



Technical Specifications of Energy efficient LED based Luminaries for Outdoor and Indoor application (Western Railway) **Western Railways' Specification No. WR/CCG/Specification/P/001 (Rev. 01) - 2018**

1.0 FOREWORD –

At present conventional type luminaries are provided for indoor lighting, offices, street lights and platform lighting. By introduction of white high power lights emitting diode, LED having more than 50,000 working hours, it is possible to use LED lamps in place of existing fluorescent T-8/ T-5/ HPSV/Metal halide. LED lights are almost maintenance free and as a result total power saving is expected to be more than 50%, keeping in view energy conservation, increased life and recurring savings on account of maintenance, use of environment friendly energy efficient LED based luminary is being considered for indoor and outdoor lighting.

2.0 Details of Existing and Proposed Fittings –

Sr No	Type of existing fitting	Wattage of existing fitting	Proposed fitting	Maximum wattage of LED fitting	Minimum initial lumen output	Application
A	For outdoor – Street light, High Mast and platform open area –					
i a.	HPSV/HPMV	70 W	LED	50 W	4000	Circulating area, Outdoor lighting, Yard lighting, High Mast
b.		150 W	LED	100 W	8000	
c.		250 W	LED	170 W	13500	
d.		400 W	LED	260 W	20000	
ii a.	Metal Halide	70 W	LED	50 W	4000	Circulating area, Outdoor lighting, Yard lighting, High Mast
b.		150 W	LED	100 W	8000	
c.		250 W	LED	190 W	15000	
iii a.	FTL	1 x 40 W	LED	30 W	2400	Street Lighting
b.		2 x 40 W	LED	60 W	4800	
	Platform Lighting –					
iv a.	FTL	1 x 40 W	LED	30 W	2400	Platform Lighting
b.		2 x 40 W	LED	60 W	4800	
c.		1 x 28 W	LED	18 W	1440	
B	For Indoor – Offices, service buildings etc. –					
v	T-5/T-8 Fitting 4 feet size	28/36 W	LED	18/20 W	1440/1600	Offices and service buildings
vi	CFL lamps	11 W	LED	7 W	560	Offices and service buildings
vii	Recess mounting fitting 2 x 2 feet size	2 x 14 W	LED	2x9 W	1440	Offices and service buildings
viii	Down lighter	70/150 W	LED	40/80 W	3200/6400	Offices and service buildings
ix	4 feet Tube light	28 W	LED	18/20 W	1440/1600	Offices and service buildings
x	2 feet Tube light	20 W	LED	10 W	800	Offices and service buildings

3.0 SCOPE –

The scope includes design, development, manufacturing, testing and supply of energy efficient luminary complete with all accessories, LED lamps with suitable current control driver circuit including mounting arrangement for street light, platform light, recessed type and ceiling mounting arrangements etc. The luminary shall be suitable for rugged service under the operational and environmental conditions. Each type of luminaire shall be supplied with associated driver circuit and required optics.

The applications of Energy Efficient LED based luminaries are as under –

- For outdoor: Street light, High mast and platform open area
- Platform lighting



iii) For Indoor: offices, service buildings etc

4.0 CONSTRUCTION –

- a) All the luminaries shall be finalized based on the performance requirement. The detailed calculation for lux level as per clause 7.8 with uniform distribution including the lux distribution curve/graph/spatial distribution shall be submitted in support of the dimensions selected and variation thereof. Housing shall be made of 1.6 mm or more thick sheet steel conforming to IS: 513 (Grade 0) or aluminium die cast having high conductivity preferably to grade 5000 or similar to high conductivity heat sink material for outdoor fittings and 1.0 mm or more thick sheet steel conforming to IS: 513 (Grade 0) for indoor fittings. Efforts shall be made to keep the overall outer dimensions as minimum as possible.
- b) Suitable number of LED lamps shall be used in the luminaire. LED lamps of NICHIA/CREE/OSRAM/SEOUL/PHILIPS LUMILEDS/LEDNIUM/AVAGO make shall be used for the purpose. The manufacturer shall submit the proof of procurement of LEDs from above OEMs at the time of testing.
- c) Suitable reflector/lenses may also be provided to increase the illumination angle wherever necessary.
- d) Supplier will be solely responsible for testing and performance of the luminaries after installation and shall also ensure the specified and uniform illumination and comfort level on the street/platform for outdoor and work desk/floor for indoor lighting.
- e) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.

