FUEL SYSTEM

GENERAL

Fuel system is limited to use of approved fuels (see LIMITATIONS). It is comprised of four major sub-systems and associated controls: fuel storage, fuel distribution, fuel jettison and fuel indicating systems.

Approved Fuels

Fuels Conforming to P&W Specifications

Type	FREEZING POINT °C / (°F)	SPECIFICATIONS		ADDITIVES		NATO CODE
		EQUIVALENCIES (INFO.)		ANTI-ICE	ANTI-STATIC	
JET A	- 40 / (- 40)	ASTM D 1655 CAN2 - 3.23	JET A JET A	* *	* YES	- -
JET A1	- 47 / (- 53)	ASTM D 1655 CAN2 - 3.23	JET A1 JET A1	* *	* YES	- -
KEROSENE JP8	- 50 / (- 58)	MIL-T-83133 AIR 3405C DERD 2494 DERD 2453 CAN 3GP23	JP8 -- AVTUR VTUR/FSII --	YES * NO YES	* * * *	F34 F34/F35 F35 F34
JET B	- 50 / (- 58)	ASTM D 1655 CAN2 - 3.22	JET B JET B	* *	* YES	- -
JP5 “HIGH FLASH POINT” FUEL	- 46 / (- 51)	MIL-T-5624 AIR 3404C DERD 2498 DERD 2452 CAN 3GP24	JP5 -- AVCAT AVCAT/FSII --	YES * NO YES *	NO * NO NO *	F44 F43/F44 F43 F43 F43/F44

* The presence or absence of additives is to be checked with the supplier.

Fuel Additives

Fuel additives must conform to the following specifications:

1. icing inhibitor: AIR 3652 or MIL-I-27686E or equivalent specification, in amounts up to 0.15% in volume.

2. anti-static additive: SHELL ASA-3 or equivalent. A sufficient quantity must be used to give the fuel 300 CONDUCTIVITY UNITS (300 picohms per meter), but without exceeding a concentration of one part per million (PPM).
3. antibacterial additive: MIL-L-19537 or equivalent at a concentration not exceeding:
   a. 135 ppm for preventive treatment
   b. 270 ppm for curative treatment.

CAUTION

NEVER POUR UNDILUTED ADDITIVE INTO A TANK.

FUEL STORAGE

Fuel Tanks

Fuel is stored in two wing tanks, two feed tanks, one center tank, forward tank and fuselage tank.

Engine Fuel Supply

Each engine is supplied by an independent pressure system. Each feed system comprises main fuel feed jet pump and a standby pump. Each pump is separated by a check valve to ensure independence operation of each pump.The fuel required for the immediate needs of each engine is always available in the feed tank.
The system ensures availability of all fuel to the feed tanks, thus ensuring continuous fuel supply throughout the flight.
The feed jet pumps of each engine is driven by motive flow fed back from the engine.
The standby pump can be switched on manually or placed in auto mode. In auto mode the pump comes on automatically whenever the fuel pressure at the engine inlet falls below 6 PSI, as sensed by pressure switches at the engine inlet. The pressure switches also provide low fuel pressure warning indication.

Shutoff valves are installed on engine feed lines. The two wing and feed tanks can be interconnected, through interconnect valves, to enable lateral fuel balancing.

APU Fuel Supply

The APU feed line branches off from the right engine feed Line, through shutoff Valve. The valve is opened only during APU operation. The line is routed directly to the APU firewall.

FUEL DISTRIBUTION

Fuel is fed to the feed tanks by transfer jet pumps and gravity.
The fuel transfer system ensures availability of all aircraft fuel to the operating engines, in the sequence predetermined to maintain the C.G. position within the optimum range and to relieve air loads on the wings for most of the flight.

Fuel usage and transfer sequence is divided into five steps, as follows:

Step no. 1 - Upper portion of the fuselage tank.
Step no. 2 - Forward tank.
Step no. 3 - Lower portion of the fuselage tank.
Step no. 4 - Center tank.
Step no. 5 - Wing tanks and the feed tanks.

Gravity flow alone ensures the timely transfer of Step no. 1. Jet pumps ensure timely transfer of Steps no. 2, 3 and no. 4.
Fuel can be transferred between left and right wing tanks by active balance valves, so supplying available fuel to the operating engine if fuel quantity in the transferring wing is more than 600 lb, and to restore lateral fuel balance in case of fuel supply asymmetry.

