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Introduction

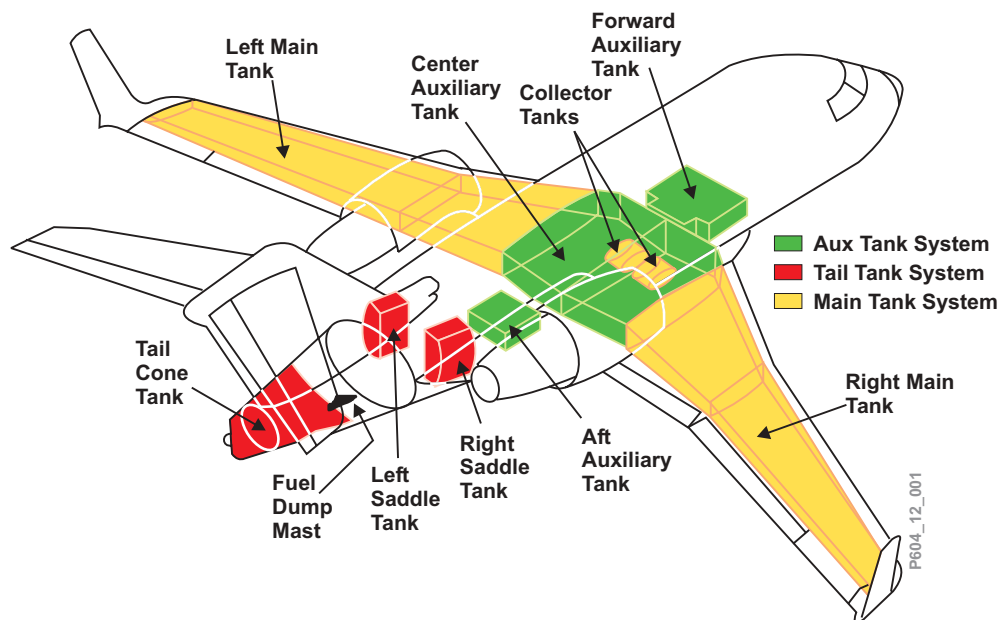
The Challenger 604's fuel system consists of a fuel tank system, a fuel distribution system, a fuel transfer system, and a refueling/defueling system. A Fuel System Computer Unit (FSCU) monitors fuel quantity and controls fuel transfer and refueling/defueling. During normal flight operations fuel management is automatic, requiring no input from the flight crew.

Fuel Tank System

Description

The fuel system storage consist of three tank systems:

- the main tanks (left and right wings)
- the auxiliary tanks (forward, center and aft tanks)
- the tail tanks (tail cone tank, left and right saddle tanks)



Fuel Tank System

Figure 12-1

The total fuel capacity is 20,000 lb/9098 kg (pressure refueling) and 15,722 lb/7130 kg (gravity refueling).

Components and Operation

Main Tank System

The left and right main tanks are integral-type fuel tanks (wet wings) that supply fuel to their respective engines via two collector tanks. Flapper valves in the wing ribs prevent fuel from surging toward the wing tips. The main tanks may be refueled by pressure or gravity. The APU's normal fuel supply is from the right main tank.

Collector Tanks

Two collector tanks, situated at the lowest point of the center auxiliary tank, are considered part of the main tank system.

Auxiliary Tank System

The auxiliary tank system consists of three interconnected tanks: the forward, center, and aft auxiliary tanks. They are located in the fuselage below the cabin floor. The auxiliary tanks are filled and drained simultaneously, and may be refueled by pressure or gravity. The auxiliary tanks feed fuel to the main wing tanks by means of transfer ejector pumps.

Tail Tank System

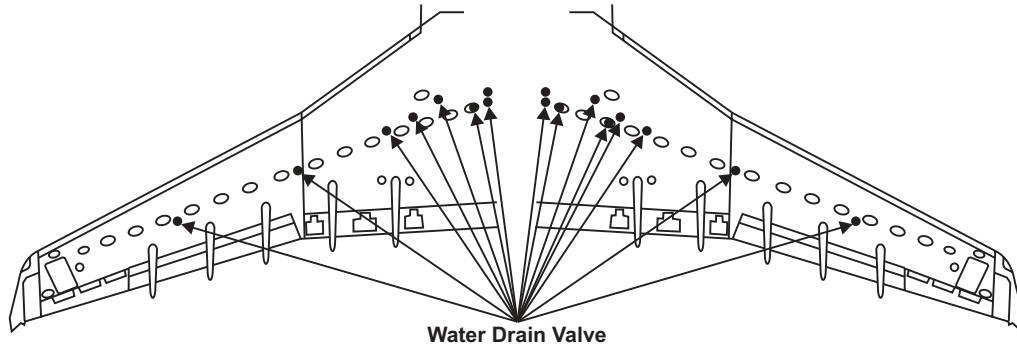
The tail tank system consists of three separate tanks (the tail cone tank and two saddle tanks) which share a common sump/manifold. The tail cone tank is a component of the fuselage tail cone structure. The saddle tanks are located in the aft equipment bay. All three tanks are pressure-fueled simultaneously by the refueling system through the common sump/manifold. The tail tanks may not be gravity refueled.

During normal operations, tail tank fuel is transferred to the auxiliary tank system by electrically operated tail transfer pumps. This transfer is scheduled and monitored by the FSCU, which ensures the aircraft is maintained within center-of-gravity limits.

During non-normal operations, the flight crew may control tail transfer pump operation manually. All the tail tank fuel may be dumped through a dump mast located at the sump/manifold of the tail tank system.

Water Drains

In order to check fuel tanks for contamination, water drains are provided for every tank. A drain valve is located at the bottom of the tail cone tank and the tail tank sump to enable fuel sampling and complete drainage when necessary.



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WATER DRAIN VALVE

Water Drains Arrangement

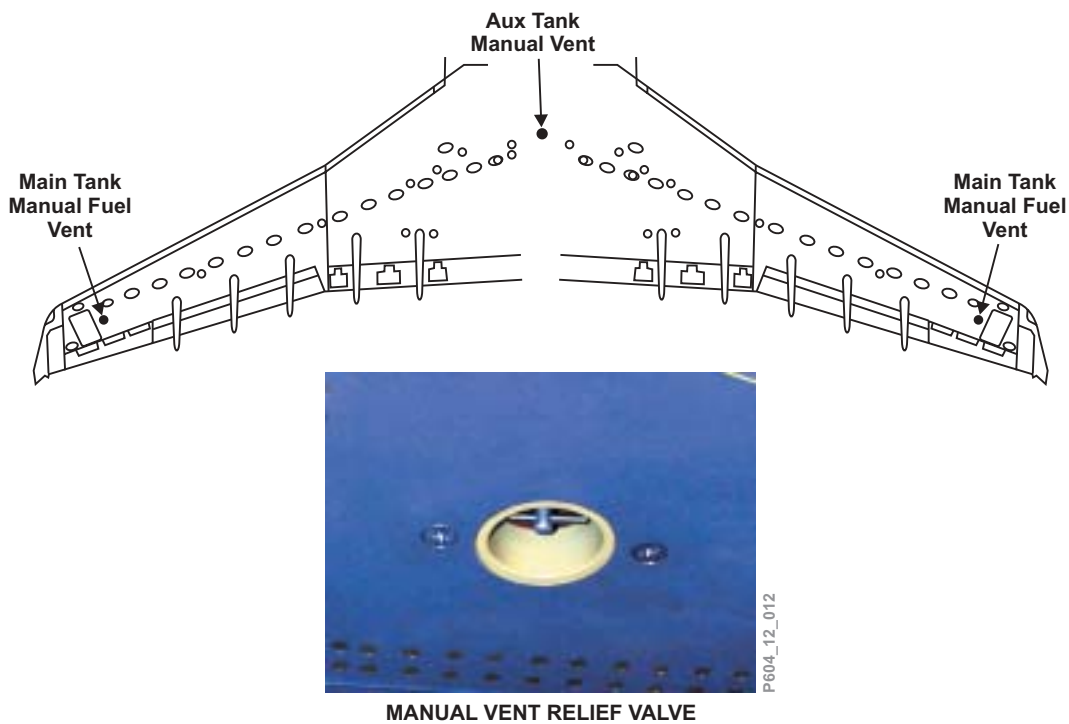
Figure 12-2

Vent System

Two wing mid-span NACA scoops vent all wing and auxiliary tanks to ensure they feed freely. The tail tanks are vented through their own dedicated system. All three (3) tail tanks are vented through a common vent line running down the vertical fin and out the bottom of the fuselage. Ram air is used to provide a slight positive pressure during flight.

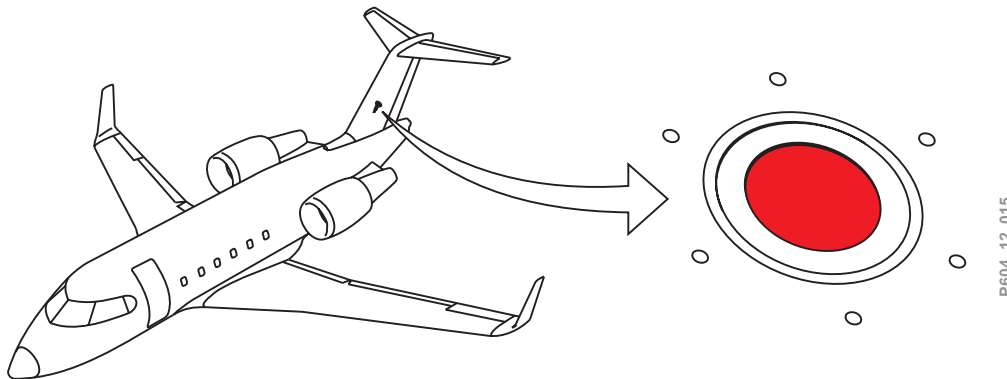
Manual Vent Relief Valves

Two manual vent relief valves are located underneath the wings near the tips and a third relief valve is located beneath the center of the auxiliary tank to prevent overpressurizing the tanks during refueling. A fourth vent relief valve for the tail tank system is located on the left side of the vertical fin, but cannot be tested manually.



