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Ships and marine technology — Gyro-compasses for high-speed craft

Navires et technologie maritime — Compas gyroscopiques pour navires à grande vitesse

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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).

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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 16328:2001), of which has been technically revised.

Annex A forms a normative part of this International Standard. Annexes B and C are for information only.

Ships and marine technology — Gyro-compasses for high-speed craft

1 Scope

This International Standard specifies the construction, performance, and type testing for gyro-compass for high-speed craft required by chapter X, SOLAS 1974 (as amended).

NOTE All requirements that are extracted from the recommendations of IMO Resolutions [Resolution A.821(19) on performance standards for gyro-compasses for high-speed craft and A.694(17)] are printed in italics.

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

IEC 60945, *Maritime 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 A.424 (XI), *Performance standards for gyro-compasses*

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 MSC.252(83), *Adoption of the revised performance standards for alert communications with an Integrated Navigation System*

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

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
gyro-compass
complete equipment including all essential elements of the complete design, including *both the gyro-compass as heading sensor and the associated heading transmission system*

3.2
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

Note 1 to entry: *It is measured from true north (000°) clockwise through 360°.*

Note 2 to entry: When the gyro-compass equipment is tested on the test stand, this "true heading" is regarded as the true heading of the lubber line. Where a gyro-compass has the facility of introducing a correction by moving the lubber line, the correction is set for the local latitude.

3.3
settled
stable situation when *any three readings taken at intervals of 30 min are within a band of 0,7°* with *the compass level and stationary*

Note 1 to entry: The settling time is the elapsed time between the time of switch-on at the initial heading error and the third recording of the settle.

3.4
settle point heading
mean value of ten readings taken at 20 min intervals after the compass has settled (3.3)

3.5
settle point error
difference between the settle point heading (3.4)*and* the *true heading*

3.6
error
difference between the observed value and the settle point heading (3.4)

3.7
repeater compass
device that reproduces the master compass card at a remote location

3.8
bearing repeater compass
device that reproduces the master compass card for the purpose of taking bearings

3.9
compass card
graduated dial of the compass which indicates the measured direction of the meridian

3.10
latitude error
error to which some gyro-compasses are subject, the magnitude and sign of which depend upon the local latitude

3.11
speed error
error to which gyro-compasses are subject, the magnitude and sign of which depend upon the speed, course, and latitude of the craft

3.12
lubber line
index line situated on the body of gyro-compass or repeater compass against which the compass card is read

3.13
master compass
main compass unit which supplies the heading information to the repeaters and other navigational aids

3.14
scorsby table
test machine which independently oscillates a platform about three axes, and is used to simulate the motion of a craft

4 Construction

Requirements for gyro-compass units.

4.1 Gyro-compass equipment[1)]

Gyro-compass equipment shall *include the provision of a compass card or analogue repeater for steering purposes and equipment for the purpose of taking a bearing.*

4.2 Continuous operation

The equipment shall be capable of continuous operation under conditions of vibration, humidity, change of temperature, and variations of the power supply, as specified in 6.10.

4.3 Bearing repeater compass[1)]

For those crafts which are required to carry a bearing repeater compass, the construction of these shall be as follows.

a) The bearing repeater compass shall be designed to be fitted with an azimuth-reading device.

b) A gimbal mechanism shall be provided to enable the bearing repeater compass card to be held horizontally against the craft's motion.

4.4 Graduation and digital display

The compass card shall *be graduated at equal intervals of 1° or a fraction thereof.* The graduation error shall be less than ±0,2°. *A numerical indication* shall *be provided* at least *at every 10°, starting from 000° clockwise through 360°.*

A digital display may be provided. When a digital display is provided, the course shall *be displayed as three digits plus, optionally, a fourth digit indicating tenths of a degree. When a gyro-compass with digital display is used, it* shall *incorporate a turning direction indicator.*

4.5 Illumination

Adequate illumination shall be provided to enable the reading of all compass cards at all times. Facilities for dimming shall be provided.

