United States Army Warfighting Center
Fort Rucker, Alabama
AUGUST 2006

STUDENT HANDOUT

TITLE: CH-47D FUEL SYSTEM

FILE NUMBER: 011-2106-3

PROPONENT FOR THIS STUDENT HANDOUT IS:

110th Aviation Training Brigade
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Fort Rucker, Alabama 36362-5000

CH-47D FUEL SYSTEM

STUDENT HANDOUT

TERMINAL LEARNING OBJECTIVE (TLO):

Action: Describe components, operational characteristics, functions, limitations, and emergency procedures for the CH-47D Fuel System.

Conditions: In a classroom, given an Operators' manual and a student handout.

Standards: Correctly answer in writing, without reference, seven of ten questions pertaining to components, operational characteristics, limitations, functions and malfunctions of the CH-47D Fuel System, In Accordance With (IAW) TM 1−1520−240−10 and the student handout.

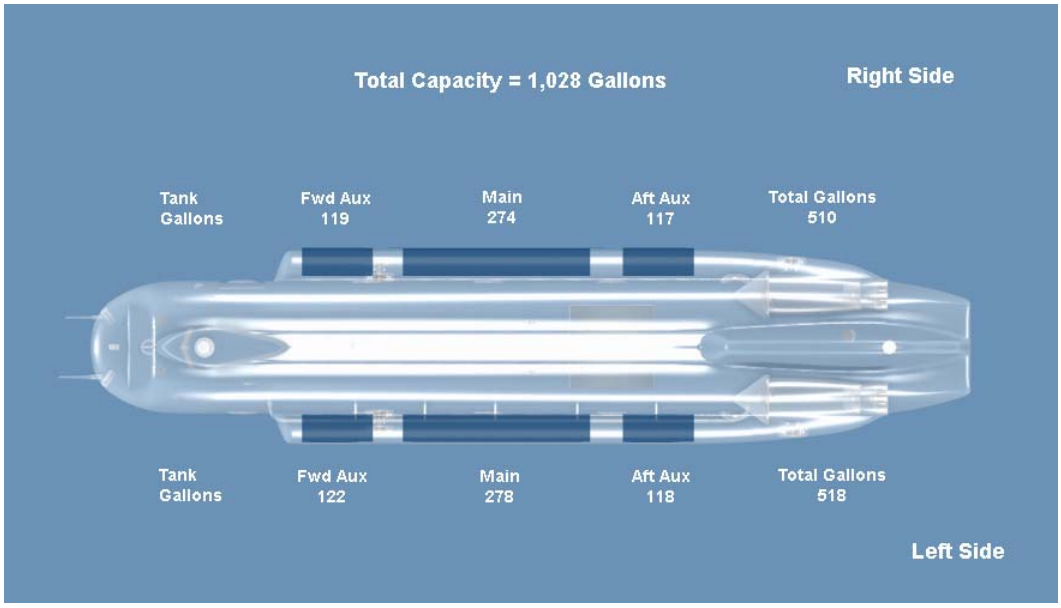
Safety Requirements: None.

Risk Assessment Level: Low.

Environmental Considerations: None.

Evaluation: Each student will be evaluated on this block of instruction during the first written examination. This will be a criterion type examination requiring a GO on each scored unit. You will have 90 minutes for the exam.

1. **Learning Step/Activity 1−Describe the general characteristics of the Fuel System.**



NOTE: The airframe fuel system furnishes fuel to the two engines, heater, and APU. Two separate systems, connected by the crossfeed and pressure refueling lines, are available.

a. Fuel tank system.

(1) Six tank assemblies.

(a) Two forward auxiliary tanks.

(b) Two main tanks.

(c) Two aft auxiliary tanks.

(d) Tank capacities (IAW TM 1-1520—240-10).

(1) Each main tank, 280 gallons – 1800 pounds.

(2) Each Aux tank, 118.5 – 800 pounds.

(3) Total capacity of 1034 gallons – 6800 pounds.

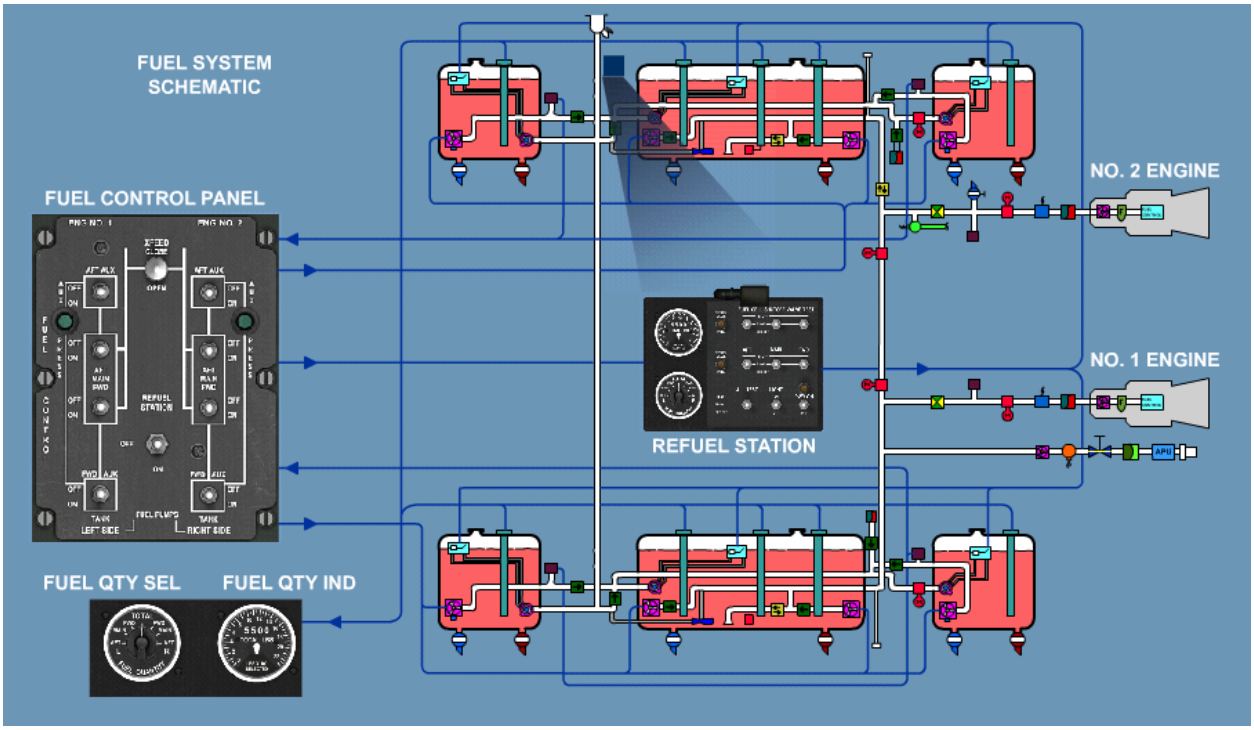
NOTE: Fuel quantities in each tank are different due to the placement of the float assembly in each of the tanks.

(e) Authorized fuels

(1) Army standard fuel is JP-8.

(2) Alternate fuel is JP-4, JP-5 or equivalent commercial fuel which can be used continuously without power reduction when JP-8 is not available.

(3) Emergency fuel is 100 LL (Low Lead) AVGAS (Aviation Gasoline) not to exceed 6 hours of cumulative operating time.



(2) Ten fuel quantity indicator probes.

(a) One in each auxiliary fuel tank.

(b) Three in each main fuel tank.

(3) Eight electrically operated boost pumps.

(a) One in each auxiliary tank that supply fuel to the main tanks.

(b) Two in each main tank:

1. Left main supplies fuel to the No.1 engine and the APU

2. Right main supplies fuel to the No.2 engine and the heater.

b. Cockpit components.

(1) Fuel control panel.

(a) Located on the overhead.

(b) Contains switches to control the fuel pumps, crossfeed fuel valves, and refuel station.

(c) Contains lights to indicate low fuel pressure in the auxiliary tanks.

(2) Master caution/advisory panel.

(a) Provide indication of low fuel pressure in the main tanks (**L/R FUEL PRESS**).

(b) Provide indication of low fuel in the main tanks (**L/R FUEL LVL**).

(3) Fuel quantity and flow indicating components.

(a) Fuel Flow indicator, rate of flow indicator in Pounds Per Hour (PPH).

(b) Fuel quantity indicator, indicates fuel quantity in pounds.

(c) Fuel quantity selector switch, used to select individual tank quantities.

c. Airframe components.

(1) Refuel Station.

(a) Located in the right forward inner tank access.

(b) Contains refuel control panel for refueling the helicopter.

(c) The pressure refueling system allows the helicopter to be completely refueled in about 4 minutes with fuel supplied at 300 Gallons Per Minute (GPM) at 55 PSI.

(2) Crossfeed fuel system.

(a) Crossfeed fuel line.

1. Located overhead at Sta. 504.

2. Used to supply fuel to both engines from a single main tank.

(b) Crossfeed fuel shutoff valves.

1. Located on the left and right side of the ramp Sta. 504.

2. Controlled by the switch on the fuel panel.

(3) Engine fuel shutoff valves.

(a) Located on the left and right side of the ramp at Sta. 498.

(b) Controlled by pulling the fire pull handles out.

(c) Shut off the fuel to the engine.

(4) De-fuel valve.

(a) Located on the right side of the ramp at Sta. 507.

(b) Used to de-fuel the helicopter.

(5) Engine driven fuel pump.

(a) Located on the accessory drive of each engine.

(b) Capable of drawing fuel from the main tank below 6,000 feet PA in the event of a dual boost pump failure in the associated main tank.

(6) Extended Range Fuel System (ERFS).

(a) ERFS I.

1. 600 gallon steel fuel tanks.

2. Total of 4 can be installed for a combined total of 2400 gallons of additional fuel.

3. Refueled from a dry lock adapter in the front cabin doorway.

(b) ERFS II (Robinson Tanks).

1. 800 gallon crashworthy tanks.

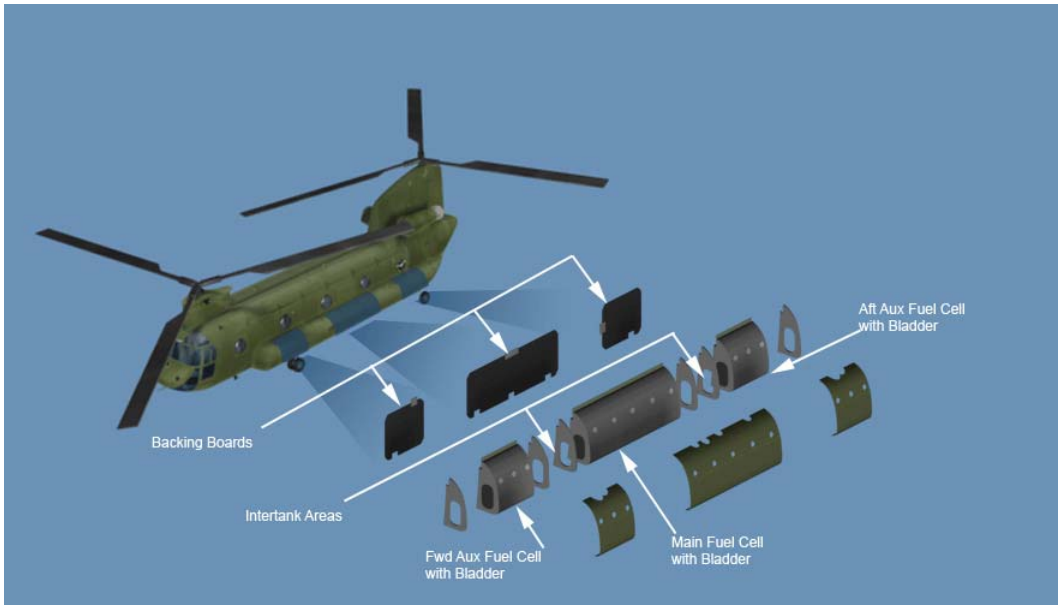
2. Total of 3 can be installed for a combined total of 2400 gallons of additional fuel.

3. Refueled from the single point pressure refueling station.

(c) Can be used for self-sustainment or Forward Area Refueling Point (FARP) operations.

2. Learning Step/Activity 2− Describe the operational characteristics and components, of the Fuel Tanks.

a. Six pods are attached to the fuselage external walls.



(1) The pod structures are hinged by their lower edge and attached to the fuselage structure by bolts to provide rigid support.

