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

**TSO-C138**

Effective
Date: *mm/dd/07*

# Technical Standard Order

Proposed

## Subject: Miscellaneous Non-Required Equipment

**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 miscellaneous non-required 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. Major design changes to miscellaneous non-required equipment 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 miscellaneous non-required equipment identified and manufactured on or after the effective date of this TSO must meet the industry or acceptable manufacturer specified MPS (MSMPS) qualification and documentation requirements in appendix 1 of this TSO. Request our approval of your MSMPS at the same time you apply for initial installation approval under a type certificate (TC) or supplemental TC (STC) or an existing TC/STC approval. Both the ACO authorizing the TSO and the ACO who approves installation, if different, must approve the MSMPS. LODA applicants must work through their civil aviation authority, the authorizing ACO and any non-United States TC/STC approval holders for MSMPS approval.

**4. MARKING.**

**a.** Mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d), except for 14 CFR § 21.607(d)(2). Use the name, type, and part number of the article. Do not use the optional model number.

**b.** Also, 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 article that you determined may be interchangeable.

**c.** 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.

**d.** If applicable, identify deviations granted to the article per 14 CFR § 21.609 by marking "Deviation. See installation/instruction manual (IM)" after the TSO number. You can abbreviate the marking to "(Dev. See IM)."

**e.** When applicable, mark the equipment as an **"INCOMPLETE SYSTEM"** or state that the article performs additional functions beyond those described in an acceptable industry MPS per appendix 1, paragraph 1.5a of this TSO.

**f.** 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," "FOR USE ON AIRCRAFT USED IN PART *{insert number}* OPERATIONS ONLY," "FOR MILITARY USE ONLY,"** or **"SEE DRAWING NO. XYZ FOR INSTALLATION LIMITATIONS."**

**5. <u>APPLICATION DATA REQUIREMENTS</u>.** 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 only submit the technical design data through their civil aviation authority):

**a.** Operating instructions and equipment limitations in an IM, sufficient to describe the equipment's operational capability. 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 miscellaneous non-required equipment, 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. Equipment approved under this TSO may contain commercial and consumer grade (referred to as commercial off the shelf (COTS) parts, subassemblies, or assemblies. 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 miscellaneous non-required equipment system complying with the standards prescribed under this TSO. In particular, identify any primary or backup Lithium battery of any chemistry. Include vendor part number cross-references, when applicable.

> **NOTE:** COTS equipment is not specifically designed and manufactured for use in aircraft, but is purchased (by a manufacturer, aircraft operator or modifier) for use in a particular aircraft system. This equipment is designed for the consumer market and typically approved by Underwriters Laboratory (UL) or other nationally recognized test laboratory (NRTL). Design data for COTS is not available to the design approval holder. However, only UL labeled COTS products or equipment, which become part of a TSO article, are considered to have received FAA design and manufacturing approval.

**f.** A component maintenance manual (CMM) covering periodic maintenance, calibration, and repair, for the continued airworthiness of installed miscellaneous non-required equipment. Include recommended inspection intervals and service life.

**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 describes test inspections and acceptances of each article to ensure production equipment conformity. The QCS should ensure that you will detect any change to the equipment that could adversely affect compliance with TSO standards, and reject the item accordingly. (Not required for LODA applicants. LODA applicants must have a QCS that meets the requirements of their civil aviation authority.)

**(1)** Applicants using suppliers of COTS parts, subassemblies or assemblies should meet the requirements of SAE International's Aerospace Standard (AS) 9100B, *Quality Management Systems-Aerospace Requirements*, dated January 2004 (or most current revision) for the incoming inspection and test program of COTS parts, subassemblies or assemblies.

**(2)** Under this TSO, suppliers of COTS parts, subassemblies or assemblies may be FAA approved if the supplier or applicant controls the design and QCS of the COTS parts and assemblies. You must show that your QCS complies with paragraph **5.h(1)** and or the COTS supplier must use a known acceptable industry QCS standard such as UL.

**(a) Configuration Control.** Applicants must document COTS equipment and approval methods with a component report. The report must include the following: manufacturer, equipment type, model and/or part number, footprint, overall dimensions, power requirements, required UL mark, weight, detail drawings, if available, installation limitations and other design criteria. The report is the basis for granting you permission to test one unit and use subsequent units from the same qualified manufacturer without further evaluation.

> **NOTE:** This TSO describes an acceptable means of design and manufacturing configuration control for equipment approved under this TSO that may contain COTS parts, subassemblies, or assemblies. If you install this equipment on or in a specific type or class of aircraft, you must determine that the equipment installation complies with the airworthiness requirements, and you must ensure product conformity.

