

REFUEL DISTRIBUTION

Refer to Refuel Schematic for component location, recognition, and operation.

All fuel tanks can be refueled either automatically (by the FMQGC) or manually (by the refuel/defuel panel). The recommended pressure is 50 psig for pressure fueling.

A balance line in each tank is used during refueling to transfer fuel to the most outboard section of the wing.

The filling sequence of the wing compartment during pressure refueling is as follows:

- Cell 2 is filled directly by the refuel system, fuel flows inboard by gravity into
- Cell 1, which is the inboard section including the feed tank. After inboard cells 1 and 2 are completely filled
- Cell 3 is filled to capacity by overflow of cell 2 fuel through the balance tube connecting cells 2 and 3

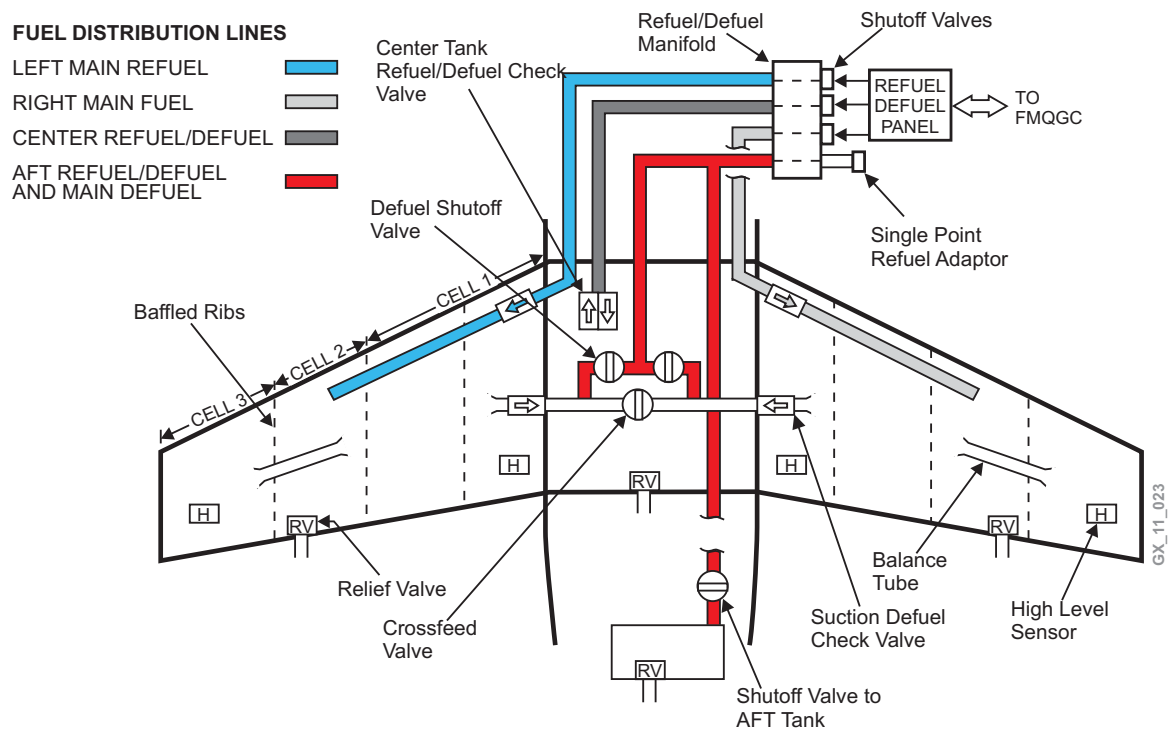
The aft and center tanks will be refueled simultaneously (automatically by the FMQGC) to maintain center-of-gravity (C of G) limits.

High level sensors installed in each tank automatically close the refuel/defuel SOVs, if the maximum fuel level capacity is reached. Relief valves augment the normal vent system to prevent overpressure in case of overfilling a tank.

As with the wing tanks, automatic refueling of the center tank is controlled by the FMQGC, with automatic shutoff commanded by the high level sensor. Automatic refueling of the aft tank is controlled by the FMQGC, with automatic shutoff commanded by the high level sensor.

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REFUEL/DEFUEL SCHEMATIC



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NORMAL FUEL LOADING

The normal fuel loading logic as planned by the FMQGC is as follows: Note that when the refuel process starts, fuel flows to all of the tanks at the same time until they reach the planned amount.

- Wing tanks only if the required fuel load is equal to or less than the wing tank capacity
- Wing tanks full and the remainder in the aft tank if the required fuel load is greater than the wing tank capacity but less than or equal to the combined capacity of the wing and aft tanks
- Any fuel in excess of the combined capacity of the wing and aft tanks is placed in the center tank

NOTE

The fuel computer always strives to keep between 0 and 400 lb maximum lateral imbalance, regardless of what FMQGC version we have.

