

	AIR COND/PRESS/VENT		1.21.10	P 1
	AIR CONDITIONING		SEQ 100	REV 17

GENERAL

The air conditioning system is fully automatic.

It provides continuous air renewal and maintains a constant selected temperature in nine aircraft zones

: One in the cockpit, and eight in the cabin.

Air is supplied by the pneumatic system, via :

- Two pack flow control valves,
- Two packs,
- The mixing unit, which mixes air coming from both the cabin and the packs.

It is then distributed to the cockpit and the cabin.

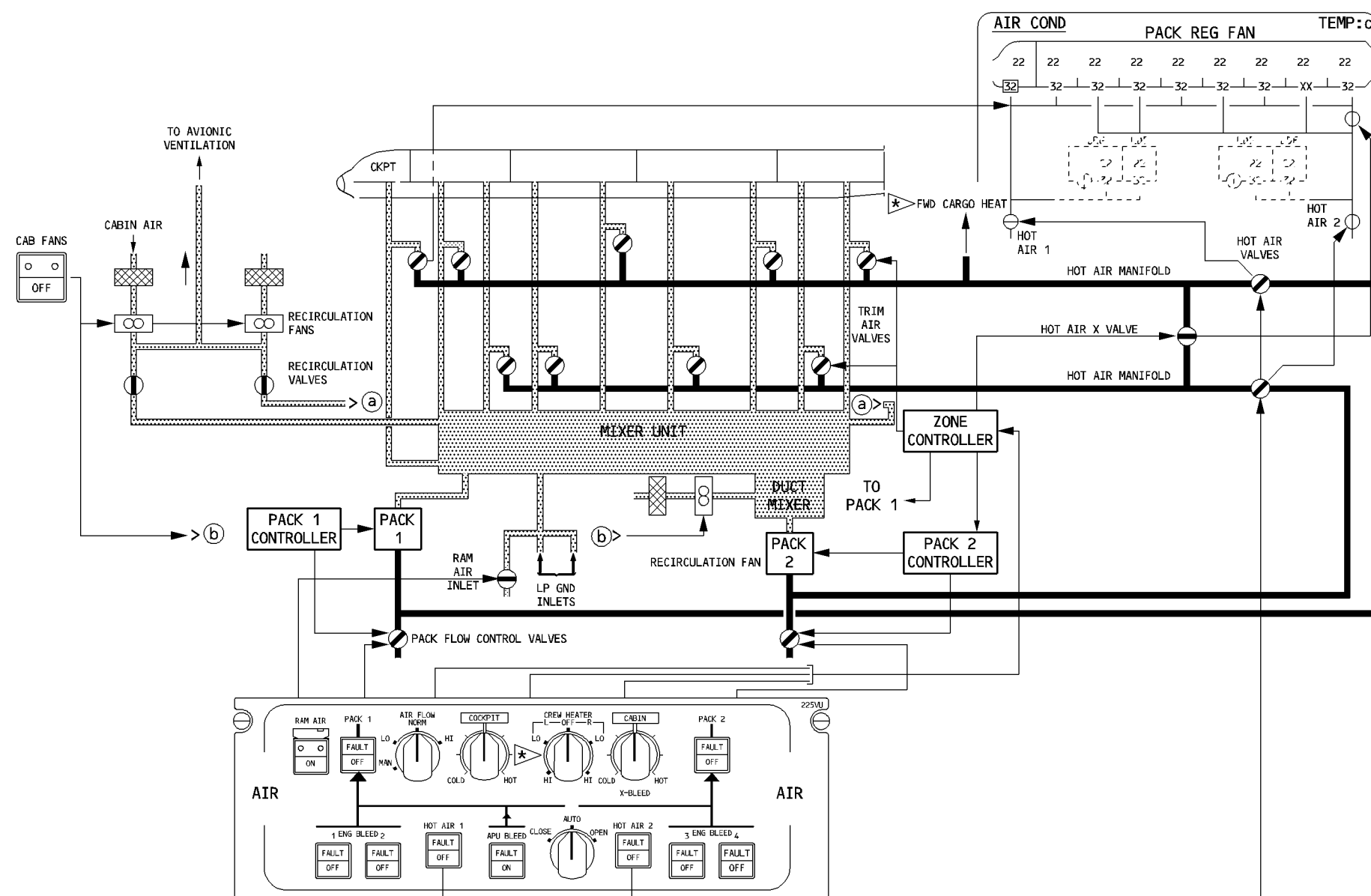
Temperature regulation is optimized via two hot air pressure regulating valves and the trim air valves that add hot air bled upstream of the packs to the mixing unit air via the two hot air manifolds.

