

 AIRBUS TRAINING <b>A320</b> SIMULATOR FLIGHT CREW OPERATING MANUAL	<b>FUEL</b>	1.28.00	P 1
	<b>CONTENTS</b>	SEQ 001	REV 36

**28.00 CONTENTS**

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**28.30 ELECTRICAL SUPPLY**

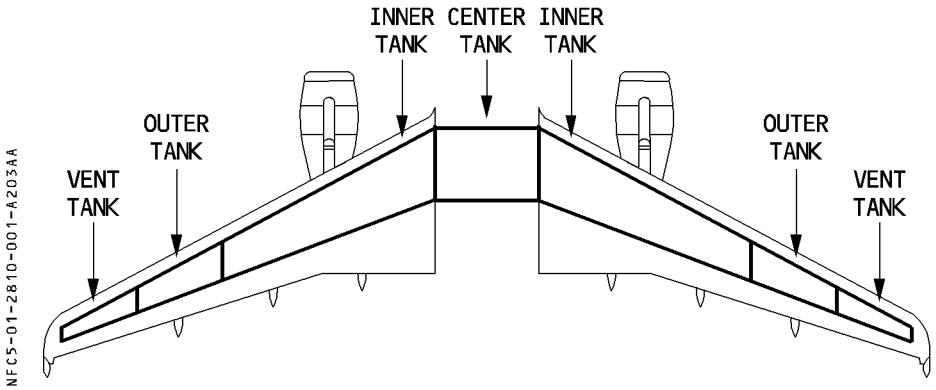
- BUS EQUIPMENT LIST

**GENERAL**

- The fuel system :
- stores fuel in the tanks
  - supplies fuel in the correct quantities to the fuel tanks during refueling
  - supplies fuel to the engines and the auxiliary power unit (APU)
  - circulates fuel to cool the integrated drive generator (IDG)
  - keeps fuel in the outer wing for wing bending and flutter relief.


**TANKS**

The fuel is stored in the wings and the center section. The wings have inner and outer tanks. There is a vent surge tank outboard of the outer tank in each wing. When the aircraft has been refueled to maximum capacity, the fuel can expand by 2 % (20° temperature rise) without spilling. There is an overpressure protector in each vent outer and inner tank and between the center tank and the left inner tank.



USABLE FUEL					
		OUTER TANKS	INNER TANKS	CENTER TANK	TOTAL
VOLUME	(liters)	880 x 2	6924 x 2	8250	23858
	(US gallons)	232 x 2	1829 x 2	2180	6302
WEIGHT *	(KG)	691 x 2	5435 x 2	6476	18728
	(LB)	1520 x 2	11982 x 2	14281	41285

\* Fuel density : 0.785 kg/l or 6.551 lb/US Gal.

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## ENGINE FEED

### GENERAL

The main fuel pump system supplies fuel from the center tank or the inner wing tanks to the engines. The system has six main fuel pumps.

### MAIN COMPONENTS

#### **TANK PUMPS**

- R In normal operation each engine is supplied by one pump in the center tank or two pumps in its own side wing tank.
- R All wing tank pumps remain on throughout the flight. They are fitted with pressure relief sequence valves which ensure that, when all pumps are running, the center tank pumps will deliver fuel preferentially.

#### **TRANSFER VALVES**

Two electrical transfer valves are mounted in each wing to permit fuel transfer from outer to inner tank.

#### **CROSS FEED VALVE**

A cross feed valve controlled by a double motor allows both engines to be fed from one side or one engine to be fed from both sides.

#### **ENGINE LP VALVES**

The fuel flow to an engine can be stopped by its low pressure (LP) fuel valve, the closure of the LP fuel valve is by :

- the engine master switch, or
- the ENG FIRE PUSH pushbutton.

