

**1.2.69 Safety Extra-Low Voltage (SELV) part**

A current-carrying part supplied from within a luminaire at extra-low voltage (not exceeding 50 V a.c. r.m.s.) with respect to any other parts or earth.

**1.2.70 Dummy lamp**

A device incorporating a cap which is in compliance with the requirements of IEC 60061.

**1.2.71 Self-shielded tungsten halogen lamp (abbreviated: self-shielded lamp)**

Tungsten halogen lamp for which a protective shield on the luminaire is not needed. The packaging of these lamps is marked with the relevant symbol of figure 1.

**1.2.72 External flexible cable or cord**

A flexible cable or cord for external connection to the input or output circuit, fixed to or assembled with, the luminaire according to one of the following methods of attachment:

- type X attachment: Method of attachment of the cable or cord such that it can be easily replaced.

NOTE 1 – The flexible cable or cord may be specially prepared and only available from the manufacturer or his service agent.

NOTE 2 – A specially prepared cable or cord may also include a part of the luminaire.

- type Y attachment: Method of attachment of the cable or cord such that any replacement can only be made by the manufacturer, his service agent or similar qualified person.

NOTE 3 – Type Y attachment may be used either with an ordinary or a special flexible cable or cord.

- type Z attachment: Method of attachment of the cable or cord such that it cannot be replaced without breaking or destroying the luminaire.

**SECTION 2: CLASSIFICATION OF LUMINAIRES****2.1 General**

This section describes the classification of luminaires.

Luminaires are classified according to the type of protection against electric shock, the degree of protection against ingress of dust, solid objects and moisture, and the material of the supporting surface.

**2.2 Classification according to type of protection against electric shock**

Luminaires shall be classified according to the type of protection against electric shock provided, as class 0, class I, class II and class III (see definitions in section 1). Luminaires with a rated voltage in excess of 250 V shall not be classified as class 0.

Rough service luminaires shall not be classified as class 0.

Luminaires shall have only a single classification. For example, for a luminaire with a built-in extra-low voltage transformer with provision for earthing, the luminaire shall be classified as class I and part of the luminaire shall not be classified as class III even though the lamp compartment is separated by a barrier from the transformer compartment.

## Annex L (informative)

### Guide to good practice in luminaire design

#### L.1 Scope

This guide to good practice is intended to advise luminaire manufacturers on the behaviour of plastic materials and finishes under the influence of temperature, UV radiation, moisture and aggressive atmospheres and to offer good practice in reflector design. ②

It applies to luminaires for indoor and outdoor use and advises on generally accepted constructions but is not exhaustive. This guide should therefore never be interpreted as a requirement since other solutions can be equally effective or even better in certain specific applications.

A classification of external influences is given in IEC 60364-3.

#### L.2 Plastics in luminaires

In luminaire construction, plastic components have become important and proven functional elements. This applies to internal parts and wiring, and to components such as translucent covers, shields and parts for structural support.

The applications relative to the "normal" usage of luminaires determine the normal running life (ageing) of these plastic parts.

Excessive hard usage and damaging influences diminish the resistance to ageing.

**Table L.1 – Damaging influences**

Damaging Influence	Cause	Effects *
High operating temperature	Operating voltage too high Ambient temperature too high Inappropriate mounting	Deformation Embrittlement Discoloration
UV radiation	Mercury-dosed high-pressure lamps with excessive UV component Germicidal lamps	Yellowing Embrittlement
Aggressive substance	Softeners (plasticizers) Incorrect cleaning (with disinfecting means)	Cracking Reduced strength Outer surface damage
* All causes can relate to all effects.		

Semi-luminaires shall comply with all relevant requirements for class II luminaires without being provided with the class II symbol.

NOTE – The class II symbol is omitted in order to avoid the symbol being applied to the complete luminaire in which the semi-luminaire is used.

Track-mounted luminaires shall not be classified as class 0.

NOTE – Some national wiring rules may not allow portable luminaires to be class 0. Other national wiring rules may not allow any luminaires to be class 0.

### 2.3 Classification according to degree of protection against ingress of dust, solid objects and moisture

Luminaires shall be classified in accordance with the "IP number" system of classification described in IEC 60529.

Symbols for the degrees of protection are given in section 3.

Tests for the degrees of protection are given in section 9.

NOTE 1 – Luminaires classified as watertight are not necessarily suitable for operation under water; pressure watertight luminaires should be used for such applications.

NOTE 2 – The IP numbers are the principal marking on luminaires but symbols may be used in addition to IP numbers if desired.

### 2.4 Classification according to material of supporting surface for which the luminaire is designed

Luminaires shall be classified according to whether they are suitable for direct mounting on normally flammable surfaces in all cases, or are primarily intended for that application or are only suitable for mounting on non-combustible surfaces as follows:

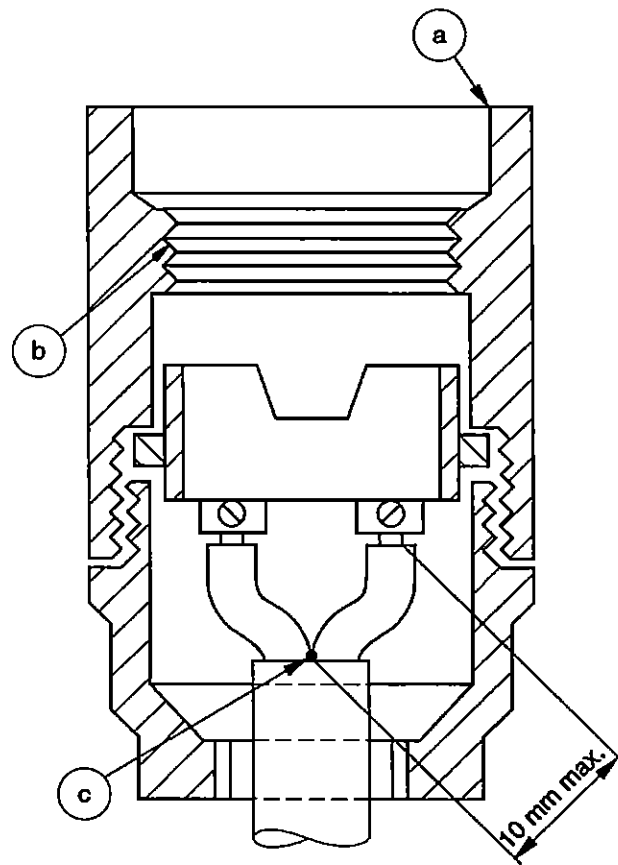
<i>Classification</i>	<i>Symbol</i>
– Portable and handheld luminaires.	Symbol not required.
– Other fixed luminaires suitable for mounting on normally flammable surfaces.	Symbol required – see figure 1.
– Other fixed luminaires suitable for mounting on non-combustible materials only.	No symbol, but warning notice may be required – see section 3.

NOTE – Readily flammable surfaces are not suitable for the direct mounting of luminaires. Requirements for luminaires classified as primarily intended for direct mounting on normally flammable surfaces are given in section 4 and related tests in section 12.

### 2.5 Classification according to the circumstances of use

Luminaires shall be classified according to whether they are intended for normal use or for rough service.

<i>Classification</i>	<i>Symbol</i>
– Luminaires for normal use.	No symbol.
– Luminaires for rough service.	Symbol – see figure 1, in 15.9.2.5.



IEC 288/98

NOTE – Lampholder may be either ES or BC.

Figure K.1 – Placing of thermocouples on a typical lampholder

## SECTION 3: MARKING

### 3.1 General

This section specifies the information to be marked on luminaires.


### 3.2 Marking on luminaires

The following information shall be distinctly and durably marked on the luminaire (see table 3.1).

- a) Marking to be observed when replacing lamps shall be visible on the outside of the luminaire (except the mounting side) or behind a cover which is removed during lamp replacement and with the lamp removed.
- b) Marking to be observed during installation shall be visible during installation on the outside of the luminaire or behind a cover or part which is removed during installation.
- c) Marking to be observed after installation shall be visible with the luminaire assembled and installed as for normal use and with the lamp in place.

Marking may be on ballasts provided the conditions under a) or b) above, as appropriate, are fulfilled.

Table 3.1

Markings belonging to a)	Markings belonging to b)	Markings belonging to c)
3.2.8* Rated wattage	3.2.1 - 3.2.2**	3.2.3 Ambient temperature
3.2.10 Special lamps	3.2.4 - 3.2.5	3.2.6 IP number
3.2.11 Cool beam	3.2.7 Type reference	3.2.13 Lighted objects
3.2.15 Bowl mirror	3.2.9 Symbols 	3.2.14 Rough service
3.2.16 Protective shield	3.2.12 Termination	
3.2.18 Ignition warning	3.2.17*** Interconnected luminaires	
3.2.19 Self-shielded lamp		
<p>* 3.2.8 Rated wattage. For luminaires for discharge lamps with remote control gear, the marking may be replaced by the instruction: "For lamp designation, see control gear".</p> <p>** 3.2.2 Rated voltage. For luminaires for discharge lamps, if the ballast is not built into the luminaire, the luminaire shall be marked with the working voltage instead of the mains voltage. For luminaires with built-in transformers for filament lamps, see IEC 60598-2-6.</p> <p>*** 3.2.17 Interconnected luminaires. For fixed luminaires this information may alternatively be provided within the installation instructions.</p>		

The earthing symbol referred to in 3.2.12 may be marked on the ballast, instead of the luminaire, if the ballast is a non-replaceable type. The height of graphical symbols shall not be less than 5 mm except that the symbols for class II and class III luminaires and for the F mark may be reduced to a minimum of 3 mm where the space available for marking is restricted. The height of letters and numerals either shown separately or with or as part of symbols shall not be less than 2 mm.

- d) *Cables. The insulation is slit and the thermocouple inserted (without touching a conductor); the insulation is then bound up.*
- e) *Mounting surfaces (see annex D). A thermocouple is attached to a copper disc (approximately 15 mm in diameter, 1 mm thick, and with a matt black finish), sunk level with the surface at the hottest point.*

*The average ambient temperature in the draught-proof enclosure is taken to be the air temperature at a position near one of the perforated walls on a level with the centre of the luminaire. The temperature is usually measured by a mercury-in-glass thermometer the bulb of which is shielded against radiation by a double-walled cylinder of polished metal.*

*The average temperature throughout a winding is measured by the increase-in-resistance method. The procedure to be followed is described in annex E.*

**NOTE** – It is found that errors are often made in the estimated calculation. An independent rough check should be made by measuring the case temperature of the component and adding a winding-to-case differential appropriate to the construction.

*It is important that all temperature measuring instruments should be checked regularly. It is also recommended that measuring authorities should interchange luminaires to improve consistency in the measurement of different materials at different temperature levels.*

#### **K.1.2 Temperature measurement of the insulation parts of lampholders**

*Thermocouples should be applied on the following measuring points, as shown in figure K.1:*

- a) *lampholder rim (not on metal or ceramic lampholders);*
- b) *at the point of contact between the lamp cap and the lampholder (if made of insulation material other than ceramic).*  
*It is the intention that measurement takes place on the lampholder, and should be as near as possible to the point of contact between the lamp cap and the lampholder without touching the lamp cap;*
- c) *at bifurcation of cable with a maximum of 10 mm from the lampholder terminals (if any – this measuring point being important as the wiring may touch it).*

For combination luminaires where the type references or the rated inputs are different for different combinations, the main part and the alternative parts may be marked with a type reference or a rated input, as appropriate, provided that the type can be identified and the rated input of the complete unit may be established from a catalogue or a similar document.

For luminaires with electro-mechanical contact systems the base plate shall be marked with the rated current of the electrical connection if the system can be used with a variety of different luminaire types.



**3.2.1** Mark of origin (this may take the form of a trade mark, the manufacturer's identification mark or the name of the responsible vendor).

**3.2.2** Rated voltage(s) in volts. Luminaires for tungsten filament lamps shall be marked only if the rated voltage is different from 250 V.

Portable class III luminaires shall be marked with the rated voltage on the outside of the luminaire.

**3.2.3** The rated maximum ambient temperature  $t_a$ , if other than 25 °C (see figure 1).

NOTE – Exceptions to this general requirement may be specified in particular sections of IEC 60598-2.

**3.2.4** Symbol for class II luminaires where applicable (see figure 1).

For portable luminaires provided with a non-detachable flexible cable or cord, the symbol for class II construction, if applicable, shall be on the outside of the luminaire.

The class II symbol shall not be applied to semi-luminaires.

**3.2.5** Symbol for class III luminaires where applicable (see figure 1).

**3.2.6** Marking (if applicable) with IP numbers for degree of protection against ingress of dust, solid objects and moisture and, if desired, additional symbols (see figure 1 and annex J). Where X is used in an IP number in figure 1, it indicates a missing numeral in the example, but both of the appropriate numerals shall be marked on the luminaire.

In cases where different IP numbers apply to distinct parts of the luminaire, the lower number shall be marked on the type label on the luminaire whereas the higher number shall be marked separately on the part concerned. The instruction sheet supplied with the luminaire shall include details of the IP numbers applying to the various parts of the luminaire. The use of different IP numbers on different parts of a luminaire is only applicable to fixed luminaires.

Marking of IP20 on ordinary luminaires is not required.

**3.2.7** Maker's model number or type reference.

**3.2.8** Rated wattage or the designation as indicated on the lamp data sheet of the type or types of lamp for which the luminaire is designed. Where the lamp wattage alone is insufficient, the number of lamps and the type shall also be given.

