

7.9 - AIR CONDITIONING AND PRESSURIZATION

The airplane is equipped with a Global Air System (GAS), which ensures air conditioning and pressurization (Figure 7.9.1).

GAS controls are located on "ECS" panel at the L.H. side of the R.H. side control wheel and above the arm rest of the L.H. passenger's seat (Figure 7.9.2).

The system is monitored through CAS messages appearing on the GDU 1500 MFD.

NOTE

A list of abbreviations used in this chapter is given in Figure 7.9.1.

The GAS is composed of 3 main sub-systems :

- Engine Bleed Air System,
- Dual zones Environmental Control System, including heating and cooling functions,
- Cabin Pressurization Control System.

These 3 sub-systems are managed by a single digital controller (GASC), which receives information coming from :

- the sensors set in the sub-systems,
- the human interfaces set in the airplane.

The GASC elaborates the proper commands to the sub-system actuators and indication or warning elements.

ENGINE BLEED AIR SYSTEM

The Engine Bleed Air System is designed to ensure the following functions :

- to bleed air from the engine,
- to ensure a controlled airflow in the cabin,
- to adjust the temperature of the bleed air at a compatible level, in order to control the cabin temperature in heating and cooling modes.

The "BLEED" switch allows to switch on the Engine Bleed Air System provided that the engine runs. The Ground Fan (GF) runs until takeoff, when "BLEED" switch is set to AUTO, and the **"MAIN GEN"** CAS message is OFF.

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.

The **"BLEED TEMP"** CAS message appears in the GDU 1500 MFD "CAS" window (in display normal conditions), when the "BLEED" switch is set to AUTO and when the Bleed Temperature switch (BTSW) or the Overheat Thermal Switch (OTSW) triggers on.

The **"BLEED OFF"** CAS message appears in the GDU 1500 MFD "CAS" window (in display normal conditions), when the engine is running and the Flow Control Shut Off Valve (FCSOV) is closed.

To reactivate the system, set "BLEED" switch to OFF/RST, then to AUTO.

To bleed air from the engine

The Engine Bleed Air System is based on 2 engine bleed ports operation. The normal operation is performed on P2.5 engine port as far as the pressure or temperature available at this port is able to comply with the needs. If one of these conditions is not fulfilled, the system automatically switches to P3 engine bleed port. The switching back to P2.5 supply is automatically performed as far as the conditions on P2.5 are restored to adapted values.

The sensor (IPPS) measures continuously the pressure at the P2.5 pressure port and sends the value to the Global Air System Controller (GASC) which manages the ports switching on condition with the Shut Off Valve (SOV). A Non Return Valve (NRV) secures the P2.5 pressure port when the P3 pressure port is opened.

To ensure a controlled airflow in the cabin

The bleed flow control operation, including bleed AUTO/bleed OFF/RST controls, is ensured by the FCISOV driven by the GASC.

To adjust the temperature of the bleed air

The bleed air outlet temperature control is ensured by the By-Pass Valve (BPV) in association with the Main Heat Exchanger (MHX).

The temperature measurement loop given by the Inlet Temperature Sensor (ITS) and the 2 Ventilated Temperature Sensors (CKVTS, CBVTS) sends the value to the GASC which compares them with the set temperature and manages the BPV position. The BPV derives a part of the bleed air through the MHX to cool it and mix it to the remaining air.

The Engine Air Bleed System is supplied by "BUS 2" bar and protected by the "CAB BLEED" CB60 circuit breaker.

DUAL ZONES ENVIRONMENTAL CONTROL SYSTEM

The Environmental Control System is based on two independent air circuits. The heating circuit uses the controlled temperature bleed air. The cooling circuit is based on a Vapor Cycle System (VCS).

The Environmental Control System is designed to ensure the following functions :

- Cockpit / Cabin Heating function
- Cockpit / Cabin Cooling function.

The Environmental Control System is supplied by "BUS 2" bar and protected by the "AIR COND" CB160 circuit breaker. Four fans are supplied by "BUS 4" bar and protected respectively by following circuit breakers : "COND FAN" CB114, "CABIN FAN" CB113, "COCKPIT FAN" CB112 and "GND FAN" CB111.

