

NORTHERN RAILWAY

TECHNICAL SPECIFICATION FOR LED BASED LUMINARIES (INPUT VOLTAGE SINGLE PHASE 230 VOLT AC, 50Hz) FOR GENERAL SERVICES APPLICATIONS

Spec No. CEE/NR/121-Elect/PS/2018 (Rev.-'3') Dated: 28.06.2018


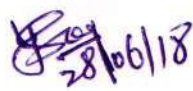
ISSUED BY

OFFICE OF THE CHIEF ELECTRICAL ENGINEER
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Valid Till 30.06.2019

Approved by:


CEGE/NR

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TECHNICAL SPECIFICATION FOR LED BASED LUMINARIES (INPUT VOLTAGE SINGLE PHASE 230 VOLT AC, 50Hz) FOR GENERAL SERVICES APPLICATIONS AND LED BASED SIGNAGES.

1.0 SCOPE:

This specification defines the requirement of Design, Manufacture, Supply, Testing & Inspection of LED based luminaries/fixtures for various applications such as Street Lights, Office Buildings, Platform Lighting and LED based signages etc. for General services over Northern Railway for indoor & outdoor applications.

2.0 REFERENCE STANDARDS:

The following documents given below are for reference to the manufacturer for design, manufacture, performance, safety, environmental, biological & other type test requirements. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall prevail.

IS/IEC:

SN	Specification no.	Description
1.	IEC: 61347-2-13/EN: 61347-2-13/ IS:15885 (Part-2/Sec.-13)-2012	LED Driver Safety Requirements- Lamp control gear; particular requirements for DC or AC supplied electronic control gear for LED modules.
2.	IEC:62384/IS:16104-2012	LED Driver Performance Requirements-DC OR AC supplied electronic control gear for LED modules performance requirements
3.	IS:14700 (Part-4/Section-2)	Standard Testing of LED Driver
4.	CISPR-15/IS:6573, IEC:61547	EMI/EMC tests for LED Driver
5.	IEC: 62031/ IS: 16103 (Part- 1 & 2)- 2012	LED Modules for general lighting- Safety Requirements and Performance Requirements.
6.	IS: 16101-2012	General Lighting-LED/LED module – Terms and Definitions
7.	IS: 16102 (Part-I &II)-2012 & IEC/PAS 62612	Self Ballasted LED Lamps for General lighting Services (Safety Requirements & Performance Requirements).
8.	IS: 16104-2012	Electronic Control Gear for LED modules – Performance Requirements

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9.	LM-80/IS:16105-2012	Approved Method for Measuring Lumen Maintenance of LED Light Source
10.	LM-79/IS:16106-2012	Approved Method for Electrical and Photometric Measurements of Solid State LED Lighting Products.
11.	L-70 (IEC-60081-1997)/IS:16107-Part--2	LED Life Expectancy
12.	IEC:62471/EN: 62471/IS:16108-2012	LED Photo Biological Safety requirements.
13.	IEC: 60571/IS: 9000	Luminaries- Environmental Requirements
14.	IEC: 60068-2-38	Environmental Testing/ Humidity Cycle Test
15.	IEC:60332-1/IS: 11000	Luminaries-Fire Retardant Test
16.	IEC:60081-1997 (Annexure-B,C &D)/ANSI_NEMA_ANSLG C78.377-2008	Ra (Colour Rendering Index) Measurement Test
17.	IEC:60529	Luminaries- Ingress Protection Test.
18.	IEC: 60598-2-1/ 60598-1	Fixed General Purpose Luminaries/ Luminaries-General Requirement & Tests
19.	IEC: 61000-3-2	EMC (Electro Magnetic Compatibility)- Limits for Harmonic Current Emission
20.	IS: 513	Specification of Cold Rolled Low Carbon Steel Sheets and Strips
21.	IS: 4905	Method of Random Sampling
22.	IS: 10322 (Part-5/Sec.-1)- 2012 & Part-1	Requirements of fixed general purpose LED Luminaries
23.	IEC: 61373	Electric shock Testing

