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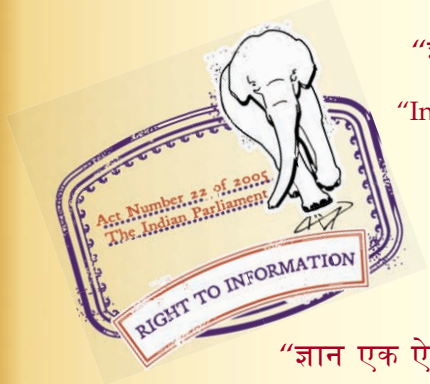

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS : 10322 (Part 2) - 1982
(Reaffirmed 2005)

Indian Standard

SPECIFICATION FOR LUMINAIRES

PART 2 CONSTRUCTIONAL REQUIREMENTS

UDC 628 94

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7 *July* 1984

Indian Standard

SPECIFICATION FOR LUMINAIRES

PART 2 CONSTRUCTIONAL REQUIREMENTS

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Indian Standard

SPECIFICATION FOR LUMINAIRES

PART 2 CONSTRUCTIONAL REQUIREMENTS

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Indian Standards Institution on 20 October 1982, after the draft finalized by the Illuminating Engineering Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard (Part 2) is one of the series of Indian Standards which deals with luminaires. This series will have the following parts:

Part 1 — General requirements,

Part 2 — Constructional requirements,

Part 3 — Screw and screwless terminals,

Part 4 — Methods of tests, and

Part 5 — Particular requirements.

0.3 In general, Parts 1, 2, 3 and 4 of this standard cover safety requirements and tests for luminaires. The object of these parts is to provide a set of requirements and tests which are considered to be generally applicable to most types of luminaires and which can be called up as required by the detailed specifications under Part 5. Parts 1, 2, 3 and 4 are thus not to be regarded as specifications by themselves for any type of luminaire, and the provisions apply only to particular types of luminaires to the extent determined by the appropriate section of Part 5.

0.4 The sections of Part 5, in making reference to any other part of the standard, specify the extent to which that section is applicable and the order in which the tests are to be performed; they also include additional requirements as necessary. The order in which the clauses in Parts 1, 2, 3 and 4 are numbered, therefore, has no particular significance as the order in which their provisions apply is determined for each type of luminaires or group of luminaires by the appropriate section in Part 5. All sections of Part 5 are self-contained and, therefore, do not contain references to other sections of Part 5.

0.5 A luminaire shall comply with a section of Part 5. If, however, an appropriate section of Part 5 does not exist for a particular luminaire or group of luminaires, the nearest applicable section of Part 5 may be used as a guide to the requirements and tests.

0.6 This standard is intended to establish essential requirements of general nature and minimum standard for design and construction of lighting fittings in order to ensure their safe performance, good construction and high class of workmanship. This standard, therefore, along with other appropriate Parts of this standard, will ultimately replace IS : 1913 (Part 1)-1978*.

0.7 In the preparation of this standard assistance has been derived from IEC : 598-1 (1979) : Luminaires, Part 1 General requirements and tests published by International Electrotechnical Commission.

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part 2) specifies general constructional requirements for luminaires for use with tungsten filament, tubular fluorescent and other discharge lamps on supply voltages not exceeding 1 000 V.

1.2 It is to be read in conjunction with the other relevant parts to which reference is made in this standard.

2. REPLACEABLE COMPONENTS

2.1 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.

2.1.1 Sealed-in components and riveted parts are ordinarily not replaceable components.

3. WIREWAYS

3.1 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.

3.1.1 Compliance shall be checked by inspection and, if necessary, by dismantling and reassembling the luminaire.

*General and safety requirements for luminaires, Part 1 Tubular fluorescent lamps (*second revision*).

†Rules for rounding off numerical values (*revised*).

4. LAMPHOLDERS

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

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.

4.3 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 shall be checked by inspection.

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

Compliance shall be checked by inspection.

5. STARTER HOLDERS

5.1 Starter holder in luminaires other than Class II shall accept starters which comply with IS : 2215-1984*. Class II luminaires may require starters of Class II construction.

6. TERMINAL BLOCKS

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

The nominal cross-sectional area of conductors of the connecting leads (tails) shall not exceed 2·5 mm^2.

