# Regulation No. XXX

## UNIFORM PROVISIONS CONCERNING THE APPROVAL OF
## I EMERGENCY CALL DEVICES (AECD)
## II VEHICLES WITH REGARD TO THE INSTALLATION OF AN AECD OF AN APPROVED TYPE
## III VEHICLES WITH REGARD TO THEIR AECS

## Contents

2.1 "*Global Navigation Satellite System receiver*" ("*GNSS receiver*") means a component of an AECD/**AECS** designed to determine ~~time, the coordinates and direction of~~ the vehicle **positioning information** using signals from global navigation satellite systems; the GNSS receiver can be included in the AECD or in another external control unit, as long as the AECD ensure its ability to provide the vehicle **positioning information** ~~location~~ in case of an event.

~~2.2 "Satellite-Based Augmentation System" (SBAS) is a system ensuring the correction of local errors of GNSS systems due to interferences via a network of ground-based stations. (ex: EGNOS, WASS, QZSS)~~

Commenté [AF1]: Repeated in Annex 5

~~2.3~~2.2 "*Communications module*" means a component of an AECD designed for voice communication and to transmit data about an accident using terrestrial mobile telephone communications networks;

~~2.4~~2.3 "~~*User*~~ ***Human/Machine*** *interface*" means a component or function of an AECD designed to allow the user to interact with the device, including by receiving visual information, obtaining visual information and introducing control commands;

~~2.5~~2.4 "*Control module*" means a component of an AECD designed to ensure the combined functioning of all components of the AECD;

~~2.6~~2.5 "*Type of AECD*" means devices that do not differ in such essential respects as:

(a) The manufacturer's trade name or mark;

(b) Their construction;

**(c) Dimensions, structure and materials of the attachments and supports.**

~~2.7~~2.6 "*Data exchange protocol*" means the set of rules and agreements that define the content, format, time parameters, sequence and error checks in messages exchanged between an AECD and the devices of Public Service Answering Party (PSAP).

~~2.8~~2.7 "*Public/Private Safety Answering Point (PSAP)*" means ~~a call center responsible for answering calls to an emergency telephone call. It can be of two types~~

- ~~Public Safety Answering Point managed by the public services of a Contracting Party to the 58 Agreement;~~
- ~~Private Safety Answering Point managed by a private company.~~

**a physical location where emergency calls are first received under the responsibility of a public authority or a private organization recognized by the national government / responsible authorities.**

**6.2.1 The navigation receiver shall be able to output the navigation solution in a NMEA-0183 protocol format (RMC, GGA, VTG, GSA and GSV message).**

The AECD setup for NMEA-0183 messages output to external devices shall be described in the operation manual

6.2.2 The navigation receiver being a part of the AECD shall be capable of receiving and processing individual GNSS signals ~~of standard accuracy~~ in L1/E1 band from at least three global navigation satellite systems, including GLONASS, GALILEO and GPS.

6.2.3 The navigation receiver being a part of the AECD shall be capable of receiving and processing combined GNSS signals ~~of standard accuracy~~ in L1/E1 band from at least three global navigation satellite systems, including GLONASS, GALILEO, GPS and SBAS.

6.2.4 The navigation receiver being a part of the AECD shall be able to provide positioning information in WGS-84 [and PZ-90] coordinate system[s].

6.2.5 Horizontal position error shall not exceed:

- under open sky conditions: 15 m at confidence level 0.95 with Position Dilution of Precision (PDOP) not less than 2.5;
- in urban canyon conditions: 40 m at confidence level 0.95 with Position Dilution of Precision (PDOP) not less than 4.

6.2.6 The specified requirements for accuracy shall be provided:

- at speed range from 0 to [140] km/h;
- linear acceleration range from 0 to [2] G.

~~6.2.1 Horizontal position error under open sky conditions and speed up to [140] km/h shall not exceed 15 m for 95% of the measurements done.~~

~~6.2.2 Horizontal position error in urban canyon conditions and speed up to [140] km/h shall not exceed 40 m for 95% of the measurements done.~~

**6.2.7 Cold start ~~T~~time to first fix shall not exceed**
- **60 sec for signal level down to minus 130 dBm;**
- **300 sec for signal level down to minus 140 dBm.**

**6.2.8 GNSS signal r~~R~~e-acquisition time after block out of 60 sec at signal level down to minus 130 dBm shall not exceed 20 sec after recovery of the navigation satellite visibility.**

**6.2.9 Sensitivity at receiver input shall be:**
- ~~acquisition - at least minus 144 dBm~~
- ~~tracking: at least minus 155 dBm~~
- ~~reacquisition - at least minus 150 dBm~~
- GNSS signals detection (cold start) do not exceed 3600 sec at signal level on the antenna input of the AECD of minus 144 dBm;
- GNSS signals tracking and navigation solution calculation is available for at least 600 sec at signal level on the antenna input of the AECD of minus 155 dBm;
- Re-acquisition of GNSS signals and calculation of the navigation solution is possible and does not exceed 20 sec at signal level on the antenna input of the AECD of minus 150 dBm.

6.2.10. AECD compliance with respect to positioning capabilities shall be demonstrated by performing test methods described in **Annex 5: Test methods for the navigation module.**

6.2.11. The testing procedures in Annex 5 can be performed either on the AECD unit including post processing ability or directly on the GNSS ~~chipset~~ **receiver being a part of the AECD**.

