



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

TSO-C48a

Effective
Date: 05/06/09

Technical Standard Order

Subject: Carbon Monoxide Detector Instruments

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, or FAA) tell you what minimum performance standards (MPS) your carbon monoxide detector instrument 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 after the effective date of this TSO. However, we may do so up to six months after it, if we know that you were working against the earlier MPS before the new change became effective.

 - b. Carbon monoxide detector instruments approved under a previous TSOA or LODA may still be manufactured under the provisions of their original approval.

 - c. Major design changes to carbon monoxide detector instruments approved under this TSO will require a new authorization. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

3. **REQUIREMENTS.** New models of carbon monoxide detector instruments identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in the SAE International's Aerospace Standard (AS) 412, *Carbon Monoxide Detector Instruments*, dated July 2001, Revision B (AS412B). See paragraph 4 of this TSO for an exception to the marking requirements.
 - a. **Functionality.** This TSO's standards apply to equipment intended to detect carbon monoxide and emit a warning when levels become dangerous.

b. Failure Condition Classification. Failure of the function defined in paragraph 3.a of this TSO is a *major* failure condition. Develop each carbon monoxide detector instrument to, at least, the design assurance level for this failure condition.

c. Environmental Qualification. Test the carbon monoxide detector instrument according to RTCA, Inc. document RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004. Apply the sections listed in appendix 1 of this TSO.

d. Software Qualification. If the carbon monoxide detector instrument includes a digital computer, develop the software according to RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992. The software design assurance level should be consistent with the failure condition classification identified in paragraph 3.b of this TSO.

e. Electronic Hardware Qualification. If the carbon monoxide detector instrument includes a complex custom micro-coded component, develop the component to the guidance in FAA advisory circular (AC) 20-152, *RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*. The hardware design assurance level should be consistent with the failure condition classification identified in paragraph 3.b of this TSO.

f. 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 carbon monoxide detector instrument maintains an equivalent level of safety. Apply for a deviation under 14 CFR 21.609 before submitting your data package.

4. MARKING.

a. Disregard AS412B, Paragraph 3.2 and mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d).

b. 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 to show the modification status.

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

c. If applicable, identify deviations granted to the article by marking “Deviation. See installation/instruction manual (IM)” after the TSO number. You can abbreviate the marking to “(Dev. See IM).”

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 IM, sufficient to describe the carbon monoxide detector instrument'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 that the carbon monoxide detector instrument, when installed according to the installation procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. Finally, the limitations must include a note with the following statement:

The conditions and tests 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 according to 14 CFR part 43 or the applicable airworthiness requirements.

- c.** Schematic drawings of the installation procedures.
- d.** Wiring diagrams of the installation procedures.
- e.** List of components, by part number, that make up the carbon monoxide detector instrument 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, and repair, for the continued airworthiness of installed carbon monoxide detector instrument. Instructions should include recommended inspection intervals and service life. Describe the details of deviations granted, as noted in paragraph **5.a** 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. The QCS should ensure that you will detect any change to the carbon monoxide detector instrument that could adversely affect compliance with the TSO MPS, and reject the item accordingly. (Not required for LODA applicants.)

- i. Manufacturer's TSO qualification test report.
- j. Nameplate drawing with 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 a minor change, follow the directions in 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, or the most current revision.

m. If the carbon monoxide detector instrument includes a digital computer: a 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 allows us to quickly resolve issues, such as partitioning and determining software levels.

n. If the carbon monoxide detector instrument includes a complex custom micro-coded component: plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary. We recommend that you submit the PHAC early in the software development process. Early submittal allows us to quickly resolve issues.

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. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.
- b. Equipment calibration procedures.
- c. Corrective maintenance procedures within 3 months after TSOA or LODA.
- d. Schematic drawings.
- e. Wiring diagrams.
- f. Material and process specifications.
- g. Results of the environmental qualification tests conducted per paragraph 3.c of this TSO.
- h. If the carbon monoxide detector instrument includes a digital computer, the appropriate

documentation defined in RTCA/DO-178B, including all data supporting the applicable objectives in Annex A, Process Objectives and Outputs by Software Level.

i. If the carbon monoxide detector instrument includes a complex custom micro-coded component, the appropriate hardware life cycle data combined with design assurance level, as defined in RTCA/DO-254, Appendix A.

7. **FURNISHED DATA REQUIREMENTS.** If furnishing one or more carbon monoxide detector instruments manufactured under this TSO to one entity (such as an operator or repair station), provide one copy of the data in paragraphs 5.a through 5.f and 5.l of this TSO. Add any other data needed for the proper installation, certification, use, or for continued airworthiness of the detector instrument.

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

a. Order RTCA documents from RTCA Inc., 1828 L Street NW, Suite 805, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.

c. Order copies of 14 CFR part 21, Subpart O from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 979050, St. Louis, MO 63197-9000. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

d. You can find a current list of technical standard orders on the FAA Internet website Regulatory and Guidance Library at www.airweb.faa.gov/rgl. You will also find the TSO Index of Articles and advisory circulars at the same site.



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**APPENDIX 1. APPLICABLE ENVIRONMENTAL
QUALIFICATIONS TESTS**

<i>RTCA/DO-160E Section</i>	<i>Title</i>	<i>Test Category</i>
4.0	Temperature and Altitude	Not required –Covered under AS412B
5.0	Temperature Variation	Not required
6.0	Humidity	Not required –Covered under AS412B
7.0	Operational Shocks and Crash Safety	Category B
8.0	Vibration	Not required –Covered under AS412B
9.0	Explosion Proofness	Not required
10.0	Waterproofness	Not required
11.0	Fluids Susceptibility	Not required
12.0	Sand and Dust	Category S
13.0	Fungus Resistance	Not required
14.0	Salt Spray	Not required
15.0	Magnetic Effect	Test and report category
16.0	Power Input	Not required –Covered under AS412B
17.0	Voltage Spike	Not required –Covered under AS412B
18.0	Audio Frequency Conducted Susceptibility – Power Inputs	Not required
19.0	Induced Signal Susceptibility	Not required
20.0	Radio Frequency Susceptibility (Radiated & Conducted)	Not required
21.0	Emission of Radio Frequency Energy	Category M
22.0	Lightning Induced Transient Susceptibility	Not required
23.0	Lightning Direct Effects	Not required
24.0	Icing	Not required
25.0	Electrostatic Discharge	Not required
26.0	Fire, Flammability	Category C