



Technical Standard Order

Proposed

Subject: Miscellaneous Non-Required Equipment

1. PURPOSE. This Technical Standard Order (TSO) prescribes the minimum standards that miscellaneous non-required equipment, also referred to herein as articles, must meet to be identified with the applicable TSO marking.

2. APPLICABILITY. This TSO is limited in applicability to miscellaneous non-required equipment. Miscellaneous non-required equipment is equipment not specifically required by Title 14 Code of Federal Regulations (CFR) Federal Aviation Regulation (FAR) Parts 91, 121, 125, 135 and 139. Video projection equipment, cathode ray tube (CRT) and Liquid Crystal Display (LCD) entertainment systems, telephones, facsimile machines, printers, stereo systems, galley carts, recovery winches, aerial cameras, logo lights, games and passenger cabin local area network computers are examples. Miscellaneous non-required equipment may be mechanical, electromechanical or electronic in design. Systems and equipment that provides flight information to the flight crew (including non-required, ancillary or "secondary" equipment); has the potential to have an adverse impact on flight crew workload; or are necessary for continued safe flight, landing and egress; are specifically not covered by this TSO. Further, articles covered by this TSO may not be any of the following:

- a. A modification of an article approved under any other TSO;
- b. An article or subcomponent of an article covered by another TSO;
- c. A material by itself. The term "material" used here refers to fabricated sub-components (e.g., structural stringers, seat cloth, plastic housings, metal structures, wiring insulation, miscellaneous knobs, handles or brackets, and so forth)
- d. A repair part;
- e. A replacement part for which a Parts Manufacturer Approval has been issued under FAR section 21.303;
- f. Software independent of a hardware platform;

- g.** Hardware processor independent of software operating system or application;
- h.** A standard part as specified in FAR Section 21.303(b)(4);
- i.** A supplier-furnished part covered by the purchaser's production approval; or
- j.** Wide usage small parts such as mechanical, fluid, or electrical components. These items are considered miscellaneous sub-components and do not provide airplane level functionality (e.g., gaskets, cables, solenoids, de-icing fluid, liquid coolant/refrigerant, electrical connectors, wiring, light bulbs, switches, etc.).
- k.** An article which, by virtue of its intended integration into the airframe structure, will change the internal loads and load distributions in the airframe structure in any manner other than the introduction of the article inertial loads into the airframe structure. Examples of this type of article are: galleys, lavatories, or closets which are attached to the airframe such that they constrain the structure and provide an additional, redundant load path for the basic airframe loads, equipment mounting provisions which constrain the fuselage frames under pressurization and alter the basic load or stress distribution in the airframe structure as a result of this constraint, or a system which requires a force actuator where the actuation forces are grounded to the basic airframe and not within the article or article mounting frame.
- l.** Portable carry-on equipment that is not intended for incorporation into the host aircraft type design. Some specific examples of portable carry-on equipment include laptops/palmtops, miscellaneous computing devices, compact disc/tape players, handheld global navigation satellite system receivers, and portable communication devices.
- m.** Aircraft interior items and subassemblies, such as carpets, curtains, panels and dividers.

3. MINIMUM STANDARDS. Miscellaneous non-required equipment that are so identified and that are manufactured on or after the effective date of this TSO must meet one or a combination of the following classes of minimum standards. Equipment manufacturers may elect to comply with various combinations of equipment classes, as defined in paragraph 5. of this TSO.

a. Class 1. *Class 1* equipment must meet the following environmental conditions and test procedures as defined by RTCA, Inc., DO-160D, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated July 29, 1997 (or the most current revision). Additional environmental conditions and test procedures may be selected and applied by the equipment manufacturer. The equipment manufacturer shall evaluate the equipment characteristics and the intended installation environments to select additional appropriate environmental conditions and test procedures. As a minimum, the TSO article must meet the following DO-160D (or the most current revision) test categories for those sections identified below.

(1) Section 4, *Temperature and Altitude*, paragraphs 4.6.1 and 4.6.2. The category selected must be appropriate for the intended installation. The equipment manufacturer shall define the appropriate functional performance for this environmental condition.

(2) Section 7, *Operational Shocks and Crash Safety*, paragraph 7.3. This applies to equipment that will be installed in an aircraft passenger or crew compartment/flight deck location. The equipment manufacturer shall define the aircraft type(s) and test type(s) as defined in Table 7-1 of DO-160D.

(3) Section 15, *Magnetic Effect*, Category A.

Note: Equipment whose inherent design would preclude any magnetic effect is exempt from Section 15 testing.

(4) Section 21, *Emission of Radio Frequency Energy*, Category L.