4.6 Lubber line

Devices using a compass card shall be provided with a lubber line to indicate the craft's heading.

4.7 Fore and aft mark

If technically necessary, the compass shall be marked in a way to facilitate installation so that the lubber line lies in a vertical fore and aft plane of the craft or parallel. Where a gyro-compass has the facility of introducing a correction by moving the lubber line, the correction during installation shall be set to zero.

1) Advice to ship surveyors for installation on board craft is given in normative annex A.

If such marks or identifications are not in the same vertical plane as the uncorrected lubber line, then the horizontal angular relationship between them shall be clearly indicated in the manufacturer's installation instruction.

4.8 Installation

The master compass shall *be installed* or adjusted *in a craft with the fore and aft datum lines parallel to the craft's fore and aft datum line to within ±0,5°. The lubber line* shall *be in the same vertical plane* passing through *the centre of the card of the compass and* shall *be aligned accurately.*

4.9 Speed error correction

Means shall *be provided for correcting the errors induced by speed and latitude. An approved accurate speed source* shall *be used for automatic speed error corrections.*

4.10 Heading information

The gyro-compass shall be *designed to enable heading information to be provided to other navigational aids such as radar, ARPA, radio direction-finder, and* heading control system[2]. *The accuracy of the other navigational aids shall not be degraded, and* shall *continue to comply with the standards specified for such aids.*

4.11 Status signal

A status signal shall *be provided to indicate that the gyro-compass is ready for use.*

4.12 Alert signal

An alert[3] *signal* shall *be provided to indicate that the gyro-compass has suffered an external power supply failure or an internal system functional failure which would invalidate the heading information.* 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 gyro-compass:

— ALR, HBT: See IEC 61162-1;

— ALC, ALF, ARC: See IEC 61924-2.

Sentences received by the gyro-compass:

— ACK, HBT: See IEC 61162-1;

— ACN: See IEC 61924-2.

4.13 Power supply

The gyro-compass shall *be provided with or connected to an uninterruptable power supply.*

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2) The term of "automatic pilots" was replaced by "heading control system" in accordance with the new IMO resolution. [Draft amendment to resolution A.342(IX) on performance standards for automatic pilots, MSC Res. 64(67) , annex 3].

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

4.14 Interface

4.14.1 *The gyro-compasses equipment* shall *provide with an output of heading information with an accuracy as defined in* 5.1.6 *when interfaced by other equipment.*

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

4.14.3 The gyro-compass 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.

5 Performance requirements

5.1 Accuracy in latitudes up to 70°

5.1.1 Settling time

When switched on *in accordance with the manufacturer's instructions, the compass* shall *settle within 6 h.*

5.1.2 Settle point error

5.1.2.1 *The settle point error* (3.5) *at any heading* shall *not exceed ±0,75° × secant latitude, and the RMS value of the differences between individual heading indications and the mean value* shall *be less than ±0,25° × secant latitude.*

5.1.2.2 *The repeatability of settle point error from one run-up to another* shall *be within 0,25° × secant latitude.*

5.1.3 Settling time under operational conditions

When switched on *in accordance with the manufacturer's instructions, the compass* shall *settle within 6 h when rolling and pitching with simple harmonic motion of any period between 6 s and 15 s, a maximum angle of 5°, and maximum horizontal acceleration of 0,22 m/s^2.*

5.1.4 Settle point error under operational conditions

The repeatability of the settle point error of the master compass shall *be within ±1° × secant latitude, including variations in magnetic fields likely to be experienced in the craft in which it is installed.*

5.1.5 Performance under operational conditions

In latitudes of up to 70° N or S in craft operating within a latitude band of 10°:

The requirements of 5.1.5.1 shall be checked by means of simulation. The requirements of 5.1.5.2 and 5.1.5.3 shall also be checked by means of simulation and by a vehicle test (sea or land) if necessary. The vehicle test shall only be performed if there is an indication of a physical problem or problems (see Annex B for information). The vehicle test shall be performed under realistic traffic conditions and the maximum acceleration in this test shall be in a band of 1 m/s^2 to 2 m/s^2.

