
**Ships and marine technology —
Transmitting heading devices
(THDs) —**

**Part 2:
Geomagnetic principles**

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Partie 2: Principes géomagnétiques*

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

This second edition cancels and replaces the first edition (ISO 22090-2:2004), which has been technically revised. It also replaces ISO 22090-2:2004/Cor 1:2005.

ISO 22090 consists of the following parts, under the general title *Ships and marine technology — Transmitting heading devices (THDs)*:

- Part 1: *Gyro-compasses*
- Part 2: *Geomagnetic principles*
- Part 3: *GNSS principles*

Ships and marine technology — Transmitting heading devices (THDs) —

Part 2: Geomagnetic principles

1 Scope

This part of ISO 22090 specifies the construction, performance, and testing of a device employing only magnetic means as transmitting heading devices required by chapter V, SOLAS 1974 (as amended).

A Transmitting Heading Device (THD) is an electronic device that provides information about the ship's true heading.

In addition to the general requirements contained in IMO Resolution A.694(17) to which IEC 60945 is associated and the relevant standard for the sensing part used, the THD equipment shall comply with the following minimum requirements.

Where the IMO performance standards which apply to the sensing part do not specify a geographical operating area the THD shall operate

- a) at a minimum rate of turn 20 °/s and
- b) from 70° latitude south to 70° latitude north as a minimum.

The THDs complying with the requirements contained in this part of ISO 22090 can be used for heading information as contained in chapter V of the SOLAS Convention.

In addition such THDs are intended to meet the dynamic requirements contained in the HSC Code, chapter 13 for the carriage of a suitable device providing heading information.

NOTE 1 Several technologies can be used to detect and transmit heading information. It is illogical to standardize the detection of the heading separately from the transmission of the heading. Therefore, separate parts of this part of ISO 22090 refer to different technologies. The requirements of this part of ISO 22090 only apply to the principle of the geomagnetic. Other technologies are covered in other parts of ISO 22090.

NOTE 2 All requirements that are extracted from the recommendation of IMO Resolution MSC.116(73) on performance standards for transmitting heading devices are printed in italics.

A standard magnetic compass with a pickup sensor could be applied as a sensing part of this standard of geomagnetic principle. However the IMO performance resolution MSC.116(73) requires that the THD is intended to be met for the dynamic requirements of the HSC code. Nevertheless, when the THD would be only used other than the HSC, the limit of rate of turn may be 6 °/s instead of 20 °/s.

2 Normative references

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

ISO 11606, *Ships and marine technology — Marine electromagnetic compasses*

ISO 25862, *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*

IEC 61162-1, *Marine 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 61924-2, *Maritime navigation and radiocommunication equipment and systems – Integrated Navigation Systems (INS) – Part 2: Modular structure for INS – Operational and performance requirements, methods of testing and required test results*

IMO Resolution MSC.116(73), *Performance standards for marine transmitting heading devices (THDs)*

IMO Resolution A.424(XI), *Performance standards for gyro-compasses*

IMO Resolution A.821(19), *Performance standards for gyro-compasses for high-speed craft*

IMO Resolution MSC.252(83), *Adoption of the revised performance standards for integrated navigation system (INS)*

IMO Resolution MSC.302(87), *Adoption of performance standards for bridge alert management*

3 Terms and definitions

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

3.1

geomagnetic principle

principle of the THDs depending (for its directional properties) upon the magnetism of the earth.

Note 1 to entry: A type to directly detect geomagnetic field is called the electromagnetic-compass-type THD (see ISO 11606), while a type to detect magnetic field via standard magnetic compass is called the magnetic-compass-type THD (see ISO 25862).

3.2

heading

ship's heading to be input to the THD function

Note 1 to entry: It is defined by the direction of the vertical projection of the fore-and-aft line of the ship onto the horizontal plane. When measured relative to the true north, magnetic north, or compass north, it is respectively defined as true heading, magnetic heading, or compass heading, and is usually expressed in degrees as a three-figure group, starting from north, in a clockwise direction around the compass card

3.3

true heading

horizontal angle between the vertical plane passing through the true meridian and the vertical plane passing through the craft's fore-and-aft datum line, measured from true north (000°) clockwise through 360°

3.4

magnetic compass

instrument designed to seek the direction of magnetic north in azimuth and to hold that direction permanently

3.5

magnetic sensor

magnetic sensing part which detects the geomagnetic field concerning heading information with or without a magnetic compass and outputs the information to a processor

3.6**processor**

device which obtains the ship's magnetic heading information for a transmitting part by adjusting the magnetic deviations

3.7**transmitting part**

device which receives heading information from the sensing part and converts this to the required accurate signal

3.8**sensing part**

sensing function of detecting any heading information connected to the transmitting device

3.9**follow-up error**

error caused by the delay between the existence of a value to be sensed and the availability of the corresponding signal or data stream at the output of the system

EXAMPLE *The difference between the real heading of the turning vessel and the available information at the output of the system.*

Note 1 to entry: *A follow-up error disappears when the system is static.*

3.10**transmission and resolution error**

error which is caused by the method used to transmit the original information to a receiving device

Note 1 to entry: *Such a method may have a limited capability to code any possible value of the information, e.g. step output with 1/6° resolution. This error is caused by the method used inside the THD and at its output to code the information.*

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3.11**static error**

error caused by any reason and which stays unchanged in value during the operation of the system, measured under static conditions

3.12**dynamic error**

error caused by dynamic influences acting on the system, such as vibration, roll, pitch, or linear acceleration

Note 1 to entry: *This error may have an amplitude and usually a frequency related to the environmental influences and the parameters of the system itself.*

4 Performance requirements**4.1 Functionality**

Geomagnetic principles of THDs detect the horizontal component of geomagnetic field and generates a ship's true heading signal for other devices.

