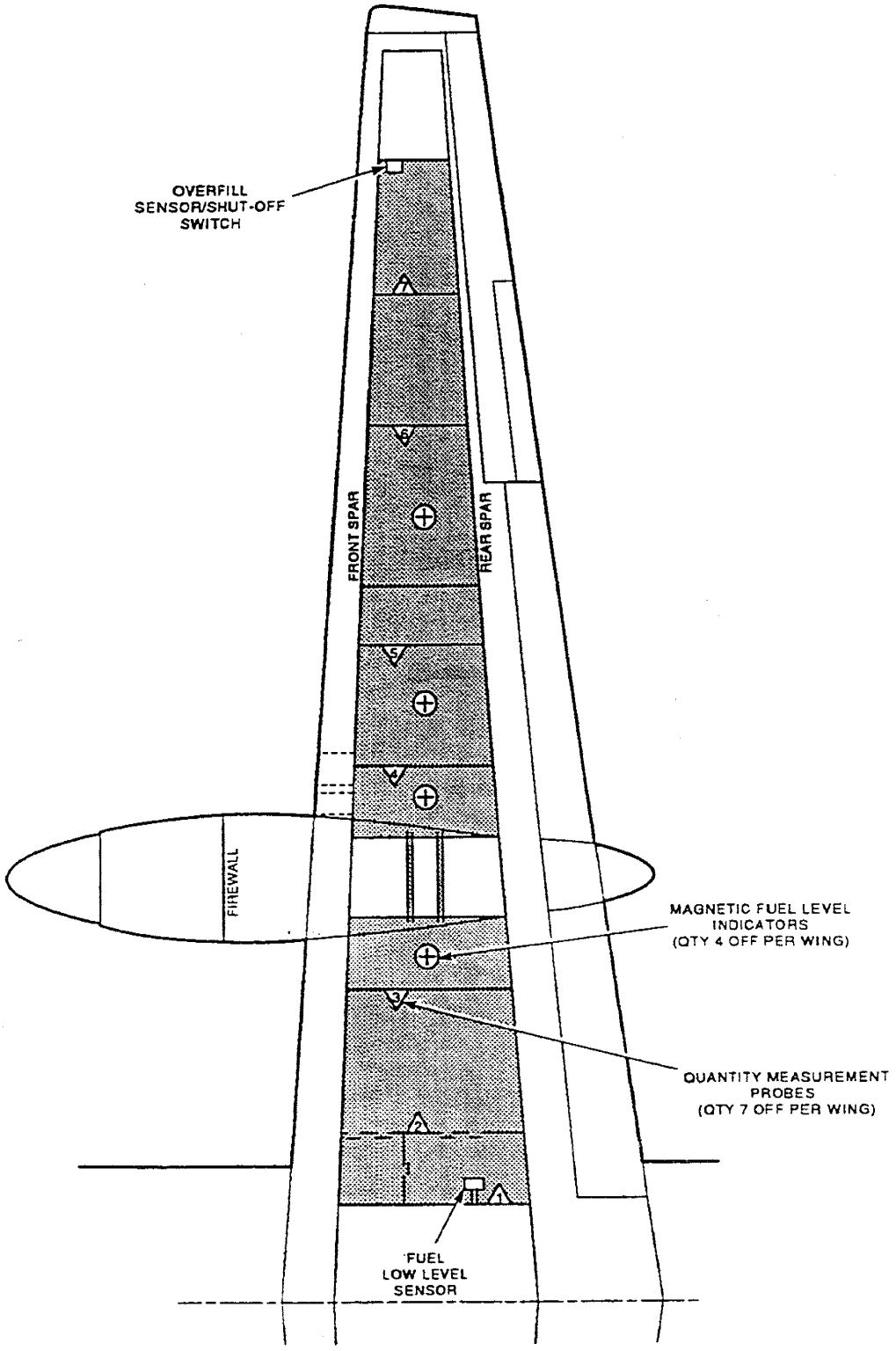


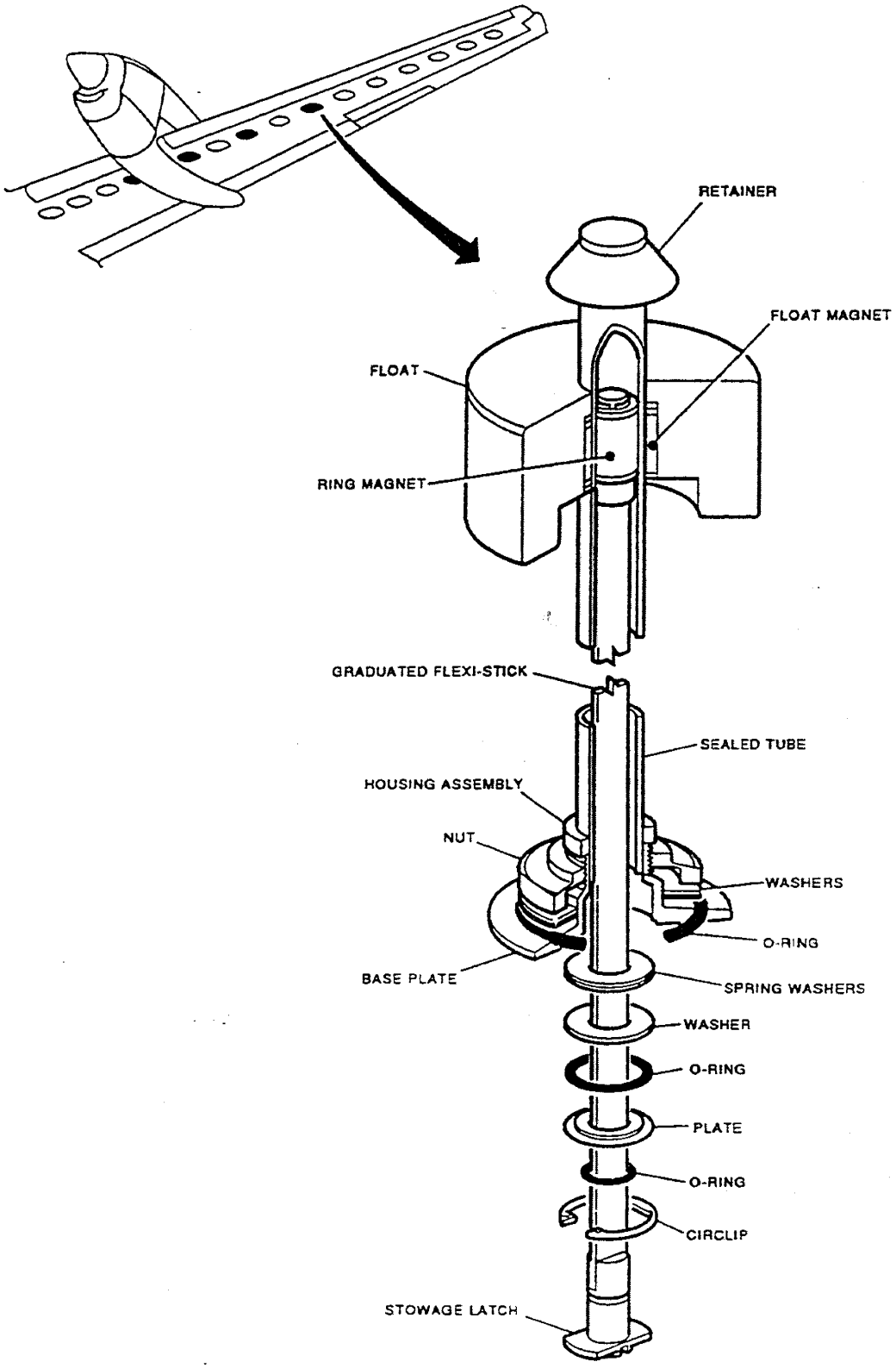

DIAGRAM 04111040-1

28-00-10020

Magnetic Fuel Level Indications




Fuel Quantity Measurement Sub-System




Magnetic Fuel Level Indicator

5. Fuel System Indications

A flight deck indication is given for the following fuel system conditions:

A. Fuel Contents

The contents of the fuel tanks are shown as a digital readout at the bottom of the engine instrument panel. FUEL QTY shows the amount of fuel in each tank.

B. Fuel Flow/Fuel Used

There is a combined fuel flow and fuel used FF/FU display on the engine instrument panel. A reading of total fuel used FU is obtained by pressing the FUEL USED button at the base of the panel. Total fuel used is reset to zero by pressing the RESET button also at the base of the panel. The Fuel Flow/Fuel Used is shown in analogue and digital format.

C. Fuel Pressure

There is a fuel pressure gauge for each engine. The gauge shows fuel pressure between the first and second stage of the fuel pump assembly. The gauge also shows oil pressure and oil temperature and is installed above the engine instrument panel.

If the fuel pressure falls to less than 6 psi a [LO PRES] (amber) caption on the roof panel will come on.

