



Federal Aviation Administration

Memorandum

Date: March 17, 2016

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 (ELOS) finding for Portable Pulse Oxygen System for the Boeing Models 737-600/-700/-700C/-800/-900/-900ER (737NG), 737-7/-8/-9 (737MAX), 787-8/-9/-10 (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS12-0037, PS12-0038, PS12-0039, PS13-0546, PS14-1031, and PS15-0817)

ELOS Memo No.: TC6918SE-T-ES-20

Reg. Ref.: § 25.1443(d), Amendment 25-0

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 Title 14, Code of Federal Regulations (14 CFR) 25.1443(d) (first aid oxygen equipment) for the Boeing Model 787-8 airplane.

This memo does not address compliance with § 25.1447(c)(4) (portable oxygen equipment for cabin attendants) or § 25.1443(e) (minimum mass flow of oxygen for portable oxygen equipment installed for use by crewmembers).

This memo was subsequently revised to extend this ELOS to the Boeing Models 737-600/-700/-700C/-800/-900/-900ER (737NG) and 737-7/-8/-9 (737MAX) airplanes.

Background

Section 25.1443(d) requires that if first aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than four liters per minute, standard temperature pressure dry (STPD). For the Models 737NG, 737MAX, and 787 series airplanes, Boeing has proposed to utilize portable first aid oxygen equipment that uses

pulse oxygen technology. Because oxygen in a pulse system is delivered in short bursts, rather than a constant flow, the actual flow rate is less than 4 liters per minute STPD so direct compliance with § 25.1443(d) cannot be shown.

The § 25.1443(d) requirement which describes the minimum mass flow of oxygen for first aid oxygen equipment was originally required by Civil Air Regulations (CAR) Part 4b, Amendment 4b-9, effective September 1, 1958. The preamble for this amendment states that a prescription is being added to define the quantity of oxygen to be made available for first aid use. To avoid having to predict the pressure altitudes at which such will be used, the prescription is in terms of flow at standard temperature and pressure. The CAR 4b requirement was adopted into § 25.1443(d) and has remained unchanged. Boeing contends that providing a high concentration of oxygen at the start of inhalation with a pulse oxygen system provides a level of protection equivalent to that provided by previously certified constant flow oxygen systems because the pulse system only provides oxygen during the phase in the respiratory cycle when it is most effectively used by the body.

Boeing proposed to show an ELOS to § 25.1443(d) by use of a comparative test with existing, compliant constant flow first aid oxygen equipment. The proposed test will demonstrate that the portable pulse oxygen delivery provides an equivalent physiological effect to a person as indicated by their oxygen saturation (SaO₂) level when subjected to a hypoxic condition induced by a combination of exercise and reduced partial pressure of oxygen brought about by increased altitude in an altitude chamber.

A proposed test plan will be submitted to the FAA for approval. Included in the test plan will be the number of test subjects, altitude exposure, method of inducing a metabolic work load and equipment used for comparison of the two types of oxygen delivery hardware.

Applicable regulation(s)

§§ 21.21(b)(1) and 25.1443(d)

Regulation(s) requiring an ELOS finding

§ 25.1443(d), Minimum mass flow of supplemental oxygen.

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

Pulse oxygen delivery provides the compensating design feature by delivering oxygen only at the start of the inhalation phase of the breathing cycle. Thus, the supplemental oxygen enters the alveoli where transfer to the blood stream takes place. The pulse delivery method does not waste oxygen by filling the transport elements of the lungs, such as the trachea, only to be exhaled or by flowing oxygen during the exhalation cycle. Another benefit of using pulse delivery is that the number of pressurized oxygen

cylinders that must be carried on the airplane may be reduced since the overall quantity of oxygen provided to the user is reduced.

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

The requirements of § 25.1443(d) provide protection to cabin occupants that may require first aid oxygen following exposure to high cabin pressure altitudes, such as following a decompression. Comparative human subject testing in an altitude chamber will show that an equivalent level of protection is provided to cabin occupants while utilizing the pulse oxygen system.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project Issue Paper ES-20 (Project No. TC6918SE-T (787-8)), Administrative Collector Issue Paper G-6 (PS06-0496, PS06-0497 (787-9)), Administrative Collector Issue Paper G-6 (PS12-0037, PS12-0038, PS12-0039 (737MAX), Administrative Collector Issue Paper G-6 (PS13-0546, PS14-1031 (787-10)), and Administrative Collector Issue Paper G-6 (PS15-0817 (737NG)). 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 finding has been made for the following regulation:
§ 25.1443(d), Minimum mass flow of supplemental oxygen (documented in TAD ELOS Memo TC6918SE-T-ES-20).

Original Signed by

Jon Regimbal

Transport Airplane Directorate,
Aircraft Certification Service

March 21, 2016

Date

ELOS Originated by Seattle ACO:	Project Engineer Robert Hettman	Routing Symbol ANM-150S
------------------------------------	------------------------------------	----------------------------