Fuel Vent System (Manual Vent Relief Valves)

Figure 12-3



Tail Tank Relief Valve

Figure 12-4

CAUTION

If the tail tank relief valve has opened (popped), it indicates an overpressure condition in the tail tank system, which must be corrected before flight.

Fuel Quantity Measurement

The FSCU measures fuel quantity through a network of 17 DC-type capacitance probes located throughout the main, auxiliary, and tail tank systems. The FSCU receives attitude information from IRS 1 and IRS 2, and corrects fuel quantity measurements for aircraft attitude. Fuel tank quantity information is processed by the data concentrator units (DCUs), and is displayed (in pounds or kilograms) on the EICAS primary page.

Fuel Distribution

Description

There are two separate fuel distribution systems, the engine fuel feed system and the APU fuel feed system.

Engine Fuel Feed System

The engine fuel feed system controls the flow of fuel from the main fuel tanks to the engines.

Fuel Management

Fuel is burned from the main tanks until they reach 93% of their capacity, then fuel transfer commences from the auxiliary tanks to the main tanks. Float valves in the main tanks regulate this fuel transfer and maintain the main tanks at 93% capacity until the auxiliary tank system and tail tank system are depleted.

When airborne, tail tank fuel is transferred forward to the auxiliary tank system at a constant rate. Tail tank fuel transfer is controlled and monitored by the FSCU.

APU Fuel Feed System

The APU fuel feed system supplies fuel to the APU. This system includes an electric boost pump located in the right main tank, a negative-G fuel supply from the left engine's motive flow system, and two shutoff valves (APU fuel SOV and negative-G SOV). For additional information, see Chapter 5 Auxiliary Power Unit.

Components and Operation

The components of the engine fuel feed system are as follows:

Collector Tanks

Two collector tanks, located at the lowest point of the center auxiliary tank, are considered part of the main tank system. They receive fuel from their respective main wing tank via gravity or scavenge ejector pump flow. Fuel from the collector tanks is supplied to each engine-driven pump unit by main ejector pumps or electric boost pumps.

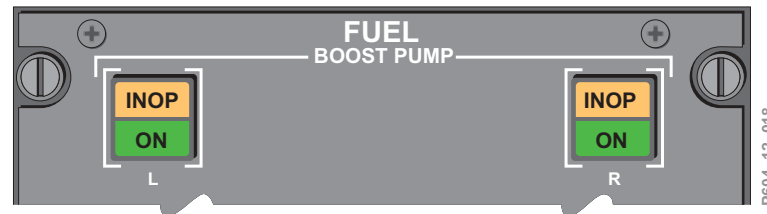
Boost Pumps

Two DC electric boost pumps provide the engines with a standby fuel feed system. They are available for engine starting, and as a backup fuel feed source if either main ejector pump output pressure is too low to satisfactorily feed its respective engine. The left boost pump is powered by the DC Battery Bus, and the right boost pump by DC Bus 2. The boost pumps are located downstream of their respective collector tanks on the fuel feed lines to the engine-driven pumps. During normal operation, the only pilot action required is to arm both BOOST PUMP switches on the FUEL control panel prior to engine start, and disarm them after shutdown.

When both BOOST PUMP switches are armed, the boost pumps are activated if low pressure is sensed at either left or right main ejector pressure switch (this is the case prior to engine start). If a single BOOST PUMP switch is armed, both boost pumps will be activated if low pressure is sensed on the armed side's main ejector pressure switch. For example, if only the left BOOST PUMP switch is armed (pressed in), then both pumps will activate if low pressure is sensed at the left main ejector output. The

boost pumps can provide fuel to both engine's fuel feed systems through a crossover feed line.

If a boost pump has been activated, sufficient pump output pressure is indicated by the green ON legend in the switch/light. Insufficient output pressure is indicated by the amber INOP legend, and the L(R) FUEL PUMP caution EICAS message.



Boost Pump Switch/Lights

Figure 12-5

Engine-Driven Pump

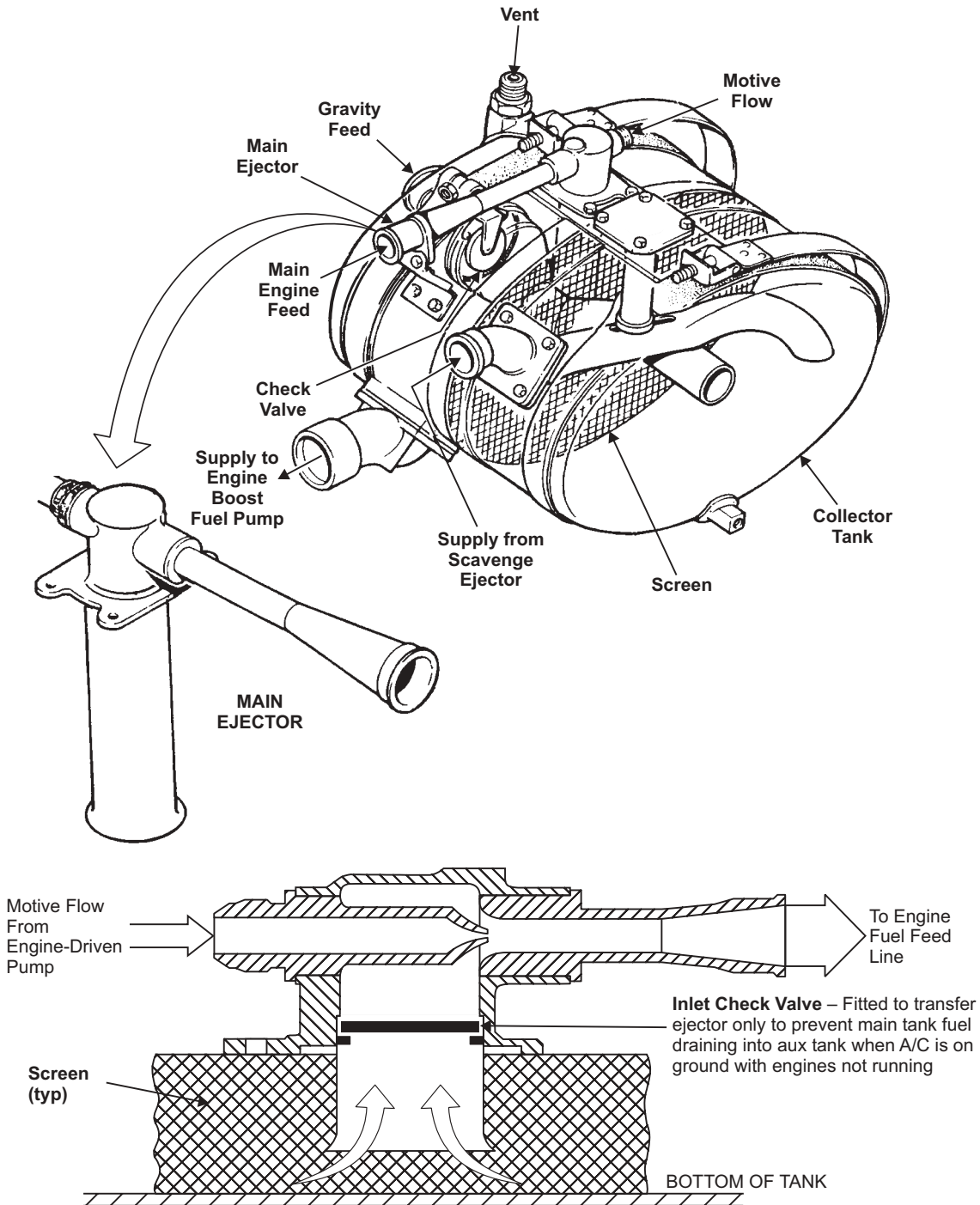
The engine-driven pump supplies high-pressure fuel to the engine Fuel Control Unit (FCU) for combustion, and to the motive flow system to power the ejector pumps. The engine-driven pump is located on the engine accessory gearbox, and operates whenever the engine core (N2) is turning. For additional information, see Chapter 18 Power Plant.

Motive Flow

Motive flow is the continuous movement of fuel under pressure through the fuel feed lines. Motive flow is generated by the engine-driven pump, and is sufficient to supply the engine with its fuel intake needs through the on-side main ejector pump. If a blockage occurs within the feed system, and motive flow fuel pressure drops (sensed at the main ejector pump pressure switch), the electric boost pumps activate and supply the engine with sufficient fuel for operation.

Ejector Pump Operation

Ejector pumps operate on the same principle as the venturi tube, and have no moving parts. The high-pressure stream of fuel at the ejector's motive flow nozzle induces a large volume of fuel to flow into the intake of the ejector. The fuel then enters the feed lines and flows under pressure.



Main Ejector and Ejector Operation

Figure 12-6

Main Ejector Pump

There are two main ejector pumps (left and right) located on top of their respective collector tanks. They receive pressurized fuel from their on-side engine's motive flow supply, and deliver an uninterrupted fuel supply from the collector tank to the respective engine. In addition, the main ejector provides the motive flow fuel supply to the on-side transfer ejector pump. Main ejector motive flow fuel is prevented from feeding the cross-side engine by a one-way check valve.

Scavenge Ejector Pump

The left and right scavenge ejector pumps are located at the lowest inboard point in each main (wing) tank. The scavenge ejectors' motive flow is created by the high-pressure fuel output of the engine-driven pumps. The scavenge ejectors transfer fuel from the main tanks to the collector tanks.

Transfer Ejector Pump

The left and right transfer ejector pumps are located at the lowest point of the center auxiliary tank. Their motive flow supply is derived from their on-side main ejector pump output. The transfer ejectors continuously transfer fuel to the main tanks, maintaining them filled to 93% capacity. A float valve located in the forward area of each main tank prevents this transfer until main tank fuel quantity is at or below 93% capacity.

