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[4910-13]

## DEPARTMENT OF TRANSPORTATION

### Federal Aviation Administration

#### 14 CFR Part 25

**[Docket No. FAA-2012-1332; Special Conditions No. 25-492-SC]**

**Special Conditions:** Embraer S.A., Model EMB-550 Airplanes; Flight Envelope Protection: General Limiting Requirements.

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Embraer S.A. Model EMB-550 airplane. This airplane will have a novel or unusual design feature, specifically new control architecture and a full digital flight control system which provides flight envelope protections. 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:** Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2011; facsimile 425-227-1149.

## **SUPPLEMENTARY INFORMATION:**

### **Background**

On May 14, 2009, Embraer S.A. applied for a type certificate for their new Model EMB-550 airplane. The Model EMB-550 airplane is the first of a new family of jet airplanes designed for corporate flight, fractional, charter, and private owner operations. The aircraft has a conventional configuration with low wing and T-tail empennage. The primary structure is metal with composite empennage and control surfaces. The Model EMB-550 airplane is designed for 8 passengers, with a maximum of 12 passengers. It is equipped with two Honeywell HTF7500-E medium bypass ratio turbofan engines mounted on aft fuselage pylons. Each engine produces approximately 6,540 pounds of thrust for normal takeoff. The primary flight controls consist of hydraulically powered fly-by-wire elevators, aileron and rudder, controlled by the pilot or copilot sidestick.

Embraer S.A. has developed comprehensive flight envelope protection features integral to the electronic flight control system design. These flight envelope protection features include limitations on angle-of-attack, normal load factor, bank angle, pitch angle, and speed. To accomplish this flight-envelope-limiting, a significant change (or multiple changes) occurs in the control laws of the electronic flight control system as the limit is approached or exceeded. When failure states occur in the electronic flight control system, flight envelope protection features can likewise either be modified, or in some cases, eliminated. The current regulations were not written with these comprehensive flight-envelope-limiting systems in mind.

## **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Embraer S.A. must show that the Model EMB-550 airplane meets the applicable provisions of part 25, as amended by Amendments 25-1 through 25-127 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 Model EMB-550 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 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 Model EMB-550 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 EMB-550 airplane will incorporate the following novel or unusual design features: new control architecture and a full digital flight control system which provides comprehensive flight envelope protections.

## **Discussion**

The applicable airworthiness regulation in this instance is 14 CFR § 25.143. The purpose of § 25.143 is to verify that any operational maneuvers conducted within the operational envelope can be accomplished smoothly with average piloting skill and without exceeding any structural limits. The pilot should be able to predict the airplane response to any control input. During the course of the flight test program, the pilot determines compliance with § 25.143 through primarily qualitative methods. During flight test, the pilot should evaluate all of the following:

- The interface between each protection function,
- Transitions from one mode to another,
- The aircraft response to intentional dynamic maneuvering, whenever applicable, through dedicated maneuvers,
- General controllability assessment,
- High speed characteristics, and
- High angle-of-attack.

Section § 25.143, however, does not adequately ensure that the novel or unusual features of the Model EMB-550 airplane will have a level of safety equivalent to that of existing standards. This special condition is therefore required to accommodate the the flight-envelope- limiting systems in the Model EMB-550 airplane. The additional safety standards in this special condition will ensure a level of safety equivalent to that of existing standards.

## **Discussion of Comments**

Notice of proposed special conditions number 25-19-SC for the Embraer S.A. Model EMB-550 airplanes was published in the *Federal Register* on January 24, 2013 (78 FR 5148). No comments were received, and the special conditions are adopted as proposed.

## **Applicability**

As discussed above, these special conditions are applicable to the Model EMB-550 airplane. Should Embraer S.A. 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 one model 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 Embraer S.A. Model EMB-550 airplanes.

### 1. General Limiting Requirements:

- a. Onset characteristics of each envelope protection feature must be smooth, appropriate to the phase of flight and type of maneuver, and not in conflict with the ability of the pilot to satisfactorily change airplane flight path, speed, or attitude as needed.
- b. Limit values of protected flight parameters (and if applicable, associated warning thresholds) must be compatible with the following:
  - i. Airplane structural limits,
  - ii. Required safe and controllable maneuvering of the airplane, and
  - iii. Margins to critical conditions. Unsafe flight characteristics/conditions must not result if dynamic maneuvering, airframe and system tolerances (both manufacturing and in-service), and non-steady atmospheric conditions, in any appropriate combination and phase of flight, can produce a limited flight parameter beyond the nominal design limit value.
- c. The airplane must be responsive to intentional dynamic maneuvering to within a suitable range of the parameter limit. Dynamic characteristics such as damping and overshoot must also be appropriate for the flight maneuver and limit parameter in question.
- d. When simultaneous envelope limiting is engaged, adverse coupling or adverse priority must not result.

2. Failure States: Electronic flight control system failures (including sensor) must not result in a condition where a parameter is limited to such a reduced value that safe and controllable maneuvering is no longer available. The crew must be alerted by suitable means if any change in envelope limiting or maneuverability is produced by single or multiple failures of the electronic

flight control system not shown to be extremely improbable.

Issued in Renton, Washington, on May 21, 2013

Jeff Duven  
Acting Manager, Transport Airplane Directorate  
Aircraft Certification Service

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