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GENERAL

The pneumatic system supplies high pressure air for:
- Air conditioning
- Engine starting
- Wing anti icing
- Hydraulic reservoir pressurization
- Water pressurization
- Pack bay ventilation turbofan actuation

High pressure air is supplied from three sources:
- Engines bleed systems
- APU load compressor
- Two HP ground connections

R Engine bleed systems are interconnected by a crossbleed duct to which the APU and ground sources are connected.
A valve, mounted on the crossbleed duct, allows the left side (ENG 1) and right side (ENG 2) to be interconnected.
Pneumatic system operation is controlled and monitored by two Bleed Monitoring Computers (BMC 1 and 2), the overhead control panel and the ECAM.
The APU bleed supply is controlled by the APU Electronic Control Box (ECB).
A leak detection system is provided to detect any overheat in the vicinity of hot air ducts.

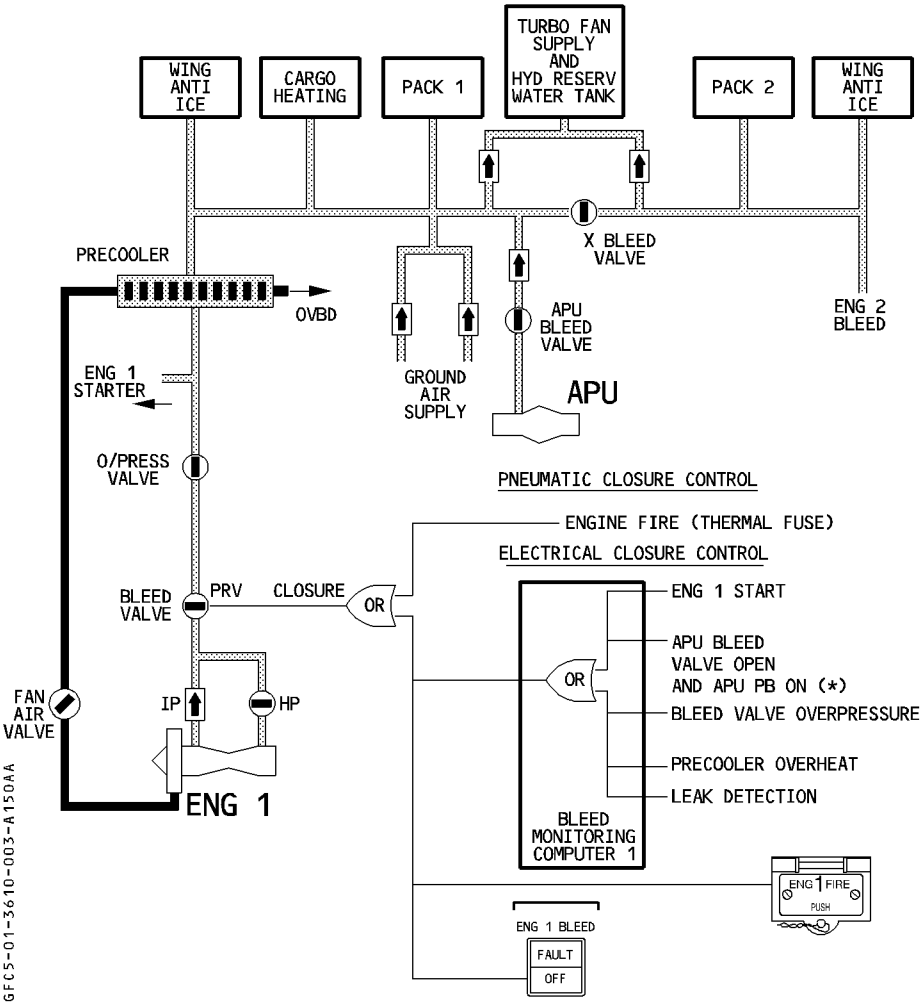
ENGINE BLEED SYSTEM

GENERAL

R Both engine bleed systems are similar
Each system is designed to:
– select the air source compressor stage
– regulate bleed air pressure
– regulate bleed air temperature
Each system is controlled and monitored by one Bleed Monitoring Computer.
Each BMC is provided with bleed pressure, temperature and valve position information, and is interconnected to:
– other systems involved with bleed system
– the other BMC
and provides indications and warnings to the ECAM and CMC.
In case of failure of one BMC, the other one takes over most of the monitoring functions.
Each bleed valve is electrically controlled by its associated BMC and pneumatically operated.

