**ON A/C ALL

28–00–00–001

FUEL SYSTEM, GENERAL

Introduction

Refer to Figures 1 and 2.

Fuel is contained in two integral main wing tanks designated No. 1 (Left) and No. 2 (Right). The fuel system provides for indicating, storing, venting, fuel feeding and scavenging, refueling/defueling, and transferring. Only tank to tank transfer is available; there is no engine crossfeed capability. The aircraft may be gravity or pressure refueled.

General

Refer to Figure 3.

A fuel gauging system supplies quantity data to the flight compartment and refuel/defuel panel for display. Fuel quantity may also be checked on the ground by use of the magnetic dipsticks (magnasticks). The usable fuel is 5,425 kg (11,960 lb), with a maximum tank to tank imbalance of 272 kg (600 lb).

Each wing tank includes a surge bay and a collector bay. The left tank supplies fuel to the left engine and the optional Auxiliary Power Unit (APU). The right tank supplies fuel to the right engine. A vent system keeps the air pressure in the fuel tanks between limits.

Fuel can be transferred between the tanks for lateral balancing or for fuel management. A single point pressure refuel/defuel system shares selected common components with the fuel transfer system. Gravity refueling may also be done through two overwing fuel filler points. The fuel system has the systems that follows:

- Storage System (28–10–00)
- Vents (28–12–00)
- Distribution System (28–20–00)
- Indicating System (28–40–00)

Detailed Description

The fuel system contains a storage system, distribution system and an indicating system.

Storage System

Refer to Figure 4.

There are two integral (wet) wing tanks that extend laterally from the fuselage to the rib just inboard of the ailerons. Each wing tank is divided into the three sections that follow:

- Surge bay
- Main tank
- Collector bay

The surge bay is located between the two ribs inboard of the aileron. The main tank extends from the surge bay to the fuselage and collector bay. The collector bay is located at the inboard and aft part of the wing tank. Fuel is contained in the main tanks and the collector bays.

Total usable fuel from the tanks is 5,425 kg (11,960 lb). The maximum lateral imbalance permitted between tanks is 272 kg (600 lb). Water drain valves in the low points of the surge bays, main tanks, and collector bays are located on the underside of the wings.

The surge bay is used for main tank venting and fuel recovery. Two outboard and one inboard vent lines are routed from each surge bay to the respective main tank to control the pressure inside the tanks . Each surge bay is connected through integral standpipes to two separate NACA vents on the bottom of the wings. During flight, any fuel that may spill into the surge bay is returned to the tank. This is achieved with ram air through the two NACA vents, which forces fuel in the surge bay up the inboard vent line and/or one or both outboard vent lines into the main tank. Two vent float valves, located near the top of the tank, open and close the outboard vent lines depending on the fuel level in the main tank.

The main tank holds the majority of the fuel and continuously supplies fuel to the collector bay. The collector bay supplies fuel for the two stage engine–driven fuel pump regardless of aircraft attitude. Fuel tank scavenging takes place using four scavenge ejector pumps in each tank which draw fuel from tank low points (depending on aircraft attitude), to keep the collector bay full. A primary ejector pump in the collector bay then provides a constant low–pressure fuel supply to the respective engine driven fuel pump, preventing possible pump cavitation. High–pressure motive flow from the engine Fuel Metering Unit (FMU) unit is used to operate the scavenge and primary ejector pumps.

Flapper check valves are located at the base of each collector bay, and select ribs. They ensure gravity fed fuel flow into the collector bay in the event scavenge flow is insufficient. If the level in a collector bay drops below approximately 150 kg (305 lb), a float switch will cause the related #1 TANK or #2 TANK FUEL LOW caution light to come on.

Vents

The vent system connects each fuel tank to ambient air pressure. This equalizes the pressure inside the tank with the pressure outside the tank and supplies sufficient venting of the fuel tanks for any aircraft flight attitude. Venting of the fuel tanks also prevents any structural damage to the aircraft during refueling or defueling.

Engine Fuel Feed

Refer to Figure 5.

Fuel to each engine is fed from the collector tank, from a primary ejector pump or an ac driven auxiliary pump, and delivered to the Fuel Metering Unit (FMU). If the engine driven pump inlet pressure drops below a preset limit, the related #1 or #2 ENG FUEL PRESS caution light will come on.

The primary ejector pump fuel supply rate is greater than the engine driven pump demand to maintain a positive fuel pressure. An AC Variable Frequency driven auxiliary pump in each collector bay serves as a back up source of fuel boost pressure for takeoff and landing. The auxiliary pump will also be used if the related primary ejector pump does not supply the necessary fuel pressure.

Related TANK 1 or TANK 2 AUX PUMP switchlights on the FUEL CONTROL TRANSFER panel control the auxiliary pumps manually. The related ON switchlight segment turns green when the pump is selected. A TANK 1 or TANK 2 AUX PUMP switch indicator on the MFD Fuel Page also shows the position of the switchlight. The TANK

1 or TANK 2 AUX PUMP light on the Fuel Page will turn green when the pump is supplying sufficient boost pressure.

The engine fuel system has an engine feed shutoff valve, which closes when the related PULL FUEL/HYD OFF handle on the Fire Protection Panel (FPP) is pulled. Advisory lights on the FPP show when the valve is open or closed.

The fuel is filtered and heated by Fuel Oil Heat Exchanger (FOHE) before entering the FMU. If the fuel filter becomes blocked, fuel bypasses the filter. The related #1 or #2 FUEL FLTR BYPASS caution light will come on any time a bypass is impending.

Distribution System

Fuel can be transferred from one tank to the other to correct fuel imbalances or for fuel management. The maximum lateral imbalance permitted between the tanks is 272 kg (600 lb).

A TRANSFER switch on the FUEL CONTROL TRANSFER panel controls the fuel transfer system. When the TRANSFER switch is selected, the auxiliary pump in the donor tank operates automatically to pump fuel to the receiver tank. A signal from the operating pump causes the related ON switchlight segment to turn green. Electrically operated fuel transfer shutoff valves open for fuel transfer and close when the transfer is stopped. Fuel transfer indications are also shown on the MFD Fuel Page. Once selected, fuel transfer will continue until deselected by the flight crew or until a high–level sensor in the wing tank which is receiving fuel detects an overfill condition, which automatically halts fuel transfer.

Refer to Figure 6.

If the Fuel Quantity Computer (FQC) detects a fuel imbalance (more than 600 lb (272 kg) difference), a yellow [BALANCE] command advisory message is shown just above the FUEL legend of the ED. The message will flash for the first 5 seconds, and then will stay on steady until the imbalance is corrected. An imbalance condition will also be shown on the Fuel Page by the analog quantity dials changing to solid yellow.

Refueling

Refer to Figures 7 and 8.

The refuel/defuel panel controls all refuel and defuel operations. Access to the panel is gained through a flush door on the rear underside of No. 2 nacelle. The dc power must be available for refueling. The FUELING ON caution light comes on, when the refuel/defuel panel access door is open and electrical power is supplied.

Refueling can be accomplished either automatically (PRESELECT REFUEL), or manually (REFUEL). When the rotary selector is turned to the PRESELECT REFUEL or REFUEL position, the MASTER VALVE CLOSED light goes out to show that the refuel/defuel shutoff valve is open. During pressure refueling, fuel pressure opens a refuel vent valve in each tank to vent the tanks through the surge bay.

During automatic refueling, the desired quantity is selected adjacent the PRESEL display on the Refuel/Defuel Indicator (RDI), by using the INCR DECR toggle switch. When the selected quantity is reached, the level control shutoff valve automatically stops fuel flow to the related tank.

During manual refueling, the desired quantity in each tank is controlled by the PRECHECK, OPEN, CLOSE switches. The RDI will display the individual tank quantities. With the rotary selector turned to the REFUEL position, refueling continues until the PRECHECK, OPEN, CLOSE switches are in the CLOSE position, the selector

switch is turned to the OFF position, or until the high level sensors sense a full tank condition.

When fueling is in progress, advisory lights on the refuel/defuel control panel indicate the position of the fuel control valves. The amber DUMP VALVE OPEN indicator light comes on when a related refuel vent opens. The refuel vent valve allows air to vent from the tank as it fills, and prevents damage should the tank overfill due to failure of both normal and backup shut–off features. In the latter case, fuel flows into the surge bay through the refuel vent valve and, if it reaches the height of the standpipes, is spilled overboard through the surge bay NACA vents.

Two PRECHECK, OPEN, CLOSE switches test the automatic shutoff operation of the related high level control unit during refueling, ensuring operation of the overfill shut off system. With the switch in the PRECHECK position a full tank is simulated for the related tank, and the high level sensor shuts off refueling to that tank by closing the level control shut off valve. This causes the related amber REFUEL SHUTOFF light to turn on. Refueling restarts when the switch is released.

Refer to Figure 9.

Gravity refueling can be done through the wing mounted gravity refuel adapter located on the top surface of the wing .

APU Fuel Feed

Fuel for APU operation is supplied by gravity feed from the No. 1 fuel tank through piping in the dorsal fairing to the APU fuel enclosure. Fuel supply is controlled by the APU PWR switchlight located in the flight compartment, on the APU CONTROL Panel. The APU is located in the rear equipment bay.

Indicating System

The fuel quantity and temperature data is shown in white on the Engine Display (ED) and the Fuel Page of the Multi Function Display (MFD). White dashes replace the digits or simulated dials if the data is not valid or not available.

The fuel gauging system consists of Fuel Quantity Computer (FQC) and capacitance type fuel probes. The system has accuracy as specified in MIL–G–26988 Class III on the ground and Class II in flight. The system meets the requirements over aircraft attitudes of ±4 degree pitch and ±3 degree roll. The system does not compensate for attitude variations in flight.

For the reference, the MIL–G–26988 specification specified accuracies are as follows:

- Class II: ±2 percent of indication, ±0.75 percent of full scale
- Class III: ±1 percent of indication, ±0.5 percent of full scale.

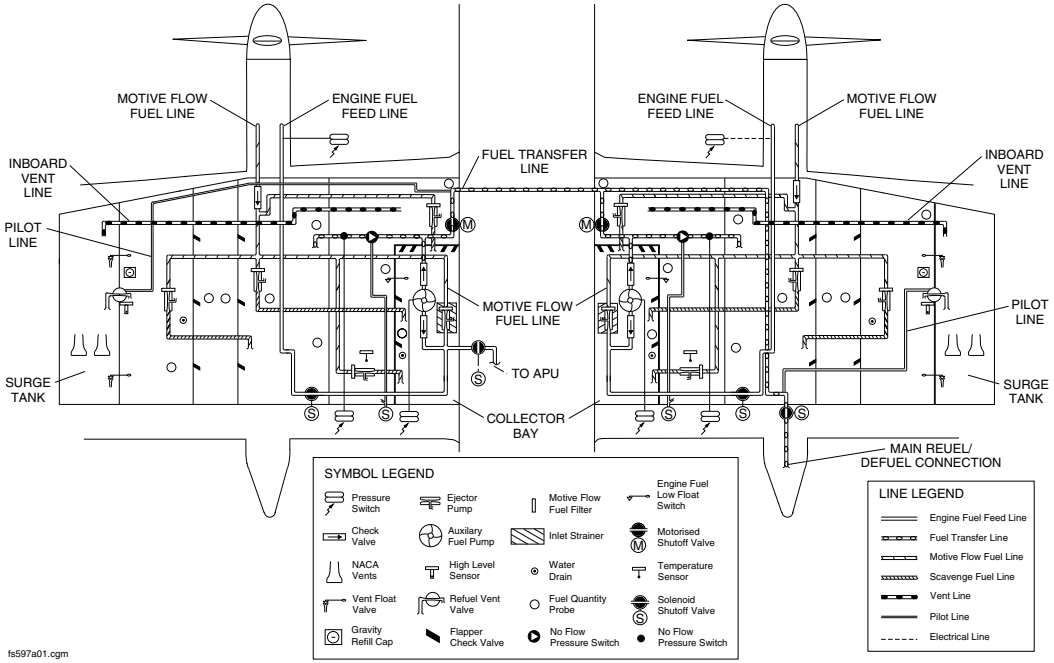
The FQC uses nine capacitance type fuel probes in each tank to determine the total fuel quantity. The fuel quantity of each tank is shown in digital form on the bottom center of the Engine Display (ED). The MFD also shows the fuel quantity of each tank on two simulated analog dials and below that the total fuel quantity in digital form. The fuel quantity can be shown in kilograms (KG) or pounds (LBS.).

The fuel flow for each engine is shown in digital form on the ED in units of KG/H or PPH. The fuel temperature (°C) in the left collector tank is shown in digital form on the MFD Fuel Page, just below the left fuel quantity dial.

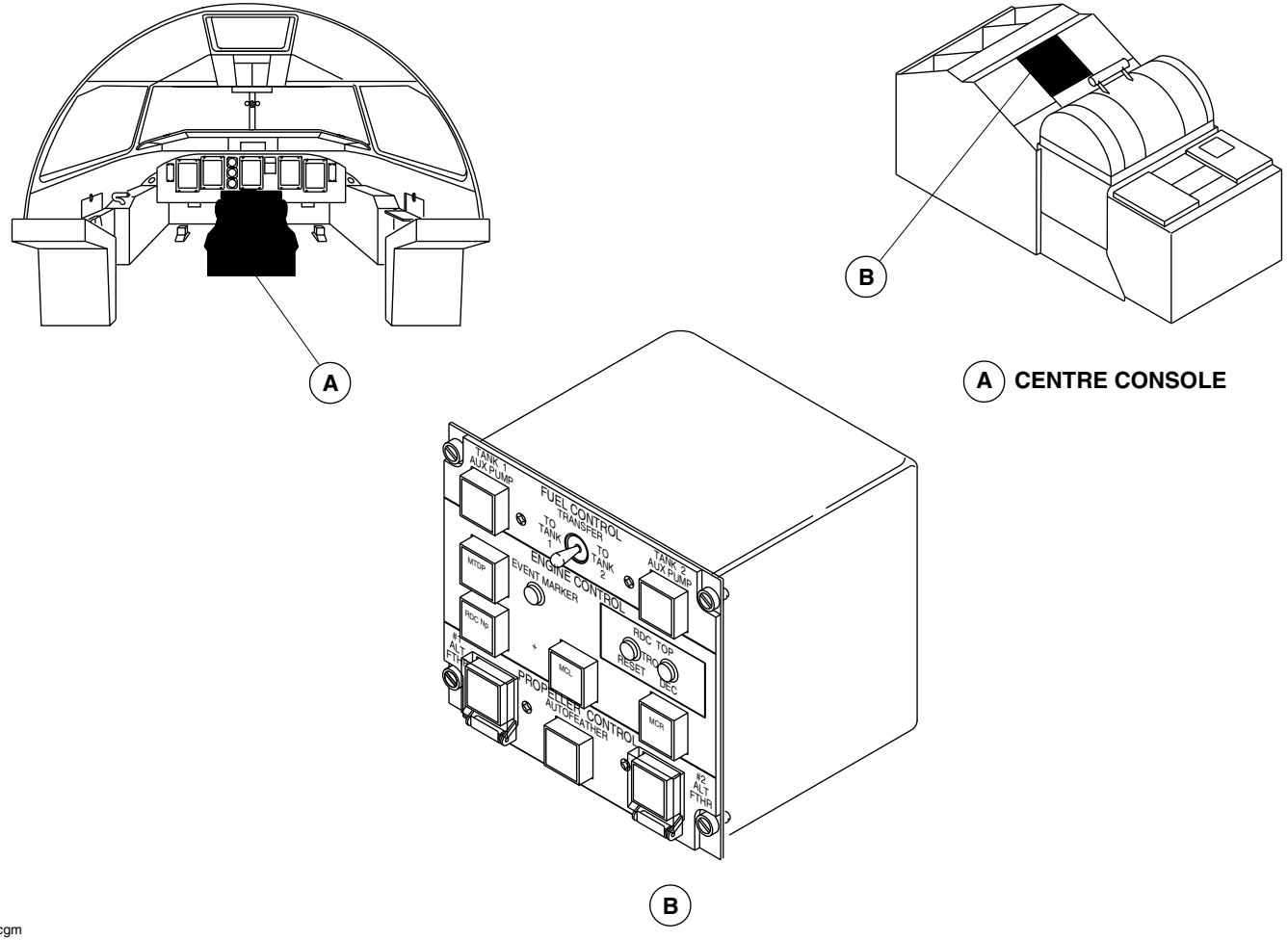
The engine inlet temperature of the fuel after it has passed through the Fuel/Oil Heat Exchanger (FOHE) for the left and right engines is shown in digital form on the bottom of the ED, just below the related fuel tank quantity. The digits are shown in white with a ± sign, and change to yellow or red if the temperature is not in the preset range. A °C unit is shown between the two inlet temperatures.

Refer to Figure 10.

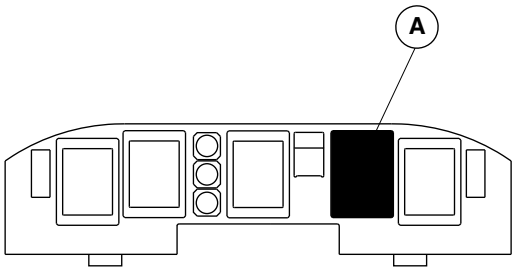
The fuel quantity of each tank is also shown on the refuel/defuel panel located at the back underside of the right nacelle. One magnetic dipstick (magnastick) on the underside of each tank can also be used on the ground to give an independent mechanical indication of the fuel quantity in liters or U.S. gallons. The magnetic dipstick readable range is between 385 kg to 2268 kg (850 lb to 5000 lb) for each tank or approximately 15% to 85% of the total usable fuel quantity of 2659 kg (5862 lb) for each tank. This limitation is because of the wing dihedral.



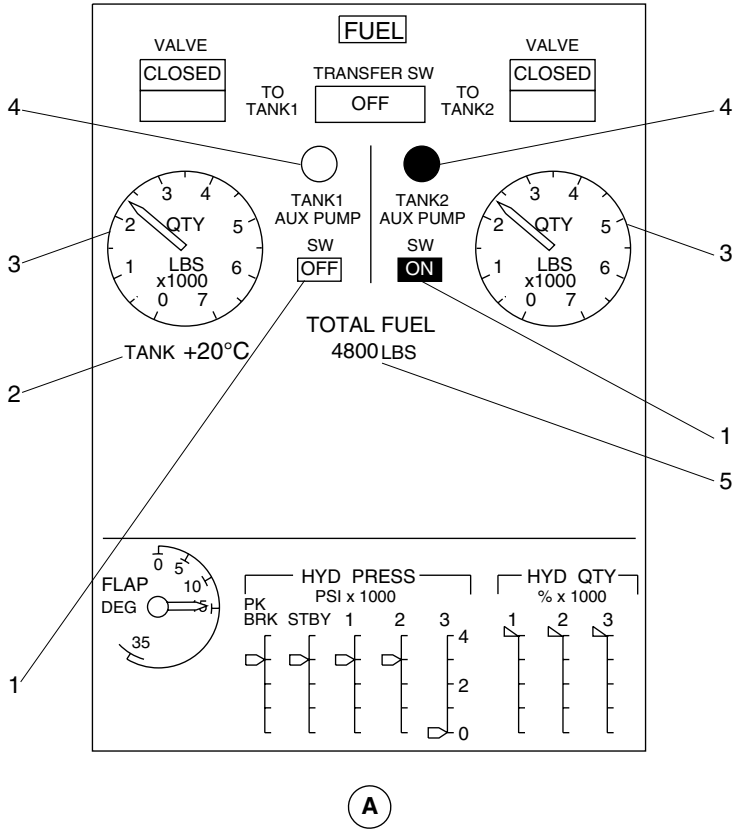
Fuel System Synoptic
Figure 1



Fuel Control Panel
Figure 2



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Auxiliary Pump Switch Position.
2. Fuel Temperature in Left Tank.
3. Left/Right Fuel Tank Quantity.
4. Left/Right Auxiliary Pump Pressure Status.
5. Total Fuel Quantity.

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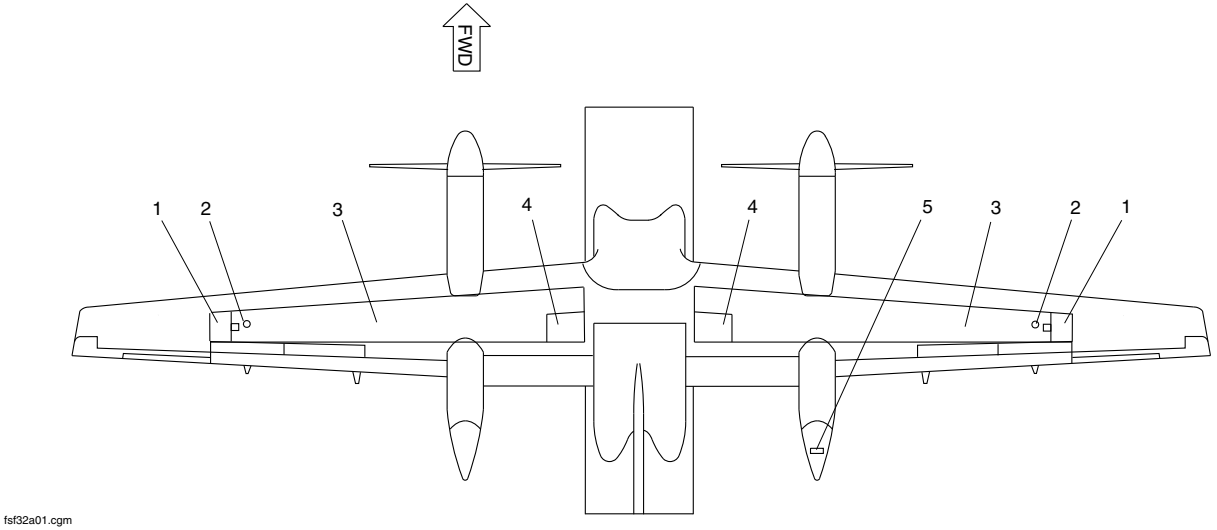
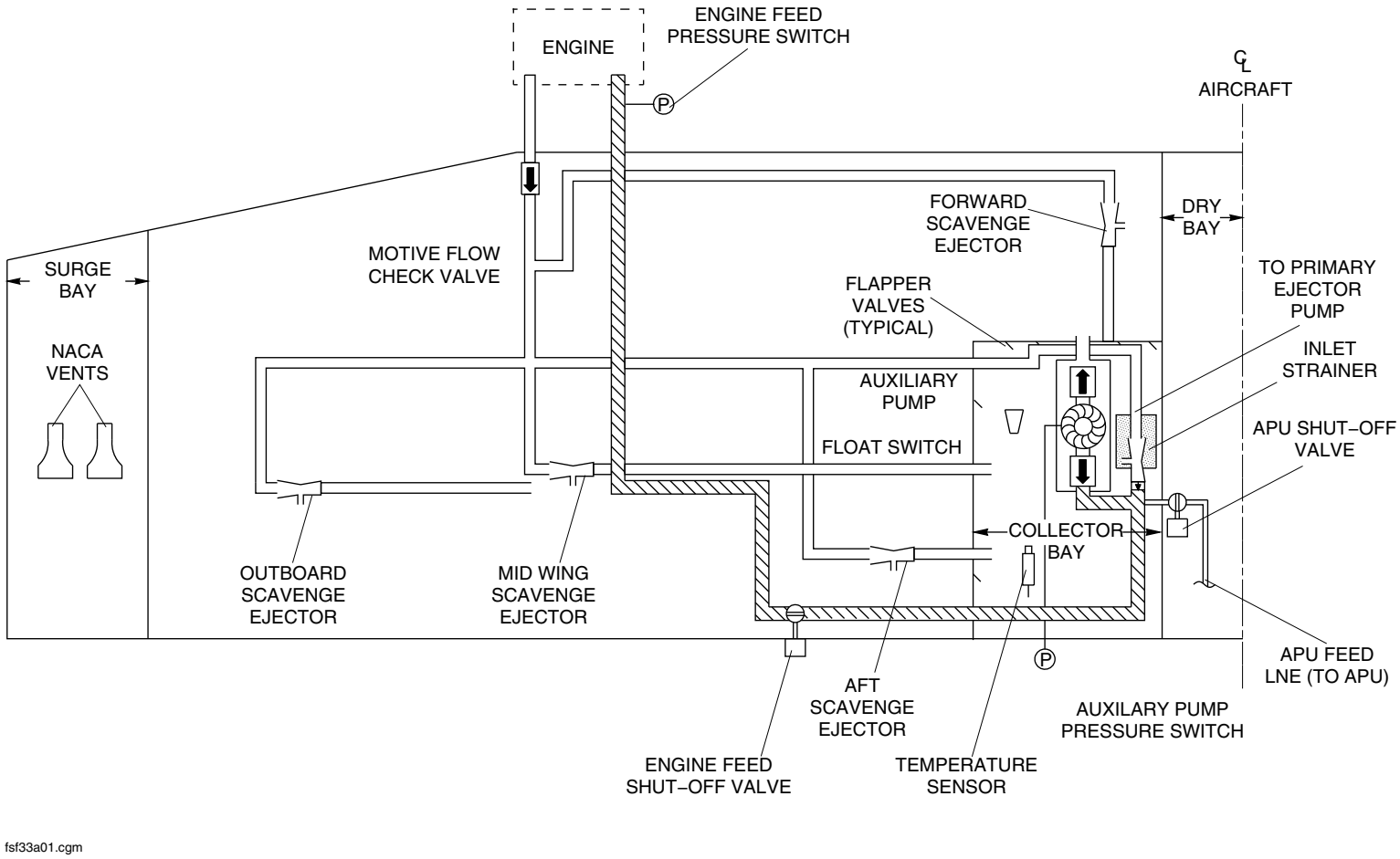
Fuel Quantity Indications
Figure 3

LEGEND

1. Surge Bay.
2. Overwing Filler Cap.
3. Main Tank.
4. Collector Bay.
5. Pressure Refuel/Defuel Control Panel.



Fuel Tank Layout
Figure 4



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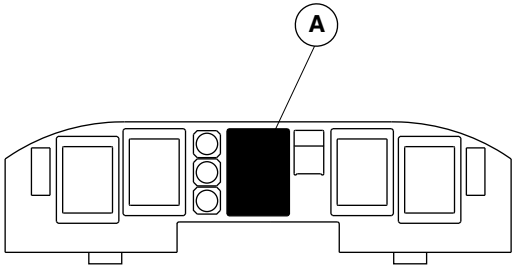
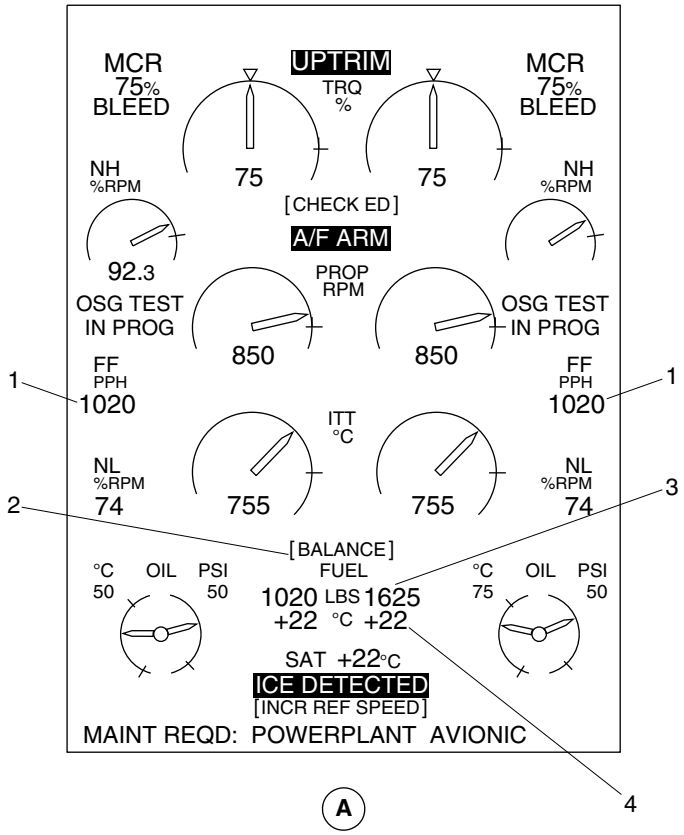
Engine Fuel Feed Schematic
Figure 5



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Flow Digital Value.
2. BALANCE Command Message (Fuel Limitation).
3. Left/Right Fuel Tank Quantity Digital Readout.
4. Left/Right Fuel Inlet Temperature Digital Value.

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ED Fuel Parameters
Figure 6

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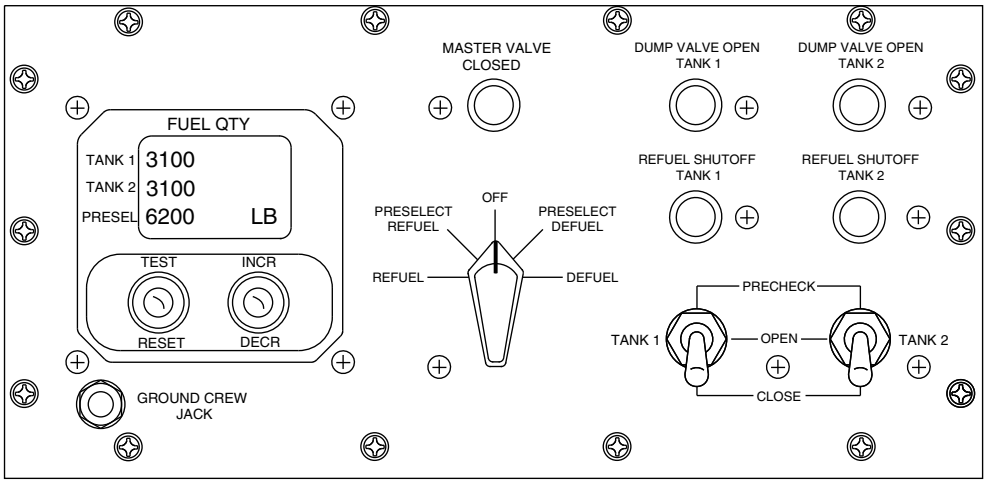

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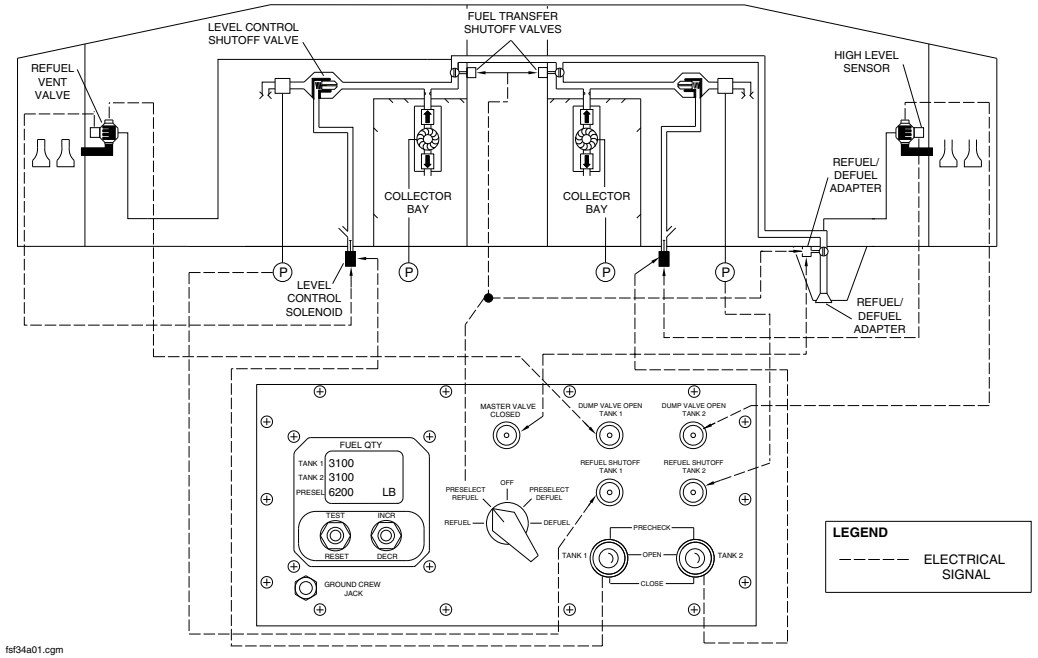
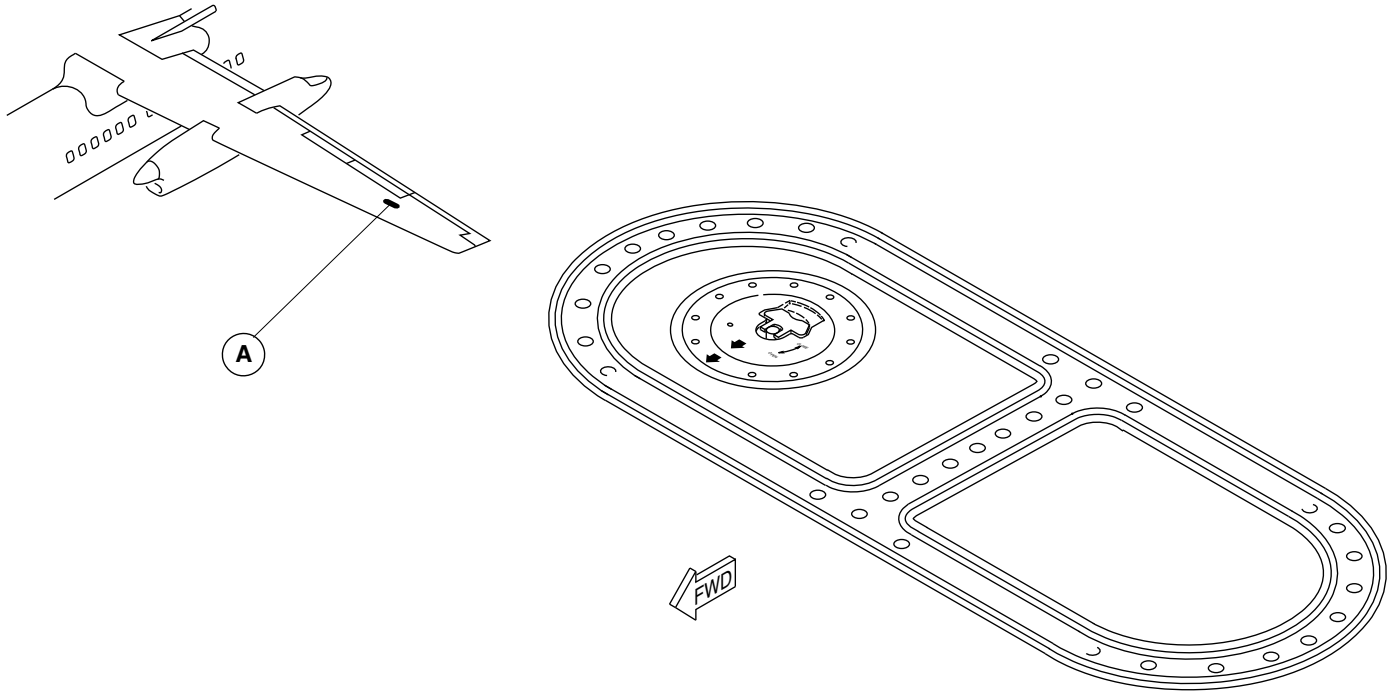
Refuel/Defuel Panel
Figure 7



Refueling Schematic
Figure 8



NOTE
Left side shown.
Right side similar.

