



Number: CTSO-C179b

Date of approval: January 17, 2024

Approved by: Xu Feng

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.

Rechargeable Lithium Batteries and Battery Systems

1. Purpose.

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for Rechargeable Lithium Batteries and Battery Systems CTSO authorization (CTSOA). This CTSO specifies the minimum performance standards that rechargeable lithium batteries and battery systems must meet for approval and identification with the applicable CTSO marking.

2. Applicability.

This CTSO affects new applications submitted after its effective date.

a. Since the effective date of this CTSO, applicants who wish to obtain the CTSOA of Rechargeable Lithium Batteries and Battery Systems should submit applications in accordance with this CTSO. CTSO-C179a will also remain effective until 6 months from this CTSO

release. After this date, Civil Aviation Administration of China (CAAC) will no longer accept new applications for CTSO-C179a.

b. Since the effective date of this CTSO, equipment approved under CTSO-C179a may still be manufactured under the provisions of its original approval.

c. Major design changes to article approved under this CTSO will require a new authorization in accordance with Section 21.353 of CCAR-21-R4.

3. Requirements.

New models of rechargeable lithium cells and lithium batteries and battery systems identified and manufactured on or after the effective date of this CTSO must meet the minimum performance standards (MPS) and documentation requirements in section 1 and section 2 of RTCA document, DO-311A, Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems, dated December 19, 2017. The CAAC did not acknowledge Appendix C of RTCA/DO-311A. Section 1.4.1 and section 1.4.2 of RTCA/DO-311A lists the energy categories and venting categories. Testing will be based on these categories and must be identified as such in paragraph 4 of this CTSO.

a. Functionality.

This CTSO's standards apply to equipment with rechargeable lithium cells, lithium batteries and battery systems intended to provide

power for aircraft equipment, including emergency systems. It should be noted that the standards specified in this CTSO do not extend to rechargeable lithium cells, lithium batteries, and battery systems intended to provide power for aircraft propulsion systems.

b. Failure Condition Classifications.

There is no standard minimum failure condition classification for this CTSO. The failure condition classification appropriate for the equipment will depend on the intended use of the equipment in a specific aircraft. Document the loss of function and malfunction failure condition classification for which the equipment is designed.

c. Functional Qualification

Demonstrate the required functional performance in section 2.2.1 of RTCA/DO-311A under the test conditions specified in section 2.4.4 of RTCA/DO-311A.

d. Environmental Qualification.

Demonstrate the required performance, under the test conditions specified in section 2.3 of RTCA/DO-311A, (Note: The test conditions directly quote the chapters of RTCA/DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment, dated December 8, 2010), using standard environmental conditions and test procedures appropriate for airborne equipment. Applicants may use a different standard environmental condition and test procedure than

RTCA/DO-160G provided the standard is appropriate for the rechargeable lithium cells, lithium batteries and battery systems.

Note: The use of RTCA/DO-160D (with Changes 1 and 2 only) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph 3.g of this CTSO.

e. Software Qualification.

If the article includes software, develop the software according to RTCA/DO-178C, Software Considerations in Airborne Systems and Equipment Certification, dated December 13, 2011, including referenced supplements as applicable, to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this CTSO. If RTCA/DO-178B, dated December 1, 1992, is used as a method of software development compliance, CAAC reserves the right to require applicants to meet additional requirements in addition to RTCA/DO-178B.

f. Electronic Hardware Qualification.

If the article includes complex custom airborne electronic hardware, develop the component according to RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, dated April 19, 2000, to at least the design assurance level consistent with the failure condition classification defined in paragraph 3.b of this CTSO. For custom airborne

electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

g. Deviations.

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

4. Marking.

a. Mark each battery and battery system permanently and legibly with all of the information in Section 21.423(b) of CCAR-21-R4 and Section 2.1.3 of RTCA/DO-311A. The marking must include the serial number.

b. Mark the article based on the following table: Label the CTSO as CTSO-C179b CLASS A-XY or CTSO-C179b CLASS B-XY, as shown below (where -X stands for energy category and Y stands for venting category):

CTSO-C179b CLASS A: During the RTCA/DO-311A section, 2.4.5.5 Battery Thermal Runaway Containment Test, all cells within the battery enter thermal runaway.

CTSO-C179b CLASS B: During the RTCA/DO-311A section, 2.4.5.5 Battery Thermal Runaway Containment Test, not all cells within the battery enter thermal runaway.

