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मानक

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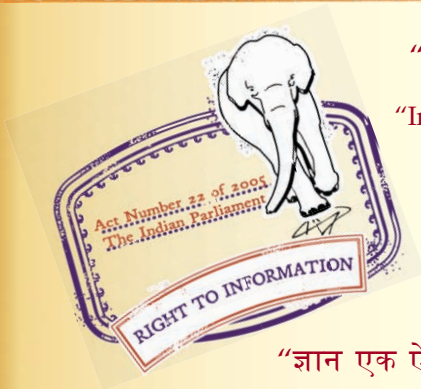
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

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IS 10322-5-3 (2012): Luminaires, Part 5: Particular Requirements, Section 3: Luminaires for Road and Street Lighting [ETD 24: Illumination Engineering and Luminaries]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

प्रदीपक

भाग 5 विवरणात्मक अपेक्षाएँ

अनुभाग 3 सड़क और गली के प्रकाश के लिए प्रदीपक

(पहला पुनरीक्षण)

Indian Standard

LUMINAIRES

PART 5 PARTICULAR REQUIREMENTS

Section 3 Luminaires for Road and Street Lighting

(*First Revision*)

ICS 29.140.40

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

FOREWORD

This Indian Standard (Part 5/Sec 3) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Illumination Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1987. This revision has been undertaken primarily to align the existing standard with latest International Standard.

This standard covers the requirements of luminaires for road and street lighting. This standard covers safety and photometric requirements.

This standard is one among the series of Indian Standards which deals with luminaires. This series consists of the following Parts and Sections:

Part 1	General requirements
Part 5	Particular requirements
Section 1	Fixed general purpose luminaires
Section 2	Recessed luminaires
Section 4	Portable general purpose luminaires
Section 5	Flood lights
Section 6	Handlamps
Section 7	Lighting chains
Section 8	Luminaires for emergency lighting

This standard is to be read in conjunction with IS 10322 (Part 1) : 2010 'Luminaires: Part 1 General requirements'. For the sake of convenience, the clauses of this standard correspond to those of IS 10322 (Part 1), instead of reproducing full text of each clause reference to relevant clauses of IS 10322 (Part 1) has been given.

This standard is based on IEC 60598-2-3 : 2002 'Luminaires — Part 2: Particular requirements, Section 3 Luminaires for road and street lighting' issued by the International Electrotechnical Commission (IEC) except for the following deviations:

Photometric requirements have been incorporated.

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 a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard***LUMINAIRES****PART 5 PARTICULAR REQUIREMENTS****Section 3 Luminaires for Road and Street Lighting***(First Revision)***1 SCOPE**

This standard (Part 5/Sec 3) specifies requirements for road and street lighting luminaires as given below for use with tungsten filament, tubular fluorescent, LED, LED modules and other discharge lamps on supply voltage not exceeding 1000 V. It is to be read in conjunction with those Sections of Part 1 to which reference is made.

- a) Luminaires for road, street lighting and other public outdoor lighting applications;
- b) Tunnel lighting;
- c) Column-integrated luminaires with a minimum total height above normal ground level of 2.5 m; and for use with electrical lighting sources on supply voltages not exceeding 1 000 V.

NOTE — Column integrated luminaires with a total height below 2.5 m are under consideration.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

<i>IS No.</i>	<i>Title</i>
9000 (Part 7/ Sec 1 to 5) : 1979	Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test
10322 (Part 1) : 2010	Luminaires: Part 1 General requirements and tests (<i>first revision</i>)
13383 (Part 2) : 1992	Photometry of luminaires — Method of measurement: Part 2 Luminaires for road and street lighting
SP 30 : 1985	National Electrical Code

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 10322 (Part 1/Sec 1) and the following shall apply.

3.1 Span Wire — Wire between main supports which carry the weight of the complete installation.

NOTE — This may include several luminaires, supply cables and a stay wire.

3.2 Suspension Wire — Wire attached to the span wire and carrying the weight of the luminaire.

3.3 Stay Wire — Tensioned wire between main supports to limit lateral and rotary movement of the suspended luminaires.

3.4 Column-Integrated Luminaires — Lighting systems formed with a luminaire integrated in a lighting column fixed in the ground.

3.5 Reflective or Decorative External Part of a Column-Integrated Luminaire — Device reflecting the light in a fixed direction or with a decorative purpose, mounted outside the lamp compartment generally at the top of the column-integrated luminaire.

NOTE — Such devices are referred to in this standard as 'external parts'.

3.6 Lighting Column — Support intended to hold one or more luminaires, consisting of one or more parts: a post, possibly an extension piece, and if necessary a bracket. It does not include columns for catenary lighting.

3.7 Nominal Height of a Column-Integrated Luminaire — Distance between the centre line of the point of entry of the external part and the intended ground level, for column-integrated luminaires planted in the ground, or the bottom of the flange plate, for column-integrated luminaires with a flange plate.