## Annex K (informative)

### Temperature measurement

**K.1.1** *The following recommendations refer to methods of making temperature measurements on luminaires in a draught-proof enclosure in accordance with 12.4.1. These methods of measurement have evolved as being particularly suitable for luminaires; alternative methods may be used if it is established that they are of at least equal precision and accuracy.*

*Temperatures of solid materials are usually measured by means of thermocouples. The output voltage is read by a high-impedance device such as a potentiometer. With a direct-reading instrument it is important to check that its input impedance is suited to the impedance of the thermocouple. Temperature-indicators of the chemical type are at present suitable only for rough checks of measurement.*

*The thermocouple wires should be of low thermal conductivity. A suitable thermocouple consists of 80/20 nickel-chromium paired with 40/60 nickel-copper (or with 40/60 nickel-aluminium). Each of the two wires (usually of strip form, or circular in section) is fine enough to pass through a 0,3 mm hole. All the end-portions of the wires liable to be exposed to radiation have a high-reflectance metal finish. The insulation of each wire is of suitable temperature and voltage rating; it is also thin but robust.*

*Thermocouples are attached to the measuring point with minimum disturbance of thermal conditions and with low-resistance thermal contact. If a particular point on a part is not specified, the point of highest temperature should be found by preliminary exploration (for this purpose, a thermocouple may be mounted in a holder made of material of low thermal conductance; instruments using thermistors are also convenient). It is important to explore materials such as glass, since the temperature may vary rapidly with position. Thermocouples mounted within or near a luminaire should have minimum exposure to conducted or radiant heat. Care should be taken to avoid voltages from current-carrying parts.*

*The following methods have been found useful for attaching thermocouple junctions at measuring points:*

- a) Mechanical clamping, e.g. under a fixing device (clamping under current-carrying parts should be avoided).*
- b) Soldering to a metal surface (with a minimum amount of solder).*
- c) By an adhesive (minimum amount required). The adhesive should not separate the thermocouple from the measuring point. An adhesive used with a translucent material should be as translucent as possible. A suitable adhesive for use with glass is formed of one part of sodium silicate to two parts of calcium sulphate, with water medium.*

*On non-metal parts the last 20 mm of the thermocouple are attached to the surface to offset the flow of heat from the measuring point.*



Luminaires for tungsten filament lamps shall be marked with the maximum rated wattage and number of lamps.

Marking of maximum rated wattage for luminaires for tungsten filament lamps with more than one lampholder may be in the form:

" $n \times \text{MAX... W}$ ",  $n$  being the number of lampholders.

**3.2.9** Where applicable, the relevant symbol (see figure 1) for suitability or non-suitability for direct mounting on normally flammable surfaces or suitability for mounting in/on normally flammable surfaces when thermally insulating material may cover the luminaire.

NOTE – A warning notice is not required when it is obvious that either a luminaire will never be mounted on normally flammable surfaces, for example portable luminaires for garden use or a luminaire will always be mounted on normally flammable surfaces, for example portable general purpose luminaires, portable child-appealing luminaires and luminaires for emergency lighting.

**3.2.10** Information concerning special lamps, if applicable.

In particular this applies to the symbols (see figure 1) for luminaires for use with high-pressure sodium lamps having either an internal starting device or requiring an external ignitor where the lamp is required to be marked with the same symbol according to IEC 60662.

**3.2.11** Symbol (see figure 1), if applicable, for luminaires for lamps of similar shape to "cool beam" lamps but where the use of a dichroic reflectorized "cool beam" lamp might impair safety.

**3.2.12** Except for type Z attachments, terminations shall be clearly marked or otherwise identified to give a clear indication as to which termination should be connected to the live side of the supply, where necessary for safety, or to ensure satisfactory operation. Earthing terminations shall be clearly indicated by the appropriate symbol shown in IEC 60417. ②

Luminaires with non-detachable flexible cables or cords which are not fitted with a plug shall include with the manufacturer's instructions any information necessary to ensure safe connection, e.g. deviations from the national standardized colour coding of the cores. ②

Extra-low voltage d.c. supplied fluorescent luminaires shall have positive supply terminations marked + or coloured red and negative supply terminations marked – or coloured black.

**3.2.13** Symbol (see figure 1) for minimum distance from lighted objects, if applicable, for luminaires which might otherwise overheat the lighted objects due to for example the applied lamp type, the shape of the reflector, the adjustability of the mounting means or the location of mounting as indicated in the installations instructions.

The minimum distance marked shall be determined by the temperature test described in item j) of 12.4.1.

The distance is measured on the optical axis of the luminaire from that part of the luminaire or lamp which is nearest to the lighted object.

The symbol for minimum distance and explanation of its meaning shall also be given either on the luminaire or in the instructions with the luminaire.

Table J.2 – Degrees of protection indicated by the second characteristic numeral

Second characteristic numeral	Degree of protection	
	Short description	Details of the type of protection provided by the enclosure
0	Non-protected	No special protection
1	Protected against dripping water	Dripping water (vertically falling drops) shall have no harmful effect
2	Protected against dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at any angle up to 15° from its normal position
3	Protected against spraying water	Water falling as a spray at an angle up to 60° from the vertical shall have no harmful effect
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effect
5	Protected against water jets	Water projected by a nozzle against the enclosure from any direction shall have no harmful effect
6	Protected against heavy seas	Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities
7	Protected against the effects of immersion	Ingress of water in a harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time
8	Protected against submersion	The equipment is suitable for continuous submersion in water under conditions which shall be specified by the manufacturer.  NOTE – Normally, this will mean that the equipment is hermetically sealed. However with certain types of equipment it can mean that water can enter but only in such a manner that it produces no harmful effects.
Specialist cleaning techniques are not covered by IP ratings. Manufacturers are recommended to give appropriate information regarding cleaning techniques, where necessary. This is in line with the recommendations contained within IEC 60529 for specialist cleaning techniques.		



**3.2.14** Symbol (see figure 1), if applicable, for rough service luminaires.

**3.2.15** Symbol (see figure 1), if applicable, for luminaires which are designed for use with bowl mirror lamps.

NOTE – Separate bowls for attachment to GLS lamps without reference to luminaire testing are not within the scope of this standard.

**3.2.16** Luminaires incorporating a glass protective shield shall be marked as follows:

"Replace any cracked protective shield"

or

with the symbol (see figure 1).

**3.2.17** The maximum number of luminaires that may be interconnected or the maximum total current that may be drawn by means of couplers provided for looping-in connection to the mains supply. For fixed luminaires this information may alternatively be provided within the installation instructions. ②

**3.2.18** A warning symbol or notice for luminaires with ignitors intended for use with double-ended high pressure discharge lamps if the voltage measured according to figure 26 exceeds 34 V peak.

- a) Warning symbol in accordance with Sheet 5036 IEC 60417 visible during replacement of the lamp. The symbol shall be explained on the luminaire or in the manufacturer's instructions provided with the luminaire, or
- b) A warning notice near to the holder of a replaceable ignitor or replaceable switching element, if any: "Attention, remove replaceable device before replacement of lamp. After lamp-replacement reinsert replaceable device".

**3.2.19** Symbol (see figure 1) for luminaires which are designed for use with self-shielded tungsten halogen lamps only. ②

### **3.3 Additional information**

In addition to the above marking, all details which are necessary to ensure proper installation, use and maintenance shall be given either on the luminaire or on built-in ballasts or in the manufacturer's instructions provided with the luminaire, for instance:

Written instructions related to safety shall be in a language which is acceptable in the country in which the equipment is to be installed.

**3.3.1** For combination luminaires, the permissible ambient temperature, the class of protection or the protection against ingress of dust, solid objects and moisture of an alternative part if not at least equal to that of the basic luminaire.

**3.3.2** Nominal frequency in hertz.

**3.3.3** Operating temperatures:

- a) The rated maximum operating temperature (of a winding)  $t_w$  in degrees Celsius;
- b) The rated maximum operating temperature (of a capacitor)  $t_c$  in degrees Celsius;

**Annex J**  
(informative)

**Explanation of IP numbers for degrees of protection**

For full details see IEC 60529 from which the following is an extract.

The type of protection covered by this system of classification is as follows:

- a) Protection of persons against contact with or approach to live parts and against contact with moving parts (other than smooth rotating shafts and the like) inside the enclosure and protection of the equipment against ingress of solid foreign bodies.
- b) Protection of the equipment inside the enclosure against harmful ingress of water.

The designation to indicate the degrees of protection consists of the characteristic letters IP followed by two numerals (the "characteristic numerals") indicating conformity with the conditions stated in tables J.1 and J.2 respectively. The first numeral indicates the degree of protection described under item a) above and the second numeral the degree of protection described under item b) above.

**Table J.1 – Degrees of protection indicated by the first characteristic numeral**

First characteristic numeral	Degree of protection	
	Short description	Brief details of objects which will be "excluded" from the enclosure
0	Non-protected	No special protection
1	Protected against solid objects greater than 50 mm	A large surface of the body, such as a hand (but no protection against deliberate access). Solid objects exceeding 50 mm in diameter
2	Protected against solid objects greater than 12 mm	Fingers or similar objects not exceeding 80 mm in length. Solid objects exceeding 12 mm in diameter
3	Protected against solid objects greater than 2,5 mm	Tools, wires, etc., of diameter or thickness greater than 2,5 mm. Solid objects exceeding 2,5 mm in diameter
4	Protected against solid objects greater than 1,0 mm	Wires or strips of thickness greater than 1,0 mm. Solid objects exceeding 1,0 mm in diameter
5	Dust-protected	Ingress of dust is not totally prevented but dust does not enter in sufficient quantity to interfere with satisfactory operation of the equipment
6	Dust-tight	No ingress of dust

- c) The maximum temperature to which the insulation of supply cables and interconnecting cables will be subjected within the luminaire under the most unfavourable conditions of normal operation, if in excess of 90 °C (see note\*\*\* to table 12.2 relating to unsleeved fixed wiring). The symbol to indicate this requirement is given in figure 1. ①
- d) Spacing requirements to be observed during installation. ①

**3.3.4** A symbol or a warning notice that the luminaire is not suitable for mounting on a normally flammable surface (see figure 1).

**3.3.5** A wiring diagram, except where the luminaire is suitable for direct connection to the mains supply.

**3.3.6** Special conditions for which the luminaire, including the ballast, is suitable; for instance, whether or not the luminaire is intended for looping-in.

**3.3.7** Luminaires provided with metal halide lamps shall, if applicable, be provided with the following warning notice:

“The luminaire shall only be used complete with its protective shield”.

**3.3.8** The limitations of use or application for semi-luminaires.

**3.3.9** In addition, the manufacturer shall be prepared to supply information on the power factor and the supply current.

For connections suitable for both resistive and inductive loads, the rated current for the inductive load shall be indicated between brackets and shall immediately follow the rated current for the resistive load. The marking may accordingly be as follows:

$$3(1)A 250 V \text{ or } 3(1)/250 \text{ or } \frac{3(1)}{250}$$

NOTE 1 – This marking is in accordance with IEC 61058-1.

NOTE 2 – The rated current values do not apply to circuits in general but only to the rating of the luminaire as a whole.

**3.3.10** Suitability for use "indoors" including the related ambient temperature.

**3.3.11** For luminaires using remote control gear, the range of lamps for which the luminaire is designed.

**3.3.12** For clip-mounted luminaires a warning when the luminaire is not suitable for mounting on tubular material.

**3.3.13** The manufacturer shall provide the specifications of all protective shields.

**3.3.14** Where necessary for correct operation, the luminaire shall be marked with the symbol for nature of supply (see figure 1).

**3.3.15** The rated current at rated voltage shall be declared by the manufacturer for any socket outlet incorporated in the luminaire, if less than the rated value.

**Annex H:** *has been deleted*

**3.3.16** The information about rough service luminaires concerning:

- the connection to IPX4 rated socket outlets;
- the correct mounting taking into account the temporary installation;
- the correct fixing to a stand, and also where the stand is not supplied with the luminaire, the maximum height of a possible stand, and its required stability by the indication of the number and minimum length of the legs.

**3.3.17** For luminaires with type X, Y or Z attachments, the mounting instructions shall contain the substance of the following information:

- for type X attachments having a specially prepared cord:  
If the external flexible cable or cord of this luminaire is damaged, it shall be replaced by a special cord or cord exclusively available from the manufacturer or his service agent.
- for type Y attachments:  
If the external flexible cable or cord of this luminaire is damaged, it shall be exclusively replaced by the manufacturer or his service agent or a similar qualified person in order to avoid a hazard.
- for type Z attachments:  
The external flexible cable or cord of this luminaire cannot be replaced; if the cord is damaged, the luminaire shall be destroyed.

**3.3.18** Luminaires which are other than ordinary, provided with a PVC non-detachable cable or cord, shall be provided with information about the intended use, i.e. 'For indoor use only'.

**3.3.101** Where the terminal block is not supplied with the the luminaire, the packaging needs to contain the following wording:

"Terminal block not included. Installation may require advice from a qualified person."

**3.4 Test of marking**

*Compliance with the requirements of 3.2 and 3.3 is checked by inspection and by the following test:*

*The durability of the marking is checked by trying to remove it by rubbing lightly for 15 s with a piece of cloth soaked with water and, after drying, for a further 15 s with a piece of cloth soaked with petroleum spirit and by inspection after the tests detailed in section 12 have been completed.*

*After the test, the marking shall be legible, marking labels shall not be easily removable and they shall show no curling.*

NOTE – The petroleum spirit used should consist of a solvent hexane with a content of aromatics of maximum 0,1 % by volume, a value of 29 % for kauri-butanol, an initial boiling-point of approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0,68 g/cm<sup>3</sup>.

