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Ships and marine technology — Low- location lighting on passenger ships — Arrangement

*Navires et technologie maritime — Éclairage situé en bas sur les navires à
passagers — Disposition*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

Annexes A to G form a normative part of this International Standard ISO 15370 which was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Lifesaving and fire protection*.

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Introduction

This International Standard is intended to supplement International Maritime Organization (IMO) requirements for low-location lighting used on passenger ships complying with the 1974 Safety of Life At Sea Convention (SOLAS 74), as amended.

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Ships and marine technology — Low-location lighting on passenger ships — Arrangement

1 Scope

This International Standard specifies the requirements for the approval, installation and maintenance of low-location lighting systems as defined in Chapter II-2, Regulations 28 and 41-2 of the *International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974)*, as amended in 1996, and the IMO International Code for Fire Safety Systems.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2919:1999, *Radiation protection — Sealed radioactive sources — General requirements and classification*.

IMO Resolution MSC.98(73)¹⁾, *International Code for Fire Safety Systems*.

IMO Resolution A.760(18) (adopted on 4 November 1993), *Symbols related to life-saving appliances and arrangements*.

IMO MSC/Circular 451 (dated 24 September 1986), *Guidance concerning the location of fire control plans for the assistance of shoreside fire-fighting personnel*.

IEC 60092-101:1994, *Electrical installations in ships — Part 101: Definitions and general requirements*.

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*.

IEC 60598-2-22:1990, *Luminaires — Part 2: Particular requirements — Section 22 — Luminaires for emergency lighting*.

IEC 60945:1996, *Marine navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*.

CIE 121-1996, *The Photometry and Goniophotometry of Luminaires*.

International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974), as amended in 1996.

1) To be published.

3 Terms and definitions

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

3.1

approval

formal acceptance of the product and arrangement issued by the competent authority

3.2

assembly station

muster station

designated internal or external space where persons are gathered in the event of an emergency

3.3

care and maintenance

all measures for the preservation and/or restoration of the original conditions of the technical elements of a system as well as all measures for the determination and evaluation of the actual conditions

3.4

competent authority

administration whose flag the ship is entitled to fly, or an organization authorized by an ADMINISTRATION to perform functions required by this International Standard

3.5

dead-end corridor

corridor or part of a corridor from which there is only one escape route

3.6

electrically powered systems

EP systems

LLL systems which require electrical power for their operation, such as systems using incandescent bulbs, light-emitting diodes, electroluminescent strips or lamps, electrofluorescent lamps, etc.

3.7

escape route

designated route through which people are intended to move from an occupied space to the closest exits

3.8

fire equipment

all items that are used in fire-fighting operations, such as firemen's outfits, fire extinguishers, fire-hose boxes, etc.

3.9

IMO symbols

symbols contained in IMO Resolution A.760(18) and IMO/MSC/Circular 451

3.10

installation plan

plan consisting of a ship's general arrangement showing the layout of the LLL system using different kinds of lines, colours, and various symbols, as appropriate

3.11

low-location lighting systems

LLL systems

electrically powered lighting or photoluminescent strips or indicators placed at points of the escape routes to readily identify such routes when the normal emergency light is less effective due to smoke

3.12

markings

indicators which identify fire equipment, doors, or other non-directional information

3.13**photoluminescent lighting system****PL system**

an LLL system having materials which contain chemicals, such as zinc sulfide, rare earth compounds, or strontium aluminate, that give it the ability to store energy when illuminated by light; the PL material emits light which becomes visible when the ambient light source is less effective

3.14**signs**

posted information, used in conjunction with LLL systems, indicating the escape routes or direction to the assembly station

3.15**visible delineation**

portrayal of the escape route by a series of contiguous strips or indicators that can be clearly seen during egress

4 Performance requirements**4.1 General**

4.1.1 The competent authority shall ensure that LLL systems and their components meet the requirements set out in this International Standard, as verified through the presentation of relevant certificates issued by recognized laboratories.

4.1.2 Combinations of PL and EP systems may be permitted. However, only one system shall be applied for each deck or stairway enclosure unless the deck or stairway enclosure is separated by normally closed doors. In addition, signs and markings made of PL materials may be used with EP systems.

