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TRANSPORT
CANADA

COAST GUARD

STANDARDS FOR

NAVIGATION LIGHTS, SHAPES, SOUND SIGNAL APPLIANCES AND RADAR REFLECTORS

1991

SHIP SAFETY BRANCH
NAVIGATION SAFETY SECTION

STANDARDS FOR NAVIGATION LIGHTS, SHAPES, SOUND SIGNAL APPLIANCES AND RADAR REFLECTORS

1 INTRODUCTION

1.1 Scope

1.1.1 These Standards apply to navigation lights, shapes, sound signal appliances and radar reflectors required by the Collision Regulations. They are based on standards contained in:

.1 the Convention on the International Regulations for Preventing Collisions at Sear, as amended, 1972;

.2 International Maritime Oraganization Resolution A.384 (X) for radar reflectors; and

.3 American Boat & Yacht Council Standard A-16 concerning electric navigation lights for vessels of less than 20 metres in length that are not required by the Canada Shipping Act to be inspected, (see paragraph 3.2).

1.1.2 Reference to regulations, rules, sections, parts, schedules or annexes refer to the Collision Regulations, as amended

1.1.3 In testing equipment for compliance:

.1 a product employing materials or having forms of construction differing from those described in these standards may be examined and tested, and issued proof of compliance, if it is found that such a product substantially meets the requirements of these standards; and

.2 a radar reflector required by the Regulations shall comply with performance standards of Resolution A.384 (X), and shall be to the satisfaction of the appropriate authority of the state whose flag the vessel is entitled to fly.

1.1.4 The appropriate authority mentioned in paragraph 1.1.3.2 for Canadian ships is the Chairman.

1.1.5 In these Standards,

"COLREG" means the International Regulations for Preventing Collisions at Sea, 1972, as amended from time to time;

"Collisions Regulations" means the Canadian Collision Regulations (C.R.C., c. 1416) as amended;

"cut-off" means the practical cut-off as defined in the Collision Regulations; or as described in the ABYC-A16 standard for small vessels;

"Chairman" means the Chairman of the Board of Steamship Inspection, Department of Transport.

"marine surveyor" means a Transport Canada Coast Guard marine surveyor appointed as a steamship inspector;

"recognized testing centre" means a centre recognized by the Chairman.

1.1.6 The following abbreviations are used throughout these Standards.

"ABYC" means American Boat & Yacht Council

"ANSI" means American National Standards Institution

"ASTM" means American Standard Testing Material

"BS" means British Standards

"CIE" means Commission Internationale de l'éclairage, ("International Commission on Lighting")

"IEC" means International Electrotechnical Commission

"NRCC" means the National Research Council of Canada

"SAE" formerly meant Society Automotive Engineering, now means Engineering Society for Advancing Mobility, Land, Sea, Air and Space.

1.1.7 The following are the testing centres currently recognized by the Chairman:

.1 For Marine Navigation Lights — Canadian Standards Association,
178 Rexdale Boulevard,
Rexdale, Ontario
M9W 1R3

.2	For Sound Signal Appliance	Railway Appliance Research Limited 1605-675 West Hastings, Vancouver, British Columbia V6B 1N2
.3	For Radar Reflectors	The Director, Admiralty Research Establishment, Funtington, West Sussex, England, P01 88UE

1.2 Other Standards

1.2.1 Electrical wiring, light filaments, fixtures and control panels for marine navigation lights manufactured in Canada shall comply with the “Ship Safety Electrical Standards”, TP 127.

1.2.2 Reference to any publication or standard is to the latest issue unless otherwise specified by the authority applying this Standard.

2. INSPECTION

2.1 Non-inspected Vessels

2.1.1 The lights of a vessel, not required to be inspected under the Canada Shipping Act will be exempt from compliance with the provisions of Annex I if they are before 1 June 1984, constructed and installed in accordance with the Collision Regulations as those Regulations read on 31 July 1974, or the Small Vessel Regulations, as those Regulations read on 31 May 1984.

3. NAVIGATION LIGHTS

3.1 Fitting of Screens

3.1.1 Manufacturers may specify a particular type of light bulb and screening arrangement to be used to meet the requirements of the regulations.

3.1.2 Practical cut-off in the horizontal sector may be calculated as shown in diagram #1.

3.2 Electric Navigation Lights For Vessels Of Less Than 20 Metres In Length That Are Not Required To Be Inspected.

3.2.1 Requirements - General

3.2.1.1 The American Boat and Yacht Council A-16 Standard describes the design, construction, performance and installation of electric navigation lights that may be fitted on these vessels.

4. SOUND SIGNAL APPLIANCES

4.1 Whistles

4.1.1 The bridge wings and/or forward on the bow are considered to be the listening posts referred to in paragraphs 1(c) and (e), of Annex III. Other positions may be considered as listening posts where a ship's design features of its watchkeeping arrangements justify such designation.

4.1.2 A recommendation on the methods of measuring noise levels at listening posts is given in paragraph 9 of these standards.

