IS : 7785 (Part I) - 1975

Indian Standard

(Reaffirmed 2003)
(Reaffirmed 2013)
(Reaffirmed 2018)

SPECIFICATION FOR ELEVATED TYPE AERODROME LIGHTING FITTINGS

PART I GENERAL REQUIREMENTS

UDC 628·971·8 : 656·71

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

Price Rs 7.00 Gr 3

October 1975

Indian Standard

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PART I GENERAL REQUIREMENTS

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PART I GENERAL REQUIREMENTS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 25 August 1975, after the draft finalized by the Illuminating Engineering Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Aerodrome lighting fittings find applications in both civil and military aerodromes for giving lighting guidance to aircrafts during dark periods and under poor visibility conditions. Though the applications and the lighting requirements are not quite the same for both civil and military aerodromes, need has been felt to coordinate requirements of both and bring out specifications for such fittings.

0.3 This standard (Part I) covering the general requirements is one of a series of Indian Standards on aerodrome lighting fittings. The subsequent standards which are under preparation will cover the following:

a) Runway lighting,
b) Taxiway lighting,
c) Approach lighting,
d) Visual approach slope indicator system,
e) Obstruction lights, and
f) Light beacons.

0.4 In preparing this standard, assistance has been derived from the following:

Advisory Circular No. 150/5345-20-1967 Specification for L-802 Runway and strip light. Federal Aviation Administration (USA).

Advisory Circular No. 150/5345-9C-1969 Specification for L-819 Fixed focus bidirectional high intensity fittings. Federal Aviation Administration (USA).

Advisory Circular No. 150/4345-26A-1971 FAA-L-823 Plug and receptacles, cable connectors. Federal Aviation Administration (USA).

Military Specification MIL-C-25050A (ASG)-1963 General requirement for colors, aeronautical lights and lighting equipment. Federal Aviation Administration (USA).

International Standards and Recommended Practices: Aerodromes Annex-14-1971. Ed 6. International Civil Aviation Organization.

Specification No. 1258-1-(1969) Specification for aviation lighting fittings. Department of Transport (Air Services), Canada.

0.5 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 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 the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) covers the general requirements of the elevated type aerodrome lighting fittings for various applications.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part XVI/Sec 1)-1968† and IS : 1885 (Part XVI/Sec 2)-1968‡ shall apply.

3. CONDITIONS OF USE

3.1 The lighting fittings shall be designed and constructed for continuous service in any ambient temperature from $-20°C$ to $+55°C$. Due allowance shall be made in addition to the effect of solar heating.

3.2 The lighting fittings shall withstand continuous outdoor operation under all normal weather conditions and the effect of blowing dust, sand, heavy rain, snow and 100 percent humidity, blast effects from jet engines including wind velocities as applicable.

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

†Electrotechnical vocabulary: Part XVI Lighting; Section 1 General aspects.

‡Electrotechnical vocabulary: Part XVI Lighting; Section 2 General illumination lighting fittings and lighting for traffic and signalling.

4. GENERAL CONSTRUCTION

4.1 The lighting fittings shall consist essentially of an optical system, a lamp or lamps, socket or sockets (lamp holder or lamp holders) mounted in a suitable metallic housing connecting leads, and a mounting assembly for installing the unit securely in place.

5. REQUIREMENTS

5.1 Optical System

5.1.1 The optical system shall consist of a glass lens assembly or a combination of lenses and may include reflectors, filters and shields. The lenses shall not melt, deform, crack, blister, bubble or get affected in any manner for colour characteristics under normal operation under the conditions of use specified in **3.1**.

5.1.2 *Aviation Colours* — Standards for aviation colours shall conform to the following fundamental colorimetric values. In Fig. 1, these limits are shown graphically in the coordinate system of the International Commission on Illumination (CIE) in which they are stated numerically.

