मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS ON

LED LIGHTING AND LUMINAIRE

Prepared By:

ELECTROTECHNICAL DEPARTMENT

BUREAU OF INDIAN STANDARDS NEW DELHI

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Introduction

LED (Light Emitting Diode) is a semiconductor device that emits light when an electric current passes through it. LEDs are highly energy-efficient, have a long operational life, and are widely used in applications ranging from general lighting to displays and signalling systems. Their efficiency, durability, and compactness make it an essential component in modern lighting technology.

LED lighting comes in various forms tailored to specific applications, with the most common types being LED bulbs, battens, and double-capped linear lamps.

LED bulbs are widely used for general indoor lighting in residential, commercial, and hospitality settings. They are designed as direct replacements for incandescent or CFL bulbs.

LED battens serve as linear lighting solutions for homes, offices, shops, schools, and corridors. These sleek, integrated fixtures replace traditional fluorescent tubes.

Double-capped linear LED lamps, such as T8 and T5 LED tubes, are primarily used as retrofit solutions for existing fluorescent fittings in offices, industrial spaces, parking areas, and commercial establishments.

In the context of lighting, it is important to differentiate between an LED light and a luminaire. An LED light typically denotes a self-contained light source. On the other hand, a luminaire is a complete lighting unit that includes one or more light sources (which may be integrated or replaceable), along with all components necessary for distributing, positioning, and protecting the light and connecting it to the power supply.

Luminaires come in a wide range of designs and configurations for specific lighting needs. The most common types include ceiling-mounted fixtures, recessed lights, wall-mounted fittings, and outdoor floodlights.

1. Indian Standards related to LED Lighting

1.1 Product Standards

1.1.1 Self - Ballasted LED Lamps for General Lighting Services - IS 16102 (Part 1 & Part 2)

Self-ballasted LED lamps *are a type of LED (Light Emitting Diode) lighting solution that includes an integrated driver or ballast within the lamp itself. This means it can be directly screwed into traditional lighting sockets (like E26, E27, or GU24) without needing an external ballast or driver.*

i) Part 1 Safety Requirements

This standard specifies the safety and interchangeability requirements, together with the test methods and conditions of Self- Ballasted LED lamps.

It specifies various tests such as: Insulation resistance, Ac voltage tests, and Resistance to heat and flame, Mechanical strength, Protection against electric shock and Cap temperature rise.

This standard prevents risks such as electrical hazards, overheating, and mechanical failures and also protect consumers by ensuring that these lamps are safe to use. Additionally, it contributes to improving the overall quality and reliability of LED lighting products.

ii) Part 2 Performance Requirements

This standard specifies the performance criteria, test methods, and conditions to ensure compliance of self-ballasted LED lamps with integral means for stable operation, intended for domestic and similar general lighting purposes.

The standard includes both type and acceptance testing. It includes test like: Marking, Dimensional checks, Endurance testing, Verification and Type tests. These tests ensure that self-ballasted LED lamps meet performance criteria such as efficacy, luminous flux, and lifespan.

1.1.2 LED Modules for General Lighting - IS 16103 (Part 1 & Part 2)

LED modules *are pre-packaged units containing multiple Light Emitting Diodes (LEDs), along with other necessary components like a driver, heat sink, and sometimes lenses or reflectors. These modules are designed to simplify the integration of LEDs into various lighting applications, offering a convenient, energy-efficient, and long-lasting lighting solution.*

i) Part 1 Safety Requirements

This standard specifies the safety requirements for LED modules intended for general lighting applications, ensuring their safe operation and use.

This standard includes various tests such as: Marking test, Provision for protective earthing, Protection against accidental contact with live parts, Moisture resistance and insulation, Electric strength, Resistance to heat, fire and tracking and Resistance to corrosion. These tests ensure protection against electrical, thermal, and mechanical hazards.

ii) Part 2 Performance Requirements

This standard specifies the performance criteria, test methods, and conditions required to demonstrate compliance for LED modules intended for general lighting applications.

The standard includes: Marking and labelling test, Luminous flux and efficacy, Color parameters (CCT, CRI), Endurance test, Dimensional check and Verification tests. These tests ensure the performance requirements for LED modules, including parameters like luminous flux, efficacy, and lifetime.

