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Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 2: Global navigation satellite system (GLONASS) - Receiver equipment - Performance standards, methods of testing and required test results (IEC 61108- 2:1998)

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(IEC 61108-2:1998)

Matériels et systèmes de navigation et de radiocommunication maritimes Systèmes mondial de navigation par satellite (GNSS) Partie 2: Système de navigation par satellite GLONASS — Matériel de réception — Normes de fonctionnement, méthodes d'essai et résultats d'essai exigibles (CEI 61108-2:1998)

Navigations- und Funkkommunikations-geräte und -systeme für die Seeschiffahrt Weltweite Navigations-Satellitensysteme (GNSS) Teil 2: Weltweites Navigations-Satellitensystem (GLONASS) Empfangsanlagen — Leistungs-anforderungen, Prüfverfahren und geforderte Prüfergebnisse (IEC 61108-2:1998)

This European Standard was approved by CENELEC on 1998-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

The text of document 80/179/FDIS, future edition 1 of IEC 61108-2, prepared by IEC TC 80, Maritime navigation and radiocommunication equipment and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61108-2 on 1998-08-01.

The following dates were fixed:

— latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1999-05-01

— latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2001-05-01

Annexes designated "normative" are part of the body of the standard. In this standard, Annex ZA is normative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61108-2:1998 was approved by CENELEC as a European Standard without any modification.

Contents

1 Scope

This International Standard specifies the minimum performance standards, methods of testing and required test results for GLONASS shipborne receiver equipment, based upon the IMO Resolution MSC.53(66), which use the signals from the Russian Ministry of Defence Global Navigation Satellite System (GLONASS), in order to determine position. This receiver standard applies to phases of the voyage in "other waters" as defined in IMO Resolution A.529.

All the text of this standard, whose meaning is identical to that in IMO Resolution MSC.53(66) will be printed in italics and the Resolution and paragraph number indicated between brackets.

The requirements in clause **4** are cross-referenced to the tests in clause **5** and vice versa.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61108. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61108 are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid international standards.

IEC 60721-3-6:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Ship environment.*

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results.*

IEC 61162-1:1995, *Maritime navigation and radiocommunication equipment and systems — Digital interfaces — Part 1: Single talker and multiple listeners.*

IMO Resolution A.529:1983, *Accuracy standards for navigation.*

IMO Resolution A.694:1991, *General requirements for shipborne radio equipment forming part of the Global maritime distress and safety system (GMDSS) and for electronic navigational aids.*

IMO Resolution A.815:1995, *World-wide radionavigation system.*

IMO Resolution MSC.53(66):1996, *Performance standards for shipborne GLONASS receiver equipment.*

ITU-R M.823-2:1996, *Technical characteristics of differential transmissions for global navigation satellite systems (GNSS) from maritime radio beacons in the frequency band 285 kHz–325 kHz (283,5 kHz–315 kHz in Region 1).*

Global Navigation Satellite System GLONASS — Interface Control Document (ICD) — GLONASS

RTCM recommended standards for differential GPS/GLONASS:1996.

3 Definitions and abbreviations

For the purposes of this International Standard, all definitions and abbreviations used, are contained in the normative reference of the GLONASS ICD specification.

4 Minimum performance standards

4.1 Object

(53.66/1.3) *Receiver equipment for the Global Navigation Satellite System (GLONASS) intended for navigational purposes on ships with maximum speeds not exceeding 50 kn* shall, *in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.*

(53.66/1.4) *This standard covers the basic requirements of position fixing for navigation purposes only and does not cover other computational facilities which may be in the equipment.*

It is recognized that other data inputs may be provided such as speed and distance measuring equipment (SDME), gyro or other navigational systems including GLONASS differential corrections. However, the basic minimum performance standards contained in this standard, pertain to the use of GLONASS signals for navigational position fixing only.

Other computational activity, input/output activity or extra display functions shall not degrade the performance of the equipment below the minimum performance standards set out in this standard.

