



**TECHNICAL SPECIFICATION
FOR
LED SIGNAL LIGHTING UNITS
FOR
SUBSIDIARY COLOUR LIGHT SIGNALS
FOR
RAILWAY SIGNALLING**

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Authors Name: Rajneesh kumar Ajay Verma Designation: Director/Signal/RDSO		
Approved by Name: Shri Mahesh Mangal Sandeep Mathur Designation: Sr. Executive Director (Co-ord)/Signal/RDSO		
Abstract This document specifies technical specification and inspection criteria for LED Signal Lighting Units for Subsidiary Colour Light Signals for Railway Signalling.		

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NAME	ORGANISATION	FUNCTION	LEVEL
Rajneesh Kumar Ajay Verma	RDSO	Member	Prepare
Mahesh Mangal Sandeep Mathur	RDSO	-	Approve

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0. FOREWORD

- 0.1 This specification is issued under the fixed serial number RDSO/SPN/153/~~2011~~ 2018 Rev. ~~4.1~~ 5.0.
- 0.2 This specification requires reference to the following Indian Railway Standards / British Standards / International Standards specifications:
- i) RDSO / SPN / 144 / 2006: Safety and reliability requirement of electronic signalling equipment
 - ii) STS/E/Relays/AC Lit LED Signal/09-2002: Tentative specification for universal plug-in type, tractive armature AC lamp proving relay (metal to carbon) for 110V AC LED signal lamp.
 - (iii) IRS:S23: Indian Railway Standard specification for electrical and electronic based signaling and interlocking equipment
 - (iv) BS 1376:1974: Specification for colours of light signals
 - (v) CENELEC Standard EN 50126: Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
 - (i) CENELEC Standard EN 50129: Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signaling
 - (ii) IEC 127: International Standard for miniature fuses
- 0.3 Wherever in this specification any of the above mentioned specification is referred to by number only without mentioning the year of issue, the latest issue of the specification is implied, otherwise the particular issue referred to is meant.
- 0.4 This specification is intended to cover the technical provisions and it does not include all the necessary provisions of a contract.
- 0.5 This specification supersedes specification number RDSO/SPN/153/~~2004~~ 2011 ~~rev.3~~ Rev. 4.1 (draft).

1.0 SCOPE

- 1.1 This specification covers the general and technical requirements of **Subsidiary** LED Signal lighting units for Railway Signalling application in RE & Non-RE areas of Indian Railways.

- 1.2 The LED signal lighting units covered in this specification include that of **Main Subsidiary Signal i.e.** Route, Calling ON & Shunt Signals. Specification also covers LED signals for use in tunnels in Metro Railway, Kolkata.

2.0 ABBREVIATIONS USED

RDSO: Research Designs & Standards Organisation

CENELEC: European Committee for Electrotechnical Standardization

IEC: International Electrotechnical Commission

BS: British Standards

RE: Railway Electrification

LC: Level Crossing

ASM: Assistant Station Master

MTBF: Mean Time Between Failures

CLS: Colour Light Signalling

ECR: Lamp Proving Relay

LED: Light Emitting Diode

UV: Ultra Violet

OK: Okay

PCB: Printed Circuit Board

ABS: Acrylonitrile Butadiene Styrene

NO/NC: Normally Open/Normally Close

C-ON: Calling-ON signal

AC/DC: Alternating Current/Direct Current

3.0 TERMINOLOGY

- 3.1 The terminology used in this specification is covered by the definitions given in IRS: S 23.

- 3.2 The terms referred to in this specification but not covered in IRS: S 23, are defined below:

Blanking & Non-Blanking failure modes of ~~Main LED signal lighting units &~~ LED signals for tunnels of Metro Railway, Kolkata-

In **blanking mode**, a Main Signal Lighting Unit shall extinguish when input current drawn by the current regulator falls outside specified limits of rated input current or illumination falls to a value which is not less than 40% of nominal illumination due to a failure or any other reason. In such case, current regulator should not draw input current more than 30 mA at maximum rated voltage.

In **non-blanking mode**, a Main Signal Lighting Unit shall remain lit when input current drawn by the current regulator falls outside specified limits of rated input current or illumination falls to a value which is less than 40% of nominal illumination due to a failure or any other reason. In such case, input current drawn by current regulator shall be limited to less than 40 mA to ensure dropping of ECR. Limit on input current shall apply when illumination has deteriorated to a value, which is not less than 40% of nominal illumination.

4.0 GENERAL REQUIREMENTS

4.1 The minimum visibility distance of Main signal LED signal lighting Units (for tunnels) shall be 600 m. in clear daylight with peak sunrays at rated voltage. The minimum visibility distance of Direction type Route Indicator with three lit LED signal lighting units shall be 400 m. in clear daylight with peak sun rays at rated voltage. The minimum visibility distance of LED signal lighting units other than Main and Route signal lighting units shall be 200 m in clear daylight with peak sunrays at rated voltage.

