



Federal Aviation Administration

Memorandum

Date: November 20, 2015

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) for Acceptable High Temperature Physiological Environment During Failure Conditions on Boeing Model 787-8/-9/-10 (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546 and PS14-1031)

Memo No.: TC6918SE-T-ES-5

Reg. Ref.: § 25.831(g)

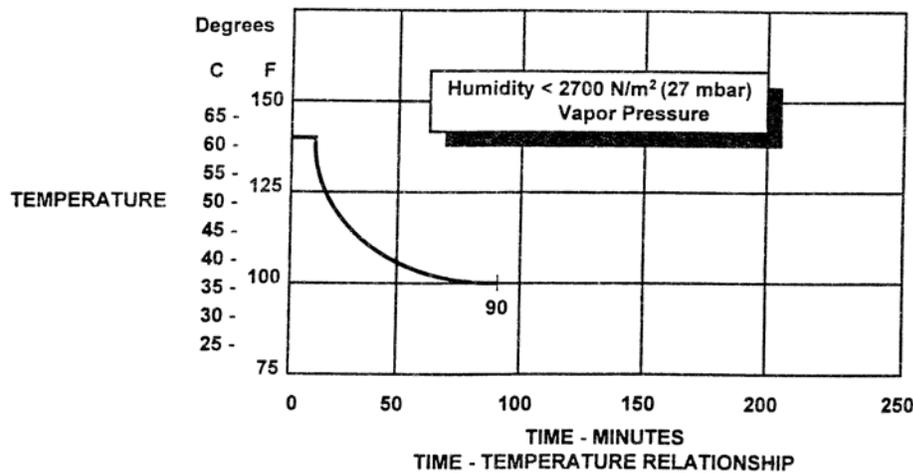
The purpose of this memorandum is to inform the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Boeing Model 787-8 airplane.

This memo was subsequently revised to extend this ELOS to the Boeing Model 787-9 and 787-10 airplanes.

Background

Boeing submitted a request for an ELOS finding to Title 14, Code of Federal Regulations (14 CFR) 25.831(g), Amendment 25-87, for the Model 787 series aircraft. Boeing proposed using the draft rule from the Mechanical Systems Harmonization Working Group (MSHWG) final report on § 25.831(g), dated July 31, 2003.

Section 25.831(g), Amendment 25-87, requires that “the exposure time at any given temperature must not exceed the values shown in the following graph after any improbable failure condition.”



Section 25.831(g) was included in Part 25 to supplement the requirements found in § 25.1309. The intent of § 25.831(g) was to limit the exposure time to high temperatures in the crew and passenger compartments to prevent a hazard to continued safe flight and landing. The regulation also includes a requirement to maintain humidity within the airplane below 27 mbar.

An applicant may request an ELOS 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 draft regulatory text that has been forwarded to the FAA by an Aviation Rulemaking Advisory Committee (ARAC) be considered as part of the certification basis for the airplane.

The FAA established ARAC to provide advice and recommendations to the FAA Administrator on rulemaking for aviation-related activities. On July 26, 2001, the FAA assigned ARAC the task to review current airworthiness standards for transport category airplanes regarding cabin and flight deck environment, to determine if any revisions to § 25.831(g) were appropriate to determine suitable physiological limits, and to provide specific recommendations.

ARAC assigned the task to develop recommendations for § 25.831(g) to the MSHWG committee, which is part of the Transport Airplane Engine Issues Group (TAEIG). The MSHWG committee was comprised of representatives from manufacturers, trade groups, associations, the medical community, and civil aviation authorities. The MSHWG issued their final report on July 31, 2003, and it was unanimously approved by the TAEIG.

Transport Standards Staff (TSS) Memorandum 00-113-1034, "INFORMATION: Use of ARAC (Aviation Rulemaking Advisory Committee) Recommended Rulemaking not yet formally adopted by the FAA, as a basis for equivalent level of safety or exemption to Part 25," dated January 4, 2001, provides the procedure for requesting the use of ARAC recommended rulemaking. Boeing requested an ELOS in accordance with the memorandum and based their request on the MSHWG final report.

Applicable regulation(s)

§§ 21.21(b)(1), 25.831(g), 25.1309(a)(b)(d).

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)

The MSHWG Final Report on FAR/JAR 25.831(g), dated July 31, 2003 recommended that regulatory authorities consider the following harmonized draft rule:

- ‘The airplane design must accommodate any environmental control system failure condition not shown to be extremely improbable, such that:
- (a) Flight deck and cabin environmental conditions shall not adversely affect the crew performance that results in a hazardous condition;
 - (b) No occupant shall sustain permanent physiological harm.’”

The FAA has determined that the draft rule from the MSHWG report provides the same level of safety as § 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

The intent of § 25.831(g) was to limit the exposure time to high temperatures in the crew and passenger compartments to prevent a hazard to continued safe flight and landing. The current regulations impose specific humidity and exposure time limits on temperatures between 100°F (37.78°C) and 140°F (60°C). For example, the exposure to a temperature of 100°F (37.78°C) shall not exceed 90 minutes with the humidity below 27 mbar.

Alternatively, the FAA finds it acceptable to provide human physiological limits (rather than temperature/humidity exposure limits) to prevent a hazard and to continue safe flight and landing. The MSHWG final report (p. 10) recommends that Advisory Circular (AC) 25-20, “Pressurization, Ventilation and Oxygen Systems Assessment for Subsonic Flight Including High Altitude Operation,” dated September 10, 1996, needs to be revised to add the following high-temperature physiological limit:

“A transient heat stress analysis can be used as a means of compliance. For applicable failure events prior to final descent, an acceptable means of compliance (MOC) is considered to be a 1 deg C rise, not to exceed 38 deg C body core temperature see page 2 of reference 3¹. As discussed in the report this is a conservative criteria for exposure of unacclimatized people working for long periods of time in a hot environment. It is

¹ Reference 3 is the ASHRA Handbook: Fundamentals, Chapter 8, Society of Heating Refrigerating and Air Conditioning Engineers Inc, 1989 & 1997 (Human Body model for perspiration coverage of the skin.)

acknowledged that occupants will be able to receive appropriate medical treatment after landing. Therefore, a 38.5 deg C body core temperature limit is acceptable, only for final approach and landing, during any time period not to exceed 20 minutes. 38.5 deg C body core temperature shall not be exceeded or sustained for any amount of time.”

The FAA has determined that the recommended revision to AC 25-20 is an acceptable method for showing compliance to the draft rule and meeting the intent of § 25.831(g).

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project Issue Paper ES-5 or Administrative Collector Issue Paper G-6. 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 Findings have been made for the following regulation(s):
§ 25.831(g), “Ventilation” (documented in TAD ELOS Memo TC6918SE-T-ES-5).



Transport Airplane Directorate,
Aircraft Certification Service

12/3/2015

Date

ELOS Originated by Seattle ACO:	Name Jeff Palmer	Routing Symbol ANM-150S
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