DASSAULT FALCON 7X

SYSTEMS SUMMARY

Air Conditioning & Pressurization

ACRONYMS

A/C	Airplane Control
ACM	Air Cycle Machine
AMM	Air Management Module
AMSAC	Air Management System Automatic Controller
AMSEC	Air Management System Emergency Controller
CB	Circuit Breakers
DU	Display Unit
EMM	Emergency Management Module
FBW	Fly By Wire
NPRV	Negative Pressure Relief Valve
OP	Overhead Panel
PDU	Primary Display Unit
PPDB	Primary Power Distribution Box
PPRV	Positive Pressure Relief Valve
PSU	Passenger Supply Unit
SPDB	Secondary Power Distribution Box
SSPC	Solid State Power Controllers
WAI	Wing Anti-Icing

INTRODUCTION

In order to maintain a comfortable area inside the cabin and the cockpit, the Falcon 7X is equipped with an air conditioning system and a pressurization system.

The air conditioning system, also referred to as Environmental Control System (ECS), generates, regulates, and distributes conditioned air in the pressurized areas:

- Cockpit,
- Cabin (FWD and AFT zones),
- Baggage compartment,
- Nose compartment.

The Environmental Control System also supplies:

- Cold air for the cooling of cockpit DU, forward FBW racks, and rear FBW racks,
- Underfloor ventilation to avoid accumulation of fuel or hydraulic vapors.

The Environmental Control System minimizes bleed extraction and therefore reduces fuel consumption during the cruise. Admission of fresh air in the airplane is modulated according to:

- Cabin temperature,
- Cockpit temperature,
- Flight altitude,
- Wing anti-icing operation.

The Environmental Control System has an automatic mode and a manual mode allowing the crew members to directly control the air conditioning valves.

Optional equipment include:

- Cabin air humidifier,
- Cabin recirculating air filtration (particles, bacteria and odors).

FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the air conditioning system is performed:

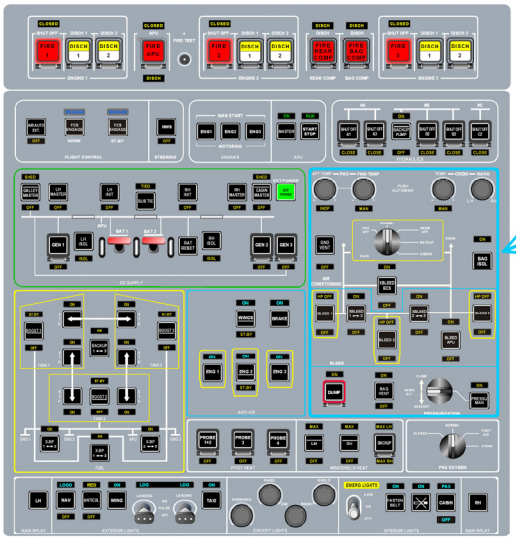
- Primarily via the AIR CONDITIONING section of the Overhead Panel (OP),
- Via a REMOTE soft key in the ECS synoptic page, for transferring cabin temperature control to the controls installed in the cabin,
- Via the BAG FAN pushbutton on the Emergency Panel to manually activate the fan located in the baggage compartment,
- Via an ECS soft key in the TEST synoptic page to trigger the pre-flight test of the ECS,
- Via a HUMID pushbutton located on the RH console to activate the humidifier (optional).

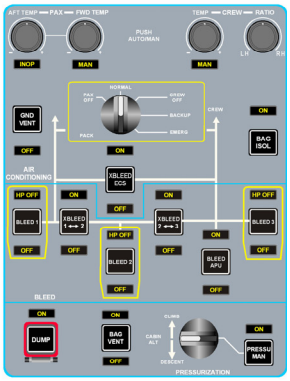
Additionally, a manual interconnect valve is used for interconnecting passenger and crew air supplies.

INDICATIONS

Crew indications with regard to conditioning are located on:

- The ECS synoptic page,
- The ENG-CAS window for CAS messages,
- The STATus synoptic / FAULT tab for fault messages.





Pressurization and air conditioning controls

CAS windows

ECS synoptic

Emergency Panel

FLIGHT DECK OVERVIEW

GENERAL

Hot bleed air from engines (or APU) is cooled

- In normal operation:
  - By the main pack,
  - Managed by the AMSAC,
- In case of partial or total failure of the main pack, or AMSAC:
  - By the emergency pack,
  - Managed by the AMSEC.

Conditioned air resulting from the mixing of cold and hot air is then distributed through 2 separate lines for the passenger and crew supplies.

In addition, for equipment cooling, cold air is distributed directly to:

- Gaspers and panel instrument (DU, forward FBW racks),
- Rear FBW racks.

PRINCIPLE

SOURCES

The air conditioning system uses the hot bleed air sources available at the level of the common bleed air manifold:

- On ground: APU or engine bleed air (if both are available, APU bleed air takes precedence)
- In flight without Wing Anti-Ice (WAI): engine 1 and 3 bleed air,
- In flight with WAI: all engines bleed air.

The hot bleed air initially goes through the Ozone Converters, in order to reduce ozone concentration, and is partly routed:

- In normal ECS operation, to a main pack,
- In EMERGency ECS operation, to an emergency pack.

GENERATION

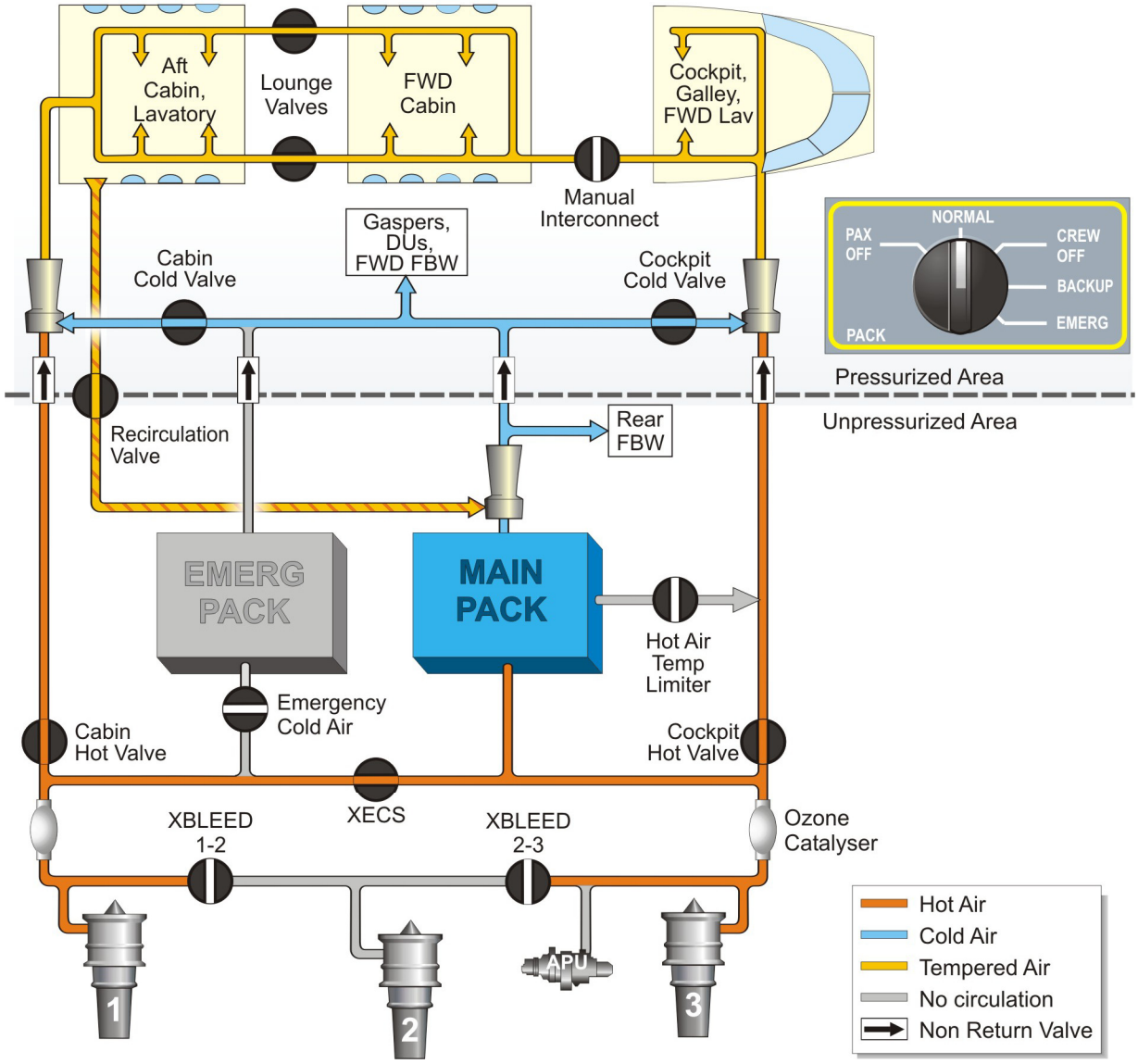
The hot bleed air is cooled by the main pack or emergency pack depending on the ECS mode of operation.

Modes

The ECS can operate in 5 modes: NORMAL, PAX OFF, CREW OFF, BACKUP and EMERG modes:

- **NORMAL**

  In NORMAL mode the hot air is cooled by the main pack.

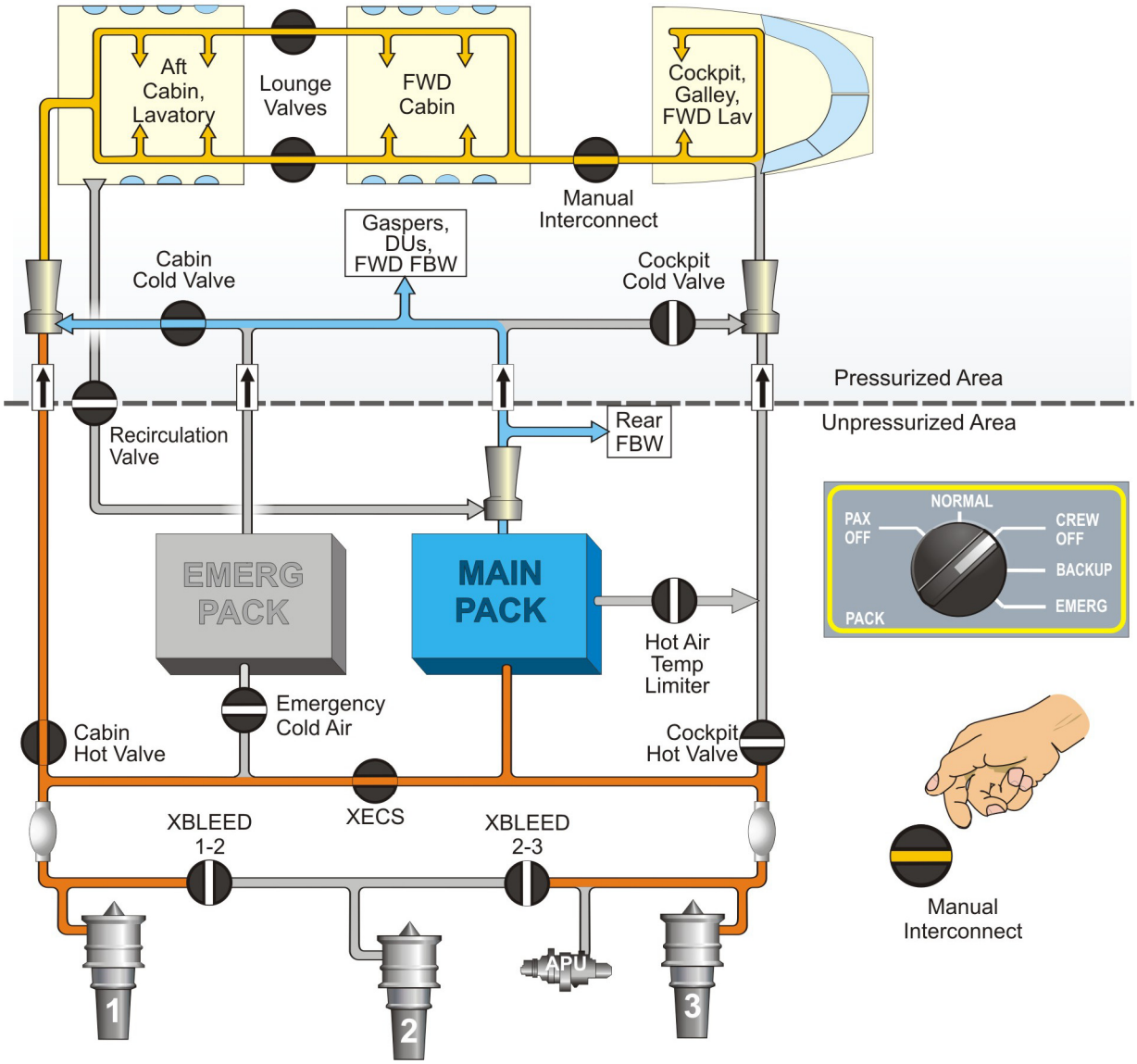


ECS NORMAL MODE

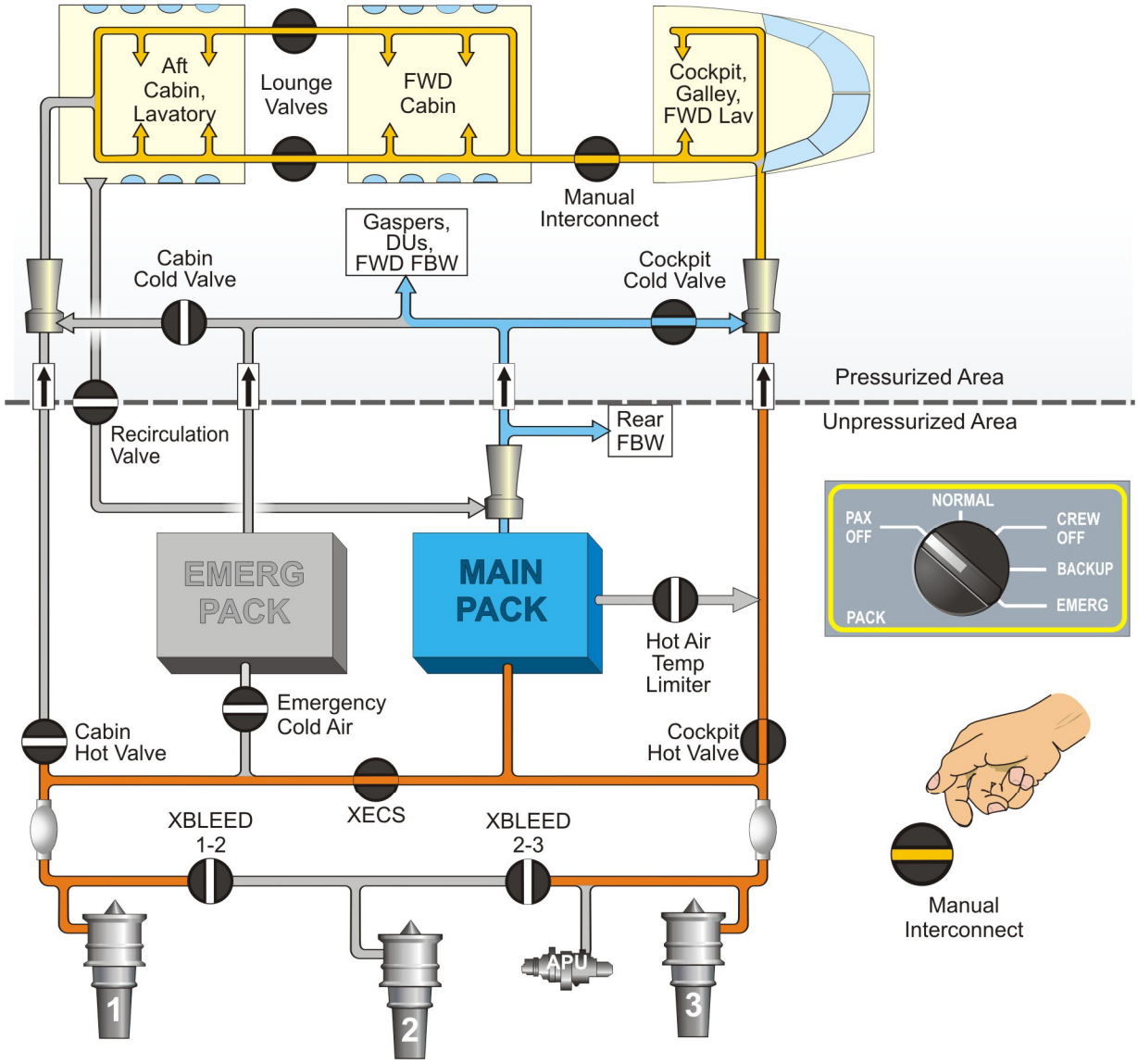
- **PAX OFF and CREW OFF**

  In PAX OFF, CREW OFF modes, the hot air is cooled by the main PACK (like in NORMAL mode).

  PAX OFF and CREW OFF are used in case of a supply failure without distribution impact by the manual interconnection. Crew or pax supply lines are isolated by closing the corresponding cold / hot valves.