D. Fuel Filter Blockage

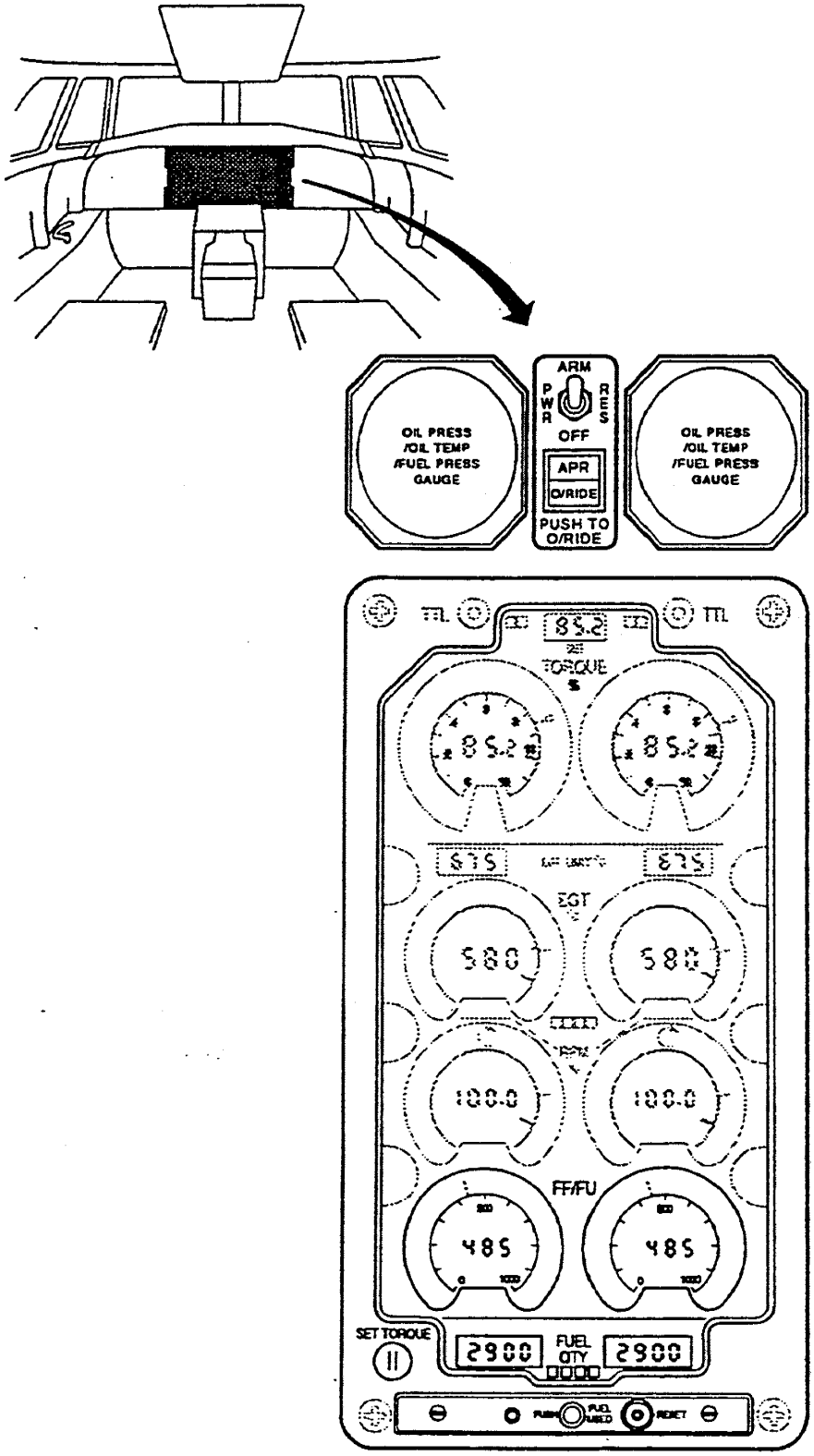
Impending blockage of the engine main fuel filter is indicated by a [FILTER] (amber) caption on the roof panel.

E. Low Fuel Level Warning

If the usable fuel quantity falls below 269 lb, in either tank, a [LO QTY] (amber) caption on the roof panel will come on.

F. Low Fuel Temperature

Low fuel temperature is indicated by a [LO TEMP] (amber) caption on the roof panel. The caption will come on when the fuel temperature downstream of the oil/fuel heat exchanger falls below 1.7°C.




Fuel System Indications

G. Refuel Control Panel

A [REFUEL] (amber) caption on the roof panel will come on when:

- The refuel panel door on the right wing is open, or
- The power switch on the refuel control panel is ON.

The panel door must be closed and the power switch OFF before the caption will go out.

