## DEPARTMENT OF TRANSPORTATION

### Federal Aviation Administration

### 14 CFR Part 25

**[Docket No. NM368 Special Conditions No. 25–362–SC]**

## Special Conditions: Boeing Model 787–8 Airplane; Crashworthiness

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

**ACTION:** Final special conditions.

**SUMMARY:** The FAA issues these special conditions for the Boeing Model 787–8 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 novel or unusual design features are associated with carbon fiber reinforced plastic used in the construction of the fuselage. For these design features, the applicable airworthiness regulations do not contain adequate or appropriate safety standards for impact response characteristics to ensure survivable crashworthiness. These 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 standards. We will issue additional special conditions for other novel or unusual design features of the Boeing Model 787–8 airplanes.

**DATES:** *Effective Date:* October 26, 2007.

**FOR FURTHER INFORMATION CONTACT:** Ian Won, FAA, Airframe/Cabin Safety, ANM–115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356; telephone (425) 227–2145; facsimile (425) 227–1320.

**SUPPLEMENTARY INFORMATION:**

### Background

On March 28, 2003, Boeing applied for an FAA type certificate for its new Boeing Model 787–8 passenger airplane. The Boeing Model 787–8 airplane will be an all-new, two-engine jet transport airplane with a two-aisle cabin. The maximum takeoff weight will be 476,000 pounds, with a maximum passenger count of 381 passengers.

### Type Certification Basis

Under provisions of Title 14 Code of Federal Regulations (CFR) 21.17, Boeing must show that Boeing Model 787–8 airplanes (hereafter referred to as ''the 787'') meet the applicable provisions of 14 CFR part 25, as amended by Amendments 25–1 through 25–117, except §§ 25.809(a) and 25.812, which will remain at Amendment 25–115. If the Administrator finds that the applicable airworthiness regulations do not contain adequate or appropriate safety standards for the 787 because of a novel or unusual design feature, special conditions are prescribed under provisions of 14 CFR 21.16.

In addition to the applicable airworthiness regulations and special conditions, the 787 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. The FAA must also issue a finding of regulatory adequacy under section 611 of Public Law 92–574, the ''Noise Control Act of 1972.''

The FAA issues special conditions, as defined in 14 CFR 11.19, under § 11.38, and they become part of the type certification basis under § 21.17(a)(2).

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

### Novel or Unusual Design Features

The 787 airplane will incorporate several novel or unusual design features. Because of rapid improvements in airplane technology, the applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features. These special conditions for the 787 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.

The 787 fuselage will be fabricated with carbon fiber reinforced plastic (CFRP) semi-monocoque construction, consisting of skins with co-cured longitudinal stringers and mechanically fastened circumferential frames. This is a novel and unusual design feature for a large transport category airplane certificated under 14 CFR part 25. Structure fabricated from CFRP may behave differently than metallic structure because of differences in material ductility, stiffness, failure modes, and energy absorption characteristics. Therefore, Boeing must evaluate impact response characteristics of the 787 to ensure that its survivable crashworthiness characteristics provide approximately the same level of safety as those of a similarly sized airplane fabricated from traditionally used metallic materials.

The FAA and industry have been working together for many years to understand how to improve transport airplane occupant safety for what are considered survivable accidents. This work has involved examining airplane accidents, conducting tests to simulate crash conditions, and performing analytical modeling of a range of crash conditions, all with the purpose of providing further insight into factors that can influence occupant safety. Results of this continuing effort have enabled specific changes to regulatory standards and design practices to improve occupant safety. This evolution is reflected in changes to the part 25 Emergency Landing Conditions regulations. For example, airplane emergency load factors in § 25.561, General, have been increased. We have added passenger seat dynamic load conditions in § 25.562, Emergency Landing Dynamic Conditions.

The seat dynamic conditions were added to the regulations based on FAA and industry tests and a review of accidents. These seat dynamic conditions reflect the environment for passengers and the airframe during a crash event. They are based on data gathered from accidents of previously certificated airplanes given conditions that were survivable. Tests of previously certificated airplanes showed that performance of the airframe was acceptable in a survivable crash event. We continually update our requirements as such new information becomes available. In the context of this evolution of the regulations, there is at present no specific dynamic regulatory requirement for airplane-level crashworthiness. However, the FAA reviews the design of each new airplane model to determine if it incorporates novel or unusual design features that may have a significant influence on the crash dynamics of the airframe. The Administrator prescribes special conditions for the airplane model if the applicable airworthiness regulations do not contain adequate or appropriate safety standards because of the novel or unusual design feature.

Because of the novel design features of the 787, Boeing must conduct an assessment to ensure that the 787 will not have dynamic characteristics that differ significantly from those found in previously certificated designs. The nature of this design assessment is largely dependent on the similarities and differences between the new type design and previously certificated airplanes. Such an assessment ensures that the level of safety of the new type

design is commensurate with that implicitly assumed in the existing regulations, and achieved by airplane designs previously certificated. If significant trends in industry warrant change to the existing regulations, the FAA may use its rulemaking process in collaboration with industry to develop an appropriate dynamic regulatory requirement for airplane level crashworthiness.

