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Small craft — Electric navigation lights — Performance of LED lights

Petits navires — Feux de navigation électriques — Performance des feux à LED

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 188, *Small craft*.

Introduction

This document was developed to provide uniform criteria for the performance, construction, and testing of LED navigation lights. Conflicting national standards might lead to confusion on the part of operators and manufacturers of craft, as well as manufacturers of LED navigation lights. These conflicts could lead to barriers to trade.

If the colour locus of navigation light is within the coordinates specified in this document, the COLREGs, CCNR[1] and CEVNI[2] requirements relating to colour loci are satisfied.

Small craft — Electric navigation lights — Performance of LED lights

1 Scope

This International Standard applies to requirements and testing for navigation lights with permanently fixed light emitting diode (LED) assemblies for small craft up to 24 m length of the hull.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

CIE 15, *Colorimetry*

CIE 69, *Methods of characterizing illuminance meters and luminance meters — Performance, characteristics and specifications*

CIE 70:1987, *Measurement of absolute luminous intensity distributions*

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

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*

IEC 60068-2-27:2008, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

COLREGs, International Regulations for Preventing Collisions at Sea, 1972

3 Terms and definitions

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

3.1
flashing light
light flashing at regular intervals at a frequency of 120 flashes or more per minute

3.2
navigation light
coloured source of illumination used to signal a craft's position, heading, and status

3.3
signal light
light radiated by navigation lights

3.4
range of visibility
distance up to which the light of the navigation light can be seen

3.5
rated voltage
voltage or voltage range specified by the manufacturer for the operation of the navigation light

3.6
zero signal direction
horizontal direction of radiation of a navigation light in the centre-line plane or parallel to it

Note 1 to entry: The zero signal direction is designated in this standard as either 0° or “dead ahead”.

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CIE International Commission on Illumination

COLREG International Regulations for Preventing Collisions at Sea, 1972

LED Light Emitting Diode

5 Minimum requirements

5.1 Luminous intensity and range of visibility

I_0 is the photometric luminous intensity in candela (cd) that is measured in the laboratory at rated voltage.

I_B is the luminous intensity under operating conditions in candela (cd) which takes into account, for example, the ageing of the light source, contamination of the optical system, and voltage drop of the craft’s power supply system.

For the values listed in Table 1, I_B is assumed to be 20 % less than the photometric luminous intensity I_0.

The range of visibility given on the navigation light depends on the interval for I_0 in Table 1 in which the luminous intensity I_0 actually measured lies. A navigation light shall not be marked with a higher or lower figure.

Table 1 — Range of visibility, luminous intensities and range of visibility designations

Nominal range of the navigation light	Minimum range value		Maximum range value		Operational luminous intensity (I_B)	Horizontal minimum photometric luminous intensity (I_0)[a]	Horizontal maximum photometric luminous intensity (I_0)[a]
nm	nm	km	nm	km	cd	cd	cd
1	1	1,85	2	3,70	0,9	1,1	5,4
2	2	3,70	5	9,26	4,3	5,4	65
3	3	5,56	5	9,26	12	15	65
5	5	9,26	7,5	13,9	52	65	257

[a] To be measured in the laboratory.

5.2 Luminous intensity distribution

5.2.1 Horizontal luminous intensity distribution

The requirements of the COLREGs apply.

For the purpose of this document, the COLREGs expression “almost zero” or “practical cut-off” is defined as a value of not greater than 12,5 % of the average photometric luminous intensity . The angle between two measurements shall not exceed 0,2°.

In the case of two-colour or three-colour navigation lights, the luminous intensity distribution shall be uniform so that in the arc of visibility of 3° on each side of the zero signal direction, the maximum permissible photometric luminous intensity of the port and starboard segments shall not be exceeded and the minimum required photometric luminous intensity shall not be less than the required value.

The horizontal luminous intensity distribution of the navigation light shall be uniform over the entire radiation angle so that the maximum and minimum values of the photometric luminous intensity do not differ by more than a factor of 1,5.

5.2.2 Vertical luminous intensity distribution

The requirements of the COLREGs apply.

In addition, the maximum vertical luminous intensity shall not exceed the horizontal luminous intensity at 0° by more than a factor of 1,5. Navigation lights with vertical luminous intensity distribution according to COLREGs, Annex I, 10 (a) specified for engine-driven craft only shall be marked accordingly.