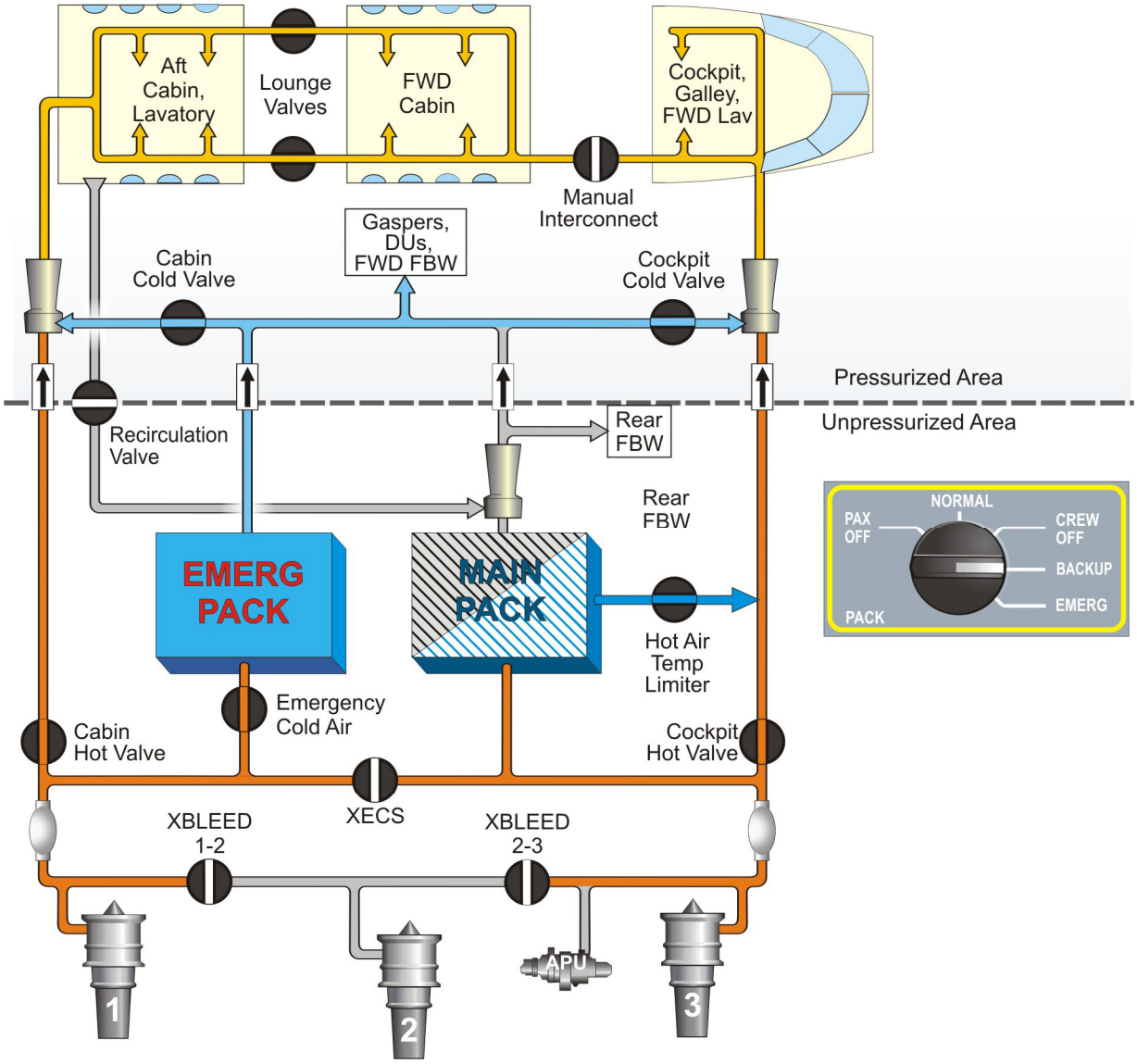
ECS CREW OFF MODE



ECS PAX OFF MODE

- **BACKUP**

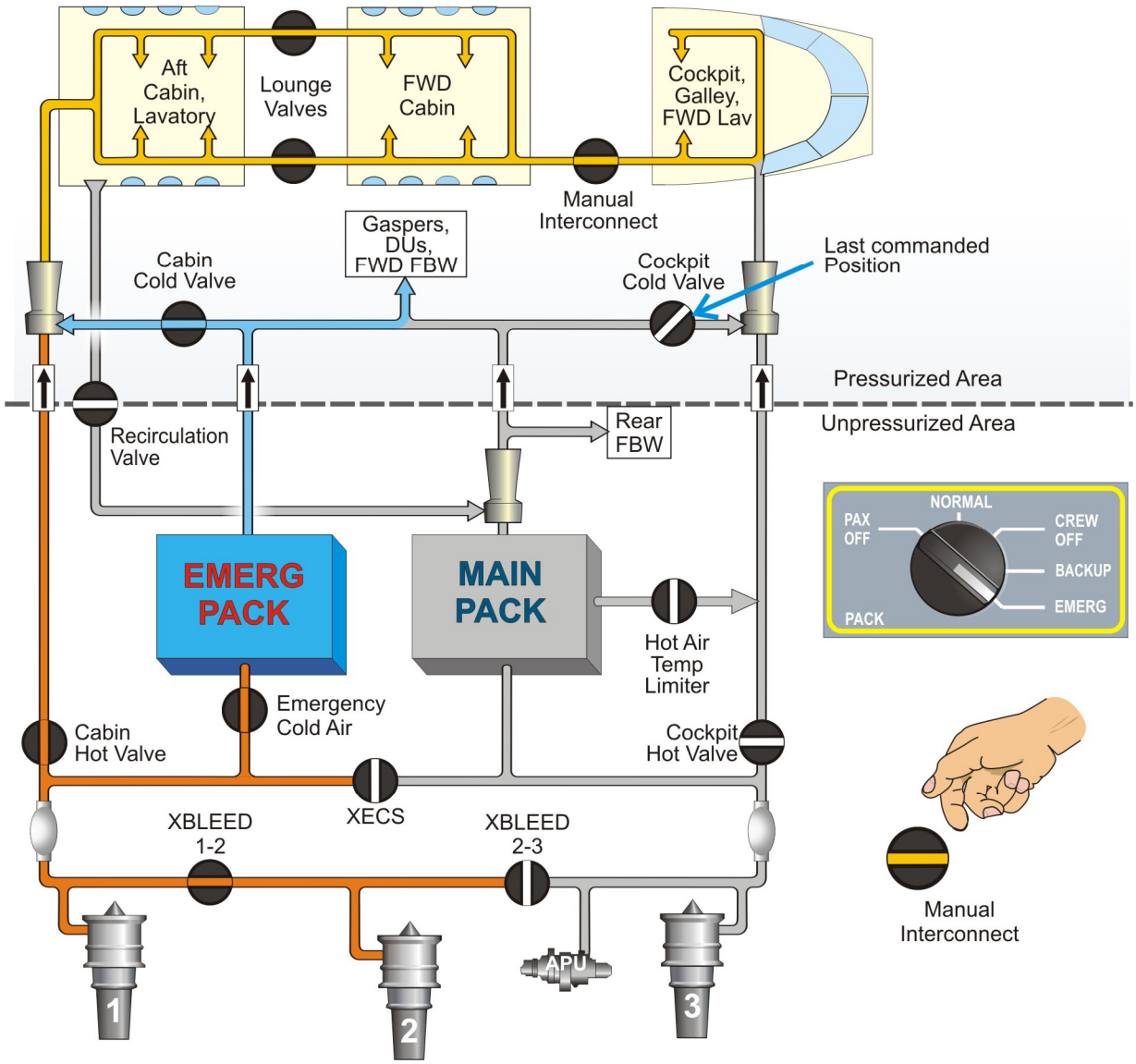
  In BACKUP mode, the hot air is cooled by the emergency pack. The system in managed by the AMSAC.



ECS BACKUP MODE

- **EMERG**

  In EMERG mode, the hot air is cooled only by the emergency pack. The system is managed by the AMSEC.



ECS EMERG MODE

Main pack

The main pack comprises the following main components:

- An Air Cycle Machine,
- 2 heat exchangers (a primary and a secondary),
- A condenser / reheater / water separator,
- Valves and sensors.

Its operation is commanded and monitored by the AMSAC.

Emergency pack

The emergency pack consists of an emergency heat exchanger designed to provide sufficient cold air flow in case of failure of the main pack in restricted operational conditions.

In ECS BACKUP mode, the AMSAC manages the emergency pack.

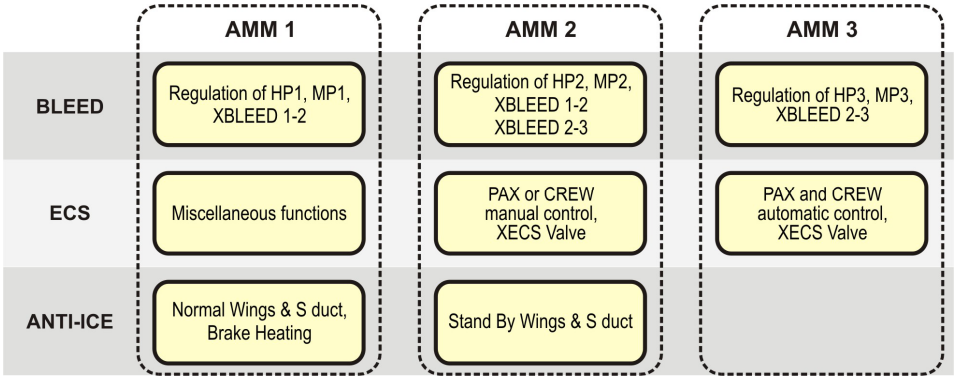
In ECS EMERG mode, the AMSEC manages the emergency pack.

Control and monitoring

When the AMSAC is in control of the ECS (NORMAL, PAX OFF, CREW OFF and BACKUP modes), it provides the following functions:

- Cabin and cockpit automatic (according to the preset temperatures) or manual (valve position) temperature control,
- ECS control and monitoring,
- System temperature and pressure monitoring,
- Gasper pressure control,
- Air recirculation below 14,000 ft.

The AMSAC comprises 3 Air Management Module cards (AMM):



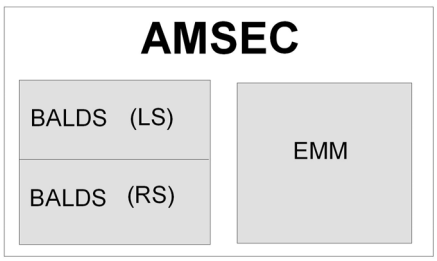
When the AMSEC Emergency Management Module (EMM) is in control of the ECS (EMERG mode), it provides the following functions:

- Cabin manual (valve position) temperature control,
- Emergency heat exchanger control and monitoring,
- System temperature monitoring.

NOTE

In all ECS modes, the Bleed Air Leak Detection function is performed by the AMSEC BALDS

The AMSEC contains two electrically isolated modules:



DISTRIBUTION

Downstream of the packs, cold air:

- Supplies directly cool air to the gaspers (cockpit, galley, lavatories and cabin), DU, FWD FBW racks and, using a separate line, the rear FBW racks,
- Flows through the cabin and cockpit cold valves to be mixed with the hot bleed air to provide conditioned air.

The conditioned air is then distributed in the cockpit, cabin and underfloor as follows:

- In the cockpit: at the pilots' feet, at the base of the windshield panels, and at the top aft of the cockpit,
- In the cabin: at the bottom of the LH / RH sideledges and for the upper part, in the Passenger Supply Unit (PSU).

EVACUATION

The conditioned air is evacuated:

- From the cockpit to the baggage compartment through dedicated ducts toward the cabin ventilation valve, and toward the baggage compartment through the isolation valves
- From the cabin to the baggage compartment toward the cabin ventilation valve, and toward the baggage compartment through the isolation valves,
- From the baggage compartment through the baggage ventilation valve.

Air used for under-floor ventilation comes from cabin distribution and is evacuated through a dedicated whole (permanent leak) and through the cabin ventilation valve.

NOTE

Air-flow from the baggage compartment to the baggage ventilation valve ensures ventilation of the PPDB and rear SPDB (including additional ventilation of rear FBW racks)

TEMPERATURE REGULATION

In NORMAL (or PAX OFF, CREW OFF and BACKUP) ECS operation, the AMSAC:

- Manages directly the cabin and cockpit target temperatures (if the temperature selectors are in AUTO mode) by varying the amount of hot air through the cabin and cockpit "hot" air valves (also referred to as "trim" valves),
- Ensures the conditioned airflow is mainly directed to the cabin (in the 60/40 ratio) by means of the cockpit cold valve,
- Manages the cabin cold air valve to maintain a constant gasper flow.

In EMERG mode, the AMSEC:

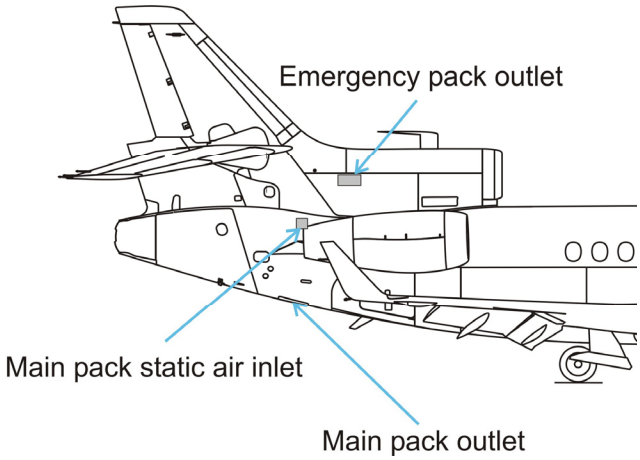
- Manages only the cabin hot valve position.

DESIGN PRINCIPLES

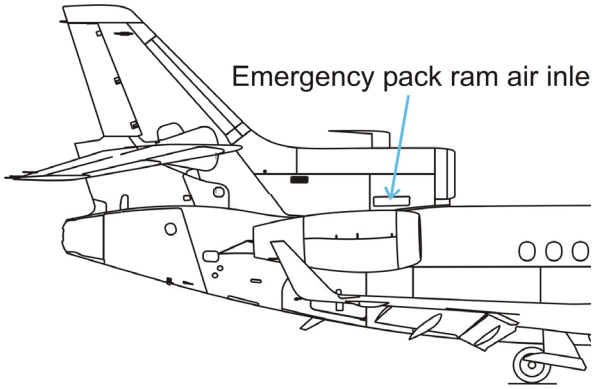
The air conditioning system was designed considering the following design principles:

- Regarding the air supplies: there are 2 independent hot air supplies routed through 2 different zones of the airplane, and 2 independent cold air sources (1 main pack and 1 emergency pack located in different A/C locations). This segregation ensures there is always a cold and a hot air supply in the event of a main engine rotor burst or multiple failures.
- Regarding the air conditioning regulation:
  - There are 2 separate controllers, AMSAC and AMSEC (located in different airplane locations) to provide either a full automatic regulation of cockpit/cabin temperature or a manual positioning of the cockpit/cabin valves,
  - An absence of air conditioning during take-off allows maximum engine thrust,
  - A recirculation jet pump is used below 14,000 ft to provide optimized cooling capability.

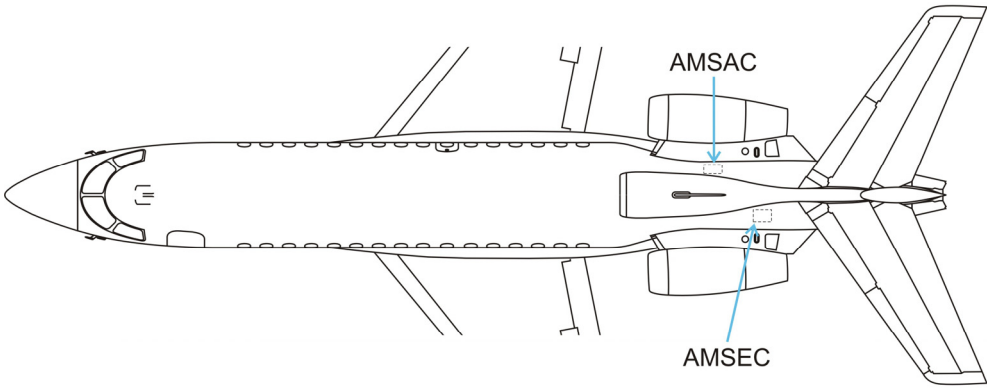
EQUIPMENT LOCATION



EQUIPMENT LOCATION (RH SIDE)



ECS EQUIPMENT LOCATION (LH SIDE)



AMSAC AND AMSEC EQUIPMENT LOCATION

ELECTRICAL POWER SUPPLY

The following paragraph describes the power supply of the main equipment of the Air Conditioning system.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC) ,
- Circuit Breakers (CB).

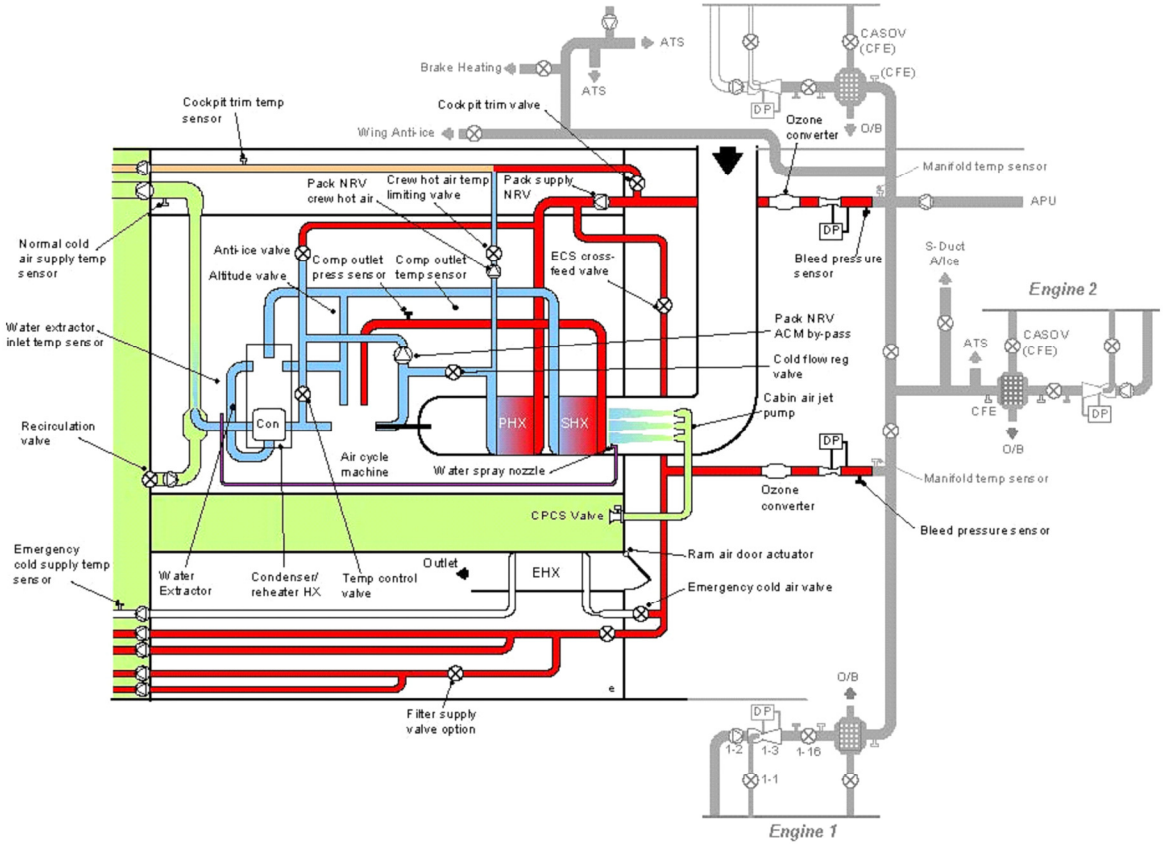
➢ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	TYPE OF PROTECTION
AMSAC AMM 1 and AMM 3	LH Main	CB
AMSAC AMM 2	RH Main	SSPC
AMSEC EMM	LH / RH Essential	SSPC
CREW and PAX PROBE FAN	LH Main	CB
HUMIDIFIER	LH MAin	CB

All ECS Valves are electrically powered by the AMSAC and / or AMSEC.

