English Translation Version for Reference Only

Number：CTSO-C200a
Date of approval：Dec 8, 2018
Approved by：Xu Chaoqun

China Civil Aviation Technical Standard Order

This China Civil Aviation Technical Standard Order (CTSO) is issued according to Part 37 of the China Civil Aviation Regulations (CCAR-37). Each CTSO is a criterion which the concerned aeronautical materials, parts or appliances used on civil aircraft must comply with when it is presented for airworthiness certification.

Airframe Low Frequency Underwater Locating Device (Acoustic) (Self-Powered)

1. Purpose.

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for Airframe Low Frequency Underwater Locating Device (ULD) (acoustic) (self-powered) CTSO authorization (CTSOA). This CTSO prescribes the minimum performance standards(MPS) that Airframe Low Frequency Underwater Locating Device (ULD) (acoustic) (self-powered) must first meet for approval and identification with the applicable CTSO marking.

2. Applicability.

This CTSO affects new application submitted after its effective date. Major design changes to article approved under this CTSO will require a new authorization in accordance with section 21.353 of CCAR-21R4.

3. Requirements.

New models of Airframe Low Frequency Underwater Locating Devices (acoustic) (self-powered) identified and manufactured on or after the effective date of this CTSO must meet the MPS qualification and documentation requirements in section 3 and 4 of SAE International's Aerospace Standard (AS) 6254A, Minimum Performance Standard for Low Frequency Underwater Locating Devices (Acoustic) (Self-Powered), dated December 6, 2015. The battery used in the ULD authorized under this CTSO must meet the minimum performance standard found in the applicable battery CTSO such as CTSO-C142a, Non-Rechargeable Lithium Cells and Batteries for ULD powered by Lithium primary batteries. Lithium powered ULD must also meet the requirements in appendix 1 of this CTSO in addition to its battery meeting CTSO-C142a.

a. Functionality. This CTSO's standards apply to equipment intended for a ULD operating at a low frequency of 8.8 kHz which extends the detection range and facilitates general position identification of a submerged aircraft. The Airframe Low Frequency ULD is intended to be mounted directly to the aircraft airframe as a supplement to the existing CTSO-C121 ULDs which are attached directly to the crash protected recorders.

b. Failure Condition Classifications.

(1) Failure of the function defined in paragraph 3.a is a minor failure

condition.

(2) Loss of the function defined in paragraph 3.a is a minor failure condition.

(3) Design the system to at least these failure condition classifications.

c. Functional Qualification. Demonstrate the required functional performance under the test conditions specified in AS6254A, sections 5, 6 and 7. Demonstrate the required battery containment performance under the test conditions in appendix 1 of this CTSO.

d. Environmental Qualification.

(1) Demonstrate the required performance under the test conditions specified in SAE AS6254A, section 5 using standard environmental conditions and test procedures appropriate for airborne equipment. You may use a different standard environmental condition and test procedure than RTCA/DO-160G, provided the standard is appropriate for the Airframe Low Frequency ULD equipment. Demonstrate the required battery containment performance under the test procedures in appendix 1 of this CTSO using standard environmental conditions and test procedures appropriate for airborne equipment.

Note: The use of RTCA/DO-160D (with Changes 1 and 2 only incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in

paragraph 3.f of this CTSO.

(2) Demonstrate the saltwater immersion tests in SAE AS6254A section 5.13 using a seawater solution meeting the requirements of ASTM D1141-98, Standard Practice for the Preparation of Substitute Ocean Water, dated 2008.

e. Software Qualification. If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178C, Software Considerations in Airborne Systems and Equipment Certification, dated December 13, 2011 to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this CTSO. You may also develop the software according to RTCA, Inc. document RTCA/DO-178B, dated December 1, 1992.

f. Deviations. For using alternative or equivalent means of compliance to the criteria in this CTSO, the applicant must show that the equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 21.368(a) in CCAR-21R4.

4. Marking.

a. Mark at least one major component permanently and legibly with all the information in 21.423(b) of CCAR-21R4.

b. Also, mark the following permanently and legibly, with at least the manufacturer’s name, subassembly part number, and the CTSO

number:

(1) Each component that is easily removable (without hand tools); and,

(2) Each subassembly of the article that you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. Electronic part marking may be used to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. Application Data Requirements.

