

## **7.9 - AIR CONDITIONING AND PRESSURIZATION**

### **AIR CONDITIONING (Figure 7.9.1)**

Air conditioning system includes the temperature and flow-pressure regulation system (ACS), the vapor cycle cooling system (VCCS), control and check systems and distribution.

#### **Temperature and flow-pressure regulation system**

Air necessary for conditioning is picked up from the engine. A valve regulates pressure and bleed hot air flow and is also used as shutoff valve. This valve is controlled by the "BLEED" switch. Hot air is cooled by going through a temperature exchanger and a cooling turbine, then it reduces the humidity through the water separator before entering the cabin through a check-valve.

Temperature exchanger is located in a duct which directs cooling air. This air is picked up outside by the NACA scoop located on R.H. FWD engine cowling. When the airplane is on ground, air flow is created by the cooling turbine driven by air picked up from the engine.

Temperature regulation is accomplished by adding hot air to the air coming from cooling turbine. An electronic control unit analyses the temperature of conditioned air, as it enters the cabin, as well as cabin ambient temperature and acts on the temperature regulation valve according to the requested temperature.

### **Vapor cycle cooling system**

The vapor cycle cooling system improves the passengers and crew comfort in warm and / or humid atmospheric conditions. The refrigerant used is called R134A.

The installation comprises :

- A high pressure pack consisting of :
  - . a condenser,
  - . a condenser fan,
  - . a compressor,
  - . an electric motor,
  - . a receiver drier,
  - . two pressure switches,
  - . an overpressure relief valve.

The horseshoe condenser surrounds the electric motor, which directly drives the compressor.

The fan is driven by its own electric motor.

A low pressure switch (LP) rated at 0.725 psi (0.05 bars) and a high pressure switch (HP) rated at 406 psi (28 bars) ensure system safety by cutting out electrical power supply of the high pressure pack, when either pressure is reached. This pack is also equipped with an overpressure relief valve rated to open at 464 psi (32 bars).

The pack is installed in the FWD compartment between frames C1 and C2 inside a metallic housing. This housing is connected by means of a flexible duct with a screened air inlet located on the R.H. side in front of the windshield.

The high pressure pack is supplied by the "VENT" BUS bar.

- An evaporator,
- A fan,
- A solenoid valve.

The evaporator is attached between frames C16 and C17 on baggage compartment ceiling. This evaporator has a thermostatic expansion valve controlled by a temperature control/sensor, which is installed on the hose at evaporator outlet.

The fan provides air circulation in the cabin through the evaporator. It is attached under the floor, on R.H. side, between frames C14 and C15. The fan is supplied by the "BUS 4" bar and protected by the CB 111 "FAN" circuit breaker.

The solenoid valve is installed on high pressure line and controlled by the high pressure pack. It is intended to avoid refrigerant migrations, when the system is off.

