DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM357; Notice No. 25–06–11–SC]

Special Conditions: Boeing Model 737–900ER Series Airplanes; Interaction of Systems and Structures

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes a special condition for the Boeing Model 737–900ER airplane. This airplane will have a novel or unusual design feature(s) when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. These design features include interaction of systems and structures. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. The proposed special condition contains 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: We must receive your comments by November 20, 2006.

ADDRESSES: You must mail two copies of your comments to: Federal Aviation Administration, Transport Airplane Directorate, Attn: Rules Docket (ANM–113), Docket No. NM357, 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. NM357. 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: Todd Martin, Aerospace Engineer, Airframe/Cabin Safety Branch, ANM–115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356; telephone (425) 227–1178; facsimile (425) 227–1323; electronic mail *Todd.Martin@faa.gov.*

SUPPLEMENTARY INFORMATION:

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 condition, 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 this special condition. 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 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 this special condition based on the comments we receive.

If you want the FAA to acknowledge receipt of your comments on this proposal, include with your comments a pre-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it back to you.

Background

On June 5, 2002, The Boeing Company, P.O. Box 3707, Seattle, Washington 98124, applied for an amendment to Type Certificate No. A16WE to include the new Model 737–900ER. The Model 737–900ER, which is a derivative of the Model 737–900 currently approved under A16WE, is a large transport airplane with two flight crew and the capacity to carry 215 passengers. The airplane is powered by two CFM 56–7B or CFM–567B/2 series turbofan engines.

Type Certification Basis

Under the provisions of § 21.101, Boeing must show that the Model 737–900ER meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25–1 through 25–108, except for earlier amendments as agreed upon by the FAA. These regulations will be incorporated into the Type Certificate No. A16WE after type certification approval of the 737–900ER.

In addition, the certification basis includes other regulations, special conditions and exemptions that are not relevant to this proposed special condition. Refer to Type Certificate No. A16WE for a complete description of the certification basis for this model airplane.

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 737–900ER because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the Model 737–900ER 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 § 11.19, under § 11.38, and they become part of the type certification basis under § 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

Model 737–900ER airplane will incorporate novel or unusual design features. This proposed special condition addresses equipment which may affect the airplane's structural performance, either directly or as a result of failure or malfunction.

This proposed special condition is identical or nearly identical to those previously required for type certification of other Boeing airplane models. The proposed special condition was derived initially from standardized requirements developed by the Aviation Rulemaking Advisory Committee (ARAC), comprised of representatives of the FAA, Europe's Joint Aviation Authorities (now replaced by the European Aviation Safety Agency), and industry.

Discussion

In addition to the requirements of part 25, subparts C and D, the following special condition applies.

Interaction of Systems and Structures

The Boeing Model 737–900ER is equipped with systems that may affect the airplane's structural performance either directly or as a result of failure or malfunction. The effects of these systems on structural performance must be considered in the certification analysis. This analysis must include consideration of normal operation and of failure conditions with required

structural strength levels related to the probability of occurrence.

Applicability

As discussed above, this special condition is applicable to the Boeing Model 737–900ER. Should Boeing apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, this special condition would apply to that model as well.

Certification of the Model 737–900ER is currently scheduled for February 2007. Because a delay would significantly affect the applicant's installation of the systems and certification of the airplane we are shortening the public comment period to 20 days.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. 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 Proposed Special Condition

Accordingly, the Federal Aviation Administration (FAA) proposes the following special condition as part of the type certification basis for Boeing Model 737–900ER airplanes.

Interaction of Systems and Structures

In addition to the requirements of part 25, subparts C and D, the following proposed special condition would apply:

a. 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 part 25, subparts C and D. Paragraph b, below, must be used to evaluate the structural performance of airplanes equipped with these systems.

b. Interaction of Systems and Structures.

(1) General: The following criteria must be used for showing compliance with this special condition for interaction of systems and structures and with § 25.629 for airplanes equipped with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, and fuel management systems.

(a) The criteria defined herein address only the direct structural consequences of the system responses and performances. 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 applicable only to structures whose failure 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 modes are not provided in this special condition.

(b) Depending upon the specific characteristics of the airplane, additional studies may be required that go beyond the criteria provided in this special condition in order 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.

(c) The following definitions are applicable to this paragraph.

Structural performance: Capability of the airplane to meet the structural requirements of part 25.

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

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).

