INTERNATIONAL STANDARD

ISO 2269

Second edition
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Shipbuilding — Class A magnetic compasses, azimuth reading devices and binnacles — Tests and certification

Construction navale — Compas magnétiques, alidades et habitacles de classe A — Essais et certification

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Contents

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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 2269 was prepared by Technical Committee ISO/TC 8, *Shipbuilding and marine structures*, Sub-Committee SC 18, *Advanced navigational instruments and systems*.

This second edition cancels and replaces the first edition (ISO 2269:1973), of which it constitutes a technical revision, limited to class A magnetic compasses, azimuth reading devices and binnacles; tests and certification of class B magnetic compasses form the subject of ISO 10316.

Annexes A, B and C form an integral part of this International Standard.

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Shipbuilding — Class A magnetic compasses, azimuth reading devices and binnacles — Tests and certification

Section 1: General

1.1 Scope

This International Standard specifies type-test and individual test methods, and gives the acceptable limits of the characteristics necessary to guarantee conformity of magnetic compasses, azimuth reading devices and binnacles to the general specifications given in ISO 449.

1.2 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 449:1979, *Shipbuilding — Magnetic compasses and binnacles, class A.*

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

1.3 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.

1.4 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 °C ± 3 °C.

1.5 Certification

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 449, 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 (see annexes A, B and C).

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

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

Section 2: Testing and certification of class A compasses

2.1 General

2.1.1 Types of compasses to be tested

Testing shall be carried out on all class A compasses, with or without a transmitting system. All compasses, other than those compasses without gimbals which are used as steering compasses only, shall be tested with their gimbal rings and outer gimbal bearings.

2.1.2 Manufacturer's statement

The manufacturer shall produce a written statement covering those requirements which cannot be ascertained during a type-test (see annex A). The statement shall include the following points:

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

b) that the paint inside the compass is of good quality and that over a period of two years it is not likely to deteriorate to such an extent as to make the compass unusable, either as a result of the change of temperature over the range of − 30 °C to + 60 °C or any other cause (for example the legibility of graduations shall not be impaired by discolouration or blistering);

c) under the conditions described in b), that the compass liquid is not likely to show any appreciable discolouration such as to render the compass unusable;

d) whether toughened or non-toughened glass is used for the top and bottom glass covers and its thickness; alternatively, when a material other than glass is used, that its strength is equivalent to that of non-toughened glass of 4,5 mm thickness;

e) that the material of the compass card will not distort;

f) that the moment of inertia of the directional system is approximately 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 pivot at 20 °C;

i) that the inner and outer bearings of the gimbal rings are of the same type;

j) the length of bar magnets or diameter of ring magnet forming the directional system.

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

2.1.3 Marking

2.1.3.1 Verify that

a) compasses are marked in a conspicuous place on the compass card and the verge ring with the name of the manufacturer, or other means of identification;

b) compass card and gimbal ring are marked with a serial number;

c) the compass verge ring is marked with type and serial number.

2.1.3.2 The markings given in 2.1.3.1 shall be noted on the certificate.

2.1.3.3 If other than alcohol, the type of liquid used shall be indicated on the bowl in the vicinity of the filling plug.

2.2 Compass and gimballing checks and tests

2.2.1 Construction and material

2.2.1.1 Condition of compass bowl

The compass shall be inspected 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.

2.2.1.2 Non-magnetic properties (type-test only)

Compass bowls and gimballing shall be tested to verify their non-magnetic properties (see 2.2.7.4).

2.2.1.3 Condition at high temperature

The compass shall be warmed slowly from room temperature to 60 °C ± 2 °C and kept at least 8 h at this temperature. After this period, the compass

shall not show any mechanical damage, leakage or bubbles. The compass liquid and paint shall not show any deterioration, and the directional system shall not be deformed. The compass shall operate satisfactorily.

The directional system shall always be in contact with its pivot.

2.2.1.4 Condition at low temperature

The compass shall be slowly cooled to $-30\ °C \pm 2\ °C$ and kept at least 8 h at this temperature. After this period the compass shall not show any mechanical damage or deformation, leakage or bubbles. The liquid in the bowl shall not freeze, discolour or separate into its ingredients. A formation of flocks or ice shall not have occurred within the liquid and the directional system shall not be deformed. There shall be no deterioration in the function of the compass.