4.1.3 The supplementary emergency lighting for ro-ro passenger ships required by Regulation II-1/42-1 of the 1974 SOLAS Convention, as amended, may be accepted to form partly or wholly the LLL system, provided that such a system complies with the requirements of this International Standard.

4.1.4 Interruption of the LLL system due to constructional practicalities (corridors, cabin doors, etc.) shall not exceed 2 m.

4.1.5 The LLL system shall function at all times for at least 60 min after its activation.

4.1.6 LLL products shall not contain radioactive materials unless such materials are designated "sealed radioactive materials" tested in accordance with ISO 2919. However, materials containing radioactive radionuclides, as shown in ISO 2919:1999, annex A, are considered as sealed radioactive materials which should be tested in accordance with ISO 2919.

4.1.7 LLL systems shall not release toxic materials under normal conditions.

4.2 Photoluminescent systems

4.2.1 Photoluminescent materials shall provide a luminance of at least 15 mcd/m² measured 10 min after the removal of all external illuminating sources. The system shall continue to provide luminance values greater than 2 mcd/m² for 60 min. The light level shall be measured at the surface of the materials. The minimum level of ambient light necessary to charge the PL material to meet the required luminance values and the spectrum emission of the light adopted during the test contained in annexes A through C, shall be verified and recorded.

4.2.2 Except where noted, PL strips should have a width of 75 mm or greater. Photoluminescent strips having a width less than 75 mm shall only be used if the luminance is increased to compensate for the reduced width in accordance with Table D.1 annex D.

4.2.3 PL materials shall be flame-retardant materials in accordance with IEC 60092-101.

4.2.4 PL materials shall be tested in accordance with annex A.

4.3 Electrically powered systems

4.3.1 Electrically powered systems shall be connected to the emergency switchboard as required by Regulation II-1/42 of the 1974 SOLAS Convention, as amended, so as to be powered by the main source of electrical power under normal circumstances and also by the emergency source(s) of electrical power (as identified by Regulations II-1/42.3) when the latter is in operation. Alternatively, for passenger ships carrying more than 36 passengers and built before October 1, 1994, EP systems may be connected to the main lighting system, provided independent batteries provide a backup of at least 60 min and are charged from the main lighting system. Performance of the system while powered by batteries shall meet all the requirements stated herein.

4.3.2 For planar or line sources such as electroluminescent or electrofluorescent panels, or side-emitting fibre optics, the surface of the indicators shall have a minimum luminance of 10 cd/m². The luminous intensity along a line source shall be uniform, such that the maximum luminance of the source does not exceed the minimum luminance of the same source by a factor of greater than ten.

4.3.3 Point sources

4.3.3.1 Miniature incandescent lamps shall provide not less than 150 mcd mean spherical intensity with a spacing of not more than 100 mm between lamps.

4.3.3.2 Sub-miniature incandescent lamps and light-emitting diodes (LEDs) shall have a minimum intensity of 35 mcd at the centre of the appropriate viewing cones. The intensity distribution shall be appropriate to the likely track directions of approach and viewing. For sources which are required to be viewed from a horizontal position, (i.e., deck mounted or horizontal bulkhead mounted fittings) the intensity distribution shall be within a 60° cone having its centre located 30° from the horizontal mounting surface of the point source and in line with the track direction. For sources which are required to be viewed vertically (i.e., the vertical LLL marking up to the door handles) the intensity distribution shall be within a 60° cone having its centre located perpendicular to the mounting surface of the point source. Spacing between sources shall be not more than 300 mm. See annex E, Figures E.1 and E.2.

4.3.4 The power-supply arrangements to the LLL system shall be arranged so that a single break in the supply cabling does not result in the system becoming ineffective.

NOTE This requirement can be achieved by using at least two battery power supplies in each single main vertical fire zone or by using fire-resistant cables, in accordance with IEC 60331, from the emergency switchboard to the input of the LLL system.

4.3.5 EP systems shall meet the relevant requirements for emergency luminaires in accordance with IEC 60598-2-22 when tested at a reference temperature of 40 °C.

4.3.6 EP systems shall meet the requirements for vibration and electromagnetic interference in accordance with IEC 60945.

4.3.7 EP systems shall provide a minimum degree of ingress protection of at least IP 55 in accordance with IEC 60529.

4.3.8 EP materials shall be flame retardant in accordance with IEC 60092-101.

4.3.9 Entire systems, including those that are automatically activated or continuously operating, shall be capable of being manually activated by a single action from the continuously manned central control station. Deactivation of the system shall only be possible from the continuously manned central control station.

