[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No.FAA-2016-3462; Notice No. 23-275-SC]

Special Conditions: Cirrus Design Corporation, Model SF50; Whole Airplane Parachute Recovery System

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Cirrus Design Corporation (Cirrus), model SF50 airplane. This airplane will have a novel or unusual design feature(s) associated with a whole airplane parachute recovery 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: These special conditions are effective **[INSERT DATE 30 DAYS AFTER PUBLICATION IN FEDERAL REGISTER]** and are applicable on July 6, 2016.

FOR FURTHER INFORMATION CONTACT: Mr. Bob Stegeman, Federal Aviation Administration, Aircraft Certification Service, Small Airplane Directorate, ACE-111, 901 Locust; Kansas City, Missouri 64106; telephone (816) 329-4140; facsimile (816) 329-4090**.**

SUPPLEMENTARY INFORMATION:

Background

On September 9, 2008, Cirrus Design Corporation applied for a type certificate for their new SF50 airplane. The SF50 is a seven seat (five adults and two children), pressurized, retractable gear, carbon composite, single engine jet airplane. The airplane will have a Maximum Take-Off Weight of 6,000 pounds, a Maximum Operating Speed of 250 Knots Calibrated Airspeed (KCAS), and a Maximum Operating Altitude of 28,000 feet.

Cirrus intends to install a whole airplane ballistic parachute system (BPS) called the Cirrus Airframe Parachute System (CAPS). This installation couples the BPS with the automatic flight controls. The CAPS will be installed as standard equipment on the SF50 airplane. Unlike the SR20 and SR22 airplanes CAPS, the SF50 CAPS is a supplemental system and no credit for the system will be used to meet part 23 requirements. The SF50 CAPS design will require some performance enhancements over existing technology used in other BPS.

The system will consist of the recovery parachute, activation and deployment systems, and autopilot functions. The SF50 CAPS will be designed for a higher gross weight, maximum activation speed, and maximum operating altitude.

Whole airplane parachute recovery systems are intended to save the lives of the occupants in life-threatening situations for which normal emergency procedures have been exhausted. Potential emergencies include, but are not limited to—loss of power or thrust; loss of airplane control; pilot disorientation; pilot incapacitation with a passenger on board; mechanical or structural failure; icing; and accidents resulting from pilot negligence or error. The recovery system should prioritize protection from most probable hazards, but it is not reasonable to expect it to protect occupants from every possible situation.

This technology, which was originally developed for ultralight and experimental aircraft, was first approved for general aviation airplanes with a Supplemental Type Certificate for the Cessna model 150/152 airplanes. The FAA issued special conditions for these airplanes to incorporate ballistic recovery systems on October 22, 1987 (Special Condition No. 23-ACE-33; Ballistic Recovery System, Inc., Modified Cessna 150/A150 Series Airplanes and 152/A152 Model Airplanes to Incorporate the GARD-150 System; Docket No. 037CE) (FR Doc. 87-26420, November 11, 1987). These special conditions were later modified for the other general aviation airplanes (Special Condition No. 23-ACE-76; Ballistic Recovery Systems, Modified for Small General Aviation Airplanes; Docket No. 118CE) (FR Doc. 94-16233, August 5, 1994), including the Cirrus Design Corporation SR20 airplanes (Special Condition No. 23-ACE-88, Ballistic Recovery Systems Cirrus SR20 Installation, Docket No. 136CE) (FR Doc. 97-27504, October 15, 1997.

The previously FAA-approved BPS consists of a parachute packed in a compartment within the airframe. A solid propellant rocket motor, adjacent to the parachute pack, extracts the parachute. A mechanical pull handle mounted within reach of the pilot and copilot or passenger activates the system. At least two separate independent actions are necessary to activate the system.

In addition to a normal BPS, the SF50 CAPS system will incorporate an airbag to assist deployment and a system for sequencing deployment and interfacing with the airplane's avionics. The avionics interface is intended to bring the airplane within a valid deployment envelope speed (67-160 KCAS).

The SF50 CAPS is a non-required system that differs from other BPS in that it will interact with the flight control system and other airplane systems. The baseline special conditions must

incorporate the required level of safety for the normal BPS as well as the aspect that interfaces with the airplane. Since it is a non required system, additional latitude exists to evaluate and substantiate the system so it will present no additional hazards.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Cirrus Design Corporation must show that the 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.

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).

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.

Novel or Unusual Design Features

The SF50 will incorporate the following novel or unusual design features:

A whole-airplane parachute recovery system that is a supplemental safety system and unlike any previously approved BPS, will add enhancements that assist deployment and autopilot functions that work to bring the airplane into an acceptable deployment envelope.

Discussion

This system is a non-required system that will interact with the flight control system. These special conditions must incorporate the required level of safety for the normal ballistic parachute system as established by Special Condition 23-ACE-76 in addition to the aspect that interfaces with the airplane.