**Commenté [12]: DENSO:**
WGS-84 is common standard position system, the GNSS devices commonly available do not output separately – rather combine GPS/GLONASS/GALILEO to output a single WGS-84 position.
*Note that GOST-R5460 allow WGS-84 or PZ-90 as optional.*

>> Please update or remove this sentence.

Partially accepted. GTRF has been eliminated and potential decision on PZ90 will be discussed in St Petersburg meeting

**Commenté [mb3]: DENSO: Please delete PZ-90 & GTRF.**
WGS-84 is common standard position system, the GNSS devices commonly available do not output separately – rather combine GPS/GLONASS/GALILEO and output a single WGS-84 position.
*Note that GOST-R5460 allow WGS-84 or PZ-90 as optional.*

Partially accepted. GTRF has been eliminated and potential decision on PZ90 will be discussed in St Petersburg meeting

**Commenté [14]: DENSO:**
Condition of this criteria should be clarified
Please refer to comments in Annex 5 section 2.2.7,

Following the remarks, section 3.7 was rewritten

**Commenté [AF5]: VALEO:** The test object of this Annex 5 is the "AECD, which includes a GNSS receiver and a GNSS Antenna".

However, the definition of AECD allows that the GNSS receiver (and antenna) are located outside of the AECD, as long as relevant data are transmitted to the AECD, and as long as AECD is able to send vehicle position in the MSD in case of event (see Part 1 §2.1 "receiving or determining the vehicle location", and §2.2 "GNSS receiver can be included in the AECD or in another external control unit).

*Our proposal is then that the test object is either the:*
*- 1) AECD, if a GNSS receiver and a GNSS antenna are included in the AECD, or*
*- 2) Control unit, external to the AECD, that contains the GNSS receiver and GNSS antenna, and that is used to provide the relevant position data to the AECD*

Partially accepted: disambiguation will come in the corresponding section in Part III

# Annex 5

## Test method for navigation solution (paragraphs 6.2. and 16.3.)

**1. Definitions**

**The purpose of the tests in Annex 5 is to verify the compliance of navigation characteristics of the AECD/AECS calculated by its GNSS receiver ~~navigation module,~~ to the requirements defined in section 6.2.**

**AECS Pre-meeting : Refer also to part II and Part III**

**For the purposes of this Annex:**

1.1 ***"Global Navigation Satellite System" (GNSS)*** **is a satellite based system that is used to pinpoint the location, speed and time of a user's receiver in any point of the Earth surface, water areas~~ of the World Ocean~~, air space, and in the near-Earth space environment.**

1.2 ***"Global Navigation Satellite System receiver" ("GNSS receiver")*** **- a component of an ~~AECD~~AECD/AECS designed to determine time, the position and direction of the vehicle using signals from global navigation satellite systems.**

1.3 ***"Satellite-Based Augmentation System" (SBAS)*** **is a system ensuring the correction of local errors of GNSS systems ~~due to interferences~~ via a network of ground-based stations. (ex: EGNOS, WAAS, SDCM, QZSS)**

1.4 ***"Cold" start mode"*** **– the condition of GNSS receiver~~navigation module~~ when position, velocity, time, almanac and ~~euhemerizes~~ ephemeris data are~~is~~ not stored in the receiver, and therefore the navigation solution is to be calculated by means of a full sky search;**

1.5 ***"Test mode"*** **– the function mode of the ~~AECD~~AECD/AECS meant for the check of functions and parameters of the ~~AECD~~AECD/AECS during system operation in the vehicle and also during the ~~AECD~~AECD/AECS tests.**

**2. Test conditions**

2.1 **The test object is the ~~AECD~~AECD/AECS, which includes navigation receiver and global navigation satellite system antenna, specifying navigation characteristics and features of the tested system.**

2.1.1 **The number of the ~~AECD~~AECD/AECS test samples shall be at least 3 pcs.**

2.1.2 **The ~~AECD~~AECD/AECS is provided for the test with the installed SIM-card, operation manual and the software (provided on electronic media).**

2.1.3 **The attached documents shall contain the following data:**

**- device serial number;**

**- hardware version;**

**- software version;**

**- device provider identification number ;**

**- unique device identifier, assigned by the system operator in case of the first activation of the device.**

**N o t e:** **For carrying out tests the originals of the operation manual containing specified convergence shall be provided.**

~~2.1.4 The navigation receiver shall be able to output the navigation solution in a NMEA-0183 protocol format (RMC, GGA, VTG, GSA and GSV message) [5]. The AECD~~

**Commenté [AF6]:** GSA: Navigation requirements extracted from the annex, as agreed in Rotherheim setup for NMEA-0183 messages output to external devices shall be described in the operation manual

2.2 The purpose of the tests is to verify the compliance of navigation characteristics of the AECD calculated by its navigation module, to the following requirements:

2.2.1 The navigation receiver being a part of the AECD shall be capable of receiving and processing individual GNSS signals of standard accuracy in L1/E1 band from at least three global navigation satellite systems, including GLONASS, GALILEO and GPS.

2.2.2 The navigation receiver being a part of the AECD shall be capable of receiving and processing combined GNSS signals of standard accuracy in L1/E1 band from at least three global navigation satellite systems, including GLONASS, GALILEO, GPS and SBAS.