4.1 High power and high lumen efficient LEDs suitable with following features shall be used –

- a) The efficiency of the LED lamps at 110°C junction temperature shall be more than 80%.
- b) The working life of the lamp at junction temperature of 110°C for 350 mA current shall be more than 50,000 hours of accumulative operation and shall be suitable for continuous operation of 24 hours per day. These features shall be supported with data sheet.
- c) Adequate heat sink with proper thermal management shall be provided.
- d) Colour temperature of the proposed white colour LED shall be between 5700°K – 6500°K.
- e) Minimum view angle of the LED shall not be less than 120°.
- f) The output of LED shall be more than 100 lumen per watt at minimal operating current and shall ensure guaranteed operation life of more than 50,000 burning hours with controlled junction temperature of 110°C.
- g) Efficiency of driver electronics shall be more than 85%.
- h) Power factor of complete fitting shall be more than 0.95.
- i) The driver card shall withstand 440 V and 1.5 KV $\pm 3\%$ surge protection and shall resume normal working when nominal voltage is applied again.
- j) Thermal management shall be in such a way that LED junction temperature shall not go beyond 80°C.
- k) Lumen maintenance report as per LM 80 standards for the LEDs used and LM 79 standards for efficacy of fixture shall be submitted along with offer or at the time of prototype test.
- l) The LED luminaire shall be free of glare.
- m) Colour rendering index – CRI ≥ 75 .

4.2 Specification for LED driver –



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- Input voltage range within 180 V_{rms} to 270 V_{rms}
- Operating input voltage – 240 V_{rms}
- No load power consumption – ≤ 500 mW
- Maximum output voltage – 105 V DC ± 3%
- Output voltage ripple should be within 3%
- Output over voltage protection – 125 V DC
- Power factor – 0.95
- Full load efficiency – ≥ 85%
- THD – ≤ 10%
- Hot swapping
- Current waveform should meet EN 61000-3-2
- LED driver shall withstand voltage of 440 V for 2 hours and restore normal working when normal voltage is applied
- Maximum temperature rise – ≤ 10°C @ 55°C T_{amb} with safety margin of 10°C
- The driver should comply to CISPR 15 for limits and methods of measurement of radio disturbance characteristics
- The equipment should comply to IEC 61547 for EMC immunity requirements
- The control gear should be compliant to IEC 61347-2-13, IEC 62031 and IEC 62384 as per the requirements

4.3 The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/PAS 62612 depending on the type of luminaire.

5.0 Referred Standards –

5.1 For Indoor Lighting –

IS: 513	Cold-rolled low carbon steel sheets and strips
IEC 60529	Classification of degree of protections provided by enclosures
EN 55015, CISPR 15	Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment
IEC 62031	LED modules of general lighting-safety requirements
EN 61547	Equipment for general lighting purposes – EMC immunity requirement.
EN 60929	Performance, AC supplied electronics ballast for tubular fluorescent lamps performance requirement.
IEC 60598-2-1	Fixed general purpose luminaires
IEC 60598-1	Luminaires –General requirement and tests
IEC 61000-3-2	Electro Magnetic compatibility (EMC) – Limits for harmonic current emission – (equipment input current phase)
IEC 60068-2-38	Environmental testing: Test Z –AD: Composite temperature/ Humidity cyclic test
IEC 61347-2-13	Lamp control gear: Particular requirements for DC or AC supplied electronic control gear for LED modules
IS 10322	Specification for the luminaires
IS 4905	Method for random sampling
LM 79	LED luminaire photometry measurement
LM 80	Lumen Maintenance
IEC 62384	DC or AC supplied electronic control gear for LED modules performance requirements
IEC/PAS 62612	Self-ballasted LED lamps for general lighting services - Performance requirements

5.2 For Outdoor Lighting –

IS: 513	Cold-rolled low carbon steel sheets
IEC 60529	Classification of degree of protections provided by enclosures
EN 55015	RFI < 30 MHz
EN 55022	RFI >30 MHz
IEC 61000-3-2	Harmonics
EN 61547	Immunity
EN 60929	Performance
IEC 60598-2-1	Fixed general purpose luminaries
IEC 60598-1	General requirement and tests
IEC 61000-3-2	Limits for Harmonic current emission –THD <10%
IEC 60068-2-38	Specification for Permitted Humidity test
IS 10322	Specification for the luminaries
IS 4905	Method for random sampling