PRINCIPLE

ECS SCHEMATIC



ECS NORMAL MODE SUPPLY SCHEMATIC

HOT AIR GENERATION

The cabin and cockpit hot air supply lines and controls are segregated to ensure that both supplies are not lost in case of an engine rotor burst.

The cockpit hot air valve is used to regulate the cockpit temperature.

The cabin hot air valve is used to regulate the cabin temperature.

In addition, the cockpit hot air limiting Valve allows mixing hot air with cooler air exhausted from the primary heat exchanger. The aim is to regulate cockpit hot air temperature at 200°C on APU bleed only. If the hot cockpit air temperature exceeds 200°C, the AMSAC drives the Cockpit Hot Air Valve closed and a CAS message is generated.

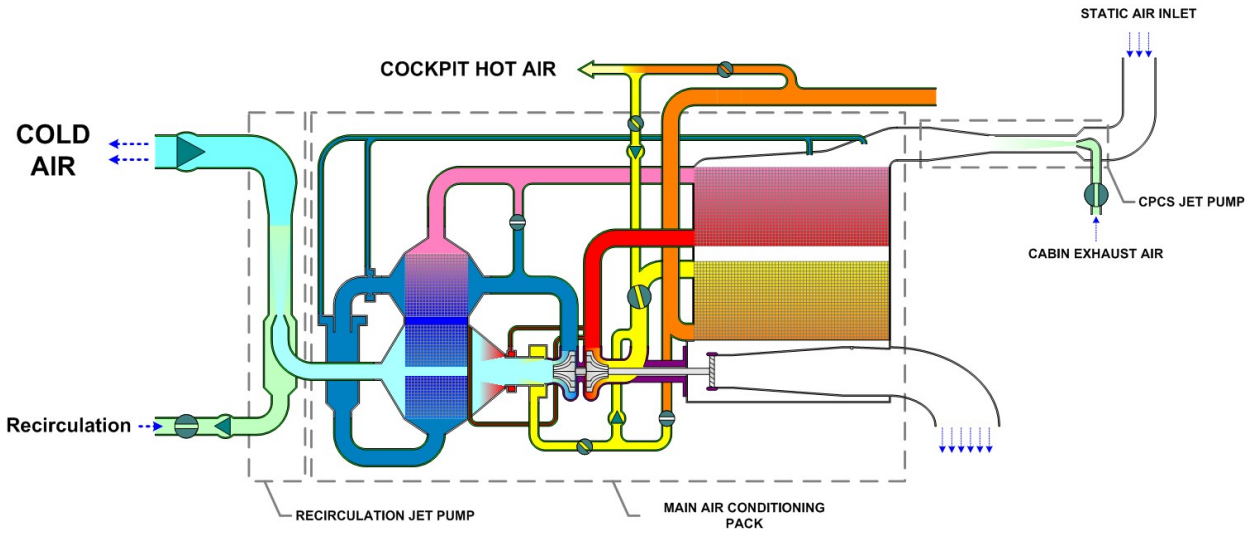
COLD AIR GENERATION

Main ECS pack

Hot air is ducted to the primary heat exchanger where it is cooled by heat transfer to cooler ambient air. The air then passes through the cold flow regulation valve and into the compressor portion of the Air Cycle Machine (ACM). After compression, the air enters the secondary heat exchanger where it is cooled by heat transfer to ambient coolant air.

On the ground and during low altitude flight, the fan of the ACM induces the airflow used to cool the bleed air in the heat exchangers.

In flight, the cabin air jet pump, accelerates the external air (the static air inlet is located behind engine 3 pylon leading edge). The induced airflow is the main source for cooling the heat exchangers and the ACM fan only assists the cabin air jet pump. The cabin air jet pump uses the air evacuated through the baggage ventilation valve.



MAIN AIR PACK SCHEMATIC

Pack component description

- **Air Cycle Machine**

  The ACM consists of a single shaft mounted on air bearings with three wheels: the turbine, the compressor and the fan.

  The ACM turbine is driven by the hot air coming from the primary heat exchanger outlet. This mechanical work results in a pressure and a temperature drop of hot air from turbine inlet to outlet. This energy is used:

  - By the ACM compressor to drive hot air through the condenser-reheater and the Water Separator,
  - By the fan to help cooling the Heat Exchangers. The fan takes air from the static air inlet and expels it through the main pack outlet located under the fuselage.

- **Condenser-reheater and water separator**

  Air at the outlet of the secondary exchanger enters the reheater, where it is cooled by air coming from the water separator and by the airflow from the ACM turbine. It passes through the condenser, where water vapor is condensed and separated from the air stream, by centrifugal action of the water separator, to avoid damage of the ACM turbine and to minimize the introduction of water into the cabin and cockpit.

  The water is routed to the spray nozzles and is atomized at the inlet of the secondary heat exchanger, maximizing its efficiency.

  Above 30,000 ft, the Altitude Valve is automatically opened in order to by-pass the water separator, as ambient air humidity remains very small. The opening of this valve reduces pressure drop, allowing the main pack to provide more cold air during high altitude cruise when inlet pressure is low.

  Air temperature at the water separator inlet must remain above 6°C, and air temperature at the outlet of the main pack is regulated at 3°C. In order to achieve these conditions, the AMSAC opens the temperature control valve, as necessary, to heat the main pack outlet. If the temperature control valve is fully open, the AMSAC drives the anti-ice valve as an auxiliary temperature control valve.

- **Recirculation Valve**

  Below an airplane altitude of 14,000 ft, the main pack outlet cold air is mixed with the recirculation air admitted through the recirculation valve, to provide additional cooling airflow.

  When Wing Anti Icing (WAI) is selected or above an airplane altitude of 14,000 ft, the recirculation valve is automatically closed and the cabin and cockpit are supplied exclusively with cold air from the main pack.

  The recirculation valve can be manually closed by the crew members using the GND VENT pushbutton of the overhead panel.

Emergency ECS pack

In case of a main pack failure, the emergency pack is used to generate cold air after selection by the crew of ECS BACKUP or EMERG modes.

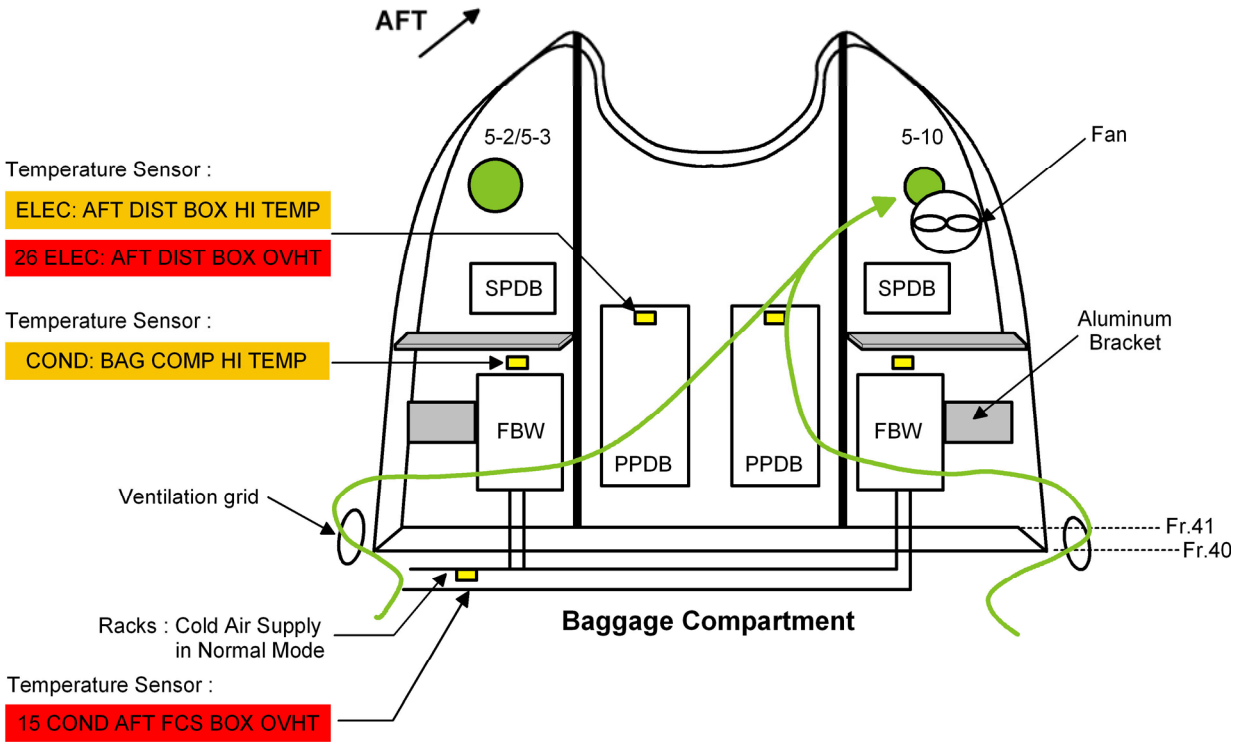
Hot air is supplied to the emergency heat exchanger via the emergency bleed line. The emergency cold air valve is open and the XBLEED ECS is closed by the AMSEC.

The pneumatic emergency cold air valve acts as a basic flow regulation device by regulating differential pressure across the emergency supply flow and the emergency pack.

The ram air door, installed just below the S-Duct and above the baggage compartment, is driven by the AMSEC to regulate a temperature of 3°C at the outlet of the emergency pack. If the ram air door is full open the temperature will follow the external temperature plus 5°C.

DISTRIBUTION

Aft FBW racks, PPDB and aft SPDB cooling



TEMPERATURE SENSOR LOCATION AND CAS MESSAGES

Aft FBW racks located in the rear bulkhead of the baggage compartment are cooled by cold air extracted directly from the outlet of the main and emergency packs.

The air evacuated from the baggage compartment through the baggage ventilation valve is ducted to provide cooling of the PPDB, aft SPDB and additional cooling of the aft FBW racks.

Finally, an electric fan provides a backup ventilation system. The baggage compartment fan is controlled:

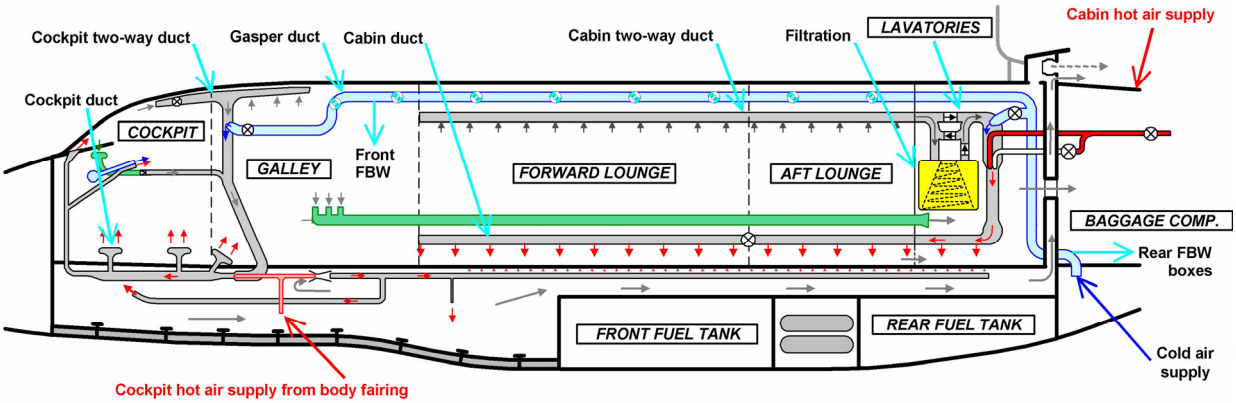
- Automatically by the avionics: when one of the temperature sensors detects a temperature above 60°C, the fan starts. It will stop as soon as the baggage compartment temperature drops below 55°C,
- Manually by the crew members through the BAG FAN switch located on the emergency panel.

Cabin and cockpit distribution schematic

In a schematic view, the air distribution system operates in two zones:

- The passenger zone (forward and aft lounges, aft lavatory),
- The crew zone (cockpit and galley, forward lavatory).

In these two zones, air distribution, recirculation and air evacuation functions are fulfilled as independently as possible from the other zone.



DISTRIBUTION SCHEMATIC

Cabin and cockpit ducts

The cabin air conditioning ducts are routed inside the left and right cabin side-ledges.

The cockpit conditioning ducts are routed along the right side of the fuselage and they supply conditioned air to the entrance area, the galley, the cockpit, the windshields and the feet.

Additionally, two-way ducts, one for the cockpit and two for the cabin (one in each PSU) are routed along the top of the cabin. They have two functions:

- To distribute cold air to the upper part of the cabin / cockpit when a temperature drop is required,
- To recycle air from the cabin / cockpit to be mixed with conditioned air when a temperature rise is required.

Each pilot selects the direction of the air supply (to the windshield for defogging or to the foot warmer) with a control lever on the instrument panel and behind the RH pilot seat.

Cabin and cockpit conditioned air ducts may be manually interconnected to allow either the cabin or the cockpit to supply both ducting systems when using CREW OFF or PAX OFF or EMERG modes. The manual interconnection valve is located on the lower right-hand side of the galley area.

Underfloor ventilation and heating

Air is distributed between the floor panels and the fuel tanks by a manifold supplied with cabin conditioning air.

Nose cone ventilation

On ground and at low altitude, an electric fan ventilates the nose cone.

In flight, ventilation is also provided by the cabin conditioned air through a calibrated orifice. The air is evacuated through the nose gear well.

Cabin air filtration (option)

When cabin air is recirculated after a temperature rise is required, the air passes through 2 filtration devices before being mixed with cold air of the main pack and redistributed in the cabin. Filtering comprises:

- Particles and bacteria filtration,
- Odor filtration.

Humidifier (option)

The humidifier provides additional humidity to the aircraft during long duration high altitude cruise. The additional humidity improves comfort for the passengers.

The system consists of actual steam generation by water evaporation prior to mixing with air, as opposed to water sprays in an air flow.

The humidifier system aims at controlling a 0°C dew point during cruise, corresponding to 20% relative humidity at a cabin temperature of 24°C.

The humidifier uses hot air as a means to generate steam; then steam and hot air are mixed and supplied to the cabin distribution system for air humidification purposes. The hot air is taken from the cabin trim air supply circuit; the water is taken from the airplane potable water supply. Humidifier drainage is performed using the airplane aft water mast, in flight or on ground.

The system is designed to operate with any kind of potable water supply. The heat exchanger technology is such that the system is tolerant to fouling resulting of mineral deposits.

The water is boiled before being injected to the distribution (bringing the water to a temperature above 60°C is a perfect protection against bacteria), thus generating:

- Extremely high quality sterile and mineral free steam,
- Avoiding condensation in the supply ducting.

The warm air and steam mixture is then injected in the aircraft air distribution hot air lines.

TEMPERATURE REGULATION

Crew member selects the desired temperature in the required compartment:

- Different temperature setting between aft and forward lounges,
- Different setting between LH and RH pilot feet.

In automatic mode:

- Hot air valve is driven open if too cold and closed if too hot,
- Cold valves are driven in order to maintain the required total flow.

In manual mode when emergency pack is used:

- Crew member controls cabin hot air valve position to stabilize cabin and cockpit temperature.
- Cold flow provided by the emergency pack is around 7 kg/min at a temperature of 3°c when the ram air door can regulate and higher if ram air door full open.

