Section - III
SYSTEMS DESCRIPTION

Sub-section 3
FUEL SYSTEM

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GENERAL

The fuel storage system consists of three fuel tanks:

- Two integral fuel tanks, one in each wing
- A ventral fuel tank under the lower aft fuselage (if installed)

The system has both a wing tank to wing tank transfer capability, and a crossfeed capability from either wing tank to one or both of the engines. A fuel transfer system permits fuel transfer from the auxiliary ventral tank into either one or both of the wing tanks.

Jet pumps use motive flow action from electrical fuel pumps to draw fuel from the wings into the number one compartment (aft center wing section). The electrical fuel pumps deliver pressurized fuel to the engines. The fuel system has a gravity refueling and a pressure refueling/defueling capability.

For information on the engine fuel system components refer to Sub-section 2 ENGINES.

WING TANKS

Each wing is a sealed structure (wet wing) forming a tank which is divided into six anti-surge compartments by spars allowing fuel to pass via stringers to the No. 1 compartment which acts as the fuel reservoir.

With the fuel pumps operating, and the appropriate transfer selection made, fuel can be transferred between the wing tanks, and from the ventral tank to the wing tanks.

NOTE: The engines cannot receive fuel directly from the ventral tank, the fuel from the ventral tank must be transferred to the wing tanks first.

Fuel cross-feed and wing to wing transfer is controlled by a lever labelled WING FUEL/X-FEED/ TRANSFER located on the lower center console.

When the WING FUEL cock is moved to the center X-FEED position, the fuel cross-feed valve is opened to connect both engine feed lines together. This allows either fuel pump to supply fuel to both engines. Non-return valves prevent fuel being fed back into the tank with the inoperative fuel pump.

When cross-feeding the fuel is drawn from one wing tank only. This results in the wings becoming progressively out of balance.

NOTE: The maximum lateral imbalance permitted is 500 lbs.

This is monitored on the left and right wing fuel contents indications displayed on the Copilot's Multifunction Display (MFD).

To correct any out-of-balance the WING FUEL cock is moved to the bottom TRANSFER position. The inter-wing transfer valve opens in addition to the cross-feed valve (already opened) and transfer of fuel from the heavy wing to the lighter wing takes place via the jet pump.

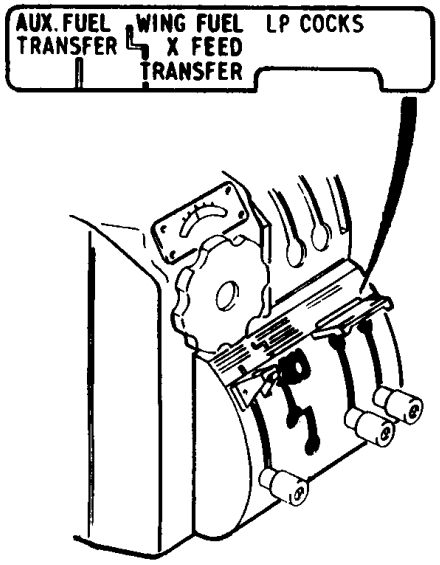


Figure 1
Wing Tank Crossfeed and Transfer

FUEL TANK VENTING

Each fuel tank is vented to the atmosphere through the vent surge tank in the wing tip. Each vent tank incorporates a NACA intake that pressurizes the vent system. Fuel that spills into the vent surge tank syphons back into the wing tanks as the tank level falls. Each wing tank is vented to the vent surge tank at its outboard end via a float valve and at its inboard end via a stringer in the wing top skin. The float valve prevents fuel loss through the vent during in-flight maneuvering.

The ventral tank vents into the left wing tank through two vent float valves, non-return valves, a pipe and a wing stringer.

DRAIN VALVES

One fuel drain valve and one water drain valve per wing fuel tank are located on the lower surface of the center wing section. In addition a drain valve below the vent surge tank allows water checks or complete draining.

A fuel drain valve and fuel tank water drain valve for the ventral tank is found on the lower forward surface of the ventral tank.

