SECTION 12

FUEL

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SECTION 12

FUEL

1. SYSTEM CONFIGURATIONS

The fuel system has one of two fuel tank configurations: a basic three-tank configuration consisting of left and right main tanks and an auxiliary tank; or a five-tank configuration, of larger capacity, which has two additional auxiliary tanks, designated the forward and rear auxiliary tanks, respectively. The systems and operations described in the following paragraphs apply to both of these configurations unless otherwise noted.

2. GENERAL (Figure 1)

The principal components of the aircraft fuel system include fuel tanks, independent ejector pumps for each engine, two electric pumps, and a fuel feed system for the auxiliary power unit (APU). A single point pressure refuel/defuel adapter is provided and gravity refueling/defueling is carried out through filler caps on the upper wing surface. Fuel and water drains are located at various low points on the fuel system components to permit manual drainage of the fuel tanks.

All the fuel and vent lines routed through the fuselage are surrounded by airtight fireproof shrouds which have integral vent and drainage lines. The relatively high elevation of the fuel lines, running from the top of the wing box centre section up to the engine nacelle level, protects them from damage in the event of a wheels-up landing.

Control of the fuel system components and fuel quantity indication are provided by the FUEL CONTROL and FUEL QUANTITY panels on the centre instrument panel. The FUEL CONTROL panel has system caution lights as well as pump and valve switch/lights and a fuel temperature gauge. The FUEL QUANTITY panel provides an indication of individual tank and total fuel quantity.

In addition to supplying the engines and the APU with fuel, the system provides a flow of fuel to cool the APU generator oil and, on aircraft that do not incorporate Canadair Service Bulletin 600-0318, the No. 3 hydraulic system fluid. Fuel in excess of the APU feed requirements is tapped from a return line from the APU and used as the cooling medium.

3. FUEL STORAGE (Figures 1 and 2)

Conforming to a wet wing design concept, the entire wing box structure is sealed to form three tanks: the left and right main tanks and the auxiliary tank. The left and right main tanks are formed by the wing box structure outboard of wing station 45.00 (left and right) and the auxiliary tank occupies the space enclosed by the wing box centre section. The capacities of the tanks, in litres (US gallons) of useable fuel, are:

	Pressure refueling Litres (US gallons)	Gravity refueling (approx.) Litres (US gallons)
Left main tank	2716 (717.5)	2519 (665.5)
	[1] 2733 (722)	[1] 2536 (670)
Right main tank	2716 (717.5)	2519 (665.5)
	[1] 2733 (722)	[1] 2536 (670)
Auxiliary tank	2835 (749)	2835 (749)
	[2] 3193 (843.5)	[2] - -
	[3] 3823 (1010)	[3] 3569 (943)
Totals	8267 (2184)	7873 (2080)
	[1] 8301 (2193)	[1] 7907 (2089)
	[2] 8625 (2278.5)	[2] - -
	[3] 9255 (2445)	[3] 8607 (2274)

[1] Aircraft 1072.
[2] Aircraft with aft fuselage tank.
[3] Aircraft with aft and forward fuselage tank.

The system contains approximately 110 pounds of unusable fuel trapped in the various system components.

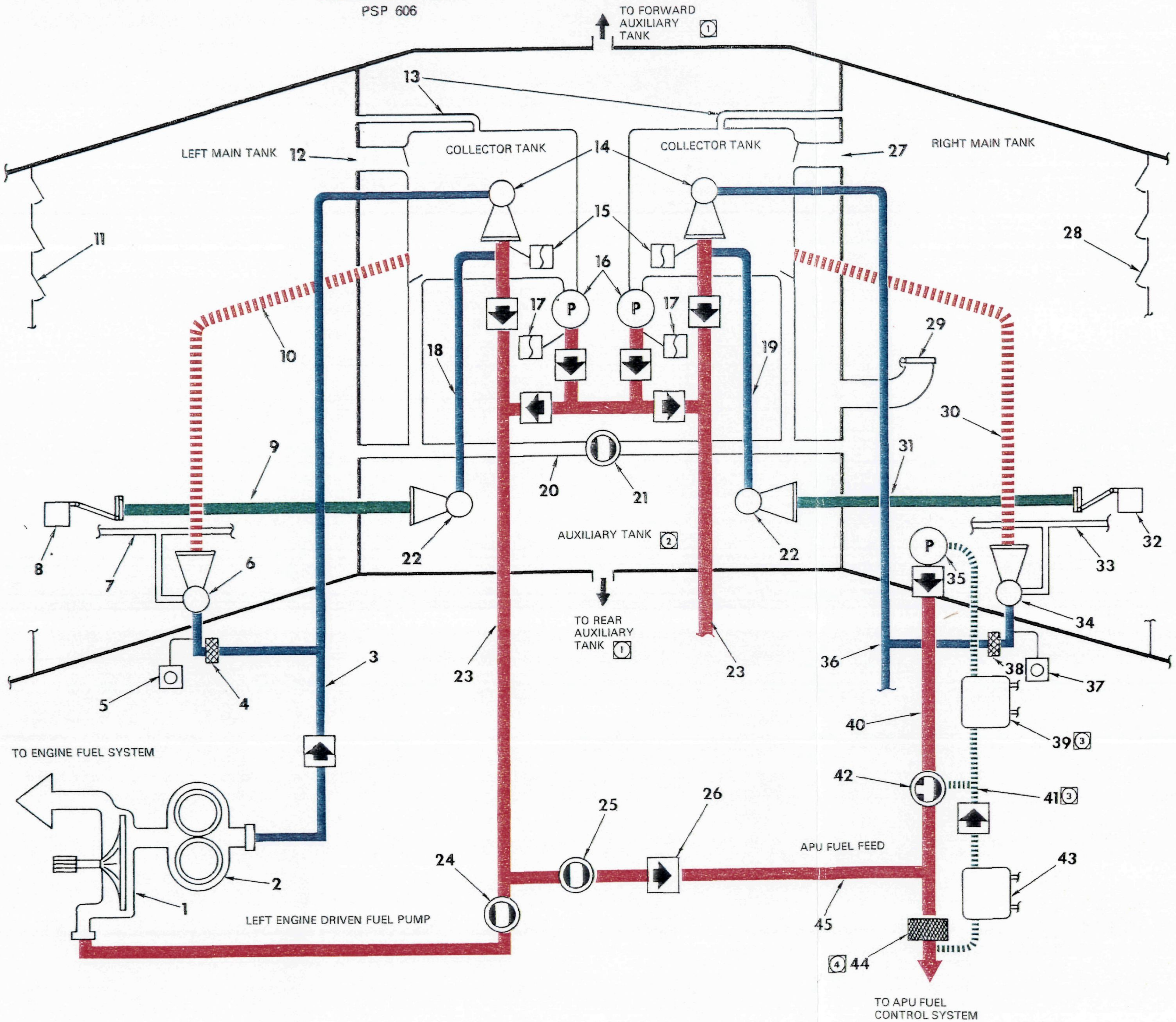
In the main tanks, the ribs of the wing box assembly act as baffles to limit centre of gravity shifts by restricting the sudden displacement of a large volume of fuel with changes in the aircraft's attitude.

Fuel in the main tanks flows inboard through lightening holes in the wing ribs. Flapper check valves, installed on the ribs at WS85.50 and WS148.00 ensure that a portion of the fuel in the main tanks remains trapped between these wing stations and the auxiliary tank at all times during flight.

A balance line, equipped with an electrically-operated shutoff valve, connects the main tanks at their lowest points. The shutoff valve is controlled by the X FLOW switch/light on the FUEL CONTROL panel and is opened to allow the main tank fuel quantities to equalize by gravity.

The auxiliary tank contains the left and right collector tanks which feed the left and right engines, respectively. The collector tanks enclose the left and right primary ejector pumps and are maintained in the full-fuel state by gravity feed lines and the scavenge ejector lines from the main tanks. The electric fuel pumps of the standby fuel feed system are also located inside the auxiliary tank, mounted beside the collector tanks. When in operation, each electric pump draws fuel only from its corresponding collector tank.

Twenty-nine flush-mounted access panels, twenty-seven for the main tanks and two for the auxiliary tank, are installed on the lower wing surface to provide access to the interior of the fuel tanks. Three similar panels serve as supports for the electric fuel pumps of the standby and APU fuel feed systems. A cover on these panels can be removed to permit servicing of the fuel pump motor elements without draining the associated fuel tanks and lines.