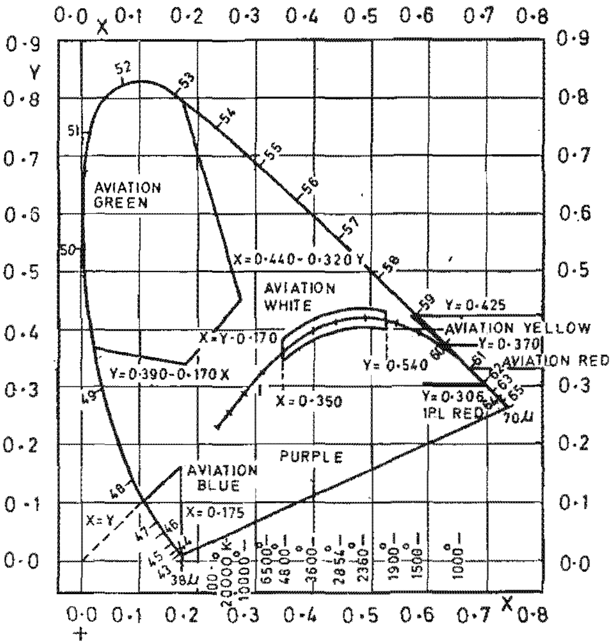

FIG. 1 CIE MIXTURE DIAGRAM SHOWING AVIATION COLOUR LIMITS

5.1.2.1 Aviation red is any colour for which y is not greater than 0·335, and z is not greater than 0·002.

5.1.2.2 Aviation yellow* is any colour for which y is not less than 0·370 or greater than 0·425, and z is not greater than 0·007.

5.1.2.3 Aviation green is any colour for which x is not greater than ($0{\cdot}440 - 0{\cdot}320\,y$) or greater than ($y - 0{\cdot}170$), and y is not less than ($0{\cdot}390 - 0{\cdot}170\,x$).

5.1.2.4 Aviation blue is any colour for which x is not greater than 0·175, y is not greater than x, and ϕ_r† divided by ϕ_w‡ is not greater than 0·015.

5.1.2.5 Aviation white is any colour for which x is not less than 0·350 or greater than 0·540, and ($y - y_o$§) is not numerically greater than 0·01.

5.1.2.6 Instrument and panel lighting red is any colour for which y is not greater than 0·306, and z is not greater than 0·001.

5.1.3 *Identification Colours* — Standards for identification colours shall conform to the following fundamental colorimetric values. In Fig. 2 these limits are shown graphically in the co-ordinated system (CIE) in which they are stated numerically.

5.1.3.1 Identification red is any colour for which y is not greater than 0·287, and z is not greater than 0·001.

5.1.3.2 Identification yellow (amberware) is any colour for which y is not less than 0·370 or greater than 0·423, and z is not greater than 0·005.

5.1.3.3 Identification green is any colour for which x is not greater than 0·312 or less than ($0{\cdot}796 - 1{\cdot}200\,y$), and y is not less than ($0{\cdot}257 + 1{\cdot}200\,x$).

5.1.3.4 Identification lunar white is any colour for which ($y - y_o$) is not greater than 0·015, and ($y_o - y$) is not greater than 0·045.

5.1.4 *Colour Standards* — Each colour standard shall consist of a set of two or more filters and an illuminant of designated colour temperature. One filter designated as the 'pale limit' shall represent the minimum colouration that is acceptable. In general, this filter shall also represent a hue limit. One or more filters of the set, designated as 'transmission standards', shall

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*The chromaticity requirements for aviation yellow are adjusted to require the same type of glass as identification yellow, but allowance is made for the difference in colour temperature ranges of the lamps.

†ϕ_r is the part of that flux which is transmitted by a replica of identification red transmission-standard filter.

‡ϕ_w is the total flux of the light under consideration.

§y_o is the y coordinate of the Planckian Radiator for which $x_o = x$.

