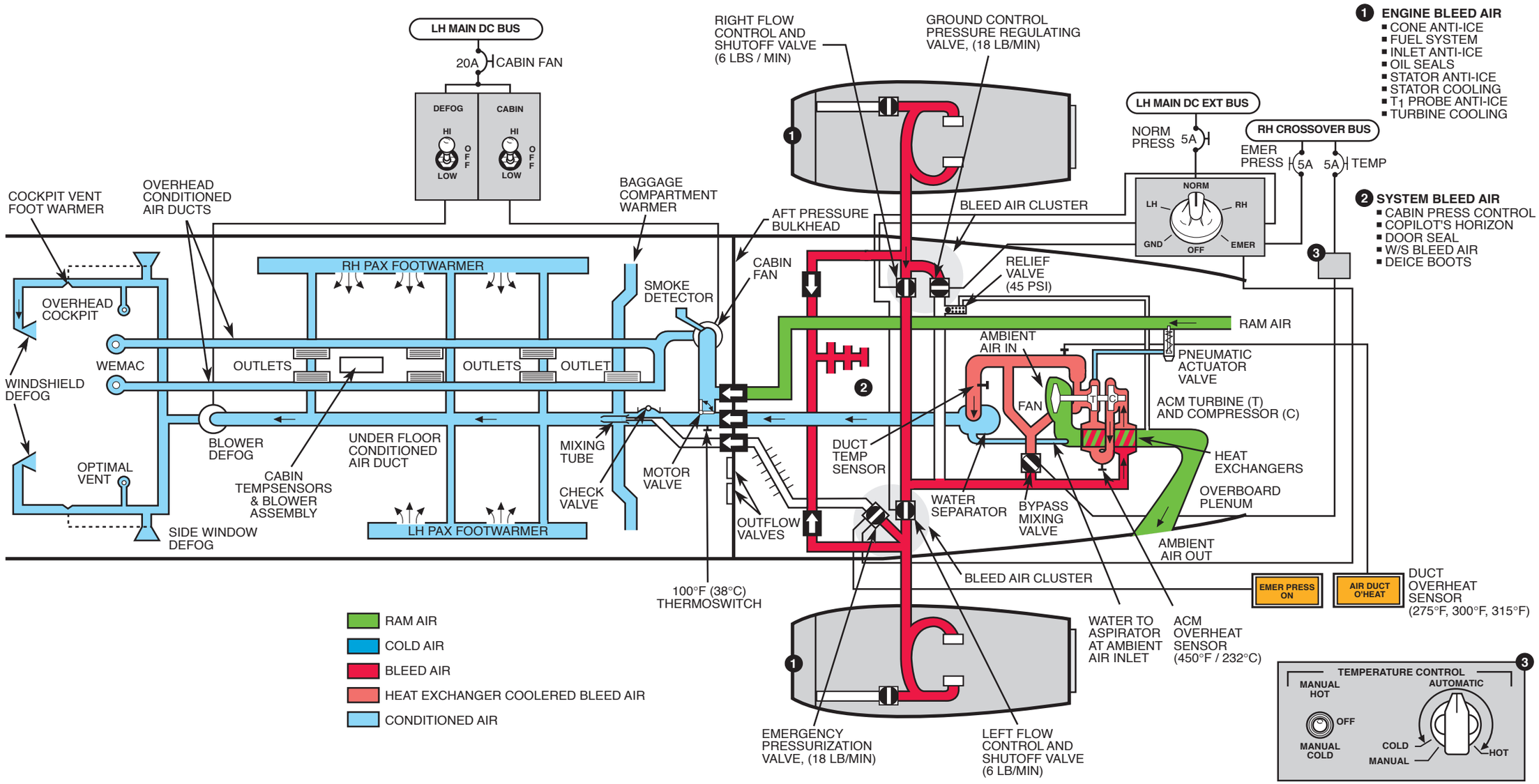
