



## FUEL SYSTEM



## SYSTEM INTRODUCTION (A319/A320)

Note: The reason for ATA 28 inclusion in these notes is for the following:

**The new A319/A320 Fuel System is a combination of the common Wing Structure of the Single Isle (SA) Aircraft manufactured (A318/A319/320) and the Fuel System Components installed in A321 since entry into service and will be the manufacturing standard with the beginning of delivery of all NEO Single Aisle Aircraft, except the A318.**

The benefit to combine both layouts, on the new A319/A320 Fuel System, is to achieve the following:

Weight reduction,

Better protection against UERF,

Cost improvements,

Communality in between all SA Aircraft variants.

Two fuel pumps are installed in each wing tank.

One fuel pump is installed for the APU.

Fuel is supplied to the engines from the wing tanks only.

As the fuel level in the wing decreases, the centre tank fuel is transferred to the wing tanks until the centre tank is empty.

Fuel transfer from the centre tank to the wing tanks is controlled by transfer valves.

When the transfer valves are opened, they supply pressure to two jet pumps in the centre tank and transfer the fuel from the centre tank to the wings.

Two engine LP valves are installed to supply or cut off fuel to the engines.

The LP valve is closed when the related engine is shut down or when the engine fire pushbutton is released.

A crossfeed valve is installed to connect or isolate the left and right-hand sides.

It enables engine to be fed from any available fuel pump.

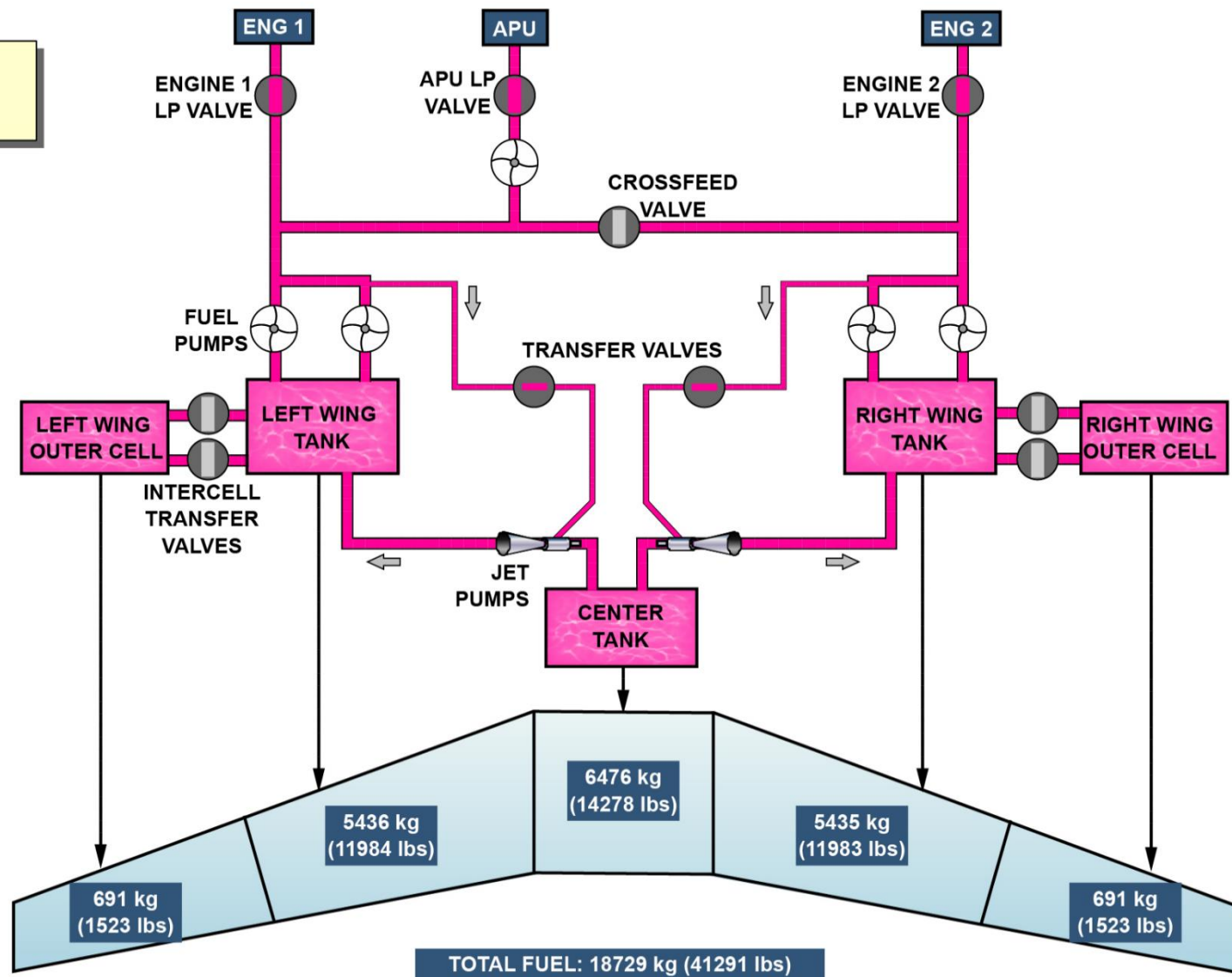
On the ground, the crossfeed valve enables fuel to be transferred from tank to tank.

The valve is closed for normal operation.

The fuel system also feeds the APU directly from the left-hand side.

The APU LP valve is installed to supply or cut off fuel to the APU.

It closes when the APU is shut down or when the APU FIRE pushbutton is released out.

**A319/A320**



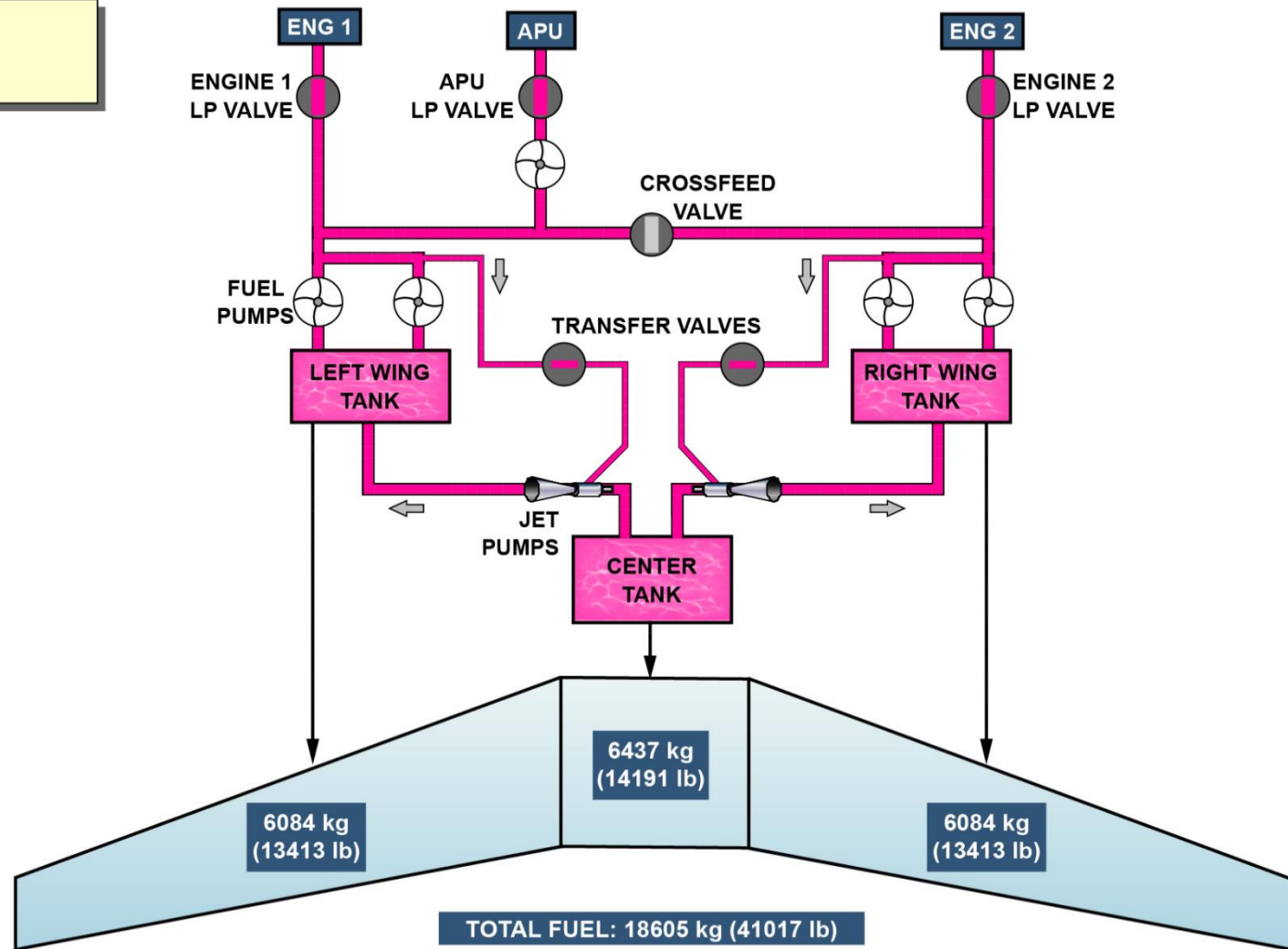
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## **A321**

The A321 fuel tanks are integrated into the centre fuselage area and the wings.

Like the A318/A319/A320, the centre tank is part of the centre wing box but unlike the A318/A319/A320, the wing tanks are not divided.

The tanks are simply called left and right-wing tanks.

**A321**



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# CONTROLS



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## FUEL SYSTEM CONTROL

### CROSSFEED

The X FEED pushbutton controls the crossfeed valve.

This pushbutton is normally released out and the crossfeed valve is closed.

If the pushbutton is pressed in, the valve opens, and the ON light comes on white.

The green OPEN light comes on when the valve is fully open.

### TANK PUMPS

When a wing tank pushbutton is pressed in, the related pump runs.

The FAULT light comes on amber associated with an ECAM caution if the main pump pressure is too low.

### CENTER TANK TRANSFER

With the CTR TK L(R) XFR transfer pushbutton pressed in, the transfer valve will be controlled automatically if the auto mode is selected.

In MAN mode, the transfer valve is manually switched on or off by the related pushbutton.

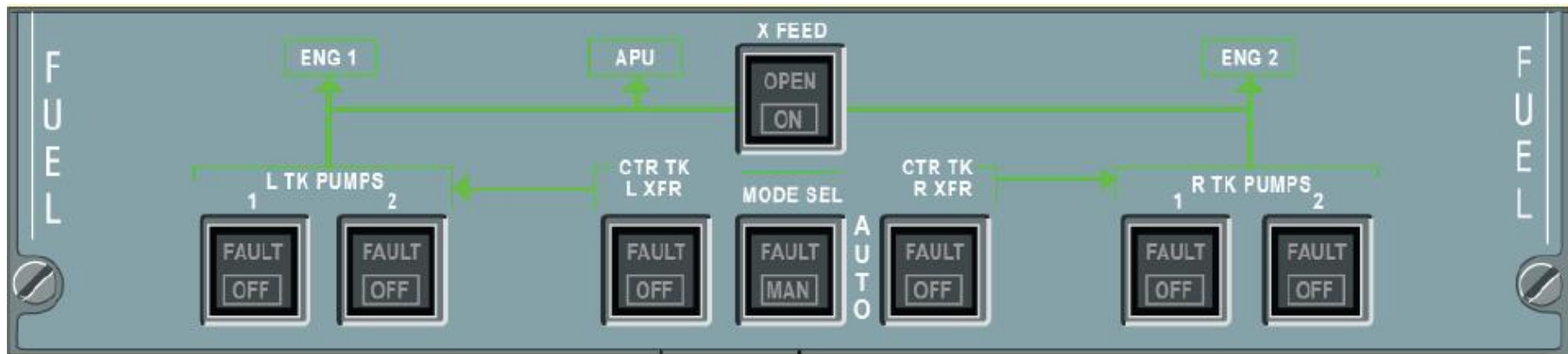
The FAULT light comes on amber associated with ECAM caution in case of associated wing tank overflow.

### MODE SELECTOR

The MODE SEL pushbutton sets the centre tank transfer valves to automatic or manual mode.

The FAULT light comes on amber associated with an ECAM caution in case of automatic transfer failure.







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## ENGINE FUEL FEED SYSTEM



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## ENGINE FUEL FEED SYSTEM

### GENERAL

The main fuel pump system supplies fuel from the wing fuel tanks to the engines. Each wing tank has two centrifugal booster pumps.

### CROSSFEED VALVE

The crossfeed valve divides the engine fuel feed system into two independent systems.

The valve is in the centre tank and is usually in the closed position.

In this position, it divides the main fuel pump system into two parts, one part for each engine.

When the crossfeed valve is open, either tank can supply fuel to either engine.

The valve is electrically controlled and operated by two DC motors.

### MAIN FUEL PUMPS

The main pumps are driven by a 3-phase 115V AC motor.

The two pumps in each wing tank are supplied by different electrical power supply bus bars.

When it is in operation, each main pump may supply fuel to:

its related engine,

Centre Tank (CT) transfer system,

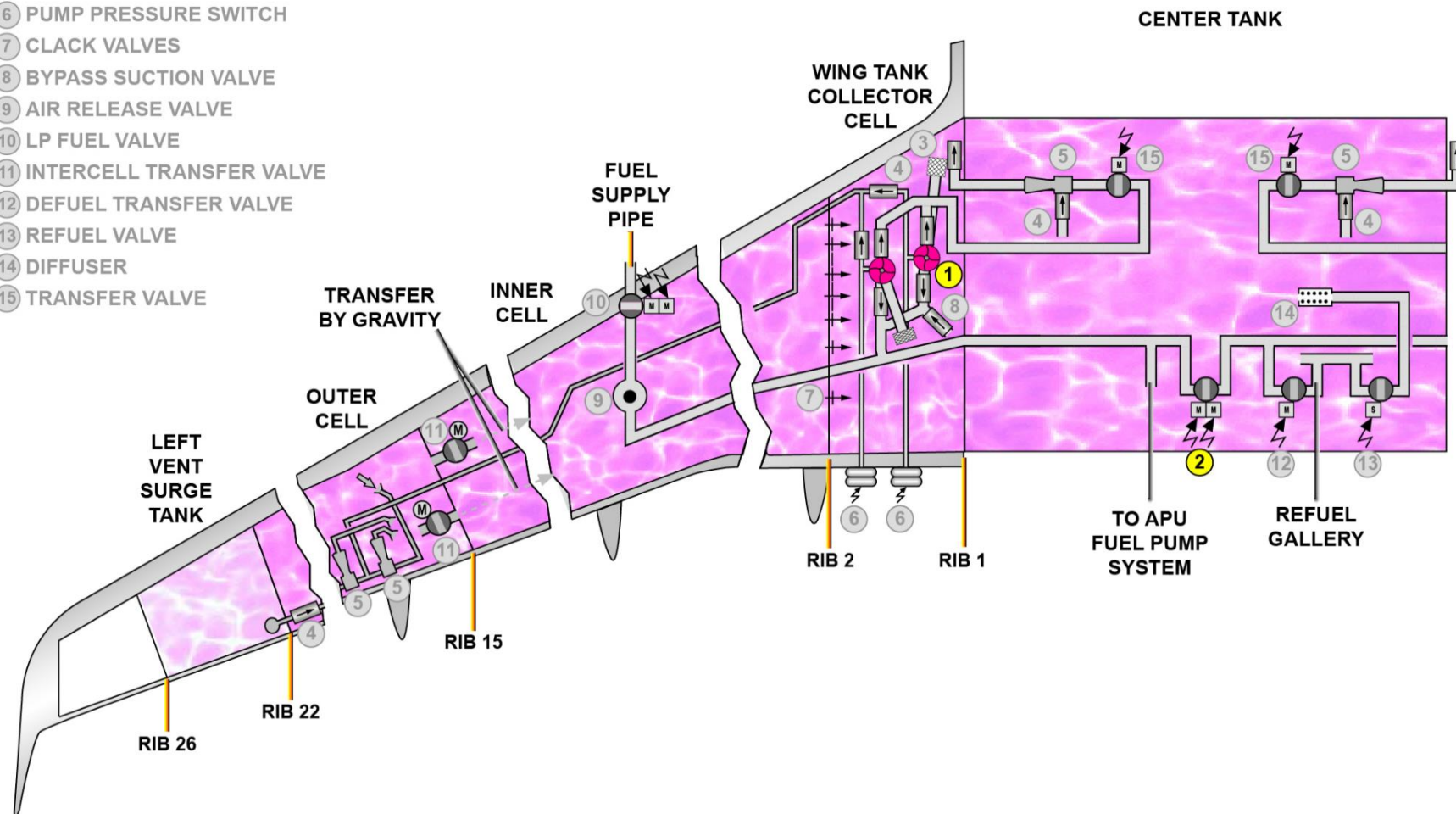
the fuel recirculation cooling system,

the crossfeed system,

the refuel/defuel system.



- ① MAIN FUEL PUMP & MAIN FUEL PUMP CANISTER
- ② CROSSFEED VALVE
- ③ STRAINER
- ④ CHECK VALVE
- ⑤ JET PUMP
- ⑥ PUMP PRESSURE SWITCH
- ⑦ CLACK VALVES
- ⑧ BYPASS SUCTION VALVE
- ⑨ AIR RELEASE VALVE
- ⑩ LP FUEL VALVE
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- ⑬ REFUEL VALVE
- ⑭ DIFFUSER
- ⑮ TRANSFER VALVE





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## FUEL PUMP CANISTER

The canister lets you replace the fuel pump without draining fuel.

The fuel pump element is in a canister attached to the bottom skin of the wing, with an inlet connected to a fuel strainer.

The canister has different outlets:

- one upper outlet is connected to the engine feed line and contains an internal flap-type check valve,

- the other upper outlet is connected to its respective Centre Tank Transfer Valve,

- a smaller outlet is connected to the scavenge jet pumps and the fuel pump pressure switch.

## CENTRE TANK JET PUMP OPERATION

Whenever the centre tank jet pump is activated, as controlled by A/C logic, the centre tank supplies fuel to its respective Wing Tank inner cell.