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

Failure condition: The term failure condition is the same as that used in § 25.1309. However, this special condition applies only to system failure conditions that affect the structural performance of the airplane (e.g., system failure conditions that include loads, change the response of the airplane to inputs as gusts or pilot actions, or lower flutter margins).

(2) Effects of Systems on Structures.

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

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

(1) Limit loads must be derived in all normal operating configurations of system from all the limit conditions specified in 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 non-linearity (rate of displacement of control surface, thresholds or any other system non-linearities) must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

(2) 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 non-linearities must be investigated beyond limit conditions to ensure that 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.

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

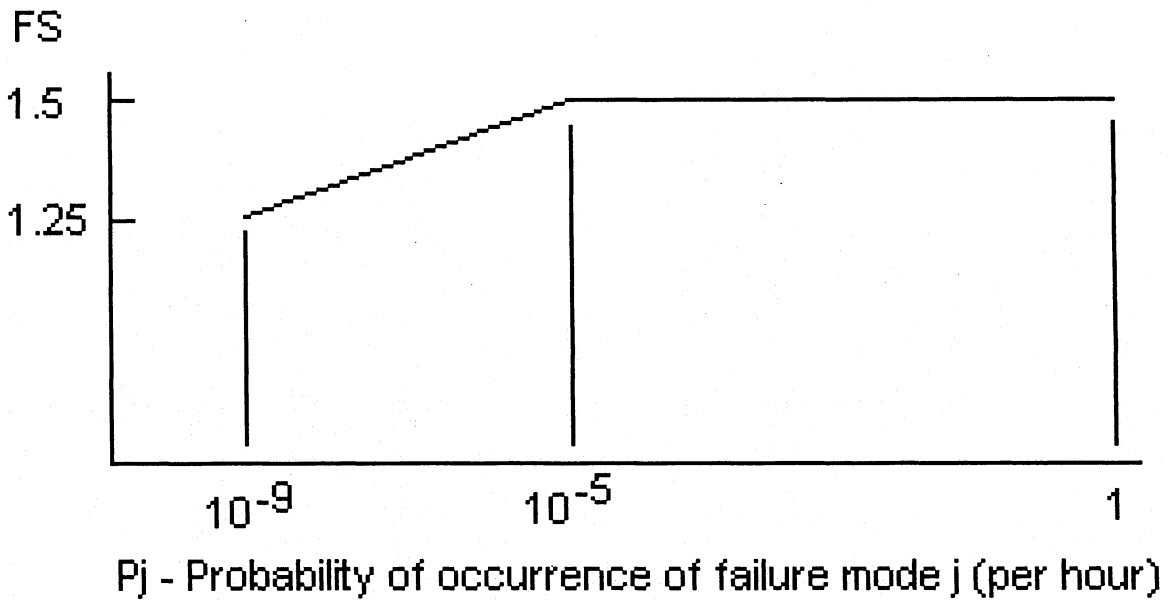
(c) *System in the failure condition.* For any system failure condition not shown to be extremely improbable, the following apply:

(1) At the time of occurrence. Starting from 1g 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 failure.

(i) For static strength substantiation, those 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 (FS) is defined in Figure 1.

Figure 1

Factor of safety at the time of occurrence



(ii) For residential strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in paragraph (c)(1)(i) of this section. For pressurized cabins, these loads must be combined with the normal operating differential pressure.

(iii) Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speed increases beyond V_c/M_c, freedom from aeroelastic instability must be shown to those increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.

(vi) 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.

(2) 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:

(i) 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 in 25.345.