1 ENGINE DRIVEN PUMP - CENTRIFUGAL ELEMENT
2 ENGINE DRIVEN PUMP - GEAR PUMP ELEMENT
3 MOTIVE FLOW LINE
4 FILTER
5 FLOW SWITCH - LEFT SCAVENGE EJECTOR
6 LEFT SCAVENGE EJECTOR
7 LEFT VENT LINES PURGE CONNECTION
8 LEFT TRANSFER LINE FLOAT VALVE
9 LEFT TRANSFER LINE
10 LEFT SCAVENGE EJECTOR LINE
11 FLAPPER CHECK VALVES - WING STATION 85
12 GRAVITY FEED LINE - LEFT MAIN TANK TO LEFT COLLECTOR TANK
13 COLLECTOR TANK VENT LINES
14 LEFT AND RIGHT PRIMARY FUEL EJECTORS
15 PRESSURE SWITCHES - LEFT AND RIGHT PRIMARY FUEL EJECTORS
16 LEFT AND RIGHT ELECTRIC BOOST PUMPS
17 PRESSURE SWITCHES - LEFT AND RIGHT ELECTRIC PUMPS
18 LEFT TRANSFER EJECTOR MOTIVE FLOW LINE
19 RIGHT TRANSFER EJECTOR MOTIVE FLOW LINE
20 MAIN TANKS BALANCE LINE
21 BALANCE LINE SHUTOFF VALVE
22 LEFT AND RIGHT TRANSFER EJECTORS
23 LEFT AND RIGHT ENGINE FUEL FEED LINES
24 LEFT FIREWALL FUEL SHUTOFF VALVE
25 APU NEGATIVE-G PROTECTION LINE SHUTOFF VALVE
26 ONE-WAY CHECK VALVE
27 GRAVITY FEED LINE - RIGHT MAIN TANK TO RIGHT COLLECTOR TANK
28 FLAPPER CHECK VALVES - WING STATION 85
29 GRAVITY FILLER CAP - AUXILIARY TANK
30 RIGHT SCAVENGE EJECTOR LINE
31 RIGHT TRANSFER LINE
32 RIGHT TRANSFER LINE FLOAT VALVE
33 RIGHT VENT LINES PURGE CONNECTION
34 RIGHT SCAVENGE EJECTOR
35 APU FUEL PUMP
36 MOTIVE FLOW LINE
37 FLOW SWITCH - RIGHT SCAVENGE EJECTOR
38 FILTER
39 HEAT EXCHANGER - NO.3 HYDRAULIC SYSTEM
40 APU FUEL FEED LINE
41 CROSSOVER LINE
42 APU FUEL SHUTOFF VALVE
43 HEAT EXCHANGER - APU GENERATOR OIL COOLER
44 FILTER
45 APU NEGATIVE-G PROTECTION FUEL FEED LINE

LEGEND

- ENGINE AND APU FUEL FEED
- EJECTOR MOTIVE FLOW LINES
- SCAVENGE EJECTOR FLOW
- TRANSFER EJECTOR FLOW
- APU FEED RETURN FLOW

EFFECTIVITY

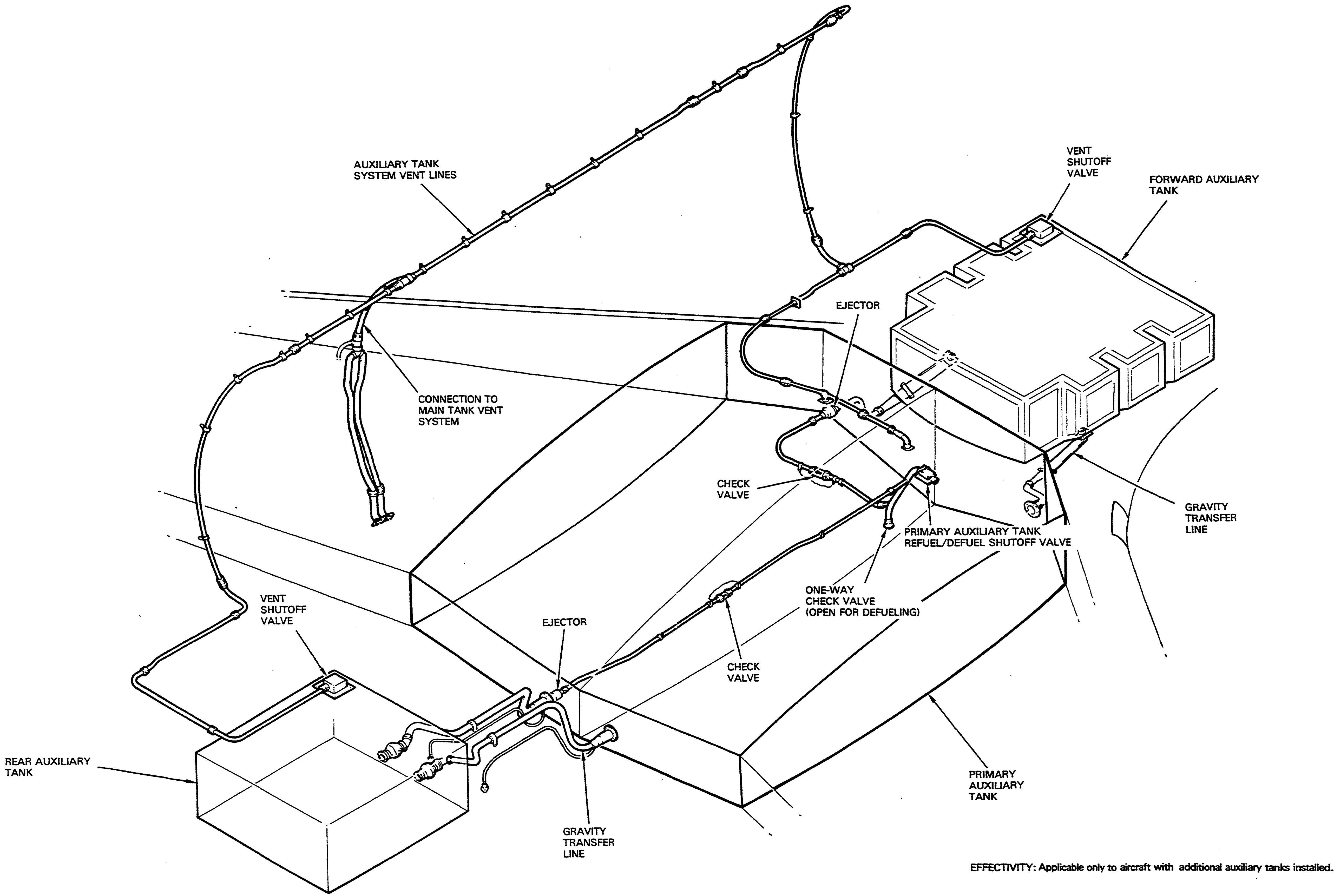
1 Applicable only to aircraft with additional auxiliary tanks installed.

2 Designated primary auxiliary tank on aircraft with additional auxiliary tanks installed (refer to Figure 2).

3 Aircraft that do not incorporate Canadair Service Bulletin 600-0318.

4 Aircraft incorporating Canadair Service Bulletin 600-0407.

Fuel Feed System - Schematic
Figure 1



EFFECTIVITY: Applicable only to aircraft with additional auxiliary tanks installed.

Auxiliary Fuel Tanks
Figure 2

On aircraft with additional auxiliary tanks, the auxiliary tank described above is designated the primary auxiliary tank and is connected by gravity flow transfer lines to the forward and rear auxiliary tanks. The additional auxiliary tanks are located under the floor beams of the centre fuselage immediately in front of and behind the fuselage pressure structure over the wing. The tanks are of double-walled aluminum alloy construction and the space between the outer and inner walls is drained and vented overboard. A general arrangement view of the additional auxiliary tank installation and its associated components is shown on Figure 2. The additional auxiliary tanks increase the usable fuel capacity of the system by 1782 pounds (805 kg).

4. FUEL DISTRIBUTION (Figures 1 and 3)

Independent fuel supplies are provided for the engines and the APU. In normal operation, the left and right engines are fed by the primary ejector pumps in the left and right collector tanks respectively. Two electric pumps are mounted beside the collector tanks and serve as backups to the primary ejectors. The APU supply is drawn directly from the right main tank by an electric pump.