4.2 Gongs

4.2.1 Gongs are required to produce a tone and sound that are separate and distinct from the bell.

5. TESTING PROCEDURES AND PERFORMANCE STANDARDS FOR NAVIGATION LIGHTS

5.1 COLLISION REGULATIONS, ANNEX I STANDARDS

5.1.1 Samples

5.1.1.1 Samples submitted for testing shall be representative of the devices as regularly manufactured and marketed.

5.1.2 Bulbs

5.1.2.1 Lights shall be tested using the types of bulbs specified to be used by the manufacturer. They shall be selected for accuracy as to filament position and shall be operated at the specified lumen output.

5.1.2.2 Alternately the lights may be tested using selected bulbs to place the filament at the lowest, the mean and the maximum vertical position and operated at design voltage.

5.1.3 Photometric Testing

5.1.3.1 The light shall be mounted on a two axis-goniometer so that the “horizontal” motion table is supported by the vertical motion supports, (see diagram 2).

5.1.3.2 Alternatively the light may be mounted on a horizontal rotating plate and the sensor moved vertically to obtain vertical displacements. During this period the distance between the centre of the light filament and the sensor must be kept constant.

5.1.3.3 Positional measurements shall be accurate to ±0.25 degrees.

5.1.3.4 Sensor to filament distance and sensor aperture size (or sensor acceptance angle) shall be selected to ensure that the sensor acceptance angle at the light is smaller than the smallest increment of motion that will be used in determining critical measurements. Cut-off angles and measurements made in the vicinity of lens deformities and support obstructions are examples of such critical measurements.

5.1.3.5 Sufficient readings shall be taken, particularly in the vicinity of lens deformities and support obstructions and when defining screen cut-offs, to adequately determine compliance.

5.1.3.6 Polar diagram recorders shall not be used in determining satisfactory cut-offs unless the recorder sensitivity and zero base line can be adjusted such that angles can be read to an accuracy of ±0.25 degrees at a light level equivalent to 10 per cent of the minimum required candela.

5.1.3.7 A suggested procedure would be to perform five (5) horizontal scans each covering the full arc of visibility at 0 degrees, ±5 degrees and ±7.5 degrees of elevation, and plotting on an x-y co-ordinate system. The areas in the vicinity of screen cut-offs could be plotted on an expanded scale as an aid in determining compliance.

5.1.3.8 The sensor shall be corrected by suitable filters to that of the standard CIE observer and shall be calibrated against a NRCC laboratory or another recognized national laboratory traceable standard lamp.

5.1.3.9 The response of the sensor and measuring amplifier shall be such that the rise time and decay time are approximately equal and sufficiently fast to reach 100 per cent of the incident light intensity when a step function is applied at a rate equal to the proposed sampling rate.

5.1.4 Chromaticity Testing

The colour of the light being emitted from the device shall be checked using one of the following methods.

5.1.4.1 Visual Method

The colour of the light from the device is compared visually with the colour of the light from a standard. The standard consists of a filter, the colour of which is determined spectra-chromatically, illuminated by a CIE source A. The chromaticity coordinates of the standard filters shall be as close as possible to the limits of the appropriate colour under test.

5.1.4.2 Tristimulus Method

In the method, photo-electric receivers, with filters to match the spectral responses of the CIE standard spectral tristimulus valves, are used to make colour measurements. The light being emitted may be collected in an intergrating sphere which in turn is used to illuminate the photo-electric receivers. If a two-beam telecolorimeter is used, portions of the light beam may be directed onto a pressed magnesium block from which the telecolorimeter will receive its input.

5.1.4.3 Spectroradiometric or Spectrophotometric Method

In these methods the actual spectral energy distribution is measured from which the chromaticity coordinates are computed. Any shift resulting from the sphere shall be corrected by filters, correction factor, or appropriate calibration. Sufficient portions of the beam shall be checked to obtain an overall colour measurement.

5.1.4.4 Precautions

1 The lamp shall be allowed to reach operating temperature before measurements are made.

2 Measurements should be made in as many directions as required to define the characteristics of the light.

3 Testing shall be done at such a distance, between the test instrument and the device, so that no further increase in distance will affect the measurement.

4 The entire light emitting surface of the device must be visible from any point on the entrance window of the test instrument.

5.1.5 Mechanical And Environmental Testing

5.1.5.1 Mechanical Strength

To ensure adequate mechanical strength for sea-going service and dimensional stability of the device, tests representative of the service to which the vessel will be subjected, shall be carried out.

5.1.5.2 Temperature

Lights shall be operated at ambient temperatures of 50 degrees C, 30 degrees C and -25 degrees C. Once temperature stabilization has been achieved at each of these three temperature stages, the lights shall be checked for distortion and damage. In addition, lights shall be cold soaked to -40 degrees C in a non-operating condition to check for permanent distortion or damage.

5.1.5.3 Water Resistance

Prior to water impingement testing, lamps shall be removed and replaced. The light shall be energized at rated voltage for a period of 1 hour a approximately 25±2 degrees C. A solid stream of water from a nozzle not less than 25.4 mm in diameter and under a pressure of 103.4 kPa, measured at the nozzle, is to be directed at the enclosure from a distance of 3.1 metres for a period of 5 minutes. The water temperature of the stream measured at the nozzle shall be 10 degrees C.