The receiver shall comply with the provisions of IMO Resolutions A.529, A.815, MSC.53(66), A.694 and IEC 61162-1 and be tested in accordance with IEC 60945.

4.2 (*5.6.1*) GLONASS receiver equipment

4.2.1 (53.66/2.1) *The words "GLONASS receiver equipment" as used in this performance standard includes all the components and units necessary for the system to properly perform its intended function(s). The "equipment"* shall *include the following minimum facilities:*

a) *antenna capable of receiving GLONASS signals;*

b) *GLONASS receiver and processor;*

c) *means of accessing the computed latitude/longitude position;*

d) *data control and interface;*

e) *position display and, if required other forms of output.*

4.2.2 The equipment may be supplied in one of several configurations to provide the necessary position information. Examples are:

— stand-alone receiver with means of accessing computed position via a keyboard with the positional information suitably displayed.

— GLONASS receiver feeding an integrated system with means of access to the computed position via an appropriate interface, and the positional information available to at least one remote location.

The above examples should not be implied as limiting the scope of future development.

4.3 Performance standards for GLONASS receiver equipment

4.3.1 *(5.6.2) General*

(53.66/3.1.1) *The GLONASS receiver equipment shall be capable of receiving and processing the Standard Positioning Service (SPS) signals of system GLONASS and provide position information in latitude and longitude SGS-90 (PZ-90) co-ordinates in degrees, minutes and thousandths of minutes and time of solution referenced to UTC (SU). Means shall be provided to transform the computed position based upon SGS-90 (PZ-90) into WGS-84 or into data compatible with the datum of the navigational chart in use. Where this facility exists, the display shall indicate that the co-ordinate conversion is being performed and shall identify the co-ordinate system in which the position is expressed.*

NOTE The IMO Resolution uses SGS-90 as the GLONASS datum. Since the time of the adoption of that Resolution the datum has been changed to PZ-90. It is assumed that the IMO Resolution will be amended accordingly (see also **4.3.2**, **5.3**, **5.5.2**, and **5.6.4.1.1**).

(53.66/3.1.2) *The GLONASS receiver equipment* shall *operate on the Standard Positioning Service (on lettered L1 frequencies and C code).*

NOTE The IMO Resolution MSC.53(66) is as in 53.66/3.1.2 above. The Russian Federation prefer the following text — "The GLONASS receiver equipment shall operate on the L1-sub-band frequencies with the standard precision navigation signal". It is assumed that the IMO Resolution will be amended accordingly.

4.3.2 *(5.6.3) Equipment output*

(53.66/3.1.3) *The GLONASS receiver equipment* shall *be provided with at least one output from which position information can be supplied to other equipment. The output of position information based upon SGS-90 (PZ-90) or WGS-84,* shall *be in accordance with IEC 61162.*

NOTE Sentences for the GLONASS receiver output are detailed in IEC 61162-1.

4.3.3 *(5.6.4) Accuracy*

4.3.3.1 (53.66/3.1.4) *The GLONASS receiver equipment* shall *have static accuracy such that the position of the antenna is determined to 100 m (45 m) (95 %) with horizontal dilution of position (HDOP) ≤ 4 (or PDOP ≤ 6).*

4.3.3.2 (53.66/3.1.5) *The GLONASS receiver equipment* shall *have dynamic accuracy such that the position of the antenna is determined to within an accuracy of 100 m* (45 m) *(95 %) with HDOP ≤ 4 (or PDOP ≤ 6) under the conditions of sea state and ship's motion likely to be experienced in ships* (see IMO Resolution A.694, IEC 60721-3-6 and IEC 60945).

NOTE The IMO Resolution MSC.53(66) is as stated in 4.3.3.1/4.3.3.2 above. The Russian Federation now state that the correct figure is 45 m in both cases and this figure will be used for testing purposes. It is assumed that the IMO Resolution will be amended accordingly.

