



Technical Standard Order

Subject: TSO-C92c, AIRBORNE GROUND PROXIMITY WARNING EQUIPMENT

a. Applicability.

(1) Minimum performance standard. This technical standard order (TSO) prescribes the minimum performance standard that airborne ground proximity warning system (GPWS) equipment must meet in order to be identified with the marking "TSO-C92c." Airborne GPWS equipment that is to be so identified and manufactured on or after the date of this TSO must meet the minimum performance standards set forth in Section 2.0 of RTCA, Inc. (RTCA) Document No. DO-161A, "Minimum Performance Standards for Airborne Ground Proximity Warning Equipment," dated May 27, 1976.

(2) Additions.

(i) Fire Protection. All materials used shall be self-extinguishing except for small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire.

NOTE: One means of showing compliance is contained in Federal Aviation Regulations (FAR), Part 25, Appendix F.

(ii) Aural and Visual Warnings. The required aural and visual warnings must initiate simultaneously. Each aural warning shall identify the reason for the warning such as "terrain," "too low," "glide slope," or other acceptable annunciation.

(iii) Deactivation Control. If the equipment incorporates a deactivation control other than a circuit breaker, the control must be a switch with a protective cover. The cover must be safety wired so that the wire must be broken in order to gain access to the switch. A frangible lock or similar device may also be used to perform this function.

(iv) Mode 4 Flap Warning Inhibition. A separate guarded control may be provided to inhibit Mode 4 warnings based on flaps being in other than the landing configuration.

(v) Speed shall be included in the logic that determines GPWS warning time for Modes 2 and 4 to allow additional time for the aircrew to react and take corrective action.

(vi) Smart Callouts. Smart callouts of altitude above the terrain shall be provided during nonprecision approaches. These advisories are normally, but are not limited to 500 feet above the terrain or the height above airport (HAA) used in the terminal (approach) procedures.

(3) Exceptions.

(i) An alternate means, with demonstrated equal or better accuracy, may be used in lieu of barometric altitude rate (accuracy specified in TSO-C10b, Altimeter, Pressure Actuated, Sensitive Type, or later revisions) and/or radio altimeter altitude (accuracy specified in TSO-C67, Airborne Radar Altimeter Equipment - For Air Carrier Aircraft, or later revisions) to meet the warning requirements described in RTCA Document No. DO-161A.

(ii) In RTCA Document No. DO-161A, paragraph 2.3, the complete cycle of two tone sweeps plus annunciation is extended from "1.4" to "2" seconds.

(4) Environmental Standard. The equipment shall be subject to the test conditions as specified in RTCA Document No. DO-160C, "Environmental Conditions and Test Procedures for Airborne Equipment" dated December 4, 1989, and changes.

(5) Computer Software. If the equipment design includes a digital computer, the software must be developed in accordance with RTCA Document No. DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," dated December 1, 1992. In accordance with RTCA/DO-178B, Paragraph 9.3, the applicant must submit the following documents to the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), having purview of the manufacturer's facilities, for review and approval.

Plan for Software Aspects of Certification (PSAC)

Software Configuration Index

Software Accomplishment Summary

All data supporting the applicable objectives found in Annex A, Process Objectives and Outputs by Software Level, must be available for review. For software developed prior to the availability of RTCA/DO-178B, Section 12.1.4 provides a method for upgrading a baseline for software development so that changes can be made in accordance with the criteria contained in RTCA/DO-178B.

NOTE 1: The FAA recommends that the PSAC be submitted early in the software development process. Early submittal will allow the applicant to resolve issues with the Software Aspects of Certification Plan, such as partitioning and determination of software levels.

NOTE 2: The applicant should substantiate software levels in the safety assessment process outlined in RTCA/DO-178B. If the equipment incorporates more than one software levels, appropriate partitioning of different software levels is required.

b. Marking.

(1) In addition to the marking specified in Federal Regulations (FAR) Section 21.607, each separate component of equipment that is manufactured under this TSO must be permanently and legibly marked with at least the name of the manufacturer, the TSO number and part number, if the Administrator finds that such marking is necessary in the interest of safety.

(2) The part number shall include the software version and level(s) in accordance with RTCA/DO-178B, and the modification status of the hardware (drawing revision or dash number).

NOTE: If multiple software levels are marked, the installation instructions must clearly identify the software level or each function.

c. Added Features. If the manufacturer elects to add features to the GPWS equipment, those features shall at least meet the same qualification testing and software verification and validation requirements as provided under this TSO. Examples of features that have been added to GPWS equipment are: using bank angle, acceleration, aircraft performance, and/or accurate aircraft positioning coupled with airport location data and terrain data in the logic that initiates a GPWS warning.

NOTE: This TSO does not contain a performance standard for the display of terrain information.

d. Data Requirements.

(1) The following data are required by 14 CFR Section 21.605. The manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration, having purview of the manufacturer's facilities, one copy each of the following technical data:

- (i) Operating instructions.
- (ii) Equipment limitations.
- (iii) Installation procedures and limitations.
- (iv) Schematic drawings as applicable to the installation procedures.
- (v) Wiring diagrams as applicable to the installation procedures.

(vi) Specifications.

(vii) List of the major components (by part number) that make up the equipment complying with the standards prescribed in this TSO.

(viii) An environmental qualification form as described in RTCA Document DO-160C.

(ix) Manufacturer's TSO qualification test report.

(x) Nameplate drawings.

(xi) The appropriate documentation as defined in RTCA Document DO-178B.

(2) Each manufacturer must have available for review by the Manager of the ACO having purview of the manufacturer's facilities, the following technical data.

(i) A drawing list, enumerating all the drawings and processes that are necessary to define the article's design.

(ii) The functional test specification to be used to test each production article to ensure compliance with this TSO.

(iii) Equipment calibration procedures.

(iv) Corrective maintenance procedures (within 12 months after TSO authorization).

(v) Schematic drawings.

(vi) Wiring diagrams.

(viii) The results of the environmental qualification tests conducted in accordance with RTCA/DO-160C.

e. Data to be furnished with manufactured units. One copy of the data and information specified in paragraphs (d)(i) through (viii) of this TSO, and instructions for periodic maintenance and calibration which are necessary for continued airworthiness must be sent to each person receiving for use one or more articles manufactured under this TSO. In addition, a note with the following statement must be included:

“The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article on or within a specific type or class of aircraft to determine that the aircraft

installation conditions are within the TSO standards. The article may be installed only if installation of the article is approved by the Administrator.”

f. Availability of Reference Documents.

(1) Copies of RTCA Documents Nos. DO-161A, DO-160C, and DO-178B may be purchased from the RTCA Inc., 1140 Connecticut Avenue, NW., Suite 1020, Washington, DC 20005.

(2) Federal Aviation Regulations Part 21, Subpart O, may be purchased from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325. Advisory Circular 20-110H, “Index of Aviation Technical Standard Orders,” or latest revision may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

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