INTERNATIONAL STANDARD 449

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Shipbuilding — Magnetic compasses and binnacles, class A

Construction navale — Compas magnétiques et habitacles, classe A

First edition — 1979-04-15

UDC 629.12.053.11 **Ref. No. ISO 449-1979 (E)**

Descripteurs : shipbuilding, magnetic compasses, binnacles, equipment specification.

FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 449 was developed by Technical Committee ISO/TC 8, *Shipbuilding*, and was circulated to the member bodies in May 1977.

It has been approved by the member bodies of the following countries :

Australia	India	Poland
Austria	Italy	Romania
Belgium	Japan	Spain
Brazil	Korea, Dem. P. Rep. of	Sweden
Chile	Korea, Rep. of	Turkey
Czechoslovakia	Mexico	United Kingdom
Finland	Netherlands	USSR
France	Norway	Yugoslavia

The member body of the following country expressed disapproval of the document on technical grounds :

Germany, F. R.

This International Standard cancels and replaces ISO Recommendation R 449-1965, of which it constitutes a technical revision.

Printed in Switzerland

Shipbuilding — Magnetic compasses and binnacles, class A

1 SCOPE

This International Standard gives general requirements regarding construction and performance for magnetic compasses, binnacles and azimuth reading devices, class A. According to the design of the ship, two types of binnacle are specified.

2 FIELD OF APPLICATION

This International Standard applies to liquid-filled magnetic compasses :

— intended for 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.

Exlusions : 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.

3 REFERENCES

ISO/R 613, *Magnetic compasses, binnacles and azimuth reading devices , Class B — General requirements.*

ISO/R 694, *Positioning of magnetic compasses in ships.*

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

ISO 2269, *Magnetic compasses and accessories — Rules for testing and certification.*

4 DEFINITIONS

The terms used in this International Standard are defined in ISO 1069.

5 MARKING

The following parts shall be marked with the information given and in the position shown in table 1.

6 MAGNETIC COMPASSES

6.1 Construction and materials

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

TABLE 1 — **Marking requirements**

Part	Position of manufacturer's name or other means of type identification	Position of serial number on the part
Magnetic compass	a) card b) verge ring	a) card b) verge ring c) gimbal ring or rings
Binnacle	Any convenient position	Not required
Azimuth reading device	On top of the base of the azimuth reading device	On top of the base of the azimuth reading device

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

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

6.1.3 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 bowl.

6.1.4 The gimbal axes shall be mutually perpendicular within a tolerance of 1°. The outer gimbal axis shall be in the fore-and-aft direction of the ship.

6.1.5 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.

6.1.6 Within the temperature range − 30 to + 60 °C

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) the supporting force shall be such that the directional system always remains in contact with its pivot;

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

6.1.7 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.

6.2 Mounting

6.2.1 The bowl of the compass shall be mounted so that the verge ring remains horizontal when the binnacle is titled 40° in any direction and in such a manner that the compass cannot be dislodged under any conditions of sea or weather.

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

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

6.3 Directional system

6.3.1 *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.

6.3.2 *Suspension*

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

6.3.3 *Magnetic moment*

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

6.3.4 *Period*

Following an initial deflection of the card of 40° from the magnetic meridian, the half period of the directional system, when measured at a temperature of 20 ± 3 °C, shall not be less than $\sqrt{\frac{2\,600}{H}}$, H being the horizontal component of the magnetic flux density in microteslas (μT) at the place of testing.

NOTE – After the initial deflection has been given, the half period is measured between the first two consecutive passings of the original indication of the course.

Alternatively, the compass may be aperiodic or heavily damped. In this case, the time taken to return to within 1° of the magnetic meridian, following an initial deflection of the card of 90°, shall not be more than $\sqrt{\frac{57\,600}{H}}$ at the above temperature.

6.3.5 *Tilt of the directional system with regard to the vertical field*

When the directional system is assembled in the bowl, the title of the card shall not exceed the value $(0{,}5 + 0{,}03\delta)°$, where δ is the absolute value of the algebraic difference between the values of the vertical flux density in microteslas (μT) at one position and at any other position.

6.4 Graduation

6.4.1 *Compass card*

The compass card shall be graduated in 360 single degrees, starting from North in 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 every 10°.

6.4.2 *Readability by the helmsman*

If a steering compass is provided for the helmsman, it shall be possible for a person with normal vision to read at a distance of 1,4 m, in both daylight and artificial light, those graduations on the card which are 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.

