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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 5: BeiDou navigation satellite system (BDS) – 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 5: Système de navigation par satellite BeiDou (BDS) – Matériels de réception – Exigences de performances, méthodes d'essai et résultats d'essai exigés

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
80/952/FDIS	80/955/RVD

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

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

All text of this document, whose meaning is identical to that in IMO resolution MSC.379(93), is printed in italics and the resolution and paragraph numbers are indicated in brackets, i.e. (M.379/A1.2).

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

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

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

Part 5: BeiDou navigation satellite system (BDS) – Receiver equipment – Performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61108 specifies the minimum performance requirements, methods of testing and required test results for BDS shipborne receiver equipment, based on IMO resolution MSC.379(93), which uses the signals from the BeiDou 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 document is different from IEC 60945, the requirement in this document takes precedence. This document 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 and MSC.302(87) associated with IEC 62923-1.

This receiver standard applies to navigation in the ocean, coastal, harbour entrances, harbour approaches and restricted waters, as defined in IMO resolution A.915(22) and IMO resolution A.1046(27).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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: 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 61108-4, *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 61162-1, *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*

IEC 61162-450, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 450: Multiple talkers and multiple listeners – Ethernet interconnection*

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*

IEC 62923-1, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 1: Operational and performance requirements, methods of testing and required test results*

IEC 62923-2, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 2: Alert and cluster identifiers and other additional features*

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*

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.1046(27), *Worldwide radionavigation system*

IMO resolution MSC.379(93), *Performance standards for shipborne BeiDou satellite navigation system (BDS) receiver equipment*

IMO resolution MSC.401(95), *Performance standards for multi-system shipborne radionavigation receivers*

RTCM 10402.4, *Recommended standards for differential GNSS (Global Navigation Satellite Systems) service*

BDS-SIS-ICD-B1I-3.0, *BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B1I (Version 3.0), China Satellite Navigation Office*

3 Terms, definitions and abbreviated terms

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
BeiDou coordinate system
BDCS
coordinate system adopted by BDS

Note 1 to entry: The definition of BDCS is in accordance with the specifications of the International earth rotation and reference system service (IERS), and it is consistent with the definition of the China geodetic coordinate system 2000 (CGCS2000). BDCS and CGCS2000 have the same ellipsoid parameters. The origin is located at the Earth's centre of mass. The Z-axis is the direction of the IERS reference pole (IRP). The X-axis is the intersection of the IERS Reference Meridian (IRM) and the plane passing through the origin and normal to the Z-axis. The Y-axis, together with Z-axis and X-axis, constitutes a right-handed orthogonal coordinate system. The length unit is the international system of units (SI) metre.

Note 2 to entry: This note applies to the French language only.

3.1.2
BDS time
BDT
time reference which adopts the international system of units (SI) second as the base unit, and accumulates continuously without leap seconds

Note 1 to entry: The start epoch of BDT is 00:00:00 on January 1, 2006 of coordinated universal time (UTC). BDT connects with UTC via UTC (NTSC), and the deviation of BDT to UTC is maintained within 50 ns (modulo 1 s). The leap second information is broadcast in the navigation message.

Note 2 to entry: This note applies to the French language only.

3.1.3
BeiDou navigation satellite system
BDS
system independently developed and operated by China and providing position, velocity and time information for users, including open service and authorized service and short messages service

3.2 Abbreviated terms

BAM	bridge alert management
CAM	central alert management
COG	course over ground
CW	continuous wave
DBDS	differential BDS
EUT	equipment under test
GNSS	global navigation satellite system
GPS	global positioning system
HAL	horizontal alert limit
HDOP	horizontal dilution of precision
HPL	horizontal protection limit
INS	integrated navigation system
MKD	minimum keyboard display
NB	narrow band
NTSC	National time service centre (Chinese academy of sciences)
OS	open service
PDOP	position dilution of precision
PNT	position, navigation and timing
PVT	position, velocity and time
RAIM	receiver autonomous integrity monitoring
RF	radio frequency
RFCS	radio frequency constellation simulator
RFI	radio frequency interference
SIS	signal in space
SOG	speed over ground
UDRE	user differential range error
UTC	universal time coordinated
WB	wide band

4 Minimum performance requirements

4.1 Object

(M.379/A1.2) The BDS Open Service (OS) provides positioning, navigation and timing services, free of direct user charges. The BDS receiver equipment shall *be capable of receiving and processing the open service signal.*

(M.379/A1.3) BDS receiver equipment intended for navigational purposes on ships with a speed not exceeding 70 knots, in addition to the general requirements specified in resolution A.694 (17) and the related standard IEC 60945, shall *comply with the following minimum performance requirements.*

(M.379/A1.4) The 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 other computational facilities which may be in the equipment nor cover the requirements for other systems that may take input from the BDS receiver.