#### **SUCTION VALVES**

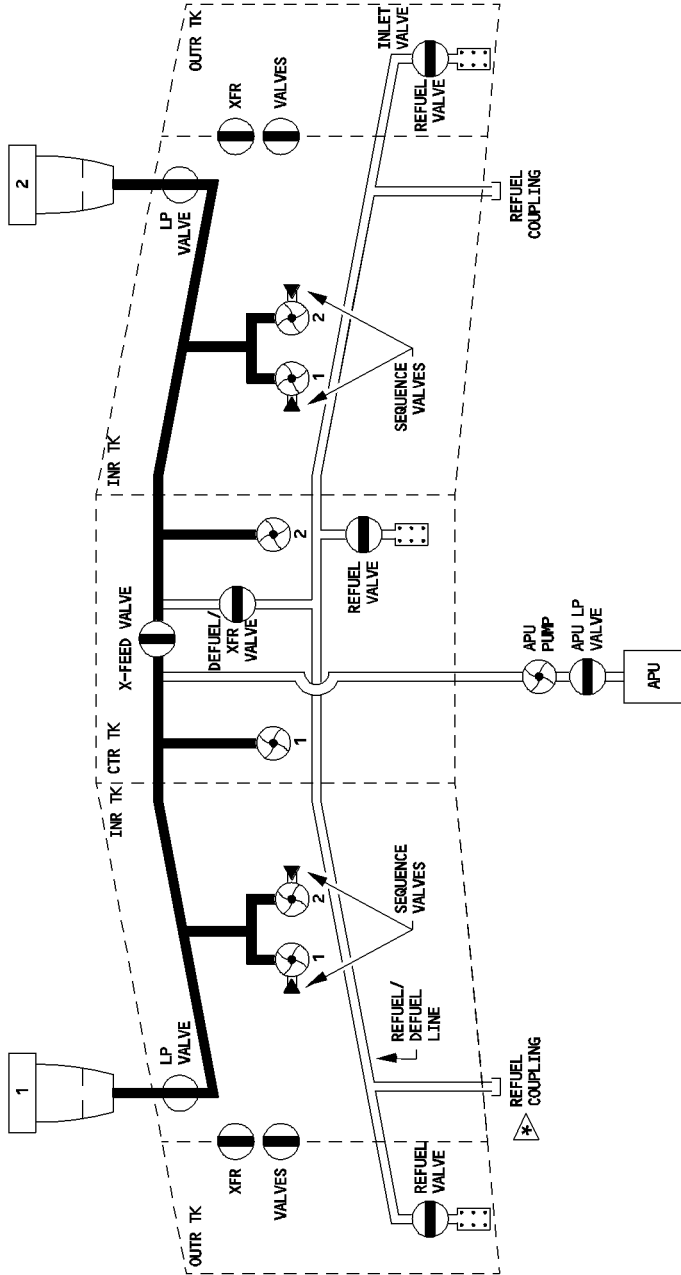
Closed by pumps pressure in normal operation, they allow engines to be fed by gravity if the inner tank pumps fail.

- R Note : Center tank pumps are not fitted with suction valves. Therefore, gravity feeding is not possible from the center tank.



**ENGINE FEED**

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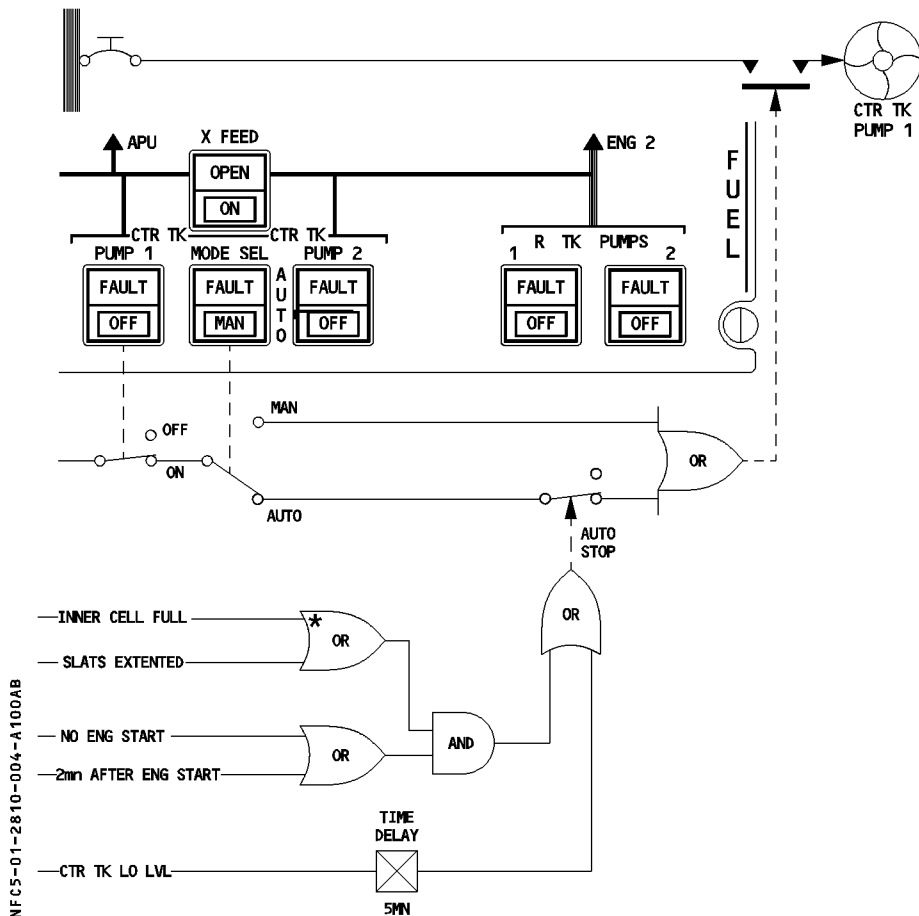


## FUEL FEED SEQUENCE


The tanks empty in the following sequence :

1. center tank
2. inner tanks (down to 750 kg in each inner tank)
3. outer tanks (fuel transferred into the inner tanks)

## CENTER TANK PUMPS CONTROL LOGIC



- \* Each center tank pump stops until approximately 500 kg (1100 lb) of its associated inner tank fuel has been used (when the fuel level reaches the underfull sensors).

