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Ships and marine technology — Marine magnetic compasses, binnacles and azimuth reading devices

Navires et structures maritimes — Compas magnétiques marins, habitacles et alidades

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 25862 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation*.

This first edition of ISO 25862 cancels and replaces ISO 449:1997, ISO 613:2000, ISO 694:2000, ISO 2269:1992 and ISO 10316:1990.

Ships and marine technology — Marine magnetic compasses, binnacles and azimuth reading devices

1 Scope

This International Standard gives requirements regarding construction and performance of marine magnetic compasses for navigation and steering purposes, binnacles and azimuth reading devices.

According to the design of the ship, two types of binnacle are specified.

This International Standard applies to liquid-filled magnetic compasses:

— intended for ship's navigation and steering purpose in sea navigation according to regulations in force;

— having a direct reading system;

— which may be of the reflecting, projecting or transmitting types.

In the context of this International Standard, a magnetic compass is an instrument consisting of a directional system supported by a single pivot inside a bowl which is completely filled with liquid, and which is supported in gimbals inside or outside the bowl. Compasses without gimbals are also covered by this International Standard; the requirements relating to gimbals do not apply to such compasses.

This International Standard applies to

— all ships to which SOLAS applies (ships of gross tonnage $\geqslant$ 150 t, engaged on international voyages and ships of gross tonnage $\geqslant$ 500 t not engaged on international voyages) fitted with class A magnetic compasses,

— all ships to which SOLAS does not apply, fitted with the class A or class B magnetic compasses, and

— lifeboats/rescue boats fitted with a class B magnetic compass (as specified in Annex H).

This International Standard does not apply to:

a) dry card compasses,

b) types of compass designed on principles different from those stated above or not complying with the descriptions given, or

c) hand bearing compasses.

The requirements for the testing and certification, positioning in ships and the deviation adjustment of compasses are given in the Annexes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*

IMO Resolution A.382(X) *Recommendations on performance standards for magnetic compasses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1069 and the following apply.

3.1
magnetic control sensor
sensor using the geomagnetic field for feeding an automatic heading-control system, or controlling an off-course alarm unit, or feeding other devices

3.2
minimum distance
distance measured between the nearest point of magnetic material which is part of the ship's structure and the centre of the compass

NOTE The minimum distance for a standard compass is given in Figure E.1 and for a steering compass is given in Figure E.2.

3.3
safe distance
distance measured between the nearest point of the item concerned and the centre of the compass

NOTE The safe distance is determined as specified in Annex F.

4 Magnetic compasses

4.1 Construction and materials

4.1.1 Magnetic material

The magnets used in the directional systems of magnetic compasses shall be of a suitable magnetic material having a high remanence and coercivity of at least 18 kA/m. All other materials used in magnetic compasses, other than transmitting compasses, shall be of non-magnetic material.

4.1.2 Lubber mark

In class A compasses, the distance between the lubber mark and the outer edge of the card shall be between 1,5 mm and 3,0 mm for direct reading and reflecting types and between 0,5 mm and 1,5 mm for projecting compasses. The width of the lubber mark shall not be greater than 0,5° of the graduation of the card.

In class B compasses, the compass shall be fitted with at least one lubber mark, indicating the direction of the ships head (the main lubber mark). Additional lubber marks are permissible.

The lubber mark shall be of such design as to allow the compass to be read from the steering position when the bowl is tilted 10° in the case of a gimbal compass or 30° in other cases.

4.1.3 Position of the card (class A only)

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 lie within 1 mm of the horizontal plane passing through the gimbal axis fixed to the bowl.

4.1.4 Angle of gimbal axes and intersection of vertical planes passing through them

The angle formed by the outer and inner gimbal axes shall be of the values given in Table 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.

Table 1 — Angle of gimbal axes

Magnetic compasses	Angle of gimbal axes
Class A	$(90 \pm 1)°$
Class B	$(90 \pm 2)°$

The outer gimbal axis shall be in the fore and aft direction. For compasses without gimbals, which are also covered by this International Standard, the requirements relating to gimbals do not apply.

4.1.5 Thickness of the top glass cover (class A only)

The thickness of the top glass cover and of the bottom glass of the compass shall be not less than 4,5 mm, if non-toughened, and not less than 3,0 mm, if toughened. These values apply also to the thickness of the top glass in hemispherical compasses. If material other than glass is used, it shall be of equivalent strength.

4.1.6 Constructional condition within the temperature range

Within the temperature ranges given in Table 2:

a) the compass shall operate satisfactorily;

b) the liquid in the compass bowl shall remain clear and free from bubbles and neither emulsify nor freeze;

c) there shall be neither inward leakage of air nor outward leakage of liquid. No bubble shall form in a compass unless it is specially provided to compensate for expansion;

NOTE A bubble provided in a compass to compensate for expansion shall not inconvenience the functioning and reading of the compass.

d) the internal paint shall not blister, crack or discolour appreciably;

e) for class A compasses, that the force exerted on the pivot bearing, in the liquid at 20 °C, by the directional system is between 0,04 N and 0,1 N when the card diameter is 165 mm or less, and is between 0,04 N and 0,14 N when the card diameter is larger than 165 mm;

f) for class B compasses, the supporting force shall be such that the directional system always remains in contact with its pivot;

g) the material of the compass card shall not distort.

Table 2 — Temperature range

Magnetic compasses	Temperature ranges
Class A	−30 °C to +60 °C
Class B	−20 °C to +60 °C

4.1.7 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 magnifying glass is in place or not.

4.2 Mounting

4.2.1 Tilt of supporting device

The bowl of the compass shall be mounted so that the verge ring remains horizontal to within 2° when the binnacle is tilted 40° in class A, 30° in class B in any direction and in such a manner that the compass cannot be dislodged under any conditions of sea or weather.

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

4.2.2 Freedom of the card of the compass with no supporting gimbal

In compasses in which no supporting gimbal is provided, the freedom of the card shall be 30° in all directions.

