

Gulfstream G150

AIRPLANE FLIGHT MANUAL

Section VII
Systems

ENVIRONMENTAL CONTROL SYSTEM (ECS)

DESCRIPTION

The environmental control system (ECS) provides conditioned air for ventilation, cabin pressurization and temperature control. The system utilizes engine bleed air supplied from the high and low pressure ports of each engine.

The LP and HP lines of each engine are connected to a bleed switching valve (BSV) which automatically transfers the source selection to HP if LP pressure is lower than 21.5 psi.

The two common lines from both BSV's are interconnected to a main line that supplies air to the environmental control unit (ECU).

A pre-cooler and an ozone converter are installed on the main line. The pre-cooler is equipped with a pneumatic bypass line that prevents the pre-cooler discharge temperature from dropping below 149°C (300°F). Heat sink for the pre-cooler is provided by ram air discharged from the air cycle machine (ACM) heat exchangers. Ram air for heat sink is supplied through a scoop located in the dorsal fin.

Further downstream the bleed air is supplied to the ACM which has a low pressure water separator.

If the air conditioning system fails, LP bleed air is supplied from the right engine for pressurization by placing the ECS selector in EMERG position. A ram air ventilation system is also incorporated as a backup system for operation at low altitudes. Ram air enters the ventilation system through a flush NACA scoop located in the aft fuselage.

Mixing cold air provides temperature control for both cockpit and cabin. Single temperature control system is provided for both cabin and cockpit. The conditioned air is supplied to both cabin and cockpit through the air distribution system.

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AIR CONDITIONING SYSTEM

Air conditioning may be utilized on ground or in flight. Cockpit and cabin temperature is normally preset for automatic control (CABIN MAN pushbutton - off) then selecting desired temperature position on TEMP CONTR knob. A secondary, manual system, for temperature control is also provided by pressing CABIN MAN pushbutton - ON. Use of air conditioning system, on ground, requires operation of APU, or either engine, at low thrust setting.

PRESSURIZATION SYSTEM

Cabin pressurization is obtained by controlling conditioned air outflow from the cabin.

Normal operation of the pressurization system is automatic and only requires selection of the landing field elevation, which can be made before take-off. Cabin altitude rate of change is normally set to nominal values of 600 fpm (ascent) and 360 fpm (descent). The system controls cabin pressure by metering the outflow of air from the cabin through the outflow valve. Digital controller directly drives the valves which respond to signals by modulating the airflow.

The system prevents exceeding cabin altitude of 13,500 ft in case of failure. The CPCS (cabin pressure control system) status is checked by pressing MODE SEL pushbutton to off (light out) and observing that FAULT light comes on momentarily.

Manual control of the system is possible at pilot discretion or after failure of the digital controller or electrical failure. In this case, cabin pressure is regulated through manual control unit, controlling the outflow valve which allows selection of raising or lowering cabin altitude at a selected rate. Cabin altitude is held then by an isobaric hold function.

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Cabin pressure differential is limited to a maximum of 8.95 psi by an automatically operated relief valve. Negative pressure in the cabin is relieved automatically by air flowing through the ram air scoop, passing through a check valve. The cabin door seal is pressurized from the hydraulic tank pressurization line. Seal pressure is regulated to 30 psi. If the seal is deflated, **DOOR SEAL PRESS LOW** message is on.

SYSTEM AUTOMATIC OPERATION

Ground mode: As electrical power is supplied, the system performs self-test, indicated by momentary illumination of FAULT light. If the CPCS determines that power lever is set at less than 70% N₁ position and landing gear weight on wheels switch is pressed, it commands the outflow valves to fully open position. It is possible at this time to set the pressurization parameters: landing field elevation altitude (FIELD ELEV knob is used for manual setting).

Take-off mode: As power lever is advanced to 70% N₁ position or higher, the CPCS sets the current cabin altitude as its reference. Cabin altitude starts decreasing at the nominal rate, till it is about 250 ft below the reference. This assures smooth transition of cabin environment into pressurized flight. If take-off is aborted, cabin returns to ground mode at the nominal rate.

Flight mode: The CPCS senses flight when the landing gear weight on wheels switch is released.