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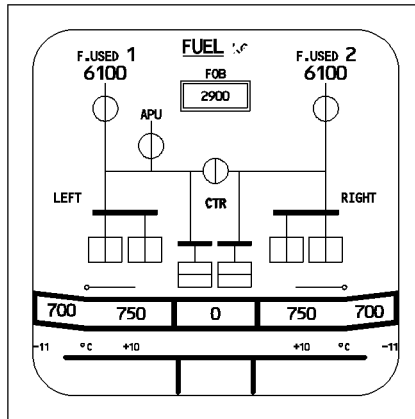
- R With the MODE SEL in MAN position, the center tank pumps will run. In manual mode the
- R CTR TK PUMP pushbuttons must be selected off when the center tank is empty.

### FUEL TRANSFER FROM OUTER TO INNER TANKS

The transfer valves automatically open when the inner tank fuel reaches the low level (about 750 kg/1650 lb), thus permitting fuel to drain from the outer to inner tanks. When open, the valves are latched open. They will automatically close at the next refuel operation (MODE SELECT at REFUEL position).


- Note :*
1. Two level sensors are installed in each inner tank. Each sensor controls two transfer valves, one in each wing, ensuring that transfer is simultaneous in both wings.
  2. The 750 kg/1650 lb value is based on a level aircraft attitude with no acceleration. During steep descents or accelerations/decelerations, the transfer valves may open with more than 750 kg/1650 lb of fuel in each inner tank and the low level warning may be triggered.

### ECAM INDICATION



**TRANSFER FROM OUTER  
TO INNER TANKS  
+  
INNER TANK FEEDING**

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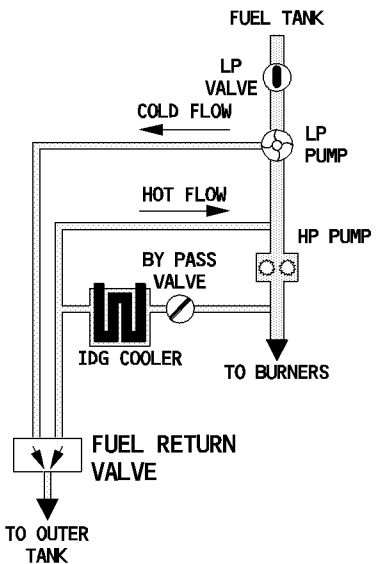
**APU FEED**

A special fuel pump supplies fuel for APU startup when fuel feed pressure is low (due to loss of tank pumps or loss of normal AC electrical supply). This pump normally runs off the AC ESS SHED, but runs off the AC STAT INV BUS if the AC ESS SHED fails.

**FUEL RECIRCULATION SYSTEM**

See also 1.70.40 "IDG COOLING SYSTEM".  
 Some of the fuel supplied to each engine goes from the high-pressure fuel line in that engine, through the integrated drive generator (IDG) heat exchanger (where it absorbs heat), to the fuel return valve, and to the outer fuel tank.  
 This operation ensures the IDG cooling when the oil temperature is high or when at low engine power.

The FADEC controls the fuel return valve.  
 If the outer tank is already full, the fuel overflows to the inner tank through a spill pipe.  
 If center tank is feeding, the wing tank will tend to overflow and the system automatically selects the CTR TK PUMP off when the inner tank is full. The wing tank pumps will feed until the engine have used approximately 500 kg (1100 lb) of fuel when the fuel level reaches the underfull sensors. The logic circuits then restart the center tank pumps.



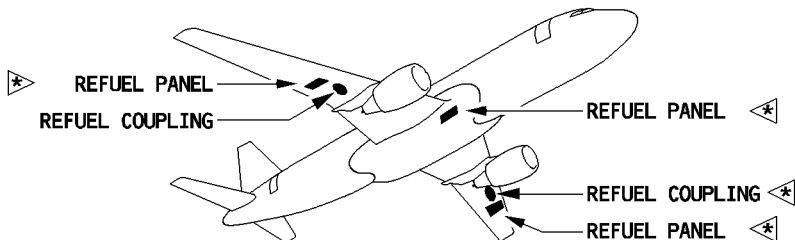
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## REFUELING – DEFUELING

- One (two) refueling point(s) is (are) installed under the wings allowing the refueling from either the right or left (◄) side of the aircraft.
- A refuel panel is located on the fuselage side beneath the right wing or under the right or left wing adjacent to the refuel coupling.

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A gallery connects the refuel coupling to the refuel valve of each tank.

Refueling is normally automatic, the required fuel load being set on the preselector. Manual control is also available.

Automatic refueling starts by the outer cells. If the selected fuel load exceeds the wing tank capacity, the center tank is refuelled simultaneously.

When an outer cell is full the fuel overflows into the inner cell through a spill pipe.

