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## 21 – AIR-CONDITIONING & PRESSURIZATION

### SYSTEM DESCRIPTION

Air-conditioning is accomplished utilizing ram air or engine bleed air to heat or cool the cockpit and is managed with indicators, valves, temperature sensors, blowers and digital controllers.

Ram air may be used when cabin pressurization is not desired or available. Opening the Ram Air Valve supplies outside air to the four Wemac vents. The flow may be increased by utilizing the re-circulating blower. When the Ram Air Valve is closed cabin air may be circulated through the Wemac vents by utilizing the re-circulating blower.

When the Cabin Pressurization Valve is turned on bleed air, from the engine compressor, flows through the Cabin Temperature Control Valve. The valve is controlled automatically by the digital Cabin Temperature Controller or manually using the Warm/Cold switch. It portions the flow of bleed air through the heat exchanger & expansion turbine or the bypass to achieve the desired cabin temperature. The air then passes through a check valve and a muffler to the Cabin Pressurization Valve. The air is distributed through the cockpits via ducting to the canopies, foot warmers and the windshield (Figure 21-1).

Cabin pressurization is available above 6,500' pressure altitude using engine bleed air and is normally controlled by the Automatic Cabin Pressure Controller by restricting the outflow of cabin air. The controller will pressurize on schedule to a maximum differential pressure at an altitude of 26000'. (Figure 21-2) The Cabin Pressure Safety Valve will open if the cabin differential reaches .5psid above maximum to protect the aircraft from over pressurization. The cabin pressurization may also be decreased or dumped by opening the Cabin Manual Dump Valve located on top of the Automatic Cabin Pressure Controller.

