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N-10

MULTI-SYSTEM SHIPBORNE RADIONAVIGATION RECEIVERS

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Foreword

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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Main changes:

1. New normative reference file include MSC. 432 (98) resolution and Appendix 5 ,Chapter 4 of Part 5 of Technical Regulations for the Statutory Surveys of Sea-going Ships Engaged on Domestic Voyages 2016 Amendments (hereinafter referred to as the regulations), and delete the appendix 1 at the same time, fixed table 7.4 (2) the standard number;

2. New MSC.432(98) content of the resolution: ship multisystem radio navigation receiver shall be tested with a single system performance standard in Article 7.4.

Table of contents

MULTI-SYSTEM SHIPBORNE RADIONAVIGATION RECEIVERS

1 Application

1.1 This guideline is applicable to the type approval and single-piece/batch product inspection of the multi-system shipborne BDS, GPS, GLONASS and GALILEO radionavigation receivers.

1.2 This guideline is not applicable to the equipment on the ships with the speed greater than 70 kn.

2 Normative references

2.1.1 SOLAS (1974) and Article 19, Chapter V in the amendment;

2.1.2 SOLAS (1974) and Article 3, Chapter X in the amendment;

2.1.3 Chapter 13, 2000 HSC Code;

2.1.4 IMO Resolution A.694 (17): General Requirements for Ship-borne Radio Equipment Forming Part of the Global Maritime Distress and Safety System (GMDSS) and for Electronic Navigational Aids;

2.1.5 IMO MSC Resolution 112 (73): Adoption of Revised Performance Standards for Ship-borne Global Positioning System (GPS) Receiver Equipment;

2.1.6 IMO MSC Resolution 113 (73): Adoption of the Revised Performance Standards for Shipborne GLONASS Receiver Equipment;

2.1.7 IMO MSC Resolution 233 (82): Adoption of Performance Standards for Shipborne GALILEO Receiver Equipment;

2.1.8 IMO MSC Resolution 191 (79): Performance Standards for the Presentation of Navigation-related Information on Shipborne Navigational Displays;

2.1.9 IMO Resolution A.1046 (27): Worldwide Radionavigation System;

2.1.10 IMO Resolution A.915 (22): Revised Maritime Policy and Requirements for a Future Global Navigation Satellite System (GNSS);

2.1.11 IMO Resolution A.953 (23): World-wide Radionavigation System;

2.1.12 IMO MSC Resolution 379 (93): Performance Standards for Shipborne Beidou Satellite Navigation System (BDS) Receiver Equipment;

2.1.13 IMO MSC Resolution 401 (95): Performance Standards for Multi-system Shipborne Radionavigation Receivers;

2.1.4 IMO MSC Resolution 432 (98): Revised Performance Standards for Multi-system Shipborne Radionavigation Receivers;

2.1.15 IEC 61108-1 2003: Maritime Navigation and Radio Communication Equipment and Systems - Global Navigation Satellite System (GNSS), Part 1: Global Positioning System (GPS) - Receiver Equipment - Performance Standards, Methods of Testing and Required Test Results;

2.1.16 IEC 61108-2 1998: Maritime Navigation and Radio Communication Equipment and Systems - Global Navigation Satellite System (GNSS), Part 2: Global Navigation Satellite System (GLONASS) - Receiver Equipment - Performance Standards, Methods of Testing and Required Test Results;

2.1.17 IEC 61108-3 2010: Maritime Navigation and Radio Communication Equipment and Systems - Global Navigation Satellite System (GNSS), Part 3: GALILEO - Receiver Equipment - Performance Standards, Methods of Testing and Required Test Results;

2.1.18 IEC 61162 series: Maritime Navigation and Radio Communication Equipment and Systems - Digital Interface;

2.1.19 IEC 62288 2014: Maritime Navigation and Radio Communication Equipment and Systems - Presentation of Navigation-related Information on Shipborne Navigational Displays - General Requirements, Methods of Testing and Required Test Results;

2.1.20 IEC 60945 2002: Maritime Navigation and Radio Communication Equipment and Systems - General Requirements - Methods of Testing and Required Test Results;

2.1.21 Appendix 5 ,Chapter 4 of Part 5 of Technical Regulations for the Statutory Surveys of Sea-going Ships Engaged on Domestic Voyages 2016 Amendments (hereinafter referred to as the regulations)

2.1.22 GD22-2015 Guidelines for Type Approval Test for Electric and Electronic Products of China Classification Society.

2.2 In case of any changes to the conventions, regulations, recommendations on performance and

testing standards mentioned above, the latest valid editions apply.