Refuel valves close automatically when the tanks contain the preselected load or when sensors detect a high fuel level.

The aircraft can be refueled when only battery power is available.

The wing tanks can be refueled by gravity through refueling points on top of the wings.

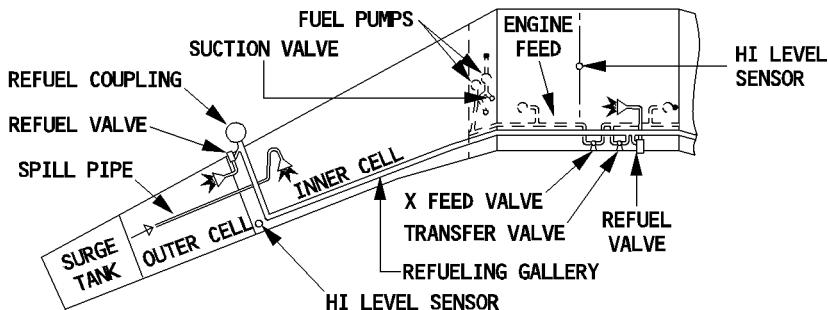
A transfer valve between the engine feed system and the refueling gallery permits :

- tank pumps to transfer fuel from one tank to another.
- defueling through the refuel coupling.


Approximate refueling time at nominal pressure is :

- 17 minutes for wing tanks.
- 20 minutes for all tanks.

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## FUEL QUANTITY INDICATION AND LEVEL SENSING

### FUEL QUANTITY INDICATION (FQI) SYSTEM

The FQI is a computerized system that :

- transmits the actual total fuel mass, as well as the quantity and temperature of fuel in the tanks, to the ECAM.
- controls automatic refueling.

Two channels perform fuel computations : channel 2 activates automatically if channel 1 fails.

The FQI system comprises :

- an FQI computer.
- a set of capacitance probes in each tank to measure fuel level and temperature.
- one densitometer (cadensicon) sensor in each wing inner tank permitting the calculation of the fuel quantity.
- one Capacitance Index Compensator (CIC) in each inner tank giving the dielectric constant of the fuel in case of cadensicon failure.
- a quantity indicator for each tank installed on the refuel/defuel panel.
- a preselector on the refuel/defuel panel that shows the preselected and actual total fuel quantity.

### FUEL LEVEL SENSING CONTROL UNIT (FLSCU)

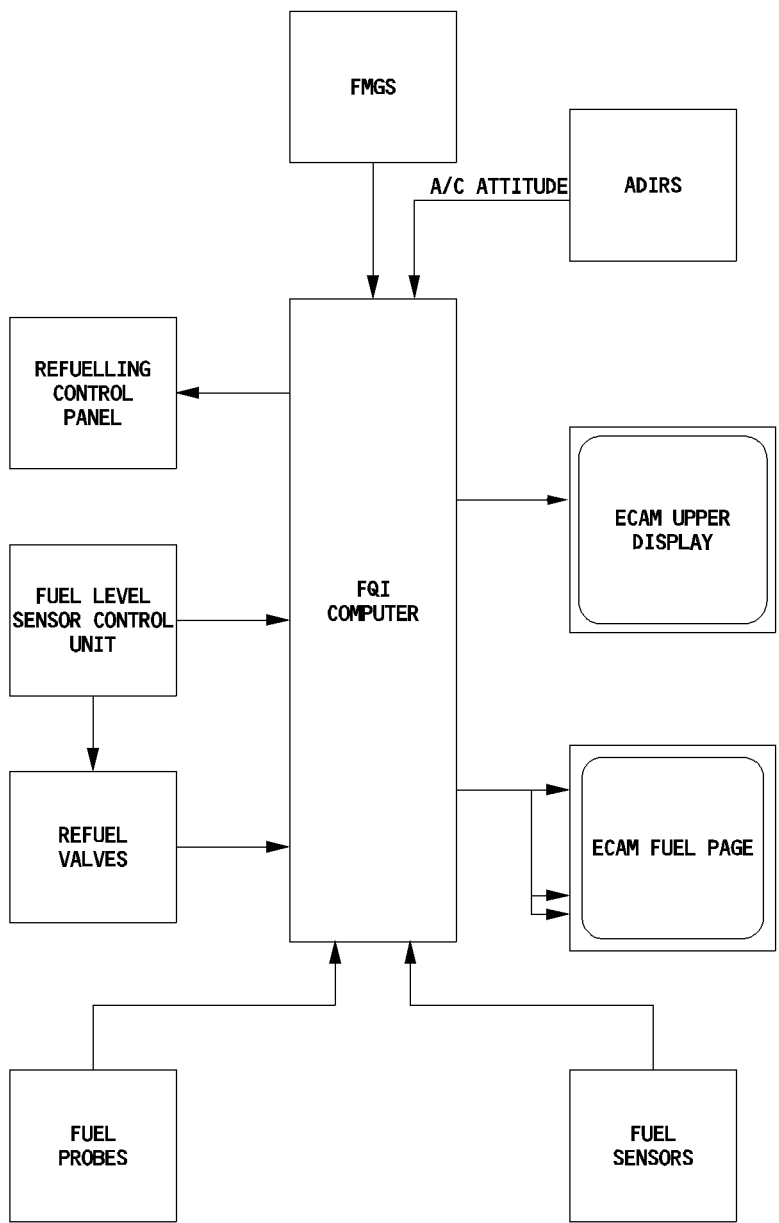
The fuel level system generates fuel-level and fuel-temperature signals in order to operate the appropriate switching functions for refueling and defueling and control the IDG cooling recirculation system and the center-tank-to-wing-tank fuel transfer system.