4.3.4 *(5.6.5) Acquisition*

(53.66/3.1.6) *The GLONASS receiver equipment* shall *be capable of selecting automatically the appropriate satellite transmitted signals for determination of the ship's position with the required accuracy and update rate.*

(53.66/3.1.8) *The GLONASS receiver equipment* shall *be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data.*

(53.66/3.1.9) *The GLONASS receiver equipment* shall *be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data.*

(53.66/3.1.10) *The GLONASS receiver equipment* shall *be capable of re-acquiring position to the required accuracy, within 5 min, when the GLONASS signals are interrupted for a period of at least 24 h, but there is no loss of power.*

(53.66/3.1.11) *The GLONASS receiver equipment* shall *be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s.*

Acquisition is defined as the processing of GLONASS satellite signals to obtain a position fix within the required accuracies.

Four conditions of the GLONASS receiver equipment are set out under which the minimum performance standards shall be met.

Condition a)

Initialisation — the equipment has

— been transported over large distances (> 1 000 km to < 10 000 km) without power or GLONASS signals

— not been powered for > 7 days

— not received GLONASS signals for > 7 days.

Condition b)

Power outage — the equipment under normal operation loses power for at least 24 h.

Condition c)

Interruption of GLONASS signals — under normal operation the GLONASS signals are interrupted for at least 24 h, but there is no loss of power.

Condition d)

Brief interruption of GLONASS signals e.g. by passing under a bridge under normal operation the signals are interrupted for 60 s or less.

No user action other than applying power and providing a clear view from the antenna for the GLONASS signals, shall be necessary, from any of the initial conditions above, in order to achieve the required acquisition time limits in Table 1.

Table 1 — Acquisition time limits

Equipment condition	a	b	c	d
Acquisition time limits (minutes)	30	5	5	2

4.3.5 *(5.6.6) Protection*

4.3.5.1 *Antenna and input/output connections*

(53.66/4) *Precautions* shall *be taken to ensure that no permanent damage can result from an accidental short-circuit or grounding of the antenna or any of its input or output connections or any of the GLONASS receiver equipment inputs or outputs for a duration of 5 min.*

4.3.5.2 *(5.6.6.2) Electromagnetic compatibility*

The GLONASS receiver equipment shall comply with the requirements of IEC 60945 concerning precautions to electromagnetic interference and EMC.

4.3.6 *(5.6.7) Antenna design*

(53.66/2.2) *The antenna design* shall *be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation.*

4.3.7 *(5.6.8) Sensitivity and dynamic range*

(53.66/3.1.7) *The GLONASS receiver equipment shall be capable of acquiring satellite signals with input signals having carrier levels in the range of – 130 dBm to – 120 dBm. Once the satellite signals have been acquired the equipment shall continue to operate satisfactorily with satellite signals having carrier levels down to – 133 dBm.*

4.3.8 *(5.6.9) Effects of specific interfering signals*

The GLONASS receiver equipment shall meet the following requirements:

a) in a normal operating mode, i.e. switched on and with antenna attached, it is subject to radiation of 3 W/m^2 at a frequency of 1 636,5 MHz for 10 min. When the unwanted signal is removed and the GLONASS receiver antenna is exposed to the normal GLONASS satellite signals, the GLONASS receiver equipment shall calculate valid position fixes within 5 min without further operator intervention.

NOTE This is equivalent to exposing the antenna to radiation from an INMARSAT-A or B transmitter at 10 m distance along the bore sight.

b) In a normal operating mode, i.e. switched on and with antenna attached, it is subject to radiation consisting of a burst of 10 pulses, each 1,0 µs to 1,5 µs long on a duty cycle of 1 600 : 1 at a frequency lying between 2,9 GHz and 3,1 GHz at power density of about 7,5 kW/m^2. The condition shall be maintained for 10 min with the bursts of pulses repeated every 3 s. When the unwanted signal is removed and the GLONASS receiver antenna is exposed to the normal GLONASS satellite signals, the receiver shall calculate valid position fixes within 5 min without further operator intervention.