REFUEL/DEFUEL FILLER POINTS

All tanks may be pressure refueled/defueled, through a coupling at the rear of the airplane. Alternatively, the wing tanks and the ventral tank may be gravity filled through a filler neck provided in each tank.

Key

Valves

1. WING TRANSFER
2. No 1 LOW PRESSURE
3. CROSS FEED
4. No. 2 LOW PRESSURE
5. VENTRAL TANK TRANSFER
6. APU FEED

WATER DRAIN

CHECK VALVE

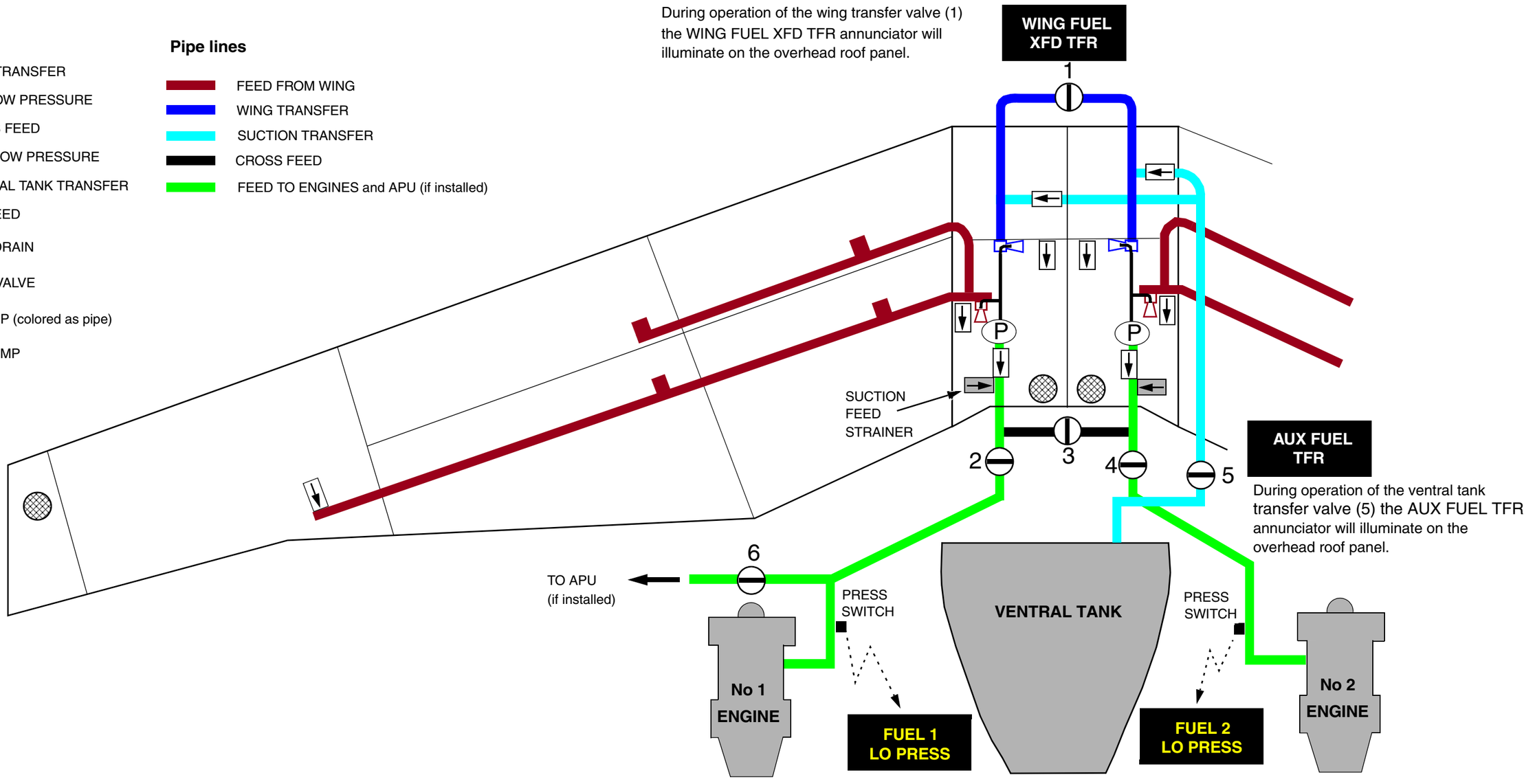
JET PUMP (colored as pipe)

P FUEL PUMP

Pipe lines

- FEED FROM WING
- WING TRANSFER
- SUCTION TRANSFER
- CROSS FEED
- FEED TO ENGINES and APU (if installed)

During operation of the wing transfer valve (1) the WING FUEL XFD TFR annunciator will illuminate on the overhead roof panel.