The FLSCU comprises :

- fuel level sensors in the tanks to sense high, low, and overflow levels.
- a fuel temperature sensor to control the IDG cooling recirculation.

When fuel quantity in one wing tank goes below 750 kg (1650 lb), the low-level sensor triggers the LO LVL warning on ECAM.

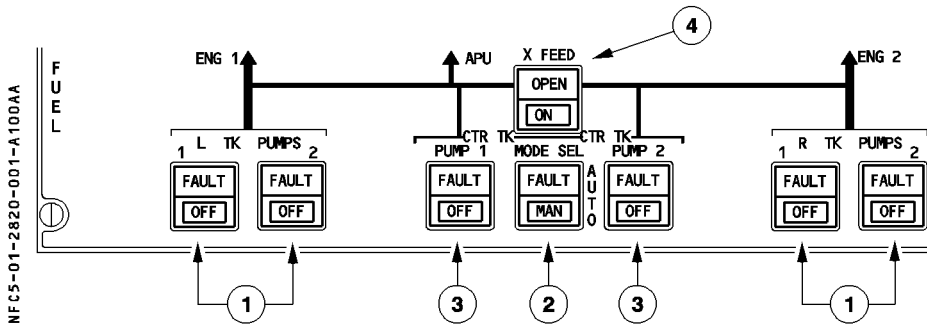
**R FUEL SYSTEM ARCHITECTURE**



NFC5-01-2810-009-A001AB



## OVERHEAD PANEL

① L (R) TK PUMPS 1(2) pb sw


- On** : Pump is on but fuel feeds only when center tank pumps delivery pressure drops below threshold.
- OFF** : Pump is OFF and OFF button lights up white.
- FAULT light** : Amber light comes on, and ECAM caution comes on, when the delivery pressure drops. It does not come on when OFF is selected.

② MODE SEL pb sw

- AUTO** : Control of center tank pumps is automatic.
- They run at engine start for 2 minutes.
  - Before or after engine start sequence, the pumps run if the slats are retracted.
  - They stop automatically 5 minutes after center tank low level is reached.
- MAN** : Flight crew controls the center tank pumps manually with center tank pumps pushbutton switches.
- FAULT light** : Amber light comes on, and ECAM caution comes on when center tank has more than 250 kg (550 lb) of fuel and the left or right wing tank has less than 5000 kg (11000 lb).

③ CTR TK PUMP 1(2) pb sw

- On** : · Pump runs if MAN mode is selected on MODE SEL pushbutton switch.  
· Pump is automatically controlled when AUTO mode is selected.
- OFF** : Pump is OFF and OFF button lights up white.
- FAULT light** : Amber light comes on, associated with ECAM caution, when the pump is in operation and the delivery pressure drops.

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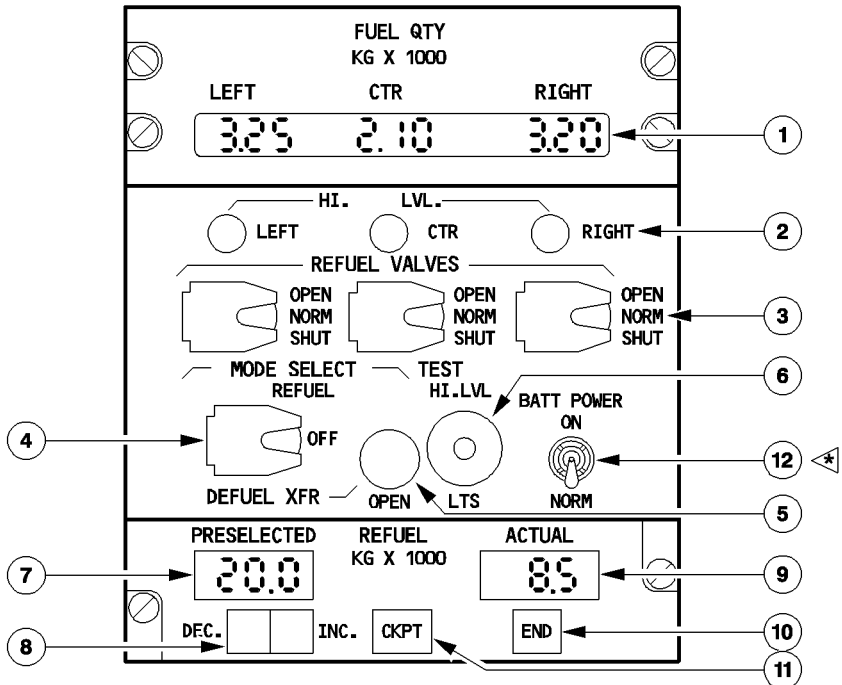
④ X FEED pb sw

- Off : Valve closes and button does not light up.
- ON : Valve opens and ON button lights up white.
- OPEN light : This green light comes on when the valve is fully open.



