सत्यमेव जयते

भारत सरकार - रेल मंत्रालय
GOVERNMENT OF INDIA - MINISTRY OF RAILWAYS

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RESEARCH DESIGNS AND STANDARDS ORGANISATION

TITLE :

SPECIFICATION FOR ENERGY EFFICIENT LED BASED LUMINAIRE UNITS FOR PASSENGER COACHES

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Sl.No.	Date of Revision/amendment	Revision/ Amendment	No. of Pages	Remarks
1.	05.07.2016	Rev.1	21	Incorporating all Amendments to Specification No. RDSO/PE/SPEC/TL/D/0091-2008 (Rev.0) and incorporation of light fittings for all types of Passenger coaches, including retro-fitment of LED lamps in the existing coaches.

अनुमोदित
APPROVED

05.07.16
कार्यकारी निदेशक/विद्युत आपुर्ति एवं ई.एम.यू.
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SPECIFICATION FOR ENERGY EFFICIENT LED BASED LUMINAIRE UNITS FOR PASSENGER COACHES

0.0 FORWARD

At present, conventional type luminaires are being provided inside the coaches of Indian Railways. With the introduction of white Light Emitting Diodes (LEDs) having the life not less than 50000 working hours, it, now, is possible to use these LED lamps in place of the existing fluorescent lamps /compact fluorescent lamps (FL/CFL) in the luminaire. These LEDs are almost maintenance free and the total saving in energy is expected to be more than 50%. Keeping in view the energy saving, the increased life of the fitting, vibration resistant features, ruggedness, no warm up period, excellent color rendering, controllable & recurring savings on account of maintenance and being environmental friendly, the use of energy efficient LED based luminaire is, now considered for provision in place of FL/CFL in the luminaire in passenger coaches of Indian Railways.

1.0 SCOPE

1.1 **New Coaches:** The scope includes design, development, manufacturing, testing and supply of energy efficient luminaires suitable for operation on 110V AC/DC supply complete with all accessories, LED lamps compatible with suitable current control driver circuit including mounting arrangement for illumination in the all type of passenger coaches i.e. air conditioned coaches, non air conditioned (sleeper), chair car, conventional EMU/MEMU, DEMU, three phase EMU, Kolkata Metro, LHB and new coaches for all passenger trains including Rajdhani and Shatabdi Express trains as per the drawing numbers listed in Annexure-3. The luminaires shall be of rugged and robust design suitable for Railway rolling stock working on Indian Railways under the operational and environmental conditions encountered during service as specified in clause 4.0. Types of luminaire covered in this specification are shown in table-1:

TABLE-1 (TYPE OF LUMINAIRE)

Sl.No.	Type of Luminaire	Maximum Wattage of complete Luminaire	Usage of Luminaire
General			
1.	Type –A	18 Watt	Passenger area (Cabin) for conventional AC coaches
2.	Type –B1	9 Watt	• Corridor, Doorway & Gangway of all conventional coaches (except ICF built AC) and Non AC LHB Coaches. • Passenger area (Cabin) of conventional Non-AC and LHB Non-AC coaches. • Conventional Non AC Chair car (Day coach)
3.	Type –B2	9 Watt	Door way & Gangway for ICF built conventional AC coaches.
4.	Type –C	9 Watt	Cabin and corridor area of ICF built SCN coaches
5.	Type –D	9 Watt	Lavatory/Mirror
6.	Type –E	1 Watt	Night light luminaire cum berth indication for AC and non-AC coaches

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7.	Type –F1	2 Watt	Berth reading light (Longitudinal) for LHB coaches
8.	Type –F2	2 Watt	Berth reading light (upper berth) for LHB coaches
9.	Type – F3	2 Watt	Berth reading light (transverse lower berth) RHS for LHB coaches
10.	Type – F4	2 Watt	Berth reading light (transverse lower berth) LHS for LHB coaches
11.	Type - F5	2 Watt	Berth reading light for Conventional coaches
12.	Type –G	1 Watt	Emergency Exit Indication light
13.	Type – H 1	1 Watt	Luminaire for Toilet indication for LHB AC coaches
14.	Type - H2	1 Watt	Luminaire for Toilet indication for Conventional AC coaches
15.	Type–I	3 Watt	Passenger alarm chain indication light
16.	Type-J	9 Watt	Luminaire for SLR coaches
17.	Type-K	9 Watt	Entrance doorway
For LHB AC Coaches			
18.	Type-L	18 Watt	Passenger area (Cabin)
19.	Type-M	9 Watt+ 1 Watt	Corridor light with night light
20.	Type-N	9 Watt	Doorway/ Gangway Area
For chair car/EMU/MEMU Coaches:			
21.	Type-O	18 Watt	Passenger area for LHB AC coaches
22.	Type-P	--	Dummy fitting for LHB AC Coaches
23.	Type-Q1	2 Watt	Reading light for LHB AC chair car (2-Seater)
24.	Type-Q2	2 Watt	Reading light for LHB AC chair car (3-Seater)
25.	Type-R	18 Watt	LHB Non-AC chair car
26.	Type-S	18 Watt	Conventional AC chair car, 3-Phase EMU
27.	Type-T	18 Watt	Compartment area for MEMU coaches (DMC/TC)