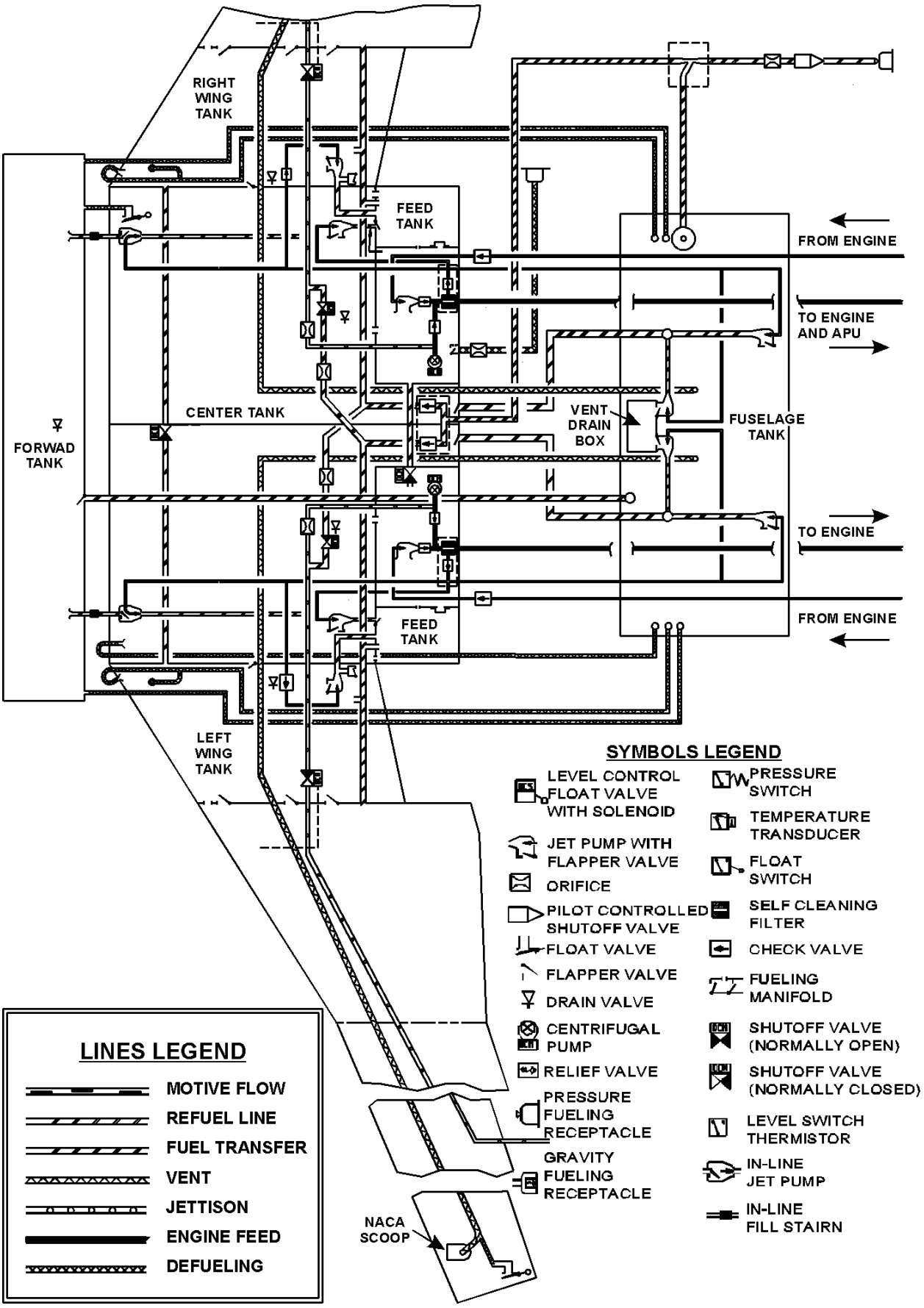

Figure 5-4. Fuel System - Schematic (Sheet 1 of 2)