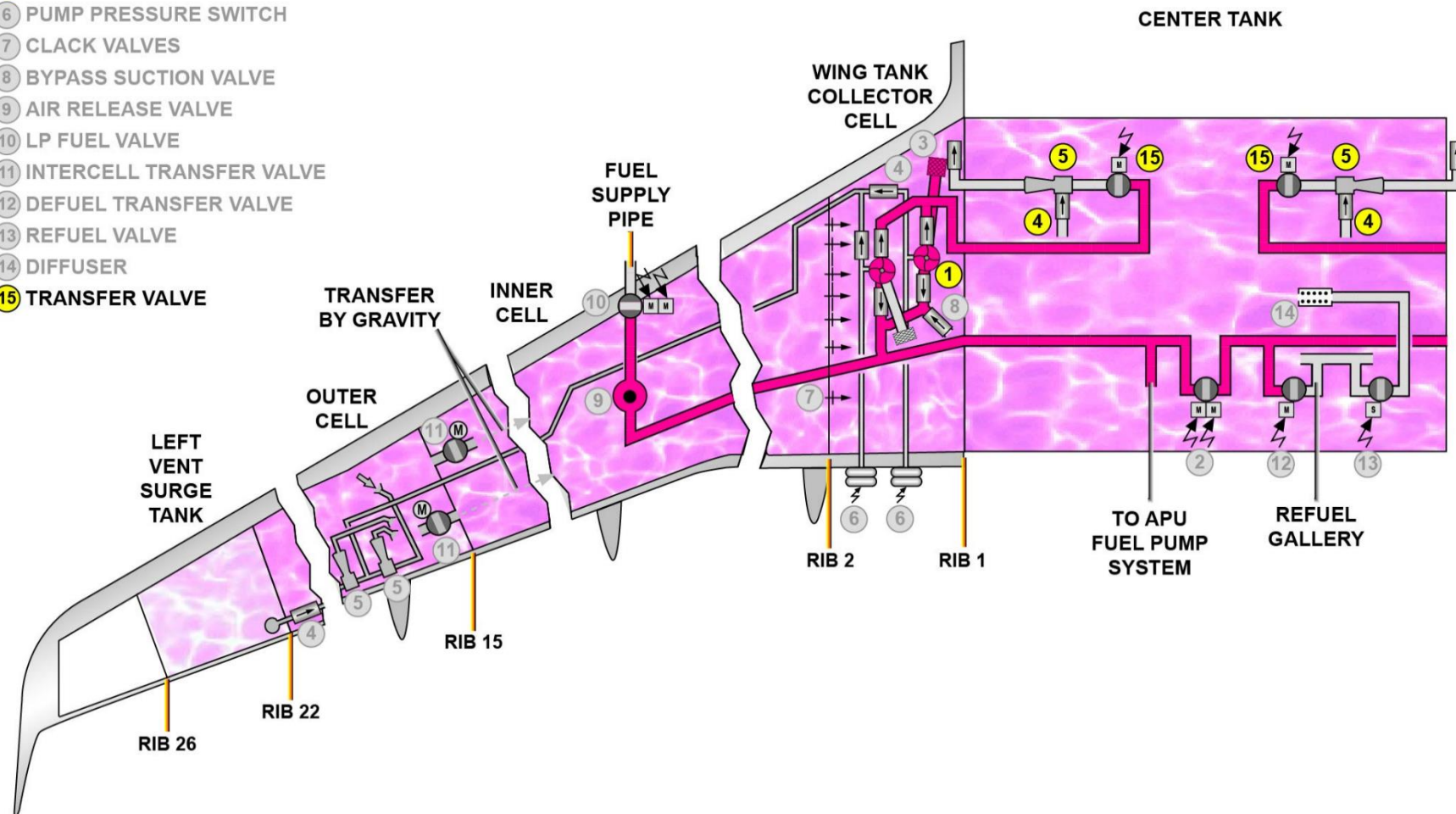
When a fuel jet pump is not in operation, the check valves prevent any reverse flow of fuel through the jet pump.

The centre fuel jet pump element is located inside the centre tank, with a lower inlet connected to a fuel strainer.

The CT transfer valve is located to the centre tank bottom skin with a connection to the transfer valve actuator, located inside the blue or yellow hydraulic compartment.



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## **AIR RELEASE VALVE**

The air release valve releases air, trapped in the engine fuel feed line, into the wing tank.

The air release valve is installed at the highest point between the pump and the LP fuel valve.

## **LOW PRESSURE (LP) FUEL VALVE**

The LP fuel valve is installed on the wing tank front spar, in the feed line to the engine.

Each LP fuel valve has an actuator with 2 electric motors.

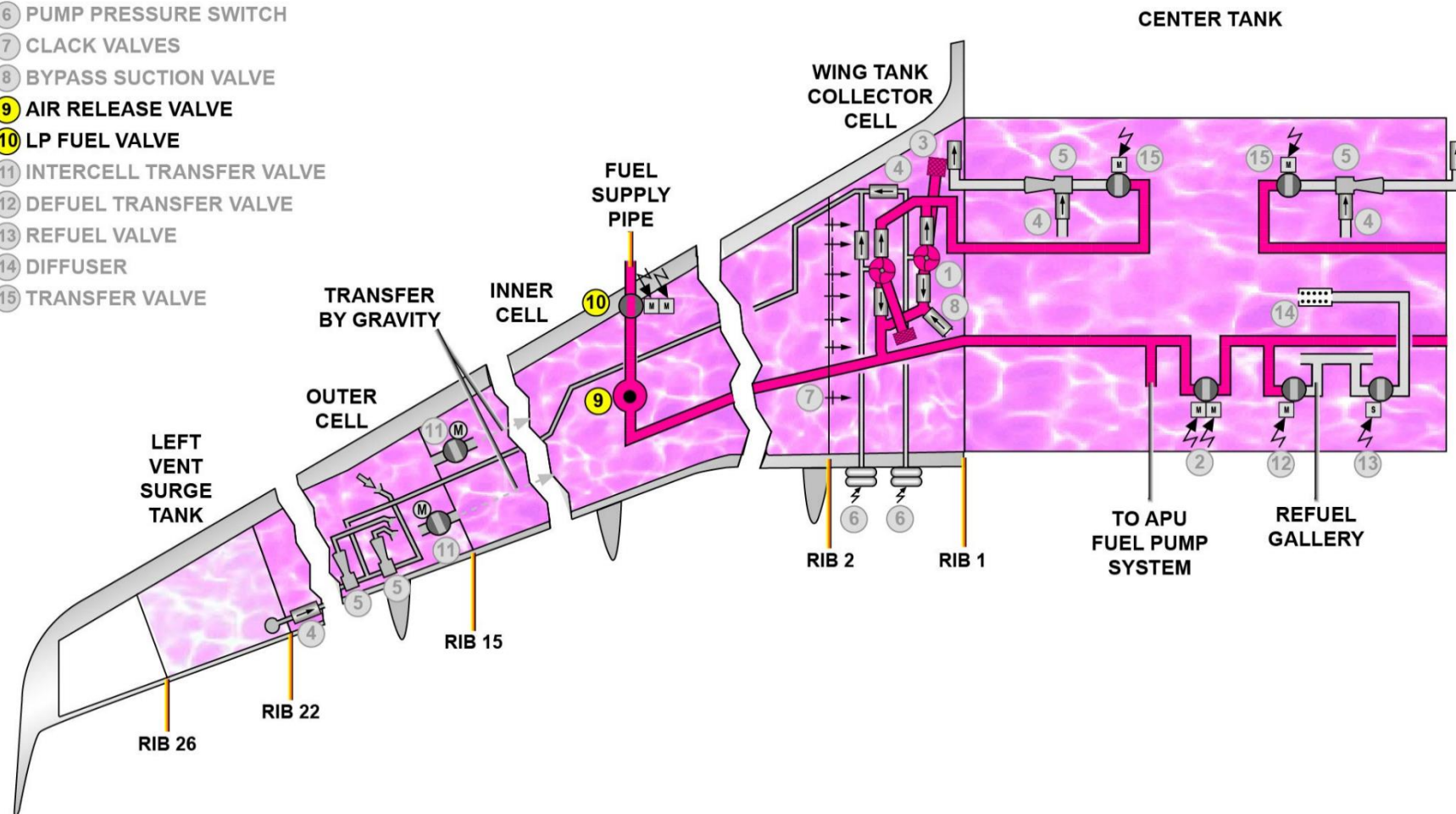
Each one of them is supplied by different 28 V DC power sources.

The LP fuel valve isolates the engine fuel feed supply at engine shutdown, i.e. normal procedure, or in case of emergency, i.e. engine fire procedure.





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## WING TANK PUMP OPERATION AND TRANSFER VALVE SUPPLY

The centre tank is emptied first by transferring fuel to the respective inner cell.

The wing tank pumps are connected to the CT XFER VALVE in order to supply the CT Jet Pump with motive fuel pressure.

As soon as the under full level sensor is dry, the transfer valve opens, and fuel is transferred into the wing tank inner cell.

When the Full Level sensor becomes wet, the transfer valve closes and the transfer stops. Left and right CT transfer is controlled independently.

When the low-level sensor inside the CT becomes dry, the CT XFR VALVE will be closed after 5 min.

The pumps in each wing tank are located in the lowest area of the inner cell in a collector cell.

Seven check valves at the bottom of rib 2 allow the fuel to flow into the collector cell but prevent the fuel from flowing back during wing down manoeuvres of the aircraft.

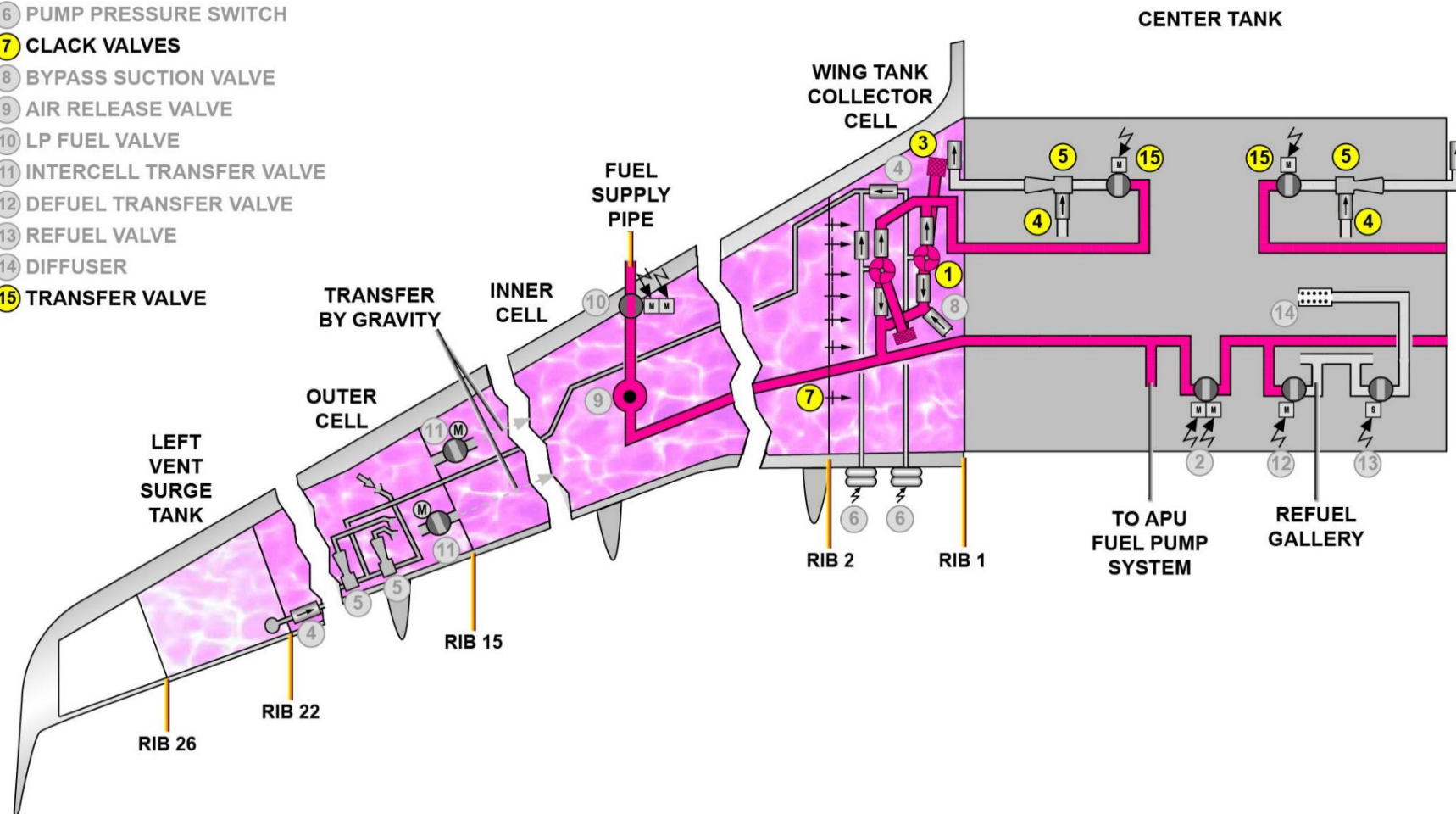
Thereby the fuel pumps are sufficiently immersed in fuel even if the fuel level in the tank is low.

Each wing tank collector cell has:

- two fuel pumps contained in their related canisters,
- two fuel strainers,
- a suction valve,
- two check valves.



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### **WING TANK PUMP PRESSURE SWITCHES/BYPASS SUCTION VALVE**

The pressure switches monitor the output of the pumps through a pressure pipe.

If the pressure from the main pump decreases to less than 6 psi (0.41 bars) the pressure switch sends a warning signal to the ECAM system.

### **BYPASS SUCTION VALVE**

A bypass suction valve is installed on the engine feed line, downstream of the main pumps.

If both wing tank pumps fail with the crossfeed valve closed, the bypass suction valve lets fuel be sucked from the wing tank by the engine fuel pump system and thus engine supply is done by "gravity".



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⑦ CLACK VALVES

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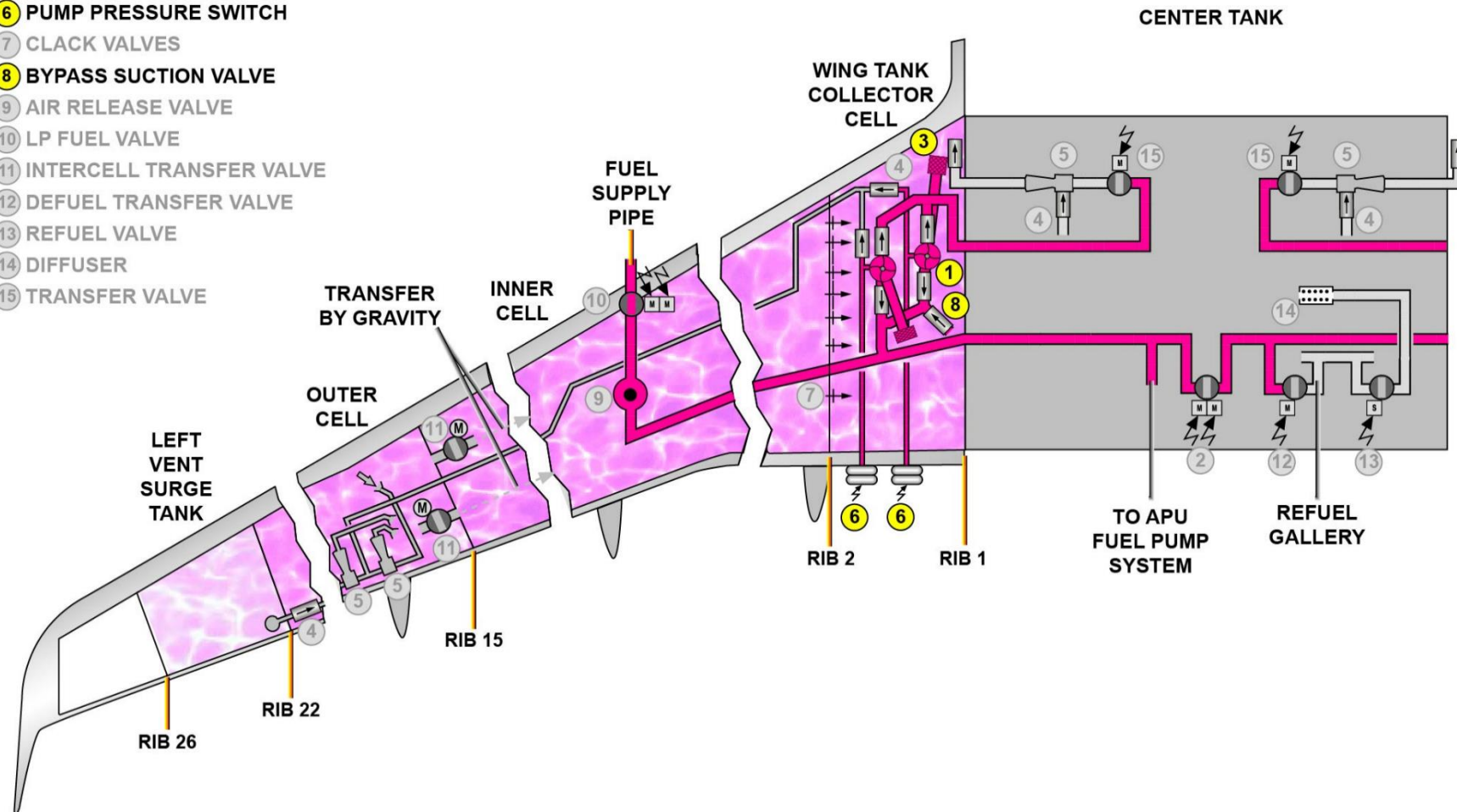
⑪ INTERCELL TRANSFER VALVE

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## WING SCAVENGE JET PUMPS

One of the two scavenge jet pumps in the outer cells removes fuel out of the vent surge tank to the rear intercell transfer valve.

A Check valve, in the line between the vent surge tank, combined with this jet pump, makes sure that fuel cannot enter the vent surge tank via the pump if the wing tank pumps are off.

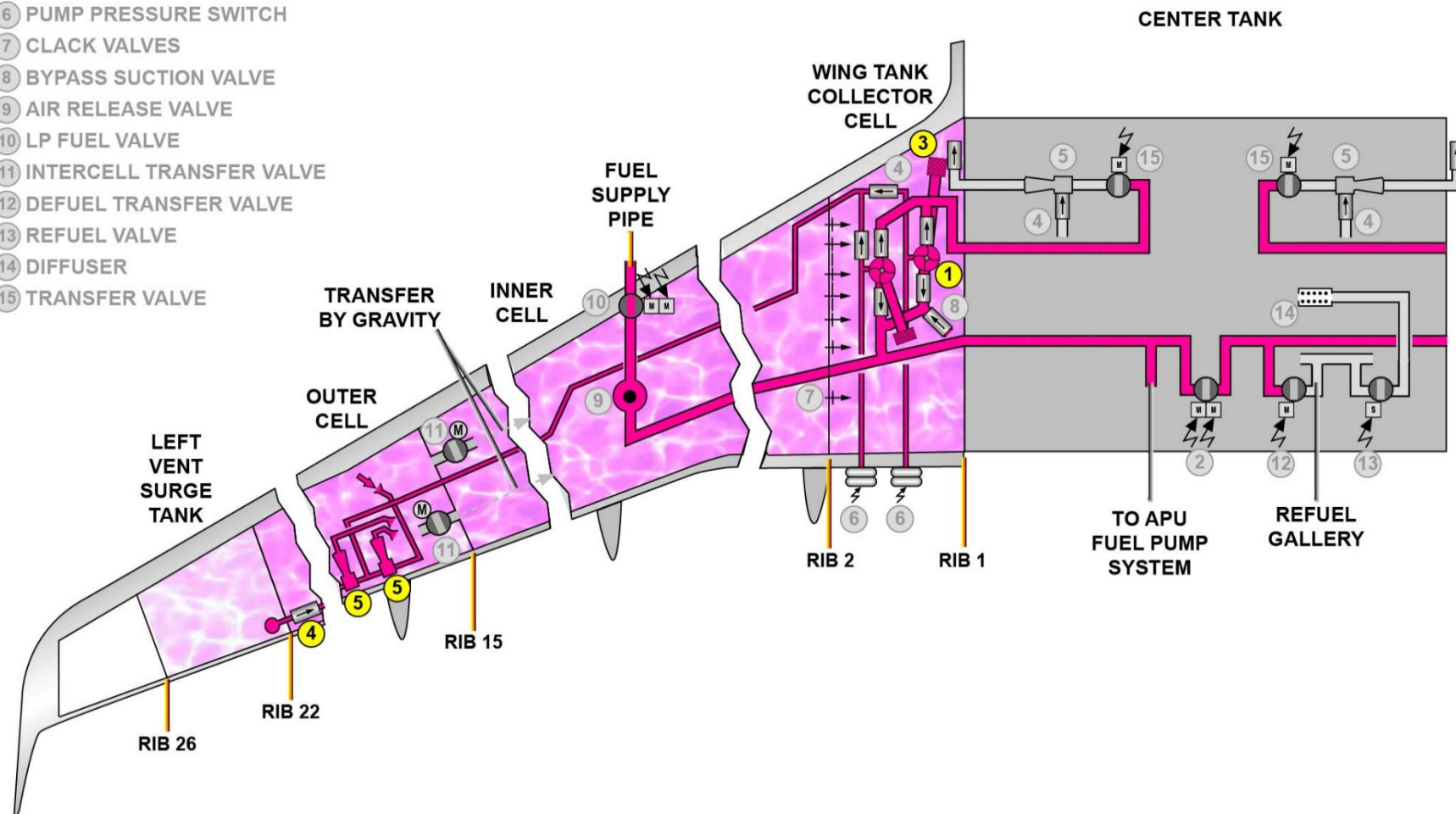
The other scavenge jet pump mixes fuel and water within the outer cell.