## REFUELING CONTROL PANEL

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① FUEL QUANTITY indicator

The number shows the quantity of fuel in each tank.

② HI LVL lt


This blue light comes on when the system detects a high fuel level.  
The corresponding refuel valve closes automatically.

③ REFUEL VALVES sel (guarded in NORM)

**NORM** : Automatic refueling logic controls the refuel valves.

**OPEN** : Valves open when the MODE SELECT switch is set to REFUEL or DEFUEL position. When the MODE SELECT switch is in the REFUEL position, each refuel/defuel valve closes when the system detects a high level in the associated tank.

**SHUT** : Valves close.

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④ MODE SELECT sw (guarded at OFF)

- OFF : Refuel system is de-energized. Refuel valves are closed.
- REFUEL : Refuel valves operate in automatic or in manual mode depending on the position of REFUEL/DEFUEL VALVES switches.
- DEFUEL : Refuel/Defuel transfer valve opens.
- Refuel valve opens if the associated REFUEL VALVE selector is at OPEN.

⑤ OPEN It

This amber light comes on when the transfer valve is open.

⑥ TEST sw

When this switch is pressed, the HI LVL lights come on if high level sensors and associated circuits are serviceable.

*Note : If tanks are full (HI LVL lights on) during this test, the HI LVL lights go out if high level sensors and associated circuits are serviceable.*

LTS : Lights on panel and all 8's on FQI and preselector come on.

⑦ PRESELECTED display

This display shows the preselected total fuel quantity in kg (lb) × 1000 (multiply by 1000 to get actual amount).

⑧ Preselector rocker switch

Pressing the left or right side of the switch decreases or increases the preselected quantity.

⑨ ACTUAL display


This display shows the total fuel on board.

⑩ END It

- This green light comes on steady when automatic refueling is completed.
- It flashes green if refueling is aborted.


⑪ CKPT It

Not used.

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⑫ BATT POWER toggle sw ◀


- ON** : When flight crew switches this switch ON momentarily and releases it, HOT BUS 1 supplies the FQI. After completion of the FQI tests (about 40 secondes), the fuel quantity indications appear and the refuel operation can be selected.  
 The electrical supply is cut off automatically :  
 – after 10 minutes, if no refuel operation is selected  
 – or, at the end of refueling
- NORM** : The FQI is not supplied by batteries

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**MAINTENANCE PANEL**

**LEFT INTENTIONALLY BLANK**

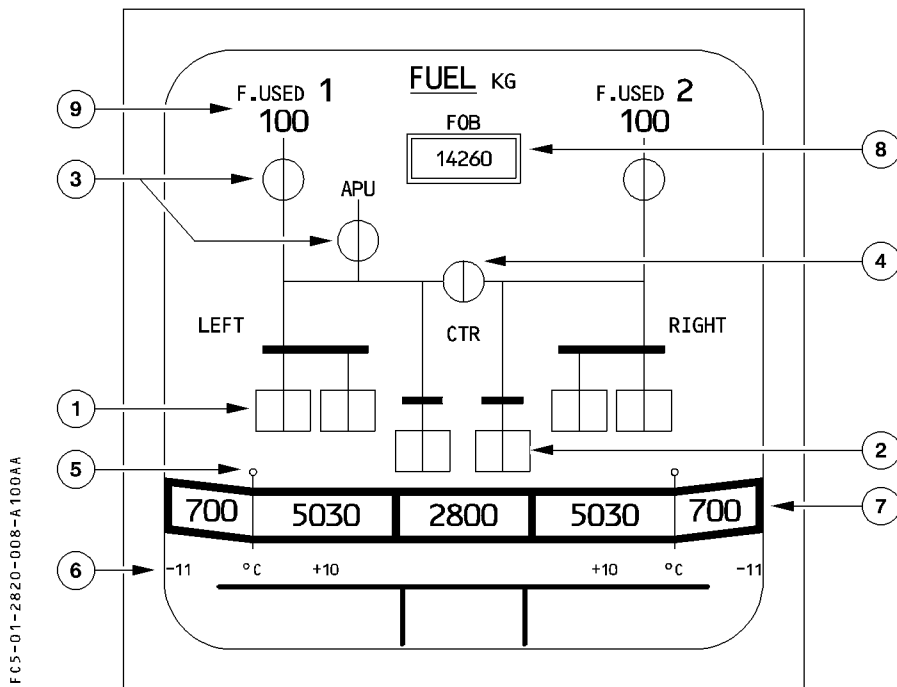


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**LEFT INTENTIONALLY BLANK**



## ECAM FUEL PAGE



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### ① Wing pumps indications

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

### ② CTR tank pumps indications

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



### ③ LP valve (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.

Transit – Amber : Valve is in transit.