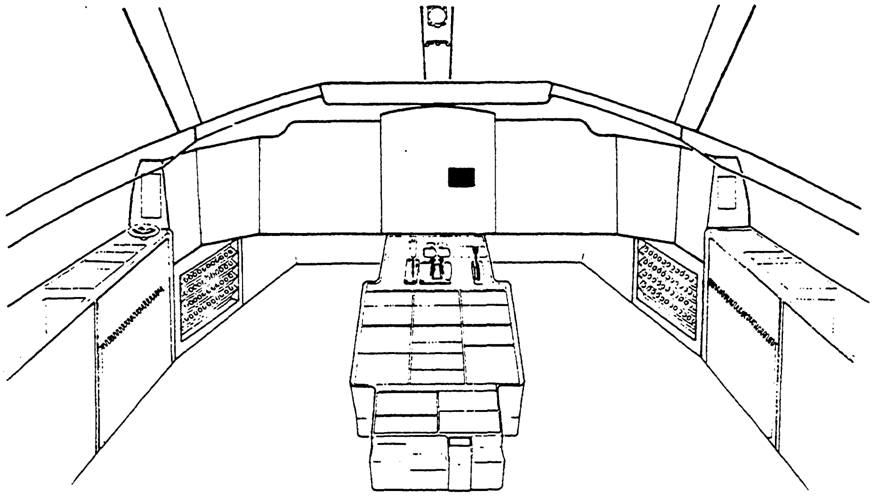
A. Ejector Pumps

An ejector pump operates on the same principle as a venturi tube to convert a small volume/high pressure input (motive flow) at the throat of the unit into a large volume/low pressure output flow at the ejector nozzle. Motive flow for the scavenge and primary pumps is provided by the high pressure stage of a two-stage engine-driven pump (EDP). The motive flow reaches pressures between 50 and 350 psi and is routed back to the fuel storage area through the engine pylon via a one-way check valve. Given a motive flow of 7.05 gal/min at 300 psi, each primary ejector produces an output flow of 25.0 gal/min at 21 psi. The output from the other ejectors is somewhat lower.

Compared with conventional electric fuel pumps, the ejectors require minimal maintenance and greatly improve fuel system reliability.

B. Engine Feed

The primary ejector pumps provide a continuous fuel flow to the engine driven pumps (EDP) at a pressure and volume sufficient for maximum engine consumption and motive flow requirements. The fuel from each ejector flows through a feed line across the firewall fuel shutoff valve to the inlet of the EDP. One-way check valves on the feed lines control the direction of flow so that each ejector supplies only the engine associated with it.

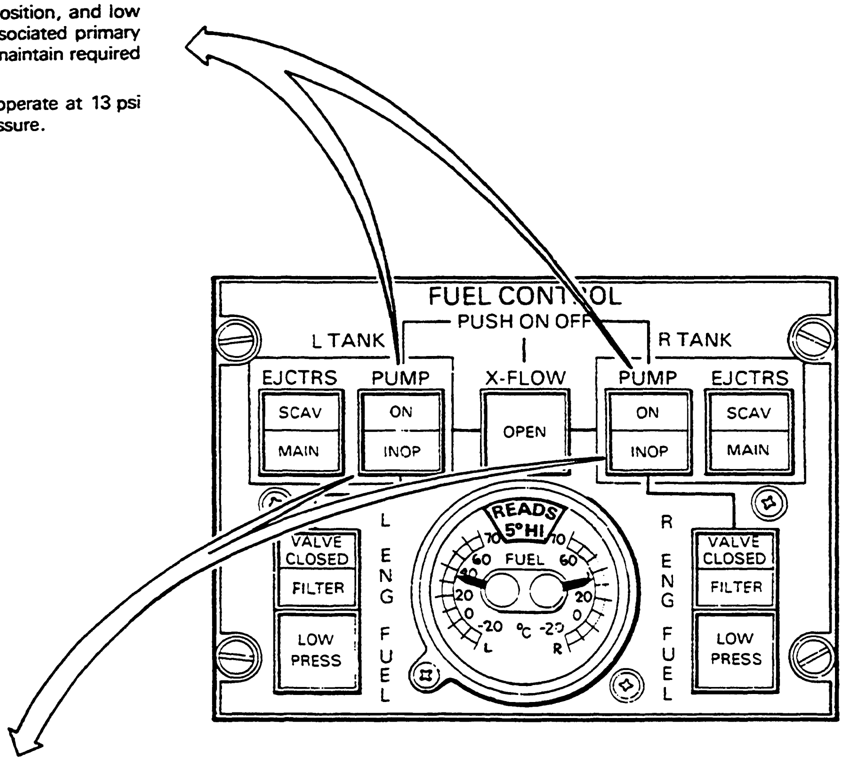


PUMP SWITCH/LIGHTS

Switch/lights control operation of electric fuel pumps in conjunction with pressure switches at primary ejector outlets.

If a PUMP switch/light is in the pressed in position, and low pressure condition is detected at outlet of associated primary ejector, both electric fuel pumps come on to maintain required fuel flow to affected engine.

Pressure switches at primary ejector outlets operate at 13 psi increasing pressure and 10 psi decreasing pressure.

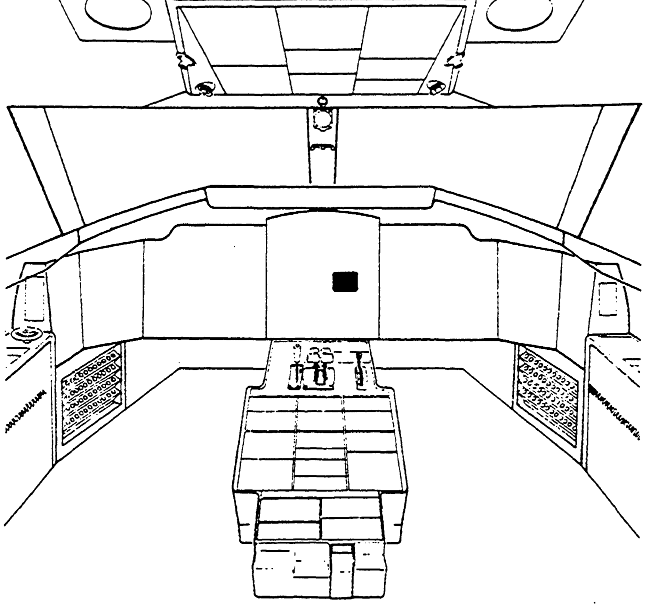


PUMP ON/INOP LIGHTS

Green ON light comes on if the associated electric pump is operating.

Amber INOP light comes on if the associated pump switch is out or if a pump failure occurs.

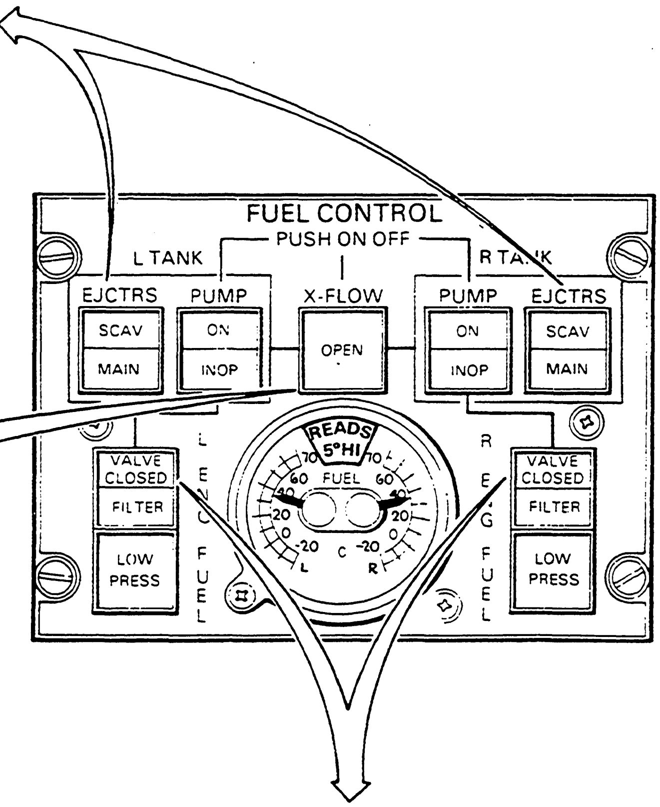
Fuel Control Panel
Figure 3 (Sheet 1)



L TANK AND R TANK EJCTRS LIGHTS

Amber SCAV light comes on if scravenge ejector failure is detected by flow switch at ejector outlet. The flow switch operates at 0.65 gal/min on increasing flow and at 0.50 gal/min on decreasing flow.

Amber MAIN light comes on if main ejector failure is detected by pressure switch at ejector outlet. Pressure switch operates at 13 psi on increasing pressure and at 10 psi on decreasing pressure.



X-FLOW SWITCH/LIGHT

When pressed in, balance line shutoff valve opens, left and right main tanks equalize by gravity flow, and green OPEN light comes on. When pressed out, balance line shutoff valve closes and light goes out.

VALVE CLOSED LIGHTS

White VALVE CLOSED light comes on if the associated firewall fuel shutoff valve is closed.

NOTE

Refer to POWER PLANT for details of fuel temperature indicator, and FILTER and LOW PRESS lights.

