

# INTERNATIONAL STANDARD

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

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# INTERNATIONAL STANDARD

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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

This fifth edition cancels and replaces the fourth edition published in 2009. This edition constitutes a technical revision.

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

- a) additional technical and environmental requirements have been included;
- b) Table 2 "Standard types of lamp holders" has been amended;
- c) Subclause 4.3.2 has been amended with a new title "Distribution systems" and a reference to IEC 60092-201 has been added;
- d) environmental requirements and tests, especially regarding shock and vibration have been changed, and references to IEC 60092-101 and IEC 60092-504 have been added;
- e) requirements on coating thickness have been deleted, material requirements in 4.2.2 being sufficient;

f) the high voltage test has been amended with regard to electronic parts.

The text of this International Standard is based on the following documents:

| Draft        | Report on voting |
|--------------|------------------|
| 18/1786/FDIS | 18/1790/RVD      |

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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 website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

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

## INTRODUCTION

IEC 60092 (all parts) 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.

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## ELECTRICAL INSTALLATIONS IN SHIPS –

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

#### 1 Scope

This part of IEC 60092 applies to luminaires and lighting accessories for use in ships. It applies primarily to luminaires for illumination purposes.

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

This document 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.

Annex A provides EMC considerations for system integrators.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

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), *Explosive atmospheres*

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

IEC 60092-201, *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 60092-353, *Electrical installations in ships – Part 353: Power cables for rated voltages 1 kV and 3 kV*

IEC 60092-360, *Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables*

IEC 60092-401, *Electrical installations in ships – Part 401: Installation and test of completed installation*

IEC 60092-504, *Electrical installations in ships – Part 504: Automation, control and instrumentation*

IEC 60155, *Glow-starters for fluorescent lamps*

IEC 60238, *Edison screw lampholders*

IEC 60309 (all parts), *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes*

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 60417, *Graphical symbols for use on equipment, available at <http://www.graphical-symbols.info/equipment>*

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

IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull*

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

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

IEC 60695-7-2, *Fire hazard testing – Part 7-2: Toxicity of fire effluent – Summary and relevance of test methods*

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

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

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 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examination and measurements – Polarization dependent loss in a single-mode fibre optic device*

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*

IEC 62444, *Cable glands for electrical installations*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 62742, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a non-metallic hull*

IEC TR 62778, *Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires*

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*

EN 12206-1, *Paints and varnishes – Coating of aluminium and aluminium alloys for architectural purposes – Part 1: Coatings prepared from thermosetting 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 hot dip galvanized or sherardised steel products for construction purposes*

EN 13032-4, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 4: LED lamps, modules and luminaires*

### 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **luminaire**

apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes all the parts necessary for supporting, fixing and protecting the lamps, but not the lamps themselves, and where necessary, circuit auxiliaries together with the means for connecting them to the supply

[SOURCE: IEC 60598-1:2020, 1.2.1, modified – The note to entry has been deleted.]

### 3.2

#### **lamp**

electric light source provided with at least one cap

Note 1 to entry: For products that have the same physical characteristics as electric lamps for general lighting, but that are built to emit optical radiation mainly in the IR or UV spectrum, the term "IR lamp" or "UV lamp" is often used.

Note 2 to entry: This entry was numbered 845-07-03 in IEC 60050-845:1987.

[SOURCE: IEC 60050-845:2020, 845-27-008, modified – In the term, the word "electric" has been deleted, as well as the second note to entry.]

### 3.3

#### **lighting accessories**

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

EXAMPLE Ceiling rose, cable gland, plug, socket-outlet, fixing material.

### 3.4

#### **continuous operation**

operation for an unlimited period without interruption within the specified environmental conditions without the specified limits of temperature being exceeded

## 4 Requirements on luminaires

### 4.1 General

Luminaires shall comply with the requirements of IEC 60598-1 and with the additional or divergent requirements included in this document. Luminaires in accordance with this document 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) The equipment shall withstand the design parameters for vibration according to IEC 60092-101.
- 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.
- 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 above ambient temperature. The 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, for example in case of floodlights or discharge lamps, these 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) Lighting units shall be easily replaceable, if applicable.

- h) Luminaires used in hazardous areas shall comply with the IEC 60079 series according to the type of protection.
- i) Special consideration should 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

In general, the requirements according to IEC 60092-101 shall be met. With respect to durability and resistance to environmental conditions, luminaires and lighting accessories shall meet the requirements specified in Clause 7. 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. See 7.2 for design parameters.
- 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) 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.
- e) Sulphur containing materials, for example for sealing purposes, shall not be used.