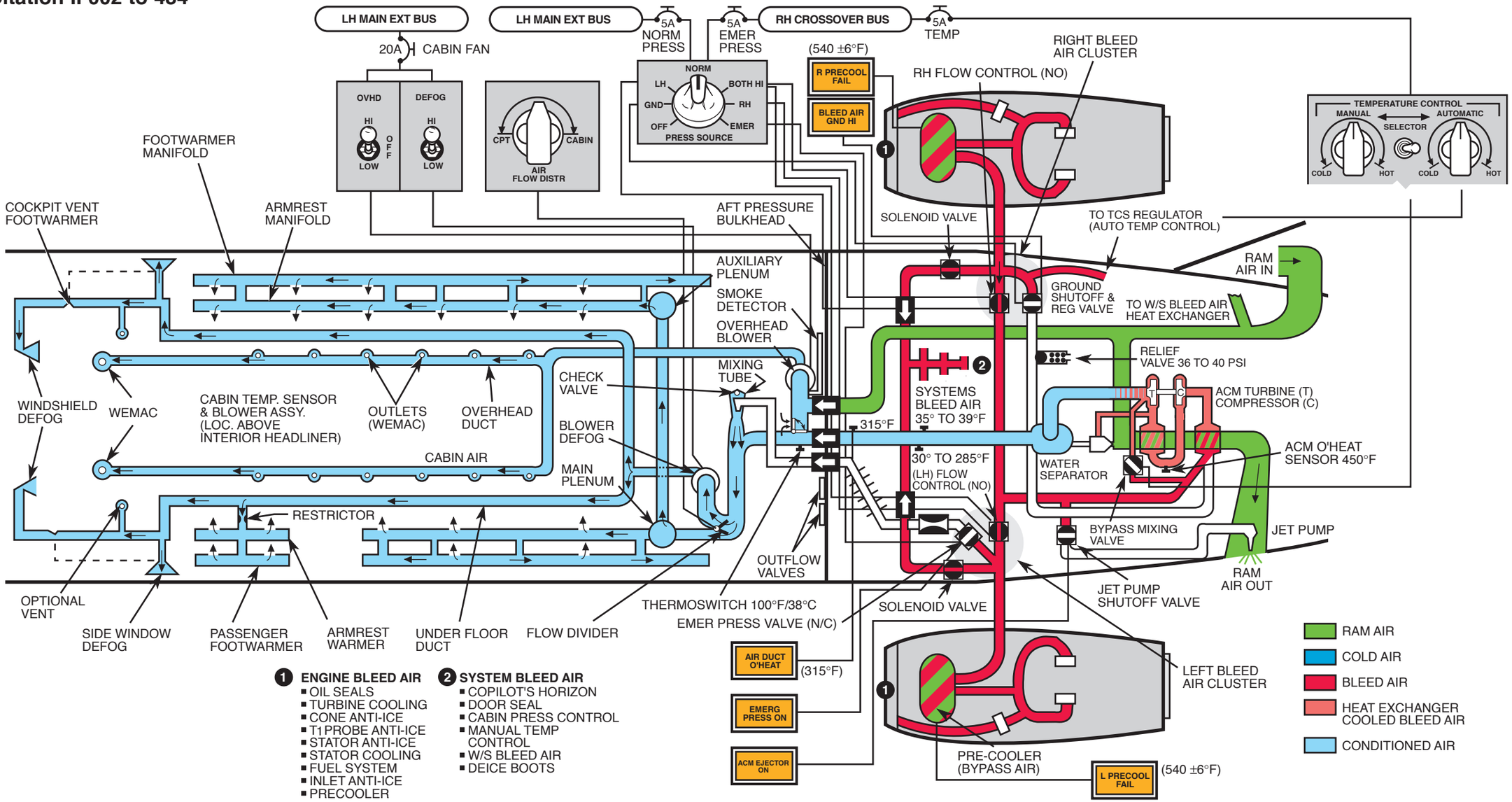
Pneumatic Air Conditioning System

