



U.S. Department  
of Transportation

**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave., S.W.  
Washington, D.C. 20591

December 20, 2013

The Honorable John D. Rockefeller, IV  
Chairman, Committee on Commerce,  
Science, and Transportation  
United States Senate  
Washington, DC 20510

Dear Mr. Chairman:

Enclosed is the Federal Aviation Administration's (FAA) report as requested in Section 347 of Public Law 112-95, the FAA Modernization and Reform Act of 2012.

The Act tasked the FAA with determining, within 90 days, if the Emergency Locator Transmitter (ELT) mounting requirements and retention tests specified by Technical Standard Orders (TSO) C91a, C126, and C126a provided adequate retention of ELT designs while in service. Based on this determination, the Act requires the FAA to make any necessary revisions to the requirements to ensure that ELTs are properly retained in the event of an aircraft accident. The enclosed report documents our findings and includes a copy of the revised TSO-C126b.

We have sent identical letters to Chairman Shuster, Senator Thune, and Congressman Rahall.

Sincerely,

A handwritten signature in black ink, appearing to read 'Michael P. Huerta', with a large circular flourish at the end.

Michael P. Huerta  
Administrator

Enclosure



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December 20, 2013

The Honorable Bill Shuster  
Chairman, House Transportation and  
Infrastructure Committee  
House of Representatives  
Washington, DC 20515

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December 20, 2013

The Honorable John Thune  
Committee on Commerce,  
Science, and Transportation  
United States Senate  
Washington, DC 20510

Dear Senator Thune:

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We have sent identical letters to Chairmen Rockefeller and Shuster and Congressman Rahall.

Sincerely,



Michael P. Huerta  
Administrator

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of Transportation

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Office of the Administrator

800 Independence Ave., S.W.  
Washington, D.C. 20591

December 20, 2013

The Honorable Nick J. Rahall, II  
House Committee on Transportation  
and Infrastructure  
House of Representatives  
Washington, DC 20515

Dear Congressman Rahall:

Enclosed is the Federal Aviation Administration's (FAA) report as requested in Section 347 of Public Law 112-95, the FAA Modernization and Reform Act of 2012.

The Act tasked the FAA with determining, within 90 days, if the Emergency Locator Transmitter (ELT) mounting requirements and retention tests specified by Technical Standard Orders (TSO) C91a, C126, and C126a provided adequate retention of ELT designs while in service. Based on this determination, the Act requires the FAA to make any necessary revisions to the requirements to ensure that ELTs are properly retained in the event of an aircraft accident. The enclosed report documents our findings and includes a copy of the revised TSO-C126b.

We have sent identical letters to Chairmen Rockefeller and Shuster and Senator Thune.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael P. Huerta", with a circled number "1" at the end.

Michael P. Huerta  
Administrator

Enclosure



**Federal Aviation  
Administration**

**EMERGENCY LOCATOR TRANSMITTERS ON GENERAL  
AVIATION AIRCRAFT**  
Mounting and Retention

**Public Law 112-95 Section 347b**

**December 2012**

## **Executive Summary**

This report responds to Section 347(b) of the FAA Modernization and Reform Act of 2012 to determine if the Emergency Locator Transmitter (ELT) mounting requirements and retention tests specified by Technical Standard Orders (TSO) C91a and C126 were adequate to assess retention capabilities in ELT designs. Based on this determination, the Act requires the Administrator to make any necessary revisions to the requirements and retention test to ensure that ELTs are properly retained in the event of an aircraft accident. The Act also requires the Federal Aviation Administration (FAA), upon completion of any revisions under subsection 347(b)(2), to submit a report on the implementation of this section to the Committee on Transportation and Infrastructure of the House of Representatives and to the Committee on Commerce, Science and Transportation of the Senate. FAA performance requirements for ELTs in use today are found in TSO-C91, TSO-C91a, TSO-C126, and TSO-C126a. The FAA evaluated the mounting requirements and tests in these TSOs and determined they did not adequately address retention capability in ELT designs. The FAA updated the design criteria to clarify use of hook and loop fasteners was not an acceptable means of attachment by publishing TSO-C126b on November 26, 2012.

## Introduction

In several recent accidents, ELTs mounted with hook and loop fasteners, commonly referred to as Velcro®, became detached from their mounting trays. The separation of the ELT from its mount caused the antenna connection to sever, rendering the ELT ineffective and severely impacting the performance of the article.

ELTs in use today typically have a technical standard order authorization (TSOA) for TSO-C91a, TSO-C126, or TSO-C126a and are incorporated into the type design of the aircraft in accordance with Title 14 Code of Federal Regulations (14 CFR) part 21 or installed as an alteration to the aircraft in accordance with 14 CFR part 43. The retention characteristics of the hook and loop style fastener may degrade over time due to wear and environmental degradation from vibration, temperature, or contamination.

