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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) –
Part 4: Shipborne DGPS and DGLONASS maritime radio beacon receiver equipment – Performance requirements, methods of testing and required test results

Matériels et systèmes de navigation et de radiocommunication maritimes – Système mondial de navigation par satellite (GNSS) –
Partie 4: Equipement pour récepteur de balises radioélectriques DGLONASS et DGPS embarqués – Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés

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International Standard IEC 61108-4 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This bilingual version (2014-12) corresponds to the English version, published in 2004-07.

The text of this standard is based on the following documents:

FDIS	Report on voting
80/394/FDIS	80/398/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

IEC 61108 consists of the following parts, under the general title *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS):*

Part 1: Global positioning system (GPS) – Receiver equipment – Performance standards, methods of testing and required test results

Part 2: Global navigation satellite system (GLONASS) – Receiver equipment – Performance standards, methods of testing and required test results

Part 3: (To be used at a later date)

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) –

Part 4: Shipborne DGPS and DGLONASS maritime radio beacon receiver equipment – Performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61108 specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards not inferior to those adopted by the IMO in resolution MSC.114(73). In addition, it takes account of IMO resolution A.694(17) and is associated with IEC 60945. When a requirement of this standard is different from IEC 60945, the requirement in this standard shall take precedence.

This standard may be satisfied by equipment integral with GNSS equipment.

This standard is applicable to HSC.

All text of this standard, whose wording is identical to that in IMO resolution MSC.114(73) and ITU-R M.823 is printed in *italics* and the resolution (abbreviated to – 114 and M.823 respectively) and paragraph numbers are indicated in brackets i.e. (114/3.3 or M.823/3.3).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

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

IEC 61162-2, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high speed transmission*

IMO Resolution MSC.114(73), *Revised recommendation on performance standards for shipborne DGPS and DGLONASS maritime radio beacon receiver equipment*

IMO Resolution A.694(17), *General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids*

ITU-R M.823-2, *Technical characteristics of differential transmissions for Global Navigation Satellite Systems (GNSS) from maritime radio beacons in the frequency band 283,5 – 315 kHz in Region 1 and 285 – 325 kHz in Regions 2 and 3*

3 Terms, definitions and abbreviations

For the purposes of this standard the following definitions and abbreviations apply.

3.1 Definitions

3.1.1
Eurofix
the Eurofix datalink is a scheme for modulation of the Loran-C and Chayka signals to establish a broadcast capability that can be used for distribution of GNSS corrections, integrity data and other information. Similar developments in the US are referred to as LORAN-COMM

3.1.2
global navigation satellite system (GNSS)
is a world-wide position, time and velocity radio determination system comprising space, ground and user segments

3.1.3
integrity
is the ability to provide users with warnings within a specified time when the system should not be used for navigation

3.2 Abbreviations

BER	Bit error rate
bps	Bits per second
DGLONASS	Differential GLONASS
DGNSS	Differential GNSS
DGPS	Differential GPS
EGNOS	European Geo-stationary Navigational Overlay System
EPFS	Electronic position fixing system
EUT	Equipment under test
MSAS	Multi-Satellite Augmentation System
MSK	Minimum shift keying
RTK	Real-Time Kinematics
SNR	Signal to noise ratio
UDRE	User defined range error
VTS	Vessel Tracking Services
WAAS	Wide-Area Augmentation System
WER	Word error rate

4 Performance requirements

4.1 Introduction

Differential services broadcast information for augmenting Global Positioning System (GPS) and the Global Navigation Satellite System (GLONASS) to provide the accuracy and integrity required for entrances and harbour approaches and other waters in which the freedom to manoeuvre is limited. Various service providers are broadcasting differential information applicable to localised areas. Different services provide information for augmenting GPS, GLONASS, or both.(114/1.1)

Receiver equipment for the reception and proper de-modulating / *decoding of differential GPS and GLONASS maritime radio beacon broadcasts (fully compliant with ITU-R M.823) intended for navigational purposes on ships with maximum speeds not exceeding 70 knots shall, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.*(114/1.2) As noted in Clause 1 – Scope: This standard is applicable to HSC.