**Annex G:** *has been deleted*



## SECTION 4: CONSTRUCTION

### 4.1 General

This section specifies general constructional requirements for luminaires. See also annex L.



### 4.2 Replaceable components

Luminaires incorporating components or parts intended to be replaceable shall be so designed that there is sufficient space to permit replacement of such components or parts without difficulty and without impairing safety.

NOTE – Sealed-in components and riveted parts are not replaceable components.

### 4.3 Wireways

Wireways shall be smooth and free from sharp edges, burrs, flashes and the like, which might cause abrasion of the insulation of the wiring. Parts such as metal set screws shall not protrude into wireways.

*Compliance is checked by inspection and, if necessary, by dismantling and reassembling the luminaire.*

### 4.4 Lampholders

**4.4.1** The requirements for electrical safety of integral lampholders shall be those applicable to the luminaire as a whole with the lampholder and lamp in fully assembled position, as for normal use.

In addition, integral lampholders shall, when mounted in the luminaire, comply with the requirements concerning safety during insertion of the lamp as specified in the appropriate lampholder standard.

**4.4.2** Connection of wiring to integral lampholder contacts may be made by any method giving reliable electrical contact over the service life of the lampholder.

**4.4.3** Luminaires for tubular fluorescent lamps designed for end-to-end mounting shall be so designed that the lamp may be changed in the middle luminaire of a row without adjusting any other luminaire. In multi-lamp luminaires for tubular fluorescent lamps, the changing of any one lamp shall not impair the security of the other lamps.

*Compliance with the requirements of 4.4.1 to 4.4.3 is checked by inspection.*

**4.4.4** Lampholders which are put into position by the user shall be capable of easy and correct positioning.

The distance between the pair of fixed lampholders for a fluorescent lamp intended to be set in a fixed position shall comply with the relevant Standard Sheet of IEC 60061-2 or (if IEC 60061-2 does not apply) the lampholder manufacturer's mounting instructions. The fixing device of lampholders shall have adequate mechanical strength so as to withstand such rough handling as may be expected in normal use. These requirements apply both to lampholders put in position by the user and to lampholders put in position by the luminaire manufacturer.

### **F.3 Test piece**

The test is made on test pieces taken from the luminaires.

### **F.4 Test procedure**

The surfaces of the test pieces shall be carefully cleaned, varnish being removed by acetone grease and finger prints by petroleum spirit or similar product.

The test cabinet containing the test solution shall be brought to a temperature of  $(30\text{ °C} \pm 1\text{ °C})$ . The test pieces, pre-heated to  $30\text{ °C}$  shall be placed in the test cabinet as quickly as possible in such a way that the ammonia vapour can take effect unhindered. The test pieces shall preferably be suspended so that they do not dip into the test solution nor touch each other. Supports or suspension devices shall be made of materials which are not susceptible to attack by ammonia vapour, for example glass or porcelain.

Testing shall be carried out at a constant temperature of  $(30\text{ °C} \pm 1\text{ °C})$  to exclude visible condensed water formation caused by temperature fluctuations, which could severely distort the test results. The test period shall commence when the test cabinet is closed and shall last for 24 h. After this treatment the test pieces shall be washed in running water; 24 h later they shall show no cracks when inspected at an optical magnification of 8x.

NOTE – In order not to influence the results of the test, the test pieces shall be handled with care.

Compliance is checked by inspection, measuring and, if applicable, by the following mechanical tests:

- i) Lampholders for a fluorescent lamp, with a test-cap in position, are subjected, for 1 min, to a pressure applied to the centre of the cap in the direction of its axis of:
- 15 N for G5 lampholders
  - 30 N for G13 lampholders
  - 30 N for lampholders for single-capped fluorescent lamps (G23, G10q, GR8 etc.). Values for other lampholders are under consideration.

After the test, the distance between the holders shall comply with the relevant Standard Sheet of IEC 60061-2 and the lampholder shall show no damage. The test-cap for this test shall comply with the following Standard Sheets in IEC 60061-3:

7006-47C for G5 lampholders

7006-60C for G13 lampholders

test-caps for other lampholders are under consideration.

After the test on lampholders for single-capped fluorescent lamps the lampholder shall not have moved from its position and the fixing device shall show no permanent deformation, so that the lamp, when reinserted, will come in its intended position.

- ii) Mounting brackets for Edison screw or bayonet-capped lampholders are subjected to testing for 1 min, to the following bending moments:
- |                                  |                            |
|----------------------------------|----------------------------|
| for E14 and B15 lampholders      | 1,0 Nm;                    |
| for E26, E27 and B22 lampholders | 2,0 Nm;                    |
| for E39 and E40 lampholders      | Value under consideration. |

**4.4.5** For luminaires with ignitors, the peak pulse voltage occurring across contacts in lampholders which are part of the pulse voltage circuit shall not be greater than the pulse voltage marked on the lampholder or, in the absence of such marking, shall not be greater than:

- |                                  |        |
|----------------------------------|--------|
| – for 250 V rated lampholders    | 2,5 kV |
| – for 500 V rated ES lampholders | 4 kV   |
| – for 750 V rated ES lampholders | 5 kV   |

Compliance is checked by measurement of the voltage occurring across the lampholder contacts during the pulse test of 10.2.2 for luminaires with ignitors.

**4.4.6** For luminaires with ignitors incorporating Edison screw lampholders, the centre contact of the lampholder shall be connected to the lead which supplies the pulse voltage.

Compliance is checked by inspection.

**4.4.7** The insulating parts of lampholders and plugs incorporated in rough service luminaires shall be of a material resistant to tracking.

Compliance is checked by the test of clause 13.4.

## Annex F (normative)

### Test for resistance to stress corrosion of copper and copper alloys

#### F.1 Test cabinet

Closeable glass vessels shall be used for the test. These may be, for example desiccator vessels or simple glass troughs with ground rim and lid. The vessels volume shall be at least 10 l. A certain ratio of test space to volume of test solution shall be maintained (20:1 to 10:1).

#### F.2 Test solution

Preparation of 1,0 l of solution:

Dissolve 107 g of ammonium chloride (reagent grade  $\text{NH}_4\text{Cl}$ ) in about 0,75 l of distilled or fully demineralized water and add as much of 30 % sodium hydroxide solution (prepared from reagent NaOH and distilled or fully demineralized water) as is necessary to reach a pH value of 10 at 22 °C. For other temperatures, adjust this solution to the corresponding pH values specified in table F.1.

**Table F.1 – pH value of the test solution**

Temperature °C	Test solution pH
$22 \pm 1$	$10,0 \pm 0,1$
$25 \pm 1$	$9,9 \pm 0,1$
$27 \pm 1$	$9,8 \pm 0,1$
$30 \pm 1$	$9,7 \pm 0,1$

After the pH adjustment, make up to 1,0 l with distilled or fully demineralized water.

This does not change the pH value any more.

Keep the temperature in any event constant to within  $\pm 1$  °C during the pH adjustment, carry out the pH measurement using an instrument which permits an adjustment of the pH value to within  $\pm 0,02$ .

The test solution may be used over a prolonged period, but the pH value which represents a measure of the ammonia concentration in the vapour atmosphere, shall be checked at least every three weeks and adjusted if necessary.

**4.4.8** Lamp connectors shall comply with all the requirements for lamp holders other than those related to retaining the lamp in position. Means for retaining the lamp have to be provided by other parts of the luminaire.

*Compliance is checked by inspection and test as required by 4.4.1 to 4.4.7.*

NOTE – The difference between lamp connectors and lampholders is clearly identified on the relevant data sheets of IEC 60061.

#### **4.5 Starter holders**

Starter holders in luminaires other than class II shall accept starters which comply with IEC 60155.

Class II luminaires may require starters of class II construction.

For class II luminaires where the starter can be touched with the standard test finger when the luminaire is fully assembled for use or open for the replacement of lamps or starters, the starter holder shall be one accepting only starters complying with the requirements for starters for class II luminaires given in IEC 60155.

*Compliance is checked by inspection.*

#### **4.6 Terminal blocks**

If luminaires are provided with connecting leads (tails) requiring a separate terminal block for the connection to the fixed wiring, adequate space for this terminal block shall be provided within the luminaire, or within a box delivered with the luminaire, or specified by the manufacturer. ②

This requirement applies to terminal blocks for connecting leads (tails) with conductor nominal cross-sectional areas not exceeding 2,5 mm<sup>2</sup>.

*Compliance is checked by measurement and by an installation test, using one terminal block for each two conductors to be connected together, as shown in figure 2, and fixed wiring having a length of approximately 80 mm. The dimensions of the terminal blocks are those specified by the manufacturer or, in the absence of such a specification, 10 mm × 20 mm × 25 mm.* ②

NOTE – Unsecured terminal blocks are permitted when they are so designed and insulated that creepage distances and clearances in accordance with section 11 are always maintained for any position of the terminal block, and that damage to internal wiring is prevented.

*The constant 234,5 relates to copper windings; for aluminium this constant is 229. Hence, for windings of copper wire:*

$$t_2 = \frac{R_2}{R_1} (t_1 + 234,5) - 234,5$$

*The temperature rise is the difference between the calculated temperature  $t_2$  and the ambient air temperature  $t_3$  at the conclusion of the test, that is:*

$$\text{temperature rise} = (t_2 - t_3) \text{ K}$$

## 4.7 Terminals and supply connections

**4.7.1** In portable luminaires of class 0, I and II and in fixed luminaires of class 0, I and II that are frequently adjusted, adequate precautions shall be taken to prevent metal parts from becoming live due to a detached wire or screw. This requirement applies to all terminals (including supply terminals).

NOTE – The requirement may be met by securing the wires adjacent to their entry to the terminals, by suitable dimensioning of the enclosure for the terminals, by the use of an enclosure of insulating material or by the provision of an insulating lining in the enclosure.

Examples of methods deemed efficient to prevent a wire from becoming detached are:

- a) wires are retained by a cord anchorage adjacent to the terminals;
- b) conductor is clamped by a spring type screwless terminal;
- c) the wire conductor is anchored to the tag before soldering, unless breakage close to the soldering place is likely to occur as a result of vibration;
- d) wires are twisted together in a reliable manner;
- e) wires are fastened together by insulation tape, sleeves, or the like;
- f) the wire conductor is inserted into a hole in a printed board, bent and soldered, the hole having a diameter slightly greater than the conductor;
- g) the wire conductor is securely wrapped around the terminal by means of a special tool (see figure 19);
- h) the wire conductor is crimped to the terminal by means of a special tool (see figure 19).

The methods under a) to h) apply to internal wiring and the methods under a) and b) to rewirable external flexible cords.

*Compliance is checked by inspection and based upon the assumption that only one conductor can become detached at the same time.*

**4.7.2** Supply terminals shall be located or shielded in such a way that, if a wire of a stranded conductor escapes from a terminal when the conductors are fitted, there is no risk of contact between live parts and metal parts which can be touched with the standard test finger when the luminaire is fully assembled for use or open for the replacement of lamps or starters.

*Compliance is checked by inspection and by the following test:*

*An 8 mm length of insulation is removed from the end of a flexible conductor having the largest cross-sectional area specified in section 5. One wire of the stranded conductor is left free and the remainder are fully inserted and clamped in the terminal. The free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around barriers.*

*The free wire of a conductor connected to a live terminal shall not touch any metal part which is accessible or connected to an accessible metal part, and the free wire of a conductor connected to an earthing terminal shall not touch any live part.*

*This test does not apply to lampholders which have been separately approved to an appropriate IEC standard and to terminals of components where the construction method justifies a shorter length of free wire.*

**4.7.3** Terminals for supply conductors, including those for non-detachable flexible cables and cords, shall be suitable for connection to be made by means of screws, nuts or equally effective devices.

**Annex E**  
(normative)

**Determination of winding temperature rises  
by the increase-in-resistance method**

NOTE – Reference to ballasts also applies to similar components such as transformers.

*Before commencing the test, arrangements are made whereby the ballast may be quickly connected by appropriate means of negligible resistance to a Wheatstone bridge, or other suitable measuring instrument, after the luminaire has been disconnected from the supply.*

*A chronometer with an easily-read second hand is essential.*

*The test procedure is as follows:*

*The luminaire remains unenergized for a period long enough to ensure that the complete luminaire, including the ballast windings, is thermally stable in a substantially constant ambient temperature ( $t_1$ ), which shall not change by more than 3 °C during this period.*

*The resistance ( $R_1$ ) of the cold ballast winding is measured and  $t_1$  noted. The luminaire is operated until thermal stability has been achieved as indicated by a suitable temperature measuring device attached to the body of the ballast. The ambient air temperature ( $t_3$ ) in the draught-proof enclosure is noted.*

*The luminaire is then disconnected from the supply, the time noted and the ballast connected immediately to the Wheatstone bridge. The resistance is measured as quickly as possible and the corresponding time noted.*

*Further resistance measurements, if necessary, are made at suitable intervals whilst the ballast is cooling, the times at which the measurements are made being recorded. These measurements enable a time/resistance curve to be plotted which is extrapolated back to the point corresponding to the instant of disconnection of the supply and the resistance  $R_2$  of the hot winding is read.*

*Since the resistance of copper varies in direct proportion to the temperatures as measured from a reference point of  $-234,5$  °C, the hot temperature  $t_2$  may be calculated from the ratio of the hot resistance  $R_2$  to the cold resistance  $R_1$  by means of the equation:*

$$\frac{R_2}{R_1} = \frac{t_2 + 234,5}{t_1 + 234,5}$$



*Connecting leads (tails) shall comply with the requirements of section 5.*

NOTE 1 – For luminaires designed to be connected by means of rigid (solid or stranded) conductors, screwless terminals of the spring type are effective devices, including the earth connection. No requirements are specified at present for using such terminals for the connection of non-detachable flexible cables and cords.