On completion of the test, the outside of the light is to be dried with a cloth and the enclosure then opened and examined for any evidence of leakage and for cracked or broken lenses or globes due to the impingement of cold water on the heated assembly. There shall be no evidence of liquid leakage or evidence of thermal shock damage to lamps, lenses or seals.

5.1.5.4 Salt Spray

The light shall be subjected to a Salt Fog Corrosion Test in accordance with ASTM Standard B117-73, Method of Salt Spray (Fog) Testing, for 2 hours, using a 5 per cent salt solution. Subsequently, the light is to be placed in a high humidity chamber (relative humidity 95±5 per cent) at 35 degrees C for a 24 hour period. The light is then to be stored at normal ambient conditions (25 degrees C with a relative humidity of 50±5 per cent) for 3 days after which the light shall still be mechanically and electrically operative.

5.1.5.5 Vibration

The light is to be mounted to a rigid test fixture in a vertical position simulating a normal ship installation. The light is to be operable throughout the test.

The light sample is to be subjected to a variable frequency test in each of three rectilinear orientation axes (horizontal, lateral, and vertical) for a period of 2 hours in each axial position (total 6 hours) at a peak-to-peak amplitude of 0.51±0.03 mm. The vibration table shall be automatically cycled between 5 and 60 hertz (Hz) every 5 minutes. For this test, peak-to-peak amplitude is defined as the maximum displacement of sinusoidal motion (i.e. total table displacement).

The light shall not fail to function during the test and there shall be no evidence of a failure of the enclosure, the mounting means, and electrical devices, or evidence of changes in spacing or orientation of components that could alter the arc of visibility. Gaskets or other means provided to ensure weathertight or watertight construction shall not be displaced or otherwise made ineffective. The failure of a lamp will not be cause for failure of the navigation light.

5.2 ABYC A-16 STANDARD

5.2.1 Testing Navigation Light Fixtures

The navigation lights to be fitted on uninspected vessels of less than 20 metres in length may be tested for compliance with the American Boat and Yacht Council A-16 Standard.

6 TESTING PROCEDURES AND PERFORMANCE STANDARDS FOR SOUND SIGNAL APPLIANCES

6.1 WHISTLES

6.1.1 Samples

Samples submitted for testing shall be representative of the devices as regularly manufactured and marketed.

6.1.2 Power Source

Samples must be powered in the same manner as specified by the manufacturer. If tolerances are allowed in the powered source the device shall be tested at the tolerance extremes.

6.1.3 Test Location

.1 Test shall be carried out either in an anechoic chamber large enough to meet the requirements of measurement of sound power at 70 Hz or may be carried out in open fields (grass surface) with the device at least 3 metres above the field surface.

.2 The test location should be proven by obtaining sound level readings at various distances to prove that the field in use obeys the inverse square law.

.3 If an area outdoors is used, readings should also be taken with the measuring microphone and sound device at various heights above the ground to show that a further increase in height does not alter the sound pressure level.

6.1.4 Measurement Equipment

.1 The equipment used shall be a sound level meter with an incorporated 1/3-octave band filter (or with an external 1/3-octave filter) which complies with ANSI S1.14 - 1971, IEC 179, BS 4197 (Sound level meters) and ANSI S1.11 - 1971, IEC 225, BS 2475 (Filters).

.2 The measuring system must have valid calibration, supplied by a national standards laboratory.

.3 Calibration must, at least, include sensitivity and frequency response for the microphone.

.4 If measurements are made outdoors, care must be exercised to ensure that calibration accuracy is maintained under humid conditions.

6.1.5 Measurement Procedure

.1 All of the following readings must be taken within the field where the inverse square law is valid.

.2 With the microphone directly ahead of the whistle, a 1/3-octave band analysis shall be made to determine the fundamental frequency and the 1/3-octave bands containing the major components of the signal between 180 Hz and 700 Hz. The whistle shall then be rotated through 360 degrees and readings taken in dB(A) and in the 1/3-octave bands (dB) as determined above.

.3 As some of the frequencies specified in Annex III do not coincide with 1/3-octave band centre frequencies, care must be exercised in selecting the appropriate 1/3-octave band.

.4 When measuring sound pressure levels for the specified frequencies the following bands shall be selected:

ANNEX III Frequency Hz	1/3-Octave Band Centre Frequency
70	63
130	125
180	200
250	250
350	315
500	500
700	630

Note: It would also be permissible to rotate the measuring microphone through 360 degrees around a stationary whistle while maintaining a constant horizontal plane passing through the centre of the whistle and staying within the field where the inverse square law is valid. The distance from the centre of the whistle to the microphone must be recorded for each station.

.5 The dB(A) readings may be required every 15 degrees up to ±45 degrees from ahead and every 30 degrees for the remaining 270 degrees. However, if the data exhibits a large standard deviation it may be necessary to increase the number of readings.

.6 All data shall be reduced to equivalent sound levels at a distance of one metre from the whistle.

.7 The dB(A) readings shall be reduced to an equivalent distance at 110 dB(A) and 100 dB(A); the angular position shall also be reported.