3 Terms and definitions

For the purposes of this guideline, the terms and definitions as specified in the aforesaid approval and inspection basis apply. For the sake of the preparation and usage, the following definitions are directly cited or supplemented in this guideline.

3.1 BDS: Beidou navigation satellite system;

3.2 GPS: Global positioning system;

3.3 GLONASS: Global navigation satellite system;

3.4 GALILEO: Galileo satellite navigation system;

3.5 COG: Course over ground;

3.6 SOG: Speed over ground;

3.7 UTC: Universal time coordinated;

3.8 PVT: Position, velocity, time;

3.9 GNSS: Global navigation satellite system.

3.10 C/A code: A pseudo random code for civil use, used to modulate the GPS satellite L1 carrier (1575.42MHz) signals;

3.11 GPS standard positioning service (SPS): A public civil service offered by the GPS C/A code;

3.12 DGPS (differential GPS): A technology augmenting the GNSS by improving the navigation performance for users. In the maritime sector, the augmentation mainly applies the following two methods: 1. using the satellite-based augmentation system (SBAS), a system supplementing the satellite signals to strengthen the performance of GNSS services; 2. using the ground-based augmentation system (GBAS), a system supplementing the signals from a ground station to strengthen the performance of GNSS services.

3.13 DBDS: Differential Beidou navigation satellite system;

3.14 Dilution of precision (DOP): A factor describing the effect of the geometric location of a

satellite on the error. The error of a satellite navigation system is the product of the range error multiplied by the dilution of precision. It is further classified into 3D position dilution of precision (PDOP), horizontal dilution of precision (HDOP) and time dilution of precision (TDOP) and etc., according to the object of research.

3.15 Acquisition: The process in which a user's unit completes the code identification, code synchronization and carrier phase synchronization of a received satellite signal.

3.16 Receiver autonomous integrity monitoring (RAIM): A method where a receiver determines the integrity of a satellite system by using the pseudorange measurement information of a redundant satellite. It can identify whether any visible satellites are faulty or which one is faulty and exclude the faulty ones from the navigation solutions.

3.17 WGS-84: World Geodetic System 1984, a geocentric reference system established by the United States Department of Defense through the orientation using the Geodetic Reference System 1980 and the BIH1984.0 system on the basis of the precise ephemeris system NSWC-9Z-2 corresponding to the WGS72.

3.18 CGCS2000: China Geodetic Coordinate System 2000, a terrestrial geocentric coordinate system established through the combined adjustment of the GPS continuous operation reference station, the space-geodetic control network, the astro-geodetic network and the space geodetic network of China. The China Geodetic Coordinate System 2000 is based on the ITRF 97 reference frame and the reference frame epoch is 2000.0.

4 Plans and documents

4.1 The following drawing documents shall be submitted to CCS for review:

(1) Outline drawings and structure drawings of the complete machines;

(2) Electrical schematic diagrams, wiring diagrams and electrical functional block diagrams;

(3) Schematic diagrams or block diagrams of supply apparatus and product power supply layout plans;

(4) System wiring diagrams;

(5) Product technical specifications;

The product technical specifications shall clearly specify the overall performance and design

requirements of the products, at least including the following:

① Provisions on the environmental conditions of the products;

② Product composition, main purchased parts and sources of procurement;

③ A detailed description of product functions and performance indices;

④ Acceptance conditions for the complete machines.