4.2 LED signal lighting units shall also be visible to a driver stopping at the foot of the signal.

4.3 LED signal lighting units shall be so designed that they fit in the existing colour light signal housings as per Table-I given below or as specified by the Purchaser.

Signal	Main Signal	Calling ON signal	Route Indicator	Position Light Shunt Signal
Reference Drawing No.	23001A/M, S 23024 /M, 23002 A/M, SA 23003 A/M MRC/SG/MISC/S/ 3-82 Alt - 1 (for Metro Railway, Kolkata)	SA : 24351 S 23463	SA: 23401 S 23407	SA: 23840 S 23841

Table-I

4.4 LED signal lighting units shall only be used with LED ECRs as per RDSO specification STS/E/Relays/AC Lit LED Signal/09-2002-as applicable.

5.0 TECHNICAL REQUIREMENTS

5.1 Colour Co-ordinates:

Colour co-ordinates of LED Signal lighting Units shall be as follows:

Red, Green & Lunar White Aspect: Class 'C' of BS: 1376

Yellow Aspect: Class 'B' of BS: 1376

Colour co-ordinates graph as per BS: 1376 is given in Annexure I.

5.2 OPERATING PARAMETERS

Operating parameters of various types of LED Signal lighting Units when used with ECRs as per RDSO specification STS/E/Relays/AC Lit LED Signal / 09-2002 shall be as per Table- II given below:

Sl. No.	Parameter	Main Signal			Subsidiary Signal		
					C-ON Signal	Route Lighting Unit	Shunt Lighting Unit
1.	Rated voltage at Input Terminals of Current Regulator	110V AC ±25 %			110V± 20%	110V± 20%	110V± 20%
2.	Current at rated voltage per unit at Input terminals of Current Regulator	140 mA +10%, -20% (rms) *			150 mA +10%, -20% (rms)	25 mA ± 5% (rms)	55 mA ± 5% (rms)
3.	Illumination measured at 1.5m from LED Signal Lighting Unit in axial direction at rated voltage	150 LUX	175 LUX	150 LUX	50 LUX - 10%, -+40%	50 LUX -10%, -+40%	30 LUX -10%, +40%
4.	Colour	Red	Yellow	Green	Yellow	Lunar white	Lunar White

Table II

Note: (i) ~~* Input current shall be within the specified tolerance limits in all design conditions of lighting except for non blanking failure mode.~~

(i) All values given in table II shall be read as nominal value ± tolerance limits.

(ii) The parameters for LED signal aspects for use in tunnels in Metro Railway, Kolkata are given later in this specification

6.0 DESIGN CRITERIA

6.1 LED SIGNAL LIGHTING UNIT

~~6.1.1 Main LED signal lighting unit shall be so designed that in all designed conditions of its lighting, except for failure in non blanking mode, it should ensure pick up of ECR and input current drawn by its current regulator should be more than specified maximum pick up current of ECR with ECR connected in circuit.~~

~~6.1.2 Main signal lighting unit shall remain lit or extinguish as per the Blanking or Non Blanking failure mode selected in the Current Regulator in case of deterioration of illumination or when input current drawn by the current regulator falls outside specified limits of rated input current due to a failure or any other reason as stipulated in Cl.3.2.~~

6.1.3 In case of Direction type Route Indicator, route signal lighting units shall be so designed that with two healthy and three defective lighting units in circuit, ECR should drop and total input current drawn by the Route Indicator Signal should be less than specified minimum release current of ECR.

6.1.4 In case of Position light Shunt Signal, shunt signal lighting units shall be so designed that with one healthy and one defective lighting unit in circuit, ECR should drop and total input current drawn by the Shunt Signal should be less than specified minimum release current of ECR.

6.1.5 LED Signal Lighting Units of Direction type Route Indicator and Position light Shunt Signal shall extinguish when input current drawn by the current regulator falls outside specified limits of rated input current or illumination falls to a value less than 40% of nominal illumination due to a failure or any other reason. In such case, a LED Signal Lighting Unit should not draw more than 2 mA.

- 6.1.6 Five route signal lighting units shall be wired in parallel in case of Direction type Route Indicator and two shunt signal lighting units shall be wired in parallel for Position light Shunt Signal. After wiring all the units of Direction type Route Indicator or Position light Shunt Signal, as the case may be, total input current drawn by the signal should be within +5%, -10% of sum of nominal input current of signal lighting units in circuit.
- 6.1.7 Calling ON signal lighting unit, shall extinguish when input current drawn by the lighting unit falls outside specified limits of rated input current or illumination falls to a value less than 40% of nominal illumination due to a failure or any other reason. In such case, input current drawn should not be more than 30 mA.
- 6.1.8 Dispersion angle of signal lighting units, measured as per Annexure II, shall be as given in Table –III. Illumination shall be measured at every 1° from axis of LED signal lighting unit to 10 % power points. There should be continuous spread of illumination.

