DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2020-0404; Special Conditions No. 25-783-SC]

Special Conditions: B/E Aerospace, Bombardier Model CL-600-2B16 (604 Variant) Airplane; Seats with Pretensioner Restraint Systems.

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Bombardier Inc. (Bombardier) Model CL-600-2B16 (604 variant) airplane. This airplane, as modified by B/E Aerospace, will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. This design feature is seats with a 3-point shoulder harness incorporating a pretensioner restraint system. 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.

DATES: Effective on B/E Aerospace on [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

FOR FURTHER INFORMATION CONTACT: Shannon Lennon, Human-Machine Interface Section, AIR-626, Technical Innovation Policy Branch, Policy and Innovation Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South 216th Street, Des Moines, Washington 98198; telephone and fax 206-231-3209; email shannon.lennon@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

On June 7, 2019, B/E Aerospace applied for a supplemental type certificate for seats with 3-point harness and pretensioner restraint systems on Bombardier Model CL-600-2B16 (604 variant) airplanes. The 604 variant is a derivative of the Bombardier Model CL-600-2B16 airplane currently approved under Type Certificate No. A21EA. This airplane variant is a twin-engine, transport category airplane with seating for 22 passengers, including crew, and a maximum take-off weight of 47,600 pounds.

Type Certification Basis

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, B/E Aerospace must show that the Bombardier Model CL-600-2B16 (604 variant) airplane, as changed, continues to meet the applicable provisions of the regulations listed in Type Certificate No. A21EA or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (e.g., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Bombardier Model CL-600-2B16 (604 variant) airplane 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 applicant apply for a supplemental type certificate to modify any other model included on the same type certificate to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Bombardier Model CL-600-2B16 (604 variant) airplane 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 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 § 21.101.

Novel or Unusual Design Features

The Bombardier Model CL-600-2B16 (604 variant) airplane, as modified by B/E Aerospace, will incorporate the following novel or unusual design feature:

Seats with a 3-point shoulder harness incorporating a pretensioner restraint system to prevent head injuries.

Discussion

B/E Aerospace has developed a system in which a pretensioning automotive retractor eliminates slack in the 3-point shoulder harness, pulling the occupant back into the seat prior to impact. This has the effect of reducing forward translation of the occupant (reduced head arc), while reducing the loads in the shoulder harness. B/E Aerospace will install, in Bombardier Model CL-600-2B16 (604 variant) airplanes, seats that incorporate a 3-point harness and pretensioner restraint system to protect seat occupants from head injuries.

Over the past 10 years, multiple sensor-driven systems have been installed in various airplanes to meet improved crashworthiness regulations. A sensor-driven system is defined as any system that activates due to a signal sent by an impact-triggered inertial sensor. These types of systems include a lap-belt airbag, a structure-mounted airbag, and a 3-point harness and pretensioner restraint system.

Shoulder harnesses have been widely used on flight-attendant seats, flight-deck seats, in business jets, and in general-aviation airplanes to reduce occupant head injury in the unlikely event of an emergency landing. Special conditions, pertinent regulations, and guidance have been published, relating to other or existing restraint systems. However, the use of a pretensioner restraint system with a 3-point harness on transport airplane seats is a novel design.

Pretensioner technology involves a step change in loading experienced by the occupant for impacts below and above that at which the device activates, because the

upper torso excursion would be interrupted by activation of the shoulder harness. This could result in the head-injury criteria being higher at an intermediate impact condition than that resulting from the maximum impact condition corresponding to the test conditions specified in § 25.562.

The ideal triangular maximum-severity pulse is defined in Advisory Circular 25.562-1B, "Dynamic Evaluation of Seat Restraint Systems and Occupant Protection on Transport Airplanes with Change 1," dated January 10, 2006. For evaluating and testing less-severe pulses to assess the effectiveness of the pretensioner setting, a similar triangular pulse should be used with acceleration, rise time, and velocity change scaled accordingly. The magnitude of the required pulse should not deviate below the ideal pulse by more than 0.5g until 1.33 t_1 is reached, where t_1 represents the time interval between 0 and t_1 on the referenced pulse shape as shown in AC 25.562-1B. This is an acceptable method of compliance to the test requirements of these special conditions.

Additionally, the pretensioner might not provide protection, after actuation, during secondary impacts. Therefore, the case where a small impact is followed by a large impact should be addressed. If the minimum deceleration severity at which the pretensioner is set to activate is unnecessarily low, the protection offered by the pretensioner may be lost by the time a second larger impact occurs.

