

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) –  
Part 3: Galileo receiver equipment – Performance requirements, methods of testing and required test results**

[IEC 61108-3:2010](#)

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**Matériels et systèmes de navigation et de radiocommunication maritimes –  
Système mondial de navigation par satellite (GNSS) –  
Partie 3: Matériel de réception Galileo – Exigences d'exploitation et de fonctionnement, méthodes d'essai et résultats d'essai exigés**



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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



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Part 3: Galileo receiver equipment – Performance requirements, methods of testing and required test results**

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**MARITIME NAVIGATION AND  
RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS –  
GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) –****Part 3: Galileo receiver equipment –  
Performance requirements, methods  
of testing and required test results**

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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.

A list of all the parts in the IEC 61108 series, under the general title: *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS)*, can be found on the IEC website.

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

## Part 3: Galileo receiver equipment – Performance requirements, methods of testing and required test results

### 1 Scope

This part of IEC 61108 specifies the minimum performance standards, methods of testing and required test results for Galileo shipborne receiver equipment, based on IMO resolution MSC.233(82), which uses the signals from the Galileo Global Navigation Satellite System in order to determine position. It takes account of the general requirements given in IMO resolution A.694(17) and is associated with IEC 60945. When a requirement in this standard is different from IEC 60945, the requirement in this standard takes precedence. It also takes account, as appropriate, of requirements for the presentation of navigation-related information on shipborne navigational displays given in IMO resolution MSC.191(79) and is associated with IEC 62288.

A description of the Galileo Open Service and Safety of Life Service is given in the Galileo interface control documents (see Bibliography). This receiver standard applies to navigation in ocean waters for the open service and harbour entrances, harbour approaches and coastal waters for the Safety of Life service, as defined in IMO resolution A.953(23).

[IEC 61108-3:2010](http://standards.iec.ch/publications/61108-3-2010)

All text of this standard, whose meaning is identical to that in IMO resolution MSC.233(82), is printed in *italics* and the resolution and paragraph numbers are indicated in brackets i.e. (M.233/A1.2).

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

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

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

IEC 61108-1:2003, *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*

IEC 61108-4, *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*

IEC 61162 (all parts), *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

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

IEC 62288, *Maritime navigation and radiocommunication equipment and systems – Presentation of navigation-related information on shipborne navigational displays – General requirements – Methods of testing and required test results*

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*

IMO resolution A.915(22), *Revised maritime policy and requirements for a future Global Navigation Satellite System (GNSS)*

IMO resolution A.953(23), *World-wide radionavigation system*

IMO resolution MSC.233(82), *Adoption of the Performance Standards for Shipborne GALILEO Receiver Equipment*

ITU-R Recommendation M.823-3, *Technical characteristics of differential transmissions for Global Navigation Satellite Systems from maritime radio beacons in the frequency band 283.5-315 kHz in Region 1 and 285-325 kHz in Regions 2 and 3*

RTCM 10402 RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 2.4

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### 3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

NOTE All definitions and abbreviations used are the same as those used in the Galileo performance signal specification.

#### 3.1 Terms and definitions

##### 3.1.1

##### **integrity**

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

#### 3.2 Abbreviations

Compass	Beidou-2 GNSS (China)
COG	Course Over Ground
CW	Continuous Wave
dGalileo, dGPS, dGLONASS	Differential Galileo, GPS, GLONASS
EUT	Equipment Under Test
FDE	Fault Detection and Exclusion
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GLONASS	GLOBAL Navigation Satellite System
GTRF	Galileo Terrestrial Reference Frame

ITRF	International Terrestrial Frame
HAL	Horizontal Alert Limit
HDOP	Horizontal Dilution Of Precision
HPL	Horizontal Protection Limit
HMI	Hazardous Misleading Information
MDE	Marginally Detectable Error
NB	Narrow Band
pdf	Probability distribution function
PDOP	Position Dilution Of Precision
$P_{HMI}$	Probability of hazardous misleading error
PVT	Position, Velocity, Time
RAIM	Receiver Autonomous Integrity Monitor
RF	Radio Frequency
RFCS	Radio Frequency Constellation Simulator
RFI	Radio Frequency Interference
SDME	Speed and Distance Measuring Equipment
SIS	Signal in space
SOG	Speed Over Ground
SV	Space Vehicle
TTA	Time-to-alarm
ULS	Up-Link Station
UTC	Universal Time Coordinated
VAL	Vertical Alert Limit
VPL	Vertical Protection Limit
WB	Wide Band

## 4 Minimum performances standards

### 4.1 Object

Galileo provides two different services of use for the maritime community.

