[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2014-0329; **Special Conditions No. 25-560-SC]**

Special Conditions: Bombardier Aerospace, Models BD-500-1A10 and BD-500-1A11 Series Airplanes; Tire Debris Impacts to Fuel Tanks

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 a novel or unusual design feature associated with the use of carbon fiber reinforced plastic (CFRP) for most of the wing fuel tank structure, which, when impacted by tire debris, may resist penetration or rupture differently from aluminum wing skins. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. 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: [Insert date 30 days after date of publication in the Federal Register].

FOR FURTHER INFORMATION CONTACT: Margaret Langsted, FAA, Propulsion and Mechanical Systems Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2677; facsimile 425-227-1149.

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.

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 part 25, as amended by Amendments 25-1 through 25-129 thereto.

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 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, 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 use of carbon fiber reinforced plastic (CFRP) for most of the wing fuel tank structure. The ability of aluminum wing skins to resist penetration or rupture when impacted by tire debris is understood from extensive experience, but the ability of CFRP construction to resist these hazards has not been established. There are no existing regulations that adequately establish a level of safety with respect to the performance of the composite materials used in the construction of wing fuel tanks. It requires the consideration of fuel tank penetration, fuel leaks, discrete source damage tolerance, and the effects of shock waves generated by tire debris impact.

Discussion

Accidents have resulted from uncontrolled fires caused by fuel leaks following penetration or rupture of the lower wing by fragments of tires or from uncontained engine failure. The Concorde accident in 2000 is the most notable example. That accident demonstrated an unanticipated failure mode in an airplane with an unusual transport airplane configuration. Impact to the lower wing surface by tire debris induced pressure waves within the fuel tank that resulted in fuel leakage and fire. Regulatory authorities subsequently required modifications to the Concorde to improve impact resistance of the lower wing or means to retain fuel if the primary fuel retention means is damaged.

In another incident, a Boeing Model 747 tire burst during an aborted takeoff from Honolulu, Hawaii. That tire debris penetrated a fuel tank access cover, causing substantial fuel leakage. Passengers were evacuated down the emergency chutes into pools of fuel that fortunately had not ignited.

These accidents highlight deficiencies in the existing regulations pertaining to fuel retention following impact of the fuel tanks by tire fragments. Following a 1985 Boeing Model 737 accident in Manchester, England, in which a fuel tank access panel was penetrated by engine debris, the FAA amended 14 CFR 25.963 to require fuel tank access panels that are resistant to both tire and engine debris (engine debris is addressed elsewhere). This regulation, § 25.963(e), only addressed the fuel tank access covers since service experience at the time showed that the lower wing skin of a conventional, subsonic airplane provided adequate inherent capability to resist tire and engine debris threats. More specifically, that regulation requires showing by analysis or tests that the access covers "... minimize penetration and deformation by tire fragments, low energy engine debris, or other likely debris." Advisory Circular (AC) 25.963-1, *Fuel Tank Access Covers*, describes the region of the wing that is vulnerable to impact damage from these sources and provides a method to substantiate that the rule has been met for tire fragments. No specific requirements were established for the contiguous wing areas into which the access covers are installed, because of the inherent ability of conventional aluminum wing skins to resist penetration by tire debris. AC 25.963-1 specifically notes, "The access covers, however, need not be more impact resistant than the contiguous tank structure," highlighting the assumption that the wing structure is more capable of resisting tire impact debris than fuel tank access covers.

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. To maintain the level of safety envisioned by 14 CFR 25.963(e), these special conditions establish a standard for resistance to potential tire debris impacts to the contiguous wing surfaces and require consideration of possible secondary effects of a tire impact, such as the induced pressure wave that was a factor in the Concorde accident. It takes into account that new construction methods and materials will not necessarily yield debris resistance that has historically been shown as adequate. The standard in these special conditions is based on the defined tire impact areas and tire fragment characteristics.

In addition, despite practical design considerations, some uncommon debris larger than that defined in paragraph 2 may cause a fuel leak within the defined area, so paragraph 3 of these special conditions also takes into consideration possible leakage paths. Fuel tank surfaces of typical transport airplanes have thick aluminum construction in the tire debris impact areas that is tolerant to tire debris larger than that defined in paragraph 2 of these special conditions. Consideration of leaks caused by larger tire fragments is needed to ensure that an adequate level of safety is provided.

Discussion of Comments

Notice of proposed special conditions No. 25-14-03-SC for the Bombardier Aerospace CSeries airplanes was published in the Federal Register on June 3, 2014, (79 FR 31886). No comments were received, and the special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the 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 on the same type certificate incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on one 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.

Tire Debris Impacts to Fuel Tanks.

1. Impacts by tire debris to any fuel tank or fuel system component located within 30 degrees to either side of wheel rotational planes may not result in penetration or otherwise induce fuel tank deformation, rupture (for example, through propagation of pressure waves), or cracking sufficient to allow a hazardous fuel leak. A hazardous fuel leak results if debris impact to a fuel tank surface causes a –

a. Running leak,

b. Dripping leak, or

c. Leak that, 15 minutes after wiping dry, results in a wetted airplane surface exceeding 6 inches in length or diameter.

The leak must be evaluated under maximum fuel head pressure.

2. Compliance with paragraph 1 must be shown by analysis or tests assuming all of the following:

a. The tire debris fragment size is 1 percent of the tire mass.

b. The tire debris fragment is propelled at a tangential speed that could be attained by a tire tread at the airplane flight manual airplane rotational speed (V_R at maximum gross weight).

c. The tire debris fragment load is distributed over an area on the fuel tank surface equal to 1½ percent of the total tire tread area.

3. Fuel leaks caused by impact from tire debris larger than that specified in paragraph 2, from any portion of a fuel tank or fuel system component located within the tire debris impact area defined in paragraph 1, may not result in hazardous quantities of fuel entering any of the following areas of the airplane:

a. Engine inlet,

b. Auxiliary power unit inlet, or

c. Cabin air inlet.

This must be shown by test or analysis, or a combination of both, for each approved engine forward thrust condition and each approved reverse thrust condition.

Issued in Renton, Washington, on September 3, 2014.

Michael Kaszycki
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service

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