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RESEARCH DESIGNS AND STANDARDS ORGANISATION

TITLE

SPECIFICATION FOR ENERGY EFFICIENT LED BASED LUMINAIRE UNITS FOR PASSENGER COACHES

विशिष्टि सं० आर डी एस ओ/पी ई/टी एल/0091-2024 (रिव "2")

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अनुमोदित
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Status of Revision

Sl. No.	Date of Revision/ amendment	Revision/ Amendment	Page no.	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 in all type of Passenger coaches including retro-fitment of LED lamps in the existing coaches.
2.	--/--/----	Rev. 2	--	• Retrofitment clause 1.2 deleted • Clause 1.3 Operating voltage of change from 90 V to 77V and Under voltage trip added • Clause 4.1, minimum ambient air temperature changed to -10˚C and altitude changed to 1776m • Clause 5.0 uniformity in accordance to EN 13272-1 added • Clause 5.0 k THD parameter changed with more clarity • Clause 5.1 CCT of the light changed in accordance to EN 13272-1 • Clause 6.11 Fire safety standard as per EN 45545 HL-3 level added • Clause 8.0 vi Undervoltage test requirement added • Clause 8.0 xiv Fire retardant test modified as per as per EN 45545 HL-3 • Clause 8.0 xxi Risk group defined for LED in accordance to EN 13272-1

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 fitling, 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~~

At present LED based Luminaires are being used across Indian Railways in lighting application of coaches. These LEDs are almost maintenance free and the total saving in energy is more than 50% in comparison to FL/CFL. The adoption of LEDs has also improved operational reliability with features such as vibration resistance, durability, excellent color rendering, instant illumination, and enhanced environmental benefits. These luminaires have proven to be highly effective in meeting the stringent performance and safety requirements of railway operations.
In light of the experience and successful deployment of LED-based luminaires, this specification has been revised to incorporate necessary modifications for further improving performance, ensuring compliance with evolving standards, and addressing operational feedback. The revised specification includes updates aligned with EN 45545 fire safety standards and other enhancements for optimal functionality and safety in passenger coaches.

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~~ 2. 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
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~~ 2. ~~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/Aluminum

enclosure (irrespective of materials given in the drawings) for thermal management and to maintain Junction Temperature (T_j) less than 85^0C.

iii) The output voltage of the driver for ~~9 W to 18 W~~ ,more than or equal to 9W 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.

~~**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, from battery charger through 60/15/9KVA, 750/415/110V transformer in LHB coaches and from auxiliary converter in EMU/MEMU/Metro/Vande Bharat coaches. The luminaire shall be suitable for operating voltage range available as input i.e. ~~90V~~ 77V to 140V AC/DC with 15% input ripple or THD. 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. Under voltage trip shall be set between 60-66 VAC(RMS)/DC and the luminaries should Switched-on automatically as soon as the voltage increases above 66V.
Light shall not fail/ destroy in voltage range from 0-200V AC/DC supply, and shall work normally after restoration of working voltage range.

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
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.
EN 45545	Railway applications — Fire protection on railway vehicles
EN 13272-1	Railway applications - Electrical lighting for rolling stock in public transport systems

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~~ -10°C
Max. Relative humidity	:	98 %
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~~ Siemens/cm
Annual rainfall	:	Ranging between 1750 to 6250 mm with thunder storm
Altitudes	:	Not exceeding ~~1200 m~~ 1776 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	• 77V ~~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~~ 2. The performance requirement of the complete luminaire shall have uniformity level of ~~at least 1:1.3 as per norm of UIC 555~~ 0.7 to 1.3 as per norms mentioned in EN 13272-1. ~~in accordance with Annexure -1~~ To ensure uniformity level, arrangement of LED luminiare in the coaches should be shared by the PU with vendors. The simulation for that should be done by the vendors. The detailed calculation for lux level, uniformity in distribution as per clause no. 6.12 & 6.13 including the lux distribution curve/graph/spatial distribution shall be submitted.

b) 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.

c) 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.

d) 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/ or any other equivalent make paint with the prior approval of Vendor approving authority) with glossy finish from inside and outside.

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

f) 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 and shall maintain proper documentary accounting of LEDs purchased and consumed.

g) 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.

h) 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.

i) Suitable grommets shall be provided for cable traversing.