For FMQGC (pre-5), the logic was set to stop fuel loading and display inhib on the fuel panel as soon as the lateral imbalance reached 400 lb. Since -5 FMQGC, the software now allows the imbalance to reach 1100 lb before shutting down and going into inhib mode.

An additional switch position on the refuel/defuel panel allows auto refueling without adding fuel to the aft tank.

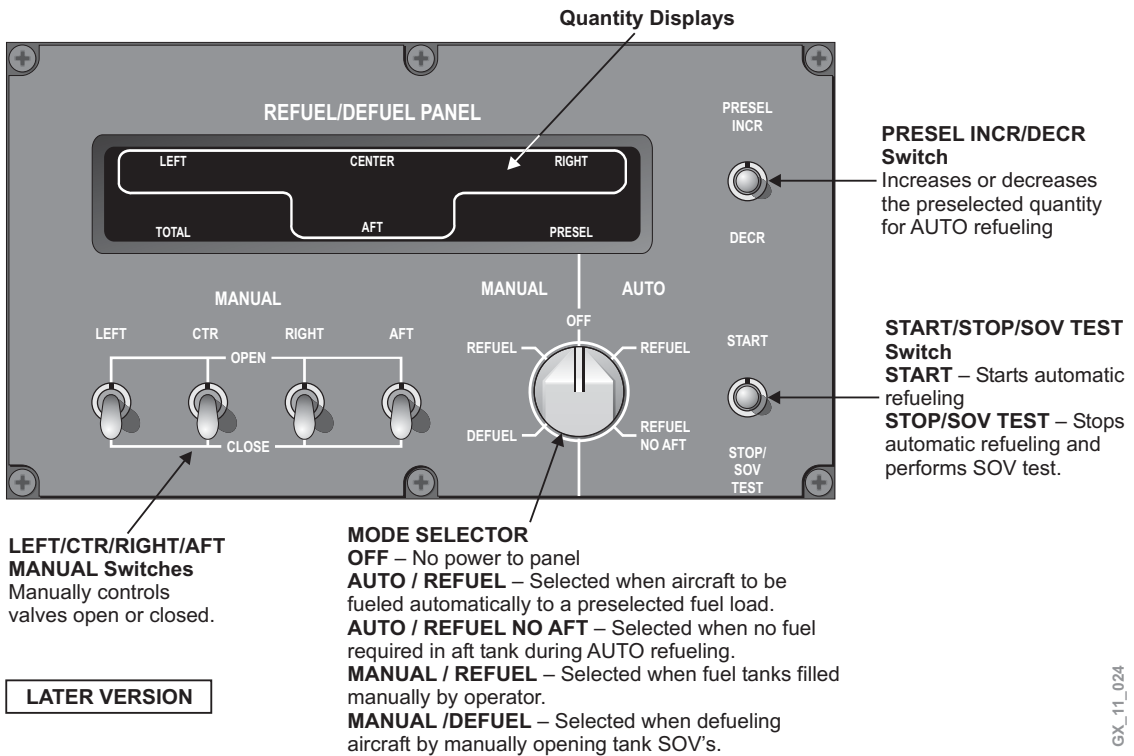
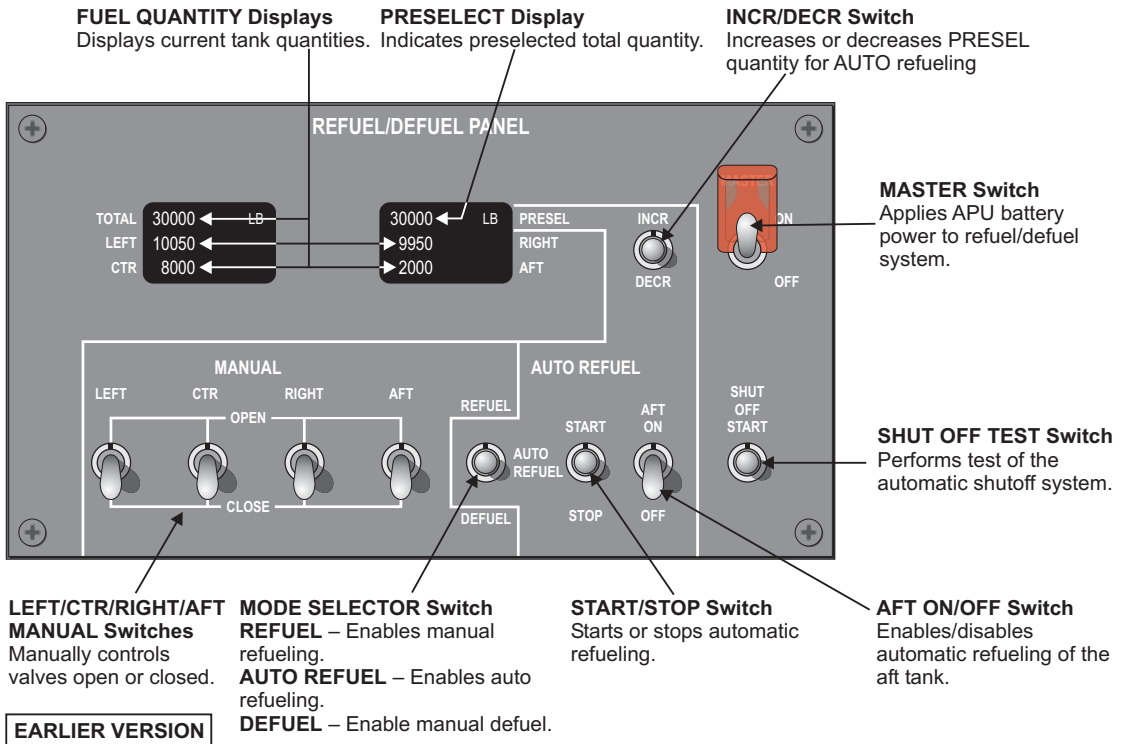
If the aft tank fueling is inhibited by use of this switch, then the refuel sequence is as follows:

- Wing tanks only if the required fuel load is equal to or less than the wing tank capacity
- Wing tanks full and the remainder in the center tank if the required fuel load is greater than the total wing capacity

Fuel Imbalance Limitations

WING TANK FUEL LOAD	GROUND/CONFIGURED FOR TAKEOFF/LANDING	FLIGHT - CLEAN CONFIGURATION
Less than 19,450 lb	1,100 lb	1,100 lb
19,450 to 20,250 lb	1,100 to 600 lb	1,100 lb
Greater than 20,250 lb	600 lb	1,100 lb

REFUEL/DEFUEL PANEL

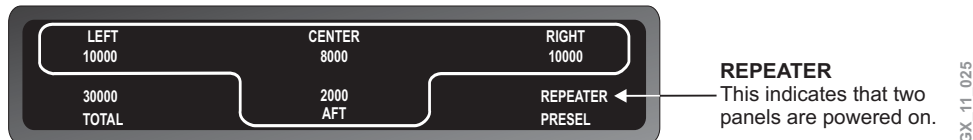


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FAULT REPORTING

Fault reporting is in the form of error messages which will appear in the display windows of the refuel/defuel panel.

The following illustration represents one example of fault reporting:



ERROR MESSAGES

The following messages may be displayed on the refuel/defuel panel if a fault exists:

INHIBIT

In manual refuel or defuel mode, displayed when a tank switch is in the OPEN position. In pressure defuel mode, displayed when an engine is on (no fire handles pulled). In auto mode, displayed when the preselected fuel quantity is invalid, airplane is in CAIMS maintenance mode, or the SOV shutoff test fails.

FULL

Displayed when the high level shutoff has been activated.

LOAD ERROR

In auto refuel mode, displayed when an invalid fuel distribution is selected. Example, one tank contains more fuel than the target quantity assigned by the automatic distribution.

IMBAL

Displayed when a predetermined fuel quantity imbalance exists between the left and right wings.

REPEATER

Displayed in the PRESEL window of the external Refuel/Defuel Panel when two panels are powered ON. The panel located in the flight compartment is in control and the outside panel provides quantity display only.

Dashes will be displayed for a fuel quantity if the computed value is invalid.

FAILED

Displayed in the PRESEL window if the Refuel/Defuel Panel is not functional.

FMQGC - FAILURE

FMQGC will be displayed in the TOTAL window and FAILURE in the PRESEL window if the Refuel/Defuel Panel is not communicating with the fuel computer.

PRESSURE REFUELING

Pressure refueling is accomplished through the single point refuel/defuel adapter, located in the right hand wing root, and is controlled by the refuel/defuel control panel. An optional duplicate refuel/defuel control panel can be installed in the flight compartment.

NOTE

A SHUTOFF TEST must be carried out prior to all refueling operations.

If the test is successful, a SOV PASS is displayed in the PRESEL window. If the test fails, a SOV FAIL is displayed in the PRESEL window.

Pressure refueling may be performed in either “automatic” or “manual” mode. The airplane does not have a fuel jettison system.

A preselect fuel quantity is used during automatic refueling of the airplane. This method will allow the airplane to be filled automatically to the desired fuel state selected.

NOTE

The preselect quantity is the desired final total fuel quantity in the tanks, and not the quantity to be added.

The computer determines the required distribution of fuel into each of the aircraft tanks to achieve the preselected value and controls each refuel valve accordingly. The refuel schedule (planning only) will fill the wings first, then the aft tank, then the center tank. If the aft or center tanks are used each will be fueled to a minimum of 500 pounds to ensure pump priming. The shutoff point, for each tank, is “anticipated” by the computer by monitoring the refueling rate to determine the correct shutoff point for each individual refueling operation.