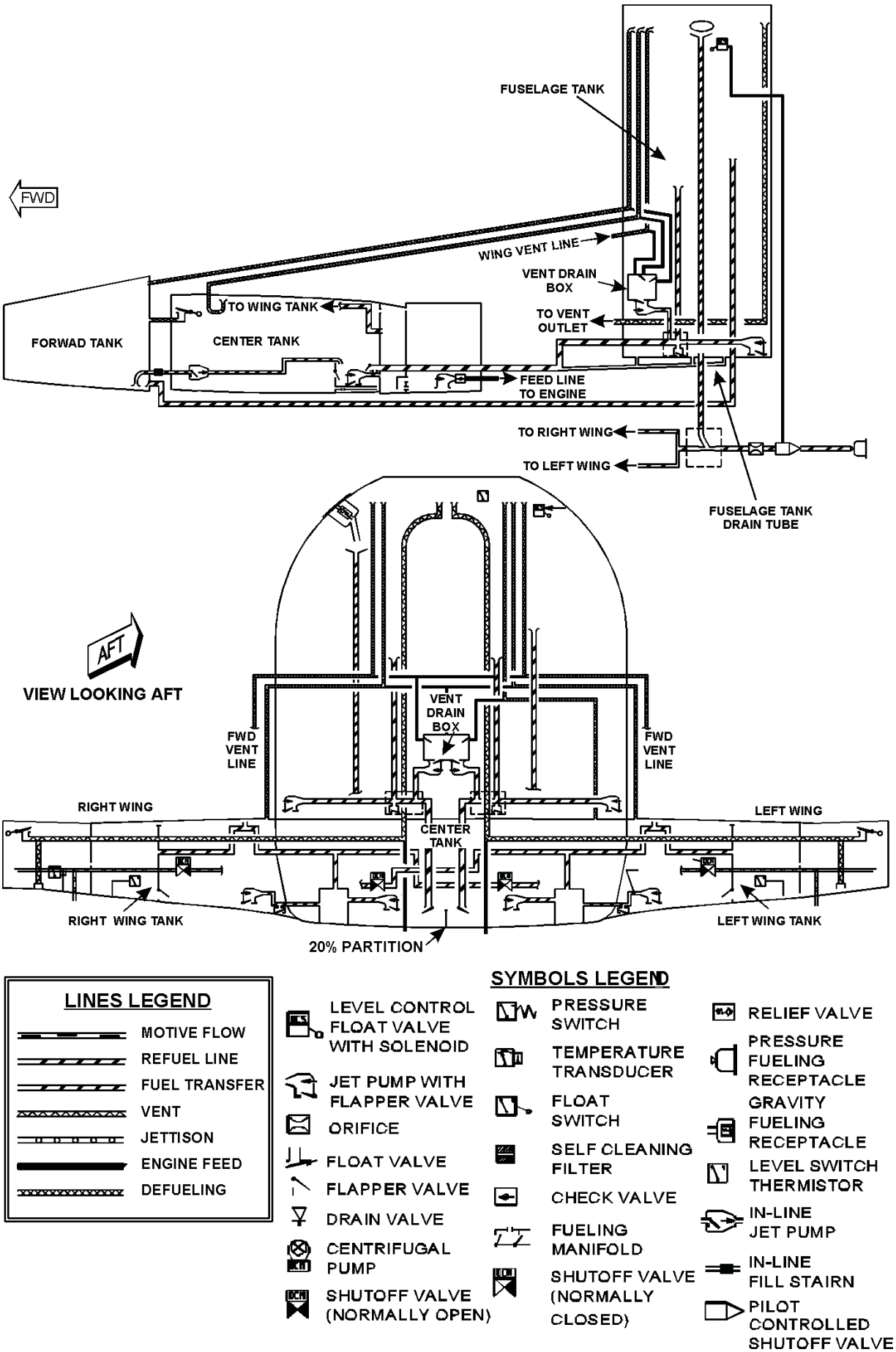

Figure 5-5. Fuel System - Schematic (Sheet 2 of 2)

FUELING

A single point pressure refueling and station is installed on the right side of the fuselage opposite of door. It contains the pressure refueling receptacle, a grounding adapter, and fueling control panel.
The fueling Line is equipped with fueling shutoff valve and Orifice which control the maximum rate of fueling
The valve is prechecked before fueling. Failure of the valve to stop fueling causes fuel overflow through both overboard vent lines and **HI-LEVEL** annunciation at the fueling panel.

FUEL TANK CAPACITIES (at 6.7 lb/US gallon)

Feed Tanks (2) 170 lb
Wing Tanks (2) (Step 5)2360 lb
Center Tank (Step 4)2660 lb
Forward Tank (Step 2)1790 lb
Fuselage Tank:
    Upper (Step 1)3310 lb
    Lower (Step 3)2200 lb
Total:15,020 lb

DEFUELING

Single point defueling receptacle is located near the right main landing gear bay, connected to the right feed tank. The defueling switch is located on the fueling control panel.
when DEFUEL switch is activated standby fuel pumps are activated to provide pressure for the defueling operation. FUEL FEED INTERCONNECT valve opens to allow defueling of both wing tanks.

REFUELLING/DEFUELING PANEL CONTROLS AND INDICATORS

MASTER POWER switch - used to activate the FQMC. switches off automatically when the panel door is closed

REFUEL AUTO/MAN switch - auto mode initiates refueling with automatic stop at the preselected quantity. Manual mode initiates refueling as required

SEL/TEST switch - fuel type selection is performed by moving the switch up to SEL position (pull to unlock). Test position initiates BIT function; holding the switch in test position for more than 5 seconds causes the panel to display FQMS fault codes

INCR/DECR switch - momentarily selecting each position increases or decreases the preselected total fuel quantity at which the automatic refueling stops. Preselection is incremental and changes automatically as long as the switch is held. The increments are as follows:
From 10 to 100 - increase/decrease by 10 lb or 5 kg
Above 100 - increase/decrease by 100 lb or 50 kg

Once the switch is released, the increment is again 10 lb or 5 kg.

