

# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

## ISO RECOMMENDATION R 449

MAGNETIC COMPASSES AND BINNACLES, CLASS A,  
FOR USE IN SEA NAVIGATION

1st EDITION

October 1965

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## BRIEF HISTORY

The ISO Recommendation R 449, *Magnetic Compasses and Binnacles, Class A, for Use in Sea Navigation*, was drawn up by Technical Committee ISO/TC 8, *Shipbuilding Details*, the Secretariat of which is held by the Stichting Nederlands Normalisatie-instituut (NNI).

Work on this question by the Technical Committee began in 1956 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In May 1963, this Draft ISO Recommendation (No. 576) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

|                |             |                |
|----------------|-------------|----------------|
| Australia      | Greece      | Spain          |
| Belgium        | Iran        | Sweden         |
| Chile          | Israel      | Switzerland    |
| Czechoslovakia | Italy       | United Kingdom |
| Denmark        | Netherlands | U.S.S.R.       |
| France         | New Zealand |                |
| Germany        | Poland      |                |

One Member Body opposed the approval of the Draft:

Japan

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council which decided, in October 1965, to accept it as an ISO RECOMMENDATION.

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## MAGNETIC COMPASSES AND BINNACLES, CLASS A, FOR USE IN SEA NAVIGATION

### INTRODUCTION

This ISO Recommendation deals with the general requirements, as regards construction and performance, for magnetic compasses and binnacles, Class A, for use in sea navigation.

### 1. GENERAL

#### 1.1 Scope

This ISO Recommendation refers to liquid magnetic compasses, intended for sea navigation, having a direct reading system, which may be of the reflecting, projecting or transmitting types.

In this context, a magnetic compass is an instrument consisting of a directional system supported on a single pivot inside a bowl which is completely filled with liquid, and which is supported in gimbals.

Hemispherical compasses, which are not supported in gimbals, are equally covered by this ISO Recommendation. The requirements relating to gimbals do not apply to such compasses.

1.1.1 *Exclusion.* This ISO Recommendation does not refer to

- (a) dry card compasses,
- (b) types of compass designed on principles different from those stated in clause 1.1 above or not complying with the description given in that clause.

#### 1.2 Units

In view of the present established practice, the following units have been retained:

the oersted as the unit of *magnetic field strength* and  
the CGS unit as the unit of *magnetic moment*.

Corresponding units in the International System (S.I.) are

for the *magnetic field strength*,  $A.m^{-1}$ , which corresponds to  $4\pi \cdot 10^{-3}$  oersted,  
for the *magnetic moment*,  $A.m^2$ , which corresponds to  $10^3$  CGS units.

#### 1.3 Definitions

For the purposes of this ISO Recommendation, the following definitions apply:

- 1.3.1 *Standard compass.* Compass used to navigate a ship.
- 1.3.2 *Steering compass.* Compass used by the helmsman when steering a ship.
- 1.3.3 *Liquid compass.* Compass whose card is immersed in liquid.

- 1.3.4 *Reflector compass.* Compass in which the image of the card can be read as a whole or in part by means of a reflecting system.
- 1.3.5 *Projector compass.* Compass in which the image of the card is projected as a whole or in part onto a screen by an optical system.
- 1.3.6 *Transmitting compass.* Compass which transmits the compass indication to repeater instruments.
- 1.3.7 *Aperiodic compass.* Compass which, after being deflected from its heading, does not oscillate through a complete period before returning to its heading.
- 1.3.8 *Directional system.* Assembly of compass card, pivot bearing and permanent magnets which, in the absence of magnetic fields due to the ship, settles in constant alignment with the magnetic meridian due to the action of terrestrial magnetism on the permanent magnets. The card is graduated and is read against a (lubber mark) which is fixed in relation to the ship's head.
- 1.3.9 *Binnacle.* Fixed stand for supporting a compass and for housing or supporting the devices for correcting the compass deviation.  
It supports the compass in gimbals so that the effects of the pitching and rolling motions of the ship are minimized; it contains provision for illuminating the compass card.
- 1.3.10 *Point of compass.* Mark on the compass card. There are 32 points to a complete circle; the arc between two adjacent points being  $11.25^\circ$ .
- 1.3.11 *Deviation.* Angle between Magnetic North and Compass North, as indicated by a magnetic compass.
- 1.3.12 *Coefficient A.* Mean of the compass deviations on not less than eight headings equally spaced round the card.
- 1.3.13 *Coefficient B.* Deviation due to the fore-and-aft component of a ship's permanent magnetism and to part of the magnetism induced in the vertical soft iron in a ship.
- 1.3.14 *Coefficient C.* Deviation due to the thwartship component of a ship's permanent magnetism and to part of the magnetism induced in the vertical soft iron in a ship.
- 1.3.15 *Coefficient D.* Deviation due to the horizontal component of the magnetic field induced in the fore-and-aft and thwartship soft iron parts in a ship.
- 1.3.16 *Coefficient H.* Deviation due to the magnetism induced by the magnets of the directional system in the device used to correct Coefficient D.
- 1.3.17 *Flinders bar.* Bar which is placed adjacent to the compass with its axis vertical, and which is used to counteract the magnetism induced in the vertical soft iron parts in a ship.
- 1.3.18 *Azimuth reading device.* Device, usually mounted on or attached to a compass bowl, for measuring the azimuth of a distant object, either celestial or terrestrial, that is, for measuring the angle at the zenith between the observer's magnetic meridian and the plane of a vertical circle passing through the object. If the verge ring of the compass is suitably graduated, it can also give a reading of the bearing of the object relative to the ship's head.
- 1.3.19 *Verge ring.* Ring for retaining the top glass cover of the compass. It may or may not be graduated in degrees relative to the ship's head.
- 1.3.20 *Directional error.* Geometrical and constructional error of the directional system, comprising inaccuracies in graduation, eccentricity of the card on its pivot and inaccuracies of orientation of the card on the magnet system.

