DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[Policy Statement Number ACE-00-23.561-01]

Issuance of Policy Statement, Methods of Approval of Retrofit Shoulder Harness Installations in Small Airplanes

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of policy statement.

SUMMARY: This document announces an FAA general statement of policy applicable to modifying small airplanes. This document advises the public, in particular, small airplane owners and modifiers, of more information related to acceptable methods of approval of retrofit shoulder harness installations. This notice is necessary to tell the public of FAA policy.

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SUPPLEMENTARY INFORMATION:

Background

This notice announces the following policy statement, ACE-00-23.561-01. The purpose of this statement is to address methods of approval for retrofit shoulder harness installations in small airplanes.

What is the general effect of this policy?

The FAA is presenting this information as a set of guidelines suitable for use. However, we do not intend that this policy set up a binding norm; it does not form a new regulation and the FAA would not apply or rely on it as a regulation.

The FAA Aircraft Certification Offices (ACO's) and Flight Standards District Offices (FSDO’s) that certify changes in type design and approve

alterations in normal, utility, and acrobatic category airplanes should try to follow this policy when appropriate. Applicants should expect the certificating officials would consider this information when making findings of compliance relevant to retrofit shoulder harness installations.

As with all advisory material, this statement of policy identifies one way, but not the only way, of compliance.

General Statement of Policy

Summary

A retrofit shoulder harness installation in a small airplane may receive approval by Supplemental Type Certificate (STC), Field Approval, or as a minor change. An STC is the most rigorous means of approval and offers the highest assurance the installation meets all the airworthiness regulations. A Field Approval is a suitable method of approval for a shoulder harness installation that needs little or no engineering. Shoulder harness installations may receive approval as a minor change in certain cases. In such cases, the FAA certificated mechanic who installs the shoulder harness records it as a minor change by making an entry in the maintenance log of the airplane.

The FAA does not encourage the approval of retrofit shoulder harness installations as minor changes. The preferred methods of approval are Supplemental Type Certificate or Field Approval. However, the FAA should not forbid the approval of a retrofit shoulder harness installation as a minor change in:

- the **front seats** of those **small airplanes manufactured before July 19, 1978**, and
- in **other seats** of those **small airplanes manufactured before December 13, 1986.**

A retrofit shoulder harness installation may receive approval as a minor change in these small airplanes if:

- The installation requires no change of the structure (such as welding or drilling holes).
- The certification basis of the airplane is 14 CFR part 23 before Amendment 23-20, part 3 of the Civil Air Regulations, or a predecessor regulation.

In addition, a minor change installation should follow the guidance for hardware, restraint angles, and attachment locations provided in:

- Advisory Circular (AC) 43.13-2A, Acceptable Methods, Techniques, and Practices Aircraft Alterations.
- AC 21-34, Shoulder Harness - Safety Installations.
- AC 23-4, Static Strength Substantiation of Attachment Points for Occupant Restraint System Installations.

Installations approved as a minor change may not provide the occupant with the protection required by regulation (Civil Air Regulation (CAR) 3.386 or 14 CFR part 23, § 23.561). However, a properly installed retrofit shoulder harness installation is a safety improvement over occupant restraint by seat belt alone.

Introduction

In January 1997, the Anchorage Aircraft Certification Office (ACO) Manager requested the Small Airplane Directorate to study the issue of retrofit shoulder harness installations in small airplanes. The Anchorage ACO specifically requested guidance for a Supplemental Type Certificate (STC) project to install shoulder harnesses in Piper PA-18 series airplanes. Shoulder harnesses are approved under Technical Standard Order (TSO)-C114 Torso Restraint Systems, or by other acceptable means appropriate to the certification basis of the airplane in which they will be installed. This policy statement addresses the approval of the shoulder harness installation only.

