



16.10 GENERAL

16.20 ENGINE BLEED AIR

16.30 APU BLEED AIR AND CROSSBLEED

16.40 AIR LEAK DETECTION

16.50 WING VENTILATION

16.60 ECAM

16.70 MAINTENANCE PANEL

The pneumatic system consists of all the systems designed to supply air to the various aircraft systems, zones or engines, with associated control, monitoring and indicating components.

The pneumatic system supplies high pressure air for :

- Engine starting.
- Air conditioning and pressurization.
- Hydraulic reservoir pressurization (on ground or in an emergency).
- Wing anti-icing.
- Potable water tank pressurization.

Compressed air is obtained from three sources :

- . High pressure air is bled from the engine compressors at the IP and HP stages. The bleed air is pressure regulated and precooled, using fan air ;
- . The APU compressor ;
- . One or two HP ground air supply units.

The pneumatic system includes :

- . The temperature and pressure regulation systems of air bled from the HP stages of the engine compressor, located in the nacelles and pylons.
- . The APU bleed air supply and crossbleed (crossfeed) systems, mainly located in the mid and aft fuselage.
- . The ground compressed air supply system provided to supply the systems from distribution HP ground air supply units through ground connectors.

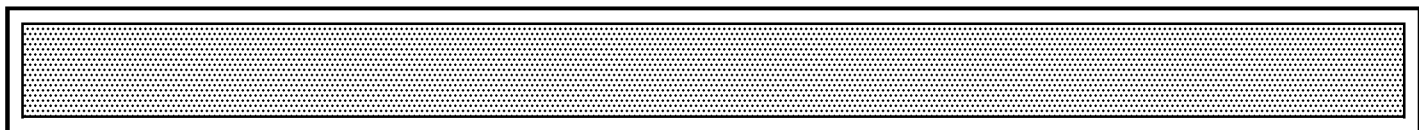
Monitoring of the pneumatic system operation and failure detection is achieved by :

- . pressure and temperature indications of air supplied by the system (overhead panel, lateral panel, L and R ECAM display units).
- . protection against overheat, due to possible leakage around the hot air ducts.

Two independent systems bleed air directly from each engine to supply :

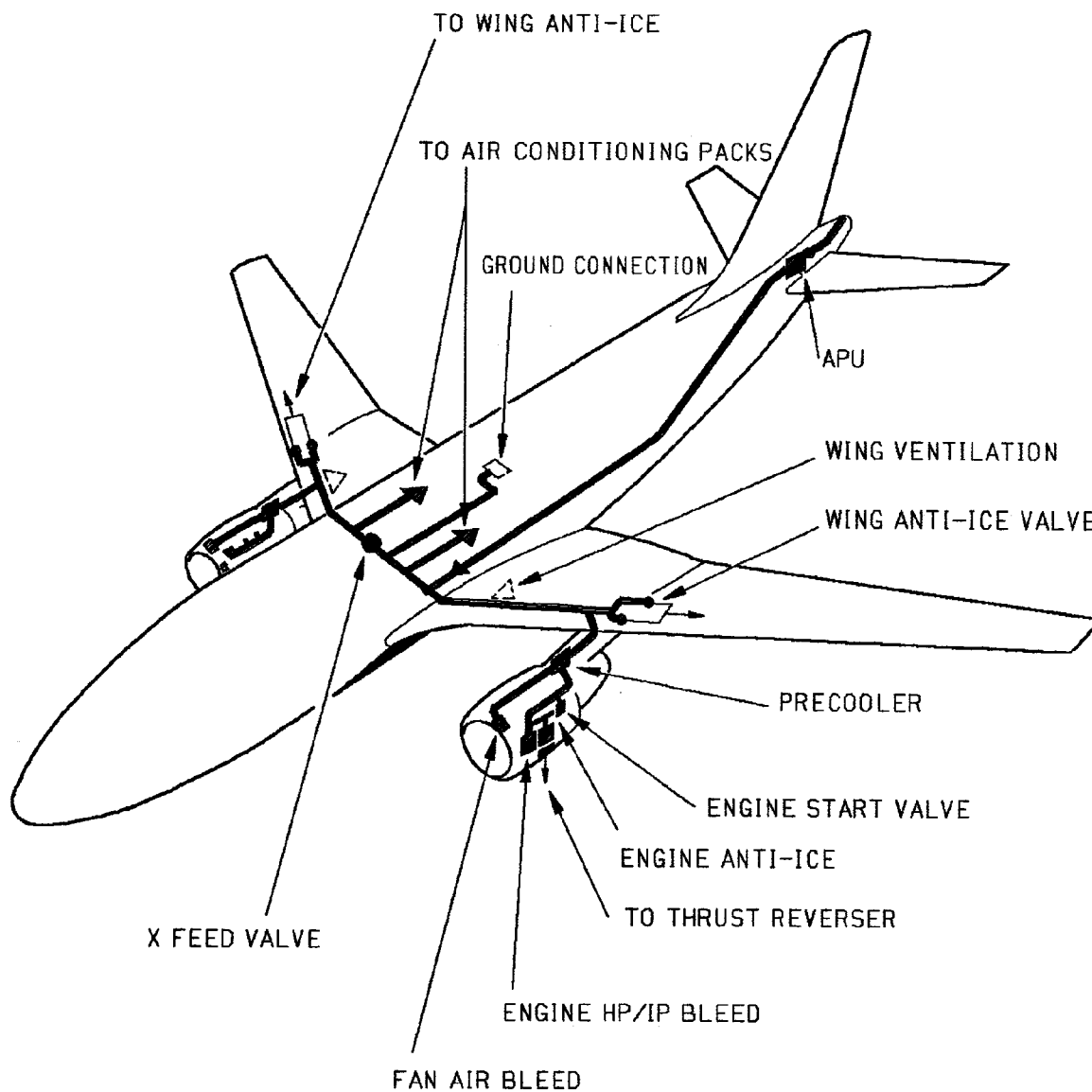
- . the thrust reverser.
- . the engine air intake ice protection system

R Code : 1610A



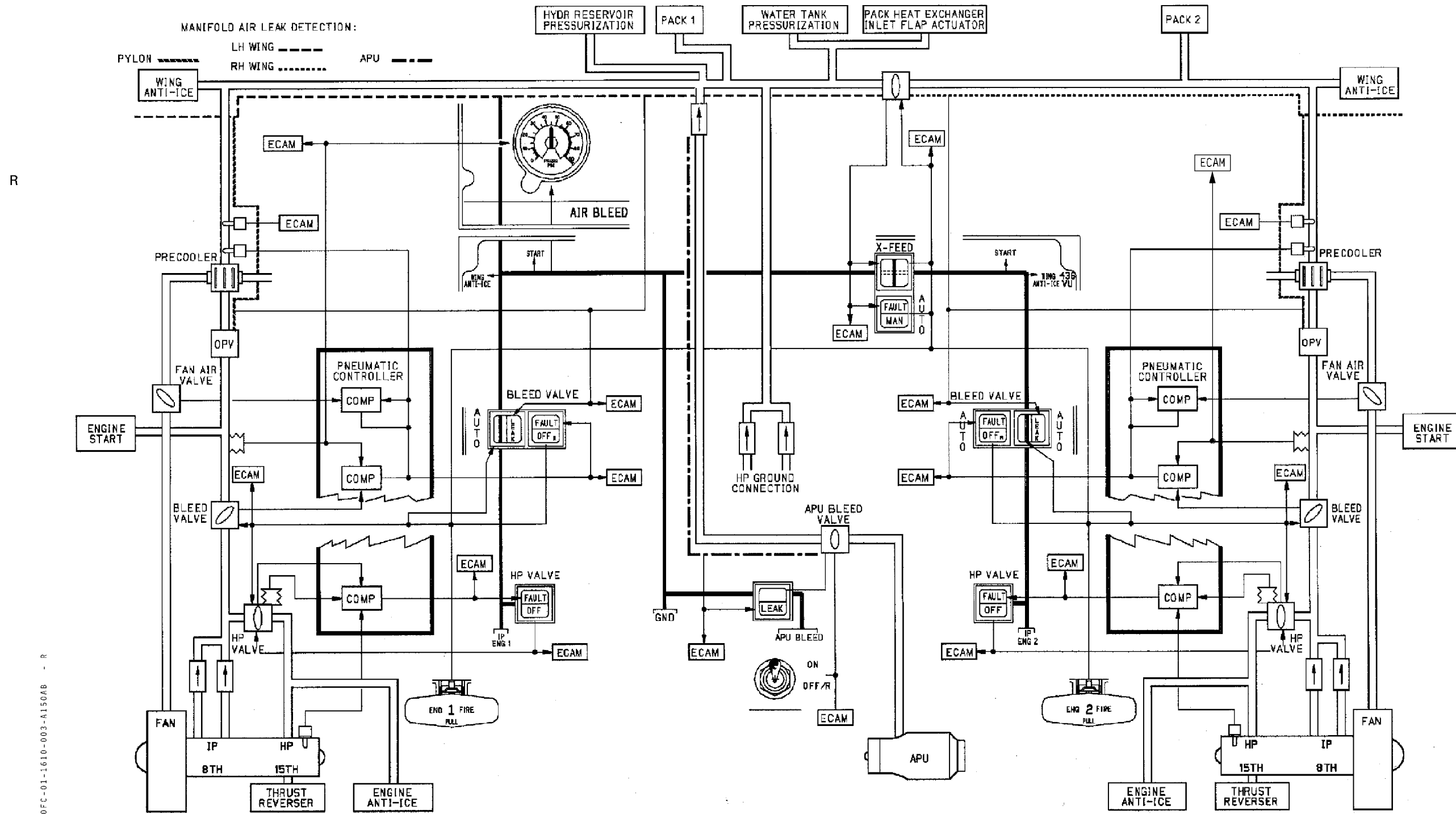
AIR SUPPLY SYSTEM

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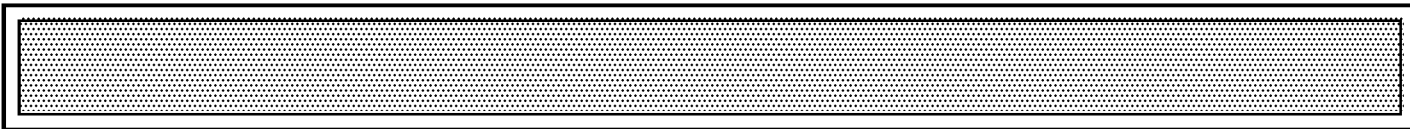
PW Eng. : All