Fuel Control Panel
Figure 3 (Sheet 2)

The collector tanks are kept full by gravity feed lines from the associated main tanks supplemented by scavenge ejectors located at the rear of the inboard section of each main tank. The position of the scavenge ejectors ensures that the collector tanks are supplied with fuel during low fuel conditions and during flight with high nose-up attitudes. Since the volume of fuel entering a collector tank always exceeds the volume consumed by its associated engine, a line between the top of the collector tank and the main tank is provided to allow for the overflow.

The sequence of fuel transfer between the auxiliary tank and the main tanks is such that all the fuel carried aboard the aircraft is transferred to the main tanks before being fed to the collector tanks. When the main tank fuel level drops below approximately 93% of full, transfer of fuel from the auxiliary tanks (primary, forward and rear) begins automatically to maintain that level in the main tanks. The transfer is effected by two transfer ejector pumps inside the primary auxiliary tank which are provided with motive flow by bleeds from the engine feed lines. Float valves, set to open when the main tank fuel quantity drops below approximately 93% of full, control the transfer and permit the transfer ejector motive flow to return to the main tank from which it originated. A check valve mounted on the intake port of the transfer ejector prevents spillage of motive flow into the auxiliary tank prior to transfer.

On aircraft with additional auxiliary tanks, the fuel transferred into the main tanks includes the fuel in the forward and rear auxiliary tanks. In order to adjust for the increased amount of fuel to be transferred in a given time, the transfer ejectors in these aircraft have a larger pumping capacity than those installed on the basic three-tank system.

C. APU Fuel Feed

The APU is supplied with fuel by an independent feed system equipped with a dc powered/ac driven electric fuel pump located in the right main fuel tank. Aircraft that do not incorporate Canadair Service Bulletin 600-0318 have two fuel/oil heat exchangers installed on the return line for cooling the APU generator oil and the No. 3 hydraulic system fluid (refer to Figure 1). Aircraft that incorporate Canadair Service Bulletin 600-0318 do not have the heat exchanger for the No. 3 hydraulic system fluid.

The pump is operated by pressing the FUEL ON/OFF switch/light on the APU control panel (refer to SECTION 5, AUXILIARY POWER UNIT). On aircraft that do not incorporate Canadair Service Bulletin 600-0318, the pump also comes on, regardless of the position of the FUEL ON/OFF switch/light, whenever one of the No. 3 hydraulic system pumps is switched on. The electrical switching is accomplished through pressure switches, associated with the No. 3 hydraulic system pumps, which operate at a preset pressure to complete circuits to the APU pump power relay.

The APU fuel feed line, which is fitted with an electrically operated fuel shutoff valve, and the return line run under the cabin floor and across the rear pressure bulkhead to connections on the APU enclosure. To ensure uninterrupted operation of the APU during negative G conditions (which, if persistent, could remove fuel from the pump intake), a negative G protection fuel feed line connects with the left engine fuel feed line just ahead of the firewall fuel shutoff valve. The line is fitted with an electrically operated fuel shutoff valve and a one-way check valve which opens when the main APU supply pressure drops 10 psi lower than the pressure in the engine fuel line.

During normal operation, both of the shutoff valves on the APU fuel system are opened and closed simultaneously by pressing the START/STOP switch/light on the APU control panel in and out (refer to SECTION 5, AUXILIARY POWER UNIT). If an APU fire occurs, the APU fuel supply is shut off by pressing the APU FIRE PUSH switch/light on the glareshield. Pressing the switch/light closes both the APU fuel shutoff valves. Whenever the shutoff valve on the APU normal feed line is closed on aircraft that do not incorporate Canadair Service Bulletin 600-0318, fuel can still be passed across the shutoff valve and a crossover line to the inlet of the No. 3 hydraulic system heat exchanger.

Fuel quantity imbalances between the left and right main tanks, caused by extended operation of the APU, are eliminated by opening the balance line shutoff valve to allow the tank contents to equalize by gravity flow.

D. Standby Feed

Two dc-powered/ac-driven (invermotor) electric fuel pumps are connected to the collector tanks and serve as sources of fuel pressure during engine starting and as backups for the primary fuel ejectors (see Figure 1, item 16, for location of pumps in system schematic). The pumps are controlled by the two PUMP switch/lights on the fuel control panel in conjunction with pressure switches in the outlet lines of the primary fuel ejectors.

Each PUMP switch/light controls both electric fuel pumps. If a switch/light is pressed in and a low fuel pressure condition exists at the outlet of the associated primary fuel ejector, both of the electric pumps come on to ensure that an adequate flow of fuel is delivered to the engine driven pump; i.e., if the left PUMP switch/light is pressed in and a low pressure condition exists at the outlet of the left primary ejector, both of the electric pumps come on to maintain fuel flow to the left engine. In this example, if the left PUMP switch/light had been left in the pressed-out position, the electric pumps would remain off until the switch/light was pressed in. The electric pumps shut down automatically when the required output pressure is re-established at the oulet of the primary ejector.

During normal operation, the PUMP switch/lights are left in the pressed-in position to ensure that there is no delay in establishing normal fuel flow to the affected engine, following a primary ejector failure.

E. Tank Vent System (Figures 2 and 4)

The fuel tanks are vented to atmosphere through common vent lines which terminate at NACA scoops on the left and right lower wing surfaces. Details of the system installed on the left side of aircraft without additional auxiliary tanks are shown in Figure 4. The vent lines on the right side of these aircraft are identical.

On aircraft with additional auxiliary tanks, the forward and rear auxiliary tanks have vent lines which are routed across the left side of the fuselage to connect with the main vent system manifolds. The vent lines from the left and right sides of the primary auxiliary tank are connected and run forward to connect with the forward auxiliary tank vent line. The forward and rear auxiliary tanks each have a vent shutoff valve at the vent outlet which closes when the tanks are full during pressure refueling. The valves open when refueling is complete (refer to REFUEL/DEFUEL SYSTEM for details of pressure refueling operations on aircraft with additional auxiliary tanks).

5. REFUEL/DEFUEL SYSTEM (Figure 5 and 6)

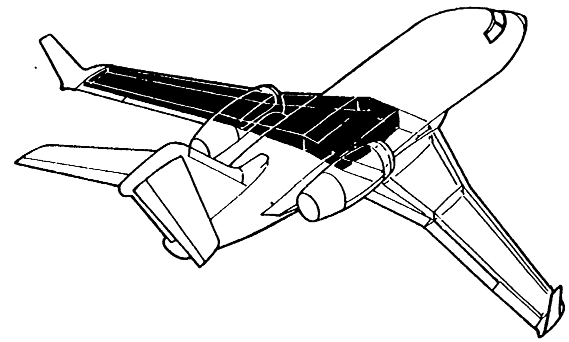
Refueling and defueling is carried out using the single point pressure refuel/defuel adapter on the right wing leading edge fillet or through gravity filler caps and drain valves associated with each fuel tank. Tank venting is maintained by the fuel tank vent system or, during pressure refueling operations, by vent relief valves which act to prevent tank overpressures. The location of the gravity filler caps or, when pressure refueling, the action of level control valves, provides fuel expansion space and protection against over-filling by limiting the full fuel volume to 98% of the total tank volume.

A. Pressure Refuel/Defuel System

The pressure refuel/defuel system consists of a single point refuel/defuel adapter, a fueling manifold, refuel/defuel shutoff valves, vent relief valves and level control valves. The system is controlled by switches on the refuel/defuel control panel in the right wing fillet.

The single point pressure refuel/defuel adapter is a bayonet-type turn-to-lock fitting designed to accommodate standard refueling nozzles. A two-way check valve, installed on the fueling manifold adjacent to the adapter, limits fuel spillage from the manifold should the connection between the adapter and the refueling nozzle fail. The fuel spilled is limited to the small amount trapped between the adapter and the two-way check valve. The adapter and the fueling manifold can accept the following maximum pressures and flow rates:

- Maximum refuel rate — 250 US gallons/minute
- Maximum refuel pressure — 55 psi
- Maximum defuel rate — 142 US gallons/minute
- Maximum defuel pressure — 8 psi (negative)



MAIN TANK VENT LINES (Left shown, right similar)