(Continued)

PRECHECK TEST/DEFUEL switch - pull to operate in defuel mode only. The momentary TEST position activates the float pilot control valve to stop refueling.

DEFUEL position activates the standby pumps and opens the feed interconnect valve.

The center (off) position stops the standby pumps and closes the feed interconnect valve

In defuel mode, the standby pumps do not stop automatically when the feed tanks are empty.

Hi Level flashing annunciation - the warning is activated by a dedicated sensor installed on one probe in the fuselage tank

Unbalance flashing annunciation - the warning comes on when fuel quantities in the two wing tanks differ by more than 300 lb. If this happens during automatic refueling, the operation is terminated.

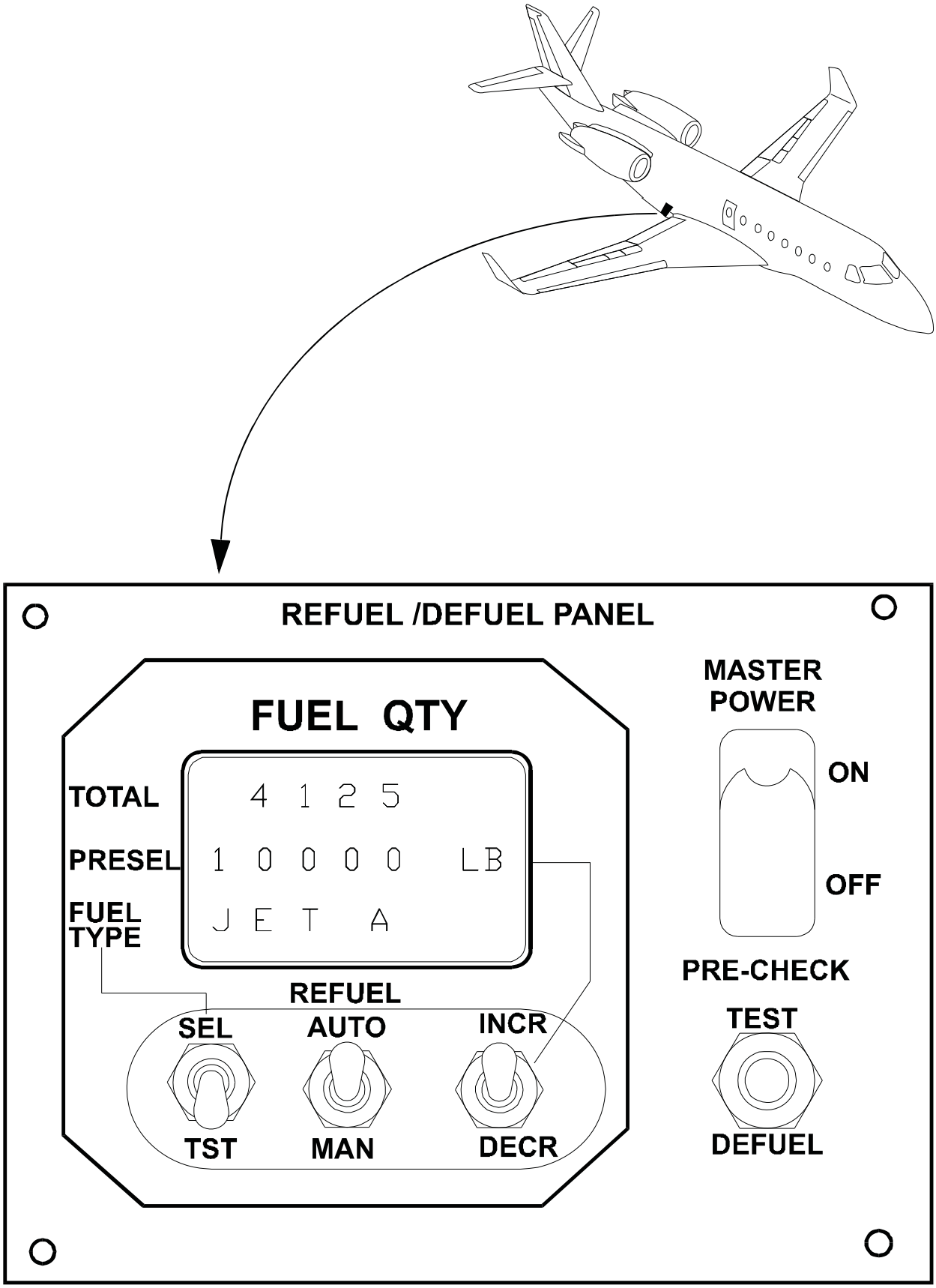

Figure 5-6. Refuelling/Defueling Panel

LATERAL FUEL BALANCE

Lateral fuel unbalance may be created under one of the following conditions:

1. Fuel flow to the engines is not symmetrical
2. One of the center tank jet pumps fails, causing wing tank on the same side to start transfer regardless of the amount of fuel in the center tank.

