

Rules and Regulations

Federal Register

Vol. 60, No. 200

Tuesday, October 17, 1995

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM-112; Special Conditions No. 25-ANM-108]

Special Condition: Gulfstream Aerospace Corporation, Model Gulfstream V, High Altitude Operations

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are for the Gulfstream Model Gulfstream V airplane. This new airplane will be capable of operating at a maximum altitude of 51,000 feet. The applicable regulations do not contain adequate or appropriate safety standards for the protection of the fuselage structure or passengers and crew from the effects of high altitude operations. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: November 16, 1995.

FOR FURTHER INFORMATION CONTACT: Gerald Lakin, FAA, Standardization Branch, ANM-113, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98055-4056, (206) 227-1187.

SUPPLEMENTARY INFORMATION:

Background

On February 26, 1992, Gulfstream Aerospace Corporation, P.O. Box 2206, Savannah, GA 31402-2206, applied for an amended type certificate in the transport airplane category for the Model Gulfstream V airplane. The Gulfstream V is a T-tail, low swept wing, business jet airplane powered by two BMW Rolls-Royce BR700-710A1-

10 turbofan engines mounted on pylons extending from the aft fuselage. Each engine will be capable of delivering 14,750 pounds thrust. The controls will be powered and capable of manual reversion. The airplane has a seating capacity of up to nineteen passengers, and a maximum takeoff weight of 89,000 pounds. Gulfstream has requested certification for operations up to 51,000 feet.

Type Certification Basis

Under the provisions of § 21.101 of the FAR, Gulfstream must show, except as provided in § 25.2, that the Model Gulfstream V meets the applicable provisions of part 25, effective February 1, 1995, as amended by Amendments 25-1 through 25-81. In addition, the proposed certification basis for the Model Gulfstream V includes part 34, effective September 10, 1990, plus any amendments in effect at the time of certification; part 36, effective December 1, 1969, as amended by Amendment 36-1 through the amendment in effect at the time of certification; and certain exceptions and special conditions that are not relevant to these special conditions. No exemptions are anticipated. These special conditions form an additional part of the type certification basis.

If the Administrator finds that the applicable airworthiness regulations (i.e., part 25, as amended) do not contain adequate or appropriate safety standards for the Gulfstream V because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16 to establish a level of safety equivalent to that established in the regulations.

Special conditions, as appropriate, are issued in accordance with § 11.49 of the FAR after public notice, as required by §§ 11.28 and 11.29, and become part of the type certification basis in accordance with § 21.101(b)(2).

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model under the provisions of § 21.101(a)(1).

Novel or Unusual Design Features

The Model Gulfstream V will be certificated for operations at a maximum altitude of 51,000 feet. This unusually high operating altitude constitutes a novel or unusual design feature for which the applicable airworthiness regulations do not contain adequate or appropriate safety standards.

There are no specific regulations that address protection requirements for the airplane fuselage pressure vessel or passengers and crew, in the event of a rapid decompression, during high altitude operations. The potential adverse impact from rapid decompression at high altitudes has made it necessary to provide adequate protection.

To ensure that a level of safety is achieved equivalent to that intended by the regulations incorporated by reference, these special conditions require compliance with additional requirements to provide protection from the direct and indirect effects of high altitude operations.

Damage tolerance methods are proposed to be used to ensure pressure vessel integrity while operating at the higher altitudes. Crack grown data are used to prescribe an inspection program which will detect cracks before an opening in the pressure vessel would allow rapid decompression. Initial crack sizes for detection are determined under § 25.571, Amendment 25-72. The cabin altitude after failure may not exceed the limits specified in Figures 3 and 4.

In order to ensure that there is adequate fresh air to crewmembers to perform their duties, to provide reasonable passenger comfort, and to enable occupants to better withstand the effects of decompression at high altitudes, the ventilation system must be designed to provide 10 cubic feet of fresh air per minute per person during normal operations. Therefore, these special conditions require that crewmembers and passengers be provided with 10 cubic feet of fresh air per minute per person. In addition, during the development of the supersonic transport special conditions, it was noted that certain pressurization failures resulted in hot ram or bleed air being used to maintain pressurization. Such a measure can lead to cabin temperatures that exceed human tolerance. Therefore, these special conditions require airplane interior

temperature limits following probable and improbable failures.