A

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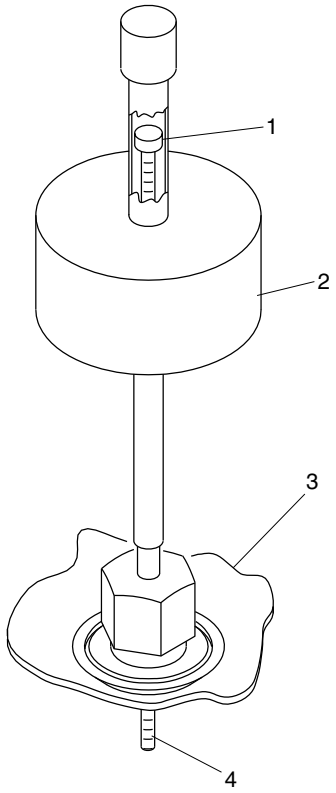
Overwing Filler Cap
Figure 9



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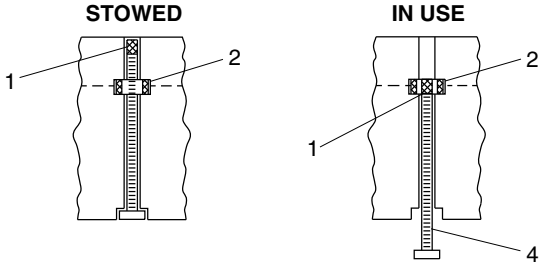
LEGEND

1. Rod Magnet.
2. Float Magnet.
3. Aircraft Lower Wing Skin.
4. Magnetic Dipstick.



Magnetic Dipstick
Figure 10

**ON A/C ALL

28–10–00–001

STORAGE

Introduction

The fuel tanks are purpose built compartments in the wings that contain all the fuel needed for engine and Auxiliary Power Unit operation.

General Description

Fuel is stored in two wing tanks which are integral parts of the aircraft structure. Each wing tank includes a surge bay and a collector bay. There are vents in the fuel storage system to prevent over–pressurization of the fuel tanks.

Detailed Description

There are two fuel tanks in the aircraft; one in each wing. Each fuel tank is formed by the structure of the wing itself. This is known as an integral wet wing tank.

Each tank is divided into three sections:

- the main tank
- the surge bay.
- the collector bay

The main tank extends from the surge bay to the fuselage and collector bay. The collector bay is located at the inboard and aft part of the wing tank. The surge bay is located between the two ribs inboard of the aileron.

The inboard end of the main fuel tank is the wing rib at WS 42 and the outboard end is the wing rib at WS 407. The fuel tanks are formed by the front and rear wing spars, and the upper and lower wing skins. The main tanks and the collector bays are the storage areas for the fuel.

The total volume of the two wing tanks is 1,785 US gal (6757 L), 12,138 lb at 6.8 lb/gal (5505.7 kg at 0.816 kg/L). The total usable fuel from the tanks is 5,318 kg (11,724 lbs). The maximum lateral imbalance permitted between tanks is 272 kg (600 lbs).

The surge bay is used for main tank venting and fuel recovery. Two outboard float vent valves and one inboard vent line control the pressure between the related surge bay and main tank. The two float vent valves, located near the top of the tank, open and close depending on the fuel level in the main tank.

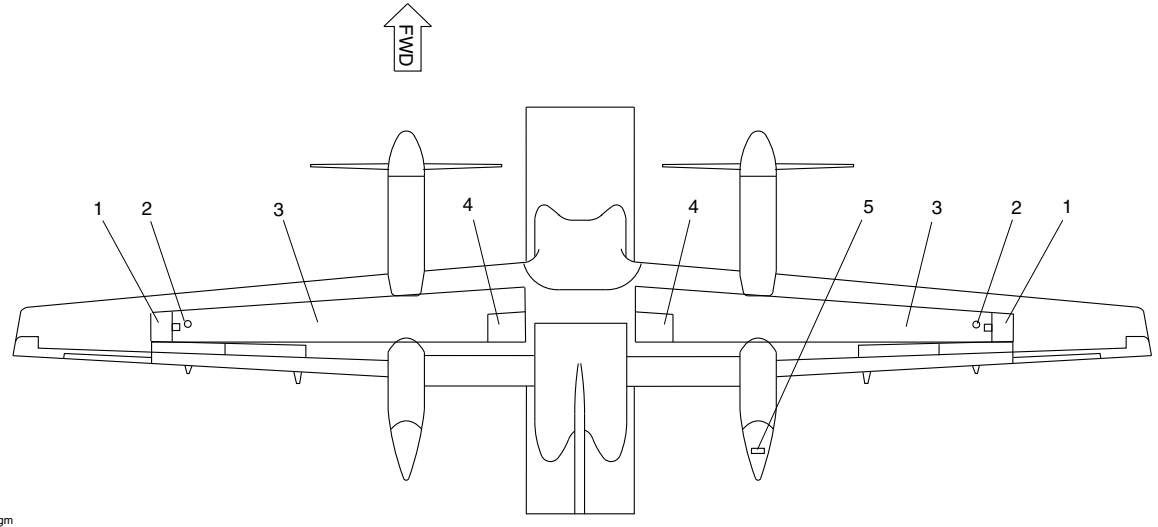
The collector bay supplies engine fuel regardless of the aircraft attitude. Fuel tank scavenging takes place using scavenge ejector pumps in each tank which draw fuel from tank low points, to keep the collector bay full. A primary ejector pump in the collector bay then provides a constant low–pressure fuel supply to the engine. High–pressure motive flow is used to operate the scavenge and primary ejector pumps.

The related No.1 TANK and No.2 TANK FUEL LOW caution light will come on if:

- park brake is off
- related collector bay level drops below approximately 150 kg (305 lbs)
- related engine is operating.

LEGEND

1. Surge Bay.
2. Overwing Filler Cap.
3. Main Tank.
4. Collector Bay.
5. Pressure Refuel/Defuel Control Panel.



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Fuel Storage, Fuel Tanks
Figure 1

**ON A/C ALL

28–11–00–001

FUEL TANKS

Introduction

The fuel tanks contain the fuel to be used by the aircraft engines and optional Auxiliary Power Unit (APU). The fuel tanks have the necessary components to move the fuel from the main tanks to the collector bays for use by the fuel distribution system.

General Description

Refer to Figures 1 and 2.

Fuel is stored in two wing tanks which are integral parts of the aircraft structure. The left (No.1) tank supplies fuel to the left (No.1) engine and the auxiliary power unit (APU). The right (No.2) tank supplies fuel to the right (No.2) engine. Each wing tank includes a surge bay and a collector bay. There are vents in the fuel storage system to prevent over–pressurization of the fuel tanks.

The fuel tanks include the components that follow:

- Flapper Check Valves (28–11–01)
- Motive Flow Lines (28–11–06)
- Motive Flow Check Valves (28–11–11)
- Scavenge Flow Lines (28–11–16)
- Forward Scavenge Ejector (28–11–21)
- Aft Scavenge Ejector (28–11–26)
- Mid Wing Scavenge Ejector (28–11–31)
- Outboard Scavenge Ejector (28–11–36)
- Gravity Refill Cap (28–11–41)
- Water Drain Valve (28–11–46).

Detailed Description

Refer to Figures 1 and 2.

There are two fuel tanks in the aircraft; one in each wing. Each fuel tank is formed by the structure of the wing itself. This is known as an integral wet wing tank.

Each tank is divided into three sections:

- the main tank
- the collector bay
- the surge bay.

The inboard end of the main fuel tank is the wing rib at WS 42 and the outboard end is the wing rib at WS 407. The fuel tanks are formed by the front and rear wing spars, and the upper and lower wing skins. The main tanks and the collector bays are the storage areas for the fuel. The total volume of the two wing tanks is 1,785 US gal (6757 L), 12,138 lb (5506 kg) at 6.8 lb/gal (0.816 kg/L)).

The wet wing tanks are prevented from leaking by sealing all the ribs, stringer joints, spars and fasteners with sealing compound.

The inboard sections of the main tank form the collector bay. The collector bay holds a constant supply of fuel for the engine fuel feed system. The collector bay is located between WS 42 and WS 79.

The surge bay is located outboard of the main tank between WS 407 and WS 425. Each surge bay is connected through integral standpipes to two separate NACA vents on the bottom of the wings. The standpipes help prevent fuel spillage overboard. Vent lines routed from each surge bay to its main tank control the pressure inside the tanks.

Access panels on the upper wing skins give access to the surge bays, main tanks, and collector bays.

Flapper Check Valves

Refer to Figure 3.

The flapper check valves are simple mechanical valves that let fuel flow inboard only. There are 36 flapper check valves, 18 in each wing. They are located at the bottom of the wing ribs and along the forward and side walls of the collector bay.

Motive Flow Check Valves

Refer to Figure 4.

There is one motive flow check valve in each tank. Each motive flow check valve is located in its related tank, downstream of each engine main motive flow line. The check valves prevent back–flow through the motive flow lines.

Motive Flow Lines

Refer to Figure 5.

The engine fuel pumps supply motive flow as a low volume, high pressure fuel flow. Motive flow is pumped to the scavenge ejectors and to the engine fuel feed system primary ejectors through the motive flow lines.

Scavenge Flow Lines

Refer to Figure 5.

The scavenge flow lines are used to transfer fuel from the main tanks to the collector bays.

Forward Scavenge Ejector

Refer to Figures 5 , 6 and 7.

There is one forward scavenge ejector in each tank. The ejectors are located in the forward inboard area of the wings. Motive flow fuel is pumped to the forward scavenge ejector through the motive flow lines. The low volume, high pressure motive flow causes the ejector to discharge a high volume, low pressure flow into the scavenge lines. They supply fuel to the collector bays through the scavenge flow lines. A 250 micron filter at the motive port of the ejector protects the small nozzle opening.

Aft Scavenge Ejector

Refer to Figures 5 , 6 and 7.

There is one aft scavenge ejector in each tank. The ejectors are located in the aft inboard area of the wings. Motive flow is pumped to the scavenge ejectors through the motive flow lines. The low volume, high pressure motive flow causes the ejector to discharge a high volume, low pressure flow into the scavenge lines. The aft scavenge ejectors supply fuel to the collector bays through the scavenge flow lines. A 250 micron filter at the motive port of the ejector protects the small nozzle opening.

Mid Wing Scavenge Ejector

Refer to Figures 5 , 6 and 7.

There is one mid wing scavenge ejector in each tank. The ejectors are located between the outboard scavenge ejectors and the collector bays. Motive flow is pumped to the scavenge ejectors through the motive flow lines. The low volume, high pressure motive flow causes the ejector to discharge a high volume, low pressure flow into the scavenge lines. The mid wing scavenge ejectors supply fuel to the collector bays through the scavenge flow lines. A 250 micron filter at the motive port of the ejector protects the small nozzle opening.

Outboard Scavenge Ejector

Refer to Figures 5 , 6 and 7.

There is one outboard scavenge ejector in each tank. The scavenge ejectors are located in the outboard area of the wings. Motive flow is pumped to the scavenge ejectors through the motive flow lines. The low volume, high pressure motive flow causes the ejector to discharge a high volume, low pressure flow into the scavenge lines. The outboard scavenge ejectors supply fuel to the inboard section of the wing. A 250 micron filter at the motive port of the ejector protects the small nozzle opening.

Gravity Refill Cap

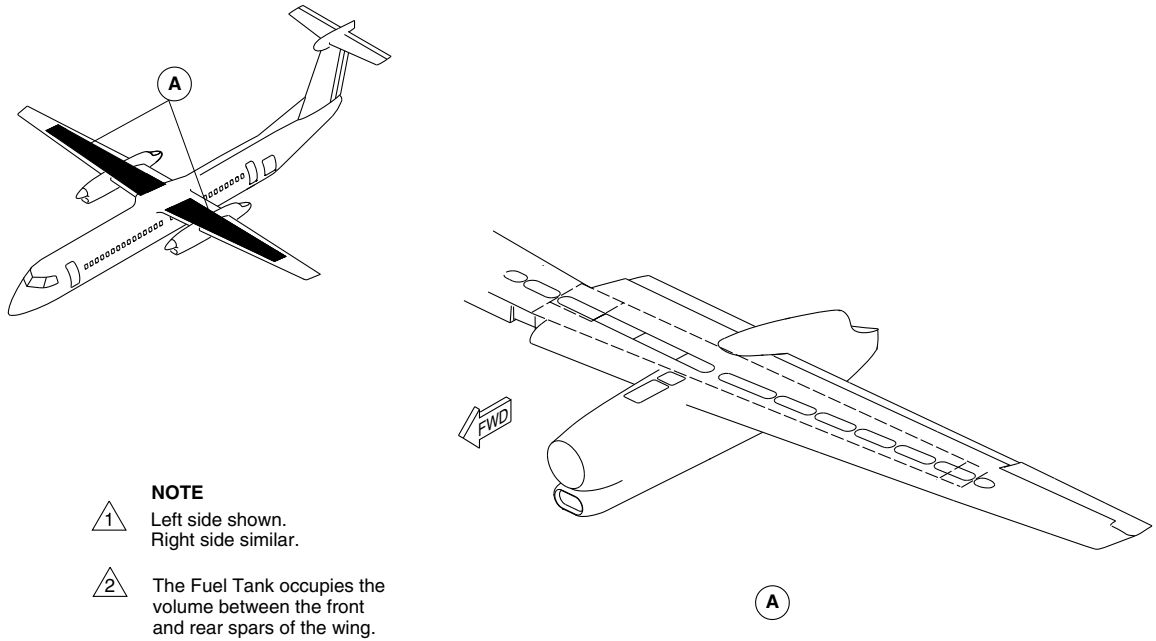
Refer to Figures 8 and 9.

There is one gravity refill cap installed at the outboard section of each wing. The stainless steel gravity refill caps are lightning proof and are installed on an access panel flush with the wing surface .

Water Drain Valve

Refer to Figure 10.

There are six water drain valves installed on the aircraft, three in each wing. They are located at the lowest points of the surge bay, main tank and collector bay to minimize the amount of trapped fuel. The drains may be opened to check for, and drain, any water accumulation in the tank. The valves are also used to drain residual fuel from the tanks when necessary.



NOTE

1. Left side shown.
   Right side similar.
2. The Fuel Tank occupies the volume between the front and rear spars of the wing.

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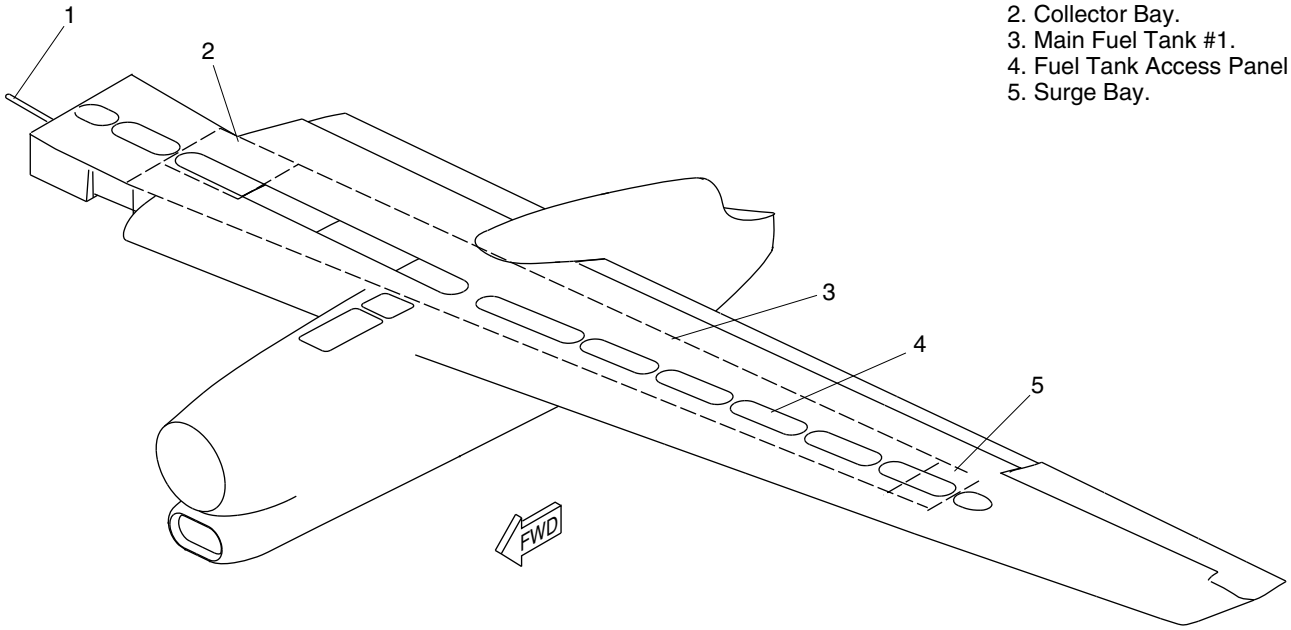
Fuel Tank Page 1
Figure 1



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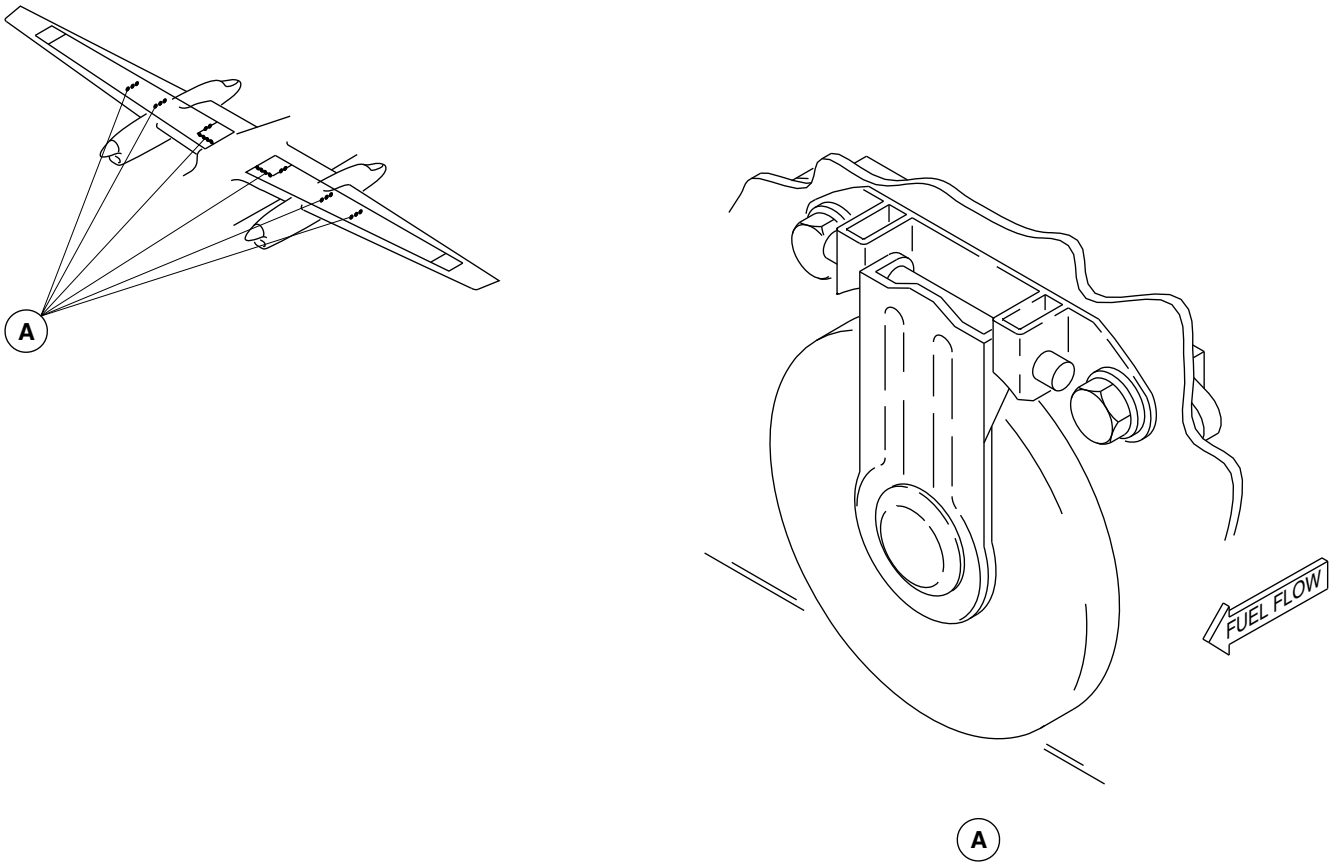
LEGEND

1. Refuel/Defuel/Transfer Manifold.
2. Collector Bay.
3. Main Fuel Tank #1.
4. Fuel Tank Access Panel (10 Per Wing).
5. Surge Bay.

Fuel Tank Page 2
Figure 2



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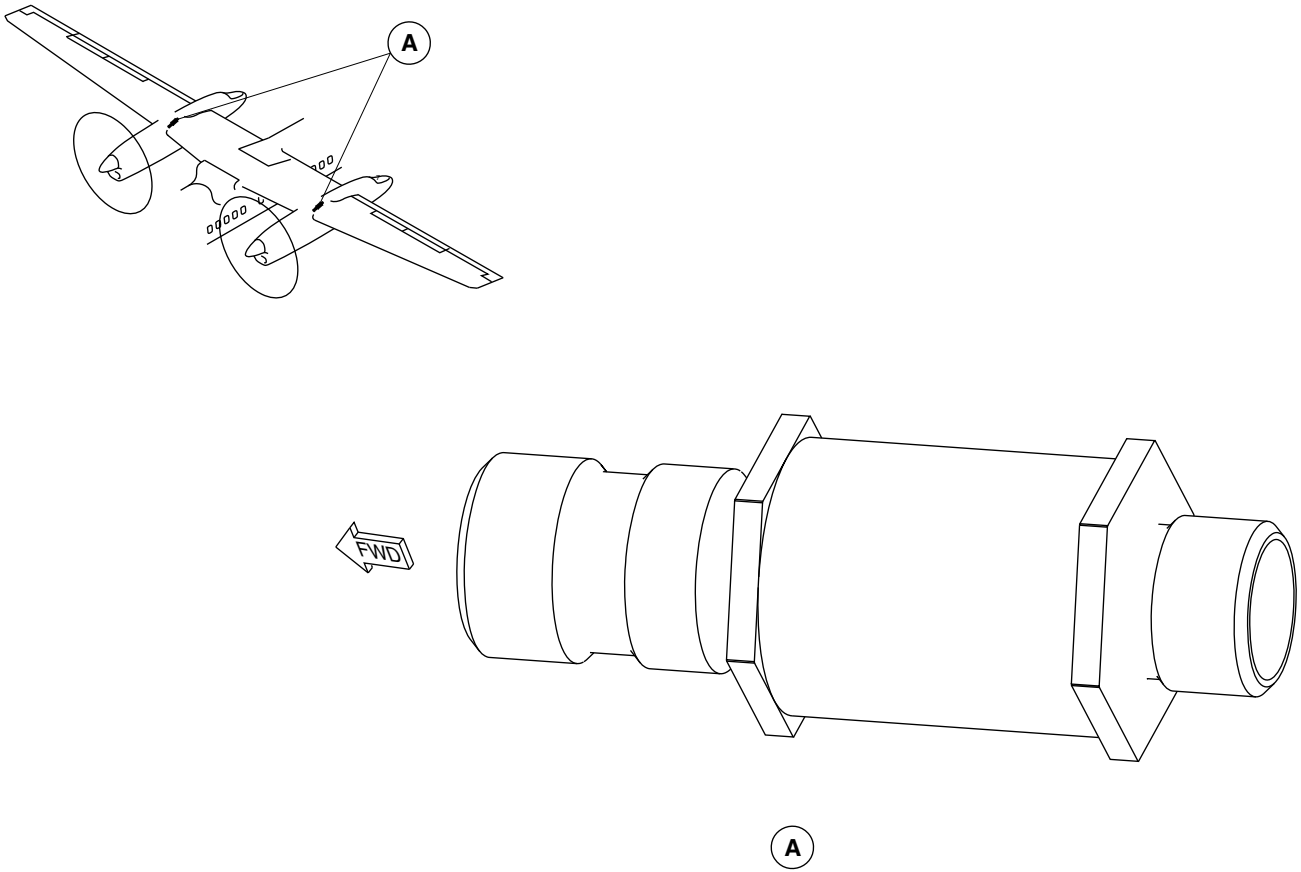
Flapper Check Valves
Figure 3



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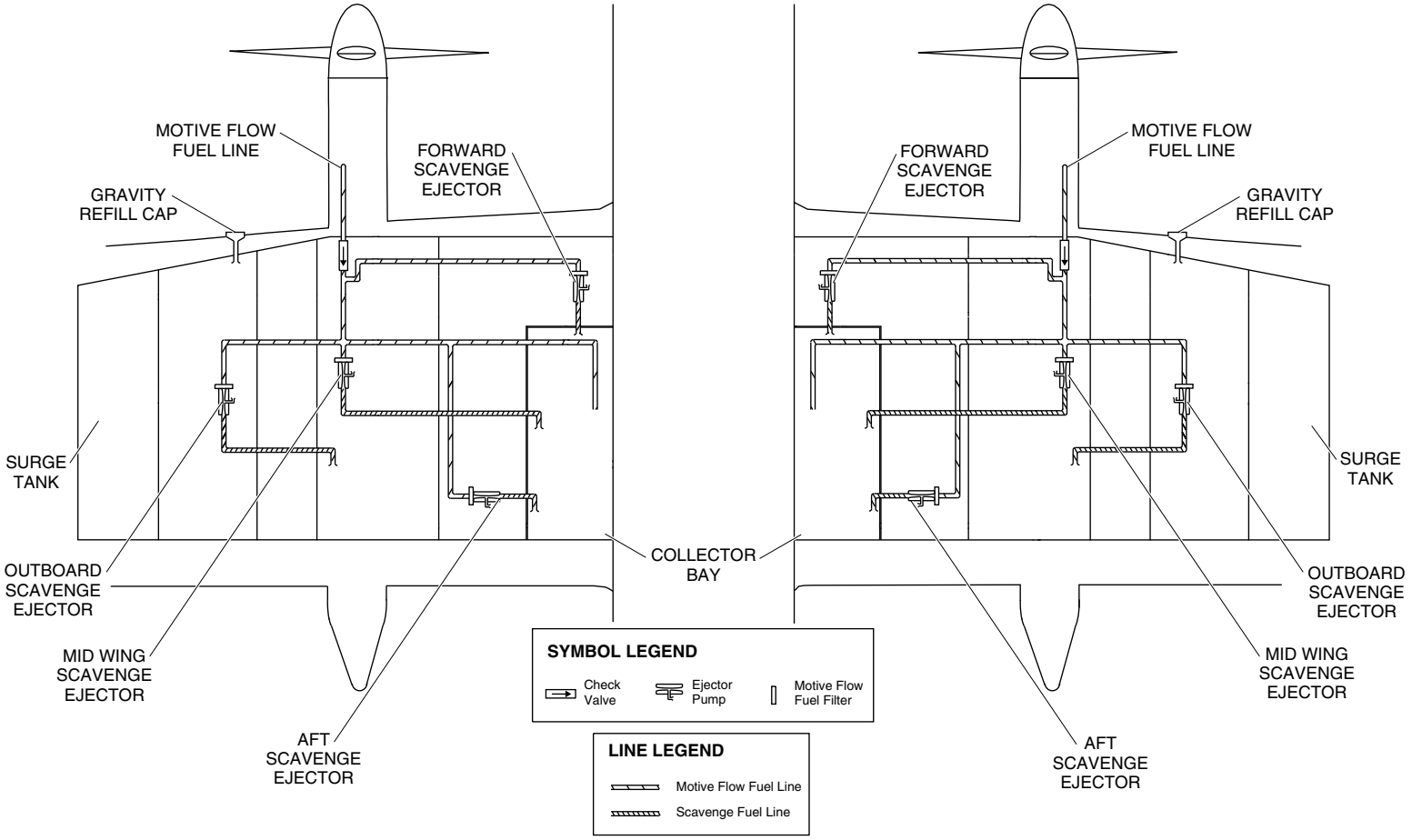
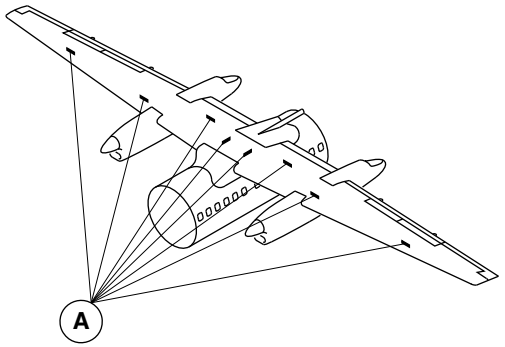
Motive Flow Check Valve
Figure 4

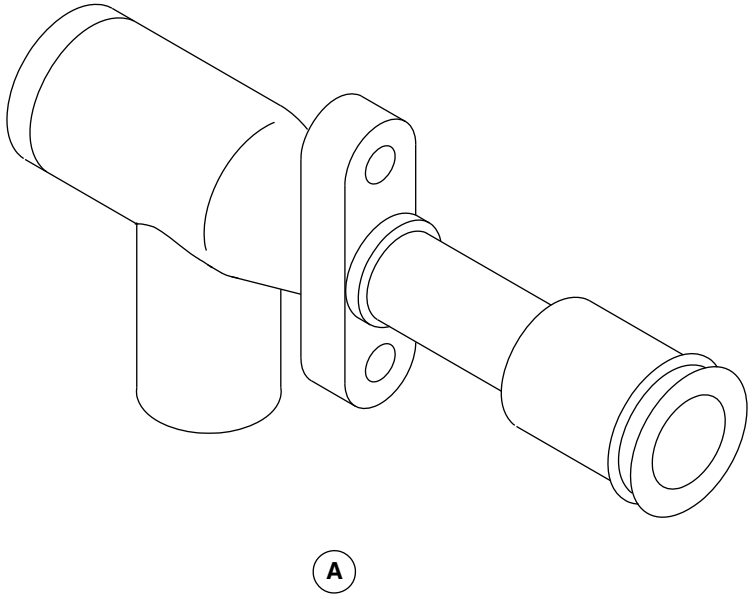


Motive Flow and Scavenge Systems
Figure 5



NOTE

One component shown.
Other seven similar.