NOTE 2 – For luminaires designed to be connected by means of a non detachable flexible cable or cord and having a rated current not exceeding 3 A, soldered, welded, crimped and similar connections, including snap-on connectors, are effective devices, including an earth connection.

NOTE 3 – For luminaires having a rated current exceeding 3 A, snap-on connectors are suitable if the connection can also be made without making use of the receptacle, for example, by means of a screwed connection for which a threaded hole is provided in the tab.

**4.7.4** Terminals, other than those for supply connection, which are not covered by separate standards for components, shall comply with the requirements of section 14 or 15.

Terminals of lampholders, switches and similar parts used for multiple connection of internal wiring shall have dimensions adequate for the purpose and shall not be used for the connection of external wiring.

*Compliance is checked by inspection and by the tests of sections 14 and 15.*

**4.7.5** If the external wiring or supply cable is unsuitable for the temperatures reached inside the luminaire, either a connection shall be provided at the point of entry of the external wiring into the luminaire for the use of heat-resistant wiring after this point, or heat-resisting parts shall be supplied with the luminaire to cover the part of the wiring placed inside it, which exceeds the wiring temperature limit.

*Compliance is checked by inspection.*

**4.7.6** If during the installation or maintenance of a luminaire electrical connections are made by a multi-pole plug and socket, unsafe connections shall be prevented.

*Compliance is checked by inspection and by trying to make unsafe connections e.g. by shifting the plug positions and the like.*

## **4.8 Switches**

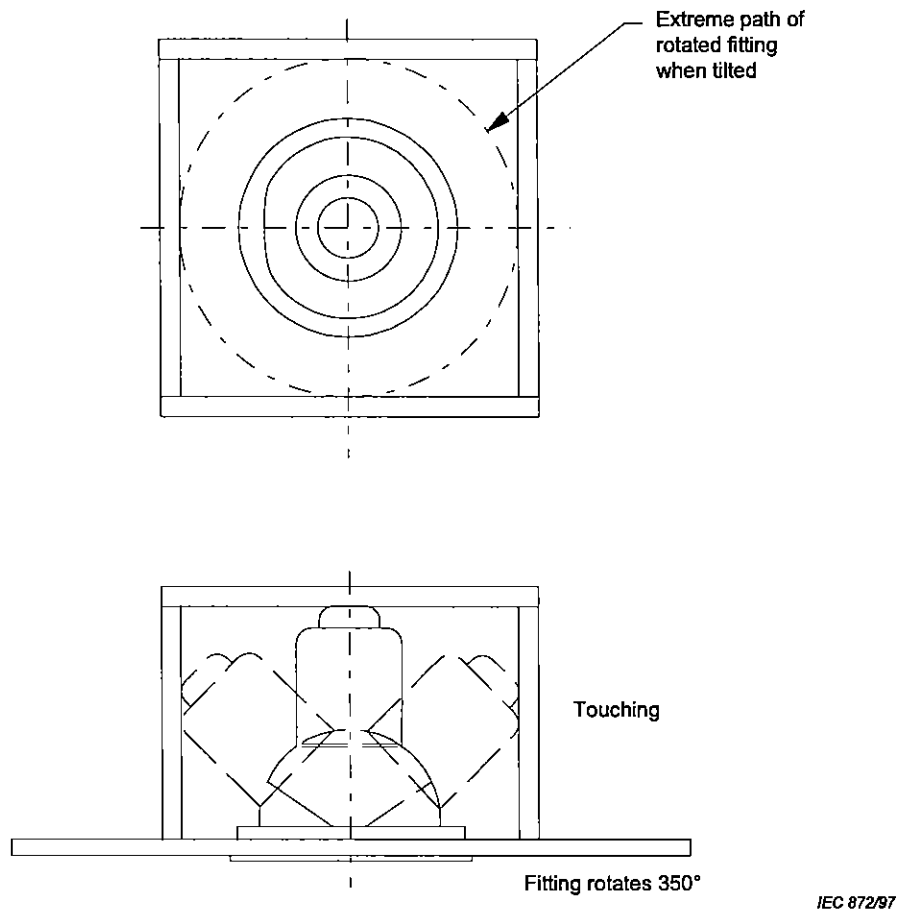
Switches shall be adequately rated and so fixed that they are secured against rotation and cannot be removed by hand.

Switches in flexible cables or cords and switched lampholders shall not be used in luminaires other than ordinary, unless the degree of protection against dust, solid objects or moisture of the switch is in accordance with the classification of the luminaire.

For luminaires intended for use on a polarized supply and where the luminaire has a single-pole on/off switch, the switch shall be wired into the live side of the supply or the side other than that identified as the neutral side.

*Compliance is checked by inspection.*

Figure D.2 illustrates the correct test box size for a luminaire which is adjustable in both axis and thus needs space within a ceiling for the adjustment.



**Figure D.2 – Correct test box size F mark and F mark (insulating ceilings)  
for adjustable luminaire**

#### 4.9 Insulating linings and sleeves

**4.9.1** Insulating linings and sleeves shall be so designed that they are reliably retained in position when switches, lampholders, terminals, wires or similar parts have been mounted.

NOTE – Self-hardening resins, such as epoxy resins, may be used to fix linings.

*Compliance is checked by inspection and by manual test.*

**4.9.2** Insulated linings, sleeves and similar parts shall have adequate mechanical, electrical and thermal strength.

*Compliance is checked by inspection, by manual test and by the electric strength test in accordance with section 10. The thermal properties of wire and sleeve are checked in accordance with section 12. Heat resistant sleeves used as covering for wires attaining a temperature exceeding the values given in table 12.2 of section 12 shall comply with the requirements of IEC 60684, taking into account the temperature measured on the wire in question. The sleeve shall be resistant to a temperature exceeding the temperature measured on the wire by 20 °C or withstand the following test:*

- a) *Three test specimens of the sleeve, about 15 cm in length, are subjected to the humidity test clause 9.3 and subsequently to the insulation resistance and electric strength tests according to section 10. A suitable uninsulated copper conductor or metal rod is passed through the specimens, and the outside is covered by a metal foil in such a way that no flashover at the ends of the samples can occur. The measurement of the insulation resistance and the electric strength test is then made between the copper conductor/metal rod and the metal foil.*
- b) *After the copper conductors/metal rods and metal foils have been removed, the specimens are placed in a heating cabinet for 240 h at a temperature of  $T + 20$  °C,  $T$  being the measured temperature of the wire.*
- c) *The specimens are allowed to cool to room temperature and are then prepared as indicated under item a) above.*

*Measurement of the insulation resistance and electric strength is then made between the copper conductor/metal rod and the metal foil.*

*Compliance is checked by the insulation resistance values and test voltages specified in table 10.1 and 10.2 in section 10.*

#### 4.10 Double and reinforced insulation

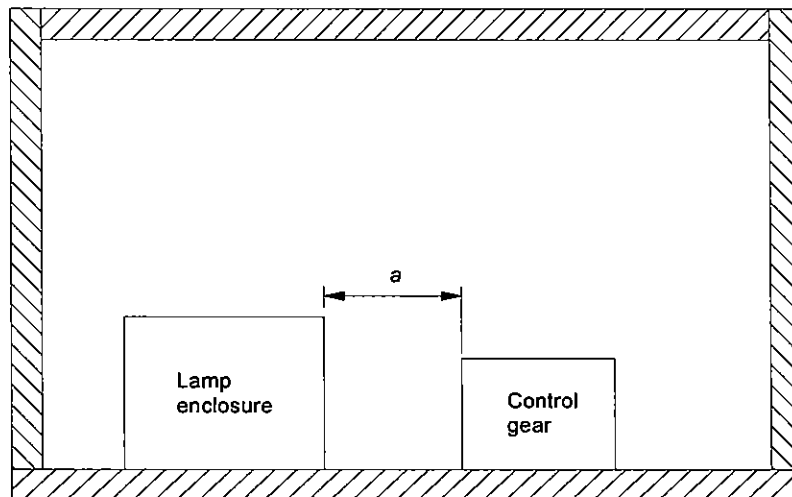
**4.10.1** For metal encased class II luminaires, contact between:

- mounting surfaces and parts with basic insulation only,
- accessible metal parts and basic insulation,

shall be effectively prevented.

NOTE – This requirement does not exclude the use of bare conductors if adequate protection is provided.

This wiring includes internal and external wiring of the luminaire, and fixed wiring of the installation.



IEC 735/96

$a$  = minimum separation as specified by the manufacturer.  
Other distances are in accordance with annex D.

**Figure D.1 – Examples of test recesses where a luminaire comprises separate parts**

*For F-mark and F-mark insulated ceilings, if there are projecting spacers or connecting boxes on the top or sides of the luminaire, then these spacers or connecting boxes shall be placed in direct contact with respectively the test box or insulating material.*

*The suspended ceiling and the interior of the box are painted black with a matt non-metallic paint, and there shall be a gap of not less than 100 mm between this assembly and the inside walls, ceiling and floor of the test enclosure.*

*When a luminaire is intended to be recessed into a wall, the test is made using a test recess similar to that described above, but with the board placed vertically.*

*No part of the test recess shall exceed 90 °C during the normal operation thermal test and 130 °C during the abnormal operation thermal test. For luminaires marked with an  $\nabla$  symbol, no part of the test recess shall exceed the temperature permitted for the mounting surface, as in table 12.1.*

*A track-mounted luminaire is connected to a track system appropriate to the luminaire. The track is mounted as in normal use, according to the manufacturer's installation instructions. The luminaire is connected to the track in the most onerous thermal position of normal use permitted by the mounting instructions or marking. The luminaire is operated under the conditions specified in 12.4.1 and 12.5.1.*

*All spacings shall be measured from the extremes of the positions of movement where luminaires are adjustable in overall dimension or position in either axis when fully installed and during normal operation (see figure D.2).*

②

Class II fixed luminaires shall be so designed that the required degree of protection against electric shock is not impaired as a result of the installation of the luminaire, for example by contact with metal conduits or metal sheaths of cables.

Capacitors shall not be connected between live parts and the body of metal encased class II luminaires, with the exception of interference suppression capacitors.

The interference suppression capacitors shall comply with the requirements of IEC 60384-14 <sup>②</sup> and the method of their connection shall be in accordance with 9.3.4 of IEC 60065.

NOTE – Contact between accessible metal parts and the basic insulation of internal wiring may be prevented by sleeves or similar parts which comply with the requirements for supplementary insulation.

*Compliance is checked by inspection.*

**4.10.2** Any assembly gap with a width greater than 0,3 mm in supplementary insulation shall not be coincidental with any such gap in basic insulation, nor shall any such gap in reinforced insulation give straight access to live parts.

Openings in double or in reinforced insulation shall not give straight access to live parts, so that the live parts can be touched with the conical pin of test probe 13 shown in figure 8 of IEC 61032.

In addition, compliance shall be ensured with the required degree of protection against electric shock in accordance with the IP classification of the luminaire.

*Compliance is checked by inspection and measurement using the relevant probe(s) in accordance with the required degree of protection against electric shock.*

**4.10.3** For parts of class II luminaires which serve as supplementary insulation or reinforced insulation:

- either they shall be fixed so that they cannot be removed without being seriously damaged;
- or they shall be unable to be replaced in an incorrect position.

Where sleeving is used as supplementary insulation on internal wiring, and where insulated linings are used in lampholders as supplementary insulation on external or internal wiring, the sleeving and lining shall be retained in position by positive means.

*Compliance is checked by inspection and by manual test.*

NOTE – Lining metal enclosures with a coating of lacquer or with any other material in the form of a coating which can be easily removed by scraping is not considered to meet this requirement. A sleeve is considered to be fixed by positive means if it can only be removed by breaking or cutting or if it is clamped at both ends or its movement on internal wiring is restricted by neighbouring components. A lining is considered to be fixed by positive means if it can only be removed by breaking or cutting or by dismantling the lampholder.

Parts, such as a tube of insulating material provided with a shoulder and used as a liner inside the nipple of a lampholder, are considered to provide supplementary insulation on external or internal wiring if they can be removed only by dismantling the lampholder.

*Recessed luminaires are mounted in a test recess, consisting of a suspended ceiling, on top of which is a rectangular box with vertical sides and horizontal top.*

*The suspended ceiling is made of a 12 mm thick porous wood-fibre board, in which a suitable opening has been made for the luminaire. The wood-fibre board shall extend at least 100 mm outside the projection of the luminaire on this board. The vertical sides of the box are made of 19 mm thick laminated wood and the top of 12 mm thick porous wood-fibre board tightly sealed to the sides.*

*The position of the recessed luminaire within the test box shall be as follows:*

- a) *F mark insulating ceilings* – 

*Sealed box touching luminaire all round with two sheets of insulating material 100 mm thick and with a coefficient of thermal conductivity equal to 0,04 W/mK (see note) tightly fitting the outside shape of the test box.*


NOTE – This may be achieved by insulating material of 5 m<sup>2</sup> k/W.