Note:

i) The luminaires shall generally be in accordance with drawings mentioned in Annexure-3. Out of these, drawings for types - B2, C, E, F5, G, H2, K & S are tentative and for guidance purpose. However, the detailed drawings for these types shall be submitted by the manufacturer maintaining overall dimensions and mounting holes for approval before offering Prototype tests. For all other types the drawings mentioned in Annexure-3 are final and if any deviation is required to improve the luminaire, prior approval shall be obtained from the Vendor approving authority.

ii) Each type of luminaire shall be supplied with the associated driver circuit and required optics. Driver card as well as complete luminaire shall have validation by LED manufacturer for its compatibility. LED array shall be designed in MS/Aluminium enclosure (irrespective of materials given in the drawings) for thermal management and to maintain Tj<85°C.

iii) The output voltage of the driver for 9 W to 18 W luminaire shall be 24V±5% DC and for luminaire less than 9 W, the output voltage shall be 6/12V±5% at constant current for entire input voltage range.

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1.2 Retro-fitment of lamps in the existing/old coaches:

The scope includes design, development, manufacturing, testing and supply of LED lamps with inbuilt driver and with IP-65 protection as per IEC-60529 to be fitted in the existing holders provided for various types of fluorescent lamp (FL) / compact fluorescent lamp (CFL) / incandescent lamps being used as a light source in all types of Train Lighting, AC, conventional EMU/MEMU, DEMU, 3 Phase EMU & DEMU and Kolkata Metro coaches of Indian Railways.

1.2.1 The following types of LED lamps to be operated in voltage range of 90V-140V AC/DC:

a) 9 W tubular LED lamps to be used in the existing holder in place of 18 W FL in TL & AC coaches

b) 5 W tubular LED lamps to be used in the existing holder in place of 11 W CFL in TL & AC coaches.

c) 5 W LED lamp to be used in the existing bayonet cap type holder in place of 15/25 W incandescent lamp in TL & AC coaches.

d) 5 W LED lamp to be used in the existing Edison screw type holder in place of 25 W incandescent lamp in TL & AC coaches.

1.2.2 The following types of LED lamps to be operated in voltage range of 90V to 170V AC:

a) 9 W (2 feet length) LED tubular lamps to be used in same holder in place of 18 W (2 feet length) FL in conventional EMU/MEMU, DEMU coaches

b) 18 W (4 feet length) LED tubular lamps to be used in same holder in place and 36 W (4 feet length) FL being used in 3 phase EMU, DEMU & Kolkata Metro coaches.

1.3 Input to the luminaire will be fed through battery bank of 110V DC in parallel with alternator, rectifier cum regulator in conventional coaches and from battery charger through 60/15/9KVA, 750/415/110V transformer in LHB coaches. The luminaire shall be suitable for operating voltage range available as input i.e. 90V to 140V DC with 15% ripple. There may be surges in input supply with peak value of approximately 350V. However, it is advised that the firm may measure the harmonic distortion and Surges in the Coach before designing the LED based luminaire. The over voltage trip shall be set between 200V to 205V AC(RMS)/DC. As soon as the voltage comes below 200 V AC(RMS)/DC, the luminaire should switch on automatically.

In case of conventional EMU/MEMU, the Input to the luminaire will be fed through 141 V AC auxiliary winding of transformer (25 kV/862/266/141 V).

2.0 INFRINGEMENT OF PATENT RIGHTS

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of the components, used in design, development and manufacturing of these light fittings and any other factor which may cause such dispute. The responsibility to settle any issue rises with the manufacturer.