When auto refueling is terminated by the computer, the quantity showing in the TOTAL window is equal to that in the PRESEL window.

Auto refueling can be interrupted at any time by moving the START/STOP switch to the STOP position. Individual tank quantities can be seen in the other two windows of the display.

The AFT ON/OFF switch allows auto refueling to take place with or without fuel being placed in the aft tank.

EARLIER VERSION RDCP REFUEL/DEFUEL PROCEDURES

NOTES

1. The maximum refueling pressure is 50 psig.
2. The Tank Pressure Relief Valves must be tested for proper function prior to refueling by manually operating the three external pull handles.
3. Maximum fuel imbalance of 400 pounds/1100 pounds (depending on FMQGC software version, see NORMAL FUEL LOADING section) is allowed between the two main tanks, following which, the tank quantity window on the RDCP flashes an IMBAL message alternating with the tank quantities every two seconds.
4. A SHUTOFF TEST of the system must be conducted during each refueling.

AUTO REFUEL

The procedure for auto refuel is as follows:

- Open the RDCP access panel
- Place the MASTER switch in the ON position
- Allow the FMQGC to conduct BITE test until tank quantities are displayed steady in all windows

NOTE

If a system fault is detected, the windows will display dashed lines or error message(s) in the individual tank windows instead of quantities. Do not proceed without investigating and rectifying fault.

- Verify no error messages are displayed in any of the individual tank quantity windows
- Verify all MANUAL tank switches are in the CLOSE position
- Place the MODE SELECTOR switch in the AUTO REFUEL position
- Note the quantities in the TOTAL and PRESEL windows. They should be the same
- Place the AFT switch in the ON or OFF position as required
- Hold the PRESEL switch in the INCR position until the PRESEL window displays the desired total fuel quantity
- Connect the refuel tender to the single point adapter and adjust the tender pressure as desired but not to exceed 50 psig

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- Place the START/STOP switch in the START position and release it
- Verify tank quantities show increase
- Place the spring-loaded SHUTOFF TEST switch in the TEST position and hold it.
- Verify the PRESEL window displays SOV TEST
- Verify all tank quantities stop increasing to confirm the refuel valves have closed
- Verify the PRESEL window displays SOV STOP alternating with the preselected value and does not display SOV FAIL
- Release the SHUTOFF TEST switch and verify tank quantities resume showing increase with the preselected quantity showing steady in the PRESEL window
- The FMQGC shall control the fueling sequence automatically within the required loading sequence
- When all tank quantities stop registering an increase, verify that the displays in the TOTAL and the PRESEL window are the same and no error message is displayed in any of the windows. Each tank window should display the quantity in it as distributed by the FMQGC in the automatic mode and should add up to the TOTAL displayed
- Disconnect the tender as required and return the RDCP MASTER switch to the OFF position
- Secure RDCP access panel

MANUAL REFUELING

In “manual” mode, it permits the operator to select and control the fuel quantity to be added in each tank through the refuel/defuel panel. In this mode, the high level sensors automatically close the refuel/defuel SOVs, if the maximum fuel level capacity is reached.

MANUAL REFUEL

The procedure for manual refuel is as follows:

- Open the RDCP access panel
- Place the MASTER switch in the ON position
- Allow the FMQGC to conduct BITE test until tank quantities are displayed steady in all windows

NOTE

If a system fault is detected, the windows will display dashed lines or error message(s) in the individual tank windows instead of quantities. Do not proceed without investigating and rectifying fault.

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- Verify no error messages are displayed in any of the individual tank quantity windows
- Verify all MANUAL tank switches are in the CLOSE position
- Verify MODE SELECTOR switch is in the mid position marked AUTO REFUEL
- Note the quantities in the TOTAL and PRESEL windows. They should be the same
- Move the MODE SELECTOR switch up to the position marked MANUAL REFUEL
- Verify the PRESEL window displays the message MANUAL instead of quantity
- Connect the refuel tender to the single point adapter and adjust the tender pressure as desired but not to exceed 50 psig
- Select the desired tank MANUAL switches to the OPEN position
- Verify that the selected tank quantities show increase
- Place the spring loaded SHUTOFF TEST switch in the TEST position and hold it
- Verify the PRESEL window displays SOV TEST
- Verify all tank quantities stop increasing to confirm the refuel valves have closed
- Verify the PRESEL window displays SOV STOP alternating with MANUAL and does not display SOV FAIL
- Release the SHUTOFF TEST switch and verify tank quantities resume showing increase with MANUAL showing steady in the PRESEL window
- When the desired fuel quantity for the selected tank is displayed on the tank window, return the MANUAL switch to the CLOSE position to terminate the fueling operation
- Return the MODE SELECTOR switch to AUTO REFUEL
- Disconnect the tender as required and return the RDCP MASTER switch to the OFF position
- Secure RDCP access panel

GRAVITY REFUELING

The wing tanks may be refueled through over wing gravity fill adapters located on top of both left and right wings. It is not possible to completely fill either wing tank by gravity fueling, since the fill adapters are located outboard and below the maximum fuel level.

