



Technical Standard Order

Subject: FLIGHT DATA RECORDER SYSTEMS

1. PURPOSE. This technical standard order (TSO) is for manufacturers of flight data recorder (FDR) systems 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 flight data recorder system must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. This TSO affects new applications submitted after this TSO's 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. FDR systems approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.

c. Major design changes to FDR systems 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 FDR systems identified and manufactured on or after the effective date of this TSO must meet the MPS in the European Organization for Civil Aviation Electronics' (EUROCAE) publication ED-112, *Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems*, dated March 2003. Table 1 below lists recorder types and the ED-112 chapter and part containing the MPS for each:

Table 1. Recorder MPS Requirements

Recorder Type	ED-112 Reference
Single FDR	Chapter 2 and Part II
FDR function in a deployable recorder	Chapter 2, Chapter 3 and Part II
FDR function in a combined recorder	Chapter 2, Chapter 4, and Part II

a. **ED-112 exceptions.** ED-112 exceptions are due to direct conflicts with 14 CFR. The following are exceptions to the ED-112 part and sections in table 1 above. As part of this TSO, we do not require:

- *Recorder start and stop times, Chapter 2-1.5.* Start and stop times must comply with applicable 14 CFR operational regulations.
- *Recorder location, Chapter 2-5.4.1.* Recorder location must comply with applicable 14 CFR certification regulations.
- *Recorder parameters, Annex II-A.* Recorder parameters must comply with applicable 14 CFR operational regulations.
- *All ED-112 requirements* for aircraft level equipment installation, test, and maintenance.

b. **Functionality.** This TSO applies to equipment intended to collect and record parameters that reflect the state and performance of an aircraft for the purposes of accident or incident investigations or flight analysis.

c. **Failure Condition Classification.** Failure of the function defined in paragraph 3.b of this TSO is a *minor* failure condition. Develop the system to at least the design assurance level equal to this failure condition classification.

d. **Environmental Qualification.** Test the equipment according to RTCA, Inc. document RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004, or most current revision.

e. **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 most current revision. The software design assurance level should be consistent with the failure classification defined in paragraph 3.c.

f. **Electronic Hardware Qualification.** If the article includes a complex micro-coded component, develop the component according to 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 defined in paragraph 3.c.

h. **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 equipment maintains an equivalent level of safety. Apply for a deviation under 14 CFR § 21.609 before submitting your data package.

4. **MARKING.** Mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d).

a. 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.

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: You must differentiate similar software and/or hardware versions, approved to different software levels and/or hardware design assurance levels, by part number.

c. When applicable, identify the equipment as an incomplete system or that the appliance performs functions beyond those described in paragraph 3.b of this TSO.

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 installation /instruction manual (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 FDR system, when installed according to the installation procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. 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 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 FDR system 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 the installed FDR system. 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. A list of all drawings and processes (including revision level), to 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 qualifications form as described in RTCA/DO-160E for each component of the system.
- m. If the article 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 article includes a complex 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.

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 12 months after TSOA or LODA.
- d. Schematic drawings.
- e. Wiring diagrams.
- f. Material and process specifications.
- g. The results of the environmental qualification tests conducted per RTCA/DO-160E, or most current revision.
- h. If the article 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 article includes a complex 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.
- j. The additional information listed in ED-112, Chapter 2-1.3.4.

7. FURNISHED DATA REQUIREMENTS. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide the following for each article manufactured under this TSO:

- a. 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, and use, or for continued airworthiness, or both, of the FDR system.
- b. If the article performs functions beyond those described in paragraph **3.b** of this TSO, send one copy of the data in paragraphs **5.l** through **5.n**.

8. HOW TO GET REFERENCED DOCUMENTS.

- a. Order RTCA documents from RTCA Inc., 1828 L Street, N.W., Suite 805, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies from the RTCA Internet website at www.rtca.org.
- b. Order EUROCAE ED-112 from EUROCAE, 17 Rue Hamelin, 75783 Paris Cedex 16, France. Telephone 33 1 45 05 71 88, fax 33 1 45 05 72 30. You can also order copies from the EUROCAE Internet website at www.eurocae.org.
- c. Order copies of 14 CFR parts 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 advisory circulars on the FAA Internet website Regulatory and Guidance library at www.airweb.faa.gov/rgl. You will also find the TSO Index of Articles at the same site.

/S/ Susan J. M. Cabler

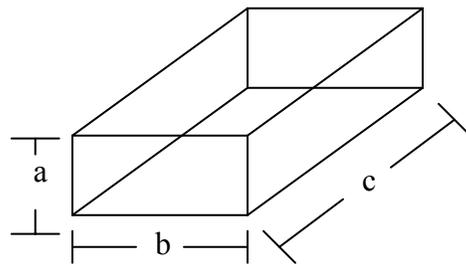
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Aircraft Certification Service

APPENDIX 1. FAA STANDARDS FOR CRASH PROTECTED ENCLOSURES

1. Physical Size. As technology allows for increased miniaturization, manufacturers continue to shrink the crash enclosure. Consequently, enclosures can be very difficult to find in wreckage. Compliance with the following dimensions will enable investigators to locate crash protected enclosures after an accident or incident. The sum of the height (a), width (b), and depth (c) of the crash enclosure must be 9 inches or greater. Each of these major dimensions must be 2 inches or greater. (Do not include the dimensions of the underwater locator beacon (ULB) or its attachment hardware in the 9-inch requirement.) Following paragraph 2, below, are five examples of a crash enclosure and the minimum required dimensions:

2. Identification. Paint the crash enclosure according to 14 CFR §§ 23.1459(d), 25.1459(d), 27.1459(d), or 29.1459(d) and mark it identically to paragraph 4 of this TSO.