7. PERFORMANCE STANDARDS FOR RADAR REFLECTORS

7.1 Application

7.1.1 If the minimum height specified in the regulations for fitting a radar reflector cannot be met, the radar reflector may be fitted a minimum height of 2 metres above the waterline and have an echoing area of 40 m^2, see diagram 3.

7.2 Performance

7.2.1 The echoing areas referred to in paragraph 7.1.1 correspond to the maximum values of the main lobes of the polar diagram, diagram 4.

7.3 Installation

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

7.3.2 Any preferred orientation of mounting should be clearly marked on the reflector. In the case of the an octahedral reflector, the correct method of mounting is one corner cavity at the top and one at the bottom.

7.4 International Standard

7.4.1 The International Maritime Organization Resolution A.384 (X) “Performance Standards for Radar Reflectors” is the adopted standard.

7.5 Effective Date

7.5.1 This Standard came into force on January 1, 1978.

8. PERFORMANCE STANDARDS FOR RADAR REFLECTORS

RESOLUTION A.384 (X)

Adopted on 14 November 1977

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

RECOGNIZING that small vessels will improve the range and probability of their radar detection, if fitted with radar reflectors,

HAVING CONSIDERED the Report of the Maritime Safety Committee on its thirty-sixth session,

RESOLVES:

(a) to adopt the Recommendation of Performance Standards for Radar Reflectors, set out in the Annex to this Resolution;

(b) to recommend that Member Governments should require all vessels of less than 100 tons gross tonnage operating in international waters and adjacent coastal areas to be fitted, if practicable, with a radar reflector complying with performance standards not inferior to those shown in the Annex to this Resolution.

REVOKES Resolution A.277(VIII).

ANNEX

RECOMMENDATION ON PERFORMANCE STANDARDS FOR RADAR REFLECTORS

1. Introduction

1.1 Small craft referred to in paragraph 2 of this Recommendation should be fitted with radar reflectors to improve the range and probability of their radar detection.

1.2 Radar reflectors should comply with the minimum performance requirements as specified in this Recommendation.

1.3 In the following paragraphs the echoing areas specified are those for the frequency of 9.3 Ghz (corresponding to a wavelength of 3.2 cm).

2. Application

2.1 All vessels of less than 100 tons gross tonnage operating in international waters and adjacent coastal areas should, if practicable, be fitted with a radar reflector.

2.2 The radar reflector should be of an approved type with an adequate polar diagram in azimuth, and an echoing area:

(i) preferably, of a least 10 m^2, mounted at a minimum height of 4 m above water level; or

(ii) if this is not practicable, of at least 40 m^2, mounted at a minimum height of 2 m above water level.

3. Performance

3.1 Reflectors should be capable of performance around 360° in azimuth using a typical marine navigational radar.

3.2 The echoing areas referred to in paragraph 2 correspond to the maximum values of the main lobes of the polar diagram.

3.3 The azimuthal polar diagram should be such that the response over a total angle of 240° is not less that -6dB with reference to the maxima of the main lobes and that the response should not remain below -6dB over any single angle of more than 10°.

4. Construction

The reflector should be capable of maintaining its reflection performance under the conditions of sea states, vibration, humidity and change of temperature likely to be experienced in the marine environment.

5. Installation

5.1 Fixing arrangements should be provided so that the reflector can be fitted either on a rigid mount or suspended in the rigging.

5.2 If there is a preferred orientation of mounting this should be clearly marked on the reflector. In the case of an octahedral reflector, the correct method of mounting is one corner cavity at the top and one at the bottom. Any other method might reduce its performance below that in 3.3.3.

9. RECOMMENDATION ON METHODS OF MEASURING NOISE LEVELS AT LISTENING POSTS

RESOLUTION A.343 (IX)

Adopted on 12 November 1975

THE ASSEMBLY,

NOTING Article 16(i) of the IMO Convention concerning the functions of the Assembly,

CONSIDERING the need to restrict the noise levels at listening posts in vessels in order to ensure an adequate probability of hearing a whistle at the audibility range given in the table of paragraph 1(c) of Annex III to the International Regulations for Preventing Collisions at Sea, 1972.

HAVING EXAMINED the Recommendation of Methods of Measuring Noise Levels at Listening Posts adopted by the Maritime Safety Committee at its thirty-second session,

RECOMMENDS that the method for measuring the noise levels at listening posts should be as follows:

(a) a precision sound level meter according to IEC - Publication No. 179 should be used in conjunction with an octave-band filter according to IEC - Publication No. 225. The microphone should be equipped with a windscreen of know transmission characteristics and an extension cable. At the beginning and the end of each series of measurements the calibration of the sound level meter should be checked with a standard sound source (e.g. a pistonphone) according to the manufacturer's instructions;

(b) all readings should be taken with the dynamic characteristic "slow". The average of the maximum values observed during a period of ten seconds when the vessel is making way at 3/4 speed will be regarded as the prevailing noise level. On bridge wings the measurements should be made on the lee side;

(c) the microphone should, if possible, be so placed that, during the measurements, it is separated by a distance of at least 1.5 m from any substantial reflecting or obstructing surface;

(d) an average value should be determined in the area of the usual listening position from measurements made in at least three different microphone positions separated by at least 0.5 m from one another and approximately at the average height of ear of normal listeners;

(e) as far as is practicable, measurements should be made in conditions of wind speed between 5 knots and 10 knots:

(i) with the wind ahead,

(ii) with the wind astern, and

(iii) with the apparent wind successively on both beams and the listening position on the corresponding lee side of the vessel;

(f) whether or not these recommended conditions can be achieved, the prevailing wind speed and direction and the course of the vessel should be recorded;

(g) furthermore, a record should be kept of the state of the sea and of the condition of loading of the vessel.