In an emergency, a ram air inlet can provide ambient air to the mixing unit.

Temperature regulation is controlled by a zone controller and two pack controllers. Flight deck and cabin temperature can be selected from the AIR panel in the cockpit.

A control panel is provided on the forward attendant panel. During cruise, the cabin crew can modify each cabin zone temperature from the cockpit, with a limited authority of $\pm 3^{\circ}\text{C}$ (5.4°F).

Low pressure air is supplied to the mixing unit via a ground connection.



	AIR COND/PRESS/VENT		1.21.10	P 3
	AIR CONDITIONING		SEQ 100	REV 15

MAIN COMPONENTS

AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by the pack controller.

Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve and is ducted to the primary heat exchanger.

Then, the cooled bleed air enters the compressor section of the aircycle machine and is compressed to a higher pressure and temperature.

It is again cooled in the main heat exchanger, and enters the turbine section where it expands. In expanding, it generates power to drive the compressor and cooling air fan.

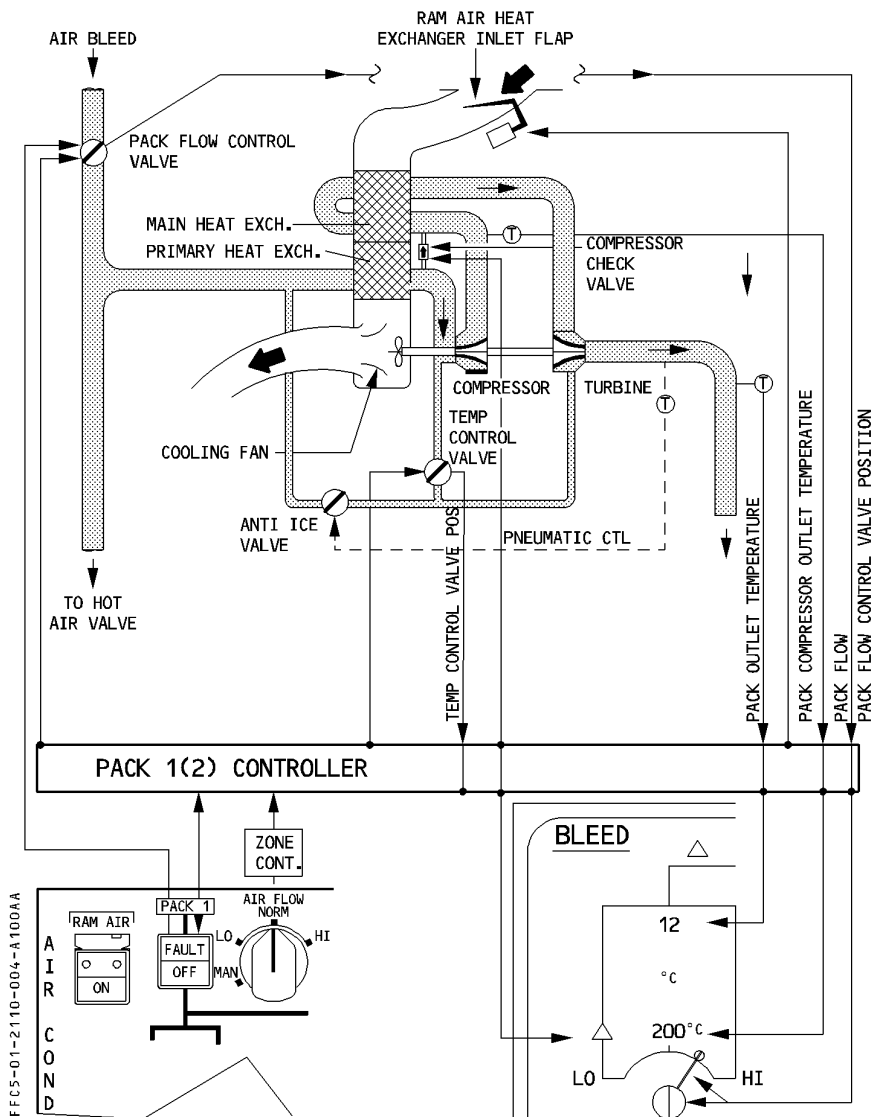
The removal of energy during this process reduces the air temperature, resulting in a very low air temperature at turbine discharge.

The temperature control valve can modify the pack outlet temperature by adding uncooled air to the turbine outlet flow.

In case of an air cycle machine failure, bleed air is only cooled by the corresponding heat exchanger.