Tests for requirements a) and c) are stated in 7.2.3.

#### 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 Distribution systems

The luminaires shall be capable of being operated on secondary distribution systems. The types of AC and DC distribution systems, nominal voltages and frequencies used on ships are specified in IEC 60092-201.

##### 4.3.3 Electromagnetic compatibility

The requirements of IEC 60533 and IEC 62742 shall be met.

Requirements to harmonic distortion shall comply with IEC 61000-3-2.

NOTE 1 IEC 61000-3-2 is developed for low voltage grid. However, it can also be used for ship installations.

NOTE 2 There are no specific requirements to LED as the requirements are the same for all types of lighting equipment. The same is applicable for IEC 60533 which applies to all types of electrical/electronic equipment, including LED.

#### 4.4 Photometric data

Photometric data in accordance with EN 13032-1 in general, and EN 13032-4 for LED, shall be provided by the manufacturer in electronic format suitable for further electronic design and calculation.

Lamps, luminaires and light systems shall be in accordance with IEC 62471:2006 and IEC TR 62778 risk group 0 and risk group 1. Risk groups 2 and 3 applications are acceptable under the condition that it is documented on board with safety instructions and operating instructions. Risk group 2 and 3 areas shall have markings with warning labels.

NOTE 1 For flashing lights and other intense pulsed light sources, IEC TR 62471-3 provides requirements.

NOTE 2 For image projectors, IEC 62471-5 provides requirements.

NOTE 3 LED lights can have a high blue light content and other high intense light spectra.

## 4.5 Environmental conditions

### 4.5.1 General

Luminaires shall be so designed as to withstand the applicable environmental influences during storage and ship's operation. The recommendations of IEC TR 60721-4-6 should be taken into account. Guidance for environmental testing can be found in IEC 60068-1. The tests shall be carried out in accordance with 7.2.

### 4.5.2 Design parameters

For inclination, motion and vibration, the requirements and tests for general applications given in IEC 60092-504 shall be met.

## 4.6 Discharge lamp luminaires

### 4.6.1 General

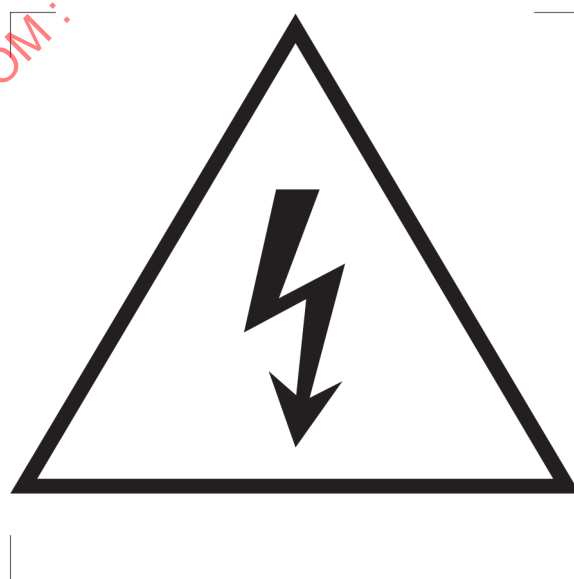
The requirements for discharge lamp luminaires with voltages above 250 V, given in IEC 60092-201, apply.

### 4.6.2 Special requirements

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 Figure 1. The marking shall be of a suitable size.



(IEC 60417-6042:2010-11)

**Figure 1 – Warning symbol for discharge lamp installations**

## 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 documents given in Table 1.

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

| Auxiliary, component, part                                                 | Requirement                                                               |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 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 for example EN 50525-3-41 [1] <sup>1</sup> . |                                                                           |

## 4.8 Cables

Choice and installation of electrical cables shall be carried out in accordance with IEC 60092-353, IEC 60092-360, IEC 60092-352 and IEC 60092-401, unless a specific requirement in this document is given.

## 4.9 Lampholders

Lampholders 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 7.2.3.