6.1.1 *Test* — Compliance shall be checked by measurement and by an installation test, using one terminal block for each two conductors to be connected together, as shown in Fig. 1 and supply cables having a length of approximately 80 mm. The dimensions of the terminals blocks are those specified by the manufacturer or, in the absence of such a specification, 10 × 20 × 25 mm.

*Specification for starters for fluorescent lamp (*third revision*).

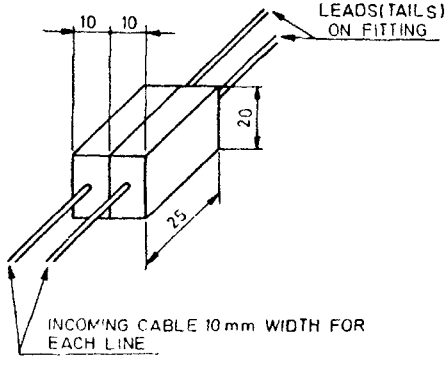


FIG. 1 TERMINAL BLOCK ARRANGEMENT FOR INSTALLATION TEST FOR LUMINAIRES WITH CONNECTING LEADS (TAILS)

6.2 Unsecured terminal blocks are permitted when they are so designed and insulated that creepage distances and clearances in accordance with Part 4 are always maintained for any position of the terminal block, and that damage to internal wiring is prevented.

7. TERMINALS AND SUPPLY CONNECTIONS

7.1 In Class 0, Class I and Class II portable luminaires and luminaires which are frequently adjusted, adequate precautions shall be taken to prevent accessible metal parts becoming live by reason of a detached wire or screw. This requirement applies to supply terminals and other terminals such as those of lampholders and switches. The requirement may be met by securing the wires adjacent to their entry to the terminals, by suitably dimensioning 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.

Compliance shall be checked by inspection.

7.2 Supply terminals shall be so located or shielded that should a wire of a stranded conductor escape from a terminal when the conductors are fitted, there is no risk of accidental connection between live parts and accessible metal parts.

7.2.1 *Test* — Compliance shall be checked, for luminaire intended to be connected to the supply by means other than a non-detachable flexible cable or cord by inspection, and for luminaires intended to be connected to the supply by means of a non-detachable flexible cable or cord, 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 **19**. One wire of the stranded conductor is left free and the remainder is 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 is 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 is not applicable to lampholders which have been separately approved in an appropriate Indian Standard.

7.3 Terminals for supply conductor, 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.

Screw terminals shall comply with the requirements of Part 3 of this standard.

Screwless terminals shall comply with the requirements of Part 3 (spring type and snap-on connectors) of this standard.

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.

For luminaires designed to be connected by means of non-detachable flexible cable or cord and having a rated current not exceeding 1 A, soldered, welded, crimped and similar connections, including snap-on connectors are effective devices, including the earth connection.

For luminaires having a rated current exceeding 1 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.

7.4 Terminals, other than those for supply connection, which are not covered by separate standards for components shall comply with the requirements of Part 3 of this standard.

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.

8. SWITCHES

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

8.2 If a live part of a switch is in the vicinity of accessible metal parts, or of metal parts connected to accessible metal parts, an insulating lining or barrier shall be interposed between this live part and the other metal part.

8.3 Live parts of a switch are the vicinity of accessible metal parts, or of metal parts connected to accessible metal parts, if the distance between these two parts is smaller than that given in Part 3 of this standard.

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

Compliance shall be checked by inspection.

9. INSULATING LININGS AND SLEEVES

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.

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

Compliance shall be checked by inspection and by manual test.

9.2 Insulated linings, sleeves and similar parts shall have adequate mechanical and electrical strength.

9.2.1 *Test* — Compliance shall be checked by inspection, by manual test and by an electric strength test in accordance with Part 4 of this standard.

10. INSULATION OF CLASS II LUMINAIRES

10.1 For Class II luminaires, contact between accessible metal parts and wire with basic insulation only shall be effectively prevented. The sheath

of a flexible cable or cord is not supplementary insulation if it is subject to undue mechanical or thermal stress. 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 luminaires, for example, by contact with conduits or metal sheaths of cables. Capacitors shall not be connected between live parts and the body of Class II luminaires.