Engine Fuel Shutoff Valves

One electrically controlled engine fuel shutoff valve (“firewall” SOV) is installed on each engine fuel feed line ahead of the engine-driven pump. When activated by pushing the L (R) ENG FIRE PUSH switch/light on the pilot's or copilot's glareshield, the SOV will close, stopping the flow of fuel to the engine, and the BOTTLE ARMED PUSH TO DISCHARGE switch/lights will illuminate. Successful closing of the engine fuel shutoff valve is indicated by a L (R) ENG SOV CLOSED advisory EICAS message. If the valve fails to close, a L (R) ENG SOV caution EICAS message is displayed.

The engine fuel shutoff valves are powered by the DC Emergency Bus. For additional information, see Chapter 9 Fire Protection.

Fuel Filter

The engine-driven pumps are each equipped with a fuel filter. The filters are mounted adjacent to the oil tank within the engine nacelle, and are monitored for contamination by an impending bypass switch. Indications of impending bypass (filter clogged) are the L (R) FUEL FILTER caution EICAS message, and a magnetic trip indicator, or red LED, tripped on Junction Box 5 (JB-5) in the aft equipment bay.

Wash Filter

The wash filters are installed along the motive flow fuel feed lines from the engine-driven pump to the main and scavenge ejector pumps. The wash filter separates ice crystals which may have formed in the fuel and channels them to the larger main ejector pump, thus protecting the smaller scavenge ejector pump from possible clogging. There are no cockpit indications associated with wash filter operation.

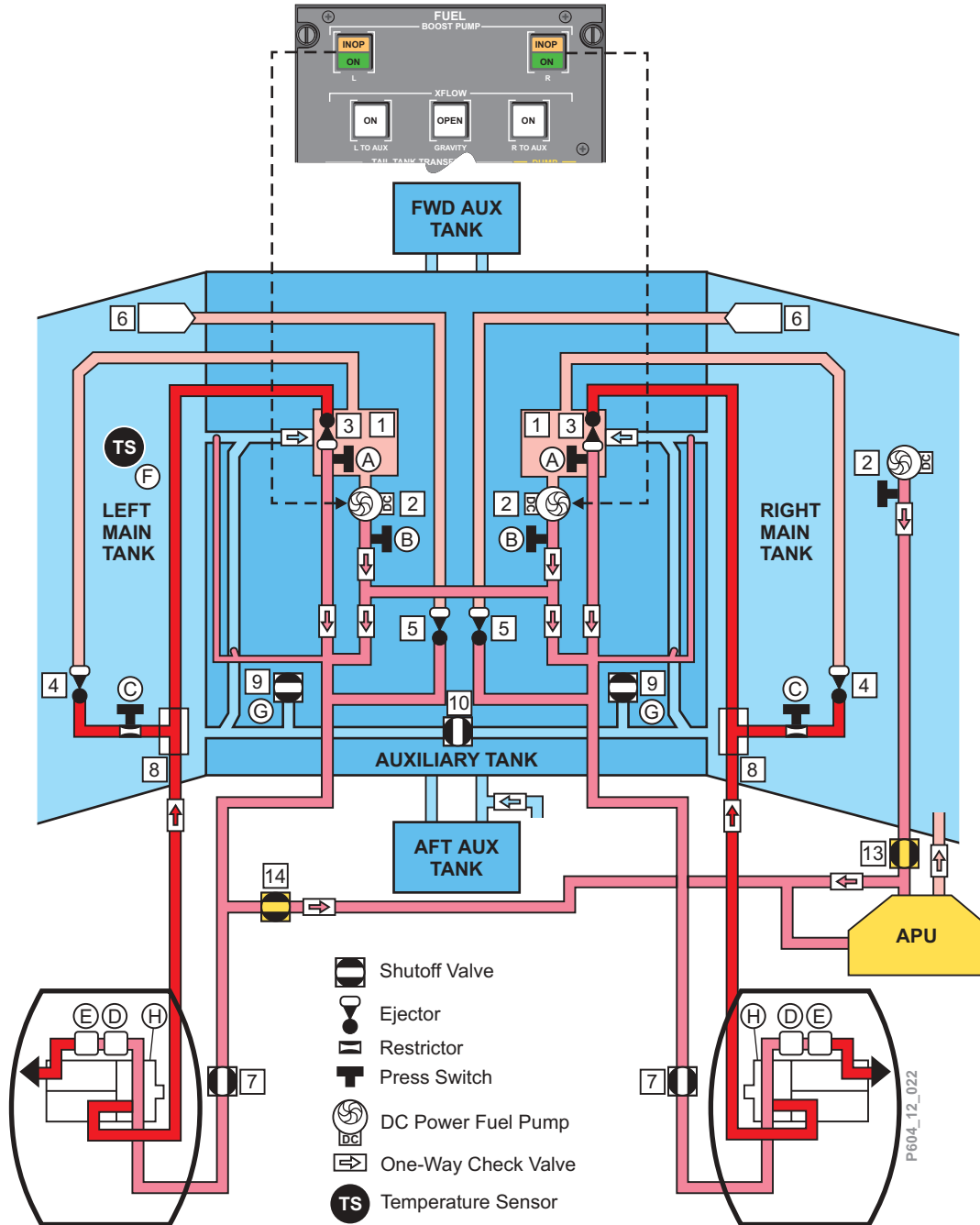
Legend

- | | | | |
|----|------------------------------------|-----|---|
| 1 | L (R) Collector Tank | (A) | L (R) P Switch = MAIN EJECTOR (Status MSG) |
| 2 | L (R) Boost Pump / APU Boost Pump | (B) | L (R) P Switch = FUEL LO PRESS (Abnormal MSG) |
| 3 | L (R) Main Ejector | (C) | L (R) ΔP Switch = SCAV EJECTOR (Abnormal MSG) |
| 4 | L (R) Scavenge Ejector | (D) | L (R) T Switch = FUEL LO TEMP (Abnormal MSG) |
| 5 | L (R) Transfer Ejector | (E) | L (R) P Switch = FUEL FILTER (Abnormal MSG) |
| 6 | L (R) Transfer Ejector Float Valve | (F) | (L) T Switch = BULK FUEL TEMP (Abnormal MSG) |
| 7 | L (R) Engine Fuel SOV | (G) | L (R) = FUEL XFLOW SOV OPEN (Abnormal MSG) |
| 8 | L (R) Wash Filter | (H) | Engine-Driven Pump |
| 9 | L (R) to Aux X-Flow Valve | | |
| 10 | Gravity Crossflow Valve | | |
| 11 | (not shown) | | |
| 12 | (not shown) | | |
| 13 | APU SOV | | |
| 14 | APU Neg-G SOV | | |

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Fuel Distribution Schematic Legend

Figure 12-7



Fuel Distribution Schematic

Figure 12-8

FUEL SYSTEM

Fuel Transfer

Description

During normal operations, fuel transfer from the tail tanks to the auxiliary tanks is controlled and monitored automatically by the FSCU. After initiating the fuel transfer, the FSCU monitors the operation to prevent CG excursions beyond acceptable forward and aft limits.

Transfer of fuel from the tail tanks to the auxiliary tanks may be interrupted automatically by the FSCU or manually by the flight crew should a malfunction occur.

Components and Operation

Fuel System Computer Unit (FSCU)

The FSCU is a two-channel computer located in the underfloor avionics/electronic bay. Its main functions are fuel quantity gauging, tail tank to auxiliary tank automatic fuel transfer, and automatic refueling shutoff. Channel 1 of the FSCU is the primary controller, and channel 2 automatically replaces channel 1 in the event of failure.

FSCU outputs are used by the data concentrator units (DCUs) for fuel quantity displays, EICAS messages, and switch/lights in the FUEL control panel.

The FSCU is powered by the APU Battery Direct Bus, DC Essential Bus, DC Battery Bus, and DC Bus 1.

Tail Tank Transfer Pumps

Two tail tank transfer pumps (primary and secondary) are installed at the sump of the tail tank system. They transfer fuel from the tail tank system to the auxiliary tank system at a constant rate of 1800 pounds per hour (900 pounds per hour if SB 604-28-007 not installed).

Rotor-Burst Protection Shroud

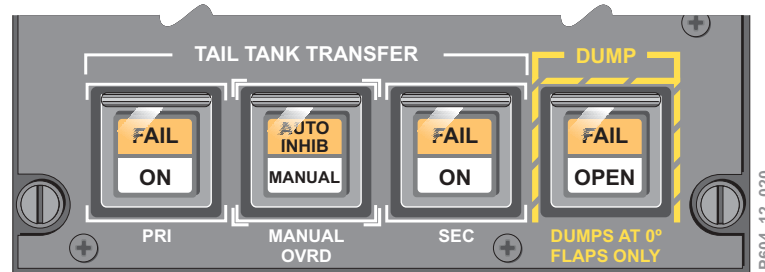
Because the tail tank lines run past the engines, a rotor-burst protection shroud covers the tail tank fuel line in this area. The shroud is pressurized with nitrogen and monitored by the FSCU. Should a rotor burst rupture the line, pressure will be lost from the shroud and tail tank fuel transfer will be inhibited. The AUTO TAIL XFER INHIB caution EICAS message will be displayed and the amber AUTO INHIB switch/light will illuminate on the FUEL control panel. Manual override is available to the flight crew if the shroud is depressurized for non-engine-related reasons, by pushing the TAIL TANK TRANSFER MANUAL OVRD switch/light on the fuel control panel.

FSCU Automatic Transfer Operation

The FSCU receives fuel quantity information from four level sensors in the auxiliary and tail tank systems. The FSCU uses this information to control tail tank fuel transfer by starting and stopping the primary or secondary tail tank transfer pumps in accordance with a fixed schedule. The FSCU shuts off the tail tank transfer pumps when the tail tank system is empty or when the auxiliary tank system is full.