- 1.3.21 *Lubber error.* Angle between the vertical plane passing through the lubber mark and the centre of rotation of the card, and the vertical plane passing through the fore-and-aft gimbal axis.

#### 1.4 Marking

The following parts should be marked with the information and in the position shown in Table 1.

TABLE 1. — Marking requirements

| Name of part                  | Position of manufacturer's name or other means of identification | Position of serial number on the part                  |
|-------------------------------|------------------------------------------------------------------|--------------------------------------------------------|
| <b>Magnetic compass</b>       | (a) Card<br>(b) Verge ring                                       | (a) Card<br>(b) Verge ring<br>(c) Gimbal ring or rings |
| <b>Binnacle</b>               | Any convenient position                                          | Not required                                           |
| <b>Azimuth reading device</b> | On top of the base of the azimuth reading device                 | On top of the base of the azimuth reading device       |

## 2. MAGNETIC COMPASSES

### 2.1 Construction and materials

- 2.1.1 The magnets used in the directional systems of magnetic compasses should be of a suitable magnetic material having a high remanence and high coercivity. All other materials used in magnetic compasses, other than transmitting compasses, should be of non-magnetic material.
- 2.1.2 The distance between the lubber mark and the outer edge of the card should be between 1.5 and 3.0 mm. The width of the lubber mark should not be greater than 0.5° of the graduation of the card. The lubber mark should be of such design as to allow the compass to be read when the bowl is tilted 10° in the case of a gimbal compass or 30° in the case of a hemispherical compass.
- 2.1.3 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 should all lie within 1 mm of the horizontal plane passing through the gimbal axis fixed to the bowl.
- 2.1.4 The gimbal axes should be mutually perpendicular within a tolerance of 1°. The outer gimbal axis should be in the fore-and-aft direction of the ship.
- 2.1.5 The thickness of the top glass cover and of the bottom glass of the compass should 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 should be of equivalent strength.
- 2.1.6 Within the temperature range  $-30^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ ,
- (a) the liquid in the compass bowl should remain clear and free from bubbles, and neither emulsify nor freeze;
  - (b) there should be neither inward leak of air nor outward leak of liquid.
- NOTE. — This requirement does not apply to the normal functioning of liquid compasses which have a combined gravity liquid reservoir and free expansion chamber fitted to the top glass cover so as to allow for changes in the density of the liquid.
- (c) paint should not blister, crack or discolour appreciably.
- 2.1.7 The balance of the compass bowl should not be disturbed by any magnifying glass or by any azimuth reading device provided for use with the compass.