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

Compliance shall be checked by inspection.

10.2 Assembly joints in basic insulation and in supplementary insulation shall not be coincidental, neither shall any assembly joint in reinforced insulation give straight access to live parts.

Compliance shall be checked by inspection.

11. ELECTRICAL CONNECTIONS AND CURRENT-CARRYING PARTS

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 shall be checked by inspection.

11.2 Spaced threaded 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.

Spaced threaded 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 shall be checked by inspection.

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 shall be checked by inspection and by manual test.

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

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

Compliance shall be checked by inspection and, if necessary, by chemical analysis.

11.5 Live parts shall not be in direct contact with wood.

Compliance shall be checked by inspection.

12. SCREWS AND CONNECTIONS (MECHANICAL) AND GLANDS

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.

12.1.1 *Test* — Compliance shall be checked by inspection and screwed connections shall be tightened and loosened five times. During the test, no damage impairing the further use of the screwed connection shall occur.

The test is made by means of a suitable test screwdriver or spanner, applying a torque as shown in Table 1.

TABLE 1 TORQUE TESTS ON SCREWS

Nominal Diameter of Screw mm	Torque	
	1	2
	Nm	Nm
Up to and including 2·8	0·2	0·4
Over 2·8 up to and including 3·0	0·25	0·5
Over 3·0 up to and including 3·2	0·30	0·6
Over 3·2 up to and including 3·6	0·40	0·8
Over 3·6 up to and including 4·1	0·70	1·2
Over 4·1 up to and including 4·7	0·80	1·8
Over 4·7 up to and including 5·3	0·80	2·0
Over 5·3 up to and including 6·0	—	2·5

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 1 applies to screws without heads if the screws, when tightened, does not protrude from the hole. Column 2 applies to other screws and to nuts.

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.

12.2.1 *Test* — Compliance shall be checked by inspection and for screws which are operated when mounting the luminaire or when replacing the lamps, by the test described in **12.1**.

12.3 Screws or nuts that engage with a thread of insulating material shall have a length engagement of at least 3 mm plus one-third of the nominal screw diameter, except that this length need not exceed 8 mm.

12.3.1 *Test* — Compliance shall be checked by inspection, by measurement and by completely removing and replacing the screw or nut, ten times.

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.

12.4.1 *Test* — Compliance shall be 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; and

— 5·0 Nm for thread sizes above M 10 or corresponding diameters.

During the test, the screw connections shall not loosen.

12.5 Screwed glands shall comply with the following test.

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 2 being applied to the spanner for 1 minute at a point 250 mm from the axis of the gland.

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

12.6 Set screws and similar parts, if any, shall be tightened with a torque as specified in Table 1.

13. MECHANICAL STRENGTH

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

TABLE 2 TORQUE TESTS ON GLANDS
(*Clause* 12.5)

Diameter of Test Rod mm	Force	
	Metal Glands	Glands of Moulded Material
	N	N
Up to and including 14	25	15
Over 14 up to and including 20	30	20
Over 20	40	30

normal use. The luminaires shall be tested as per the method given in Part 4 of this standard.

14. SUSPENSIONS AND ADJUSTING DEVICES

14.1 Mechanical suspensions shall have adequate factors of safety. Compliance shall be checked by the appropriate following tests.

14.2 *Test 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 bearing cable fully extended.

14.2.1 *Test for rigid suspension luminaires* — A torque of 2·5 Nm is applied to the luminaires for a period of 1 minute, first in a clockwise and then in an anti-clockwise 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.

14.2.2 *Test 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 minute, in various directions at the free end, with the brackets 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 brackets arm shall not be permanently displaced or deformed so as to endanger safety; and

b) For light-duty brackets (for example, domestic brackets), a similar test to Item (a) shall be applied for 1 minute, but with a force of 10 N, and the bending moment resulting from this test shall be not less than 1·0 Nm.

14.3 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^2.

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

Where luminaires of mass greater than 5 kg are 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.

14.4 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 by more than 360° during operation.

14.4.1 *Test* — The adjusting device, equipped with the appropriate cable or cord shall be operated in accordance with the details of Table 3. 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.

After the test, not more than 50 percent of the strands in a conductor shall be broken, and the cord or cable shall be subjected to, and shall satisfy, the insulation resistance and high-voltage tests specified in Part 4 of this standard.

