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Shipbuilding — Class B magnetic compasses — Tests and certification

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Contents

	Page
1 Scope	1
2 Normative references	1
3 Definitions	1
4 Test conditions	1
5 Certification	1
6 Compass and gimbal ring	2
7 Hand bearing compasses	5

Annex

A Resistance to vibration	7
A.1 General	7
A.2 Test procedure	7
A.3 Test requirements	7

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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.

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 10316 was prepared by Technical Committee ISO/TC 8, *Shipbuilding and marine structures*.

Annex A of this International Standard is for information only.

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Shipbuilding — Class B magnetic compasses — Tests and certification

1 Scope

This International Standard specifies type-tests and individual tests, and gives acceptable limits of characteristics necessary to guarantee conformity of magnetic compasses of class B, including hand bearing compasses, to the specifications given in ISO 613.

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 613:1982, *Shipbuilding — Magnetic compasses, binnacles and azimuth reading devices — Class B*.

ISO 1069:1973, *Magnetic compasses and binnacles for sea navigation — Vocabulary*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 1069 apply.

Unless otherwise stated, *H* is to be understood as the horizontal component of the magnetic flux density, in microtesla (μT) at the place of examination.

4 Test conditions

Type-testing shall be carried out before the instruments covered come into regular service. For type-testing, new devices only will be accepted.

Individual testing shall be carried out before installation on-board ship; it is also desirable periodically and after repair. For individual testing, all devices shall be in a clean and serviceable state when submitted for testing.

Unless otherwise stated, all tests shall be carried out at a temperature of $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

5 Certification

5.1 Test certificate

Devices which have passed the type-tests or the individual tests and comply with the requirements shall be so certified in the language of the test authority and in English.

Each type-test certificate is valid exclusively for the model tested. In case of alterations or technical improvements which affect its compliance with ISO 613, the model shall be given a new identification number (or mark) and the type-test repeated. All alterations shall be submitted to the original test authority who will decide whether a new type-test is necessary.

Copies of the certificate shall be issued on demand. They shall be explicitly marked "copy".

Acceptance of type-test certificates and individual test certificates between countries will be a matter for mutual agreement.

5.2 Statement of manufacturer or importer

This statement applies to type-testing only.

The manufacturer shall produce a written statement covering those requirements which cannot be ascertained during the type-test. The statement shall contain the following points:

- a) the coercivity and magnetic moment of the magnets of the directional system;

- b) that the paint used inside the compass is of good quality and that over a period of 2 years it is not likely to deteriorate to such an extent as to make the compass unusable, either as a result of a change of temperature over the range of $-20\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$ or any other cause (for example the legibility of graduations shall not be impaired by discolouration or blistering);
- c) under the circumstances described in b), that the compass liquid is not likely to show any appreciable discolouration such as to render the compass unusable;
- d) whether non-toughened or toughened glass is used for the top and bottom glass covers: alternatively, when material other than glass is used, that its strength is equivalent to that of non-toughened glass;
- e) that the material of the compass card will not distort;
- f) that the moment of inertia of the directional system is appreciably the same about all horizontal axes passing through the bearing surface of the pivot jewel;
- g) the vertical distance between the mid plane of the magnets of the directional system and the inner gimbal axis of the compass supplied;
- h) the supporting force on the compass pivot at $20\text{ }^{\circ}\text{C}$.

5.3 Marking

5.3.1 Check that

- a) compasses are marked in a conspicuous place on the compass card with the name of the manufacturer;
- b) compasses bear the type identification or a reference number.

5.3.2 The markings indicated in 5.3.1 shall be shown on the certificate.

5.3.3 The type of liquid used, if other than alcohol, shall be marked on the bowl in the vicinity of the filling plug.

If the compass is sealed, a label shall state "this compass cannot be re-filled".

5.4 Sample checks

In order to check that the manufacturer's statement in 5.2 has been fulfilled, sample checks may be carried out.

6 Compass and gimbal ring

Testing shall be carried out on

- a) steering compasses;
- b) standby steering and emergency compasses (These include projector, reflector or transmitting compasses, and compasses which allow course readings and control navigational aids.);
- c) hand bearing compasses.

