IS : 10322 (Part 5/Sec 3) - 1987
(Superseding IS : 2149-1970)

Indian Standard

(Reaffirmed 1995)

SPECIFICATION FOR LUMINAIRES

PART 5 PARTICULAR REQUIREMENTS

Section 3 Luminaires for Road and Street Lighting

UDC 628·94 : 628·971·6

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

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Indian Standard

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0. FOREWORD

0.1 This Indian Standard (Part 5/Sec 3) was adopted by the Bureau of Indian Standards on 28 October 1987, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 IS : 2149* was first published in 1962 and subsequently revised in 1970 to include photometric requirements and photometric test procedures. In order to take account of the developments in the field of illumination engineering, this standard has now been prepared as a part of a new series of Indian standards on luminaires. This standard, therefore, supersedes IS : 2149-1970* published earlier on this subject.

0.3 This standard (Part 5/Sec 3) is one among a series of Indian Standards which deal with luminaires. This series consists of 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.

0.4 In general, Part 1, 2, 3 and 4 of this standard cover safety requirements 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. Part 1, 2, 3 and 4 are thus not to be regarded as a specification by itself for any type of luminaires and their provisions apply only to particular types of luminaires to the extent determined by the appropriate section of Part 5.

0.5 The sections of Part 5, in making reference to any other parts 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 Part 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 luminaire or group of luminaires by the appropriate section of Part 5. All sections of Part 5 are self-contained and, therefore, do not contain references to other sections of Part 5.

0.6 In the preparation of this standerd, assistance has been derived from IEC Publication 598-2-3 (1979) 'Luminaires, Part 2 Particular requirements, Section 3 Luminaires for road and street lighting', published by the International Electrotechnical Commission (IEC).

0.7 For the purpose of deciding whether a particular requirement of the standard is complied with, the final value, observed or calculated , expressing the result of a test or analysis 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 specified value in this standard.

*Specification for luminaires for street lighting (*first revision*).

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

1. SCOPE

1.1 This standard (Part 5/Sec 3) specifies requirements for luminaires for road and street lighting, for use with tungsten filament, tubular fluorescent and other discharge lamps on supply voltages not exceeding 1 000V. It is to be read in conjunction with Part 1 to 4 of this standard to which reference is made.

2. DEFINITIONS

2.0 For the purpose of this section, the definitions given in Part 1 of this standard shall apply together with the following definitions.

2.1 Span Wire — A wire between main supports which carries the weigh of the complete installation.

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

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

2.3 Stay Wire — A tensioned wire between main supports to limit lateral and rotary movement of the suspended luminaires.

3. GENERAL TEST REQUIREMENTS

3.1 The provisions of **3** of Part 1 of this standard shall apply. The tests shall be carried out in the order listed in **13**.

4. CLASSIFICATION OF LUMINAIRES

4.1 Luminaires shall be classified in accordance with the provisions of **5** of Part 1 of this standard.

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.

5. MARKING

5.1 The provisions of **6** of Part 1 of this standard 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 controlgear, 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* **6.3.1**); and
e) The range of cross-sectional areas of suspension wires suitable for the luminaire, if applicable.

5.1.1 The luminaires may also be marked with Standard Mark.

NOTE — 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 Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6. CONSTRUCTION

6.0 The provisions of Part 2 of this standard shall apply together with the requirements of **6.1** to **6.4**.

6.1 Road and street lighting luminaires shall have protection against ingress of moisture of at least IP X3.

6.2 Luminaires for suspension on span wires shall be fitted with clamping devices for this purpose and the range of span wires 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 shall be 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 span wire.

6.3 The means for attaching the luminaire to its support shall be appropriate to the weight of the luminaire. 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 and internal accessories shall be provided with means to prevent the dislodgement of any part of the luminaire by vibration, either in service or during maintenance.

Parts of luminaires 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 shall be checked by inspection and, for mast arm or post top mounted luminaires, by the test of **6.3.1**.

