
**Ships and marine technology —
Marine electromagnetic compasses**

*Navires et technologie maritime — Compas électromagnétiques de
marine*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

This third edition cancels and replaces the second edition (ISO 11606:2000), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11606:2000/Cor 1:2005.

The main changes are as follows:

- in [Clause 1](#), added text relating to IMO Resolution MSC.166(78) and the applicability of this document;
- in [Clause 2](#), replaced ISO 449:1997 with ISO 25862:2019, and deleted IEC 61162-1, IEC 61162-2 and IMO Resolution MSC.86(70);
- in [Clause 3](#), added term *electromagnetic compass* ([3.1](#));
- in [5.7](#) and [11.1.12](#), added a provision on displays for presentation and a reference to IEC 62288;
- in [5.10](#), updated interface requirements;
- in [7.3](#), updated failure alarm requirements;
- in [11.2.9](#), updated other environmental conditions requirements;
- deleted former Annex A;
- in the Bibliography, added ISO 22090-2, IEC 61162-1, IEC 61162-2, IEC 61162-450, IEC 62288, IEC 62923-1, IEC 62923-2, IMO Resolution MSC.86(70), IMO Resolution MSC.166(78), IMO Resolution MSC.191(79), IMO Resolution MSC.302(87) and IMO Resolution MSC.466(101).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Ships and marine technology — Marine electromagnetic compasses

1 Scope

This document specifies general requirements, type tests and individual tests for the marine electromagnetic compasses, intended for steering purposes and/or taking bearings on board ships, required by Chapter V of SOLAS, 1974 and the International Code of Safety for High-Speed Craft (HSC Code). In accordance with IMO Resolution MSC.166(78), this document is applicable to marine electromagnetic compasses fitted before 1 July 2002. For marine electromagnetic compasses installed on or after 1 July 2002, ISO 22090-2 is applicable. The magnetic compasses specified in this document apply to ships the overall length of which is normally not less than 24 m.

NOTE In this document requirements extracted from the recommendations of IMO resolutions are printed in italics.

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.

ISO 1069, *Magnetic compasses and binnacles for sea navigation — Vocabulary*

ISO 25862:2019, *Ships and marine technology — Marine magnetic compasses, binnacles and azimuth reading devices*

IEC 60945, *Marine navigation and radiocommunication equipment and systems — 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. 813(19), *General requirements for electromagnetic compatibility (EMC) for all electrical and electronic ship's equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1069 and the following apply

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

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

3.1

electromagnetic compass

item of the electronic equipment that uses the geomagnetic field to obtain information about the ship's heading

Note 1 to entry: This information is conveyed to the main compass (used for steering and taking bearings), to additional repeater indicators and, if required, to other navigational equipment.

3.2

magnetic sensor

sensor that detects geomagnetic field and supplies appropriate output concerning direction to the processor (3.4)

3.3

main compass

display unit that shows the output of the processor (3.4) with a compass card or an electronic image of a compass card

3.4

processor

device that processes the output of the magnetic sensor (3.2) and provides the ship's magnetic heading and/or true heading

3.5

repeater indicator

additional indicator that may be equipped with a display that uses a different type of compass card

4 Composition

The electromagnetic compass system shall consist of a magnetic sensor, a processor, a main compass display and facilities for other repeater indicators and equipment.

5 Construction and material

5.1 Requirements

Electromagnetic compasses shall fulfil the requirements in 5.2 to 5.17.

5.2 Electrical wiring

Electrical wiring, such as that for the direct-current power supply and that for connecting the units, shall not produce any perceptible errors in the heading information.

Twist cables are recommended for this purpose.

5.3 Non-magnetic housing

The housing of the magnetic sensor system shall be non-magnetic.

5.4 Fore-and-aft marks

[IMO Resolution MSC.86(70), Annex 2, 4.1.1] *Fore-and-aft marks shall be inscribed on the housing of the magnetic sensor system and the bottom part of the binnacle of the main compass. The units shall be installed on the fore-and-aft line of the ship.*

[IMO Resolution MSC.86(70), Annex 2, 4.1.2] *The fore-and-aft marks shall be within $\pm 0,5^\circ$ of the fore-and-aft axis of the unit.*

5.5 Graduation

5.5.1 Graduation of main compass card

The main compass shall be of the compass card type, which shall be graduated in 360 single degrees, starting from North (000°) in the clockwise direction as viewed from above. Each tenth degree shall be marked with the three corresponding numbers. The accuracy of the graduation shall be better than

0,2° on any heading. The cardinal points shall be indicated by the capital letters N, S, E and W; the intermediate points may also be marked.

Alternatively, the North point may be indicated by a suitable symbol.

5.5.2 Indication of the repeater indicator

The graduation of the indicator, if of the card type, shall be the same as that of the main compass card. If a repeater indicator is used for steering purposes, it shall be of the card type.

In the case of numerical displays, three-digit numbers, in degrees, shall be shown.

5.5.3 Centre of the graduation

The main compass, and repeater indicators to be used for bearing purposes, shall be fitted with a seat for a shadow pin which accommodates bearings or, if no seat is provided, the centre of the graduation shall be clearly indicated.

5.5.4 Graduation of the verge ring

The main compass, and repeater indicators to be used for bearing purposes, shall be provided with a verge ring, which is graduated in degrees, for the measurement of bearings relative to the ship's head. The scale shall be graduated in 360 single degrees in clockwise direction as viewed from above.

Both the zero mark indicating the bearing of the ship's head and the 180° mark indicating the bearing of the ship's stern shall be within $\pm 0,5^\circ$ of the fore-and-aft marks.

