[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. FAA-2016-9172; Special Conditions No. 23-276-SC]

Special Conditions: DAHER-SOCATA, Model TBM 700; Inflatable Four-Point Restraint Safety Belt with an Integrated Airbag Device

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the installation of an inflatable four-point restraint safety belt with an integrated airbag device at the pilot and copilot seats on the DAHER-SOCATA, Model TBM 700 airplane. These airplanes, as modified by the installation of these inflatable safety belts, will have novel and unusual design features associated with the upper-torso restraint portions of the four-point safety belts, which contain an integrated airbag device. 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 OF PUBLICATION IN FEDERAL REGISTER]** and are applicable on December 6, 2016.

FOR FURTHER INFORMATION CONTACT: Mr. Bob Stegeman, Federal Aviation Administration, Aircraft Certification Service, Small Airplane Directorate, ACE-111, 901 Locust, Room 301, Kansas City, MO; telephone (816)-329-4140; facsimile (816)-329-4090.

SUPPLEMENTARY INFORMATION:

Background

On January 5, 2016, DAHER-SOCATA (SOCATA) applied for FAA validation for the optional installation of a four-point safety belt restraint system for the pilot and copilot seats and incorporating integrated inflatable airbags for both on the Model TBM 700 airplane. The Model TBM 700 airplane is a single-engine powering a four bladed turbopropellor. It has a maximum takeoff weight of 6578 pounds (2984 kg). In addition to a pilot and copilot, it can seat up to five passengers.

The inflatable restraint systems are four-point safety belt restraint systems consisting of a lap belt and shoulder harness with an inflatable airbag attached to the shoulder harness straps. The inflatable portion of the restraint system will rely on sensors electronically activating the inflator for deployment.

If an emergency landing occurs, the airbags will inflate and provide a protective cushion between the head of the occupant (pilot and copilot) and the structure of the airplane. This will reduce the potential for head and torso injury. The inflatable restraint behaves in a manner similar to an automotive airbag; however, the airbag is integrated into the shoulder harness straps. Airbags and inflatable restraints are standard in the automotive industry; the use of an inflatable restraint system is novel for general aviation.

The FAA has determined that this project will be accomplished on the basis of providing the same level of safety as the current certification requirements of airplane occupant restraint systems. The FAA has the following two primary safety concerns with the installation of airbags or inflatable restraints that—

1. They perform properly under foreseeable operating conditions; and

2. They do not perform in a manner or at such times as to impede the pilot's ability to maintain control of the airplane or constitute a hazard to the airplane or occupants.

The latter point has the potential to be the more rigorous of the requirements. An unexpected deployment while conducting the takeoff or landing phases of flight may result in an unsafe condition. The unexpected deployment may either startle the pilot or generate a force sufficient to cause a sudden movement of the control yoke. Both actions may result in a loss of control of the airplane. The consequences are magnified due to the low operating altitudes during these phases of flight. The FAA has considered this when establishing these special conditions.

The inflatable restraint system relies on sensors to electronically activate the inflator for deployment. These sensors could be susceptible to inadvertent activation, causing deployment in a potentially unsafe manner. The consequences of an inadvertent deployment must be considered in establishing the reliability of the system. SOCATA must show that the effects of an inadvertent deployment in flight are not a hazard to the airplane and that an inadvertent deployment is extremely improbable. In addition, general aviation aircraft are susceptible to a large amount of cumulative wear and tear on a restraint system. The potential for inadvertent deployment may increase as a result of this cumulative damage. Therefore, the impact of wear and tear resulting with an inadvertent deployment must be considered. The effect of this

cumulative damage means duration of life expectations must be established for the appropriate system components in the restraint system design.

There are additional factors to be considered to minimize the chances of inadvertent deployment. General aviation airplanes are exposed to a unique operating environment, since the same airplane may be used by both experienced and student pilots. The effect of this environment on inadvertent deployment must be understood. Therefore, qualification testing of the firing hardware and software must consider the following—

1. The airplane vibration levels appropriate for a general aviation airplane; and

2. The inertial loads that result from typical flight or ground maneuvers, including gusts and hard landings.

Any tendency for the firing mechanism to activate as a result of these loads or acceleration levels is unacceptable.

Other influences on inadvertent deployment include High-Intensity Radiated Fields (HIRF) and lightning. Since the sensors that trigger deployment are electronic, they must be protected from the effects of these threats. To comply with HIRF and lightning requirements, the inflatable restraint system is considered a critical system, since its inadvertent deployment could have a hazardous effect on the airplane.

