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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. FAA-2015-3464; Special Conditions No. 23-272-SC]

Special Conditions: Cirrus Aircraft Corporation, SF50; Auto Throttle

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Cirrus Aircraft Corporation Model SF50 airplane. This airplane will have a novel or unusual design feature(s) associated with installation of an Auto Throttle System. 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 **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]** and are applicable on December 2, 2015.

FOR FURTHER INFORMATION CONTACT: Jeff Pretz, Regulations and Policy Branch, ACE-111, Federal Aviation Administration, Small Airplane Directorate, Aircraft Certification Service, ACE-111, 901 Locust, Room 301, Kansas City, MO 64106; telephone (816) 329-3239, facsimile (816) 329-4090.

SUPPLEMENTARY INFORMATION:

Background

On September 9, 2008, Cirrus Aircraft Corporation applied for a type certificate for their new Model SF50. On December 11, 2012 Cirrus elected to adjust the certification basis of the SF50 to include 14 CFR part 23 through amendment 62. The SF50 is a low-wing, 7-seat (5 adults and 2 children), pressurized, retractable gear, carbon composite airplane with one turbofan engine mounted partially in the upper aft fuselage. It is constructed largely of carbon and fiberglass composite materials. Like other Cirrus products, the SF50 includes a ballistically deployed airframe parachute. The SF50 has a maximum operating altitude of 28,000 feet and the maximum takeoff weight will be at or below 6,000 pounds with a range at economy cruise of roughly 1,000 nautical miles.

Current part 23 airworthiness regulations do not contain appropriate safety standards for an Auto Throttle System (ATS) installation; therefore, special conditions are required to establish an acceptable level of safety. Part 25 regulations contain appropriate safety standards for these systems, making the intent for this project to apply the language in § 25.1329 for the auto throttle, while substituting § 23.1309 and § 23.143 in place of the similar part 25 regulations referenced in § 25.1329. In addition, malfunction of the ATS to perform its intended function shall be evaluated per the Loss of Thrust Control (LOTC) criteria established under part 33 for electronic engine controls. An analysis must show that no single failure or malfunction or probable combinations of failures of the ATS will permit the LOTC probability to exceed those established under part 33 for an electronic engine control.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Cirrus must show that the Model SF50 meets the applicable provisions of part 23, as amended by amendments 23-1 through 23-62 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 23) do not contain adequate or appropriate safety standards for the SF50 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 SF50 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 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, 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 SF50 will incorporate the following novel or unusual design features: An ATS as part of the automatic flight control system. The ATS utilizes a Garmin “smart” autopilot servo with a physical connection to the throttle quadrant control linkage. The auto throttle may be controlled by the pilot with an optional auto throttle control panel adjacent to the throttle lever.

The auto throttle also provides an envelope protection function which does not require installation of the optional control panel.

Discussion

Part 23 currently does not sufficiently address auto throttle (also referred to as auto thrust) technology and safety concerns. Therefore, special conditions must be developed and applied to this project to ensure an acceptable level of safety has been obtained. For approval to use the ATS during flight, the SF50 must demonstrate compliance to the intent of the requirements of § 25.1329, applying the appropriate part 23 references to § 23.1309 (to include performing a functional hazard assessment or system safety assessment to determine the applicable Software and Airborne Electronic Hardware assurance levels, and compliance to DO-178C & DO-254, as required) and § 23.143.

In addition, a malfunction of the ATS to perform its intended function is an LOTC event, and may result in a total loss of thrust control, transients, or uncommanded thrust changes. The classification of the failure condition for an LOTC event on a Class II single-engine aircraft is hazardous for aircraft that stall at or below 61 knots. From publication AC 23.1309-1E, based upon failure probability values shown in Figure 2, an LOTC event would have to meet a probability of failure value not to exceed 1×10^{-6} . In-service data for LOTC in single-engine turbine aircraft shows LOTC events exceed this probability; therefore, part 33 requirements for engine control probabilities will be accepted for the part 23 LOTC requirement.

The probabilities of failure for an LOTC event on a turbine engine shall not exceed the following (see AC33.28-1 and ANE-1993-33.28TLD-R1 for further guidance):

1. Average Events per Million Hours: 10 (1×10^{-5} per hour)

2. Maximum Events per Million Hours: $100 (1 \times 10^{-4}$ per hour)

Note: The maximum events per flight hour are intended for Time Limited Dispatch (TLD) operation where the risk exposure is mitigated by limiting the time in which the aircraft is operated in the degraded condition.