- b) *F mark* – 

*During the test, the sides of the box are placed at a distance of 50 mm to 75 mm from the luminaire where it is mounted in the suspended ceiling.*

NOTE – The distance of 50 mm to 75 mm takes into account circular luminaires tested in rectangular boxes.

*The top of the luminaire shall be in contact with the inside top of the test recess.*

- c) *No F mark*,  (see figure 1), or warning notice – *Luminaires suitable for direct mounting on non-combustible surfaces only.*

*For recessed luminaires of this kind, the test recess shall be of the same materials. The same dimensions as those used for F marked luminaires shall apply but with 25 mm spacing between the top of the luminaire and the box unless the manufacturers' installation instructions indicate otherwise for any of these dimensions. Non-combustible insulating material may have to be used for the test recess construction.*

*The 25 mm dimension shall be measured from the inside top of the box to the substantially flat top surface of the luminaire. If there are spacers or connecting boxes on top of the luminaire which project more than 25 mm above its top surface, these spacers or connection boxes are placed in direct contact with the top of the test box.*

*If a luminaire is provided having separated parts intended for recessed mounting, (for example, having separate lamp enclosure and control gear enclosure) the test recess shall be constructed as a single box observing the manufacturers' recommendations for minimum spacing between parts (see figure D.1). Where no spacing information is provided, separate test recesses shall be used for each part.*

#### **4.11 Electrical connections and current-carrying parts**

**4.11.1** Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics at least equivalent, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage of the insulating material.

*Compliance is checked by inspection.*

**4.11.2** Self-tapping screws shall not be used for the connection of current-carrying parts, unless they clamp these parts directly in contact with each other, and are provided with a suitable means of locking.

Thread-cutting screws shall not be used for the interconnection of current-carrying parts of metal which is soft or liable to creep, such as zinc or aluminium.

Self-tapping screws may be used to provide earth continuity, if it is not necessary to disturb the connection in normal use, and at least two screws are used for each connection.

*Compliance is checked by inspection.*

NOTE – See figure 22 for some examples of screws.

**4.11.3** Screws and rivets which serve as electrical as well as mechanical connections shall be locked against loosening. Spring washers may provide satisfactory locking. For rivets, a non-circular shank or an appropriate notch may be sufficient.

Sealing compound which softens on heating provides satisfactory locking only for screw connections not subject to torsion in normal use.

*Compliance is checked by inspection and manual test.*

**4.11.4** Current-carrying parts shall be of copper, an alloy containing at least 50 % copper, or a material having at least equivalent characteristics.

NOTE – Aluminium conductors can be accepted as having at least equivalent characteristics subject to an assessment of suitability being made in each individual case.

This requirement does not apply to screws which do not essentially carry current, such as terminal screws.

Current-carrying parts shall be resistant to, or adequately protected against, corrosion.

NOTE – Copper and copper alloys containing at least 50 % copper are considered to meet this requirement.

*Compliance is checked by inspection and, if necessary, by chemical analysis.*

**4.11.5** Current-carrying parts shall not be in direct contact with wood.

*Compliance is checked by inspection.*

## Annex D (normative)

### Draught-proof enclosure

*The following recommendations refer to the construction and use of a suitable draught-proof enclosure for luminaires, as required for the tests of normal and abnormal operation. Alternative constructions for draught-proof enclosures are suitable if it is established that similar results are obtained.*

*The draught-proof enclosure is rectangular, with a double skin on top and on at least three sides, and with a solid base. The double skins are of perforated metal, spaced approximately 150 mm apart, with regular perforations of 1 mm to 2 mm diameter, occupying about 40 % of the whole area of each skin.*

*The internal surfaces are painted with a matt paint. The three principal internal dimensions are each at least 900 mm. There shall be a clearance of at least 200 mm between the internal surfaces and any part of the largest luminaire for which the enclosure is designed.*

NOTE – If it is required to test two or more luminaires in a large enclosure, care should be taken that radiation from one luminaire cannot affect any other.

*There is a clearance of at least 300 mm above the top of the enclosure and around the perforated sides. The enclosure is at a location protected as far as possible from draughts and sudden changes in air temperature; it is also protected from sources of radiant heat.*

*A luminaire under test is positioned as far away as possible from the six internal surfaces of the enclosure. The luminaire is mounted (subject to the requirements of 12.4.1 and 12.5.1) as under service conditions.*

*A luminaire for direct fixing to a ceiling or wall should be fixed to a mounting surface comprising a wood or wood-fibre board. A non-combustible insulating material is used if the luminaire is not suitable for mounting on a combustible surface. The board is 15 mm to 20 mm thick, and extends not less than 100 mm (but preferably not more than 200 mm) beyond the normal projection of the smoothed outline of the luminaire. There is a clearance of at least 100 mm between the board and the internal surfaces of the enclosure. The board is painted black with a matt non-metallic paint.*

*A luminaire for corner-fixing is fixed in a corner comprising two boards, each complying with the preceding requirements.*

*A third board is required if the luminaire is to be fixed in a vertical corner immediately below a simulated ceiling.*

*Luminaires shall not cause the recess to attain temperatures likely to cause a hazard or fire risk and compliance is checked by the following test.*



**4.11.6** Electro-mechanical contact systems shall withstand the electrical stresses occurring in normal use.

*Compliance is checked by subjecting the electro-mechanical contact systems to 100 operations at a speed which corresponds to practical usage (an operation is either making or breaking the contact). The test is made with a.c. at rated voltage, and the test current shall be 1,25 times the rated current of the electrical contact system. The power factor of the load shall be approximately 0,6, unless a different rated current is marked for resistive loads, in which case the load power factor shall be unity.*

*Where a luminaire is marked for both resistive and inductive loads, it shall be subjected to tests at power factors of both unity and 0,6.*

*Before and after the tests, the electro-mechanical contact systems shall be loaded with 1,5 times rated current, and the voltage drop across each contact shall not exceed 50 mV.*

*Following completion of these tests the electro-mechanical contact system shall withstand an electric strength test made in accordance with 10.2. [the test voltage however being reduced to 1 500 V]*

*After the test the samples shall show:*

- no wear impairing their further use;*
- no deterioration of enclosures or barriers;*
- no loosening of electrical or mechanical connections.*

*For electro-mechanical contact systems the mechanical test of 4.14.3 is made simultaneously with this electrical test.*

## **4.12 Screws and connections (mechanical) and glands**

**4.12.1** Screws and mechanical connections, the failure of which might cause the luminaire to become unsafe, shall withstand the mechanical stresses occurring in normal use.

Screws shall not be made of a material which is soft or liable to creep.

NOTE – Examples are zinc, some grades of aluminium and several thermoplastics.

Screws which are operated for maintenance purposes shall not be of insulating material if their replacement by a metal screw could impair supplementary or reinforced insulation.

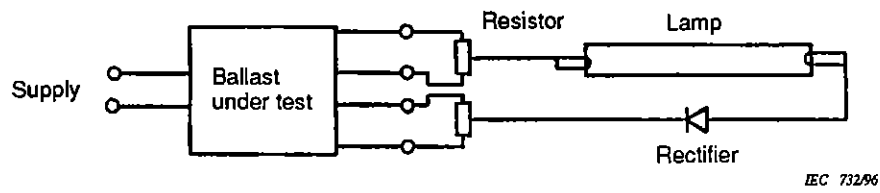
Screws used to provide earthing continuity, e.g. fixing screws for ballasts and other components, shall comply with the requirement in the first paragraph of this subclause as far as the ballast is concerned as at least one screw retaining the ballast will have a mechanical and electrical function.

Changing the screw retaining the ballast is not considered to be maintenance.

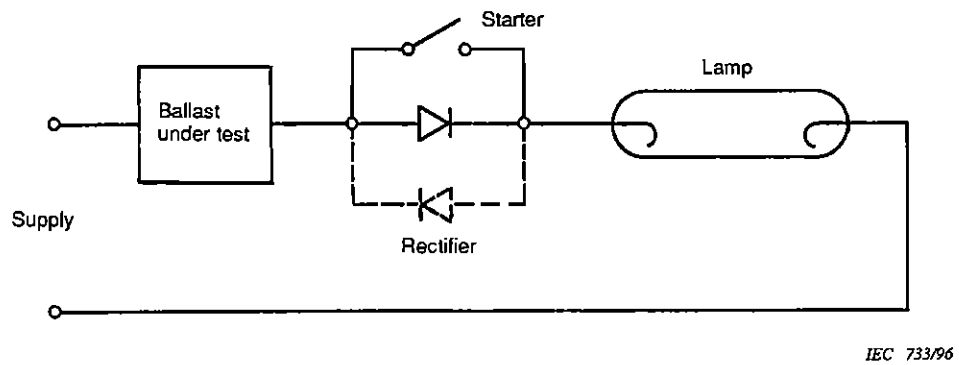
Screws of insulating material used in cord anchorages can be accepted bearing directly on the cable or cord as replacement of such screws is not regarded as maintenance.

2

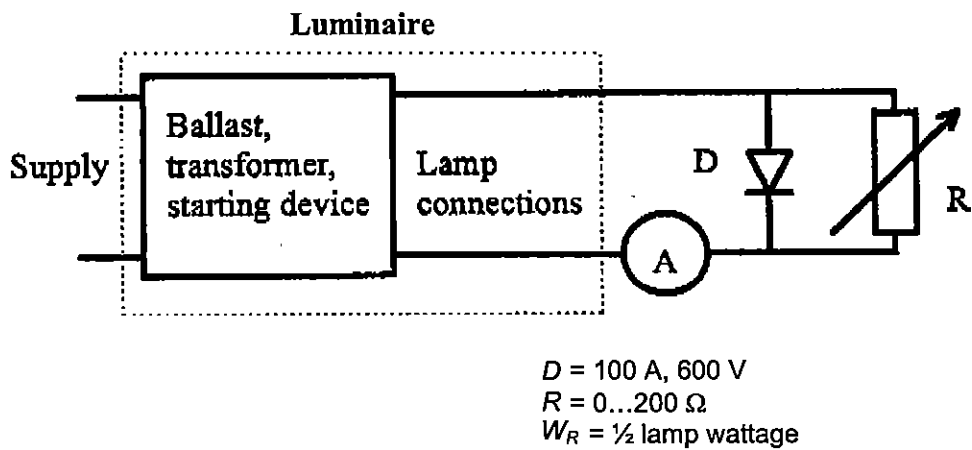
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**Figure C.1 – Circuit for testing rectifying effect  
(some capacitive starterless ballasts only)**



**Figure C.2 – Circuit for testing rectifying effect  
(ballasts for single pin lamps)**



**Figure C.3 – Test circuit for the operation of high pressure sodium and some metal halide lamps**

Compliance is checked by inspection and screws and nuts transmitting contact pressure or which are likely to be tightened by the user, shall be tightened and loosened five times. Screws and nuts of insulating material shall be removed completely during each operation of loosening of the screws. During the test, no damage impairing the further use of the fixing or screwed connection shall occur. After the test it shall still be possible to introduce the screw or nut made of insulation material in the intended manner.

The test is made by means of a suitable test screwdriver or spanner, applying a torque as shown in table 4.1 except that for screws of insulating material used in cord anchorage and bearing directly on the cable or cord the torque is 0,5 Nm.

Table 4.1 – Torque tests on screws

Nominal outer thread diameter of screw mm	Torque		
	1 Nm	2 Nm	3 Nm
Up to and including 2,8	0,20	0,40	0,40
Over 2,8 up to and including 3,0	0,25	0,50	0,50
Over 3,0 up to and including 3,2	0,30	0,60	0,50
Over 3,2 up to and including 3,6	0,40	0,80	0,60
Over 3,6 up to and including 4,1	0,70	1,20	0,60
Over 4,1 up to and including 4,7	0,80	1,80	0,90
Over 4,7 up to and including 5,3	0,80	2,00	1,00
Over 5,3 up to and including 6,0	–	2,50	1,25
Over 6,0 up to and including 8,0	–	8,00	4,00
Over 8,0 up to and including 10,0	–	17,00	8,50
Over 10,0 up to and including 12,0	–	29,00	14,50
Over 12,0 up to and including 14,0	–	48,00	24,00
Over 14,0 up to and including 16,0	–	114,00	57,00

The shape of the blade of the screwdriver shall suit the head of the screw to be tested. The screws shall not be tightened in jerks. Damage to covers is neglected.

Column 1 of table 4.1 applies to metal screws without heads if the tightened screw does not protrude from the hole;

Column 2 applies to:

- other metal screws and to nuts;
- screws of insulating material
  - having a hexagonal head with the dimensions across flats exceeding the overall thread diameter;
  - having a cylindrical head and a key socket with a cross-corner dimension exceeding the overall thread diameter;
  - having a head with a slot or cross slots, the length of which exceeds 1,5 times the overall thread diameter.

Column 3 applies to other screws of insulating material.