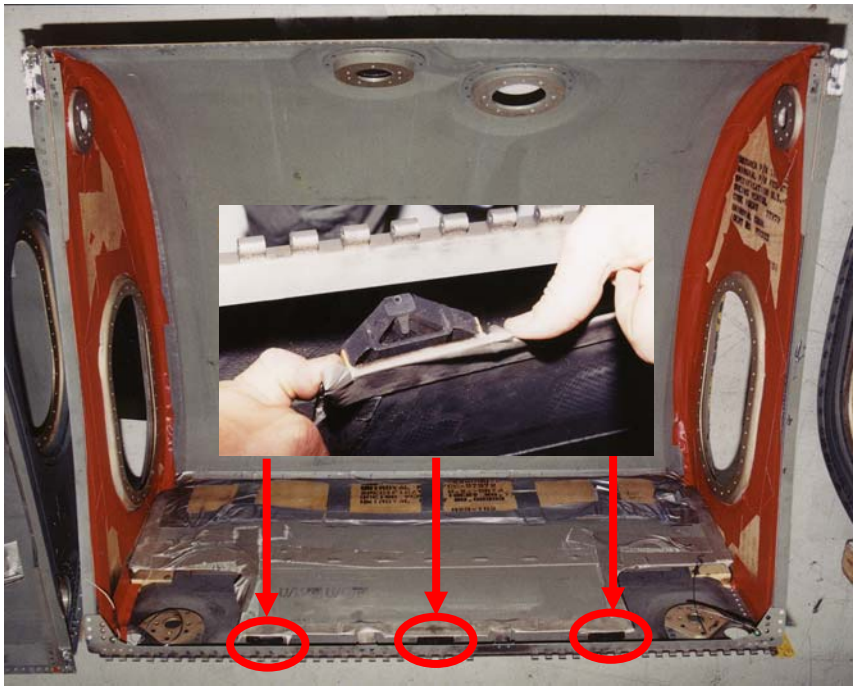
(2) The fuel pod skin is made up of a laminated honeycomb and fiberglass panel riveted to magnesium alloy bulkheads and stringers.

(3) The end bulkheads of each pod structure forms the fore and aft facing walls of the inter-tank end bays.

(4) Access panels are mounted externally to the pod on both ends for mounting the pump brackets and line connections.

(5) Inserted between the fuel pods, cells, and fuselage are backing boards made of fiberglass honeycomb weave to minimize chaffing of the cells against the pods and fuselage.

(6) Isolation panels are installed at the bottom of the pods to minimize vibrations.



NOTE: The fuel cell isolators are similar to the isolators under the cabin flooring.

(7) The fuel pods are designed to break away from the helicopter during high "G" force impacts.

(a) The mounting bolts for the fuel pod are made of materials that will allow them to shear off releasing the pod from the airframe in a crash.

(b) The tank assembly is self sealing to prevent the fuel from spilling reducing the chance of a post crash fire.

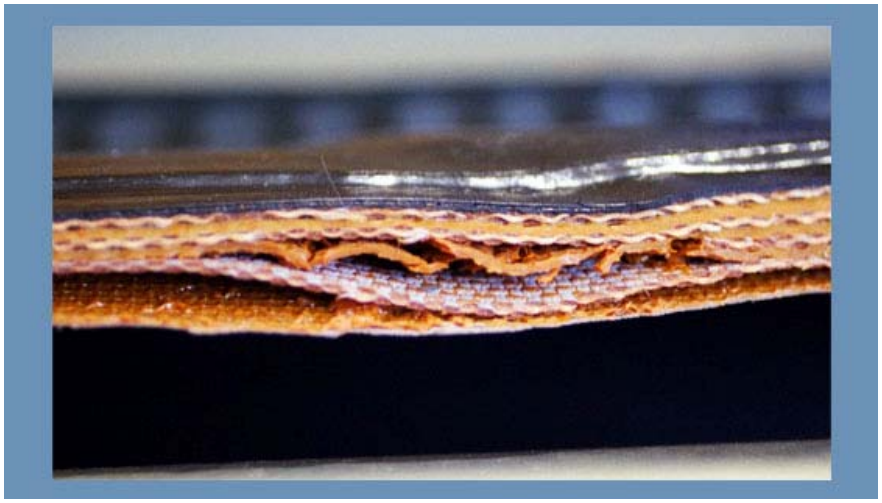
b. Cells are crashworthy, and self-sealing.

(1) Fuel cells are located in each pod.

(2) The cells are constructed of laminations of rubber and fabric with adapters and fittings bonded into the construction of the cell to provide for the mounting of internal components, access doors, and mounting clamps.

(3) They are secured in the pod by shear bolts that are threaded into the tank support from the pod exterior walls and the access panel mounting hardware.

(4) Each cell is self-sealing against up to a 50-caliber round. Penetration of the tank wall or fuel line by a projectile exposes the sealant to fuel, activating the sealant (un-vulcanized rubber) closing the hole(s).



(a) The self-sealing agent is located between the outside fabric liner and internal fabric liner.

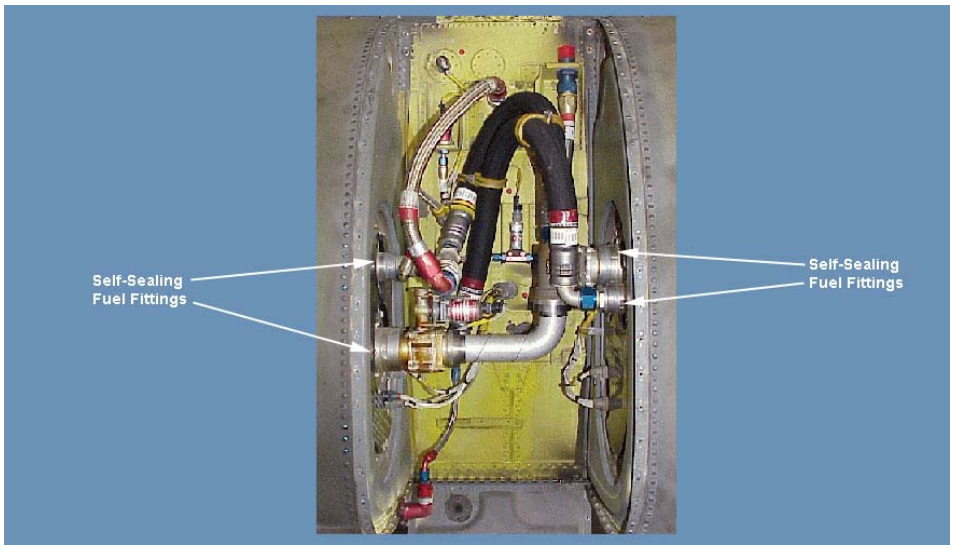
(b) When it comes in contact with fuel, it is designed to react and turn to gel, sealing the breach.

1. Some gel may be visible outside of the cell. This should appear green in color.

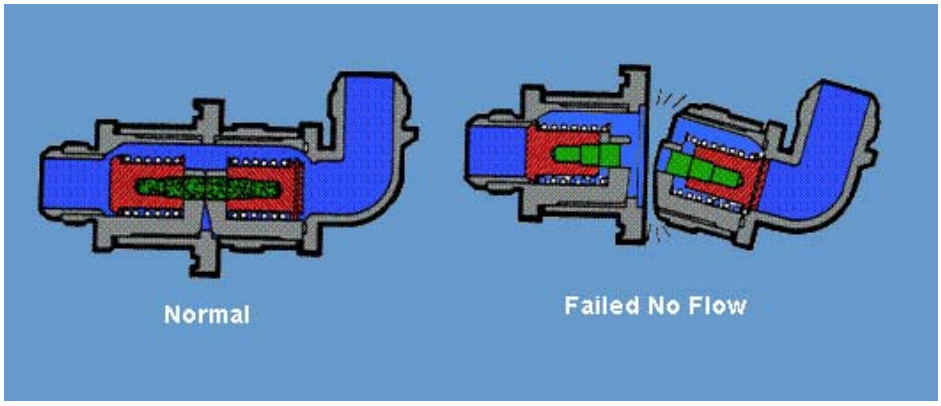
2. The reacted gel will be semi-soft at first, and then it will turn into a sponge-like substance.

NOTE: If the self sealing chemical is inadvertently activated and not noticed by maintenance personnel, the pilot will not notice any change in fuel quantity due to the design of the fuel quantity indicating system.

c. Break away fittings.



(1) Frangible (breakaway) fittings are located on all fuel lines that enter or exit the pod to minimize the likelihood of a post-crash fire.

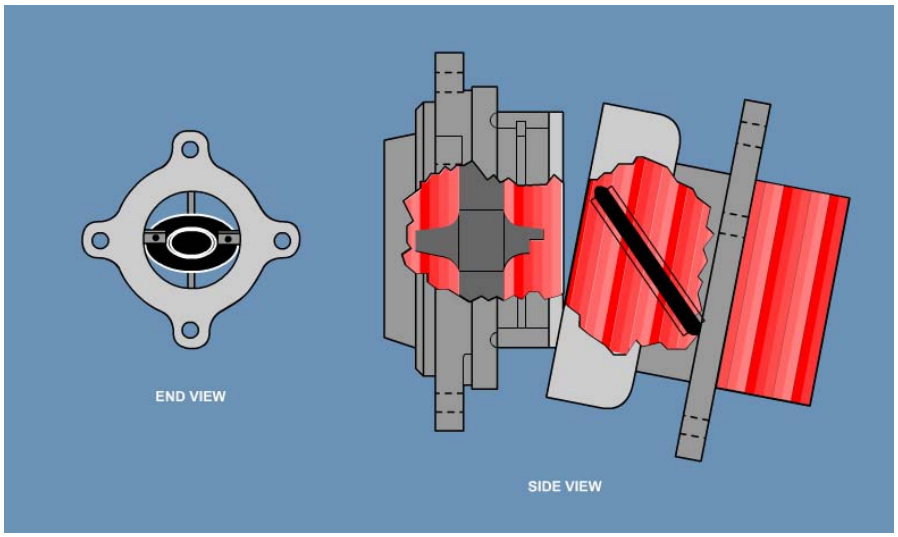


(2) Under high impact loads, the breakaway fittings will break at predetermined locations, seal themselves, and retain the fuel.

(a) They are mounted on the access panels that provide access to the interior of the cells.

(b) These fittings prevent fuel spillage if the pods break away during a crash sequence by automatically closing at the frangible point external of the pod and seal the fuel in the tanks and hoses.

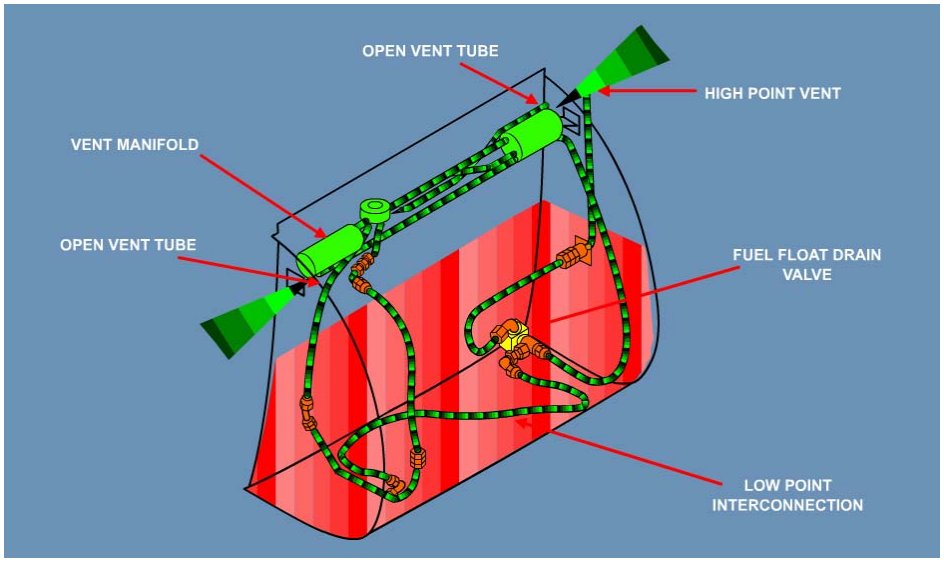
(c) The main tank, forward upper frangible fittings are captive fittings. These fittings seal both internal and external.



d. The electrical connectors from the airframe have "lanyards" attached to disconnect the cannon plugs during a high "G" force impact.

e. Roll-over vent system.

NOTE: The main and auxiliary tank vent manifolds are the same in construction with the exception that the main tank manifold tubing extends the vent boxes to each end of the cell and the slug trap is on the forward end of the unit.



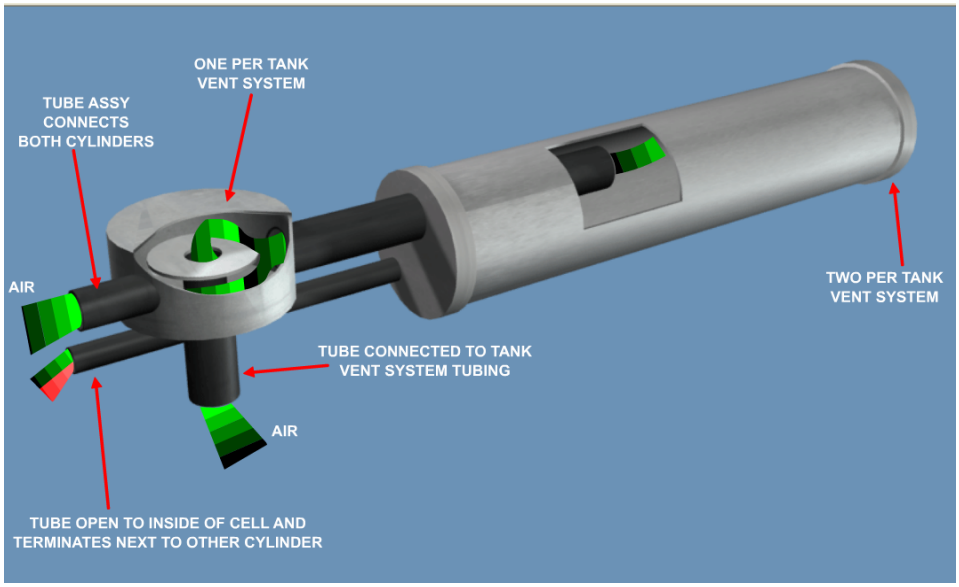
(1) A vent system made up of tubes and two vent boxes in each tank.