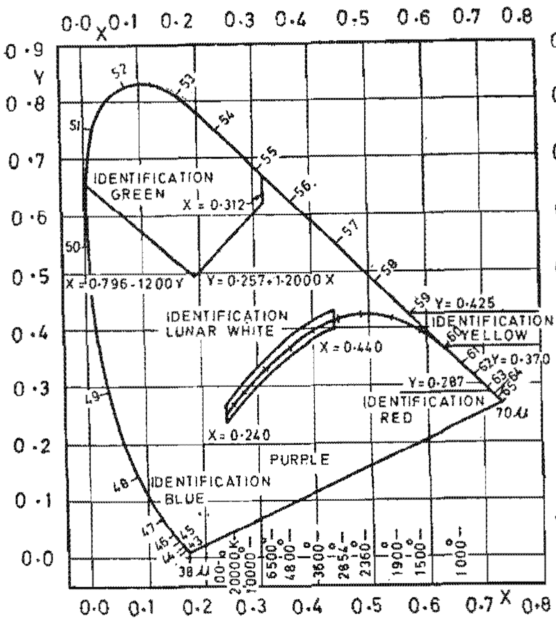

Fig. 2 CIE Mixture Diagram Showing Identification Colour Limits

provide a basis for measuring the transmission of ware that is near the minimum acceptable transmission for its grade. A reference to **5.1.5** where different grades, such as A, B, C have been dealt with, shall be made. The pale limit may be used as a basis for measuring the transmission. When a second chromaticity limit is deemed advisable, an additional filter may be used, or a transmission standard may be used as such, and these filters shall be designated as 'red limit', 'blue limit', etc. For identification green, separate yellow-green and blue-green standards are required.

5.1.4.1 *Chromaticity* — In combination with the designated light source, each of the filters of a standard shall give a chromaticity conforming to the fundamental definition for the colour represented. The chromaticity of the transmission standard shall also conform to the limits in Table 1. The same set of filters may be adopted for use with more than one illuminant, provided the resulting trichromatic coordinates fall within the fundamental definitions.

5.1.4.2 *Uniformity of colouring* — The colouring matter shall be uniformly distributed throughout the material, except in the case of selenium red and yellow filters for which a slight variation will be accepted as unavoidable.

TABLE 1 CHROMATICITY LIMITS FOR TRANSMISSION STANDARDS (ILLUMINANT 2 854°K)

(*Clause* 5.1.4.1)

COLOUR	LIMIT	COLOUR	LIMIT
(1)	(2)	(1)	(2)
Aviation red	$y < 0·310$	Identification red	$y < 0·280$
Aviation yellow	$y < 0·403$	Identification yellow	$y < 0·403$
Aviation green	$x < 0·210$	Identification green	$y > 0·150 + 2·000$
Aviation blue	$y < 0·086$		
Instrument and panel lighting red	$y < 0·306$	Identification lunar white	$x < 0·285$

5.1.4.3 *Dimensions* — The standard filters shall be cut square, not more than 50·5 mm nor less than 49 mm on each side, and shall be not less than 1·5 mm thick.

5.1.4.4 *Optical quality* — Standard filters shall have sufficiently plane, parallel, and well-polished faces, and shall be sufficiently free from bubbles, striae, scratches, and other defects.

5.1.4.5 *Transmission* — The transmission of the standard filters for 2 854° K shall be not less than 0·60 times the minimum transmission ratio specified for the ware.

5.1.5 *Transmission and Brightness*

5.1.5.1 *Transmission of non-diffusing ware* — The transmission ratio of non-diffusing ware shall be not less than the value specified in Table 2 for non-diffusing ware of the grade and colour stipulated.