Given the level of safety of the occupant restraints currently installed, the inflatable restraint system must show that it will offer an equivalent level of protection for an emergency landing. If an inadvertent deployment occurs, the restraint must still be at least as strong as a Technical Standard Order approved belt and shoulder harnesses. There is no requirement for the

inflatable portion of the restraint to offer protection during multiple impacts, where more than one impact would require protection.

Where installed, the inflatable restraint system must deploy and provide protection for each occupant under an emergency landing condition. The Model TBM 700 airplane seats are certificated to the structural requirements of § 23.562; therefore, the test emergency landing pulses identified in § 23.562 must be used to satisfy this requirement.

A wide range of occupants may use the inflatable restraint; therefore, the protection offered by this restraint should be effective for occupants that range from the fifth percentile female to the ninety-fifth percentile male. Energy absorption must be performed in a consistent manner for this occupant range.

In support of this operational capability, there must be a means to verify the integrity of this system before each flight. SOCATA may establish inspection intervals where they have demonstrated the system to be reliable between these intervals.

An inflatable restraint may be armed even though no occupant is using the seat. While there will be means to verify the integrity of the system before flight, it is also prudent to require unoccupied seats with active restraints not pose a hazard to any occupant. This will protect any individual performing maintenance inside the cockpit while the aircraft is on the ground. The restraint must also provide suitable visual warnings that would alert rescue personnel to the presence of an inflatable restraint system.

The design must also prevent the inflatable seatbelt from being incorrectly buckled or installed to avoid hindering proper deployment of the airbag. SOCATA may show that such deployment is not hazardous to the occupant and will still provide the required protection.

The cabins of the SOCATA, Model TBM 700 airplane identified in these special conditions are confined areas, and the FAA is concerned that noxious gasses may accumulate if the airbag deploys. When deployment occurs, either by design or inadvertently, there must not be a release of hazardous quantities of gas or particulate matter into the cockpit.

An inflatable restraint should not increase the risk already associated with fire. The inflatable restraint should be protected from the effects of fire to avoid creating an additional hazard such as, a rupture of the inflator, for example.

Finally, the airbag is likely to have a large volume displacement, and possibly impede the egress of an occupant. Since the bag deflates to absorb energy, it is likely that the inflatable restraint would be deflated at the time an occupant would attempt egress. However, it is appropriate to specify a time interval after which the inflatable restraint may not impede rapid egress. Ten seconds has been chosen as reasonable time. This time limit offers a level of protection throughout an impact event.

Type Certification Basis

Under the provisions of 14 CFR 21.17, SOCATA must show that the Model TBM 700 airplane continues to meet the applicable provisions of the applicable regulations in effect on the date of application for the type certificate. The regulations incorporated by reference in the type certificate are commonly referred to as the original type certification basis**.**

The certification basis also includes all exemptions, if any; equivalent level of safety findings, if any; and special conditions not relevant to the special conditions adopted by this rulemaking action.

If the Administrator determines that the applicable airworthiness regulations (i.e., 14 CFR part 23) do not contain adequate or appropriate safety standards for the inflatable restraint, as installed on the SOCATA, Model TBM 700 airplane 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 Model TBM 700 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 § 11.19, under § 11.38 and they become part of the type certification basis under § 21.17(a)(2).

Special conditions are initially applicable to the models for which they are issued**.** Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model.

Novel or Unusual Design Features

The SOCATA, Model TBM 700 airplane will incorporate the following novel or unusual design feature:

Installation of inflatable four-point restraint safety belt with an integrated airbag device for the pilot and copilot seats.

Discussion

The purpose of the airbag is to reduce the potential for injury in the event of an accident. In a severe impact, an airbag will deploy from the shoulder harness in a manner similar to an automotive airbag. The airbag will deploy between the head of the occupant and airplane interior structure, which will provide some protection to the head of the occupant. The restraint will rely on sensors to electronically activate the inflator for deployment.

The Code of Federal Regulations states performance criteria for seats and restraints in an objective manner. However, none of these criteria are adequate to address the specific issues raised concerning inflatable restraints. Therefore, the FAA has determined that in addition to the requirements of part 21 and part 23, special conditions are needed to address the installation of this inflatable restraint.

Accordingly, these special conditions are adopted for the SOCATA, Model TBM 700 airplanes equipped with four-point inflatable restraints. Other conditions may be developed, as needed, based on further FAA review and discussions with the manufacturer and civil aviation authorities.

Discussion of Comments

Final special conditions number 23-276-SC[1] for the DAHER-SOCATA, Model TBM 700 airplanes and requesting comments was published in the Federal Register on September 30, 2016 (81 FR 67093). One comment was received that compared restraint safety to that of an automobile and stressed the importance considering airbag safety, the possibility of injuring or

[1] https://www.regulations.gov/document?D=FAA-2016-9172-0001

killing occupants during deployment and considerations for occupant safety for a range of occupants.

