English Translation Version for Reference Only

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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.

Airborne Low-Range Radio Altimeter

1. Purpose.

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for airborne low-range radio altimeter CTSO authorization (CTSOA). This CTSO prescribes the minimum performance standards(MPS) that airborne low-range radio altimeters must first meet for approval and identification with the applicable CTSO marking.

2. Applicability.

This CTSO is applicable for new applications after the effective date of this CTSO.

a. The applicant must submit an application according to this CTSO after its effective date. However, up to six months after this CTSO's effective date, if the applicant could show working against the prior MPS

before the new change became effective, the application for previous revision could be accepted.

b. The CTSOA article approved under a previous CTSO may still be manufactured under the provisions of original approval after the effective date of this CTSO.

c. Major design changes to article approved under this CTSO will require a new authorization in accordance with section 21.310 of CCAR-21R3.

3. Requirements.

New models of airborne low-range radio altimeters identified and manufactured on or after the effective date of this CTSO must meet the applicable MPS qualification and documentation requirements in EUROCAE document ED-30, Minimum Performance Standards for Airborne Low-Range Radar Altimeter Equipment, Edition 2, dated March 1980, as modified by Appendix 1 of this CTSO. The applicable Chapter 2 and Chapter 3 requirements are defined in Table 1 for the appropriate functional class.

Table 1

Low-Range Radio Altimeter Functional Class	Low-Range Radio Altimeter Class Description	Applicable Requirements in ED-30
A	Approach and landing	2.1-2.8, 3.1.1, 3.2.1 (all), 3.3.1
B	Terrain Avoidance (ground proximity warning systems)	2.1-2.8, 3.1.2, 3.2.3 (all), 3.3.2

Note: It is possible for a radio altimeter to meet both functional classes.

a. Functionality. This CTSO's standards apply to equipment intended to operate in applications which provide measured height above terrain for clearance and landing data.

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 under the test conditions specified in chapters 4 and 5 of EUROCAE ED-30.

d. Environmental Qualification. Demonstrate the required performance under the test conditions specified in chapter 4 of EUROCAE document ED-30 using standard environmental conditions and test procedures appropriate for airborne equipment.

Note: The use of RTCA/DO-160A, as prescribed in ED-30, or any DO-160 revision earlier than RTCA/DO-160D Change 3 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, Inc. document RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992, to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this CTSO.

Note: The certification liaison process objectives will be considered satisfied after CAAC review of the applicable life cycle data.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, dated April 19, 2000, to 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.

Note: The certification liaison process objectives will be considered satisfied after CAAC review of the applicable life cycle data.

g. 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 21.310(b) in CCAR-21R3.

4. Marking.

a. Mark at least one major component permanently and legibly with all the information in section 21.312(d) of CCAR-21R3. The marking must include the serial number.

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 21.310(c)(3) in CCAR-21R3 and one copy each of the following technical data:

a. A Manual(s) containing the following:

(1) Operating instructions and equipment 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 airborne low-range radio altimeter, 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; and,

(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 airborne low-range radio altimeter.

(7) List of replaceable components, by part number, that makes up the airborne low-range radio altimeter. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of airborne low-range radio altimeters. 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. 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 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 your 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) don’t 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 performance data defined in paragraph 5.f.(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.f.(1).

g. The quality system description required by section 21.143 and 21.310(c)(2) of CCAR-21R3, 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.

h. Material and process specifications list.

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

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

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-l. For simple custom airborne electronic hardware, the following data: 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), the applicant must also make available items 6.a through 6.h 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 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 airborne low-range radio altimeter.

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

8. Availability of Referenced Documents.

a. 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.

b. Order EUROCAE documents from:

European Organisation for Civil Aviation Equipment

102 rue Etienne Dolet, 92240 Malakoff, France

You may also order them online from www.eurocae.net.

APPENDIX 1. MODIFICATIONS AND ADDITIONS TO EUROCAE ED-30 for MINIMUM PERFORMANCE STANDARDS FOR LOW RANGE RADIO ALTIMETERS

1.0. ED-30 REQUIREMENT MODIFICATIONS.

1.1. ED-30 Paragraph 1.3 (Radio Altimeters with Auto-Surveillance). CTSO-C87a does not include a separate category for monitoring. Design the radio altimeter to support the failure condition classification of the intended installation.

1.2. ED-30 Paragraph 2.2 (Transmitter Operating Frequency). Add the following requirement to ED-30 paragraph 2.2: The radio altimeter shall meet the requirements the authorities determined applicable.

1.3. ED-30 Paragraph 2.5 (Failure Warning). Add the following sentence to the beginning of ED-30 paragraph 2.5 to clarify that a failure detection system is required: “A failure detection system must be incorporated in the equipment to indicate to the pilot, and to any systems utilizing the radio altimeter data, of a failure of the radio altimeter to accomplish its intended function because of the following conditions: (1) Loss of power, and (2) Loss of signal or altitude sensing capability when within the manufacturer’s stated operating altitude range.”

1.4. ED-30 Paragraph 3.2.2 (Category A2). CTSO-C87a does not include Category A2. If alternate accuracy requirements not meeting the requirements of paragraph 3.2.1 are desired, the applicant should apply

for a deviation in accordance with paragraph 3.g. of this CTSO.

1.5. ED-30 Paragraph 3.2.4 (Category C). CTSO-C87a does not include Category C. If the radio altimeter has been designed and tested to tighter accuracy requirements, include the design information, test results, and limitations with the application for CTSO and document the performance in the installation manual.

1.6. ED-30 (Appendix). The ED-30 appendix references CTSO-C87 and RTCA/DO-123 for external loop loss standards. Because CTSO-C87 and DO-123 are longer current, reference RTCA/DO-155, Minimum Performance Standards Airborne Low-Range Radar Altimeters, Appendix B, for external loop loss standards.

2.0. ADDITIONAL REQUIREMENT to ED-30: Rate Data. The equipment need not provide a rate data output as a condition of compliance with this minimum performance standard. Altimeters with rate outputs must meet the following accuracy requirements for at least 95 percent of all observations for heights from the terrain to the antenna:

RATE DATA		
Height (ft)	Range (ft/sec)	Accuracy (ft/sec)
3-100	0-15	±(1.5ft.+0.01h+0.1/r/)
100-200	0-20	±(2.0ft.+0.01h+0.1/r/)

Where: h = altitude in feet; and /r/ = absolute value of rate (feet/sec.)