Sl. No.		Main (For Tunnels) & Calling ON signal lighting units	Route signal lighting units	Shunt signal lighting units
i)	At 50% power points	4° to 10°	10° + 2°	15° + 2°
ii)	At 10% power points	15° Max.	20° Max.	30° Max.

Table III

Dispersion angle at 10% power points for all types of LED signal lighting units shall not be measured in acceptance test and may be measured in type test for academic interest only but shall not be counted for evaluation.

- 6.1.9 Signal lighting units shall not light upto 60 V.
- 6.1.10 Fluctuation in input voltage shall not result in latching of signal to Blanking/ non blanking failure mode.
- 6.1.11 The LED Signal Units shall work satisfactorily (Input current will remain in the limits as specified in Clause 5.2) in ambient temperature varying from -10°C to +70°C and a relative humidity upto 95%. at 40°C ± 2°C as specified in RDSO/ SPN/144/2006.
- 6.1.12 The LED Signal Unit shall not reflect sunlight/headlight of loco as it may give misleading aspect to the driver.
- 6.1.13 Light from LED signal lighting unit, when projected on a white target at 1.5 m from LED signal lighting unit, the target shall be uniformly illuminated within half power points and shall be free from dark circles.
- 6.1.14 LED Signal Lighting Units shall have a display area of 125 mm ± 1 mm diameter for ~~Main and~~ Calling ON signals and 85 mm ± 1 mm diameter for Route and Shunt signals.
- 6.1.15 LED signal lighting unit shall be provided with a curved transparent cover of UV stabilized polycarbonate material having a thickness of 2.5 mm ± 0.5 mm. LED signals for use in tunnels in Metro Railway, Kolkata shall have UV stabilized cover of polycarbonate material or UV stabilized polycarbonate lenses on inner surface.
- 6.1.16 Body of LED signal lighting unit shall be made of industrial grade plastic like ABS or fiber glass. Metallic body parts may be used where these facilitate heat dissipation. LED Signal Unit shall get fitted securely on the existing signal housings without any modification on them. A gasket made of EPDM (**Ethylene Propylene Diene Monomer**)-20 rubber shall be provided and pasted on the rim with the help of Anaerobic adhesive to the LED unit.

- 6.1.17 Body of LED signal lighting unit ~~& current regulator~~ shall be hermetically sealed.
- 6.1.18 Number of LEDs used should not be less than ~~60 for Red and Yellow, 30 for Green Main LED signal lighting units,~~ 30 for Calling ON, 16 for Route and 13 for Shunt signal lighting units. Variation from stipulated number shall be considered based on merits of the design.
- 6.1.19 Design shall be such that failure of a LED shall not vary illumination by more than 5 % of nominal illumination for **main and** calling ON signal lighting units and 10 % of nominal illumination for route and shunt signal lighting units. This tolerance for LED signals for use in tunnels of Metro Railway Kolkata shall be 20%.
- 6.1.20 LEDs in the unit shall be arranged in more than one array so that in the eventuality of failure of an array, whole unit does not become blank. LEDs in the arrays shall be interleaved so that effect of failure of any array is spread out. Route and shunt signal lighting units and main LED units for use in tunnels in Metro Railway, Kolkata may have one array.
- ~~6.1.21 LED signals for use of road traffic shall be used without ECR.~~
- 6.1.22 Sensing of illumination, if used, shall activate after signal lighting unit is completely lit to prevent hunting.
- 6.1.23 LEDs used in LED signal lighting units shall be of high performance quality and from reputed manufacturers as stipulated by RDSO. The maximum junction temperature of a LED shall not be less than 100 deg. and epoxy used in the LED shall have UV inhibitors.
- 6.1.24 Manufacturer shall maintain proper account of LEDs being used. The record shall include various details like source of supply, procurement invoice no. & date, quantity, incoming rejection, lot-wise consumption etc. which may be verified by inspecting officials.
- 6.1.25 At least 10% LEDs of every procured lot shall be tested before use to check electrical/optical characteristics as per LED manufacturer's data sheet. Lot-wise test record shall be maintained, which may be verified by inspecting officials.
- 6.1.26 Number of LEDs and their Part no. shall not be changed without prior approval of RDSO.
- 6.2 **CURRENT REGULATION CIRCUIT REGULATOR**
- ~~6.2.1 Current regulator in case of Main Signal Lighting Units shall be an independent unit and shall be fitted in place of signal transformer in the existing colour light signal housings.~~
- ~~6.2.2 Current regulator shall have selectable option for blanking and non-blanking the signal lighting unit to meet requirement of clause 6.1.2.~~
- 6.2.3 There shall be only one type of current regulator **circuit** for all Main signal aspects (**for Tunnels**).
- 6.2.4 Current regulation of LED signal lighting unit shall be within 2% for input voltage range as specified in Cl. 5.2.
- 6.2.5 Current regulator **circuit** shall be so designed that normally LEDs of a LED array are driven within average drive current range recommended by the LED manufacturer and in no circumstances LEDs of an array shall be driven by current more than the maximum current recommended by the LED manufacturer. Details of the same shall be submitted at type approval stage.