During 1998, the Small Airplane Directorate took part in the Aviation Safety Program to increase the use and effectiveness of occupant restraint systems in general aviation airplanes. This program supports the occupant survivability element of the Administrator's Safety Agenda for general aviation. The FAA has a goal of significantly reducing the number of fatal accidents over a ten-year period. Most of the content of this policy was presented in a paper at the August 19, 1998, meeting of this Aviation Safety Program.

The Manager of the Aircraft Maintenance Division of Flight Standards, AFS-300, has reviewed and agrees with this policy.

GENERAL DISCUSSION OF COMMENTS

Has FAA taken any action to this point?

We issued a notice of policy statement, request for comments. This proposed policy appeared in the *Federal Register* on June 14, 2000 (65 FR 37449) and the public comment period closed July 14, 2000.

Was the public invited to comment?

The FAA encouraged interested people to join in making this proposed policy. We received comments from 12 different commenters. Commenters included pilots, operators, individuals, manufacturers, and organizations representing these groups. Most of the commenters were supportive of the proposed policy.

Commenters praised the proposed policy for promoting safety, especially on older airplanes. We will discuss the general comments and concerns then we will discuss comments that are more specific.

General and Miscellaneous Comments

One individual wrote, "I would like to give my support to the opportunity for minor changes to allow shoulder harness installations in older aircraft." Another commenter noted, "This is indicative of a long overdue recognition that

better is the enemy of the good, and people need to make these reasonable improvements even if they cannot be of the standard of current regulations for new aircraft. Well done!" A commenter representing an organization wrote that they had reviewed the policy memorandum proposal on retrofit shoulder harness on small airplanes and agree.

Mandatory Harness Requirement

A pilot wrote, "Having actually been in an aircraft crash situation, I feel quite strongly that shoulder harnesses in all aircraft seating positions should be mandatory."

Removing many of the barriers associated with installing retrofit shoulder harnesses will allow owners of older aircraft to have them installed in their aircraft. With the removal of these barriers, it is not necessary to place an additional regulatory burden on aircraft owners. The policy statement does not form a new regulation and the FAA will not apply or rely on it as a regulation.

Acceptable Harnesses for Minor Change Installations

An operator and pilot commented, "Many of the racing industries commonly available four and five point safety harnesses are tested to standards and loads that easily exceed the FAA's 1,500 pound failure limit load. These very affordable harnesses, much less expensive shoulder and lap harnesses could be easily installed with over the counter hardware aviation hardware and would be a highly positive safety enhancement." Similarly, a manufacturer wrote that minor change installations of retrofit shoulder harnesses should include those produced under a Parts Manufacturer Approval (PMA), harnesses that meet military specification requirements, and harnesses that meet Society of Automotive Engineers aircraft restraint system requirements.

We agree that removing many of the barriers associated with the installation of retrofit shoulder harnesses will allow owners of certain small

aircraft to increase the level of safety in their aircraft. We also agree that we should allow minor change installations that use non-TSO-C114 harnesses. However, apart from TSO-C114 harnesses, we will accept only those harnesses that meet the Society of Automotive Engineers Aerospace Standard 8043, harnesses produced under a Parts Manufacturer Approval (PMA) or harnesses that meet aircraft military specification requirements. We have revised the policy statement to include these other harnesses.

Attachments to Unsupported Tubes

The same manufacturer also suggested that:

- FAA allow attachments to unsupported tube elements as minor changes;

- the unsupported tube issue needs more study;

- companion guidance materiel to the retrofit shoulder harness policy statement should address restraint attachment points; and

- FAA develop guidance regarding replacement and maintenance of existing seat belts and shoulder harness installations.

We disagree. The FAA will study this suggestion in further detail but we are unwilling to change existing guidance on methods of attachment. We agree that we should develop companion guidance that addresses the restraint points and replacement and maintenance.

Level of Safety, Attachment Methods, and Material Variability

A second manufacturer wrote concerning the policy that we address:

- appropriate attachment methods in the policy,

- production material variability, and

- improper installation and attachment.

We agree with these comments and address them in the policy statement.

