

## AIR CONDITIONING AND PRESSURIZATION

### CONTROLS AND INDICATORS

#### BLEED AIR CONTROL SWITCHES (two position)

BLEED 1 or 2 - starts bleed air flow from the No.1 and/or No.2 engine to both air conditioning packs

OFF - stops bleed air flow from selected engine

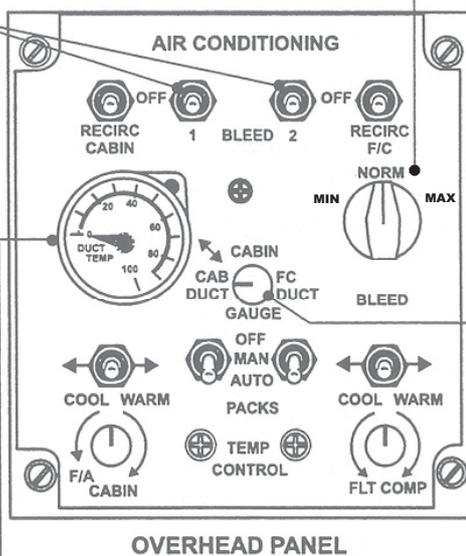
#### BLEED AIR FLOW CONTROL (rotary action)

- controls bleed air flow rate to both packs

MIN - minimum bleed air flow

NORM - used for enroute flight conditions

MAX - maximum bleed air flow



#### DUCT TEMPERATURE INDICATOR

- shows air temperature in cabin duct, cabin zone or flight compartment duct as selected on the duct temperature selector

#### CABIN/DUCT TEMPERATURE SELECTOR (rotary selection)

CAB DUCT - indicates air temperature in supply duct from aft pack

CABIN - indicates cabin zone air temperature

FC DUCT - indicates temperature in supply duct from forward pack

**PACK CONTROL SWITCHES (three position)**

- left switch controls aft pack (cabin)
- right switch controls forward pack (flight compartment)

MAN - temperature is controlled using associated MANUAL TEMPERATURE CONTROL switch

AUTO - temperature is controlled automatically

OFF - selects associated pack off

**CABIN RECIRCULATION FAN SWITCH (two position)**

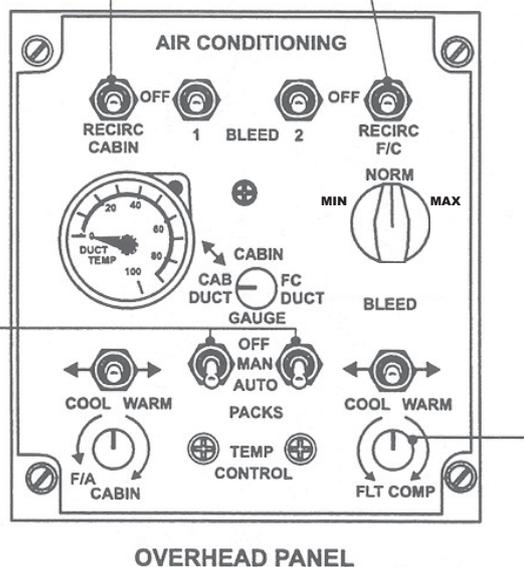
RECIRC - turns the cabin recirculation fan on.

OFF - turns the fan off.

**FLT COMPT RECIRCULATION FAN SWITCH (two position)**

RECIRC - turns the flight compartment recirculation fan on.

OFF - turns the fan off.

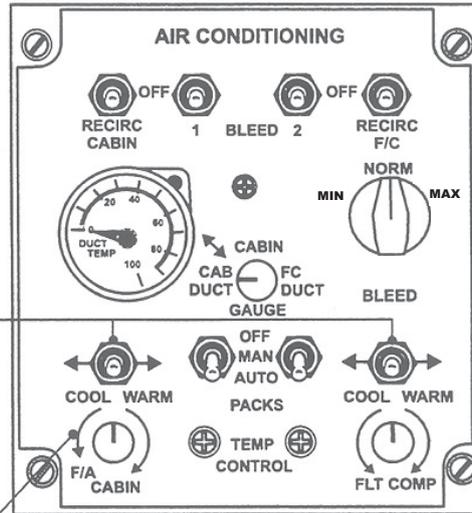


**FLIGHT COMPARTMENT AUTOMATIC TEMPERATURE CONTROL (rotary action)**

ROTATE - adjusts flight compartment temperature when the associated PACK control switch is selected to AUTO

**MANUAL TEMPERATURE CONTROL SWITCHES  
(three position, spring loaded to center)**

- provides manual control when associated PACK CONTROL switch selected to MAN.
- holding switch towards COOL or WARM, directs pack bypass valves in selected direction