1.1.3 Double- Capped LED Linear Lamps - IS 16614 (Part 1 & Part 2)

Double-Capped LED Linear Lamps *are LED lamps that have two caps (one at each end) designed to fit into existing linear tube fixtures that traditionally housed fluorescent tubes. These lamps use LED technology to provide energy-efficient, long-lasting illumination, and are commonly used as a retrofit solution for upgrading traditional fluorescent lighting systems.*

i) Part 1 Safety Specification

This standard specifies the safety and interchangeability requirements for double-capped LED linear lamps. These lamps are designed to retrofit and replace traditional fluorescent lamps with G5 and G13 caps, commonly used in general lighting applications.

The standard includes: Marking test, Interchangeability test, Pin-safety during insertion, Protection against accidental contact with live parts test, Insulation resistance test, Electric strength test, Cap temperature rise test, Resistance to heat test, Resistance to flame and ignitation test, Fault conditions test, IP test, Creepage and clearances distance test. These tests ensure that double-capped LED linear lamps meet essential safety standards, protecting users from electrical, mechanical, and thermal hazards.

ii) Part 2 Performance Specification

This standard specifies the performance requirements, together with the test methods and conditions, required to show compliance of double-capped LED linear retrofit and conversion lamps, with G5 and G13 caps in general lighting applications.

The standard includes: Marking test, Dimension test, Power factor measurement, Total Harmonic Distortion (THD) test, Luminous intensity distribution, Peak luminous intensity measurement, Beam angle determination, chromaticity coordinates and Correlated Color Temperature (CCT), Color Rendering Index (CRI) evaluation, Luminous efficacy measurement, Lamp life test, Endurance test. These tests ensure double-capped LED linear lamps meet performance requirements like efficacy, luminous flux, and lifespan, promoting energy-efficient, reliable lighting solutions

1.1.4 Particular Requirements for Electronic Controlgear for LED Modules - IS 15885 (Part 2/ Sec 13)

This standard specifies particular safety requirements for electronic control gear for use on d.c. supplies up to and including 1 000 V and a.c. supplies up to and including 1 000 V at 50 Hz and at an output frequency which can deviate from the supply frequency, associated with LED modules.

The standard includes: Marking test, Protection against accidental contact with live parts, Provisions for protective earthing, Moisture resistance and insulation test, Electric strength test, Transformer heating test, Resistance to heat test, creepage and clearances distances test, Resistance to corrosion test. These tests helps to prevent electrical, thermal, and mechanical hazards, ensuring that controlgear operates reliably and safely.

1.2 Test Methods

1.2.1 Lumen Maintenance of Solid State Light (LED) Sources - IS 16105

This standard specifies the method of measurement of lumen maintenance of LED packages, arrays and modules only.

The standard includes: Lumen maintenance test, Case temperature control test, Chromaticity shifts measurement (optional) test, Environmental condition monitoring test, Sample verification test. These tests ensure enhancing product quality, reliability, longevity, and performance of LED products by providing a standardized method for evaluating lumen maintenance.

1.2.2 Electrical and Photometric Measurements of Solid State Lighting (LED) Products- IS 16106

This standard specifies procedures for performing reproducible measurements of total luminous flux, electrical power, luminous intensity distribution, and chromaticity of LED-based lighting products under standard test conditions.

This standard includes following testing equipments:

i) *Integrating Sphere*- Measures total luminous flux, luminous efficacy, CCT, and CRI;
ii) *Goniophotometer*- Measures luminous intensity distribution, beam angle, and spatial light distribution;
iii) *Spectroradiometer*- Measures spectral power distribution, chromaticity, CCT, and CRI; and
iv) *Photometer Head*- Measures illuminance or luminous intensity at a specific point.

It also provides a systematic method for measuring the electrical and photometric characteristics of LED products.

1.2.3 Photobiological Safety of Lamps and Lamp Systems - IS 16108

This standard specifies the photobiological safety of lamps and lamp systems including luminaires. it also defines the exposure limits, reference measurement technique and classification scheme for the evaluation and control of photobiological hazards from all electrically powered sources of optical radiation, including LEDs but excluding lasers, in the wavelength range from 200 nm through 3000 nm.