Note: Equipment whose inherent design would not emit radio frequency energy is exempt from Section 21 testing.

b. Class 2. Class 2 equipment must contain software that satisfies RTCA, Inc., DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 or the most current revision.

c. Class 3. <RESERVED>

d. Class 4. <RESERVED>

e. Class 5. <RESERVED>

f. Class 6. <RESERVED>

4. MANUFACTURER SPECIFIED FUNCTIONAL PERFORMANCE AND TEST CONDITIONS. Equipment manufacturers must define the functional performance of the article for which TSO application has been made. The manufacturer specified functional performance requirements must be defined to ensure that the equipment will satisfactorily perform its intended function(s) under conditions encountered in routine aeronautical operations. Since measured values of equipment performance characteristics may be a function of the measurement method, the manufacturer must specify test conditions, methods of test and pass/fail criteria. Manufacturer specified functional performance requirements shall be readily verified through bench test procedures, if possible.

a. Equipment Performance - Standard Conditions. The following guidelines apply to defining the equipment performance requirements.

(1) Requirements shall be limited to those that are essential to the intended or expected use(s) of the equipment.

(2) Requirements shall be expressed in minimum terms (i.e., the threshold of performance requirements and values to be achieved in a prescribed operational environment).

(3) Requirements shall be stated in quantifiable terms of performance rather than design specifications.

(4) Each requirement shall be stated in a single paragraph.

(5) Unless a requirement can be verified solely through visual inspection, it shall be expressed in quantifiable terms so that it can be verified by a test procedure.

b. Verification Test Procedures. Equipment functional performance test objectives shall be verified by one or more of the analysis, inspection, demonstration, and test methods, which are defined as follows:

(1) **Analysis.** Verification by technical/mathematical evaluation using mathematical representations (i.e., models, simulation, and algorithms), charts, graphs, drawings and representative data. An example means of analysis could be a bit comparison of the actual outputs of the article under test with the expected outputs for a specific set of inputs.

(2) **Inspection.** Verification by visual examination or observation using representative documentation to compare appropriate characteristics with specific requirements.

(3) **Demonstration.** Verification by operation, movement or adjustment using qualitative criteria rather than measuring instruments and quantitative data to assure performance of functions and capabilities.

(4) **Test.** Verification by examination or trial under appropriate conditions using measuring instruments that yield analytical data for use in comparing measured performance against specific requirements.

c. Installed Equipment Test Objectives. Equipment manufacturers may encounter circumstances where the equipment under test cannot satisfy functional performance verification using bench test procedures. In such cases, the manufacturer must identify verification tests for the installed equipment. Verification tests of installed equipment shall be included in the equipment installation instructions to ensure that the article, when installed in accordance with the installation procedures, continues to meet the requirements of this TSO

5. REQUIREMENTS.

a. Failure Condition Classification. Failure of the function defined in paragraph 4. of this TSO has been determined to be no greater than a *minor* failure condition. The equipment

manufacturer must declare the article's operational context and resultant failure condition classification (i.e., *no hazard effect* or *minor*) in the installation instructions (see paragraph **7.a.2.** 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. The applicant must develop the system to, at least, the design assurance level equal to the declared failure condition classification.

b. Functional Qualification. The required performance shall be demonstrated under the test conditions specified in accordance with paragraph **4.** of this TSO.

c. Environmental Qualification. As a minimum, the equipment shall be subject to test conditions specified in **3.a.** of this TSO. The functional performance standards appropriate for these tests shall be developed per paragraph **4.** of this TSO.

d. Software Qualification. If the article includes a digital computer, the software must be developed in accordance with paragraph **3.b.** of this TSO.

e. Flammability. All materials used must be self-extinguishing when tested in accordance with applicable requirements of Title 14 Code of Federal Regulations (CFR) Federal Aviation Regulation (FAR) Parts 25.853 and Part 25, Appendix F. This requirement is not applicable to small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire.

f. Elective Minimum Standards. In addition to paragraphs **5.c.** and **5.d.** of this TSO, equipment manufacturers may elect to demonstrate compliance to additional equipment minimum standards classifications, as defined in paragraph **3.**

Note: This paragraph is currently a placeholder for future expansion of the minimum standards referenced as <RESERVED> classes in paragraph 3. of this TSO.

g. Deviations. The FAA has allowed provisions for using alternative or equivalent means of compliance to the criteria set forth in the minimum standards of this TSO. Applicants invoking these provisions shall demonstrate that an equivalent level of safety is maintained and shall apply for a deviation in accordance with 14 CFR 21.609.