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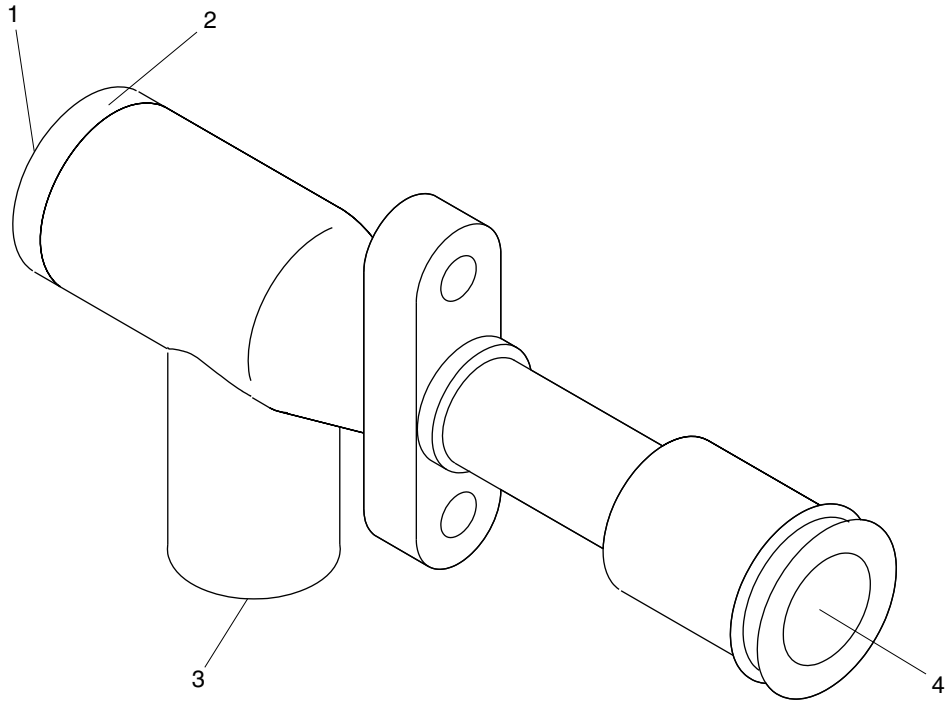
Scavenge Ejectors
Figure 6



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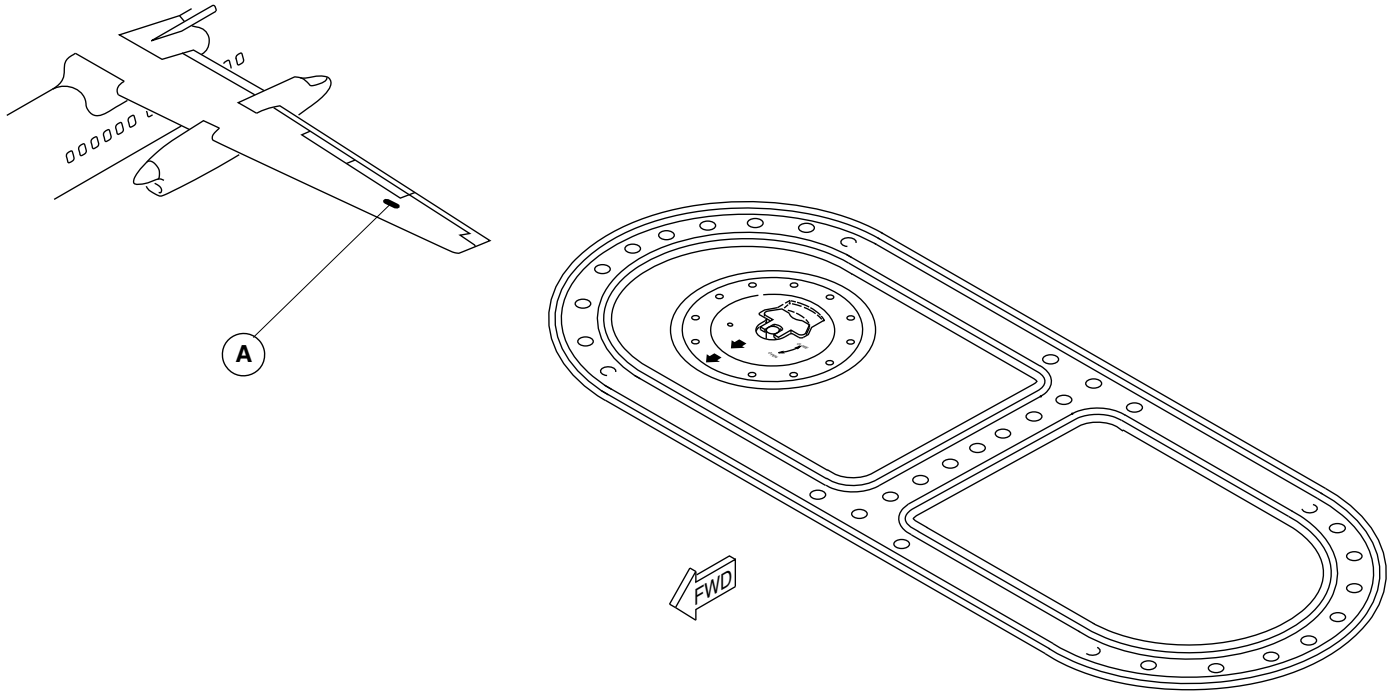
LEGEND

1. Motive Fuel Flow Inlet.
2. Fuel Filter.
3. Fuel Inlet.
4. Scavenge Fuel Flow Outlet.

Scavenge Ejector
Figure 7

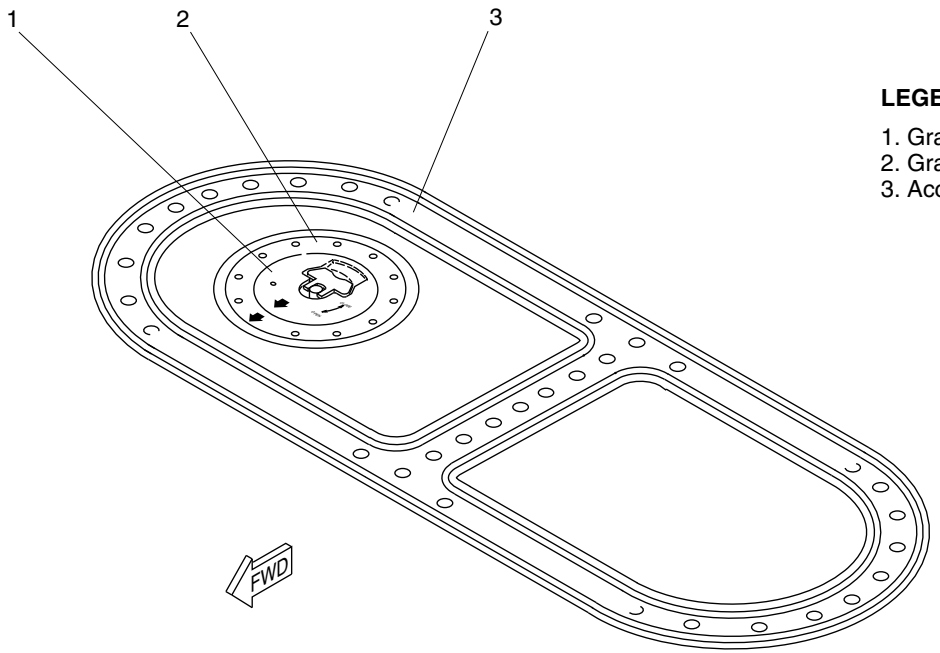


NOTE
Left side shown.
Right side similar.

A

fs321a01.cgm

Gravity Refill Cap Locator
Figure 8



LEGEND

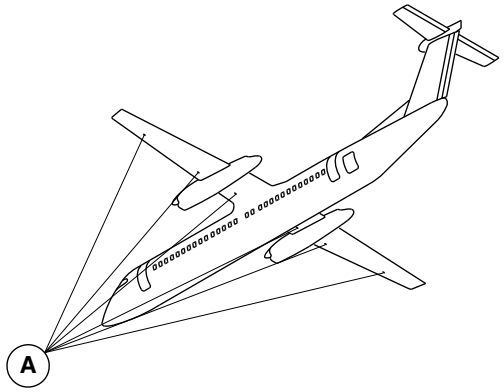
1. Gravity Refill Cap.
2. Gravity Refill Adapter.
3. Access Panel.

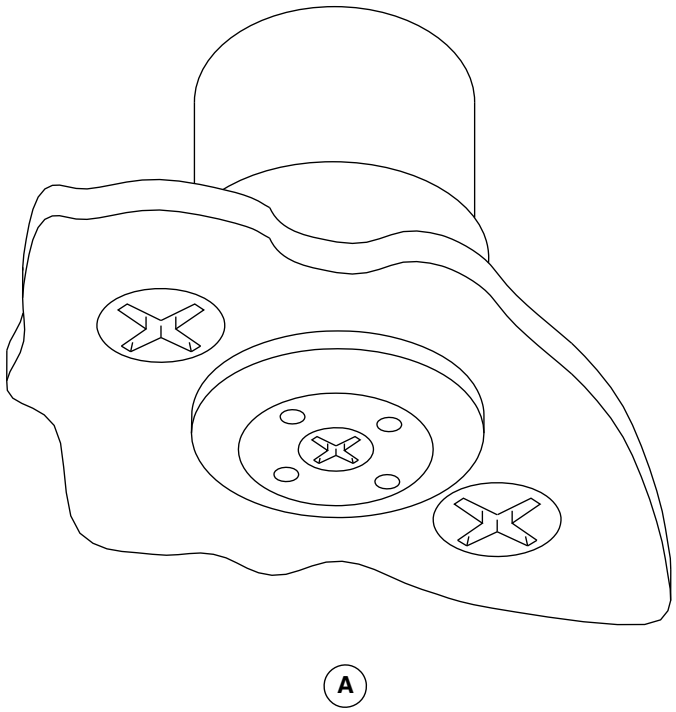
NOTE

Arrow on filler cap must align with arrow on adapter.

fs322a01.cgm

Gravity Refill Cap Detail
Figure 9





NOTE

One Drain Valve shown.
Other five Valves similar.

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Water Drain Valve
Figure 10

**ON A/C ALL

28–12–00–001

VENTS

Introduction

The vent system connects each fuel tank to ambient air pressure. This equalizes the pressure inside the tank with the pressure outside the tank and supplies sufficient venting of the fuel tanks for any aircraft flight attitude. Venting of the fuel tanks also prevents any structural damage to the aircraft during refueling or defueling.

General Description

The vent system lets air enter the fuel tanks as the fuel is supplied to the engines, or during aircraft defueling. This prevents structural damage to the tanks from an excessively low internal pressure. The vents also let air out of the tanks when the aircraft is being refuelled to prevent the tanks from overpressurizing.

The vent system includes the components that follow:

- Inboard Vent Line (28–12–01)
- Outboard Vent Line (28–12–06)
- Vent Float Valves (28–12–11)
- NACA Vent Inlet (28–12–21).

Detailed Description

Refer to Figures 1 and 2.

The vent system keeps the wing tank pressure within safe limits for all aircraft operations and flight manoeuvres. It allows unrestricted air flow between the tank and ambient air. Each fuel tank is vented to its related surge bay through an inboard vent line. The surge bay itself is vented to the outside through two NACA vents located on the underside of the wing.

Each surge bay also has two (forward and aft) outboard vent lines with vent float valves. The vent float valves close the outboard vent lines when the fuel level rises above the opening of the vent lines. During a climb, the aft vent float valve closes and venting is supplied by the forward outboard vent line. During a descent, the forward vent float valve closes and venting is supplied by the aft outboard vent line.

Inboard Vent Line

Refer to Figure 2.

An inboard vent line is routed from the surge bay along the forward wing spar to the inboard part of the main fuel tank. This line supplies venting when the fuel is moving outboard or inboard in the tank, as in climb, uncoordinated flight maneuvers, accelerated rolls, refueling and defueling. The line is completely unobstructed in order to supply continuous overpressure protection for the wing tank.

The outboard end of the vent line extends down to within 0.5 in. (12.7 mm) of the bottom of the surge bay. Due to the slight pressurization of the surge bay excess fuel in the bottom of the bay is scavenged back into the main tank.

Outboard Vent Line

Refer to Figure 2.

There are two outboard vent lines in each fuel tank connecting the main fuel tank to the surge bay. The vent lines extend down to within 0.5 in. (12.7 mm) of the bottom of the surge bay. As the surge bay is pressurized in flight, through the NACA vents, any fuel in the surge bay is scavenged by the outboard vent lines back into the main tank.

The vent float valves, located near the top of the tank, open and close the outboard vent lines depending on the fuel level in the main tank.

Vent Float Valves

Refer to Figures 3 and 4.

Two vent float valves are located near the top of the rib dividing the main tank from the surge bay (WS 407). The float valve closes the outboard vent line if the fuel level in the tank rises above the opening of the vent valve. The outboard vent lines located on the forward part of the fuel tanks, supply venting during climbs. The vent lines located on the aft part of the tanks supply venting in descents.

Inlet NACA Vents

Refer to Figures 5 and 6.

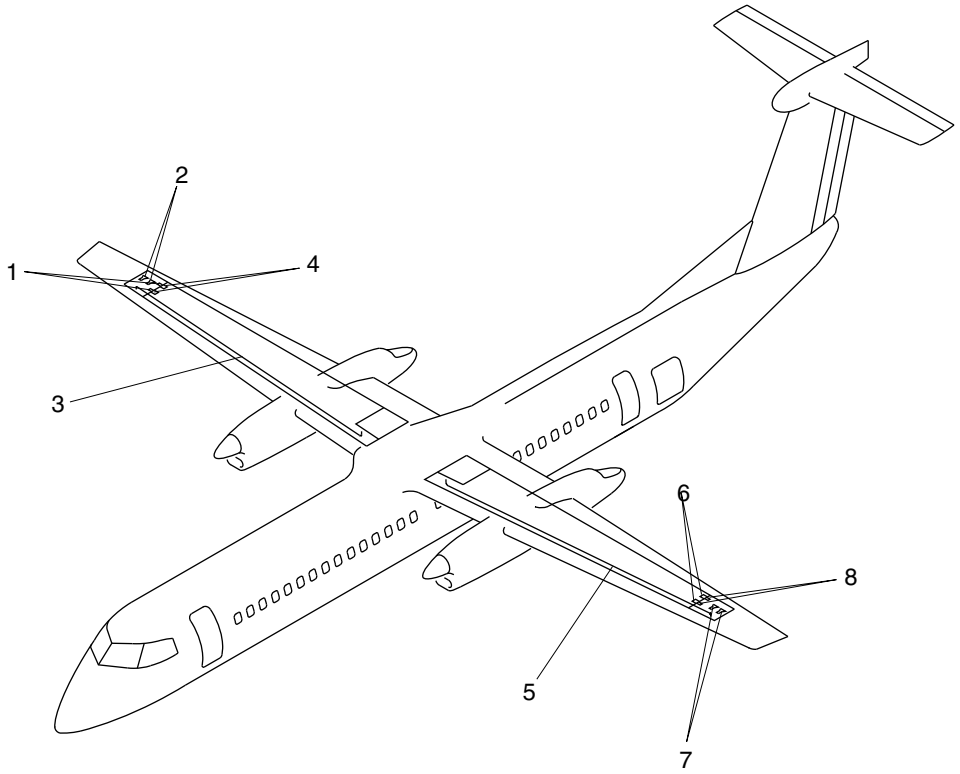
The surge bay is vented overboard through dual NACA vents. The vents are located on the lower front edge of each wing. They are ice–free ram air vents which keep a slight positive pressure in the fuel tank while in flight. The NACA vents are connected to standpipes which extend up to the top rear of the surge bay. These standpipes prevent any fuel which may accumulate in the bottom of the surge bay from spilling overboard.

On aircraft with ModSum 4–124457 incorporated, the NACA vents are modified to have provisions for the installation of either upper vent scoop assembly or flame arrestor.

On aircraft with ModSum 4–201646 incorporated, the NACA vents are connected to the upper vent scoop assembly.

On aircraft with ModSum 4–309305 incorporated, the NACA vents are connected to the flame arrestors. These flame arrestors will improve safety of aircraft in the event of ground fire and other possible incidents.

On aircraft with ModSum 4–124544 incorporated, the upper vent scoop assembly or flame arrestor is connected with the bracket assembly to prevent the vibration.



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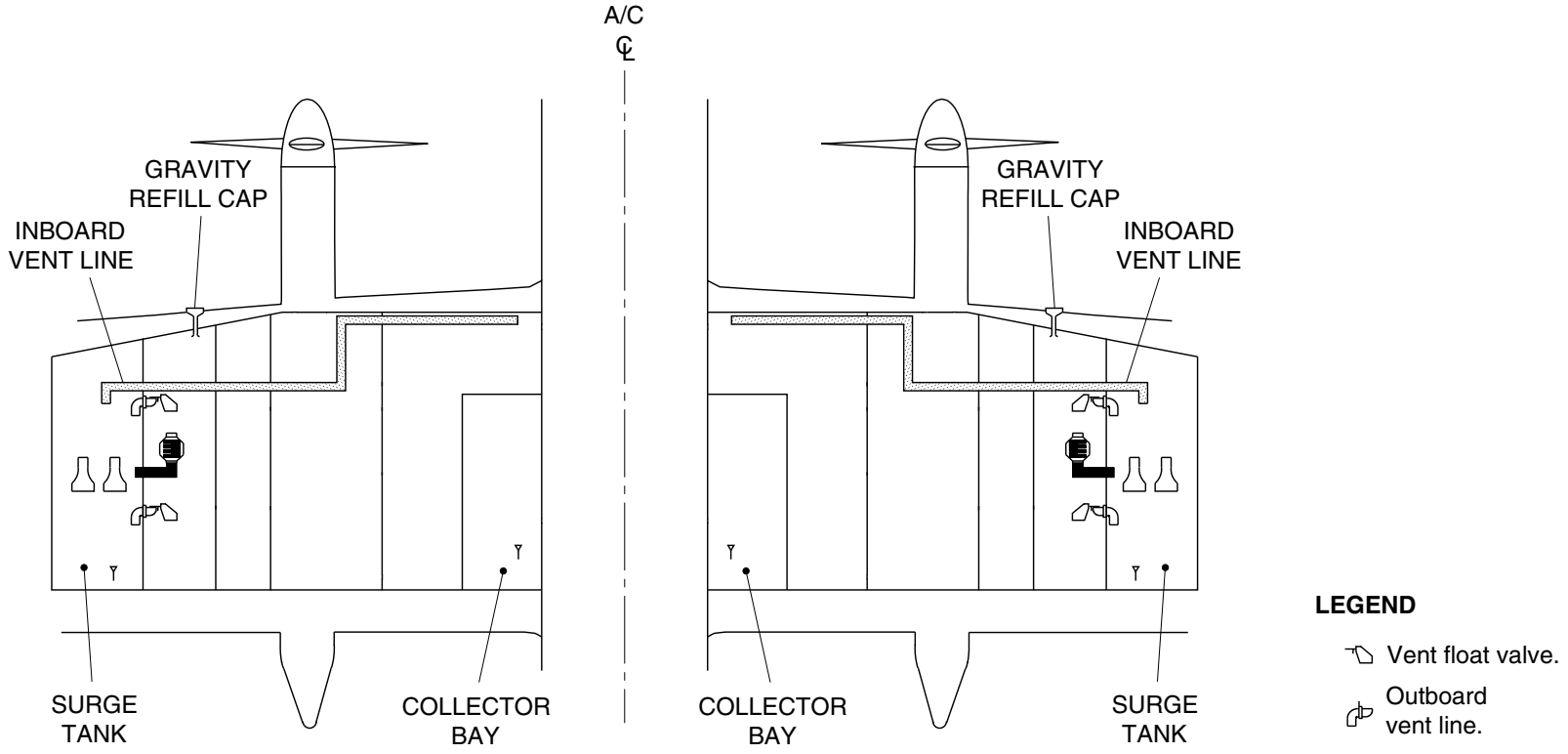
LEGEND

1. Outboard Vent Lines.
2. NACA Vents.
3. Inboard Vent Line.
4. Vent Float Valves (2).
5. Inboard Vent Line.
6. Vent Float Valves (2).
7. NACA Vents.
8. .Outboard Vent Lines.

VENT SYSTEM PAGE 1
Figure 1



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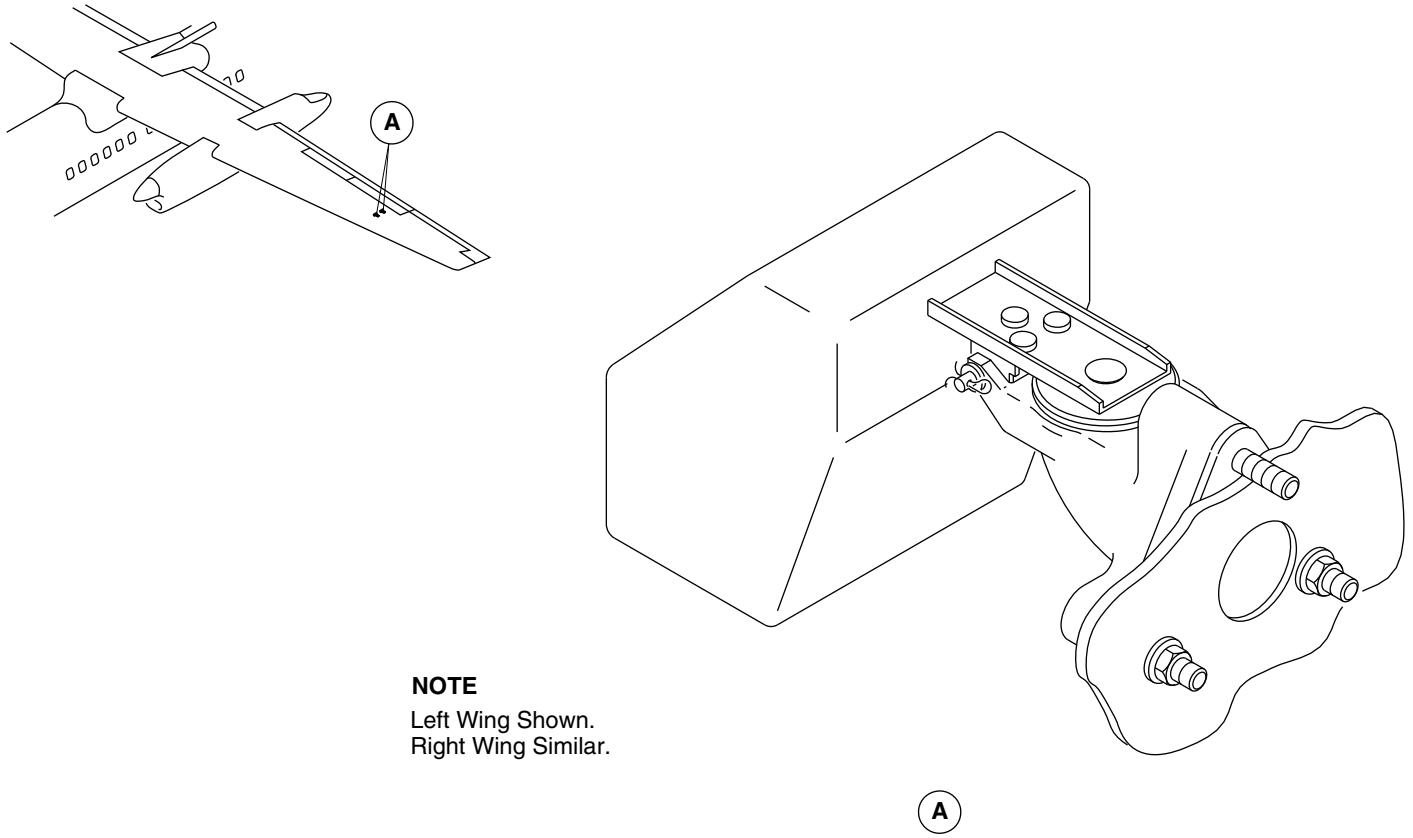
Vent System Page 2
Figure 2



NOTE
Left Wing Shown.
Right Wing Similar.

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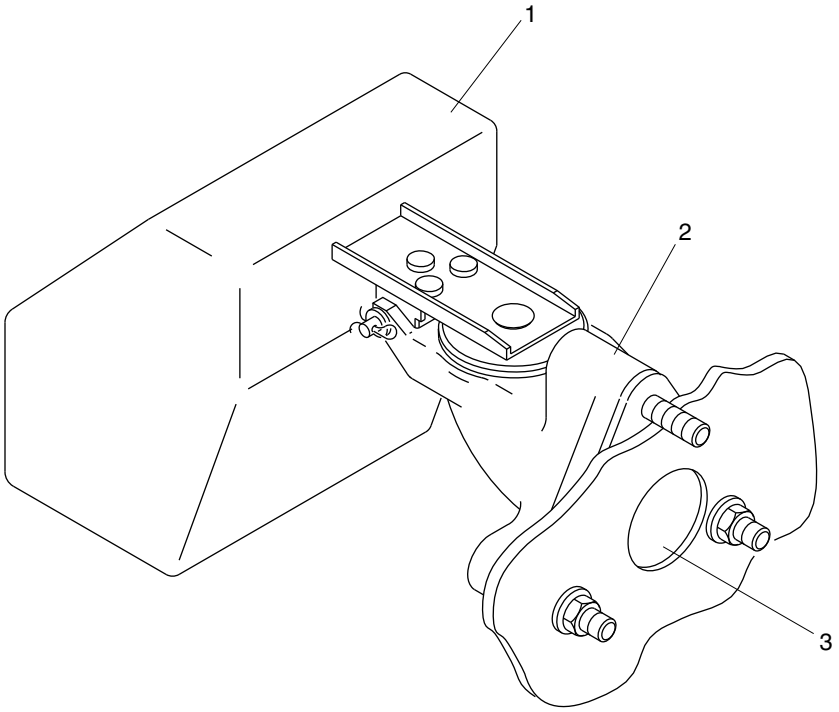
VENT FLOAT VALVE PAGE 1
Figure 3



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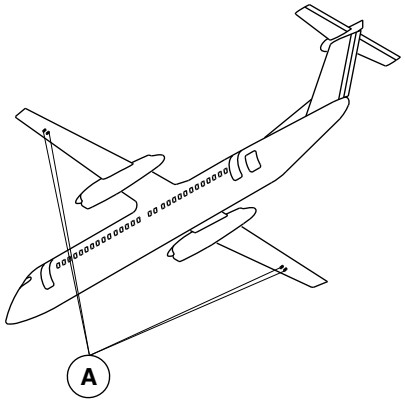
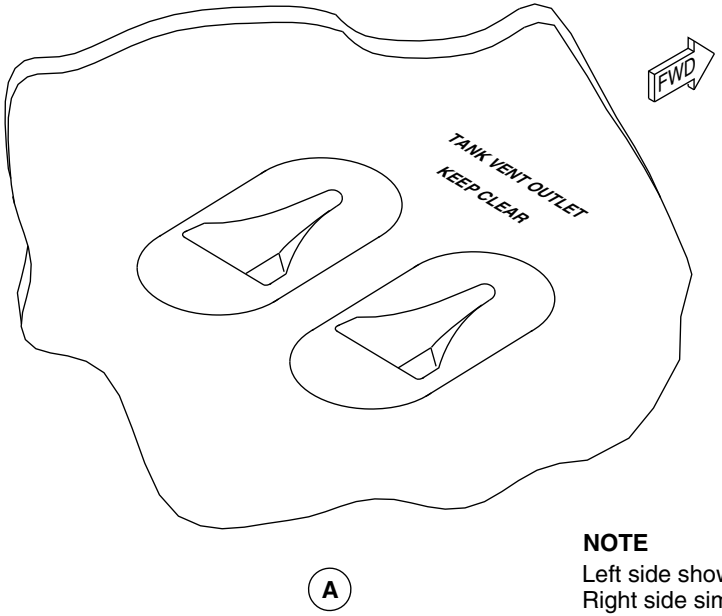
LEGEND

1. Float.
2. Valve.
3. Connection to Surge Bay.

VENT FLOAT VALVE PAGE 2
Figure 4





NOTE
Left side shown.
Right side similar.

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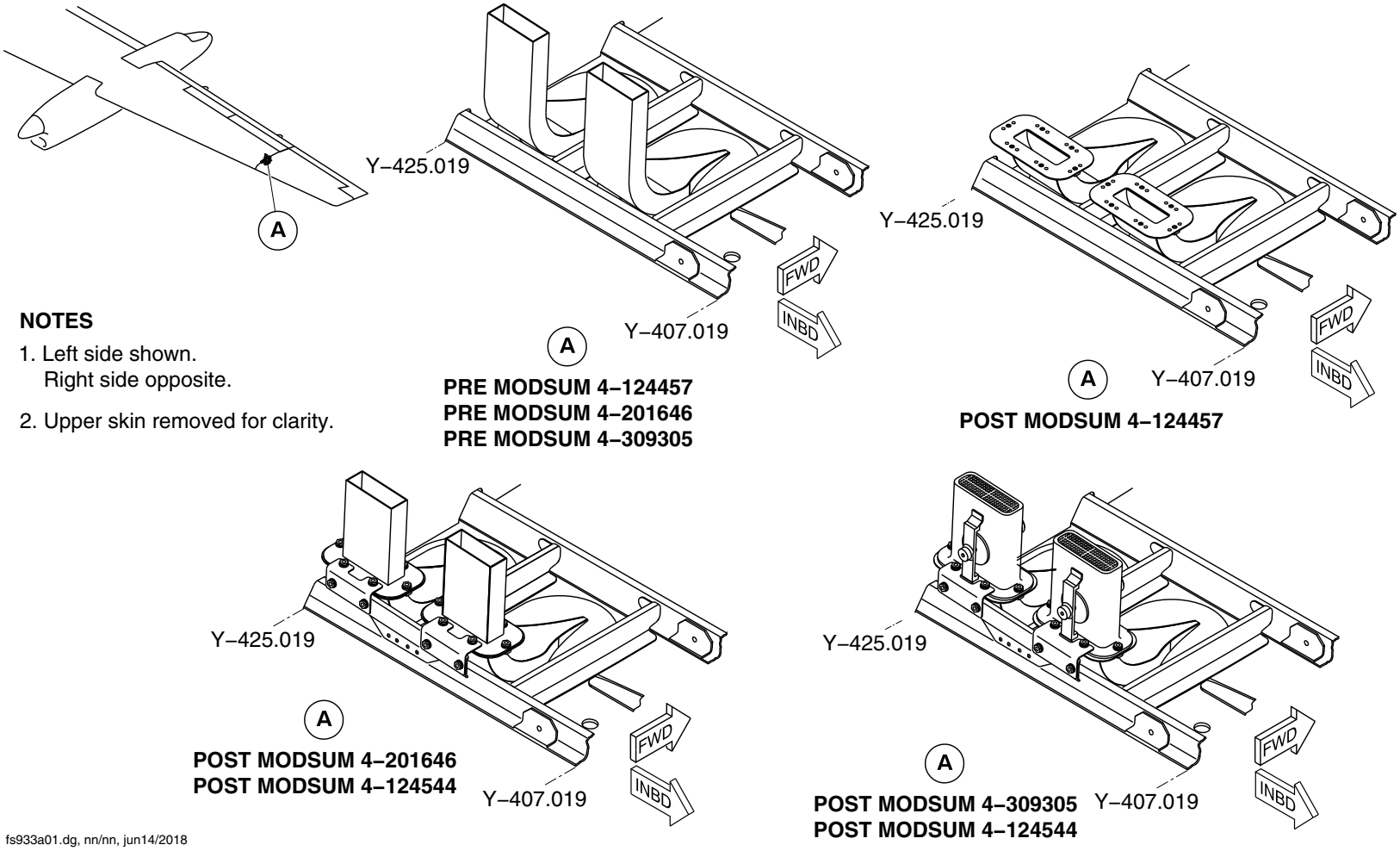
NACA INLET VENT
Figure 5



NOTES

1. Left side shown.
   Right side opposite.
2. Upper skin removed for clarity.

PRE MODSUM 4–124457
PRE MODSUM 4–201646
PRE MODSUM 4–309305

POST MODSUM 4–124457

POST MODSUM 4–201646
POST MODSUM 4–124544

POST MODSUM 4–309305
POST MODSUM 4–124544

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NACA Inlet Vent Standpipe
Figure 6

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28–20–00–001

DISTRIBUTION

Introduction

The distribution system supplies engine and APU fuel feed, refueling and defueling, and fuel transfer between the tanks.

General Description

The distribution system includes the systems that follows:

- Engine Fuel Feed (28–21–00)
- APU Fuel Feed (28–22–00)
- Fuel Transfer (28–23–00)
- Refuel/Defuel (28–24–00)

Detailed Description

Refer to Figures 1 and 2.

The function of the distribution system is to automatically supply fuel to an operating engine, supply fuel to the APU when selected and let fuel be transferred when selected in the flight compartment. The system also lets the aircraft be refueled or defueled when selected on the Refuel/Defuel panel.

Engine Fuel Feed

The engine fuel feed system supplies pressurized fuel to the aircraft engines. Engine No.1 receives its fuel from tank No.1. Engine No.2 receives its fuel from tank No.2.

APU Fuel Feed

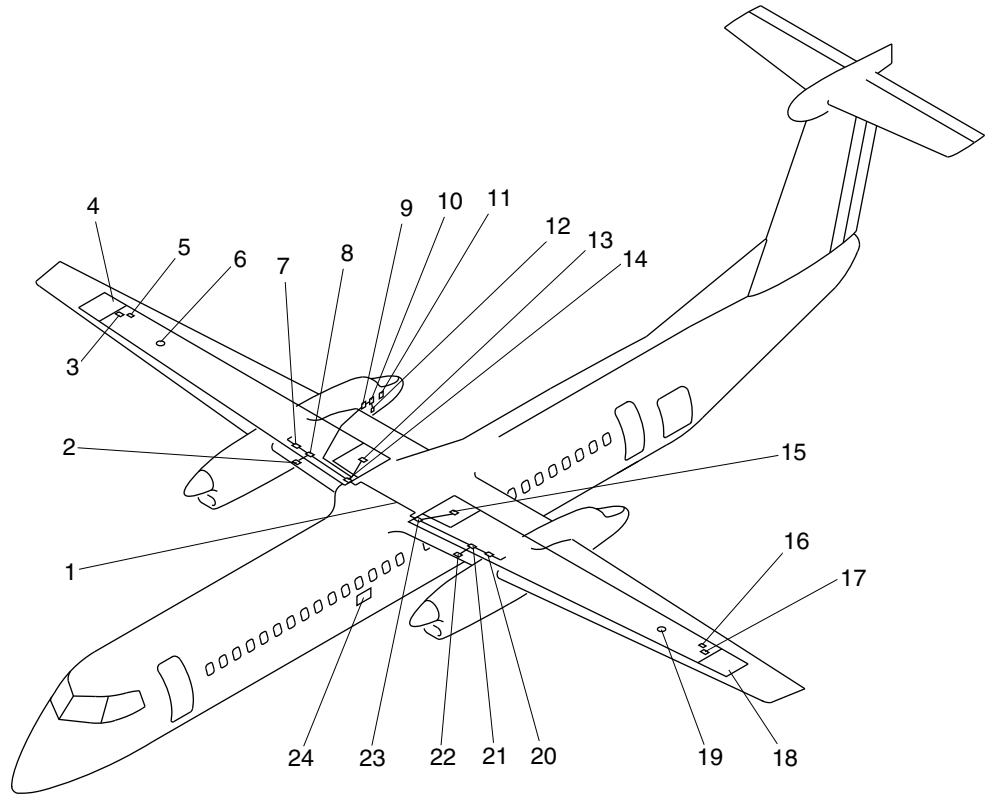
The APU fuel feed system supplies fuel to the APU. Fuel for the APU is supplied by gravity feed from the No.1 fuel tank.

