



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

TSO-C166a

Effective
Date: 12/21/06

Technical Standard Order

Subject: Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers of 1090 MHz ADS-B and TIS-B equipment applying for a TSO authorization or letter of TSO design approval (LODA). In it, we tell you what minimum performance standards (MPS) your 1090 MHz Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service–Broadcast (TIS-B) equipment must first meet for approval and identification with the applicable TSO marking.
2. **APPLICABILITY.** This TSO affects new applications submitted after this TSO’s effective date. 1090 MHz ADS-B and TIS-B equipment approved under a previous TSO authorization may continue to be manufactured under the provisions of their original approval, as specified in Title 14 of the Code of Federal Regulations (14 CFR) § 21.603(b). Major design changes to 1090 MHz ADS-B and TIS-B equipment approved under previous versions of this TSO require a new authorization under this TSO. See 14 CFR § 21.611(b). We will not accept new applications under previous versions of this TSO after the effective date of this TSO.
3. **REQUIREMENTS.** New models of 1090 MHz ADS-B and TIS-B equipment identified and manufactured on or after the effective date of this TSO must meet the MPS set forth in Section 2 of RTCA, Inc. document RTCA/DO-260A, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B), dated April 10, 2003, with the exception of paragraph **3a(3)** below, and as modified by Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006. The 1090 MHz equipment classes applicable to this TSO are defined in RTCA/DO-260A, Section 2.1.11.
 - a. **Functionality.**

(1) The standards of this TSO apply to aircraft equipment intended to transmit and receive broadcast messages about an aircraft’s position (latitude and longitude), velocity, time, integrity, and other parameters. Similarly equipped operators will share these messages with one

another, and ground-based facilities, such as air traffic services. These message parameters form the basis for various ADS-B and TIS-B reports.

(2) This TSO supports two major classes of 1090 MHz ADS-B and TIS-B equipment:
(a) Class A equipment, consisting of transmit and receive subsystems; and (b) Class B equipment, containing a transmit subsystem only.

(a) **Class A equipment** includes Classes A0, A1, A2 and A3. The FAA requires 1090 MHz airborne Class A equipment to include the capability of receiving both ADS-B and TIS-B messages and delivering both ADS-B and TIS-B reports, as well as transmitting ADS-B messages. A Receive-only Class of equipment is allowed as per paragraph **5b**.

(b) **Class B equipment** includes Classes B0 and B1. Classes B0 and B1 are the same as A0 and A1, except they do not have receive subsystems. Note that Classes B2 and B3 are not for aircraft use.

(3) Manufacturers should note that equipment not built to the standards of RTCA/DO-260A, as modified by Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006, may not be compatible with future applications defined in RTCA/DO-289, Minimum Aviation System Performance Standards for Aircraft Surveillance Applications, dated December 9, 2003.

b. Use of ADS-B Reports in Airborne Applications. This TSO addresses only broadcasting messages from transmit subsystems and assembling reports in receiver subsystems. The MPS of this TSO do not address applications that use the information in reports. If you manufacture 1090 MHz ADS-B and TIS-B equipment, you must seek design approval for applications. You can get design approval by complying with an appropriate TSO for the subject application or, during installation approval, through the type certification or supplemental type certification process as the case may be. During the certification process, 1090 MHz ADS-B and TIS-B equipment approved under this TSO may require installation limitations. These limitations should identify those applications requiring validation as part of the installation approval process.

NOTE: For industry-recommended practices on how to display ADS-B and TIS-B information, see guidance in the following documents:

RTCA/DO-243, Guidance for Initial Implementation of Cockpit Display of Traffic Information, dated February 19, 1998;

RTCA/DO-249, Development and Implementation Planning Guide for Automatic Dependent Surveillance Broadcast (ADS-B) Applications, dated October 6, 1999;

RTCA/DO-259, Application Descriptions for Initial Cockpit Display of Traffic Information (CDTI) Applications, dated September 13, 2000; and

SAE International's Aerospace Recommended Practice (ARP) 5365, Human Interface Criteria for Cockpit Display of Traffic Information, dated January 1999.

c. Failure Condition Classification. Failure of the function defined in paragraphs 3 and 3a of this TSO will depend on the equipment's intended use for the ADS-B and TIS-B report information. For the least demanding uses, the failure condition classifications for the different classes of 1090 MHz equipment are as follows:

(1) For Class A0 receiver subsystems, we consider an un-annunciated failure that provides onboard applications with incorrect reports a minor failure condition. A minor failure condition should occur no more than once per 10^3 flight hours.