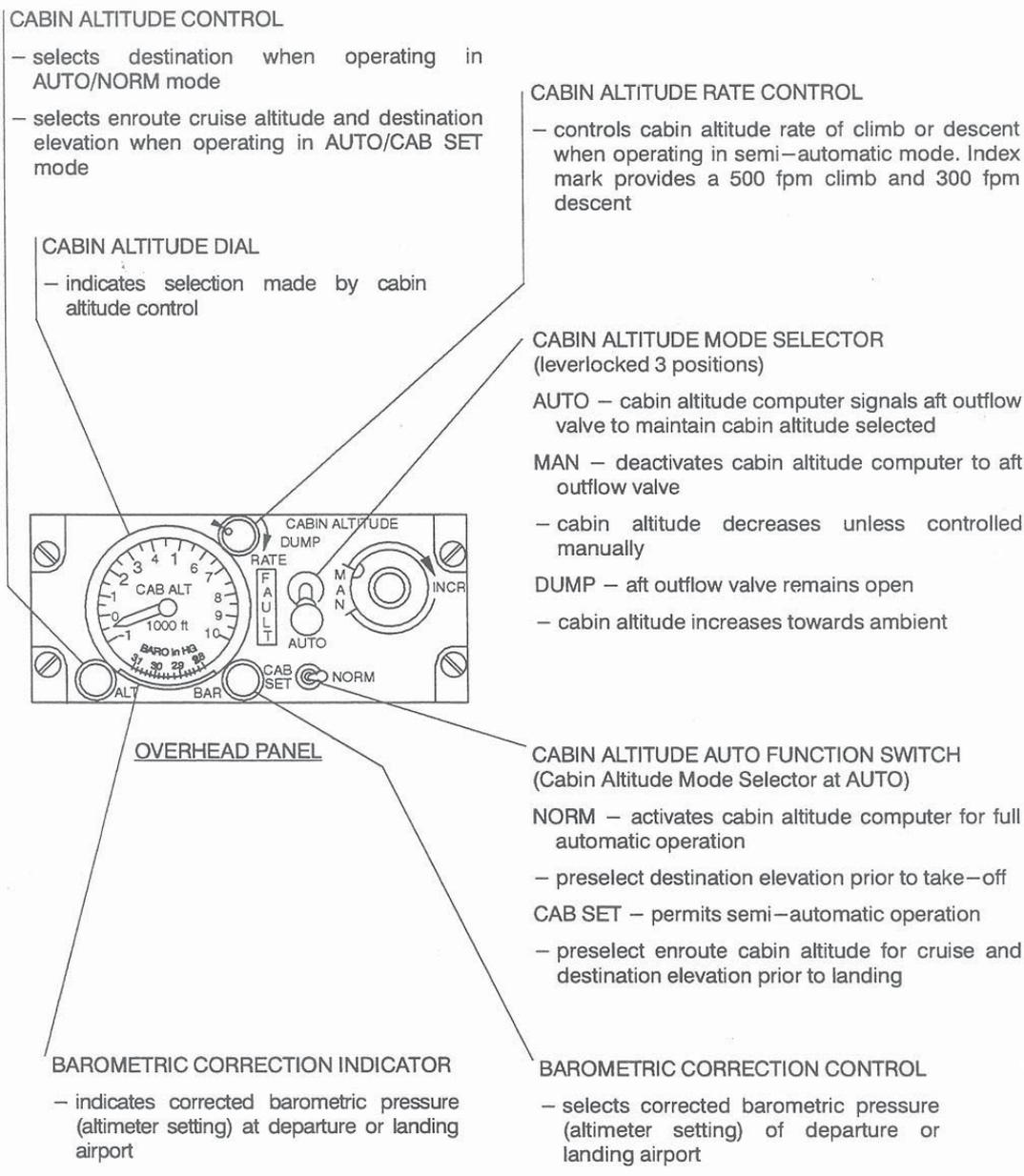


OVERHEAD PANEL

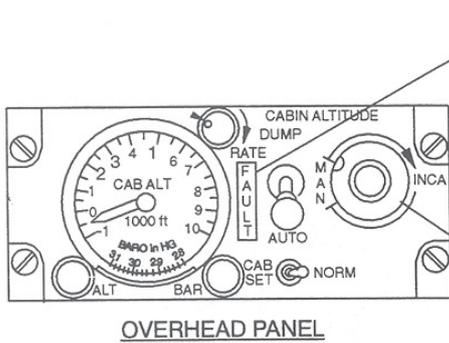
**CABIN AUTOMATIC TEMPERATURE CONTROL  
(rotary action)**

ROTATE - adjusts cabin temperature when the associated PACK control switch is selected to AUTO

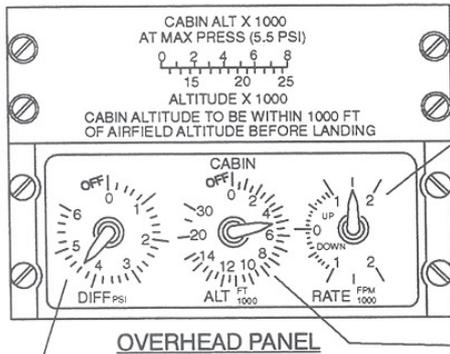
F/A - rotating fully counterclockwise to the F/A detent allows flight attendant to control cabin temperature from the FLIGHT ATTENDANT'S panel



*Cabin altitude control panel*

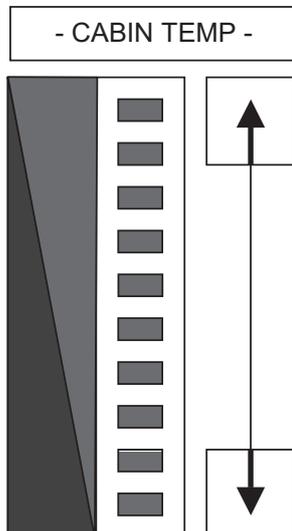


- FAULT LIGHT
- ILLUMINATED – briefly (2 sec.) during self-test.
- continuously if there is a system malfunction
- CABIN ALTITUDE MANUAL CONTROL
- Set full counterclockwise for AUTO
- used when cabin altitude Mode Selector selected to MAN
- controls forward outflow valve
- turning knob clockwise opens outflow valve increasing cabin altitude
- control effectiveness decreases as cabin altitude approaches ambient



- CABIN ALTITUDE RATE OF CLIMB INDICATOR
- indicates cabin altitude rate of climb or descent in feet per minute
- CABIN ALTIMETER
- indicates cabin altitude in feet
- CABIN DIFFERENTIAL PRESSURE INDICATOR
- indicates the differential pressure between cabin and ambient in pounds per square inch

*Cabin altitude/pressurisation control panel*



## SYSTEMS DESCRIPTION

### Air conditioning general

Conditioned air for the flight compartment and cabin comes from dual air conditioning packs located in the rear fuselage.

