

# INTERNATIONAL STANDARD

**Electrical installations in ships –  
Part 306: Equipment – Luminaires and lighting accessories**



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IEC 60092-306

Edition 4.0 2009-11

# INTERNATIONAL STANDARD

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**Electrical installations in ships –  
Part 306: Equipment – Luminaires and lighting accessories**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

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ICS 47.020.60

ISBN 2-8318-1070-4

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSTALLATIONS IN SHIPS –****Part 306: Equipment –  
Luminaires and lighting accessories**

## FOREWORD

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International Standard IEC 60092-306 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This fourth edition cancels and replaces the third edition published in 1980. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) Title has been amended;
- b) Scope has been stated more precisely;
- c) Requirements on mechanical design and materials have been amended and stated more precisely;
- d) Table 2 – Standard types of lampholders, has been amended;
- e) Environmental tests, especially regarding shock and vibration have been added;

- f) Requirements and tests concerning special chemical and physical attributes have been added;
- g) Standard has been editorially revised.

The text of this standard is based on the following documents:

FDIS	Report on voting
18/1137/FDIS	18/1143/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60092 series, published under the general title *Electrical installations in ships*, can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the maintenance date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

## INTRODUCTION

IEC 60092 forms a series of international standards for electrical installations in sea-going ships, incorporating good practice and coordinating, as far as possible, existing rules.

These standards form a code of practical interpretation and amplification of the requirements of the International Convention for the Safety of Life at Sea, a guide for future regulations which may be prepared and a statement of practice for use by shipowners, shipbuilders and appropriate organizations.

## ELECTRICAL INSTALLATIONS IN SHIPS –

### Part 306: Equipment – Luminaires and lighting accessories

#### 1 Scope

This International Standard applies to luminaires and lighting accessories for use in ships. It applies primarily to luminaires for illumination purposes.

NOTE Boats, submarines (except naval submarines), watercraft and floating equipment are ships to which this standard applies.

This standard also applies to lighting accessories associated with the wiring and current consuming appliance of an installation.

This standard does not apply to portable luminaires, navigation lights, search lights, daylight signalling lamps, signal lights including the relevant control and monitoring equipment and other lights used for navigation in channels, harbours, etc.

For navigation lights, see EN 14744, for search lights, see ISO 17884, for daylight signalling lamps, see ISO 25861.

#### 2 Normative references

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

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

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

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60079 (all parts), *Equipment for explosive atmospheres*

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

IEC 60092-201:1994, *Electrical installations in ships – Part 201: System design – General*

IEC 60092-352, *Electrical installations in ships – Part 352: Choice and installation of electrical cables*

IEC 60155, *Glow-starters for fluorescent lamps*

IEC 60238, *Edison screw lampholders*

IEC 60332-1-2:2004, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60400, *Lampholders for tubular fluorescent lamps and starterholders*

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

IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility*

IEC 60598-1, *Luminaires – Part 1: General requirements and tests*

IEC 60684-2, *Flexible insulating sleeving – Part 2: Methods of test*

IEC/TR 60721-4-6, *Classification of environmental conditions – Part 4-6: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Ship environment*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60754-1, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of the amount of halogen acid gas*

IEC 60838-1, *Miscellaneous lampholders – Part 1: General requirements and tests*

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

IEC 61184, *Bayonet lampholders*

IEC 61347-2-1, *Lamp controlgear – Part 2-1: Particular requirements for starting devices (other than glow starters)*

IEC 61995-1, *Devices for the connection of luminaires for household and similar purposes – Part 1: General requirements*

IEC 61995-2, *Devices for the connection of luminaires for household and similar purposes – Part 2: Standard sheets for DCL*

ISO 2409, *Paints and varnishes – Cross-cut test*

ISO 3882, *Metallic and other inorganic coatings – Review of methods of measurement of thickness*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

ISO 9001, *Quality management systems – Requirements*

ISO 17884, *Ships and marine technology – Searchlights for high-speed craft*

ISO 25861 *Ships and marine technology – Navigation – Daylight signalling lamps*

Defence Standard 02-713, *Determination of the Toxicity Index of the Products of Combustion from Small Specimens of Materials*

EN 12206-1, *Paints and varnishes – Coating of aluminium and aluminium alloys for architectural purposes – Part 1: Coatings prepared from coating powder*

EN 13032-1, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 1: Measurement and file format*

EN 13438, *Paints and varnishes – Powder organic coatings for galvanized or sherardised steel products for construction purposes*

EN 14744, *Inland navigation vessels and sea-going vessels – Navigation light*

IEC 62444, *Cable glands for electrical installations*<sup>1</sup>

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60598-1 and the following apply.