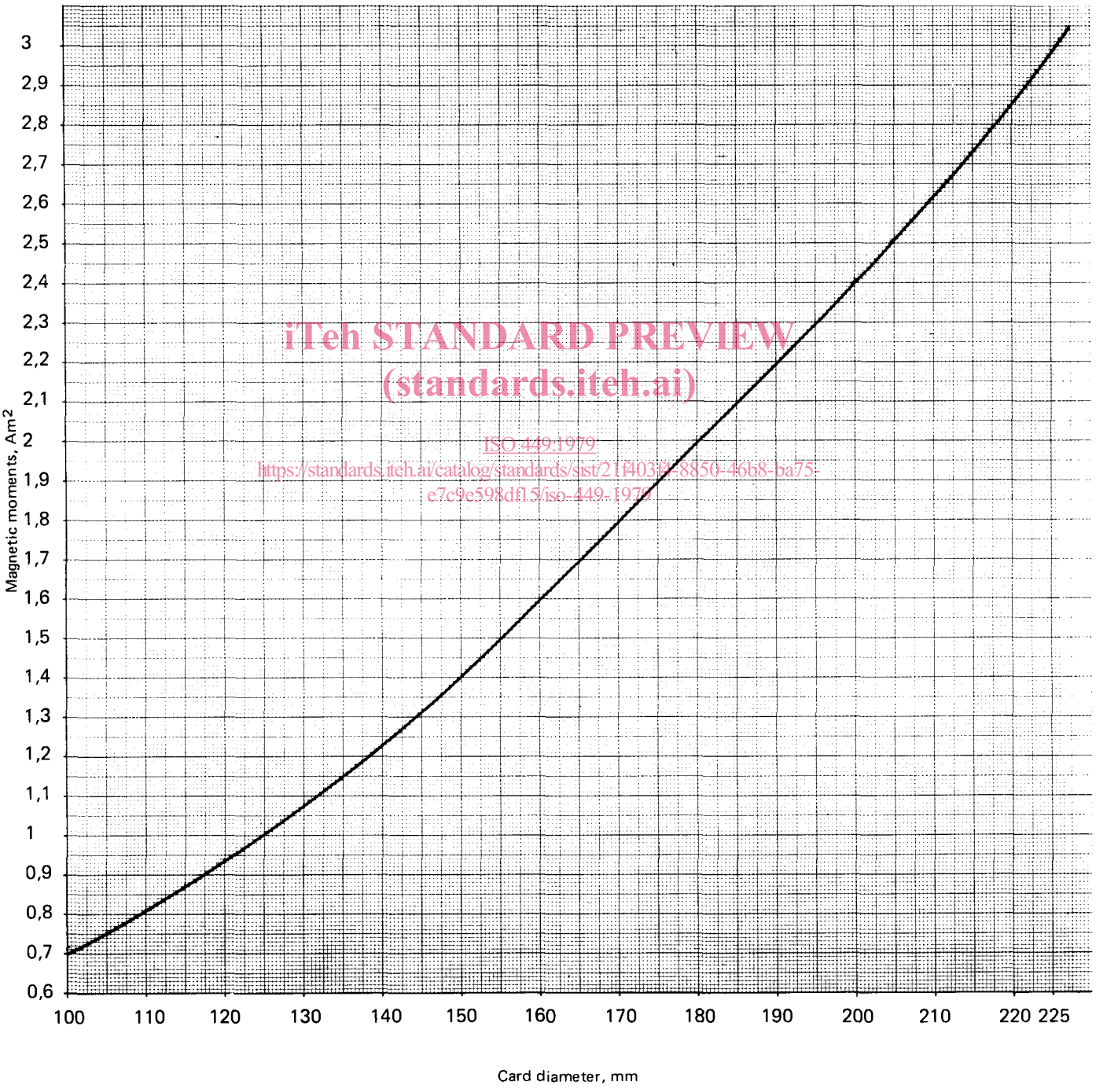

FIGURE – **Magnetic moments of liquid filled compasses**
(minimum requirements)

6.4.3 *Standard compass*

If the standard 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 in 360 degrees in a clockwise direction, zero, as seen through the azimuth reading device, indicating the direction of the ship's head.

6.5 Accuracy

6.5.1 *Constructional errors*

6.5.1.1 In compasses other than transmitting compasses, the directional error shall not exceed 0,5 ° on any heading.

6.5.1.2 The fixed lubber error shall not excced 0,5°.

6.5.2 *Error due to friction*

With the compass at a temperature of 20 ± 3 °C, the card, when given an initial deflection of 2°, first one side of the magnetic meridian and then on the other, shall return to within $(3/H)^\circ$ of its original position, H being as defined in 6.3.4.