FURTHER RECOMMENDS that Administrations should institute programmes of measurement in accordance with the above, within the limits of their capabilities, in order that evidence may be collected on the noise levels currently experienced at listening posts, both on existing vessels and on new vessels when brought into service. Administrations are invited to submit the results of such measurement to the Organization for consideration by the appropriate sub-committee(s).

ADOPTS provisional guidelines on maximum acceptable noise levels at listening posts, as illustrated below.

PROVISIONAL GUIDELINES ON MAXIMUM ACCEPTABLE NOISE LEVELS AT LISTENING POSTS

1. It is desirable that the background noise levels at listening posts should not on average exceed the noise level defined by octave-band levels as follows:

(a) 68 dB in the band centred on 250 Hz;

(b) 63 dB in the band centred on 500 Hz.

2. Ship designers and builders should be encouraged to meet this requirement in new vessels. Measurements should be made when possible in accordance with the method recommended above, in order to check results.

3. So far as existing vessels are concerned, it is recognized that problems of a ship construction mature may make it difficult, if not impossible, to meet the requirement. These vessels should therefore comply as far as is feasible.

10. SCREENING OF SIDELIGHTS

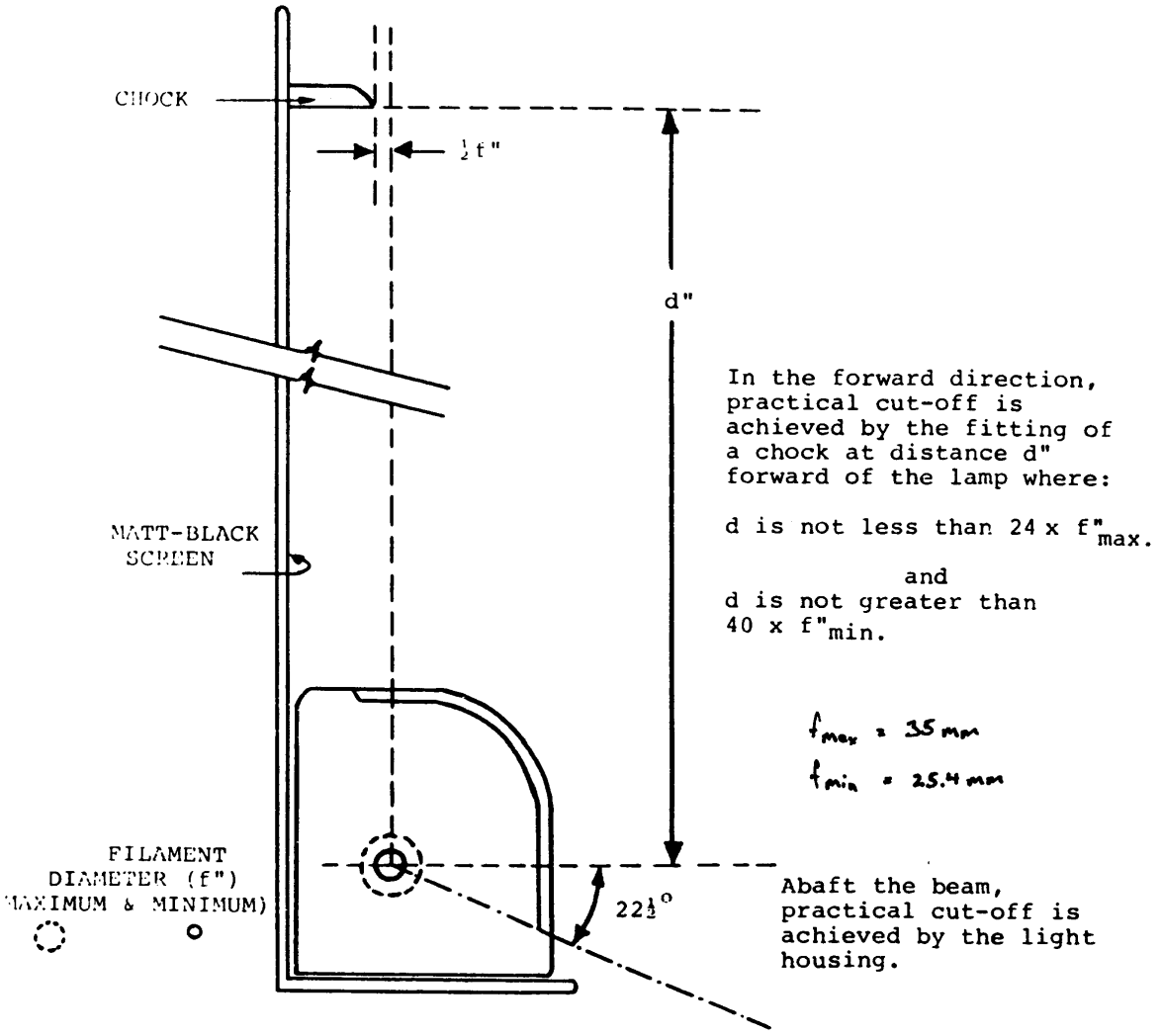


Diagram 1

* Individual screening arrangements described by the light manufacturer, that comply with the “cut off” specified in the Collision Regulations will be accepted.

