



Federal Aviation Administration

Memorandum

Date: November 20, 2015

To: Manager, Boeing Aviation Safety Oversight Office, ANM-100B

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Shannon Lennon, ANM-150S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Passenger Door Operational Arrow Location and Color on Boeing Model 787, Boeing Commercial Airplanes Delegated Compliance Organization (BDCO) Project No. PS07-0585, 787-9, Project Nos. PS06-0496 and PS06-0497, and 787-10, Project Nos. PS13-0546 and PS14-1031

ELOS Memo #: PS07-0585-CS-18

Regulatory Ref: § 25.811

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Boeing Model 787.

This memo was subsequently revised to extend this ELOS to the Boeing Models 787-9 and 787-10 airplanes.

Background

On the Model 787 series aircraft, the projected tip of the door handle marking arrow is more than one inch from the centerline of the exit handle when the handle has reached the full travel. Title 14, Code of Federal Regulations (14 CFR) 25.811(e)(4)(ii) requires that the center line of the handle be within 1 inch of the projected tip of the arrow. In addition, the proposed arrow and "OPEN" text on the 787 emergency exit doors is green in lieu of red as required by § 25.811(e)(4)(i) and (iii). These door features apply at all passenger cabin emergency exits on the Model 787 series.

Section 25.811(e)(4)(ii) requires the door arrow be positioned so that the projected point of the door arrow is within 1 inch of the centerline of the exit handle when the exit handle has reached its full travel and released the door locking mechanism.

Section 25.811(e)(4)(i) requires the emergency exit doors be marked with an arrow that is red in color and section 25.811(e)(4)(iii) requires the word “OPEN” in red letters near the head of the arrow.

Applicable regulation(s)

§ 25.811

Regulation(s) requiring an ELOS finding

§ 25.811(e)(4)(i), (ii) and (iii)

Description of compensating design features or alternative Methods of Compliance (MoC) which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The door design is found to provide an ELOS to the requirements in § 25.811(e)(4)(i), (ii), and (iii) based on the following compensating features:

- a) The design provides markings that provide a clear indication of direction of rotation and how far the exit handle should rotate when opening the door.
- b) The green arrow design clearly indicates a full 180 degree rotational motion required to open the door whereas § 25.811(e)(i) only requires the arrow cover 70 degrees of arc.
- c) The 787 door opens (clears all stops and guides) at 165 degrees with the emergency power assist system firing at 172 degrees (prior to the 180 degree door handle rotation). By the time the door has cleared the door stops and guides (165 degrees), the door handle will continue to rotate to its final position without any effort required from the person opening the door.
- d) Incorporation of an FAA-accepted special emphasis briefing to be included in the aircraft flight manual along with the requirement that the briefing be given to the passengers prior to each flight and prior to each landing.
- e) Development of an FAA-accepted implementation plan that will ensure incorporation of appropriate emergency exit operation information in the flight attendant training manual and in standard passenger information cards (such as those required by section 121.571(b)) at each passenger seat place that can be occupied for taxi, takeoff and landing. The green arrow and “OPEN” on the door must be depicted on a flight safety card at each passenger seat that can be occupied for taxi, takeoff and landing.

Explanation of how design features or alternative Methods of Compliance (MoC) provide an equivalent level of safety to the level of safety intended by the regulation

The FAA considers the Model 787 door design, with the use of a green arrow, green “OPEN” text, and the position of the arrow relative to the position of the fully rotated door handle, to provide an ELOS to the requirements in § 25.811(e)(4)(i), (ii), and (iii).

Arrow Location:

Airplane safety is improved when the emergency exits are clearly marked with instructions that make operation of the exit intuitive to all users under normal and emergency conditions. Section 25.811(e)(4)(ii) requires the door arrow be positioned so that the projected point of the door arrow is within 1 inch of the centerline of the exit handle when the exit handle has reached its full travel and released the door locking mechanism. The intent of the requirement is to ensure that the markings give a clear indication of how far the exit handle must travel, against any resistance that may be felt, to release the locking mechanism and open the door. The Model 787 door design meets the “intent of the rule” by utilizing markings that provide a clear indication of the direction of rotation and how far the exit handle should be rotated when opening the door.

While the 787 door handles are designed with a full travel of 180 degrees, the door is free to rotate outboard (all door stops and guides cleared) by the time the handle has rotated 165 degrees and the emergency power assist system activates when the handle has been rotated 172 degrees. By the time the door has cleared the door stops and guides (165 degrees), the door handle will continue to rotate to its final position without any effort required from the person opening the door. In fact, effort would be required to stop the handle from continuing to rotate to the full open position.

Color, Green vs. Red:

Section 25.811(e)(4)(i) requires the emergency exit doors be marked with an arrow that is red in color and § 25.811(e)(4)(iii) requires the word “OPEN” in red letters near the head of the arrow. These regulations were adopted at Amendment 25-1, when specific requirements for both interior and exterior markings were incorporated into the 14 CFR part 25 regulations. The selection of red for door operating instructions in Amendment 25-1 is not explicitly supported by any current industry standard. Further, based on current industry standards, specifically Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 557D, green is a more appropriate color for emergency exit markings because it provides a greater contrast than the red and is considered the appropriate color for emergency egress.

While the green 787 door arrow and green “OPEN” text do not meet the literal requirement, they do meet the “intent of the rule” by providing exit markings that contrast well with the background color and are consistent with recommendations provided in several industry standards for emergency exit markings. The green exit markings provide legible operating instructions that are clearly visible in both normal and emergency lighting conditions.

Information must be provided regarding the use of the color green (and its associated message) to the airlines to assure consistency with regard to the use of color as shown on the safety cards with the actual airplane design. Additionally, the flight attendant training manual must clearly communicate this “green” message. Referring to Amendment 25-1, the linkage between exit markings with passenger safety cards and attendant briefing was recognized as critical in ensuring awareness of exits and exit operation.

The green emergency exit door arrow and “OPEN” text must be included in the standard passenger information card that is produced and installed by each Model 787 operator in lieu of installing a separate flight safety card. Necessary information must be provided to facilitate operator special emphasis briefings intended to convey the green emergency exit information.

Additionally, the FAA has determined that special emphasis briefings, associated with conveying the green emergency exit operation information, must be given to passengers prior to takeoff and also prior to landing.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned equivalent level of safety finding in project Issue Paper CS-18 or Administrative Collector Issue Paper G-6. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number should be listed in the type certificate data sheet under the Certification Basis section. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulations:

§ 25.811(e)(4), Emergency Exit Marking (documented in ELOS Memo PS07-0585-CS-18)

Todd Martin For Suzanne Masterson
Transport Airplane Directorate,
Aircraft Certification Service

11/25/15
Date

ELOS Originated by Seattle ACO:	Shannon Lennon	ANM-150S
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