(6) Software, at least including the following:

① A description of the main software modules of the products and software version number;

② Software maintenance and update instructions.

(7) The product operating manuals, installation manuals, familiarization materials and maintenance manuals (bilingual in Chinese and English or in English), at least including the following contents:

Operating manuals:

① The concept of the multimode system and the benefits and limitations of using two or more GNSS (the ground radio navigation system and the augmentation system may be taken into account);

② A statement on which GNSS, terrestrial radio navigation system (if any) and augmentation system (if any) are supported (i.e., as the sources for the PVT solution);

③ A sentence on which navigation phase(s) is (are) supported and by which PVT source(s);

④ The user guidance for receivers necessary to achieve the navigation phase requirements;

⑤ A detailed description of the adjustment method of indicators and threshold values;

⑥ An explanation of the fusion process and input selection for multiple systems;

⑦ A description of possible failures and their effects on the receiver equipment;

⑧ Fault analysis for functions, verifying that the equipment is designed based on the safe design principles and ensuring that the equipment is designed with the "fault safety" actions. The influence of all failure modes shall be taken into account, such as the faults caused by electrical appliances, components and radio frequency interference.

Installation Manuals:

① The details of components and the interconnections between them;

② The details of interfaces and connections for data input/output, and interconnection diagrams;

③ The configuration options and commissioning instructions;

④ The power supply and earthing arrangements; and

⑤ The recommendations on the physical layout of the equipment, including the antenna mounting requirements and necessary space for installation and maintenance.

Familiarization materials: which should explain all configurations, functions, limitations, controls, displays, alerts, indications and standard operator checks of the equipment;

Maintenance manuals: support the maintenance information of the equipment;

The manuals shall include the list of all the terms, abbreviations, symbols, and icons displayed by the systems or equipment and related interpretations. The detailed descriptions of the user operating interfaces and function menus shall be included to facilitate the understanding and operating of the users and testing personnel.

(8) Outlines of type test and delivery test

The description of the following shall be included at least: sampling of type test, batching grouping and sampling principles of delivery test, requirements for test equipment, test items, test methods and criterion of test results.

4.2 The scope and details of the submitted drawings and technical materials shall be such that the compliance of products with the regulations and related standards can be reviewed and verified, and the appearance, structures and electrical design of the products can be inspected and tested.

4.3 The submitted documents shall be managed and identified as per the regulations of the quality

management system of the manufacturer. The submitted technical documents shall be convenient for checking with related technical requirements.

5 Technical requirements for design

5.1 The electrical safety, suitability of power supply conditions, environmental suitability and electromagnetic compatibility of the equipment shall be suitable for the working environment of ships and in line with the testing requirements for the "indoor equipment" or "outdoor equipment" as specified in IEC60945.

5.2 Requirements for functions and performance

5.2.1 Operate using civil access navigation signals of at least two independent GNSS, provided in the radionavigation satellite service (space-to-earth) frequency bands designated in Article 5 of the Radio Regulations of the International Telecommunication Union;

5.2.2 Provide PVT data with the necessary level of resilience and integrity, whether it is used directly as the input to other equipment, or provided for use within the Integrated Navigation Systems (INS);

5.2.3 Where the terrestrial radionavigation system (s) signals are provided and used in the protected frequency bands, the equipment shall be able to operate using the terrestrial radionavigation system (s) signals provided in the protected frequency bands;

5.2.4 Have the facilities to process the augmentation data, in accordance with the appropriate methods;

5.2.4 Provide the facilities for the user to select or deselect the radionavigation and augmentation signals;

5.2.6 Be capable of processing and combining the above signals to provide a single PVT solution, including:

(1) The position information of the consistent common reference point in latitude and longitude, referenced to the implementation of an International Terrestrial Reference Frame (ITRF), with the coordinates in degrees and minutes to a precision reflective of the accuracy of the position information, up to 0.0001 minute;

(2) The COG of the consistent common reference point in degrees to a precision reflective of the accuracy of the calculated course information, relative to true north, up to 0.1 degree;