An amber AUTO INHIB light on the FUEL control panel illuminates to indicate that rotor-burst protection shroud pressure is low, and all automatic fuel transfer modes are disabled. This is accompanied by the AUTO TAIL XFER INHIB caution EICAS message.

Normal operation of the automatic tail tank transfer pumps will not illuminate the switch/lights on the FUEL control panel. If the primary or secondary tail transfer pump fails during automatic operation, the FSCU switches to the other pump and displays the PRI (SEC) TAIL XFER FAIL status EICAS message.



Tail Tank Transfer Switch/Lights

Figure 12-9

NOTE

Normal automatic fuel transfer between tail and auxiliary tanks is inhibited while the aircraft is on the ground (Weight On Wheels sensed by the proximity sensing electronic unit). On the ground, transfer can only be accomplished by pressing the MANUAL OVRD switch/light and selecting the PRI or SEC transfer pump.

FSCU Manual Transfer Operation

The FSCU alerts the crew of tail tank fuel transfer abnormalities by EICAS messages. The FUEL control panel allows the crew to override the FSCU automatic fuel transfer system.

The TAIL TANK HEAVY caution EICAS message alerts the crew of excessive tail tank fuel weight (relative to the auxiliary tanks). By pressing the guarded MANUAL OVRD switch/light, the crew can manually transfer the tail tank fuel by selecting the guarded PRI (SEC) TAIL TANK TRANSFER pump switch/light. The white ON indicator illuminates within the switch/light to indicate satisfactory pump output pressure. If pump output pressure is low, or the pump has failed, the amber INOP indicator illuminates within the switch/light and the PRI (SEC) TAIL XFER PUMP caution EICAS message is displayed. If the transfer is unsuccessful, the crew can utilize the tail tank fuel DUMP system to reduce the fuel quantity in the tail tank.

Similarly, the AUX TANK HEAVY caution EICAS message indicates excessive auxiliary tank fuel weight (relative to the tail tank system). Selecting only the MANUAL OVRD switch/light will override FSCU automatic transfer functions, stopping fuel transfer between the tail and auxiliary tanks, thereby allowing the auxiliary tanks to deplete to normal levels.

NOTE

When operating in manual override, the selected (PRI or SEC) fuel pump will not automatically shut off when the tail tank is empty. The flight crew must monitor manual transfer operations and turn off the selected pump when the tail tank is empty.

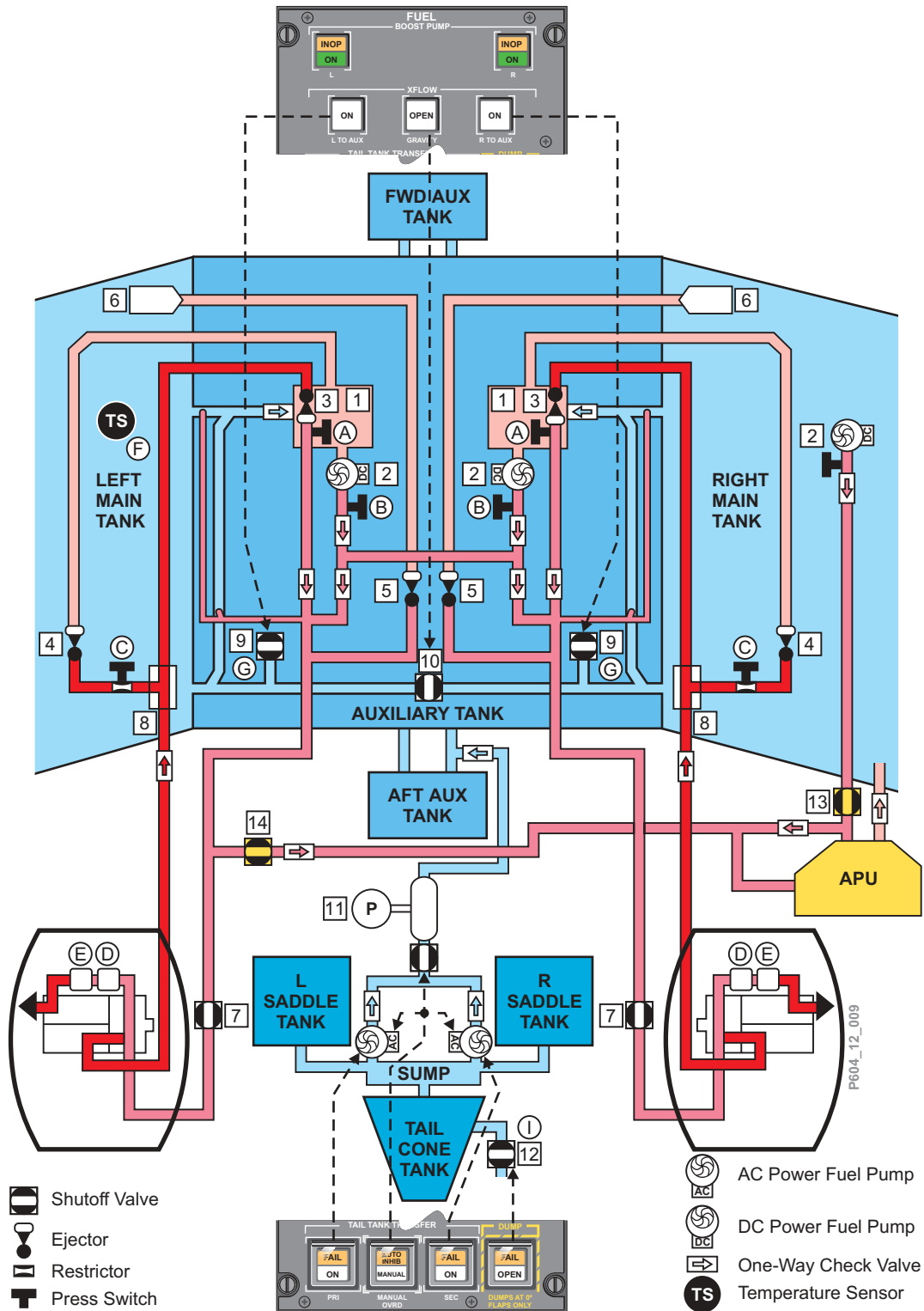
Legend

- | | |
|--|---|
| 1 L (R) Collector Tank | (A) L (R) P Switch = MAIN EJECTOR (Status MSG) |
| 2 L (R) Boost Pump / APU Boost Pump | (B) L (R) P Switch = FUEL LO PRESS (Abnormal MSG) |
| 3 L (R) Main Ejector | (C) L (R) ΔP Switch = SCAV EJECTOR (Abnormal MSG) |
| 4 L (R) Scavenge Ejector | (D) L (R) T Switch = FUEL LO TEMP (Abnormal MSG) |
| 5 L (R) Transfer Ejector | (E) L (R) P Switch = FUEL FILTER (Abnormal MSG) |
| 6 L (R) Transfer Ejector Float Valve | (F) (L) T Switch = BULK FUEL TEMP (Abnormal MSG) |
| 7 L (R) Engine Fuel SOV | (G) L (R) = FUEL XFLOW SOV OPEN (Abnormal MSG) |
| 8 L (R) Wash Filter | (H) (not shown) |
| 9 L (R) to Aux X-Flow Valve | (I) Contactor = TAIL DUMP SOV (Abnormal MSG) |
| 10 Gravity Crossflow Valve | |
| 11 Rotor-Burst N ₂ Cylinder | |
| 12 Tail Dump SOV | |
| 13 APU SOV | |
| 14 APU Neg-G SOV | |

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Fuel Transfer Schematic Legend

Figure 12-10

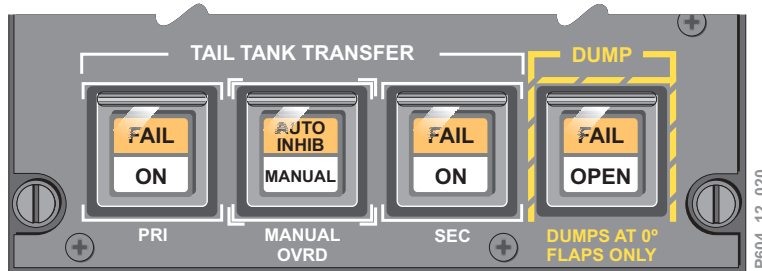


Fuel Dumping

If attempts to transfer fuel from the tail tank to auxiliary tank fail, the tail tank fuel can be dumped. Fuel dumping must be carried out with the flaps at 0°.

A guarded DUMP switch/light, powered by the DC Battery Bus, is located on the FUEL control panel. Once pressed in, the dump valve is commanded open, and the white OPEN indicator illuminates on the switch/light. Fuel is dumped at a rate of approximately 100-120 lb/min (45-55 kg/min). Five minutes after the dump valve is selected OPEN, the TAIL DUMP SOV caution EICAS message is displayed to remind the flight crew that the dump valve is open.

If the dump valve is not in the position commanded by the switch/light, the amber FAIL indicator will illuminate and the TAIL DUMP SOV caution EICAS message will be displayed.



Fuel Dump Switch/Light

Figure 12-12

NOTE

Fuel may be inadvertently dumped on the ground, via the fuel dump mast, if the BATT MASTER switch is selected on, and the fuel DUMP switch is pressed in.

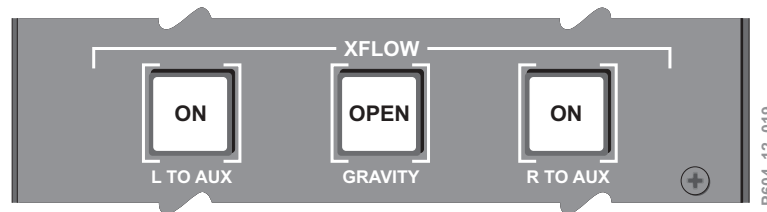
Fuel Crossflow (XFLOW)

Whenever there is a fuel imbalance between the two main tanks (more than 400 lbs on taxi, takeoff or landing, or more than 800 lbs in flight), the FUEL IMBALANCE caution EICAS message is displayed.

