Rules and Regulations

Federal Register
Vol. 76, No. 134
Wednesday, July 13, 2011

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM460; Special Conditions No. 25–439–SC]

Special Conditions: Gulfstream Aerospace LP (GALP) Model G250 Airplane, Interaction of Systems and Structures

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued for the Gulfstream Aerospace LP (GALP) Model G250 airplane. This airplane will have a novel or unusual design feature associated with a fly-by-wire (FBW) flight control system that governs the yaw and roll axes. 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 July 1, 2011. We must receive your comments by August 29, 2011.

ADDRESSES: You must mail two copies of your comments to: Federal Aviation Administration, Transport Airplane Directorate, *Attn:* Rules Docket (ANM–113), Docket No. NM460, 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. NM460. You can inspect comments in the Rules Docket weekdays, except Federal holidays, between 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: Carl Niedermeyer, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356; telephone (425) 227–2279; e-mail *carl.niedermeyer@faa.gov;* 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 about 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 p.m., Monday through Friday, except Federal holidays.

We will consider all comments we receive by the closing date for comments. 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 March 30, 2006, GALP applied for a type certificate for their new Model G250 airplane. The G250 is an 8–10 passenger (19 maximum), twin-engine airplane with a maximum operating altitude of 45,000 feet and a range of approximately 3,400 nautical miles. Airplane dimensions are 61.69-foot wing span, 66.6-foot overall length, and 20.8-foot tail height. Maximum takeoff weight is 39,600 pounds and maximum landing weight 32,700 pounds. Maximum cruise speed is mach 0.85, dive speed is mach 0.92. The avionics suite will be the Rockwell Collins Pro Line Fusion.

Type Certification Basis

Under the provisions of 14 CFR 21.17, GALP must show that the Model G250 airplane meets the applicable provisions of part 25 as amended by Amendments 25–1 through 25–117.

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 Model G250 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 type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, the special conditions would also apply to the other model.

In addition to the applicable airworthiness regulations and special conditions, the Model G250 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; 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 Model G250 will incorporate the following novel or unusual design features:

The GALP Model G250 airplane has an FBW flight control system that governs the yaw and roll axes. The current rules are inadequate for considering the effects on structural

performance of this system and its failures.

Discussion

Active flight control systems are capable of providing automatic responses to inputs from sources other than the pilots. Active flight control systems have been expanded in function, effectiveness, and reliability to the point that FBW flight controls, without a manual backup system to override FBW system failures, are becoming standard equipment. As a result of these advancements in flight controls technology, the current safety standards contained in Title 14 Code of Federal Regulations (14 CFR) part 25 do not provide an adequate basis to address an acceptable level of safety for airplanes so equipped. Instead, certification of these systems has been achieved by issuance of special conditions under the provisions of § 21.16.

For example, stability augmentation systems (SASs), and to a lesser extent load alleviation systems (LASs), have been used on transport airplanes for many years. Past approvals of these systems were based on individual findings of equivalent level of safety with existing rules and on special conditions. Advisory Circular 25.672–1 was issued on November 11, 1983, to provide an equivalent means of compliance under the provisions of § 21.21(b)(1) for SAS, LAS, and flutter control systems (FCSs), another type of active control system.

Although autopilots are also considered active control systems, their control authority historically has been limited such that the consequences of system failures could be readily counteracted by the pilot. Now, autopilot functions are integrated into the primary flight controls and are given sufficient control authority to maneuver the airplane to its structural design limits. This advanced technology, with its expanded authority, requires a new approach to account for the interaction of control systems and structures.

The usual deterministic approach to defining the loads envelope contained in 14 CFR part 25 does not fully account for system effectiveness and system reliability. These automatic systems may be inoperative or may operate in a degraded mode with less than full-system authority. Therefore, it is necessary to determine the structural factors of safety and operating margins such that the joint probability of structural failures, due to application of loads during system malfunctions, is not greater than that found in airplanes equipped with earlier-technology control systems. To achieve this objective, it is necessary to define the failure conditions with their associated frequency of occurrence to determine the structural factors of safety and operating margins that will ensure an acceptable level of safety.