The system includes an automatic load shedding feature which :

- shuts off the Ground Fan (GF) and the Condenser Fan "COND FAN" and opens compressor clutch when **"MAIN GEN"** CAS message is ON.
- shuts off all the Vapor Cycle System (VCS) during engine start.

Heating circuit

Hot air coming from the bleed air system is mixed with the cabin recirculating air in the Mixing Ejector (MIXEJ) in order to lower the blown air temperature. The resultant air flow enters the Hot Air Distributor (HAD) and is distributed in the cockpit / cabin zones regarding the demand.

It is dispatched :

- in the cockpit through ports located on pedestal sides, under each seat or through the demisting outlets.
- in the cabin through ports located on the lower section of the L.H. and R.H. side cabin upholstery.

The "HOT AIR FLOW" distributor allows to select the windshield defog / cabin heating functions.

When the "A/C" switch is set to OFF position, the temperature is set by default by the GASC to 23°C.

Cooling circuit

There are two separate circuits : one for the cockpit and the other for the cabin.

In each circuit, air is sucked by means of a variable speed electrical fan, then it is blown through an evaporator and ducted to the different zones :

- cockpit circuit : by passing into the upper panel equipped with 2 swivelling and adjustable air outlets, through air outlets located on arm rests of pilot and R.H. front passenger stations and through ports located under instrument panel,
- cabin circuit : by passing into the overhead duct equipped with 4 swivelling and adjustable air outlets and through ports located on the floor between the cabinets and the intermediate passenger's seats.

The VCS can be switched on, only if the fans are set at least to minimum speed. The compressor clutch and the condenser fan are controlled by the GASC.

In automatic mode, the temperature of each zone is controlled independently by the system according to the settings of the "TEMP/°C" and "CABIN TEMP/°C" selectors, which can vary from 17°C to 27°C. In this mode, the speed of each fan is automatically controlled.

In manual mode, the blown air temperature is controlled by the system according to the settings of each temperature selector. In this mode, the speed of each fan is set manually from Off to maximum speed position.

The "A/C" switch allows to switch on or off the Vapor Cycle System.

- If set to AUTO position :
 - . on "ECS" panel, the "TEMP/°C" selector enables to select requested temperature of the cockpit zone,
 - . above arm rest of L.H. passenger's seat, the "CABIN TEMP/°C" selector enables to select requested temperature of the cabin zone.
- If set to MANUAL position :
 - . on "ECS" panel, the "TEMP/°C" selector enables to select requested temperature and the "FAN SPEED" selector enables to choose blown air speed in the cockpit zone,
 - . above arm rest of L.H. passenger's seat, the "CABIN TEMP/°C" selector enables to select requested temperature and the "FAN SPEED" selector enables to choose blown air speed in the cabin zone.

The "CONTROL" selector set to COCKPIT position inhibits the operation of the controls located in the cabin zone ; only the cockpit controls settings are taken into account. If set to CABIN position, each zone controls its proper values.

Emergency air control ("EMERGENCY RAM AIR" control knob), located under R.H. area 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.

CABIN PRESSURIZATION CONTROL SYSTEM

The cabin altitude check is automatically ensured by the pressurization control system through a monitoring of the cabin pressure. The opening of the Outflow Valve (OFV) is controlled by the GASC through a torque motor fitted on the valve.

The Landing Field Elevation entered by the pilot in the MFD is used by the GASC to manage the optimal cabin altitude rate of change in order to land with a cabin altitude equal to LFE minus 200 ft.

The Landing Field Elevation selection is done using :

- Destination airport of the flight plan pressing "SYSTEM" and then "FMS LFE" on the MFD
- A manual entry pressing "SYSTEM" then "MAN LFE" on the MFD.

The cabin altitude is automatically calculated by the GASC using the data sent by GDU 1500 MFD.

