



# Federal Aviation Administration

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## Memorandum

Date: January 28, 2016

To: Manager, Boeing Aviation Safety Oversight Office, ANM-100B

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Mark Freisthler, ANM-120S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) for Gust and Continuous Turbulence Design Loads on Boeing Model 787 Series Aircraft, (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546 and PS14-1031)

Memo No.: TC6918SE-T-A-9

Reg. Ref.: §§ 25.341, 25.343, 25.345, 25.371, 25.373, and 25.391

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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 Model 787-8 series of aircraft.

This memo is being revised to define 787 series as mentioned in this ELOS as being applicable to the Boeing Model 787-8, 787-9, and 787-10.

### Background

Boeing has requested the use of Joint Aviation Authorities (JAA) Notice of Proposed Amendment (NPA) 25C-309, "Gust and Continuous Turbulence Design Loads," Final Version dated 9 January 2003, for showing compliance to the requirements of Title 14, Code of Federal Regulations (14 CFR) 25.341, 25.343, 25.345, 25.371, 25.373 and 25.391.

The Aviation Rulemaking Advisory Committee (ARAC), comprising regulatory authorities and industry, proposed revisions to gust and continuous turbulence loads of §§ 25.341, 25.343, 25.345, 25.371, 25.373, 25.391, 25.395. These proposed standards are captured by the European Aviation Safety Agency (EASA) Certification Specification (CS) at Amendment 25/1 (EASA NPA No. 11/2004). These standards have been incorporated in 14 CFR part 25 at Amendment 25-141. The certification bases of Boeing Models 787-8, 787-9, and 787-10 were established prior to the FAA's issuance of Amendment 25-141. Therefore, this equivalent safety finding is necessary for §§ 25.341, 25.343, 25.345, 25.371, 25.373, 25.391, 25.395 at the amendment levels prior to Amendment 25-141, which were the amendment levels of these rules included in the certification bases of Boeing Models 787-8, 787-9, and 787-10.

## **Applicable regulation(s)**

§§ 25.341, 25.343, 25.345, 25.371, 25.373, 25.391

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

§ 25.341 at amendment 25-86,  
§ 25.343 at amendment 25-86,  
§ 25.345 at amendment 25-91,  
§ 25.371 at amendment 25-91,  
§ 25.373 at amendment 25-86, and  
§ 25.391 at amendment 25-86.

## **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 regulatory authorities and the aviation industries of the U.S., Canada and Europe, convened under the Aviation Rulemaking Advisory Committee (ARAC), with the aim of finding a single gust design methodology that would account for both discrete gust and continuous turbulence. After considering several methodologies, the ARAC has recommended that a continuous turbulence criterion be utilized as this method accounts for aircraft response to realistic, atmospheric characteristics.

The ARAC proposal (as incorporated by NPA 25C-309) includes a revision to the gust intensity model used in the design envelope method for continuous turbulence, elimination of the mission analysis method, provisions for treating non-linearities, and reorganization and clarification of the requirement.

The design envelope criterion is retained with a revised gust intensity distribution with altitude. The proposed gust intensities are based on analysis of gust measurements from the Civil Aircraft Airworthiness Data Recording Program (CAADRP). The CAADRP data is the most recent gust information available and it represents measurements of gusts and turbulence on transport airplanes in actual operation.

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

Section 25.341 at amendment 25-86 required consideration of non-linearities only in relation to stability augmentation systems; however, with modern transport airplanes it is possible that the primary flight control systems and the airplane itself could exhibit significant non-linearities. The ARAC proposal would require that any significant non-linearity be considered in a realistic or conservative manner, and it would provide additional criteria that can be used with other rational approaches that can account for non-linearities (e.g., time domain solutions). The ARAC proposed standards in this case provide a higher level of safety than the earlier rules, and have since been incorporated into 14 CFR part 25.

## **FAA approval and documentation of the ELOS**

The FAA has approved the aforementioned Equivalent Level of Safety Finding in project Issue Paper A-9 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 Safety Findings have been made for the following regulation(s):

- § 25.341 Gust and turbulence loads
- § 25.343 Design Fuel and Oil Loads
- § 25.345 High Lift Devices
- § 25.371 Gyroscopic Loads
- § 25.373 Speed Control Devices
- § 25.391 Control Surface Loads: General

(documented in TAD ELOS Memo TC6918SE-T-A-9).

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Transport Airplane Directorate,  
Aircraft Certification Service

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Date

ELOS Originated by ACO:	Mark Freisthler	ANM-120S
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