The cabin altitude is then adjusted at a rate proportional to the aircraft rate of climb, preprogrammed into the CPCS logic. It also considers the selected landing field elevation. As the aircraft leaves the ground, cabin altitude automatically climbs or descends until it intersects on automatic cabin altitude schedule. Cabin rate of change never exceeds its rate limit and is less than this limit when the aircraft climbs or descends at less than maximum rate.

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Once the aircraft has been in steady state flight for one minute, present cabin altitude is locked at this value to provide a steady state cabin altitude. If aircraft changes altitude, cabin pressure changes till a new cruise condition is established. To prevent unwanted cabin altitude variations during rough-air flight, aircraft altitude signal is buffered to permit rapid aircraft altitude excursions of ± 500 fpm before releasing established cruise condition. Upon an aircraft descent of 500 fpm or more, descent mode detector is triggered, which commands the cabin to proceed to the selected landing field elevation.

Cabin differential pressure (ΔP) is continuously monitored not to exceed 8.95 psi. During flight, cabin altitude changes to either the scheduled altitude or the selected landing altitude, as appropriate.

Landing mode: During descent, cabin altitude decreases. If selected landing field elevation is higher than actual field elevation, the cabin depressurizes before reaching the ground. If selected landing field elevation is lower than actual field elevation, the aircraft lands with pressurized cabin. In this case, upon touchdown, the cabin will start to climb at 500 fpm for one minute before switching to ground mode (outflow valve fully open).

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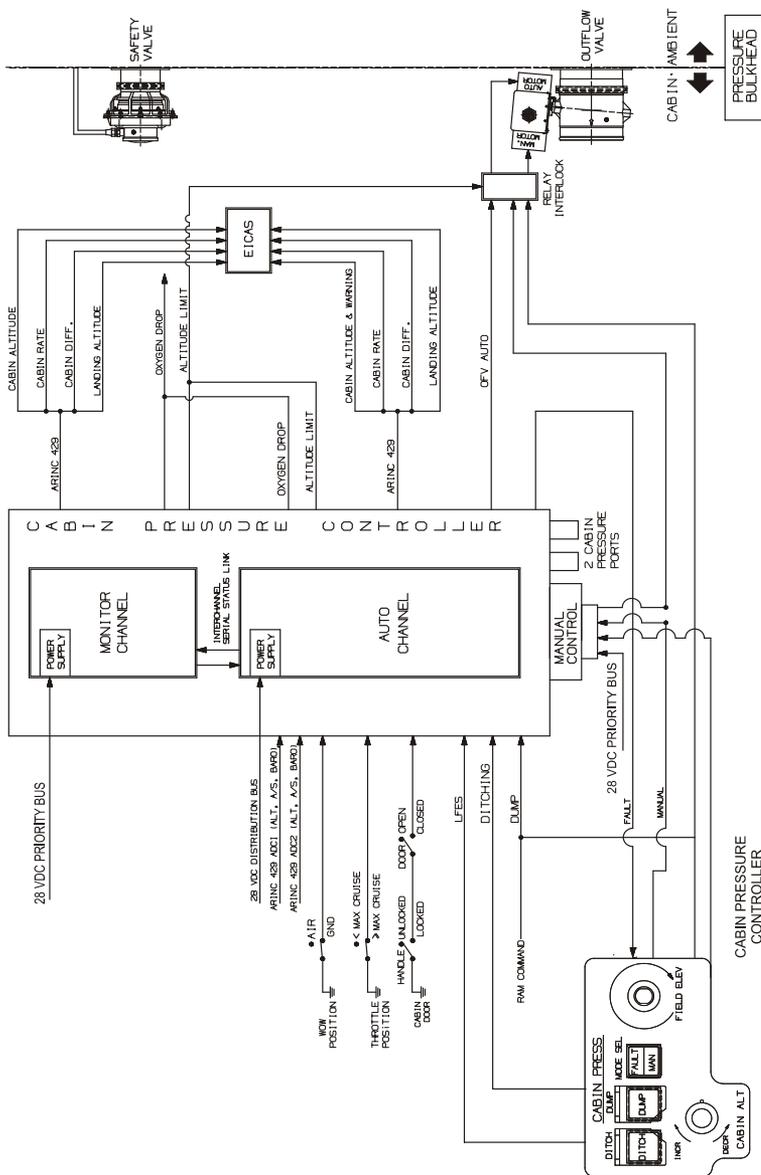


