



# Federal Aviation Administration

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## Memorandum

Date: November 23, 2010

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Steve Happenny, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Airbus Model A350 series Ventilation System Failures – Cabin Temperature and Humidity (FAA Project Number TC0544IB-T)

ELOS Memo#: TC0544IB-T –ES-15

Reg. Ref.: § 25.831(g)

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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

Airbus has declared that the A350 aircraft will not demonstrate compliance with airworthiness requirement § 25.831(g) that states in part “(g) *The exposure time at any given temperature must not exceed the values shown in the following graph after any improbable failure condition.*” The intent of 14 CFR 25.831(g) is to ensure that in the event of airplane ventilation system failures, the temperature and humidity within the airplane shall not exceed values that are hazardous to the occupants.

In the preamble to Amendment 25-87, during the Supersonic Transport (SST) review in the 1960s, it was noted that certain pressurization system failures, whether considered alone or in combination with the use of ram air for emergency pressurization, could lead to cabin temperatures exceeding human tolerance. The FAA therefore concluded that any failure or combination of failures that could lead to temperature exposures that would cause undue discomfort must be shown to be improbable. Minor corrective actions (e.g., selection of alternate equipment or procedures) would be allowed if necessary for probable failures. The FAA also concluded that any failure or combination of failures that could lead to intolerable temperature exposures must be extremely improbable. Major corrective actions (e.g.,

emergency descent, configuration changes) would be allowed for an improbable failure condition. Temperature limits were incorporated into the special conditions imposed on executive transport airplanes when approved for high altitude operation. The SST and executive transport special conditions contained two graphs that provided the requirements for the probable and improbable cases. In formulating § 25.831(g), the FAA determined that the public interest is served by adopting, per Amendment 25-87, time-temperature limits associated with improbable failure conditions. Section 25.831(g) at Amendment 25-87 does not allow the time of exposure at any given temperature to exceed the values given in the associated graph.

While well intended, Amendment 25-87 incorporated a time-temperature relationship containing a single-point humidity requirement. Manufacturers have found this difficult or impossible to comply with under the assumption of loss of all conditioned airflow for flight following failure, including descent and landing under all operating environments, especially in warmer and/or humid climates. It should be noted that no mention of the 27 mBar limit appears in Amendment 25-87. It has been speculated that the fixed humidity level of 27 mBar appears to be a reasonable limit for altitude conditions around 10,000 feet. Unfortunately this humidity level is often exceeded at lower altitudes at and near sea level for airport ambient conditions. Thus, this requirement would prohibit the use of outside air to ventilate the aircraft during high humidity conditions above 27 mBar. It is this restriction to any fixed humidity limit that created the need for rulemaking in this section of Part 25.

The FAA formed an Aviation Rulemaking Advisory Committee (ARAC) to review this regulation and recommend any needed changes. ARAC Mechanical Systems Harmonization Working Group (MSHWG) developed a new, performance-based standard to preserve a tolerable environment by limiting the metabolic and environmental heat loads to passengers and crew during exposures to a potential heat stress event. The report was submitted to the FAA in October 2003. Airbus has requested an Equivalent Level of Safety Finding (ELOS) for § 25.831(g) and proposes to use ARAC Recommended Rulemaking to preserve a tolerable environment using a new, performance-based standard. Airbus proposed to use ARAC Recommended Rulemaking from the MSHWG, in accordance with the Transport Airplane Directorate (TAD) Memo 00-113-1034, dated January 4, 2001, which provides guidance on the use of ARAC Recommended Rulemaking not yet formally adopted by the FAA.

**Applicable regulation(s)**

§§ 25.831(g), K25.1.2

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

§ 25.831(g)

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

Airbus showed that the A350 airplane meets the full intent of the proposed regulation via the means recommended in the ARAC MSHWG report on 25.831(g). The TAD Memo 00-113-1034, dated January 4, 2001, provides guidance on the use of ARAC

Recommended Rulemaking not yet formally adopted by the FAA; the Transport Airplane Directorate believes that it is appropriate to use an equivalent level of safety finding for § 25.831(g).

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

Although noncompliant with the regulation, the fact that this time-temperature relationship of § 25.831(g) contains a single-point humidity requirement of 27 mbar vapor pressure unfortunately prohibits the use of outside air to ventilate the aircraft during high humidity ambient conditions above 27 mbar (under failure conditions like loss of all conditioned airflow). It is this fixed humidity level that makes it impossible to directly comply with § 25.831(g). Consequently, the applicant used a recommended standard developed by the MSHWG (body core temperature rise not above 38°C steady – state and 38.5°C transient) to demonstrate that the intent of § 25.831(g) is met. The applicant provided supplemental information which discusses specific aspects of the airplane environmental control system and the environmental conditions which address this subject. The accompanying issue paper and referenced documents describe the methodology and all assumptions that have been used for the transient heat stress analysis used to evaluate the resulting body core temperatures under hot ambient conditions, together with the analysis results and the compensating factors to demonstrate an equivalent level of safety with respect to § 25.831(g). The use of the performance – based standard as contained in the proposed alternate standard by the MSHWG ensures an equivalent level of safety compared to § 25.831(g) since it preserves the crew's ability to perform their expected duties, while maintaining an acceptable level of safety and health for all aircraft occupants during the event. In summary, the criteria used to provide an equivalent level of safety with the intent of § 25.831(g) was found to be acceptable by the ARAC MSHWG group of specialists which included medical doctors, flight physiologists and engineers.

**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-15, titled “Ventilation System Failures – Cabin Temperature and Humidity.” 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):  
§ 25.831(g)  
(documented in TAD ELOS Memo TC0544IB-T –ES-15)

Original signed by

*Victor Wicklund*

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Manager, Transport Airplane Directorate,  
Aircraft Certification Service

December 1, 2010

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Date

ELOS Originated by Transport Standards Staff:	Project Engineer Stephen Happenny	Routing Symbol ANM-112
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