Secondary functions

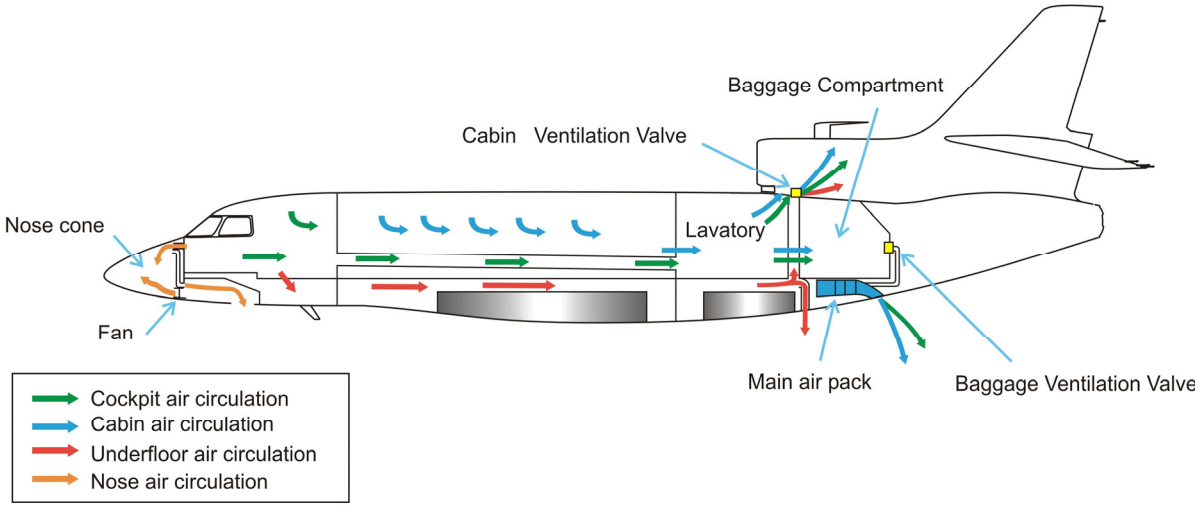
The AFT and FWD lounges temperatures are adjusted using two lounge valves located in the cabin ducts. Opening the valves allows warmer air to the forward lounge, closing the valves allows more warm air to the aft lounge.

In temperature manual mode, the cabin and cockpit hot air valves positions are proportional to the potentiometer setting one control for the both lounges and the lounges valves are at a fixed 45° setting.

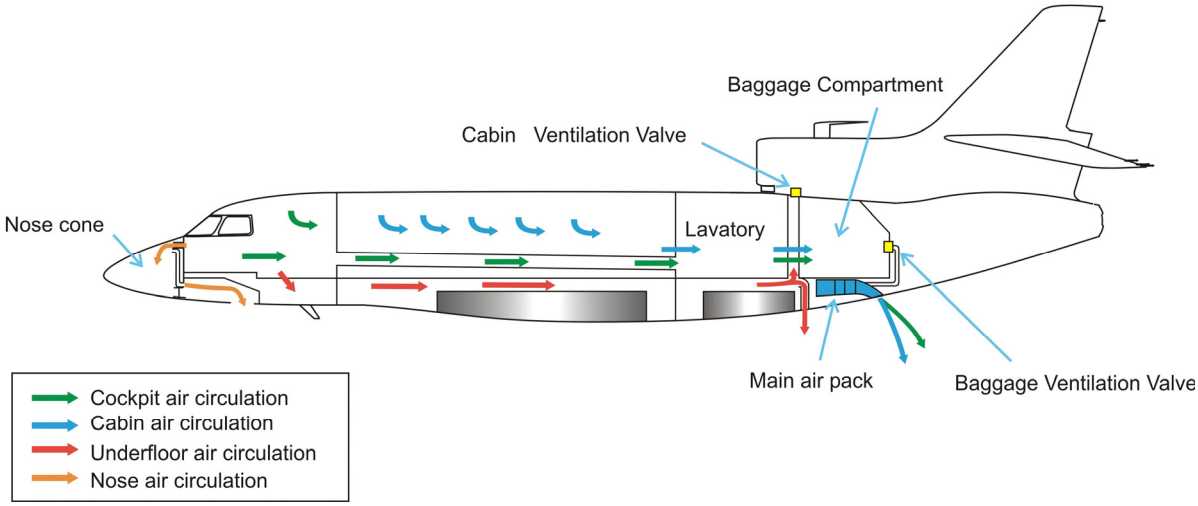
The LH / RH crew ratio is adjusted the same way via a butterfly valve splitting the cockpit floor warm air left and right (up to the 70/30 ratio).

AIR EVACUATION

Air evacuation diagrams



AIR EVACUATION CIRCUITS ON GROUND AND UP TO 30,000 FT



AIR EVACUATION CIRCUITS ABOVE 30,000 FT

Possible smoke in cockpit or passenger cabin is evacuated using the air evacuation path.

Baggage compartment conditioning

The baggage compartment is conditioned and ventilated by the cockpit and the cabin air entering the compartment through the baggage isolation valves and evacuated, in flight through the baggage compartment ventilation valve and on ground trough the ground ventilation valve. These valves are located at the rear of the baggage compartment.

The baggage compartment can be isolated from the cabin by means of the isolation valves. When the baggage compartment isolation is commanded and at least one of the isolation valve is not closed, a CAS message is displayed.

OPERATING MODES

The air conditioning system has 5 modes of operation, which ensure air supply under normal and abnormal conditions, and can be seen as 3 main modes with 2 sub-modes:

- NORMAL mode with the CREW OFF and PAX OFF sub-modes. These modes are driven by the AMSAC, with multiple system protections. In this mode, cold air is supplied by the MAIN PACK.
- BACKUP mode. This mode is driven by the AMSAC, and is a degraded mode but with the same system protections. In this mode, the cold air is supplied by the emergency pack (the ACM, secondary exchanger and condenser-reheater-water separator of the main pack are bypassed but the primary exchanger is still operating) and comfort can be degraded at low altitude.
- EMERG mode. This mode is driven by the AMSEC. It is a highly degraded mode with only a few parameters monitored. In this mode, the cold air is supplied by the emergency pack.

On ground, a pre-flight test of the ECS system has to be performed. Its aim is to check the correct operation of the emergency pack.

NORMAL mode

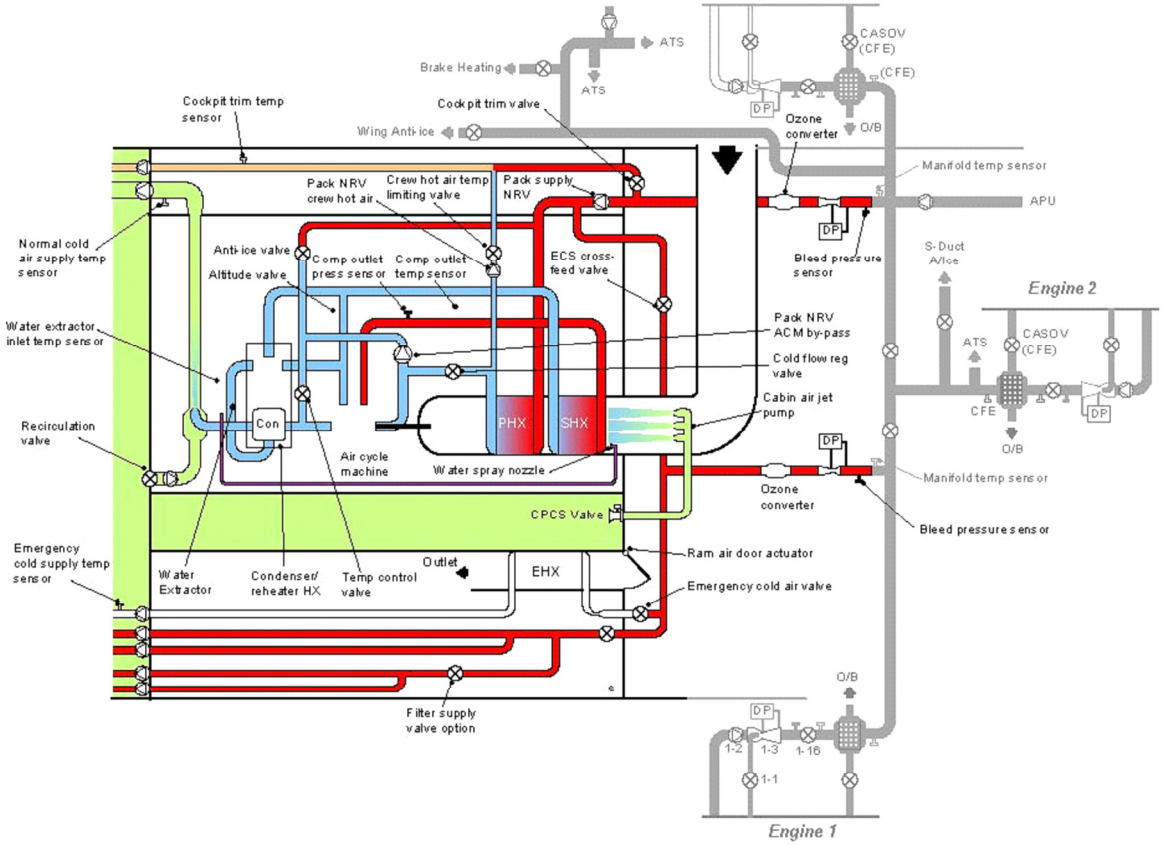
In this mode, cabin and cockpit temperature can be regulated in:

- Automatically by the system controller, based on a selected zone temperature, or
- By the crew members, manually controlling the position of the cabin or cockpit valves.

To maximize engine performance, there is no air conditioning during the first part of the take-off when at least 2 throttles are in take-off position and weight on wheels. In such conditions, the cold flow regulation valve, the anti-ice valve and temperature control valve, and the cabin and cockpit hot valves are closed.

Air conditioning is available again:

- When all engines are operating and weight off wheel,
- Or after one or two engine failures (N1 below flight idle) and:
  - Throttles are retarded from take off position,
  - Or airplane altitude exceeds 15,000 ft.



ECS NORMAL MODE SUPPLY SCHEMATIC

CREW OFF mode

The CREW OFF mode is selected in the event that control of the hot and/or cold air supply to the cockpit is lost due to a valve or a sensor failure. The crew member is alerted through CAS message and the selector has to be turned to the CREW OFF.

In this mode, the AMSAC closes the cockpit cold air valve and the cockpit hot air valve and fully opens the lounge valves. The crew members are required to manually open the interconnection valve, allowing the cabin to supply conditioned air to the cockpit zone.

The AMSAC maintains control of all other valves.

PAX OFF mode

The PAX OFF mode is selected in the event that control of the hot and/or cold air supply to the cabin is lost due to a valve or a sensor failure. The crew members is alerted through CAS message and the selector has to be turned to the PAX OFF.

In this mode, the AMSAC closes the cabin cold air valve and the cabin hot air valve and fully opens the lounge valves. The crew members are required to manually open the interconnection valve, allowing the cockpit to supply conditioned air to the cabin zones.

The AMSAC maintains control of all other valves.

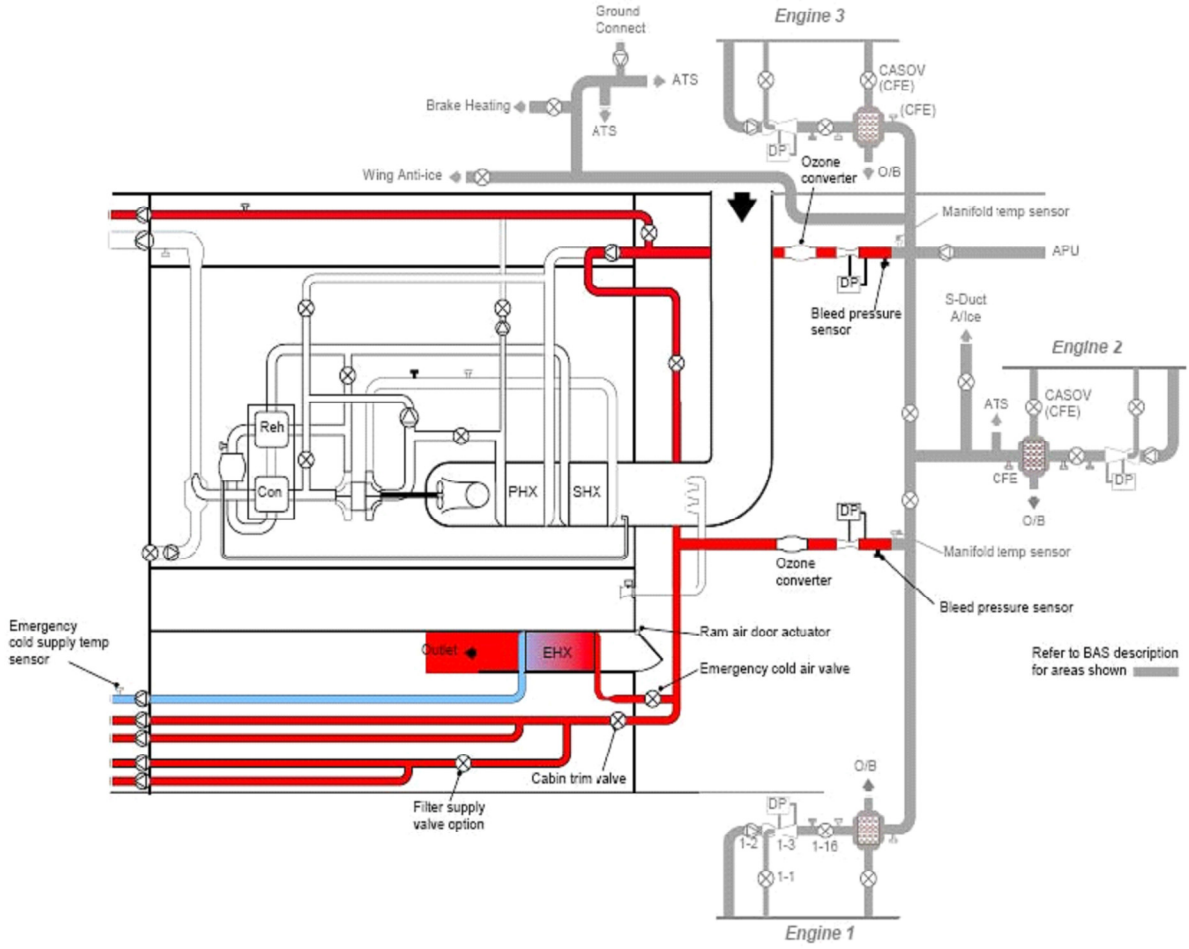
BACKUP mode

The BACKUP mode is selected in the event that the main pack is unable to provide cold air, but the AMSAC is still able to control all the others functionalities of the air conditioning system. The crew member is alerted through CAS message.

In this mode, cold air is provided by the emergency pack. The AMSAC closes the cold flow regulation valve as well as the temperature control valve, isolating the main pack.

The normal mode system protections are still provided by the AMSAC, and specifically the cockpit hot air temperature limit, by the normal operation of the primary heat exchanger.

The main pack primary heat exchanger is used only to maintain maximum cockpit air at 180°C.



BACKUP MODE SUPPLY SCHEMATIC

EMERGENCY mode

The EMERG mode is selected in case of a total loss of control of the air conditioning system by the AMSAC.

The AMSEC:

- Closes the engine HP bleed valves and the MP 3 bleed valve,
- Closes the XBLEED 2↔3,
- Opens the XBLEED 1↔2,
- Closes the ECS Crossfeed Valve (XBLEED ECS),
- Opens the emergency cold air valve.

In that case, hot bleed air (LP) is supplied by engines 1 and 2 only. The cold air is supplied by the EMERGency PACK only.

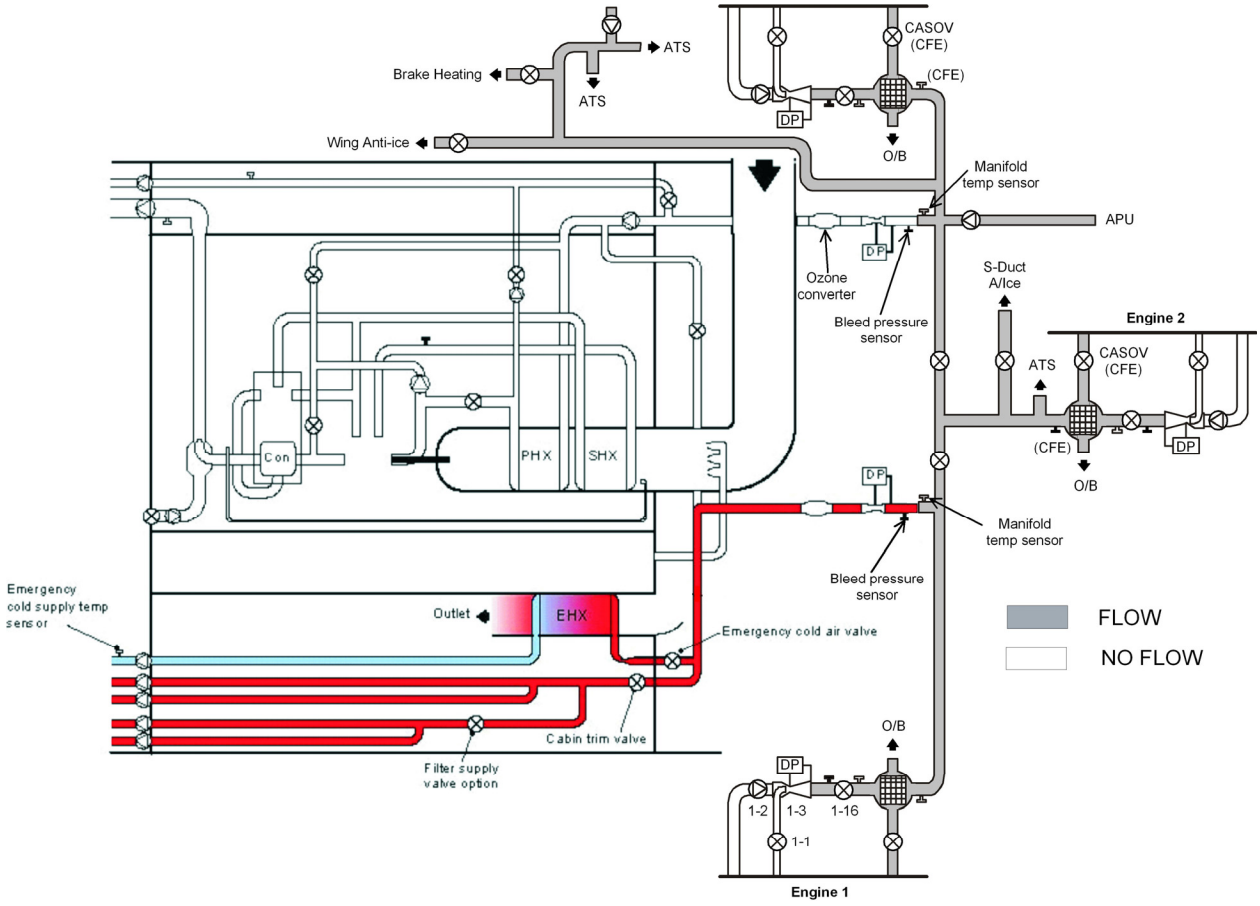
Conditioned air is supplied by the cabin distribution system. The lounge valves are driven fully open by the AMSEC, and the cockpit cold air valve is driven fully closed.