2.2.3 The navigation receiver being a part of the AECD shall be able to provide positioning information in WGS-84, PZ-90 and GTRF coordinate systems.

2.2.4 According to 2.2.2, horizontal position error shall not exceed:

- under open sky conditions: 15 m at confidence level 0.95 with Position Dilution of Precision (PDOP) not more than 2.5
- in urban canyon conditions: 40 m at confidence level 0.95 with Position Dilution of Precision (PDOP) not more than 4The specified requirements for accuracy shall be provided:
- at speed range from 0 to [140] km/h;
- linear acceleration range from 0 to [2] G;

2.2.5 GNSS signal re-acquisition time after block out of 60 sec and signal level down to minus 130 dBm shall not exceed 20 sec after recovery of the navigation satellite visibility.

2.2.6 Time to first fix shall not exceed:

- 60 sec for signal level down to minus 130 dBm
- 300 sec for signal level down to minus 140 dBm.

2.2.7 The navigation receiver being a part of the AECD shall provide:

- GNSS signals search (detection) at the level of valid signal at the antenna input (antenna amplifier input) of minus144 dBm;
- GNSS signals tracking and navigation solution calculation at the level of valid signal at the antenna input (antenna amplifier input) of minus 155 dBm
- Re-acquisition of GNSS signals and calculation of the navigation solution at the level of valid signal at the antenna input (antenna amplifier input) of minus150 dBm.

2.3 Test conditions

2.3.12.1.4 Tests are carried out in normal climatic conditions in accordance with standard ISO 16750-1:2006:

- air temperature (23 ± 5) °C and
- relative air humidity of 25 % to 75 %.

2.3.22.1.5 Technical service of tested samples during tests is not conducted.

2.3.32.1.6 Tests of the AECDAECD/AECS in respect of its navigation receiver shall be performed with test and auxiliary equipment specified in Table 4.

**Commenté [mb7]: DENSO:** Only 1 of these global GNSS system should be mandatory.

Not accepted: These are the constellations agreed in the "if fitted" approach

**Commenté [mb8]: DENSO:** This should be deleted.

Not accepted: These are the constellations agreed in the "if fitted" approach

**Commenté [19]: DENSO:**
"Valid signal" statement needs should clarification of how to measure.

DENSO discussion;
C/N ratio can be provided from GSV sentence of NMEA regardless of navigation fix or not.

Not accepted: signal strength is simulated an not measured

In any case, following the remarks, section 3.7 was rewritten

**T a b l e 4 – Recommended list of measurement instruments, test and auxiliary equipment**

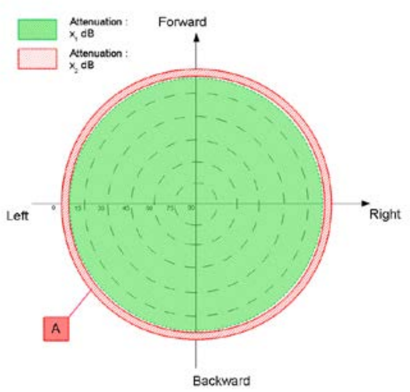
| Equipment name | Required technical characteristics of test equipment | |
|---|---|---|
| | Scale range | Scale accuracy |
| | | |
| Global navigation satellite system simulator of GLONASS, Galileo and GPS signals | Number of simulated signals – at least 18 | Mean square deviation of random accuracy component of pseudo-range to GLONASS / Galileo / GPS satellites not more:<br>*- stadiometric code phase – 0,1 m;*<br>*- communication carrier phase – 0,001 m;*<br>*- pseudovelocity– 0,005 m/sec.* |
| Digital stopwatch | Maximum count volume – 9h 59 min 59,99sec | Daily variation at (25+5)°C not more + 1,0sec.<br>Time discreteness- 0,01sec. |
| Vector network analyzer | Frequency range 300 kHz .. 4000 kHz<br>Dynamic range<br>(minus 85 .. 40) dB | AccF 1·10-6<br>AccA (0,1 .. 0,5) dB |
| Low-noise amplifier | Frequency range 1200.. 1700 MHz<br>Noise coefficient not more 2,0 dB<br>Amplifier gain coefficient 24 dB | |
| Attenuator | Dynamic range<br>(0 .. 11) dB | Acc ± 0,5 dB |
| Attenuator | Dynamic range<br>(0 .. 110) dB | Acc ± 0,5 dB |
| Power source | Range of direct current voltage setting from 0,1 to 30 V<br>Current intensity of output voltage at least 3A | Acc0 ± 3%<br>Acc1 ± 1% |
| | | |
| | | |
| N o t e – it is allowed to apply other similar types of equipment providing determination of characteristics with required accuracy. | | |

| Equipment name | Required technical characteristics of test equipment | |
|---|---|---|
| | Scale range | Scale accuracy |
| | | |

~~2.3.4~~2.1.7 **Unless otherwise specified, GNSS signal simulation shall follow "Open sky" pattern as shown in Figure 1.**

**Figure 1: Open sky definition**

| Zone | Elevation range (deg) | Azimuth range (deg) |
|---|---|---|
| A | 0 – 5 | 0 – 360 |
| Background | Area out of Zone A | |




**1) Open Sky plot.**

**Attenuation:**

| | |
|---|---|
| | 0 dB |
| A | ~~-~~100 dB or signal is switched off |

Commenté [110]: DENSO: Please allow to attenuate or switch off for testing – due to realistic test equipment support.