3.8 Door Opening of a Column-Integrated Luminaire — Opening in the column of a column-integrated luminaire for access to electrical equipment.

3.9 Cable Entry Slot of a Column Integrated Luminaire — Opening in the part of a column-integrated luminaire below ground for the cable entry.

3.10 Connection Box of a Column Integrated Luminaire — Box containing terminal blocks: protecting devices allowing the connection of a column-integrated luminaire to the mains and the looping of electricity supply cables.

IS 10322 (Part 5/Sec 3) : 2012

3.11 Tunnel Luminaires — Luminaires for lighting tunnels which are mounted direct or on frames to the wall or ceiling of the tunnel.

4 GENERAL TEST REQUIREMENTS

The provisions of IS 10322 (Part 1/Sec 0) shall apply.

The tests described in each appropriate Sections of Part 1 shall be carried out in the order listed in this standard.

In order to facilitate testing, and due to the dimensions of the sample, it is allowed to make use of the appropriate parts of the luminaire only (this is mainly applicable to column-integrated luminaires).

5 CLASSIFICATION OF LUMINAIRES

Luminaires shall be classified in accordance with the provisions of IS 10322 (Part 1/Sec 2).

NOTE — Luminaires for road and street lighting are normally suitable for one or more of the following modes of installation:

- a) On a pipe (bracket) or the like;
- b) On a mast (column) arm;
- c) On a post top;
- d) On span or suspension wires; and
- e) On a wall.

6 MARKING

6.1 The provisions of IS 10322 (Part 1/Sec 3) apply. In addition, the following information shall be provided in the instruction leaflet supplied with the luminaire:

- a) Design attitude (normal operating position);
- b) Weight including control gear, if any;
- c) Overall dimensions;
- d) If intended for mounting more than 8 m above ground level, the maximum projected area subjected to wind force (*see 7.3.1*);
- e) Range of cross-sectional areas of suspension wires suitable for the luminaire, if applicable;
- f) Suitability for indoor use provided the 10°C, allowed for the effects of natural air movement, has not been deducted from measured temperature (*see 13.1*);
- g) Dimensions of the compartment in which the connection box is placed; and
- h) The torque setting, in newton metre, to be applied to any bolts or screws which fix the luminaire to its support.

6.2 BIS Certification Marking

The luminaires may also be marked with the Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986*

and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 CONSTRUCTION

The provisions of IS 10322 (Part 1/Sec 4) apply together with the requirements of **7.1** to **7.5**.

7.1 All luminaires shall have protection against ingress of moisture of at least IPX3, except for tunnel-lighting luminaires and glazing of column-integrated luminaires with an open-sided external part, for which IPX5 is required.

For column-integrated luminaires, door opening included, the IP classification shall be as follows:

- a) Parts below 2.5 m: IP3X (*see SP 30*); and
- b) Parts above 2.5 m: IP2X (when the external part is open-sided, the IP classification of the glazing shall be 5X).

7.2 Luminaires for suspension on span wires shall be fitted with clamping devices for this purpose and the range of span-wire sizes for which the clamping devices are suitable shall be stated in the instruction leaflet supplied with the luminaire. The device shall clamp the span wire to prevent movement of the luminaire with respect to the span wire.

The suspension devices shall not damage the span wire during installation and during normal use of the luminaire.

Compliance is checked by inspection after fitting the luminaire to the smallest and largest span wires in the range stated by the luminaire manufacturer.

NOTE — Care should be taken to avoid electrolytic corrosion between the clamping device and the span wire.

7.3 The means for attaching the luminaire or external part to its support shall be appropriate to the weight of the luminaire or external part. The connection shall be designed to withstand wind speeds of 150 km/h on the projected surface of the assembly without undue deflection.

Fixings which carry the weight of the luminaire or external part and internal accessories shall be provided with means to prevent the dislodgement of any part of the luminaire or external part by vibration, either in service or during maintenance.

Parts of luminaires or external parts which are fixed other than with at least two devices, for example, screws or equivalent means of sufficient strength, shall have such extra protection as to prevent those parts falling and endangering persons, animals and

surroundings, should a fixing device fail under normal conditions.

Compliance is checked by inspection and, for mast-arm or post-top mounted luminaires or external parts, by the test of 7.3.1.

The wind-force test is not required to be performed on tunnel luminaires.

NOTE — In considering the possible effects of vibration, the luminaire should be studied in conjunction with the lamp and the column with which it may be used.

7.3.1 Static Load Test for Mast-Arm or Post-Top Mounted Luminaires or External Parts

The luminaire or external part is mounted in such a way that the most critical surface is loaded.

The most critical surface is determined by calculating the highest value of:

$$C_d \times S$$

where

C_d = drag coefficient; and

S = area of the surface to be loaded, in m^2 .

The drag coefficient depends on the shape of the surface. For luminaires or external parts for which the C_d is not measured, the value of 1.2 shall be taken.

The means of attachment shall be secured in accordance with the manufacturer's instructions.