4.3 Directional system

4.3.1 Moment of inertia

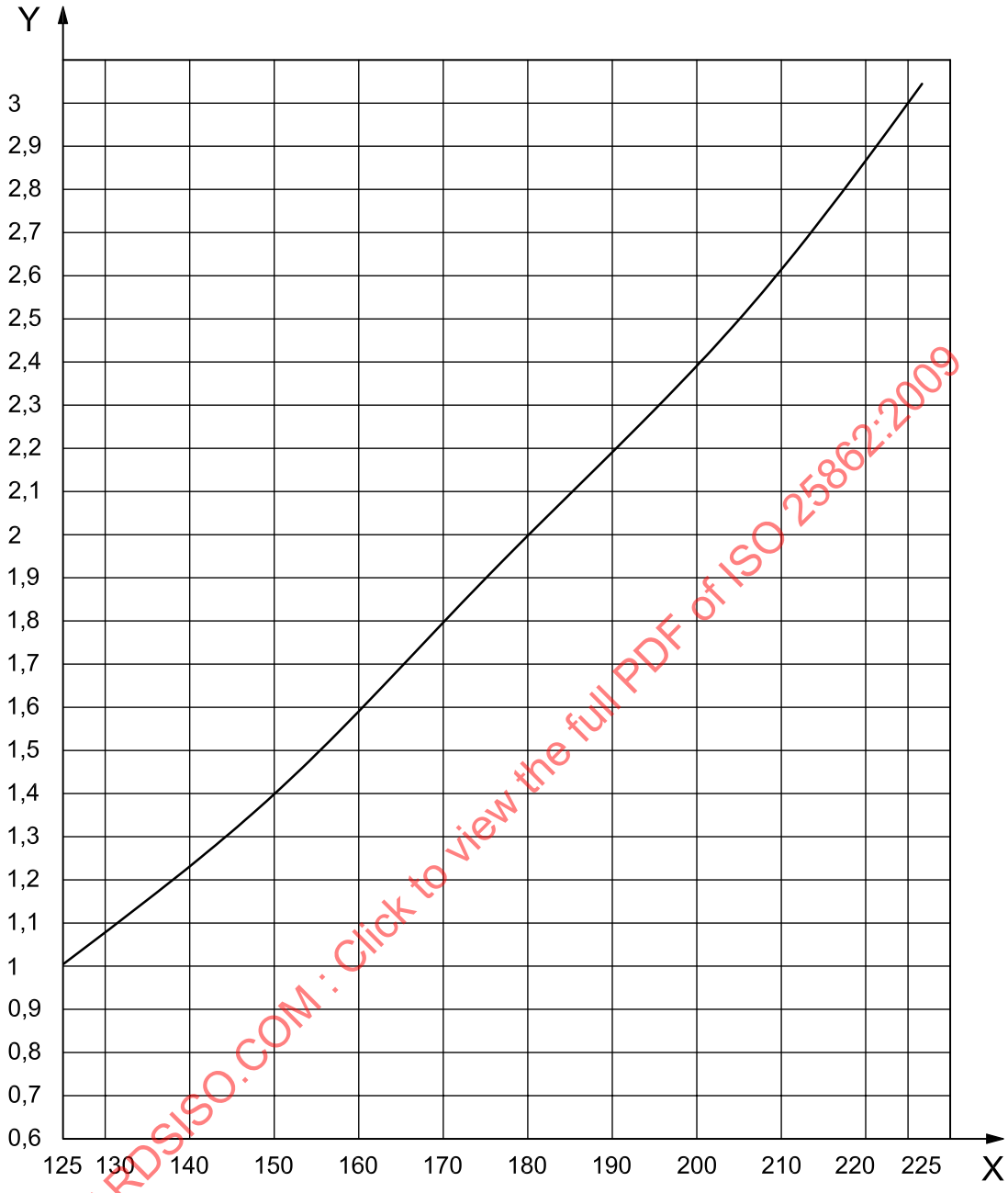
The moment of inertia of the directional system shall be approximately the same about all horizontal axes passing through the point of support on the pivot jewel.

4.3.2 Suspension (class A only)

The directional system shall be retained in position by suitable means and remain free when the bowl is tilted 10° in any direction.

4.3.3 Magnetic moment (class A only)

The magnetic moment of the magnets in the directional system shall not be less than the value given in Figure 1.



Key

X card diameter, expressed in mm

Y magnetic moments, expressed in $A \cdot m^2$

Figure 1 — Magnetic moments of liquid filled compasses (minimum requirements)

4.3.4 Settling time

Following an initial deflection of the card of 90° from the magnetic meridian, the time taken to return finally to within 1° of the magnetic meridian shall not exceed $240/\sqrt{H}$ at a temperature of (20 ± 3) °C, where H is the horizontal component of the magnetic flux density in microteslas (μT) at the place of testing.

4.3.5 Tilt of the directional system with regard to the vertical field (class A only)

The directional system shall be so constructed, or balanced in such a way, that it does not incline more than 0,5° from the horizontal plane when the vertical flux density is zero. The inclination shall not change by more than 3° when the vertical flux density changes 100 μT.

4.3.6 Supporting force (class A only)

The force exerted on the pivot bearing, in the liquid used, by the directional system shall be between 0,04 N and 0,1 N when the card diameter is 165 mm or less, and shall be between 0,04 N and 0,14 N when the card diameter is larger than 165 mm.

4.4 Compass card

4.4.1 Graduation

The compass card shall be graduated with 360 single degrees, starting from North in the clockwise direction as viewed from above. Each tenth degree should be marked with the three corresponding numbers. North should also be indicated by “000°”. 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 as given in Table 3.

Table 3 — Graduation of the card

Magnetic compasses	Equal interval of the graduation	Card numbered
Class A	1°	Every 10°
Class B	Not more than 5°	Every 30°

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

4.4.2 Diameter of the card

The diameter of the compass card for binnacles of the following types are as given in Table 4.

Table 4 — Diameter of the card

Magnetic compasses	Binnacle types	Diameter of the card
Class A	A1	165 mm or more
	A2	125 mm or more
Class B	A1	125 mm or more
	A2	

NOTE 1 Binnacle type A1 (see 5.1) is defined as the height of the binnacle being not less than 1 m; if the height of the binnacle is less than 1 m, it is binnacle type A2 (see 5.2).

NOTE 2 Diameter of the card of the magnetic compass for lifeboat/rescue boats is given in H.2.1.

4.4.3 Readability

Steering compasses of each class shall be able to be read by a person with normal vision at a distance from the magnetic compasses as given in Table 5 in both daylight and artificial light, the graduations on the card being contained within a sector whose width is not less than 15° to each side of the lubber mark. The use of a magnifying glass is permitted.

For reflecting and projecting compasses, the lubber mark shall be visible and the 30° sector of the card shall be readable by a person with normal vision at a distance of 1 m from the periscope tube.

Table 5 — Readable distance

Magnetic compasses	Readable distance of compasses
Class A	1,4 m
Class B	1,0 m

4.4.4 Bearing compasses

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

4.5 Accuracy

4.5.1 Directional error

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

a) error of magnet orientation with regard to the graduation of the card (collimation error);

b) inaccuracies of the compass card graduation;

c) eccentricity of the compass card graduation with regard to the rotation centre of the card.

The directional error shall on no heading exceed the values as given in Table 6.

Table 6 — Accuracy of the directional errors

Magnetic compasses	Permissible directional error
Class A	0,5°
Class B	1,5°

In transmitting compasses, the directional error applies to the compass without fluxgate. The fluxgate of a transmitting compass shall be placed so that the influence on the card heading shall not exceed 0,5° in the case of class A.

NOTE If the test is undertaken in the compass bowl, the resulting value then includes the deviation due to any magnetic material in the compass and/or in the fluxgate.

4.5.2 Error of lubber marks

Lubber error is a constructional error of the compass bowl and gimbal, 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.

No lubber error shall exceed the values given in Table 7.

Table 7 — Lubber errors

Magnetic compasses	Maximum lubber error
Class A	0,5°
Class B	1,0°

4.5.3 Error due to friction

With the compass at a temperature of (20 ± 3) °C, the card is given an initial deflection (for values see Table 8) first on one side of the meridian and then on the other. It shall return to its original position within the values given in Table 8, where H is as defined in 4.3.4.

Table 8 — Error due to friction

Magnetic compasses	Initial deflection	Maximum angle to return
Class A	2°	Less than $(3/H)$°
Class B	5°	Less than $(9/H)$°

4.5.4 Swirl error

With the compass at a temperature of (20 ± 3) °C and rotating at a uniform rotational speed of 6°/s in the horizontal plane, the card deflection from the magnetic meridian when the bowl has been rotated 180° shall not exceed the values given in Table 9.

Alternatively, when rotating at a uniform rotational speed of 1,5°/s, the card deflection, measured after the bowl has been rotated 360°, shall at no point exceed the values given in Table 9, where H is as defined in 4.3.4.