(a) The system allows outside air to enter or exit the cells during refuel and fuel usage.

(b) Vent manifold (vent boxes and slug traps):

1. The vent box allows air to vent in and out of the cells as fuel level changes.

2. The slug trap is in the system to prevent trapped fuel from entering the vent hoses and tubing.



NOTE: The system, by design, also prevents fuel from spilling in the event of a rollover.

(2) Sump drain valve.

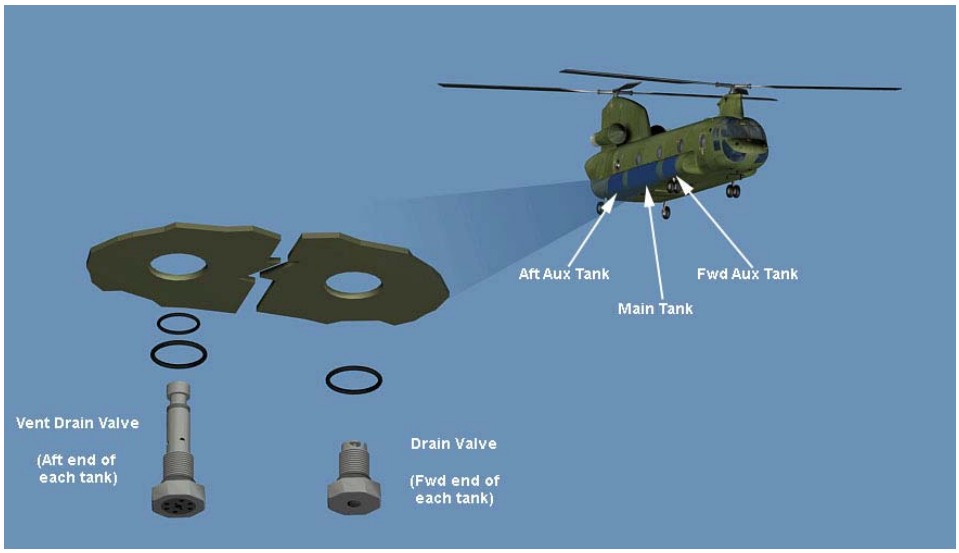
(a) Sump drains are installed in the forward bottom position.

(b) These valves are not part of the vent system

(c) They are used to drain the tanks to facilitate maintenance.

(d) Closed during water operations.

(3) Vents are installed at the top and bottom of each tank.



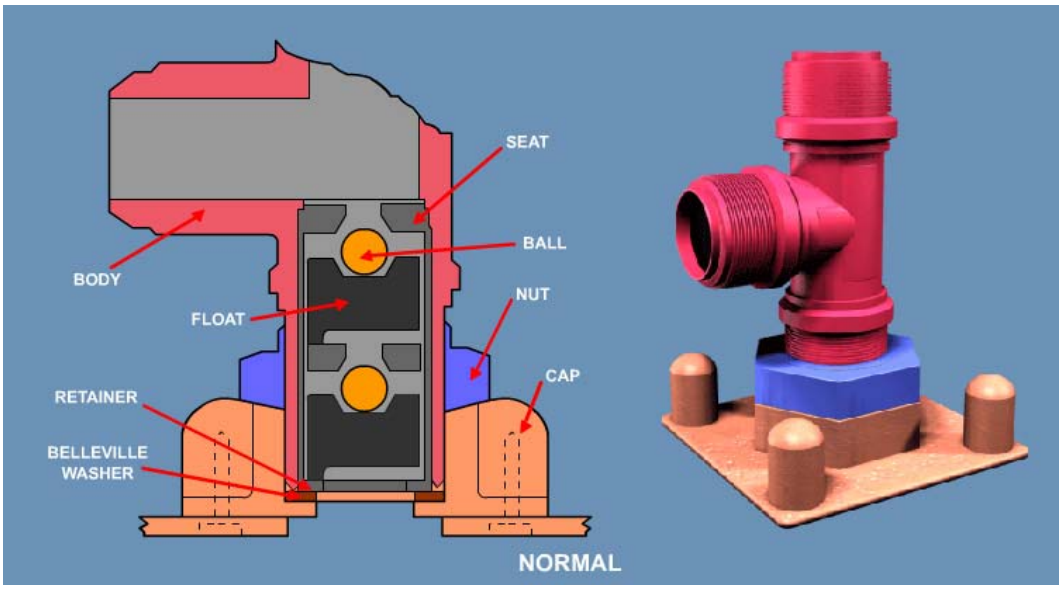
(a) The primary vents are:

1. Float/drain valve assemblies installed on the bottom aft end of each pod to allow venting of moisture, trapped fuel, and air during normal operation.

2. They have a maximum outlet capacity of 9 GPM.

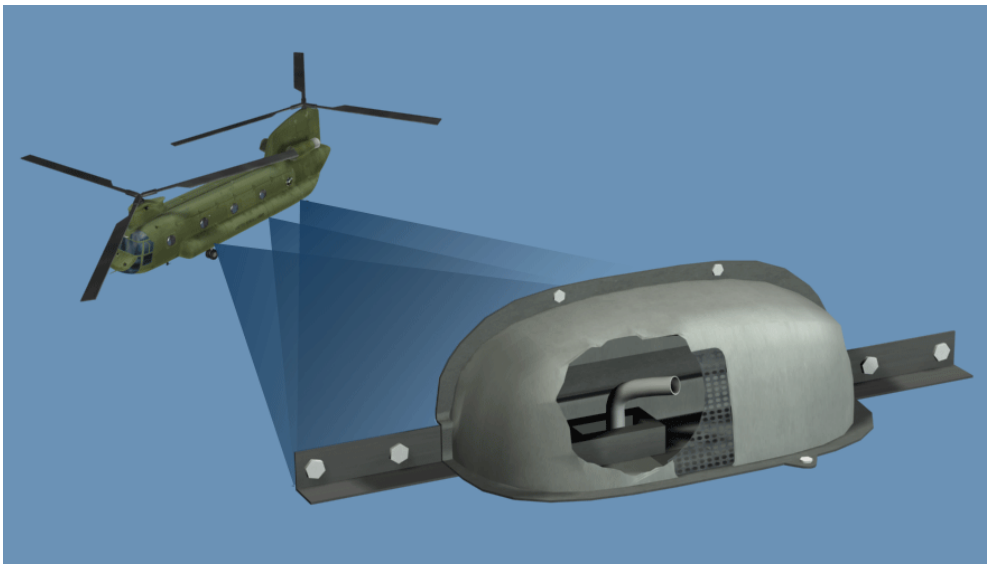
3. The vents are screwed into the body of the float housing.

4. When landing in water, the floats in the valve will move up, causing the plastic ball bearings to seal the drains.



NOTES: These drains can be used to drain the tanks to facilitate maintenance.

(b) The alternate vents are the high vent pipes on top of each pod.



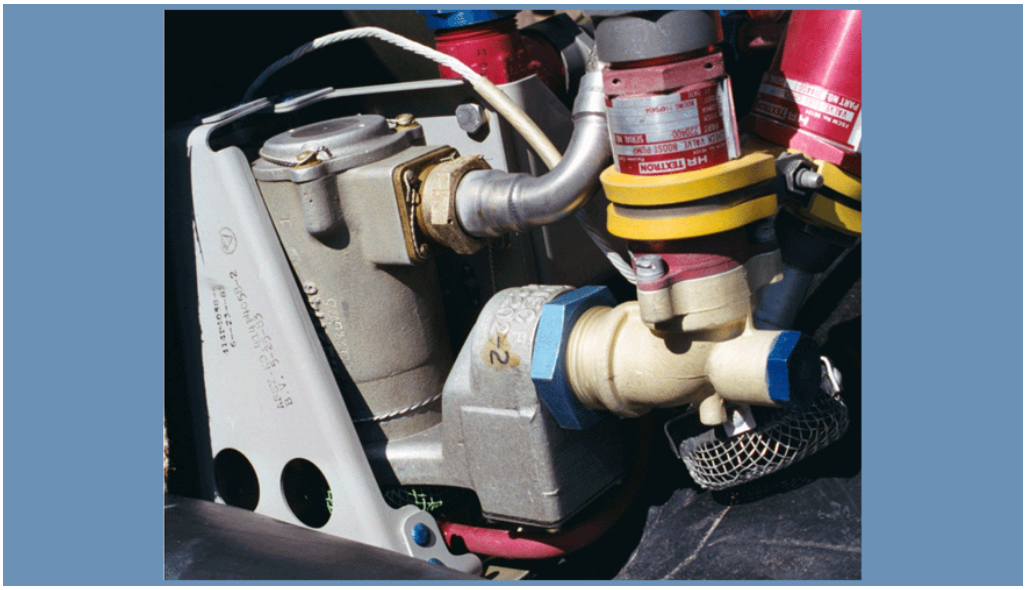
1. Vents are in the top of the tank with a fiberglass cover to prevent ice formation.

2. These become the ONLY vents during water landings or when the bottom vents are closed.

3. The high vent pipes will also vent fuel in the event the vents on the bottom of the pod exceed 9 GPM.

NOTE: The vent system is not capable to keep up with the fuel pumps if the high level shutoff valves fail. This situation will result in main tank over-pressurization.

e. Fuel boost pumps.



(1) There is one pump in each auxiliary tank, and two pumps in each main tank.

(2) Each pump is single stage impeller type, providing at least 22 PSI.

(3) The function of the main tank boost pumps is to provide positive fuel pressure to the engines. The forward pumps in the main tanks are also used to evacuate the pressure refueling manifolds and crossover line through the operation of the jet pumps.

(4) The function of the auxiliary tank pumps is to transfer fuel to the main tanks.

NOTE: The fuel acts as a lubricant and cooling agent for the pumps.

(5) Electrical power.

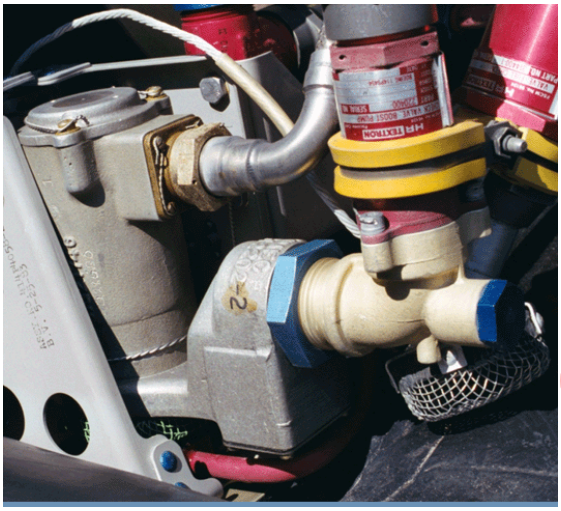
(a) Operated by 115/200 VAC through the LH or RH FUEL PUMPS circuit breaker.

1. Left system breakers are on the No.1 PDP.

2. Right system breakers are on the No.2 PDP.

(b) Controlled by 28 VDC through the LH or RH FUEL PUMP CONT circuit breakers on the No.1 and No.2 PDP.

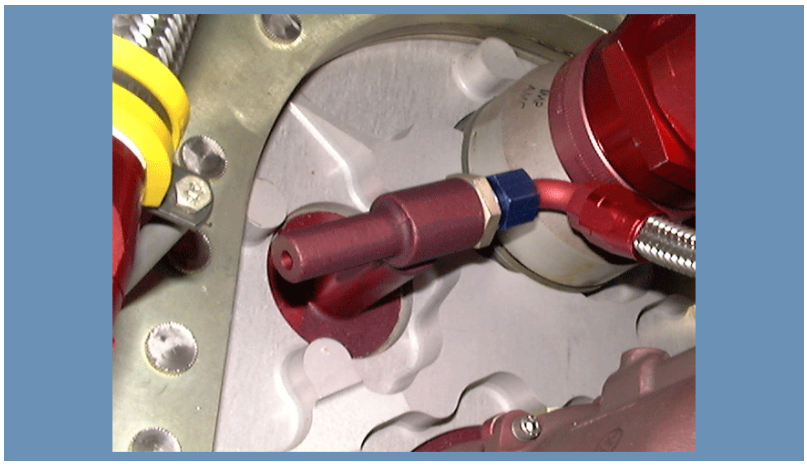
f. Bellmouth fitting.



(1) Located in each main tank at the aft end.