Accepted

**3. Test procedures**

**3.1 NMEA-0183 messages output test.**

**3.1.1 Make connections according to Figure 2.**

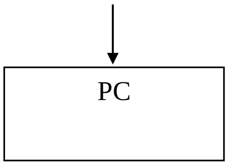



**Figure 2 – Diagram of test stand**

**3.1.2 Prepare and turn on the ~~AECD~~AECD/AECS. By means of operation manual and developer software set up the navigation module for receiving signals from GLONASS, Galileo, GPS GNSS and SBAS. Set up the navigation module to output NMEA-0183 messages (messages RMC, GGA, VTG, GSA and GSV).**

**3.1.3 Set up the simulator according to the simulator user guide. Initialize simulator script with the parameters, given in Table 5 for GLONASS, Galileo, GPS GNSS and SBAS signals.**

**T a b l e 5 – Main parameters of simulation script for static scenario**

| Simulated parameter | Value |
|---|---|
| Test duration, hh:mm:ss | 01:00:00 |
| Output frequency | 1 Hz |
| ~~AECD~~AECD/AECS location:<br>- CS WGS-84; | Any specified land point between latitude range 80°N and 80°S |
| Troposphere:<br>Ionosphere: | Standard predefined model by the GNSS simulator<br>Standard predefined model by the GNSS simulator |
| PDOP value | ~~≤~~ ≥2.5 in the test time interval |
| Simulated signals | - GNSS GLONASS (L1 frequency band CT code);<br>- GNSS Galileo (E1 frequency band OS);<br>- GNSS GPS (L1 frequency band C/A code);<br>- GNSS GLONASS/Galileo/GPS/SBAS. |
| Signal strength:<br>- GNSS GLONASS;<br>- GNSS Galileo;<br>- GNSS GPS | <br>minus 141 dBm;<br>minus 135 dBm;<br>minus 138,5 dBm. |

**Commenté [mb11]: DENSO:** Should read "applicable GNSS system"

Not accepted: These are the constellations agreed in the "if fitted" approach

**Commenté [AF12]: VALEO:** All GNSS scenarios (Annex 5 Table 5,6 and 7) are simulated with a signal strength lower than in common tests procedures.

Example : -138,5 dBm (GPS) in the UN Draft versus -130dBm (GPS) in
ION STD 101 "Recommended Test Procedures For GPS receivers".

*We guess this is intended to take into account vehicle attenuation, is that right?*

Not accepted

The most recent official GPS interface specification was published in 2012 (IS-GPS-200 ICD) and it defines that GPS strength (-138.5 dBm).

Same value was previously defined in the GPS SPS performance standard (2008)

The *recommended* ION STD 101 is the outcome of the GPS Test Standards Working Group which is not publicly available and do not belong to an official source.

These values in the table might be conservatives but, considering the nature and objectives of the present document, it fits the purpose.

**Commenté [AF13]:** It should say more or equal to 2.5

| Simulated parameter | Value |
|---|---|
| Number of simulated satellites | - at least 6 GLONASS satellites;<br>- at least 6 Galileo satellites;<br>- at least 6 GPS satellites;<br>- at least 2 SBAS satellites |

3.1.4 By means of corresponding serial interface set the connection between the ~~AECD~~AECD/AECS and PC. Control the possibility of receiving navigation information via NMEA-0183 protocol. The value of field 6 in the GGA messages is set to “2”.

3.1.5 Test results are considered successful if navigation information via NMEA-0183 protocol is received.

3.2 The assessment of positioning accuracy in autonomous static mode.

3.2.1 Make connections according to Figure 2.

3.2.2 Prepare and turn on the ~~AECD~~AECD/AECS. By means of developer software make sure that navigation module is set up for receiving global navigation satellite systems GLONASS, Galileo, GPS and SBAS combined signals. Set up navigation module to output messages according to the NMEA-0183 protocol (GGA, RMC, VTG, GSA and GSV messages)

3.2.3 Set up the simulator in accordance with its operational manual. Start simulation of combined GNSS GLONASS, Galileo, GPS and SBAS signals script with set parameters, given in Table 5.

3.2.4 Set up the recording of NMEA-0183 messages after receiving the navigation solution. Up to the moment the simulation script is complete, the NMEA-0183 messages are output by the navigation module to a file.

3.2.5 Upon receiving the navigation solution set up recording of NMEA-0183 messages output by navigation module to a file, up to the moment the simulation script is complete.

3.2.6 Extract coordinates: latitude (B) and longitude (L) contained in GGA (RMC) messages.

3.2.7 Calculate the systematic inaccuracy of coordinate’s determination on stationary intervals according to formulas (1), (2), for example for latitude coordinate (B):

$$\Delta B(j) = B(j) - B_{truej}, \quad (1)$$

$$dB = \frac{1}{N} \cdot \sum_{j=1}^{N} \Delta B(j), \quad (2)$$

Where Btruej – actual value of B coordinate in j–ed time moment, angle sec.;

B(j) – determined by the navigation module value of B coordinate in j time moment, angle sec;

N – amount of GGA (RMC) messages, received during the test of navigation module.

Similarly calculate the systematic inaccuracy of L (longitude) coordinate.