AIR CONDITIONING & PRESSURIZATION

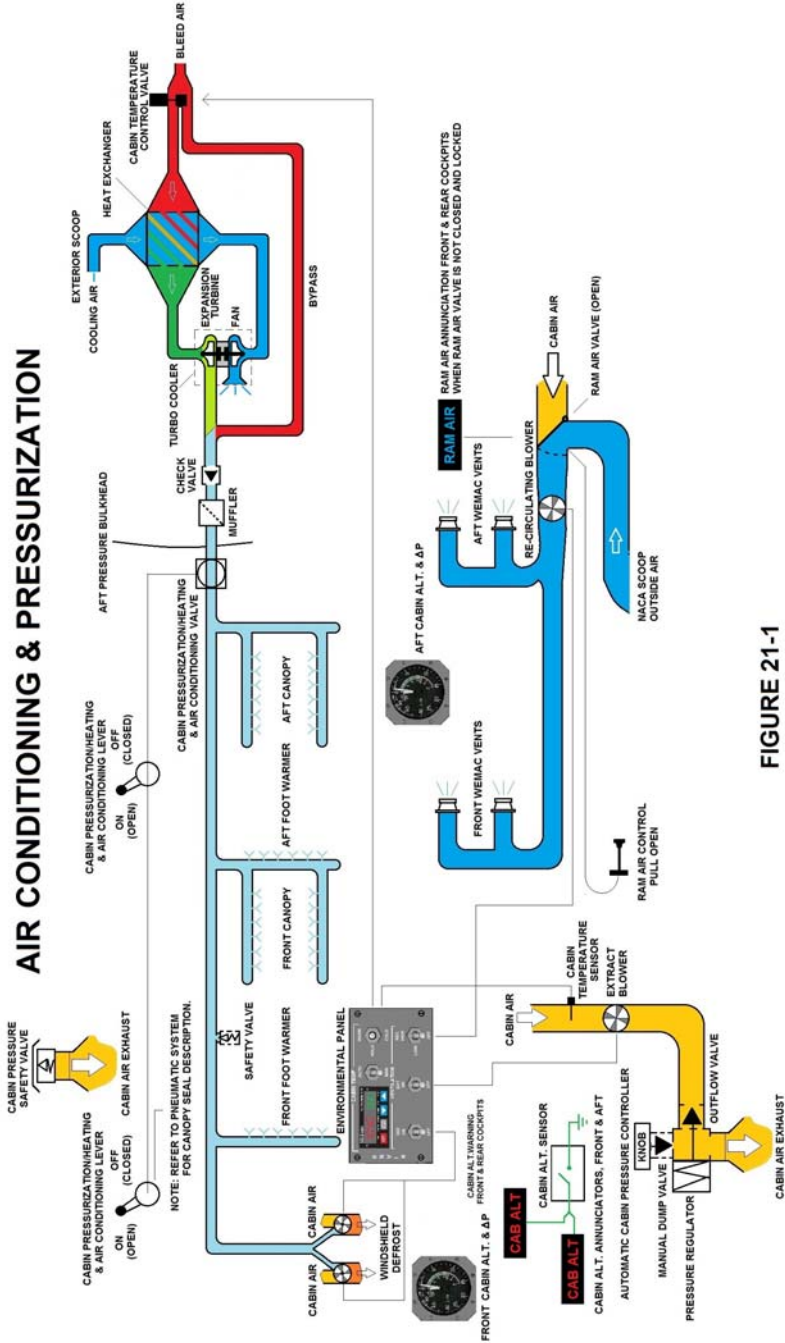


FIGURE 21-1

## DESCRIPTION OF COMPONENTS

### AUTOMATIC CABIN PRESSURE CONTROLLER (FIGURES 21-1 THRU 21-3)

The Automatic Cabin Pressure Controller does not require electrical power and is located on the floor just left of the front seat. Pressurization of the cabin is controlled automatically on a predetermined schedule that is not adjustable by the pilot:

- **At altitudes below 6,500' pressure altitude**, a pressure regulator within the controller will keep the outflow valve, also located within the controller, open preventing the cabin from pressurizing.
- **At altitudes 6,500' to 26,000' pressure altitude**, the pressure regulator will start to close the outflow valve gradually pressurizing the cabin on the predetermined schedule up to a maximum differential pressure of 3.28psid at 26,000'.
- **At altitudes above 26,000' pressure altitude**, the pressure regulator will control the outflow valve to maintain a cabin pressure at 3.28psid.