#### 3.1

##### **lamp**

source made in order to produce an optical radiation, usually visible

[IEV 845-07-03]

#### 3.2

##### **lighting accessories**

additional parts which are needed for mounting or for electrical connection and which are usually delivered together with the luminaire

NOTE Examples are ceiling rose, cable gland, plug, socket-outlet.

### 4 Requirements on luminaires

#### 4.1 General

Luminaires shall comply with the requirements of IEC 60598-1 and with the additional requirements included in this standard. Luminaires in accordance with this standard shall be suitable for continuous operation.

#### 4.2 Mechanical requirements

##### 4.2.1 Design

The design of luminaires shall comply with the requirements of IEC 60092-101 and with the following additional requirements.

- a) Luminaires shall have sufficient mechanical resistance for the intended use. The mechanical properties shall be in accordance with intended purpose and installation location. To meet the requirement of mechanical resistance, the equipment shall withstand the respective shock and vibration conditions given in the Tables 3 and 4.
- b) Luminaires shall be designed, dimensioned and equipped with mounting devices in such a way that they will present no hazard to persons, in particular during operation and maintenance work.
- c) The minimum degrees of IP protection in accordance with IEC 60529 required in the different environmental conditions related to locations are given in IEC 60092-201:1994, Table 5.
- d) Luminaires shall be so constructed as to provide for adequate dissipation of heat from lamps and related components. The temperature rise of terminals for connection of supply cables shall not exceed 40 °C. Insulation material of internal parts shall be of a temperature class which corresponds to the maximum temperature within the luminaires.
- e) The temperature of surface parts which can be touched during operation shall not exceed 60 °C. If this is not possible, e. g. in case of floodlights or discharge lamps, these

<sup>1</sup> To be published.

luminaires shall be mounted in a way that they cannot be reached without the use of additional facilities.

- f) Luminaires shall be constructed in such a way that they can be easily cleaned inside, if applicable.
- g) Lamps shall be easily replaceable, if applicable.
- h) Luminaires used in hazardous areas shall comply with the relevant part of IEC 60079. Hazardous spaces of ships can be e. g. paint stores and battery rooms where, depending on ventilation arrangement, luminaires may be required to comply with relevant parts of IEC 60079.
- i) Special consideration shall be given to the design of luminaires for installation in areas where the ambient temperature is  $\geq +45\text{ °C}$  or  $\leq -25\text{ °C}$ .

#### **4.2.2 Materials**

With respect to durability and resistance to environmental conditions, luminaires and lighting accessories shall meet the requirements specified in Clause 7 of this standard. The materials shall additionally comply with the following requirements.

- a) The materials used for the luminaires and their mounting parts shall be non-toxic and flame retardant.
- b) Parts which require surface protection shall be designed in a way that functional and operational safety is ensured.
- c) Non-metallic external parts of luminaires, enclosures and attachments shall withstand the exposure to UV and visible radiation and shall be halogen-free.
- d) External parts and housings of luminaires intended for outdoor installation shall be of metal.
- e) If coating of the luminaires or parts or enclosures is necessary to achieve corrosion resistance, it shall be in accordance with EN 12206-1 in case of aluminium and aluminium alloy or in accordance with EN 13438 in case of steel.

Tests for requirements a) and c) are stated in 7.2.5.

### **4.3 Electrical requirements**

#### **4.3.1 Electrical safety**

Electrical safety shall be ensured by compliance with the tests specified in 7.3.

#### **4.3.2 Luminaires for use on IT power distribution systems**

Luminaires intended to be operated on on-board power supply systems shall be designed in such a way that they may be operated on a power distribution system which is not earthed (IT-system). Switches in luminaires intended for use on IT-systems shall be bipolar. If fuses are included in the luminaire, they shall be installed in each line conductor.

#### **4.3.3 Electromagnetic compatibility**

In general, the requirements stated in IEC 60533 shall be met. Luminaires specified for use in the bridge area and radio room shall meet the requirements stated in IEC 60945.

### **4.4 Illumination technology**

Photometric data in accordance with EN 13032-1 shall be provided by the manufacturer in electronic format suitable for further electronic design and calculation.

#### 4.5 Environmental conditions

Luminaires shall be so designed as to withstand the applicable environmental influences during storage and ship's operation. The tests shall be carried out in accordance with 7.2.

For environmental tests, the recommendations of IEC/TR 60721-4-6 should be taken into account.

