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भारत सरकार, रेल मंत्रालय

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

**TECHNICAL SPECIFICATION**  
**FOR**  
**BATTERY OPERATED LED BASED**  
**TORCH LIGHT CUM FLASHING HAND SIGNAL LAMP**  
**SPECIFICATION No. RDSO/SPN/195/2008 Revision: 2.2**

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<b>Abstract</b>  This document specifies technical specification and inspection criteria for Battery Operated LED Based Torch Light Cum Flashing Hand Signal Lamp.			

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## **SPECIFICATION FOR BATTERY OPERATED LED BASED TORCH LIGHT CUM FLASHING HAND SIGNAL LAMP**

### **SPECIFICATION NO: RDSO/SPN/195/2008 Rev. 2.2**

#### **0 FOREWORD:**

- 0.1 This specification is issued under the fixed serial number RDSO/SPN/195/2008.
- 0.2 This specification is meant for specifying general & technical requirements of LED based torch light cum flashing hand signal lamp (also referred as HS lamp in this specification). It also specifies various tests to ensure consistency of quality of equipment. The flashing hand signal lamp unit must have the highest reliability under severe environmental conditions of operation i.e. water ingress, dust, humidity, high ambient temperature, shocks and vibrations. This specification supersedes earlier specifications on flashing hand signal lamp.
- 0.3 The customized lamp shall be manufactured to principal dimensions in accordance with conceptual sketch, and dimensions indicated therein as per Annexure-I.
- 0.4 The other relevant specifications are: -
  - (a) IS: 6303/1984 for dry cell batteries.
  - (b) Specification IEC 86-1/86-2 for alkaline cells.
  - (c) Standard BS: 1376 of 1974 for colors of light signals.
  - (d) IS-2083 for flashlights.
- 0.5 Wherever in this specification, any 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.
- 0.6 This specification is intended to cover the technical provisions and it does not include all the necessary provisions of a contract.

#### **1.0 SCOPE**

- 1.1 This user requirement based specification includes in its ambit all components required to be assembled into the ultimate product named Battery operated LED Based Torch Light-cum-Hand Signal Lamp.
- 1.2 The purpose of this specification is to develop a lightweight, rugged, maintainable and user-friendly Battery operated LED Based Torch Light-cum-Hand Signal Lamp which is IP-65 compliant.
- 1.3 Battery operated LED Based Torch Light-cum-Hand Signal Lamp shall be powered by four commercially available leak proof dry cell batteries type R-20 or LR-20 HP-2 size D (Duracell or equivalent) of 1.5V each.

## 2.0 TECHNICAL REQUIREMENTS:

### 2.1 Color Co-ordinates:

Red Aspect: Class 'C' of BS: 1376

Green Aspect: Class 'C' of BS: 1376

White light for torch mode: Class 'C' of BS: 1376. Deviation from the specified class may be agreed provided the light is suitable for torch light and is comfortable for reading and visibility in the dark.

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

### 2.2 Operating requirements:

#### 2.2.1 Performance parameters:

2.2.1.1 In white light mode, the H.S. Lamp shall function as a normal 4 cell torch with white LEDs. The design of the torch should comply with the following parameters:

Rated Voltage	6 Volts
Illumination (min.) measured at 1.5 m in axial direction (in Lux) in operating voltage range. (as per Annexure III)	40 Lux.
Dispersion Angle at 50% power points (as per Annexure III)	4° to 15°

2.2.1.2 The LED based colour display shall meet the under-mentioned working parameters.

Parameter	Quasi-static Green Aspect	Quasi-static Red Aspect
Rated Voltage (Volts)	6	6
No. of flashing pulses per minute	220 to 270	220 to 270
Illumination (min.) at 1.5m measured in axial direction (in Lux) in operating voltage range. (as per Annexure III)	60	40
Dispersion Angle at 50% power points (as per Annexure III)	4° to 10°	

2.2.1.3 Variation in dispersion angle may be agreed provided visibility and other requirements of this specification are complied.

2.2.1.4 Illumination shall be measured in steady mode. To enable the measurement in steady mode for colour aspects, suitable provision shall be provided inside the lamp which shall not be visible or accessible to the user. Normally lamps shall be provided with flashing colour aspects and steady mode shall be operated for measurement only.

