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Airbus
A318/A319/A320/A321

ATA 28
Fuel

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EASA Part-66
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Revision Identification:

- The date given in the column "Revision" on the face of this cover is binding for the complete Training Manual.
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- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

ATA 28 FUEL

28-00 GENERAL

DESCRIPTION

Fuel-System:

- keeps the fuel in the main fuel tanks and the center tank, which are open to atmosphere through the vent surge tanks
- controls and supplies the fuel in the correct quantities to the fuel tanks during refuel operations
- supplies the fuel to the engines
- supplies the fuel to the APU (**A**uxiliary **P**ower **U**nit)
- supplies the fuel to decrease the temperature of the Integrated Drive Generators
- gives indications in the cockpit of the usual system operation
- gives indications in the cockpit of the failures that could cause an unusual condition.
- is controlled by one FQIC (**F**uel **Q**uantity **I**ndicating **C**omputer) and two FLSCU (**F**uel **L**evel **S**ensing **C**ontrol **U**nits).

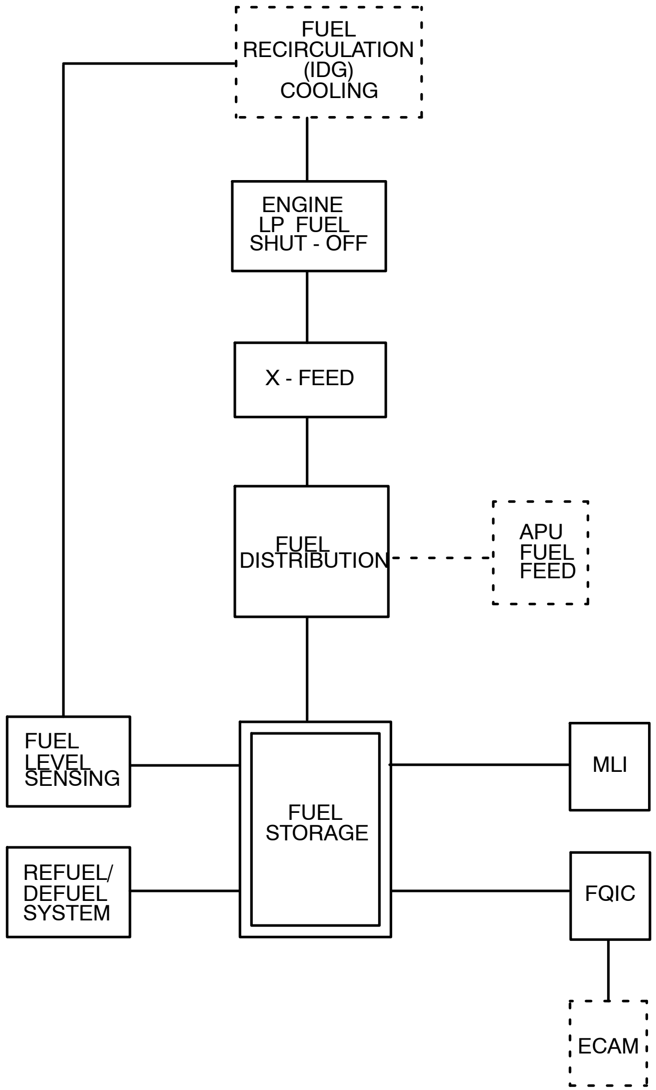

Figure 1 Fuel System - Sub Systems

A318/319/320

NOTE:
A319/320 manufactured after Jan 2014 are equipped with the A321 Center Tank Transfer System. The Outer and Inner Cell remain unchanged.

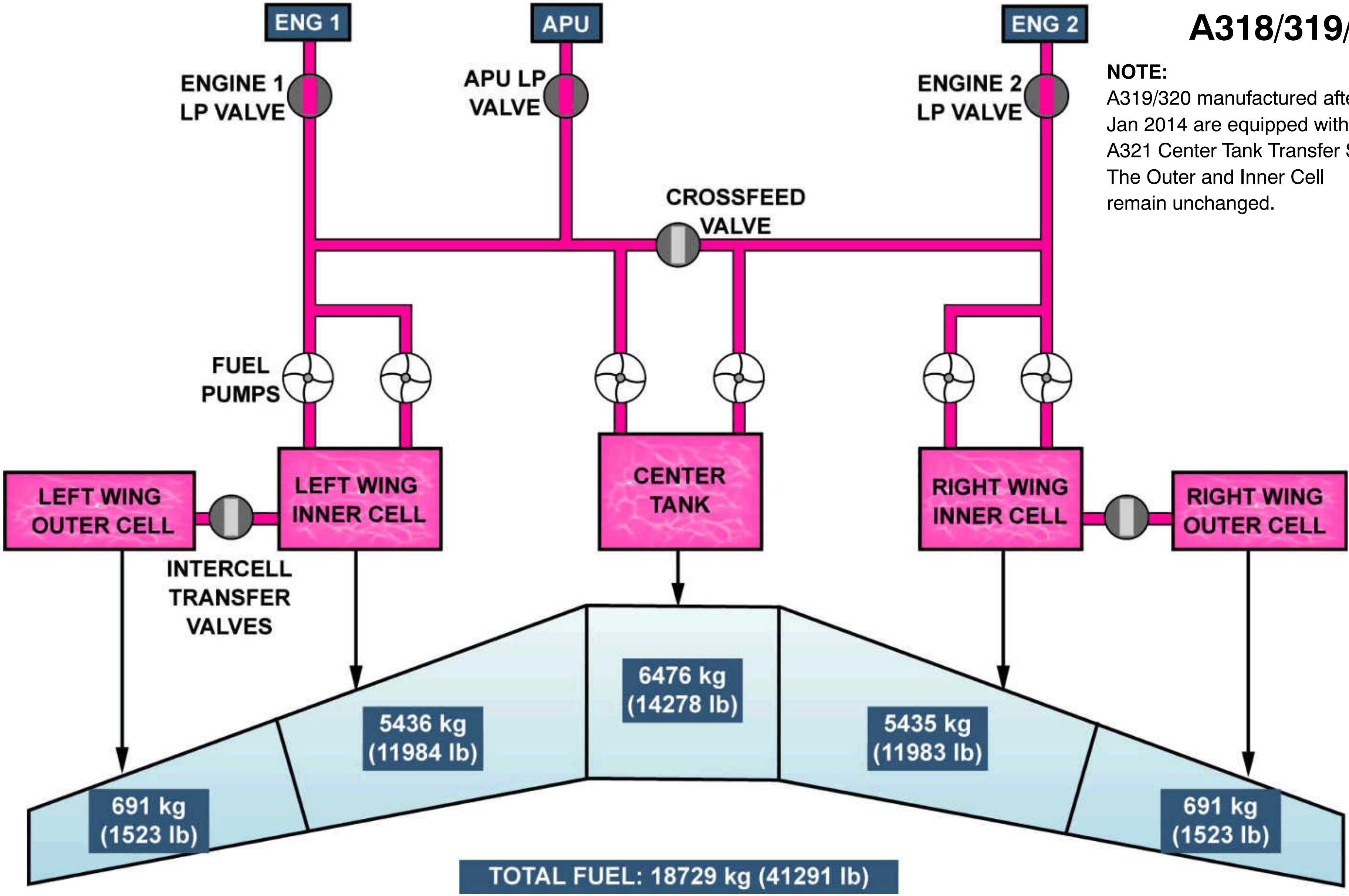

Figure 2 Tank Location A318–320

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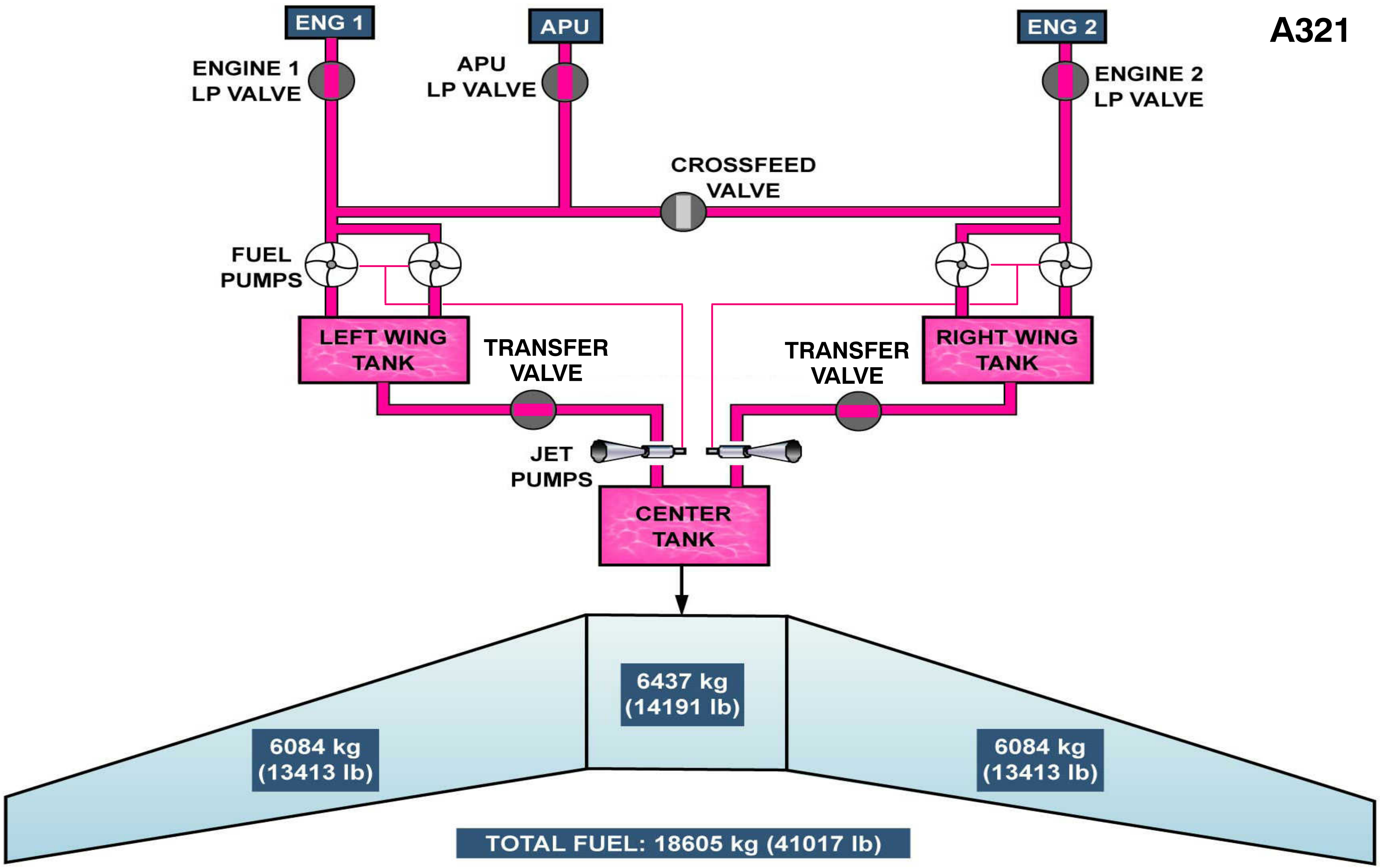

Figure 3 Tank Location A321

FUEL SYSTEM DESCRIPTION

Operating Limitations

The system is designed to operate within:

- altitude range 0 ft to 39000 ft
- ambient temperature range of minus 40 deg.C to plus 50 deg.C at zero altitude
- and minus 70 deg.C to minus 30 deg.C at 39000ft
- Fuel temperature range of −54 deg.C to +50 deg.C, the upper temperature limit subject to fall off with increasing altitude to + 40 deg.C at 36000 ft.

Fuel Pump System

Each main tank has two centrifugal booster pumps capable of supplying the engines with fuel at the required pressure and flow rate.

The wing tank pumps (21 QAP, 22QA, 25QA, 26QA) are located in a collector box formed by root Rib 1 and Rib 2. Rib 2 is sealed except for vent holes at the top and clack valves at the bottom through which fuel gravitates into the enclosure. Two inward−opening hinged panels in Rib 2 provide access into this area. This configuration makes sure that the pumps are fully in fuel during flight maneuvers.

Each pump has an intake pipe fitted with a strainer (5QM,6QM,70M,8QM). A bypass pipe with suction valve enables the engine to get fuel by suction if the pumps do not work.

NOTE: The center tank pumps (37QA, 38QA) do not have a bypass and fuel can be obtained from the center tank only by operating the pumps.

Pressure relief sequence valves on the wing tank pumps give precedence to center tank pump delivery.

Scavenge System

The scavenge jet pumps are installed in the wing tank and in the center tank.

The wing tank pumps moves fuel which has entered the wing surge tank back in the outer cell of the wing.

The center tank jet pumps move the fuel to the related center tank main pump inlets.

Crossfeed System

A crossfeed line routed through the fuselage center section provides interconnection of the L and R engine feed systems.

The fuel crossfeed system consists of the crossfeed valve (5 QE),which is normally closed, together with its electrical control circuit and indication. The valve is installed in the engine fuel feed pipeline in the center section connecting the LH and RH engine fuel feed lines. An electrical actuator with twin motors operates the valve. Both motors are supplied from separate 28V D.C. power sources, one from the Busbar 2 and one from Battery Busbar.

The valve is controlled by the X FEED pushbutton switch (4QE) on the pilots panel 40VU.

LP (Low Pressure) Fuel Fire Shut−Off Control.

In case of engine/APU fire the fuel supply to the engines (or APU) is shut off by the LP valves which are electrically actuated by operation of the related ENG FIRE (or APU FIRE) push−button. The valves are normally in the open position, when the engines/APU are running. At every engine/APU off, the valves are closed.

APU (Auxiliary Power Unit) Feed System

The APU takes its fuel from a connection in the main engine feed system which supplies the APU at the required pressure.

The APU feed line incorporates a supplementary fuel pump powered by the aircraft batteries, and an LP fuel shut−off valve.

The APU usually takes its supply from the left hand engine feed line.

When the cross feed valve is open, the right−hand engine feed line can also supply the APU fuel supply line. The operation of the pump is fully automatically. The adjacent pressure switch controls the operation and monitors the pump inlet pressure. When the aircraft is on the ground, the pump can be operated by a pushbutton switch (8QC) in the APU compartment to purge the fuel line.

NOTE:
A319/320 manufactured after Jan 2014 are equipped with the A321 Center Tank Transfer System.
The Outer and Inner Cell remain unchanged.

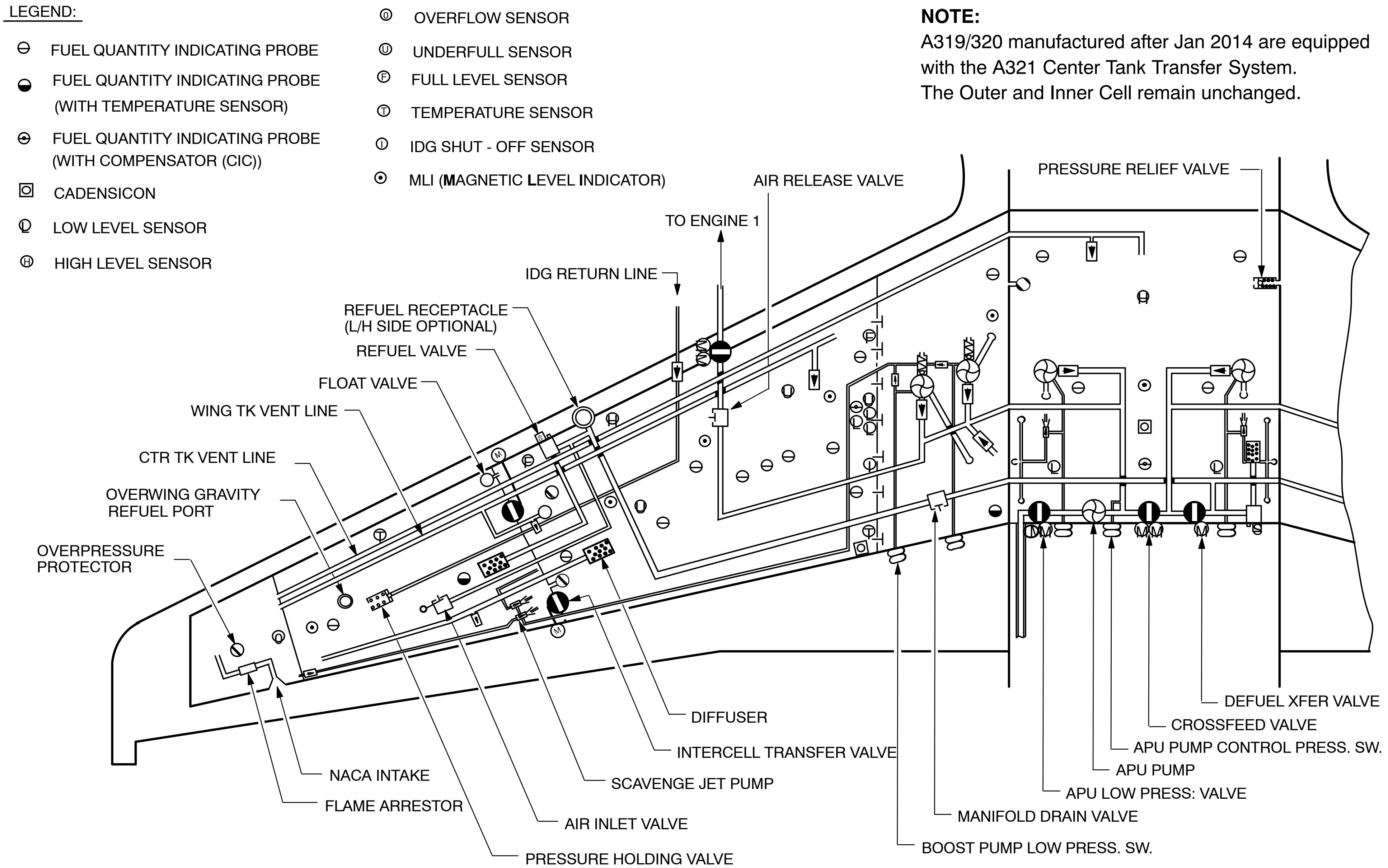

Figure 4 Basic Schematic A318/319/320

Tank Vent System

Each fuel tank vents through vent lines into a vent surge tank, which is located outboard of each wing tank.

The center tank vents into the vent surge tank on the LH (**L**eft **H**and) side. Each vent surge tank vents to atmosphere through a NACA type intake mounted within the tank on an access pane! (550AB,650AB). installed in the intake is a vent protector (48QM,49QM) (flame arrestor) which reduces the risk of a ground fire.

Each wing tank inner cell vents through an open duct at the inboard end and a vent float valve (16QM,170M) at the outboard end. The ducts are large enough to ensure that if the pressure refueling shut−off failed, excess fuel can be discharged overboard through the NACA intake without the tank pressure exceeding design limits.

Vent Float Valves

A vent float valve (15QM,18QM) fitted to the outer side of sealed Rib 15 permits air to be vented from the outer cell to the inner cell during flight maneuvers.

The center tank vent line is a conventional open line, large enough for airflow only. With its open end at the center of the tank the line runs through the wing tank to the vent surge tank. If there is a refueling overflow, a pressure relief va!ve (97QM) permits fuel to flow into the RH wing tank inner cell.

Fuel Spill

Fuel spilled through the vent pipes into the vent surge tank is induced back into the outer cell by a scavenge jet pump using motivating force from the wing fuel pumps. The vent surge tank will hold 190 Liters (50 U.S. gal.) before overflowing into the upturned NACA intake duct.

Overpressure Protectors

Overpressure protectors (46QM, 47QM 96QM, 102QM, I03QM) are installed in the system to relieve pressure in the tanks that might occur through vent blockage or a pressure refueling gallery failure. Overpressure protectors are disposed as follows:

- **Center tank**: Mounted in an interconnecting pipe in the LH tank wall,excess pressure in the center tank relieves into the LH inner cell.
- **Vent tank**: mounted on a handhole cover between Ribs 24 and 25 will relieve to permit venting if the vent protector (48QM,49QM) or NACA intake be comes blocked.

Refuel/Defuel System.

Fuel supplied to the refuel / defuel couplings from a ground fuel supply is distributed in the required quantities to the aircraft tanks through the refuel valves.

The system can also be used to defuel the aircraft through the same couplings.

FQI (Fuel Quantity Indicating) System

The system gives:

- full fuel mass measurement and display.
- automatic control of refueling to give automatic shut−off at a preselected quantity with correct distribution of final load.
- system integrity monitoring using BITE (**B**uilt−**I**n **T**est **E**quipment).
- Aeronautical Radio Incorporated ARINC 429 digital data outputs which give related FQI information to the other airborne systems
- fuel temperature measurement (and display on ECAM).

Attitude data (acceleration) is received through the ARINC link during flight from the ADIRS (**A**ir **D**ata **I**nertial **R**eference **S**ystem) and is used as an alternate source of attitude.

Manual Magnetic Indicator

One MLI is installed in the center tank and five in each wing tank, distributed four in each inner cell and one in each outer cell.

Prior of using the MLIs for measurement the fuel quantity a reading is taken from an attitude monitor (39QM) in the RH (**R**ight−**H**and) fuselage fairing to determine the out of−level attitude of the aircraft in the pitch and roll axis.

Intercell Transfer System

When the fuel level in either wing−tank inner−cell drops to the low level sensors,the transfer valves in both the LH and the RH wing tanks open automatically.

There are two low level sensors in each inner cell. Each sensor will signal two valves to open, one in each wing, ensuring that transfer is simultaneous in each wing.

A signal from the sensors energizes Channel 1 and Channel 2 relays to open the transfer valves. When opened they electrically latch in the open position until the system is reset by the next refueling selection.

LEGEND:

- FUEL QUANTITY INDICATING PROBE
- FUEL QUANTITY INDICATING PROBE (WITH TEMPERATURE SENSOR)
- FUEL QUANTITY INDICATING PROBE (WITH COMPENSATOR (CIC))
- CADENSICON
- LOW LEVEL SENSOR
- HIGH LEVEL SENSOR
- OVERFLOW SENSOR
- UNDERFULL SENSOR
- FULL LEVEL SENSOR
- TEMPERATURE SENSOR
- IDG SHUT - OFF SENSOR
- MLI (**M**AGNETIC **L**EVEL **I**NDICATOR)

NOTE:
A319/320 manufactured after Jan 2014 are equipped with the A321 Center Tank Transfer System.
The Outer and Inner Cell remain unchanged.

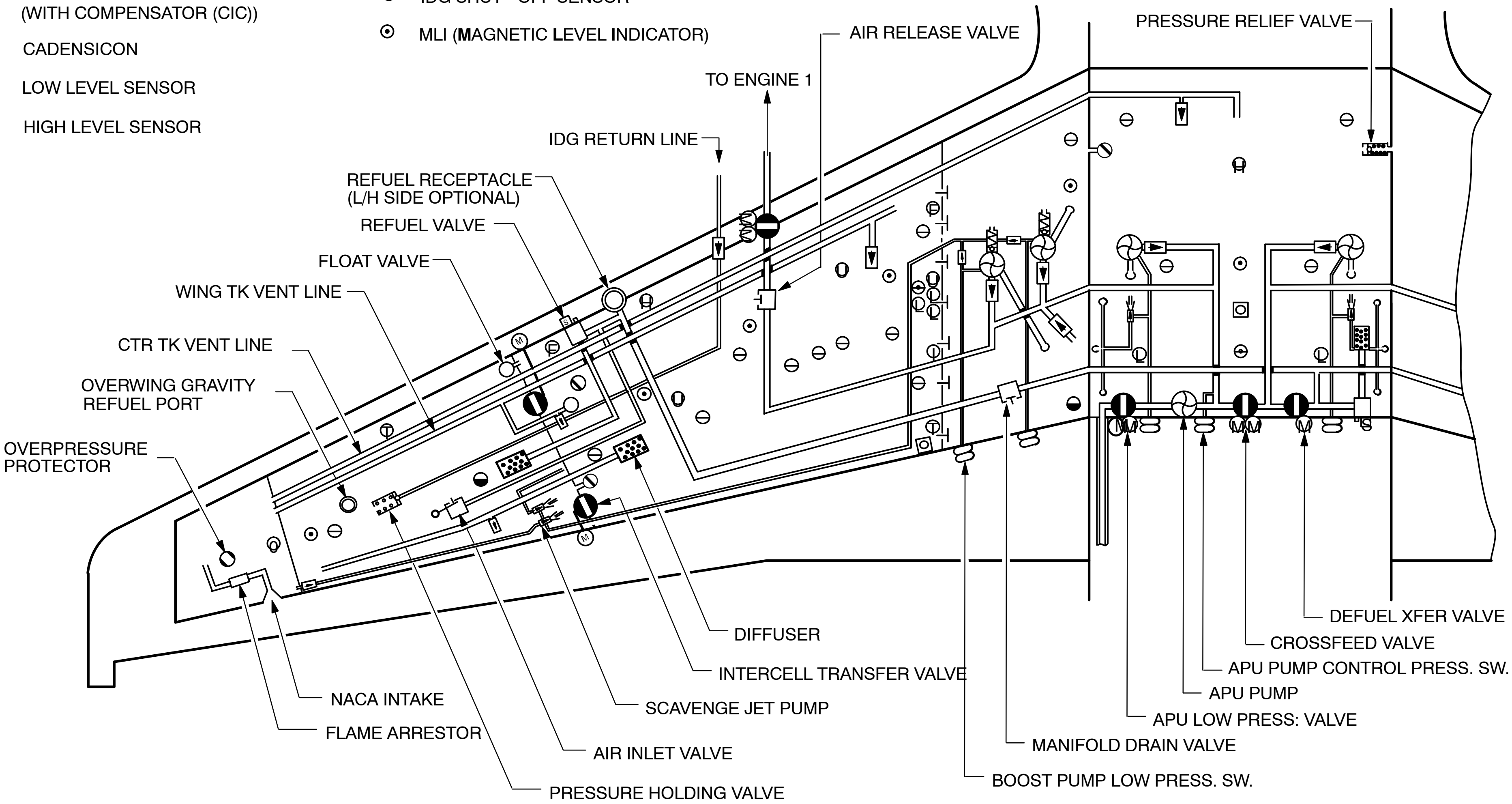

Figure 5 Basic Schematic A318/319/320

FUEL SYSTEM DESCRIPTION

Operating Limitations

The system is designed to operate within:

- altitude range 0 ft to 39000 ft
- ambient temperature range of minus 40 deg.C to plus 50 deg.C at zero altitude
- and minus 70 deg.C to minus 30 deg.C at 39000ft
- fuel temperature range of −54 deg.C to +50 deg C, the upper temperature limit subject to fall off with increasing altitude to + 40 deg.C at 36000 ft.

Fuel Pump system

There are two fuel pumps in each wing tank. The fuel pumps operate together to supply fuel to the their related engines.

The fuel pumps also take fuel from the wing tanks and pass it through the jet pumps in the center (transfer) tank. This flow of fuel causes a suction pressure in the jet pumps. This suction pressure removes the fuel from the center tank and moves it to the related wing tank.

Crossfeed System

Same as A318/319/320

LP (Low Pressure) Fuel Fire Shut−Off Control.

Same as A318/319/320.

APU (Auxiliary Power Unit) Feed System

Same as A318/319/320.

Tank Vent System

Same as A318/319/320.

Fuel Spill

Fuel spilled through the vent pipes into the vent surge tank is induced back into the wing tank by clack valves.

Overpressure Protectors

Same as A318/319/320.

Refuel / Defuel System.

Same as A318 / 319 / 320.

FQI (Fuel Quantity Indicating) System

Same as A318 / 319 / 320.

Manual Magnetic Indicator

One MLI (**M**agnetic **L**evel **I**ndicator) is installed in the center tank and seven are in each wing tank.

Prior of using the MLIs for mesurement the fuel quantity a reading is taken from an attitude monitor (39QM) in the RH (**R**ight−**H**and) fuselage fairing to determine the out of−level attitude of the aircraft in the pitch and roll axis.

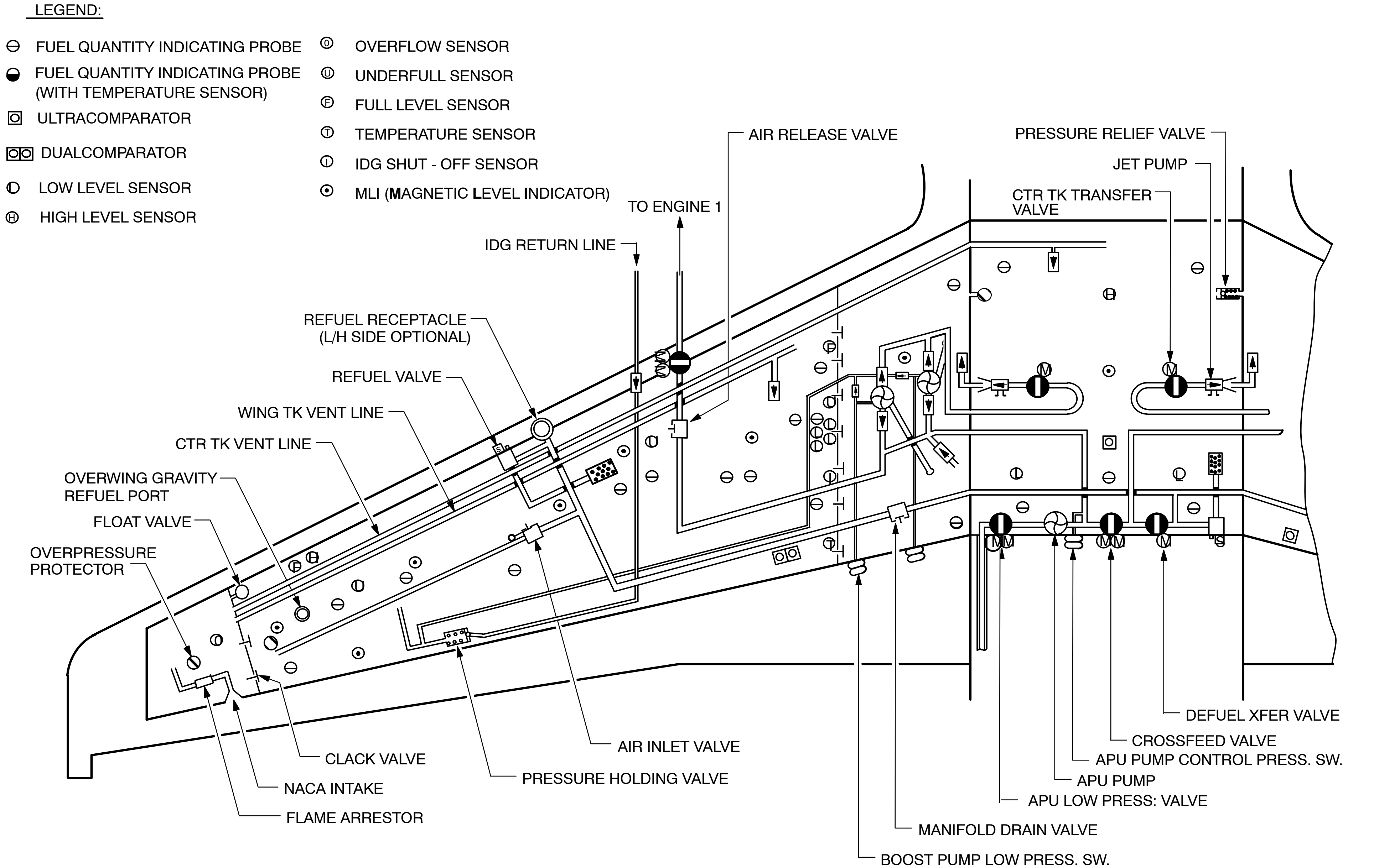

Figure 6 Basic Schematic A321

COCKPIT SYSTEM CTL AND INDK. A318/319/320

(1) L and R Tank Pump PB Switches (4)

Each PB Switch controls one fuel boost pump in the wing tanks. OFF light (white) and FAULT light (amber) are integrated in the switch.

- OFF – (PB Switch OUT)
  - The pump is switched off. The OFF light is on and the FAULT light is deactivated.
- ON – (PB Switch IN)
  - The pump runs, but supplies fuel to the engine only if the outletpressure of the CTR TK Pump drops. The FAULT light is activated.
  - The FAULT light comes on amber, if the pump-outlet-pressure drops. In that case ECAM will be activated.

(2) Mode Selector PB Switch A318/319/320

This PB Switch activates / deactivates the Automatic-Feed-Mode of the center tank boost pumps. In the switch are FAULT- and MAN light integrated.

- AUTO – (PB Switch IN)
  - The CTR TK Pumps are controlled automatically. They run:
    - after engine-start for 2 minutes.
    - before and after engine-start, if the slats are up.
    - until the CTR TK is empty plus 5 minutes.
  - The FAULT light comes on, if the CTR TK contains > 250 Kg of fuel and the fuel quantity in one of the INNER WING TKs drops below < 5000 Kg. In that case ECAM will be activated.
- MAN – (PB Switch OUT)
  - The CTR TK Pumps are controlled by their PB Switches manually.

(3) Center Tank Pump PB Switch (2) A318/319/320

Each PB Switch controls one fuel boost pump in the center tank. OFF- and FAULT light are integrated in the switch.

- OFF – (PB Switch OUT)
  - The pump is switched off. The OFF light is on (white) and the FAULT light is deactivated.
- ON – (PB Switch IN)
  - The pump runs, supplies fuel to the engine in MAN MODE. In AUTO MODE the pump is controled automatically.
  - The FAULT light comes on amber, if the pump is activated, and the pump outletpressure drops. In that case ECAM will be activated.

(4) X-Feed PB Switch

This PB Switch controls the cross feed valve in the engine feed system. ON light (white) and OPEN light (green) are integrated in the switch.

- OFF – (PB Switch OUT)
  - The cross feed valve is closed. No light is on.
- ON – (PB Switch IN)
  - The cross feed valve is open. The ON light is on. The OPEN light comes on when the cross feed valve reaches full open position.

OVERHEAD PANEL

NOTE: After Jan 2014 the Fuel Panel is modified similar to A321

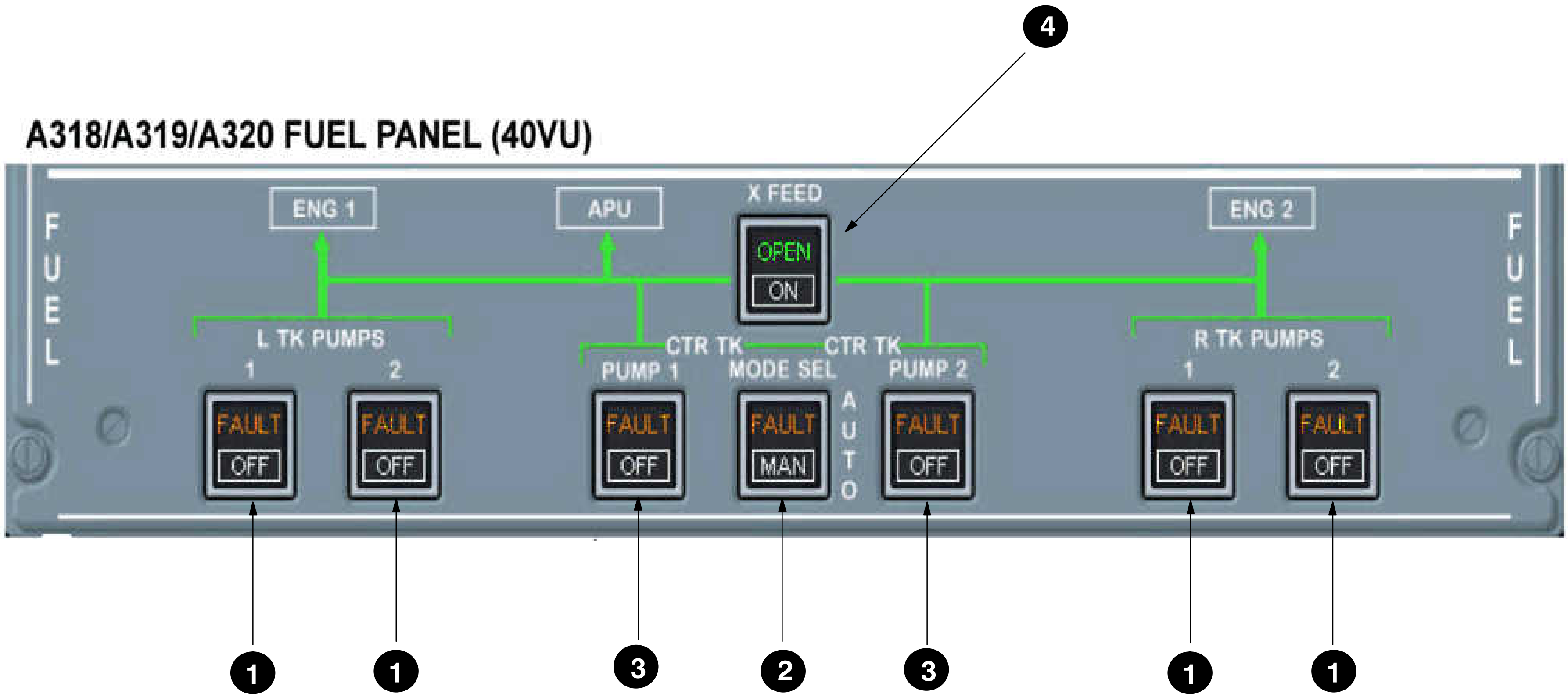

Figure 7 Fuel Control Panel A318/319/320

COCKPIT SYSTEM CTL AND INDIKATION A321

(1) L and R Tank Pump PB Switch (4)

Same as A318/319/320

(2) Mode Selector PB Switch

Controls the Automatic Mode of the CTR TK transfer valves

- AUTO – (PB Switch IN)
  - The transfer valves are controlled by level sensors
    "The valves open if the associated wing tank is not full".
  - The FAULT light comes on, if the CTR TK contains > 250 Kg of fuel and the fuel quantity in one of the WING TKs drops below < 5000 Kg.
    In that case ECAM will be activated.
- MAN – (PB Switch OUT)
  - The transfer valves are controlled by their PB switches.

(3) Transfer Valve PB Switches (2)

Each PB Switch controls one transfer valve in the center tank. OFF- and FAULT light are integrated in the switch.

- OFF – (PB Switch OUT)
  - The transfer valve is closed.
- ON – (PB Switch IN)
  - The transfer valve opens
- FAULT – The light comes on if, the associated wing tank overflows. In that case the ECAM will be activated.

(4) X-Feed PB Switch

Same as A318/319/320

OVERHEAD PANEL

A321 Fuel Panel (40 VU)

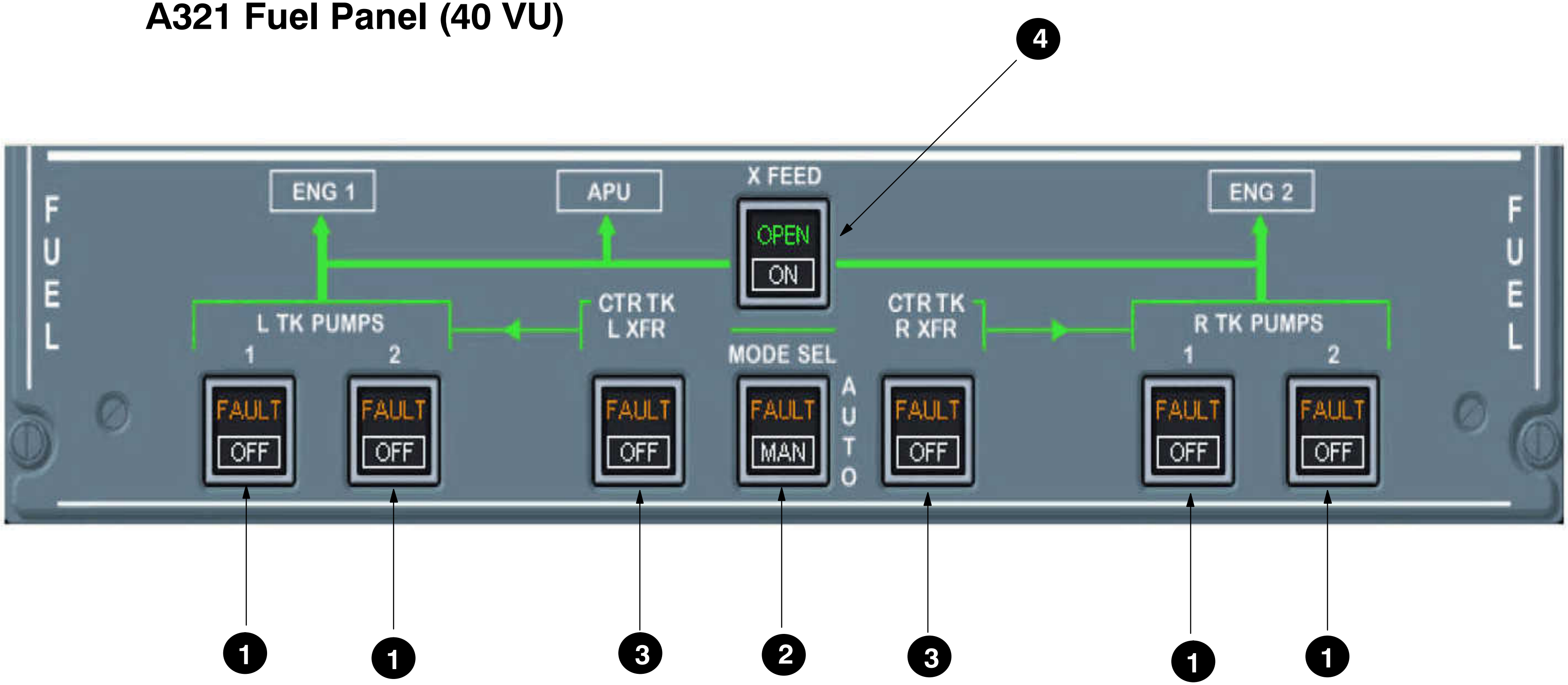

Figure 8 Fuel Control Panel A321

(OPTIONAL) REFUELING PANEL IN THE COCKPIT

(1) PRESELECTED Dislay

Displays the preselected total fuel quantity in Kg x 1000 (multiply by 1000 to get actual amount).

(2) ACTUAL Display

Displays the total fuel on board in Kg x 1000.

(3) PRESELECTOR ROCKER Switch

Pressing either side of the switch increases or decreases the preselected quantity.

(4) END Light (Green)

- Illuminates steady when automatic refuelling is completed.
- It flashes when automatic refuel operation has stopped for any reason. Associated with the green refuel light on the wing extinguishing

(5) PWR PB Switch

This switch activates/deactivates the automatic refueling from the cockpit.

ON light (white) and FAULT light (amber) are integrated in the switch.

- ON:
  - Refuel system is energized.

    Cockpit refuel control /Preselector panel takes priority. (CKPT lights illuminate on cockpit and external refuel control panels.)
  - Automatic high level test
  - REFUEL caption is displayed on ECAM
- OFF:
  - Refuel system is deenergized.
  - ECAM ”REFUEL” message is cleared.
  - Priority is cleared.
- FAULT:
  - Illuminates when auto high level test was not satisfied.

(6) CTL PB Switch

This switch starts the refuelling operation. In the switch are VALVE light (amber) and ON light (white) integrated.

- ON:
  - Start of refueling:

    Associated with refuel green lights illumination on wing.
  - Auto shut off occures when the selected load is reached or in case of HI level detection.
- Off:
  - Refuel stops. The selected load can be reset.
- VALVE:
  - Illuminates, if one or more refuel valve switch/es at the refuel control panel is/are not in NORM position.

(7) CKPT Light (white)

Comes on when PWR pushbutton switch is ON associated with the CKPT light on the external refuel clontrol panel.

OVERHEAD PANEL

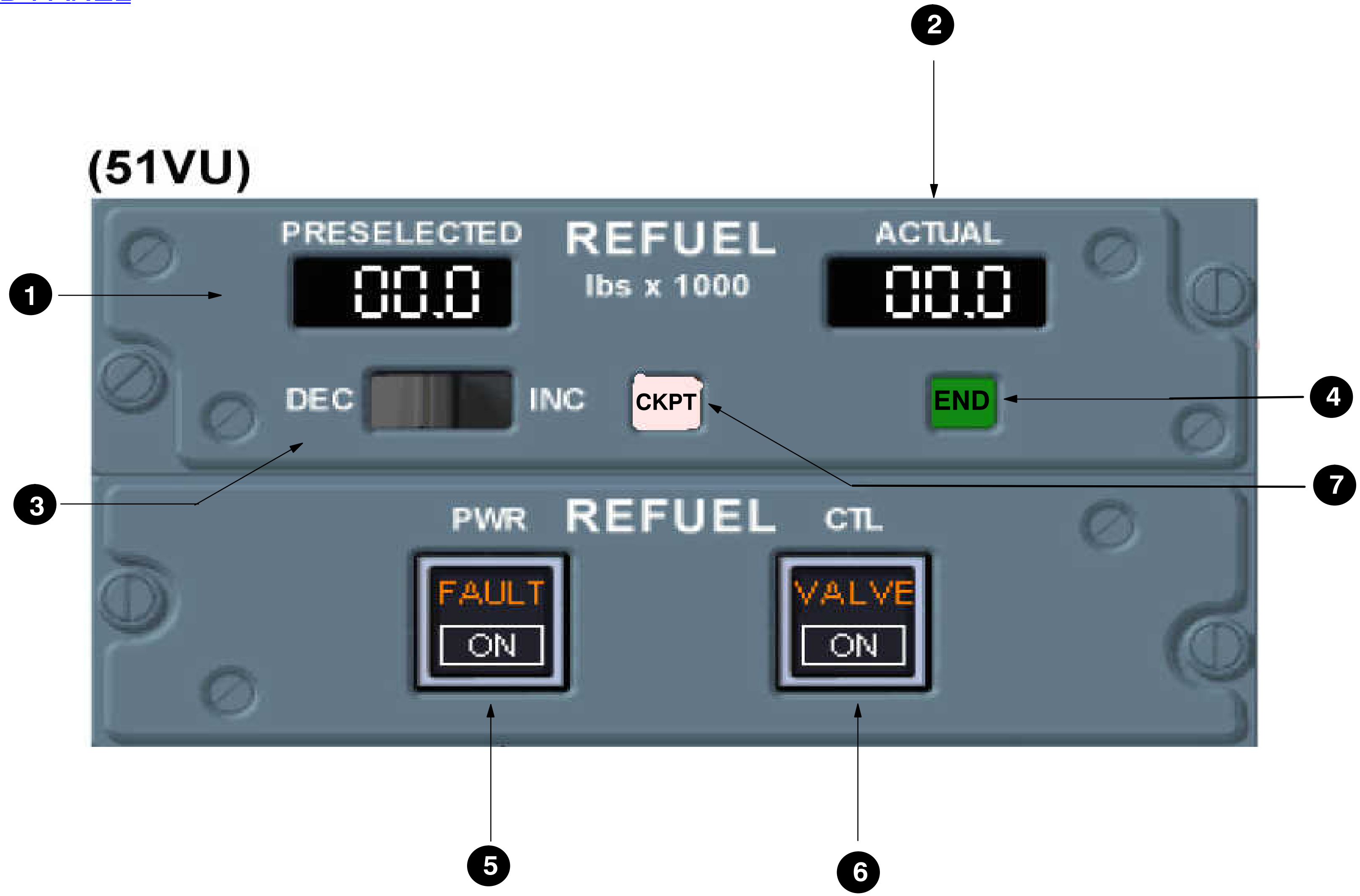

Figure 9 Cockpit Refuel Panel

REFUELING CONTROL PANEL 800 VU

(1) FUEL QUANTITY Indicator

Displays the quantity of fuel in each tank.

(2) HI LVL Lights

Illuminate blue when high level is detected.The corresponding refuel valve closes automatically.

(3) REFUEL VALVES Select Switch (guarded in NORM)

NORM:

- Refuel valves are controlled by automatic refuelling logic.

OPEN:

- Valves open when the MODE SELECT sw is set to REFUEL or DEFUEL position. In REFUEL position each refuel / defuel valve will close when high level is detected in the associated tank.

SHUT:

- Valve close.

(4) MODE SELECT Switch (guarded at OFF)

OFF:

- Refuel system is deenergized. Refuel valves are closed.

REFUEL:

- Refuel valves operate in automatic or in manual mode depending on the position of REFUEL VALVE switches.

DEFUEL:

- Defuel/Transfer valve opens. Refuel valve opens provided associated REFUEL VALVE selector is at OPEN position.

(5) OPEN XFR Light

Comes on amber when the Defuel/Transfer valve is open.

(6) TEST Switch

When pressed to HI.LVL

- the HI LVL lights come on if high level sensors and associated circuits are serviceable.

NOTE: If tanks are full (HI LVL lights on) when test is performed,the HI LVL lights extingush if high level sensors and associated circuits are ser viceable.

When pressed to LTS

- HI.LVL lights, End light, CKPT light, XFR light are on
- all FQI tank indications, Preselected- and Actual-indictions show.8's.

(7) PRESELECTED Display

Displays the preselected total fuel quantity in kg (lb) x 1000.

(8) Preselector Rocker Switch

Pressing either side of the switch increases or decreases the preselected quantity.

(9) ACTUAL Display

Displays the total fuel on board.

(10) END Light

GREEN:

- Automatic refuelling is completed.

GREEN FLASHING:

- Fuelling aborded.

(11) CKPT Light

Indicates that cockpit refuel panel (optional) has priority.
Illuminates when electrical PWR pb switch on cockpit refuel panel is pressed.

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(12) **BATT. POWER Toggle Switch** (IF INSTALLED!)

ON:

- When momentarily selected on and released the FQI is supplied by BAT 1. After completion of FQI tests (about 40 sec), the fuel quan tity indications appear and the refuel operation can be selected.

  The electrical supply is automatically cut off after 10 min, if no refuel operation is selected or at the end of refuelling.

NORM:

- The FQI is not supplied by BAT.

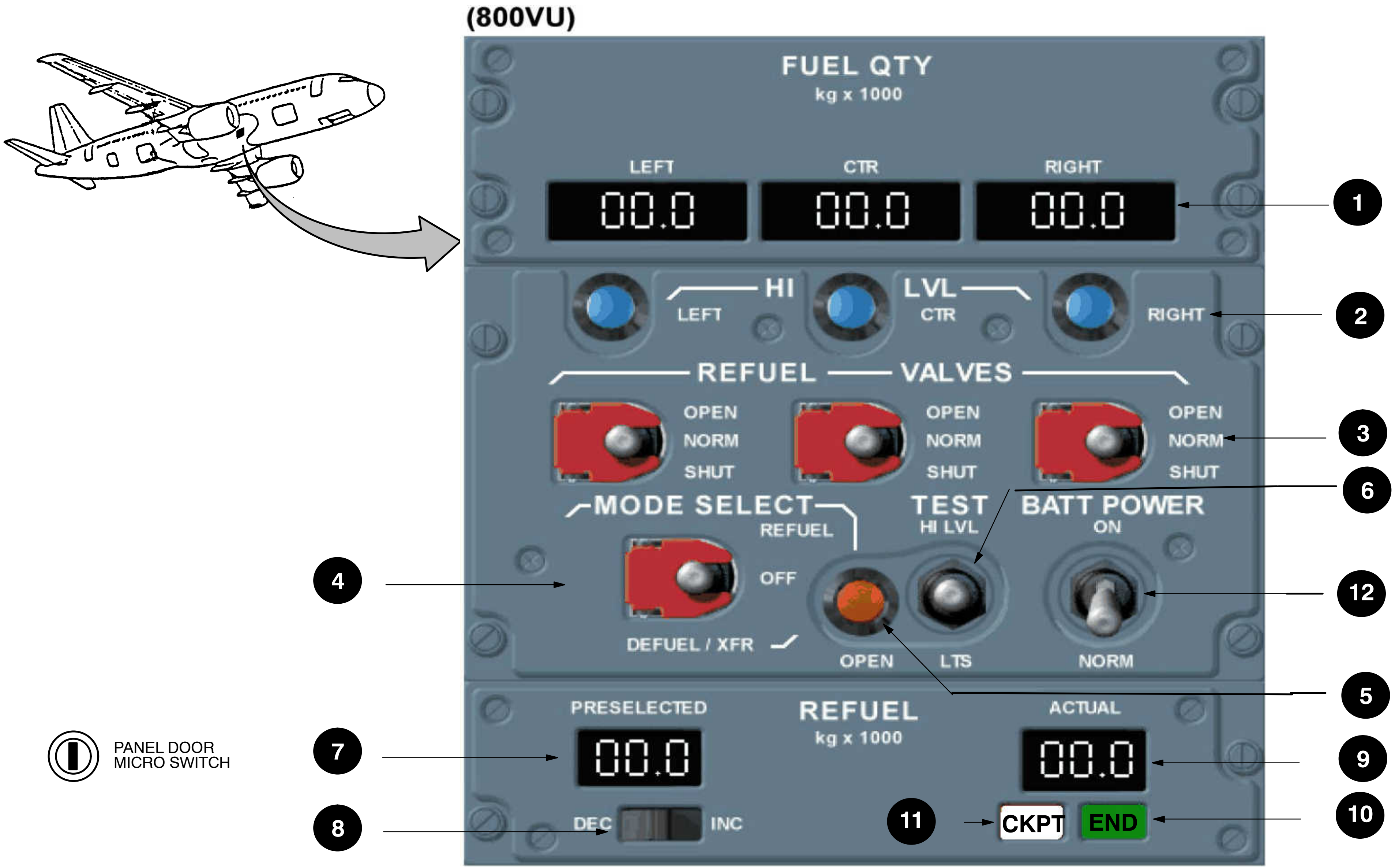


Figure 10 Refueling Control Panel

ECAM PAGE PRESENTATION

1 Wing Pumps Indications

- In line – Green: pump pressure is normal (pump contactor on)
- Cross line – Amber: pump contactor is off
- LO – Amber: pump pressure is low (pump contactor is on)

2 Ctr TK Pumps Indications

- In line – Green: pump pressure is normal (pump contactor on)
- LO – Amber: pump pressure is low (pump contactor is on)
- Cross line – Green: pump contactor is off and auto shut off required
- Cross line – Amber: pump contactor is off and auto shut off not required

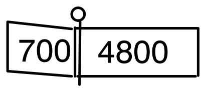
3 LP Valves (ENG – APU) Indications

- In line – Green: Valve is open
- In line – Amber: Valve is open with ENG (APU) MASTER switch OFF or FIRE pushbutton out.
- Cross line – Green: APU valve is closed
- Cross line – Amber: ENG valve is closed or APU valve is closed with master switch ON

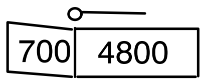
4 X Feed Indications

- In line – Green: Valve is open
- In line – Amber: Valve is open with pushbutton switch off
- Cross line – Green: Valve is closed
- Cross line – Amber: Valve is closed with Pushbutton switch in ON
- Transit – Valve is in transit

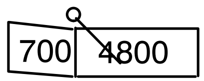
5 Transfer Valves Indications



- In line – Green: Both valves closed and no low level
- In line – Amber: Both valves closed at low level, or one valve open if it has to be closed



- Cross line – Green: Both valves open
- Cross line – Amber: One open and no low level



– Green: Transit

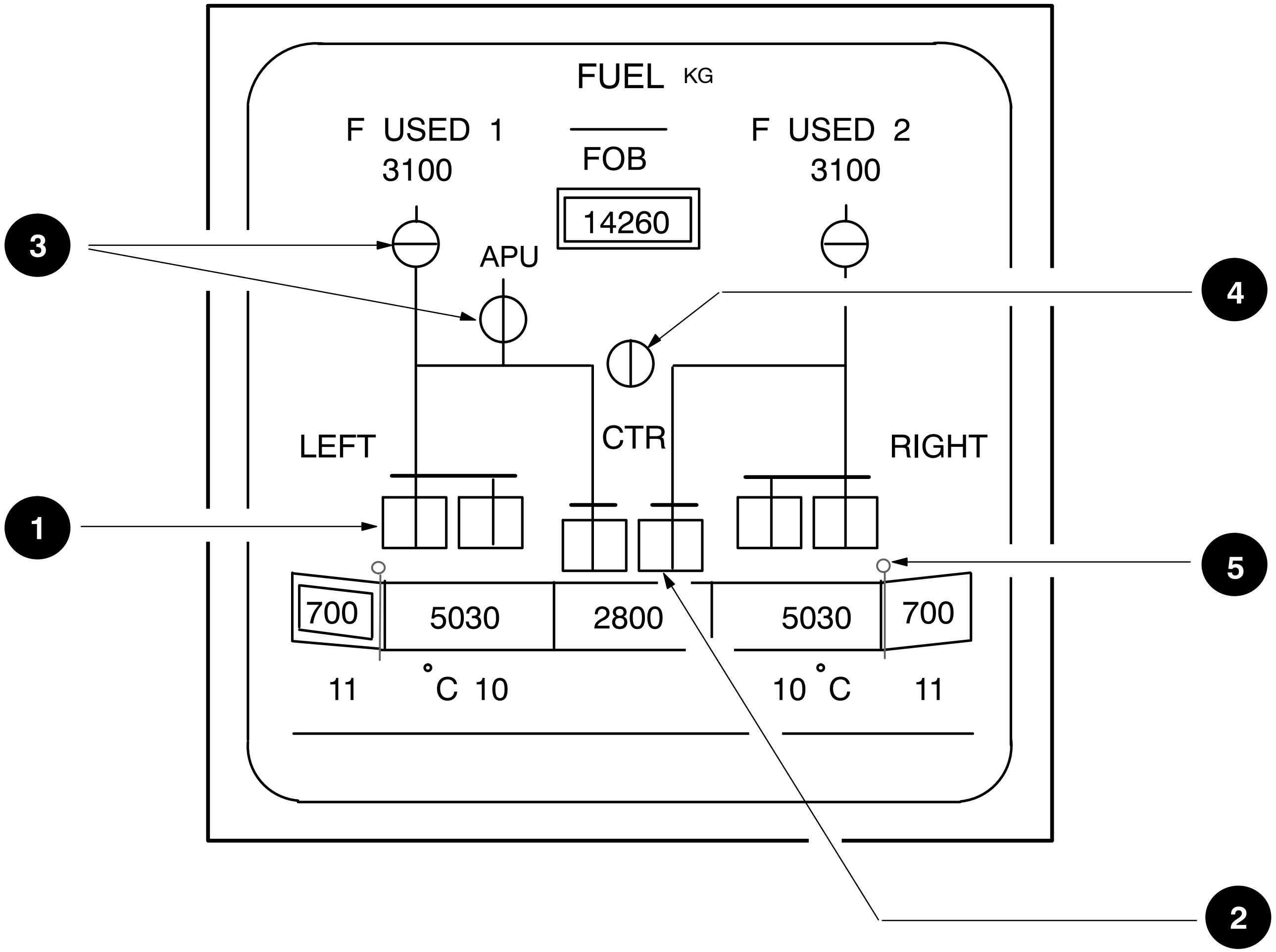


Figure 11 ECAM Fuel Page A319/320

Ecam Presentation (Cont)

(6) Fuel Quantity Indication

700 | 4800 – It is normally green.

700 | 4800 – Amber line appears across the last two digits when FQI is inaccurat (degraded mode)

700 | 4800 – The indicaton is boxed amber in case of unusable fuel
- both transfer valves fail in the closed position
- both center tank boost pumps fail

It is advisory in phases 2 and 6, when fuel unbalance more 1500 Kg exist.The indication for the wing with the higher fuel level pulses.

XX | XX – Fuel quantity not valid

(7) Fuel Temperature Indication

This appears when its associated sensor is wet

°C 10 – It is normally green

– It is advisery in phase 2 and 6 only, if the fuel temperature is above 45° C or below – 40° C.

– It becomes amber, and ECAM displays a caution, if the temperature exceed the high / low limits.

(8) Fuel On Board Indication

FOB
1100

– It is normally green.

