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

TSO-C212a

Effective
Date: *mm/dd/25*

Technical Standard Order

Subject: ***Air-to-Air Radar (ATAR) for Traffic Surveillance***

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 ATAR equipment 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-C212 will also remain effective until [*insert date 18 months after publication date of TSO-C212a*]. After this date, we will no longer accept applications for TSO-C212.

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

3. REQUIREMENTS.

a. New models of ATAR equipment identified and manufactured on or after the effective date of this TSO must meet the MPS qualification in this TSO and documentation requirements in sections 2.1 and 2.2 of RTCA Document No. RTCA/DO-366B, *Minimum Operational Performance Standards (MOPS) for Air-to-Air Radar (ATAR) for Traffic Surveillance,* dated March 13, 2025. These requirements apply to the radar classes listed in table 1 of this TSO that are incorporated into the ATAR equipment. The different classes for this TSO are defined by the type of Detect and Avoid (DAA) equipment and the speed of the aircraft in which the radar is installed. Table 1 identifies each class, the relevant encounter characteristics, and the ownship performance parameters associated with that radar class.

b. DAA Well Clear (DWC) refers to the DAA En Route Well Clear definition found in section 2.2.4.3.1 of RTCA/DO-365C, Change 1, *MOPS for DAA Systems,* dated March 13, 2025.

c. Non-Cooperative DWC (DWC-NC) refers to well clear definition that applies to non-cooperative intruders.

Note: The MPS in this TSO is intended for equipment to support Class A and Class B of ATAR equipment, as described in RTCA/DO-366B. TSO-C211a provides MPS for different classes of DAA equipment.

Table 1 – ATAR Radar Classes

Radar Class	Ownship Maximum Speed (KTAS[1])	Ownship Minimum Speed (KTAS[1])	DWC Definition	Delay Time[2] (second)	Roll Rate (deg/sec)	Turn Rate (deg/sec)
A1[3]	291	100	DWC-NC	25	5	1.5
A2	200	40	DWC-NC	25	5	3
A3[4]	110	40	DWC-NC	25	5	7
B1[5]	200	40	DWC	25	5	3
B2[5,6]	Customized[7]	Customized[7]	DWC-NC	10[8]	Customized[7]	Customized[7]

Notes:

1. *KTAS refers to Knots True Air Speed.*
2. *Delay time is the period between Radar Declaration Range (when the last known measurement is available) and the point where maneuvering begins.*
3. *Class A1 supports the highest allowed ownship speed below 10,000 feet.*
4. *Class A3, called the Low Size, Weight, and Power (LSWaP) radar, is intended to support SWaP-constrained ownship aircraft operating at lower speeds.*
5. *Class B1 and B2 have additional features to support Airborne Collision Avoidance System (ACAS) Xu collision avoidance functionality.*
6. *Class B2 takes advantage of higher maneuverability and lower delay times that can significantly reduce radar range requirements.*
7. *Class B2 allows for customization of these values based on the airframe performance.*
8. *Delay time for Class B2 radar is normally chosen at 10 seconds, but any choice for this value must be justifiable.*
9. *Table 1 of this TSO takes precedence over RTCA/DO-388B Table 1-2 and Table B-1.*

d. Functionality. This TSO's standards apply to equipment intended to be used in aircraft (uncrewed and crewed) operating under instrument flight rules to detect and generate

tracks for all airborne traffic within the radar detection volume. The on-board radar complements other on-board airborne surveillance sensors by providing detection of non-cooperative traffic (aircraft without surveillance transponders or Automatic Dependent Surveillance-Broadcast Out capability, or not operating such equipment due to malfunction or deliberate action)

e. Failure Condition Classification.

(1) Loss of the function defined in paragraph **3.d** is a *Minor* failure condition.

(2) Failure of the function defined in paragraph **3.d,** resulting in an unannunciated loss of traffic detection and tracking capability or erroneous data output, is a *Major* failure condition.

(3) Develop the system to, at least, the design assurance level applicable to these failure condition classifications.

f. Functional Qualification. Demonstrate the required functional performance under the test conditions specified in section 2.4 of RTCA/DO-366B.

g. Environmental Qualification. Demonstrate the required performance under the test conditions specified in section 2.3 of RTCA/DO-366B, using standard environmental conditions and test procedures appropriate for airborne equipment. You may use a different standard environmental condition and test procedure than that specified in section 2.3 of RTCA/DO-366B, which includes the use of RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment,* dated December 8, 2010, RTCA/DO-185B, MIL-STD-810G and MIL-STD-704, provided the standard selected is appropriate for the ATAR equipment.