Active fuel balancing may be achieved by pressing BALANCE TO LEFT or TO RIGHT switch, as required. Standby fuel pumps are operating. Fuel balance may also be accomplished by gravity, using interconnect valve between wing and feed tanks.

If one engine is inoperative, the pilot opens the interconnect valve and activates the standby fuel pump on the inoperative side, to supply fuel from the failed engine side.

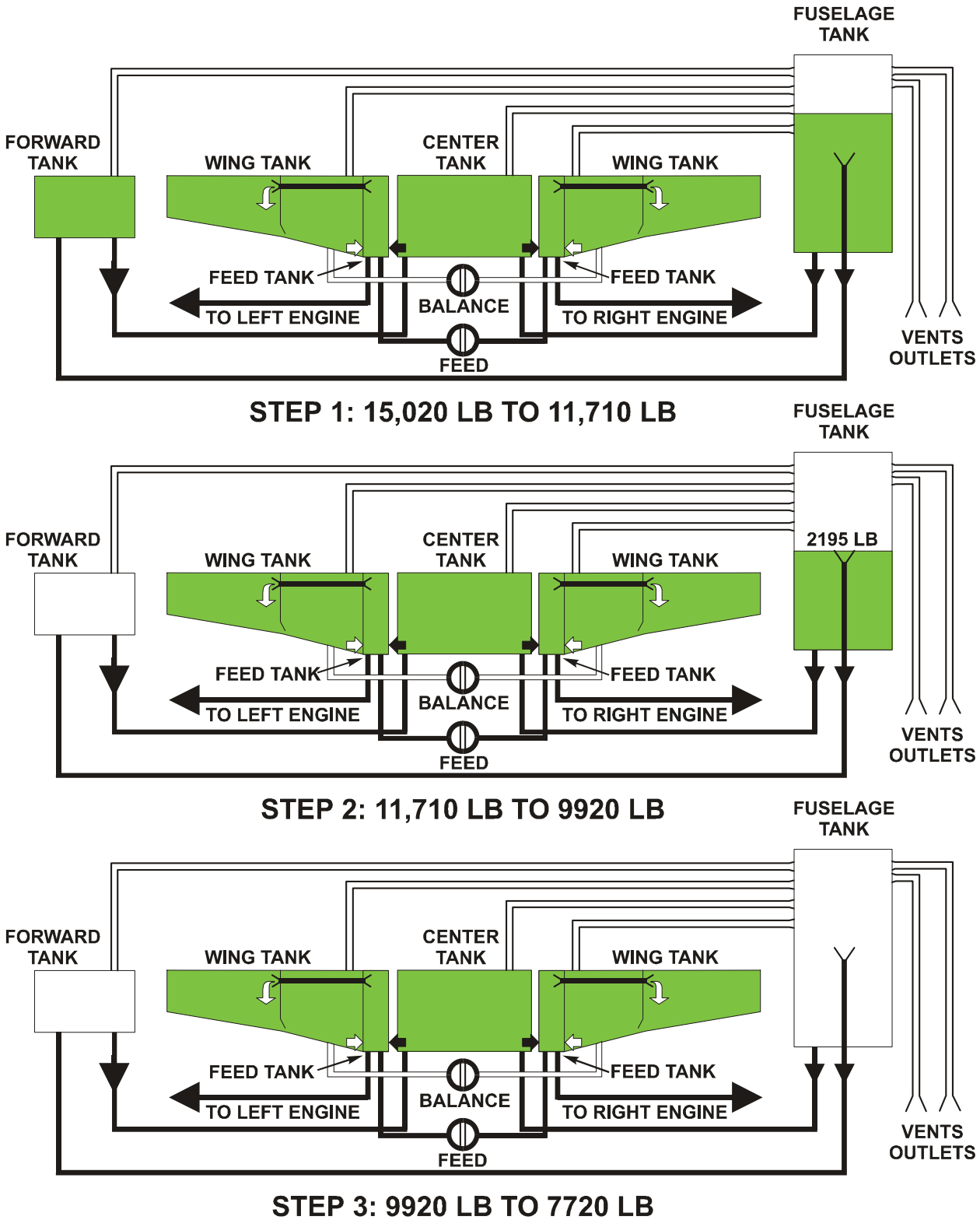

Figure 5-7. Fuel Usage and Transfer Sequence (Sheet 1 of 2)