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

6.3.1 *Wind Force Test for Mast Arm or Post Top Mounted Luminaires*

6.3.1.1 The luminaire is mounted with its largest projected area as viewed in elevation lying in the horizontal plane, and with the means of attachment secured in accordance with the manufacturer's recommendations.

6.3.1.2 The constant evenly distributed load is applied for 10 min on the luminaire using sand bags providing 1·5 kN/m² of lantern projected area for mounting heights up to 8 m, 2·0 kN/m² for mounting heights of 8 m to less than 15 m and 2·4 kN/m² for mounting heights of 15 m and over. The luminaire is then turned 180°, in the vertical plane, about the point of attachment, and the test is repeated.

6.3.1.3 During the test, there shall be no failure or movement about the point of attachment and after either part of this test, there shall be no permanent set exceeding 1°.

6.4 If the use of a single lampholder does not ensure the correct position of the lamp an adequate supporting device shall be provided.

For adjustable lampholders or optical parts, suitable reference marks shall be provided. Compliance shall be checked by inspection.

7. CREEPAGE DISTANCES AND CLEARANCES

7.1 The provisions given in **4** of Part 4 of this standard shall apply.

8. PROVISION FOR EARTHING

8.1 The provisions given in **20** of Part 2 of this standard shall apply.

9. TERMINALS

9.1 The provisions given in Part 3 of this standard shall apply.

Terminals for supply connection shall allow the connection of conductors having nominal cross-sectional areas according to Table 1 of Part 3 of this standard, excluding provision of supply cables with cross-sectional areas smaller than 1 mm².

Compliance shall be checked by fitting conductors of smallest and largest cross-sectional areas specified.

10. EXTERNAL AND INTERNAL WIRING

10.1 The provisions given in **19** of Part 2 of this standard shall apply.

10.2 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 connection.

Compliance shall be checked by the relevant test given in Part 3 of this standard, 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 the torque of 0·35 Nm are applied.

11. PROTECTION AGAINST ELECTRIC SHOCK

11.1 The provisions given in **21** of Part 2 of this standard shall apply.

12. PHOTOMETRIC REQUIREMENTS

12.1 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 **12.2** to **12.4**.

12.2 The coordinate system used for defining the space around the road lighting luminaire is known as the *C*-gamma system and is shown in Fig. 1. 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 this axis. The half-planes parallel to the longitudinal roadway axis are defined by the angles $C = 0°$ and $C = 180°$. The half-planes perpendicular to the road axis are defined by the angles $C = 90°$ on the road side and $C = 270°$ on the kerb side. The elevation angles in these planes are indicated by γ, increasing from vertically downwards $\gamma = 0°$ to vertically upwards $\gamma = 180°$. Every direction is clearly defined by values of C and γ.

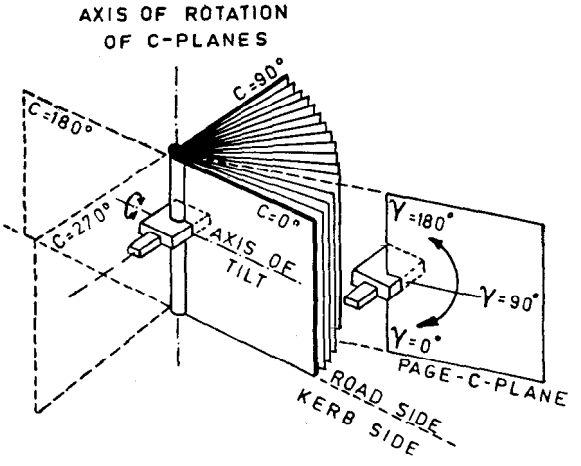


FIG. 1 *C*-GAMMA SYSTEM

12.3 Performance Data to be Provided by Manufacturer

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

a) Light distribution in the longitudinal roadway vertical planc ($C = 0°$ and $C = 180°$).

b) Light distribution in the transverse vertical plane on roadside ($C = 90°$) and on kerb side ($C = 270°$).

c) Light distribution in the plane containing the maximum intensity the principal vertical plane. The *C*-angle of this plane shall be stated.

d) Light distribution in the principal conical surface through the direction of maximum intensity. The value of thc constant angle γ to be stated by the supplier.

e) Light output ratio and downward light output ratio.