- 6.2.6 An MOV or Gas Discharge Tube of rating 200V shall be there at the input of the ~~CR~~ Current regulation circuit to take care of power surges.
- 6.2.7 A line filter circuit in a failsafe manner shall be provided at the input of the current regulation circuit. ~~regulator unit.~~
- 6.2.8 Bridge rectifiers used in the unit shall be 2 in no. in parallel and each rectifier should have 2 diodes in series to provide redundancy in case of failures.
- 6.2.9 Electrolytic capacitors in power circuit shall be used in series parallel combination to achieve failsafe redundancy.
- 6.2.10 If there is any external resistance in the design, it shall be of SMD type and in series parallel combination to achieve failsafe redundancy.
- 6.2.11 Coils/transformers, if used in current regulation circuit ~~regulator~~ shall be fire retardant and conform to 'H' class.
- 6.2.12 There shall be no terminals for DC lighting as DC lighting ceases to exist.
- ~~6.2.13 There shall not be any discrete jumpers. Integrated aligned rugged jumper selection arrangement shall be provided for blanking/non blanking options. It shall not be mechanically feasible to simultaneously select both blanking and non blanking mode. All selections shall be covered under single transparent cover with minimum gap at top to avoid loosening of selection arrangement due to vibrations.~~
- 6.3 A fuse terminal block as per RDSO specification no. RDSO/SPN/189/2004 ver. 1 (or latest) with glass fuse of 0.63 Amp rating as per IEC 127 with fuse blown indication using neon lamp should be supplied alongwith with the built in current regulator for use in signal lighting circuits. The current in case of indications due to fuse blown condition should not exceed 02 mA.
- 6.4 The electronic components, switches and connectors used shall be of Industrial grade and shall comply Cl. 5.1 of RDSO/ SPN/144/2006, as applicable. The operating temperature rating of the capacitors used shall be upto 105 deg. C or more. ~~The connectors used for interconnection between current regulator and LED signal lighting unit in case of main signals shall be of military grade.~~ Glass fuse shall be as per IEC 127. The voltage rating of capacitors should be more than double that of normal incidental peak voltage.
- 6.5 All Units shall meet the requirements as mentioned in clauses 2.3, 2.5, 5.2 & 6 of RDSO /SPN/144/2006.
- 6.6 Total harmonic distortion over full operating voltage range for LED signals shall be less than 20%.
- 6.7 Parts of body of any signal lighting unit as visible from front after fitting in CLS unit shall be black. Any permanent means e.g. backside of body, collar etc. of colour of the aspect may be used to indicate aspect colour for Main signal lighting units (for Tunnels). Rest signal lighting units ~~and current regulator~~ shall be of black colour.

7.0 LED SIGNAL FOR USE IN TUNNELS IN METRO RAILWAY, KOLKATA

- 7.1 For use inside tunnel in Metro Railway, Kolkata, LED lighting units shall be so designed that they fit into existing colour light signal units of Metro Railway (Drg. No. MRC/SG/MISC/S/3-82 Alt-1 of Metro Railway).
- 7.2 General and technical requirements shall confirm clauses 4.1, 4.2, 4.3 & 5.1.
- 7.3 Operating parameters:

Operating parameters of various types of LED lighting units when used with ECR's as per RDSO specification STS/E/Relays/AC lit LED Signal/09-2002 shall be as follows:

Sl. No.	Parameter	Main Signal for use in tunnels		
1.	Rated voltage at Input terminals	110V \pm 20 % AC (rms), 50Hz		
2.	Current at rated voltage per unit at Input terminals	140 mA \pm 20% (rms)		
3.	Illumination measured at 1.5m from LED Signal Lighting Unit in axial direction at rated voltage	80 LUX -10% + 40%	80 LUX -10% + 40%	80 LUX -10% + 40%
4.	Colour	Red	Yellow	Green

Table IV

7.4 DESIGN CRITERIA

- 7.4.1 LED Signal lamp shall be so designed that in all designed conditions of its lighting, it should ensure pick up of ECR and input current drawn should be more than specified maximum pick up current of ECR with ECR connected in circuit.
- 7.4.2 Green and Yellow aspect shall be designed to extinguish in case of failure resulting in non-correspondence with ECR. In such case, input current shall be limited to ≤ 10 mA to ensure dropping of ECR to avoid double aspect due to cascading circuit. In case of extinguishing of lamp due to an intermittent failure, it shall not restore automatically if failure disappears and shall restore only on re setting of the signal.
- 7.4.3 In case of Red aspect, design should not force blanking. In such case input current drawn by the LED Signal shall be limited to less than Drop Away current of LED ECR to ensure dropping of ECR. In case of extinguishing of lamp due to an intermittent failure, it should not restore automatically if failure disappears and would restore only on resetting the signal
- 7.4.4 Design criteria shall meet clauses 6.1.8, 6.1.9, 6.1.10, 6.1.11, 6.1.12, 6.1.13, 6.1.15, 6.1.16, 6.1.17, 6.1.19, 6.1.20, 6.1.22, 6.1.23, 6.1.24, 6.1.25, 6.1.26.
- 7.5 The LED signal lighting units shall have a display area of 85 ± 1 mm. diameter for Red, Yellow and Green aspects. Variations in this may be permitted based on the merits of the design.
- 7.6 No. of LED's used should not be less than 16 for Red, and Yellow and should not be less than 7 for Green aspect. Variations from stipulated nos. shall be considered based on merits on the design.