This manufacturer also wants to see the policy address the loading, level of safety, head impact injury criteria, and strength requirements of 14 CFR part 23, § 23.561.

The FAA disagrees. Installation of shoulder harnesses may be accomplished without FAA approval if the installation is a minor change to the airplane design. If the installation is a major change, a Supplemental Type Certificate or Field Approval must be obtained.

For aircraft type certificated before the effective date of Amendment 23-20, the shoulder harnesses need not meet the requirements of 14 CFR § 23.561, and its predecessor regulations, if the installation of the harness is not essential to the operation of the airplane. A shoulder harness installed as a minor change does not have to provide the level of safety required in 14 CFR § 23.561. The head impact injury criteria and strength requirements of the harness, including fitting factors, do not have to be met for minor change installations.

THE POLICY

References

1. Advisory Circular (AC) 21-34, Shoulder Harness — Safety Belt Installations, June 4, 1993.
2. AC 23-4, Static Strength Substantiation of Attachment Points for Occupant Restraint System Installations, June 20, 1986.
3. AC 43.13-2A, Acceptable Methods, Techniques, and Practices — Aircraft Alterations, Revised 1977.
4. Order 8300.10, Airworthiness Inspector's Handbook, Change 12, December 14, 1999, Volume II.
5. Technical Standard Order (TSO)-C114, Torso Restraint Systems, March 27, 1987.
6. Technical Standard Order C-22f, Safety Belts, May 1, 1972.

Discussion

What are the Requirements?

1. Front seat shoulder harnesses required. Section 23.785 of 14 CFR part 23 as amended by Amendment 23-19 effective July 18, 1977, required all normal, utility, and acrobatic category airplanes for which **application for type certificate was made on or after July 18, 1977,** to have an approved shoulder harness for each front seat. Section 91.205(b)(14) requires all small civil airplanes **manufactured after July 18, 1978**, to have an approved shoulder harness for each front seat. The shoulder harness must be designed to protect the occupant from serious head injury when the occupant experiences the ultimate inertia forces specified in § 23.561(b)(2). The inertia force requirements are discussed in paragraph 3 below.

2. Shoulder harnesses required at all seats. Section 91.205(b)(16) requires all normal, utility, and acrobatic category airplanes with a seating configuration of 9 or less, excluding pilot seats, **manufactured after December 12, 1986**, to have a shoulder harness, for forward-facing and aft-facing seats, that meets the requirements of § 23.785(g) [which requires that the occupant be protected from the ultimate inertia forces specified in § 23.561(b)(2)]. Section 23.785(g) also provides: "For other seat orientations, the seat and restraint means must be designed to provide a level of occupant protection equivalent to that provided for forward and aft-facing seats with safety belts and shoulder harnesses installed." The above part 91 operating rule stems from § 23.2, Special retroactive requirements, Amendment 23-32, effective December 12, 1985.

3. Belts or harnesses provided for in the design. Civil Air Regulation (CAR) 3.386 and part 23, § 23.561, Amendments 23-0 through 23-34, effective February 17, 1987, require occupant protection from serious injury during a minor

crash landing when "proper use is made of belts or harnesses provided for in the design," when the occupants are subjected to the following ultimate inertia forces:

	Normal & Utility Category	Acrobatic Category
Forward	9.0g	9.0g
Sideward	1.5g	1.5g
Upward	3.0g	4.5g

With Amendment 23-36, effective September 14, 1988, the text of § 23.561 quoted above was changed to read: "proper use is made of seats, safety belts, and shoulder harnesses provided for in the design." Section 23.785(b) was also changed to read:

"Each forward-facing or aft-facing seat/restraint system in normal, utility, or acrobatic category airplanes must consist of a seat, safety belt, and shoulder harness that are designed to provide the occupant protection provisions required in § 23.562 of this part. Other seat orientations must provide the same level of occupant protection as a forward-facing or aft-facing seat with a safety belt and shoulder harness, and provide the protection provisions of § 23.562 of this part."