#### 2.2.2 Cell Life Requirement:

HS lamp shall meet the under-mentioned cell life requirements when used with leak proof cells as per clause 1.3.

2.2.2.1 For white light mode:

Minimum normal cell life on continuous discharge basis up to low battery indicator (LBI)	40 hrs.
Min. operating battery life after low battery indicator (LBI)	6 hrs.

2.2.2.2 For colour light mode:

Parameter	Quasi-static Green Aspect	Quasi-static Red Aspect
Minimum normal cell life on continuous discharge basis up to LBI	150 hrs.	150 hrs.
Min. operating battery life after low battery indicator (LBI)	12 hrs.	12 hrs.

2.2.2.3 Cell life shall be measured individually for white light mode and every aspect of colour light mode. New cells should live the specified life of a particular mode/aspect when HS lamp is continuously lit in that mode/aspect. No deterioration in illumination is permitted during normal cell life. For specified minimum battery life after low battery indicator (LBI), 25% fall in illumination from its original value is permitted.

## 2.3 Visibility

Light from the lamp in colour aspects should be visible and discernable from a distance of 1.0 Km. along the longitudinal axis of the lamp and from 100 meters distance at six degrees angular displacement from longitudinal axis.

For carrying out the test, H.S. lamp should be kept at 1.1 meter above rail level and viewed at local sun set time under conditions of clear weather and against the sun.

## 3.0 DESIGN CRITERIA:

- 3.1 The external appearance of the lamp shall be of BLACK colour and in matt finish.
- 3.2 The battery operated flashing Hand Signal Lamp shall be manufactured out of materials of highest grade and purity to meet required parameters and be free from defects of workmanship, material or design. The components & materials used in the manufacture of the equipment shall be screened and should be of high quality. The switches, connectors, PCB and electronic components used shall be of industrial grade and as per relevant Indian Standard Specification (IS). The vendor shall indicate specification / particulars in this regard. The rating of all electronic components used shall be marked and be readable clearly on components or in the relevant datasheet. As the hand signal lamp is to be used out- door under all weather conditions, it shall not employ ferrous components. All metallic



electrical contacts shall be made of phosphorous bronze, brass or copper. Screws, nuts and other metallic components provided in the equipment should be of brass or stainless steel. The screws should be of adequate thickness and ruggedness.

- 3.3 The lamp shall comprise of light module and battery compartment. Light module shall have white light for torch and red & green colour light.

The body of the lamp shall be made of industrial grade plastic like ABS. A guarantee shall be given by the manufacturer that no re-constituted or recovered material has been used for the manufacture of modules. The body shall be in a single mould except the moving parts like battery doors etc.

A conceptual sketch of the lamp is enclosed as Annexure-I. Minor variations in the dimensions may be accepted. HS Lamp with body in cylindrical shape with cross sectional area not exceeding to that in sketch at Annex-I may also be considered depending upon the merits of design.

- 3.3.1 Light module shall comprise of LEDs and UV stabilized polycarbonate clear lense/cover to give concentric beam of light. Polycarbonate clear lense/cover shall be surrounded by a projection protruding for few millimeters. No electronic component except LEDs shall be visible from the lense.
- 3.3.2 Red and Green colour light shall be quasi static i.e. with 220 to 270 pulses per minute. It shall not be feasible to have more than one of the red, green or white light simultaneously by operating their switches or otherwise.
- 3.3.3 The Battery compartment shall be so designed as to accept either 4 Nos. R-20 dry cells or 4 nos. LR-20 alkaline cells. The battery compartment should have isolation from light module and its electric circuitry so that leakage of dry cell does not affect the electric circuit/ components.
- 3.3.4 The HS lamp shall be provided with a group of FOUR individual sealed type *TACT* switches with suitable cover or cap in which each switch can be independently pressed to switch-ON the desired aspect (RED, GREEN or WHITE torch) or keep the torch in STANDBY mode. The purpose of the standby mode is to keep the lamp in OFF mode while in service. Tact switches shall be of high performance and able to withstand at least 100000 operations. Switches shall be robust in nature to withstand jerks etc. Tact switches of NKK and Knitter makes are preferable. Switches should be located near the handle. Switches of other reputed makes may be agreed if fulfilling the requirements of this specification to the RDSO's satisfaction. Colour of cover/ cap of the switches should be same as that of their respective aspect. Location of switches should be such that these can be easily operated when the lamp is held in the hand.