11. A TWO-AXIS GONIOMETER

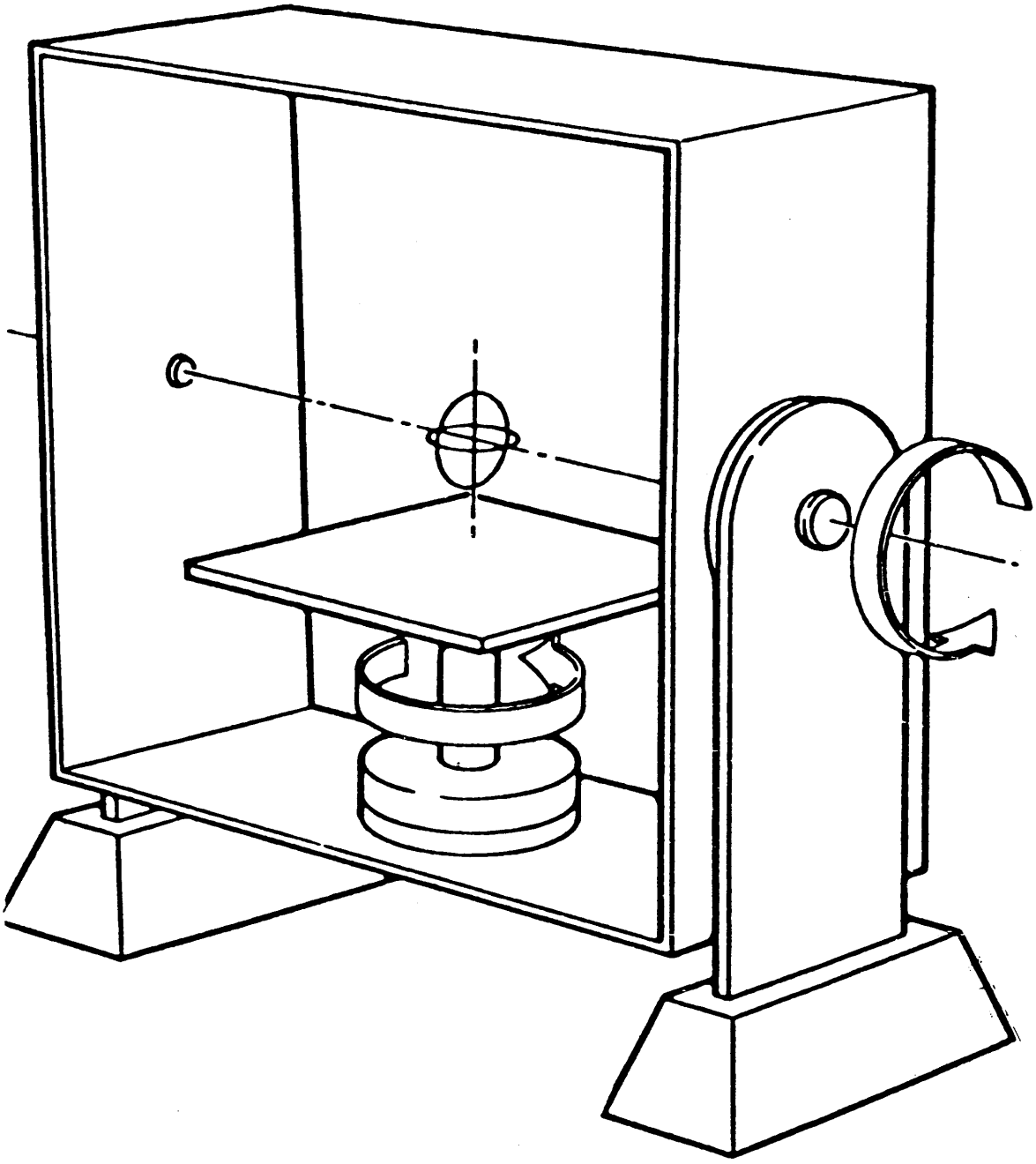
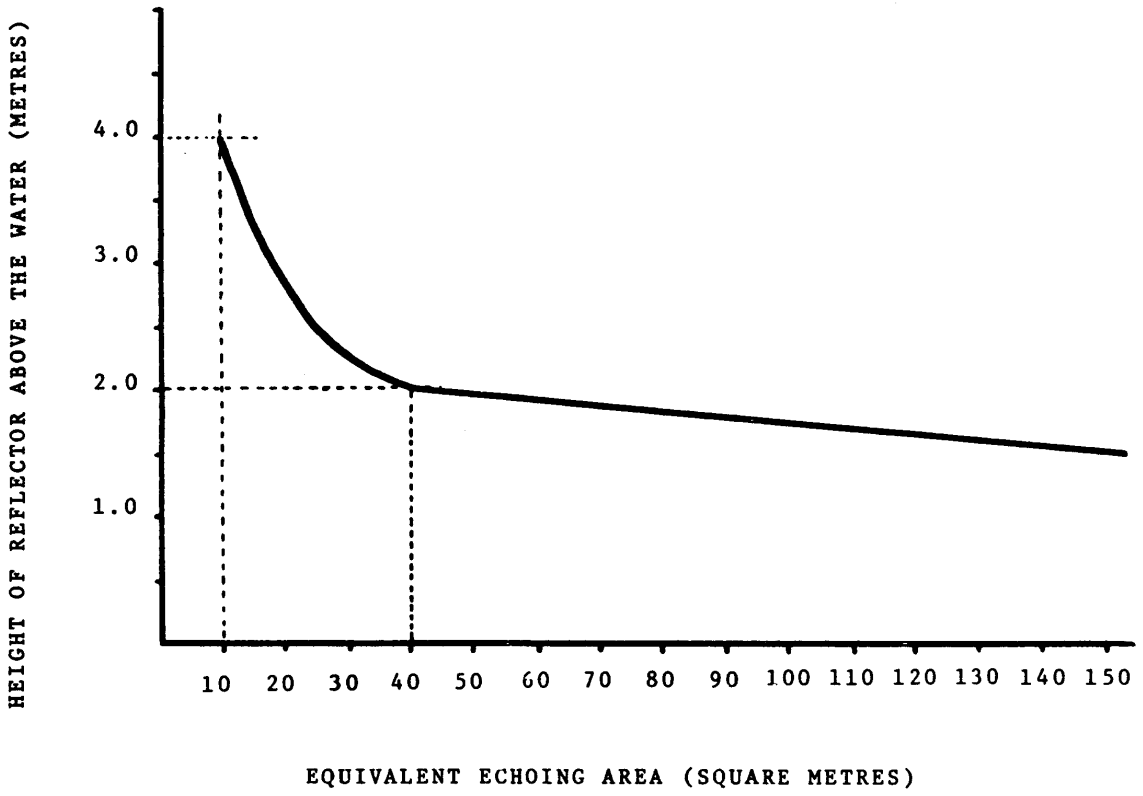