TABLE 2 TRANSMISSION LIMITS (ILLUMINANT 2 854°K)

TYPE OF WARE	GRADE	RED	YELLOW	GREEN	BLUE	LUNAR WHITE	WHITE	R_m*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Non-diffusing wares Aviation Colours	A†	0·200	0·450	0·225	0·025	—	—	—
	B‡	0·175	0·400	0·200	0·022	—	0·950	40(95)
	C§	0·150	0·350	0·175	0·016	—	0·925	—
	D‖	0·130	0·300	0·150	0·008	—	0·900	—
Non-diffusing wares, Identification Colours	B	0·048	0·400	0·048	—	0·120	—	40

*R_m values are minimum or maximum acceptable readings when transmission ratios are tested on the relative basis specified above. In the case of aviation colours for non-diffusing ware, R_m is 95 for ' white '.

†Grade A is to be used only when the highest possible transmission is essential.

‡Grade B is suitable for pressed ware (of a uniform thickness, not more than 6 mm, throughout the working area), such as position light and identification cover glasses, smooth obstruction-light cover glasses, filters for carrier approach lights, etc.

§Grade C is suitable for such blown ware as code-beacon and contact-light filters.

‖Grade D is suitable for thick-sectioned glassware, such as beacon lenses, including course lights, obstruction-light lenses, and contact-light lenses and also for filters for airport approach lights.

5.1.5.2 *Brightness of diffusing ware* — The brightness of diffusing ware shall be within the limits specified in Table 3 for diffusing ware of the colour and grade stipulated.

TABLE 3 BRIGHTNESS LIMITS

Type of Ware	Grade	Red	Yellow	Green	Blue	Lunar White	White	R_m*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Diffusing ware, Aviation Colours	B (*Min*)	—	—	—	—	—	0·800	80
	B (*Max*)	—	—	—	—	—	1·200	120
Diffusing ware, Identification Colours	B (*Min*)	0·048	0·400	0 048	—	0·120	—	40
	B (*Max*)	0·120	1·000	0·120	—	0·300	—	100

*R_m values are minimum or maximum acceptable readings when transmission ratios are tested on the relative basis specified above.

5.1.5.3 *Assembled equipment* — When lighting units use incandescent lamps as illuminants and it is not practicable to inspect the light-transmitting ware by itself, units utilizing diffusing ware shall conform to the requirements for brightness, but units using non-diffusing ware shall not be tested for transmission. In such cases, the procurement order shall contain luminous requirements covering the performance of the assembled unit.

5.1.6 The physical strength of lenses shall be sufficient to enable them to withstand normal outdoor rough service. The outside surfaces of the lenses shall be resistant to abrasion so that blowing sand, snow or blast from the jet engine exhaust will not affect their performance. The material of the lenses shall not be affected chemically by the oil and gasoline fumes at airports. The colouring matter of the lenses shall be uniformly diffused throughout.

5.1.7 *Bubble Obstruction*

5.1.7.1 The distribution of bubbles shall be reasonably uniform throughout the lens filter. The percentage of useful surface obstructed by bubbles (B) shall not exceed one. This percentage shall be determined by multiplying one hundred times the ratio of the sum of the squares of the projected effective diameters of the bubbles (d^2) to the square of the projected effective diameter (D^2), or

$$B = \frac{100\, d^2}{D^2}$$

and shall not exceed 1.

5.1.7.2 The effective diameter of a non-circular cover or bubble is one half the sum of the largest and smallest dimensions of the cover or bubble.

5.1.7.3 The total number of bubbles shall not exceed the number shown below:

Effective Diameter of Bubble	*Number of Bubbles per Effective 1 000 mm² of Projected Area of Cover*
mm	
1·270 to 1·525	5
1·015 „ 1·270	6
0·760 „ 1·015	10
0·510 „ 0·760	17
0·380 „ 0·510	40
0·255 „ 0·380	67
0·130 „ 0·255	155

5.1.7.4 *Large bubbles* — When bubbles larger than 1·27 mm effective diameter are grouped, non-overlaping circular or square area of 1 000 mm^2 of projected pattern in such a way that no unit of area has more than 5 bubbles. No more than 8 bubbles greater than 1·27 mm effective diameter shall be allowed within any 1 000 mm^2 of projected area.