In one type of sensor which utilizes a magnetic compass, the performances and requirements of the compass shall conform to the ones referred to ISO 25862 and the other type of the sensor shall fulfil the performance requirements concerning the marine electromagnetic compasses in ISO 11606.

4.2 Information

4.2.1 *All displays with the exception of the sensor, and all outputs of heading shall indicate true heading.*

4.2.2 *Manually entered values used for electronic correction shall be indicated by adequate means.*

4.3 Fore-and-aft mark

On the bottom part of the binnacle and/or the housing of the sensor system, a fore-and-aft mark shall be inscribed to facilitate installation in the fore-and-aft line of the ship. The units shall be installed on the fore-and-aft line of the ship. In magnetic-compass-type THDs, it shall be in the vertical plane passing through the centre of the compass card and the main lubber mark to within $\pm 0,5^\circ$.

4.4 Heading information

The THD shall provide true heading information to the other navigational equipment.

4.5 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.

4.6 Non-magnetic housing

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

4.7 Alert signal

An alert¹⁾ shall be provided to indicate malfunctions of the THD or a failure of the power supply.

An alert output shall be provided as any alert conditions. The alert shall conform to the presentation and handling requirements of Bridge Alert Management [IMO Res. MSC.302(87)]. A suitable interface shall be provided for alert communications with an integrated navigation system [IMO Res. MSC.252(83) and IEC 61924-2].

The following sentences shall be provided for the alert communications interface:

Sentences transmitted by the THD:

- ALR, HBT: see IEC 61162-1;
- ALC, ALF, ARC: see IEC 61924-2.

Sentences received by the THD:

- ACK, HBT: see IEC 61162-1;
- ACN: see IEC 61924-2.

4.8 Interface

4.8.1 The THD shall provide interface facilities which meet the relevant International Standards IEC 61162-1 and/or IEC 61162-2 as amended.

4.8.2 The THD equipment shall provide an appropriate data source and at least one output of heading information, which is able to comply with the IEC 61162-2. The IEC 61162-2 heading output shall be updated at a rate of once per 20 ms. The THS sentence detailed in IEC 61162-1 shall be provided for heading information.

1) The term of "Alarm" was replaced by "Alert" in accordance with IMO Resolution MSC.252(83) and IMO Resolution MSC.302(87).

5 Accuracy

5.1 General

The THD shall meet at least the following accuracy at the output of the device under sea conditions as specified in IMO Resolution A.424(XI) or A.821(19) as applicable.

5.2 Accuracy of transmission data

The transmission error, including the resolution error, shall be less than $\pm 0,2^\circ$.

5.3 Static error (settle point error)

The static errors shall be less than $\pm 1,0^\circ$ (95 %).

5.4 Dynamic error

The dynamic error amplitude shall be less than $\pm 1,5^\circ$ (95 %). The dynamic error frequency for test shall be less than 0,033 Hz equivalent to a period not shorter than 30 s if the amplitude of the dynamic error exceeds $\pm 0,5^\circ$.

5.5 Follow-up error

The follow-up error for the rates of turn shall be

- less than $\pm 0,5^\circ$ up to a rate of 10 %/s and
- less than $\pm 1,5^\circ$ at a rate of between 10 %/s and 20 %/s.

5.6 Settling time requirements to the directional system

In magnetic-compass-type sensors, the directional system shall always settle in the original direction. Following an initial deflection of the card of 90° from the magnetic meridian, the time taken to return finally to within 1° of the magnetic meridian shall not exceed $\sqrt{57\,600/H}$ s at a temperature of $20\text{ }^\circ\text{C} \pm 3\text{ }^\circ\text{C}$, where H is the horizontal component of the magnetic flux density in microteslas (μT) at the place of testing.

5.7 Correcting the magnetic heading by magnetic variations

In order to get true headings, correcting the magnetic heading for magnetic variations shall be carried out within the errors of $0,5^\circ$. The means of correcting magnetic variation may be either automatic or manual.

The values used for electronic compensation should be indicated by adequate means and shall be stored such that values are automatically recovered when switching on.

5.8 Adjusting of magnetic deviations and heeling error

It shall be possible to adjust the coefficients A, B, C, and D so that the residual value of each coefficient is less than $\pm 1^\circ$.

5.8.1 Check by bearings

The binnacles shall contain a device for correcting the deviation due to the horizontal components of the ship's permanent magnetism. This device shall be capable of correcting a coefficient A up to $\pm 3^\circ$, coefficients B and C of up to at least $(720/H)^\circ$, coefficient D of up to $\pm 7^\circ$, vertical component of the ship's magnetic field (producing the heeling error) of up to $\pm 75\ \mu\text{T}$, H being as defined in 5.6.