Each scavenge jet pump receives its motive fuel pressure from the wing tank pumps, if running.





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## INTERCELL TRANSFER VALVES

The outer cell fuel flows to the inner cell by gravity through the intercell transfer valves, which open when the inner cell fuel quantity decreases to a given low level value.

Each valve is operated by an electrical motor.

The intercell transfer valve motor is attached at the rear or front wing spar while the valve body is inside the tank at Rib 15.

The connection between the motor and the valve body is achieved through a rotating shaft.

When controlled to open the valves are latched open and close again on ground during next refuelling operation or electrical power up of the fuel system.





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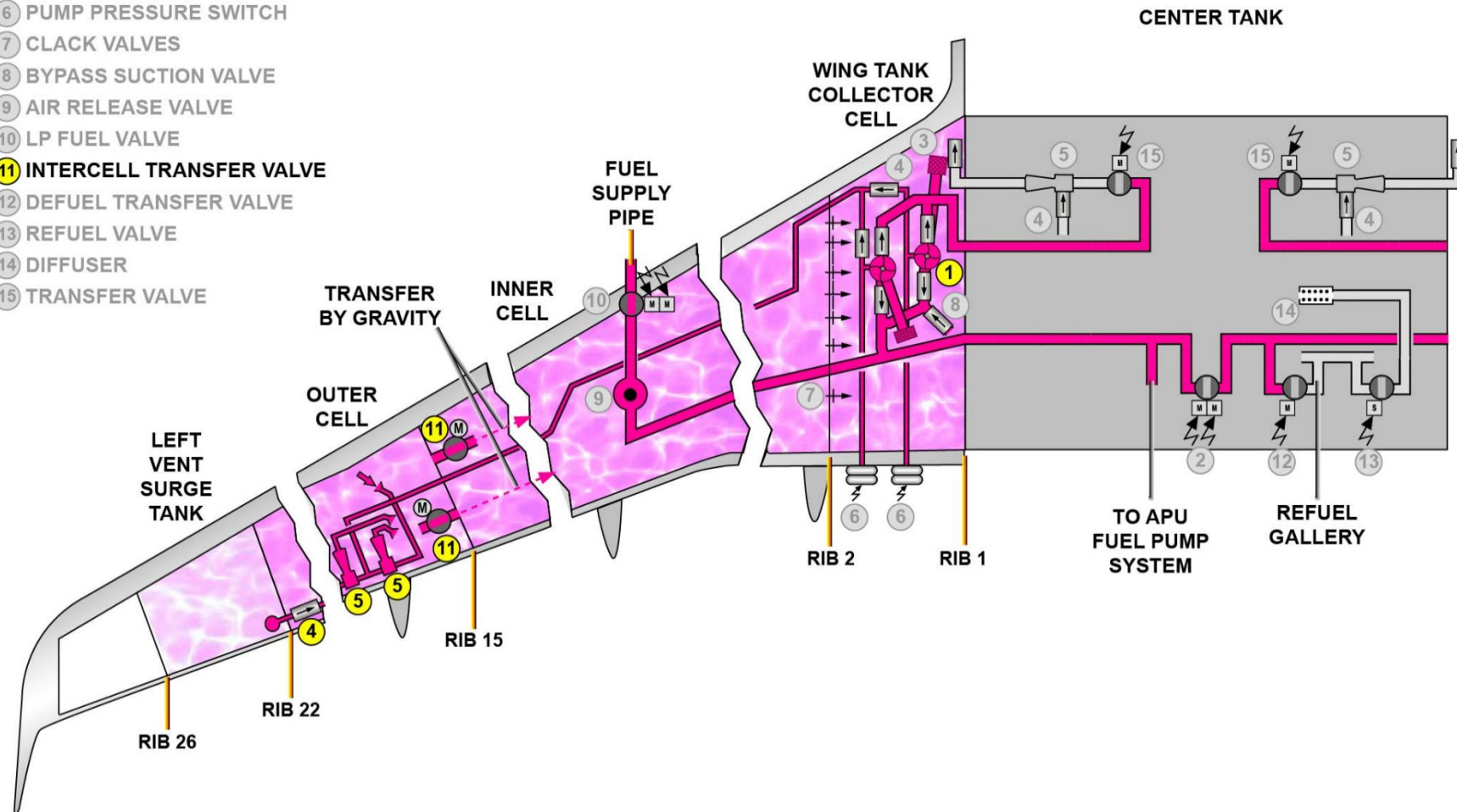
⑪ INTERCELL TRANSFER VALVE

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## **DEFUEL TRANSFER VALVE**

The defuel transfer valve is electrically controlled and operated by one DC motor.

The control is done through the Refuel / Defuel control panel in the belly fairing.

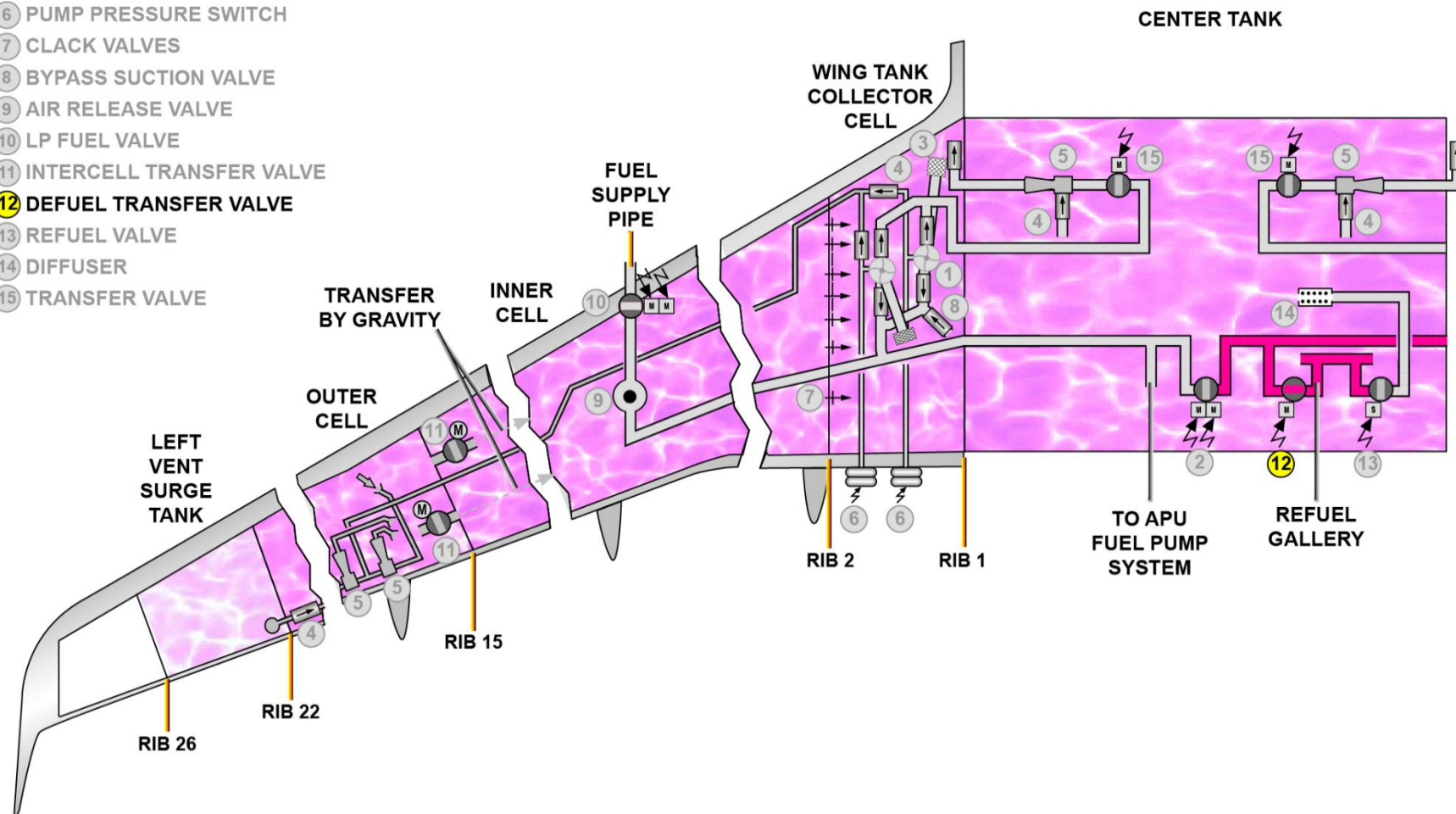
The valve can only be controlled to open on ground.

When open, the valve interconnects the right-hand engine supply line with the Refuel Gallery and allows fuel transfers and defueling operations.

The crossfeed valve needs to be controlled to open from the cockpit overhead panel, if a connection to the left hand engine supply line is necessary.



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## IDG COOLING SYSTEM



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## **FUEL IDG COOLING SYSTEM (A319/A320 PW1100G)**

### **PRINCIPLE**

The temperature of the Integrated Drive Generator (IDG) oil is decreased by fuel through a recirculation system.

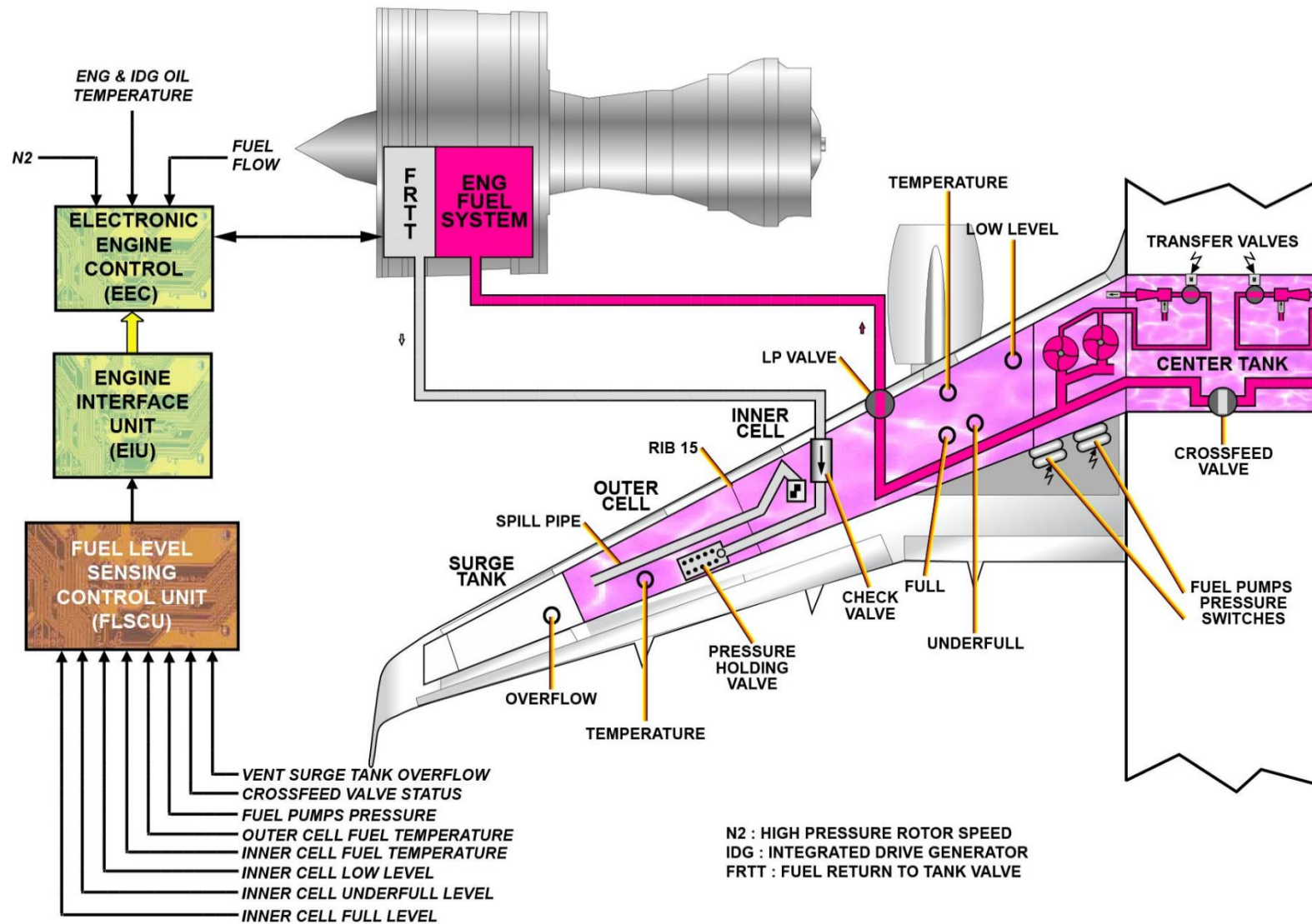
Some of the fuel that supplies the engines is used to decrease the temperature of the IDG oil.

A Fuel Return To Tank valve (FRTT) lets the hot fuel return to the outer cell. The FRTT opens the fuel flow back to the aircraft tank in special engine configurations (N2, fuel flow...).

The return valve mixes the hot fuel with cold fuel from the Low Pressure (LP) fuel pump to keep the temperature of the returned fuel less than 100°C (212°F).

The Fuel Level Sensing Control Unit (FLSCU) 1 and the Engine Electronic Control (EEC) 1 control the recirculation system in the left wing. FLSCU 2 and EEC 2 control the right-wing system.







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## FUEL RETURN

The recirculated fuel is sent to the outer cell through a check valve and a pressure-holding valve to not let the fuel get to boiling temperature.

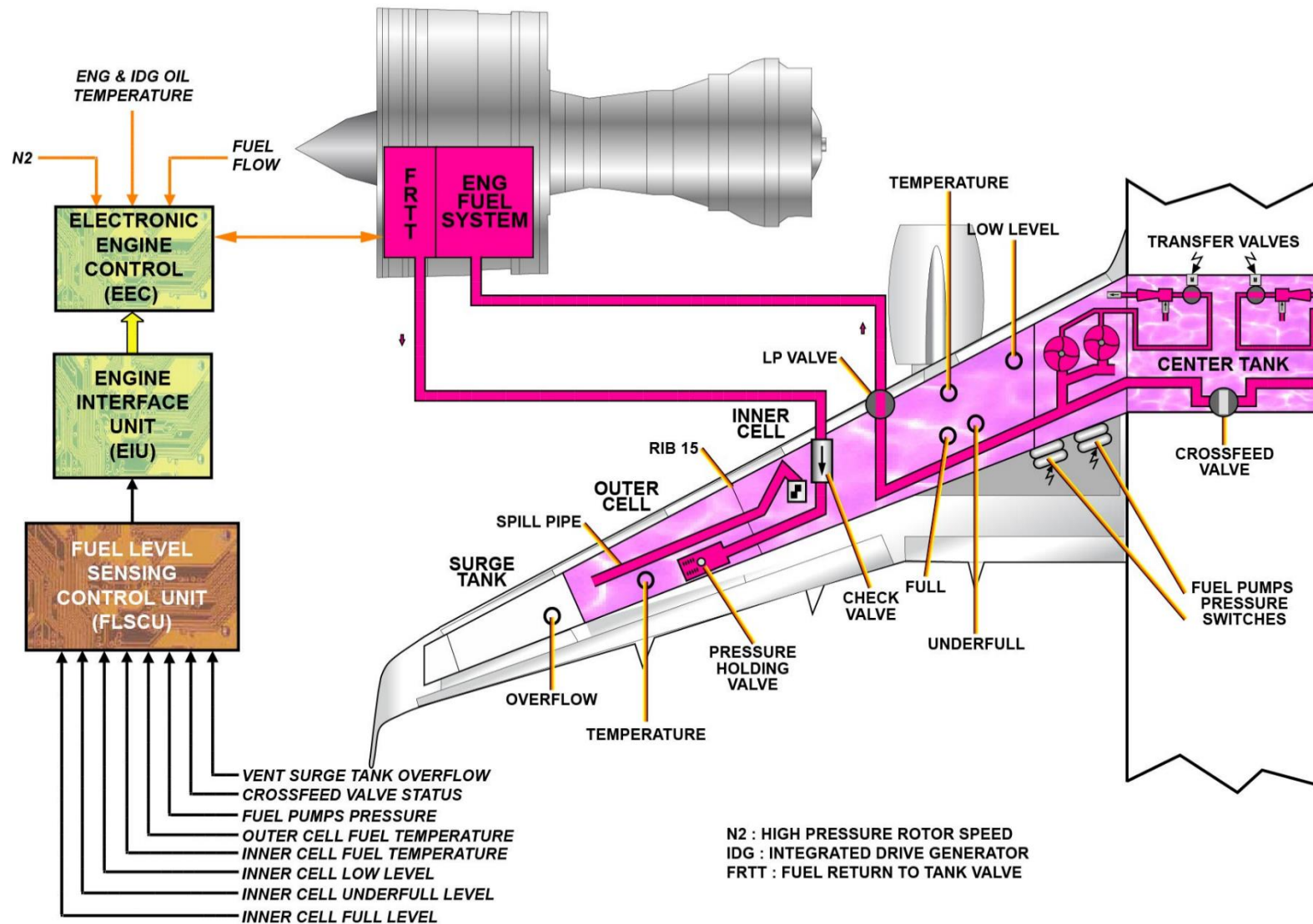
The pressure-holding valve keeps a pressure of 15.5 psi in the return line.

If the pressure increases, fuel bleeds through the valve into the outer cell.

The check valve prevents fuel flow from the wing tank to the engine when the recirculation system is not in operation.

Note: When the outer cell is full, the fuel overflows into the inner cell through a spill pipe.