FOR INFO

R



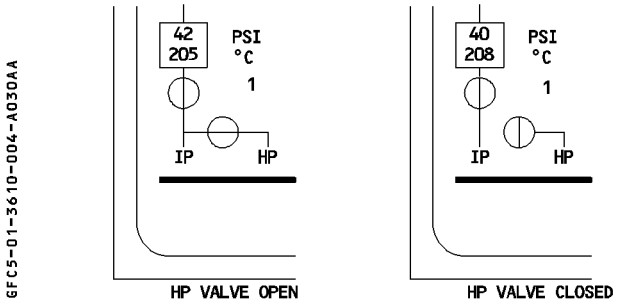
(*) The Engine 2 bleed valve closes, when the APU bleed valve opens, only if the crossbleed valve is open.

ENGINE AIR SUPPLY

R Air is normally bled from the intermediate pressure stage (IP) of engine HP compressor, to
R minimize fuel penalty.
When pressure from IP is not sufficient (low engine speed), air is bled from the high pressure (HP) stage thru the HP valve which limits downstream pressure to 40 ± 4 psi.
Two intermediate pressure check valves, one mounted downstream of each IP port, close to prevent air from HP stage being circulated to the IP stage.

ECAM INDICATION

R



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PRESSURE REGULATION AND LIMITATION

Downstream of the junction of HP and IP ducting, air is admitted into the bleed valve. This bleed valve acts as a shut-off, and as a Pressure Regulating Valve (PRV).
Delivery pressure is regulated between 44 and 52 psi, depending on the flow.
The pressure can be reduced, in case of over temperature at the precooler inlet.
In case of a pressure regulation failure, the overpressure valve (OPV) closes, when the pressure is greater than 85 psi.
The bleed valve is fully closed:

- Pneumatically, in case of:
  - Upstream pressure less than 8 psi, or
  - Engine fire (thermal fuse)
- Electrically through the :
  - BLEED pushbutton, when switched OFF.
  - ENG FIRE pushbutton, when pushed.
  - BMC, in the following cases:
    - Overtemperature
    - Overpressure
    - Leak detection
    - APU bleed ON (for Engine 2, provided the crossbleed valve is not closed).
    - Starting sequence

TEMPERATURE REGULATION AND LIMITATION

The temperature regulation of bleed air is achieved by a precooler, that is mounted downstream of the bleed valve.
The precooler is an air-to-air heat exchanger, which uses cooling air that is bled from the engine fan, to regulate the temperature to 200°C.
Fan airflow is controlled by the Fan Air Valve.
When wing anti-ice is selected off, the temperature may be regulated to 150°C, upon zone controller demand.
The fan air valve is spring-loaded closed, in the absence of pressure.