Table 9 — Swirl error

Magnetic compasses		Card deflection	
		Rotational speed: 6°/s measured after rotated 180°	Rotational speed: 1,5°/s measured after rotated 360°
Class A	With a card 200 mm or more in diameter	$(108/H)$°	$(54/H)$°
	With a card less than 200 mm in diameter		$(36/H)$°
Class B			$(40/H)$°

4.5.5 Induction error (class A only)

To avoid the induction error which is caused by an inadequate arrangement of magnetic elements in the directional system and introduced by magnetic induction in correctors (iron spheres or similar conventional correctors) of coefficient D due to the magnetic elements in the directional system, one of the following requirements shall be fulfilled:

a) The value of the ratio of coefficient H to coefficient D shall not exceed 0,08.

b) The coefficient F of the sextantal deviation caused by a small magnet, less than 50 mm in length, placed in the same horizontal plane as the magnetic elements at a tangential distance of about 40 cm from the centre of the directional system, is less than 0,01 of coefficient B of the semicircular deviation.

4.5.6 Mounting error of azimuth reading device

Where the azimuth reading device is pivoted on the compass bowl, the vertical axis of the device shall be within 0,5 mm of the pivot point.

4.5.7 Error due to eccentricity of the verge ring (class A only)

If the verge ring is graduated, the perpendicular to the plane of this ring through the centre of the graduations shall be within 0,5 mm of the pivot point.

4.6 Environmental conditions tests of magnetic compasses (class A only)

Damp heat test and rain and spray tests shall be carried out as specified in IEC 60945 and all requirements shall be met.

Optionally, the vibration test may be additionally carried out as specified in IEC 60945.

NOTE Environmental conditions tests of the magnetic compass for lifeboat/rescue boats are given in H.2.3.

5 Binnacles

Depending on the type of ship on which it shall be fixed, one of two types of binnacle may be used: type A1 or type A2. The characteristics of the two types are as specified in 5.1 and 5.2.

Magnetic compasses and binnacles are combined to be used as given in Table 10.

Table 10 — Types of binnacles

Magnetic compasses	Binnacles	
Class A	Type A1	Type A2
Class B	Type A1	Type A2

5.1 Binnacle type A1

Binnacle type A1 shall be of such a height that the magnets of the directional system of the compass are at least 1,0 m above the under-surface of the binnacle deck fittings and meet the requirements given in 5.1.1 to 5.1.5.

5.1.1 Construction and materials

5.1.1.1 Only high quality non-magnetic materials of sufficient strength shall be used for the construction of binnacles, helmet and box, brackets and holding-down bolts.

5.1.1.2 Provision shall be made in the binnacle to allow correction of any misalignment thereof in respect of the fore and aft line of the ship, by an angle of not less than 4° and not more than 6°.

5.1.2 Provision for correction of deviation (if fitted in class B compasses)

5.1.2.1 Material

Where corrector magnets are used, they shall be of a suitable magnetic material of high remanence and coercivity of not less than 11,2 kA/m.

Material used for correcting induced fields shall have a high permeability, a low coercivity and a negligible remanence.

Built-in magnets must be capable of being put into a neutral position or be removable. Built-in magnets for B and C correction must not produce a heeling error.

5.1.2.2 Compensation for horizontal permanent magnetism

Binnacles shall contain a device for correcting the deviation due to the horizontal components of the ship's permanent magnetism. This device shall be capable of correcting a coefficient B of up to at least (720/H)° and a coefficient C of up to at least (720/H)°, where H is as defined in 4.3.4.

Provision shall be made in binnacles so that no magnets of the correcting system come so close to the directional system as to distort the field and produce a deviation of more than (20/H)° on any course, even when there is a heel or pitch of 15°.

5.1.2.3 Correction for heeling error

Binnacles shall contain a device for correcting heeling error. This device shall be adjustable and capable of providing a vertical magnetic field at the magnets of the directional system over the range +75 μT to −75 μT.

Provision shall be made in binnacles so that no magnets of the correcting system come so close to the directional system as to distort the field and produce a deviation of more than (20/H)° expected heeling errors on any course, even when there is a heel or pitch of 15°, where H is as defined in 4.3.4.

5.1.2.4 Compensation for horizontal induced fields due to the horizontal component of the earth's magnetic field in the soft iron in a ship

Binnacles shall be provided with a device for compensating the horizontal magnetic fields due to induction caused by the horizontal component of the earth's magnetic field in the soft iron in a ship. This device shall be capable of correcting a coefficient D of up to 10°.

When binnacles are vertical, and compensation is effected by spheres, the centre of the device shall not be further than 15 mm from the horizontal plane passing through the magnetic element of the directional system.

5.1.2.5 Compensation for horizontal induced fields due to the vertical component of the earth's magnetic field in the soft iron in a ship

Binnacles shall be provided with a device for compensating the horizontal magnetic fields due to induction caused by the vertical component of the earth's magnetic fields in the soft iron in a ship. When a Flinders' bar is used, it may be hollow, provided the diameter of the hole does not exceed 40 % of the diameter of the bar.

When binnacles are vertical, the magnetic pole of the compensating device shall lie in the same horizontal plane as the centres of the magnets of the directional system. When a Flinders' bar is used, its magnetic pole shall be taken at 1/12 of its length from the end.

5.1.2.6 Positions and attachment of correcting devices

Provision shall be made in binnacles for recording the positions of the correcting devices referred to in 5.1.2.2, 5.1.2.3 and 5.1.2.4.

Provision shall be made for all correcting devices to be satisfactorily secured after adjustment.

5.1.2.7 Corrector coils

Provision may be made for the fitting of corrector coils to provide compensation, if the ship is fitted with degaussing coils.

5.1.3 Accuracy of fore and aft marks

Where fore and aft marks are provided on binnacles, they shall be in the same vertical plane to within 0,5° as the axis of the fore and aft gimbal bearings.

5.1.4 Illumination

The binnacle shall contain adequate provision for illuminating the card and the lubber mark by the ship's electric supply and from an emergency light source.

In projector and reflector binnacles these shall provide a clear image at the helmsman's position.

A device shall be provided for dimming the electric light from the ship's mains.

The electric lamps, fittings and wirings shall have no influence on the directional system.

5.1.5 Other requirements

Binnacles shall satisfy the following tests specified in IEC 60945 (Ed.4, 2001-02).

1) damp heat,

2) corrosion (salt mist).

5.2 Binnacle type A2

This binnacle is used in sea navigation when the design of the ship makes the provision of a full-sized binnacle impracticable.

With regard to height, there are no requirements provided that binnacles meet the following requirements.

5.2.1 Construction and materials

Only high quality non-magnetic material of sufficient strength shall be used.

5.2.2 Provision for correction of deviation

5.2.2.1 Material

Where correcting magnets are used they shall be of suitable magnetic material of high remanence and coercivity not less than 11,2 kA/m. Material used for correcting induced fields shall have a high permeability, a low coercivity and a low remanence.

5.2.2.2 Compensation for horizontal permanent magnetism

Binnacles shall contain a device for correcting the deviation due to the horizontal components of the ship's permanent magnetism. This device shall be capable of correcting a coefficient B of up to at least (720/H)° and a coefficient C of up to at least (720/H)°, where H is as defined in 4.3.4.

Provision shall be made in binnacles so that no magnets of the correcting system come so close to the directional system as to distort the field and produce a deviation of more than (40/H)° on any course, even when there is a heel or pitch of 15°.

5.2.2.3 Correction for heeling error

Binnacles shall contain a device for correcting the heeling error. This device shall be adjustable and capable of providing a vertical field at the position of the directional system over the range of +75 μT to −75 μT.

Provision shall be made in binnacles so that no magnets of the correcting system come so close to the directional system as to distort the field and produce a deviation of more than (80/H)° on any course, even when there is a heel or pitch of 15°, where H is as defined in 4.3.4.

NOTE The magnetic fields produced by the devices referred to in 5.2.2.2 and 5.2.2.3 shall be as uniform as possible in the space swept by the directional system and should in no case introduce a significant sextantal error.

