



Department of Transportation  
**Federal Aviation Administration**  
Aircraft Certification Service  
Washington, DC

**TSO-C45b**

Effective  
Date: 08/22/06

# Technical Standard Order

---

Subject: **MANIFOLD PRESSURE INSTRUMENTS**

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers of manifold pressure instruments applying for a TSO authorization or letter of design approval (LODA). In it, we (the Federal Aviation Administration, or FAA) tell you what minimum performance standards (MPS) your manifold pressure 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. Manifold pressure instruments approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.
  - c. Major design changes to manifold pressure instruments approved under previous versions of this TSO require a new authorization under this TSO. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).
3. **REQUIREMENTS.** New models of manifold pressure instruments identified and manufactured on or after the effective date of this TSO must meet the MPS in SAE International's Aerospace Standard (AS) 8042, *Manifold Pressure Instruments*, dated December 1, 1985 (or the most current revision), as amended by appendix 1 of this TSO.
  - a. **Functionality.** This TSO's standards apply to manifold pressure instruments used on all aircraft.
  - b. **Failure Condition Classification.** Failure of the function defined in paragraphs 3 and 3.a of this TSO is a *major* failure condition. Develop each manifold pressure instrument to at least the design assurance level equal to the failure condition classification of the system on which the manifold pressure instrument is installed.

c. **Environmental Qualification.** Test the manifold pressure instrument according to Section 7 of SAE AS 8042 and RTCA Inc. document RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004, or the most current revision.

d. **Software Qualification.** If the manifold pressure 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, or the most current revision.

e. **Electronic Hardware Qualification.** If the manifold pressure 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 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, show that your manifold pressure instrument maintains an equivalent level of safety. Apply for a deviation under 14 CFR § 21.609 before submitting your data package.

#### 4. **MARKING.**

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d), except for the following:

(1) 14 CFR § 21.607(d)(2). Use the name, type, and part number. Do not use the optional model number.

(2) 14 CFR § 21.607(d)(3). Use the date of manufacture. Do not use the optional serial number.

b. Mark the following permanently and legibly, with at least the manufacturer's name, 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 manifold pressure instrument that you determined may be interchangeable.

c. If the component includes a digital computer, 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/hardware versions, approved to different software levels, must be differentiated by part number.

d. Also, mark:

(1) The type of instrument: Type I (Direct Indicating) or Type II (Remote Indicating.) These instruments consist of a separate transmitter and indicator.

(2) Nominal power input (electrical voltage and frequency, vacuum, or air pressure) or electrical rating.

e. Optional marking is permitted to allow the use of aircraft specific or operational specific installation limitations, such as: **“FOR USE ON {insert aircraft type or serial number} ONLY,”** or reference specific installation drawing number which contains limitations or **“FOR USE ON AIRCRAFT USED IN PART {insert number} OPERATIONS ONLY,”** or **“SEE DRAWING NO. XYZ FOR INSTALLATION LIMITATIONS.”**

f. If applicable, identify deviations granted to the equipment 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), letter of TSO design approval applicants submit the same data through their civil aviation authority:)

a. Operating instructions and equipment limitations in an 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 that the manifold pressure instrument, when installed according to installation procedures, still meets this TSO’s requirements. The limitations must identify any unique aspects of the installation. Finally, the limitations 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 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 manifold pressure 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 manifold pressure instruments. 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 equipment 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 manifold'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 qualifications form as described in the environmental qualifications document in paragraph 3.c of this TSO for each component of the system.

m. . If the manifold pressure 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 will allow you to quickly resolve issues, such as partitioning and determining software levels.

n. . If the manifold pressure instrument includes a complex custom micro-coded component: a 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.

**NOTE:** Substantiate the software levels using the safety assessment process in RTCA/DO-178B or the most current revision. If the manifold pressure instrument includes more than one software level, you must partition different 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 documentation in paragraph 3.c of this TSO.

h. If the manifold pressure 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. For software developed before RTCA/DO-178B, see RTCA/DO-178A, Section 12.1.4 for a method of upgrading a baseline for software development. This will ensure that you make changes that meet the criteria in RTCA/DO-178B or the most current revision.

i. If the manifold pressure 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, Table A-1.

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

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

a. 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 them online at [www.sae.org](http://www.sae.org).

b. 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 them online at [www.rtca.org](http://www.rtca.org).

c. Order copies of 14 CFR part 21, subpart O, 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 them from the Government Printing Office website at [www.access.gpo.gov](http://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's Regulatory and Guidance library at [www.airweb.faa.gov/rgl](http://www.airweb.faa.gov/rgl). You will also find advisory circulars and the TSO Index of Articles at the same site.

*/s/ Susan J.M. Cabler*

Susan J. M Cabler  
Acting Manager, Aircraft Engineering Division  
Aircraft Certification Service

## **APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR MANIFOLD PRESSURE INSTRUMENTS**

This appendix lists FAA modifications to the MPS for manifold pressure instruments. The applicable standard is SAE AS 8042, *Manifold Pressure Instruments*, dated December 1, 1985, or the latest revision.

1. We don't require manifold pressure instruments to meet the requirements in paragraphs 3.1, 3.2, and 3.3.
2. Replace paragraph 3.24.2 (Fire Hazards). It should read as follows (changed text in gray):

Except for small parts (such as fasteners, grommets, knobs, seals, and small electrical parts) that would not contribute significantly to the propagation of a fire, all material used must be self-extinguishing when tested in accordance with the requirements of 14 CFR § 25.869(a)(4) and the applicable portions of Part I, Appendix F.