PACK SCHEMATIC

FOR INFO



	AIR COND/PRESS/VENT		1.21.10	P 5
	AIR CONDITIONING		SEQ 100	REV 17

PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the pack controller.

In the absence of air pressure, a spring keeps the valve closed.

In the absence of electrical supply, the valve pneumatically controls the flow to 125 %, provided air supply is available.

The valve closes automatically in case of pack compressor overheating, engine starting, operation of the fire or ditching pushbuttons, any unclosed doors at engine start, or insufficient upstream pressure. The valve is controlled from the AIR panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin, if both packs fail.

The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR panel.

This pushbutton opens the ram air valve, provided that ditching is not selected.

The outflow valves open about 50 %, provided that they are under automatic control and ΔP is less than one psi. They do not automatically open if they are under manual control, even if ΔP is less than one psi. If ΔP is greater than one psi, the check valve, located downstream the ram air door, will not open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

A pre-mixing chamber (duct mixer) enables the cargo temperature control with mixed air.

Note : *In case both packs are inoperative, the recirculation valves are partially closed.*

HOT AIR VALVES

These valves regulate the pressure of hot air, tapped upstream of the packs.

They are pneumatically-operated and electrically-controlled from the HOT AIR 1 and HOT AIR 2 pushbuttons on the AIR panel. In the absence of electrical supply, the hot air valves are closed. In the absence of air pressure, a spring keeps the valve closed.

The valve closes automatically, if the duct overheats.

TRIM AIR VALVES

These valves are electrically-controlled by the zone controller. One trim air valve, associated with each zone, adjusts the temperature by adding hot air from the two hot air manifolds. For the cockpit supply, only one trim air valve is fitted to regulate air from the hot air manifold 2. Air from the hot air manifold 1 passes through a restrictor.

	AIR COND/PRESS/VENT		1.21.10	P 6
	AIR CONDITIONING		SEQ 100	REV 16

HOT AIR X VALVE

A HOT AIR X valve is fitted between the two hot air manifolds. The valve is normally closed. It automatically opens, if one hot air supply fails.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by one zone controller and two pack controllers.

PACK CONTROLLER

Each pack controller regulates the temperature of its associated pack, in accordance with a demand signal from the zone controller, by modulating the temperature control valve and the ram air inlet flap. The ram air inlet flap closes during takeoff and landing to avoid ingestion of foreign objects.

Note : *During takeoff, the ram air inlet flap closes when the thrust lever is at or above CL, and the wheel speed (sent by the BSCU) is at or above 70 knots.*

During landing, they close as soon as the landing gear is compressed, and the speed is at or above 70 knots.

They open, when the speed is below 70 knots, with a 15-second delay.

The pack controllers also provide flow regulation by modulating the associated pack flow control valve, in accordance with the zone controller demand.

ZONE CONTROLLER

AIR FLOW CONTROL

Air flow is usually in the NORM position because air flow is automatically managed by the controller, depending on the number of passengers entered in the MCDU. However, the other positions can be selected to comply with warnings, cautions, or cabin needs.

Whatever the crew selects, the system receives a high flow demand for any of the following circumstances :

- In single pack operation, or
- When the APU is supplying bleed air.

Note : *Due to ambient conditions, high flow may not be achieved at APU supply.*

	AIR COND/PRESS/VENT		1.21.10	P 7
	AIR CONDITIONING		SEQ 103	REV 15

Engine pressure demand

When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the zone controller sends a pressure demand signal to both engines' Engine Interface Units (EIU), in order to increase the minimum idle and to raise the bleed pressure.

APU flow demand

When the APU bleed valve is open, the zone controller signals the APU Electronic Control Box ECB to increase the APU flow output when any zone temperature demand cannot be satisfied.

Bleed temperature demand

If the cooling demand cannot be satisfied, the zone controller signals the Bleed Monitoring Computer (BMC) to decrease the bleed temperature from normal (200°C) to reduced setting (150°C). This reduction is inhibited, if the wing-anti-ice is ON.

TEMPERATURE REGULATION

The zone controller regulates the cabin and cockpit temperature.

BASIC TEMPERATURE REGULATION

The flight crew uses the temperature selectors on the air conditioning panel in the cockpit to select the reference temperature. The flight attendant adjusts the cabin temperature from the Forward Attendant Panel (FAP).

The cabin altitude can be automatically corrected to adjust the cabin temperature for passenger comfort. The correction is done to the master temperature selected in the cockpit to compensate for the dryness of the air and the coldness of the lining. (The altitude correction can be programmed, but the basic manufacturer setting is without correction).