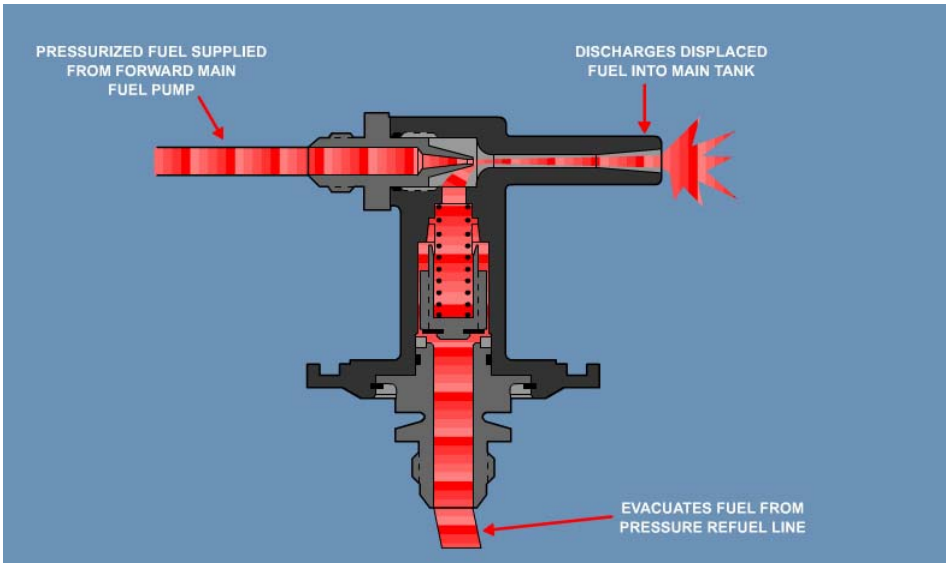
(2) Used to draw fuel out of the main tanks using the engine driven fuel pumps when the pumps in the main tanks fail.

g. Jet pump for evacuating the pressure refueling system.



(1) Installed internally on the forward left and right access panels of the main tanks.

(2) Operates on the Venturi principle.



(3) It is used to draw the fuel from the refuel crossover line and inter-tank manifolds after single point pressure refueling.

(4) As fuel is pumped by the main fuel pump, additional tubing is connected on a tee fitting from the fuel pump to the jet pump.

(5) Fuel pressure from the tank pump creates a venturi or vacuum effect in the jet pump drawing the fuel from the refuel crossover line and fuel manifolds between the forward and main tanks and depositing it in the main tanks.

(6) Pressure refueling line is not self-sealing.

(7) Operates when either main tank forward fuel boost pump is turned on.

h. Shutoff valve.

(1) Located on the forward end of each tank access panel.

(2) Pressure refueling shutoff valve allow fuel to enter the tank during.

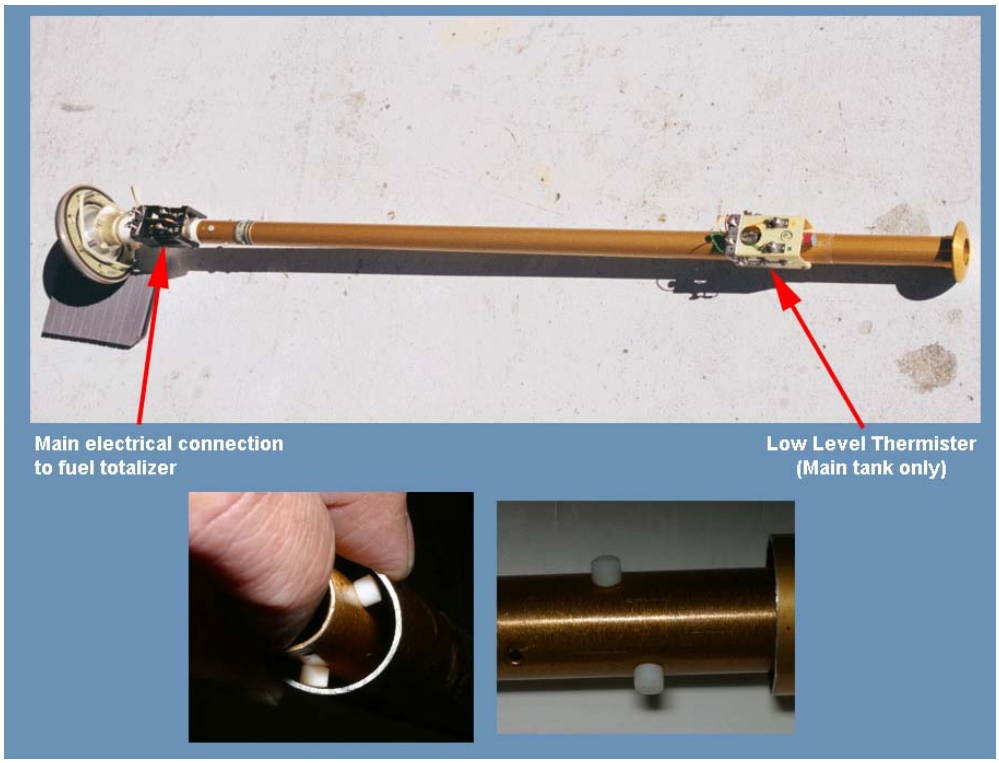
i. High level control valves.

(1) Located in the center of each tank near the over the wing filling port.

(2) Fuel level control valve controls the operation of the pressure refueling shutoff valve.

NOTE: Shutoff and high level control valves will be discussed during the pressure refueling LSA of the lesson.

j. Fuel quantity probes.



(1) Three fuel quantity probes are in each main tank.

(2) One fuel quantity probe is in each auxiliary tank.

(3) Capacitance type.

(4) The probes provide signals to the fuel quantity indicating system through the switch box.

(a) They are constructed of two cylindrical tubes, one inside and insulated from the other, to form a capacitor.

(b) The air and fuel act as the dielectric (conductor) and the capacitance changes as the fuel level in the tank changes.

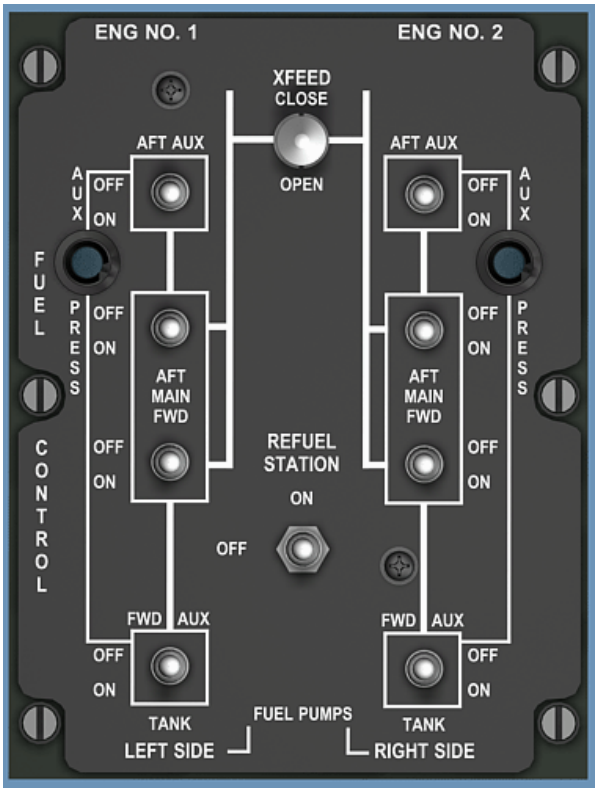
(c) This change causes an imbalance in the capacitance bridge circuit in the gauge and the indicator is driven until circuit is balanced.

(d) The center probe has a thermistor unit mounted at the bottom to send an indication of low fuel to the thermistor control unit behind the canted console in the cockpit. Power for the thermistor control unit is provided by the No.1 DC bus.

(e) When approximately 20% of fuel is remaining 320 to 420 Lbs, the thermistor control unit illuminates the left or right fuel low caution lights.

(f) Electrically connected to the cockpit fuel quantity indicator.

3. Learning Step/Activity 3−Describe the operational characteristics and airframe mounted components for the fuel system.



a. Fuel control panel. Located on the overhead panel.

(1) FUEL PUMP switches.

(a) Allows for pilot control for each fuel boost pump.

(b) Two position switches

(c) LEFT and RIGHT side.

(d) One switch for each Aux tank pump (one per tank), and one switch for each main tank pump (2 per tank).

(2) AUX PRESS indicating lights.

(a) Indicate that one or both auxiliary fuel pumps are producing less than 10 PSI.

(b) Indicates that the pump has failed or the tank is empty.

(b) The fuel pump switch must be on to provide electrical power.

(3) REFUELING STATION switch supplies 28 VDC to the refuel station control panel when turned on.

(4) XFEED switch controls operation of the crossfeed valves.

b. Fuel pump relays:

(a) The fuel pump control relays are located in two relay boxes mounted in the cabin, left and right sides at Sta. 340.

1. The relay boxes are bolted to the airframe. This attachment to the airframe is the electrical ground for the relays.

2. The function of each relay is to control application of AC power to the pumps.

NOTE: All of the boost pump relays are controlled by the fuel pump switches with 28 VDC. Each relay supplies its respective pump with 115 VAC, three phase, for operation.

3. The auxiliary pump relays are controlled by thermistor control units, mounted externally on the top of each relay box, and two thermistors mounted on each auxiliary pump mounting bracket.

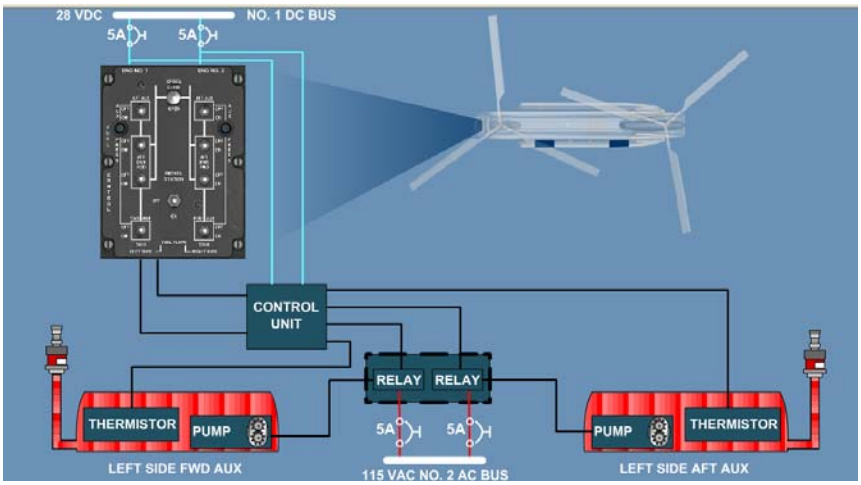
(b) Selecting a main tank pump switch to ON:

1. Supplies 28 VDC to the respective pump relay.

2. The relay then closes, sending AC power to that pump.

NOTE: If in the event one boost pump fails, an in-line check valve above that pump closes to prevent reverse flow or air to be drawn into the engine supply line. If both pumps in one tank fail, fuel is drawn from that tank by the engine driven fuel pump through a separate fitting connected in-line above the aft pump, commonly called the bellmouth fitting.

(c) Selecting an auxiliary pump switch to ON:

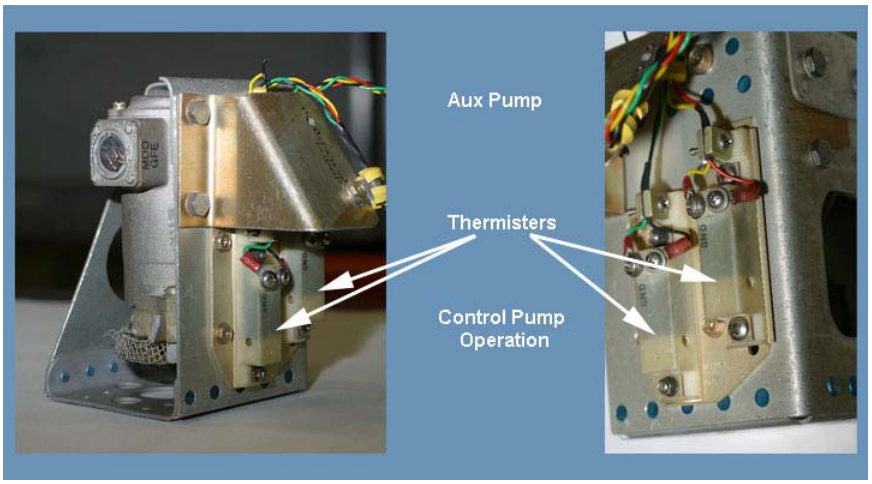


1. Supplies DC power to the respective fuel pump thermistor control unit.

NOTE: The thermistor control unit is connected to the thermistors mounted on the auxiliary pump brackets.

2. With fuel in the selected tank, covering both thermistors on the pump mounting bracket, DC power is then sent to the respective relay through the thermistor control unit.

    a. Two thermistors are used to control the pump operation.



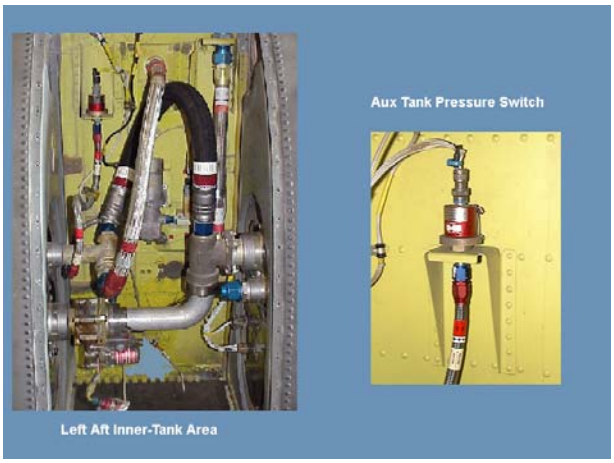
    b. When the lower thermistor is uncovered, pump shuts off.

    c. When the upper thermistor is covered, pump turns on.