The FAA and industry have collected a significant amount of experimental data as well as data from crashes of transport category airplanes that shows a high occupant survival rate at vertical descent velocities up to 30 ft/sec. Most of this data was collected on narrow-body (single aisle) transport category airplanes. Based on this information, the FAA finds it appropriate and necessary for an assessment of the 787 to span a range of airplane vertical descent speeds up to 30 ft/sec.

The FAA is imposing these special conditions to maintain the level of safety envisioned in the existing airworthiness standards under foreseeable survivable impact events.

**Discussion of Final Special Conditions**

To provide the same level of safety as exists with conventional airplane construction, Boeing must show that the 787 has sufficient crashworthiness capabilities under foreseeable survivable impact events. To show this, Boeing will have to evaluate the impact response characteristics of the 787 to ensure that its crashworthiness characteristics are not significantly different from those of a similarly sized airplane built from traditionally used metals. If the evaluation shows that the 787 impact response characteristics are significantly different, Boeing will have to make design changes to bring the different impact response characteristics in line with those of a similarly sized metal construction airplane, or incorporate mitigating design features.

Factors in crash survivability are retention of items of mass, maintenance of occupant emergency egress paths, maintenance of acceptable acceleration and loads experienced by the occupants, and maintenance of a survivable volume. The FAA has reviewed available data from accidents, tests simulating crash conditions, and analytical modeling of a range of crash conditions. From this information we have concluded that airplane performance should be evaluated over a range of airplane level vertical impact speeds up to 30 ft/sec.

If the 787 impact characteristics differ significantly from those of a previously certificated wide body transport, this will result in a need to meet load factors higher than those defined in 14 CFR 25.561. The higher load factors will be necessary in order to maintain the same level of safety for the occupants, in terms of retention of items of mass. In the case of acceleration and loads experienced by the occupants, means would have to be incorporated to reduce load levels experienced by those occupants to the injury criteria levels of § 25.562, or load levels of a previously certificated comparable airplane, in order to maintain the same level of safety for the occupants.

**Discussion of Comments**

Notice of Proposed Special Conditions No. 25–07–05–SC for the 787 was published in the **Federal Register** on June 11, 2007 (72 FR 32021). Several comments were received from two commenters.

*First Commenter:* The commenter, a member of the public, provided suggestions and comments related to the subject of crash simulation structural analysis as it pertains to the applicant's demonstration of compliance to these special conditions. This commenter agreed with the intent of the special conditions. However, he suggested that they be expanded or new special conditions developed to require a full fuselage fuel fed fire test to address possible fire, smoke, and toxicity (FST) hazards that may be associated with use of carbon fiber epoxy structure on the 787.

The commenter recommended that the special conditions include a requirement for a full scale drop test with a forward velocity vector to simulate a condition representative of a wheels-up landing, with the resultant vector sum of the vertical and longitudinal velocity components being included to assess the loads on the passengers and crew.

*FAA Response:* We agree that fuselage post-crash fire survivability of the 787, including FST hazards that may be associated with use of carbon fiber epoxy structure, is an important issue. This issue is outside the scope of these special conditions, however. It is being addressed in conjunction with the requirements for § 25.856(b) relating to fuselage fire penetration protection.

The FAA considered longitudinal loading conditions as well as combined longitudinal and vertical loading conditions of the 787 airframe under survivable crash conditions and emergency landing conditions with various landing gear configurations (wheels up configurations). The factors (principally deformation, mass, and friction) that govern impact response characteristics in the longitudinal direction are not significantly altered with the change from metallic to composite fuselage structure. Given the similarity of the 787 to the current fleet with respect to these conditions, the FAA has determined that these special conditions will be limited to an assessment of the 787 for the vertical impact direction.

With respect to the commenter's suggestions on the specific method of compliance, the FAA does not mandate a specific method of compliance for the requirements specified. The applicant is responsible for demonstrating compliance with these special conditions.

*Second Commenter:* This commenter, also a member of the public, suggested that the FAA conduct the crash impact testing necessary to show that the 787 meets these special conditions. He suggested that requirements for demonstrating compliance with the crashworthiness special conditions should consist of a drop test of a fuselage section of the 787 from a height of 14 feet onto concrete with an impact velocity of approximately 30 feet per second. The commenter suggested that the criteria of these special conditions should be that the 787 demonstrate the same level of vertical impact shock-absorption capability as demonstrated by an FAA-sponsored drop test of a Boeing 737 fuselage section conducted in 2000. This commenter also suggested that the special conditions be expanded to address post-crash fire survivability of the 787 in the post-impact damaged state. He provided suggestions and comments related to means of compliance to these special conditions, and also some comments on issues outside the scope of these special conditions.

*FAA Response:* The Administrator prescribes special conditions necessary to establish a level of safety equivalent to that established by the existing airworthiness standards. The requirements of these special conditions were prescribed to ensure that the 787 provides an equivalent level of occupant safety and survivability under foreseeable survivable impact events to that provided by previously certificated wide-body transports of similar size.