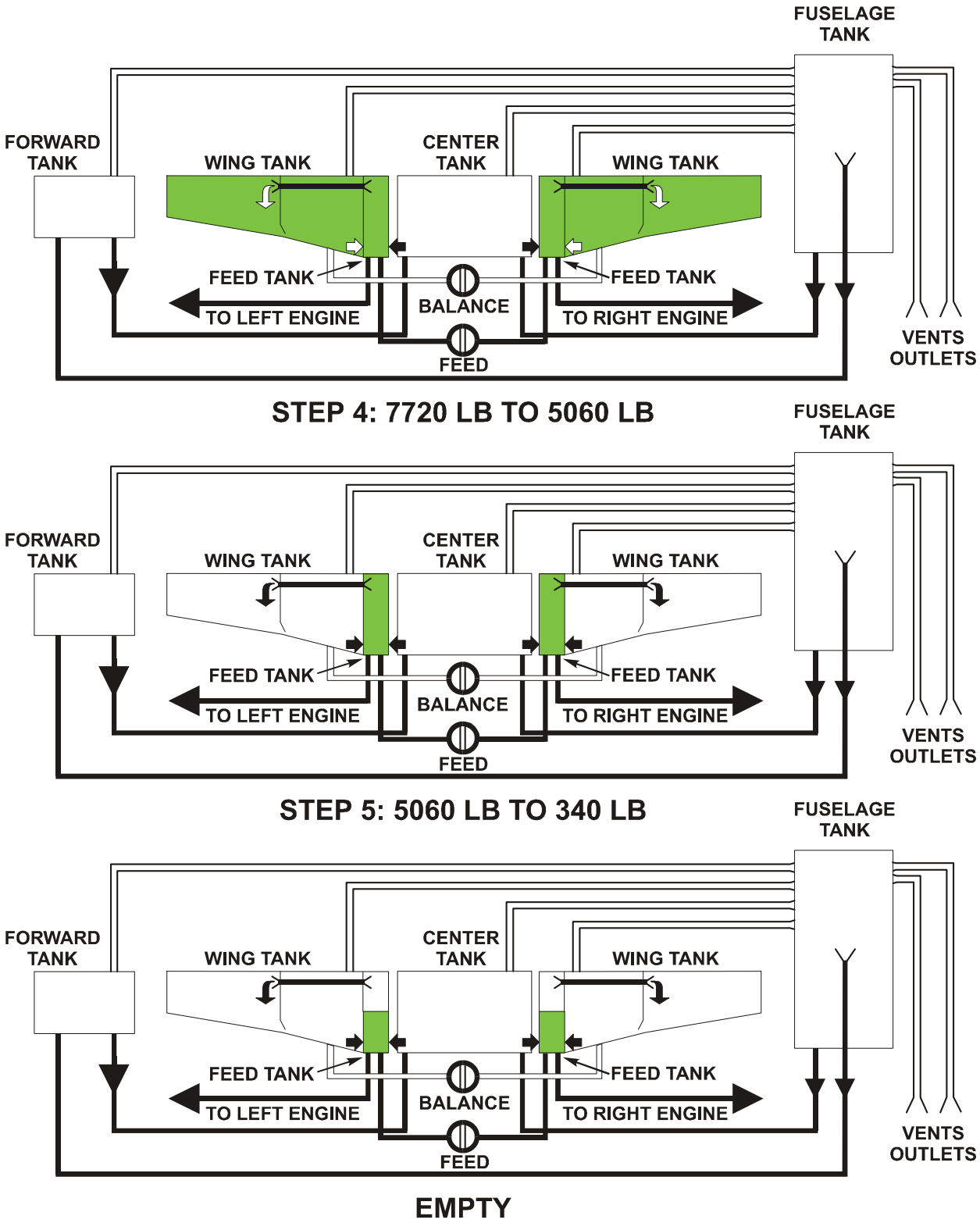

Figure 5-8. Fuel Usage and Transfer Sequence (Sheet 2 of 2)

FUEL JETTISON

Fuel jettisoning is achieved by opening the jettison valve (L, R, or both, as required), and fuel is forced out by the standby pumps which come on after the JETTISON pushbutton is pressed.

Fuel jettison lines are routed from the outlet of the standby boost pumps, ending at jettison outlets located between aileron and flap of each wing.

Fuel jettison from each feed tank is stopped automatically when the respective wing tank fuel quantity drops below 600 lb (approximately 1560 lb total) or when feed tank fuel quantity drops below 130 lb; jettison is resumed if feed tank fuel quantity rises above 150 lb. Fuel jettison may be stopped manually when pressing the JETTISON pushbuttons to off.
When total fuel quantity is less than 5000 lb, it is recommended to operate only one jettison valve, with WING INTERCONNECT valve open.