Citation, Citation I



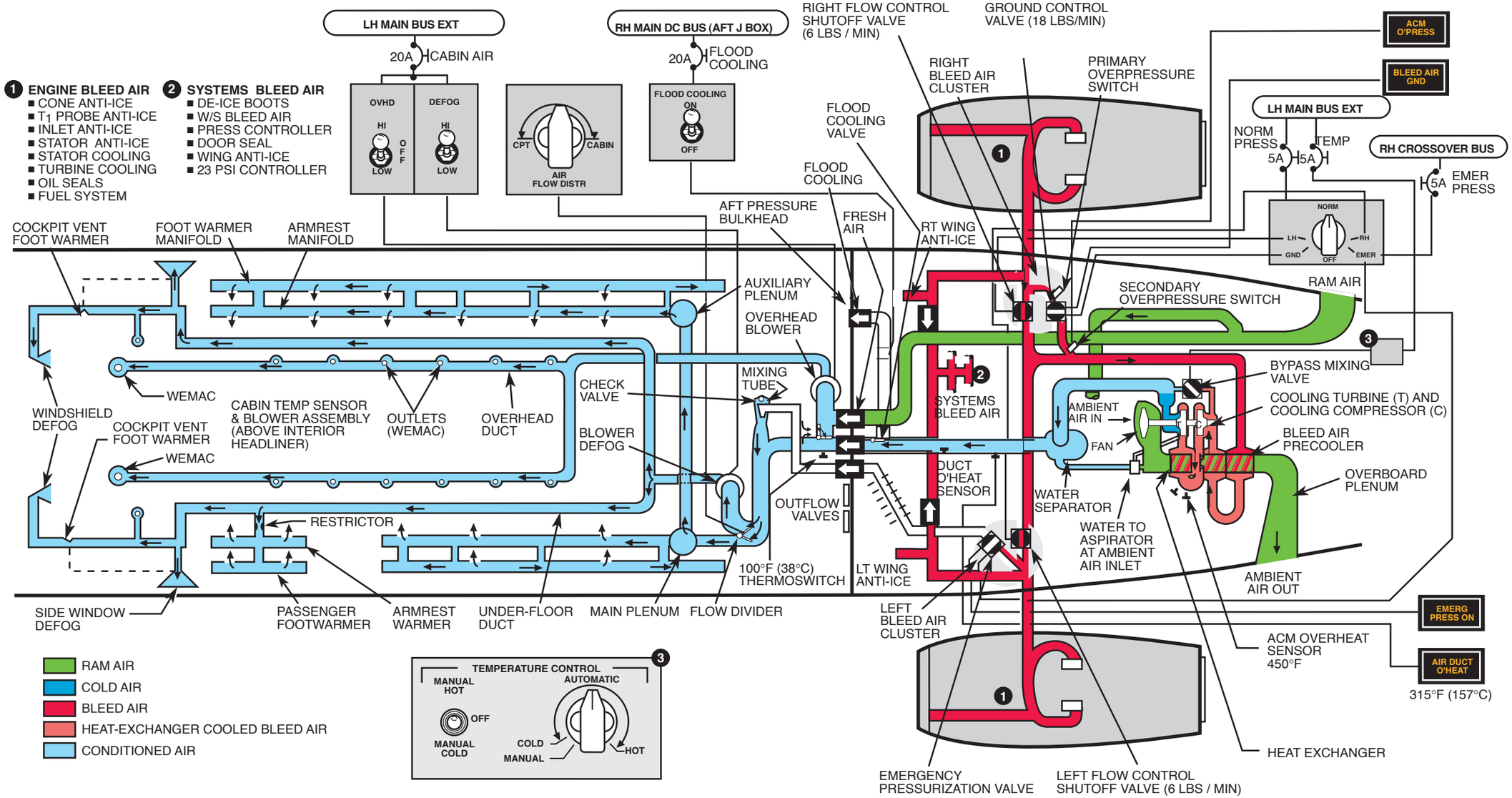
Pneumatic Air Conditioning System

Citation II 002 to 484



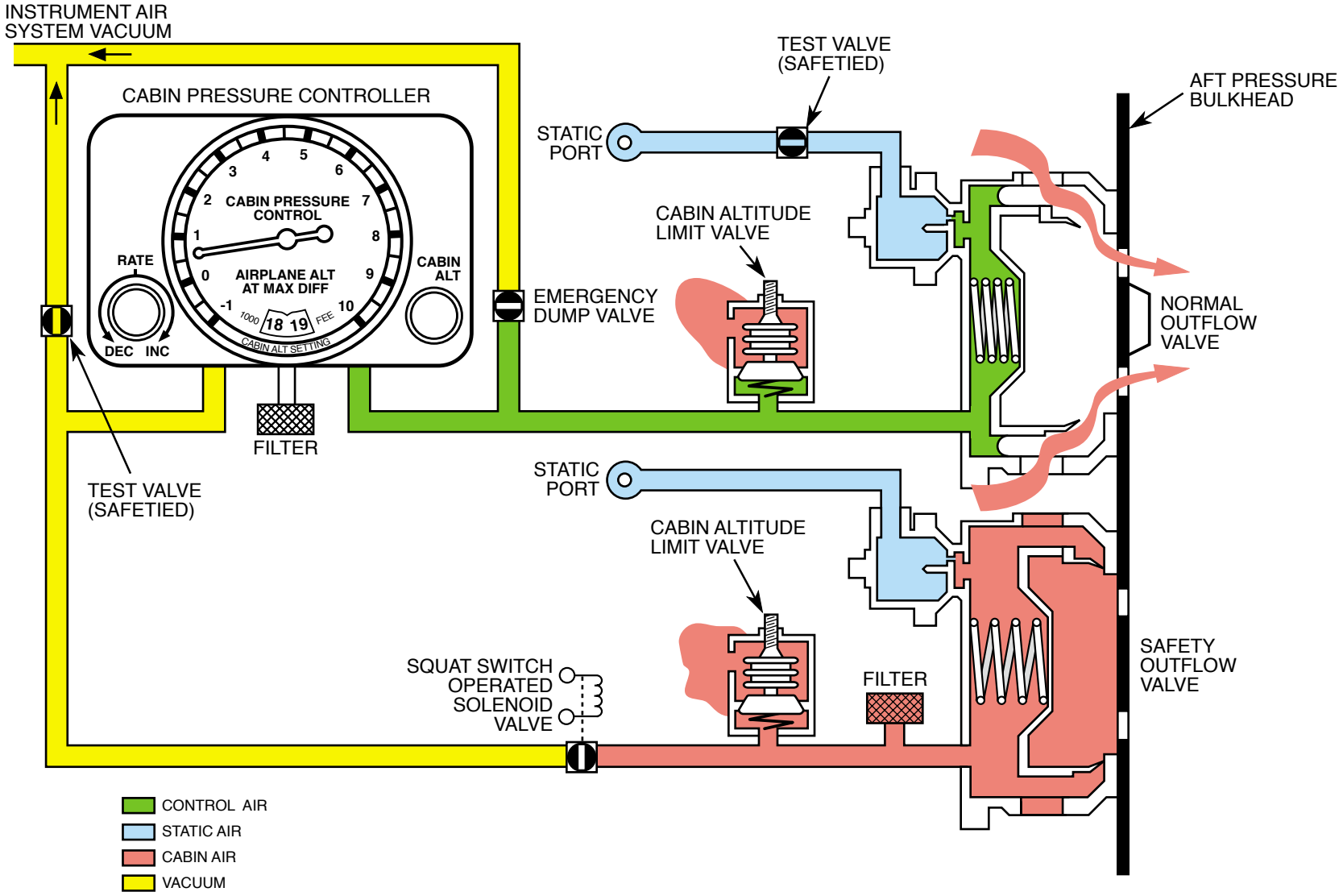
Pneumatic Air Conditioning System

Citation II 484, 485 and sub; SII



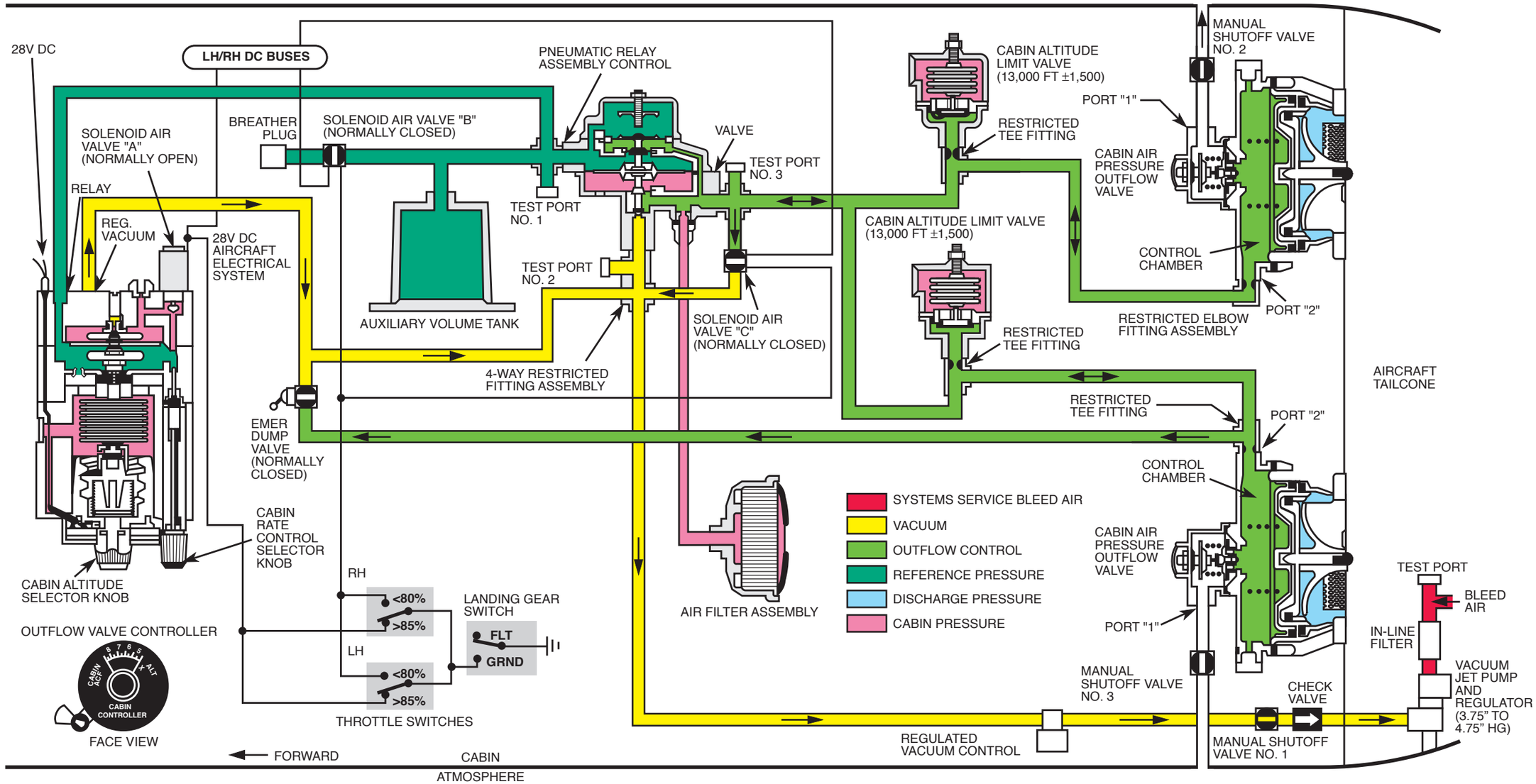
Pressurization System

Citation 001 to 214



Pressurization System

Citation 214 and sub; CI; CII; CII-627; SII



Bleed Air Sources

Bleed air from each engine's centrifical compressor flows through transfer tubes and elbow assemblies before entering the bleed air cluster. At the bleed air cluster, the bleed air flow splits to supply the:

- air conditioning and pressurization systems through the left and right flow control shutoff valves
- emergency pressurization through emergency pressurization valve (left engine only)
- ground air conditioning through ground shutoff valve or shut-off pressure regulating valve (right engine only).
- airframe anti-icing and deicing system (see Ice and Rain Protection).

