

(R) Exits and Their Operation – Air Transport Cabin Emergency

RATIONALE

This revision updates the recommended design practices for emergency exits installed in the passenger cabin of transport category airplanes.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) provides design and performance recommendations for emergency exits in the passenger cabin.

1.1 PURPOSE

The purpose of this ARP is to supplement the emergency exit certification requirements and guidance (e.g., FAA Part 25, EASA Part 25, FAA Advisory Circular 25.783-1A, etc.) by identifying design features that will help to make the operation of airplane passenger exits safe, simple, quick, and more intuitive under normal and emergency conditions. This document is not intended to specify particular design methods or mechanisms to be used to accomplish the objectives established herein.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. However, nothing in this document supersedes applicable laws or regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA or Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP503 Emergency Evacuation Illumination

ARP577 Emergency Placarding - Internal and External

2.2 FAA Publications

Available from the Federal Aviation Administration, 800 Independence Avenue SW, Washington, D.C. 20591, Tel. 866-835-5322, www.faa.gov.

Advisory Circular No. 25.783-1A Fuselage Doors and Hatches

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<http://www.sae.org/technical/standards/ARP488E>**

2.3 Code of Federal Regulations

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-0000, www.gpoaccess.gov.

14 CFR Part 25 Airworthiness Standards, Transport Category Airplanes

2.4 EASA Publications

Available from European Aviation Safety Agency, Postfach 10 12 53, D-50452 Koeln, Germany

CS-25 EASA Certification Specifications for Large Aeroplanes

2.5 Transport Canada Publications

Available from Transport Canada, 330 Sparks Street, Ottawa, ON, K1A 0N5

Advisory Circular No. 500-003 Emergency Exits Exposed to Freezing Rain

2.6 Definitions

2.6.1 5th Percentile Female: A female that is approximately 60 inches tall and weighs no more than 102 pounds.

2.6.2 50th Percentile Male: A male that is approximately 70 inches tall and weighs 170 (+/- 5) pounds.

2.6.3 95th Percentile Male: A male that is approximately 74 inches tall and weighs no less than 210 pounds.

2.6.4 Emergency Mode: The exit is in a condition such that its emergency power assist and evacuation assist means (as applicable) are automatically activated upon opening the exit from the inside of the airplane (e.g., armed mode).

2.6.5 Normal Mode: The exit is in a condition such that its emergency power assist and evacuation assist means (as applicable) are not activated upon opening the exit from the inside of the airplane (e.g., disarmed mode).

2.7 Mandating and Recommending Words

2.7.1 Shall: indicates a mandatory criterion

2.7.2 Should: indicates a criterion for which an alternative, including non-compliance, may be applied if it is documented and justified.

3. RECOMMENDATIONS

3.1 General Recommendations

3.1.1 Each floor-level passenger cabin emergency exit should have similar operating procedures to the other floor-level emergency exits on an aircraft.

3.1.2 An exit with a door/hatch that is automatically stowed out of the egress path when opened is preferable to a removable hatch that must be manually stowed.

3.1.3 For each exit design, the ability to operate the exit shall be demonstrated with the evacuation system in both the Normal and Emergency Modes. This should be accomplished by using a test sample of at least five participants who are representative of those expected to operate the exit, including a 5th percentile female and a 95th percentile male. Each test participant should open the exit from the inside with it in the Normal Mode and separately with it in the Emergency Mode.

