ETSO-C196b

ED Decision 2020/011/R (applicable from 25.7.2020)

AIRBORNE SUPPLEMENTAL NAVIGATION SENSORS FOR GLOBAL POSITIONING SYSTEM EQUIPMENT USING AIRCRAFT-BASED AUGMENTATION

1 Applicability

This ETSO provides the requirements which airborne supplemental navigation sensors for Global Positioning System equipment using aircraft-based augmentation that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

Note: Revision b provides applicants with the option to use an ETSO-2C206 GNSS circuit card assembly (CCA) as part of their ETSO application. There is no technical change to the MOPS in comparison with ETSO-C196a.

2 Procedures

2.1 General

The applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

This section applies only for ETSO articles that use an ETSO-2C206 GNSS CCA.

Applicants who use an ETSO-2C206 GNSS CCA will need to coordinate with their GNSS CCA supplier for at least the following aspects:

2.2.1 Access to the Information of the Selected ETSO-2C206 CCA

The applicant is responsible for establishing the necessary communication channels with the ETSO-2C206 holder company. Applicants who use an ETSO-2C206 SBAS CCA will need to coordinate with their SBAS CCA supplier to obtain the documentation that supports ETSO-2C206.

The applicant's organisation shall establish a means of communication to obtain timely notifications of design changes, open problem reports (at least the ones that impact the usage of the CCA), occurrence reports and airworthiness directives that affect or relate to the ETSO-2C206 article.

2.2.2 Assessment of Design Changes

The applicant shall perform an impact analysis of the design changes to the ETSO-2C206 article, and shall perform the necessary development life-cycle activities that are impacted by the ETSO-2C206 changes.

Note: If a major change (as assessed per point 21.A.611) is applied to the ETSO-2C206 article, which is installed in the ETSO-C196b article, it is also systematically considered to be major for the ETSO-C196b function.

2.2.3 Assessment and Reporting of Open Problem Reports (OPRs)

The applicant shall perform the assessment of the ETSO-2C206 CCA OPRs. The applicant shall report the resulting OPRs that affect the ETSO-C196b article.

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

The applicable standards are those provided in the Radio Technical Commission for Aeronautics (RTCA) document DO-316, Minimum Operational Performance Standards (MOPS) for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, dated 14 April 2009, Section 2.

Use of an ETSO-2C206 GNSS CCA functional sensor

ETSO-196b applicants have the option to use an ETSO-2C206 GNSS CCA functional sensor. Applicants who choose to use an ETSO-2C206 GNSS CCA can take credit for certification compliance by virtue of the ETSO-2C206 ETSOA for:

— meeting the MPS Section 2.1 requirements;

— the development assurance of the hardware/software;

— the classification of the failure conditions;

— the MPS Section 2.3 performance testing (functional qualification), except that specified in Appendix 1 to this ETSO; and

— partial environmental testing performed on the ETSO-2C206 GNSS CCA.

After the integration of the ETSO-2C206 CCA in the ETSO-196b article, the applicant shall perform the testing described in Appendix 1. The applicant shall also complete the environmental qualification testing. The testing shall include the detailed functional test procedures delivered by the ETSO-2C206 GNSS CCA provider. This testing is required to address the paragraphs of this ETSO that are not covered by the items listed above.

Note: An end-use equipment manufacturer that uses an ETSO-2C206 SBAS CCA functional sensor assumes full responsibility for the design and the function under their ETSO-C196b authorisation.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

Test to EUROCAE ED-14( ) Sections 9 and 26 are considered to be optional. Tests to Sections 10, 11, 12, 13, and 14 are required only when the component is installed on the outside of the aircraft, such as the antenna.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

Applicants who use ETSO-2C206 GNSS CCA functional sensors may use the ETSO 2C206 authorisation as substantiation for compliance with the software development assurance aspects of the CCA.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

Applicants who use ETSO-2C206 GNSS CCA functional sensors may use the ETSO 2C206 authorisation as substantiation for compliance with the hardware development assurance aspects of the CCA.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

A failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for a malfunction of oceanic/remote, en route and terminal navigation and lateral navigation (LNAV) approaches.

A failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition for a loss of navigation of oceanic/remote, en route and terminal navigation and lateral navigation (LNAV) approaches.

Note: These failure condition classifications are considered to be the minimum classifications. Guidance for the installation of navigation systems at the aircraft level (e.g. Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance (CS ACNS)) could require a different failure condition classification.

3.2.2 Additional Specific

Barometric-aided Fault Detection and Exclusion (FDE). If the equipment uses barometric-aiding to enhance the availability of FDE, then the equipment must meet the requirements in RTCA document DO-316, Appendix G.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

None.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/7]
[Amdt ETSO/16]

Appendix 1 to ETSO-C196b – End-Use Equipment Manufacturer Tests for GNSS CCA functional PVT Sensors Used for Navigation and Non-Navigation Applications

ED Decision 2020/011/R

1. SCOPE

This Appendix describes the required supplementary equipment level testing, in addition to the environmental testing of RTCA document DO-316, Section 2.2, that the manufacturer of the end-use equipment is required to conduct in order to receive an ETSO-C196b authorisation if they use an ETSO-2C206 GNSS CCA functional sensor. These test procedures are intended to streamline and simplify the ETSO-C196b authorisation process for the manufacturer of the end-use equipment by allowing credit for the design and selected testing performed at the GNSS CCA functional sensor level. However, the manufacturer of the end-use equipment remains fully responsible for the design and control of the article per their ETSO-C196b authorisation.

2. GENERAL PRINCIPLES

(a) The testing methods for GPS equipment have been standardised by RTCA document DO-316, and these serve as the basis for ETSO-C196b. RTCA document DO-316 was written to cover equipment that can be installed on aircraft. Section 2.2 specifically addresses the issues of the environment in which the equipment operates, and provides the approved test methods to validate its performance in this environment. Section 2.2 represents the RTCA consensus in identifying which RTCA document DO-316 requirements are sensitive to environmental effects. These requirements are listed in Table 2-2, referenced in Section 2.2.1.

(b) The determination that a MOPS requirement is susceptible to the environment does not depend on whether or not the implementation is a GNSS CCA within an ETSO-C196b article. Only the sensitivity to the environment is affected. This is the same concept as an equipment enclosure that is designed to protect against a benign environment compared with one that is designed for a severe environment; the identification of the susceptible requirements is the same.

(c) Therefore, this Appendix uses Table 2-2 of RTCA document DO-316, Section 2.2.1, to identify the MOPS requirements that are susceptible to environmental conditions for a GNSS CCA functional sensor in the end-use equipment. The focus is on the change in environment seen by the GNSS CCA functional sensor as a result of its installation in the end-use equipment. For example, other components inside the end-use equipment may radiate RF energy that could interfere with the GPS functions; therefore, the ambient testing performed at the CCA level is not equivalent to the tests performed in the end-use equipment. This is the basis for defining the Section 2.3 performance tests that need to be repeated by the manufacturer of the end-use equipment.

(d) Table 2-2, referenced in RTCA document DO-316, Section 2.2.1, is the prime source to determine the MOPS performance requirements that are susceptible to environmental conditions. Based on that table, the susceptible requirements can be grouped into two categories: those that are susceptible to most types of environmental conditions (described in Section 3) and those that are susceptible to only a few (described in Section 4).

3. PERFORMANCE REQUIREMENTS THAT ARE SUSCEPTIBLE TO MOST ENVIRONMENTAL CONDITIONS

3.1. RTCA document DO-316: Accuracy, sensitivity and dynamic range

The RTCA document DO-316 requirements for accuracy (2.1.3.1) and for sensitivity and dynamic range (2.1.1.10) are sensitive to most environmental conditions. Section 3 identifies the testing that manufacturers of end-use equipment are required to repeat to demonstrate that the GNSS CCA functional sensor continues to meet the accuracy and dynamic range performance requirements after installation in the end-use equipment. All the tests shall be run under conditions in which the functions of the end-use equipment are fully enabled to create the worst-case environment.