On **Citation II units 002 to 484 except 482**, hot bleed air from each engine flows through a precooler before flowing to the bleed air cluster. If bleed air temperature exceeds 540°F (282°C), the appropriate PRECOOL FAIL annunciator illuminates. Bleed air from the right engine also supplies the automatic temperature control system regulator.

The PRESS SOURCE selector controls bleed air flow from the engines to the bleed air cluster through the flow control shutoff, ground shutoff, and emergency pressurization valves (see **Table 4C-1**).

Position	Function
OFF	Left and right flow control shutoff valves closed.
GND	Left and right flow control shutoff valves closed. Ground shutoff valve or shutoff pressure regulating valve (Citation II units 002 to 484 except 482) opens when right engine is operating.
LH	Left flow control shutoff valve opened and right flow control shutoff valve closed. Left engine supplies bleed air for air conditioning system.
NORM	Left and right flow control shutoff valves open with engines supplying bleed air for air conditioning system. Normal operating position.
BOTH HI	Left and right flow control shutoff valves open at high flow rate (Citation II units 002 to 484 except 482).
RH	Right flow control shutoff valve open and left flow control shutoff valve closed. Right engine supplies bleed air for air conditioning system.
EMER	Emergency pressurization valve open and left and right flow control shutoff valves closed. All bleed air routed into cabin for emergency pressurization.

Table 4C-1; PRESS SOURCE Switch Selection

Air Conditioning

On the ground with the PRESS SOURCE selector in the GND position, the left and right flow control shutoff valves close and the ground shutoff valve or shutoff pressure regulating valve (**Citation II units 002 to 484 except 482**) opens. Bleed air from the right engine flows through the open ground shutoff valve to the air conditioning system. On **Citation II and SII aircraft**, with the ground shutoff or shutoff pressure regulating valve open, the BLEED AIR GND HI or BLEED AIR GND annunciator illuminates.

With both engines operating and the PRESS SOURCE selector in the NORM position, the left and right flow control shutoff valves open. Engine bleed air then flows from each engine to the air conditioning system.

A bypass valve, controlled by the temperature control system, opens to bypass hot bleed air from the air cycle machine (ACM). As the bypass valve opens, more air bypasses the ACM resulting in hotter air entering the cabin and cockpit. On **Citation, Citation I, and Citation II units 002 to 484 except 482**, the bypass valve opens to bypass the primary heat exchanger. On **Citation II units 482; 485 and subsequent and Citation SII aircraft**, the bypass valve opens to bypass the ACM compressor.

Hot bleed air flowing through the primary heat exchanger partially cools before flowing to the compressor. As the rapidly spinning compressor squeezes the bleed air it heats. If the temperature of bleed air leaving the compressor reaches 435 to 450°F (224 to 232°C), a temperature sensor initiates an air conditioning system shutdown by closing the left and right flow control shutoff valves and opening the emergency pressurization valve. If temperature drops within 12 seconds, the system resets. The emergency pressurization valve closes and the flow control valves open. After 12 seconds, the system must be manually reset by the crew.

The warmer pressurized bleed air then flows to the secondary heat exchanger for the next stage of cooling. Air then flows to the ACM turbine where it rapidly expands and cools as it expends energy to turn the turbine. The turbine, in turn, drives the compressor. On **Citation, Citation I, and Citation II units 485 and subsequent, and Citation SII**, the turbine also drives a fan that draws ram air through the heat exchangers.

Cold moisture-laden air leaving the ACM turbine passes through the centrifugal water separator before it combines with hot bleed air bypassed from the air conditioning system. As the air enters the water separator, a swirling motion induced by vanes separates water from the air. The extracted water is drawn across the ACM heat exchangers to aid cooling.

Finally, the temperature controlled air enters the pressure vessel through a check valve in the aft pressure bulkhead. From this point the air flow splits to supply the overhead and underfloor air conditioning ducts.

Temperature Control

With the TEMPERATURE CONTROL knob in the AUTOMATIC range, the temperature controller responds to temperature data provided by a temperature sensor in the air conditioning duct and the overhead cabin. The controller then commands the bypass valve to open or close to increase or decrease the temperature of air entering the distribution ducts.

