

IEC 72506

NOTE – The rigid supporting surface should be arranged vertically for a side impact test.

Figure 21 – Apparatus for ball impact tests

For luminaires incorporating lamp control gear, compliance with this requirement shall be met by spacing the lamp control gear from the mounting surface in accordance with 4.16.1, or by the use of thermal protection in accordance with 4.16.2, or by compliance with 4.16.3.

For luminaires that do not contain lamp control gear, the requirements are met by compliance with section 12.

4.16.1 The lamp control gear shall be spaced from the mounting surface by a minimum distance of either:

- a) 10 mm, including the thickness of the luminaire case material when the spacing includes a minimum of 3 mm air space between the outer surface of the luminaire case and the mounting surface of the luminaire in the region of the lamp control gear, and a minimum of 3 mm air space between the lamp control gear case and the inner surface of the luminaire case. If there is no control gear case, the distance of 10 mm shall apply from the active part, for example windings of the lamp controlgear.

NOTE – The luminaire case should be substantially continuous in the projected area of the lamp control gear so that a direct path of at least 35 mm is provided between the active part of the lamp controlgear and the mounting surface; otherwise, the requirement of item b) applies.

or

- b) 35 mm.

NOTE – The spacing of 35 mm is primarily to take account of stirrup-mounted luminaires where the lamp controlgear to mounting surface distance is often much greater than 10 mm.

In both instances the luminaire shall be so designed that any necessary air space is automatically obtained when it is mounted as in normal use.

Compliance is checked by inspection and by measurements.

4.16.2 The luminaire shall incorporate a temperature sensing control to limit the temperature of the mounting surface of the luminaire to a safe value. This temperature sensing control may be either external to the lamp controlgear or be part of a thermally protected lamp controlgear in accordance with the relevant auxiliary standard.

The temperature sensing control may be either a self-resetting thermal cut-out, a manual reset thermal cut-out or a thermal link (a thermal cut-out which operates only once and then requires replacement).

A temperature sensing control external to the lamp controlgear shall not be of the plug-in type or an otherwise easily replaceable type. It shall be kept in a fixed position with regard to the ballast/transformer.

NOTE – Cementing or the like to the ballast/transformer is not permitted.

Compliance is checked by inspection and by the test of 12.6.2.

The requirements of this subclause are deemed to be complied with for luminaires incorporating "class P" thermally protected ballast/transformer(s), marked with the symbol ∇^P , and temperature declared thermally protected ballast/transformer(s), symbol ∇ with a marked value equal to or below 130 °C, in accordance with the relevant auxiliary standard, without any further tests.

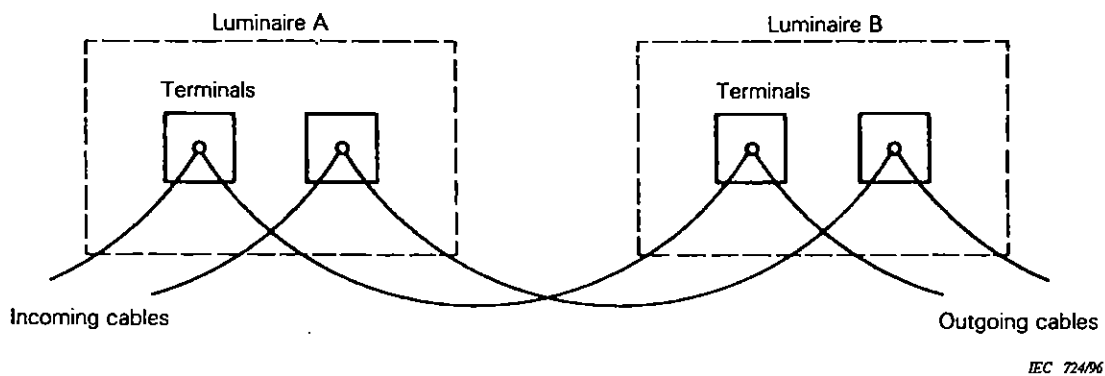


Figure 20A – Illustration of the term "looping-in" (feed through)

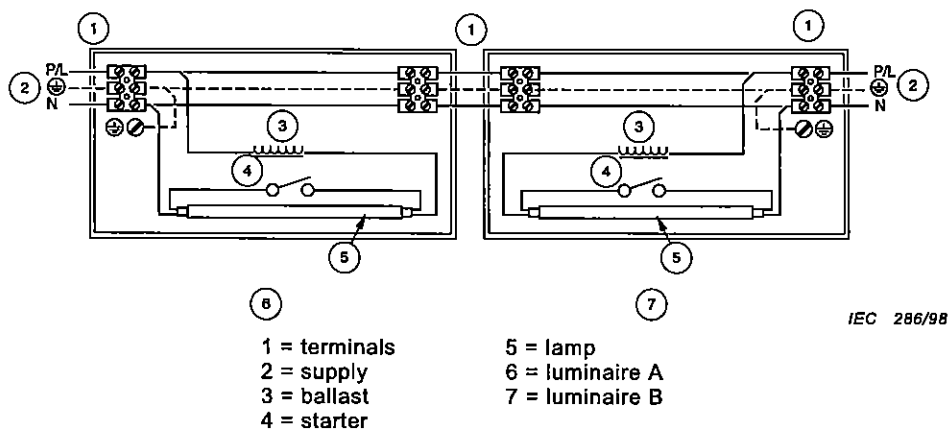


Figure 20B – Illustration of the term "through wiring" terminating in the luminaire.
(Can be used for three-phase through wiring where the luminaire is connected between L1, L2 and L3 and the neutral in turn)

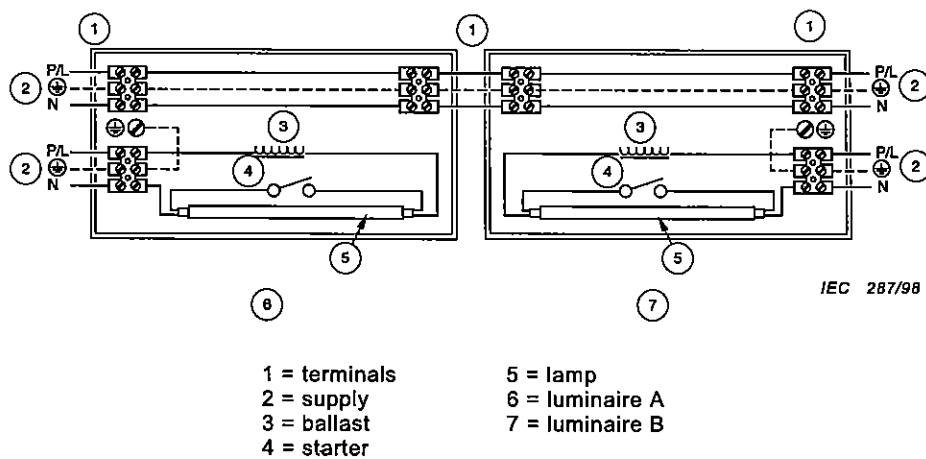


Figure 20C – Illustration of the term "through wiring" not terminating in the luminaire

Luminaires incorporating ballast/transformer(s) without the symbol for thermally protected ballasts or with a marked value above 130 °C shall comply with the requirements of 4.16.1 or 4.16.3.

4.16.3 If the luminaire does not comply with the spacing requirements of 4.16.1, and does not incorporate thermal cut-outs in accordance with 4.16.2, it shall be so designed that it satisfies the test of 12.6.

NOTE – This requirement and its test are based on the assumption that, during failure of the ballast/transformer, for instance owing to short-circuited windings or a short-circuit to the case, the ballast/transformer winding will not exceed 350 °C for a duration of more than 15 min and therefore that the temperature of the mounting surface will not exceed 180 °C for a duration of more than 15 min.

– For an explanation of  marking of luminaires, see annex N.

4.17 Drain holes

Drip-proof, rain-proof, splash-proof and jet-proof luminaires shall be so designed that if water accumulates in the luminaire it can drain out effectively, for example by opening one or more drain holes. Watertight luminaires shall have no provision for draining.

Compliance is checked by inspection and by the tests of section 9.

NOTE – A drain hole in the back of a luminaire for surface mounting is effective only if the design ensures a clearance of at least 5 mm from the mounting surface, for example, by means of projections from the back.

4.18 Resistance to corrosion

NOTE – Since the tests of clause 4.18 and annex F may be destructive, they may be carried out on separate samples in accordance with 0.4.2.

4.18.1 Ferrous parts of drip-proof, rain-proof, splash-proof, jet-proof, watertight and pressure-watertight luminaires, the rusting of which might cause the luminaire to become unsafe, shall be adequately protected against rusting.

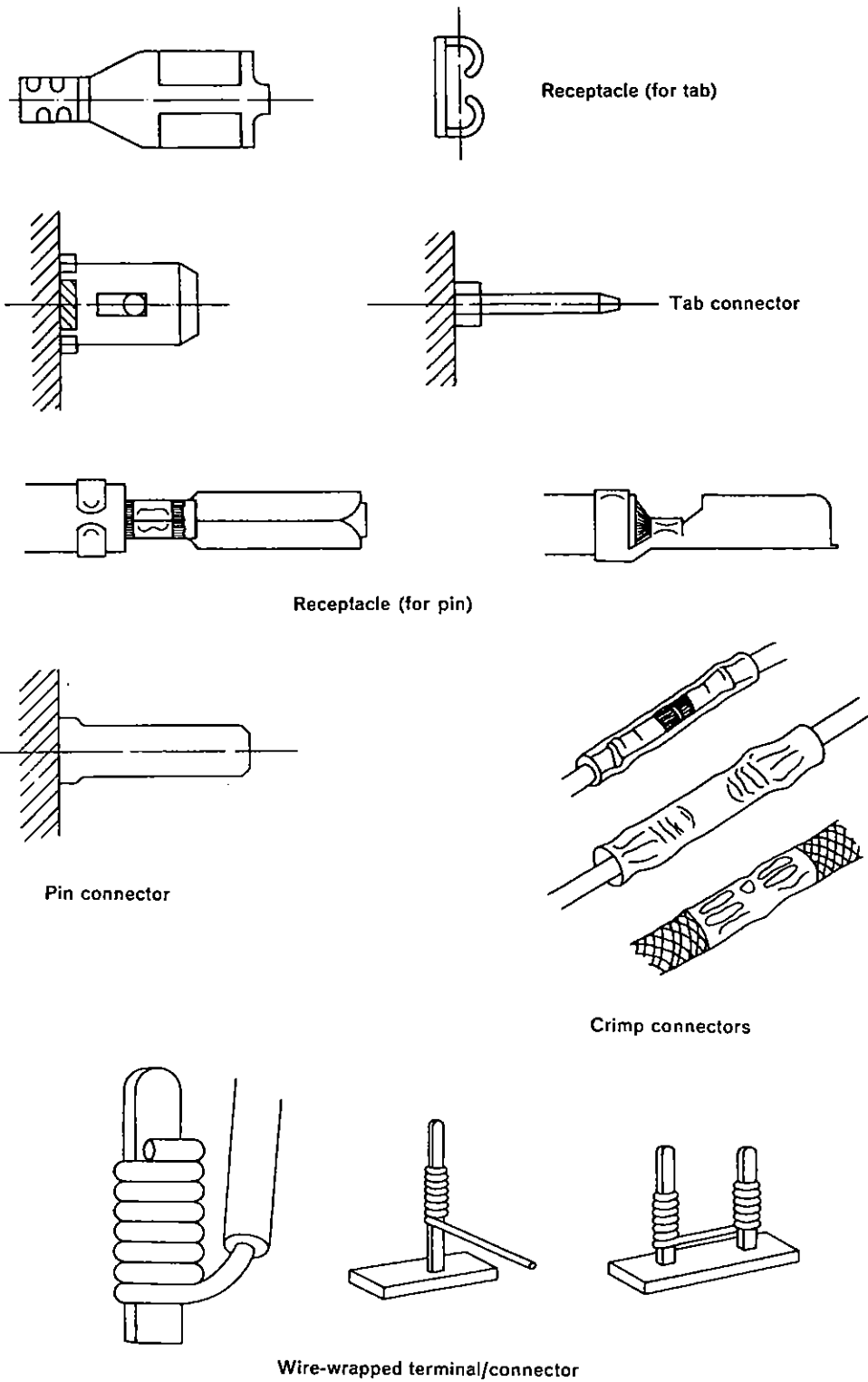
Compliance is to be checked by the following test:

All grease is removed from the parts to be tested. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 20 °C ± 5 °C. Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of 20 °C ± 5 °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of 100 °C ± 5 °C, their surfaces shall show no signs of rust.