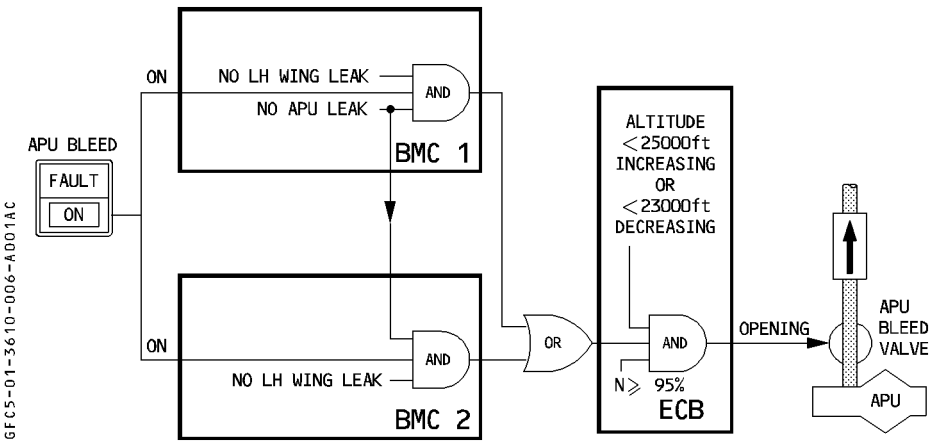
APU BLEED AIR SUPPLY

Air supplied by the APU load compressor is available on ground and in flight.
APU bleed air is controlled by the APU bleed valve which operates as shut off valve. It is electrically controlled and pneumatically operated
The APU bleed valve is controlled by the APU BLEED pushbutton on the AIR panel.
When pushbutton is selected to ON, APU bleed air supplies the pneumatic system provided APU N > 95%. This causes the X-BLEED valve to open and the engine bleed valves to close.
A non-return valve, located near the crossbleed duct, protects the APU when air is bled from another source.

APU BLEED VALVE OPENING LOGIC

FOR INFO

R



HP GROUND AIR SUPPLY

Air is supplied via two HP ground connectors to the aircraft pneumatic system. The crossbleed valve has to be opened manually to provide air for both sides.

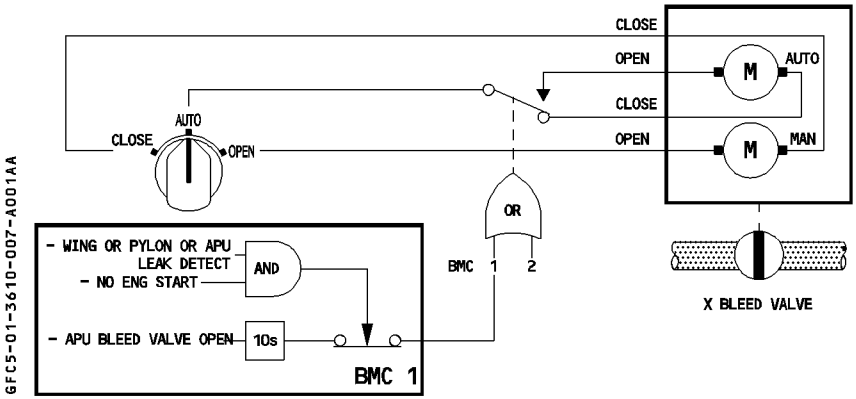
CROSSBLEED

A crossbleed valve, installed on the crossbleed duct, permits the isolation or interconnection of LH (ENG1) and RH (ENG2) air supply system.
The crossbleed valve is electrically controlled from a rotary selector located on the AIR panel.
The valve is controlled by two electric motors : one for the automatic mode, the other one for the manual mode.
In automatic mode the crossbleed valve is normally closed and opens when APU bleed air is used. In this case, it closes when any air leak is detected (except during engine start).