GENERAL SCHEMATICS



Mod : 3881

PW Eng : All



GENERAL

The system is designed to :

- R – control the supply of bleed air from the engine using IP bleed air, plus HP bleed air when required,
- R – regulate bleed air pressure,
- R – regulate bleed air temperature.

AIR BLEED SELECTION

Air is generally bled from an intermediate stage of the engine HP compressor (IP stage) to minimize engine pressure losses.

During low engine speeds, when the pressure from the IP stage is low, air is automatically bled from the last compressor stage (HP stage), particularly during descent, with engines at idle.

Supply of HP bleed air is provided by a pneumatically operated, electrically controlled butterfly valve, called the HP valve.

When the HP valve is closed, air is directly bled from the IP stage through IP bleed air check valves.

When the HP valve is open, the HP stage pressure is higher than the IP bleed pressure and thus closes the check valves ; air is therefore bled from HP stage only.

The HP valve pneumatic operation is controlled by two solenoids which allow opening of the HP valve up to different pressures depending on whether wing anti-ice is selected or not. In normal automatic operation the HP valve is :

- Pneumatically opened when the bleed pressure is below that required.
- Electrically closed if the HP bleed temperature or pressure exceed preset values.

PRESSURE REGULATION AND LIMITATION

Downstream of the junction of the IP and HP bleed air supply is a pneumatically operated electrically controlled butterfly valve called the Bleed Valve, which acts as a shutoff and pressure regulating valve.

The bleed valve regulates the bleed air pressure supplied to the aircraft at 46 PSI, provided the supply pressure is sufficient.

The bleed valve automatically closes in the following cases :

- . pneumatic controller fault
- . overheat at the precooler outlet,
- . bleed leak detection,
- . failure of pressure regulation,
- . failure of temperature regulation at the precooler outlet,
- . actuation of the associated ENG FIRE handle,
- . APU bleed valve open.

In the absence of air pressure, the valve is spring-loaded closed independently from electrical power supply.

An overpressure valve installed at the pylon duct inlet protects the system against overpressure.

TEMPERATURE REGULATION AND LIMITATION

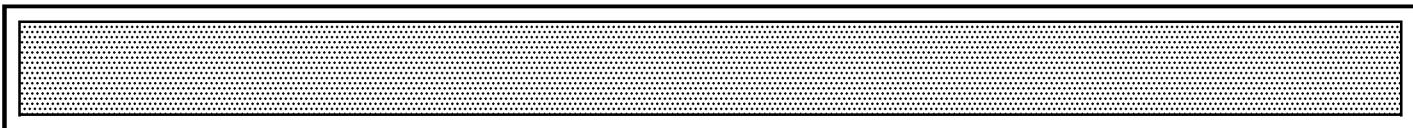
Under stabilized conditions, the system limits temperature downstream of the Bleed Valve by means of an air to air heat exchanger called the Precooler. It uses cold air from the engine fan supplied via the Fan Air Valve.

This is a butterfly valve pneumatically operated and electrically controlled by the pneumatic controller. In the absence of air pressure, the valve is spring loaded closed independently from electrical power supply.

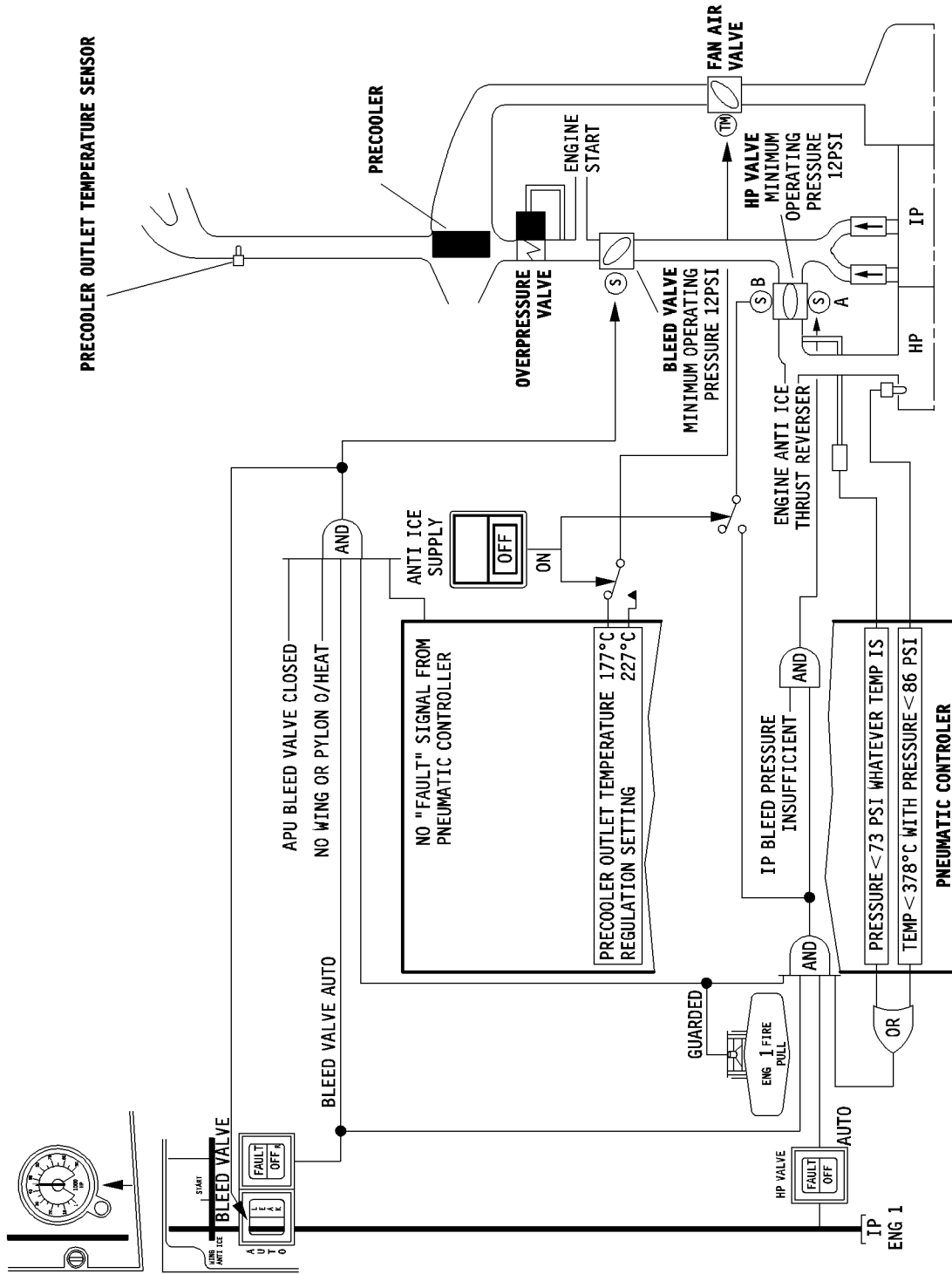
A sensor measuring the precooler outlet temperature is connected to the pneumatic controller. This temperature is used to control the Fan Air Valve operation, regulating the precooler outlet temperature and also to provide a precooler overheat warning as follows :

- . The normal precooler outlet temperature regulation is around 177°C, this setting is increased to 227°C in flight with wing anti-ice ON.
- . The normal precooler overheat detection is set at 207°C, this setting is increased to 255°C, in flight with wing anti-ice ON, or the other engine BLEED VALVE selected OFF.