A constant evenly distributed load is applied for 10 min on the most critical surface.

The load shall be equal to:

$$F = 1/2 R_h \times S \times C_d \times V^2 \text{ (N)}$$

where

R_h = 1,225 kg/m^3 (air volumic mass); and

V = wind speed, in m/s .

The wind speeds relevant to the mounting heights of luminaires or external parts shall be,

V = 45 m/s (163 km/h) for heights up to 8 m ;

V = 52 m/s (188 km/h) for heights between 8 m and 15 m ; and

V = 57 m/s (205 km/h) for heights of more than 15 m .

The drag coefficient is 1.2 (or the exact value measured in Annex A).

After the test, there shall be no visible failure impairing the safety, no permanent deformation from the attachment which exceeds a slope of more than 2 cm/m , and no rotation around the point of attachment.

NOTES

1 See Annex A for measurement of C_d .

2 See Fig. 1 for methods of equal distribution of the load. In cases where bags are used, these can be filled with sand, lead shot or small balls.

3 The wind speed may be determined by national rules, if any.

7.4 If the use of a single lamp holder does not ensure the correct position of Fig. 1 of the lamp, an adequate supporting device shall be provided.

For adjustable lamp holders or optical parts, suitable reference marks shall be provided.

Compliance is checked by inspection.

7.5 Glass covers shall either consist of a glass that fractures into small pieces or shall be provided with a guard of sufficiently small mesh or a film-coated glass that retains glass fragments.

For flat glass covers compliance is checked by inspection and, if the glass is not provided with a guard, by the following test:

The glass component is supported over the whole area to ensure that particles will not be scattered upon fragmentation and that movement of the particles is prevented. Shatter the glass with a centre punch at a point 30 mm from the mid-point of one of the longer edges of glass towards the centre. Within 5 min of fracture, count the particles in a 50 mm^2 , located approximately at the centre of the area of coarsest fracture but always within the confines of the glass.

A glass is deemed to have passed the test if the number of particles in the 50 mm square is more than 60; glass splinters and pieces less than the full thickness of the glass being excluded from the count. For glass of smaller size where a 50 $mm \times 50 mm$ area is not possible, the number of pieces necessary in the count is proportionately reduced.

In the count of the total number of particles in the 50 mm^2 , the particles in the centre of the square plus those at the edge shall be taken into account. In order to count particles at the edge of the square, it is recommended that all pieces intersected by two adjacent sides be included and all particles intersected by the two other sides be ignored (*see* Fig. 2).

A suitable method of counting the particles is to place a square of 50 mm side, of transparent material over the glass and mark a spot of ink as each particle within the square is counted.

NOTES

1 Where possible, the area of measurement shall not be within 30 mm of any edge, hole or machining of the glass.

2 When the test sample remains as one sheet, the fragmentation lines would normally be used to indicate fractures and the size

and number of particles would thus be evaluated, unless reinforcing or a film were employed.

3 For glass covers formed from a flat plate, a test is under consideration.

7.6 The connection compartment of column-integrated luminaires shall provide adequate space within the door opening for:

- a) Luminaire terminals;
- b) Protective devices;
- c) Termination and looping of electricity supply cables; and

d) Connection box (if any).

The compartment shall be provided with means for attaching such equipment. Where such means is of metal, it shall be of corrosion-resistant material or suitably protected against corrosion.

7.7 With regard to load calculation and verification of structural design by testing, column-integrated luminaires, except for their external part, shall comply with relevant standards, if any.

