



# Technical Standard Order

## Proposed

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**Subject: COCKPIT VOICE RECORDER EQUIPMENT**

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers of cockpit voice recorder (CVR) equipment 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 standard (MPS) your CVR 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.

a. Prior revisions to this TSO are no longer effective. Generally we will not accept applications submitted for prior revisions of this TSO after this TSO's effective date. However, we may do so up to six months after this TSO's effective date, if we know that you were working against the earlier MPS before this change became effective.

b. CVR equipment approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.

c. Major design changes to CVR equipment approved under this TSO will require a new authorization under this TSO. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

d. TSOs that may be used in conjunction with this TSO are those covering:

- Flight data recorder equipment,
- Image recorder equipment,
- Data link recorder equipment, and
- Recorder independent power supply.

3. **REQUIREMENTS.** New models of CVR equipment 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) document ED-112, *Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems*, dated March 2003. The table below lists recorder types and the ED-112 section or part with the MPS for each:

**Table 1. Recorder MPS Requirements**

<b>Recorder Type</b>	<b>ED-112 Reference</b>
CVR	Section 2 and Part I (exclude Annexes)
CVR function in deployable recorder	Section 2, Part I (exclude Annexes), and Section 3
CVR function in combined recorder	Section 2, Part I (exclude Annexes), and Section 4

See Appendix 1 for size and shape standards for crash protected enclosures.

**a. Exceptions to ED-112.** We make the following two exceptions to ED-112 to comply with 14 CFR requirements:

- *Recorder start and stop times, Chapter 2-1.5:* We don't require Chapter 2-1.5 as part of this TSO. Start and stop times must comply with applicable 14 CFR operational regulations.
- *Recorder location, Chapter 2-5.4.1:* We don't require Chapter 2-5.4.1 as part of this TSO. Recorder location must comply with applicable 14 CFR certification regulations.

**b. Functionality.** This TSO's standards apply to a device that uses a combination of microphones and other audio and digital inputs to collect and record the aural environment of the cockpit including communications among flight crew members.

**c. Failure Condition Classification.** Develop the system to at least the design assurance level associated with the failure condition classification in the table below:

**Table 2. Classifications of Failure Conditions for Recorders**

<b>Recorder Type</b>	<b>Failure Classification</b>
CVR	Minor
CVR function in deployable recorder	Major
CVR function in combined recorder:	

• Airplane or rotorcraft with two recorders	Minor
• Rotorcraft with one combined recorder	Major

**d. Design Assurance Level Guidance.**

- For systems, use SAE International's Aerospace Recommended Practice (ARP) 4754, *Considerations for Highly Integrated or Complex Aircraft Systems*, dated November 1, 1996, or the most current revision.
- For hardware, use RTCA, Inc. document RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, dated April 19, 2000, or the most current revision.
- For software, use EUROCAE/RTCA document ED-12B/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992, or the most current revision, and
- For safety objectives for different installations, see the latest versions of FAA advisory circulars (AC) 23.1309-1C, AC 25-1309-1A, AC 27-1B and AC 29-2C (for 14 CFR part 23, 25, 27 and 29 certificated aircraft, respectively).

**e. Functional Qualification.** Demonstrate the required performance listed under the test conditions in ED-112.

**f. 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.

**g. Software Qualification.** If the article includes a digital computer, develop the software according to RTCA/DO-178B, or the most current revision, and to the design assurance level specified in ED-112, paragraph 2-1.9.

**h. Electronic Hardware Qualification.** If the article contains electronic devices whose functions cannot be feasibly evaluated by test or analysis, develop the electronic hardware according to RTCA/DO-254, or the most current revision.

**i. 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.**

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

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

(2) 14 CFR § 21.607(d)(3). Use both the date of manufacture and product 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 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.

**NOTE:** Similar software versions, approved to different software levels, must be differentiated by part number.

**d.** If applicable, identify deviations granted to the article 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), LODA applicants submit the same data through their civil aviation authority:)

**a.** Installation procedures and limitations in an installation/instruction manual (IM), sufficient to ensure that the CVR equipment, when installed according to the installation procedures, still meets this TSO's requirements. Describe any deviations in detail. If needed, identify equipment by part number, version, revision, and criticality level of software, classification for use, and environmental categories.