The crew members must open the manual interconnection valve and must manually set the desired temperature using the cabin manual control. The LH / RH pilot flow ratio valve remains in its last position.

Cabin duct temperature and EMERGency PACK outlet temperature are monitored by the AMSEC and CAS messages are generated in case of overheat (respectively **COND: PAX SUPPLY FAIL** and **COND: EMERG PACK HI TEMP**).

NOTE

Wings and S-DUCT A/I are no longer available when EMERG mode is selected.



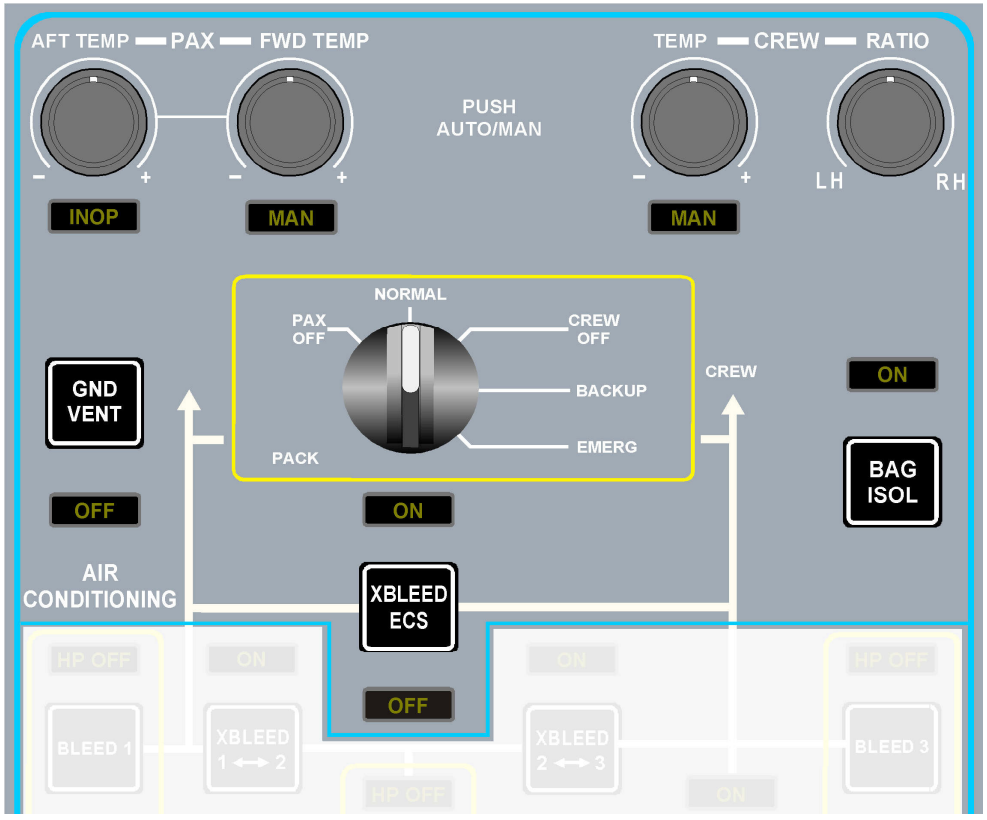
EMERGENCY MODE SUPPLY

CONTROLS

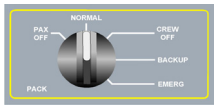
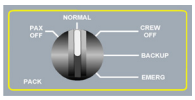
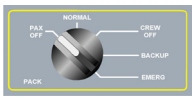
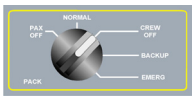
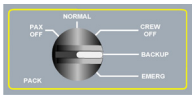
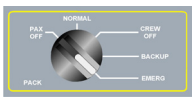
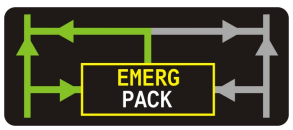
Crew has control on the Air Conditioning system through:

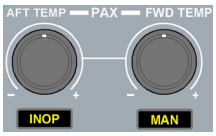
- The Air Conditioning part of the Overhead Panel (OP),
- A manual interconnect valve,
- One pushbutton on the Emergency Panel,
- A soft key on the ECS synoptic page for remote control,
- A soft key on the TEST synoptic page for ECS pre-flight test,
- A pushbutton on RH console for optional humidifier.

OVERHEAD PANEL



AIR CONDITIONING OVERHEAD PANEL

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	PACK rotary switch: switches between the five ECS control modes. NORMAL: Main pack is used (primary and secondary heat exchanger) PAX OFF or CREW OFF: Main pack is operative. The respective cold and hot valves are closed. BACKUP: The emergency pack is used with AMSAC control. EMERG: The emergency pack is used with AMSEC control.	Normal 	
		PAX OFF 	
		CREW OFF 	
		BACKUP 	
		EMERG 	

<table>
<tr><th>CONTROL</th><th>FUNCTION</th><th>TO ACTIVATE
TO DEACTIVATE</th><th>SYNOPTIC</th></tr>
<tr><td rowspan="2"> 
</td><td rowspan="2">AUTO mode: the AFT TEMP rotary knob, and the FWD TEMP rotary pushbutton are used to set cabins target temperature (between 12°C and 32°C).

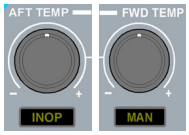
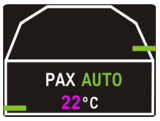
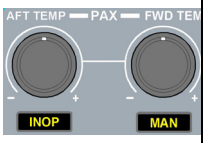
Push on the FWD TEMP rotary pushbutton to select pax Auto / MAN mode.

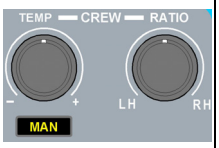
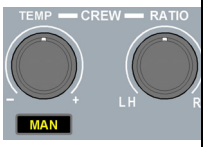
MAN mode: The crew manages the corresponding hot valve position.

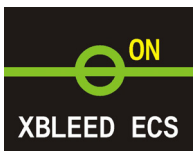
NOTE

In MAN mode:

-MAN is displayed under the PAX FWD TEMP rotary knobs,

-INOP is displayed under the PAX AFT TEMP rotary knobs and it is disabled.</td><td>Auto mode 
</td><td>PAX Auto 
</td></tr>
<tr><td>MAN mode 
</td><td>PAX Manual 
</td></tr>
</table>

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	AUTO mode: the CREW TEMP rotary pushbutton are used to set cockpit target temperature (between 12°C and 32°C). CREW RATIO rotary knob allows the crew members to modulate the proportions of hot air supplied to the cockpit floor right hand and left hand sides when the PACK mode selector is in the NORMAL, PAX OFF, or BACKUP positions. Push on the TEMP rotary pushbutton to select crew auto / MAN mode. MAN mode: The crew manages the corresponding hot valve position.	Auto mode 	CREW Auto 
		MAN mode 	CREW Manual 

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	BAG COMP pushbutton when pressed closes the baggage isolation valves and the baggage ventilation valve.	Normal 	No synoptic
		ON 	No synoptic
	GND VENT pushbutton: when pressed closes the ground ventilation and recirculation valves	Normal 	No synoptic
		OFF 	No synoptic
	XBLEED ECS pushbutton: when pressed cycles through - Unlighted auto (normal) position, - ON: opens the XBLEED ECS valve, - OFF: closes the XBLEED ECS valve.	Unlighted auto 	
		OFF 	
		ON 	

MANUAL INTERCONNECT VALVE

The manual interconnect valve allows to manually interconnecting the cabin and cockpit air line.

This valve is installed under the forward cabin floor and the manual lever to move the valve is located in the crew lavatory area.

Normally, the interconnect valve is closed to ensure independent conditioned air supplies to the cabin and the cockpit. In case of a failure of the conditioned air source for either the cabin or cockpit, the pilot opens the isolation valve and the zone with the failure is ventilated by the air supply to the other zone.

EMERGENCY PANEL

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	BAG FAN pushbutton on Emergency Panel: activates the baggage compartment fan	Normal  ON 	No synoptic

REMOTE SOFT KEY

In AUTO mode, by selecting the REMOTE soft key, the cabin temperature can be controlled directly from buttons located in the cabin, independently for the two lounges.

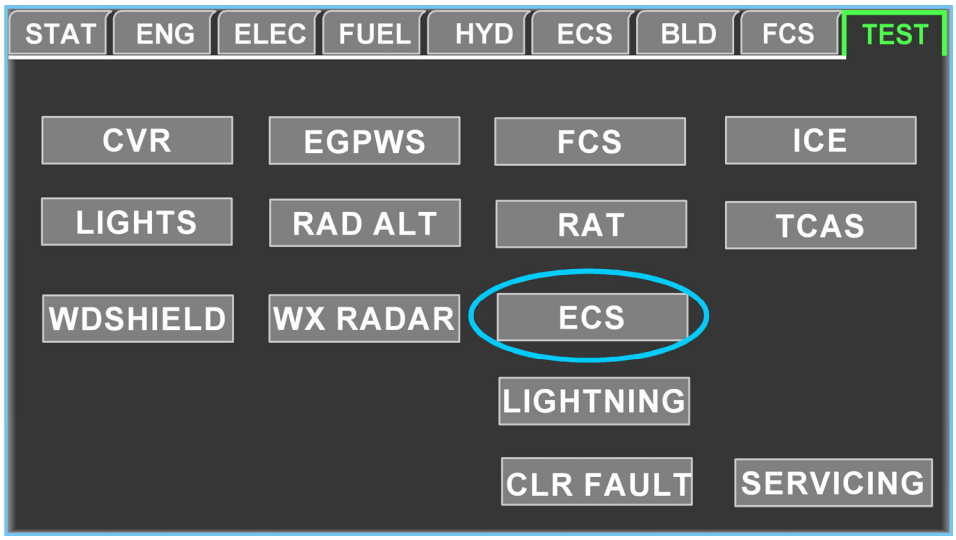
NOTE

The REMOTE control is selectable in AUTO mode and with the PACK rotary switch on the NORMAL position only. Upon MAN mode selection, the REMOTE control is automatically de-selected and the REMOTE selection is impossible.

ECS TEST

A preflight test must be performed by the crew members before first flight of the day. This test is used to check Emergency ECS is operational.

This test is actuated via the ECS soft key available in the TEST synoptic page.



ECS TEST

HUMIDIFIER PUSHBUTTON

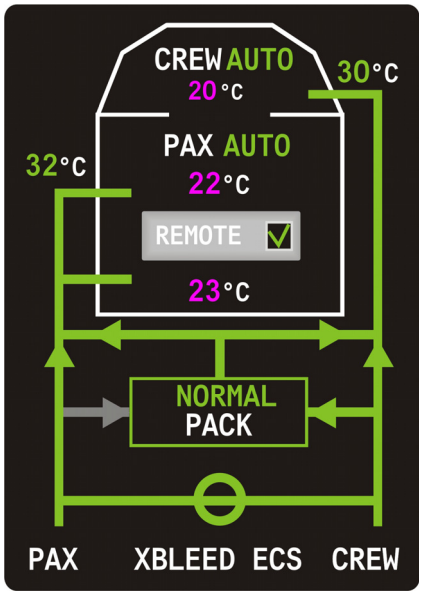
The AUTO – OFF selection of the humidifier is accomplished by a dedicated pushbutton in the cockpit on RH console. This pushbutton is easily accessible by RH pilot.

Cockpit humidifier pushbutton
in AUTO position

Cockpit humidifier pushbutton
in OFF position

INDICATIONS

The ECS synoptic page displays operating modes, system status, cockpit and cabins temperatures, crew and pax supply ducts temperature.



ECS SYNOPTIC PAGE - CONDITIONING PART

OPERATING MODES

The following operating modes are displayed on the synoptic:

- PAX mode indication:
  - AUTO displayed in green,
  - MAN displayed in amber.
- CREW mode indication:
  - AUTO displayed in green,
  - MAN displayed in amber.
- ECS mode indication:
  - AUTO displayed in green,
  - PAX OFF displayed in amber,
  - CREW OFF displayed in amber,
  - BACKUP displayed in amber,
  - EMERG displayed in amber.

COCKPIT AND CABIN TEMPERATURES

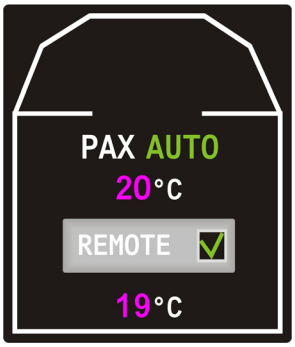
The cockpit temperature indication is displayed beside the CREW label.

The cabin temperature indication is displayed under the PAX label. Two cabin temperature indications are displayed: forward and aft cabin temperatures.

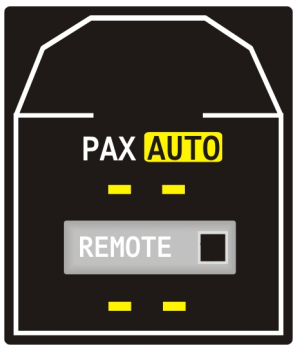
In AUTO mode the readouts range from 12 to 32°C and corresponding to the desired temperature commanded by the crew members. The temperature indications are displayed in magenta (target value)

When CREW TEMP (or PAX FWD TEMP) rotary pushbutton is in MAN, the corresponding temperature indication is replaced by a percentage indication, indicating the position of the cabin hot air valve. The corresponding temperature indication is displayed in green (active value).

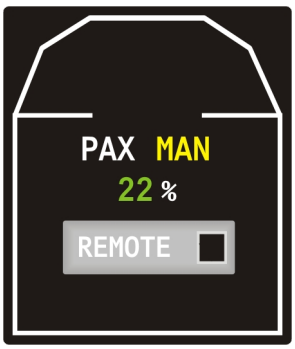
When the signal is invalid, two amber dashes are displayed in place of the temperature indication.



Temperatures in AUTO mode and Remote operarting



PAX AUTO mode failed and Remote disabled



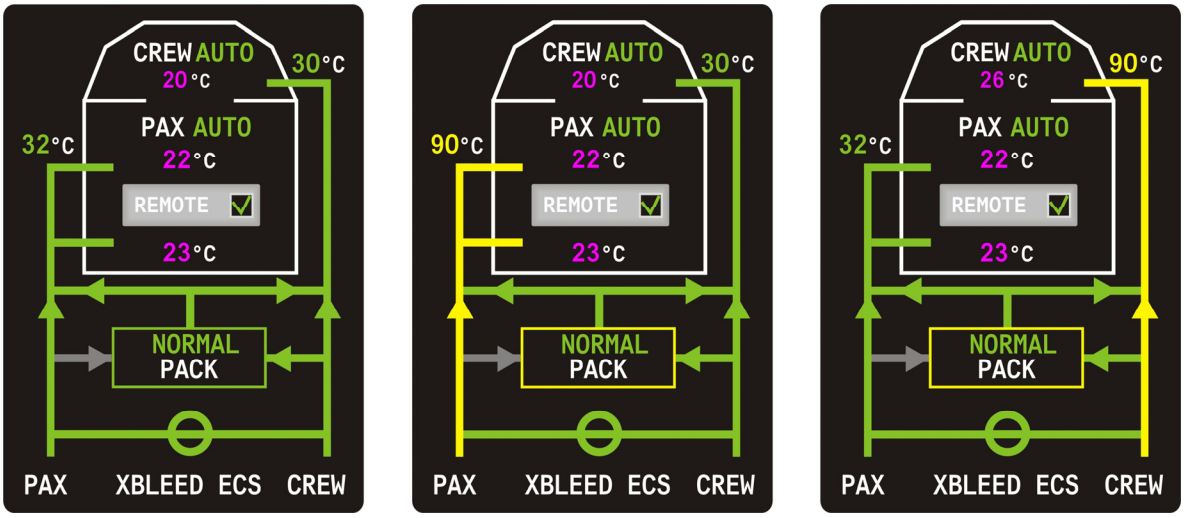
MAN mode for cabin temperature setting and Remote disabled

TEMPERATURE INDICATIONS

CREW AND PAX SUPPLY DUCTS TEMPERATURE

The flow lines on the synoptic are color coded as follows:

- The green indicates the active state with airflow through the ducts,
- The gray indicates the inactive state and no airflow through the ducts,
- The amber indicates abnormal status in association with the applicable caution CAS message.



Normal | T cabin duct air > 85°C | T cockpit duct air > 85°C

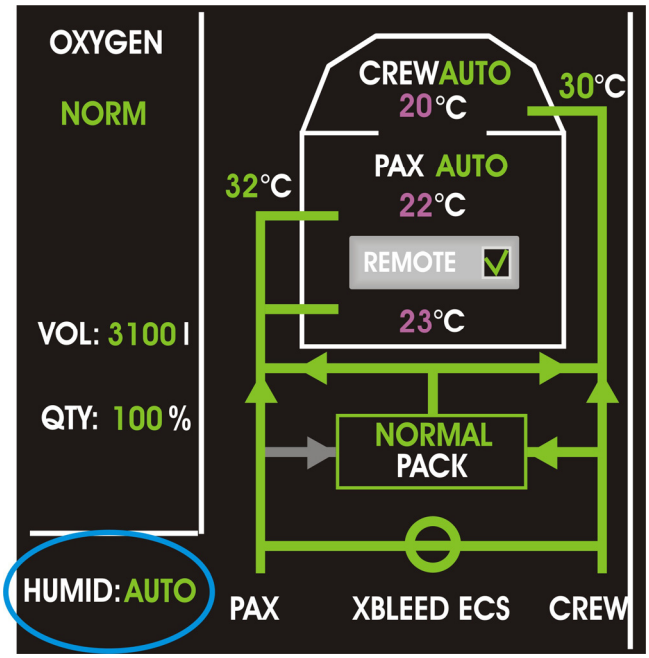
CREW AND PAX SUPPLY DUCTS TEMPERATURE

HUMIDIFIER STATUS

The status of the humidifier system is displayed on the ECS synoptic:

- AUTO green label is displayed when humidifier is in automatic mode,
- OFF amber label is displayed when humidifier is off.

