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Ships and marine technology — Marine radar reflectors

Navires et technologie maritime — Réflecteurs radars de marine

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8729 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation.*

This second edition cancels and replaces the first edition (ISO 8729:1987), which has been technically revised.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Ships and marine technology — Marine radar reflectors

1 Scope

This International Standard specifies the minimum requirements for a radar reflector intended to enhance returns from small vessels as required by IMO Resolution A.384(X).

It lays down the specification for the construction, performance, installation, testing and inspection of such radar reflectors.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 945:1994, *Marine navigational equipment — General requirements — Methods of testing and required test results.*

IMO Resolution A.384(X) (adopted on 14 November 1977), *Performance standards for radar reflectors.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 radar reflector: Any passive device which is designed to enhance returns from small radar targets.

3.2 echoing area: Area which is 4π times the ratio of the power per unit solid angle scattered in a specified direction to the power per unit area in a plane wave incident on the scatterer from a specified direction.

NOTE — It is dependent on the radar operating frequency, and the three-dimensional orientation of the reflector. Polarization of the transmitter and the received wave affects the effective echoing area of the reflector.

In case of free space propagation, the echoing area σ, in square metres, can be measured by the following equation:

$$\sigma = \frac{(4\pi)^3 \times S \times R^4}{P \times G^2 \times \lambda^2}$$

where

S is the receiver power, in watts;

R is the distance between radar and target, in metres;

P is the transmitting peak power, in watts;

G is the antenna gain;

λ is the wave length, in metres.

3.3 azimuthal polar diagram: Polar diagram relating the echoing area of the reflector to the azimuthal angle about its vertical axis.

3.4 Luneberg reflector: Reflector, making use of a number of concentric spheres of varying refractive index, capable of focusing incident energy onto a reflecting surface (see figure 1).

3.5 corner reflector: Reflector, consisting of three flat conducting surfaces intersecting mutually at right angles, which reflects the greater part of the incident waves parallel to their direction of incidence (see figure 2).

4 Construction

4.1 Structure and materials

The materials used for the radar reflector shall be of sufficient strength and quality as to make the reflector capable of maintaining reflection performance under conditions of stress due to sea states, vibration, humidity and change of temperature likely to be experienced in the marine environment as specified in 6.2 and 6.3. Use of ferrous metals should be avoided.

4.2 Colour

The radar reflector intended for installation on board vessels shall not be coloured black. It should be of a highly visible colour.

5 Performance requirements

The radar reflector shall comply with the following minimum requirements for all frequencies between 9 320 MHz and 9 500 MHz.

5.1 Reflecting pattern in horizontal plane

5.1.1 The maximum echoing area of the radar reflector shall be at least 10 m^2.

5.1.2 Its azimuthal polar diagrams shall be such that its response over a total angle of 240° is not less than 2,5 m^2. The response shall not remain below this level over any single angle of more than 10°.

NOTE — Typical azimuthal polar diagrams of two types of marine radar reflector are shown in figures 1 and 2.

5.1.3 These requirements shall be assessed by reference to related azimuthal polar diagrams about the reflector's vertical axis and tilted from the vertical at angles not exceeding ± 3°.

5.2 Reflecting pattern in vertical plane

The performance of the reflector, up to at least ± 15° from the horizontal shall be such that its response at any inclination remains above 0,625 m^2 over a total angle of at least 240°.

5.3 Other requirements

The radar reflector shall be in accordance with the requirements for class X equipment in IEC 945:1994, clause 3.