Energy Category (X)	Venting Category (Y)
1	A
1	B
1	C
2	A
2	B
2	C
3	A
3	B
3	C
4	A
4	B
4	C

(For example: CTSO-C179b CLASS B-1A would be a rechargeable lithium battery and battery system that is of energy category 1 and a venting category A and not all the cells entered thermal runaway during RTCA/DO-311A section 2.4.5.5 testing.)

c. Mark following components permanently and legibly, including the manufacturer's name, subassembly part number, and CTSO number:

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

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

d. 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.

e. The applicant may use electronic part marking to identify software

and 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 give CAAC a statement of conformance, pursuant to Section 21.353(a)(1) in CCAR-21-R4 and one copy each of the following technical data to support the design and production approval.

a. Manuals containing the following:

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

(2) Detailed description of all deviations.

(3) A summary of test results including pass/fail criteria and the required reportable information according to paragraph 3 of this CTSO.

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

“This article meets the minimum requirements of technical standard

order. Installation of this article requires separate approval.”

(5) 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.

(6) A summary of the test conditions used for environmental qualifications for each component of the article. For example, drafting a form as described in RTCA/DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment, Appendix A.

(7) Schematic drawings, wiring diagrams, and any other documentation necessary for installation.

(8) By-part-number list of replaceable components that makes up the article. Include vendor part number cross-references, when applicable.

b. Instruction of continued airworthiness, including the requirements for periodic maintenance, calibration, and repair of equipment, to ensure that the article continues to meet the CTSO approved design. If applicable, the recommended inspection interval and service life should be included.

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

accomplishment summary.

d. If the article includes simple or complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

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

f. Identify functionality contained in the article not evaluated under paragraph 3 of this CTSO (defined as non-CTSO functions). Non-CTSO functions are accepted in parallel with the CTSOA. For those non-CTSO functions to be accepted, applicant must declare these functions and include the following information with the 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.f.(1).

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

(4) Interface requirements and applicable installation test procedures to ensure compliance with the non-CTSO function(s) data defined in paragraph 5.f.(1).

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

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

g. The quality system description required by Section 21.358 of CCAR-21-R4, including functional test specifications. The quality system must ensure that you will detect any change to the approved design that could adversely affect compliance with the CTSO MPS, and reject the article accordingly. Applicants who currently hold CTSOAs must submit revisions to the existing quality manual as necessary (not required for applicants that don't hold CTSOAs).

h. Provide a description of the organization as required by Section 21.355 of CCAR-21-R4.

i. Material and process specifications list.

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

k. Manufacturer's CTSO qualification report showing results of

testing accomplished according to paragraph 3.c of this CTSO.

1. One copy of the test results including methods, data and test reports from testing in accordance with paragraph 3 of this CTSO.

6. Manufacturer Data Requirements.

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

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 Annex A, Process Objectives and Outputs by Software Level of RTCA/DO-178B or RTCA/DO-178C.

h. If the article includes complex custom airborne electronic hardware, the appropriate hardware life-cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table

A-1. For simple custom airborne electronic hardware, the following data are required: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

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

7. Furnished Data Requirements.

a. When furnishing one or more articles manufactured under this CTSO to one entity (such as an operator or repair station), provide one copy 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 continued compliance with this CTSO.

b. If the article contains declared non-CTSO function(s), include one copy of the data in paragraphs 5.f.(1) through 5.f.(6).

8. Availability of Referenced Documents.

Order RTCA documents from RTCA Inc. 1150 18th Street NW, Suite 910, Washington, D.C. 20036. You can also order copies online at www.rtca.org.

Appendix 1 Minimum Operational Performance Standard for Rechargeable Lithium Batteries and Battery Systems

This appendix prescribes the minimum performance standards (MPS) for airplane galley insert equipment. The applicable standard is RTCA/DO-311A, Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems, dated December 19, 2017. We modified it as follows:

RTCA/DO-311A	Current Wording	Modified Wording
1.7 References		Addition: “GB/T 38031-2020 Safety requirements for traction batteries for electric vehicles.” Addition: “GB/T 31486-2015 Electrical performance requirements and test methods for traction batteries for electric vehicles.”
1.8 Definition of Terms	Thermal Runaway: Rapid self-sustained heating of a battery cell driven by exothermic chemical reactions of the materials within the cell. Thermal runaway is generally evidenced by a sharp increase in temperature and pressure and a drop in cell voltage.	Thermal Runaway: Rapid self-sustained heating of a battery cell driven by exothermic chemical reactions of the materials within the cell. Thermal runaway is generally evidenced by a sharp increase in temperature and pressure and a drop in cell voltage. The criteria for thermal runaway determination are as follows: a) The triggering entity experiences a voltage drop, with a decrease exceeding 25% of the initial voltage. b) The temperature at the monitored location reaches the maximum working temperature specified by the manufacturer.