**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. If the article uses supplier COTS parts, subassemblies or assemblies, the drawings must reflect the manufacturer's part number. Different manufacturers of the same part number must be fully interchangeable with each other with respect to dimension, function, and performance. For a minor change, follow the directions in 14 CFR § 21.611(a). Show any revisions to the drawing list only at our request.

**l.** An environmental qualifications form as described in the environmental qualifications document referenced in appendix 1, paragraph 1.5e of this TSO for each component of the system.

**m.** Manufacturer's specified MPS (MSMPS) approved by the FAA, as outlined in appendix 1, paragraph 1.5 of this TSO.

**6. <u>MANUFACTURER DATA REQUIREMENTS</u>.** 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 12 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 appendix 1, paragraph 1.5e of this TSO.

**h.** Records of all inspections and tests performed to control the conformity of all COTS grade parts, subassemblies, or assemblies.

**i.** Traceability of production equipment identification number to incoming lots of COTS parts, subassemblies, or assemblies you accepted.

**j.** If the article includes a digital computer, the appropriate documentation defined in appendix 1, paragraph 1.5f of this TSO, including all data supporting the applicable objectives in RTCA, Inc. document RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 or the most current revision, Annex A, Process Objectives and Outputs by Software Level.

**k.** If the article includes complex electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in appendix 1, paragraph 1.5g to include RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, dated April 19, 2000 (or the most current revision), Appendix A, TableA-l.

**7. FURNISHED DATA REQUIREMENTS.** If furnishing one or more articles manufactured under this TSO to one entity (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 continued airworthiness, of the miscellaneous non-required equipment.

**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, 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 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 and a TSO Index of Articles (a list of TSO approval holders and articles model/part numbers) on the FAA Internet website Regulatory and Guidance library at www.airweb.faa.gov/rgl.

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# APPENDIX 1. FAA MPS FOR MISCELLANEOUS NON-REQUIRED EQUIPMENT

**1.1 PURPOSE.** This standard provides the MPS for miscellaneous non-required equipment. There is no common functional MPS covering the range of potential articles under this TSO. If you are a manufacturer, we require you to propose an acceptable industry MPS for FAA approval., or gain our approval to use your own manufacturer-specified MPS (MSMPS). Each MSMPS you submit for our approval under this TSO must cover the specific function(s) the article provides

**1.2 SCOPE.** Miscellaneous non-required equipment is mechanical, electromechanical or electronic equipment that:

**a.** Is not specifically required by 14 CFR parts 23, 25, 27, 29, 31, 33, 91, 121, 125, 135, and 139,

**b.** Whose functional failure has ***no safety effect*** on the aircraft or its operation, emergency egress, or cabin safety,

**c.** Is installed in the cabin or easily accessible from the cabin,

**d.** Must not be used by the flight crew for aircraft operation, and

**e.** Must not interface with required flight control systems.

**1.3 EQUIPMENT *NOT* ELIGIBLE FOR APPROVAL.**

**a.** Required equipment and equipment or components covered by PMA or another TSO.

**b.** Modified equipment or components of another TSO article.

**c.** Equipment or equipment components (including non-required, extra or “supplemental” equipment) that:

**(1)** Are installed in the flight deck and provide operational information to the flight crew,

**(2)** Can adversely impact flight crew workload (for example, equipment classified with failure conditions of *minor* or higher),

**(3)** Interface with flight critical systems or flight deck equipment, or

**(4)** Are necessary for continued safe flight, landing or egress.

**d.** Fabricated sub-components (such as stringers, fabric, plastic housings, wire or acoustic insulation, knobs, switches, handles or brackets).

**e.** Repair or replacement parts already approved or subject to approval under 14 CFR § 21.303, parts manufacturer approval (PMA).

**f.** Software components independent of a hardware platform.

**g.** Custom micro-coded components independent of any required software operating system or application.

**h.** Standard parts, as specified in 14 CFR § 21.303(b)(4).

**i.** Supplier-furnished parts covered by the purchaser's production approval.

**j.** Mechanical, fluid, and electrical sub-components that in themselves perform no aircraft level function. Examples are gaskets, cables, solenoids, de-icing fluid, liquid coolant/refrigerant, electrical component/connectors, wiring, light bulbs, and switches.

**k.** Cabin décor components (carpets, curtains, panels and dividers).

**l.** Portable electronic devices (PED), that is, carry-on equipment not intended to be installed on the aircraft. Examples are laptops/palmtops, miscellaneous computing devices, compact disc/tape players, handheld global navigation satellite system receivers, and portable communication devices.