The FAA Modernization and Reform Act of 2012 directed that Federal Aviation Administration (FAA) assess retention capabilities in ELT designs and make any necessary revisions to the requirements and retention test to ensure that ELTs are properly retained in the event of an aircraft accident, as indicated below:

### **SEC. 347. EMERGENCY LOCATOR TRANSMITTERS ON GENERAL AVIATION AIRCRAFT.**

(a) INSPECTION.—As part of the annual inspection of general aviation aircraft, the Administrator of the Federal Aviation Administration shall require a detailed inspection of each emergency locator transmitter (in this section referred to as an “ELT”) installed in general aviation aircraft operating in the United States to ensure that the ELT is mounted and retained in accordance with the manufacturer’s specifications.

(b) MOUNTING AND RETENTION.—

(1) IN GENERAL.—Not later than 90 days after the date of enactment of this Act, the Administrator shall determine if the ELT mounting requirements and retention tests specified by Technical Standard Orders C91a and C126 are adequate to assess retention capabilities in ELT designs.

(2) REVISION.—Based on the determination under paragraph (1), the Administrator shall make any necessary revisions to the requirements and retention tests referred to in paragraph (1) to ensure that ELTs are properly retained in the event of an aircraft accident.

(c) REPORT.—Upon the completion of any revisions under subsection (b)(2), the Administrator shall submit a report on the implementation of this section to—

- (1) the Committee on Commerce, Science, and Transportation of the Senate; and
- (2) the Committee on Transportation and Infrastructure of the House of Representatives.

## Actions

The FAA evaluated the mounting requirements and retention tests specified in TSO-C91a, TSO-C126 and TSO-C126a. These TSOs specifically address ELT mounting and require the mounting design to meet certain specifications. However, they do not

require or preclude any specific type of retention mechanism. Based upon its evaluation, the FAA determined that the standards contained in these TSOs did not adequately address the use of hook and loop fasteners. While these types of fasteners can meet the TSO requirements for retention forces in laboratory conditions, accident investigations<sup>1</sup> have found these fasteners are not reliable in service. For these reasons, the FAA took the following actions:

In accordance with Section 347(b)(1), on May 15, 2012, the Administrator made a determination and found the ELT mounting requirements and retention tests specified in TSO-C91a and TSO-C126 were not adequate.

Federal Register Notice (FR Doc. 2012-17115, 77 Fed. Reg. 41473) was published on July 13, 2012, announcing the availability and inviting public comment to TSO-C126b. The FAA received 20 comments; approximately 15 were technical and 5 were administrative. These comments were considered and posted alongside TSO-C126b on the FAA's Regulatory and Guidance Library.

The FAA issued TSO-C126b on November 26, 2012, updating the design criteria, and is attached.<sup>2</sup>

## **Conclusion**

Based on the evaluation of the mounting requirements and retention test, the FAA issued TSO-C126b, *406 MHz Emergency Locator Transmitters*, on November 26, 2012. The purpose of the TSO revision is to preclude the use of hook and loop fasteners as a means of securing an ELT in its mounting tray for future ELT designs. TSO-C91a was cancelled for unrelated reasons, so no further action is needed to preclude new approvals using hook and loop fasteners for 121.5 MHz ELT designs.

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<sup>1</sup> This refers to both the National Transportation Safety Board (NTSB) recommendation A-10-170, and FAA safety recommendation 10.178.

<sup>2</sup> The new TSOs are published in the FAA Regulations and Guidance Library (RGL), not the Federal Register.



Department of Transportation  
**Federal Aviation Administration**  
Aircraft Certification Service  
Washington, D.C.

**TSO-C126b**

Effective  
Date: 11/26/12

# Technical Standard Order

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**Subject: 406 MHz Emergency Locator Transmitter (ELT)**

- 1. PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your 406 MHz ELT must first meet for approval and identification with the applicable TSO marking.
- 2. APPLICABILITY.** This TSO affects new applications submitted after its effective date.

  - a.** All prior revisions to this TSO are no longer effective. Generally, we will not accept applications for the previous revision after the effective date of this TSO. We may do so, however, up to six months after it, if we know that you were working against the prior MPS before the new change became effective.
  - b.** 406 MHz ELTs approved under a previous TSOA may still be manufactured under the provisions of its original approval.
- 3. REQUIREMENTS.** New models of 406 MHz ELTs identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in RTCA Inc. document, RTCA/DO-204A, *Minimum Operational Performance Standards (MOPS) for 406 MHz Emergency Locator Transmitters (ELTs)*, dated December 6, 2007, sections 2.2 and 2.4. The 406 MHz ELT must include a 121.5 MHz homing beacon. We also require that you obtain a Cospas-Sarsat type approval certificate before applying for this TSO. Additionally, the use of hook and loop fasteners is not an acceptable means of attachment in complying with the Crash Safety requirements of section 2.2.5 of RTCA/DO-204A for automatic fixed (AF) and automatic portable (AP) ELTs.