The zone controller computes a temperature demand, depending on the selected temperature and the actual temperature.

The actual temperature is measured by sensors in the :

- Cockpit
- Lavatory extraction circuit and galley ventilation system for the cabin.

A signal corresponding to the lowest demanded zone temperature goes to the pack controller, which then makes both packs produce the required outlet temperature.

OPTIMIZED TEMPERATURE REGULATION

The zone controller optimizes temperature by acting on the trim air valves.
The temperature selection range is from 18°C (64°F) to 30°C (86°F).

	AIR COND/PRESS/VENT		1.21.10	P 9
	AIR CONDITIONING		SEQ 100	REV 16

SYSTEM OPERATION UNDER FAILURE CONDITION

Each controller is composed of two identical channels. Only one channel is active. After each touchdown, the active channel changes.

ZONE CONTROLLER

CHANNEL 1 OR 2 FAILURE

This failure has no effect on zone temperature regulation.

CHANNELS 1 AND 2 FAILURE

Optimized and backup temperature regulation are lost. The packs deliver a fixed pack outlet temperature of 20°C (68°F). This failure removes all information from the ECAM COND page. Flow selection from the AIR FLOW selector is lost.

PACK CONTROLLERS

CHANNEL 1 OR 2 FAILURE

This failure has no effect on pack regulation.

CHANNELS 1 AND 2 FAILURE

The pack outlet temperature is controlled at 12° C ± 6° C (54° F ± 10° F) by the corresponding anti-ice valve. ECAM signals, related to the corresponding pack, are lost. The flow control valve pneumatically regulates the flow to the NORM value.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in the heat exchanger cooling mode. Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve and goes to the primary heat exchanger. Then, the compressor check valve opens and air is cooled only by the heat exchanger. The ACM seizure reduces the pack flow.

As they do for normal pack operation :

- The pack controller regulates temperature, in accordance with zone controller demand, by modulating the temperature control valve and the ram air inlet flap.
- The zone controller regulates the hot air flow through the trim air valves to optimize cockpit/cabin temperature regulation. Hot air flow is lower than for normal pack operation, because pack flow is reduced.

Note : *A pack with a seized ACM must be switched off on ground due to unavailability of RAM air cooling.*

	AIR COND/PRESS/VENT		1.21.10	P 10
	AIR CONDITIONING		SEQ 100	REV 15

HOT AIR VALVES FAILURE

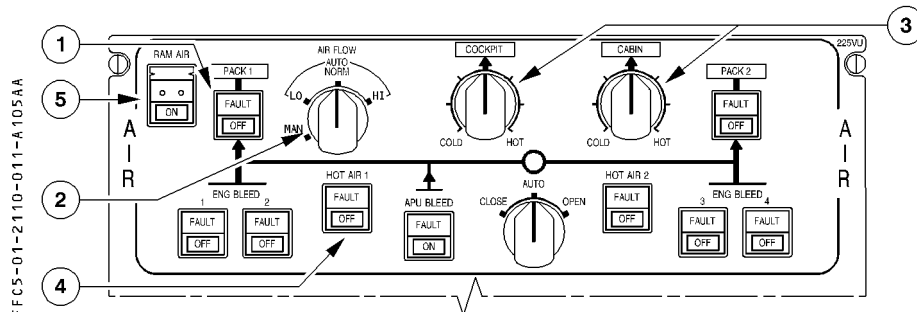
- One or both valves failed open : No effect.
- One valve failed closed : No effect (HOT AIR X valve opens).
- Both valves failed closed : Optimized regulation is lost. Trim air valves are driven to full closed position. Pack outlet temperature is regulated according to the lowest cabin demand.

TRIM AIR VALVE FAILURE

- Failed closed : Optimized temperature regulation is lost in the affected zone.
- Failed open : The higher heat load of the affected cabin zone will be compensated by a decreasing pack outlet temperature.

CONTROLS AND INDICATORS

OVERHEAD PANEL



① PACK pushbutton

- On : The pack flow control valve is automatically-controlled. It opens, except in the following cases :
- Upstream pressure below minimum,
 - Compressor outlet overheat,
 - Engine start sequence :
 1. Both valves close when :
 - The MODE selector is set to IGN, when on ground (valves reopen if MASTER switch or MAN START pushbutton are not set to ON within 30 seconds)
 - The MODE selector is set to IGN (or CRANK) and when (on either engine):
 - The MASTER switch is set to ON (or MAN START pushbutton is set to ON) and,
 - The start valve is open, and
 - $N3 < 50 \%$.
 2. On ground, reopening of the valves is delayed 30 seconds to avoid a supplementary pack closure cycle during subsequent engine start.
 - Any door is not closed and locked, aircraft on ground, and any engine running.
 - Onside engine fire pushbutton is pressed.
 - Ditching is selected.