3.0 REFERRED STANDARDS: The latest following standards shall be referred to

IEC 62504	General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions

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IEC 62560	Self-ballasted LED lamps for general lighting services Part-1-Safety requirements
IEC 62612 / IS 16102 (Pt-2)	Self-ballasted LED lamps for general lighting services Part-2 Performance requirements
IEC 60598-1	Luminaires- General requirements and tests
IEC 62707-1	LED Binning-Part 1 General requirements and white grid
IEC 62717/IS 16103(Pt-2)	LED modules for general lighting-performance requirements
IEC 61347-2-13	Particular requirements for DC or AC supplied control gear for LED modules
IEC 62384/ IS 16104	DC or AC supplied electronic control gear for LED modules- performance requirements
IEC 62722-2-1	Luminaire performance Part-1: General requirements and Part-2-1: Particular requirements for LED luminaire
IEC 62031/IS16103(Pt-1)	LED modules for general lighting – Safety specifications
IEC 61347-1	Lamp control gear – General and safety requirements
IS 16107 (Part-1)	LED luminaires for general lighting purposes Part 1 safety requirements
IEC 62471/ IS 16108	Photo Biological safety of Lamps and Lamp system
IS 16107 (Part-2)	LED luminaires for general lighting Part 2 Performance requirements
IS: 513	Cold-rolled low carbon steel sheets.
IEC 60529	Classification of degree of protections provided by enclosures.
IEC 60571	Electronic equipment used on Railway vehicles.
ELRS/SPEC/S1/0015-OCT, 2001 (Rev.0)	Specification of Electronics used in Rolling Stock Application.
IEC 61373	Shock and Vibration Tests for rolling stock application
IEC 61000	Electromagnetic compatibility (EMC)
IS16106	Electrical and photometric measurement of solid state lighting (LED) products
LM-80 / IS16105	Method of measurement of lumen maintenance of solid state lighting (LED) sources
TM-21-11	Projecting long term lumen maintenance of LED light.
UIC-555	Electric lighting in passenger rolling stock.

4.0 SERVICE CONDITIONS:

Recess mounting type light unit complete with luminaire and mounting accessories shall be suitable for working on coaches of Indian Railways under the following environmental and operational conditions encountered during service.

4.1 Environmental conditions

Maximum ambient air temperature : 55° C
Minimum ambient air temperature : -5° C
Max. Relative humidity : 98 %

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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/m^3
Coastal area	:	The equipment shall be designed to work in coastal area in humid, salt laden and corrosive atmosphere.

The maximum value of the condition in the coastal area will be as follows:

Max. pH value	:	8.5
Sulphate	:	7 mg/litre
Max. concentration of chlorine	:	6 mg/ litre
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

4.2 Working Conditions

Train Speed	200 km/h
Supply voltage	• 110 V AC/DC (conventional/LHB / 3-phase EMU, DEMU/ Kolkata Metro coaches) • 127V AC (Conventional EMU/MEMU coaches)
Voltage range	• 90 V-140 V AC/ DC(conventional/LHB/3-phase EMU, DEMU/ Kolkata Metro coaches) • 90 V-170 V AC (Conventional EMU/MEMU coaches)
Vibration and shocks	Maximum vertical acceleration 3.0 g Maximum lateral acceleration 3.0 g Maximum longitudinal acceleration 3.0 g ('g' being the value of acceleration due to gravity)
Frequency & Amplitude	Sinusoidal form of vibration, the frequency 'f' lies between 1 Hz and 100 Hz. The amplitude 'a' expressed in mm is given as a function of 'f' by the equation $a = 25 / f$ for value of 'f' between 1 Hz and 10 Hz $a = 250/ f^2$ for value of 'f' between 10 Hz and 100Hz

Track irregularities, level of shocks and vibrations to which the luminaires are exposed may be far more than actually given in IEC for on board (Ceiling) mounting arrangement. Measured data of vibration levels at critical locations of light fitting and its mounting arrangement of existing fittings, which can be used for design and in case of any doubt, the manufacturer must carry out instrumented trials on the existing stock for measurement of shocks and vibrations in consultation with the Vendor approving Authority at design stage itself. The fitting and its mounting arrangement shall be so designed that the performance is not adversely affected due to such high level of vibrations and shocks.

4.3 The manufacturer shall provide "In the field service support" during guarantee period.

5.0 CONSTRUCTION

a) The RCF/ICF drawings of various types of luminaires mentioned in the specification are listed in Annexure 3. The performance requirement of the complete luminaire shall have uniformity level of at least 1:1.3 as per norm of UIC 555 in accordance with Annexure -1. The detailed calculation for lux level, uniformity in distribution as

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per clause no. 6.12 & 6.13 including the lux distribution curve/graph/spatial distribution shall be submitted. Deep drawn (not fabricated) housing of luminaire shall be made of 1.00 mm thick Steel sheet conforming to IS: 513 (Grade DD) unless otherwise mentioned in the respective drawings.