Continuous flow passenger oxygen equipment is certificated for use up to 40,000 feet; however, for rapid decompressions above 34,000 feet, reverse diffusion leads to low oxygen partial pressure in the lungs, to the extent that a small percentage of passengers may lose useful consciousness at 35,000 feet. The percentage increases to an estimated 60 percent at 40,000 feet, even with the use of the continuous flow system. To prevent permanent physiological damage, the cabin altitude must not exceed 25,000 feet for more than two minutes. The maximum peak cabin altitude of 40,000 feet is consistent with the standards established for previous certification programs. In addition, at these altitudes the other aspects of decompression sickness have a significant detrimental effect on pilot performance (for example, a pilot can be incapacitated by internal expanding gases).

Decompression above 37,000 feet can result in cabin altitudes that approach the physiological limits of the average person; therefore, every effort must be made to provide the pilots with adequate oxygen equipment to withstand these severe decompressions. Reducing the time interval between pressurization failure and the time the pilot receives oxygen will provide a safety margin against being incapacitated and can be accomplished by the use of mask-mounted regulators. These special conditions therefore require pressure demand masks with mask-mounted regulators for the flightcrew. This combination of equipment will provide the best practical protection for the failures covered by the proposed special conditions and for improbable failures not covered by the special conditions, provided the cabin altitude is limited.

As discussed above, these special conditions are applicable initially to the Model Gulfstream V. Should Gulfstream apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well, under the provisions of § 21.101(a)(1).

Discussion of Comments

Notice of Proposed Special Conditions No. ANM-95-5-NM for the Gulfstream Aerospace Corporation, Model Gulfstream V, was published in the Federal Register on June 28, 1995 (60 FR 33366). One commenter, the

applicant, submitted four comments as follows:

(1) The commenter states that the current nomenclature for the turbofan engine is BMW Rolls-Royce BR700-710A1-10 in lieu of Rolls-Royce BR710-48. The FAA agrees with the commenter and has incorporated the change in this document.

(2) The commenter states that the presently accepted Certification Basis for the Gulfstream V is part 25, effective February 1, 1965, as amended by Amendments 25-1 through 25-81 in lieu of Amendment 25-75. The FAA agrees with the commenter and has incorporated the change in this document.

(3) The commenter asks the question whether certain wording discrepancies under the "Novel or Unusual Design Features" portion of the notice are typographical errors or if there has been a change in philosophy. The wording has to do with the value of "rapid decompressions above 24,000 feet," and "decompression above 27,000 feet." In numerous preceding publications over the years of such high altitude special conditions, these altitudes have been stated as 34,000 and 37,000 feet respectively. The FAA confirms that these discrepancies are typographical errors made by the Federal Register when they published the notice. The correct values are 34,000 feet and 37,000 feet respectively, and those values are reflected in this document.

(4) The commenter asks the question whether a change in Figure 3, Cabin Altitude Vs Time, is an error or a change in philosophy/requirements. The question has to do with the fact that the horizontal portion of the 25,000 foot altitude line begins to break downward at the 6 minute point of the figure. In numerous preceding publications over the years of such high altitude special conditions, this break point in the graph has been at 7 minutes. The FAA confirms that the 6 minute break point is in error and the 7 minute break value is correct. Figure 3 is corrected in this document to reflect the 7 minute break value point.

Conclusion

This action affects certain design features only on the Gulfstream V airplane. It is not a rule of general applicability and affects only the manufacturer who applied to the FAA for approval of these features on the airplane.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Federal Aviation Administration, Reporting and recordkeeping requirements.

The authority citation for these proposed special conditions is as follows:

Authority: 49 U.S.C. app. 1344, 1348(c), 1352, 1354(a), 1355, 1421 through 1431, 1502, 1651(b)(2), 42 U.S.C. 1857f-10, 4321 et seq.; E.O. 11514; and 49 U.S.C. 106(g).

The Special Conditions

Accordingly, the following special conditions are issued as part of the type certification basis for the Gulfstream Aerospace Corporation, Model Gulfstream V series airplanes.

1. Pressure Vessel Integrity

(a) The maximum extent of failure and pressure vessel opening that can be demonstrated to comply with paragraph 4 (Pressurization) of this special condition must be determined. It must be demonstrated by crack propagation and damage tolerance analysis supported by testing that a larger opening or a more severe failure than demonstrated will not occur in normal operations.