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

a) Built in angle of tilt,

b) Isolux diagram,

c) Isocandela diagram,

d) Ratio of intensity I_{88}/I_{80} in the plane $C = 0°$,

e) Flashed area *F* of the luminaire viewed from $\gamma = 76°$ in the plane $C = 0°$, and

f) Specific luminaire index given in $SLI =$

$$13{\cdot}84 - 3{\cdot}31 \log I_{80}° + 1{\cdot}3 \left(\log \frac{I_{80}}{I_{88}}\right)^{\frac{1}{2}} - 0{\cdot}08 \log \frac{I_{80}}{I_{88}} + 1{\cdot}29 \log F$$

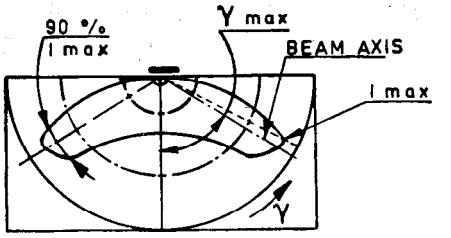
12.3.3 *Luminaire Classification* — To indicate the suitability or otherwise for a given application, a 3-way classification system based on:

a) the extent to which the light is thrown up and down a road,

b) the degree of sideways spread of light across a road, and

c) the amount of control excercised over light emitted at high angles, shall be recommended.

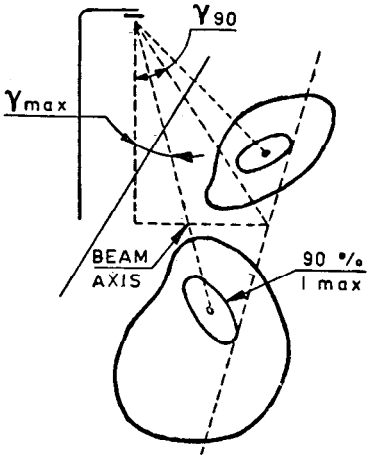
12.3.3.1 *Throw*—Throw is defined by the angle (γ_{max}) that the beam axis makes with the downward vertical. The beam axis is defined by the direction midway between the two directions of 90 percent I_{max} (Fig. 2 and 3).



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 Figure 3).

FIG. 2 LUMINOUS INTENSITY DISTRIBUTION OF A ROAD LIGHTING LUMINAIRE IN THE PLANE OF MAXIMUM INTENSITY (I_{max})

12.3.3.2 *Spread* — Spread is defined by the most distant longtudinal roadway line parallel to the road axis that just touches the far side of the 90 percent I_{max} contour on the road surface (Fig. 3). Spread is the γ angle of this tangent in the $C = 90$ plane (γ 90°).



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. 3 ISOCANDELA DIAGRAM PROJECTED ON THE ROAD

12.3.3.3 *Control* — It is defined by *SLI*, the specific luminaire index 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:

$$SLI = 13{\cdot}84 - 3{\cdot}31 \log I_{80} + 1{\cdot}3 (\log I_{80}/I_{88})^{\frac{1}{2}} - 0{\cdot}08 \log I_{80}/I_{88} + 1{\cdot}29 \log F$$

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

TABLE 1 CLASSIFICATION SYSTEM FOR THE PHOTOMETRIC PROPERTIES OF LUMINAIRES

THROW	SPREAD	CONTROL
Short	$\gamma max < 60°$ narrow	$\gamma 90 < 45°$ limited $SLI < 2$
Intermedtate	$60° \leqslant \gamma max \leqslant 70°$ average $45° \leqslant \gamma 90$	$\leqslant 55°$ moderate $2 \leqslant SLI \leqslant 4$
Long	$\gamma max > 70°$ broad	$\gamma 90 > 55°$ tight $SLI > 4$

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 (Fig. 4).

12.3.4 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.

12.3.5 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.

NOTE — A separate Indian standard on methods of photometry of luminaires for street lighting is under preparation.

12.4 Light-Controlling Components —The attachment of refractors, rgflectors 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.