#### 4.6 Special requirements on discharge lamp luminaires

On discharge lamp luminaires all ballasts, capacitors and other auxiliaries mounted separately from the luminaires shall be enclosed in an earthed metal casing.

Discharge lamps should be used only in fixed luminaires.

Discharge lamp installations shall be durably marked with the warning symbol given in IEC 60598-1. The marking shall be of a suitable size.

Transformers should be located as close as possible to the luminaire installation but no more than 100 m apart from the luminaire's installation.

#### 4.7 Component parts

Component parts of luminaires shall comply with their relevant standards and shall be in accordance with the requirements stated in 4.2 and the requirements stated in the publications given in Table 1.

**Table 1 – Special requirements on component parts**

Auxiliary, component, part	Requirements
Internal wiring, single core	Halogen-free, flame retardant and with low emission of smoke <sup>a</sup>
Starting devices (other than glow starters)	IEC 61347-2-1
Glow starters	IEC 60155
Devices for connection of luminaires (DCL)	IEC 61995-1 and IEC 61995-2
Cable glands	IEC 62444
<sup>a</sup> For details, see e.g. HD 22.9 S2 [1] <sup>2</sup> and HD 22.9 S2/A1 [2].	

Choice and installation of electrical cables for external wiring shall be carried out in accordance with IEC 60092-352, unless a specific requirement in this standard is given.

#### 4.8 Lampholders

Lampholders allowed to be used in luminaires shall comply with their relevant standard and shall be of a type listed in Table 2.

Lampholders shall be provided with effective means for locking the lamp in the holder.

Lampholders of different types have different ability to retain the lamp during vibration. The effectivity of this combination shall be checked together with the way of fixing the lamp holder in the luminaire during the tests in 7.2.1.

<sup>2</sup> Figures in square brackets refer to the Bibliography.

**Table 2 – Standard types of lampholders**

Lampholder for	Designation	Maximum lamp ratings		
		Voltage V	Load power W	Current A
Screw cap lamps <sup>a</sup>	E40	250	3 000	16
	E27		250	4
	E14		60	2
Bayonet cap lamps <sup>d</sup>	B22	250	200	4
	B15d		250	4
	B15s	55	15	2
Tubular fluorescent lamps <sup>b</sup>	G13	250	115	–
	G5		80	–
Tubular compact fluorescent lamps <sup>b</sup>	G23	250	5 to 11	–
	2G7		5 to 11	–
	G24d		10 to 26	–
	G24q		10 to 26	–
	2G10		18 to 36	–
	2G11		18 to 55	–
	GX24q		13 to 57	–
	GX24d		13 to 26	–
Low voltage halogen lamps <sup>c</sup>	G4	12 and 24	5 to 20	–
	GU4	12	5 to 35	–
	GU5.3		10 to 50	–
	GY6.35		20 to 150	–
High voltage halogen lamps <sup>c</sup>	GU 10, GZ 10	250	35 to 50	–
	R7S		60 to 2 000	–
High intensity discharge lamps (HID)	E 40 <sup>a</sup>	750	1 000	–
	E 27 <sup>a</sup>		150	–
	RX7S <sup>c</sup>	1 000	400	–
	Fc2 <sup>c</sup>			
	G8,5 <sup>c</sup>	750	72	–
	G12 <sup>c</sup>		150	–
<sup>a</sup> In accordance with IEC 60238.				
<sup>b</sup> In accordance with IEC 60400.				
<sup>c</sup> In accordance with IEC 60838-1.				
<sup>d</sup> In accordance with IEC 61184.				

#### 4.9 Marking

Marking shall be in accordance with the provisions stated in IEC 60598-1.

Luminaires shall be marked for easy identification.

The marking shall at least include the following data:

- type identification;

- manufacturer or manufacturer's reference;
- degree of protection;
- supply voltage;
- indication of each device belonging to the luminaires, e.g. mounting parts;
- type and number of lamp(s);
- rated power of lamp(s).

The marking shall be durable and not removable.

The marking language shall be English or English and additional language(s).

## **5 Requirements on lighting accessories**

### **5.1 General**

Lighting accessories shall comply with the requirements of IEC 60598-1 and with the additional requirements included in this standard. Insulated conductors shall be installed in a way that stress cannot be applied by the conductors to any terminal to which the conductors may be connected. Lighting accessories shall be so designed as to withstand the appropriate environmental influences during storage and ship's operation.

### **5.2 Enclosures**

Enclosures shall preferably be made of cast brass, bronze or iron, or of welded sheet steel with corrosion-resistant finish, or of corrosion-resistant light alloys, or of flame-retardant and halogen-free insulating material.

