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: Jim Voytilla, ANM-100B

Subject: INFORMATION: Equivalent Level of Safety Finding on Cabin Altitude Warning System for Operations into High Altitude Airports for the Boeing Company Model 787-8/-9/-10 (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546 and PS14-1031)

Memo No.: TC6918SE-T-ES-19

Reg. Ref.: §§ 21.21(b)(1), 25.841(a), (b)(6), & (b)(8), 25.1309(c), and 25.1447(c)(1)

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 finding (ELOS) for the Model 787-8 airplane.

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

Background

Boeing intends to certify the Model 787 series airplane for takeoff and landing at airports with elevations up to 14,500 feet. Per Title 14, Code of Federal Regulations (CFR) 25.841(a), under normal operating conditions, the cabin pressure altitude cannot exceed 8,000 feet. Section 25.841(b)(6) requires crew warning indication when the cabin pressure altitude exceeds the safe or preset pressure differential and cabin pressure altitude limits are exceeded. This regulation states that the warning requirement for cabin pressure altitude limits may be met if the warning is set for 10,000 feet. Use of this accepted setting for operations into, and out of, airports at elevations exceeding 10,000 feet would result in nuisance altitude warnings during takeoffs and landings. Boeing has designed a system that changes the cabin pressure altitude warning limit

under specific conditions for these high altitude airport operations and requested an equivalent level of safety to allow a cabin pressure altitude warning that annunciates at cabin pressure altitudes greater than 10,000 feet.

Applicable regulation(s)

§§ 21.21(b)(1), 25.841(a), (b)(6) & (b)(8), 25.1309(c), and 25.1447(c)(1)

Regulation(s) requiring an ELOS

§ 25.841(b)(6)

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 cabin pressure altitude must equal the airport elevation during departure or landing. Boeing has designed a cabin pressure control system, a cabin altitude warning system with multiple cabin altitude warning limits, and associated flight deck indications for high altitude operations, that allow takeoffs and landings at airport elevations between 8,000 feet and 14,500 feet for Model 787 airplanes.

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

The Model 787 uses cabin altitude sensors and Display and Crew Alerting (DCA) software to generate a warning level Engine Indicating and Crew Alerting System (EICAS) message "CABIN ALTITUDE" and an aural alert when the cabin pressure altitude exceeds 10,000 feet during normal operations. This warning limit will also generate the "CABIN ALTITUDE" EICAS message during high altitude airport (i.e., Greater than 9,500 feet) operations. Boeing has proposed that the Model 787 design include additional cabin altitude warning limits for use during high altitude airport operations. The resulting cabin altitude warning configurations are as follows:

Destination Airport Altitude	**Cabin Altitude Warning Limit**
Less than 9,500 feet	10,000 feet
Greater than 9,500 feet and Less than 14,000 feet	14,650 feet
Greater than 14,000 feet	15,650 feet

If a landing field is selected for a destination field in excess of 8,000 feet and the aircraft holds between 10,000 feet and 15,650 feet, the occupants and crew may be exposed to cabin altitudes of 10,000 feet or greater for duration in excess of that allowed by the operating rules and without cabin altitude warning in the high altitude mode. The operating rules §§ 91.211, 121.329(b), and

135.89(b)(1) address the use of oxygen to prevent hypoxia and related degraded pilot performance. To mitigate this, Boeing provided additional information concerning a "HIGH CABIN ALT MODE" memo message that appears in white text at the bottom of the EICAS message window when the cabin altitude warning limit shifts from 10,000 feet to a higher setting. There is no manual means to clear or override the "HIGH CABIN ALT MODE" memo message and the memo message only clears when the cabin altitude warning limit shifts back to 10,000 feet. This memo message meets the compensating factor requirement for visual indication to the flight crew. In addition, the flight crew will be required to don oxygen masks during operations into, and out of, high altitude airports. The requirement to don oxygen masks is similar to previously certified Boeing airplanes that conduct high altitude operations. These procedures will be FAA approved and inserted into the Airplane Flight Manual.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding in project issue paper ES-19 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 Safety Findings have been made for the following regulation(s):
§ 25.841(b)(6), "Pressurized Cabins" (documented in TAD ELOS Memo TC6918SE-T-ES-19).

Christopher Parker

Transport Airplane Directorate,
Aircraft Certification Service

12/3/2015

Date

ELOS Originated by ACO:	Nick Wilson	ANM-150S