**Commenté [AF14]: GSA:** Settings needed to test SBAS compatibility in the simulator

**Commenté [mb15]: DENSO:** Should read “GNSS”

Not accepted: These are the constellations agreed in the “if fitted” approach

**Commenté [AF16]: GSA:** Step needed to make the description clearer

3.2.8 **Calculate standard deviation (SD) value according to formula (3) for B coordinate:**

$$\sigma_B = \sqrt{\frac{\sum_{j=1}^{N}(B(j) - dB)^2}{N-1}}, \quad (3)$$

**Similarly calculate the (SD) value for L (longitude) coordinate.**

3.2.9 **Convert calculated SD values of latitude and longitude determination from angle seconds to meters according to formulas (4) – (5):**

**- for latitude:**

$$dB(м) = 2 \cdot \frac{a(1-e^2)}{(1-e^2 sin^2\varphi)^{3/2}} \cdot \frac{0{,}5'' \cdot \pi}{180 \cdot 3600''} \cdot dB, \quad (4)$$

**- for longitude:**

$$dL(м) = 2 \cdot \frac{a \cdot cos\varphi}{\sqrt{1-e^2 sin^2\varphi}} \cdot \frac{0{,}5'' \cdot \pi}{180 \cdot 3600''} \cdot dL, \quad (5)$$

**Where a – major semiaxis of ellipsoid, m**

**e – first eccentricity**

**φ – current latitude, rad.**

3.2.10 **Calculate horizontal positioncoordinates error (at confidence level 0.95) according to formula (6):**

$$\Pi = \sqrt{dB^2(m) + dL^2(m)} + 2 \cdot \sqrt{\sigma_B^2(m) + \sigma_L^2(m)}, \quad (6)$$

3.2.11 **Repeat test procedures according to 3.2.3 – 3.2.9 only for GLONASS GNSS signals with simulation parameters, given in Table 5.**

3.2.12 **Repeat test procedures according to 3.2.3 – 3.2.9 only for GPS GNSS signals with simulation parameters, given in Table 5.**

3.2.13 **Repeat test procedures according to 3.2.3 – 3.2.9 for GNSS Galileo signals with simulation parameters, given in Table 5.**

3.2.14 **Repeat test procedures according to 3.2.3 – 3.2.12 with other AECDAECD/AECS samples, provided for the test.**

3.2.15 **Determine average values according to (6) obtained for all tested AECDAECD/AECS samples.**

3.2.16 **Tests results are considered satisfactory if horizontal coordinates position errors as defined by formula (6) obtained with all AECDAECD/AECS samples do not exceed 15 m under open sky conditions at confidence level 0.95 for all simulation scripts.**

3.3 **The assessment of positioning accuracy in autonomous dynamic mode.**

3.3.1 **Repeat test procedures described in section 3.2, except 3.2.10 - 3.2.12 with simulation script for maneuvering movement (Table 6).**

**Commenté [mb17]: DENSO:** Please delete reference to multiple GNSS systems.

Not accepted: These are the constellations agreed in the "if fitted" approach

**Table 6 – Main parameters of simulation script for maneuvering movement**

| Simulated parameter | Value |
|---|---|
| Test duration, hh:mm:ss | 01:00:00 |
| Output frequency | 1 Hz |
| ~~AECD~~AECD/AECS location:<br>- CS WGS-84; | <br>Any specified land point between latitude range 80°N and 80°S |
| Model of movement:<br>- speed, km/h;<br>turn radius, m;<br>- turn acceleration, m/sec2 | Maneuvering movement<br>140<br>500<br>0,2 |
| Troposphere:<br>Ionosphere: | Standard predefined model by the GNSS simulator<br>Standard predefined model by the GNSS simulator |
| PDOP value | ~~≤~~≥2.5 in the test time interval |
| Simulated signals | - combined GLONASS / Galileo / GPS / SBAS. |
| Signal strength:<br>- GNSS GLONASS;<br>- GNSS Galileo;<br>- GNSS GPS | <br>minus 141 dBm;<br>minus 135 dBm;<br>minus 138,5 dBm. |
| Number of simulated satellites | - at least 6 GLONASS satellites;<br>- at least 6 Galileo satellites;<br>- at least 6 GPS satellites;<br>- at least 2 SBAS satellites |

3.3.2 Determine average values according to (6) obtained for all tested ~~AECD~~AECD/AECS samples.

3.3.3 Tests results are considered satisfactory if horizontal ~~coordinates~~ position errors obtained with all ~~AECD~~AECD/AECS samples do not exceed 15 m under open sky conditions at confidence level 0.95.