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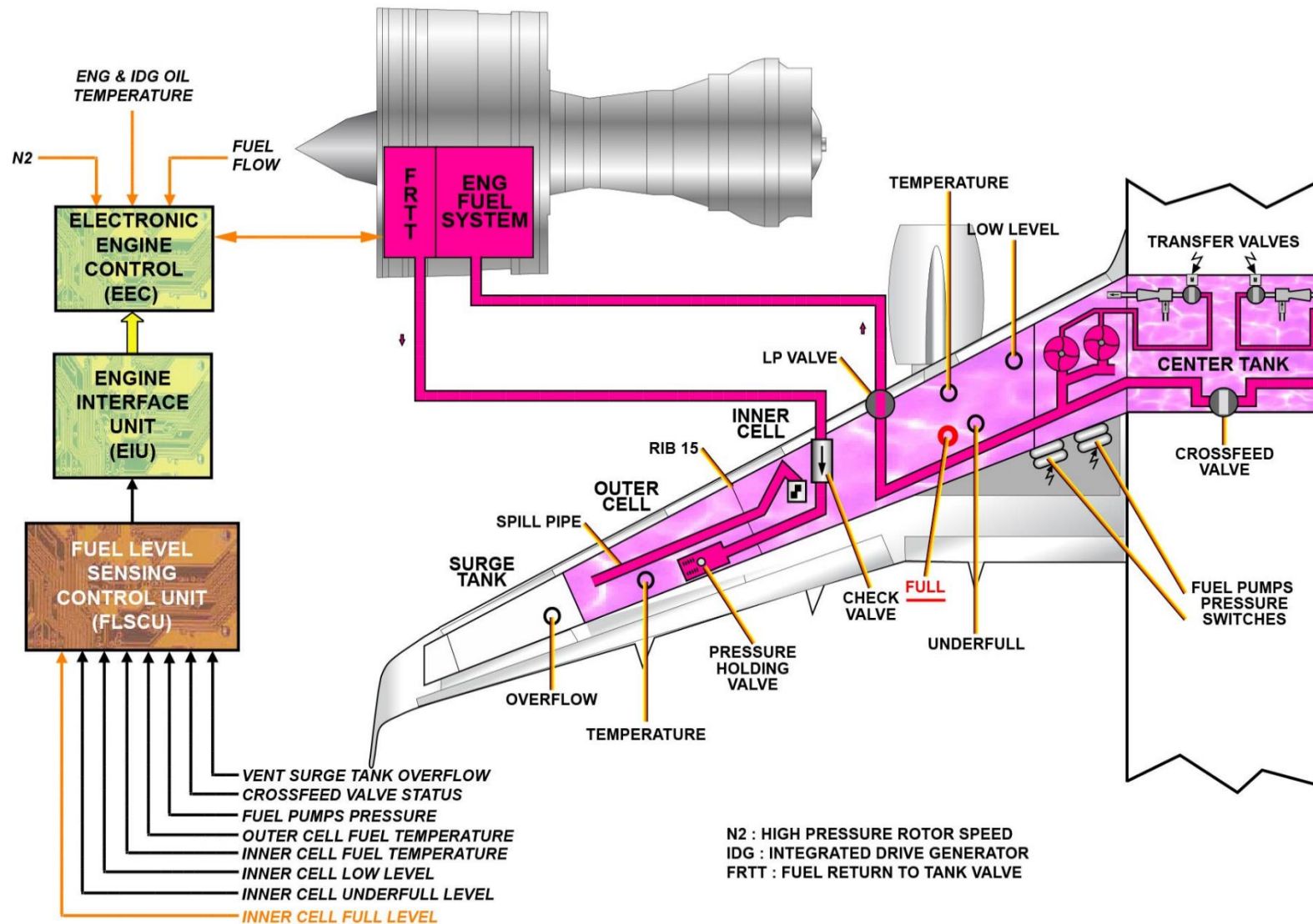
## **PUMP LOGIC**

While fuel is supplied from the centre tank, the wing tanks will stay full and will possibly overfill because the returned fuel is supplied to the wing tanks.

If this occurs, the centre tank transfer valves close when the inner cell gets to the FULL level sensor.

The wing tank pumps will supply the fuel to the engine until approximately 500 kg (1100 lbs) of fuel are used and the UNDERFULL sensor is reached.

The logic circuit then open the centre tank transfer valves again.





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## FUEL RETURN TO TANK VALVE CLOSURE

### OVERFLOW

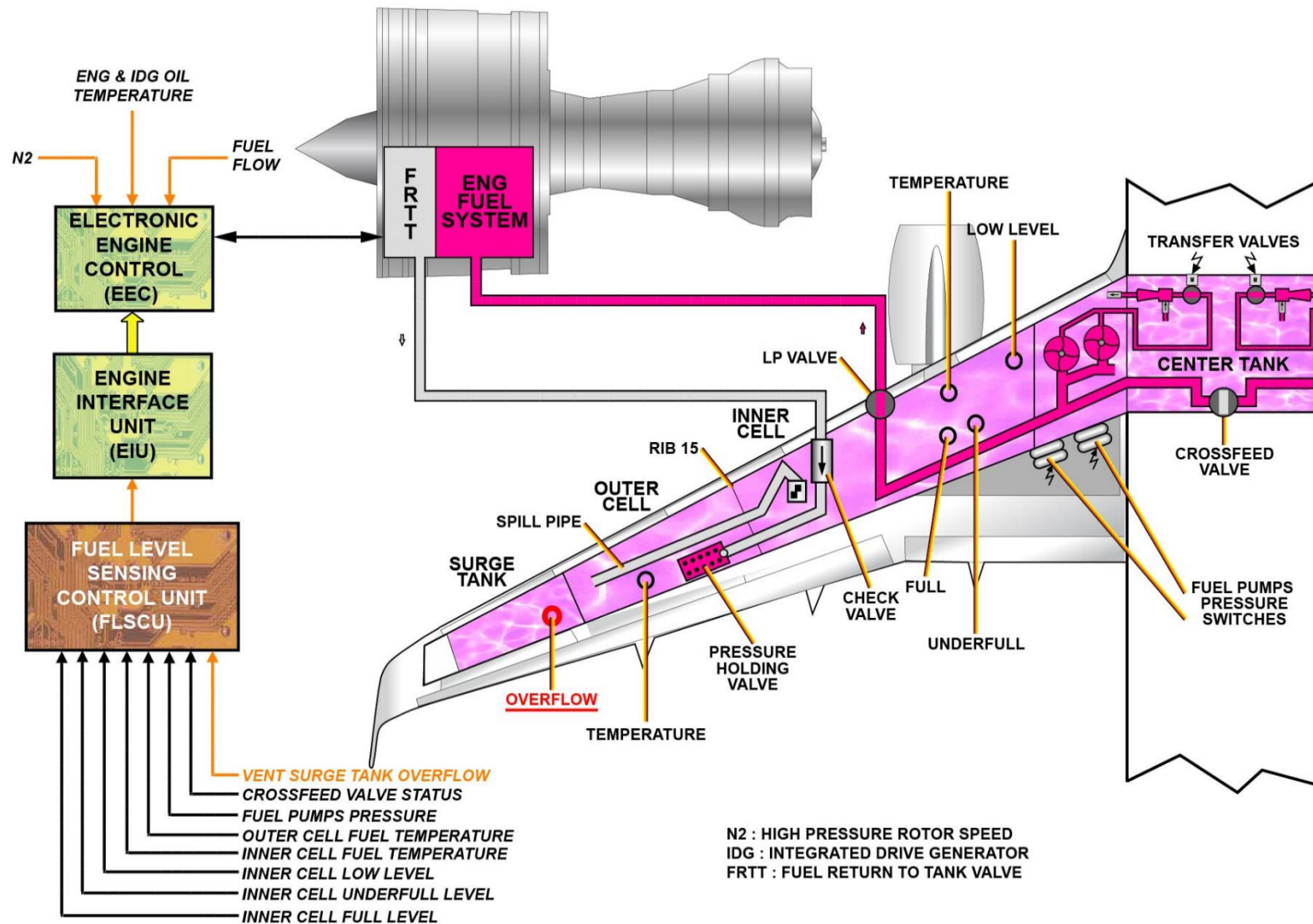
The FRTT closes if the centre tank transfer valves do not obey the logic signals of the full level sensors.

This causes the wing tank to overflow through the tank ventilation system into the vent surge tank.

The overflow sensor sends an electrical signal to the FLSCU.

The FLSCU sends a closure signal to the EEC through the Engine Interface Unit (EIU).

The EEC closes the FRTT and stops the fuel supply back to the outer cell.





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## **FUEL RETURN TO TANK VALVE CLOSURE**

### **OUTER CELL HIGH TEMPERATURE**

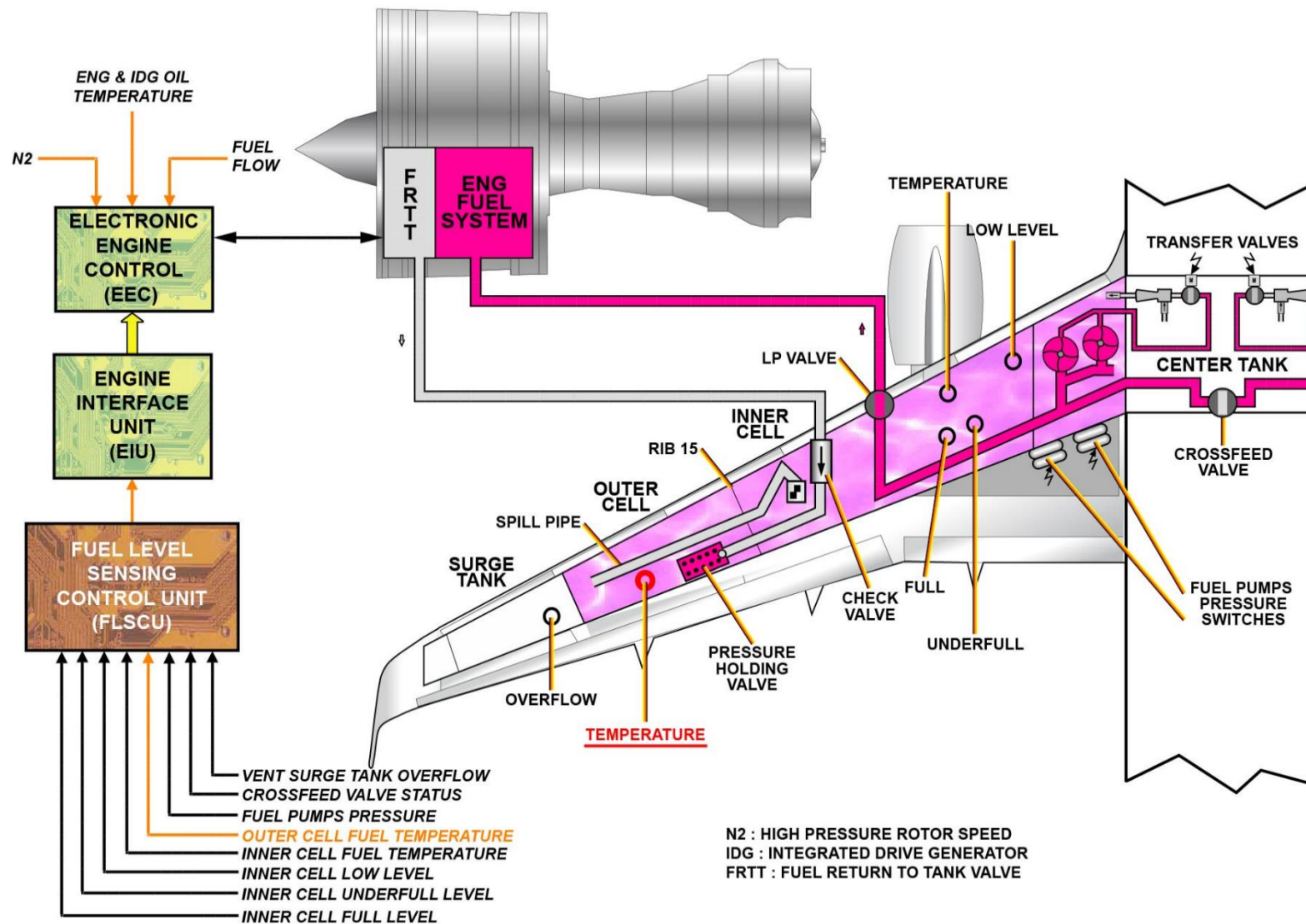
The FRTT closes if the fuel temperature is too high in the outer cell, i.e. 55°C (131°F).

Because the returned fuel from the engine is hot, the FLSCU prevents an overtemperature in the wing tanks.

The FLSCU sends a closure signal to the EEC through the EIU.

The EEC closes the FRTT and stops the fuel supply back to the outer cell.







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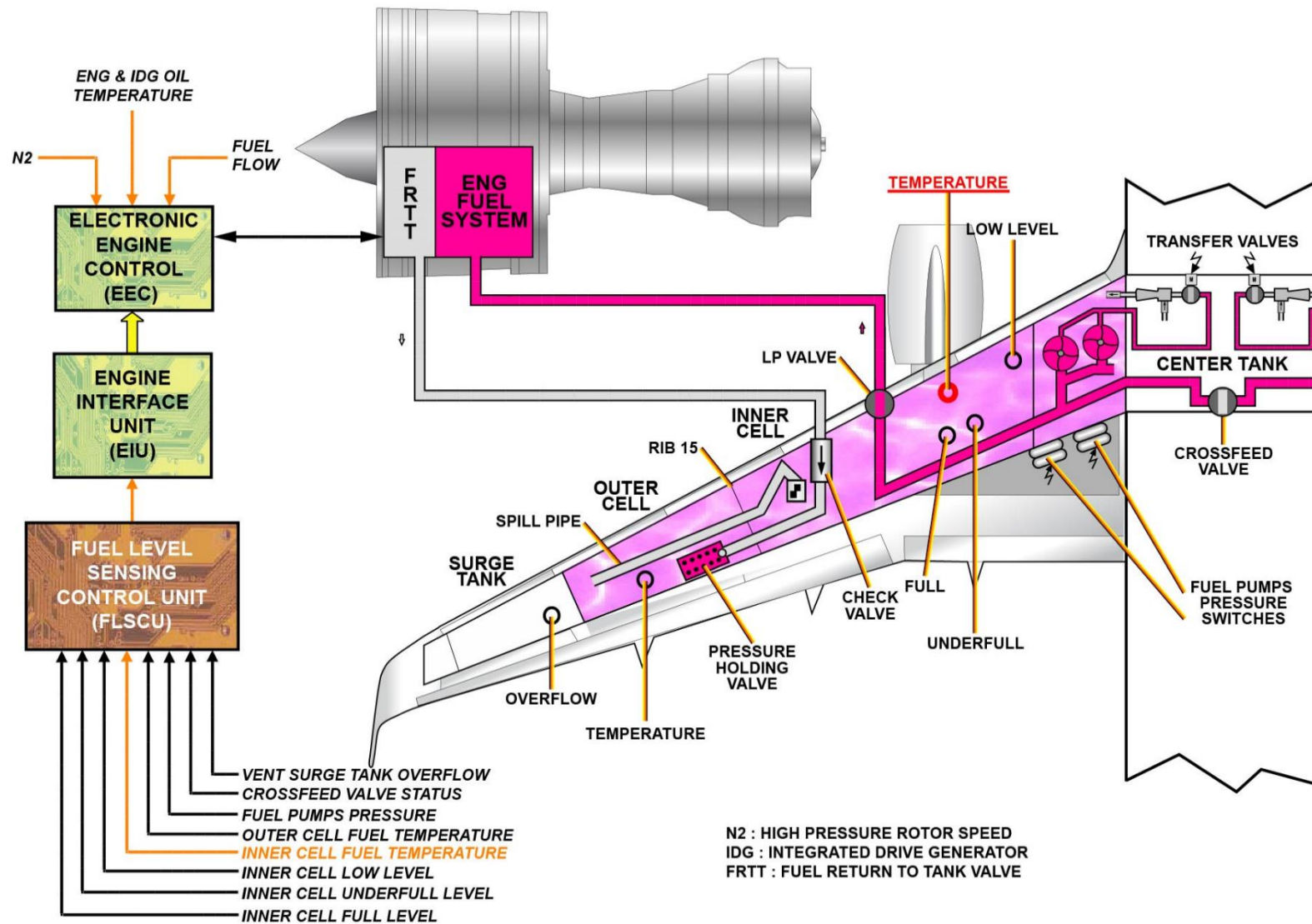
**FUEL RETURN TO TANK VALVE CLOSURE (continued)****INNER CELL HIGH TEMPERATURE**

The FRTT closes if the fuel temperature in the inner cell is too high, i.e. 52.5°C (126.5°F).

Thus, a large volume of high-temperature fuel will not go into the inner cell if the intercell valve opens.

This also keeps the fuel temperature at an acceptable level if a tank rupture occurs.







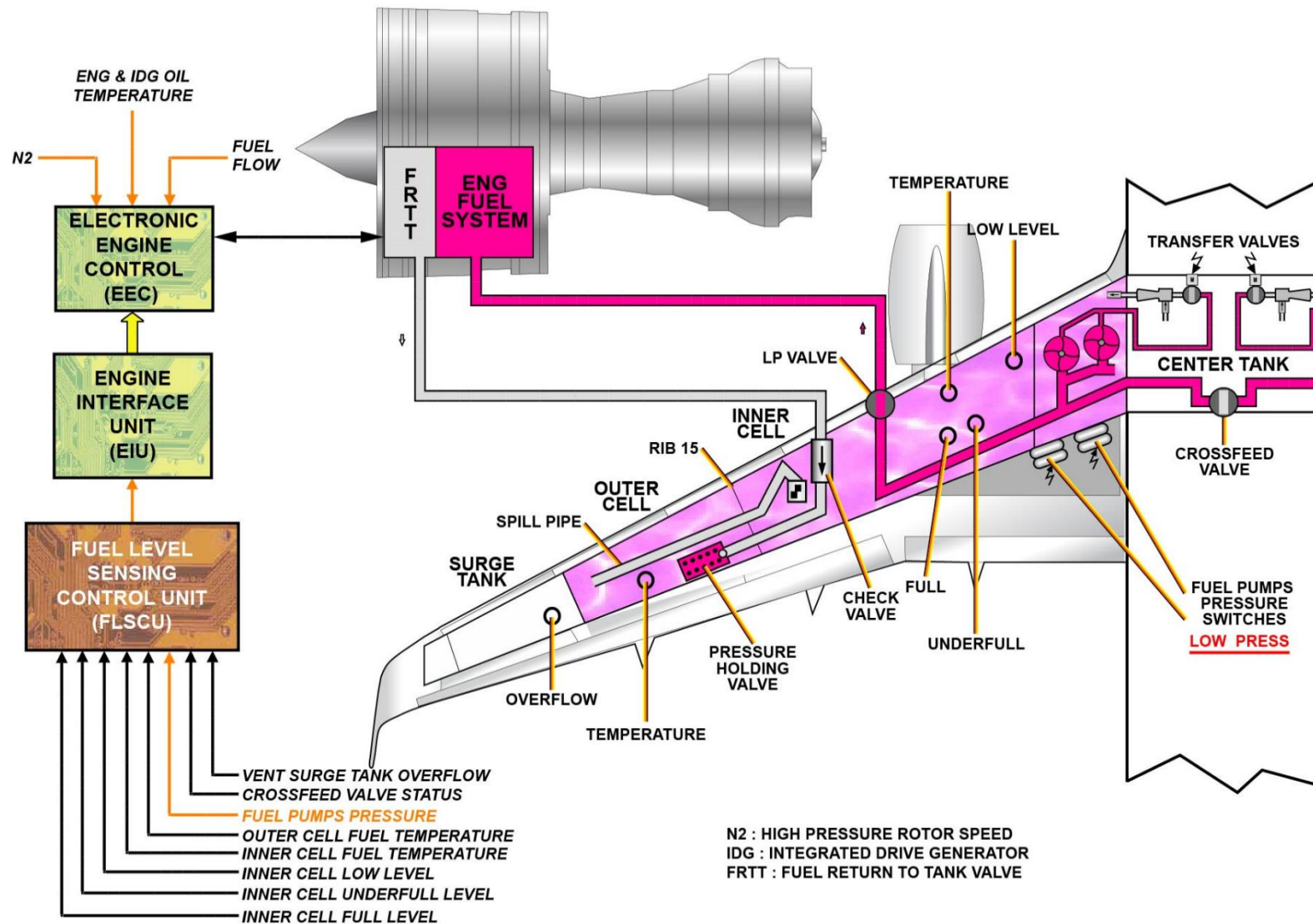
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## **FUEL RETURN TO TANK VALVE CLOSURE (continued)**

### **PUMP PRESSURE LOSS**

The FRTT closes if a fuel pump Low Pressure (LP) is sensed by all pump pressure switches of one wing for the related engine when the crossfeed valve is closed, or if a fuel pump LP is sensed by all pump pressure switches of the two wings when the crossfeed valve is open.