7.8 The door of a column-integrated luminaire shall

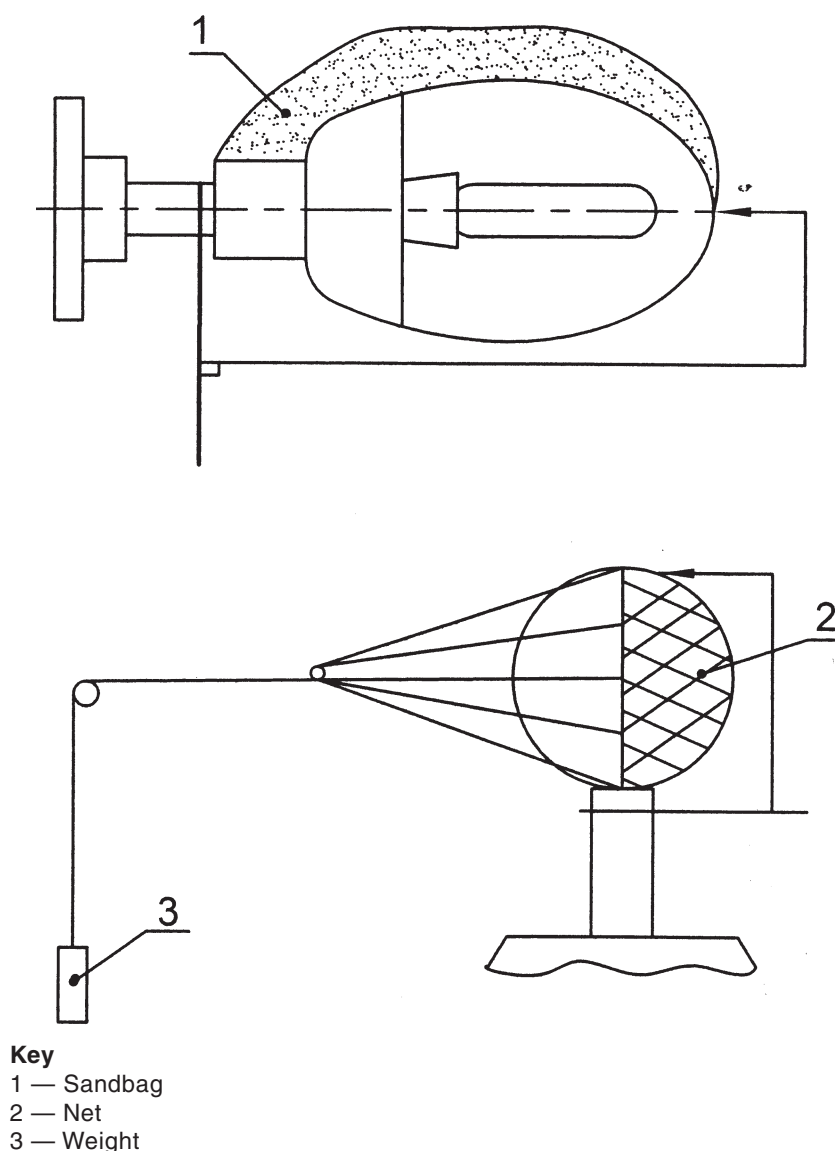


FIG. 1 DIFFERENT PROCEDURES FOR THE STATIC WIND-FORCE TEST

be treated against corrosion in accordance with the treatment applied to the column-integrated luminaire.

Compliance is checked by inspection and by the test specified in 4.18 of IS 10322 (Part 1).

The opening of the door shall be designed in such a way that only authorized persons will be able to open it.

A type test will be performed on a sample of the door. The test equipment shall be that used for the pendulum hammer, the vertical fall, spring-operated impact test apparatus specified in IS 9000 (Part 7/Sec 1 to 5) or by other suitable means giving equivalent results. An impact energy of 5 Nm shall be applied three times.

Blows will be applied in the centre of the door on the largest side when the door has several facets.

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

- a) the locking device shall still be operational;
- b) no visible cracks shall be present on the sample; and
- c) the level of IP protection shall not be reduced (*see 7.1*).

7.9 For column-integrated luminaries,

- a) the cable entry slot shall be not less than 50 mm × 150 mm; and
- b) the cable path from the slot to the connection compartment shall be not less than 50 mm, and shall be free from obstructions, sharp edges, burrs, flashes and the like that might cause abrasion of the cables.