– Amber line appears across the last two digits when FQI is inaccurat (degraded mode)

– The indicaton is boxed amber in case of unusual fuel
- both transfer valves fail in the closed position
- both center tank boost pumps fail

(9) Fuel Used Indication

F USED 1
1500

– The engine identification number is amber when the engine is below idle, and white when it is at or above idle.

– The fuel used indication is green from phase 2 until elec. power is cutof. It is automatically reset when the engine is started on ground

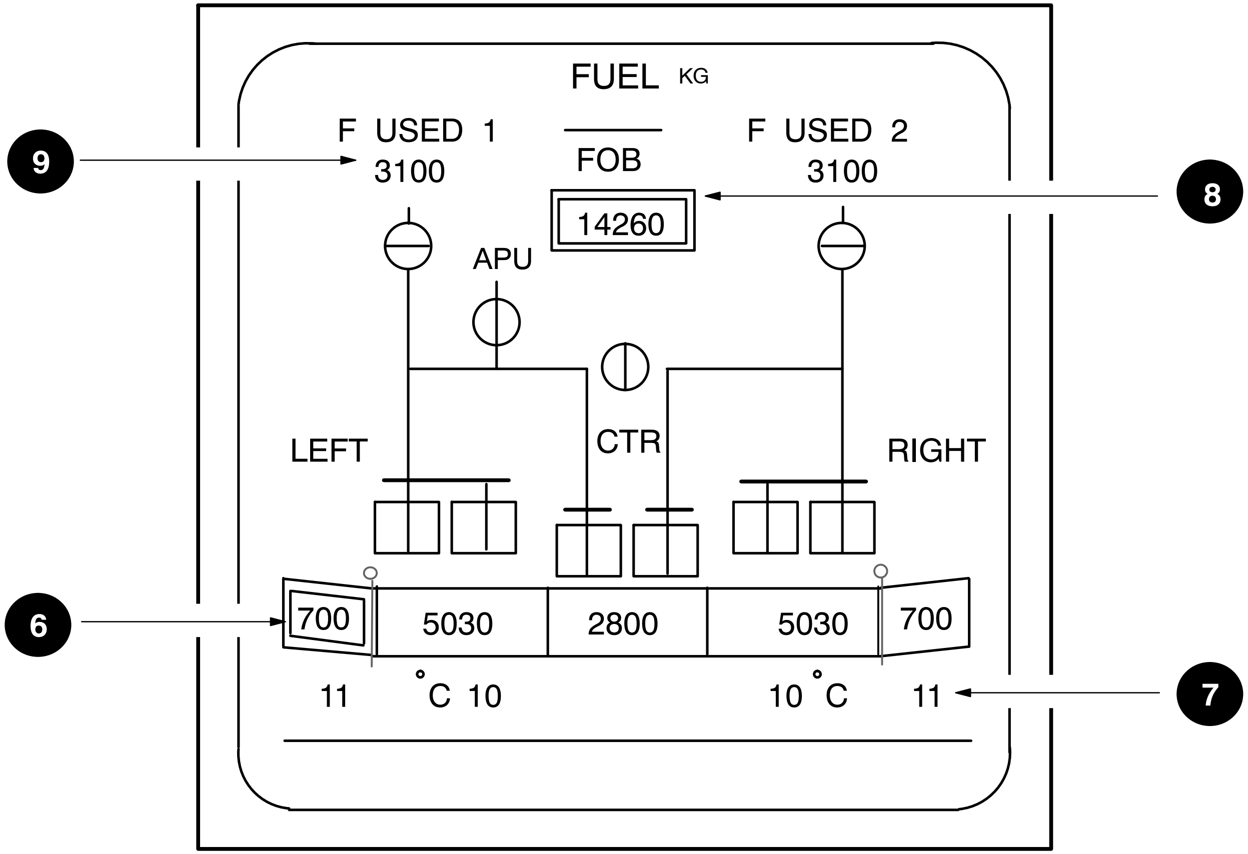


Figure 12 ECAM Fuel Page A319/320

Ecam Presentation (Cont)

(10) **Total Fuel Indication**

FOB : 12860 – An amber half box appears around FOB indication when the quantity shown is not all usable.

Reasons for this are :

- both transfer valves fail in the closed position
- both center tank boost pumps fail

– Amber line appears across the last two digits when FQI is inaccurate (degraded mode)

(11) **Memo Indications (green)**

– The indication appears when the related function is selected.

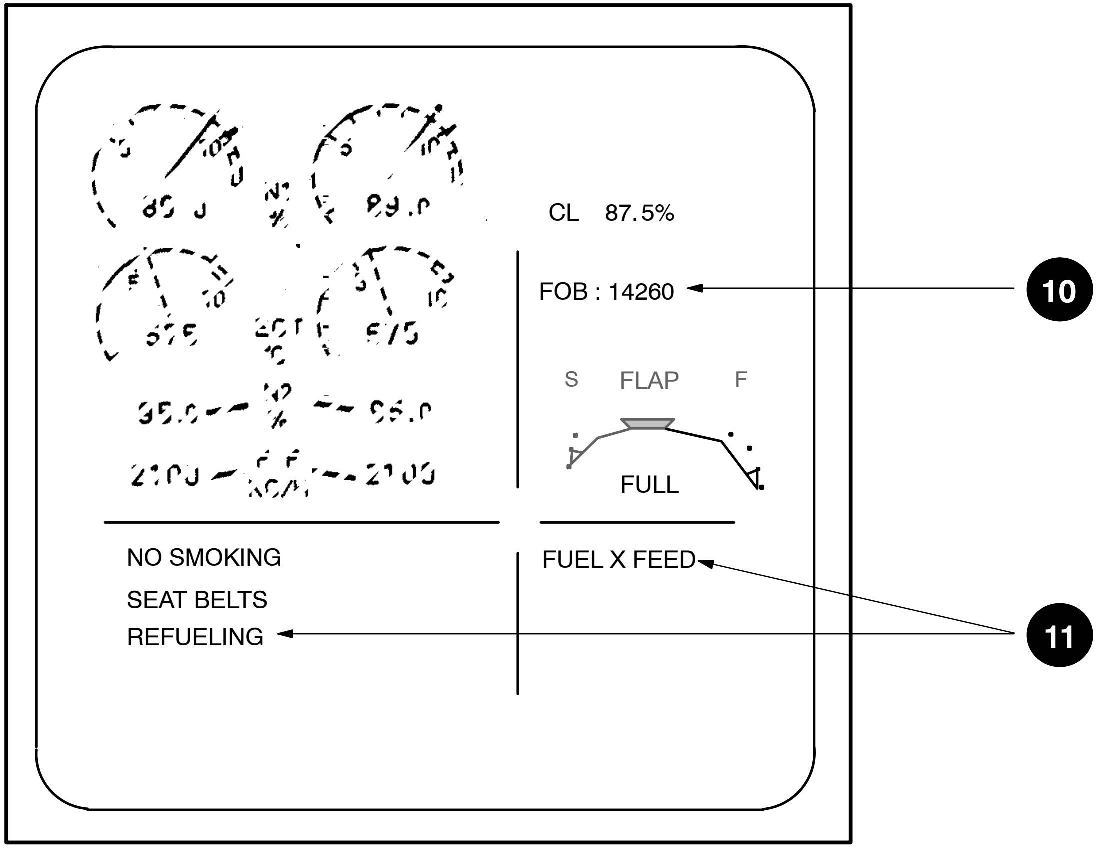


Figure 13 E/W Display

ECAM PAGE PRESENTATION A318 / ENHANCED SYSTEM

Ecam Presentation

All symboles like in the standard indication except for intercell Xfer valves and APU LP-Shut off valve.

Intercell Xfer Valves

See box **B** next page.

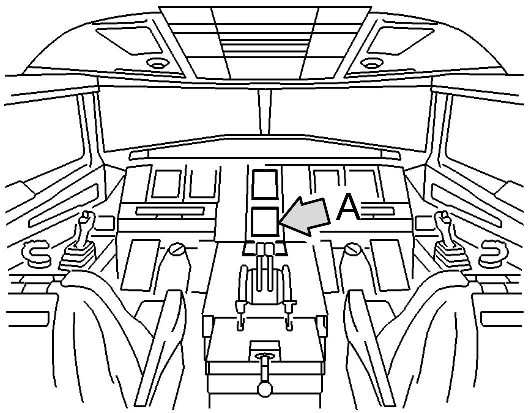
APU LP Shut Off Valve (see item: C)

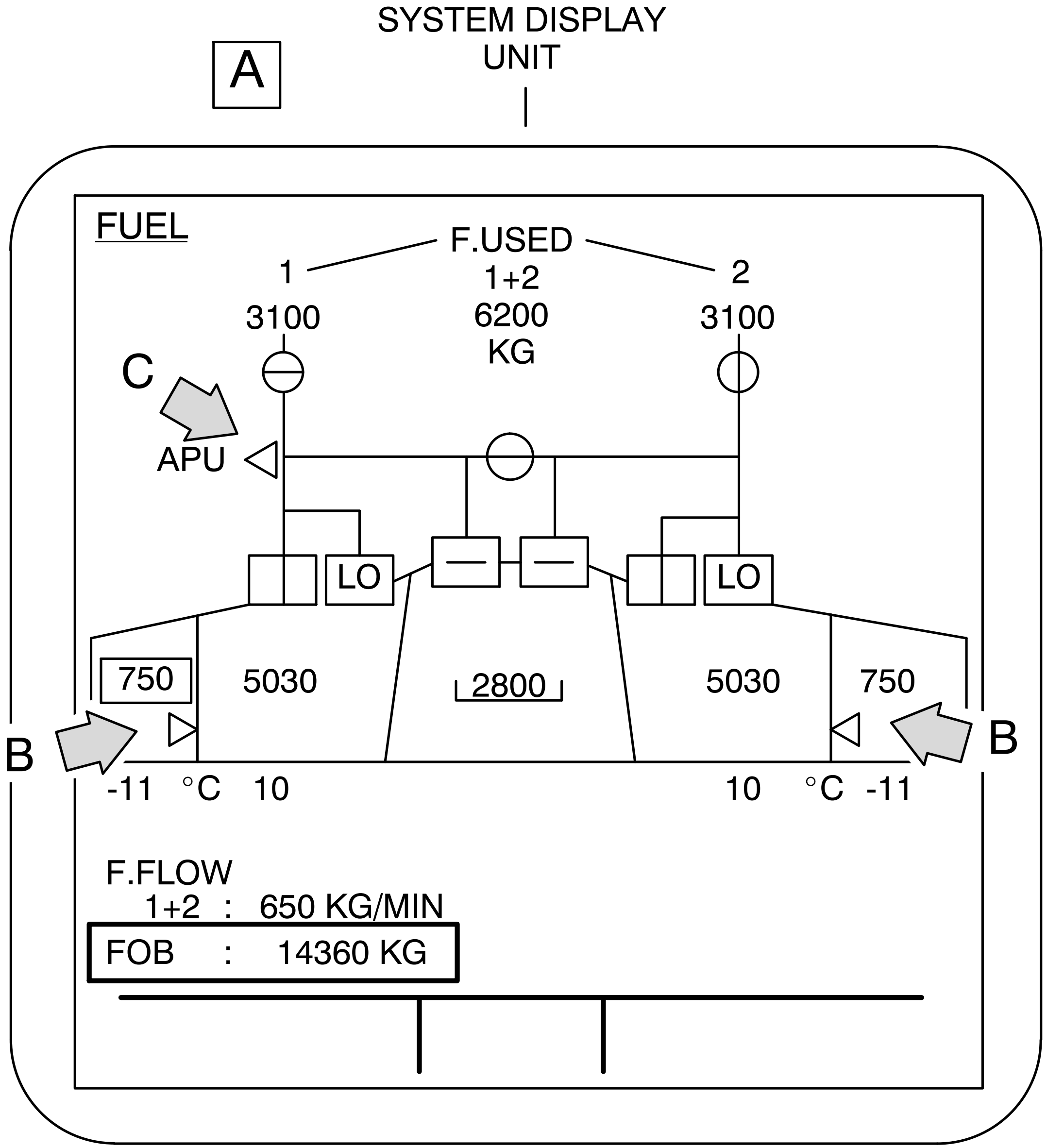
Valve closed: White

Valve open: Green

Valve transit or: Amber

emergency operation.





B

INDICATION		COLOR	VALVE OPERATION
LEFT	RIGHT		
		NONE	BOTH VALVES CLOSED
▶	◀	AMBER	BOTH VALVES FULLY OPEN BUT AT LEAST ONE SHOULD BE CLOSED
▷	◁	GREEN	ONE OR MORE VALVES IN TANK IS FULLY OPEN
▷	◁	AMBER	ONE VALVE IN OPERATION
XX	XX	AMBER	DATA NOT AVAILABLE

Figure 14 E/W Display A318/Enhanced System

ECAM PAGE PRESENTATION

1 Wing Pumps Indications

– Same as A318 / 319 / 320

2 Ctr TK Valves Indications

In line – Green: Transfer valve is open

In line – Amber: Transfer valve position disagrees with switch position (open)

Cross line – Green: Transfer valve is closed

Cross line – Amber: Transfer valve position disagrees with switch position (closed)

3 LP Valves (ENG – APU) Indications

– Same as A318 / 319 / 320

4 X Feed Indications

– Same as A318 / 319 / 320

6 Fuel Quantity Indication

4800 – It is normally green.
- the wing tank indication turns amber if a wing tank overflows

4800 – Amber line appears across the last two digits when FQI is inaccurat (degraded mode)

3500 – The center tank indication is boxed amber
- both transfer valves fail in the closed position

4800 – It is advisory in phases 2 and 6, when fuel unblance more 1500 Kg exist.The indication for the wing with the higher fuel level pulses.

XX – Fuel quantity not valid

7 Fuel Temperature Indication

– Same as A318 / 319 / 320

8 Fuel On Board Indication

– Same as A318 / 319 / 320

9 Fuel Used Indication

– Same as A318 / 319 / 320

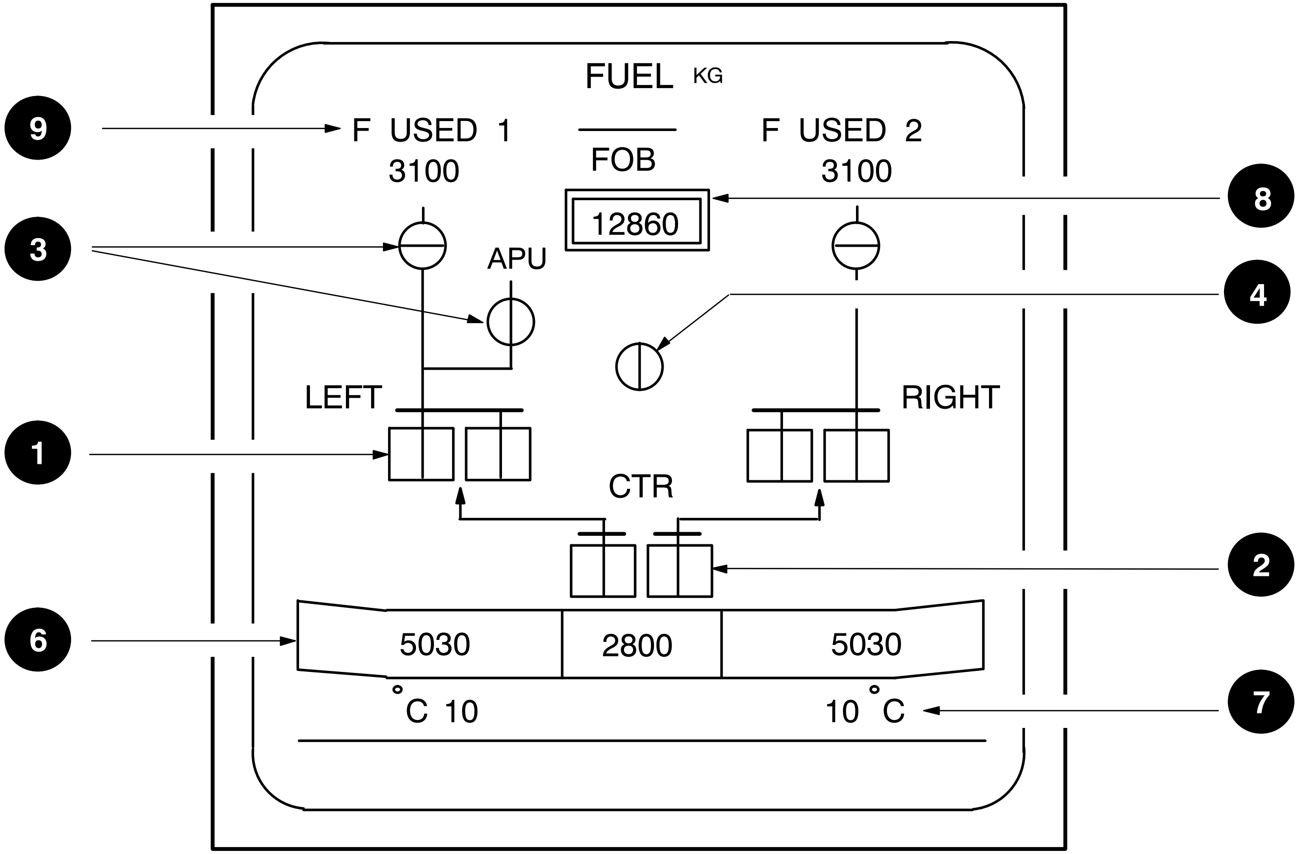


Figure 15 ECAM Fuel Page A321

Ecam Presentation (Cont)

(10) **Total Fuel Indication**

FOB: 12860
- An amber half box appears around FOB when the quantity shown is not all usable
  - both transfer valves fail in the open position
- Amber line appears across the last two digits when FQI is inaccurat (degraded mode)

(11) **Memo Indications (green)**

- The indication appears when the related function is selected, or the indicated condition exist.

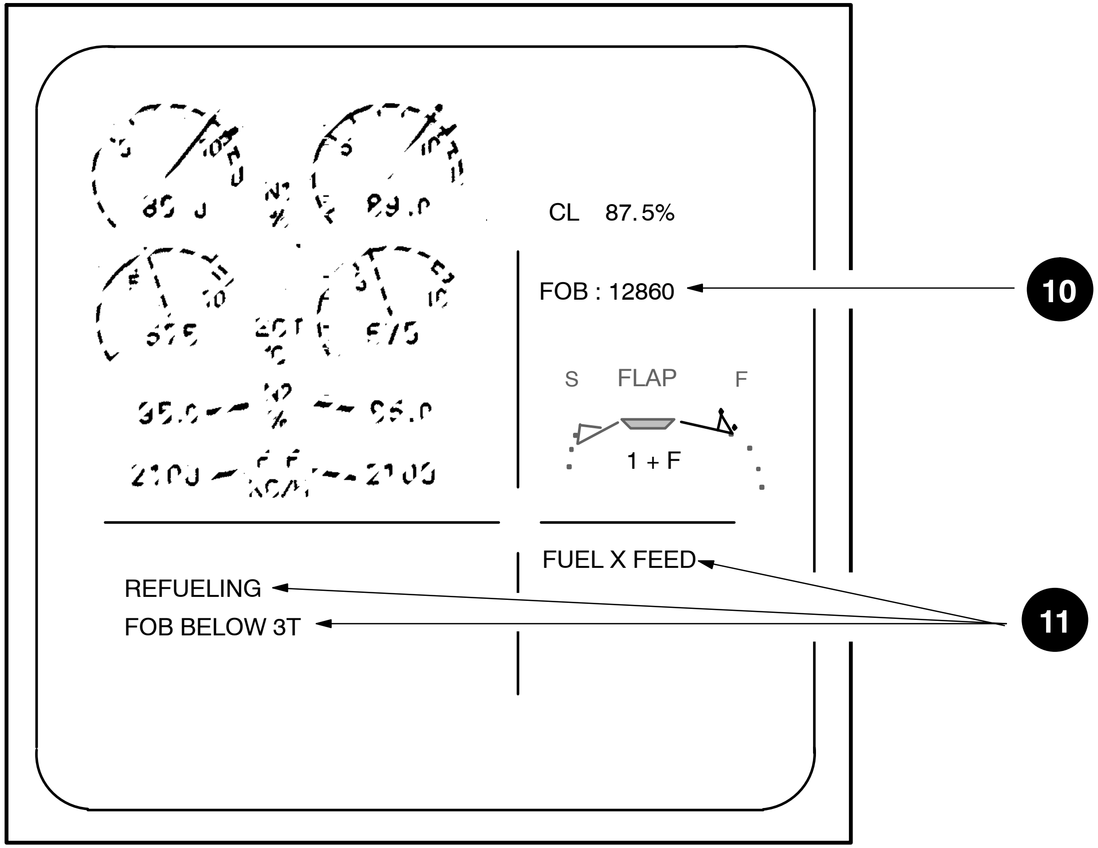
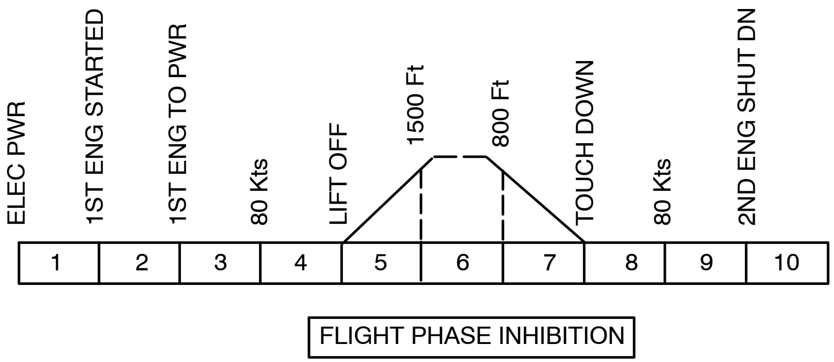


Figure 16 E/W Display

ECAM WARNINGS AND CAUTIONS

Example A318/319/320

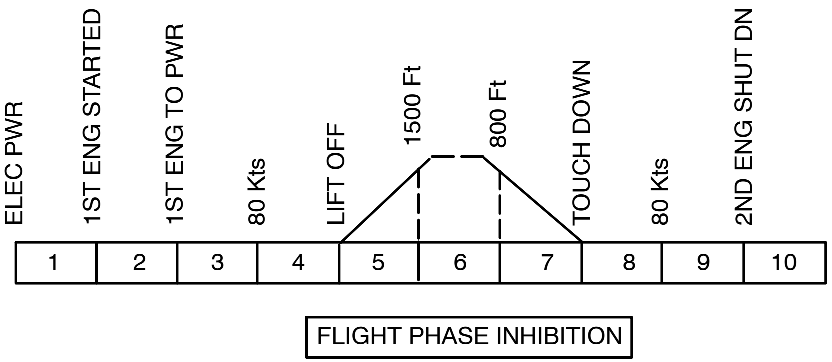


* inhibited if PUMP selected OFF

E / WD : FAILURE TITEL conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L (R) TK PUMP 1 + 2 LO PR	SINGLE CHIME	MASTER CAUT	FUEL	L (R) TK PUMP 1 + 2 FAULT lt	3. 4. 5. 7. 8 *
CTR TK PUMP 1 (2) LO PR				CTR TK PUMP 1 (2) FAULT lt	
CTR TK PUMPS LO PR				CTR TK PUMP FAULT lts	
CTR TK PUMPS OFF CTR TK pb at OFF with no FAULT				OFF lt on CTR TK PUMP pb	1, 3, 4, 5, 7, 8, 9, 10
AUTO FEED FAULT (CTR TK > 250 kg (550 lbs) and L or R WING TK < 5000 kg (110000 lbs)) OR (CTR TK pumps do not stop after slat extension or CTR TK low level)				MODE SEL FAULT lt NIL	3. 4. 5, 8
L (R) WING TK LO LVL 750 kg (1650 lbs)				NIL	3, 4, 5, 7, 8
L + R WING TK LO LVL Low level detected in both wing inner cells (remaining flt time about 30 min)					

Figure 17 ECAM Warnings/Inhibition Phases (1)

Example A318/319/320



E / WD : FAILURE TITEL conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L (R) OUTER TK HI TEMP or L (R) INNER TK HI TEMP Fuel temp above : . in outer cell above 55° on ground 60° in flight . in inner cell above 45° on ground 54° in flight	SINGLE CHIME	MASTER CAUT	FUEL	NIL	3, 4, 5, 7, 8
L (R) XFR VALVE CLOSED both transfer valves fail to open after inner cell low level	SINGLE CHIME	MASTER CAUT	FUEL	NIL	3, 4, 5, 7, 8
ENG 1 (2) LP VALVE OPEN valve disagree in open position	SINGLE CHIME	MASTER CAUT	FUEL	NIL	4, 5, 7, 8
APU LP VALVE FAULT valve position disagree	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
L (R) WING TK LO TEMP fuel low temp	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
L (R) TK PUMP 1 (2) LO PR	NIL	NIL	FUEL	L (R) TK PUMP 1 (2) FAULT lt	3, 4, 5, 7, 8 *
XFEED VALVE FAULT valve position disagree	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
FQI CH 1 (2) FAULT	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *

* PUMP LO PR is inhibited if pump is selected OFF in phases 1 and 10

Figure 18 ECAM Warnings/Inhibition Phases (2)

CB PANEL LOCATION: EXAMPLE A319/320

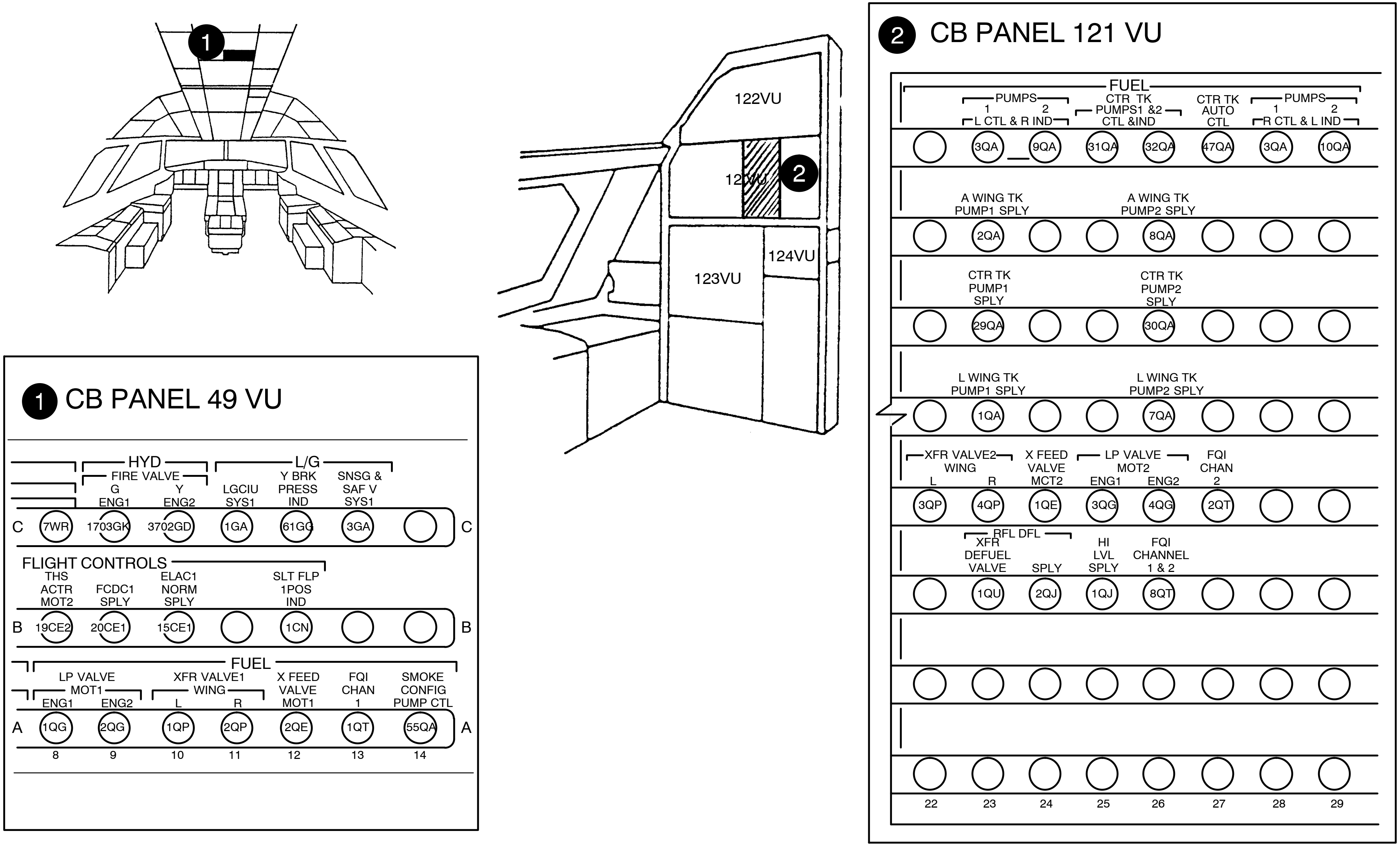


Figure 19 CB Panel Location

ELECTRICAL POWER SUPPLY: EXAMPLE A319/320

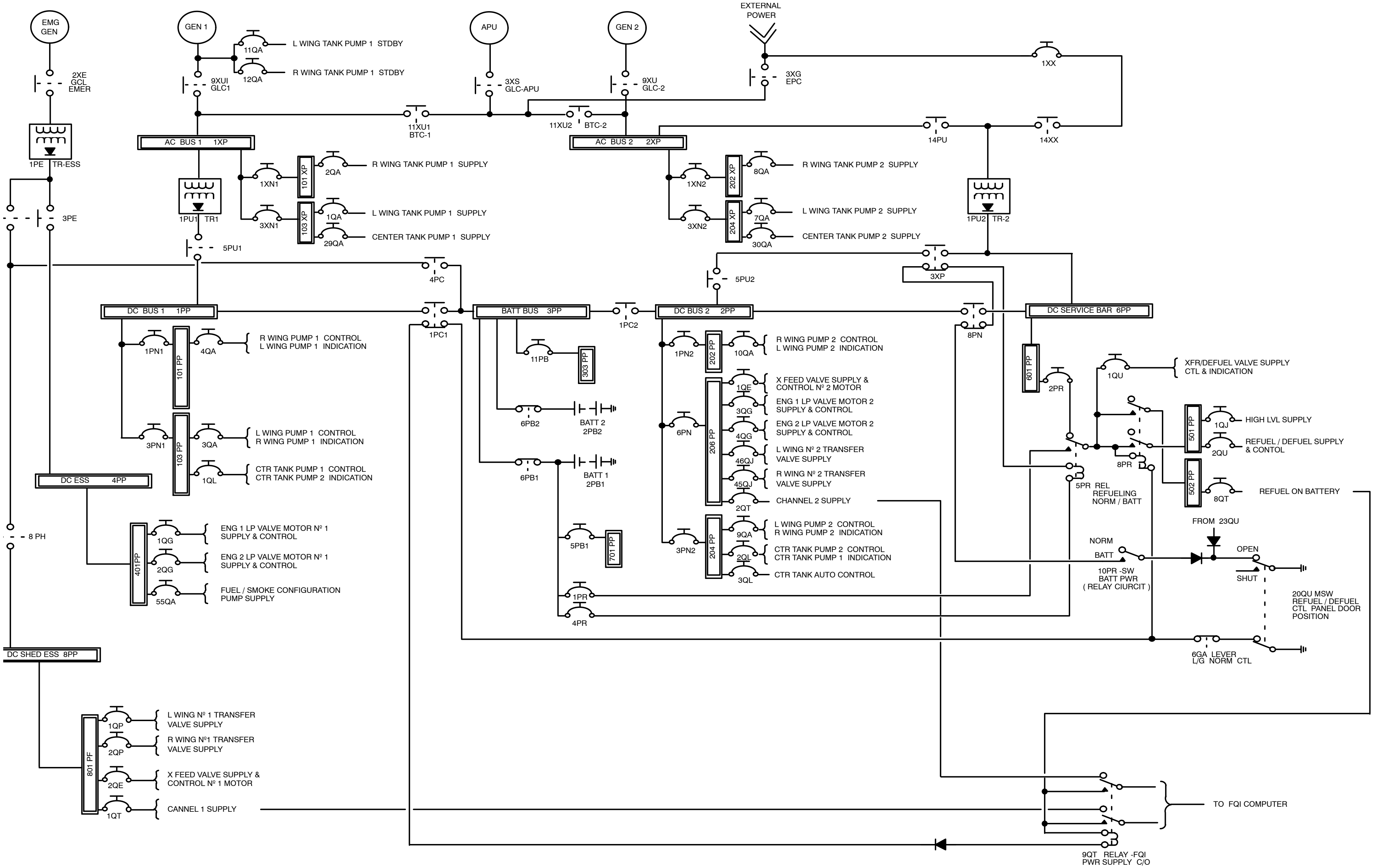


Figure 20 Electrical Power Supply

ACCESS PANELS

General Description

Access holes in the wing are closed by:

- Access panels
- Door panels
- Cover plates

Access Panels

There are 21 access panels installed in the wing bottom skin and two panels in the main wheel well (access to the center tank).
These are of different types.
The access panels are attached to the bottom skin panel with bolts which go either:

- through the access panel and into nuts on the bottom skin panel
- or through a ring clamp and into nuts on the access panel.

Safety Precautions

You must obey the fuel safety procedures when you do work in a fuel tank.
– REF AMM Task 28 – 00 – 00 – 910 – 001
You must obey these precautions when you go in a fuel tank or when you remove a fuel tank access panel (panels).
Read this precautions together with the special notes and precautions which are applicable to specified maintenance operations.

NOTE: This precautions are the minimum safety standard for work in a fuel tank.
But, the Local Regulations can make other safety precautions necessary.

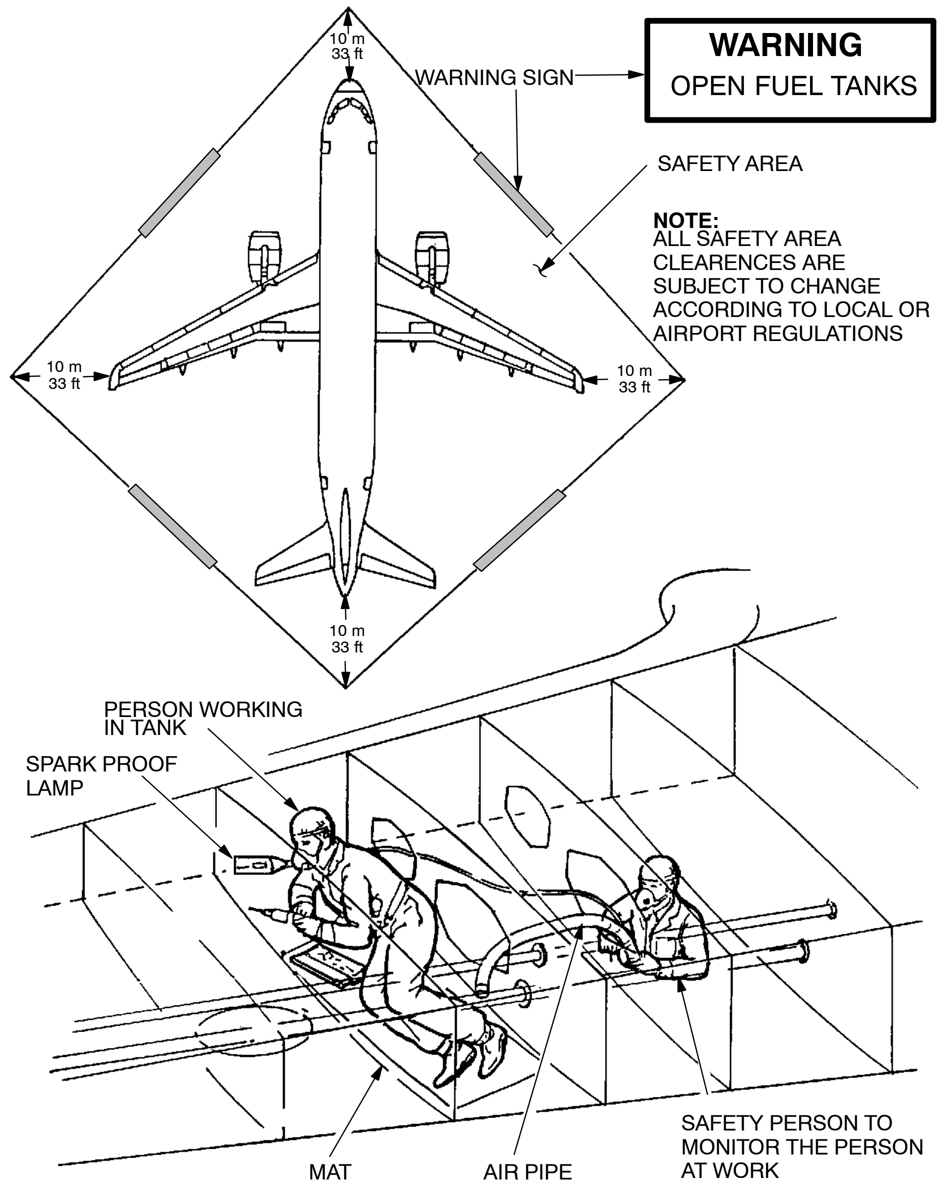
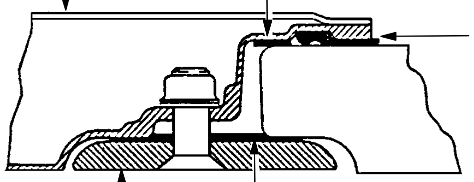
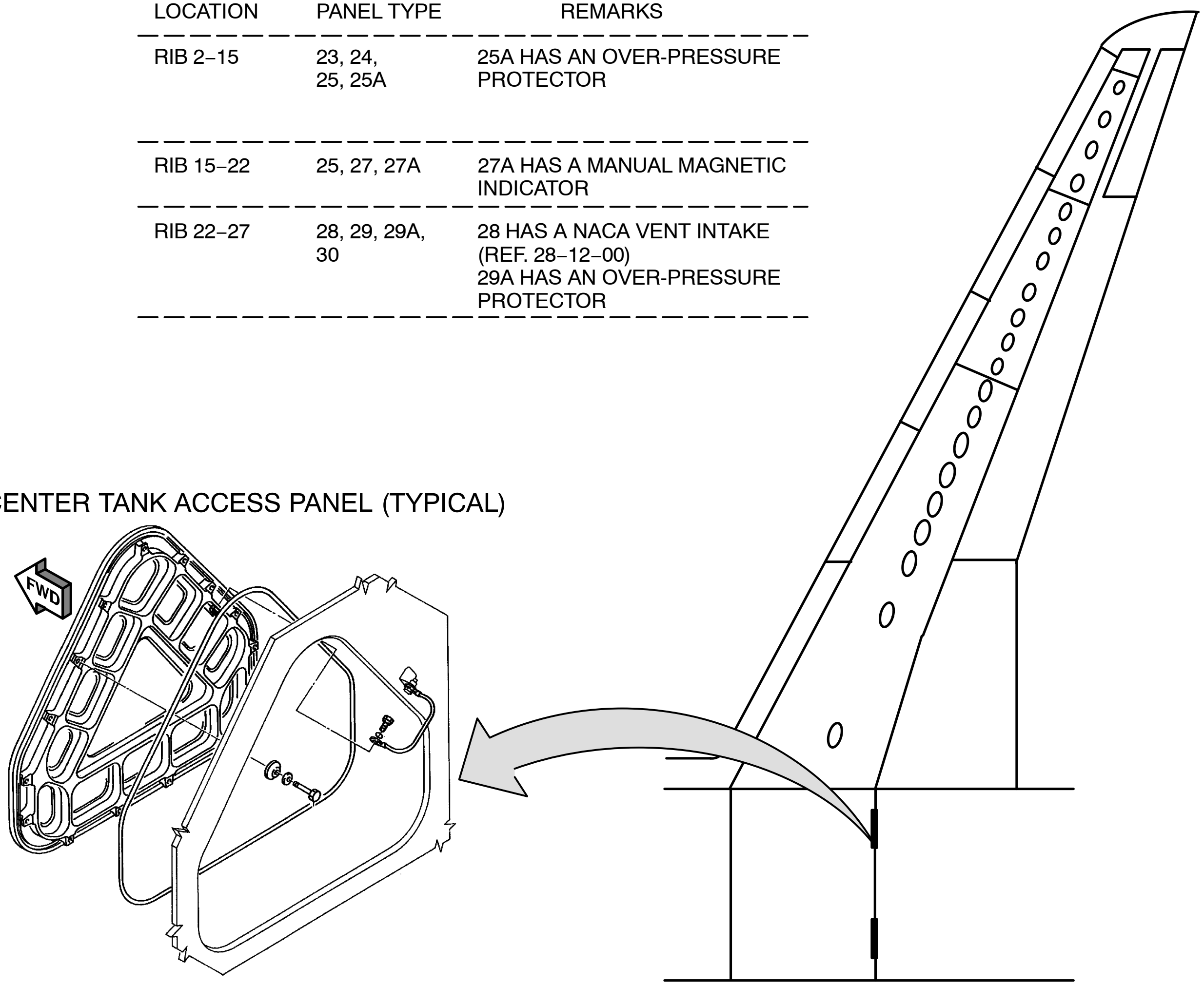


Figure 21 Precaution Example



LOCATION	PANEL TYPE	REMARKS
RIB 2–15	23, 24, 25, 25A	25A HAS AN OVER-PRESSURE PROTECTOR
RIB 15–22	25, 27, 27A	27A HAS A MANUAL MAGNETIC INDICATOR
RIB 22–27	28, 29, 29A, 30	28 HAS A NACA VENT INTAKE (REF. 28–12–00) 29A HAS AN OVER-PRESSURE PROTECTOR



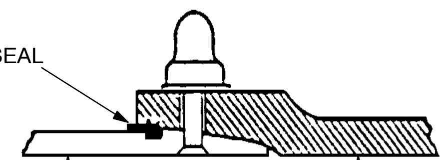
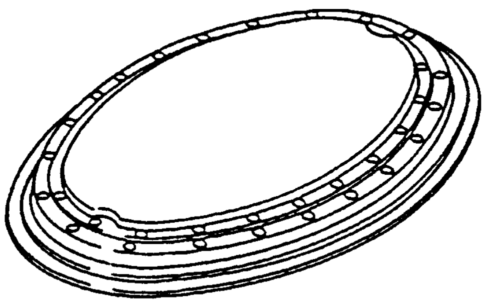


Figure 22 Access Panels

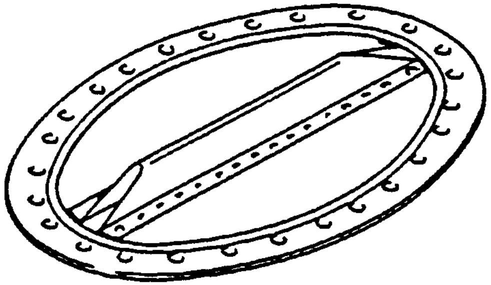
PANEL TYPES AND LOCATIONS

LOCATION	PANEL TYPE	REMARKS
RIB 2–15	23, 24, 25, 25A	25A HAS AN OVER-PRESSURE PROTECTOR
RIB 15–22	25, 27, 27A	27A HAS A MANUAL MAGNETIC INDICATOR
RIB 22–27	28, 29, 29A, 30	28 HAS A NACA VENT INTAKE (REF. 28–12–00) 29A HAS AN OVER-PRESSURE PROTECTOR

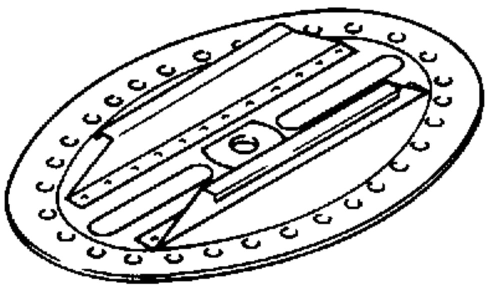
TYPES 23 and 24



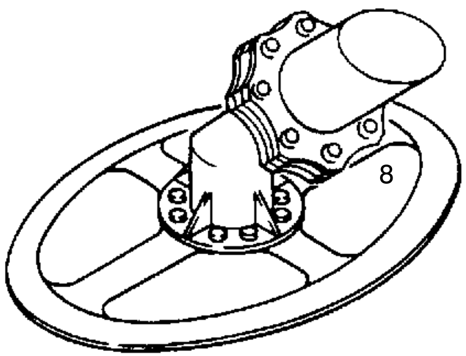
TYPES 25, 27,and 29



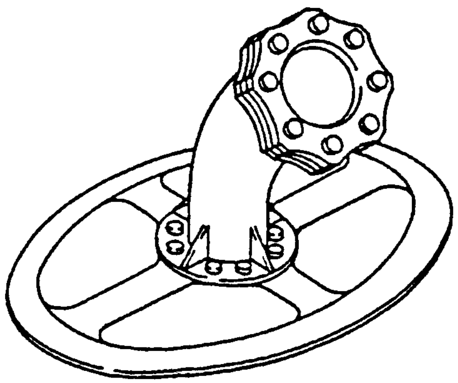
TYPE 27A



TYPE 27B



TYPE 25A



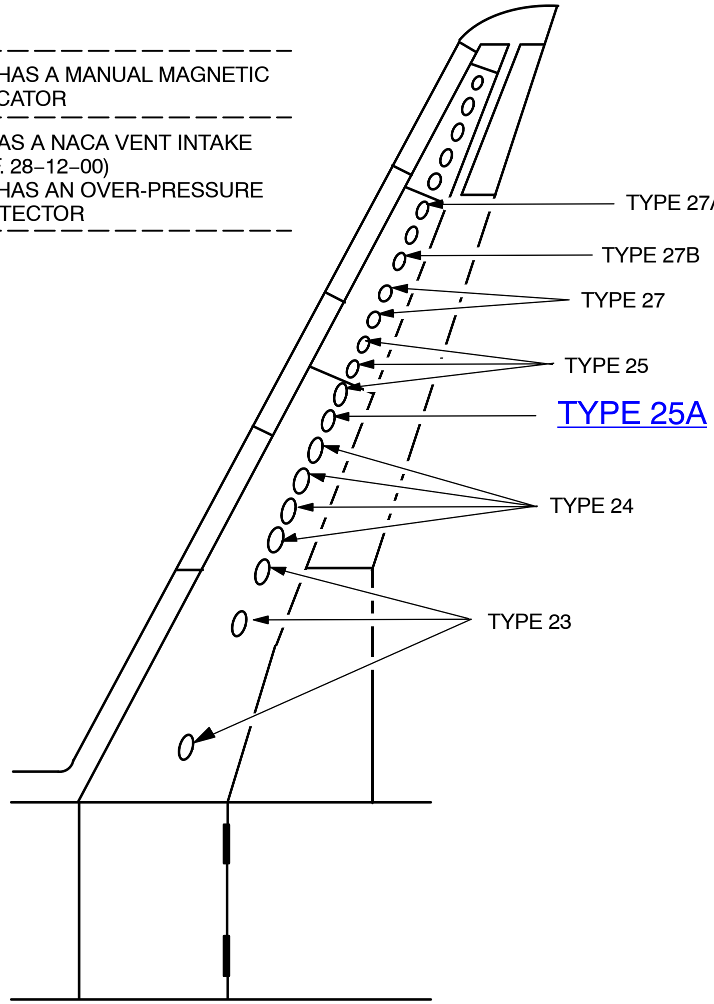
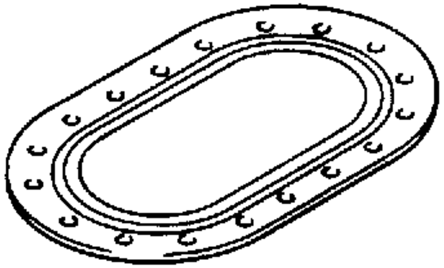
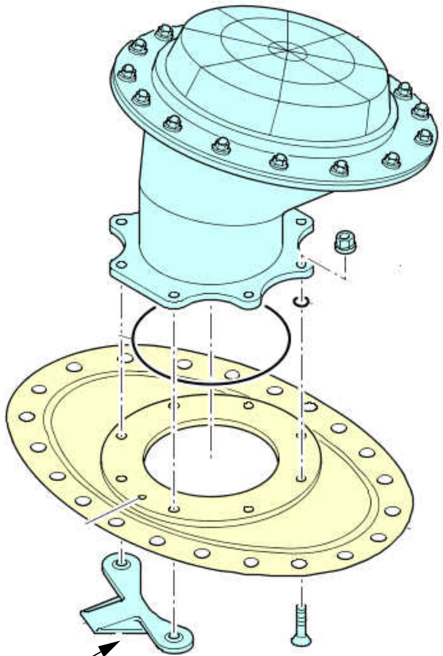


Figure 23 Access Panels

TYPE 30



LOCATION	PANEL TYPE	REMARKS
RIB 2–15	23, 24, 25, 25A	25A HAS AN OVER-PRESSURE PROTECTOR
RIB 15–22	25, 27, 27A	27A HAS A MANUAL MAGNETIC INDICATOR
RIB 22–27	28, 29, 29A, 30	28 HAS A NACA VENT INTAKE (REF. 28–12–00) 29A HAS AN OVER-PRESSURE PROTECTOR

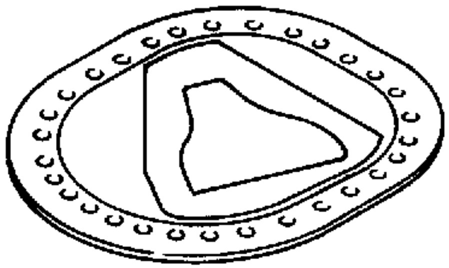


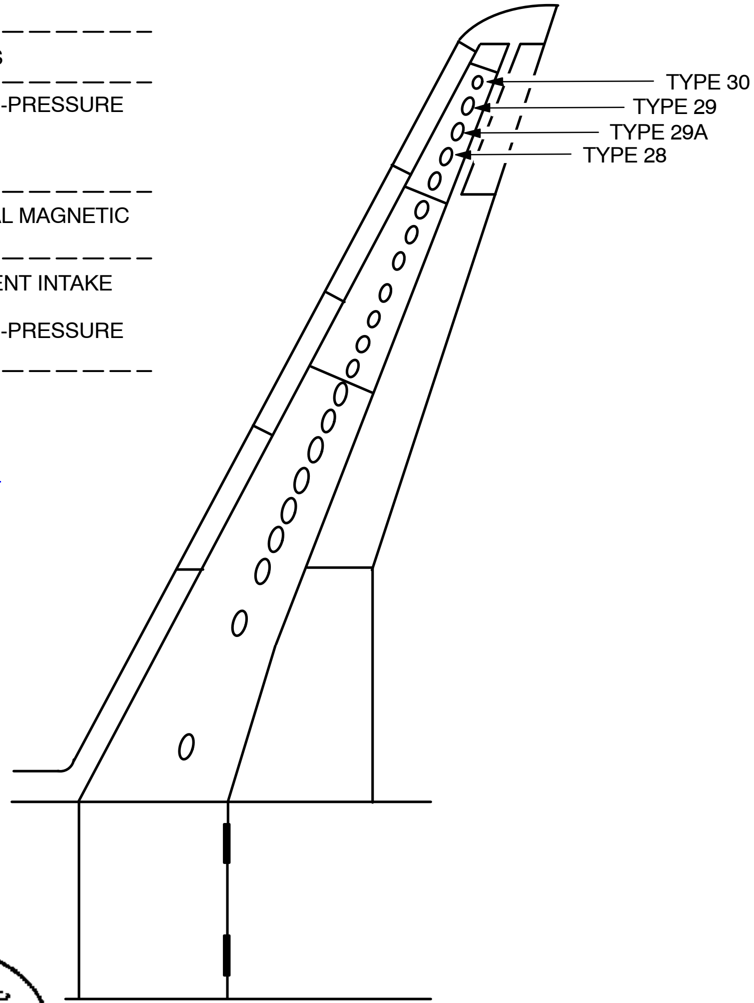
OVER PRESSURE PROTECTOR

TYPE 25 A + 29A

NACA VENT INTAKE

TYPE 28





VORTEX GENERATOR
(enhanced A/C)

Figure 24 Access Panels

Modified access panels (enhanced A/C only)

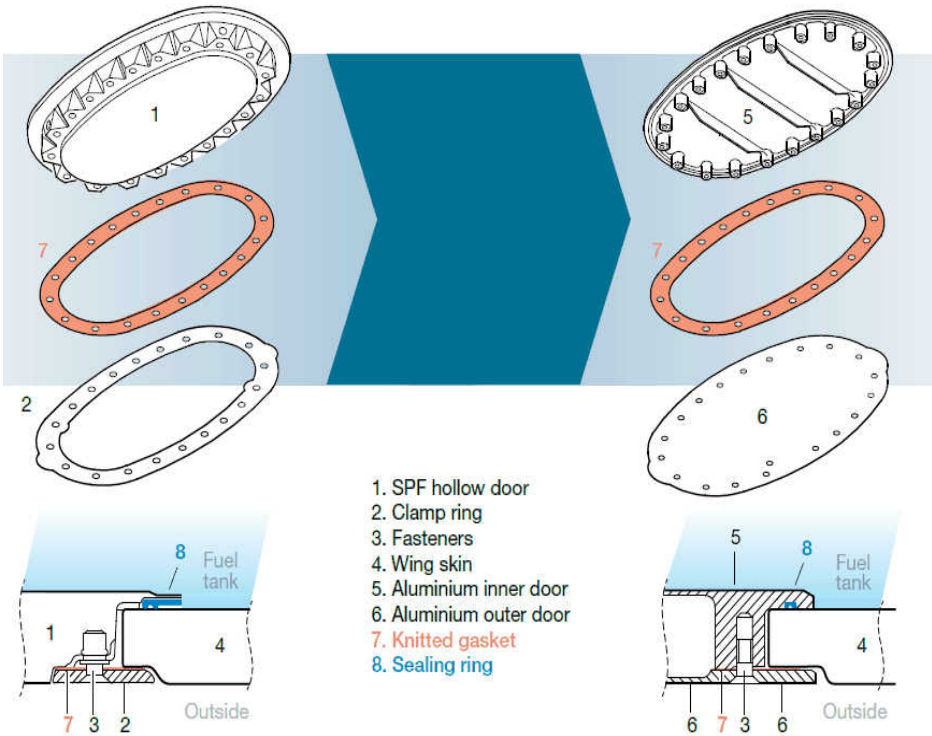
Before the modification, some of the fuel tank accesses panels were fitted as standard with panels made in a light titanium structure filled with foam, and held in place by a clamp ring.

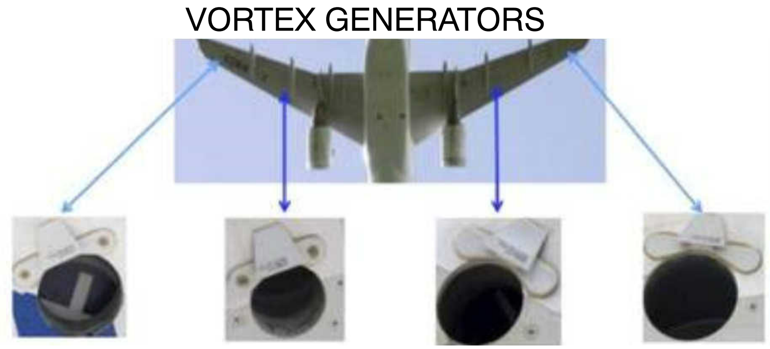
A drawback to this design is that fuel sometimes entered the hollow structure. The modification introduced a new machined aluminum panel composed of an inner and outer door that clamp together against the wing skin, sealing the hole. These are now installed as standard.

Vortex Generator (enhanced A/C only)

In order to reduce aircraft noise levels vortex generators have been installed on enhanced aircraft.

Acc. CDL all generators may be missing (always check actual CDL).





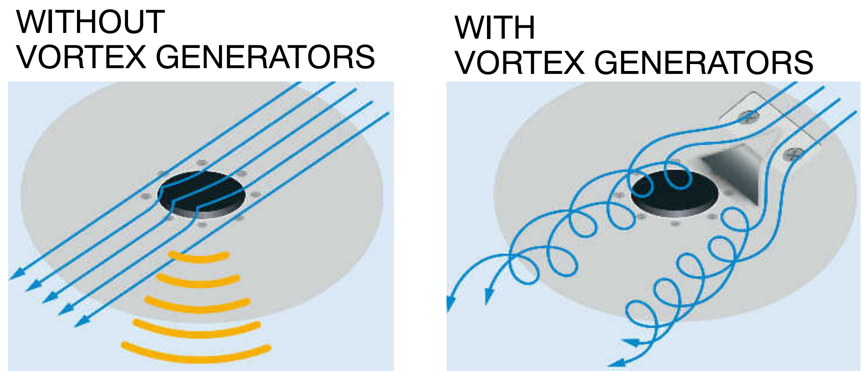


Figure 25 Modified Access Panels and Vortex Generators

FUEL STORAGE

Tank Presentation

Fuel is carried in tree tanks:

- the left hand wing tank
- the right hand wing tank
- the center tank
  - on A321 center transfer tank

The tanks are integral tanks, the wing tanks are formed by forward and rear spar, upper and lower skin, and closed ribs.

Each fuel tank, when nomally full, has 2% additionel space for expansion without spillage into the vent surge tank which can contain 190 ltr before overflowing.

On A318/319/320 Rib15 divides the wing tank in an outer and an inner cell. Electrically operated transfer valves are provided to transfer the outer cell fuel into the inner cell when the inner cell detects low level (approx. 75O kgs).

– The wing tank of the 321 does not have a devision off an inner and outer zell, it is just one tank.

To be sure, that the wing tank pumps always immersed in fuel during flight manoeuvers, they are located in the collector box formed between rib 1 and 2.

Clack valves installed at the bottom of rib 2 let the fuel enter into the collector box but prevent reverse flow.

Access to the wing tanks is provided by man–holes on the lower wing skin.

The center tank is located forward of the wheel well between the cabin floor and the airconditioning compartment.

Access to the center tank is provided by panels in the rear spar, (accessable from the main wheel well).

In all tanks boost pumps, pressure switches, valve actuators, drain valves magnetic level sticks, etc. may be replaced with–out getting access to the tank.

Clack Valves

The clack valves in the Rib 2 let the fuel enter the area between Rib 1 and Rib 2 but do not let fuel outboard oft he Rib 2.

This makes sure that the main fuel pumps are always in fuel during wing down maneuvers.