3. The relay then closes, supplying AC power to that pump.

NOTE: When an auxiliary tank empties, and the thermistors on that pump mounting bracket become uncovered, DC power is interrupted to the pump relay through the thermistor control unit. This in turn removes AC power from the pump. In order for the pump to turn on again, fuel must cover both thermistors on the pump mount bracket.

b. Fuel pressure switches.



(1) The switches are diaphragm/contact types.

(a) Fuel pressure enters the bottom port, pressing the diaphragm up.

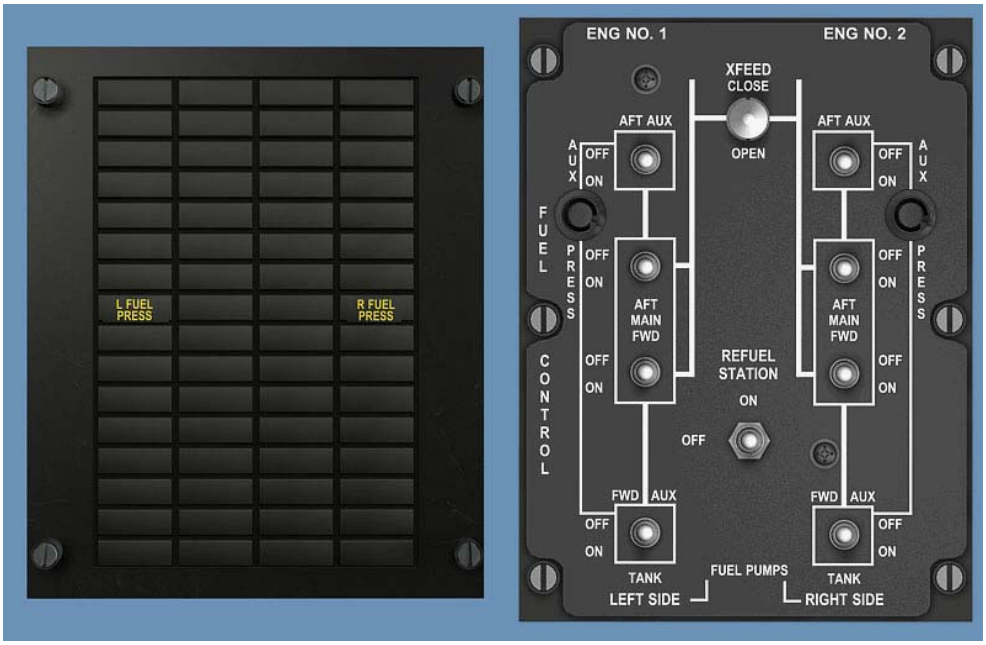
(b) When the diaphragm moves up the contact opens, removing the ground, turning off the appropriate light.

NOTE: Power for the main pressure switches is supplied by the essential DC bus through the caution panel L or R FUEL PRESS caution lights.

(2) The main tank pressure switches are mounted on the manifolds with the engine and crossfeed fuel valves.

(3) The auxiliary tank pressure switches are in the inner-tank areas. They sense fuel pressure in the supply line leading to the main tanks

(4) Indicate that both fuel boost pumps in the associated main tank is producing less than 10 PSI.



c. Crossfeed fuel valves.

(1) There is one located at each end of the crossfeed fuel line on the left and right side of aft cabin area, Sta. 498.

(2) These valves enable fuel to be supplied from either or both systems to either or both engines.

(3) Two valves are installed to trap fuel between the engine fuel manifolds to prevent fuel starvation of one engine in the event that that side fuel pumps fail.

(4) They isolate the crossfeed line from both systems.

(5) 28 VDC Electrical power is provided from the No.1 DC bus through the XFEED CONT circuit breaker.

(6) Manually controlled by a crewmember if electrical power is not available.

(7) Warning lights.

(a) Illuminate when the valve is cycling between open and closed positions.

(b) Should be out when the valve is fully open or closed.

(c) If light is ON when the valve is OPEN.

1. A fault in the electrical circuit exists, requires a −13 entry.

2. Valve position and switch position do not match.

3. Valves are in transition, opening or closing.

d. Engine fuel valves.

(1) Controlled by FIRE PULL-FUEL SHUTOFF handle on the center instrument panel.

NOTE: Pulling the handle also arms the fire extinguisher switch.

(2) The engine fuel shutoff valves are installed in the main supply lines to each engine, in the ramp area, mounted on the engine fuel manifolds at Sta. 498.

(3) They isolate the airframe fuel system from the engine(s) during certain emergencies.

(4) Power is from 28 VDC essential bus, through the ENGINE FUEL SHUTOFF No.1 and No.2 circuit breakers.

(a) Handle out, the valve is closed.

(b) Handle in, the valve is open.

(5) The fuel valves can be manually operated by a crewmember in the back.

(6) Warning lights, operate like the crossfeed fuel valve lights.

NOTE: Both the engine fuel valves and crossfeed fuel vales incorporate a thermal relief feature to allow fuel to flow back into the main tanks.

e. Fuel check valves, mounted in-line before the engine fuel shutoff valves.

(1) The valves prevent reverse flow from the engines during normal operation if fuel supply is greater than engine demand, and to prevent fuel transfer from one side top another if a side's fuel pumps are off and the crossfeed valves are open.

(2) During static times (non-operational) the check valves incorporate a thermal relief feature to allow fuel to flow back into the main tanks through the bellmouth fittings before the temperature in the line from the check valve to the engine reaches a point where the line could rupture due to fuel expansion.

g. Fuel quantity indicator.

(1) Electrically connected to capacitance type tank units in each tank. 115 VAC from the No.1 AC bus through the FUEL QTY circuit breaker.

(2) Indicates the amount of fuel remaining in the tanks in pounds.

(a) The cockpit indicator receives power from the No.1 AC bus through the fuel quantity indicator switch box.

(b) The refuel station indicator is powered by the No.1 AC bus through the fuel quantity indicator switch box when AC power is applied to the helicopter.

(c) When AC power is removed, as in during single point (or cold) refueling, the refuel station indicator is provided 115 VAC by the inverter, which will be discussed later in this lesson.

(3) The total fuel indication is a digital readout that is constantly displayed when power is applied to the respective indicator.

(4) Individual tank readings are provided by the pointer.

(a) Indicates quantity in the individual tank selected by the selector switch.

(b) Hidden when the selector switch is at TOTAL.

(c) Will spin backwards if fuel selector switch is not placed in a tank detent

(d) The digital readout is not affected when an individual tank is selected.

(5) The indicator contains:

(a) Two servo amplifiers.

1. One for total, or digital, indication.

2. One for individual, or pointer, tank readout.

(b) Two servo motors.

1. One to drive the total indication for readout.

2. One to drive the pointer for individual tank readout.

(c) Elements of bridge circuits that work in conjunction with the tank probes and calibration potentiometer.

(d) Two calibration potentiometers that assist in balancing the readout circuits to give as accurate a reading as possible to the total or individual tank readouts.

(6) With the probes connected to the respective indicator, the servo motors drive the total or individual readout portion of the indicator to balance the capacitance bridge circuit.

NOTE: If the selector switch is placed in between detents the indicators could display a counter-clockwise rotation of the pointer and the digital readout reading a rapid reduction in fuel on board. This is due to the bridge circuit and calibration potentiometers not being able to balance the circuits in the indicator to give an accurate reading.

f. Fuel selector switch.

(1) The fuel quantity selector switch is a seven position switch.

(2) The cockpit selector switch is powered by the No.1 AC bus.

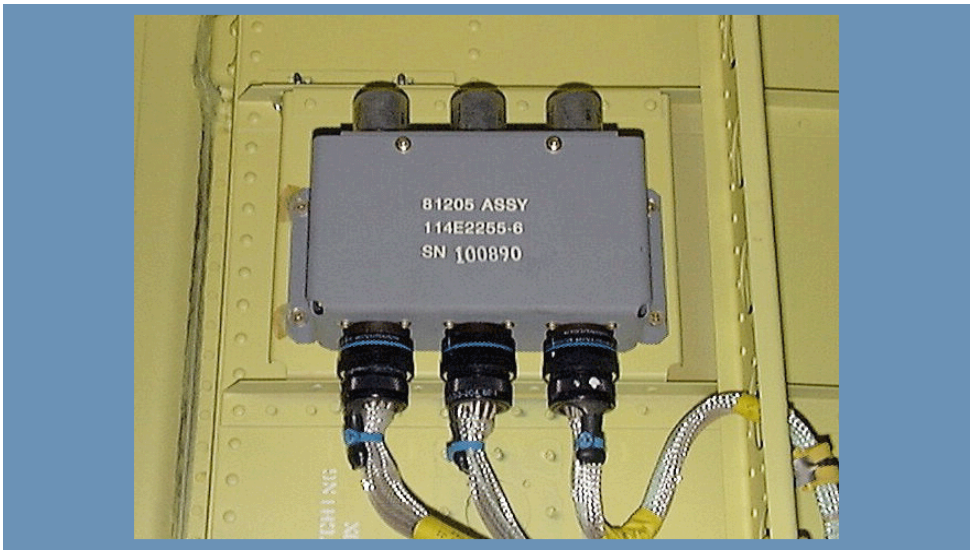
(3) Both selector switches receive information from all ten probes.

(4) When power is applied, the total signal is connected to the digital readout of the indicator.

(a) When the selector switch is in TOTAL, the digital readout displays total fuel on board and the pointer remains behind the mask.

(b) When any of the individual tank positions are selected, that tanks' fuel reading is connected to the pointer of the indicator; the digital readout should remain constant.

g. The fuel quantity indicator switch box is located at Sta.232 overhead in the cabin.



(1) The box includes three relays and three receptacles for connection to the airframe wiring.

(2) Fuel quantity electrical signals from the ten probes are connected to the switch box.

(a) If the refuel station switch on the overhead panel and the refuel panel power switch are OFF, the signals are connected to the cockpit fuel quantity selector switch.

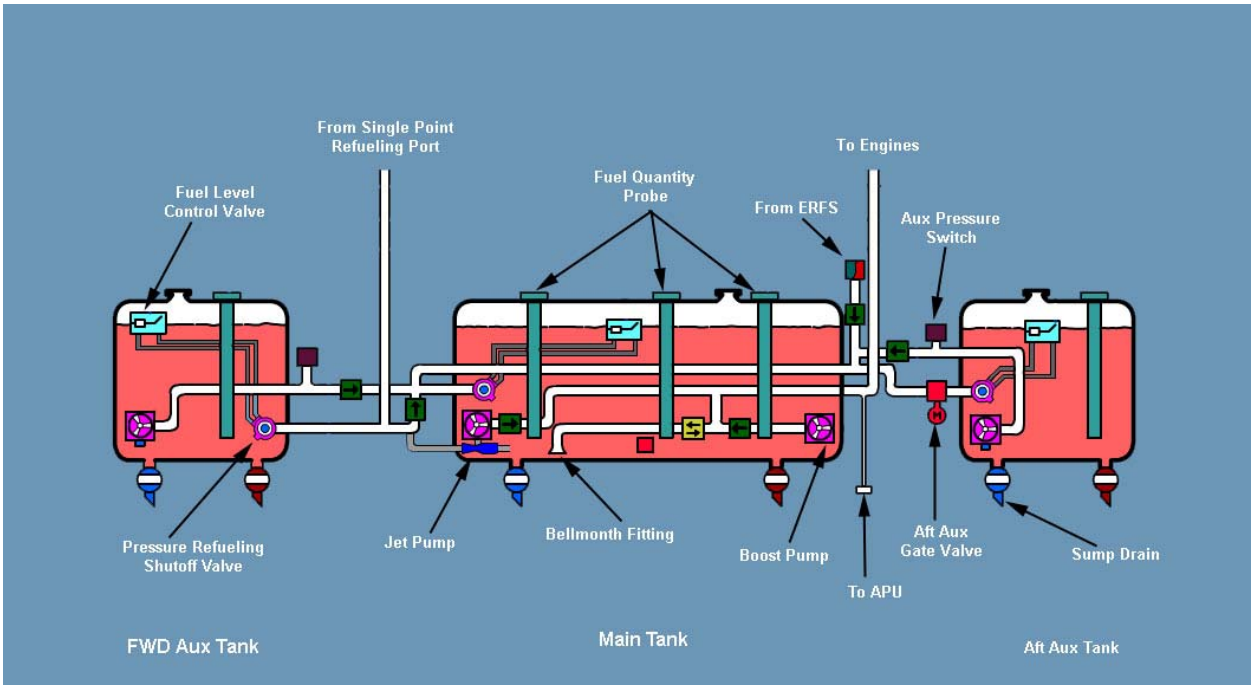
(b) When the cockpit and refuel station switches are ON, 28 VDC is connected to the switch box and operates the relays.

(c) This connects the electrical fuel quantity signal to the refuel station selector switch.

NOTE: Turning off either switch de-energizes the relays and disconnects the switch box from the refuel panel.

4. Learning Step/Activity 4−Describe operational characteristics and components of Pressure Refueling.

a. Single point pressure refueling operation.



(1) The helicopter can be rapidly refueled, all tanks, in approximately 4 minutes.

(a) Fuel enters the pressure refueling adapter, the right refuel manifold, and enters the right forward auxiliary tank through the lower breakaway fitting on the aft access door to that tank.

(b) Fuel enters the right main tank through the bottom orifice of each manifold.