Discussion of Comments

Notice of proposed special conditions No. 23-15-04-SC for the Cirrus Aircraft Corporation Model SF50 airplanes was published in the Federal Register on August 21, 2015 (80 FR 50808). No comments were received, and the special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the Model SF50. Should Cirrus 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.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the Federal Register; however, as the certification date for the Cirrus Aircraft Corporation Model SF50 airplane is imminent, the FAA finds that good cause exists to make these special conditions effective upon issuance.

Conclusion

This action affects only certain novel or unusual design features on one model of airplanes. 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.

List of Subjects in 14 CFR Part 23

Aircraft, Aviation safety, Signs and symbols.

Citation

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704, 14 CFR 21.16 and 14 CFR 11.38 and 11.19.

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 Cirrus Aircraft Corporation Model SF50 airplanes.

1. Certification of Auto Throttle System under Part 23.

a. Quick disengagement controls for the auto thrust functions must be provided for each pilot.

The auto thrust quick disengagement controls must be located on the thrust control levers. Quick disengagement controls must be readily accessible to each pilot while operating the thrust control levers.

b. The effects of a failure of the system to disengage the auto thrust functions when manually commanded by the pilot must be assessed in accordance with the requirements of § 23.1309.

c. Engagement or switching of the flight guidance system, a mode, or a sensor may not cause the auto thrust system to affect a transient response that alters the airplane's flight path any greater than a minor transient, as defined in paragraph (l)(1) of this section.

d. Under normal conditions, the disengagement of any automatic control function of a flight guidance system may not cause a transient response of the airplane's flight path any greater than a minor transient.

e. Under rare normal and non-normal conditions, disengagement of any automatic control function of a flight guidance system may not result in a transient any greater than a significant transient, as defined in paragraph (l)(2) of this section.

f. The function and direction of motion of each command reference control, such as heading select or vertical speed, must be plainly indicated on, or adjacent to, each control if necessary to prevent inappropriate use or confusion.

g. Under any condition of flight appropriate to its use, the flight guidance system may not produce hazardous loads on the airplane, nor create hazardous deviations in the flight path. This applies to both fault-free operation and in the event of a malfunction, and assumes that the pilot begins corrective action within a reasonable period of time.

h. When the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the airplane experiences an excursion outside this range, a means must be provided to prevent the flight guidance system from providing guidance or control to an unsafe speed.

i. The flight guidance system functions, controls, indications, and alerts must be designed to minimize flight crew errors and confusion concerning the behavior and operation of the flight guidance system. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and

consistent manner. The indications must be visible to each pilot under all expected lighting conditions.

j. Following disengagement of the auto thrust function, a caution (visual and auditory) must be provided to each pilot.

k. During auto thrust operation, it must be possible for the flight crew to move the thrust levers without requiring excessive force. The auto thrust may not create a potential hazard when the flight crew applies an override force to the thrust levers.

l. For purposes of this section, a transient is a disturbance in the control or flight path of the airplane that is not consistent with response to flight crew inputs or environmental conditions.

(1) A minor transient would not significantly reduce safety margins and would involve flight crew actions that are well within their capabilities. A minor transient may involve a slight increase in flight crew workload or some physical discomfort to passengers or cabin crew.

(2) A significant transient may lead to a significant reduction in safety margins, an increase in flight crew workload, discomfort to the flight crew, or physical distress to the passengers or cabin crew, possibly including non-fatal injuries. Significant transients do not require, in order to remain within or recover to the normal flight envelope, any of the following:

- i. Exceptional piloting skill, alertness, or strength.
- ii. Forces applied by the pilot which are greater than those specified in § 23.143(c).
- iii. Accelerations or attitudes in the airplane that might result in further hazard to secured or non-secured occupants.

It must also be demonstrated, through tests and analysis, that no single failure or malfunction or probable combinations of failures of the auto thrust system components results in

the probability for LOTC, or un-commanded thrust changes and transients that result in an LOTC event, to exceed the following:

(1) Average Events per Million Hours: 10 (1×10^{-5} per hour)

(2) Maximum Events per Million Hours: 100 (1×10^{-4} per hour)

Note: The term "probable" in the context of "probable combination of failures" does not have the same meaning as used for a safety assessment process. The term "probable" in "probable combination of failures" means "foreseeable," or those failure conditions anticipated to occur one or more times during the operational life of each airplane.

Issued in Kansas City, Missouri, on December 2, 2015.

Patrick Mullen
Acting Manager, Small Airplane Directorate
Aircraft Certification Service
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