The emergency landing ultimate inertia load factors have remained unchanged from Amendment 23-36 through Amendment 23-52, effective April 30, 1998. Amendment 23-52 is the latest amendment level to part 23.

For inertia force requirements for occupant protection preceding CAR 3, refer to Table 1 in AC 21-34 which lists the requirements for the regulations dating from Bulletin 7-A to the original part 23.

What are the methods of approval for retrofit shoulder harness installations?

1. Supplemental Type Certificate (STC). An STC is the most desirable and most rigorous approval. The STC offers the highest assurance that all of the

airworthiness regulations have been met. The STC approvals are issued by the FAA Aircraft Certification Offices (ACO's). STC approvals are usually obtained by a shoulder harness installation kit supplier for multiple airplane installations in an airplane model or model series.

AC's 21-34 and 23-4 (References 1 and 2) provide guidance and acceptable means of compliance for shoulder harness and seat belt installations. AC 23-4 specifically addresses part 23 installations. These AC's are also applicable to installations in airplanes having a certification basis of predecessor regulations (for example, CAR 3).

An applicant for an STC may use a salvaged airplane fuselage to substantiate the strength of the fuselage and the shoulder harness attachment fittings by structural tests, since the shoulder harness attachment structural test may damage an airworthy fuselage. It may be a problem that the available test airframe may be stronger than the lowest strength production airframe. This may be a problem in steel tube airframes.

During many years of producing such airframes, various specification materials may have been used. For example, many CAR 3 (and predecessor regulations) airplanes were originally produced from 1025 steel tubing and later constructed from higher strength 4130 steel. In one case studied, two different specification 1025 steel tubings were used which may have an ultimate tensile strength (UTS) ranging from 55,000 to 79,000 pounds per square inch (psi). The UTS of 4130 steel is 90,000 to 95,000 psi.

The test article should be representative of the lowest strength production airframe. This may be accomplished by a conformity inspection using the production drawings. The strength of materials of parts affected by the modification needs to be verified by the airframe manufacturer's process and production records. The serial number of the test article needs to be verified.

An alternative course of action would be to determine, by appropriate tests (for example, chemical analysis, hardness tests, strength tests), the strength of the parts of the test article affected by the modification. Follow with testing to a conservatively higher load that accounts for the difference in strengths of the test article and the lowest strength production article. Determination of the higher applied test load should take into account any uncertainty in the test(s) used to determine the strength of the material.

Another alternate course of action may be to conduct the harness pull test on the available test airframe. The applicant may then substantiate the strength of other tubing specifications by a combination of test results and analysis.

AC 23-4 provides an acceptable means of compliance for static strength substantiation of attachment points for occupant restraint system installations. A test block is described to apply the 9.0-g forward inertia load. The safety belt installation alone is tested to 100 percent of the load. The shoulder and safety belt combined load is distributed 40 percent to the shoulder harness and 60 percent to the seat belt.

In airplanes having side-by-side seats, the pull test may need to be applied simultaneously to the harness fittings for both seats. However, this depends on the type of harness and where the upper ends are anchored. Normally, this would not be necessary for a single diagonal belt shoulder harness attached to the outboard fuselage side or wing spar root end.

In the case of a pull test for a retrofit shoulder harness installation in the tandem seated tubular steel PA-18 fuselage, the forward inertia load was applied simultaneously for both harnesses. This was done for convenience in applying and reacting the loads. It was found, that due to the tube geometry, the load at the aft harness attachment caused a tension in the rear spar carrythrough tube. The front seat shoulder harness upper end was attached to the rear spar carrythrough

tube. This enabled the front seat harness attachment to test to a higher load than if the pull test was done to each harness individually. In such a case, the test loads for each harness should be done individually.

Part 21, § 21.50(b) requires the holder of an STC to furnish Instructions for Continued Airworthiness, prepared in accordance with § 23.1529.