1. The top orifice of the manifold is connected to a tube which runs through the main tank.

2. The bottom orifice of the manifold has an internal flapper valve to prevent reverse

fuel flow during normal transfer from the aft auxiliary tanks to the mains.

3. The fuel exits the top orifice, and supplies fuel to the aft auxiliary tank through the bottom breakaway fitting on the forward end of the aft tank.

(c) As fuel is being delivered to the right tanks through the right refuel manifold, fuel is transferred to the left tanks through the refuel crossover line, routed under the cabin floor, via the left refuel manifold.

(d) Fuel enters the left side tanks the same manner as the right side tanks.

(2) 300 GPM flow at a maximum of 55 PSI.

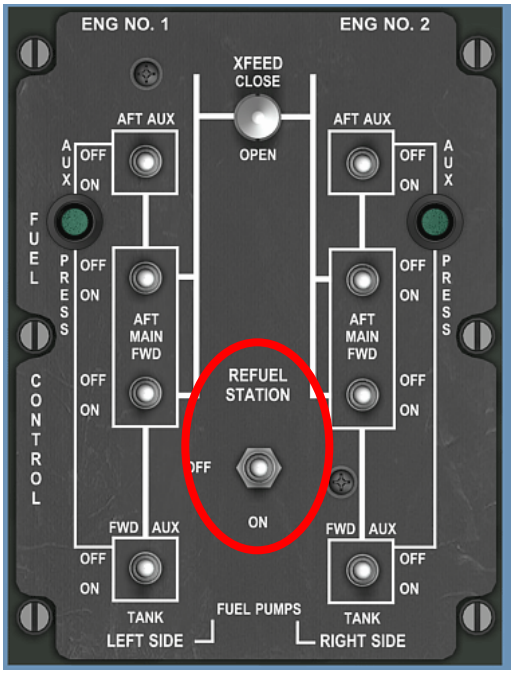
(3) Electrical power is from the 28 VDC switched battery bus through the REFUEL circuit breaker on the No.1 PDP.

(4) The battery switch does not need to be on.

NOTE: If the aircraft is not going to be operated after pressure refueling one boost pump in either main tank must be operated for a minimum of two minutes to evacuate the pressure refueling lines.

b. Components

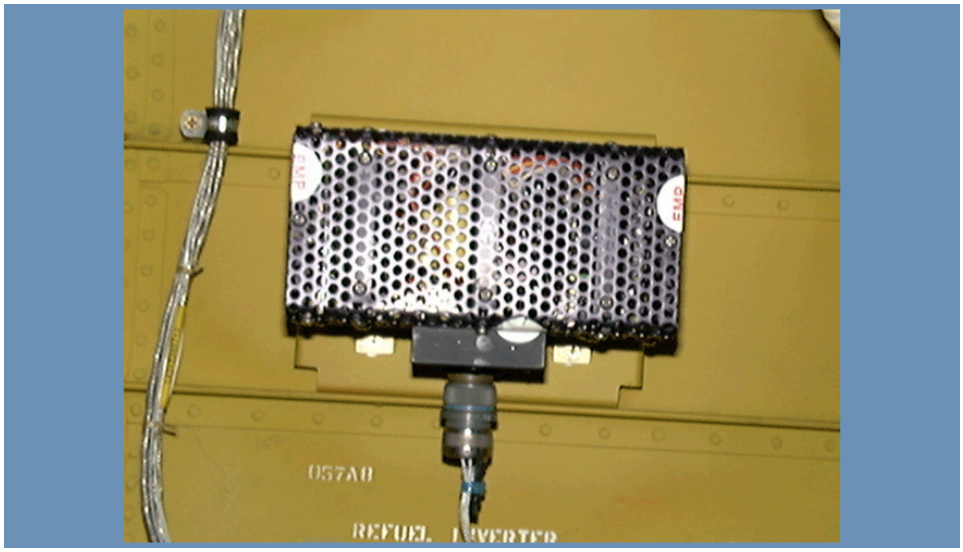
(1) REFUEL STA switch.



(a) Located on the fuel control panel on the overhead in the cockpit.

(b) Controls power to the pressure refueling station.

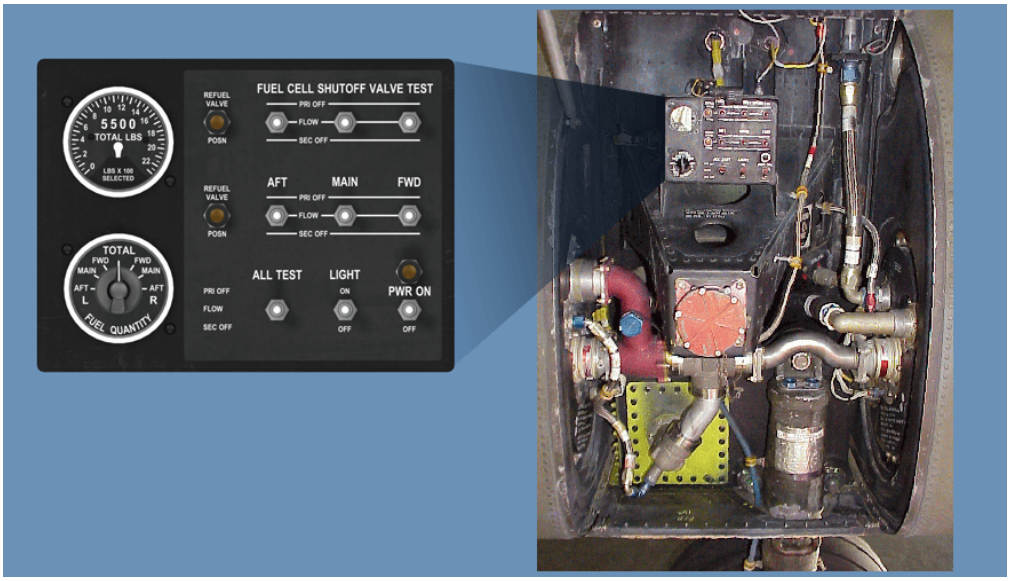
(2) The refuel station panel indicator receives power from a solid state inverter.



(a) The inverter is located at Sta. 283 right side, just above the seat back support pole.

(b) It is powered by 28 VDC from the battery bus through the refuel circuit breaker on the No. 1 Power Distribution Panel (PDP), and inverts output power to 115 VAC to operate the refuel panel fuel quantity indicator.

(3) Pressure refueling station.



(a) Located in the right forward landing gear access.

(b) Controls and monitors the refueling operation.

(c) Contains:

1. PWR switch controls power to the refuel station and refueling valves.

NOTE: The pressure refueling station fuel quantity indicator and selector switch are identical to those in the cockpit. This indicator and selector switch will only operate when the refuel station switch on the cockpit fuel control panel is ON and the power switch on the refueling station panel is at POWER ON.

2. Fuel quantity indicator.

3. Fuel selector switch.

4. Refuel valve position indicating lights.

    a. Light should come on momentarily, and then go out when the PWR switch is turned ON or OFF. This indicates that the valve has opened or closed.

    b. The light will come on and remain on when the valve stops in transit due to the electrical circuit, valve relay, or motor becoming inoperative or the valve fails before completing the cycle.

    c. If the light does not come on momentarily when the PWR switch is turned ON, aft auxiliary tanks will not refuel.

    d. If the light does not come on momentarily when the PWR switch is turned OFF, aft auxiliary tanks fuel is not usable.

5. FUEL CELL SHUTOFF VALVE TEST switches.

    a. There are seven, three position high level fuel shutoff valve test switches on the refuel station control panel.

NOTE: Six switches electrically control individual tank floats, and are marked “PRI OFF”, “FLOW”, and “SEC OFF”. The seventh switch, titled “ALLTEST”, is marked the same as the individual tank switches, electrically controlling all tank floats.

    b. Controls the dual fuel level control valves electrically (solenoid valves).

c. Used to test the automatic shutoff feature in each tank.

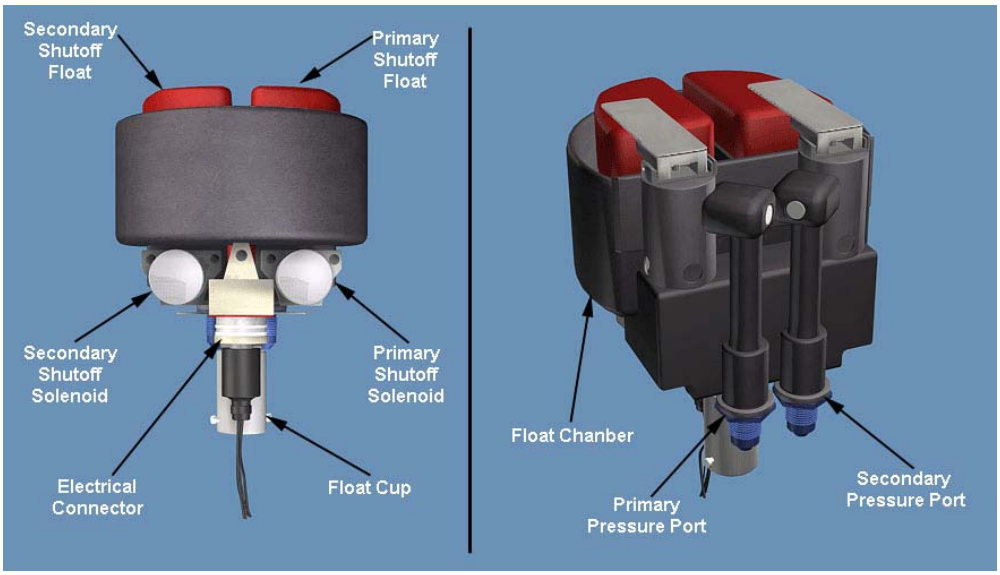
d. Used to stop refueling when the desired fuel level is attained in individual tanks.

e. Should stop the fuel flow when moved to PRI OFF or SEC OFF within 4 seconds.

NOTE: The pressure refueling system allows the helicopter to be completely refueled in about 4 minutes with fuel supplied at 300 GPM at 55 PSI.

(4) D-1 nozzle receptacle is located in the right forward landing gear access.

(5) Dual fuel level control valves (floats).



(a) There are six high level shutoff valves, located inside of each tank near the top.

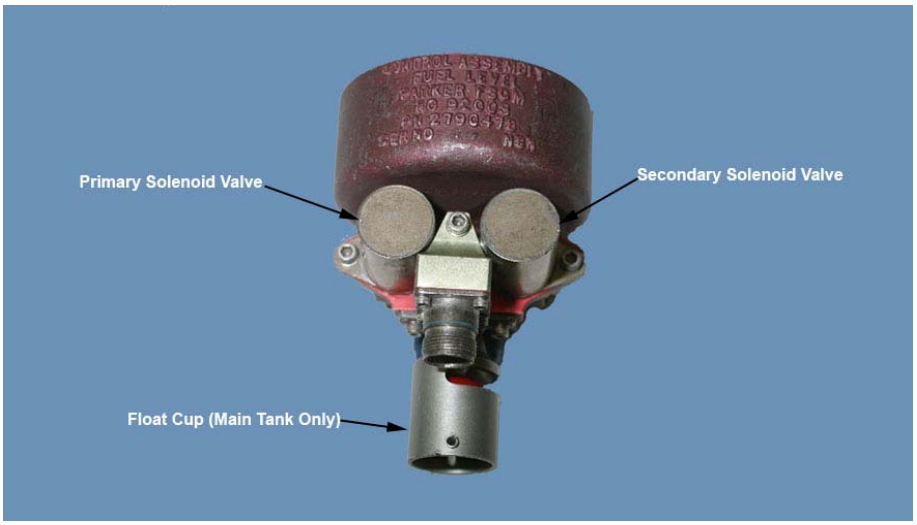
(b) They provide a means of shutting off fuel flow during single point refueling when the tank fills to the desired level, either automatically or with the shutoff valve test switches. This prevents fuel cell over-pressurization, or provides the pilot with fuel/weight management

(c) Controls the opening and closing of the dual shutoff valve.

(d) Contains:

1. Two floats that can be raised by fuel level or a solenoid valve.

2. Two solenoid valves.



a. Controlled by the FUEL CELL SHUTOFF VALVE TEST switches on the refueling panel.

b. Primary and secondary solenoid valves

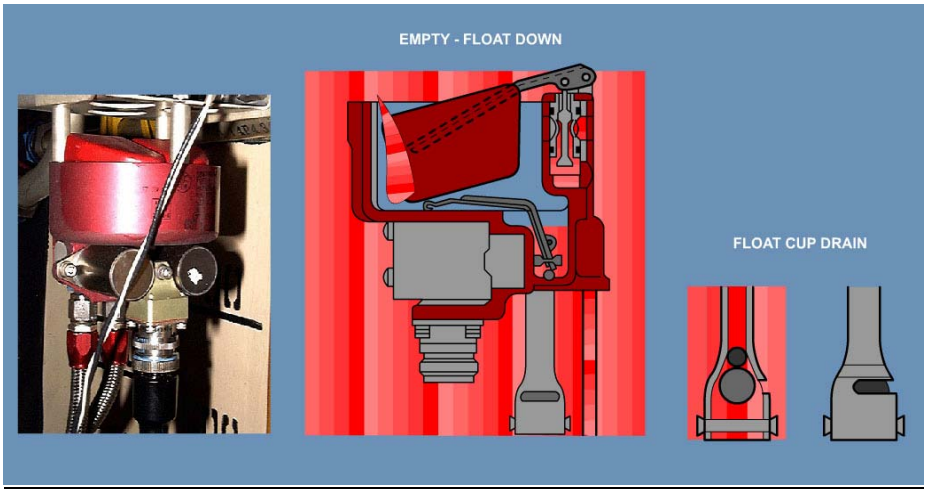
c. Mechanically lift float simulating high fuel level.