5.1.5.1 *The residual steady-state error, after correction for speed and course influences at a speed of 70 kn,* shall *not exceed ±0,25° × secant latitude.*

5.1.5.2 *The maximum error due to a rapid alteration of speed of 70 kn* shall *be kept to a minimum, and* shall *not exceed ±2°.* The horizontal acceleration shall not exceed 2,0 m/s^2.

5.1.5.3 *The error due to a rapid alteration of course of 180°* up to *maximum rate of turn of 20°/s in any azimuth direction* up to *a speed of 70 kn shall not exceed ±3°.* The horizontal acceleration shall not exceed 2,0 m/s^2.

5.1.5.4 *The transient and steady-state errors due to rolling, pitching, and yawing, with simple harmonic motions of any period between 6 s and 15 s, maximum angles of 20°, 10°, and 5° respectively, and a maximum horizontal acceleration not exceeding 1 m/s^2, and at any course especially at 45°, 90°, and 315° shall not exceed ±1° × secant latitude.*

5.1.6 Synchronization between the master compass and repeaters

5.1.6.1 Once the repeaters have been synchronized with the master, *the maximum divergence in reading between the master compass and* repeater *under all operational conditions* shall *not exceed ±0,5°.* for the purposes of this requirement, the latitude and speed correction shall be assumed equal to zero.

5.1.6.2 *The follow-up rate of the transmission system* shall *be at least 20°/s.*

5.2 Other requirements

The gyro-compass shall *determine the direction of the head of the high-speed crafts (HSC) in relation to geographic (true) north.*

In addition to the general requirements contained in IMO *Resolution A.694 (17), the gyro-compass equipment installed in craft operating under the following conditions:*

1 *speed exceeding 30 kn and up to 70 kn;*

2 *maximum rate of turn 20°/s;*

3 *normal range of operation between 70° N and 70° S shall, as required by chapter 13 of the HSC Code, comply with the minimum performance requirements specified in these standards.*

The gyro-compass, within a speed range of up to 30 kn, shall *comply with the requirements of* IMO *Resolution A.424 (XI), and within a speed range of 30 kn to 70 kn* shall *comply with the requirements of* this document.

Other requirements shall be in accordance with the relevant clauses in IEC 60945.

6 Type tests

6.1 General

6.1.1 Unless otherwise stated in this International Standard, the requirements of IEC 60945 shall apply.

6.1.2 The construction of the gyro-compass shall conform to the requirements specified in Clause 4.

6.2 Settling time test

The master compass shall be securely positioned on a nominally level and stationary base. It shall be energized from nominal value power supplies and started in accordance with the manufacturer's instructions from an initial heading error (to east) of 30° or more.

The settling time (see 3.3) shall meet the requirements of 5.1.1.

6.3 Settle-point-error test

When the master compass has settled (3.3), the settle point error (3.5) shall conform to the requirements specified in 5.1.2.1.

6.4 Settle-point-heading repeatability test

The master compass shall be started in accordance with the manufacturer's instructions from an initial heading error (to east) of 30° or more and shall be allowed to settle.

The settle point heading shall be determined as specified in 3.4. The master compass shall then be switched off for a period of not less than 12 h and not more than 7 d, and then started again from an initial heading error (to west) of 30° or more and the settle point heading measured again.

The master compass shall then be switched off for a period of not less than 12 h and not more than 7 d, and started again from an initial heading error (to east) of 30° or more and the settle point heading determined. The three values of settle point heading obtained shall be recorded and the difference between any two shall not exceed 0,25° × secant latitude.

NOTE If this test follows the test described in 6.3, the "settle" obtained in 6.3 may be used as the first value required by this repeatability test provided that the second "settle" follows a switch-off period of not less than 12 h and not more than 7 d.