The center tank may be refueled through a gravity fill adapter located on top of the right hand wing.

Gravity fueling of the aft tank is not possible therefore; no fill adapter is provided.

SUCTION DEFUELING

Suction defueling of the fuel tanks is carried out by applying suction (recommended pressure of -8 psig) to the single point refuel/defuel adapter, using the refuel/defuel control panel.

WING TANK

Suction defueling of the wing tanks is accomplished by opening a valve which connects the refuel/defuel manifold to the engine feed line. This allows fuel to be drawn out of the tank through the suction defuel check valve in the feed tank.

CENTER TANK

The center tank is defueled through the refuel/defuel shutoff valve.

AFT TANK

The aft tank may be suction defueled, using the same line and shutoff valve used for pressure refueling of the tank.

SUCTION DEFUEL

The procedure for suction defuel is as follows:

- Open the RDCP access panel
- Place the MASTER switch in the ON position
- Allow the FMQGC to conduct BITE test until tank quantities are displayed steady in all windows

NOTE

If a system fault is detected, the windows will display dashed lines or error message(s) in the individual tank windows instead of quantities. Do not proceed without investigating and rectifying fault.

- Verify no error messages are displayed in any of the individual tank quantity windows
- Verify all MANUAL tank switches are in the CLOSE position
- Verify the AUTO REFUEL switch is in the mid position marked AUTO REFUEL
- Note the quantities in the TOTAL and PRESEL windows. They should be the same
- Move the MODE SELECTOR switch to the position marked MANUAL DEFUEL
- Verify the PRESEL window displays the message DEFUEL

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- Connect the refuel tender to the single point adapter and adjust the tender pressure to negative 8 psig (suction) maximum
- Select the desired tank MANUAL switches to the OPEN position
- Verify tank quantities show decrease
- When the desired fuel quantity for the selected tank is displayed on the tank window, return the MANUAL switch to the CLOSE position to terminate the defueling operation
- Move the MODE SELECTOR switch to AUTO REFUEL
- Disconnect the tender as required and return the RDCP MASTER switch to the OFF position
- Secure RDCP access panel

PRESSURE DEFUELING

Pressure defueling of the fuel tanks is accomplished through the fuel shutoff valves and single point adapter. Pressure defueling is identical to suction defueling, except that primary defueling flow is provided by the AC boost pumps or DC auxiliary pump in each feed tank.

NOTE

AC or DC electrical power is required to operate the airplane pumps for this procedure.

Direct pressure defueling of the wing tank is accomplished using the AC boost pumps or DC auxiliary pump in each feed tank.

Direct pressure defueling of the center tank is not possible. Center tank fuel may however be transferred to the wing tanks using the center tank transfer pumps. From there, it may then be defueled via the wing tank.

Direct pressure defueling of the aft fuselage tank is not possible. Aft fuselage tank fuel may however be transferred to the wing tanks using the aft transfer pumps. From the wing tank, it may then be defueled via the wing tank.

LATER VERSION RDCP REFUEL/DEFUEL PROCEDURES

Differences in Later Refuel/Defuel Panel are as follows:

- The MODE SELECTOR switch is now rotary and includes the aft tank control switch
- The START/STOP switch now includes the SOV test function
- The master ON/OFF switch is part of the mode selector switch

EICAS MESSAGES

FUEL IMBALANCE

Indicates that a fuel quantity imbalance exists between the left and right wing tanks of:

- More than 1100 lbs (499 kg) in flight
- Between 600 lbs (272 kg) and 1100 lbs (499 kg) on ground or in Takeoff / Approach configuration.

AFT XFER OFF SCHED

Indicates that fuel transfer from the aft tanks to the wings is unable to keep pace with the optimum aft transfer schedule.

FUEL COMPUTR FAIL

Indicates that both channels of the fuel system computer have failed.

L (R) FUEL RECIRC FAIL

Indicates that the FRTT valve is not in the commanded or allowed position.

→ FUEL XFER FAIL

Transfer from the left wing to the right wing has been requested and failed.

← FUEL XFER FAIL

Transfer from right wing to left wing has been requested and failed.

FUEL TEMP SENSOR

On ground, indicates that a fuel temperature sensor is failed. With flaps deployed, will be posted only if the failure requires corrective action.

FUEL LO QTY

Indicates fuel in the left or right wing tank is less than 600 lbs (272 kg).

FUEL UNIT MISMATCH

The refuel/defuel panel and EICAS indications are correct but in different units of measurements.