FLUID QUANTITY MEASUREMENT SYSTEM

Description

The fluid quantity measurement system (FQMS) measures the fuel quantity in each tank using multiple probes.
It also senses and provides oil and hydraulic level using sensors and compensators

The FQMS performs the following major functions, based on the correct fuel type input by the pilot:

1. Measures wing, feed, forward, central, and fuselage tank fuel levels and fuel dielectric data.
2. Computes, monitors and provides fuel quantity information of each fuel tank and total fuel through a dual ARINC 429 busses on the EICAS. Monitors and provides fuel flow measurements. Computes fuel leak detection and provides messages to the EICAS.
3. Measures and provides fuel low level message to the EICAS. Provides fuel High level condition during refuel.
4. Measures and provides fuel temperature information, and provides low temperature condition message to the EICAS.
5. Measures and provides hydraulic fluid level measurements, and low level message to the EICAS.
6. Provides engine oil low level message to the EICAS.
7. Provides APU oil low level message to the EICAS.
8. Provides automatic stop of fuel dump, and wing fuel active balance. Monitors and provides filter pop-out discrete status to the EICAS. Monitors system performance for fault detection and isolation, with faults recorded in nonvolatile memory; this may be displayed in assisting maintenance. Provides operator with display and control of refuel and defuel operations automatic / manual refuel and manual defuel.
9. BIT Functions of the FQMS, sending results to the EICAS, and via EICAS to the MDC.

Fluid Quantity Measurement Computer - FQMC

The FQMC has two channels for independent / isolated left and right tank signal processing. Each FQMC channel is connected to its own circuit breaker powered by 28 Vdc emergency bus. The low level signals are processed by the opposite side processor. No aircraft calibrations or adjustments are required at aircraft installation or with tank unit replacement. The FQMC monitors and process all fuel quantity , fuel flow, fuel temperature in the right wing, hydraulic reservoirs fluid level, APU oil low level, engine oil low level, fuel and hydraulic filters pop-put status and provide all data through dual ARINC 429 data bus to the EICAS. The FQMC includes BIT for FQMC and tank units integrity.
The FQMC also communicates with the refuel / defuel panel (RDP), in order to enable the refuelling process.

FUEL SYSTEM CONTROLS AND INDICATORS

STBY PUMP Switches - Has three positions:

OFF - Standby pump is off.

AUTO - Standby pump is off, except when fuel supply pressure to the respective (L or R) engine is low; once pump comes on in AUTO position, it stays on till switched off by the pilot.

ON - Standby pump is on continuously.

WING INTERCONNECT pushbutton - pressed to connect left and right wing and feed fuel tanks. **IN TRAN** annunciators come on when the valves are in transit; **OPEN** annunciators come on when the valves are open

BALANCE TO RIGHT or TO LEFT pushbutton - pressed to open fuel balance valves and activates the opposite (L or R) standby pump of the wing tank which supplies fuel.

The valves close when fuel quantity in the supplying wing tank drops below 600 lb.

IN TRAN annunciator comes on when valves are in transit; **OPEN** annunciator comes on when the valves are open

JETTISON **OPEN/IN TRAN** Pushbutton (2) - when each of these pushbutton is pressed, the respective standby pump comes on and jettison valve opens to allow fuel jettison. The valves close when fuel quantity in the respective wing tank drops below 600 lb

REFUEL OFF Pushbutton - This pushbutton is pressed to stop pressure refuelling from the cockpit.

PAYLOAD knob (on EICAS panel) - has three positions as follows (see Figure 5-69):

INC - increases payload weight

OFF - no change to payload

DEC - decreases payload weight

Warning Messages

FEED TANK FUEL LOW - Low fuel quantity (approx. 130 lb) in either feed tank

Caution Messages

FQMC FAIL (L/R) - Fluid quantity measurement computer failed

FUEL WING UNBAL - Asymmetry between left and right wing fuel quantity greater than 300 lb

FUEL LEAK (computed) - Operative during cruise only, fuel consumption indicates an apparent leak

FUEL LEVEL LOW - Fuel quantity in either wing tank is less than 300 lb (approx. 960 lb total)

FUEL XFER ABNORMAL - Forward fuel tank transfers too early (cg may shift out of aft limit)

FUEL TANK TEMP LOW - Fuel tank temperature too low for the selected fuel type

FUEL PUMP ON (L/R) - Fuel standby pump is operating. (Comes on when: fuel pressure drops, STBY FUEL PUMP switch is ON or FUEL JETTISON or BALANCE pushbuttons are pressed)

FUEL PUMP INOP (L/R) - Fuel standby pump inoperative. STBY FUEL PUMP switch is OFF, or ON/AUTO with low fuel pressure, or STBY PUMP cb is out

FUEL PRESS LOW (L/R) - Comes on with low fuel pressure. If steady ON, boost jet pump has failed and automatic changeover to standby pump did not occur

FUEL FILTER (L/R) - Both left & right fuel filters are clogged (probably due to contaminated fuel)

Status Messages

FUEL FILTER (L/R) - Respective fuel filter is clogged

REFUEL DOOR - Refueling door is open

(Continued)

SHUTOFF, **CLOSE/IN TRAN** Annunciator (3) (**L/R**) on overhead panel - When fire shutoff valves close or open (by pressing **FIRE/OVERHT** pushbutton), **IN TRAN** light is on at time of valve operation. When valve is closed, **CLOSE** light stays on continuously.