Earlier automatic control systems usually provided two states: fully functioning, or totally inoperative. These conditions were readily detected by the flight crew. The new active flight control systems have failure modes that allow the system to function in a degraded mode without full authority. These degraded modes are not readily detectable by the flightcrew, therefore monitoring systems are required on these new systems to provide an annunciation of degraded system capability.

In these special conditions, and in the current standards and regulations, the term ''any'' is used. Use of this term has traditionally been understood to require the applicant to address all items covered by the term, rather than addressing only a portion of the items. The use of the term ''any'' in these special conditions continues this traditional understanding.

Applicability

As discussed above, these special conditions are applicable to the GALP Model G250 airplane. Should GALP 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 the GALP Model G250 airplane. It is not a rule of general applicability and it affects only the applicant who applied to the FAA for approval of these features on the airplane.

The FAA has determined that prior public notice and comment are unnecessary and impracticable, and good cause exists for adopting these special conditions 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 the GALP Model G250 airplane.

Interaction of Systems and Structures

For airplanes equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions must be taken into account when showing compliance with the requirements of Subparts C and D of 14 CFR part 25.

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 system.

1. The criteria defined herein only address the direct structural consequences of the system responses and performance. They cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. These criteria 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 that define acceptable limits on handling characteristics or stability requirements, when operating in the system degraded or inoperative mode, are not provided in these special conditions.

2. Depending upon the specific characteristics of the airplane, additional criteria may be required that 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 or maneuver descriptions for an airplane equipped with a load-alleviation system.

3. The following definitions are applicable to these special conditions.

(a) *Structural performance:* Capability of the airplane to meet the structural requirements of 14 CFR part 25.

(b) *Flight limitations:* Limitations that can be applied to the airplane flight conditions following a detectable in-flight occurrence and that are included in the airplane flight manual (AFM; e.g., speed limitations, avoidance of severe weather conditions, etc.).

(c) *Operational limitations:* Limitations, including flight limitations, that can be applied to the airplane operating conditions before dispatch (e.g., fuel, payload, and Master Minimum Equipment List limitations).

(d) *Probabilistic terms:* The probabilistic terms (probable, improbable, extremely improbable) used in these special conditions are the same as those used in § 25.1309.

(e) *Failure condition:* This term is the same as that used in § 25.1309. However, these special conditions apply only to system-failure conditions that affect the structural performance of the airplane (e.g., system-failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins).

Effects of Systems on Structures

The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure.

4. *System fully operative.* With the system fully operative, the following apply:

(a) Limit loads must be derived in all normal operating configurations of the system from all the limit load conditions specified in 14 CFR part 25, subpart C (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 changes in control-surface limits, rate of displacement of control surface, thresholds, or any other system nonlinearities must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

(b) The airplane must meet the strength requirements of part 25 (static strength, 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 when it can be shown that the airplane has design features that will not allow it to exceed those limit conditions.

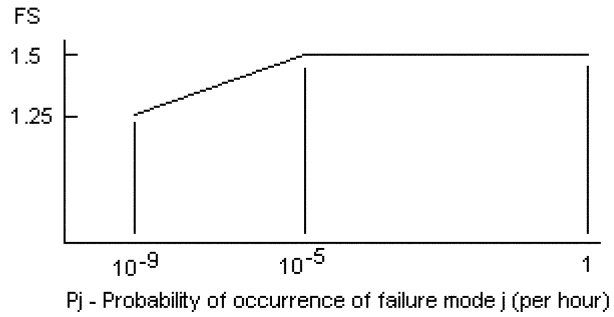
(c) The airplane must meet the aeroelastic stability requirements of § 25.629.

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

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

(1) For static-strength substantiation, these loads, multiplied by an appropriate factor of safety that is related to the probability of occurrence of the failure, are ultimate loads to be considered for design. The factor of safety is defined in Figure 1.

Figure 1: Factor of safety at the time of occurrence



(2) For residual strength substantiation, the airplane must be able to withstand two-thirds of the ultimate loads defined in paragraph 5(a)(1) of these special conditions. For pressurized cabins, these loads must be combined with the normal operating differential pressure.