The FAA revised § 23.1309, Equipment, systems, and installations, in amendment 23-62 (76 FR 75736, December 2, 2011) to address two different types of equipment and systems installed in the airplane. This system operates at the limit of the normal operating envelope and challenges normal expectations of such a supplemental system. Amendment 23-62 preamble states:

Section 23.1309 lists the qualifiers "under the airplane operating and environmental conditions".

Section 23.1309, amendment 23-62 preamble also describes two actions for the applicant. First, the applicant must consider the full normal operating envelope of the airplane, as defined by the Airplane Flight Manual, with any modification to that envelope associated with abnormal or emergency procedures and any anticipated flightcrew action. Second, the applicant must consider the anticipated external and internal airplane environmental conditions, as well as any additional conditions where equipment and systems are assumed to "perform as intended".

Section 23.1309(a)(2) requires analysis of any installed equipment or system with potential failure conditions that are catastrophic, hazardous, major, or minor, to determine their impact on the safe operation of the airplane. The applicant must show that they do not adversely affect

proper functioning of the equipment, systems, or installations covered by § 23.1309 and do not otherwise adversely influence the safety of the airplane or its occupants.

Section 23.1309(a)(2) does not mandate that non-required equipment and systems function properly during all airplane operations once in service, provided all potential failure conditions have no effect on the safe operation of the airplane. The equipment or system must function in the manner expected by the manufacturer's operating manual for the equipment or system. An applicant's statement of intended function must be sufficiently detailed so the FAA can evaluate whether the system is appropriate for its intended function(s).

To incorporate the intent of amendment 23-62, the FAA issues these special conditions to include previous BPS special conditions, address the interaction CAPS with other airplane systems, and that it is a non-required system. The system must function within specified manufacturer’s limits while operated within the manufacturers recommended envelope. Since it is a non-required system, the means of substantiation have been altered to reflect the bounds of the operating envelope, the means of analysis that can be substantiated with overlapping lower-level testing/analysis, and relieve in-flight deployment to avoid unnecessary expense and the inherent danger in performing this test.

All special condition requirements must meet two fundamental criteria:

- The installed system must not introduce unacceptable hazards prior to or after activation.

- The applicant must show that the system does not adversely affect proper functioning of the equipment, systems, or installations covered by § 23.1309 and do not otherwise adversely influence the safety of the airplane or its occupants.

The applicant does not have to demonstrate the system in flight on a test airplane.

Discussion of Comments

Notice of proposed special conditions No. 23-16-01-SC for the Cirrus Design Corporation SF50 airplanes was published in the Federal Register on March 18, 2016 (81 FR 14801). The FAA received 11 comments that disagreed with the special condition provisions for demonstration via test or test supported by analysis. These comments primarily focused on the concern that the FAA should require testing of the BPS in flight to validate intended performance.

The process of an applicant showing compliance to these BPS system special conditions is a complex and multi-tiered process. The applicant must conservatively demonstrate each function of the entire deployment event sequentially, from pulling the handle to securing the airplane after ground impact, to meet the special conditions. These separate events and functions can be demonstrated to satisfy the requirements of these special conditions with lower-level testing, normally using analysis supported by test. This is consistent with certification methods used on many other parts of the airplane.

The FAA decision to allow a means of compliance without requiring inflight deployment on a test airplane is not a complete elimination of testing or an evaluation of the system. The FAA believes that test or analysis supported by test will provide an acceptable level of safety to demonstrate that the system will perform its intended function; therefore, no in-flight deployment on a test airplane will be required.

The Cirrus SF50 BPS is a non-required safety device intended to improve occupant survivability in emergencies and under extreme conditions. The certification requirements contained in these special conditions are consistent with the requirements of §§ 23.1301(a) and

23.1309(a) for equipment that is not required for type certification or by the operating rules. Because the BPS is non-required equipment, its design must be shown to be appropriate for the intended function and it must not adversely affect safety. The FAA Aircraft Certification Service has evaluated the intended function, design, and installation of the SF50 BPS, and has considered what is required to meet an acceptable confidence level.

The potential operational decision to deploy the BPS in service would be the result of an emergency, one that will invariably result in a controlled crash. While the BPS is expected to improve occupant survivability in an emergency, the residual risk to the occupants is not completely eliminated. The primary hazard introduced while performing a comprehensive BPS flight test is the risk to the flight test crew when exposed to controlled crash conditions during a successful deployment. The FAA has determined the requirement to demonstrate the BPS via testing or testing supported by analysis to be "appropriate for the intended function and does not adversely affect safety". Therefore, the FAA will not require a comprehensive flight test deployment.

Another commenter requested clarification of paragraph 1(c)(3), regarding definition of occupant protection after aircraft structure damage. To clarify, the FAA's intent of this paragraph was to ensure that the cabin can protect the occupants after a normal deployment even if the cabin experiences damage resulting from the deployment process or as a result of ground impact. The paragraph does not assume any airplane damage prior to system deployment.