The applicant must furnish the responsible certification personnel with the related data to support design and production approval. The application data include a statement of conformance as specified in section 21.353(a)(1) in CCAR-21R4 and one copy each of the following technical data:

a. A Manual(s) containing the following:

(1) Operating instructions and article limitations sufficient to describe the equipment's operational capability.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the Airframe Low Frequency ULD, when installed according to the installation or operational procedures, still meets this CTSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

"This article meets the minimum performance and quality control standards required by a CTSO. Installation of this article requires separate approval."

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

(i) Software part number including revision and design assurance level;

(ii) Airborne electronic hardware part number including revision and design assurance level;

(iii) Functional description.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as

described in RTCA/DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the Airframe Low Frequency ULD.

(7) List of replaceable components, by part number, that makes up the Airframe Low Frequency ULD (acoustic) (self-powered). Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, to ensure that the Airframe Low Frequency ULD continues to meet the CTSO approved design. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. A drawing depicting how the article will be marked with the information required by paragraph 4 of this CTSO.

e. Identify functionality or performance contained in the article not evaluated under paragraph 3 of this CTSO (that is, non-CTSO functions). Non-CTSO functions are accepted in parallel with the CTSO authorization. For those non-CTSO functions to be accepted, the applicant must declare these functions and include the following

information with CTSO application:

(1) Description of the non-CTSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-CTSO function(s) do not interfere with the article's compliance with the requirements of paragraph 3.

(2) Installation procedures and limitations sufficient to ensure that the non-CTSO function(s) meets the declared functions and performance specification(s) described in paragraph 5.e.(1).

(3) Instructions for continued performance applicable to the non-CTSO function(s) described in paragraph 5.e.(1).

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph 5.e.(1).

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting CTSO article is not affected by the non-CTSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-CTSO function(s) as described in paragraph 5.e.(1).

f. The quality system description required by section 21.358 of CCAR-21-R4, including functional test specifications. The quality system

should ensure that it will detect any change to the approved design that could adversely affect compliance with the CTSO MPS, and reject the article accordingly.

g. Material and process specifications list.

h. List of all drawings and processes (including revision level) that define the article's design.

i. Manufacturer's CTSO qualification report showing results of testing accomplished according to paragraph 3.c of this CTSO.

6. Manufacturer Data Requirements.

Besides the data given directly to the authorities, have the following technical data available for review by the authorities:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this CTSO.

b. Article calibration procedures.

c. Schematic drawings.

d. Wiring diagrams.

e. Material and process specifications.

f. The results of the environmental qualification tests conducted according to paragraph 3.d of this CTSO.

g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B or RTCA/DO-178C specified in paragraph

3.e of this CTSO, including all data supporting the applicable objectives in RTCA/DO-178B Annex A, Process Objectives and Outputs by Software Level.

h. If the article contains non-CTSO function(s), you must also make available items 6.a through 6.g as they pertain to the non-CTSO function(s).

7. Furnished Data Requirements.

a. If furnishing one or more articles manufactured under this CTSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs 5.a and 5.b of this CTSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the CTSO, of the Airframe Low Frequency ULD.

b. If the article contains declared non-CTSO function(s), include one copy of the data in paragraphs 5.e.(1) through 5.e.(4).

8. Availability of Referenced Documents.

a. Order SAE documents from:

Society of Automotive Engineers, Inc.

400 Commonwealth Drive, WARRENDALE, PA 15096-001, USA.

You may also order them online from www.sae.org.

b. Order RTCA documents from:

Radio Technical Commission for Aeronautics, Inc.

1150 18th Street NW, Suite 910, Washington D.C. 20036

You may also order them online from www.rtca.org.

c. Order ASTM documents from:

100 Barr Harbor Drive, P.O. Box C700, West Conshohocken,

PA 19428-2959, USA

You may also order them online from www.astm.org.

Appendix 1. Lithium Battery Containment Requirements

The Airframe Low Frequency ULD must provide the containment of any hazardous products of the failure of its internal lithium battery without additional external containment devices other than the mounting bracket. Include the following note in the installation instructions required in paragraph 5.a.(3) of this CTSO.

Note: The ULD is intended to be mounted to the structure of the aircraft and provide a locating signal after a crash in water. Placing the ULD inside a containment vessel will prevent it from performing its intended function of transmitting low frequency ultrasonic pulses to aid the location of the mishap aircraft.

Sections 1.5, 1.6, 1.7 and 2 of RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013, provide safety, design and qualification requirements and guidelines pertinent to designing safe batteries meeting part 23, 25, 27 and 29 requirements and additional Special Conditions (SC) required for installation for the low frequency ULD on aircraft. Consider each of these requirements and guidelines when designing cells and batteries.