The three XFLOW switch/lights on the FUEL control panel correspond to three valves in the crossflow line. The motorized gate-valves, located in the auxiliary tank are powered by 28 VDC. Pushing one of the XFLOW switch/lights allows manual fuel transfer between the designated tanks.

NOTE

The FUEL IMBALANCE message will be triggered in flight whenever more than 400 pounds' fuel imbalance exists between the left and right main tanks, and flaps are set at 20-degree position or more.



XFLOW Switch/Lights

Figure 12-13

L (R) TO AUX XFLOW Switch/Lights

Pushing the L (R) TO AUX switch/light opens a valve which allows fuel from the selected wing tank into the auxiliary tank. Fuel is then evenly distributed by the transfer ejectors to both LEFT and RIGHT main tanks. When the fuel imbalance reduces to less than 100 lbs after a 50-second time delay, the FUEL XFLOW SOV OPEN caution EICAS message will be displayed to remind the crew to deselect the appropriate XFLOW switch/light.

NOTE

An electric switch interlock inhibits simultaneous opening of both L TO AUX and R TO AUX valves.

GRAVITY XFLOW Switch/Light

Pushing the GRAVITY XFLOW switch/light opens the gravity crossflow valve, allowing fuel to flow freely between the main tanks and to balance evenly. Flying in a slight sideslip with the heavy wing up can accelerate the balancing process. When the GRAVITY XFLOW switch/light is selected, the OPEN indicator illuminates to indicate gravity crossflow valve operation. There are no EICAS messages associated with gravity crossflow valve operation. The flight crew must monitor main tank fuel quantity indications to determine when the imbalance has been corrected.

An L (R) TO AUX crossflow switch/light should not be selected in combination with the GRAVITY XFLOW switch/light.

NOTE

GRAVITY XFLOW valve operation on the ground should be closely monitored since fuel will flow from the higher wing to the lower wing without any EICAS messages to indicate when the imbalance has been corrected.

Refueling/Defueling System

Description

A single-point refuel/defuel adapter is located in the right wing root area. The FUEL/DEFUEL control panel is situated above the adapter on the side of the fuselage. The FUEL/DEFUEL panel is used to test the integrity of the components of the fuel system, and to select the individual fuel tanks for refueling and defueling.

An optional refuel/defuel panel is installed on the flight deck behind the copilot seat. This panel has priority over the external panel, and displays individual fuel tank quantity information and valve status.

Both internal and external FUEL /DEFUEL panels are normally powered by the APU BATT DIR BUS.

To prevent overfilling the tanks, each tank system is equipped with high level sensors. The high level sensor closes the associated shutoff valve(s) when the respective tank is filled to capacity. The tank vent system ensures overfill protection during refueling. Manual vent relief valves augment the normal vent system to prevent main and auxiliary tank overpressure during refueling.

NOTE

Maximum usable fuel capacities are attainable through pressure refueling only.

LOCATION	POUNDS	KILOS	GALLONS (US)	GALLONS (IMP)	LITERS
Left main tank	4874	2210	722	601	2733
Right main tank	4874	2210	722	601	2733
Center aux tank	5066	2296	750	625	2839
Forward aux tank	1465	664	217	181	821
Aft aux tank	641	291	95	79	360
Left saddle tank	903	409	134	111	506
Right saddle tank	903	409	134	111	506
Tail cone tank	1341	608	199	165	752
Total capacity	20067	9097	2973	2474	11250

Based on a fuel density of 6.75 lb (3.06 kg) / US gallon, and aircraft parked with 0.5° nose down and wings level.

Max Usable Capacities Attainable through Pressure Refueling

Table 12-1

LOCATION	POUNDS	KILOS	GALLONS (US)	GALLONS (IMP)	LITERS
Left main tank	4523	2051	670	558	2536
Right main tank	4523	2051	670	558	2536
Auxiliary tank	6676	3028	989	823	3743
Total capacity	15722	7130	2329	1939	8815

Based on a fuel density of 6.75 lb (3.06 kg) / US gallon, and aircraft parked with 0.5° nose down and wings level.

Max Usable Capacities Attainable through Overwing Refueling

Table 12-2

LOCATION	POUNDS	KILOS	GALLONS (US)	GALLONS (IMP)	LITERS
Total capacity	129	59	19	16	72

Unusable fuel is the quantity of trapped and residual fuel.

Unusable Fuel

Table 12-3

Components and Operation

FUEL/DEFUEL Panel

The FUEL/DEFUEL panel has controls for testing the systems' functionality and to initiate or terminate selective tank fueling or defueling. Maximum pressure during refueling is 50 psi and maximum defueling pressure is negative 8 psi. The maximum fuel imbalance for structural integrity is 2500 lb between the two main tanks.

To ensure FUEL / DEFUEL panel power has been turned off, a power kill switch disconnects the panel from the APU battery direct bus when the panel is stowed and the door closed.

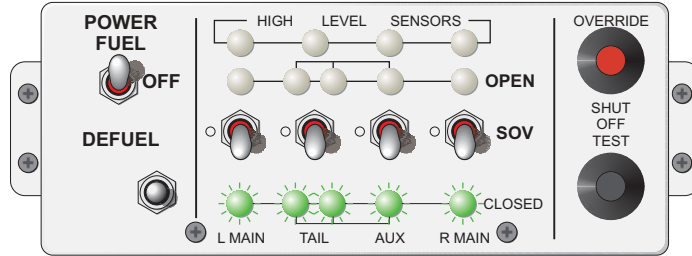
FUEL/DEFUEL Panel Operation Test

To complete the test:

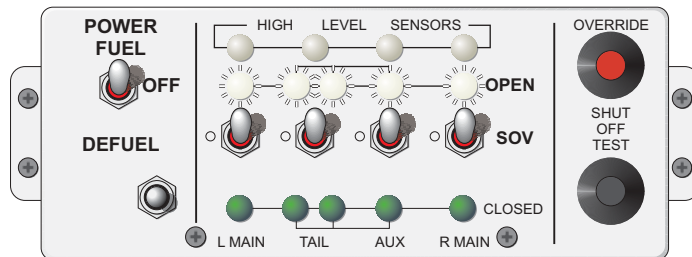
- fuel adapter and pressure must be available from the tender (Max 50 psi)
- place POWER switch to the FUEL position
- select all SOV switches to the OPEN position (All five white SOV OPEN lights illuminate)
- push and hold the SHUTOFF TEST switch (To check automatic fueling shutoff feature),
- Verify that:
 - all four white HIGH-LEVEL SENSOR lights illuminate
 - all five white SOV OPEN lights extinguish, and
 - all five green SOV CLOSED lights illuminate
- release the SHUTOFF TEST button to verify that all the above lights revert to their status prior to test start, and
- start refueling

NOTE

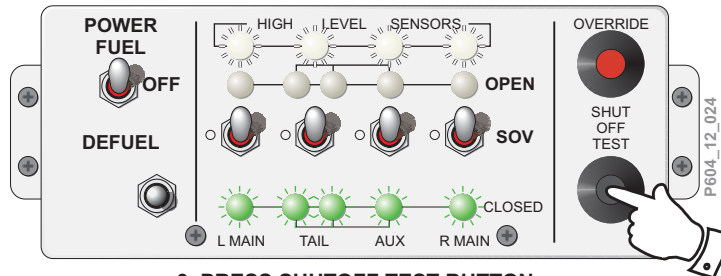
The functional test of the refueling system must be conducted prior to each refueling/defueling. During the test, the high-level sensors generate a false high-level signal to the FSCU, which then closes the refuel shutoff valves.



1. FUEL TRUCK CONNECTED AND PRESSURE (MAX 50 PSI) ESTABLISHED



2. ALL SOV SWITCHES SELECTED OPEN



3. PRESS SHUTOFF TEST BUTTON

FUEL / DEFUEL Panel Operation Test

Figure 12-14

Pressure Refueling

For partial fuel loads it is recommended to fill the main tanks completely first, then the auxiliary and tail tanks as required. For safety reasons and to maintain proper C of G, the FSCU will prevent refueling of the auxiliary tank without the tail tank being selected. The auxiliary and tail tanks must always be selected together and the refuel SOVs must be confirmed open to ensure proper filling of the auxiliary and tail tanks.

To open the shutoff valve (SOV) for the respective tank, toggle the appropriate SOV switch to OPEN. When the tank is full, the respective HIGH-LEVEL SENSOR light and SOV CLOSED light will illuminate to indicate the SOV has closed automatically. Should this fail, as evidenced by fuel dumping overboard from the vent system, toggle the switch down to manually close the SOV.

In order to achieve maximum fuel quantity in the auxiliary tank, pressure must be kept constant at the FUEL/DEFUEL ADAPTER. If an interruption of 30 seconds or more during refueling occurs, the FSCU will close the TAIL SOVs and the AUX SOV, preventing fuel from going to these tanks. If this occurs, the FSCU may be overridden by holding the OVERRIDE button on the FUEL/DEFUEL panel, or, the POWER switch may be cycled OFF then to FUEL. The affected TAIL and AUX SOV(s) will reopen, allowing more fuel into the tanks unless the HIGH LEVEL SENSOR light of the affected tank has been triggered.

If a long interruption occurs during refueling, and depending on how much fuel there is in the auxiliary tank at this stage, the forward and aft auxiliary tanks will not be further pressurized by the ejectors and their vent valves will open. Their level will drop and equalize with the center auxiliary tank. This will cause the level in the center auxiliary tank to rise, and if the level is high enough, it may trigger the auxiliary tank HIGH LEVEL SENSOR. If this is the case, the FSCU will not allow the AUX SOV to reopen, and only gravity refueling will be possible to fill the remaining volume of the auxiliary tanks.