(b) Inspection schedules and procedures must be established to assure that cracks and normal fuselage leak rates will not deteriorate to the extent that an unsafe condition could exist during normal operation.

(c) With regard to the fuselage structural design for cabin pressure capability above 45,000 feet altitude, the pressure vessel structure, including doors and windows, must comply with § 25.365(d), using a factor of 1.67 instead of the 1.33 factor described.

2. Ventilation

In lieu of the requirements of § 25.831(a), the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crewmembers to perform their duties without undue discomfort or fatigue, and to provide reasonable passenger comfort during normal operating conditions and also in the event of any probable failure to any system which could adversely affect the cabin ventilating air. For normal operations, crew members must be provided with at least 10 cubic feet of fresh air per minute per person, or the equivalent in filtered, recirculated air based on the volume and composition at the corresponding cabin pressure altitude of not more than 8,000 feet.

3. Air Conditioning

In lieu of the requirements of § 25.831, paragraphs (b) through (e), the cabin cooling system must be designed to meet the following conditions during flight above 15,000 feet mean sea level (MSL).

(a) After any probable failure, the cabin temperature-time history may not exceed the values shown in Figure 1.

(b) After any improbable failure, the cabin temperature-time history may not exceed the values shown in Figure 2.

4. Pressurization

In addition to the requirements of FAR 25.841, the following apply:

(a) The pressurization system, which includes for this purpose bleed air, air conditioning, and pressure control systems, must prevent the cabin altitude from exceeding the cabin altitude-time history shown in Figure 3 after each of the following:

(1) Any probable malfunction or failure of the pressurization system. The existence of undetected, latent malfunctions, or failures, in conjunction with probable failures must be considered.

(2) Any single failure in the pressurization system combined with the occurrence of a leak produced by a complete loss of a door seal element, or

a fuselage leak through an opening having an effective area 2.0 times the effective area that produces the maximum permissible fuselage leak rate approved for normal operation, whichever produces a more severe leak.

(b) The cabin altitude-time history may not exceed that shown in Figure 4 after each of the following:

(1) The maximum pressure vessel opening resulting from an initially detectable crack propagating for a period encompassing four normal inspection intervals. Mid-panel cracks and cracks through skin-stringer and skin-frame combinations must be considered.

(2) The pressure vessel opening or duct failure resulting from probable damage (failure effect) while under maximum operating cabin pressure differential due to a tire burst, engine rotor burst, loss of antennas or stall warning vanes, or any probable equipment failure (bleed air, pressure control, air conditioning, electrical

source(s), etc.) that affects pressurization.

(3) Complete loss of thrust from all engines.

(c) In showing compliance with paragraphs d.1. and d.2. of these special conditions (Pressurization), it may be assumed that an emergency descent is made by approved emergency procedure. A 17-second crew recognition and reaction time must be applied between cabin altitude warning and the initiation of an emergency descent.

5. Oxygen Equipment and Supply

(a) A continuous flow oxygen system must be provided for the passengers.

(b) A quick donning pressure demand mask with mask-mounted regulator must be provided for each pilot. Quick donning from the stowed position must be demonstrated to show that the mask can be withdrawn from stowage and donned within 5 seconds.