Either pack supplies temperature controlled air by processing bleed air from the engines or the APU. The temperature-controlled air is mixed with recirculated cabin air in the mixer manifold of either pack for distribution back to the cabin/flight compartment ducts.

Conditioned air from an external ground source can be supplied to the system.

### Air conditioning packs

Conditioned air is provided by two identical packs located behind the aft pressure dome. The forward pack supplies air to the flight compartment while the aft pack supplies air to the cabin. If either pack fails, airflow to the cabin and flight compartment will continue from the operating pack. The packs are controlled from the AIR CONDITIONING control panel.

The BLEED airflow control selector sets the schedule for the Pressure Regulator and Shut-Off Valves (PRSOVs) to control the airflow rate to each pack. If one valve is closed (one pack shutdown), the airflow is divided in half. The pack temperature control is automatic when the PACK control switches are selected to AUTO.

Conditioned air flows into a mixing chamber where it blends with recirculated air and, if required, hot bleed air. Pack temperature control valves adjust the flow of both cold and hot by-passed bleed air to achieve the desired conditioned air temperature. The air is then ducted to the temperature-controlled compartments of the airplane. The pack temperature control valves may be controlled automatically or manually.

### Air distribution

Conditioned air from the packs flow into a common manifold where it is diverted to the cabin and flight compartment. Cabin airflow is directed to the overhead and floor grilles simultaneously. Gasper airflow is tapped off its respective supply duct and is adjusted by rotating the gasper (counterclockwise to increase airflow).

System pressure and flow is increased by two recirculation fans located aft of the pressure bulkhead. They are controlled by the RECIRC CABIN and RECIRC F/C switches on the AIR CONDITIONING control panel.

Conditioned airflow for the flight compartment is controlled by flow control levers on the right and left sidewall. The levers slide from left (CLOSED) to right (OPEN). The upper lever controls side window de-misting and the lower lever controls airflow through grilles on the side consoles, outboard of the rudder pedals.

### Recirculation fans

Two recirculation fans are located aft of the pressure dome. One recirculation fan serves each pack. Air is drawn directly from the forward cabin and flight compartment. Separate RECIRC switches on the AIR CONDITIONING control panel control both fans.

A separate avionics-cooling fan draws air through the avionics rack and discharges it under the floor. The fan is operational whenever DC power is on. Fan failure is indicated by annunciation on the forward flight attendant's panel.

### Temperature control

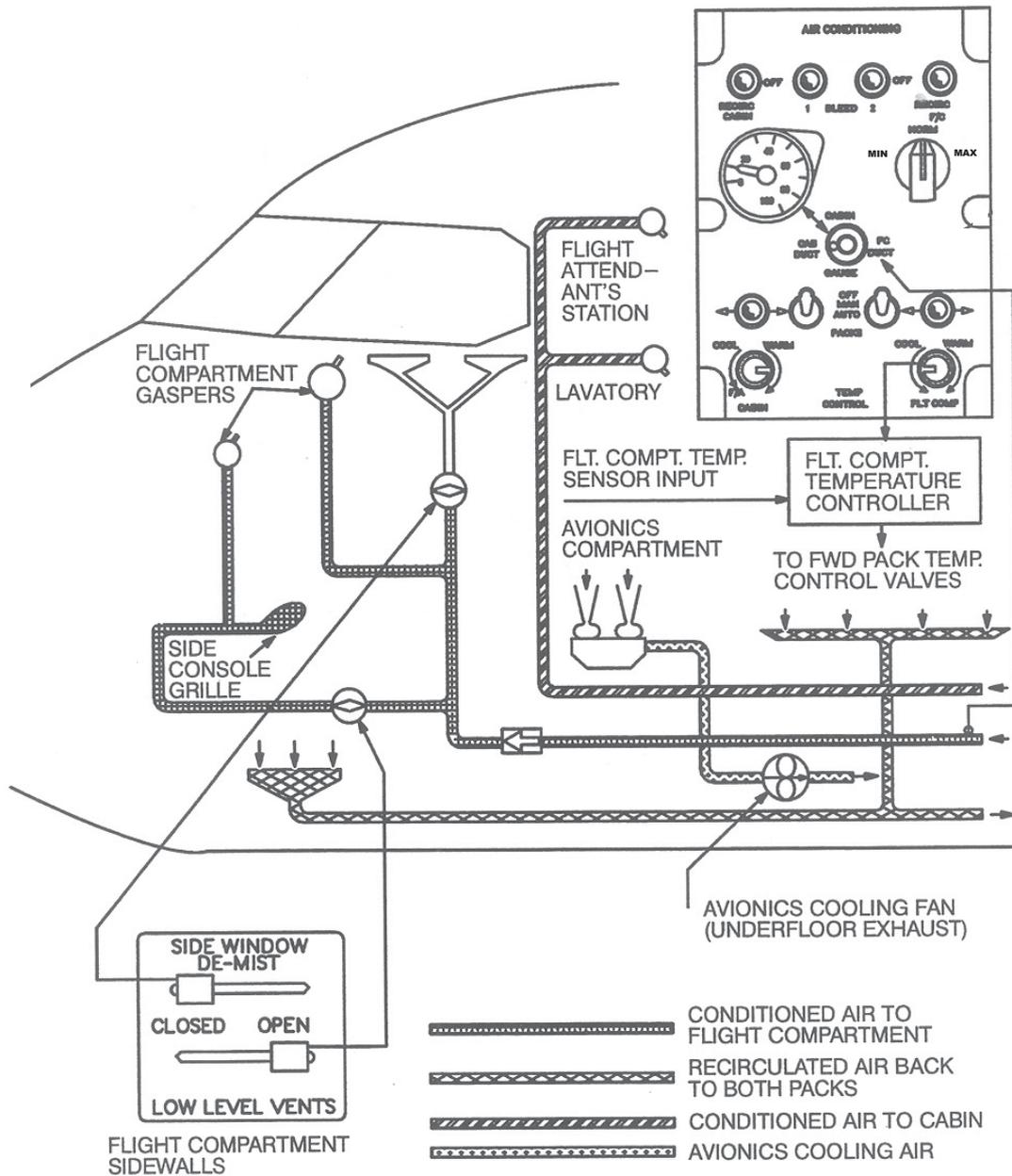
Temperature control for the cabin and flight compartment is controlled by a pair of automatic temperature controllers. Each controller regulates its compartment temperature by comparing it with that selected. When the CABIN selector in the flight compartment is selected to the F/A position, the cabin temperature selection is controlled from the flight attendant's panel. The temperature gauge on the AIR CONDITIONING control panel indicates the cabin temperature or supply duct temperature from each pack.