Clack Valves (A321)

The clack valves in the Rib 22 let the fuel that has enterd the vent surge tanks return to the related wing tank.The clack valves do not let fuel enter the vent surge tanks from the wing tanks,

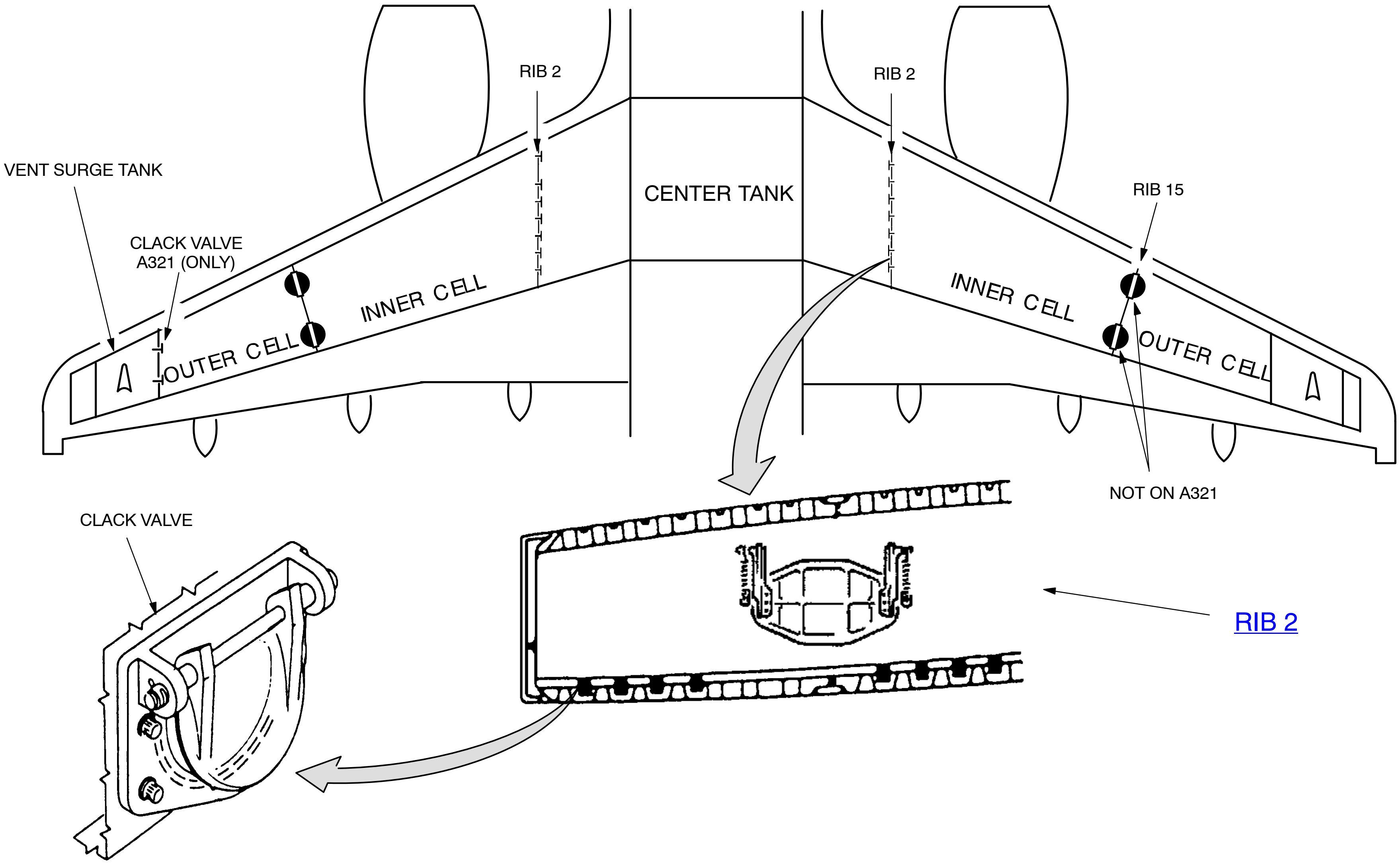


Figure 26 Fuel Storage

Water drain valves

Each tank has one or more water drain valves. These are used to:

- drain the water from the fuel in the fuel tanks
- drain all the remaining fuel from the tank (for maintenance).

The water drain valves are installed at the lowest part of each tank as follows (A318/319/320):

- outboard of RIB 22 (vent surge tank drain)
- outboard of RIB 15 (wing−tank outer−cell drain)
- inboard of RIB 2 (wing−tank inner−cell drain)
- inboard of RIB 1 LH and RH (center tank drain).

The water drain valves are installed at the lowest part of each tank as follows (A321):

- outboard of RIB 22 (vent surge tank drain)
- inboard of RIB 2 (wing tank drain)
- inboard of RIB 1 LH and RH (center tank drain).

The primary components are:

- the body, which has a mounting flange
- a remote inlet (wing−tank water drain only)
- an outer valve and spring
- an inner valve and spring
- a support guide.

The mounting flange connects the valve to the aircraft skin. The body contains the inner and outer valves and springs. The inner valve is installed in the outer valve and the springs keep the two valves in the closed position. The support guide keeps the two valves aligned when they operate. The remote inlet has a short pipe connected to it, which goes to the lowest part of the fuel tank.

The water drain valves in the center tank and the vent surge tanks do not have a remote inlet. Thus they only drain their adjacent area.

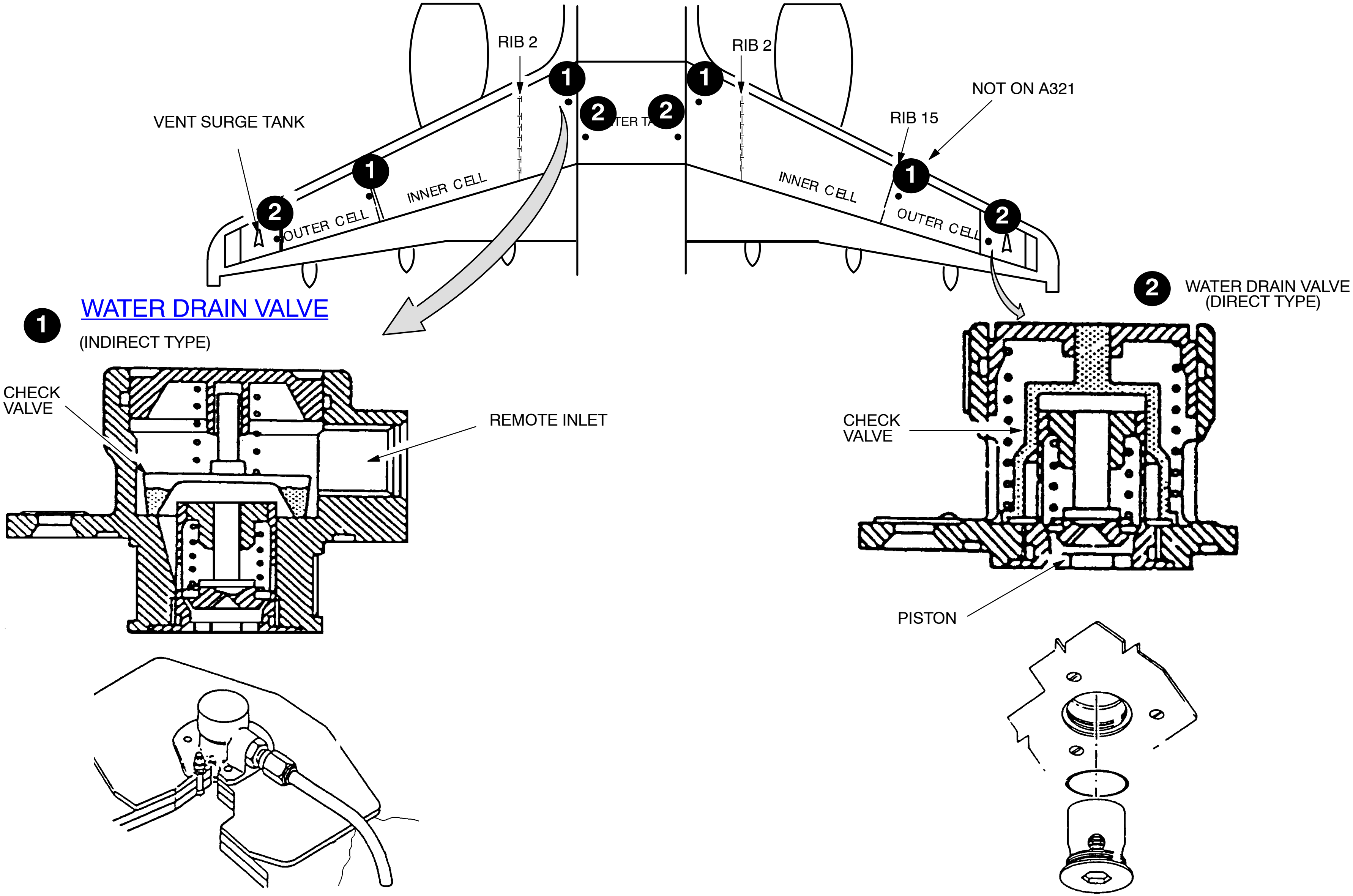


Figure 27 Water Drain Valve

FUEL TANK VENTILATION

General

The fuel tank ventilation system allow air to enter the tanks during fuel use, and also allow air to escape during refuelling.

If any of the fuel tanks become overfilled, fuel will also escape through the vent system, preventing damage to the wing.

The fuel vent system consist of left and right vent tank, located in the wing tip area, and pipes connecting the individual tanks to the vent surge tanks

Right wing tank is ventilated to right surge tank. Left wing tank and the center tank are ventilated to left surge tank.

The surge tank is connected to ambient via a NACA intake. To minimize the risk of explosion due to lightning, a flame arrestor is installed between the intake and the surge tank to prevent a ground fire to enter the vent tank.

A overboard Overpressure Protector protects the surge tank from overpressure.

The dimension of the vent system is sufficent to allow fuel spillage in case of a fill valve failure.

Vent float valves will prevent fuel from entering the vent system during excessive flight manoeuvres.

On A318 / 319 / 320 a Jet Pump system, using the wing tank booster pumps as motive power will collect eventual fuel from the surge tanks and discharge it into the wing tanks.

The structure is protected against failure in the ventilation system by means of burstable Overpressure Protectors. The Inner cell is connected to outer cell and to the center tank. The inner cell has in addition a overboard pressure relief device.

The overboard Overpressure Protectors are visible from the ground.

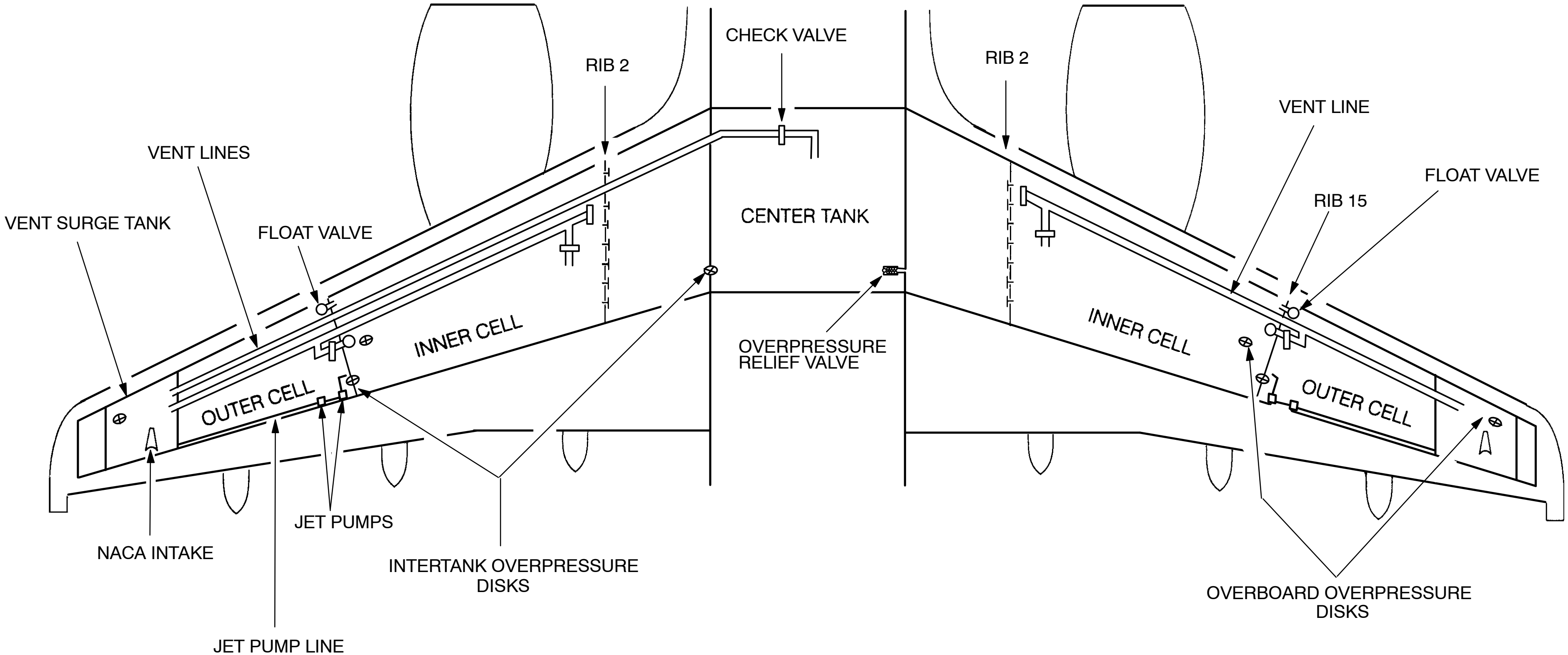


Figure 28 Tank Ventilation System A318/319/320

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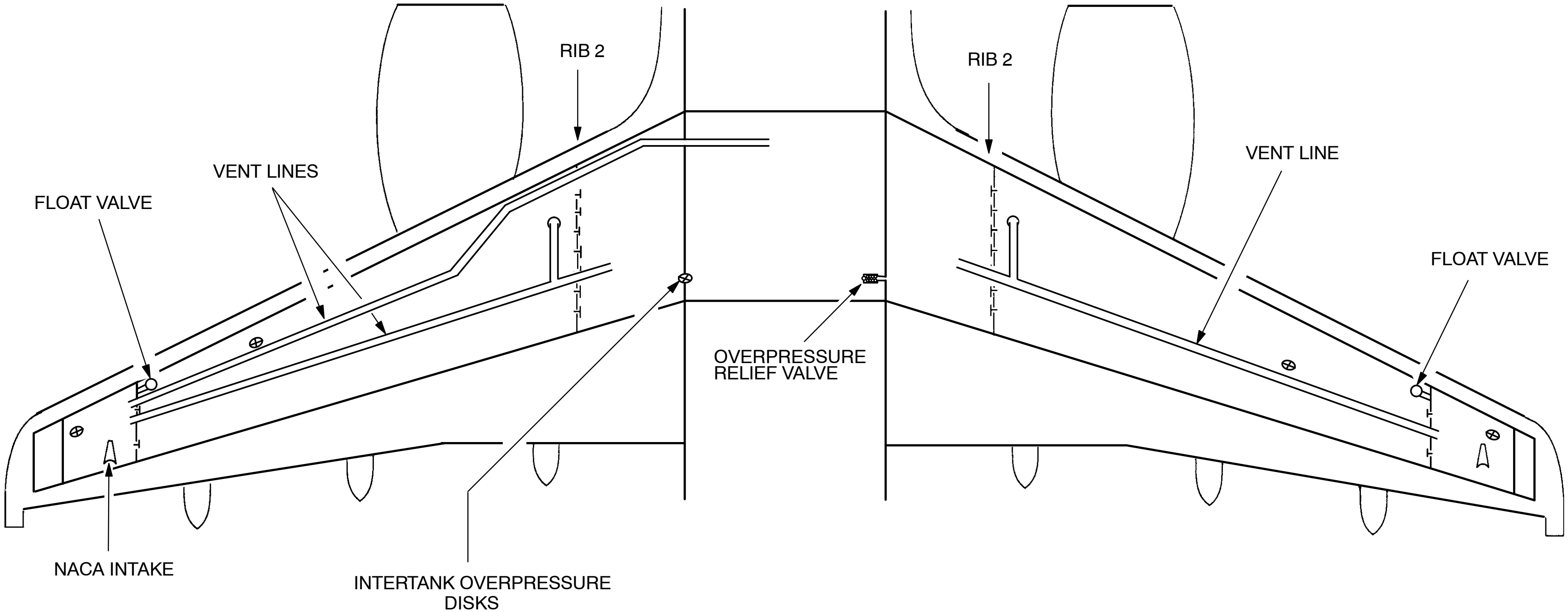


Figure 29 Tank Ventilation System A321

TANK VENT SYSTEM COMPONENTS

Vent Surge Tank

A vent surge tank is located outboard of the left and right wing tanks. The purpose of the vent tank is to ventilate the fuel tanks and allow air to enter the tank during fuel use.

The vent surge tank is connected to ambient through a NACA intake.

Vent Protector

The vent protector is a static unit comprising a flanged cartridge with anti-icing baffles and a single section of rolled corrugated strip forming a flame arrestor.

The protector locates in the intake with O - ring seals to ensure gas tight joints, and is secured with bolts

Check Valves

Rubber check valves are installed in the vent lines to allow any fuel that findes its way into the vent lines to drain back into the tank.

Vent Float Valve

A float operated arm opens or closes this valve depending upon the fuel level.

The valve will also open:

- when subjected to an inward pressure differential of 0.5 psig with a full tank.
- against an outward pressure differential of 1 psig with fuel level below the float.

Overpressure Protectors

Overpressure protectors are installed between the tanks or overboard through the lower surface.

The protectors contain a carbon disc which bursts when subjected to overpressure. When an protector relieves into an adjoining tank a basket retains the pices of broken disc.

For the disc bursting pressure REF AMM bursting pressure table.

An overpressure relief valve (not shown) is located between the center tank and the right tank.

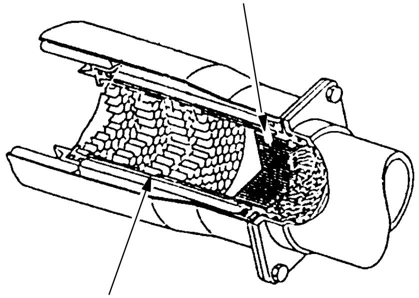
Vent Ducts

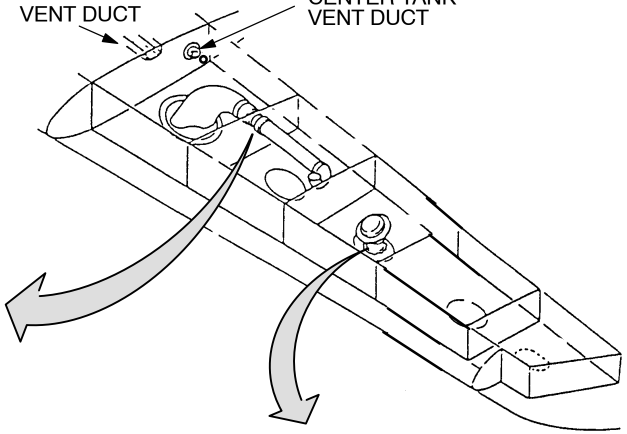
In the wing tank there is a gallery formed by a pair of top surface stringers capped by sealig plate which extendes from Rib 2 to the vent surge tank.

The ducts are large enough to ensure that if the pressure refueling shut-off failed, exess fuel can be discharged overboard to the NACA intake without the tank pressure exeeding designed limits.

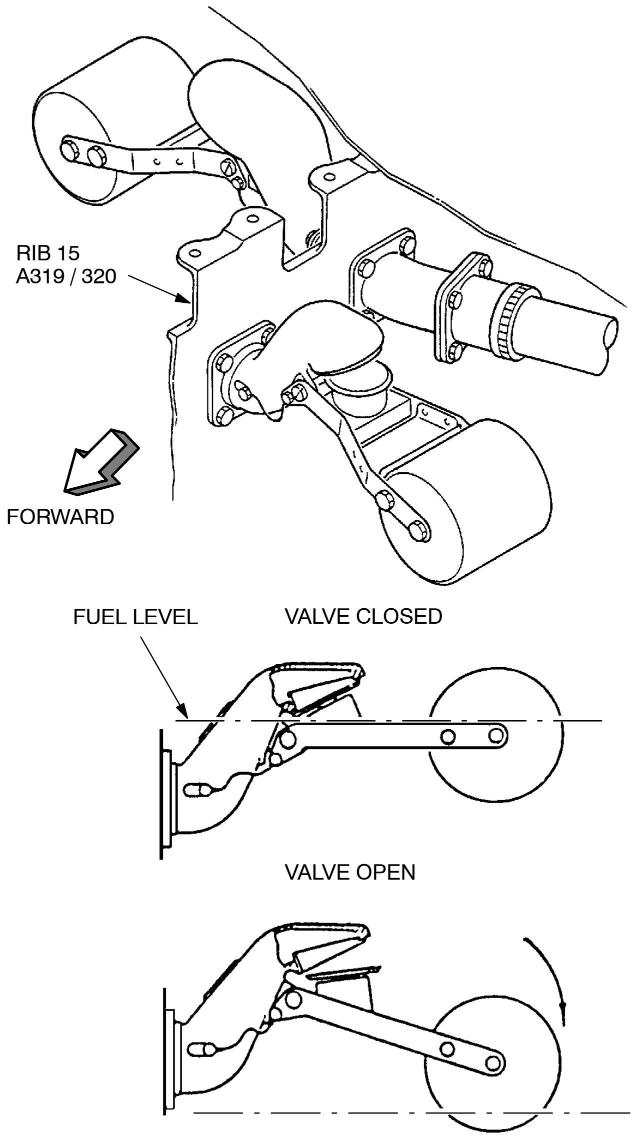
The center tank vent line is a conventional open line large enough for airflow only. With its open end at the center tank, the line runs through the wing tank to the vent surge tank.

VENT PROTECTOR

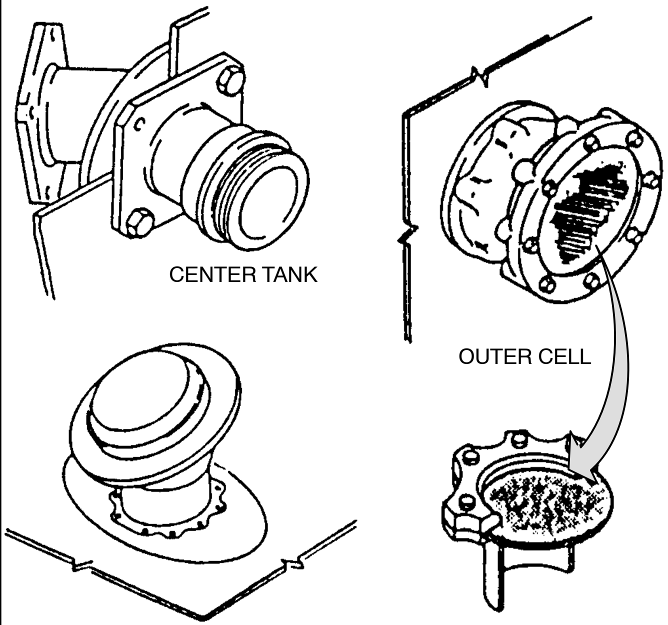




FLOAT VALVE (TYPICAL)



OVERPRESSURE PROTECTORS



CHECK VALVE (TYPICAL)

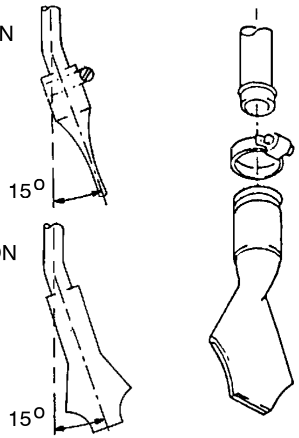


Figure 30 Tank Vent System Components

CENTER TANK AREA VENTILATION

General Description

The Center tank is located above the the Air Condition compartment.

The center tank ventilation system:

- has a vapour seal membrane that seals the bottom of the center tank from the airconditioning compartment.
- lets a flow of air from the air condition systems ducted to a distribution manifold at the tank front spar to go through the space between the membrane and the bottom of the center tank to ambient through the drain mast.
- A collecting manifold at the rear spar drains the air to ambient via a drain mast at the lower surface of the fuselage.
- The drain mast is aiso connected to the APU fuel supply shroud.

In the event of fuel flowing from the drain mast, check the leak monitor to determine the area of leakage center tank or APU fuel supply line.

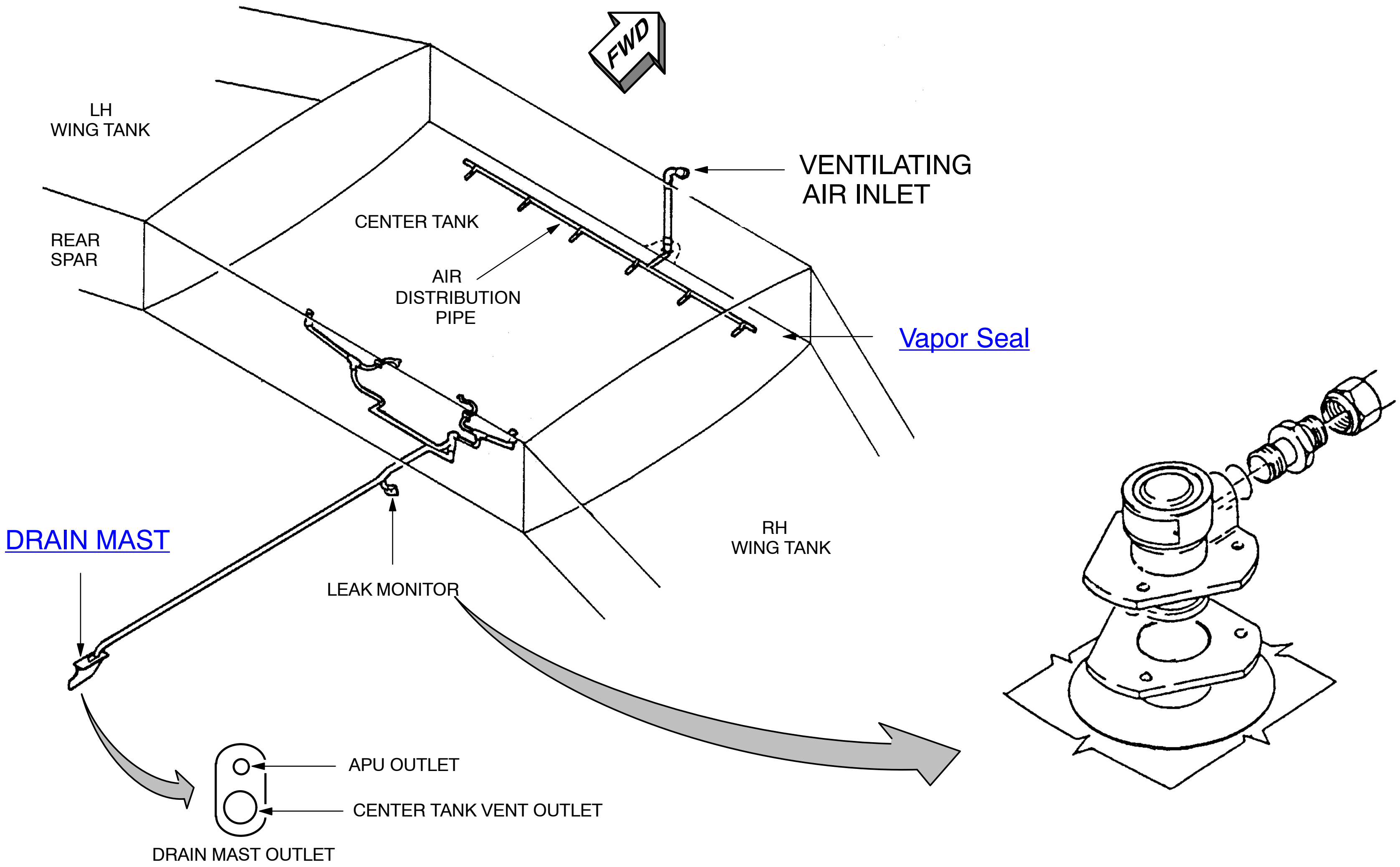


Figure 31 External Ventilation System

REFUEL/DEFUEL SYSTEM DESCRIPTION

System Description

A single refuel/defuel receptacle is located in right wing leading edge.

– Optionally one additional receptacle can be installed in leftwing.

The receptacle is connected to a Fuel Fill Gallery, running inside the tanks from right to left wing.

Three solenoid operated refuel valves are connected to the refuel gallery. The wing tank valves are located on the tank front spar in the inner cell area. The center tank valve is on the rear spar in the center tank area.

A refuel/defuel control panel is located at the lower right fuselage.

- or the refuel/defuel panel can be located on the lower surface of the RH wing next to the refuel receptacle.

– Optionally an additional refuel panel can be installed on the cockpit overhead panel.

System Operation General

NOTE: Refueling at both right and left receptacle simultaneously is not permitted. Refuel pressure at the couplings is max 50 psi (3.45 bar)

This will give the following flow rates:

• all tanks ~ 1400 l/min

This is an average flow rate of 1400 l / min (370 USG/min), which will fill the tanks from empty in approximately 20 minutes.

When automatic refueling is performed, the required total fuel quantity is pre-selected with the rocker switch on the refuel control panel. When selected fuel level is above full wing tanks, the center tank valve will open allowing simultaneous filling of all tanks.

The refuel valve solenoids receives power for opening through the control panel.

The wing tank refuel valves are connected to a duct, discharging the fuel into the outer cells. When outer cells are full, the fuel will enter the inner cells through a spill pipe. Fuel enters the tanks passing a diffuser, preventing build up of electro static charge.

Top Up:

During automatic refueling, the fill valves will close before selected level is obtained. This is started 5 seconds after the primary fill quantity has been reached

The FQIC calculates the final level in the individual tank, using the actual tank density, high level values (if appropriate) and the the actuell quantity preselected.

The fill valve will open again, when level is not correct within +/ - 100 kg.
At the end of the top up, the refueling is completed.

When the pre-selected level is reached, the refuelling will stop automatically by deenergizing the refuel valve solenoids the ”END” light will illuminate.

Refueling may be performed with battery power only.

The refuel valves can be opened manually in case of solenoid failure or if power is not available.

A HI LVL sensing system prevents the tanks from being overfilled.

A defuel/transfer valve can be opened from the refuel control panel.
The valve will connect the fuel feed line (of engine no 2) with the fuel fill line and is operated for defuel of the aircraft, or for transfer of fuel between the tanks.

The tank booster pumps are used to pressurize the fill line during defueling and transfer.

Gravity refueling of the wing tanks are possible through fill ports on the wing upper outer surface into outer cell.

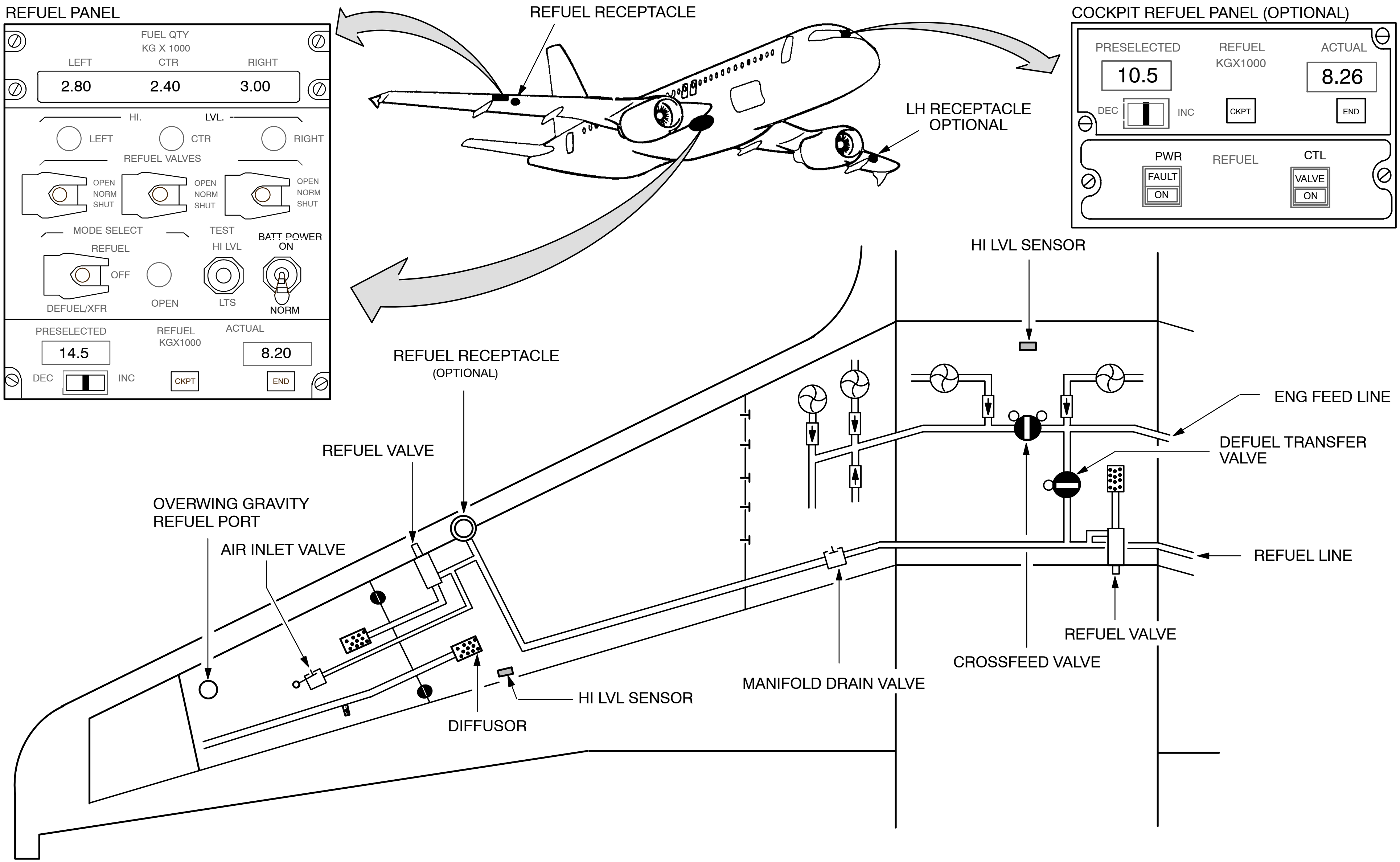


Figure 32 Refuel/Defuel Schematic

REFUEL/DEFUEL SYSTEM OPERATION

Automatic Refueling Operation

Refueling can be performed with External Power or with Aircraft Batteries in use.

Preparation

You must stop the fuel tanker 60 m (200 ft.) from the aircraft nose, if there is a test on the weather radar. Do not refuel the aircraft until the test is completed.

Before you refuel the aircraft you must make the area around the aircraft safe.

Aircraft fuel is flammable. Persons in the safety area must not :

- smoke.
- make sparks or fire.
- use any equipment which is not approved for the refuel procedure.

Obey the safety precautions for the refuel procedure.

Make sure that the fuel tanker driver has drained the water from the fuel tanker.

CAUTION: DO NOT USE THE TWO REFUEL / DEFUEL COUPLINGS AT THE SAME TIME TO REFUEL THE AIRCRAFT. USE ONLY ONE SIDE.

WARNING: YOU MUST MAKE SURE THAT YOU HAVE GROUNDED THE FUEL TANKER AND THE AIRCRAFT CORRECTLY

Make sure that the hose coupling is clean, then connect it to the aircraft.

Energize the aircraft electrical network.

Open the access door 192 MB. Make sure that the panel floodlight comes on.

Refuel pressure at the couplings is 50 psi 3.45 bar).

On Panel 800 VU:

Set and hold the TEST switch in the LTS position.

- all panel lights come on.
- the FUEL QTY and REFUEL displays show eights.

Release the TEST switch.

- all panel lights go off.
- the FUEL QTY and REFUEL displays show the actual tank quantities.

Set and hold the TEST switch to the HI LVL position.

- the HI LVL lights come on.

Release the TEST switch

- the HI LVL lights go off

Automatic Refueling

The required total quantity of fuel is preselected by using the rocker switch to decrease or increase the figure until the required total quantiy is shown on the preselector indicator.

The total contents actually in the tanks is shown in the ACTUAL display.

- REFUEL VALVES switches remain at NORM and guarded.
- lift the guard then set the MODE SELECT switch to REFUEL
- start the pumps on the fuel tanker.

All REFUEL VALVES open, the tanks fill simultaneously but in the wing tanks the outer cells will fill before the inner cells start filling to ensure the Maximal Operation Speed (VMO) requirements are met. If less than a full load is being taken on, the distribution is in the following order : outer cells, inner cells,center tank, depending on the fuel load required.

On the REFUEL panel, the END light comes on when refuelling is completed and the final quantity on board will be as PRESELECTED with 200 kg tolerace.

- Set the MODE SELECT switch to OFF and guard it.

Close Up

Close the access door 192 MB.

De−energize the aircraft electrical network.

Disconnect the hose−coupling ot the fuel tanker from the aircraft.

Install the cap of the refuel coupling.

Disconnect the fuel tanker to aircraft cable.

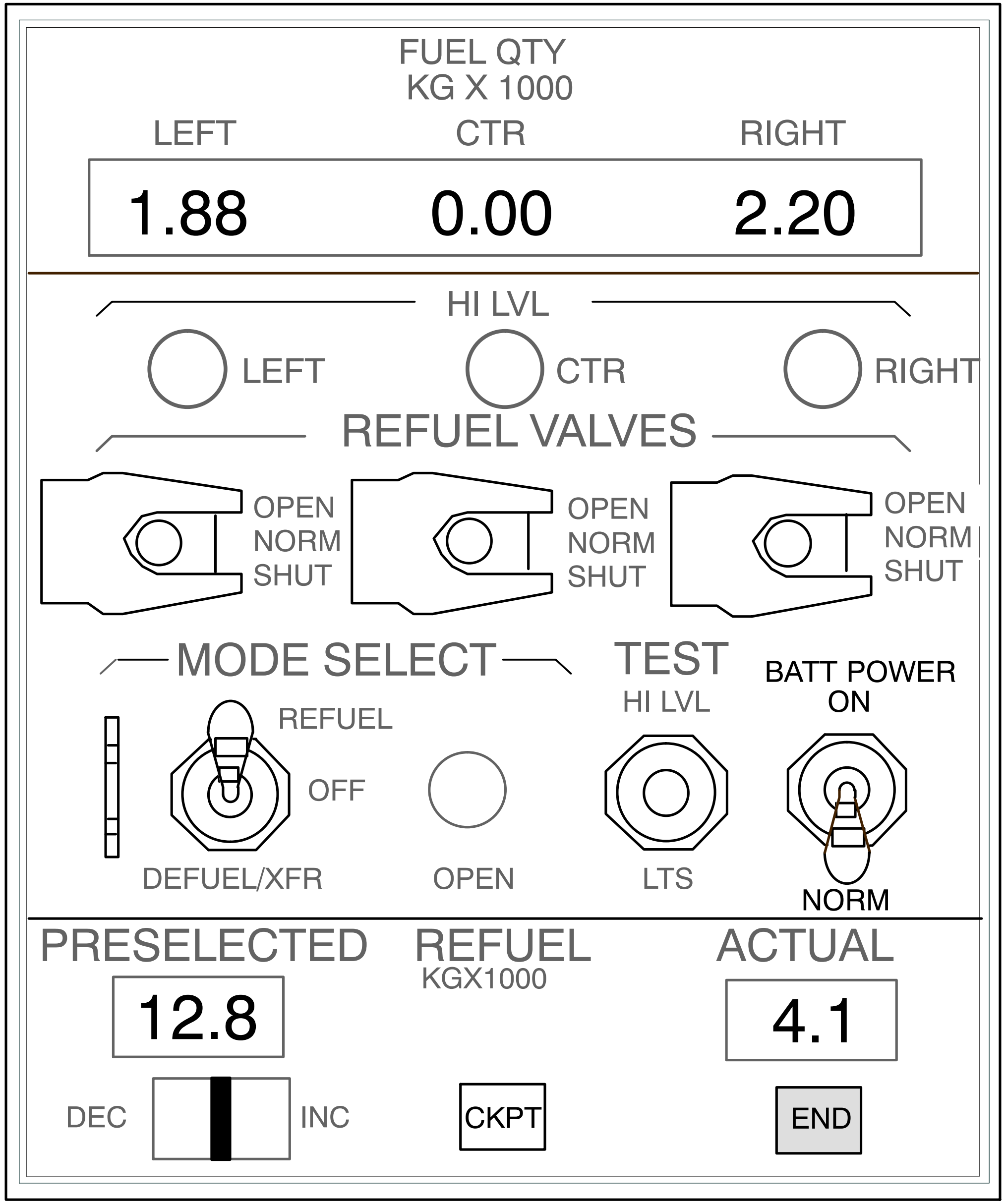


Figure 33 Automatic Refueling Operation

REFUEL/DEFUEL SYSTEM OPERATION (CONT)

Automatic Refueling From The Cockpit

Preparation

The preparation is the same as descripted on automatic refueling operation.

The cockpit refuel control and preselector panel takes priority over the refuel/defuel control panel in the RH fuselage fairing.

The intercell transfer valves are open when the fuel in the inner cell drops to 750 KG, and they electrically latch in the open position until the system is reset by the next refuel selection. The transfer valves must be in the closed position for refuelling when the wing tanks will not be full.

Refueling Procedure

Push the PWR pushbutton switch in.

- the ON light comes on.
- the FAULT light stays off.
- the CKPT light on the preselector comes on.
- the upper ECAM display shows the message REFUEL (green).

Put the preselector rocker switch to the INC position and hold it there. The number on the PRESELECTED display should increase.

When the display shows the required fuel load, release the rocker switch.

Push and release the CTL pushbutton switch.

- The ON light comes on.
- The VALVE light stays off.
- The green ready−to−refuel light on the wing outboard of the refuel coupling comes on (as long as the preselected value is higher than the actual value).

The pumps on the fuel truck may be started.

On the preselector make sure that the number on the ACTUAL display increases.The fuel flow stops for approximately five seconds near the end of the refuel operation.This lets the computer calculate accurately where to put the last of the fuel.

Monitor the END light.

- When it comes on the ready−to−refuel light on the wing will go off.

Push and release the CTL pushbutton switch.

- make sure that the numbers on the ACTUAL and the PRESELECTED displays are stable and the same.

On the ECAM fuel page,make sure that the fuel is divided correctly between the tanks.The final quantity on board will be as preselected +200 kg and −0 kg. If the tanks are partially fueled the tank quantities will be equal within 50 kg.

Release (out) the PWR pushbutton switch.

- The ON light goes off.
- The END light and the CKPT light go off.

COCKPIT REFUEL PANEL 51 VU

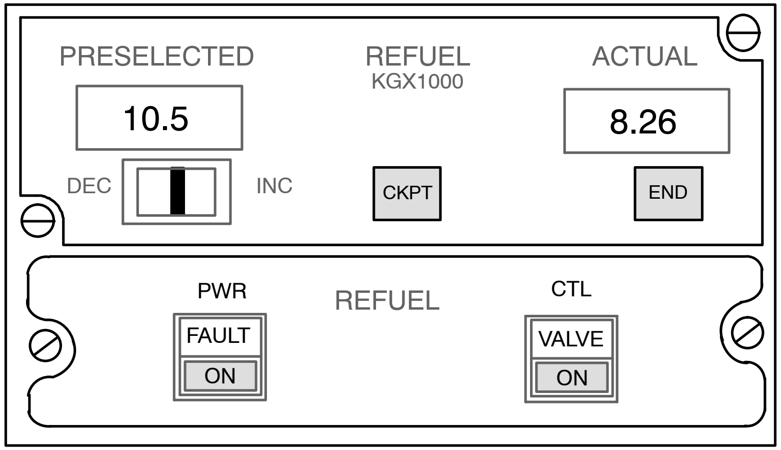


Figure 34 Refueling From The Cockpit

Refuel/Defuel System Operation (Cont)

Manual Pressure Refueling

This procedure is valid for manual refueling, the fuel preselect feature is not used, and refueling must be monitored and manually stopped when required quantity is achieved.

Preparation

The preparation is the same as descripted on automatic refueling operation.

Refueling Procedure

Set the MODE SELECT switch to REFUEL

- set the related REFUEL VALVES switch(es) to OPEN
- monitor the fuel quantities entering the tanks at the indicator (6 QT)

When the tank(s) has the required amound(s) or HI LVL light illuminates (in this case the refuel valve closes automatically)

- set the related REFUEL VALVES switch(es) to SHUT

– Make sure that all switches are in normal position and close the Refuel Control Panel

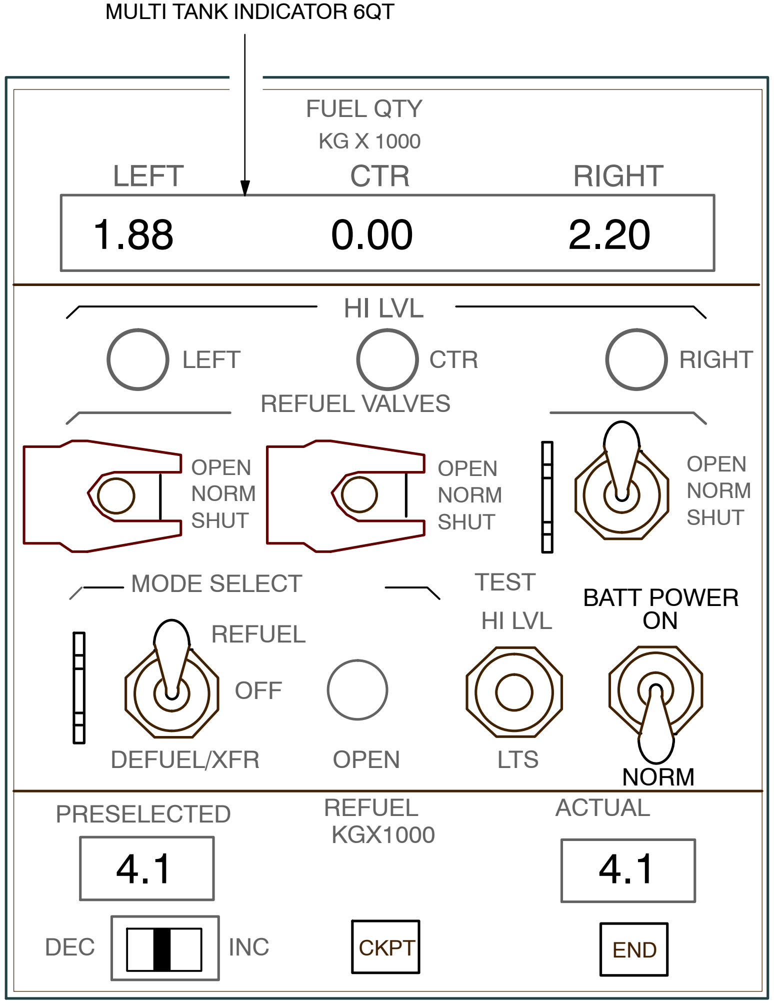


Figure 35 Refuel/Defuel Indicator

REFUEL/DEFUEL SYSTM OPERATION (CONT)

Pressure Refueling Without Electrical Power

Preparation

You must stop the fuel tanker 200 ft. (60 m) from the aircraft nose, if there is a test on the weather radar. Do not refuel the aircraft until the test is completed.

Before you refuel the aircraft you must make the area around the aircraft safe.

Aircraft fuel is flammable. Persons in the safety area must not :

- Smoke.
- Make sparks or fire.
- use any equipment which is not approved for the refuel procedure.

Obey the safety precautions for the refuel procedure.

Make sure that the fuel tanker driver has drained the water from the fuel tanker.

CAUTION: DO NOT USE THE TWO REFUEL/DEFUEL COUPLINGS AT THE SAME TIME TO REFUEL THE AIRCRAFT. USE ONLY ONE SIDE.

WARNING: YOU MUST MAKE SURE THAT YOU HAVE GROUNDED THE FUEL TANKER AND THE AIRCRAFT CORRECTLY

Make sure that the hose coupling is clean, then connect it to the aircraft.

Refuel pressure at the couplings is 50 psi (3.45 bar).

Operation

Open the related access panel (522JB/622JB)

- Each refuel valve has a plunger by which it can be opened manually in the event of electrical failure.

If you refuel the center tank,open the RH main landing gear door.

Release the MLI (**M**agnetic **L**evel **I**ndicators) of the tanks to be refueled

WARNING: WHEN A REFUEL VALVE IS MANUALLY OPENED THERE IS NO PROTECTION AGAINST OVERFILLING THE RELATED FUEL TANK.

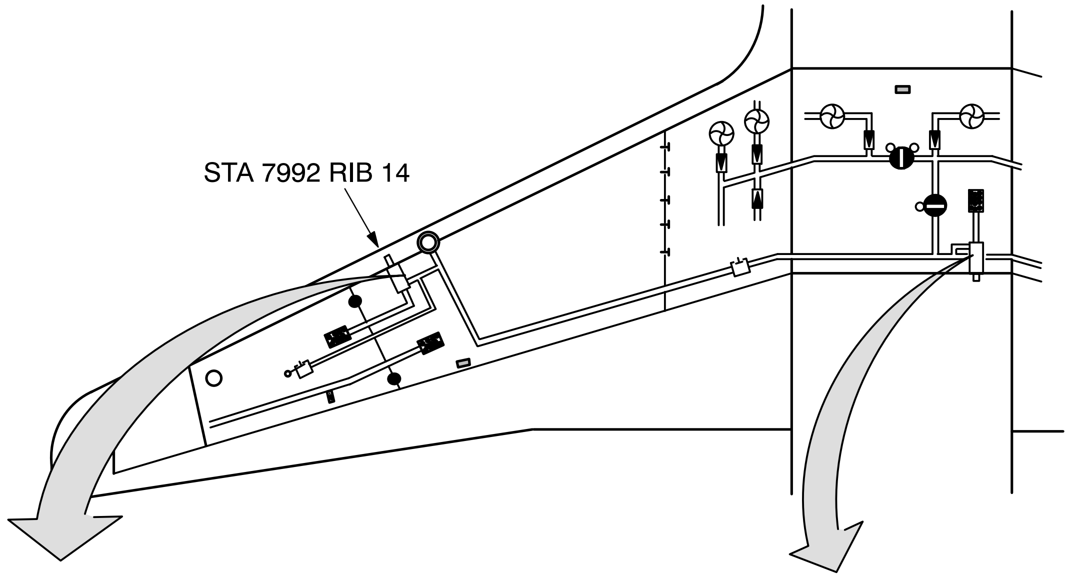
Start the pump on the fuel tanker.

- Push and hold in the manual plunger(s) on the refuel valve(s) of the applicable fuel tank(s).
- Use the MLI to monitor the quantity of fuel in each tank.
- Be careful not to overfill the tanks as there is no electrical power to operate the high level protection system.
- Refer to the fuel tables for the maximum capacity of each fuel tank and for the total fuel capacity.
- When the quantity of fuel in the tank is correct,release the manual plunger on the related refuel valve.
- When all the fuel quantities are correct,stop the pump on the fuel tanker.
- Retract and lock the MLI.

If you have refueled the center tank,close the RH main landing gear door.

Enter a remark in A/C Log for a check of fuel level when elec. power is available.

REFUELING VALVE LOCATIONS



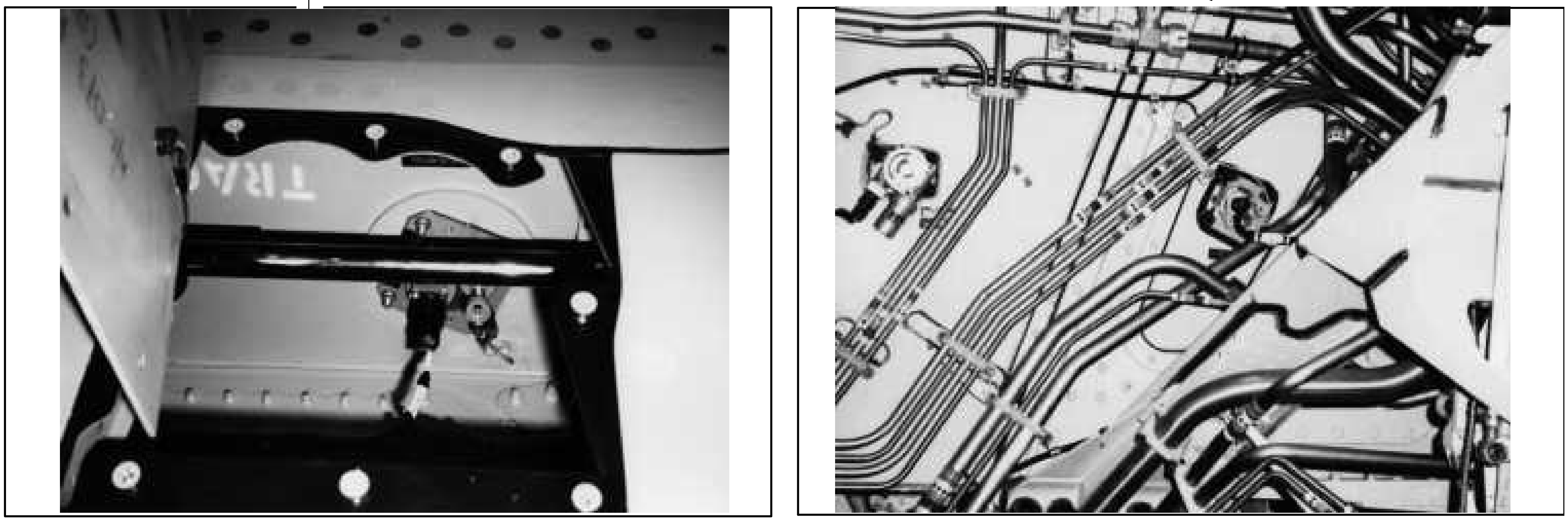


Figure 36 Refueling Valves

REFUEL/DEFUEL SYSTEM OPERATION (CONT)

Overwing (Gravity) Refueling. (From MSN 3828 no Gravity Plug is installed)

Preparation

The preparation is the same as descripted on pressure refueling without electrical power.

Operation

Overwing gravity refueling is accomplished at the refuel point on top of each wing. Fuel is delivered directly into the outer cell from which the inner cell is filled via the intercell transfer valves.

Check position of intercell transfer valves on ECAM fuel page.

The intercell transfer valves open during flight and stay electrically latched in the open position, until the system is reset by the next refuel selection.

<u>If the intercell transfer valves are closed,open them as follows:</u>

On the ground refuel/defuel control panel:

- make sure that the MODE SELECT switch is in OFF position..

In the cockpit :

- open the circuit breakers FUEL/XFR VALVE1/WING/L/1QP
- (49VU A10) and FUEL/XFR VALVE2/WING/L/3QP (121VU M22)
- or the circuit breakers FUEL/XFR VALVE1/WING/R/2QP
- (49 VU A11) and FUEL/XFR VALVE2/WING/R/4QP (121VU M23)
- after five seconds close the circuit breakers again.

Make sure the valves show open on the ECAM fuel page.

- connect the ground-cable of the refuel nozzle to the wing ground-connector.
- remove the applicable overwing refuel cap.
- put the fuelling nozzle into the overwing refuel point and start the pump on the fuel truck.
- keep the rate of refuel the same as or less than the rate of flow through the transfer valves.
- monitor the fuel quantity on the ground refuel / defuel control panel

The overwing refuel point is not at the highest point on the wing. Thus you cannot refuel the wings to full.

If necessary use the fuel pumps in the wing tanks to move fuel to the center tank from the wing tanks. (Refer to Fuel Transfer).

- when the fuel quantities are correct, stop the pump on the fuel truck.
- remove the fuel nozzle from the overwing point and install the overwing refuel cap.
- disconnect the ground-cable of the refuel nozzle from the wing ground-connection.

Close the intercell transfer valves as follows:

- on the ground refuel/defuel control panel put the MODE SELECT switch to REFUEL.
- Make sure that the ECAM Fuel page shows the valves closed.
- on the ground refuel/defuel control panel put the MODE SELECT switch to OFF.

Make sure the fuel configuration is corrected before the next flight (the wing tank outer-cells must be filled). If electrical power is available, transfer fuel from the inner cells or center tank to the outer cells.

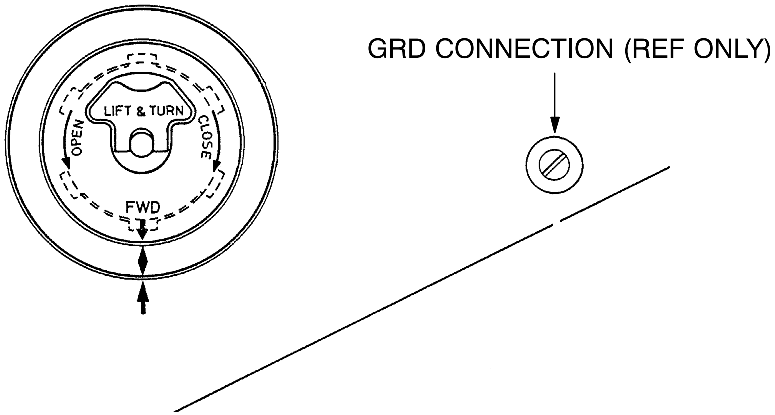


Figure 37 Gravity Refuel Cap

Defueling/Fuel Transfer Operation

For a defueling or fuel transfer, operate the REFUEL / DEFUEL panel 800 VU and the FUEL panel in the cockpit while watching the FUEL page on the lower ECAM display unit.

When defueling/transfer, the engine feed pumps are used to push the fuel through the engine feed pipeline and then by transfer valve through the refuel lines.

To discharge at the refuel coupling:

- set the MODE SELECT switch to DEFUEL/XFR position and check that OPEN light comes on.
- put XFEED pushbutton ON and check that the valve is OPEN (FUEL panel on flight deck)
- make sure that the REFUEL VALVES are CLOSED.
- on FUEL panel, switch ON the pumps of the tanks to be emptied.

When required tank quantity is defuelled, reset the system as follow:

- on the FUEL panel, set XFEED pushbutton to OFF and the MODE SELECT pushbutton to AUTO.
- on the REFUEL/DEFUEL panel set MODE SELECT to OFF and check that OPEN light goes off.

NOTE: The flight unbalance limitation is 2000 KG.

For a fuel transfer from tank to tank:

- set the MODE SELECT switch to DEFUEL/XFR position and check that OPEN light comes on.
- put XFEED pushbutton ON and check that the valve is OPEN (FUEL panel on flight deck)
- set the refuel valve of the tank to be filled to OPEN
- on FUEL panel, switch ON the pumps of the tank to be emptied.

When required quantity is transfered reset the system.

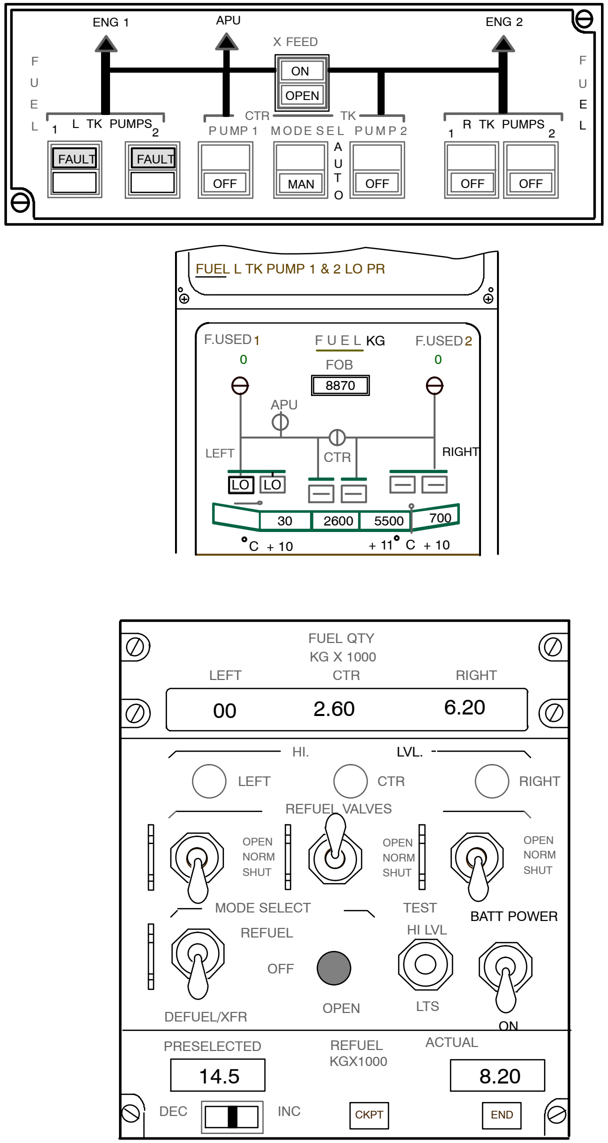


Figure 38 Defueling/Fuel Transfer Operation

REFUEL/DEFUEL SYSTEM COMPONETS

Component description

Refuel/Defuel Coupling

The single refuel coupling is positioned beneath the RH wing (and LH wing optional) leading edge.It is a 2.5 inch diameter self–sealing coupling, flange bolted to the refuel pipeline.

When not used the coupling is fitted with a pressure blanking cap, which provides a second seal.

Gravity Refueling Adapter

An overwing gravity feed fueling adapter and cap is provided in each wing for gravity refueling directly into the outer cell

Refuel Valves

Each refuel valve comprises a canister and valve assembly. A valve assembly may be removed from a canister without lossof fuel.