3.0 COMMON TECHNICAL PARAMETERS FOR ALL TYPES OF LED LUMINARIES:

3.1 GENERAL TECHNICAL REQUIREMENTS:-

- 3.1.1 The suitable connector make-Tyco/Wago/Molex/Phoenix shall be provided for LED connection between driver output and LED for high power LED luminaries and for low power LED fittings connection with confermer coating.
- 3.1.2 The material of grommet shall be of Silicon rubber and PG gland of make-Rotex/Intraflux/Roster/Jigo/Phoenix should be provided.
- 3.1.3 LED of make Nichia/Osram/Samsung/Lumiled/Cree/Seoul.
- 3.1.4 MOV (Metal Oxide Variaster) of make-Epcos/Littlefuse/ Samwha/ Bourns/ Vishay to be provided.
- 3.1.5 The illumination of luminaries will be uniform without dark bands or abrupt variations and smoothing to the eyes.
- 3.1.6 The luminaries works on single phase three core wires system (Phase, Neutral & Earth). Length of 50CM 'ISI' marked three core wire shall be provided with LED luminaries & LED tube light fittings.
- 3.1.7 LM 79 Test report in respect of LED luminaries of manufacturer shall be provided along with supply of material.
- 3.1.8 LM 80 Test report of the LED chip of LED manufacturer shall be provided along with supply of material.
- 3.1.9 Power Factor of luminary shall be ≥ 0.90 at full load.
- 3.1.10 The nominal voltage of luminary shall be 230 Volt AC $\pm 5\%$, 50Hz.
- 3.1.11 The input operating voltage of luminary shall be 140V- 270 Volt AC.
- 3.1.12 The working temperature of luminary shall be -10°C to 50°C
- 3.1.13 The insulation resistance between Earth & current carrying part shorted together shall not be less than 100 M ohm at 60% RH with 500 V megger & after HV test.
- 3.1.14 The complete unit cubicle together with its mounting arrangement shall be subjected to shock testing as per latest IEC 61373.
- 3.1.15 The firm shall provide the technical details as per Annexure-'A' attached.
- 3.1.16 The tolerance limit of technical parameters wherever not given shall be applicable as per relevant IS/IEC.

3.2 LED/ LED LIGHT SOURCE

S.N.	Description	Specification
3.2.1	LED make	NICHIA/OSRAM/SAMSUNG/LUMILEDS/CREE/SEOUL
3.2.2	LED type	<p>(a) <u>For Street Lights, High Mast Lights, Low Bay/Medium Bay/High Bay - High Power LED (Ceramic/EMC package) ($\geq 1\text{ watt}$)</u></p> <p>(b) <u>For LED Bulbs, LED tube light fittings & LED Signages -Low Power LED ($\leq 1\text{ watt}$)</u></p>
3.2.3	Lumen Output	<p>≥ 140 Lumens/ Watt – For High Power LED</p> <p>≥ 110 Lumens/ Watt – For Low Power LED</p>

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3.2.4	LED Life Expectancy	≥ 50,000 burning hours (To be supported by LM 80 Report & TM21 Report of manufacturer of LED chip)
3.2.5	Beam Angle of LED	120°
3.2.6	Range of Color Temperature	5500-6500K
3.2.7	Color Rendering Index	≥70 – For street lights & high mast fittings ≥80 – For LED Bulbs & LED tube light fittings
3.2.8	LED Wattage	LED should not be operated more than 90% of rated capacity in luminary