5.2.2.4 Compensation for horizontal induced fields due to the horizontal component of the earth's magnetic field in the soft iron of the ship

Binnacles may be provided with a device for compensating the horizontal magnetic fields due to induction caused by the horizontal component of the earth's magnetic field in the soft iron of the ship. This device shall be capable of correcting a coefficient D of up to 7°.

When binnacles are vertical and compensation is effected by spheres, the centre of the device shall not be further than 15 mm from the horizontal plane passing through the magnetic element of the directional system.

5.2.2.5 Compensation for horizontal induced fields due to the vertical component of the Earth's magnetic field in the soft iron of the ship

Binnacles may be provided with a device for compensating the horizontal magnetic fields to the induction caused by the vertical component of the Earth's magnetic field in the soft iron of the ship. When a Flinders' bar is used, it may be hollow, provided that the diameter of the hole does not exceed 40 % of the diameter of the bar.

When binnacles are vertical, the magnetic pole of the device shall lie in the same horizontal plane as the centres of the magnets of the directional system. When a Flinders' bar is used, its magnetic pole shall be taken at 1/12 of its length from the end.

The distance between the vertical axis of a Flinders' bar from the centre of the card shall be at least 3,5 times the length of the magnetic needles.

5.2.2.6 Attachment of correcting devices

Provision shall be made for all correcting devices to be satisfactorily secured after adjustment.

5.2.3 Accuracy of fore and aft marks

In order that the mounting may be undertaken accurately, fore and aft marks shall be provided and these shall be within 0,5° (1,0° in class B) of the fore and aft axis of the gimbal bearings.

5.2.4 Illumination

The binnacle shall contain adequate provision for illuminating the card by the ship's electric supply and from an emergency light source. In projector and reflector binnacles, these shall provide a clear image at the helmsman's position. A device shall be provided for dimming the electric light from the ship's mains.

The electric lamps, fitting and wiring shall have no influence on the directional system.

5.2.5 Other requirements (class A only)

Binnacles shall satisfy the following tests specified in IEC 60945:

a) damp heat;

b) corrosion (salt mist).

6 Azimuth reading devices (class A and, if fitted, class B)

There shall be an appropriate azimuth reading device for the bearing compass. Types A1 and A2 binnacles may be supplied with a suitable pelorus which may be fitted away from the binnacle.

6.1 Azimuth sight

The field of vision shall be at least 5° on each side of the line of sight and it shall be possible to take azimuths of celestial bodies and bearings of distant objects whose altitudes are between 5° below and 60° (10° in class B) above the horizontal.

The required accuracy of the azimuth shall be fulfilled with the group of azimuth reading devices described in Annex C in the altitude range of 5° above to 50° above.

6.2 Azimuth reading devices with vanes

It shall be possible to take bearings of distant objects whose altitudes are between 5° below and 30° above the horizontal.

6.3 Level

A level shall be provided for azimuth mirror or prism instruments.

This level shall be of accuracy within 1°.

7 Marking

The following parts shall be marked with the information, in the position indicated, given in Table 11.

Table 11 — Marking requirements

Part	Position of manufacturer's name or other means of type identification	Position of serial number on the part
Magnetic compasses	Card Verge ring	Card Verge ring Gimbal ring or rings
Binnacle	Any conventional position, together with type marking	Not required
Azimuth reading device	On top of the azimuth reading devices	On top of the azimuth reading devices

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

The marking shall be noted on the type-test certificate (see Annex D).

8 Designation

Magnetic compasses stated as complying with this International Standard shall be designated by the following indications, in the order given:

— type of compass (reflector, projector, transmitting);

— number of this International Standard;

— type of binnacle;

— card diameter, in millimetres.

EXAMPLE Reflector magnetic compass, class A with binnacle type A2 and a card diameter of 180 mm is designated: Reflector magnetic compass ISO 25862 - A2 - 180.

Annex A
(normative)

General testing and certification of marine magnetic compasses, binnacles and azimuth reading devices

A.1 Introduction

This Annex gives general information about the testing and certifications on marine magnetic compasses, azimuth reading devices and binnacles.

The testing and certification of:

— magnetic compasses are as specified in Annex B;

— azimuth reading devices are as specified in Annex C;

— binnacles are as specified in Annex D.

A.2 Scope of testing

Annexes B, C and D specify type-test and individual test methods, and give the acceptable limits of the characteristics necessary to state conformity of magnetic compasses, azimuth reading devices and binnacles to the general specifications given in this International Standard.

A.3 Types of compasses to be tested

Testing shall be carried out on all class A and class B marine magnetic 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.

A.4 Test conditions

Type-testing shall be carried out before the instruments covered come into regular service. Type-testing is acceptable only for new devices.

Individual testing shall be carried out before installation on-board ship; it should also be done 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 ± 3) °C.

A.5 Certification

Devices which have passed the type-tests or the individual tests and comply with the requirements shall be 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 this International Standard, 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 the certificate form in the last part of Annexes B, C and D).

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.

Annex B
(normative)

Testing and certification of marine magnetic compasses

B.1 Manufacturer's statement

The manufacturer shall produce a written statement covering those requirements which cannot be ascertained during a type-test (see B.4). 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 or 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.

B.2 Marking

Verify that the markings are as given in Table 11.

B.3 Compass and gimballing checks and tests

B.3.1 Construction and material

B.3.1.1 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.

B.3.1.2 Non-magnetic properties (type-test only)

Since the manufacturers have given a guarantee declaration, only sample checks are necessary.

Compass bowls and gimballing shall be tested to verify their non-magnetic properties.

B.3.1.3 Condition at high temperature

The compass shall be warmed slowly from room temperature to (60 ± 2) °C and maintained 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 paint shall not show any deterioration, and the directional system shall not be deformed. The compass shall operate satisfactorily, and shall meet the requirements of 4.1.6.

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

B.3.1.4 Condition at low temperature

Class A compasses shall be slowly cooled to (-30 ± 2) °C. Class B compasses shall be slowly cooled to (-20 ± 2) °C. In either case they shall be maintained 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 freeze or discolour nor shall its ingredients separate. 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, and it shall meet the requirements of 4.1.6.

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

B.3.1.5 Thickness of top and bottom glass covers (type-test only)

The thickness of top and bottom glass covers, measured by means of a micrometer, shall meet the requirement of 4.1.5. As this requires opening the compass, it shall be done when the other examinations have been carried out.

B.3.1.6 Transmitting system

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

B.3.2 Compass gimballing

B.3.2.1 Plane of gimbal axes (type-test only)

Inspect the gimbal axes. They shall lie in one plane, within a tolerance of 1 mm, as specified 4.1.4.

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

B.3.2.2 Angle of gimbal axes and intersection of vertical planes passing through them (type-test only)

Measurement of the axes angles may be made by means of the test stand graduation, whereby 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.

The test results shall meet the requirements of 4.1.4.

B.3.2.3 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. The measurement may be carried out by a clinometer placed on the top glass cover or verge ring. The test result shall meet the requirement of 4.2.1.

B.3.2.4 Horizontal position

The compass bowl shall be balanced so that its verge ring or top glass cover settles in the horizontal plane 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 and the result shall meet the requirement of 4.1.7.

B.3.2.5 Friction of inner gimbal axis

When the gimbal ring is kept in the horizontal position and the compass bowl is inclined by ± 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.

B.3.2.6 Inner and outer gimbal bearings (type-test only)

The bearings of the inner and outer gimbal axes shall be of the same type; a visual check shall be carried out.

B.3.3 Compass bowl

B.3.3.1 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 360° clockwise, zero, as seen through the azimuth reading device, indicating the direction of the ship's head.

This graduation shall be checked.

B.3.3.2 Error due to eccentricity of bearing ring graduation (if any 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 B.1 as a function of the graduation diameter.