5.3 Colorimetric requirements

The chromaticity areas given in Table 2 apply.

Table 2 — Colour range vertices

Signal light colour	Coordinates of the vertices						
White	x	0,310	0,443	0,500	0,500	0,453	0,310
	y	0,283	0,382	0,382	0,440	0,440	0,348
Red	x	0,690	0,710	0,680	0,660		
	y	0,290	0,290	0,320	0,320		
Green	x	0,009	0,284	0,207	0,013		
	y	0,720	0,520	0,397	0,494		
Yellow	x	0,612	0,618	0,575	0,575		
	y	0,382	0,382	0,425	0,406		
Blue	x	0,136	0,218	0,185	0,102		
	y	0,040	0,142	0,175	0,105		

5.4 Flashing light

The ruling dimension for the range of visibility is the visually effective luminous intensity (I_{EFF}). I_{EFF} is a measure for the conspicuity and efficiency of the flashing light emitted.

I_{EFF} shall attain at least the minimum horizontal photometric luminous intensity values I_0 in Table 1.

I_{EFF} is calculated as follows from the maximum instantaneous luminous intensity in the observation direction (I_{MAX}) according to the Blondel-Rey equation:

$$I_{EFF} = \frac{\int_{t_1}^{t_2} I_{MAX} dt}{0{,}2 + (t_2 - t_1)}$$

where

I_{EFF} is the effective luminous intensity, in candela;

I_{MAX} is the instantaneous value, in candela;

0,2 is the Blondel-Rey constant for night observation, in seconds;

t_1, t_2 are the integration time limits, in seconds.

If the duration of the light phenomenon less the rise time and decay time, i.e. the time in which the instantaneous luminous intensity attains or exceeds the required minimum luminous intensity, is greater than 0,3 s, the light may be regarded as a steady light. The effective luminous intensity shall not then be determined.

The luminous intensity ranges of visibility and chromaticity areas in 5.1 and 5.3 apply, but without the upper limit for the luminous intensity.

The vertical radiation shall be at least 4°.

With an inclination of the flashing light to the horizontal of up to ±2°, the luminous intensities shall still be at least 80 % of the luminous intensity at 0°.

5.5 Electrical safety

The electrical safety shall be ensured as described in IEC 60945:2002.

5.6 Reflectors

Reflectors are permitted only in hermetically-sealed systems.

5.7 Power supply

The requirements of IEC 60945:2002 apply except for those regarding the following:

a) extreme power supply;

b) excessive conditions;

c) power supply failure.

5.8 General requirements

5.8.1 General

Unless otherwise indicated in this International Standard, the requirements of IEC 60945:2002 apply.

5.8.2 Equipment category

Navigation lights belong to the equipment category “exposed to the weather” as specified in IEC 60945:2002.

5.8.3 Vibration

The requirements of IEC 60945:2002 apply with the additional requirements described in 6.3.5.

5.8.4 Rain and spray

The requirements of IEC 60945:2002 apply with the addition that a navigation light in continuous duty shall meet the requirements of IP66 without any change.

The test shall be as described in 6.3.6.

5.8.5 Solar radiation

The test shall be as described in 6.3.7.

5.8.6 Corrosion (salt mist)

The test shall be as described in 6.3.1.

5.8.7 Electromagnetic compatibility

The test shall be as described in IEC 60945:2002.

5.8.8 Compass safe distance

The requirements of IEC 60945:2002 do not apply to navigation lights that consist mainly of non-magnetic materials.

5.8.9 Housing temperature

Housing parts of electrically powered navigation lights that can be accessed by hand during normal operation shall meet the requirements of the test described in 6.4.2.

5.8.10 Mechanical shock

The test shall be as described in 6.4.1.

5.9 Deviations caused by service life conditions

The manufacturer shall provide indication when the required range of visibility can no longer be attained, for example as a result of degradation, ageing, or failure of parts of the light source.

5.10 Influence of temperature

5.10.1 Influence of temperature on chromaticity coordinates and luminous intensity

Navigation lights shall be tested at ambient temperatures of –25 °C to +30 °C and it shall be ensured that the luminous intensity and chromaticity coordinates meet the requirements of this document both 1 min after switching on and after 120 min operation.

The test shall be as described in 6.2.4.

5.10.2 Dry heat and low temperature

The navigation light in the energized state shall withstand ambient temperatures of -25 °C to +55 °C without damage.