DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. CE197; Special Conditions No. 23–138–SC]

Special Conditions: AMSAFE, Incorporated, Zenair Model CH2000, Inflatable Three-Point Self-Adjusting Restraint Safety Belt With an Integrated Inflatable Airbag Device

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the installation of an AMSAFE, Inc. Inflatable Three-Point Self-Adjusting Restraint Safety Belt with an Integrated Inflatable Airbag Device on the Zenair model CH2000. This airplane, as modified by AMSAFE, Inc. will have novel and unusual design features associated with the lap belt portion of the safety belt, which contains 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.

EFFECTIVE DATE: October 2, 2003.

FOR FURTHER INFORMATION CONTACT: Mr. Pat Mullen, Federal Aviation Administration, Aircraft Certification Service, Small Airplane Directorate, ACE–111, 901 Locust, Kansas City, Missouri, 816–329–4128, fax 816–329–4090.

SUPPLEMENTARY INFORMATION:

Background

On March 8, 2003, AMSAFE, Inc. Inflatable Restraints Division, 5456 East McDowell Road, Mesa, AZ, 85215, applied for a supplemental type certificate to install an inflatable lapbelt restraint with a standard upper torso restraint (or shoulder harness) in the Zenair model CH2000. The model CH2000 is a single-engine, two-place airplane with a stall speed in the landing configuration that is below 45 knots.

The inflatable restraint system is a three-point restraint system consisting of a shoulder harness and an inflatable airbag lap belt, and will be installed on both the pilot and co-pilot seats. In the event of an emergency landing, the airbag will inflate and provide a protective cushion between the occupant's head and the airplane's yoke and instrument panel. This will reduce the potential for head and torso injury. The inflatable restraint behaves in a manner that is similar to an automotive airbag, but in this case, the airbags are integrated into the lapbelt. The shoulder harness is conventional and does not inflate. While airbags and inflatable restraints are standard in the automotive industry, the use of an inflatable three-point restraint is novel for general aviation operations.

The FAA has determined that this project will be accomplished on the basis of providing the same current level of safety of the model CH2000 occupant restraint design. The FAA has considered the installation of airbags as having two primary safety concerns:

- That they perform properly under foreseeable operating conditions; and
- That 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 and 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. Either action could result in a loss of control of the airplane, the consequences of which are magnified due to the low operating altitudes during these phases of flight. The FAA has considered this when establishing the special conditions.

The inflatable airbag is integrated into the lap belt and 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. AMSAFE, Inc. must show that the effects of an inadvertent deployment in flight are not a hazard to the airplane or that an inadvertent deployment is extremely improbable. In addition, any general aviation aircraft can generate a large amount of cumulative wear and tear on a restraint system. It is likely that the potential for inadvertent deployment increases as a result of this cumulative damage. Therefore, the impact of wear and tear on inadvertent deployment must be considered. Ultimately, because of the effects of this cumulative damage, a life limit 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 of the restraint must be understood. Therefore, qualification testing of the firing hardware/software must consider the following:

- The airplane vibration levels appropriate for a general aviation airplane; and
- 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 electromagnetic 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 AMSAFE, Inc. 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 current Zenair model CH2000 lap belt and shoulder harness restraint, the inflatable restraint must show that it will offer an equivalent level of protection in the event of an emergency landing. In the event of an inadvertent deployment, the restraint must still be at least as strong as a Technical Standard Order certificated belt and shoulder harness. 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.

The inflatable seatbelt system must deploy and provide protection for each occupant under a crash condition where it is necessary to prevent serious head injury. However, the Zenair CH2000 seats are not certificated to the requirements specified in § 23.562 and it is not known if they would remain intact following exposure to the crash pulse identified in § 23.562. Therefore, the test crash pulse used to satisfy this requirement may have a peak longitudinal deceleration lower than that required by § 23.562. However, the test pulse must have an onset rate (deceleration divided by time) equal to or greater than the onset rate of the

pulse described in § 23.562. This will demonstrate that the crash sensor will trigger when exposed to a rapidly applied deceleration, like an actual crash event.

It is possible a wide range of occupants will use the inflatable restraint. Thus, 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. As an option, AMSAFE, Inc. can establish inspection intervals where they have demonstrated the system to be reliable between these intervals.

