[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM434; Notice No. 25-412-SC]

Special Conditions: Bombardier Inc. Model CL-600-2E25 airplane, Interaction of Systems and Structures.

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued for the Bombardier Inc. Model CL-600-2E25 airplane. This airplane will have a novel or unusual design feature associated with the rudder-traveler limiting system controlling the command-by-wire (CBW) rudder. This system can serve to alleviate loads in the airframe but, in a failure state, can create loads in the airframe. 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: The effective date of these special conditions is November 5, 2010. We must receive your comments by January 5, 2011.

ADDRESSES: You must mail two copies of your comments to: Federal Aviation Administration, Transport Airplane Directorate, Attn: Rules Docket (ANM-113), Docket No. NM434, 1601 Lind Avenue SW., Renton, Washington, 98057-3356. You may deliver two copies to the Transport Airplane Directorate at the above address. You must mark your comments:

Docket No. NM434. You can inspect comments in the Rules Docket weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: Todd Martin, FAA, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone (425) 227-1178; facsimile (425) 227-1149.

SUPPLEMENTARY INFORMATION:

The FAA has determined that notice of, and opportunity for prior public comment on, these special conditions are impracticable because these procedures would significantly delay issuance of the design approval and thus delivery of the affected aircraft. In addition, the substance of these special conditions has been subject to the public-comment process in several prior instances with no substantive comments received. The FAA therefore finds that good cause exists for making these special conditions effective upon issuance.

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the 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 special conditions. You can inspect the docket 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 preamble between 7:30 a.m. and 4:00 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 these special conditions based on the comments we receive.

If you want us to acknowledge receipt of your comments on these special conditions, include with your comments a self-addressed, stamped postcard on which you have written the docket number. We will stamp the date on the postcard and mail it back to you.

Background

On February 28, 2007, Bombardier Inc. applied for an amendment to Type Certificate No. A21EA, through Transport Canada, to include the new Model CL-600-2E25 airplane. The CL-600-2E25, which is a derivative of the CL-600-2D24 currently approved under Type Certificate No. A21EA, is to be certified for a maximum occupancy of 110 people, including 5 crewmembers. The CL-600-2E25 has increased gross weight, extended wing tip, and increased fuselage length to accommodate the additional passengers as compared to the CL-600-2D24.

The CL-600-2E25 will have a CBW rudder-control system that will affect the structural performance of the airplane. The airplane will use CBW Rudder Electronic Control Unit (ECU) software as a replacement for the Rudder Travel Limiter to limit rudder commands. The CBW Rudder ECU controls the rudder, trim, and yaw damping as well. This system can serve to alleviate loads in the airframe but, in a failure state, can create loads in the airframe. The current rules do not adequately account for the effects of this system and its failures on structural performance. The special conditions defined herein provide the criteria to be used in assessing the effects of this system on structures.

Type Certification Basis

Under the provisions of § 21.101, Bombardier Inc. must show that the Model CL-600-2E25 airplane meets the applicable provisions of Title 14, Code of Federal Regulations (14 CFR) part 25, as amended by Amendments 25-1 through 25-119, except for earlier amendments as agreed upon by the FAA. These regulations will be incorporated into Type Certificate No. A21EA after type-certification approval of the Model CL-600-2E25. The regulations incorporated by reference in the type certificate are commonly referred to as the "original type-certification basis." The regulations incorporated by reference in Type Certificate No. A21EA are as follows:

The original type-certification basis for the Model CL-600-2D24 (CRJ 900), shown on TCDS A21EA, Revision 25, and reprinted below.

Model CL-600-2D15/CL-600-2D24

Part 25, including Amendments 25-1 through 25-86, Amendments 25-88 through Amendments 25-90, and Amendments 25-92 through 25-98 with the following exceptions:

- Section 25.783(f) at Amendment 25-23 shall replace § 25.783(f) at Amendment 25-88 for the Aft Cargo Compartment and Main Avionics Bay Doors only (common doors with CL- 600-2C10 (CRJ-700);
- Section 25.807(d)(6) at Amendment 25-72 shall replace § 25.807(h) at Amendment 25-94;
- Sections 25.365, 25.831(a), and 25.1447(c) at Amendment 25-87. Part 25, Amendment 25-91, is not included in the type-certification basis.