This standard covers the basic requirements of maritime radio beacon receiver equipment providing augmentation information to position-fixing equipment, including health messages. *It does not cover other computational facilities which may be in the equipment.*(114/1.3)

Additional functionality (e.g. use of differential corrections and integrity, from multiple beacon reference stations, Eurofix, LORAN-COMM, VTS, FM subcarrier, commercial satellite, WAAS, EGNOS, MSAS and RTK) is permitted if the manufacturer can demonstrate that this does not degrade performance.

4.2 Composition

The words "DGPS and DGLONASS maritime radio beacon receiver equipment" as used in this performance standard includes all the components and units necessary for the system to properly perform its intended functions. The equipment shall include the following minimum facilities:(114/2)

1) *antenna capable of receiving DGPS or DGLONASS maritime radio beacon signals*;(114/2.1)
2) *DGPS and DGLONASS maritime radio beacon receiver and processor;* (114/2.2)
3) *receiver control interface*; (114/2.3) (See also 4.3 2))
4) *data output interface* (114/2.4) (See also 4.3 5)), and
5) broadcast station database capable of storing at least the following data for a minimum of 1000 stations. These data elements can be initially downloaded and shall be updated from DGNSS broadcasts:

   ID_{REF1}, ID_{REF2}

   BROADCAST STATION ID

   BROADCAST STATION NAME

   FREQUENCY

   REFERENCE STATION POSITION

   REFERENCE STATION DATUM

   OFFICIAL OPERATION STATUS (operational, test, or not operational)
6) broadcast station database capable of calculating and storing at least the following data for a minimum of 10 closest stations. The receiver shall update these data elements from information included in DGNSS broadcasts:

   TIME/DATE of UPDATE

   REFERENCE STATION HEALTH

   WORD ERROR RATE (WER)

   DISTANCE (user to reference station(s))

4.3 Functional requirements

The DGPS and DGLONASS maritime radio beacon receiver equipment shall: (114/3)

1) *operate in the band of 283,5 to 315 kHz in Region 1 and 285 to 325 kHz in Regions 2 and 3 in accordance with ITU-R M.823* (114/3.1). The receiver shall perform to the requirements of this standard while subjected to typical radio frequency interference and noise sources, as follows:

– atmospheric noise (e.g. local thunderstorms);
– man-made noise (e.g. own ship, shipyard industrial, etc.);
– Gaussian noise;
– interference from LF and MF radio stations outside the band.

The specifications of these are further developed in Annex A.

– precipitation static (especially in the high latitudes) is not specified or tested against, but H-field antennas are recommended to be used on ships that go to the high latitudes that experience this environmental interference; (See Annex D.)

2) *provide means of automatically and manually selecting the station;* (114/3.2) When in manual mode, operator action shall be required for a change and the receiver shall provide an indication of other available stations. The database shall be continually updated and utilised to select reference stations;(See Annex E.)

3) *make the data available for use with a delay not exceeding 100 ms after its reception;* (114/3.3) The delay from the first bit of the modulated data to the last bit of the decoded data output from the receiver shall be less than 100 ms plus the transmission time of the message;

4) *be capable of acquiring a signal in less than 45 s in the presence of electrical storms*; (114/3.4);

5) *have an omni-directional antenna in the horizontal plane.* (114/3.6) The difference between the maximum and minimum signal strength shall be less than:

.1 5 dB over frequency range
.2 3 dB over azimuth
.3 3 dB over roll of 20°;

6) and make available the health status of the station being used, to the system.

4.4 Protection

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 DGPS and DGLONASS maritime radio beacon receiver equipment inputs or outputs for a duration of five minutes.* (114/4)

4.5 Integrity

The following functions shall be performed in either an integrated DGNSS receiver or an associated GNSS receiver. As a consequence, there are no tests for these clauses within this standard.

4.5.1 DGNSS integrity status

When in differential mode, the GNSS receiver shall give a DGNSS integrity indication:

a) if no DGNSS message is received within 10 s;
b) while in manual station selection mode and the selected station is unhealthy, unmonitored, or signal quality is below threshold;
c) while in automatic station selection mode and the only available station is unhealthy, unmonitored, or signal quality is below threshold.