NOTE – Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small helical springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.



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Figure 19 – Further examples of screwless terminals

4.18.2 Contacts and other parts made of rolled copper or copper alloy sheet, the failure of which might cause the luminaire to become unsafe, shall be free from stress corrosion.

Compliance is checked by the test given in annex F which shall be made on samples not subjected to any other test.

4.18.3 Parts of aluminium or aluminium alloy in drip-proof, rain-proof, splash-proof, jet-proof, watertight and pressure-watertight luminaires, shall be resistant to corrosion, if otherwise the luminaire might become unsafe.

NOTE – Guidance on resistance to corrosion is given in annex L.

4.19 Ignitors

Ignitors used in luminaires shall be electrically compatible with the associated ballast in the luminaire.

Compliance is checked by inspection.

4.20 Rough service luminaires – Vibration requirements

Rough service luminaires shall have adequate resistance to vibrations.

Compliance is checked by the following vibration test.

The luminaire is fastened in its most onerous but normal position of installation to a vibration generator.

The direction of vibration is in the most onerous direction and the severity is:

Duration: 30 min

Amplitude: 0,35 mm

Frequency range: 10 Hz, 55 Hz, 10 Hz

Sweep rate: approximately one octave per minute.

After the test the luminaire shall have no loosened parts which could impair the safety.

4.21 Protective shield (tungsten halogen lamps)

4.21.1 Luminaires incorporating tungsten halogen lamps, without an integral outer envelope, shall be fitted with a protective shield except when the lamp is:

- a mains voltage (general lighting source) replacement lamp;* or
- a low pressure tungsten halogen lamp as specified in 9.1 of IEC 60357.

* The lamp will be one which conforms to IEC 60432-2.

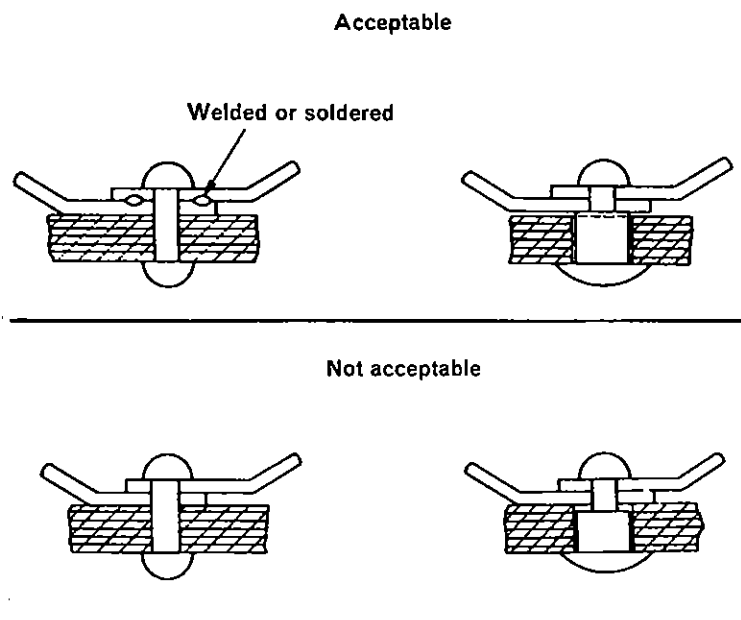


Figure 17 – Construction of electrical connections

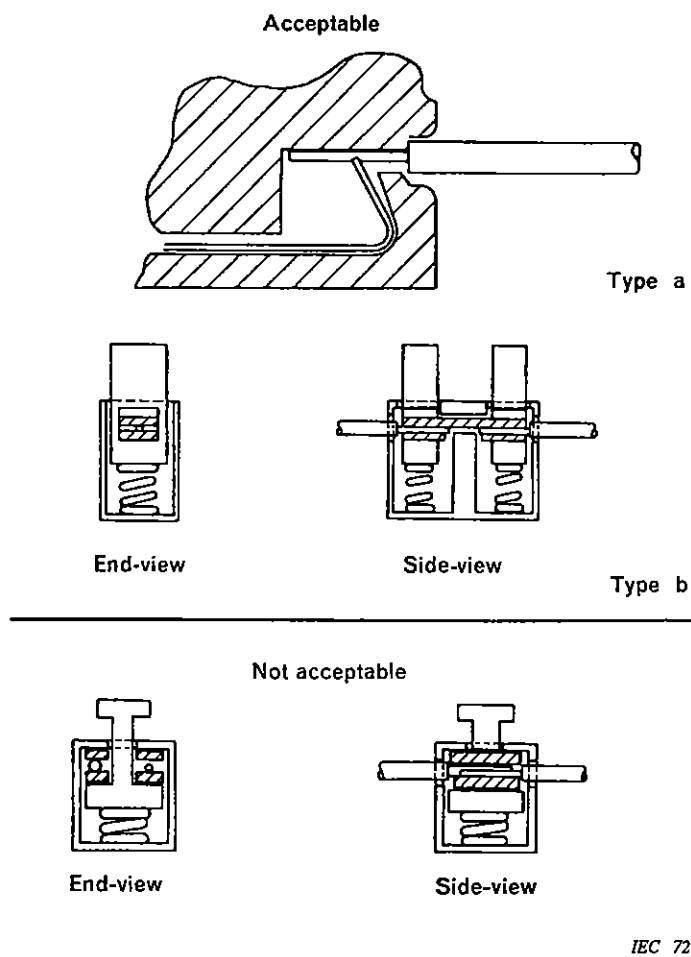


Figure 18 – Examples of spring-type screwless terminals

4.21.2 Parts of the lamp compartment shall so be designed that particles from a shattering lamp cannot impair safety.

4.21.3 All openings in the luminaire shall be such that no parts of a shattered lamp can leave the luminaire by a direct path, including the rear of recessed luminaires.

4.21.4 *Compliance with 4.21.1 to 4.21.3 is checked by inspection and by the following tests:*

- *the protective shield shall comply with the impact test of 4.13.1 with the impact energy of table 4.3 for fragile parts;*
- *parts of the lamp compartment, if of insulating material, shall comply with the resistance to flame and ignition test of 13.3.2.*

NOTE – This requirement is intended to improve safety by eliminating the hazards due to chance failure of a lamp or incorrect application. Existing open luminaires not fitted with a protective shield do not necessarily present a hazard.



4.22 Attachments to lamps

Luminaires shall not incorporate attachments to lamps which might cause overheating or damage to the lamps, lamp caps or holders, luminaires or attachments.

Attachments to fluorescent lamps are only allowed if supplied or approved by the luminaire manufacturer. The total weight of the lamp plus attachment shall not exceed:

- 100 g for lamps with cap G5, and
- 500 g for lamps with cap G13.

Compliance is checked by inspection, by weighing and by thermal measurements if appropriate.

NOTE – Examples of attachments to incandescent lamps which might not comply with these requirements are bowl mirror reflectors, reflectors around lamps etc. Examples which might be permitted are springs for attachment of lightweight shades to lamps and similar devices.

4.23 Semi-luminaires

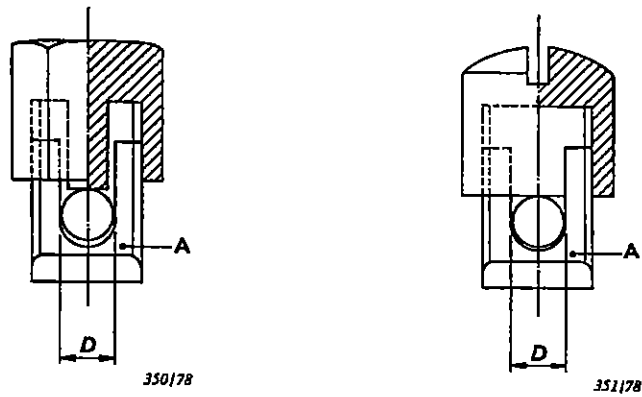
Semi-luminaires shall comply with all relevant requirements for class II luminaires.

NOTE – The class II symbol is omitted to avoid it being considered as applying to the complete luminaire in which the semi-luminaire is used.

4.24 UV radiation

Luminaires shall not emit excessive radiation.

NOTE – See annex P, procedure A or B for method of calculation to provide effective radiation shielding.



A = fixed part
 D = conductor space

| Terminal size | Minimum diameter D of conductor space ¹⁾ | Minimum distance between fixed part and end of conductor when fully inserted |
|---------------|---|--|
| | mm | mm |
| 0 | 1,4 | 1,5 |
| 1 | 1,7 | 1,5 |
| 2 | 2,0 | 1,5 |
| 3 | 2,7 | 1,8 |
| 4 | 3,6 | 1,8 |
| 5 | 4,3 | 2,0 |
| 6 | 5,5 | 2,5 |
| 7 | 7,0 | 3,0 |

¹⁾ The torque value to be applied is that specified in column II or V of table 14.4 as appropriate.

Figure 16 – Mantle terminals

4.25 Mechanical hazard

Luminaires shall have no sharp points or edges that could, during installation, normal use, or maintenance, create a hazard for the user.

Compliance is checked by inspection.

4.26 Short-circuit protection

4.26.1 Adequate means shall be provided to prevent the impairing of safety due to unintended short-circuiting of uninsulated accessible SELV parts of opposite polarity.

NOTE – Class III luminaires supplied from a separate unspecified SELV supply should have one conductor insulated. Where insulation is not provided, the luminaire manufacturer should declare the maximum VA output and type reference of the SELV source, and the test in 4.26.2 should be conducted with this transformer/converter.

4.26.2 A type test sample is operated at 0,9 to 1,1 times its rated voltage with its nominal load. A test chain as specified in 4.26.3 is hung over accessible uninsulated SELV parts. The test chain shall form the shortest possible path by being loaded at each end, subject to a maximum of 250 g with a weight equal to:

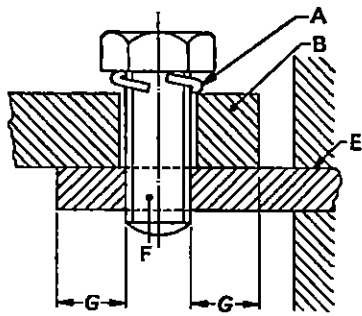
$$(15 'X') \text{ g}$$

where 'X' is the distance between conductors in the unloaded state, in centimetres.

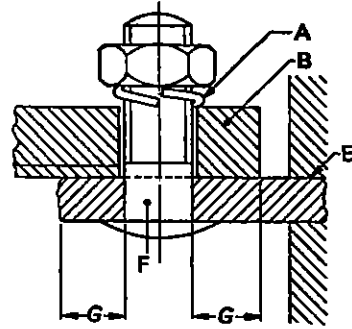
The test chain shall not melt through, nor shall any part of the type test sample reach a temperature exceeding the values of tables 12.1 and 12.2.

4.26.3 Test chain: A chain of sufficient length of an uncoated metal, having links in accordance with IEC 61032: figure 10 and made of 63 % Cu/37 % Zn. The chain shall have a resistance value of $0,05 \Omega/\text{m} \pm 10 \%$ when stretched with a load of 200 g/m.

NOTE – The resistance value of the test chain should be checked before each measurement.



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A = locking means
B = cable lug or bar
E = fixed part

F = stud
G = distance between edge of hole
and side of clamping area

NOTE – For certain types of equipment, the use of terminals of a size smaller than those specified is allowed.

| Terminal size | Minimum distance G between edge of hole and side of clamping area mm | Torque Nm | |
|---------------|--|-----------|-------|
| | | III 1) | VI 1) |
| 6 | 7,5 | 2,0 | 2,0 |
| 7 | 9,0 | 2,5 | 3,0 |

1) The values specified apply to the studs covered by the corresponding columns in table 14.4.