6. MARKING. In accordance with 14 CFR Part 21.607(d), articles manufactured under this TSO must be marked as follows:

a. At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR Part 21.607(d), except for the option provided in 14 CFR Part 21.607(d)(3), where the date of manufacture must be used in lieu of the optional serial number.

b. In addition to the requirements of 14 CFR 21.607(d), each separate component that is easily removable (without hand tools), an interchangeable element or a separate sub-assembly of

the article must be permanently and legibly marked with at least the name of the manufacturer, manufacturer's part number and the TSO number.

c. If the component includes a digital computer, the part number must include hardware and software identification, or a separate part number may be utilized for hardware and software. Either approach must include a means for showing the modification status. Note that similar software versions which have been approved to different software levels must be differentiated by part number.

d. When applicable, identify the equipment as an incomplete system, which provides subsystem functionality for broader scoped, installed system applications.

e. As a minimum, the major component satisfying the marking requirement specified in paragraph **6.a.** must also be permanently and legibly marked with the equipment class for which compliance to paragraph **3.** of this TSO has been determined. The example equipment marking, *TSO-C138 Class 1/2/4*, implies satisfying the minimum standards of paragraph **3.a.**, **3.b.** and **3.d.** of this TSO.

7. DATA REQUIREMENTS.

a. Application Data. Planning for design approval is an interactive process between the FAA and the applicant. As such, applicants are highly encouraged to obtain agreement with the certification office on the TSO data package scope and content. In accordance with 14 CFR 21.605(a)(2), the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), having purview of the manufacturer's facilities, one copy each of the following technical data to support the FAA design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the operational capability of the equipment.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the article, when installed in accordance with the installation procedures, continues to meet the requirements of this TSO. The limitations shall also be sufficient to identify any unique aspects of the installation. The limitations also shall include the following:

(a) A note with the following statement:

"The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. The article may be installed only if further evaluation by the applicant, i.e. user/installer, documents an acceptable installation and is approved by the Administrator."

(b) When applicable, identify the appliance as an incomplete system or a multi-use system and describe the functions that are intended to be provided by the appliance.

(c) The article's operational context and resultant failure condition classification, in accordance with paragraph 5.a. of this TSO.

(3) Schematic drawings as applicable to the installation procedures.

(4) Wiring diagrams as applicable to the installation procedures.

(5) Material and process specifications.

(6) List of the components, by part number, that make up the miscellaneous non-required equipment complying with the standards prescribed in this TSO.

(7) Instructions for periodic maintenance, calibration and repair which are necessary for continued airworthiness once the miscellaneous non-required equipment is installed; including recommended inspection intervals and service life.

(8) The quality control functional test specification to be used to test each production article to ensure compliance with this TSO, as required by 14 CFR 21.605(a)(3) and 21.143(a).

(9) Manufacturer's TSO qualification test report.

(10) Nameplate drawing.

(11) A drawing list, enumerating all of the drawings and processes that are necessary to define the article's design.

(12) The manufacturer specified functional performance document in accordance with paragraph 4 of this TSO.

(13) An environmental qualification form as described in the environmental considerations document referenced in paragraph 3.a. for each component of the system.

(14) If the article includes a digital computer: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. The FAA recommends that the PSAC be submitted early in the software development process. Early submittal will allow timely resolution of issues such as partitioning and determination of software levels.

b. Manufacturer Data. In addition to those data requirements that are to be furnished directly to the FAA, each manufacturer must have available for review by the manager of the ACO having purview of the manufacturer's facilities, the following technical data:

(1) The functional qualification specifications (as defined in accordance with paragraph 4.) to be used to qualify each production article to ensure compliance with this TSO.

(2) Equipment calibration procedures.

(3) Corrective maintenance procedures within 12 months after TSO authorization.

(4) Schematic drawings.

(5) Wiring diagrams.

(6) The results of the environmental qualification tests conducted in accordance with RTCA/DO-160D or the most current revision..

(7) If the article includes a digital computer, the appropriate documentation as defined in RTCA/DO-178B or the most current revision, including all data supporting the applicable objectives found in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

c. Furnished Data.

(1) One copy of the technical data and information specified in paragraphs 7.a.(1) through 7.a.(7), 7.a.(12) and 7.a.(13) of this TSO and any other data or information that are necessary for the proper installation certification and use and/or for continued airworthiness of the miscellaneous non-required equipment must go to each person, i.e. installer and/or operator, receiving for use one or more articles manufactured under this TSO.

8. AVAILABILITY OF REFERENCED DOCUMENTS.

a. Copies of RTCA Document Nos. DO-160D and DO-178B may be purchased from the RTCA Inc., 1140 Connecticut Avenue, N.W., Suite 1020, Washington, D.C. 20036.

b. Federal Aviation Regulations 14 CFR Part 21, Subpart O, may be purchased from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325.

c. AC 20-110, "Index of Aviation Technical Standard Orders," and FAA advisory circulars (AC) may be obtained from;

U.S. Department of Transportation
Subsequent Distribution Office
Ardmore East Business Center
3341Q 75th Avenue
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