(2) For all other classes of 1090 MHz ADS-B and TIS-B receiver subsystems, we consider an un-annunciated failure that provides onboard applications with incorrect reports a major failure condition. A major failure condition should occur no more than once per 10^5 flight hours.

(3) For all classes of 1090 MHz ADS-B transmitter subsystems, we consider an un-annunciated failure that broadcasts incorrect ADS-B messages to users a major failure condition. An un-annunciated failure resulting in loss of function is considered minor.

NOTE: The above failure condition classifications are driven by airspace considerations. They are independent of the aircraft on which the equipment is installed.

(4) To meet at least a design assurance level equal to a minor failure condition, you must develop software to RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992, Level D. For a major failure condition, you must develop software to RTCA/DO-178B, Level C.

(5) You may develop equipment to a higher design assurance level in anticipation of more demanding applications. For example, if the 1090 MHz ADS-B equipment broadcast messages that include information about the status of own-ship Traffic Alert and Collision Avoidance System (TCAS), and this information could be used by other aircraft to make decisions about maneuvering, the failure condition classification for erroneous data of this type could be hazardous/severe-major. Therefore, you should include, in the operating instructions and equipment limitations, the hardware and software design assurance levels to which you developed the equipment.

(6) You must also include in the operating instructions and equipment limitations, any assumptions about aircraft installation, software and hardware used in the interface, or procedures required for maintaining the design assurance levels.

d. Functional Qualification. Demonstrate the required performance under the test conditions in RTCA/DO-260A, Section 2.4, Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006.

e. Environmental Qualification. Test the equipment to the conditions in RTCA/DO-160E, Environmental Conditions and Test Procedures for Airborne Equipment, dated December 9, 2004. The means for verifying equipment performance must be consistent with the test procedures specified in RTCA/DO-260A, Section 2.3, Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006.

f. Software Qualification. If the article includes a digital computer, develop the software in accordance with paragraph **3c(4)**.

g. Deviations. We provide for alternative or equivalent means of compliance to the MPS of this TSO. If you invoke these provisions, you must demonstrate that your equipment maintains an equivalent level of safety. Apply for a deviation per Title 14 of the Code of Federal Regulations (14 CFR) § 21.609.

4. MARKING. Per the requirements of 14 CFR § 21.607(d), mark articles manufactured under this TSO as follows:

a. At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR § 21.607(d).

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

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

c. Transmitting and receiving components must be permanently and legibly marked. The following table explains how to mark components. Find the equipment class in RTCA/DO-260A, Section 2.1.11, and the receiving equipment type in RTCA/DO-260A, Section 2.2.6.

<i>If component can:</i>	<i>Mark it with:</i>	<i>Sample marking pattern:</i>
Transmit and receive	Equipment class it supports, and Receiving equipment type	Class A0/Type 1
Transmit, but not receive	Equipment class it supports	Class B1, or Class A3-Transmitting Only
Receive, but not transmit	Equipment class it supports, and Receiving equipment type	Class A2/Type 2-Receiving Only

d. If the component includes a digital computer, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means for showing the modification status.

NOTE: Similar software versions, approved to different software levels, must be differentiated by part number.

e. When applicable, identify the component or equipment as a partial system or that the appliance does anything beyond the functions in paragraphs 3 and 3a of this TSO.