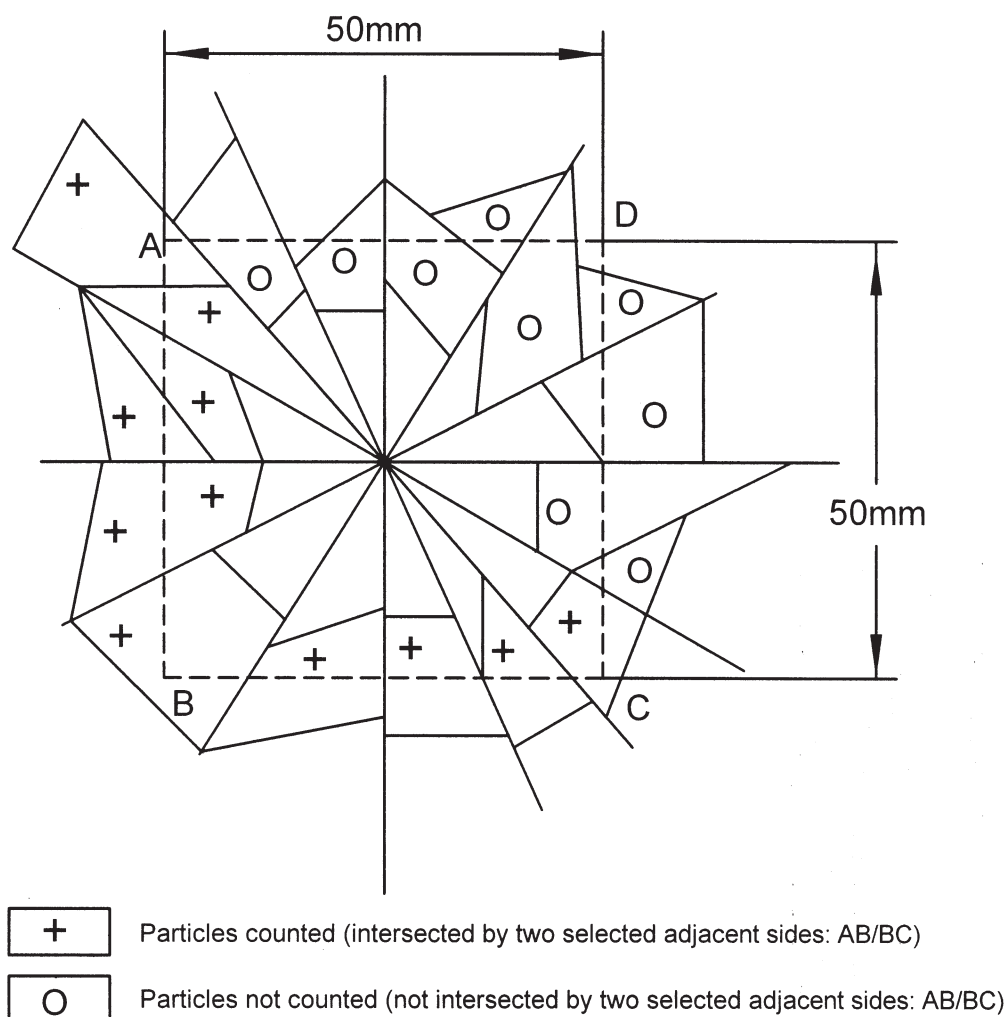


FIG. 2 COUNTING PARTICLES AT THE EDGE OF THE SQUARE

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Compliance is checked by inspection and by measurements.

8 CREEPAGE DISTANCES AND CLEARANCES

The provisions of IS 10322 (Part 1/Sec 11) shall apply.

9 PROVISION FOR EARTHING

The provisions of IS 10322 (Part 1/Sec 7) shall apply together with the requirements of 9.1.

9.1 The attachment of the fixed part of the terminal shall be designed and executed so as to prevent it from being rotated when the clamping part is moved.

Compliance is checked by inspection and by the mechanical tests specified in of IS 10322 (Part 1/Sec 14 and Sec 15).

10 TERMINALS

The provisions of IS 10322 (Part 1/Sec 14 and Sec 15) shall apply.

Terminals for supply connection shall allow the connection of conductors having nominal cross-sectional areas according to Table 14.1 of IS 10322 (Part 1/Sec 14), excluding the provision of supply cables with cross-sectional areas smaller than 1 mm².

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

11 EXTERNAL AND INTERNAL WIRING

The provisions of IS 10322 (Part 1/Sec 5) shall apply together with the requirements.

11.1 A luminaire for road and street lighting shall be provided with a cord anchorage such that the conductors for supply cables are relieved from strain where they are connected to the terminals, if, without the cord anchorage, the weight of the supply cables would exert a strain on the connections.

Compliance is checked by the relevant test of IS 10322 (Part 1/Sec 5), but with a pull of 60 N and a torque of 0.25 Nm.

The values for the pull and the torque to be applied depend on the weight of the supply cables. In general, the specified values are adequate, but for luminaires intended to be mounted higher than 20 m and where the weight of the supply cables affecting the cord anchorage exceeds 4 kg a pull of 100 N and a torque of 0.35 Nm are applied.

12 PROTECTION AGAINST ELECTRIC SHOCK

The provisions of IS 10322 (Part 1/Sec 8) shall apply.

13 ENDURANCE TESTS AND THERMAL TESTS

The provisions of IS 10322 (Part 1/Sec 12) shall apply together with the following.

13.1 When applying the limits given in the tables of IS 10322 (Part 1/Sec 12), 10°C shall be deducted from the temperatures measured on the luminaire in the test enclosure to allow for the effects of natural air movement which occur in the working environment of the luminaire.

Products intended for use outdoors only shall be tested at their declared $t_a \pm 5^\circ\text{C}$. 10°C can then be deducted from the measured temperature after the test.

13.2 Luminaires with an IP classification greater than IP20 shall be subjected to the relevant tests of 12.4, 12.5 and 12.6 of IS 10322 (Part 1/Sec 12) after the test(s) of 9.2 but before the test(s) of 9.3 of IS 10322 (Part 1/Sec 9) specified in 14.

14 RESISTANCE TO DUST AND MOISTURE

The provisions of IS 10322 (Part 1/Sec 9) shall apply together with the following.

14.1 For luminaires with an IP classification greater than IP20 the order of the tests specified in IS 10322 (Part 1/Sec 9) shall be as specified in 13.2.

15 INSULATION RESISTANCE AND ELECTRIC STRENGTH

The provisions of IS 10322 (Part 1/Sec 10) shall apply.

16 RESISTANCE TO HEAT, FIRE AND TRACKING

The provisions of IS 10322 (Part 1/Sec 13) shall apply.

17 PHOTOMETRIC TESTS

17.0 The photometric performance shall be determined by the test method given in IS 13383 (Part 2). The photometric requirements shall be as given in 17.1 to 17.4.