Note : If there is no electrical power, the flow valves remain open and permit 125 % flow.

- OFF : The pack flow control valve closes, provided it is electrically-supplied.
- FAULT It : The amber light and associated ECAM caution come on, when the pack flow control valve position disagrees with the selected position, or in case of compressor outlet overheat or pack outlet overheat.

	AIR COND/PRESS/VENT		1.21.10	P 12
	AIR CONDITIONING		SEQ 105	REV 17

② AIR FLOW sel

The air flow selector functions are as follows :

- LO : 80 % of the normal flow (to be selected in case of bleed fault).
- NORM : The delivered airflow is based on the number of passengers entered in the MCDU, and on the cabin temperature demand.
- HI : Flow, corresponding to the NORM selection + 200 l/s (to be selected at cabin fans fault, or if the crew wants a higher ventilation rate).
- MAN : Fixed pack flow and recirculation flow (Air management is off).

In case one bleed fails, HI Flow is limited to 112 %.

Any selection is irrelevant in single pack operations, or with APU bleed supply. In these cases, HI pack flow demand is automatically generated.

③ Zone temperature sel

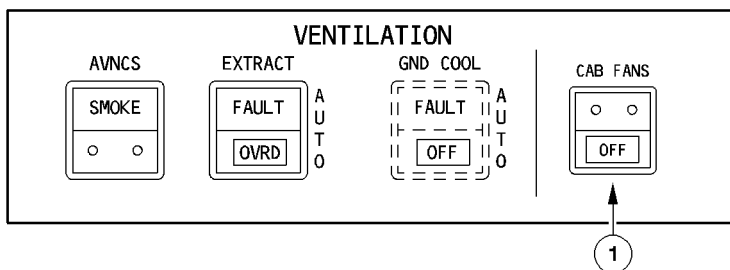
- 12 o'clock position : 24° C (76° F)
- COLD position : 18° C (64° F)
- HOT position : 30° C (86° F)

④ HOT AIR 1 (or 2) pushbutton

- On : The valve regulates hot air pressure.
- OFF : The valve closes.
The FAULT circuit is reset.
Forward cargo heating is lost, if HOT AIR 1 is affected .
Aft cargo heating is lost, if HOT AIR 2 is affected .
- FAULT It : The amber light and associated ECAM caution come on, when duct overheat is detected (88° C/190°F). The valve, and the associated trim air valves automatically close. The FAULT light goes off, when temperature drops below 70° C, and the flight crew selects OFF.

⑤ RAM AIR pushbutton (guarded)

- ON : The ON light comes on white.
If the DITCHING pushbutton, on the CABIN PRESS panel, is in the normal position :
 - The RAM air inlet opens.
 - If $\Delta p < 1$ psi : Each outflow valve opens to about 50 %, when under automatic control. They do not automatically open when under manual control. The emergency ram air flow is directly supplied to the mixer unit.
 - If $\Delta P \geq 1$ psi : Each outflow valve remains normally controlled. No emergency ram air flows in.
- Off : The RAM air inlet closes and the outflow valves return to normal position.



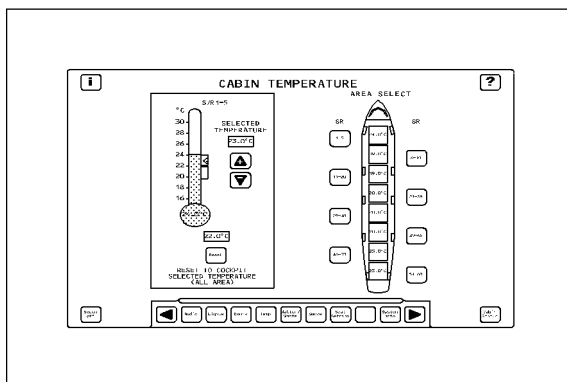
①CAB FANS pb

On	:	The three cabin fans run. Two of them blow air from the cabin to the avionics compartment and to the conditioning system's mixing unit. The third one only blows air to the conditioning system's mixing unit.
OFF	:	The three cabin fans stop.

Note : If a fan failure occurs, the ECAM caution is displayed.

