

SECTION VI ANTI-ICE & ENVIRONMENTAL

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SECTION VI

ANTI-ICE & ENVIRONMENTAL

BLEED AIR SUPPLY

Engine bleed air is used extensively for anti-icing and cabin environmental control. The source of this air is through low- and high-pressure ports on each engine compressor. High pressure (HP) or low pressure (LP) air is automatically supplied on an as-needed basis to meet pressurization requirements. The bleed air obtained from the engine's HP and LP ports is routed through shutoff and regulator valves. The bleed air is then ducted into either the anti-ice system or the Environmental Control Unit (ECU) or PACK. The PACK conditions the air for the cabin and cockpit distribution systems.

Shutoff valves and check valves are installed in the tailcone plumbing to control the bleed air from the left and right engines. In addition to the plumbing, the system includes control switches and incorporates an overheat, overpressurization and leak detection/warning system. A small amount of high-pressure bleed air is also used to pressurize the hydraulic reservoir described in Section 3, this manual.

The auxiliary power unit provides an additional bleed air source to operate the PACK when the aircraft engines are not running. The auxiliary power unit is designed for ground use only.

BLEED AIR SWITCHES

The L and R BLEED, and EMER PRESS switches, located on the PRESSURIZATION panel, control the respective left and right bleed-air shutoff valves, and the left and right emergency pressurization valves. The EMER PRESS switch is dependent on the L and R BLEED switches. Both L and R BLEED switches must be in the On position (OFF not illuminated) in order for both emergency pressurization valves to open with activation of the EMER PRESS switch. However, in the event of a L or R BLEED circuit breaker failure, it is possible to have bleed air supplied through an emergency pressurization valve of one engine and through the normal ducting of the other engine.

HP SHUTOFF VALVES

A pressure sensor within the HP ducting sends a signal to the ECS controller which drives the HP shutoff valves according to altitude and thrust lever angle.

The following CAS illumination is specific to the HP shutoff valves:

CAS	Color	Description
BLEED OVHT	Amber	Bleed air temperature in the associated (L or R) bleed air duct is excessive.

PYLON OVERHEAT

Four temperature sensors around the pylon structure provide for overheat indication.

The following CAS illumination is specific to pylon overheat detection:

CAS	Color	Description
ENG PYLON OVHT	Red	The associated (L or R) engine pylon area is overheated.

TAILCONE LEAK DETECTION

Tailcone sensing elements are installed along the ducting between the left and right high-pressure shutoff valves including the pack bi-level pressure shutoff valve, ECS pressure valves and ECS check valves. The loop-type elements detect elevated tailcone temperatures caused by a leak in the bleed-air ducting.

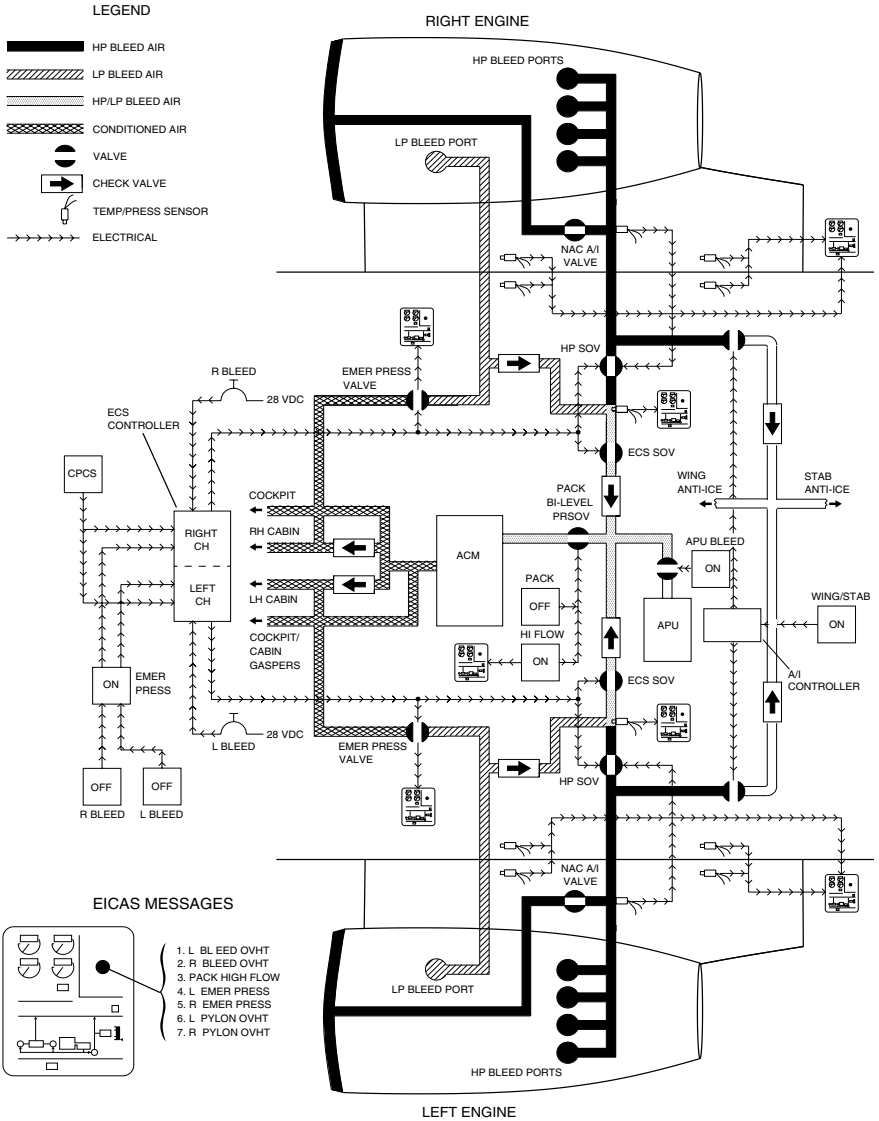
If a leak occurs between the high pressure shutoff valve and the ECS check valve, the corresponding BLEED AIR LEAK red CAS and CWP will illuminate. This CAS will also occur if a leak is detected between the ECS check valve and the pack bi-level pressure shutoff valve. The tailcone overheat detection system operates on 28-vdc supplied from the left essential bus.

The following CAS illumination is specific to tailcone overheat detection:

CAS	Color	Description
BLEED AIR LEAK	Red	A leak is detected in the associated (L or R) bleed air ducting (tailcone).



Illumination of the BLEED AIR LEAK red CAS will cause the APU to shut down.



BLEED AIR SYSTEM SCHEMATIC
Figure 6-1

ANTI-ICE SYSTEMS

Aircraft anti-ice protection is provided through the use of electrically heated and engine bleed-air heated anti-ice systems. Electrically heated systems include the pitot-static probes, total air temperature probe, engine inlet air temperature/pressure sensors, stall warning vanes, and windshields. Engine bleed air is utilized to provide anti-icing for the leading edge surfaces of the wings, horizontal stabilizer, and engine nacelle inlets. The engine fan spinners are unheated.

ICE DETECTOR SYSTEM

The ice detector system is installed to detect an icing condition and notifies the crew by illumination of the ICE DETECTED amber or white CAS described below. The ice detector system is always capable of detecting ice, provided aircraft electrical power is available. A self-test of the ice detector system is conducted every time aircraft power is turned on, and the ICE DETECT circuit breaker is engaged. The ice detector system receives 28-vdc power from the right essential bus through the 10-amp ICE DETECT circuit breaker on the copilot's circuit breaker panel (ANTI-ICE group).

The ICE DETECTED white CAS illuminates when ice is detected, the aircraft is airborne, and the following anti-icing systems are turned on:

- WING/STAB anti-ice selected ON.
- L and R NAC anti-ice selected ON and inlet pressure is present.

The ICE DETECTED amber CAS illuminates when ice is detected, the aircraft is airborne, and any of the following anti-icing systems are turned off:

- WING/STAB anti-ice selected Off,
or
- L or R NAC anti-ice selected Off.

The following CAS illuminations are specific to the ice detection system:

CAS	Color	Description
ICE DET FAIL	Amber	The ice detection system has failed.
ICE DETECTED	Amber	Ice is detected and the appropriate (left and right nacelle heat, and wing/stab heat) anti-ice systems are not turned on.
ICE DETECTED	White	Ice is detected and the appropriate (L and R nacelle heat, and wing/stab heat) anti-ice systems are turned on.