- i) *Luminaires not containing special devices and whose safety is covered by design only.*

*The lamp in the luminaire is replaced by the test circuit as shown in figure C.3. By varying the resistor  $R_2$ , the lamp current is adjusted to maximum, but in any case not higher than three times the normal lamp current.*

- ii) *Luminaires containing a special device within the luminaire but outside the ballast, transformer or starting device or incorporated into the ballast, transformer or starting device, where the ballast, transformer or starting device is marked accordingly.*

*The lamp in the luminaire is replaced by the test circuit as shown in figure C.3. By varying the resistor  $R_2$ , the lamp current is adjusted to a value equal to twice the normal lamp current. After having reached steady conditions the current is increased in suitable steps until the protection device has reacted. Care is taken to achieve steady conditions as far as possible at each step.*

- 3) *Lamps removed and not replaced*

- 4) *One electrode of lamp open-circuited*

*The conditions may be produced by switching. (Alternatively, a test lamp may be suitably modified.)*

*The electrode selected shall be that which more adversely affects the results.*

- 5) *Lamp will not start but both electrodes are intact. For this condition, a non-serviceable or modified test lamp may be used.*

- 6) *Blockage of the motor(s) contained in the luminaire.*



*The values given in table 4.1 for screws over 6,0 mm diameter apply to steel screws and the like, which are used mainly in the mounting of the luminaire.*

*The values given in table 4.1 for screws over 6,0 mm diameter do not apply to nipple threads of lampholders, the requirements for which are specified in clause 15 of IEC 60238.*

*The requirements of this subclause do not apply to metal nuts used as means of fixing for push-button switches.*

**4.12.2** *Screws transmitting contact pressure, screws which are operated when mounting or connecting the luminaires and having nominal diameter less than 3 mm, shall screw into metal.*

*Screws or nuts which are operated when mounting the luminaire or replacing lamps include screws or nuts for fixing covers, lids, etc. Connections for screwed conduits, screws for mounting the luminaire to its mounting surface, hand-operated fixing screws or nuts of glass covers and screwed lids are excluded.*

*Compliance is checked by inspection and for screws which are operated when mounting the luminaire or when replacing the lamps, by the test described in 4.12.1.*

**4.12.3** *Not used.*

**4.12.4** *Screwed and other fixed connections between different parts of luminaires shall be made in such a way that they do not work loose through such torsion, bending stresses, vibration, etc., as may occur in normal use. Fixed arms and suspension tubes shall be securely attached.*

**NOTE** – Examples of means of preventing the loosening of connections are soldering, welding, lock nuts and set screws.

*Compliance is checked by inspection and by attempting to loosen locked connections with a torque not exceeding:*

- 2,5 Nm for thread size up to and including M 10 or corresponding diameters;
- 5,0 Nm for thread sizes above M 10 or corresponding diameters.

*For lampholders which are exposed to a rotary action during lamp replacement, compliance shall be checked by inspection and by attempting to loosen locked screwed mechanical connections for 1 min with a torque not exceeding:*

- 4,0 Nm for E40 lampholders;
- 2,0 Nm for E26, E27 and B22 lampholders;
- 1,2 Nm for E14 and B15 lampholders (except candle type);
- 0,5 Nm for E14 and B15 candle lampholders;
- 0,5 Nm for E10 lampholders.

*For push-button switches, the means of fixing are subjected to a torque not exceeding 0,8 Nm.*

*During the test, such screwed connections shall not loosen.*

## Annex C (normative)

### Abnormal circuit conditions

The following is a list of abnormal circuit conditions which are applicable to a tubular fluorescent or other discharge lamp luminaire and from which the thermally most onerous condition shall be taken (see 12.5.1). If the luminaire contains more than one lamp, the abnormal conditions shall be applied only to the one lamp, which leads to the most adverse results. The abnormal condition shall be set up before the test is started. Conditions 4) and 5) refer only to lamps with two preheated electrodes (e.g. fluorescent lamps). The descriptions include instructions on test arrangements. Conveniently the abnormal circuit condition is produced or simulated by remote switching so that it is not necessary to disturb a luminaire which has just completed the test of normal operation.

#### 1) Short-circuit of starter contacts

This condition applies to starters with moving contacts, including starters incorporated in lamps.

#### 2) Lamp rectification

##### a) Luminaires for fluorescent lamps (figures C.1 and C.2)

This is a fault condition which may occur after extended use in luminaires employing starterless ballasts with capacitive reactance control. When testing luminaires for the rectifying effect, the circuit shown in figure C.1 shall be used. The lamp is connected to the midpoint of the appropriate equivalent resistors. The rectifier polarity is chosen so as to give the most unfavourable operating conditions. If necessary, the lamp is started using a suitable starting device.

The rectifier characteristics shall be:

- peak inverse voltage  $\geq 800\text{ V}$
- reverse leakage current  $\leq 10\text{ }\mu\text{A}$
- forward current  $> 3$  times nominal lamp running current
- transition time  $\leq 50\text{ }\mu\text{s}$

Luminaires for tubular fluorescent lamps having Fa6 caps however, shall be tested as follows:

Initially the lamp is operated under normal conditions with a short-circuited rectifier in series with the lamp. Then the bridging of the rectifier is opened. The rectifier shall be inserted in both polarities. The test is finished if the lamp extinguishes. If not, the following test is carried out:

The lamp is operated as shown in figure C.2. The rectifier polarity shall be chosen so as to give the most unfavourable operating conditions. If necessary, the lamp is started using a suitable starting device.

- b) Luminaires for metal halide lamps and high pressure sodium vapour lamps which, according to the lamp specification, can lead to ballast, transformer or starting device overloading (figure C.3).

**4.12.5** Screwed glands shall comply with the following test:

Screwed glands shall be fitted with a cylindrical metal rod having a diameter equal to the nearest whole number of millimetres below the internal diameter of the packing. The glands shall then be tightened by means of a suitable spanner, the force shown in table 4.2 being applied to the spanner for 1 min at a point 250 mm from the axis of the gland.

**Table 4.2 – Torque tests on glands**

Diameter of test rod mm	Force	
	Metal glands N	Glands of moulded material N
Up to and including 14	25	15
Over 14 up to and including 20	30	20
Over 20	40	30

After the test, the luminaire and the glands shall show no damage.

**4.13 Mechanical strength**

**4.13.1** Luminaires shall have adequate mechanical strength and be so constructed as to be safe after such rough handling as may be expected in normal use.

Compliance is checked by applying blows to the sample by means of the spring-operated impact test apparatus specified in IEC 60068-2-63 or by other suitable means giving equivalent results.

NOTE – Equivalent impact energies obtained by different methods do not necessarily give the same test result.

The hammer spring shall be such that the product of the compression, in millimetres, and the force exerted, in newtons, equals 1 000, the compression being approximately 20 mm. The spring shall be adjustable so as to cause the hammer to strike with an impact energy and spring compression as shown in table 4.3.

*When choosing the range of lamps for testing, the requirement of 3.2.8 should be taken into account.*

*If a lamp is operated by a transformer or similar device within or external to the luminaire, the rating of the test lamp shall correspond to the marking on the luminaire, transformer or similar instructions.*

#### *Tubular fluorescent and other discharge lamps*

*When a lamp is operated under reference conditions (according to the relevant IEC lamp standard), the lamp voltage, current and power shall be as close as possible to the lamp rated values, and shall be within 2,5 % of these values.*

*If a reference ballast is not available, lamps are selected using a production ballast which at the calibration current has an impedance within  $\pm 1$  % of that of the reference ballast.*

NOTE 1 – Self-ballasted lamps are considered as fluorescent or other discharge lamps for the purpose of section 12. If the luminaire is for use with filament lamps and self-ballasted lamps or other discharge lamps incorporating series filaments, it should be tested with the most onerous lamp (which in general will be with filament lamps).

NOTE 2 – If the luminaire is for use with a combination of lamp types (e.g. filament lamp plus a discharge lamp), it should be tested with the thermally most onerous.

If the luminaire is for use with either filament or discharge lamps, it should be tested with the more onerous (or, if not known, with each in turn).

It is usually found that translucent materials attain a higher temperature with a discharge lamp or a discharge lamp incorporating a series filament than with a filament lamp, for a given lamp power.

NOTE 3 – If the luminaire is designed for a lamp type for which specifications have not yet been established, a test lamp should be selected after consultation with the lamp manufacturer.



Table 4.3 – Impact energy and spring compression

Type of luminaire	Impact energy Nm		Compression mm	
	Fragile parts	Other parts	Fragile parts	Other parts
Recessed luminaires, fixed general purpose luminaires and portable luminaires for wall mounting	0,2	0,35	13	17
Portable floor and table luminaires, photo and film luminaires	0,35	0,50	17	20
Floodlights, road and street lighting luminaires, swimming-pool luminaires, portable garden luminaires and child-appealing luminaires	0,5	0,70	20	24
Rough service luminaires, handlamps and lighting chains	Other testing methods			
<p>NOTE – Lampholders and other components are retested only in so far they protrude beyond the projection of the outline of the luminaire. The front of the lampholders is never retested since in normal operation this part is covered by the lamp.</p> <p>Fragile parts are parts such as glass and translucent covers providing only protection against dust, solid objects and moisture, and ceramic and small parts protruding from the enclosure by less than 26 mm, or if their surface area does not exceed 4 cm<sup>2</sup>.</p> <p>Protective shields required on account of 4.24 are regarded as fragile parts.</p>				

Translucent covers, neither providing protection against electric shock and/or UV, nor forming part of the protection against dust, solid objects, moisture and lamps, are not tested.

The sample is mounted or supported as in normal use on a rigid wooden board, cable entries being left open, knockouts opened, and cover-fixing and similar screws tightened with a torque equal to two-thirds of that specified in table 4.1.

Three blows shall be applied to the point which is likely to be the weakest, paying special attention to insulating material enclosing live parts and to bushings of insulating material, if any. Additional samples may be necessary to find the weakest point; in case of doubt, the test shall be repeated on a fresh sample to which three blows only are applied.

After the test, the sample shall show no damage, in particular:

- 1) live parts shall not have become accessible;
- 2) the effectiveness of insulating linings and barriers shall not have been impaired;
- 3) the sample shall continue to afford the degree of protection against ingress of dust, solid objects and moisture, in accordance with its classification;
- 4) it shall be possible to remove and to replace external covers without these covers or their insulating linings breaking.

Breakage of an enclosure is, however, allowed if its removal does not impair safety.

In case of doubt, supplementary insulation or reinforced insulation is subjected to an electric strength test as specified in section 10.

- b) *Conduction.* The lampholder and associated wiring receive heat by conduction from the lamp cap and if the luminaire can operate with the lamp in the cap-up position, by convection transfer from the outer surface of the lamp. Testing these conditions requires Heat Test Source (HTS) lamps manufactured in accordance with IEC 60634.

Where HTS lamps are not available, an Alternative Heat Test Source (AHTS) lamp is used. This is defined as follows:

An alternative heat test source (AHTS) represents a commercial lamp of the same category which has a  $\Delta t_s$  value from 5 °C below to the specified value of table 3 of IEC 60432, when measured under the conditions specified in IEC 60360.

The following guidelines will help selection of suitable lamps:

Compared with clear or frosted lamps, higher cap temperatures are principally to be found on lamps which have:

- 1) a white coated or dark coloured bulb;
- 2) a smaller bulb;
- 3) a shorter light centre length.

Small differences from the specified  $\Delta t_s$  of table 3 of IEC 60432 are corrected as in IEC 60634 for the adjustment of the HTS lamp by the test voltage, but such adjustment shall not cause the wattage to exceed 105 % of the rated wattage (corresponding to 103,2 % voltage).

Additionally, for the thermal test by conduction only, the outer surface of a lamp may be hand painted with a suitable high temperature paint, commencing in the area of the cap and, if necessary, extending over all the bulb surface.

For reflector and bowl mirror lamps, only the test voltage shall be used for adjustment of the temperature.

For endurance testing, HTS lamps which have been modified to give increased cap temperature are not used.

If the luminaire is provided with a marking for special lamps, or if it is obvious that special lamps are to be used in the luminaire, the tests are made with such special lamps.

Lamps are chosen in accordance with the maximum wattage for which the luminaire is marked. In case of doubt for luminaires marked with a maximum 60 W, E27 or B22 cap, tests shall also be made with a 40 W round bulb lamp.

The voltage rating of the test lamps shall be typical of the voltage rating in the market for which the luminaire is intended. If the luminaire is intended for two or more different groups of voltages supply, e.g. for 200 V-250 V and for 100 V-130 V, then the testing shall at least be carried out with lamps in the low voltage range (i.e. with the higher current), but taking into account the comments in a) above.

*Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in section 11, and small chips which do not adversely affect the protection against electric shock, dust or moisture, are neglected.*

**4.13.2** Metal parts enclosing live parts shall have adequate mechanical strength.

*Compliance is checked by the appropriate tests of 4.13.3 to 4.13.5.*

**4.13.3** *A straight unjointed test finger is used, with the same dimensions as the standard test finger specified in IEC 60529. The finger is pressed against the surface with a force of 30 N.*

*During the test, metal parts shall not touch live parts.*

*After the test, covers shall not be excessively deformed and the luminaire shall continue to meet the requirements of section 11.*

#### **4.13.4 Rough service luminaires**

Rough service luminaires shall have protection against ingress of solid objects and moisture of at least IP54.

Rough service luminaires shall not be of class 0 construction.

*Compliance is checked by inspection and the appropriate test of 9.2.0.*

Rough service luminaires shall have adequate mechanical strength and shall not overturn under circumstances that may be expected during normal use. In addition the fixation means of the stand to which the luminaire is connected shall have adequate mechanical strength.