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

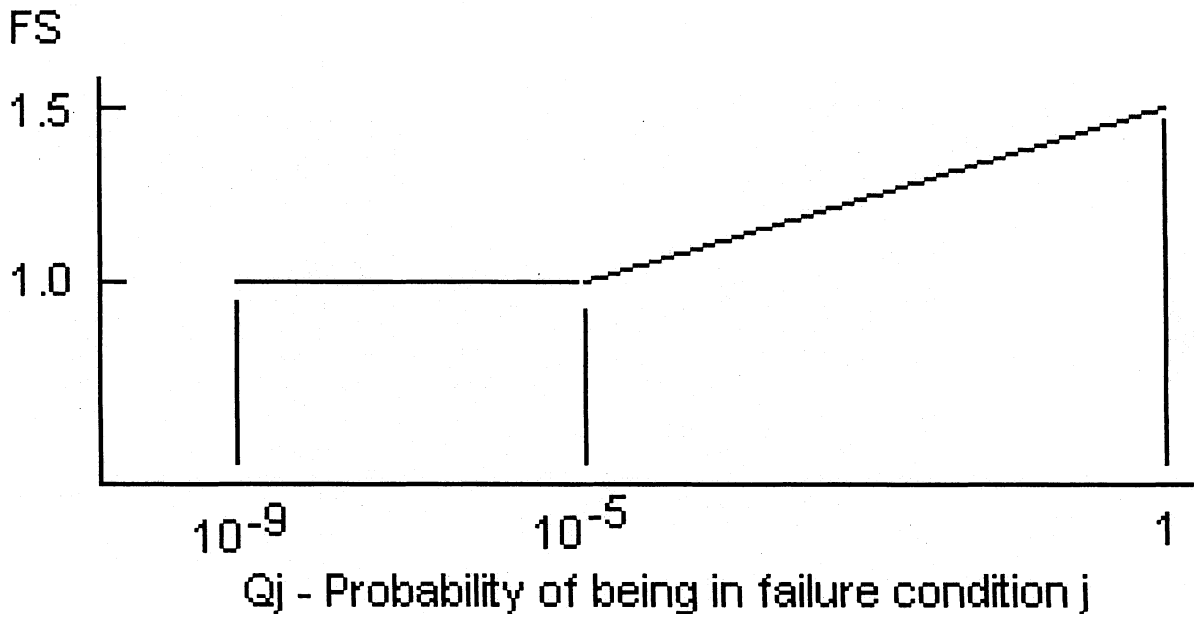
(D) The limit yaw maneuvering conditions specified in § 25.351.

(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 (c)(2)(i) of this special condition 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:
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 subpart C.

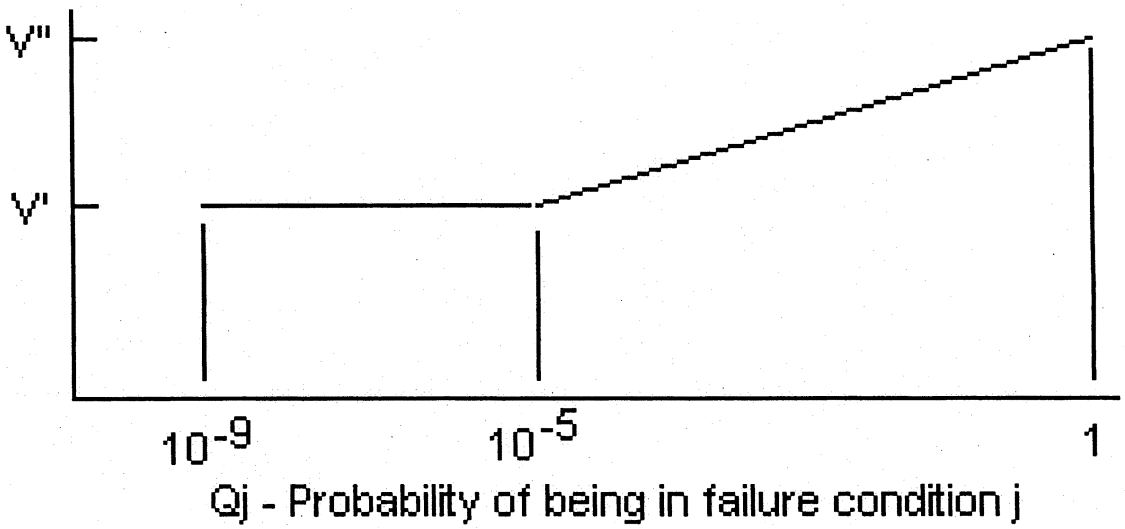
(iii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in paragraph (c)(2)(ii). For pressurized cabins, these loads must be defined combined with the normal operating differential pressure.

(iv) If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance, then their effects 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

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).

(3) Consideration of certain failure conditions may be required by other sections of this Part, 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.

(d) *Warning considerations.* For system failure detection and warning, the following apply:

(1) The system must be checked for failure conditions, not extremely improbably, that degrade the structural capability 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 in lieu of warning systems to achieve the objective of this requirement. These certification maintenance requirements must be limited to components the failures of which are not readily detectable by normal warning 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 factor of safety 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 crew during flight.

(e) *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 this Special Condition must be met, including the provisions of paragraph (b), for the dispatched condition and paragraph (c) 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 1E–3 per flight hour.

Issued in Renton, Washington, on October 19, 2006.

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