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

Part 2: Geomagnetic principles

Navires et technologie maritime — Dispositifs de transmission de données de pilotage —

Partie 2: Principes géomagnétiques

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 22090-2 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation*.

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 devices 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 should 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 one. 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 should 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 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.

ISO 449, *Ships and marine technology — Magnetic compasses, binnacles and azimuth reading devices — Class A*

ISO 11606:2000, *Ships and marine technology — Marine electromagnetic compasses*

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

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

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

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

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

3.2
heading
any ship's heading to be input to the THD function.

NOTE 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 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 *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.*

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 *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 the 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 449, and the other type of 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 ± 0,5°.

4.4 Heading information

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

At least one output shall *be in accordance with the relevant international marine interface standard:* IEC 61162 series as amended.

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 Alarm signal

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

An alarm output shall be provided for any alarm conditions.

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 ± 0,2°.*

5.3 Static error (settle point error)

The static errors shall *be less than ± 1,0° (95 %).*

5.4 Dynamic error

The dynamic error amplitude shall *be less than ± 1,5° (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 ± 0,5°.*

5.5 Follow-up error

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

— *less than ± 0,5° up to a rate of 10°/s; and*

— *less than ± 1,5° 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 $\sqrt{57600/H}$ s at a temperature of 20 °C ± 3 °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 for 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°. The means of correcting magnetic variation may be either automatic, or manual then automatic.

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, D so that the residual value of each coefficient is less than ± 1°.

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 ± 3°, coefficients B and C of up to at least (720/H)°, a coefficient D of up to ± 7°, vertical component of the ship's magnetic field (producing the heeling error) of up to ± 75 μT, H being as defined in 5.6.

5.8.2 Check by magnetic fields

In electromagnetic-compass-type THDs, each coefficient of residual deviations shall be obtained by the following equations.

$$B = \frac{180°}{\pi} \times \frac{n_N - n_S}{2n'}, \quad C = \frac{180°}{\pi} \times \frac{n_W - n_E}{2n'}, \quad D = \frac{180°}{\pi} \times \frac{(n_N + n_S) - (n_W + n_E)}{4n'}$$

where n_N, n_E, n_S, n_W are the ship's northern magnetic field when the ship's heading is N, E, S and W respectively. The n' is the mean value of n_N, n_E, n_S, n_W. Coefficient A shall be negligibly small in electromagnetic-compass-type THDs.

The compensating devices shall be protected against accidental alterations.

5.9 Means of adjusting the deviation by vertical soft iron on the ship

Means of adjusting the deviation by vertical soft iron on the ship should be provided.