The canister inlet and outlet being sealed by a spring loaded sleeve valve and flap valves respectiely.

The canisters are flange bolted within the tanks. to the front spar in each wing tank and to the rear spar in the center tank. A valve assembly is inserted to its canister from outside the tank.

The valve is actuated by a solenoid which is energized when the MODE SEL switch is set to REFUEL and the associated REFUEL VALVE switch is set to OPEN or NORM.

A manual plunger will, when depressed, open the valve mechanically. The valve will close again when the plunger is released.

Defuel/Transfer Valve

The defuel / transfer valve is in the center tank, on the rear spar. The valve connects the main fuel pump system to the refuel gallery.

When open, the valve lets the fuel in the main fuel pump system be moved into the refuel gallery.

This lets the fuel be:

- moved from one tank to the other
- delivered to the refuel / defuel coupling for removal from the aircraft

An actuator operates the transfer valve, the clamp attaches the actuator to the defuel / transfer valve.

The MODE SELECT switch, on the refuel/defuel control panel controls the position of the valve.

When the valve is open, the OPEN light (adjacent to the switch on the refuel/defuel control panel) will come on.

1 Defuel Transfer Valve

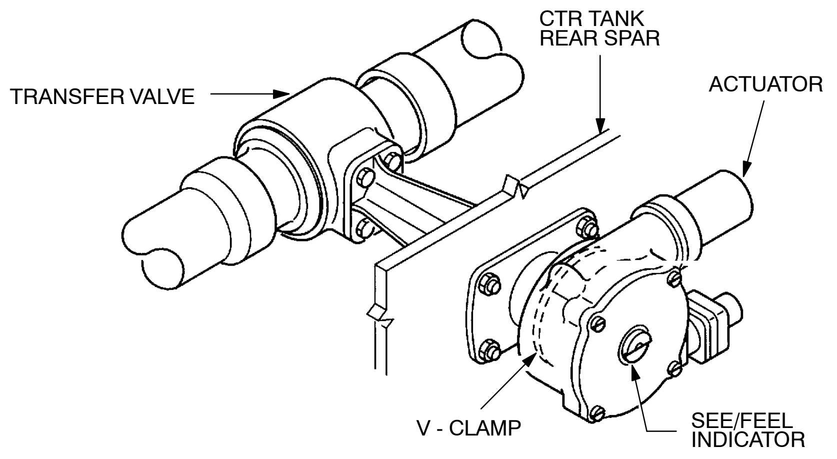


Figure 39 Refuel/Defuel Sys. Components (1)

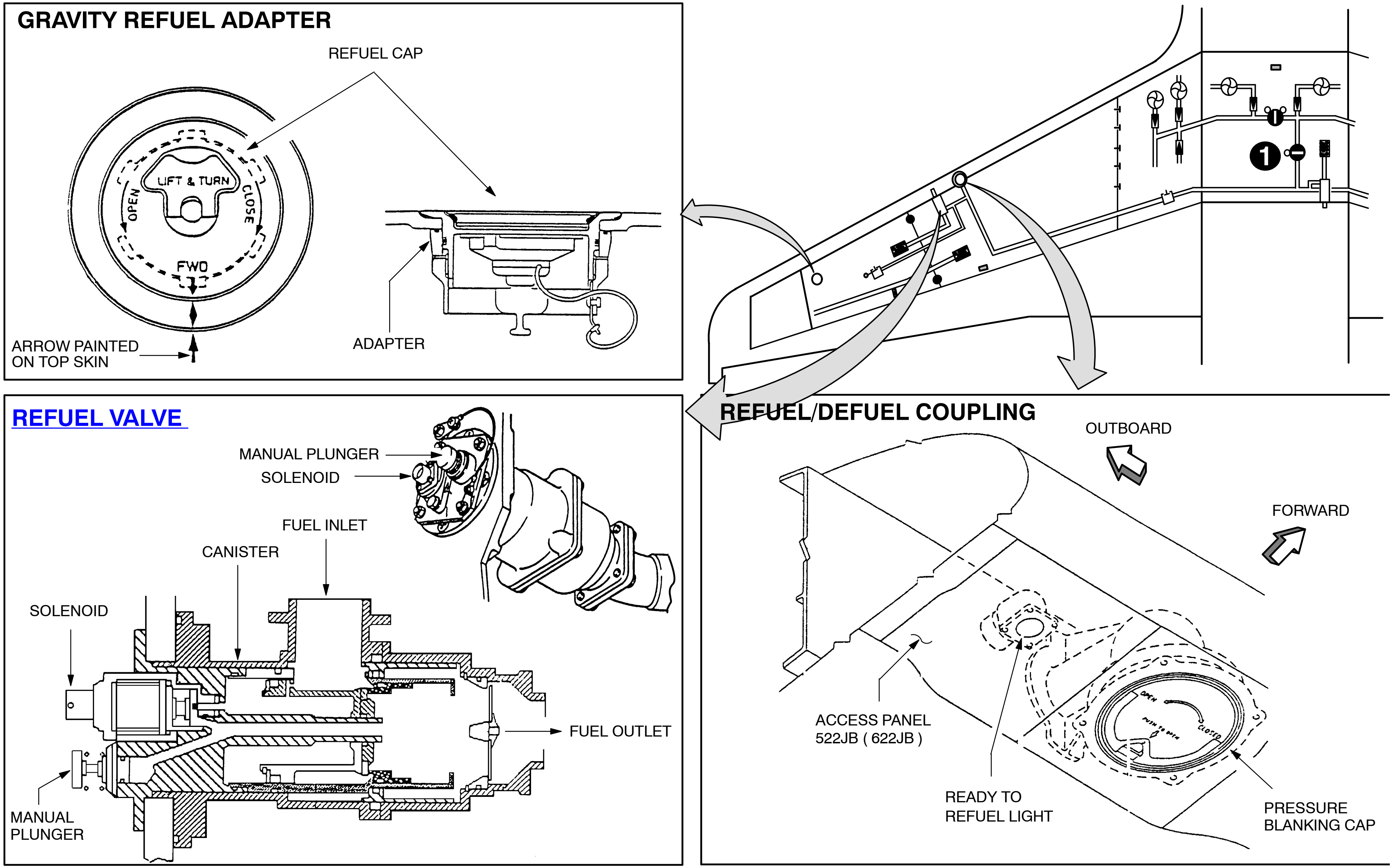


Figure 40 Refuel/Defuel Sys. Components (2)

COMPONENT DESCRIPTION (CONT)

Air Inlet Valve

An air inlet valve is in the refuel gallery, adjacent to the rear face of the front spar (RIB 16). The air inlet valve lets air into the refuel gallery after the refuel procedure.

Thus fuel can drain from the refuel gallery through the fuel drain valve.

A pipe extends from the valve to the outboad side of RIB21.

This pipe makes sure that the air inlet remains above the fuel level at all times. This stops the gravity movement of fuel from one tank to the other.

A float makes sure that the refuel gallery drains only when the fuel level in the outer cells fall to empty.

Fuel Drain Valve

A drain valve allows the fuel to drain from the refuel pipeline in each wing tank.

Fuel is free to flow through the valve except under pressure.

During refueling, the refuel pressure presses the spring loaded valve down to its seating to prevent uncontrolled fuel flow from the valve.

A chek valve prevents reverse flow through the valve.

Diffusers

Diffusers are installed to the ends of the refuel lines in the tanks.

They direct the fuel into the tanks with a minimum of turbulence and electo-

static build–up.

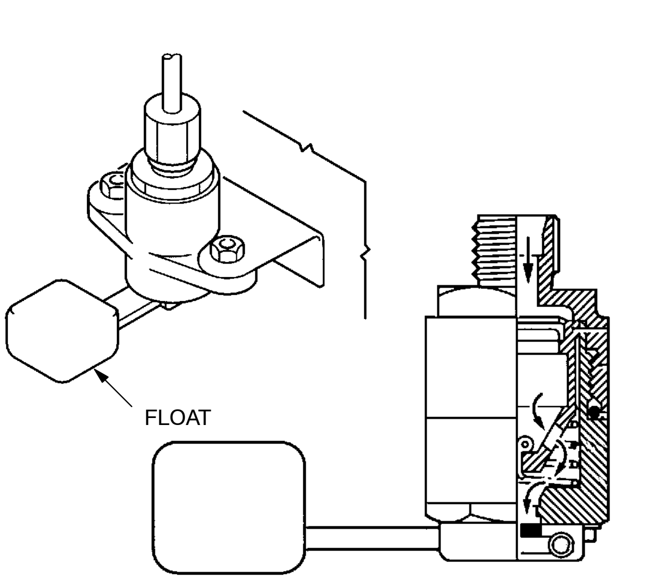
Fuel from the refuel line ejects from the diffuser and is deflected across the floor of the tank.

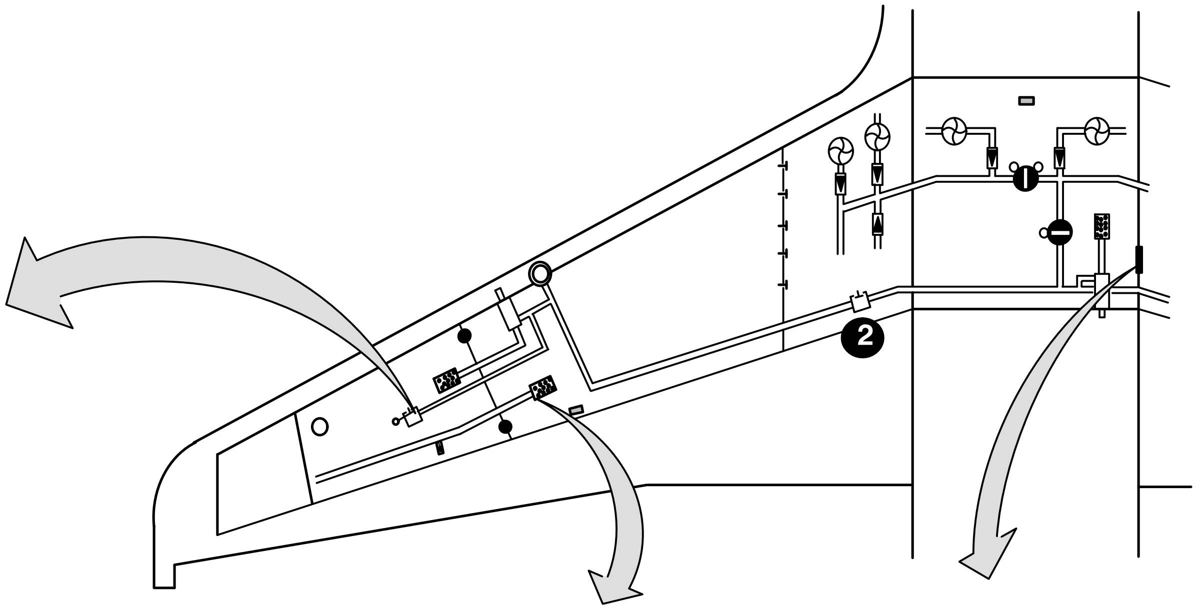
Pressure Relief Valve

The pressure relief valve is a simple poppet type check valve mounted on the center tank RH wall.

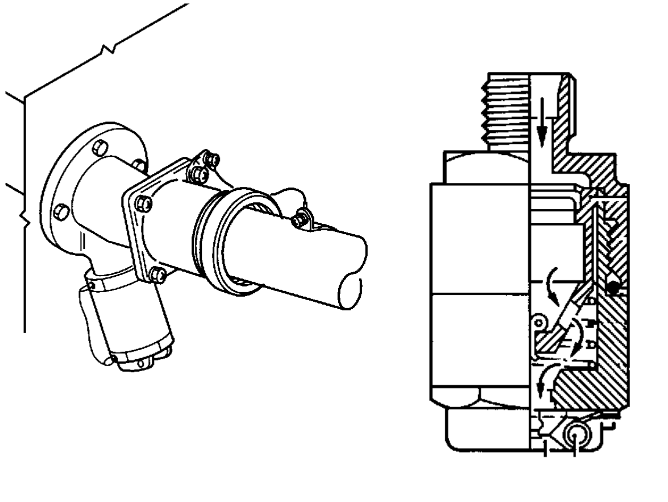
It will relief fuel into the RH wing tank in the event of a center tank refueling overflow. The vent pipe is not capable of channelling away the excess fuel at an equivalent rate, as it is designed for airflow only.

AIR INLET VALVE

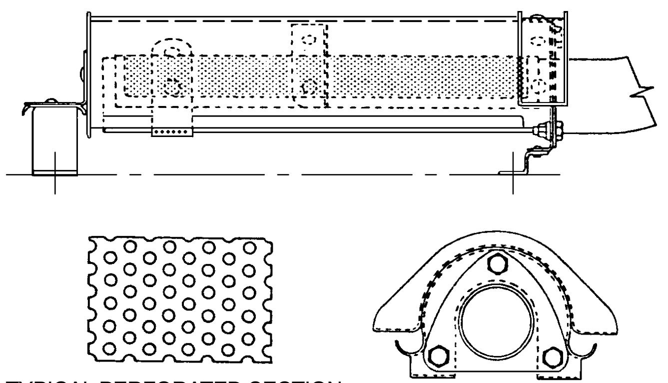




2 FUEL DRAIN VALVE



DIFFUSER (TYPICAL)



PRESSURE RELIEF VALVE

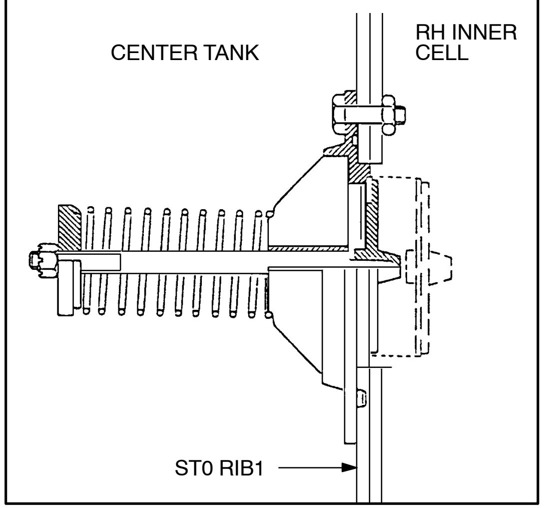


Figure 41 Refuel/Defuel System Components

REFUEL/DEFUEL SYSTEM DESCRIPTION A321

System Description

A single refuel/defuel receptacle is located in right wing leading edge.

– Optionally one additional receptacle can be installed in leftwing.

The receptacle is connected to a fuel fill gallery, running inside the tanks from right to left wing.

Three solenoid operated refuel valves are connected to the refuel gallery. The wing tank valves are located on the tank front spar in the inner cell area. The center tank valve is on the rear spar in the center tank area.

A refuel/defuel control panel is located at the lower right fuselage.

- or the refuel/defuel panel can be located on the lower surface of the RH wing next to the refuel receptacle.

– Optionally an additional refuel panel can be installed on the cockpit

overhead panel.

System Operation General

NOTE: Refueling at both right and left receptacle simultaneously is not permittet. Refuel pressure at the couplings is max 50 psi (3.45 bar) This will give the following flow rates: all tanks ~1400 l/min

This is an average flow rate of 1400 l/min (370 USG/min), which will fill the tanks from empty in approximately 20 minutes.

When automatic refueling is performed, the required total fuel quantity is pre−selected with the rocker switch on the refuel control panel.When selected fuel level is above full wing tanks, the center tank valve will open allowing simultaneous filling of all tanks.

The refuel valve solenoids receives power for opening through the control panel.

The wing tank refuel valves are connected to a duct, discharging the fuel into the tanks. Fuel enters the tanks passing a diffuser, preventing build up of electro static charge.

Top Up:

During automatic refueling, the fill valves will close before selected level is obtained. This is started 5 seconds after the primary fill quantity has been reached

The FQIC calculates the final level in the individual tank, using the actual tank density, high level values (if appropriate) and the the actuell quantity preselected.

The fill valve will open again, when level is not correct within +/- 100 kg. At the end of the top up, the refueling is completed.

When the pre−selected level is reached, the refuelling will stop automatically by deenergizing the refuel valve solenoids the ”END” light will illuminate..

Refueling may be performed with battery power only.

The refuel valves can be opened manually in case of solenoid failure or if power is not available.

A HI LVL sensing system prevents the tanks from being overfilled.

A defuel / transfer valve can be opened from the refuel control panel. The valve will connect the fuel feed line with the fuel fill line and is operated for defuel of the aircraft, or for transfer of fuel between the tanks.

The wing tank booster pumps are used to pressurize the fill line during defueling and transfer of the wing tanks.

If there is fuel in the center tank, you must move the fuel in the wing tanks before you can defuel the aircraft completly.

Gravity refueling of the wing tanks are possible through fill ports on the wing upper outer surface.

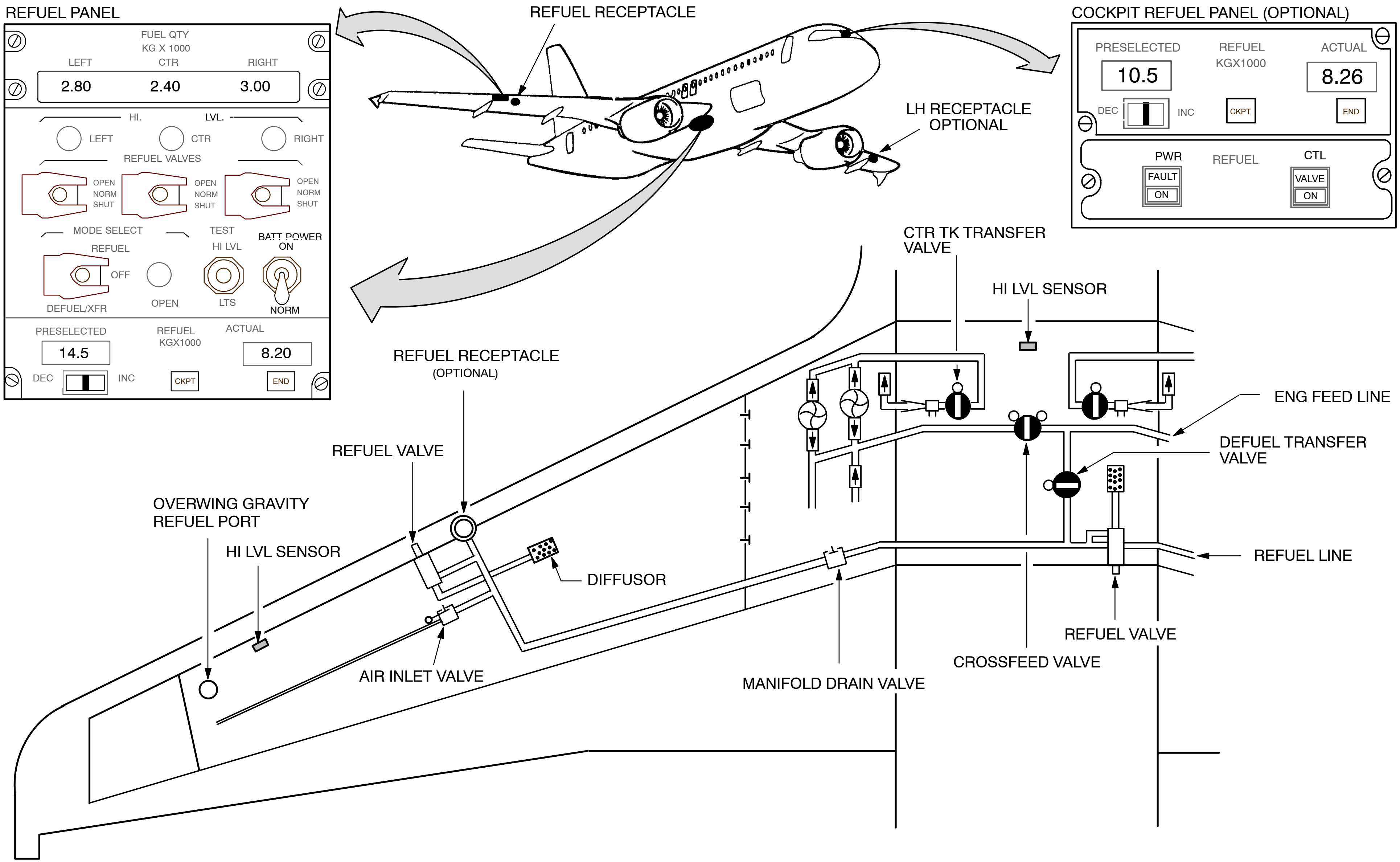


Figure 42 Refuel/Defuel Schematic A321

INTERCELL TRANSFER SYSTEM

Fuel Management

When the fuel is used, the center tank will be emptied first, followed by the left and right wing tank inner cells.

When a low level sensor in one of the inner cells, detects less than 75O kg, the fuel transfer valves in the rib between inner and outer cells will be opened and the fuel will transfered by gravity into the inner cells.

Fuel transfer from outer cell to inner cell will always be simultaneously on left and right wing and will take place when the first of four level sensors are exposed to air.

General

The intercell transfer system has at each wing:

- two intercell transfer valves
- two intercell–transfer–valve actuators
- two intercell–transfer–valve drive shafts

One intercell transfer valve is on the outboard side of RIB 15 near to the bottom of the rib and the wing front spar.

The other intercell transfer valve is on the inboard side of RIB 15 near to the bottom of the rib and the wing rear spar.

One intercell–transfer–valve actuator is on the front face of the wing front spar. The other intercell–transfer–valve actuator is on the rear face of the wing rear spar.

Thus the actuators can be replaced without access to the related fuel tank.

Operation

The operation of the intercell transfer valves is controlled automatically by the FLSCU (**F**uel **L**evel **S**ensing **C**ontrol **U**nit) and the FQIC (**F**uel **Q**uantity **I**ndicating **C**omputer)

When the low level sensors in inner cell are dry, the FLSCU sends an open signal to the related actuators.

When open, the intercell transfer valves will not close until the next refuel operation. At the start of a refuel operation the intercell transfer valve actuators are sent a close signal by the FQIC.

Intercell transfer valve position information is sent to the DMC (**D**isplay **M**anagement **C**omputer) by the FQIC and the FLSCU. The DMC sends intercell tansfer system and valve position data to the ECAM.

The intercell transfer valve position is shown on the SD FUEL page. If specified failures occur:

- a warning is shown on the EWD
- the FWC (**F**light **W**arning **C**omputer) operates the audible warning and causes the MASTER CAUT light to come on.

If both intercell transfer valves in one tank fail to open when commanded:

- the FQI (**F**uel **Q**uantity **I**ndication) for the related outer cell goes amber in color and is shown boxed. This is to indicate that the fuel in outer cell is unusable
- the FOB (**F**uel **O**n **B**oard) indication on the SD FUEL page is shown amber and boxed. This to indicate that the FOB is not fully usable.
- the FOB indication on the ECAM EWD is also shown amber and half boxed.

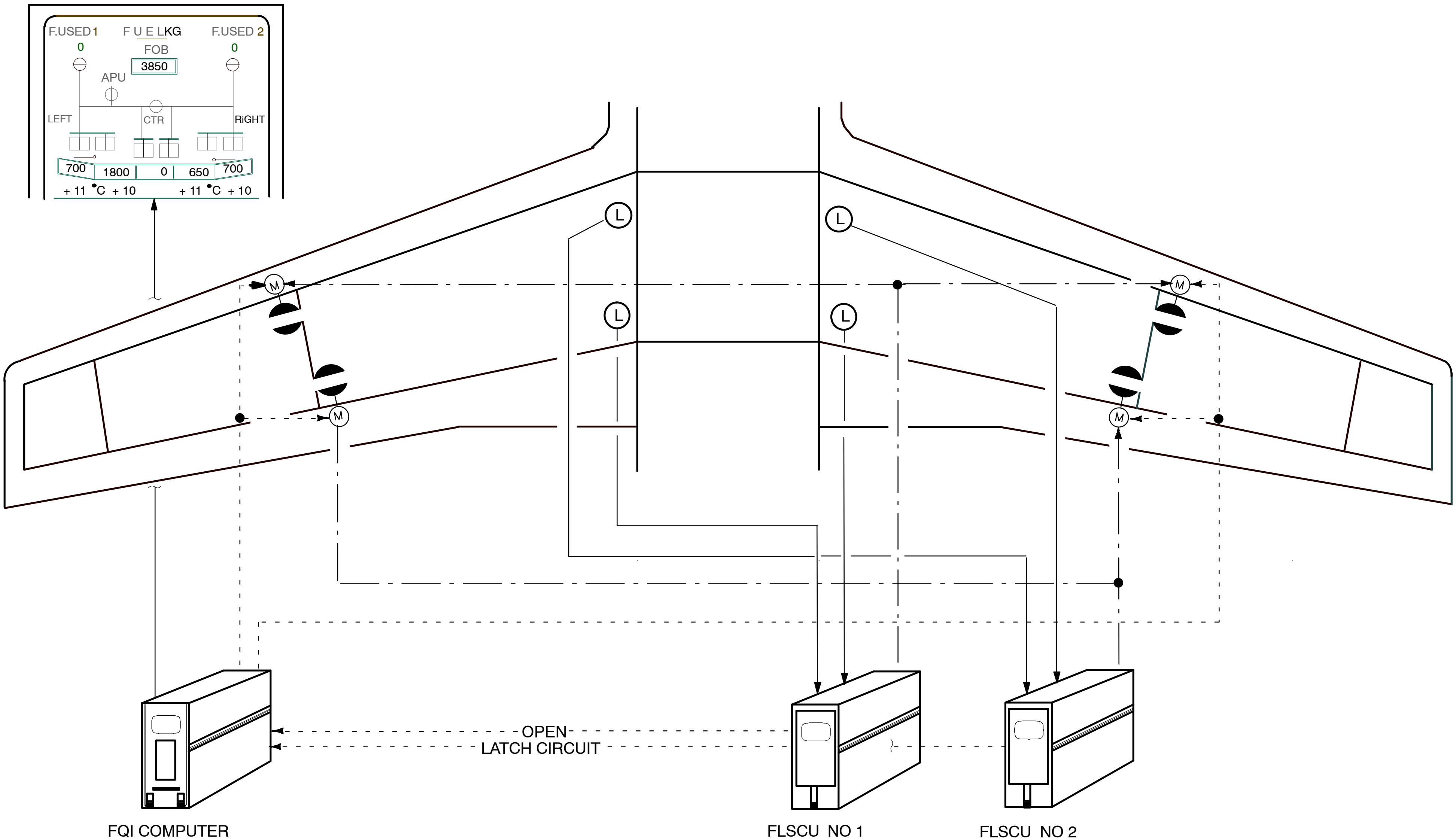


Figure 43 Intercell Transfer System

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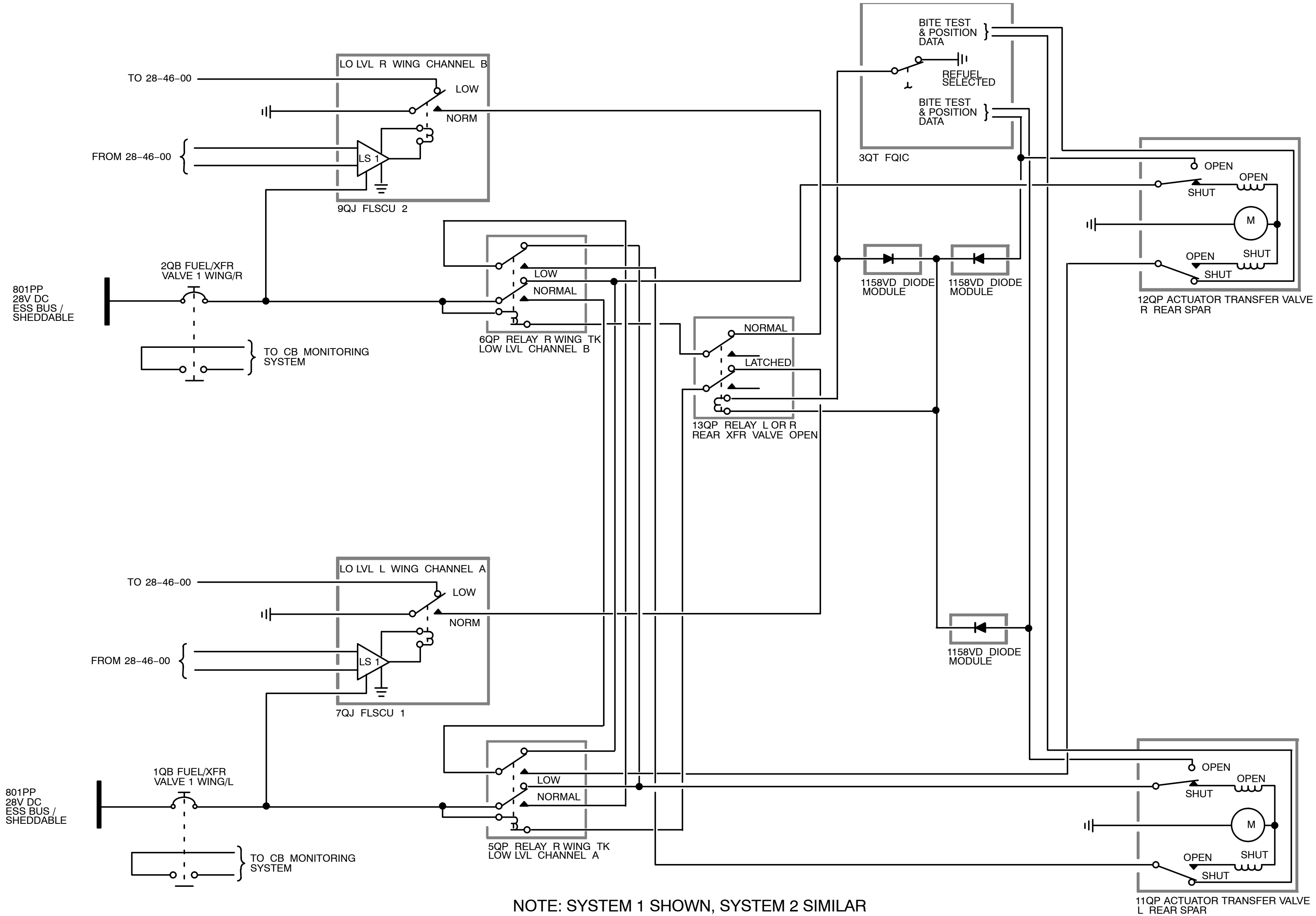


Figure 44 Fuel Transfer Valve Elec. Schematic

INTERCELL TRANSFER SYSTEM (CONT)

Component Description

Intercell Transfer Valve

The intercell transfer valve has:

- a housing
- a ball valve
- a valve spindel
- two end retainers

The ball valve is in the housing and is keept in position by the two end retainers.

One of the retainers has four holes for installation to the RIB15. The ball valve has a master key-way that engages the valve spindle, and a hole to allow fuel through when open.

The valve spindle has splines at one end for installation of the related drive shaft.

Intercell Transfer Valve Drive Shaft

The drive shaft is in three pieces that are connected by two univesal joints.

The universal joints permit lateral movement of the drive shaft in its installed position.

One end of the drive shaft has internal splines that engages the valve spindle to the splines of the intercell transfer valve.

The other end of the drive shaft has a master key-way to engage the intercell transfer valve actuator.

The mounting plate is on the drive shaft and attaches to the inner face of the related fuel tank.

Intercell Transfer Valve Actuator

The intercell transfer valve actuator has an electrical motor that drives a differential gear. The differential gear engages a drive spindle that has a master key-way to engage the valve drive shaft.

One operation of the electrical motor will turn the ball valve through 90 deg. to open or close the valve.

Limit switches in the actuator control this 90 deg. movementand set the electrical circuit for the next operation.

A V-band clamp attaches the actuator to the flange of the actuatur mounting of the drive shaft.

A location dowel makes sure that the actuator engages the actuator mounting correctly. A see feel/indicator gives the valve position, without removal of the actuator or entry to the fuel tank.

Jet Pumps

Ref. Main Fuel Pump System (Scavenge Jet Pumps)

Transfer Valve & Jet Pump Installation

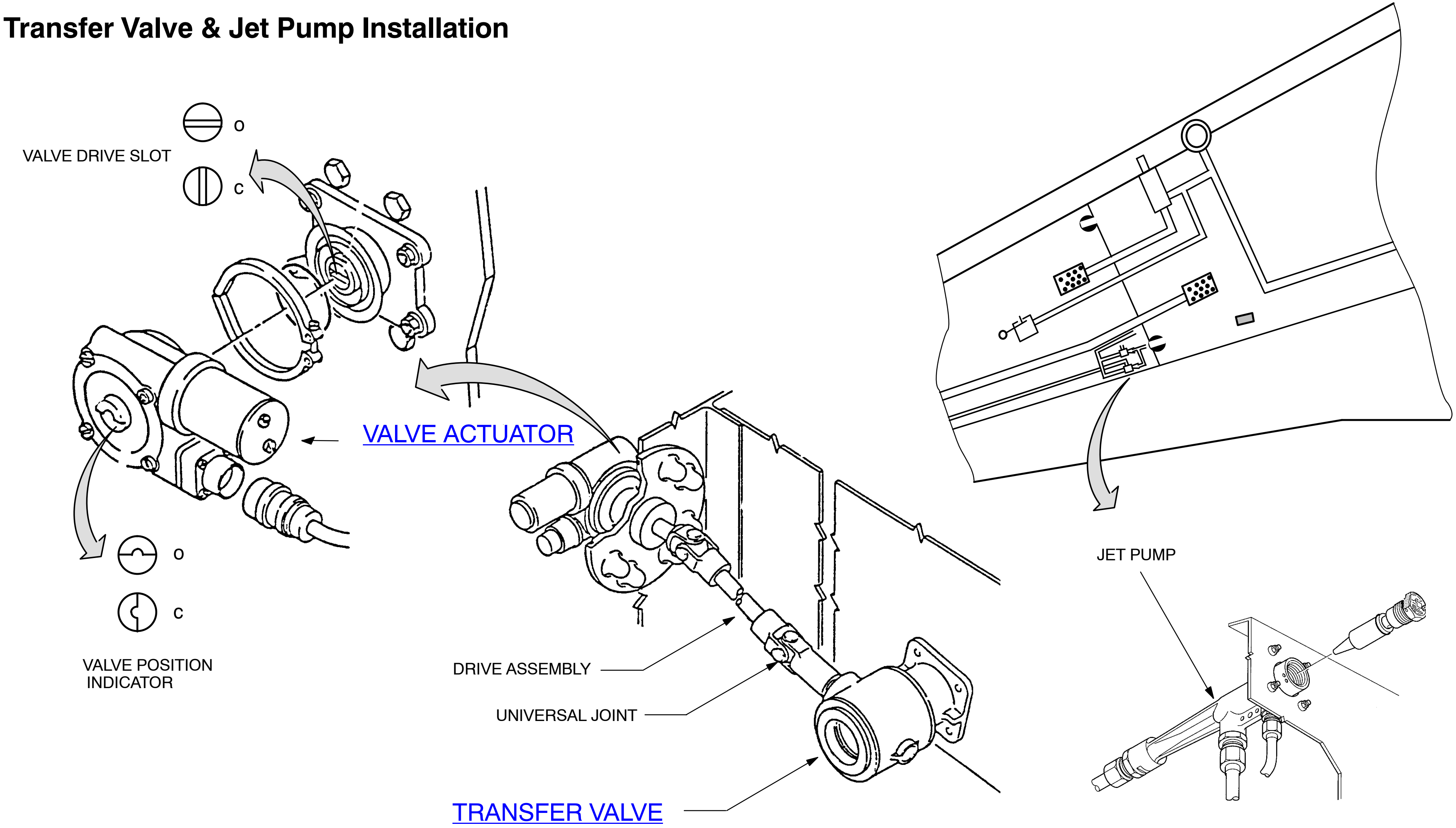


Figure 45 Intercell Transfer System Components

MAIN FUEL PUMP SYSTEM

General Description

When the system is in operation, each main pump supplys fuel to:

- its related engine
- the crossfeed system
- the refuel defuel system (for pressure defueling/fuel transfer)

If specified failures occur:

- a warning is given on the EWD
- the FUEL page is shown on the SD

Engine Supply

The fuel is supplied to the engines by six centrifugal booster pumps. Two pumps are located in the center tank and two pumps in left and right wing tank inner cell.

The pumps are controled by switches on the overhead panel.

The system is designed for minimum pilot work load. During preflight check list, all pump switches, provided fuel in the tanks, are switched on.

A Mode selector switch provides center tank boost pump automatic control.

The fuel system will now operate without further interference from the pilots, throughout the flight.

The individual pump is installed in a cannister containing a slide valve, permitting pump replacement without draining the tank.

Each pump canister has an intake pipe fittet with a strainer.

Pump output pressure is 30 PSI. Sequence valves mounted on the wing tank boost pumps reduces the output pressure to 25 PSI, thus giving priority to the center tank pumps, whenever they are operating.

A bypass pipe with check valve in each wing tank, enables the engine to obtain fuel by suction if both wing tank pumps fail.The suction valve is closed by the pump pressure.

Fuel Low Pressure valves in the supply lines will close and isolate the engine or the APU when stopped, or when the respective FIRE push– button is activated.

Crossfeed System

A Cross–feed valve connects left and right fuel feed system. To provide ”any tank to any engine supply”.

When closed, the valve divides the main fuel pump system into two parts, one part for each engine.

APU Supply

A dedicated APU fuel pump may automatically supply the APU if the booster pumps are not operating. (outputpressure is <22 psi)

The APU boost pump takes fuel from the left side feed line and is operated by AC Bus 1 or by the batteries via the static inverter.

The APU booster pump will start when the APU master switch is selected to ON and the fuel pressure in the feed line is below 22 psi.

Refuel Defuel System

Description see page 48.

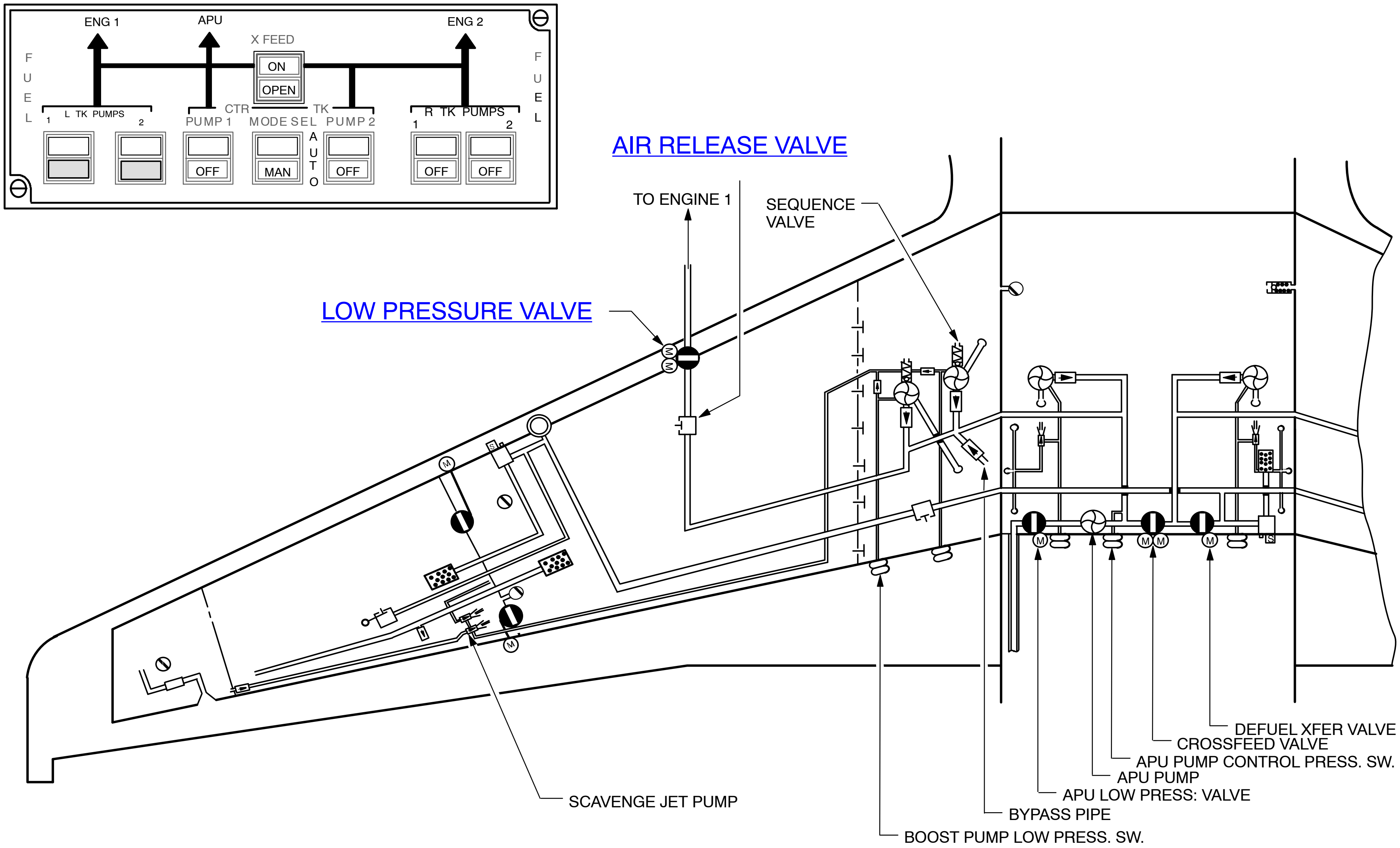


Figure 46 Fuel Feed System A318/319/320

COMPONENTS

Fuel Feed Pump

All six pumps are identical. The pump has a motor driven impeller which delivers fuel at 4989 kg/hr at 30 psi.

The pump is operated by 3 phase I l5V AC. Non -resetable thermal fuses fittet to the pump prevent the temperature of the electric motor from rising above 175°C.

If the temperature of the pump increases to more than 175°C the fuses operate. This causes the pump to stop. It cannot operate again and must be replaced.

The pump is installed in a canister so that the pump can be removed without having to drain the fuel tank.

As the pumps are cooled by fuel, pump operation should be avoided when fuel tank is empty.

Fuel Pump Canister

The canister, boltet to the tank floor, contains a slide valve that closes the fuel inlet port when the pump is removed.

When the pump is installed, it holds the slide valve in open position.

The wing tank canister has two primary fuel outlets.

One outlet contains the outlet valve and is the fuel supply to the engine feed pipe.The other outlet has a sequence valve.

The center tank canister has only one outlet to the engine feed system.

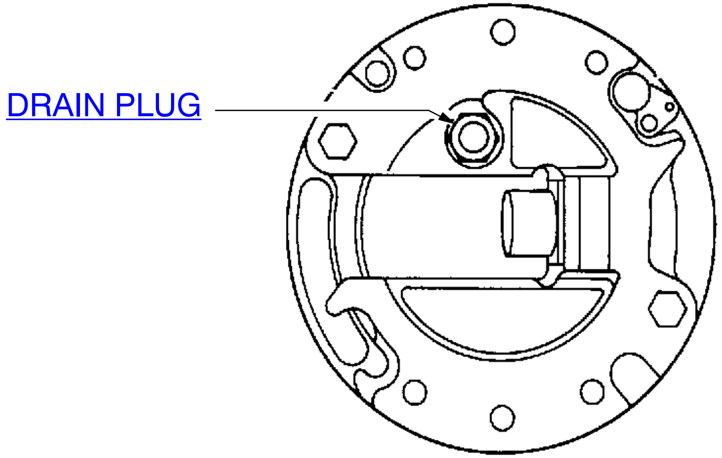
A small opening in the side of the canister (wing & center tank) connects the pressure from the fuel pump to, the related pressure switch and to the scavenge jet pumps.

Sequence Valve

Sequence valves are pressure relief valves attached to the secundary outlets on the wing tank pumps only.

These valves prevent the pump outlet pressure rising above 25 psi.

This pressure is lower than center tank pump output pressure and therefore permits center tank delivery to predominate.



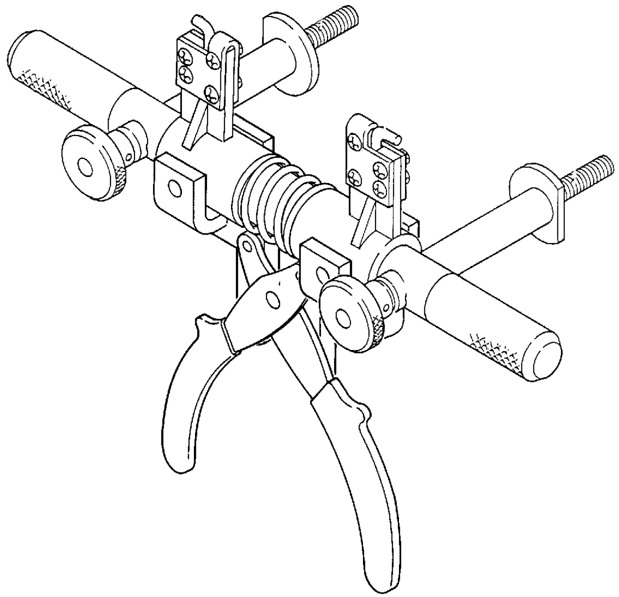
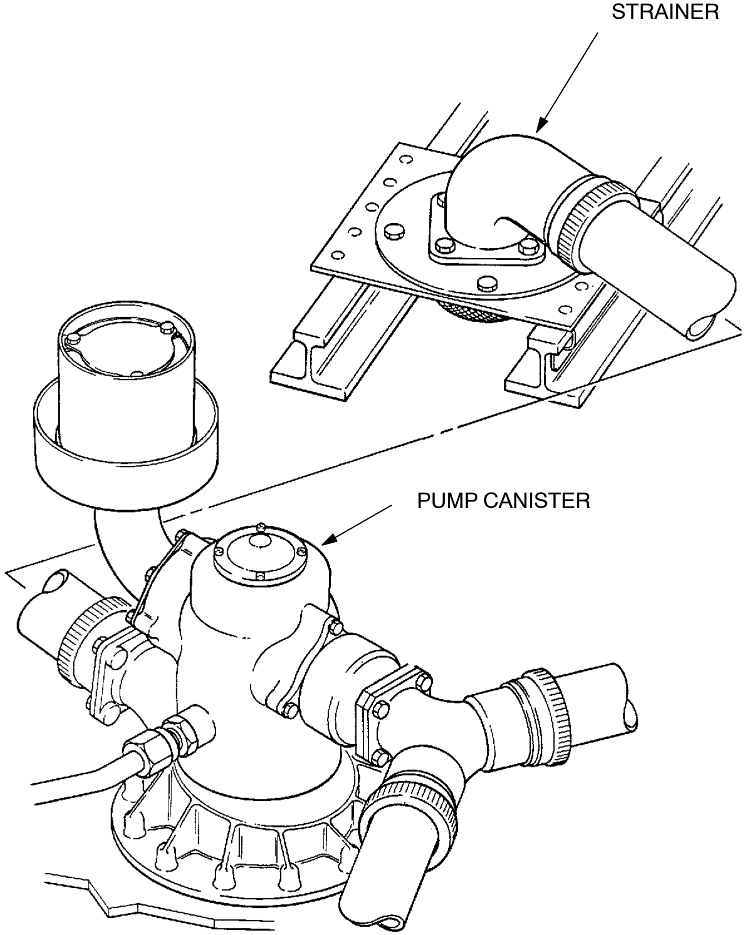
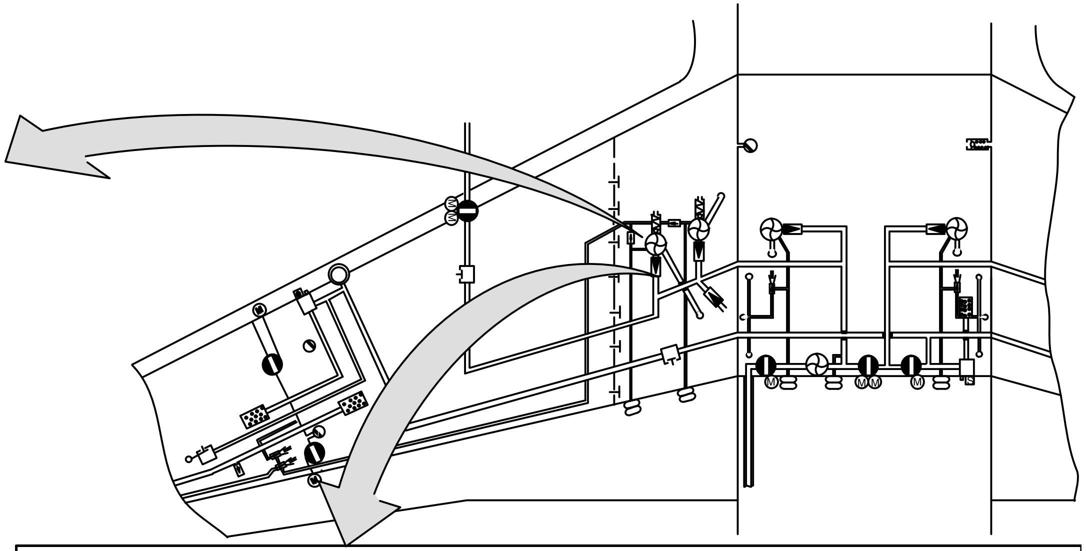


Figure 47 Fuel Pump Removal Tool

Fuel Pump Canister and Strainer





Wing TK Fuel Pump

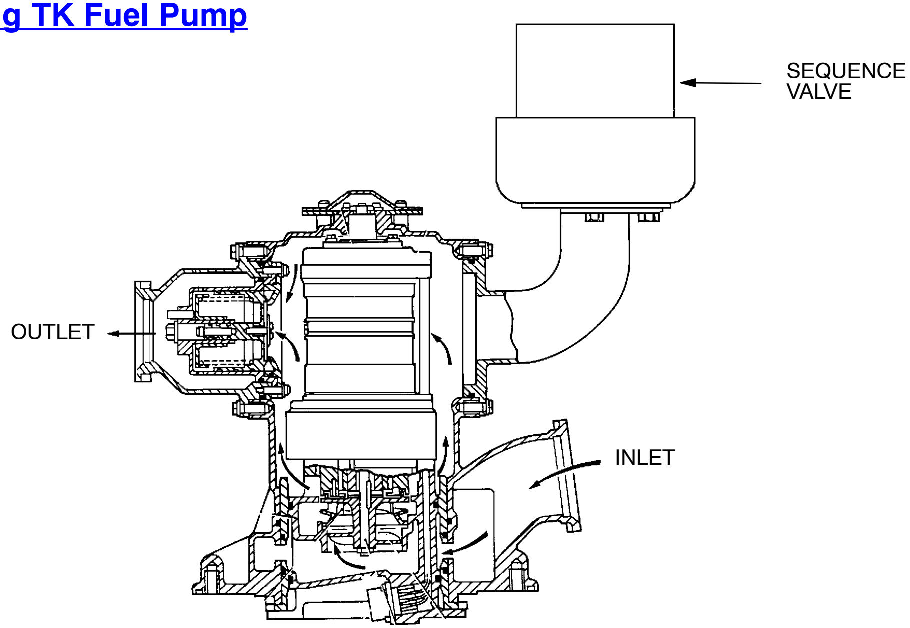


Figure 48 Fuel Feed System Components

COMPONENT DESCRIPTION (CONT)

Air Release Valve

An air release valve is installed in the left and right engine fuel feed line at the highest point inside the tank, it will allow air but not fuel to escape from the fuel line.

The air release valve body houses a diaphragm and a float and is capped by a rubber check valve.

Under pump pressure the diaphragm operates to permit air to bleed from the pipeline as it fills with fuel.

Fuel loss is prevented by the float which lifts to close the valve.

The check valve prevents air being sucked back into the line.

Scavenge Jet Pump

The scavenge jet pumps are in the wing tank on the rear spar between RIB 15 and RIB 16 and in the center tank on the rear spar.

The one wing tank jet pump move fuel which has entered the wing surge tank, via the fuel tank vent system, to the rear intercell transfer valve.

The other wing tank jet pump move fuel caught in the wing tank outer cell to the rear intercell transfer valve.

The center tank jet pumps move fuel caught in the center tank to the related tank main pump inlet.

When assembled to the related tank rear spar the screwed insert can be removed, if necessary, from outside the tank.

Pump Pressure Switch

The pressure switches monitor the output pressure of the fuel pumps. They are installed on the rear face of the wing and center tank rear spar.

A banjo-connection and a pressure pipe connect the pressure switch to the fuel pump. If the pressure from the main pump decreases to less than 6 psi the pressure switch:

- puts on the amber FAULT light in the related main pump P/B switch
- sends a signal to the ECAM system
- sends a signal to the FLSCU (**F**uel **L**evel **S**ensing **C**ontrol **U**nit)

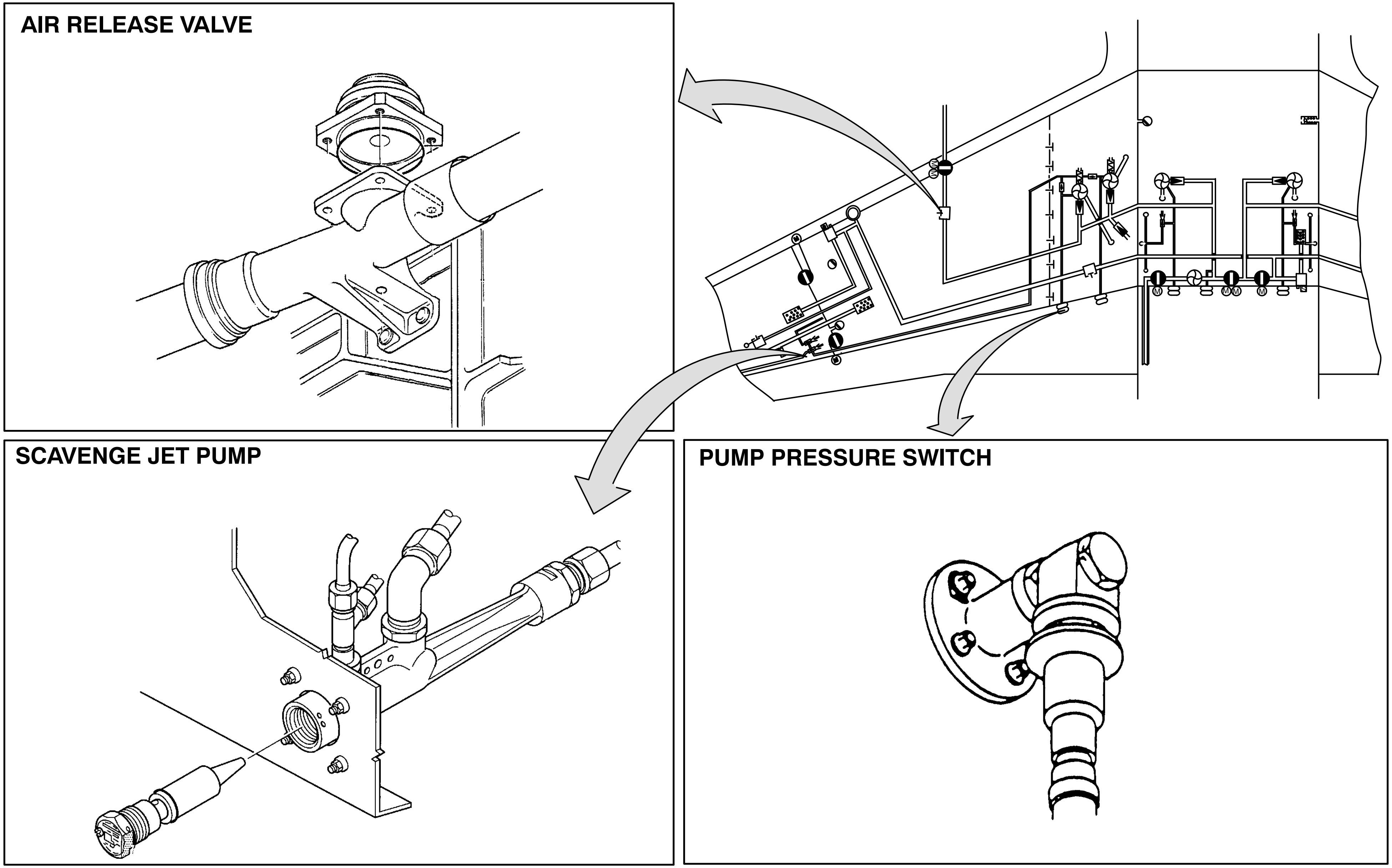


Figure 49 Fuel Feed System Components

MAIN PUMP CONTROL

Wing Tank Pumps

The wing tank pumps of the main fuel pump system are manually controlled.

Normally the two pumps in the wing tank supply an engine. But, one pump can supply the necessary fuel for an engine.

The L/H - R/H TK PUMPS P/B switches are usally set on together. The main pumps then operate continuously. If one main pump has a failure (or is set to OFF), the other pump will continue to supply fuel to its related engine.

Center Tank Pumps (before Modification Jan 2014)

The center tank pumps have two modes of operation:

- manual
- automatic

In manual mode (MODE SEL P/B switch released out), the operation of the pumps is controlled by the CTR TK PUMPS P/B switches.

In automatic mode (MODE SEL P/B switch pushed in) the center tank pumps are controlled by the Fuel Level Sensing Control Unit depend on, slats position, wing and center tank low level sensors.

If the CTR TK PUMPS P/B switches set to ON:

During engine start, regardless of the slats position, the center tank pumps will operate for two minutes to scavenge any water in the tank before take off.

On ground, before take off, when slats are extended, the center tank pumps will stop and the fuel will be supplied by the wing tank pumps.

During climb, when slats are retracted below 16° the center tank pumps will start and the higher pressure will give priority to the center tank pumps.

The pumps will now operate untill center tank low level plus five minutes is obtained. Fault inhibit relays do not let the FAULT annunciators come ON during the five minute periode.

If left or right wing tanks, due to the IDG oil cooling system, reach full level, the center tank pumps will be stopped untill underfull level in wing tanks are sensed. Underfull level is approximately 500 kg below full level.