The requirements below include tests from RTCA/DO-347. Although written for rechargeable lithium batteries, the authorities

consider these tests appropriate for demonstrating that non-rechargeable lithium batteries meet the SCs where indicated below. When conducting these tests and the test method states “charge the battery in accordance with the manufacturer’s instructions”, use a battery with a 100% state of charge instead.

1. Lithium Primary Batteries used in Airframe Low Frequency ULD must independently:

a. Meet the requirements in CTSO-C142a, Non-rechargeable Lithium Cells and Batteries, paragraph 3, and

b. Pass the tests in CTSO-142a, Appendix 1, Table 2, and

c. Pass the following tests in RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013, as follows:

(1) Section 2.3.7 Short-circuit Test of a Cell

(2) Section 2.3.9 Short-circuit Test with Protection Disabled (required only for multi-cell batteries)

(3) Section 2.3.10 Insulation Resistance Test

Note: Transport Aircraft Directorate (TAD) SC 1 requires each individual cell within a battery be designed to maintain safe temperatures and pressures. TAD SC 2 addresses these same issues but at the battery level. SC 2 requires the battery to be designed to prevent propagation of a thermal event (i.e., self-sustained, uncontrolled increases in temperature

or pressure) from one cell to adjacent cells. Current SCs are available from the TAD Transport Airplane Issues (TAI) List.

2. The Airframe Low Frequency ULD with a primary lithium battery by itself or installed in its mounting bracket must pass the Section 2.3.15 Thermal Runaway Containment Test in RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013. Do not compromise the integrity of the ULD to instrument or trigger the internal battery. Induce thermal runaway with either a. or b. below then complete c.

a. Perform step e. of test method RTCA/DO-347 2.3.15.1 in lieu of RTCA/DO-347 2.3.15.1 steps c. and d. Step b is not required to complete step e. Apply the heating element to the exterior of the Airframe Low Frequency ULD or heat the ULD in a test chamber for this test to maintain the integrity of the item under test. Use of a test chamber heated to just above the triggering temperature will facilitate more accurate measurements of the ULD case temperature during the runaway.

b. Alternate method to induce a thermal runaway

In a cell closest to the center of the battery:

(1) Connect the terminals of a single electrically isolated cell to a power supply set to a constant voltage of at least 1.5 times the rated nominal cell voltage and charge with a current limit of I1 (or Imax if less than I1) of a single cell (+/- 50mA).

(2) Monitor the battery voltage during charge and terminate the charge when the peak voltage is reached.

(3) Subject the cell to a direct short circuit of less than 5 mOhm.

(4) Install the battery into the ULD (and bracket, as necessary) prior to the onset of Thermal Runaway.

(5) Monitor and record the battery voltage and current, the ULD case temperature, the ULD bracket temperature and continue with RTCA/DO-347 2.3.15.2 step g.

c. For RTCA/DO-347 2.3.15.1 steps g. and h., monitor and record the test chamber temperature and the external temperature of the ULD. Verify post-test that the battery did in fact experience thermal runaway by observing the ULD contained decomposition products akin to those obtained from conducting this test on a bare battery.

3. The ULD or the ULD in its mounting bracket must contain all non-gaseous products of 2 above. O-ring residue is acceptable. If any gasses are emitted, they must be emitted through a consistent, repeatable location such as around the closure threads or through a venting port.

Note 1: TAD SC 3 does allow explosive and toxic gases to be uncontained and not vented overboard if they do not accumulate in hazardous quantities.

Note 2: The authorities may impose additional special condition requirements for installation. Installers may use CTSO test data,

including the battery containment test data as part of the certification package in showing compliance with an authorities' installation special condition.

4. In the manual required in paragraph 5.a.(3) of this CTSO, document the test results to include the nature and volume of any gasses emitted, maximum case temperature during a thermal runaway, and whether or not the mounting bracket was required to attain containment. If venting occurs, document the location in the data required in paragraph 5.a.(6) of this CTSO so that installers may design and fabricate appropriate venting systems that will not interfere with the intended function of the ULD as described in the Note at the beginning of this Appendix. If the applicant choses to incorporate a venting port in the ULD and/or ULD mounting bracket, document the interface in paragraph 5.a.(6) of this CTSO.

5. Develop a means to prevent inadvertent opening of ULDs with failed batteries that may be under internal pressure. This may include voltage or external temperature checks prior to opening the device. Include any appropriate Cautions and Warnings and document in the manual required in paragraph 5.b of this CTSO.