(3) The SOG of the consistent common reference point in knots to a precision reflective of the accuracy of the calculated course information, up to 0.01kn;

(4) The time, referenced to UTC (BIPM), accurate to 0.1 second;

5.2.7 Be capable of providing the PVT solution to the required accuracy within:

(1) 5 min where there is no valid satellite almanac data (cold start);

(2) 1 min where there is valid satellite almanac data (warm start); and

(3) 2 min, when subjected to a power interruption or loss of signals of <60 s;

5.2.8 Be capable of generating a new PVT solution at least once every 0.5s for high-speed crafts (HSC) and at least once every 1s for conventional vessels;

5.2.9 Be capable of assessing whether the performance of the PVT solution (e.g., accuracy and integrity) meets the requirements for each phase[1] of navigation. An alert shall be provided when such assessment cannot be determined;

5.2.10 Provide a caution if after 2s for HSC or 3s for conventional vessels, the equipment is unable to assess the current achieved performance (e.g., accuracy and integrity) with respect to each navigation phase;

5.2.11 Provide a warning, if after 5s for HSC or 7s for conventional vessels, the new PVT data hasn't been calculated. Under such conditions, the last known position and the time of the last valid fix, with the explicit indication of this state so that no ambiguity can exist, shall be output until the normal operation is resumed;

5.2.12 If it is not possible to provide a new position update at the next scheduled update, output the last plausible position, SOG, COG, and the time of the last valid fix, with indication of this state so that no ambiguity can exist, until the position update is resumed;

5.2.13 Provide an indication of augmentation status, including:

(1) The receipt of augmentation signals;

(2) The validity of the signals received;

Note[1] The "each navigation phase" referred to herein refers to the "operating requirements" as specified in the annex of IMO A.1046 (27).

(3) Whether the augmentation is applied to the position in the PVT solution; and

(4) The identification of the augmentation signals;

5.2.14 Provide the following information, in alphanumerical form, for the final PVT solution and for each individual source when requested, to a local display (or a separate interfaced display):

(1) Position;

(2) SOG and COG;

(3) Time;

(4) PVT solution source(s);

(5) An assessment of the navigation phase(s) for which the performance requirements are supported;

(6) The identification of the augmentation signal(s) applied to the position solution; and

(7) Any alert information.

5.3 Interface and integration requirements

5.3.1 Provide the following interfaces in accordance with the relevant international standards:

(1) At least one interface from which the PVT solution shall be available in the WGS 84 (i.e., including the location information, COG, SOG, time, PVT source(s) (available and used), assessment of phase(s) of navigation for which the performance requirements are met, and augmentation information) shall be provided. The means may be provided for transforming the computed position based upon WGS 84 into the data compatible with the datum of the navigational chart in use;

(2) At least one interface from which the data from all available sources can be provided (e.g., to an Integrated Navigation System (INS) for the enhanced assessment of the PVT information which shall be available in WGS 84);

(3) An interface for alert management (i.e., with the Bridge Alert Management (BAM)); and

(4) At least one interface for receiving the augmentation signals;

5.3.2 Be capable of operating satisfactorily under normal interference conditions, consistent with the requirements of Resolution A.694(17), and taking into account the typical electromagnetic and radio frequency spectrum environment on board and from outside a vessel;

5.3.3 Ensure that no permanent damage can result from a short circuit or grounding of the antenna or any of its input or output connections or any of the circuits.

5.4 Input and output requirements

5.4.1 The equipment shall provide the interfaces of data control/configuration receivers;

5.4.2 The output of the equipment shall meet the following requirements:

(1) Provide at least 2 output ports, through which such information as positions, UTC, COG, SOG and alerts can be sent to other equipment. The position output shall be based on the WGS 84 datum or the CGCS 2000 datum and comply with the requirements of IEC 61162.

(2) Provide at least one normally closed contact, which shall indicate the faults in a receiver;

(3) Provide a two-way communication interface in line with the requirements of IEC 61162, through which the alerts can be transmitted to an external system and the audible alerts from the receiver can be confirmed from the external system;

(4) Provide the facilities processing the data input into the receiver according to ITU-R standards and appropriate RTCM standards and indicating whether the received signals are being used for ship positioning.