The directional system shall always be in contact with its pivot.

2.2.1.5 Thickness of top and bottom glass covers (type-test only)

When made of non-toughened glass, the glass covers of compasses (including compasses that have no gimbals outside the bowl) shall have a thickness of at least 4,5 mm.

When toughened glass is used, the thickness shall be at least 3 mm.

When material other than glass is used, its properties shall be at least as strong as above [see 2.1.2 d)].

The thickness of the glass may be measured by means of a micrometer. As this requires the opening of the compass, it shall be done when the other examinations have been carried out.

2.2.1.6 Transmitting system

A transmitting system shall not interfere with reading the card or taking bearings with an azimuth reading device.

2.2.2 Compass gimballing

2.2.2.1 Plane of gimbal axes (type-test only)

The gimbal axes shall lie in one plane, within a tolerance of 1 mm.

This test may be carried out from a fixed horizontal reference plane by means of a suitable scale.

2.2.2.2 Angle of gimbal axes and intersection of vertical planes passing through them (type-test only)

The angle formed by the outer and inner gimbal axes shall be $90° \pm 1°$. The vertical planes through the gimbal axes shall intersect to within 1 mm of the pivot point. Any end play shall not cause these tolerances to be exceeded.

The outer gimbal axis shall be in the fore and aft direction.

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

Determination of the intersection line may be carried out on a test stand by measuring the displacement of the compass support in a direction perpendicular to either of the gimbal axes.

2.2.2.3 Freedom of movement within gimbal ring

When the gimbal ring is in the horizontal plane, the compass bowl shall freely revolve about the inner axis up to $\pm 40°$.

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

2.2.2.4 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 gimbal ring is fixed in a horizontal position. This shall be so whether the azimuth reading device or other attachment or magnifier is in position or not.

Measurement shall be carried out by placing a spirit level of suitable sensitivity on the top glass or its verge ring.

2.2.2.5 Friction of inner gimbal axis

When the gimbal ring is kept in the horizontal position and the compass bowl is inclined by $\pm 5°$, it shall return to within 2° of the horizontal plane.

The test may be carried out by means of a clinometer or spirit level.

2.2.2.6 Inner and outer gimbal bearings (type-test only)

The bearings of the inner and outer gimbal axes shall be of the same type.

2.2.3 Compass bowl

2.2.3.1 Relative bearing ring graduation (if any)

If the standard compass is provided with a scale for the measurement of bearings relative to the ship's head, the scale shall be graduated in 360° clockwise, zero, as seen through the azimuth reading device, indicating the direction of the ship's head.

This graduation shall be checked.

2.2.3.2 Error due to eccentricity of bearing ring graduation

If there is a relative bearing ring, the perpendicular to the plane of this ring, through the graduation centre, shall be within 0,5 mm of the pivot point.

This may be tested when the compass bowl is dismantled by centring the pivot on the test stand, rotating the compass bowl and observing the eccentricity of the relative bearing ring through the test stand telescope.

Alternatively, examination may be carried out on assembled compasses by measuring the graduation diameter and reading the directional error in the test stand. The maximum permissible direction error is given in table 1 as a function of the graduation diameter.

Table 1 — Maximum permissible direction error

Graduation diameter, mm	Maximum permissible direction error, °
115	0,5
142	0,4
190	0,3
280	0,2

2.2.3.3 Accuracy of centring of azimuth reading device (type-test only)

The distance between the rotating axis of the azimuth reading device (bridge type or ring type) and the vertical rotation axis of the compass card, passing through the pivot point, shall not exceed 0,5 mm.

Depending on the construction of the azimuth reading device, the rotation axis may be defined either by an indentation or centre boss on the top glass cover of the compass, or by the centre of the inside or outside of the verge ring, or by the compass bowl outside rim.

The examination may be carried out by measuring, on a compass test stand, the displacement which is necessary to bring the compass pivot point, when horizontal, and the rotation axis of the azimuth reading device, one after the other into coincidence with the rotation axis of the test stand.

2.2.4 Compass card bearing

2.2.4.1 Height of pivot bearing (type-test only)

The pivot point shall not deviate from the horizontal plane through the inner gimbal axis by more than 1 mm. Should the pivot bearing be equipped with a vertical spring suspension, this condition shall be fulfilled when the directional system is completely immersed.