4.5.2 GNSS integrity status

If the Range-rate Correction or the Pseudorange Correction of a satellite is out of tolerance, the binary code in the ITU-R M.823-2 types 1, 9, 31 and 34 messages will indicate to the GNSS receiver that the satellite shall not be used.

4.6 Interfaces

The equipment shall *have at least one serial data output that conforms to the relevant international marine interface standard*; (114/3.5) as defined in IEC 61162-1, IEC 61162-2, or IEC 61162-3 as appropriate.

4.7 IEC 61162-1, IEC 61162-2 implementation

Integrated equipment and stand-alone receivers shall use the following IEC 61162-1 messages for control and status reporting:

– MSK – MSK Receiver Interface (input/output)
– MSS – MSK Receiver Signal (output)

The Talker Identifier Mnemonic for stand-alone receivers is:

– COMMUNICATIONS: Data Receiver: CR

Stand-alone receivers shall use GGA, GNS or GLL (as defined in IEC 61162-1) to receive position data from the GNSS receiver for its automatic functions. (input)

The DGNSS receiver shall provide ITU-R M.823 data output to a port for testing. See also Annex F for informative guidance on ITU-R M.823 interface matters.

4.8 IEC 61162-3 implementation

Integrated equipment and stand-alone receivers shall use the following IEC 61162–3 parameter groups for control, status and data reporting:

– GNSS Position Data
– GNSS Differential Correction Receiver Signal Status
– GNSS Differential Correction Receiver Interface
– GNSS Differential Corrections

4.9 Display and control

The selected operational mode (manual or automatic) shall be clearly indicated or available on an appropriate interface

The following information shall be available for display of the selected station and the next two nearest stations (see 5) of 4.2):

– reference Station ID;
– station name;
– frequency;
– calculated distance to the station;
– station health (from message header);
– signal quality (acceptable < 10 % WER, unacceptable > 10 % WER).

4.10 Installation

For information guidance on installation see Annex D.

5 Technical characteristics

5.1 Carrier frequency

The carrier frequency of the differential correction signal of a radio-beacon station is *an integer multiple of 500 Hz.* (M.823/1.1)

5.2 Frequency tolerance

Frequency tolerance of the carrier is *±2 Hz.* (M.823/1.2)

5.3 Message types

Table 1 is for information and shows message types which may be transmitted by a service provider.

Table 1 – Message types (M823/1.2)

GPS message type number	Title	GLONASS message type number
1	Differential GNSS corrections (full set of satellites)	31
3	Reference station parameters	32
4	Reference Station Datum	4
5	Constellation health	33
6	Null frame	34 (*N*=0 or *N*=1)
7	Radio beacon almanacs	35
9	Subset differential GNSS corrections (this may replace Types 1 or 31)	34 (*N*>1)
16	Special message	36
27 (see note)	Extended beacon almanac	N/A
NOTE New message now being implemented worldwide. Equipment for test from 2005 should incorporate this message type.		

5.4 Data transmission rate

The receiver shall be *capable of receiving data at selectable rates of 25 (GLONASS only), 50, 100 and 200 bits/s.* (M.823/1.6)

5.5 Dynamic range

The receiver shall have *a dynamic range of 10 µV/m to 150 mV/m* (M.823/1.11). 10µV/m is the requirement to be met while tracking, 20 µV/m is the requirement for acquisition.

5.6 Maximum bit error ratio

The receiver shall *operate at a maximum bit error ratio of* 1×10^{-3} *in the presence of Gaussian noise at a signal to noise ratio of 7 dB in the occupied bandwidth.* (M.823/1.12)

5.7 Receiver selectivity and stability

The receiver shall have *adequate selectivity and frequency stability to operate with transmissions 500 Hz apart having frequency tolerances of ±2 Hz and protection ratios given in* Table 2. (M.823/1.14)

5.8 Automatic frequency selection

Automatic frequency selection as provided in the receiver, shall be capable of searching for, receiving, collecting, storing and utilising beacon almanac information from Type 7 / 35 messages and any other relevant message. (M.823/1.17)

5.8.1 Switching criteria

The receivers shall switch from the current reference station when the Reference Station Health or signal quality falls below the minimum criteria of 5.8.2 or is no longer the nearest reference station. The receiver shall be able to select, tune and acquire valid ITU-R M.823 data within 10 s from the nearest reference station that meets minimum requirements for Reference Station Health and signal quality. See informative Annex E for method of carrying out this process.