**b.** Installation procedures and limitations in an IM, sufficient to ensure that the CVR equipment, when installed according to installation procedures, still meets this TSO's requirements. Limitations must identify 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 in accordance with the applicable airworthiness requirements and, if applicable, the requirements of 14 CFR part 43.

- 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 CVR equipment 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 CVR equipment. Include recommended inspection intervals and service life.
- g. Material and process specifications list.
- h. The quality control system description (QCS) required by 14 CFR §§ 21.143 and 21.605(a)(3), including functional test specifications. The QCS tests each production article to ensure compliance with this TSO. (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 drawings and processes (including revision level), to define the article's design. For a minor change, you only need to make the revision to the list available on request.
- l. An environmental qualifications form as described in RTCA/DO-160E, or the most current revision, 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.

**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 RTCA/DO-160E, or the most current revision.
- h. If the article includes a microprocessor, the appropriate documentation defined in RTCA/DO-178B, or the most current revision, including all data supporting the applicable objectives in Annex A, Process Objectives and Outputs by Software Level.

**7. FURNISHED DATA REQUIREMENTS.** If giving one or more articles to one source (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 other data needed for the proper installation, certification, and use, or for continued airworthiness, or both, of the CVR equipment.
- b. One copy of the data in paragraphs **5.k** through **5.m**, if the appliance performs functions beyond those described in paragraphs **3** and **3.c** of this TSO.

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

- a. Order RTCA documents from RTCA Inc., 1828 L Street, N.W., Suite 805, Washington, D.C. 20036-4001. Telephone (202) 833-9339, fax (202) 833-9434. You can also order through the RTCA Internet website at [www.rtca.org](http://www.rtca.org).
- b. Order EUROCAE documents from EUROCAE, 17 rue Hamelin, 75116 Paris France. Telephone 33 (0) 1 4505 7188, fax 33 (0) 1 4505 7230. You can also order from the EUROCAE Internet website at [www.eurocae.org](http://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 from the Government Printing Office, electronic CFR Internet website at [www.gpoaccess.gov/ecfr](http://www.gpoaccess.gov/ecfr). Select "Title 14, Aeronautics and Space."
- d. 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](http://www.sae.org).

e. You can find a current list of technical standard orders on the FAA Internet website Regulatory and Guidance Library at [www.airweb.faa.gov/rgl](http://www.airweb.faa.gov/rgl). At the same site you will find the TSO Index of Articles, and if you select “Advisory Circulars,” you’ll be able to view and download all referenced FAA ACs.

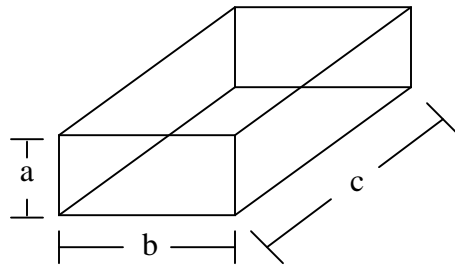
David W. Hempe  
Manager, Aircraft Engineering Division  
Aircraft Certification Service

**APPENDIX 1. FEDERAL AVIATION ADMINISTRATION  
STANDARDS FOR CRASH PROTECTED ENCLOSURE**

**1. Physical Size.** As technology allows for increased miniaturization, manufacturers continue to shrink the crash enclosure. Now, the enclosure can be very difficult to find in wreckage. The sum of the height (a), width (b), and depth (c) of the crash enclosure must be 10 inches or greater. Each of these major dimensions must be 2 inches or greater. Here are five examples of a crash enclosure and the minimum required dimensions:

**2. Identification.** Paint the crash enclosure according to 14 CFR §§ 23.1457(g), 25.1457(g), 27.1457(g), or 29.1457(g) and mark it identically to the CVR box in paragraph 4 of this TSO.