		<p>c) The rate of temperature rise at the monitored location, represented as $dT/dt > 1^{\circ}\text{C/s}$ and sustains for a minimum duration of 3 seconds.</p> <p>The occurrence of thermal runaway is determined when either a) & c) or b) & c) are satisfied.”</p>
1.8.1 Acronyms and Abbreviations		<p>Addition : CAAC Civil aviation administration of China;</p> <p>Addition : CTSO China Technical Standard Order.</p>
2.1.3.1 Standalone Battery Marking	<p>c. In addition, the following information should be included as applicable.</p> <ol style="list-style-type: none"> 1. Qualification marking (TSO, ETSO, UL, UN, etc.) 2. Modification numbers or letters 3. Weight 	<p>c. In addition, the following information should be included as applicable.</p> <ol style="list-style-type: none"> 1. Qualification marking (CTSO, TSO, ETSO, UL, UN, etc.) 2. Modification numbers or letters 3. Weight
2.1.3.1 Standalone Battery Marking		<p>Addition: d. The marking requirements for cells should be in accordance with the section 2.1.3.2. Embedded Battery Marking.</p>
2.2.1.6 Capacity at Low and High Temperatures	<p>The battery shall comply with the low and high temperature capacity values declared in the design documentation when discharged at the Operating Low and Operating High Temperatures (per Section 4 of RTCA/DO-160 for the category declared by the manufacturer).</p>	<p>The battery shall comply with the low and high temperature capacity values declared in the design documentation when discharged at the Operating Low and Operating High Temperatures (per Section 4 of RTCA/DO-160G for the category declared by the manufacturer).</p>
2.3.1 Environmental Performance Requirements	<p>The environmental test procedures are contained in RTCA/DO-160. The following performance requirements apply when</p>	<p>The environmental test procedures are contained in RTCA/DO-160G. The following performance requirements apply when</p>

	performing environmental tests.	performing environmental tests.
2.4.4.4.1 Test Method	a. Each handle on the EUT shall be subjected to a load of 2 times the EUT weight. The load shall be applied in a vertical upward direction.	a. Each handle on the EUT shall be subjected to a load equal to 2 times the EUT weight. The load should be applied in consistent with the direction of the handle lifting the battery."
2.4.4.13.1 Test Method for Standalone Batteries	c. With the EUT at ambient temperature, connect a 1 ohm resistor (or the minimum resistance needed to prevent overcurrent tripping) between the positive and negative terminals of the discharged EUT. The resistor shall remain connected until the EUT voltage is below 5% of the EPV.	c. With the EUT at ambient temperature, connect a 1 ohm resistor (or the minimum resistance needed to prevent overcurrent tripping) between the positive and negative terminals of the discharged EUT. The resistor shall remain connected until the EUT voltage is below 5% of the EPV. For EUT with a charge/discharge management system, over-discharge can be achieved through the management system until the EUT voltage is below 5% of the EPV.
2.4.4.13.2 Test Method for Embedded Batteries	c. With the EUT at ambient temperature, connect a 1 ohm resistor (or the minimum resistance needed to prevent overcurrent tripping) between the positive and negative terminals of the discharged battery. The resistor shall remain connected until the battery voltage is below 5% of the EPV.	c. With the EUT at ambient temperature, connect a 1 ohm resistor (or the minimum resistance needed to prevent overcurrent tripping) between the positive and negative terminals of the discharged EUT. The resistor shall remain connected until the EUT voltage is below 5% of the EPV. For EUT with a charge/discharge management system, over-discharge can be achieved through the management system until the EUT voltage is below 5% of the EPV.
2.4.5.4.1 Test Method for	i. Continue to monitor the	i. Continue to monitor the

Single Cell Thermal Runaway via Overcharging	EUT for 16 hours after the power supply has been removed.	EUT for 8 hours after the power supply has been removed.
2.4.5.4.2 Test Method for Single Cell Thermal Runaway via Overheating	h. Continue to monitor the EUT for 16 hours after the power to the heating device has been removed.	h. Continue to monitor the EUT for 8 hours after the power to the heating device has been removed.
2.4.5.5 Battery Thermal Runaway Containment Test	In this case, compliance to this standard would require coordination with the FAA or applicable regulatory agency.	In this case, compliance to this standard would require coordination with the CAAC or applicable regulatory agency.
2.4.5.5.1 Test Method Battery Thermal Runaway via Overcharging	f. Continue to monitor the EUT for 16 hours after the initial thermal runaway event.	f. Continue to monitor the EUT for 8 hours after the initial thermal runaway event.
2.4.5.5.2 Test Method for Battery Thermal Runaway via Overheating	g. Continue to monitor the EUT for 16 hours after the initial thermal runaway event.	g. Continue to monitor the EUT for 8 hours after the initial thermal runaway event.
Appendix A A.6 Shipping		Deletion: Delete “In the U.S., these regulations are found in 49 CFR Parts 100-185.”

(The English version is for reference only. In case of any discrepancy or ambiguity of meaning between this English translation and the Chinese version, the latter shall prevail.)