INTERNATIONAL STANDARD

ISO 8728

Second edition
1997-06-15

Ships and marine technology — Marine gyro-compasses

Navires et technologie maritime — Compas gyroscopiques à usage marin

Reference number
ISO 8728:1997(E)

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.

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.

International Standard ISO 8728 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation.*

This second edition cancels and replaces the first edition (ISO 8728:1987), which has been technically revised.

Annex A forms an integral part of this International Standard. Annex B is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Ships and marine technology — Marine gyro-compasses

1 Scope

This International Standard specifies the construction, performance and type testing for gyro-compasses required by Chapter V of SOLAS, 1974.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/R 694:1968, *Positioning of magnetic compasses in ships.*

IEC 945:1994, *Marine navigational equipment — General requirements — Methods of testing and required test results.*

International Convention on Safety of Life at Sea (SOLAS) 1974 (amended).

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 gyro-compass: Complete equipment including all essential elements of the complete design.

3.2 true heading: Horizontal angle between the vertical plane passing through the true meridian and the vertical plane passing through the ship's fore-and-aft datum line; it is measured from true north (000°) clockwise through 360°.

NOTE — When the gyro-compass equipment is not installed on board ship, 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 — 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 as defined in 3.3.

3.5 settle point error: Difference between the settle point heading as defined in 3.4 and the true heading.

3.6 error: Difference between the observed value and the settle point heading as defined in 3.4.

3.7 bearing repeater compass: Device that reproduces the master compass card at a remote location.

3.8 compass card: Graduated dial of the compass which indicates the measured direction of the meridian.

3.9 latitude error: Error to which some gyro-compasses are subject, the magnitude and sign of which depend upon the local latitude.

NOTE — Means are provided for correcting this error.

3.10 speed error: Error to which gyro-compasses are subject, the magnitude and sign of which depend upon the speed, course and latitude of the ship.

NOTE — Means are provided for correcting this error.

3.11 lubber line: Index line situated on the body of a compass against which the compass heading is read.

3.12 master compass: Main compass unit which supplies the heading information to the repeaters and other navigational aids.

3.13 Scorsby table: Test machine which independently oscillates a platform about three axes; it is used to simulate the motion of a ship.

4 Construction

Gyro-compass units shall conform to the following requirements.

4.1 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 6.10.1 to 6.10.5.

4.2 For those ships which are required to carry bearing repeater compasses, 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 ship's motion.

c) Any bearing repeater compass intended for use on an open deck shall be waterproof.

4.3 The compass card shall be graduated at equal intervals of 1° or 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°.

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

4.5 Both master compass and repeater compasses shall be provided with a lubber line to indicate the ship's heading.

4.5.1 The base or some other fixed extremity of the compass shall be marked or identified in such a way as to facilitate the installation of the compass in a ship so that the lubber line lies in a vertical fore-and-aft plane of the ship. 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.

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.

4.6 Means shall be provided for correcting the errors induced by speed and latitude. Graphical or tabular means of correction may be used.

4.7 Steps shall be taken to eliminate as far as is practical the causes of, and to suppress, electromagnetic interference between the gyro-compass and other equipment on board.

4.8 Mechanical noise from all units shall be so limited as to ensure the hearing of sounds on which the safety of the ship may depend.

4.9 The equipment shall be so constructed that it is readily accessible for maintenance purposes.

4.10 An automatic alarm shall be provided to indicate a power failure in the gyro-compass.

4.11 Means shall be incorporated for the protection of the equipment from excessive currents and voltages, transients and accidental reversal of power supply polarity.

4.12 The gyro-compass shall be designed to enable heading information to be provided to other navigational aids.

5 Performance requirements

5.1 Accuracy in latitudes up to 60°

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 as defined in 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 a maximum horizontal acceleration of 0,22 m/s^2.

5.1.4 Settle point error under general conditions

The repeatability of the settle point error of the master compass shall be within ± 1° × secant latitude under the general conditions and including variations in magnetic fields likely to be experienced in the ship in which it is installed.

5.1.5 Residual error in correction

The residual steady state error, after correction for speed and course influences at a speed of 20 kn[1)], shall not exceed ± 0,25° × secant latitude.

5.1.6 Effect of alteration of speed

The error due to a rapid alteration of speed of 20 kn shall not exceed ± 2°.

---

1) knots

5.1.7 Effect of alteration of course

The error due to a rapid alteration of course of 180° at a speed of 20 kn shall not exceed ± 3°.

5.1.8 Accuracy on a Scorsby table

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, shall not exceed ± 1° × secant latitude.

5.1.9 Synchronization between the master compass and repeaters

Once the repeaters have been synchronized with the master, the maximum divergence in reading between the master compass and repeaters 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.

5.2 Other requirements

Gyro-compasses shall be in accordance with the requirements of IEC 945:1994, clause 3.

6 Type tests

6.1 Construction

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 (high) 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 as defined in 3.3, the settle point error (see 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 (high) 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 days and then started again from an initial heading error (low) 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 days and then started again from an initial heading error (high) of 30° or more and the settle point heading determined. The three values of settle point heading so 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, then the "settle" obtained from that test 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 days.

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 the roll axis.

The other nominally horizontal axis at right angles to the first shall be designated 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 as defined in 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 20° ± 2°, period 10 s ± 1 s;

— pitch axis: Peak amplitude 10° ± 1°, period 6 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 indicated 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, the 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 ± 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 so mounted, the compass shall be settled (see 3.3) and the settle point heading shall be obtained (see 3.4) with the device stationary and nominally level. The device shall then be submitted to the motion previously described having a peak acceleration of 1,0 ± 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.

NOTE — 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 5°/s, the table being stopped at every 30° and the compass heading and the repeater heading recorded. 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 5.1.9.

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 correction test

This test applies to gyro-compass units fitted with a correction device for speed and course error.

With the master compass mounted on a level and stationary base and the lubber line of the compass aligned North-South, the master compass shall be settled and the settle point heading recorded.

A speed correction signal of 20 kn shall be applied to the compass equipment and the compass allowed to resettle.

The difference between the settle point heading so 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, then 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.

Speed and course error, in degrees, for a compass aligned North-South is

$$\frac{V}{5\pi} \times \text{secant latitude}$$

where V is the speed in knots.

6.10 General requirement test

For all the environmental tests in the general requirement 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 of the gyro-compass shall be energised 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.

6.10.1 Voltage variation test

The supply voltage shall be set of 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.

6.10.2 Frequency variation test

The supply 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.

6.10.3 Vibration tests

6.10.3.1 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;

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 tabulated below 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 headings 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.

6.10.3.2 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;

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 and any difference between these recorded headings and the datum settle point heading shall be not more than 1° × secant latitude during the test.