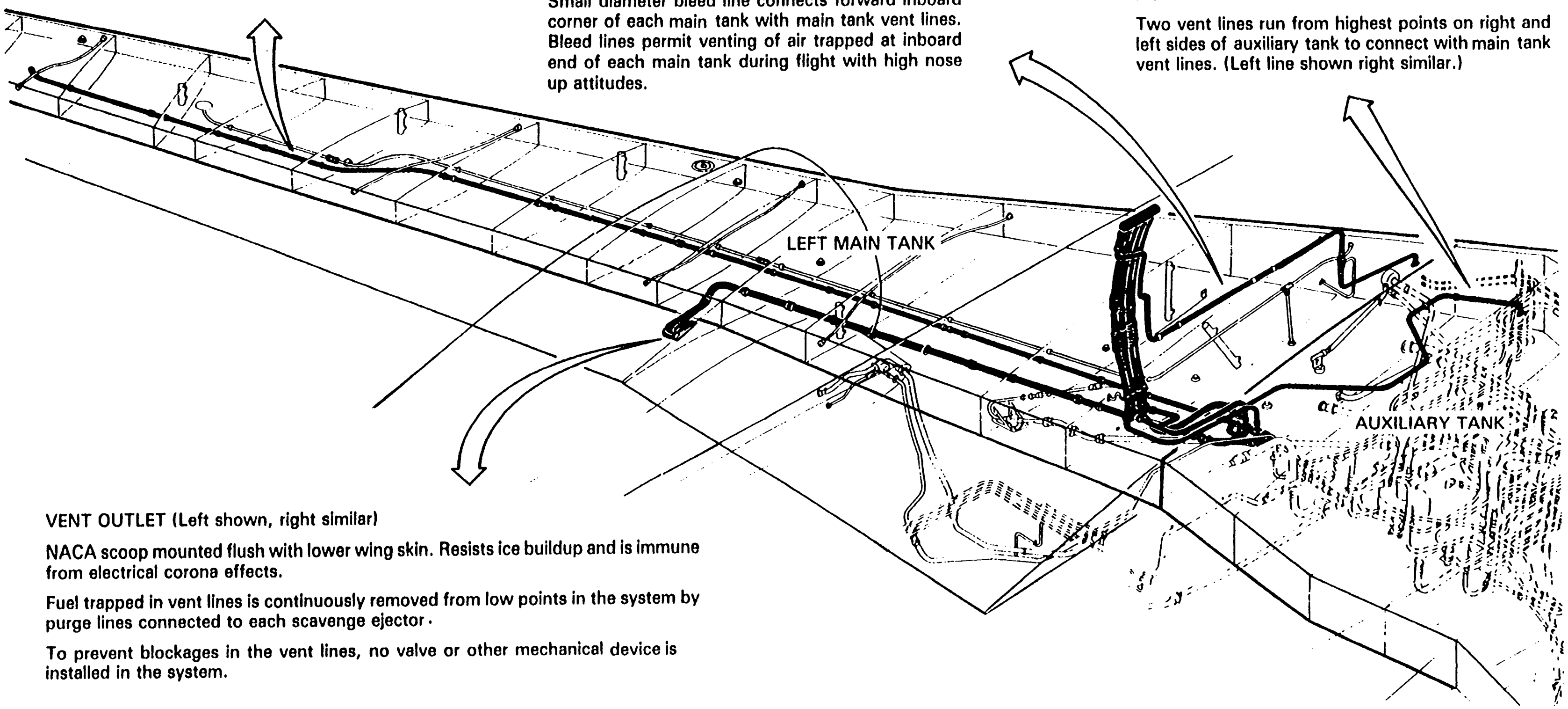
Tubes extend from wing tip area to centre section where they exit through upper wing skin and enter fuselage. Sections of vent lines adjacent to pressure cabin are surrounded by airtight ventilated shrouds.

MAIN TANK BLEED LINE (Left shown, right similar)

Small diameter bleed line connects forward inboard corner of each main tank with main tank vent lines. Bleed lines permit venting of air trapped at inboard end of each main tank during flight with high nose up attitudes.

AUXILIARY TANK VENTING

Two vent lines run from highest points on right and left sides of auxiliary tank to connect with main tank vent lines. (Left line shown right similar.)



VENT OUTLET (Left shown, right similar)

NACA scoop mounted flush with lower wing skin. Resists ice buildup and is immune from electrical corona effects.

Fuel trapped in vent lines is continuously removed from low points in the system by purge lines connected to each scavenge ejector.

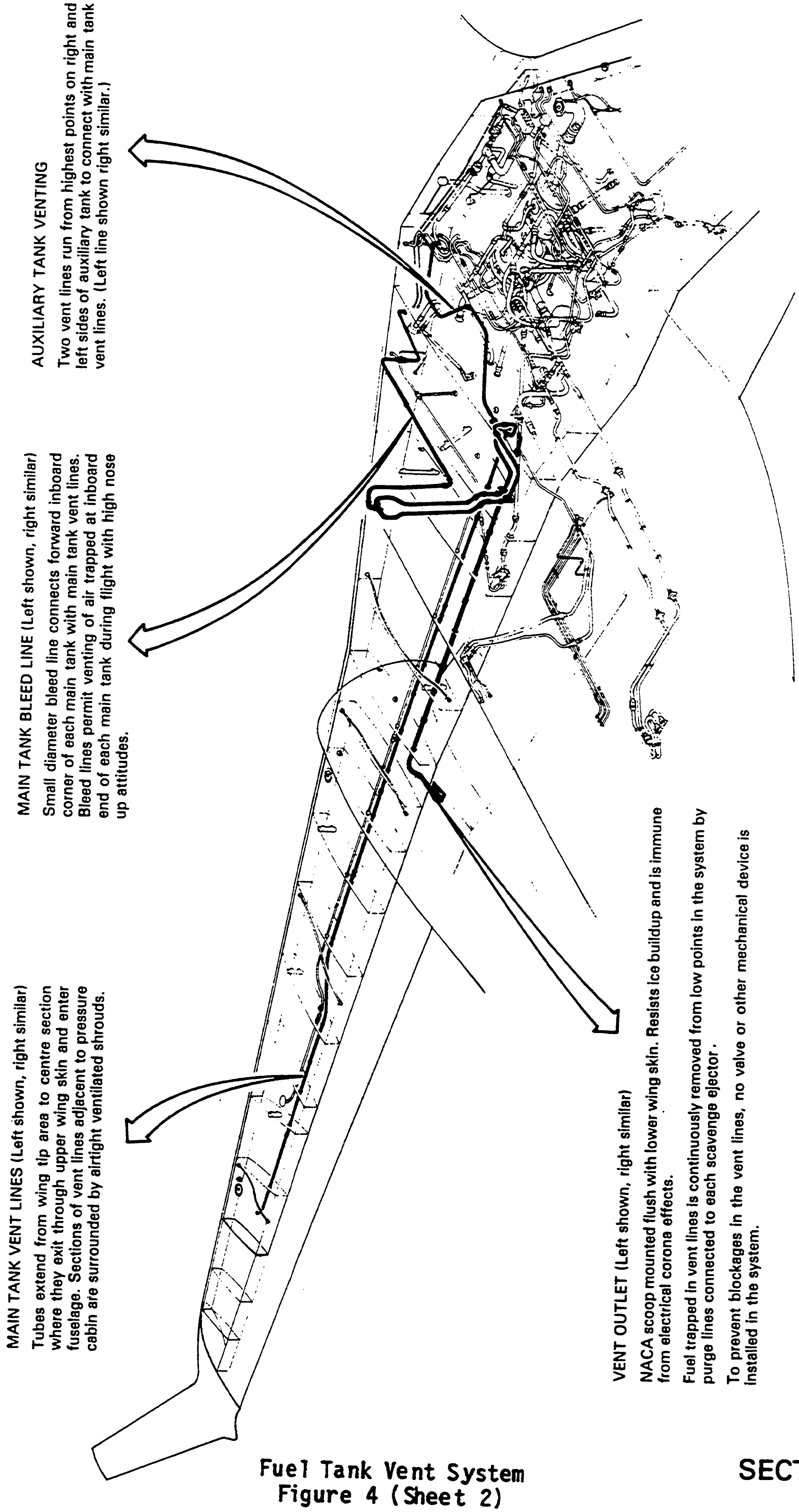
To prevent blockages in the vent lines, no valve or other mechanical device is installed in the system.

EFFECTIVITY: A/C 1004 TO 1013

NOTE

The fuel tank vent system maintains acceptable pressure differences between the exterior and interior of the three fuel tanks during all flight conditions, during refueling/defueling operations and following fuel transfer between tanks.

Fuel Tank Vent System
Figure 4 (Sheet 1)



EFFECTIVITY: A/C 1014 TO 1037

NOTE

The fuel tank vent system maintains acceptable pressure differences between the exterior and interior of the three fuel tanks during all flight conditions, during refueling/defueling operations and following fuel transfer between tanks.