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

14.5 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 shall be checked by inspection.

14.6 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 shall be checked by inspection.

TABLE 3 TESTS ON ADJUSTING DEVICES

(*Clause* 14.4.1)

Type of Luminaire	Number of Cycles of Operation	
	Over Anticipated Normal Working Range of Movement	Over Maximum Possible Range of Movement
Luminaires intended to be frequently adjusted, for example, drawing board luminaires	1 500	150
Luminaires intended to be occasionally adjusted, for example, shop-window spotlights	150	15
Luminaires intended to be adjusted during installation only, for example, floodlighting luminaires	45	5

15. FLAMMABLE MATERIALS

15.1 Parts of flammable materials not having an insulation function, including covers, shades and similar parts, which do not withstand the 300°C hot mandrel test specified in Part 4 shall be adequately spaced from any heated part of the luminaire (for example, ballasts under failure conditions or parts of filament lamps) which could raise the material to its ignition temperature. These parts of flammable materials shall have suitable fastenings or supporting devices to maintain this spacing.

15.2 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 withstand temperatures up to 350°C, shall not have any holes, and shall have height and length at least equal to the corresponding dimensions of the heated parts. The requirements of this clause do not apply in those cases where the luminaire provides an effective barrier to burning drops.

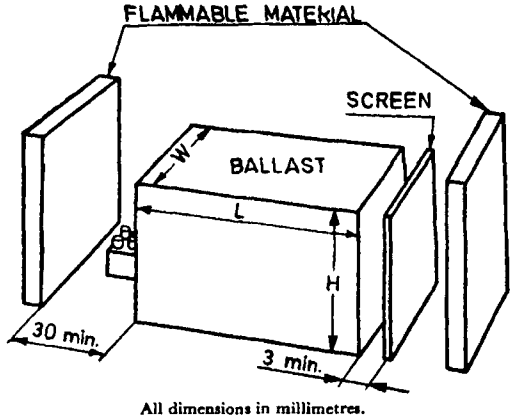
Materials which burn fiercely, such as celluloid, shall not be used for translucent covers or shades.

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

The requirements of this clause are in Figure 2.

Compliance shall be checked by inspection and by measurement.

A sheet steel screen of 0·5 mm thickness complies with the 350°C requirement.



All dimensions in millimetres.

FIG. 2 ILLUSTRATION OF THE REQUIREMENTS OF CLAUSE 15

16. LUMINAIRES MARKED WITH (F) SYMBOL

16.1 Luminaires classified as suitable for direct mounting on normally flammable surfaces, that is luminaires marked with the symbol (F) shall have non-flammable material between windings and possible mounting surfaces.

Compliance shall be checked by measuring the shortest distance from any visible winding to any mounting surface. A hole in non-flammable material permitting a distance of less than 35 mm shall not exceed 10 mm^2.

If windings are totally enclosed by a non-flammable canister, no measurement is made.

The (F) symbol requirements apply only to luminaires which;

a) are for fluorescent or discharge lamps;
b) incorporate a ballast of inductive type or a transformer; and
c) are offered for mounting on normally flammable surfaces.

16.2. Requirements for luminaires with regard to temperature of adjacent surfaces under failed ballast conditions.

For luminaires with an  symbol, the excessive ballast temperatures which may arise due to ballast failure shall not cause a fire hazard.

This requirement shall be met by spacing the ballast from the mounting surface in accordance with **16.2.1** or by the use of thermal cut-outs in accordance with **16.2.2** or by compliance with **16.2.3**.

16.2.1 The ballast case shall be spaced from the mounting surface by a distance of at least 10 mm (including the thickness of the luminaire case material).

This 10 mm spacing shall include 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 ballast, and a minimum of 3 mm air space between the ballast case and the inner surface of the luminaire case. The luminaire shall be so designed that the necessary air space between the mounting surface and the luminaire case is automatically obtained when it is mounted as in normal use.

Compliance shall be checked by inspection and by measurement.

16.2.2 The luminaire shall include a temperature sensing control external to the ballast to limit the temperature of the mounting surface 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 (a thermal cut-out which operates only once and then requires replacement).

Compliance shall be checked by inspection and by the test specified in Part IV of this standard.

