Federal Aviation Administration

Memorandum

Date: January 7, 2011

To: Manager, Transport Standards Staff, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-110

Prepared by: Robert Hettman, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Airbus Model A350 series Passenger Oxygen System (FAA Project Number TC0544IB-T)

ELOS Memo#.: TC0544IB-T-ES-13

Reg. Ref.: § 25.1443(c)

Background

Airbus has submitted a request for an Equivalent Safety Finding to Title 14 Code of Federal Regulations (CFR) section 25.1443(c) for the Model A350. Section 25.1443(c) specifies minimum mass flow requirements for passenger and cabin attendant supplemental oxygen systems in terms of mean tracheal partial pressure, breathing rate, and tidal volume per breath. The current requirement of § 25.1443(c) focuses on the substantiation of mean tracheal oxygen partial pressure, which is based on the constant flow oxygen systems and test methodologies available at the inception of the rule forty years ago, and do not specifically correspond to how human subjects would respond if actually subjected to decompression conditions. Alternatively it is possible to verify the hypoxia protection capability of oxygen equipment by measuring the blood oxygenation level instead of substantiating the mean tracheal oxygen partial pressure.

Airbus plans to install a flow controlled oxygen system, called a continuous flow oxygen system on the A350. The system will not deliver oxygen per the minimum mass flow performance parameters specified in § 25.1443(c).

Applicable regulation

§ 25.1443(c)

Regulation requiring an ELOS finding
§ 25.1443(c), 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)

The blood oxygenation level in human bodies is characterized by the stabilized arterial blood oxygen saturation level (SaO2). The SaO2 level is directly related to the level of hypoxia protection. Human subject testing in an altitude chamber will be conducted to demonstrate that the flow controlled passenger oxygen system provides a level of hypoxia protection equivalent or better than the level of protection required by § 25.1443(c). The purpose of the test is to demonstrate that the flow controlled oxygen system ensures test subjects SaO2 levels, which are sufficient or at least as high as the applicable baseline SaO2 level. A summary of the test is described below:

1. Between 10,000 ft and 18,500 ft cabin pressure altitude, the supplemental oxygen system for the passenger and cabin crew shall provide oxygen to maintain a SaO2 level that is equivalent with the SaO2 level reached at 10,000 ft cabin pressure altitude when breathing standard air. Breathing standard air at 10,000 ft cabin pressure altitude provides a mean tracheal oxygen partial pressure of 100 mmHg as required by § 25.1443(c).
2. Between 18,500 ft and 40,000 ft cabin pressure altitude, the supplemental oxygen system for the passenger and cabin crew shall provide oxygen to maintain a blood oxygenation level that is equivalent with the blood oxygenation level reached at 14,000 ft cabin pressure altitude when breathing standard air. Breathing standard air at 14,000 ft cabin pressure altitude provides a mean tracheal oxygen partial pressure of 83.8 mmHg as required by § 25.1443(c).
3. The testing shall be accomplished in accordance with established industry practices. The evaluation of the passenger oxygen system performance must include an agreed number of masks and randomly selected novice human subjects. If new and novel test methods are used, statistical means must be provided to justify the quantity of test subjects.
4. The test subjects shall be exposed to the full range of altitudes for which the system will be certified to. A series of exposures at increments of at maximum 7,500 feet pressure altitude is acceptable for compliance demonstration.
5. To address the increased breathing rate of a panicking person, the flow controlled oxygen equipment may be demonstrated by tests using a breathing machine (breathing machine performance as specified in SAE ARP 1109B). The tidal volume and breathing rate specified in § 25.1443(c) should be used for tests using a breathing machine.
6. For a subset of the test runs, the altitude chamber may be simulated on ground by using hypoxic gas mixtures.

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(c) provide protection to cabin occupants from the effects of hypoxia by requiring physiological breathing environments (mean tracheal oxygen partial pressures) equivalent to those at 10,000 or 14,000 feet depending on the actual cabin pressure altitude. Human subject testing in an altitude chamber will show that an equivalent level of protection from hypoxia is provided to cabin occupants while utilizing the flow controlled oxygen system.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper ES-13. 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):
§ 25.1443(c), Minimum mass flow of supplemental oxygen
(documented in TAD ELOS Memo TC0544IB-T -ES-13)

for Manager, Transport Airplane Directorate,
Aircraft Certification Service

JANUARY 7, 2011
Date

ELOS Originated by Transport Standards Staff:	Project Engineer Robert Hettman	Routing Symbol ANM-112