Fuel Tank Vent System
Figure 4 (Sheet 2)

AUXILIARY TANK VENTING

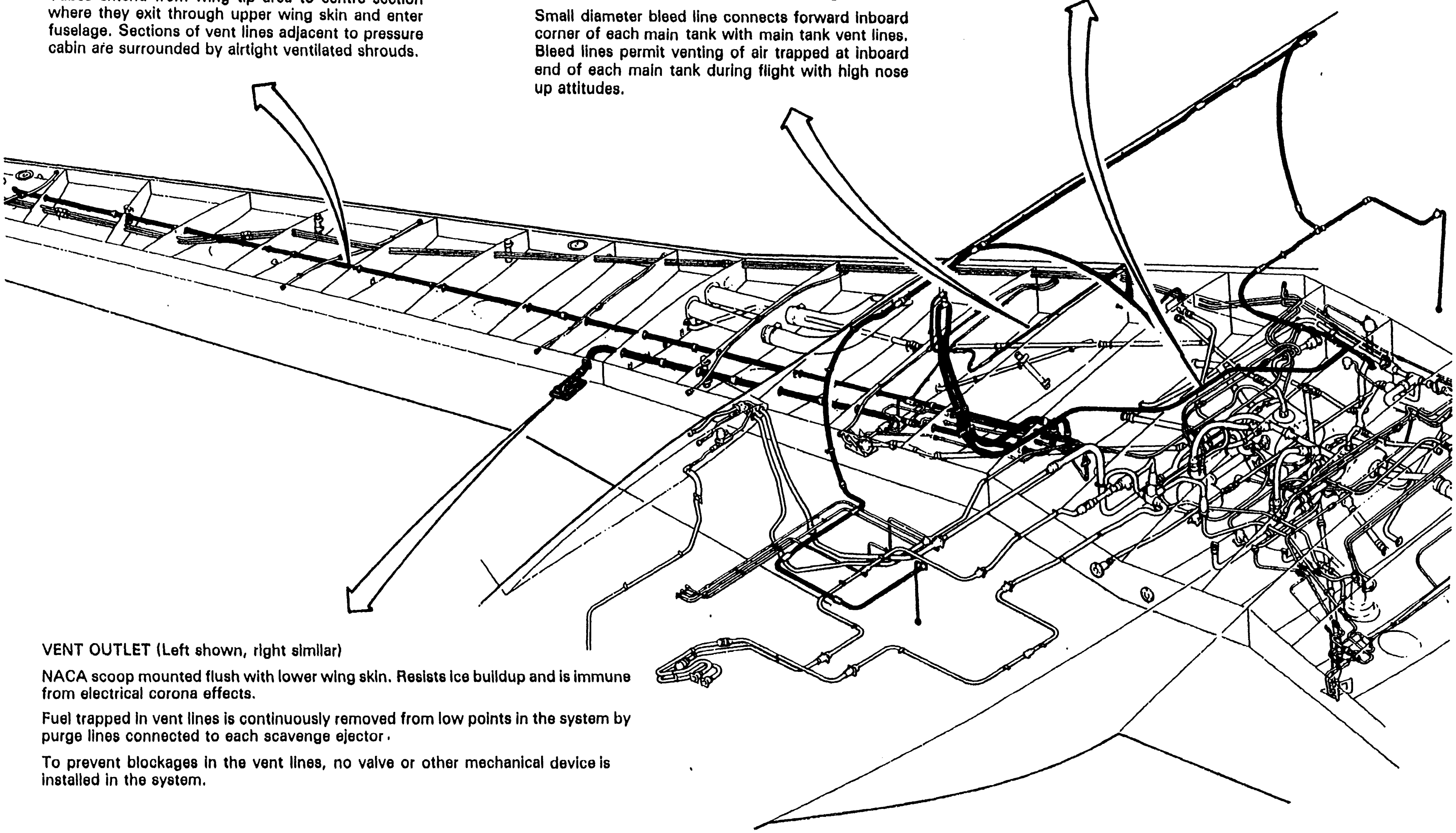
Two vent lines run from highest points on right and left sides of auxiliary tank to connect with main tank vent lines. (Left line shown right similar.)

MAIN TANK VENT LINES (Left shown, right similar)

Tubes extend from wing tip area to centre section where they exit through upper wing skin and enter fuselage. Sections of vent lines adjacent to pressure cabin are surrounded by airtight ventilated shrouds.

MAIN TANK BLEED LINE (Left shown, right similar)

Small diameter bleed line connects forward inboard corner of each main tank with main tank vent lines. Bleed lines permit venting of air trapped at inboard end of each main tank during flight with high nose up attitudes.



VENT OUTLET (Left shown, right similar)

NACA scoop mounted flush with lower wing skin. Resists ice buildup and is immune from electrical corona effects.

Fuel trapped in vent lines is continuously removed from low points in the system by purge lines connected to each scavenge ejector.

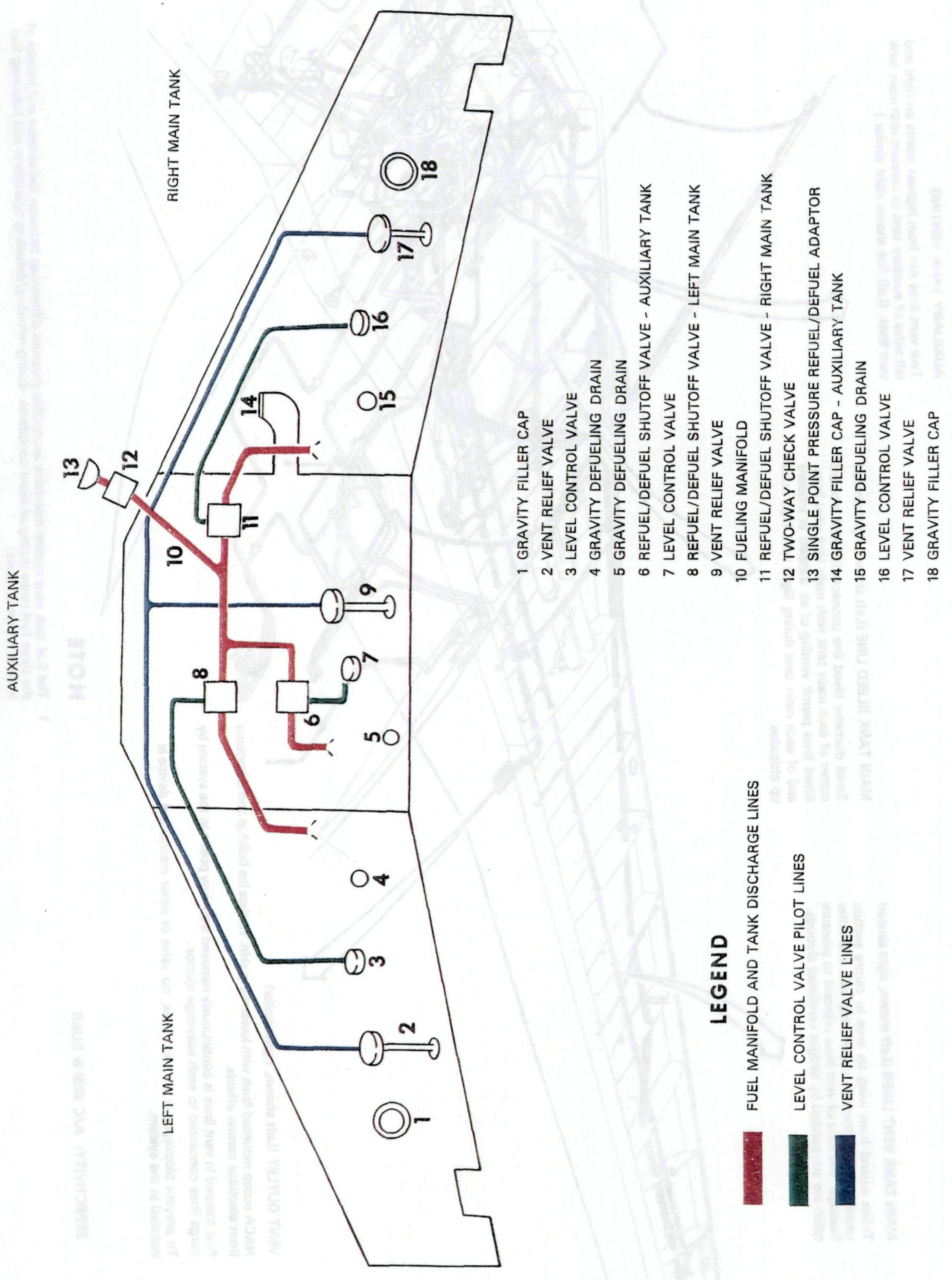
To prevent blockages in the vent lines, no valve or other mechanical device is installed in the system.