### CABIN ALTITUDE VS PRESSURE ALTITUDE

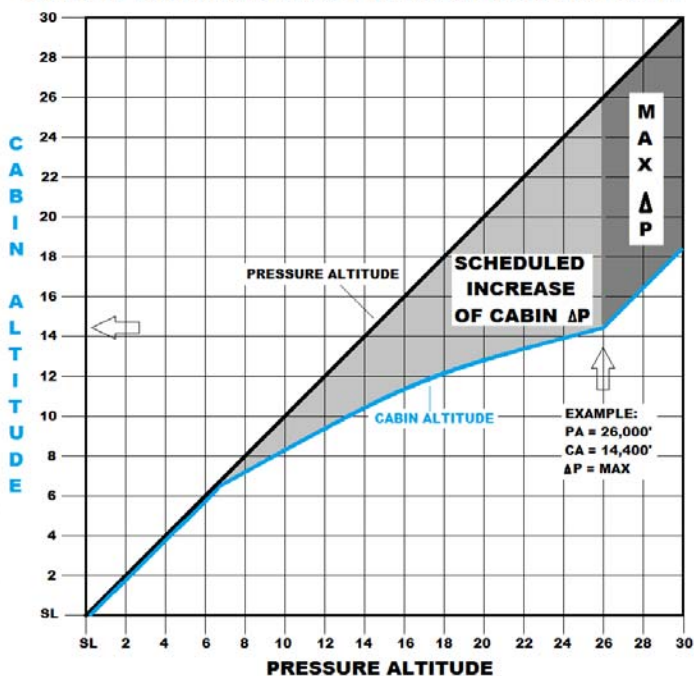


FIGURE 21-2

## AUTOMATIC CABIN PRESSURE CONTROLLER

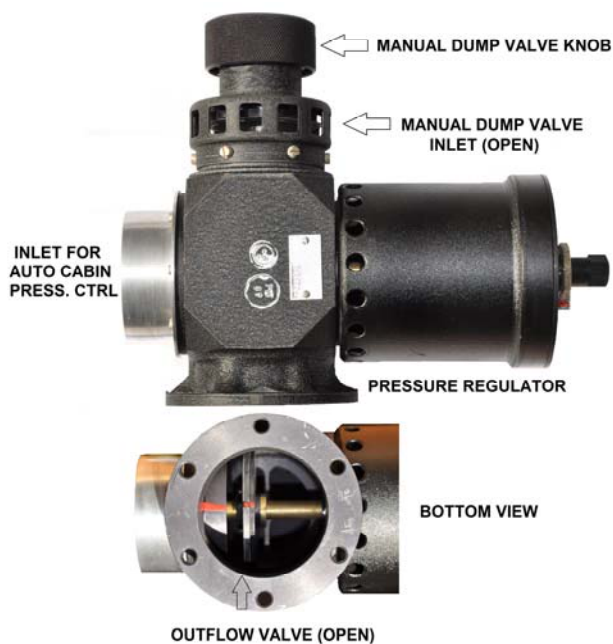


FIGURE 21-3

**CABIN MANUAL DUMP VALVE (FIGURE 21-3)**

The Cabin Manual Dump Valve is located on top of the Automatic Cabin Pressure Controller. The valve may be used to decrease or dump the cabin pressure by turning manual dump valve knob CCW. The normal position is closed or the fully CW position.

**CABIN PRESSURE SAFETY VALVE (FIGURE 21-1)**

The Cabin Pressure Safety Valve is located on the floor next to the right front corner of the front seat under a protective cover; it is not accessible by the pilot. The purpose of the valve is to protect the aircraft from over pressurization and will open at 3.77psid.

**CABIN TEMPERATURE CONTROL VALVE (FIGURE 21-1)**

The Cabin Temperature Control valve is controlled through the Digital Temperature Controller in the AUTO mode or manually in the MAN mode. The valve is electrically actuated and powered from the SEC bus through circuit breaker B6 (A/C). The valve will take approximately 18 seconds to travel from full hot to full cold or vice versa. The valve is protected by micro switches that limit the travel of the valve.

### **CABIN TEMPERATURE SENSOR (FIGURE 21-1)**

The Cabin Temperature Sensor is located in the duct leading to the outflow valve. The sensor reports to the Digital Cabin Temperature Controller which displays the temperature as PV (Present Value) and uses it to regulate the cabin temperature in AUTO mode.

### **CANOPY AIR (FIGURE 21-1)**

When the Cabin Pressurization Valve is open conditioned air is directed to both canopies to keep them clear of moisture.

### **CHECK VALVE (FIGURE 21-1)**

The check valve prevents cabin air from discharging through the supply ducting should there be a pressure drop or loss of integrity prior to the check valve.

### **EXTRACT BLOWER (FIGURE 21-1)**

The main purpose of the extract blower is to aid in the removal of hot air from the cockpit during ground operations. The pickup is the top of the rear instrument panel and forces air out the open outflow valve.

### **FOOT WARMERS (FIGURE 21-1)**

Foot warmers are located below each cockpit instrument panel. When the Cabin Pressurization Valve is open conditioned air is directed downward towards the pilot's feet.

### **HEAT EXCHANGER (FIGURE 21-1)**

The purpose of the heat exchanger is to reduce the temperature of the bleed air prior to entering the expansion turbine. Air directed over the tubes of the heat exchanger removes approximately ten percent of the heat from the bleed air.

### **MUFFLER (FIGURE 21-1)**

The purpose of the muffler is to reduce the noise of the bleed air entering the cockpit.

### **RE-CIRCULATING BLOWER (FIGURE 21-1)**

The re-circulating blower pushes air, through dedicated ducting, to the Wemac vents. The blower has two possible sources of air, cabin air, when the ram air valve is closed or outside air when the ram air valve is open.

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## **RAM AIR VALVE (FIGURE 21-1)**

The ram air valve is designed with an over center lock that prevents the valve from inadvertently opening. In addition it is a plug type valve, meaning; the cabin pressure pushes the valve against the seat insuring a good seal. The valve must be closed for the cabin to pressurize. When the valve is opened it will allow air from outside to enter the cockpit through the ducting for the Wemac vents.

## **SAFETY VALVE (Heating) (FIGURE 21-1)**

The safety valve prevents over pressurization of the ducting for the heating and air conditioning. The valve opens when an overpressure condition exists and will close when the condition is no longer present.

## **TURBO COOLER (FIGURE 21-1)**

The two major parts of the turbo cooler are the expansion turbine and the fan. The purpose of the expansion turbine is to lower the velocity, pressure and temperature of the air entering the cockpit. High velocity air turns the turbine which turns a fan via an interconnecting shaft. The fan pulls cooling air through the heat exchanger exhausting it within the engine compartment. The load of the fan reduces the air velocity on the turbine side by ninety percent. The expansion of the air exiting the turbine also drops the pressure and temperature.

