



Number: CTSO-C161a

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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.

### Ground Based Augmentation System Positioning and Navigation Equipment

#### **1. Purpose.**

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for Ground Based Augmentation System Positioning and Navigation Equipment CTSO authorization (CTSOA). This CTSO prescribes the minimum performance standards(MPS) that Ground Based Augmentation System Positioning and Navigation Equipment 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-21-R4.

### **3. Requirements**

New models of GBAS equipment identified and manufactured on or after the effective date of this CTSO must meet the MPS for the positioning and navigation equipment in RTCA/DO-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated December 16, 2008, section 2 as modified by appendices 1 and 2 of this CTSO for airborne equipment class (AEC) C to support Category I precision approach. This MPS also applies to equipment that implements the optional GBAS positioning service. This CTSO does not apply to AEC D equipment as the additional requirements to support the GBAS Approach Service Type D and Category III precision approaches have not been validated. A new CTSO or a revision to this CTSO for AEC D equipment will be issued once these additional requirements are validated.

**a. Functionality.** This CTSO's standards apply to equipment intended to output deviations relative to a precision approach path using GBAS, and to provide position information to a navigation management unit that outputs deviation commands referenced to a desired flight path. These standards do not address integration issues with other avionics except for automatic dependent surveillance. The positioning and navigation functions are defined in section 2.3 of RTCA/DO-253C. In accordance with section 2.1, equipment obtaining this CTSOA must also

comply with the position, velocity and time (PVT) output requirements of either, CTSO-C145d, CTSO-C146d or CTSO-C196b.

**NOTE:** CTSO-C196b, which is based on RTCA/ DO-316, Minimum Operational Performance Standards for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, dated April 14, 2009 is not referenced in RTCA DO-253C. RTCA/DO-316 was published after the publication of DO-253C.

**b. Failure Condition Classifications.** Failure of the function defined in paragraph 3a of this CTSO is a major failure condition for the position data and a hazardous failure condition for the precision approach navigation data. Loss of the function is a minor failure condition for both position data and precision approach data. Develop the system to, at least, the design assurance level equal to these failure condition classifications.

**c. Functional Qualification.** Demonstrate the required functional performance under the test conditions specified in RTCA/DO-253C, section 2.5.

**d. Environmental Qualification.** Demonstrate the required performance under the test conditions specified in RTCA/DO-253C, section 2.4 using standard environmental conditions and test procedures appropriate for airborne equipment.

**NOTE:** Although no specific version of RTCA/DO-160 environmental conditions and test procedures are specified, use of

RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions 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-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992. The software design assurance level should be consistent with the failure condition classification defined in paragraph 3.b of this CTSO.

**NOTE:** After CAAC reviews the lifecycle data, it can be consider that the goals of certification liaison process have been achieved.

**f. Electronic Hardware Qualification.** If the article includes a complex custom micro-coded component to accomplish the function, develop the component according to RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, dated August 19, 2000. The hardware assurance level should be 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:** After CAAC reviews the lifecycle data, it can be consider that the goals of certification liaison process have been achieved.

**g. Deviations.** We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this CTSO. If you

invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under section 21.368 (a) CCAR-21-R4.

#### **4. Marking.**

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

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

c. If the article includes a deviation per paragraph 3.g of this CTSO, the marking must include a means to indicate a deviation was granted.

d. If the component includes software and/or airborne electronic hardware, 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, developed and tested to different

software levels, must be differentiated by part number.

#### **4. Application Data Requirements.**

The applicant must give the certification officer who responsible for your facility a statement of conformance, as specified in section 21.353 (I)1 of CCAR-21-R4 and one copy each of the following technical data to support your design and production approval.

a. Operating instructions and equipment limitations in an installation manual (IM), sufficient to describe the equipment's operational capability. Describe in detail any deviations. 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 GBAS equipment, when installed according to the installation 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 China technical standard order (CTSO). If you are installing this article on or in a specific type or class of aircraft, you must obtain separate approval for installation.”

c. Schematic drawings of the installation procedures.

- d. Wiring diagrams of the installation procedures.
- e. List of components, by part number, that makes up the GBAS equipment. Include vendor part number cross-references, when applicable.
- f. A component maintenance manual (CMM), as appropriate, covering periodic maintenance, calibration, and repair, for the continued airworthiness of GBAS equipment. Include recommended inspection intervals and service life, as appropriate.
- g. Material and process specifications list.
- h. The quality control system (QCS) description. Required by section 21.358 CCAR-21-R4, including functional test specifications. The QCS should 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.
- i. Manufacturer's CTSO qualification report showing results of testing accomplished according to paragraph **3c** of this CTSO.
- j. Nameplate drawing with the information required by paragraph **4** of this CTSO.
- k. List of all drawings and processes (including revision level) that define the article's design.
- l. 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-160F, *Environmental Conditions and Test Procedures for Airborne Equipment*, appendix A.