- Two service valves,

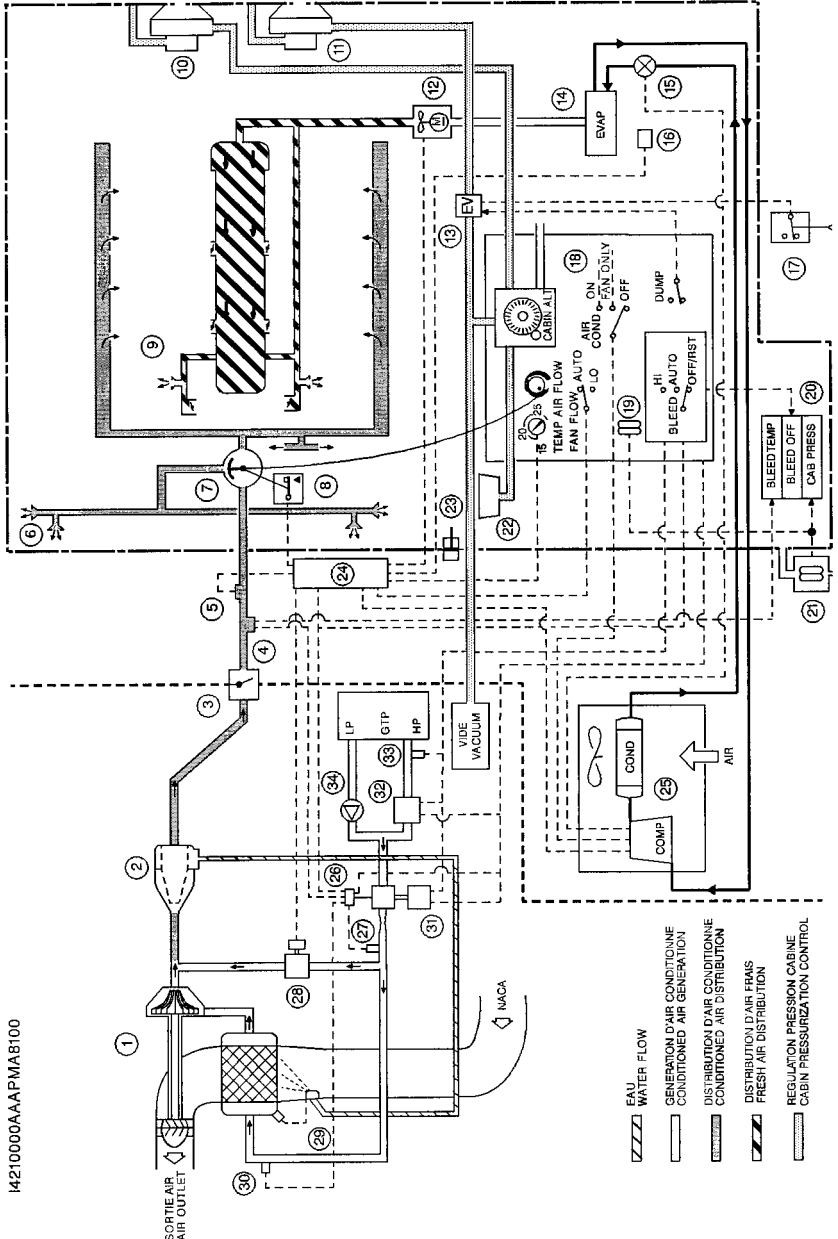
The low pressure (LP) service valve and the high pressure (HP) service valve are installed into supply hoses in the R.H. equipment compartment between frames C1 and C2.

Both valves fool-proofing is ensured by their different diameters ; LP service valve diameter is more important than HP one.

- A sight glass, used to check correct refrigerant filling without bubbles. It is located on the flexible hose at high pressure pack inlet.

- |  |   |
|--|---|
| 1) Heat exchanger/cooling turbine pack   | 21) Cabin differential pressure switch    |
| 2) Water separator                       | 22) Auxiliary volume tank                 |
| 3) Check valve                           | 23) Emergency air supply                  |
| 4) Duct overtemperature switch           | 24) Controller                            |
| 5) Duct temperature sensor               | 25) Compressor/condenser pack             |
| 6) Demisting outlets                     | 26) Pressure regulating and shutoff valve |
| 7) Distribution box                      | 27) Overpressure switch                   |
| 8) Demisting microswitch                 | 28) Temperature control valve             |
| 9) Air outlets and distribution orifices | 29) Water injector                        |
| 10) Outflow valve                        | 30) Overtemperature switch                |
| 11) Safety valve                         | 31) Remote datum                          |
| 12) Cabin fan                            | 32) HP shutoff valve                      |
| 13) Depressurization solenoid valve      | 33) HP pressure switch selector           |
| 14) Evaporator                           | 34) Non-return valve                      |
| 15) Refrigerant solenoid valve           |   |
| 16) Cabin temperature sensor             |   |
| 17) Ground safety switch                 |   |
| 18) Control panel                        |   |
| 19) Cabin altitude switch                |   |
| 20) Advisory panel                       |   |

Figure 7.9.1 (1/2) – AIR CONDITIONING



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Figure 7.9.1 (2/2) - AIR CONDITIONING

When vapor cycle cooling system operation is requested by the controller, the compressor pressurizes the refrigerant and discharges it to the condenser through the HP pressure switch.

At the condenser outlet, refrigerant cooled by the condenser fan flows through the receiver drier to the thermostatic expansion valve located at the evaporator inlet.

The temperature control/sensor monitors the hose temperature at the evaporator outlet and pilots the thermostatic expansion valve opening or closing to control the refrigerant flow through the exchanger.

The expansion of the high pressure liquid refrigerant to a low pressure liquid extracts heat from the cabin air flowing through the evaporator and the low pressure refrigerant gas flows back to the compressor through the LP pressure switch.