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

k) ~~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~~. The total harmonic distortion (THD) of the current and voltage drawn by the

luminaire, measured at full load and nominal voltage, shall not exceed 8% to minimize the impact on the power source.

l) 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~~ LED at junction temperature of 85^0C ~~for 350mA/ 175mA/80mA/65mA~~ test current between 350mA and 65mA 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~~ 4000K- 5000K for neutral 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 85^0C.

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

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 105ºC 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 125ºC (allowing thermal margin of 25ºC).

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 120ºC 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.

6.6 The unit shall be maintenance free.

6.7 ~~Temperature of diffuser's surface shall be lower than the fluorescent/compact fluorescent luminaire being used presently.~~

6.8 ~~The control gear shall be designed in such a way that temperature of heat sink shall not be more than 45^{0}C for air-conditioned coaches and 10ºC above the ambient for non-air-conditioned coaches.~~

6.9 Diffusers used shall be such that the glare from individual LED is restricted and shall appear as a single source of light as in the case for lighted globe and it shall not cause inconvenience to the passengers.

6.10 ~~The illumination of the luminaire provided in the coach shall not have multiple shadows under one Luminaire.~~

6.11 The complete luminiare should comply with standard EN 45545 HL-3 for all equipments under scope of supply and the reports should be submitted to vendor approving authority.

6.12 **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 given below:

Sl. No.	Type of Luminaire	Vertical Distance (Mtrs) from the floor level	Average Illumination Level (Lux)	Colour of illumination
1.	Type –A	0.84	120	~~Cool day~~ Neutral white
2.	Type –B1 & B2	0.84	80	~~Cool day~~ Neutral white
3.	Type –C	0.84	80	~~Cool day~~ Neutral white
4.	Type –D	0.50	100	~~Cool day~~ Neutral white
5.	Type –E	10.0*	Clearly visible	Blue
6.	Type – F1/F2/F3/F4/F5	0.75	100	~~Cool day~~ Neutral white
7.	Type –G	10.0*	Clearly visible	~~Cool day~~ Neutral white
8.	Type –H1/H2	10.0*	Clearly visible	Green - Vacant

				Red – Occupied
9.	Type –I	400*	Clearly visible	Red
10.	Type –J	0.84	80	~~Cool day~~ Neutral white
11.	Type –K	0.84	80	~~Cool day~~ Neutral white
12.	Type –L	0.84	120	~~Cool day~~ Neutral white
13.	Type –M	0.84	80	~~Cool day~~ Neutral white
14.	Type –N	0.84	80	~~Cool day~~ Neutral white
15.	Type –O	0.84	120	~~Cool day~~ Neutral white
16.	Type –P	-	-	-
17.	Type –Q1/Q2	1.20	100	~~Cool day~~ Neutral white
18.	Type-R	0.84	120	~~Cool day~~ Neutral white
19.	Type-S	0.84	120	~~Cool day~~ Neutral white
20.	Type-T	0.84	120	~~Cool day~~ Neutral white

* Horizontal distances

Note:

1. Variation in illumination level shall be ± 2% for input voltage range from 77V ~~90V~~ to 140 V AC/DC (for TL&AC coaches, 3 phase EMU, DEMU & Kolkata Metro coaches) and 90 V AC to 170 V AC (For Conventional EMU / MEMU coaches).
2. ~~The illumination shall not have infra-red and ultra-violet emission. The test certificate from the NABL approved laboratory shall be submitted.~~

6.13 After 50,000 burning hours, the luminaire intensity shall be at least 70% with degree of uniformity between 0.7 to 1.3 as per norms of EN 13272-1 ~~of at least 1:1.3 as per UIC 555~~. Data sheet showing year wise deterioration in the LED shall also be submitted along with design.

6.14 Detailed design shall be furnished before manufacturing of prototype. However, information as per Annexure-~~2~~ 1 shall be submitted by the manufacturers along with in-house test results while offering for witnessing the prototype testing at firm's premises.

7.0 TESTS:

Tests are classified as:–

- Prototype test
- Type test
- Acceptance test
- Routine rest.

7.1 Prototype Test

Prototype test is conducted on the first unit developed by the firm as per the relevant specification.

7.2 Type Test

Type tests shall be carried out to prove confirmation with the requirement of specification and general quality/design features of the unit. The results of the type tests shall be valid for a maximum period of 3 years. In case of any change in Bill of Material (BOM) or design of unit, complete type test shall be repeated.