WING INSPECTION LIGHT

The wing inspection light, located on the right forward fuselage, may be used to visually inspect the right wing leading edge for ice accumulation during night operations. The light is illuminated by depressing the WING INSP momentary switch located in the LIGHTS group of the center switch panel. The light illuminates a black dot on the outboard wing leading edge to enhance visual detection of ice accumulation. Power is supplied from the R MAIN bus through the 3-amp WING INSP circuit breaker on the copilot's circuit breaker panel (LIGHTS group).

ENGINE AND NACELLE INLET ANTI-ICE

The engine and nacelle inlet anti-ice system provides anti-ice protection for the nacelle inlets and the engine inlet air pressure/temperature sensors. The engine inlets are anti-iced by directing engine bleed air through piccolo tubes to the inner surfaces of the nacelle inlet lip. After circulating around the inlet lip, excess bleed air is vented overboard through a hose at the bottom of the nacelle lip. The engine inlet air pressure/temperature sensors are anti-iced by integral heating elements whenever the respective L or R NAC anti-icing system is selected ON.

Each engine and nacelle anti-ice system consists of a bleed air duct, a nacelle anti-ice pressure switch, a nacelle anti-ice pressure regulating shutoff valve and a nacelle anti-ice switch. All anti-ice systems require electrical power to operate except the engine nacelle inlet heating systems which fail on when electrical power is not available to the respective nacelle anti-ice pressure regulating shutoff valve. Electrical power is provided from the L and R MAIN buses through the respective NAC circuit breakers located within the ANTI-ICE group [L and R HEAT] on the pilot's and copilot's circuit breaker panels.

System activation is indicated by a NAC green EI illuminated next to each engine ITT display. This illumination indicates that the respective L or R NAC switches are ON and that adequate bleed air pressure is being supplied to each nacelle lip.

An amber NAC illumination indicates that the respective L or R NAC switches are on with inadequate bleed air pressure being supplied to the nacelle lip or a circuitry fault to the pressure/temperature sensor. This EI will be accompanied by the L or R NAC HT amber CAS. If bleed air pressure of 6.5 psi or greater is sensed at the nacelle anti-ice shutoff valve with the L or R NAC switches off, the NAC amber EI will be accompanied by the respective L or R NAC HT FAIL ON amber CAS.

The following CAS illuminations are specific to the nacelle inlet anti-ice system:

CAS	Color	Description
NAC HT	Amber	<ul style="list-style-type: none"> - The associated (L or R) nacelle heat system is turned on, but the bleed air pressure to the nacelle is low. <li style="text-align: center;">or - The associated (L or R) nacelle heat system is turned on, but the PT₂ heater is failed.
NAC HT FAIL ON	Amber	The associated nacelle heat system is turned off, but bleed air pressure is still present at the nacelle.

WING/STAB ANTI-ICE SYSTEM

The wing/stab anti-ice system utilizes high pressure (HP) bleed air directed through piccolo (diffuser) tubes in the leading edge of the wing and horizontal stabilizer. The bleed air used to warm the wing is then vented through the inboard wing boxes. The bleed air used to heat the stabilizer is vented overboard at the outboard ends of the stabilizer.

System components consist of the piccolo tubes, anti-ice Pressure Regulating Shutoff Valves (PRSOVs), anti-ice check valves, WING/STAB ON/off switch, wing temperature control and under/overheat sensors, electrical circuitry, and inputs from the integrated ECS temperature controller.

As the bleed air transfers to the piccolo tubes, it is routed through the pylon, into the tailcone, through a pressure regulating shutoff valve and modulating valve, a check valve, and into a common manifold. From the manifold, the wing supply duct branches forward and the horizontal stabilizer supply branches aft to the piccolo tubes. Check valves are provided to prevent bleed air cross flow from one source to the other, thus providing pneumatic isolation of the two bleed air sources.

The wing/stab anti-ice system is activated by selecting the WING/STAB switch located in the ANTI-ICE panel to ON. Electrical power is provided from the L and R MAIN buses through the respective circuit breakers located within the ANTI-ICE group [L or R WING/STAB HT] on the pilot's and copilot's circuit breaker panels. When activated, both anti-ice PRSOVs are energized open. The system controller then uses single control channels for each side to provide automatic control of the airplane wing and stabilizer leading edge skin temperature.

Each wing is continuously monitored by a wing temperature control sensor. The sensor supplies wing skin temperature information to a system controller. The controller then regulates the amount of HP bleed air allowed in the system by modulating the PRSOVs on each side to maintain the colder of the two wings at the established temperature. Under/overheat sensors also monitor wing and horizontal stabilizer temperatures and provide under/overheat signals to the controller.

Should the temperature exceed the established high value on any leading-edge surface, the sensors will trigger respective WING OVHT, STAB OVHT, or WING/STAB OVHT red CAS/CWP regardless of anti-ice systems being on or off. These CAS/CWP will extinguish once the leading edge temperature drops into the normal range.

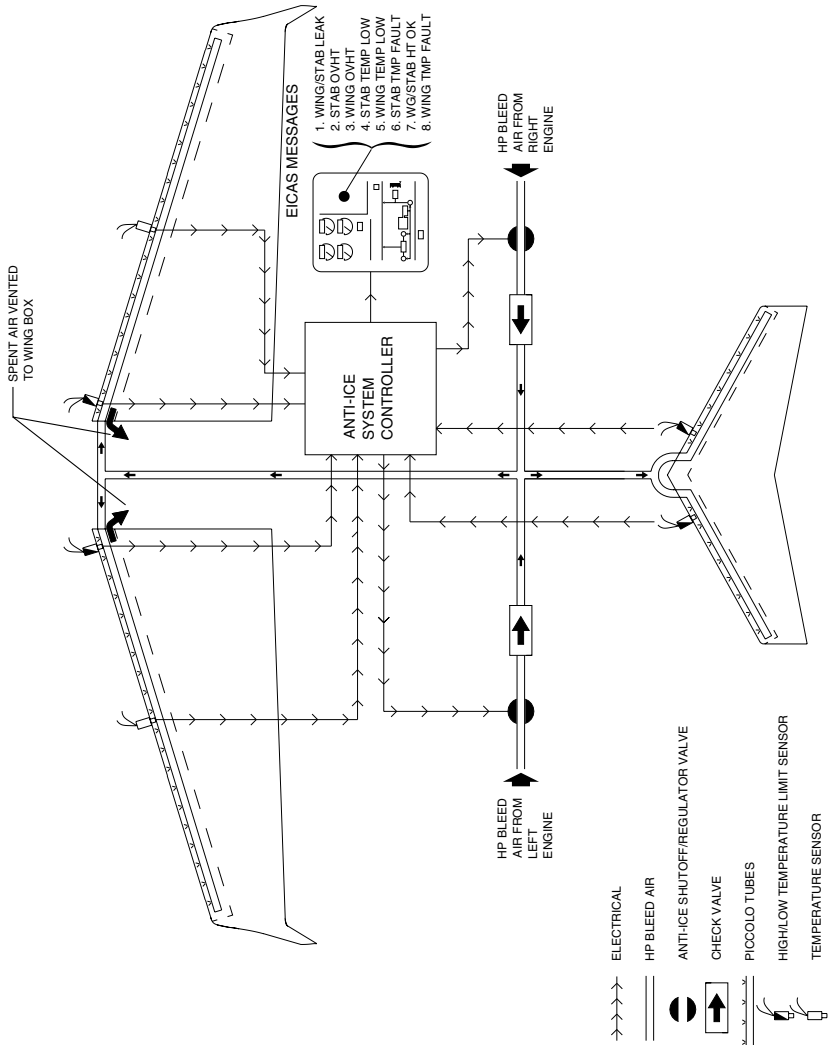
Should the temperature drop below the established low value on any leading-edge surface with anti-ice systems on, the sensors will trigger respective WING TEMP LOW or STAB TEMP LOW amber CAS. These CAS will extinguish once the leading edge temperature reaches the normal range.

Faults within the overheat/underheat sensors are indicated by illumination of the corresponding WING TMP FAULT and/or STAB TMP FAULT white CAS, and a WING and/or STAB TEMP LOW amber CAS with the system On.