### **5.3 Ceiling roses**

Ceiling roses shall be made of flame-retardant, non-conducting and moisture-resistant material. Materials for ceiling roses shall pass the tests stated in Table 7 and the humid heat test stated in Table 6.

## **6 Requirements on socket-outlets and plugs for luminaires connection**

Socket-outlets and plugs shall be dimensioned in a way that they meet the requirements specified in Clause 7 and the following requirements.

- a) The electrical clearances and creepage distances of socket-outlets and plugs not interlocked with switches shall be such that a short-circuit arc cannot be initiated. This requirement is valid for the plug being normally withdrawn from the socket-outlet, while a current 50 % higher than the rated current flowing at rated voltage.
- b) Where socket-outlets with earthing contacts are required, the socket-outlets and plugs shall be provided with an additional contact for earthing the casing or frame of appliance. The earthing contact shall connect in advance of the live contact pins when inserting the plug.

- c) Socket-outlets and plugs with a specified degree of protection shall be provided with effective means to maintain the same degree of protection after the plug is removed from the socket-outlet. Where a loose cover is used for this purpose, it shall be anchored to its socket-outlet, for example by means of a chain.

## 7 Tests

### 7.1 General

In addition to the tests in accordance with IEC 60598-1, the luminaires shall pass the tests listed in Clause 7. If not stated otherwise, a visual inspection and operational test shall be carried out before and after each test. At least three luminaires of any type shall be tested, any additional number of items shall be agreed upon. Unless stated or agreed upon otherwise, proof shall be furnished in the form of an inspection certificate.

If applicable, luminaires shall be tested with their dedicated lamp(s) and lighting accessories. Before testing they shall be fitted (equipped) and mounted for operation. If necessary, e.g. in case of vibration and shock test, an appropriate mounting fixture shall be used.

The manufacturer shall maintain a quality assurance system in accordance with ISO 9001.

### 7.2 Environmental tests

#### 7.2.1 Vibration exposure

The luminaires shall be fitted with the respective lamp, if applicable. The luminaires will have passed the test if they are fully functional and free of damage during and after the test.

The luminaires shall be subjected to vibration for the given duration in the direction of each axis of the x, y, z coordinate system given in Table 3.

**Table 3 – Vibration exposure**

Exposure	Test	Frequency change	Displacement amplitude	Acceleration	Duration	Frequency range
		Octave per min	mm	m/s <sup>2</sup>	min	Hz
General vibration	In accordance with IEC 60068-2-6	≤1,0	±1,0	–	90	2 <sup>+3</sup> <sub>–0</sub> to 13,2
			–	7,0		13,2 to 100

#### 7.2.2 Shock exposure

If the luminaires shall be operated aboard a ship, usually no requirements as regards shock resistance apply. Exceptions shall be stipulated by the customer.

If shock requirements are stipulated, for example for luminaires to be operated aboard highspeed watercraft (HSC), the luminaires fitted for operation shall additionally be resistant to the stipulated number of shocks in both the positive and negative direction of each axis of the x, y, z coordinate system.

The test may be carried out in accordance with IEC 60068-2-27. The luminaires shall be fitted with the respective lamp, if applicable. The luminaires will have passed the test, if they are fully functional and free of damage during and after the test. For each test, the impulse duration and impulse form, acceleration and number of shocks per axis direction shall be

stated. An example is given in Table 4. The given values are in accordance with IEC/TR 60721-4-6.

**Table 4 – Shock exposure**

Exposure	Test	Acceleration	Impulse form	Impulse duration	Number
		$\text{ms}^{-2}$		ms	per axis direction
Recommended shock	In accordance with IEC 60068-2-27	250	Half sine	6	100

### 7.2.3 Climatic exposure

The luminaires shall be fitted with the respective lamp, if applicable, and operated at the specified operating voltage. The luminaires will have passed the test, if they are fully functional and free of damage during and after the test. Climatic conditions are given in Table 5.