3.3 LED DRIVER

3.3.1	Driver type	Constant current driver with short circuit & open circuit protection The LED driver shall be required compulsory registration as per IS: 15885 (Part-2/sec.-13)- 2012 from 'BIS' in favour of tenderer or other authorized manufacturer.
3.3.2	THD (Current)	<10%
3.3.3	Driver Efficiency	Up to 100 watt : >85% (Minimum) Above 100 watt : >90% (Minimum)
3.3.4	Driver components	Industrial Grade or above. Driver current should be less than rated current of component used to meet the rated life.
3.3.5	PCB	PCB shall be FR4 grade minimum 0.8-1.0 mm thick or more to be fixed with high thermal conductive paste or tape on the extruded Aluminum heat sink for Street Light & High Mast Light. For LED Bulbs & LED tube light the same may be provided, if required
3.3.6	Driver Cut in & Cut off Voltage	The driver should be designed at cut in voltage 120 volt AC & cut off voltage at 300 volt AC
3.3.7	Junction Temperature	Switching Device such as Transistors & MOSFETs etc. shall not exceed 85 deg. C (allowing thermal margin of 25 deg. C)

3.3.8	Surge Protection	<p>(1) <u>Internal Voltage Surge Protection</u> : To protect the luminaire from switching surges, the driver of all luminaries should have internal surge protection of MOV of ≥ 2.5 KV (Metal Oxide Varister) of Make-Epcos/Littlefuse/Samwha/Bourns/Vishay(on board).</p> <p>(2) <u>External (SPD) Surge Protection Device (For Street Light fittings, High Mast Lights, Low Bay/Medium Bay/High Bay)</u>: External Surge protection of minimum 10 KV to be separately installed with the each fixture. (As per ANSI C 136.2- 2014). However, MOV make will be same as per Para 3.3.8 (1)</p>
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4.0 TECHNICAL PARAMETERS FOR LED STREET LIGHT/HIGH MAST LIGHT:
General Technical Requirements of Luminaries Para 3.1, Specification of LED & LED Driver Para 3.2 & 3.3 will remain applicable

4.1	System Lumen efficacy of the complete Luminary	≥ 110 lm/Watt (+/- 5%)
4.2	Finishing	Anodized/Powder coated
4.3	Lamp Cover	Distortion free, clear, heat resistance Toughened Glass of thickness 4.0mm of material make-Mico/Bricker/Asahi/Saint gobain/Borosil/Laopala
4.4	Secondary optics	Polycarbonate Lens make-Ledlink/Ledil/kathod/Optica/Bicom
4.5	Mounting	Suitable for existing pole/ Universal with dedicated mounting Kits/Bracket Mounting of adjustable type.
4.6	Ingress protection	IP-66
4.7	Construction of Housing	Single Housing, Side entry, High Pressure aluminum die cast/extruded aluminum, grey color corrosion resistant polyester powder coating with separate optical and control gear compartments. The housing shall be high conductivity (LM6/ADC12/LM24) with integral heat sink & heat proof silicon rubber.
4.8	Gasket between housing & cover	Silicon Gasket

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4.9	Impact Resistance	IK-07
4.10	Type of Power Supply	SMPS
4.11	Over Voltage Protection	Unit shall withstand 300 Volt AC for One Minute and cut off. It will automatically 'ON' when voltage comes in operating voltage range.
4.12	Reverse Polarity	Shall be operated with Reverse Voltage for Three Minutes at Maximum Value of Voltage Range
4.13	High Voltage Test	Shall be Tested at 1500 Volt AC for One Minute between Supply Terminals & Body of the Unit.
4.14	Fixing of Cover Frame	The cover to be fixed to the housing by means of stainless steel screws.

5.0 TECHNICAL PARAMETERS FOR LED TUBE LIGHT (LAMP) & TUBE LIGHT FITTING:

General Technical Requirements of Luminaries Para 3.1, Specification of LED & LED Driver Para 3.2 & 3.3 will remain applicable

(a) LED TUBE LIGHT (Lamp)