→ FUEL XFER ON

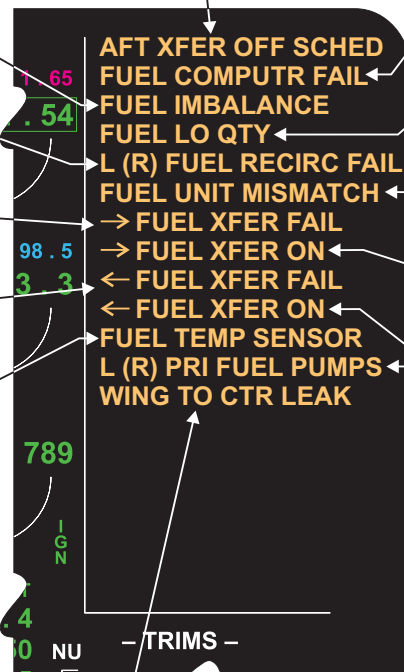
Indicates that fuel is being transferred from the left wing tank to the right wing unrequested.

← FUEL XFER ON

Indicates that fuel is being transferred from the right wing tank to the left wing unrequested.

L (R) PRI FUEL PUMPS

Indicates both left or both right forward and aft primary AC pumps have failed to operate when requested.

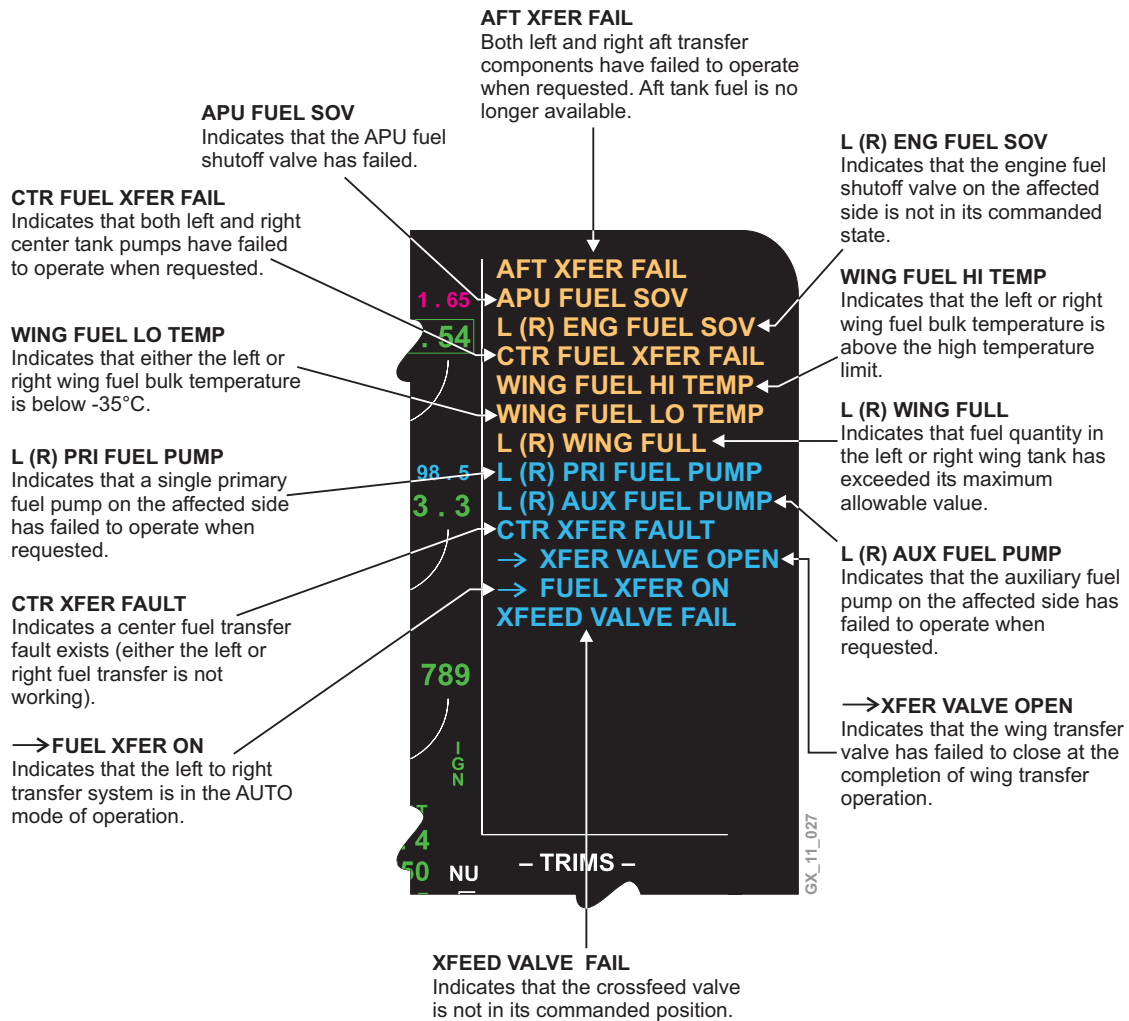


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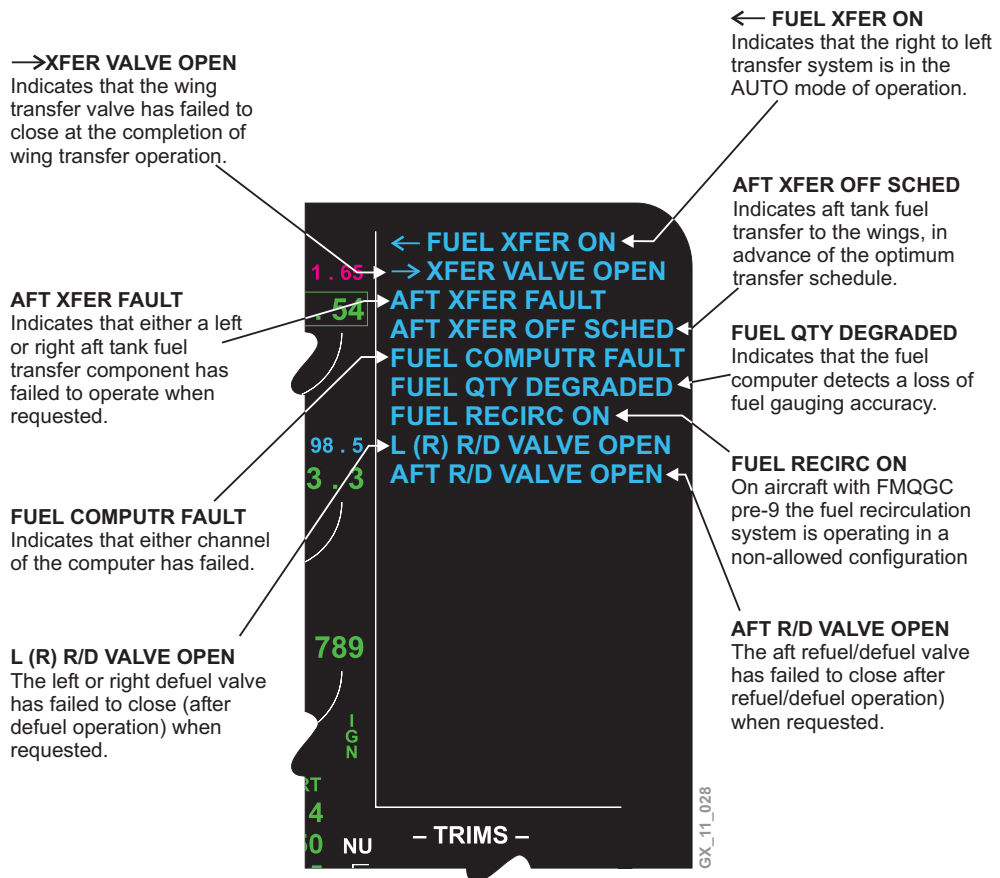
WING TO CTR LEAK

Indicates that the fuel level in the center tank has increased by 600 lbs or more.

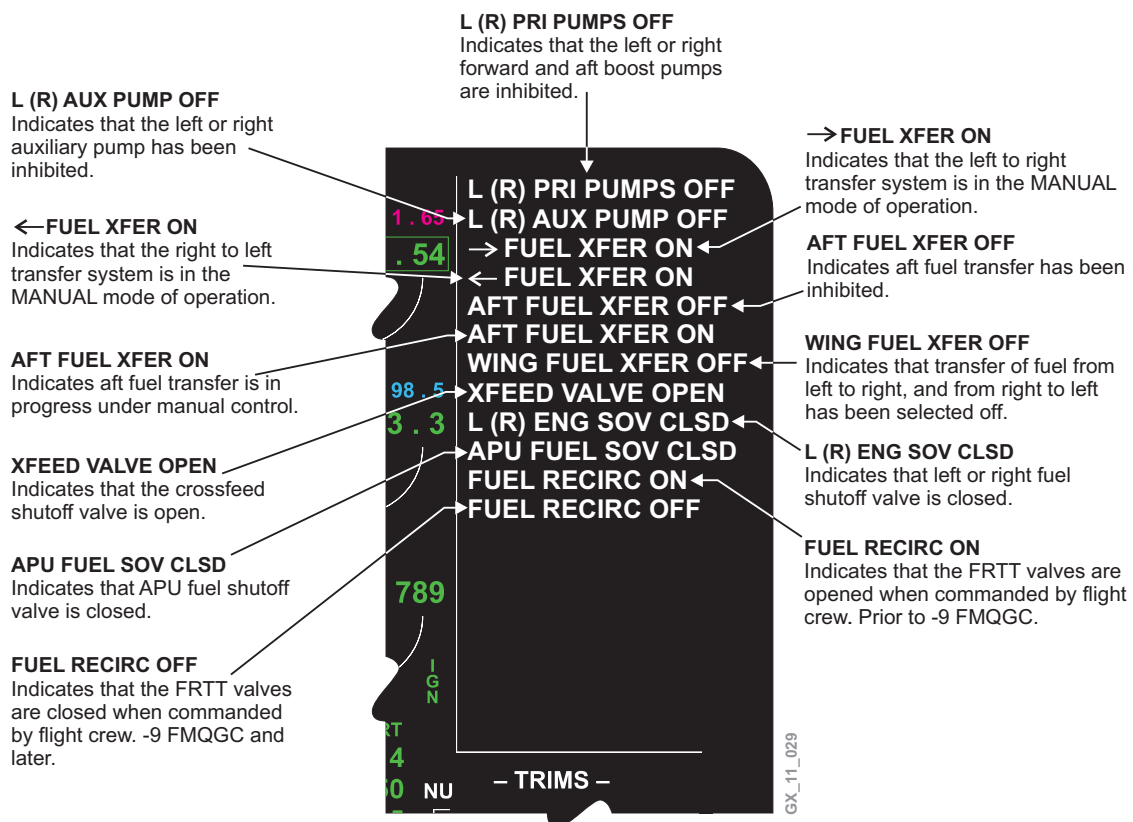
EICAS MESSAGES (Cont)