This is to stop the return fuel flow during engine gravity feeding. LP is sensed by the pump LP switch and a signal is sent to the FLSCU.



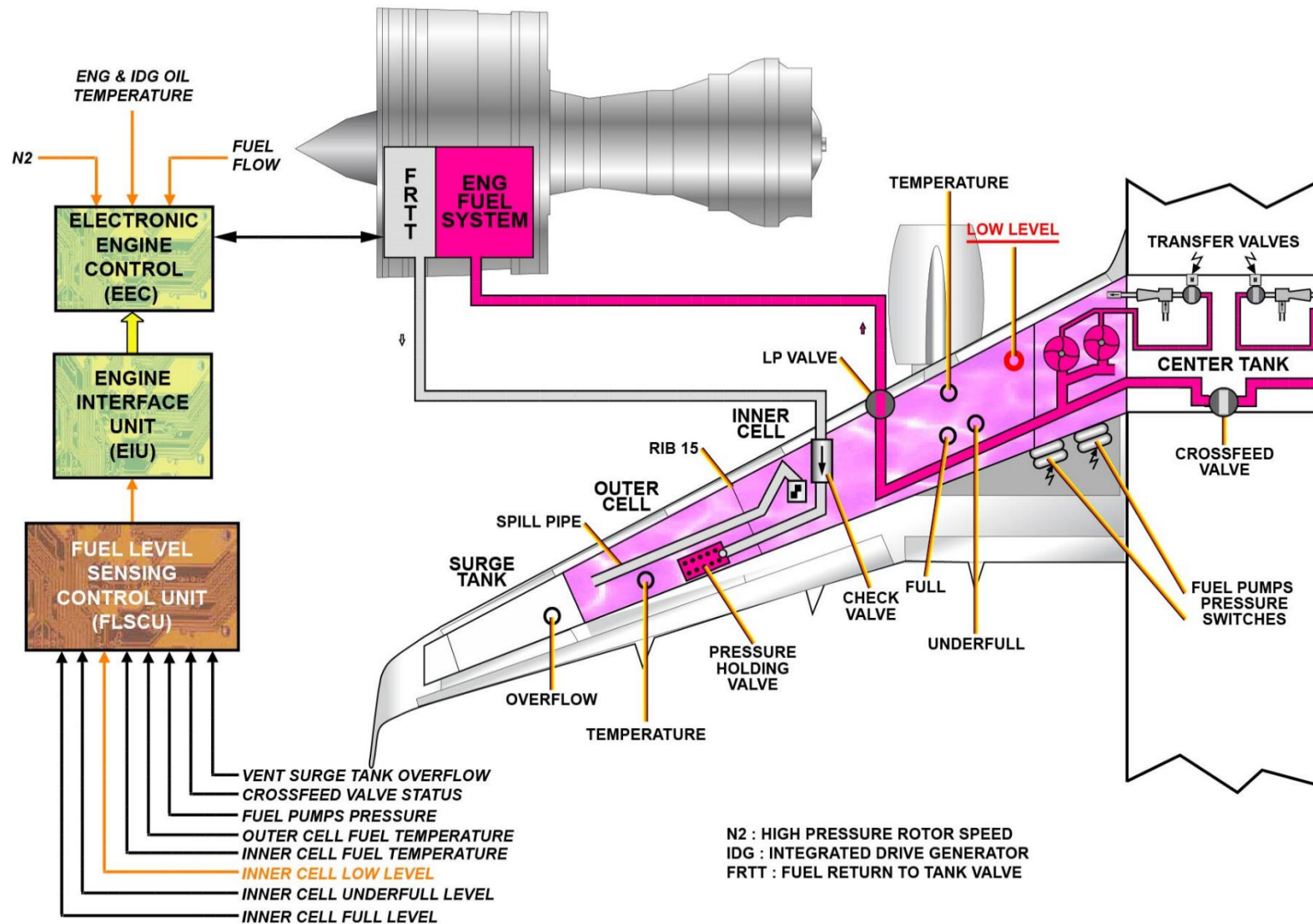


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## **LOW LEVEL**

The FRTT closes when the fuel level in the inner cell decreases to the INNER LOW LEVEL sensor at 280 kg (620 lbs).

NOTE: When the FRTT closes, this decreases the quantity of fuel that cannot be used.





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## A321 FUEL RECIRCULATION SYSTEM

### GENERAL

The recirculation system has for each engine:

- A recirculation pipe

- A cooling fuel pipe

- A piccolo tube

- A recirculation pressure-holding valve

- Three recirculation check valves

The recirculation pipe connects to the Fuel Return Valve (FRV) and the inboard face of rib 16 in the wing tank.

Two holes at the end of the recirculation pipe let the fuel go into the wing tank.

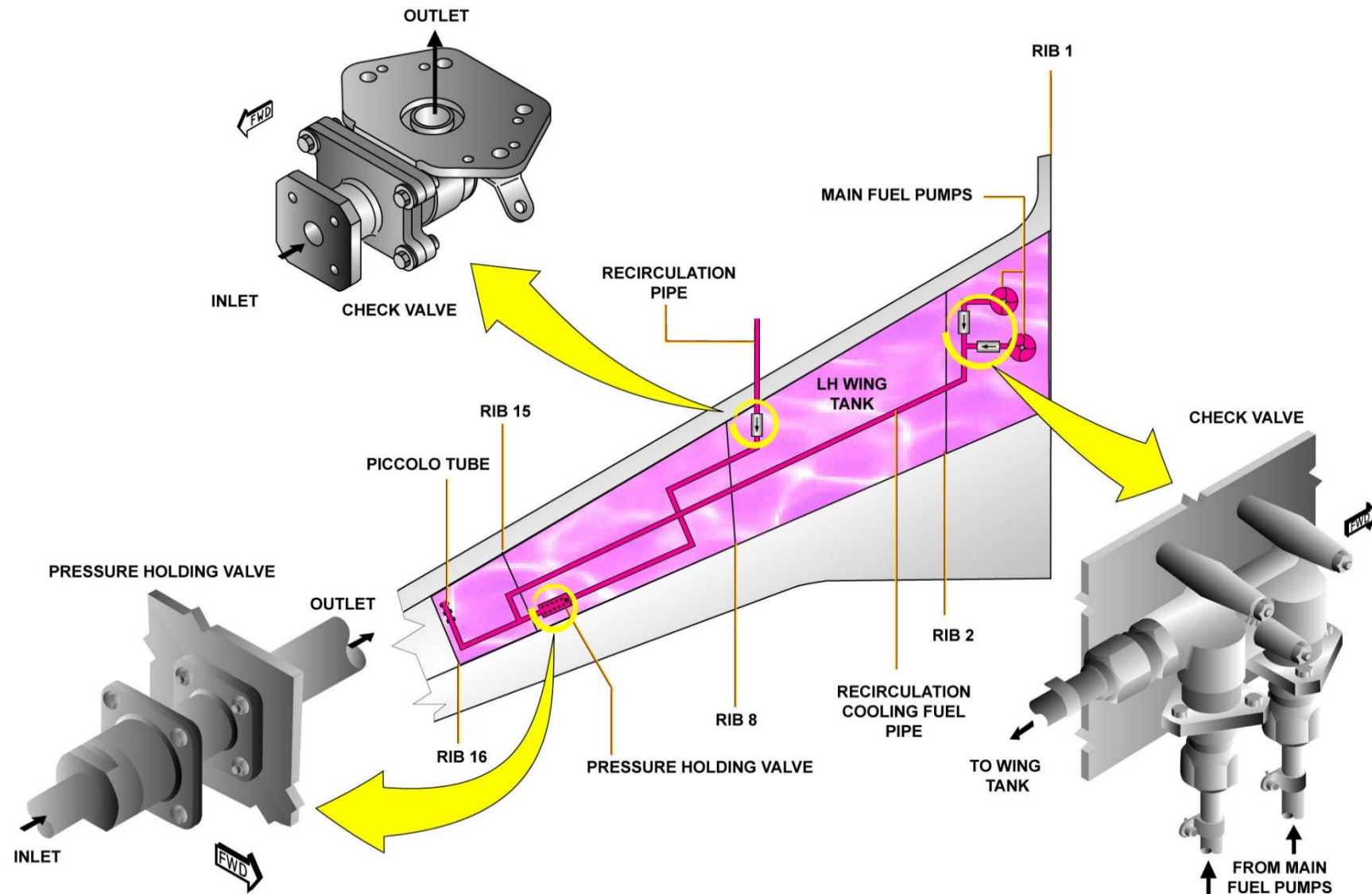
The piccolo tube is attached to the end of the recirculation pipe.

The piccolo tube has six holes that let the fuel go into the wing tank.

The cooling fuel pipe is attached to the recirculation pipe on the outboard face of rib 15.

The main fuel pumps move the fuel through the cooling fuel pipe.









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## FUEL FEED SYSTEM



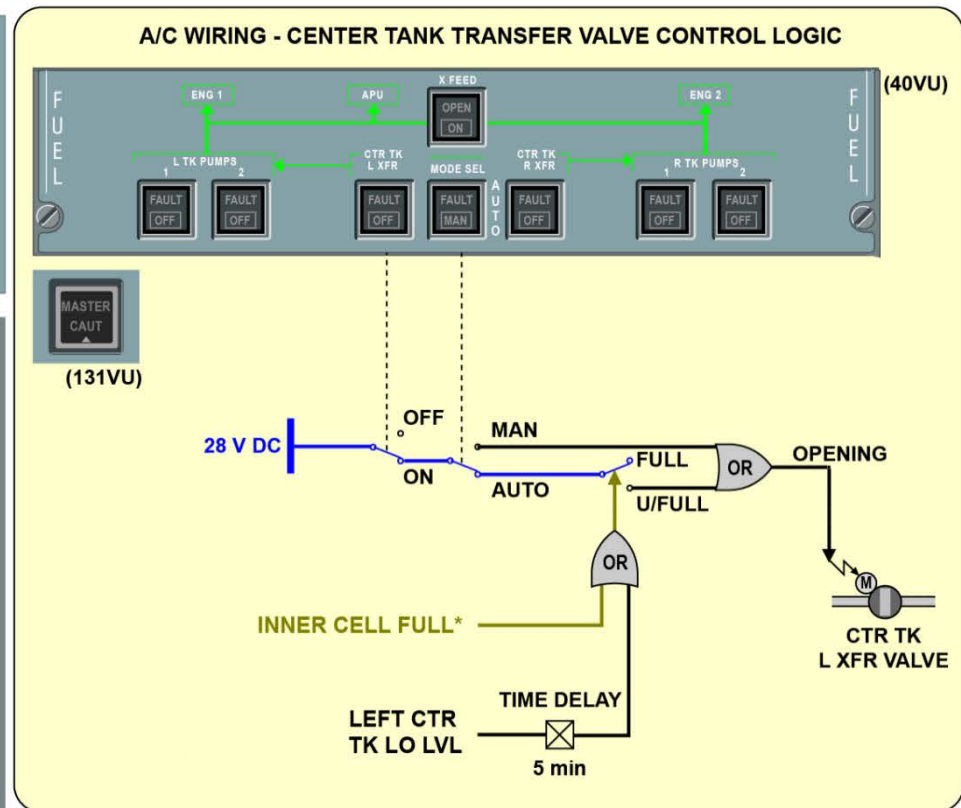
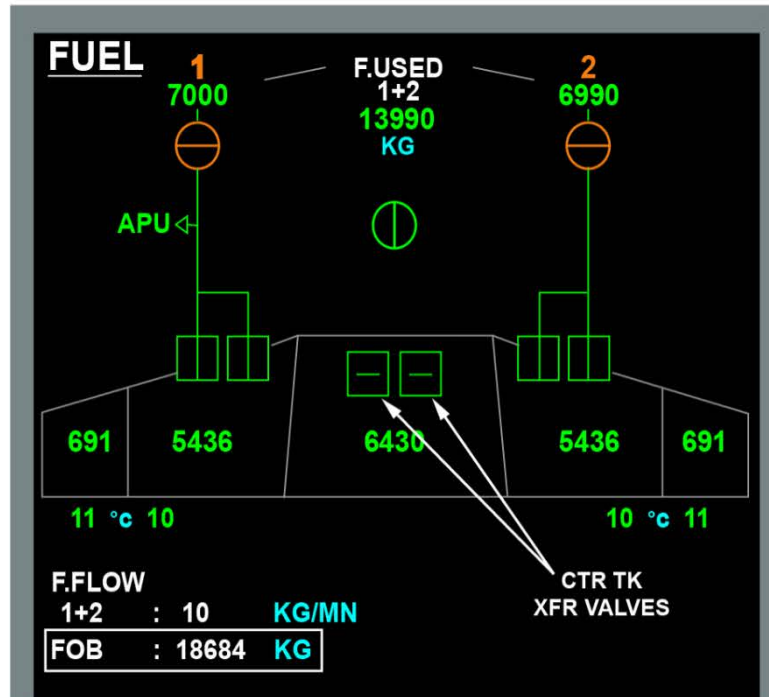
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## **FUEL FEED SYSTEM OPERATION (A319/A320)**

### **AUTO MODE**

The auto mode will cover the following steps:

- normal operation,
- transfer sequence,
- abnormal operation,
- failure conditions.





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## AUTO MODE

### NORMAL OPERATION

A/C configuration before take-off is:

- full load of fuel,

- all 4 wing pumps ON,

- Centre Tank (CTR TK) transfer valve P/BSWs ON,

- MODE SElector P/BSW set to AUTO mode.

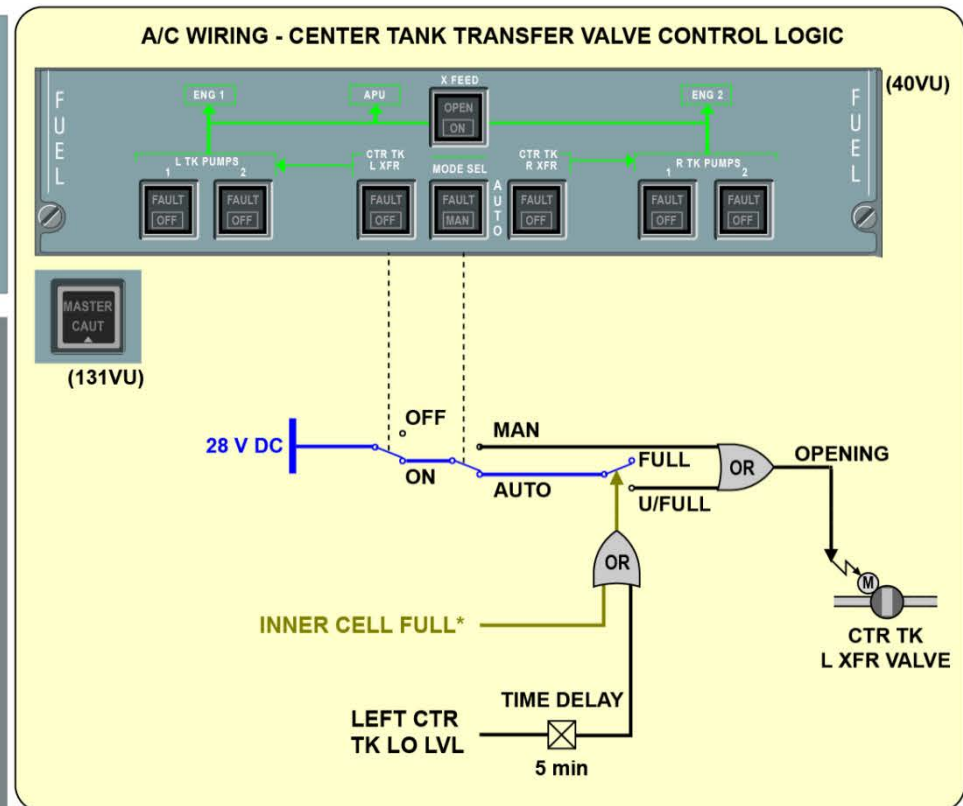
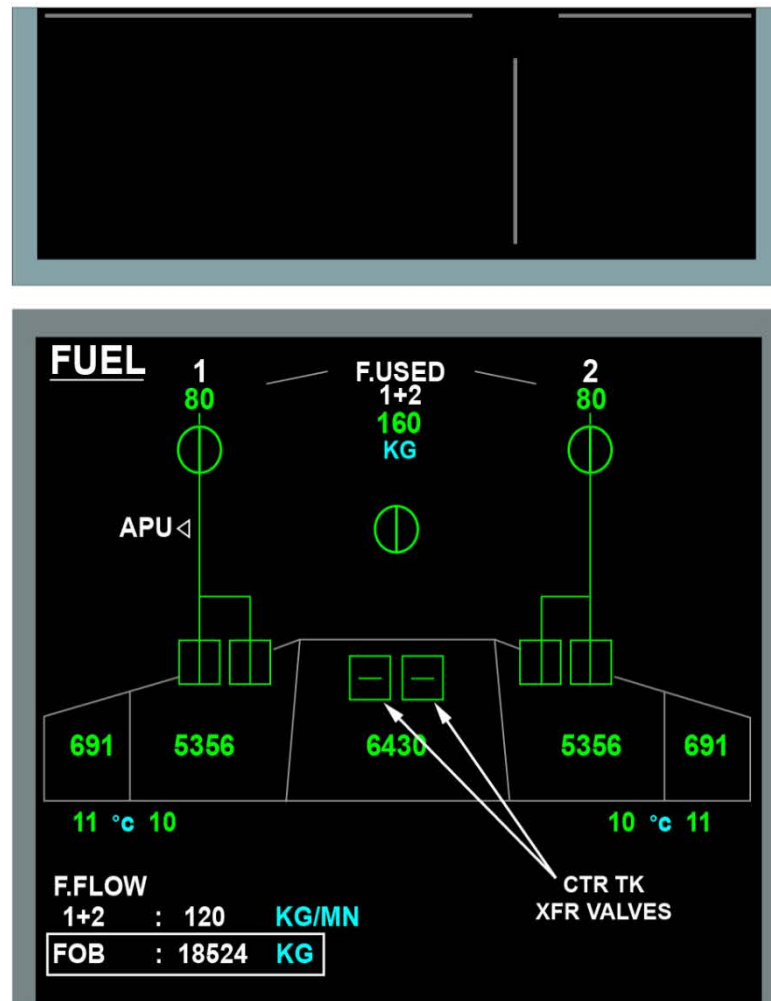
The centre tank transfer valves indications are green when in CLOSED position on the ECAM.

Note: Left and right centre tank transfer valves control is independent from each other.

At engine start, the fuel used indication is reset.

The engine identification number changes colour from amber to white at or above idle.

Engines are supplied directly from the wing tanks.





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## TRANSFER SEQUENCE

Each centre tank transfer valve is controlled independently by its adjacent wing tank level sensors, i.e. full and under full.

When the fuel level in one wing has decreased by 500 kg (1100 lb), and has therefore reached the under full level, the centre tank transfer valve is controlled to open, and is displayed green, in line on the ECAM.