EFFECTIVITY: A/C 1038 & SUBS

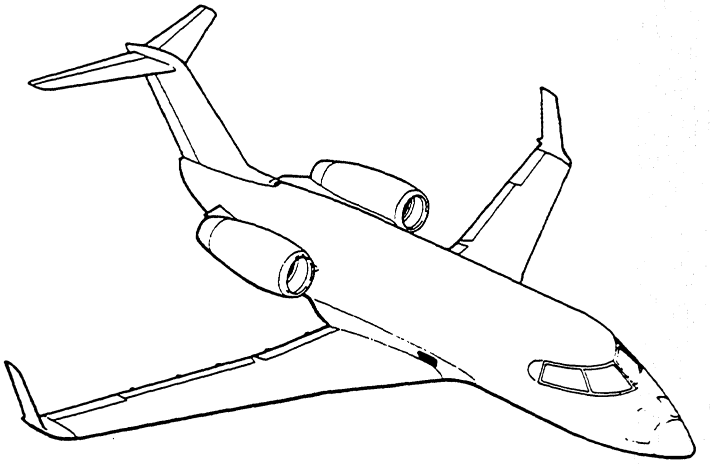
NOTE

1. The fuel tank vent system maintains acceptable pressure differences between the exterior and interior of the three fuel tanks during all flight conditions, during refueling/defueling operations and following fuel transfer between tanks.
2. Refer to Figure 2 for details of the vent lines installed on aircraft 1038 to 1075 with additional auxiliary tanks and aircraft 1076 and subsequent.

Fuel Tank Vent System
Figure 4 (Sheet 3)



Refuel/Defuel System - Schematic
Figure 5



POWER ON INDICATOR

Green light comes on when POWER switch is set to ON.

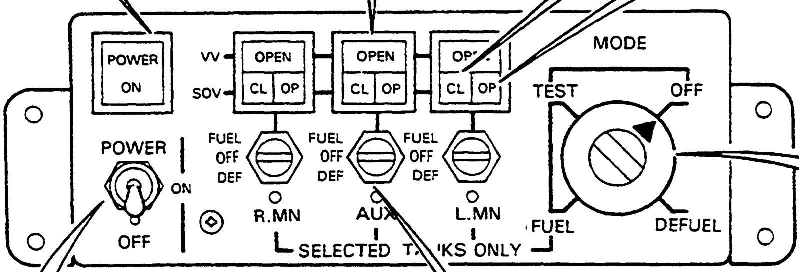
VENT RELIEF VALVE STATUS LIGHTS

Green OPEN light comes on if POWER switch is ON and the vent relief valve in the associated fuel tank is open.

SHUTOFF VALVES STATUS LIGHTS

Green CL light comes on if POWER switch is ON and the refuel/defuel shutoff valve of associated fuel tank is closed.

Amber OP light comes on if POWER switch is ON and the refuel/defuel shutoff valve of associated fuel tank is open.



ROTARY MODE SELECTOR SWITCH

FUEL - Opens refuel/defuel shutoff valves in conjunction with FUEL selection on FUEL/DEF switches to permit pressure refueling.

DEFUEL - Opens refuel/defuel shutoff valves in conjunction with DEF selection on FUEL/DEF switches to permit pressure defueling.

OFF – Disarms FUEL/DEF switches.

TEST – Tests operation of refuel/defuel shutoff valves after fueling pressure is applied at the refueling nozzle by simulating full fuel condition in tanks. With POWER switch ON and FUEL/DEF switches set at FUEL, the SOV-CL lights go out and the SOV-OP lights come on for 20 to 30 seconds. Correct operation of the shutoff valves is indicated when the SOV-CL lights come on immediately after the SOV-OP lights go out.

POWER SWITCH

Setting switch to ON arms contacts of the rotary MODE selector switch. Switch connects directly to the 28-volt dc battery direct bus. Flight compartment switch selection is not necessary during pressure refuel/defuel operations.

FUEL/DEF SWITCHES

Control operation of the refuel/defuel shutoff valves in conjunction with mode selections on the rotary MODE selector switch.

Refuel/Defuel Control Panel
Figure 6

After a suitable positive or negative pressure has been established at the refuel/defuel adapter, the transfer of fuel into or out of the fuel tanks is obtained by energizing and de-energizing the refuel/defuel shutoff valves on the fueling manifold. Each of the shutoff valves contains a spring-loaded poppet valve and a solenoid operated by the POWER, MODE and FUEL/DEF switches on the refuel/defuel control panel.

B. Pressure Refueling

With the POWER switch ON and the rotary MODE selector turned to FUEL, setting the FUEL/DEF switches to FUEL energizes the associated shutoff valve solenoids. When the solenoids are energized, fuel flows from the shutoff valves through small-diameter pilot lines to the level control valves in the fuel tanks. The action of the flow through the shutoff valves opens the valve pistons to allow the transfer of fuel from the fueling manifold into the tanks. When the tanks are full, the floats of the level control valves close the pilot lines to the shutoff valves. Back pressure, transmitted through the pilot lines, and spring tension provided by the internal mechanism of the shutoff valves, close the valves to stop the transfer of fuel to the tanks. The SOV OP and SOV CL lights on the refuel/defuel control panel, controlled by integral electrical switches on the shutoff valves, monitor valve position (refer to Figure 6).

Vent relief valves, one in each main tank and one in the (primary) auxiliary tank, prevent fuel tank overpressures should the fuel tank vent system or the refuel/defuel shutoff valves fail during pressure refueling operations. Each vent relief valve is connected by a pressure-sensing line to the fueling manifold and is designed to open on positive fluid pressure only, therefore remaining closed during pressure defueling. Integral microswitches close when the vent relief valves open, causing the green VV OPEN lights on the refuel/defuel control panel to come on. The valve outlets are fitted with flame arrestors to eliminate the risk of fire during fuel venting.

On aircraft with additional auxiliary tanks, the primary auxiliary tank is not filled directly from the fueling manifold and its associated refuel/defuel shutoff valve. On these aircraft, the auxiliary tank refuel/defuel shutoff valve is connected to a tube assembly fitted with two ejectors which transfer fuel into the forward and rear auxiliary tanks at flow rates proportional to the respective tank volumes. At the same time, a portion of the transferred fuel flows by gravity into the primary auxiliary tank. When the forward and rear auxiliary tanks are full, their vent shutoff valves close and fuel flows at an increased rate into the primary auxiliary tank until it also fills and the auxiliary tank refuel/defuel shutoff valve closes. The fuel levels in the three tanks then equalize and the vent shutoff valves on the forward and rear auxiliary tanks open to restore normal system venting. A space equal to 2 percent of the total three tank volume remains empty in the auxiliary tank system following refueling.

C. Pressure Defueling

With the rotary MODE selector switch set to DEFUEL, the shutoff valve solenoids are energized if their associated FUEL/DEF switches are at the OFF or FUEL positions. The energized solenoids act to keep the refuel/defuel shutoff valves closed if defueling suction is present in the fueling manifold. When the FUEL/DEF switches are set to DEF, power is removed from the associated shutoff valve solenoids, defueling suction opens the shutoff valves and fuel flows from the tanks to the adapter nozzle connection. Individual tanks are defueled by setting the associated FUEL/DEF switches to DEF while leaving the remaining FUEL/DEF switches at OFF or FUEL. When the desired amount of fuel has been removed from the tanks, the shutoff valves are closed by setting the FUEL/DEF switches and the MODE selector switch to OFF.

On aircraft with additional auxiliary tanks, a one-way check valve below the primary auxiliary tank refuel/defuel shutoff valve opens when defueling suction is applied to permit defueling of the auxiliary tanks.

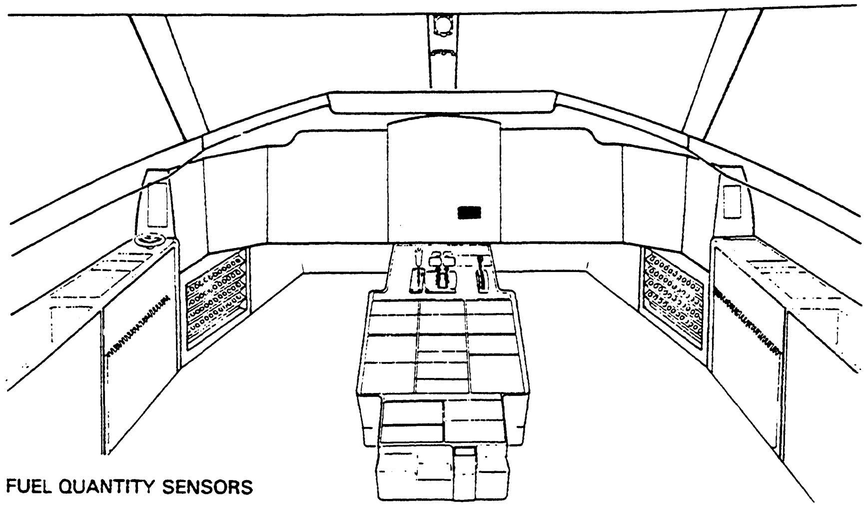
D. Gravity Refueling and Defueling

The fuel tanks may be filled by gravity through filler caps provided on each main tank and on the (primary) auxiliary tank. The filler caps for the left and right main tanks are mounted flush with the upper wing skin at wing stations 230.00 (left and right). The (primary) auxiliary tank filler cap is recessed below the right wing skin adjacent to the wing root fillet. Fuel spilled into the filler cap recess is discharged through a drain exiting on the lower wing surface.