3.2. RTCA document DO-316: Section 2.3.6 Accuracy Test

(a) The accuracy test described in Section 2.3.6 is actually a joint test that covers accuracy, sensitivity and dynamic range. This joint testing also applies under the environment as stated in Section 2.2.1.1.5, with the environmental adaptations as described in Section 2.2.1.1.1.

(b) The demonstration of accuracy is performed in accordance with Section 2.3.6 only for the test case with broadband external interference noise. This test must be repeated when the GNSS CCA functional sensor is installed in the end-use equipment, and it is sufficient to perform it using broadband interference.

(1) The environmental testing is limited to broadband interference, as it represents the worst-case signal-to-noise condition, which is the most sensitive to environmental effects. This applies equally to the environment for the GNSS CCA functional sensor that is created by the end-use equipment.

(2) Section 2.3.6 contains a measurement accuracy test in 2.3.6.1, with the simulator and interference conditions described in 2.3.6.2, and the detailed test procedure in 2.3.6.2.1. The Section 2.3.6 test must be run under the worst-case environment identified in Section 5 ‘Additional considerations for internal interference sources’ below.

(3) Section 2.3.6.3 is a 24-hour actual satellite accuracy test. The Section 2.3.6.3 test exposes the equipment to a variety of signal conditions and data-processing conditions over varying satellite geometries that will increase the confidence that no unforeseen interactions between the components within the end-use equipment and the GNSS CCA functional sensor will go undetected.

(c) The test threshold is relaxed from 110 % to 125 %, as specified in Table 2-6 of the Section 2.3.6.2.1 test procedure, to shorten the duration of the test. However, the Section 2.3.6 testing for the GNSS CCA functional sensor in the end-use equipment shall be under the ambient conditions per Section 2.3 with the 110-% test pass threshold for maximum test sensitivity.

(d) Only the broadband external interference noise test case using the minimum satellite power will be executed in most cases to shorten the duration of the test. The testing of Sections 2.3.6.1 and 2.3.6.2 will be repeated for both the minimum and the maximum satellite power only for the worst-case environment.

4. PERFORMANCE REQUIREMENTS THAT ARE PARTIALLY SUSCEPTIBLE TO ENVIRONMENTAL CONDITIONS

(a) Table 2-2 in RTCA document DO-316 indicates that the acquisition time (2.1.1.7) and the reacquisition time (2.1.1.9) requirements are sensitive to four environmental conditions: icing, lightning-induced transient susceptibility, lightning direct effects, and normal/abnormal operating conditions. The requirements for loss of navigation (2.1.1.11.2) and loss of integrity (2.1.1.11.1) are sensitive to low and high operating temperatures.

Note: RTCA document DO-316 Table 2-2 contains a typo that erroneously numbers the loss of navigation and loss of integrity requirements as 2.1.1.13.2 and 2.1.1.13.1.

(b) The lightning-induced transient susceptibility, lightning direct effects, or icing environmental conditions are not pertinent to the environment that is created by the end-use equipment relative to the GNSS CCA functional sensor. However, the manufacturer of the end-use equipment remains responsible for meeting the overall environmental qualification at the end-use equipment level.

(c) Loss of navigation and loss of integrity indications are limited to temperature testing and the information in RTCA document DO-316, Sections 2.2.1.1.2 and 2.2.1.1.3, is appropriate. The purpose is to ensure that the interface that is used to indicate the loss of navigation or integrity is functional under the environmental conditions that are present after the GNSS CCA functional sensor is installed in the end-use equipment. Sections 2.2.1.1.2 and 2.2.1.1.3 indicate that any source that generates the indication can be used, since it is the interface and not the detection mechanism that is verified. The temperature testing performed at the end-use equipment level is the worst-case scenario. It is not necessary to repeat the GNSS CCA level test at room temperature in the end-use equipment since the environmental qualification adequately addresses the testing for these requirements.