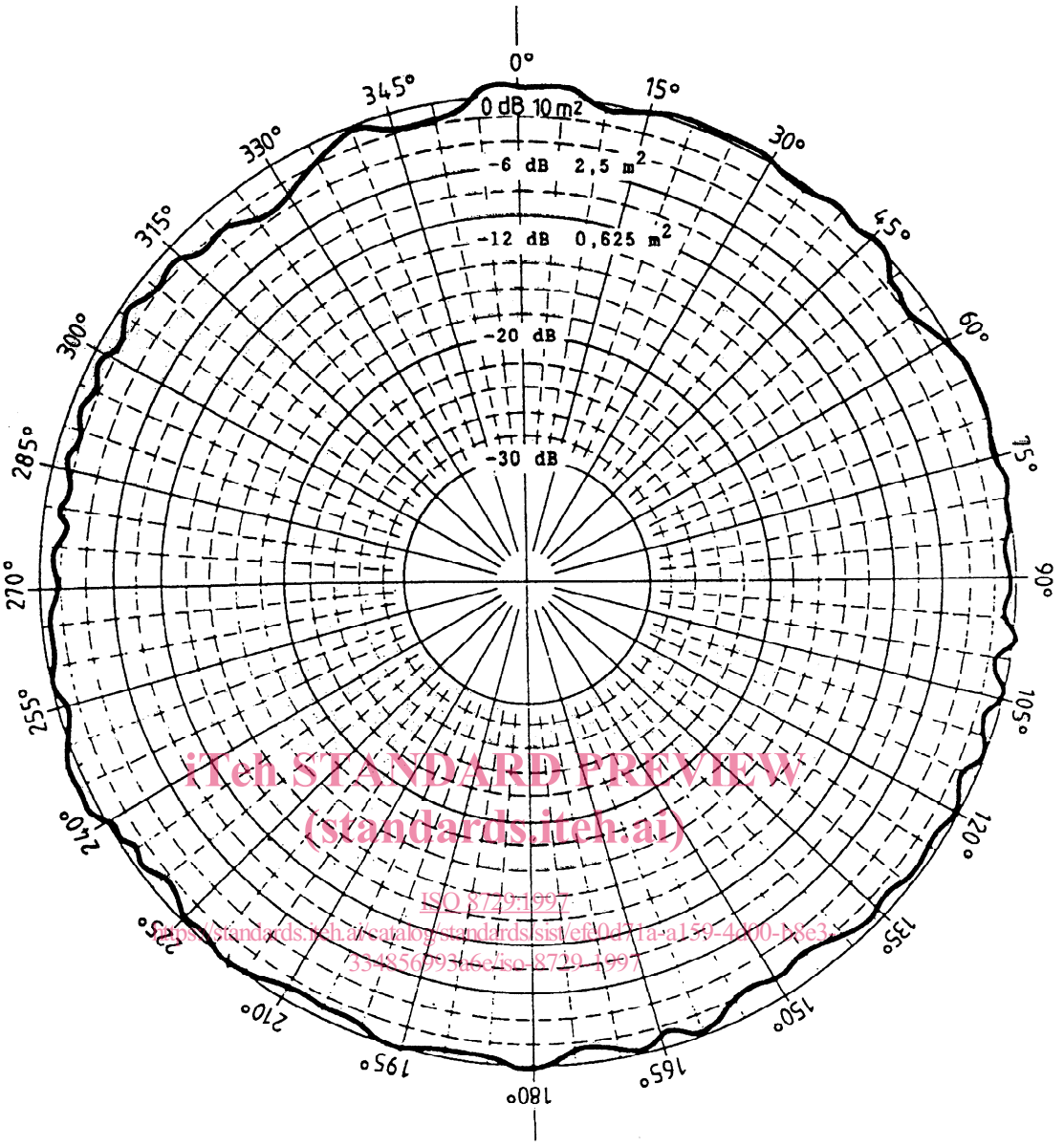


Figure 1 — Example diagram produced by a Luneberg reflector

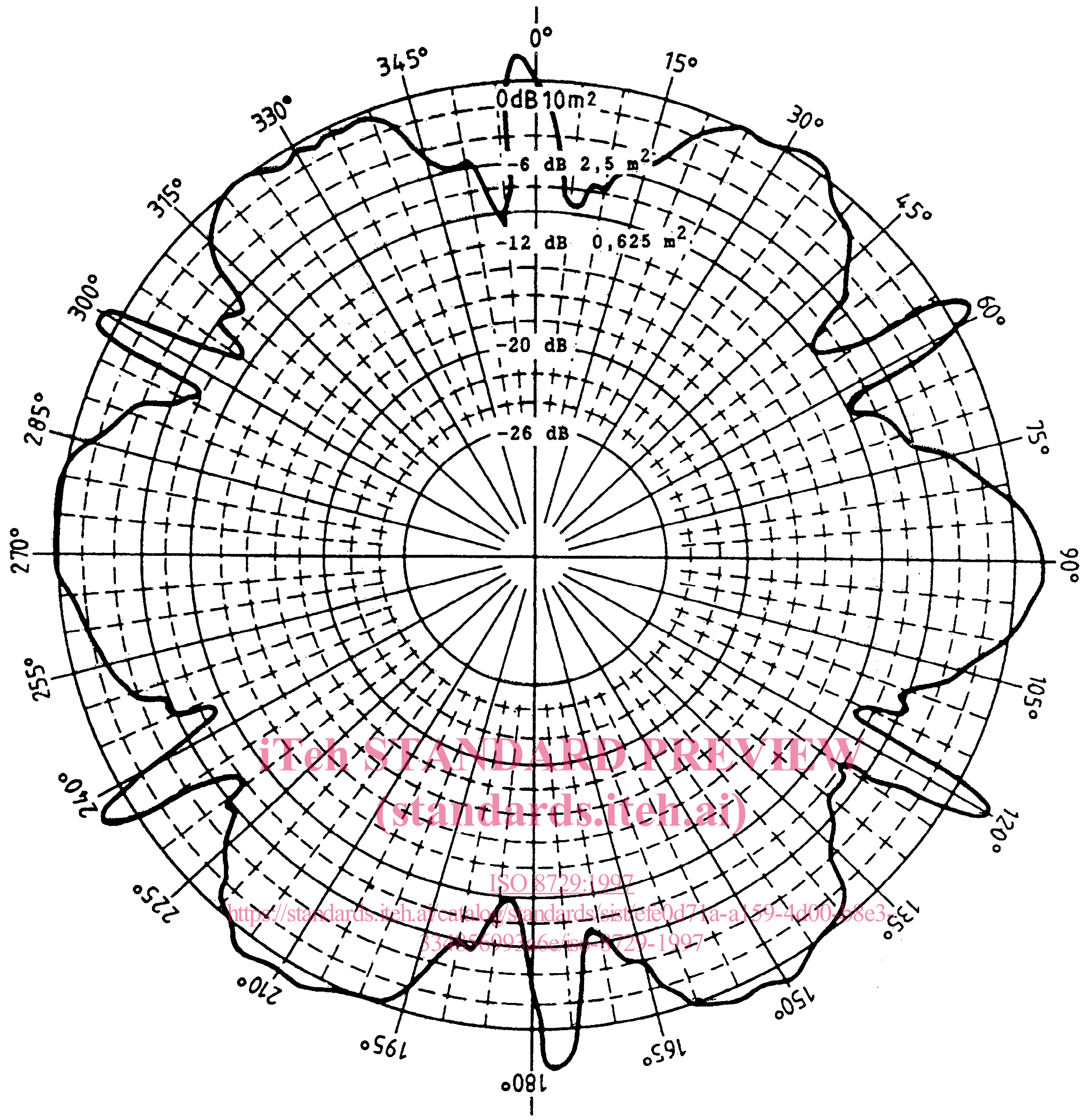


Figure 2 — Example diagram produced by a corner reflector

6 Type tests and inspection

6.1 Visual inspection

A visual inspection shall be carried out to confirm that the construction and finish of the reflector are satisfactory.

6.2 Performance test

The performance test shall be carried out in a chamber or on a test site where the background noise level has been reduced to the equivalent echoing area of 0,01 m² or less at frequencies between 9 320 MHz and 9 500 MHz. The test shall consist of measurement of polar patterns of the reflector within the volume defined in 5.1 and 5.2. These shall be spaced in elevation with a separation not exceeding 2,5°.

6.3 Mechanical strength test

The reflector shall be mounted in the recommended way and moved under water at a relative velocity of 1,3 m/s in both directions in each of three mutually perpendicular planes consecutively.

The reflector, mounted in the recommended way, shall also be subjected to a jet of water delivered at a rate of 1 kPa for a period of not less than 10 s on five separate locations on each face.

6.4 Other tests

The following tests shall be performed on the reflector:

— Dry heat cycle test, in accordance with IEC 945:1994, 4.4.2;
— Damp heat cycle test, in accordance with IEC 945:1994, 4.4.3;
— Low temperature cycle test, in accordance with IEC 945:1994, 4.4.4;
— Thermal shock test, in accordance with IEC 945:1994, 4.4.5;
— Drop test, in accordance with IEC 945:1994, 4.4.6;
— Vibration test, in accordance with IEC 945:1994, 4.4.7;
— Corrosion test, in accordance with IEC 945:1994, 4.4.11.

7 Marking

A label shall be affixed to each reflector, on a surface that does not contribute significantly to radar reflector performance, indicating:

a) the manufacturer;
b) the mark or type number;
c) the year of manufacture;
d) the recommended mounting height of installation (see 8.3 and annex A);
e) the mass of the reflector;
f) the maximum echoing area of the reflector;
g) the compass safe distance, if applicable;
h) the recommended orientation of mounting.