17.1 The photometric data of a luminaire shall consist of a set of luminous intensity values in different directions, derived from measurement on a distribution photometer (gonophotometer). The coordinate system to be used and the directions in which luminous intensity values are required are specified in 17.2 to 17.4.

17.2 The coordinate system used for defining the space around the road lighting luminaire is the space around the road lighting luminaire is known as the C-gamma system and is shown in Fig. 3. The centre of the coordinate system coincides with the centre of the optical system of the luminaire. The vertical axis of the system is formed by the perpendicular line dropped from the centre of the luminaire to the horizontal plane to be illuminated, independent of any luminaire tilt. Vertical half planes rotate around the axis. The half-plane parallel to the longitudinal roadway axis are defined by the angles

$C = 0^\circ$ and $C = 180^\circ$. The half-planes perpendicular to the road axis are defined by the angles $C = 90^\circ$ on the road side and $C = 270^\circ$ on the kerb side. The elevation angles in these planes are indicated by γ , increasing from vertically downwards $\gamma = 0^\circ$ to $\gamma = 180^\circ$. Every direction is clearly defined by values of C and γ .

17.3 Performance Data to be Provided by Manufacturer

17.3.1 The manufacturer or supplier shall provide the following data relating to the performance of the luminaire:

- Light distribution in the longitudinal roadway vertical plane ($C = 0^\circ$ and $C = 180^\circ$);
- Light distribution in the transverse vertical plane on road side ($C = 90^\circ$) and on the kerb side ($C = 270^\circ$);
- Light distribution in the plane containing the maximum intensity the principal vertical plane. The C -angle of this plane shall be stated;
- Light distribution in the principal conical surface through the direction of maximum intensity. The value of the constant angle γ to be stated by the supplier; and
- Light output ratio and downward light output ratio.

17.3.2 If requested by the purchaser or responsible agent, the following data shall also be provided:

- Built in angle of tilt;
- Isolux diagram;
- Isocandela diagram;
- Ratio of intensity I_{88}/I_{80} (in candela) in the plane $C = 0^\circ$;
- Flushed area F (in m^2) of the luminaire viewed from $\gamma = 76^\circ$ in the plane $C = 0^\circ$; and
- Specific luminaire index given in $SLI = 13.84 - 3.31 \log I_{80^\circ} + (\log I_{88}/I_{80})^{1/2} - 0.08 \log I_{80^\circ}/I_{88} + 1.29 \log F$.

17.3.3 Luminaire Classification

To indicate the suitability or otherwise for a given application, a 3-way classification system based on

- the extent to which the light is thrown up and down a road;
- the degree of sideways spread of light across a road; and
- the amount of control exercised over the light omitted at high angles shall be recommended.

17.3.3.1 Throw

Throw is defined by the angle (γ_{Max}) that the beam axis makes with the downward vertical. The beam axis is

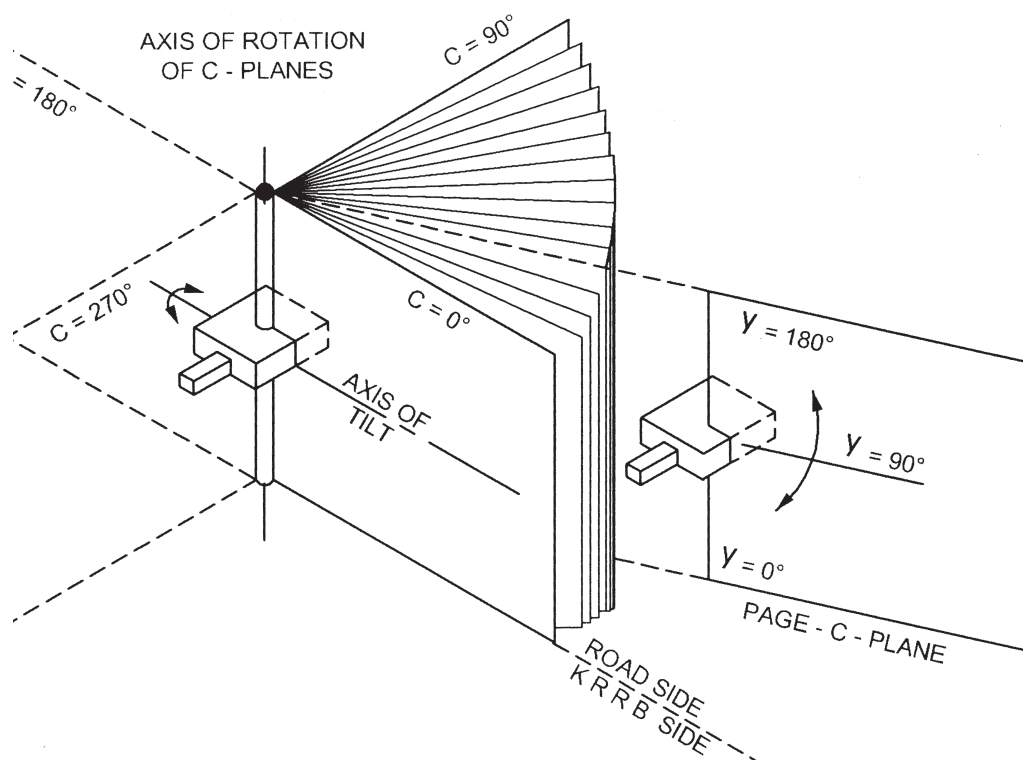
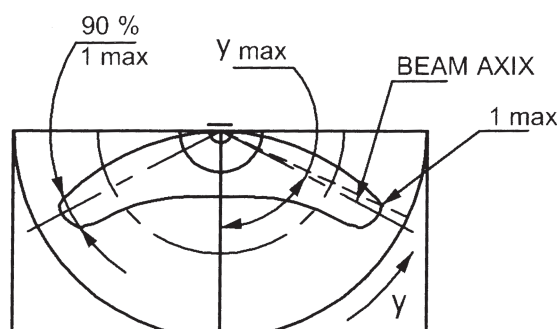