5.8.2 Minimum requirements

The minimum requirements shall be:

5.8.2.1 Reference station health

– State 000-101 – reference station OK to use;

– State 110 (unmonitored) – do not use unless no other stations are available, and then the user must be warned;

– State 111 – do not use reference station under any circumstances.

5.8.2.2 Signal quality

WER < 0,1 as measured over 25 ITU-R M.823 words, the measurement not being older than 5 min.

5.9 Protection ratios

The protection ratios to be applied shall be *as in* Table 2 (M.823-2 – Table 5)

Table 2 – Protection ratios

Frequency separation between wanted and interfering signal kHz	**Protection ratio** dB	
Wanted	**Differential (G1D)**	**Differential (G1D)**
Interfering	**Radio beacon (A1A)***	**Differential (G1D)**
0	15	15
0,5	–25	–22
1,0	–45	–36
1,5	–50	–42
2,0	–55	–47
* Applicable to radio beacons in the European maritime area under the 1985 Geneva Agreement.		

6 Methods of testing and required test results

This clause defines the type test 'methods of measurement' and 'results required' ensuring that equipment complies with the requirements of Clauses 4 and 5.

6.1 General conditions of measurement and test signals

All the tests to the general requirements of IEC 60945 shall be carried out on the EUT. The equipment shall comply with those requirements of IEC 60945 appropriate to its category, i.e. 'protected' (from the weather) or 'exposed' (to the weather).

The manufacturer shall declare which equipment or units are 'protected' or 'exposed'. The manufacturer shall declare the 'preconditioning' required before environmental checks.

For the purposes of this standard the following test related definitions shall apply:

Performance check – Reconfiguration of the EUT and checking, by non-quantitative visual checks and by conducting the test procedure below, that the system is still operative for the purposes of IEC 60945.

Performance test for the purposes of IEC 60945 – Reconfigure the EUT and perform test 6.2.2.2 a), with a signal level of 34 dBμV/m, ensuring that the system is compliant.

By inspection – a visual check of the equipment or documentation.

Test procedure: After manual frequency selection and a settling time of 30 s, the EUT shall achieve continuous decoding with a WER of 0 % as measured using the methodology in Annex B.

Test signal A shall be a sequence of ITU 823 message nine type 9-3s and one type 7 that form a continuous parity loop. The station ID of test signal A shall be an ID of a station that is stored in the almanac. The type 7 message shall give data for station B.

Test signal B shall contain ITU 823 messages – Type 9-3 and 3 for station. B. The station ID of test signal B shall not be an ID of a station that is stored in the almanac.

Test signal C shall contain ITU 823 messages – Type 9-3. The station ID of test signal C shall be an ID of a station that is stored in the almanac and is closer in distance to the EUT than signal D from station D.

Test signal D shall contain ITU 823 messages – Type 9-3. The station ID of test signal D shall be an ID of a station that is stored in the almanac and is not as close in distance to the EUT as signal C from station C.

Test signal E shall contain 50 ITU 823 messages – Type 9-3 with health status "healthy", followed by a sequence of 50 ITU 823 messages – Type 9-3 with health status "unhealthy". The station ID of test signal E shall be an ID of a station that is stored in the almanac and is closer in distance to the EUT than signal D from station D.

Test signal F shall contain 150 ITU 823 messages – Type 9-3 with a WER of zero, followed by a sequence of 150 ITU 823 messages – Type 9-3 with a WER of 100 %. The station ID of test signal E shall be an ID of a station that is stored in the almanac and is closer in distance to the EUT than signal D from station D.