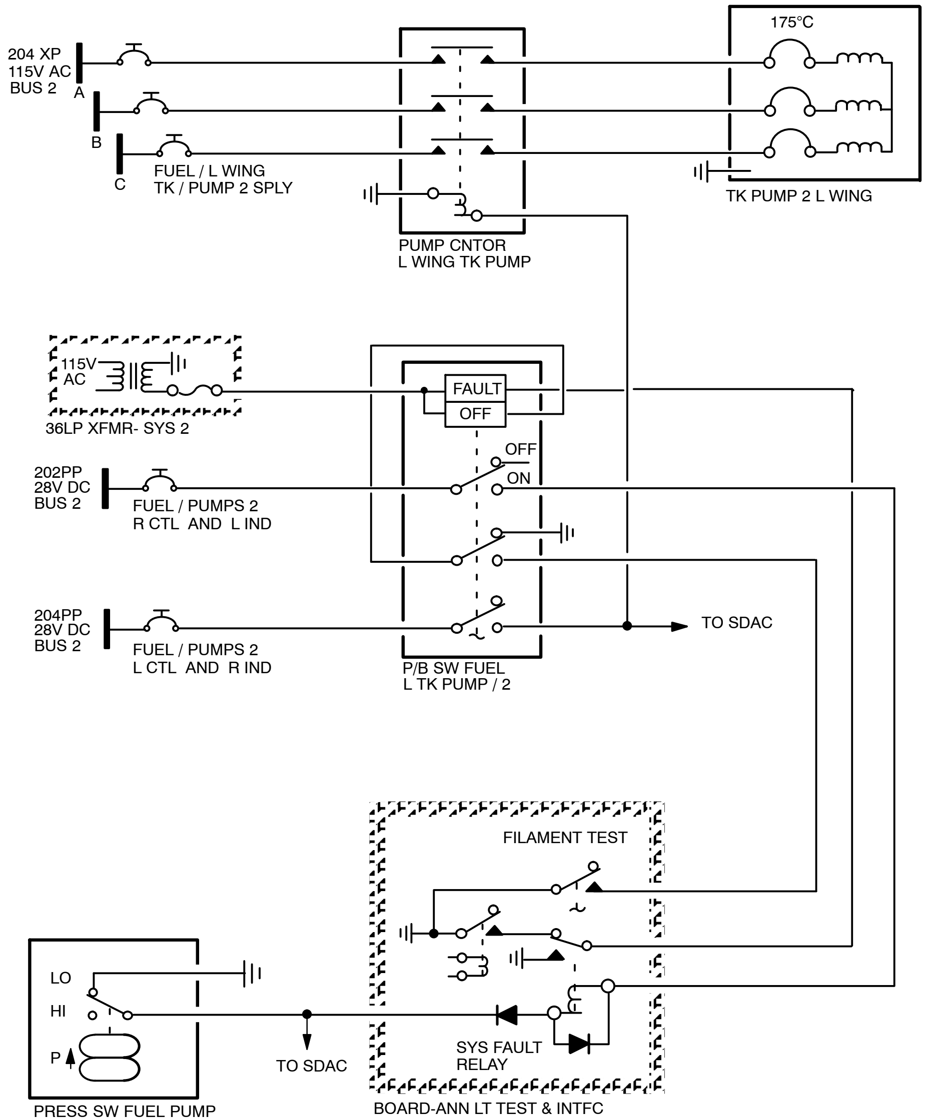
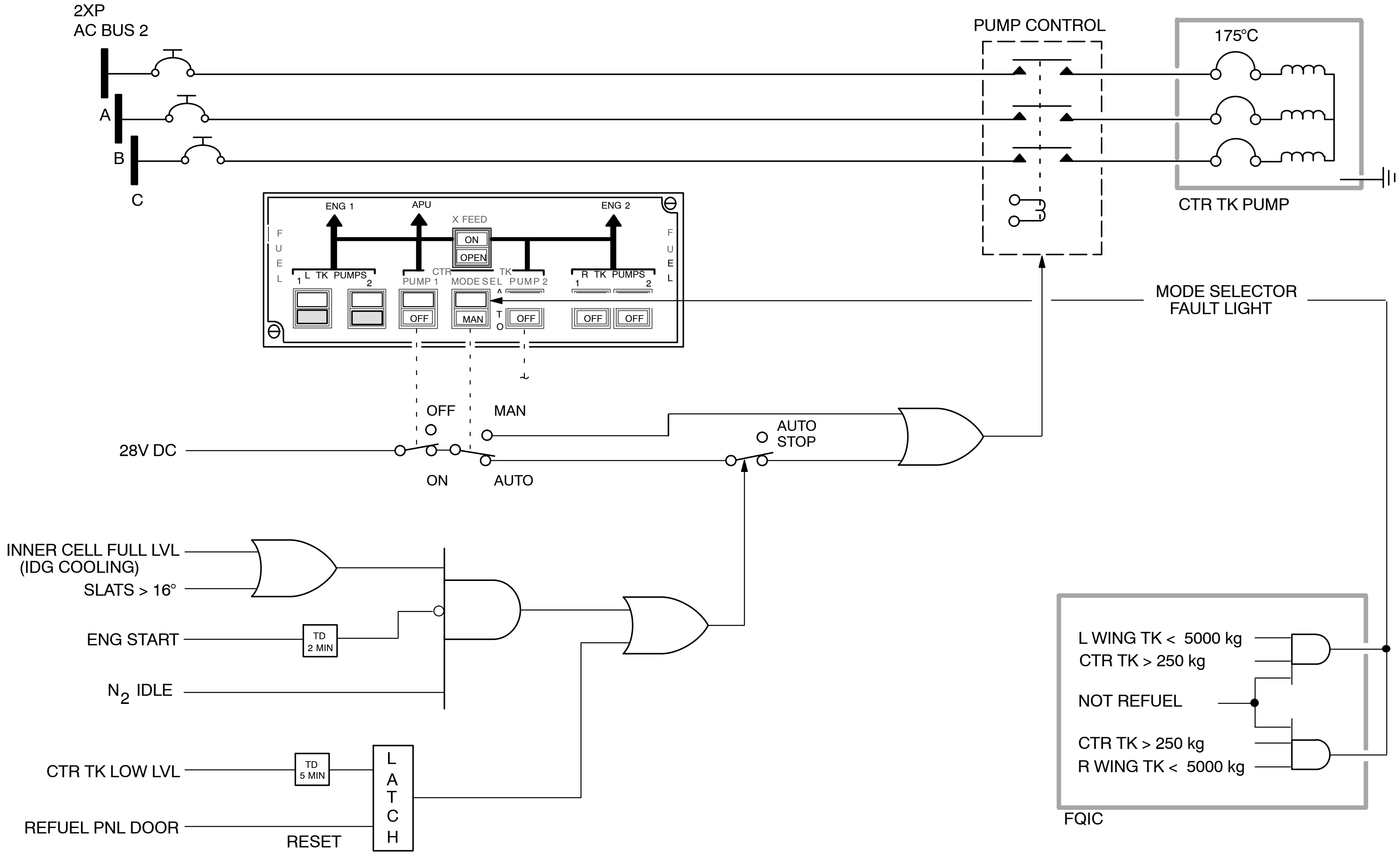


Figure 50 Wing Tank Pump Control (Typical)



NOTE: Before Modification Jan 2014

Figure 51 CTR TK PUMP Control Logic

MAIN FUEL PUMP SYSTEM

General Description

When the system is in operation, each main pump supplys fuel to:

- its related engine
- the crossfeed system
- the refuel defuel system
- the recirculation cooling system
- the main transfer system

Engine Supply

The main fuel pump system supplys the fuel from the wing tanks to the engines.

The system has four main fuel pumps, two in each wing.

The main pumps in each wing operate together to supply the fuel to their related engine.The pumps are controlled by switches on the overhead panel.

The individual pump is installed in a cannister containing a slide valve, permitting pump replacement without draining the tank.

A bypass pipe with check valve in each wing tank, enables the engine to obtain fuel by suction if both wing tank pumps fail.The suction valve is closed by the pump pressure.

Fuel Low Pressure valves in the supply lines will close and isolate the engine or the APU when stopped, or when the respective FIRE push– button is activated.

Crossfeed System

Same as A318/319/320.

Refuel Defuel System

Description see page 62.

Recirculation System

Description see page

Main Transfer System

The main transfer system controls the flow of fuel from the center (transfer) tank to the two wing tanks.

The FLSCU (**F**uel **L**evel **S**ensing **C**ontrol **U**nit) automatically controls the system, but the crew can if necessary, manually control it from the cockpit.

Two jet pumps and two transfer valves are installed instead of center tank boost pumps.

The jet pump delivers the fuel from the center tank to the respective wing tank.

Operating pressure for the jet pump is taken from the related wing tank pumps.

The jet pumps are controlled by the center tank transfer valves.

If specified failures occur:

- a warning is given on the EDW
- the FUEL page shows on the SD

In case of jet pumps failure, fuel from the center tank spills by gravity through the jet pump and a check valve into the wing tank, when the fuel level in the wing tank reached a certain level.

In this case 2000 kg remain in the center tank as unusable fuel.

NOTE: In case of wing tank opening the center tank must be emptied.

APU Supply

Same as A318/319/320.

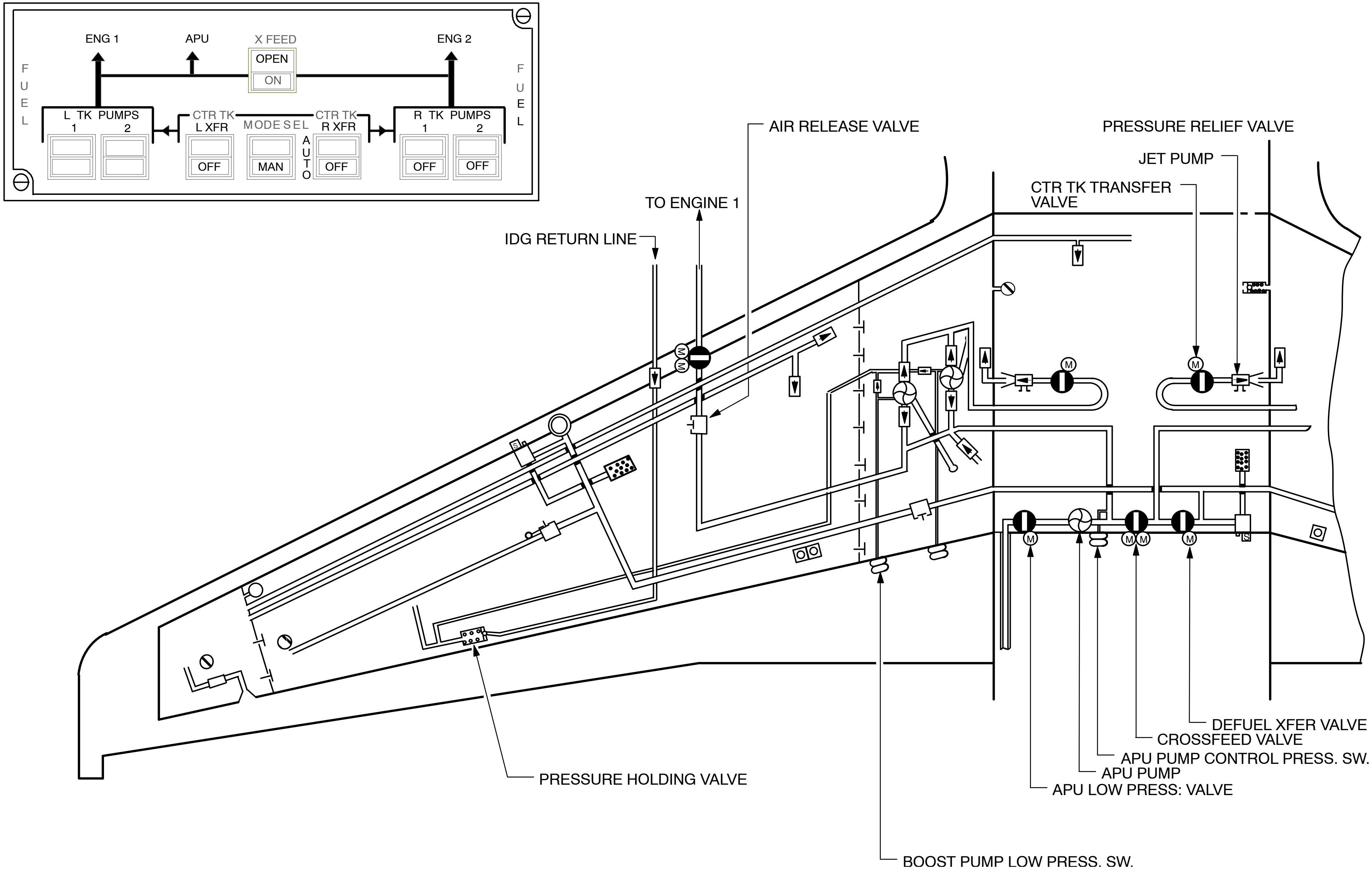


Figure 52 Fuel Feed System A321

COMPONENTS

Wing Tank Pumps

Same as A318/319/320.

Fuel Pump Canister

The canister has two primary fuel outlets. One outlet contains the outlet valve and is the fuel supply to the engine feed pipe.

The other outlet is the fuel supply to the jet pump.

A small opening in the side of the canister connects the fuel pump to:

- the related pressure switch
- the recirculation system

Pump Pressure switch

Same as A318/319/320.

Jet Pump

The jet pump and its related strainer is attached to the bottom skin of the center tank (between FR36 and FR42 LH and RH side)

The jet pump has two fuel inlets, the pressure inlet and the suction inlet.

The jet pump body has a flange at the suction inlet. The flange attaches the strainer to the jet pump and the pump to the bottom skin of the tank.

When fuel from the pressure inlet goes through the jet nozzle, it causes a suction at the suction inlet.

The flow of fuel goes through and out of the jet pump outlet body.

A non returne valve prevents an opposit flow through the jet pump.

Strainer

The strainer is attached to the jet pump and removes contamination from the fuel that enters the related pump.

Control Valve

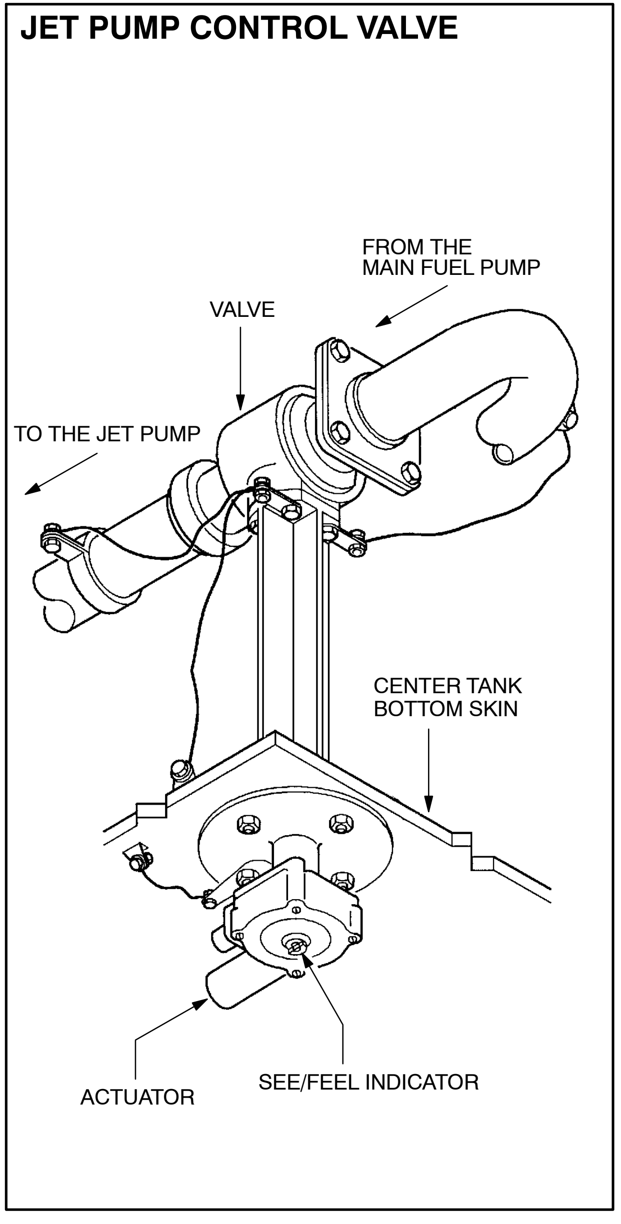
The control valve is a ball valve and is attached to the upper face of the center tank bottom skin.

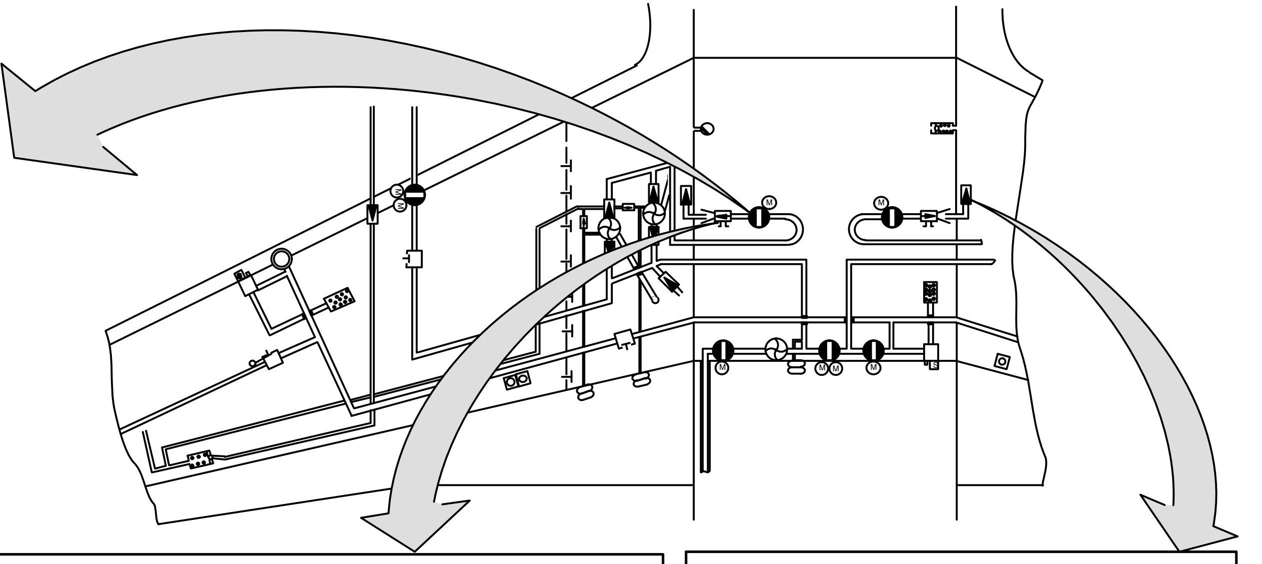
The valve is driven by an actuator. The actuator has an electrial motor that drives a differential gear to turn the ball valve to 90°.

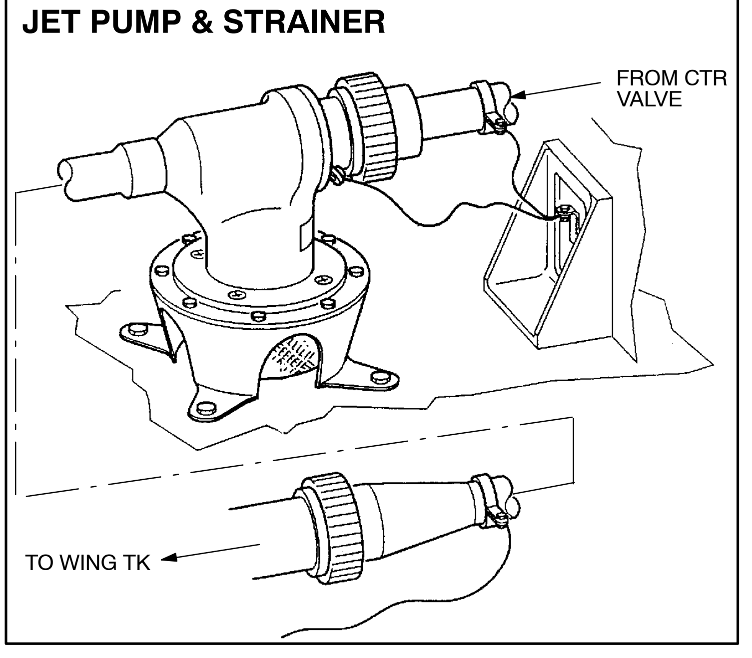
Limit switches in the actuator control this 90° movement and set the electrical circuit for the next operation.

A V-band clamp attaches the actuator to the flange of the drive assembly. A location peg makes sure that the actuator engages correctly.

The see/feel indicator gives an indication of the valve position without removal of the actuator.







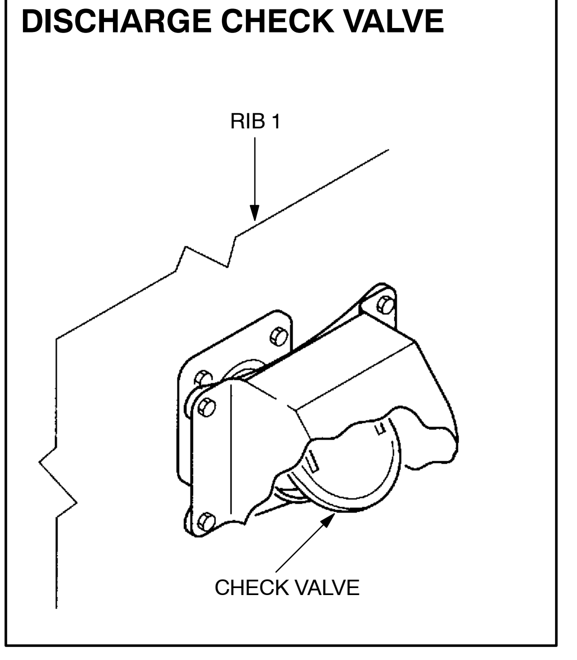


Figure 53 Fuel Feed System Components

MAIN TRANSFER SYSTEM

Center Tank Transfer Control Logic (also A319/320 after Modification)

As long as the fuel is transfered from center (transfer tank) to wing tank, the wing tanks are still full and will tend to overfill

In this case the transfer operation will stop when full sensors are wet.

Wing tank fuel is then supplied to engine until 200 KG of fuel have been used i.e. at least one underfull sensor is dry, the logic circuit then restarts the center tank transfer operation.

Automatic Operation

The Fuel Level Sensing Control Unit has automatic control of the main transfer system when:

- the MODE SEL switch is pushed in (AUTO)
- the related CTR TK XFR switch is in ON

The control valves are automatically set to open or closed, independently of each other.Each jet pump will supply fuel to the related wing tank, when its control valve is open.

A control valve will open when the related UNDERFULL sensor is dry and the related LOW LVL sensor is wet.

A control valve will close when the related FULL sensors become wet again.

A signal is given to a time delay relay when the related LOW LVL sensor becomes dry. The control valve stays open for five minutes and then closes.

If a LOW LVL sensor becomes wet again during this five minute periode the related control valve will stay open. This cycle continues until the LOW LVL sensor stays dry for the five minute periode. The related control valve then closes and the center tank is empty.

- a fault inhibit circuit do not let the FAULT annunciators come on during the five minute periode.

Manual Operation

The crew have manual control of the transfer system when they

- release out (MAN) the MODE SEL switch
- push in the CTR TK L XFR (CTR TK R XFR) switch

In this configuration the jet pumps will operate continuously until the related CTR TK XFR switch is released out.

Main Transfer System Fault Indication

The main transfer system has FAULT annunciators on:

- the MODE SEL P/B switch
- the CTR TK XFR P/B switches

If a fault occures in the main transfer system, the related FAULT annunciator will come on. A failure message will be shown on ECAM (FUEL R (L) XFR VALVE FAULT).

The FAULT annunciator of the MODE SEL P/B switch will only come on in the AUTO configuration. If it comes on, the P/B switch must be set to OFF.

The FAULT annunciator of the CTR TK XFR switches can come on in the AUTO or the MAN configuration. If it comes on, the related P/B switch must be set to OFF.

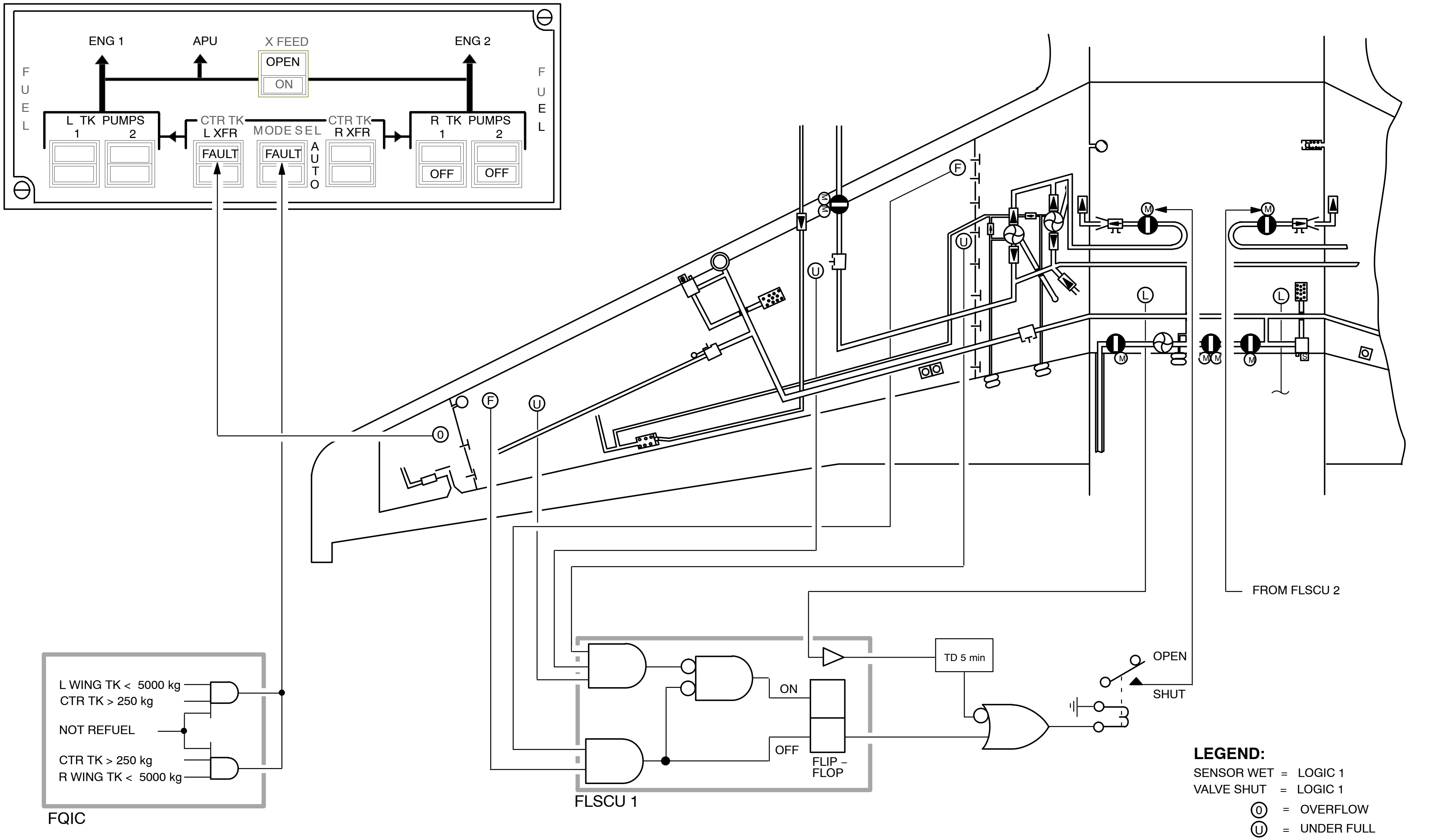
If one of the CTR TK XFR switches is set to OFF:

- fuel will be transfered from the ctr tank to one wing tank only. The crew must crossfed fuel from one wing tank to the other to keep aerodynamic ballance of the aircraft.

Gravity Transfer (also A319/320 after Modification)

Gravity transfers fuel from the center tank if the two CTR TK XFR switches are set to OFF. Fuel only gravity transfers to the wing tanks when the level of fuel in the center tank is greater than that in the wing tanks.

When gravity transfer is in operation, approximately 2000 kg of unusable fuel will remain in the center tank.



NOTE: After Modification the CTR Tank logic also applies for A319/320.

Figure 54 CTR Tank Transfer Logic

CROSSFEED SYSTEM

System Description

The valve of the crossfeed system is usually closed, and in this configuration it divides the main fuel pump system into two parts (one for each engine).

When the valve is open, the two fuel supplyers are connected together. Thus the two engines can be supplied with fuel from one of the wing tanks or from the two wing tanks.

The crossfeed system is operated manually by the X FEED P/B switch on the fuel control panel in the cockpit.

The Engine/Warning Display and the System Display give crossfeed information to the crew. If specified failures occure:

- a warning is given on the EWD
- the FUEL page shows on the SD

Crossfeed Valve

The crossfeed valve body is attached to the foreward face of the rear spar of the center tank with four studs. The studs also attach the drive assembly to the rear spar of the tank.

The drive assembly has a flange to which the actuator is attached with a clamp.

The valve actuator has two electrical motors which drive the same differential gear to turn the ball valve through 90°. Limit switches in the actuator control this 90° movement and set the electrical circuit for the next operation.

One of the two motors can open/close the valve if the other motor do not operate.

A location peg makes sure the actuator engages correctly during installation.

Operation/Control

The crossfeed valve is controlled manually. To operate it is necessary to have:

- the 28V DC BUS2 and the 28V DC ESS. SHED BUS energized
- the cicuit breakers 1QE and 2QE closed

When the X FEED P/B switch is pushed/released the two electric motors are energized and the valve turns to the related position.

The valve signals its position to the ECAM FUEL page display.

Indidcating

The valve position is shown on the FUEL page of the ECAM System Display. If a failure occures the FUEL page is shown automatically on the SD.

System Failures:

- If the valve is not in the set position
  - the message FUEL X FEED FAULT is shown on the EWD (**E**ngine/**W**arning **D**isplay).
  - the crossfeed valve indication is shown amber on the ECAM SD FUEL page

BITE Test

The crossfeed system has current comparator that compares the current supplied to the two actuator motors. The current comparator is monitored by the FQIC (**F**uel **Q**uantity **I**ndicating **C**omputer).

The FQIC reports crossfeed actuator motor failures to the CFDS.

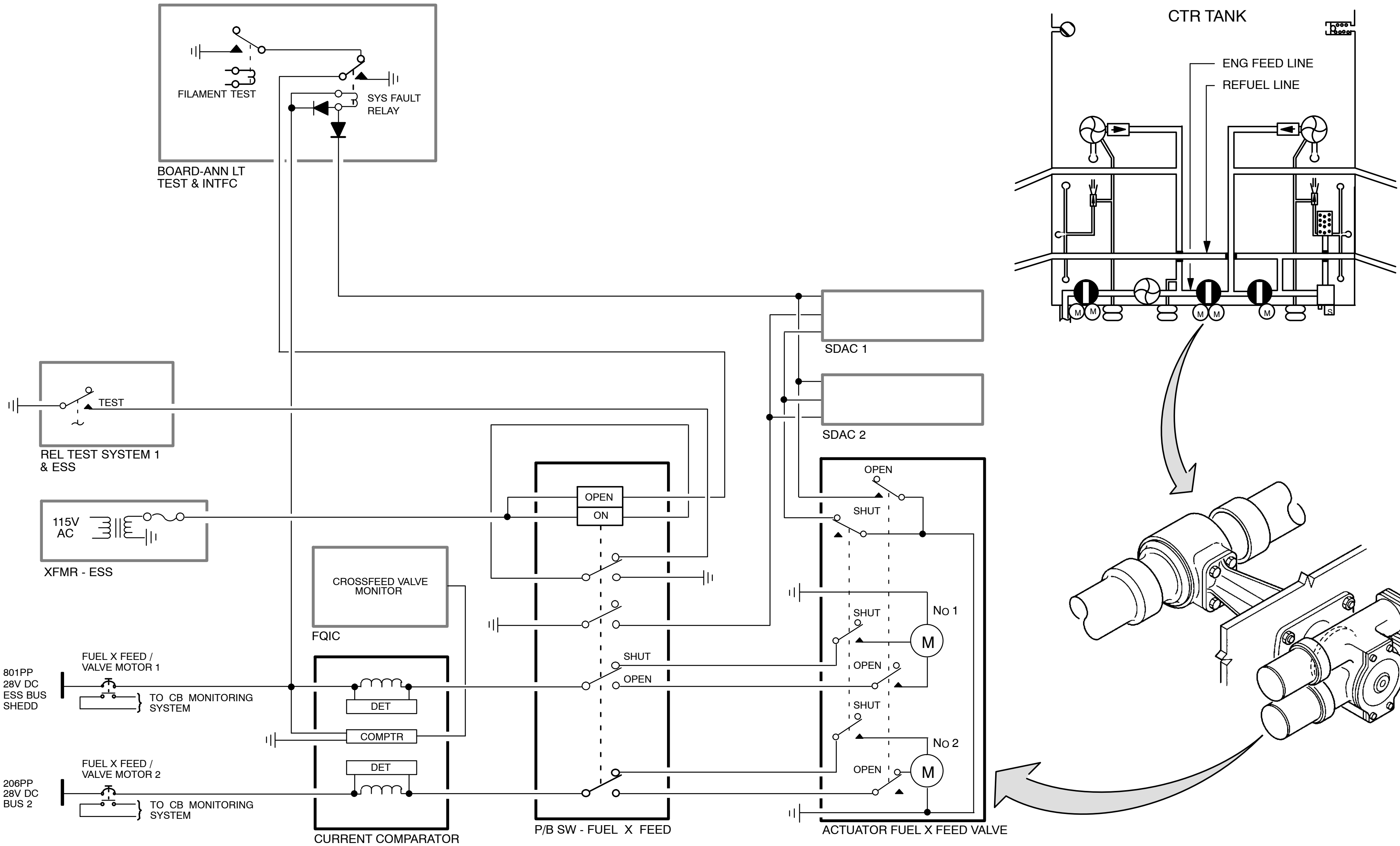


Figure 55 Crossfeed Valve Control Cicuit

ENGINE LP FUEL SHUT OFF

System Description

The engine LP fuel shut-off system controls the LP fuel valves. Each LP fuel valve isolates its engine from fuel supply at the front spar.

The related ENG MASTER switch controls the operation of the LP fuel valve.

But if the related engine FIRE PUSH switch is operated the LP fuel valve closes.

- if the LP fuel valve of one engine is closed, all the fuel in the aircraft is still avialable to the other engine.

The Engine / Warning Display and the System Display give LP shut off information to the crew. If specified failures occure:

- a warning is given on the EWD
- the FUEL page shows on the SD

LP Fuel Valve

The LP fuel valve is installed between the engine pylon and the front face of the wing front spar.

The valve body contains a ball vave. Each LP fuel valve has an actuator .The interface between the actuator and the valve is a valve spindel.The actuator is attached to the valve with a clamp.

The LP valve actuator has two electrical motors which drive the same differential gear to turn the ball valve through 90°. Limit switches in the actuator control this 90° movement and set the electrical circuit for the next operation.

One of the two motors can open/close the valve if the other motor do not operate.

The two motors get their power supply from different sources. If demage occurs to the electrical circuit it is necessary to make sure that the valve can still operate.Thus the electrical supply to each motor goes through a different routing.

The actuator drive shaft has a see/feel indicator which gives an indication of the valve position without removal of the LP fuel valve.

Operation/Control

The engine LP fuel shutoff system is controlled manually. To operate the system it is necessary to have:

- the 28V DC ESS BUS 1 and the 28V DC BUS 2 energized
- the circuit breakers 1QG, 2QG, 3QG, 4QG closed

When the No1 ENG MASTER switch is set to OFF / ON the open or shut side of the actuator motor is energized. The actuator then turnes the valve to the related position.

But the operation of the ENG1 FIRE PUSH switch always overrides an ON selection and closes the valve.

(only the operation of valve no1 is given,valve no 2 circuit is similar)

Indicating

The valve actuatotrs send position data to SDAC1 and SDAC2 (the **S**ystem **D**ata **A**quisition **C**oncentrators). The SDACs process the data and send it to the ECAM which shows the information on the FUEL page.

If electrical failures occure in the LP shut off systemthey cause:

- the FWS (**F**light **W**arning **S**ytem) to give an aural and visuell warning
- the ECAM to show a failure message on EWD, and the FUEL page to show on the SD.

The warning message given is:

- ENG1 LP VALVE FAULT

This shows that the No1 LP fuel valve is not in the set position.

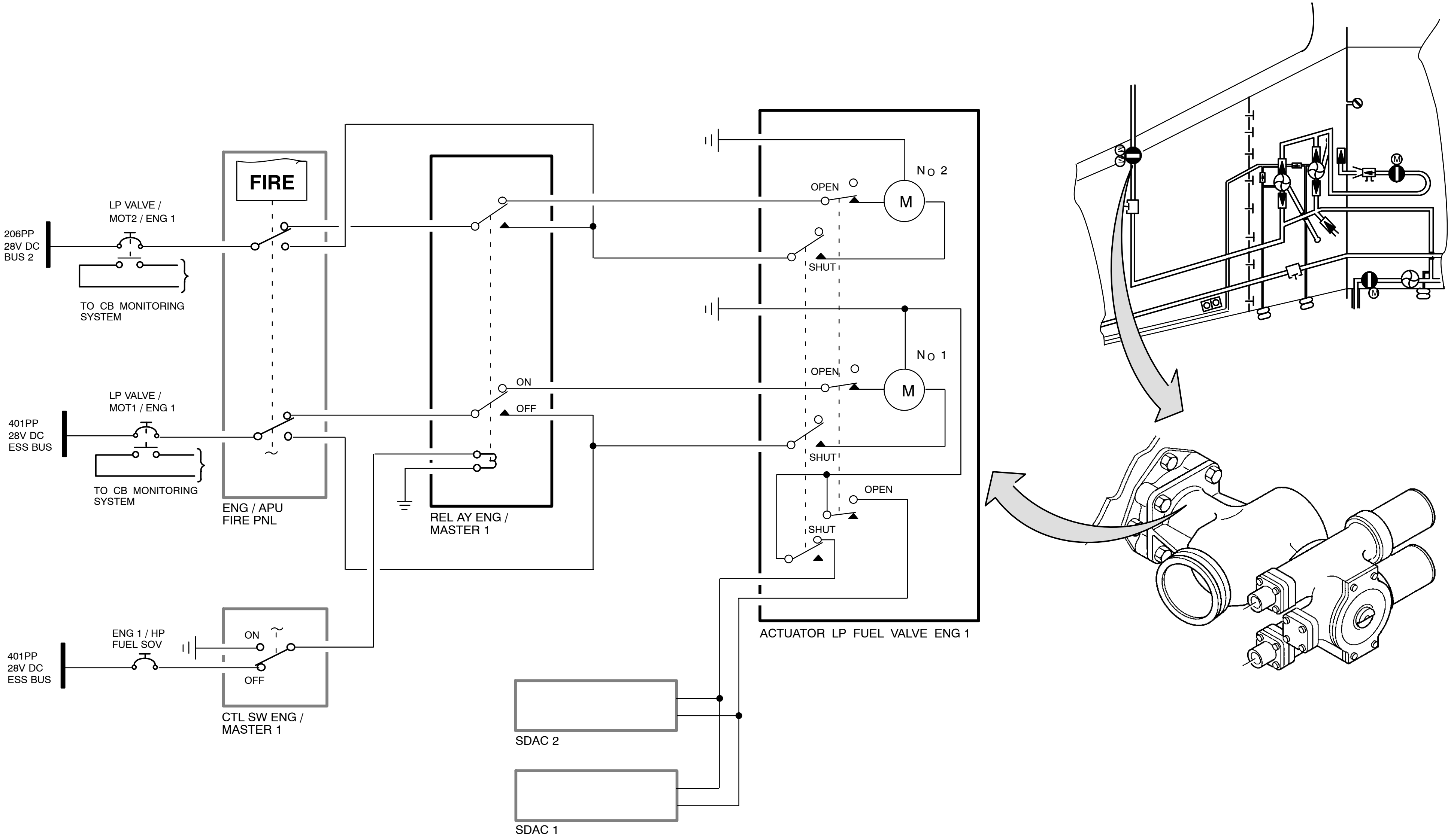


Figure 56 LP Shut Off Valve Circuit

APU FUEL FEED

General Description

The APU usually takes its fuel supply from the LH engine feed line, but when the cross feed valve is open, the RH feed line can also supply the APU with fuel.

Normally, the necessary fuel pressure is achieved by the main engine fuel pumps. The fuel pressure is monitored by the APU fuel pressure switch.

If the fuel pressure in the APU feed line drops below 22 PSI, the APU fuel pressure switch energizes the APU fuel pump to ensure a stable fuel supply to the APU.

APU Fuel Pump

The pump element is a centrifugal type impeller which is driven by a 3 phase electrical motor, supplied with single phase 115V AC.

The fuel then circulates through the unit, cools and lubricates the pump element. A thermal fuse, set at 175°C protects the motor from an overheat condition.

Pump Canister

The pump canister contains the pump and is attached to the center tank rear spar. The engine fuel crossfeed and the APU fuel line are bolted to the canister within the tank.

APU Low Pressure Valve

One APU low pressure valve is located on the center tank rear spar. The valve is operated by a dual DC motor.

The valve will open when the APU MASTER SW is selected to ON. Closing of the valve is done by setting the switch to OFF position. In case of APU fire the LP valve will close automatically.

A see indicator is located on the actuator body in a window and the valve position is displayed on ECAM.

Pressure Switch

The pressure switch has a cylindrical chamber with a banjo type head. A bolt secures it to a check valve on the rear spar.

The fuel pressure in the crossfeed line goes through the check and the banjo head to operate a microswitch in the chamber.

When fuel pressure drops below 22PSI the microswitch closes and gives a signal to start the APU fuel pump.

Fuel Feed Line

The APU fuel feed line connects the engine fuel feed line with the APU fuel distribution system.The APU feed installation includes:

- a tube, installed from the crossfeed line to the top of the wing center tank (immediately fwd of FR 42).
- a double walled vent hose, installed from FR42 to FR80
- high pressure Teflon flexible hose
- a fire sleeve from FR80 to the APU fuel inlet connection
- a drain tube,which connects the vented shroud to the drain mast of the center tank external ventilation system

Operation/Control and Indication

Ref. to ATA Chapter 49

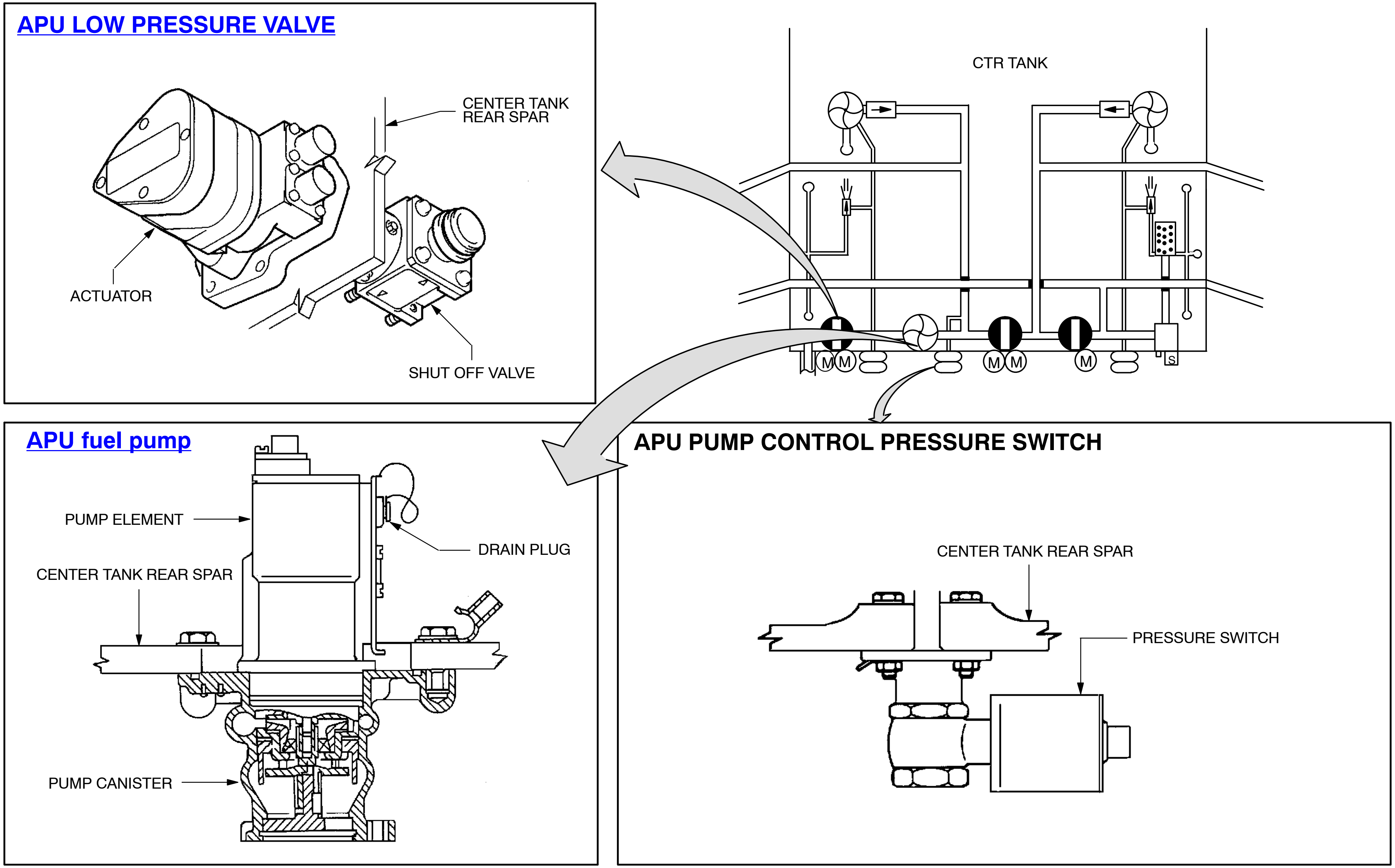


Figure 57 APU Fuel Feed Components

FUEL RECIRCULATION SYSTEM

General System Description

The IDG oil and the engine oil system cooling is provided with fuel as the primary source for heat exchange.

The IDG (**I**ntegrated **D**rive **G**enerator) oil is cooled by part of the fuel supplied to each engine. During oil cooling the temperature of the fuel increases.

The fuel recirculation system moves the warm fuel from the IDG cooling system back to the related wing tank.

Each engine has a recirculation pipe which moves the warm fuel to the wing tank. The interface between each IDG cooling system and each recirculation pipe is a FRV (**F**uel **R**eturn **V**alve).

The FRV opens at low engine fuel flow if the engine oil temperature is above 93° C.

The operation of the FRV is controlled by the FADEC (**F**ull **A**uthority **D**igital **E**ngine **C**ontrol) system.

The system has (for each engine):

- a recirculation pipe
- a recirculation check valve
- a pressure holding valve

Control and Indication

The recirculation system operation is full automatically, contolled by the two FLSCU’s and their related sensors.

Two temperature sensors in each wing tank send the fuel temperature data to the FLSCU’s. The fuel temperature data from the LH wing goes to the FLSCU 1,while the data from the RH wing goes to FLSCU 2.

Thus the FLSCU 1 (together with the No 1 FADEC) controls the recirculation system in the LH wing. The FLSCU 2 (together with the No 2 FADEC) controls the system in the RH wing.

The FLSCU 1 or FLSCU 2 sends a signal to close the related fuel return valve (through the FADEC) if one of these conditions occure:

- the temperature sensor in the wing inner cell sends a high fuel temperature signal (52.5° C approximately).
- the temperature sensor in the wing outer cell sends a high fuel temperature signal (55° C approximately).
- low fuel pump pressure occurs in a wing with crossfeed valve in closed position (gravity fuel supply to the related engine).
- low fuel pump pressure occurs in both wings with crossfeed valve in open position (gravity fuel supply to both engine).
- the surge tank overflow sensor becomes wet.
- the wing tank fuel contens decreases to 280 kg (IDG shut-off sensor).

The temperature of the fuel in the wing inner and outer cell is given on the ECAM System Display FUEL page.

Fuel temperature warnings are given on the Engine/Warning Display

Pump Logic

As long as fuel being delivered from the center tank to the engines, the wing tank will tend to overfill as the recirculated fuel is delivered to the wing tanks.

In this case the center tank pumps will stop when the inner cell reaches the full level.

The wing tank pumps will now feed the engine untill approximately 500kg of fuel have been used i.e. the underfull sensors are reached. The logic cicuit then restarts the center tank pumps.

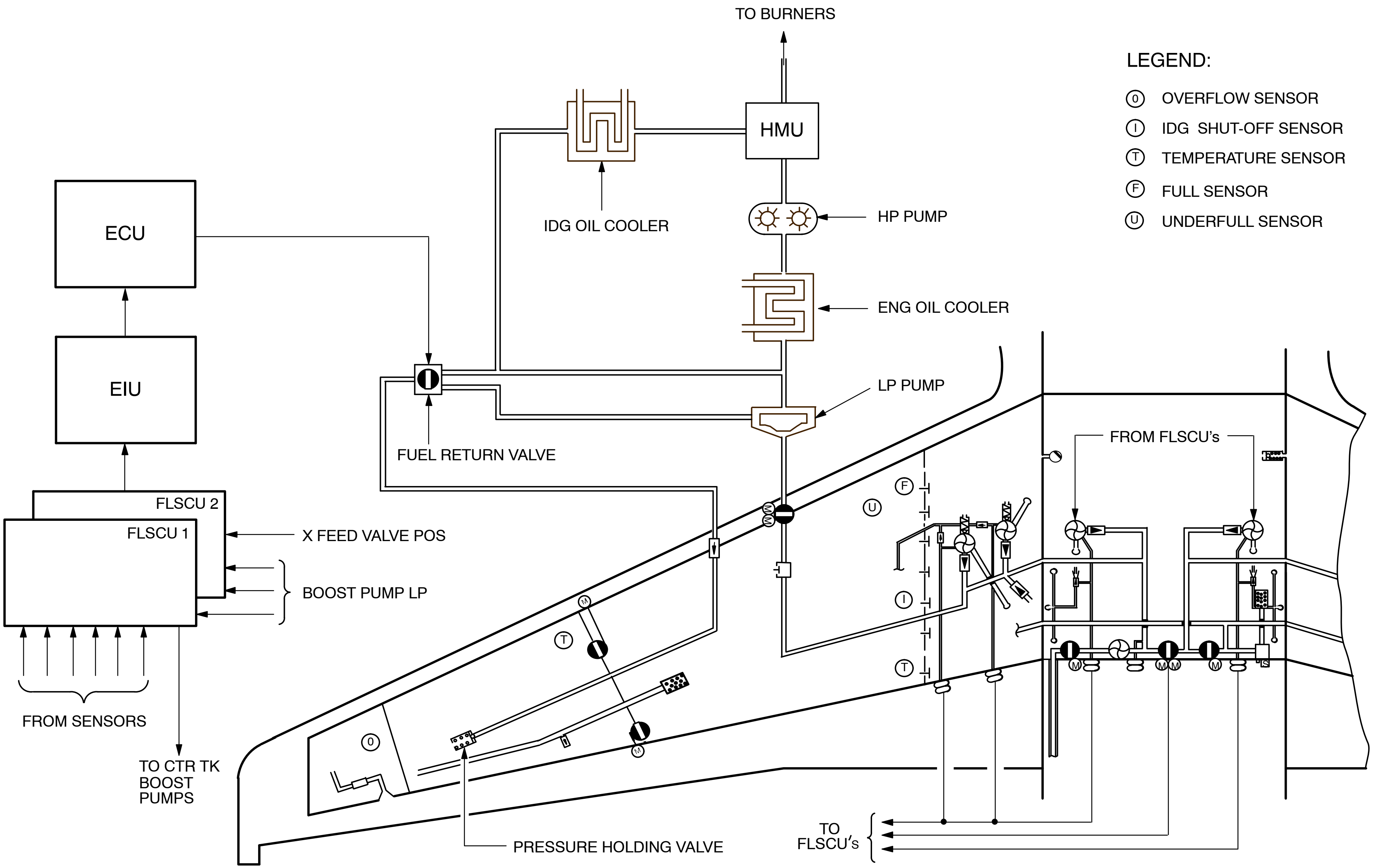


Figure 58 Fuel Recirculation System

COMPONENTS

Reciculation Pipe

The recirculation pipe is between the FRV and the pressure holding valve at the outboard face of RIB 17 in the wing tank.

Recirculation Check Valve

The recirculation check valve is attached to the lower surface of the wing bottom skin in the engine pylon.

It connects the recirculation pipe from the engine to the recirculation pipe in the wing. When the recirculation system is not in operation, it closes to prevent a reverse fuel flow from the recirculation system to the engine.

Pressure Holding Valve

The pressure holding valve is in an adapter that attaches to the inboard face of RIB 17. When the recirculation system is in operation, the valve keeps a pressure of 15.5 psi in the recirculation pipe.

This pressure makes sure that the warm fuel in the pipe does not boil.

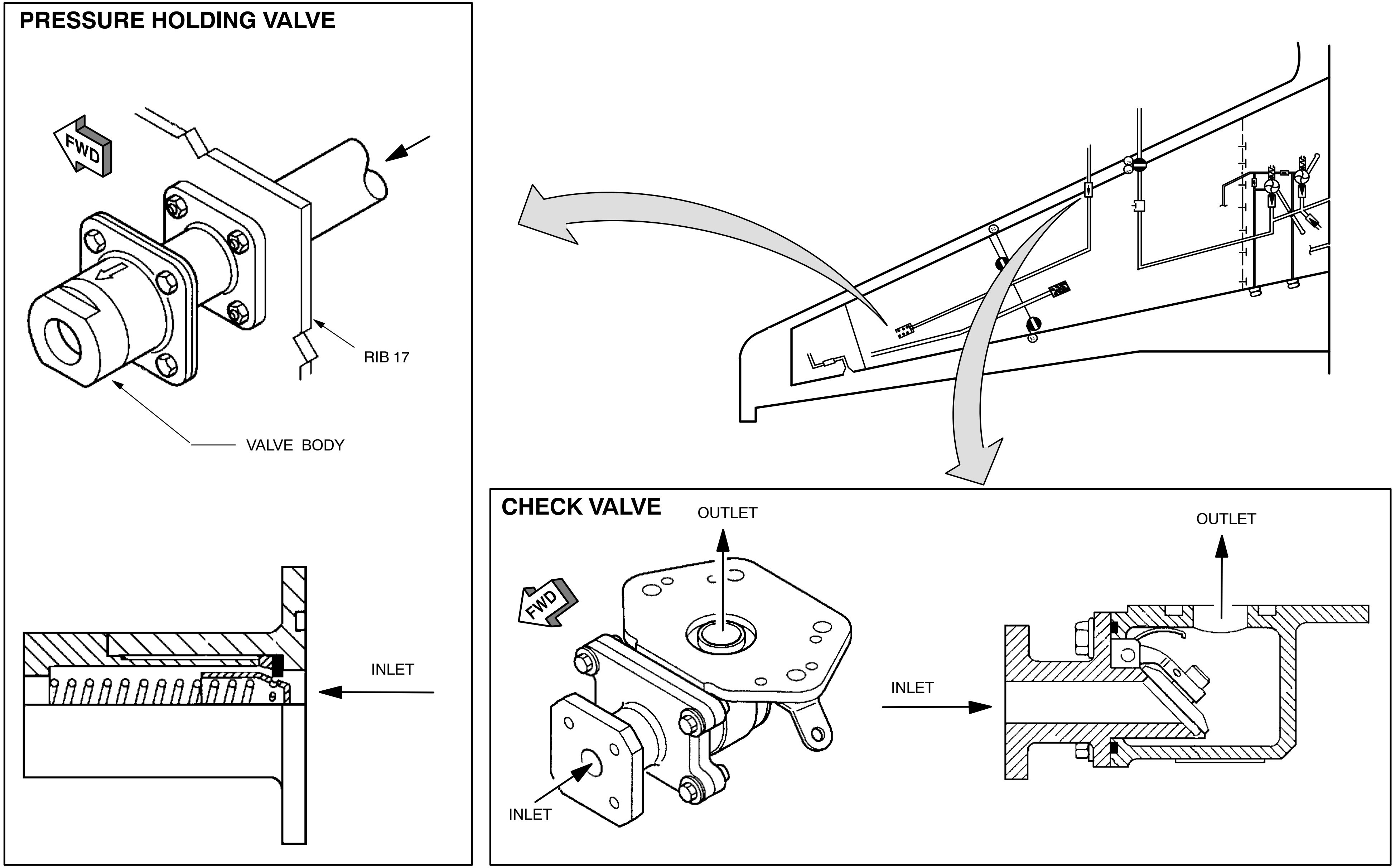


Figure 59 Recirculation System Components

ENGINE HEAT MANAGEMENT SYSTEM

General Description

The IDG oil and the engine oil system cooling is provided with fuel as the primary source for heat exchange.

The fuel downstream of the engine low pressure pump passes through the oil coolers to absorb the heat from the oil systems.

Some of the fuel used in the heat management system may be returned to the wing tanks.

A "fuel divider and return to tank valve" is controlled by the EEC (**E**lectronic **E**ngine **C**ontrol).

The fuel divider and return to tank valve controls the fuel flow path through the coolers and the return of fuel to the tank, as determined by the EEC.

The EEC logic is a function of the temperatures in the fuel and oil systems, and the engine power setting.

The fuel recirculation system has (for each engine):

- a recirculation pipe
- a cooling fuel pipe
- a piccolo tube
- a pressure holding valve
- a recirculation check valve
- a recirculation manifold

Control and Indication

The recirculation system operation is full automatically, contolled by engine-FADEC and the two FLSCUs and their related sensors.

One temperature sensor in each wing tank send the fuel temperature data to the FLSCUs. The fuel temperature data from the LH wing goes to the FLSCU 1, while the data from the RH wing goes to FLSCU 2.

Thus the FLSCU 1 (together with the No 1 EEC) controls the recirculation system in the LH wing. The FLSCU 2 (together with the No 2 EEC) controls the system in the RH wing.

The FLSCU 1 or FLSCU 2 sends a signal to close the related diverter & return valve (through the FADEC) if one of these conditions occure:

- the temperature sensor in the wing tank sends a high fuel temperature signal (52.5° C approximately).
- low fuel pump pressure occurs in a wing with crossfeed valve in closed position (gravity fuel supply to the related engine).
- low fuel pump pressure occurs in both wings with crossfeed valve in open position (gravity fuel supply to both engine).
- the surge tank overflow sensor becomes wet.
- the wing tank fuel contens decreases to 280 kg (IDG shut-off sensor).

The temperature of the fuel in the wing tanks is shown on the ECAM System Display FUEL page.

Fuel temperature warnings are given on the Engine/Warning Display.

Center Tank Transfer Control Logic

As long as the fuel is transfered from center (transfer tank) to wing tank, and recirculated fuel is delivered to the wing, the wing tanks are still full and will tend to overfill.

In this case the transfer operation will stop when full sensors are wet.

Wing tank fuel is then supplied to engine until 200 Kg of fuel have been used i.e. at least one underfull sensor is dry, the logic circuit then restarts the center tank transfer operation.

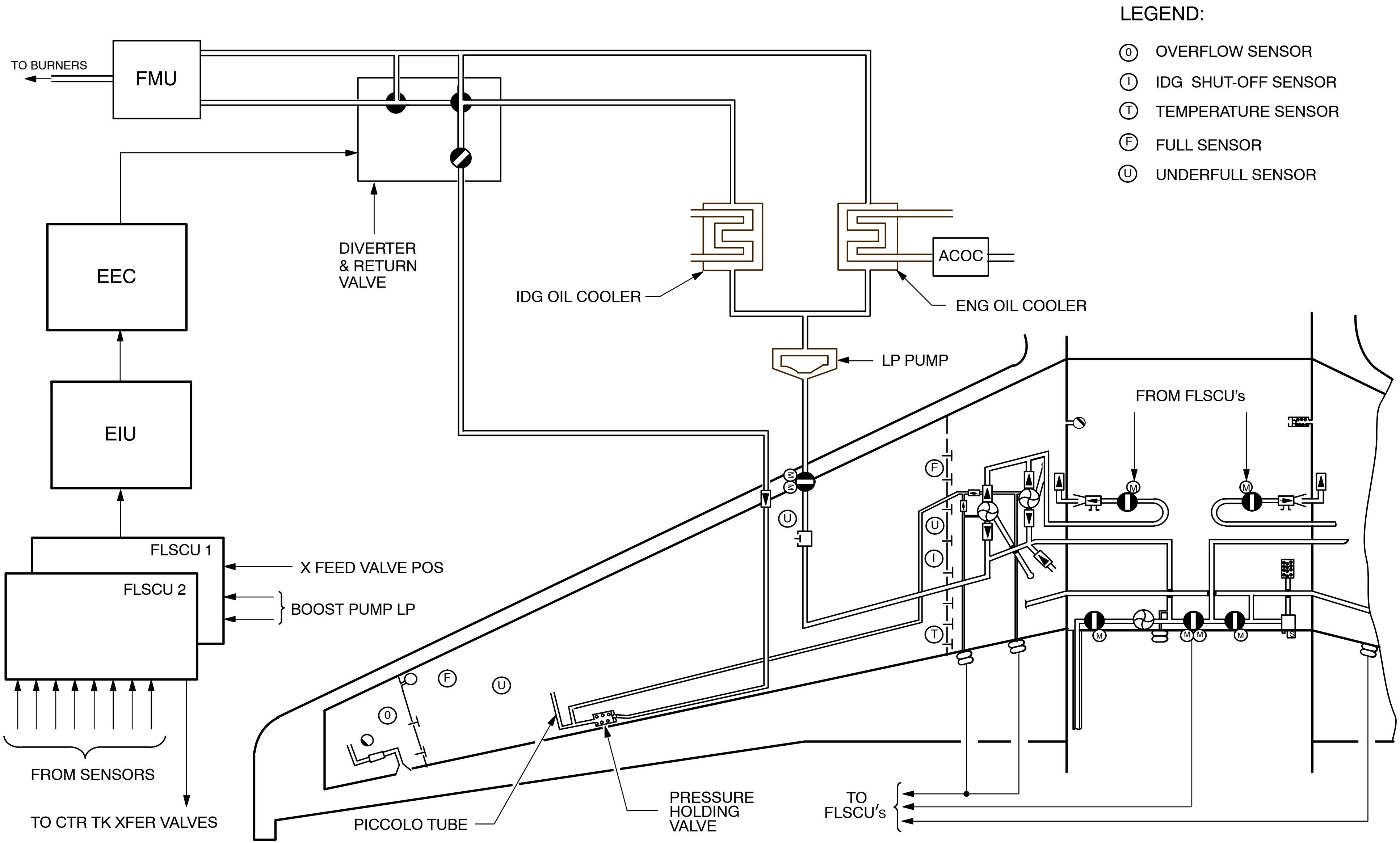


Figure 60 Fuel Recirculation System

COMPONENTS

Recirculation Pipe

The recirculation pipe is between the diverter & return valve and the inboard face of RIB 16 in the wing tank.