Additional FAA Requirements for Model CL-600-2D15/CL-600-2D24

1. 14 CFR part 36, effective September 10, 1990, and including all amendments effective on the date of type certification.
2. 14 CFR part 34, effective September 10, 1990, and including all amendments effective on the date of type certification.
3. Special Conditions:
    a) *High Intensity Radiated Fields*, No. 25-ANM-109, dated October 31, 1995.
    b) *Go-around Performance Credit for Use of Automatic Power Reserve (APR)*, No. 25-167-SC, dated October 24, 2000 (same as CL-600-2C10).
    c) *Sudden Engine Stoppage*, No. 25-217-SC, dated October 04, 2002.
    d) *Passenger Seats with Non-traditional, Large, Non-metallic Panels*, No. 25-384-SC, dated August 12, 2009.
4. Exemptions: Exemption No. 7447, hydraulic-systems testing per 14 CFR 25.1435(b)(1). Equivalent safety has been established for the following requirements:

    CL-600-2D15/CL-600-2D24

    1. Section 25.103 and others, *Reduced Minimum Operating Speed Factors*.
    2. Section 25.811(d)(2), *Main Door Exit Marking Sign*.
    3. Section 25.813(c)(2)(i), *Emergency Exit Access*.
    4. Section 25.904, *Performance Credit for Use of APR During Reduced Thrust Takeoff*.
    5. Section 25.933(a)(1)(ii), *Thrust Reverser System*.
    6. Section 25, appendix I, § 25.5(b)(4), *Lack of On/Off Switch for Automatic Takeoff*

Thrust Control System (ATTCS).

7. Section 25.841(b)(6), *High Altitude Takeoff and Landing Operations* documented in Transport Airplane Directorate ELOS Memo AT2587NY-T, dated January 31, 2007.

In addition, the certification basis includes other regulations, special conditions, and exemptions that are not relevant to these special conditions. Type Certificate No. A21EA will be updated to include a complete description of the certification basis for this airplane model.

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 CL-600-2E25 because of a novel or unusual design feature, special conditions are prescribed under the provisions of 14 CFR 21.16.

In addition to the applicable airworthiness regulations and special conditions, the CL-600-2E25 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 14 CFR 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 Bombardier Model CL-600-2E25 airplane will incorporate the following novel or unusual design features:

The CL-600-2E25 airplane will have a CBW rudder-control system that will affect the structural performance of the airplane. The airplane will use a CBW Rudder ECU software as a replacement for the rudder-travel limiter to limit rudder commands. The CBW Rudder ECU controls the rudder, trim, and yaw damping as well.

Discussion

This CBW system can affect the airplane's structural performance, either directly or as a result of failure or malfunction. That is, the CBW system affects how the airplane responds in maneuver and gust conditions, and thereby affects the airplane's structural capability. Such systems represent a novel and unusual feature when compared to the technology envisioned in the current airworthiness standards. Special conditions are needed to require consideration of the effects of the system on the structural capability and aeroelastic stability of the airplane, both in the normal and in the failed state. These special conditions require that the airplane meet the structural requirements of subparts C and D of 14 CFR part 25 when the airplane systems are fully operative. These special conditions also require that the airplane meet these requirements considering failure conditions. In some cases, these special conditions allow reduced margins (in terms of speed margins and factors of safety) for failure conditions, as a function of system reliability.

The Administrator considers these special conditions necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Applicability

As discussed above, these special conditions are applicable to the Model CL-600-2E25. Should Bombardier Inc. apply at a later date for a change to the type certificate to include another airplane model 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 of airplane. It is not a rule of general applicability.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the Federal Register. However, as the certification date for the Model CL-600-2E25 is imminent, the FAA finds that good cause exists to make these special conditions effective upon issuance.

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 Model CL-600-2E25 airplanes modified according to DCA 0145-000-00020-2008/FAA (latest revision approved by the FAA).

1. CWB Rudder-Control-System Special Conditions

The Bombardier Model CL-600-2E25 airplane is equipped with systems that affect the airplane's structural performance either directly or as a result of failure or malfunction. The influence of these systems and their failure conditions must be taken into account when showing compliance with requirements of 14 CFR part 25, subparts C and D. The following criteria must be used for showing compliance with these special conditions for airplanes equipped with flight-control systems, autopilots, stability-augmentation systems, load-alleviation systems, flutter-control systems, fuel-management systems, and other systems that either directly, or as a result of failure or malfunction, affect structural performance. If these special conditions are used for other systems, it may be necessary to adapt the criteria to the specific systems.

(a) The criteria defined here address only direct structural consequences of system responses and performances. They cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. They may, in some instances, duplicate standards already established for this evaluation. These criteria are only applicable to structure the failure of which could prevent continued safe flight and landing. Specific criteria defining acceptable limits on handling characteristics or stability requirements, when operating in the system-degraded or inoperative mode, are not provided in these special conditions.

(b) Depending on the specific characteristics of the airplane, additional studies may be required, which go beyond the criteria provided in these special conditions, to demonstrate the capability of the airplane to meet other realistic conditions such as alternative gust conditions or maneuvers for an airplane equipped with a load-alleviation system.