During operation of the ventral tank transfer valve (5) the AUX FUEL TFR annunciator will illuminate on the overhead roof panel.

Figure 2
Fuel Feed System

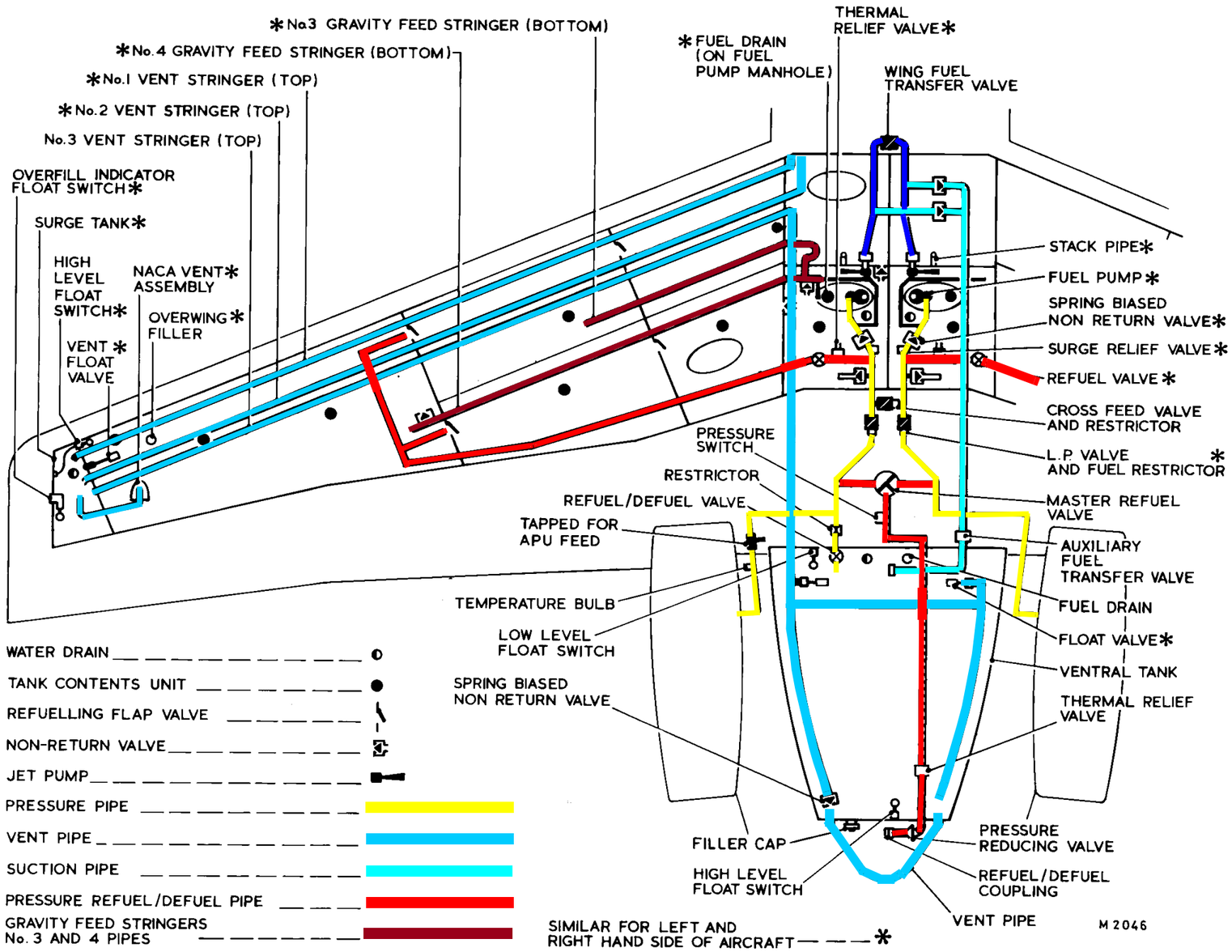


Figure 3
Refuel/Defuel System

Gravity Filler

A flush mounted fuel filler assembly is located on the upper surface of each wing near the outboard leading edge. The assembly includes a wing skin adaptor, flap valve, lockable cap and a lanyard that attaches the cap to the wing. Each cap is recessed to allow for the flush fitting handles and is marked with an arrow to indicate the open and closed positions. The filler cap adaptor also incorporates a rubber flap valve that prevents fuel spillage during flight, in the event that the cap is inadvertently left off.

The ventral tank is gravity fueled through the ventral tank filler assembly, which is accessible through a hinged door aft of the rear equipment bay door beneath the aft section of the right engine. The ventral tank is gravity fueled in the same manner as the wing tank.

Pressure Refueling

