

# Proposed Rules

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This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

## DEPARTMENT OF TRANSPORTATION

### Federal Aviation Administration

#### 14 CFR Part 25

[Docket No. NM399 Special Conditions No. 25-09-02-SC]

#### Special Conditions: Boeing Model 747-8/-8F Airplane, Additional Airframe Structural Design Requirements Related to Sudden Engine Stoppage Due to Fan Blade Failures

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Notice of proposed special conditions.

**SUMMARY:** This document proposes special conditions for the Boeing Model 747-8/-8F airplane. This airplane will have novel or unusual design features when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. These design features include larger engines with large bypass fans capable of producing much larger and more complex dynamic loads. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards. Additional special conditions will be issued for other novel or unusual design features of the Boeing 747-8/-8F airplanes.

**DATES:** Comments must be received on or before May 26, 2009.

**ADDRESSES:** Comments on this proposal may be mailed in duplicate to: Federal Aviation Administration, Transport Airplane Directorate, Attention: Rules Docket (ANM-113), Docket No. NM399, 1601 Lind Avenue, SW., Renton, Washington 98057-3356; or delivered in duplicate to the Transport Airplane Directorate at the above address. All comments must be marked Docket No. NM399. Comments may be inspected in the Rules Docket weekdays, except

Federal holidays, between 7:30 a.m. and 4 p.m.

**FOR FURTHER INFORMATION CONTACT:** Mark Freisthler, FAA, Airframe & Cabin Safety Branch, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057-3356; telephone (425) 227-1119; facsimile (425) 227-1149.

#### SUPPLEMENTARY INFORMATION:

##### Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The most helpful comments reference a specific portion of the proposed special conditions, explain the reason for any recommended change, and include supporting data. We ask that you send us two copies of written comments.

We will file in the docket all comments we receive as well as a report summarizing each substantive public contact with FAA personnel concerning these proposed special conditions. The docket is available for public inspection before and after the comment closing date. If you wish to review the docket in person, go to the address in the **ADDRESSES** section of this notice between 7:30 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

We will consider all comments we receive on or before the closing date for comments. We will consider comments filed late if it is possible to do so without incurring expense or delay. We may change the proposed special conditions based on comments we receive.

If you want the FAA to acknowledge receipt of your comments on this proposal, include with your comments a pre-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it back to you.

##### Background

On November 4, 2005, The Boeing Company, PO Box 3707, Seattle, WA, 98124, applied for an amendment to Type Certificate Number A20WE to include the new Model 747-8 passenger airplane and the new Model 747-8F freighter airplane. The Model 747-8 and the Model 747-8F are derivatives of the 747-400 and the 747-400F, respectively. Both the Model 747-8 and

the Model 747-8F are four-engine jet transport airplanes that will have a maximum takeoff weight of 970,000 pounds and new General Electric GENx-2B67 engines. The Model 747-8 will have two flight crew and the capacity to carry 660 passengers. The Model 747-8F will have two flight crew and a zero passenger capacity, although Boeing has submitted a petition for exemption to allow the carriage of supernumeraries.

##### Type Certification Basis

Under the provisions of 14 CFR 21.101, Boeing must show that the Model 747-8 and 747-8F airplanes (hereafter referred as 747-8/-8F) meet the applicable provisions of part 25, as amended by Amendments 25-1 through 25-117, except for earlier amendments as agreed upon by the FAA. These regulations will be incorporated into Type Certificate No. A20WE after type certification approval of the 747-8/-8F.

In addition, the certification basis includes other regulations, special conditions and exemptions that are not relevant to these proposed special conditions. Type Certificate No. A20WE will be updated to include a complete description of the certification basis for these model airplanes.

If the Administrator finds that the applicable airworthiness regulations (*i.e.*, 14 CFR part 25) do not contain adequate or appropriate safety standards for the 747-8/-8F because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the 747-8/-8F must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36.

Special conditions, as defined in § 11.19, are issued under § 11.38, and become part of the type certification basis under § 21.101.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same or similar novel or unusual design feature, the special

conditions would also apply to the other model under § 21.101.

### Novel or Unusual Design Features

The Boeing Model 747-8/-8F airplane will incorporate the following novel or unusual design features: high-bypass engines with a fan diameter approximately twelve percent greater than those currently installed on other Boeing Model 747 airplanes.