5.4.3 The reporting sentences for PNT shall be in accordance with the requirements of IEC61162, and the following sentences shall be used:

DTM – Datum reference system

GBS – GNSS satellite fault detection

GFA – GNSS fix accuracy and integrity

GNS - GNSS fix data

RMC – Recommended minimum specific GNSS data

ZDA – Time and date

If the WGS-84 coordinates are not used to the sentences, the DTM sentences shall be used in accordance with the requirements of IEC 61162.

5.4.4 The reporting sentences for alarms shall be in accordance with the requirements of IEC61162, and the following sentences shall be used:

ALR - Set alarm state

ACK – Acknowledge alarm

In addition, in order to integrate with other navigational aids, the following sentences may also be provided:

GRS – GNSS range residuals

GSA – GNSS DOP and active satellites

GST – GNSS pseudorange error statistics

GSV – GNSS satellites in view

Note: The GBS, GRS, GSA, GST and GSV sentences shall support the external integrity checkout and synchronize with the corresponding fix data (GNS).

6 Materials and components

Materials and components are to comply with relevant requirements of CCS Rules.

7 Type approval and unit/batch testing

7.1 Principles

The equipment is subject to the type approval of CCS. The issuance, retention, revision, renewal and abolishment of the type approval certificates shall be in accordance with Chapter 3, Volume 1 of the Rules for Classification of Sea-going Steel Ships.

7.2 Selection of typical samples and test arrangement

The models and specifications of the test samples shall be technologically representative, covering all the products for which the applications for type approval are submitted. The test samples shall be sampled by the surveyors of CCS at the site of the product manufacturer.

7.3 Testing agency

The type approval tests shall be carried out by an authorized impartial testing agency approved by CCS and certified by international/national laboratories. If the manufacturer is provided with the required testing conditions, some test items, except for the Beidou performance test, may be carried out at the premise of the manufacturer upon the review and approval of the surveyors of CCS and under their supervision on the site.

When determining the testing agency, the testing conditions necessary for the test items as specified in IEC 61108 shall be fully taken into account and the written documents shall be submitted and reviewed by the surveyors of CCS.

7.4 Items and requirements of type approval test

Ship multisystem radio navigation receiver shall be tested with a single system performance standard .The type approval test items are as shown in the tables below.

Environment conditions test items specified in IEC60945 Table 7.4 (1)

S/N	Test item	Test method	Remarks
1.	Ergonomics and HMI inspection	IEC 60945, 6.1	May be combined with the performance test
2.	Hardware	IEC 60945, 6.2	May be combined with the performance test
3.	Software	IEC 60945, 6.3	May be combined with the performance test
4.	Connection between units	IEC 60945, 6.4	May be combined with the performance test
5.	Extreme power supply variation test	IEC 60945, 7.1	Normal test temperature
6.	Excess power supply conditions	IEC 60945, 7.2	
7.	Dry heat, including extreme power supply conditions	IEC 60945, 8.2 & 7.1	
8.	Damp heat	IEC 60945, 8.3	
9.	Low temperature, including extreme power supply conditions	IEC 60945, 8.4 & 7.1	
10.	Vibration test	IEC 60945, 8.7	
11.	Antenna part rainfall and water test	IEC 60945, 8.8	
12.	Salt mist test	IEC 60945, 8.12	Not required if the materials are provided by the manufacturer.
13.	Conducted emission test	IEC 60945, 9.2	

Continued Table 7.4 (1)