4.2 BDS receiver equipment

(See 5.6.1)

4.2.1 Minimum facilities

(*M.379/A2.1) The term "BDS receiver equipment" as used in the performance standards includes all the components and units necessary for the system to properly perform its intended functions. The BDS receiver equipment* shall *include the following minimum facilities:*

1) antenna capable of receiving BDS signals;

2) BDS 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.

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

If BDS forms part of an approved multi-system PNT, requirements of facilities 3) 4) and 5) may be provided within the multi-system PNT.

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 requirements set out in this document.

4.2.2 Configuration

The BDS 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;

– BDS 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. With this option, a separate user interface called as MKD shall be provided as a backup.

– as one of PVT methods included in a multi-system PNT equipment based on IMO resolution MSC.401(95).

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 manufacturers complying with approved quality systems as applicable.

4.3 Performance of BDS receiver equipment

4.3.1 General

(See 5.6.2)

(M.379/A3.1) The BDS receiver equipment shall *be capable of receiving and processing the BDS positioning and velocity, and timing signals, and* shall *use the ionospheric model broadcast to the receiver by the constellation to generate ionospheric corrections.*

A detailed description of the BDS navigation signal characteristics is given in BDS SIS Interface Control Document.

(M.379/A3.2) The BDS receiver equipment shall *provide position information in latitude and longitude in degrees, minutes and thousandths of minutes.*

Means may be provided to transform the computed position based upon the BeiDou coordinate system (BDCS) into data compatible with the datum of the navigational chart in use. Where this facility exists, the display shall indicate that co-ordinate conversion is being performed and shall identify the co-ordinate system in which the position is expressed.

NOTE BDCS is adopted by BDS and differs from WGS 84 by less than 5 cm worldwide. Conversion to WGS 84 is not needed for maritime navigation.

(M.379/A3.3) The BDS receiver equipment shall *provide time referenced to universal time coordinated UTC (NTSC).*

4.3.2 Equipment interfaces

(See 5.6.3)

(M.379/A3.4) The BDS 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 WGS 84 datum and* shall *be in accordance with international standards. The output of UTC, course over ground (COG), speed over ground (SOG) and alarms* shall *be consistent with the requirements of M.379/A3.15 and M.379/A3.17.*

(M.379/A3.16) The BDS receiver equipment shall *provide at least one normally closed contact, which* shall *indicate failure of the BDS receiver equipment.*

(M.379/A3.17) The BDS 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 BDS receiver can be acknowledged from external systems; the interface* shall *comply with relevant international standards.*

Sentences shall be based on IEC 61162-1. The physical interface shall be based on IEC 61162-1 or IEC 61162-2 or IEC 61162-450.

Logical interfaces for the BDS receiver are shown in Figure 1, where required interfaces are indicated with solid lines and optional interfaces are indicated in dashed lines.

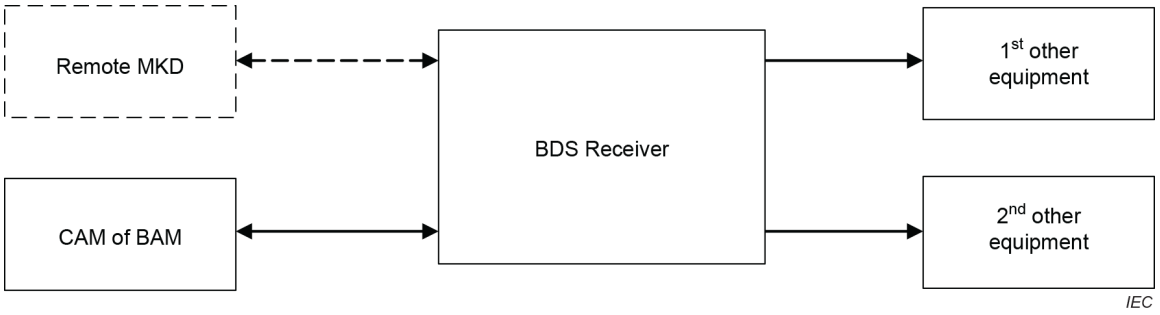

Figure 1 – Logical interfaces of BDS receiver

BDS receiver shall use talker ID "GB".