6.0 Service Conditions –

Street light/Indoor light on pipe/recess mounting type light unit complete with luminaries and mounting accessories shall be suitable for street, office complex railway platforms (covered and open) and residential colonies of Indian Railways under the following environmental conditions –

6.1 Environmental Conditions –

- Maximum ambient air : 55°C (For outdoor Application) and 45°C (For Indoor temperature Applications)
- Minimum ambient air : -5°C temperature
- Max. Relative humidity : 100%
- Atmosphere : Extremely dusty and desert weather and desert terrain in certain areas. The dust contents in air may reach as high values as 1.6 mg/m³
- Coastal area : The equipment shall be designed to work in coastal area in humid salt laden and corrosive atmosphere.

6.2 The maximum value of the environmental condition in the coastal area will be as follows –

- Max. pH value : 8.5
- Sulphate : 7 mg/liter
- Max. Concentration : 6 mg/liter of chlorine
- Max. Conductivity : 130 micro sec/cm
- Annual rainfall : Ranging between 1750 to 6250 mm with thunder storm
- Altitudes : Not exceeding 1200 m above sea level

6.3 The supplier shall provide "In the field service support" during guarantee period.

7.0 TECHNICAL REQUIREMENTS –

- 7.1 The luminaire casing/housing shall be made of 1.6 mm or more thick sheet steel conforming to IS: 513 (Grade 0) or aluminium die cast having high conductivity preferably to grade 5000 or similar to high conductivity heat sink material for outdoor fittings and 1.0 mm or more thick sheet steel conforming to IS: 513 (Grade 0) for indoor fittings.
- 7.2 The electronic components used shall be as follows –

- a) IC (Integrated Circuit) shall be of industrial grade or above.
 - b) Metallic film / Paper / Polyester Capacitor shall be rated for a maximum temperature of 105°C.
 - c) The resistors shall be preferably made of metal film of adequate rating. The actual loading versus rating shall be 3.
 - d) The junction temperature of switching devices such as Transistors and MOSFETS etc. shall not exceed 125°C (allowing thermal margin of 25°C).
 - e) The conformal coating used on PCBs should be clear and transparent and should not affect colour code of electronic components or the product code of the company.
 - f) The heavy components shall be properly fixed. The solder connection should be with good finish.
 - g) The electronics components covered for this equipment shall pass all the tests called for in the specification. The tenderer shall indicate the deviation or compliance otherwise the offer may not be considered for evaluation.
 - h) The infrastructure for Quality Assurance facilities as called for in the specification shall be available for the manufacturing of this product.
- 7.3** The connecting wires used inside the luminaire shall be low smoke halogen free, fire retardant e-beam/PTFE cable and fuse protection shall be provided in input side.
- 7.4** Care shall be taken in the design that there is no water stagnation anywhere. The entire housing shall be dust and water proof having IP 65 protection for outdoor application and IP 20 protection for indoor application as per IEC 60529.
- 7.5** The control gear shall be designed in such a way so that temperature rise of heat sink shall not be more than 10°C with respect to ambient temperature.
- 7.6** For platform lighting, luminaire shall be such that the glare from individual LED is restricted and shall not cause inconvenience to the public.
- 7.7** All the material used in the luminaire shall be halogen free and fire retardant confirming to UL 94.
- 7.8** Illumination level: The fitting shall be so designed that the illumination level shall be evenly distributed and shall be free from glare. Illumination level of different types of luminaire shall be as below –

Sr No	Type of Luminaries	Vertical distance of fittings from the floor level (Meters)	Minimum Illumination level (Lux) at centre	Colour of Illumination street light
Street Light –				
1	50 W	5	25	Daylight white
2	100 W	7	25	Daylight white
3	170 W	7	25	Daylight white
4	260 W	7	25	Daylight white
5	190 W	7	25	Daylight white
6	30 W	5	25	Daylight white
7	60 W	7	25	Daylight white
Platform Light –				
8	30W	4	50	Daylight white
9	60W	4	50	Daylight white