Key Areas Covered:

a) ***Exposure Limits*****-** The standard outlines specific factors affecting retinal exposure limits, including pupil diameter**,** angular subtense of the source, and the measurement field-of-view.
b) ***Measurement of Lamps and Lamp Systems*****-** It specifies measurement conditions and measurement procedures to accurately assess the optical radiation emitted by lamps and lamp systems.
c) ***Lamp Classification*****-** Lamps are classified based on their emission characteristics into continuous wave lamps and pulsed lamps**.**

2. Indian Standards related to Luminaires

2.1 Product Standards

2.1.1 IS 10322 series (Part 1 & Part 5)

i) General Requirements and Tests of Luminaires - IS 10322 (Part 1)

IS 10322 (Part 1) outlines the general requirements and tests for luminaires incorporating electric light source for operation from supply voltages up to 1 100 V. The requirements and related tests of this standard covers:

a) Classification;
b) Marking;
c) Mechanical construction; and
d) Electrical construction.

ii) Particular Requirements of Luminaires - IS 10322 (Part 5)

IS 10322 (Part 5) provides particular requirements for various types of luminaires. This part is divided into multiple sections, each focusing on specific categories of luminaires to ensure safety, performance, and quality.

IS 10322 (Part 5) comprises the following sections:

a) Section 1 Fixed General Purpose Luminaires

This standard specifies requirements for fixed general purpose luminaires for use with tungsten filament, tubular fluorescent, LED, LED modules and other discharge lamps on supply voltage not exceeding 1 000 V.

b) Section 2 Recessed Luminaires

This standard specifies requirements for recessed luminaires for use with tungsten filament, tubular fluorescent, LED, LED modules and other discharge lamps on supply voltage not exceeding 1 000 V.

c) Section 3 Luminaires for Road and Street Lighting

This standard specifies requirements for road and street lighting luminaries.

d) Section 4 Portable General Purpose Luminaires

This standard specifies requirements for portable general purpose luminaires, other than handlamps, for use with tungsten filament, tubular fluorescent and other discharge lamps on supply voltages not exceeding 250 V.

e) Section 5 Floodlights

This standard specifies requirements for floodlights for use with tungsten filament, tubular fluorescent LED, LED modules and other discharge lamps on supply voltages not exceeding 1 000 V.

f) Section 6 Handlamps

This standard specifies requirements for handlamps and similar portable luminaires which are held in the hand, hooked up or resting on a surface for use with electric light sources on supply voltages not exceeding 250 V.

g) Section 7 Lighting Chains

This standard specifies requirements for lighting chains fitted with series, parallel or a combination of series/parallel connected light sources for use either indoors or outdoors on supply voltages not exceeding 250 V.

h) Section 8 Emergency Lights

This standard specifies requirements for emergency lighting luminaires for use with electrical light sources on emergency power supplies not exceeding 1 000 V

i) Section 9 Rope Lights

This standard specifies requirements for rope lights (sealed lighting chains) fitted with non-replaceable series- or parallel- or a combination of series/parallel-connected light sources for use either indoors or outdoors on supply voltages not exceeding 250 V.

2.2 Test Methods

2.2.1 Performance Requirements for Luminaires - IS 16107 (Part 2/ Sec 1 & Part 2/ Sec 2)

i) Section 1- LED Luminaire

This standard specifies the performance requirements for LED luminaires, together with the test methods and conditions.

The standard includes: Marking test, Luminaire power test, Luminous flux test, Light intensity test, Angular beam distribution test, Luminaire efficacy test, Life test, Endurance test, Chromaticity coordinates and Correlated Colour Temperature (CCT) test, Colour Rendering Index (CRI) test. These tests ensure energy-efficient, effective, safe, and reliable LED luminaires for various lighting applications.

ii) Section 2 - LED Street Lighting Luminaire

This standard specifies design of LED luminaires for street lighting, ensuring their performance meets specified criteria for efficiency, durability, and safety.

The standard includes: Marking test, Total input power test, Power factor test, Luminaire efficacy test, Chromaticity tolerance, Correlated Colour Temperature (CCT) test, Colour Rendering Index (CRI) test. These tests ensure safe, efficient and reliable lighting of LED street light for public spaces.