(3) 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 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.

(4) 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.

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

(1) The 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.

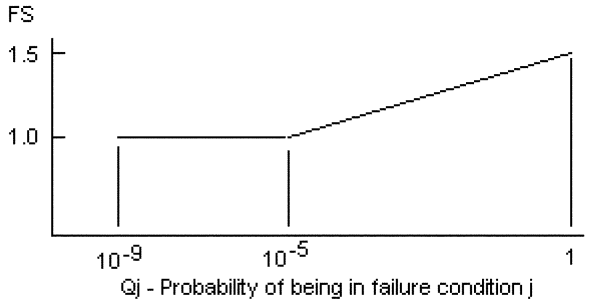
(C) The limit rolling conditions specified in § 25.349, and the limit unsymmetrical conditions specified in §§ 25.367, and 25.427(b) and (c).

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

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

(2) For static-strength substantiation, each part of the structure must be able to withstand the loads in paragraph 5(b)(1) of these special conditions, multiplied by a factor of safety depending on the probability of being in this failure state. The factor of safety is defined in Figure 2.

Figure 2: Factor of safety for continuation of flight



$Q_j = (T_j)(P_j)$

Where:

Qj = Probability of being in failure condition j

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

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

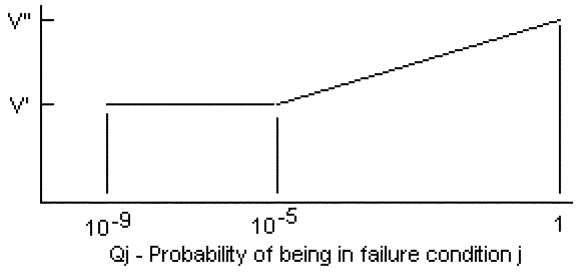
Note: If P_j is greater than 10^{-3} per flight hour, then a 1.5 factor of safety must be applied to all limit load conditions specified in 14 CFR part 25, subpart C.

(3) For residual-strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in paragraph 5(b)(2) of these special conditions. For pressurized cabins, these loads must be combined with the normal operating differential pressure.

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

(5) 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: 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:

Qj = Probability of being in failure condition j

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″.

(6) 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).

(c) Consideration of certain failure conditions may be required by other sections of 14 CFR 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.

Failure Indications

6. For system-failure detection and indication, the following apply:

(a) The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability below the level required by 14 CFR part 25, or which 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, in lieu of detection-and-indication systems to achieve the objective of this requirement. These inspections should be Certification Maintenance Requirements (CMR; see Advisory Circular 25.19). These CMRs must be limited to components that are not readily detectable by normal detection-and-indication systems, and where service history shows that inspections will provide an adequate level of safety.

(b) 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 factor of safety between the airplane strength and the loads of 14 CFR part 25, subpart C below 1.25, or flutter margins below V″, must be signaled to the crew during flight with required crew action specified in the AFM.

7. *Dispatch with known failure conditions.* If the airplane is to be dispatched in a known system-failure condition that affects structural performance, or that affects the reliability of the remaining system to maintain structural performance, then the provisions of these special conditions must be met, including the provisions described in these special conditions in paragraph 4 for the dispatched condition and paragraph 5 for subsequent failures. Expected operational limitations may be taken into account in establishing Pj 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 Qj 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 1E–3 per hour.

Issued in Renton, Washington, on July 1, 2011.

Jeffrey E. Duven,

Acting Manager, Transport Airplane Directorate, Aircraft Certification Service.

[FR Doc. 2011–17533 Filed 7–12–11; 8:45 am]

BILLING CODE 4910–13–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM461; Special Conditions No. 25–440–SC]

Special Conditions; Gulfstream Aerospace LP (GALP) Model G250 Airplane, Design Roll-Maneuver Requirement

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued for the Gulfstream Aerospace LP (GALP) Model G250 airplane. This airplane will have novel or unusual design features associated with electronic flight controls as they relate to design roll-maneuver requirements. 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 July 1, 2011. We must receive your comments by August 29, 2011.

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Background

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