H. Master Caution

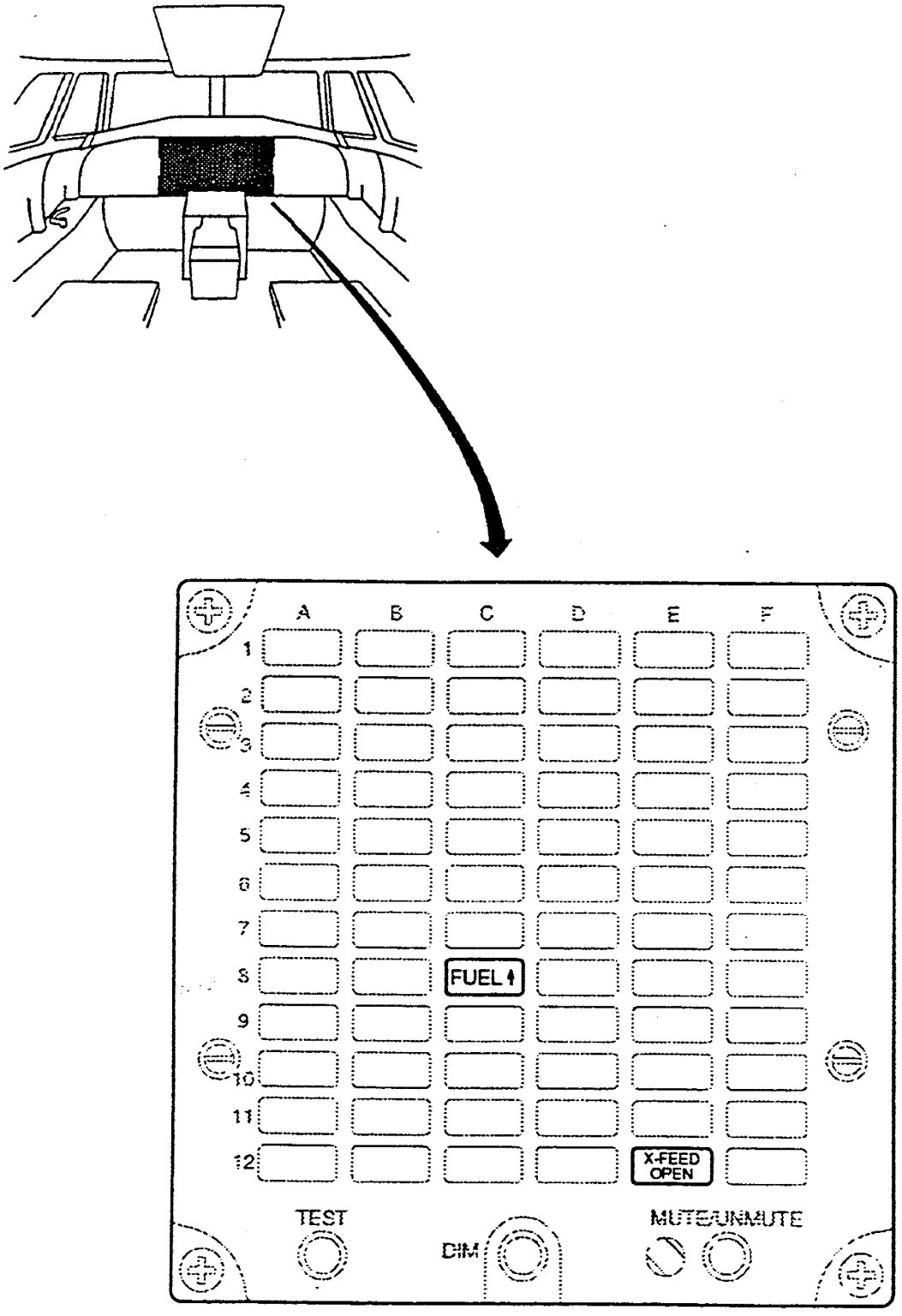
Any amber caption relating to the fuel system on the roof panel will cause a CAP [FUEL] (amber) caption to come on.

I. LP Valve Position

A roof panel caption shows the position of the LP valve. When the valve is open the caption will show black, while in transit it will show amber/black cross hatched. The caption will show SHUT in white letters when the valve is closed.

J. Crossfeed Shut-off Valve

A CAP [X-FEED OPEN] (green) caption will come on if the crossfeed shut-off valve is open. When the valve is shut, the roof panel will show a black caption. While the valve is in transit the roof panel caption will show amber/black cross-hatched.