On **Citation, Citation I, Citation II units 482, 485 and subsequent, and Citation SII**, placing the TEMPERATURE CONTROL knob in the MANUAL position allows the crew to manually control cabin temperature by directly opening or closing the bypass valve with the MANUAL HOT/MANUAL COLD switch. Holding the switch in the MANUAL HOT position opens the bypass valve to increase cabin temperature; holding it in the MANUAL COLD position closes the bypass valve to decrease cabin temperature. When released, the switch spring-loads to the OFF position with the bypass valve remaining at its last position.

On **Citation II units 002 to 484 except 482**, placing the TEMPERATURE CONTROL SELECTOR in the manual position (toward MANUAL knob) allows the crew to manually control cabin temperature with the MANUAL knob. Rotating the knob counterclockwise closes the bypass valve to decrease air temperature. Rotating the knob clockwise opens the bypass valve to increase cabin temperature.

On **Citation II and SII**, adjusting the AIR FLOW DISTR knob between the CKPT and CABIN positions operates a motor-driven flow divider that controls air flow into the cabin armrest and foot warmer manifolds and the underfloor cockpit supply duct.

Placing the CABIN or OVHD switch in HI or LOW activates a blower that increases airflow through the overhead ducts.

Flood Cooling (Optional)

On **Citation II units 482 and 485 and subsequent; SII**, placing the FLOOD COOLING switch in the ON position energizes a blower fan and closes the normal air conditioning supply duct. Most of the conditioned air from the air conditioning system then flows through a grill in the aft pressure bulkhead. This system allows for rapid cooling of the cabin on the ground and in flight below 10,000 ft.

Ram Air Supply

A ram air scoop in the vertical stabilizer fin through a check valve supplies fresh air to the air conditioning system and the cabin. The check valve prevents cabin pressurization loss through the ram air ventilation system.

Pressurization

With the air conditioning system operating, a constant supply of pressurized air enters the cabin. The pressurization system then maintains a selected cabin climb rate, altitude, and descent rate by governing cabin pressure loss through pneumatically operated outflow valves. On the **Citation units 001 to 213**, the system has a normal outflow valve and a safety outflow valve directly controlled by the pressurization controller. On **Citation units 001 to 213 with SB 21-9, Citation I, Citation II, and SII aircraft**, the system has two outflow valves indirectly controlled by the pressurization controller through a pneumatic relay.

Safety devices built into system prevent complete loss of cabin pressurization or an excessive cabin pressure differential rate.

Depending on the aircraft, the system's 8.0 to 8.7 PSID maximum cabin pressure differential provides a comfortable cabin altitude up to the aircraft's maximum operating altitude (**see Table 4C-2**).

Aircraft	Maximum Operating Altitude	Maximum Cabin PSID
Citation 001 to 213	35,000	8.0 ±0.1
Citation 001 to 213 with SB 21-9, Citation 213 and subsequent; Citation I	41,000	8.5 ±0.1
Citation II and SII	43,000	8.7 ±0.1

Table 4C-2; Cabin Pressurization

Normal Operation

On **Citation units 001 to 213**, the instrument air vacuum source supplies control pressure for the pressurization system. On **Citation units 214 and subsequent, Citation I, II, and SII aircraft**, with an engine operating, bleed air directed through a pressure regulator and ejector supplies vacuum for operation of the pressurization system.

After setting the desired cabin climb rate and cruising altitude on the pressurization controller, the system begins pressurizing the cabin once the aircraft takes off. On the **Citation units 001 to 213**, a single squat switch controls system pressurization and depressurization as the aircraft takes off and lands. On **all other aircraft**, two 85% N_2 RPM switches and a squat switch control system pressurization and depressurization.

As the aircraft climbs to altitude, the pressurization controller responds to an imbalance created within its control chambers by commanding the outflow valves to close. As the outflow valves close, less cabin air escapes the cabin. When the aircraft reaches cruising altitude, the system maintains the selected cabin altitude by maintaining the necessary cabin pressure differential between cabin pressure and ambient pressure.