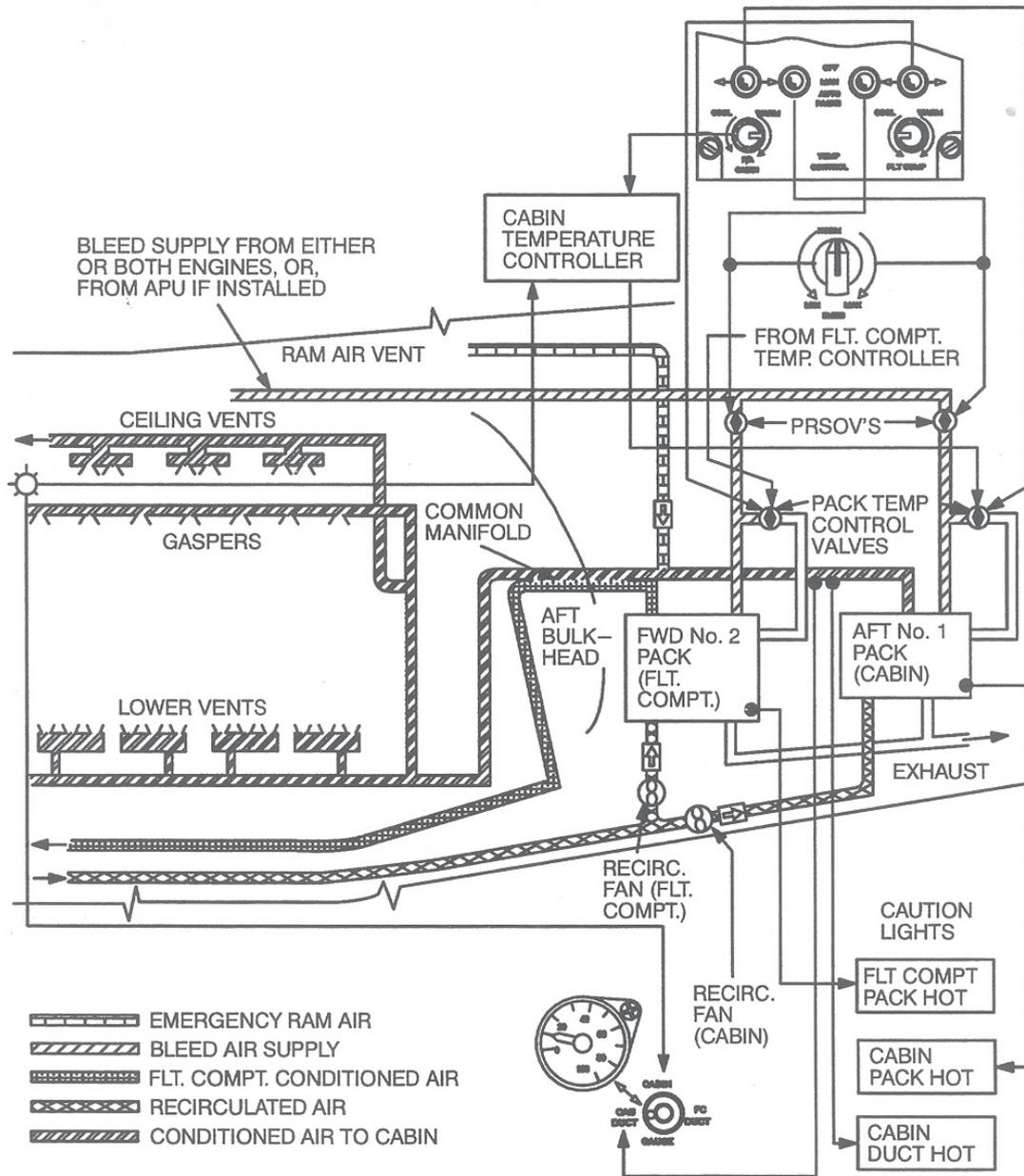
In the automatic mode, the desired temperature is selected on the respective temperature controller. The sensed and selected temperature for each compartment is processed in its associated automatic temperature controller, which then signals the pack temperature control valve. The pack temperature control valve then establishes the mixture of refrigerated and bypassed air for that compartment. When stabilised, the controller regardless of variations in outside air temperature maintains the temperature.

If a malfunction occurs in the automatic system, cabin and flight compartment temperatures can be maintained with the manual temperature control switches.

**CAUTION:** When operating the cabin or flight compartment in manual mode, care must be taken to avoid excessive COOL/WARM selections, which can cause duct overtemperature or duct icing to occur.

