**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2013-0905; Special Conditions No. 25-531-SC]**

**Special Conditions:** Airbus Model A350-900 Airplane; Flight-Envelope Protection, Normal Load-Factor (G) Limiting

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

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for Airbus Model A350-900 airplanes. These airplanes will have a novel or unusual design feature associated with a flight-control system that prevents the pilot from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. 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 Date: [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].**

**FOR FURTHER INFORMATION CONTACT:** Joe Jacobsen, FAA, Airplane and Flightcrew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone (425) 227-2011; facsimile (425) 227-1320.

## SUPPLEMENTARY INFORMATION:

### Background

On August 25, 2008, Airbus applied for a type certificate for their new Model A350-900 airplane. Later, Airbus requested, and the FAA approved, an extension to the application for FAA type certification to November 15, 2009. The Model A350-900 airplane has a conventional layout with twin wing-mounted Rolls-Royce Trent XWB engines. It features a twin-aisle, 9-abreast, economy-class layout, and accommodates side-by-side placement of LD-3 containers in the cargo compartment. The basic Model A350-900 airplane configuration accommodates 315 passengers in a standard two-class arrangement. The design cruise speed is Mach 0.85 with a maximum take-off weight of 602,000 lbs.

The normal load-factor limit on Airbus Model A350-900 airplanes is unique in that traditional airplanes with conventional flight-control systems (mechanical linkages) are limited in the pitch axis only by the elevator surface area and deflection limit. The elevator-control power is normally derived for adequate controllability and maneuverability at the most critical longitudinal pitching moment. The result is that traditional airplanes have a significant portion of the flight envelope wherein maneuverability in excess of limit structural-design values is possible.

Title 14, Code of Federal Regulations (14 CFR) part 25 does not specify requirements or policy for demonstrating maneuver controls that impose any handling-qualities requirements beyond the design limit structural loads. Nevertheless, some pilots have become accustomed to the availability of this excess maneuver capacity in case of extreme emergency, such as upset recoveries or collision avoidance.

These special conditions are needed to ensure adequate maneuverability and controllability for the Model A350-900 airplane using the Airbus flight-control system.

## Type Certification Basis

Under 14 CFR 21.17, Airbus must show that the Model A350-900 airplane meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25-1 through 25-129.

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 A350-900 airplane because of a novel or unusual design feature, special conditions are prescribed under § 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 final special conditions, the Model A350-900 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 must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, under § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

## Novel or Unusual Design Features

The Airbus Model A350-900 airplane will incorporate the following novel or unusual design features: an electronic flight-control system (EFCS), that when operating in its normal mode, will prevent airplane pitch attitudes greater than +30 degrees and less than –15 degrees,

and roll angles greater than plus or minus 67 degrees. In addition, positive spiral stability is introduced for roll angles greater than 33 degrees at speeds below $V_{MO}/M_{MO}$. At speeds greater than $V_{MO}$ and up to $V_{DF}$, maximum aileron-control force is limited to only 45 degrees maximum bank angle.

## Discussion

Flight-envelope protection that limits normal load-factor (g) limiting is considered novel and unusual because the current regulations do not provide standards for maneuverability and controllability evaluations for such systems. Special conditions are needed to ensure adequate maneuverability and controllability when using this design feature.

As with previous fly-by-wire airplanes, the FAA has no regulatory or safety reason to inhibit the design concept of the Airbus A350 flight-control system with load-factor limiting. Pilots accustomed to this control feature may feel more freedom in commanding full stick-displacement maneuvers because of the following:

- Knowledge that the limit system will protect the structure,
- Low stick-force/displacement gradients, and
- Smooth transition from pilot elevator control to limit control.

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

Notice of proposed special conditions no. 25-13-28-SC for Airbus Model A350-900 airplanes was published in the *Federal Register* on December 17, 2013 (78 FR 76249). No comments were received, and the special conditions are adopted as proposed.

## Applicability

As discussed above, these special conditions apply to Airbus Model A350-900 airplanes. Should Airbus apply later 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 Airbus Model A350-900 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, to meet the intent of adequate maneuverability and controllability required by § 25.143(a), and in the absence of other limiting factors, the following special conditions are issued as part of the type-certification basis for Airbus Model A350-900 airplanes.

1) The positive limiting load factor must not be less than:
    a) 2.5g for the EFCS normal state with the high-lift devices retracted up to $V_{MO}/M_{MO}$. The positive limiting load factor may be gradually reduced down to 2.25g above $V_{MO}/M_{MO}$.
    b) 2.0g for the EFCS normal state with the high-lift devices extended.
2) The negative limiting load factor must be equal to or more negative than:
    a) Minus 1.0g for the EFCS normal state with the high-lift devices retracted.

b) 0.0g for the EFCS normal state with high-lift devices extended.

3) Maximum reachable positive load-factor wings level may be limited by flight-control system characteristics or flight-envelope protections (other than load-factor protection) provided that:
   a) the required values are readily achievable in turns, and
   b) wings-level pitch-up responsiveness is satisfactory.
4) Maximum achievable negative load factor may be limited by flight-control system characteristics or flight-envelope protections (other than load-factor protection) provided that:
   a) pitch-down responsiveness is satisfactory
   b) from level flight, 0g is readily achievable or alternatively, a satisfactory trajectory change is readily achievable at operational speeds (from $V_{LS}$ to maximum speed–10 knots). $V_{LS}$ is the lowest speed at which the crew may fly with auto-thrust or auto-pilot engaged. It is displayed on primary flight displays as the top of the low-speed amber band, and is the lower end of the normal flight envelope. The formula (maximum speed–10 knots) is to cover typical margin from $V_{MO}/M_{MO}$ to cruise speeds, and typical margin from $V_{FE}$ to standard speed in high lift configurations.

Note: For the FAA to consider a trajectory change as satisfactory, the applicant should propose and justify a pitch rate that provides sufficient maneuvering capability in the most critical scenarios. Compliance demonstration with the above requirements may be performed without ice accretion on the airframe.

Issued in Renton, Washington, on July 15, 2014.

John P. Piccola, Jr.,
Acting Manager, Transport Airplane Directorate,
Aircraft Certification Service.

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