*Compliance is checked by the test of a) to d) below.*

a) Fixed rough service luminaires and portable rough service luminaires (not hand-held)

*Each of three samples of the luminaire shall be subjected to three single impacts, at points likely to be the weakest, on any surface normally exposed. The sample without lamp (or lamps) is mounted as in normal use on a rigid supporting surface.*

*The impacts are produced by dropping a steel sphere 50 mm diameter weighing 0,51 kg from a height H (1,3 m) as shown in figure 21, to produce an impact energy of 6,5 Nm.*

*Each of the three samples of a luminaire intended for outdoor use shall additionally be cooled to a temperature of  $-5\text{ °C} \pm 2\text{ °C}$  and maintained at that temperature for 3 h.*

*Whilst the samples are at this temperature they shall be subjected to the impact test specified above.*

## Annex B (normative)

### Test lamps

*For the tests of section 12, it is convenient to keep a stock of lamp types commonly required. These are selected from normal production lamps for characteristics as close as possible to the objective characteristics listed in the appropriate standards. The selected lamps are aged (at least 24 h for filament lamps and at least 100 h for tubular fluorescent and other discharge lamps, with occasional off periods), and a further check is made that their characteristics are still satisfactory and stable. Lamps shall not be retained as test lamps for longer than about three-quarters of their typical operating period in normal service. Lamps are inspected before each test for any damage or signs of approaching unserviceability. Discharge lamps shall be checked regularly to ensure that there has been no appreciable shift in electrical characteristics which would influence the temperatures in luminaires.*

*If a lamp can be inserted in a circuit in more than one position – e.g. a fluorescent lamp – marks shall be made to assist consistent insertion. Great care shall be taken in handling test lamps; in particular, sodium and mercury-halide discharge lamps and amalgam fluorescent lamps shall not be moved while still hot.*

*A lamp selected for a particular test shall be of a rating and type for which the luminaire is claimed to be suitable. If a choice of lamp shape, construction or finish is indicated by the manufacturer, the thermally most onerous shall be taken. Otherwise, the most common type shall be used.*

*The following requirements refer to the selection of lamps as test lamps, and to lamp selection for a particular test of a luminaire.*

#### *Filament lamps*

*In seeking to test the luminaire with lamps which develop the most onerous conditions within it, consideration needs to be given to two principal modes of heat transfer, radiation and conduction:*

- a) *Radiation. The materials of the luminaire are heated by radiation from the lamp filament, supplemented, for the area immediately around and especially above the lamp, by convected heat from the bulb surface. In general, for testing such conditions, clear lamps are used. The filament shapes used in most HV lamps provide a slightly irregular radiation pattern but are unlikely to have highly directional properties. There is more variation in lamps designed for LV (100-130 V), as lamps with transverse or axial filaments may produce different heating patterns which could be important in certain designs. Where reflector lamps are involved, note is taken of clear areas in the neck region. If it is intended to use lamps with heat transmitting reflectors, such lamps are used for tests. Light centre length also plays a role.*

## b) Hand-held luminaires

*The luminaire is caused to fall four times from a height of 1 m on to a concrete floor. The falls are made from four different horizontal starting positions, the luminaire being turned through 90° around its axis between each fall. Lamps are removed but protective glasses, if any, are not removed for this test.*

*After the test of 4.13.4 a) or 4.13.4 b) the luminaire shall show no damage impairing safety and its further use. The parts protecting the lamp against damage shall not have loosened.*

NOTE – These parts may have become deformed. Breakage of a protective glass or translucent cover is ignored if the glass or cover is not the sole means of protecting the lamp against damage.

## c) Luminaires delivered with a stand

*Any lamp(s) are removed before the tests.*

*The luminaire and stand shall not overturn at an angle of 6° from the vertical.*

*The luminaire shall withstand the impacts resulting from overturning four times from an angle up to 15° from the vertical.*

*The fixation means of the stand shall withstand a force of four times the weight of the luminaire in the most onerous direction.*

*If the luminaire overturns during the test on the plane inclined at an angle of 15° from the vertical, the test of 12.5.1 is made with the luminaire on a horizontal surface, in the most unfavourable of the overturned positions that may reasonably be expected in practice.*

## d) Luminaires for temporary installations and suitable for mounting on a stand

*The luminaire shall withstand four impacts resulting from the following test.*

*Any lamp(s) are removed before the test.*

*The luminaire is suspended by an aluminium rod along a concrete or brick wall. The length of the rod is that of the stand as indicated for a possible stand in the mounting instruction.*

*The luminaire is lifted until the rod is in the horizontal plane and then allowed to fall freely against the wall.*

*After the test there shall be no impairing of the safety.*

**4.13.5** Not used.**4.13.6** Plug-ballast/transformers and mains socket-outlet-mounted luminaires shall have adequate mechanical strength.

*Compliance is checked by the following test, which is made in a tumbling barrel as shown in figure 25.*

*The barrel is turned at a rate of five revolutions per minute, 10 falls per minute thus taking place.*

*The sample falls from a height of 50 cm on to a steel plate 3 mm thick, the number of falls being:*

- 50 if the mass of the sample does not exceed 250 g;
- 25 if the mass of the sample exceeds 250 g.

## Annex A (normative)

### Test to establish whether a conductive part may cause an electric shock

*In order to determine whether a conductive part is a live part which may cause an electric shock, the luminaire is operated at rated supply voltage and nominal frequency and the following tests conducted:*

- a) *The current flowing between the part concerned and earth is measured, the measuring circuit having a non-inductive resistance of  $2\,000\ \Omega \pm 50\ \Omega$ . The part concerned is a live part if an a.c. current of more than 0,7 mA (peak) or 2 mA d.c. is measured.*

*For frequencies above 1 kHz, the limit of 0,7 mA is multiplied by the values of the frequency in kHz, but shall not exceed 70 mA (peak). The limits of the leakage current components are cumulative.*

- b) *The voltage between the part concerned and any accessible part is measured, the measuring circuit having a non-inductive resistance of  $50\,000\ \Omega$ . The part concerned is a live part if a voltage of more than 34 V (peak) is measured.*

*For the above tests, one pole of the test supply shall be at earth potential.*

NOTE – A simplified method of measurement is under consideration.

*After the test, the sample shall show no damage within the meaning of this standard, but it need not be operative and any damage to the glass bulb shall be ignored. Provided that the protection against electric shock is not affected, small pieces which may have broken off the sample are ignored.*

*Distortion of pins and damage to the finish and small dents which do not reduce the creepage distances or clearances below the values specified in section 11 are ignored.*

#### **4.14 Suspensions and adjusting devices**

##### **4.14.1 Mechanical suspensions shall have adequate factors of safety.**

*Compliance is checked by the appropriate following tests.*

*Test A, for all suspended luminaires: A constant evenly distributed load equal to four times the weight of the luminaire shall be added to the luminaire in the normal direction of the load for a period of 1 h. There shall be no appreciable deformation of the components of the suspension system at the end of this period. Where alternative means of fixing or suspension are provided, each shall be tested separately.*

*For adjustable suspension, the load shall be applied with the supporting cable fully extended.*

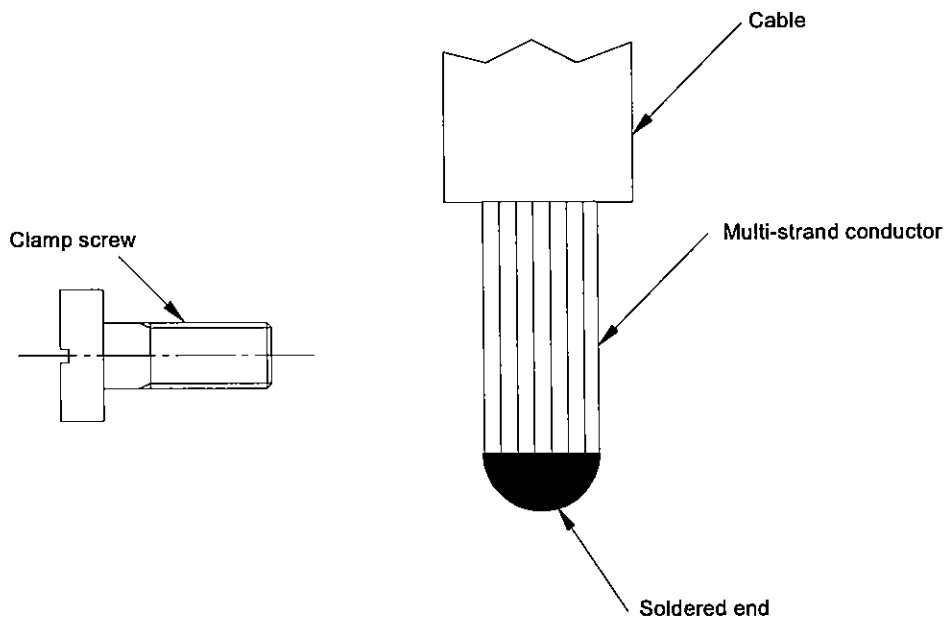
*Test B, for rigid suspension luminaires: A torque of 2,5 Nm is applied to the luminaires for a period of 1 min, first in a clockwise and then in an anticlockwise direction. For this test, it shall not be possible to rotate the luminaire relative to the fixed part by more than one revolution in either direction.*

*Test C, for rigid suspension brackets: Details of the test for rigid suspension brackets are as follows:*

- a) For heavy-duty brackets (for example workshop brackets), a force of 40 N shall be applied for 1 min, in various directions at the free end, with the bracket arm fixed as in normal use. The bending moment resulting from this test shall be not less than 2,5 Nm. When the test force has been removed, the bracket arm shall not be permanently displaced or deformed so as to endanger safety.*
- b) For light-duty brackets (for example domestic brackets), a similar test to item a) shall be applied for 1 min, but with a force of 10 N, and the bending moment resulting from this test shall be not less than 1,0 Nm.*

*Test D, for track-mounted luminaires: The mass of the luminaire shall not exceed the value, recommended by the track manufacturer, of the maximum loading for which the luminaire suspension devices are suitable.*

*Test E, for clip-mounted luminaires: A pull is applied on the cable without jerk for 1 min in the most unfavourable direction in normal use. During the test the clip is mounted on standard test "shelves" made of ordinary window glass, one with a nominal thickness of 10 mm and one with the maximum thickness onto which the clip can be mounted. For this test the thickness of the test shelf is increased by multiples of 10 mm. The clip shall not start moving on the glass at a pull of 20 N.*



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Figure 28 – Example of permitted degree of soldering



*Clip-mounted luminaires shall, in addition, be tested on the metal rod having a polished chromium plated finish and a nominal diameter of 20 mm. The luminaire shall not rotate under its own weight and shall not fall off the rod when a pull of 20 N is applied on the cable. The test on a polished metal rod is not applied to luminaires marked "not suitable for mounting on tubular material".*

NOTE 1 – The increase in the thickness of the test sheet by 10 mm steps for the maximum thickness, limits the possibility of forcing the clip onto the test shelf.

NOTE 2 – The test shelf for a maximum thickness test may comprise layers of glass and wood, provided that the surfaces that are gripped by the clip of the luminaire are of glass.

**4.14.2** The mass of the luminaire suspended by flexible cables or cords shall not exceed 5 kg. The total nominal cross-sectional area of the conductors of flexible cables or cords suspending pendants shall be such that the stress in the conductors does not exceed 15 N/mm<sup>2</sup>.

For the calculation of the stress, only the conductors are considered.

Where a luminaire of mass greater than 5 kg is intended to be suspended, the design of the luminaire or of the flexible cable or cord shall be such as to prevent any tension being applied to the conductors.

NOTE – This requirement can be met by using a cable which incorporates suitable load-carrying cores.

For the semi-luminaires intended for connection to Edison screw or bayonet lampholders the mass and effective bending moment shall not exceed the maximum value given in table 4.4. The bending moment is relative to the point of contact, in the fully inserted position, of the semi-luminaire contact(s) with the centre contact of an Edison screw lampholder or the plungers of a bayonet lampholder.

**Table 4.4 – Test on semi-luminaires**

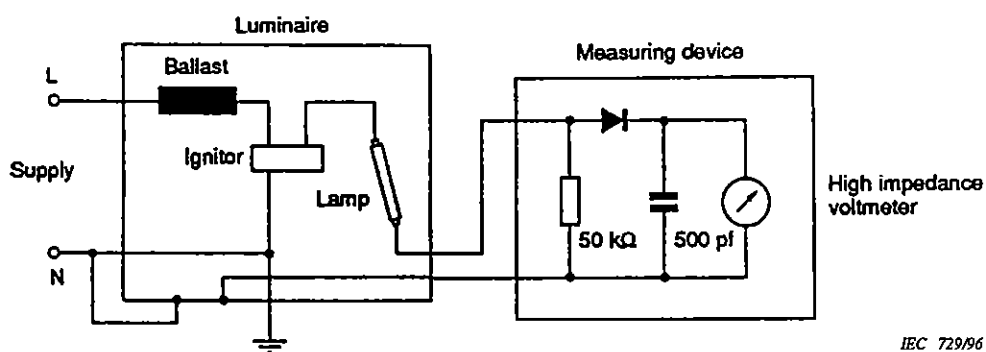
Lampholders	Luminaires	
	Maximum mass	Maximum bending moment
E14 and B15	1,8 kg	0,9 Nm
E27 and B22	2,0 kg	1,8 Nm

NOTE – These values are lower than those to which a lampholder would normally be tested to provide a safety margin.