4.3.10 EP materials shall be tested in accordance with annex F.

5 Technical product documentation

5.1 The technical product documentation for LLL systems shall comprise the following documents:

- installation plan, which should include the wiring layout and contain examples of the details of LLL signs, markings, and arrangements;
- list of items depicted in the installation plan;
- description of installation;
- comparative specimen sketches and drawings;
- maintenance specifications.

5.2 Approval documentation for PL materials shall include the minimum level of ambient light necessary to charge the PL material to meet the required luminance as specified in 4.2.

6 Installation on board

6.1 General

6.1.1 Positioning of the LLL system and signs shall be arranged to enable persons to readily identify all escape routes and exits. However, LLL should not be installed in public spaces. In addition, to prevent escaping persons from having to cross LLL strips, lighting need not be installed along the door thresholds or across stairway landings.

6.1.2 LLL systems shall be fitted in accordance with the manufacturer's specification. When the LLL system is installed on decks, it shall be arranged in such a way that the LLL strips do not constitute a danger for the free circulation of people. Generally, LLL strips should be flush with the carpet or the primary deck-covering surface. When fitted on bulkheads, the arrangement shall be such that the fire integrity of divisions is not impaired.

6.2 Corridors

6.2.1 In all corridors the visual effect of the LLL system shall be continuous, except where interrupted by intersections with other corridors, cabin doors, or local enlargements or recesses, to provide a visible delineation along the escape routes. In way of local enlargements or recesses, the maximum interruption permitted in LLL systems shall not exceed 2 m.

6.2.2 The LLL shall be installed on at least one side of the corridor. In corridors more than 2 m wide, LLL shall be installed on both sides. Small individual recesses, less than 2 m long in the line of the corridor or with a combined total length less than 50 % of the length of the corridor, shall not be included when calculating the width of a corridor.

6.2.3 The LLL system shall be located either on the bulkhead within 300 mm of the deck, or on the deck within 150 mm of the bulkhead. LLL may be installed at a distance greater than 150 mm from the bulkhead in way of recesses, as shown in normative annex G, Figure G.1, or where the escape routes cross open spaces, public spaces, lobbies or landings exceeding 4 m in the line of escape. Steps in corridors shall comply with 6.4.

6.2.4 In dead-end corridors, the LLL system shall include arrows or equivalent direction indicators, at intervals of no more than 1 m, pointing away from the dead end.

6.3 Doors

6.3.1 Doors which form part of the escape route (e.g., doors in stairways, main vertical-zone boundaries in corridors), or doors leading to open decks shall be marked by LLL in accordance with this International Standard. Transparent doors along the escape route need not be marked if they are a swinging type without fixed means for

their closure. Where a door is used in both directions as a primary or secondary means of escape (e.g., a door at the main vertical zone boundary) it shall be marked on both sides. To prevent confusion, only exit doors shall be marked with the LLL.

6.3.2 The LLL shall be installed at the door frame or at the door leaf up to the exit door handle, even when, for any practical reason, the LLL system is arranged in the corridor side opposite to the exit door handle. In addition, for double-leaf doors more than 2 m wide, LLL strips shall be fitted up to the height of the handles on the door frame.

6.4 Stairways

6.4.1 In all stairways on the escape route, LLL installed on the bulkhead or vertical side shall be at a height no more than 300 mm above the forward edge of each step. The LLL shall be installed on both sides of the stairway if the width is 2 m or more, and not on the centre handrail.

6.4.2 The top and the bottom of each set of stairs shall be identified to show that there are no further steps.

6.4.3 Within the stairway enclosure, only the stairway need be marked except where the distance between the entry doors and the stairs, or between any sequential set of stairs, exceeds 2 m, when the most direct route shall be marked along the bulkhead. See normative annex G, Figure G.2.

6.5 Signs and markings

6.5.1 The display of any sign or marking installed on board shall conform to the appropriate IMO symbols given in IMO Resolution A760(18) or ISO symbols.

6.5.2 All escape route signs shall be of photoluminescent material or marked by lighting and fitted in the lower 300 mm of the bulkhead or at the position specified at the subsequent points. The minimum dimension for signs and markings is 50 mm × 50 mm.