The following CAS illuminations are specific to the wing/stab anti-ice system:

CAS	Color	Description
STAB OVHT	Red	The horizontal stabilizer leading edge is overheated.
WING/STAB LEAK	Red	A leak is detected in the ducting which supplies bleed air to the wing/stabilizer heat system.
WING OVHT	Red	The wing leading edge is overheated.
STAB TEMP LOW	Amber	Stabilizer heat is turned on, but the horizontal stabilizer leading edge temperature is too low for effective anti-icing.
WING TEMP LOW	Amber	Wing heat is turned on, but the wing leading edge temperature is too low for effective anti-icing.

CAS	Color	Description
STAB TMP FAULT	White	- A horizontal stabilizer temperature sensor has failed. or - The horizontal stabilizer high or low temperature sensor is invalid.
WING TMP FAULT	White	- A wing temperature sensor has failed. or - The wing high or low temperature sensor is invalid.
WG/STAB HT OK	White	The wing/stabilizer heat system checks OK.



WING/STAB ANTI-ICE SYSTEM SCHEMATIC
Figure 6-2

WINDSHIELD DEFOG AND ICE PROTECTION

Windshield defogging and ice protection is accomplished using electrically heated windshield panels. The system is designed so that if desired, it may be activated before takeoff and remain on until shutdown. The system is comprised of two windshield panels with integral heaters, dual-channel windshield heat control unit, system switches, engine driven alternators and associated aircraft wiring.

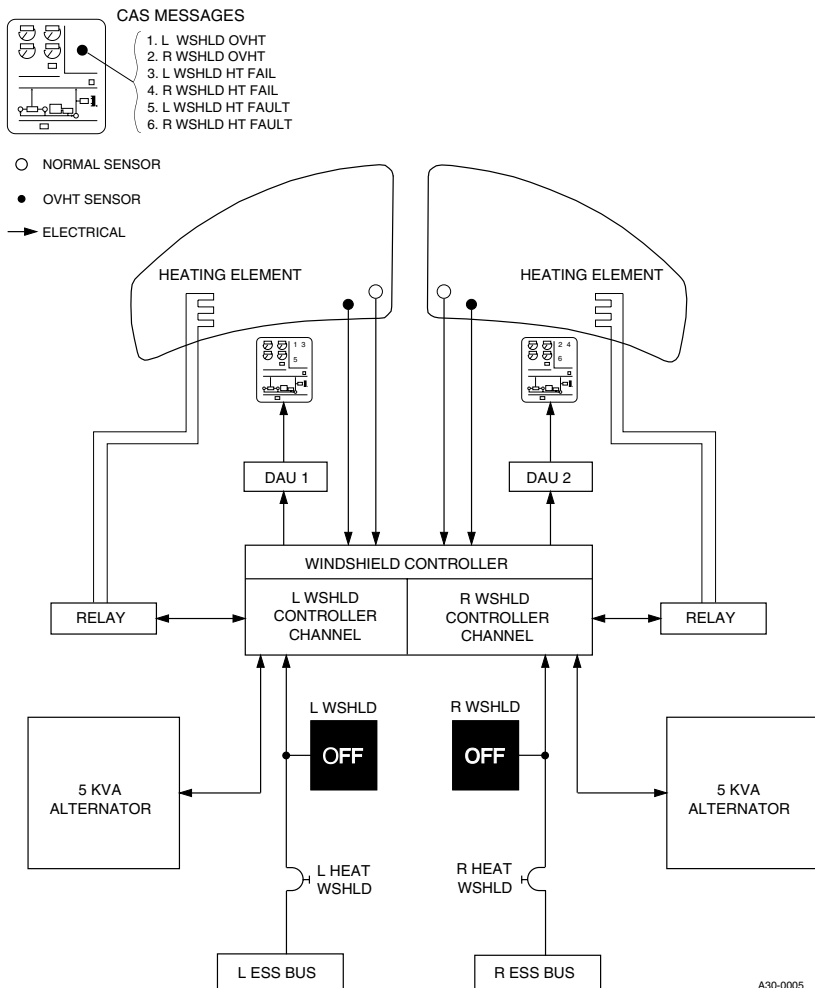
The same windshield panels are used for defogging and ice protection. The dual-channel windshield heat control unit automatically regulates windshield temperatures to preclude the formation of external ice and internal windshield surface condensation (fogging). Separate L and R WSHLD switches and power supplies provide for system redundancy.

Each system utilizes the 200-vac output from an alternator on its respective engine to power the integral heaters. The control circuit receives 28-vdc through the 5-amp WSHLD circuit breakers located within the ANTI-ICE group [L and R HEAT] on the pilot's and copilot's circuit breaker panels.

During normal operation the controller regulates the output of the alternators to maintain the desired windshield temperature. If there is a fault in the circuitry for normal operation, the system can continue to operate in a degraded mode. In the degraded mode the output of the alternator is no longer modulated and the controller cycles power full to the windshield. The controller continues to cycle power on and off to control operation when functioning in the degraded mode.

The following CAS illuminations are specific to the windshield defog and ice protection systems:

CAS	Color	Description
WSHLD HT FAIL	Amber	The associated (L or R) windshield heat system is on, but the windshield temperature is too low for effective anti-icing.
WSHLD OVHT	Amber	The associated (L or R) windshield is overheated.
WSHLD HT FAULT	White	The associated (L or R) windshield heat system is operating but in a degraded mode.



WINDSHIELD ANTI-ICE SCHEMATIC
Figure 6-3

BAGGAGE COMPARTMENT HEATING SYSTEM

The tailcone baggage compartment features a heating system to prevent the unpressurized compartment from freezing. An ON/OFF switch located in the ceiling of the compartment provides for control. Once the system switch has been turned ON before flight, operation of the system is fully automatic and requires no crew regulation or monitoring. Baggage compartment heat is available for both ground and in-flight operations.

Heating is provided through electrical blanket heaters installed on the left, right and bottom sides of the tailcone baggage compartment. Two temperature sensors enable and disable the blanket heaters. The heaters will not activate unless the temperature falls below the established low value and will deactivate when the temperature reaches the established high value. The heaters are self-regulating whereby power consumption is reduced as temperature increases.

The baggage compartment heaters are powered by 28-vdc through the R NON-ESS bus. A baggage heat circuit breaker is located on the aft left power distribution panel within the tailcone.

ENVIRONMENTAL CONTROL SYSTEM (ECS)

The environmental control systems provide:

- conditioned air to the passenger and crew compartments for normal ventilation and pressurization,
- unconditioned air for emergency pressurization, and
- temperature control of passenger and crew compartments.

ECS CONTROLLER

A dual channel ECS controller provides the circuitry required to operate the ECS valves, HP shutoff valves and the emergency pressurization valves. The left and right channels independently control their respective shutoff valves. The controller receives and monitors signals from pressure sensors, the cabin pressurization controller, thrust lever angle, L and R BLEED switch positions and EMER PRESS switch position.

The ECS controller channels are powered by 28-vdc from the respective L and R essential buses through the L and R BLEED circuit breakers located in their respective pilot and copilot circuit breaker panels (ENVIRONMENTAL/ENVIR group).

ECS SHUTOFF VALVE

Normally during flight the ECS shutoff valves will be de-energized open. When a L or R BLEED switch is set to OFF, the respective ECS shutoff valve will be energized to the closed position. When the L and R BLEED switches are On and the EMER PRESS switch is activated, the bleed air shutoff valves will close and the emergency pressurization valves will be energized open and the HP bleed air will be shut off. The ECS shutoff valves will close automatically whenever emergency pressurization or a fire switch (respective ENGINE panel) is activated.

ENVIRONMENTAL CONTROL UNIT (ECU) OR PACK

The ECU or PACK consists of a precooler, primary and secondary heat exchangers, an Air Cycle Machine (ACM), and various pneumatic control valves and sensors. System control is accomplished by the Pressure Regulating Shutoff Valve (PRSOV). A water separator is installed to reduce humidity of the discharged air.

PRECOOLER AND HEAT EXCHANGERS

Ram air from a PACK air scoop is used to provide the cooling media for the precooler, primary and secondary heat exchangers. In the absence of ram air (ground operations), a fan wheel within the air cycle machine is used to create airflow across the precooler and heat exchangers.