(d) EUROCAE ED-14 Section 16 relates to aircraft power supplies (refer to ETSO Section 3.1.2 for the environmental qualification requirements). Sections 16.5.1.2 and 16.6.1.2 are for normal/abnormal operating conditions. Given the potential susceptibility of the GNSS CCA functional sensor to power supply noise, it is prudent to repeat the tests at the end-use equipment level on this basis. Table 2-2, referenced in RTCA document DO-316, Section 2.2.1, does not guarantee the execution of specific acquisition testing.

(e) Sections 4.1 and 4.2 identify the testing that manufacturers of end-use equipment are required to repeat to demonstrate that the GNSS CCA functional sensor continues to meet the acquisition time and reacquisition time performance requirements relative to the normal/abnormal operating conditions after installation in the end-use equipment. All the tests shall be run under conditions in which the functions of the end-use equipment are fully enabled to create the worst-case environment.

4.1. RTCA DO-316: Section 2.3.3 Initial Acquisition Test Procedures

The information in RTCA document DO-316, Section 2.2.1.1.4, on the initial acquisition test in Section 2.3.3, applies. The manufacturer of the end-use equipment shall repeat the initial acquisition testing described in RTCA document DO-316, Section 2.3.3.

4.2. RTCA document DO-316: Section 2.3.4 Satellite Reacquisition Time Test

The manufacturer of the end-use equipment is required to repeat the satellite reacquisition time testing in RTCA document DO-316, Section 2.3.4.

5. ADDITIONAL CONSIDERATIONS FOR INTERNAL INTERFERENCE SOURCES

(a) Installing a GNSS CCA functional sensor into end-use equipment that also includes other functions requires a careful evaluation of the potential internally radiated and conducted interference. The manufacturer of the end-use equipment must evaluate each operating mode to determine whether the mode changes the environment for the installed GNSS CCA functional sensor. If there is only one environment or there is clearly one worst-case environment, then the accuracy and message loss rate testing in Section 3 can be run in that operating mode only. For example, if the end-use equipment includes an RF transmitter that radiates at one frequency, one could reasonably argue that setting the transmitter at full power with maximum data throughput would generate a clear worst-case environment in which to run all the testing.

(b) In the case of multiple environments, the accuracy and message loss rate tests can either be run under each environment, or the methodology in RTCA document DO-316, Section 2.2.1.2.3, can be used to run an aggregate with approximately equal time in each mode. The methodology in Section 2.2.1.2.3 must be used to identify the modes of greatest susceptibility under which the combined accuracy and message loss rate tests are repeated in addition to the aggregate test. For example, the 2.2.1.2.3 methodology is appropriate for end-use equipment that contains a high-power transmitter that operates on a large number of frequencies such that it is impractical to run a test at each frequency. This is analogous to the large number of frequencies that need to be tested during the EUROCAE ED-14 Section 19 testing on induced signal susceptibility and the Section 20 testing on radio frequency susceptibility, and this is the reason why the Section 2.2.1.2.3 methodology was developed.

(c) It is sufficient to identify one worst-case environment when performing acquisition and 24-hour accuracy testing.

6. SUMMARY

(a) The manufacturer of end-use equipment that incorporates a GNSS CCA functional sensor is required to repeat the following RTCA document DO-316 Section 2.3 testing under ambient conditions (see paragraph 5) after installing the GNSS CCA functional sensor in the end-use equipment:

— The Section 2.3.6 accuracy test adapted per Section 2.2.1.1.1, except that the 110 % test pass threshold is used.

Note: Refer to Section 5 ‘Additional considerations for internal interference sources’ of this Appendix, which could affect the test methodology.

— The Section 2.3.3 initial acquisition test.

— The Section 2.3.4 satellite reacquisition time test.

(b) The manufacturer of the end-use equipment remains responsible for completing a full environmental qualification evaluation (see ETSO Section 3.1.2) at the end-use equipment level. The manufacturer of the end-use equipment that incorporates a GNSS CCA functional sensor is required to repeat the Loss of Navigation and Loss of

Integrity indication environmental testing according to RTCA document DO-316, Sections 2.2.1.1.2 and 2.2.1.1.3.

[Amdt ETSO/16]