All compasses, other than those hemispherical compasses which are used as steering compasses only, shall be tested with their gimbal ring(s).

6.1 Construction and materials

6.1.1 Non-magnetic properties

For type-testing only, examine compass bowls and gimbals to ascertain their non-magnetic properties.

6.1.2 Condition of compass bowl

Inspect the compass to see that it is undamaged and mechanically perfect. The liquid shall be colourless and free from turbidity and formation of flocks. There shall be no leaks. The paint, including that on the compass card, shall be free from cracks and blisters.

6.1.3 Condition at high temperature

Warm the compass slowly from ambient temperature to $+60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and keep it at this temperature for at least 8 h. After this period, the compass shall not show any mechanical damage, leakage or bubbles. The compass liquid and the paint shall not show any deterioration. The compass operation shall not be affected. The directional system shall remain in contact with the pivot and shall not be deformed.

6.1.4 Condition at low temperature

Cool the compass slowly to $-20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and keep it at this temperature for at least 8 h. After this period, the compass shall not show any mechanical damage or deformation, leakage or bubbles. The liquid in the bowl shall not be frozen, discoloured or separated into its constituent parts. A formation of flocks or ice shall not have occurred within the liquid. The compass operation shall not be affected. The directional system shall remain in contact with the pivot and shall not be deformed.

6.2 Gimballing

These tests are for type-testing only.

6.2.1 Angle of gimbals axes

The range formed by the inner and outer gimbals axes shall be $90^\circ \pm 2^\circ$.

Measurement of the axes angles may be made by means of the graduation of the test stand, when first one and then the other gimbals axis is brought into the vertical plane of view passing through the graduation centre, by turning the compass support.

6.2.2 Freedom of movement within gimbals rings

When the gimbals ring is in the horizontal plane, the compass bowl shall revolve freely about the inner axis up to $\pm 30^\circ$.

The measurement may be carried out by a clinometer placed on the top glass cover or its verge ring.

6.2.3 Horizontal position

The compass bowl shall be balanced so that its verge ring or top glass cover settles in the horizontal plane to within 2° when the gimbals is fixed in a horizontal position; this shall be so whether the azimuth reading device or magnifying glass is in place or not.

Measurement shall be carried out using a spirit-level of suitable sensitivity placed on the top glass cover or its verge ring.

6.3 Compass card bearing

6.3.1 Directional system resistance to displacement

The bearing of the directional system shall be constructed in such a way that it returns to the original position on its pivot when the bowl is completely inverted and returned to normal.

This may be checked by visual inspection.

6.3.2 Freedom of tilt of directional system

The bearing of the directional system and the compass bowl be constructed in such a way that the directional system can rotate freely when the compass bowl is tilted in any direction at an angle of

- a) 10° in the case of a compass with gimbals;
- b) 30° in the case of a compass without gimbals.

The examination may be carried out by means of a revolving platform with adjustable inclination.

6.4 Lubber marks

6.4.1 Number of lubber marks

Each compass shall be fitted with a lubber mark indicating the direction of the ship's head (main lubber mark). Other lubber marks are allowed showing the direction of the ship's stern or athwartships respectively. These additional lubber marks shall fulfil the conditions laid down in 6.4.2 and 6.4.3. The main lubber mark shall be clearly identifiable as such.

6.4.2 Length of lubber mark(s)

The lubber mark(s) shall be of such a shape that the card may be read against the lubber mark when the compass bowl of a gimbals compass is tilted 10° , and that of a hemispherical compass is tilted 30° , from the horizontal plane.

When the compass is of the reflector or projector type, a plate lubber line is permitted.

The examination may be carried out by visual inspection in conjunction with the examination described in 6.3.2.

6.4.3 Width of lubber mark(s)

The width of the lubber mark(s) shall be no greater than 1° of the graduation of the card.

This shall be checked by visual inspection.