6.5 Settling time on a Scorsby table

The master compass shall be mounted on a Scorsby table with the master compass' fore and aft line nominally parallel with one axis of the table which shall be designated as the roll axis.

The other nominally horizontal axis, at right angles to the first, shall be designated as the pitch axis.

The compass shall then be switched on in accordance with the manufacturer's instructions with the following nominal simple harmonic table motions:

— roll axis: peak amplitude 5° ± 1°, period 15 s ± 1 s;

— pitch axis: peak amplitude 5° ± 1°, period 6 s ± 1 s.

The settling time measured between switch-on and compass settle (see 3.3) shall conform to the requirements specified in 5.1.3.

NOTE Compass readings to determine the settle condition may be taken with the Scorsby table stationary and nominally level, and with a minimum delay before resuming the specified table motion.

6.6 Scorsby test

The master compass shall be settled on the Scorsby table with the table stationary, nominally level and its roll axis aligned north–south within ±1°.

The compass lubber line shall be aligned to within ±1° of the table roll axis. The following nominal simple harmonic motions shall be applied simultaneously to the three axes of the table for 25 min:

— roll axis: peak amplitude 25° ± 2°, period 6 s ± 1 s;

— pitch axis: peak amplitude 15° ± 2°, period 10 s ± 1 s;

— yaw axis: peak amplitude 5° ± 1°, period 15 s ± 1 s.

At the end of 25 min, the table motion shall be stopped, the table returned to its original position and the compass heading recorded without delay.

This test shall be repeated with the roll axis of the motion table aligned at 045° ± 1°, at 090° ± 1° and at 315° ± 1°. At each of these headings, the compass settle point shall be determined before commencing the table motion, and any change of heading indication by the compass between the settle point heading, immediately prior to the motion and the heading at the conclusion of the motion, shall be recorded as error due to motion.

In each of the four tests, error due to the motion shall be less than ±1° × secant latitude.

Any horizontal accelerations applied during this test shall not exceed 1 m/s^2.

6.7 Intercardinal motion test

The master compass shall be securely mounted on a device having the ability to move with nominal simple harmonic motion such that the component of motion in a horizontal plane shall have a peak acceleration of 1,0 m/s^2 ± 0,1 m/s^2. The direction of motion of the device in the horizontal plane shall be an intercardinal direction to within ±3°.

When mounted, the compass shall be settled (3.3) and the settle point heading (3.4) shall be obtained with the device stationary and nominally levelled. The device shall then be submitted to the motion described previously, having a peak acceleration of 1,0 m/s^2 ± 0,1 m/s^2 with a periodic time of not less than 3 s, for a duration of 2 h. Any difference between the compass heading recorded during the motion and the settle point heading prior to the motion will be considered as due to the motion; it shall not exceed 1° × secant latitude.

The master compass heading recorded during the motion should discount any modulation at frequencies equal to or higher than the frequency of the applied motion.

6.8 Repeater accuracy test

This test only applies to compass equipment which includes a repeater compass. The latitude and speed error correction shall be assumed equal to zero. The master compass shall be settled on a level rotary table and the repeater aligned with the master compass. The table and master compass shall be turned at a rate not greater than 20°/s, the table being stopped at every 30°, and the compass heading and the repeater heading recorded. The compass and repeater heading may be recorded simultaneously at every 30° as a minimum. This procedure shall be repeated in the reverse direction of rotation. The maximum divergence in reading between the master compass and the repeater shall conform to the requirements specified in 5.1.6.

NOTE The exact angle of the table when readings are taken is unimportant since the object of the test is to compare master and repeater heading indications.

If the repeater compass to be tested is intended for use on an open deck, it shall be tested at a temperature of −20 °C ± 3 °C and again at +60 °C ± 3 °C having been exposed to the test temperature for 2 h prior to the test. Any climatically controlled system designed as a part of the repeater installation may be switched on for this test.