*Compliance is checked by inspection, by measurements and by calculation.*

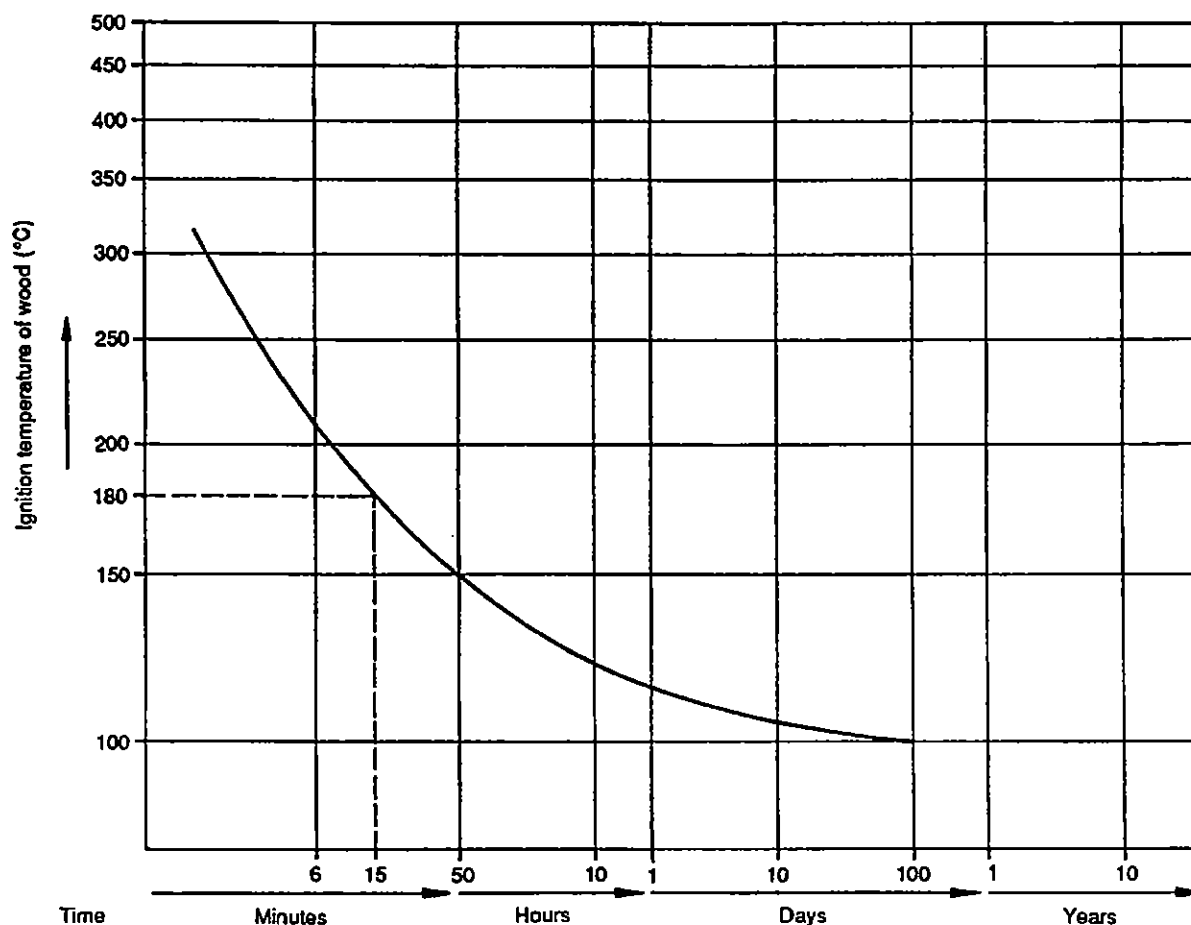
**4.14.3** Adjusting devices, for example joints, hoisting devices, adjusting brackets or telescopic tubes, shall be so constructed that cords or cables are not pressed, clamped, damaged or twisted along the longitudinal axis by more than 360° during operation.

NOTE – If a luminaire has more than one joint the 360° limit applies to each joint if they are not too close together. Each case needs to be judged on its own merits.



NOTE – The polarity of the diode to be reversed if necessary.

Figure 26 – Test circuit for safety during insertion



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Figure 27 – Ignition temperatures of wood as a function of time

*Compliance is checked by the following test:*

*The adjusting device, equipped with the appropriate cable or cord shall be operated in accordance with table 4.5. A cycle of operation is a movement from one extreme of the range to the other and back to the starting position. The rate of movement shall not cause the device to heat appreciably and shall not exceed 600 cycles per hour.*

*For electro-mechanical contact systems this test is conducted simultaneously with the electrical connection test of 4.11.6.*

*Compliance is checked by inspection.*

*After the test, not more than 50 % of the strands in a conductor shall be broken nor shall there be any serious damage to the insulation, if any, of the flexible cord. The cord or cable shall be subjected to, and shall satisfy, the insulation resistance and high-voltage tests specified in section 10.*

*Ball-joints and the like, where the clamping means can be adjusted, are tested with the joints only lightly clamped to avoid excessive friction. If necessary, the clamping areas are readjusted during the test.*

*For adjusting devices that consist of a flexible tube the range of adjustment for this test is normally 135° in both directions from the vertical. However where this adjustment cannot be achieved without using unreasonable force the flexible tube is bent only to the positions where it will remain by itself.*

**Table 4.5 – Test on adjusting devices**

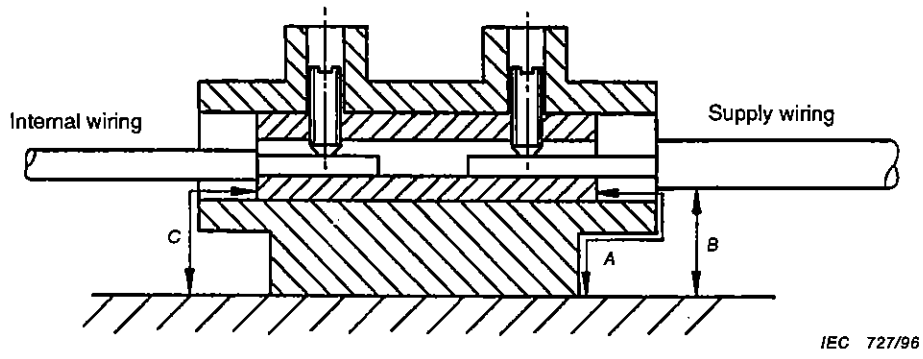
<b>Type of luminaire</b>	<b>Number of cycles of operation</b>
<i>Luminaires intended to be frequently adjusted, for example drawing board luminaires</i>	1 500
<i>Luminaires intended to be occasionally adjusted, for example shop-window spotlights</i>	150
<i>Luminaires intended to be adjusted during installation only, for example floodlighting luminaires</i>	45

**4.14.4** Cords or cables passing through telescopic tubes shall not be fixed to the outer tube. Means shall be provided for avoiding strain on the conductors at the terminals.

*Compliance is checked by inspection.*

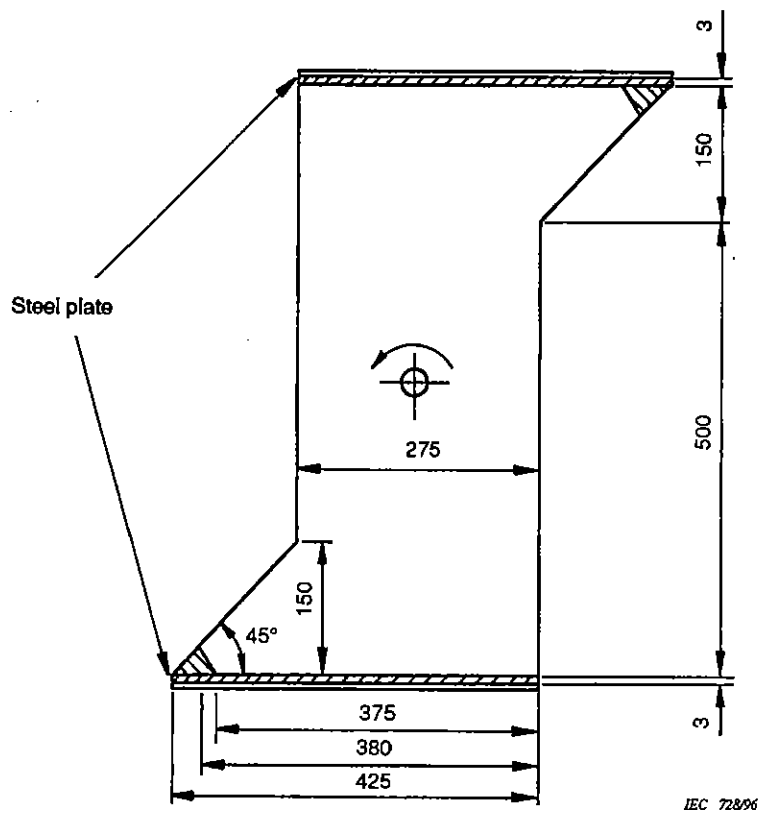
**4.14.5** Guide pulleys for flexible cords shall be dimensioned to prevent damage to the cords by excessive bending. Grooves in the pulleys shall be well rounded, the diameter of the pulley at the bottom of the groove being at least three times the diameter of the cord. Accessible metal pulleys shall be earthed.

*Compliance is checked by inspection.*



- A = creepage distance
- B = clearance (supply wiring)
- C = clearance (internal wiring)

Figure 24 – Illustration of creepage and clearance measurements at a supply terminal



Dimensions in millimetres

The width of the tumbling barrel is not specified.

Figure 25 – Tumbling barrel

**4.14.6** Plug-ballast/transformers and mains socket-outlet-mounted luminaires shall not impose undue strain on socket-outlets.

*Compliance is checked by the following test. The plug-ballast/transformer or mains socket-outlet-mounted luminaire is inserted, as in normal use, into a fixed socket-outlet pivoted about a horizontal axis through the centre lines of the contact tubes at a distance of 8 mm behind the engagement face of the socket-outlet.*

*The additional torque which has to be applied to the socket-outlet to maintain the engagement face in the vertical plane shall not exceed 0,25 Nm.*

*For adjustable mains socket-outlet-mounted luminaires the total torque transmitted to the socket-outlet during adjustment shall not exceed 0,5 Nm.*

*The socket-outlet used for the test shall have the earth contact (if any) removed unless the socket has shuttered pin receptacles that are uncovered by the action of inserting the earth pin.*

#### **4.15 Flammable materials**

Covers, shades and similar parts not having an insulation function, and which do not withstand the 650 °C glow-wire test of 13.3.2, shall be adequately spaced from any heated part of the luminaire which could raise the material to its ignition temperature. These parts made of flammable material shall have suitable fastenings or supporting devices to maintain this spacing.

The spacing from heated parts mentioned above shall be at least 30 mm, unless the material is protected by a screen spaced at least 3 mm from the heated parts. This screen shall comply with the needle-flame test of 13.3.1, shall have no holes, and shall have a height and a length at least equal to the corresponding dimensions of the heated parts. A screen is not required in cases where the luminaire provides an effective barrier to burning drops.

NOTE – The requirements of this clause are illustrated in figure 4.

Materials which burn fiercely, such as celluloid, shall not be used.

The requirements of this clause do not apply to small parts such as wiring clips and resin-bonded paper parts used inside the luminaire.

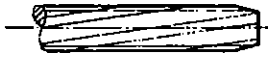
Spacing is not required from electronic circuits if under abnormal conditions the operating current does not exceed normal conditions current by more than 10 %.

Spacing is not required from parts of luminaires incorporating a temperature sensing control which provides protection against overheating of the covers, shades or similar parts.

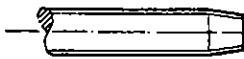
The requirements of this clause do not apply to a transformer supplied within an enclosure of its own, that is IP20 or higher, complying with IEC 60742 or IEC 60989.



Self-tapping screw; pointed or flat



Thread-cutting screw



Thread-forming screw (thread formed by deformation)

*IEC 726/96*

**Figure 22 – Examples of self-tapping, thread-cutting and thread-forming screws  
(from ISO 1891)**

*Compliance is checked by inspection, by measurement and by operating the luminaire in the abnormal condition with a slowly and steadily increasing current through the windings of the ballast or transformer, until the temperature sensing control operates. During and after this test, covers, shades and similar parts shall not catch fire and accessible parts shall not become live.*

*To check whether accessible parts have become live a test in accordance with annex A is made.*

Luminaires made of thermoplastic materials shall withstand temperature rises due to fault conditions in ballasts/transformers and electronic devices, so that no danger occurs when mounted as in normal use.

This requirement shall be met by one of the following measures:

- a) Constructive measures ensuring that:
- during failure conditions, the components are kept in place, for example by temperature-independent supports;
  - luminaire parts cannot be overheated in such a way that live parts can become accessible.

*Compliance is checked by inspection and/or the test of 12.7.1.*


- b) The use of a temperature sensing control to limit the temperature of the ballast/transformer and electronic device fixation points and exposed parts of the luminaire to a safe value. The temperature sensing control may be either an auto-reset thermal cut-out, a manual-reset thermal cut-out, or a thermal link.

*Compliance is checked by the test of 12.7.2.*

- c) The thermoplastic materials used for the luminaires shall be suitable for the maximum surface temperature permitted by the use of thermally protected ballasts complying with the relevant auxiliary standard.

*Compliance shall be checked by the test of 12.7.2.*

#### **4.16 Luminaires marked with symbol**

For luminaires with an  symbol, the excessive temperatures which may arise due to the failure of a component shall not overheat the mounting surface.

The requirements of this clause 4.16 are not applicable to a transformer supplied within an enclosure of its own, i.e. IP20 or higher complying with IEC 60742 or IEC 60989. For shaver transformers or shaver supply units incorporated in a luminaire and complying with IEC 60742, the requirements of 4.16.1 apply. Electronic lamp control gear and small wound devices that may be incorporated into these components are exempt from the requirements of this clause.

NOTE – Examples of small wound devices are windings having ferrite or non-laminated cores, these being normally mounted on a printed circuit board.