Table B.1 — Maximum permissible direction error

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

B.3.3.3 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 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.

B.3.4 Compass card bearing

B.3.4.1 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. In cases where the pivot bearing is 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.

B.3.4.2 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.

B.3.4.3 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, then return to its normal position, when the compass bowl is tilted in any direction at the following angles:

a) 10° when the compass bowl has an external gimbal system, and meets the requirements specified in 4.3.2;

b) 30° in other cases, and meets the requirements in 4.2.2.

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

B.3.5 Lubber marks

B.3.5.1 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 athwartship, respectively. These lubber marks shall fulfil the requirements specified in 4.1.2.

B.3.5.2 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 specified in 4.1.2. In the case of a gimballed compass, the use of a plate lubber line is permitted (see also 4.4.3).

The examination may be carried out by visual inspection in conjunction with the examination in 4.1.2.

B.3.5.3 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.

NOTE The width of the lubber mark(s) of the magnetic compass for lifeboat/rescue boats are specified in H.2.2.

B.3.5.4 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.

B.3.6 Directional system

B.3.6.1 Compass card

B.3.6.1.1 Graduation

The card shall be graduated with 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”; the intermediate points may also be marked. Alternatively, the north point may be indicated by a suitable symbol. The card shall be numbered as given in Table 3.

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.

B.3.6.1.2 Diameter of the card

Visually inspect the diameter of the compass card for the binnacle; the results shall meet the requirements of 4.4.2.

B.3.6.1.3 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.

For reflecting and projecting compasses, the main lubber mark shall be checked.

The use of a magnifying device is permitted.

The examination shall be carried out visually.

The results shall meet the requirements of 4.4.3.

B.3.6.1.4 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.

B.3.6.2 Directional system magnets

B.3.6.2.1 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.

B.3.6.2.2 Induction error (type-test only)

a) 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 out by the Meldau four-corrector method, or any other equivalent method.

   When testing using the Meldau method, 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.

   The test result shall meet the requirement of 4.5.5 a).

b) The coefficient F of the sextantal deviation caused by a small magnet, less than 50 mm in length, placed in the same horizontal plane as the magnetic elements at a tangential distance of about 400 mm from the centre of the directional system, is less than 0,01 of coefficient B of the semicircular deviation.

   The test result shall meet the requirement of 4.5.5 b).

B.3.6.2.3 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.

B.3.6.2.4 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 $(0{,}5 \pm 0{,}03\ \delta)°$ in the N-S direction, where δ is 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.

The test shall be carried out with liquid-filled compasses of the conventional type when the bowl is dismantled or by means of a suitable optical device when closed. In the case of other compasses, the test may be carried out when the bowl is dismantled.

B.3.6.3 Settling time

Following an initial deflection of the card of 90° from the magnetic meridian, the time taken to return finally to within 1° of the magnetic meridian shall not exceed the values required in 4.3.4.

This is repeated on the other side of the meridian and the mean is taken.

B.3.7 Accuracy

B.3.7.1 Directional error

The directional error shall be measured as specified in this subclause. The results shall meet the requirements of 4.5.1.

The examination may be carried out on a compass test stand. After having brought the rotation centre of the compass card into the rotation axis of the test stand, the directional error can be read at the card graduation by means of a telescope or any other appropriate means, when the vertical plane of the sight passing through the rotation axis has been aligned with the magnetic meridian in advance. This measurement shall be carried out on at least four equidistant headings. When measuring, the top glass shall be tapped gently to eliminate the error due to friction (see 4.5.3).

In transmitting compasses the directional error applies to the compass without fluxgate. The fluxgate of a transmitting compass shall be placed so that the influence on the card heading shall meet the values in 4.5.1.

NOTE If the test is undertaken in the compass bowl, the resulting value then includes the deviation due to any magnetic material in the compass and/or in the fluxgate.

B.3.7.2 Error of lubber marks

Lubber error is a constructional error of the compass bowl and gimbal, 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.

For compasses with a movable lubber mark, but with an auxiliary graduation for coefficient A correction, 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.

Lubber error shall meet the values in 4.5.2.

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 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 plane of view passing through the rotation centre of the test stand and reading the master graduation vernier. After this, the pivot point shall be brought into the rotation centre of the test stand and the compass support turned until the lubber mark lies in the vertical plane of view.

The angle of rotation is the lubber error.

B.3.7.3 Error due to friction

When the card is given an initial deflection of 2°, first on one side of the meridian and then on the other, it shall return to within the value in 4.5.3 of its original position.

The test shall be carried out by deflecting the card 2°, keeping it in this position for at least 10 s and releasing it. The test shall be repeated by deflecting the card on the other side of the meridian. The larger of the two 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.

B.3.7.4 Swirl error

With the compass rotating at a uniform rotational frequency of 6°/s in the horizontal plane, the card deflection when the bowl has been rotated 180° shall meet a value in 4.5.4 from the magnetic meridian.

Alternatively, when rotating at a uniform rotational frequency of 1,5°/s, the card deflection, measured after the bowl has been rotated 360°, shall at no point exceed the values given in Table 9.

The observation shall start after the compass has been rotated 360°. After having given the compass liquid a suitable time to settle, the measurement shall be repeated by rotating the compass in the opposite direction. The average of the values obtained shall be taken to be the swirl error of the compass.

Any irregularity noted in the movement of the directional system during the test in excess of $(9/H)°$ should be investigated. The cause of the irregularity may be:

a) friction of the pivot;

b) magnetic material contained in the compass.

In order to determine the cause, a friction test may be carried out on the heading(s) where the irregularity occurs. If the result of this test is satisfactory, a test for magnetic material may then be carried out by obtaining a deviation curve. This will indicate whether there is any magnetic material in the compass.

B.3.7.5 Environmental condition test of magnetic compasses (class A only)

Damp heat test, vibration test and rain and spray test shall be carried out in accordance with the methods of testing and required test results specified in IEC 60945. All requirements shall be met.

B.4 Test certificate

The test certificate for compasses is as follows.

Type-test and individual test certificate for compasses

[NAME OF TEST ESTABLISHMENT]

Type / Individual *) No.: .....

Test of class A / class B *) compass with / without *) fluxgate or other transmitting element(s) to ISO 25862.

Manufacturer: .....

Name of compass and gimbal: .....

Serial number of compass and gimbal: .....

Name of transmitting system: .....

Serial number of transmitting system: .....

Manufacturer's statement and signature below.

Test of compass without transmitting system

The above numbered magnetic compass has been tested and found to comply with ISO 25862.

The following test clauses have been omitted: Nos.: .....

.....

Test of compass with transmitting system

The above numbered magnetic compass and the above numbered transmitting system have been tested together and found to comply with ISO 25862.

The following test clauses have been omitted: Nos.: .....

.....

Signature of the manufacturer or his representative: .....

Place of issue: .....

Country: .....

Date: .....

*) Delete as applicable.

Statement of manufacturer or importer

a) The coercivity and magnetic moment of the directional magnets are:

coercivity: ..... A/m

magnetic moment: ..... $A \cdot m^2$

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

c) Under the conditions described in b) the compass liquid is not likely to show any appreciable discolouration such as to render the compass unusable.

d) Toughened / Non-toughened *) glass is used for the top and bottom glass covers with a thickness of

top glass ..... mm.

bottom glass ..... mm.

Glass is not used ..... is used with a thickness of ..... mm.

The strength of this material is equivalent to non-toughened glass .....mm thick.

e) The material of the compass card will not distort.

f) 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 is ..... mm.

h) The supporting force on the pivot at 20 °C is .....N.

i) The inner and outer bearings of the gimbal rings are of the same type.

j) The length of the bar magnets / The diameter of the ring magnet *) forming the directional system is ..... mm.

k) The ratio of the distance between the vertical axis of a Flinders' bar and the centre of the card to the length of the magnetic needles is ..... times.