If the cabin or flight compartment duct hot caution lights illuminate, the associated temperature control valves are automatically commanded to the full cool position, regardless of AUTO or MAN operation. If the overtemperature condition persists or reappears, the associated PACK should be selected OFF by the flight crew.



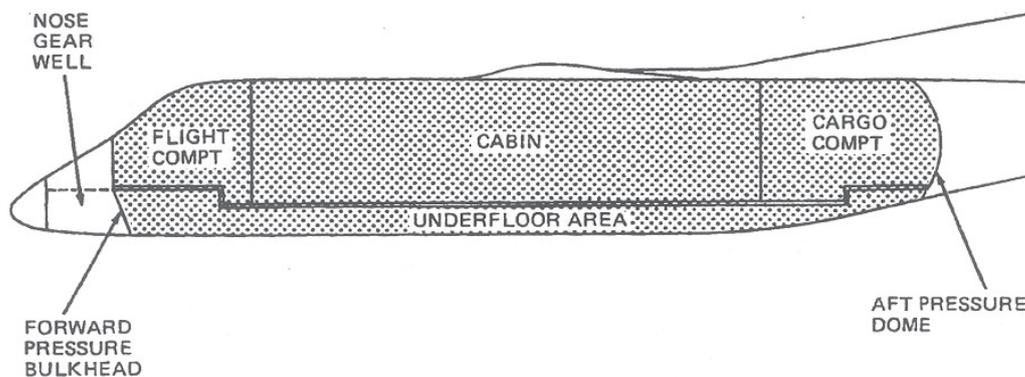


### Pressurization general

The pressurization system controls cabin altitude by regulating the discharge of conditioned air from the cabin. The pressurized area consists of the flight compartment, the cabin, the baggage compartment and the underfloor area throughout the aircraft.

Pressurization is normally regulated by the Cabin Pressure Controller, which modulates a pair of aft automatic outflow valves located on the aft pressure dome. One valve is electro-pneumatic controlled, while the other is pneumatically slaved to the first. A third outflow valve is located in the forward pressure bulkhead for manual pressurization control and smoke removal.

The modes of operation are AUTO/NORM, AUTO/CAB SET, MAN and DUMP. In the automatic modes, a cabin altitude computer receives inputs from cabin and ambient pressure sensors, weight on wheel switches, power lever position and the cabin altitude selector. The computer then commands the aft outflow valves to modulate and maintain the desired cabin altitude.



*Pressurized areas*

### Automatic operation

When electrical power is applied to the airplane, the computer performs a system test. The FAULT light on the cabin altitude controller illuminates for 2 seconds, after which it goes out if no fault is detected. For automatic operation, select on the cabin altitude controller:

Cabin altitude mode selector	AUTO
Cabin altitude auto function switch	NORM
Cabin altitude rate control	Index mark
Cabin altitude indicator	To airport elevation
Barometric correction indicator	Current altimeter setting prior to take off
Cabin altitude manual control	Full counterclockwise

### Ground mode

When all doors are closed, air conditioning packs selected ON and one or more bleed valve ON, the cabin altitude descends slightly below ambient. When the power levers are advanced for take off, the cabin altitude descends to 140 feet below the existing cabin altitude until lift off and landing gear is selected UP. At lift off, the cabin altitude is controlled to achieve a smooth pressure transition from ground to flight and maintain the cabin altitude-scheduling program.

### Climb mode

During automatic operation with the cabin altitude auto function switch at NORM, there is a fixed schedule of cabin altitude versus aircraft altitude. Each aircraft altitude has a corresponding 'scheduled' cabin altitude, therefore during climb, the cabin altitude rate of climb increases proportionally with the aircraft rate of climb. The computer utilises stored data on aircraft performance to adjust the cabin altitude at the minimum adequate rate throughout the climb until cruise altitude is reached.

### Cruise mode

During cruise, the computer compares the selected airport altitude with the 'scheduled' cabin altitude. Then it selects the higher of the two for the cabin to maintain, and keeps the system within the required pressure differential limits. If a climb or descent is initiated, the cabin responds in accordance with the rate setting selected on the cabin altitude rate control.

### .Descent mode

Prior to descent select the cabin altitude indicator to the destination airport elevation. This input allows the computer to determine a suitable cabin altitude schedule for descent, and ensures that the aircraft will be fully depressurized upon landing.

When the aircraft starts to descend, the cabin altitude follows into the descent mode at a rate equivalent to the setting on the cabin altitude rate control. The cabin altitude descent rate will continue until touchdown, or, to the pre-selected altitude on the cabin altitude indicator, whichever comes first. If the pre-selected altitude on the cabin altitude indicator is above the

destination field elevation, the aircraft will be depressurized before touchdown, and the final cabin altitude will equal ambient altitude. If the pre-selected altitude on the cabin altitude indicator is below the destination field elevation, the aircraft will land pressurized.

Upon touchdown, the cabin altitude will ascend to field elevation at 600 fpm for approximately one minute, after which the computer opens the aft outflow valves fully to vent the cabin of any residual pressure to ambient.