3.4 Test of movement in shadow areas, areas of intermittent reception of navigation signals and urban canyons.

Commenté [AF18]: It should say more or equal to 2.5

**3.4.1** **Repeat test procedures described in section 3.3 for simulation script for movement in shadow areas and areas of intermittent reception of navigation signals (Table 7) with an urban canyon signal pattern described in Fig.3.**

**T a b l e 7 – Main parameters of movement in shadow areas and areas of intermittent reception of navigation signals**

| Simulated parameter | Value |
|---|---|
| Test duration, hh:mm:ss | 01:00:00 |
| Output frequency | 1 Hz |
| Motion start point:<br>- CS WGS-84; | <br>Any specified land point between latitude range 80°N and 80°S |
| Model of movement:<br>- speed, km/h;<br>turn radius, m;<br>- turn acceleration, m/sec$^2$ | Maneuvering movement<br>140<br>500<br>0,2 |
| Satellite visibility:<br>- signal visibility intervals, sec;<br>- signal absence intervals, sec. | <br>300<br>600 |
| Troposphere:<br>Ionosphere: | Standard predefined model by the GNSS simulator<br>Standard predefined model by the GNSS simulator |
| ~~Geometric factor~~ PDOP value | ~~≤~~ ≥4 in the test time interval |
| Simulated signals | - combined GLONASS / Galileo / GPS / SBAS. |
| Signal strength:<br>- GNSS GLONASS;<br>- GNSS Galileo;<br>- GNSS GPS | <br>minus 141 dBm;<br>minus 135 dBm;<br>minus 138,5 dBm. |
| Number of simulated satellites | - at least 6 GLONASS satellites;<br>- at least 6 Galileo satellites;<br>- at least 6 GPS satellites;<br>- at least 2 SBAS satellites |

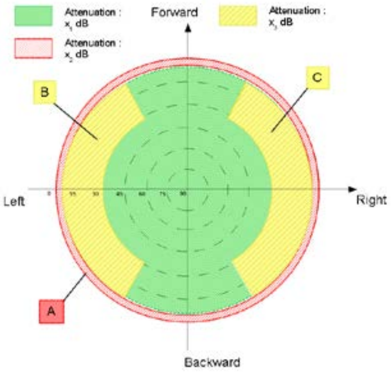
**Commenté [AF19]:** QUALCOMM:
Please clarify difference between “signal visibility interval = 300s” and “signal absence interval=600s”….

Question will be clarified in person, (question unclear…)

**Commenté [AF20]:** It should say more or equal to 4

**Figure 3: Urban canyon definition**

| Zone | Elevation range (deg) | Azimuth range (deg) |
|---|---|---|
| A | 0 – 5 | 0 – 360 |
| B | 5 - 30 | 210 – 330 |
| C | 5 - 30 | 30 - 150 |
| Background | Area out of Zones A, B, C | |




**2) Urban canyon plot.**

**Attenuation:**

| | |
|---|---|
| | 0 dB |
| B | -40 dB |
| C | -40 dB |
| A | -100dB or signal is switched off |

**3.4.2** **Tests results are considered satisfactory if horizontal position~~coordinates~~ errors obtained with all ~~AECD~~AECD/AECS samples do not exceed 40 m in urban canyon conditions at confidence level 0.95.**

**3.5** **Cold start time to first fix test.**

**3.5.1** **Prepare and turn on the ~~AECD~~AECD/AECS. By means of developer software make sure that GNSS module is set to receive GNSS GLONASS, Galileo and GPS signals.**

**3.5.2** **Delete all position, velocity, time, almanac and euhemerizes data from the navigation receiver.**

**3.5.3** **Set up the simulator according to the simulator user guide. Initialize simulator script with the parameters, given in Table 5 for GNSS GLONASS, Galileo and GPS signals with signal level minus 130 dBm.**

**Commenté [121]: DENSO:** Please allow to attenuate or switch off for testing – due to realistic test equipment support. (approx. -140 dB – 40dB=-180dB, out of range of typical test equipment – to switch OFF is realistic)

Partially accepted. It is a more realistic scenario as it is right now (-40 dbm).

**Commenté [mb22]: DENSO:** Please delete

Not accepted: These are the constellations agreed in the “if fitted” approach

3.5.4 By means of a stop watch measure time interval between signal simulation start and the first navigation solution result.

3.5.5 Conduct test procedures according to 3.5.2 – 3.5.4 at least 10 times.

3.5.6 Calculate average time to first fix in cold start mode based on measurements for all ~~AECD~~AECD/AECS samples, provided for the test.

3.5.7 The test result is considered to be positive, if average values of time to first fix, calculated as described in 3.5.6 do not exceed 60 sec for signal level down to minus 130 dBm for all the simulated signals.

3.5.8 Repeat test procedure according to 3.5.1-3.5.5 with signal level minus 140 dBm.

3.5.9 The test result according to 3.5.8 is considered to be positive, if average values of time to first fix, calculated as described in 3.5.6 do not exceed 300 sec for signal level down to minus 140 dBm for all the simulated signals.

3.6 Test of re-acquisition time of tracking signals after block out of 60 sec.

3.6.1 Prepare and turn on the ~~AECD~~AECD/AECS according to operational manual. By means of developer software make sure that navigation module is set up to receive GNSS GLONASS, Galileo and GPS signals.

3.6.2 Set up the simulator according to the simulator user guide. Initialize simulator script with the parameters, given in Table 5 for GNSS GLONASS, Galileo and GPS signals with signal level minus 130 dBm.

3.6.3 Wait for 15 minutes and make sure navigation module has calculated ~~AECD~~AECD/AECS position.

3.6.4 Disconnect the GNSS antenna cable from the ~~AECD~~AECD/AECS and connect it again after time interval of 60 sec. By means of stopwatch determine time interval between cable connection moment and restoration of satellites tracking and calculation of the navigation solution.