5. APPLICATION DATA REQUIREMENTS. As a TSO manufacturer-applicant, you must give the FAA aircraft certification office (ACO) manager responsible for your facilities a statement of conformance as specified in 14 CFR § 21.605(a)(1), and one copy each of the following technical data to support our design and production approval. (Under 14 CFR § 21.617(a)(2), LODA applicants submit the same data through their civil aviation authority)

a. Operating instructions and equipment limitations in an installation/instruction manual (IM), sufficient to describe the equipment's operational capability. Describe any deviations in detail. If needed, identify equipment by part number, version, revision, and criticality level of software/hardware, classification for use, and environmental categories.

b. Installation procedures and limitations in an IM, sufficient to ensure the 1090 MHz ADS-B and TIS-B equipment, when installed per the installation procedures, continues to meet the requirements of this TSO. The limitations must identify any unique aspects of the installation. For non-transponder-based 1090 MHz ADS-B equipment, manufacturers must include a limitation stating that the equipment cannot be co-installed in aircraft with a Mode-S transponder (see RTCA/DO-260A Section 3.0). The manufacturer may additionally state that other civil aviation authorities may allow these installations. Finally, the limitations also must include a note with the following statement:

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article on, or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

NOTE: If you build Receiving Only class of equipment (see paragraph 4c of this TSO), you must also include the following statement:

Installation of this Receiving Only class of equipment is intended only for those aircraft in which a 1090 MHz ADS-B transmit class of equipment, or other complementary ADS-B link transmit class of equipment (such as UAT), is already installed.

c. Schematic drawings, as applicable to the installation procedures.

- d. Wiring diagrams, as applicable to the installation procedures.
- e. List of components, by part number, that make up the 1090 MHz ADS-B and TIS-B system complying with the standards in this TSO. Include vendor part number cross-references, when applicable.
- f. A component maintenance manual (CMM) covering periodic maintenance, calibration, repair, and continued airworthiness of the installed 1090 MHz ADS-B and TIS-B equipment. Describe the details of deviations granted, as noted in paragraph **5a** of this TSO.
- g. Material and process specifications list.
- h. The quality control system (QCS) description required by 14 CFR § 21.143 and § 21.605(a)(3), including functional test specifications for testing each production article to ensure compliance with this TSO.
- i. Manufacturer's TSO qualification test report on the results of the testing required by paragraph **3d**.
- j. Nameplate drawing giving the information required by paragraph **4** of this TSO.
- k. List of all drawings and processes (including revision level) that define the article's design. For minor changes, follow the requirements of 14 CFR § 21.611(a). Show any revisions to the drawing list only on our request.
- l. An environmental qualification form as described in RTCA/DO-160E, Appendix A, for each component of the system.
- m. If the article includes a digital computer: plan for software aspects of certification (PSAC); software configuration index; and software accomplishment summary. We recommend that you submit the PSAC early in the software development process. Early submittal will allow us to quickly resolve issues, such as partitioning and determination of software levels.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to us, have the following technical data available for review by the responsible ACO or civil aviation authority:

- a. The functional qualification specifications for qualifying each production article to ensure compliance with this TSO.
- b. Equipment calibration procedures.
- c. Corrective maintenance procedures within 12 months after TSO authorization.
- d. Schematic drawings.
- e. Wiring diagrams.

f. Material and process specifications.

g. The results of the environmental qualification tests conducted per RTCA/DO-160E and RTCA/DO-260A, Section 2.3, as appropriate.

h. If the article includes a digital computer, the appropriate documentation as defined in RTCA/DO-178B, including all data supporting the applicable objectives in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

7. FURNISHED DATA REQUIREMENTS. If furnishing one or more articles manufactured under the TSO to one entity (such as an operator or repair station), provide the following:

a. One copy of the data in paragraphs **5a** through **5f** and **5l** of this TSO. Add any other data needed for the proper operation, storage, or continued airworthiness of the 1090 MHz ADS-B and TIS-B equipment.

b. If the data listed in paragraph **5m** is proprietary information, then it may not be required to be released to the user of the TSO article.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order copies of RTCA documents from RTCA, Inc., 1828 L Street, N.W., Suite 805, Washington, D.C. 20036; telephone (202) 833-9339, fax (202) 833-9434. You can also obtain copies through the RTCA Internet website: <http://www.rtca.org>.

b. Order copies of SAE document from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001; telephone (724) 776-4970, fax (724) 776-0790. You can also obtain copies through the SAE Internet website @ www.sae.org.

c. Order copies of 14 CFR parts from the Superintendent of Documents, Government Printing Office, P.O. Box 37154, Pittsburgh PA 15250-7954. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at <http://www.gpoaccess.gov/ecfr/>.

d. You can find a current list of technical standard orders of 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.

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