NOTE This condition is approximately equivalent to exposing the antenna to radiation from a 60 kW "S" band marine radar operating at a nominal 1,2 µs pulse width at 600 pulses/s using a 4 m slot antenna rotating at 20 r/min with the GLONASS antenna placed in the plane of the bore site of the radar antenna at a distance of 10 m from the centre of rotation.

4.3.9 *(5.6.10) Position update*

(53.66/3.1.12) *The GLONASS receiver equipment* shall *generate, display and output a new position solution at least once every 2 s.*

(53.66/3.1.13) *The minimum resolution of position i.e. latitude and longitude* shall *be 0,001 min.*

4.3.10 *(5.6.11) Failure warnings and status indications*

(53.66/5) *The equipment* shall *provide an indication if the position calculated is likely to be outside of the requirements of these performance standards.*

The GLONASS receiver equipment shall *provide as a minimum:*

(53.66/5.1) *an indication within 5 s if either*

a) *the specified HDOP has been exceeded; or*

b) *a new position has not been calculated for more than 2 s.*

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, shall be output until normal operation is resumed;

(53.66/5.2) *a warning of loss of position; and*

(53.66/5.3) *differential GLONASS status indication of:*

a) *the receipt of DGLONASS signals; and*

b) *whether DGLONASS corrections are being applied to the indicated ship's position.*

4.3.11 *(5.6.12) Differential GLONASS input*

(53.66/3.1.14) *The GLONASS receiver equipment* shall *have the facilities to process and receive differential GLONASS(DGLONASS) data fed to it in accordance with the standards of Recommendation ITU-R M.823* and an appropriate RTCM standard. *When a GLONASS receiver is equipped with a differential receiver, performance standards for static and dynamic accuracies (53.66/3.1.4, 3.1.5)* shall *be 10 m 95 %.*

NOTE The standard for the differential GLONASS receiver is contained in future IEC 61108-4 (Global Navigation Satellite Systems (GNSS) — Part 4: Differential GPS (DGPS) and differential GLONASS (DGLONASS) maritime radiobeacon receiver equipment — Performance standards, methods of testing and required test results).

5 Methods of testing and required test results

5.1 Test sites

The manufacturer shall, unless otherwise agreed, set up the GLONASS receiver equipment to be tested and ensure that it is operating normally before testing commences.

5.2 Test sequence

The sequence of tests is not specified. Before the commencement of testing the sequence shall be agreed between the test laboratory and the supplier of the equipment.

Where appropriate, tests against different clauses of this standard may be carried out simultaneously. The manufacturer shall provide sufficient technical documentation to permit the GLONASS receiver equipment to be operated correctly.

Additional data shall be provided to cover specific tests which do not form part of the normal user operations for example means to remove the almanac data, for the purpose of testing under **5.6.5**.

5.3 Standard test signals

The aim of the performance tests is to establish that the GLONASS receiver equipment meets the minimum performance standards set out in clause 4, by performing practical tests under various environmental conditions. Because of the difficulty of establishing uniformity of performance of GLONASS signal simulators, over a range of simulators which may be provided by test laboratories and the difficulty of uniformly coupling the simulated signals into varying and unknown GLONASS receiver equipment architectures, these tests have been based upon using the actual GLONASS signals.

Other methods of simulating the test signals may be used, provided that the simulator produces signals which have the same characteristics as the satellites, including receiver noise, had good satellite signal reception been used from geometrically well placed satellites in a normally dynamic constellation.

A "performance check" is defined as a shortened version of the static accuracy test described in **5.6.4.1**, i.e. a minimum of 100 position measurements shall be taken over a period of not < 5 min and not > 10 min, discarding any measurements with HDOP ≥ 4. The position of the antenna of the EUT shall not be in error compared with the known position by > 45 m (95 %) using GLONASS signals and PZ-90 as the reference datum.