### 12-02.2.12. Semi-automatic operation

For semi-automatic operation, the following selections must be made on the cabin altitude controller:

Cabin altitude mode selector	AUTO
Cabin altitude auto function switch	CAB SET
Cabin altitude rate control	Index mark
Cabin altitude indicator	Desired cabin cruise altitude
Barometric correction indicator	Current altimeter setting
Manual control	Full counter clockwise

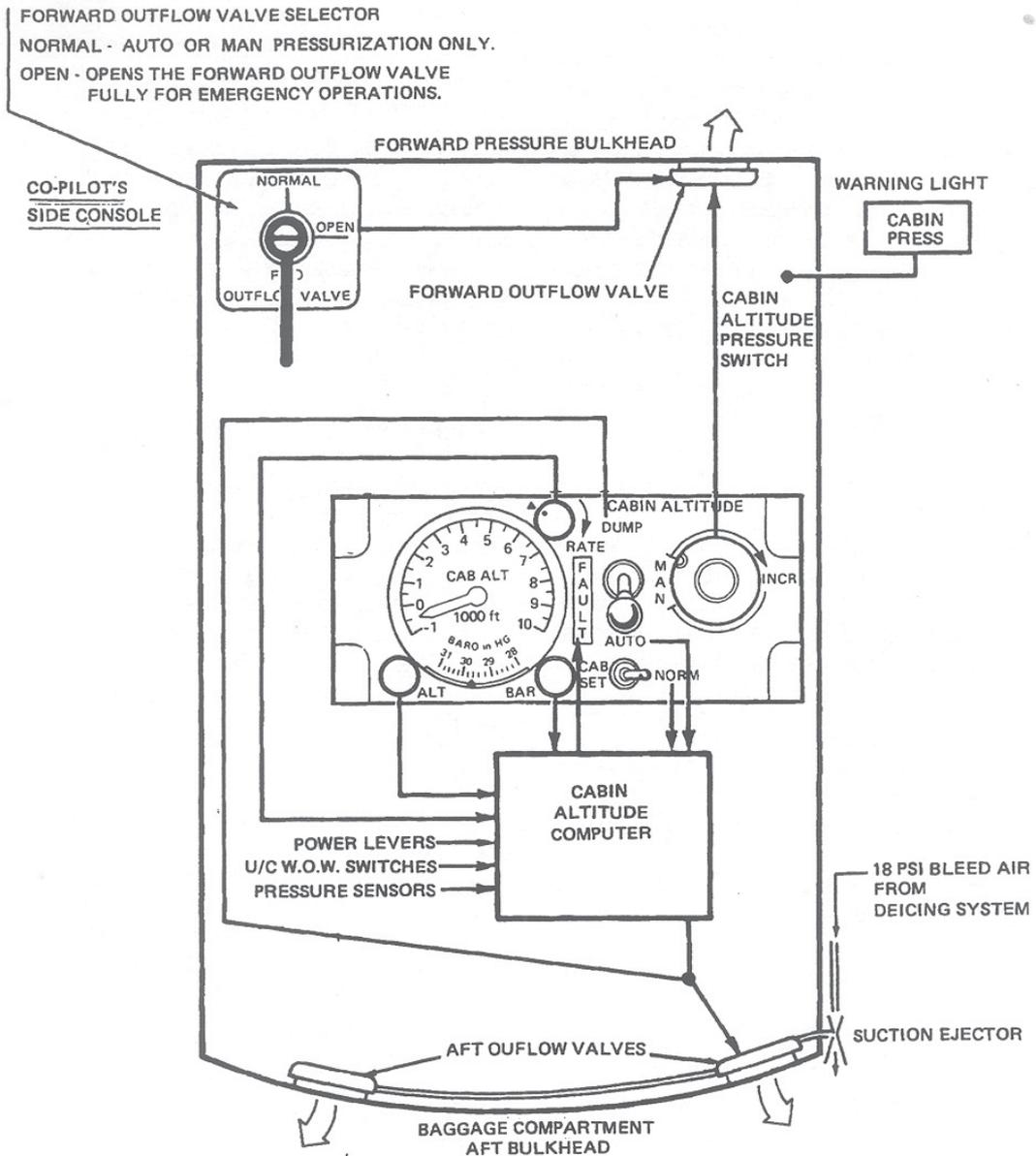
When the RATE knob is left at its index mark, the cabin altitude operates at a rate of 500 fpm up and 300 fpm down.

Adjusting the knob clockwise, increases the rate up to a maximum of  $2500 \pm 150$  fpm up or  $1500 \pm 150$  fpm down. Adjusting the knob counter clockwise, decreases the rate up to a maximum  $150 \pm 50$  fpm up to  $90 \pm 50$  fpm down.

Prior to descent from cruise altitude, confirm the:

Cabin altitude indicator	Destination field elevation
Barometric correction control	Reset to destination altimeter setting

All other operations are the same as for fully automatic operation.