m. If the article includes software: 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 submission allows CAAC to quickly resolve issues, such as partitioning and determining software levels.

n. If the article includes a complex custom 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 hardware development process. Early submittal allows CAAC to quickly resolve issues.

o. Identify functionality, features or performance contained in the article not evaluated under paragraph 3 of this CTSO (i.e. non-CTSO functions). Non-CTSO can be approved in conjunction with the CTSO authorization. The applicant must declare the functions and provide the following information with your CTSO application:

( 1 ) Description of the non-CTSO function(s), such as performance specifications and software, hardware, and environmental qualification levels. Add a statement confirming that the non-CTSO functions do not interfere with the article's compliance with the



requirements of paragraph 3.

( 2 ) Installation and operating instructions/limitations for the non-CTSO function(s), to ensure the satisfaction with the function and specification defined in paragraph 5.o.(1).

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

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

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

( 6 ) Plans and results of test/analysis, as appropriate, to verify intended function of the declared non-CTSO function(s) as described in paragraph 5.o.(1).

## **6. Manufacturer Data Requirements.**

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

- a. Functional qualification specifications for qualifying each production article to ensure compliance with this CTSO.
- b. Equipment calibration procedures.

- c. Schematic drawings.
- d. Corrective maintenance procedures (within 12 months after CTSOA)
- e. Wiring diagrams.
- f. Material and process specifications.
- g. The results of the environmental qualification tests conducted according to paragraph 3.d of this CTSO.
- h. If the article includes software, the appropriate documentation defined in the version of RTCA/DO-178B specified by paragraph 3.e of this CTSO, including all data supporting the applicable objectives in Annex A, Process Objectives and Outputs by Software Level.
- i. If the article includes a 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.
- j. If the article contains non-CTSO function(s), the applicant must also make available items 6.a through 6.i as they pertain to the non-CTSO function(s).
- k. If any external equipment was used to validate the article's compliance with the requirements in this CTSO such as simulators, stimulators or other similar devices, the appropriate documentation showing its accreditation and suitability for the intended purpose.

## **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 technical data and information specified in paragraphs 5.a through 5.f of this CTSO. Add any data needed for the proper installation, certification, use, or for continued compliance with the CTSO, of the GBAS equipment.

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

## **8. Availability of Referenced Documents.**

Order RTCA documents from:

Radio Technical Commission for Aeronautics, Inc.

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

You can also order copies online at: [www.rtca.org](http://www.rtca.org).

**APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR GROUND BASED AUGMENTATION SYSTEM POSITIONING AND NAVIAGATION EQUIPMENT**

This appendix prescribes the MPS for GBAS equipment for AEC C and equipment using the GBAS Positioning Service. The applicable standard is RTCA/DO-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated December 16, 2008, section 2. This CTSO modified it as follow:

1. Except as modified by appendix 2 of this CTSO, for all RTCA/DO-253C references to RTCA/DO 246(), use RTCA/DO-246B, GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-In-Space Interface Control Document (ICD), dated November 28, 2001.

2. Page 35, section 2.3.6.4.1, modify Table 2-7 and the note under the table as highlighted below (rest of section unchanged):

**Table 2-7 GPS Tracking Constraints for DD DLL Discriminators**

Region(see Figure 2-3)	3db Pre-correlation bandwidth, BW	Average Correlator Spacing (d1 and 2d1) [C/A chips]	Instantaneous Correlator Spacing (d1 and 2d1) [C/A chips]	Differential Group Delay	Applicable AEC
1	$(-50 \times x) + 12 < BW \leq 7 \text{ MHz}$	0.1-0.2	0.09-0.22	$\leq 600 \text{ ns} - \text{DA} - \text{DC}$	C
	$2 < BW \leq 7 \text{ MHz}$	0.2-0.6	0.18-0.65		
2	$(-50 \times x) + 12 < BW \leq (133.33 \times x) + 2.67 \text{ MHz}$	0.07-0.085	0.063-0.094	$\leq 150 \text{ ns} - \text{DA} - \text{DC}$	C & D
	$(-50 \times x) + 12 < BW$	0.085-0.1	0.077-0.11		
	$7 < BW \leq 14 \text{ MHz}$	0.1-0.24	0.09-0.26		
3	$14 < BW \leq 16 \text{ MHz}$	0.1-0.24	0.09-0.26	$\leq 150 \text{ ns} -$	C & D

**English Translation Version for Reference Only**

CAAC			CTSO-C161a		
	(133.33*x)+2.667<BW≤16MHz	0.085-0.1	0.077-0.11	DA – DC	

*Note (1): DA is the differential group delay contribution of the antenna through the output of the pre-amp. DC is the differential group delay contribution of the installation specific connection between the antenna and the PAN equipment.*