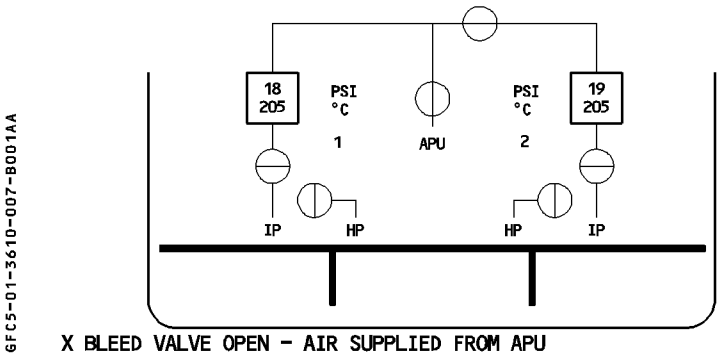
X-BLEED VALVE CONTROL LOGIC

FOR INFO

R



ECAM INDICATION



X BLEED VALVE OPEN - AIR SUPPLIED FROM APU

LEAK DETECTION

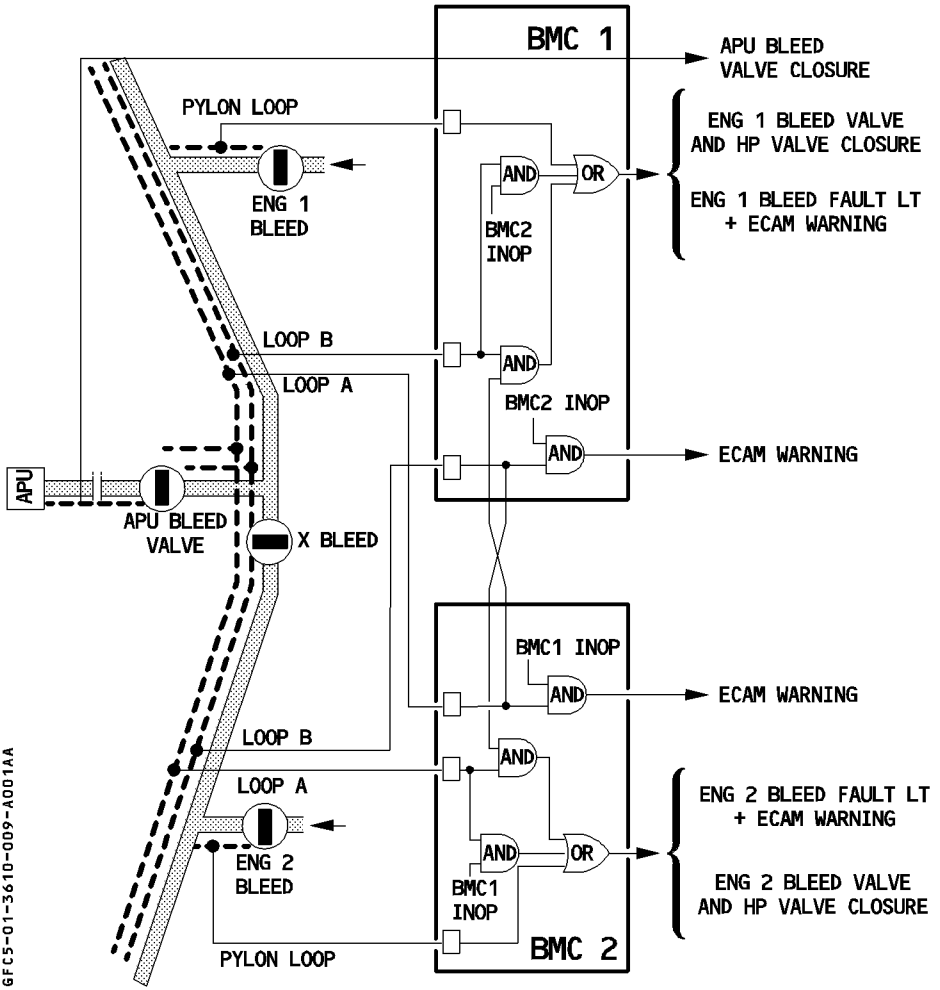
The air leakage detection loops detect any ambient overheat in the vicinity of the hot air ducts in the fuselage, pylons and wings.
The sensing elements are tied to form a single loop, for pylon and APU, or, a double loop for the wing.
A wing leak signal is activated when the two loops detect a leak, or when one loop detects the leak and the other is inoperative.
The system has identical control logic included in each BMC.

- In case of wing leak signal
  - the bleed valve and the HP valve on the related side are automatically closed.
  - the associated FAULT light on the AIR panel is illuminated
  - R the X-bleed valve automatically closes (except during an engine start or manually R selected open).
  - if the APU bleed valve is opened, and if the leak concerns the left wing, it automatically closes (except during engine start).
- In case of pylon leak signal
  - the bleed valve and the HP valve on the related side are automatically closed
  - the FAULT light associated with the related engine is illuminated on the AIR panel
  - R the X-bleed valve automatically closes (except during an engine start or manually R selected open).
- In case of APU leak signal
  - the APU bleed valve automatically closes
  - the FAULT light illuminates on the APU bleed pushbutton on the AIR panel.
  - R the X-bleed valve automatically closes (except during an engine start or manually R selected open).

R APU bleed leak detection is performed only by BMC 1.