**Figure 1. Crash enclosure shaped like a rectangular prism**



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

$$a + b + c \geq 10.0 \text{ inches}$$

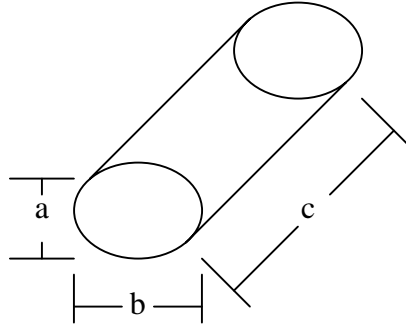
**APPENDIX 1. FEDERAL AVIATION ADMINISTRATION  
STANDARDS FOR CRASH PROTECTED ENCLOSURE, Continued**

**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.

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

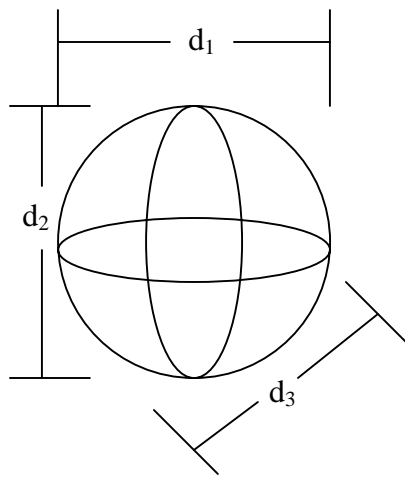
$$a + b + c \geq 10.0 \text{ inches}$$



**APPENDIX 1. FEDERAL AVIATION ADMINISTRATION  
STANDARDS FOR CRASH PROTECTED ENCLOSURE, 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 3.33 inches because of the,  $a + b + c \geq 10$  inches, requirement.



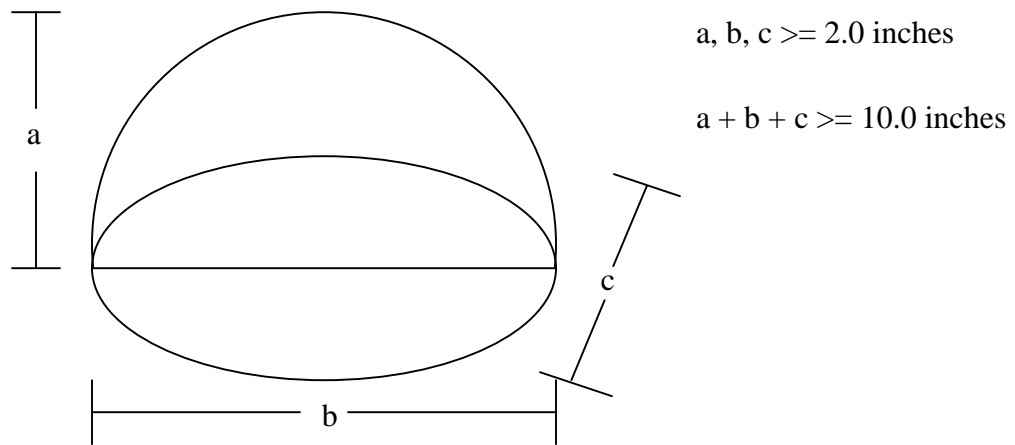
$$d_i \geq 3.33 \text{ inches}$$

$$d_1 + d_2 + d_3 \geq 10.0 \text{ inches}$$

**APPENDIX 1. FEDERAL AVIATION ADMINISTRATION  
STANDARDS FOR CRASH PROTECTED ENCLOSURE, Continued**

**Figure 4. Crash enclosure shaped like an ellipsoid hemisphere**

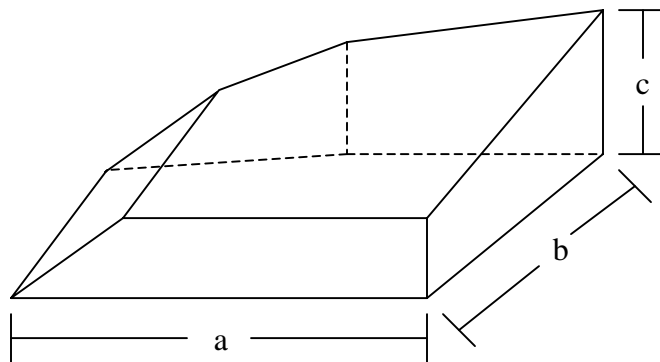
Dimensions a, b, and c are not necessarily equal.



**APPENDIX 1. FEDERAL AVIATION ADMINISTRATION  
STANDARDS FOR CRASH PROTECTED ENCLOSURE, 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.



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

$$a + b + c \geq 10.0 \text{ inches}$$