AIR CYCLE MACHINE (ACM)

An Air Cycle Machine (ACM) is used to refrigerate bleed air, providing a source of cool air. The ACM is a three-wheel (fan, compressor, and cooling turbine) unit installed in the tailcone. Bleed air from the aircraft engines is first cooled by a precooler, then the amount of air is regulated by the PRSOV before being admitted into the ACM. The ACM then cools the bleed air further with the primary heat exchanger before compressing it in its compressor section. After the bleed air is compressed, heat is again extracted with a secondary heat exchanger before entering the turbine section of the machine. Additional heat is extracted from the compressed air by converting some of its heat energy to work (driving the cooling turbine) and rapid expansion of the air as it exits the turbine. This refrigerated air is passed through a water separator to remove the water before being supplied to the cabin and crew air distribution systems.

ACM BYPASS VALVE

When pressure at the compressor inlet exceeds the pressure at the compressor outlet, airflow is permitted around the compressor section through the ACM bypass check valve. This prevents the compressor from restricting airflow during operation of the ACM at low speeds.

LOW LIMIT TEMPERATURE SENSOR

A temperature sensor, at the water separator outlet, is used to modulate an anti-ice modulating valve. The anti-ice modulating valve is incorporated into the ACM to maintain a constant outlet temperature and prevent icing at the turbine outlet. To accomplish this, the anti-ice modulating valve mixes warm bleed air with the cooling turbine discharge air to produce the desired temperature.

PACK OVERTEMP SENSOR

Overheat conditions of the ACM are monitored by the pack overtemp sensor. The pack overtemp sensor, mounted downstream of the ACM compressor discharge, will illuminate the PACK OVHT amber CAS when the temperature has exceeded 450° F (212° C).

The following CAS illumination is specific to pack overheat detection:

CAS	Color	Description
PACK OVHT	Amber	Compressor discharge air temperature (air conditioning pack) is excessive.

AIR CYCLE MACHINE CONTROLS

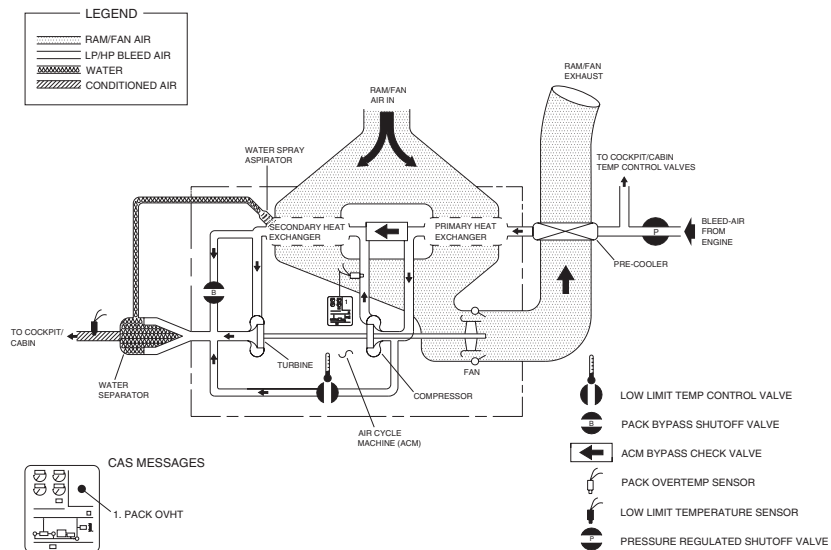
Control of the air cycle machine is through the use of the PACK and HI FLOW switches located on the PRESSURIZATION panel. These switches control the Pressure Regulating Shutoff Valve (PRSOV). The PRSOV controls inlet air to either 18 (normal) or 26 (HI FLOW) psig. The air cycle machine is always On (not illuminated) for normal operations.

PACK Switch — When set to OFF (illuminated), the bleed air supply to the ACM is shut off (PRSOV closed). When set to On (not illuminated), bleed air is allowed to pass through the ACM and enter the air distribution system at 18 psig.

HI FLOW Switch — When set to ON (illuminated), the bleed air coming out of the ACM compressor section must pass through the cooling turbine and enter the air distribution system at 26 psig.

The following CAS illuminations are specific to PACK control:

CAS	Color	Description
ECS FAIL	Amber	Both channels of the Pack has failed.
ECS FAULT	Amber or White	A fault has been detected in the appropriate (L or R ECS) channel of the ECS controller (Amber on the ground or White during flight.)
PACK HIGH FLOW	White	HI FLOW is selected on the air conditioning pack.



AIR CYCLE MACHINE SYSTEM SCHEMATIC

Figure 6-4

TEMPERATURE CONTROL SYSTEM

The temperature of the environmental air is controlled by mixing bleed air upstream of the air cycle machine with refrigerated air downstream of the air cycle machine. The resulting conditioned air is ducted into the cabin and cockpit. Separate controls are provided for the cockpit and cabin creating two temperature zones. Each temperature control system consists of a temperature control valve, torque motor, temperature controller, duct temperature sensor, air temperature sensor, and a COLD-HOT selector. A MANUAL TEMP switch allows the temperature control valves to be operated manually by rotation of the temperature selector knobs.

Temperature control valve position, thus, temperature regulation, is pneumatically controlled by the electrically operated temperature control system. During normal operation, the respective system temperature controller will automatically maintain the temperature set with the (COCKPIT or CABIN) COLD-HOT selector on the ENVIRONMENTAL CONTROL panel. The controllers maintain the selected temperature by comparing input signals from various temperature sensors and then electrically controlling the torque motors that provide pneumatic pressure (servo air) to the temperature control valves. The cockpit and cabin air temperature sensors have small blowers that draw air past the sensing elements to assure rapid sensing of temperature changes. Whenever the MANUAL TEMP switch is ON, the respective temperature control valve will respond directly to movement of the (COCKPIT or CABIN) COLD-HOT selector.

Each system has duct temperature sensors and limiters to provide for duct temperature indication and protection. The temperature sensors signal the ECS integrated controller of temperature information during normal operation. Temperature is displayed on the ECS page as digital CAB and CKPT indications.

If excessively high temperatures are reached in the cabin or cockpit supply duct, the overtemp limiter will signal the ECS integrated controller to close the respective cabin or cockpit temperature control valve. In this event, a CAB DUCT OVHT or CKPT DUCT OVHT amber CAS will illuminate. These CAS are primarily for protection during emergency pressurization (EMER PRESS) operation.

Electrical power for the temperature control system is 28-vdc supplied by the R MAIN bus for the automatic mode or the R essential bus for the manual mode. Power is supplied through the respective 1-amp AUTO or MAN circuit breaker located on the copilot's ENVIR panel (TEMP CTRL group). In the event power is lost to the right main and essential buses, the temperature control valves will fail to the full closed (cold) position.

The following CAS illuminations are specific to duct overheat detection:

CAS	Color	Description
CAB DUCT OVHT	Amber	Temperature of the cabin bleed air distribution duct has exceeded the system limit.
CKPT DUCT OVHT	Amber	Temperature of the cockpit bleed air distribution duct has exceeded the system limit.