Figure 15 – Lug terminals

SECTION 5: EXTERNAL AND INTERNAL WIRING

5.1 General

This section specifies general requirements for the electrical connections to a supply and for the internal wiring of luminaires.

5.2 Supply connection and other external wiring

5.2.1 Luminaires shall be provided with one of the following means of connection to the supply:

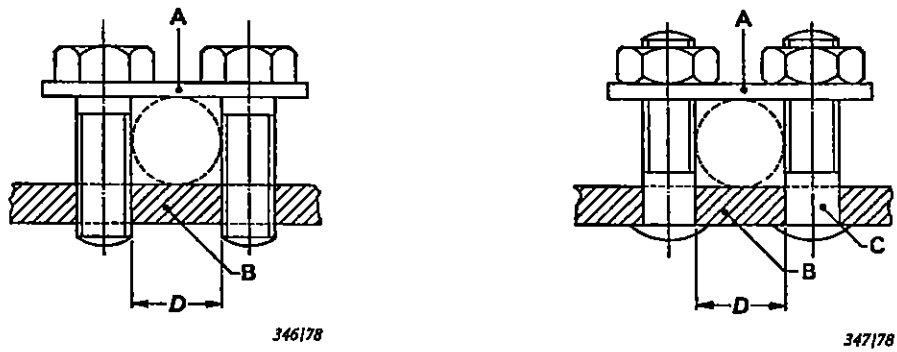
| | |
|---|---|
| Fixed luminaires | <p>terminals; plugs for engagement with socket-outlets; non-detachable flexible cables or cords; adapters for engagement with supply tracks; appliance inlets;</p> <p>connecting leads (tails): Where the luminaire is delivered with connecting leads (tails) and without a means of connection to the supply, the manufacturer of the luminaire shall specify which terminal block may be used which shall conform to EN 60998-2-1 or EN 60998-2-2; either the terminal block to be used shall be specified or the following shall be defined:</p> <ul style="list-style-type: none"> - the type of terminal (screw/screwless); - number of terminals; - rated voltage; - rated connecting capacity; - any necessary preparation of the ends of conductors; - any fixing method |
| The requirements of subclauses 4.6, 4.7.1, 4.7.2, 4.10.1, 11.2, 12 and 13.2 shall be applied. | |
| Ordinary portable luminaires | non-detachable flexible cables or cords; appliance inlets |
| Other portable luminaires | non-detachable flexible cables or cords |
| Track-mounted luminaires | adaptors or connectors |
| Semi-luminaires | Edison screw or bayonet cap |

Portable luminaires intended for wall mounting and incorporating a junction box and cord anchorage may be delivered without a non-detachable flexible cable or cord, if instructions for mounting are enclosed with the luminaire.

Luminaires declared by the manufacturer to be suitable for use outdoors shall not have PVC-insulated external wiring.

NOTE – In Australia, Austria and Japan PVC insulated cables are acceptable for outdoor use.

5.2.2 Flexible cables or cords used as a means of connection to the supply, when supplied by the luminaire manufacturer, shall be at least equal in their mechanical and electrical properties to those specified in HD 21 and HD 22, as indicated in table 5.1, and shall be capable of withstanding, without deterioration, the highest temperature to which they may be exposed under normal conditions of use.



- A = saddle
- B = fixed part
- C = stud
- D = conductor space

NOTE – The shape of the section of the conductor space may differ from those shown in the figures, provided a circle with a diameter equal to the minimum value specified for *D* can be inscribed.

The shape of the upper and lower faces of the saddle may be different, to accommodate conductors of either small or large cross-sectional area, by reversing the saddle.

The terminals may have more than two clamping screws or studs.

| Terminal size | Minimum diameter <i>D</i> of conductor space | Torque |
|---------------|--|--------|
| | mm | Nm |
| 3 | 3,0 | 0,5 |
| 4 | 4,0 | 0,8 |
| 5 | 4,5 | 1,2 |
| 6 | 5,5 | 1,2 |
| 7 | 7,0 | 2,0 |

Figure 14 – Saddle terminals

Table 5.1 – Non detachable flexible cables or cords

| | Rubber | PVC |
|-----------------------------------|---------|----------------------|
| Class 0 luminaires | H03RT-F | H03VH-H |
| Ordinary class I luminaires | H03RT-F | H03VVH2-F H03VV-F |
| Ordinary class II luminaires | H05RR-F | H03VVH2-F H03VV-F |
| Luminaires other than ordinary | H05RN-F | – |
| Portable rough service luminaires | H07RN-F | – |

NOTE 1 – For supply voltages greater than 250 V, higher voltage grade cables and cords than those given in the above table may be necessary.

To provide adequate mechanical strength, the nominal cross-sectional area of the conductors shall be not less than:

- 0,75 mm² for ordinary luminaires;
- 1,0 mm² for other luminaires.

If the luminaire is provided with a 10/16 A socket-outlet, the flexible conductor nominal cross-section area shall be at least 1,5 mm².

5.2.3 Where the non-detachable flexible cable or cord is provided with the luminaire, it shall be connected to the luminaire by one of the following methods:

- type X attachment;
- type Y attachment;
- type Z attachment.

5.2.4 *Compliance with the requirements of 5.2.1 to 5.2.3 is checked by inspection and, if necessary, by fitting the appropriate flexible cable or cord.*

5.2.5 Terminations within luminaires utilizing type Z attachment shall not be made by means of screwed connections.

5.2.6 Cable entries shall be suitable for the introduction of the conduit or the protective covering of the cable or flexible cord so that the cores are completely protected, and they shall provide the degree of protection against dust or moisture in accordance with the classification of the luminaire, when the conduit, cable or flexible cord is fitted.

| Terminal size | Minimum diameter <i>D</i> of conductor space mm | Torque Nm | | | |
|---------------|--|-------------------|------------|-------------------|---------------------|
| | | III ¹⁾ | | IV ¹⁾ | |
| | | One screw | Two screws | One screw or stud | Two screws or studs |
| 0 | 1,4 | 0,4 | – | 0,4 | – |
| 1 | 1,7 | 0,5 | – | 0,5 | – |
| 2 | 2,0 | 0,8 | – | 0,8 | – |
| 3 | 2,7 | 1,2 | 0,5 | 1,2 | 0,5 |
| 4 | 3,6 | 2,0 | 1,2 | 2,0 | 1,2 |
| 5 | 4,3 | 2,0 | 1,2 | 2,0 | 1,2 |
| 6 | 5,5 | 2,0 | 1,2 | 2,0 | 1,2 |
| 7 | 7,0 | 2,5 | 2,0 | 3,0 | 2,0 |

¹⁾ The values specified apply to the screws or studs covered by the corresponding columns in table 14.4.

Figure 13 (2nd part) – Screw terminals and stud terminals

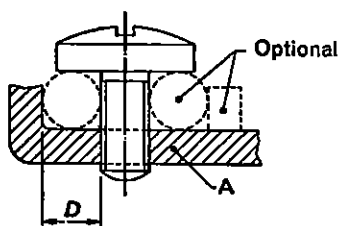
5.2.7 Cable entries through rigid materials for external flexible cables and cords shall have smoothly rounded edges of minimum radius 0,5 mm.

Compliance with the requirements of 5.2.5 to 5.2.7 is checked by inspection and by manual tests.

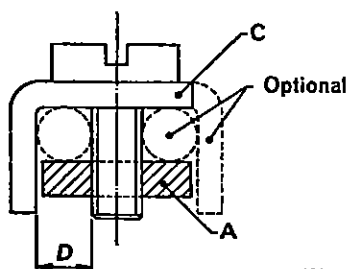
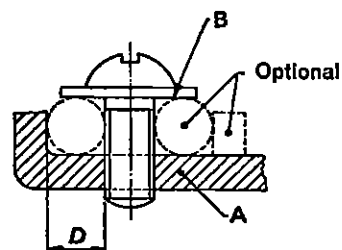
5.2.8 If, in class II luminaires, in adjustable luminaires or in portable luminaires other than those for wall mounting, a flexible cable or cord where entering or leaving the luminaire passes through accessible metal parts or through metal parts in contact with accessible metal parts, the opening shall be provided with a tough bushing of insulating material having smoothly rounded edges, so fixed that it cannot easily be removed. Bushings of material likely to deteriorate with age (for example rubber) shall not be used in openings with sharp edges.

NOTE – The term "easily removable bushings" is used to describe a bushing which can be pulled out of its mounting by hand or a bushing screwed into a luminaire but not secured with a lock nut or appropriate adhesive such as a self-hardening resin.

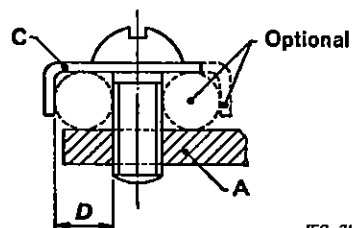
Screw not requiring washer
 or clamping plate



Screw requiring washer
 or clamping plate

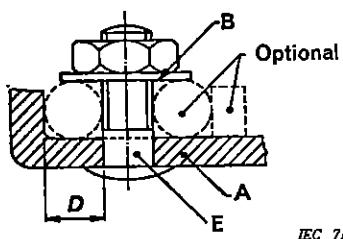


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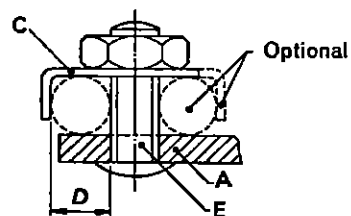


IEC 71896

Screw terminals



IEC 71996



IEC 72096

Stud terminals

- A = fixed part
- B = washer or clamping plate
- C = anti-spread device
- D = conductor space
- E = stud

NOTE – The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

Figure 13 (1st part)

If tubes or other guards are provided for the protection of flexible cables or cords at the entry to the luminaire they shall be of insulating material.

Helical metal springs and similar components, even when covered with insulated material, are not guards.

Compliance is checked by inspection.

5.2.9 Bushings which screw into the luminaire shall be locked in position. If bushings are fixed with an adhesive, it shall be of the self-hardening resin type.

Compliance is checked by inspection.

5.2.10 Luminaires provided with or designed for use with non-detachable flexible cables or cords shall have a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals, and such that their covering is protected from abrasion. It shall be clear how the relief from strain and the prevention of twisting is intended to be effected. For luminaires supplied without a cable or cord, suitable test cables or cords of the largest and smallest sizes recommended by the luminaire manufacturer shall be used for the tests.

It shall not be possible to push the flexible cable or cord into the luminaire to such an extent that the cable or cord is subjected to undue mechanical or thermal stress. Methods such as tying the cable or cord into a knot or tying the ends with string shall not be used.

Cord anchorage shall be of insulating material or be provided with a fixed insulating lining if an insulation fault on the cable or cord could make accessible metal parts live.

5.2.10.1 For type X attachment cord and luminaires designed for use with non-detachable cables and cords, cord anchorages shall be such that: ②

a) at least one part is fixed to, or is integral with, the luminaire;

NOTE – A cord anchorage is described as fixed to or held by the luminaire if this is actually the case when the wiring is inserted and the luminaire is completely assembled.

b) they are suitable for the different types of flexible cable or cord that are appropriate for connecting to the luminaire, except where the luminaire allows only one type of cable or cord to be fitted;

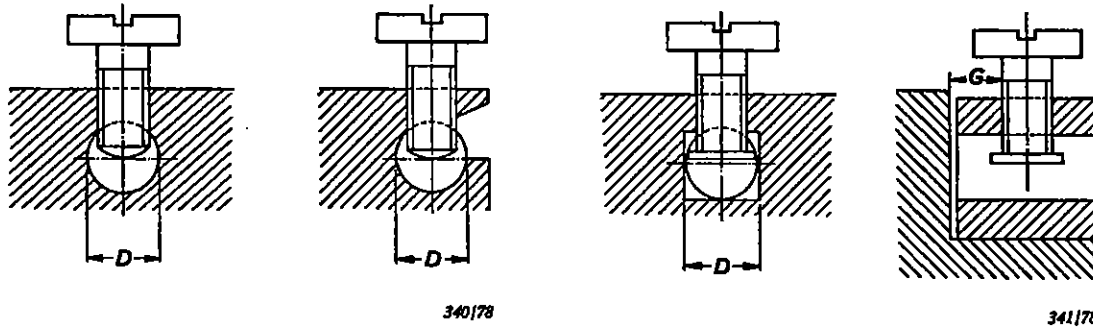
c) they do not damage the cable or cord and they are unlikely to be damaged when they are tightened or loosened in normal use;

d) the whole flexible cable or cord with its covering, if any, is capable of being mounted into the cord anchorage;

e) the cable or cord does not touch clamping screws of the cord anchorage if these screws are of metal and are accessible or electrically connected to accessible metal parts;

f) the cable or cord is not clamped by a metal screw which bears directly on the cable or cord;

g) replacement of the flexible cable or cord does not require the use of a tool specially designed for the purpose.