12.4.1 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.

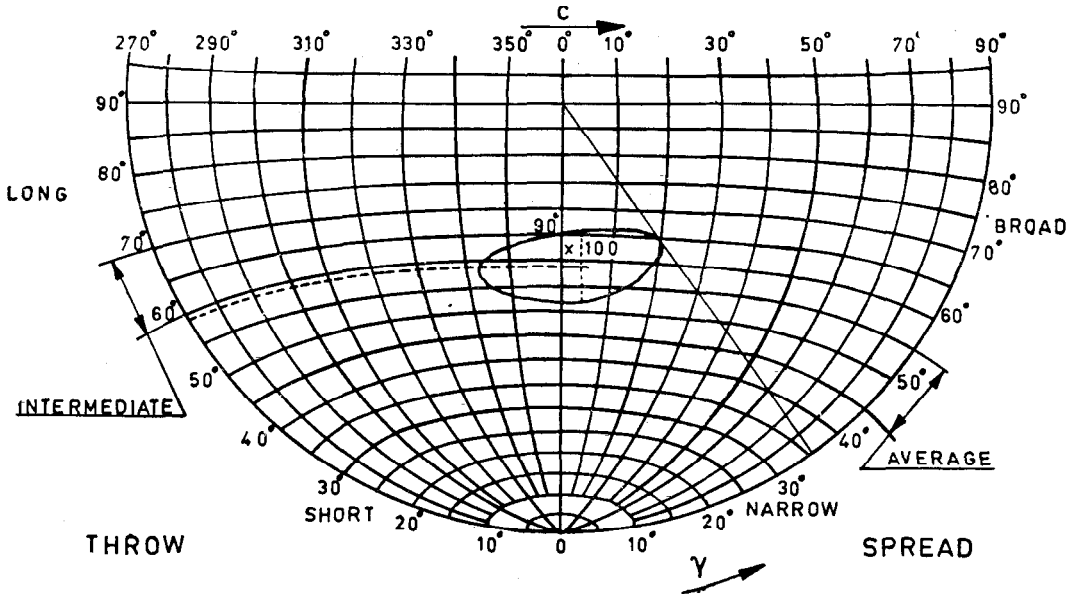
13. TESTS

13.1 Classification of Tests

13.1.1 *Type Tests* — The following shall constitute type tests:

a) Visual examination (*see* **13.2**),

b) Protection against electric shock (*see* **11.1**),



In the above example, Throw $\gamma max = 59°$
and Spread $\gamma\ 90° = 36°$

FIG. 4 DEFINITION OF THROW AND SPREAD

c) Mechanical strength test (*see* **13.3**),

d) Endurance test and thermal test (*see* **13.4**),

e) Resistance to dust and moisture (*see* **13.5**),

f) Insulation resistance and electric strength (*see* **13.6**),

g) Resistance to heat, fire and tracking (*see* **13.7**),

h) Photometric tests (*see* **13.8**), and

j) Cord anchorage test (*under consideration*).

13.1.1.1 Number of samples shall be one which should be subjected to the type tests specified in **13.1.1**, in the order specified therein.

13.1.1.2 *Criteria for approval*—The sample shall pass all the type tests, for proving conformity with the requirements of this standard. If one or more failures occur, the testing authority may call for two more samples and subject them to those tests in which the failure occurred. No single failure shall be permitted in the repeat test.

13.1.2 *Acceptance Tests* —The following shall constitute the acceptance tests:

a) Visual examination (*see* **13.2**),

b) Resistance to dust and moisture (*see* **13.5**),

c) Insulation resistance and electric strength (*see* **13.6**), and

d) Photometric tests (*see* **13.8**).

13.1.2.1 The number of samples for acceptance tests shall be agreed to between the purchaser and the supplier. However, a recommended plan of sampling is given in Appendix A.

13.1.3 *Routine Tests* — The following shall constitute the routine tests:

a) Visual examination (*see* **13.2**), and

b) Insulation resistance and electric strength (*see* **13.6**).

13.2 Visual Examination — The luminaires shall be examined visually for external finish, workmanship and electric connections.