FORWARD ATTENDANT PANEL

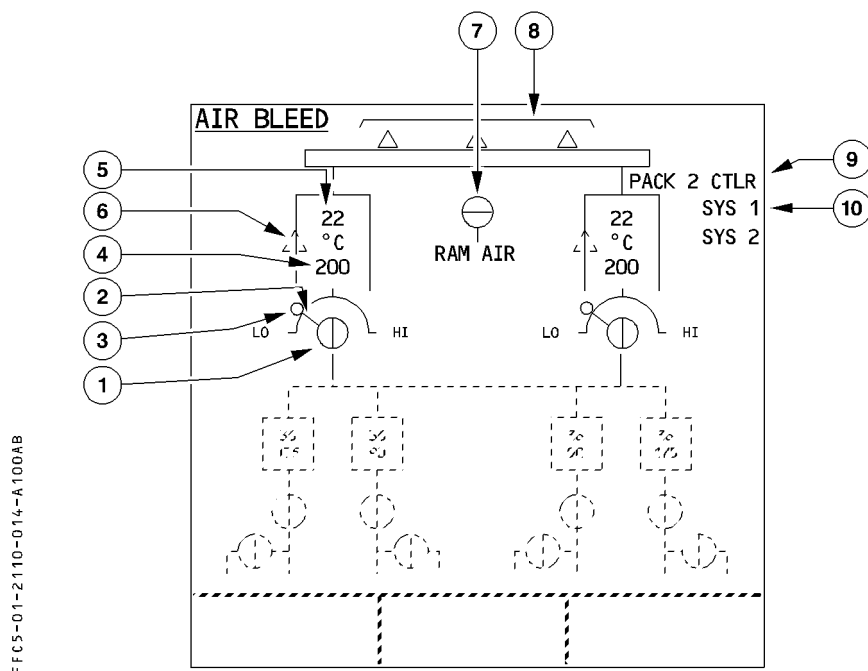
Allows fine trimming of individual zone temperature ($\pm 3^{\circ}\text{C}/\pm 5.4^{\circ}\text{F}$).



ADDITIONAL ATTENDANT PANEL

The additional attendant panels can be installed in different locations.
The temperature setting of the related zone can be changed ($\pm 3^{\circ}\text{C}/\pm 5.4^{\circ}\text{F}$).

ECAM BLEED PAGE



①Pack flow control valve

Crossline	- Amber	: Valve is closed.
In line	- Amber	: Valve is failed open.
In line	- Green	: Valve is not fully closed.

②Pack flow indication

The needle position (green) represents the actual flow rate.

LO	:	80 % airflow
HI	:	NORM airflow + 200 l/s.

③Target airflow

The small circle represents the target airflow. The circle is always in cyan.

If the target airflow data is unavailable (at pneumatic flow regulation or at APU supply), the circle is removed.

	AIR COND/PRESS/VENT		1.21.10	P 15
	AIR CONDITIONING		SEQ 100	REV 16

④ Pack compressor outlet temperature indication

It is normally displayed in green.

It is displayed in amber, if the temperature is above 260°C.

⑤ Pack outlet temperature indication

It is normally displayed in green.

It is displayed in amber, if the temperature is above 95°C, or if the temperature is lower than 70°C.

⑥ Bypass mode

No display : It is fully closed.

The triangle is green, if the ACM is seized (compressor bypass valve opens).

⑦ Emergency Ram Air inlet indication

Crossline - Green : The flap is normally closed.

In transit - Amber : The flap is partially open.

In line - Amber : If open on ground, or if the flap position disagrees with the ram air pushbutton state (OFF).

In line - Green : The flap is fully opened.

Crossline - Amber : The flap is closed and the RAM AIR pushbutton in ON position.

⑧ Indication of bleed users

Triangles, rectangle, and vertical lines are displayed in green in normal operation.

Triangles, rectangle, and vertical lines are displayed in amber, if no air comes from the two flow valves (fully closed), and the RAM AIR flap is fully closed.