3. Two control valves.

a. When float is down, a small amount of the fuel flows into the tank.

b. When float is up, fuel flow is stopped creating a back pressure to the dual fuel shutoff valve.

4. Float cup, Main Tanks only.

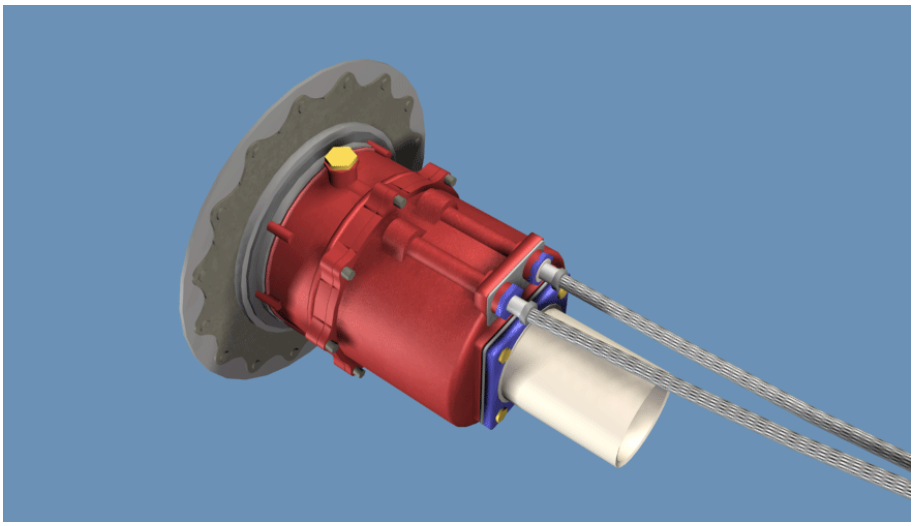


a. The extension has a float/ball bearing assembly internally to keep the cup full to prevent fuel from entering the main tanks when they are full. This occurs at approximately 1800+ 50 lbs of fuel.

b. When the fuel level in the tank lowers, the cup empties, the float in the

extension drops, opening the plunger type valve, allowing fuel to enter that tank. This occurs at approximately 1650+ 50 lbs of fuel.

(6) Dual fuel shutoff valves.



(a) Located on the forward end of each tank on the tank access panel.

(b) The pressure refueling shutoff valves are connected to the high level shutoff valves by way of two independent sense tubes.

(c) Each valve has a primary and secondary port.

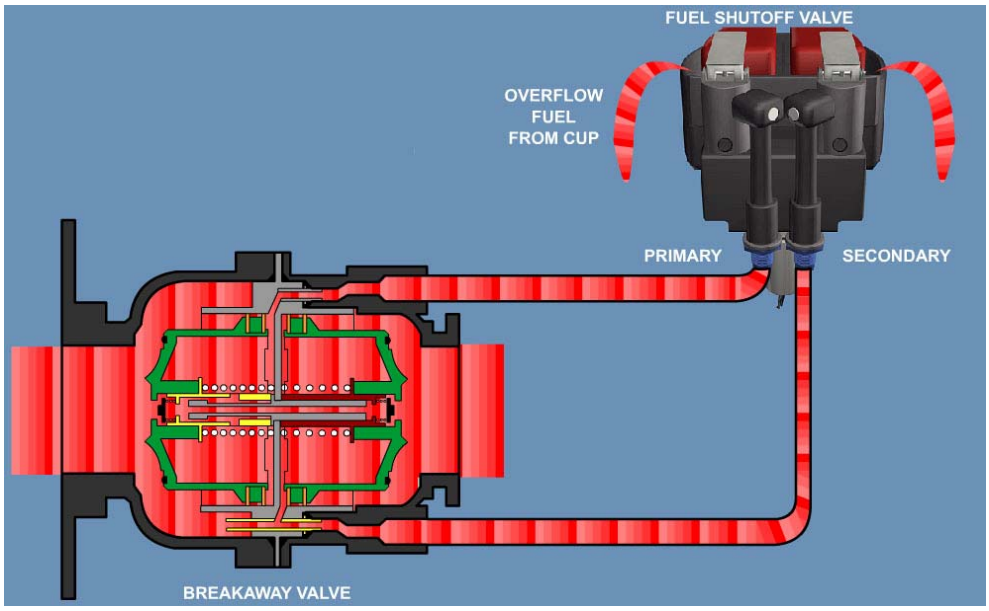
(d) During pressure refueling, or fuel transfer to the main tanks during normal operation, the fuel pressure forces the shutoff valve ports open, allowing fuel to transfer to that respective tank.

(e) Fuel travels through the sense tubes to the high level shutoff valves.

(f) While the floats are down, fuel does not remain in the high level float cups.

(g) When the tank fuel level reaches the high level shutoff valve and lifts the floats, the floats close a plunger type valve in the high level valve body.

NOTE: The high level shutoff valve works similar to a toilet tank or carburetor float bowl.



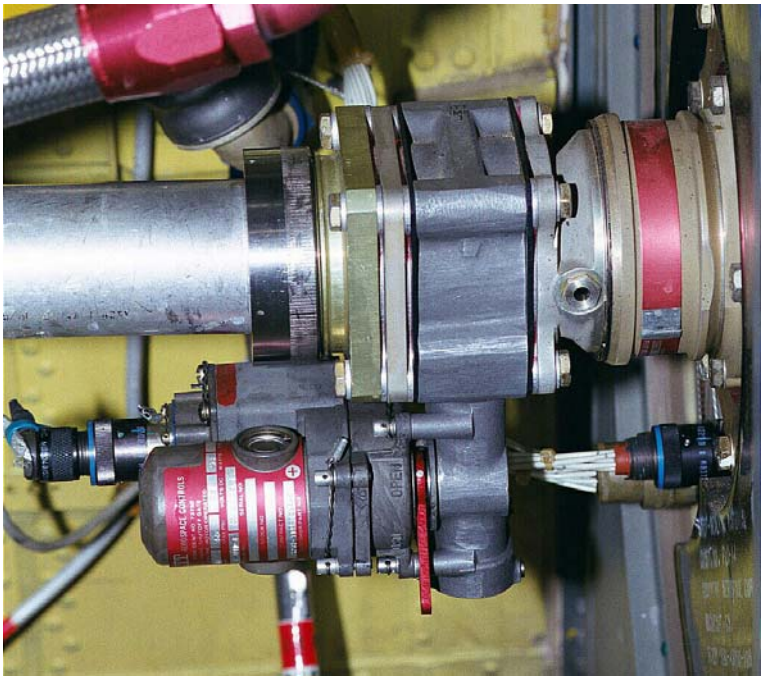
(h) When that high level valve is closed, back pressure through the sense tubes overrides the fuel pressure going into the tank, closing the primary and/or secondary ports, stopping fuel from entering that tank.

(i) Controlled by the dual fuel level control valve.

1. Main tank: Shutoff fuel from coming in from refueling or transferring in from the auxiliary tanks.

2. Aux tank: Shutoff fuel from coming in during refueling.

(7) Refueling valve.



(a) Located in the right and left aft inner tank areas.

(b) When closed, prevents feedback into the aft auxiliary tanks during fuel transfer.

(c) When open, allows aft auxiliary tanks to be refueled.

(d) Controlled by the refuel station PWR switch on the refuel panel.

(e) Indicating lights on refueling panel indicate when the valve has opened or closed.

(f) The valves may be closed using the manual handle.

CAUTION: Be sure the refuel station operating before pressure fueling. If the station is not operating, the fuel shutoff valves cannot be checked properly and fuel cell over-pressurization may result.

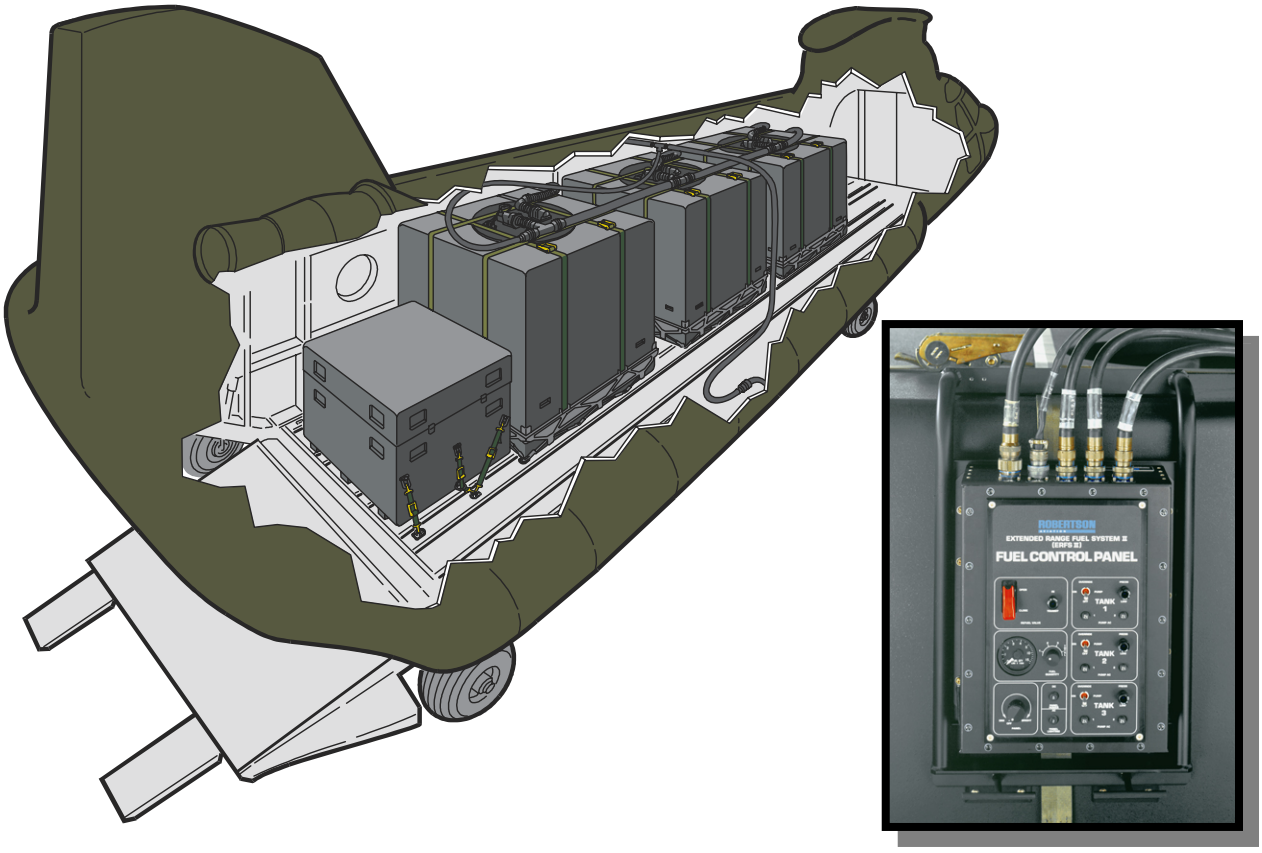
c. Defuel Valve

(1) Located on the right side of the ramp Sta.507.

(2) Used to defuel the helicopter using the pumps and crossfeed fuel line.

5. Learning Step/Activity 5−Describe operational characteristics and components of ERFS II

a. The Extended Range Fuel System II (ERFS II) as configured and installed in the helicopter is a crashworthy, ballistically self-sealing, internal auxiliary fuel tank system designed to provide a safe and convenient means of increasing the range and endurance of the and transporting fuel for forward area refueling operations.



b. The ERFS II consists of five major functional components.

(1) Tank assembly in which 1, 2 or 3 tanks can be installed in the helicopter.

(a) The tank consists of:

1. Outer container is an aluminum honeycomb and fiberglass shell that provides protection and support for the bladder.

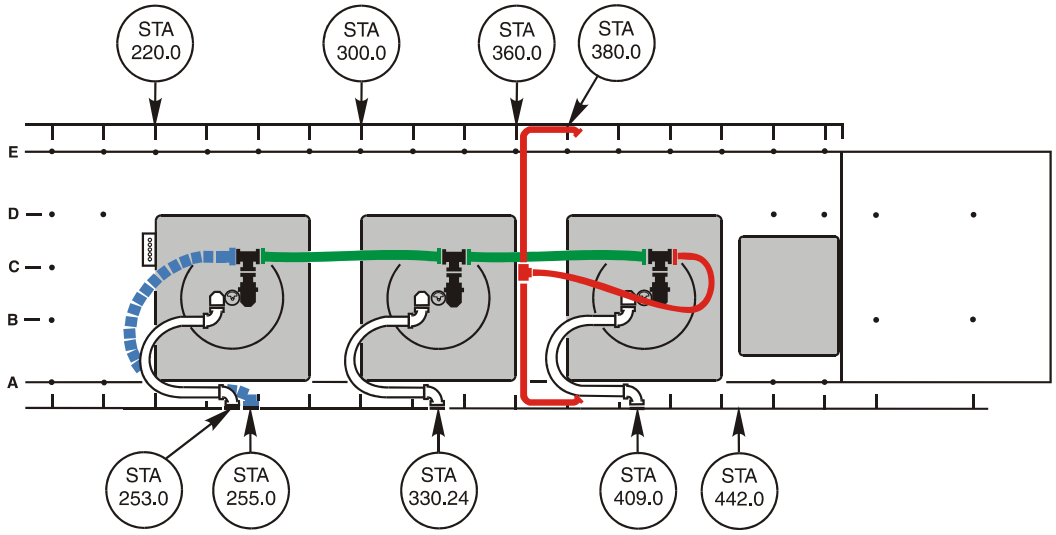
2. Internal crashworthy, ballistically self-sealing bladder is made of rubberized cloth.