The evaporator fan suctions hot and moistened cabin air through the evaporator and expels it cold and dry in a duct where it is blown into the cabin overhead duct equipped with air outlets and through air outlets located on arm rests of pilot and R.H. front passenger stations.

The system operates under two modes :

- engine running with "GENERATOR" selector on "MAIN",
- engine off with "SOURCE" selector on "GPU".

The system includes an automatic load shedding feature which operates when :

- "GENERATOR" selector is on "ST-BY",
- "AIRFRAME DE-ICE" switch is "ON",
- "PROP DE-ICE" switch is "ON",
- engine is started with system fed by a GPU.

**Distribution**

Conditioned air enters the distribution box from where it is dispatched either into the cabin through two outlets located at the level of rudder pedals, through a row of ports located on the lower section of the L.H. and R.H. side upholstery or through the demisting outlets. Each seat is also provided with a swivelling and adjustable air outlet, supplied with fresh air by the vapor cycle cooling system.

**NOTE :**

*For a better efficiency of vapor cycle cooling system, do not obstruct air suction point at the level of baggage compartment.*

**Control and check** (Figure 7.9.3)**AIR CONDITIONING SYSTEM**

Air conditioning system controls are located on "ECS" panel and indicator lights are grouped on advisory panel.

Conditioning occurs when :

- "BLEED" switch is set to "AUTO", what leads to opening of pressure regulator and shut-off valve and switches off "BLEED OFF" warning light, and at the same time
- "AIR COND" switch is set to "ON", what ensures automatic regulation of cabin temperature.

During specific flight configurations, such as high altitude and low temperature flight conditions, the cabin heating can be speeded-up by setting "BLEED" switch to "HI".

The "BLEED" switch is fitted with a blocking device between "AUTO" and "OFF/RST" positions preventing the operator from a non expected setting of "BLEED" switch to "OFF/RST" position.

Two overtemperature switches cause the illumination of "BLEED OFF" and "BLEED TEMP" warning lights located on advisory panel and simultaneously the closing of the pressure regulating and shut-off valve. These overtemperature switches are located at the temperature exchanger inlet and at the cabin inlet. System cannot be reactivated as long as "BLEED TEMP" warning light is illuminated. After "BLEED TEMP" warning light has gone out, set "BLEED" switch to "OFF/RST", then to "AUTO" to reactivate the system.

An air overpressure switch located after pressure regulating and shut-off valve causes the illumination of "BLEED OFF" warning light and simultaneously the closing of the pressure regulating and shut-off valve. To reactivate the system, set "BLEED" switch to "OFF/RST", then to "AUTO".

### VAPOR CYCLE COOLING SYSTEM

The "AIR COND" switch has three positions :

- "OFF" : No automatic regulation of cabin temperature.
- "FAN ONLY" : Controls only cabin fan operation.
- "ON" : Controls operation of the cabin fan and automatic regulation of cabin temperature.

The "FAN FLOW" switch has two positions :

- "AUTO" : Selects full speed for the cabin fan, when "AIR COND" switch is set to "FAN ONLY" and lets controller manage speed, when "AIR COND" switch is set to "ON".
- "LO" : Selects low speed for the cabin fan.

"CABIN TEMP/°C" selector enables to select requested temperature in the cabin.

An "ECS FAULT" amber warning light illuminates when the controller detects a faulty operation of ECS system.

#### **NOTE :**

*"ECS FAULT" warning light illumination requires mandatorily a corrective action from maintenance service before next flight.*

"AIR FLOW" distributor directs air flow to demisting outlets ("DEFOG") or to the cabin ("CABIN").

Whatever the selected cabin temperature is, "HOT" position enables hot air to be directed only to demisting outlets and starts vapor cycle cooling system operation, when "AIR COND" switch is set to "ON".

Emergency air control ("RAM AIR" control knob), located under R.H. instrument panel facing control wheel, enables outside air to enter the cabin through a valve. In "NORMAL" position, the valve is closed and the control is locked. To open emergency ventilation valve, press on locking knob and move control rearwards.



**PRESSURIZATION** (Figures 7.9.2 and 7.9.3)

Pressurization system maintains the pressure corresponding to an altitude compatible with passengers' safety and comfort inside the cabin.