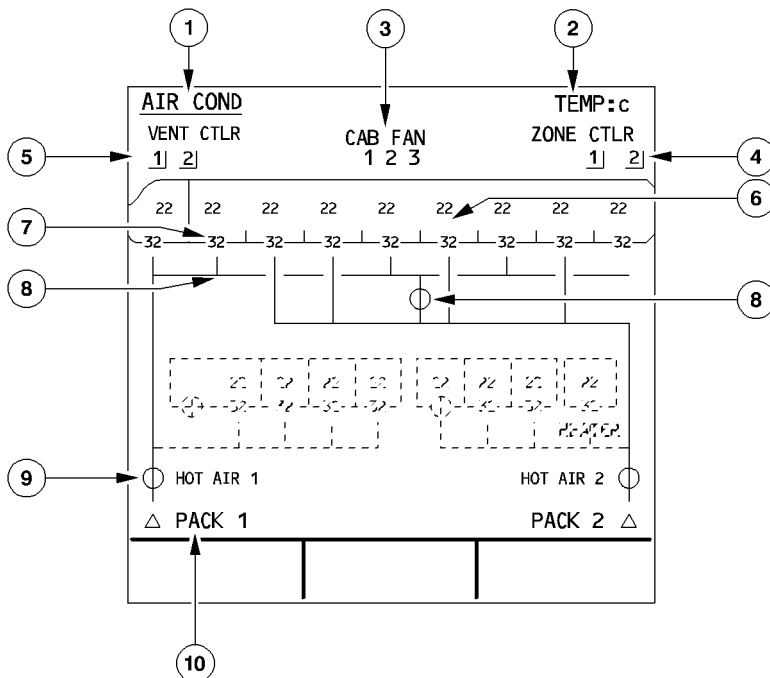
⑨ Pack controller status

PACK 1(2) CTRL : It is not displayed in normal operation.
It is green, if System 1 or System 2 is faulty.
it is amber, if both systems are faulty.

⑩ Pack controller active system

SYS 1(2) : It is not displayed in normal operation.
It is amber, if System 1(2) is faulty.

ECAM COND PAGE



① System page title

② Unit of displayed temperatures

③ Indication of the cabin recirculation fans status

If no fan is failed, nothing is displayed.

CAB FAN : Amber if 3 fans are failed.

1 2 3 : Fan failed in amber, the others in green.

④ Zone controller indication

ZONE CTRL : It is not displayed, if both systems are operative.
It is amber, if both systems are faulty.
It is green, if only one system is faulty.

1 (2) : It is an amber number, with a grey frame, if System 1(2) is faulty.
It is a green number, with grey frame, if System 1(2) is not faulty, and System 2(1) is faulty.
It is not displayed, if both systems are operative.

	AIR COND/PRESS/VENT		1.21.10	P 17
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⑤ Ventilation controller indication

- VENT CTRL : It is not displayed, if both systems are operative.
It is amber, if both systems are faulty.
It is green, if only one system is faulty.
- 1 (2) : It is an amber number, with a grey frame, if System 1(2) is faulty.
It is a green number, with a grey frame, if System 1(2) is not faulty, and System 2(1) is faulty.
It is not displayed, if both systems are operative.

⑥ Zone temperature

The indication is in green.

Note : This information is also displayed on the ECAM CRUISE page.

⑦ Zone duct temperature

Normally, the indication is in green. It becomes amber, in case of a duct overheat.

⑧ Hot air shutoff valve position

- Crossline - Green : Valve is normally closed.
In line - Green : Valve is normally open.
Crossline - Amber : Valve is abnormally closed.

⑨ Hot air pressure regulating valve position 1 (2)

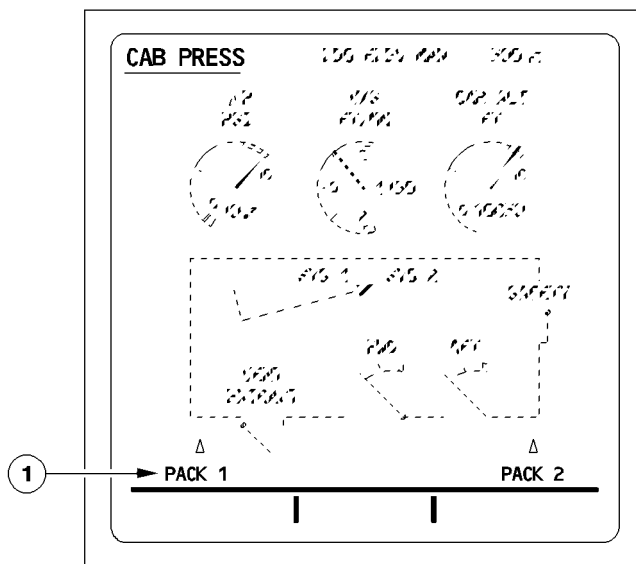
- In line - Green : Valve is normally open, and the Flow Control Valve 1(2) is open.
In line - Amber : Valve is abnormally open.
Crossline - Green : Valve is normally closed.
Crossline - Amber :
- Valve is abnormally closed, or
- Flow Control Valve 1(2) is closed, or
- The respective HOT AIR pb is OFF, or
- There is a duct overheat for the related Trim Air Valve.

⑩ Pack 1 (2) Indication

- Triangle 1(2) is in green, and text PACK 1(2) is in white, when the flow control valve 1(2) is not fully closed.
Triangle 1(2) is in amber, and text PACK 1(2) is in amber, when the flow control valve 1(2) is fully closed.

