



# Federal Aviation Administration

---

---

## Memorandum

Date: December 8, 2010

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Stephen Styskal

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Boeing 747-400 Large Cargo Freighter Visual Inspection Camera System, FAA Project No. PS05-0023

ELOS Memo #: PS05-0023-C-2

Reg. Ref.: §§ 25.783(f) and 21.21(b)

---

---

The purpose of this memorandum is to inform 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 Boeing Model 747-400 Large Cargo Freighter (LCF) airplanes equipped with a visual inspection camera system.

### **Background**

The Boeing Company has proposed a unique swing tail door design to support conversion of a Model 747-400 passenger aircraft into a 747-400 LCF configuration to carry large/outsized parts. The size of the swing tail door and the design of the latch and locking system present some unique challenges with regard to compliance with the requirements of Title 14 Code of Federal Regulations (14 CFR) 25.783(f), Amendment 25-114. Boeing has proposed to utilize a remotely controlled camera system in order to be able to verify the swing tail door is fully closed, latched and locked when visual inspection of the system is required.

Section 25.783(f) requires that each door for which unlatching of the door could be a hazard must have a provision for direct visual inspection to determine, without ambiguity, if the door is fully closed, latched and locked. The provision must be permanent and discernible under

operational lighting conditions, or by means of a flashlight or equivalent light source. Analysis of the 747-400 LCF design indicates that the swing tail door would result in a hazard if the door became unlatched during operation.

The swing tail door includes latch pin actuators (LPA) arranged in three lock trains around the periphery of the swing tail section to provide latching and locking functionality. Each LPA is mounted to a clevis fitting and has a latch pin that extends to engage a fixed lug on the forward section of the airplane to latch and lock the swing tail in place when it is closed. Each LPA has an integral latch retention shaft and a separate lock mechanism. Each lock train drives the LPA lock mechanisms to the locked and unlocked positions.

Certain LPAs are mounted in the crown area, and cannot be viewed without ambiguity unless specialized tooling or hardware is provided to gain access/proximity to the LPAs. Several other LPAs are also subject to the same accessibility issues.

Section 25.783(f) at Amendment 25-114 requires that there be “a provision for direct visual inspection, without ambiguity, if the door is fully closed, latched, and locked.” The Federal Aviation Administration (FAA) has concluded that a remotely operated camera viewing system provides, at best, indirect inspection capabilities. As such, an equivalent level of safety finding would be necessary if the proposed approach was utilized as part of the showing of compliance to § 25.783(f).

The FAA agrees that a remote camera viewing system with proper lighting, controllability and resolution could be found to provide an equivalent level of safety to the requirements of section 25.783(f) when used in combination with the unaided, albeit somewhat distant, visual inspection of the latch retention and lock sectors of each LPA. Any remote viewing system that provides acceptable capabilities (as determined by the FAA) may be utilized in conjunction with this equivalent level of safety finding.

### **Applicable regulation(s)**

§ 25.783(f)

### **Regulation(s) requiring an ELOS finding**

§ 25.783(f)

### **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 camera viewing system is considered to provide an ELOS to § 25.783(f) as long as it offers the following compensating features:

- The camera system and extension pole system will be available at a secure location in close proximity to the aircraft, at each LCF site and under direct control of the aircraft

operation site leader or their designee. The camera system and extension pole system equipment will be stored, operated and maintained in accordance with aircraft operations and maintenance procedures.

- The requirement to perform a visual inspection to verify the latched and locked condition prior to each departure will be listed in the FAA Master Minimum Equipment List (MMEL) for dispatch in the event of swing tail indication (not closed, not latched, not locked) after all door closing, latching, and locking operations have been completed.
- The Boeing Dispatch Deviation Guide (DDG) will provide specific procedures to be accomplished prior to each MMEL authorized departure for a direct visual inspection of the latched and locked condition using the camera system, including information contained in and referenced in the Boeing Airplane Maintenance Manual (AMM) containing the instructions for the use of the camera system.
- The 747-400 LCF AMM will contain the instructions for:
  - Set up and assembly of the equipment inside the swing tail
  - Verification of camera function prior to its use
  - Use of the camera system to inspect latch retention and lock sectors not otherwise readily viewable
  - Disassembly of the equipment
- There will be a planned check/maintenance placard where the camera is stored. There will also be additional placards on the camera system equipment that will have operation instructions and provide space to note the date the last check was performed.
- A certification test/demonstration will be conducted of the direct visual inspection of each latch retention and lock sector. The demonstration will be a combination of unaided direct visual inspection of the accessible LPAs with flashlights as required along with the use of the camera system.

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

A remotely controlled camera viewing system shall be used in combination with an unaided, albeit distant, visual inspection of the latch retention and lock sectors of each LPA to provide an ELOS to the requirements of § 25.783(f) at Amendment 25-114. This ELOS is dependent on the FAA's determination that a specific remotely controlled camera viewing system design provides the ability to determine, without ambiguity, that the swing tail is fully closed, latched and locked. It is acceptable that the camera system provide its own light source to assist in this determination. The camera system must be approved by the FAA prior to use. Additionally, subsequent changes to the operating environment that would restrict the established camera system operating/maneuvering space will necessitate coordination with the FAA for re-evaluation of the system for continuing compliance to part 25.

The camera system's usage will be required under conditions identified in the Boeing 747-400 LCF MMEL, DDG, and AMM for those LPAs otherwise not readily accessible. These documents will contain requirements that the operator must use the FAA approved camera system, for those LPAs otherwise not readily accessible, in the event that a visual inspection of the status of each of the latch retention/lock shafts is required. This provision is necessary, in accordance with Advisory Circular (AC) 25.783-1A, when a remote indication of an unlatched and/or unlocked LPA remains after all closing, latching, and locking operations have been completed and a determination whether to permit flight needs to be made.

### **FAA approval and documentation of the ELOS finding**

The FAA has approved the aforementioned ELOS finding in project issue paper C-2. This memorandum provides standardized documentation of the ELOS finding 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 regulation(s):  
§ 25.783(f) (documented in TAD ELOS Memo PS05-0023-C-2).

Original Signed by

*Franklin Tiangsing*

\_\_\_\_\_  
Manager, Transport Airplane Directorate,  
Aircraft Certification Service

January 4, 2011

\_\_\_\_\_  
Date

ELOS Originated by Seattle ACO:	Project Engineer Stephen Styskal	Routing Symbol ANM-150S
------------------------------------	-------------------------------------	----------------------------