7.7 Current regulator circuit for LED signal units for use in Metro Railway, Kolkata should be housed in the same housing as that of the LED unit. If any other module is required, its details shall be given but such additional module shall be housed in the signal unit. The details of fixing additional unit shall be advised. Built in provision for non-blanking feature in Red LED signal aspect and blanking feature in Green LED signal aspects should be there. Yellow LED aspect should have selectable option for blanking/non blanking mode. Other criteria for current regulator unit shall conform to cl. 6.2.3, 6.2.4 and 6.2.5.

7.8 Compliance to Cl. 6.4, 6.5, 6.6 and 6.7 of this specification shall also be applicable for LED units used in tunnels in Metro Railway, Kolkata.

8.0 TESTS & PERFORMANCE CRITERIA

8.1 The LED signal lighting unit ~~and current regulator units~~ shall pass the climatic tests as per Sl. No. 1, 2, 3, 4, 5, 6, 7 & 12 of Cl. 9.3 of specification RDSO / SPN / 144 / 2006. LED signal lighting unit ~~and current regulator~~ shall be considered as out-door track side electronic equipment. For vibration test, upto & including 75 Kg. weight categories shall apply.

8.1.1 The LED signal lighting unit ~~and current regulator~~ shall pass driving rain test as per Sl. No. 9 of Cl. 9.3 of specification RDSO / SPN / 144 / 2006. These units shall be tested after fixing in an enclosure similar to colour light signal housing without hood and with backdoor open.

8.1.2 After test as per every Sl. No. of Cl. 9.3 of specification RDSO / SPN / 144 / 2006, as specified above, no LED should fail; there should not be any damage in the unit or visual change in colour. Also input current and illumination shall not change by more than $\pm 5\%$ of original values and will be within specified values as per clause 5.2. After completion of all tests, colour co-ordinates shall remain within specified class as per clause 5.1.

8.2 Applied high voltage test for LED signal lighting unit, ~~current regulator~~: The equipment shall withstand for one minute without puncture and arcing a test voltage of 2000Volts rms applied between body and all AC line terminals looped together.

(For testing with part of body which is used as heat sink, test voltage shall be 1500Volts rms) The test voltage shall be alternating of approximately sinusoidal waveform of any frequency between 50 Hz and 100 Hz. In case of LED signal lighting unit, it should not generate any spark during the test.

8.3 Insulation Resistance Test for LED signal lighting unit ~~and current regulator~~: This test shall be carried out-

- (a) Before the high voltage test
- (b) After the high voltage test
- (c) After completion of the climatic test

The Insulation Resistance shall be measured between the body and the current carrying terminals looped together at a potential of 500 V DC. There shall not be appreciable change in the values measured before and after high voltage test and these values shall not be less than 100 Mega ohms. After completion of climatic test, the insulation resistance shall not be less than 10 Mega ohms for the equipment at a temperature of 40°C and relative humidity 60%.

8.4 Dispersion Angle test: This shall be measured as per Annexure II.

8.5 FAIL SAFETY

- i) LED signal lighting Units ~~and current regulator~~ shall be so designed that any short/open or any other defect in any of the component will not lead to unsafe / undesirable situation.
- ii) There shall never be any possibility of change in colour of signal light unit with variation in temperature, current, voltage and ageing to unsafe side i.e. in any usual / unusual circumstances.
Red to Yellow or
Green Yellow to
Green
Lunar White to Yellow or Green
- iii) LED signal lighting Units ~~and current regulator~~ shall comply Cl. 3 & 4 of specification RDSO / SPN / 144 / 2006, as applicable.
- iv) Fail safety validation shall be done by an independent agency which has credentials & experience for similar validations. Fail safety validation shall be done as per CENELEC standards EN 50126 & EN 50129 for Safety Integrity Level 4.

8.6 Burning in test: LED signal lighting unit ~~and current regulator~~ shall be kept continuously ON for minimum 168 hrs. at 60 °C at rated voltage. There shall not be any difference in operating parameters before and after burning in test.

8.7 Thermal cycling and power cycling tests: All PCBs and power supply modules shall be subjected to thermal cycling and power cycling tests respectively as per Cl. 9.3 of specification RDSO / SPN / 144 / 2006. Proper test record having traceability to respective PCB/module shall be maintained by the manufacturer.

8.8 Calculation details of MTBF as per Part stress method shall be furnished by the manufacturer at the time of initial approval.