Fuel Transfer

The fuel transfer system is controlled by the Fuel Control Panel and lets fuel transfer from one tank to the other either in flight or when the aircraft is on the ground.

Refuel/Defuel

The refuel/defuel system provides for pressure refueling or defueling when connected to pressurized equipment. The auxiliary pumps can also be used for defueling. The refuel/defuel system can be powered by battery.



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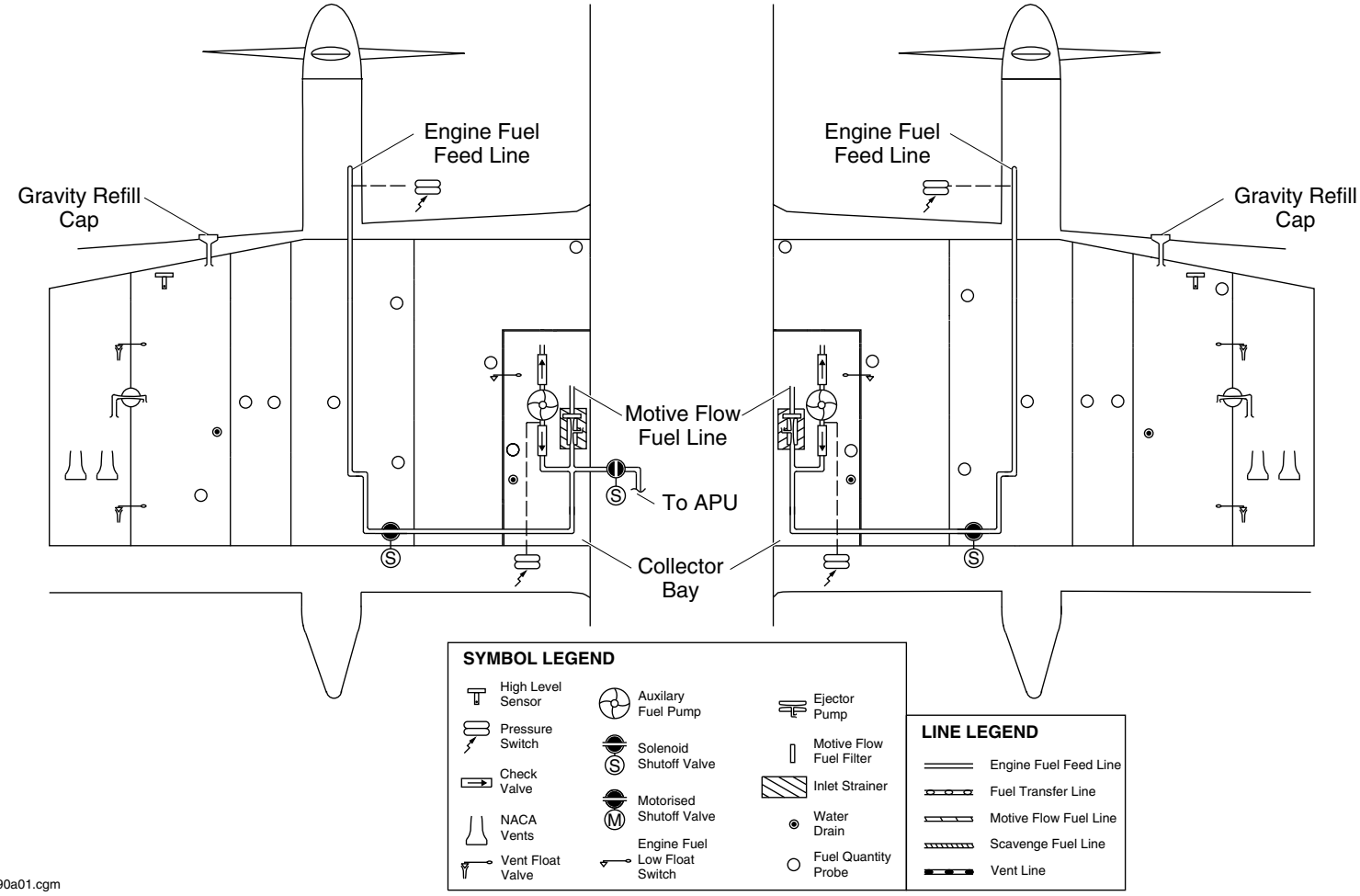
LEGEND

1. Refuel /Defuel/Transfer Manifold.
2. Level Control Solenoid.
3. Refuel Vent Valve.
4. Surge Bay.
5. High Level Sensor.
6. Gravity Refill Cap.
7. No–Flow Pressure Switch.
8. Level Control Shut–Off Valve.
9. Refuel/Defuel Shut–Off Valve.
10. Refuel Adapter.
11. Refuel/Defuel Panel, Refuel/Defuel Indicator.
12. Refuel Shroud Drain.
13. Auxiliary Pump.
14. Fuel Transfer Shut–Off Valve.
15. Auxiliary Pump.
16. High Level Sensor.
17. Refuel Vent Valve.
18. Surge Bay.
19. Gravity Refill Cap.
20. No–Flow Pressure Switch.
21. Level Control Shut–Off Valve.
22. Level Control Solenoid.
23. Fuel Transfer Shut–Off Valve.
24. High Level Control Unit.

Fuel Distribution System Layout
Figure 1



Fuel Feed
Figure 2

**ON A/C ALL

28–21–00–001

ENGINE FUEL FEED

Introduction

The engine fuel feed system supplies pressurized fuel from the tanks to the engines. The pressure and flow rate of the fuel is sufficient to satisfy all engine operational requirements.

General Description

Each individual tank supplies fuel to its related engine only. Engine feed from each tank to its related engine includes an engine feed pumping system housed in the collector bay, and a fuel emergency shut–off valve.

The engine fuel feed system includes the components that follow:

- Primary Ejector Pump (28–21–01)
- Engine Feed Lines (28–21–06)
- Inlet Strainer (28–21–11)
- Engine Feed Shut–off Valve (28–21–26)
- Auxiliary Pump (28–21–31)
- Auxiliary Pump Pressure Switch (28–21–36).

Detailed Description

Refer to Figures 1 and 2.

A primary ejector pump located in each collector bay supplies fuel to its related engine. Each primary ejector pump uses high pressure motive flow fuel to transfer fuel from the collector bay to the engine. The engine driven fuel pump in the Fuel Metering Unit (FMU) of each engine supplies the motive flow fuel. An electrically driven auxiliary pump is installed in each collector bay for use in the event of a primary ejector pump failure. Either the primary ejector pump or the auxiliary pump can supply the required amount of engine fuel feed.

There is an engine feed shut–off valve located on the rear spar of each wing. The valve is used to stop the fuel supply to the engine in the event of a fire.

Primary Ejector Pump

Refer to Figures 3 , 4 and 5.

There is one primary ejector pump located in each collector bay. The primary ejector pump delivery rate is always greater than the engine–driven pump demand. This makes sure that there is positive pressure to the engine–driven pump to prevent the possibility of pump cavitation. If the inlet boost pressure drops below 5.5 psi (38 kPa), a pressure switch at the high–pressure pump inlet sends a signal to turn on the related ENG FUEL PRESS caution light in the flight compartment.

The primary ejector pump is a venturi type with no moving parts. The pump gets its motive flow fuel from the engine driven fuel pump. This high pressure motive flow fuel is fed directly into the ejector throat, causing fuel to be drawn from the collector bay and delivered to the

engine feed line. A check valve prevents fuel from flowing back into the ejector pump.

Engine Feed LInes

Refer to Figure 2.

The engine feed lines transfer the fuel from the primary ejector pumps or the auxiliary pumps to the engines.

Inlet Strainer

Refer to Figures 3 and 4.

There are two inlet strainers; one for each primary ejector pump. Each inlet strainer is installed around the fuel inlet port of its related primary ejector pump. The inlet strainers help prevent foreign objects from entering the fuel flow.

Engine Feed Shut–off Valve

Refer to Figure 6.

The engine feed shut–off valve is installed inside the tank on the rear spar. The valve is used to stop the fuel supply to the engine in the event of a fire. The valve has an electrically driven actuator which operates an open–closed ball valve positioned in the engine fuel feed line. The actuator is electrically powered by a 28 Vdc motor which is installed on the dry side of the spar and splined to the valve. The actuator has physical and electrical position indication and may be replaced without changing the valve or draining the fuel tank.

The engine feed shut–off valve is controlled and operated by the PULL FUEL/HYD OFF handle located in the flight compartment, on the Engine Fire Protection panel. One green light and one white light for each tank are located on the Engine Fire Protection Panel to show the valve position. The green light comes on to show that the feed valve is open, and the white light comes on to show that the valve is closed. The battery bus supplies the electrical power to the engine feed shut–off valve.

Auxiliary Pump

Refer to Figures 7 and 8.

The auxiliary pump is installed on the wing lower skin inside the collector bay of each main tank, adjacent to the primary ejector pump. The auxiliary pump is a submerged, electrically operated, centrifugal pump. It is connected in parallel with the primary ejector pump. Each auxiliary fuel pump is powered by its related 115 Vac variable frequency power bus and is protected by a 5 A circuit breaker (B1 for FUEL AUX PMP1 and E1 for FUEL AUX PMP2). The canister–type pumps are accessible from the bottom surface of the wing, and permit removal of the pumping element without entering or draining the tank. There are two outlet ports, one for engine feed and one for fuel transfer. There is a check valve in each outlet port.

Refer to Figure 5.

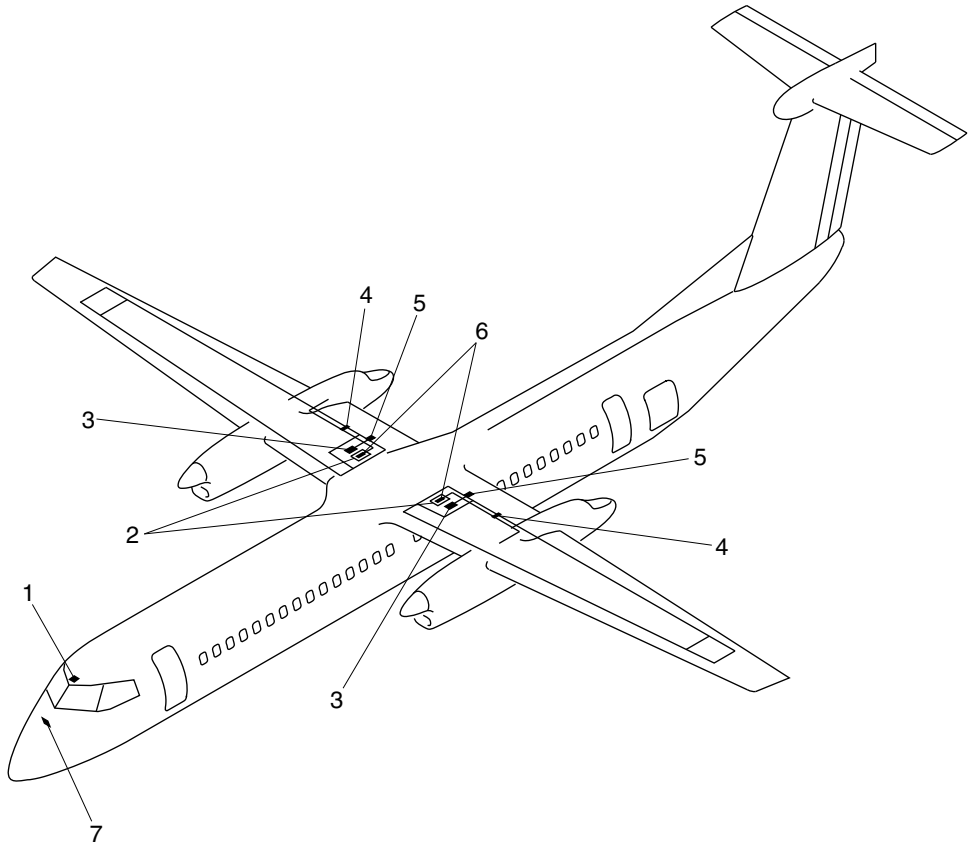
If a primary ejector pump does not supply the minimum required fuel pressure, the related auxiliary pump serves as a backup source for pressurized engine fuel feed. When the related AUX PUMP switchlight on the FUEL CONTROL TRANSFER panel is pushed, the auxiliary pump turns on (Refer to SDS 28–23–00 Fuel Transfer). After the pump starts, the related ENG FUEL PRESS caution light goes out. The auxiliary pumps are used for takeoff, landing and during operation with low fuel levels.

The auxiliary pumps start automatically for fuel transfer. The auxiliary pumps also start automatically for pressure defueling if a variable–frequency ac power source is available on the ground.

Auxiliary Pump Pressure Switch

Refer to Figures 9 and 10.

There are two auxiliary pump pressure switches, one connected to each auxiliary pump. The pressure switch closes when 4 psi (28 kPa) of fuel pressure is supplied. The auxiliary pump pressure switch then sends a signal to the FUEL CONTROL TRANSFER panel in the flight compartment. This signal causes the related ON switchlight segment for TANK1 or TANK2 to turn green. In addition, an indicator on the Multi Function Display (MFD) Fuel Page changes from white (no pressure) to green (pressure).



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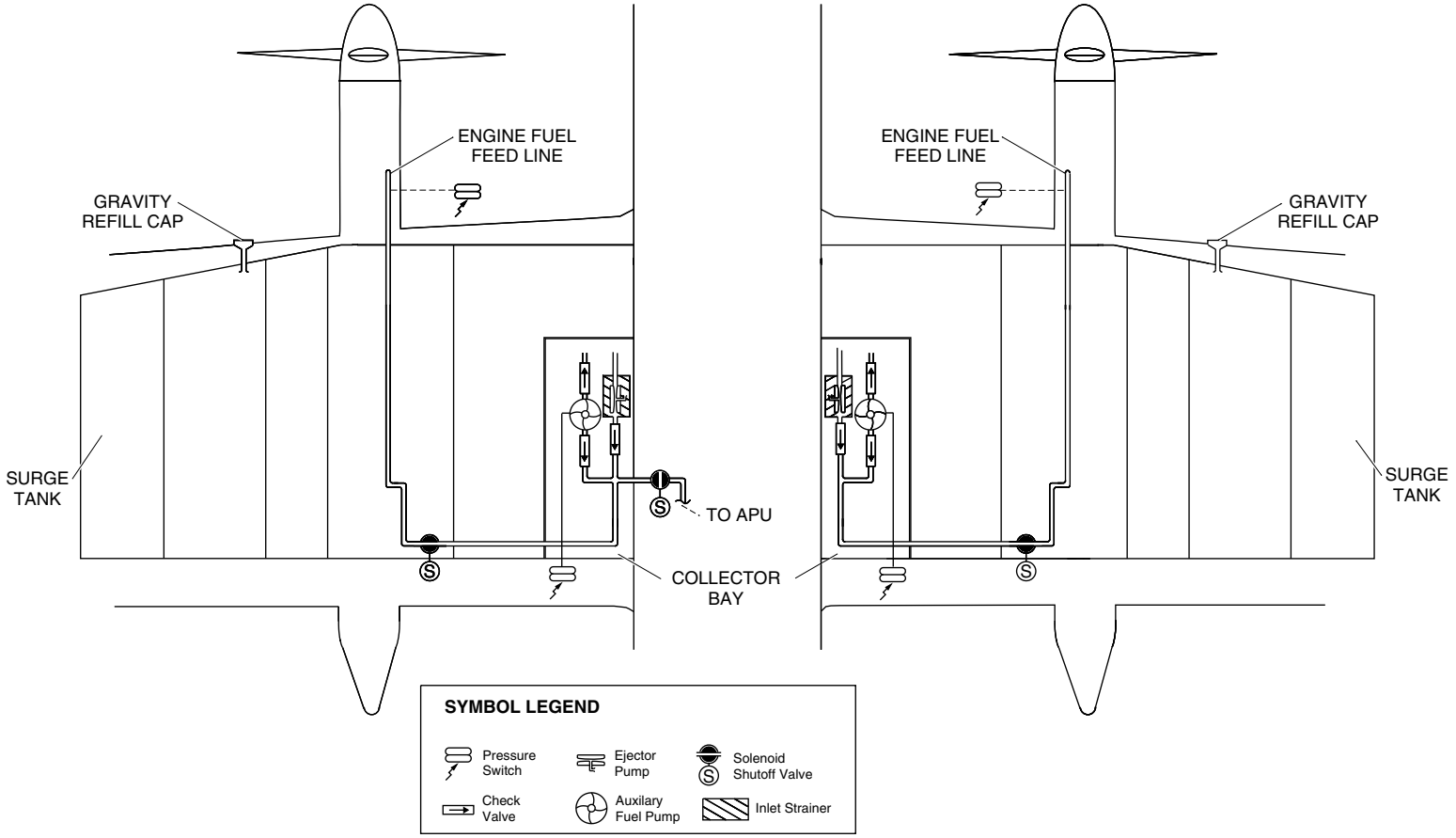
LEGEND

1. Firex Control Panel.
2. Inlet Strainer.
3. Auxiliary Pump.
4. Engine Feed Shut–Off Valve.
5. Auxiliary Pump and Pressure Switch.
6. Primary Ejector Pump.
7. Fuel Control Panel

ENGINE FUEL FEED SYSTEM PAGE 1
Figure 1



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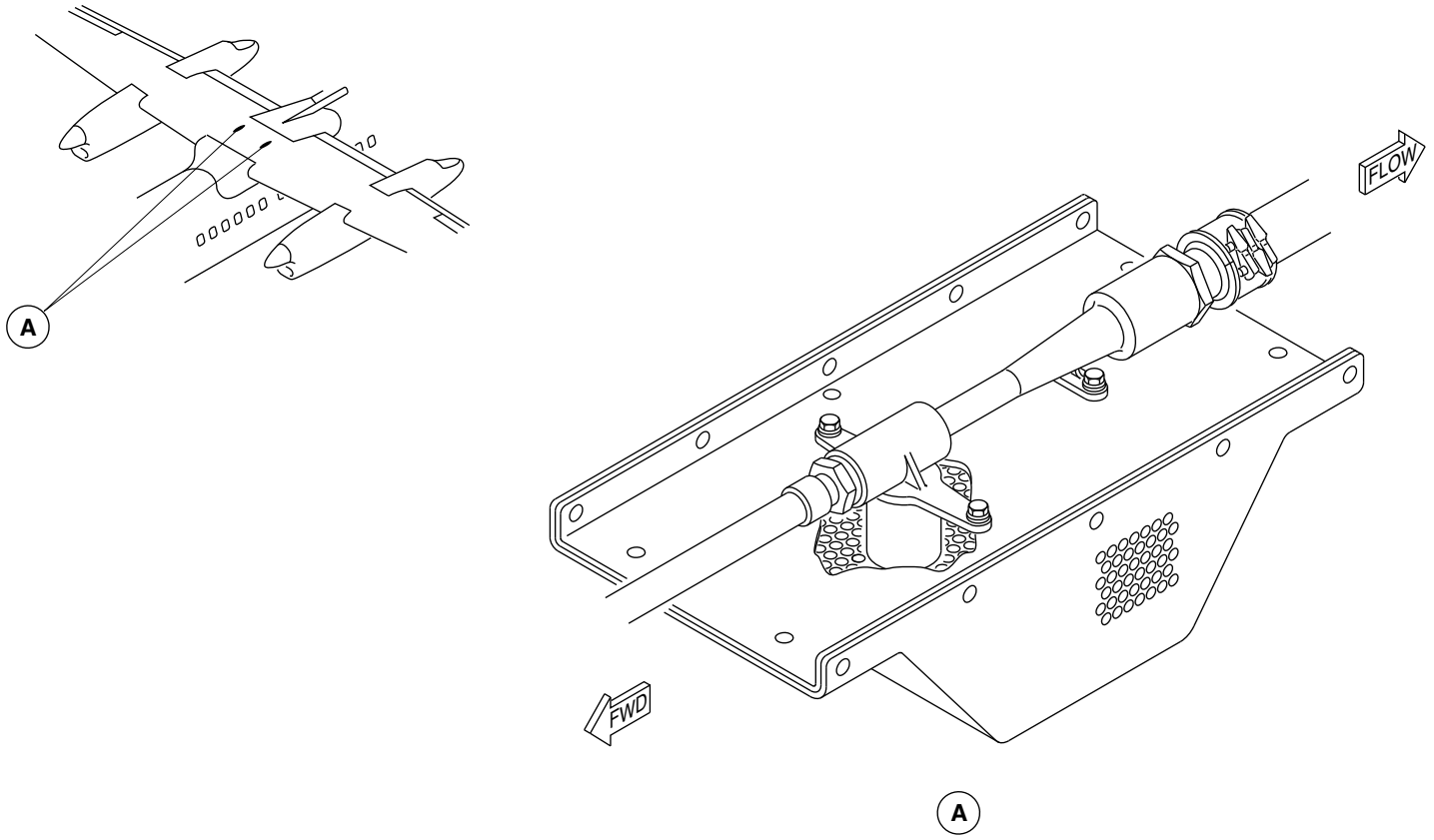
ENGINE FUEL FEED SYSTEM PAGE 2
Figure 2



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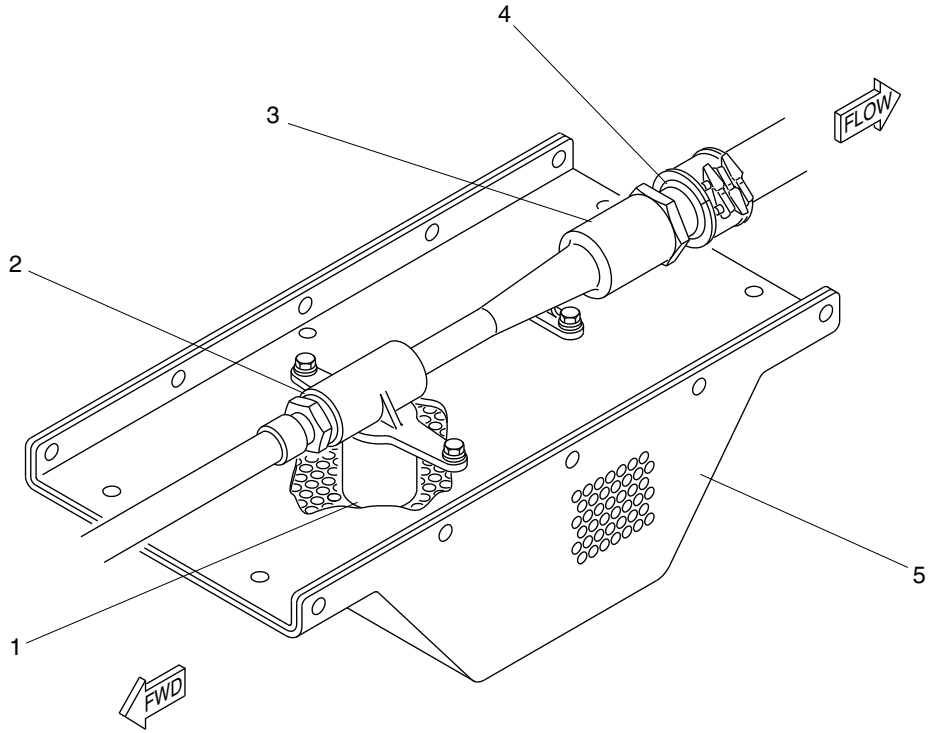
PRIMARY EJECTOR PUMP AND INLET STRAINER
Figure 3



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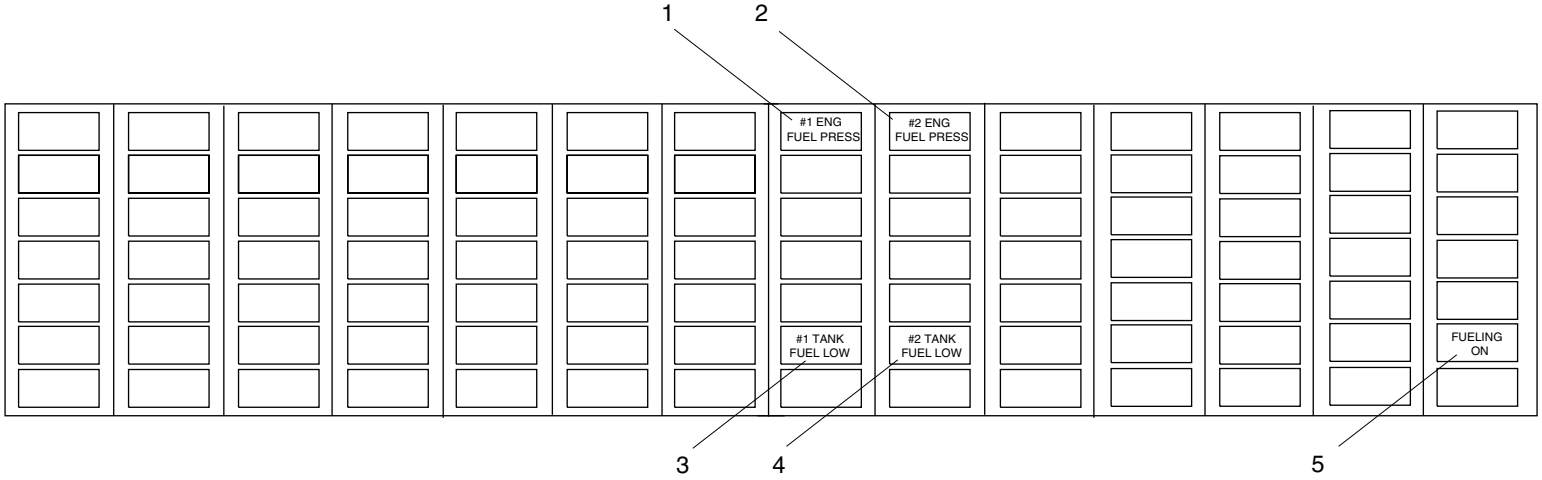
LEGEND

1. Fuel Inlet.
2. Motive Fuel Inlet.
3. Check Valve.
4. Engine Feed Outlet.
5. Inlet Strainer.

PRIMARY EJECTOR PUMP AND INLET STRAINER DETAIL
Figure 4

LEGEND

1. # 1 Engine Fuel Pressure (Amber).
2. # 2 Engine Fuel Pressure (Amber).
3. # 1 Tank Fuel Low (Amber).
4. # 2 Tank Fuel Low (Amber).
5. Fueling On (Amber).



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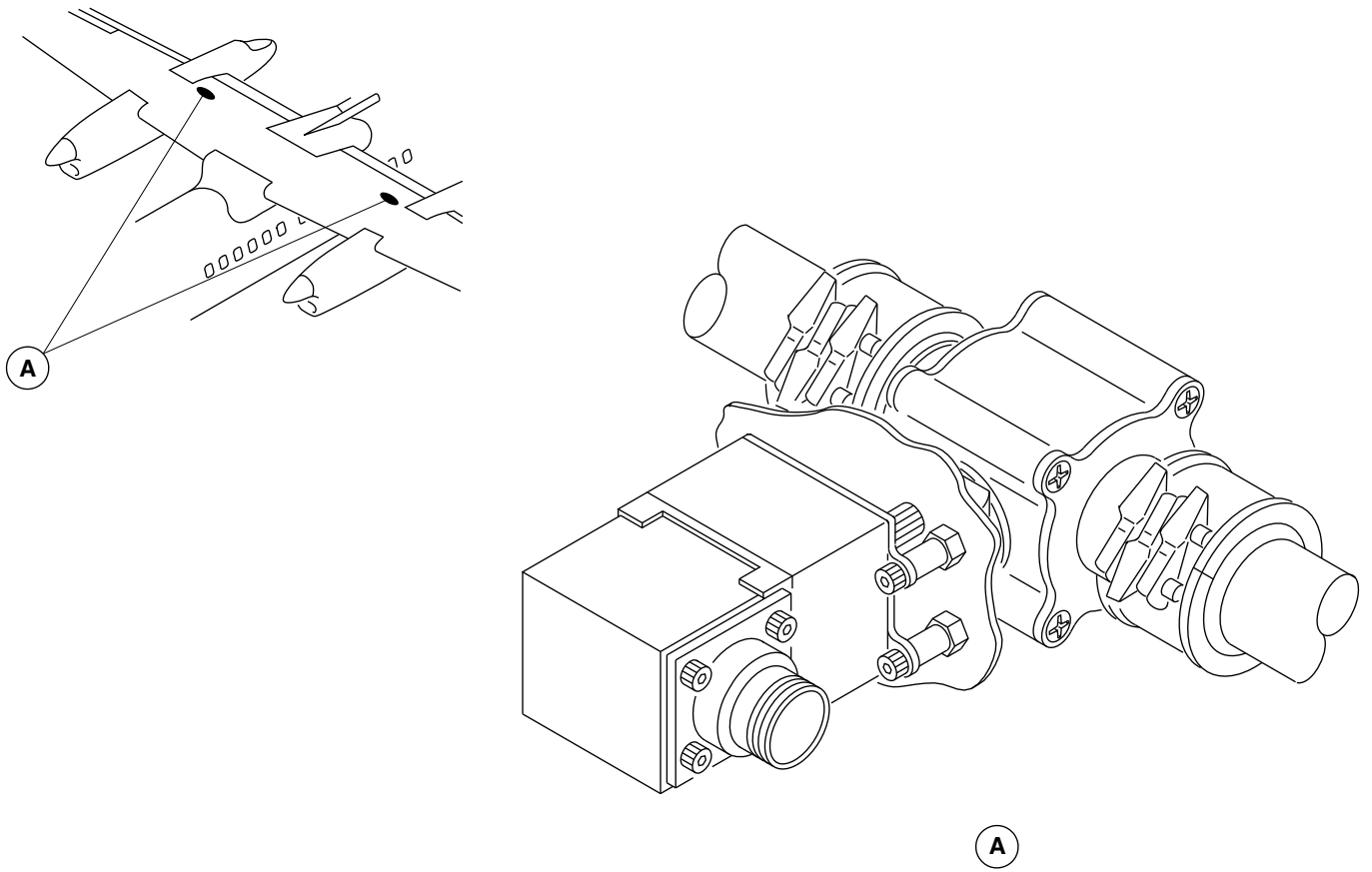
FUEL SYSTEM CAUTION LIGHTS
Figure 5



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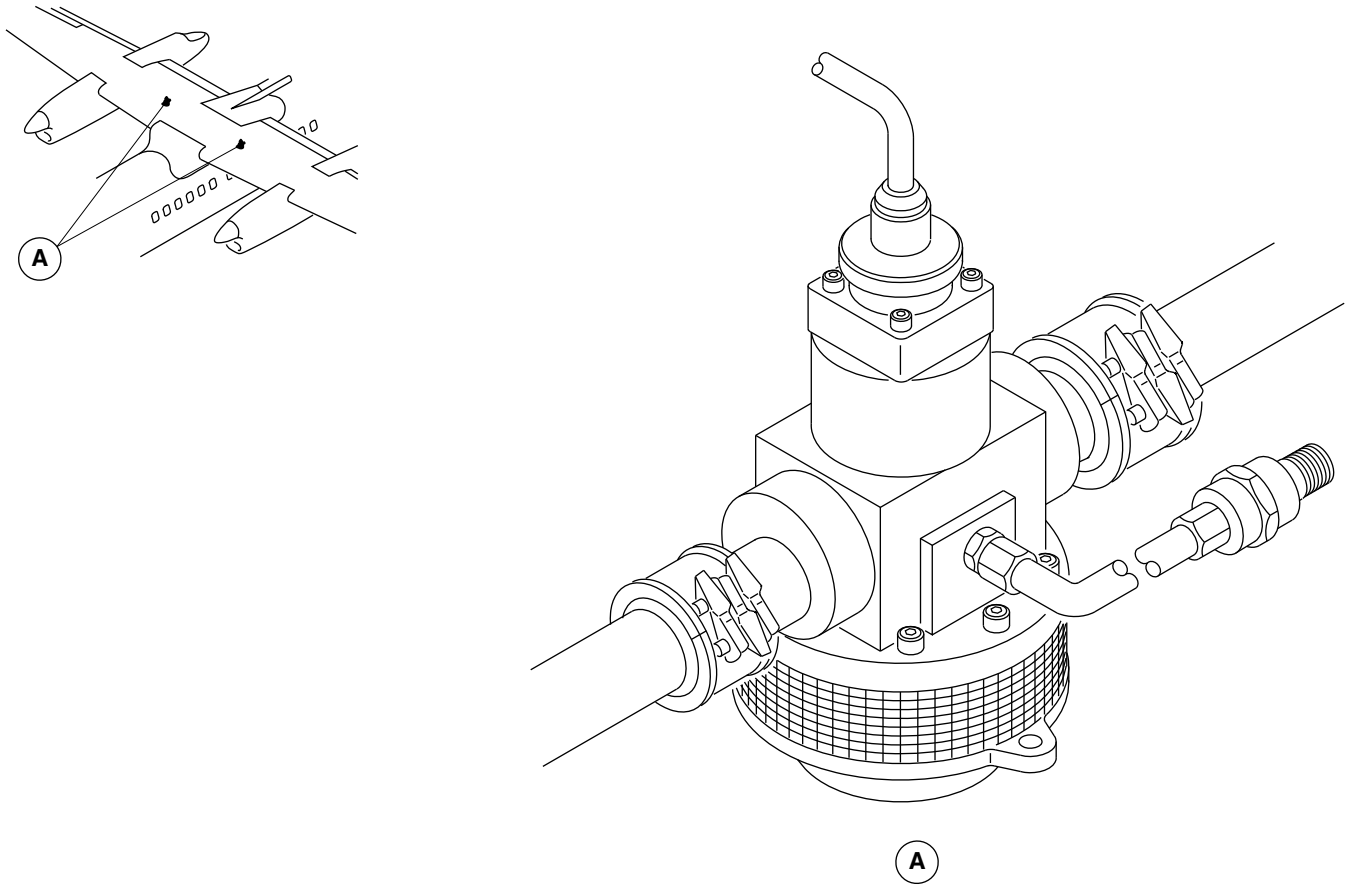
ENGINE FEED SHUT–OFF VALVE LOCATOR
Figure 6