The cover label, if used over the tact switches should be of polycarbonate and should be so pasted that looks uniform and cannot be peeled off even under adverse weather.

- 3.4 HS Lamp shall be provided with an appropriate ergonomic handle integral with the body. Lamp should have provision of two buckles and a good quality nylon strap of 1-meter length fastened with these buckles for hanging the lamp on shoulders. Shape & thickness of the handle should be such that it provides comfortable grip.

- 3.5 There should be no need to use any type of screwdriver or to deal with any wires for the purpose of replacement of batteries. The battery compartment cover should be robust in design and hinges should be avoided in it. Any other arrangement for the cover can also be accepted depending on its user-friendliness for replacement of batteries, ruggedness and durability.
- 3.6 Weight: The complete lamp shall be designed to weigh as minimum as feasible but it should not be more than 600 gms. excluding weight of batteries.
- 3.7 Light from HS lamp, when projected on a white target at 1.5 m from LED signal lighting unit, shall illuminate the target uniformly without any dark circles within half power points.
- 3.8 The transparent cover/ lenses, as applicable, shall be of polycarbonate material having minimum thickness of 1.5 mm.
- 3.9 The HS lamp shall have insulation resistance of more than 100-M ohms. The insulation resistance shall be measured between the body of lamp and the current carrying terminals looped together at a potential of 500 V DC.
- 3.10 LEDs used shall be of high performance quality and from NISCHIA/Japan or AVAGO/USA. The minimum junction temperature of a LED shall not be less than 100 deg. LEDs of other reputed makes may be agreed subject to compliance of the requirements of this specification. SMD type LEDs may be used if operating requirements of the HS lamp are met.
- 3.11 Normally LEDs of the LED based hand signal lamps shall be driven within average drive current range recommended by the LED manufacturer and in no circumstances LEDs shall be driven by current more than the maximum current recommended by the LED manufacturer
  - 3.11.1 Components including number of LEDs and their part no. shall not be changed without prior approval of RDSO.
- 3.12 The following shall be ensured while designing the Hand Signal Lamp:
  - 3.12.1 Reverse polarity protection shall be suitably provided. Design shall be such that it does not employ fuses.
  - 3.12.2 The lamp shall be free from interference from radio frequencies. It shall not malfunction in the vicinity of any walkie – talkie set working on VHF range.
  - 3.12.3 Steady Green/Red mode of the H. S. Lamp should not be possible for the user.
  - 3.12.4 The switches for RED & GREEN shall be at extreme ends.
  - 3.12.5 An ON/OFF switch of PUSH to ON (clause 3.3.4) type shall be used for cutting the power supply when the lamp is not in use for long periods.
- 3.13 VISUAL HEALTH INDICATOR

- 3.13.1 One pilot amber LED of 3.0 mm size shall be provided to indicate that the hand signal lamp is in good working condition and shall turn on only when the lamp is switched on. Location of this LED shall be such that it is always visible to the user irrespective of mode/ aspect in use.
- 3.13.2 The pilot amber LED provided as above shall also serve as low battery indication (LBI) and shall begin to flash at 220-270 pulses per minute, if the battery has lived its minimum normal specified life as per clause 2.2.2.
- 3.13.3 A minimum no. of two LED's shall be used for each colour. All LEDs shall be configured in such a way that failure of an LED shall not affect the working of the unit in that mode. It is desirable that (i) any such failure is indicated through extinguishing of pilot amber LED provided as above, (ii) the pilot amber LED does not light when the HS lamp is switched on to a mode/ aspect with a faulty LED and (iii) a circuit fault is indicated by an extinguished pilot LED.

### 3.14 MARKING

- 3.14.1 On each of the modules, following details shall be provided on non-ferrous metallic label or using non-erasable screen printing on the body. No marking shall be hand written or hand etched.