16.2.3 If the luminaire does not comply with the spacing requirements of **16.2.1** and does not incorporate thermal cut-outs in accordance with **16.2.2** it shall be so designed that it satisfies the test specified in Part 4.

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

17. DRAIN HOLES

17.1 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.

17.1.1 *Test* — Compliance shall be checked by inspection and by the tests specified in Part 4 of this standard.

17.2 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.

18. RESISTANCE TO CORROSION

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

19. EXTERNAL AND INTERNAL WIRING

19.1 Supply Connection and other External Wiring

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

Fixed luminaires	Terminals;
	Plugs for engagement with socket-outlets connecting leads (tails);
	Non-detachable flexible cables or cords;
	Adapters for engagement with supply tracks.
Ordinary portable luminaires	Non-detachable flexible cables or cords; Appliance inlets.
Other portable luminaires	Non-detachable flexible cables or cords.

19.1.2 Non-detachable flexible cables and cords shall be of sufficient mechanical and electrical properties and should comply with the relevant Indian Standards on flexible cables and cords.

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

	Ordinary luminaires mm²	Other luminaires mm²
Total current up to and including 3A	0·5	1·0
Total current greater than 3A	0·75	1·0

19.1.3 Non-detachable flexible cables or cords shall be connected to rewirable luminaires in such a manner that replacement may be performed without special purpose tools, for example, crimping tools.

19.1.4 Compliance with the requirements of **19.1.1** and **19.1.3** shall be checked by inspection and, if necessary, by fitting the appropriate flexible cable or cord.

19.1.5 For non-rewirable luminaires, where moulded-in flexible cables or cords may be used, the cable or cord shall not be connected by means of screwed connections.

19.1.6 Cables 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.

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

19.1.8 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 by removed. Bushings which deteriorate with age (for example, rubber) shall not be used in openings with sharp edges.

Easily removable bushings are described as bushings which can be pulled off the cable with the bare hand or by pulling the actual cable, and bushings screwed into luminaires which are not secured or fastened with a lock nut or appropriate adhesive, for example, a self-hardening resin.

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 materials.

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

Compliance shall be checked by inspection.

19.1.9 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 shall be checked by inspection.

19.1.10 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.

It shall not be possible to push the flexible cord or cable 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 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. This requirement does not apply to luminaires for wall mounting and to other luminaires provided with a sheathed flexible cable or cord that is unlikely to be stressed at the cord anchorage at any time during its life.

Cord anchorages shall be so designed that :

a) At least one part is fixed to, or is integral with, the luminaire; a cord anchorage is described as fixed to or held by the luminaire;

b) if this is actually the case when the wiring is inserted and the luminaire is completely assembled;

c) They are suitable for the different types of flexible cables or cords which may be connected to the luminaire;

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

e) The whole flexible cable or cord with its covering, if any, may be mounted into the cord anchorage.

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. Achorages 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.

19.1.10.1 *Test* : Compliance shall be checked by inspection and by the following tests which are made with the cable which is fitted to the luminaire as delivered.

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-third of that specified in Table 4.

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 100 times to a pull of the value shown in Table 4. The pulls are applied without jerks, each time for 1 second. 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 100th 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 4.

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.

TABLE 4 TEST FOR CORD ANCHORAGE

Total Nominal Cross-Sectional Area of All Conductors Together mm^2	Pull	Torque
	N	Nm
(1)	(2)	(3)
Up to and including 1·5	60	0·15
Over 1·5 up to and including 3	60	0·25
Over 3 up to and including 5	80	0·35
Over 5 up to and including 8	120	0·35

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

19.1.11.1 *Test* — Compliance shall be checked by the tests of **19.2.**

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

Compliance shall be checked by inspection.

19.1.13 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.

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.

19.2 Internal Wiring

19.2.1 Internal wiring shall be made with conductors of suitable size and type with nominal cross-sections not less than 0·5 mm^2 and a minimum nominal insulation thickness of 0·6 mm if of rubber or PVC. However, for some types of decorative luminaires, such as chandeliers, in which the space provided for the internal wiring may be severely restricted, conductors with a minimum nominal cross sectional area of 0·4 mm^2 and a minimum insulation thickness of 0·5 mm may be used. The wiring shall be insulated with a material capable of withstanding the maximum temperature to which it is subjected in normal use, without deterioration capable of affecting the safety of the luminaire when properly installed and connected to the supply. Sleeves to protect hot spots are suitable. If conductors whose insulation is coloured green-yellow are used for internal wiring, they shall be reserved for making earth connections only.