FOR INFO

R


BMC 1
APU BLEED VALVE CLOSURE
PYLON LOOP
ENG 1 BLEED VALVE AND HP VALVE CLOSURE
ENG 1 BLEED FAULT LT + ECAM WARNING
AND
OR
ENG 1 BLEED
BMC2 INOP
LOOP B
LOOP A
AND
BMC2 INOP
AND
ECAM WARNING
APU
APU BLEED VALVE
X BLEED
BMC1 INOP
AND
ECAM WARNING
LOOP B
AND
LOOP A
ENG 2 BLEED FAULT LT + ECAM WARNING
AND
OR
ENG 2 BLEED
BMC1 INOP
ENG 2 BLEED VALVE AND HP VALVE CLOSURE
PYLON LOOP
BMC 2
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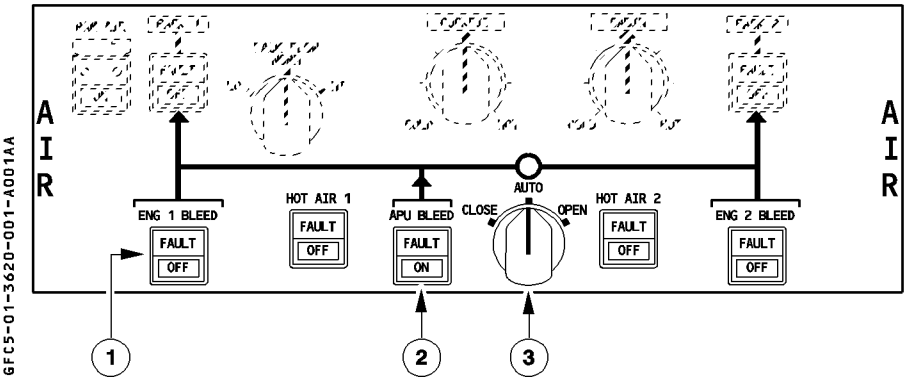
R **OPERATION FOLLOWING FAILURES**

BMC FAILURE

R If one BMC is failed the other BMC takes over monitoring of the bleed system and ensures the following ECAM warnings :
R – ENG BLEED FAULT (overpressure and overtemperature only)
– WING LEAK
R – BLEED LO TEMP (if wing anti ice is on)
R Nevertheless the associated FAULT light on the AIR panel is lost, and the bleed valve does not close automatically.
ENG BLEED LEAK warning is lost for the associated engine as well as APU BLEED LEAK warning if BMC1 is concerned.

OVERHEAD PANEL



① ENG 1 (2) BLEED pb sw

On : Bleed valve opens provided:
- Upstream pressure is above 8 psi.
- APU BLEED pushbutton is at OFF, or, APU bleed valve is closed.
- R There is no onside wing or pylon leak, overpressure or overtemperature
- R detected.
- R ENG FIRE pushbutton not released out
- R Eng start valve closed

FAULT lt : illuminates amber, associated with ECAM caution, in case of:
- Bleed valve not closed during engine start
- Bleed valve not closed with APU bleed ON (and for RH engine X-bleed open)

and additionally associated with autoclosure of the bleed and HP valves :
- Overpressure downstream of the bleed valve.
- Bleed overheat
- Wing or engine leak on the related side

It extinguishes when the ENG BLEED pushbutton is at OFF provided the failure has disappeared

OFF : Bleed valve and HP valve close. OFF light illuminates white. FAULT light and autoclosure signal are reset.

(2) APU BLEED pb sw

ON : APU valve opens provided :
- N > 95 %
- Altitude < 25000 ft climbing
  or < 23000 ft descending
- No leak detected on APU or LH bleed (Should a leak occur on the right side, the X–bleed would close).

ON light illuminates blue.

Off : APU valves closes.

FAULT lt : illuminates amber, associated with ECAM caution, when APU leak is detected.