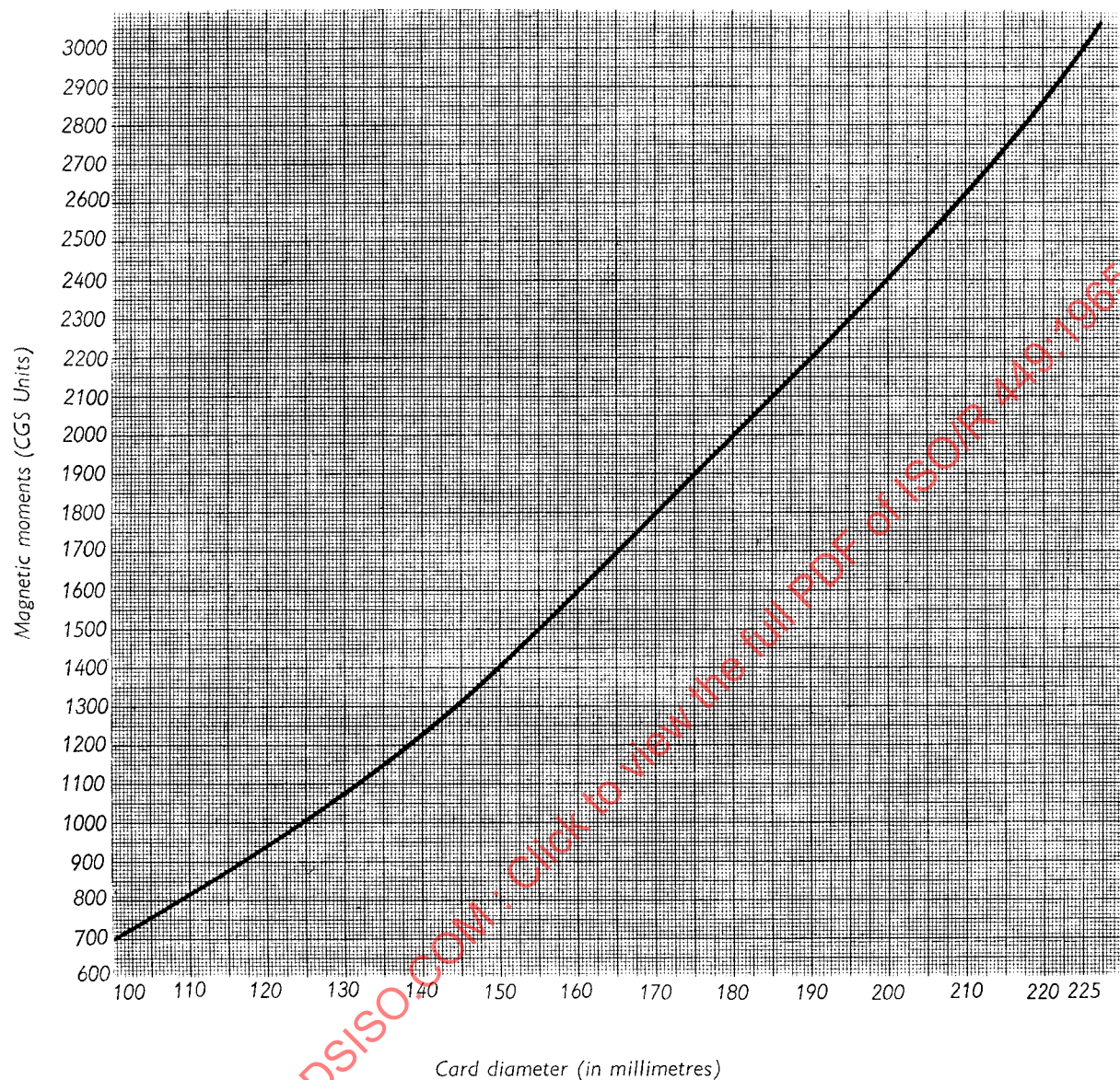


FIGURE. — Magnetic moments of fluid compasses  
(Minimum requirements)

## 2.2 Mounting

- 2.2.1 The bowl of the compass should be mounted so that the verge ring remains horizontal when the binnacle is tilted  $40^\circ$  in any direction and so that the compass cannot be dislodged under any conditions of sea or weather.  
The bearings of the inner and outer gimbal axes should be of the same type.
- 2.2.2 In compasses of the hemispherical type, in which no supporting gimbal is provided, the freedom of the card should be  $30^\circ$  in all directions.

## 2.3 Directional system

- 2.3.1 *Moment of inertia.* The moment of inertia of the directional system should be appreciably the same about all horizontal axes passing through the point of support on the pivot jewel.
- 2.3.2 *Suspension.* The directional system should be retained in position by suitable means and remain free, when the bowl is tilted  $10^\circ$  in any direction.
- 2.3.3 *Supporting force.* When measured at a temperature of  $20^\circ\text{C} \pm 3^\circ\text{C}$ , the force exerted by the directional system on the pivot in the liquid used should be between 4 gf and 10 gf, when the diameter of the card is 165 mm or less, and should be between 4 gf and 14 gf, when the diameter of the card is greater than 165 mm.
- 2.3.4 *Magnetic moment.* The magnetic moment of the magnets in the directional system should not be less than the value given in the figure, page 8.
- 2.3.5 *Period.* Following an initial deflection of the card of  $40^\circ$  from the magnetic meridian, the half period of the directional system, when measured at a temperature of  $20^\circ\text{C} \pm 3^\circ\text{C}$ , should not be less than  $\sqrt{(26/H)}$ , where  $H$  is the horizontal magnetic field strength in oersted.
- 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  $1^\circ$  of the magnetic meridian, following an initial deflection of the card of  $90^\circ$ , should not be more than  $\sqrt{(576/H)}$ , at the above temperature.
- 2.3.6 *Tilt of the card.* When the directional system is assembled in the bowl, the tilt of the card should not exceed the value  $(0.5 + 3\delta)^\circ$ , where  $\delta$  is the absolute value of the algebraic difference between the values of the vertical magnetic field strength in oersted at one position and at any other position.

## 2.4 Graduation

- 2.4.1 *Compass card.* The compass card is graduated in 360 single degrees, starting from North in a clockwise direction as viewed from above. The cardinal points are 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 emblem.
- 2.4.2 *Readability by the helmsman.* If a steering compass is provided for the helmsman, it should 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  $15^\circ$  to each side of the lubber mark. The use of a magnifying glass is permitted.  
For reflecting and projecting compasses, the lubber mark should be visible and the  $30^\circ$  sector of the card should be readable by a person with normal vision at a distance of 1 m from the periscope tube.
- 2.4.3 *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 should 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.