6.5 Directional system

6.5.1 Compass card

6.5.1.1 Graduation

Compass cards shall be graduated in equal intervals of not greater than 5° starting from North with the figures increasing clockwise when viewed from above. The interval between two successive figures shall not exceed 30° .

The cardinal points shall be indicated by the capital letters N, S, E and W. North may also be indicated by suitable graphic design. Intermediate points may also be marked.

6.5.1.2 Readability

In steering compasses, the line thickness and the heights of figures and letters shall allow a person with normal vision to read the card, in both daylight and artificial light, at a distance of 1 m.

The use of a magnifying device is permitted.

If only a part of the card is visible, it shall be possible to read at least 15° on each side of the lubber mark.

The examinations required by 6.5.1.1 and 6.5.1.2 shall be carried out visually.

6.5.2 Directional system magnetic moment

The magnetic moment of the directional system shall, depending on the card diameter, be not less than the values given in figure 1.

Testing may be carried out by means of a magnetometer (deflection method) or by any other appropriate means.

6.5.3 Period

6.5.3.1 Half-period of periodic oscillating directional systems

After an initial card deflection of 40° from the magnetic meridian, the half-period of the directional system shall not be less than the greater of the two following values:

4 s, or

(0,06 *d*) s, where *d* is the card diameter in millimetres.

The half-period shall be measured between the first two consecutive passings of the original course indication when the horizontal component of the magnetic flux density is 18 µT.

The measurement shall be repeated by deflecting the directional system in the opposite rotational direction, and the mean value taken. Before measuring, the directional system shall be kept deflected for 10 s.

Measuring the period may be carried out by means of a stop-watch or other suitable device.

The half-period of the directional system shall be taken as the mean value of two readings.

6.5.3.2 Settling time of aperiodic directional systems

Aperiodic (or heavily damped) systems are those systems which, after an initial deflection, return to the magnetic meridian without a full oscillation. When the horizontal component of the magnetic flux density is 18 µT, the time taken to approach finally to within 2,5° of the magnetic meridian, following an initial deflection of the card of 90°, shall be not more than the lesser of the two following values:

60 s, or

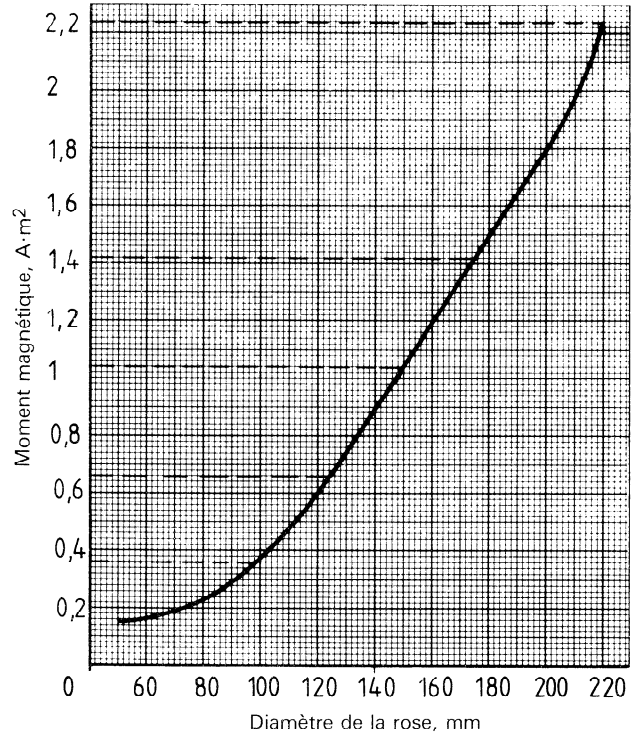


Figure 1 — Magnetic moment of directional system magnets: lower desirable limiting values

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(0,4 *d*) s, where *d* is the card diameter in millimetres.

The measurement shall be repeated by deflecting the card in the opposite rotational direction.

The settling time may be measured by means of a stop-watch or other suitable device.

The settling time of the directional system shall be taken as the mean value of two readings.