It is possible that an inflatable restraint will 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's also prudent to require that unoccupied seats with active restraints not constitute a hazard to any occupant. This will protect any individual performing maintenance items inside the cockpit while the aircraft is on the ground and includes protection against inadvertent deployment.

In addition, the use and operation of this restraint must be transparent to the user. Therefore, the design must prevent the inflatable seatbelt from being incorrectly buckled and/or installed such that the airbag would not properly deploy. As an alternative, AMSAFE, Inc. may show that such deployment is not hazardous to the occupant, and will still provide the required protection.

The cockpit of the model CH2000 is a confined area, and the FAA is concerned that noxious gasses may accumulate in the event the inflatable restraint deploys. When deployment does occur, either by design or inadvertently, there must not be a release of hazardous quantities of gas or particulate matter into the cockpit area.

Fire is a concern for any airplane, regardless of the size or class of the airplane. An inflatable restraint should not increase the risk already associated with fire. Therefore, the inflatable restraint should be protected from the effects of fire, so that an additional hazard is not created by, for example, a rupture of the inflator.

Finally, the inflatable restraint is likely to have a large volume displacement, where the inflated bag could 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 will offer a level of protection throughout the impact event.

Type Certification Basis

Under the provisions of § 21.101, AMSAFE, Inc. must show that the Zenair model CH2000, as changed, continues to meet the applicable provisions of the regulations incorporated by reference in Type Certificate No. TA5CH or the applicable regulations in effect on the date of application for the change. The regulations incorporated by reference in the type certificate are commonly referred to as the ''original type certification basis.'' The regulations incorporated by reference in Type Certificate No. TA5CH are as follows:

FAR 21.29 and FAR 23 effective February 1, 1965, as amended by 23–1 through 23–42.

JAR–VLA effective April 26, 1990, through Amendment VLA/92/1 effective January 1, 1992, used as a safety equivalence to FAR 23, as provided by AC 23–11.

FAR 36 dated December 1, 1969, as amended by current amendment as of date of type certification.

For the model listed above, the certification basis also includes all exemptions, if any; equivalent level of safety findings, if any; and the special conditions adopted by this rulemaking action.

The Administrator has determined that the applicable airworthiness regulations (*i.e.*, part 23 as amended) do not contain adequate or appropriate safety standards for the AMSAFE, Inc. inflatable restraint as installed on Zenair model CH2000 because of a novel or unusual design feature. Therefore, special conditions are prescribed under the provisions of § 21.16.

Special conditions, as appropriate, as defined in § 11.19, are issued in accordance with § 11.38, and become part of the type certification basis in accordance with § 21.101.

Special conditions are initially applicable to the model for which they are issued. Should the applicant apply for a supplemental type certificate to modify any other model included on the same type certificate to incorporate the same novel or unusual design feature, the special conditions would also apply to that model under the provisions of § 21.101.

Novel or Unusual Design Features

The Zenair model CH2000 will incorporate the following novel or unusual design feature:

The AMSAFE, Inc. Inflatable Three-Point Self-Adjusting Restraint safety belt with an integrated inflatable airbag device. The purpose of the inflatable airbag seatbelt is to reduce the potential for injury in the event of an accident. In a severe impact, an airbag will deploy from the lapbelt portion of the restraint, in a manner similar to an automotive airbag. The airbag will deploy between the head of the occupant and the airplane's yoke and instrument panel. This will, therefore, provide some protection to the head of the occupant. The restraint will rely on sensors to electronically activate the inflator for deployment.

Title 14 of the Code of Federal Regulations, parts 21 and 23, 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 Zenair model CH2000 equipped with the AMSAFE, Inc. Three-Point Self-Adjusting Restraint safety belt with an integrated inflatable airbag device. Other conditions may be developed, as needed, based on further FAA review and discussions with the manufacturer and civil aviation authorities.

Discussion of Comments

Notice of proposed special conditions No. 23–03–01–SC for the Zenair model CH2000 equipped with the AMSAFE, Inc. Three-Point Self-Adjusting Restraint safety belt with an integrated airbag device was published on July 17, 2003 (68 FR 42315). One comment was received, regarding the requirement that the lapbelt must deploy and provide protection under the crash conditions specified in § 23.562 (proposed Special Condition No. 1).