The piccolo tube is attached to the end of the recirculation pipe. The piccolo tube has holes that let the fuel go into the wing tank.

The cooling fuel pipe is attached to the recirculation pipe. The main fuel pumps move the fuel (at ambient temperature) through the cooling pipe to the recirculation pipe.

Recirculation Check Valve

The recirculation check valve is attached to the lower surface of the wing bottom skin in the engine pylon.

It connects the recirculation pipe from the engine to the recirculation pipe in the wing. When the recirculation system is not in operation, it closes to prevent a fuel flow from the recirculation system to the main fuel pumps.

Pressure Holding Valve

The pressure holding valve is in an adapter that attaches to the inboard face of RIB 15. When the recirculation system is in operation, the valve keeps a pressure of 15.5 psi in the recirculation pipe.

This pressure makes sure that the warm fuel in the pipe does not boil.

Recirculation Manifold

The manifold is attached to the inboard face of RIB 2.

The manifold contains two additional recirculation check valves which are closed when their related fuel pump is not in operation.

This prevents a return flow from the recirculation system to the main fuel pump.

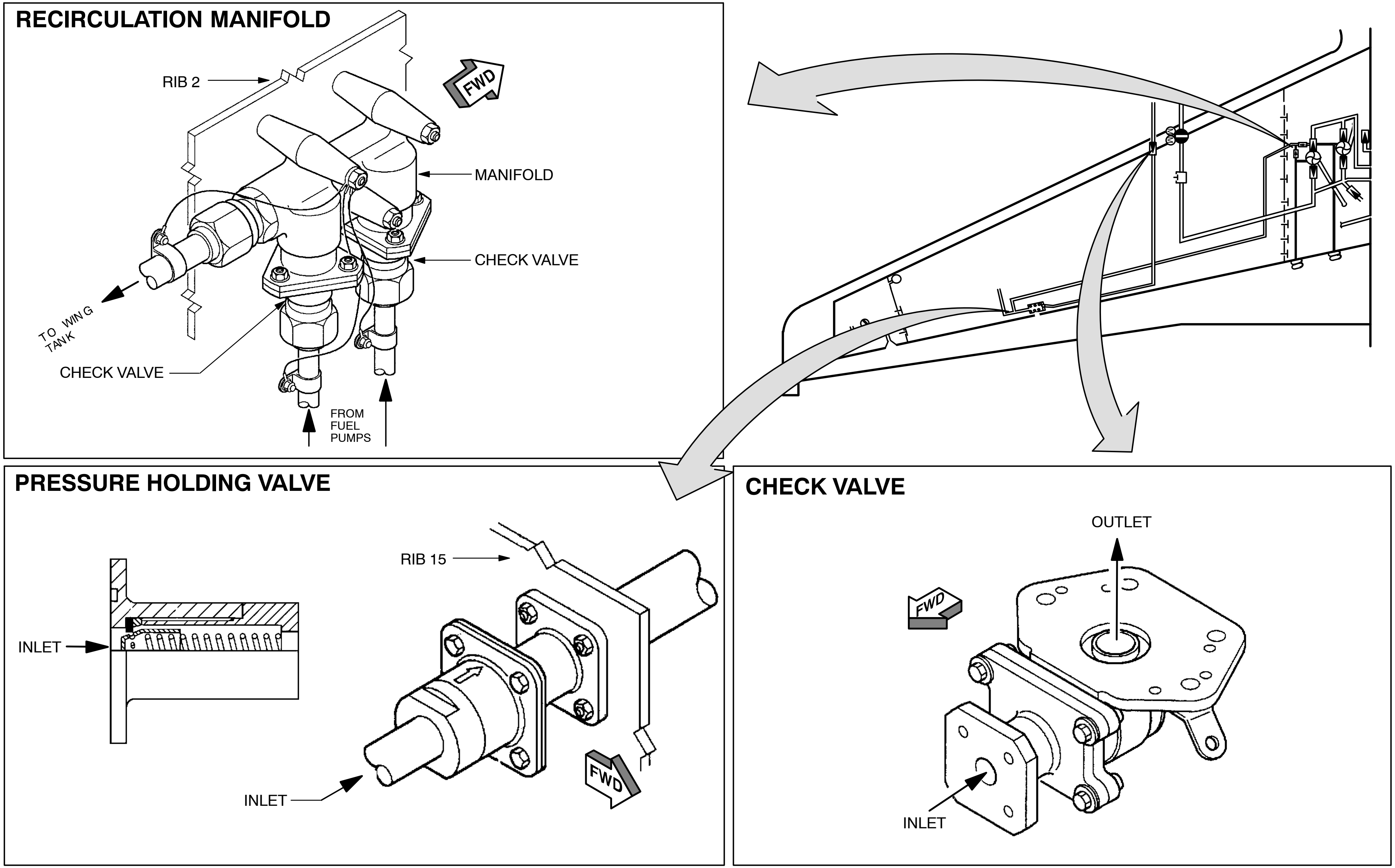


Figure 61 Recirculation System Components

FUEL LEVEL SENSING

Tank Level Sensing

All the sensors are similar.

A sensor consist of a thermistor and a fast blow fuse. When an electrical current goes through the thermistor, its temperature increases. The electrical resistance of the thermistor changes with its temperature.

When the sensor is in the fuel, the temperature increase is less than when the sensor is in the air. The FLSCU compares the current value from the sensor to a specified value to find if the related sensor is wet or dry.

The tank level system has temperature sensors (two on A318 / 319 / 320 or one sensor on A321 in each wing) that the FLSCU's monitor continuously. Each temperature sensor is near the lowest part of the fuel tank / -cell.

This makes sure that the sensor is immersed in fuel for most of the time.

The sensor consist of a platinum-wire resistor and a fast blow fuse. The electrical resistance of the sensor is in relation to the adjacent fuel.

When the temperature of the fuel is at a specified level the FLSCU stops the recirculation system.

SENSOR FUNCTION A318/319/320

High Level Sensors

- Installed near the top of each fuel tank. When the sensor becomes wet the FLSCU signals the associated tank refuel solenoid valve to close, and will illuminate the ”HI LEVEL” light on the refuel panel.

Low Level Sensors

- in the center tank (130 kg), when dry, they will signal the center tank boost pump to stop, with a time delay of 5 minutes.
- In the wing tank (750 kg), when dry, they will open LH and RH Transfer valves simultaneously. If the sensor is exposed to air for more than 30 se conds, ”FUEL LO LEVEL” warning will be indicated on the ECAM display.

IDG Low Level Sensors

- will stop IDG fuel return when the fuel level is below 280kg.

Full Level Sensors

- in the left and right inner cells,controls the operation of the center tank pumps when ”AUTO” is selected. They will stop the center tank pumps when covered in fuel.

Underfull Level Sensors

- in left and right inner cells, controls the operation of the center tank pumps when ”AUTO” is selected. When dry the center tank pumps start again if there is no low level in the center tank. The difference between full/underfull is approximately 500kg.

Overflow Level Sensor

- in the Vent Surge tanks, will signal the respective IDG fuel return valve to close.

Temperature Sensors

- inner cell (52.5°C) and/or outer cell (55°C) will signal the respective IDG fuel return valve to close if the specified temperature is exceeded.

SENSOR FUNCTION A321

The function of the High Level , the IDG Low Level, the Overflow Level and the Temperature Sensor (52.5° C) is the same as A318/319/320.

Full/Underfull Level Sensors

- the FLSCUs use the sensor data to control the main transfer and the recir-culation system. The difference between full and underfull is approximately 200kg.

Low Level Sensors

- in the wing tank (750 kg), when they are dry for 30 sec continuously a LO LEVEL warning is shown on EC
- in the wing tank (1500 kg), when they are dry for 30 sec continuously a advisory “FOB BELOW 3T“ is shown on the EWD.
- in the center tank (130 kg), when dry, they will signal the center tank transfer valve to close, with a time delay of 5 minutes.

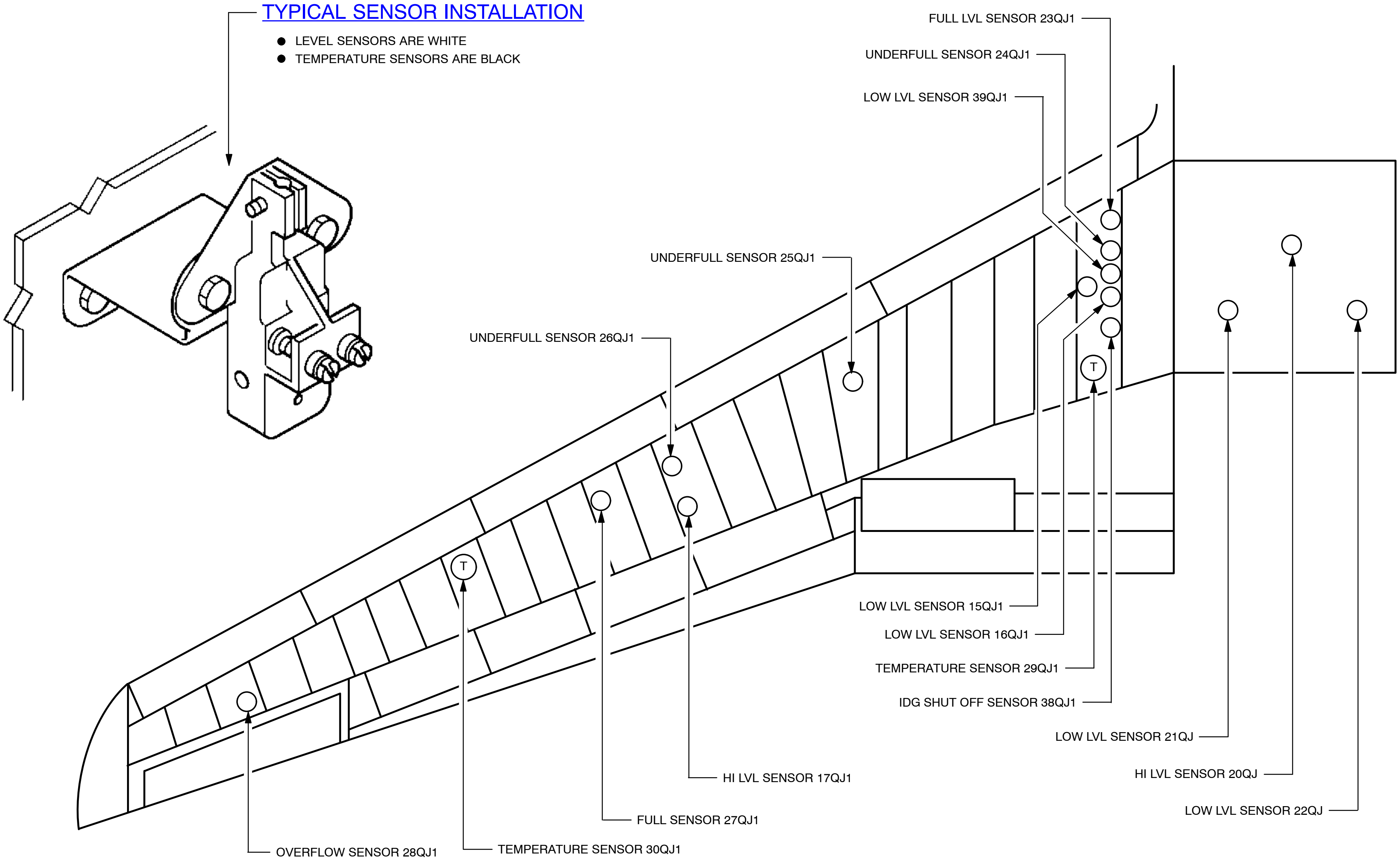


Figure 62 Level/Temp. Sensors A318/319/320

FUEL LEVEL SENSING CONTROL UNIT

General Description

The FLSCUs (**F**uel **L**evel **S**ensing **C**ontrol **U**nits) are in the FWD electronics rack 92VU, in the aircraft avionic bay.

The FLSCUs use signal codition to find if the fuel adjacent to a given sensor is in a specified condition.

Each FLSCU sends an electrical current to its related sensors, the voltage of which is set. When the electrical current comes back to the FLSCU from a sensor the voltage is measured. The FLSCUs compare the measured voltage to the set value to find out if:

- the sensor is wet or dry (for the level sensors)
- the adjacent fuel is hot (for the temperature sensors).

The voltage that goes back to the FLSCUs from high level, low level, temperature, full and underfull sensors goes through groups of logic gates. These logic gates help to make sure that:

- incorrect warnings are not shown on the EWD during flight
- on A318/319/320, the center tank fuel pumps operates correctly at all air craft attitudes
- on A318 / 319 / 320, the intercell transfer system operates correctly
- on A321, the main transfer system operates correctly at all aircraft attitudes
- on all aircrafts, the recirculation system operates correctly
- on all aircrafts, the high level shut off system operates correctly

Test

The high level sensors and their circuits are tested from the refuel/defuel panel 800VU, with the TEST switch (2QJ).The same switch also has a filament test facility (Light Test).

The FQIS computer BITE has test facility for all the sensors and their circuits. When BITE is operated, with a failure monitor signal, the CFDS will show and identify a:

- defective sensor and/or defective control unit.

If necessary you can perform a special test of the tank level system, using the Test Set (Ref. the related AMM TASK).

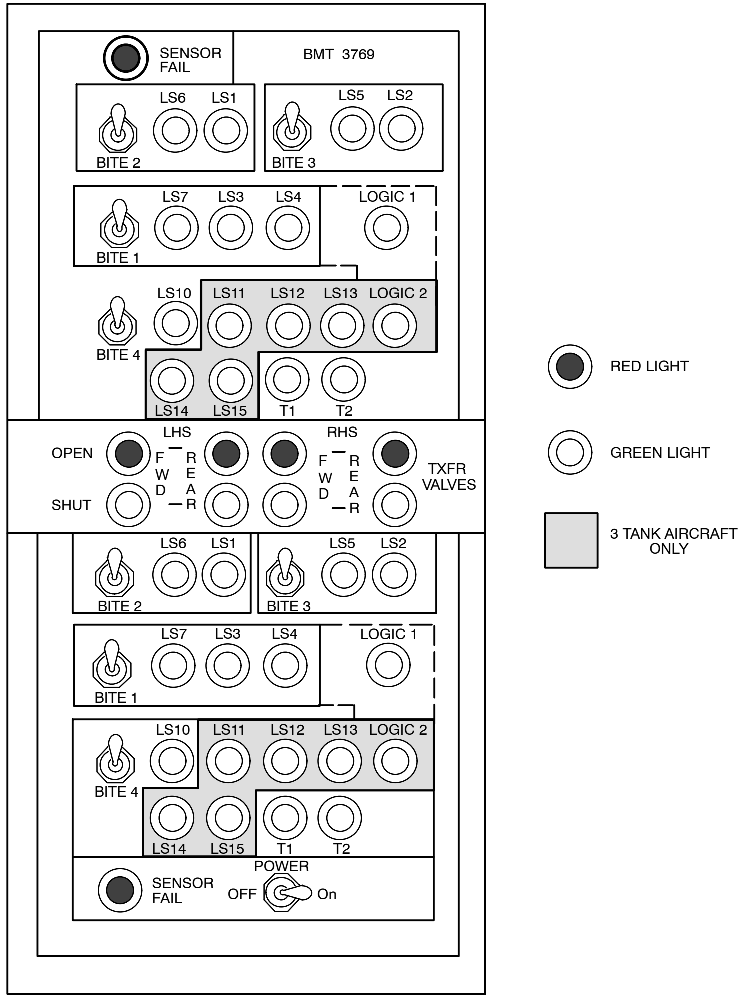


Figure 63 FLSCU - Test Set

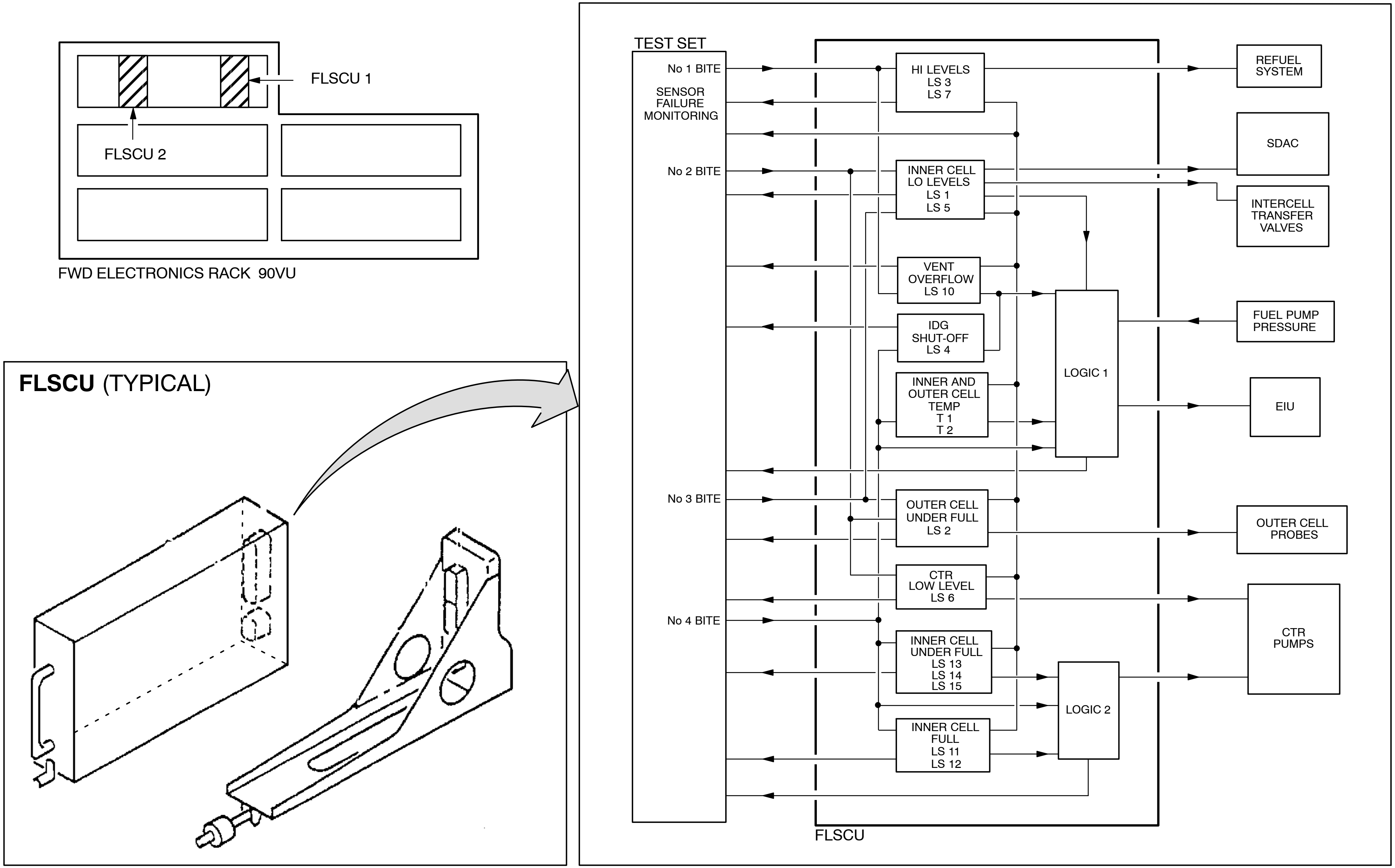


Figure 64 Fuel Level Sensing Control Unit

FUEL QUANTITY INDICATING

System Description

The fuel quantity indicating system measures the quantity of fuel in the range from unusable fuel to fuel overflow. It gives indications for each fuel tank.

The system has on A318/319/320:

- fuel quantity probes
- a FQIC (**F**uel **Q**uantity **I**ndication **C**omputer)
- three cadensicons
- three capacity index compensators

The system has on A321.

- fuel quantity probes
- a fuel quantity computer
- two ultracomparators
- a dualcomparator

The fuel quantity probes are in the fuel tanks. The FQIC regulary monitors the fuel quantity probes and uses signal conditions to calculate the volume of fuel in the related tank.

The FQIC also monitors the cadensicon/capacity index compensators (on A318/319/320) or the ultracomp/dualcomps (on A321) and uses their data to calculate the density of the fuel in the tanks.

When the FQIC has calculated the volume of fuel in the tanks and the fuel density, it can calculate the fuel mass.

The fuel mass is displayed on:

- the SD FUEL page and the EWD
- the fuel quantity preselector (during a refuel)
- the multi tank fuel quantity indicator (during a refuel)

Indications

The FQI, and the temperature measurement indications are shown on the ECAM SD FUEL page. When specified FQI or FLSS conditions occur, the EWD gives a warning message and the FWC gives an audible warning.

BITE Test

The built-in test equipment is installed in the FQIC. It monitors inputs, outputs and operation to give results from the regular system tests.

Fault information for each flight, and up to sixty-four flight legs kept in the BITE memories.

The menus on the MCDU give access to the test results. The test also monitors some of the fuel system inputs to the Flight Warning System.

A HI LVL test switch is provided to allow a limited BITE testing of the high level sensors only. This test occurs automatically at a refueling from the optional refuel control panel in the cockpit.

L/G Control Lever

The FQI computer receives ground information from the landing gear control lever, when selected DOWN and refuel on battery. This signal is used to provide electrical supply to the FQI computer in this specific configuration.

ADIRU

Acceleration data is received from Air Data Inertial Reference system during flight and is used as an alternate source of attitude.

Normally, effects of attitude, changes in acceleration, effective pitch and roll angles are calculated from the hight of fuel at each probe and the knowledge of the tank geometry stored in the computer memory.

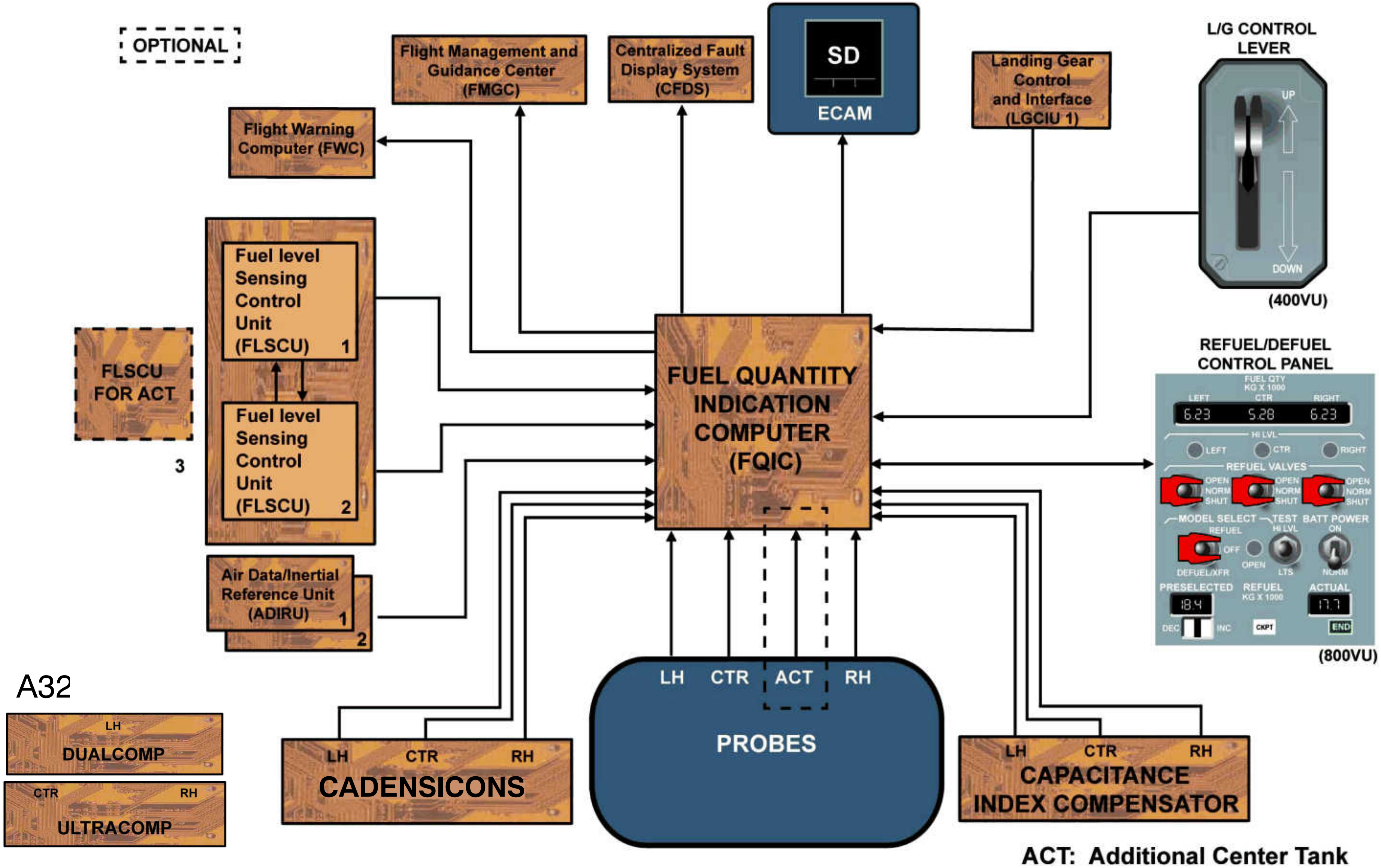


Figure 65 Quantity Indicating A318/319/320

COMPONENTS

Fuel Quantity Computer

The FQIC controls the FQI system.

One or two OBRMs (depend on FQIC standard) are attached to the FQIC and contain the software to operate the FQIC.

The FQIC has two processing channels that are the same. The channels are identified as Channel 1 and Channel 2. Each channel has a data acquisition board and a CPU board. The components that remain are common for each of the channels. Each channel does these operations:

- Computation of the fuel mass held in each wing
- Computation of the ACTUAL total fuel mass
- Computation of the PRESELECTED fuel mass
- Computation of the automatic refuel control
- discrete outputs to the refuel valves and FWCs (system failures)
- continuous automatic tests for faults (BITE)
- FLSS BITE
- continuously monitors the status of the other channel
- ARINC 429 digital output to the interfaces

Normally, the two channels operate continuously, with each channel monitoring the status of the other channel.The most accurate being the operational one. If this channel fails, the operation will be changed to the other channel.

This will not decrease the satisfactory operation of the FQI system, but the CFDS report will indicate the failure.

Preselector

The preselector 5QT is installed adjacent to the to the Refuel/Defuel Control Panel (optional the preselector 10QT can be installed in the cockpit).

The preselector gets fuel quantity data from the FQIC through an ARINC 429 bus. The LED display module then gives these indications:

- the PRESELECTED fuel quantitiy
- the ACTUAL fuel quantity

The preselector is pre-programmed to display in either kgs or lbs.

The FQIC also sends an identification bit that will identify if the quantity data is sent in kg or lbs.

If there is a difference between the identification bit and the indicator programm, the preselector prevents an LED display.

The preselector has a rocker switch that is used to set the PRESELECTED fuel quantity for an automatic refuel operation.

The preselector has an END annunciator, that comes on when the refuel procedure is satisfactorily completed. If a refuel failure condition has occured the END annunciator will flash.

A single white lamp, identified CKPT, used when a preselector unit installed in the cockpit has taken priority.

Multi Tank Indicator

The MTI is installed on the refuel/defuel control panel.

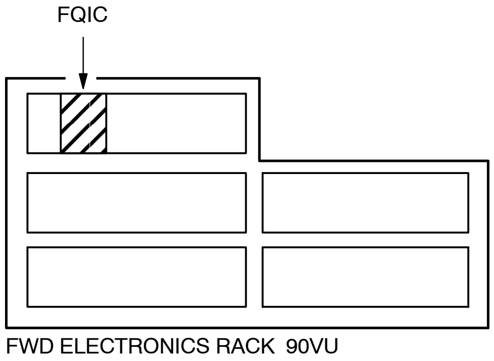
The MTI receives the fuel quantity data from the FQIC through the ARINC 429 data links.

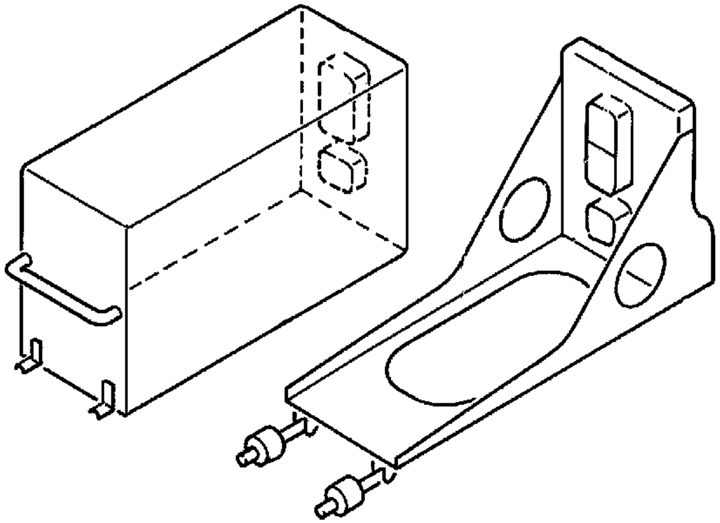
The LED display module then gives the quantity indications.

The indicator is pre-programmed to display in either kgs or lbs.The FQIC also sends an identification bit that will identify if the quantity data is sent in kg or lbs.

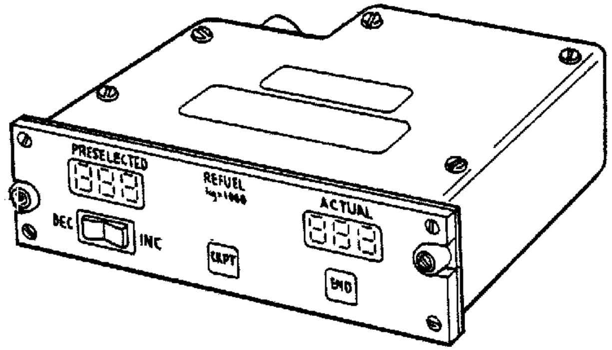
If there is a difference between the identification bit and the indicator programm, the indicator prevents an LED display.

FUEL QUANTITY COMPUTER





PRESELECTOR 5QT (10QT OPTIONAL)



MULTI TANK INDICATOR

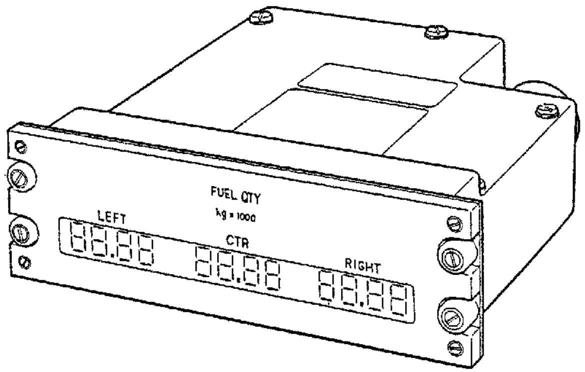


Figure 66 System Components

COMPONENTS (CONT)

Fuel Quantity Probes

Each probe is assembled in the same way. To make an allowance for the depth and size of the fuel tanks, the lengths of the probes are different.

The probe has two concentric aluminum tubes which are anodized and covered with polyurethane.

Sets of centralising pins are installed at differnt places along the lenght of the tubes. These keep the inner tube concentric with the outer tube.

The open ends of the tube let the fuel move freely up and down between the tubes.

A terminal block is installed on the side of each probe to connect it with the related tank harness.

The electrical capacitance-value of the probe changes in relation to the depth of fuel in the tank.When the probe is dry, its capacitance value is low, but as fuel moves up the probe, it capacitance value increases. The FQIC continiuosly measures the capacitance value.

Some probes have diodes that are used to measure the temperature of the adjacent fuel. The FQIC supplies a voltage to the diodes and monitors the voltage that returns from them.

The voltage drop across the diodes is in relation to the temperature of the fuel. The FQIC calculates the temperature of the fuel and displays it on the SD FUEL page of the ECAM.

Some probes have a CIC (**C**apacitance **I**ndex **C**ompensator) at their lower end. The CIC has two functions:

- when fully covered in fuel, to measure dielectric constant (K)
- when not fully covered in fuel, as a probe

The FQIC uses the k value to calculate the fuel density.

Cadensicons (A318/319/320)

The cadensicons are installed near to the lowest part of the fuel tanks.

to calculate the fuel density.

The cadensicon has a capacitor assembly, a detector assembly and a circuit card assembly installed in a base assembly. The base assembly is connected to the tank harnes. Fuel moves freely in and out of the cadensicon through holes in the cover.

The fuel is, the dielectric between the parallel plates of the capacitor assembly. The FQIC calculates the charge on the plates, from which K, the relative permittivity of the fuel is calculated.

The detector assembly contains a float and a detector. The detector is a variable transformer turned by the float. Pressure on the float is in relation to the density of the fuel. If the density varies the pressure difference on the float causes the float to move. When the float moves the detector moves in relation to it and therefor the transformer ratio changes. The FQIC uses the transfomer ratio to calculate the fuel density.

A thermistor changes the transformer ratio to make allowances for variations in fuel temperature.

Ultracomp (A321)

The ultracomp housing contains a parallel plate capacitor, a velocimeter and a temperature sensor. A interconnecting board connects the ultracomp to the related tank harness.

Fuel moves freely in and out of the ultracomp through holes in the housing. The fuel acts as a the dielectric between the parallel plates of the capacitor.

The FQIC calculates the charge on the plates, from which K, the relative permittivity of the fuel is calculated.

The velocimeter measures the VOS (**V**elocity **O**f **S**ound) through the fuel. It transmits a sound wave through the fuel to a fixed target .

The FQIC monitors the the velocimeter and calculates the time taken for the sound wave to reach the target and return.

The temperature sensor gives a signal (T) in relation to the fuel temperature.

The FQIC uses the values K, VOS and T to calculate the fuel density.

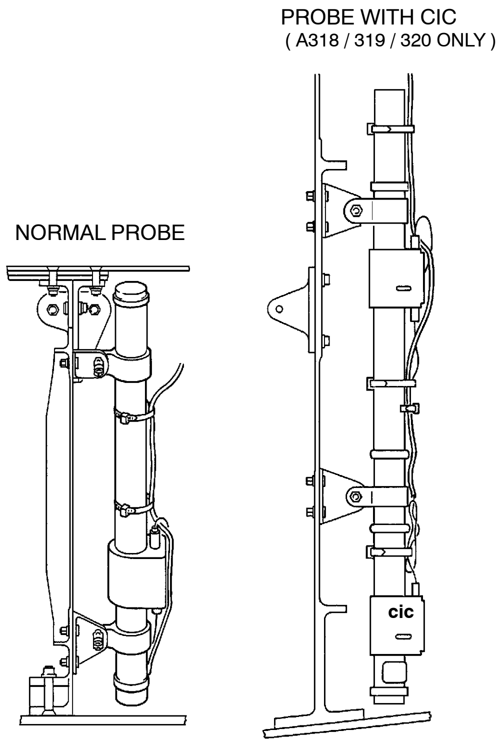
Dualcomp (A321)

The dualcomp housing contains two parallel plate capacitors. A interconnecting board connects the dualcomp to the related tank harness.

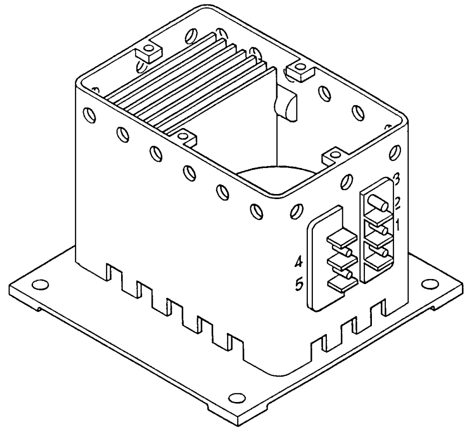
Fuel moves freely in and out of the ultracomp through holes in the housing. The fuel acts as a the dielectric between the parallel plates of the capacitor. The FQIC calculates the charge on the plates, from which K, the relative permittivity of the fuel is calculated.

The FQIC uses the value K with the VOS and T values from the ultracomp in the opposit wing tank to calculate the fuel density

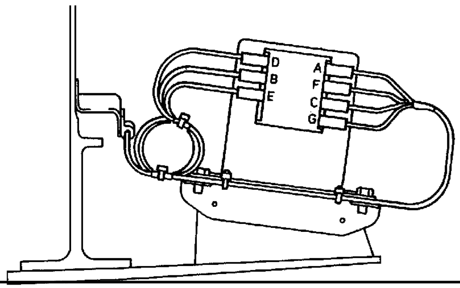
FUEL QTY. PROBE (TYPICAL)



ULTRACOMP (A321 ONLY)



CADENSICON (A318/319/320 ONLY)



DUALCOMP (A321 ONLY)

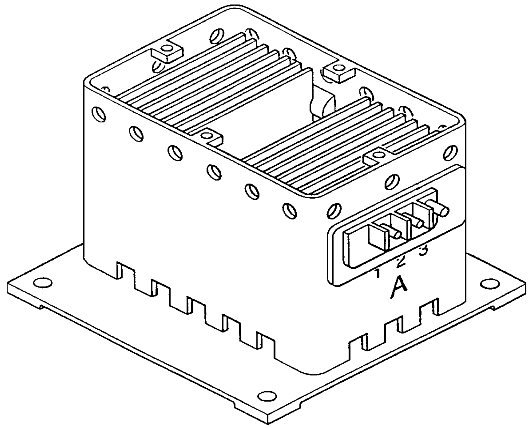


Figure 67 System Components

FUEL LEVEL MAGNETIC INDICATION

Fuel Level Magnetic Indicators

The Manual Fuel Quantity Measuring system is used when the normal quantity system is inoperative or if the indicated quantity for some reason wants to be confirmed.

On A318 / 319 / 320:

- One MMI (**M**anual **M**agnetic **I**ndicator) is installed in the center tank and five in each wing tank: 4 in each inner cell, 1 in each outer cell.

ON A321:

- One MMI (**M**anual **M**agnetic **I**ndicator) is installed in the center tank and seven in each wing tank.

The wing tank MMIs are in the bottom surface of the wing tanks. The center tank MMI is in the belly fairing directly below the center tank.

Each MMI assembly is almost the same. Only the angles of the body mounting flanges and the MMI tube lengts are different.

The MMI has two components:

- the MLI (**M**agnetic **L**evel **I**ndicator)
- the MLI housing which contains a tube and a float

Fuel Level Magnetic Indicator Operation

Prior to using the manual magnetic indicators, a reading is taken on the attitude monitor to determine the out–of–level attitude of the aircraft in the pitch and roll axes.

To measure the FUEL QUANTITY, the magnetic level indicator has to be unlocked. To accomplish this, use a screwdriver to push the applicable MLI and turn it through 90°. Hold and carefully lower the MLI fully.

Then carefully lift the MLI until you feel the magnetic link between the MLI and the float magnet.

Read the unit mark nearest to the bottom–skin of the wing and write down the number. Retract the MLI and use a scrwdriver to turn it through 90° to lock it.

Use the table for the applicable aircraft attitude and the applicable MLI stick number to find the volume of the fuel in each tank.

Then you must multiply this by the fuel relative density to get the fuel mass.

Attitude Monitor

The attitude monitor is a circular level with a graduated surface.

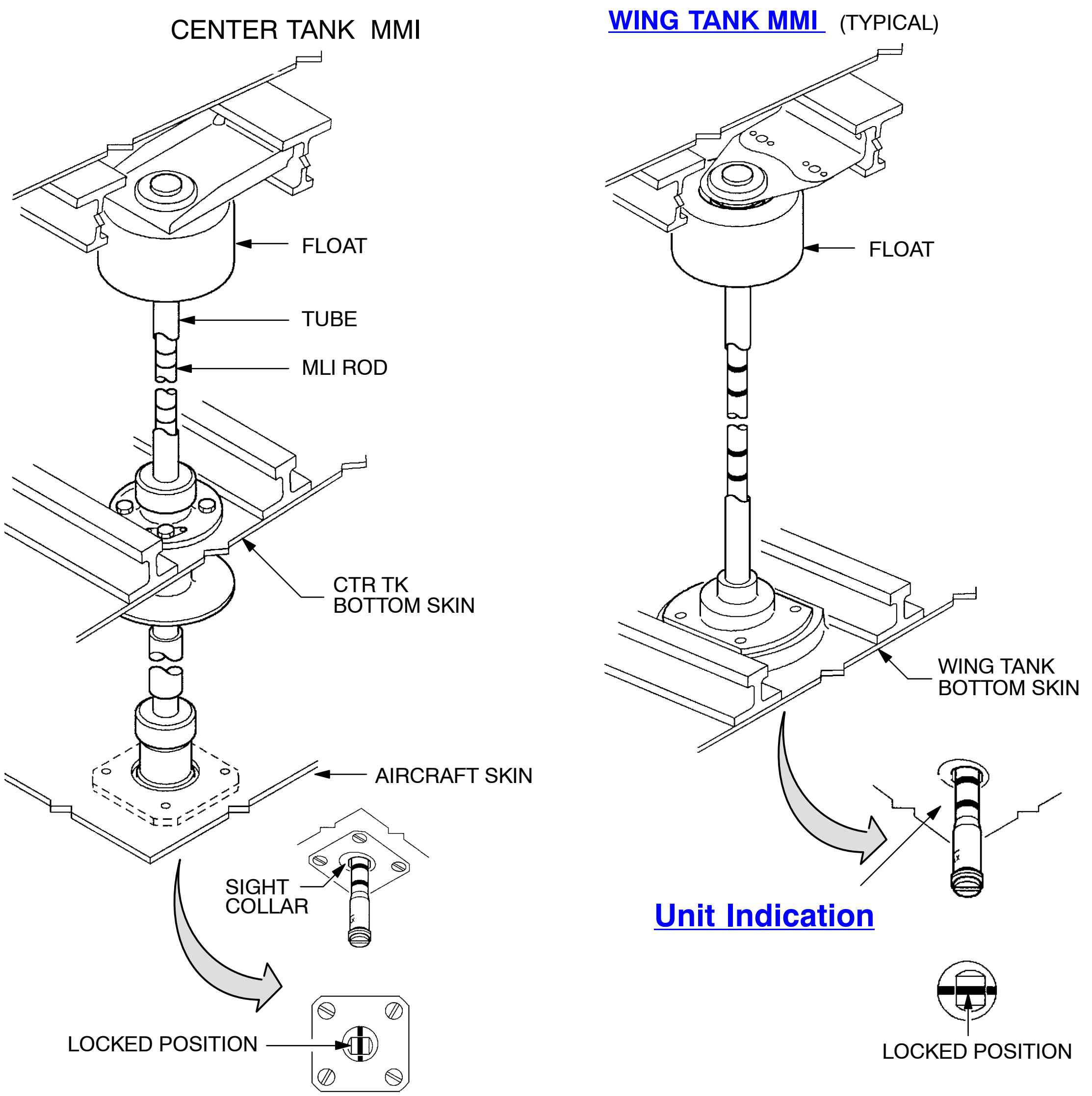
Each square of the grid is equal to .5° of change of attitude. The position of the bubble in relation to the grid indicates the aircraft attitude.

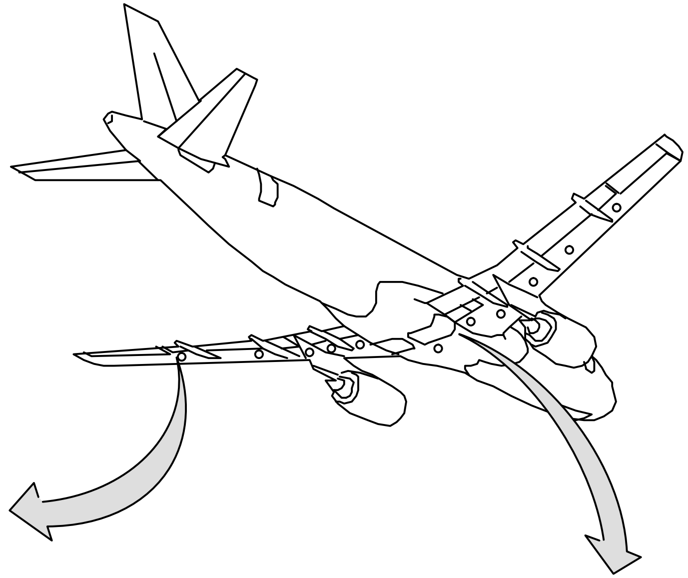
IF the attitude monitor is INOP:

- it is possible to find PITCH and ROLL data with the ADIRS, described in the related AMM task (12–11–28–860–001) and further a quick leveling procedure with a spirit level is given in AMM task (08–21–00–200–001)

Note: Since March 2009 (MSN 3828) the MLI No.1 is removed from A318/319/320 aircrafts, and on A321 the MLI‘s No.1,5,6 and 7 are removed.

CENTER/WING TANK MMI





ATTITUDE MONITOR

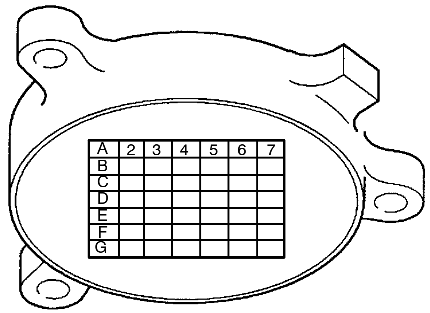


Figure 68 Fuel Level Magnetic Indicatig System

Fuel Level Magnetic Indication (Cont.)

Fuel Quantity Tables

There is a specific table for each indicator on both wings.

The aircraft attitude, the fuel density and reading on the metering stick allow the fuel quantity in each tank to be read, using the FUEL QUANTITY TABLES.(see AMM ATA 12- 00).

Example A320

AC ATTITUDE : PITCH = minus 0.5
ROLL = plus 1.0

MLI READING : STICK No.1 40 UNITS

Now you have to use AMM TASK 12–11–28–860–001 to find the GRID SQUARE LETTER and NUMBER

PITCH minus 0.5 = GRID SQUARE No 3
ROLL plus 1.0 = GRID SQUARE LETTER F

The related Fuel Quantity = RIGHT WING 1450 ltr
LEFT WING 1300 ltr

The measured Fuel Density = 0.798
The Fuel Mass is:

RIGHT WING 1450 ltr × 0.798 = 1157 kg
LEFT WING 1300 ltr × 0.798 = 1037 kg

Figure 69 Fuel Quantity Table (Example A320)

Fuel QTY. Table (A318/319/320)

UNITS ON MLI

GRID SQUARE LETTER — GRID SQUARE NUMBER

UNITS	ATTITUDE MONITOR READING B LEFT WING / F RIGHT WING 1	2	3	4	5	6	7
2	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50
6	100	100	100	100	100	100	100
8	150	150	150	150	150	150	150
10	200	200	200	200	200	200	200
12	250	250	250	250	250	250	250
14	300	300	300	300	300	300	300
16	350	350	350	350	350	350	350
18	400	400	400	400	400	400	400
20	450	450	450	450	450	450	450
22	550	550	550	550	550	550	550
24	600	600	600	600	600	600	600
26	700	700	700	700	700	700	700
28	800	800	800	800	800	800	800
30	900	900	900	900	900	900	850
32	1000	1000	1000	1000	1000	1000	950
34	1100	1100	1100	1100	1100	1100	1100
36	1200	1200	1200	1200	1200	1200	1200
38	1300	1300	1300	1300	1300	1300	1300
40	1450	1450	1450	1450	1450	1450	1450
42	1550	1550	1550	1550	1550	1550	1550
44	1700	1700	1700	1700	1700	1700	1700
46	1800	1800	1800	1800	1800	1800	1800
48	1950	1950	1950	1950	1950	1950	1950
50	2100	2100	2100	2100	2100	2100	2100
52	2250	2250	2250	2250	2250	2250	2250
54	2400	2400	2400	2400	2400	2400	2450
56	2550	2550	2600	2600	2600	2600	2600
58	2750	2750	2750	2750	2750	2750	2750
60	2850	2850	2850	2850	2900	2900	2950
62	3000	3000	3000	3050	3050	3050	3100
63	3050	3050	3050	3100	3150	3150	3200
MAX	3350	3350	3350	3350	3400	3450	3500

UNITS	ATTITUDE MONITOR READING B RIGHT WING / F LEFT WING 1	2	3	4	5	6	7
2	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50
6	100	100	100	100	100	100	100
8	150	150	150	150	150	150	150
10	200	200	200	200	200	200	150
12	250	250	250	250	250	250	200
14	300	300	300	300	300	300	250
16	350	350	350	350	350	350	300
18	400	400	400	400	400	400	350
20	450	450	450	450	450	450	450
22	500	500	500	500	500	500	500
24	550	550	550	550	550	550	550
26	650	650	650	650	650	650	650
28	700	700	700	700	700	700	700
30	800	800	800	800	800	800	800
32	900	900	900	900	900	900	850
34	1000	1000	1000	1000	950	950	950
36	1100	1100	1100	1100	1050	1050	1050
38	1200	1200	1200	1200	1200	1150	1150
40	1300	1300	1300	1300	1300	1300	1300
42	1400	1400	1400	1400	1400	1400	1400
44	1500	1500	1500	1500	1500	1500	1500
46	1600	1600	1600	1600	1600	1600	1600
48	1700	1700	1700	1700	1700	1700	1700
50	1850	1850	1850	1850	1850	1850	1850
52	1950	1950	1950	1950	1950	1950	1950
54	2100	2100	2100	2100	2100	2100	2100
56	2250	2250	2250	2250	2250	2250	2250
58	2400	2400	2400	2400	2400	2400	2400
60	2550	2550	2550	2550	2550	2550	2550
62	2700	2700	2700	2700	2700	2700	2700
63	2750	2750	2750	2750	2750	2750	2750
MAX	3000	3000	3000	3000	3000	3000	3000

LITRES

Fuel Quantity - MLI Stick No.1 Attitudes B and F
Figure 317/ TASK 12–11–28–991–016

Figure 70 Fuel Quantity Table (A318/319/320)

Fuel QTY. Table (A321)

GRID SQUARE LETTER — UNITS ON MLI — GRID SQUARE NUMBER

MLI No. 1 ROLL = 0

UNITS	ATTITUDE MONITOR READING — BOTH WINGS D 1	2	3	4	5	6	D 7
0	50	50	50	50	50	50	50
2	50	50	50	50	50	50	50
4	100	100	100	100	100	100	100
6	150	150	150	150	150	150	150
8	150	150	150	150	150	150	150
10	200	200	200	200	200	200	200
12	250	250	250	250	250	250	250
14	300	300	300	300	300	300	300
16	350	350	350	350	350	350	350
18	400	400	400	400	400	400	400
20	500	500	500	450	450	450	450
22	550	550	550	550	550	550	550
24	650	600	600	600	600	600	600
26	700	700	700	700	700	700	700
28	800	800	800	800	750	750	750
30	900	850	850	850	850	850	850
32	950	950	950	950	950	950	950

MLI No. 1 ROLL = 0

UNITS	ATTITUDE MONITOR READING — BOTH WINGS D 1	2	3	4	5	6	D 7
34	1050	1050	1050	1050	1050	1050	1050
36	1150	1150	1150	1150	1150	1150	1150
38	1300	1250	1250	1250	1250	1250	1250
40	1400	1400	1400	1400	1400	1400	1400
42	1500	1500	1500	1500	1500	1500	1500
44	1650	1650	1650	1650	1650	1650	1650
46	1750	1750	1750	1750	1750	1750	1750
48	1900	1900	1900	1900	1900	1900	1900
50	2000	2000	2050	2050	2050	2050	2050
52	2150	2150	2150	2150	2200	2200	2200
54	2300	2300	2300	2300	2350	2350	2350
56	2450	2450	2450	2450	2500	2500	2500
58	2600	2600	2600	2650	2650	2650	2700
60	2750	2750	2800	2800	2800	2800	2850
62	2900	2900	2950	2950	3000	3000	3000
64	3050	3100	3100	3150	3150	3150	3200

LITRES

GRID SQUARE LETTER — UNITS ON MLI — GRID SQUARE NUMBER

MLI No. 3 ROLL = -1.5

UNITS	ATTITUDE MONITOR READING — A LEFT WING 1	2	3	4	5	6	G RIGHT WING 7
0	4300	4200	4150	4100	4000	3950	3850
2	4500	4450	4350	4300	4250	4150	4100
4	4700	4650	4600	4550	4450	4400	4350
6	4900	4850	4800	4750	4700	4650	4600
8	5100	5050	5050	5000	4950	4900	4850
10	5300	5250	5250	5200	5150	5150	5100
12	5450	5450	5450	5400	5400	5350	5350
14	5650	5650	5650	5650	5600	5600	5600
16	5800	5800	5800	5850	5850	5850	5800
18	5950	5950	6000	6000	6000	6050	6050
20	6100	6100	6150	6150	6200	6250	6250
22	6200	6250	6300	6350	6400	6400	6450

MLI No. 3 ROLL = -1.5

UNITS	ATTITUDE MONITOR READING — G LEFT WING 1	2	3	4	5	6	A RIGHT WING 7
0	5050	5050	5050	5050	5000	5000	5000
2	5150	5150	5150	5150	5150	5100	5100
4	5250	5250	5250	5250	5250	5250	5250
6	5350	5350	5350	5350	5350	5350	5350
8	5450	5450	5450	5450	5450	5450	5450
10	5550	5550	5550	5550	5550	5550	5550
12	5650	5650	5650	5650	5650	5650	5650
14	5700	5750	5750	5750	5750	5750	5800
16	5800	5800	5850	5850	5850	5850	5900
18	5900	5900	5900	5950	5950	5950	6000
20	6000	6000	6000	6050	6050	6050	6100
22	6050	6100	6100	6150	6150	6150	6200

LITRES

Fuel QTY. Table CTR TK (A318/319/320/321)

GRID SQUARE LETTER — UNITS ON MLI — GRID SQUARE NUMBER

UNITS	ATTITUDE MONITOR READING — LINE D 1	2	3	4	5	6	7
2	300	300	300	300	300	300	300
4	450	450	500	500	500	500	500
6	600	600	650	650	650	650	600
8	750	750	750	750	750	750	750
10	900	900	900	900	900	900	900
12	1050	1000	1000	1000	1000	1000	1050
14	1250	1250	1200	1200	1200	1200	1200
16	1500	1450	1450	1450	1400	1400	1400
18	1700	1700	1700	1650	1650	1650	1600
20	1900	1900	1900	1900	1900	1850	1850
22	2100	2100	2100	2100	2050	2050	2000
24	2300	2300	2300	2250	2250	2200	2200
26	2500	2500	2450	2450	2400	2400	2350
28	2700	2700	2700	2650	2600	2600	2550
30	2900	2900	2900	2900	2850	2800	2750
32	3100	3100	3100	3100	3050	3050	3000
34	3300	3300	3300	3300	3250	3250	3200
36	3500	3500	3500	3500	3450	3450	3400
38	3700	3750	3750	3700	3700	3650	3650
40	3950	3950	3950	3950	3900	3900	3850
42	4150	4150	4150	4150	4100	4100	4050
44	4350	4350	4350	4350	4300	4300	4250
46	4550	4550	4550	4550	4500	4500	4450
48	4750	4750	4750	4750	4700	4700	4650
50	4950	4950	4950	4950	4900	4900	4850
52	5200	5200	5200	5150	5100	5100	5050
54	5400	5400	5400	5400	5350	5300	5250
56	5600	5600	5600	5600	5550	5500	5450
58	5800	5800	5800	5800	5750	5700	5650
60	6000	6000	6000	6000	5950	5950	5900
62	6200	6200	6200	6200	6150	6150	6100
64	6400	6400	6400	6400	6350	6350	6300
66	6600	6600	6600	6600	6550	6550	6500
68	6800	6800	6800	6800	6750	6750	6700
70	7000	7000	7000	7000	6950	6950	6900
72	7200	7200	7200	7150	7150	7150	7100
74	7400	7400	7400	7350	7350	7350	7300
76	7600	7600	7600	7550	7550	7550	7500
78	7800	7800	7800	7750	7750	7700	7700
MAX	7900	7900	7900	7900	7850	7850	7800

LITRES

Figure 71 Fuel Quantity Tables

MCDU UTILZATION

Example :

This eample deals with the MCDU of the A318/319/320. The utilization of the MCDU A321 is almost the same.

NOTE: The fuel is a ”type 1” system and is not available in CFDS ”BACKUP” mode.

The displayed menue and related data come from the best channel (or channel 1 when both cannels are equally good)of the FQIC.

The cannel providing the data is indicated in the top left corner of the MCDU.

The NEXT PAGE gives access to:

- < FQIS STATUS
- <FLSS STATUS
- <INPUT PARAMETER VALUES

If no failure is detected, ”NO FAULT” is displayed.
Here is an example of the display when failures are reported.

