



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: Jim Voytilla, ANM-100B

Subject: INFORMATION: Equivalent Level of Safety Finding for Engine Ignitor Configuration on the Boeing Model 787-8/-9/-10 (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546 and PS14-1031)

Memo No.: TC6918SE-T-P-27

Reg. Ref.: § 21.21(b)(1) and 25.1145(a)

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

Title 14, Code of Federal Regulations (14 CFR) 25.1145 establishes requirements for the switches accessible by the flight crew for control of the engine ignition systems. Section 25.1145(a) states, “ignition switches must control each engine ignition circuit on each engine.” The requirement in this subsection requires switches to control each ignition circuit on each engine and is intended to allow the ignition systems to be controlled separately so that each circuit’s operation may be separately checked and individual circuits may be selected or deactivated in the event of an ignition system malfunction. The Boeing Model 787 airplane does not provide individual flight deck switches for the control of each engine ignition circuit as required by this rule. In lieu of direct compliance, the applicant has provided automated features in the design that provide control and monitoring of each engine ignitor and as such are proposed by the applicant to provide an ELOS to a design that would be directly compliant with § 25.1145(a).

Applicable regulation(s)

§§ 21.21(b)(1) and 25.1145

Regulation(s) requiring an ELOS

§ 25.1145(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 Boeing Model 787 engine ignition control system design uses the high integrity electronic engine control (EEC) and aircraft power relays to perform the igniter configuration functions instead of the pilot. On the ground, the EEC software will automatically alternate each engine ignition system on successive starts and set an appropriate fault message if the ignition system is malfunctioning. In-flight, the EEC will always command both ignition systems 'ON' to start the engine. The EEC automatic control of the ignition is carried out through Autostart and Auto-relight software logic. All EEC software is Level A and flight critical per DO-178B. Therefore, the software has been shown through testing to be highly reliable. An EEC failure of ignition control is remote and would only occur as a total software failure in the EEC and would result in an in-flight engine shutdown per standard operating procedure. Because of this, the loss of direct control of ignition power, selection, or excitation due to EEC failure will not impact safety of flight and is not impacted by the absence of manual ignition switches.

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

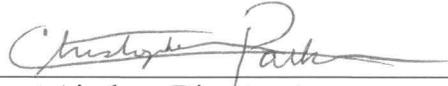
The EEC autostart software logic monitors exhaust gas temperature (EGT), shaft speed, and shaft speed rate-of-change during all start attempts, ground and in-flight, until the engine stabilizes, ensuring no abnormal behavior. The autostart software applies corrective action if there is a hung start, locked rotor, hot start, or failure of the combustor to light-off. Actions initiated by the autostart software include flight crew notification, implementation of dual ignition, modified fuel scheduling, fuel supply cycling, or aborting the start sequence (which applies to ground start attempts only) prior to another start attempt. When the engine is running, the auto-relight logic is initiated if a flameout or rollback is detected by the EEC software. Auto-relight corrective action includes fuel rescheduling and selection of dual ignition to assist in engine recovery or to sustain engine operation. The design features and integrity provided by the EEC automated functions provide an ELOS to cockpit igniter circuit control switches through software logic that monitors igniter health and automatically provides configuration control of the engine ignition system without the need for pilot input. The FAA concurs with the rationale provided by the applicant that the Boeing Model 787 EEC automated software functions that provide control and monitoring of individual engine ignitor circuits provide a level of safety equivalent to a design that would be directly compliant with § 25.1145(a).

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned ELOS finding in project Issue Paper P-27 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):
14 CFR 25.1145(a) (documented in TAD ELOS Memo TC6918SE-T-P-27).



Transport Airplane Directorate,
Aircraft Certification Service

12/3/2015

Date

ELOS Originated By Seattle ACO:	Project Engineer Sherry Vevea	Routing Symbol ANM-140S
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