### Discussion

High-bypass engines with a fan diameter approximately twelve percent greater than those currently installed on other Boeing Model 747 airplanes, such as the 747-400 series were not envisioned when § 25.361 was adopted in 1965. Section 25.361 addresses loads imposed by engine seizure. Because of the higher inertia of the rotating components, worst case engine seizure events become increasingly more severe with increasing engine size.

Typically the design torque loads associated with typical failure scenarios have been estimated by the engine manufacturer. These loads are used by the airframe manufacturer as limit loads. Section 25.305 requires that supporting structure be able to support limit loads without detrimental permanent deformation, meaning that supporting structure should remain serviceable after a limit load event. Limit loads are expected to occur about once in the lifetime of any airplane. For turbine engine installations, § 25.361(b)(1) requires that the engine mounts and supporting structures be designed to withstand a "limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure."

Since § 25.361(b)(1) was adopted the size, configuration, and failure modes of turbine engines have changed significantly. Current engines are much larger and are designed with large bypass fans. In the failure event prescribed by § 25.361 they produce much higher transient loads on the engine mounts and supporting structure than previous designs. At the same time, the likelihood of such an event occurring in modern engines has become less. The service history of modern turbine engines shows that engine seizures are rare events, much less than what is typically expected for "limit" loads. While it is important for the airplane to be able to support such rare loads safely without failure, it is unrealistic to expect that no permanent deformation will occur.

Given this situation, the Aviation Rulemaking Advisory Committee (ARAC) has proposed a design standard

for today's large engines. For the commonly occurring deceleration events, the proposed standard would require engine mounts and structures to support maximum torques without detrimental permanent deformation. For the rare-but-severe engine seizure events such as loss of any fan, compressor, or turbine blade, the proposed standard would require engine mounts and structures to support maximum torques without failure, but allow for some deformation in the structure.

The FAA concludes that modern large engines, including those on the 747-8/-8F, are novel and unusual compared to those envisioned when § 25.361(b)(1) was adopted and thus warrant special conditions. These proposed special conditions contain design criteria recommended by ARAC.

### Applicability

As discussed above, these proposed special conditions are applicable to Boeing Model 747-8/-8F airplanes. Should Boeing apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design features, these proposed special conditions would apply to that model as well under the provisions of § 21.101.

### Conclusion

This action affects only certain novel or unusual design features of the Boeing Model 747-8/-8F airplanes. It is not a rule of general applicability.

### List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these proposed Special Conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

### The Proposed Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for the 747-8/-8F airplanes.

In lieu of § 25.361(b) the following special conditions are proposed:

1. For turbine engine installations, the engine mounts, pylons and supporting airframe primary structure (such as the affected wing and fuselage primary structure) must be designed to withstand 1g level flight loads acting simultaneously with the maximum torque load, considered as limit load, imposed by each of the following:

(a) Sudden engine deceleration due to a malfunction which could result in a temporary loss of power or thrust; and

(b) The maximum acceleration of the engine.

2. For auxiliary power unit installations, the power unit mounts and supporting airframe primary structure (such as the affected fuselage primary structure) must be designed to withstand 1g level flight loads acting simultaneously with the maximum torque load, considered as limit load, imposed by each of the following:

(a) Sudden auxiliary power unit deceleration due to malfunction or structural failure; and

(b) The maximum acceleration of the power unit.

3. For turbine engine installations, the engine mounts, pylons and supporting airframe primary structure (such as the affected wing and fuselage primary structure) must be designed to withstand 1g flight loads acting simultaneously with the transient dynamic loads, considered as ultimate load, imposed by each of the following:

(a) Sudden engine stoppage due to the loss of any fan, compressor, or turbine blade; and separately

(b) Where applicable to a specific engine design, any other engine structural failure that results in higher loads.

4. The ultimate loads developed from the conditions specified in paragraphs 3(a) and 3(b) are to be multiplied by a factor of 1.0 when applied to engine mounts and pylons and multiplied by a factor of 1.25 when applied to the supporting airframe primary structure (such as the affected wing and fuselage primary structure). In addition, the airplane must be capable of continued safe flight considering the aerodynamic effects on controllability due to any permanent deformation that results from the conditions specified in paragraph 3, above.

Issued in Renton, Washington, on January 22, 2009.

**Ali Bahrami,**

*Manager, Transport Airplane Directorate, Aircraft Certification Service.*

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