Terminals without pressure plate

Terminals with pressure plate

D = conductor space

G = distance between clamping screw and end of conductor when fully inserted

NOTE – The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

The shape of the conductor space may differ from those shown, provided a circle with a diameter equal to the minimum value specified for D can be inscribed.

| Terminal size | Minimum diameter D of conductor space mm | Minimum distance G between clamping screw and end of conductor when fully inserted | | Torque Nm | | | | | |
|---------------|---|--|-----|--------------|------------|-----------|------------|-----------|------------|
| | | | | I 1) | | III 1) | | IV 1) | |
| | | | | One screw | Two screws | One screw | Two screws | One screw | Two screws |
| 1 | 2,5 | 1,5 | 1,5 | 0,2 | 0,2 | 0,4 | 0,4 | 0,4 | 0,4 |
| 2 | 3,0 | 1,5 | 1,5 | 0,25 | 0,2 | 0,5 | 0,4 | 0,5 | 0,4 |
| 3 | 3,6 | 1,8 | 1,5 | 0,4 | 0,2 | 0,8 | 0,4 | 0,8 | 0,4 |
| 4 | 4,0 | 1,8 | 1,5 | 0,4 | 0,25 | 0,8 | 0,5 | 0,8 | 0,5 |
| 5 | 4,5 | 2,0 | 1,5 | 0,7 | 0,25 | 1,2 | 0,5 | 1,2 | 0,5 |
| 6 | 5,5 | 2,5 | 2,0 | 0,8 | 0,7 | 2,0 | 1,2 | 2,0 | 1,2 |
| 7 | 7,0 | 3,0 | 2,0 | 1,2 | 0,7 | 2,5 | 1,2 | 3,0 | 1,2 |

1) The values specified apply to the screws covered by the corresponding columns in table 14.4.

Figure 12 – Pillar terminals

Glands shall not be used as cord anchorages in portable or adjustable luminaires, unless they have provision for clamping all types and sizes of cables and cords which might be used for the supply connection. Anchorages of labyrinth type may be used if it is evident from the design or by means of suitable marking how the flexible cable or cord is to be mounted.

Compliance is checked by the test of 5.2.10.3.

5.2.10.2 For type Y and Z attachments, cord anchorages shall be adequate.

Compliance is checked by the test of 5.2.10.3.

NOTE – The test is carried out on the cable or cord supplied with the luminaire.

5.2.10.3 *Compliance is checked by inspection and by the following tests which are made with the cable or cord which is fitted to the luminaire as delivered.* ②

The conductors are introduced into the terminals and the terminal screws, if any, are tightened just sufficiently to prevent the conductors from easily changing their position.

The cord anchorage is used in the normal manner, clamping screws, if any, being tightened with a torque two-thirds of that specified in table 4.1.

After this preparation, it shall not be possible to push the cable or cord into the luminaire in such a way as to cause movement of the cable or cord at the terminals, or to cause the cable or cord to come into contact with moving parts or parts which operate at a temperature higher than that permissible for the insulation of the conductors.

The cable or cord is then subjected 25 times to a pull of the value shown in table 5.2.

The pulls are applied without jerks, each time for 1 s. The measurement of the longitudinal displacement of the cable or cord is made during this test. A mark is made on the cable or cord at a distance of approximately 20 mm from the cord anchorage while it is subjected to the first pull and during the 25th pull the mark shall not have been displaced by more than 2 mm.

The cable or cord shall then be subjected to a torque of the value shown in table 5.2.

During and after the above tests, the conductors shall not have moved noticeably in the terminals and the cable or cord shall not be damaged.

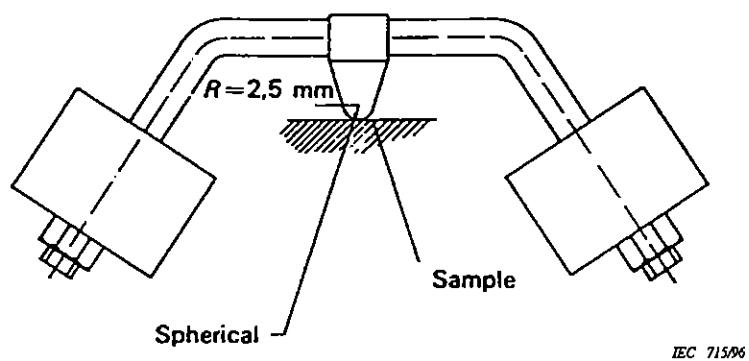
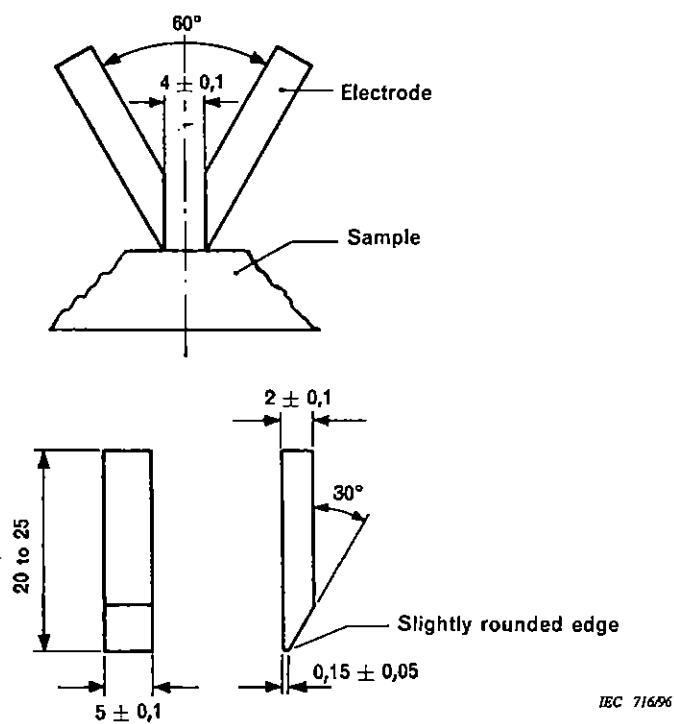


Figure 10 – Ball-pressure apparatus



Dimensions in millimetres

Figure 11 – Arrangement and dimensions of the electrodes for the tracking test

Table 5.2 –Tests for cord anchorage

| <i>Total nominal cross-sectional area of all conductors together</i> <i>mm²</i> | <i>Pull</i> <i>N</i> | <i>Torque</i> <i>Nm</i> |
|---|-------------------------|----------------------------|
| <i>Up to and including 1,5</i> | <i>60</i> | <i>0,15</i> |
| <i>Over 1,5 up to and including 3</i> | <i>60</i> | <i>0,25</i> |
| <i>Over 3 up to and including 5</i> | <i>80</i> | <i>0,35</i> |
| <i>Over 5 up to and including 8</i> | <i>120</i> | <i>0,35</i> |

5.2.11 If external wiring passes into the luminaire, it shall comply with the appropriate requirements for internal wiring.

Compliance is checked by the tests of 5.3.

5.2.12 Fixed luminaires for looping-in shall be provided with terminals intended for maintaining the electrical continuity of supply cables feeding the luminaire, but not terminating in it.

Compliance is checked by inspection.

5.2.13 The ends of flexible stranded conductors may be tinned but shall not have additional solder applied, unless a means is provided of ensuring that clamped connections cannot work loose owing to cold flow of the solder (see figure 28).

NOTE – This requirement is met when spring terminals are used. Securing the clamping screws is not an adequate means of preventing the connection of soldered strands from working loose owing to cold flow of the solder.

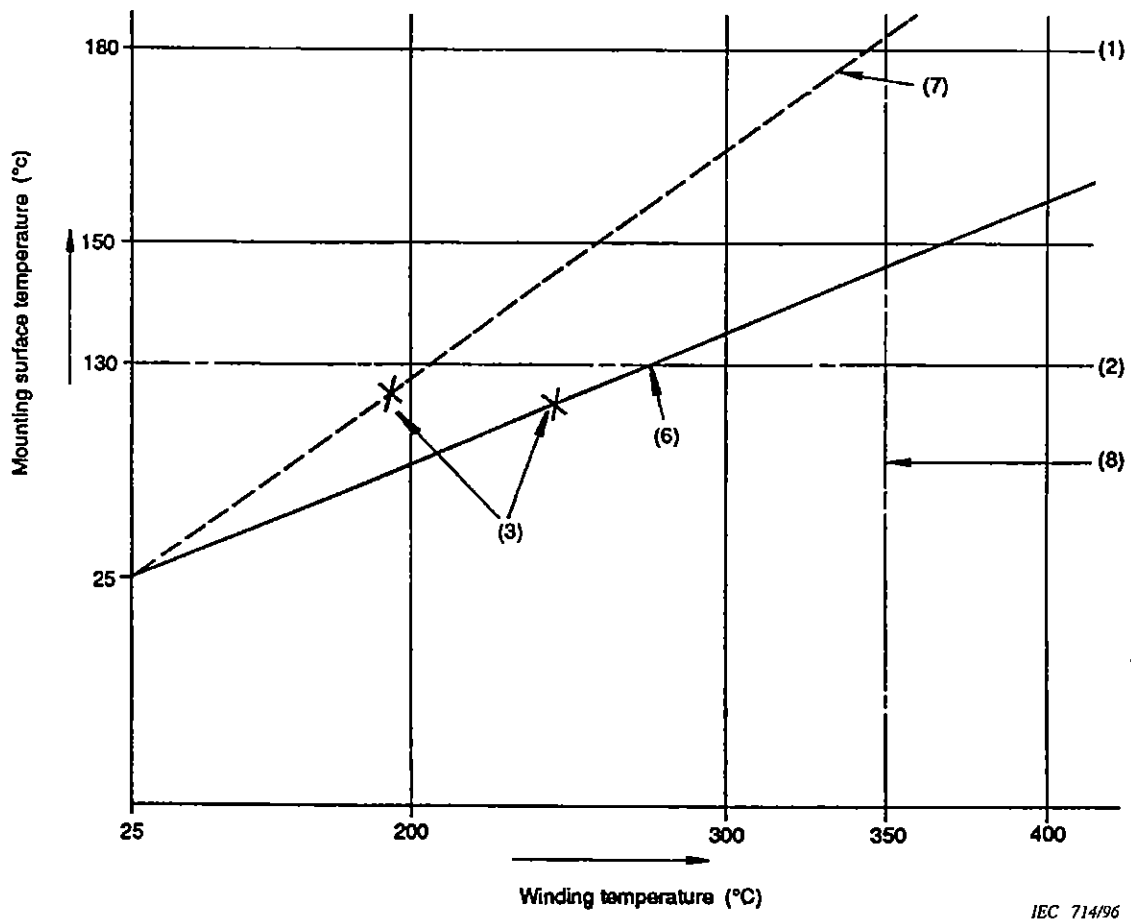
5.2.14 If a plug is supplied with the luminaire by the manufacturer, the plug shall have the same degree of protection against electric shock and degree of protection against ingress of dust, solid objects and moisture as the luminaire.

A class III luminaire shall not be provided with a plug which permits connection with a socket-outlet according to IEC 60083.

5.2.15 Connecting leads [tails] of extra-low voltage d.c. supplied fluorescent luminaires where supplied as the means of connection of the luminaire to the supply shall be colour coded red to indicate positive and black to indicate negative.