Mod : 5146 + 6007



GENERAL SCHEMATICS

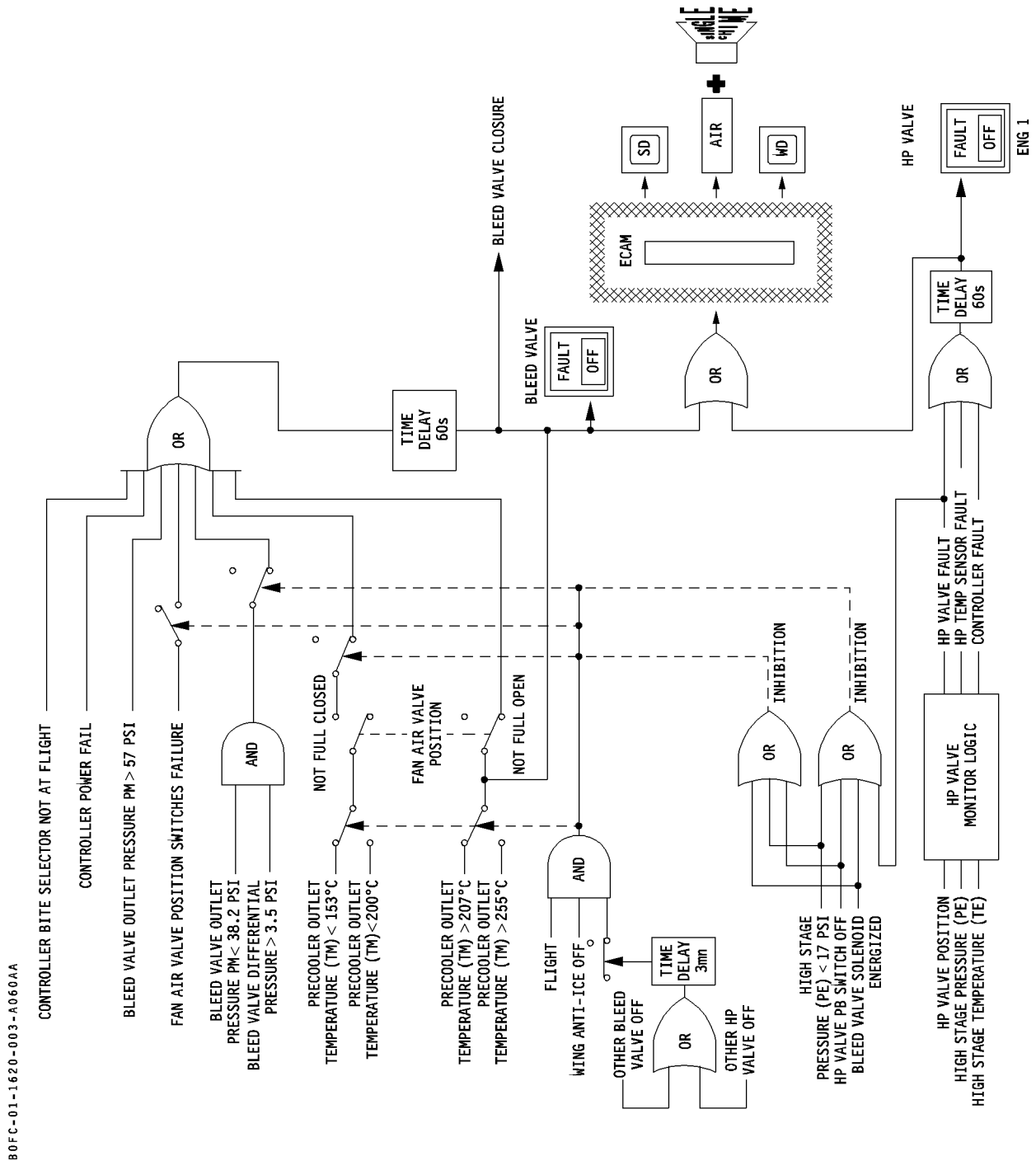


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Code : 0130

PW Eng. : All

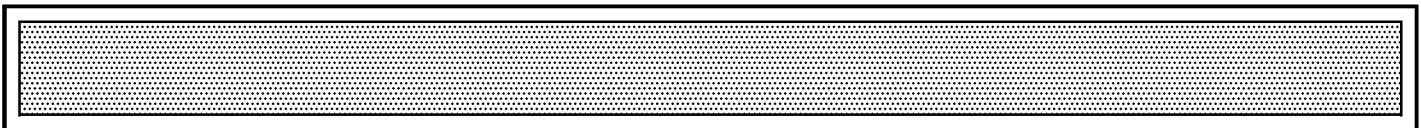
WARNING LOGIC



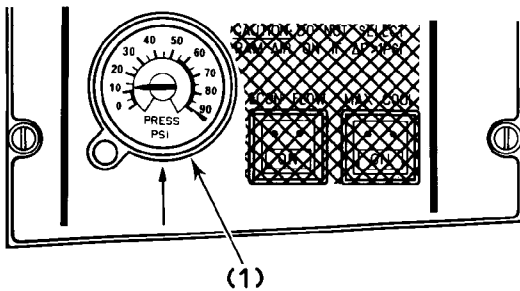
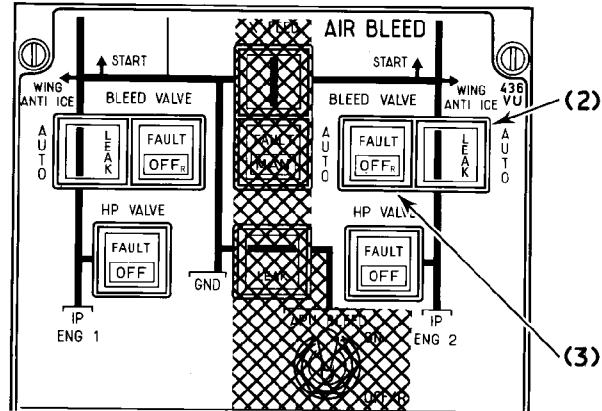
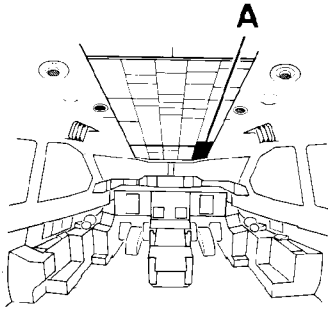
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Mod. : 5051 + 5146 + 6007



A. AIR BLEED PANEL



FB1.1620.004-AA.001

(1) PRESS Indicator

The indicator shows the pneumatic pressure at the ENG 1 bleed valve outlet.
 The normal pressure ranges between 30 and 50 PSI.

(2) BLEED VALVE Annunciator

▪ **Flowbar :**

- . In line, green : the ENG 1 (2) bleed valve is controlled open.
- . Off : the ENG 1 (2) bleed valve is controlled closed.

▪ **LEAK :**

The light comes on amber accompanied by ECAM activation when ambient overheat, due to leak, is detected by the related loops in wing or pylon.
 The associated bleed valve closes automatically.

(3) BLEED VALVE Pushbutton Switch

It controls operation of the associated engine bleed valve. A FAULT and an OFF/R light are integrated in the P/B switch.

▪ **AUTO (P/B switch pressed-in) :**

Flowbar integrated in the BLEED VALVE annunciator is in line when the valve is controlled open. The valve operates automatically. It opens and regulates pressure provided the APU BLEED valve is closed.
 The bleed valve is automatically latched after automatic closure in the event of leakage or failure, and the flowbar goes off.

▪ **OFF/R (P/B switch released-out) :**

Flowbar is off, the OFF/R light comes on white.
 The bleed valve and the HP valve are closed, bleed valve latching is reset :

▪ **FAULT :**

The light comes on amber accompanied by ECAM activation when :

- . Bleed valve temperature or pressure regulation fails.
- . Overheat at the precooler outlet.
- . Pneumatic controller fault
- . Fan air valve not at commanded position.

FAULT light remains on as long as overheat prevails.

R
R

R

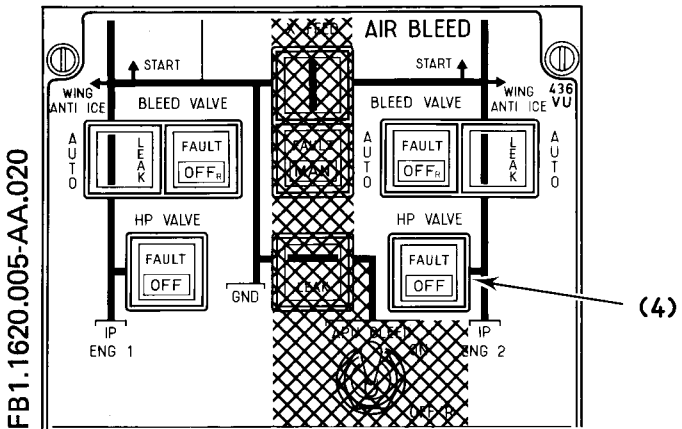
R
R

R

R

R

- **OFF (P/B switch released-out) :**
 The valve is closed and the OFF light comes on white.
- **FAULT :**
 The light comes on amber accompanied by ECAM activation when :
 - . The HP valve position does not agree with automatic command or P/B switch position.
 - . The HP valve fails (does not automatically close).
 - . The temperature sensors fail.



(4) HP VALVE Pushbutton Switch

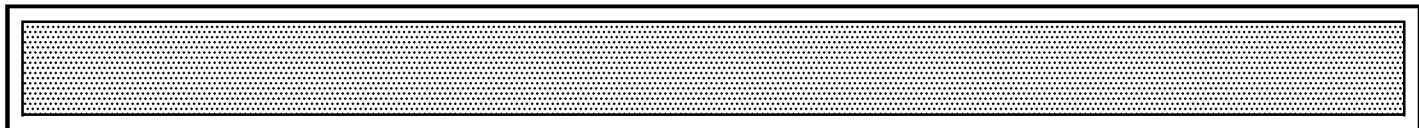
It controls the engine HP valve for HP stage air supply. An OFF and a FAULT indication are integrated in the P/B switch.