If any sample fails in any of the type tests, two fresh samples shall be taken and tested. If any sample again fails in that test, the whole lot shall be rejected.

7.3 Acceptance Tests:

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

7.3.1 Sample size and criteria for conformity

The luminaire 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.

7.4 Routine Tests:

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.

7.5 Test Scheme:

Sl. No.	Description of test	Clause no.	Prototype Test	Type Test	Acceptance Test	Routine Test
1.	Visual and Dimensional check	8 (i)	Y	Y	Y	Y
2.	Checking of Purchase documents of LED	8 (ii)	Y	Y	Y	Y
3.	Resistance to humidity	8 (iii)	Y	Y	-	-
4.	Insulation resistance test	8 (iv)	Y	Y	Y	Y
5.	HV test	8 (v)	Y	Y	Y	Y
6.	Over voltage and under voltage protection	8 (vi)	Y	Y	Y	Y
7.	Wattage measurement	8 (vii)	Y	Y	Y	-
8.	Short circuit protection	8 (viii)	Y	Y	-	-
9.	Surge protection	8 (ix)	Y	Y	-	-
10.	Reverse polarity	8 (x)	Y	Y	Y	Y
11.	Temperature rise Test	8 (xi)	Y	Y	-	-
12.	Ra (Colour Rendering Index) measurement test	8 (xii)	Y	Y	Y	Y
13.	Lux measurement	8 (xiii)	Y	Y	Y	Y
14.	Fire retardant Test	8 (xiv)	Y	Y	-	-
15.	Test for IP65 protection	8 (xv)	Y	Y	-	-
16.	Vibration and Shock test	8 (xvi)	Y	-	-	-
17.	Environmental tests	8 (xvii)	Y	-	-	-
18.	Life test	8 (xviii)	Y	-	-	-
19.	EMI/EMC Test	8 (xix)	Y	-	-	-
20.	Endurance Test	8 (xx)	Y	Y	-	-
21.	Safety	8 (xxi)	Y	-	-	-

8.0 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. Documents shall also be verified as mentioned in the specification.

ii) Checking of Purchase documents of LED

Document of purchase of LED lamps from the approved sources viz. NICHIA/OSRAM/SAMSUNG/LUMILEDS/CREE/AVAGO with bill of entry and certificate of conformance from manufacturer along with validation of driver controller card and luminaire by the manufacturer of the LEDs to ascertain the life of the LEDs shall be checked.

iii) Resistance to humidity test

This is carried out by suspending the painted panels in corrosion chamber maintained at 98% RH and temperature cycle of 42 to 48^{0}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 100MΩ at 60% RH when measured with 500V megger before and after HV test.

v) HV test

Immediately after insulation resistance test, an AC voltage of 1.72 KV rms (1500 + 2 x rated voltage) of sine wave form 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 and under voltage protection

The Luminaire shall withstand at 250V DC/AC for two minutes.
The Luminaire shall withstand at 50V DC/AC for 2 Minutes.
The luminaire shall restore to its normal operation after restoring the supply to normal working voltage range.

vii) Wattage measurement

The wattage of luminaire shall be measured at 77V ~~90V~~, 110V and at 140V DC. In case of luminaire for conventional EMU/MEMU, DEMU, it shall be measured at 90V, 110V, 140 V and 170V AC. Wattage shall not be greater than as declared in the design.

viii) Short circuit protection

The luminaire shall withstand Short circuit protection. The luminaire shall work normal after re-setting.

ix) Surge protection

It shall withstand a surge of 3kV ±5% as per the procedure given in IEC-60571 at the input terminals for all types of luminaire.

x) 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 in correct polarity and Luminaire shall operate in a normal way.

xi) Temperature rise Test:

Temperature rise Test shall be conducted at 77~~90~~ V DC 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 to 55^0C and compared with maximum permissible temperature (for power devices at junction). The thermal margin available shall be compared with the safety margin declared by the manufacturer. Under loading conditions as specified above, the corrected temperature of the power devices shall have a safety margin of minimum 10^0 C.