5.2.16 Appliance inlets incorporated into luminaires as the means of connection to the supply shall comply with the requirements of IEC 60320. Looping-in of luminaires shall be achieved by appliance couplers, which, if of the class II type, shall not accept class I type plugs, or shall be achieved using screw or screwless terminals.

Compliance with the requirements of 5.2.13 to 5.2.16 is checked by inspection.



IEC 714/96

- (1) Limiting value of mounting surface temperature in case of failed winding.
- (2) Limiting value of mounting surface temperature during abnormal operation at 1,1 times rated voltage (see 12.6.1a).
- (3) Measuring point at 1,1 times rated voltage (see 12.6.1b)).
- (6) Straight line drawn through the single measuring point and the 25 °C point indicating a satisfactory luminaire as the extrapolation of the line to a winding temperature of 350 °C is below a mounting surface temperature of 180 °C.
- (7) Straight dashed line drawn through two measuring points and indicating a luminaire which fails the test because the extrapolation of the line exceeds a mounting surface temperature of 180 °C before reaching a winding temperature of 350 °C.
- (8) Assumed maximum value of the winding temperature of a failed winding.

Figure 9 – Relation between winding temperature and mounting surface temperature

5.3 Internal wiring

5.3.1 Internal wiring shall be made with conductors of a suitable size and type to handle the power occurring during normal use. The insulation of the wiring shall be made of a material capable of withstanding the voltage and the maximum temperature to which it is subjected, without affecting the safety when properly installed and connected to the mains. ②

If cables with common type of insulation (PVC or rubber) are used as through wiring, they do not need to be delivered with the luminaire if the way of mounting is clear from the manufacturer's instructions. However, if special cables or sleeves, e.g. due to high temperatures, are necessary, the through wiring shall always be factory assembled. The requirements of 3.3.3 c) shall be taken into account in the latter case. ①

Wires coloured green and yellow shall be used for making earth connections only.

NOTE 1 – The temperature limits for the insulation are given in the tables of section 12.

NOTE 2 – Sleeves in compliance with 4.9.2 are suitable to protect hot spots.

Compliance is checked by inspection and the following test, after the temperature and heating tests of section 12.

The socket-outlet, if any, is loaded with the declared value specified by the manufacturer and, if not declared, with its rated current at rated voltage.

When stable conditions are reached, the voltage is increased until an over-wattage of 5 %, or an over-voltage of 6 % (depending on the type of lamp), is present.

When the new stable conditions are reached, all temperatures on components, cables, etc., which can be influenced by the self-heating of the conductor shall be checked in accordance with the requirements of 12.4.

5.3.1.1 For wiring which is directly connected to the fixed wiring, e.g. via a terminal block, and the disconnection from the mains is relied upon by the external protection device(s), the following is applicable: ②

For normal operating currents higher than 2 A:

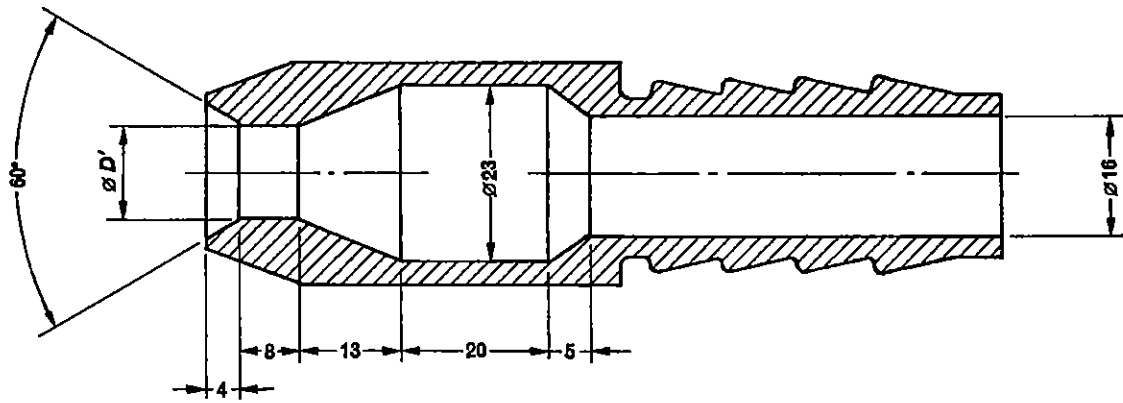
- nominal cross-sectional area: minimum 0,5 mm²,
- for through-wiring of fixed luminaires: minimum 1,5 mm²,
- nominal insulation thickness: minimum 0,6 mm (PVC or rubber).

For mechanical protected wiring carrying normal operating currents lower than 2 A:

- nominal cross-sectional area: minimum 0,4 mm²,
- nominal insulation thickness: minimum 0,5 mm (PVC or rubber).

The required mechanical protection is regarded to be adequate when extra insulation is added at the following places where the wire insulation may be damaged:

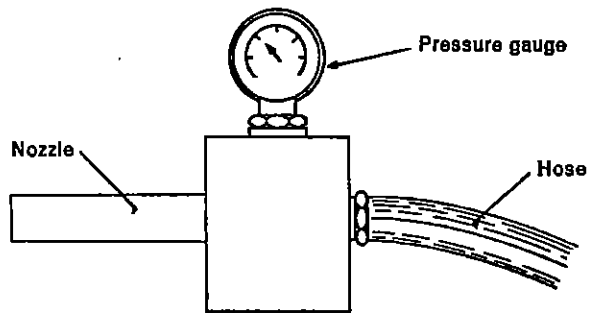
- in small openings of pipes when, during production, the wires are slid through,
- when bending wires closely around metal not specially treated to produce smooth edges.



$D' = 6,3$ mm for the test of 9.2.6 (second characteristic numeral 5)
 $D' = 12,5$ mm for the test of 9.2.7 (second characteristic numeral 6)



Detail of nozzle



IEC 713/96

Dimensions in millimetres

Figure 8 – Nozzle for spray test

5.3.1.2 For wiring which is connected to the fixed wiring via an internal current-limiting device and limiting the current to 2 A maximum, e.g. lamp current control device, circuit cut-outs, fuses, protective impedance or isolating transformers, the following is applicable:

- the minimum cross-sectional area which may be less than 0,4 mm² shall be selected in relation to the maximum current during normal operating conditions and the time and level of the current flowing during failure conditions, owing to the fact that overheating of the wire insulation shall be prevented under any condition;
- the minimum insulation thickness which may be less than 0,5 mm (PVC or rubber) shall be selected in relation to the voltage stress occurring.

5.3.1.3 In class II luminaires where the internal wiring has a live conductor and touches accessible metal parts under normal operating conditions, the insulation, at least at the places of contact, shall comply with the requirements for double or reinforced insulation relevant to the voltage stress, e.g. by applying sheathed cables or sleeves.

5.3.1.4 Conductors without insulation may be used provided that adequate precautions have been taken to ensure adherence to the creepage distances and clearance requirements of section 11 and also with regard to the class of protection of section 2.

5.3.1.5 The SELV current-carrying parts do not have to be insulated. However, if insulation is applied, they shall be tested as mentioned in section 10.

5.3.1.6 When insulation materials are used which have insulating or mechanical properties higher than PVC or rubber, an insulation thickness shall be selected which gives the same degree of protection.

5.3.2 Internal wiring shall be so situated or protected that it cannot be damaged by sharp edges, rivets, screws and similar components, or by moving parts of switches, joints, raising and lowering devices, telescopic tubes and similar parts. Wiring shall not be twisted along the longitudinal axis of the cable through an angle exceeding 360°.

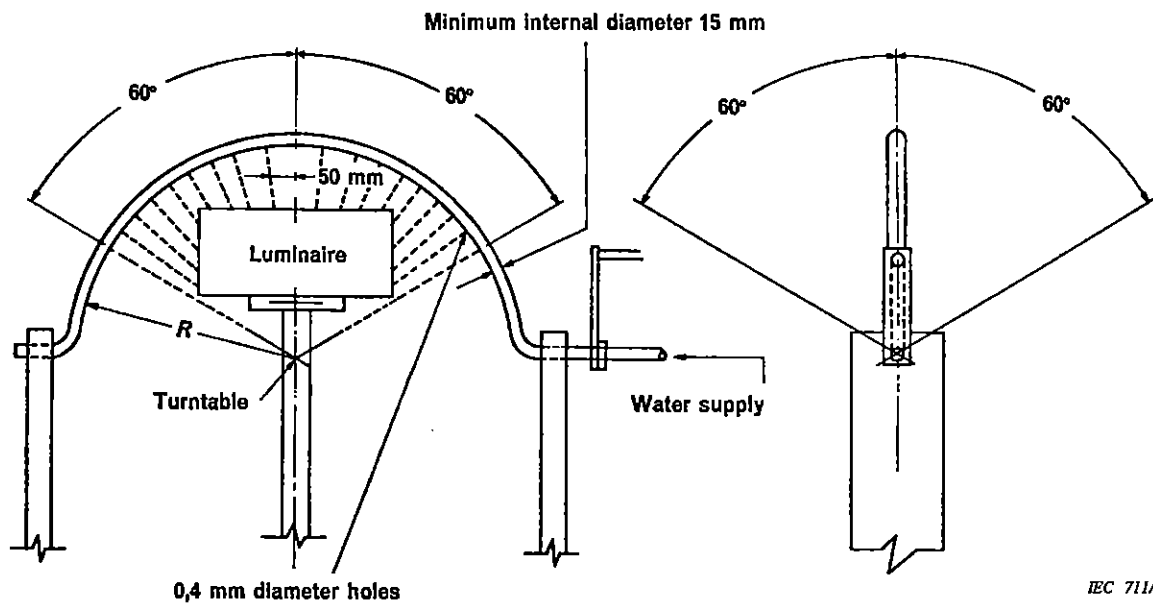
Compliance is checked by inspection (see also 4.14.4 and 4.14.5) and in accordance with the test of 4.14.3.

5.3.3 If in class II luminaires, in adjustable luminaires, or in portable luminaires other than those for wall mounting, internal wiring passes through accessible metal parts or through metal parts in contact with accessible metal parts, the opening shall be provided with a tough bushing of insulating material, having smoothly rounded edges, so fixed that it cannot easily be removed. Bushings of material likely to deteriorate with age (for example rubber) shall not be used in openings with sharp edges.

NOTE – The term "easily removable bushings" is used to describe a bushing which can be pulled out of its mounting by hand or a bushing screwed into a luminaire but not secured with a lock nut or appropriate adhesive such as a self-hardening resin.

If the cable entry openings have smoothly rounded edges and the internal wiring is not required to be moved in service, this requirement is met by the use of a separate protective sheath over a cable that has no special protective sheath, or by using a cable which incorporates a protective sheath.

②



| Luminaire protection | | |
|-------------------------|----------------|-----------------|
| | rainproof | splash-proof |
| Oscillation half-angle | $\pm 60^\circ$ | $\pm 180^\circ$ |
| Holes within half-angle | $\pm 60^\circ$ | $\pm 90^\circ$ |

Figure 7 – Apparatus for testing protection against rain and splashing

5.3.4 Joints and junctions in internal wiring, excluding terminations on components, shall be provided with an insulating covering no less effective than the insulation of the wiring. ②

Compliance with the requirements of 5.3.3 and 5.3.4 is checked by inspection.

5.3.5 Where internal wiring passes out of the luminaire and the design is such that the wiring may be subject to strain, the requirements for external wiring apply. The requirements for external wiring do not apply to internal wiring of ordinary luminaires which has a length of less than 80 mm outside the luminaire. For luminaires other than ordinary, all wiring external to the enclosure shall comply with the external wiring requirements.

Compliance is checked by inspection, measurements and, if appropriate, in accordance with the tests of 5.2.10.1.

5.3.6 Wiring of adjustable luminaires shall be fixed by means of wire carriers, clips or similar parts of insulating material at all places where it might otherwise rub against metal parts in the normal movement of the luminaire in such a way that the insulation may be damaged.

5.3.7 The ends of flexible stranded conductors may be tinned but shall not have additional solder applied unless a means is provided of ensuring that clamped connections cannot work loose owing to cold flow of the solder (see figure 28).

