

Magnetic compasses and binnacles —

**Part 1: Specification for class A
magnetic compasses, their binnacles
and azimuth reading devices (including
test procedures)**

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Foreword

This revision of BS MA 2-1, having been prepared under the direction of the Shipbuilding and Marine Industry Standards Committee, supersedes BS MA 2-1:1969 and BS MA 2-5, BS MA 2-6 and BS MA 2-7 (all published in 1972), which are withdrawn.

This Part specifies requirements and describes test procedures for class A magnetic compasses and their binnacles and azimuth reading devices. During its preparation account has been taken of ISO 2269.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This Part of BS MA 2 specifies requirements for class A magnetic compasses, their binnacles and azimuth reading devices.

NOTE The title of the publication referred to in this standard is given on the inside back cover.

1.2 Definitions

For the purposes of this Part of BS MA 2, the definitions given in BS MA 2-4 apply.

1.3 Test certificates

1.3.1 Type testing shall be carried out before the instruments specified enter regular service. All tests, except those identified as type tests only, apply to individual testing.

New devices only are accepted by type testing. All compasses other than those compasses, without gimbals, which are used as steering compasses only, are to be tested complete with their gimbal rings and outer gimbal bearings.

1.3.2 Devices that have passed type or individual tests and comply with the requirements shall be so certified.

1.3.3 Each type test certificate is valid exclusively for the model tested. In case of alterations or technical improvements, which affect its compliance with this Part of BS MA 2, 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 Appendix A, Appendix B and Appendix C).

1.3.4 Copies of the certificate shall be issued on demand; they shall be explicitly marked "copy".

Section 2. Compasses, bowls and gimbals

2.1 General

2.1.1 Temperature conditions for testing

Testing shall be carried out on all class A magnetic compasses, with or without transmitting system, at a temperature of 20 ± 3 °C, except for the high and low temperature tests (see 2.2.2 and 2.2.3).

The order in which tests are carried out is at the discretion of the testing authority except that 2.2.1, 2.2.2 and 2.2.3 shall be performed first and in that order.

2.1.2 Manufacturer's statement

The manufacturer shall produce a written statement covering those requirements that cannot easily be ascertained during a type test (see Appendix A).

The statement shall contain the following.

- a) The coercivity and magnetic moment of the directional magnets.
- b) An assertion that the paint inside the compass is of such a quality that over a period of 2 years it is not likely to deteriorate to such an extent as to make the compass unserviceable, 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 discoloration or blistering).
- c) An assertion under the conditions described in item b), that the compass liquid will not show discoloration to an extent sufficient to render the compass unserviceable.
- 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) An assertion that the material of the compass card will not distort.
- f) An assertion that the moment of inertia of the directional system is 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) An assertion that the inner and outer bearings of the gimbal rings are of the same type.
- j) The length of the bar magnet or the diameter of the ring magnet forming the directional system.
- k) The diameter of the compass card.

NOTE In order to check that the manufacturer's statement in 2.1.2 has been fulfilled, sample checks may be carried out.

2.1.3 Marking

Compasses shall be marked with the following information which shall be similarly recorded on the test certificate.

- a) The compass card and the verge shall be marked in a conspicuous place with the name of the manufacturer and the verge also marked with the type number.
- b) The compass card, verge and gimbal ring shall be marked with the same serial number.

- c) The type of liquid used shall be indicated on the bowl in the vicinity of the filling plug.

2.2 Construction and materials

2.2.1 Condition of compass bowl

The compass shall be inspected for damage and to ensure its sound mechanical condition. 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.

2.2.2 Condition at high temperature

After the compass is warmed up progressively over a period of at least 1 h from room temperature to $58 \pm 2^\circ\text{C}$ and maintained at this temperature for at least 8 h it 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. There shall be no deterioration in the functioning of the compass.

The directional system shall be in contact with its pivot at all times.

2.2.3 Condition at low temperature

After the compass is cooled down progressively over a period of 1 h from room temperature to $-28 \pm 2^\circ\text{C}$ and maintained at this temperature for at least 8 h it 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. 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 functioning of the compass.

The directional system shall be in contact with its pivot at all times.

2.2.4 Non-magnetic properties

2.2.4.1 Requirement. Compass bowls and gimbaling shall be non-magnetic.

2.2.4.2 Method of test. The test is carried out using the swirl test (see 2.8.4.2) or equivalent.

2.2.5 Thickness of the top and bottom glass covers

2.2.5.1 Requirement. 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 not less than 4.5 mm.

When toughened glass is used, the thickness shall be not less than 3.0 mm.

When material other than glass is used, its properties shall be at least equivalent to that of glass [see 2.1.2 d)].

2.2.5.2 Method of test (type test only). The thickness of the glass is measured using a micrometer. As this requires the opening of the compass, it is done when the other examinations have been completed.

2.2.6 Transmitting system

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

2.3 Gimbaling

2.3.1 Plane of the gimbal axes

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

2.3.1.2 Method of test (type test only). This test is carried out from a fixed horizontal plane of reference by means of a suitable scale.

2.3.2 Angle of the gimbal axes and the intersection of the vertical planes passing through them

2.3.2.1 Requirement. The angle formed by the outer and inner gimbal axes shall be $90 \pm 1^\circ$. 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.

2.3.2.2 Method of test (type test only). The measurement of the angle of the axes is carried out using the graduation of the testing stand, when first one then the other gimbal axis is brought into the vertical plane of view passing through the centre of the graduation, by turning the compass support.