An STC can not be used to modify an aircraft without the permission of the STC holder. FAA Notice 8110.69 dated June 30, 1997, requires the STC holder to provide the customer (installer or airplane owner) with a signed permission statement that includes the following:

- product (aircraft, engine, propeller, or appliance) to be altered, including serial number of the product;
- the STC number; and
- the person(s) who is being given consent to use the STC.

The permission statement needs to be kept as part of the aircraft records. The requirement for this permission statement originated in the Federal Aviation Authorization Act of 1996 (Public Law 104-264). This provision was put into law to try to stop the pirating of STC's.

2. Field Approval. A shoulder harness installation in a small airplane may receive a Field Approval (FAA Form 337) granted by a Flight Standards Aviation Safety Inspector. Field Approvals are appropriate for alterations that involve little or no engineering. If the installation requires structural modifications, an Aircraft Certification Office will need to assist in the Field Approval process by approving the structural aspects of the installation. A Field Approval constitutes a change to type design and must meet the same regulatory requirements as an STC.

AC 43.13-2A (Reference 3) contains methods, techniques, and practices acceptable to the Administrator for use in altering civil aircraft. Chapter 9 covers shoulder harness installations. Section 3 covers attachment methods. Shoulder

harnesses installed under Field Approval must meet the same regulatory requirements as an STC. Therefore, the applicant should demonstrate by test 9.0-g forward load capability. The test load should be 814 pounds for Normal Category or 910 pounds for Utility or Acrobatic Category, in accordance with AC 23-4.

Reference 4, Chapter 1, Perform Field Approval of Major Repairs and Major Alterations, Section 1, paragraph 5. D(2) states: "Acceptable data that may be used on an individual basis to obtain approval are:

- AC's 43.13-1A and 43.13-2A, as amended*
- Manufacturer's technical information (for example, manuals, bulletins, kits, and so on)
- FAA Field Approvals"

* Note: Advisory Circular (AC) 43.13-1B, dated September 8, 1998 superseded AC 43.13-1A.

When using a previous Field Approval as acceptable data, the pull test need not be done if it can be determined that a previous pull test applied 814 pounds for Normal Category or 910 pounds for Utility or Acrobatic Category. Field Approvals for shoulder harness installations should not be done by referencing a previous Field Approval and deleting the pull test, unless the attachment parts have a Parts Manufacturer Approval (PMA), or other FAA approval. If the attachment parts have no FAA approval, the strength is not known or assured, since they have not been manufactured to an FAA approved quality control system.

Shoulder harness installations attaching to the center of an unsupported wing carrythrough tube, or other unsupported member, should not receive a Field Approval without a design approval from an Aircraft Certification Office. Applying the test load in such cases may cause damage or permanent set to the affected structure.

Existing FAA guidance, including AC 43.13-2A and AC 21-34, recommend against attachment to the center of unsupported members. Figure 9-16 in AC 43.13-2A shows typical shoulder harness attachments to tubular members. These are all at tube intersections and not at the center of unsupported tubes.

Figure 9-12 shows a typical wing carrythrough member installation. This appears to be in the center of the carrythrough member that is a hat section as found in metal skinned airplanes. Part of the figure shows that the hat section is riveted to sheet metal skin (which would provide longitudinal support).

Personnel performing the Field Approval must ensure that both the harness and belt are compatible and have a TSO approval.

Flight Standards Information Bulletin for Airworthiness (FSAW) 98-03, dated January 30, 1998, (Reference 4) requires that a Field Approval include Instructions for Continued Airworthiness prepared (in the case of part 23 airplanes) under § 23.1529. The Instructions will be documented on FAA Form 337, and become a part of either the inspection or maintenance program of the aircraft, or both.

3. Minor change. Part 21, § 21.93(a), Classification of changes in type design, states: "A minor change is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product."

Information provided to us by the Anchorage ACO indicates that some shoulder harness installations, that provide known safety improvements, have been approved as a minor change. In these situations, the FAA certificated mechanic who installs it makes an entry in the maintenance log of the airplane.