If the pressurization system fails to control the outflow valves and cabin altitude increases to 13,000 ±1,500 ft, cabin altitude limit valves overcome opening pressure to close the outflow valves.

If cabin differential pressure exceeds the normal operating value, the outflow valves open partially to release excess pressure to atmosphere.

During landing, actuation of the squat switch commands the outflow valves to open and equalize cabin pressure with ambient pressure.

Emergency Dump

Lifting the guard then moving the EMER DUMP lever up supplies vacuum to both outflow valves to open them and depressurize the cabin. With the PRESS SOURCE switch in any other position than OFF, the cabin altitude limit valves prevent cabin altitude from exceeding 13,000 ±1,500 ft.

Emergency Pressurization

If cabin altitude climbs to 10,000 ±350 ft, the CABIN ALT annunciator illuminates and the Master Warning lights flash.

If cabin altitude continues climbing, placing the PRESS SOURCE selector in the EMER position closes the left and right flow control shutoff valves, opens the emergency pressurization valve, and illuminates the EMERG PRESS ON annunciator. Hot bleed air obtained directly from the left engine flows into the distribution ducts to pressurize the cabin.

Environmental Systems

Bleed Air System

Power Source	HP bleed air from either/both engine(s)
Distribution	Air cycle machine (ACM) Automatic temperature control selector (**CII 001 to 484**) Copilot's horizon gyro (**except CII-627 and subsequent**) Door seal Engine anti-ice system Fuel system Left engine to cabin (EMER position) Pressurization controller Windshield bleed air Wing deice system (**C0/CI/CII**)
Control	Bleed air cluster valves Bleed air pressure regulator ENGINE ANTI ICE switches Lower forward door latch pin PRESS SOURCE selector SURFACE DEICE switch/ejectors W/S BLEED HI/LOW switch W/S BLEED AIR manual shutoff valves
Monitor	Gyro pressure gage Vacuum pressure gage (**C0 001 to 213**) Annunciators BLD AIR GND EMERG PRESS ON ENG ANTI FAIL LH/RH L/R PRECOOL FAIL (**CII 002 to 481, 483, and 484**) SURFACE DEICE W/S AIR O'HEAT
Protection	Circuit breakers Fail safe valves Sensors

Environmental Systems (cont.)

Air Conditioning System

Power Source	Air cycle machine (ACM) Ram air Mixing valve (bypass modulating and shutoff valve)
Distribution	Overhead duct Underfloor duct
Control	PRESS SOURCE selector Auto temp rheostat Manual temp rheostat (**CII 002 to 481, 483, and 484**) Switches DEFOG fan OVHD fan Cabin fan (**C0; CI**) FLOW DISTR selector (**CII; SII**) TEMPERATURE CONTROL SELECTOR (**C0; CI; CII 482, 485 and subsequent; SII)**
Monitor	CABIN TEMP indicator (optional) Annunciators AIR DUCT O'HEAT EMERG PRESS ON BLEED AIR GROUND (**C0; CI 001 to 469**) BLD AIR GND/HI (**CI 470 and subsequent; CII; SII**) ACM EJECTOR ON (**CII 002 to 481, 483, and 484**) ACM O'PRESS (**CII 482, 485 and subsequent; SII**)
Protection	Circuit breakers

Pressurization System

Power Source	Emergency pressurization from left engine HP bleed air from either/both engine(s)
Distribution	Emergency pressurization duct Overhead ducts Under-floor ducts
Control	Aircraft pressurization controller CABIN RATE knob Control power (28V DC and vacuum) Landing gear squat switch (left) Outflow valves PRESS SOURCE rotary selector Pressure regulator Throttles
Monitor	Annunciators ACM O'PRESS CABIN ALT 10,000 FT BLD AIR GND (**C0, CI 001 TO 469**) BLD AIR GND/HI (**C1 470 and subsequent; CII; SII**) EMERG PRESS ON CABIN ALT/DIFF PRESS indicator
Protection	Cabin altitude limit switches Circuit breakers Emergency dump valve Oxygen system Passenger oxygen system baro-sensor 10,000 ft cabin sensor