9.0 INSPECTION CRITERIA

9.1 TYPE TEST

For type test, two samples of every type of LED signal lighting unit ~~and current regulator~~ shall be subjected to following tests as applicable:

- (i) Visual inspection & dimensional check (Clause 4.3, 6.1.13, 6.1.14, 6.1.15, 6.1.16, 6.1.17, 6.1.18, 6.1.20, 6.1.23, 6.2.1, 6.2.2, 6.2.3, 6.4, 6.5, 6.7, 7.1, 7.5, 7.6, 7.7, 7.8).
- (ii) Colour co-ordinates (Clause 5.1)
- (iii) Operating Parameters (Clause 5.2, 7.3)
- (iv) Output current regulation of current regulator (Clause 6.2.4)
- (v) Compatibility with ECR (Clause 4.4, 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7)
- (vi) Ambient temperature test (Clause 6.1.11)

- (vii) Climatic tests (Clause 8.1, 8.1.1, 8.1.2)
- (viii) UV Stabilization test on cover (Clause 6.1.15)
- (ix) Effect of reflected light (Clause 6.1.12)
- (x) Visibility test (Clause 4.1, 4.2)
- (xi) Fail safety (Clause 4.4, 5.1, 5.2, 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.1.9, 6.1.10, 6.1.19, 6.1.20, 6.1.22, 6.1.23, 6.2.2, 6.2.4, 6.2.5, 6.3, 6.5, 6.6, 6.7, 8.5, 8.8)
- (xii) Applied high voltage test (Clause 8.2)
- (xiii) Insulation resistance test (Clause 8.3)
- (xiv) Minimum lighting voltage(Clause 6.1.9)
- (xv) Dispersion Angle test (Clause 6.1.8)
- (xvi) Fluctuation in input voltage (Clause 6.1.10)

9.1.1 An open blown out model of offered LED signals ~~and current regulator~~ shall also be submitted for initial type test.

9.1.2 Documents as per Cl. 14.0 shall be submitted alongwith samples.

9.1.3 Fail safety is not required for subsequent maintenance approvals provided there is no change in circuit design.

9.2 ACCEPTANCE TEST

9.2.1 Out of a lot, 20% of the samples shall be subjected to following tests:

- (i) Visual inspection & dimensional check (Clause 4.3, 6.1.13, 6.1.16, 6.1.17, 6.1.18, 6.1.23, 6.2.1, 6.2.2, 6.2.3, 6.4, 6.5, 6.7, 7.1, 7.5, 7.6, 7.7,7.8)
- (ii) Operating Parameters (Clause 5.2, 7.3)
- (iii) Minimum lighting voltage(Clause 6.1.9)
- (iv) Compatibility with ECR (Clause 4.4, 6.1.1, 6.1.3, 6.1.4, 6.1.6)

9.2.2 Minimum five samples from those which have passed tests as per Cl. 9.2.1 shall be subjected to following tests-

- (i) Ambient temperature test (Clause 6.1.11)
- (ii) Colour co-ordinates (Clause 5.1)
- (iii) Output current regulation of current regulator (Clause 6.2.4)
- (iv) Insulation resistance test (Clause 8.3 (a))

- (v) Dispersion Angle test (Clause 6.1.8)
- (v) Fluctuation in input voltage (Clause 6.1.10)
- 9.2.3 Acceptance tests as per Cl. 9.2.2 (ii) to (vi) shall be conducted after ambient temperature test. Operating parameters, minimum lighting voltage, compatibility with ECR shall also be conducted after ambient temperature test.
- 9.2.4 Failure in any of the tests is not acceptable.

9.3 ROUTINE TEST

- 9.3.1 Following routine tests besides other tests, as deemed fit to ensure quality, reliability and compliance of this specification shall be done by the manufacturer on all the units:
 - (i) Thermal cycling & power cycling tests (Clause 8.7)
 - (ii) Visual inspection & dimensional check (Clause 4.3, 6.1.14, 6.1.17, 6.1.18, 6.1.19, 6.1.24, 6.2.1, 6.2.2, 6.2.3, 6.4, 6.6, 6.8, 7.1, 7.6, 7.8, 7.11, 7.1A, 7.5A, 7.6A, 7.7A)
 - (iii) Burning in test (Clause 8.6)
 - (iv) Colour co-ordinates (Clause 5.1)
 - (iv) Operating Parameters (Clause 5.2, 7.3)
 - (v) Output current regulation of current regulator (Clause 6.2.4)
 - (vi) Compatibility with ECR (Clause 4.4, 6.1.1, 6.1.3, 6.1.4, 6.1.6)
 - (vii) Insulation resistance test (Clause 8.3 (a))
 - (viii) Minimum lighting voltage (Clause 6.1.9)
 - (ix) Dispersion Angle test (Clause 6.1.8)
- 9.3.2 Tests as per Cl. 9.3.1 (iv) to (ix) shall be conducted after Burning in test.