A standard type 2 1/2 inch pressure refueling coupling is accessible through a hinged door recessed into the ventral tank fairing at the rear right side of the airplane. The airplane fuel system accepts a maximum refueling supply pressure of 50 psi.

Incorporated into the fuel system is a pressure reducing valve that reduces the refueling pressure within the system to 25 psi. Restrictors limit flow rates into tanks and surge relief valves modulate transient high pressures.

Table 1: Pressure Refueling Quantities

Tank	*U.S. Gallons*	*Liters*
Wing Left	631	2391
Wing Right	631	2391
Ventral Tank	224	850
Total	1486	5632

NOTES:

1. *When gravity refueling is used the tank capacities will increase by 3 U.S. gallons (11 Liters).*
2. *For airplanes without an external toilet servicing facility, the capacity of the ventral tank will increase by 5 U.S. gallons (19 liters).*

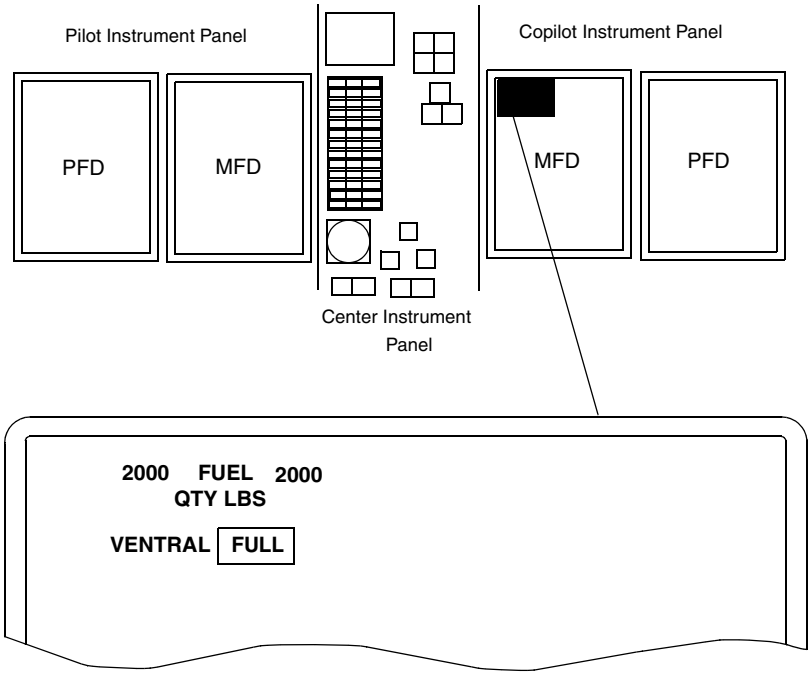
FUEL PROBES and FLOAT SWITCHES

Both wing tanks have a capacitance type contents indicating system. Six capacitance type transmitter probes in each wing supply fuel quantity information to the fuel quantity indications on the Copilot's Multifunction Display (MFD).