CAP-Fuel System

6. Fuel System Controls

A. LP valves

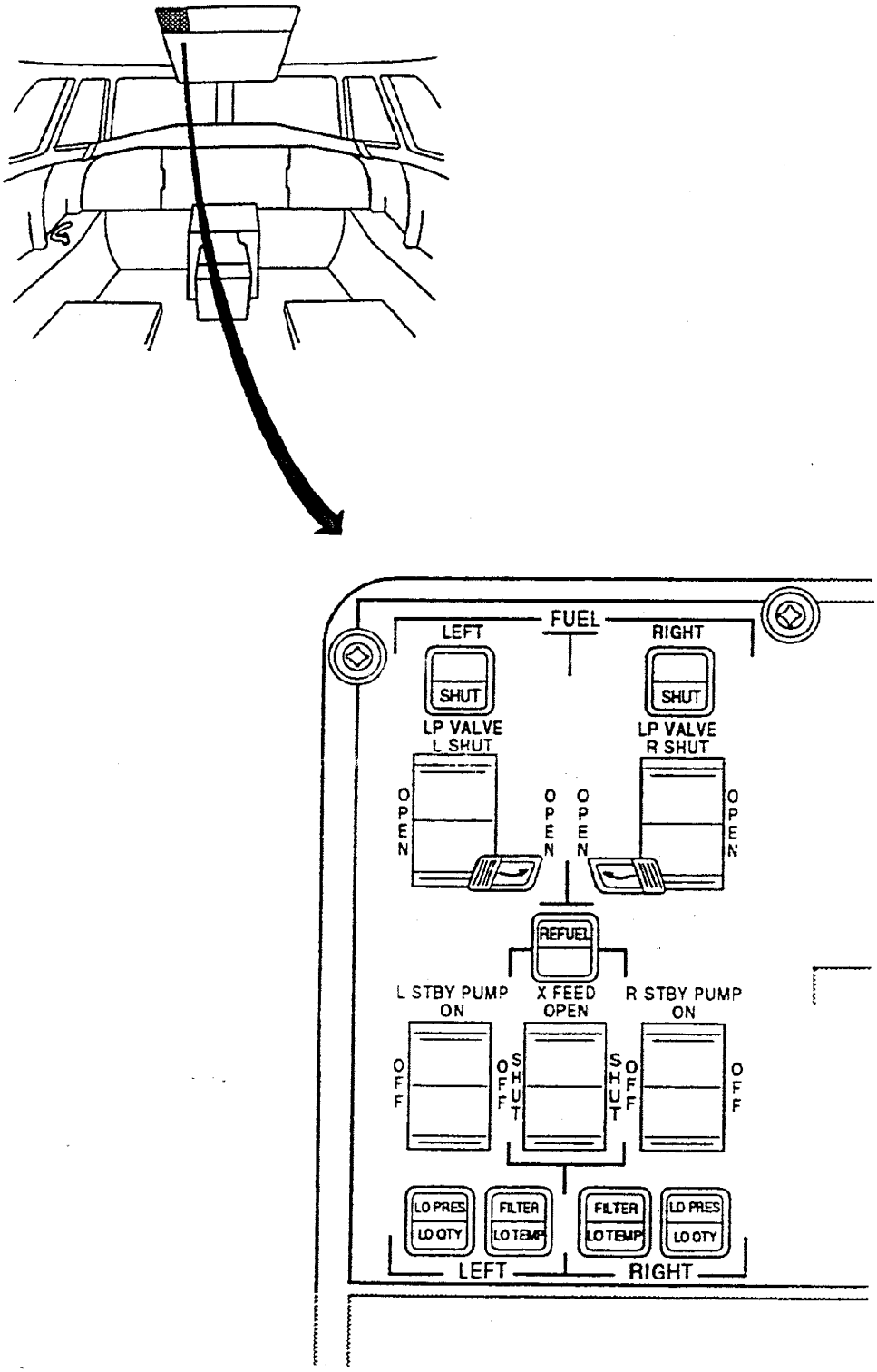
The fuel LP valves are controlled by two guarded switches in the roof panel. They are identified as left and right LP VALVE SHUT/OPEN. The valves will also close when the CONDITION lever is moved to the FEATHERED position.

B. Standby Pumps

The standby pumps are controlled by two switches on the roof panel. They are identified left and right STBY PUMP ON/OFF.

C. Crossfeed Shut-off Valve

The crossfeed shut-off valve is controlled by a switch on the roof panel. The switch is located between the two STBY PUMP switches, it is identified XFEED OPEN/SHUT. A standby pump switch must be selected ON before the crossfeed shut-off valve will open.




31-10-10095

Fuel System Controls