Serial No., Month/Year of Mfg.

Specification No. Version No.\*

Manufacturer's Name

A sticker with "USE LEAK PROOF CELLS ONLY" should be pasted on body. This instruction can be engraved/ embossed on the body instead of pasting the sticker.

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

- 3.14.2 A brief detail about information conveyed by the pilot amber LED (i.e., LED Lit-Lamp OK, LED Flashing- Battery Low, Switch On & LED not lit-Lamp defective) shall be written using non erasable screen printing at a conspicuous place on the body for guidance of the user.
- 3.14.3 All markings/indications shall be easily legible and durable. Where the marking is by use of labels, the labels of non-ferrous metal shall be firmly fixed and shall not be capable of being removed by hand. Durability of marking shall be checked by rubbing the marking by hand with a piece of cloth soaked with petroleum spirit. This requirement shall also be met after completion of climatic test.
- 3.14.4 On every module, manufacturer's name or trademark shall be embossed or engraved. The words Indian Railway Property shall also be engraved /embossed on every unit in letters of 5mm size (minimum) at a conspicuous place.

## 4.0 TESTS

The HS lamp is normally required to be used outdoor as well as on board locos/coaches traveling up to 160 KMPH, under all weather conditions ranging from damp coastal to hot dry climate and subject to rain, dust and vibrations that accompany such service and from mean sea level (MSL) up to 1500 meter above MSL. The unit shall employ non- ferrous components to withstand corrosion effects of nature. Environment parameters/ tests that the unit shall be designed to withstand are given below.

### 4.1 Ambient temperature severities: $-10^{\circ}\text{C}$ to $+60^{\circ}\text{C}$

Test for above will be conducted in energized condition for 4 hours each at minus  $10^{\circ}\text{C}$  ( $-3^{\circ}\text{C}$ ,  $+0^{\circ}\text{C}$ ) and plus  $60^{\circ}\text{C}$  ( $+3^{\circ}\text{C}$ ,  $-0^{\circ}\text{C}$ ) separately for red and green aspects and white torch light. During and after each of these tests, no LED shall fail & there should not be any damage in the unit or visual change in colour. After 1 hour of recovery period of each of these tests, deterioration in illumination, if any, shall not be more than 5% of original value subject to compliance of minimum illumination criteria as per clause 2.2.

4.1.1 Ambient temperature severities test shall be conducted with either specified cells or a separate power supply. During test for any ambient temperature severity, malfunction or leakage of cells shall not be considered as failure of the HS lamp. In such case, test for that ambient temperature severity shall be repeated with new cells after properly cleaning the battery compartment from inside.

4.2 Climatic tests: A total of 6 HS lamps having 2 HS lamps each lit individually for red aspect, green aspect and white light shall be able to withstand following environmental/climatic tests:

SN	Name of test	Reference Specification	Recovery period
1	<i>Change of temperature test at lower temp. – <math>10 \pm 3^{\circ}\text{C}</math> and upper temp <math>+70 \pm 2^{\circ}\text{C}</math> (2 Cycles and duration of exposure 3 hrs. after the stability in chamber has been reached)</i>	<i>Part-XIV/Section 2 of IS: 9000</i>	2 hours
2.	<i>Damp heat cyclic test (one cycle of <math>12 + 12 = 24</math> hours), (Upper temperature <math>55^{\circ}\text{C} \pm 2^{\circ}\text{C}</math>, relative humidity at all times shall not be less than 98%)</i>	<i>Part-V/Section 2 of IS: 9000</i>	2 hours
3.	<i>Salt Atmosphere test (3 cycles of 22 hours)</i>	<i>Part-XI/ Procedure 3 of IS: 9000</i>	4 hours
4.	<i>Driving rain test for two hours</i>	<i>Part-XVI (Test condition 'C', Clause 7.1.3) of IS: 9000</i>	4 hours.
5.	<i>Dust Test at <math>40 \pm 3^{\circ}\text{C}</math> for the period of 1 hour.</i>	<i>Part-XII</i>	2 hours
6.	<i>Vibration test</i>	<i>5 to 150 Hz, Acceleration: 5g, 20 sweep cycles on 3 axes (IS: 9001 Pt. XIII)</i>	-

All tests shall be conducted in energized condition of the unit. During and after each of these tests, no LED shall fail & there should not be any damage in the unit or visual change in colour. After recovery period of each of these tests, deterioration in illumination, if any, will not be more than 5 % of original value subject to compliance of minimum illumination criteria as per clause 2.2. Insulation resistance shall not be less than 100-M.ohms. After completion of all tests, colour co-ordinates shall remain within specified values.