NOTE – This requirement is met when spring terminals are used. Securing the clamping screws is not an adequate means of preventing the connecting of soldered strands from working loose owing to cold flow of the solder.

Compliance with the requirements of 5.3.6 and 5.3.7 is checked by inspection.

SECTION 6: Not used

SECTION 7: PROVISION FOR EARTHING

7.1 General

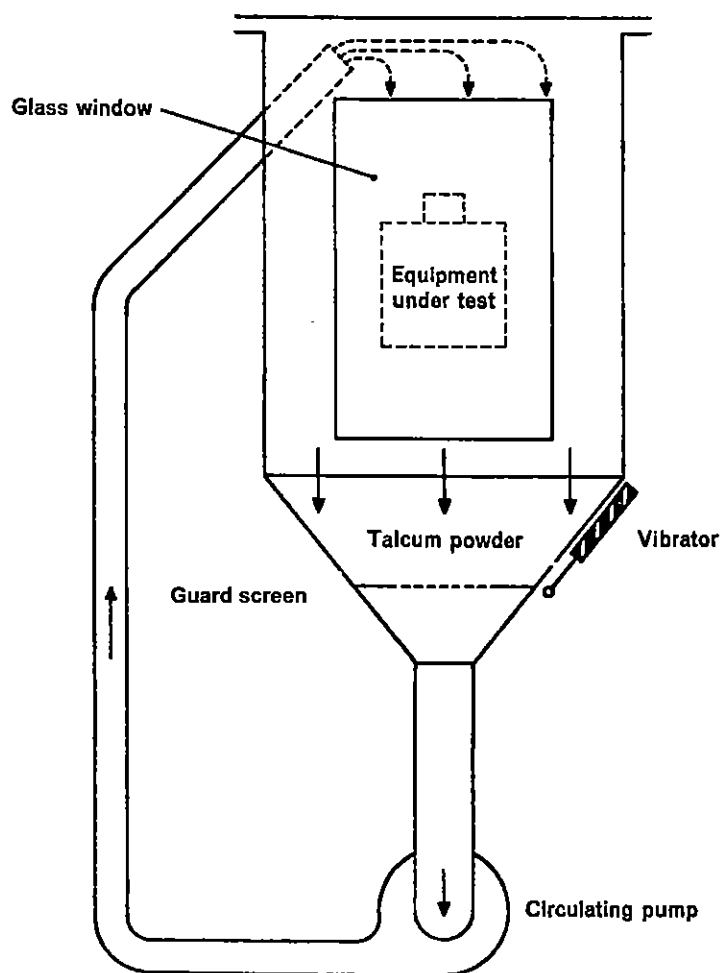
This section specifies requirements, where applicable, for the earthing of luminaires. ①

7.2 Provision for earthing

7.2.1 Metal parts of class I luminaires which are accessible when the luminaire has been mounted, or is opened for replacement of a lamp or replaceable starter or for cleaning purposes, and which may become live in the event of an insulation fault, shall be permanently and reliably connected to an earthing terminal or earthing contact.

NOTE – Metal parts screened from live parts by metal parts which are connected to the earthing terminal or earthing contact, and metal parts separated from live parts by double insulation or by reinforced insulation, are not, for the purpose of this requirement, regarded as likely to become live in the event of an insulation fault.

Figure 5 – This figure has been withdrawn from the present edition.



②

IEC 1742/99

Figure 6 – Apparatus for proving protection against dust

Metal parts of luminaires which may become live in the event of an insulation fault and which are not accessible when the luminaire has been mounted, but are liable to come into contact with the supporting surface, shall be permanently and reliably connected to an earthing terminal.

NOTE – The earthing of starters and lamp caps is not a requirement but earthing of lamp caps may be necessary as a starting aid.

The earthing connections shall be of low resistance.

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

Thread-forming screws may be used to provide earthing continuity if they comply with the requirements for screw terminals (see section 14).

For class I luminaires with detachable parts provided with connectors or similar connection devices, the earth connection shall be made before the current-carrying contacts are made and the current-carrying contacts shall separate before the earth connection is broken.

7.2.2 Surfaces in adjustable joints, telescopic tubes, etc., providing earthing continuity, shall be such that a good electrical contact is ensured.

7.2.3 *Compliance with the requirements of 7.2.1 and 7.2.2 is checked by inspection and by the following test:*

A current of at least 10 A, derived from a source with a no-load voltage not exceeding 12 V, shall be passed between the earthing terminal or earthing contact and each of the accessible metal parts in turn.

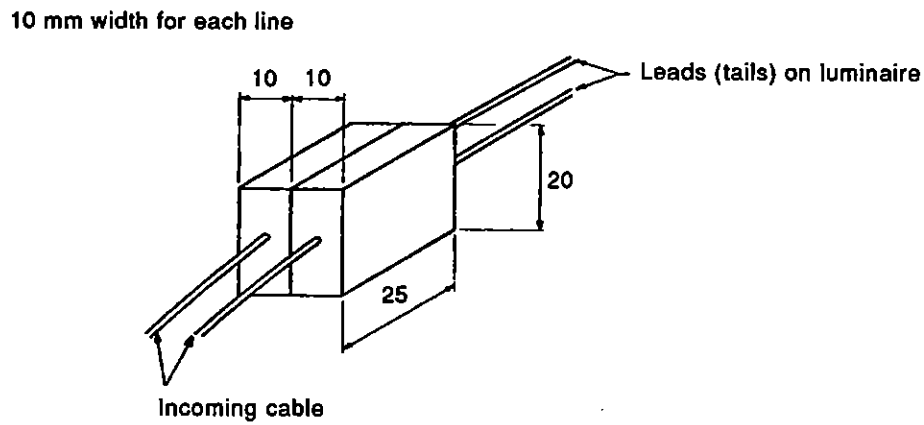
The voltage drop between the earthing terminal or earthing contact and the accessible metal part shall be measured and the resistance calculated from the current and the voltage drop. In no case shall the resistance exceed 0,5 Ω . When type testing, the current shall be applied for a period of at least 1 min.

NOTE – In the case of a luminaire with a non-detachable flexible cable for the supply connection, the earthing contact is at the plug or supply end of the flexible cable or cord.

7.2.4 Earthing terminals shall comply with the requirements of 4.7.3. The connection shall be adequately locked against accidental loosening.

For screw terminals, it shall not be possible to loosen the clamping means by hand.

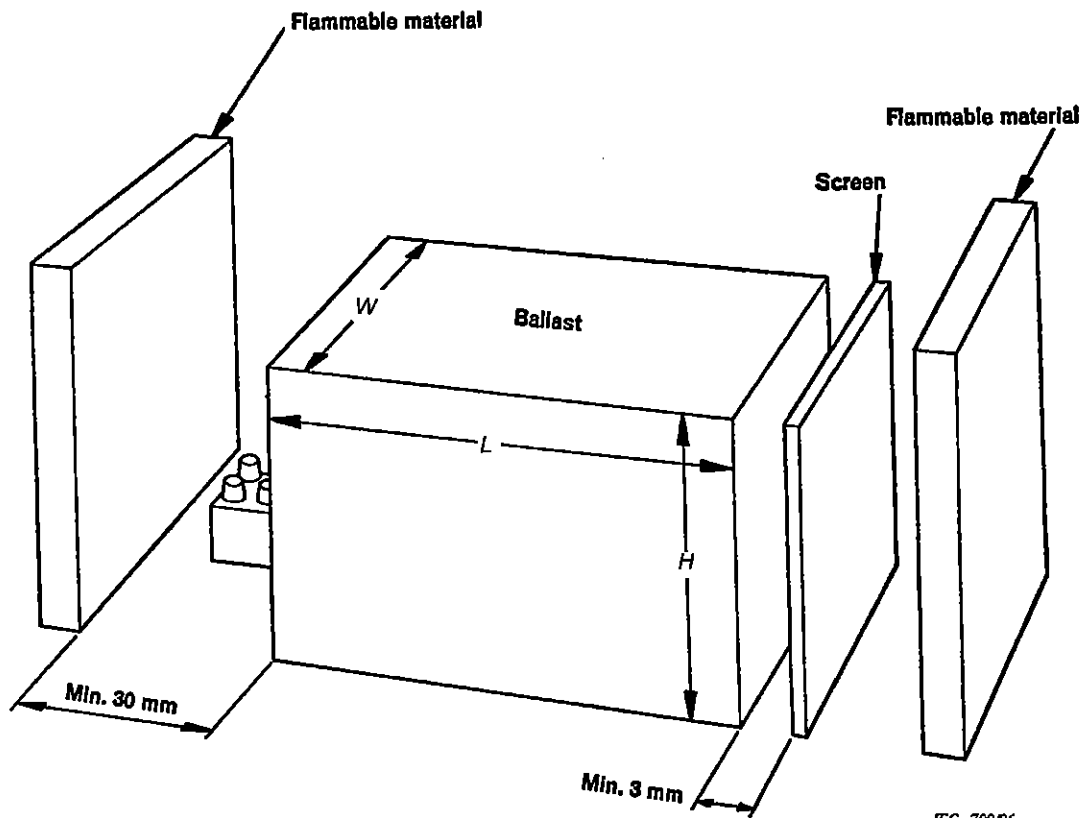
For screwless terminals, it shall not be possible to loosen the clamping means unintentionally.



IEC 708/96

Figure 2 – Terminal block arrangement for installation test for luminaires with connecting leads (tails)

Figure 3 – This figure has been withdrawn from the present edition.



IEC 709/96

Figure 4 – Illustration of the requirements of clause 4.15

Compliance is checked by inspection, by manual test and by the tests specified in 4.7.3.

NOTE – In general, the designs commonly used for current-carrying terminals provide sufficient resilience to comply with this requirement; for other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

7.2.5 For a luminaire provided with a connector socket for a mains supply, the earth contact shall be an integral part of the socket.

7.2.6 For a luminaire to be connected to supply cables or to a non-detachable flexible cable or cord, the earth terminal shall be adjacent to the mains terminal.

NOTE – Luminaires may be provided with type X or Y attachments.

7.2.7 For luminaires other than ordinary luminaires, all parts of an earth terminal shall be such as to minimize the danger of electrolytic corrosion resulting from contact with the earth conductor or any other metal in contact with them.

7.2.8 Either the screw or the other part of the earth terminal shall be made of brass or other non-rusting metal or a material with a non-rusting surface and the contact surfaces shall be bare metal.

7.2.9 *Compliance with the requirements of 7.2.5 to 7.2.8 is checked by inspection and by manual test.*

7.2.10 If a fixed class II luminaire designed for looping-in is provided with internal terminal(s) for maintaining the electrical continuity of an earthing conductor not terminating in the luminaire, this(these) terminal(s) shall be insulated from accessible metal parts by double insulation or reinforced insulation.

Compliance is checked by inspection.





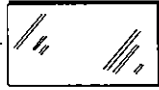
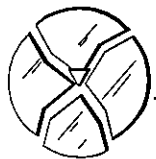

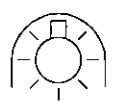
7.2.11 When a class I luminaire is supplied with an attached flexible cord, this cord shall have an earthing core coloured green-yellow.

The green-yellow core of a flexible cable or cord shall be connected to the earthing terminal of the luminaire and to the earthing contact of the plug if one is attached.

All conductors, whether internal or external, which are identified by the green and yellow colour combination shall only be connected to an earthing terminal.

For luminaires with non-detachable flexible cables or cords, the arrangement of the terminals, or the length of the conductors between the cord anchorage and the terminals, shall be such that, should the cable or cord move out of the cord anchorage, the current-carrying conductor becomes taut before the earthing conductor.

Compliance is checked by inspection.

| | |
|---|--|
| Rough service luminaires |  |
| Luminaires for use with high pressure sodium lamps that require an external ignitor (to the lamp) |  |
| Luminaires for use with high pressure sodium lamps having an internal starting device |  |
| Replace any cracked protective shield |   (Rectangular) |
| | or |
| |   (Round) |
| Luminaires designed for use with self-shielded tungsten halogen lamps only |  |

NOTE – For the lamp symbol within the 'arch' see IEC 60417, sheet IEC 60417-5012.