The existing regulations do not adequately address seats with pretensioner restraint systems. Therefore, the proposed configuration requires special conditions.

Special conditions 1 through 5 address ensuring that the pretensioner system activates when intended, to provide the necessary protection of occupants. This includes protection of a range of occupants under various accident conditions. Special conditions 6 through 11 address maintenance and reliability of the pretensioner system, including any outside influences on the mechanism, to ensure it functions as intended.

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

The FAA issued Notice of Proposed Special Conditions No. 25-20-04-SC for the Bombardier Model CL-600-2B16 (604 variant) airplane, which was published in the *Federal Register* on September 4, 2020 (85 FR 55198). The FAA received responses from four commenters supporting the special conditions. The special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the Bombardier Model CL-600-2B16 (604 variant) airplane. Should B/E Aerospace apply at a later date for a supplemental type certificate to modify any other model included on Type Certificate No. A21EA to incorporate the same novel or unusual design feature, these special conditions would apply to that model as well.

Conclusion

This action affects only a certain novel or unusual design feature on one model of airplanes. It is not a rule of general applicability and affects only the applicant who applied to the FAA for approval of these features on the airplane.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

Authority Citation

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(f), 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 Model CL-600-2B16 (604 variant), as modified by B/E Aerospace.

In addition to the requirements of § 25.562, forward-facing passenger seats incorporating pretensioner restraint systems must meet the following:

1. **Head Injury Criteria** – The Head Injury Criteria value must not exceed 1,000 units at any condition at which the pretensioner does or does not deploy, up to the maximum severity pulse that corresponds to the test conditions specified in § 25.562. Tests must be performed to demonstrate this, taking into account any necessary tolerances for deployment.
2. **Protection during Secondary Impacts** – The pretensioner activation setting must be demonstrated to maximize the probability of the protection being available when needed, considering secondary impacts.
3. **Protection of Occupants Other than 50th Percentile** – Protection of occupants for a range of stature from a 2-year-old child to a 95th percentile male must be shown. For shoulder harnesses that include pretensioners, protection of occupants other than a 50th percentile male may be shown by test or analysis. In addition, the pretensioner must not introduce a hazard to passengers due to the following seating configurations:
    a. The seat occupant is holding an infant.
    b. The seat occupant is a child in a child restraint device.
    c. The seat occupant is a pregnant woman.
4. **Occupants Adopting the Brace Position** – Occupants in the traditional brace position when the pretensioner activates must not experience adverse effects from the pretensioner activation.
5. **Inadvertent Pretensioner Actuation**

a. The probability of inadvertent pretensioner actuation must be shown to be extremely remote (i.e., average probability per flight hour of less than 10^{-7}).

b. The system must be shown not susceptible to inadvertent pretensioner actuation as a result of wear and tear, or inertia loads resulting from in-flight or ground maneuvers likely to be experienced in service.

c. The seated occupant must not be seriously injured as a result of inadvertent pretensioner actuation.

d. Inadvertent pretensioner activation must not cause a hazard to the airplane nor cause serious injury to anyone who may be positioned close to the retractor or belt (e.g., seated in an adjacent seat or standing adjacent to the seat).

6. **Availability of the Pretensioner Function Prior to Flight** – The design must provide means for a crewmember to verify the availability of the pretensioner function prior to each flight, or the probability of failure of the pretensioner function must be demonstrated to be extremely remote (i.e., average probability per flight hour of less than 10^{-7}) between inspection intervals.

7. **Incorrect Seatbelt Orientation** – The system design must ensure that any incorrect orientation (twisting) of the seatbelt does not compromise the pretensioner protection function.

8. **Contamination Protection** – The pretensioner mechanisms and controls must be protected from external contamination associated with that which could occur on or around passenger seating.

9. **Prevention of Hazards** – The pretensioner system must not induce a hazard to passengers in case of fire, nor create a fire hazard if activated.

10. **Functionality after Loss of Power** – The system must function properly after loss of normal airplane electrical power, and after a transverse separation in the fuselage at the most critical location. A separation at the location of the system does not have to be considered.
11. **High-intensity Radiated Fields (HIRF) and Lightning Protection** – For airplanes that do not already incorporate 14 CFR 25.1316 and 25.1317 into their certification basis, the equipment must meet the applicable requirements of §§ 25.1316 and 25.1317. Electrostatic discharge must also be considered in the design and testing of the equipment.

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Patrick R. Mullen
Manager, Technical Innovation Policy Branch
Policy and Innovation Division
Aircraft Certification Service
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