



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

**TSO-C151d**

Effective  
Date: 8/31/17

# Technical Standard Order

---

**Subject: Terrain Awareness and Warning Systems (TAWS)**

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 TAWS 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. TSO-C151c will also remain effective until February 28, 2019. After this date, we will no longer accept applications for TSO-C151c.

b. TAWS approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. **REQUIREMENTS.** New models of TAWS identified and manufactured on or after the effective date of this TSO must meet the requirements in RTCA/DO-367, *Minimum Operational Performance Standard (MOPS) for Terrain Awareness and Warning Systems (TAWS) Airborne Equipment*, Section 2. Requirements for Class A, Class B, and Class C equipment are discussed in sections 2.2.1, 2.2.2 and 2.2.3, respectively. This equipment is intended for fixed-wing aircraft only.

a. **Functionality.** This TSO's standards apply to equipment intended to provide flight crews with aural and visual alerts aimed at reducing the risk of CFIT accidents through increased terrain awareness. Class A systems include Terrain Displays intended to provide awareness to the flight crew of the aircraft's proximity to terrain.

b. **Failure Condition Classifications.**

(1) For Class A and B systems, failure of the function defined in paragraph 3.a due to a TAWS computer malfunction resulting in false terrain warnings, un-announced loss of function, or presentation of misleading information is a major failure condition.

(2) For Class C systems, failure of the function defined in paragraph 3.a due to a TAWS computer malfunction resulting in false terrain warnings, un-annunciated loss of function, or presentation of misleading information is a minor failure condition.

(3) Loss of the function defined in paragraph 3.a is a minor failure condition.

(4) 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-367, section 2.4. Test procedures for Class A, Class B, and Class C equipment are in sections 2.4.10, 2.4.11, and 2.4.12, respectively.

d. **Environmental Qualification.** Demonstrate the required performance under the test conditions specified in RTCA/DO-367, section 2.3 using standard environmental conditions and test procedures appropriate for airborne equipment. You may use a different standard environmental condition and test procedure than RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, provided the standard is appropriate for the TAWS.

**Note:** The use of RTCA/DO-160D (with Changes 1 and 2 only, without Change 3 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-178C, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 13, 2011, including referenced supplements as applicable, to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this TSO. You may also develop the software according to RTCA, Inc. Document RTCA/DO-178B, dated December 1, 1992 if you follow the guidance in AC 20-115C, *Airborne Software Assurance*, dated July 19, 2013, or latest revision.

f. **Electronic Hardware Qualification.** If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. Document RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, to at least the design assurance level consistent with the failure condition classification defined in paragraph 3.b of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

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 Title 14 of the Code of Federal Regulations (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).

**b.** 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.

**c.** 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.g**) through their civil aviation authority.

**a.** Manuals containing the following:

**(1)** Operating instructions and article limitations sufficient to describe the equipment's operational capability. The operating instructions must include information on the effects of loss of GPS on the TAWS function if the TAWS relies on GPS. Additionally, the instructions must contain processes for updating the terrain database.

**(2)** Detailed description of all deviations.

**(3)** Installation procedures and limitations sufficient to ensure that the TAWS, 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 also include a note with the following statement:

“This article meets the minimum requirements of TSO-C151d. 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 TAWS.

(7) By-part-number list of replaceable components that makes up the TAWS. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, to ensure that the TAWS continues to meet the TSO approved design. 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. If the article includes simple or complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

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

f. Identify functionality 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) do not 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.f.(1).

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

(4) Interface requirements and applicable installation test procedures to ensure compliance with the non-TSO function(s) performance data defined in paragraph **5.f.(1)**.

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

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

**g.** The quality manual 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. Applicants who currently hold TSOAs must submit revisions to the existing quality manual as necessary (not required for LODA applicants).

**h.** A description of your organization as required by 14 CFR § 21.605.

**i.** Materials and process specifications list.

**j.** A list of all drawings and processes (including revision level) that define the article's design.

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

**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 or RTCA/DO-178C specified in paragraph **3.e** of this TSO, including all data supporting the applicable objectives in Annex A, *Process Objectives and Outputs by Software Level* of RTCA/DO-178B or RTCA/DO-178C.

**h.** If the article includes complex custom airborne electronic hardware, the appropriate hardware life-cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1. For simple custom airborne electronic hardware, the following data is required: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

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

## **7. FURNISHED DATA REQUIREMENTS.**

**a.** When furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or online 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 TAWS.

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

**c.** If the article contains software, include one copy of the Open Problem Report (OPR) summary to type certification, supplemental type certification, or amended type certification design approval holders.

## **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 SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone: (724) 776-4970, fx: (724) 776-0790. You can also order copies online at [www.sae.org](http://www.sae.org).

**c.** Order copies of parts 21, 45, 91, 121, and 135 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197-9000. Telephone (202) 512-1800, fax (202) 512-2104. You can also order copies online at [www.gpo.gov](http://www.gpo.gov).

d. You can find a current list of TSOs and advisory circulars at <http://rgl.faa.gov/>. You will also find the TSO Index of Articles at the same site.

A handwritten signature in cursive script that reads "Louis R. Volchansky".

Louis R. Volchansky  
Manager, Systems and Equipment Standards Branch  
Aircraft Certification Service