5.1	Type of Tube Light	T8, Indoor Type
5.2	Length	1200mm/600mm (+/- 2%)
5.3	System Lumen Efficacy	100 lm/W (+/- 5%)
5.4	LED tube light lamp construction	The LED tube light (lamp) shall be with inbuilt control driver and designed in such a way that driver should fitted in the LED tube light (lamp) or LED driver shall be fixed to the lamp in such a way that the driver end cap shall be detachable/replaceable and they provide access to the driver which may be replaced if defective.
5.5	Ingress Protection	IP20

5.6	Lamp Cover/Diffuser	The diffuser of polycarbonate sheet shall be milky to ensure uniformity of light and Polycarbonate material shall be fire retardant conforming to UL94-VO grade made from "Lexan SP 24-492x" (not less than 0.8-1.0mm thick) of GE plastic/Bayer/Mitsubishi/Sabic/ LG/Makvolon/Samsung make.
5.7	Wattage of LED used in Package	≤1 watt
5.8	High Surge Protection	As per Para 3.3.8 item no. (1)
5.9	LED Tube Light Heat Sink	Fabricated Aluminum for heat sink shall be with proper thermal management
5.10	End Cap (Both ends)	Fixed to the tube rod on both ends in such a way that these shall be detachable/replaceable

(b) BATTEN/ FITTING WITH LED TUBE LIGHT (LAMP)

5.11	Type of Fitting	Suitable for T8 tube light
5.12	Details of Fixture	Suitable for Single /Double Tube Light (lamp)
5.13	Type of Diffuser	Milky
5.14	Mounting Arrangement	The fixture shall be provided with suitable mounting arrangement for wall mounting as well as for platform mounting on steel structure complete with SS mounting clamps
5.15	Tube Holder	The fixture shall be fitted with Bi-Pin G13 holder suitable for T8 tube light (lamp)
5.16	Batten (Box Type)	The batten should be high pressure Die-Cast/ extruded aluminum with ADC12 alloy or CRCA sheet (0.6mm thick) power coated to white colour
5.17	Tube light (lamp)	Specification of Tube light (lamp) will remain applicable as per para 5.0 (a)

6.0 TECHNICAL PARAMETERS FOR LED BULBS:

General Technical Requirements of Luminaries Para 3.1, Specification of LED & LED Driver Para 3.2 & 3.3 will remain applicable

6.1	Type of Bulbs	LED Bulb up to 23 Watt
6.2	Type of Base	B 22
6.3	System Lumen Efficacy of the Bulb	100 lm/W (+/- 5%)
6.4	High Surge Protection	As per Para 3.3.8 (1)
6.5	Beam Angle of Luminary	270°
6.6	Construction of Housing	Injection molded plastic housing with Aluminum insert minimum thickness 1.0 mm
6.7	Lamp Cover/Diffuser	Polycarbonate milky diffuser shall be fire retardant conforming to UL94-VO grade made from "Lexan SP 24-492x" (not less than 0.8-1.0mm thick) of GE plastic/Sabic/LG/Makvolon/Bayer/Mitsubishi/Covestro make.
6.8	LED Life	≥25,000 burning hours
6.9	Ingress Protection	IP20
6.10	Wattage of LED used in Package	≤1 watt

7.0 TECHNICAL PARAMETERS FOR LED SIGNAGE BOARDS:

General Technical Requirements of Luminaries Para 3.1, Specification of LED & LED Driver Para 3.2 & 3.3 will remain applicable

7.1	Type of Signage	(a) Backlit Signage (b) 3D Character Backlit Signage
7.2	Backlit signage for utility services (a)	SMD (Surface Mounted Device) LED Glow Sign Board etc.
7.3	3D Character Backlit Signage (b)	SMD LED Glow Sign Railway Station Name Boards etc.