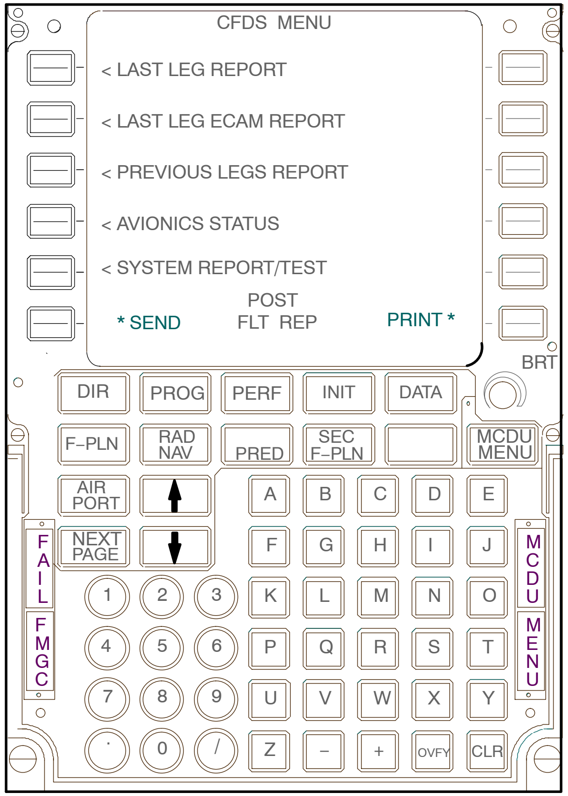


Figure 72 Multipurpose Control Display Unit

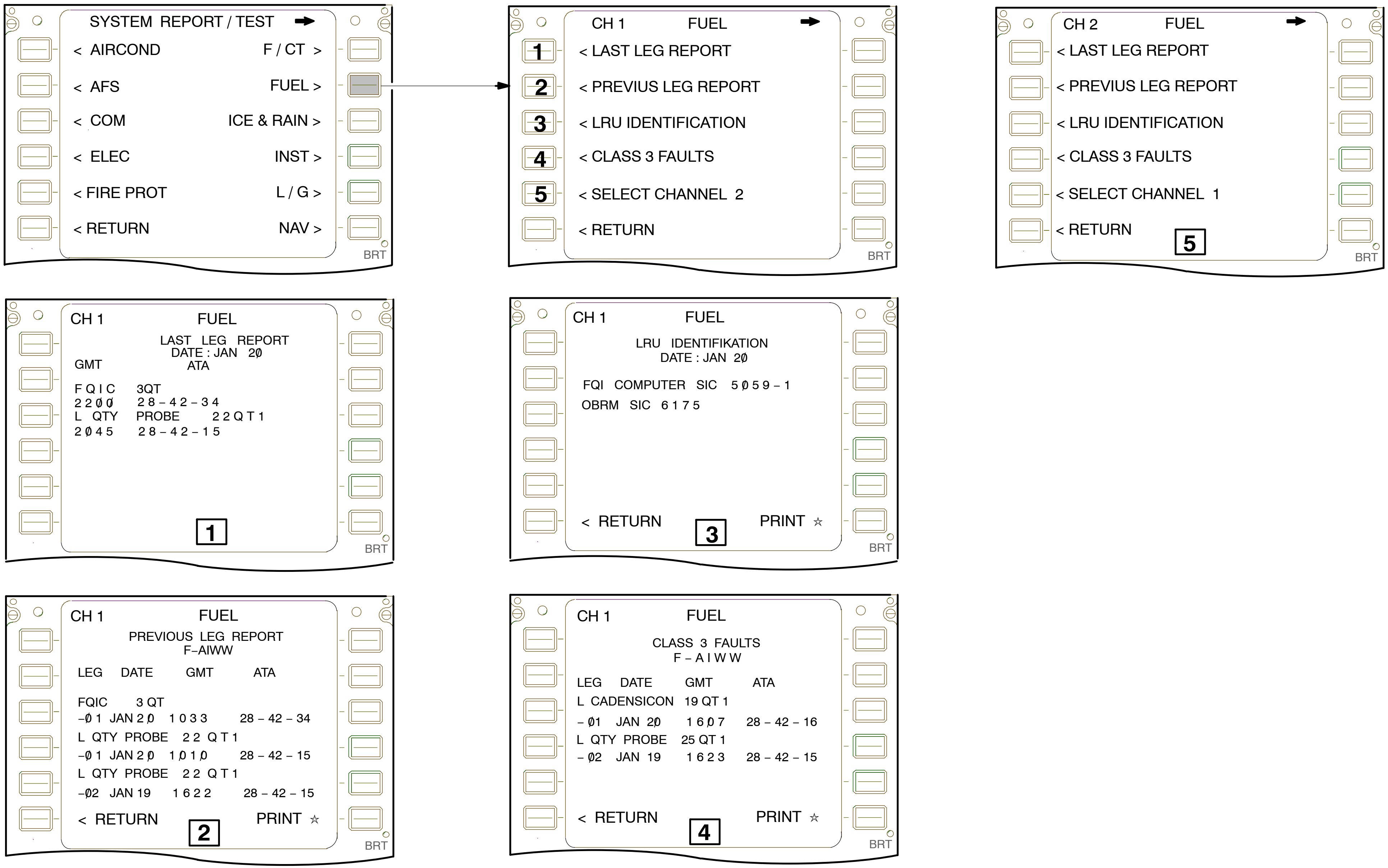


Figure 73 MCDU Utilization

28/MCDU/L2/B1/B2

MCDU UTILIZATION (CONT)

- [6] The FQIS STATUS allows access to channel 1 (or 2) BITE memory.

  A list is produced of every FQIS LRU detected as being currently failed or deemed failed at the last power−on FLSS BITE test.

  The operating grade for each channel is displayed and decoded as follows :

  - GRADE 1: normal operation,
  - GRADE 2: nomal operation,
  - GRADE 3: normal operation with reduced accuracy,
  - GRADE 4: outside normal operation (display blanked),
  - GRADE 5: FQIC outputs disabled.
- [7] The FLSS BITE is run automatically 30sec after power−up and consists of four separate procedures:
  - BITE 1: High level sensors, surge tank sensors.
  - BITE 2: Rear intercell transfer valves, some low level sensors.
  - BITE 3: Outer cell underfull sensors, remaining low level sensors, fwd intercell transfer valves.
  - BITE 4: Inner cell full/underfull sensors, logic control circuits, temperature sensors.

Selection of NEXT PAGE result in a list of failed FLSS LRUs.

EXAMPLE:
BITE 4 is failed:− R underfull sensor and L wing temperature sensor are failed.

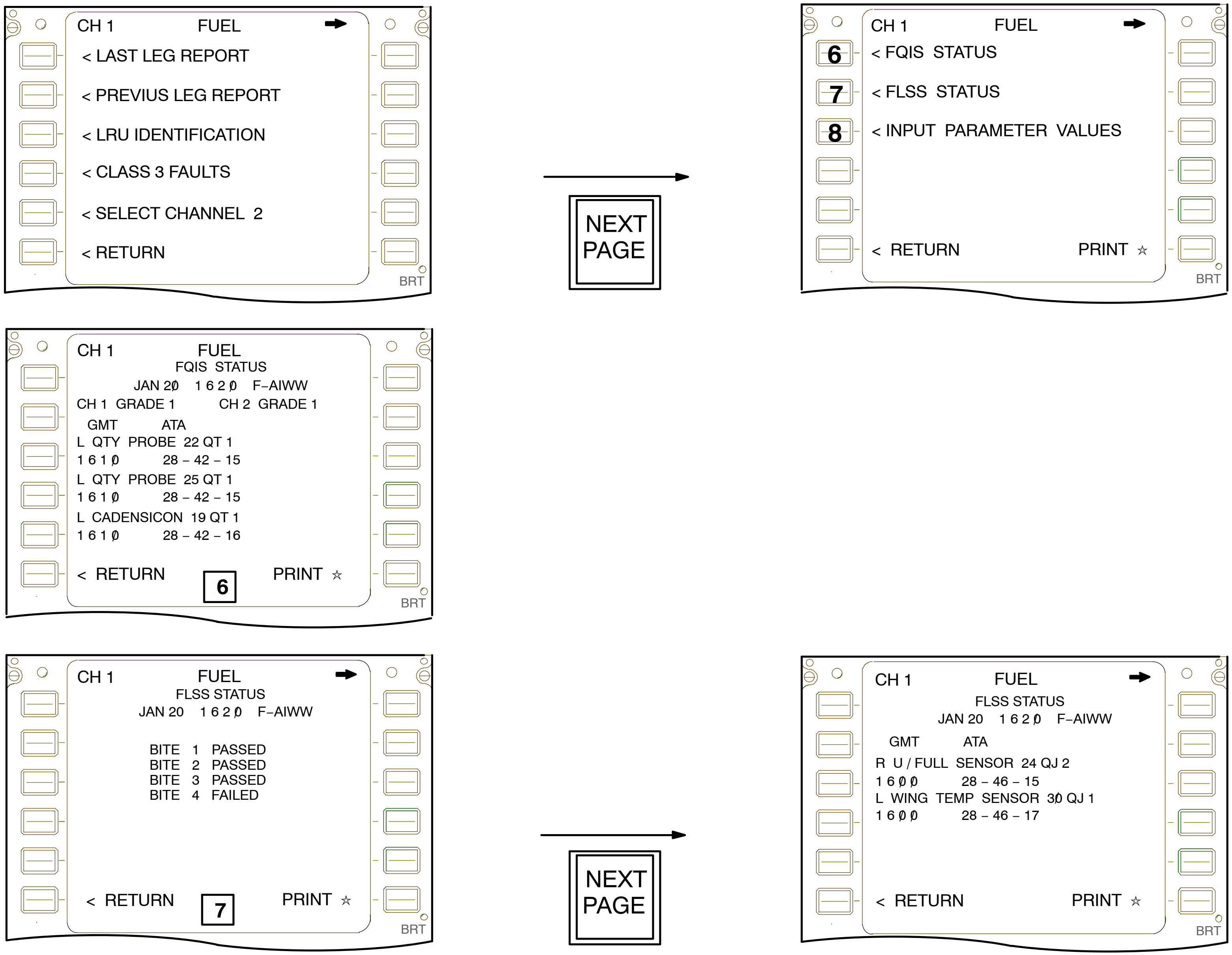


Figure 74 MCDU Utilization

28/MCDU/L2/B1/B2

MCDU UTILIZATION (CONT)

- 8 The following informations are provided:
  - Permitivity calculated from cadensicon,
  - Density calculated from cadensicon,
  - Permitivity calculated from CIC
  - Fuel temperature in inner and outer cells,
  - Effective pitch and roll attitudes.

  NEXT PAGE: FQIS PROBE CAPACITANCES

  This page gives the values for all the capacitance devices in the tanks.
  - L wing probes (No 1 to 14): line 1 to 4 column 2,
  - R wing probes (No 1 to 14): line 7 to 10 column2,
  - CTR TK probes (No 1 to 5): line 5 to 6 column 1,
  - L, CTR, R CIC: line 4, line 6 and line 10 column 3.
  - L, CTR, R cadensicon: line 4, line 6 and line 10 column 4.

  EXAMPLE: L wing probe No 10 is 48 pF.
  CTR TK probe No 4 is 102.3 pF.

NEXT PAGE: FQIS DISCRETE INPUTS

This page gives the states of all the discrete inputs to the FQIC.
A ”1” represents the active state.

EXAMPLE:

Bit position R3 is a ”1”: means that the refuel door is open.

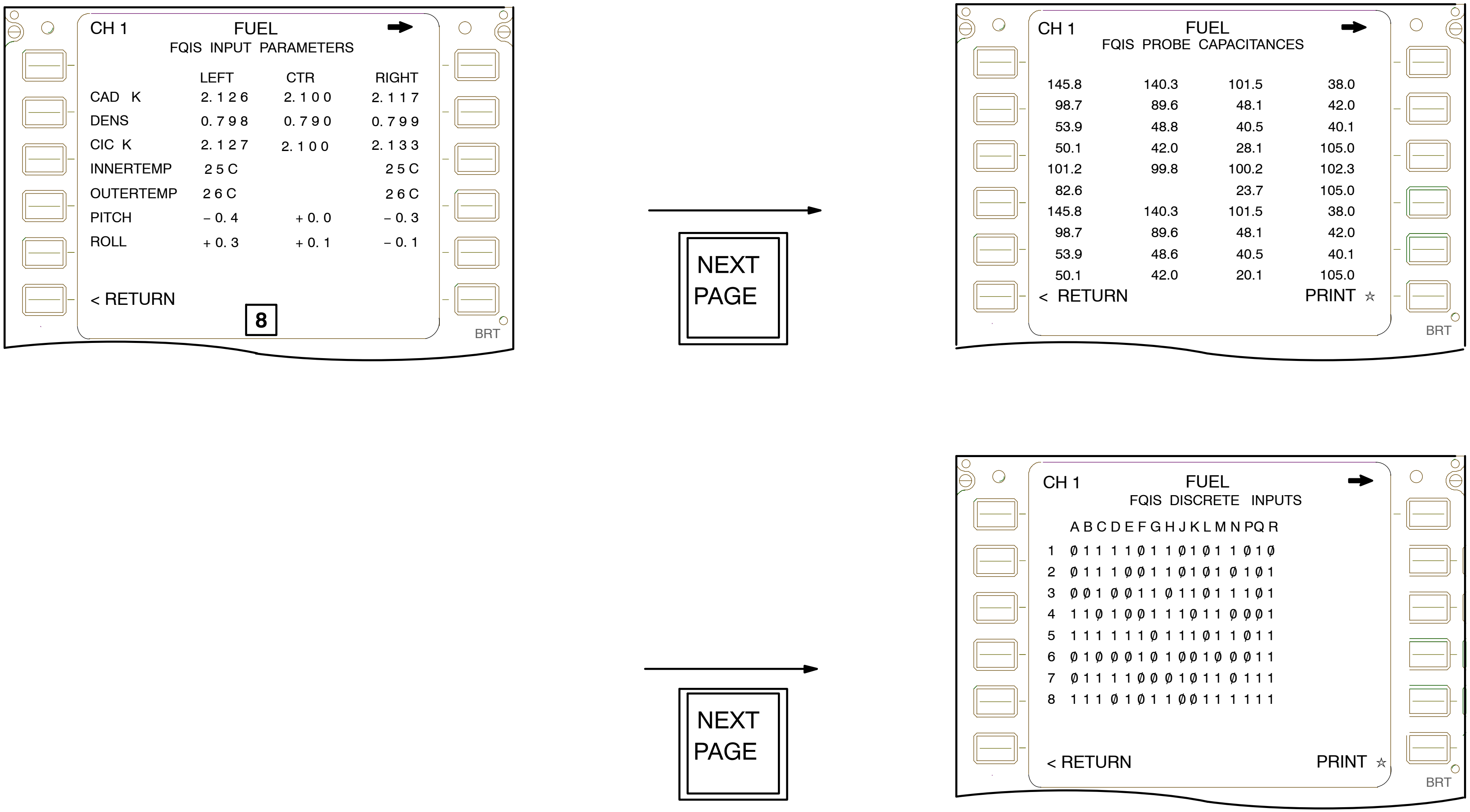


Figure 75 MCDU Utilization

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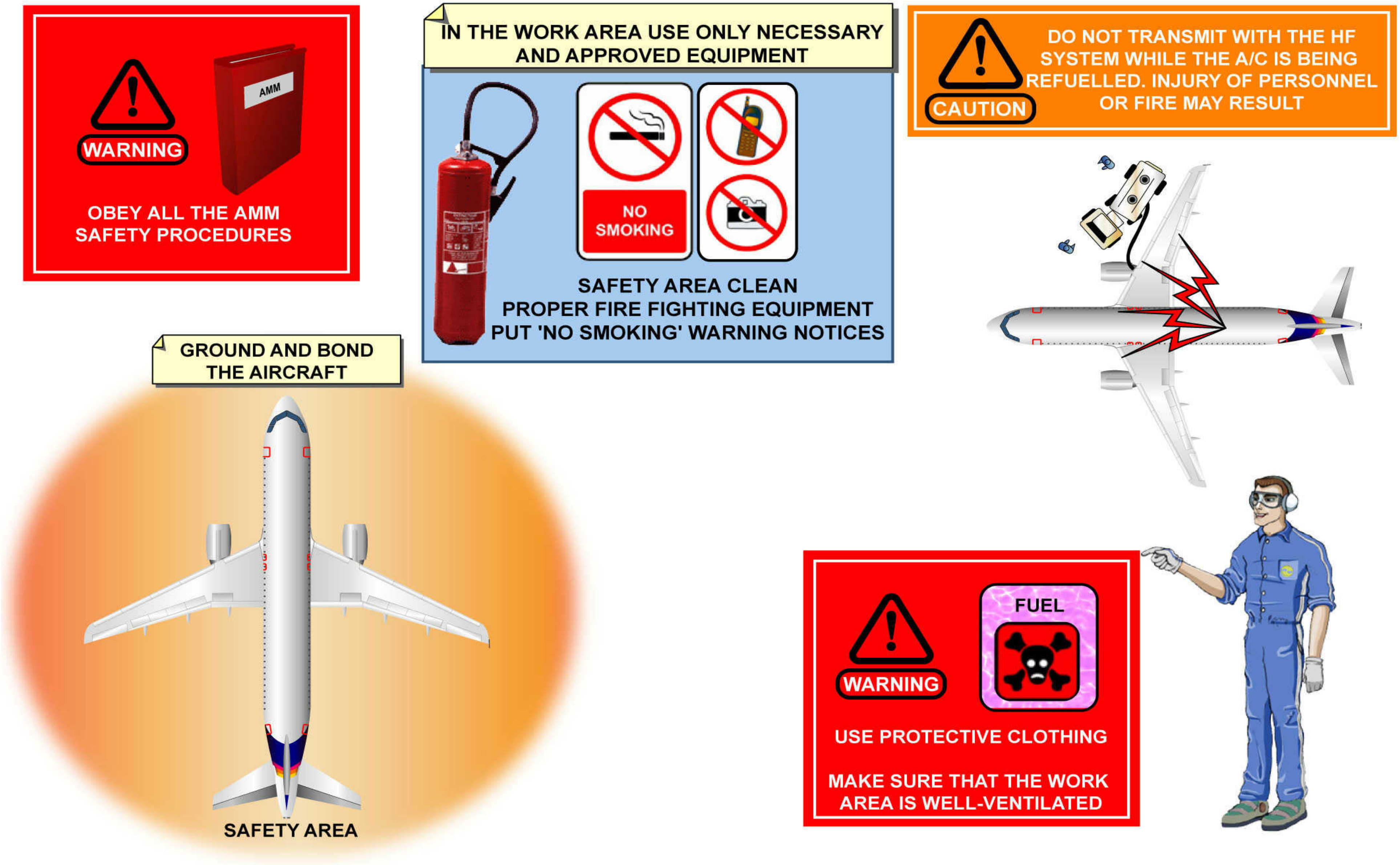


Figure 76 Fuel Safety

ADDITIONAL CENTER TANK

General Description

The aircraft has provisions which lets the operator install and operate the aircraft with one additional center tank.

The additional center tank transfer system controls the fuel transfer from the ACT to the center tank.

The ACT is installed in the AFT cargo compartment and can hold approximately 2277 kg of usable fuel.

A fuel line connects the ACT with the main fuel gallery or with the center tank.

In flight, an electrical control circuit automatically controls the fuel transfer from the ATC to the center tank via the level sensors in the ATC and center tank.

Air pressure from the cabin pressure control system pressurizes the ACT for the forward transfer.

A manual selected electrical pump, which is installed in the center tank, provides standby transfer at low flight levels and a transfer capability on ground.

The refuel system refuels the ATC.

The Electronic Instrument System gives information about the ACT trasfer system to the crew. If specified failures occur:

- a warning is given on the upper ECAM display unit
- the FUEL page shows on the lower ECAM unit.

At business jets more than one ACT can be installed, also in forward cargo compartment.

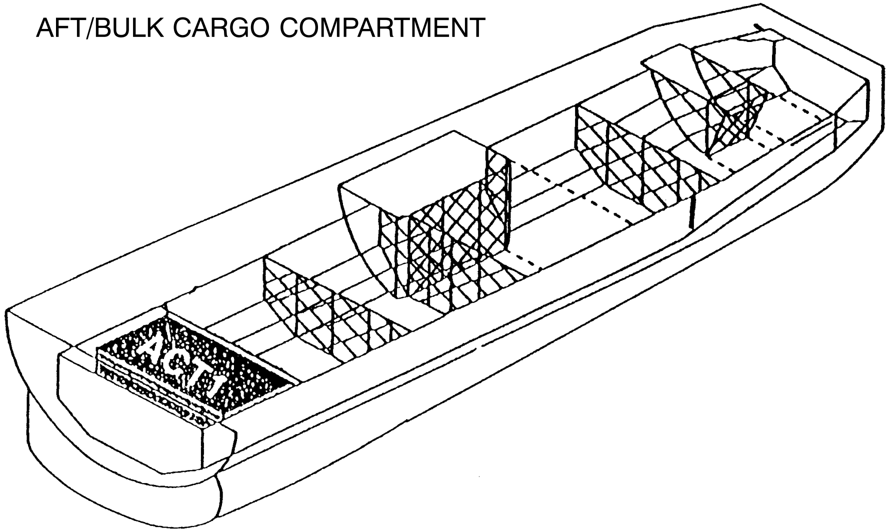


Figure 77 Additional Center Tank Installation

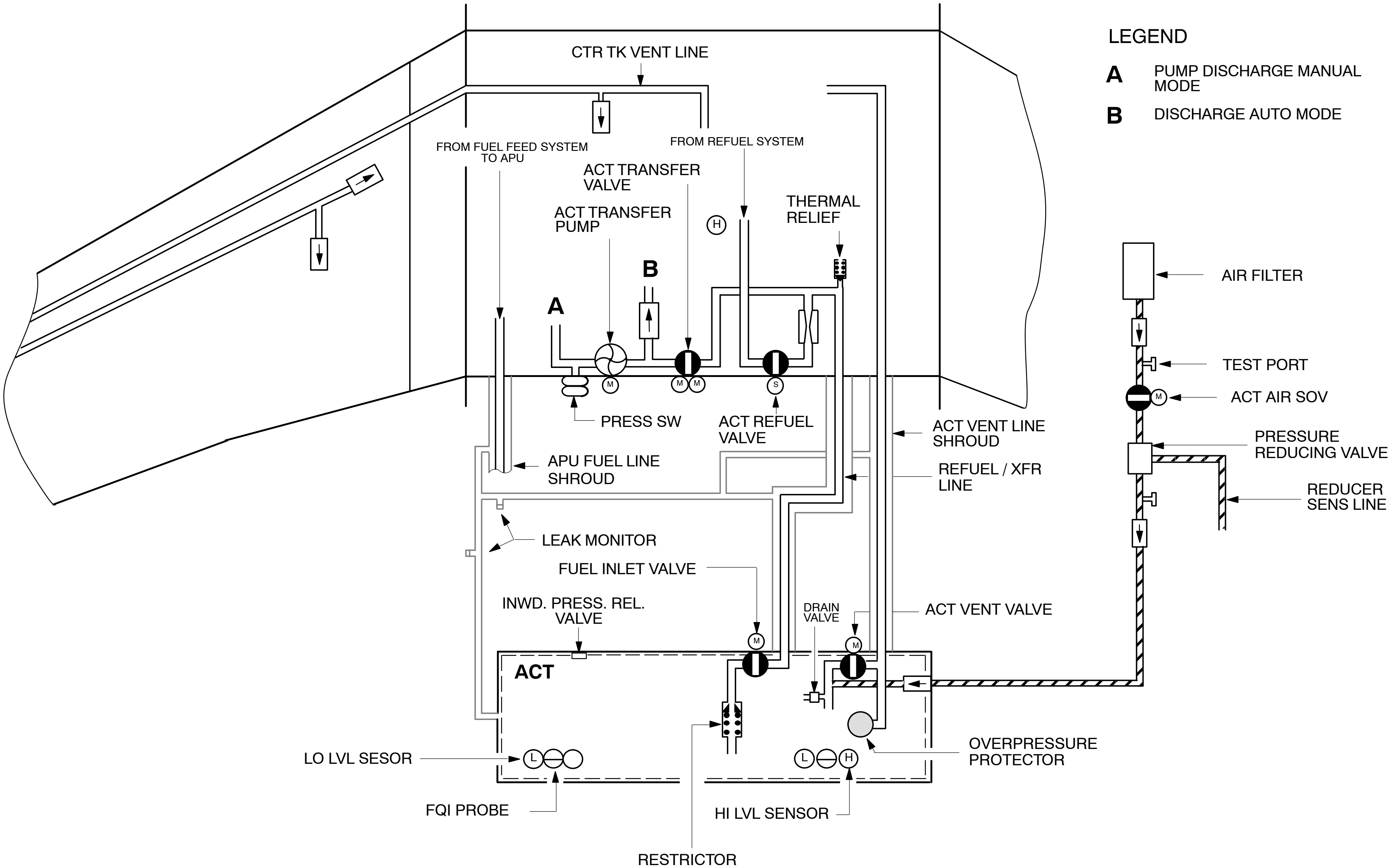


Figure 78 ACT Basic Schematic

1 **ACT PB Switch**

- **AUTO**

  Control of the fuel tranfer is automatic. The automatic foreward transfer occurs if:
  - The aircraft is in flight and
  - the slats are retracted and
  - at least one ACT low level sensor is wet and
  - the center tank high level sensor has been dry for at least 10 minutes.

  The automatic foreward transfer stops as soon as one of the above conditions is not met.
- **FWD**

  Manual transfer to the center tank is initiated by energizing the ACT transfer pump in the center tank and opening:
  - the ACT transfer valve
  - the ACT inlet valve
- **FAULT light**

  Amber light and ECAM caution comes on when:
  - the center tank has less than 3000 kg of fuel and the ACT has more than 250 kg of fuel and
  - the ACT PB switch is in AUTO

2 **HI LVL System Test PB Switch**

- The ACT HI LVL light will come on or go out (if on) when you push the TEST pushbutton switch.

3 **ACT 1 HI LVL Light**

- The ACT HI LVL Light will come on when:
  - A high level of fuel is in the ACT 1, or when you push the TEST PB Switch.
- The ACT HI LVL Light will go out when:
  - No HI LVL of fuel in the ACT 1 is detected, or when you push the TEST PB Switch during Hi LVL occurs.

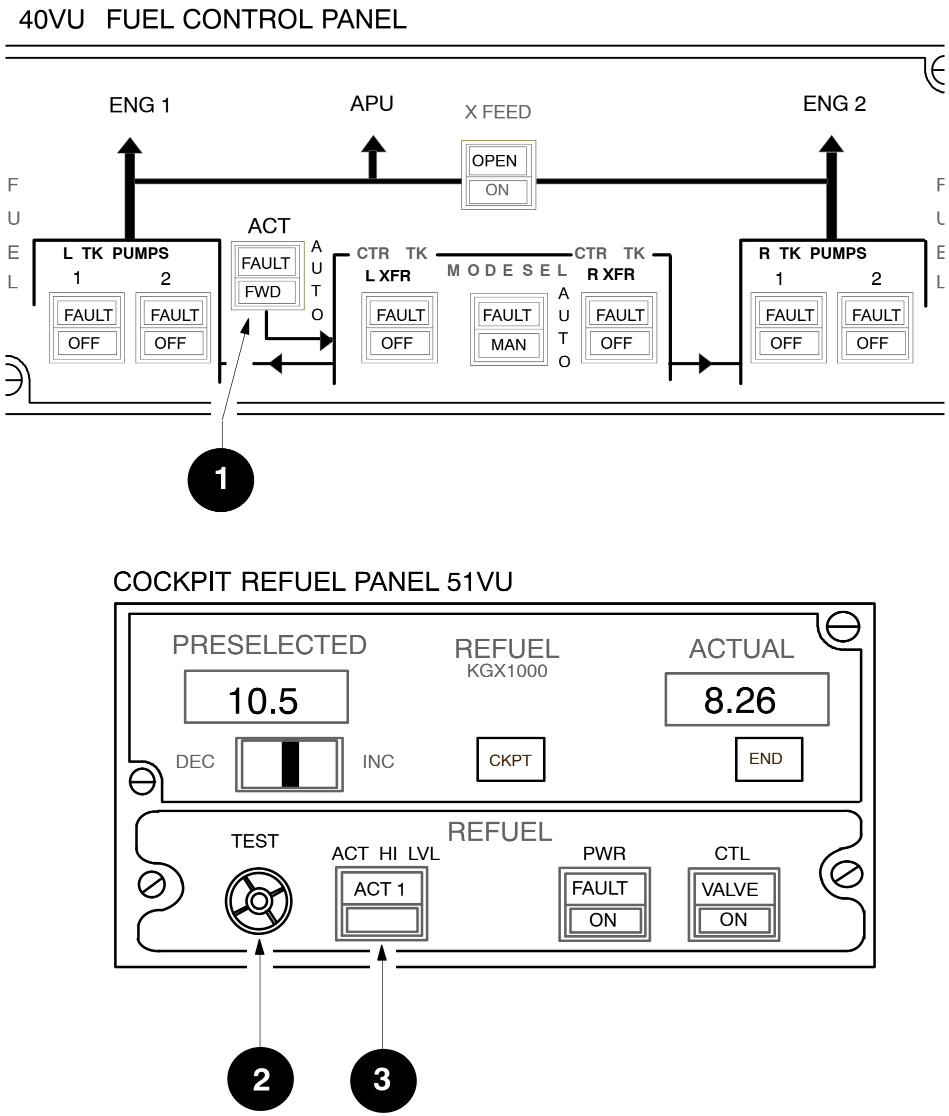


Figure 79 Fuel Control Panel And Cockpit Refuel Panel

4 ACT Tank Quantity Indication

(Only if ACT is connected)

- shows the actual fuel quantity

5 ACT to CTR TK XFR Symbol (green)

△ **AUTO:** Fuel transfer by means of cabin pressure

▲ **MANUAL:** Fuel transfer by means of electrical pump

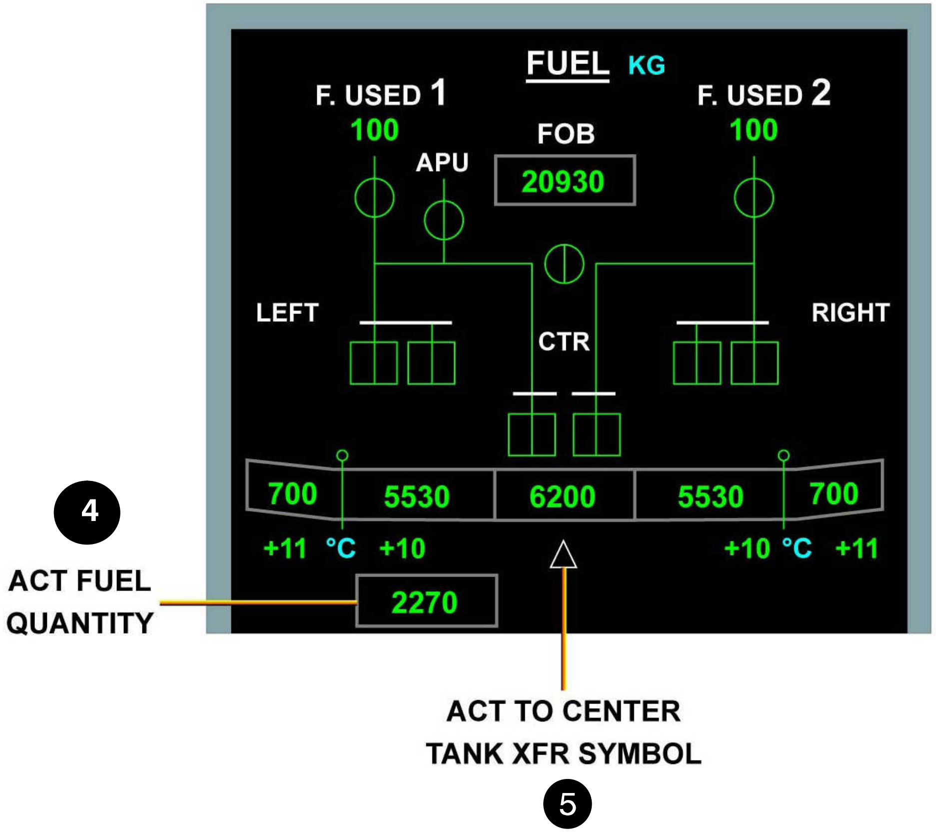


Figure 80 Fuel Control Panels

6 FQI SELECT Switch

- selects tank quantitiy to be displayed on CTR TK indicator (MTI)
  - CTR + ACT (total quantity)
  - CTR (CTR tank quantity)
  - ACT (ACT tank quantity)

7 HI LVL Light

- comes on blue when ACT HI LVL sensor is immersed
- comes on blue during HI LFL test

8 REFUEL VALVE Switch

- controlles the ACT refuel valve

NORM: Valve is controlled by automatic refuel logic when all REFUEL VALVE switches are set to NORMAL

OPEN: Valve will open when MODE SELECT switch is in REFUEL or DEFUEL / XFR position

SHUT: Valve closed independ of MODE SELECT switch position

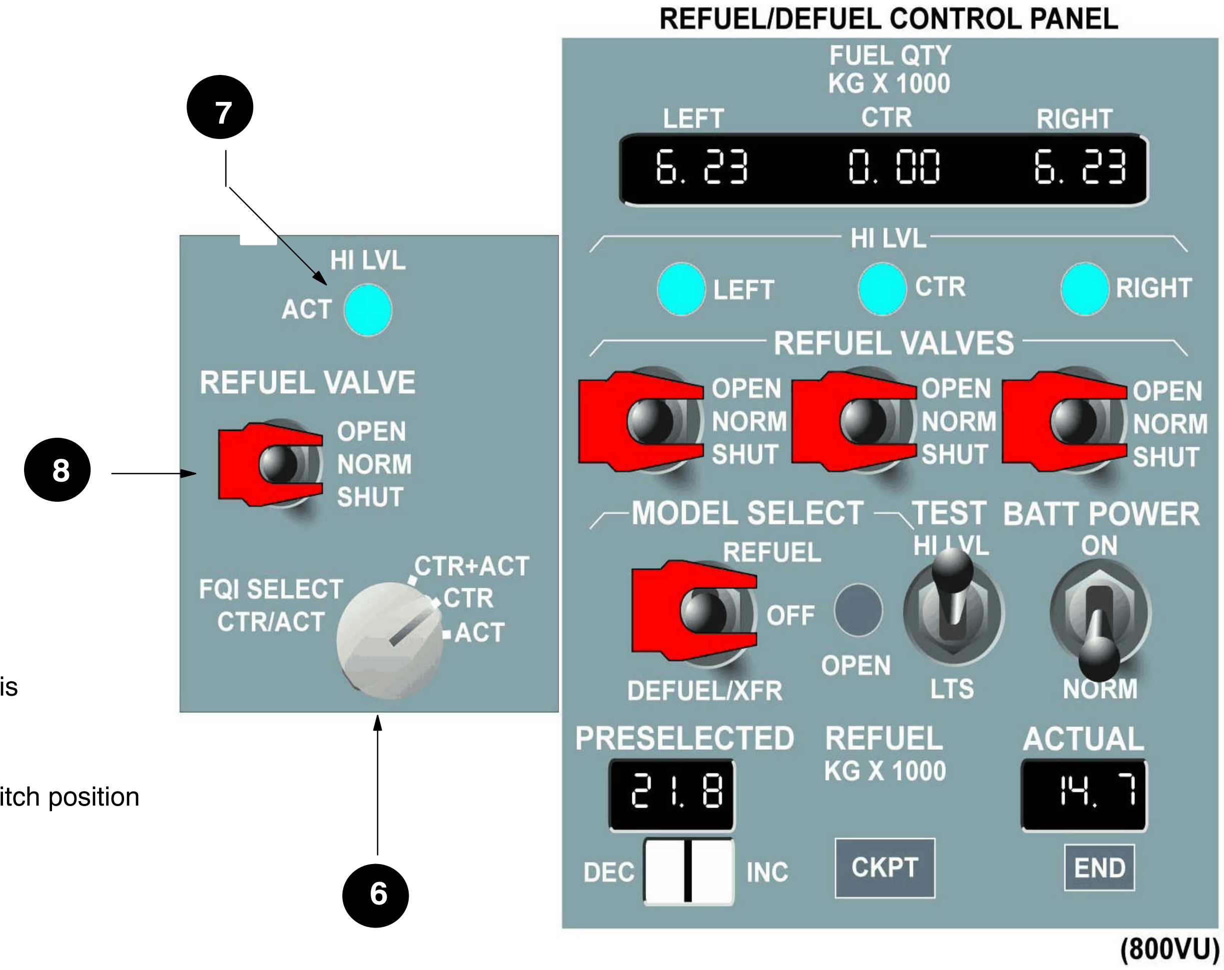


Figure 81 Refuel Control Panel

ACT Indication/Level Sensing

The FQIC already has the provision incorporated to cover the ACT requirements. Both FQIC–OBRM have a software update to process the additional ACT fuel information

A thirt FLSCU is implemented compared.

Two fuel quantity probes are installed in the ACT. They are installed in a position that lets you remove them without removing the ACT from the aircraft.

Each FQI probe has a high level and a low level sensor. Only one of the high level sensors is connected to the level sensing system

- when the ATC low level sensor become dry, the FLSCU 3 sends a signal to stop the forward fuel transfer after 5 minutes of time.
- when the hi level sensor becomes wet, the refueling stops.

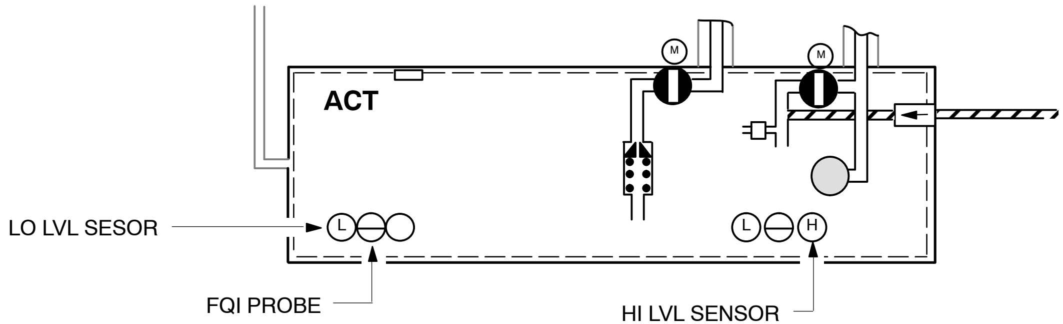


Figure 82 ACT Indication/Level Sensing

Additional Center Tank Description

It has the same external dimensions as the A319/320/321 container (LD3).

The nominal usable fuel is 2277 kg, the unusable fuel is approximately 29kg and the expansion space is 46kg.

The ACT is located in cargo compartment N° 3 (between FR47.2 and FR47.5)

The ACT is made of light alloy structure with an internal flexible bladder tank.The gap between the rigid container and the flexible blatter tank drains and vents to the drain mast through the drain line.

An inward pressure relief valve protects the bladder tank from too much inward differential pressure.

The pipes between the ACT and the center tank are shrouded. The gap between the shroud and the pipe drains and vents overboard through the drain mast.

Two leak monitors in the drain lines keep a small quantity of drainage for fuel leak analysis. Location: Outside the aircraft behind left hand wheel well.

- one connects to the drain line from the ACT vent pipe and the refuel/transfer pipe
- one connects to the drain line from the ACT.

ACT INSTALLATION

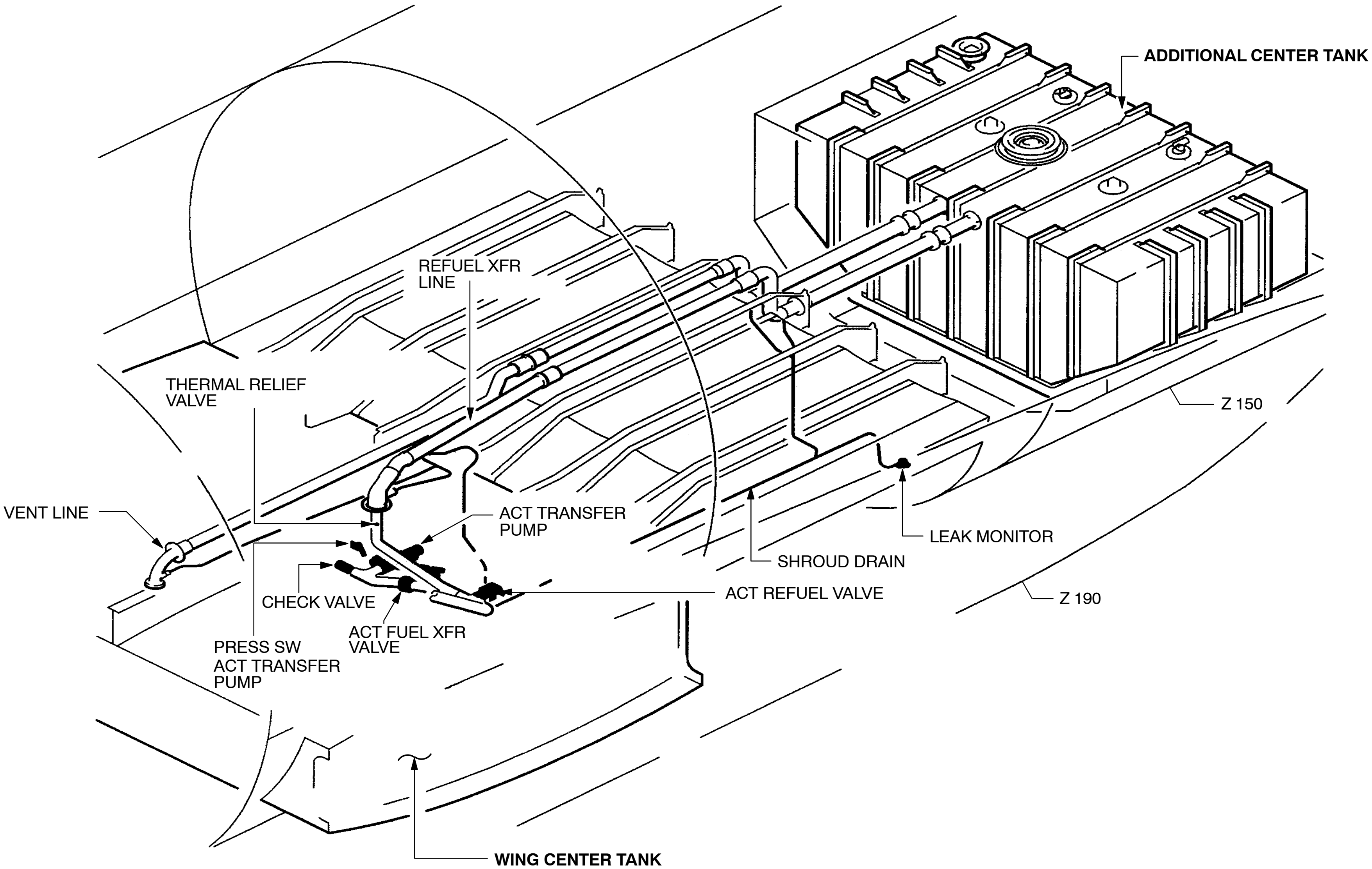


Figure 83 ACT Installation

ATC REFUEL/DEFUEL

ACT Refuel/Defuel System General

The ACT refuel / defuel system has these components

- an ACT fuel pump
- an ACT fuel transfer valve
- an ACT fuel inlet valve
- an ACT refuel restrictor valve an ACT refuel valve

  (The ACT refuel valve is installed as part of the ACT system provision. It do not have a function without the ACT installed).

There are two different ways to refuel the ATC:

- pressure refueling in automatic mode
- pressure refueling in manual mode

Operation

Refueling Automatic Mode

In automatic mode, when the preselected quantity is greater than the maximum capacity of both the center tank and the wing tanks, fuel will automatically be added to the ACT

When the refuel is selected, the refuel transfer system commands the ACT refuel valve and the ACT1 fuel inlet valve to the open position. The ACT and the basic aircraft tanks are refuelled at the same time. When the ACT is full the ACT high level sensor closes the ACT1 fuel inlet valve and ACT refuel valve and stops the refuelling.

Refueling Manual Mode

In manual mode, the MODE SELECT switch on the refueling control panel (801 VU) is set to REFUEL and the REFUEL VALVES switch (800 VU) is set to OPEN (this opens the ATC refuel and the fuel inlet valve). The quantities of fuel that go into the tank are then monitored at the MTI. When the tank has the required amount, the REFUEL VALVE switch are set to SHUT.

Or the refueling will be stopped by the HI LVL contol circuit.

NOTE: To protect the aircraft it is not possible to refuel the ACT if:

– the ACT transfer valve is not closed

– the ACT vent valve is not open

– the ACT air shut–off valve is not closed

Defueling Mode

To defuel the aircraft you must use the main fuel pumps to remove the fuel from the fuel tanks. If there is fuel in the ACT, you must move the fuel to the center tank, by pushing the ACT-pb-sw to FWD. If there is fuel in the center (transfer) tank, you must move the fuel of the center tank to the wing tanks first, before you can defuel the ACT completely.

To move fuel from the ACT to the center tank on the ground the FUELLING BUS (501PP) must be powered (access panel door 192MB must be open).

This causes the center tank high level sensor to be powered. When the center tank high level sensor is wet (or not powered) it is not possible to defuel the ACT. This prevents fuel overflowing from the center tank onto the ground.

REFUEL/DEFUEL SYSTEM

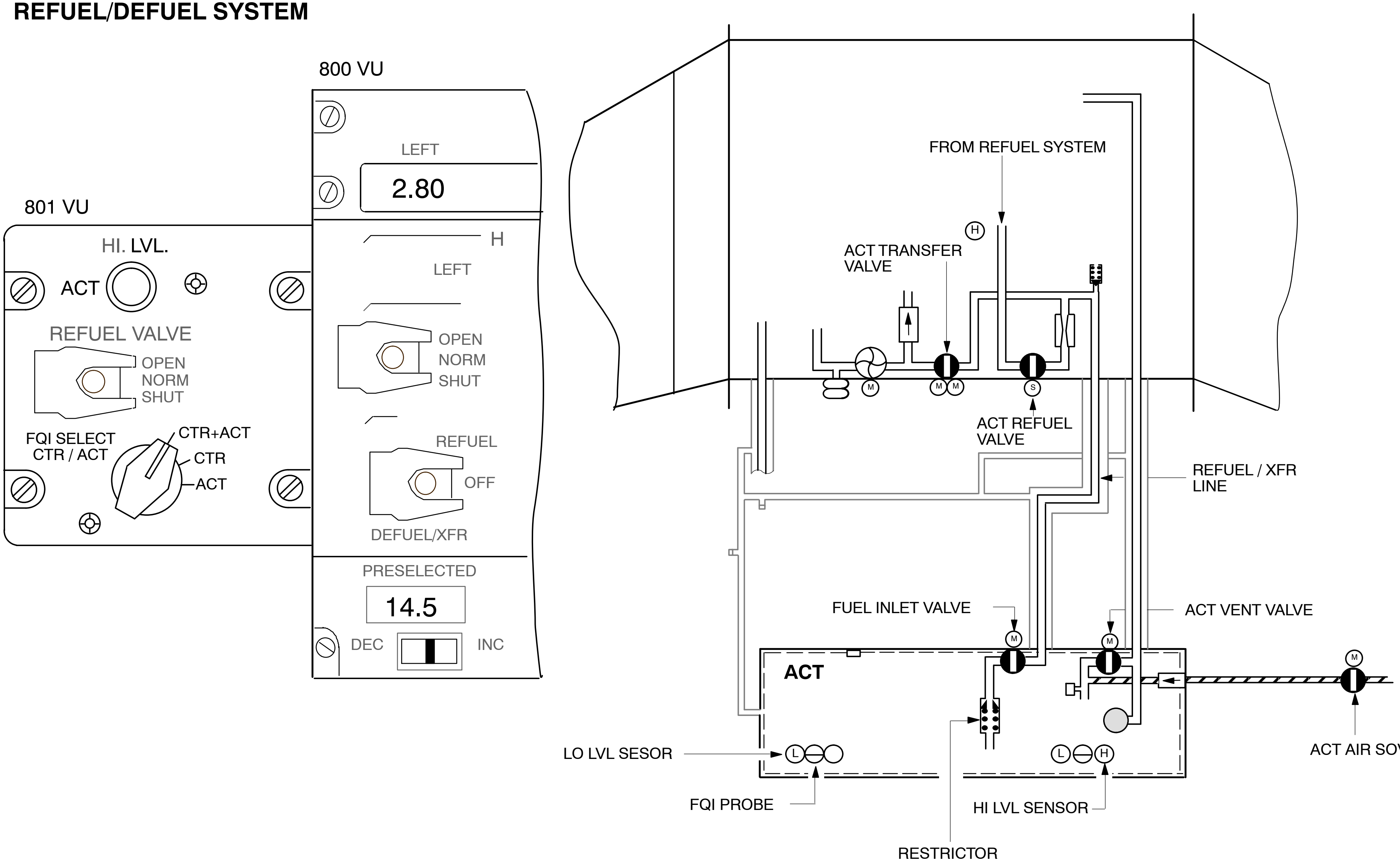


Figure 84 Refuel/Defuel System

FUEL TRANSFER SYSTEM

ACT Transfer System General

The additional center tank transfer system controls the fuel transfer from the ACT (**A**dditional **C**enter **T**ank) to the center tank.

In flight, an electrical control circuit automatically controls the fuel transfer from the ACT to the center tank via the level sensors in the ACT and center tank. Air pressure from the cabin pressure control system pressurizes the ACT for the forward transfer.

A manual selected pump, which is installed in the center tank, provides standby transfer at low flight levels and a transfer capability on the ground.

The ECAM (**E**lectronic **C**entralised **A**ircraft **M**onitoring) gives information about the ACT transfer system to the crew. If specific failures occur:

- a fault caption on the AUTO/MAN PB sw illuminates
- a warning is given on the upper ECAM display unit
- the fuel page shows on the lower ECAM display unit.

The fuel transfer system has these components:

- an ACT fuel pump pressure switch
- an ACT fuel pump and its related mounting plate,
- an ACT fuel transfer valve and its related electrical actuator,
- an ACT1 fuel inlet valve and its related electrical actuator,
- an ACT transfer thermal relief valve,
- an ACT1 refuel restrictor valve,
- a check valve,
- a shrouded fuel transfer line.

ACT Transfer System Operation

When the aircraft is on the ground the ACT automatic transfer system is inoperative and (if the crew take no action) the:

- ACT fuel transfer valve is closed,
- ACT air shut–off valve is closed,
- ACT1 vent valve is open,
- ACT1 fuel inlet valve is closed,
- ACT refuel valve is closed,
- the ACT transfer pump does not operate.

Automatic Forward Transfer

For the automatic forward transfer to occur, you must have these conditions:

- the aircraft is in flight,
- the slats are retracted,
- the ACT pushbutton switch is in the AUTO position (on the overhead FUEL panel 40VU)
- at least one ACT low level sensor is wet,
- the center tank HI LVL sensor has been dry for at least 10 minutes.

When these conditions occur, the control circuit:

- closes the vent valve
- opens the air shutoff valve
- opens the fuel transfer valve
- pens the fuel inlet valve.

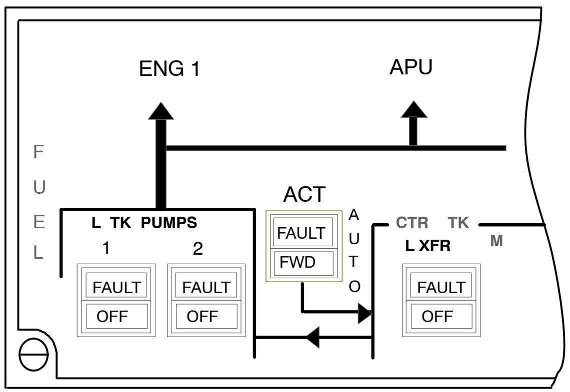
The air pressure in the cargo compartment transfers the fuel from the ACT to the center tank.

If the center tank HI LVL sensor becomes wet during a forward fuel transfer, the Tank Level Sensing system and the control circuit closes the ACT fuel transfer valve and the ACT fuel inlet valve. The fuel transfer stops. When the center tank HI LVL sensor becomes dry, the Tank Level Sensing system and the control circuit (after a 10 minutes delay) open the ACT fuel transfer valve and the ACT fuel inlet valve. The fuel transfer starts again.

When the ACT low level sensors become dry, the control circuit:

- opens the vent valve
- closes the air shutoff valve
- closes the fuel transfer valve
- closes the ACT fuel inlet valve.

The fuel transfer from the ACT to the center tank stops



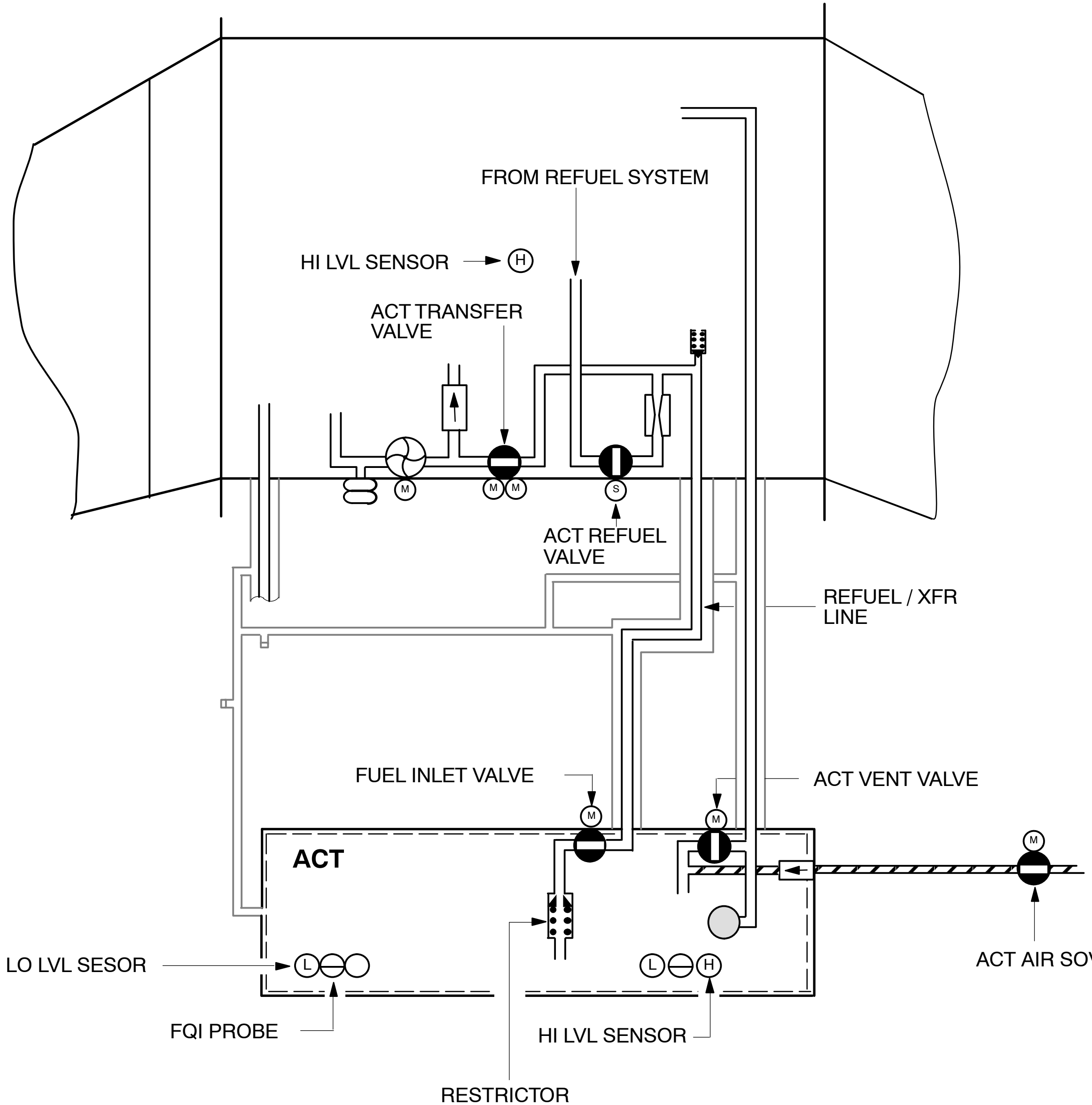


Figure 85 Automatic FWD Trasfer

FUEL TRANSFER SYSTEM (CONT)

Manual Forward Transfer

For a manual forward transfer to occur, you must push the ACT pushbutton switch (the FWD legend comes on).

When the ACT pushbutton switch is pushed, the electrical control circuit:

- opens the ACT fuel transfer valve
- opens the ACT fuel inlet valve
- energizes the ACT transfer pump.

It transfers the fuel from the ACT to the center tank.

If the ACT pump pressure switch detects a low pressure for more than 180 seconds (and the ACT is empty if the aircraft is in flight) the FUEL−ACT PUMP LO PR warning appears on the upper ECAM display unit. When the ACT pushbutton switch is released (the FWD legend goes off) the control circuit:

- closes the ACT fuel transfer valve
- closes the ACT fuel inlet valve
- de−energizes the ACT transfer pump.

Thus the fuel transfer from the ACT to the center tank is stopped.

Operation with Failure

Failure of the Automatic Transfer

The FQIC signals a transfer fault if in the center tank there is less than 3000Kg of usable fuel and in the ACT there is more than 250Kg fuel available, then:

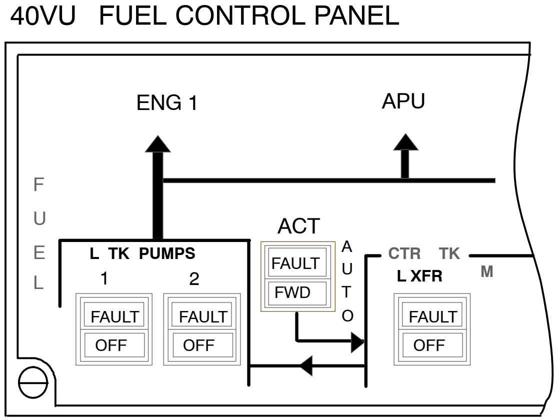
- the EWD shows the warning FUEL
- ACT XFR FAULT on the upper ECAM display unit
- The FAULT legend in the ACT pushbutton switch comes on.

Failure of the ACT Transfer Pump

If the ACT transfer pump is selected to run and the ACT transfer pump pressure switch detects a low pressure for more than 180 seconds (with the ACT empty if the aircraft is in flight)

- the EWD shows the warning FUEL−ACT PUMP LO PR,
- the FAULT legend in the ACT pushbutton switch comes on.

MANUAL FWD TRANSFER



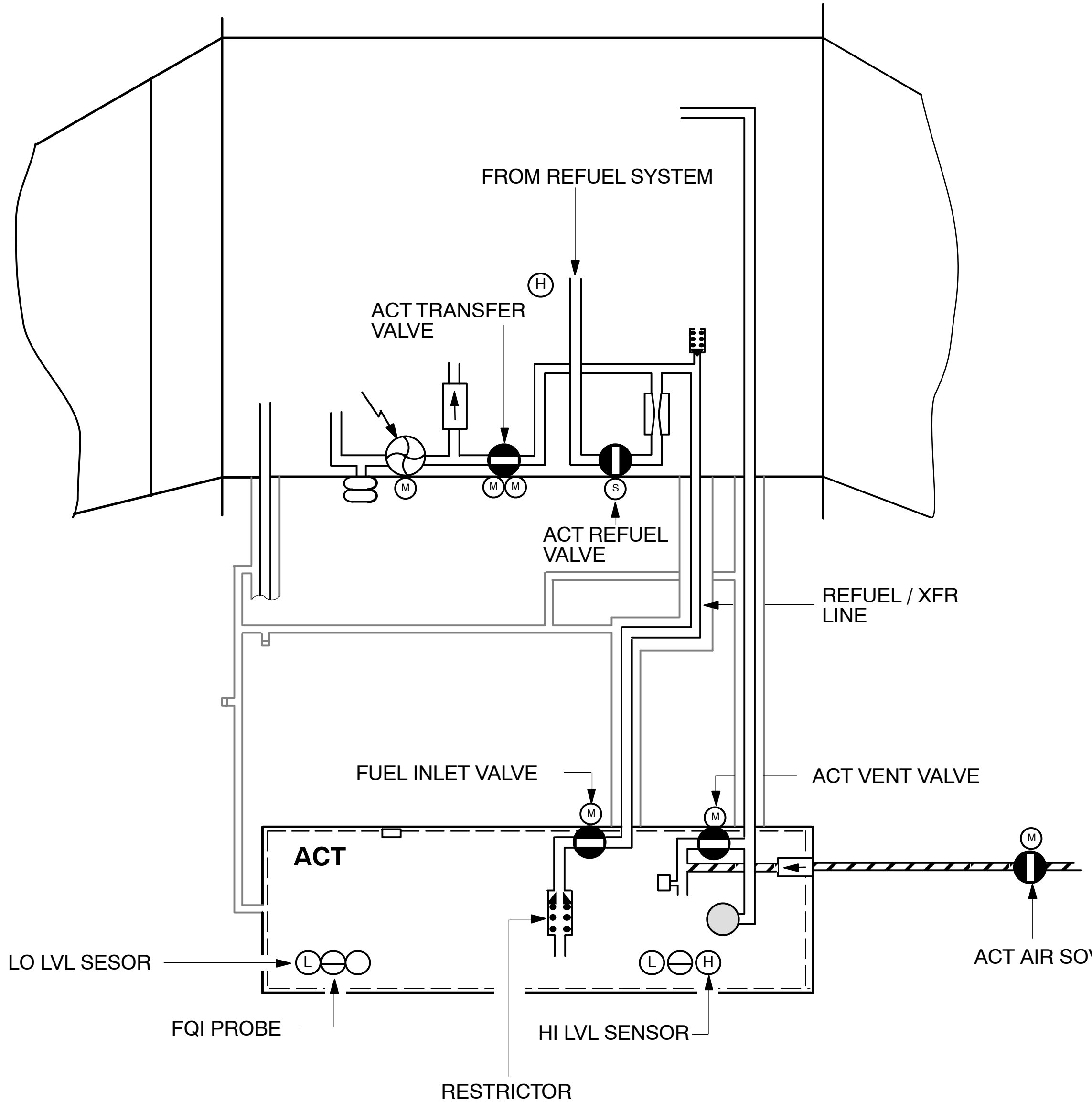


Figure 86 Manual FWD Transfer

ATC VENT/PRESSURIZATION SYSTEM

ACT Vent System General

The vent system of the ACT has:

- an ACT1 vent valve and its related electrical actuator,
- an inward pressure relief valve,
- an overpressure protector,
- a fuel drain valve,
- a shrouded ACT vent line.