ECAM CAB PRESS PAGE

FFCS-01-2110-018-A001AA



①PACK indication

pack flow control valve open :

△ Green

PACK 1 White

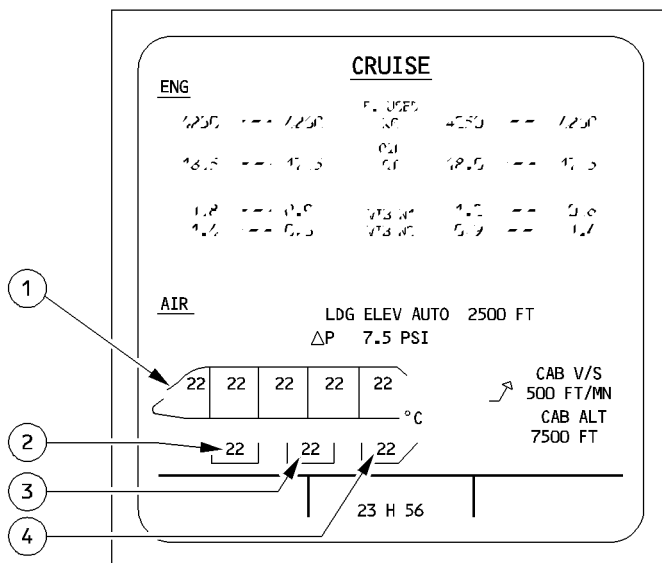
pack flow control valve closed :

△ Amber

PACK 1 Amber

ECAM CRUISE PAGE

FFCS-01-2110-019-A105AB



① Cockpit and cabin zones air temperature

Only the cockpit and four cabin temperature zones are displayed (each one corresponding to the mean value of zone 1-2, 3-4, 5-6 and 7-8).

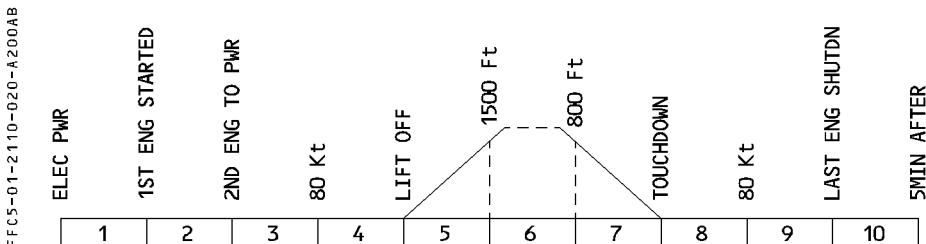
② Forward cargo temperature

③ Aft cargo temperature

④ Bulk cargo temperature

Note : The forward, Aft and Bulk cargo indication do not appear when the corresponding temperature control option is not installed.

WARNINGS AND CAUTIONS



EWD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PACK 1(2) OVHT Pack compressor outlet temperature > 260°C or pack outlet temp > 95°C	SINGLE CHIME	MASTER CAUT	BLEED	PACK FAULT It	3, 4, 5, 7, 8
PACKVALVE1(2) FAULT Pack valve disagrees with selected position				PACK OFF It	1 to 5 7 to 10
PACK1(2) OFF Pack pb at off, with no failure				PACK FAULT It	3, 4, 5, 7, 8
PACK 1+2 FAULT One pack off, then the other fault				NIL	
PACK 1(2) REGUL FAULT Pack controller failed, or air is only cooled by heat exchanger (ACM fault, or RAM door failed closed, or Temperature Control Valve failed).	NIL	NIL	NIL	NIL	1, 2, 3, 4, 5, 7, 8
ZONE CTL SYS 1(2) FAULT One zone controller channel is failed.					
ZONE REGUL FAULT Zone controller failed, or hot air valve 1+2 failed.	SINGLE CHIME	MASTER CAUT	COND	HOT AIR FAULT It	3, 4, 5, 7, 8
DUCT OVHT Duct temp > 88°C	NIL	NIL		NIL	NIL
HOT AIR SYS 1(2) FAULT Hot air valve 1(2) and hot air x valve failed closed.					
PC 1(2) SYS 1(2) FAULT Total loss of pack controller 1(2) detected of the pack controller lane 1(2).					

* Only in case of a single failure.

MEMO DISPLAY

- The RAM AIR message appears in green, if the RAM AIR pushbutton is ON.
It becomes amber in flight Phases 1 and 2.
- The AIR FLOW LO or HI message appears in green, according to the AIR FLOW selector position.