6.5.3 *Swirl error*

With the compass at a temperature of 20 ± 3 °C and rotating at a uniform speed of 6° per second in the horizontal plane, the deflection of the card when the bowl has been rotated through 180°, shall not exceed $(108/H)^\circ$ from the magnetic meridian, H being defined as in 6.3.4.

Alternatively, when rotating at a uniform speed of 1,5° per second, the deflection of the card, measured after the bowl has been rotated through 360°, shall at no point exceed the following values :

a) $(54/H)^\circ$ for compasses with cards 200 mm or more in diameter;

b) $(36/H)^\circ$ for compasses with cards less than 200 mm in diameter;

H being defined as in 6.3.4.

6.5.4 *Induction error*

When coefficient D is corrected by spheres or some similar conventional device, the error introduced by magnetic induction in these correctors due to the magnets in the directional system, shall be such that the value of the ratio of coefficient H to coefficient D does not exceed 0,08.

6.5.5 *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.

6.5.6 *Error due to eccentricity of the verge ring*

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.

7 BINNACLES

Depending on the type of ship on which it shall be fixed, two types if binnacles may be used : types A1 or type A2. The characteristics of the different types are indicated in 7.1 and 7.2.

7.1 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 following requirements.

7.1.1 *Construction and materials*

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

7.1.1.2 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°.

7.1.2 *Provision for correction of deviation*

7.1.2.1 MATERIAL

Where corrector magnets are used, they shall be of a suitable magentic material of high remanence and coercivity of not less than 11 200 A/m. Material used for correcting induced fields shall have a high permeability, a low coercivity and a negligible remanence.

7.1.2.2 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 $(720/H)^\circ$ and a coefficient C of up to at least $(720/H)^\circ$, H being as defined in 6.3.4.

Where the magnets of the directional system are of the conventional bar or ring type, provision shall be made in binnacles so that no magnet of the correcting system comes nearer than twice its own length to the magnets of the directional system.

7.1.2.3 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 to − 75 μ.

When the magnets of the directional system are of the conventional bar or ring type, the upper end of the magnets of the correcting device shall not be nearer than twice their own length from the magnets of the directional system.

NOTE – The magnetic fields produced by the devices referred to in 7.1.2.2 and 7.1.2.3 shall be as uniform as possible in the space swept by the directional system and shall in no case introduce a significant sextantal error.

7.1.2.4 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.

7.1.2.5 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 magentic 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 1/12th of its length from the end.

7.1.2.6 Positions and attachment of correcting devices

Provision shall be made in binnacles for recording the positions of the correcting devices referred to in 7.1.2.2, 7.1.2.3 and 7.1.2.4.

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

7.1.2.7 Corrector coils

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

7.1.3 *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.

7.1.4 *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 wirings shall have no influence on the directional system.

7.2 Binnacles 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, no descriptions are laid down, provided that binnacles meet the following requirements.

7.2.1 *Construction and materials*

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

7.2.2 *Provision for correction of deviation*

7.2.2.1 Material

Where correcting magnets are used they shall be of suitable magnetic material of high remanence and coercivity not less than 11 200 A/m. Material used for correcting induced fields shall have a high permeability, a low coercivity and a low remanence.

7.2.2.2 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 $(720/H)°$, H being as defined in 6.3.4. 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 may be a heel or pitch of 15°.

7.2.2.3 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 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 may be a heel or pitch of 15°.

NOTE — The magnetic fields produced by the devices referred to in 7.2.2.2 and 7.2.2.3 shall be as uniform as possible in the space swept by the directional system and should in no case introduce a significant sextantal error.

7.2.2.4 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.

7.2.2.5 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.

7.2.2.6 Attachment of correcting devices

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

7.2.3 *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° of the fore-and-aft axis of the gimbal bearings.

7.2.4 *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 helsman'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.

8 AZIMUTH READING DEVICES

There shall be an appropriate azimuth reading device for the standard compass. An A2 binnacle may be supplied with a suitable pelorus which may be fitted away from the binnacle.

8.1 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° above the horizontal.

8.2 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.

9 DESIGNATION

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

- number of this International Standard;
- type of binnacle;
- card diameter in millimetres;
- type of compass (reflector, projector, transmitting).

Example : reflector magnetic compass, class A with binnacle type A2 and a card diameter of 180 mm as follows :

Reflector magnetic compass ISO 449 – A2 – 180