6.6 Accuracy

6.6.1 Directional error

The directional error is a constructional error of the directional system. It is composed of

- a) error of orientation of the magnets with regard to the compass card graduation (collimation error);
- b) inaccuracies of the compass card graduation;
- c) eccentricity of the compass card graduation with regard to the card centre of rotation.

The directional error shall not exceed 1,5°.

The examination may be carried out on a compass test stand. After having brought the compass card centre of rotation into the test stand axis of rotation, the directional error can be read at the card gradu-

ation by means of a telescope, when the vertical sight plane passing through the axis of rotation has been aligned with the magnetic meridian in advance. This measurement shall be carried out on at least four equidistant headings. When measuring, tap the top glass cover gently to eliminate the error due to friction (see 6.6.3).

NOTE 1 If the test is carried out in the compass bowl, it should be noted that the resulting value then includes the deviation due to magnetic material in the compass.

6.6.2 Lubber mark error

The lubber mark error is a constructional error of the compass bowl and gimbals which depends on the relative position of the main lubber mark (if it is fixed), the pivot bearing, and the direction of the outer gimbal axis.

In compasses with a movable lubber mark, but with an auxiliary graduation for coefficient A correction, and also in transmitting compasses or compasses which operate auto-pilots with a rotatable compass bowl, the lubber mark shall be brought into the zero position before testing.

The lubber mark error shall not exceed 1° .

For compasses with a movable lubber mark but without an auxiliary graduation or other means of securing a definite position of the lubber mark in relation to the direction of the outer gimbal axis, or for compasses without gimbals — as in hemispherical compasses for steering purposes only — the lubber mark error becomes undefined and cannot be determined.

The examination may be carried out on a compass test stand by bringing the outer gimbal axis into the vertical sight plane passing through the test stand centre of rotation and reading the vernier of the master graduation. After this, the pivot point shall be brought into the test stand centre of rotation and the compass support turned until the lubber mark lies in the vertical sight plane. The angle of rotation is the lubber error.

6.6.2.1 If there are additional lubber marks, their error shall not exceed 1° .

This test may be made by comparison with the test stand master graduation, when testing the lubber error according to the procedure in 6.6.2.

6.6.2.2 For projector compasses, the course, as read from the projected image, shall agree with that read at the main lubber mark to within 1° .

6.6.3 Error due to friction

The directional system, when given an initial deflection of 5° and kept in this position for 10 s, shall, when released, return to within $(9/II)^\circ$ of its original position. The original position shall be attained after gently tapping the top glass cover.

Repeat the test by deflecting the directional system in the opposite direction; the larger of the values obtained shall be taken as the error due to friction. The reading may be carried out at the lubber mark, or more accurately, by means of the compass test stand telescope.

6.6.4 Swirl error

When the compass bowl is rotated around its vertical axis, at a uniform rotational frequency of 360° in $4 \text{ min} \pm 10 \text{ s}$, the deflection of the directional system from the magnetic meridian shall not be more than $(40/II)^\circ$.

The observation shall start after the compass has been rotated 180° or 360° as appropriate. After giving the compass liquid a suitable time to settle, the measurement shall be repeated by rotating the compass in the opposite direction. The larger of the values obtained shall be taken to be the compass swirl error.

7 Hand bearing compasses

In view of their particular nature, magnetic hand bearing compasses shall meet some special requirements. The test requirements as specified in 7.1 to 7.3.3 collectively supersede the test requirements in 6.3.2, 6.5.1, 6.5.3, 6.6.4.

7.1 Freedom of tilt of directional system

The bearing of the directional system and the compass bowl shall be constructed in such a way that the directional system can rotate freely when the compass bowl is tilted to an angle of 10° in any direction.

The examination may be carried out by means of a revolving platform with adjustable inclination.

7.2 Settling time

After an initial deflection of 90° , the card shall return to its original position to within 2° in no more than $(65/\sqrt{H})$ s.

The card shall be maintained at 90° from its original position for a few seconds and the time taken by the card to pass from the deflected position to the original position (to within 2°) shall be measured using a stop-watch or any other suitable device.