### ④ X feed indications

In line – Green : valve is open.

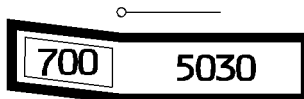
In line – Amber : valve is open with pushbutton switch off.

Cross line – Green : valve is closed.

Cross line – Amber : valve is closed with pushbutton switch ON.

Transit – Amber : valve is in transit.

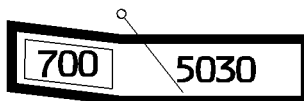
### ⑤ Transfer valves indications



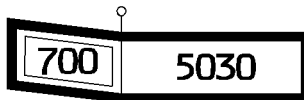
One transfer valve is open :

Green : LH or RH inner cell is at low level.

Amber : LH and RH inner cells are not at low level (associated with ECAM caution).




One transfer valve is in transit.



Both transfer valves are closed

Green : LH or RH inner cells are not at Low Level.

Amber : LH and RH inner cell is at low level (associated with ECAM caution).

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### ⑥ Fuel temperature indication

This appears when its associated temperature sensor is wet.  
It is normally green.

Advisory in phases 2 and 6 only, when fuel temperature is :

- above 45° C for inner cell or 55° C for outer cell.
- below – 40° C.

It becomes amber, and ECAM displays a caution, if the temperature goes above the high limit or below the low limit.

### ⑦ Fuel quantity indication

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- Normally green
- An amber line appears across the last two digits when FQI is inaccurate (Refer to 3.04.28). The outer indication is boxed amber if both transfer valves fail to open when inner at low level.
- R – The center tank indication is boxed amber if both center tank pumps are failed or
- R switched OFF.
- Advisory in flight phases 2 and 6, when difference between fuel quantities in the two wings is greater than 1500 kg (3300 lb). The indications of the wing inner and outer tanks with the highest fuel level pulses.

### R ⑧ Fuel on board (FOB) indication

It is normally green.

An amber line appears across the last two digits when the FQI is inaccurate (Refer to 3.04.28).

The indication is boxed amber if :

- Center tank pumps failed or switched OFF
- Both transfer valves fail to open when inner cell at low level.

### ⑨ Fuel used indication

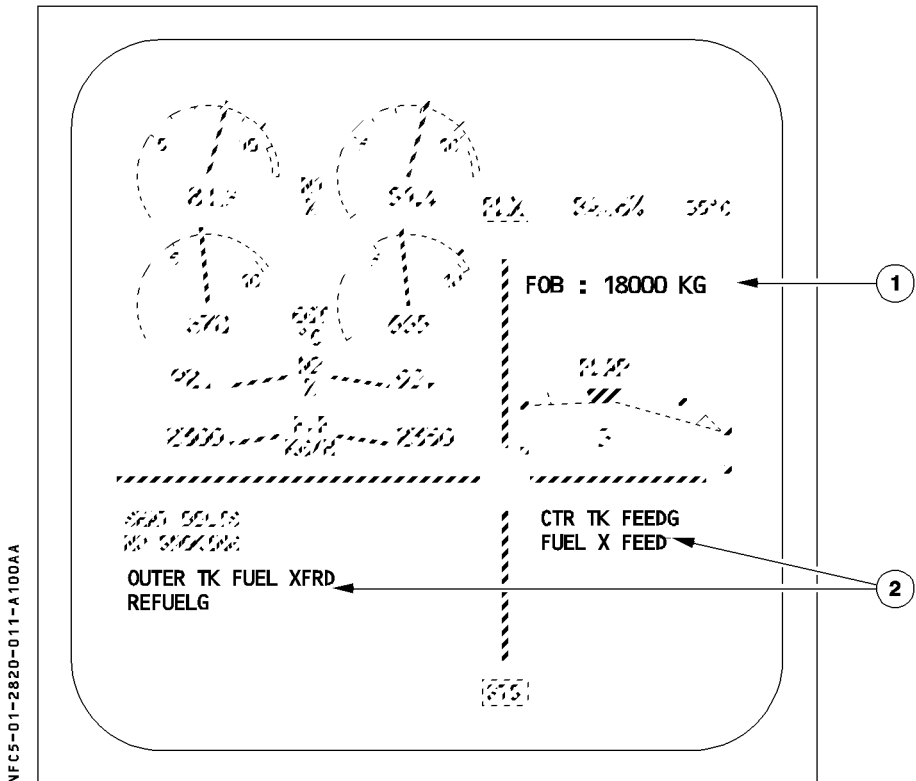
F.USED 1

3100

- The engine identification number is amber when the engine is below idle, and it is white when it is at or above idle.
- The fuel used indication is green from flight phase 2 until electrical power is cut off at the end of the flight. It is automatically reset when the engine is started on ground.