5.2 Socket (Lamp Holder) — The socket for the lighting fittings shall be either (a) medium pre-focus base type (P 28/24) or (b) prong type base with 15·9 mm spacing between prongs and shall be capable of carrying at least 10 A and insulated for 250 V. All electrical conducting parts shall be made of corrosion-resistant, high conductivity materials. Aluminium shall not be used.

5.3 Housing — All metal parts of the housing shall be fabricated from aluminium alloy of Type A5 or A6 conforming to IS : 617-1959*. Copper bearing hardware in contact with aluminium shall be either nickel or zinc plated. A means for drainage shall be provided in the bottom of housing to drain water.

Suitable means shall be provided for holding the lens and reflector assembly securely in place on the metal housing. A continuous metal band fitted either with a trunk latch or an acceptable substitute, to assure a positive holding of the lens assembly shall be provided. The fitting shall include a means for levelling the optical system when mounted on the central column. The levelling adjustment shall be accessible from above with lens removed. Where an asymetrical lens is used, means shall be provided to indicate correct orientation with respect to runway/taxiway centre line. Where lens/reflector assembly is removed for relamping, it shall be keyed for correct orientation. Sighting device shall be included on each unit to check alignment of optical system with respect to adjacent units when installed in

*Specification for aluminium and aluminium alloy ingots and castings for general engineering purposes (*revised*).

place. The unit shall be designed to require no special tools for relamping or for cleaning purposes.

5.4 When parts are plated for corrosion prevention, zinc plating and cadmium plating, wherever used, should be tested in accordance with IS : 1573-1970* and IS : 1572-1968† respectively for service condition 3. For nickel plating, reference shall be made to IS : 4827-1968‡.

5.5 Leads — A connecting lead assembly shall be supplied to make connection between the socket and receptacle of the source of supply. This lead shall consist of an appropriate length of twin tough rubber sheath (TRS) flexible [either silicone rubber insulated or with polychloroprene (PCP) sheath] with neoprene sheath 2·5 mm^2 cross section of 250 V grade conforming to IS : 434 (Part I)-1964§. The lead shall be connected to the socket and terminated in a plug as in Fig. 3(a) or Fig. 3(b). Suitable means shall be proivded to prevent strain at the socket terminals. The moulded plugs shall be made of polychloroprene (PCP).

5.6 Mounting Assembly

5.6.1 The mounting assembly shall consist of a breakable coupling, and a base plate or stake as required. If specified by the purchaser a pipe column may be provided. The overall height of the unit, mounted in place, shall not exceed 350 mm above ground level. All parts of the mounting assembly shall be made of non-ferrous metal or ferrous metal protected against corrosion. Where they are plated with zinc or cadmium, they shall conform to the requirements of **5.4**.

5.6.2 The breakable coupling shall be firmly secured to the base plate or stake. The coupling shall have a 'shearing' groove produced by securing, moulding, etc, which will withstand a static load of 1 400 N with less than 15 mm deflection when the load is applied perpendicular to the axis of the coupling at a point 300 mm above the shearing groove. The coupling shall break clearly at the groove when a static load of 2 500 N is applied at the same point. The breakable coupling shall also be provided with one or more drainage holes near the shearing groove.

5.6.3 The base plate or the metal stake of the fittings shall be designed to receive the breakable coupling. These shall be designed such that when assembled to the breakable coupling, the shearing groove on the coupling shall be not more than 30 mm above the top of the base plate/metal stake. Unless otherwise specified, the base plate shall have a bolt hole circle of diameter 260 mm to receive six bolts of size M 10.