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7.4	Color Scheme (a)	Sizes may be referred for the purpose of uniformity and standardization over Northern Railway for Part-I as per Booklet "Signage for Rail users" by Chief Traffic Manager, Delhi, Northern Railway for guidance only. However boards shall be sleek type having thickness equal to or less than 75 mm or 3 inch
7.5	Color Scheme (b)	As per CTM booklet "Signage for Rail uses" for Part-II for guidance only and Size may be decided by Consignee/ Purchaser as per site requirement for station name boards etc. However boards shall be sleek type having thickness equal to or less than 75 mm or 3 inch.
7.6	Luminous Intensity	Backlit Signage: Minimum 990 mcd (milli candela) 3D Character Backlit Signage: Minimum 3000 mcd (milli candela)
7.7	Signage Board	Backlit Signage: Sleek type energy efficient SMD LED based glow sign boards made of MS steel square tube of size 25mm x 25mm x14 gauge for frame and with 24 mm Aluminum, extrusion male- female clip on fixture to catch and release the sheet 3D Character Backlit Signage: The background of board shall be made of 3mm thick ACP (Aluminum composite panel) of prescribed color by consignee. The enclosure shall be fabricated from MS steel square tube of size 25 x 25 mm of 14 gauge.
7.8	Language	All matter shall be written in Hindi, English or other Regional Language in 3 D shape as per purchaser consignee requirement

8.0 GUARANTEE:

The complete luminaire/LED Bulb shall have replacement guarantee for satisfactory performance and manufacturing defects for a period of 60 months from the date of commissioning or 72 months from the date of supply whichever is earlier.

9.0 IDENTIFICATION:

The firm shall embossed/engraved firm name, month & year of manufacture, guarantee period, serial number, rated input voltage & wattage inside & outside the fittings and also screen print on LED Panel and LED Driver, the firm name & year of manufacturing.

10.0 INSPECTION:

The Inspection shall be done by M/s RITES at manufacturers works. In case of works tender, respective Branch Officer will decide/deviate for consignee inspection with proper justification. The manufacturer should have full facility for carrying out acceptance tests as per IS/IEC specification shall be made available by the manufacturer to inspecting authority at manufacturers cost. The inspection of material shall be carried out as per Railway Board letter no. 2000/RS(G)/379/2 dated 10.09.2013 for minimum value of Stores or latest instruction issued from Railway Board.

11.0 TESTS:

The LED, LED driver and luminaries shall be tested with the applicable IS/IEC reference standards given in Para 2.0 of this specification.

11.1 TYPES OF TESTS:**11.1.1 Type Tests:**

Inspecting Agency M/s RITES will verify the documents available with the firm for type tests mentioned in Para 11.1.4 carried out from Govt. Laboratory/National/International Accredited Laboratory to ensure the confirmation with the requirement of specification for the luminaries. For signages, Type Tests mentioned in Para 11.1.4 are not applicable. However, for signages following checks are applicable to Para 7.4, 7.5, 7.6 & 7.7.

11.1.2 Acceptance Tests:

These tests shall be carried out by an Inspecting Agency at the manufacturer works on sample taken from a lot for the purpose of acceptance of material.

11.1.3 Routine Tests:

These tests shall be performed by the manufacturer on each item and the records shall be shown to the Inspecting Agency during the inspection of lot offered for acceptance tests.

11.1.4 TESTS SCHEME:

SN	Description of test	Reference Para of the specification	Type Test	Acceptance Test	Routine Test
1.	Visual and Dimension Check	As per requirements	-	Y	Y
2.	Checking of documents i.e. Bills/Invoice for purchase of LED	Para 3.2.1	-	Y	Y

