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[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2013-0904; Notice No. 25-13-14-SC]

Special Conditions: Airbus, Model A350-900 Series Airplane; Electronic Flight Control System: Lateral-Directional and Longitudinal Stability and Low Energy Awareness

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Airbus Model A350-900 series airplanes. These airplanes will have a novel or unusual design feature(s) associated with lateral-directional and longitudinal stability and low energy awareness**.** The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed 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: Send your comments on or before **[insert a date 45 days after date of publication in the Federal Register].**

ADDRESSES: Send comments identified by docket number FAA-2013-0904 using any of the following methods:

- Federal eRegulations Portal: Go to http://www.regulations.gov/ and follow the online instructions for sending your comments electronically.

- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to http://www.regulations.gov/, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at http://DocketsInfo.dot.gov/.

Docket: Background documents or comments received may be read at http://www.regulations.gov/ at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.

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:

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 will consider all comments we receive on or before the closing date for comments. We may change these proposed special conditions based on the comments we receive.

Background

On August 25, 2008, Airbus applied for a type certificate for their new Model A350-900 series airplane. Later, Airbus requested and the FAA approved an extension to the application for FAA type certification to June 28, 2009. The Model A350-900 series 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 series configuration will accommodate 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. Airbus proposes the Model A350-900 series to be certified for extended operations (ETOPS) beyond 180 minutes at entry into service for up to a 420-minute maximum diversion time.

Lateral-directional Static Stability

The electronic flight control system (EFCS) on the A350, like its predecessors the A320, A330, A340, and A380, contains fly-by-wire control laws that can result in neutral lateral-directional static stability; therefore, the conventional requirements in the regulations are not met.

Positive static directional stability is defined as the tendency to recover from a skid with the rudder free. Positive static lateral stability is defined as the tendency to raise the low wing in a sideslip with the aileron controls free. These control criteria are intended to accomplish the following:

a) Provide additional cues of inadvertent sideslips and skids through control force changes.

b) Ensure that short periods of unattended operation do not result in any significant changes in yaw or bank angle.

c) Provide predictable roll and yaw response.

d) Provide acceptable level of pilot attention (workload) to attain and maintain a coordinated turn.

The Flight Test Harmonization Working Group has recommended a rule and advisory material change for § 25.177, Static lateral-directional stability. This harmonized text will form the basis for these proposed special conditions.

Longitudinal Static Stability

Static longitudinal stability on airplanes with mechanical links to the pitch control surface means that a pull force on the controller will result in a reduction in speed relative to the trim speed, and a push force will result in a higher speed than the trim speed. Longitudinal stability is required by the regulations for the following reasons:

a) Speed change cues are provided to the pilot through increased and decreased forces on the controller.

b) Short periods of unattended control of the airplane do not result in significant changes in attitude, airspeed or load factor.

c) A predictable pitch response is provided to the pilot.

d) An acceptable level of pilot attention (workload) to attain and maintain trim speed and altitude is provided to the pilot.

e) Longitudinal stability provides gust stability.

The pitch control movement of the sidestick on the A350 is designed to be a normal load factor or "g" command that results in an initial movement of the elevator surface to attain the commanded load factor that's then followed by integrated movement of the stabilizer and elevator to automatically trim the airplane to a neutral, 1g, stick-free stability. The flight path commanded by the initial sidestick input will remain, stick-free, until another command is given by the pilot. This control function is applied during "normal" control law within the speed range from initiation of the angle of attack protection limit, $V_{\alpha prot}$, to V_{MO}/M_{MO}. Once outside this speed range, the control laws introduce the conventional longitudinal static stability as described above.

As a result of neutral static stability, the A350 does not meet the requirements in 14 CFR part 25 for static longitudinal stability.

Low Energy Awareness

Past experience on airplanes fitted with a flight control system providing neutral longitudinal stability shows there is insufficient feedback cues to the pilot of excursion below normal operational speeds. The maximum angle of attack protection system limits the airplane angle of attack and prevents stall during normal operating speeds, but this system is not sufficient to prevent stall at low speed excursions below normal operational speeds. Until intervention, there are no stability cues since the aircraft remains trimmed. Additionally, feedback from the pitching moment due to thrust variation is reduced by the flight control laws. Recovery from a

low speed excursion may become hazardous when the low speed situation is associated with a low altitude and with the engines at low thrust or with performance limiting conditions.

Type Certification Basis

Under Title 14, Code of Federal Regulations (14 CFR) 21.17, Airbus must show that the Model A350-900 series 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 series 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 proposed special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and proposed special conditions, the Model A350-900 series 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, 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 series will incorporate the following novel or unusual design features: a flight control design feature within the normal operational envelope in which

side stick deflection in the roll axis commands roll rate; an operational design which does not comply with the static longitudinal stability requirements of §§ 25.171, 25.173, and 25.175, and a low energy state where recovery may become hazardous when associated with a low altitude and performance limiting conditions.

Discussion

1. In the absence of positive lateral stability, the curve of lateral control surface deflections against sideslip angle should be in a conventional sense, and reasonably in harmony with rudder deflection during steady heading sideslip maneuvers.