Figure 1. Crash enclosure shaped like a rectangular prism.



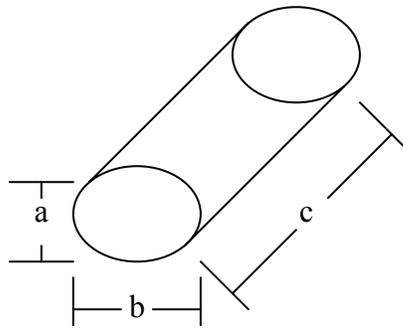
$$a, b, c \geq 2.0 \text{ inches}$$

$$a + b + c \geq 9 \text{ inches}$$

APPENDIX 1. FAA STANDARDS FOR CRASH PROTECTED ENCLOSURES, continued

Figure 2. Crash enclosure shaped like an elliptical cylinder.

Apply minimum dimensions to the major axis (a), minor axis (b), and length (c) of the enclosure.



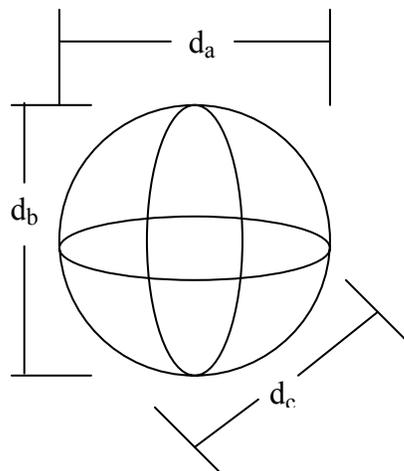
$$a, b, c \geq 2.0 \text{ inches}$$

$$a + b + c \geq 9.0 \text{ inches}$$

APPENDIX 1. FAA STANDARDS FOR CRASH PROTECTED ENCLOSURES, continued

Figure 3. Crash enclosure shaped like a sphere.

Height, width, and depth are all equal to the diameter of the sphere which must be equal to or greater than 3.0 inches because of the $a + b + c \geq 9$ inches requirement



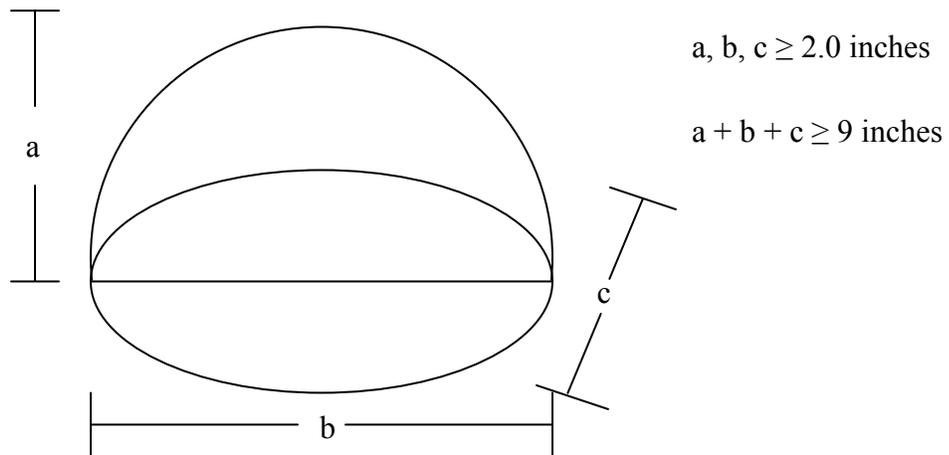
$$(d_a = d_b = d_c) \geq 3.0 \text{ inches}$$

$$d_a + d_b + d_c \geq 9 \text{ inches}$$

APPENDIX 1. FAA STANDARDS FOR CRASH PROTECTED ENCLOSURES, continued

Figure 4. Crash enclosure shaped like an ellipsoid hemisphere.

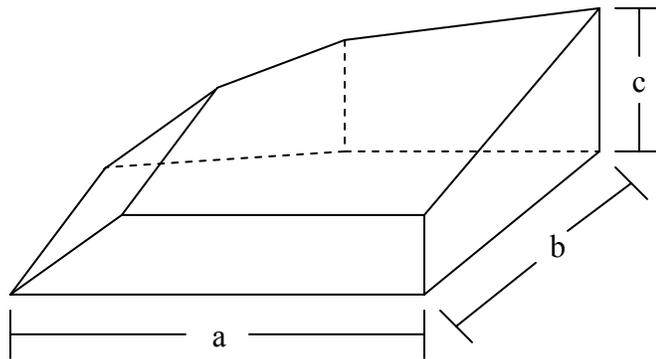
Dimensions a, b and c are not necessarily equal.



APPENDIX 1. FAA STANDARDS FOR CRASH PROTECTED ENCLOSURES, continued

Figure 5. Crash enclosure is generically shaped.

Width (a) is the largest width of the enclosure, depth (b) is the largest depth of the enclosure and height (c) is the largest height of the enclosure. Take each of these major dimensions from the outer surface of the enclosure. Do not include any protrusions such as mounting flanges or plates.



$$a, b, c \geq 2.0 \text{ inches}$$

$$a + b + c \geq 9 \text{ inches}$$