**m.** Wireless equipment such as local area network (LAN) systems.

**n.** Equipment to be integrated into the airframe structure, that will change airframe internal loads and load distributions in any manner aside from the inertial loads. Examples are:

**(1)** Galleys, lavatories, or closets that constrain the structure and provide an additional redundant load path;

**(2)** Equipment mounted so it constrains the fuselage frames under pressurization; or

**(3)** A system with an actuator where the loads are grounded to the basic airframe.

**1.4 <u>EQUIPMENT ELIGIBLE FOR APPROVAL</u>.** Aircraft Engineering Division, AIR-100 must approve any other equipment not listed in paragraph 1.4a through 1.4d below that you submit as meeting the intent of this TSO. The equipment must have a failure condition classification of ***no safety effect*** to be eligible for this TSO. Some examples are:

**a.** Miscellaneous computers, facsimile machines, printers.

**b.** Telephones, infrared camera/radar systems for search and rescue, audio and video systems for ground surveillance of passenger cabin, cargo compartment, or external viewing for passengers or security, and logo lights.

**c.** Cabin flight information systems. Non-flight GPS-enabled aircraft tracking equipment, miscellaneous temperature indicating or regulating equipment, and miscellaneous indicating lights.

**d.** Gasper air vent outlets, manual or electric window shades, toilets, faucets, and sinks.

**1.5 DETAIL REQUIREMENTS.** Miscellaneous non-required equipment must meet one of the FAA-approved MPS qualification and documentation requirements in paragraph 1.5a or 1.5b below. Before applying for a TSO authorization or LODA, you must gain approval to use an industry MPS or your MSMPS from the aircraft certification office (ACO) responsible for the initial or existing installation approval (TC or STC) of the article and the TSO project ACO. The project ACO will send a copy of your approved MSMPS to the manager of the Aircraft Engineering Division, AIR-100, Washington, DC where all approved MSMPS will be available to the public. We may accept your use of prior MSMPS approvals of other applicants without further evaluation, if the installations are the same.

**a. Industry MPS.** You must specify an industry MPS that you will apply to the equipment. Regardless of the industry MPS used, the equipment must meet the minimum environmental qualification tests specified in paragraph 1.5e below.

**b. Manufacturer Specified MPS (MSMPS).** You must define a MSMPS with sufficient detail to ensure that the equipment will satisfactorily perform its intended function(s) under all foreseeable operating conditions. Since measured values of equipment performance characteristics may be a function of the measurement method, specify test conditions, test methods and pass/fail criteria. Your MSMPS should be readily verifiable through bench test procedures.

**(1) MSMPS Requirements**. The MPS for your equipment must be:

**(a)** Limited to MPS essential to the intended use(s) of the equipment.

**(b)** Organized to state each standard parameter in a single paragraph, and expressed in minimum terms. For example, it should state the threshold of performance requirements and values to achieve in a prescribed operational environment.

**(c)** Able to establish quantifiable performance, rather than design specifications.

**(d)** Expressed in quantifiable terms so the equipment can be verified by test, unless you can verify it by looking at it or trying it out.

**(2) Verification Test Procedures.** Verify compliance with the equipment's functional performance according to the MSMPS by one or more analysis, inspections, demonstrations, and tests, defined as follows:

**(a) Analysis/Similarity.** Prove the equipment meets specific requirements by technical evaluation or comparing it to previously qualified equipment. Verifying by technical evaluation means using mathematical representations (models, simulation, and algorithms), charts, graphs, drawings and representative data. One example could be a bit comparison of the actual outputs for an article under test with the expected outputs for a specific set of inputs.

**(b) Inspection.** Visually examine or observe, using representative documentation to compare appropriate characteristics with specific requirements.

**(c) Demonstration.** Operate, move or adjust the article using qualitative criteria (rather than measuring instruments) and quantitative data to ensure performance of functions and capabilities.

**(d) Test.** Examine or test articles under specified conditions using measuring instruments that yield quantitative analytical data. You can use the data to compare the measured performance against specific requirements.

**(3) Installed Equipment Test Objectives.** You may find that you can't verify the performance of the installed equipment using bench test procedures. If so, you must set up functional performance verification tests for the installed equipment. Include verification tests for the installed equipment in the installation/instructions manual (IM) to ensure that the article, when installed in accordance with the installation procedures, continues to meet the requirements of this TSO.