- 4.2.1 Climatic tests shall be conducted with either specified cells or a separate power supply. During any climatic test, malfunction or leakage of cells shall not be considered as failure of the HS lamp. In such case, that test shall be repeated with new cells after properly cleaning the battery compartment from inside.
- 4.2.2 Test report for IP-65 complaint housing shall be submitted at the time of type tests.
- 4.3 Dispersion Angle test: This shall be measured as per Annexure III in every colour and white light.
- 4.4 Burning in test: The HS lamp shall be kept continuously ON at 60 °C. at rated voltage for minimum 24 hrs. for each for red, green aspects and white torch light. There shall not be any difference in performance parameters before and after burning in test. The test shall be conducted with either specified cells or a separate power supply.
- 4.5 Drop Test: The HS lamp shall withstand free drop from a height of 1.5 meters above an RCC platform of 75mm thickness or on a steel plate 12 mm thick. For the purpose of the drop test, the units shall be powered with 4 numbers of R-20 cells. Lamp shall continue to function effectively, satisfy all parameters after ensuring two drops. Appearance of cracks on the body may not be deemed as disqualification as long as lamp continues to function. The lamp, however, shall not disintegrate.
- 4.6 Life test for switch: This test shall be performed on one sample, loaded with cells. Every switch position shall be operated for at least 10,000 operations in type test at the rate of 25 to 35 operations per minute. There should not be any problem in switch operation or its functioning after the test.
- 4.7 VHF Interference test: The working of the H. S. Lamp shall be checked for any interference by keeping a VHF transmitting set (5 Watt) at a distance of 10cm from the H.S. Lamp. The functioning of the H.S. Lamp shall not be affected at any of the VHF frequencies.

## **5.0 TEST PLAN**

### **5.1 Type test**

Type test shall be performed on six samples. Burning-in test shall be conducted first. Colour co-ordinates, climatic, ambient temperature severities, dispersion angle, vibration, visual alarm, current drain & design parameters, durability of marking (Cl. 3.13.2) and cell life tests shall be conducted for each colour aspect and white light on two samples each. Cell life requirement test will be conducted with both LR-20 and R-20 cells. Visibility test shall be performed on two samples each for red and green aspects. Rest tests shall be performed on all samples, unless specified otherwise in the relevant test clause. Cell life

test shall be conducted with new cells after climatic, ambient temperature severities and vibration tests. All samples shall individually pass the type tests.

The unit shall be subjected to the following tests-

- i) Visual inspection (as per clause 3 as feasible through visual inspection)
- ii) Colour co-ordinates (as per clause 2.1)
- iii) Operating Parameters (as per clause 2.2)
- iv) Ambient Temperature Severities test (as per clause 4.1)
- v) Climatic tests (as per clause 4.2)
- vi) Visibility test (as per clause 2.3)
- vii) Visual Health Indicator Test (as per clause 3.13)
- viii) Vibration Test (as per clause 4.2)
- ix) Insulation test (as per clause 3.9)
- x) Burning in test (as per clause 4.4)
- xi) Drop test (as per clause 4.5)
- xii) Reverse polarity protection test (as per clause 3.12)
- xiii) Current drain & design parameters' test (as per clause 3.11 & 5.1.2)
- xiv) Life test for switch (as per clause 4.6 & 3.3.4)
- xv) Verification of marking (as per clause 3.14)
- xv) IP-65 housing (as per Clause 4.2.2)
- (xvi) Weight Test ((as per clause 3.6)
- (xvii) UV Stabilization test on polycarbonate lense (as per cl. 3.3.1)

5.1.1 Vendor shall submit make, grade and data sheet of all electronic components and switches along with samples for type test. Vendor shall also submit chemical composition and relevant IS or international specification of all metallic components used and housing of HS lamp.