3.6.5 Repeat test procedure according to 3.6.4 at least 10 times.

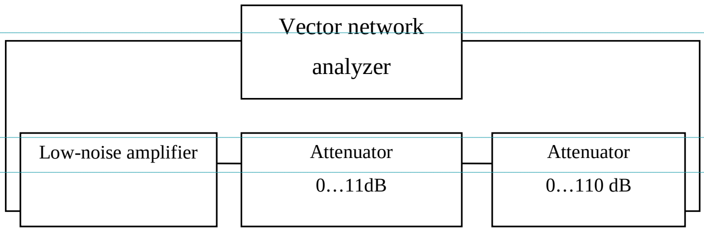
3.6.6 Calculate average value of re-acquisition time of satellite tracking signals by the ~~AECD~~AECD/AECS for all performed measurements and all ~~AECD~~AECD/AECS samples provided for the test.

3.6.7 The test result is considered to be positive, if average values of re-acquisition time after block out of 60 sec measured as described in 3.6.6 do not exceed 20 seconds.

~~3.7 Test of navigation receiver sensitivity in cold start mode, tracking mode, and re-acquisition scenario.~~

~~3.7.1 Turn on the vector network analyser. Calibrate the network vector analyser according to its operational manual.~~

~~3.7.2 Set up the diagram according to Figure 4.~~




~~Figure 4 – Diagram of path calibration~~

**Commenté [AF23]: VALEO:** Test described in Annex 5 §3.5.7 requires a Cold start TTFF in less than 60s, while strength of simulated signals are -141dBm (GLONASS), -135dBm (Galileo) and -138.5 (GPS), ie based on Table5.

*We think the test success criterion shall be relaxed at 300s, in order to comply with required Annex 5 §2.2.6 (cold start TTFF in less than 300s at -140dBm)*

Partially accepted: the steps for 300s were missing. However note that 60s is already a relaxing criteria for cold start TTFF with 3 constellations.

**Commenté [AF24]: VALEO:** Test described in Annex 5 §3.5.7 requires a Cold start TTFF in less than 60s, while strength of simulated signals are -141dBm (GLONASS), -135dBm (Galileo) and -138.5 (GPS), ie based on Table5.

*We think the test success criterion shall be relaxed at 300s, in order to comply with required Annex 5 §2.2.6 (cold start TTFF in less than 300s at -140dBm)*

Partially accepted: the steps for 300s were missing. However note that 60s is already a relaxing criteria for cold start TTFF with 3 constellations.

**Commenté [mb25]: DENSO:** Please delete

Not accepted: These are the constellations agreed in the "if fitted" approach

**Commenté [AF26]: QUALCOMM:** The block out time and reacquisition time are not clearly specified in the document. Is it 60s block out and 20s reacquisition time? Recommendation: either increasing -150dBm to -145dBm, or reducing the block out time to 20s with the reacquisition time remains at 20s.

Following the remarks, section 3.7 was rewritten

**Commenté [AF27]: QUALCOMM:** For Block out of 60s and reacquisition at 20s under urban canyon, it is recommended to add a requirement that there are at least 8 SVs combined in view in the green urban canyon zone

Not accepted, the intention of the urban canyon scenario is to test the performance in challenging environments. In any case, having 3 constellations is an extra advantage, because this situation (8 SVs in view) is very likely to happen

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Set zero signal path attenuation on attenuators. Measure the frequency response for a given signal path in the L1/E1 band of GNSS GLONASS/Galileo/GPS. Record the average path transmission factor in [dB] in this frequency band.

Assemble the circuit shown in Figure 5.

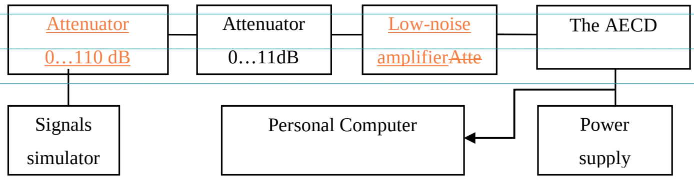



Figure 5 – Arrangement for evaluation of GNSS module sensitivity

Prepare and turn on AECD according to operational manual. By means of developer software make sure that GNSS module is set to receive GNSS GLONASS, Galileo and GPS signals. Clear the navigation module RAM such that the "cold" start mode of the navigation module of the AECD is achieved.

Set signal path attenuation value equal to 110 dB. Prepare GNSS signals simulator according to its operation manual. Start GNSS GLONASS/Galileo/GPS signals simulation script, with parameters given in Table 5. Set output power level of the simulator to minus 130 dBm..

Check that the position, velocity and time information is reset.

Decrease path attenuation using attenuators in 1 dB steps (increase the navigation signal power on the navigation module input) until the AECD acquires navigation fix. Record the signal level on the AECD GNSS module input.

N o t e – Time interval between path attenuation changes shall not be less than 120 s.

Set the signal path attenuation on attenuators such that the signal on AECD antenna input is equal to minus140 dBm. Wait for 15 min to allow the navigation module to collect the ephemerides and the GNSS almanac.

Increase the signal path attenuation setting on attenuators in 1 dB steps (decrease the navigation signal power) until the navigation fix is reset. Taking into account the initial transmission factor of the signal path, record such GNSS signal level on an input of the AECD GNSS module antenna that resulted in the last navigation fix of the GNSS module in tracking mode.