Auxiliary Tank Quantity Indication

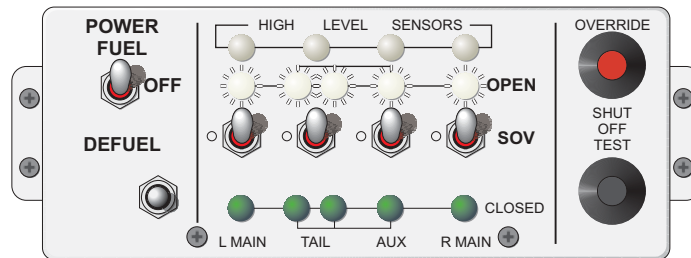
Since the auxiliary tank fuel quantity indication is generated using the center and forward auxiliary tank capacitance probes, the cockpit reading for the auxiliary tank during refueling does not immediately reflect actual auxiliary tank contents. Actual tank contents will only indicate after the three tank levels have equalized (approximately one to eight minutes later).

Override Button

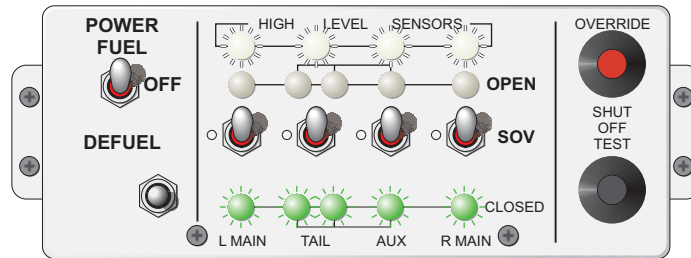
The override button allows fueling/defueling of the auxiliary or tail tanks individually, provided the high-level sensor has not been triggered in the selected tank system. The override button must be held for the duration of individual auxiliary or tail tank fueling/defueling.

WARNING

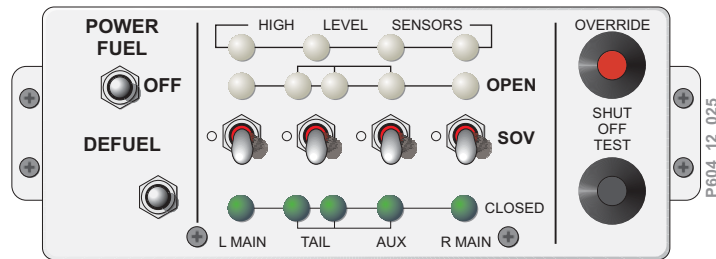
IF INDIVIDUAL FUELING OF AUXILIARY OR TAIL TANKS HAS BEEN CARRIED OUT USING THE OVERRIDE BUTTON, THE C OF G LIMITS MUST BE CALCULATED MANUALLY.



4. OPERATION TEST COMPLETE, RELEASE SHUTOFF TEST BUTTON, ALL SELECTED TANK SOVs OPEN



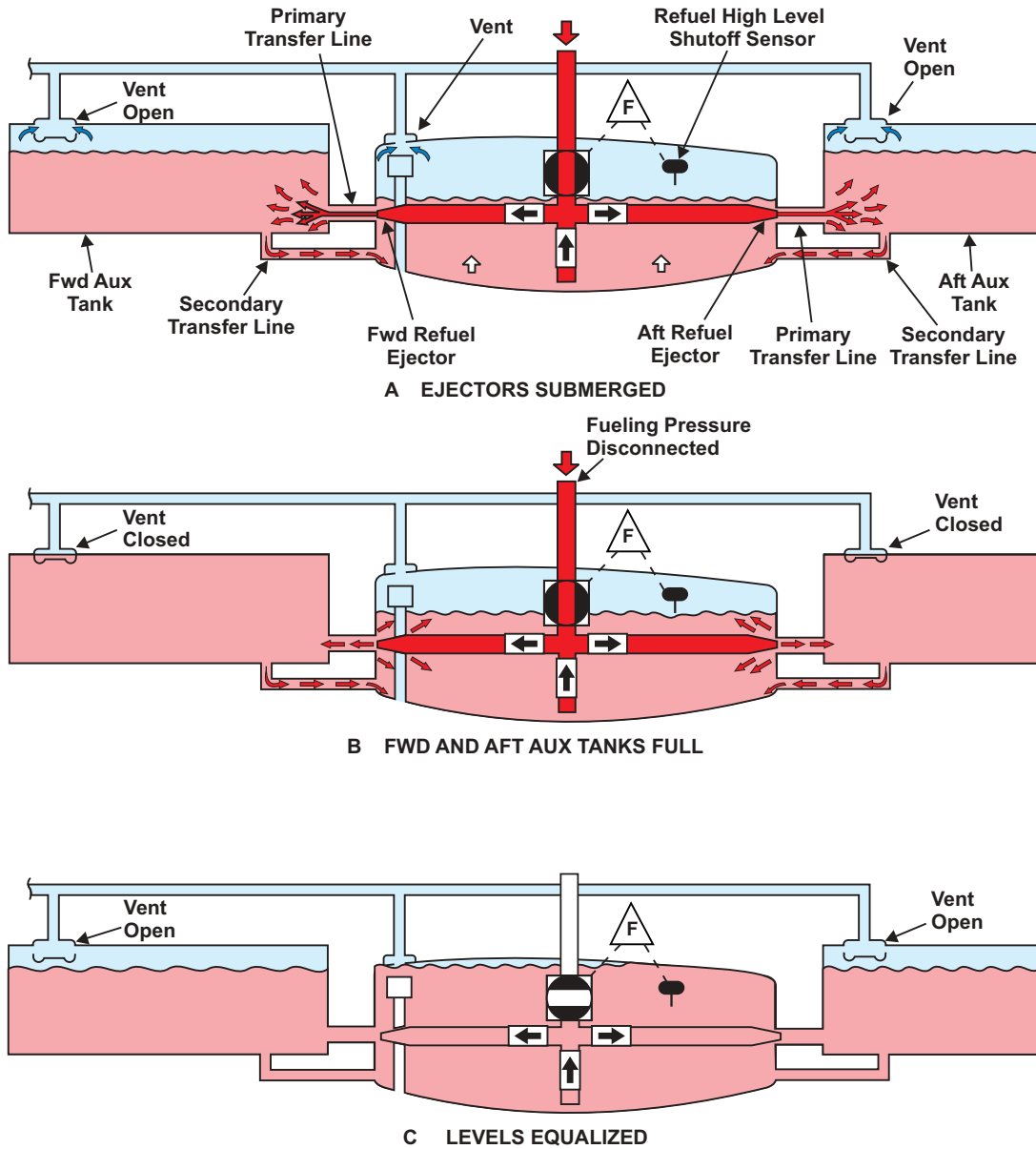
5. AS EACH FUEL TANK REACHES FULL CAPACITY, THE HIGH LEVEL SENSOR CLOSES THE REFUEL SOV



6. REFUELING COMPLETE, TURN OFF ALL TANK SOV SWITCHES, POWER SWITCH OFF

FUEL / DEFUEL Panel Pressure Refueling

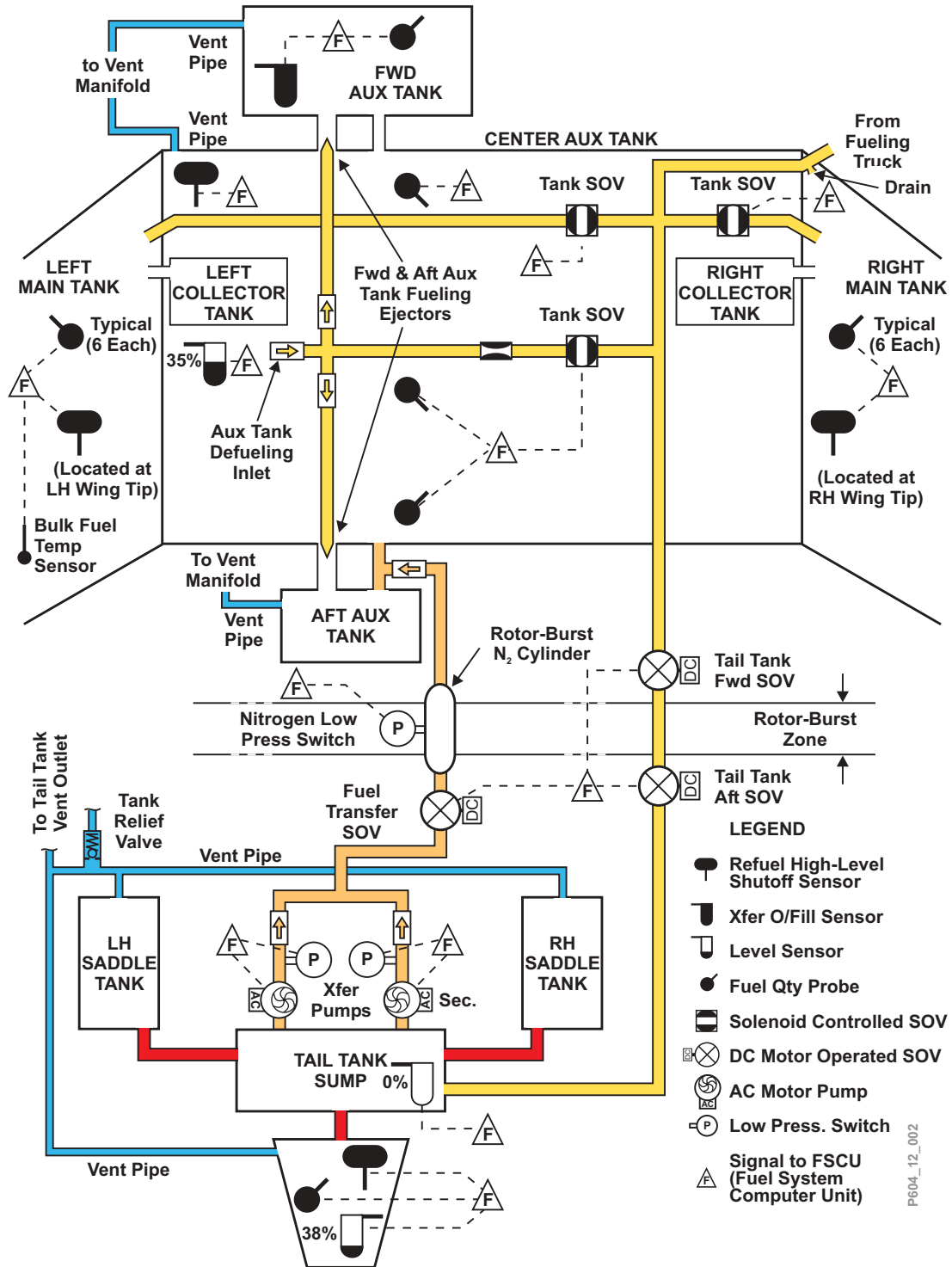
Figure 12-15



F Denotes signal to/from Fuel System Computer Unit (FSCU)