Technical data;

Inlet pressure:	58psi.
Outlet pressure:	19psi
Minimum temp drop:	40°C

## **WINDSHIELD DEFROST (FIGURE 21-1)**

When the Cabin Pressurization Valve is open conditioned air is directed to the windshield to keep them clear of moisture. The windshield conditioned air may be supplemented with ambient air from the cabin with use of the defrost blowers.

## CONTROLS AND INDICATORS

### ANNUNCIATOR LIGHTS (Figure 21-4)

The annunciator panels are located in both cockpits and are interconnected. They are powered from the main bus C/B A8.

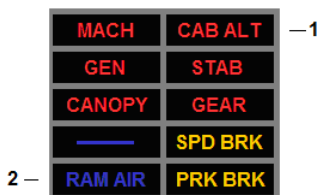


FIGURE 21-4

1.) **CAB ALT:** A remote sensor monitors the aircraft pressure altitude and the cabin altitude. When the cabin differential pressure is at or above 3.67psid the “CAB ALT” light will illuminate.

2.) **RAM AIR:** When the Ram air valve is not fully closed and locked, regardless of control position, the “RAM AIR” light will illuminate.

### CABIN ALTITUDE/ PRESSURE DIFFERENTIAL (FIGURE 21-5)

Cabin Altimeters & Pressure Differential indicators are located in both cockpits. The instrument senses the cabin altitude and displays it on the outer scale. The instrument also senses and displays a comparison between cabin altitude and aircraft pressure altitude on the inner scale.

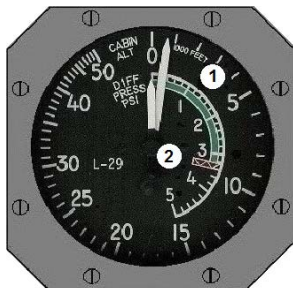


FIGURE 21-5

- 1.) **CABIN ALTITUDE:** Is indicated in thousands of feet on the outer scale.
- 2.) **CABIN PRESSURE DIFFERENTIAL:** Is displayed on the inner scale in pounds per square inch (PSID).

## **CABIN MANUAL DUMP VALVE KNOB (FIGURE 21-3)**

The Cabin Manual Dump Valve Knob is located on top of the Automatic Cabin Pressure Controller. Turning the knob CCW will open the dump valve. This will decrease or dump the cabin pressure. Turning the knob fully CW will close the dump valve and allow the Automatic Pressure Controller to control/regulate the cabin pressure differential. The normal position of the knob is closed or the fully CW position.

## **CABIN PRESSURIZATION LEVER (FIGURE 21-6)**

The Cabin Pressurization/heating & air-conditioning levers are located on the right console in both cockpits and are interconnected. This lever controls two valves, the front canopy seal valve and the cabin pressurization/heating & air-conditioning valve. The aft travel of the lever operates the Canopy Seal Valve and the forward travel controls the Cabin Pressurization/heating & air-conditioning Valve. The operation of the canopy seal valve is discussed in section 7.36.



**FIGURE 21-6**

### **\*\*\* CAUTION \*\*\***

**TO PREVENT DAMAGE TO THE CANOPY GLASS IT IS PROHIBITED TO SET THE CABIN PRESSURIZATION LEVER TO "CABIN PRESS ON" WITH THE ENGINE RUNNING ON THE GROUND.**

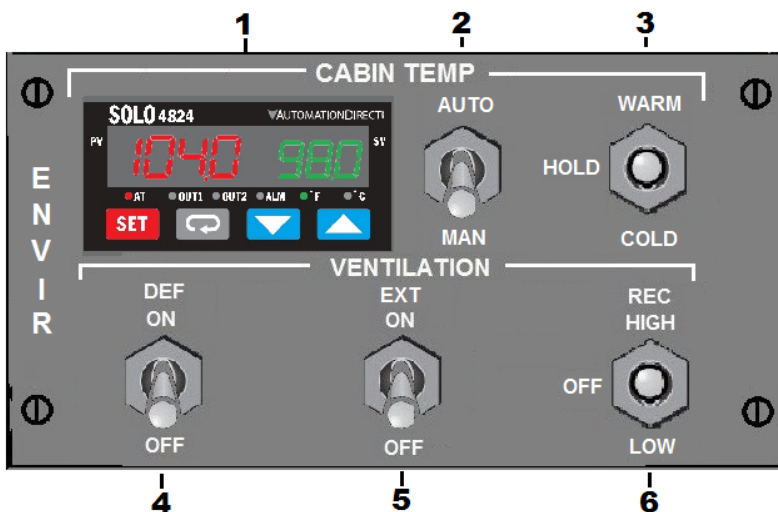
### **\*\*\* CAUTION \*\*\***

**WHEN THE CABIN PRESSURIZATION LEVER IS SET TO "CANOPY SEAL ON", THE SEAL FOR THE FRONT CANOPY WILL INFLATE IF THE CANOPY LOCK LEVER IS IN THE LOCK POSITION EVEN IF THE CANOPY IS OPEN.**