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.k** of this TSO.

h. Software Qualification. If the article includes software, develop the software according to 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.e** of this TSO. You may also develop the software according to RTCA/DO-178B, dated December 1, 1992, if you follow the guidance in Advisory Circular (AC) 20-115D, *Airborne Software Development Assurance Using EUROCAE ED-12() and RTCA DO-178()*, dated July 21, 2017.

i. Electronic Hardware Qualification. If the article includes complex custom electronic hardware in either the aircraft or ground control station, develop the component according to RTCA/DO-254*, Design Assurance Guidance for Airborne Electronic Hardware (AEH),* dated April 19, 2000, and AC 20-152A, *Development Assurance for*

Airborne Electronic Hardware, issued October 2022, to at least the design assurance level consistent with the failure condition classification defined in paragraph **3.e** of this TSO. For custom electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies. AEH (as specified in RTCA/DO-254) includes line replaceable units, programmable logic devices, application specific integrated circuits, circuit boards, commercial off-the-shelf components, etc., used in aircraft safety critical functions.

j. Aircraft Systems Information Security Protection. If the article includes connectivity to non-trusted services (e.g., non-governmental) and networks, such as internet, portable electronics devices, and commercial-off-the-shelf technologies that are not certified and accredited for secure operations by a government authority or other trusted service provider, then develop security specific assurance to at least the article or item level consistent with failure condition classification defined in paragraph **3.e** of this TSO. Develop security assurance objectives according to RTCA/DO-356A*, Airworthiness Security Methods and Considerations*, dated June 21, 2018. RTCA/DO-356A Appendix A, Security Assurance Objectives gives guidance for applicants performing security assurance objectives for ITEM level, and security measures for security requirements during the aircraft installation approval process according to RTCA/DO-326B, *Airworthiness Security Process Specification*, dated September 26, 2024. RTCA/DO-326B Table 4-1, Data Submittals for the Security Aspects of Aircraft System Modifications gives airworthiness security process activities guidance.

k. 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). Include all incorporated radar classes and article designator, unless the radar classes and article designator are identified in the installation instructions or by software.

b. If the article includes software or electronic hardware, or both, 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 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 that are specifically designed and used for that article.

5. APPLICATION DATA REQUIREMENTS.

You must give the FAA Aircraft Certification Branch (ACB) 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 are sufficient to describe the equipment's operational capability. Include detailed operating information on each radar class incorporated into the ATAR system, specifically including the design parameters for each incorporated radar class listed in table 1 of this TSO.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the ATAR equipment, 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-C212a.
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, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for the installation of the ATAR equipment.

(7) By-part-number list of replaceable components that make up the ATAR equipment. Include vendor part number cross-references when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, to ensure that the DAA equipment continues to meet the approved TSO design. Include recommended inspection intervals and service life, as appropriate.

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

d. If the article includes simple or complex custom electronic hardware: a plan for hardware aspects of certification, 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 or performance contained in the article not evaluated under paragraph **3** of this TSO (that is, non-TSO functions). Non-TSO functions can be accepted in parallel with the TSOA. 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, analysis, and results, as appropriate, to verify that the 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. If the article has been determined to require aircraft systems information security protection in accordance with paragraph **3.j** of this TSO: a plan for security aspects of certification (PSecAC), a system security scope definition, a system security risk assessment, and PSecAC Summary (or similar document, as applicable).

h. The quality manual required by 14 CFR 21.608, including functional test specifications. The quality system must ensure that you 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).

i. A description of your organization as required by 14 CFR 21.605.

j. Material and process specifications list.

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

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

6. MANUFACTURER DATA REQUIREMENTS.

Besides the data given directly to the responsible certification branch, have the following technical data available for review by ACB:

Note: The following data for a LODA applicant may be made available for review through its civil aviation authority. Refer to the applicable bilateral agreement for specific details regarding access to this data.

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.g** of this TSO.

g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B or RTCA/DO-178C as specified in paragraph **3.h** of this TSO, including all data supporting the applicable objectives in RTCA/DO-178B or RTCA/DO-178C, Annex A, *Process Objectives and Outputs by Software Level*.

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, and AC 20-152A. For simple custom airborne electronic hardware, the following data are 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 items **6.a** through **6.h** available 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 non-changeable format 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 ATAR equipment.

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)** of this TSO.

c. If the article contains software or airborne electronic hardware, include one copy of the Open Problem Reports (OPR) summary to type certification, supplemental type certification, or amended type certification design approval holders. We recommend following the guidance in AC 20-189, *Management of Open Problem Reports (OPRs),* dated September 16, 2022, when preparing the OPR summary report.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th St, NW, Suite 910, Washington, D.C. 20036. Telephone: (202) 833-9339; fax: (202) 833-9434. You can also order copies online at RTCA.

b. Order ASTM International documents from ASTM International, 100 Bar Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428. Telephone: (877) 909-2786 (US & Canada), (610) 832-9585 (international); fax: (610) 832-9555. You can also find them online at ASTM.

c. Order copies of 14 CFR parts from the Superintendent of Documents, Government Publishing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone: (202) 512-1800; fax: (202) 512-2104. You can also order copies online at GPO Bookstore or find them online on the following websites:

(1) The FAA Dynamic Regulatory System (DRS) website at DRS.

(2) The U.S. Government's online Electronic Code of Federal Regulations website at eCFR (select Title 14 - Aeronautics and Space).

d. You can find electronic copies of TSOs and ACs, and a concise listing of TSO authorizations (TSOA) for specific articles with basic information on those TSOAs at the FAA DRS at DRS.

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