Temperature at junction shall not exceed 125^0C when corrected to 55^0C. The Luminaire shall also be subjected for short time rating after continuous loading to ensure the temperature rise within the permissible limit. ~~The maximum temperature rise of the electronic devices on the PCBs shall not be more than 20^0C~~.

xii) 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 & y shall be within 5 SDCM (Standards Deviation for Colour matching) from the standardised rated value as per ~~Annexure - D of IEC 60081~~ IEC 62717. The Colour Rendering Index shall be minimum 80.

~~The initial reading of the general colour-rendering index (Ra) shall not be less than the rated value decreased by 3.~~

Certificate based on relevant standards to this measurement shall be obtained from the OEM.

xiii) Lux measurement

Lux measurement with the help of Lux meter shall be carried out at a distance as shown in clause no. 6.12 above. Value obtained shall not be less than the Lux specified in clause no. 6.12 of the specification.

xiv) Fire retardant Test

The complete luminiare should comply with standard EN 45545 HL-3 for all equipments under scope of supply. Firm should submit fire safety assessment with test reports to vendor approving authority.

xv) Test for IP protection

This test shall be conducted as per IEC 60529 except berth reading light.

xvi) Vibration and Shock Test

The complete unit cubicle together with its mounting arrangements (including shock-absorbing devices, if provided) shall be subjected to the vibration and shock testing (for Category-1, Class A) as per latest IEC 61373.

xvii) Environmental tests

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

  a) Dry heat test.
  b) Damp heat test
  c) Test in corrosive atmosphere
  d) Burn-in test on PCB controller card only as per RDSO specification no. ELRS/SPEC/S1/0015-OCT, 2001 (Rev.0) for 45 hours.

- In routine tests, 100% luminaires shall be kept 'ON' for 48 hours at 50^0C ± 5^0C, electrical parameters before and after tests shall be recorded and shall be in range before and after dry heat test. All parameters shall remain in the limit.

- In acceptance tests, 5 luminaires shall be kept 'ON' for 2 hours at 50^0C ± 5^0C and -10^0C± 3^0C. No luminaires shall fail in this test.

xviii) Life Test

- The lumen maintenance & life test shall be as per LM80/IS 16105 and TM-21 respectively.

- ~~The lumen maintenance of the lamp shall not be less than 90% of the initial lumens after 6000 burning hours at condition of case temperature (or solder point temperature) of 105^0C and ensure testing is done at minimum 80% of its absolute maximum forward current (i_f). The initial lumens will be taken after 100 hours aging.~~ Certificate from OEM of LED manufacturer shall be submitted.

xix) EMI/EMC Test

EMI/EMC tests shall be conducted on complete luminaire unit as per IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-6.

xx) Endurance Test

The Luminaire shall be kept "ON" with input voltage of 140 V DC (for luminaires for voltage range of 77 ~~90~~-140 V DC/AC) and at 170 V AC (for luminaires for voltage range of 90-170 V 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 pass this test. Then, the test is to be continued beyond 20,000 cycles up to one lakh cycles, followed by performance test.

xxi) Safety:

The complete Luminaire unit, LED and driver shall comply with the safety requirements as per IEC mentioned in clause no. 3.0 above.

LEDs used in the luminaire shall comply to Risk Group 0 or 1 (RG0/RG1) as per IEC 62471. Photo biological test report/datasheet mentioning Risk Group should be submitted during design approval.

9.0 MARKING:

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

a) Indian Railways Insignia
b) Year of manufacture/Serial Number (MMYY/ABCD)
c) Name of Manufacturer
d) Rated watt and voltage (Input)
e) Rated watt - Output

9.2 The make, month and year of manufacture shall also be marked on driver and LED panel.

9.3 The following information shall be distinctly and indelibly marked on the lamps for retro fitment:

a) Indian Railways Insignia
b) Year of manufacture/Serial Number
c) Name of Manufacturer
d) Rated watt and voltage

10.0 ISO CERTIFICATION:

Firm shall possess the ISO certification for design, development, manufacturing and supply of the complete Lighting Unit.

11.0 GUARANTEE

The complete Luminaire 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.

12.0 APPROVAL

12.1 While seeking approval, the firm shall submit a sample to the Vendor approving authority along with test results, circuit diagrams and dimensional drawing of the Luminaire. The prototype testing shall be carried out at manufacturer's work.

12.2 The manufacturer shall also submit details like make, type, reliability grade, rating and loading of various electronic components used in the circuit. The temperature rise of the various components under the most adverse conditions shall also be declared.

