[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2014-0434; Special Conditions No. 25-544-SC]

Special Conditions: Bombardier Aerospace, Models BD-500-1A10 and BD-500-1A11; Composite Wing and Fuel Tank Structure Post-Crash Fire Survivability

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Bombardier Aerospace, Models BD-500-1A10 and BD-500-1A11 series airplanes. These airplanes 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 are composite materials used in the construction of the fuel tank skin and structure, which may behave differently in a post-crash fire than traditional aluminum construction. 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 airworthiness standards.

EFFECTIVE DATE: This action is effective on **[Insert date 30 days after date of publication in the Federal Register].**

FOR FURTHER INFORMATION CONTACT: Alan Sinclair, FAA, Airframe and Cabin Safety Branch, ANM-115 Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2195; facsimile 425-227-1232.

SUPPLEMENTARY INFORMATION:

Background

On December 10, 2009, Bombardier Aerospace applied for a type certificate for their new Models BD-500-1A10 and BD-500-1A11 series airplanes (hereafter collectively referred to as "CSeries"). The CSeries airplanes are swept-wing monoplanes with an aluminum alloy fuselage sized for 5-abreast seating. Passenger capacity is designated as 110 for the Model BD-500-1A10 and 125 for the Model BD-500-1A11. Maximum takeoff weight is 131,000 pounds for the Model BD-500-1A10 and 144,000 pounds for the Model BD-500-1A11.

Conventional airplanes with aluminum skin and structure provide a well-understood level of safety during post-crash fire scenarios with respect to fuel tanks. This is based on service history and extensive full-scale fire testing. The CSeries airplanes will not be fabricated primarily with aluminum for the fuel tank structure. Instead, they will be fabricated using predominantly composite structure and skin for the wings and fuel tanks. Composites may or may not have the equivalent capability of aluminum, and current regulations do not provide objective performance requirements for wing and fuel tank structure with respect to post-crash fire safety. Because the use of composite structure is novel and unusual with respect to the designs envisioned when the applicable regulations were promulgated, additional tests and analyses substantiation will be required to show that the CSeries airplanes will provide an acceptable level of safety with respect to the performance of the wings and fuel tanks during an external fuel-fed fire.

Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Bombardier Aerospace must show that the CSeries airplanes meet the applicable provisions of 14 CFR part 25 as amended by Amendments 25-1 through 25-129.

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 CSeries airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

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.

In addition to the applicable airworthiness regulations and special conditions, the CSeries airplanes 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, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

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

Novel or Unusual Design Features

The CSeries airplanes will incorporate the following novel or unusual design features: The structural elements and skin of the wings and fuel tanks will be fabricated using predominantly composite materials rather than conventional aluminum.

Discussion

Transport category airplanes in operation today have traditionally been designed with aluminum materials. Conventional airplanes with aluminum skin and structure provide a well-understood level of safety during post-crash fires with respect to fuel tanks. Current regulations were developed and have evolved under the assumption that wing construction would be of aluminum materials.

Aluminum has the following properties with respect to fuel tanks and fuel-fed external fires:

- Aluminum is highly thermally conductive and readily transmits the heat of a fuel-fed external fire to fuel in the tank. This has the benefit of rapidly driving the fuel tank ullage to exceed the upper flammability limit of fuel vapors prior to fuel tank skin burn-through or heating of the wing upper surface above the auto-ignition temperature, thus greatly reducing the threat of fuel tank explosion.
- Aluminum panels at thicknesses previously used in wing lower surfaces of large transport category airplanes have been fire resistant as defined in 14 CFR 1.1 and Advisory Circular (AC) 20-135, *Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards, and Criteria*.
- Heat absorption capacity of aluminum and fuel prevent burn-through or wing collapse for a time interval that generally exceeds the passenger evacuation time.

The ability of aluminum wing surfaces to withstand post-crash fire conditions when wetted by fuel on their interior surface has been demonstrated by tests conducted at the FAA Technical Center. Results of these tests have verified adequate dissipation of heat across wetted aluminum fuel tank surfaces so that localized hot spots do not occur, thus minimizing the threat

of explosion. This inherent capability of aluminum to dissipate heat also allows the wing lower surface to retain its load-carrying characteristics during a fuel-fed ground fire and significantly delay wing collapse or burn-through for a time interval that usually exceeds evacuation times. In addition, as an aluminum fuel tank is heated with significant quantities of fuel inside, fuel vapor accumulates in the ullage space, exceeding the upper flammability limit relatively quickly and thus reducing the threat of a fuel tank explosion prior to fuel tank burn-through.

Fuel tanks constructed with composite materials may or may not have equivalent properties. AC 20-107B (Change 1), *Composite Aircraft Structure*, section 11b, "Fire Protection, Flammability and Thermal Issues," states: "Wing and fuselage applications should consider the effects of composite design and construction on the resulting passenger safety in the event of in-flight fires or emergency landing conditions, which combine with subsequent egress when a fuel-fed fire is possible." Pertinent to the wing structure, post-crash fire passenger survivability is dependent on the time available for passenger evacuation prior to fuel tank breach or structural failure. Structural failure can be a result of degradation in load-carrying capability in the upper or lower wing surface caused by a fuel-fed ground fire and also as a result of over-pressurization caused by ignition of fuel vapors in the fuel tank.

For the CSeries airplanes, composite materials will be used to fabricate the majority of the wing fuel tank. Hence, the current regulations may not be adequate for the certification of the CSeries airplanes featuring wing fuel tanks fabricated with composite material. Therefore, Bombardier must present additional confirmation by test and analysis that the CSeries airplanes' design provides an acceptable level of safety with respect to the performance of the wing fuel tanks when exposed to the direct effects of post-crash ground fire or under-wing fuel-fed fires.

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 airworthiness standards.

Discussion of Comments

Notice of proposed special conditions No. 25-14-08-SC for the Bombardier CSeries airplanes was published in the Federal Register on July 16, 2014 (79 FR 41457). No comments were received, and the special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the Models BD-500-1A10 and BD-500-1A11 series airplanes. Should Bombardier Aerospace apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on two model series of 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 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 Bombardier Aerospace Models BD-500-1A10 and BD-500-1A11 series airplanes.

Composite Wing and Fuel Tank Post-Crash Fire Survivability

1. The wing fuel tank structure must withstand an external fuel-fed pool fire for a minimum of 5 minutes.

2. The integrity of the wing fuel tank structure must be demonstrated at:

- Minimum fuel load, not less than reserve fuel level;
- Maximum fuel load equal to the maximum range fuel quantity; and
- Any other critical fuel loads.

3. The demonstration must consider fuel tank flammability, burn-through resistance, wing structural strength retention properties, and auto-ignition threats from localized heating of composite structure, fasteners, or any other feature that may produce an ignition source during a ground fire event for the required time duration.

Issued in Renton, Washington, on October 16, 2014.

Michael Kascycki
Acting Manager, Transport Airplane Directorate

[FR Doc. 2014-25239 Filed 10/22/2014 at 8:45 am; Publication Date: 10/23/2014]