S/N	Test item	Test method	Remarks
14.	Test of radiated emissions from enclosure ports	IEC 60945, 9.3	
15.	Immunity to conducted disturbances induced by radio-frequency fields	IEC 60945, 10.3	
16.	Radio-frequency electromagnetic field immunity	IEC 60945, 10.4	
17.	Electrical Fast Transient Immunity	IEC 60945, 10.5	
18.	Surge Immunity	IEC 60945, 10.6	
19.	Power supply short-term variation immunity	IEC 60945, 10.7	
20.	Power failure immunity	IEC 60945, 10.8	
21.	Electrostatic discharge immunity	IEC 60945, 10.9	
22.	Noise and audible signals	IEC 60945, 11.1	
23.	Magnetic compass safe distance	IEC 60945, 11.2	
24.	Insulation of dangerous voltage	IEC 60945, 12.1	The IP rating of the enclosures of the equipment installed in cabins shall be at least IP20.
25.	Emissions from visual display units (VDU)	IEC 60945, 12.3	Not required for LCD screens.
26.	Withstand voltage test	Article 2.14 of GD22-2015	Complete machine test (only applicable to the power supply units above 50V)
27.	Measurement of insulation resistance	Article 2.3 of GD22-2015	
The performance inspection/test items combined with the environment conditions test shall be carried out according to the following steps: • Start the equipment from its initial state (cold start); • Check the receiver acquisition time; • Check and verify the normal signal tracking, continuous output of valid fix results and normal navigation of the receiver.			

Equipment function and performance test items **Table 7.4 (2)**

S/N	Test item	GPS signal processing test	GLONASS signal processing test	GALILEO signal processing test	BDS signal processing test	Remarks
1.	Function test	Refer to the requirements as specified in 5.2 of this guideline.				Functions of the complete machine
2.	Ship position output inspection	Clause 5.6.2 of IEC 61108-1: 2003	Clause 5.6.2 of IEC 61108-2:1998	Clause 5.6.2 of IEC 61108-3: 2010	Article 5.6.3, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	Document review
3.	Interfaces with other devices and output test	Clause 5.6.3 of IEC 61108-1: 2003	Clause 5.6.3 of IEC 61108-2:1998	Clause 5.6.3 of IEC 61108-3: 2010	Article 5.6.3, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	The specific inspection and test items shall be determined in accordance with the IEC61162 series standards on which the interfaces are based.
4.	Accuracy test	Clause 5.6.4 of IEC 61108-1: 2003	Clause 5.6.4 of IEC 61108-2:1998	Clause 5.6.4 of IEC 61108-3: 2010	Article 5.6.4, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	Pay attention to the test conditions; the reference points and antenna oscillators are required.
5.	Acquisition test	Clause 5.6.5 of IEC 61108-1: 2003	Clause 5.6.5 of IEC 61108-2:1998	Clause 5.6.5 of IEC 61108-3: 2010	Article 5.6.5, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	—
6.	Connection of antenna to input/output	Clause 5.6.6 of IEC 61108-1: 2003	Clause 5.6.6 of IEC 61108-2:1998	Clause 5.6.6 of IEC 61108-3: 2010	Article 5.6.6, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	—

Continued Table 7.4(2)

S/N	Test item	GPS signal processing test	GLONASS signal processing test	GALILEO signal processing test	BDS signal processing test	Remarks
7.	Antenna installation	Clause 5.6.7 of IEC 61108-1: 2003	Clause 5.6.7 of IEC 61108-2:1998	Clause 5.6.7 of IEC 61108-3: 2010	Article 5.6.7, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	Document review
8.	Sensitivity and dynamic range	Clause 5.6.8 of IEC 61108-1: 2003	Clause 5.6.8 of IEC 61108-2:1998	Clause 5.6.8 of IEC 61108-3: 2010	Article 5.6.8, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	The special microwave anechoic chambers and signal simulators are required.
9.	Special interfering signal disturbance	Clause 5.6.9 of IEC 61108-1: 2003	Clause 5.6.9 of IEC 61108-2:1998	Clause 5.6.9 of IEC 61108-3: 2010	Article 5.6.9, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	The signal simulators and S frequency band radars are required.
10.	Position update	Clause 5.6.10 of IEC 61108-1: 2003	Clause 5.6.10 of IEC 61108-2:1998	Clause 5.6.10 of IEC 61108-3: 2010	Article 5.6.10, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	
11.	Input of the differential navigation satellite system	Clause 5.6.11 of IEC 61108-1: 2003	Clause 5.6.12 of IEC 61108-2:1998	Clause 5.6.11 of IEC 61108-3: 2010	Article 5.6.11, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	Document review
12.	Fault alarm and status indication	Clause 5.6.12 of IEC 61108-1: 2003	Clause 5.6.11 of IEC 61108-2:1998	Clause 5.6.12 of IEC 61108-3: 2010	Article 5.6.12, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	