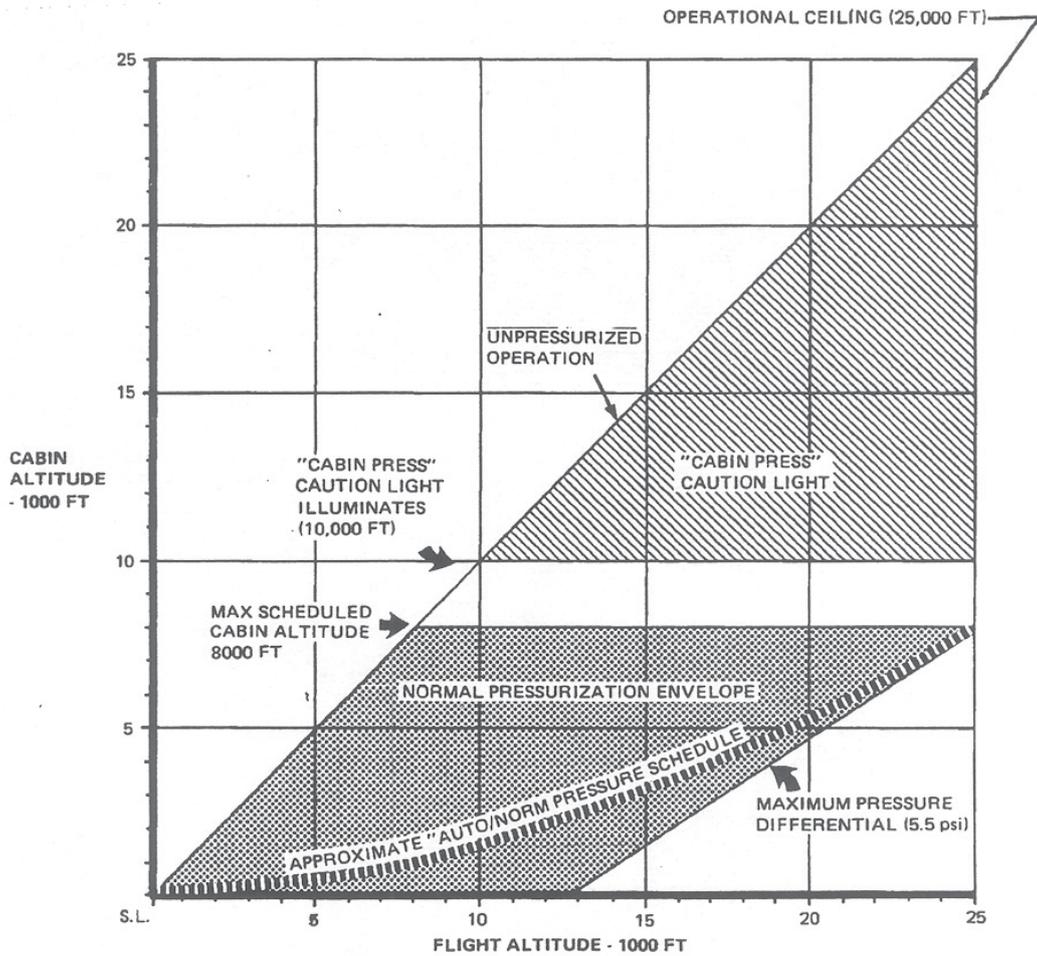
Cabin altitude control schematic

The necessary control settings for operation of the pressurisation system in any of the four modes are summarised below.

MODE	SELECTOR PANEL SETTINGS					
	AUTO/MAN DUMP SWITCH	CAB SET / NORM	RATE	CABIN ALTITUDE DIAL	BAROMETRIC CORRECTION INDICATOR	MANUAL CONTROLLER
FULLY AUTOMATIC	AUTO	NORM	MID (INDEX MARK)	SET TO AIRPORT ALTITUDE	SET CURRENT ALTIMETER SETTING	FULL COUNTER CLOCKWISE
SEMI AUTOMATIC	AUTO	CAB SET	MID	EN ROUTE, THEN DESTINATION	SET CURRENT ALTIMETER SETTING	FULL COUNTER CLOCKWISE
MANUAL	MAN	-	-	-	-	ADJUST AS NECESSARY
DUMP	DUMP	-	-	-	-	-

*Pressurization mode control settings*

- Normal cabin pressure differential limit .....  $5.5 \pm .3$  psi.
- Maximum cabin pressure differential limit during taxiing, takeoff, and landing ..... 0.5 psi
- Maximum cabin pressure differential limit ..... 5.95 psi
- Maximum cabin altitude (pressurized flight) ..... 8,000 feet



Pressurization envelope

## NON-NORMAL INDICATIONS AND OPERATION

### Air-conditioning

If a wing leading edge duct temperature exceeds 290°C, the associated nacelle shut-off valve closes to prevent any further increase in temperature. This causes the BLEED HOT caution light to illuminate. When the overtemperature condition clears, the caution light goes out and normal system operation is restored. For more information on this subject refer to section 12-16 'Pneumatics'.

If a pack compressor discharge duct temperature exceeds 207°C, the associated CABIN or FLT COMPT PACK HOT caution light illuminates. This closes the associated PRSOV to the pack and cuts off the hot bleed air supply. When the over temperature condition ceases, the light extinguishes and normal system operation is restored.

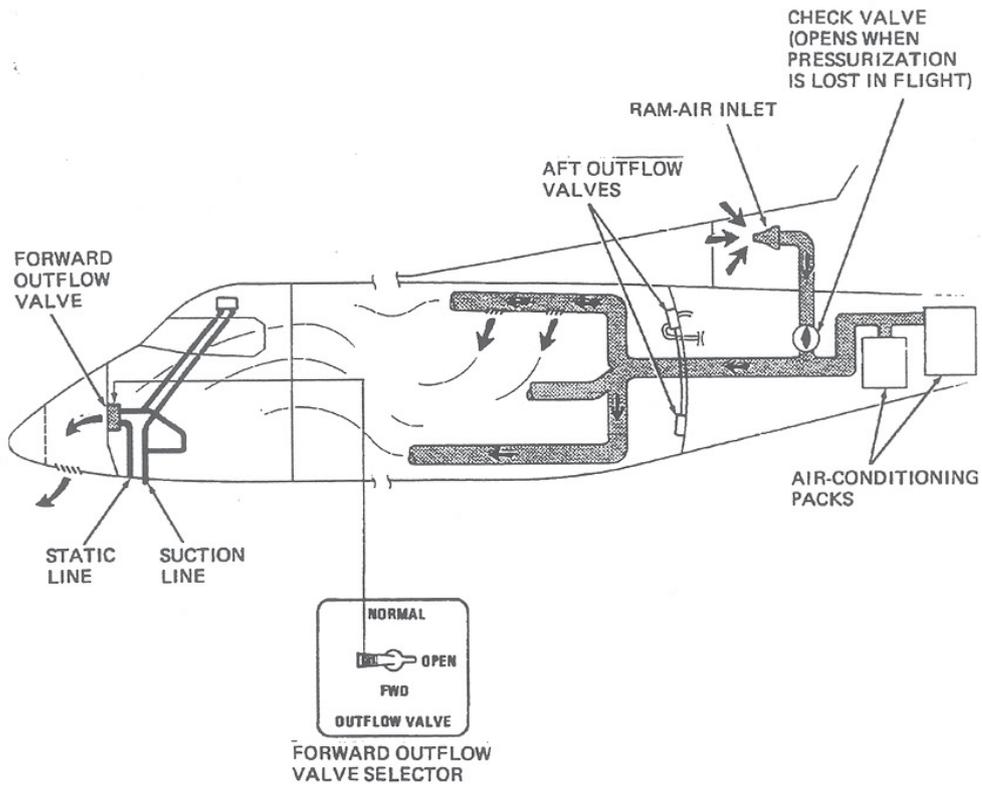
If the CABIN DUCT HOT or FLT COMPT DUCT HOT caution light illuminates due to a duct temperature in excess of 88°C, the associated pack temperature control valves are commanded to the full cool position to control the over temperature. As temperatures fall to 82°C the caution lights extinguishes. However, if the temperature remains high for over 20 seconds (caution light remains illuminated), the pack temperature control valve may be faulty, and the pack should be shut down by selecting the associated PACKS control switch to OFF.