For positioning reporting purposes, the following sentences shall be available for output in any combination.

- DTM – Datum reference (see Annex C)
- GBS – GNSS satellite fault detection (see Annex C)
- GFA – GNSS fix accuracy and integrity (see Annex C)
- GNS – GNSS fix data (see Annex C)
- RMC – Recommended minimum specific GNSS data
- VTG – Course over ground and ground speed
- ZDA – Time and date

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

For reporting GNSS differential correction data the following sentence shall be available:

- GDC – GNSS differential correction (see Annex C)

For alert reporting and alert command purposes, the following sentences shall be available.

- ACN – Alert command
- ALC – Cyclic alert list
- ALF – Alert sentence
- ARC – Alert command refused
- HBT – Heartbeat supervision sentence

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

- GRS – GNSS range residuals (see Annex C)
- GSA – GNSS DOP and active satellites (see Annex C)
- GST – GNSS pseudorange error statistics (see Annex C)
- GSV – GNSS satellites in view (see Annex C)

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

4.3.3 Accuracy

(See 5.6.4)

4.3.3.1 Static position accuracy

(M.379/A3.5) The BDS receiver equipment shall *have static accuracy such that the position of the antenna is determined to be within 25 m horizontally (95 %) and 30 m vertically (95 %).*

NOTE The BDS receiver equipment typically has accuracy better than 10 m (95 %).

4.3.3.2 Dynamic position accuracy

(M.379/A3.6) The BDS receiver equipment shall *have dynamic accuracy equivalent to the static accuracy specified in* 4.3.3.1 *above under the normal sea states and motion experienced in ships.*

4.3.4 Acquisition

(See 5.6.5)

(M.379/A3.8) The BDS 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.*

(M.379/A3.11) The BDS receiver equipment shall *be capable of acquiring position, velocity and time to the required accuracy within 12 min where there is no valid almanac data.*

(M.379/A3.12) The BDS receiver equipment shall *be capable of acquiring position, velocity and time to the required accuracy within 1 min where there is valid almanac data.*

(M.379/A3.13) The BDS receiver equipment shall *be capable of reacquiring position, velocity and time to the required accuracy within 1 min when there has been a service interruption of 60 s or less.*

(M.401/A3.7) The BDS receiver equipment shall *be capable of providing the PVT solution to the required accuracy within:*

– *5 min where there is no valid satellite almanac data (cold start);*
– *1 min where there is valid satellite almanac data (warm start); and*
– *2 min, when subjected to a power interruption or loss of signals of < 60 s;*

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

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

Condition A

Initialization (cold start) – The equipment has no valid almanac because it has:

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

Condition B

Warm start – The equipment has a valid almanac.

– Power outage – the equipment under normal operation loses power for at least 24 h; or
– Interruption of BDS signals – under normal operation the BDS signals receptions are interrupted for at least 24 h, but there is no loss of power.

Condition C

Brief interruption of power or BDS signals – under normal operation, the power or the signals are interrupted for 60 s.

No user action other than applying power and providing a clear view from the antenna for the BDS 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	2

4.3.5 Protection

(See 5.6.6)

(M.379/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 BDS receiver equipment inputs or outputs for a duration of five minutes.*

4.3.6 Antenna design

(See 5.6.7)

(M.379/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 obstructions that might exist on the ship.*

4.3.7 Sensitivity and dynamic range

(See 5.6.8)

(M.379/A3.9) The BDS 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 Effects of specific interfering signals

(See 5.6.9)

The BDS 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 BDS receiver antenna is exposed to the normal BDS satellite signals, the BDS receiver equipment shall calculate valid position fixes within 5 min without further operator intervention.