The fuel probes are positioned within the tanks so that between certain limits, the airplane attitude does not effect the indicated contents. A high level/low level float switch in the ventral tank supplies fuel level information to the Data Concentrator Unit (DCU) which is then indicated on the Copilot's Multifunction Display (MFD).

FUEL QUANTITY INDICATIONS

The left and right fuel quantity indications on the Copilot's MFD display the quantity of fuel in each wing tank. The fuel quantity indications display the actual usable fuel in level flight. The ventral tank fuel indication receives fuel level information from the associated high level/low level float switch via the DCU. The indication displays either FULL, EMPTY or a cross-hatch pattern, the cross-hatch pattern indicating that the fuel level is between full and empty or that electrical power is off. The tanks also contain a small amount of unusable fuel most of which may be drained together with any water content from the tanks via the water/fuel drains.



The fuel distribution system is divided into three subsystems:

- Engine feed system
- Wing tank transfer system
- Auxiliary tank transfer system

The engine feed system supplies positive pressure fuel from an electric fuel pump in the rear center wing section to the engine driven pump in the engine fuel control. The wing tank transfer system allows fuel balancing between the wing fuel tanks in flight and on the ground. The auxiliary transfer system distributes fuel from the ventral tank in equal portions to the left and right wing tank systems.

REFUEL/DEFUEL CONTROL and INDICATIONS

During refueling, with airplane batteries ON, fuel quantity is monitored by paging through the pilot's CDU to the ENGINE page. This process will also power up other units on the airplane creating a drain on the airplane batteries.

Drain of the airplane batteries has been reduced on airplanes which have incorporated RAC Service Bulletin SB 24-3641. Incorporation of this SB allows the display of fuel quantity on the pilot's CDU following the selection of the Refuel Control Panel POWER switch to ON. Selecting the airplane batteries to ON (for these airplanes) is not required.

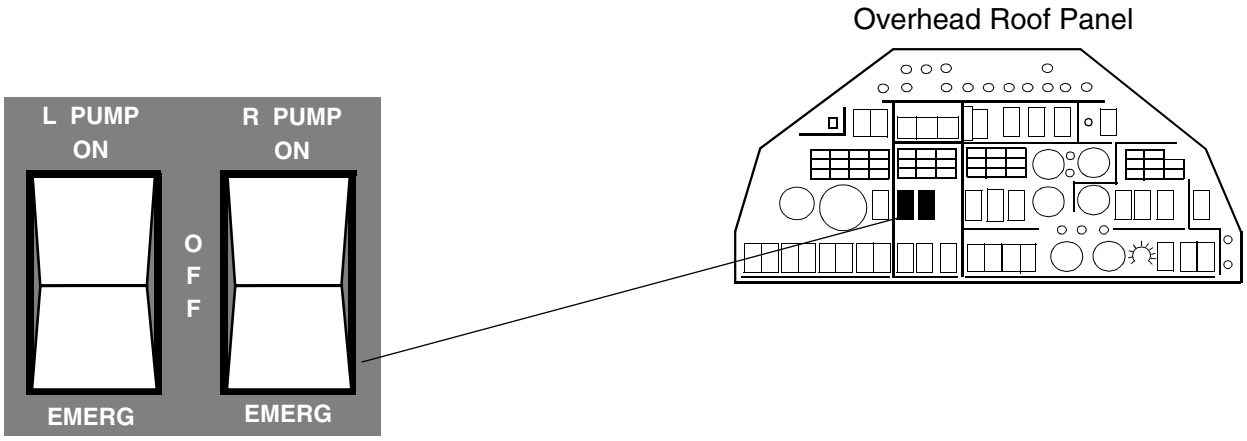
ENGINE FUEL FEED SYSTEM

FUEL PUMPS

Two electrically operated fuel pumps, one per wing tank, located in the fuel reservoir (compartment No. 1), supply fuel to their respective engines and also provide motive flow fuel to its associated jet pumps. Non-return valves in the fuel pump outlets and the sides of the fuel pump reservoirs make sure the direction of fuel flow is from the wing tanks to the engines. In the event of a single pump failure, a cross-feed facility permits the operational pump to feed both engines.