Figure 7-21-1. Cabin Pressure Control System - Schematic

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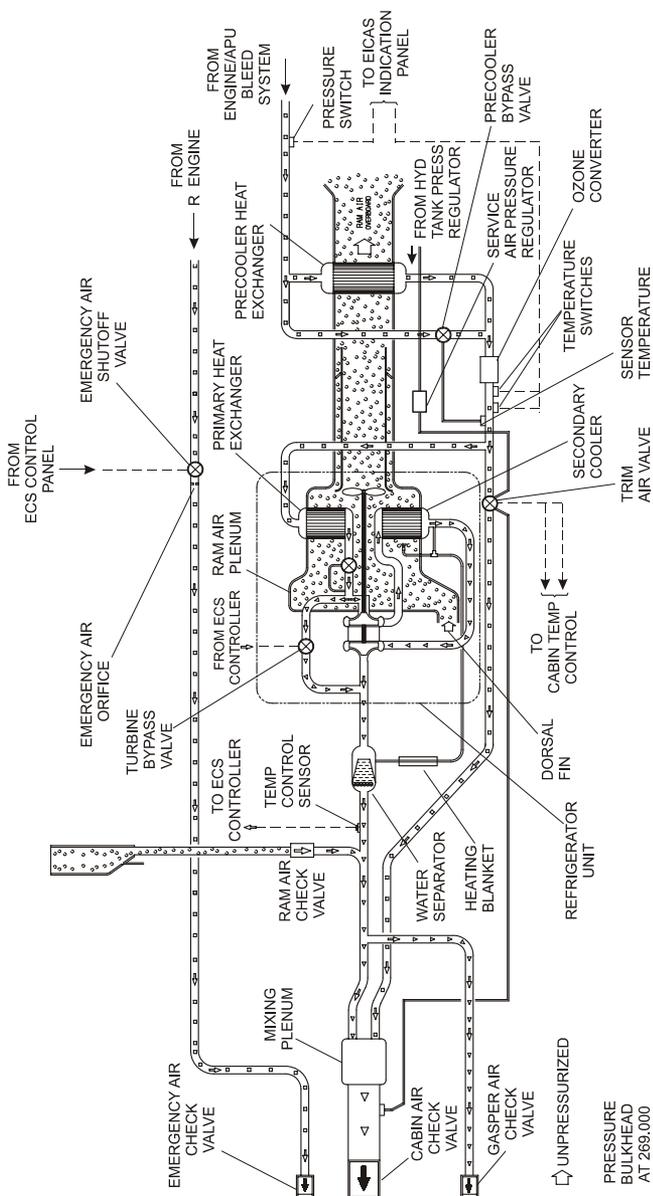