6.5.3 Directional arrows may only be incorporated in LLL strips if they are located in dead-end corridors or accompanied by an assembly-station sign located in a stairway enclosure at the deck of the assembly station.

6.5.4 The colour of the signs and markings shall contrast with the background.

6.5.5 Exit signs shall be provided at all exits from the escape route and shall be installed at the same side as the door handle or operating mechanism. For double-leaf doors, an exit sign shall be installed at each leaf.

6.5.6 Sliding fire and watertight doors which are indicated by LLL shall be marked adjacent to their opening handles to show the direction and means of opening. In addition, the primary opening handle on double-leaf doors shall be clearly marked.

6.5.7 Local control handles on watertight doors shall be marked with signs indicating the direction in which they must be moved.

6.5.8 Fire equipment location markings shall be of photoluminescent material and located at or on the equipment.

6.6 Information placard

In all cabins, a placard explaining the LLL system shall be installed true-to-side on the inside of the cabin door. In addition, the placard shall have a diagram showing the location of, and the way to, the two closest exits with respect to the cabin.

7 Approval of the installation

7.1 The arrangement of LLL systems shall be approved by the competent authority. For this purpose, the manufacturer or the installer shall submit the installation plan and description, including certificates which state that the materials and components of PL and EP systems meet the requirements of clause 4, which will become the basis for the checking of the system after its completion.

7.2 For PL systems, the ambient lighting within the proposed installation area shall be of the correct luminance and spectrum to suit the type of photoluminescent material installed. After the installation, PL systems shall be tested at the place of use in accordance with annex B at least twice on each deck and the measurements shall be recorded in accordance with annex C. In addition, system measurements shall be carried out under the judgement of the competent authority.

8 Care and maintenance

8.1 A copy of the technical product documentation specified in clause 5, as well as the records of the measurements described in clause 7, shall be kept on board to be available to surveyors and inspectors.

8.2 LLL systems shall be visually examined and spot checked to ensure proper operation and condition at least once a week, and the area and results recorded. The entire vessel shall be covered within a six month period.

8.3 For PL systems, the measurements described in clause 7 shall be repeated and recorded whenever the lighting system, walls, floor or ceiling decorations in the area are substantially changed. The performance of PL systems depends on the ambient lighting and, therefore, it is important that the lighting reflectors/diffusers to the normal lighting are kept clean. For PL systems, the ambient light and the emitted light from the surface shall be measured and compared with the manufacturer's data. Results shall be recorded and kept for inspection by the competent authority, if requested.

8.4 It is recommended that, at least once a year, LLL systems be tested on one deck in each LLL main vertical zone. The system should be checked for operation and the light emitted from electroluminescent EP systems should be measured. Results should be recorded and kept for inspection by the competent authority. The competent authority shall ensure that the complete system has been tested over a five year period.

8.5 If the luminance for a particular reading does not meet the requirements of this International Standard, readings shall be taken in at least ten locations approximately 10 m apart in the specific area. If the ambient light is adequate, but more than 30 % of the readings do not meet the requirements of this International Standard, the PL system shall be replaced. For EP systems, where more than 30 % of the readings do not meet the requirements, the system shall be completely serviced and all deficiencies rectified. If between 20 % and 30 % of the readings do not meet the requirements of this International Standard, the LLL system shall be checked again in one year, where the corrective measures described in the previous point are not adopted.

Annex A (normative)

Testing of photoluminescent low-location lighting materials

A.1 Purpose

To assess the required excitation for photoluminescent materials to comply with the required luminance performance under controlled laboratory conditions.

A.2 Terms and definitions

For the purposes of this annex, the following terms and definitions apply.

A.2.1

excitation

effect of visible light in the appropriate spectrum which allows the materials to store energy

A.2.2

luminance

luminous intensity per unit area of the material

NOTE The luminance is measured in millicandelas per square metre.

A.2.3

luminance decay

function of the diminishing luminance exhibited by the material over time

A.3 Material samples

At least two samples of representative commercial materials shall be tested. Where the dimensions of the standard materials are not suitable for the luminance measurement instrumentation, special test samples shall be prepared having suitable dimensions for measurement purposes.

A.4 Testing

A.4.1 Excitation shall be provided by a tubular fluorescent lamp having an intensity of 25 lux at a nominal colour temperature of 3 000 K.

