



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: FUSELAGE DOORS, HATCHES,
AND EXITS

Date: 12/10/86

Initiated by: ANM-110

AC No: 25.783-1

Change:

1. PURPOSE. This advisory circular sets forth acceptable means of compliance with the provisions of Part 25 of the Federal Aviation Regulations (FAR) dealing with the certification requirements for fuselage doors. Guidance information is provided for showing compliance with structural and functional safety standards for doors and their operating systems. The intent of the requirements and some acceptable means of compliance are discussed. Other means are acceptable if they meet the intent of the regulations. For the purpose of showing compliance with § 25.783 of the FAR, hatches and exits are also considered to be doors.

2. RELATED FAR SECTIONS. The contents of this advisory circular are considered by the FAA in determining compliance of doors, hatches, and exits with the safety requirements of § 25.783, Amdt. 25-54. Other related Sections are 25.365, 25.571, 25.809, and 25.1309.

3. DEFINITIONS OF TERMS. Inconsistent or inaccurate use of certain terms may lead to the installation of doors, exits, and hatches that do not fully meet the objectives of the appropriate sections of the FAR. In order to ensure that such installations do fully meet the objectives of these sections, the following definitions should be observed:

a. Initial opening movement, as used in § 25.783(e), refers to that door movement caused by operation of a handle or other door control mechanism which is required to place the door in a position free of structure that would interfere with continued opening of the door, and which requires overcoming cabin pressure loads during this initial movement.

b. Inward, as used in § 25.783(b) and (e), means having a directional component of movement that is inward with respect to the mean pressure plane of the body cutout.

c. Latches, as used in this AC, are structural elements which carry basic airframe loads, including cabin pressure loads.

d. Locks are mechanical elements which prevent latches from becoming inadvertently disengaged.

e. Locked, as used in § 25.783(b), (e), (f), and § 25.809, is intended to apply to:

(i) External doors and doors sealing the pressure cabin from the unpressurized zones of the fuselage; and

(ii) Hatches, windows, and panels in the fuselage which are closed and opened without the use of tools (as opposed to those with quick-release fasteners and fasteners such as screws and bolts).

f. Inadvertently by persons, as used in § 25.783(b), has been accepted as meaning undeliberate (i.e., without forethought, consideration or consultation). The single action movement of a handle, for instance, would be considered inadvertent opening during unpressurized flight.

4. BACKGROUND. For several years, considerable attention has been given to developing design criteria to prevent inadvertent opening of outward opening doors in pressurized cabins in flight. In 1974, a critical design review team was assigned the task of reviewing outward opening doors on wide body airplanes and of developing safety standards relative to design and operation of these doors. These criteria were made applicable to all external passenger, cargo, and service doors, including those in narrow body airplanes, by Amdt. 25-54 to Part 25 of the FAR.

5. STRUCTURAL REQUIREMENTS. The door structure, including hinges, stops, and latches, must be designed to either the damage tolerance requirements of § 25.571 of the FAR, Amdt. 25-45, or to the earlier fail-safe requirement, depending on the certification basis of the airplane. In assessing the extent of damage under §§ 25.571 and 25.783, consideration must be given to single element failures in the primary door structure such as: frames, stringers, intercostals, latches, hinges, stops, and stop supports. The skin panels on doors which must comply with § 25.571, Amdt. 25-45, should be designed damage tolerant with a high probability of detecting any crack before the crack causes door failure or cabin depressurization. The obvious partial failure criteria or the damage tolerance criteria may be used for skin panels on doors with an earlier certification basis.

6. DETAIL DESIGN CONSIDERATIONS.

a. Section 25.783(b) specifies that there must be a means to lock and safeguard each external door against opening in flight--either inadvertently by persons or as a result of mechanical failure or failure of a single structural element either during or after closure. Section 25.783(f) further requires that inadvertent opening be extremely improbable. In order to safeguard doors for which the initial movement is not inward from opening in flight, each latch should have an individual lock. In this regard, it should not be possible to position the locks in the locked position if any of the latches are not in the fully latched position. The loads on doors for which the initial movement is inward are usually carried by fixed stops; therefore, it is generally not necessary to provide latches and a separate lock for each individual stop for such doors. It is not considered acceptable to rely solely on cabin pressure to prevent inadvertent opening of doors in flight because there have been instances of doors opening during unpressurized flight, such as landing. All doors should, therefore, incorporate features in the locking mechanism which provide a positive means to prevent the door from vibrating open or from being opened inadvertently by passengers. The means should be effective throughout the approved operating envelope of the airplane. In this regard, overcenter features of the latching mechanism are not considered to be acceptable locking

means. These safety features should not complicate the opening of passenger emergency exits under emergency conditions.

b. Except as noted in paragraph d below, § 25.783(e) specifies that there must be a provision for direct visual inspection of the locking mechanism to determine if external doors, for which the initial opening is not inward, are fully closed and locked. In order to enable the appropriate crewmembers to determine that such doors are fully closed and fully locked, it will generally be necessary to provide a means to visually inspect each individual lock of the locking mechanism. Means that do not permit direct visual inspection of each lock are unacceptable, unless there is no failure mode of the locking mechanism that would allow a false visual indication that each latch is properly positioned and locked. If optical devices are used to view the locking mechanism, it should be demonstrated that they are not subject to fogging, to obstruction by dislodged material, or to a false indication of a locked condition.

c. Except as noted in paragraph d below, § 25.783(f) requires that external doors have provisions to prevent pressurization to an unsafe level if they are not fully closed and locked. This may be achieved by installing in the door a vent panel which remains open, preventing pressurization until the door is properly closed and locked. If this means of compliance is used, the vent panel should be designed so that no single failure in the operating linkage will allow the vent panel to close until the door is properly latched and locked. Also, the vent panel operating linkage should monitor the position of the door locks before allowing the vents to close. Other means of preventing pressurization to an unsafe level may be acceptable provided they are as reliable as the installation of vent panels. Means that affect operation of the pressurization system must be considered in showing compliance with the applicable pressurization system reliability requirements.