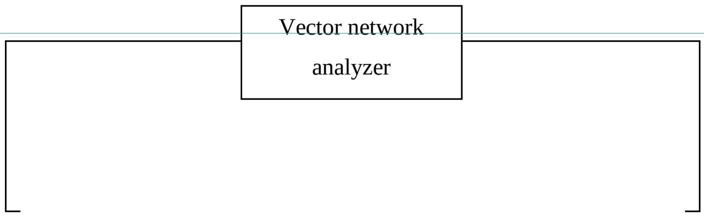
Decrease path attenuation using attenuators in 1 dB steps (increase the navigation signal power on the navigation module input) until the AECD acquires navigation fix. Record the signal level on the AECD GNSS module input.

The test results shall be considered positive if the GNSS signal level on the antenna input of the AECD does not exceed minus 144 dBm in cold start mode as recorded in 3.7.8, minus 155 dBm in tracking mode as recorded in 3.7.109, and minus 150 dBm in reacquisition mode as recorded in 3.7.1110 for each AECD submitted to tests.

### 3.7 Test of navigation receiver sensitivity in cold start mode, tracking mode, and re-acquisition scenario.

3.7.1 Turn on the vector network analyser. Calibrate the network vector analyser according to its operational manual.

3.7.2 Set up the diagram according to Figure 4.




**Commenté [128]: DENSO:** we feel that the LNA should be located next to the Signal simulator (similar to figure 5 in AECS-07-13e document)
>> Please confirm?

Accepted

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**Commenté [mb29]: DENSO:** Since typical GNSS receivers acquisition level is -145DB >> please consider to start this test sequence at approximately. -150dB to improve test efficiency.

Following the remarks, section 3.7 was rewritten

**Commenté [mb30]: DENSO:** Please check if there is some class to specify -130dB, considering Table 5 mentions different levels for each GNSS system?

Following the remarks, section 3.7 was rewritten

**Commenté [AF31]: VALEO:** We think the additional remark "in less than 300s" should be added because a cold start is being done to check acquisition sensitivity

Following the remarks, section 3.7 was rewritten

**Commenté [mb32]: DENSO:** Denso have data that 107 seconds is realistic with current hardware @ -144dB.
>> Recommend to change this value to 180 seconds to ensure margin.

Following the remarks, section 3.7 was rewritten

**Commenté [133]: DENSO:** please check, possible typing error.

Following the remarks, section 3.7 was rewritten

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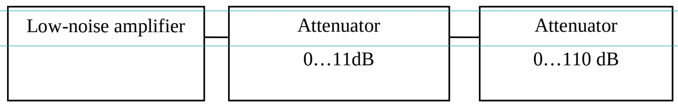


**Figure 4 – Diagram of path calibration**

**3.7.3 Set zero signal path attenuation on attenuators. Measure the frequency response for a given signal path in the L1/E1 band of GNSS GLONASS/Galileo/GPS. Record the average path transmission factor in [dB] in this frequency band.**

**3.7.4 Assemble the circuit shown in Figure 5.**

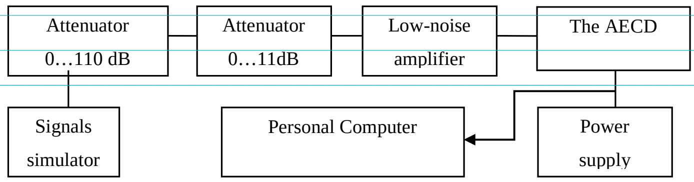


**Figure 5 – Arrangement for evaluation of GNSS module sensitivity**

**3.7.5 Prepare and turn on AECD/AECS according to operational manual. By means of developer software make sure that GNSS receiver is set to receive GNSS GLONASS, Galileo and GPS signals. Clear the navigation module RAM such that the "cold" start mode of the navigation module of the AECD/AECS is achieved. Check that the position, velocity and time information is reset.**

**3.7.6 Prepare GNSS signals simulator according to its operation manual. Start GNSS GLONASS/Galileo/GPS signals simulation script, with parameters given in Table 5. Set output power level of the simulator to minus 144 dBm..**

**3.7.7 By means of a stopwatch, measure time interval between signal simulation start and the first navigation solution result.**

**3.7.8 Set the signal path attenuation on attenuators such that the signal on AECD/AECS antenna input is equal to minus 155 dBm**

**3.7.9 By means of a stopwatch, verify that AECD/AECS still provides navigation solution for at least 600 sec.**

**3.7.10 Set the signal path attenuation on attenuators such that the signal on AECD/AECS antenna input is equal to minus 150 dBm.**

**3.7.11 Disconnect the GNSS antenna cable from the AECD/AECS and connect it again after time interval of 20 sec.**

**3.7.12 By means of stopwatch, determine time interval between cable connection moment and restoration of satellites tracking and calculation of the navigation solution.**

**3.7.13 The test result is considered to be positive, if value of time to first fix in "cold" start mode as measured in 3.7.7 do not exceed 3600 sec at signal level on the antenna input of the AECD/AECS of minus 144 dBm, GNSS navigation solution is available for at least 600 sec at signal level on the antenna input of the AECD/AECS of minus 155 dBm as measured in 3.7.9, and re-acquisition of GNSS signals and calculation of the navigation solution at signal level on the antenna input of the AECD/AECS of minus 150 dBm is possible and time interval measured in 3.7.12 does not exceed 20 sec.**

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