**Table 2 – Standard types of lampholders**

| Lampholder for:                | Designation      | Maximum lamp ratings |                 |              |
|--------------------------------|------------------|----------------------|-----------------|--------------|
|                                |                  | Voltage<br>V         | Load power<br>W | Current<br>A |
| Screw cap lamps <sup>a</sup>   | E40              | 250                  | 3 000           | 16           |
|                                | E39 <sup>e</sup> | 250                  | 3 000           | 15           |
|                                | E27              | 250                  | 250             | 4            |
|                                | E26 <sup>e</sup> | 300                  | 200             | 6            |
|                                | E14              | 250                  | 60              | 2            |
| Bayonet cap lamps <sup>b</sup> | B22              | 250                  | 200             | 4            |
|                                | B15d             |                      | 250             | 4            |
|                                | B15s             | 55                   | 15              | 2            |

<sup>1</sup> Figures in square brackets refer to the Bibliography.

| Lampholder for:                                                                                                                                                                                                                            | Designation        | Maximum lamp ratings |                 |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------|-----------------|--------------|
|                                                                                                                                                                                                                                            |                    | Voltage<br>V         | Load power<br>W | Current<br>A |
| Tubular fluorescent lamps <sup>c</sup>                                                                                                                                                                                                     | G13                | 250                  | 115             | –            |
|                                                                                                                                                                                                                                            | G5                 |                      | 80              | –            |
|                                                                                                                                                                                                                                            | G24q               |                      | 10 to 26        | –            |
|                                                                                                                                                                                                                                            | GX24q              |                      | 13 to 57        | –            |
|                                                                                                                                                                                                                                            | GX24d              |                      | 13 to 26        | –            |
| Low voltage halogen lamps <sup>d</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>d</sup>                                                                                                                                                                                                    | GU 10, GZ 10       | 250                  | 35 to 50        | –            |
|                                                                                                                                                                                                                                            | GY16 <sup>e</sup>  |                      | 2 000           | 20           |
|                                                                                                                                                                                                                                            | GY9.5 <sup>e</sup> |                      | 1 000           | 20           |
|                                                                                                                                                                                                                                            | GX9.5 <sup>e</sup> |                      | 650             | 20           |
|                                                                                                                                                                                                                                            | R7S                |                      | 60 to 2 000     | –            |
| High intensity discharge lamps (HID)                                                                                                                                                                                                       | E40 <sup>a</sup>   | 750                  | 1 000           | –            |
|                                                                                                                                                                                                                                            | E27 <sup>a</sup>   |                      | 150             | –            |
|                                                                                                                                                                                                                                            | RX7S <sup>d</sup>  |                      | 400             | –            |
|                                                                                                                                                                                                                                            | G38                | 1 000                | 400             | –            |
|                                                                                                                                                                                                                                            | Fc2 <sup>d</sup>   |                      | 400             | –            |
|                                                                                                                                                                                                                                            | G38 <sup>e</sup>   |                      | 3 000           | 40           |
|                                                                                                                                                                                                                                            | G8.5 <sup>d</sup>  | 750                  | 72              | –            |
|                                                                                                                                                                                                                                            | G12 <sup>d</sup>   |                      | 150             | –            |
|                                                                                                                                                                                                                                            | GY16 <sup>e</sup>  | 500                  | 2 000           | 20           |
|                                                                                                                                                                                                                                            | GY9.5 <sup>e</sup> |                      | 650             | 10/20        |
| Prefocus base lamp                                                                                                                                                                                                                         | P28s <sup>e</sup>  | 250                  | 500             | 10           |
| <sup>a</sup> In accordance with IEC 60238.<br><sup>b</sup> In accordance with IEC 61184.<br><sup>c</sup> In accordance with IEC 60400.<br><sup>d</sup> In accordance with IEC 60838-1.<br><sup>e</sup> These types are used in Japan only. |                    |                      |                 |              |

#### 4.10 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, for example mounting parts;
- type and number of lamp/s;
- rated power of lamp/s.

The marking shall be durable and not removable as well in hazardous areas.

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 or divergent requirements included in this document. 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 Materials**

#### **5.2.1 Enclosures**

In general, the requirements on materials according to IEC 60092-101 shall be met.

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 plastics.

#### **5.2.2 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 5 and the humid heat test stated in Table 3.

### **5.3 Automated lighting controllers**

Controllers for emergency lighting shall be independent and separated from controllers for main lighting.

Systems for automatic or remote switching or dimming of lighting shall have the following functions.

- a) Switching to appropriate light intensity in case of:
  - 1) loss of main power
  - 2) loss of emergency power (main power is available)
  - 3) release of fire alarm
  - 4) release of general alarm, and
  - 5) failure in the lighting control system (power failure, hardware failure, communication failure).
- b) Failure of lighting control system shall send an alert signal to the bridge alert system.
- c) There shall be a setting for minimum light intensity for the purpose of emergency lighting.

NOTE 5.3 is not intended for local dimming of lights, such as for mess rooms or cabins.