8 Installation

8.1 Method

The radar reflector shall be installed in accordance with a method recommended by the manufacturer.

Fixing arrangements shall be provided so that the reflector can be fitted in its correct orientation either on a rigid mount or suspended in rigging.

8.2 Positioning

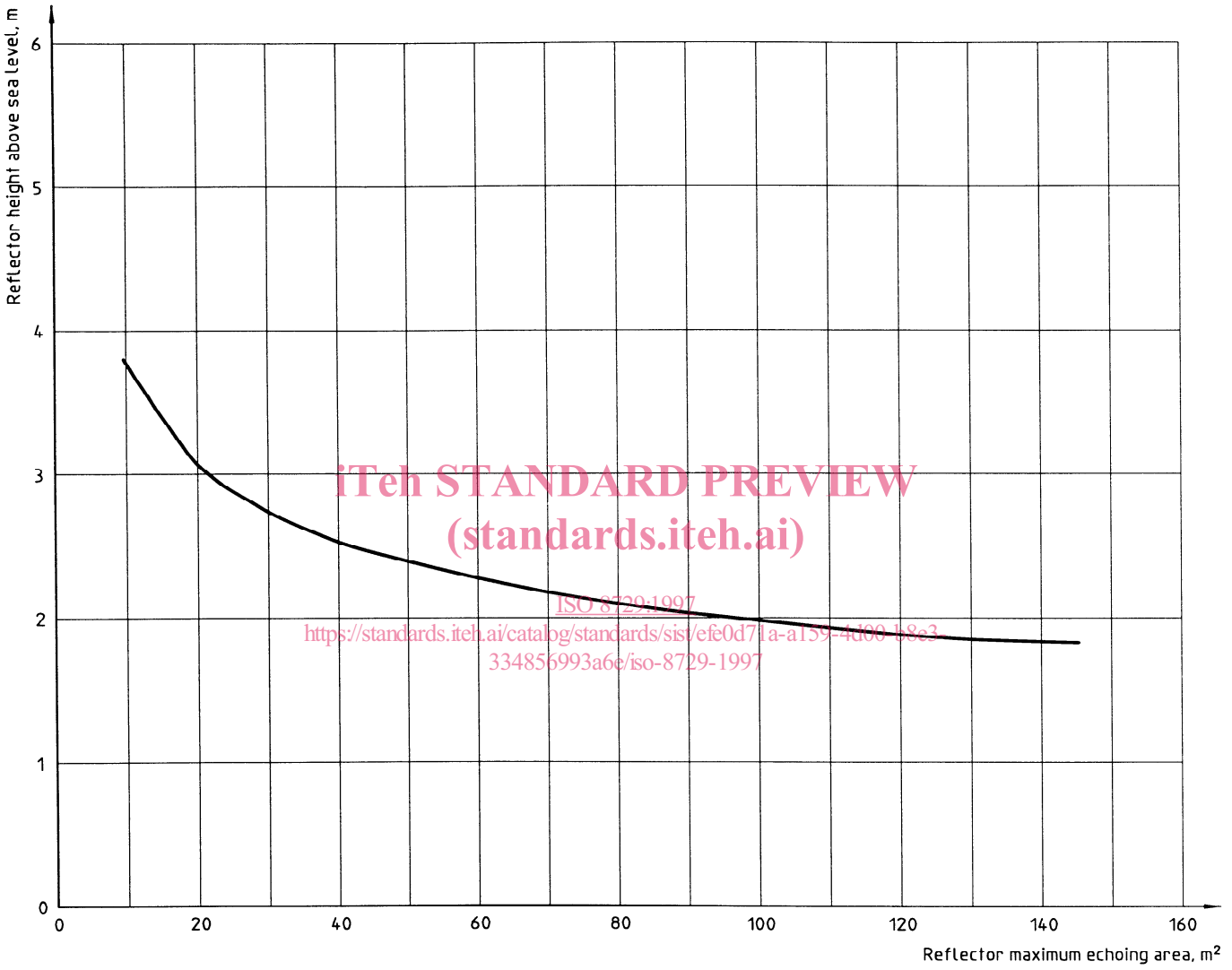
The radar reflector should be installed in the optimum position for the avoidance of shadow sectors.

8.3 Mounting height

The mounting height of a reflector shall be higher than the value given in annex A.

Annex A
(normative)

Mounting height of the reflectors



Annex B
(informative)

Bibliography

[1] IMO Resolution A.477(XII) (adopted on 19 November 1981), *Performance standards for radar equipment.*