5.5.5 Accuracy of fore-and-aft marks

The fore-and-aft marks of the main compass, and of repeater indicators to be used for bearing purposes, shall be in the vertical plane passing through the centre of the compass card and the main lubber mark to within $\pm 0,5^\circ$.

5.5.6 Readability of the graduation

It shall be possible for a person with normal vision to read the main compass card and the indication of the repeater indicator at a distance of 1,0 m, both in daylight and in artificial light.

5.5.7 Horizontal position of the compass plane

The plane of the compass card of the main compass, and of repeater indicators to be used for bearing purposes, shall be so balanced that it is horizontal to within $\pm 2^\circ$.

5.6 Lubber marks

5.6.1 General

The main compass display and all repeater indicators shall be fitted with at least one lubber mark, indicating the direction of the ship's head. Additional lubber marks indicating the direction of ship's stem and athwartship are permissible.

The width of the lubber mark shall not be greater than 0,5° on the card or 0,5 mm, whichever is smaller.

The distance between the lubber mark and the outer edge of the card shall not be more than 1,5 mm.

5.6.2 Accuracy

The main lubber mark shall be within $\pm 0,5^\circ$ of the 0° to 180° line of the verge ring.

Additional lubber marks shall be within $\pm 1^\circ$.

5.7 Illumination

The units shall be provided with adequate provision for illuminating the controls and displays. A device shall be provided for dimming the electric light. If a display is used for presentation, the equipment shall comply with MSC.191(79), as amended by MSC.466(101), and with IEC 62288.

5.8 Compensation of deviation and heeling error

5.8.1 General

[IMO Resolution MSC.86(70), Annex 2, 4.3] *Provision shall be made for correcting the heeling error and the coefficients A, B, C, D and E. It shall be possible to correct the following values:*

- *vertical component of the ship's magnetic field (producing the heeling error): up to $\pm 75 \mu\text{T}$;*
- *coefficient A: up to $\pm 3^\circ$;*
- *coefficient B: up to $\pm(720/H)^\circ$;*
- *coefficient C: up to $\pm(720/H)^\circ$;*
- *coefficient D: up to $\pm 7^\circ$;*
- *coefficient E: up to $\pm 3^\circ$;*

where *H* is the horizontal component of the geomagnetic flux density in microteslas (μT).

The devices for correcting the coefficients *A, B, C, D* and *E* shall not produce any undesired deviation greater than 1° . The devices for correcting heeling error shall not produce any undesired alteration of the vertical component of the ship's magnetic field greater than $1 \mu\text{T}$.

5.8.2 Indication of compensation

[IMO Resolution MSC.86(70), Annex 2, 4.3.1] *The values used for electronic compensation shall be indicated by adequate means and shall be stored such that values are automatically recovered on switch on.*

5.8.3 Protection of compensation

[IMO Resolution MSC.86(70), Annex 2, 4.3.2] *The compensating devices shall be protected against accidental alterations.*

5.9 Heading output

[IMO Resolution MSC.86(70), Annex 2, 4.4] *All displays and outputs of heading should be able to indicate true heading. An indication of any deviation and variation applied to compensate the heading shall be capable of being displayed or included in the output.*

The type of heading displayed shall be conspicuously indicated and the type of heading shall be identified with a transmitted heading.

5.10 Outputs to other equipment

The electromagnetic compass shall be so designed that it is able to provide the azimuth information, within a transmitting error of not greater than $\pm 0,5^\circ$, to the navigational equipment, radars, direction finders, heading control systems and additional position measurement instruments. If these navigational instruments have digital outputs, they shall meet the requirements prescribed in IEC 61162-1, IEC 61162-2 or IEC 61162-450.

5.11 Gimbals

5.11.1 Direction of gimbal axes

If gimbals are provided, the outer gimbal axis shall be in the fore-and-aft direction.

5.11.2 Angle between the gimbal axes

If gimbals are provided, the angle between the axes of the inner and outer gimbals shall be $90^\circ \pm 1^\circ$, except if the diameter of the outer gimbal ring is less than 150 mm: in this case, the angle shall be $90^\circ \pm 2^\circ$.

5.11.3 Freedom of tilt of the main compass

The main compass shall be constructed in such a way that it can revolve about the inner gimbal axis freely up to 30° when the gimbal ring, if fitted, is horizontal.

5.11.4 Precaution against dislodging of the main compass and the repeater indicators

The main compass and repeater indicators shall be constructed in such a way that, if they are fitted on gimbals, they return to their normal position and are not dislodged after tilting.

5.12 Fitting the main compass

Provision shall be made in the bottom part of the magnetic sensor unit, the main compass and card-type repeater indicators in order to allow correction of any misalignment thereof in respect of the fore-and-aft line of the ship, by an angle of up to $\pm 5^\circ$.

5.13 Height of the compass card plane

Main compasses shall be so constructed that the plane of the compass card is at least 1 m above the lower surface of the binnacle deck fittings, and capable of taking bearings of celestial bodies and other distant objects.

5.14 Watertightness of repeater indicators

The main compass and all repeater indicators intended for use on an open deck shall be waterproof.

5.15 Azimuth reading devices

5.15.1 Provision of azimuth reading devices

There shall be at least one appropriate azimuth reading device to take bearings of celestial bodies and other distant objects.

5.15.2 Azimuth sight

The field of vision shall be at least 5° on each side of the line sight and it shall be possible to take azimuths of celestial bodies and bearings of distant objects whose altitudes are between 5° below and 60° above the horizontal.

This requirement on the accuracy of the azimuth shall be fulfilled in the altitude range from 5° above the horizontal to 50° below the horizontal.

5.16 Construction for maintenance and inspection

Equipment shall be so constructed that it is possible to carry out maintenance and inspection easily.