(c) The following definitions are applicable to these special conditions:

(1) **Structural performance**: The capability of the airplane to meet the structural requirements of part 25.

(2) **Flight limitations**: Limitations that can be applied to the airplane flight conditions following an in-flight failure occurrence, and that are included in the flight manual (speed limitations or avoidance of severe weather conditions, for example).

(3) **Operational limitations**: Limitations, including flight limitations, that can be applied to the airplane operating conditions before dispatch, and which include, for example, fuel, payload, and master minimum-equipment-list limitations.

(4) **Probabilistic terms**: Terms, including probable, improbable, and extremely improbable, used in these special conditions and which are the same as those probabilistic terms used in § 25.1309.

(5) **Failure condition**: The same term as used in § 25.1309. However, in these special conditions, the term “failure condition” applies only to system-failure conditions that affect structural performance of the airplane. Examples are system-failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins.

Note: Although failure-annunciation-system reliability must be included in probability calculations for paragraph (d)(2) of these special conditions, there is no specific reliability requirement for the annunciation system required in paragraph (e) of these special conditions.

(d) **General**. The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure:

(1) **System fully operative**. With the system fully operative, the following apply:

(i) Limit loads must be derived in all normal operating configurations of the system from all the limit conditions specified in subpart C of 14 CFR part 25 (or used in lieu of those specified in subpart C), taking into account any special behavior of such a system or associated functions, or any effect on the structural performance of the airplane that may occur up to the limit loads. In particular, any significant degree of nonlinearity in rate of displacement of control surface or thresholds, or any other system nonlinearities, must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

(ii) The airplane must meet the strength requirements of part 25 for static strength and residual strength, using the specified factors to derive ultimate loads from the limit loads defined above. The effect of nonlinearities must be investigated beyond limit conditions to ensure the behavior of the system presents no anomaly compared to the behavior below limit conditions. However, conditions beyond limit conditions need not be considered if the applicant demonstrates that the airplane has design features that will not allow it to exceed those limit conditions.

(iii) The airplane must meet the aeroelastic stability requirements of § 25.629.

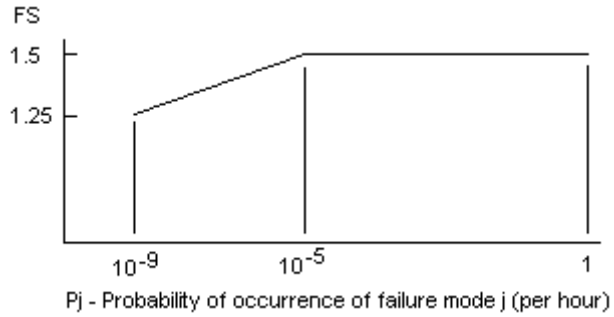
(2) **System in the failure condition**. For any system failure condition not shown to be extremely improbable, the following apply:

(i) **Establishing loads at the time of occurrence**. Starting from 1g level flight conditions, a realistic scenario including pilot corrective actions must be established to determine loads occurring at the time of failure and immediately after failure.

(A) For static-strength substantiation, these loads, multiplied by an appropriate factor of safety related to probability of occurrence of the failure, are ultimate loads to be considered for

design. The factor of safety (FS) is defined in Figure 1.

Figure 1: FS at the time of occurrence



(B) For residual-strength substantiation, the airplane must be able to withstand two-thirds of the ultimate loads defined in paragraph (d)(2)(i)(A) of these special conditions. For pressurized cabins, these loads must be combined with the normal operating differential pressure.

(C) Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speeds beyond design cruise speed or design cruise mach number (V_C/M_C), freedom from aeroelastic instability must be shown to increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.

(D) Failures of the system that result in forced structural vibrations (oscillatory failures) must not produce loads that could result in detrimental deformation of primary structure.

(3) **Establishing loads in the system-failed state for the continuation of the flight**. For airplane-flight continuation in the system-failed state, and considering any appropriate reconfiguration and flight limitations, the following apply:

(i) Loads derived from the following conditions (or used in lieu of the following conditions) at speeds up to V_C/M_C, or the speed limitation prescribed for the remainder of the flight, must be determined:

(A) The limit symmetrical-maneuvering conditions specified in §§ 25.331 and 25.345.

(B) The limit gust-and-turbulence conditions specified in §§ 25.341 and 25.345.

