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N-02 GYROCOMPASSES

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Foreword:

This Guideline is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

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GYROCOMPASSES

1 Application

This guideline applies to the type approval test and routine inspection of marine gyrocompasses.

2 Normative references

- (1) IMO A.424 (XI) Performance Standards of Gyro-compass;
- (2) ISO 8728 – 1997 Ships and marine technology – Marine Gyrocompasses;
- (3) IEC 60945 – 2002-08 Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results.

3 Terms and definitions

3.1 For the purpose of this guideline:

(1) Intercardinal motion error

Motion error between reference points of the cardinal direction, specifically referring to the intercardinal motion error which is measured with the compass being placed on an intercardinal motion test bed which moves in the intercardinal direction, i.e. the direction of the line connecting 45° and 225° or 135° and 315° to a deviation of not more than $\pm 3^\circ$, with the maximum acceleration of the horizontal component of its motion being $1.0 \pm m/s^2$ in cycles of more than 3 s for a duration of 2 h.

(2) True heading

True heading is the 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 gyrocompass equipment is not installed on board the ship, this "true heading" is regarded as the true heading of the lubber line. Where the gyrocompass has the facility of introducing a correction by moving the lubber line, the correction is to be set for the local latitude.

(3) Settled

Stable situation when any three readings taken at intervals of 30 min are within a band of 0.7° , with the compass being on a level and stationary base. Note: The settling time is the elapsed time between the start at the initial heading error and the third stable readings.

(4) Settle point heading

Mean value of ten readings taken at 20 min intervals after the compass has settled as defined in (3).

(5) Settle point error

Difference between the settle point heading as defined in (4) and true heading.

(6) Error

Difference between the observed value and the settle point heading as defined in (4).

(7) Bearing repeater compass

Device that reproduces the master compass card at a remote location.

(8) Compass card

Graduated dial of the compass which indicates the measured direction of the meridian.

(9) Latitude error

Error to which some gyrocompasses are subject, the magnitude and sign of which depend upon the local latitude. Note: Means are provided for correcting this error.

(10) Speed error

Error to which gyrocompasses 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.

(11) Lubber line

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

(12) Master compass

Main compass unit which determines and supplies the heading information to the repeaters and other navigational aids.

(13) Scorsby table

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

4 Plans and documents

4.1 The following plans and documents are to be submitted to CCS for approval or information:

4.1.1 Plans and documents for approval

- (1) Drawing of gyrocompass system;
- (2) Drawing of master compass figuration;
- (3) Electric diagram of master compass;
- (4) Drawing of power supply box figuration (if applicable);
- (5) Electric diagram of power supply box (if applicable);
- (6) Drawing of heading transmission box figuration (if applicable);
- (7) Electric diagram of heading transmission box (if applicable);
- (8) Technical instructions;
- (9) Technical specifications;
- (10) Routine test program;
- (11) Type test program.

4.1.2 Plans and documents for information

- (1) Drawing of master compass wiring;
- (2) Drawing of power supply box wiring (if applicable);
- (3) Drawing of heading transmission box wiring (if applicable);
- (4) Instructions for operation and maintenance (including maintenance information for qualified crew members).

For navigational gyrocompass and steering gyrocompass, plans and documents are to be submitted separately.

5 Design and technical requirements

5.1 Structure of gyrocompass

5.1.1 The equipment is to be capable of continuous operation under conditions of vibration, humidity, change of temperature and variations of power supply as specified.

5.1.2 For those ships which are required to carry bearing repeater compasses, the construction of these are to be as follows:

- (1) The bearing repeater compass is to be designed to be fitted with an azimuth reading device;
- (2) A gimbal mechanism is to be provided to enable the bearing repeater compass card to be held horizontally against the ship's motion;
- (3) The degree of protective enclosure of any bearing repeater compass intended for use on an open deck is to be IP56.

5.1.3 The compass card is to be graduated at equal intervals of 1° or fraction thereof. The graduation error is to be less than $\pm 0.2^\circ$. A numerical indication is to be provided at least at every 10° , starting from 000° clockwise through 360° .

5.1.4 Fully adequate illumination is to be provided to enable the reading of all compass cards at all times. Facilities for dimming are to be provided.

5.1.5 Both master compass and repeater compasses are to be provided with a lubber line to indicate the ship's heading. The base of the compass is to 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 gyrocompass has the facility of introducing a correction by moving the lubber line, the correction during installation is to be set to zero.

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

5.1.7 Steps are to be taken to eliminate as far as is practical the causes of, and to suppress, electromagnetic interference between the gyrocompass and other equipment on board.