*Note (2): x denotes the average correlator spacing for  $d_1$  in C/A chips.*

3. Page 49, section 2.3.8.1.3, add a new paragraph g. to the list of conditions as follows:

g) The distance (slant range) between the aircraft and the GBAS reference point is less than the maximum GBAS usable distance, if the maximum GBAS usable distance ( $D_{max}$ ) is provided in the Type 2 message being used [LAAS-281]

4. Page 57, section 2.3.9.5, replace the differential correction magnitude check,  $\delta PR_i$  equation as follows:

$$\delta PR_i \equiv PRC_i + RRC_i * (t - t_{zcount}) + TC_i$$

5. Page A-6, replace the Maximum Use Distance ( $D_{max}$ ) definition as follows:

Maximum Use Distance ( $D_{max}$ ) – the maximum distance from the GBAS reference point for which the integrity is assured.

6. If a manufacturer elects to provide the authentication capability in its equipment as specified in section 2.3.7.3 of RTCA/DO-253C, the equipment shall also perform the differential correction magnitude check in section 2.3.9.5.

NOTE: There are additional sections of RTCA/DO -246D that are

applicable when VDB authentication is implemented. These are specified in appendix 2.

7. Summary of CTSO changes relative to DO-253C.

LAAS Requirement Designator [LAAS-xxx]	Change Status from DO-253C
093	Changed
123	Changed
281	Changed
351 and 352	New application (see item 6 above)

NOTE: RTCA/DO-253C provides the requirements of the LAAS equipment. In order to describe conveniently, each LAAS requirements are specified designator in DO-253C. The form of the numbers is LAAS-xxx, xxx are three numbers.

**APPENDIX 2. MINIMUM PERFORMANCE STANDARD FOR GNSS-BASED  
PRECISION APPROACH LOCAL AREA AUGMENTATION SYSTEM (LAAS)  
SIGNAL-IN-SPACE INTERFACE CONTROL DOCUMENT (ICD)**

This appendix prescribes the interface control document for GBAS as it applies to AEC C for this CTSO. The applicable standard is RTCA/DO-246B, GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document, dated November 28, 2001. We modified it as follows:

1. Page 22, replace the ephemeris CRC bit order of transmission in section 2.4.3.2. Message Type 1 parameters, with the updated definition in the latest revision, RTCA/DO-246D, dated December 16, 2008, section 2.4.3.2.

NOTE: This change reorders the bits of the ephemeris CRC from their previous transmission order of r1, r2, r3, r4 ... r16, where r1 is the least significant bit and bit r16 is the most significant bit, to r9, r10, r11 ... r16, followed by r1, r2, ... r8, where r9 and r1 are the first bits of each byte into the bit scrambler. This change is not backwards compatible with the existing standard. The change was adopted for compatibility with a significant number of current implementations of ground equipment and avionics. This change affects [LAAS-107], [LAAS-117], [LAAS-118], and [LAAS-214]. Other changes to RTCA/DO-246B, reflected in RTCA/DO-246D, to support the newly incorporated GBAS Approach

Service Type D are not relevant for this CTSO and should not be implemented.

2. Appendix A, replace appendix A, Cyclic Redundancy Checks (CRCs), with RTCA/DO-246D, appendix A.

3. Page B-2, replace Table B-1 Example of Type 1 Message, with RTCA/DO-246D, Table B-1.

4. Page B-4, replace Table B-2 Example of Type 1 and Type 2 Messages in One Burst with RTCA/DO-246D, Table B-2.

5. Page B-7, replace Table B-3 Example of Type 4 Message with RTCA/DO-246D, Table B-4 as modified below for the runway number valid range.

The valid range for runway number is 0-36.

6. Page B-10, replace Table B-4 Example of Type 5 Message with RTCA/DO-246D, appendix B, Table B-6, Example of Type 5 Message.

7. If a manufacturer elects to provide the authentication capability in its equipment as specified in section 2.3.7.3 of RTCA/DO-253C, the following paragraphs from RTCA DO-246D, dated 16 December 2008 are applicable:

a. Message Type 2, Additional Data Block 4, VDB Authentication Parameters description and Table 2-16 in DO-246D, section 2.4.4.1, pages 33 and 35.

b. Message Type 3 – Null Message and Table 2-17 Format of



Message Type 3 in DO-246D, section 2.4.5, page 37.

c. Reference Path Identifier in DO-246D, section 2.4.6.4, page 53.

8. Summary of RTCA/DO-253C requirements affected by our modifications to DO-246B.

Appendix 2 Item number	LAAS Requirement Designator [LAAS-xxx]
1	107, 117, 118, 214
2	Editorial
3	Editorial
4	Editorial
5	Editorial
6	Editorial
7	328, 329, 330 and 331