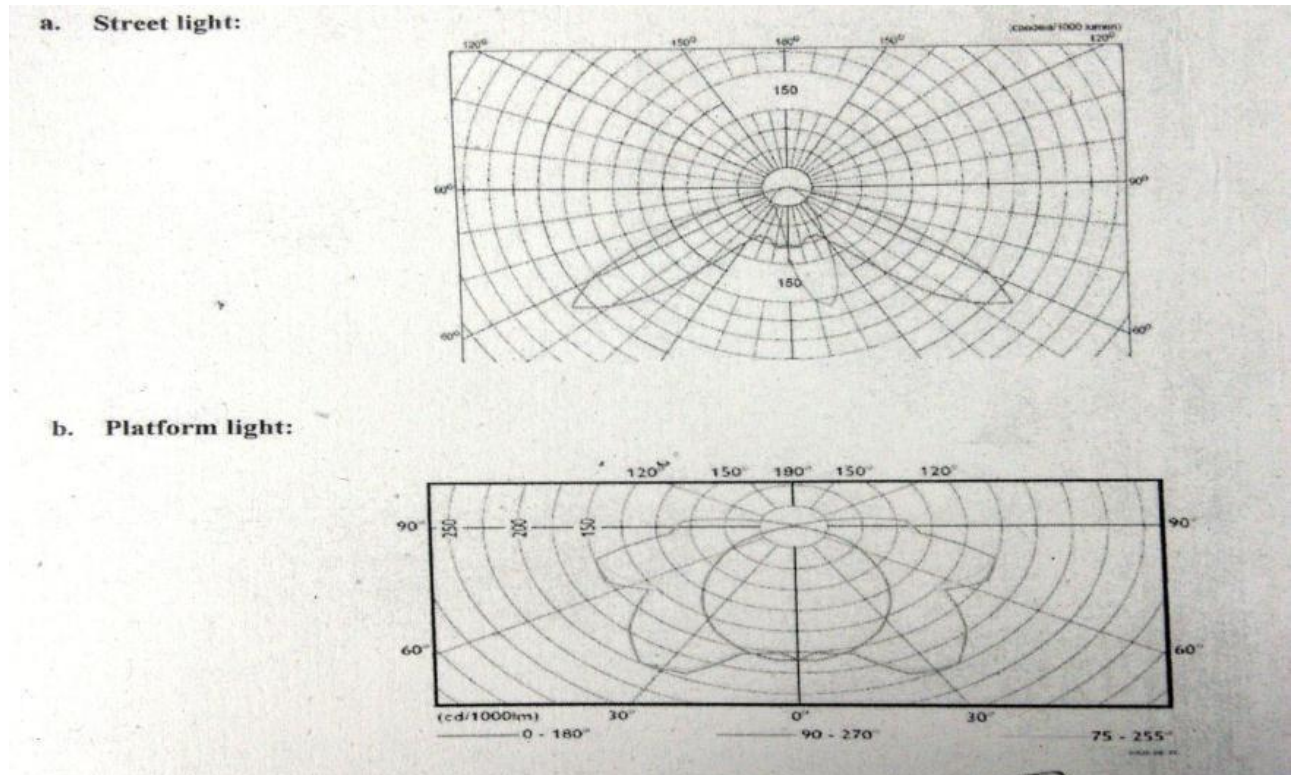
Sr No	Place to be illuminated	Vertical distance of fittings from the floor level (Mtrs)	Average Illumination level (Lux)	Colour Temp in °K
Indoor Light –				
1	Work areas like cabins and work stations	2.743	250 at 1 meter above ground level	5500 to 7000
2	Corridors	2.743	125 on the floor	5500 to 7000

Note –

1. Variation in illumination level shall be $\pm 2\%$ is allowed in input voltage range from 180 V AC to 250 V AC.
2. The illumination shall not have infra-red and ultra-violet emission. The test certificate from the NABL approved laboratory shall be submitted.
3. Electronic efficiency shall be more than 85%.

7.8.1 Polar curves –

Typical distribution of illumination of these luminaries shall be as given below –



8.0 Tests For Indoor and Outdoor Lighting –

Tests are classified as –

- Type test
- Acceptance test
- Routine test

8.1 Type Test –

All the tests mentioned in the specifications should be carried out by NABL accredited lab by the manufacturer and be submitted to the inspecting agency. The inspecting agency should inspect the material based on the same. However no test certificates should be more than three years old.

8.2 Acceptance Test –

These tests are carried out by an inspecting authority at the supplier's premises on sample taken from a lot for the purpose of acceptance of the lot. Acceptance tests shall not be carried out from particular size from the lot on which type tests have already been conducted. Recommended sampling plan is given below –

8.2.1 Sample size and criterion for conformity –

The luminaries shall be selected from the lot at random. In order to ensure randomness of selection, procedures given in IS: 4905 –1968 (Reaffirmed 2001) may be followed.

