



Federal Aviation Administration

Memorandum

Date: November 23, 2015

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Ken Schroer, ANM-100S

Subject: INFORMATION: Equivalent Level of Safety Finding for 787 Instrument Systems, § 25.1333, on Boeing Company Model 787-8/-9/-10 (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546 and PS14-1031)

Memo No.: TC6918SE-T-SA-29

Reg. Ref.: § 25.1333(a)

The purpose of this memorandum is to inform the 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 airplane.

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

Background

Title 14, Code of Federal Regulations (CFR) 25.1333(a) was written prior to the widespread use of digital electronic equipment with digital interfaces. At the time of its writing and most recent revision (1977), airplanes were equipped with single thread sensor systems feeding single thread display systems. The analog equipment was not amenable to the kind of signal consolidation that is possible with today's digital equipment. Therefore, it was necessary that the Captain's and First Officer's instruments be driven from independent sources, and that other equipment using these sources could not compromise the signal separation. Boeing has proposed that based upon the 787 integrated architecture, that the high integrity and availability of critical signals meet the equivalent integrity and availability that would be provided by independent signal source at each pilot station.

Applicable regulation(s)

§ 25.1333(a)

Regulation(s) requiring an ELOS

§ 25.1333(a)

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 design is intended to provide the flight crew with data of high integrity and high availability. The 787 relies on multiple independent, high-integrity systems to relieve the flight crew of the responsibility for maintaining high integrity with respect to attitude, altitude and airspeed. By voting and monitoring the sensor signals in the flight control modules (FCM), faulty sensors are automatically detected and removed from the selected output. Application Cyclical Redundance Checks (CRCs) are used to ensure that the high integrity of voted data is preserved from source to destination. To ensure adequate availability of voted signals, the voting and monitoring function is performed in three FCMs. The display system performs automatic selection of the voted data sources quickly and unobtrusively by switching away from failed FCMs without flight crew action. In addition, the common data network provides a level of hardware isolation not available in previous avionics data networks

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

Although the 787 architecture does not provide complete independence of physical component sensors used by the Captain's and First Officer's flight deck instruments, the redundancy management methods used in multiple, high-integrity systems communicating on a high integrity data network meet the intent of the regulation of providing high-integrity, high-availability attitude, altitude, and airspeed to each of the flight deck displays. Boeing will provide system description documents, qualification test reports, certification flight test reports, and system and airplane-level safety analysis reports to demonstrate that the 787 architecture provides an equivalent level of safety as required by § 25.1333(a).

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned ELOS finding in project Issue Paper SA-29 or Administrative Collector Issue Paper G-6. This memorandum provides standardized documentation of the ELOS finding that is nonproprietary 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 must be listed in the type certificate data sheet under the certification basis section.

Equivalent Safety Findings have been made for the following regulation(s): § 25.1333(a), "Instrument Systems", (documented in TAD ELOS Memo TC6918SE-T-SA-29).



Transport Airplane Directorate
Aircraft Certification Service

11/24/15

Date

ELOS Originated by Seattle ACO:	Frank vanLeynseele	ANM-130S
------------------------------------	--------------------	----------