



# Technical Standard Order

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## Subject: TSO-C44b, FUEL FLOWMETERS

a. Applicability.

(1) Minimum Performance Standards. This technical standard order (TSO) prescribes the minimum performance standard that fuel flowmeters must meet in order to be identified with the applicable TSO marking. Fuel flowmeters that are to be so identified and that are manufactured on or after the date of this TSO must meet the standards set forth in the Society of Automotive Engineers, Inc. (SAE) Aerospace Standard (AS) 407B, "Fuel Flowmeters," reaffirmed May 1991, as amended and supplemented by this TSO.

(2) Exception.

(i) Correction to Section 1. of AS 407B: As referenced in this TSO, AS 407B specifies minimum requirements for fuel flowmeters for use on reciprocating engine or turbine-powered civil aircraft. In addition, the following specifically numbered subsections in AS 407B do not concern minimum performance and, therefore, are not essential to compliance with this section: subsection 3.1, 3.2, and 4.2.1.

(ii) Thermal shock: This test shall apply to any hermetically sealed components. The components shall be subjected to four cycles of exposure to water  $85^{\circ} \pm 2^{\circ} \text{C}$  and  $5^{\circ} \pm 2^{\circ} \text{C}$  without evidence of moisture penetration or damage to coating or enclosure. Each cycle of the test shall consist of immersing the component in water at  $85^{\circ} \pm 2^{\circ} \text{C}$  for a period of 30 minutes, and then within 5 seconds of removal from the bath, the component shall be immersed for a period of 30 minutes in the other bath maintained at  $5^{\circ} \pm 2^{\circ} \text{C}$ .

This cycle shall be repeated continuously, one cycle following the other until four cycles have been completed. Following this test, the component shall be subjected to the Sealing test specified in (iii). No leakage shall occur as a result of the test.

(iii) Sealing: This performance test shall apply to any hermetically sealed components. The component shall be immersed in a suitable liquid, such as water. The absolute pressure of the air above the liquid shall then be reduced to approximately 1 inch of mercury (Hg) and maintained for 1 minute, or until air bubbles cease to be given off by the liquid,

whichever is longer. The absolute pressure shall then be increased by 2 ½ inches Hg. Any bubbles coming from within the component case shall be considered as leakage and shall be cause of rejection. Bubbles which are the result of entrapped air in the various exterior parts of the case shall not be considered as leakage. Other test methods which provide evidence equal to the immersion test of the integrity of the instrument's seals may be used. If the component incorporates nonhermetically sealed appurtenances such as a case extension, these appurtenances may be removed prior to the Sealing test.

(iv) Correction to subsection 3.3.1: Under column A. the temperature values for unheated areas (Temperature Uncontrolled) shall be -55° to 70° C.

(3) Environmental Standards. The conditions and procedures prescribed in AS 407B are to be used.

(4) 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 document 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 level, appropriate partitioning of different software levels is required. As an alternative to substantiating the software level(s) in a safety assessment, the applicant may develop all software that affects navigation and integrity functions to at least the Level C criteria.

b. Marking.

(1) To comply with 14 Code of Federal Aviation Regulation (CFR) Section 21.607(d), the technical standard order authorization (TSOA) holder shall identify the software and hardware with the part number, or shall utilize a separate part number that identifies the software and hardware. 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 for each function.

(2) The TSOA holder shall legibly and permanently mark each separate, major component of equipment with the name of the manufacturer, the TSO number, and the part number, if the Administrator finds that such marking is necessary in the interests of safety.

(3) Range (transmitters only).

(4) Electrical rating.

c. 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 and limitations.

(ii) Installation procedures and limitations.

(iii) Schematic drawings applicable to installation.

(iv) Wiring diagrams applicable to the installation.

(v) Specifications.

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

(vii) Manufacturer's TSO qualification test report.

(viii) Nameplate drawing.

(ix) 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 of the drawings and processes that 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.

(vii) The results of the environmental qualification tests conducted in accordance with AS 407B.

(3) Data to be furnished with manufactured units. One copy of the data and information specified in paragraphs (c) (1) (i) through (c) (1) (vii) 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 test required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install the article either on or within a specific type or class of aircraft to demonstrate 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.”

e. Availability of Reference Documents.

(1) Copies of SAE AS 407B may be purchased from the Society of Automotive Engineers Inc., Department 331, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

(2) Copies of RTCA Document Nos. DO-178B may be purchased from the RTCA, Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036-4001.

(3) Code of Federal Aviation Regulations, Part 21, Subpart O may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325.

(4) Advisory Circular 20-110, "Index of Aviation Technical Standard Orders," may be obtained from the U.S. Department of Transportation, General Services Section, M-443.2, Washington, DC 20590.

/S/ John K. McGrath  
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