8.3 Routine Test –

These tests shall be performed by the manufacturer on each complete unit of the same type and the results shall be submitted to the inspecting agency, prior to offering the lot for acceptance test. The firm shall maintain the records with traceability.

8.4 Test Scheme –

Sr No	Description of test	Clause No.	Prototype Test (only for outdoor)	Type test		Acceptance Test	Routine Test
				Outdoor	Indoor		
1	Visual and Dimensional check	9 (i)	Y	Y	Y	Y	Y
2	Checking of documents of purchase of LED	9 (ii)	Y	Y	Y	Y	Y
3	Resistance to humidity	9 (iii)	Y	Y	Y	--	--
4	Insulation resistance test	9 (iv)	Y	Y	Y	Y	Y
5	HV test	9 (v)	Y	Y	Y	Y	Y
6	Over voltage protection	9 (vi)	Y	Y	Y	--	--
7	Surge protection	9 (vii)	Y	Y	Y	--	--
8	Reverse Polarity	9 (viii)	Y	Y	Y	Y	Y
9	Temperature rise test	9 (ix)	Y	Y	Y	--	--
10	Ra (Colour rendering index) measurement test	9 (x)	Y	Y	Y	--	--
11	Lux measurement	9 (xi)	Y	Y	Y	Y	Y
12	Fire retardant test	9 (xii)	Y	Y	Y	--	--
13	Test for IP 65 protection	9 (xiii)	Y	Y	Y	--	--
14	Environmental tests	9 (xv)	Y	Y	--	--	--
15	Reliability test	9 (xvi)	Y	Y	--	--	--
16	Life test	9 (xvii)	Y	Y	Y	--	--
17	Endurance test	9 (xviii)	Y	Y	--	--	--
18	EMI/EMC (only for indoor lighting)	--	--	--	Y	--	--

9.0 Method of Testing –

(i) Visual and Dimensional Check –

The unit shall be checked visually for all dimensions as per approved design and drawing. General workmanship should be good; all the components properly secured and sharp edges shall be rounded off. Check the marking and quality of the workmanship visually. Check the rating and make of electronic / electrical items.

(ii) Checking of documents of purchase of LED –

Check document of purchase of LED lamps of approved sources viz. NICHIA/OSRAM/ CREE/SEOUL/PHILIPS LUMILEDS/LEDNIUM/AVAGO.

(iii) Resistance to humidity test –

This is carried out by suspending the painted panels in corrosion chamber maintained at 100% RH and temperature cycle of 42 to 48°C for 7 days and examining it for any sign of deterioration and corrosion of metal surface.

(iv) Insulation resistance test –

The insulation resistance of the unit between earth and current carrying parts shorted together shall not be less than 2 MΩ when measured with 500 Volt Megger.

(v) HV test –

Immediately after insulation resistance test, an AC voltage of 1.72 KV_{rms} (1500 + 2 x rated voltage) of sine waveform of 50 Hz shall be applied for one minute between the live parts and frame. There shall not be any kind of break down, flashover or tripping of supply.

(vi) Over voltage protection –

The outdoor luminaire shall withstand at 415 Volt AC for two minutes.

(vii) Surge protection –



It shall withstand a surge of $1.5 \text{ KV} \pm 3\%$ for 50 micro second $\pm 20\%$ at the input terminals for all types and shall resume normal working when nominal voltage is applied again. (Tests shall comply with Clause 5.4 of latest IEC 60571-1).

(viii) **Reverse polarity –**

The luminaire shall withstand polarity reversal. It shall be operated with reverse voltage for 5 minutes at maximum value of voltage range. At the end of this period, the supply shall be made correct polarity and luminaire shall operate in a normal way.

(ix) **Temperature rise test –**

Temperature rise test shall be conducted at 180 Volt AC for outdoor lighting and 100 Volt AC for indoor lighting with full load. The temperature rise shall be recorded by temperature detectors mounted at the specified reference points on the body of semiconductors, capacitors and other components as agreed between purchaser and manufacturer. The maximum recorded temperature under worst conditions shall be corrected at 55°C and compared with maximum permissible temperature (for power devices at junction). Under loading conditions as specified above, the corrected temperature of the power devices shall have a safety margin of minimum 10°C . Temperature at junction shall not exceed 100°C when corrected to 55°C . The luminaire shall also be subjected for short time rating after continuous loading to ensure the temperature rise is within the permissible limit. The maximum temperature rise of the electronics devices on the PCBs shall be in limit for industrial grade components suitable for 85°C environment. In case of exceeding limit, use of MIL grade component shall be considered keeping RDSO informed.