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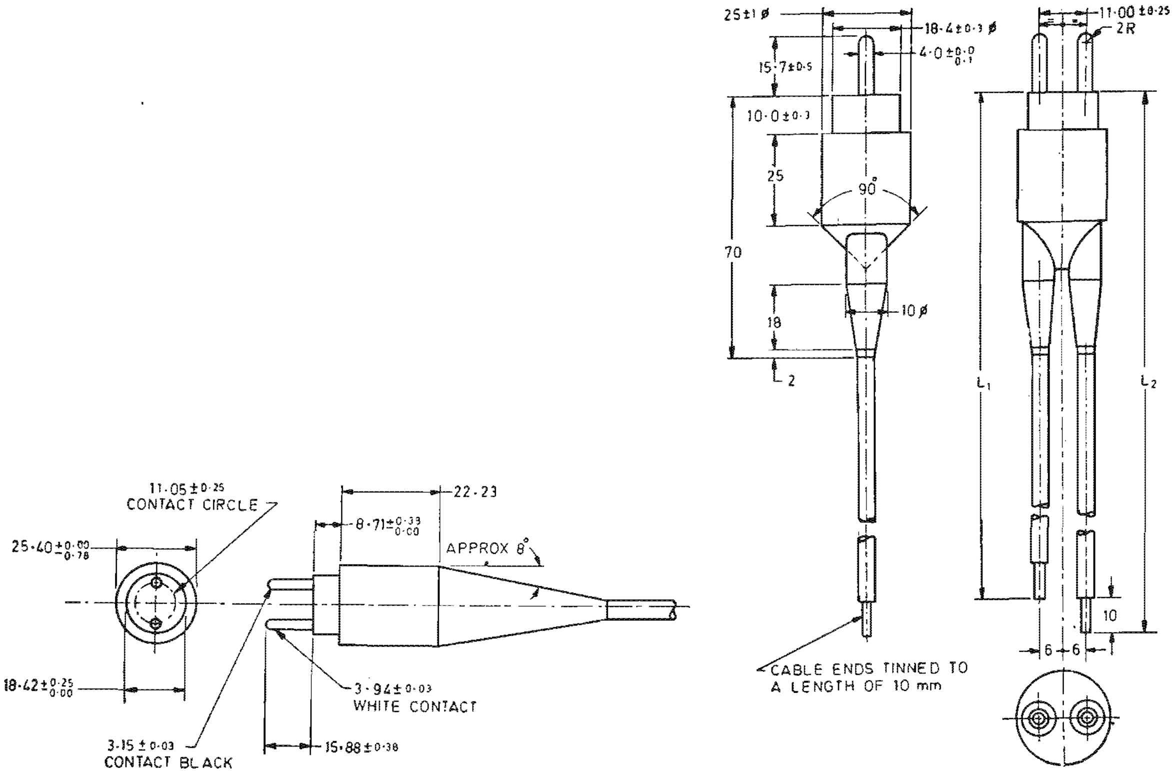
*Specification for electroplated coatings for zinc on iron and steel (*first revision*).

†Specification for electroplated coatings of cadmium on iron and steel (*first revision*).

‡Specification for electroplated coatings of nickel and chromium on copper and copper alloys.

§Specification for rubber insulated cables : Part I With copper conductors (*revised*).



3A Type 1 3B Type 2

All dimensions in millimetres.

Fig. 3 Plug Types

5.6.4 *Gaskets* — The gasket material between the metal part of housing and glass shall be such that it is watertight and heat resistant and it shall withstand temprature of 90°C without damage. Wherever a base flange is used with a gasket, it shall be such that it has a minimum thickness of 3 mm and provides a watertight joint.

5.6.5 *Fastners* — All fastners shall be suitably protected against corrosion by cadmium plating. The cadmium plating shall conform to service condition 3 of IS : 1572-1968*.

5.7 Painting — Paint for the finish shall be high quality enamel suitable for the drying process used. The colour shall be Golden Yellow (No. 356 of IS : 5-1961†). Paint for the prime coat shall be suitable for the metal treatment involved. The paint finish shall be resistant to heat from the lamp and weathering.

5.8 Tests

5.8.1 *Visual Examination* — The lens/filter glasses shall be examined for bubbles and shall conform to **5.1.7**.