12.3 Final approval for appearance in vendor directory is subject to field trials for a period of three months for performance/lumen measurement of the luminaire as compared to test results during prototype.

12.4 WITHDRAWAL OF APPROVAL

Approval granted to the manufacturer is liable to be withdrawn in the event of noticing any change at a later date in the design or change from the bill of material as approved earlier without seeking the prototype approving authority's approval or using components of inferior specification/quality compromising with the reliability.

13.0 SCHEDULE OF TECHNICAL REQUIREMENTS:

13.1 General

a) The manufacturer shall have minimum three years' experience in design, manufacturing, installation and commissioning of different types of LED based luminaire.

b) The manufacturer should have technical collaboration/MoU with the LED manufacturer for supply of LEDs and know-how for adequate thermal management to ensure minimum guaranteed performance as given in the specification, the selection procedure for selecting right type of LEDs for such application.

c) The MoU should also indicate the Quality Assurance Plan (QAP) for handling, storage and life cycle test of the LED proposed to be used.

d) The manufacturer shall have all the requisite testing facilities for the tests mentioned above at their works. However, special tests such as IP protection, environmental, surge, vibration and shock tests etc. may be carried out in any NABL approved labs and test results shall be submitted to Vendor approving authority.

13.2 DETAILS OF ESSENTIAL INFRASTRUCTURE

- Dust free environment with ESD protection for the assembly of LEDs/PCB.
- Testing jigs for the testing of assembled LEDs/PCB.
- Component lead forming machines for through hole devices.
- Temperature controlled automatic wave-soldering machine with auto-fluxing facilities for through hole devices.
- Automatic Temperature controlled re-flow-soldering machine for surface mounted devices.
- Stencil and solder paste application machine for surface mounted devices
- Automatic Device insertion (Pick and place) machine for surface mounted devices with in-circuit testing facility.

All the above facilities are considered essential and shall be verified by Vendor approving authority. However, the firm may outsource only LEDs/PCB assembly and soldering with the sub-vendor at the developmental stage, which shall have the all above facilities. Railways officials may visit the premises of sub-vendor engaged by the firm for LEDs/PCB assembly. The firm shall arrange the visit to the sub-vendor's premises.

13.3 MOCK UP Facilities for uniformity and lux level

Actual of the coach compartment/cabin (similar to at least two cabins of 3-tier AC coach) and lavatory etc shall be arranged by the manufacturer for measurement of lux level and uniformity level. Achievement shall be submitted along with the test data of prototype sample being offered for witnessing the prototype tests.

13.4 ESSENTIAL MEASURING INSTRUMENTS FOR TESTING

The following instruments with up-to-date calibration are considered essential for testing purpose: -

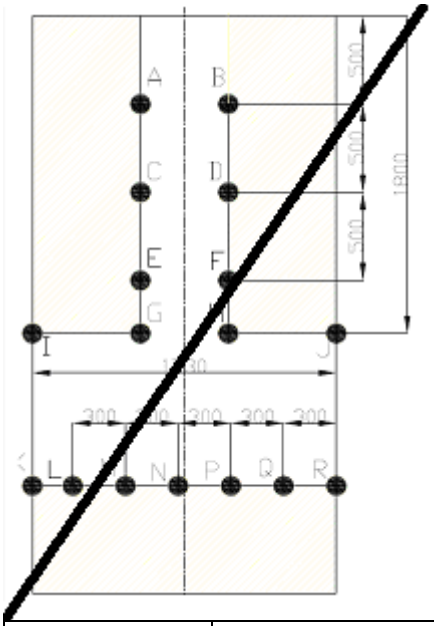
- Variable regulated DC supply at least up to 300 Volts.
- Heat chamber/oven having minimum range of 0-150°C with alternate arrangement of standby power supply for carrying out endurance tests.
- H.V. Tester.
- Adequate number of meters for measurement of different electrical parameters.
- Megger (500Volt)
- Measuring Gauges such as Vernier caliper, micrometers, dial gauge,
- Non-contact digital thermometer, contact less thermometer and room thermometer.
- Digital multimeter.
- Digital Weighing machine.
- Complete test bench for measuring the different parameters as mentioned in the specification.
- Milli-ohm/Micro-ohm meter
- Lux meter.
- Storage type Oscilloscope.
- Power analyzer
- Chroma meter
- 8-channel Digital temperature scanner
- Spectrophotometer for single LED checking.
- Computerized test bench for PCB testing
- Computerised test setup for electrical parameter of Light testing
- Centre lathe, CNC milling machine, hydraulic press etc for manufacturing of luminaires (Optional)
- Dark room
- Powder coating plant (Optional)