In flight, the GASC controls the opening of the OFV in order to reach the automatic computed cabin altitude. The "PRES MODE" switch allows to select 2 pressurization modes :

- if set to AUTO, the GASC controls the cabin altitude rate of change in order to optimize comfort and avoid reaching maximum ΔP or negative ΔP
- if set to MAX DIFF, the cabin altitude is minimized throughout the flight. For airplane altitudes below 13500 ft, this results in cabin altitudes that could be as low as 0 ft. Above 13500 ft, the cabin altitude is minimized while maintaining $\Delta P \leq 6.0$ PSI.

The GDU 1500 MFD shows landing field altitude, cabin climb speed in Sea Level ft/min and cabin-atmosphere differential pressure (ΔP) in PSI.

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).

Overpressure and negative relief safety are managed by both OFV and SFV. The safety functions are ensured by independent pneumatic modules fitted on both valves, which override the GASC control when necessary.

The **"CABIN ALTITUDE"** CAS message appears in the GDU 1500 MFD "CAS" window (in display normal conditions) when the cabin altitude is over 10000 ft.

The **"CABIN DIFF PRESS"** CAS message appears in the GDU 1500 MFD "CAS" window (in display normal conditions) when the cabin-atmosphere differential pressure is over 6.2 psi (427 mb).

The "DUMP" switch allows the pilot to open the OFV in order to de-pressurize the cabin. The OFV is fitted with a cabin altitude limitation device which overrides the "DUMP" function and forces the closure of the OFV if the cabin altitude reaches 14500 ft.

The **"CPCS BACK UP MODE"** CAS message appears in the GDU 1500 MFD CAS window when, due to malfunction, GASC cannot compute optimal cabin altitude.

In this case, cabin altitude is controlled by GASC to 9800 ft default value.

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| 1) Demisting outlets | 24) Demisting microswitch |
| 2) Front vents | 25) Hot air distributor (HAD) |
| 3) Cockpit ventilated temperature sensor (CKVTS) | 26) (Cabin) Inlet temperature Sensor (ITS) |
| 4) Cabin ventilated temperature sensor (CBVTS) | 27) (Cabin) Bleed temperature switch (BTSW) |
| 5) Air ports | 28) Mixing ejector (MIXEJ) |
| 6) Cabin control panel | 29) Check valve |
| 7) Global air system controller (GASC) | 30) MFD unit |
| 8) Out-flow valve (OFV) | 31) Ground safety microswitch |
| 9) Safety valve (SFV) | 32) Differential pressure switch |
| 10) Condenser fan | 33) By-pass valve (BPV) |
| 11) Condenser | 34) Cabin altitude alarm switch |
| 12) High pressure switch | 35) Emergency air supply system
(EMERGENCY RAM AIR) |
| 13) Drier filter | 36) Main heat exchanger (MHX) |
| 14) Cabin fan | 37) Ground fan (GF) |
| 15) Cabin evaporator | 38) Flow control shut off valve (FCSOV) |
| 16) Cabin blown temperature sensor (CBBTS) | 39) Bleed differential pressure sensor |
| 17) Cabin thermostatic valve | 40) Compressor |
| 18) Low pressure switch | 41) Shut-off valve (SOV) |
| 19) ECS panel | 42) Overheat thermal switch (OTSW) |
| 20) Cockpit thermostatic valve | 43) Non return valve (NRV) |
| 21) Cockpit fan | 44) Intermediate port pressure sensor (IPPS) |
| 22) Cockpit evaporator | 45) Cabin pressure sensor |
| 23) Cockpit blown temperature sensor (CKBTS) | |