6.9 Speed error correction test

With the master compass mounted on a level and stationary base and the lubber line of the compass aligned to north, the master compass shall be settled and the settled point heading recorded.

A speed signal of 70 kn shall be applied to the gyro-compass and allowed to resettle.

The difference between the settle point heading obtained and that recorded initially shall agree with the value computed theoretically for the latitude of the test to within 0,25° × secant latitude.

If the latitude and speed correction is performed within the heading signal transmission system, the heading readings required for the purposes of this test shall be taken on a repeater driven by the transmission system on the output signal of the transmission system.

6.10 General requirement test

6.10.1 General Information

For these tests, the datum from which settle point variations shall be measured is the settle point heading obtained in the absence of the particular environmental condition to be applied. Where the gyro-compass includes repeater compasses, at least one repeater compass shall be energized and

aligned with the master compass at all times during the course of environmental tests. Each remaining repeater compass output shall be connected to a normal load, or to a suitable impedance representing a normal load, supplied by the manufacturer.

6.10.2 Voltage variation test

The supply voltage shall be set to 10 % above the nominal value for 3 h, during which time the compass heading shall be recorded at 20 min intervals. The supply voltage shall then be set to a value 10 % below nominal for 3 h, and the compass heading again recorded at 20 min intervals. None of the recorded headings shall depart from the original datum by more than 1° × secant latitude.

6.10.3 Frequency variation test

In case of an AC supply, the frequency shall be set to 5 % above the nominal value for 3 h, during which time the compass heading shall be recorded at 20 min intervals. The supply frequency shall then be set to a value 5 % below nominal for 3 h and the compass heading again recorded at 20 min intervals. None of the recorded headings shall depart from the original datum by more than 1° × secant latitude.

6.10.4 Vibration test

6.10.4.1 Vibration test of master compass

In all these tests, the direction of the master compass lubber line shall be +30° ± 1° to the meridian. The master compass shall be subjected to the vibration described below. Three separate tests shall be carried out, the direction of vibration being

a) +30° ± 1° to the meridian and horizontal,

b) −60° ± 1° to the meridian and horizontal, and

c) vertical.

In each case, the compass shall be settled initially and then the vibration shall be applied at the lowest frequency, holding the appropriate vibration amplitude for a period of 25 min. At the end of that period, the frequency and amplitude shall be changed to the next value in Table 1 and held for a further 25 min. This process shall continue until the entire frequency range has been covered.

Table 1

Frequency Hz	**Amplitude** mm
5	±0,71
7	±0,71
10	±0,71
14	±0,63
20	±0,31
28	±0,16
40	±0,08

The indicated heading shall be recorded at the end of each period; any difference between these recorded heading and the datum settle point heading shall be not more than 1° × secant latitude during the test.

NOTE Provision may be made to reduce or nullify any adverse effect on the equipment performance caused by the presence of any electromagnetic field due to the vibration unit.

6.10.4.2 Vibration test of compass equipment other than master compass

This equipment, complete with any shock absorbers which are part of it, shall be secured by its normal means of support to the vibration table. It shall then be connected in its normal electrical configuration to the master compass. The master compass shall then be switched on in accordance with the manufacturer's instructions and its settle point heading ascertained and recorded.

The equipment on the vibration table shall then be vibrated vertically at all frequencies between

a) 5 Hz and 13,2 Hz with an amplitude of 1,0 mm, and

b) 13,2 Hz and 40 Hz with a maximum acceleration of 0,7 × 9,8 m/s^2; taking at least 25 min to cover each frequency range.

This whole procedure shall be repeated when the equipment is vibrated in two mutually perpendicular directions in the horizontal plane. There shall be no electrical or mechanical failure during any part of this series of tests.

The indicated heading shall be recorded at the end of each period; any difference between these recorded heading and the datum settle point heading shall be not more than 1° × secant latitude during the test.