- **AUTO (P/B switch pressed-in) :**
 The valve is automatically open provided the related BLEED VALVE P/B switch is selected AUTO (pressed-in).
 The HP valve remains open as long as :
 - . With ANTI ICE WING SUPPLY P/B switch selected OFF : The HP stage pressure is lower than 86 PSI.
 - . With ANTI ICE WING SUPPLY P/B switch selected ON : The HP stage pressure is lower than 141 PSI.
 - . The HP stage temperature is lower than 378 ° C with pressure higher than 73 PSI.

The HP valve automatically closes when :
 . BLEED VALVE P/B switch is released – out to OFF/R.
 . Respective ENG FIRE handle is pulled.

R

PW Eng. : All



GENERAL

- R The APU Bleed and Cross Bleed system is designed to :
 - Supply the air conditioning system and, the wing anti ice system with air bled from the Auxiliary Power Unit (APU).
- R - Allow crossfeed between the LH and RH air bleeds.
- R - Supply air for engine start.
 - Pressurize hydraulic reservoirs when LH engine air bleed is not available.

APU BLEED AIR SUPPLY

- R Air supply from the APU is available on the ground and in flight up to a maximum authorized altitude of 20,000 ft.
 APU air bleed is controlled by an APU bleed valve which is an integral part of the APU.
- R
- R The APU bleed valve is a pneumatically operated, electrically controlled butterfly valve.
 In the absence of air pressure, the valve is spring-loaded closed.
- R The valve is automatically controlled closed when :
 - . APU compressor speed lower than 95 %
 - . reverse flow in APU air bleed ducting sensed by an airflow sensor associated with a built-in pressure switch
- R . an APU bleed leak or LH bleed leak is detected
- R A check valve located near the crossfeed duct prevents reverse bleed flow into the APU bleed duct.
- R
- R When the APU bleed valve is open, the engine bleed valves are automatically closed and APU output performance is modified and adapted to meet associated air system requirements (air conditioning, wing anti ice, engine starting).
- R

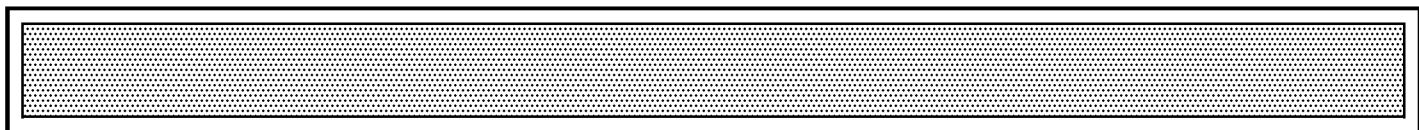
CROSSFEED

The crossfeed valve installed on the crossfeed duct is designed to isolate or interconnect both air bleed systems.
 The crossfeed valve is an electrically controlled, shutoff valve.
 For safety reasons, the valve is equipped with two electric motors which can both actuate the butterfly in the opening and closing directions : one motor is used in automatic mode, the other one in manual mode.
 Each motor includes a brake system which locks the butterfly in its actual position when power supply is cut off.

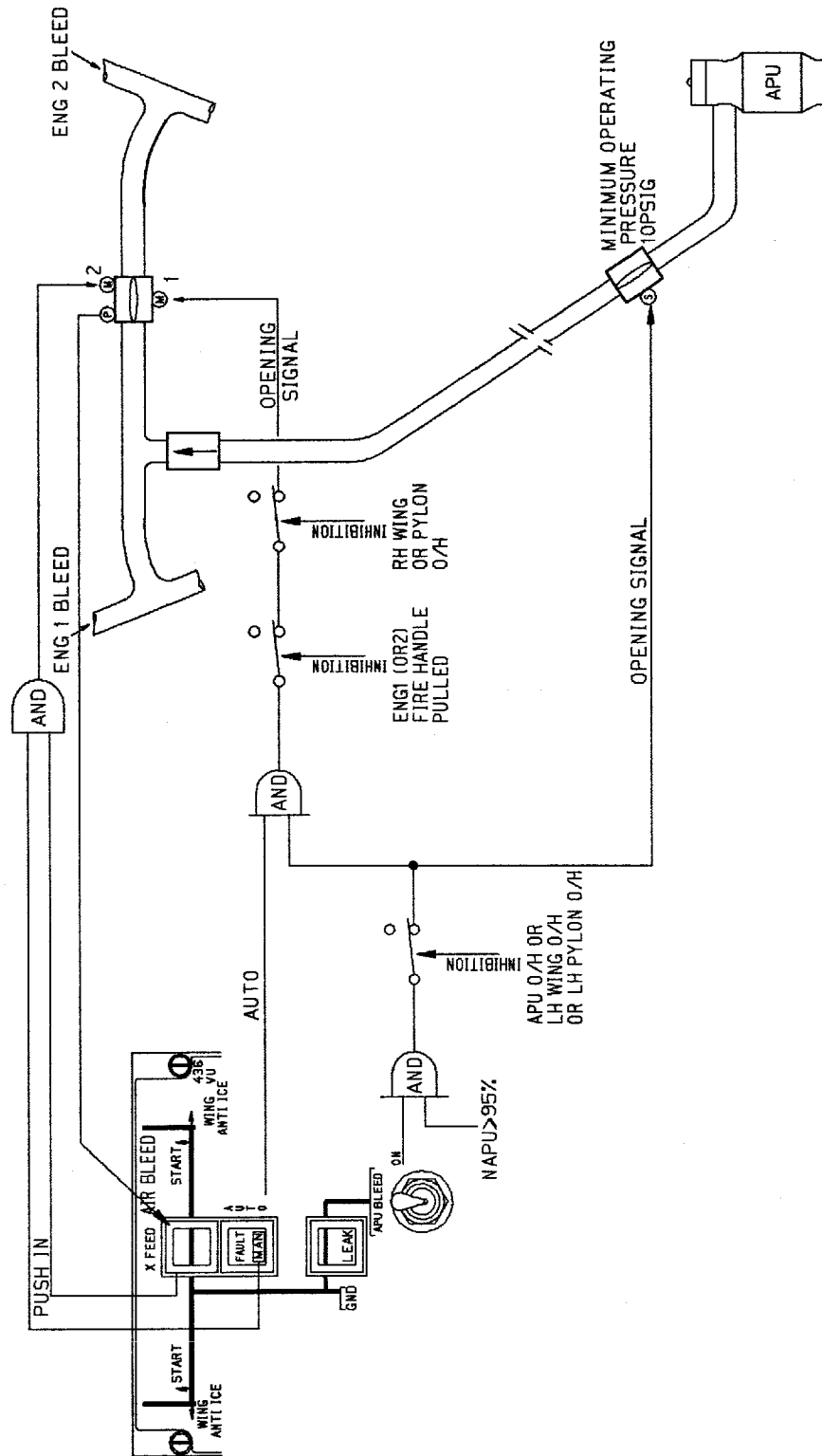
The valve can be selected open or closed using the XFEED pushbutton, after XFEED mode MAN is selected.
 In normal automatic operation, the crossfeed valve is controlled to the same position as the APU bleed valve, i.e. :
 Closed : when the APU bleed valve is closed and bleed is supplied by the engines
 Open : when the APU bleed valve is open.
 The Crossfeed Valve is also closed when :
 - Either ENG FIRE handle is pulled
 - LH, RH or APU bleed LEAK is detected.

GROUND COMPRESSED AIR SUPPLY SYSTEM

On the ground, the aircraft bleed system can be supplied by HP ground air supply units.
 This allows :
 - supply to the air conditioning packs (not recommended due to possible pack contamination)
 - engine starting
 - hydraulic reservoir pressurization.
 Air supply is achieved through two HP ground connectors located in the RH air conditioning pack cooling air inlet.



GENERAL SCHEMATICS

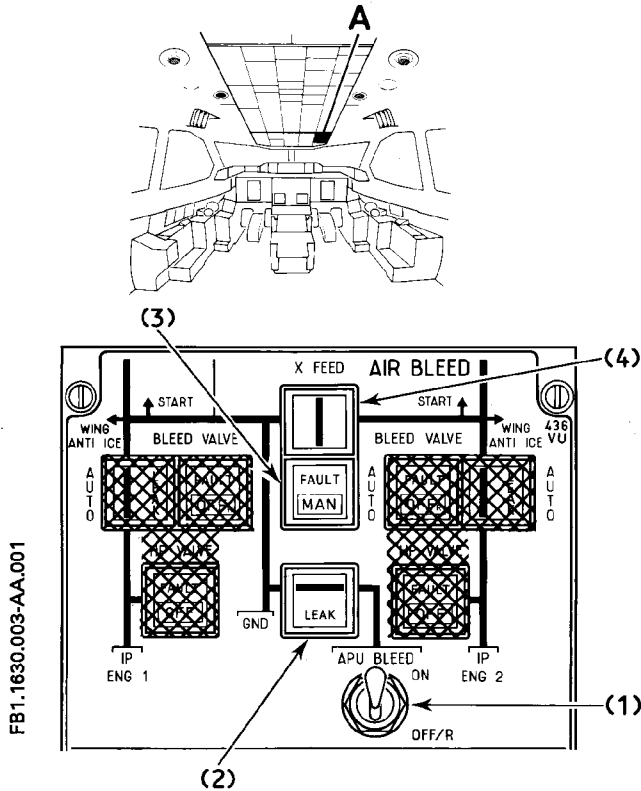


OPS.F.CO.B1.1630.002-AA.001

Vers. : All

Eng. : All

A. AIR BLEED PANEL



(1) APU BLEED Switch

The switch controls the operation of the APU bleed valve.