The system uses the air conditioning system to pressurize the cabin and the vacuum generation system for check and safety. Pressure controller, located on "ECS" panel allows pilot selecting :

- a cabin altitude between sea level and 9350 ft,
- the cabin climb speed.

A three position indicator shows cabin altitude, cabin climb speed and cabin-atmosphere differential pressure. Cabin altitude is maintained by an outflow valve and a safety valve limits differential pressure between cabin and atmosphere at 6.2 psi (427 mb).

These valves are attached to rear pressure bulkhead and each one is connected to a static port located on rear cone for the outflow valve and under rear baggage compartment for safety valve.

Cabin is automatically depressurized as soon as the airplane is on ground through landing gear switch (airplane on ground) or, if necessary, by actuating "DUMP" switch located on "ECS" panel (in normal operation, this switch is protected and locked by a cover).

**Indicating**

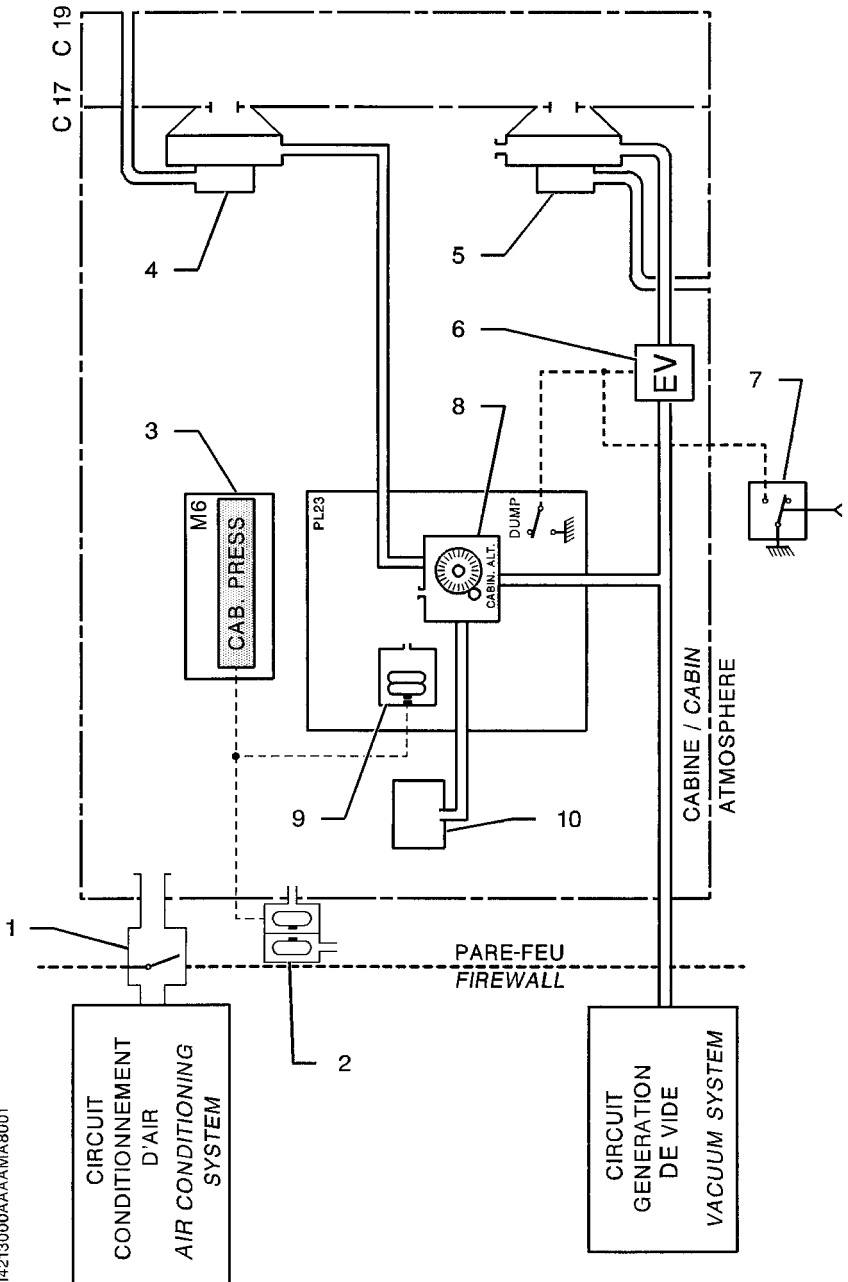
In addition to the three purpose indicator, the system consists of the "CAB PRESS" warning light which illuminates when cabin altitude reaches 10000 ft or if cabin-atmosphere differential pressure exceeds 6.2 psi (427 mb).