TEMPERATURE CONTROL VALVES

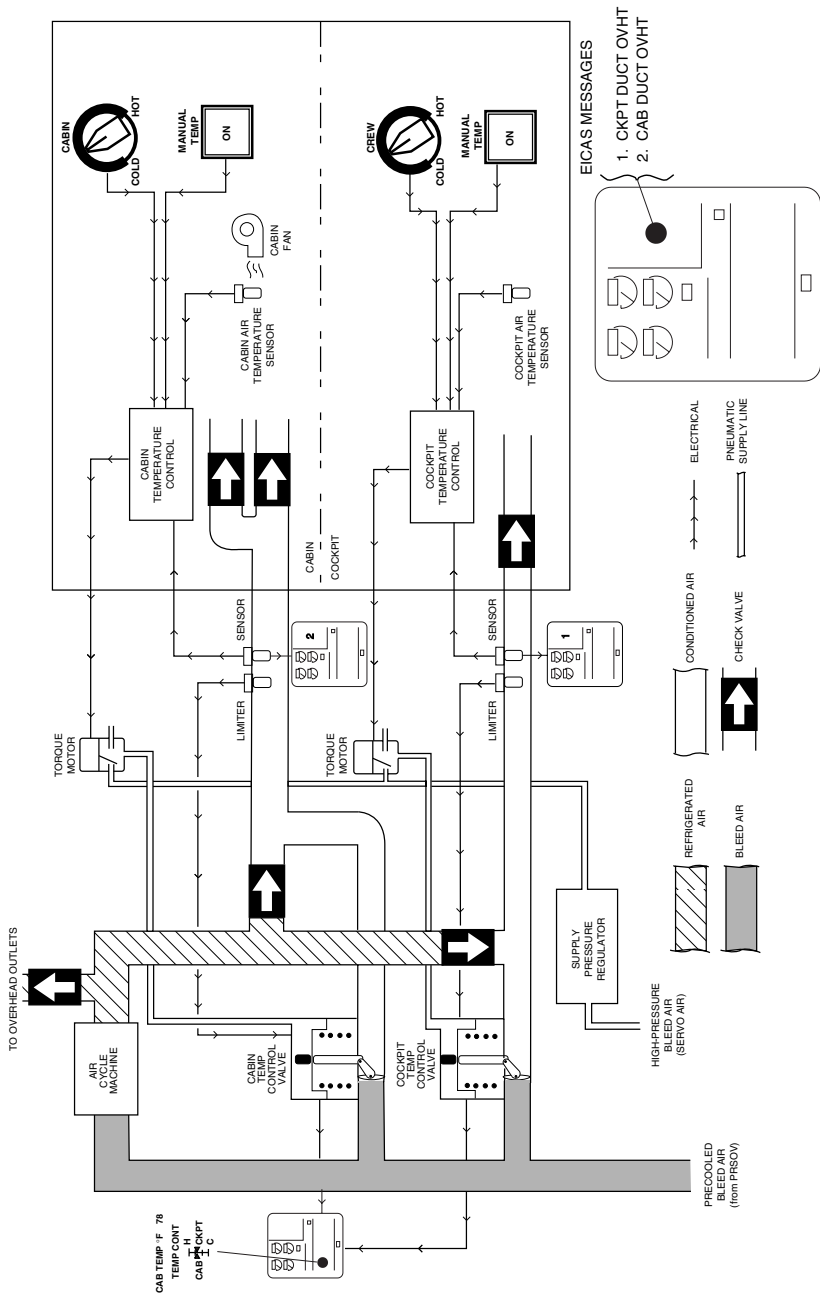
The temperature control valves are pneumatically operated. Regulated high-pressure bleed air is used to provide the required pneumatic pressure (servo air). The APU will provide servo air when it is being used to run the air cycle machine. The valves are spring-loaded closed and opened with pneumatic pressure. Valve position is controlled by varying the pneumatic pressure with a torque motor.

MANUAL TEMP SWITCH

The MANUAL TEMP switch allows the temperature control valves to be operated manually by rotation of the respective COLD-HOT temperature selector knob.

CREW AND CABIN COLD-HOT SELECTORS

A COCKPIT TEMPERATURE COLD-HOT and a CABIN TEMPERATURE COLD-HOT selector are located on the ENVIRONMENTAL CONTROL panel. During normal operation, these selectors are used to select the desired system temperature to be maintained automatically by the temperature controllers. In MANUAL TEMP mode (ON illuminated), these rheostat-type selectors directly vary the current input to the pneumatic torque motors which position the temperature control valves. Rotating the selectors clockwise from COLD to HOT is equivalent to selecting temperatures ranging from 60° F (16° C) to 90° F (32° C).

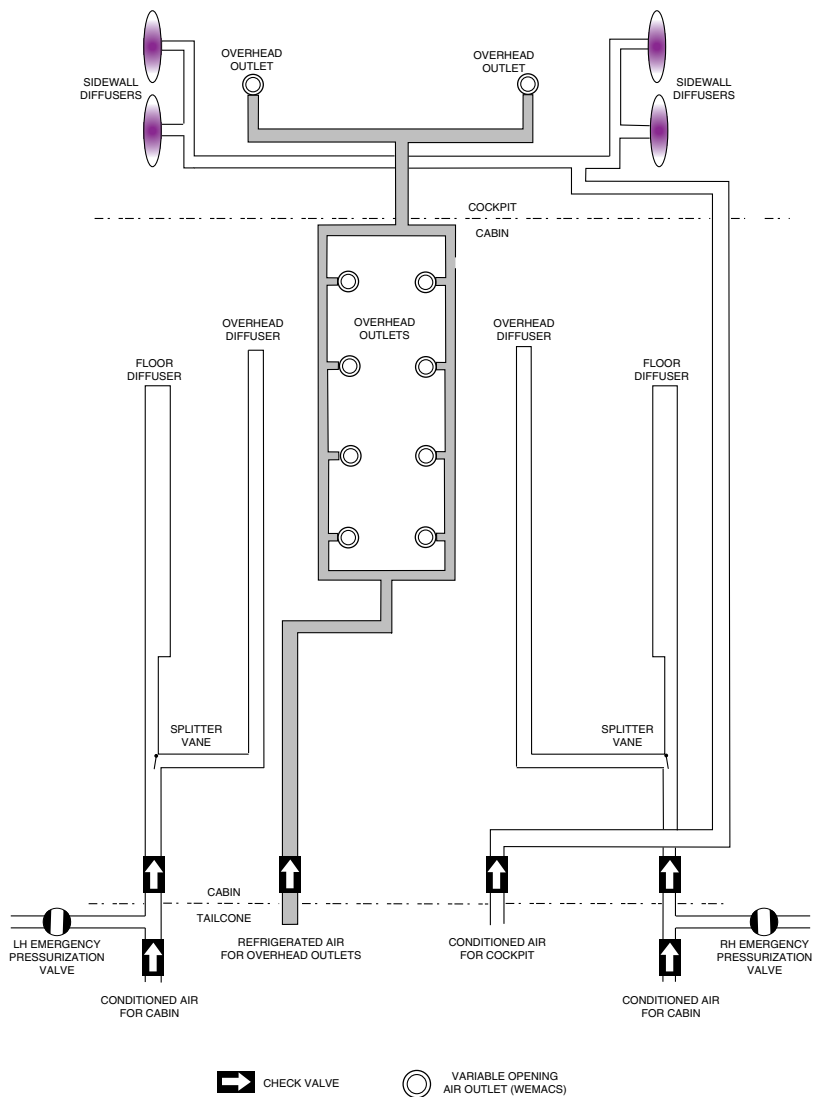


TEMPERATURE CONTROL SCHEMATIC
Figure 6-5

AIR DISTRIBUTION

Conditioned air enters the cabin through three separate ducts. Two ducts supply air to the floor and overhead diffusers. The third duct supplies air to the sidewall diffusers. Crew and passengers may regulate the gasper air by opening or closing the individual outlets.

The environmental control system will automatically divert some of the air from the overhead diffusers to the floor diffusers. This flow splitting is accomplished by a temperature activated splitter vane which diverts the majority of the flow to the floor diffusers during heating mode, and allows the majority of the flow to the overhead diffuser during cooling mode. This feature minimizes vertical air stratification in the cabin and provides for more efficient cabin heating.



COCKPIT/CABIN AIR DISTRIBUTION SCHEMATIC
Figure 6-6

OXYGEN SYSTEM

The aircraft oxygen system provides oxygen service for the crew and passengers. The system consists of the crew and passenger distribution systems, and a high-pressure oxygen storage system. Electrical power to operate the passenger oxygen system is supplied by the EMER BATT bus through a 2-amp PAX OXY circuit breaker located on the pilot's circuit breaker panel (ENVIRONMENTAL group).

Oxygen is available to the crew at all times and can be made available to the passengers either automatically above 14,500 (± 250) feet cabin altitude, or manually at all altitudes through the use of the DEPLOY switch located on the copilot's PAX OXYGEN panel. The oxygen system is designed for use during emergency descent to a cabin altitude not requiring oxygen, and is not to be used for extended periods of flight at cabin altitudes requiring oxygen (Refer to oxygen duration chart, Section IV of the AFM) or as a substitute for the normal pressurization system. An optional altitude compensating regulator is available for extended oxygen duration. Smoking is prohibited when oxygen is in use.