  - a. Functionality.** This TSO's standards apply to equipment intended to locate aircraft that terminate flight as a result of an accident.
  - b. Failure Condition Classifications.**

    - (1) Failure of the function defined in paragraph **3.a** resulting in signal outputs not meeting the requirements in paragraph **3** is a minor failure condition.

- (2) Loss of the function defined in paragraph **3.a** is a minor failure condition.
- (3) Design the system to at least these failure condition classifications.

**c. Functional Qualification.** Demonstrate the required functional performance under the test conditions specified in RTCA/DO-204A, Section 2.6. The shock and crash safety tests in RTCA/DO-204A sections 2.3.4.1 and 2.6.3.2 require testing coincident with each orthogonal axes individually. Additionally, to better simulate more realistic aircraft crash scenarios, we recommend shock and crash safety testing be accomplished with simultaneous longitudinal and vertical cross-axis forces.

**d. Environmental Qualification.** Demonstrate the required performance under the test conditions specified in RTCA/DO-204A, sections 2.3 and 2.5 using standard environmental conditions and test procedures appropriate for airborne equipment. RTCA/DO-204A requires the use of RTCA/DO-160E; however, you may use a different standard environmental condition and test procedure than RTCA/DO-160E, provided the standard is appropriate for the 406 MHz ELT.

**Note:** The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.g** of this TSO.

**e. Software Qualification.** If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 to at least the software level consistent with the failure condition classification defined in paragraph **3.b** of this TSO.

**Note:** The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

**f. Batteries.** ELT manufacturers must specify half-life and battery replacement intervals. See also Appendix **1** of this TSO.

**g. Deviations.** We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

#### **4. MARKING.**

**a.** Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number.

**b.** Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

- (1) Each component that is easily removable (without hand tools); and,
- (2) Each subassembly of the article that you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. You may use electronic part marking to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

**5. APPLICATION DATA REQUIREMENTS.** You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph 5.f) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the 406 MHz ELT, when installed according to the installation or operational procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statements:

“This article meets the minimum performance and quality control standards required by a technical standard order (TSO).  
Installation of this article requires separate approval.”

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

- (a) Software part number including revision and design assurance level;
- (b) Airborne electronic hardware part number including revision and design assurance level; and,
- (c) Functional description.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the 406 MHz ELT.

(7) List of replaceable components, by part number, that makes up the 406 MHz ELT. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of 406 MHz ELT. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. A drawing depicting how the article will be marked with the information required by paragraph 4 of this TSO.

e. Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph 3.

(2) Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph 5.e.(1).

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph 5.e.(1).

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph 5.e.(1).

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph 5.e.(1).

f. The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved

design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

**g.** Material and process specifications list.

**h.** List of all drawings and processes (including revision level) that define the article's design.

**i.** Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

**j.** Cospas-Sarsat type approval certificate.

**6. MANUFACTURER DATA REQUIREMENTS.** Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

**a.** Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

**b.** Article calibration procedures.

**c.** Schematic drawings.

**d.** Wiring diagrams.

**e.** Material and process specifications.

**f.** The results of the environmental qualification tests conducted according to paragraph **3.d** of this TSO.

**g.** If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in RTCA/DO-178B *Annex A, Process Objectives and Outputs by Software Level.*

**h.** If the article contains non-TSO function(s), you must also make available items **6.a** through **6.g** as they pertain to the non-TSO function(s).

**7. FURNISHED DATA REQUIREMENTS.**

**a.** If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the 406 MHz ELT.

**b.** If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.e.(1)** through **5.e.(4)**.

**8. HOW TO GET REFERENCED DOCUMENTS.**

**a.** Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at [www.rtca.org](http://www.rtca.org).

**b.** Order copies of 14 CFR parts 21 and 45 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at [www.access.gpo.gov](http://www.access.gpo.gov). Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

**c.** You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov/>. You will also find the TSO Index of Articles at the same site.



Susan J. M. Cabler  
Assistant Manager, Aircraft Engineering  
Division

### **Appendix 1. Battery Standards Requirements**

**1.** The battery used in the 406 MHz ELT authorized under this TSO must be appropriate for the intended operational environment, not pose a hazard to the aircraft, meet the requirements of acceptable battery standards and be approved by the Administrator.

**a.** If you use nickel-cadmium or lead acid batteries, the battery must comply with TSO-C173, *Nickel-Cadmium and Lead-Acid Batteries*.

**b.** If you use rechargeable lithium cells and lithium batteries, the battery must comply with TSO-C179a, *Permanently Installed Rechargeable Lithium Cells, Batteries and Battery Systems*.

**c.** If you use non-rechargeable lithium cells and batteries, the battery must comply with TSO-C142a, *Non-Rechargeable Lithium Cells and Batteries*, for guidance.

**d.** If you use a battery with a different chemistry, use an appropriate battery standard and identify that standard in your TSOA application or in a notification of a change in design.

**2.** See RTCA/DO-188, *Emergency Locator Transmitter (ELT) Batteries Guidance and Recommendations*, for guidance and recommendations to solve ELT battery problems.