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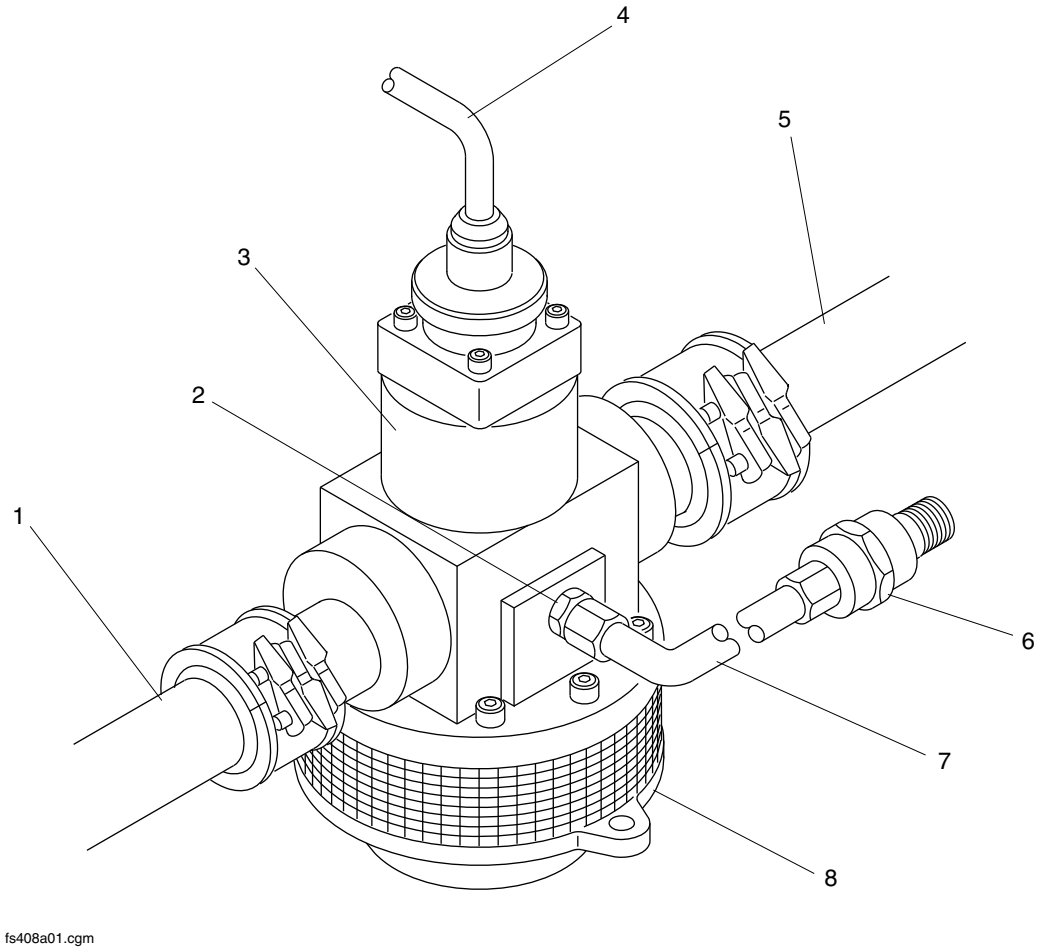
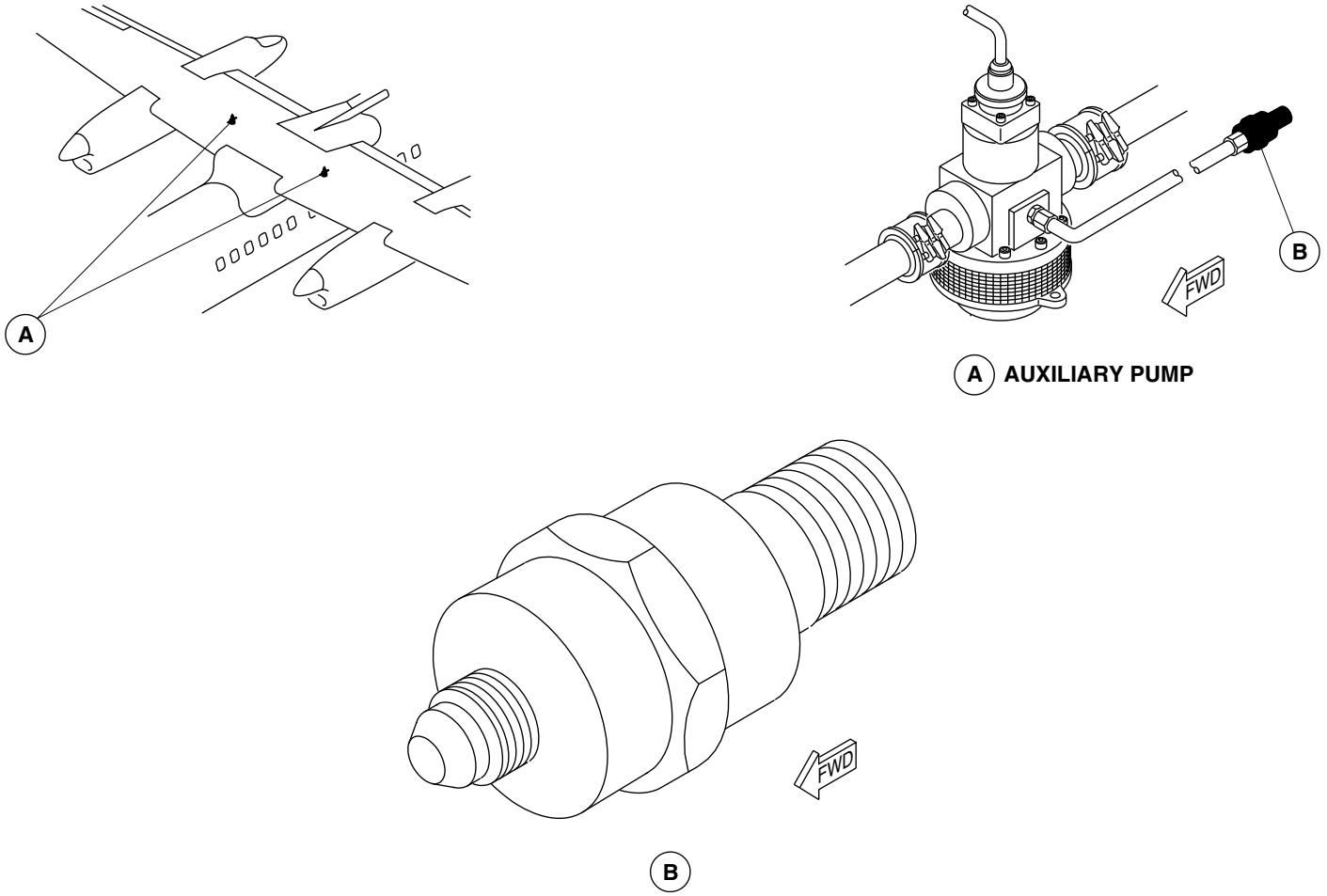
AUXILIARY PUMP LOCATOR
Figure 7



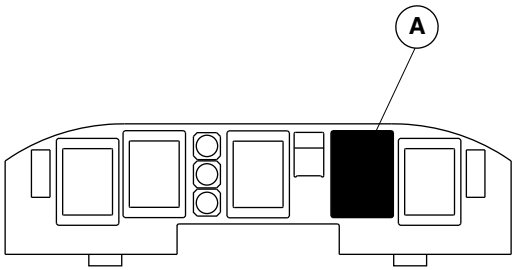
LEGEND

1. Fuel Outlet.
2. Pump Pressure Pilot Port.
3. Pump Canister.
4. To 115VAC Power.
5. Fuel Outlet.
6. Pressure Switch.
7. Pilot Line.
8. Fuel Inlet.

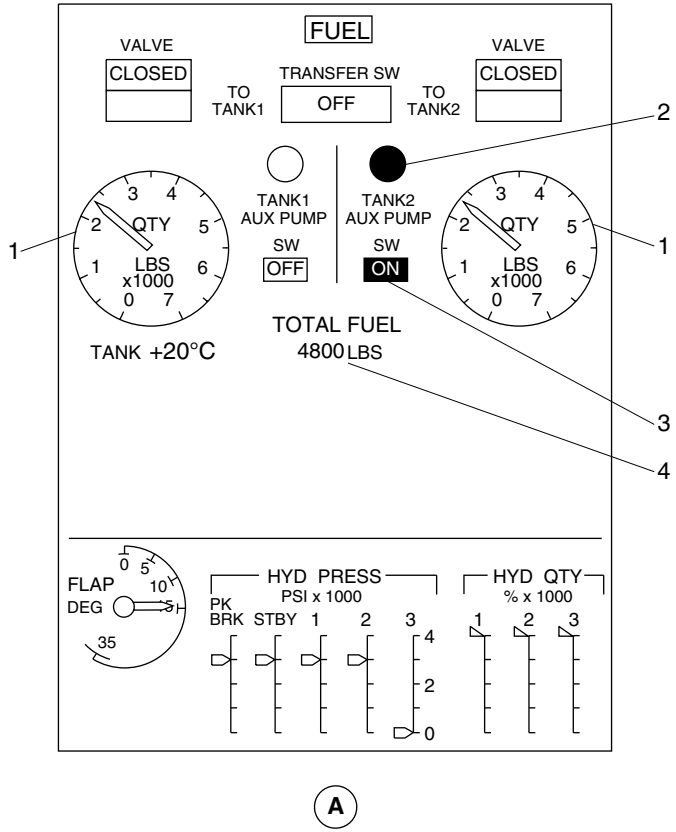
AUXILIARY PUMP DETAIL
Figure 8



AUXILIARY PUMP PRESSURE SWITCH
Figure 9



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Tank Quantity.
2. Right Auxiliary Pump Pressure Status.
3. Right Fuel Auxiliary Pump Switch Position.
4. Total Fuel Quantity in Tanks.

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MFD FUEL PAGE
Figure 10

**ON A/C ALL

28–22–00–001

APU FUEL FEED

Introduction

The Auxiliary Power Unit fuel feed system supplies a flow of fuel from the left (No.1) fuel tank to the Auxiliary Power Unit (APU).

General Description

Fuel for APU operation is supplied by gravity feed from the No.1 fuel tank through piping in the dorsal fairing to the APU fuel enclosure. Fuel supply is controlled by the APU PWR switchlight located in the flight compartment, on the APU CONTROL Panel. The APU is located in the rear equipment bay.

The APU fuel feed system includes the component that follows:

- APU shut–off Valve (28–22–01).

Detailed Description

Refer to Figure 1.

The fuel supply system is interconnected with the APU start/stop circuits and when the APU speed reaches 3%, the fuel flows to the unit. The fuel system is de–energized to shutdown the APU. The system is electrically powered by 28 Vdc from the right main bus through a 5 A APU FUEL circuit breaker. The APU fuel supply system has a fuel shut–off valve, related open/close indicator lights, a check valve, and piping to supply the fuel to the fuel enclosure on the APU. A check valve is installed in the fuel supply line, downstream of the APU shut–off valve. The check valve gives thermal relief for the downstream line.

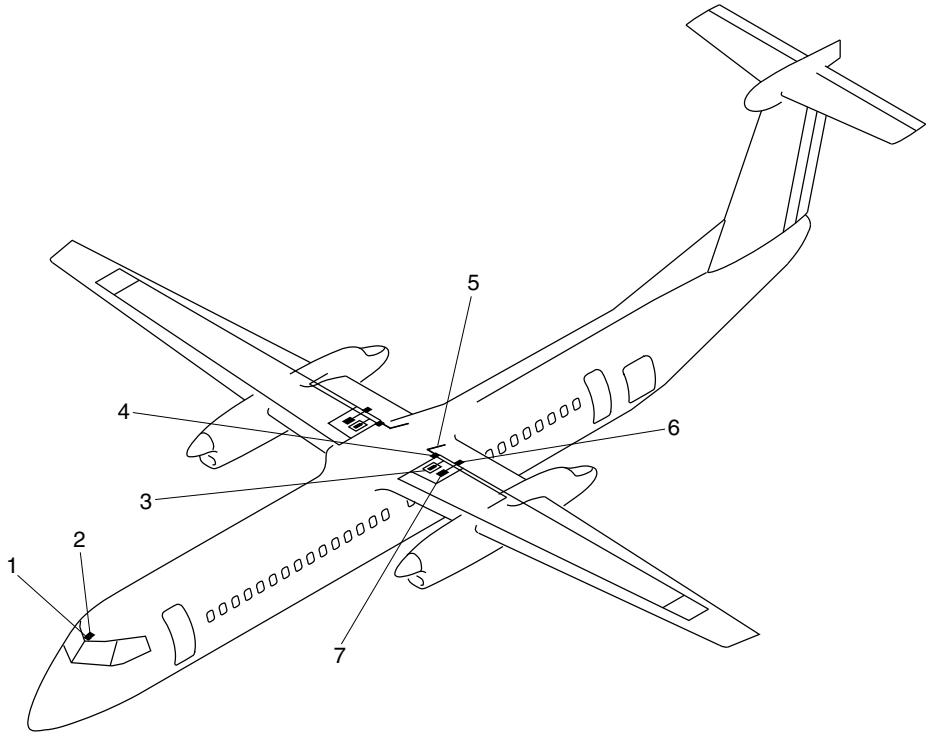
APU Shut–off Valve

Refer to Figure 2.

The APU shut–off valve gives a positive fuel stop in the supply line to the APU. The valve has an electrical actuator that operates an open/close type ball valve. The ball is enclosed in a tee–shaped fitting, located inside the fuel tank and installed onto the rear spar. The actuator is located externally to the fitting. The shut–off valve has a manual override and indicator arm. Valve operation is controlled by the APU PWR switchlight located in the flight compartment, on the APU CONTROL Panel. The valve position is shown by a green FUEL VALVE OPEN light and a white FUEL VALVE CLOSED light on the APU Fire Protection Panel on the overhead console.

The APU shut–off valve closes and stops the fuel flow to the APU under these conditions:

- the APU PWR switchlight is selected OFF
- fire is sensed in the APU / tailcone area
- the APU fire extinguisher switch (EXTG) on the Fire Protection Panel is selected ON
- the Weight on Wheels (WOW) switch is open (aircraft off ground).



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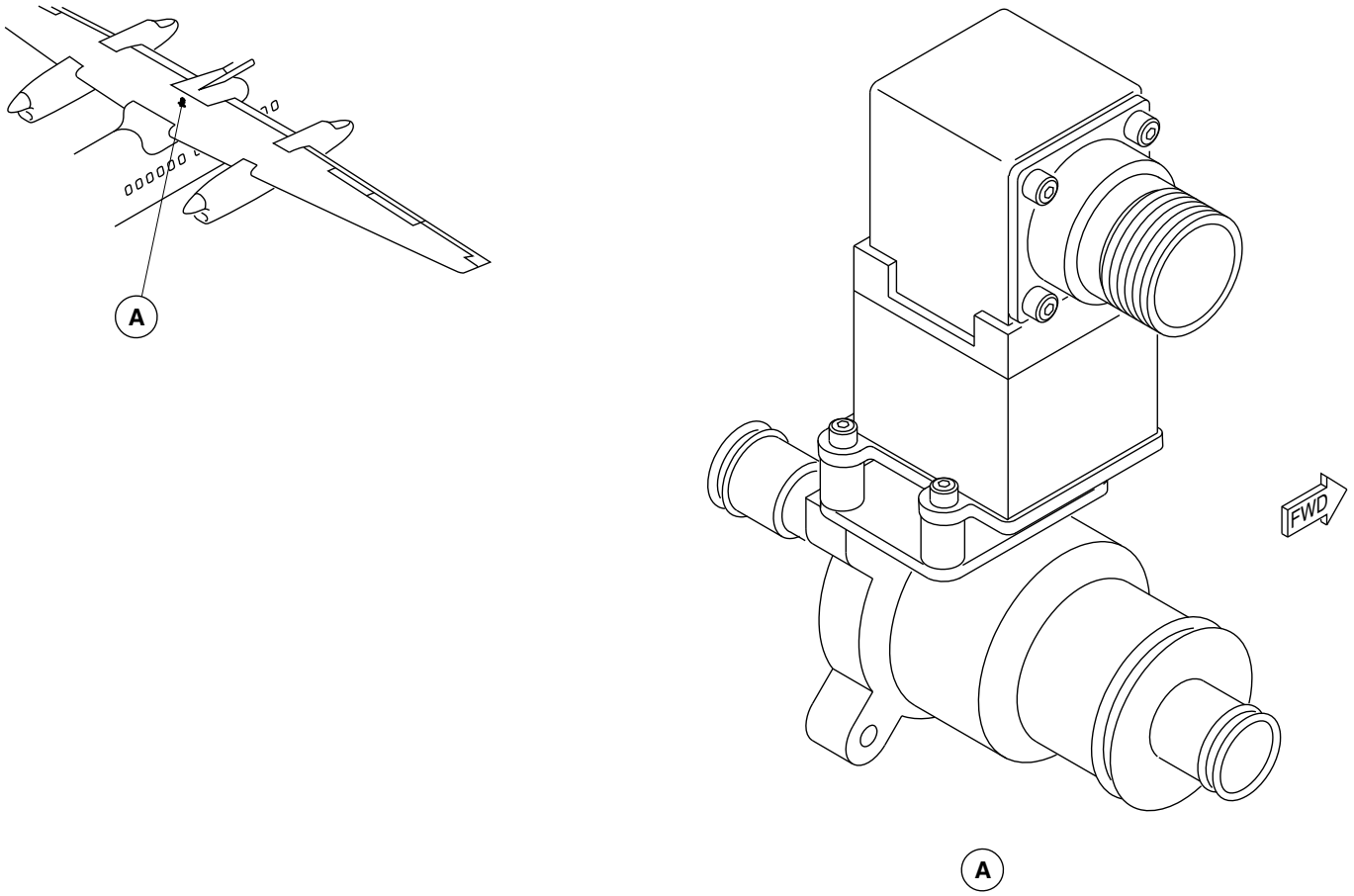
LEGEND

1. APU Control Panel.
2. Fire Protection Control Panel.
3. Inlet Strainer.
4. APU Shut–Off Valve.
5. APU Feed Line.
6. Auxiliary Pump Pressure Switch.
7. Auxiliary Pump.

APU Fuel Feed System
Figure 1



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APU Shut–off Valve
Figure 2

**ON A/C ALL

28–23–00–001

FUEL TRANSFER

Introduction

The fuel transfer system moves fuel from one tank to the other to correct fuel imbalances or for fuel management. The system can empty one fuel tank for maintenance without defueling the aircraft.

General Description

Fuel can be transferred when the aircraft is in the air or on the ground. Fuel transfer is controlled through the FUEL CONTROL TRANSFER panel. The fuel transfer system shares some of its components with the refuel/defuel system. Fuel transfer cannot occur during the refuel/defuel process.

The fuel transfer system uses the auxiliary pump, part of the engine feed system, and the refuel/defuel/transfer manifold. Fuel is transferred by the auxiliary pump of the donor tank. Fuel transfer data is shown in the flight compartment.

The fuel transfer system includes the components that follow:

- Fuel Transfer Shut–off Valves (28–23–01)
- Level Control Shut–off Valves (28–23–06)
- Level Control Solenoid (28–23–11)
- Fuel Control Transfer Panel (28–23–16).

Detailed Description

Refer to Figures 1 , 2 and 3.

The fuel transfer system is used to correct lateral fuel imbalance, either in flight or when the aircraft is on the ground. The system is also used for fuel management with one engine inoperative. The fuel transfer system is controlled by a three position TRANSFER switch on the FUEL CONTROL TRANSFER panel in the flight compartment. The panel has a control switch and lights to indicate the correct operation of various components of the system.

Fuel flows from the auxiliary pump of the donor tank through a transfer line into the receiver tank. A restrictor in the transfer line limits the fuel flow used for transfer. This makes sure there is sufficient fuel flow to the engine. Once selected, fuel transfer will continue until the TRANSFER switch is set to the center position, or until the high level sensor unit in the receiver tank senses an overfill condition.

Fuel Transfer Shut–off Valves

Refer to Figure 4.

There is one fuel transfer shut–off valve in each wing. Each fuel transfer valve is located inside the related wing tank, with the valve actuator located externally on Wing Station (WS) 42. The fuel transfer shut–off valves open during refueling, defueling or fuel transfer. The valves are 28 Vdc motor operated valves and have position indicators on the body of the valves. In refuel or defuel manual mode, the valves are controlled by the refuel/defuel control panel in the right nacelle. In refuel or defuel pre–select mode, the valves are controlled by the Fuel Quantity Computer (FQC). In

transfer mode, the valves are controlled by the TRANSFER switch on the FUEL CONTROL TRANSFER panel.

Level Control Shut–off Valves

Refer to Figures 5 and 6.

There is one level control shut–off valve in each wing. The level control shut–off valves let fuel flow during transfer and refuel/defuel operations. The valves are hydro–mechanically controlled by the level control solenoids. The valves are kept closed by springs and fuel pressure on the backs of the main poppets.

Level Control Solenoid

Refer to Figures 5 and 6.

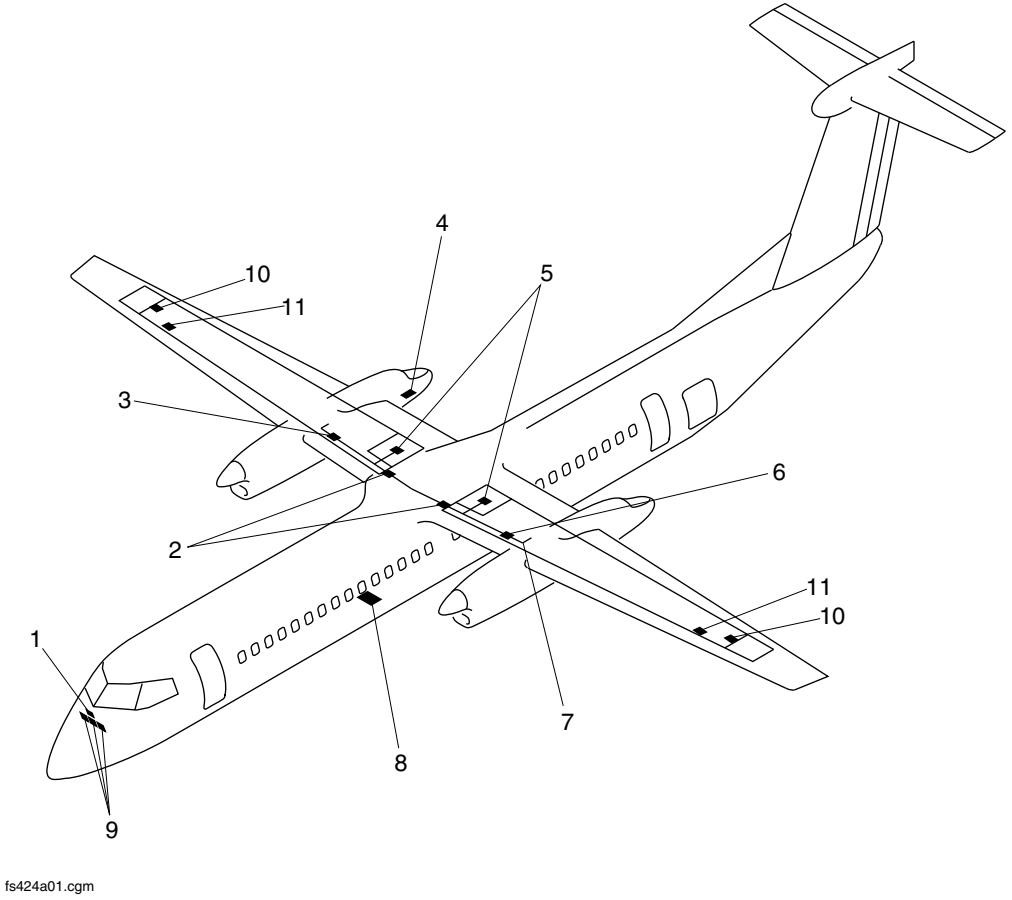
There is one level control solenoid in each wing. A pilot line connects each level control solenoid to its related level control shut–off valve. The solenoids are installed on the aft face of the rear wing spar.

The Fuel Quantity Computer (FQC) controls the solenoids. The high level unit can also control the solenoids when the fuel level in the tanks is high. When the level control solenoid is de–energized, there is fuel pressure in the pilot line. This lets the fuel pressure at the inlet of the valve be applied to the valve's control chamber to keep the valve closed. When the level control solenoid is energized, the pilot line opens to release the pressure in the control chamber and the level control shut–off valve opens.

Fuel Control Transfer Panel

Refer to Figures 7 , 8 and 9.

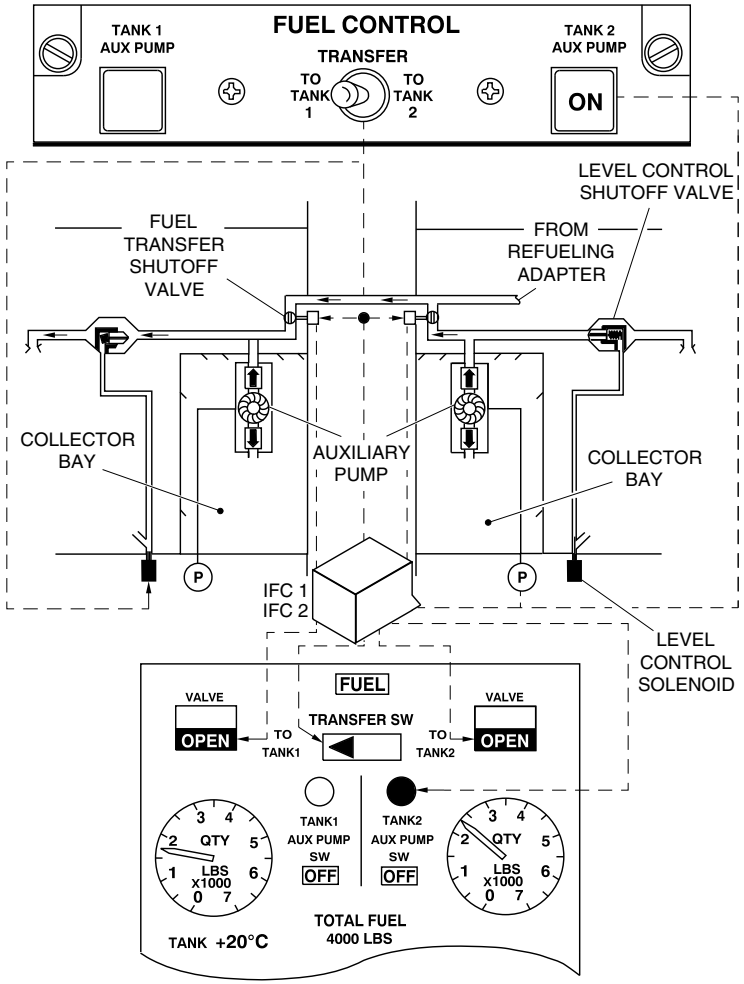
The FUEL CONTROL TRANSFER panel is located in the flight compartment on the engine instrument panel. The FUEL CONTROL TRANSFER panel has a TRANSFER switch and two switchlights. The TRANSFER switch is used to set the direction of fuel transfer (TO TANK 1 or TO TANK 2) by operating the auxiliary pump of the donor tank. A signal from the operating auxiliary pump causes the related ON switchlight segment to turn green. Fuel transfer indications are shown on the FUEL CONTROL TRANSFER panel and the Fuel Page of the Multi Function Display (MFD).



LEGEND

1. Fuel Control (Transfer) Panel.
2. Transfer Shut–Off Valve.
3. Level Control Shut–Off Valve.
4. Refuel/Defuel Panel.
5. Auxiliary Pump.
6. Level Control Shut–Off Valve.
7. Refuel/Defuel/Transfer Manifold.
8. Fuel Quantity Computer.
9. EIS Displays.
10. Refuel Vent Valve and High Level Sensor.
11. Gravity Refill Cap.

Fuel Transfer System
Figure 1



LEGEND

- - - Electrical signal.
(P) Pressure switch.