2.2.2 Photometry of luminaires - Method of Measurement - IS 13383 (Part 1, Part 2 & Part 3)

i) Photometry of Luminaires for use in Interior Lighting - IS 13383 (Part 1)

This standard covers methods of photometry for luminaires designed primarily for indoor use with lamps for general lighting service and suitable for ac electricity supply up to 250 V at 50 Hz.

ii) Photometry of Luminaires for Road and Street Lighting - IS 13383 (Part 2)

This standard applies to testing of luminaires designed primarily for road and street lighting, suitable for ac electricity supply and using the following lamp types:

a) High pressure mercury vapour;

b) Blended or self — ballasted mercury vapour;
c) Low pressure sodium vapour;
d) High pressure sodium vapour;
e) Tubular fluorescent;
f) Incandescent; and
g) Tungsten halogen.

iii) Photometry of Luminaires for Floodlighting - IS 13383 (Part 3)

This standard covers the photometry of floodlights used for interior and exterior lighting purposes and equipped with incandescent or discharge (including tubular fluorescent) electric lamp or with reflector lamps.

3. Code of Practices

3.1 National Lighting Code - SP 72

The National Lighting Code (NLC) offers guidance on lighting practices for various types of occupancies, covering the design, selection, installation, and maintenance of indoor and outdoor lighting systems.

It also addresses scientific principles of illumination, including light sources, luminaires, and photometry, and emphasizes the integration of daylighting in design. The code also promotes energy efficiency by providing guidelines for effective energy management and conservation in lighting installations.

This NLC is divided into 13 parts some of which are having sections making a total of 29 parts and sections as given-

Part 1 Lighting vocabulary;
Part 2 Physics of light in 3 sections;
Part 3 Electric light sources and their accessories in 2 sections;
Part 4 Luminaires in 2 sections;
Part 5 Interior illumination in 5 sections;
Part 6 Exterior illumination in 7 sections;
Part 7 Lighting for hazardous areas;
Part 8 Road lighting;
Part 9 Energy-effective lighting systems;
Part 10 Installation aspects for lighting in 3 sections;
Part 11 Daylighting for buildings;
Part 12 Emergency lighting; and
Part 13 Lighting maintenance.

3.2 Code of practice for Interior Illumination - IS 3646 (Part 1)

i) Part 1 General Requirements and Recommendations for Working Interiors

This code covers the principles and practice governing good lighting in buildings and relates chiefly to the lighting of working area's in industrial, commercial and public buildings, hospitals and schools.

Key Areas Covered:

a) ***Functions of Lighting*** **-** Visual performance, Visual comfort, Safety;
b) ***Lighting Requirements*****-** Lighting criteria, Visual tasks, Economic aspect, Lighting levels, *Illuminance, Glare****,*** Illuminance requirements and recommendations;
c) ***Lighting Design Considerations***- Maintenance factor, Energy efficiency requirements, additional benefits of daylight, Room brightness; and
d) ***Specific Lighting Requirements in Various Areas in Industrial Zones -***

- *Traffic zones inside Buildings*
- *General areas inside Buildings*
- *Logistics and Warehouses*
- *Industrial Activities and Crafts*
- *Offices*

- *Retail Premises*
- *Places of Public Assembly*
- *Educational Premises*
- *Health Care Premises*
- *Transportation Areas*

3.3 Code of Practice for Road and Tunnel Lighting - IS 1944

This code provides guidance to public lighting authorities who are concerned with the preparation of public lighting schemes, their installation and maintenance. This code deals only with electric lighting sources.

Key Areas Covered in ***Road Lighting*** for Specific Areas:

a) Lighting parameters for Category 'A' roads;
b) Lighting parameters for Category 'B' roads;
c) Lighting parameters for junctions and conflict areas;
d) Lighting parameters Pedestrian areas and toll plazas;
e) Lighting parameters bus and truck bays; and
f) Lighting parameters motorized roads.

Key Areas Covered in ***Tunnel Lighting***:

a) Interior zone luminance;
b) Luminance ratios for various speeds; and
c) Traffic density.

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