6.10.5 Temperature test

The compass equipment shall be placed in a chamber at normal room temperature, switched on and allowed to settle. The settle point heading shall be obtained and recorded. The temperature of the chamber shall then be raised to 45 °C ± 2 °C and maintained for a period of 3 h. At the end of this period, the compass heading indication shall again be recorded. The temperature of the chamber shall then be reduced to 0 °C ± 2 °C and maintained at this temperature for 3 h. At the end of this period, the compass heading indication shall be recorded once more. Neither of the recorded heading indications shall differ from the datum settle point heading by more than 1° × secant latitude.

When the temperature of the chamber is being changed, it should not alter by a rate which exceeds 45 °C per hour.

6.10.6 Damp heat test

The compass equipment shall be placed in a chamber at normal room temperature and humidity, and then be switched on and allowed to settle. The settle point heading shall be obtained and recorded. The temperature and relative humidity of the chamber shall then be raised steadily over a period of 3 h ± 0,5 h to 40 °C ± 2 °C, and a relative humidity of 93 % ± 3 %. These conditions shall be maintained for a further period of 3 h ± 0,5 h.

The compass indication at the end of this test shall not differ from the datum settle point heading by more than 1° × secant latitude.

6.10.7 Other tests

Other tests include

a) rain test,

NOTE In the case of the rain test, only exposed equipment is tested.

b) conducted interference test,

c) radiated interference test, and

d) acoustic noise test.

In the case of the acoustic noise test, no measurement shall be made at the time of starting the gyro-compass, and only equipment intended for installation in wheelhouse and bridge wings is tested.

6.11 Interface test

The interface facilities shall be subjected to the tests specified in IEC 61162-1 and/or IEC 61162-2. Observe the IEC 61162-2 heading output rate and ensure that it is updated at least once per 20 ms. The interface as well as the repeaters shall meet the performance test specified in 6.8. The interface for the alert communications specified in 4.12 shall be confirmed by the analytical evaluation of manufacturer's documentation and operation check.

7 Marking and identification

Each unit of a gyro-compass shall be marked with the following:

— *identification of the manufacturer;*

— *equipment type number or model identification under which it was type tested;*

— *serial number of the unit.*

Each unit of the equipment shall be marked with the minimum safe distance at which it may be mounted from a standard and a steering magnetic compass. The safe distance shall be measured in accordance with ISO 25862.

8 Information

8.1 Information shall be provided to enable competent members of a craft's crew to operate and maintain the equipment efficiently.

8.2 *A qualitative description of the effects of gyro-compass errors due to high speed, accelerations, course changes, sea state, etc., and a qualitative description of corresponding errors in other navigational aids,* shall *be provided to the user.*

Annex A
(normative)

Advice to ship surveyors for installation of gyro-compasses and repeater compasses on board crafts

To ensure that the errors induced by the motions specified in 5.1.5.4 are not exceeded in practice, it will be necessary to pay particular attention to the sitting of the master compass.

Where the master compass and/or any repeater compass are to be used for taking bearings, the horizontal angle between the vertical plane passing through the centre of the compass card, including the lubber line, and the vertical plane passing through the craft's fore and aft datum line, should be within ±0,5° when installed.

Annex B
(informative)

Vehicle test

A vehicle test is only carried out if there is indication of a physical problem or problems, for example

a) mechanical boundaries,

b) data communications, and

c) stability under traffic conditions over a longer time interval.

A typical test may be performed under the following conditions.

The equipment is installed on a vehicle. The vehicle is accelerated slowly to a speed of approximately to 70 kn or the maximum speed limited by the national traffic regulations on a road that is straight for a few kilometres. Before the turn is started, the vehicle slows down to a lower speed (10 kn to 20 kn or as necessary according to the vehicle, traffic, and environment). After a 180° turn, the vehicle is accelerated to a speed of approximately 70 kn or the maximum speed limited by the national traffic regulations. The vehicle then stops at the end of the straight test road. The recorded course should be in a band of ±3° after the turn. Problems, for example, caused by data communication during the turn or other traffic situations, should be reduced to a minimum.