3. Column assembly is the primary operating element of the tank.

   a. All "in-tank" components, i.e., pumps, valves, switches, sensors, electrical harnesses and hoses, are attached to the column assembly.

   b. When assembled with the container and bladder, the column assembly seals the tank.

4. Vent hose connects between the vent breakaway valve on top of the tank and one of three vent fittings mounted in the left side of the helicopter fuselage.



a. This hose vents fuel vapor overboard and provides vent air to the tank during normal operations.

b. The hose will also vent fuel overboard in case of a high-level shutoff valve failure during single-point pressure refueling operations.

5. Grounding cable provides a means of dissipating any static or EMI-induced charge from the tank into the helicopter ground.

(b) The empty weight is approximately 600 pounds.

(c) Capacity of approximately 800 US gallons.

(2) Restraint System is used to safely secure each ERFS II tank into the helicopter cargo compartment.

(a) The restraint system It consists of a rectangular aluminum restraint frame assembly and a system of adjustable polyester straps that encircle the tank.

(b) The restraint frame assembly attaches to the tie-down rings in the helicopter cargo floor to provide longitudinal, lateral, and vertical restraint.

(c) With the tank(s) one-half full of fuel, the restraint system is rated at 8 G's in the forward, vertical, and lateral directions, and greater than 3 G's aft.

(3) Fuel transfer hose kit is a configuration-variable collection of fuel hoses that, when connected; create the desired fuel transfer paths, or manifold, between the ERFS II tank(s), the helicopter main fuel system, and the FARE kit.

(a) The fuel transfer hose kit All fuel hoses are fabricated with self-sealing hose, and are equipped with either quick disconnect or sexless couplings.

(b) One fuel hose connects the ERFS II with the helicopter single-point pressure refueling connection. Another hose connects one tank with another.

(c) Two additional hoses interface the ERFS II tank(s) with the helicopter main fuel system.

(4) Fuel Control Panel provides the primary control for single-point pressure refueling of the ERFS II tanks, and the transfer of fuel from the ERFS II tanks into the helicopter main fuel tanks.

(a) The panel houses a refuel valve switch that actuates the ERFS II single-point pressure refueling valve, located in the helicopter forward left inter-tank bay, and an indicator light that illuminates when the valve is opening or closing.

(b) Transfer of fuel from each ERFS II tank may be individually controlled by its respective fuel transfer pump switch. These switches energize the dual fuel transfer pumps in each tank. Fuel transfer rates are approximately 23 GPM.

(c) Fuel quantity in each tank or total fuel in all tanks is displayed in pounds on a Night Vision Goggle (NVG) compatible fuel quantity gauge that is mounted in the control panel.

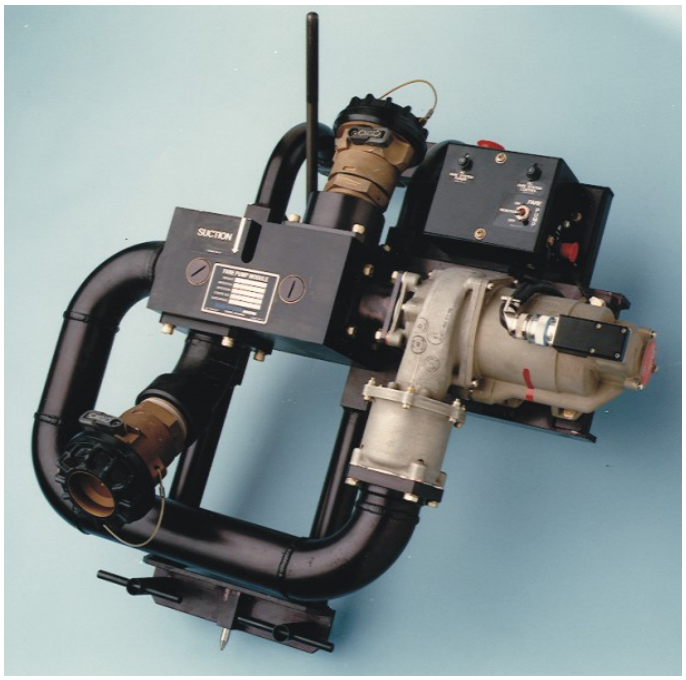
(d) Selection of individual tank fuel quantity or total system fuel quantity is via a fuel quantity selector switch.

(e) Panel lighting is controlled by a switch/rheostat.

(5) Forward Area Refueling Equipment (FARE) kit

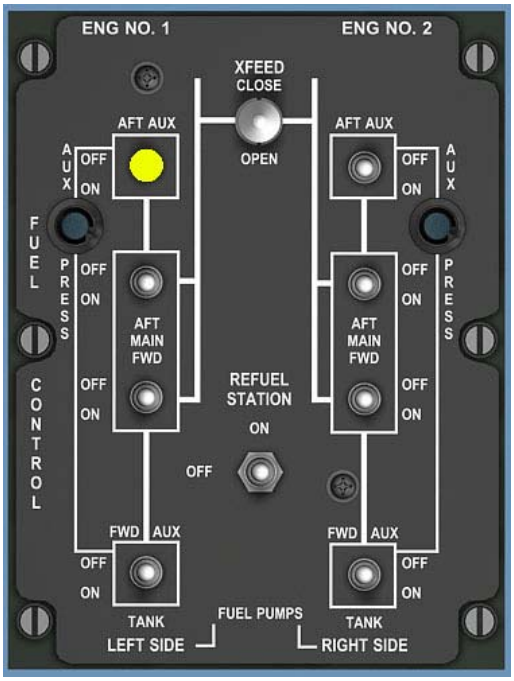
(a) Used to transfer fuel from the ERFS II tanks to other helicopter or combat weapons systems, or to defuel the ERFS II tanks.

(b) Consists of a FARE pump module, collapsible hoses, sexless "Y" coupling, filters, flow meters, and dispensing nozzles necessary to permit tactical forward area refueling of combat weapons systems at two refueling points 200 feet from the helicopter.



6. Learning Step/Activity 6−Describe Fuel System Emergency Procedures.

a. Aux Fuel Pump Failure. Pg: 9−23.



(1) An auxiliary fuel pump failure will be indicated by an AUX PRESS indicating light, on the FUEL CONTROL panel, illuminating and/or the fuel quantity in the affected tank remaining at the same level. Should this occur, proceed as follows:

(a) FUEL QUANTITY selector switch — Check.

If one or both auxiliary fuel tanks have fuel remaining:

(b) AC-DC FUEL PUMP circuit breakers — Check In.

(c) FWD and AFT AUX FUEL PUMP switches affected side) — OFF.

(d) AUX FUEL PUMP switch — ON (each aux tank with fuel remaining) then — OFF.

If AUX PRESS indicating light remains on:

(e) AUX FUEL PUMP switch(es) (inoperative pump(s)) — ON for operative pumps or OFF for inoperative pumps.

NOTE: This procedure is not exactly as listed in TM 1-1520-240-10.

b. Fuel Venting. Pg: 9−24

(1) Fuel venting from either main tank vent indicates a possibility of fuel cell over pressurization.

(a) Should venting occur:

1. **AUX FUEL PUMP switches (affected side) or ERFS/ERFS II pump switches if installed — OFF.**

2. Main tank (affected side) — Monitor.

(b) When 1,000 pounds of fuel remain:

3. AUX FUEL PUMP switches (affected side or ERFS/ERFS II (if installed) — ON. (monitor fuel quantity).

(c) When tanks quantity reaches 1,600 pounds:

4. **AUX FUEL PUMP switches (affected side) or ERFS/ERFS II pump switches if installed — OFF.**

5. Repeat steps 2 through 4 until auxiliary tanks are empty.

c. L or R FUEL PRESS caution. Pg: 9−24

(1) If both main tank fuel pumps fail, fuel will be drawn from the main tanks as long as the helicopter is operated below 6,000 feet pressure altitude.

(a) If the L or R FUEL PRESS caution comes on:

1. **XFEED switch — OPEN (above 6,000 feet PA).**

2. FUEL PUMP (S) circuit breakers — Check in.

(b) Pump(s) are operational

3. XFEED switch — CLOSED.

(c) Pumps are not operational

4. FUEL PUMP switches — OFF (inoperative pump(s)).

d. Fuel Low (L/R FUEL LVL) caution. Pg: 9−24

(1) If the L FUEL LOW and R FUEL LOW caution come on perform the following:

WARNING: Failure of main tank fuel boost pumps with the crossfeed open and a fuel low condition may result in a dual engine flameout. Nose low attitude should be avoided. Nose low attitude in excess of five degrees may cause fuel starvation prior to the fuel low caution light illuminating.

(a) Fuel quantity — Check individual tanks.

(b) XFEED switch — As required.

(c) Land as soon as practicable.

e. FUEL LOW (FUEL LVL) and FUEL PRESS caution. Pg: 9−24

(1) If the L FUEL LOW and R FUEL LOW caution come on (both caution lights on either L or RT side) perform the following:

WARNING: Failure of main tank fuel boost pumps with the crossfeed open and a fuel low condition may result in a dual engine flameout. Nose low attitude should be avoided. Nose low attitude in excess of five degrees may cause fuel starvation prior to the fuel low caution light illuminating.

(a) **XFEED — CLOSED.**

(b) **Land as soon as possible.**

Appendix C - Practical Exercises and Solutions

CH-47D FUEL SYSTEM

PRACTICAL EXERCISE

NOTE: This practical exercise covers the instruction you received in this handout. Completion is optional, but strongly encouraged!

1. How does auxiliary tank fuel get to the engine?

2. What indicates that the refueling valve has opened or closed properly?

3. What does the FUEL PRESS caution light indicate?

4. What is the purpose of the jet pump?

5. Must the battery be turned on to get electrical power for pressure refueling?

6. The _____ in the _____ tank has the low level thermister connected to it, giving the pilot the LOW FUEL master caution light?

7. What is the maximum pressure for pressure refueling?

8. If the refueling valves remain closed, how does this affect pressure refueling?

9. How will you know if both MAIN TANK fuel pumps fail on one side?

10. If the refueling valve remains open, how does this affect normal fuel system operation?

11. What action must the pilot take to electrically close an engine fuel shutoff valve in the aft cargo compartment?

12. What prevents fuel from spilling in a crash where the helicopter rolls over?

13. What is the purpose of the cross-feed fuel valves?

14. What is the identification for an inoperative auxiliary fuel pump?

15. What helicopter attitude must be avoided when the FUEL LOW caution light is on?

16. What are the authorized fuels for the CH-47D?

17. If the engine fuel valves do not have electrical power available, they can be operated _____?

18. With the crossfeed fuel valve closed, what components are supplied fuel from the electrically operated boost pump in the Right Main tank?

19. What is the difference in the operation between the main and Aux fuel boost pumps?

20. Will the engine fuel valve operate normally when the fuel valve warning light is on?

21. What is the purpose of the refuel valve position lights?

22. What is the purpose of the aux tank pressure refueling shutoff valve?

23. What should be done if the helicopter is not to be operated immediately after pressure refueling?

24. What action must be taken if both float switches are inoperative for either main tank?

25. What activates the low fuel quantity caution light on the master caution panel?

26. What immediate action should you take if a FUEL PRESS caution light comes on during flight above 6,000 feet pressure altitude?

27. How many electrically operated boost bumps are there for the CH-47D fuel system?

28. When the FUEL LOW caution light is on, how much fuel is remaining in the main tanks?

29. How many fuel quantity probes are in the left main tank?

CH-47D FUEL SYSTEM
PRACTICAL EXERCISE SOLUTIONS

1. Through the main tank.
2. Refuel valve position indicating lights
3. Both main tank fuel boost pumps are producing less than 10 psi.
4. To evacuate the pressure refueling line.
5. No.
6. Center Probe in the main tank
7. 55 psi.
8. The aft aux tanks will not refuel.
9. Corresponding Fuel Pressure Light
10. The fuel in the aft aux tank will not be useable.
11. Pull the Engine Fire Pull Handle
12. The rollover vent system
13. To allow one system to feed both engines
14. Auxiliary pressure light on with fuel in the tank.
15. Nose low.
16. JP4, JP5, JP8, and JET A
17. Manually.
18. Heater and the #2 Engine.
19. The main pumps do not automatically shut off and the Aux pumps do
20. Yes.
21. To indicate when the valve has opened or closed properly.
22. To stop the flow of fuel into the tank when pressure refueling is completed
23. Start APU and operate the forward fuel boost pump in either main tank for 2 minutes.
24. Repair it before flight.
25. A thermister located on each of the center main tank probes.
26. Crossfeed Open.

27. 8.

28. 320 to 420 pounds or 20%.

29. Three.