(x) **Ra (Colour Rendering Index) measurement test –**

The lumen is the unit of luminous flux, which is equal to the flux emitted in a solid angle of one Steradian by a uniform point source of one candela.

The initial reading of the chromaticity co-ordinates x and y shall be within 5 SDCM (Standard Deviation for Colour Matching) from the standardized rated value as per Annexure D of IEC 60081 –1997.

The initial reading of the general colour rendering index (Ra) shall not be less than the rated value decreased by 3. The lumen maintenance of the lamp shall not be less than 80% of the initial lumen after 20,000 burning hours and 70% of the initial lumen after 50,000 hours. The initial lumen will be after 100 hours aging.

Photometric test shall be conducted as per Annexure B of IEC 60081-97. The lumen maintenance test shall be done as per Annexure C of IEC 60081-97.

(xi) **Lux measurement –**

Lux measurement with the help of Lux meter shall be done at a distance as shown in Para 7.8 above. Value obtained shall not be less than the lux specified in the table therein, considering 10% Lumen is absorbed by the reflector.

(xii) **Fire retardant test –**

Fire retardant test shall be conducted as per IEC 332-1 (for outdoor lighting) and IEC 60332-1 (for indoor lighting) of the wire used in the fittings.

(xiii) **Test for IP65 protection (For outdoor lighting) and Test for IP20 protection (For indoor lighting) –**

This test shall be conducted as per IEC 60529.

(xiv) **Environmental tests –**

The luminaire shall meet the following tests as prescribed in IEC-60571 –

- Dry heat test
- Damp heat test
- Test in corrosive atmosphere
- Combined dust, humidity and heat test

(xv) **Reliability Test –**

The reliability can only be determined in actual service. However, the following tests shall be carried out on the prototype to simulate as close as possible, the service conditions.



There shall be no failure during this test.

- a. The light unit shall be mounted in an oven maintained at 75°C for outdoor lighting and 45°C for indoor lighting.
- b. The light will be operated at the specified maximum voltage and at 75°C for outdoor lighting and 45°C for indoor lighting for a period of 100 hours.

(xvi) **Life Test –**

For outdoor lighting : The lumen maintenance and life test shall be done as per Annexure C of IEC 60081-97.

For indoor lighting : The lumen maintenance and life test shall be done as per Annexure C of LM 80 report of LEDs

(xvii) **Endurance Test –**

The luminaire shall be kept "ON" with input voltage of 250 Volt AC for 200 hours. After this the luminaire is subjected to 20,000 cycles of "ON" and "OFF", each cycle consisting of 3 seconds "ON" and 10 seconds "OFF" period. Luminaire should survive this test. Test is to be continued for one lakh cycles, followed by performance test.

(xviii) **Safety –**

The luminaire shall comply with the safety requirements as per IEC: 61195.

(xix) **Vibration test –**

The complete unit cubicles together with its mounting arrangements (including shock absorbing devices, if provided) shall be subjected to the vibration and shock testing (for category I class A/B) as per latest IEC 61373.

10.0 Marking –

The following information shall be distinctly and indelibly marked on the housing –

- a) Year of manufacture / Batch Number / Serial Number.
- b) Name of Manufacturer
- c) Rated watt and voltage
- d) Input frequency

11.0 Manufacturer's certificates –

Manufacturer should submit the certificate of having purchased LED from one of the approved source (LM 80 certificate should be submitted).

Manufacturer's test certificate to be submitted for

- (i) Mechanical Strength
- (ii) Endurance test and Thermal test
- (iii) Resistance to dust and moisture
- (iv) Insulation resistance and electrical strength
- (v) Resistance to heat, fire and tracking, and
- (vi) Photometric test as per IS: 10322 Part – 5, Sec. – 2.

12.0 Guarantee –

The complete system of LED lights (including driver etc.) shall be guaranteed for satisfactory performance and manufacturing defects for a period of 60 months from date of commissioning or 72 months from the date of supply whichever is earlier.

Sr. Divisional Electrical Engineer (Power),
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For and on behalf of The President of India