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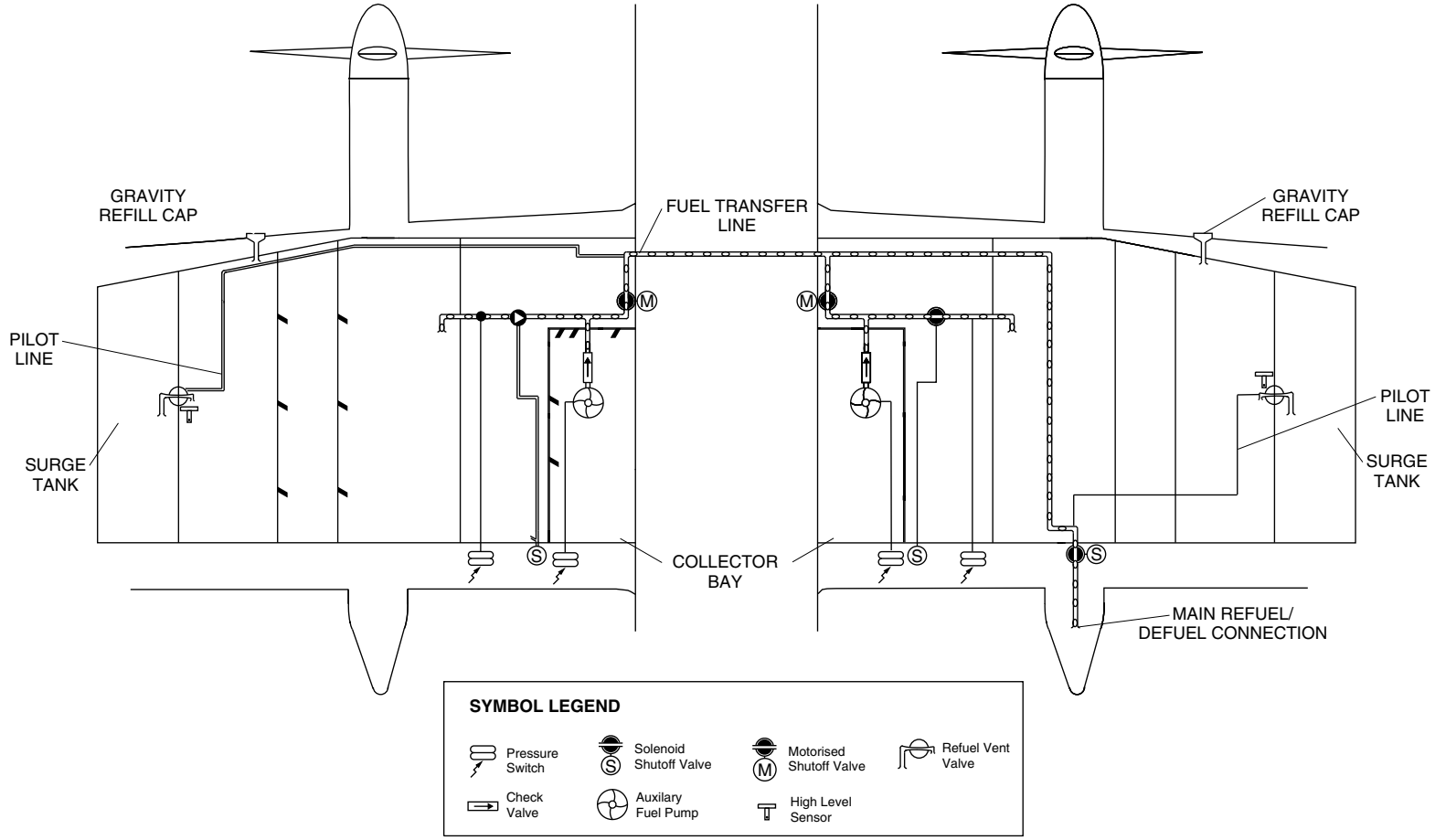
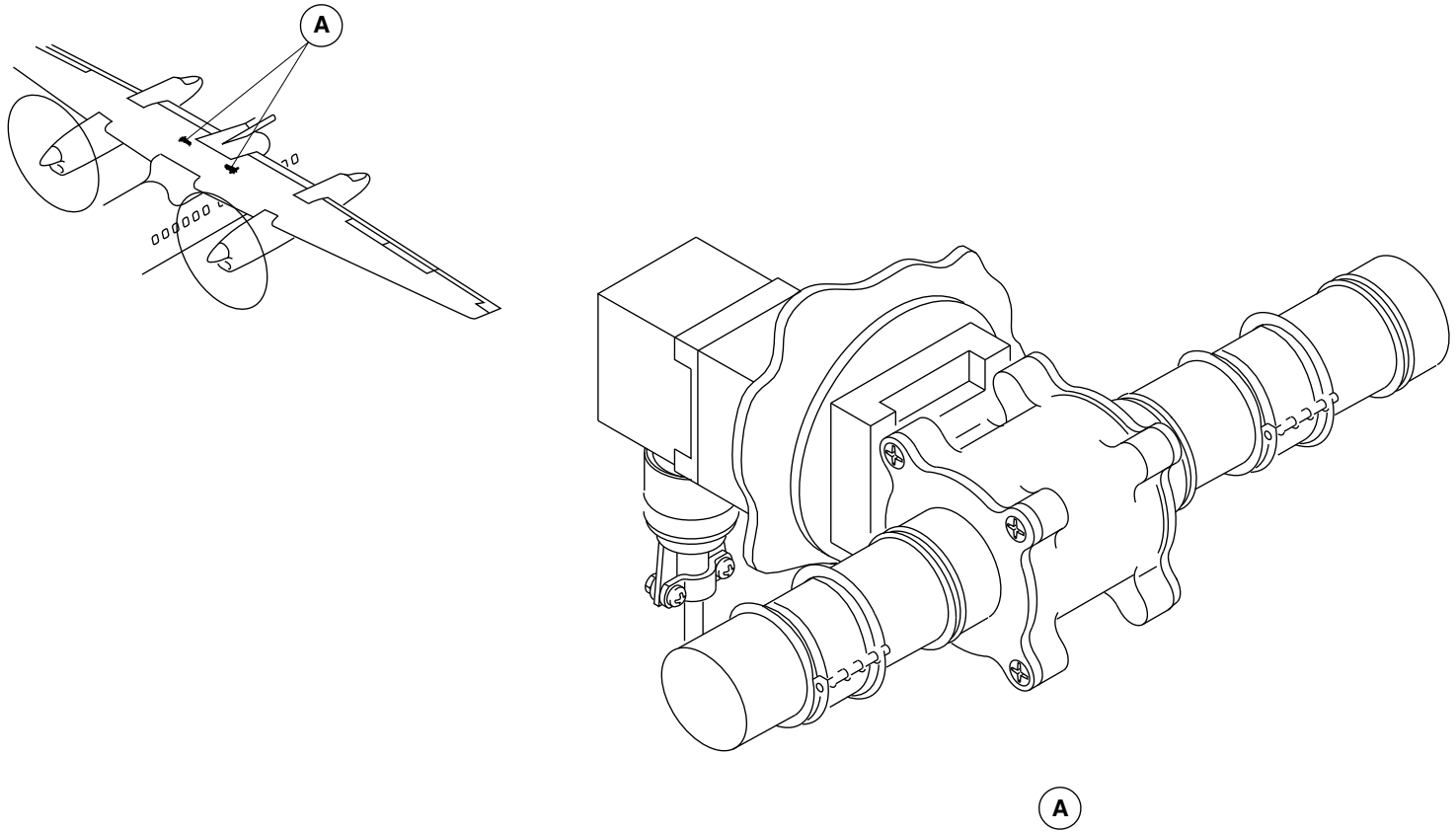
Fuel Transfer Schematic
Figure 2



Fuel Transfer Control Panel Locator
Figure 3



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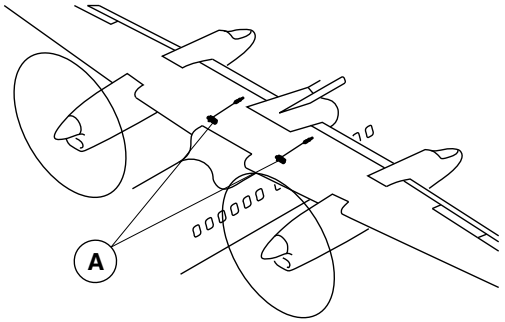
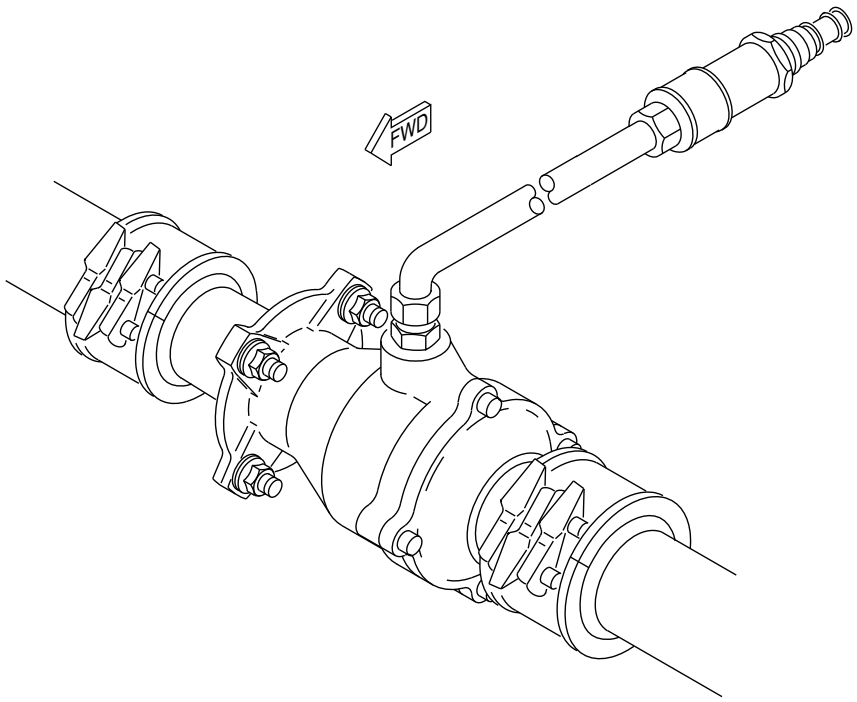
Fuel Transfer Shut–off Valve
Figure 4





NOTE

Left component shown.
Right component similar.

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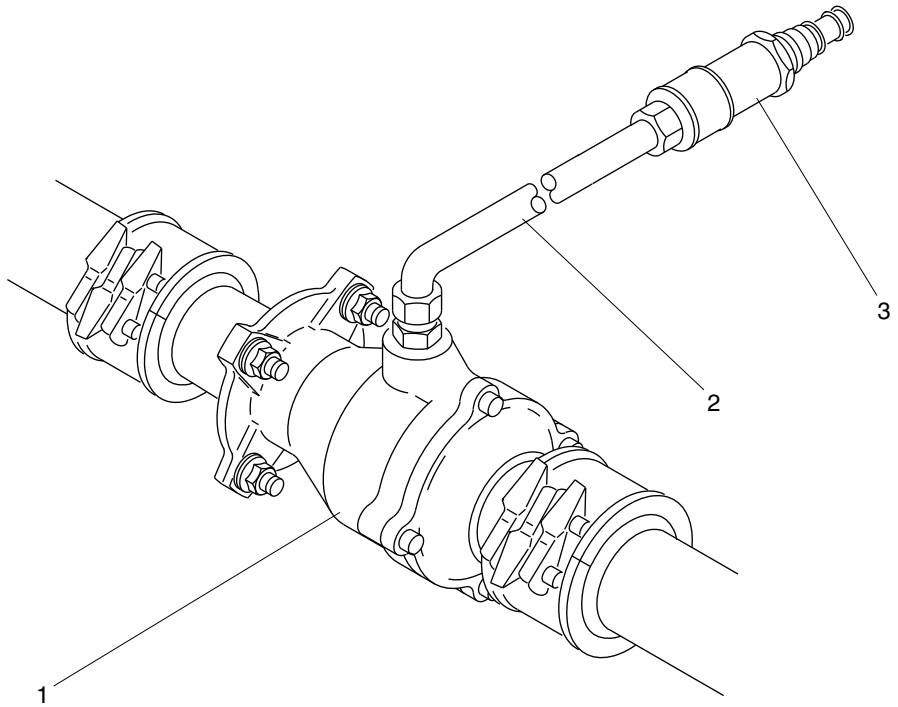
Level Control Shut–off Valve and Solenoid Page 1
Figure 5



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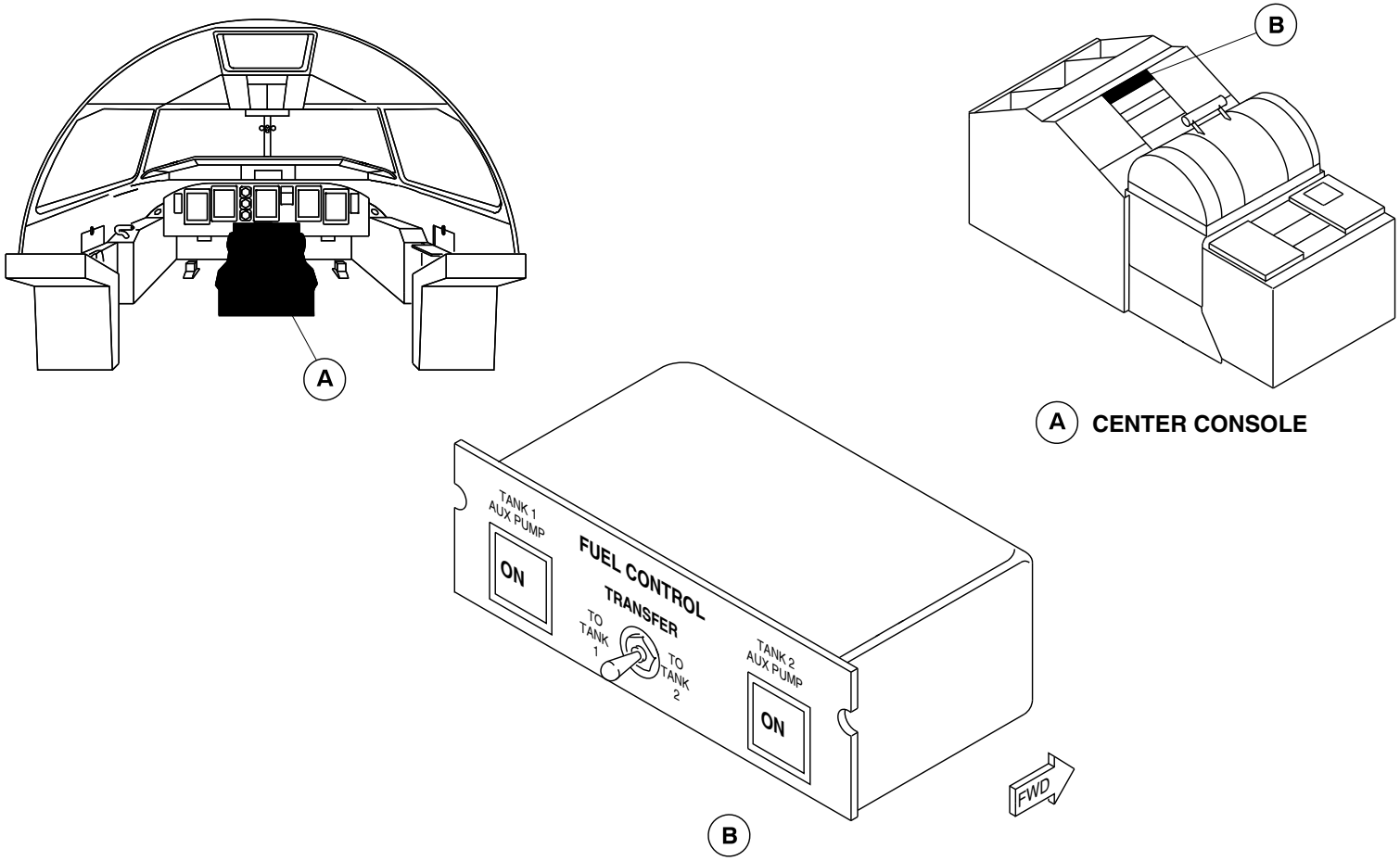
LEGEND

1. Level Control Shutoff Valve.
2. Pilot Line.
3. Level Control Solenoid.

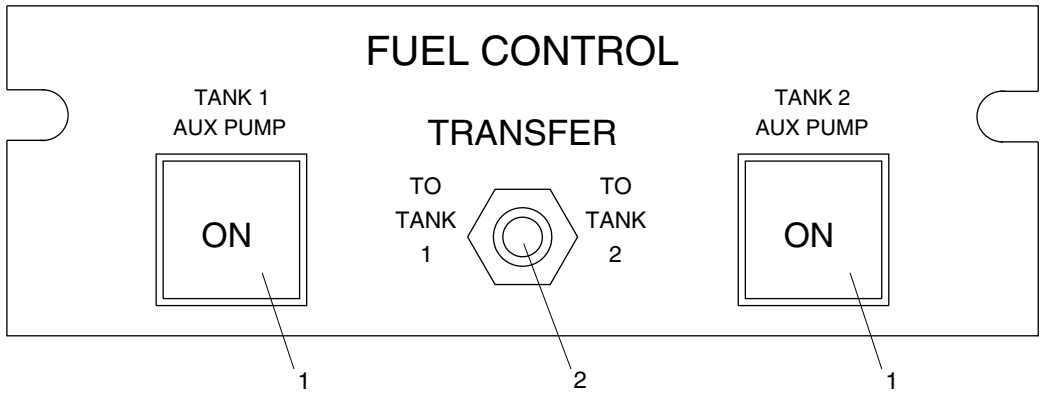
Level Control Shut–off Valve and Solenoid Page 2
Figure 6



Fuel Control Transfer Panel Locator
Figure 7

LEGEND

1. Tank #1 and Tank #2 Auxiliary Pump Switch Lights.
2. Fuel Transfer Selector Switch.



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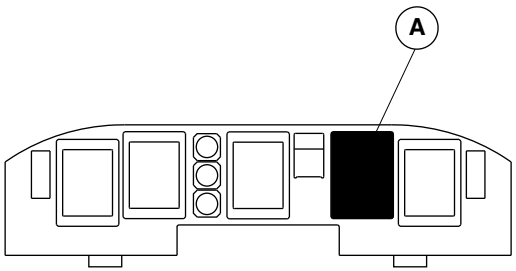
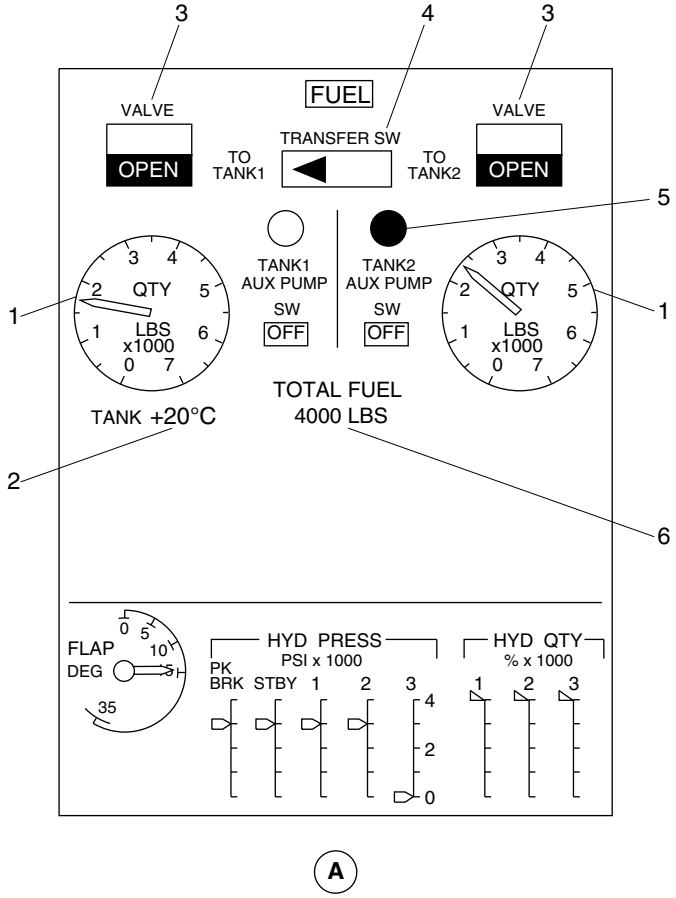
Fuel Control Transfer Panel Detail
Figure 8



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Tank Quantity.
2. Fuel Temperature in Left Tank.
3. Left/Right Fuel Transfer Valve Position.
4. Fuel Transfer Switch Indication.
5. Pressure State in the Left/Right Auxiliary Fuel Pumps.
6. Total Fuel Quantity in Tanks.

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Fuel Transfer, MFD Fuel Page
Figure 9

**ON A/C ALL

28–24–00–001

REFUEL/DEFUEL

Introduction

The refuel/defuel system is used for pressure refueling or defueling through a single point adapter.

General Description

Refer to Figures 1 and 2.

The aircraft is refueled or defueled through the single point pressure refueling/defueling adapter located in the right engine nacelle. Both automatic and manual refueling modes are available. Selected and actual fuel tank quantities are displayed on the refuel/defuel control panel in the right engine nacelle. The Fuel Quantity Computer (FQC) controls the logic of the automatic refueling and defueling process.

Gravity refueling can be done through a gravity refuel adapter on the top surface of the wing. Defueling can be done by external suction pressure, or by use of the auxiliary pumps in each collector bay.

The refuel/defuel system has the components that follow:

- Refuel/Defuel Control Panel
- Refuel/Defuel Indicator
- Refuel/Defuel Shut–Off Valve
- Refuel/Defuel Shut–Off Valve Actuator
- Refuel/Defuel Adapter
- No–Flow Pressure Switch
- Refuel Vent Valve
- High Level Sensor

Detailed Description

Refer to Figures 1 and 2.

The refueling/defueling fuel flow into or from each tank is through the refueling/defueling adapter and manifold, controlled by the refuel/defuel shut–off valve. Pressure refueling uses the same level control shut–off valves, solenoid valves, and refueling/defueling/transfer shut–off valves that are used for fuel transfer. The maximum refueling pressure is 50 psi (344.7 kPa), which gives a refueling flow rate of approximately 125 US gal/min (437 L/min). A minimum of 20 psi (138 kPa) refuelling pressure is necessary for the system to operate properly. Defueling can be done by external suction pressure or by the use of the auxiliary pumps in each collector bay.

In the pre–select mode, the refueling/defueling operation stops when the selected tank contents reach a pre–selected level. In the manual mode, refueling of the aircraft continues until stopped by the operator, or until the high level sensor senses a full tank and stops refueling. A refuel vent valve in each tank is kept open with fuel pressure during pressure refueling. The DUMP VALVE OPEN TANK 1 or TANK 2 indicator light on the refuel/defuel panel comes on when the related refuel vent valve is open. The refuel vent valve prevents structural damage, that could occur if fuel continues to flow into full tanks.

A solenoid valve controls the operation of the level control shut–off valve in each tank. In the pre–select mode, the Fuel Quantity Computer (FQC) signals the solenoid valve to close the level control shut–off valve. The refueling flow into each tank stops automatically at the pre–selected fuel level on the Refuel/Defuel Indicator (RDI) . In the manual mode, the operator stops the refueling process by selecting the appropriate switch on the refuel/defuel control panel.

The solenoid valve causes the level control valve to close. If the solenoid valve does not close automatically, the related level control valve stays open, and the refueling process continues. When the tank is full, the high level sensor located at the high point of the tank, sends a signal to the High Level Control Unit (HLCU). The HLCU de–energizes the solenoid valve and causes the level control valve to close.

Refer to Figures 3 and 4.

Operation of the HLCU shut–off feature can be checked using the PRECHECK, OPEN, CLOSE switch, on the refuel/defuel control panel. With the switch in the PRECHECK position for the related tank, the HLCU shuts off refueling to that tank. A no–flow pressure switch in the delivery line, located downstream of each level control shut–off valve, senses the pressure drop when the valve closes. At approximately 2 psi (13.8 kPa), the switch closes and turns on the REFUEL SHUTOFF light for the related tank on the refuel/defuel panel.

Refer to Figure 5.

When the REFUEL/DEFUEL door is opened and electrical power is supplied to the refuel/defuel control panel, the following lights come on:

- FUELING ON caution light on the Caution and Warning Panel
- MASTER VALVE CLOSED light on refuel/defuel panel
- White floodlight for the refuel/defuel panel.

Gravity refueling can be done through the gravity refuel adapter located on the top surface of the wing. The lightning proof cap is flush mounted.

Refuel/Defuel Control Panel

Refer to Figures 3 and 5.

The refuel/defuel control panel is located in the right engine nacelle, and controls pressure refueling and defueling.

The refuel/defuel control panel has one selector switch, four toggle switches, five indicator lights and a Refuel/Defuel Indicator (RDI). The rotary selector switch is used to set either the pre–select or manual mode for refueling or defueling. With the rotary mode switch in the PRESELECT REFUEL or PRESELECT DEFUEL position, the refuel/defuel operation stops automatically, when the pre–selected levels are reached. With the rotary mode select switch in the REFUEL or DEFUEL position, refueling or defueling continues until the select switch is set to the OFF position. The high level sensors

will always stop refueling to the related tank, when a full tank is sensed.

The two PRECHECK/OPEN/CLOSE switches test the automatic shut–off operation of the related HLCU, when in the PRECHECK position. When in the switch is in the CLOSE position, no fuel can enter the related tank. When the switch is in the OPEN position, refuel and defuel operations can be done.

Refuel/Defuel Indicator

Refer to Figure 3.

The Refuel/Defuel Indicator (RDI) is located on the refuel/defuel control panel. The indicator shows the quantity of fuel:

- in each wing
- selected in the automatic mode for refueling
- selected for each individual wing in the manual mode for refueling.

All quantities are shown in pounds or kilograms. The preselect values, which are shown on the RDI, are set using the INCR/DECR switch on the refuel/defuel control panel. The TEST RESET switch on the indicator is used to show and clear fault codes. Dashes shown on the RDI show a fault has been found with the related tank. A blank shown on the display indicates a Refuel/Defuel Indicator, Fuel Quantity Computer, or refuel/defuel control panel failure.

Refuel/Defuel Shut–off Valve

Refer to Figures 6 and 7.

The refuel/defuel shut–off valve is installed in the refuel/defuel/transfer manifold, and is opened when refueling or defueling. The valve is located on the right side aft wing spar. The valve is closed in flight to isolate the refuel adapter from the rest of the fuel system. The refuel/defuel shut–off valve is operated by an electrically driven actuator. A thermal relief valve is installed in the valve to prevent excessive pressure buildup in the fuel system lines.

Refuel/Defuel Shut–off Valve Actuator

Refer to Figures 6 and 7.

The refuel/defuel shut–off valve actuator is attached to the refuel/defuel shut–off valve by a spline shaft. The actuator is installed on the dry side of the rear wing spar. The actuator has a physical and electrical position indication and may be replaced without draining fuel from the tank. The actuator has a lever that operates the valve and gives a position indication. The actuator is controlled by the mode selection switch on the refuel/defuel control panel. The switch opens the valve and turns off the MASTER VALVE CLOSED indicator light when any refuel/defuel mode is set.

Refuel/Defuel Adapter

Refer to Figure 8.

The refuel/defuel adapter is installed in the right engine nacelle. The adapter gives single–point pressure refuel/defuel access for the aircraft. The adapter has a metal body that has a spring–loaded closed poppet valve. A circular cap protects the poppet valve from damage and contamination.

No–Flow Pressure Switch

Refer to Figure 9.

There are two no–flow pressure switches in the refuel/defuel system. A no–flow pressure switch is installed downstream of each level control shut–off valve. The no–flow switch senses the pressure in the fuel lines. When the level control shut–off valve closes, the pressure in the line decreases and the switch closes. This completes an electrical circuit and turns on the related white REFUEL SHUTOFF (TANK1 or TANK2) indicator on the refuel/defuel control panel. This white light indicates that related level control shut–off valve is closed and refueling of that fuel tank is no longer possible.

Refuel Vent Valve

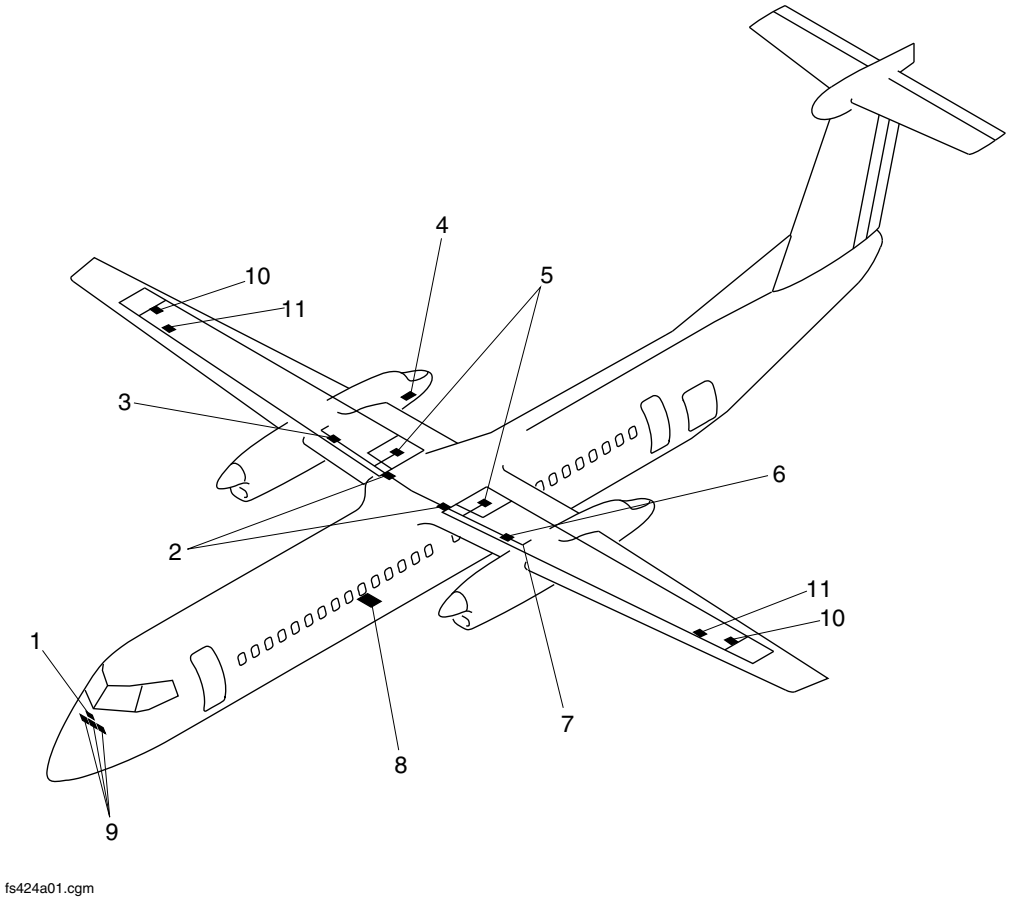
Refer to Figure 10.

A refuel vent valve is installed in each outboard bay tank wall. The valves are kept open with fuel pressure during refueling. This protects the structure if an automatic or backup shut–off does not occur. If the tank overfills due to a malfunction of the pressure refueling shut–off system, the open valve dumps fuel into the surge bay. If the surge bay fills up, fuel will spill overboard through the NACA vents. The refuel vent valve also releases pressure from the tank if it is more than 3.0 ±0.25 psi (20.7 ±1.72 kPa) above atmospheric pressure. An electrical switch on the valve senses the valve position and sends the information to the refuel/defuel control panel. The DUMP VALVE OPEN (TANK1 or TANK2) indicator lights on the refuel/defuel control panel come on when the related refuel vent valve is open. If the valve does not open during refueling, the refuel/defuel control panel will stop the pressure refueling.

High Level Sensor

Refer to Figure 11.

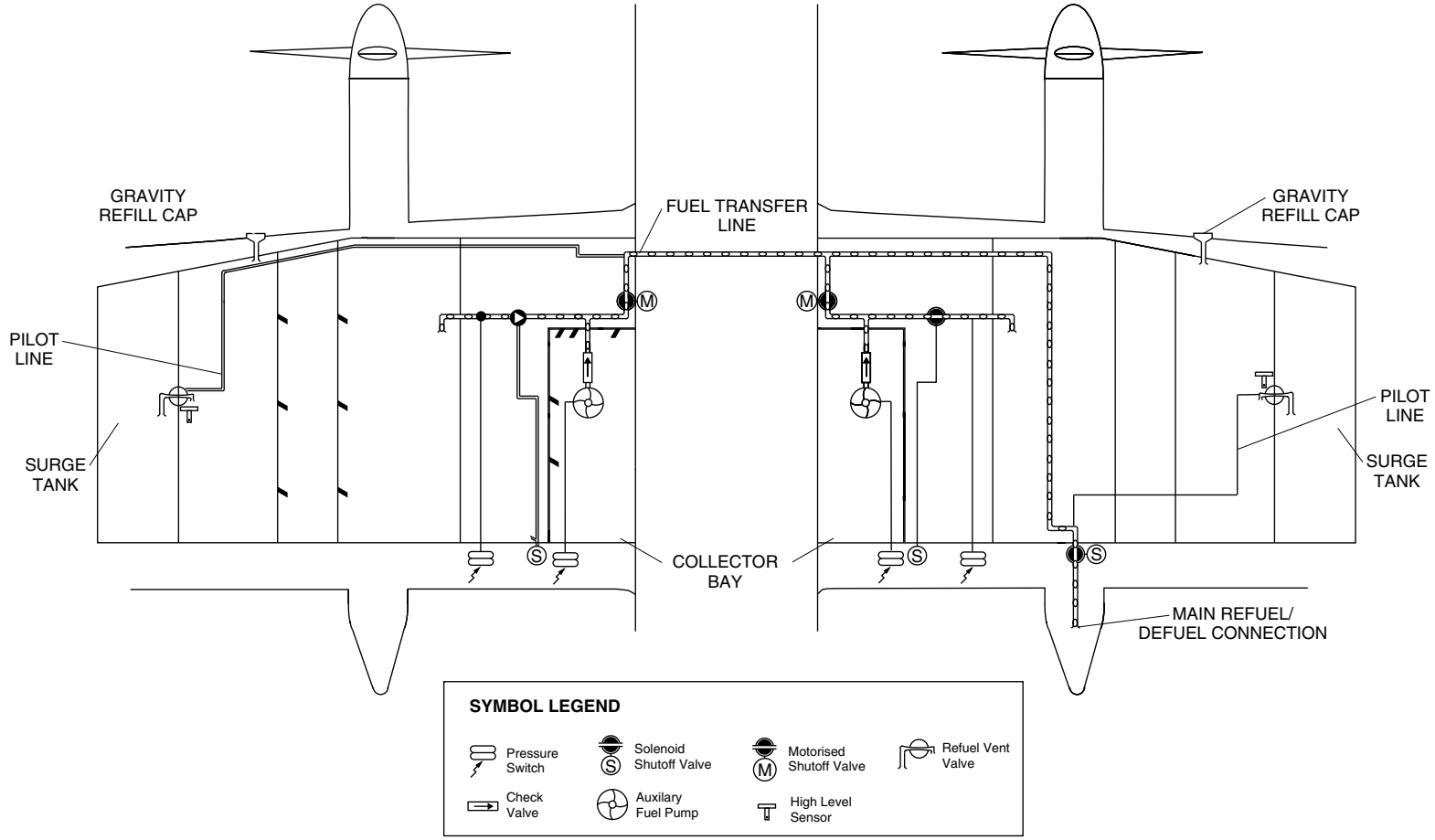
A high level sensor is attached to each refuel vent valve. The high level sensor is a dual thermistor bead type. One bead gives a reference temperature while the other senses the fuel level. The sensors are monitored by the high level control unit.



LEGEND

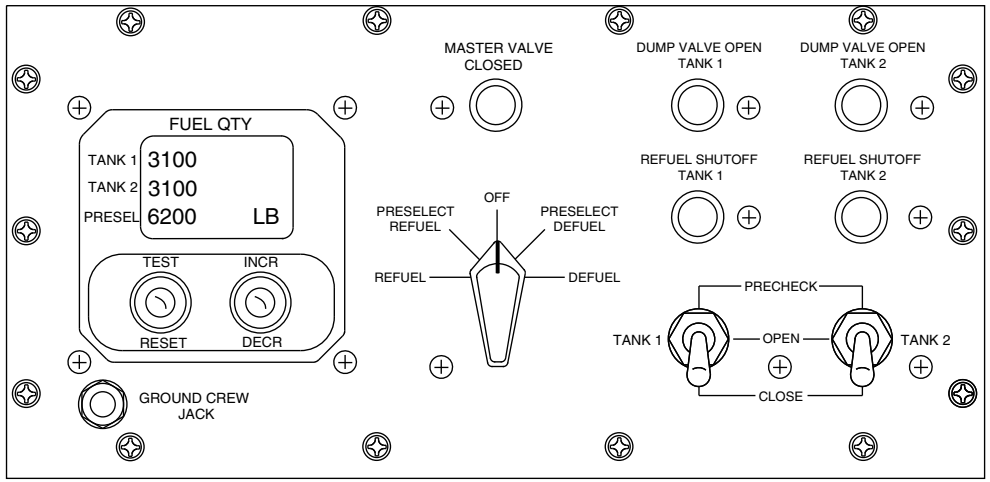
1. Fuel Control (Transfer) Panel.
2. Transfer Shut–Off Valve.
3. Level Control Shut–Off Valve.
4. Refuel/Defuel Panel.
5. Auxiliary Pump.
6. Level Control Shut–Off Valve.
7. Refuel/Defuel/Transfer Manifold.
8. Fuel Quantity Computer.
9. EIS Displays.
10. Refuel Vent Valve and High Level Sensor.
11. Gravity Refill Cap.