**Table 5 – Climatic conditions, operation**

Exposure	Test	Requirement, remark
<b>Cold</b>	In accordance with IEC 60068-2-1, Test Ad	Minimum temperature for outdoor luminaires: $-25\text{ }^{\circ}\text{C}$ Minimum temperature for indoor luminaires: $0\text{ }^{\circ}\text{C}$ Test duration: 16 h
<b>Dry heat</b>	In accordance with IEC 60068-2-2, Test Bd	Maximum temperature for outdoor luminaires: $+70\text{ }^{\circ}\text{C}$ Maximum temperature for indoor luminaires: $+55\text{ }^{\circ}\text{C}$ Test duration: 16 h
<b>Damp heat</b>	In accordance with IEC 60068-2-78, Test Cab, steady state	Applicable only for indoor luminaires Temperature $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ Relative humidity value : $93^{+2}_{-3}\%$ Test duration: 48 h
<b>Salt mist</b>	In accordance with IEC 60068-2-52, Test Kb	Applicable only for outdoor luminaires Severity degree 1:4 cycles of a 2 h spraying period followed by a 7 days storage duration at humid heat

### 7.2.4 Storage during climatic exposure

Divergent from the requirements stated in 7.2.3 the test shall be carried out with the packaged luminaires and shall be regarded as passed, if the luminaires are fully functional and free of damage after each test stated in Table 6.

**Table 6 – Exposure to climatic conditions, storage**

Exposure	Test	Requirement, remark
<b>Cold</b>	In accordance with IEC 60068-2-1, Test Ae	Minimum temperature: –30 °C Test duration: 48 h
<b>Dry heat</b>	In accordance with IEC 60068-2-2, Test Be	Maximum temperature: +60 °C Test duration: 48 h
<b>Humid heat</b>	In accordance with IEC 60068-2-78, Test Cab, steady state	Temperature: 40 °C ± 2 °C Relative humidity value: $93^{+2}_{-3}$ % Test duration: 4 days

### 7.2.5 Special chemical and physical attributes

The tests stated in Table 7 shall be performed and evaluated to confirm the required attributes given in 4.2.2 a) and c).

**Table 7 – Special chemical and physical attributes of non-metallic materials**

Characteristic/test criterion	Test method	Test result
<b>Halogen concentration</b>	Amount of chlorine: For materials (e. g. housings, parts) in accordance with IEC 60684 -2; for cables in accordance with IEC 60754-1	Mass fractions: Chlorine ≤0,5 % Fluorine ≤0,1 %
	Amount of fluorine: For materials including cables in accordance with IEC 60684-2	
<b>UV resistance</b>	In accordance with ISO 4892-3 or ISO 4892-2	No changes of surface or colour
<b>Toxicity</b>	In accordance with Def. Stan. 02-713	Toxicity index ≤ 5
<b>Burning behaviour</b>	For materials of end-products (e. g. housings, parts) in accordance with IEC 60695-2-11	In accordance with IEC 60695-2-11, Temperature 850 °C
	For cables: In accordance with IEC 60332-1-2	In accordance with IEC 60332-1-2, Annex A

## 7.3 Electrical tests

### 7.3.1 High voltage test

The high voltage test shall be carried out before and after each environmental test. The requirements are stated in Table 8. Carrying out of the test procedure is described in IEC 60598-1.

**Table 8 – High voltage test**

Rated voltage $U_n$ V	Test voltage a.c. 50 or 60 Hz V
Up to and including 65	$2 \times U_n + 500$
66 up to and including 250	1 500
251 up to and including 500	2 000
501 up to and including 690	2 500

### 7.3.2 Insulation resistance

The measuring of the insulation resistance value shall be carried out before and after each environmental test given in Table 3 and Table 5. The requirements are stated in Table 9.

**Table 9 – Insulation resistance**

Rated supply voltage $U_n$ V	Test voltage $U_n$ V	Minimum insulation resistance	
		Before test MΩ	After test MΩ
$U_n < 65$	$2 \times U_n$ min. 24 V	10	1,0
$U_n > 65$	500	100	10

### 7.4 Coating thickness

The coating thickness shall be at least 40 µm. The coating thickness shall be determined by manually operated measurement in accordance with ISO 2409. An equivalent test method (non-destructive method) in accordance with ISO 3882 is permissible. The manufacturer shall state which of the ISO test methods has been used. The test procedure is described in IEC 60598-1.

## 8 Packaging and marking

Packaging and marking shall be carried out as customary in the trade. The text on the packaging label shall at least correspond to the contents of the marking according to 4.9.

## Bibliography

- [1] HD 22.9 S2, *Rubber insulated cables of rated voltages up to and including 450/750 V – Part 9: Single core non-sheathed cables for fixed wiring having low emission of smoke and corrosive gases*
  - [2] HD 22.9 S2/A1, *Rubber insulated cables of rated voltages up to and including 450/750 V – Part 9: Single core non-sheathed cables for fixed wiring having low emission of smoke and corrosive gases; Amendment A1*
  - [3] IEC 60092-502, *Electrical installations in ships – Part 502: Tankers – Special features*
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