10.0 INFORMATION TO BE GIVEN BY PURCHASER

- (i) Type of LED signal lighting unit –
~~Main signal Red Aspect Main LED signal, Yellow Aspect Main LED signal or Green Aspect Main LED signal,~~
Calling ON LED signal lighting unit, Route LED signal lighting unit, Shunt LED signal lighting unit,
(Five route LED signal lighting units are required for one Direction type route indicator & three shunt LED signal lighting units are required for a Position light shunt signal)
Metro Railway, Kolkata tunnel use - LED signal Red, and Yellow and Green aspect.
- (ii) Type of housing (Ref. Cl. 4.3)
- ~~(iii) In case of requirement of spare current regulators, details of vendor shall also be specified, as the design of current regulators is vendor specific.~~

11.0 SCOPE OF SUPPLY

Scope of supply shall include the following material, if not asked otherwise by the purchaser - ~~In case of Main signal aspect One LED signal lighting unit, one current regulator and one fuse blown indicator as per cl. 6.3 with one spare fuse per Main signal aspect.~~

~~One spare current regulator shall be supplied with every 8 current regulators with a minimum of one per order.~~

In case of use in tunnels in Metro Railway, Kolkata, every aspect shall be supplied with built in current regulator, fuse blown indicator as per Cl. 6.3 with one spare fuse and any additional circuit module (if it's part of the design). In such case, one LED signal lighting unit with built in current regulator, one additional circuit module for ECR operation shall be supplied with every 6 modules with a minimum of one per order.

12. WARRANTEE

The supplier shall give a warrantee of 60 months for all types of LED signal lighting units, ~~current regulators~~ & other supplies except fuses.

13.0 MARKING

- 13.1 Clauses 12.1 and 12.2 of specification RDSO / SPN / 144 / 2006 shall be complied.
- 13.2 The words Indian Railway Property shall be engraved /embossed on every unit in letters of 5mm size (minimum) at a conspicuous place.
- 13.3 The anodized name plate shall be firmly attached to every unit and shall show the following information:
- (a) Name or trademark of the manufacturer
 - (b) Serial number of the unit
 - (c) Version No. of the unit*
 - (d) RDSO's specification number
 - (e) Name and aspect of the signal
 - (f) Operating voltage- 110V AC
 - (g) Month and year of manufacture

*In case of an alteration in the design of a unit, new version number shall be assigned.

14.0 DOCUMENTATION

Following documents shall be supplied with each set of 10 units subject to a minimum of 1 set of documents: -

- (a) Two copies of Installation and maintenance manual. This should also include following information:
 - (i) Guaranteed performance data, technical and other particulars
 - (ii) Schematic block diagram showing mounting arrangement of various components & details of each type of assembled PCB
 - (iii) Details of Hardware e.g. schematic diagrams of the system circuits/ components, details for each type of assembled PCB and part list
 - (iv) Mechanical drawings of every unit
 - (v) Part no. and manufacturer's data sheet of LEDs used
 - (vi) Trouble shooting procedure alongwith test voltages and waveforms at various test points in the PCBs.
 - (vii) Dos & Don'ts (Pocket size laminated cards)
- (b) Pre-Commissioning check list

15.0 PACKING

- 15.1 All the units and their sub assemblies shall be individually wrapped in bubble sheet and packed in individual card board boxes. The empty spaces shall be filled with suitable filling material. Alternatively, these may be packed in thermocole boxes. The units shall be finally packed in a wooden case or card boxes of sufficient strength so that it can withstand bumps and jerks encountered in a road/ rail journey.
- 15.2 Every box shall be marked with code numbers, contents and name of manufacturer. The upside shall be indicated with an arrow. Boxes should have standard signages to indicate the correct position and precaution "Handle with Care" with necessary instructions.
- 15.3 The units and their sub assemblies shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage.