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

2.3.3 Freedom of movement within the gimbal ring

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

2.3.3.2 Method of test. The measurement is carried out using a clinometer placed on the top glass cover or verge ring.

2.3.4 Horizontal position

2.3.4.1 Requirement. 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, whether the azimuth reading device or other attachment or magnifier is in position or not.

2.3.4.2 Method of test. The measurement is carried out by placing a spirit level on the top glass or its verge ring.

2.3.5 Friction of the inner gimbals axis

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

2.3.5.2 Method of test. The test is carried out using a clinometer or spirit level.

2.3.6 Inner and outer gimbals bearings (type test only)

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

2.4 Compass bowl

2.4.1 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 single degrees in a clockwise direction with zero, as seen through the azimuth reading device, indicating the direction of the ship's head.

2.4.2 Error due to eccentricity of the graduation of the bearing ring

2.4.2.1 Requirement. Where a relative bearing ring is fitted, the perpendicular to the plane of this ring, through the centre of the graduations, shall be within 0.5 mm of the pivot point (see Table 1).

Table 1 — Permissible angular error

Diameter of the graduation	Maximum permissible angular error
mm	degrees
115	0.5
142	0.4
190	0.3
280	0.2

2.4.2.2 Method of test. The test is carried out by centring the pivot on the testing stand, rotating the compass bowl and observing the eccentricity of the relative bearing ring through the telescope of the testing stand or by measuring the diameter of the graduation and reading the angular error in the testing stand.

2.4.3 Accuracy of centring of the azimuth reading device

2.4.3.1 Requirement. The distance between the rotating axis of the azimuth reading device (bridge type or ring type) and the vertical axis of rotation 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 axis of rotation shall be defined 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 outside rim of the compass bowl.

2.4.3.2 Method of test (type test only). The examination is carried out by measuring on a compass testing stand the displacement that is necessary to bring the pivot point of the compass, when horizontal, and the axis of rotation of the azimuth reading device, one after the other into coincidence with the axis of rotation of the testing stand.

2.5 Compass card bearing

2.5.1 Height of the pivot bearing

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

2.5.1.2 Method of test (type test only). When the compass bowl is opened, this examination is carried out using a depth gauge, the rim of the compass being the plane of reference.

2.5.2 Retention of the directional system against displacement

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

2.5.3 Freedom of tilt of the directional system

2.5.3.1 Requirement. The directional system and the compass bowl shall be constructed in such a manner that the directional system shall rotate freely when the compass bowl is tilted in any direction at an angle of:

- 10° when the compass bowl has an external gimbals system;
- 30° in other cases.

2.5.3.2 Method of test. The examination is carried out using a revolving platform with adjustable inclination.

2.6 Lubber marks

2.6.1 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.

If other lubber marks are fitted showing the direction of the ship's stern and thwartship respectively, they shall fulfil the conditions specified in 2.6.2 to 2.6.4.

2.6.2 Visibility of lubber mark(s)

2.6.2.1 Requirement. The main lubber mark shall be so designed that the card can be read from the steering position against the lubber mark when the compass bowl is tilted in accordance with 2.5.3.

NOTE In the case of a reflector compass the use of a plate lubber line is permitted.

2.6.2.2 Method of test. The examination is carried out by visual inspection in conjunction with the examination described in 2.5.3.

2.6.3 Width of lubber mark(s)

2.6.3.1 Requirement. The width of the lubber mark(s) shall subtend an angle not greater than 0.5° .

2.6.3.2 Method of test. The examination is carried out by visual inspection.

2.6.4 Distance between lubber mark(s) and outer edge of card

2.6.4.1 Requirement. The distance between the lubber mark and the outer edge of the card shall be between 1.5 mm and 3.0 mm except in the case of projector compasses, where the tolerance shall be between 0.5 mm and 1.5 mm.

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

2.6.4.2 Method of test. The examination is carried out using a mirror gauge that is laid on top of the rim of the bowl, or by travelling microscope, or by direct measurement when the compass is dismantled.

2.7 Directional system

2.7.1 Compass card

2.7.1.1 Graduation

2.7.1.1.1 Requirement. The card shall be graduated in 360 single degrees starting from North in a clockwise direction as viewed from above. The cardinal points shall be indicated by the capital letters N, S, E, and W.

NOTE The intermediate points may also be marked, and the North point may be indicated by a suitable symbol.

The card shall be numbered at intervals of 10° .

Where the compass card is printed on both sides, the graduations shall coincide.

2.7.1.1.2 Method of test. The examination is carried out visually.

2.7.1.2 Readability

2.7.1.2.1 Requirement. In steering compasses, the thickness of the lines and the height of the figures and letters shall enable 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 legible to a person with normal vision at a distance of 1 m from the periscope tube.

2.7.1.2.2 Method of test. The examination is carried out visually.

NOTE The use of a magnifying device is permitted.

2.7.1.3 Relationship of edge of compass card and pivot bearing

2.7.1.3.1 Requirement. When the verge ring and the seating for the azimuth reading device are both horizontal, the graduated edge of the card, 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.

2.7.1.3.2 Method of test (type test only). This measurement can only be made when the compass bowl is opened and is made using a depth gauge from a fixed plane of reference.

2.7.2 Magnets of the directional system

2.7.2.1 Magnetic moment. The magnetic moment of the directional system shall be not less than the values shown in Figure 1.

2.7.2.2 Arrangement of magnets

2.7.2.2.1 Requirement. The poles of the magnets of the directional system shall be arranged in such a manner 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 , which shall not exceed 0.08.

2.7.2.2.2 Method of test (type test only). The test is carried out using the four corrector method of Meldau.