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3.	Checking of documents of purchase of Connector, Grommet, PG gland, LED Driver & LED Driver Components, MOV	Para 3.1.1 for Connector Para 3.1.2 for Grommet & PG Gland Para 3.3.1 & 3.3.4 for LED Driver & LED Driver Components Para 3.1.4 for MOV	-	Y	Y
4.	Checking of documents of Lamp Cover, Secondary Optics, Diffuser,	Para 4.3 for Lamp Cover Para 4.4 for Secondary Optics Para 5.6 & 6.7 for Diffusers	-	Y	Y
5.	Operating Voltage	Para 3.1.10	-	Y	Y
6.	Input Voltage Range of Luminary	Para 3.1.11	-	Y	-
7.	Over Voltage Protection	Para 4.11	Y	Y	-
8.	HV Test	Para 4.13	-	Y	-
9.	Power Factor	Para 3.1.9 As per IS: 16102 (Part 2)- 2012 Para 15	Y	Y	-
10.	Harmonics (THD)	Para 3.3.2 As per IS: 16102 (Part 2)- 2012 Para 15	Y	--	-
11.	Type of power Supply (SMPS)	Para 4.10	-	Y	Y
12.	High Power LED ≥ 1 watt	Para 3.2.2 (a)	Y*	-	Y
13.	Low Power LED < 1 watt	Para 3.2.2 (b), Para 5.7 & Para 6.10	Y*	-	Y
14.	Beam Angle - LED	Para 3.2.5 (Covered under LM80)	Y*	-	-
15.	LED Life Test (L-70 & TM-21)	Para 3.2.4 & Para 6.8	Y*	-	-
16.	All Tests as per LM-79	Para 3.1.7	Y	-	-
17.	All Tests as per LM-80	Para 3.1.8	Y*	-	-
18.	LED Driver Cut in & Cut off Voltage	Para 3.3.6	Y	-	-
19.	LED Driver Efficiency	Para 3.3.3	Y	-	-
20.	LED Driver Certificate from BIS	Para 3.3.1	Y*	-	-

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21.	High Surge Protection (Street Lights)	Para 3.3.8 (1 & 2)	Y	-	-
22.	Surge Protection (LED Bulbs & LED Tube Lights)	Para 3.3.8 (1), Para 6.4 and Para 5.8	Y	-	-
23.	System Lumen Efficacy	Para 4.1, Para 5.3 & Para 6.3	Y	Y	-
24.	3 Core wire of 50 CM length	Para 3.1.6 (IS: 694)	-	Y	Y
25.	Beam Angle of Luminaries	Para 6.5	Y	-	-
26.	Checking of Tube Light Length & Batten	Para 5.2 & Para 5.17	-	Y	-
27.	Type of Base for LED Bulb	Para 6.2 (As per IS: 16102 (Part 1-2012) Para 6.1)	-	Y	-
28.	Finishing of Luminaries	Para 4.2	-	Y	Y
29.	Mounting of Luminary	Para 4.5 & Para 4.14	Y	Y	-
30.	Construction of Housing of Luminary	Para 4.7 & Para 6.6	Y	Y	-
31.	Gasket of Luminary	Para 4.8	-	Y	Y
32.	Impact Resistance of Luminary	Para 4.9	Y	-	-
33.	Checking of PCB	Para 3.3.5	Y	-	-
34.	Lux Measurement	IS: 16106- 2012, Para 11.0	-	Y	Y
35.	Fire Retardant Test	UL94-VO	Y	-	-
36.	Reverse Polarity	Para 4.12	-	Y	Y
37.	Protection Against Electric Shock	Para 3.1.14 IEC: 61373	-	Y	Y
38.	Junction Temperature	Para 3.3.7	Y	-	-
39.	Working Temperature	Para 3.1.12 IS: 16105- 2012, Para 4	Y	-	-
40.	Wattage Measurement Test	Para 3.2.8 & Para 6.1	-	Y	-
41.	Insulation Resistance Test	Para 3.1.13	-	Y	-

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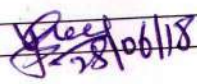
42.	Ra (Color Rendering Index) measurement test	Para 3.2.7 (cover under LM80)	Y*	-	-
43.	CCT (Correlated Colour Temperature)	Para 3.2.6 (Covered under LM80)	Y*	-	-
44.	Test for IP Protection	Para 4.6, Para 5.5 & Para 6.9	Y	--	-
45.	Identification	Para 9.0	-	Y	Y
46.	Luminous Intensity Test For Signages	Para 7.6	-	Y	-
47.	Signages Board	Para 7.4,7.5 & 7.7	-	Y	-

