



Federal Aviation Administration

Memorandum

Date: January 20, 2011

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

From: Manager, Transport Airplane Directorate, ANM-100

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Subject: Equivalent Level of Safety (ELOS) Finding for Cowling and Nacelle Skin Fireproof Regions on Boeing Models 747-8F and -8 (Reference Project Nos. PS05-0211/-0212)

ELOS Memo #: PS05-0212-P-16

Reg. Ref.: §§ 25.1191 and 25.1193

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 design of the cowling and nacelle skin fireproof regions on the Boeing Model 747-8F/-8 airplanes.

Background

Boeing Model 747-8/-8F airplanes, equipped with GENx-2B engines, do not directly comply with the requirements of Title 14, Code of Federal Regulations (14 CFR) 25.1193 as applicable to engine fire zone nacelle cowling. Section 25.1193(e)(3) applies to the cowl and the nacelle skin and it is the applicable fire resistance standard for cowls surrounding engine fire zones and any other airplane skin areas subject to flame during engine fire conditions. This rule prescriptively requires those parts of the airplane be fireproof, regardless of the level of hazard that might be judged to be created by the burn through of those areas.

Portions of the Boeing Model 747-8/-8F engine fire zone nacelle cowls are designed to be fireproof both in flight and on the ground. The remainder of the nacelle cowl structure is designed to be fireproof in flight and fire resistant on the ground.

The fire resistant portions of the cowl design do not directly comply with the prescriptive requirements of § 25.1193.

Applicable Regulation(s)

§§ 25.1191 and 25.1193

Regulation requiring an ELOS

§ 25.1193(e)(3)

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

During flight conditions, the full cowl (360 degrees) for the fire zone will be fireproof.

During ground operations, a minimum of +/- 45 degrees from the top centerline of the cowl, a total of 90 degrees will be fireproof, and the remaining lower area will be fire resistant.

All fire testing will be conducted in accordance with Advisory Circular (AC) 20-135.

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

The Federal Aviation Administration (FAA) has allowed some wing strut mounted turbofan engine nacelles to be fireproof for a defined (upper) sector of the engine fire zone or nacelle surface, in lieu of the prescriptive regulatory requirement of 360 degrees full circumference of the nacelle.

The ability to withstand the effects of fire varies with the potential hazards associated with different flight and ground operating conditions. The nacelle cowl structure surrounding the fire zone that is not fireproof is designed to be fire resistant. This ELOS documents the approach to define the potential hazard and develop an appropriate design that addresses the threat affiliated with an engine fire.

The size of the fireproof versus fire resistant areas varies based on model configuration. Determination of the size of the fireproof sector is based on airflow characteristics data generated by the airframe manufacturer during actual flight and/or ground test of the proposed design. Airflow patterns affiliated with airplane angles of attack, speeds and configurations are evaluated for the effect of an engine fire penetrating the nacelle and causing damage to other critical structure.

Flight operations from minimum V1 to minimum touchdown speed, will have fireproof skin in areas subject to flame if a fire starts in an engine fire zone. The most critical engine operating conditions which can affect the fire resistance of the cowling (including engine power, bleed extraction, ventilation, etc.), are examined and the most critical used to evaluate the fireproof qualities of the installation.

During ground operations, the nacelle skins in areas subject to flame during a fire in a designated fire zone are fireproof under any anticipated ground operating conditions where a skin burn-through (or other adverse effects of a fire) could result in a serious injury to crew, passengers or ground personnel. Hazards of concern include, but are not limited to, events such as fuel tank explosion, hazardous spread of fire to flammable fluid sources outside the fire zone, overheating of critical elements outside the fire zone, and fuselage penetration.

Fire testing is performed in accordance with AC 20-135, with the test article subjected to conditions that are present during and after a severe engine failure event (i.e., backside airflow, vibration, differential pressure, etc).

Conditions for this approval address in-flight safety of the airplane, including maintaining the functionality of the fire detection and control features during a fire event, as well as safety during ground operations, including emergency evacuation.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in Issue Paper P-16. 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 certification 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):
 § 25.1193(e)(3) Cowling and Nacelle Skin (documented in TAD ELOS Memo PS05-0212-P-16).



 Manager, Transport Standards Staff
 Propulsion/Mechanical Systems Branch, ANM-112

FEBRUARY 11, 2011

 Date

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