OXYGEN STORAGE AND PRESSURE REGULATION

The high-pressure oxygen storage system consists of a storage cylinder, a shutoff valve and regulating assembly, a direct reading pressure gauge and service valve attached to the regulator, an overpressure burst disk and indicator, a combined pressure/temperature transducer for EICAS display, and a solenoid operated passenger oxygen valve with an integral system pressure switch. *On aircraft modified by SB 45-12-1 (Installation of Remote Oxygen Servicing Provisions)*, a remote service valve and gauge are installed allowing service through the nose access door.

The oxygen storage cylinder has a minimum storage capacity of 645 liters of oxygen at 70° F (21° C) when charged to 1850 psi. The cylinder is located in the nose compartment, or may be installed in the lavatory within a left closeout. The shutoff and pressure regulator assembly form an integral part of the storage cylinder and provide for pressure regulation, pressure/temperature indication, and servicing.

Oxygen pressure for the passenger and crew distribution systems is regulated to a pressure of 60 to 80 psi. The shutoff and pressure regulator assembly also incorporates a burst disc pressure relief valve to discharge the oxygen cylinder contents overboard in the event that cylinder pressure reaches 2500 to 2775 psi. Should the cylinder contents be discharged overboard, the green overboard discharge indicator on the outside surface of the aircraft near the storage cylinder will be ruptured or missing, and the EICAS pressure display will illuminate amber dashes.

The oxygen pressure gauge is located near the service port. The pressure/temperature transducer will provide pressure and temperature signals to the EICAS. *On aircraft modified by SB 45-12-1*, this transducer also provides information to the oxygen servicing pressure gauge. Temperature and pressure signals are input to the temperature compensated pressure warning system in EICAS to alert the crew of low or high oxygen quantity.

A pressure switch, integral with the oxygen control valve, will provide a signal to EICAS indicating when the regulator is off. The system pressure distribution line is vented when the regulator is in the OFF position, thus preventing trapped pressure in the line from giving an erroneous indication that oxygen is available.

The following CAS illuminations are specific to oxygen pressure:

CAS	Color	Description
OXYGEN OFF	Amber	The oxygen line pressure is low (i.e., bottle regulator is off or oxygen supply is depleted).
OXYGEN PRESS HI	Amber	Oxygen bottle quantity is not within the normal range (too high).
OXYGEN QTY LOW	Amber	Oxygen bottle quantity is not within the normal range (too low).

OXYGEN SYSTEM COCKPIT CONTROLS

The oxygen system cockpit controls consist of two switches located on the copilot's PAX OXYGEN panel. The PAX OXY / AUTO switch automatically controls oxygen availability to the passenger oxygen distribution system. The DEPLOY switch provides manual activation. Oxygen is available to the crew oxygen distribution system at all times when the oxygen cylinder shutoff valve is open. Control positions and system functions are as follows:

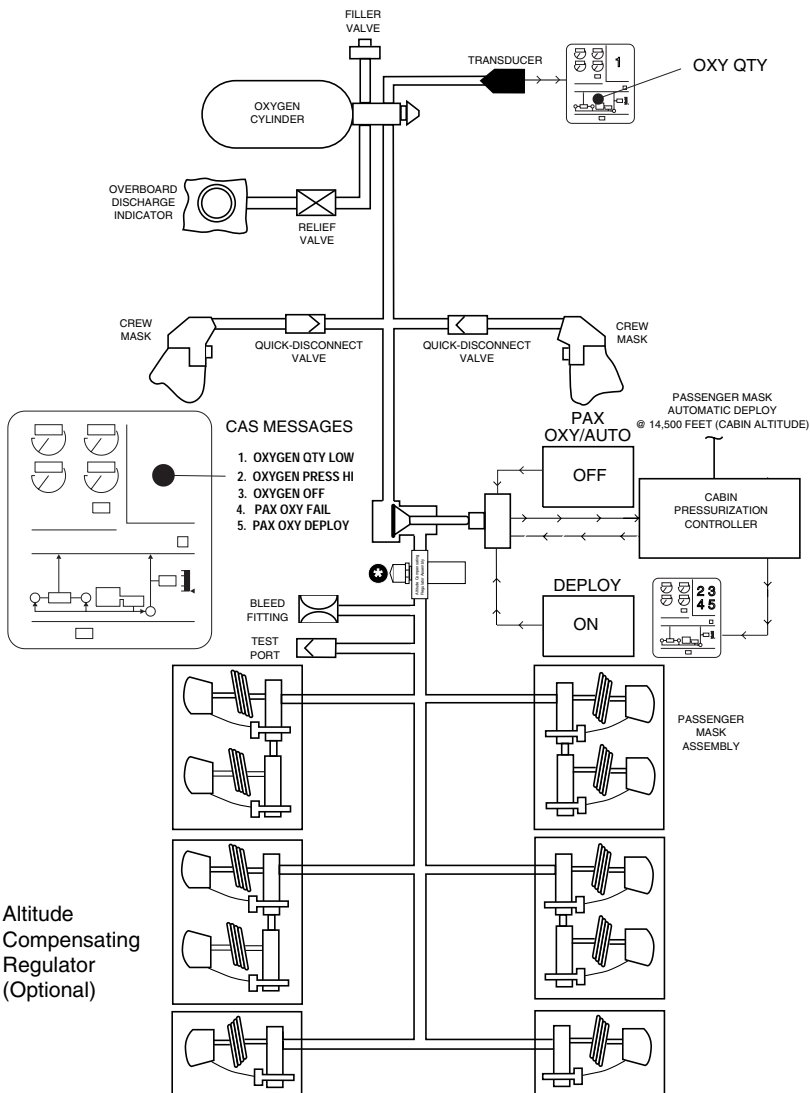
1. With the PAX OXY/AUTO switch On (OFF not illuminated), oxygen is available to the passenger distribution system and the passenger masks will deploy automatically in the event cabin altitude climbs to 14,500 feet. Should the cabin altitude reach 14,500 (± 250) feet, an electrical signal from the pressurization indicator will cause the solenoid valve (integral with the passenger oxygen valve) to open, the passenger oxygen masks will deploy, and the cabin overhead lights will illuminate to provide maximum visibility for donning masks. This is the normal position of the switch.

2. With the DEPLOY switch ON, oxygen is available to the passenger distribution system and the passenger masks will deploy. Activation of the DEPLOY switch will manually open the passenger oxygen valve and allow oxygen pressure to deploy the passenger masks. This position can be used to deploy the passenger masks at any cabin altitude. During automatic deployment of the masks, ON will illuminate.

3. With the PAX OXY/AUTO valve in the OFF position, oxygen will not be automatically made available to the passenger distribution system regardless of cabin altitude. This position can be used when oxygen is required for the crew members only.

The following CAS illuminations are specific to passenger oxygen valve operation:

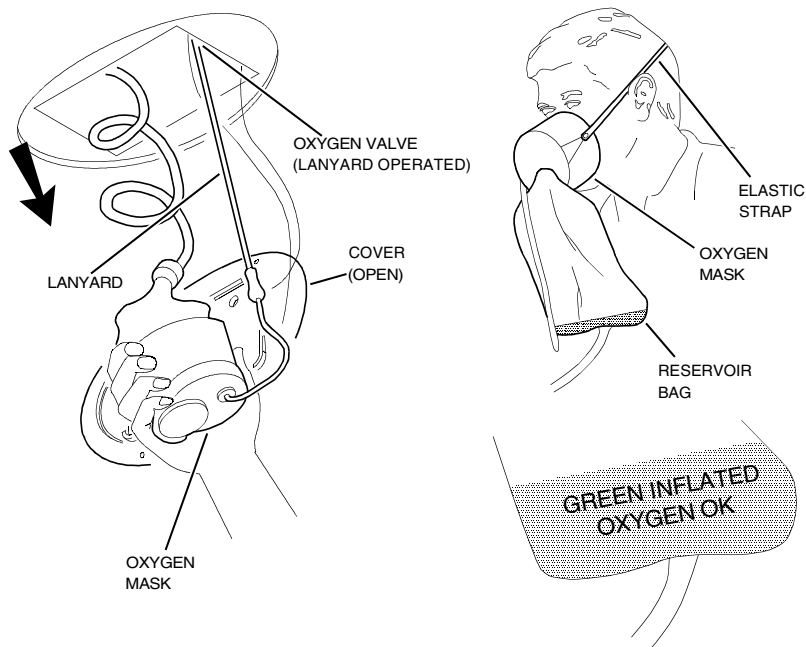
CAS	Color	Description
PAX OXY FAIL	Amber	A failure of the passenger oxygen valve is detected. Passenger oxygen mask deployment may not be possible.
PAX OXY DEPLOY	White	The passenger oxygen valve is activated (auto or manual) causing the passenger oxygen masks to deploy.