Pressure Refueling (Auxiliary Tanks)

Figure 12-16



Refuel / Defuel System Schematic
Figure 12-17

Overwing Gravity Refueling

Gravity refueling will average 7% less volume than pressure refueling in the main and auxiliary tank systems since the main and auxiliary overwing filler points are below the highest point of the respective tank. Overwing filler caps are installed on each wing. The auxiliary tank gravity refueling panel and cap are situated on the right wing root. **The tail tank cannot be gravity refueled.**

NOTE

During overwing gravity refueling, the pilots must ensure the aircraft is within center-of-gravity limits.

CAUTION

Do not open the overwing fueling caps unless the fuel quantity in the main tanks is below 93% capacity.

Pressure Defueling

- select DEFUEL on the POWER switch
- ensure that the SOV switches of only those tanks that are to be defueled are in the OPEN position and the remaining SOV switches are in the CLOSED position
- apply suction from the fuel truck (max -8 psi) at the fuel/defuel adapter

When the auxiliary tank or either main tanks are fully defueled, their respective SOV CLOSED (green) light will illuminate and the associated (white) SOV OPEN light will extinguish.

When defueling is completed, move the applicable tank SOV switches to CLOSE.

NOTE

If defueling pressure is applied and the POWER FUEL/DEFUEL switch is inadvertently selected OFF, fuel will be drawn from the main and auxiliary tanks only. Any fuel in the tail tank system will remain trapped, possibly creating a tail-heavy condition.

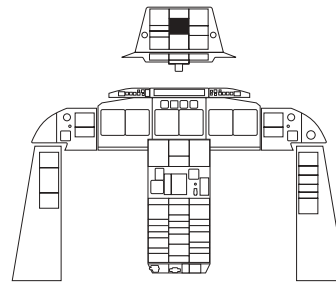
Gravity Defueling

The main and auxiliary tanks can be gravity defueled through a tank drain valve which has an integral check valve. The tail cone tank may be drained through the DC motor operated dump valve.

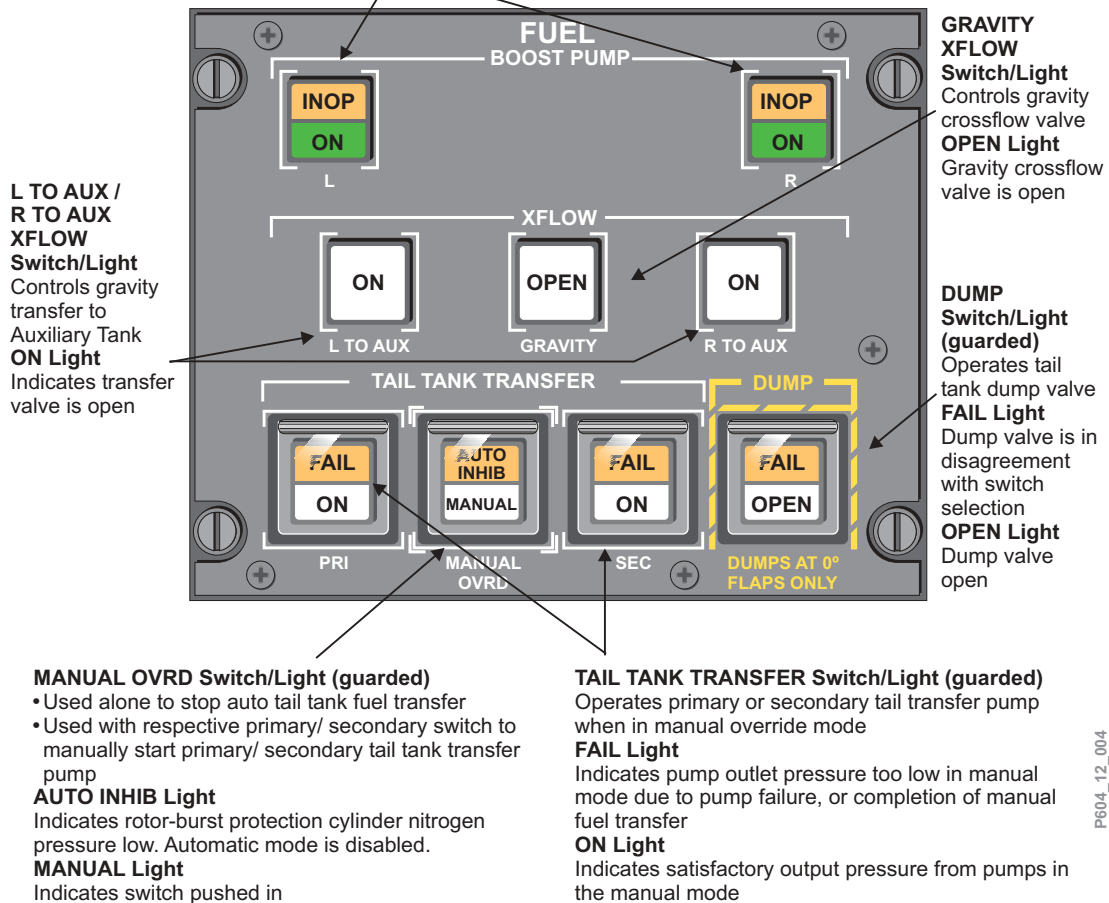
The tank drain valves are installed on the lowest access cover of each tank, and sealed from the outside with a screwed-in cover plug. A special adapter is required to operate the check valve for gravity defueling operations.

Controls and Indicators

FUEL Control Panel



BOOST PUMP Switch/Light
Operates both electric fuel boost pumps upon loss of respective main ejector output pressure
INOP Light
Indicates pump outlet pressure too low
ON Light
Indicates pump outlet pressure is satisfactory



P604_12_004

FUEL Control Panel

Figure 12-18

Fuel Quantity Indicators

Fuel quantity is displayed in the lower left corner of the EICAS primary page. The sum of all tanks is displayed next to the word TOTAL. The next line indicates, respectively, left main, center auxiliary and right main fuel quantity. The tail tank readout is on the last line. Fuel quantity and fuel flow are normally displayed in LB (pounds) but can also be configured in KG (kilogram) at the Completion Center.

Fuel quantity data can also be read on the optional interior refuel panel (behind the copilot seat).

NOTE

Total fuel quantity data must be entered in the FMS (PERF INIT page) prior to flight.

Bulk Fuel Temperature Indication

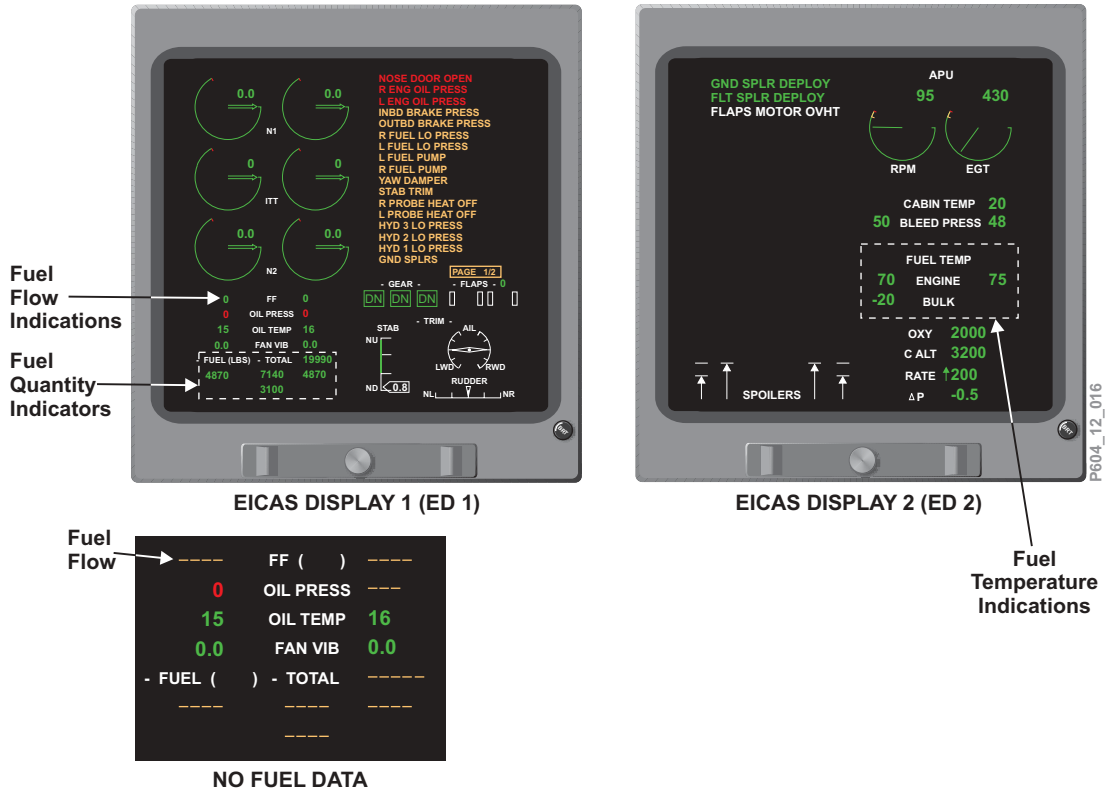
Temperature is monitored by a probe in the left main tank and displayed on the EICAS status page. Numerals are green at temperatures above -37°C . At or below -37°C , the numerals are amber and an associated BULK FUEL TEMP caution EICAS message will be displayed.