- R ■ **ON :**
 - Crossfeed valve opens if X FEED Mode P/B switch selected AUTO.
 - R · APU bleed valve opens and engine 1 and 2 bleed valves close, provided that the APU RPM is above 95 % and no APU or LH bleed leak is detected.
 - R
- **OFF/R :**
 - APU bleed valve closes and the automatic monitoring system is reset.

(2) APU BLEED VALVE Annunciator :

- **Flowbar :**
 - Comes on to indicate the position of the APU bleed valve.
 - In line : the valve is open
 - Off : the valve is closed.

■ **LEAK :**

Comes on amber accompanied by ECAM activation, when overheat is detected by the loops in APU pneumatic duct.

(3) X FEED Mode Pushbutton Switch

The P/B switch selects the operating mode, automatic or manual, of the crossfeed valve.

■ **AUTO (P/B switch pressed-in) :**

Valve operates automatically actuated by electric motor 1. The crossfeed valve is open when air is bled from the APU.

The crossfeed valve is closed when :

- air is bled from engines 1 and 2
- ENG 1 (2) FIRE handle is pulled
- APU FIRE handle is pulled
- overheat is detected in APU or LH (RH) wing or LH (RH) pylon ducts.

■ **MAN (P/B switch released-out) :**

The MAN light comes on white. The crossfeed valve is operated manually by pressing the X FEED flowbar pushbutton switch which activates electric motor 2.

■ **FAULT :**

The light comes on accompanied by ECAM activation when crossfeed valve position disagrees with automatic selected position.

Note : The FAULT light comes on without ECAM activation during valve transit in automatic mode.

(4) X FEED Valve position Pushbutton Switch

In AUTO mode the selection of the X FEED valve position P/B switch is without any effect on valve positioning and related indication.

In MAN mode :

■ **Pressed-in :**

The X FEED valve is manually opened

■ **Released-out :**

The X FEED valve is manually closed. The integrated green flowbar displays valve position.

■ **In line :**

The valve is open (automatically or manually)

■ **Cross line :**

The valve is closed (automatically or manually)

GENERAL

R This continuous monitoring system is designed to detect, by means of detection loops, any ambient overheat, to protect the structures and components in the vicinity of the hot air ducts in the fuselage, pylons and wings, on which leaks or bursts may possibly occur.

The sensing elements comprise a central lead (nickel wire) embedded in an insulating material and are integrated in an inconel tube connected to aircraft ground.

Each sensing element is permanently subjected to the temperature of the compartment it protects : for any temperature higher than a preset value and applied to a small length of the element, the resistance of the eutectic mixture rapidly decreases and the central lead is grounded ; this results in an overheat signal transmitted from an overheat detection controller which triggers, illumination of annunciator lights and closing of the valve (s) associated with the affected system.

The sensing elements are tied to form a single or double loop. The detection loops are installed in the following aircraft areas.

ENGINE PYLON MONITORING AREA

Each LH and RH engine pylon is provided with a continuous overheat monitoring system, more particularly located at the outlet of the pylon ventilation duct.

The system is designed as a single loop and the overheat signal is triggered at $204^{\circ}\text{C} \pm 12^{\circ}\text{C}$.

WINGS AND FUSELAGE CENTER SECTION MONITORING AREA

The aircraft is divided into two zones, LH and RH, independently from the sensing element routing through the wings and the fuselage center section.

The separation is made at level of the crossfeed valve.

Each zone is provided with a continuous overheat monitoring system comprising twin loops, in order to eliminate spurious warnings.

The overheat signal is triggered at $124^{\circ}\text{C} \pm 7^{\circ}\text{C}$.

The sensing elements are routed :

- through each wing along the front web of the wing spar box.
- through the fuselage center section, in line with orifices drilled in the duct double shroud.

FUSELAGE AFT SECTION AND APU MONITORING AREA

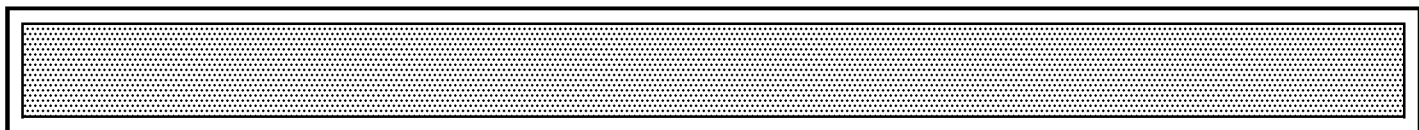
Hot air supply system from the APU comprises a single detection loop, running from the check valve near the crossfeed duct to the APU compartment (excluding the associated fire zone).

Overheat signal triggered at :
 (Td = temperature detection)
 $T_d = 124^{\circ}\text{C} \pm 7^{\circ}\text{C}$ between the check valve and FR80
 $T_d = 154^{\circ}\text{C} \pm 9^{\circ}\text{C}$ between FR80 and the APU compartment.

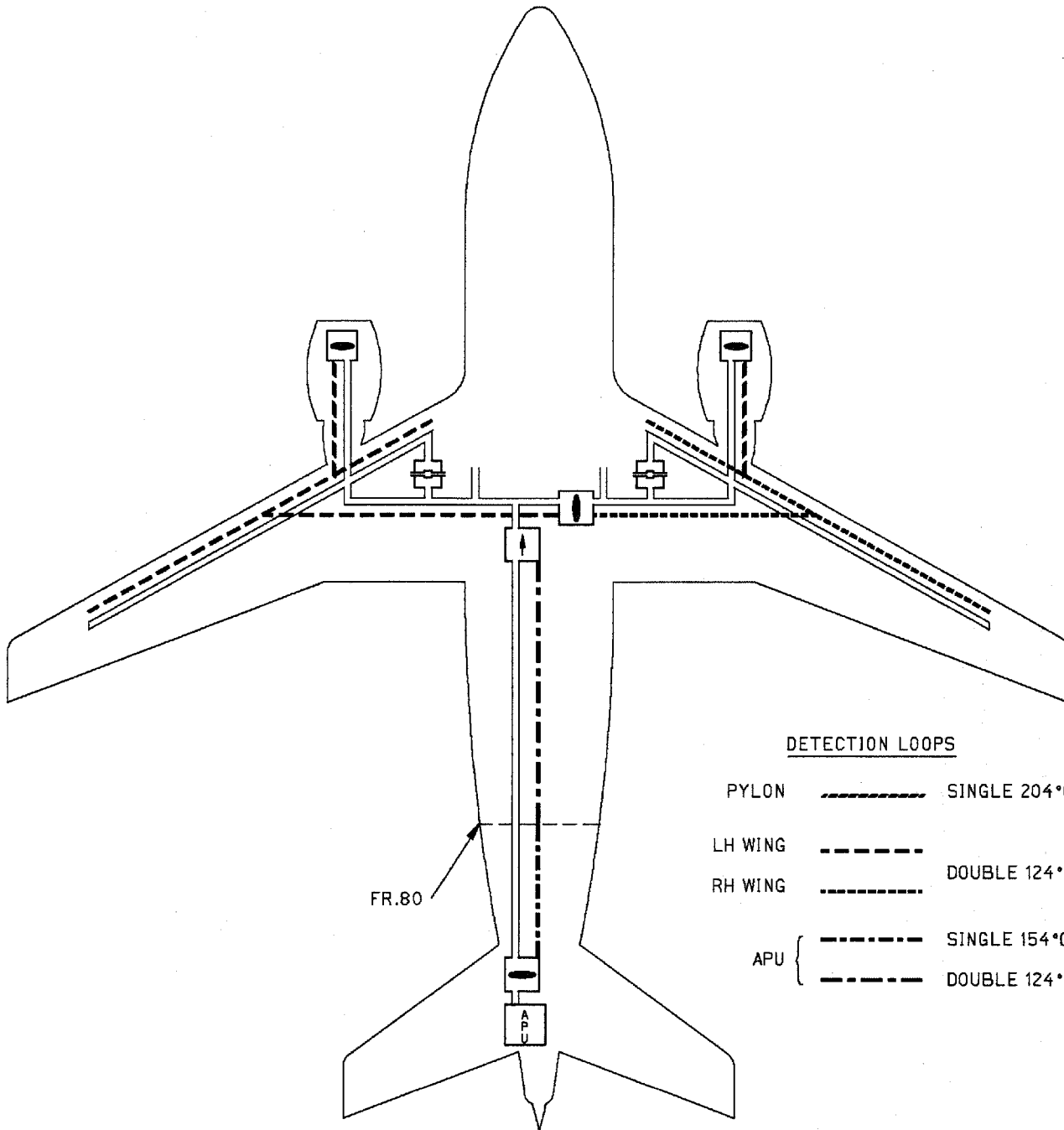
In the event of overheat, the corresponding amber LEAK light comes on on the overhead panel and the ECAM system is activated.

This light remains on as long as the overheat condition prevails. But the valves affected by overheat (s) are spring loaded closed and the circuits must be reset to open the valves when the overheat condition has disappeared.

Moreover, in the event of pylon or wing overheat, WING/or PYLON / LEAK memorized fault annunciator (MFA) comes on on the lateral panel and remains on even after the overheat condition has disappeared ; this facilitates fault isolation after aircraft landing.