BILLING CODE 4910-13-M

Figure 1

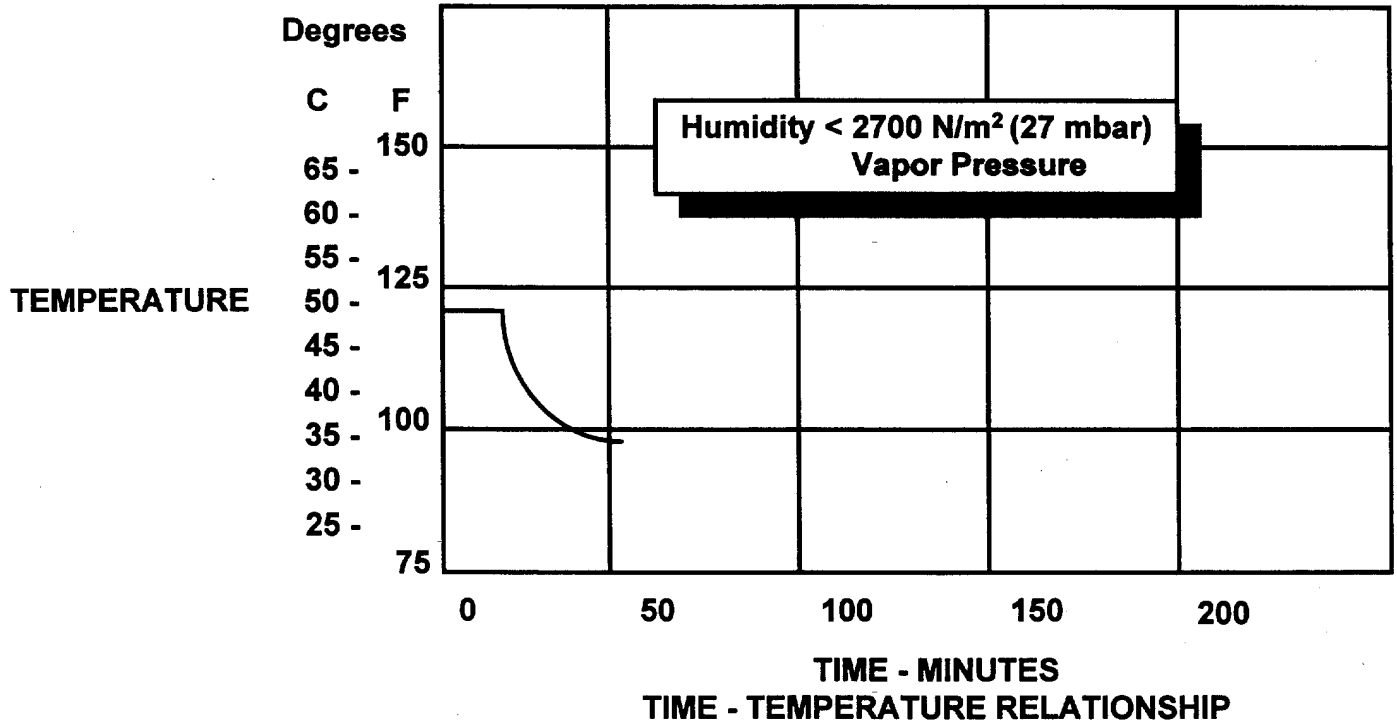


Figure 2

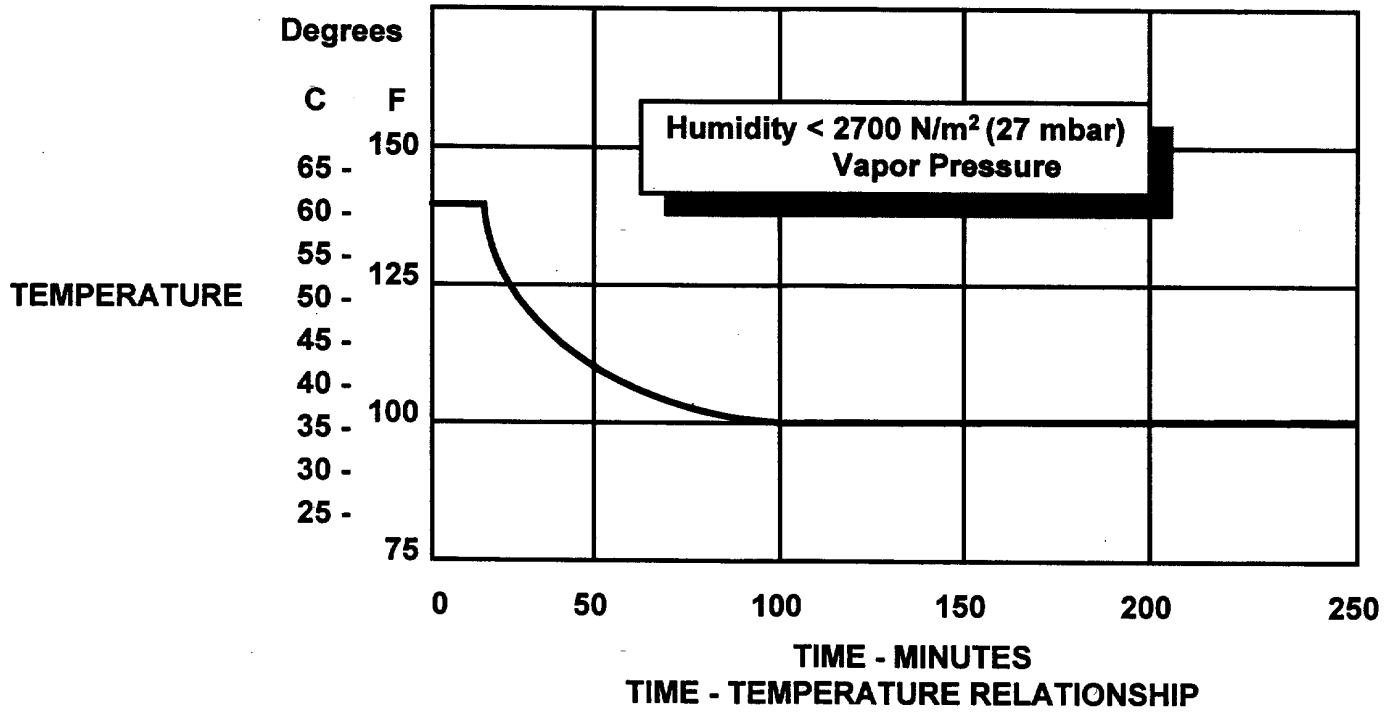
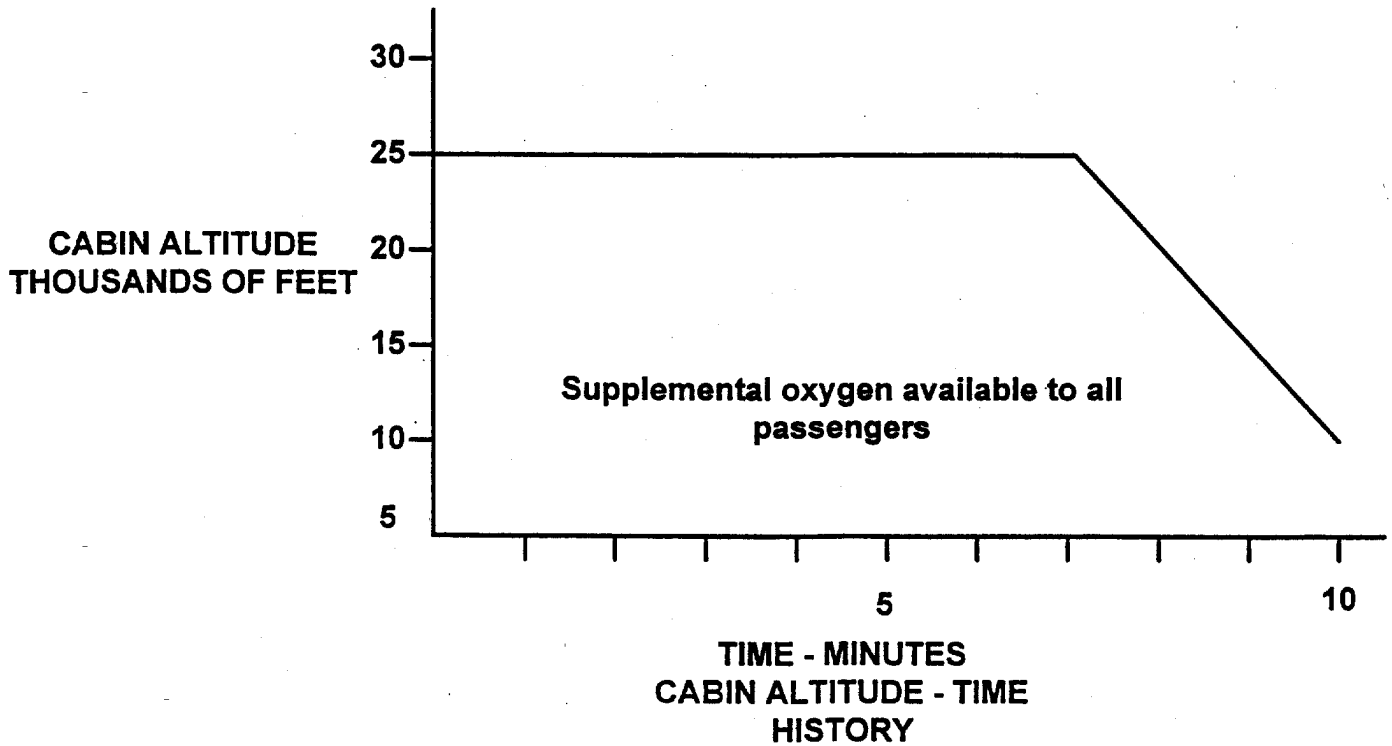
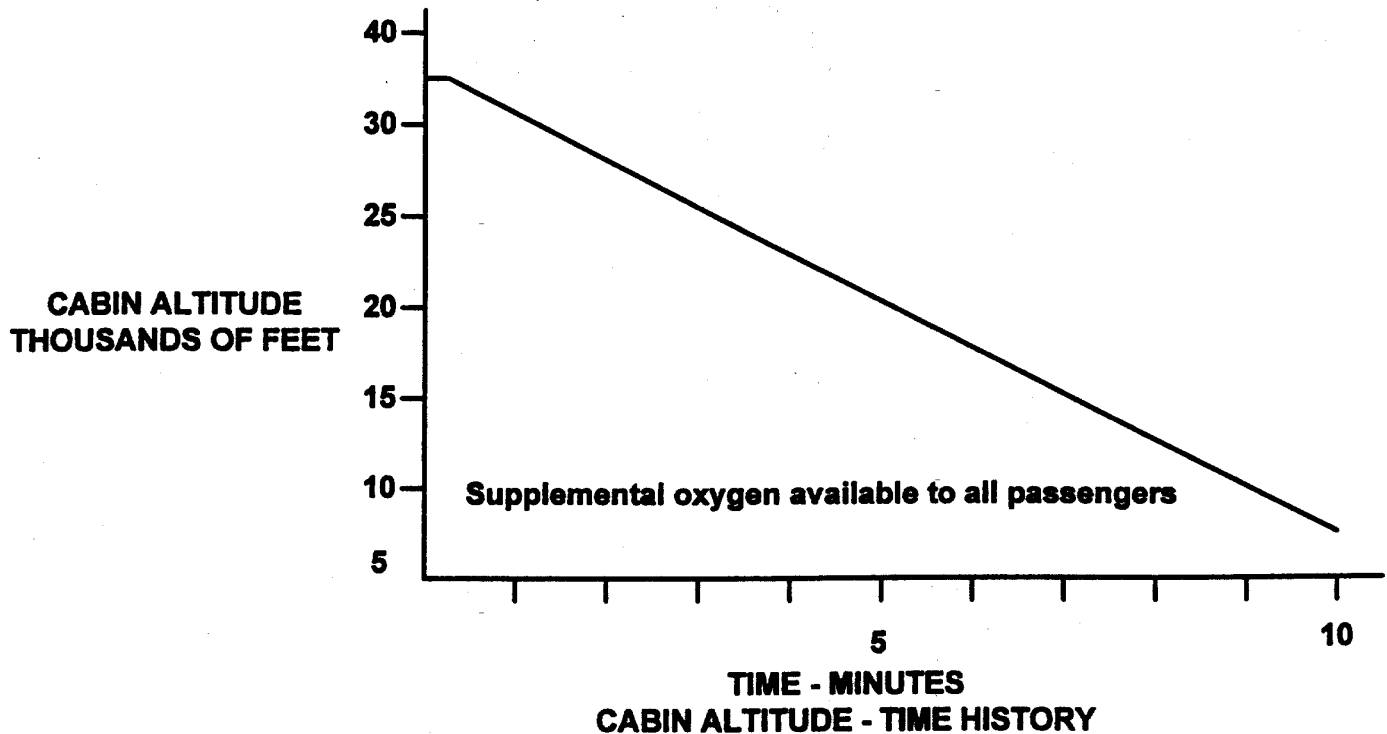


Figure 3



NOTE: For figure 3, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 30,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

Figure 4



NOTE: For figure 4, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 40,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

BILLING CODE 4910-13-C

Issued in Renton, Washington, on October 5, 1995.

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[FR Doc. 95-25676 Filed 10-16-95; 8:45 am]

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