



Federal Aviation Administration

Memorandum

Date: June 13, 2011

To: Manager, Seattle Aircraft Certification Office, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-112

Prepared by: Sue Lucier, (425) 917-6438

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Fire Requirements on Fire Safety Requirements for the GENx-2B Engine Fan Case on Boeing Models 747-8/-8F Engine Fan Case, FAA Project Nos. PS05-0211 and PS05-0212

ELOS Memo#: PS05-0211-P-23

Regulatory Ref: §§ 21.21(b)(1), 25.1181(b) and 25.1182(a)

This memorandum informs 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 747-8/-8F airplanes.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.1181(a)(6) specifically designates the compressor section of turbine engines as a fire zone. Section 25.1181(b) requires that each fire zone meet the requirements of §§ 25.863, 25.865, 25.867, 25.869, and 25.1185 through 25.1203. The fan case compartment is considered to be a compressor section of a turbine engine, which is identified as a designated fire zone in § 25.1181(a)(6).

Note: An FAA memorandum from the Manager, Transport Standards Staff, dated January 27, 1993, recommended policy for an engine fire zone definition under § 25.1181. That recommendation is withdrawn.

For a nacelle area immediately behind a firewall, § 25.1182(a) requires compliance to §§ 25.1103(b), 25.1165(d) and (e), 25.1183, 25.1185(c), 25.1187, 25.1189, and 25.1195 through 25.1203, including those (regulations) concerned with designated fire zones. The thrust reverser (T/R) latch beam cavity is located within the nacelle at the bottom of the thrust reverser, and is isolated from the engine core compartment (compressor) fire zone by a firewall. Section 25.1182 therefore applies to this area. This cavity contains flammable fluid lines, and §

25.1182(a) therefore requires fire detection and extinguishing in the cavity. The fire detection/extinguishment requirements are defined in §§ 25.1195 through 25.1203.

Boeing proposes that the current design of the 747-8F/8 GENx-2B engine has compensating design features that show the GENx-2B engine fan compartment and T/R latch beam cavity design is equivalently safe to the fire detection and extinguishing requirements of §§ 25.1181(a)(6), 25.1181(b), and 25.1182(a) and has proposed an equivalent level of safety finding for both of these areas.

Applicable regulation(s)

§§ 21.21(b)(1), 25.1181(b) and 25.1182

Regulation(s) requiring an ELOS finding

§ 25.1181(b) and 25.1182

Description of compensating design features or alternative Methods of Compliance (MoC) which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The features that support an equivalent level of safety finding for the elimination of fire detection and extinguishers in these areas of the design are as follows:

For the fan case compartment-

- The accessory gear box (AGB) is not located in the fan case compartment,
- Although the powered door opening system has components that are not fire resistant, it is a closed system containing approximately 3 quarts of engine oil, and is depressurized in flight. An equivalent safety finding for this non-fire-resistant tubing is discussed in a separate issue paper.
- The only hydraulic lines in the fan compartment that are pressurized in flight are the thrust reverser track lock supply line, which is pressurized in flight.
- The engine oil system lines operate at 2 psi or less, and therefore should not create a high pressure spray in the event of leaks.
- Boeing has demonstrated that no ignition sources are present within the zone during normal and foreseeable failure conditions. (Note: Foreseeable failure conditions include a large, prolonged fire impinging on any area of the fire zone's firewall or cowls.)

For the thrust reverser latch beam compartment-

- The only hydraulic lines in the latch beam compartment are the thrust reverser track lock supply line, which is pressurized in flight.
- The applicant has demonstrated that no ignition sources are present within the zone during normal and foreseeable failure conditions. (Note: Foreseeable failure conditions include a large, prolonged fire impinging on any area of the fire zone's firewall or cowls.)

Explanation of how design features or alternative Methods of Compliance (MoC) provide an ELOS to the level of safety intended by the regulation

Section 25.1181(a) lists those regions of the engine that have historically contained both ignition sources and potential flammable fluid leakage, and defines these as “designated fire zones.” Designated fire zones are required to meet the regulations listed in § 25.1181(b). The “compressor and accessory sections of the turbine engine,” listed in § 25.1181(a)(6), is considered by the FAA to include the compartment surrounding the fan case.

Section 25.1182 prescribes requirements for nacelle areas behind firewalls. The fan case compartment and the thrust reverser latch beam compartment are located behind engine firewalls, and are subject to regulations listed in § 25.1182. Those regulations include some of the regulations listed in § 25.1181(b) for fire zones, including the requirement for detection and extinguishing.

Both §§ 25.1181 and 25.1182 regulations are designed to minimize the spread of the engine fire that starts in a fire zone, to adjacent compartments. The design of these two compartments has been found to have an equivalent level of safety to a compartment that includes fire detection and extinguishing. This finding is based on the compartment having no ignition source contained within each compartment, and the incorporation of design features that minimize available flammable fluid that would otherwise feed the fire (if ignited) during flight.

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned ELOS finding in project Issue Paper P-23. 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.

An example of an appropriate statement is provided below. ELOS findings have been made for the following regulation(s):

The portion of §§ 25.1181(b) and 25.1182 that requires compliance with the fire detection and extinguishing requirements defined in §§ 25.1195 through 25.1203, for the fan case compartment, in ELOS Memo No. PS05-0211-P-23.

The portion of § 25.1182 that requires compliance with the fire detection and extinguishing requirements defined in §§ 25.1195 through 25.1203, thrust reverser latch beam compartment, in ELOS Memo No. PS05-0211-P-23.

Original Signed by

Victor Wicklund

June 14, 2011

Manager, Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by Seattle ACO:	Project Engineer Sue Lucier	Routing Symbol ANM-140S
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