In the event of an electrical failure, the HP shutoff valves are de-energized closed to prevent any thermal hazard from the hot HP bleed air. However, the PRSOVs must be energized to close and thus remain open when electrical power is off. In this case LP bleed air is allowed into the air conditioning system for temperature control and cabin pressurization.

### Emergency ram air ventilation

If both air conditioning packs fail, ventilation through the cabin and flight compartment is supplied through the ram air duct in the dorsal fin. Ram airflow is continuously being applied to the emergency ventilation system in flight through the ram air duct. Following the loss of normal air conditioning, and subsequent loss of cabin pressure, airflow through the ram air duct and cabin begins.

To initiate full ventilation throughout the cabin and flight compartment, turn the forward outflow valve selector clockwise 90° to the OPEN position. This opens the forward outflow valve to ambient. The flight may have to be continued at a lower altitude if practicable due to loss of pressurisation.



EMERGENCY RAM AIR VENTILATION

### Caution lights

FLT COMP DUCT HOT	Indicates overheat (over 88°C) in flight compartment supply duct.
Applicable ECL	CABIN DUCT HOT or FLT COMPT DUCT HOT
Remarks	Pack temperature trim valves are automatically driven to maximum flight compartment cooling position to direct cool air to the duct until temperature is 82°C. Below 82°C caution light goes out and normal operation resumes.
CABIN DUCT HOT	Indicates overheat (over 88°C) in cabin supply duct.
Applicable ECL	CABIN DUCT HOT or FLT COMPT DUCT HOT
Remarks	Pack temperature trim valves are automatically driven to maximum cooling position to direct cool air to the duct until temperature is 82°C. Below 82°C caution light goes out and normal operation resumes.
FLT COMP PACK HOT	Flight compartment pack compressor discharge temperature exceeds 207°C.
Applicable ECL	CABIN PACK HOT or FLT COMPT PACK HOT
Remarks	Normal operation is automatically interrupted and flight compartment bleed air system is shut down until air cycle machine cools. Caution light goes out and normal operation resumes. PRSOV energizes closed to cut off bleed air supply.
CABIN PACK HOT	Cabin pack compressor discharge temperature exceeds 207°C.
Applicable ECL	CABIN PACK HOT or FLT COMPT PACK HOT
Remarks	Normal operation is automatically interrupted and cabin bleed air system is shut down until air cycle machine cools. Caution light goes out and normal operation resumes. PRSOV energizes closed to cut off bleed air supply.

#### 12-02.3.4. Pressurization

#### 12-02.3.5. Manual operation

The manual mode is provided in the event a loss of electrical power is experienced or a malfunction occurs in the automatic pressurization system resulting in cabin pressure exceeding the maximum pressure differential limits.

In the manual mode, selecting the cabin altitude controller to MAN deactivates the pressurization computer and closes the aft outflow valves. The cabin outflow now occurs through the forward outflow valve: with the aft outflow valves closed, cabin altitude decreases rapidly. Turning the cabin altitude manual control clockwise (towards INCR) opens the forward outflow valve to increase the cabin altitude while turning it counterclockwise closes the valve to decrease the cabin altitude. When operating in manual mode, the cabin altimeter, cabin differential pressure indicator and cabin altitude rate of climb indicator should be monitored carefully.

The manual system may be operated with the automatic system functioning during flight to evacuate smoke from the flight compartment without depressurizing the aircraft. Selecting the cabin altitude manual control clockwise meters suction generated by slipstream to open the forward outflow valve. The automatic system, trying to maintain cabin pressure, will begin to close the aft outflow valves. This redirects all the exhaust through the forward outflow valve for as long as the selector is at OPEN position effectively increasing the air change rate in the flight compartment.

#### 12-02.3.6. Unpressurized operation

For flight without cabin pressurisation, select cabin altitude mode selector to DUMP. This signals the aft outflow valves to remain open preventing the aircraft from pressurizing. DUMP may also be selected to maximise the evacuation of smoke from the cabin through the aft outflow valves.

#### 12-02.3.7. Non-normal indications

If the cabin altitude exceeds 10,000 feet, this automatically illuminates the CABIN PRESS warning light on the warning light panel. The light will remain illuminated until the cabin altitude decreases below 10,000 feet. If the cabin altitude continues to climb uncontrolled, the aft outflow valves should be closed and pressurization continued under manual control.

#### 12-02.3.8. Warning light

	Cabin pressure exceeds 10.000 feet
Applicable ECL	Excessive cabin altitude
Remarks	Cabin pressure warning light goes out when cabin altitude descends below 10.000 feet