## ECAM UPPER DISPLAY

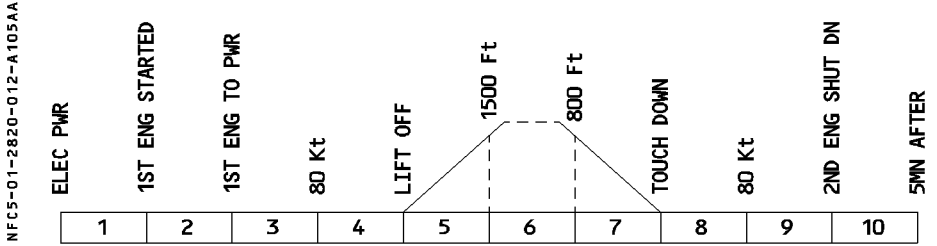


### ① Total fuel indication

R An amber half box appears around FOB when the quantity shown is not all usable (intercell transfer valve failure or loss of center tank pumps).  
In case of degraded data, the last two significant digits have dashes across them (refer to 3.04.28).

### ② Memo indications : (green)

**WARNINGS AND CAUTIONS**



E / WD : FAILURE TITLE 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 It	3, 4, 5, 7, 8 *	
CTR TK PUMP 1(2) LO PR				CTR TK PUMP 1(2) FAULT It		
CTR TK PUMPS LO PR				CTR TK PUMP FAULT Its		
CTR TK PUMPS OFF CTR TK pb at OFF with no FAULT				OFF It on CTR TK PUMP pb	1, 3, 4, 5, 7, 8, 9, 10	
AUTO FEED FAULT (CTR TK > 250 kg (550 lb) and L or R WING TK < 5000 kg (11000 lb) —OR— (CTR TK pumps do not stop after slat extension or CTR TK low level)				MODE SEL FAULT Its	3, 4, 5, 8	
L(R) WING TK LO LVL (750 kg - 1650 lb)				NIL	3, 4, 5, 7, 8, 9	
L + R WING TK LO LVL Low level detected in both wing inner cells (remaining flight time is about 30 min)						
L(R) OUTER TK HI TEMP or L(R) INNER TK HI TEMP Fuel temp above : in outer cell above 55° on ground in outer cell above 60° in flight in inner cell above 45° on ground in inner cell above 54° in flight						3, 4, 5, 7, 8
L(R) XFR VALVE CLOSED both transfer valves fail to open after inner cell low level						
ENG 1(2) LP VALVE OPEN valve disagree in open position						4, 5, 7, 8

\* inhibited if pump selected OFF

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
APU LP VALVE FAULT valve position disagree	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
L(R) OUTER TK LO TEMP or L(R) INNER TK LO TEMP fuel temperature < - 48°C					
L(R) TK PUMP 1(2) LO PR				L(R) TK PUMP 1(2) FAULT It	
L(R) XFR VALVE OPEN either transfer valve opens before inner cell reaches low level				NIL	
X FEED VALVE FAULT valve position disagree					
FQI CH 1 (2) FAULT					

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

**MEMO DISPLAY**

- OTR TK FUEL XFRD appears in green if at least one transfer valve is open in one wing tank.
- CTR TK FEEDG appears in green if at least one center tank pump is energized.
- FUEL X FEED appears in green if fuel X FEED valve pushbutton switch is ON and X FEED valve is not fully closed. It appears in amber in flight phases 3, 4 or 5.
- REFUELG appears in green when the fuselage refueling control panel door is opened.

**BUS EQUIPMENT LIST**

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
FQI	CH 1				SHED	(1)
	CH 2		DC2			(1)
INNER TANK PUMPS	L 1	AC1 (3)	DC1		X (2) (3)	
	L 2	AC2	DC2			
	R 1	AC1 (3)	DC1		X (2) (3)	
	R 2	AC2	DC2			
CTR TK PUMPS (←)	1	AC1	DC1			
	2	AC 2	DC2			
CROSS FEED VALVE	MOT 1				SHED	
	MOT 2		DC2			
ENGINE LP VALVES	ENG 1 MOT 1				X	
	ENG 1 MOT 2		DC2			
	ENG 2 MOT 1				X	
	ENG 2 MOT 2		DC2			
XFR VALVES	L 1				SHED	
	L 2		DC2			
	R 1				SHED	
	R 2		DC2			
APU	PUMP			AC STAT INV or AC ESS SHED		HOT 1
	LP VALVE		DC BAT			HOT1
REFUEL VALVES			DC2			(1)

- (1) HOT BUS supplies power during refueling on battery.
- (2) This occurs if DC BUS 1 is lost.
- (3) In smoke configuration (GEN 1 LINE pushbutton OFF), inner tank pumps 1 are supplied directly by IDG (instead of AC 1) and pump relays by DC ESS (instead of DC 1).