5.4 Determination of accuracy

In the determination of the accuracy of position being calculated by the GLONASS receiver equipment, note shall be taken of the geometry of the satellites in use. The HDOP measurement is an indication of the suitability of the constellation in view for use in receiver equipment testing. If the HDOP is ≤ 4, the test conditions can be considered as suitable. If HDOP is > 4 but ≤ 6, then results may be unreliable. For HDOP > 6, testing shall be delayed until better geometry is established. The aim of the accuracy tests is to establish that the measurement of position calculated by the EUT under static and dynamic conditions is as good or better than the performance levels set in this minimum performance standard. If a simulator is used, the HDOP threshold shall be set at ≤ 4 or PDOP ≤ 6.

5.5 Organisation of test conditions

5.5.1 *Testing under ambient conditions*

All tests shall be carried out at under ambient conditions, which are defined as at temperatures between + 10 °C and + 35 °C and relative humidity between 20 % and 70 %.

When it is impractical to carry out the test under the conditions stated above, a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

For practical purposes, for those parts of the equipment which are exposed to the weather (formerly class X of IEC 60945) e.g. antenna, the test conditions shall be within the environmental limits of the exposed class specified in IEC 60945.

5.5.2 *Static test site*

The antenna shall be mounted according to the manufacturer's instructions at a height of between 1 m and 1,5 m above the electrical ground in an area providing clear line of sight to the satellites from zenith through to an angle of + 5° above horizontal. The position of the antenna shall be known, with reference to PZ-90 to an accuracy of better than 5,0 m in (x,y,z). Maximum cable lengths as specified by the manufacturer shall be used during testing.

All static tests shall utilise actual GLONASS signals.

5.6 Performance tests

NOTE The number in brackets is the subclause of the relevant performance requirement.

5.6.1 *(4.2.1) GLONASS receiver equipment*

The equipment under test (EUT) shall be checked for composition by inspection of the equipment and the manufacturer's documentation.

5.6.2 *(4.3.1) Position output*

The EUT shall be checked for the form of the position output by inspection of the manufacturer's documentation.

5.6.3 *(4.3.2) Equipment output*

The EUT shall be checked for conformity to IEC 61162-1 by inspection of the manufacturer's documentation and electrical and protocol tests.

5.6.4 *(4.3.3) Accuracy*

5.6.4.1 *Static*

5.6.4.1.1 *GLONASS*

Position fix measurements shall be taken over a period of not < 2 h. The average position of the antenna shall be calculated from at least 1 000 consecutive position fix measurements taken over that period.

The distribution of the 1 000 measurements shall not be in error compared with the known horizontal position in PZ-90 co-ordinates of the antenna by > 45 m (95 %), having discarded measurements taken in conditions of HDOP > 4 and PDOP > 6.

5.6.4.1.2 *Differential GLONASS*

Position fix measurements shall be taken once per second over a period of not < 2 h. The average position of the antenna shall be calculated from these measurements.

The distribution of the measurements shall not be in error compared with the known horizontal position of the antenna by > 10 m (95 %). The horizontal position of the antenna shall be known to within 0,1 m in the datum used for the generation of the corrections. The corrections shall be provided by an actual DGLONASS broadcast in accordance with ITU-R M.823.

5.6.4.2 *Angular movement of the antenna*

The static tests specified in **5.6.4.1.1** and **5.6.4.1.2** shall be repeated with the antenna performing an angular displacement of ± 22,5° (simulating roll) in a period of about 8 s (see IEC 60721-3-6) during the duration of the test.

The results shall be as in **5.6.4.1.1** and **5.6.4.1.2**.

5.6.4.3 *Dynamic*

5.6.4.3.1 *GLONASS*

The tests for dynamic accuracy are a practical interpretation of the conditions set out in IEC 60721-3-6, Table V, section e) X-direction (surge) and Y-direction (sway). These are stated as surge 5 m/s^2 and sway 6 m/s^2 for all classes of environment.