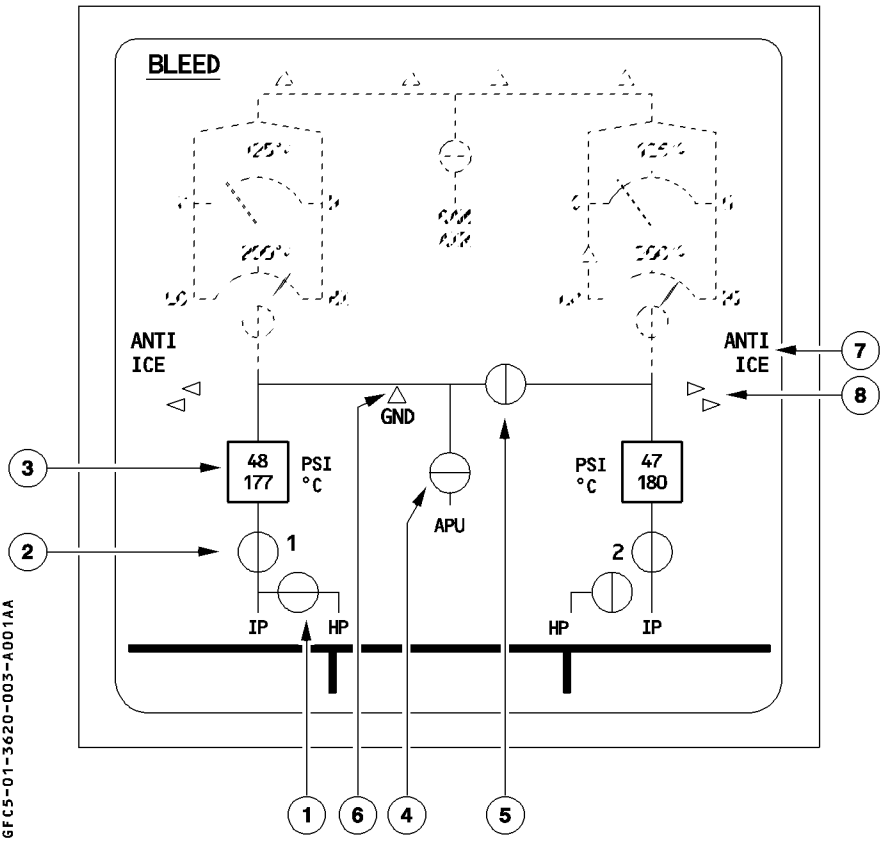
(3) X-BLEED sel

AUTO : X-bleed valve is open if APU bleed valve is open
X-bleed valve is closed if APU bleed valve is closed.

OPEN : X-bleed valve is open.

CLOSE : X-bleed valve is closed.

ECAM BLEED PAGE



(1) HP VALVES

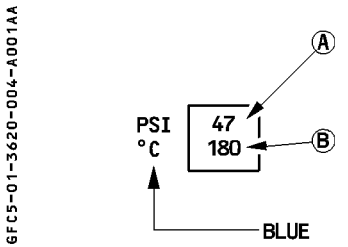
- ⓘ green : HP valve normally fully closed
- ⊖ green : HP valve not fully closed
- R ⓘ amber : HP valve disagree in closed position
- R or when HP valve is fully closed and the respective engine is not running.

(2) ENGINE BLEED VALVES

R In line – Green : The bleed valve is normally open.
R Crossline – Green : The bleed valve is fully closed (by manual or automatic
R control).
R In line – Amber : The bleed valve disagrees in the open position.
R Crossline – Amber : The bleed valve disagrees in the closed position,
or the bleed valve is fully closed and the respective engine is not running.

Note : In certain circumstances (such as different engine setting, or minor bleed valve regulation drift), it is possible that one bleed valve on one side closes and will be indicated closed and green on the ECAM BLEED page. There is no operational impact on the bleed system, provided there is no associated "AIR ENG X BLEED FAULT" ECAM warning.

(3) ENGINE BLEED INDICATIONS



(A) Precooler inlet pressure
Is is normally in green.
It becomes amber, if lower than 4 psi, or in case the BMC detects an overpressure (above 60 psi).