**c. Failure Condition Classification.** Failure of function(s) defined in paragraphs 1.5a or 1.5b of this appendix is a ***no safety effect*** failure condition. Develop the system to, at least, the design assurance level equal to this failure condition classification. Declare the article's operational context and resultant failure condition classification (that is, ***no safety effect***) in the IM (see paragraph **5.b** of this TSO). This will ensure that the article, when installed according to the installation procedures and limitations, continues to meet the requirements of this TSO.

**d. Functional Qualification.** Demonstrate the required performance under the test conditions specified in paragraph 1.5a or 1.5b of this appendix.

**e. Environmental Qualification.** Test the equipment according to RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004, or the most current revision. Develop standards appropriate for these tests per paragraph 1.5a or 1.5b of this appendix. After evaluating the equipment characteristics and intended installation environments, you may apply or the FAA may impose, per paragraph 1.5 above, additional environmental conditions and test procedures. At a minimum, test the article to meet the following RTCA/DO-160E test categories:

**(1) Temperature and Altitude.** Section 4, paragraphs 4.5.2, 4.5.4, 4.6.1 and 4.6.2. Select a category appropriate for the intended installation. Define the appropriate functional performance for this environmental condition.

**(2) Operational Shocks and Crash Safety.** Section 7, paragraphs 7.2 and 7.3. Select a category appropriate for the intended installation. Applies to equipment to be installed in an aircraft passenger or crew compartment/flight deck. Define the aircraft type(s) and test type(s) from Table 7-1 and the applicable airworthiness requirements for the aircraft type into which the article may be installed, such as 14 CFR §§ 23, 25, 27 or 29.561.

**(3) Vibration Test.** Section 8, select a category and vibration curve test appropriate for the intended installation. Define the appropriate functional performance for this environmental condition.

**(4) Magnetic Effect.** Section 15, Category A, exempts any equipment whose inherent design prevents any magnetic effect.

**(5) Power Input Test**. Section 16 requires a test for equipment designed to use either the aircraft AC or DC electrical power for primary power. Select a category appropriate for the intended installation. Define the appropriate functional performance for this environmental condition.

**(6) Voltage Spike Test.** Section 17 requires a test for equipment designed to use either the aircraft AC or DC electrical power for primary power. Select a category appropriate for the intended installation. Define the appropriate functional performance for this environmental condition.

**(7) Emission of Radio Frequency Energy.** Section 21, select a category appropriate for the intended installation. Equipment whose inherent design does not emit radio frequency energy is exempt from testing.

**f. Software Qualification.** If the article 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. Develop the functional performance standards and tests consistent with the ***no safety effect*** failure condition classification stated in paragraph 1.5c of this appendix.

**g. Electronic Hardware Qualification.** If the article includes complex electronic hardware, develop the component to the guidance in AC 20-152, "RTCA, Inc document RTCA/DO-254, Develop the functional performance standards and tests consistent with the ***no safety affect*** failure condition classification stated in paragraph 1.5c of this appendix.

**h. Flammability.** All materials used (including insulation on electrical wires) must be self-extinguishing when tested according to 14 CFR § 25.853(a) or installed in a metal enclosure per AC 25-10. This requirement doesn't apply to small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that don't contribute significantly to fire propagation. A small part is considered to have a volume no greater than 50 $in^3$.

**(1)** If the equipment or component carries UL marking or another FAA accepted NRTL, we will accept the initial UL compliance testing as meeting 14 CFR part 25 requirements.

**(2)** Equipment or components without UL marking with non-metallic cases, exposed panels and large circuit boards greater than 36 $in^2$ must meet 14 CFR part 25 Appendix F Part I(a)(ii).

**i. Heat Release and Smoke Density.** Exposed panels/surfaces totaling more than one square foot in surface area must meet the heat release and smoke density requirements of 14 CFR § 25.853 and 14 CFR part 25, Appendix F, Parts IV and V.

**j. Battery Qualification.** If the equipment uses a battery as a power source, the battery must meet the requirements of the applicable battery standards:

**(1)** TSO-C142a, *Non-Rechargeable Lithium Cells and Batteries* (see RTCA, Inc. document RTCA/DO-227*, Minimum Operational Performance Standards for Lithium Batteries,* dated June 23, 1995), or the most current revision.

**(2)** TSO-C179, *Rechargeable Lithium Cells and Lithium Batteries* (reference UL 1642, *Standard for Safety for Lithium Batteries,* fourth edition, dated September 19, 2005).

**k. Elective Minimum Standards.** In addition to paragraphs 1.5e through 1.5i above, you may demonstrate compliance to other equipment minimum standards classifications**.**