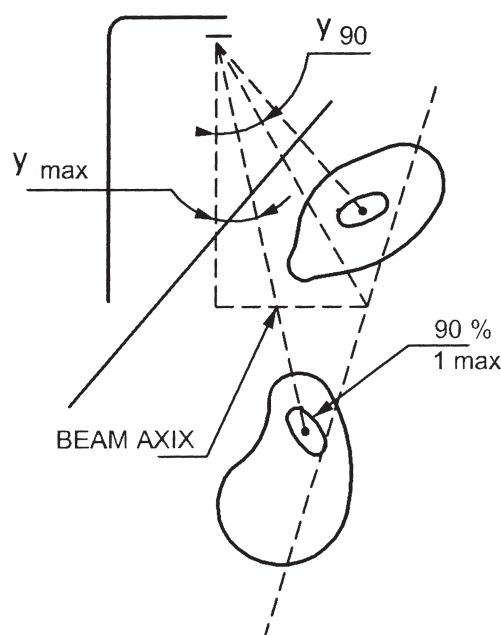
FIG. 3 C- γ -SYSTEM

defined by the direction midway between the two directions of 90 percent I_{Max} (see Fig. 4 and Fig. 5).



NOTE — The figure shows the beam axis making an angle γ_{Max} with the downward vertical, located midway between two directions of 90 percent I_{Max} . The angle γ_{Max} defines the 'throw' of the luminaire (see also Fig. 5).

FIG. 4 LUMINOUS INTENSITY DISTRIBUTION OF ROAD LIGHTING LUMINAIRE IN THE PLANE OF MAXIMUM INTENSITY (I_{Max})



NOTE — The figure indicates the angle γ_{90} in the plane at right angles to the road axis between the downward vertical and the line parallel to the road axis that just cuts the far side of the 90 percent I_{Max} contour. The value of γ_{90} determines the spread of the luminaire and the angle γ_{Max} its 'throw'.

FIG. 5 ISOCANDELA DIAGRAM PROJECTED ON THE ROAD

17.3.3.2 Spread

Spread is defined by the most distant longitudinal roadway line parallel to the road axis that just touches the far side of the 90 percent I_{Max} contour on the road surface (see Fig. 5). Spread is the γ angle of this tangent in $C = 90^\circ$ plane ($\gamma = 90^\circ$).

17.3.3.3 Control

It is defined by SLI, which consists of those parameters in the glare control mark of an installation which are characteristics of the luminaire used.

SLI is determined by using the formula:

$$\text{SLI} = 13.84 - 3.31 \log I_{80} + 1.3 (\log I_{88}/I_{80})^{1/2} - 0.08 \log I_{80}/I_{88} + 1.29 \log F$$

Three degrees each of throw spread and control shall be recognized for classifying the photometric properties of the luminaires as given in Table 1.

17.3.4 The above data shall be stated for clean luminaires mounted in the designed attitude and equipped with lamps each with its light centre in the correct nominal position. The data shall also include the nominal average lumens through the life of the lamp (or lamps) for which the luminaire is designed.

17.3.5 For luminaires employing tubular fluorescent lamps, the above data shall be prepared on the basis of the luminaires operating in an ambient temperature of 25°C with no wind. If the luminaire is specially designed for nominal operation in a higher or lower ambient temperature, the photometric data may be prepared for the particular design temperature which shall be stated specifically in each set of data or charts.

17.4 Light-Controlling Components

The attachment of refractors, reflectors or any other light-controlling component shall be such that they can only be fitted or replaced in the correct relationship to their light source. Top entry, post top and similar luminaires which produce an asymmetric light distribution shall bear a clear indication of the correct orientation of the luminaire and/or refractor(s) or reflector(s) with respect to the carriageway.