These special conditions do not mandate a specific method of compliance for the requirements specified. The applicant is responsible for demonstrating compliance with these special conditions. The FAA's role is to verify that the special conditions have been complied with, rather than to develop a method for compliance. While there are merits in conducting a

full-scale test, there are other approaches using tests and analysis that can actually yield more data than would a single test. Thus, we consider it more effective to establish the standards and encourage the applicant to develop the most effective method of compliance.

The FAA agrees that fuselage post-crash fire survivability of the 787, including FST hazards that may be associated with use of carbon fiber epoxy structure, is an important issue. This issue is outside the scope of these special conditions, however. It is being addressed in conjunction with the requirements for § 25.856(b) relating to fuselage fire penetration protection.

These special conditions are adopted as proposed.

**Applicability**

As discussed above, these special conditions are applicable to the 787. Should Boeing apply at a later date for a change to the type certificate to include another model on the same type certificate incorporating the same novel or unusual design features, these special conditions would apply to that model as well.

**Conclusion**

This action affects only certain novel or unusual design features of the 787. 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 special conditions is as follows:

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

**The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the Boeing Model 787–8 airplane.

The Boeing Model 787–8 must provide an equivalent level of occupant safety and survivability to that provided by previously certificated wide-body transports of similar size under foreseeable survivable impact events for the following four criteria. In order to demonstrate an equivalent level of occupant safety and survivability, the applicant must demonstrate that the Model 787–8 meets the following criteria for a range of airplane vertical descent velocities up to 30 ft/sec.

1. Retention of items of mass. The occupants, i.e., passengers, flight attendants, and flightcrew, must be protected during the impact event from release of seats, overhead bins, and other items of mass due to the impact loads and resultant structural deformation of the supporting airframe and floor structures. The applicant must show that loads due to the impact event and resultant structural deformation of the supporting airframe and floor structure at the interface of the airplane structure to seats, overhead bins, and other items of mass are comparable to those of previously certificated wide-body transports of similar size for the range of descent velocities stated above. The attachments of these items need not be designed for static emergency landing loads in excess of those defined in § 25.561 if impact response characteristics of the Boeing Model 787–8 yield load factors at the attach points that are comparable to those for a previously certificated wide-body transport category airplane.

2. Maintenance of acceptable acceleration and loads experienced by the occupants. The applicant must show that the impact response characteristics of the Boeing Model 787–8, specifically the vertical acceleration levels experienced at the seat/floor interface and loads experienced by the occupants during the impact events, are consistent with those found in § 25.562(b) or with levels expected for a previously certificated wide-body transport category airplane for the conditions stated above.

3. Maintenance of a survivable volume. For the conditions stated above, the applicant must show that all areas of the airplane occupied for takeoff and landing provide a survivable volume comparable to that of previously certificated wide-body transports of similar size during and after the impact event. This means that structural deformation will not result in infringement of the occupants' normal living space so that passenger survivability will not be significantly affected.

4. Maintenance of occupant emergency egress paths. The evacuation of occupants must be comparable to that from a previously certificated wide-body transport of similar size. To show this, the applicant must show that the suitability of the egress paths, as determined following the vertical impact events, is comparable to the suitability of the egress paths of a comparable, certificated wide-body transport, as determined following the same vertical impact events.

Issued in Renton, Washington, on September 14, 2007.

**Ali Bahrami,**

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

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## DEPARTMENT OF TRANSPORTATION

## Federal Aviation Administration

## 14 CFR Part 39

**[Docket No. FAA–2007–28349; Directorate Identifier 2007–NM–025–AD; Amendment 39–15211; AD 2007–20–01]**

**RIN 2120–AA64**

## Airworthiness Directives; Boeing Model 747–100B SUD, 747–200B, 747–200C, 747–200F, 747–300, 747–400, 747–400D, 747–400F, and 747SP Series Airplanes

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

**ACTION:** Final rule.

**SUMMARY:** The FAA is adopting a new airworthiness directive (AD) for certain Boeing Model 747–100B SUD, 747–200B, 747–200C, 747–200F, 747–300, 747–400, 747–400D, 747–400F, and 747SP series airplanes. This AD requires reconfiguring the clamps of certain wire bundles and applying insulating sealant to certain fasteners inside the fuel tanks. This AD results from fuel system reviews conducted by the manufacturer. We are issuing this AD to prevent arcing inside the fuel tanks in the event of a lightning strike or high-powered short circuit, which could result in a fuel tank explosion or fire.

**DATES:** This AD becomes effective October 31, 2007.

The Director of the Federal Register approved the incorporation by reference of certain publications listed in the AD as of October 31, 2007.

**ADDRESSES:** You may examine the AD docket on the Internet at *http://dms.dot.gov* or in person at the U.S. Department of Transportation, Docket Operations, M–30, West Building Ground Floor, Room W12–140, 1200 New Jersey Avenue, SE., Washington, DC.

Contact Boeing Commercial Airplanes, P.O. Box 3707, Seattle, Washington 98124–2207, for service information identified in this AD.

**FOR FURTHER INFORMATION CONTACT:** Sulmo Mariano, Aerospace Engineer, Propulsion Branch, ANM–140S, FAA, Seattle Aircraft Certification Office,