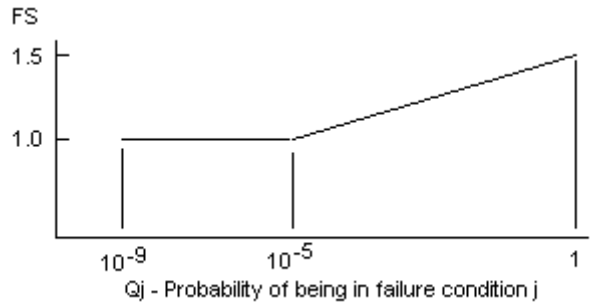
(C) The limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in §§ 25.367 and 25.427(b) and (c).

(D) The limit yaw-maneuvering conditions specified in § 25.351.

(E) The limit ground-loading conditions specified in §§ 25.473 and 25.491.

(ii) For static-strength substantiation, each part of the structure must be able to withstand the loads in paragraph (d)(3)(i) of these special conditions, multiplied by a FS depending on the probability of being in this failure state. The FS is defined in Figure 2.

Figure 2: FS for continuation of flight



$Q_j = (T_j)(P_j)$ where:

T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then a 1.5 FS must be applied to all limit-load conditions specified in part 25, subpart C.

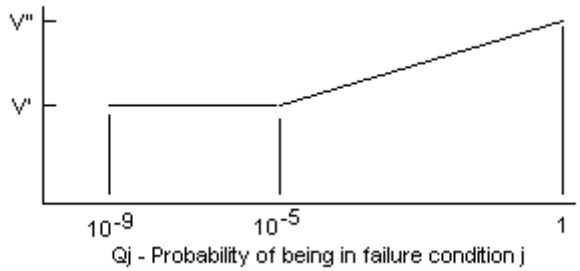
(iii) For residual-strength substantiation, the airplane must be able to withstand two-thirds of the ultimate loads defined in paragraph (d)(3)(ii) of these special conditions. For pressurized

cabins, these loads must be combined with the normal operating differential pressure.

(iv) If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance, then the effects of these loads must be taken into account.

(v) Freedom from aeroelastic instability must be shown up to a speed determined from Figure 3. Flutter-clearance speeds V' and V" may be based on the speed limitation specified for the remainder of the flight using the margins defined by § 25.629(b).

Figure 3: Flutter-clearance speed



V' = Clearance speed as defined by § 25.629(b)(2)

V" = Clearance speed as defined by § 25.629(b)(1)

$Q_j = (T_j)(P_j)$ where:

T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then the flutter-clearance speed must not be less than V".

(vi) Freedom from aeroelastic instability must also be shown up to V' in Figure 3 above, for any probable system-failure condition, combined with any damage, required or selected for investigation by § 25.571(b).

(4) Consideration of certain failure conditions may be required by other sections of part 25 regardless of calculated system reliability. Where analysis shows the probability of these failure conditions to be less than 10^{-9}, criteria other than those specified in this paragraph may be used for structural substantiation to show continued safe flight and landing.

(e) **Failure indications**. For system failure detection and indication, the following apply:

(1) The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability of the airplane below the level required by part 25 or significantly reduce the reliability of the remaining system. As far as reasonably practicable, the flightcrew must be made aware of these failures before flight. Certain elements of the control system, such as mechanical and hydraulic components, may use special periodic inspections, and electronic components may use daily checks, instead of detection and indication systems to achieve the objective of this requirement. Such certification-maintenance inspections or daily checks must be limited to components on which faults are not readily detectable by normal detection and indication systems, and where service history shows that inspections will provide an adequate level of safety.

(2) The existence of any failure condition, not extremely improbable during flight, that could significantly affect the structural capability of the airplane and for which the associated reduction in airworthiness can be minimized by suitable flight limitations, must be signaled to the flightcrew. For example, failure conditions that result in a FS between the airplane strength and the loads of part 25, subpart C, below 1.25, or flutter margins below V", must be signaled to the crewmembers during flight.

(f) **Dispatch with known failure conditions**. If the airplane is to be dispatched in a

known system-failure condition that affects structural performance, or affects the reliability of the remaining system to maintain structural performance, then the provisions of these special conditions must be met, including the provisions of paragraph (d)(1) of these special conditions for the dispatched condition, and paragraph (d)(2) of these special conditions for subsequent failures. Expected operational limitations may be taken into account in establishing P_j as the probability of failure occurrence for determining the safety margin in Figure 1. Flight limitations and expected operational limitations may be taken into account in establishing Q_j as the combined probability of being in the dispatched failure condition and the subsequent failure condition for the safety margins in Figures 2 and 3. These limitations must be such that the probability of being in this combined failure state, and then subsequently encountering limit load conditions, is extremely improbable. No reduction in these safety margins is allowed if the subsequent system-failure rate is greater than 10^{-3} per hour.

Issued in Renton, Washington, on November 5, 2010.

/s/

Jeffrey Duven
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service