A plug-type electrical grounding attachment, placarded ELECTRICAL GROUND STUD, is located just forward of each filler cap on the lower surface of the wing leading edge.

Gravity defueling is carried out through gravity defueling drains located at the lowest point in each tank. Each drain consists of a capped orifice into which an adapter is inserted to allow fuel to drain from the tank.

In addition to the gravity defueling receptacles, water drains are provided at various locations on the lower wing surface. The valves are opened by using a screwdriver to depress and rotate the valve core to expose drain holes on the base of the valve housing.



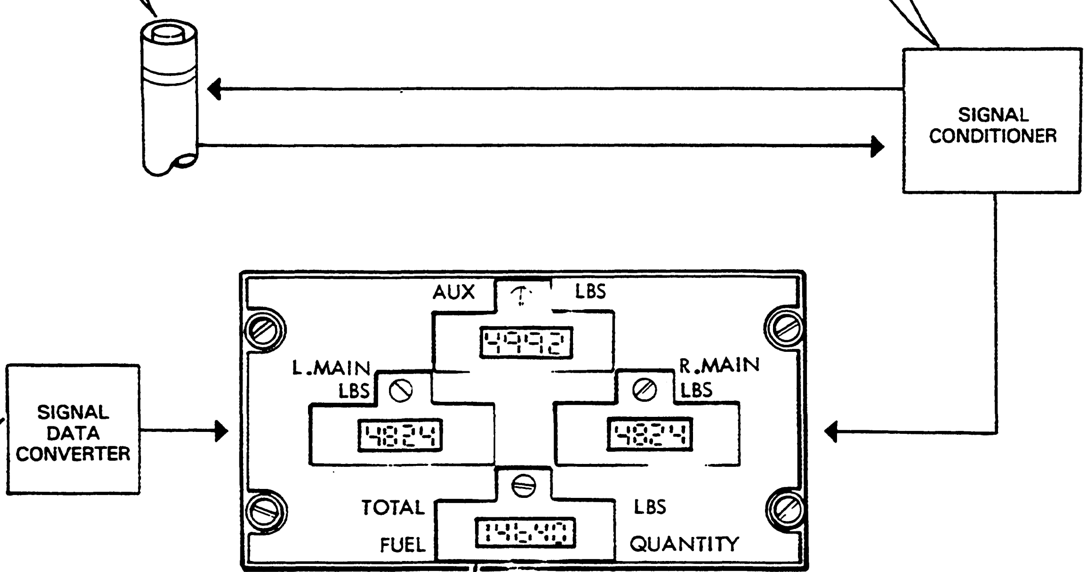
CAPACITANCE TYPE FUEL QUANTITY SENSORS

6 in each main tank.
2 in auxiliary tank.
1 in each collector tank.

Aircraft with additional auxiliary tanks have 3 sensors in the primary auxiliary tank.

SIGNAL CONDITIONER

Located in underfloor avionics bay. Internal inverter generates high frequency ac signal to energize quantity sensors. Converts return signals from quantity sensors into 0 to 5 volt dc signals suitable for use by quantity indicator.



SIGNAL DATA CONVERTER

Located in underfloor avionics by. Provides dual power supply, tapped from the battery bus and the dc essential bus, for the indicator logic circuits and display lamps.

DIGITAL READOUTS

Internally illuminated digital displays. Readouts provide continuous indication of usable fuel quantity in each tank plus system total.

Display ranges:

L MAIN	0 to4824 Lb
R MAIN	0 to4824 Lb
AUX	0 to 4992 Lb (6774 Lb)
TOTAL	0 to14640 Lb(16422 Lb)

Figures in brackets are applicable to aircraft with additional auxiliary tanks.

NOTE

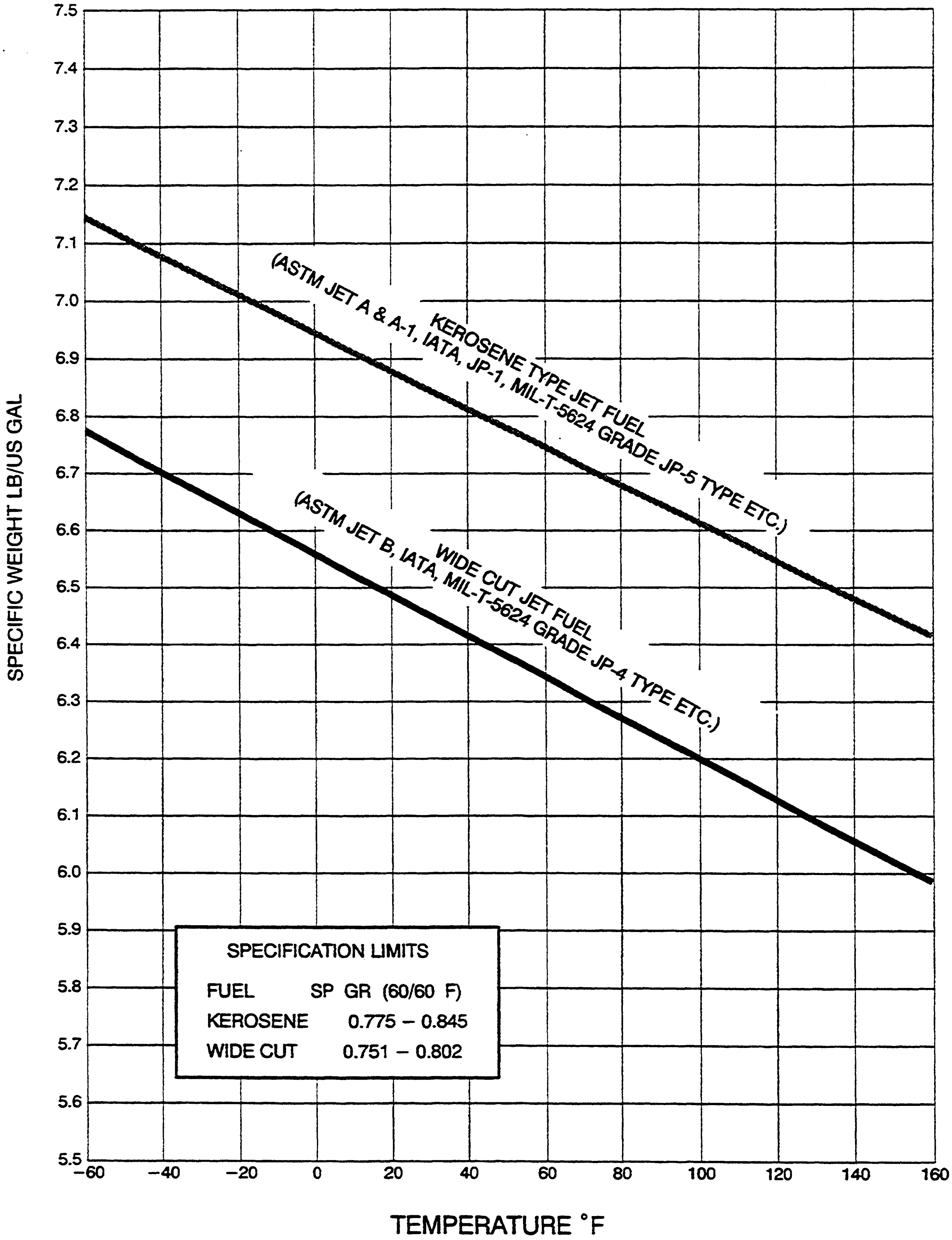
Refer to POWER PLANT for details of indicator test.

Fuel Quantity Indicating System
Figure 7

6. FUEL QUANTITY INDICATING SYSTEM (Figures 7 and 8)

The fuel quantity indicating system consists of capacitance-type fuel quantity sensors in the fuel tanks, a signal conditioner to power the quantity sensors and process their fuel quantity signals and a fuel quantity panel powered by a signal data converter. The individual tank and total usable fuel contents in pounds are displayed as digital readouts on the FUEL QUANTITY panel. On all aircraft, the fuel quantity displayed for each main tank includes the fuel contained in the associated collector tank (when full, each collector tank contains 41 pounds of fuel). On aircraft with additional auxiliary tanks, the fuel quantity displayed for the auxiliary tank includes the fuel contained in the forward and rear auxiliary tanks.

NOTE: On aircraft with additional auxiliary tanks, the auxiliary fuel quantity indicator is accurate only in level flight. Upon liftoff and at initial climb attitudes, the auxiliary tank quantity will read up to 1000 pounds below actual quantity.



Fuel Specific Weight
Figure 8