The commenter is in general agreement with the special conditions proposed for this particular program. In addition, the commenter is in agreement that a dynamic test is necessary to demonstrate the deployment timing and positioning of the inflatable lapbelt. However, the commenter states that proposed SC No. 1, as written, requires the inflatable restraint to operate only when subjected to the crash pulse

identified in § 23.562. In addition, since the seats installed in the Zenair CH2000 do not meet the requirements of § 23.562, an inflatable restraint that operates only after being exposed to this pulse may offer little benefit.

The commenter suggests that reference to § 23.562 be retained, but allow for the following:

- The test pulse may have a reduction in the peak longitudinal deceleration but the onset rate (deceleration divided by time) must be equal to or greater than the pulse specified in § 23.562.
- The peak longitudinal deceleration must be greater than the deployment threshold of the crash sensor.
- The peak longitudinal deceleration must be equal to or greater than the forward static design load factors required by the original certification basis of the airplane.

The FAA concurs. The seats installed in the Zenair CH2000 may not satisfy the requirements of § 23.562, so it is not appropriate to install an inflatable restraint that will deploy only when subjected to the crash pulse specified in § 23.562. The FAA agrees that the test pulse used to satisfy the dynamic test requirements must be less severe than that specified in § 23.562. In addition, we agree with the commenter that the onset rate of the test pulse should be equal to or greater than the onset rate of the pulse required by § 23.562. This will show that the crash sensor will trigger when exposed to a high deceleration that builds up in rapid time, like a real crash event.

The FAA will incorporate the commenter's input into Special Condition No. 1.

Applicability

As discussed above, these special conditions are applicable to the Zenair model CH2000 equipped with the AMSAFE, Inc. Three-Point Self-Adjusting Restraint safety belt with an integrated inflatable airbag device. Should AMSAFE, Inc. apply at a later date for a supplemental type certificate to modify any other model on Type Certificate number TA5CH to incorporate the same novel or unusual design feature, the special conditions would apply to that model as well under the provisions of § 21.101.

Conclusion

This action affects only certain novel or unusual design features on the Zenair model CH2000. 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 and 44701; 14 CFR 21.16 and 21.101; 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 typ certification basis for the Zenair model CH2000, as modified by AMSAFE, Inc.

Three-Point Self-Adjusting Restraint Safety Belt With an Integrated Airbag Device

1. It must be shown that the inflatable lapbelt will deploy and provide protection under crash conditions where it is necessary to prevent serious head injuries. Compliance will be demonstrated using the dynamic test condition specified in § 23.562, which may be modified as follows:

a. The peak longitudinal deceleration may be reduced, however the onset rate of the deceleration must be equal to or greater then the crash pulse identified in § 23.562.

b. The peak longitudinal deceleration must be above the deployment threshold of the crash sensor, and equal to or greater than the forward static design longitudinal load factor required by the original certification basis of the airplane.

The means of protection must take into consideration a range of stature from a 5th percentile female to a 95th percentile male. The inflatable lapbelt must provide a consistent approach to energy absorption throughout that range.

2. The inflatable lapbelt must provide adequate protection for each occupant. In addition, unoccupied seats that have active seat belts must not constitute a hazard to any occupant.

3. The design must prevent the inflatable safety belt from being incorrectly buckled and/or incorrectly installed such that the airbag would not properly deploy. Alternatively, it must be shown that such deployment is not hazardous to the occupant and will provide the required protection.

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

5. It must be shown (or be extremely improbable) that an inadvertent deployment of the restraint system during the most critical part of the flight does 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 certificated belt and shoulder harness.

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

7. It must be shown that an inadvertent deployment that could cause injury to a standing or sitting person is improbable.

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

9. For the purposes of complying with HIRF and lightning requirements, the inflatable safety belt system is considered a critical system since its deployment could have a hazardous effect on the airplane.

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

11. The inflatable safety belt installation must be protected from the effects of fire such that no hazard to occupants will result.

12. There must be a means to verify the integrity of the inflatable safety belt activation system prior to each flight or it must be demonstrated to reliably operate between inspection intervals.

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

14. 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 October 2, 2003.

Dorenda D. Baker,

Acting Manager, Small Airplane Directorate, Aircraft Certification Service.

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