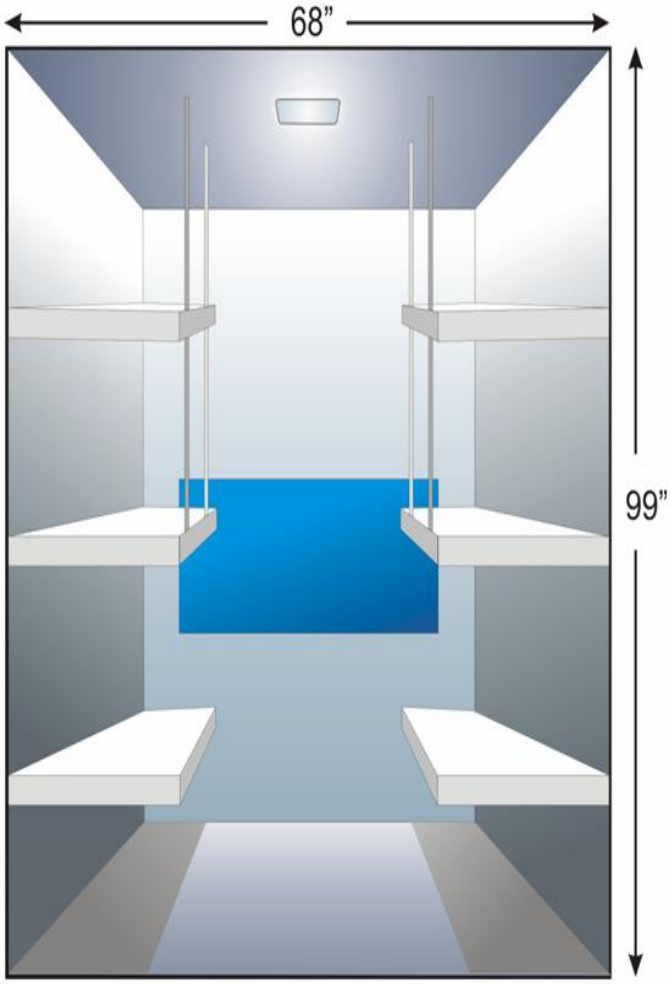
All the above facilities are considered essential at the developmental stage itself and shall be verified by Vendor approving authority before considering the firm as a developmental source.

****

~~**Annexure –1**~~

~~GENERAL LAYOUT OF COUPE (ACCN)~~





~~Measurement location~~	~~Lux measurement~~			
	~~Ground Level~~	~~Lower berth~~	~~Middle berth~~	~~Upper berth~~
~~A~~				
~~B~~				
~~C~~				
~~D~~				
~~E~~				
~~F~~				
~~G~~				
~~H~~				
~~I~~				
~~J~~				
~~K~~				
~~L~~				
~~M~~				
~~N~~				
~~P~~				
~~Q~~				
~~R~~				
~~Linearity~~				
~~Uniformity~~				

Annexure- 1

LUMINAIRE WISE DATA TO BE FURNISHED BY THE MANUFACTURER WHILE OFFERING FOR WITNESSING THE PROTOTYPE TESTS

ILLUMINATION CHARACTERISTICS: T_j = ….^{0}C, I_f =……mA

Sl.No.	Parameter	Absolute Values		
		Min.	Typical	Max.
1	Luminous Flux (lm)			
2	Storage Temperature (^{0}C)			
3	Viewing Angle (Degree)			
4	Luminous Efficiency(lm/w)			
5	Dominant Wavelength (nm)			
6	Color temperature (K)			
7	Forward Voltage(v) Rank			
8	Colour Rendering Index			
9	CIE Coordinates (Rank ___)			

