

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Ground Based Augmentation System Positioning and Navigation Equipment

### **1 - Applicability**

This ETSO gives the requirements which that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### **2 - Procedures**

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### **3 - Technical Conditions**

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the Radio Technical Commission for Aeronautics (RTCA) Document DO-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated 16/12/2008, section 2 as modified by appendices 1 and 2 of this ETSO for airborne equipment class (AEC) C to support Category I precision approach. These standards also apply to equipment that implements the optional GBAS positioning service. This ETSO 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 ETSO or a revision to this ETSO for AEC D equipment will be issued once these additional requirements are validated.

This TSO's standards apply to equipment intended to output deviations relative to a precision approach path using GBAS, and to provide position information to an ETSO-C161a 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 of RTCA/DO-253C, equipment obtaining this ETSOA must also comply with the position, velocity and time (PVT) output requirements of either, ETSO-C145c, ETSO-C146c or ETSO-C196a.

Note: ETSO-C196a, which is based on RTCA/DO-316, Minimum Operational Performance Standards for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, is not referenced in RTCA DO-253C. RTCA/DO-316 was published after the publication of DO-253C. ETSO-C129a is not applicable to this ETSO.

#### 3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1. The required performance is defined in RTCA/DO253C section 2.4.

#### 3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2.

#### 3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3.

#### 3.2 - Specific

##### 3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for the malfunction of position data and a hazardous failure condition for the malfunction of precision approach navigation data.

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition for the loss of position data and a minor failure condition for the loss of precision approach navigation data.

### **4 - Marking**

#### 4.1 - General

Marking as detailed in CS-ETSO Subpart A paragraph 1.2.

#### 4.2 - Specific

None

### **5 - Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

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

This Appendix prescribes the minimum performance standards (MPS) for GBAS equipment for airborne equipment class (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 16/12/2008, section 2. The applicable standard is modified as follows:

**1.** Except as modified by appendix 2 of this ETSO, 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 28/11/2001.

**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)	3 dB Pre-correlation bandwidth, BW	Average Correlator Spacing ( $d_1$ and $2d_1$ ) [C/A chips]	Instantaneous Correlator Spacing ( $d_1$ and $2d_1$ ) [C/A chips]	Differential Group Delay	Applicable AEC
1	$(-50 \cdot x) + 12 < BW \leq 7$ MHz	0.1-0.2	0.09-0.22	$\leq 600$ ns - $D_A - D_C$	C
	$2 < BW \leq 7$ MHz	0.2-0.6	0.18-0.65		
2	$(-50 \cdot x) + 12 < BW \leq (133.33 \cdot x) + 2.667$ MHz	0.07-0.085	0.063-0.094	$\leq 150$ ns - $D_A - D_C$	C & D
	$(-50 \cdot x) + 12 < BW \leq 14$ MHz	0.085-0.1	0.077-0.11		
	$7 < BW \leq 14$ MHz	0.1-0.24	0.09-0.26		
3	$14 < BW \leq 16$ MHz	0.1-0.24	0.09-0.26	$\leq 150$ ns - $D_A - D_C$	C & D
	$(133.33 \cdot x) + 2.667 < BW \leq 16$ MHz	0.085-0.1	0.077-0.11		

Note (1):  $D_A$  is the differential group delay contribution of the antenna through the output of the pre-amp.  $D_C$  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:

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

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

**Maximum Use Distance (Dmax)** – 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 ETSO changes relative to DO-253C.

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

## **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 ETSO. The applicable standard is RTCA/DO-246B, GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document, dated 28 November 2001. The applicable standard is modified 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 bite 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 ETSO 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 1-36.

**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 16/12/2008 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 these modifications to DO-246B.

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