**NOTE :**

*"CAB PRESS" warning light illumination has no effect on system functioning - Refer to Section 3 "Emergency procedures".*

- 1) Check valve
- 2) Cabin differential pressure switch
- 3) Advisory panel
- 4) Outflow valve
- 5) Safety valve
- 6) Depressurization valve
- 7) Landing gear switch (airplane on ground)
- 8) Pressure controller
- 9) Cabin altitude switch
- 10) Auxiliary volume tank

Figure 7.9.2 (1/2) - PRESSURIZATION



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Figure 7.9.2 (2/2) - PRESSURIZATION

- 1) Amber warning light
- 2) Warning light test push-button
- 3) "BLEED" switch - "HI / AUTO / OFF/RST"
- 4) "AIR COND" switch - "ON / FAN ONLY / OFF"
- 5) "FAN FLOW" switch - "AUTO / LO"
- 6) "DUMP" switch
- 7) "AIR FLOW" distributor - "HOT / DEFOG / CABIN"
- 8) "CABIN TEMP/°C" selector
- 9) Cabin rate selector
- 10) Cabin altitude selector

Figure 7.9.3 (1/2) - "ECS" CONTROL AND CHECK PANEL

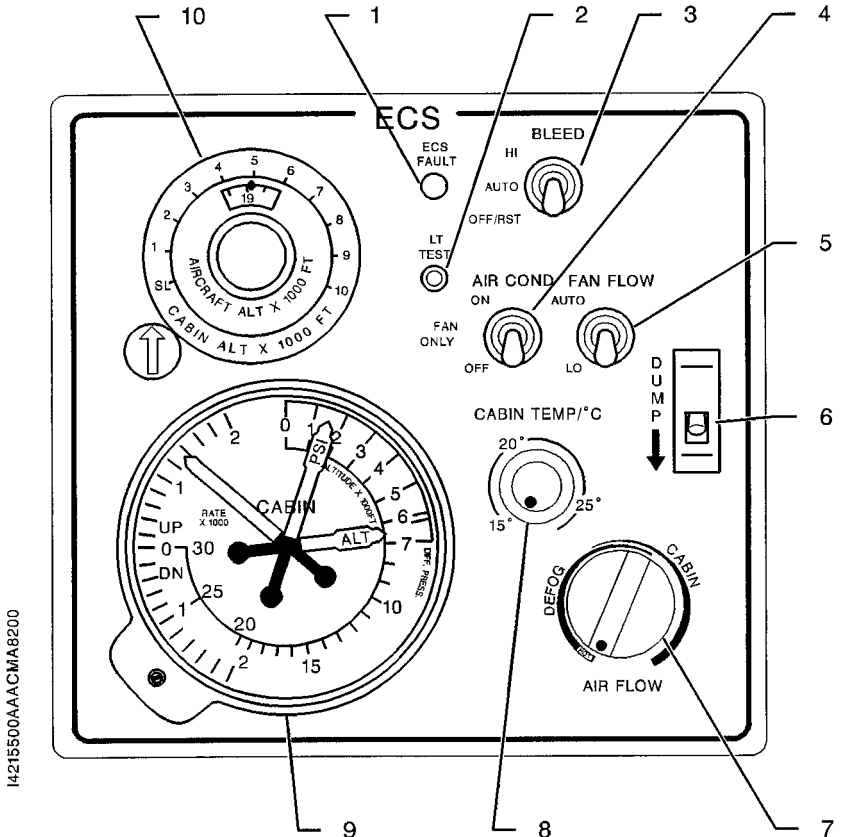
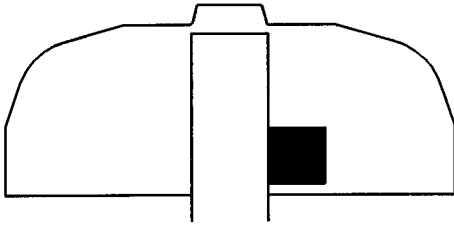


Figure 7.9.3 (2/2) - "ECS" CONTROL AND CHECK PANEL

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