DETECTION LOOPS



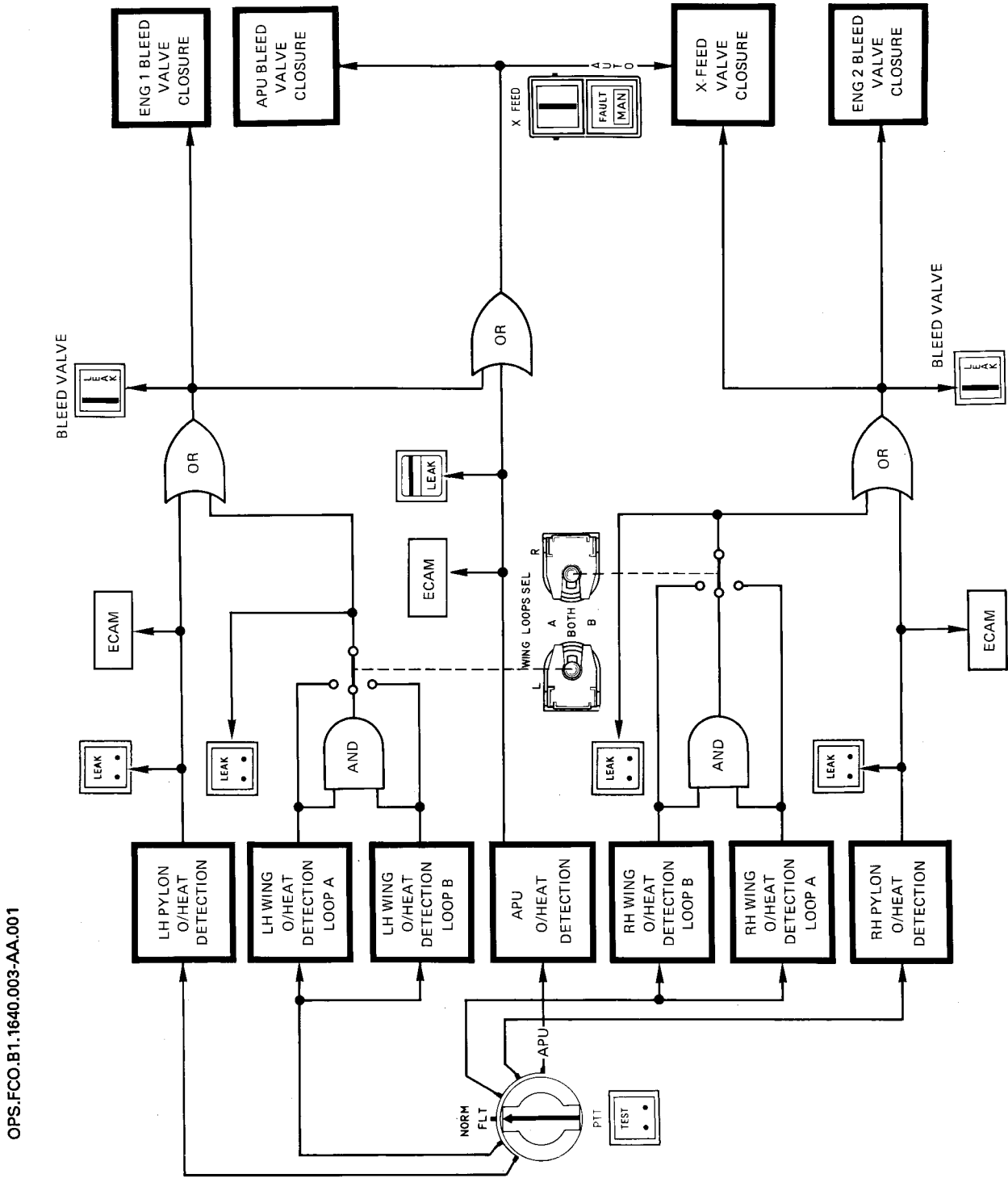
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Vers. : All

Eng. : All

LOGIC DIAGRAM

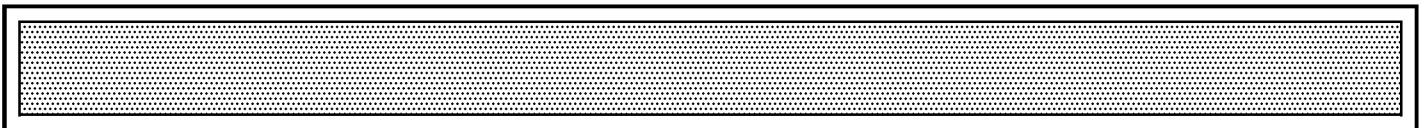
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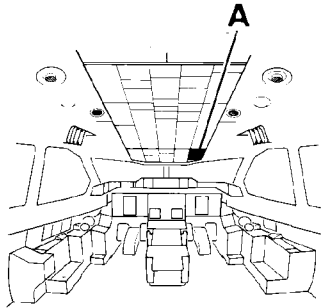
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Vers. : All

Eng. : All



A. AIR BLEED PANEL

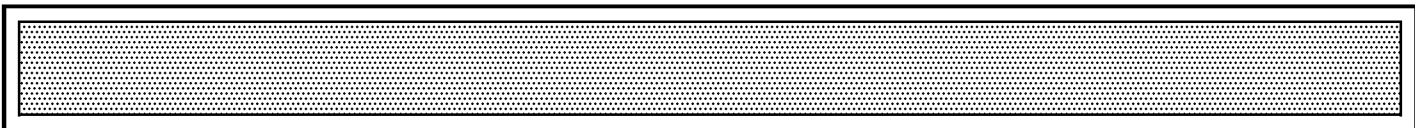
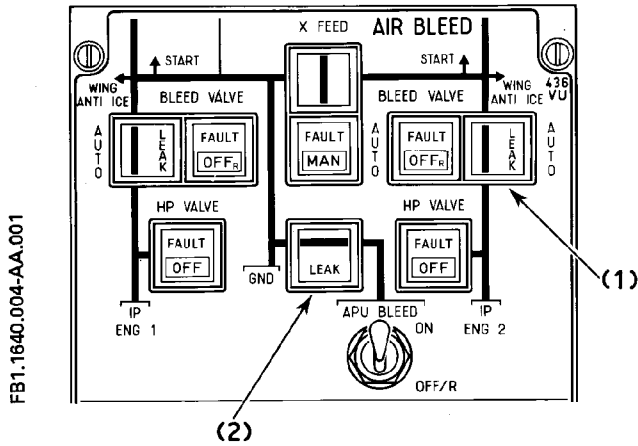


(1) BLEED VALVE Annunciator

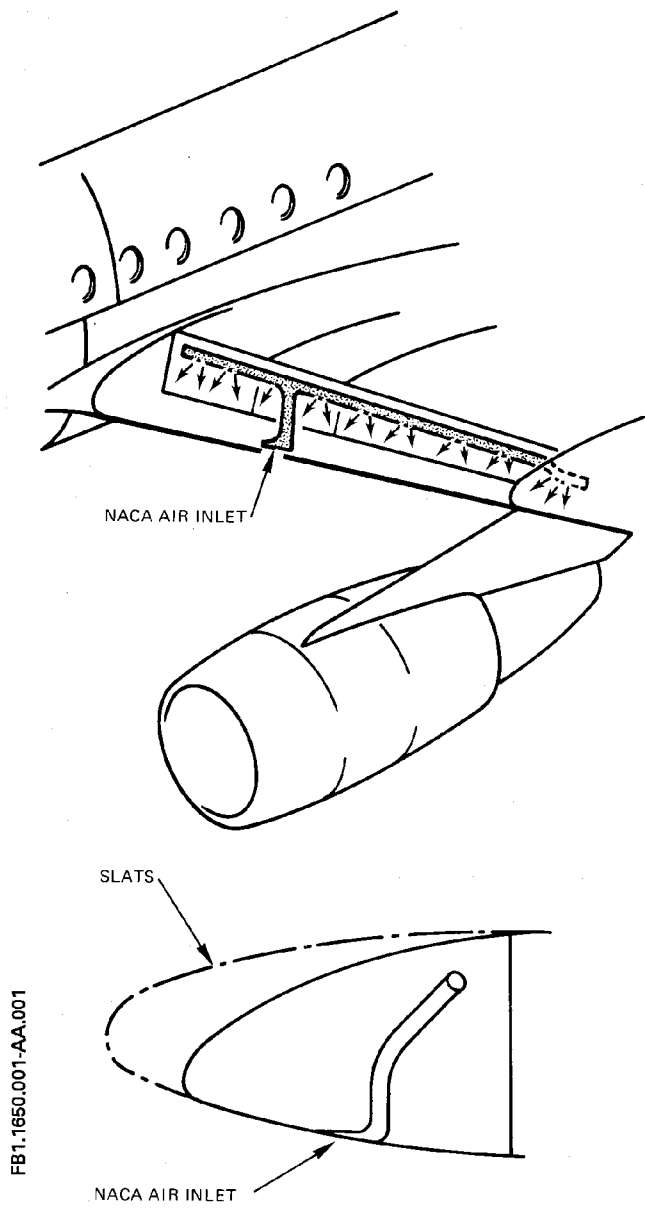
The LEAK light comes on amber accompanied by ECAM activation when ambient overheat, due to leak, is detected by the related loops in wing or pylon. The associated bleed valve closes automatically.