Annexure-2

Details of LED Light Fittings of LHB, Conventional & MEMU/EMU coaches

Sr. No.	Description	Type of fitting	Drawing. No.	
			PU	NO.
1	LED Light Fitting for Passenger Area (Cabin) of conventional AC coaches	Type-A (18 W)	RCF	CC76452
2	LED Light Fitting for Corridor, Doorway & Gangway for all conventional Coaches (except ICF built AC Coaches) and Non AC LHB Coaches, Passenger area (Cabin) for conventional & LHB Non AC Coaches and Conventional Non AC Chair Car (Day Coach).	Type-B 1 (9 W)	RCF	CC76453
3	LED Light Fitting for Doorway & Gangway for ICF built conventional AC Coaches	Type-B 2 (9 W)	ICF	ICF/STD-7-6-050
4	LED light fitting for Cabin & Corridor Area of ICF Built SCN coaches	Type-C (9 W)	ICF	ICF/STD-7-6-046
5	LED Light Fitting for Lavatory/Mirror	Type-D (9 W)	RCF	LW76092
6	LED Light Fitting for Night Light with Berth Indication for AC & Non AC Coaches.	Type-E (1 W)	ICF	ICF/STD/7-6-053 (2 Sheets)
7	LED Light Fitting for Berth Reading Light (Longitudinal) for LHB coaches.	Type-F1 (2 W)	RCF	LW76093
8	LED Light Fitting for Berth Reading Light Upper Berth for LHB coaches.	Type-F2 (2 W)	RCF	LW76094
9	LED Light Fitting for Berth Reading Light Transverse Lower Berth RHS for LHB coaches.	Type-F3 (2 W)	RCF	LW76095
10	LED Light Fitting for Berth Reading Light Transverse Lower Berth LHS for LHB coaches.	Type-F4 (2 W)	RCF	LW76096
11	LED Light Fitting for Berth Reading Light for conventional AC coaches	Type F-5 (2W)	ICF	ICF/STD-7-6-051
12	LED Light Fitting for Emergency Exit indication.	Type-G (1 W)	ICF	ICF/STD-7-6-049
13	LED Light Fitting for Toilet Indication in LHB AC Coaches	Type-H 1 (1 W)	RCF	LW76097
14	LED Light Fitting for Toilet Indication in Conventional AC Coaches	Type-H 2 (1 W)	ICF	ICF/STD-7-6-052
15	LED Light Fitting for Passenger Alarm Chain Indication	Type-I (3 W)	RCF	LW76098
16	LED Light Fitting for SLR Coaches	Type-J (9 W)	RCF	CC76457
17	LED Light Fitting for Entrance Doorway	Type-K (9 W)		ICF/STD-7-6-048
18	LED Light Fitting for Passenger area (Cabin) for LHB AC Coaches	Type-L (18 W)	RCF	LW76090
19	LED Light Fitting with Night light (Corridor Area) for LHB AC Coaches	Type-M (9W + 1W)	RCF	LW76091
20	LED Light Fitting for Doorway/Gangway area for LHB AC Coaches	Type-N (9 W)	RCF	LW76099
21	LED Light Fitting for LHB type AC Chair Car	Type-O (18 W)	RCF	LW76100
22	Dummy Fitting for LHB type AC Chair Car	Type-P	RCF	LW76101
23	LED Light Fitting for Reading Light for LHB AC Chair Car (2 seater)	Type-Q1 (2 W)	RCF	LW76102
24	LED Light Fitting for Reading Light for LHB AC Chair Car (3 seater)	Type-Q2 (2 W)	RCF	LW76103

25	LED Light Fitting for LHB Non-AC Chair Car	Type-R (18 W)	RCF	LW76104 (3 Sheets)
26	LED Light Fitting for Conv. AC Chair Car, EMU & DEMU coaches	Type-S (18 W)	ICF	ICF/STD-7-6-047
27	LED Light Fitting for MEMU coaches (DMC/TC)	Type-T (18 W)	RCF	CC76460 (9 sheets)
PART DRAWING				
28	Diffuser for LHB type Coaches		RCF	LW76105
29	Frame for LED light fitting for LHB type AC chair Car		RCF	LW76106
30	LED Module box with diffuser		RCF	LW76107
31	Diffuser for LED light fitting for LHB Non AC Chair Car		RCF	LW76108
32	Details for berth reading lights		RCF	LW76109
33	Front Cover		RCF	LW76110
34	Front cover		RCF	LW76111
35	Front cover for Transverse Lower Berth (RHS)		RCF	LW76112
36	Front cover for Transverse Lower Berth (LHS)		RCF	LW76113
37	FRP bracket Assembly		RCF	LW76114