## 6 Socket-outlets and plugs for the luminaires' connection

Generally, the requirements according to the IEC 60309 series apply.

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

- 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

The luminaires shall pass the tests listed in IEC 60598-1, as modified by Clause 7, and its additional tests as shown.

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, and 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, for example in case of vibration test, an appropriate mounting fixture shall be used.

### 7.2 Design parameters

#### 7.2.1 Climatic exposure, operation

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 3.

**Table 3 – Climatic conditions, operation**

| Exposure  | Test                                               | Requirement, remark                                                                                                                                                                             |
|-----------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cold      | In accordance with IEC 60068-2-1, test Ad          | Minimum temperature for outdoor luminaires: –25 °C<br>Minimum temperature for indoor luminaires: 0 °C<br>Test duration: 16 h                                                                    |
| Dry heat  | In accordance with IEC 60068-2-2, test Be          | Maximum temperature for outdoor luminaires: +70 °C<br>Maximum temperature for indoor luminaires: +55 °C<br>Test duration: 16 h                                                                  |
| Damp heat | In accordance with IEC 60068-2-30, test Db, cyclic | Applicable only for indoor luminaires<br>Temperature: 55 °C ± 2 °C<br>Relative humidity value: 95 $\begin{smallmatrix} +2 \\ -3 \end{smallmatrix}$ %<br>Test duration: two cycles (12 h + 12 h) |
| Salt mist | In accordance with IEC 60068-2-52, test Kb         | Applicable only for outdoor luminaires<br>Severity 1: 4 cycles of a 2 h spraying period followed by a 7 days storage duration at humid heat.                                                    |

**7.2.2 Climatic exposure, storage**

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 4.

**Table 4 – Climatic conditions, storage**

| Exposure   | Test                                                      | Requirement, remark                                                                                                                  |
|------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Cold       | In accordance with IEC 60068-2-1, test Ab                 | Minimum temperature: –30 °C<br>Test duration: 48 h                                                                                   |
| Dry heat   | In accordance with IEC 60068-2-2, test Bb                 | Maximum temperature: +60 °C<br>Test duration: 48 h                                                                                   |
| Humid heat | In accordance with IEC 60068-2-78, test Cab, steady state | Temperature: 40 °C ± 2 °C<br>Relative humidity value: 93 $\begin{smallmatrix} +2 \\ -3 \end{smallmatrix}$ %<br>Test duration: 4 days |

**7.2.3 Special chemical and physical attributes**

The tests stated in Table 5 shall be performed and evaluated to confirm the required attributes given in 4.2.2 a) and c).

**Table 5 – Special chemical and physical attributes**

| Characteristic/test criterion | Test method                                                                                                                             | Test result                                                       |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Halogen concentration         | Amount of chlorine:<br>For materials (e.g. housings, parts), in accordance with IEC 60684-2; for cables, in accordance with IEC 60754-1 | Mass fractions:<br>Chlorine $\leq 0,5$ %<br>Fluorine $\leq 0,1$ % |
|                               | Amount of fluorine:<br>For materials including cables, in accordance with IEC 60684-2                                                   |                                                                   |
| UV resistance                 | In accordance with ISO 4892-3 or ISO 4892-2                                                                                             | No changes of surface or colour                                   |
| Toxicity                      | In accordance with IEC 60695-7-2                                                                                                        | Toxicity index $\leq 5$                                           |
| Fire hazard                   | For materials of end-products incorporating housings and parts: in accordance with IEC 60695-2-11                                       | In accordance with IEC 60695-2-11, temperature 850 °C             |
| Flame spread                  | For cables: in accordance with IEC 60332-1-2                                                                                            | In accordance with IEC 60332-1-2:2004, Annex A                    |

### 7.3 Electrical tests

#### 7.3.1 High voltage test

The requirements shall be in accordance with IEC 60092-504 and as stated in Table 6. The duration of application of the test voltage shall be 1 min. Printed circuits with electronic components, for example LEDs, which could potentially be damaged should be removed during the test.

**Table 6 – High voltage test**

| Rated voltage $U_n$<br>V      | Test voltage<br>AC 50 Hz or 60 Hz<br>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                                  |
| 691 up to and including 1 000 | 3 000                                  |

Period of application of test voltage: 1 min.

#### 7.3.2 Insulation resistance test

The measuring of the insulation resistance value shall be carried out before and after high voltage test, damp heat test and cold test. The requirements are in accordance with IEC 60092-504 and stated in Table 7.