(2) APU BLEED VALVE Annunciator :

The LEAK light comes on amber accompanied by ECAM activation when overheat is detected by the loops in APU pneumatic ducts.

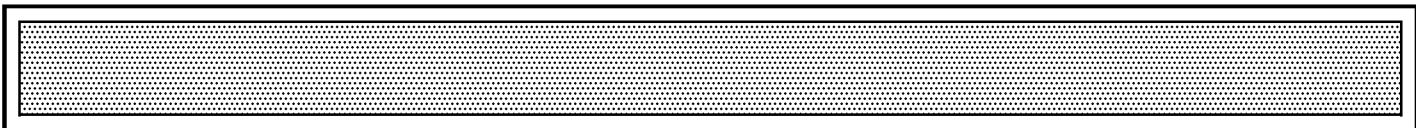


Ventilation of the wing leading edge section, located between the engine pylon and the fuselage, is ensured, in flight only by a NACA type ram air inlet circulating ram air and supplying a piccolo tube for distribution of air to the spar box in which the air bleed ducts are located. No monitoring or manual control is provided.

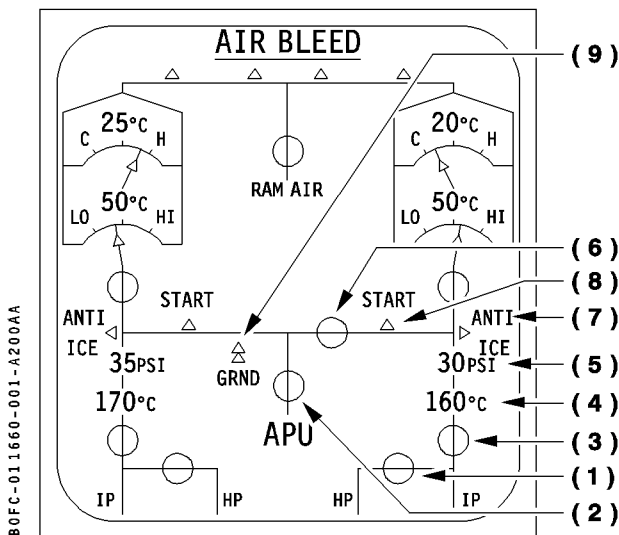


Vers. : All

Eng. : All



PNEUMATIC SYSTEM DISPLAY



(3) Bleed Valve Position Indication :

	Green	The bleed valve is controlled open
	Amber	The bleed valve is controlled closed.

(4) Precooler Temperature Indication :

The temperature indication becomes amber when

- the temperature $\geq 255^\circ\text{C}$ with WING ANTI ICE selected ON or one BLEED VALVE OFF.
- the temperature $\geq 207^\circ\text{C}$ with WING ANTI ICE selected OFF and both BLEED VALVES ON.

(5) Precooler Pressure Indication :

The pressure indication becomes amber when the pressure $\leq 8\text{ PSI}$ or $\geq 57\text{ PSI}$.
Engine 1 indication is replaced by amber "XX" if the associated input signal is lost.

R
R

(6) Crossfeed Valve Position Indication :

	Green	The crossfeed valve is open.
	Green	The crossfeed valve is closed.

(1) HP Valve Position Indication

	Green	The HP valve is open
	Green	The HP valve is closed automatically
	Amber	The HP valve is closed : - The HP VALVE P/B switch is selected OFF.

*Note : After engine shut down, the valve may be shown open.
This indication has to be disregarded.*

(2) APU Bleed Valve Position Indication :

	Green	Only displayed if APU MASTER SW is in ON position, the APU bleed valve is open.
	Amber	Only displayed if APU MASTER SW is in ON position, the APU bleed valve is closed.
	White	Replaces valve indication when APU MASTER SW is in OFF position

(7) Wing Anti Ice Indication :

ANTI ICE	White	ANTI ICE indication is only displayed when WING SUPPLY P/B-switch is selected ON.
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(8) Engine Start Indication :

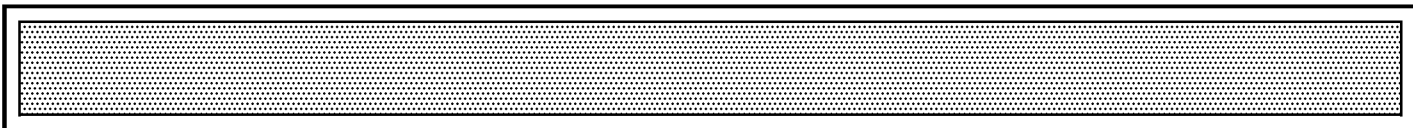
START	White	START indication is only displayed when START A, START B or CRANK is selected on the ignition selector.
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(9) Ground Supply Indication :

The ground supply indication is not displayed in flight.

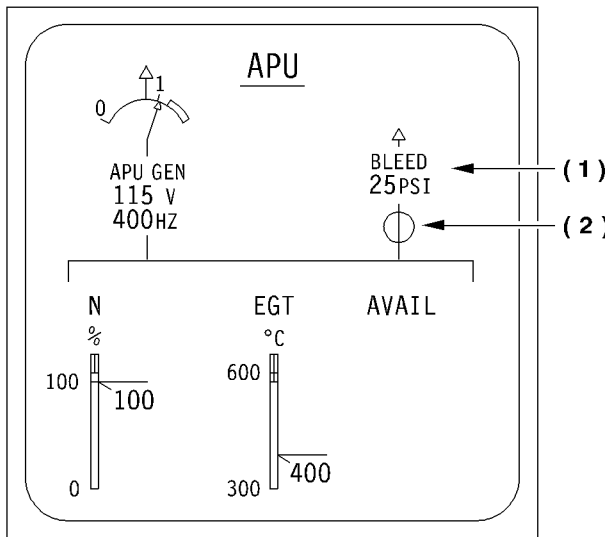
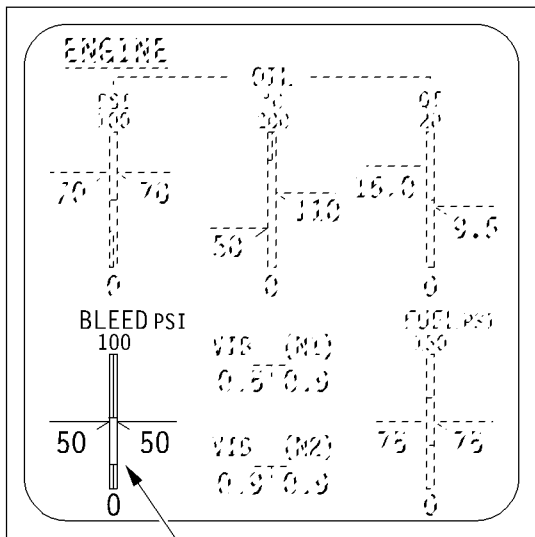
GRND	White	The ground supply indication is displayed independently of ground supply connection.
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Mod. : 5146 + 5448 + 7259



ENGINE START PAGE

APU PAGE



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(1) BLEED pressure indication :

The indication is green

- becomes amber when the pressure is :
 - lower than 8 PSI during engine start
 - or
 - greater than 57 PSI.

R
R
R
R

Note : Indication is replaced by "XX" in amber in case of loss of electrical power supply.

(1) APU BLEED Pressure Indication

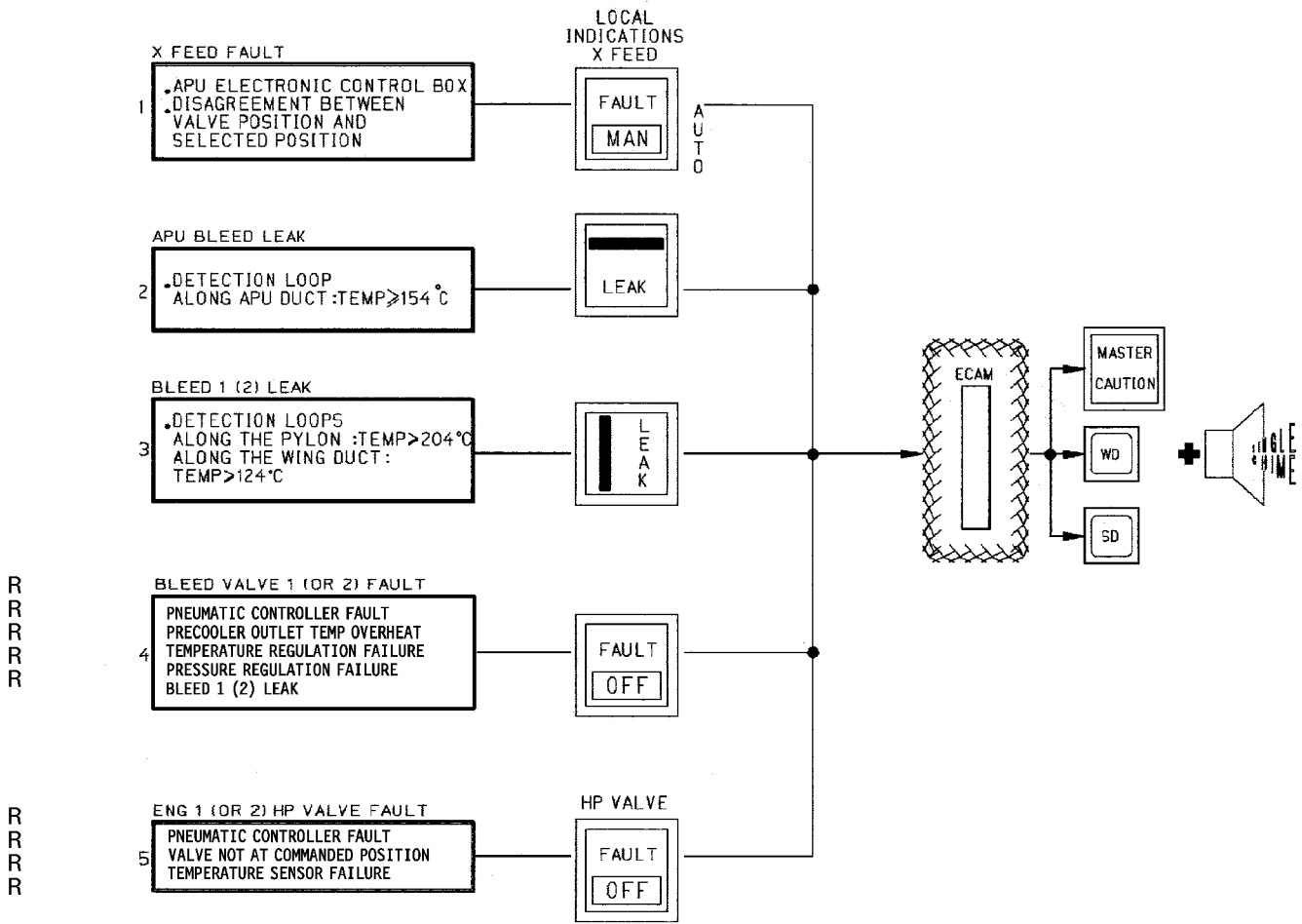
The indication is green.