Aircraft accidents differ from car accidents in that they typically involve much higher speeds and also introduce a vertical impact component. The aviation regulations require an assessment of occupant safety in the horizontal and vertical planes. An airbag is normally triggered, deployed, and effective only in the horizontal plane. The special condition requires assessment for 5th percentile females to 95th percentile males. As such, very large and very small occupants are not considered in this special condition, but this is consistent with other FAA occupant safety rules.

Aircraft airbags, or inflatable restraints, (including the airbags subject to this special condition) are fundamentally different in their operation in comparison to automotive airbags. Automotive airbags normally deploy from the dashboard or steering wheel and push against the rigid structure as they powerfully deploy and engage the occupant. Inflatable restraints have the airbag deploy from the restraint and push away from the occupant and do not press on the occupant until the occupant, with significant inertia, is moving forward and impacting the interior. Smaller occupants, normally those killed by automotive airbags, are not as likely to engage the aircraft inflatable restraints against the interior.

There are no known fatalities or significant injuries from aircraft inflatable restraints that are attributable only to the airbag deployment itself. By nature, the inflatable restraints move away from the occupant, so injury to the occupant from deployment is very unlikely. Smaller occupants and children are still recommended to ride in aft seating, like in an automobile. These

special conditions do consider and peripherally address a range of occupant sizes consistent with part 23 occupant safety rules.

This special condition does address the potential hazards commented upon, and the safety and effectiveness of the airbag system with consideration to a range of occupant sizes. No changes were made as a result of this comment, and the special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the SOCATA, Model TBM 700 airplane. Should SOCATA 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 SOCATA, Model TBM 700 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 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 and 44701; 14 CFR 21.16 and 21.17; and 14 CFR 11.38 and 11.19.

The Special Conditions

The FAA has determined that this project will be accomplished on the basis of not lowering the current level of safety of the SOCATA, Model TBM 700 airplane occupant restraint systems. 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 the SOCATA, Model TBM 700 airplane.

1. **Installation of inflatable four-point restraint safety belt with an integrated airbag device.**

a. It must be shown that the inflatable restraint will deploy and provide protection under emergency landing conditions. Compliance will be demonstrated using the dynamic test condition specified in § 23.562(b)(2). It is not necessary to account for floor warpage, as required by § 23.562(b)(3), or vertical dynamic loads, as required by § 23.562(b)(1). The means of protection must take into consideration a range of stature from a 5^{th} percentile female to a 95^{th} percentile male. The inflatable restraint must provide a consistent approach to energy absorption throughout that range.

b. The inflatable restraint must provide adequate protection for the occupant. In addition, unoccupied seats that have an active restraint must not constitute a hazard to any occupant.

c. The design must prevent the inflatable restraint from being incorrectly buckled and incorrectly installed, such that the airbag would not properly deploy. It must be shown that such deployment is not hazardous to the occupant and will provide the required protection.

d. It must be shown that the inflatable restraint system is not susceptible to inadvertent deployment as a result of wear and tear or the inertial loads resulting from in-flight or ground maneuvers (including gusts and hard landings) that are likely to be experienced in service.

e. It must be extremely improbable for an inadvertent deployment of the restraint system to occur, or an inadvertent deployment must not impede the pilot's ability to maintain control of the airplane or cause an unsafe condition or hazard to the airplane. In addition, a deployed inflatable restraint must be at least as strong as a Technical Standard Order, TSO-C114, certificated belt and shoulder harness.

f. It must be shown that deployment of the inflatable restraint system is not hazardous to the occupant or will not result in injuries that could impede rapid egress. This assessment should include occupants whose restraint is loosely fastened.

g. It must be shown that an inadvertent deployment that could cause injury to a standing or sitting person is improbable. In addition, the restraint must also provide suitable visual warnings that would alert rescue personnel to the presence of an inflatable restraint system.

h. It must be shown that the inflatable restraint will not impede rapid egress of the occupants 10 seconds after its deployment.

i. To comply with HIRF and lightning requirements, the inflatable restraint system is considered a critical system since its deployment could have a hazardous effect on the airplane.

j. It must be shown that the inflatable restraints will not release hazardous quantities of gas or particulate matter into the cabin.

k. The inflatable restraint system installation must be protected from the effects of fire such that no hazard to occupants will result.

l. There must be a means to verify the integrity of the inflatable restraint activation system before each flight or it must be demonstrated to reliably operate between inspection intervals.

m. A life limit must be established for appropriate system components.

n. Qualification testing of the internal firing mechanism must be performed at vibration levels appropriate for a general aviation airplane.

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

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