When the compass bowl is opened, this examination may be carried out by using a depth gauge, the compass rim being the reference plane.

2.2.4.2 Protection of directional system against displacement

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

This can be checked by inspection.

2.2.4.3 Freedom of tilt of directional system

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 in any direction at an angle of:

a) 10° when the compass bowl has an external gimbal system;

b) 30° in other cases.

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

2.2.5 Lubber marks

2.2.5.1 Number of lubber marks

Each compass shall be fitted with a lubber mark indicating the direction of the ship's head (main lubber mark). This main lubber mark shall be clearly identifiable and be within 0,5° of the fore and aft gimbal axis.

Other lubber marks are allowed, showing the direction of the ship's stern and thwartship respectively. These lubber marks shall fulfil the conditions laid down in 2.2.5.2 to 2.2.5.4.

2.2.5.2 Visibility of lubber mark(s)

The main lubber mark shall be of such design that the card may be read from the steering position against the lubber mark when the compass bowl is tilted as in 2.2.4.3. In the case of a gimballed compass, the use of a plate lubber line is permitted (see also 2.2.6.1.2).

The examination may be carried out by visual inspection in conjunction with the examination in 2.2.4.3.

2.2.5.3 Width of lubber mark(s)

The width of the lubber mark(s) shall not subtend an angle greater than 0,5° of the card graduation.

The examination may be carried out by visual inspection.

2.2.5.4 Distance between lubber mark(s) and card outer edge

The distance between the lubber mark(s) and the card outer edge shall be between 1,5 mm and 3 mm except in the case of projector compasses, when the tolerance shall be between 0,5 mm and 1,5 mm.

The examination may be carried out by using a mirror gauge which is laid on top of the bowl rim, or by travelling microscope, or by direct measurement when the compass is dismantled.

In the case of hemispherical compasses, this becomes a type-test only and can be ascertained when the compass is dismantled.

2.2.6 Directional system

2.2.6.1 Compass card

2.2.6.1.1 Graduation

The card shall be graduated in 360 single degrees starting from north clockwise as viewed from above. The cardinal points shall be indicated by the capital letters N, S, E and W; the intermediate points may also be marked. Alternatively, the north point may be indicated by a suitable symbol. The card shall be numbered every 10°.

Where the compass card is printed on both sides, the graduations shall coincide with a tolerance of 0,2°.

The examination shall be carried out visually.

2.2.6.1.2 Readability

In steering compasses, the line thickness and the height of the figures and letters shall allow a person with normal vision to read the card both in daylight and in artificial light at a distance of 1,4 m.

For reflecting and projecting compasses, the main lubber mark and at least 15° of the card on either side shall be readable by a person with normal vision at a distance of 1 m from the periscope tube.

The use of a magnifying device is permitted.

The examination shall be carried out visually.

2.2.6.1.3 Relationship of edge of compass card and pivot bearing (type-test only)

When the verge ring and the seating for the azimuth reading device are both horizontal, the card graduated edge, the lubber mark if a point, the pivot point and the outer gimbal axis shall all lie within 1 mm of the horizontal plane passing through the gimbal axis fixed to the compass bowl. This measurement can only be made when the compass bowl is opened. It can be made using a depth gauge from a fixed reference plane.

2.2.6.2 Directional system magnets

2.2.6.2.1 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 any other appropriate means.