All symbols shall comply with the proportional requirements given in IEC 60416.

Figure 1 (concluded)

SECTION 8: PROTECTION AGAINST ELECTRIC SHOCK

8.1 General

This section specifies requirements for protection against electric shock from luminaires. A test to determine whether a conductive part is a live part which may cause an electric shock is described in annex A. ①

8.2 Protection against electric shock

8.2.1 Luminaires shall be so constructed that their live parts are not accessible when the luminaire has been installed and wired as in normal use, and when it is opened as necessary for replacing lamps or (replaceable) starters, even if the operation cannot be achieved by hand.

Protection against electric shock shall be maintained for all methods and positions of installation in normal use having regard to the limitations indicated in the manufacturer's installation instructions, and for all adjustments of adjustable luminaires. Protection shall be maintained after removal of all parts which can be removed by hand, except lamps and the following parts of the lampholders:

- a) For bayonet lampholders:
 - 1) domes (terminal covers);
 - 2) skirts.
- b) For Edison screw lampholders:
 - 1) domes (terminal covers) for cord grip types only;
 - 2) outer shells.

Covers in fixed luminaires that cannot be removed by a single action with one hand are not removed. However, covers which have to be removed for changing lamps or starters are removed for this test.

NOTE – A single action with one hand is normally taken to include removal of items such as a knurled headed screw or a shade retaining ring.

Supply conductors held by screwless terminals with push-button releasing devices shall not be removed for this test.

The use of push-button type terminal blocks without the use of a cover is not precluded by this requirement. This is possible as some specific actions are required in order to release wiring from these blocks. ②

Class 0, class I and class II luminaires intended for tubular tungsten filament lamps having a cap/base at each end shall incorporate a means of automatic double-pole disconnection operative when the lamp is being changed. This requirement does not apply if the relevant cap and holder combination(s) is (are) covered by standards which incorporate special requirements with regard to accessibility of live parts which may cause an electric shock.

The insulating properties of lacquer, enamel, paper and similar materials shall not be relied upon to give the required protection against electric shock and protection against short-circuit.









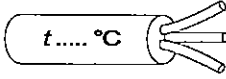
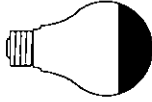
| | | |
|---|------|---|
| Ordinary | IP20 | No symbol |
| Drip-proof | IPX1 |  (One drop) |
| Rain-proof | IPX3 |  (One drop in a square) |
| Splash-proof | IPX4 |  (One drop in a triangle) |
| Jet-proof | IPX5 |  (Two triangles with one drop in each) |
| Powerful water jet-proof | IPX6 | No symbol |
| Watertight (immersible) | IPX7 |  (Two drops) |
| Pressure-watertight (submersible) | IPX8 |  (Two drops followed by an indication of the maximum depth of submersion in metres) |
| Protected against solid objects greater than 2,5 mm | IP3X | No symbol |
| Protected against solid objects greater than 1 mm | IP4X | No symbol |
| Dust-proof | IP5X |  (A mesh without a frame) |
| Dust-tight | IP6X |  (A mesh with a frame) |
| Use of heat resistant supply cables, inter-connecting cables or external wiring | |  (The number of cores shown is optional) |
| Luminaires designed for use with bowl mirror lamps | |  |

Figure 1 (continued)

Luminaires with ignitors intended for use with double ended high pressure discharge lamps shall be tested according to figure 26.

If the voltage measured according to figure 26 exceeds 34 V (peak), the ignitor shall only be active if the lamp is fully inserted, or a warning according to 3.2.18 a) or b) respectively shall be fitted to the luminaire.

8.2.2 For portable luminaires, protection against electric shock shall also be maintained after movable parts of the luminaires have been placed in the most unfavourable position, which can be effected by hand.

8.2.3 Metal parts of class II luminaires which are insulated from live parts by basic insulation only are live parts for the purpose of this section.

This applies also to starters and non-current-carrying parts of lamp caps, if they are accessible other than when the luminaire is open for lamp or starter changing.

This does not apply to the caps of single-ended compact fluorescent lamps which comply with IEC 60901.

For class II luminaires, glass lamp bulbs are not required to have further protection against electric shock. If glass bowls and other protective glasses have to be removed when the lamp is replaced or if they do not withstand the test of clause 4.13, they shall not be used as supplementary insulation.

NOTE – The combination of requirements in 8.2.1 and 8.2.3 means that in class II luminaires, basic insulated metal parts other than those of starters and non-current-carrying parts of lamp caps are not allowed to be accessible when the luminaire is opened for lamp or starter replacement, but basic insulation may be accessible.

Class I luminaires incorporating lampholders for bayonet cap lamps shall either:

- 1) be so designed that the lamp cap is not accessible to the standard test finger when the luminaire is assembled as in normal use, or
- 2) be provided with a metal lampholder which is earthed.

There is no evidence that during normal use double-ended halogen lamps will fail in a manner that would expose the filament, and in a Class II luminaire they do not require an insulating barrier between the lamp and a metal reflector.







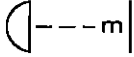



8.2.4 Portable luminaires for connection to the supply by means of a non-detachable flexible cord and plug shall have protection against electric shock which is independent of the supporting surface.

For portable luminaires, terminal blocks shall be completely covered.

8.2.5 *Compliance with the requirements of 8.2.1 to 8.2.4 is checked by inspection and if necessary by a test with the standard test finger specified in IEC 60529.*

This finger shall be applied to every possible position, if necessary with a force of 10 N, an electrical indicator being used to show contact with live parts. Movable parts, including shades, shall be placed in the most unfavourable position by hand; if of metal they shall not touch live parts of the luminaire or of the lamps.

NOTE – It is recommended that a lamp be used for the indication of contact and that the voltage should be not less than 40 V.

| | | |
|---|---|-------------------|
| Amperes | A | |
| Frequency (hertz) | Hz | |
| Volts | V | |
| Watts | W | |
| AC supply |  | (IEC 60417-5032a) |
| DC supply |  | (IEC 60417-5031a) |
| DC and AC supply |  | (IEC 60417-5033) |
| Class II |  | |
| Class III |  | |
| Rated maximum ambient temperature | $t_a \dots ^\circ\text{C}$ | |
| Warning against the use of cool-beam lamps ... |  | |
| Minimum distance from lighted objects (metres) |  | |
| Luminaires suitable for direct mounting on flammable surfaces |  | |
| Luminaires not suitable for direct mounting on normally flammable surfaces (suitable only for mounting on non-flammable surfaces) |  | |
| Luminaires suitable for mounting in/on normally flammable surfaces when thermally insulating material may cover the luminaire |  | |

NOTE – The marking of the symbols corresponding to IP numbers is optional.

(continued)

Figure 1 – Symbols

8.2.6 Covers and other parts providing protection against electric shock shall have adequate mechanical strength and shall be reliably secured so that they will not work loose with normal handling.

Compliance is checked by inspection, by manual test and by the tests of section 4.

8.2.7 Luminaires (other than those mentioned below) incorporating a capacitor of capacitance exceeding 0,5 μF shall be provided with a discharge device so that the voltage across the capacitor 1 min after disconnection of the luminaire from the source of supply at rated voltage does not exceed 50 V.

Portable luminaires designed to be connected to the supply by means of a plug, track adaptor connected luminaires, or luminaires with supply connector with contacts accessible with the standard test finger and incorporating a capacitor of capacitance exceeding 0,1 μF (or 0,25 μF for luminaires with a rated voltage less than 150 V) shall be provided with a discharge device so that 1 s after disconnection the voltage between the pins of the plug or adaptor/connector contacts does not exceed 34 V.

Other luminaires connected to the supply by means of a plug and incorporating a capacitor exceeding 0,1 μF (or 0,25 μF for luminaires of rated voltage less than 150 V) and track adaptors mounted in luminaires shall discharge so that after 5 s the voltage between the pins of the plug does not exceed 60 V r.m.s.

Subclause 0.4.2 requires that, unless otherwise specified, the tests of this part of IEC 60598 shall be conducted with the lamp in circuit. In the case of this subclause the lamp shall be in circuit when measurement is made of the voltage from the compensation capacitor, if it leads to a more onerous result.

Compliance is checked by measurement.

NOTE – The discharge device (for all types of luminaire) may be incorporated on or within the capacitor or mounted separately within the luminaire.

SECTION 9: RESISTANCE TO DUST, SOLID OBJECTS AND MOISTURE

9.1 General

This section specifies the requirements and tests for luminaires classified as resistant to dust, solid objects and moisture in accordance with section 2, including ordinary luminaires.

9.2 Tests for ingress of dust, solid objects and moisture

The enclosure of a luminaire shall provide the degree of protection against ingress of dust, solid objects and moisture in accordance with the classification of the luminaire and the IP number marked on the luminaire.

NOTE – The tests for the ingress of dust, solid objects and moisture specified in this standard are not all identical to the tests in IEC 60529 because of the technical characteristics of luminaires. An explanation of the IP numbering system is given in annex J.

Compliance is checked by the appropriate tests specified in 9.2.0 to 9.2.9, and for other IP ratings by the appropriate tests specified in IEC 60529.

15.9.2 Heating tests

The thermal performance of terminals (or connections) is checked on the terminals which have been subjected to the test of 15.9.1.

15.9.2.1 *After having cooled down to the ambient temperature, each conductor is replaced by a new solid copper non-insulated conductor having the largest cross-sectional area specified in clause 15.7 and each lead assembly is replaced by a new appropriate lead assembly which is then connected to, and withdrawn from, the terminal or the relevant part of the connection five times.*

The conductors are then replaced by new non-insulated conductors.

15.9.2.2 *Each terminal with its conductor is loaded with the test current (a.c. or d.c.) for a time just sufficient for the voltage drop to be measured. For these measurements and the measurements of 15.9.2.4, the requirements of 15.9.1 apply.*

15.9.2.3 *Terminals (or connections) with rated current up to and including 6 A are then subjected to an ageing test, without current, of 25 cycles duration, each cycle comprising 30 min at a temperature of $T \pm 5$ °C or 100 °C ± 5 °C, whichever is the higher, followed by a cooling down period to a temperature between 15 °C and 30 °C. Terminals (or connections) with rated current exceeding 6 A are subjected to an ageing test of 100 such cycles.*

NOTE – The temperature T is the marked maximum rated temperature for T -marked components, such as lampholders.

15.9.2.4 *The voltage drop is again measured on each terminal:*

- a) after the 10th and 25th cycles for terminals with rated current up to and including 6 A;*
- b) after the 50th and 100th cycles for terminals with rated current greater than 6 A.*

If, for all terminals, the voltage drop, in both cases, does not exceed by more than 50 % the voltage drop measurements on the same terminal tested under 15.9.2.2, or if the increase in voltage drop is less than 2 mV, the terminals comply with the requirement.

If the voltage drop of any of the terminals exceeds 22,5 mV, the terminals are rejected.

If, for one of the terminals, the voltage drop measured under a) or b) exceeds by more than 50 %, with a minimum of 2 mV, the voltage drop measured on the same terminal under 15.9.2.2 but does not exceed 22,5 mV, the ten terminals are subjected to a new ageing test, according to current rating, of 25 cycles or 100 cycles duration without current.

After the 10th and 25th or 50th and 100th cycles (according to current rating), the voltage drops are again measured. For any terminal, the voltage drop shall not exceed 22,5 mV.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the value given in this subclause.

15.9.2.5 *If a terminal is so designed that the conductor is tightened against a surface of insulating material, this surface shall not become deformed during these heating tests.*

Compliance is checked by inspection.

Before the tests for second characteristic numeral, with the exception of IPX8, the luminaire complete with lamp(s) shall be switched on and brought to a stable operating temperature at rated voltage.

The water for the tests shall be at a temperature of $15\text{ °C} \pm 10\text{ °C}$.

①

Luminaires shall be mounted and wired as in normal use and placed in the most unfavourable position, complete with their protective translucent covers, if any, for the tests of 9.2.0 to 9.2.9.

②

Where connection is made by a plug or a similar device then this shall be regarded as part of the complete luminaire and shall be included in the tests and similarly for any separate controlgear.