Diagram 2

12. MINIMUM INSTALLATION HEIGHT OF REFLECTORS ABOVE THE WATER AND CORRESPONDING ECHOING AREAS FOR ADEQUATE DETECTION BY STANDARD SHIPBOARD RADARS



EQUIVALENT ECHOING AREA (SQUARE METRES)

Diagram 3

13. TYPICAL AZIMUTHAL POLAR DIAGRAM FOR A RADAR REFLECTOR

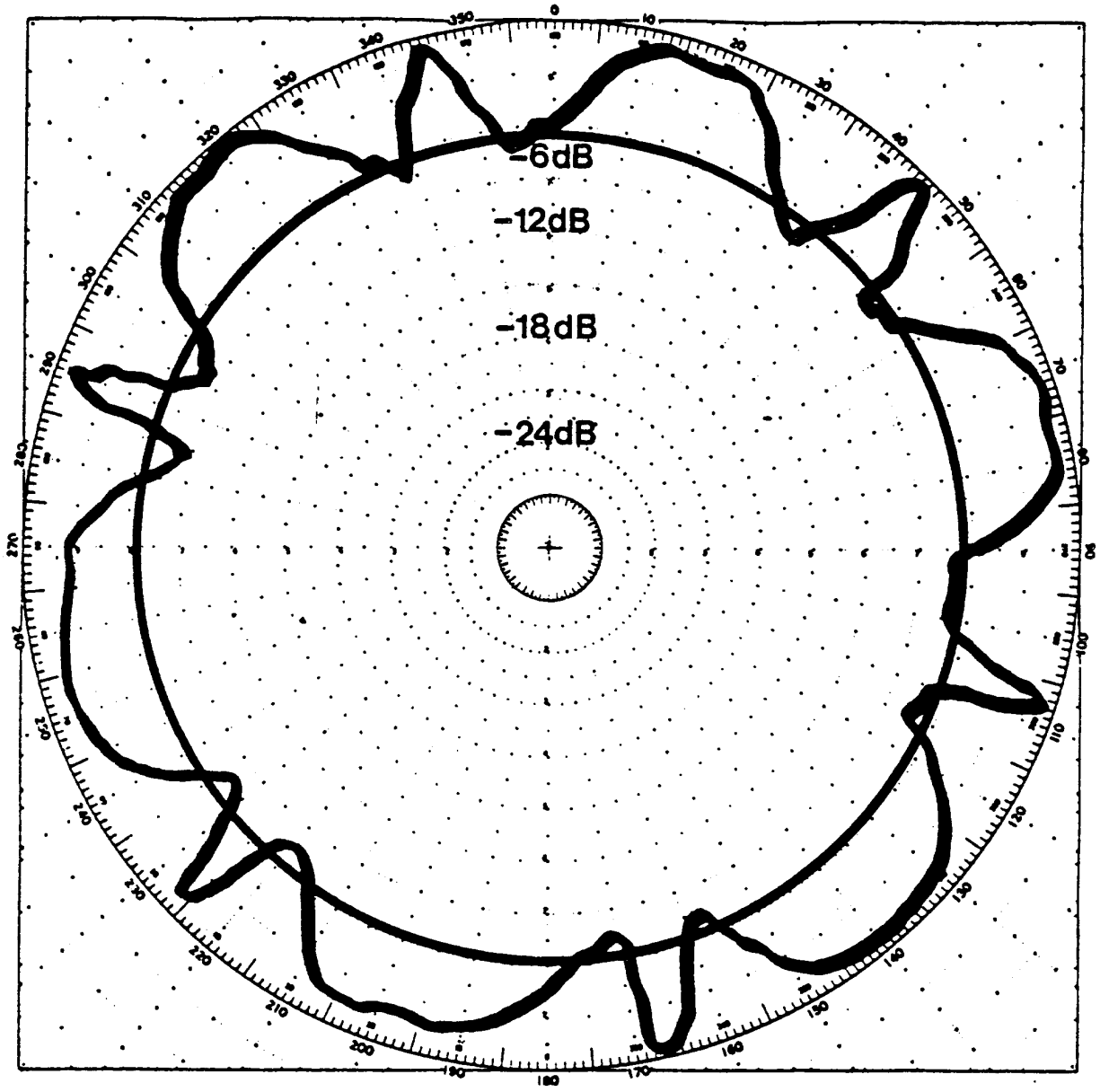
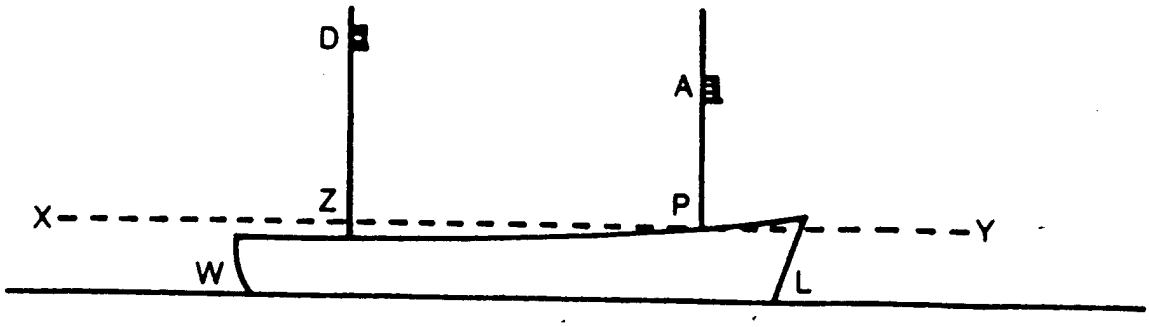


Diagram 4

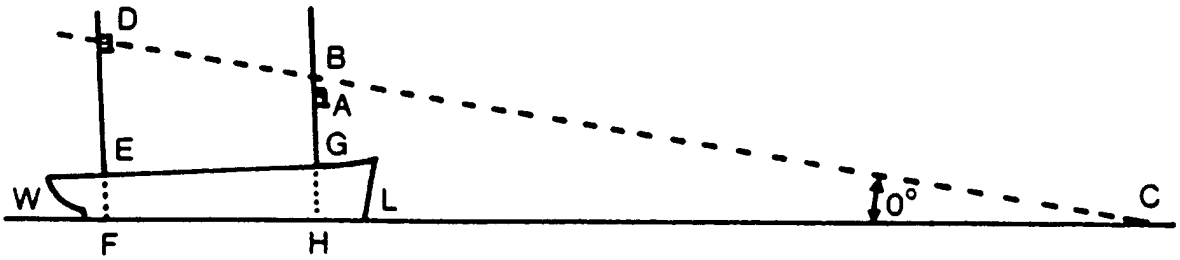
14. VERTICAL SEPARATION OF MASTHEAD LIGHTS

14.1 Collision Regulations Annex 1 paragraph 2(a)(ii)



WL is waterline with vessel on even keel.
XZY is parallel to WL passing through the point P on the uppermost continuous deck, vertically below A.
A is the foremast light; D is the mainmast light.
It is required that ZD is at least 4.5 metres more than AP.

14.2 Collision Regulations Annex 1 paragraph 2(b)



1. To find Angle C (with the aid of the Ship's drawing)

Horizontal distance CL + LH + HF = CF

Vertical heights DE + EF = DF

$$\text{Tan C} = \frac{BH}{CF}$$

2. To find BH (The height where the dotted line crosses the foremast)

$$\text{Tan C} = \frac{\text{BH}}{\text{CH}}$$

$$\text{BH} = \text{CH} \times \text{Tan C}$$

3. To find height of B above A (with the aid of the Ship's drawing)

$$\text{AB} = \text{BH} - \text{AH}$$

WL is waterline with maximum trim by the stern.
C is 1000 metres ahead of the vessel's stem.
A is the foremast light; D is the mainmast light.
CD produced cuts the foremast at B; for the foremast light to be seen from C distinctly separate from and below the mainmast light, it must be placed a minimum distance of about 0.5m below B at position A.