2. Since conventional relationships between stick forces and control surface displacements do not apply to the "load factor command" flight control system on the A350, longitudinal stability characteristics should be evaluated by assessing the airplane handling qualities during simulator and flight test maneuvers appropriate to operation of the airplane. This may be accomplished by using the Handling Qualities Rating Method presented in Appendix 7 of the Flight Test Guide, AC 25-7A, or an acceptable alternative method proposed by Airbus. Important considerations are as follows:

a) Adequate speed control without excessive pilot workload

b) Acceptable high and low speed protection, and

c) Provision for adequate cues to the pilot of significant speed excursions beyond V_{MO}/M_{MO}, and low speed awareness flight conditions.

3. The airplane should provide adequate awareness cues to the pilot of a low energy (low speed/low thrust/low height) state to ensure that the airplane retains sufficient energy to recover when flight control laws provide neutral longitudinal stability significantly below the normal operating speeds. This may be accomplished as follows:

a) Adequate low speed/low thrust cues at low altitude may be provided by a strong positive static stability force gradient (1 pound per 6 knots applied through the sidestick), or

b) The low energy awareness may be provided by an appropriate warning with the following characteristics:

(i) It should be unique, unambiguous, and unmistakable.

(ii) It should be active at appropriate altitudes and in appropriate configurations (i.e., at low altitude, in the approach and landing configurations).

(iii) It should be sufficiently timely to allow recovery to a stabilized flight condition inside the normal flight envelope while maintaining the desired flight path and without entering the flight controls angle-of-attack protection mode.

(iv) It should not be triggered during normal operation, including operation in moderate turbulence for recommended maneuvers at recommended speeds.

(v) It should not be cancelable by the pilot other than by achieving a higher energy state.

(vi) There should be an adequate hierarchy among the various warnings so that the pilot is not confused and led to take inappropriate recovery action if multiple warnings occur.

c) Global energy awareness and non-nuisance of low energy cues should be evaluated by simulator and flight tests in the whole take-off and landing altitude range for which certification is requested. This would include all relevant combinations of weight, center of gravity position, configuration, airbrakes position, and available thrust, including reduced and derated take-off thrust operations and engine failure cases. A sufficient

number of tests should be conducted, allowing the level of energy awareness and the effects of energy management errors to be assessed.

Applicability

As discussed above, these proposed special conditions apply to Airbus Model A350-900 series 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 proposed 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 series 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 Proposed Special Conditions

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Airbus Model A350-900 series airplanes**.**

1. Electronic Flight Control System: Lateral-Directional and Longitudinal Stability and Low Energy Awareness. In lieu of the requirements of §§ 25.171, 25.173, 25.175 and 25.177, the following special conditions apply:

a. The airplane must be shown to have suitable static lateral, directional, and longitudinal stability in any condition normally encountered in service, including the effects of atmospheric disturbance. The showing of suitable static lateral, directional, and longitudinal stability must be

based on the airplane handling qualities, including pilot workload and pilot compensation, for specific test procedures during the flight test evaluations.

b. The airplane must provide adequate awareness to the pilot of a low energy (low speed/low thrust/low height) state when fitted with flight control laws presenting neutral longitudinal stability significantly below the normal operating speeds. "Adequate awareness" means warning information must be provided to alert the crew of unsafe operating conditions and to enable them to take appropriate corrective action.

c. The static directional stability (as shown by the tendency to recover from a skid with the rudder free) must be positive for any landing gear and flap position and symmetrical power condition, at speeds from 1.13 V_{SR1}, up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate).

d. The static lateral stability (as shown by the tendency to raise the low wing in a sideslip with the aileron controls free) for any landing gear and wing-flap position and symmetric power condition, may not be negative at any airspeed (except that speeds higher than V_{FE} need not be considered for wing-flaps extended configurations nor speeds higher than V_{LE} for landing gear extended configurations) in the following airspeed ranges:

(1) From 1.13 V_{SR1} to V_{MO} / M_{MO}.

(2) From V_{MO}/M_{MO} to V_{FC}/M_{FC}, unless the divergence is –

(i) Gradual;

(ii) Easily recognizable by the pilot; and

(iii) Easily controllable by the pilot.

e. In straight, steady sideslips over the range of sideslip angles appropriate to the operation of the airplane, but not less than those obtained with one-half of the available rudder control movement (but not exceeding a rudder control force of 180 pounds), rudder control movements and forces

must be substantially proportional to the angle of sideslip in a stable sense; and the factor of proportionality must lie between limits found necessary for safe operation. This requirement must be met for the configurations and speeds specified in paragraph (c) of this section.

f. For sideslip angles greater than those prescribed by paragraph (e) of this section, up to the angle at which full rudder control is used or a rudder control force of 180 pounds is obtained, the rudder control forces may not reverse, and increased rudder deflection must be needed for increased angles of sideslip. Compliance with this requirement must be shown using straight, steady sideslips, unless full lateral control input is achieved before reaching either full rudder control input or a rudder control force of 180 pounds; a straight, steady sideslip need not be maintained after achieving full lateral control input. This requirement must be met at all approved landing gear and wing-flap positions for the range of operating speeds and power conditions appropriate to each landing gear and wing-flap position with all engines operating.

Issued in Renton, Washington, on October 22, 2013

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