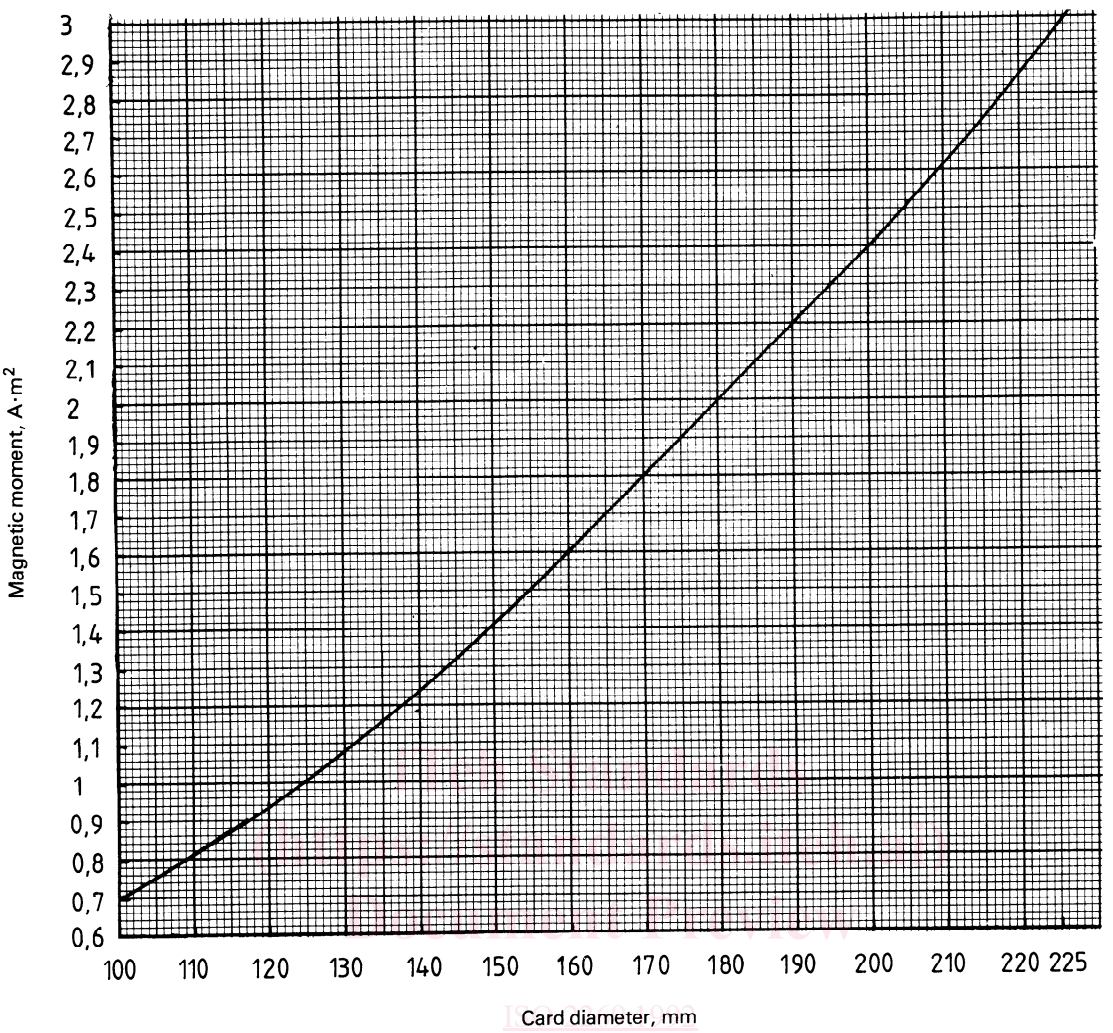

Figure 1 — Magnetic moment of liquid compasses, class A — Minimum requirements

2.2.6.2.2 Arrangement of magnets (type-test only)

The poles of the directional system magnets shall be arranged in such a way that no excess sextantal or octantal deviations will be produced by the influence of the correcting devices. The criterion for this is the ratio of octantal and quadrantal coefficients H/D, and the ratio H/D shall not exceed 0,08.

The test shall be carried by the four corrector method of Meldau, or any other equivalent method.

In the Meldau test, the compass shall be mounted on a stand and two soft iron correctors placed diametrically opposite and symmetrical to the rotation centre. The device with the two soft iron correctors shall then be rotated around the fixed compass and coefficient D calculated.

To cancel out the quadrantal deviation, two additional exactly similar correctors shall be placed at the same distance from the centre with their line of connection at right angles to that of the original pair.

The arrangement of the four soft iron correctors shall then be rotated around the compass and coefficient H calculated.

From these values the ratio of the coefficient H to coefficient D is obtained.

2.2.6.2.3 Coercivity (type-test only)

The magnets used in the directional system shall be of a suitable magnetic material having a high remanence and a high coercivity.

2.2.6.2.4 Change in tilt when vertical flux density has changed (type-test only)

The tilt of the directional system card when balanced and assembled in the bowl shall not exceed: 0,5° in the E-W direction and $(0,5 + 0,03\delta)°$ in the N-S direction, δ being the absolute value of the algebraic difference between the values of the vertical magnetic flux density in microteslas at one location and at any other location.