d. The regulatory requirements discussed in paragraphs 6b and c of this AC do not apply to:

(1) Inward opening removable emergency escape hatches such as overwing hatches which are removed only during emergency evacuation; or

(2) Small maintenance access hatches, the loss of which would not present a hazard to the airplane or occupants. Such hatches should have areas considerably less than those defined by § 25.365(e)(2) of the FAR and no greater than the failures assumed in the decompression analysis submitted for compliance with the pressurization and oxygen requirements of Part 25, such as §§ 25.841 and 25.1441, and any applicable special conditions.

7. INDICATING SYSTEM.

a. In addition to the means for direct visual inspection of the locking mechanism, § 25.783(e) also specifies that there must be a visual means to signal the appropriate flight crewmembers if any external door is not fully closed and locked. This requirement applies to any passenger, cargo, or service door and to any hatch (except those defined in paragraph 6d(2) of this AC), regardless of whether the initial opening movement is inward or outward. The indicating system should monitor the locking mechanism directly.

b. For doors for which the initial opening movement is not inward, § 25.783(e) further specifies that the means to signal the flight crewmembers must be designed such that any failure or combination of failures that would result in an erroneous closed and locked indication is improbable. This can usually be achieved by installation of dual and independent indicating systems on such doors; however, the necessary level of safety may, in some instances, be achieved with a single system.

c. The indicating system should be designed so that relative deflection between the indicating system and the airplane structure during ground and flight conditions will not result in false indications.

d. On some airplanes, doors may be designed to carry basic fuselage loads in addition to the cabin pressure loads. Where doors are designed to carry basic fuselage loads and when the structural integrity of the fuselage would be compromised if the door were not properly closed, latched, and locked, then a more reliable warning system is needed. There is justification in this case to require a more conspicuous warning system than a steady light would provide. Flashing lights and aural warnings may be necessary to alert the flightcrew to an unsafe condition.

8. DOOR JAM CONDITION. An external door, exit, or hatch which may be used for emergency exit in a crash should be designed to allow for fuselage distortion likely to result from a minor crash. This is usually achieved by allowing sufficient clearance between the door and surrounding fuselage support structure to accommodate likely distortions. Also, the possibility of distortion in the door cutout should be minimized by designing the door cutout frame with more strength than that of the surrounding structure.

9. SAFETY ASSESSMENT. Inadvertent opening of external doors must be shown to be extremely improbable by a safety analysis in accordance with § 25.783(f). This does not mean that a numerical safety analysis is always necessary to demonstrate compliance with this requirement, since door designs generally include design features which can be readily assessed for failure modes which impact safety. The safety analysis may be a detailed design review, a qualitative analysis, or a quantitative probability analysis. In evaluating a failure condition that results in total failure or inadvertent opening of the door, all contributing events should be considered, including failure of door and door supporting structure, flexibility in structures and linkages, failure of the operating system, failure of the warning system, and likely errors in operating and maintaining the door. In this regard, intentional opening by persons is not considered improbable. It should, therefore, not be possible to open the door during pressurized flight. Guidelines for performing a safety assessment are contained in AC 25.1309-1, System Design Analysis. Compliance may also be shown by comparison with earlier designs which have demonstrated a satisfactory level of safety.

10. DOOR OPERATING REQUIREMENTS.

a. Each door used for emergency egress must be openable from both the inside and the outside in accordance with § 25.783(b), even though persons may be crowded against the door on the inside of the airplane. Inward opening doors

may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. An acceptable method of ensuring that external doors which have inward movement are openable is by minimizing door inward motion and the possibility of bodily interference with operation of the inside handle.

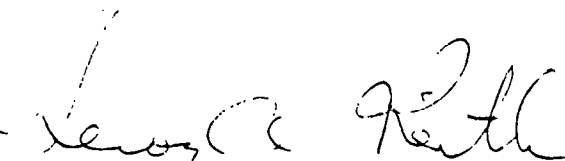
b. The means of opening must be simple and obvious and must be arranged and marked so that it can be readily located and operated under the required emergency conditions. Emergency exits utilized by passengers should not have more than one simple manual handle operation required to unlock and open the door. Sequence operations may be used for those exits utilized only by the flightcrew if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use. Sliding window emergency exits in the flightcrew area do not need to be openable from the outside if other approved exits allow access and are readily accessible to the flightcrew area.

11. EMERGENCY EGRESS.

a. As specified by § 25.809(b), each emergency exit must be capable of being opened within 10 seconds, when there is no fuselage deformation, measured from the time when the opening means is actuated to the time that the exit is fully opened and with the airplane in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear.

b. An acceptable method of ensuring that emergency exits can be opened under the above conditions is to provide a dedicated and independent power source as the primary means for opening the exit when activated. If a single power-boost or single power-operated system is the primary system for operating more than one exit in an emergency, each exit should still meet the requirements of the above paragraphs in the event of failure of the primary system.

12. OPERATING FORCES. Operation of emergency exits should be demonstrated without the use of primary aircraft power and without requiring exceptional skill or strength on the part of the operator. Operating forces should include the effects of maximum allowable ground cabin pressure differential. As a guide, these forces should not exceed 50 lbs. in either the horizontal or vertical directions. If a single power-boost or single power-operated system is the primary system for opening two or more exits in an emergency and if manual operation is the backup, it should be demonstrated that each exit can be opened under all the conditions specified in § 25.809 after failure of the primary system.



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