OXYGEN SYSTEM SCHEMATIC
Figure 6-7

PASSENGER MASKS

The passenger oxygen masks are stowed in the headliner above the passenger seats. Whenever the compartment doors open automatically or manually the passenger oxygen masks will fall free and oxygen will be available for passenger use. The reservoir bag incorporates a green-colored chamber which will inflate when oxygen is flowing to the mask. Passengers should don masks and pull the mask lanyard to initiate oxygen flow. An orifice incorporated in the mask tubing connections will provide a constant flow rate of 4.5 liters per minute. The compartment covers can be opened manually for mask cleaning and servicing per Maintenance Manual instructions.

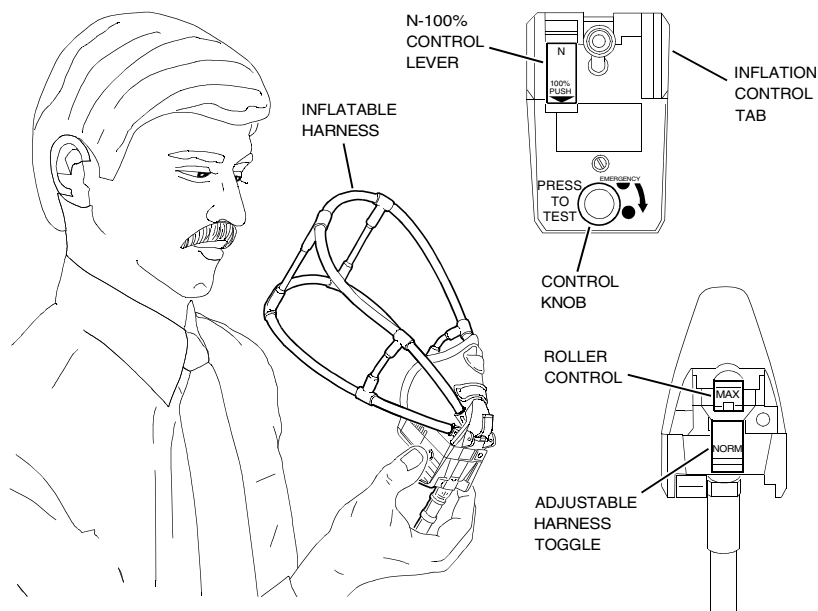


PASSENGER MASK
Figure 6-8

CREW MASKS

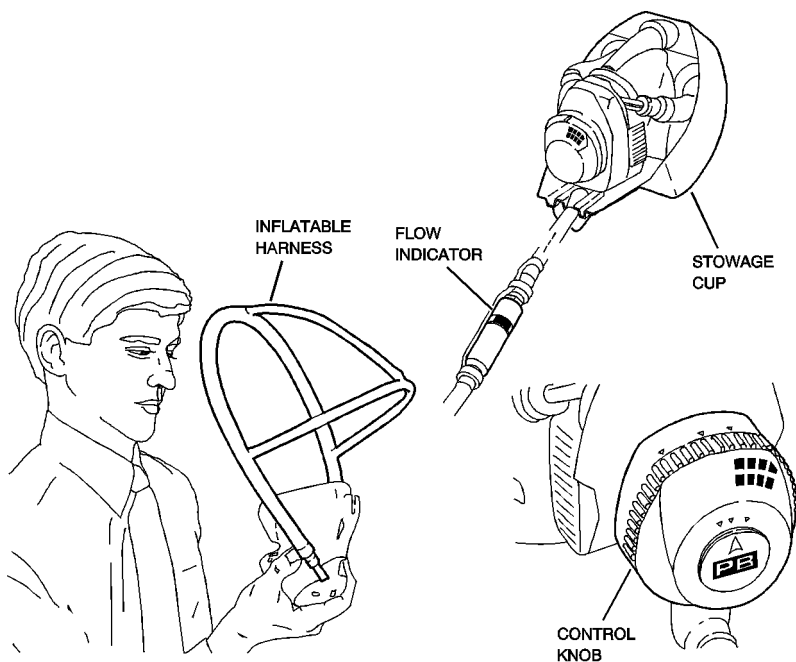
The flight crew oxygen masks are stowed in accessible stowage cups over each crew member's outboard shoulder, two models of pneumatic harness oxygen crew mask are available. The mask can be donned and functioning within 5 seconds by using one hand (refer to the Airplane Flight Manual for detailed operation procedures). The Puritan-Bennett model contains a mask mounted automatic diluter-demand regulator with single knob mode control (NORM - 100% - EMER). A purge valve will automatically bias open when the mask is used in conjunction with smoke goggles, the EMER position can be used to quickly purge the goggles of smoke. The EROS model, also with a mask mounted regulator, has the controls on the lower side of the regulator. A red control lever (N-100%) on the forward side and a red control knob with a normal (☐) and an emergency (●) setting for controlling oxygen supply. The purge valve is manually opened on this model.

To use the mask, the crew member grasps the mask and pulls it from the stowage cup. Holding the mask harness inflated, don the mask, when the mask is in position release the inflation control to allow the mask to adjust into position. Adjust mask as necessary for comfort.



CREW MASKS (EROS)
Figure 6-9

A "comfort control" feature (if applicable) allows the tension in the harness to be adjusted by adding or reducing the amount of pressure in the harness. The EROS mask is manually controlled and in an emergency, the adjustable harness toggle must be switched to the NORM position to deflate the harness to full tension. On the Puritan-Bennett mask, a built-in altitude sensing aneroid automatically deflates the harness assembly (tightest setting), before cabin altitude reaches 15,000 feet.



CREW MASKS
(Puritan-Bennett)
Figure 6-10

PRESSURIZATION SYSTEM

Cabin pressurization is provided by conditioned air entering the cabin through the air distribution ducts and controlled by modulating the amount of air exhausted from the cabin. The Cabin Pressure Control System (CPCS) regulates the exhausted air at a rate that sets the cabin altitude.

CABIN PRESSURE CONTROL SYSTEM (CPCS)

The dual channel CPCS consists of a primary outflow valve, secondary outflow valve, jet pump, air filter, check valve and Cabin Pressurization Controller (CPC). The dual channel CPCS uses a primary and secondary channel. Both channels function the same and are capable of performing all operations required for automatic cabin pressurization.

The primary channel controls the primary outflow valve and the secondary channel controls the secondary outflow valve. A pressurization vacuum jet pump supplies servo pressure to both primary and secondary outflow valves during normal pressurization. An air filter and check valve prevent contaminated or overheated bleed air from entering the primary outflow valve.

GROUND MODE

To prevent possible injury resulting from closing or opening the cabin door with the aircraft partially pressurized, the outflow valves are fully open when the CPC is in ground mode. The CPC remains in ground mode until any of the following occurs:

- The left thrust lever is advanced for takeoff (T/O detent).
- The main gear weight-on-wheels switches indicate the aircraft is airborne.
- Airspeed is greater than 150 knots when transitioning to climb mode.
- Airspeed is less than 65 knots when transitioning from any mode but climb.

CABIN PRESSURE CONTROLLER (CPC)

The CPC is located on the copilot's PRESSURIZATION panel. This panel provides all the necessary crew interface with the pressurization system. The CPC contains two cabin pressure sensors (one for each channel), a liquid crystal display, LDG ALT selector and MANUAL rate control knobs.

Signals generated by the CPC are used to activate the altitude warning voice, the EICAS altitude warning, the emergency pressurization system, the oxygen system and the ACM (air cycle machine) bypass valve. Operating power for the primary (left) and secondary (right) channels of the cabin pressure controller is 28-vdc supplied through the 2-amp PRI and SEC circuit breakers on the respective pilot's and copilot's circuit breaker panels.