(M.233/A1.3) *The Galileo Open Service provides positioning, navigation and timing services, free of direct user charges. The Open Service can be used on one (L1, E5a, E5b), two (L1 and E5a or L1 and E5b) or three (L1, E5a and E5b) frequencies.*

(M.233/A1.4) *The Galileo Safety of Life Service can be used on one (L1 or E5b) or two (L1 and E5b) frequencies. Each of the L1 and E5b frequencies carries a navigation data message that includes integrity information. The E5a frequency does not include integrity data.*

(M.233/A1.5) *Galileo receiver equipment intended for navigation purposes on ships of speeds not exceeding 70 knots, in addition to the general requirements specified in IEC 60945, shall comply with the following minimum performance requirements.*

(M.233/A1.6) *These standards cover the basic requirements of position fixing, determination of course over ground (COG), speed over ground (SOG) and timing, either for navigation purposes or as input to other functions. The standards do not cover the other computational facilities which may be in the equipment nor cover the requirements for any other systems that may take input from the Galileo receiver. Other computational activity, input/output*

activity or extra display functions which may be provided shall not degrade the performance of the equipment below the minimum performance standards set out in this standard.

## 4.2 Galileo receiver equipment

(See 5.6.1)

### 4.2.1 Minimum facilities

(M.233/A2.1) *The words “Galileo receiver equipment” as used in these performance standards include all the components and units necessary for the system properly to perform its intended functions. The Galileo receiver equipment shall include the following minimum facilities:*

- .1 antenna capable of receiving Galileo signals;
- .2 Galileo receiver and processor;
- .3 means of accessing the computed latitude/longitude position;
- .4 data control and interface; and
- .5 position display and, if required, other forms of output.

NOTE If Galileo forms part of an approved Integrated Navigation System (INS), requirements of .3, .4 and .5 may be provided within the INS.

### 4.2.2 Configuration

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

- stand-alone receiver with means of accessing computed position via a keyboard with the positional information suitably displayed;
- Galileo black box receiver fed with operational parameters from external devices/remote locations and 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.

### 4.2.3 Quality assurance

The equipment shall be designed, produced and documented by companies complying with approved quality systems as applicable.

## 4.3 Performance standards for Galileo receiver equipment

### 4.3.1 General

(See 5.6.2)

(M.233/A3.1) *The Galileo receiver equipment shall be capable of receiving and processing the Galileo positioning and velocity, and timing signals on:*

- i) *for a single frequency receiver, the L1 frequency alone. The receiver shall use the ionospheric model broadcast to the receiver by the constellation to generate ionospheric corrections;*
- ii) *for a dual frequency receiver, either the L1 and E5b frequencies or the L1 and E5a frequencies. The receiver shall use dual frequency processing to generate ionospheric corrections;*

A detailed description of the Galileo Navigation Signal Characteristics is given in Annex A.

*(M.233/A3.2) The Galileo receiver equipment shall provide position information in latitude and longitude in degrees, minutes and thousandths of minutes;*

NOTE Galileo uses Galileo Terrestrial Reference Frame System (GTRF) datum which is a realization of the International Terrestrial Reference Frame (ITRF) system and differs from WGS 84 by less than 5 cm worldwide.

*(M.233/A3.3) The Galileo receiver equipment shall provide time referenced to universal time coordinated UTC (Bureau International des Poids et Mesures).*

#### **4.3.2 Equipment output**

(See 5.6.3)

*(M.233/A3.4) The Galileo receiver equipment shall be provided with at least two outputs from which position information, UTC, course over ground (COG), speed over ground (SOG) and alarms can be supplied to other equipment. The output of position information shall be based on the WGS84 datum and shall be in accordance with IEC 61162. The output of UTC, course over ground (COG), speed over ground (SOG) and alarms shall be consistent with the requirements of M.233/A3.16 and M.233/A3.18;*

*(M.233/A3.17) The Galileo receiver equipment shall have at least one normally closed contact which shall indicate failure of the Galileo receiver equipment;*

*(M.233/A3.18) The Galileo receiver equipment shall have a bidirectional interface to facilitate communication so that alarms can be transferred to external systems and so that audible alarms from the Galileo receiver can be acknowledged from external systems; the interface shall comply with IEC 61162.*

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For reporting purposes the following sentences shall be available in any combination.

- DTM – Datum reference (see IEC 61162-1)
- GBS – GNSS Satellite fault detection (see IEC 61162-1)
- GFA – GNSS Fix Accuracy and integrity (see IEC 61162-1)
- GNS – GNSS fix data (see IEC 61162-1)
- RMC – Recommended minimum specific GNSS data (see IEC 61162-1)
- ZDA – Time and date (see IEC 61162-1)

If a sentence uses a datum other than WGS-84 then the DTM sentence shall be used in compliance with IEC 61162-1.

For alarm reporting purposes the following sentences shall be available.