Figure 7-21-3. Temperature Control System - Schematic

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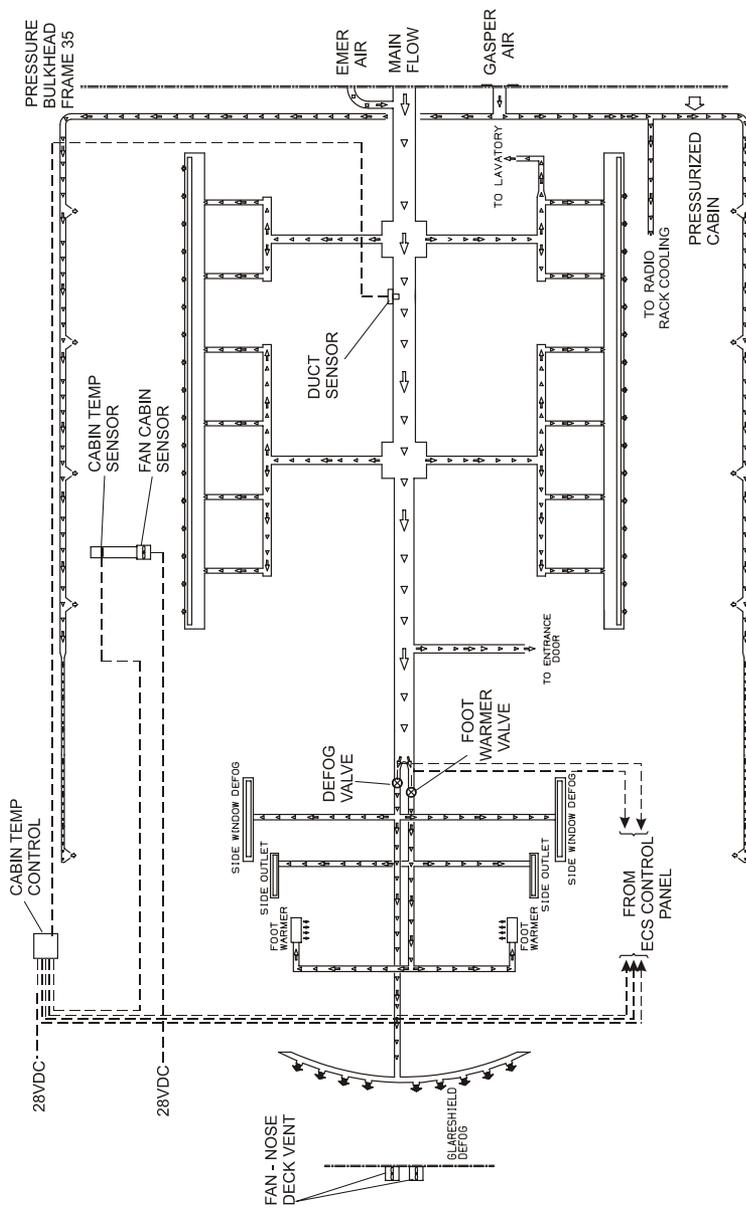


Figure 7-21-4. Cabin Air Distribution System - Schematic

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ECS CONTROLS AND INDICATORS (Figure 7-21-5)

ECS selector - Controls air source shutoff valves according to following positions:

RAM - Closes both engine bleed and APU air supplies and opens outflow valves, simultaneously dumping cabin pressure through outflow valve. Used only as required at altitudes below 13,000 ft. Temperature control is not available in RAM position.

APU - Selects bleed air from APU only.

L ENG - Selects bleed air from left engine only.

BOTH ENGINES - Selects bleed air from both engines.

R ENG - Selects bleed air from right engine only.

EMERG - Connects R engine, low-pressure bleed air port, directly to the mixing plenum in the cabin. Provides emergency air pressure source, to prevent cabin decompression, if airconditioning system fails. Cabin temperature is controlled by right engine thrust.

TEMP CONTR knob - Used for cabin temperature control.

DEFOG switch - Controls windshield defog air temperature.

AIR COND switch - Controls cockpit air temperature.

APU AIRFLOW pushbutton - Pressed to increase APU conditioned air flow. HI FLOW light comes on.

CABIN TEMP pushbutton - Allows selection of automatic or manual control of cabin temperature, overrides automatic system operation. MAN light comes on.

FIELD ELEV knob- Used for manual setting of the required landing field elevation in 50 feet increments (msl).

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MODE SEL pushbutton - Used when reverting to manual pressurization controls. MAN light comes on.

DUMP pushbutton - Used to dump cabin pressure in emergency; cabin altitude is limited to 13,000 ft \pm 1500 ft. (Cabin rate may reach 10,000 fpm).

DITCH pushbutton - Closes outflow valve for ditching.

CABIN ALT knob - Used for manual control of cabin altitude, overriding automatic operation. INCR position causes the outflow valves to open, raising the cabin altitude; DECR position closes the valves and lowers cabin altitude.

EICAS Displays

On primary page:

- Cabin Altitude
- Cabin Altitude Manual Mode Annunciation
- Cabin Differential Press
- Cabin Rate
- Cabin Rate Arrow

On secondary page:

- Landing field elevation

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Warning Messages

- BLEED PRESS/TEMP HI - Excessive pressure or temperature downstream of either bleed switching valve
- CABIN DOOR UNLOCK - Cabin door is unlocked
- DUCT TEMP HI - Excessive duct-air temperature downstream of mixing plenum
- L ENG/APU BLEED LEAK - Leak or rupture in bleed air ducting from left engine or APU. APU automatically shuts down
- R ENG BLEED LEAK - Leak or rupture in bleed air ducting from right engine
- CAB ALT 15000 - Cabin altitude above 15,000 ft. Cabin pressure controller malfunction
- CAB ALT HI - Cabin altitude above 10,000 ft. Cabin pressure controller auto mode malfunction