There is no indication displayed when the APU BLEED valve is closed.

(2) Bleed Valve Position Indication :

	Green	APU BLEED valve open
	Green	APU BLEED valve closed

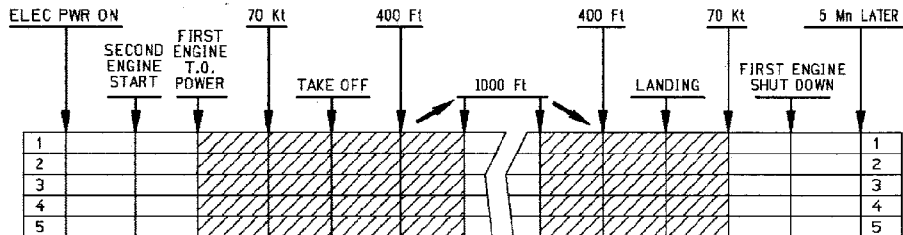
WARNING LOGIC



R
R
R
R

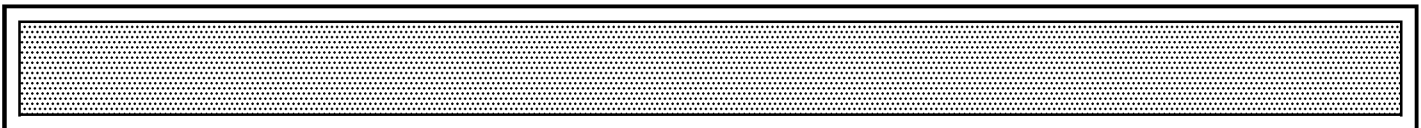
R
R
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ECAM AUTOMATIC FLIGHT PHASE INHIBITION

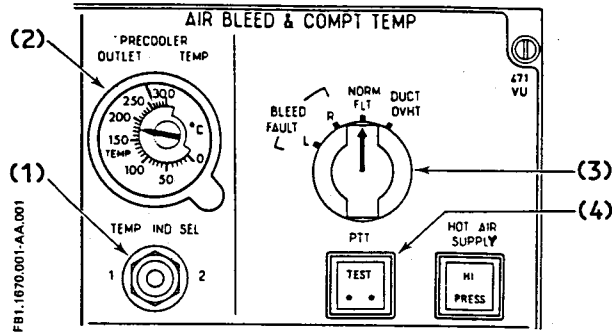


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Mod. : 5051



A. AIR BLEED and COMPT TEMP PANEL



(4) PTT Pushbutton Switch :

A TEST indication is integrated in the PTT (Press To Test) P/B switch. The P/B switch initiates the test of the selected warning circuit.

■ **TEST**

The light comes on white when the AIR BLEED and COMPT TEMP TEST rotary selector is placed in a test position.

The light is off with test selector in NORM FLT position.

■ **Pressed and held**

The selected circuit is tested.

After a BLEED FAULT L (R) test, the corresponding BLEED VALVE P/B switch must be selected OFF/R to reset the detection circuits.

■ **Released**

Test circuit is deactivated.

(1) TEMP IND SEL Switch :

The selector switch controls the display of precooler outlet temperature on the PRECOOLER OUTLET TEMP indicator.

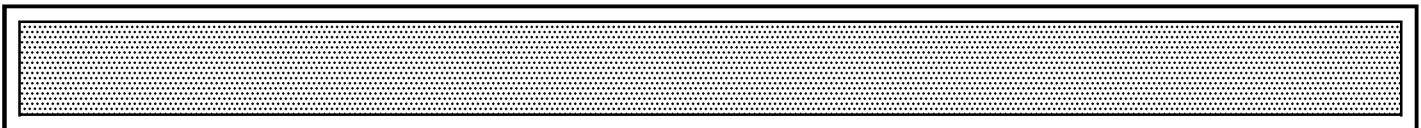
- 1 Precooler outlet temperature of ENG 1 is displayed.
- 2 Precooler outlet temperature of ENG 2 is displayed.

(2) PRECOOLER OUTLET TEMP Indicator :

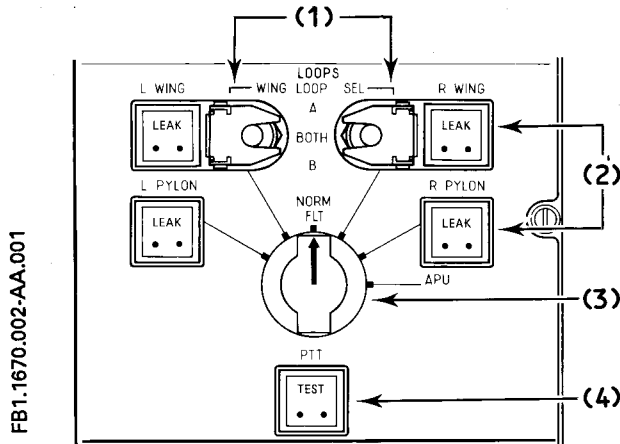
The temperature at the selected ENG 1 or ENG 2 precooler outlet is indicated in °C.
 Normal operating temperature is between 160 °C and 240 °C.

(3) AIR BLEED and COMPT TEMP TEST ROTARY SELECTOR :

The selector activates the PTT P/B switch and connects it to the respective BLEED FAULT or DUCT OVHT warning circuit.



B. LOOPS PANEL



(1) L/R WING LOOP SEL Switches :

Switches control the selection of wing loops for ground test.

The wing loops can be tested separately for ground test or one loop can be isolated if unreliable.

- **BOTH**
 (Normal guarded position) : Signal from both loops A and B required to trigger LEAK warning.
- **A or B**
 During test or in the event of loop failure, warning is triggered by the selected loop A or B.

(2) L (R) WING/PYLON LEAK Memorized Fault Annunciator (MFA) :

Comes on white when the corresponding overheat is detected.

Annunciator remains on after overheat has disappeared to facilitate fault location on the ground. MFA goes off when MFA RESET P/B switch is pressed.

(3) Loop Test Rotary Selector :

Activates the PTT P/B switch and connects it to the selected loops in wing, APU or pylon pneumatic ducts for test.

The test may be performed with APU bleed air supply or with engine bleed air supply or without bleed air supply.

- **NORM FLT**
 Normal operating position. Test function is deactivated.
- **L (R) WING**
 The selected loops (A, B or BOTH) detection circuit in the LH (RH) wing pneumatic ducts and the LEAK warning electrical circuits are connected. Warnings are activated when PTT P/B switch is pressed. The TEST light in the PTT P/B switch comes on white.
- **APU**
 The loops detection circuit in the APU pneumatic ducts and the LEAK warning electrical circuit are connected. Warnings are activated when PTT P/B switch is pressed. The TEST light in the PTT P/B switch comes on white.
- **L (R) PYLON**
 The loops detection circuit in the LH (RH) pylon pneumatic ducts and the LEAK warning electrical circuit are connected. Warnings are activated when PTT P/B switch is pressed. The TEST light in the PTT P/B switch comes on white.

(4) PTT Pushbutton Switch

The P/B switch activates the test of the loop detection circuit selected by the test selector switch. A TEST indication is integrated in the P/B switch.

- **Pressed and held**
 The selected system is tested.
 If the test is successful :
 - Associated MFA comes on white
 - Associated LEAK light on overhead panel comes on accompanied by ECAM activation.
 - LO PR light of ANTI ICE/WING/SUPPLY P/B switch comes on on overhead panel.
- **Released**
 The loop detection circuit test is no longer activated and corresponding warnings are cancelled.
- **TEST**
 The light comes on white when the test rotary selector is placed in a circuit test position. It is off when the test selector switch is in NORM FLT position.