A.4.2 Test samples shall be dark conditioned for at least 24 h prior to excitation.

NOTE The intent is to fully discharge the materials prior to excitation.

A.4.3 The conditioned samples shall be excited directly for at least 24 h with an anticipated average illuminance for the materials to meet the luminance requirements specified in 4.2.1.

NOTE The intent is to fully charge the materials at the chosen illuminance.

A.4.4 The excitation illuminance shall be measured within the same plane as the test sample and recorded for each test.

A.4.5 The luminance measurements specified in A.5 shall be repeated with varying luminances until the excitation parameters are established in compliance with 4.2.1.

A.4.6 The ambient temperature during tests shall be $23\text{ °C} \pm 2\text{ °C}$.

A.5 Measurements

A.5.1 The surface luminance measurements shall be conducted using a fixed-geometry instrument calibrated in accordance with appropriate national standards.

A.5.2 The arrangement of the measurement instrument shall ensure that the results are not affected by extraneous light.

A.5.3 The test patch to be measured on each sample shall be consistent between tests and have a diameter of between 25 mm and 50 mm.

A.5.4 The tests shall assess the full luminance decay required in 4.2.1.

A.5.5 The measuring instrument shall incorporate a fast-response photometer head with CIE²⁾ photopic correction and have a measurement range of at least 10^{-4} cd/m^2 to 10 cd/m^2 . If the results are within 10 % of the required luminance, the measurements should be confirmed with an instrument having a measurement range of 10^{-5} cd/m^2 to 10 cd/m^2 .

A.6 Results

Results should be presented in any format that clearly establishes the excitation illuminance that will allow the products to provide the minimum required luminance after 10 min and after 60 min.

2) International Commission on Illumination.

Annex B (normative)

Assessment of installations on board

B.1 Purpose

The purpose of this annex is to ensure that installed photoluminescent materials will be capable of providing the required luminance performance following excitation from the normal installed electrical lighting.

B.2 Luminance measurements

B.2.1 All measurements shall be carried out on the installed material following a period of excitation of at least 24 h. Measurements shall be taken in areas where the material is not subject to excitation due to daylight.

B.2.2 The measurements shall be carried out in accordance with the requirements of clause A.5.

B.2.3 Measurements shall be taken as specified in 7.2.

B.3 Results

The results of the measurements shall be recorded in tabular form (annex C) and stored for examination by the competent authority.

Annex C (normative)

Measurement record for photoluminescent materials

Measurement record				Record No. _____		
Measurement in accordance with ISO 15370				Page _____ of _____		
Name of ship: _____						
Call sign: _____						
Flag state: _____						
Measurement number	Product identification	Location of measurement (deck, frame, etc.)	Illuminance lx	Type of light source	Luminance at 10 min mcd/m ²	Luminance at 60 min mcd/m ²
Measurement meter: _____ Manufacturer: _____ Model: _____						
Date of calibration: _____						
Notes: _____ _____						
Measurement carried out by: _____				Signature: _____		Date: _____
Competent authority (if present): _____				Signature: _____		Date: _____

Annex D (normative)

Width versus luminance

The chart and table in Figure D.1 are based on the following formulas:

Formula to calculate luminance at 10 min:

$$L = \frac{1125}{W}$$

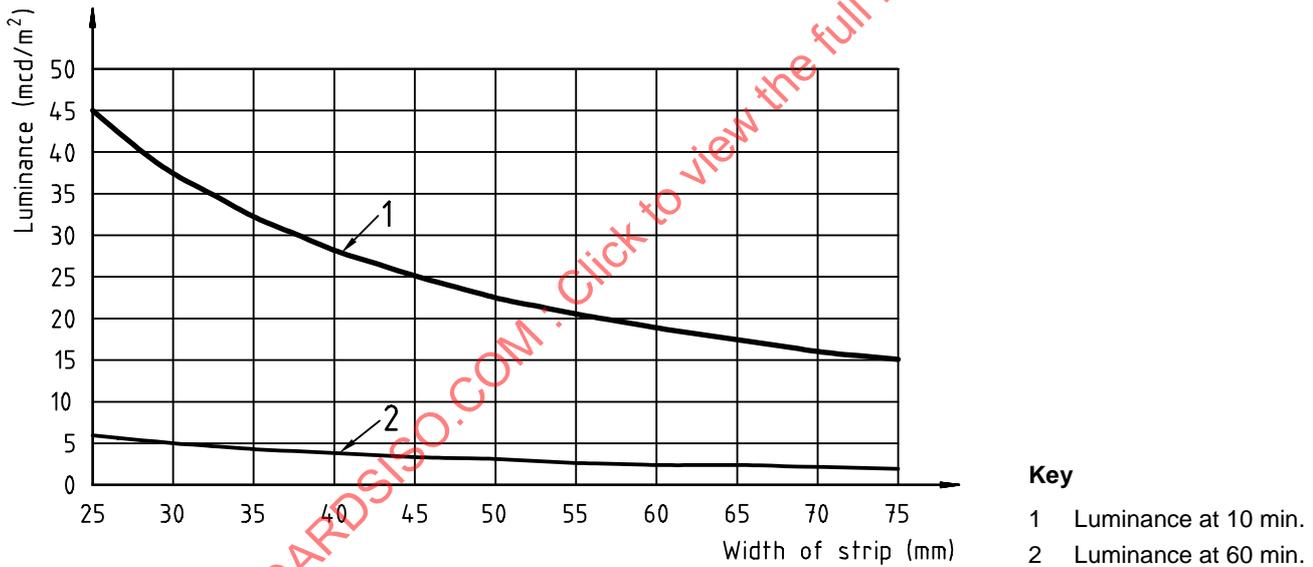
Formula to calculate luminance at 60 min:

$$L = \frac{150}{W}$$

where

L is the luminance, in millicandelas per square metre;

W is the width, in millimetres.

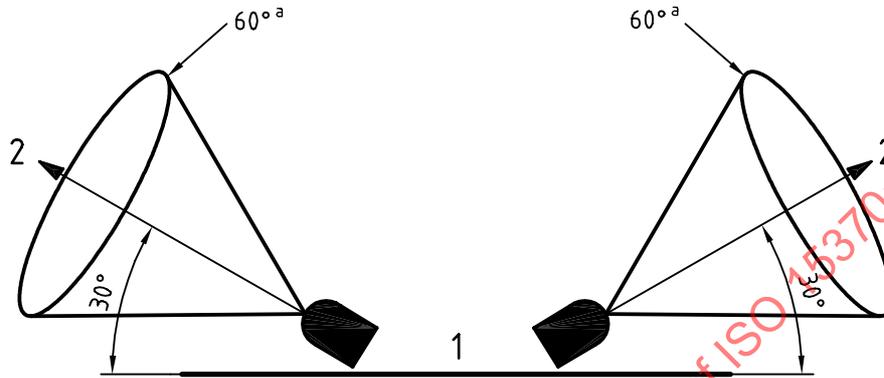


Width mm	Luminance at 10 min mcd/m ²	Luminance at 60 min mcd/m ²
75	15,0	2,0
70	16,07	2,14
65	17,31	2,31
60	18,75	2,50
55	20,45	2,73
50	22,50	3,00
45	25,00	3,33
40	28,13	3,75
35	32,14	4,29
30	37,50	5,00
25	45,00	6,00

Figure D.1 — Width versus luminance chart and table

Annex E
(normative)

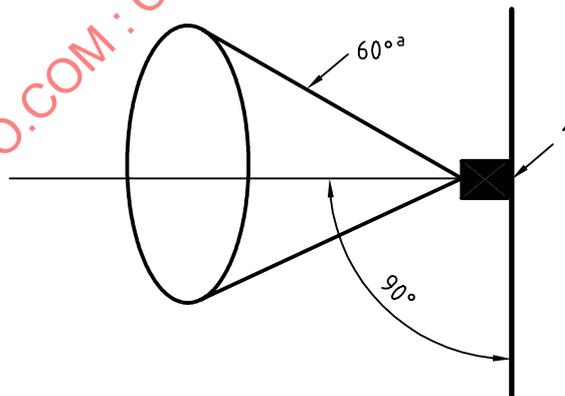
Examples of point-source mounting



Key

- 1 Point sources
- 2 Mcd Peak
- a Cone.

Figure E.1 — Horizontal mounting surface



Key

- 1 Point sources
- 2 Mcd Peak
- a Cone.

Figure E.2 — Vertical mounting surface