Refuel/Defuel System
Figure 1



Refuel/Defuel System Block Diagram
Figure 2

A RIGHT NACELLE



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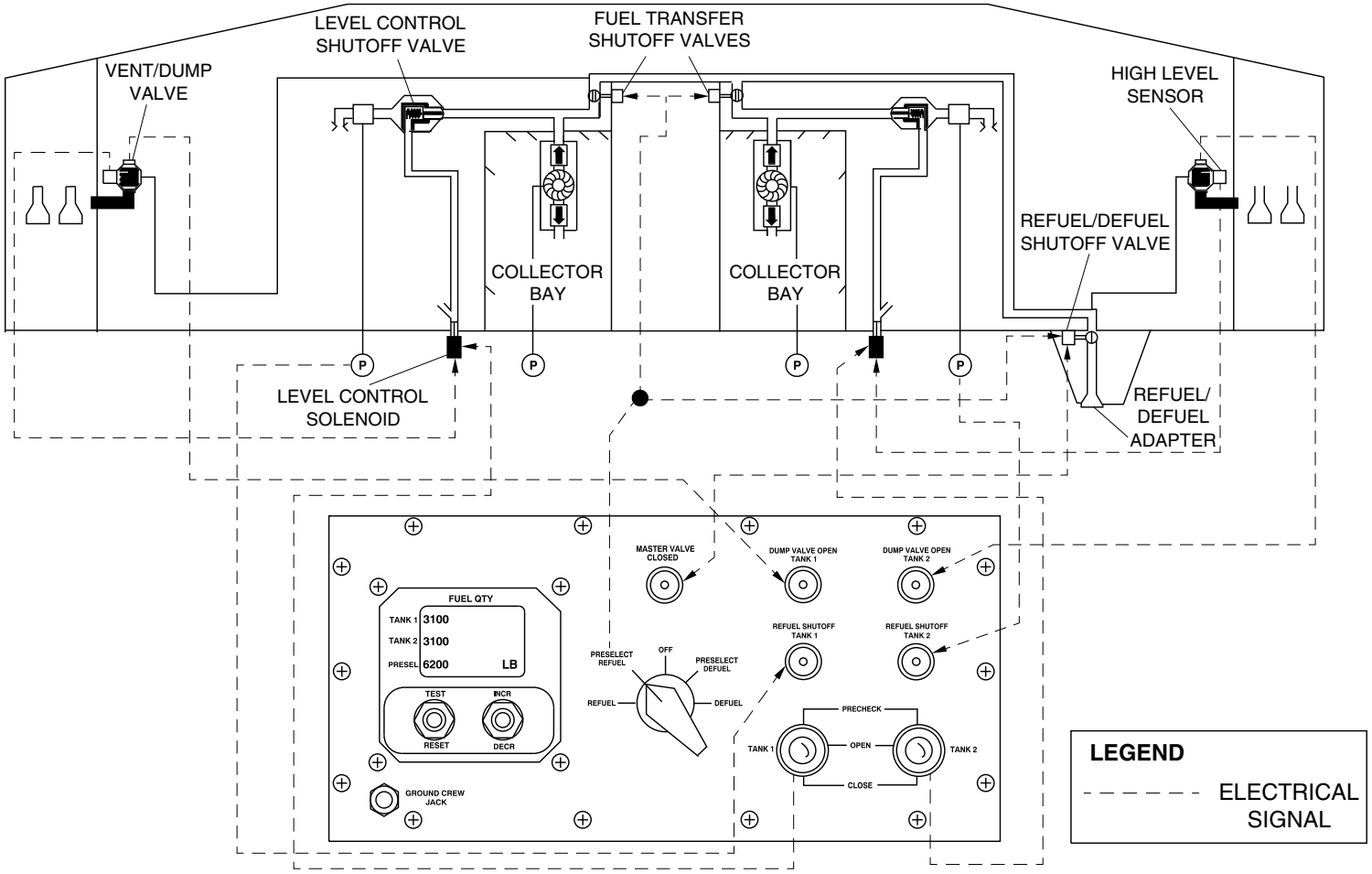
Refuel/Defuel Control Panel Locator
Figure 3



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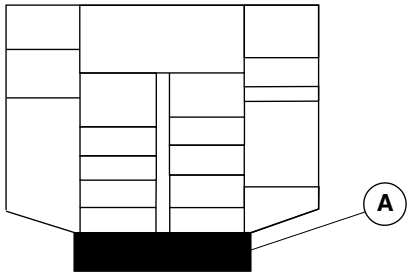
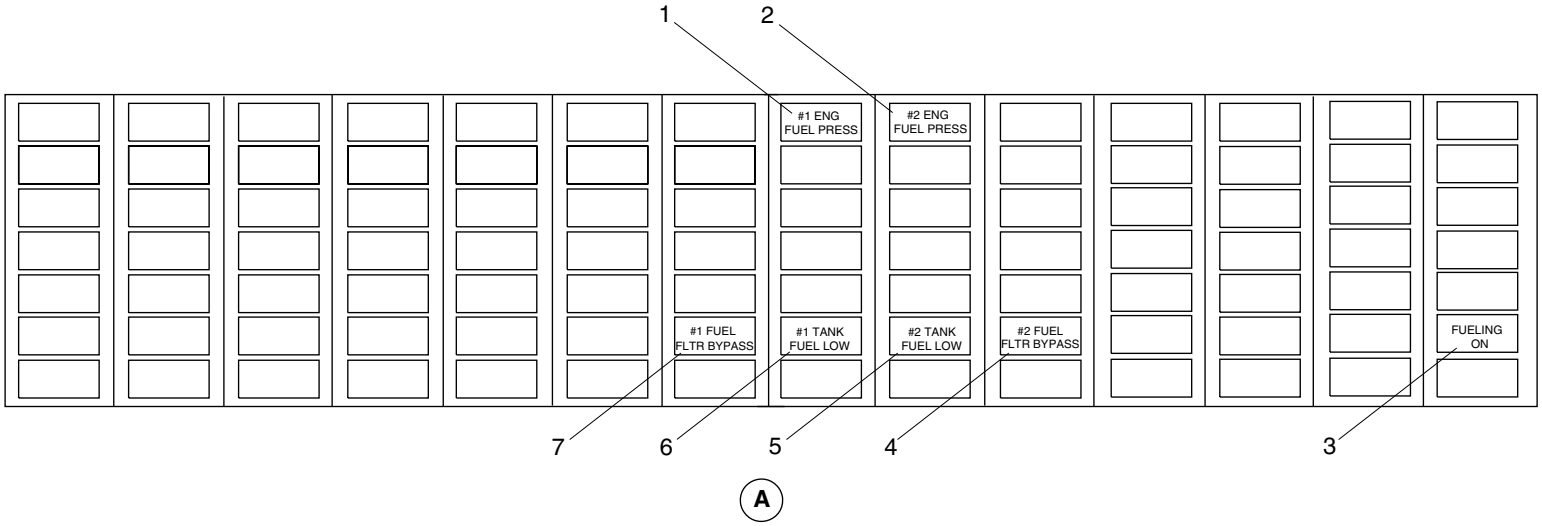
Refueling Schematic
Figure 4



OVERHEAD CONSOLE

LEGEND

1. # 1 Engine Fuel Pressure (Amber).
2. # 2 Engine Fuel Pressure (Amber).
3. Fueling On (Amber).
4. # 2 Fuel Filter Bypass (Amber).
5. # 2 Tank Fuel Low (Amber).
6. # 1 Tank fuel Low (Amber).
7. # 1 Fuel Filter Bypass (Amber).



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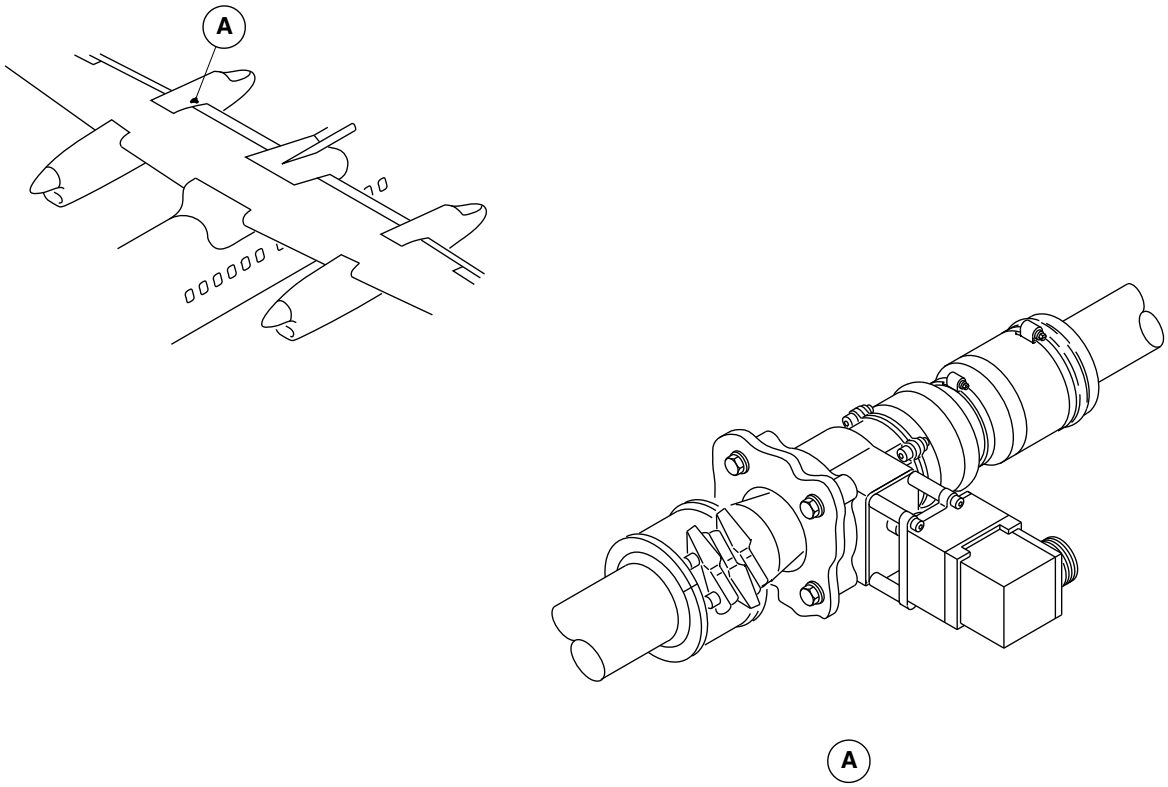
Fuel System Caution Lights
Figure 5



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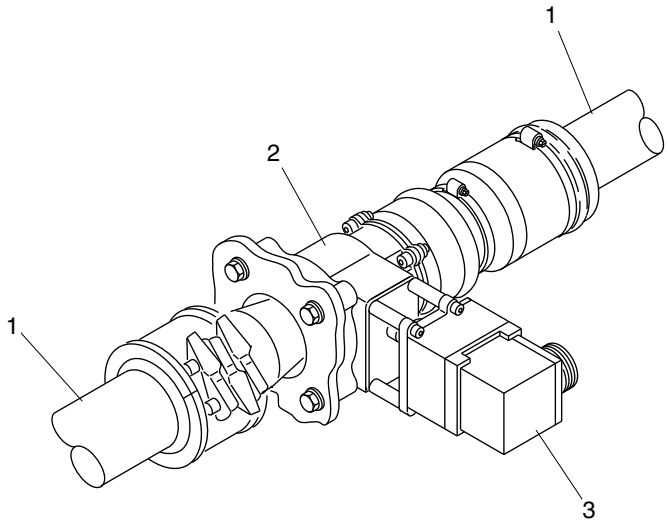
Refuel/Defuel Shut–off Valve Locator
Figure 6



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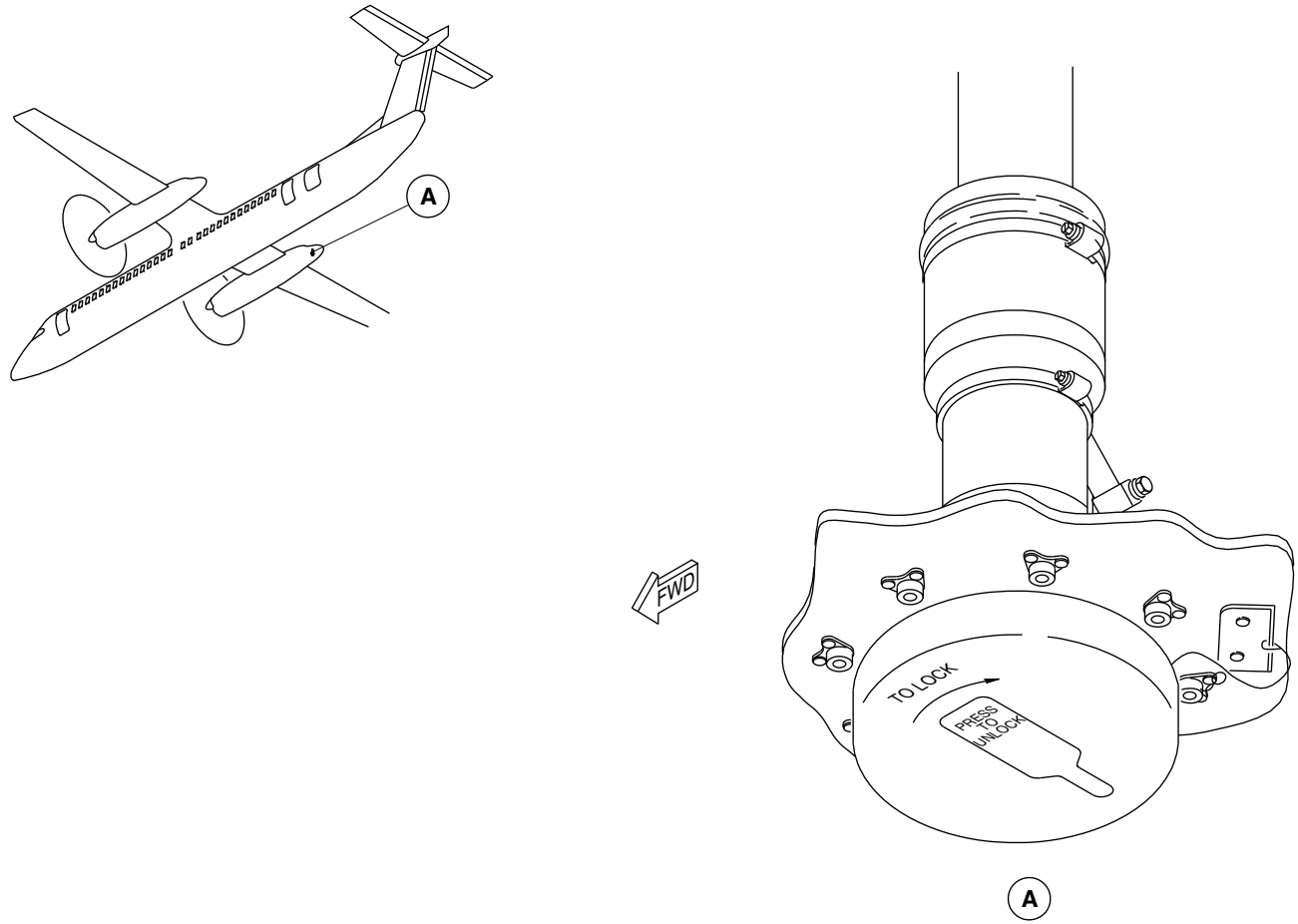
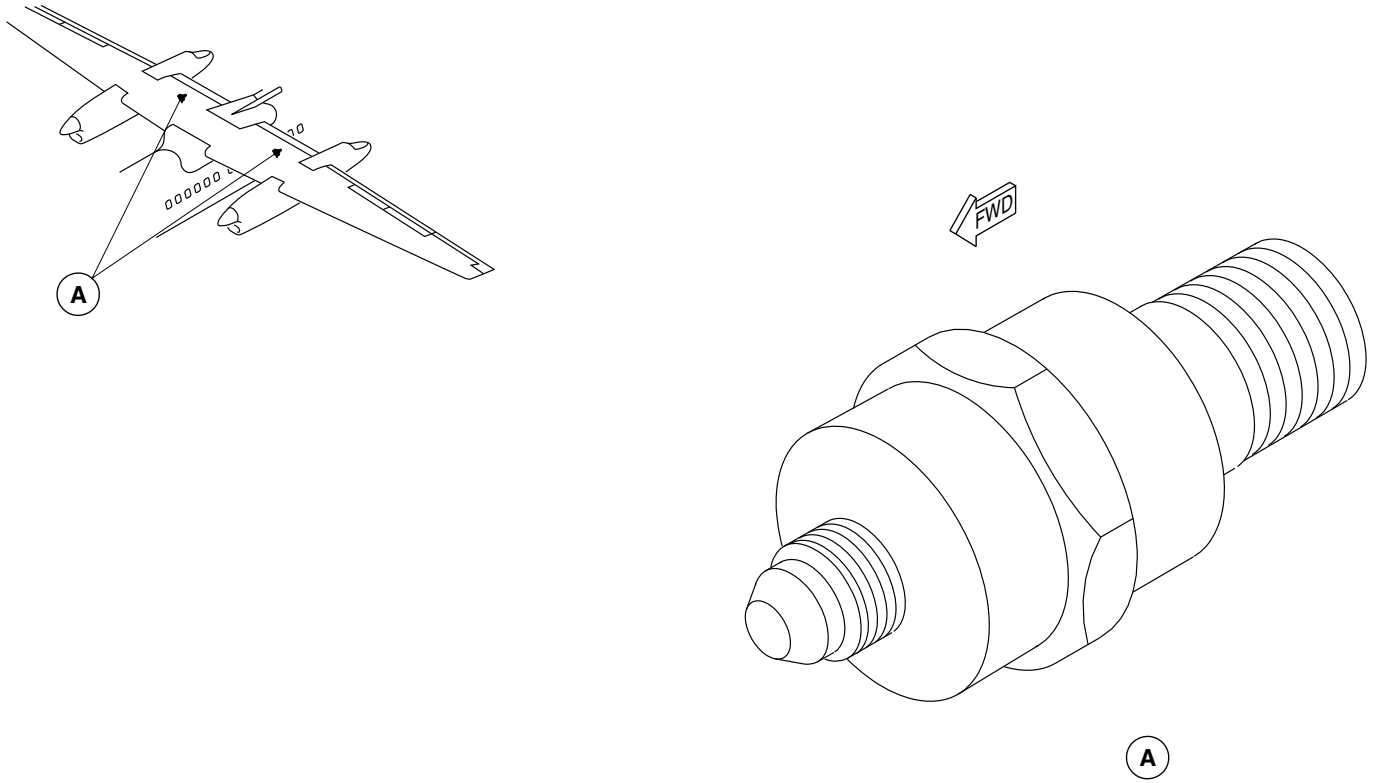
LEGEND

1. Refuel/Defuel/Transfer Manifold.
2. Refuel/Defuel Shut–Off Valve.
3. Actuator.

Refuel/Defuel Shut–off Valve Detail
Figure 7



Refuel/Defuel Adapter Locator
Figure 8



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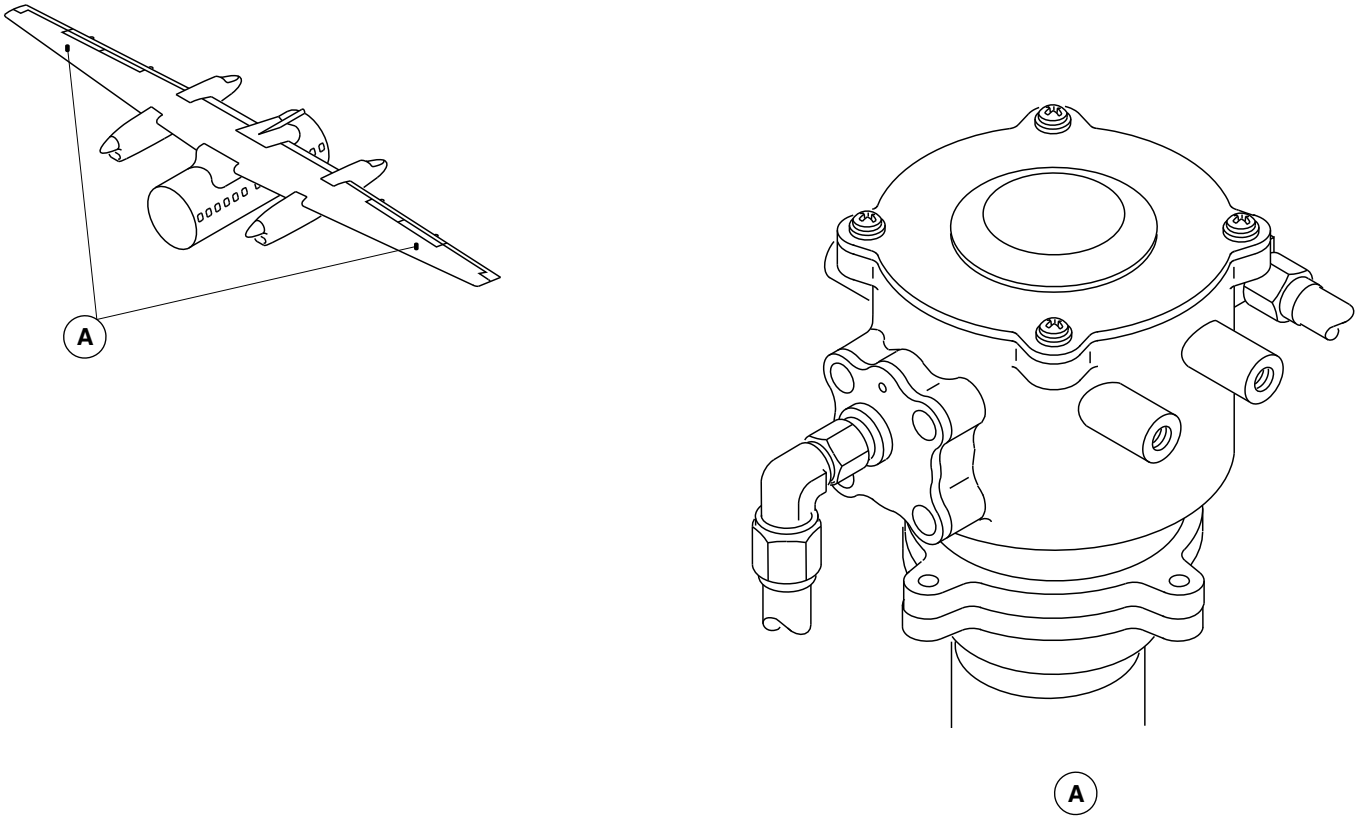
No–Flow Pressure Switch Locator
Figure 9



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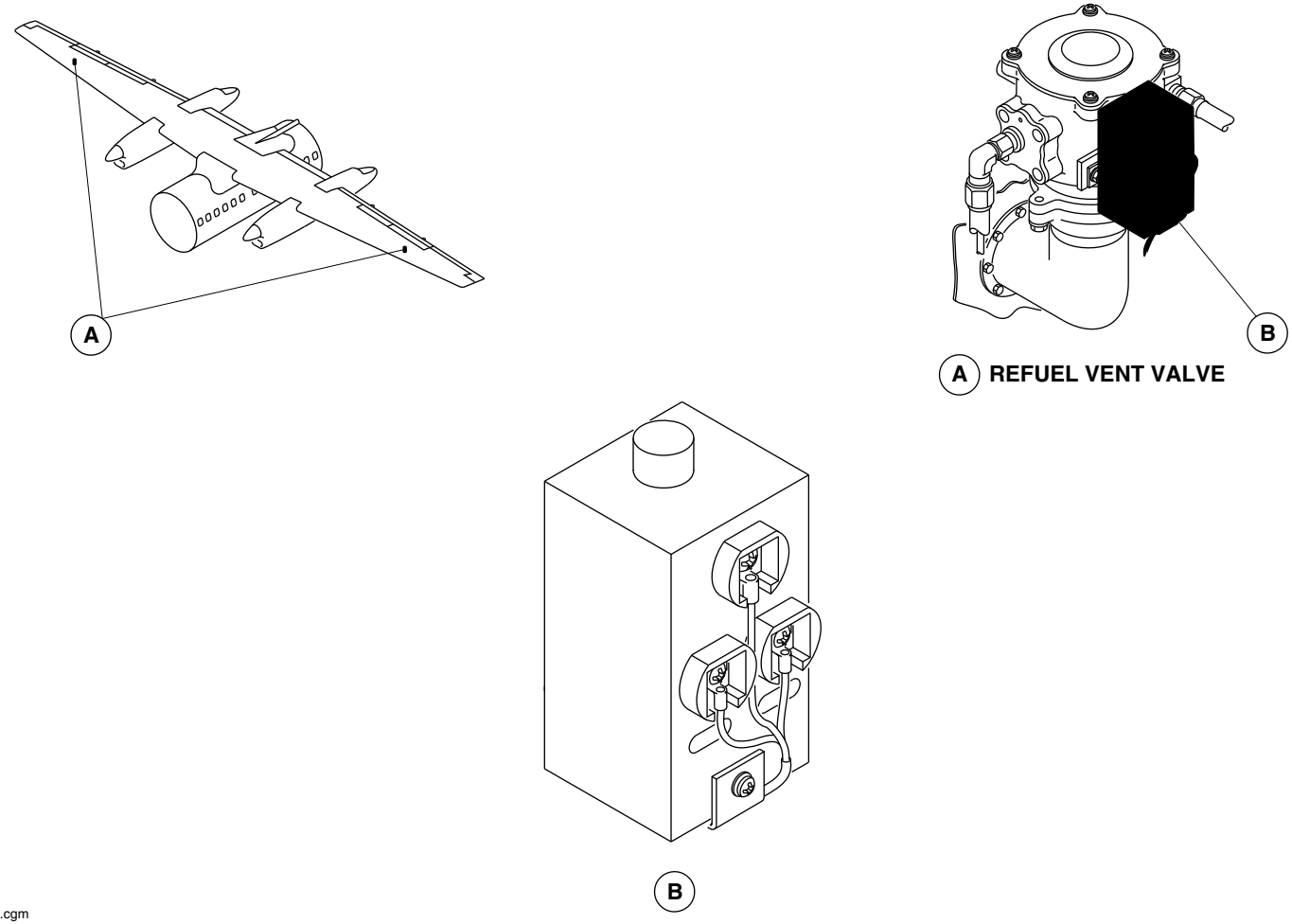
Refuel Vent Valve Locator
Figure 10



High Level Sensor Locator
Figure 11

**ON A/C ALL

28–40–00–001

INDICATING

Introduction

The fuel indicating system supplies information on fuel quantity, low level detection and fuel temperature for display in the flight compartment. Fuel quantity is also shown on the refuel/defuel control panel.

General Description

Refer to Figure 1.

The fuel indicating system provides an accurate measure of the fuel quantity in the wing tanks. Nine DC capacitance type fuel probes located in each wing send inputs to the Fuel Quantity Computer (FQC) to calculate the aircraft fuel quantity. The Engine Indicating System (EIS) in the flight compartment displays the fuel quantity information to the flight crew. The fuel quantity information is also displayed on the Refuel/Defuel Indicator (RDI) located in the refuel/defuel panel. A magnastick located in each wing provides an independent mechanical indication of fuel tank quantity.

Low fuel level is sensed by a float switch in each collector bay and is indicated by a caution light on the Caution and Warning Panel. Fuel tank temperature is measured by a Resistance Temperature Device (RTD) sensor in the left collector bay and is displayed in the flight compartment.

The fuel indicating system has these components:

- Fuel Quantity Computer (28–40–01)
- High Level Control Unit (28–40–06)
- High Level Switch (28–40–11)
- Float Switch (28–40–16)
- Temperature Sensor (28–40–21)
- Magnastick (28–40–26)
- Fuel Quantity Probe (28–40–31).
- EMI Filter Adapter

Detailed Description

Refer to Figures 1 , 2 and 3.

The fuel indicating system shows the aircraft fuel quantity in the flight compartment and on the refuel/defuel control panel. The fuel quantity in each tank is shown digitally on the bottom center of the Engine Display (ED). The Fuel Page of the Multi Function Display (MFD) shows the fuel quantity in each tank on two simulated analog dials and the total fuel quantity in digital form. The fuel quantity can be shown in kilograms (kg) or pounds (lbs).

Refer to Figure 4.

Fuel quantity and temperature data are shown in white on the Engine Display (ED) and on the Fuel Page of the Multi Function Display (MFD). White dashes replace the display digits if the data is not valid. The display changes color to yellow if in the caution range or red if in the warning range.

If a fuel imbalance condition is detected, a yellow [BALANCE] advisory message is shown just above the FUEL legend of the ED. The message flashes continuously until a pilot action rectifies the imbalance. An imbalance condition is also shown on the MFD Fuel page by the analog pointers changing to yellow and both ED digital fuel quantities changing to yellow.

The fuel inlet temperatures to the left and right engines are shown digitally on the bottom of the ED, just below the related tank fuel quantity. The digits are shown in white with a + or – sign. The digits change to yellow if the fuel temperature is in the caution range and to red if the temperature exceeds the allowable limits. A °C unit is shown between the two inlet temperatures. The fuel temperature in the left collector tank is shown digitally on the Fuel Page, just below the left fuel quantity dial.

The Fuel Quantity Computer (FQC) supplies the fuel probes with a 1kHz electrical excitation signal that causes an average dc output proportional to the effective capacitance of each probe. The nine probes in each tank are connected to seven excitation signals. The output of each probe is wired in parallel to one of two processors in the FQC. This arrangement allows for fault isolation to a single probe and is recorded in the FQC NVM.

The FQC converts the total of all valid probe signals to fuel weight for each tank. The FQC then transmits the data for left, right, and total fuel quantity, to the Input Output Processors (IOPs) in the Integrated Flight Cabinets (IFCs). The IOPs in the IFCs transmit the fuel quantity signal to the Electronic Instrument System (EIS) through the dual ARINC 429 data busses. The information is also shown on the Refuel/Defuel Indicator (RDI) during refueling. The RDI shows the quantity of fuel in each wing and the total quantity of fuel when selected in the automatic mode for refueling. When selected in the manual mode, the RDI shows only the quantity of fuel selected for each individual wing. All quantities can be shown in pounds or kilograms (refer to SDS 28–24–00 Refuel/Defuel).

The pre–select values for refuelling are selected using the INCR/DECR switch on the refuel/defuel control panel and are shown on the RDI. The FQC automatically starts the refuel or defuel operation four seconds after the last switch operation. The RDI also displays fault information from the FQC. The TEST/RESET switch located on the refuel/defuel control panel shows and clears fault codes.

The FQC does not process faulted probe signals because their total output data is not valid. The indicated display for data not valid is as follows:

- The ED digital quantity is replaced with white dashes.
- The MFD FUEL page QTY needle pointer, scale marks and scale numbers go out of view.
- The MFD FUEL page TOTAL FUEL digital quantity is replaced with white dashes.
- The RDI digital quantity is replaced with yellow dashes.

A blank display indicates an FQC or RDI failure.

Fuel Quantity Computer

Refer to Figure 5.

The Fuel Quantity Computer (FQC) is located in the avionics bay below the passenger compartment floor. The FQC has two independent processors. Each of these processors:

- calculates the fuel quantities in each tank independently
- controls the level control solenoid for pre–select refueling

- performs a Built–In Test (BIT) of the fuel gauging components
- sends quantity, temperature compensation, and BIT data to the EIS displays.

The right processor also calculates fuel temperature measurements and transmits the information to the Refuel/Defuel Indicator (RDI).

The FQC performs an initial BIT when it starts up and a continuous BIT when it is in operation. The FQC is self–calibrating and needs no adjustments.

High Level Control Unit

Refer to Figure 6.

The High Level Control Unit (HLCU) monitors the high level sensors and transmits a signal to prevent overfilling the tanks during refuel or fuel transfer operations. This unit also serves as a signal conditioner for the temperature sensor. The unit is located below the cabin compartment floor.

The pre–check test switch on the refuel/defuel control panel tests the automatic shutoff operation of the high level control unit. The HLCU does a continuous BIT on itself and the high level sensor. Any fault sensed will stop the refueling procedure.

The HLCU conditions the fuel tank temperature signal and transmits the signal to the IFC .

Float Switch

Refer to Figures 7 and 8.

There are two low fuel level float switches, one installed in each collector bay. The float switches operate a #1 TANK FUEL LOW or a #2 TANK FUEL LOW caution light on the Caution and Warning Panel. Operation of the low fuel level sensing system is independent from the rest of the indicating system.

Temperature Sensor

Refer to Figures 3 and 9.

The tank temperature sensor is located on the No.1 tank collector bay wall. The sensor uses electrical resistance to monitor the fuel temperature. The analog output is sent to the HLCU for signal conditioning, and then to the IFCs for the EIS to display. The system is operational when electrical power is supplied to the aircraft. The temperature is shown on the MFD Fuel Page and ranges from –70 to +75 °C (–94 to 167 °F).

Magnastick

Refer to Figures 10 and 11.