Y - Lab Test Report Documents

Y*- Document to be submitted from OEM


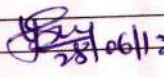
Note: The references for preparation of this specification have been drawn from the RCF specification no. RCF/EL/PS/LED/001, RCF/EL/PS/LED/002 and RDSO specification no. RDSO/PE/Spec./TL/0091-2016 (REV. "1") dated 05.07.2016 for LED luminaries for coaches, relevant information from divisions/HQ of Northern Railway and technical specification of the tender documents for LED luminaries of CPWD & EESL as well as the known developments on LED based lights technology. However, the specification will be reviewed after validation of 30th June '2019' and thereafter to include the developments on LED based technology, if any.

Validity: 30.06.2019

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ANNEXURE-'A'

SN	Description Para as Per specification	Technical Requirement as per specification no. CEE/NR/121-Elect/PS/2018 (Rev.-'3') dated XX.06.2018	Technical Parameter offered by the Firm
Common Technical Parameters For All Types of LED Luminaries			
1.	LED make	NICHIA/OSRAM/SAMSUNG/LUMILEDS/CREE/SEOUL	
2.	Lumen Output	≥140 Lumens/ Watt – For High Power LED ≥110 Lumens/ Watt – For Low Power LED	
3.	Range of Color Temperature	5500-6500K	
4.	Color Rendering Index	≥70 – For street lights & high mast fittings ≥80 – For LED Bulbs & LED tube light fittings	
5.	Driver type	Constant current driver with short circuit & open circuit protection The LED driver shall be required compulsory registration as per IS: 15885 (Part-2/sec.-13)- 2012	
6.	THD (Current)	<10%	
7.	Working Temperature	-10°C to 50°C	
(A) For Street Light/High Mast Light			
(i)	System Lumen efficacy of the complete Luminary	≥110 lm/Watt (+/- 5%)	
(ii)	Ingress protection	IP-66	
(iii)	Surge Protection	1. Internal Voltage Surge Protection : MOV of ≥2.5 KV (Metal Oxide Varister) of Make-Epcos/Littlefuse/Samwha/ Bourns/ Vishay (on board). 2. External (SPD) Surge Protection Device (For Street Light fittings, High Mast Lights, Low Bay/Medium Bay/High Bay): External Surge protection of minimum 10 KV to be separately installed with the each fixture.	
(iv)	Over Voltage Protection	Unit shall withstand 300 Volt AC for One Minute and cut off. It will automatically 'ON' when voltage comes in operating voltage range	
(v)	Wattage of LED used	≥1 watt	
(B) For Tube Light Fitting/Lamp			
(i)	System Lumen efficacy of the complete Luminary	≥100 lm/Watt (+/- 5%)	
(ii)	Ingress protection	IP-20	
(iii)	Surge Protection	MOV of ≥2.5 KV (Metal Oxide Varister) of Make-Epcos/ Littlefuse/ Samwha/Bourns/Vishay (on board)	

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(iv)	Wattage of LED used	≤1 watt	
(iv)	LED tube light lamp construction	The LED tube light (lamp) shall be with inbuilt control driver and designed in such a way that driver should fitted in the LED tube light (lamp) or LED driver shall be fixed to the lamp in such a way that the driver end cap shall be detachable/replaceable and they provide access to the driver which may be replaced, if defective	
(C) For LED Bulb (Lamp)			
(i)	Wattage of Bulb	Wattage as per description	
(ii)	Type of Base	B 22	
(iii)	System Lumen Efficacy of the Bulb	100 lm/W (+/- 5%)	
(iv)	High Surge Protection	MOV of ≥2.5KV (Metal Oxide Varister) of Make-Epcos/Littlefuse/Samwha/Bourns/Vishay (on board)	
(v)	Beam Angle of Luminary	270°	
(v)	Ingress protection	IP-20	
(vi)	Wattage of LED used	≤1 watt	