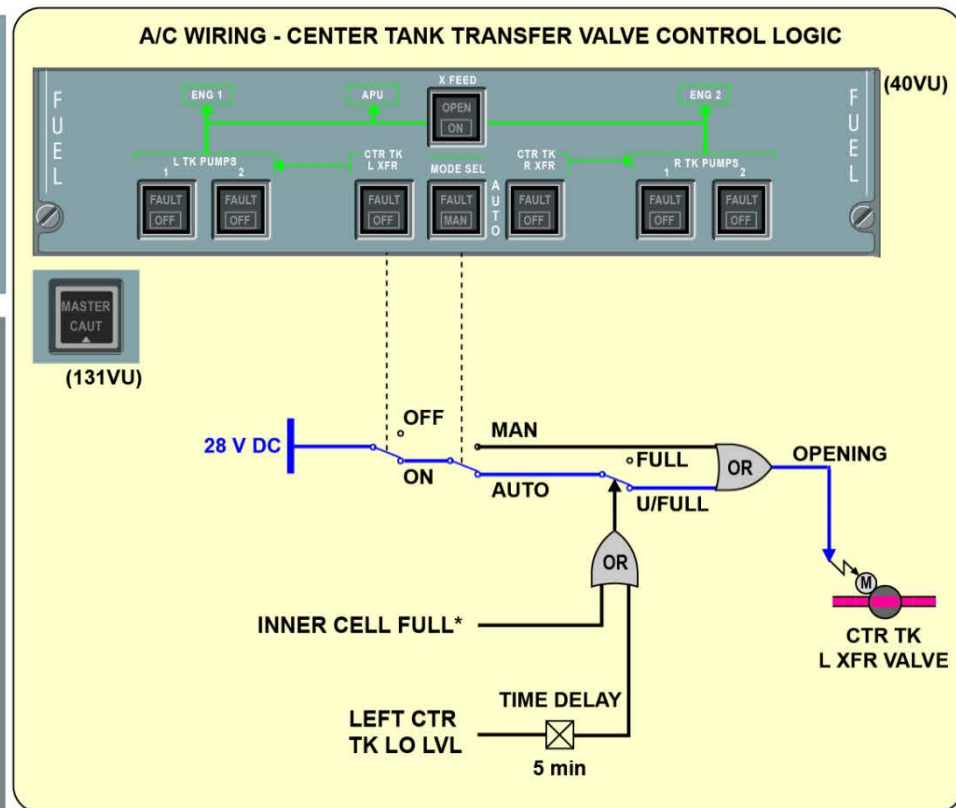
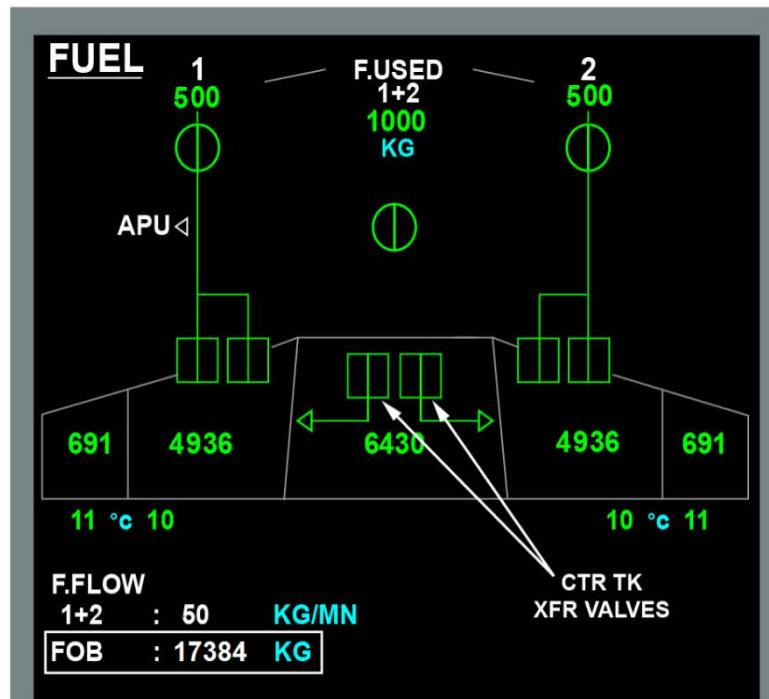
Fuel is transferred from the centre tank to the wing tank.

When the full level is reached, the transfer valve is controlled to close, and is displayed green, cross line on the ECAM.

Note: This sequence can be initiated on ground depending upon the fuel level.

The transfer sequence is terminated; the centre tank transfer valves close when the centre tank low level sensors are dry and 5 minutes time delay has elapsed.





\* CTR TK Transfer valve re-opens when the fuel level drop by fuel burn to the Underfull sensors (500 KG below FULL LVL)





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## **INNER CELL LOW LEVEL**

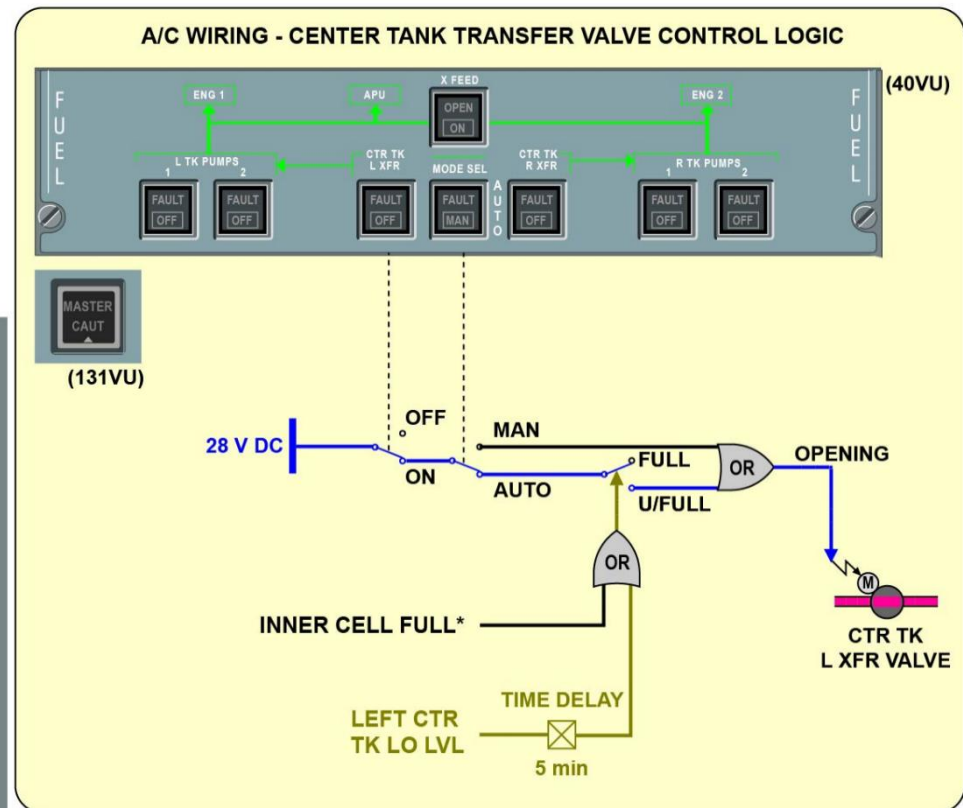
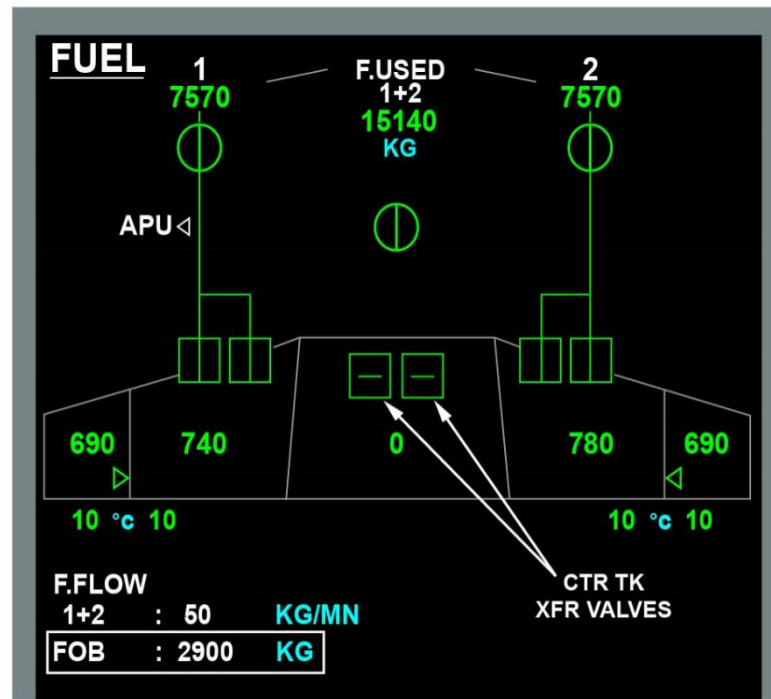
We can see the fuel quantity indication on the wing tank.

When the first inner cell quantity decreases to the LO LVL value, the transfer valves open automatically and are latched until the next refuelling.

The outer cell fuel flows to the related side inner cell.



\* InterCell Transfer Valves open, when there is a LO LVL in one wing tank.





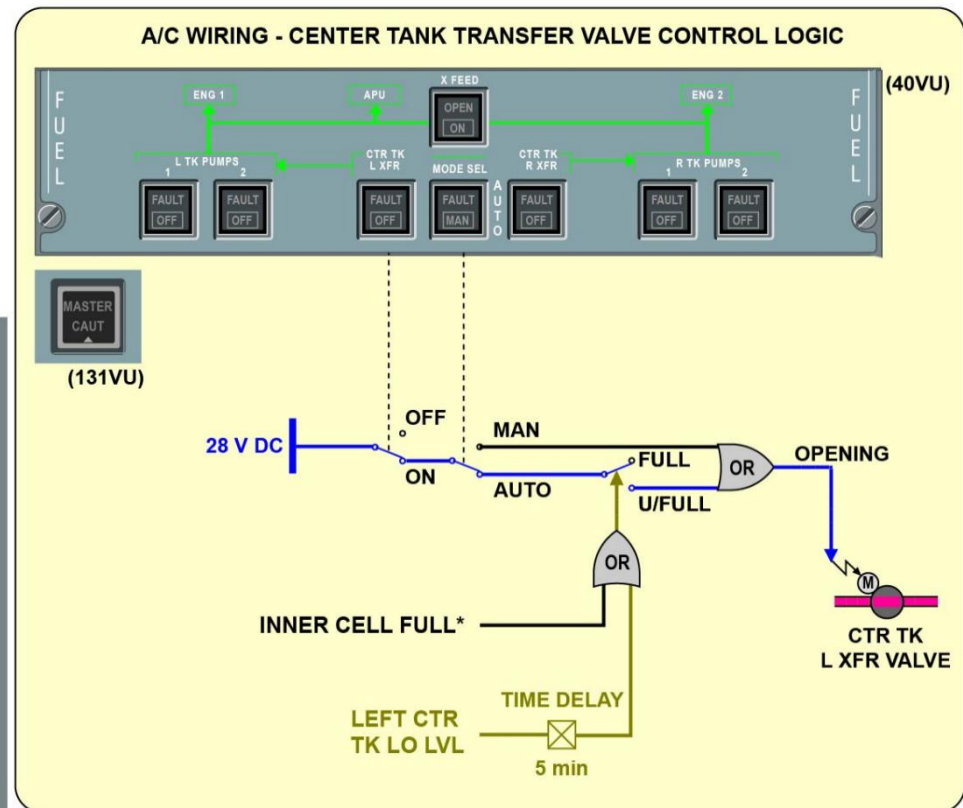
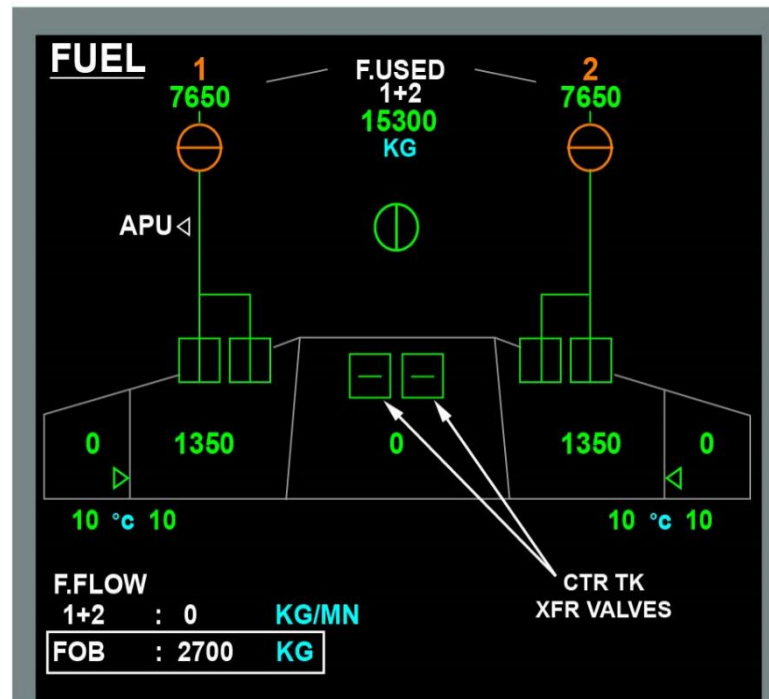
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## LANDING

After landing, when the engines are stopped, the engine identification numbers become amber.



ENG 1 + 2 MASTER OFF





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## **ABNORMAL OPERATION**

A/C in flight, in case of centre tank transfer valves not controlled to open, the FAULT light on the MODE SEL P/BSW and the MASTER CAUT come on and the single chime sounds.

## **FAILURE CONDITIONS**

The failure conditions are:

- failure of the centre tank transfer valves,

- with more than 250 kg (550 lb) fuel left in the centre tank, with less than 5000 kg (11000 lb) fuel in either wing tank.

The FUEL page is automatically displayed and shows:

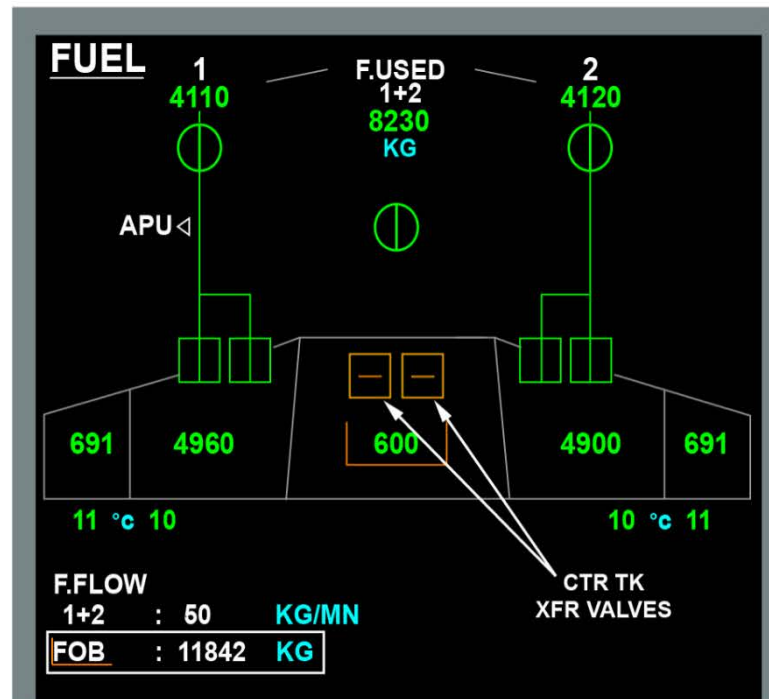
- centre tank transfer valves amber crossed, centre tank fuel quantity boxed amber, Fuel On Board (FOB) boxed amber,

- on the EWD an AUTO XFR FAULT message appears and, an amber half box is shown around the FOB indication.

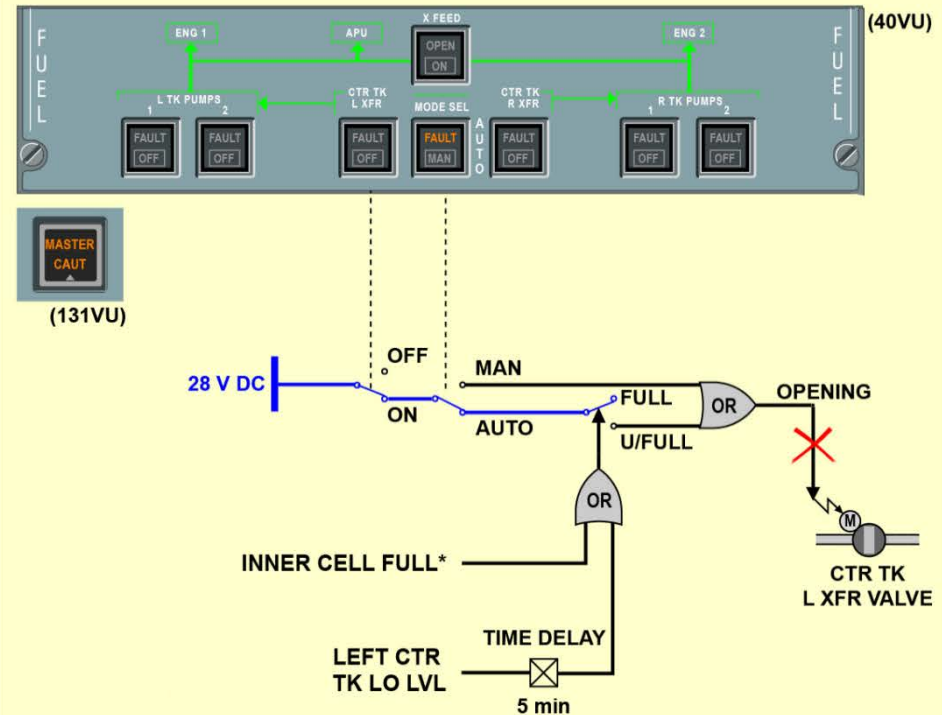
The crew must set the MODE SEL P/BSW to MAN mode.



## AUTO XFR FAULT



## A/C WIRING - CENTER TANK TRANSFER VALVE CONTROL LOGIC



EWD

FOB : 11842 KG







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## MANUAL MODE

In manual mode, the centre tank transfer valves are directly controlled from the respective CTR TK P/BSW.

The FAULT light in the CTR TK left or right transfer P/BSW comes on amber, associated with an ECAM caution in case of related wing tank overflow.