Amber dashes are displayed if avionics data are invalid.



HUMIDIFIER STATUS

CONTROLS

PACK MODE SELECTOR

The PACK rotary switch located on the overhead panel provides the crew the ability to select one of the five following modes: NORMAL, BACKUP, CREW OFF, PAX OFF and EMERG.

The table summarizes the operational status in all modes.

MODES	CONTROL AND MONITORING	SYSTEM IMPACT	ECS FUNCTIONS LOST
NORMAL	AMSAC	None	None
PAX OFF & CREW OFF	AMSAC	PAX and CREW supplies are to be manually interconnected	None
BACKUP	AMSAC	Main pack isolated	Main pack cooling Aft FBW cooling Recirculation below 14,000 ft
EMERGency	AMSEC	Main pack is isolated (Bleed 3 isolated and XECS open) Emergency Heat Exchanger is fed by engine 1 and 2 bleed air PAX and CREW supplies are to be manually interconnected	Main pack cooling Aft FBW cooling Recirculation below 14,000 ft Automatic temperature regulation

PAX FWD TEMP AND PAX AFT TEMP ROTARY KNOBS

The PAX FWD TEMP and PAX AFT TEMP rotary knobs allow the crew members to select:

- In AUTO mode a desired temperature for the forward and aft cabin between 12°C and 32°C,
- In MAN mode a desired cabin hot air valve position.

Switching between AUTO and MAN is made by pushing on the PAX FWD TEMP rotary pushbutton.

In MAN mode, PAX AFT TEMP rotary knob is disabled (INOP lighted) and PAX valve position setting is made through the PAX FWD TEMP rotary pushbutton.

In ECS EMERG mode, the AMSAC modulates the cabin hot air valve to the desired position set point of the PAX FWD TEMP rotary pushbutton, regardless of the state of the AUTO / MAN mode (the PAX AFT TEMP is not used by the AMSEC).

XBLEED ECS PUSHBUTTON

The XBLEED ECS pushbutton allows the crew members to manually open or close the ECS cross-feed valve. The AMSAC drives the valve when the ECS Mode Selector is in the NORMAL, PAX OFF, CREW OFF or BACKUP position. With the XBLEED ECS pushbutton in the AUTO position and the ECS operating correctly, the AMSAC drives the ECS cross-feed valve open. The AMSAC automatically drives the XBLEED ECS valve closed if there is a main pack overheat or a distribution duct overpressure.

When the PACK rotary switch is in the EMERG position, the AMSEC drives the XBLEED ECS valve closed irrespective of pilot command.

With the XBLEED ECS pushbutton in the OFF position, the XBLEED ECS valve is driven to close position.

With the XBLEED ECS pushbutton in the ON position, the XBLEED ECS valve is driven to open position, except in EMERG mode.

GND VENT PUSHBUTTON

The GND VENT pushbutton allows the crew members to manually close the recirculation valve and the ground ventilation valve.

With the GND VENT pushbutton in the normal position (unlighted):

- The recirculation valve is controlled by the AMSAC and closes at 14,000 ft, (except if the PACK rotary switch is in the EMERG position; the valve remains in the last commanded position),
- The ground ventilation valve is controlled by the cabin ventilation valve.

With the GND VENT pushbutton in the OFF position, the recirculation valve and the GND VENT Valve are driven to the close position.

CREW RATIO SELECTOR

The CREW RATIO rotary knob allows the crew members to modulate the proportions of hot air supplied to the cockpit floor right hand and left hand sides when the PACK rotary switch is in the NORMAL, PAX OFF, or BACKUP positions.

The AMSAC modulates the crew LH / RH distribution valve to the desired position set point; the central position supplies a 50 / 50 flow split and this can be increased to a maximum flow split of 70 / 30 in either direction.

With the PACK rotary switch in the EMERG position, the valve remains in the last commanded position.

TEST MODE

This test is used to check Emergency ECS is operational.

The test is actuated via the ECS soft key in the TEST synoptic. It is sequenced in 3 phases.

TEST PHASE 1.

Air conditioning flow is reduced as cabin and cockpit, cold and hot valves, are closed.
XBLEED 1-2 and XBLEED 2-3 are closed.
Lounge valves are open.
Approximately 15 seconds after the beginning of the conditioning test phase 1, the **COND: TEST WAITING EMERG** message is displayed.

TEST PHASE 2.

After selection of the ECS EMERG mode, cold air flows through the gasper pressure sensor testing it:

- If pressure is detected, the emergency system works correctly as emergency cold air valve has been checked open and no leak was detected,
- If not, a CAS message is generated **COND: GASPER SENSOR FAIL**.

Approximately 20 seconds after the beginning of the conditioning test phase 2, the **COND: TEST WAITING NORM** message is displayed.

TEST PHASE 3.

After selection of the ECS NORM mode:

- If the emergency system was checked operational, no conditioning CAS messages shall be displayed,
- If not, the **COND: TEST FAIL** is displayed.

SYSTEM MONITORING

The air conditioning system's are continuously monitored for the following items:

- Overheat (Ducts, ACM, aft FBW racks, nose cone),
- Ducts and gasper overpressure,
- Position of valves (baggage isolation valves, cabin and cockpit cold and hot valves, emergency cold valves, XBLEED ECS, recirculation, ground ventilation),
- Baggage compartment fan operation,
- Valves and Sensors integrity.

ACTIVE PROTECTIONS

In NORMAL, PAX OFF or CREW OFF mode, the AMSAC provides the following automatic protections:

- MAIN pack overheat by isolating the main pack,
- ACM compressor outlet overheat by isolating the main pack,
- Gasper overpressure by closing the XBLEED ECS valve and the recirculation valve,
- PPDB or rear FBW racks high temperature by starting the baggage fan.

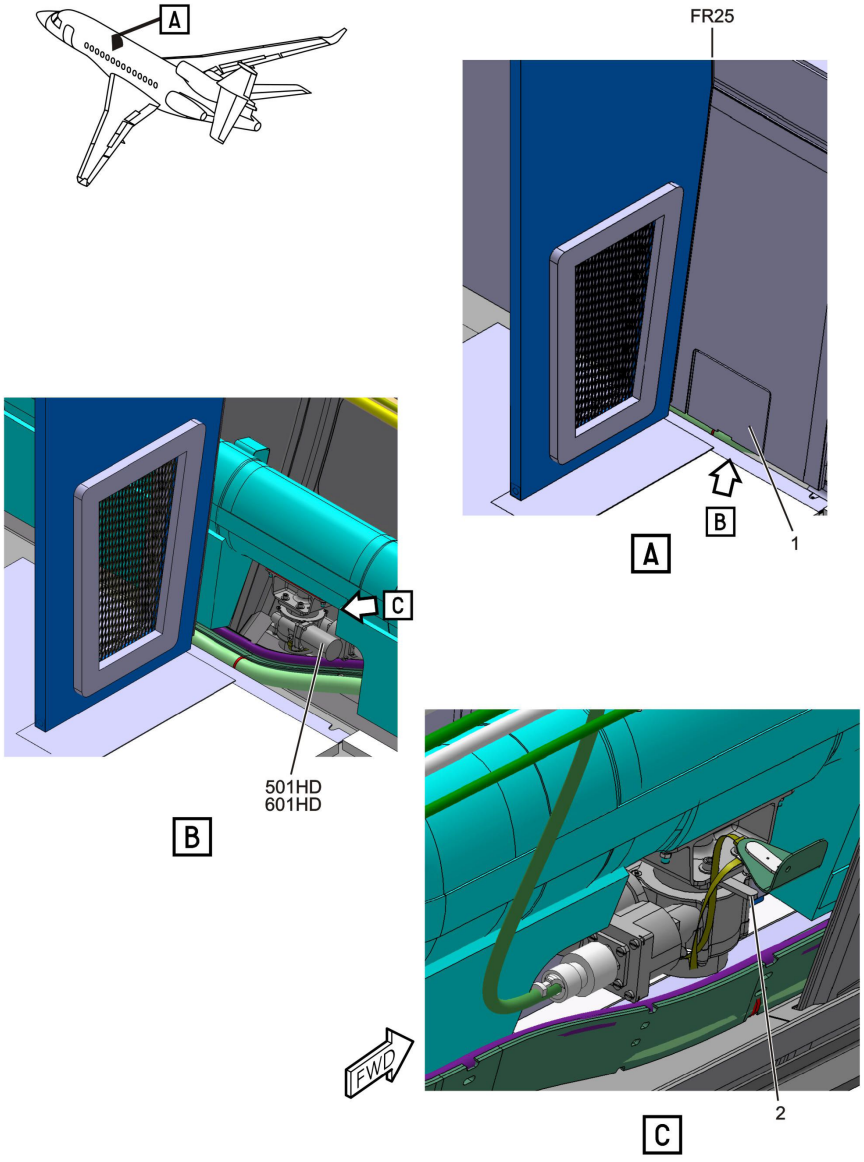
ACTIVE PROTECTIONS

In NORMAL, PAX OFF or CREW OFF mode, the AMSAC provides the following automatic protections:

- MAIN pack overheat: when MAIN pack outlet temperature exceeds 80°C, the Cold Flow Valve (between the primary and the secondary heat exchangers) and the Temperature Control Valve are automatically closed isolating the MAIN pack.
- ACM outlet overheat: if the compressor ACM outlet temperature exceeds 200°C, the Cold Flow Regulation Valve and the XBLEED ECS valve are closed. In case of the cold flow regulation valve fails open, the AMSAC closes the XBLEED 2-3 and the MP 3 bleed valve isolating engine 3 bleed air.
- Gasper overpressure: If the gasper pressure exceeds 100 mbar, the AMSAC closes the XBLEED ECS valve and the recirculation valve.
- Baggage fan is automatically started if the temperature (detected by one of the 4 temperature sensors located close to the aft FBW racks or in the PPDB) exceeds 60°C.

LOUNGE VALVE

The lounge valve can manually open secured.



LOUNGE VALVE LOCATION

INTRODUCTION TO PRESSURIZATION

The pressurization system adjusts the cabin pressure by regulating the conditioned air discharge outside the cabin, depending on:

- Airplane altitude,
- Airplane vertical speed,
- Maximum differential pressure supported by the airframe.

In case of failure (overpressure, negative pressure, maximum altitude), protections ensure that altitude and structural limitations are not exceeded.

The pressurization system has an automatic mode and a manual mode, allowing the crew members to control directly the pressurization valves.

There is no optional equipment associated with the pressurization system.

FLIGHT DECK OVERVIEW

CONTROLS

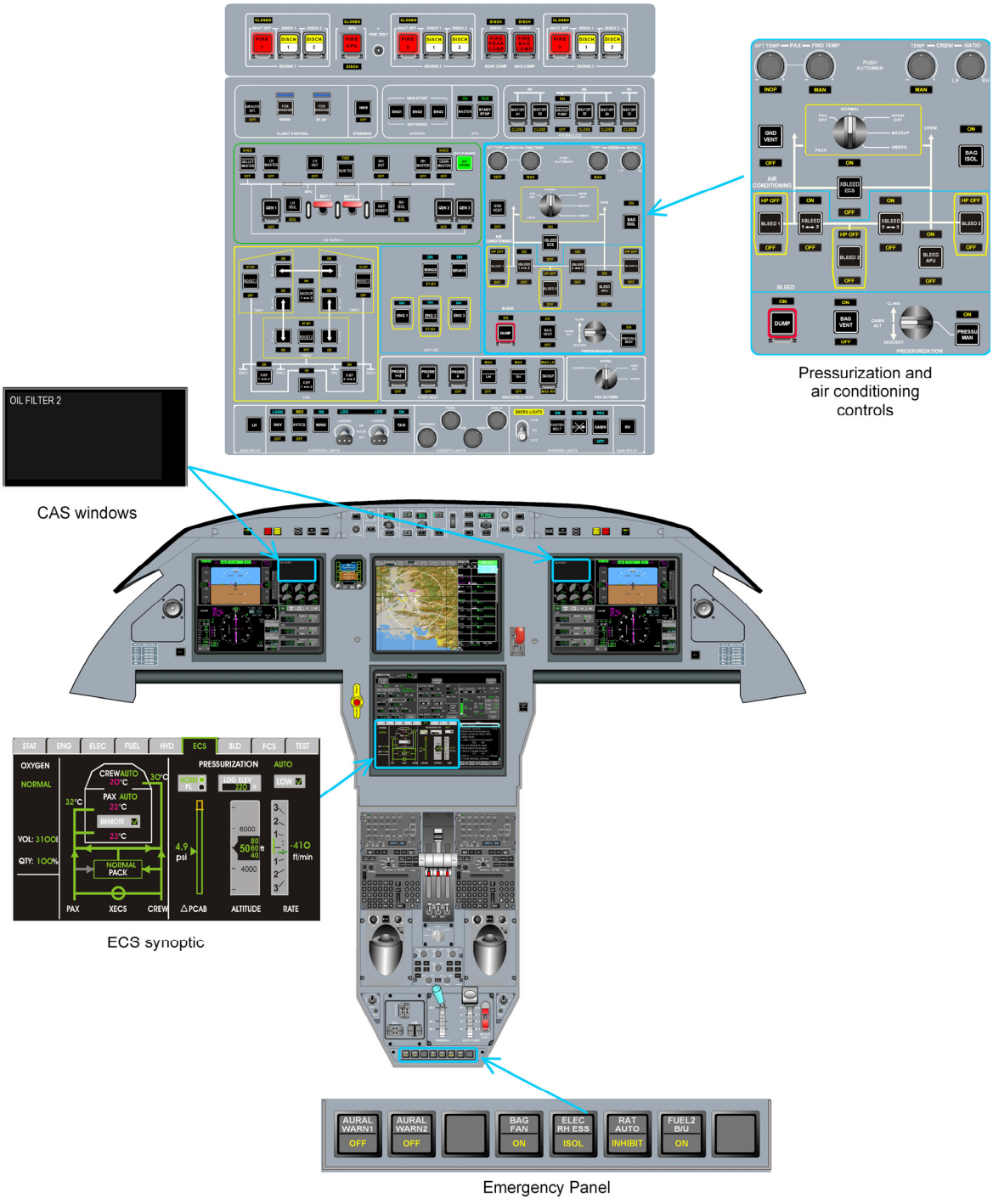
Crew control of the pressurization system is performed:

- Primarily via the PRESSURIZATION section of the overhead panel,
- Via a LOW soft key in the ECS synoptic to reduce the normal cabin altitude rate by approximately 300 ft/min.

INDICATIONS

Crew indications with regard to pressurization are located in:

- The ECS synoptic,
- At the bottom of the STATus synoptic for the cabin altitude,
- In the ENG-CAS window for CAS messages,
- In STATUS synoptic / FAULT tab for fault messages.



FLIGHT DECK OVERVIEW

GENERAL

The purpose of pressurization is to maintain a level of pressure inside the fuselage that is comfortable for the passengers and the crew, taking into account structural limits of the airframe, whatever the flying conditions.

The pressurization system also provides the control of:

- Nose cone ventilation and pressurization,
- Baggage compartment isolation, ventilation and main pack heat exchanger cooling,
- Underfloor ventilation air evacuation.

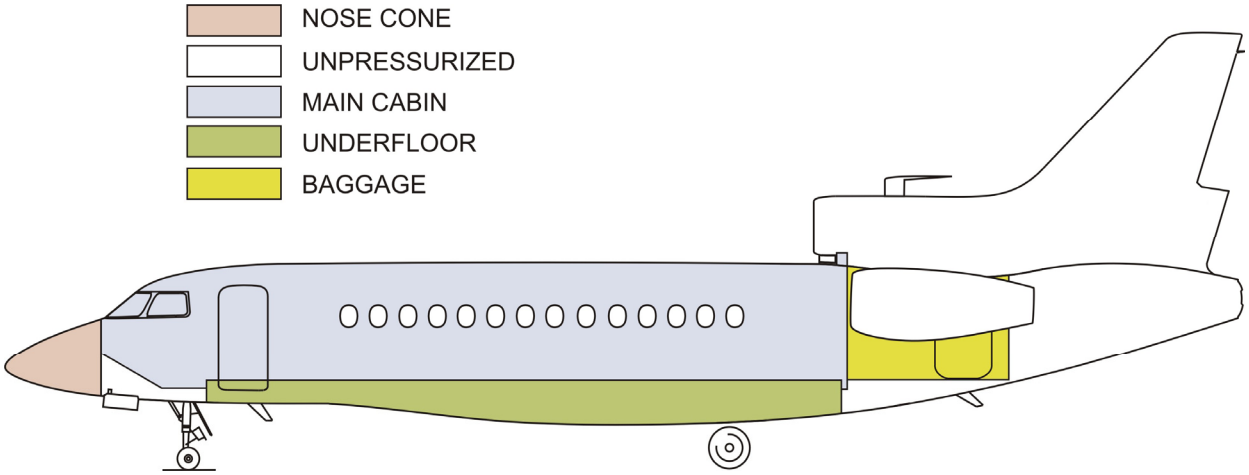
PRESSURIZED AREAS

The airplane comprises three pressurized areas:

- The main cabin, including the cockpit, the forward and aft lounges, and the toilet
- The baggage compartment,
- The nose cone compartment, semi-pressurized and air cooled for satisfactory operation of avionics.

The baggage compartment can be isolated in case of leak or fire.