Signature: ..... Date: .....

Company stamp:

*) Delete as applicable.

Annex C
(normative)

Testing and certification of azimuth reading devices

C.1 General

C.1.1 Groups of azimuth devices to be tested

There are three different groups of azimuth reading devices to be tested.

Group I: Sights or telescope-sights, which require exact aiming at distant objects.

Group II: Azimuth mirror or prism instruments — Thomson type, which do not require exact aiming and from which bearings may be obtained of diminished accuracy at small angles of yaw up to 5°.

Group III: Pelorus, which is mounted away from the binnacle and is used with A2 binnacles, where the size of the binnacle or its position in the ship is difficult to take bearings.

Group I and II azimuth reading devices shall only be accepted for type-testing in connection with a suitable compass.

The requirements and test methods are different for two groups (see C.2.5.1 and C.2.5.2).

C.1.2 Manufacturer's statement for azimuth reading devices

The manufacturer shall note, on a separate certificate for azimuth reading devices, his name, and the type and serial number together with the type and card diameter of the compass to which the azimuth reading device belongs.

Azimuth reading devices shall be clearly marked with the manufacturer's name, type and serial number. Such markings shall also be indicated on the certificate.

C.2 Azimuth reading device checks and tests

C.2.1 Material

All parts of azimuth reading devices shall be manufactured from non-magnetic material.

This shall be tested by exposing the azimuth reading device to a flux density of 2 mT along its longitudinal, transverse and perpendicular axes consecutively. After each exposure, the azimuth reading device shall be placed on the compass to which it belongs. When the device is slowly turned on the compass, no discernible deviation of the directional system shall occur.

C.2.2 Mounting upon compass

The azimuth reading device shall easily rotate on the compass to which it belongs. No lateral movement which causes a difference in the reading of more than 0,2° shall be possible.

The examination may be carried out by using the card or verge ring graduation of the compass.

C.2.3 Adjustment of spirit level

A spirit level shall be fitted to Group II azimuth reading devices and shall be adjusted in such a way that its zero position indicates the horizontal position of the compass top glass or verge ring within a tolerance of 1°. The use of adjusting screws is allowed.

The examination may be carried out by comparing the spirit level of the azimuth reading device with a calibrated spirit level placed on the top glass or verge ring.

C.2.4 Field of view and range of altitude (type-test only)

C.2.4.1 The field of view of an azimuth reading device shall be at least 5° in the horizontal plane on each side of the line of sight.

The examination may be carried out by means of the compass card or verge ring graduations.

C.2.4.2 The altitude range covered by an azimuth reading device shall be at least as follows:

— Group I: 5° below to 30° above the horizon;

— Group II and III: 5° below to 60° above the horizon.

The examination may be carried out by means of fixed angle marks on a plumb line or an illuminated vertical slit.

C.2.5 Accuracy

C.2.5.1 Sights or telescope-sights (group I)

C.2.5.1.1 Parallelism of vanes

The vertical bearing thread of the object vane and the slit of the eye vane shall be parallel to each other.

The examination shall be carried out by observation.

C.2.5.1.2 Perpendicularity of vanes upon base

The plane of sight defined by the object and eye vanes shall be perpendicular to the top glass or to the verge ring of the compass, respectively. In addition, the plane of sight shall pass through the rotation axis of the azimuth reading device and shall contain the horizontal bearing thread for card bearings, as well as the index mark for bearings relative to the ship's head on the verge ring graduation.

The examination for perpendicularity of the vanes may be carried out by viewing a plumb line or an illuminated vertical slit and by reading the bearing on the graduation. Then the sight shall be turned exactly 180° and viewed again through it in the reverse direction. If the object is still parallel with the vanes and still lies in the plane of sight, the vanes are perpendicular to the plane of rotation and at the same time it is verified that the plane of sight passes through the rotation axis.

NOTE As it is necessary for this test that the graduation centre lies exactly in the rotation axis (eccentricity below 0,1 mm), the test can be carried out on a special test stand with appliances suitable for azimuth reading devices of all types.

C.2.5.1.3 Attachment and adjustment of observation mirror

The mirror, if fitted, used to take bearings of high-altitude objects shall be attached and adjusted in such a way that the reflection plane is parallel to the plane of sight in any position to within the tolerances given in Table C.2. If the mirror is of the bilateral type, each of the two mirror sides shall fulfil these requirements. The use of adjusting (correction) screws is allowed.

The examination shall be carried out by observation. When inclining the mirror, the vertical bearing thread and its reflected image shall remain in coincidence.

C.2.5.1.4 Freedom of distortion of mirror and shades

With or without the shades the bearing errors shall not exceed the values given in Table C.1.

Table C.1 — Bearing error (difference from bearing on horizon)

Altitude of observed object	Maximum permissible error
Between 5° below and 30° above the horizon	0,3°
More than 30° above the horizon	0,5°

C.2.5.1.5 Prismatic magnifying glass (if any)

When reading card bearings by means of a prismatic magnifying glass, the readings shall not differ from the readings of the horizontal bearing thread by more than 0,3°.

The examination shall be carried out by inspection.

C.2.5.2 Azimuth mirror or prism instruments such as Thomson type (group II)

C.2.5.2.1 Construction

There may be four types of error in a group II azimuth reading device:

a) a collimating lens of incorrect power or placed at the wrong distance from the compass card graduated edge;

b) a prism, the axis of which is not at right angles to the line of sight;

c) a prism, the axis of which is not parallel to the plane of the compass top glass;

d) shades that are not optically flat.

C.2.5.2.2 Focal length of lens

The collimating lens focal length shall equal 1,12 × the compass card radius and be placed at that distance from the graduations at the card edge.

This can be checked in the following two ways.

a) A distant object is correctly aimed. The observer's head is then moved so that the object appears first at one extremity of the field of view and then at the other. The error in the readings should not be more than those given in Table C.2, condition a).

b) A distant object is correctly aimed. The observer's head is held still, and the azimuth mirror is rotated 5° first to one side and then to the other. The errors produced should not be greater than those given in Table C.2, condition b).

Table C.2 — Bearing accuracy

Altitude of the observed object	Maximum permissible error	
	condition a)	condition b)
Between 5° below and 40° above the horizon	0,3°	1,0°
Between 40° and 50° above the horizon	0,3°	1,5°
27° above the horizon	0,3°	0,5°

C.2.5.2.3 Error caused by mechanical inaccuracy

C.2.5.2.3.1 Prism axis not at right angles to line of sight

The bearing of a distant object is taken by means of plane sights or any other instrument, for which the error is known. The difference between this and the bearing by the azimuth mirror is compared and shall not exceed the value given in Table C.2, condition a).

C.2.5.2.3.2 Prism axis not parallel to plane of compass top glass

The compass is placed so that the top glass is horizontal. A plumb line at a reasonable distance (not less than 2 m) is sighted accurately. The prism is rotated about its axis. Any change in the bearing shall not exceed the value given in Table C.2, condition b).

C.2.5.2.4 Card diameter

The card diameter of the compass shall be stated in the certificate (see C.3).

C.2.5.2.5 Error in shades of azimuth mirror

A distant light (not less than 2 m away) is directed by the prism on to the compass card graduations. The shades are then placed in line and in no position should the line of sight be appreciably changed.

Adjusting screws are allowed under the prism.

C.2.5.2.6 Level

When the azimuth reading device with a level is tilted 1°, this tilt shall be recognized (see 6.3).

C.2.6 Shadow pin (if any)

The perpendicularity and centring shall be examined visually while rotating both the compass and the pin, while a distant light is producing a shadow.

