



Federal Aviation Administration

Memorandum

Date: December 22, 2010

To: Manager, Seattle Aircraft Certification Office, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Rene Buendia, ANM-150S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Boeing 747-8/8F Visual Indication of Forward and Aft Lower Lobe Cargo Door Locked Condition (Project No. PS05-0212)

ELOS Memo#: PS05-0212-C-1

Reg. Ref.: §§ 21.21(b) and 25.783(e)

The purpose of this memorandum is to inform the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate on the establishment of an equivalent level of safety finding (ELOS) for the Boeing Model 747-8/8F visual indication of forward and aft lower lobe cargo door locked condition.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.783(e), Amendment 25-88, requires that there must be a provision for direct visual inspection of the locking mechanism to determine if external doors, for which the initial opening movement is not inward (including cargo doors), are fully closed and locked. The provision must be permanent and discernible under operational lighting conditions, or by means of a flashlight or equivalent light source. The Model 747-8/8F series lower lobe cargo doors are initial outward opening external doors. These doors are unchanged relative to the doors installed on Model 747-400F with respect to the following provisions for direct visual inspection of the closed, latched and locked condition:

- The lower lobe cargo door closed condition is verified by the door being faired with the fuselage. Boeing reports that doors not fully closed will be apparent by an approximate 3 inch opening along the lower edge of the door.
- The lower lobe cargo door design incorporates external viewports for visual inspection of the latched condition via alignment of yellow stripes on each latch cam with yellow arrows to the corresponding latch pin support fitting.

- The lower lobe cargo door locking mechanism is manually operated via an external handle mounted to the door. The locking mechanism cannot be operated to the locked position unless all the latches are rotated to the latched position. The vent doors in the closed position provide a means of determining that each latch is locked.

An ELOS finding was made for the 747-400F door, however, the certification basis of the 747-400F is earlier than the 747-8/8F, and therefore the previous 747-400F ELOS in and of itself is not sufficient.

Applicable regulation(s)

§§ 21.21(b) and 25.783(e)

Regulation(s) requiring an ELOS finding

§§ 25.783(e)

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

The 747-8F and 747-8 forward and aft lower lobe cargo doors, while providing a means for direct visual inspection of the closed condition and of the latched condition (via the eight viewports on the door outer skin), provide a means for indirect visual inspection of the locked condition. The movement and final position of the lock handle at the input to the lock mechanism and of the pressure limiting (vent) doors at the other end of the lock mechanism provide direct visual confirmation that the entire lock mechanism is in the locked position. They also provide the indirect visual inspection means of the locked condition.

Visual inspection for the condition of door closed, door latched, and door locked are performed as follows:

- a. Check that the door skin is flush with the fuselage skin for verification of door closed condition.
- b. Check that the door is fully latched by observing, through the door viewports, that the stripe on each rotary latch cam (total of 8 latch cams) is aligned with the arrow on the adjacent latch pin fitting.
- c. Observe pressure limiting doors closing while moving the lock handle to the closed position. In the closed position, the lock handle is flush with the door skin and both pressure limiting doors are closed/flush with the door skin.

Additional details that ensure the visual determination of closed and locked include the following:

- a. There are no single failure modes that could allow a false closed, latched, and locked condition. There are no single failure modes in the lock mechanism that will result in both pressure limiting doors going to the closed/flush state if the lock sectors are not monitoring the respective latch cams.

- b. The closed position of the pressure limiting doors, used to provide direct visual confirmation of the locked condition, is maintained by the engagement of the lock handle assembly lockpin to the handle box mounted lockpin receptacle. The lock handle is linked directly to the pressure limiting doors via bellcranks, pushrods and torque tubes. The pressure limiting doors are spring-biased to the open state and any failure in the lock mechanism in series between the handle and the pressure limiting doors will cause the pressure limiting doors to remain open.
- c. Erroneous flight deck indication of door closed, latched, and locked will be shown to be improbable per the requirements in § 25.783(e). Additionally, nuisance flight deck indication of the door status (false indication of door not closed, not latched, and/or not locked) will be shown to be improbable.
- d. The number of latches necessary to retain the door is seven of the installed eight.
- e. The number of locks necessary to restrain the latches is seven of the installed eight.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

Compensating features are noted above regarding the design of the 747-8/8F forward and aft lower lobe cargo door mechanisms. These features compensate for the inability to directly visually confirm that the locking mechanism is in the closed and locked condition.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper C-1. This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The Transport Directorate 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 (TC's & ATC's) or in the Limitations and Conditions Section of the STC Certificate. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulation(s):
 § 25.783(e) (documented in TAD ELOS Memo PS05-0212-C-1)

for Franklin Thompson
 Manager, Transport Airplane Directorate,
 Aircraft Certification Service

12/22/10
 Date

ELOS Originated by Seattle ACO:	Project Engineer Rene Buendia	Routing Symbol ANM-150S
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