The following CAS illuminations are specific to cabin pressure controller system:

CAS	Color	Description
CAB DELTA P	Amber	Cabin differential pressure limit (either positive or negative) is exceeded.
CAB PRESS FAIL	Amber	Both channels (L and R) of the cabin pressurization control system have failed. System pressurization will go to maximum differential pressure and cabin pressurization displays will become amber dashes.
CAB PRESS MAN	Amber	Cabin pressurization has reverted to manual rate mode because of the loss of all air data input (dual ADC failure).
CAB PRESS FAIL	White	Associated channel (L or R) of the cabin pressurization control system has failed. System operation will automatically switch to the opposite channel.
CAB PRESS MAN	White	Cabin pressurization manual rate mode is selected by the crew.

EMERGENCY PRESSURIZATION

In the event of normal cabin airflow malfunction, emergency pressurization is provided by routing LP bleed air directly into the cabin through the emergency pressurization valves. The L and R BLEED switches need to be ON for automatic or manual activation of the emergency pressurization system to both sides. EMER PRESS can be selectively turned off on the left or right side by turning the respective L or R BLEED switch OFF.

Emergency pressurization is accomplished automatically by opening the emergency pressurization valves in response to signals from the cabin pressure controller or manually by pressing the EMER PRESS switch on the PRESSURIZATION panel. When the aircraft is below 25,000 feet pressure altitude and the system is in automatic mode with a takeoff or landing field elevation greater than 8000 feet specified, the cabin pressure controller will not trigger the emergency pressurization unless the cabin altitude increases to 14,500 (± 250) feet.

Emergency pressurization is provided by two independent channels (primary and secondary) of the cabin pressure controller. If triggered automatically, the primary and secondary channels will activate approximately at the same time in response to the cabin pressure controller. If triggered manually, the primary and secondary channels may be activated separately. When automatic or manual emergency pressurization is triggered, the following events occur:

- EMER PRESS switch illuminates ON.
- EMER PRESS ON amber CAS illuminates.
- Emergency pressurization valves open.
- The HP bleed-air shutoff valves close.

Extended operation with emergency pressurization will increase cabin temperature, especially at higher thrust settings. Temperature control will only be possible by reducing thrust or turning an L or R BLEED switch OFF. At altitudes not requiring pressurization, both L and R BLEED switches can be selected OFF.

Once cabin pressure has been restored by EMER PRESS activation, or after descent, the cabin pressure controller will automatically reset the emergency pressurization system at 8300 or 13,300 feet, depending on the triggering altitude (9500 or 14,500 feet). Depressing the EMER PRESS switch when the cabin altitude is below 8000 feet will extinguish the switch and CAS, and restore normal pressurization.

The following CAS illumination is specific to the emergency pressurization system:

CAS	Color	Description
EMER PRESS ON	Amber	The associated (L or R) emergency pressurization valve is open (manually or automatically).

PRESSURIZATION CONTROLS AND INDICATORS

CABIN PRESSURIZATION CONTROL DISPLAY

The cabin pressurization control display on the PRESSURIZATION panel includes an LCD (liquid crystal display) for presenting CAB RATE (cabin rate), DELTA P (differential pressure), CAB ALT (cabin altitude), manual cabin, and landing field elevations.

LDG ALT KNOB

The LDG ALT rotary knob is used to select landing field elevation during automatic pressurization mode. Rotation of the knob illuminates an LA and displays the present landing field altitude for 5 seconds. The rotary knob adjusts the landing altitude DN or UP in 100-foot increments per detent.

MANUAL PRESS SWITCH AND MANUAL KNOB

Manual control of the pressurization system is initiated by pressing the MANUAL PRESS switch ON. In the event of a dual ADC failure, manual mode is automatically initiated.

The MANUAL rate knob allows the crew to control how fast the cabin pressurization system reaches the desired cabin altitude. Rotation of the knob illuminates an MR and displays the present manual rate temporarily. The rotary knob adjusts the manual pressurization rate DN or UP in 100 foot-per-minute increments per detent. When the desired cabin altitude is approached, rotate the manual control knob in the appropriate direction until the manual cabin rate reaches zero.

EMER DEPRESS SWITCH

The EMER DEPRESS switch is an alternate-action switch located on the PRESSURIZATION panel. A guard is installed over the switch to prevent inadvertent actuation. The switch is used to depressurize the cabin and increase cabin airflow for smoke and fume evacuation. The EMER DEPRESS function is available in both automatic and manual modes. When EMER DEPRESS is selected ON, a EMER DEPRESS white CAS illuminates and the outflow valves receive a signal to move toward the full open position. The cabin altitude will ascend to the aircraft altitude or 13,700 (± 500) feet (cabin altitude limiter), whichever is less. To de-select this mode, depress and release the EMER DEPRESS switch.

The following CAS illumination is specific to the emergency depressurization system:

CAS	Color	Description
EMER DEPRESS	White	Emergency depressurization is selected by the crew.

PRESSURIZATION WARNING SYSTEM

The pressurization system provides the capability to operate at high altitude fields (8000 - 13,700 ft elevation) without triggering annunciations and emergency pressurization. The logic employed for this feature is as follows:

Conditions	Pressurization system will:
TAKEOFF	
Takeoff from field elevation less than 8000 ft	<ul style="list-style-type: none"> - Annunciate loss of cabin pressure if cabin altitude exceeds 8750 ft. - Activate emergency pressurization if cabin altitude exceeds 9500 ft. - Activate cabin altitude warning voice if cabin altitude exceeds 10,000 ft. - <i>Aircraft 45-236 & subsequent and prior aircraft modified by SB 45-22-5</i>, activate CABIN ALTITUDE red CAS and CABIN ALT red CWP if cabin altitude exceeds 10,000 ft.
Takeoff from field elevation greater than 8000 ft	<ul style="list-style-type: none"> - Annunciate loss of cabin pressure if cabin altitude exceeds 14,500 ft. - Activate emergency pressurization if cabin altitude exceeds 14,500 ft. - Activate cabin altitude warning voice if cabin altitude exceeds 14,500 ft. - <i>Aircraft 45-236 & subsequent and prior aircraft modified by SB 45-22-5</i>, activate CABIN ALTITUDE red CAS and CABIN ALT red CWP if cabin altitude exceeds 14,500 ft. <p>When the aircraft climbs above 24,500 ft: Resume settings specified in "Takeoff from field elevation less than 8000 ft".</p>
LANDING	
Landing at field elevation less than 8000 ft (as selected on LDG ALT)	<ul style="list-style-type: none"> - Annunciate loss of cabin pressure if cabin altitude exceeds 8750 ft. - Activate emergency pressurization if cabin altitude exceeds 9500 ft. - Activate cabin altitude warning voice if cabin altitude exceeds 10,000 ft. - <i>Aircraft 45-236 & subsequent and prior aircraft modified by SB 45-22-5</i>, activate CABIN ALTITUDE red CAS and CABIN ALT red CWP if cabin altitude exceeds 10,000 ft.
Landing at field elevation greater than 8000 ft (as selected on LDG ALT)	<p>Maintain the settings specified in "Landing at field elevation less than 8000 ft (as selected on LDG ALT)" until the aircraft descends below 24,500 ft.</p> <p>When the aircraft descends below 24,500 ft:</p> <ul style="list-style-type: none"> - Annunciate loss of cabin pressure if cabin altitude exceeds 14,500 ft. - Activate emergency pressurization if cabin altitude exceeds 14,500 ft. - Activate cabin altitude warning voice if cabin altitude exceeds 14,500 ft. - <i>Aircraft 45-236 & subsequent and prior aircraft modified by SB 45-22-5</i>, activate CABIN ALTITUDE red CAS and CABIN ALT red CWP if cabin altitude exceeds 14,500 ft.

Applicable operating rules, pertaining to the use of oxygen at high cabin altitude, must be observed.

The following CAS illuminations are specific to the pressurization warning system:

CAS	Color	Description
CABIN ALTITUDE <i>(Aircraft 45-236 & subsequent and prior aircraft modified by SB 45-22-5)</i>	Red	The cabin altitude exceeds 10,000 feet (pressurization system LDG ALT set below 8000) or 14,500 feet (pressurization system LDG ALT set above 8000).
CABIN ALTITUDE	Amber	The cabin altitude is higher than normal for the given conditions.