13.3 Mechanical Strength Test — The provisions of **5** of Part 4 of this standard shall apply.

13.4 Endurance Test and Thermal Test — The provisions of **6** of Part 4 of this standard shall apply.

13.5 Resistance to Dust and Moisture — The provisions of **2** of Part 4 of this standard shall apply.

13.6 Insulation Resistance and Electric Strength Test —The provisions of **3** of Part 4 of this standard shall apply.

13.7 Resistance to Heat, Fire and Tracking — The provisions of **7** of Part 4 of this standard shall apply.

13.8 Photometric Requirements — The photometric tests shall be carried out to check the photometric requirements mentioned in **12.**

NOTE — A separate Indian standard on methods of photometry of luminaires for street lighting is under preparation.

APPENDIX A

(*Clause* 13.1.2.1)

SAMPLING PLAN FOR ACCEPTANCE TESTS

A-1. LOT

A-1.1 In any consignment all the luminaires of same size and manufactured from the same material under similar conditions of production shall be grouped together to constitute a lot.

A-2. SCALE OF SAMPLING

A-2.1 For judging the conformity of a lot to the requirements of the acceptance tests, sampling shall be done for each lot separately. For this purpose, the number of luminaires to be selected at random from each lot shall depend upod the size of the lot and shall be in accordance with Table 2.

A-2.2 These luminaires shall be selected at random from the lot. In order to ensure the randomness of selection, procedures given in IS : 4905-1968* may be followed.

A-3. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

A-3.1 The luminaires selected in accordance with col 1 and 2 of Table 2 shall be subjected to visual examination, insulation resistance test and electric strength test. A luminaire failing to satisfy any of these acceptance test shall

*Methods for random sampling.

be termed as defective. The lot shall be considered as conforming to the requirements of these acceptance tests if the number of defectives is less than or equal to the corresponding acceptance number given in col 3 of Table 2, otherwise not.

A-3.2 A lot which is found as conforming to the above requirements shall then be tested for the remaining acceptance tests, namely, resistance to dust and moisture and photometric tests. For this purpose, the sample size shall be selected in accordance with col 4 of Table 2. The lot shall be considered as conforming to the requirements of these acceptance tests if there are no failures.

A-3.3 The lot shall be considered as conforming to the requirements of acceptance tests if **A-3.1** and **A-3.2** are satisfied.

TABLE 2 SAMPLE SIZE AND ACCEPTANCE NUMBER

(*Clauses* A-2.1, A-3.1 *and* A-3.2)

Lot Size	For Visual Examination, Insulation Resistance and Electric Strength		For Other Acceptance Tests
	Sample Size	Acceptance Number	Sample Size
(1)	(2)	(3)	(4)
Up to 150	8	0	2
151 to 300	13	0	2
301 to 500	20	1	3
501 to 1 000	32	2	5
1 001 to 3 000	50	3	8
3 001 and above	80	5	8

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 3310131, 3311375

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:	**Telephone**
Central: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	3310131, 3311375
*Eastern: 1/14 C I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	362499
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*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 — 276800

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400097 — 896528

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Section 3 Luminaires for Road and Street Lighting

(*Page* 6, *clause* **13.8**) — Substitute the following for the existing clause:

'**13.8 Photometric Tests** — The photometric performance shall be determined by the test method given in IS 13383 (Part 2) : 1992 Photometry of luminaires — Method of measurement : Part 2 Luminaires for road and street lighting.

The photometric requirements shall be as given in **12**.'

(*Page* 6, *clause* **13.8**, *Note*) — Delete.

(ETD 24)

Reprography Unit, BIS, New Delhi, India

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TO
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Section 3 Luminaires for Road and Street Lighting

(*Page* 6, *clause* **13.8** (*see also Amendment No.* 1) — Substitute the following for the existing matter:

'The photometric performance shall be determined by a suitable photometric test as agreed between the purchaser and the supplier:'

(*Page* 6, *Appendix* A) — Delete.

(ET 24)

Reprography Unit, BIS, New Delhi, India