Engine Fuel Temperature Indications

Temperatures are sensed by a probe located on the top of each engine's fuel filter housing. Numerals are green above 5°C and amber if below 5°C . An associated L/R FUEL LO TEMP caution EICAS message will be displayed.

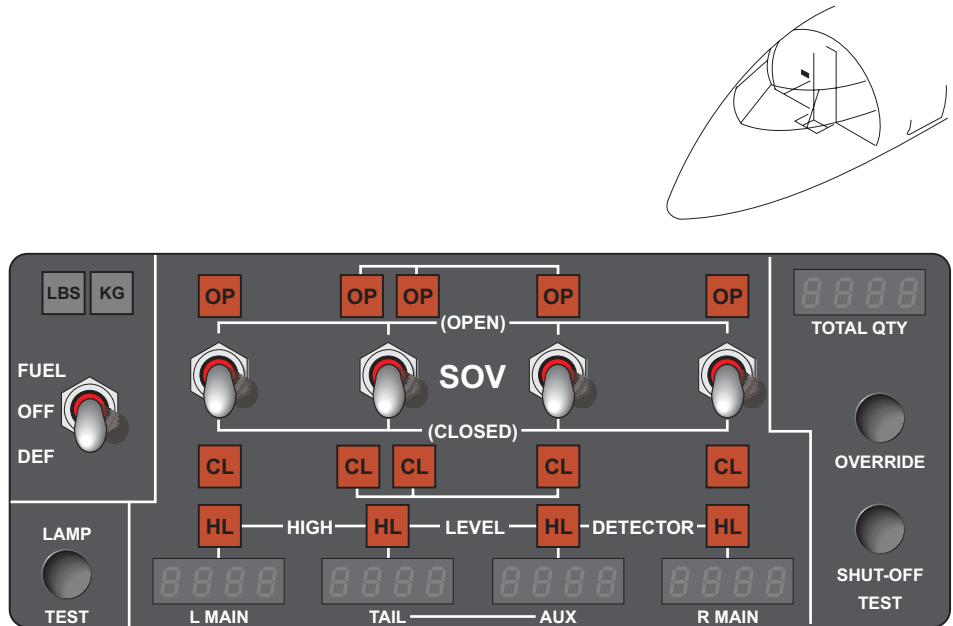
Fuel Flow Indications

Fuel flow indications are displayed for each engine immediately below the N2 arcs on the primary EICAS page. The normally green fuel flow indication will turn amber and display dashed lines if fuel flow exceeds 5000 pph, (2,273 kg/hr) or if the input value is invalid. Fuel flow can also be viewed through FMS page selection.



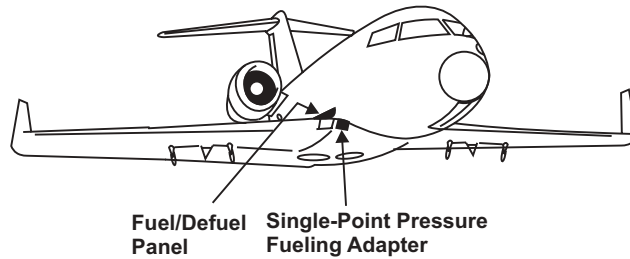
EICAS Fuel Information Display

Figure 12-19



Interior Optional FUEL/DEFUEL Panel

Figure 12-20

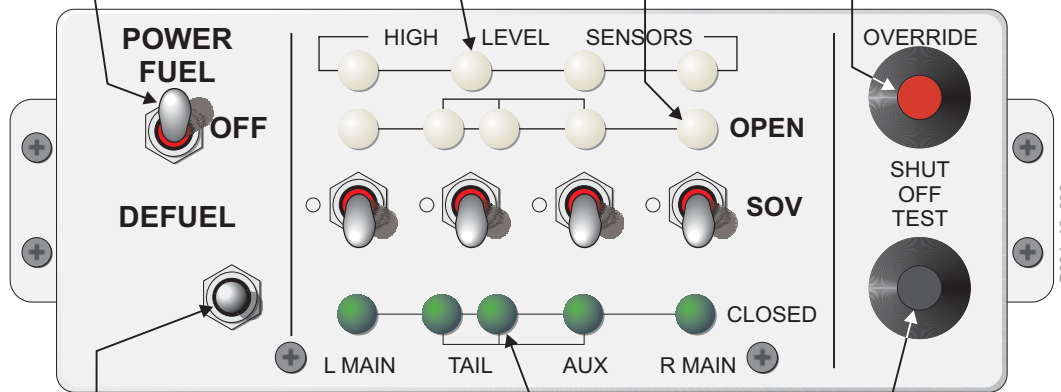


Power Toggle Switch
Supplies power directly from the APU battery direct bus to the fuel/defuel control system.

High Level Sensor Lights
Indicates that the fuel level in the respective tank has reached the full capacity

SOV Open Lights
Indicates that the respective SOVs are open

Override Button
Allows individual fueling of the auxiliary tank or tail tank, disables the FSCU while depressed



Power Kill Switch
Removes power to fuel/defuel panel when access panel closed

SOV closed lights
Indicates that the respective fuel/defuel shutoff valves (SOV) are closed.

Shutoff Test Button
Tests automatic shutoff during fueling

Exterior FUEL/DEFUEL Panel

Figure 12-21

EICAS Messages

MESSAGE	MEANING
APU PUMP	APU fuel pump has failed.
APU SOV	APU fuel shutoff valve is open with the APU FIRE PUSH switch activated, or the fuel shutoff valve position does not match the APU PWR FUEL switch position, within 5 seconds.
APU NEG-G SOV	APU negative-'G' shutoff valve is open with the APU FIRE PUSH switch activated, or the negative-'G' shutoff valve position does not match the APU PWR FUEL switch position, within 5 seconds.
AUTO TAIL XFER	Automatic function of the tail tank transfer has failed.
AUTO TAIL XFER INHIB	Automatic function of the tail tank transfer is inhibited.
AUX TANK HEAVY	Aux tank excessive fuel compared to the tail tank.
BULK FUEL TEMP	Fuel temperature in the left main tank is below -37°C.
DUMP VALVE OPEN	Fuel dump shutoff valve has been open longer than 5 minutes.
L ENG SOV	The fuel shutoff valve is not closed after actuation of the respective engine fire push switch/light.
R ENG SOV	
L FUEL FILTER	Respective fuel filter is in impending bypass mode.
R FUEL FILTER	
FUEL IMBALANCE	Fuel difference between the wing tanks is > 800 lb (in flight) or > 400 lb (taxi/takeoff or approach).
L FUEL LO PRESS	Insufficient pressure at the respective engine pump inlet.
R FUEL LO PRESS	
L FUEL LO TEMP	Fuel temperature at the respective engine pump is < 5°C.
R FUEL LO TEMP	
L FUEL PUMP	The respective electric boost pump has failed.
R FUEL PUMP	
FUEL XFLOW SOV OPEN	L/R crossflow shutoff valve is open and fuel imbalance is less than 100 lb.
PRI TAIL XFER PUMP	In manual mode, the primary transfer pump has failed, or pump outlet pressure is low, or fuel transfer is completed.
SEC TAIL XFER PUMP	In manual mode, the secondary transfer pump has failed, or pump outlet pressure is low, or fuel transfer is completed.
L SCAV EJECTOR	Low output pressure at the respective scavenge ejector.
R SCAV EJECTOR	
TAIL DUMP SOV	Dump valve is not in agreement with the tail tank dump switch/light position.

EICAS Messages

Table 12-4

MESSAGE	MEANING
TAIL TANK HEAVY	Tail tank excessive fuel compared to the aux tank fuel.
TAIL XFER SOV	Transfer shutoff valve failed between full open and full closed position.
TAIL XFER SOV CLSD	With either primary and/or secondary tail tank transfer pump pressures output at an acceptable high level, the tail tank transfer SOV is not fully open.
TAIL XFER SOV OPEN	With either primary and/or secondary tail tank transfer pump pressures low, the tail tank transfer SOV is not fully closed.
APU SOV CLOSED	After APU fire push is activated, the fuel shutoff and negative-'G' shutoff valves are closed.
L ENG SOV CLOSED	L engine fuel SOV closed after activation of respective fire push switch/light.
R ENG SOV CLOSED	R engine fuel SOV closed after activation of respective fire push switch/light.
L FUEL PUMP ON	L fuel pump on, with sufficient outlet fuel pressure.
R FUEL PUMP ON	R fuel pump on, with sufficient outlet fuel pressure.
FUEL CH 1 FAIL	Respective channel in the fuel system computer has failed.
FUEL CH 2 FAIL	
FUEL QTY ACCURACY	Both fuel system computer (FSC) channels have degraded accuracy signal, or one FSC channel has degraded accuracy while the other channel has a data word label invalid.
FUEL QTY ATT CORR	Inertial reference system (IRS) is not valid for both channels of the FSCU with airplane weight off wheels.
L MAIN EJECTOR FAIL	Low fuel pressure at respective main ejector, with respective engine running.
R MAIN EJECTOR FAIL	
PRI TAIL XFER FAIL	Primary tail xfer pump failed in auto mode.
SEC TAIL XFER FAIL	Secondary tail xfer pump failed in auto mode.
TAIL RFL SOV OPEN	Tail refuel SOV open with DC BUS 1 powered.

EICAS Messages

Table 12-4