Caution Messages

- CAB AUTO PRESS FAIL - Automatic cabin pressurization failure
- CAB AUTO TEMP FAIL - Cabin automatic temperature control malfunction
- DOOR SEAL PRESS LOW - Cabin door seal is not inflated
- NOSE TEMP HI - Nose compartment blowers malfunction

Status Messages

- CAB PRESS IN TEST - Cabin pressure control system test is in progress
- CAB PRESS MONITOR - Malfunction in cabin pressure control monitoring
- ECS BLEED OFF - ECS selector in RAM position or APU position and APU not running

Advisory Messages

- CAB PRESS TEST OK - Successful cabin pressure control system test
- CABIN DOOR UNLOCK - Cabin door checked locked and Cabin Door Reset pushbutton has been pressed after CABIN DOOR UNLOCK caution message

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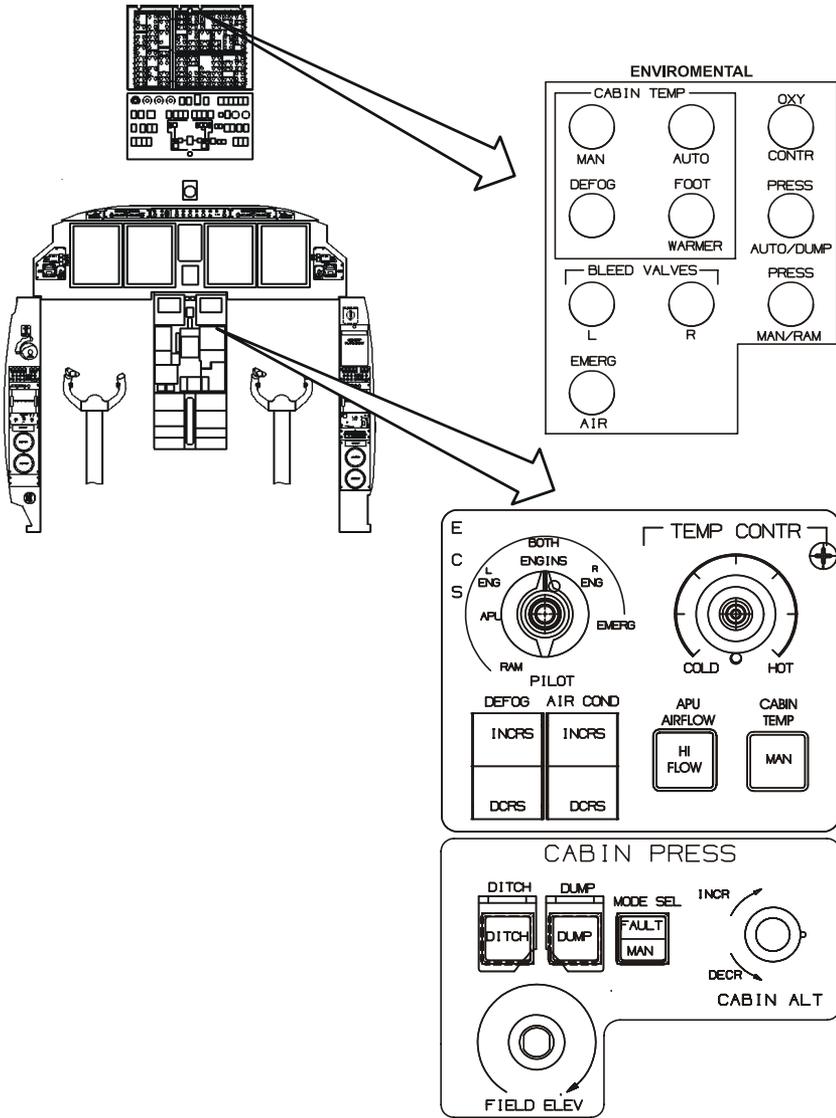


Figure 7-21-5. ECS Controls and Indicators