NOTE

The valve closes when fire extinguishing system is activated, according to which FIRE/OVERHT pushbutton was pressed.

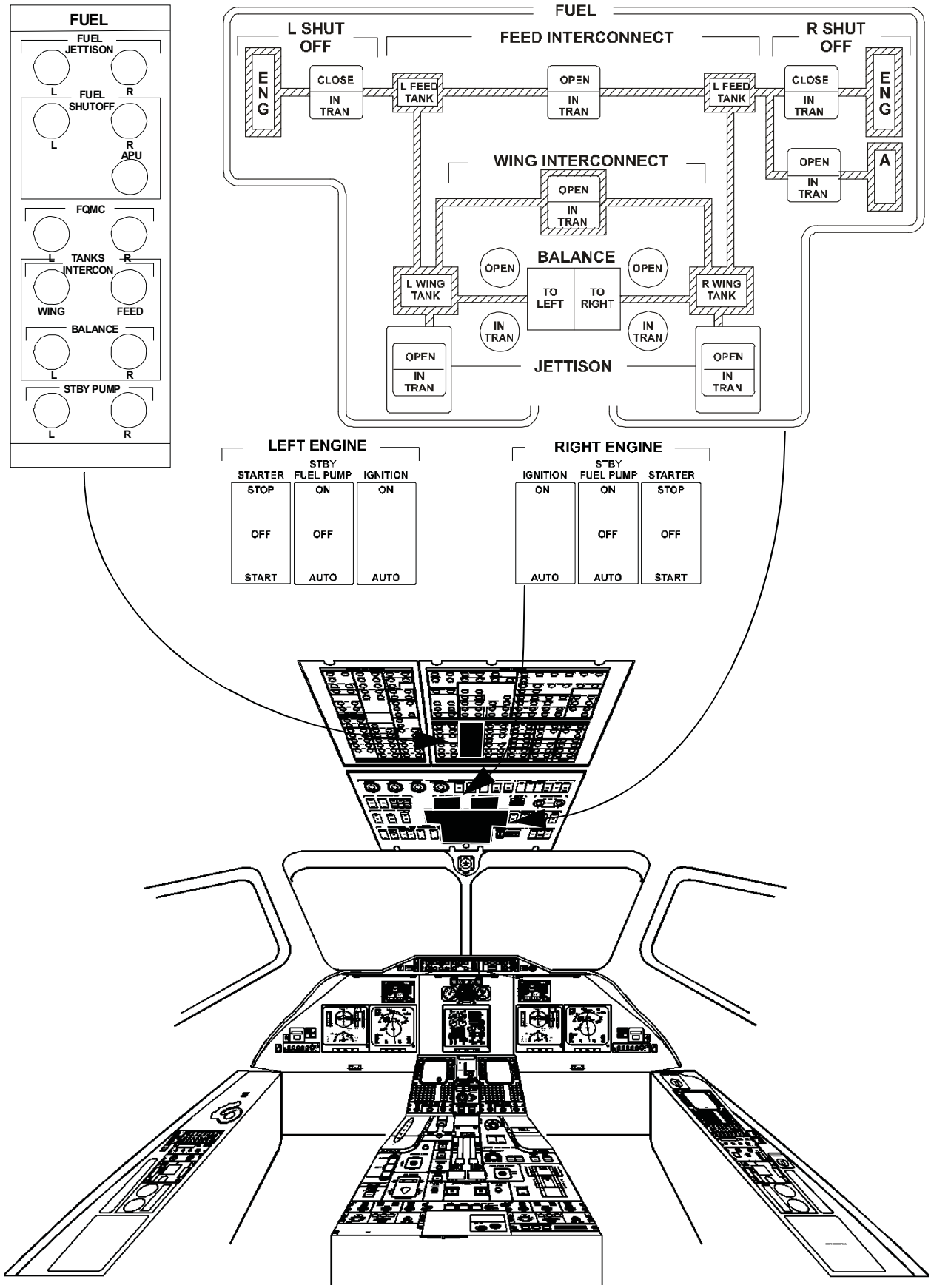

Figure 5-9. Fuel System Controls and Indicators