The underfloor area is pressurized and ventilated, in order to avoid possible fuel or hydraulic fluid vapors accumulation.



PRESSURIZED AND VENTILATED AREAS

PRINCIPLE

PRINCIPLE OF OPERATION

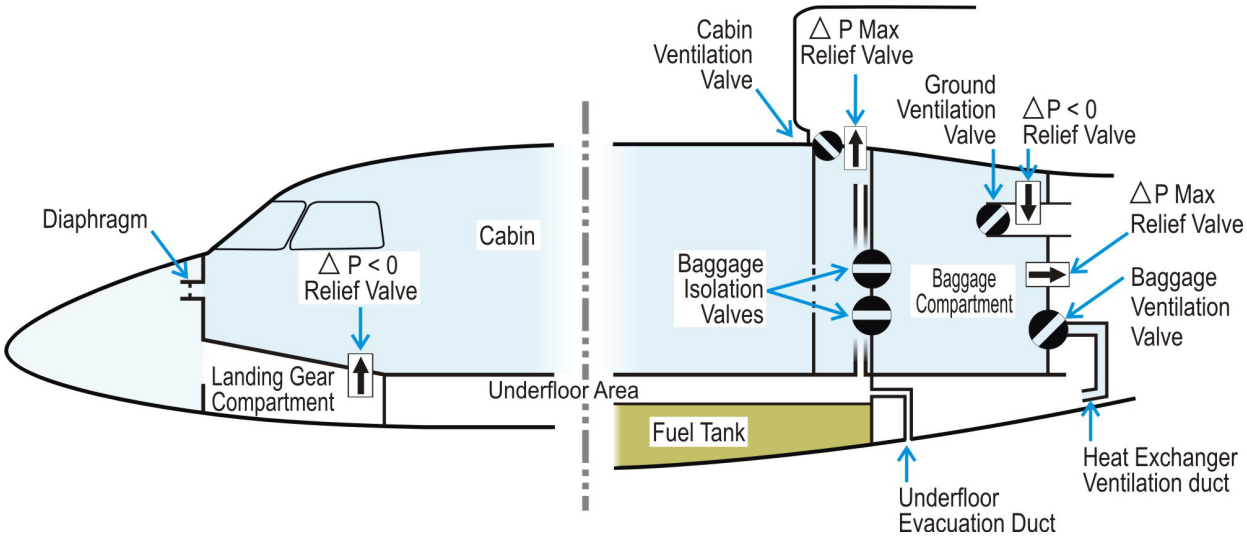
Cabin and cockpit pressurization

Pressurization is achieved automatically or manually by regulating cabin conditioning airflow through two electrically commanded outflow valves located in the fuselage rear bulkhead:

- The Cabin Ventilation Valve,
- The Baggage Ventilation Valve.

Each valve has its own controller (double channel, with one channel active at a time).

The cabin ventilation controller can be considered as the “master” controller as it sends orders to the baggage ventilation valve controller.



PRINCIPLE SCHEMATIC

➢ *Refer to "Protections" section for a description of negative and positive relief valves*

- **Automatic mode**

  In automatic mode, the pressurization system automatically controls cabin altitude, Delta P and cabin Vertical Speed (pressurization rate of change) according to programmed laws and destination airfield elevation.

  In normal operation, cabin altitude target is 6,000 ft.

  Inputs for the control of the pressurization are primarily:
  - NORM / FL law and LOW rate selection,
  - Airplane altitude, vertical speed and baro correction,
  - Weight-On-Wheel, T/O power, doors closed,
  - LDG ELEV: Destination airfield elevation.

  And secondarily, to optimize the comfort:
  - Init Cruising level,
  - Time To Destination.

- **Manual mode**

  In manual mode, the crew manually opens or closes the cabin ventilation valves to achieve the desired cabin vertical speed.

Nose cone ventilation and pressurization

Nose cone ventilation is required for ensuring an adequate operation of the avionics while pressurization avoids water from seeping into the compartment through the seels.

- On ground, the nose cone fan provides ventilation of the nose cone.
- In flight, slight pressurization is provided by conditioned air flowing through a diaphragm.

Baggage isolation, ventilation and main pack heat exchanger cooling

The baggage compartment can be isolated from the cabin by closing the 2 baggage isolation valves:

- Automatically, by the cabin ventilation valve controller when it senses a cabin depressurization ,
- Manually, by the crew through a BAG ISOL pushbutton in case of fire or smoke in the baggage compartment.

When the baggage compartment is isolated, the “cabin air jet pump” located downstream of the baggage compartment ventilation valve, is not fed and cooling of the main pack heat exchangers is left to the ACM (less effective in high altitude).

Underfloor ventilation air evacuation

The underfloor air is evacuated:

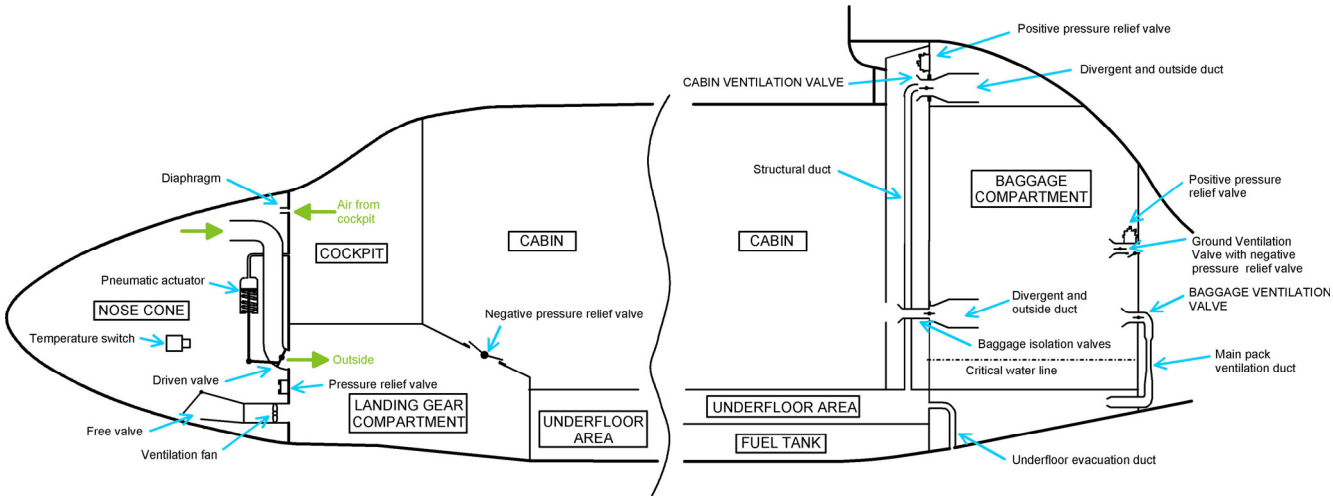
- On ground and in low altitude flight, through a dedicated duct to the ambient air and through the cabin ventilation valve,
- In flight, through the dedicated duct only.

DESIGN PRINCIPLES

The pressurization system was designed considering the following design principles:

- Regarding the pressurization regulation:
  - For passenger confort, ensure cabin altitude at the maximum certified ceiling does not exceed 6,000 ft,
  - Provide a fully automatic normal mode of operation and a manual backup mode,
  - Allow high altitude airfield operations up to 14,200 ft,
- Pressurization regulation and mechanical protections ensure that Delta P will remain within limits acceptable for the structure,
- Ventilation of ECS pack is performed by pressurization jet pump, to avoid implementation of ram air intake which would induce drag,
- A pressurized bulkhead allows isolation of the baggage compartment in case of rotor burst.

EQUIPMENT LOCATION



EQUIPMENT LOCATION ON AIRPLANE

ELECTRICAL POWER SUPPLY

Following paragraph describes the power supply of the main equipment of the Pressurization system.

Electrical protection is provided:

- Either by Solid State Power Controllers (SSPC) ,
- Or by Circuit Breakers (CB).

➢ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	TYPE OF PROTECTION
Cabin valve	LH and RH Essential (one for each computer)	CB
Baggage valve	LH and RH Main (one for each computer)	SSPC
Isolation valves	LH and RH Essential (one for each computer)	CB
Ground vent valve	LH Main	CB
Nose cone fan	LH Main	CB

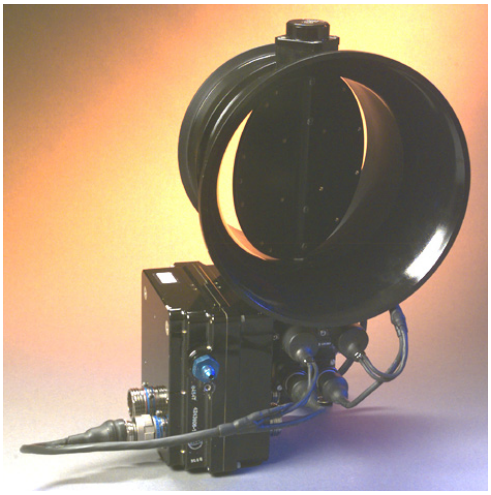
PRESSURIZATION SYSTEM MAIN COMPONENTS

CABIN VENTILATION VALVE

The cabin ventilation valve is located on the main cabin pressure bulkhead, below the S-Duct, allowing cabin air to exit the pressurized cabin.

The cabin ventilation valve consists of a valve body assembly, a rotary electromechanical actuator, and a dual channel digital electronic control with manual control backup.

The valve controller is fitted with two digital and two analog pressure sensors.



CABIN VENTILATION VALVE

The actuator is a motor and gearbox assembly that drives the butterfly plate within the flow body. The actuator accepts inputs from its two dedicated valve controller channels. Each channel in the automatic controller controls a DC motor. The two motor inputs are transmitted through a planetary differential gear system to the output shaft and the butterfly plate.

The cabin pressure control unit is a redundant, dual-channel, microprocessor-based pressure transducer and controller in a single case. The control is designed to automatically switch from one channel to the other in case of a detected fault.

The controller transmits data to, and receives data from the integrated avionics system in automatic mode. In addition, the controller can be controlled by the overhead panel controls in manual mode.

The cabin pressure controller controls the cabin ventilation valve to modulate cabin pressure, depending on:

- Inputs from the integrated avionics system,
- The position of the Baggage Ventilation Valve,
- Inputs from the valve actuator,
- Cabin pressure feedback.

BAGGAGE VENTILATION VALVE

The baggage ventilation valve is located on the baggage compartment pressure bulkhead, allowing cabin air to exit the pressurized baggage compartment. In addition, it provides airflow for the main air pack cooling.

The baggage ventilation valve includes the same components as the cabin ventilation valve except for the pressure sensors. The baggage ventilation valve is slaved to its digital controller.

GROUND VENTILATION VALVE

Ventilation, on ground, of the baggage compartment is provided through the ground ventilation valve, located on the baggage compartment pressure bulkhead. This valve participates to cabin depressurization on ground. It can be manually actuated.

VENTILATION VALVES CONTROL LOGIC

On the cabin ventilation valve, only one controller channel is active at a time to control the valve position. In case of a fault in the “active” controller channel of the cabin ventilation valve, the previously inactive controller channel gains “master” control without flight crew interaction.

On ground when not in takeoff or landing mode (Ground Mode), the cabin ventilation valve, the baggage ventilation valve and the ground ventilation valve are commanded open.

On the ground during takeoff and landing phases (Take-Off / Landing Mode), the cabin ventilation valve provides all sensing and control laws and send valve commands to the baggage ventilation valve.

During airplane climb, cruise and descent:

If there is an adequate airflow: the baggage ventilation valve remains fully open. During this time, the cabin ventilation valve provides the primary sensing and control laws, only controlling itself to perform cabin pressure control,

If there is not an adequate airflow for the baggage ventilation valve to remain fully open (mainly during high altitude operation): the cabin ventilation valve remains closed and the whole cabin airflow exhausts through the baggage ventilation valve. During this phase, the cabin ventilation valve provides the primary sensing and control laws, sending commands to the baggage ventilation valve. Just before the cabin ventilation valve goes to the full closed position, the baggage ventilation valve begins to close, so that there is an overlap in control of the two valves.

BAGGAGE COMPARTMENT PRESSURIZATION AND ISOLATION

The baggage compartment is normally pressurized at approximately the same differential pressure as the main cabin area.

Due to engine layout, the baggage compartment could be a path for fuselage depressurization in case of a rotor burst, or could be the source for hazardous smoke in case of a fire. Therefore, if a depressurization in the baggage compartment is sensed or if a fire is detected, the baggage compartment can be isolated from the rest of the pressurized cabin.

The baggage compartment isolation is provided by closing the two baggage isolation valves:

- Automatically, when the cabin ventilation valve senses a rapid cabin decompression (cabin altitude exceeding 14,200 ft),
- Or manually by the flight crew when he receives a fire warning or a slow cabin decompression warning, by selecting the BAG ISOL pushbutton on the overhead panel.

NOSE CONE PRESSURIZATION

The nose cone is ventilated during ground and low altitude flight operations. It is also pressurized in normal flight conditions and the transition from ventilation to pressurization is entirely automatic. The function of the pressurization is to ensure a positive differential pressure of the nose cone in order to achieve sufficient sealing.

UNDERFLOOR AREA VENTILATION

Underfloor ventilation is provided to avoid fuel or hydraulic fluid vapors accumulation.

The underfloor air is normally vented through the underfloor ventilation orifice path, however, in case of low cabin to ambient differential pressure conditions, underfloor ventilation is increased by the cabin ventilation valve.

The underfloor air is ventilated through the cabin ventilation valve (and not through the baggage compartment, because air ventilated through the baggage ventilation valve passes then through the heat exchanger of the main air pack).

PRESSURIZATION SYSTEM OPERATION

AUTOMATIC PRESSURIZATION MODE

In automatic mode, the pressurization system automatically controls cabin altitude and pressurization rate of change according to programmed laws and airfield elevation.

The automatic mode has two main laws of operation:

- The NORMal law (NORM),
- The Flight Level law (FL),

Both automatic mode laws have the capability of a LOW cabin altitude rate of change option.

The pressurization system allows high altitude landing and take-off.

It also provides on the ground:

- Pre-pressurization of the cabin at an altitude below the runway elevation, in order to avoid cabin pressure bumps during take-off,
- Automatic depressurization sequence, by pressurizing cabin at an altitude below the runway elevation, in order to avoid cabin pressure bumps during landing.

NORM law

This mode provides the most comfortable pressurization mode by limiting the cabin pressure rate of change during climb and descent based on airplane vertical flight plan data provided by the FMS (time to top of climb, time to destination, cruising level).

FL law

This mode is intended to maintain a low cabin altitude of 1,000 ft until airplane reaches 27,000 ft. Climbing to 51,000 ft is possible in this mode but cabin pressure variation is less comfortable above 27,000 ft.

LOW cabin rate

LOW cabin altitude rate of change can be activated with either NORM or FL laws to limit the rate of change to lower values: +300 / -300 ft/min instead of +500 / -450 ft/min.

High altitude landing and take-off

When the flight plan includes an airfield elevation above 8,000 ft, the nominal excessive cabin altitude threshold (8,300 ft ± 250 ft) is automatically modified by the pressurization system while the airplane is in descent or on the ground to the landing field elevation plus 1,700 ft. This altitude will never be higher than the cabin limit of 14,500 ft. The cabin altitude is regulated at 8,000 ft, until the airplane descends through 25,000 ft, then increases normally to the landing field elevation as per the flight plan.

Flight Abort Mode

If the airplane descends shortly after take-off, the cabin altitude is commanded towards the take-off airfield elevation to ensure emergency egress is permitted.

Manual pressurization mode

In case of failure of the automatic pressurization mode, the crew can:

- Activate the manual pressurization mode with the PRESSU MAN pushbutton on the overhead panel:
  - Cabin and baggage ventilation valves remain in their last commanded position.
  - A target cabin altitude is displayed in magenta in the ECS synoptic. This altitude is the target cabin altitude corresponding to the current airplane altitude as computed by the pressurization law.
- Directly control the cabin altitude rate (cabin Vertical Speed) using the CABIN ALT spring loaded rotary knob:
  - When actuated the knob opens or closes the cabin ventilation valve (only). When released, the valve remains in its last position.
  - The baggage ventilation valve is not regulated by the knob. It can be manually closed or opened using the BAG VENT pushbutton. When the baggage ventilation valve is closed, the cabin air jet pump, which cools the main air pack is not fed. Cooling is then only ensured by the ACM fan which is less effective above 40,000 ft.

NOTE

In manual pressurization mode, the cabin altitude limit of 14,500 ft remains active as long as the cabin ventilation valve is operative.

DUMP emergency depressurization mode

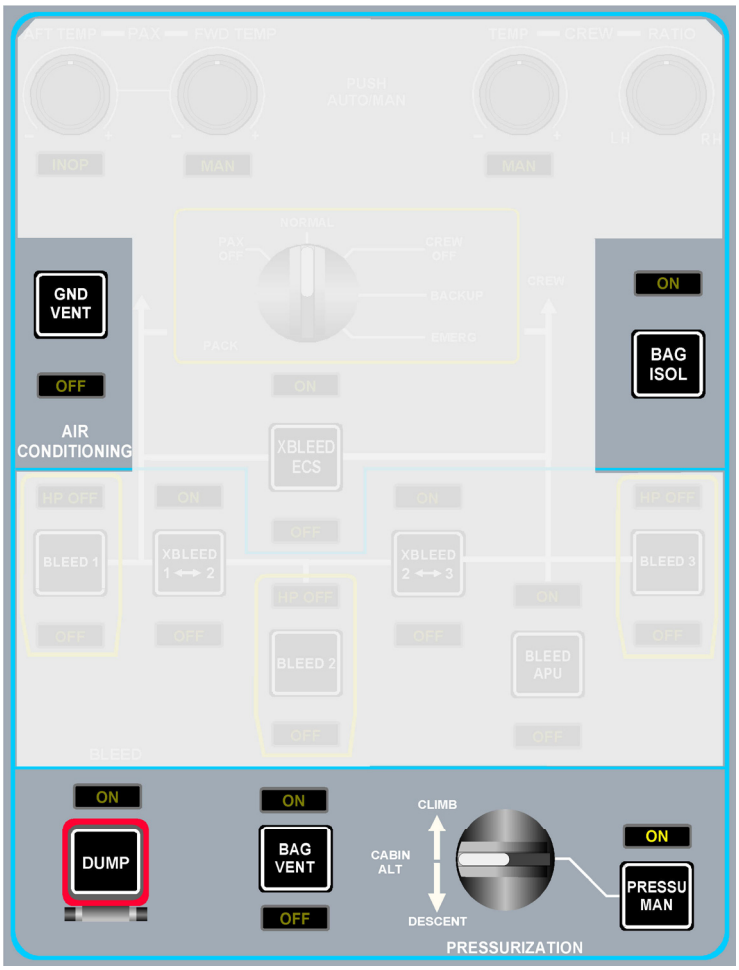
In DUMP mode, the cabin ventilation valve is commanded open. The baggage ventilation valve remains in its last commanded position. The cabin altitude limitation overrides the dump command when the cabin exceeds the altitude limit threshold.