3.1.4 Increasing cabin differential pressure should act to increase the security and retention of the exit door/hatch.

- 3.1.5 Opening the exit at the maximum residual cabin differential pressure at which the exit can be opened shall not create a hazard to the person opening the exit.
- 3.1.6 Means shall be provided to safeguard against inadvertent exit opening by passengers or crew during movement of the airplane on the ground or in flight. In addition, design precautions shall be taken to minimize the possibility of a person intentionally opening the exit during flight, except where emergency procedures require in-flight opening of the exit (e.g., smoke evacuation).
- 3.1.7 The exit shall be fully openable in the Emergency Mode when the airplane is in adverse attitudes that correspond to the loss of one or more legs of landing gear. This should be demonstrated, using a 5th percentile female, with the exit positioned in the worst-case attitude and taking into account the combined effects of the door/hatch weight, door/hatch motion and deployment of the evacuation assist means.
- 3.1.8 An exit equipped with an emergency power assist system should be fully openable in the event of airplane power loss, while the airplane is positioned at its normal attitude (i.e., losing the power to an emergency power assisted exit shall not cause the exit to be unopenable). It should be demonstrated that a 50th percentile male can open the exit from inside the airplane without the benefit of the power assist system when the airplane is positioned at normal airplane attitude.
- 3.1.9 An exit designated as an entry or service door and equipped with an emergency power assist system and/or an evacuation assist means that can be automatically deployed when the exit is opened, shall be provided with a means inside the airplane, on or adjacent to the door/hatch, to allow opening of the exit without activation of these devices (i.e., the ability to arm/disarm the system). This exit shall also have a means to automatically prevent deployment of the assist means if the exit is opened from outside the airplane. The power assist system may activate if the exit is opened from the outside, provided it does not create a hazard to the person opening the exit.
- 3.1.9.1 An exit dedicated for emergency use only and equipped with an emergency power assist system and/or an evacuation assist means that is automatically deployed when the exit is opened, should be provided with a means inside the airplane, on or adjacent to the door/hatch, to allow opening of the exit without activation of these devices (i.e., the ability to arm/disarm the system). For non-floor level exits, the means shall not be accessible to passengers.
- 3.1.9.2 Any potential hazards associated with opening an exit, which is dedicated for emergency use only, from the outside shall be identified in warning placards on the exterior of the exit (i.e., automatic activation of a descent device and/or a door power assist system),
- 3.1.9.3 The exit shall be openable in the event of ice buildup on the outside of the airplane. The ability to do so should be demonstrated by test. An acceptable test method is described in Transport Canada Advisory Circular No. 500-003.
- 3.1.9.4 The exit shall have a visual means that indicates when all required operations to close, latch, and lock the door have been completed.
- 3.1.9.5 The exit shall have a means to permit viewing of the conditions outside the airplane. If the outside viewing means cannot be positioned on the door, it may be located adjacent to the exit, provided there are no obstructions between it and the exit. The outside viewing means shall also permit viewing of the ground in the vicinity of where the evacuees would normally be expected to contact the ground when using the deployed evacuation assist means with the airplane in the normal attitude (all landing gear intact) and in the adverse attitudes corresponding to the loss of one or more legs of landing gear.

3.2 Detail Recommendations

3.2.1 Opening Handle, Interior, Floor-Level Exits

- 3.2.1.1 The handle used for opening an exit in normal (non-emergency) conditions shall also be used for opening the exit in Emergency Mode.
- 3.2.1.2 The handle location and operation shall be obvious. The handle should be located on the door. If the handle cannot be located on the door, it should be positioned immediately adjacent to the door away from seated passengers.
- 3.2.1.3 The entire operation of the handle shall be a smooth continuous motion, with no abrupt changes in force or direction. Adequate hand clearance shall be provided throughout the handle travel, and the arc of handle rotation shall not exceed 180 degrees.
- 3.2.1.4 Secondary operations (e.g., removing covers, unlocking stops, straps, bars, or catches) shall not be necessary to open the exit in the emergency mode.
- 3.2.1.5 In the event that an exit is for some reason limited to partial opening, the handle should not further impede someone's ability to use the exit.
- 3.2.1.6 The handle grip should be at least 10.2 cm (4 inches) wide, and the initial movement of the handle grip should be generally upwards.
- 3.2.1.7 The motion of the handle grip should provide the maximum mechanical advantage to assist in opening the exit. With the airplane in the normal attitude and subjected to the maximum normal allowable on-ground cabin pressure differential, the force required to operate the handle in the Emergency Mode should not exceed 222 newtons (50 pounds), and it shall be demonstrated that a 5th percentile female can fully open the exit.
- 3.2.1.8 The range of motion of the handle grip, through its full travel, should be between 76 cm (30 inches) and 140 cm (55 inches) above the floor.
- 3.2.1.9 The handle grip shall not be covered, hidden or obstructed by any cabin furnishings and shall contrast in color with the background and adjacent trim to enable locating the handle grip in emergency lighting conditions (see ARP503 for recommended emergency evacuation illumination levels).
- 3.2.1.10 The interior handle shall automatically return to the closed position when the exit is closed from outside the airplane. When the exit is closed from the outside, movement of the interior handle shall not be hazardous to someone positioned inside of the airplane near the exit.

3.2.2 Opening Handle, Interior, Non-Floor-Level Exits

- 3.2.2.1 The opening handle location and operation shall be obvious. The handle should be located on and positioned near the top of the door/hatch. The handle should be clearly visible and accessible, even if covered by a cover intended to preclude inadvertent opening by a passenger.
- 3.2.2.2 The handle grip should be at least 10.2 cm (4 inches) wide.
- 3.2.2.3 The motion of the handle grip shall provide the maximum mechanical advantage to assist in opening the exit. For removable hatches, the motion of the handle grip should facilitate the removal and handling of the hatch. With the airplane in the normal attitude and subjected to the maximum allowable on-ground cabin pressure differential, the force required to operate the handle in Emergency Mode should not exceed 222 newtons (50 pounds), and it shall be demonstrated that a 5th percentile female can fully open the exit.
- 3.2.2.4 If the exit can be closed from the outside, the interior handle shall automatically return to the closed position when the exit is closed from outside the airplane.