Applicability

As discussed above, these special conditions are applicable to the 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 SF50 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 airplane. 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, 14 CFR 11.38, 11.39, 21.16 and 21.17.

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 SF50 airplanes.

1. **Whole Airplane Parachute Recovery System With Flight Control and Deployment Augmentation.**

(a) System Validation.

(1) The applicant must demonstrate by test, or analysis supported by test, that the system will not cause an unacceptable hazard or otherwise exceed the system deployment design loads for the critical flight conditions.

(2) The recovery system activation envelope must include speeds at or near V_S up to at least V_o. The applicant must satisfactorily demonstrate by test, or by analysis supported by test, the logic and automatic control interface that allow the recovery system activation over this speed range.

(b) Occupant Restraint.

Each seat in the airplane must be equipped with an approved restraint system, which will protect the occupants from serious head and upper torso injuries during a recovery system deployment and ground impact at the critical load conditions.

(c) Parachute Performance.

(1) A 1.5 factor of safety applied to the limit load must be used for all components of the recovery system as well as the attachment structure, the cabin structure surrounding the occupants, and any interconnecting structure of the airplane. Limit loads are defined as the parachute deployment forces developed within the operational envelope of the system. Lower factors of safety for airplane weight and velocity may be used, so that when combined in the energy equation, represent a 1.5 factor of safety of the energy equation.

(2) Stitching must be of a type that will not ravel when broken.

(3) The applicant must show via test, or analysis supported by test, that with the recovery parachute deployed and the airplane structure damaged, the airplane impact during

touchdown will result in an occupant environment in which serious injury to the occupants is improbable.

(4) The applicant must show via test, or analysis supported by test, that with the recovery parachute deployed, the airplane can impact the ground in various adverse weather conditions, including winds up to 15 knots, without endangering the airplane occupants at and after touchdown.

(d) System Function and Operations.

(1) The installation design and location of the extraction device must consider fire hazards associated with the activation of the parachute system and reduce this potential as much as possible without compromising function of the extraction device.

(2) A system safety analysis will be conducted on the recovery system that will consider the effects of annunciated and un-annunciated failures. This analysis will address both losses of function as well as malfunction (including un-commanded system activation). The applicant must show that they do not adversely affect proper functioning of the equipment, systems, or installations covered by § 23.1309, and do not otherwise adversely influence the safety of the airplane or its occupants. It must be shown that reliable and functional deployment in the adverse weather conditions that the airplane is approved for have been considered. For example, if the airplane is certified for flight in icing conditions, and flight test in icing reveals that ice may cover the deployment area, then the possible adverse effects of ice or an ice layer covering the parachute deployment area should be analyzed.

(3) The recovery system must be designed to safeguard against inadvertent activation. Two separate and intentional actions will be required to activate the system.

(4) It must be demonstrated that the system can be activated without difficulty by occupants of various sizes, from a 10th percentile female to a 90th percentile male, while sitting in the pilot or copilot seat.

(5) The system must be labeled for identification, function, and operating limitations.

(6) The airplane must be equipped with ASTM F 2316-06 conforming placards suitable to draw attention of first responders. Section 11 of ASTM F 2316-06, specifies that the airplane should be marked with a "danger" placard placed adjacent to the exit point of each rocket/parachute, an "identifying" placard attached to each rocket, and "warning" placard(s) applied where occupant(s) enter the airplane or where rescue personnel can readily see the placard(s).

(e) Design and Construction.

(1) All components of the system must be protected against deterioration due to weathering, corrosion, and abrasion.

(2) Adequate provisions must be made for ventilation and drainage of the system compartments and associated structure to ensure the sound condition of the system.

(f) Materials and workmanship.

(1) The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

i. Be established by experience or tests;

ii. Meet approved specifications that ensure their having the strength and other properties assumed in the design data; and

iii. Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

(2) Workmanship must be of a high standard.

(3) The parachute(s) must be identified with a data panel that defines the Manufacturer, Date of Manufacture, Part Number, and Serial Number.

(g) Systems Maintenance and Inspection.

(1) Instructions for continued airworthiness must be prepared for the system that meet the requirements of § 23.1529.

(2) Adequate means must be provided to permit the close examination of the system components to ensure proper functioning, alignment, lubrication, and adjustment during the required inspection of the system.

(h) Operating Limitations.

(1) Operating limitations must be prescribed to ensure proper operation of the system. A detailed discussion of the system, including operation, limitations, and deployment envelope must be included in the Airplane Flight Manual.

(2) Operating limitations must be prescribed for inspecting and overhauling the system components at approved intervals.

Issued in Kansas City, Missouri, on July 6, 2016.

William Schinstock
Acting Manager, Small Airplane Directorate
Aircraft Certification Service
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