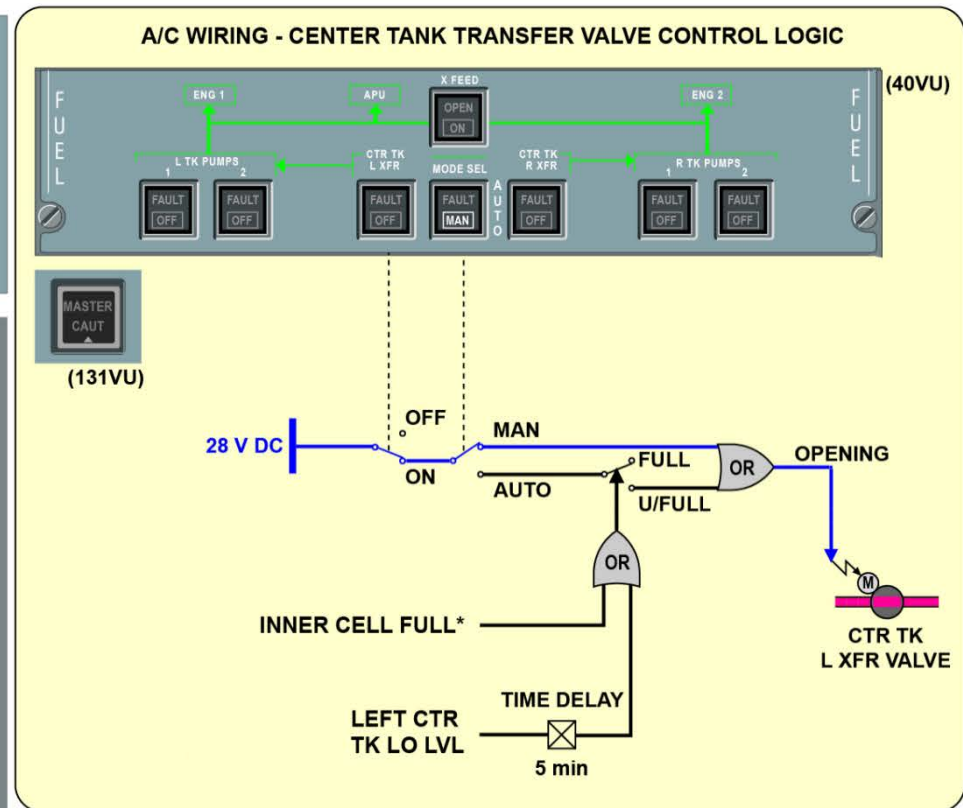
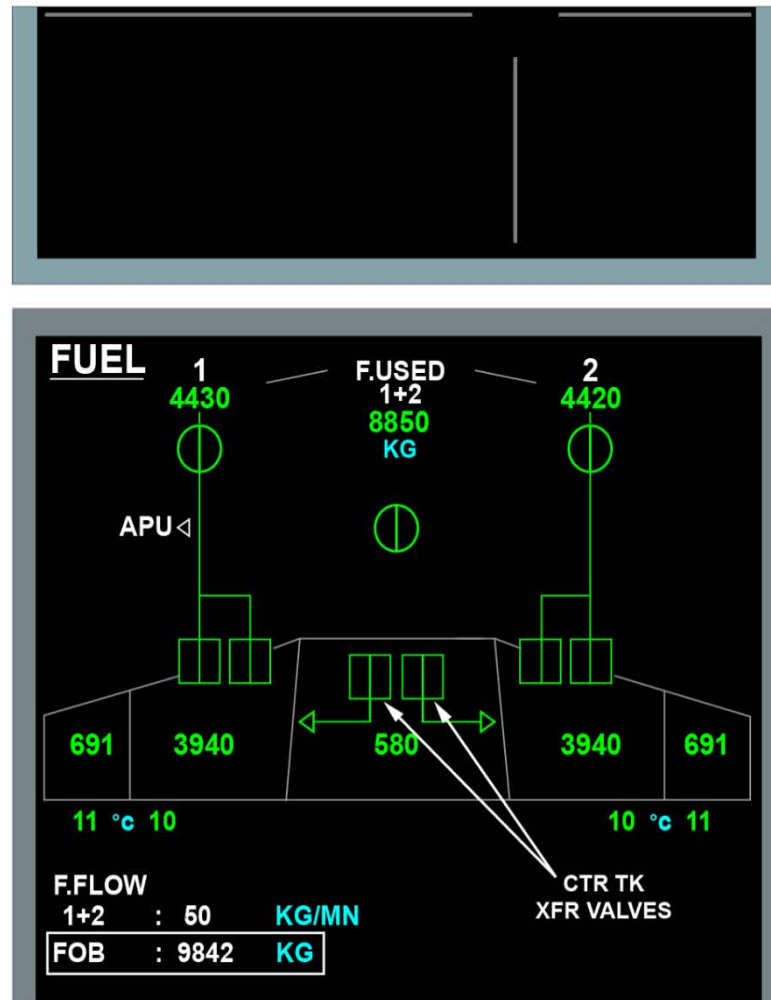
The related CTR TK L XFR or R XFR P/B switch must be set to OFF.

After the FAULT light disappears the P/B will be selected and remains in that position until the FAULT light appears again.

This procedure needs to be repeated as long as there is fuel in the Centre Tank.

After the tank is empty both P/B switches are left in the OFF position with the valve symbols indicated in amber on the ECAM FUEL SD.

CAUTION: In manual transfer mode fuel spillage might occur if the CTR TK XFR P/BSW is not selected to OFF after FAULT light indication due to related wing tank overflow.





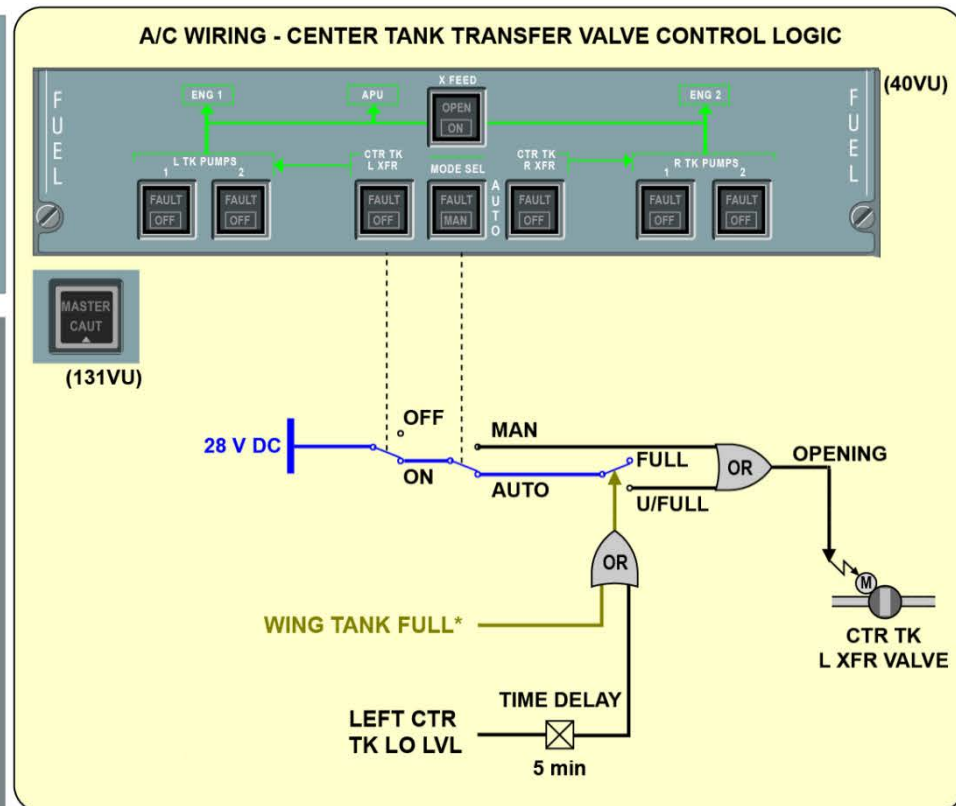
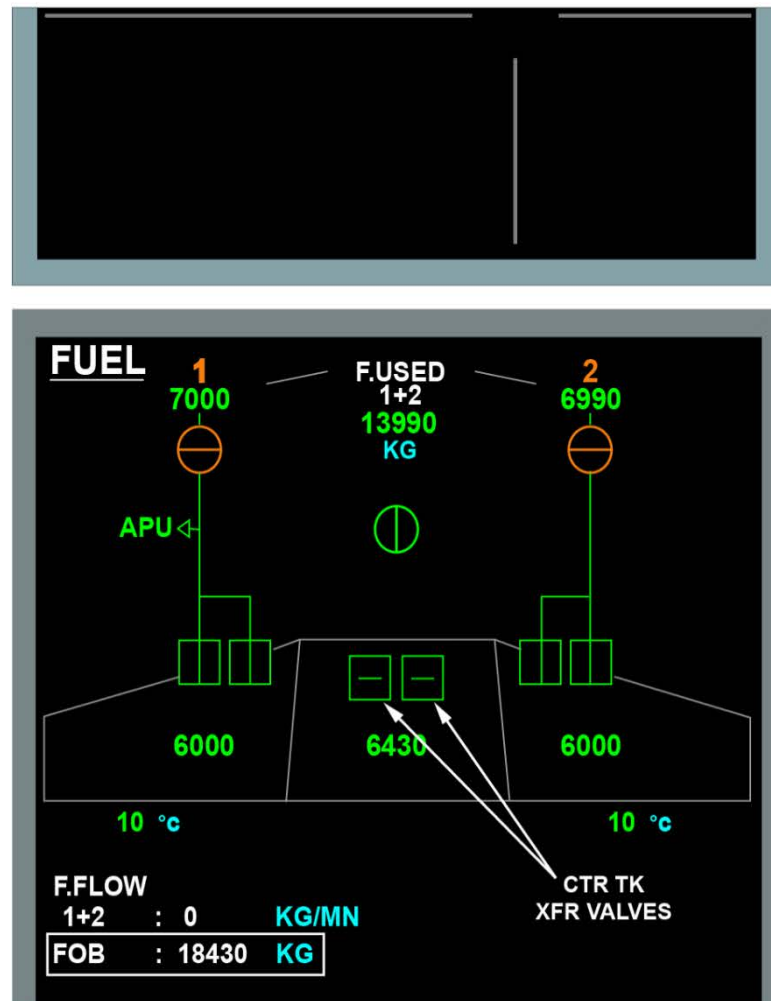
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## **FUEL FEED SYSTEM OPERATION (A321)**

### **AUTO MODE**

The auto mode will cover the following steps:

- normal operation,
- transfer sequence,
- abnormal operation,
- failure conditions.





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## **AUTO MODE**

### **NORMAL OPERATION**

A/C configuration before take-off is:

full load of fuel,

all 4 wing pumps ON,

Centre Tank (CTR TK) transfer valve P/BSWs ON,

MODE SElector P/BSW set to AUTO mode.

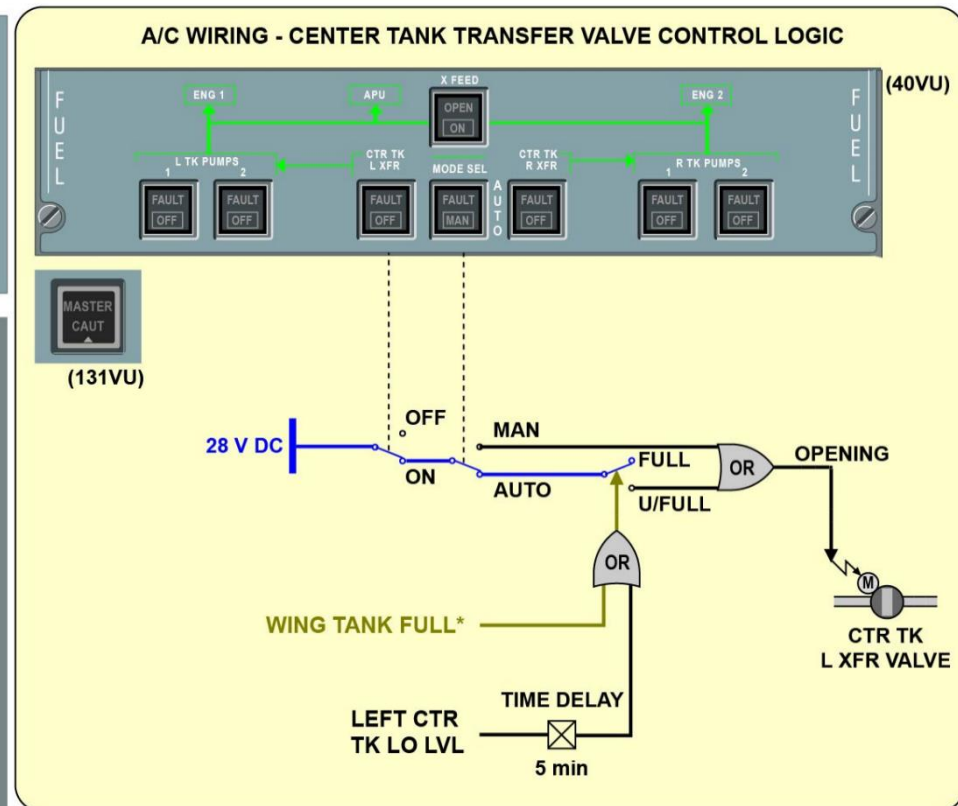
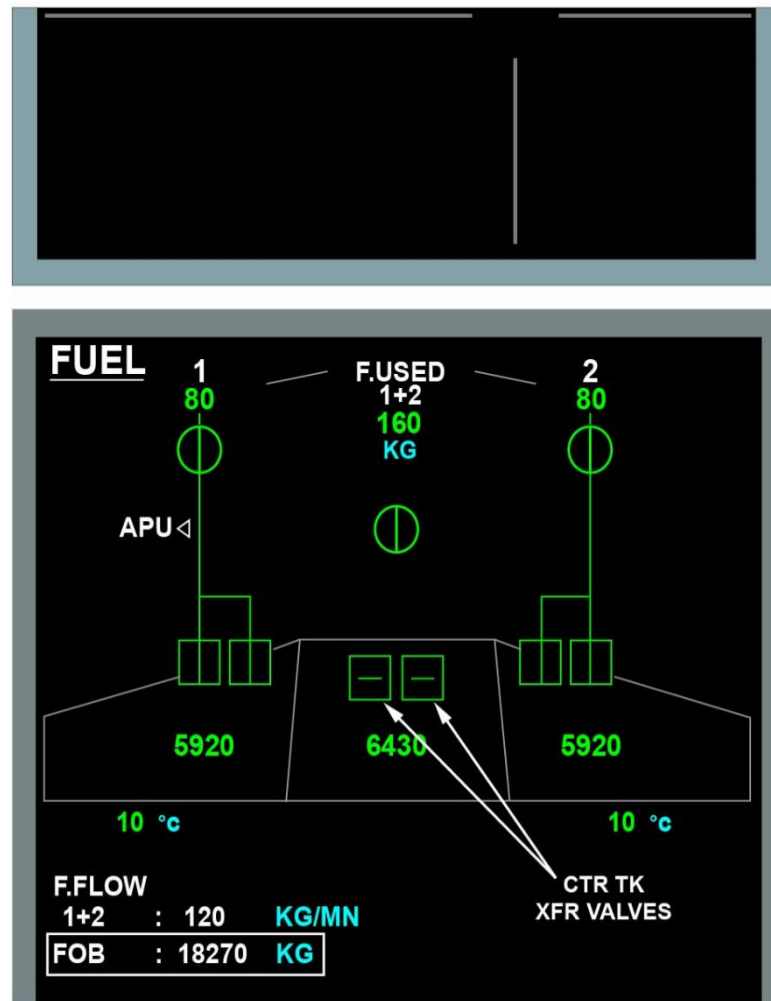
The centre tank transfer valves indications are green when in CLOSED position on the ECAM.

NOTE: Left and right centre tank transfer valves control is independent from each other.

At engine start, the fuel used indication is reset.

The engine identification number changes colour from amber to white at or above idle.

Engines are supplied directly from the wing tanks.





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## TRANSFER SEQUENCE

Each centre tank transfer valve is controlled independently by its adjacent wing tank level sensors, i.e. full and under full.

When the fuel level in one wing has decreased by 200 kg (440 lb), and has therefore reached the under full level, the centre tank transfer valve is controlled to open, and is displayed green, in line on the ECAM.

Fuel is transferred from the centre tank to the wing tank.

When the full level is reached, the transfer valve is controlled to close, and is displayed green, cross line on the ECAM.

Note: This sequence can be initiated on ground depending upon the fuel level.

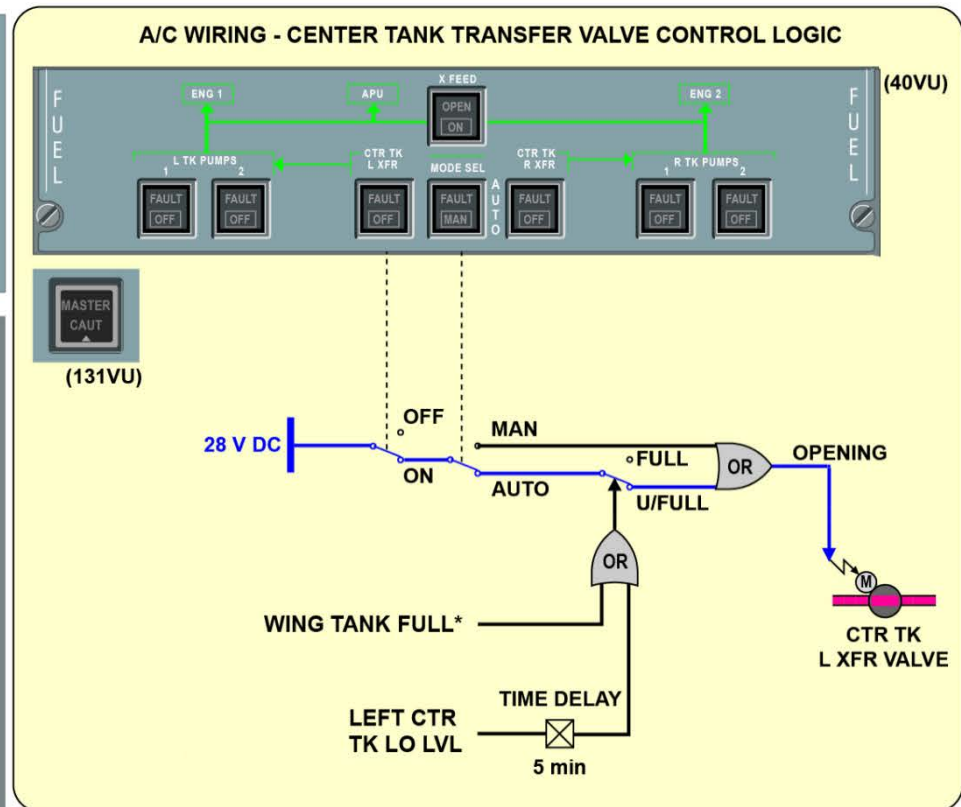
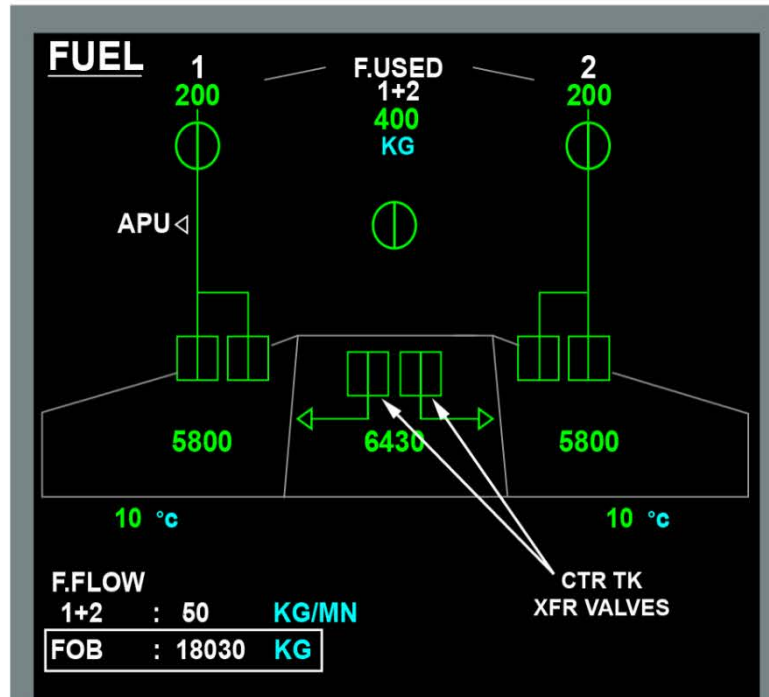
The transfer sequence is terminated; the centre tank transfer valves close when the centre tank low level sensors are dry and 5 minutes time delay has elapsed.