CONTROLS

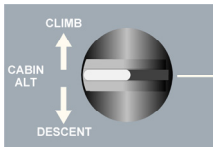
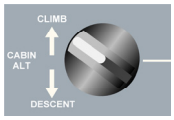
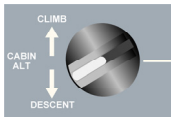
Crew has control on the air conditioning system through:

- The pressurization part of the Overhead Panel
- A soft key within ECS synoptic page for landing field elevation selection.

OVERHEAD PANEL



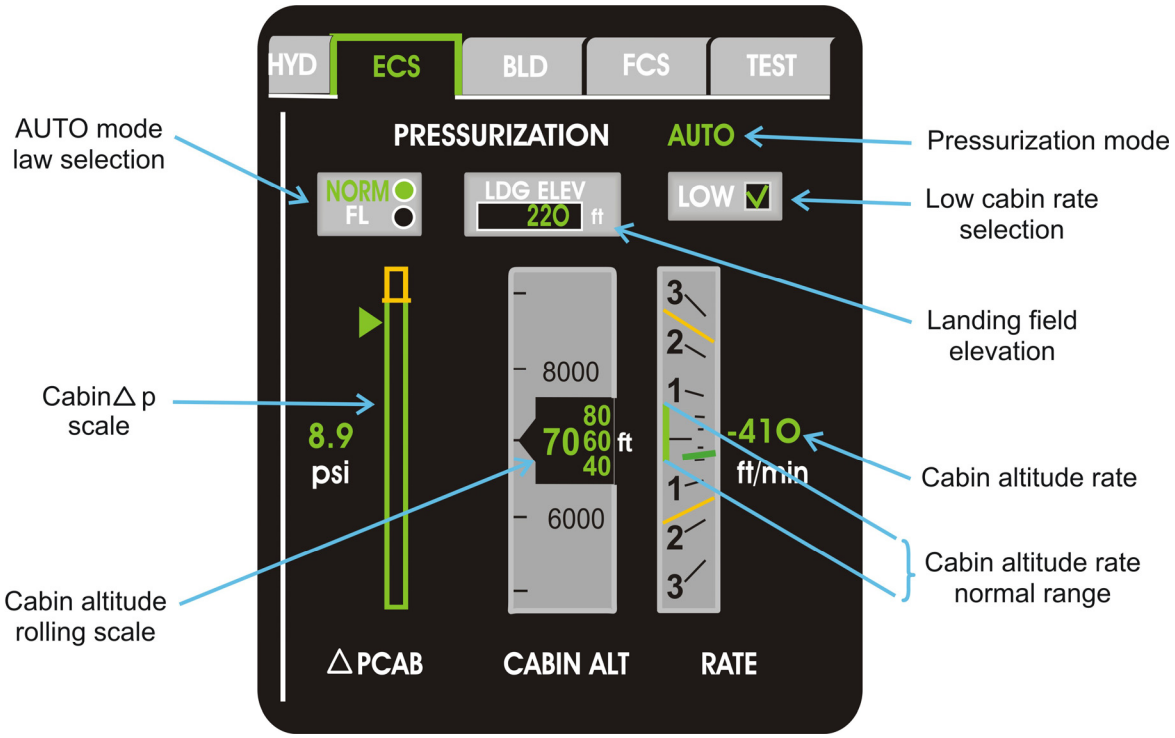
PRESSURIZATION CONTROLS ON THE OVERHEAD PANEL

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	- Allows the selection of automatic / MAN mode of the pressurization system - In MAN mode, use the manual pressurization control knob	Push off: automatic mode 	
		Push in: MAN mode 	
	DUMP guarded pushbutton, allows a rapid depressurization by forcing the cabin ventilation valve to fully open (until the cabin altitude limit is reached)	Guarded: automatic mode 	No synoptic
		Raise the guard and push on: DUMP mode 	
	CABIN ALT spring loaded knob: increase or decrease rate of climb in manual mode	Rotating clockwise 	Cabin altitude rate increase
		Rotating counter clockwise 	Cabin altitude rate decrease

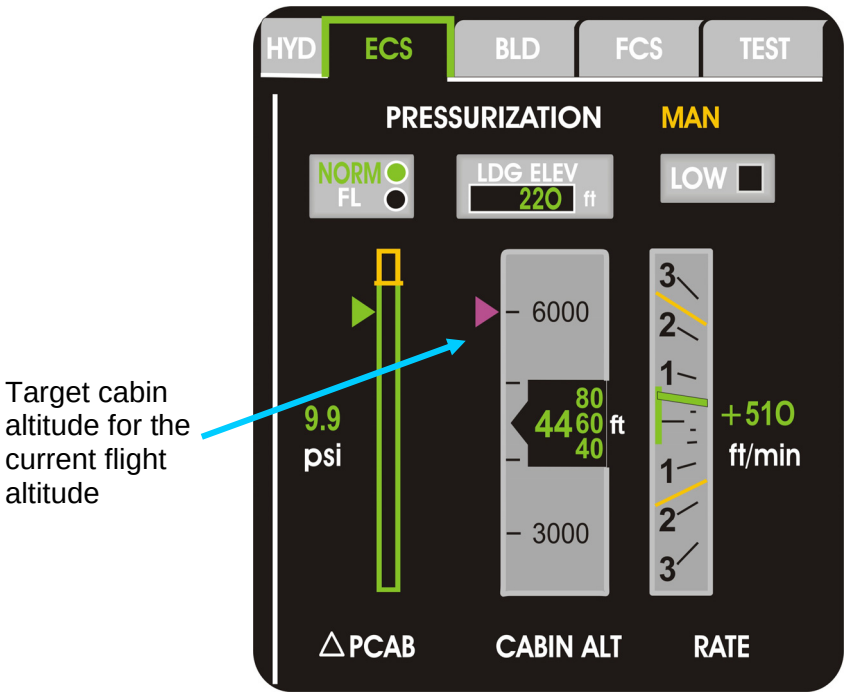
CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	BAG VENT pushbutton: cycling through, ON, OFF, AUTO position allows to open, close or set to auto the baggage ventilation valve	Unlighted Auto 	No synoptic
		ON 	No synoptic
		OFF 	No synoptic
	BAG ISOL pushbutton: when pressed closes the baggage isolation valves and the baggage ventilation valve	Normal 	No synoptic
		ON 	No synoptic
	GND VENT pushbutton: when pressed closes the ground ventilation valve and the cabin recirculation valve.	Normal 	No synoptic
		OFF 	No synoptic

INDICATIONS

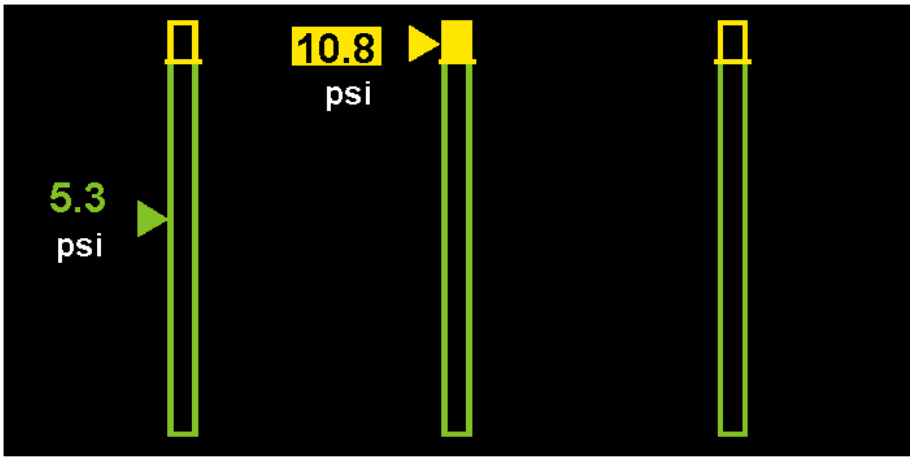
PRESSURIZATION SYNOPTIC IN ECS PAGE



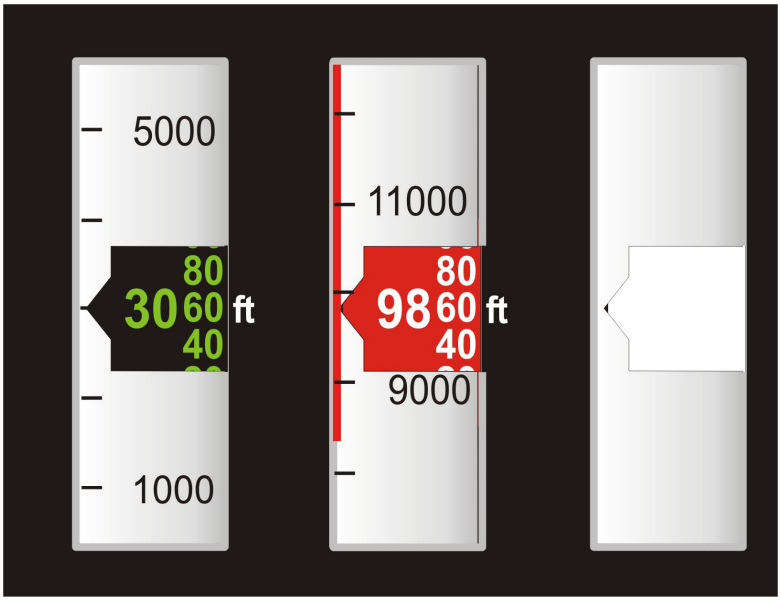
PRESSURIZATION SYNOPTIC IN AUTOMATIC MODE



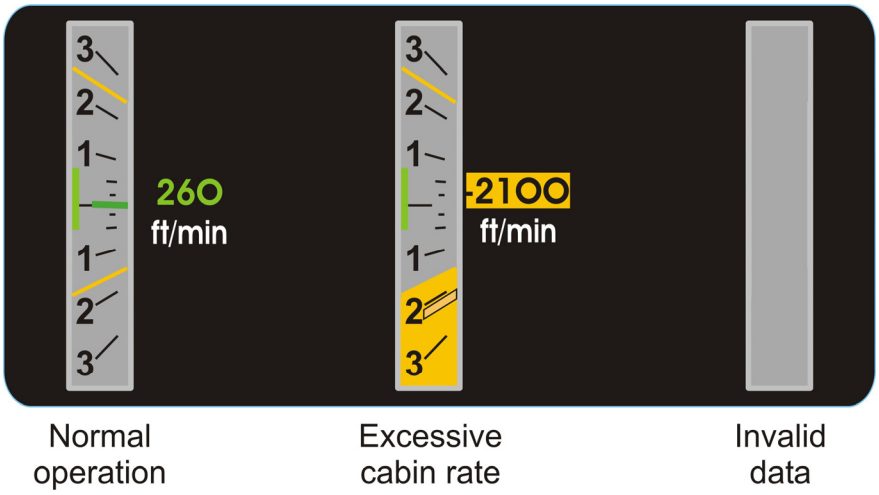
PRESSURIZATION SYNOPTIC IN MANUAL MODE



CABIN DIFFERENTIAL PRESSURE INDICATIONS

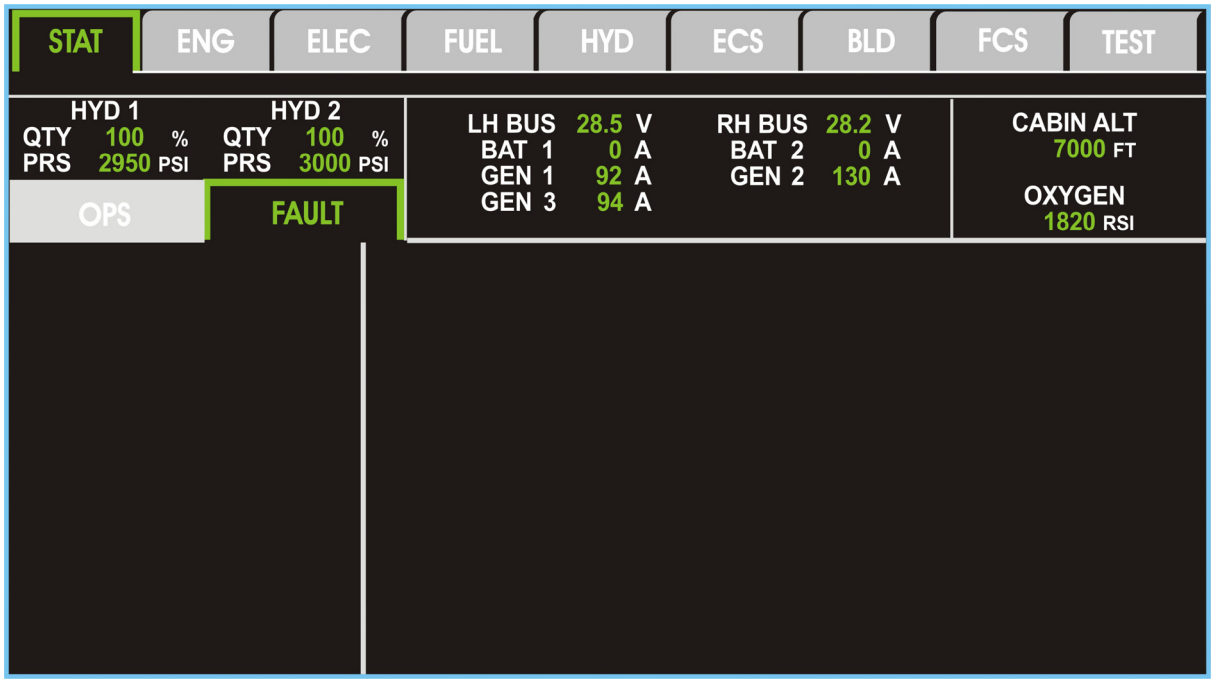


CABIN ALTITUDE INDICATIONS



CABIN RATE INDICATION

STAT SYNOPTIC



STAT SYNOPTIC

SYSTEM MONITORING

The pressurization system's condition is continuously monitored for the following items:

Cabin altitude and differential pressure (limit thresholds and deviations among theoretical cabin-airplane altitude law),

Failure monitoring of the valves,

Landing elevation initialization.

ACTIVE PROTECTIONS

The pressurization system automatically protects the airplane and passengers among:

- Positive differential pressure limit by means of 2 positive pressure relief valves and the cabin ventilation valve,
- Negative pressure limit by means of 2 negative pressure relief valves,
- Too high cabin altitude, by closing the cabin and baggage ventilation valves and the baggage isolation valves.

Pressurization system protection consists of:

- Positive differential pressure limitation,
- Negative differential pressure prevention,
- Cabin altitude limiting.

The cabin ventilation valve and the baggage ventilation valve perform all the protections except the cabin altitude limiting.

POSITIVE DIFFERENTIAL PRESSURE RELIEF

The positive differential pressure relief protects the structure from the effects of excessive positive differential pressure (cabin pressure above external ambient pressure). This function is achieved by means of two positive pressure relief and by the cabin ventilation valve.

A maximum differential pressure limit is included in the software of each automatic cabin pressure controller. If the cabin rate of climb is unable to keep up with the airplane rate of climb so that the differential pressure exceeds +10.20 psi, the cabin rate is gradually boosted in such a way that the designed maximum differential pressure for the fuselage is not exceeded.

The electronic limit is only operative in automatic mode, since manual and altitude limit control overrides the automatic controller.

In manual mode (after a dual failure of the cabin ventilation valve), the positive differential pressure relief is achieved by two Positive Pressure Relief Valves (PPRV), located one in the main cabin and the other in the baggage compartment. Both PPRV exhaust to ambient. The pneumatic differential pressure relief set point between cabin and ambient is +10.4 to +10.6 psi.

NEGATIVE DIFFERENTIAL PRESSURE RELIEF

The negative pressure relief protects the structure from the effects of negative differential pressure (external pressure above cabin pressure).

This function is achieved by means of two Negative Pressure Relief Valves (NPRV), located one in the forward landing gear compartment, the other one collocated with the ground ventilation valve on the baggage compartment bulkhead.

CABIN ALTITUDE LIMITING

Cabin Altitude Limiting is active upon cabin depressurization above 14,500 ft, ensuring all fuselage air exhaust apertures are closed. The pressurization system can only perform altitude limiting within boundaries (it obviously cannot provide altitude limiting in case of a window, door seal, fuselage or other non-baggage compartment leak).

The cabin altitude limiting function closes the outflow valves prior to the cabin altitude exceeding the given limit. The cabin ventilation valve detects cabin decompression using its own sensors and closes itself automatically.

Whenever the cabin ventilation valve detects cabin decompression, it closes the baggage isolation valves.

DUMP (EMERGENCY DEPRESSURIZATION)

The dump function opens the cabin ventilation valve to exhaust cabin air to the atmosphere in less than 30 seconds.

The DUMP switch is a guarded, alternate pushbutton. It is unlighted for normal operation.

The cabin altitude limitation overrides the dump command when the cabin exceeds the altitude limit threshold.