C.2.7 Pelorus

a) When a pelorus is provided for a ship with an A2 binnacle, its accuracy can be checked as in C.2.5.1.

b) The freedom of movement of a pelorus within its gimbals shall be equal to that expected of a compass bowl, namely 40°.

c) The difference in directional error of the graduation shall not exceed 0,5°.

C.3 Test certificate

The test certificate for azimuth reading devices is as follows.

Certificate for azimuth reading devices

[NAME OF TEST ESTABLISHMENT]

Certificate for azimuth reading devices in accordance with ISO 25862 type test / individual test *) No.: .....

Manufacturer: .....

This test applies to azimuth reading devices group I / group II *) / group III

Type: .....

Serial no.: .....

(Groups I and II shall be supplied with a suitable compass.)

Compass supplied:

Name: .....

Serial No.: .....

Type: .....

Diameter of bowl: .....

The above numbered azimuth reading devices have been tested [in conjunction with the compass numbered above+] and have been found to comply with ISO 25862.

The errors found were:

Altitude	Correction (in degrees)
−5°	.....
0°	.....
+10°	.....
+20°	.....
+30°	.....
+40°	.....
+50°	.....

Signature of the manufacturer or his representative: .....

Place of issue: .....

Country: .....

Date: .....

*) Delete as applicable.

+) In the case of group III instruments, reference to the compass is unnecessary.

Annex D
(normative)

Type-testing and certification of binnacles

D.1 General

Type-testing shall be carried out before the binnacle comes into regular service. Each binnacle shall be provided with its compass, azimuth reading device, correctors and, if fitted, a transmitting system. Individual testing of binnacles and correcting devices is not required.

Only new devices are accepted for type-testing.

Magnetic compasses and binnacles are combined to be used as indicated in Table D.1.

Table D.1 — Types of binnacles

Magnetic compasses	Binnacles	
Class A	Type A1	Type A2
Class B	Type A1	Type A2

D.1.1 Binnacles and correcting devices to be tested

Type-testing should be carried out on all binnacles and correcting devices. These include binnacles for projector, reflector or transmitting compasses.

There are two types of binnacle to be tested:

Type A1: A binnacle of such a design and height that the magnets of the compass directional system shall be at least 1 m above the undersurface of the binnacle deck fitting.

Type A2: A binnacle which may be used where a type A1 binnacle is unsuitable. The binnacle height is not specified.

Where the requirements and test methods are different for these two types, the test methods are specified separately for A1 and A2.

A type A2 binnacle may be supplied without quadrantal correctors and without Flinders' bar, but when there is provision for fitting these correctors, both shall be provided when the binnacle is submitted for type approval.

D.1.2 Manufacturer's statement for binnacles

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

a) the vertical distance between the mid-plane of the directional system magnets and the gimbal bearings centre of the compass supplied;

b) that with the exception of the correcting devices (and where appropriate, certain parts of the compass transmission system), the binnacles and fittings are free from magnetic material;

c) when natural wood is used for the exterior of the binnacle it is seasoned tropical hardwood (e.g. teak). Any other wood used in the binnacle is to be seasoned hardwood, or marine ply. When a material other than wood is used, its properties shall be stated;

d) all materials used are of sufficient strength;

e) the coercivity of the corrector magnets;

f) that the material used for correcting induced fields has a high permeability, a low coercivity and a negligible remanence;

g) where wooden parts are joined by an adhesive only, the type of adhesive used.

D.2 Binnacles

D.2.1 Construction and material

D.2.1.1 Dimensions

In binnacle type A1, the directional system magnets shall be at least 1 m from the underside of the binnacle deck fittings.

D.2.1.2 Non-magnetic properties

As the manufacturers have given a guarantee declaration, only sample checks are necessary.

D.2.2 Compass suspension

D.2.2.1 Outer gimbal axis

The axis shall be in the binnacle fore and aft line within 0,5°.

D.2.2.2 Tilt of supporting device

The compass verge ring shall remain horizontal to within 2° when the binnacle is tilted 40° in class A, 30° in class B in any direction, and the test results shall meet the requirements of 4.2.1.

Where there is no or negligible lateral play in the suspension, this can be tested by tilting the compass bowl, while the binnacle remains horizontal, and measuring the angle with a clinometer.

If the compass is mounted in a flexible suspension or controlled by springs, then it is necessary to tilt the binnacle and for the compass to remain horizontal. This measurement should be taken both with and without the azimuth reading device or other attachment (for example, magnifier or fluxgate) in position.

D.2.2.3 Precautions against dislodging

The compass shall be secured against dislodging in any conditions of sea or weather. This securing shall not impair the compass in the free movement within the limits of D.2.2.2.

D.2.2.4 Friction of gimbal and compass axes

When the compass bowl is inclined 5° in any direction and released, it shall return to within 2° of the horizontal plane.

This measurement should be undertaken both with a suitable level and with an azimuth reading device and any other fittings which may sometimes be attached in position and also without them.

D.2.2.5 Play in outer gimbal axis bearing

The outer gimbal axis shall not be able to move within its bearing more than 0,5 mm in a fore and aft direction.

The measurements may be carried out by means of a feeler gauge.

D.2.2.6 Compass suspensions provided with springs

D.2.2.6.1 Horizontal movement of compass bowl and gimballing

The horizontal movement of the bowl and gimballing shall not exceed 5 mm in any direction from the normal position.

This measurement may be carried out by means of a gauge or scale, using the binnacle inner rim for reference.

D.2.2.6.2 Effect of azimuth reading device

The vertical displacement of the compass bowl centre caused by the mass of an azimuth reading device shall not exceed 3 mm.

The measurement may be carried out by means of a gauge or scale, using a suitable horizontal plane for reference.

D.2.3 Provisions to correct misalignment

D.2.3.1 Fore and aft marks provided on binnacles shall be in the same vertical plane to within the values in Table D.2 as the axis of the fore and aft gimbal bearings.

Table D.2 — Accuracy of fore and aft marks

Magnetic compasses	Accuracy of fore and aft marks
Class A	0,5°
Class B	1°

The examination may be carried out with the aid of a plumb line and with the compass in the binnacle.

D.2.3.2 In type A1 binnacles, provisions shall be made for any misalignment in respect of the fore and aft line of the ship by turning the binnacle through an angle of not less than 4° and not more than 6°. This requirement is not obligatory in type A2 binnacles. The examination may be carried out with the compass in the binnacle.

D.2.3.3 The course as read from the projected image shall agree with the course read at the main lubber mark to within 0,5°.

D.2.4 Correcting devices, marking, coercivity and securing (type A1 binnacles and, if fitted, type A2 binnacles)

Corrector magnets shall be marked red at the north seeking end and shall have a coercivity of not less than 11 200 A/m.

All fittings carrying correction devices shall be securely joined to the binnacle and well protected against sea and weather.

Suitable devices (for instance a scale) to indicate the position of the correcting devices at any given time shall be provided. Holes or grooves used for horizontal corrector magnets shall be numbered and the numbers shall read from the bottom upwards (type A1 binnacles only).

Provisions shall be made to secure the correcting devices of the binnacles against unauthorized access and unintentional displacement.

The examination shall be carried out visually.

D.2.4.1 Heeling error corrector magnets

Heeling magnets shall be able to produce a vertical flux density over the range −75 µT to +75 µT at the directional system magnets.

This can be checked by using a vertical force instrument or any other magnetometer or by measuring the magnetic moment and calculating the field intensity.