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

5.1.9 The equipment is to be so constructed that it is readily accessible for maintenance purposes.

5.1.10 An automatic alarm is to be provided to indicate a power failure in the gyrocompass.

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

5.1.12 The gyrocompass is to be designed to enable heading information to be provided to other navigational aids.

5.2 Performance requirements

5.2.1 The performance of a gyrocompass is to be assessed for operation accuracy in latitudes up to 60° :

(1) Settling time

When switched on according to the manufacturer's instructions, the compass is to settle within 6 h.

(2) Settle point error

① The settle point error at any heading is not to exceed $\pm 0.75^\circ \times \text{Sec } \Phi$ (Φ being the latitude where the compass is located); the RMS value of the differences between individual heading indications and the mean value is to be less than $\pm 0.25^\circ \times \text{Sec } \Phi$.

② The repeatability of settle point error from one run-up to another is to be within $0.25^\circ \times \text{Sec } \Phi$.

(3) Settle time under operational conditions

When switched on according to the manufacturer's instructions, the compass is to 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 .

(4) Settle point error under general conditions

The repeatability of the settle point error of the master compass is to be within $\pm 1^\circ \times \text{Sec } \Phi$ under the general conditions and including variations in magnetic fields likely to be experienced in the ship in which it is installed.

(5) Residual error in correction

The residual steady state error, after correction for speed and course influences at a speed of 20 kn, is not to exceed $\pm 0.25^\circ \times \text{Sec } \Phi$.

(6) Effect of alteration of speed

The error due to a rapid alteration of speed of 20 kn is not to exceed $\pm 2^\circ$.

(7) Effect of alteration of course

The error due to a rapid alteration of course of 180° at a speed of 20 kn is not to exceed $\pm 3^\circ$.

(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 , are not to exceed $\pm 1^\circ \times \text{sec } \Phi$.

(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 and repeaters under all operational conditions is not to exceed $\pm 0.5^\circ$; for the purposes of this requirement, the latitude and speed correction is to be assumed equal to zero.

5.2.2 Other requirements

Gyrocompasses are to be in accordance with IEC 60945:2002-08, clause 3: Definitions and abbreviations.

6 Selection of typical samples

Generally navigational compasses are to be selected as typical samples. Each component of a gyrocompass is to have a nameplate indicating the manufacturer, type, serial number, manufacturing date and the minimum safe distance from the magnetic compass.

7 Type test

7.1 The type test mainly includes the following items:

7.1.1 Construction (6.1 of ISO 8728 1997)

7.1.2 Setting time test (6.2 of ISO 8728 1997)

7.1.3 Settle point error test (6.3 of ISO 8728 1997)

7.1.4 Settle point heading repeatability test (6.4 of ISO 8728 1997)

7.1.5 Setting time on a Scorsby table (6.5 of ISO 8728 1997)

7.1.6 Scorsby test (6.6 of ISO 8728 1997)

7.1.7 Intercardinal motion test (6.7 of ISO 8728 1997)

7.1.8 Repeater accuracy test (6.8 of ISO 8728 1997)

7.1.9 Speed correction test (6.9 of ISO 8728 1997)

7.1.10 General requirement test (6.10 of ISO 8728 1997)

(1) Voltage variation test (6.10.1 of ISO 8728 1997)

(2) Frequency variation test (6.10.2 of ISO 8728 1997)

(3) Vibration test (6.10.3 of ISO 8728 1997)

① Vibration test of master compass (6.10.3.1 of ISO 8728 1997)

② Vibration test of compass equipment other than master compass (6.10.3.2 of ISO 8728 1997)

(4) Temperature test (6.10.4 of ISO 8728 1997)

(5) Damp heat test (6.10.5 of ISO 8728 1997)

(6) Other tests (6.10.6 of ISO 8728 1997)

① Rain test (8.8 of IEC 60945 2002-08) (if applicable)

② Conducted Interference test (9.2 of IEC 60945 2002-08)

③ Radiated Interference test (9.3 of IEC 60945 2002-08)

④ Acoustic noise test (11.1 of IEC 60945 2002-08)

⑤ Test for minimum safe distance from magnetic compass (11.2 of IEC 60945 2002-08 or performed according to ISO/R694:2002)

(7) Enclosure test (2.15 of CCS Guidelines for Type Approval Test of Electric and Electronic Products).

8 Inspection

8.1 The routine inspection of approved products generally is to be carried out as follows.

8.1.1 Test items:

(1) figuration and construction;

(2) settling time;

(3) settle point error;

- (4) scorsby error;
- (5) alarm test;
- (6) insulation resistance measurement.

8.1.2 Verification items:

- (1) assembly record;
- (2) steady state error, after correction for speed;
- (3) accuracy of repeatability of settle point error;
- (4) matching accuracy of master and repeaters.

8.2 Sampling ratio

In general, at least one sample is to be taken for each type and the sampling ratio for inspection is 20%.