There are four low level sensors per wing tank:

two for 1500 kg (3300 lb) level,

two for 750 kg (1650 lb) level.





\* CTR TK Transfer valve re-opens when the fuel level drop by fuel burn to the Underfull sensors (200 KG below FULL LVL)



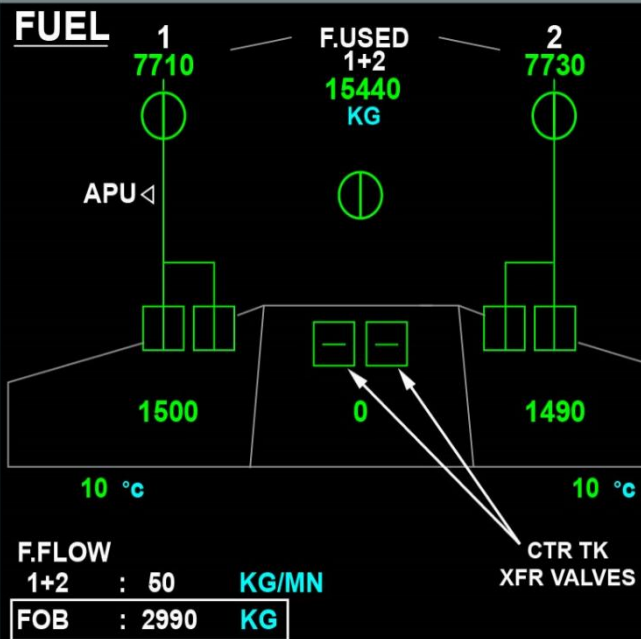


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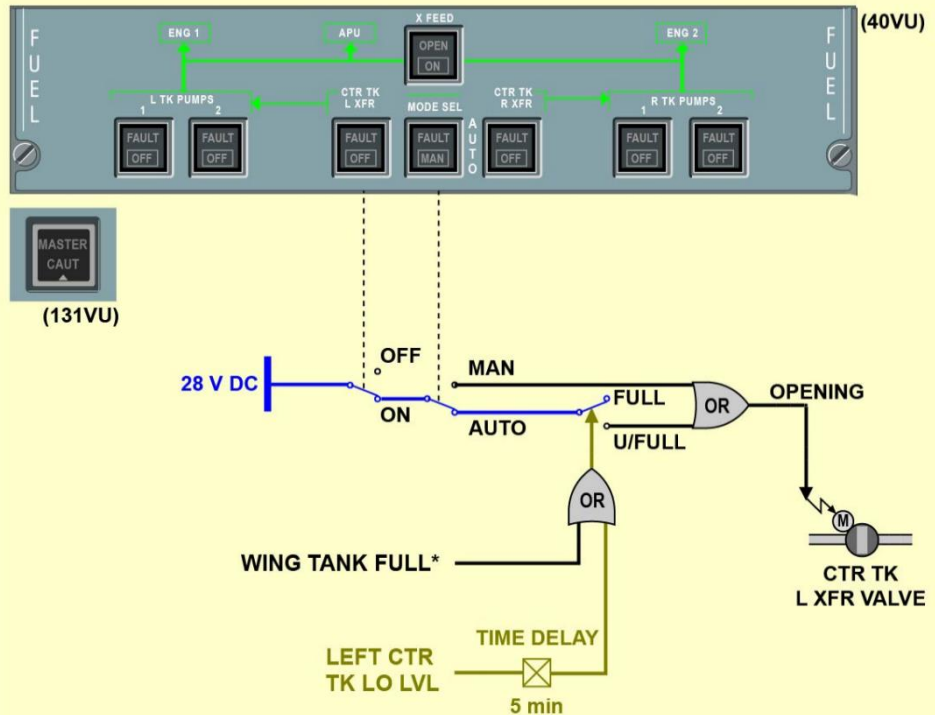
When the fuel level in the wing tanks has decreased and two 1500 kg (3300 lb) level sensors in a wing are continuously dry for 30 seconds, a MEMO message is shown.



FOB BELOW 3 T



# A/C WIRING - CENTER TANK TRANSFER VALVE CONTROL LOGIC

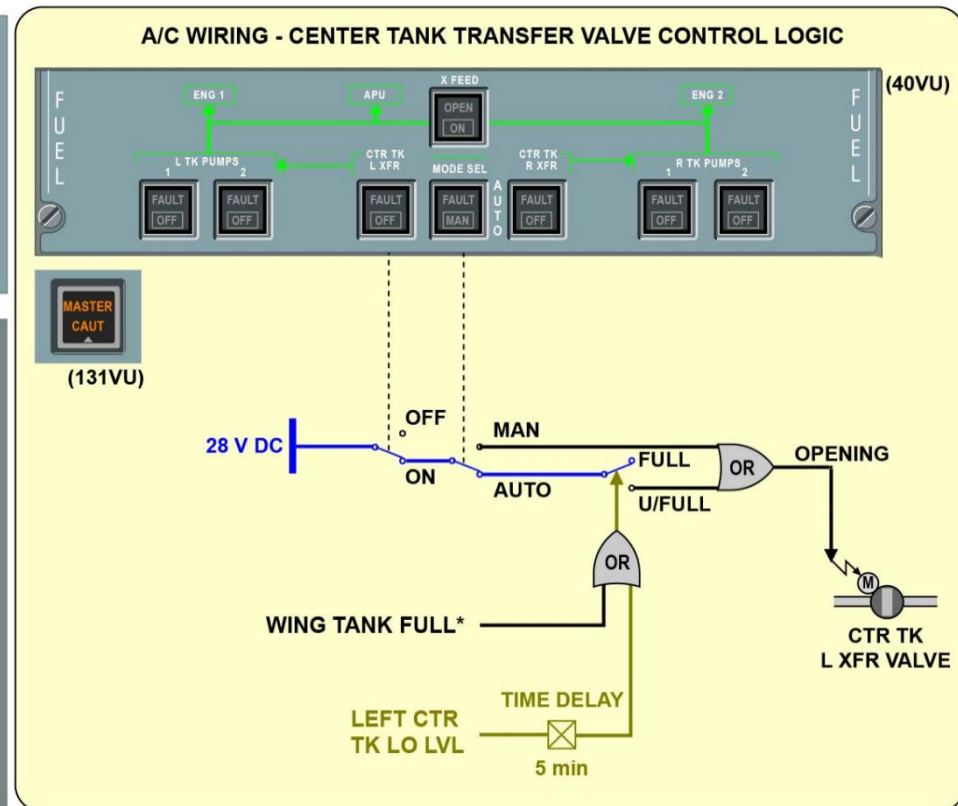
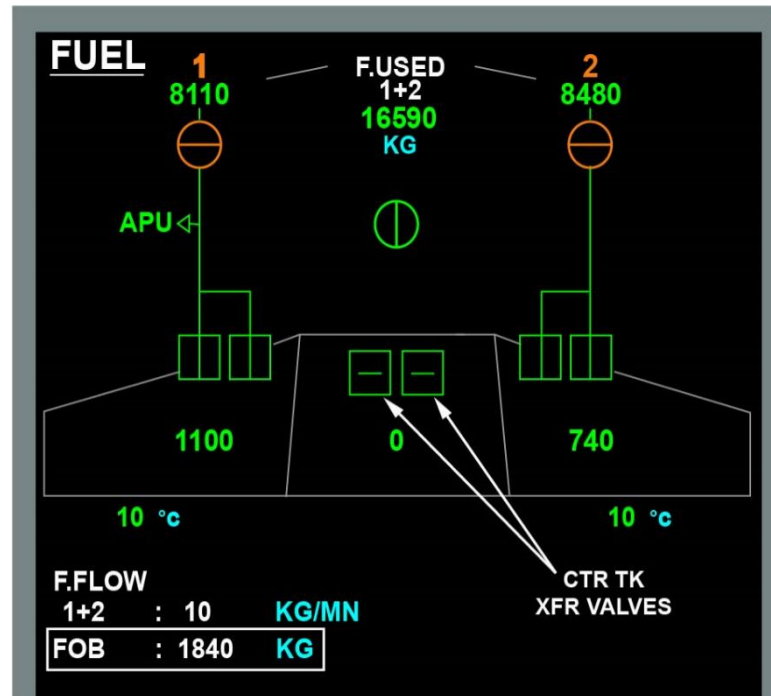
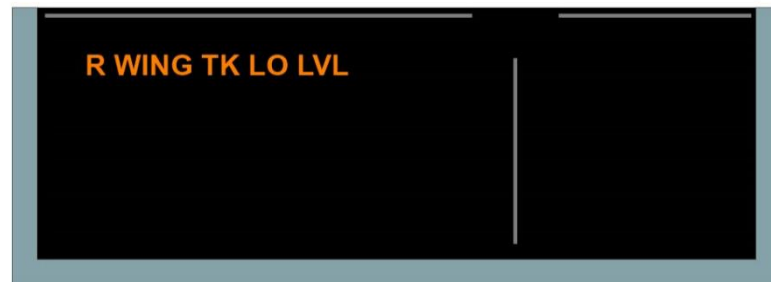




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When the fuel level still decreases and two 750 kg (1650 lb) low-level sensors in a wing are continuously dry for 30 seconds a low fuel level warning is triggered, i.e. single chime, MASTER CAUTION.

When the engines are stopped, the engine identification numbers become amber.





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## **ABNORMAL OPERATION**

A/C in flight, in case of centre tank transfer valves not controlled to open, the FAULT light on the MODE SEL P/BSW and the MASTER CAUT come on and the single chime sounds.

## **FAILURE CONDITIONS**

The failure conditions are:

failure of the centre tank transfer valves,

with more than 250 kg (550 lb) fuel left in the centre tank, with less than 5000 kg (11000 lb) fuel in either wing tank.

The FUEL page is automatically displayed and shows:

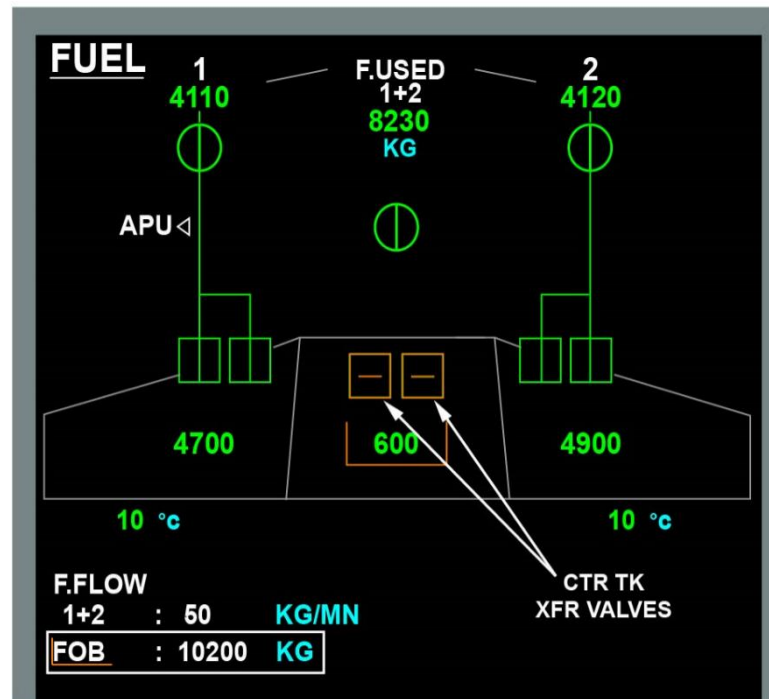
centre tank transfer valves amber crossed, centre tank fuel quantity boxed amber, Fuel On Board (FOB) boxed amber,

on the EWD an AUTO XFR FAULT message appears and, an amber half box is shown around the FOB indication.

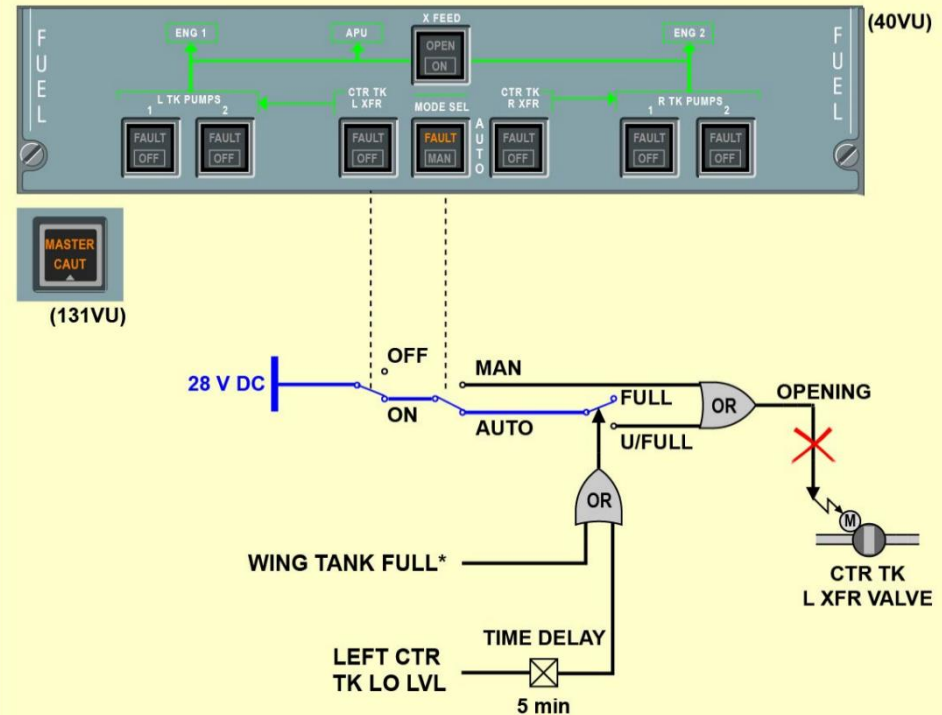
The crew must set the MODE SEL P/BSW to MAN mode.



## AUTO XFR FAULT



## A/C WIRING - CENTER TANK TRANSFER VALVE CONTROL LOGIC



EWD

FOB : 10200 KG







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## MANUAL MODE

In manual mode, the centre tank transfer valves are directly controlled from the respective CTR TK P/BSW.

The FAULT light in the CTR TK left or right transfer P/BSW comes on amber, associated with an ECAM caution in case of related wing tank overflow.

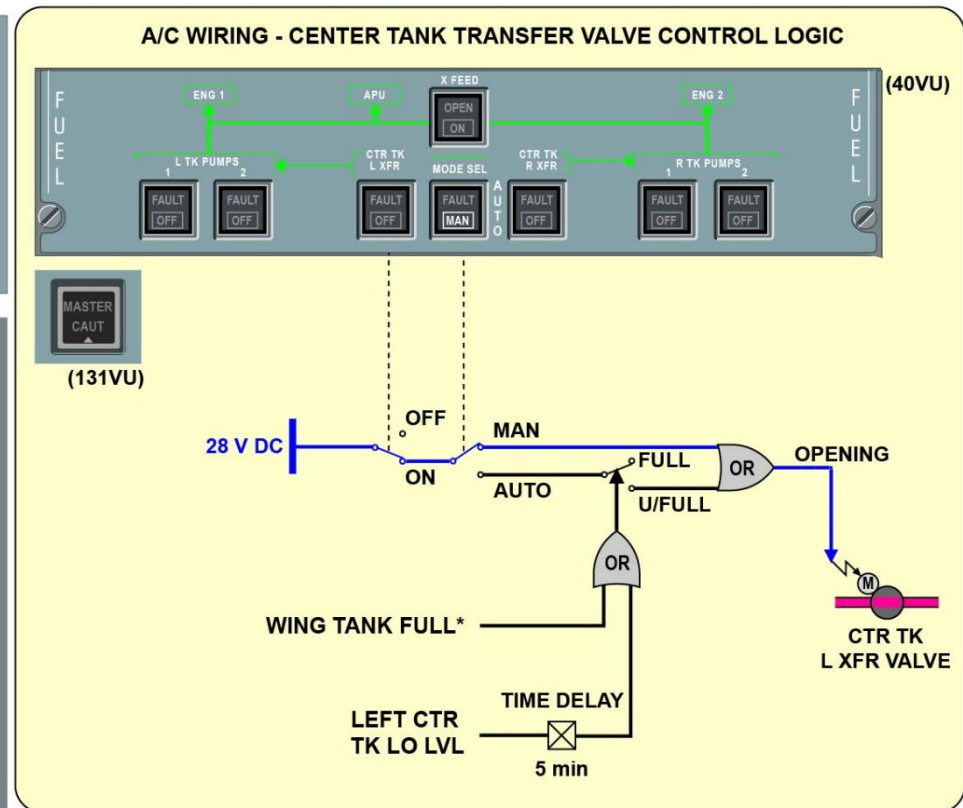
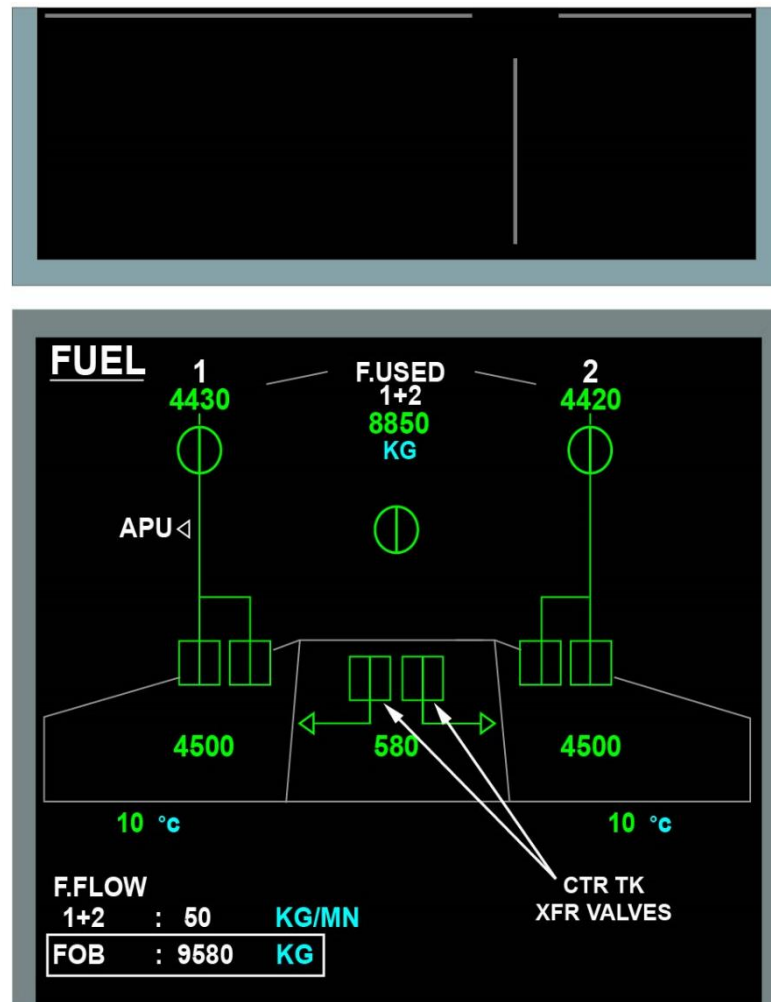
The related CTR TK L XFR or R XFR P/B switch must be set to OFF.

After the FAULT light disappears the P/B will be selected and remains in that position until the FAULT light appears again.

This procedure needs to be repeated as long as there is fuel in the Centre Tank.

After the tank is empty both P/B switches are left in the OFF position with the valve symbols indicated in amber on the ECAM FUEL SD.

CAUTION: In manual transfer mode fuel spillage might occur if the CTR TK XFR P/BSW is not selected to OFF after FAULT light indication due to related wing tank overflow.





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