Figure 7.9.1 (1/2) - GLOBAL AIR SYSTEM ITEMS LIST AND ABBREVIATIONS

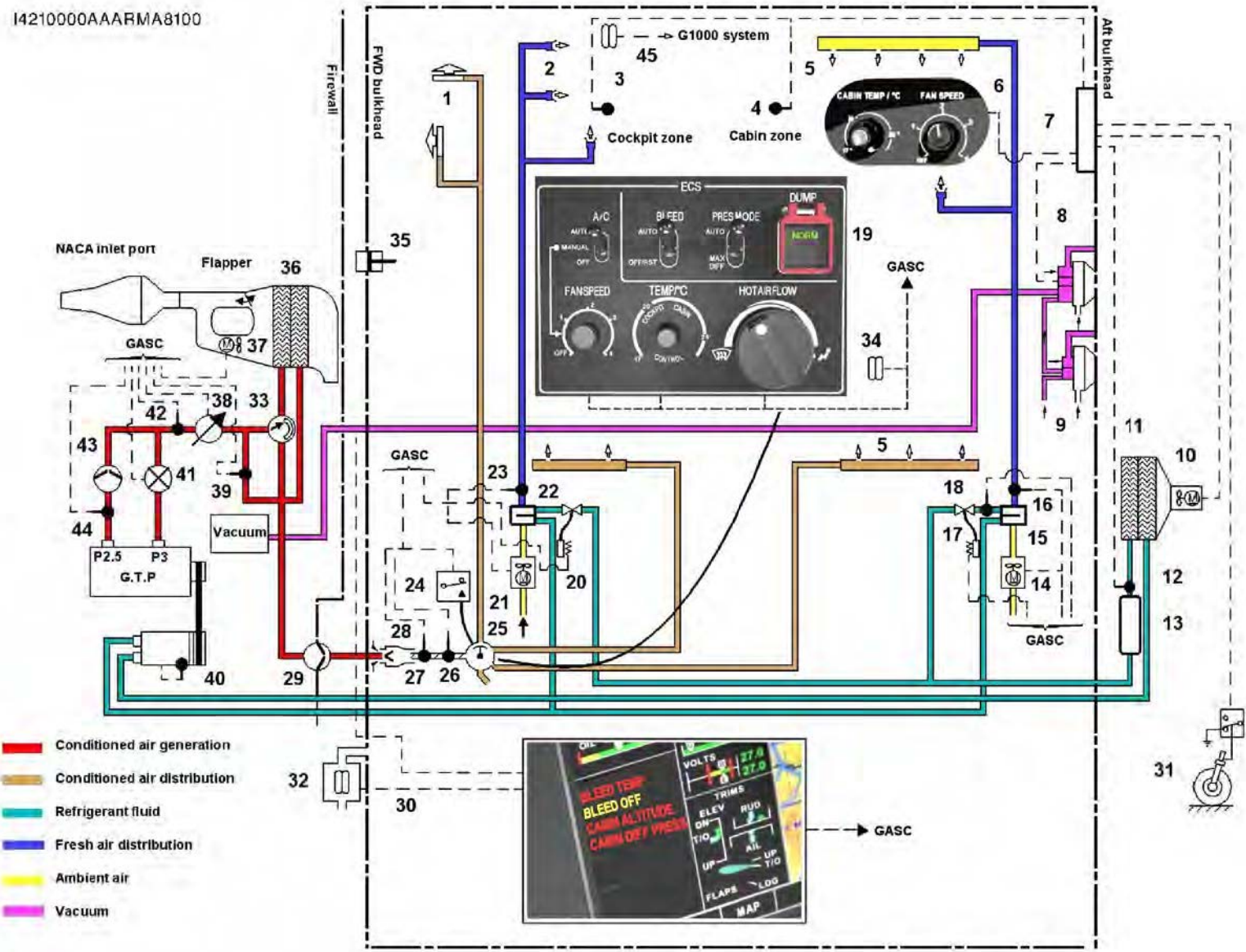
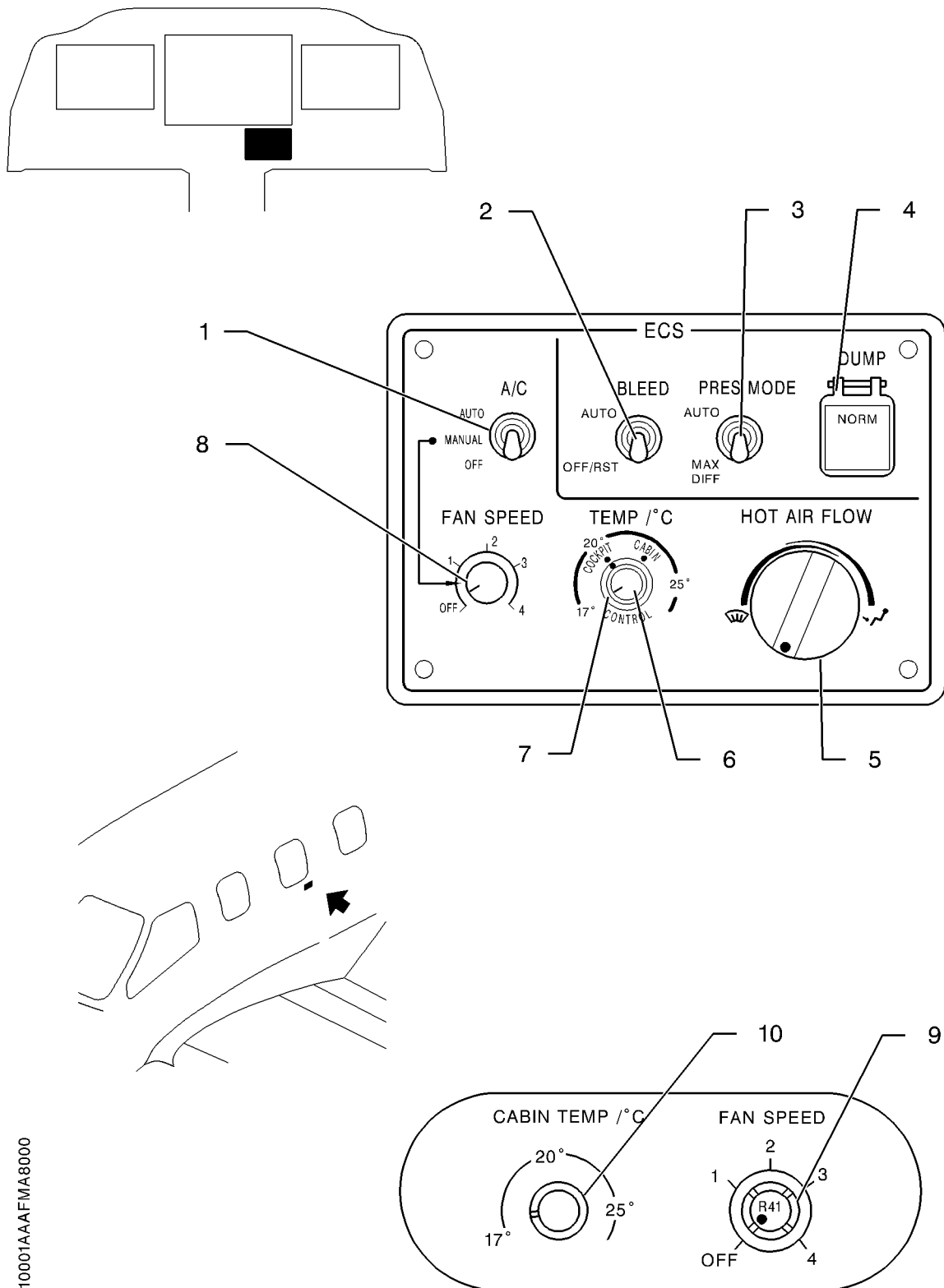


Figure 7.9.1 (2/2) - Global Air System

- 1) "A/C" switch
- 2) "BLEED" switch
- 3) "PRES MODE" switch
- 4) "DUMP" switch
- 5) "HOT AIR FLOW" distributor
- 6) "TEMP/° C" selector (cockpit/cabin)
- 7) "CONTROL" selector
- 8) "FAN SPEED" selector (cockpit)
- 9) "FAN SPEED" selector (cabin)
- 10) "CABIN TEMP/° C" selector (cabin)

Figure 7.9.2 (1/2) - GAS controls



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Figure 7.9.2 (2/2) - GAS controls