For tests of 9.2.3 to 9.2.9, a fixed luminaire intended for mounting with its body in contact with a surface shall be tested with an expanded metal spacer interposed between the luminaire and the mounting surface. The spacer shall be at least equal in overall size to the projection of the luminaire, and have dimensions as follows:

②

| | | | | |
|-------------------|-----|-------|-----|----|
| Longway of mesh | 10 | mm to | 20 | mm |
| Shortway of mesh | 4 | mm to | 7 | mm |
| Strand width | 1,5 | mm to | 2 | mm |
| Strand thickness | 0,3 | mm to | 0,5 | mm |
| Overall thickness | 1,8 | mm to | 3 | mm |

Luminaires having provision for draining water by means of drain holes shall be mounted with the lowest drain hole open unless otherwise specified in the manufacturer's installation instructions.

If the installation instructions indicate that a drip-proof luminaire is for ceiling or under-canopy mounting, the luminaire shall be attached to the underside of a flat board or plate which extends 10 mm beyond that part of the luminaire perimeter in contact with the mounting surface.

For recessed luminaires, the parts in the recess and the parts protruding from the recess shall each be tested according to their IP classification as indicated in the manufacturer's mounting instructions.

NOTE – A box encapsulating the part in the recess may be necessary for the test of subclauses 9.2.4 to 9.2.9.

②

For IP2X luminaires, the enclosure denotes that part of the luminaire containing the main part other than the lamp and optical controls.

NOTE – Since luminaires have no hazardous moving parts, the level of safety as specified in IEC 60529 is achieved.

Portable luminaires, wired as in normal use, shall be placed in the most unfavourable position of normal use.

Glands, if any, shall be tightened with a torque equal to two-thirds of that applied to glands in the test of 4.12.5.

Fixing screws of covers, other than hand-operated fixing screws of glass covers, shall be tightened with a torque equal to two-thirds of that specified in table 4.1.

Table 15.2 – Conductor pull force

| Maximum rated current of terminals A | Pull N | |
|---|-------------|--------------------------------|
| | Spring type | Pin or tab and receptacle type |
| 6 | 20 | 8 |
| 10 | 30 | 15 |
| 16 | 30 | 15 |

NOTE – If the component rating is less than the terminal capacity, the component rating is used.

The pull is applied without jerks, for 1 min, in the direction opposite to that used for the application or insertion of the conductor or lead assembly.

During the test, the conductor or lead assembly shall not move out from the terminal and neither the terminal nor the conductor or lead assembly shall undergo any alteration impairing its future use.

15.9 Electrical tests

Terminals and connections shall have adequate electrical performance.

Compliance is checked by the tests of 15.9.1 and 15.9.2.

15.9.1 Contact resistance test

The electrical performance of terminals (or connections) is checked on a set of ten terminals. If all the terminals contained within the luminaire are not of the same design, one set of ten terminals of each design is subjected to the test.

15.9.1.1 *For spring-type terminals, the test according to 15.9.1.3 is made with ten solid copper non-insulated conductors.*

Five conductors having the largest cross-sectional areas specified in clause 15.7 are connected as in normal use, each to one terminal.

Five conductors having the smallest cross-sectional areas specified in clause 15.7 are connected as in normal use, each to one of the five remaining terminals.

15.9.1.2 *In the case of pin or tab and receptacle type terminals, the test according to 15.9.1.3 is made with lead assemblies.*

15.9.1.3 *Each terminal with its conductor is loaded with the test current (a.c. or d.c.) and after 1 h the voltage drop across the terminal, still at the test current is measured. The measuring points are located as close as possible to the contact point across which the voltage drop is being measured.*

The measured voltage drop shall not exceed 15 mV.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the value given in this subclause.

Screwed lids shall be tightened with a torque having a value in Newton metres numerically equal to one-tenth of the nominal diameter of the screw thread in millimetres. Screws fixing other caps shall be tightened with a torque equal to two-thirds of that specified in table 4.1.

After completion of the tests, the luminaire shall withstand the electric strength test specified in section 10, and inspection shall show:

- a) no deposit of talcum powder in dust-proof luminaires, such that, if the powder were conductive, the insulation would fail to meet the requirements of this standard;
- b) no deposit of talcum powder inside enclosures for dust-tight luminaires;
- c) no trace of water on current-carrying parts or SELV parts or on insulation where it could become a hazard for the user or surroundings, for example where it could reduce the creepage distances below the values specified in section 11;
- d) i) For luminaires without drain holes, there shall be no water entry.

NOTE – Care should be taken not to mistake condensation for water entry.

- ii) For luminaires with drain holes, water entry including condensation is allowed during the tests if it can drain out effectively and provided it does not reduce the creepage and clearance distances below the minimum levels specified in the standard.
- e) no trace of water entered in any part of a watertight or pressure watertight luminaire;
- f) no contact permitted with live parts by the relevant test probe for first characteristic IP numeral 2;
no entry into the luminaire enclosure by the relevant test probe for first characteristic IP numerals 3 and 4.

For luminaires with drain holes in accordance with 4.17, no contact permitted through the drain holes with live parts with the relevant test probe for the first characteristic IP numerals 3 and 4.

9.2.0 Tests

Solid-object-proof luminaires (first characteristic IP numeral 2) shall be tested with the standard test finger specified in IEC 60529 according to the requirements of sections 8 and 11 of this standard.

NOTE – Luminaires with first characteristic IP numeral 2 are not required to be tested with the sphere specified in IEC 60529.

Solid-object-proof luminaires (first characteristic IP numerals 3 and 4) shall be tested at every possible point (excluding gaskets) with a probe in accordance with test probe C or D of IEC 61032, applied with a force as follows:

Table 9.1 – Solid-object-proof luminaire test

| | Test probe according IEC 61032 | Probe wire diameter | Application force |
|--------------------|--------------------------------|---|-------------------|
| First IP numeral 3 | C | 2,5 $\begin{smallmatrix} +0,05 \\ -0,00 \end{smallmatrix}$ mm | 3 N \pm 10 % |
| First IP numeral 4 | D | 1 $\begin{smallmatrix} +0,05 \\ -0,00 \end{smallmatrix}$ mm | 1 N \pm 10 % |

Table 15.1 – Conductor rating

| Maximum rated current of terminals A | Nominal cross-sectional areas of conductors mm ² |
|---|--|
| 6 | 0,5 to 1 |
| 10 | >1 to 1,5 |
| 16 | >1,5 to 2,5 |



NOTE – Terminals are usually referred to by a designation. Size 0, for example, is generally a 6 A rating. If the component rating is less than the technical capacity, the component rating is used.

Compliance is checked by inspection, by measurement and by fitting conductors of the smallest and largest cross-sectional areas specified.

15.8 Mechanical tests

Terminals and connections shall have adequate mechanical strength.

Compliance is checked by the tests of 15.8.1 and 15.8.2, which are made on one terminal of each of four samples.

15.8.1 *In the case of spring-type terminals, the test is made alternately with solid copper conductors having the largest and then the smallest cross-sectional areas specified in clause 15.7. These conductors are connected to, and disconnected from, each terminal five times. If all the terminals contained within the luminaire are not of the same design, one terminal of each design is subjected to the test.*

For the first four connections, new conductors are used each time. For the fifth connection, the same conductor is used as for the fourth connection and it is clamped at the same place. For each connection, the conductors are pushed into the terminals as far as the stop.

If the terminal is stated by the manufacturer to be suitable for stranded conductors (see 15.3.10), an additional test is then made with two rigid stranded copper conductors, the first having the largest cross-sectional area specified in clause 15.7, and the second having the smallest cross-sectional area. These conductors are subjected to only one connection and disconnection.

After the final connection, each conductor is subjected to a pull test according to table 15.2.

15.8.2 *Pin or tab and receptacle type connections are also subjected to a pull test according to table 15.2.*

The end of the probe wire shall be cut at right angles to its length and be free from burrs.

9.2.1 Dust-proof luminaires (first characteristic IP numeral 5) shall be tested in a dust chamber similar to that shown in figure 6, in which talcum powder is maintained in suspension by an air current. The chamber shall contain 2 kg of powder for every cubic metre of its volume. The talcum powder used shall be able to pass through a square-meshed sieve whose nominal wire diameter is 50 μm and whose nominal free distance between wires is 75 μm . It shall not have been used for more than 20 tests.

The test shall proceed as follows:

- a) The luminaire is suspended outside the dust chamber and operated at rated supply voltage until operating temperature is achieved.
- b) The luminaire whilst still operating is placed with the minimum disturbance in the dust chamber.
- c) The door of the dust chamber is closed.
- d) The fan/blower causing the talcum powder to be in suspension is switched on.
- e) After 1 min the luminaire is switched off and allowed to cool for 3 h whilst the talcum powder remains in suspension.

NOTE – The 1 min interval between switching on the fan/blower and switching off the luminaire is to ensure that the talcum powder is properly in suspension around the luminaire during initial cooling, which is most important with smaller luminaires. The luminaire is operated initially as in item a) to ensure the test chamber is not overheated.

9.2.2 Dust-tight luminaires (first characteristic IP numeral 6) are tested in accordance with 9.2.1.

9.2.3 Drip-proof luminaires (second characteristic IP numeral 1) are subjected for 10 min to an artificial rainfall of 3 mm/min, falling vertically from a height of 200 mm above the top of the luminaire.

9.2.4 Rain-proof luminaires (second characteristic IP numeral 3) are sprayed with water for 10 min by means of a spray apparatus as shown in figure 7. The radius of the semicircular tube shall be as small as possible and compatible with the size and position of the luminaire.

The tube shall be perforated so that jets of water are directed towards the centre of the circle and the water pressure at the inlet of the apparatus shall be approximately 80 kN/m².

The tube shall be caused to oscillate through an angle of 120°, 60° on either side of the vertical, the time for one complete oscillation (2 × 120°) being about 4 s.

The luminaire shall be mounted above the pivot line of the tube so that the ends of the luminaire receive adequate coverage from the jets. The luminaire shall be turned about its vertical axis during the test at a rate of 1 rev/min.

After this 10 min period, the luminaire shall be switched off and allowed to cool naturally whilst the water spray is continued for a further 10 min.

15.6.2 Heating tests

15.6.2.1 Terminals (or connections) with rated current up to and including 6 A are then subjected to an ageing test, without current, of 25 cycles duration, each cycle comprising 30 min at a temperature of $T \pm 5$ °C or 100 °C ± 5 °C, whichever is the higher, followed by a cooling down period to a temperature between 15 °C and 30 °C. Terminals (or connections) with rated current exceeding 6 A are subjected to an ageing test of 100 such cycles.

NOTE – The temperature T is the marked maximum rated temperature for T -marked components such as lampholders.

15.6.2.2 The voltage drop is again measured on each terminal:

- a) after the 10th and 25th cycles for terminals with rated current up to and including 6 A;
- b) after the 50th and 100th cycles for terminals with rated current greater than 6 A.

If, for all terminals, the voltage drop, in both cases, does not exceed by more than 50 % the voltage drop measurements on the same terminal tested under 15.6.1, or if the increase in voltage drop is less than 2 mV, the terminals comply with the requirement.

If the voltage drop of any of the terminals exceeds 22,5 mV, the terminals are rejected.

If, for one of the terminals, the voltage drop measured under a) or b) exceeds by more than 50 %, with a minimum of 2 mV, the voltage drop measured on the same terminal under 15.6.1 but does not exceed 22,5 mV, the four terminals are subjected to a new ageing test, according to current rating, of 25 cycles or 100 cycles duration without current.

After the 10th and 25th or 50th and 100th cycles (according to current rating), the voltage drops are again measured. For any terminal, the voltage drop shall not exceed 22,5 mV.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the values given in this subclause.

15.6.2.3 If a terminal is so designed that the conductor is tightened against a surface of insulating material, this surface shall not be deformed during these heating tests.

Compliance is checked by inspection.

TERMINALS AND CONNECTIONS FOR EXTERNAL WIRING

15.7 Conductors

Spring-type terminals shall be suitable for the connection of rigid conductors, solid or stranded, with the nominal cross-sectional areas given in table 15.1.