Federal Aviation Administration

Memorandum

Date: May 19, 2014

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 Design Airspeeds on Boeing Models 787-8/-9 (Project Nos. TC6918SE-T, PS06-0496 and PS06-0497)

Memo No.: TC6918SE-T-A-10

Reg. Ref.: §§ 25.335(b), 21.21(b)(1)

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 airplanes.

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

Background

Boeing requested an ELOS finding to allow the use of an overspeed protection function in the determination of the design speed margin between V_C/M_C and V_D/M_D required by Title 14, Code of Federal Regulations (14 CFR) 25.335(b).

Applicable regulation(s)

§§ 25.335(b), 21.21(b)(1)

Regulation(s) requiring an ELOS

§ 25.335(b)

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 787-8/-9 is equipped with an electronic flight control system which provides positive warning and control inputs at speeds above V_C/M_C. Also, positive warning and control inputs are provided if the bank angle exceeds a threshold which is a function of speed. The presence of this function will influence the results of the traditional recovery maneuver which is used in § 25.335(b)(1) to define a minimum speed increment between V_C/M_C and V_D/M_D. This function is similar to the hardened overspeed protection system installed in the 777-200LR and the 777-300ER. The proposed reduction in the speed margin for the 787-8/-9 is also comparable to the 777 airplanes. Because of the similarity of the system and its effects on the determination of the design dive speed, Boeing proposes demonstration, reliability, and failure requirements in support of this equivalent safety request similar to that used in support of the similar equivalent safety finding on the 777-200LR/-300ER.

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

In support of this request, Boeing will demonstrate that the reduced upset margin coupled with the envelope protection function will provide a level of safety for the 787-8/-9 that is equivalent to complying with the airworthiness standard as written (§ 25.335(b)). The evaluation will consider inadvertent upsets that are caused by pilot-induced maneuvers and atmospheric upsets. The initiation of these evaluations will be at speeds to V_C/M_C and consider upset recoveries from limit conditions. The upset recoveries evaluated will include upsets in each airplane axis (pitch and roll/yaw) and multi-axis combinations.

In addition to the upset demonstrations, Boeing will show that the probability of the loss of compensating features is less than 10^{-5} per flight hour of operations.

In addition to the above, for loss of the overspeed protection function, the function-off V_D/M_D as defined in § 25.335(b) will be associated with this failure condition for the definition of loads related to V_D/M_D as well as for the justification to § 25.629. In consideration of the failure rate requirements, ultimate strength for these loading conditions with Safety Factor = 1.0 and clearance speeds per § 25.629(b)(2) will be shown for failure conditions affecting the high speed protection function.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned ELOS finding in project Issue Papers A-10 (Project No. TC6918SE-T) and G-6 (Project Nos. PS06-0496 and PS06-0497). 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 retrival 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):
§ 25.335(b), "–Structures – Design Airspeeds" (documented in TAD ELOS Memo TC6918SE-T-A-10)

Susan Masterson

Transport Airplane Directorate,
Aircraft Certification Service

May 19, 2014
Date

ELOS Originated by ACO:	Mark Freisthler	ANM-120S