- ALR – Set Alarm State (see IEC 61162-1)
- ACK – Acknowledge Alarm (see IEC 61162-1)

In addition, for integrating with other navigational aids, the following sentences may be available in any combination.

- GRS – GNSS range residuals (see IEC 61162-1)
- GSA – GNSS DOP and active satellites (see IEC 61162-1)
- GST – GNSS pseudo-range error statistics (see IEC 61162-1)
- GSV – GNSS satellites in view (see IEC 61162-1)

NOTE GBS, GRS, GSA, GST, GSV are required to support external integrity checking. They are to be synchronized with corresponding fix data (GNS).

### 4.3.3 Accuracy

(See 5.6.4)

#### 4.3.3.1 Static position accuracy

(M.233/A3.5) *The Galileo receiver equipment shall have static accuracy such that the position of the antenna is determined to within:*

- i) *15 m horizontal (95 %) and 35 m vertical (95 %) for single frequency operations on the L1 frequency;*
- ii) *10 m horizontal (95 %) and 10 m vertical (95 %) for dual frequency operations on L1 and E5a or L1 and E5b frequencies.*

NOTE The minimum accuracy requirements specified for dual frequency processing are based on the performance requirements established in IMO resolution A.915(22) and IMO resolution A.953(23) for navigation in harbour entrances, harbour approaches and coastal waters. The Galileo Safety of Life service is expected be able to provide better accuracy (4 m horizontal 95 % and 8 m vertical 95 %).

#### 4.3.3.2 Dynamic position accuracy

(M.233/A3.6) *The Galileo receiver equipment shall have dynamic accuracy equivalent to the static accuracy specified in 4.3.3.1 above under the sea states and motion experienced in ships as described in IMO resolution A.694(17), IEC 60721-3-6 and IEC 60945.*

### 4.3.4 Acquisition

(See 5.6.5)

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(M.233/A3.9) *The Galileo receiver equipment shall be capable of selecting automatically the appropriate satellite-transmitted signals to determine the ship's position and velocity, and time with the required accuracy and update rate;*

<https://standards.iteh.ai/catalog/standards/sist/df4afa0f-bcda-4ead-833d-1c3e29e3e106/iec-61108-3-2010>

<https://standards.iteh.ai/catalog/standards/sist/df4afa0f-bcda-4ead-833d-1c3e29e3e106/iec-61108-3-2010>

(M.233/A3.12) *The Galileo receiver equipment shall be capable of acquiring position, velocity and time to the required accuracy within 5 min when there is no valid almanac data (cold start);*

(M.233/A3.13) *The Galileo receiver equipment shall be capable of acquiring position, velocity and time to the required accuracy within 1 min when there is valid almanac data (warm start);*

(M.233/A3.14) *The Galileo receiver equipment shall be capable of re-acquiring position, velocity and time to the required accuracy within 1 min when there has been a service interruption of 60 s or less;*

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

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

#### Condition A

Initialization (cold start) – the equipment has

- been transported over large distances (>1 000 km to <10 000 km) without power or Galileo signals or by the deletion of the current almanac; or
- not been powered for >7 days.

#### Condition B

Warm start – the equipment has a valid almanac (Power outage and/or interruption of Galileo signal reception for at least 24 h).



**Condition C**

Brief interruption of power for 60 s.

No user action other than applying power and providing a clear view from the antenna for the Galileo 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
Acquisition time limits (min)	5	1	1

**4.3.5 Antenna and input/output connections**

(See 5.6.6)

(M.233/A5) *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 Galileo receiver equipment inputs or outputs for a duration of 5 min.*

**4.3.6 Antenna design**

(See 5.6.7)

(M.233/A2.2) *The antenna design shall be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation, taking into consideration any obstruction that might exist on the ship.*

**4.3.7 Dynamic range**

(See 5.6.8)

(M.233/A3.10) *The Galileo receiver equipment shall be capable of acquiring satellite signals with input signals having carrier levels in the range of –128 dBm to –118 dBm. Once the satellite signals have been acquired, the equipment shall continue to operate satisfactorily with satellite signals having carrier levels down to –131 dBm.*

**4.3.8 Protection from specific interfering signals**

(See 5.6.9)

The Galileo 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<sup>2</sup> at a frequency of 1636,5 MHz for 10 min. When the unwanted signal is removed and the Galileo receiver antenna is exposed to the normal Galileo satellite signals, the Galileo receiver equipment shall calculate valid position fixes within 5 min without further operator intervention;

NOTE 1 This is equivalent to exposing a Galileo antenna to radiation from an Inmarsat Fleet77 antenna 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<sup>2</sup>. 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 Galileo receiver antenna is exposed to the normal Galileo satellite signals, the receiver shall calculate valid position fixes within 5 min without further operator intervention.

NOTE 2 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