The actuator closes the ACT1 vent valve to pressurize the ACT1 for automatic fuel transfer.

The inward pressure relief valve prevents excessive inward pressure on the bladder bag during descent and emergency descent.

The overpressure protector installed in the vent line depressurizes the ACT through the vent line if the tank pressure is too high.

The shrouded ACT vent line connects the ACT to the air–space at the top of the center tank. The center tank air–space is ventilated to atmosphere by the tank venting system.

ACT Pressurization System General

In the pressurization system the following components are installed:

- a cabin intake air–filter
- three check valves,
- an ACT air shut–off valve and its related electrical actuator
- a pressure reducing valve.

The ACT air shutoff valve is installed in the pressurization line of the ACT. The actuator opens the valve when the automatic fuel forward transfer is selected. This activates the pressurization system and the air pressure in the cargo compartment (pressurized from the pressure control system) enters the ACT through the pressurization line and transfers the fuel from the ACT to the center tank.

In the pressurization line is a pressure reducing valve which regulates the ACT pressurization supply to about 0.34 bar (5 psi) over ambient air pressure. It also has check valves which prevent the vapor from the ACT entering the cabin. The pressurization line has a filter to make sure that clean air goes into the tank.

ACT VENT/PRESSURIZATION SYSTEM

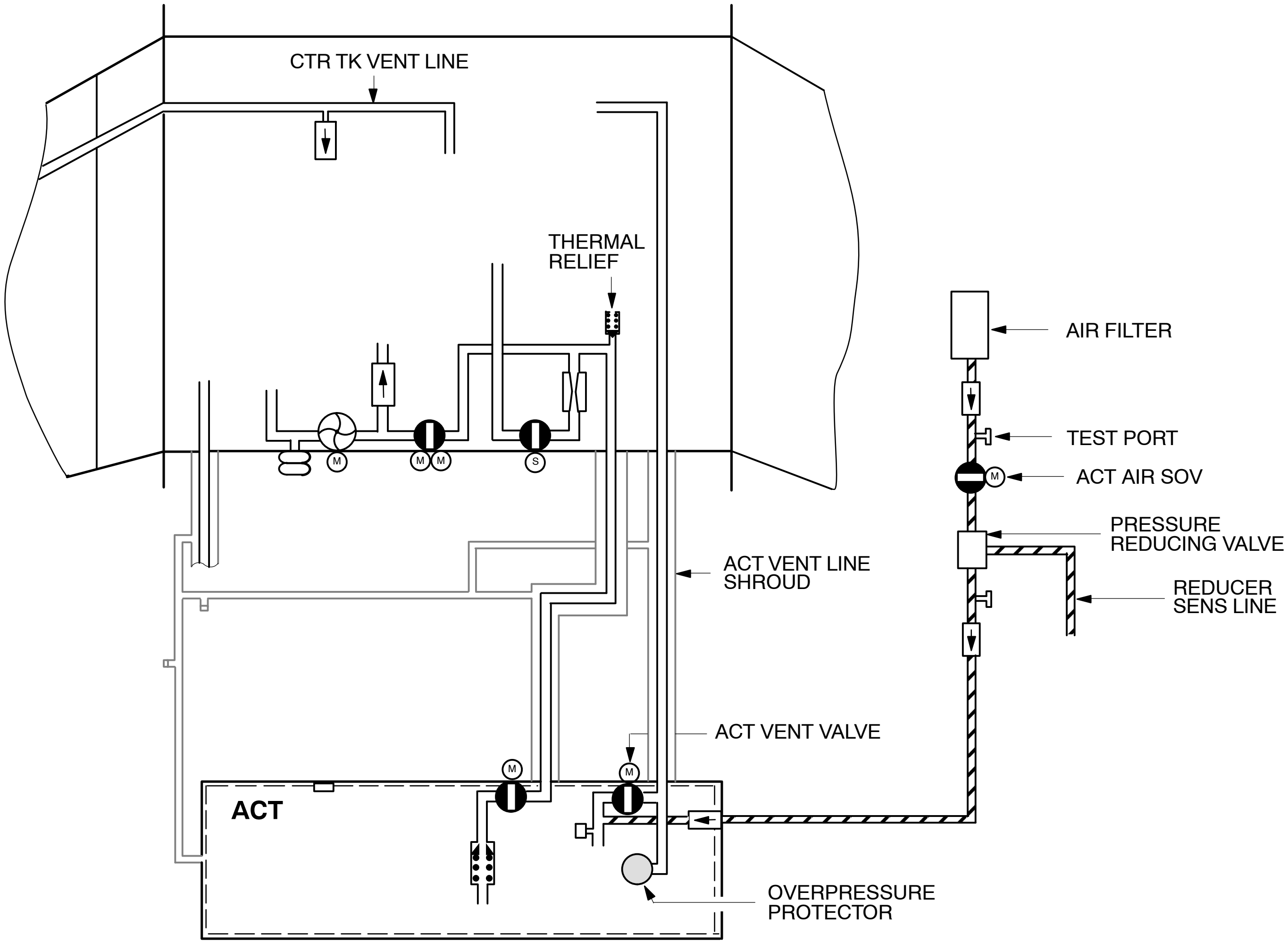


Figure 87 Pressurization System

ACT COMPONENTS (ALL SUB SYSTEMS)

Leak Monitors/Drain Valve

The leak monitors are used to check the evidence of fuel leaks in the ACT system.

Drain Valves (same kind like wing tanks, not shown)

The drain valves are used to drain the water from the fuel and to drain all the remaining fuel from the tank for maintenance.

Operation:

- The body has an inner and outer valve and the springs.The inner valve is installed in the outer valve and the springs keep the two valves in the closed position.
- When a drain tool opens the outer valve, the inner valve opens at the same time. Then fuel or water can flow out through the valve. If the outer valve closes the inner valve also closes. When the outer valve is removed the inner valve stays closed and prevents a fuel leak.

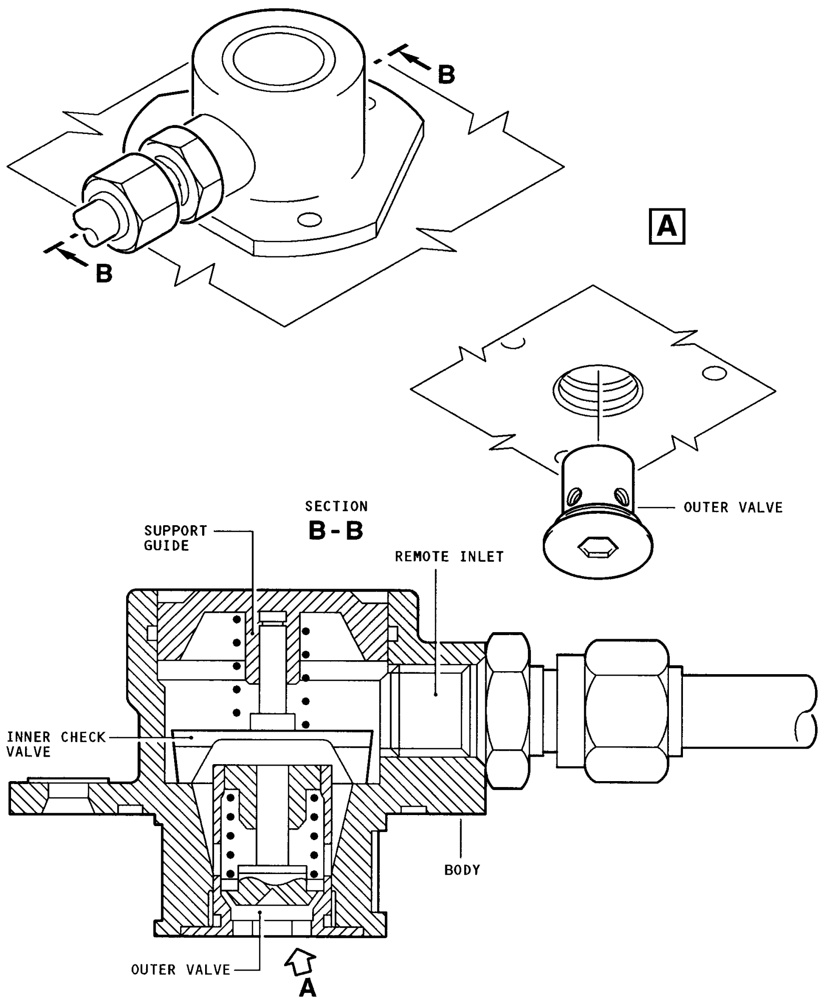
ACT Thermal Relief Valve

The valve body contains a ball and a spring. The spring holds the ball against a valve seat. When fuel pressure increases to more than 2.75 bar (40 psi) the ball lifts (against the pressure of the spring) to release the fuel through the outlet holes.

Inward Pressure Relief Valve (not shown)

The inward pressure relief valve prevents exessive inward pressure on the bladder bag during descent or emergency descent.

Leak Monitor / Water Drain Valve



Thermal Relief Valve

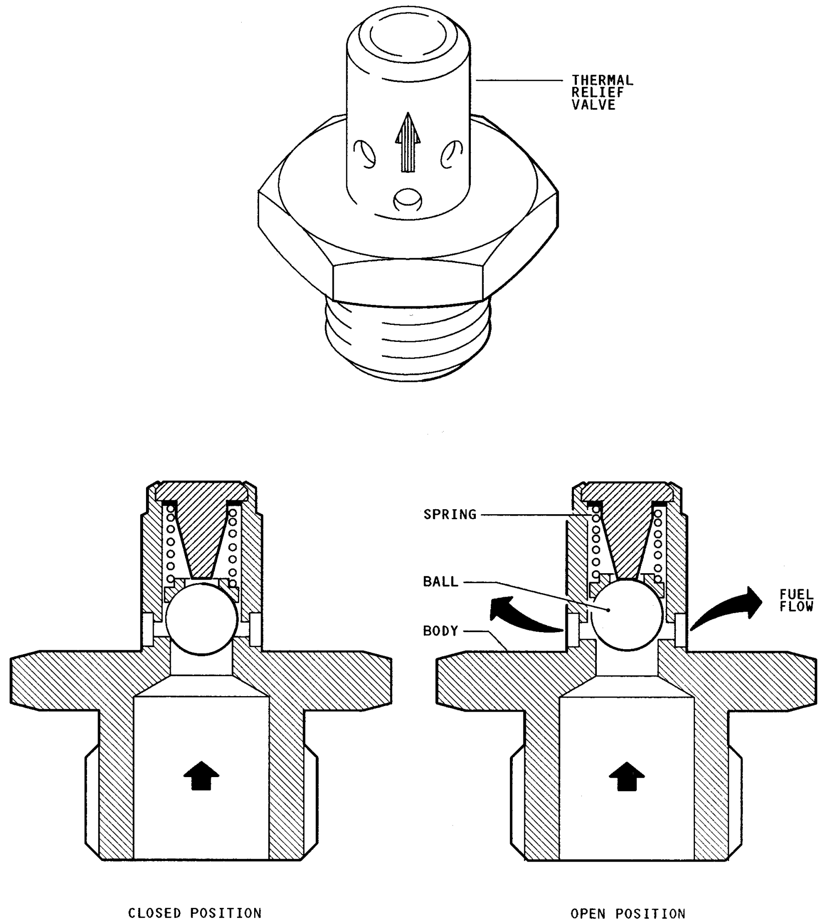


Figure 88 ACT Components

ACT COMPONENTS (CONTINUES)

ACT Fuel Transfer Valve

Located on the fuel transfer line, it allows fuel transfer between the center tank and the ACT. The valve opens when an automatic or manual fuel forward transfer is selected.

The valve has two sub-assemblies, a drive assembly and a valve assembly.The drive assembly interfaces the actuator and the valve assembly.

The valve assembly is within the center tank.

The drive assembly is mounted through the aft wall of the center tank. It has two electric motors which turn the ball valve in the valve assembly.

One of the two motors can operate the valve if the other motor is demaged. ACT

ACT Vent Valve

Connects the ACT to the aircraft vent system. In closed position, it allows pressurization of the ACT.

In open position, it allows ventilation of the ACT through the vent line to the center tank. (the valve housing and the actuator are the same as the fuel inlet valve)

ACT Rerfuel Valve (not shown)

Installed at the rear spar FR42 in the fuel line to the main fuel gallery.

(the valve is the same kind as wing/ctr tank refuel valve)

ACT Fuel Inlet Valve

Located on the fuel inlet line and controlled by the automatic logic, it allows fuel to enter or go out of the ATC. It opens when an automatic, manual fuel forward transfer or refuel is selected.

The valve housing contains a ball valve assembly (ball and spindle) which is connected to the drive assembly through a V-clamp.

The inlet valve actuator of the drive assembly is located on the outside of the ACT

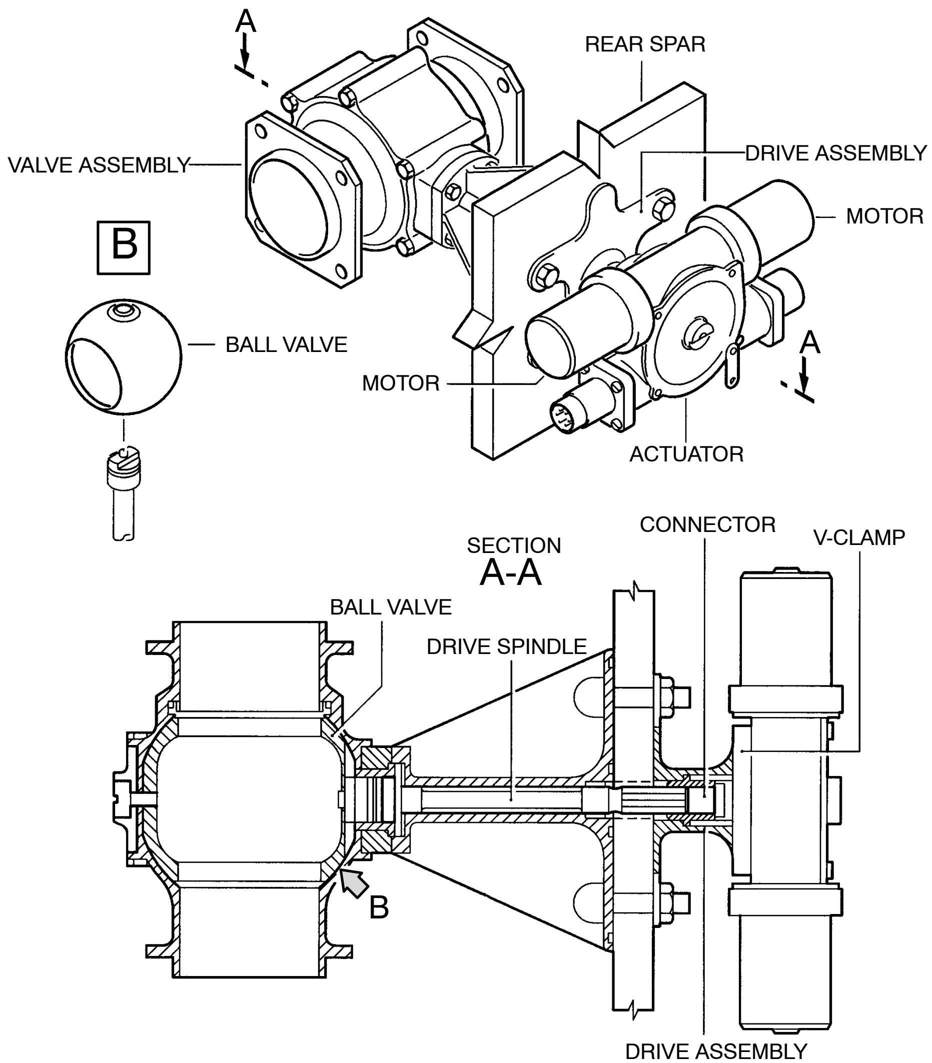
ACT Vent Valve

Connects the ACT to the aircraft vent system. In closed position, it allows pressurization of the ACT.

In open position, it allows ventilation of the ACT through the vent line.

(the valve housing and the actuator are the same as the fuel inlet valve)

FUEL TRANSFER VALVE AND ACTUATOR



FUEL INLET VALVE/ACT VENT VALVE

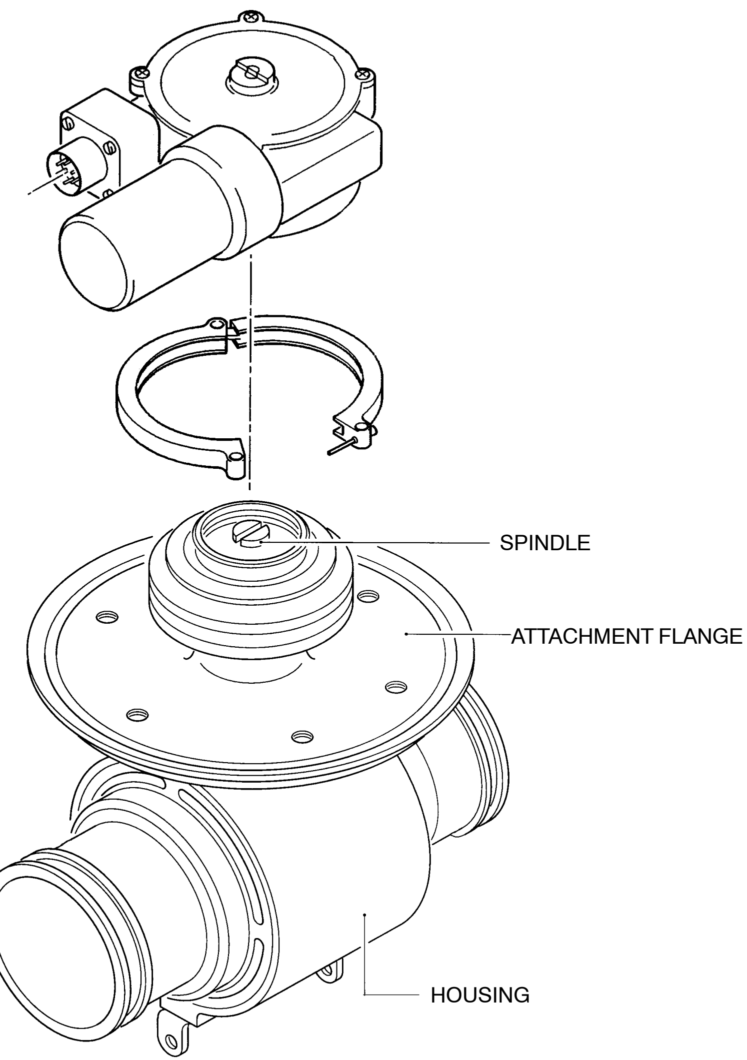


Figure 89 Transfer System Components

ACT COMPONENTS (CONTINUES)

ACT Refuel Restrictor Valve

A refuel restrictor valve is installed in the fuel line inside the ACT.

This valve makes sure that the refuel rate of the ACT is within a safe limit, but it will not limit the defuel rate of the ACT.

ACT Transfer Pump

The ACT transfer pump is installed at the raer spar FR42. The pump operates when manual forward transfer is selected.

The Electricall driven pump is installed in a pump mounting plate which allows a change of the pump without defuelling the ctr. tank.

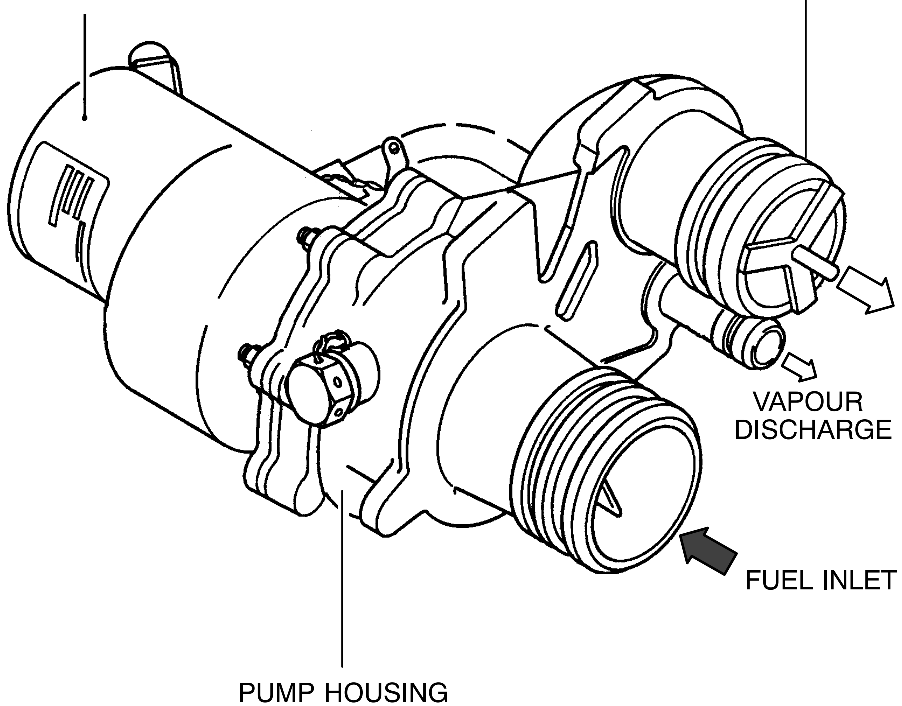
- when the pump is removed from its mounting plate a non return valve (not shown) closes and prevents a fuel leak from the ctr. tank.
- the non return valve in the mounting plate also closes if the pump is not op erating to prevent a reverse flow to the ACT.

ACT Pump Pressure Switch

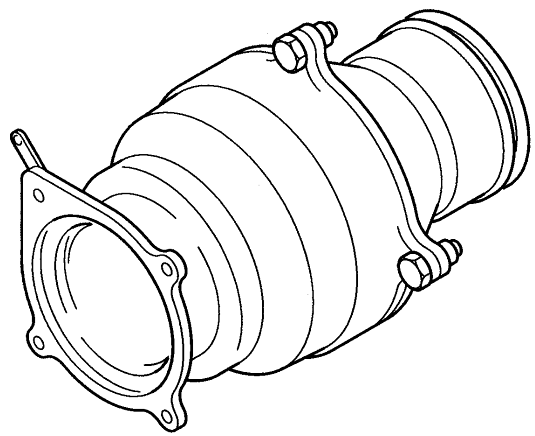
The pressure switch monitors the fuel pressure downstream of the fuel transfer pump. When the switch detects a low pressure (> 6 psi) for more then 180 seconds and the ACT is empty (if A/C is in flight) a warning appears on the EWD.

The ACT P/B switch must be switched OFF.

FUEL TRANSFER PUMP



ACT REFUEL RESTRICTOR VALVE



ACT PUMP PRESSURE SWITCH

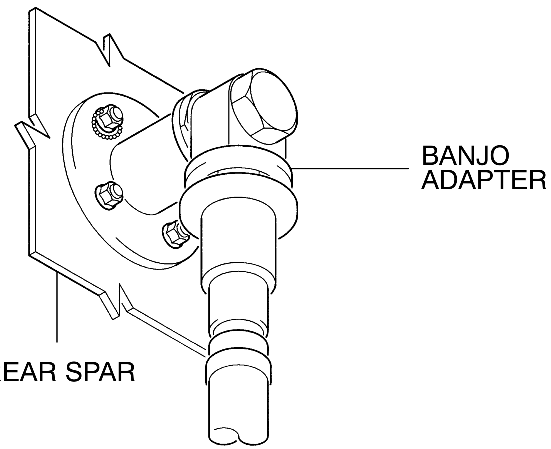


Figure 90 Transfer System Components

ACT COMPONENTS (CONTINUES)

ACT Air Shutoff Valve

The air shutoff valve is installed in the pressurization line of the ACT. When open, the air can flow from the cargo compartment to the ACT.

The actuator opens the valve when automatic fuel forward transfer is seclected.

Cabin Intake Air Filter

This filter cleans the air which goes into the ACT.

Pressure Reducing Valve

The valve is installed in the pressurization line to the ACT.

It regulates the ACT pressurization supply to obout 0.34 bar (5 psi) over ambient air pressure.

It also has check valves which prevents the vapor from ACT entering the cabin.

Overpressure Protector

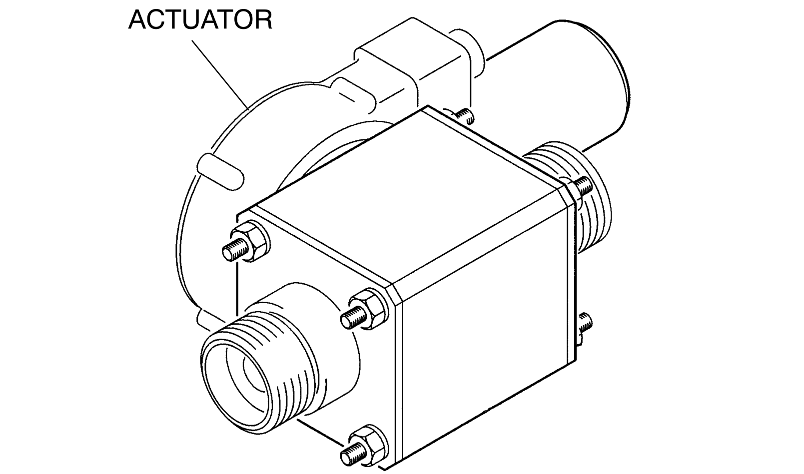
The overpressure protector installed in the vent line depressurizes the ACT through the vent line if the tank pressure is too high.

ACT Vent Valve (same as Fuel Inlet Valve)

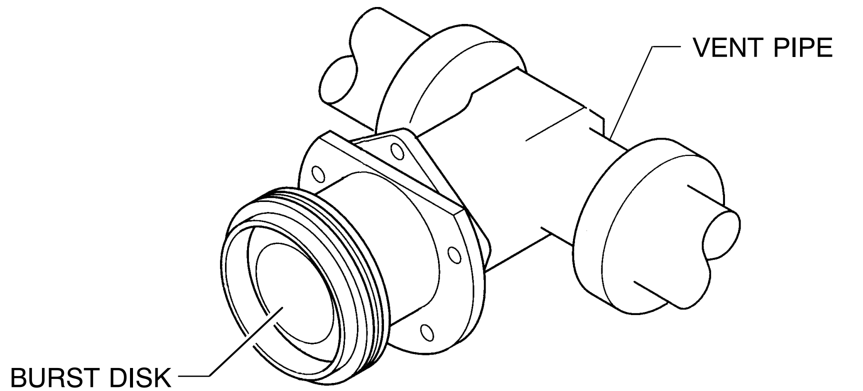
In closed position, it allows pressurization of the ACT for automatic fuel forward transfer.

In open position, the ACT is ventilated through the vent line.

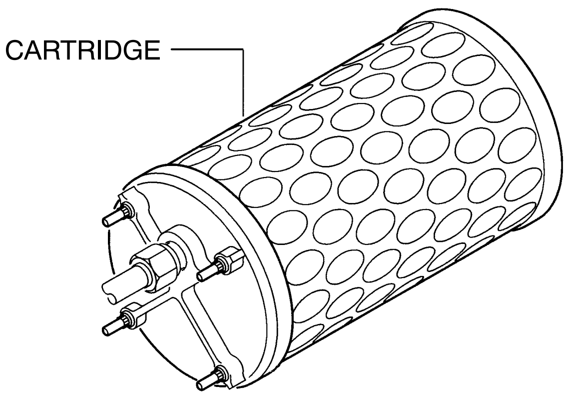
AIR SHUTOFF VALVE



OVERPRESSURE PROTECTOR



CABIN INTAKE AIR FILTER



PRESSURE REDUCING VALVE

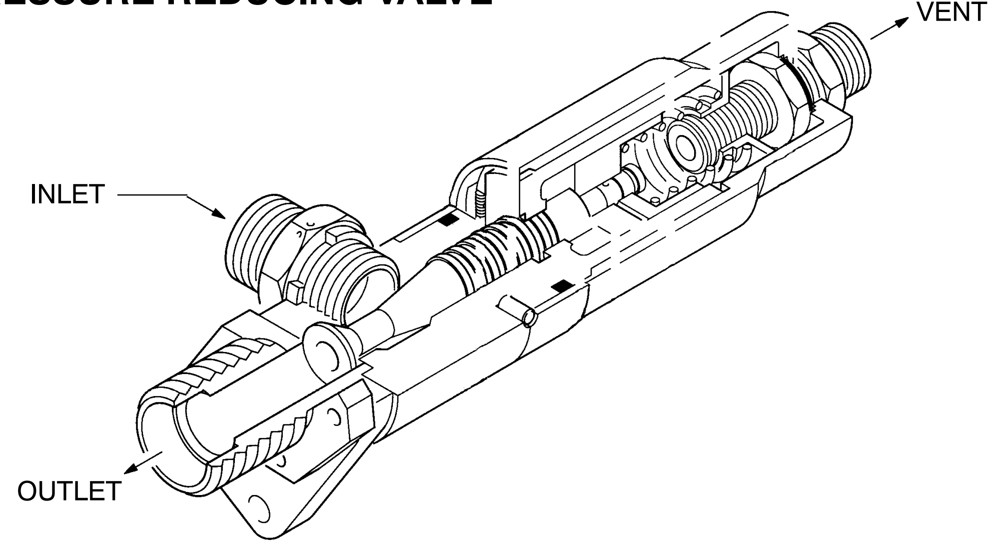


Figure 91 Pressurization Components

FUEL TANK SAFETY

BACKGROUND INFORMATION

GENERAL

Since 1959 there have been 17 fuel tank ignition events, resulting in:

- 542 fatalities
- 11 hull losses
- 3 others with substantial damage.

Causes

- 3 unknown
- 4 caused by external wing fires
- 4 electrostatics
- 2 lightning
- 2 pumps or wiring suspected
- 1 by small bomb
- 1 maintenance action

IGNITION EVENT EXAMPLES

Thai B737-400

On March 2001, a B737, operated by Thai Airways, was destroyed by an explosion and fire at Bangkok International Airport, Thailand.

After investigation, the NTSB has determined that the center fuel tank exploded, shortly after the main fuel tanks were refueled. The cause of the explosion was the ignition of the flammable fuel/air mixture in the center fuel tank. The source of the ignition energy for the explosion could not be determined with certainty, but the most likely source was an explosion originating at the center tank fuel pumps.

NOTE: The pumps were operating dry (no fuel passing through them) at the time of the explosion!

TWA Flight 800

Twenty minutes after taking off from New York‘s JFK International Airport on July 17, 1996, Paris-bound TWA Flight 800 exploded. All 230 passengers were most likely killed from what medical examiners described as ”phenomenal whiplash”.

It is widely accepted that an explosion in the central fuel tank of the aircraft caused its destruction. However, it is unclear exactly what caused this explosion. Researchers examined retrieved parts of the airplane and other similar models to seek explanations for Flight 800‘s explosion. It has been billed as the longest and most expensive accident investigation in American aviation history.

There were several factors that made TWA Flight 800 a ticking time bomb. The two key factors that contributed to the dangerous environment for the 25 year-old Boeing model 747-131 were the condition of the aircraft‘s electrical hardware and the presence of a highly explosive fuel-air ratio in the central fuel tank.

After arriving at JFK International Airport from Athens, Greece, the plane sat on the ground for four hours with the air conditioning units operating before departing for Paris at 8:19 p.m.. The plane exploded 20 minutes later, while ascending at 13,760 ft.

The central fuel tank, which is capable of holding 13,000 gallons of jet fuel, only contained 50 gallons at the time it exploded, meaning that it was less than one-half percent full. TWA Flight 800 was using Jet A fuel, which is most commonly used for commercial jets.

The central fuel tank is located on the underside of the fuselage, directly between the wings.

The source of ignition energy for the explosion could not be determined with certainty.

However, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter through electrical wiring associated with the fuel quantity indication system.

5 Key Accidents	707 Elkton MD 747 Madrid	737 Manila 747 New York	737 Bangkok
Safety Approach: Ignition Sources	Prevent ignition sources (improvements to affected model after accident)	Re-examine design and maintenance to better prevent ignition sources (SFAR 88) Whole Fleet Solution	Recognition that our best efforts may not be adequate to prevent all explosions
Flammability	Some R&D. Not found to be practical. No requirements established.	FAA research led to inerting developments. Industry (ARAC) deemed it impractical.	FAA Simplified system developed. Recognized that inerting is practical, and may be needed to achieve balanced solution

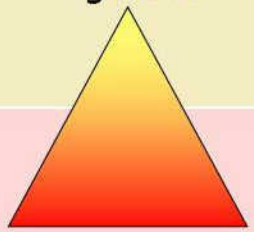


Figure 92 Introduction background for SFAR 88

IGNITION SOURCES

General

Upon realizing that the central fuel tank of TWA Flight 800 exploded and that the explosion was not likely by a bomb, the NTSB focused on finding the source of ignition. However, after scrutinizing all of the recovered wreckage, which accounts for over 95 % of the plane, they found nothing to support any plausible theory of ignition. The investigation focused on examining the electrical wiring near the central fuel tank, which consists largely of wiring for the FQIS (**F**uel **Q**uantity **I**ndicating **S**ystem) and for control of the fuel pumps. Unfortunately, most of this wiring was burned or damaged from the explosion, thus hindering an analysis into the role that it could have played in causing the explosion. However, this did not leave the NTSB completely in the dark concerning ignition sources. Electrical arcing and autoignition are two source theories that were tested by the NTSB.

Electrical Arcing

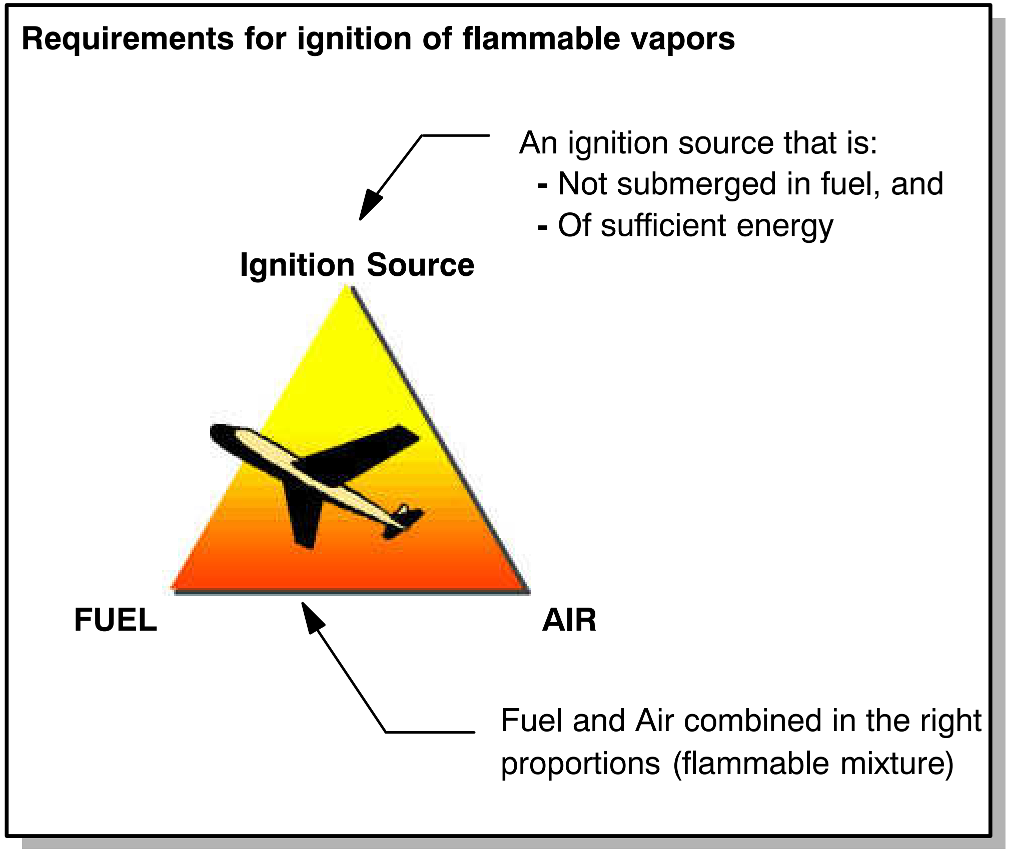
In search of answers to the question of ignition, the NTSB conducted an investigation into the state of electrical wiring in operational Boeing 747s and similar models from other manufacturers to see if a spark could occur in the central fuel tank. The findings from this investigation were discouraging. Between May of 1997 and July of 1998, the NTSB examined a number of existingjets, of which many were old, reaching ages up to 27 1 /2 years old. Findings include „sharp metal shavings both on and between wire bundles“, and three−quarter inch coatings of lint on wires, what NTSB investigators describe as syrup: a sticky combination of spilled beverages, leaking water and lavatory fluids, dust and other materials that build up over years of service.

The presence of sharp metal shavings, which can be attributed to drilling, can strip insulation away from wires. As a result, the core conducting wires become exposed and enhance the likelihood of a spark. Exposed wires that are coated with „syrup“ or metallic drill shavings can be dangerous because either substance can act as a conductor. Consequently, substances such as these could function as a base point for an electric arc, which could ignite the contents of a fuel tank. The NTSB initiated simulations with these conditions to see if it was possible to create an electrical arc. In one rare case, when bare wires were bundled close to each other, an arc was created.

Autoignition

Another possible source of ignition is from the terminals of the FQIS wires in the central fuel tank on which copper sulfide can build up. This phenomenon has been observed in aging electrical systems, and is a result of the natural deterioration of wiring. The buildups can become sources of localized heat. This can cause a threat because of autoignition. If the localized heat source is hot enough, the fuel around it may reach a temperature at which it will automatically ignite.

Another theory of how autoignition could have occurred within the central fuel tank of TWA Flight 800 involves the scavenger pump and faulty check valves. The scavenger pump is a possible source of ignition because it resides within the central fuel tank. NTSB officials believe that fuel was being transferred between tanks when the explosion occurred, suggesting that the scavenger pump in the central fuel tank was operating. If the scavenger pump was operating and its check valve was too tight, it may have allowed only fuel, and not vapor to pass through it, resulting in a concentration of vapor around the check valve of the scavenger pump. The vapors have a lower autoignition temperature than the liquid and the pump is a significant source of energy that could become hot enough to cause autoignition of fuel vapor.



ELECTRICAL ARCING

DRILL SHAVING AND CONTAMINATION ON WIRE BUNDLES

Figure 93 Accident Findings

REGULATION

General

As a result of this accident, multiple ADs (**A**irworthiness **D**irectives) on multiple models were issued.

BACKGROUND

Subsequent to accidents involving Fuel Tank System explosions in flight (Boeing 747−131 flight TWA800) and on the ground, the FAA (**U**nited **S**tates **F**ederal **A**viation **A**dministration) published Special Federal Aviation Regulation 88 (SFAR88) in June 2001. SFAR 88 required a safety review of the aircraft Fuel Tank System to determine that the design meets the requirements of FAR § 25.901 and § 25.981(a) and (b).
A similar regulation has been recommended by the European JAA (**J**oint **A**viation **A**uthorities) to the European National Aviation Authorities in JAA letter 04/00/02/07/03−L024 of 3 February 2003. The review was requested to be mandated by European National Airworthiness Authorities using JAR § 25.901(c), § 25.1309.

In August 2005 the EASA (**E**uropean **A**viation **S**afety **A**gency) published a policy statement on the process for developing instructions for maintenance and inspection of Fuel Tank System ignition source prevention that also included the EASA expectations with regard to compliance times of the corrective actions on the unsafe and the not unsafe part of the harmonised design review results. On a global scale the TC (**T**ype **C**ertificate) holders committed themselves to the EASA published compliance dates (see EASA policy statement). The EASA policy statement was revised in March 2006 resetting the date of 31 December 2005 for the unsafe related actions to 1 July 2006.

Fuel Airworthiness Limitations are items arising from a systems safety analysis that have been shown to have failure mode(s) associated with an “unsafe condition“ as defined in FAA‘s memo 2003−112−15 “SFAR 88 - Mandatory Action Decision Criteria“. These are identified in Failure Conditions for which an unacceptable probability of ignition risk could exist if specific tasks and/or practices are not performed in accordance with the manufacturers requirements.

This EASA Airworthiness Directive mandates the Fuel Airworthiness Limitations CDCCL(**C**omprising maintenance/inspection tasks and Critical **D**esign **C**onfiguration **C**ontrol **L**imitations) for the type of aircraft, that resulted from the design reviews and the JAA recommendation and EASA policy statement mentioned above.

Enhanced Airworthiness Program

The FAA and EASA have indicated that operators must train their maintenance and engineering personnel regarding the changes brought about by SFAR 88.

See *EASA ED Decision No 2009/007/R of the Executive Director of the Agency.*

Fuel System Safety Compliance Data

AIRWORTHINESS DIRECTIVES ISSUED

Phase One SFAR Rule Implementation	June 6, 2001 SFAR 88 Rule became effective. Applicable TC, STC holders had to comply by December 6, 2002
Phase Two FAR Rule Implementation	June 6, 2001 FAR Parts 25,91,121,125,129 amended to require instructions for maintenance and inspection of the fuel tank system had to be incorporated into the operators Maintenance Program and be FAA approved by June 7, 2004
Enhanced Airworthiness Program. **Covering Phase 1+2 and Continuation Training** EASA DECISION NO 2009/007/R	The FAA and European Aviation Safety Agency (EASA) have indicated that operators must train their maintenance and engineering personnel regarding the changes brought about by SFAR 88. March, 2009

Figure 94 Fuel System Safety Compliance Data

AIRWORTHINESS LIMITATION PRECAUTIONS

Airworthiness Limitation Instructions (ALIs)

All occurrences of fuel tank system ALIs found in this chapter of the AMM are identified by this step after the General section in the applicable ALI inspection task.

NOTE: ALI – Refer to the Customer Services Directorate for important information on **A**irworthiness **L**imitation **I**nstructions (ALIs).

Inspection tasks that are ALIs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Section 9 of the MPD (**M**aintenance **P**lanning **D**ata) document.

These ALIs identify inspection tasks related to fuel tank ignition source prevention which must be done to maintain the design level of safety for the operational life of the airplane.

These ALIs are mandatory and cannot be changed or deleted without the approval of the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency. Strict adherence to methods, techniques and practices as prescribed is required to ensure the ALI is complied with.

Any use of methods, techniques or practices not contained in these ALIs must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

NOTE: The Fuel Airworthiness Limitations are a part of the **A**irworthiness **L**imitation **I**nstructions (ALIs).

AIRBUS
Customer Services Directorate

A318/A319/A320/A321 Fuel Airworthiness Limitations

SECTION 0 - INTRODUCTION

1. **SCOPE**

This document contains the Fuel Airworthiness Limitations that arise from compliance with JAA's Interim Policy on Fuel Tank Safety (INT/POL/25/12) and FAA's Special Federal Aviation Regulation (SFAR) 88. They have been derived in accordance with JAA's draft Temporary Guidance Leaflet (TGL) 47 and FAA's Advisory Circular (AC) 25.981-1B. The nomenclature and means of promulgation follow the FAA's memorandum ref PS-ANM100-2004-10029 'Policy Statement on Process for Developing SFAR 88-related Instructions for Maintenance and Inspection of Fuel Tank Systems'. This latter document has been jointly developed between FAA and JAA to ensure a unified approach.

These requirements, together with the Life Limits / Monitored Parts, structural Airworthiness Limitation Items (ALI) and systems Certification Maintenance Requirements (CMR) comprise the Airworthiness Limitation Section which satisfies the requirements of JAR 25.1529 Appendix H paragraph 25.4.

IMPORTANT: At first delivery of an aircraft configuration into an operator's fleet, the requirements given in this document are mandatory, except in so far that interval escalations can be justified in accordance with the procedure stated herein. If a more restrictive Fuel ALI is issued on an aircraft configuration already in service, the requirement for existing operators to follow the revised FAL document will normally be mandated by Airworthiness Directive (Consigne de Navigabilité).

Non-compliance suspends the validity of the Airworthiness Certificate.

The identification of Fuel Airworthiness Limitations in no way diminishes the importance of other tasks and practices associated with the fuel system. Changes to these are subject to normal practices and procedures between the operator and his national authorities.

This document does not take into account Airworthiness Directives (Consigne de Navigabilité) which, if issued against an existing Fuel Airworthiness Limitation, supersede the specific requirement given in this document.

2. **APPLICABILITY**

Ref. 95A.1931/05	Issue 1 19 Dec 05	Section 0	Page 1

AIRBUS
Customer Services Directorate

A318/A319/A320/A321 Fuel Airworthiness Limitations

SECTION 2

CRITICAL DESIGN CONFIGURATION CONTROL LIMITATIONS

	CDCCL	Requirement	Reference	Applica bility
1	Air gap between a fuel quantity indicating probes and the aircraft structure.	Critical to prevent spark generation during lightning strike conditions and must not be compromised The gap stated in the relevant maintenance procedure in the AMM must be achieved during installation of a fuel quantity probe.	AMM 28-42-15-400	ALL
2	Separation of fuel quantity and level indicating system wiring from other wiring.	To prevent cross coupling of high voltage transients and thereby keep unsafe ignition energies from inside the tank it is required that operators obey the wire routing and separation standards given in the Electrical Standard Practices Manual (ESPM).	ESPM 20-10-00 20-33-11 20-33-20 20-33-21 20-33-22	ALL
3	Direct bonding on items of equipment inside a fuel tank.	Direct bonding is critical to prevent spark generation during component failure and lightning strike conditions and must not be compromised Direct bonding in fuel tanks must be carried out during component installation to the appropriate bonding method and standard stated within the installation procedure in the AMM.	AMM 28-11-37 28-11-41 28-12-41 28-12-45 28-12-46 28-13-43 28-15-41 28-21-42 28-21-52 28-25-41 28-25-42 28-25-46 28-25-52 28-42-15 28-42-16 28-42-46 28-42-48 28-43-21 57-27-11	ALL
4	Safety critical features of fuel pumps	These features must be maintained throughout the full life of the fuel pump to avoid the possibility of generation of an ignition source by overheating or sparks caused by arcing, friction etc. Repair and overhaul of fuel pumps must be carried out in accordance with the equipment manufacturer's maintenance instructions or other maintenance instructions acceptable to the certifying authority.	CMM 28-21-51 28-22-19	ALL

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Figure 95 Example Of Fuel Airworthiness Limitations

CRITICAL DESIGN CONFIGURATION CONTROL LIMITATIONS

CDCCLs (Critical Design Configuration Control Limitations)

All occurrences of CDCCLs found in this chapter of the AMM are identified by this note after each applicable CDCCL design feature:

NOTE: CDCCL − Refer to the task: Fuel General (AMM 28−00−00/001), for important information on CDCCLs (**C**ritical **D**esign **C**onfiguration **C**ontrol **L**imitations).

Design features that are CDCCLs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Section 9 of the MPD (**M**aintenance **P**lanning **D**ata) document.

CDCCLs are a means of identifying certain design configuration features intended to preclude a fuel tank ignition source for the operational life of the airplane.

CDCCLs are mandatory and cannot be changed or deleted without the approval of the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

A critical fuel tank ignition source prevention feature may exist in the fuel system and its related installation or in systems that, if a failure condition were to develop, could interact with the fuel system in such a way that an unsafe condition would develop without this limitation.

Strict adherence to configuration, methods, techniques, and practices as prescribed is required to ensure the CDCCL is complied with.

Any use of parts, methods, techniques or practices not contained in the applicable CDCCL must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

SEPARATION / ROUTING RULES (Airbus)

WARNING: THE CORRECT SEPARATION BETWEEN SENSITIVE WIRING AND WIRING OF OTHER SYSTEMS IS NECESSARY TO PRESERVE THE CRITICAL IGNITION SOURCE PREVENTION FEATURES OF THE SYSTEM DESIGN AND IS THEREFORE CLASSIFIED AS A CRITICAL DESIGN CONFIGURATION CONTROL LIMITATION (CDCCL).

A CDCCL MUST BE KEPT IN THE APPROVED CONFIGURATION TO ENSURE UNSAFE CONDITIONS DO NOT DEVELOP AS A RESULT OF MODIFICATION, MAINTENANCE OR REPAIR.

WARNING: BASED ON SFAR 88 FUEL IGNITION PREVENTION, THE REPAIR OF CABLES IS NOT TO BE PERMITTED.

AN UNSATISFACTORY CABLE MUST BE REPLACED WITH A NEW ONE THAT HAS THE SAME P/N.

A318/A319/A320/A321
AIRCRAFT MAINTENANCE MANUAL
AMM

TASK 28-21-52-400-001

Installation of the Fuel Pump Canister 1QM(4QM)

WARNING: THIS PROCEDURE USES A FUEL SYSTEM ITEM THAT IS IN A CATEGORY KNOWN AS A CRITICAL DESIGN CONFIGURATION CONTROL LIMITATION (CDCCL). CDCCL IDENTIFIES AN ITEM THAT CAN BE THE SOURCE OF A POSSIBLE FUEL TANK IGNITION. YOU MUST KEEP ALL CDCCL ITEMS IN THE APPROVED CONFIGURATION. DAMAGE, WEAR OR CHANGES TO A CDCCL ITEM CAN CAUSE A POSSIBLE FUEL TANK EXPLOSION.
WARNING: MAKE SURE THAT THE FLIGHT CONTROL SAFETY-LOCKS AND THE WARNING NOTICES ARE IN POSITION.
WARNING: MAKE SURE THAT THE GROUND SAFETY-LOCKS ARE IN POSITION ON THE LANDING GEAR.

1. Reason for the Job
   Self Explanatory

2. Job Set-up Information

C. Installation of the Fuel Pump Canister 1QM(4QM)

(1) Install the new sealing ring (8) and the new O-rings (18) and (22).

(2) Engage the connectors (1) and (2), while you put the canister (7) in position.

(3) Install the canister (7) with the screws (6).

NOTE: You must bond one of the screws (6)
(Ref. AMM TASK 28-21-52-991-001) (Ref. AMM TASK 20-28-00-912-002)

WARNING: THIS INSTRUCTION IS APPLICABLE TO A CRITICAL DESIGN CONFIGURATION CONTROL LIMITATION (CDCCL) ITEM. CAREFULLY OBEY ALL GIVEN INSTRUCTIONS WHEN YOU DO THIS STEP. IF YOU DO NOT OBEY THESE INSTRUCTIONS, A DANGEROUS CONDITION CAN OCCUR THAT CAN CAUSE A POSSIBLE FUEL TANK EXPLOSION.

EFFECTIVITY	28-21-052-400-001
ALL	Page 1 of 10 Print Date: February 19, 2008

All CDCCL items are identified by a WARNING in the procedures where they occur in the AMM and are identified by this warning after each applicable CDCCL design feature:
CDCCL-Refer to the task: Fuel General **(AMM 28-00-00/001)**

C. Critical Design Configuration Control Limitations (CDCCLs)

WARNING: OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO ANY MAINTENANCE THAT MAY AFFECT A CDCCL. IF YOU DO NOT FOLLOW THE PROCEDURES, IT CAN INCREASE THE RISK OF A FUEL TANK IGNITION SOURCE.

(1) Make sure you follow the procedures for items identified as CDCCLs.

You must keep CDCCL items in a serviceable condition. It is possible that damage, wear or changes to a CDCCL item can cause a fuel tank explosion.
When a procedure identifies a CDCCL item, it is a mandatory condition that you do the instruction correctly and accurately as the procedure tells you.

Figure 96 Example of A320 Family Critical Design Configuration Control Limitations (CDCCLs)

INFORMATION AND SAFETY

SPECIAL TOOLS AND EQUIPMENT

Adapter Assembly, Lamb Air Mover for Main Fuel Tank.

Adapter, Fuel Tank Ventilation for Reserve Fuel Tank and Wing Surge Tank.

Air Moving Equipment for Horizontal Stabilizer Fuel Tank.

Standard Tools and Equipment

1. Lamb Air Mover – Venturi 3-inch diameter
2. Air Heater/Blower – Electric, Explosion-proof
3. Air Compressor – Explosion-proof, Portable, for use with Lamb Air Mover
4. Light – Extension, Explosion-proof
5. Flashlight – Explosion-proof
6. Containers – Nonstatic material with rounded corners, to hold tools or fuel-saturated rags inside the tank
7. Combustible Gas Indicator

The instruments with a 10 to 1 scale in addition to the normal scale for determining the percent of the lower explosive limit will give more accurate indications of vapor concentrations in the health-safe range.

Refer to operating instructions on inside of instrument cover. When indicator sampling line replace- ment is required, new sampling lines should be obtained from manufacturers of combustible gas indicators.

Sampling lines of ordinary rubber absorb large quantities of fuel vapors, resulting in lower Indicator readings, and therefore should not be used.

Figure 97 Special Tools and Equipment

GAS MEASURING EQUIPMENT

INSTALLATION OF GAS MEASURING PROBE

FULL FACEMASK

RESPIRATOR

TANK ACCESS SOCKS

Figure 98 Tank Entering Equipment

WORKING DEVICE, EQUIPMENT AND MATERIALS:

MAINTENANCE JOB CARD

JOBTITLE

WORKING DEVICE, EQUIPMENT AND MATERIALS:

NOTE: Before initiation of any devices (equipment) you must check every tool regarding any defects (e.g. isolation defects) or anny imminent dangers!

Standard tools have to be checked particulary with regard to potential defects of it's protective coating (chrome surface).

Explosion-protected electrical machines or tools are specially labelled and can be recognized by:

- **The round label with the inscription "EX"**
- **The blue label (Tank Tools) with the inscription "T"**

WARNING: IT IS STRICTLY FORBIDDEN TO POSITION OR TO RUN ELECTRICAL EQUIPMENT OR DEVICES INSIDE THE (CORDONED OFF) HAZARDDOUS AREA WHICH ARE NOT EXPLOSION-PROTECTED.

KEEP IN MIND TO POSITION ALL NEEDED MAINTENANCE EQUIPMENT BEFORE YOU OPEN THE FUEL TANK ACCESS DOORS. PREVENT UNNECESSARY MOVEMENT OF EQUIPMENT-THIS CAN CAUSE SPARKS WHICH CAN CAUSE FUEL VAPOURS TO IGNITE.

IF YOU ARE WORKINGWITH SOLVENTS INSIDE AN AIRCRAFT FUEL TANK YOU HAVE TO USE EXPLOSION-PROOF TOOLS (MADE OF BERYLLIUM)AND EQUIPMENT ONLY!

THEUSE OF STANDARD TOOLS IS STRICTLYFORBIDDEN!

CAUTION: ALL WORKING DEVICES AND EQUIPMENT MUST BE PLACED IN SUCH AWAY THAT THEY DON'T CAUSE ANY RISKS (E.G. STUMBLING ACROSS CABLE AND DON'T HANDICAP ESCAPE ROUTES.

Figure 99 Working Device, Equipment and Materials

GENERAL SAFETY ADVICES

This chapter contains definitions and guidelines for (a) tank inspection(s) and specific operations (e.g.fuel tank sample for laboratory analysis) as well as safety-advices, which must be followed at any time.

NOTE: When working on the Fuel System and/or Fuel System Components of an aircraft. Always obey the definitions for the Critical Design CDCCL (**C**onfiguration **C**ontrol **L**imitations)listed in the chapter Fuel Tank Safety.

Never enter an aircraft fuel tank if the kerosene gas concentration is > 600 ppm! If the kerosene gas concentration is > 600 ppm the tank is a fire hazard and not safe from explosion(s)!

Never enter an aircraft fuel tank unless you have written approval (Maintenance Job Order) to do so

Never enter an aircraft fuel tank if there is no safety-person (observer) outside the tank

Never enter an aircraft fuel tank without approved protective clothing! This applies to all parts of your body that enter the tank. It is forbidden to wear watches, necklaces, rings etc.

Never enter an aircraft fuel tank if the kerosene gas concentration is not monitored by gas measurement and warning equipment (gas detectors).

If the kerosene gas concentration is >= 70 ppm you must wear a personal respirator!

Small quantities of fuel-drops or fuel-puddles at your workarea must be removed immediately with adequate materials (e.g. rags) and must be disposed professionally

Open fuel tanks and every other sealed section in the aircraft, in which work is to be done,must be ventilated without any interruption.

Figure 100 General Safety Advices

WARNING

Never operate the ventilation equipment (blower etc.) without supervision

Before using of any devices (equipment) you must check every tool regarding any defects (e.g. isolation defects) or any imminent dangers

It is necessary, that personnel who is experienced in the use of fire extinguishers is available during operations at the aircraft fuel system or inside an aircraft fuel tank

Never enter an aircraft fuel tank if you have no permission for tank inspections from Betriebsleiter/Wartungsleiter vom Dienst and Medical Service

If you doesn‘t feel comfortable or if your body is not fit for tank inspections you can stop a running tank inspection or refuse a starting tank inspection at any time

Don‘t forget personal hygienic and skin protection

Never carry out a tank inspection if you are pregnant

- Open lights and fire (naked flames) are strictly forbidden
- Smoking is strictly forbidden
- The use of non Explosion-protected mobile phones, pager, cameras or pocket radios (also i-pod/ mp3-player) is strictly forbidden

Figure 101 General Safety Advices (cont.)

SAFETY PRECAUTIONS

Make sure that you have the correct fire fighting equipment available.

When you have to work on a fuel system wiring, you must use test equipment that is approved (otherwise, unapproved equipment could cause fire or an explosion).

Make sure that the lighting in the work area is sufficient to work safely.

Wear protective goggles or face mask, clothes and gloves and avoid wearing metallic clothing (e.g. footwear or a belt with a metal buckle) which can cause sparks.

In the work area you must not:

- smoke,
- use flames which do not have protection,
- operate electrical equipment which is not necessary for the task,
- pull or move metal objects along the ground,
- use hearing-aids or battery-operated equipment which will cause sparks.

MAINTENANCE JOB CARD

JOBTITLE

FUEL TANK SAFETY:

CRITICAL DESIGN CONFIGURATION CONTROL LIMITATIONS (CDCCL)

For training purpose only! Refer to SFAR 88.

NOTE: The CDCCL are listed in these mandatory documents (only use latest revision)

For Airbus Aircraft:
Fuel Airworthiness Limitations – ALS Part 5

For Boeing Aircraft:
AWL (**Air**worthiness **L**imitations)/CMR (**C**ertification **M**aintenance **R**equirements)

These Documents can be found in the Intranet (MRBR/Appendix A).

Latest revision is listed in the Aircraft Maintenance Schedule (MS) Introduction Chapter 2.8 Reference Documents.

The CDCCL provide instructions to keep the critical ignition source prevention feature when working on the Fuel System and/or Fuel System Components of an aircraft.

If you work on the Fuel System and/or Fuel System Components of an aircraft you have to obey the CDCCL.

Examples for workings on a Fuel System and/or Fuel System Components of an aircraft:

- Working on the **F**uel **Q**uantity **I**ndication **S**ystem (FQIS).
- Resetting of tripped circuit breakers.
- Workings inside the fuel tanks, e.g. installation/repair of tank units, bonding leads or tank structure.
- Working in fuel vapor areas, e.g. opening floor panels above center tank, external wires over center tank, work at the wing trailing edge or tank access door.
- Working on wire installations which could interfere with the wiring of the fuel system.

Figure 102 Fuel Tank Safety Refer to SFAR 88

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