EICAS MESSAGES (Cont)

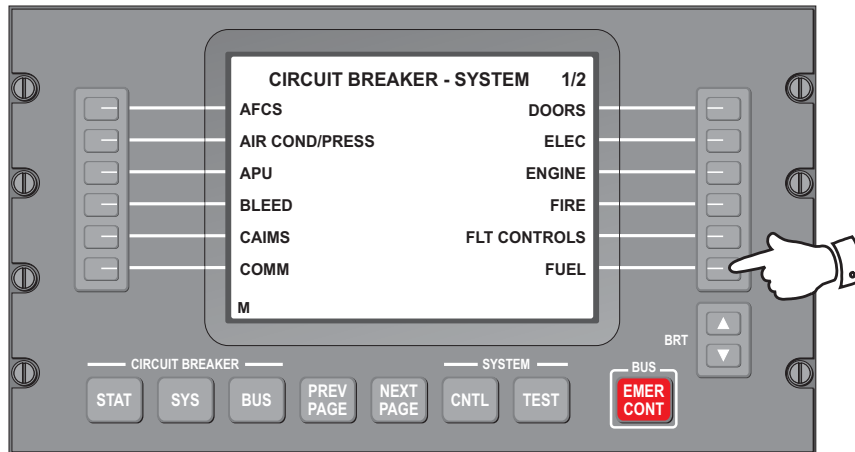


EICAS MESSAGES (Cont)



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EMS CIRCUIT PROTECTION



CB - FUEL SYSTEM				1/6
XFER SOV C	DC ESS		IN	
XFER SOV O	DC ESS		IN	
XFER SOV C	BATT		IN	
XFER SOV O	BATT		IN	
AFT TANK L PUMP	AC 2		IN	
AFT TANK L SOV C	DC 1		IN	

CB - FUEL SYSTEM				2/6
AFT TANK L SOV O	DC 1	X	IN	
AFT TANK R PUMP	AC 3	X	IN	
AFT TANK R SOV C	DC 2	X	IN	
AFT TANK R SOV O	DC 2	X	IN	
APU FIRE SOV	DC EMER	DCPC	IN	
FUEL COMPUTR CH A	BATT		IN	

CB - FUEL SYSTEM				3/6
FUEL COMPUTR CH B	DC ESS	X	IN	
FUEL R/D CH A	APU BATT	ASCA	IN	
FUEL R/D CH B	APU BATT	ASCA	IN	
L AFT PRI PUMP	AC 1		IN	
L AUX PUMP	DC ESS		IN	
L CTR XFER PUMP	AC 1		IN	

CB - FUEL SYSTEM				4/6
L ENG FUEL SOV	DC EMER	DCPC	IN	
L FWD PRI PUMP	AC 2	X	IN	
L FUEL RECIRC VLV	DC 1	X	IN	
R AFT PRI PUMP	AC 4	X	IN	
R AUX PUMP	BATT	X	IN	
R CTR XFER PUMP	AC 4	X	IN	

CB - FUEL SYSTEM				5/6
R ENG FUEL SOV	DC EMER	DCPC	IN	
R FWD PRI PUMP	AC 3	X	IN	
R FUEL RECIRC VLV	DC 2	X	IN	
R/D MOTOR VALVES	APU BATT	ASCA	IN	
R/D PANEL COCKPIT	APU BATT	ASCA	IN	
R/D PANEL EXT	APU BATT	ASCA	IN	

CB - FUEL SYSTEM				6/6
R/D SOL VALVES	APU BATT	ASCA	IN	
X FEED SOV C	BATT		IN	
XFEED SOV O	BATT		IN	

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NOTE: The fuel recirculation protection is not active, TBD by flight test.