There are two magnasticks. One magnastick is installed in each main tank, outboard of the engines. The magnasticks give an alternate means to measure the fuel quantity when the aircraft is on the ground. A magnastick is a calibrated rod with a magnet attached. It moves within a tube that extends vertically from the bottom of the fuel tank. A float moves up and down on the outside surface of this tube to match the fuel level in the tank. The float contains a magnet that attracts the magnet on the magnastick. The magnastick is accessed at the bottom of the wing. When the rod is released, it

moves slowly down until the rod magnet is attracted by the float magnet. The fuel quantity is shown in US gallons or in litres.

Fuel Quantity Probe

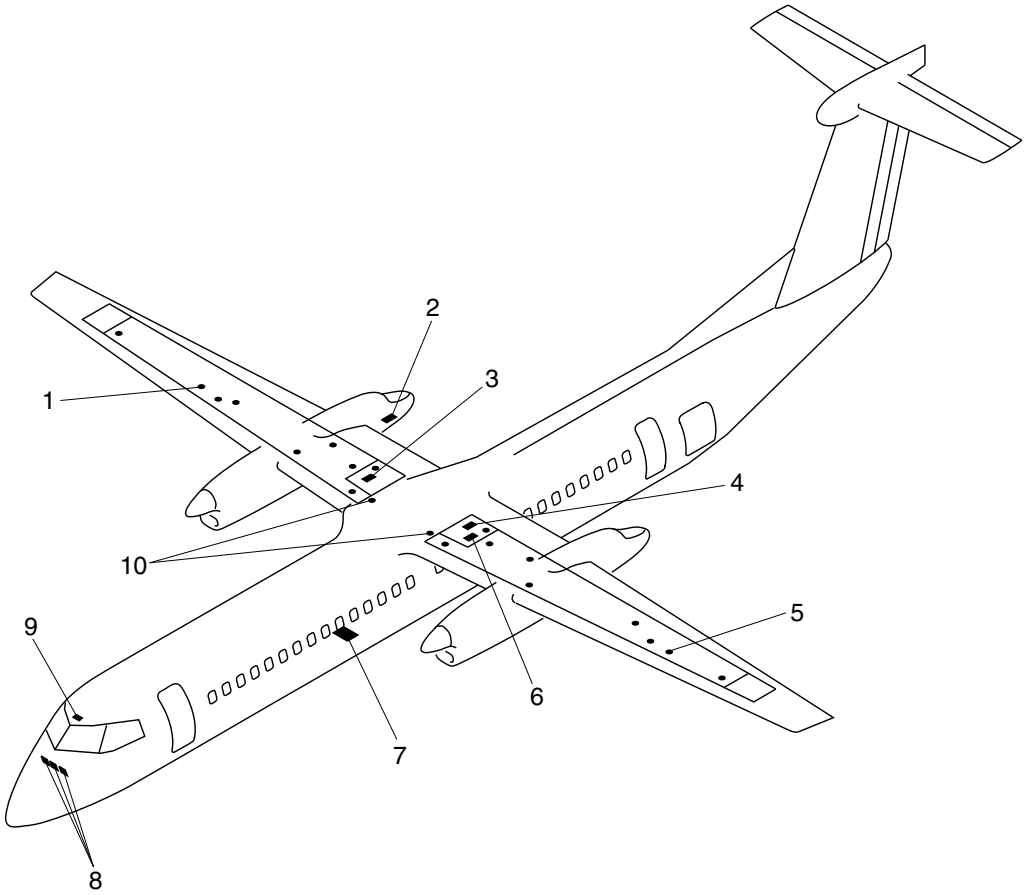
Refer to Figure 12.

There are 18 fuel quantity probes, nine in each wing. The probes contain two concentric metal cylinders, a terminal block, and two mounting brackets. The cylinders form the capacitor elements (plates); the inner plate is the high–impedance element and the outer plate is the low–impedance element. Changes in fuel levels around each probe cause corresponding changes in the effective capacitance of each probe. The probes are monitored by the fuel quantity computer.

EMI Filter Adapter

Refer to Figure 1.

There are two EMI filter adapters, one in each wing. The EMI filter adapters are installed on the dry bay connectors 2800–P4 and 2800–P5 inside the wing. The adapters contain filter capacitors to protect the fuel system from electromagnetic interference.



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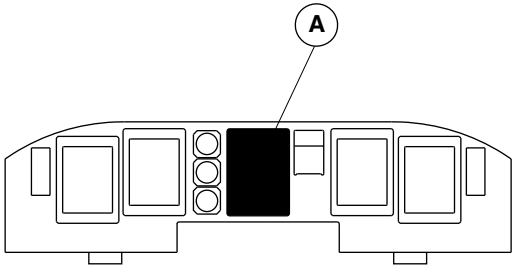
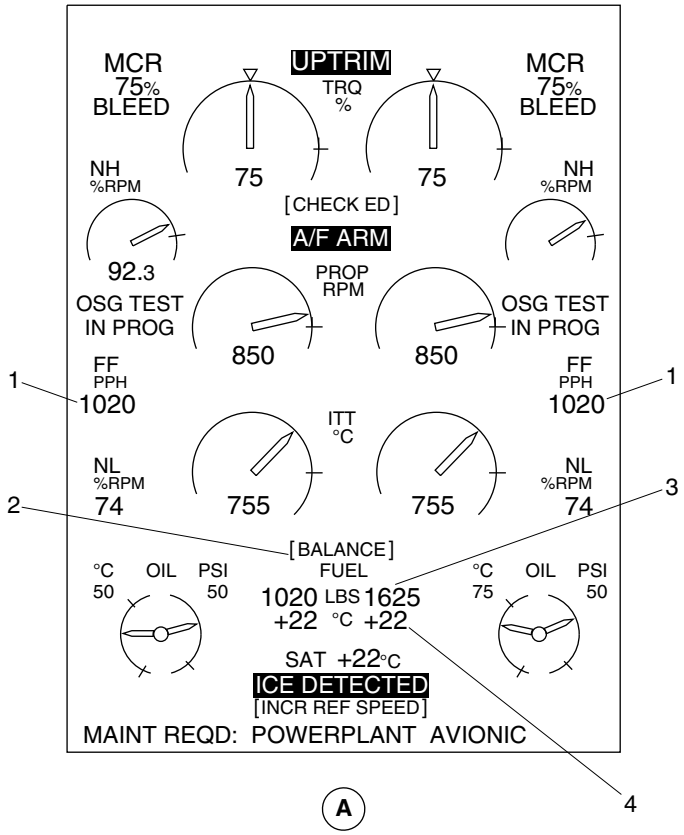
LEGEND

1. Right wing fuel probe (9).
2. Refuel/defuel panel.
3. Low level float.
4. Temperature sensor.
5. Left wing fuel probe (9).
6. Low level float.
7. Fuel quantity computer.
8. EIS display.
9. Caution and warning panel.
10. EMI filter adapter.

Fuel Indicating System
Figure 1



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Flow Digital Value.
2. BALANCE Command Message (Fuel Limitation).
3. Left/Right Fuel Tank Quantity Digital Readout.
4. Left/Right Fuel Inlet Temperature Digital Value.

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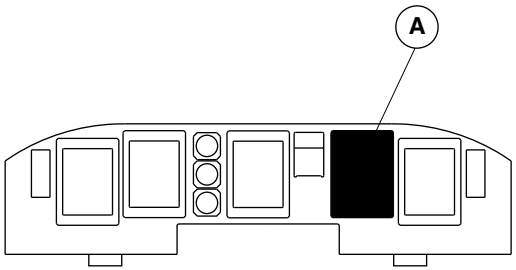
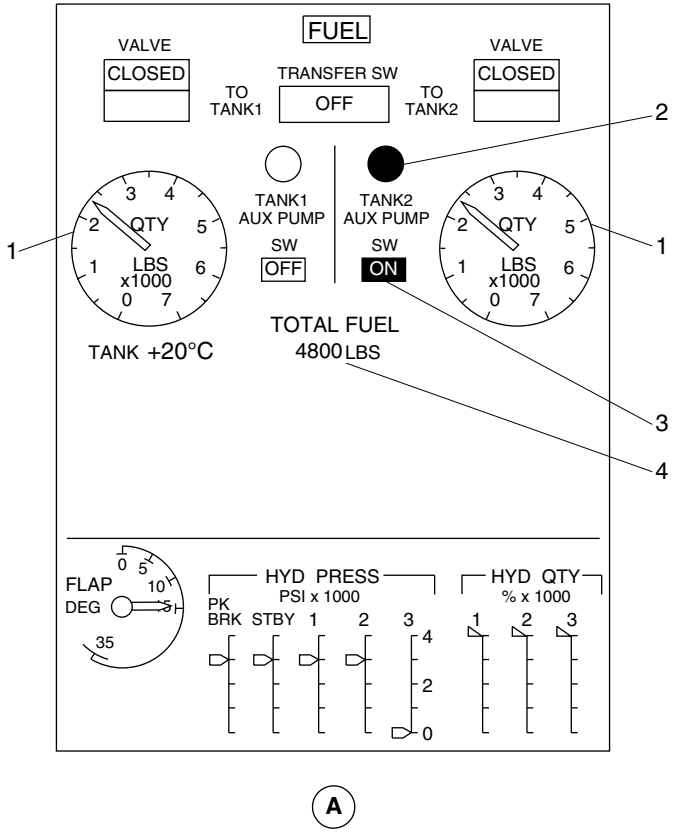
Fuel Quantity Indication / Engine Display
Figure 2



MAIN INSTRUMENT PANEL



LEGEND

1. Left/Right Fuel Tank Quantity.
2. Right Auxiliary Pump Pressure Status.
3. Right Fuel Auxiliary Pump Switch Position.
4. Total Fuel Quantity in Tanks.

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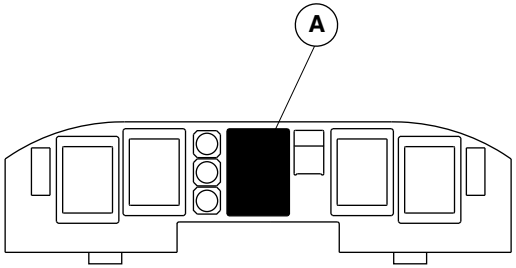
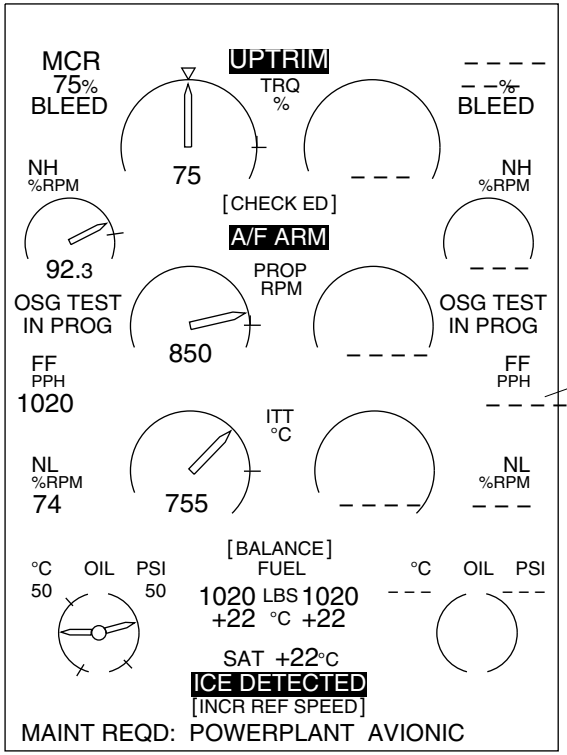
MFD Fuel Page
Figure 3



MAIN INSTRUMENT PANEL



LEGEND

1. Right Fuel Flow Digital Value Fail Annunciation.

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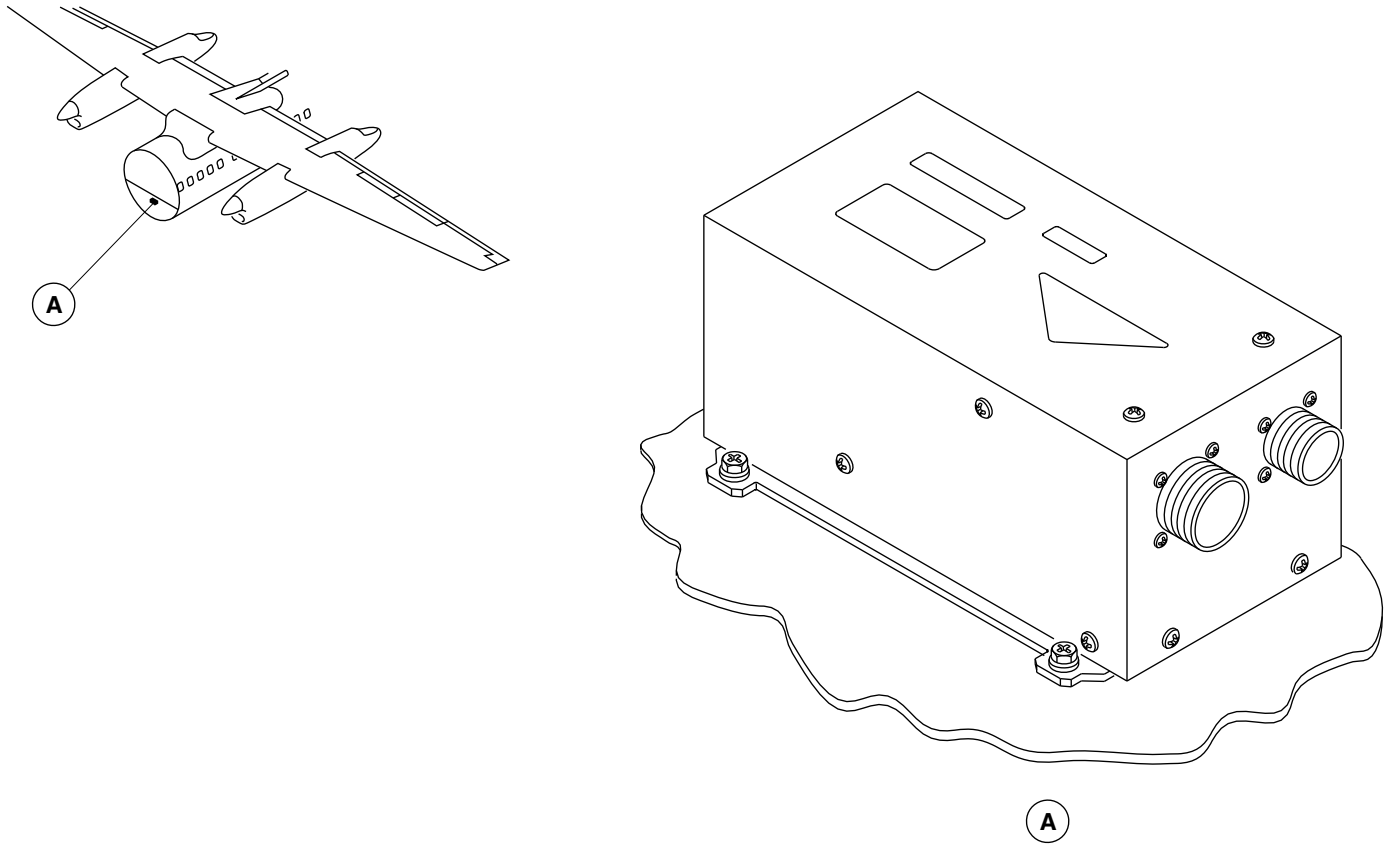
Engine Display Fail Page
Figure 4



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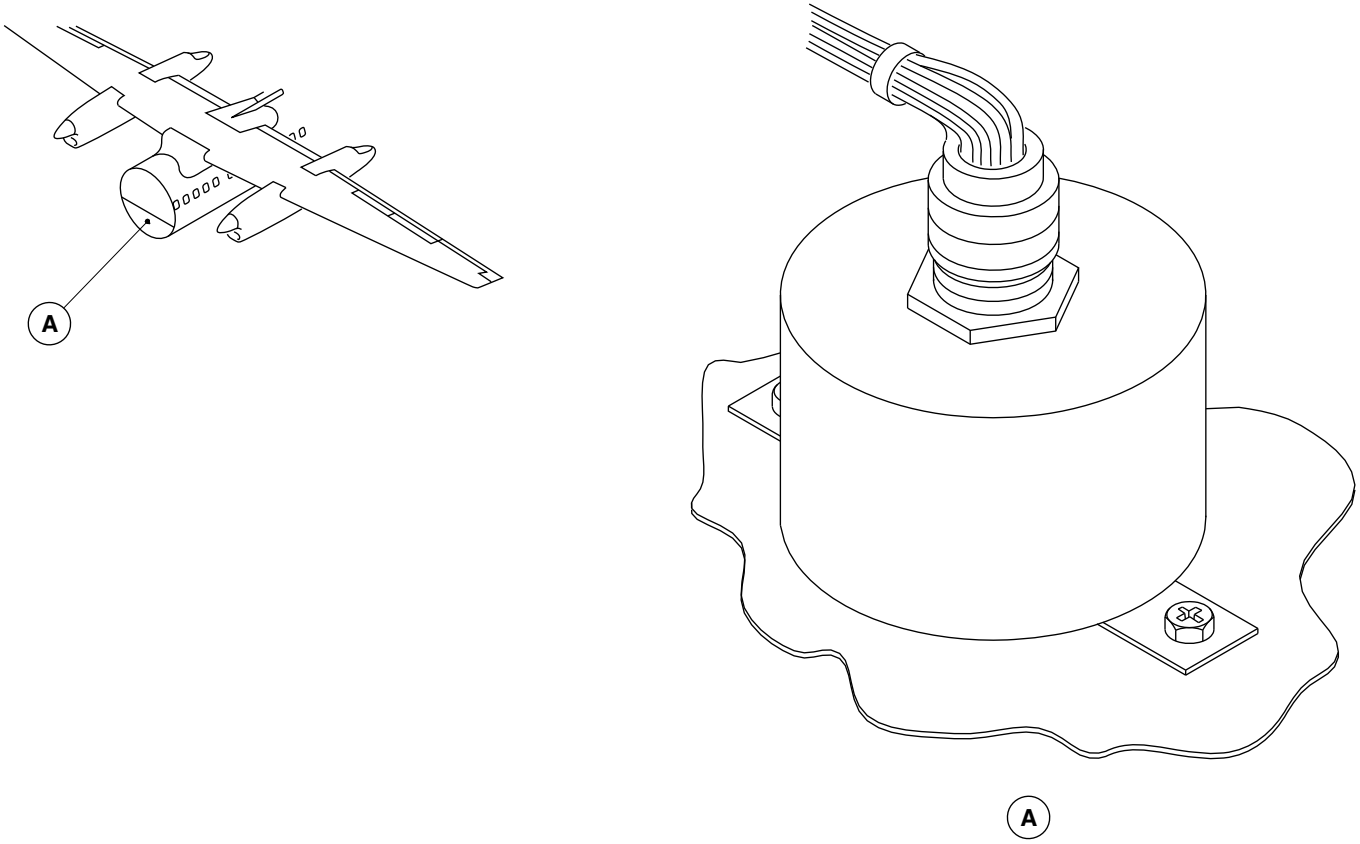
Fuel Quantity Computer
Figure 5



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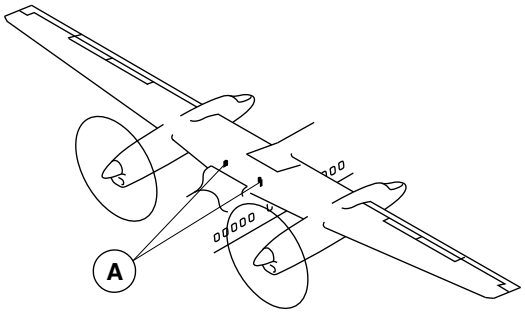
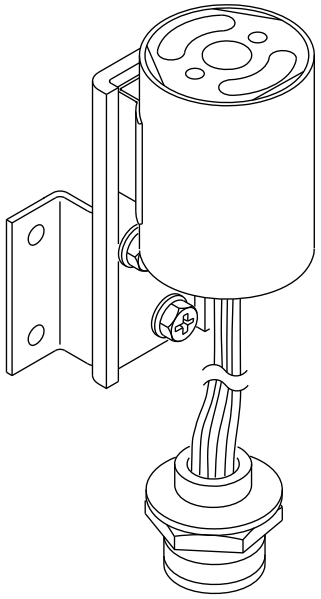
High Level Control Unit
Figure 6





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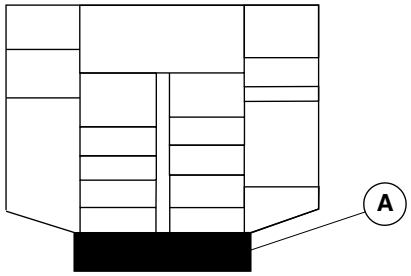
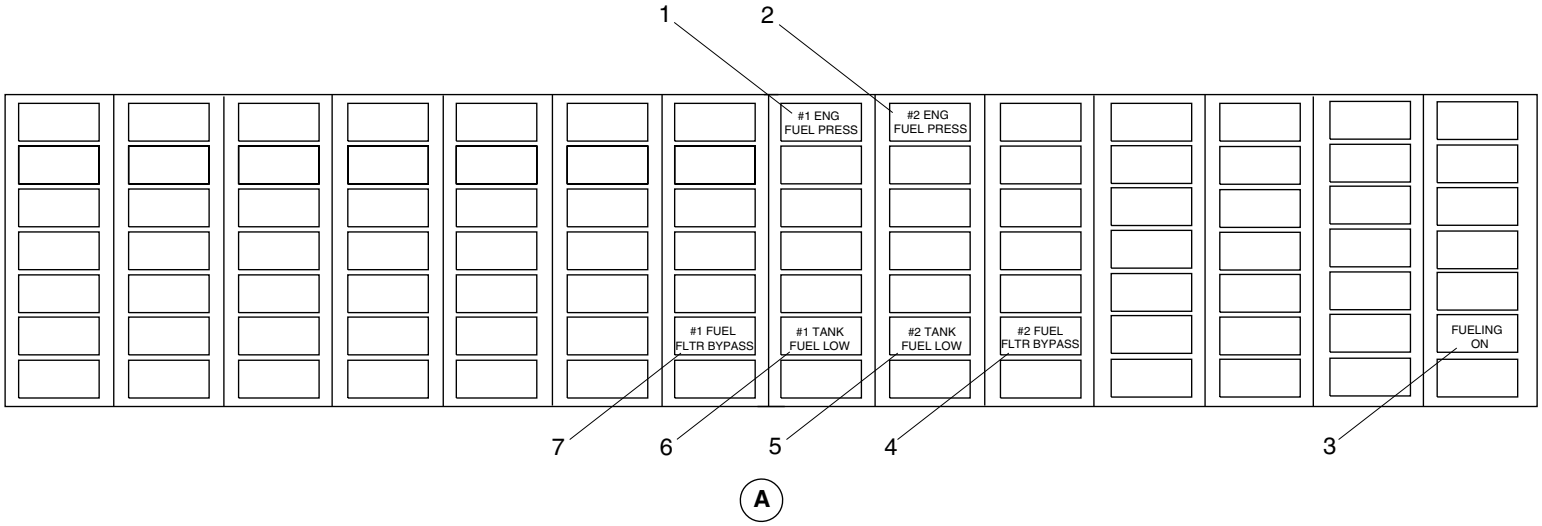
Float Switch
Figure 7



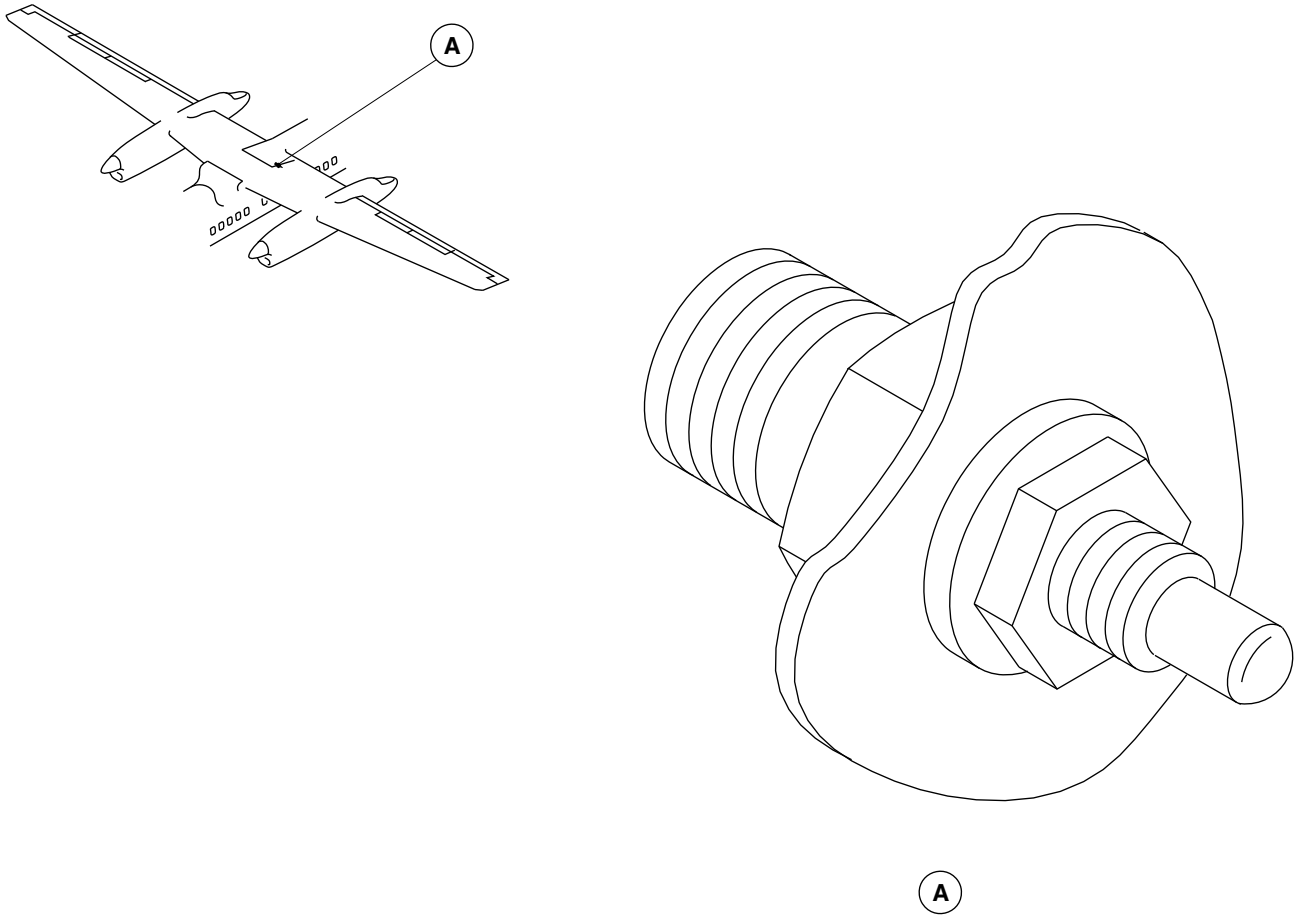
OVERHEAD CONSOLE

LEGEND

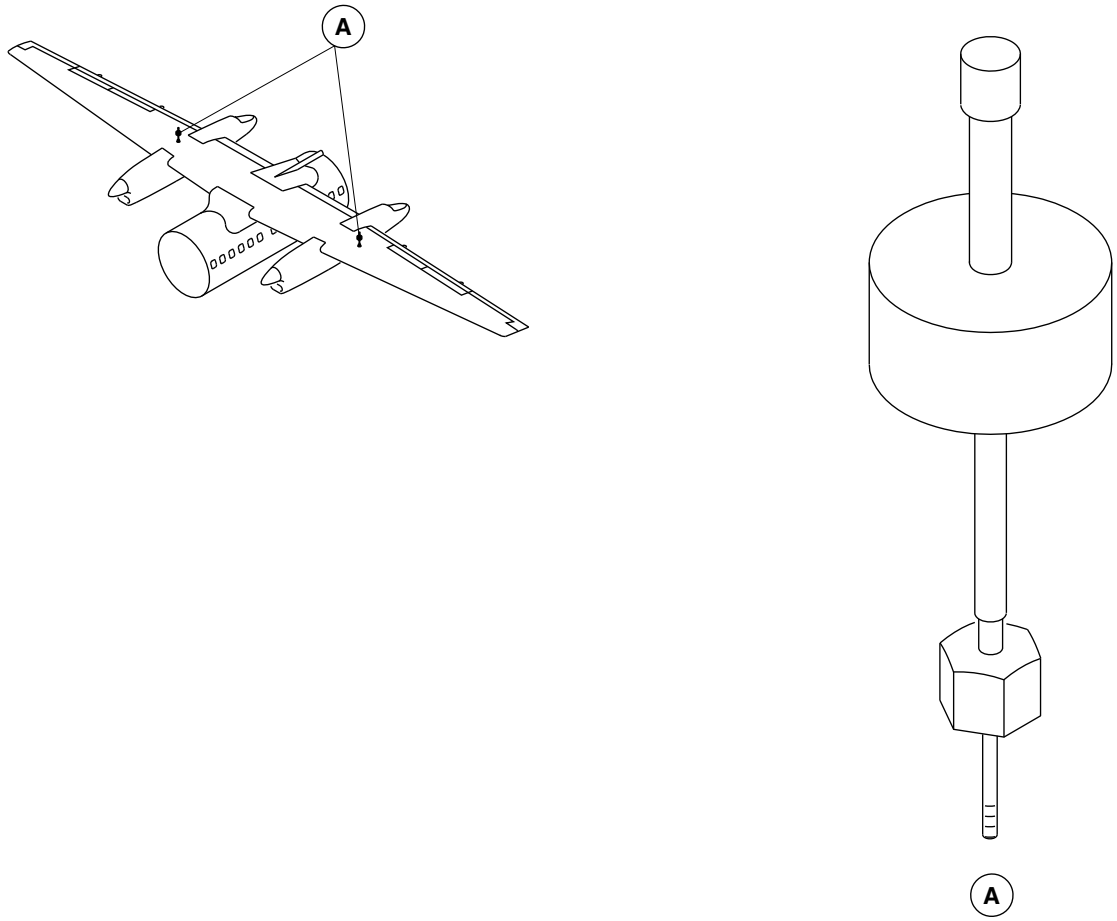
1. # 1 Engine Fuel Pressure (Amber).
2. # 2 Engine Fuel Pressure (Amber).
3. Fueling On (Amber).
4. # 2 Fuel Filter Bypass (Amber).
5. # 2 Tank Fuel Low (Amber).
6. # 1 Tank fuel Low (Amber).
7. # 1 Fuel Filter Bypass (Amber).



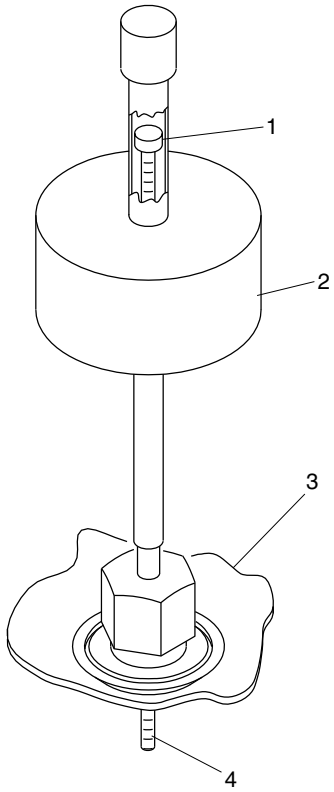
Fuel System Caution Lights
Figure 8



Temperature Sensor
Figure 9



Magnastick Locator
Figure 10



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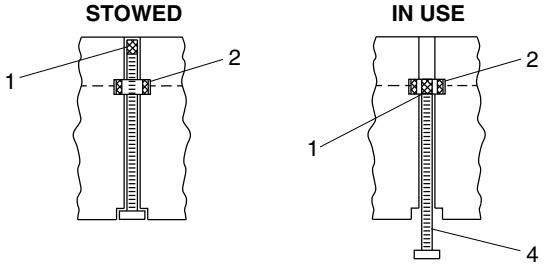
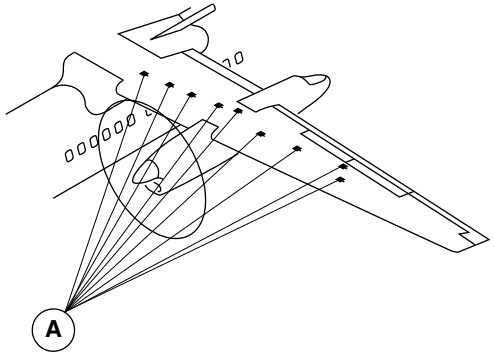
LEGEND

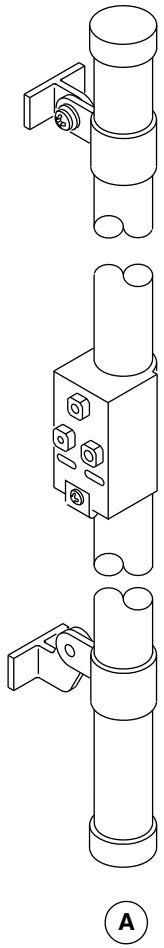
1. Rod Magnet.
2. Float Magnet.
3. Aircraft Lower Wing Skin.
4. Magnetic Dipstick.



Magnastick Detail
Figure 11



NOTE
Left Side Shown.
Right Side Similar.



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Fuel Quantity Probes
Figure 12

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