If internal wiring of fixed luminaires for looping-in or through-wiring acts as part of the fixed wiring, such wiring shall be copper conductors with not less than 1·5 mm^2 cross-sectional area.

19.2.1.1 *Test* — Compliance shall be checked by inspection after the temperature rise and heating tests Specified in Part 4 of this standard.

19.2.2 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 through an angle exceeding 360°.

19.2.2.1 *Test*—Compliance shall be checked by inspection and by the tests of **14·4** to **14.6**.

19.2.3 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 through metal parts in contact with accessible metal parts, the opening shall be provided with a tough bushing of

insulating material, having rounded edges, so fixed that it cannot easily be removed. Bushings of material likely to deteriorate with age (for example, rubber and the like) shall not be used in openings with sharp edges.

Easily removable bushings are described as bushings which can be pulled off the cable with the bare hand or by pulling the actual cable, and bushings screwed into luminaires which are not secured or fastened with a lock nut or appropriate adhesive, for example, a self-hardening resin.

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

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

19.2.5 *Test*—Compliance with the requirements of **19.2.3** and **19.2.4** shall be checked by inspection.

19.2.6 Where internal passes out of the luminaire and the design in 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 outside the luminaire if the length outside the luminaire is less than 80 mm.

19.2.6.1 *Test*—Compliance shall be checked by the tests specified in **19.1.8**.

19.2.7 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.

Compliance shall be checked by inspection.

19.2.8 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.

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

20. PROVISION FOR EARTHING

20.1 Provision for Earthing

20.1.1 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.

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.

Metal parts of luminaires, 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.

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.

Spaced threaded 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* Part 3 of this standard).

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

20.1.3 *Test* — Compliance with the requirements of **20.1.1** and **20.1.2** shall be 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.

20.1.4 Earthing terminals shall comply with the requirements of Part 3 of this standard. Their clamping means 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.

20.1.4.1 *Test* — Compliance shall be checked by inspection, by manual test and by the tests specified in Part 3 of this standard.

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 the adequately resilient part which is not likely to be removed inadvertently may be necessary.

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

20.1.6 For a luminaire to be connected to supply cables or provided with a non-detachable flexible cord or cable, the earth terminal shall be adjacent to the main terminals.

20.1.7 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.

20.1.8 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.

20.1.9 *Test* — Compliance with the requirements of **20.1.5** to **20.1.8** shall be checked by inspection and by manual test.

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

Compliance shall be checked by inspection.

20.1.11 When a Class I luminaire is supplied with an attached flexible cord, this cord shall have an earthing core coloured green-and-yellow. The green-and-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.

Any conductor, either internal or external, identified by the green/yellow colour combination shall not be connected to terminal other than earthing terminals.

Compliance shall be checked by inspection.

21. PROTECTION AGAINST ELECTRIC SHOCK

21.1 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 independent of the position of mounting and adjustment of the luminaire, and shall be maintained after removal of all parts which can be removed by hand, except lamps and shrouds of Edison and bayonet lampholders. Covers in fixed luminaires, other than tungsten filament lamp luminaires, which cannot be removed by 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.

21.2 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 affected by hand.

21.3 Metal parts of Class II luminaires which are insulated from live parts by basic insulation only are live parts for the purpose of this standard. 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.

For Class II luminaires, glass 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 Part 4 of this standard, they shall not be used as supplementary insulation.

21.4 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.

21.5 Compliance with the requirements of **21.1** to **21.4** shall be checked by inspection and if necessary by a test with the standards test finger as shown in Fig. 3.

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.

