Memorandum

U.S. Department of Transportation
Federal Aviation Administration

Subject:	Information: Equivalent Level of Safety Finding for the Alenia Aeronautica Model C-27J FAA Project Number TC0371IB-T	Date:	March 17, 2010
		Reg Ref:	14 CFR 25.831(g)
From:	Manager, Propulsion/Mechanical Systems Branch, ANM-112 Transport Standards Staff	Reply to Attn of:	Steve Happenny ANM-112
To:	Manager, International Branch, ANM-116	ELOS Memo #:	TC0371IB-T-S-17

Background

Alenia Aeronautica has declared that the C-27J 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 Federal Aviation Administration (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. The fixed humidity level of 27 mBar is 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. Alenia Aeronautica 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. Alenia Aeronautica 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.

In Alenia Aeronautica letter 04/LT/0400/T810E/080213 dated March 20, 2008, Alenia Aeronautica requested an ELOS finding for § 25.831(g). An issue paper documents the FAA findings on whether the proposed Alenia Aeronautica means of compliance provides a level of safety equivalent to that provided by § 25.831(g). An ELOS finding may be requested by an applicant when literal compliance to the regulation cannot be shown and when compensating factors exist to provide an equivalent level of safety. The FAA also allows applicants to request for consideration as part of the certification basis for the airplane, draft regulatory text which has been submitted to the FAA by ARAC. In this case that draft regulatory text came from the MSHWG final report on § 25.831(g), dated July 31, 2003. FAA has approved several requests for ELOS on other certification programs where the applicant utilized the approach discussed in the MSHWG report. While Alenia's proposal deviates from previous approvals, it does meet the intent of the ARAC recommendation.

Applicable regulation(s)
§ 25.831(g) as proposed by the ARAC MSHWG Report on 25.831(g) per the guidelines established in TAD Memo 00-113-1034, dated January 4, 2001.

Regulation(s) requiring an ELOS
§ 25.831(g)

Description of compensating design features or alternative standards that allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)
Alenia Aeronautica will show that the C-27J airplane will meet 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).

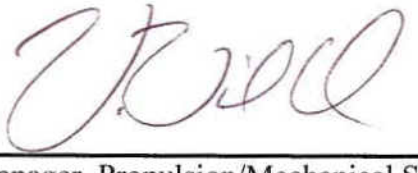
Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation
FAA has stated that all applicants may utilize a thermal analysis based upon computer modeling with validation, or the use of new or historical temperature exposure test data for demonstrating compliance for steady-state and transient conditions as deemed appropriate. FAA will ensure that all applicants who request an equivalent level of safety finding for § 25.831(g) are required to follow the same methodology or equivalent means as noted in the MSHWG report. The pass-fail criteria shall be in accordance with page 10 of the MSHWG report which states, "For applicable failure events prior to final descent, an acceptable means of compliance is considered to be a 1 °C rise, not to exceed 38 °C body core temperature as noted in *"Criteria for a Recommended Standard; Occupational Exposure to Hot Environments Revised Criteria 1986,"* National Institute for Occupational Safety and Health, Department of Health and Human Services Publication No. 86-113, April 1986. As discussed in the ARAC report this is a conservative criteria for exposure of unacclimatized people working for long periods of time in a hot environment; as stated in the report, "*It is acknowledged that occupants will be able to receive appropriate medical treatment immediately after landing. Therefore, a 38.5 °C body core temperature limit is acceptable, only for final approach and landing, during any time period not to exceed 20 minutes. 38.5 °C body core temperature shall not be exceeded or sustained for any amount of time.*" Therefore, applicants must meet the stated criteria which limits temperature rise in occupants to 38 °C [100.4 °F] body core temperature (steady-state) and 38.5 °C [101.3 °F] body core temperature (transient condition not to exceed 20 minutes).

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper S-17. The FAA, ENAC and Alenia Aeronautica concurred that the body core temperature must meet the stated criteria which limits temperature rise in occupants to 38 °C [100.4 degree F] body core temperature (steady-state) and 38.5 °C [101.3 degree F] body core temperature (transient condition not to exceed 20 minutes). Furthermore, Alenia Aeronautica reported that, *"The steady and transient simulations showed that C-27J aircraft environment in extreme hot conditions and the consequent body core temperature are within the limitations established by MSHWG Final Report on FAR/JAR 25.831(g); thus an ELOS is claimed as applicable for the FAR 25.831(g) requirement."* FAA concurred with this statement based upon the material submitted by Alenia Aeronautica.

This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Airplane 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 Supplemental Type Certificate. An example of an appropriate statement is provided below.

Equivalent Safety Findings have been made for the following regulation(s): § 25.831(g) "Acceptable High Temperature Physiological Environment During Failure Conditions" [(Documented in TAD ELOS Memo TC03711B-T-S-17)]



MARCH 17, 2010

Manager, Propulsion/Mechanical Systems Branch, ANM-112
Transport Standards Staff,

Date

ELOS Originated by: Standards Staff, Mechanical Systems Branch	Project Engineer: Steven Happenny	Routing Symbol: ANM-112