17.4.1 Prismatic refractors shall preferably have a smooth exterior surface. Where the optical design of a refractor requires prisms on its outer (or light-emerging) surface, the prisms shall either be provided with a sealed cover or be of a type which does not hold water droplets or dirt and which is not difficult to clean.

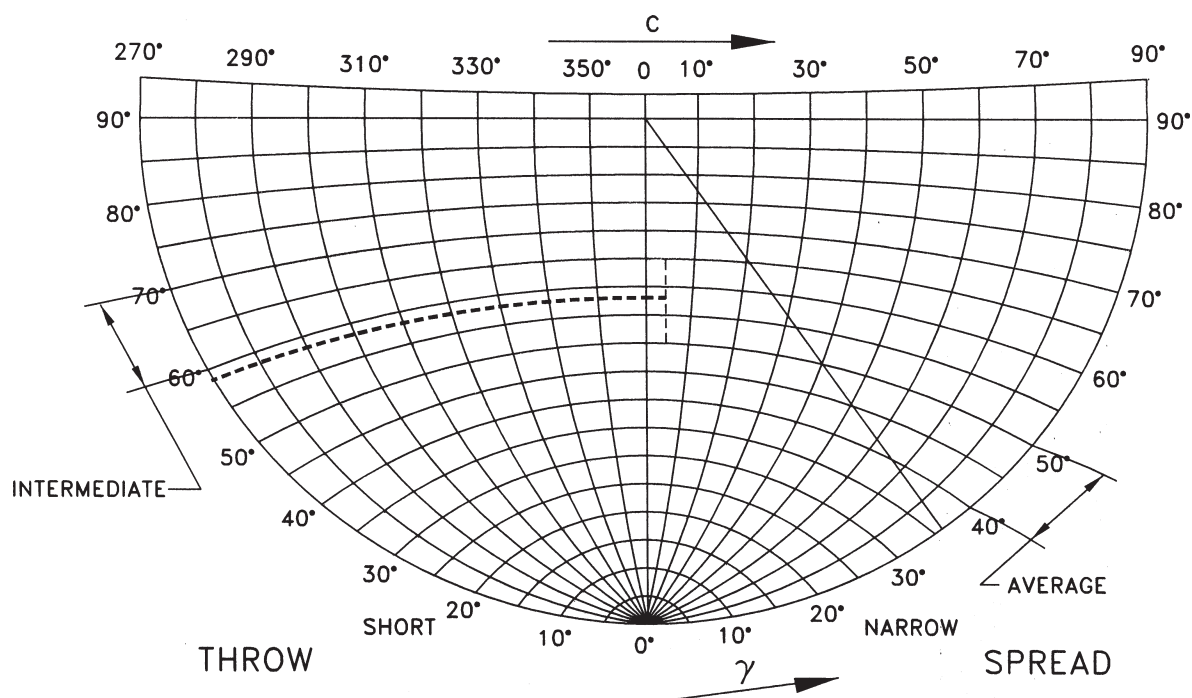


FIG. 6 DEFINITION OF THROW AND SPREAD

Table 1 Classification System for the Photometric Properties of Luminaires
(Clause 17.3.3.3)

Sl No. (1)	Throw (2)	Spread (3)	Control (4)
i)	Short ($\gamma_{\text{Max}} < 60^\circ$)	Narrow ($\gamma 90 < 45^\circ$)	Limited ($\text{SLI} < 2$)
ii)	Intermediate ($60^\circ \leq \gamma_{\text{Max}} \leq 70^\circ$)	Average ($45^\circ \leq \gamma 90 \leq 55^\circ$)	Moderate ($2 \leq \text{SLI} \leq 4$)
iii)	Long ($\gamma_{\text{Max}} \geq 70^\circ$)	Broad ($\gamma 9^\circ \geq 55^\circ$)	Tight ($\text{SLI} > 4$)

NOTE — The throw and spread of a luminaire shall be determined from an isocandela diagram in which isocandela contours are projected on the plane illuminated by the luminaire. They can also be determined from isocandela diagram in zenithal projection (see Fig. 6).

ANNEX A

(Clause 7.3.1)

DRAG COEFFICIENT MEASUREMENTS

A-1 MEASUREMENT METHODS

The drag coefficient measurement is performed in the same way as the method used to determine the drag coefficient values.

The luminaire measurement is easier than measurement on a complicated structure (motionless tested luminaire representing the actual size of the luminaire).

The common practice is to place the luminaire as indicated by the manufacturer's installation rules in a wind tunnel.

The wind tunnel should be such that the surface S of the luminaire represents 5 percent maximum of the cross-sectional area of the wind tunnel.

The wind speed used in the measurement should represent as far as possible the reality, according to 7.3.1. A speed of 25 m/s should be considered as a minimum.

After the measurement, no visible failure must impair the safety of the luminaire.

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002

Telephones : 2323 0131, 2323 3375, 2323 9402

Website: www.bis.org.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 60 3843 60 9285
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