5.8.2 *Photometric Test* — The optical performance of the lighting fittings shall be determined by the photometric readings. The readings shall be taken with a lamp stabilized for its rated lumen output. The photometric readings shall be taken for the horizontal as well as vertical distribution of light and shall comply with particular light distribution requirement specified in the relevant part of this standard.

5.8.3 *Test for Resistance to Heat*

5.8.3.1 The lighting fittings shall be operated with lamps of maximum wattage to be used, in still air at 27 ± 5°C for one hour, after which the fittings shall, if practicable, be immediately immersed in water at a temperature of 10°C or, if immersion is not practicable, they shall be sprayed with water at a temperature of 10°C in a manner simulating rainfall.

5.8.3.2 The fittings shall be operated at full output in an ambient temperature of 50°C for a period of 24 hours and there shall be no deterioration or permanent deformation of insulating materials or other parts.

5.8.4 *Test for Temperature Shock* — The lens/filters of the fittings shall be heated in an oven to a temperature of 100 ± 2°C for one hour. They shall then be immediately immersed in water at a temperature of 0 to 5°C. No cracking or other failure should occur.

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*Specification for electroplated coatings for cadmium on iron and steel (*first revision*).
†Specification for colours ready mixed paints (*second revision*).

5.8.5 *Test for Temperature-Rise* — The test for temperature-rise shall be conducted in accordance with **11.7** of IS : 1913-1969*. The temperature at any point of the holder shall not exceed 200°C. After this test, insulation resistance shall be measured in accordance with **11.2** of IS : 1913-1969*and the value thus measured shall not be less than 0·1 MΩ.

5.8.6 *Rainproof Test* — This test shall be conducted in accordance with **11.5.2** of IS : 1913-1969* which is applicable for rain-proof class of lighting fittings.

5.8.7 *Insulation Resistance (Dry) Test* — This test shall be conducted in accordance with **11.2** of IS : 1913-1969*.

5.8.8 *High Voltage Test* — This test shall be conducted in accordance with **11.3** of IS : 1913-1969*.

5.8.9 *Test for Mechanical Strength*

5.8.9.1 *For lead* — The plug connected to the socket shall not show any evidence of separation when subject to a static full load of 50 N.

5.8.9.2 *For breakable couplings* — This test shall be performed with the couplings secured tightly in a base plate which has been bolted rigidly. Insert in the breakable couplings a 400 mm length of round aluminium rod suitably turned down at one end to fit tightly in the breakable couplings. The load shall be applied at not more than 250 N per minute until the coupling breaks. The average breaking strength after conducting tests of at least five couplings shall not exceed 2 500 N.

*General and safety requirements for electric lighting fittings (*second revision*).

INDIAN STANDARDS

ON

ILLUMINATING ENGINEERING

IS:

1777-1961 Industrial lighting fittings with metal reflectors
1885(Part XVI/Sec 1)-1968 Electrotechnical vocabulary: Part XVI Section 1 General aspects
1885(Part XVI/Sec 2)-1968 Electrotechnical vocabulary: Part XVI Section 2 General illumination, lighting fittings and lighting for tı signalling
1913-1969 General and safety requirements for electric lighting fittings (*first r*
1944-1970 Code of practice for lighting of public thoroughfares
1947-1961 Flood lights
2149-1970 Luminaires for street lighting (*first revision*)
2206(Part I)-1962 Flameproof electric lighting fittings: Part I Well-glass and types
2493-1963 Well-glass lighting fittings for use underground in mines (non-fl 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(Part I)-1966 Code of practice for interior illumination: Part I Principles lighting and aspects of design
3646(Part II)-1966 Code of practice for interior illumination: Part II Sch values of illumination and glare index
3646(Part III)-1968 Code of practice for interior illumination: Part III Calcu 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
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7785(Part I)-1975 Elevated type aerodrome lighting fittings: Part I requirements

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