Continued Table 7.4(2)

S/N	Test item	GPS signal processing test	GLONASS signal processing test	GALILEO signal processing test	BDS signal processing test	Remarks
13.	COG and SOG output	Clause 5.6.13 of IEC 61108-1: 2003		Clauses 5.6.13 and 5.6.14 of IEC 61108-3: 2010	Article 5.6.12, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	
14.	UTC output	Clause 5.6.14 of IEC 61108-1: 2003		Clause 5.6.15 of IEC 61108-3: 2010	Article 5.6.13, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	—
15.	Performance test under typical interference conditions	Clause 5.7 of IEC 61108-1: 2003		Clause 5.7 of IEC 61108-3: 2010	Article 5.6.14, Annex 2, Appendix 5 ,Chapter 4 of Part 5 of Regulations	The special microwave anechoic chambers and signal simulators are required.
16.	Presentation of navigation-related information	Clauses 4 and 7 of IEC62288-2014				The tests as specified in Clause 4 may be combined with the performance test.

7.5 Single-piece/batch testing

Before the delivery from the factory, the single-piece/batch testing shall be performed and the certificates of marine products shall be issued.

After the type approval, the manufacturer shall, according to the quality control documents submitted for approval, control the production and testing processes of the products, perform the specified delivery test on every marine product and issue the delivery test reports. The surveyors of CCS shall, on the basis of the review of delivery test reports, sample for testing at the rate of 5%, but no less than two sets. The single-piece/batch testing shall at least include the following items:

- Data verification of main components (parts)

- Software version confirmation

- Visual inspection

- Function verification tests: multi-system switch, display function, fault alarm, status indication and acquisition tests;

- Performance test: fix accuracy;

If the surveyors deem necessary, the test items and sample quantity shall be added.

Annex 1 Performance Standards for Shipborne GALILEO Receiver Equipment

1 GALILEO receiver equipment

1.1 The GALILEO receiver equipment shall be provided with at least the following devices:

(1) antenna capable of receiving Galileo signals;;

(2) A GALILEO receiver and processor;

(3) means of accessing the computed latitude/longitude position;;

(4) Data controls and interfaces; and

(5) position display and, if required, other forms of output.

Note: If the GALILEO forms part of an approved integrated navigation system, the devices specified in (3), (4) and (5) may be provided within the INS.

1.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation, taking into consideration any obstructions that might exist on the ship.

2 Performance standards for GALILEO receiver equipment

2.1 The GALILEO receiver equipment shall:

2.1.1 Be capable of receiving and processing the GALILEO PVT signals on:

(1) For a single-frequency receiver, the L1 frequency shall be used. The receiver shall broadcast its ionosphere models by using the satellite constellations to generate the ionosphere correction;

(2) For a dual-frequency receiver, the L1 and E5b frequencies or L1 and E5a frequencies shall be used. The receiver shall use the doal frequency processing and generating the ionosphere corrections;

2.1.2 Provide the position information in latitudes and longitudes (in degrees, minutes, and per mil minute);

2.1.3 Provide the time referenced to the UTC (BIPM);

2.1.4 Provide at least 2 output ports, through which such information as positions, UTC, COG, SOG and alerts can be supplied to other equipment. The position information output shall be based on the WGS 84 datum and comply with related international standards. The output of UTC, COG, SOG and alerts shall be consistent with the requirements of 2.1.16 and 2.1.18;