16.0 INFRINGEMENT OF PATENT RIGHTS

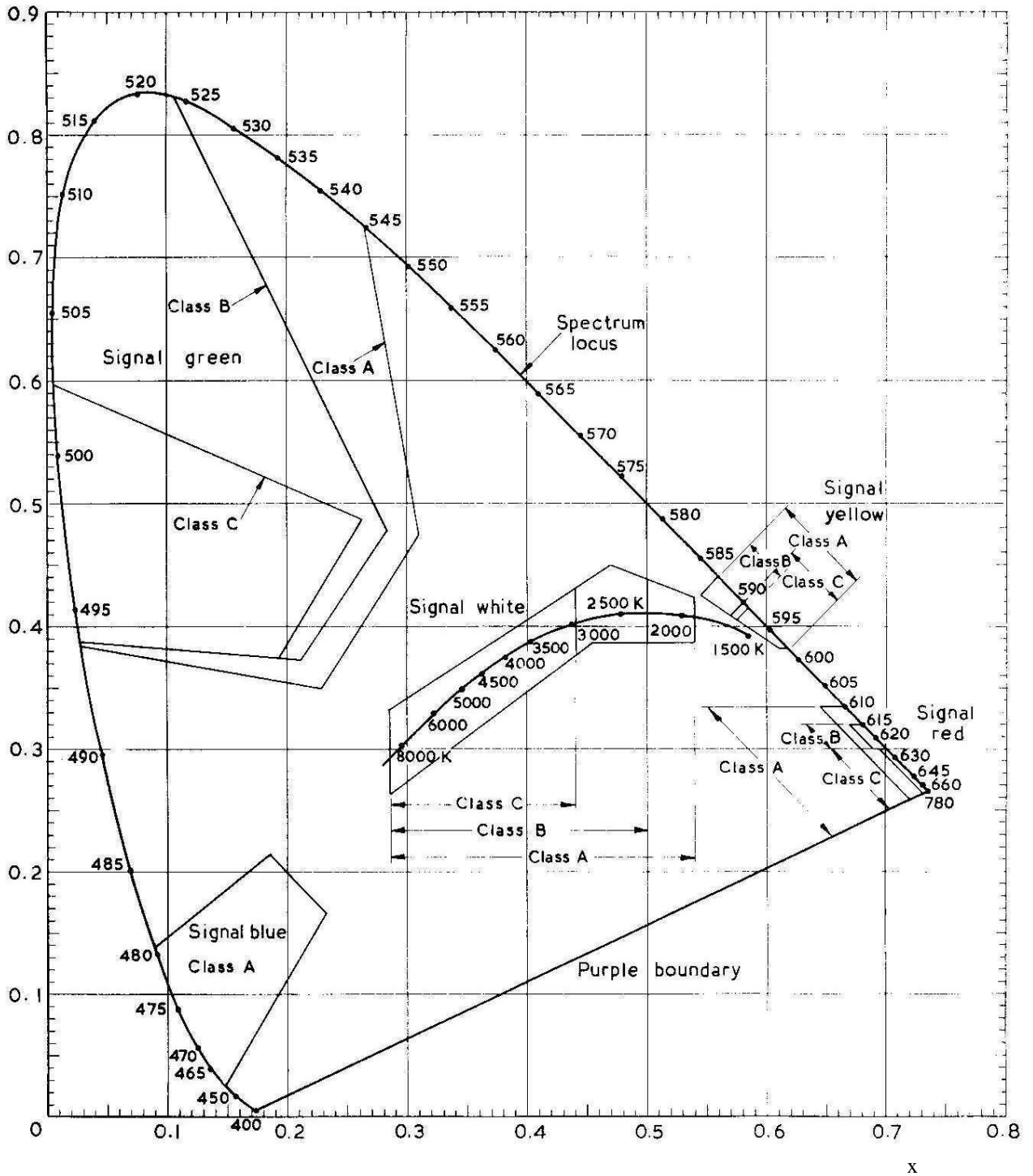
Indian Railways shall not be responsible for infringement of patent rights due to similarity in design, manufacturing process, use of components used in design, development of manufacturing of LED signal and any other factor which may cause such dispute.

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Annexure I

BS 1376 : 1974

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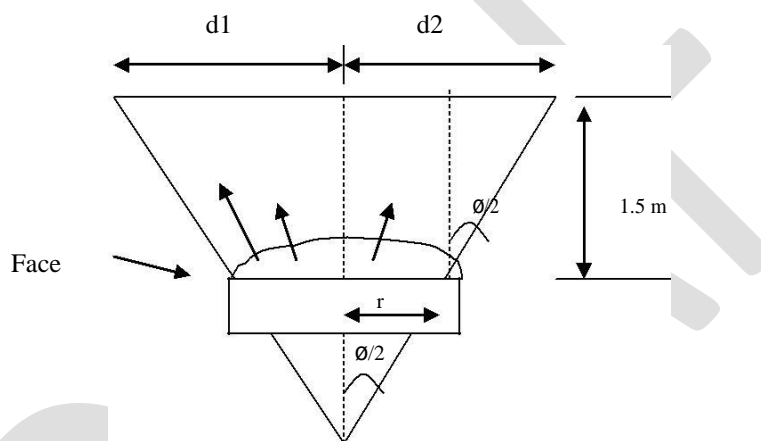


Chromaticity limits for signal colours

Annexure II

Measurement procedure for Dispersion Angle

1. Light up the aspect at the nominal voltage on 110 V and place it on the test bench.
2. The Dispersion Angle shall be calculated by measuring the half intensity points of the dominant wavelength at 1.5 m from LED signal lighting unit in axial direction on both the sides and taking average of the distances, d_1 & d_2 in metres
($d = (d_1 + d_2) / 2$)
3. The half intensity, point is where half of the normal illumination at rated voltage falls. The Dispersion Angle shall be calculated using the formula
$$\tan^{-1} \frac{d}{1.5} = \theta/2$$
4. 'r' is the distance from centre of the unit to the outer most LED provided in the unit.



5. **Dispersion Angle = θ**