(B) Precooler outlet temperature
It is normally in green.
It becomes amber, if the BMC detects an overheat or low temperature.
Overheat : Temperature exceeds :
– 290°C for more than 5 seconds, or
– 270°C for more than 15 seconds, or
– 257°C for more than 55 seconds.
Low temperature is detected, if the bleed temperature drops below 150°C, and if
R wing anti-ice is on. Low temperature may, however, only be due to low outside air
R temperature.

④ APU BLEED VALVE

R Displayed only if the APU MASTER SW is ON.
⊖ green : APU valve not fully open
⏀ green : APU valve fully open.

⑤ CROSS BLEED VALVE

⏀ green : crossbleed valve is normally closed.
⊖ green : crossbleed valve is normally open.
⏀ amber : crossbleed valve disagrees in closed position.
⊖ amber : crossbleed valve disagrees in open position.
⊘ amber : crossbleed valve in transit

⑥ GND HP ground connection indication

△ : displayed in white on the ground
GND

⑦ ANTI ICE indication

Displayed in white when the WING pushbutton on the ANTI ICE panel is at ON and both valves on the related side are open. The associated ANTI ICE indication becomes amber when:
– the position of at least one valve of the related side disagrees with the anti ice selection
– at least one arrow symbol is amber on the related side.

(8) Arrows

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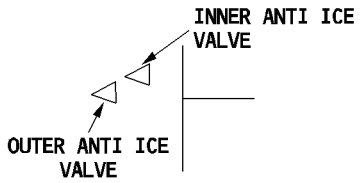
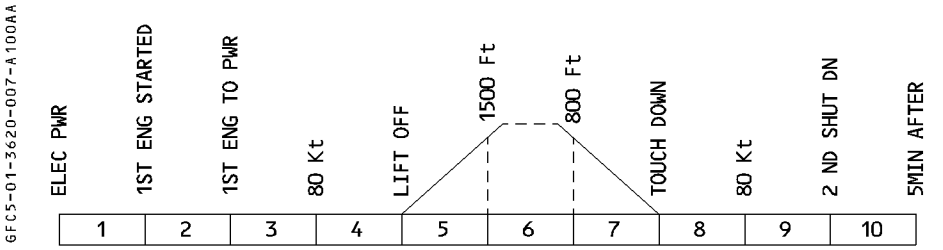


ARROW DISPLAY	
not displayed	Valve closed
green	Valve normally open
amber	Valve open and at least one of the following condition is met : – bleed air pressure high or low – wing anti ice pushbutton is OFF – open for more than 35 seconds while aircraft is on the ground.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ABNORM BLEED CONFIG configuration of bleed system has to be changed	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 8
ENG 1 (2) BLEED FAULT Bleed air pressure overheat or low pressure* or high pressure				ENG BLEED FAULT lt	1, 3, 4, 5, 7, 8, 10
L (R) WING LEAK temperature > 124° C detected by the loops					3, 4, 5, 7, 8
ENG 1 (2) BLEED LEAK temperature > 204° C detected by the loop					
ENG 1 (2) BLEED NOT CLSD Bleed valve not automatically closed during engine start or with APU bleed selected					
APU BLEED FAULT APU available and valve disagree				NIL	
APU BLEED LEAK temperature > 124° C detected by the loop				APU BLEED FAULT lt	
X BLEED FAULT Valve disagree				NIL	
BLEED LO TEMP Bleed air below 150°C with wing anti ice selected on.					1 to 5 8 to 10
ENG 1 (2) HPV NOT OPEN HP valve is abnormally closed	NIL	NIL			3, 4, 5, 7, 8
BMC 1(2) FAULT Computer failure					
L (R) WNG LEAK DET FAULT Both detection loops inoperative in one wing			NIL		

* Local warning is not triggered in case of low pressure.

MEMO DISPLAY

– APU BLEED appears in green if the APU is available and the APU BLEED pushbutton is ON.

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
BMC	1					X	
	2		DC2				
BLEED VALVES	ENG 1					X	
	ENG 2		DC2				
HP VALVES AND FAN AIR VALVES	ENG 1		DC1				
	ENG 2		DC2				
X-BLEED VALVE	AUTO CONTROL		DC2				
	MANUAL CONTROL					X	