**ENVIRONMENTAL CONTROL PANEL (FIGURE 21-7)**

The environmental control panel is located in the front cockpit on the center of the right console.



**FIGURE 21-7**

**1.) DIGITAL TEMPERATURE CONTROLLER (Fig. 21-7)**

The Digital temperature controller will automatically position the temperature control valve to maintain the selected temperature. The controller is electrically powered from the SEC bus through circuit breaker B6 (A/C). Indications, functions and basic operations are described below.

**INDICATIONS****PV**

Present value indicates the current cabin temperature in the auto or manual mode.

**SV**

Selected value indicates the desired cabin temperature.

**AT**

This auto tuning function is not active.

**OUT1**

When the OUT1 LED light is illuminated the controller is driving the cabin temperature control valve to cold.

**OUT2**

When the OUT2 LED light is illuminated the controller is driving the cabin temperature control valve to warm.

## ALM

The alarm function is not active.

## °F/°C

The illumination of the corresponding LED indicates what values are displayed; °F= Fahrenheit or °C= Celsius.

## FUNCTION BUTTONS



### SET BUTTON

Press the set button to select the desired function mode or to confirm the setting value.



### ROTATE BUTTON

Press the rotate button to select parameters within the regulation mode.



### DOWN BUTTON

Press the Down button to decrease the values displayed on the SV display. Hold the Down button to speed up the rate of change.



### UP BUTTON

Press the Up button to increase the values displayed on the SV display. Hold the Up button to speed up the rate of change.

## INITIAL POWER UP

When power is first applied the splash screen appears. The screen will show the firmware version on the PV display and the two output types for this particular controller on the SV display (information for maintenance only). After three seconds the controller will start automatically controlling the cabin temperature control valve to achieve the SV if the AUTO/MAN switch is in AUTO position.

## TEMPERATURE CHANGE

After the initial power up sequence, the desired temperature may be changed by simply pushing the up or down buttons until the desired temperature is reached. The SV value will flash until it is confirmed by pushing the set button.

Refer to supplemental section 9-21, for detailed operating and programming instructions.

## 2.) AUTO/MANUAL TEMPERATURE SWITCH (Fig. 21-7)

This switch allows controlling the temperature control valve with the digital controller (in AUTO) or manually via the manual temperature control switch (in MAN).

**3.) MANUAL TEMPERATURE CONTROL SWITCH (Fig. 21-7)**

This switch is used to position the temperature control valve manually. In the COLD position it will drive the temperature control valve so that engine bleed air is directed to the cooling unit. In the HOLD position it will keep the temperature control valve in its present position. In the WARM position it will drive the temperature control valve to direct the engine bleed to bypass the cooling unit.

**4.) DEFROST BLOWER SWITCH, DEF (Fig. 21-7)**

When this DEF switch is turned on the defrost blowers will add flow of cabin air to the defrost outlets.

**5.) EXTRACT BLOWER, EXT (Fig. 21-7)**

The EXT switch turns on or off the extract blower. The blower aids in removing hot air from the cockpits when unpressurized.

**6.) RE-CIRCULATING BLOWER SWITCH, REC (Fig. 21-7)**

The REC switch has three positions OFF, HIGH or LOW and controls the speed of the re-circulating blower.

**RAM AIR CONTROL (FIGURE 21-8)**

The Ram Air Control is located on the lower right of the front instrument panel. Press the center of the control to unlock and move the control. Moving the control in or forward closes the ram air valve, out or aft opens the valve.

**FIGURE 21-8****\*\*\* CAUTION \*\*\***

**THE AIRCRAFT WILL NOT PRESSURIZE WITH THE RAM AIR VALVE OPEN AND IT IS PROHIBITED TO OPEN THE RAM AIR VALVE WITH GREATER THAN 1PSID.**