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

21.6.1 *Test* — Compliance shall be checked by inspection, by manual test and by the tests specified in **21.7.**

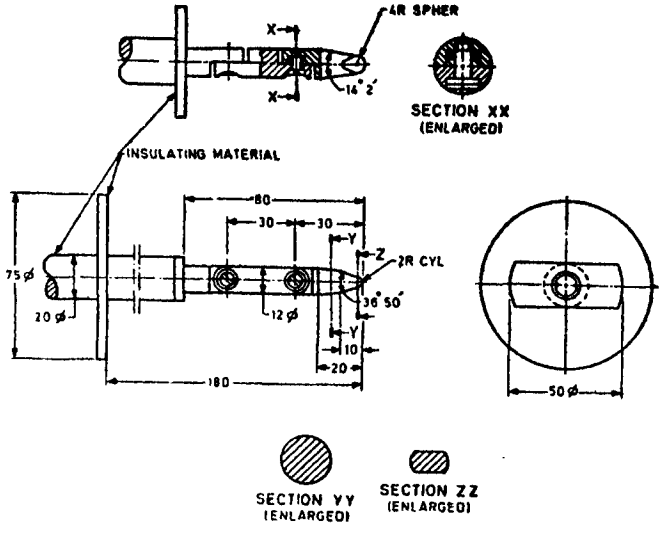


FIG. 3 STANDARD TEST FINGER

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

21.7.1 Luminaires designed to be connected to the supply by means of a plug and incorporating a capacitance exceeding 0·1μF (or 0·25μF for luminaires with a rated voltage less than 150 V) shall be provided with a discharge device so that 1 second after disconnection, the voltage between the pins of the plugs does not exceed 34 V.

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

INDIAN STANDARDS

ON

ILLUMINATING ENGINEERING

IS:

1777-1978 Industrial lighting fittings with metal reflectors (*first revision*)
1885 (Part XVI/Sec 1)-1968 Electrotechnical vocabulary: Part XVI Lighting: Section 1 General aspects
1885 (Part XVI/Sec 2)-1969 Electrotechnical vocabulary: Part XVI Lighting: Section 2 General illumination, lighting fittings and lighting for traffic and signalling
1913 (Part I)-1978 General and safety requirements for luminaires: Part I Tubular fluorescent lamps (*second revision*)
1944 (Parts I & II)-1970 Code of practice for lighting of public thoroughfares
(Part V)-1981 Part V Lighting for grade separated junctions, bridges and elevated roads (Group D)
(Part VI)-1981 Part VI Lighting for town and city centres and civic importance (Group E)
(Part VII)-1981 Part VII Lighting for roads with special requirements (Group F)
1947-1988 Flood lights (*first revision*)
2149-1970 Luminaires for street lighting (*first revision*)
2206 (Part I)-1962 Flameproof electric lighting fittings: Part I Well-glass and bulkhead types
2206 (Part II)-1976 Flameproof electric lighting fittings: Part II Fittings using glass tubes
2493-1963 Well-glass lighting fittings for use underground in mines (non-flameproof type)
2672-1966 Code of practice for library lighting
3287-1965 Industrial lighting fittings with plastic reflectors
3528-1966 Waterproof electric lighting fittings
3553-1966 Watertight electric lighting fittings
3646: Code of practice for interior illumination:
(Part I)-1966 Principles for good lighting and aspects of design
(Part II)-1966 Schedule for values of illumination and glare index
(Part III)-1966 Calculation of coefficients of utilization by the BZ method
4012-1967 Dust-proof electric lighting fittings
4013-1967 Dust-tight electric lighting fittings
4347-1967 Code of practice for hospital lighting
5077-1969 Decorative lighting outfits
6585-1972 Screwless terminal and electrical connections for lighting fittings
6665-1972 Code of practice for industrial lighting
7537-1974 Road traffic singnals
7569-1981 Cast acrylic sheets for use in luminaires (*first revision*)
7678-1975 Method of photometric testing of incandescent type luminaires for general lighting service
7785: Elevated type aerodrome lighting fittings:
(Part I)-1975 General requirements
(Part II)-1976 Fixed focus high intensity bi-directional runway edge lighting fittings
(Part III)-1976 Low intensity runway edge lighting fittings
(Part IV/Sec 1)-1981 Angle of approach, lighting section 1 Visual approach slope indicators
(Part V/Sec 1)-1981 Approach lighting fittings, Section 1 High intensity elevated approach lighting fittings
8030-1976 Luminaires for hospitals
8224-1976 Electric lighting fittings for division 2 areas
9583-1981 Emergency lighting units