2.1.5 Have the static accuracy such that the antenna position may be determined within the following scopes:

(1) Within 15m (95%) in the horizontal direction and 35 m (95%) in the vertical direction for the single-frequency operation on the L1 frequency;

(2) Within 10m (95%) in both the horizontal and vertical directions for the dual-frequency operation on the L1 and E5a frequencies or L1 and E5b frequencies;

2.1.6 Have the level of dynamic accuracy equivalent to the static accuracy specified 2.1.5 according to the sea conditions and ship motions;

2.1.7 Have the position resolution equal to or better than the latitude and accuracy of 0.001 minute;

2.1.8 Have the time service accuracy and can determine the time within 50ns of UTC;

2.1.9 Be capable of automatically selecting the appropriate satellite transmission signals to determine the ship position, speed and time, with the required accuracy and update rate;

2.1.10 Be capable of acquiring the satellite signals, with the carrier level of input signals being -128 dBm to -118 dBm. Once the satellite signals are acquired and the carrier level of satellite signals drops to -131 dBm, the equipment shall continue to run satisfactorily;

2.1.11 Be capable of operating satisfactorily under the normal interference conditions as specified in the Resolution A.694 (17);

2.1.12 Be capable of acquiring the position, speed and time information with the required accuracy within 5 min where there is no valid satellite almanac data (cold start);

2.1.13 Be capable of acquiring the position, speed and time information with the required accuracy within 1 min where there is valid satellite almanac data (warm start);

2.1.14 Be capable of acquiring the position, speed and time information with the required accuracy within 1 min when subjected to a service interruption of 60s or less;

2.1.15 Be capable of generating a new position solution and output it to a display and digital interface at least once every 1s for conventional vessels and at least once every 0.5s for HSC;

2.1.16 Provide COG, SOG and UTC output, with the validity indications consistent with those of the position output. The accuracy of COG and SOG shall not be below the related performance standards for the heading, speed and distance measuring equipment, and the accuracy required under all sorts of dynamic conditions that might be encountered on board shall be provided;

2.1.17 Provide at least one normally closed contact, which shall indicate the faults in the receiver equipment;

2.1.18 Provide a two-way communication interface in line with related international standards, through which the alerts can be transmitted to an external system and the audible alerts from the GALILEO receiver can be confirmed from the external system;

2.1.19 Provide the facilities processing the differential GALILEO (DGALILEO) data according to ITU-R standards and appropriate RTCM standards and indicating the receipt of DGALILEO signals and whether they are being used for ship positions.

3 Integrity inspection, fault alarm and status indication

3.1 The GALILEO receiver equipment shall also indicate whether the performance of the GALILEO is beyond the general navigation requirements for the inland segments of the ocean-going routes, coastal routes, the routes in approach channels and restricted waters and those specified in Resolution A.953 (23) or Resolution A. 915 (22), Annex 2 and the subsequent amendments. The GALILEO receiver equipment shall at least:

3.1.1 Give an alarm within 5s after the position loss, or when it fails to calculate the new positions based on the information provided by the GALILEO satellite constellations after 1s for conventional vessels and after 0.5s for HSC. In this case, the last known position and the time of the last valid fix, with the explicit indication of this state so that no ambiguity can exist, shall be output until the normal operation is resumed;

3.1.2 Use the RAIM to e provide the provide integrity performance appropriate to the operation being undertaken;

3.1.3 Provide the self-test function.

3.2 For a receiver capable of processing the GALILEO safety of life service, the integrity monitoring and alert algorithm shall be based on the appropriate combination of the GALILEO

integrity information and RAIM. If the period beyond the horizontal alert limit (HAL) of 25m is at least 3s, the receiver shall provide an alarm within the time to alarm (TTA) of 10s upon the occurrence of the event. The probability of events shall be higher than 99.999% within 3h (integrity risks ≤ 10-5/3 h).

4 Protection

The appropriate preventive measures shall be taken to ensure that no permanent damage can result from an accident short circuit or grounding of the antenna or any of its input or output connections or any of the inputs or outputs of the GALILEO receiver equipment lasting 5min or less.