The tube provided for one or more heeling-error magnets to correct the influence of vertical magnetism shall be fitted centrally below the compass bowl in the binnacle vertical axis, unless a suitable special device is fitted. When several heeling-error magnets are provided for, the casings shall be constructed so that the magnets can be placed in a symmetrical arrangement about its axis. The heeling-error magnet, or the holder for the heeling-error magnets, respectively, shall be capable of being safely secured in position by some suitable means. Provision shall be made so that the distance between the upper end of the correcting magnets and the magnets of the directional system cannot be less than twice the length of the correcting magnets in class A1 binnacles.

In type A2 binnacles, no precise dimensions are required, but the effect on the directional system shall not be any less favourable. In particular, provision shall be made so that no correcting system magnets come so close to the directional system as to distort the field and produce a deviation of more than (80/H)° on any course, even where there is a heel or pitch of 15°.

The examination in the case of the type A1 binnacle shall be carried out by inspection.

In the case of the type A2 binnacle, which is smaller, it can be necessary to provide means for changing the vertical field in the vicinity of the directional element. The field thus produced is to be corrected with the heeling magnets, and the binnacle tilted 15°. The resulting deviation shall not exceed (80/H)°.

D.2.4.2 Mounting of horizontal corrector magnets

D.2.4.2.1 Error of alignment

The direction of the fore and aft and athwartship corrector magnets shall not deviate more than 2° from the direction of the outer gimbal axis or its perpendicular, respectively, and shall be within 2° of the horizontal.

D.2.4.2.2 Position error

The holes or grooves for the fore and aft and for the athwartship corrector magnets, when of the conventional type, shall be mounted in such a manner and be of such a size that the mid-point of the appropriate magnets when in place lies within 5 mm of the vertical planes passing through athwartship and the fore and aft gimbal axes, respectively.

NOTE The examinations required by D.2.4.2.1 and D.2.4.2.2 can be carried out by using a levelling instrument and in such a way that the vertical planes passing through the gimbal axes are represented by plumb lines from which the distance measurement can be made.

D.2.4.2.3 Minimum distance of horizontal correcting magnets from directional system and their strength

Binnacles shall contain a device for correcting the deviation due to the horizontal components of the ship's permanent magnetism.

The device shall be capable of correcting a coefficient B and C of at least (720/H)°, where H is as defined in 4.3.4.

In type A1 binnacles, the holes or grooves for the horizontal corrector magnets shall be fitted to the binnacle in such a way that when the compass directional system is of the conventional type, consisting of bar or ring magnets, no magnet of the correcting system shall lie nearer than twice its length from the directional system magnets.

In type A2 binnacles, no precise dimension as to the proximity of the correcting magnets to the directional element is required, but provision shall be made so that no magnets of the correcting system come so close to the directional system as to distort the field and produce a deviation of more than (40/H)° on any course, even with a heel or pitch of 15°.

The amount of deviation that can be corrected by the corrector magnets can be measured by placing the maximum number of correcting magnets in the athwartship direction, setting the compass on the corrector stand in its binnacle and aligning it on north or south. The angular difference between the stand alignment and the magnetic north or south indicates the correcting power of the magnets. This should be repeated on east or west using the fore and aft magnets.

The distance of the magnets from the directional element in a type A1 binnacle shall be measured.

In a type A2 binnacle, the compass in its binnacle is placed on the test stand and aligned to north or south. An external magnetic force sufficiently far away to create a reasonably even field in the vicinity of the directional element is applied until a deviation of (720/H)° is obtained. This deviation is then corrected by the magnets in the binnacle. The binnacle is tilted 15°. The resulting deviation shall not exceed (40/H)°.

Repeat on east and/or west.

D.2.4.3 Attachment of quadrantal correctors

In the case of a type A 1 binnacle, the quadrantal correctors shall be capable of correcting a deviation of up to 10°.

In the case of a type A2 binnacle, when quadrantal correctors are supplied, they shall be capable of correcting a deviation of up to 7°.

In both cases, when the binnacle axes are vertical the device centre shall not be more than 15 mm from the horizontal plane, passing through the centre of the directional system magnetic element.

In both cases, the axes of the correctors shall be fitted in such a way that they can be moved in the direction of their axis along a binnacle diameter, which shall not deviate more than 2° from the direction of the athwartship gimbal axis.

Alignment errors can be checked by means of the card or verge ring graduations.

The amount of deviation that can be corrected can be checked by placing the compass and binnacle on a test stand on a quadrantal course with and without the correctors in position.

The height of the correctors relative to the directional element can be checked by measuring the distance of the device centre from the inner gimbal axis and applying the information provided by the manufacturer. The result shall meet the requirements of 5.1.2.4.

D.2.4.4 Flinders' bar

With a type A1 binnacle, a Flinders' bar shall be provided which meets the requirements of 5.1.2.5. With type A2 binnacles, a Flinders' bar, which meets the requirements of 5.2.2.5, may be provided.

D.2.4.4.1 The line connecting the vertical axis of the Flinders' bar to the compass centre shall not deviate more than 2° from the direction of the fore and aft gimbal axis.

D.2.4.4.2 The top end of the bar shall be 1/12 of its length (with a tolerance of ± 10 mm) above the horizontal plane passing through the centre of the directional system magnets. If a hollow Flinders' bar is used, the diameter of the hole shall not exceed 40 % of the diameter of the bar.

D.2.5 Corrector coils

D.2.5.1 Provision may be made for the fitting of corrector coils to provide compensation if the ship is fitted with degaussing coils.

D.2.6 Illumination

The binnacle shall contain adequate provision for illuminating the card by means of the ship's electric supply and from an emergency light source. In projector and reflector binnacles. these shall provide a clear image at the helmsman's position. Devices shall be provided for dimming the illumination at both the helmsman's position and the binnacle.

D.2.6.1 Magnetic influence of lamps, plugs, sockets, switches, dimmers and wiring

The lamps, plugs, sockets, switches, dimmers and wiring, whether energized or not, shall have no perceptible magnetic effect on the compass on any heading.

The examination can be carried out by trial and shall meet the requirements of 5.1.4 or 5.2.4 whichever is applicable.

D.2.6.2 Readability of reflector and projector compasses

In compasses of the reflector or projector type, the optical system shall be such that the image of the lubber mark and a sector of the card 15° on either side of the lubber mark shall allow a person with normal vision to read the card both in daylight and artificial light at a distance of 1 m from the periscope tube.

D.3 Test certificate

The test certificate for binnacles is as follows.

Type-test certificate for binnacles

[NAME OF TEST ESTABLISHMENT]

Type-test certificate No.: .....

of binnacle class A1 *) / class A2 in accordance with ISO 25862.

Manufacturer: .....

Name: .....

Serial No.: .....

Manufacturer's statement and signature is below.

This binnacle has been tested with compass:

No.: .....

Type-test No. .....

and is in accordance with ISO 25862.

Signature of the manufacturer or his representative: .....

Place of issue: .....

Country: .....

Date: .....

*) Delete as applicable.

Statement of manufacturer or importer

a) The vertical distance between mid-plane of the magnets of the directional system and the centre of the gimbal bearings of the compass supplied is ..... mm.

b) With the exception of the correcting magnets (and where appropriate certain parts of the compass transmitting system) the binnacles and fittings are free from magnetic material.

c) When natural wood is used for the exterior of the binnacle it is seasoned tropical hardwood (e.g. teak). Any other wood in the binnacle is seasoned hardwood or marine ply.

When a material other than wood is used its properties are as follows: .....

.....

.....

d) All materials are of sufficient strength.

e) The coercivity of the magnets is ..... A/m.

f) The material used for correcting induced fields has a high permeability, a low coercivity and a negligible remanence.

g) Where wooden parts of the binnacle are joined by an adhesive only, the adhesive is .....

Signature: ..... Date: .....

Company stamp: