Federal Aviation Administration

Memorandum

Date: December 17, 2010

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Robert Hettman, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Airbus Model A350 series Crew Determination of Quantity of Oxygen in Passenger Gaseous Oxygen System Distributed Cylinders (FAA Project Number TC0544IB-T)

ELOS Memo#: TC0544IB-T –ES-7

Reg. Ref.: § 25.1441(c)

This memorandum informs 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 for the Airbus Model A350 aircraft.

Background

Title 14 Code of Federal Regulations (14 CFR) part 25 section 25.1441(c) requires a means to allow the crew to readily determine, during flight, the quantity of oxygen available in each oxygen supply source. The basic passenger supplemental oxygen system on the Airbus Model A350 will be a chemical oxygen generator system. As an option, the passenger supplemental oxygen system will incorporate small, one-time use lifetime sealed gaseous oxygen cylinders distributed throughout the cabin. As such, no means will be incorporated to inform the crew of the quantity of oxygen available in each of the small cylinders.

The § 25.1441(c) requirement to provide a means for the crew to readily determine, during flight, the quantity of oxygen available at each source was originally required by Civil Air Regulations (CAR) Part 4b. The associated guidance at the time, Civil Aeronautics Manual (CAM) 4b, tied the CAR 4b requirement to the measurement of pressure, which corresponds to the design of typical systems at the time and today, as previously described. CAM 4b stated that at least one pressure gauge, which could be

observed by a flight crew member during flight, should be installed to indicate the pressure in each source of oxygen supply.

The ability to obtain oxygen quantity information is important for typical gaseous oxygen system designs. These designs commonly utilize several pressurized cylinders which are connected together with a manifold and act as a single supply source. By knowing the pressure in this supply source and the number of cylinders, the quantity of oxygen can be determined. Depletion of oxygen within this system due to use or leakage is not uncommon. Leakage most often occurs in the high pressure portion of the system, typically at the cylinder, pressure regulators or at fittings associated with the high pressure tubing interconnecting the cylinders, and is related to improper maintenance activities or in-service wear or damage. Maintenance activities associated with this kind of system that can expose it to damage include replacing or refilling depleted cylinders, removing and replacing cylinders for periodic maintenance, and performing periodic leak checks. Because the quantity of oxygen within this system depletes over time, a means to determine the quantity of oxygen (i.e. system pressure) is made available to the flight crew during flight.

In the distributed gaseous oxygen system, a small gaseous oxygen source is located in each passenger service unit which provides oxygen for up to 6 oxygen masks. The oxygen source is a single use metallic sealed high pressure steel cylinder equipped with a single-stage pressure reducer. The activation of oxygen supply is initiated by pulling a mask towards the passenger which removes the activation pin. Removal of the activation pin releases a spring loaded needle inside the actuator assembly. The spring loaded needle punctures a rupture disc which allows oxygen to flow through the pressure reducer and into the oxygen masks.

Airbus requested an ELOS with § 25.1441(c) for an oxygen source that is a lifetime sealed high pressure oxygen cylinder. Airbus proposes that if the oxygen source is a lifetime sealed high pressure oxygen cylinder, the oxygen source can be considered to be at full oxygen capacity provided the oxygen quantity has not depleted since the date of manufacture.

Applicable regulation
§ 25.1441(c)

Regulation requiring an ELOS finding
§ 25.1441(c)

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 oxygen cylinder assembly consists of the oxygen cylinder and actuator/regulator assembly. The oxygen cylinder assembly is designed to be single use and refilling of the cylinder or re-use of the actuator/regulator assembly is not intended. The cylinder

assembly is designed and tested to ensure that it will retain its required quantity of oxygen throughout its expected life under foreseeable operating conditions. When the cylinder is activated under normal operation, positive indication is provided because the activation pin is no longer visible and the oxygen masks will no longer be connected to the activation pin. Positive indication is also provided under each passenger service unit, readily visible within the passenger cabin, if a distributed gaseous oxygen cylinder has been depleted due to over pressurization. Design considerations have also been incorporated to prevent maintenance personnel or overhaul facilities from "re-setting" the indication means so that it appears that an empty cylinder is actually full. Airbus also concurred to define maintenance and inspection procedures in the Maintenance Review Board (MRB) Report to ensure that i) discharged cylinders are removed from the airplane within a reasonably short time under normal maintenance procedures, and ii) cylinders are not installed on the airplane past their expiration date. Each cylinder will be labeled such that the expiration date can be easily determined by maintenance. In addition, the life limit of the cylinder has been established by test and analysis.

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

Each distributed gaseous oxygen cylinder assembly is designed and tested to ensure that it will retain the required quantity of oxygen throughout its service life under foreseeable operating conditions. As such, the crew is ensured that a sufficient oxygen supply remains inside the cylinder over the entire life limit, or until the flow of oxygen has been initiated. If a cylinder has been depleted due to activation or over-pressurization, positive indication is provided so the cylinder assembly can be replaced with a full unit.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned equivalent level of safety finding in the A350 project issue paper ES-7, titled "Crew Determination of Quantity of Oxygen in Passenger Gaseous Oxygen System Distributed Cylinders." 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 A350 Type Certificate Data Sheet under the Certification Basis section. An example of an appropriate statement is provided below:

An Equivalent Level of Safety Finding has been made for the following regulation: § 25.1441(c) (documented in TAD ELOS Memo TC0544IB-T –ES-7).

Original signed by

Victor Wicklund January 4, 2011

Manager, Transport Airplane Directorate, Date
Aircraft Certification Service

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