One shoulder harness installation kit supplier uses this process (no FAA approvals) to install shoulder harnesses in PA-18 airplanes. The installation does

not require modification of the airframe. The front seat harness attaches to the center of the rear wing spar carrythrough tube. However, it may not meet the 9.0-g forward inertia load required by CAR 3.386. The kit supplier stated that some airplane owners who had accidents reported that the harness installation had saved their lives.

In general, shoulder harness installations should not use the center of an unsupported wing carrythrough tube or other unsupported member as an attachment point. This type of attachment may pose a risk to the structural integrity of the airplane. Although the attachment may be a clamp-on fitting that does not alter the existing airframe, the installation may result in a major change in the type design. This is because the shoulder harness attachment may introduce new loading conditions into the carrythrough tube.

It is acceptable for the carrythrough structure to be damaged in an emergency landing. However, it is unacceptable for the tube to fail in-flight. Carrythrough tubes, highly loaded in compression, may experience a beam-column buckling failure if the occupant applies a load to the shoulder harness attachment. In some cases, very small loads on the shoulder harness attachment may cause beam-column buckling failures.

Some shoulder harnesses that have been installed by minor change do not have a TSO approval. TSO-C114, Torso Restraint Systems, was issued March 27, 1987. Torso restraint systems manufactured before that date did not have to meet the prescribed Society of Automotive Engineers standard, Aerospace Standard 8043, Aircraft Torso Restraint System, dated March 1986. AC 43.13-2A and AC 21-34 provide guidance for acceptable harnesses. Acceptable harnesses for minor change installations include:

- harnesses that meet TSO-C114 or Military Specification (MIL-SPEC) requirements,

- harnesses that have been produced under a Parts Manufacturer Approval (PMA), or

- other harnesses appropriate to the certification basis of the aircraft.

We have studied the circumstances and legality of shoulder harness installations done by minor change. An airplane owner may wish to install shoulder harnesses, but an STC or prior Field Approval is not available for his airplane. In this case, it is not likely that an individual airplane owner would apply for an STC or a Field Approval. This is because of the costs involved in hiring an engineering consultant to perform the structural test and any associated structural analysis. Also, there is a possibility that the airframe may be damaged during the pull test. In such installations, a pull test would not be done and there is no assurance that the installation will provide occupant protection to the ultimate inertia force requirements (particularly the 9.0-g forward force) of § 23.561 or CAR 3.386.

Concerning the legality of shoulder harness installation by minor change, we conclude: Since CAR 3.386 and § 23.561(b)(1) before Amendment 23-36 (which became effective September 14, 1988) state that "proper use is made of belts or harnesses provided in the design," the previously approved seat belt installation alone must meet the prescribed ultimate inertia forces.

Civil Air Regulation 3.652, Functional and installational requirements, states: "Each item of equipment which is **essential to the safe operation of the airplane** shall be found by the Administrator to perform adequately the functions for which it is to be used, shall function properly when installed, and shall be adequately labeled as to its identification, function, operational limitations, or any combination of these, whichever is applicable."

Before Amendment 23-20 (which became effective September 1, 1977), § 23.1301 contained essentially the same requirement as CAR 3.652. Amendment

23-20 deleted the words “essential to safe operation” and made the provisions of § 23.1301 applicable to “each item of installed equipment.”

Regarding these rules we conclude that if a shoulder harness is not required equipment, it is not essential to the safe operation of the airplane. Therefore, CAR 3.652 and § 23.1301, before Amendment 23-20, should not be used as a basis to prohibit shoulder harness installation by minor change. These rules should be applied to shoulder harness installations made by STC and Field Approval.

The mechanic making such installations should consult AC 43.13-2A, Chapter 9, for information on restraint systems, effective restraint angles, attachment methods, and other details of installation.

Issued in Kansas City, Missouri, on September 19, 2000

s/

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