b) Diffuser of sufficient strength shall be provided under the LED chamber to ensure glare free light and to protect the luminaire. Diffuser material shall be Fire retardant conforming to UL94-V0 grade made from "Lexan SP 24-492x" polycarbonate material (not less than 1.50 mm thick) of GE Plastic/Sabic make or any other equivalent make with the prior approval of Vendor approving authority. Selection of diffuser shall be such that the individual LEDs are not visible and appearance looks like a brightly lighted surface.

c) All steel items excluding hardware shall be given surface treatment for anti-rust and anti-corrosion before finishing with powder coating. The thickness of powder coating shall not be less than 60 microns to white colour (Shade no 042 'IFB white' of M/s Berger or similar in M/s Asian / M/s Nerolac make paint) with glossy finish from inside and outside.

d) Housing of the driver for the luminaire (if required) shall be made of Aluminium or fire retardant polycarbonate/fibre sheet having IP65 protection.

e) Suitable number of LEDs shall be used in the luminaire. LED of NICHIA/OSRAM/SAMSUNG/LUMILEDS/CREE/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.

f) Manufacturer shall be solely responsible for testing and performance of the luminaire after installation and shall also ensure the specified and uniform illumination and comfort level in the coach.

g) Suitable WAGO/Phoenix or equivalent other makes cage-clamp type connectors with the approval of Vendor approving authority shall be used between driver and LED array and between driver to input.

h) Suitable grommets shall be provided for cable traversing.

i) The weight of the luminaire shall be as low as feasible.

j) Total harmonic distortion (THD) shall be less than 15% for luminaires up to 4Watt and less than 10% for luminaires more than 4 Watt at full load at nominal voltage.

k) The power factor of the luminaire shall be more than 0.90 for the luminaire up to 4 Watt and more than 0.95 for the luminaire above 4Watt.

5.1 High lumen and energy efficient LEDs with the following features shall be used:

a) The working life of the lamp at junction temperature of 85^{0}C for 350mA/ 175mA/80mA/65mA current shall not be less than 50000 hours of cumulative operation and shall be suitable for continuous operation of 24 hours per day. These features shall be supported by datasheet.

b) Colour temperature of the white colour LED used in the luminaire shall be in the range of 6000 K-7000 K for cool day white.

c) The output of LED (efficacy) shall not be less than 150 lumen per watt at minimal operating current and shall ensure guaranteed operation life of not less than 50000 burning hours with the controlled junction temperature of 85^{0}C.

d) LED controller (Driver) shall be EMI/EMC compliant.

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e) The LEDs used shall have white point stability less than 5 step (Macadam ellipse) or as per LM80. The manufacturer shall submit the compliance from OEM.

f) The LEDs shall be LM80 certified for white LED along with TM21 projection for more than 50000 hours.

g) The LEDs used shall be UL certified with UL number.

h) The LED driving current shall not be more than 80% of absolute maximum forward current.

i) The LED beam/view angle (typical) shall be 120^0 or more.

6.0 TECHNICAL REQUIREMENTS

6.1 The luminaire casing/housing shall be made as per the requirement in Clause 5.0(a).

6.2 The electronic components used shall be as follows:-

a) All the electronic components used in the circuit shall be of industrial grade or above.

b) Metallic film/Paper/Polyester Capacitor shall be rated for 105°C or above.

d) The resistors shall be preferably made of metal film/chip resistor of adequate rating. The actual loading versus rating shall be 3.

e) The junction temperature of the Switching devices such as transistors and MOSFETs etc. shall not exceed 125°C (allowing thermal margin of 25°C).

g) The protective cum adhesive coating (fire retardant) used on PCBs shall be clear and transparent and shall not affect color code of electronic components or the product code of the company.

h) The heavy components shall be properly fixed. The solder connection should be with good finish.

i) The electronic circuits, PCB and components shall meet the requirement of RDSO Specification No. ELRS/SPEC/S1/0015-OCT, 2001 (Rev.0) for electronics used in Rolling Stock Application. The electronics covered for this equipment shall pass all the tests called for in the specification. The manufacturer shall indicate the deviation or compliance.

j) The infrastructure for Quality Assurance facilities as called for in the specification shall be available with the manufacture for this product.

6.3 Low smoke, halogen free, fire retardant thin walled flexible e-beam/PTFE cable with multi-strand copper conductors suitable for continuous operation at 120°C shall be used inside the luminaire as connecting wires and fuse protection shall be provided at input side.

6.4 Adequate heat sink with proper thermal management shall be provided. Design should not consider heat dissipation through roof top as roof is provided with heat insulation material.

6.5 Care shall be taken in the design that there is no stagnation of water anywhere in the luminaire as well as driver. The entire housing shall be dust proof and water spray having IP-65 protection as per IEC 60529.

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