Each fuel pump is controlled by a three position rocker switch on the flight compartment overhead roof panel. The switch positions are: ON/OFF/EMERG. The normal operating position is ON, and power to the pumps is taken from the PS1 busbar for the left pump and the PS2 busbar for the right pump.

When the EMERG position is selected both pumps are powered from PE busbar. Under normal conditions, each fuel pump delivers fuel to its respective engine via a low pressure fuel cock.



Should both fuel pumps fail, fuel still gravity feeds into the fuel reservoir of each wing so that the engine driven pumps can draw the fuel for operation under suction feed. Warning of pump failure is provided by a FUEL 1 LO PRESS and/or FUEL 2 LO PRESS amber annunciator located on the overhead roof panel. To alert the flight crew of these warnings, these annunciators are accompanied by a flashing repeater annunciator located on the MWS panel.

JET PUMPS

Each fuel pump also supplies fuel to two jet pumps. One jet pump drains fuel from the wing manifold stringers to maintain the wing reservoir full. It also makes sure a fuel supply is provided to the fuel pump during momentary negative "g" conditions. The second jet-pump forms part of the fuel transfer system and induces a flow into the associated wing tank reservoir from either the opposite wing tank or the ventral tanks, dependent on the transfer selection made.

The transfer system jet pumps also operate a scavenge system which continuously transfers fuel between the center section beam and the fuel pump reservoirs to prevent water accumulation. Jet pumps only operate when their inlets are completely submerged and when their associated fuel pumps are on.

FUEL PRESSURE SWITCH

A pressure switch in each fuel line, upstream of the engine driven pumps, monitors fuel pressure.

The pressure switch illuminates the ENG 1 or ENG 2 LO PRESS annunciators on the overhead roof when the pressure drops below 6.5 (± .5) psi and extinguishes the annunciators when the fuel pressure increases. The FUEL repeater annunciator, on the MWS panel, will also illuminate to direct the flight crew's attention to the overhead roof panel.

LOW PRESSURE COCKS and LEVERS

A low pressure (LP) fuel cock valve, one in each engine supply line, isolates the engine fuel feed pipes from the wing tanks and provides system shutdown for engine fire control procedures. The LP COCK levers, one for each engine, are located on the center control pedestal and mechanically open and close the LP fuel cock valves when moved up or down respectively.

To operate, lift a hinged guard installed above the control levers before the levers are moved to the closed (down) position. The LP COCK levers also incorporate a spring loaded knob to lock the lever in either the open or closed positions.

NOTE: Closing the No. 1 LP COCK lever will also close the fuel supply to the APU (if installed).

HIGH PRESSURE COCKS and LEVERS

The HP COCK levers, one for each engine, are located above the LP COCK levers on the center control pedestal and open and close the manual fuel shutoff valve inside the fuel control unit.

Each shutoff valve opens or closes when the associated HP COCK control lever is moved up or down respectively. The HP COCK levers incorporate a spring loaded knob to lock the lever in either the open or closed positions. Opening the HP COCK lever during the engine start cycle initiates ignition.

Fuel To Engine Cutoff

Placing the HP COCK in the closed position, closes the manual fuel shutoff valve, moves the thrust lever to the idle position and shuts off fuel to the engine should an engine fire occur. The hydraulic supply valve is also closed by this action as a fire control measure.

AUXILIARY TANK TRANSFER

The AUX FUEL TRANSFER lever is located on the center control pedestal and mechanically actuates the ventral tank transfer valve. Moving the lever to the down position opens the transfer valve and the white AUX FUEL TFR annunciator on the overhead roof panel will illuminate.

AUX FUEL TFR

With both fuel pumps operating, fuel transfers from the ventral tank to both wing tanks with jet pump operation in approximately 10 minutes.

When only one fuel pump is operational, the fuel from the ventral tank can only transfer to the wing with the operational fuel pump running. Under this condition the transfer process time may increase to over 18 minutes.

NOTE: To make sure the fuel in the ventral tank has been completely transferred, the AUX FUEL TRANSFER lever should be left open for at least 2 minutes after the completion of fuel transfer and the airplane has reached it's cruising altitude.

If both fuel pumps are inoperative the fuel in the ventral tank cannot be transferred.

NOTE: Overweight landing procedure and inspection is required for any landing made with fuel in the ventral tank.

Moving the AUX FUEL TRANSFER lever to the up position closes the ventral tank transfer valve and the white AUX FUEL TFR annunciator will extinguish. Auxiliary fuel transfer process should begin as soon as the indicated fuel in each wing reduces to 3300 lbs.

WING TANK CROSSFEED and TRANSFER

The WING FUEL cock is located on the center control pedestal and mechanically actuates the wing tank crossfeed valve and the transfer valves. The WING FUEL cock has three positions:

- WING FUEL up gate position (all valves closed)
- X-FEED center position (crossfeed valve open)
- TRANSFER bottom position (crossfeed and transfer valves open)

The WING FUEL position closes the crossfeed and transfer valves and allows fuel to feed from the left/right wing tanks to the left/right engines respectively. The lever should be in this position for all normal flight conditions.

The X-FEED position opens the crossfeed valve and allows fuel from either wing tank to feed one or both engines. In the event of a fuel pump failure, the X-FEED position enables the operating fuel pump to supply both engines.

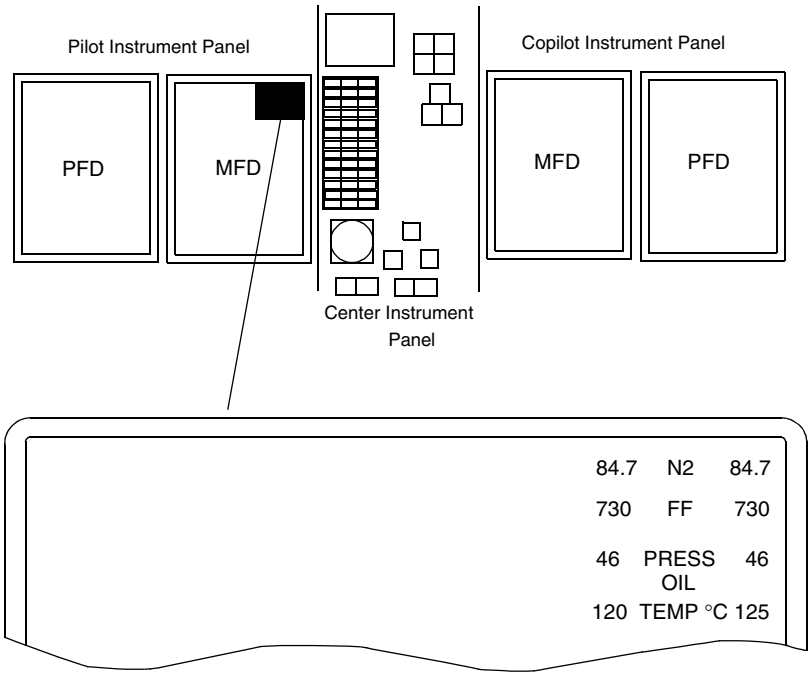
The TRANSFER position opens the transfer valve and enables wing to wing fuel transfer. With the lever in the TRANSFER position and a single fuel pump operating, fuel transfers from the opposite wing tank to the wing tank containing the operating fuel pump.

FUEL XFD TFR ANNUNCIATOR

The white FUEL XFD TFR repeater annunciator on the MWS panel will illuminate when the WING FUEL cock is in either the X-FEED or the TRANSFER position.

FUEL FLOW INDICATIONS

Dual FUEL FLOW indications on the Pilot's Multifunction Display (MFD) provide a visual account of the fuel consumption rate. A flow transmitter on each engine sends a signal through the Engine Indicating System and displays the fuel flow figures on the Pilot's MFD.



FUEL TEMPERATURE INDICATOR

A temperature bulb in the left engine fuel supply line is electrically connected to the outside air/fuel temperature indicator on the upper left area of the center control pedestal. The indicator displays the fuel temperature when the PUSH FUEL TEMP switch is pushed.