5.1.2 Vendor shall submit design parameters like voltages for LBI, input current, power consumption etc. along with their tolerances to achieve specified operating parameters.

## 5.2 Routine Tests:

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. Parameters measured after Burning-in test shall be recorded and enclosed with every unit:-

- i) Visual inspection of each unit (as per clause 3 as feasible through visual inspection)
- ii) Colour co-ordinates (as per clause 2.1)
- iii) Performance Parameters (as per clause 2.2.1)
- iv) Visual Health Indicator Test (as per clause 3.13)
- v) Burning-in test (as per clause 4.4)
- vi) Design parameters like voltages for LBI, input current, power consumption etc. (as per clause 5.1.2)
- vii) Verification of marking (as per clause 3.14)
- viii) Weight test (as per clause 3.6)

5.2.1 Test record shall be properly maintained with traceability to lot / samples tested, which may be verified by inspecting officials.

5.2.2 Manufacturer shall maintain proper accountal of LEDs, switches and all electronic components 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.

### 5.3 Acceptance test:

Acceptance test as per following sample plan shall be carried out: -

(a) Verify sample plan:

<i>Lot size</i>	<i>Sample size</i>
Up to 20 Nos.	3 Nos.
Between 21-50 Nos.	6 Nos.
Between 51 –100 Nos.	9 Nos.
Between 101-150 Nos.	12 Nos.
More than 151	15 Nos.

(b) Following shall constitute acceptance test:

- i) Visual inspection (as per clause 3 as feasible through visual inspection)
- ii) Colour coordinates (as per clause 2.1)
- iii) Performance parameters (as per clause 2.2.1)
- iv) Ambient Temperature Severities test (as per clause 4.1)  
A unit may not be tested for each type of colour and white light. At least one third of samples should be subjected to each type of colour and white light.
- v) Visual Health Indicator Test (as per clause 3.13.1 & 3.13.2)
- vi) Insulation test (as per clause 3.9)
- vii) Burning-in test (as per clause 4.4)  
(Burn- in test shall be performed for min. 50% of time duration for every colour and white light)
- viii) Drop test on one sample – performance test to ensure proper functioning after the drop test (as per clause 4.5)  
(In case lamp develops cracks but passes the test, vendor shall replace the respective unit for supply.)
- ix) Reverse polarity protection test (as per clause 3.12)
- x) Verification of design parameters (as per clause 5.1.2)
- xi) Weight test (as per clause 3.6)
- xii) Verification of marking (as per clause 3.14)  
(Clause 3.14.3 shall be tested on one sample.)

5.3.1 Burn-in, visual inspection and verification of marking / embossing tests shall be performed on all samples. Rest tests shall be performed in each mode on one third of sample size if not specified otherwise in the relevant clauses. Parameters shall be measured after Burn-in test.

5.4 For type test and acceptance test, both R-20 and LR-20 cells shall be provided by the vendor.

## **6.0 DOCUMENTATION**

A pocket sized laminated card containing operational instructions, indications communicated through pilot amber LED, purpose of stand, battery replacement procedure and Do's and Don'ts shall be provided with every unit.

## **7.0 SCOPE OF SUPPLY**

HS lamps may be procured either with 4 nos. of leak proof R -20 cells or without cells as per purchaser's requirement which should be clearly mentioned in the purchase order. If lamps are procured with cells, cells should not be older than three months at the time of supply.

## **8.0 PACKING**

- 8.1 Each lamp shall be individually wrapped in bubble sheet and packed in individual card board boxes. Cells in their original packing shall be kept separately in the box. 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. Final packing cases shall not contain more than 100 lamps, each individually packed.
- 8.2 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 signage to indicate the correct position and precaution "**Handle with Care**" with necessary instructions.
- 8.3 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.

## **9.0 WARRANTY**

The supplier shall give a warranty of 24 months for HS lamp excluding cells from the date of supply.

## **10.0 INFRINGEMENT OF PATENT RIGHTS:**

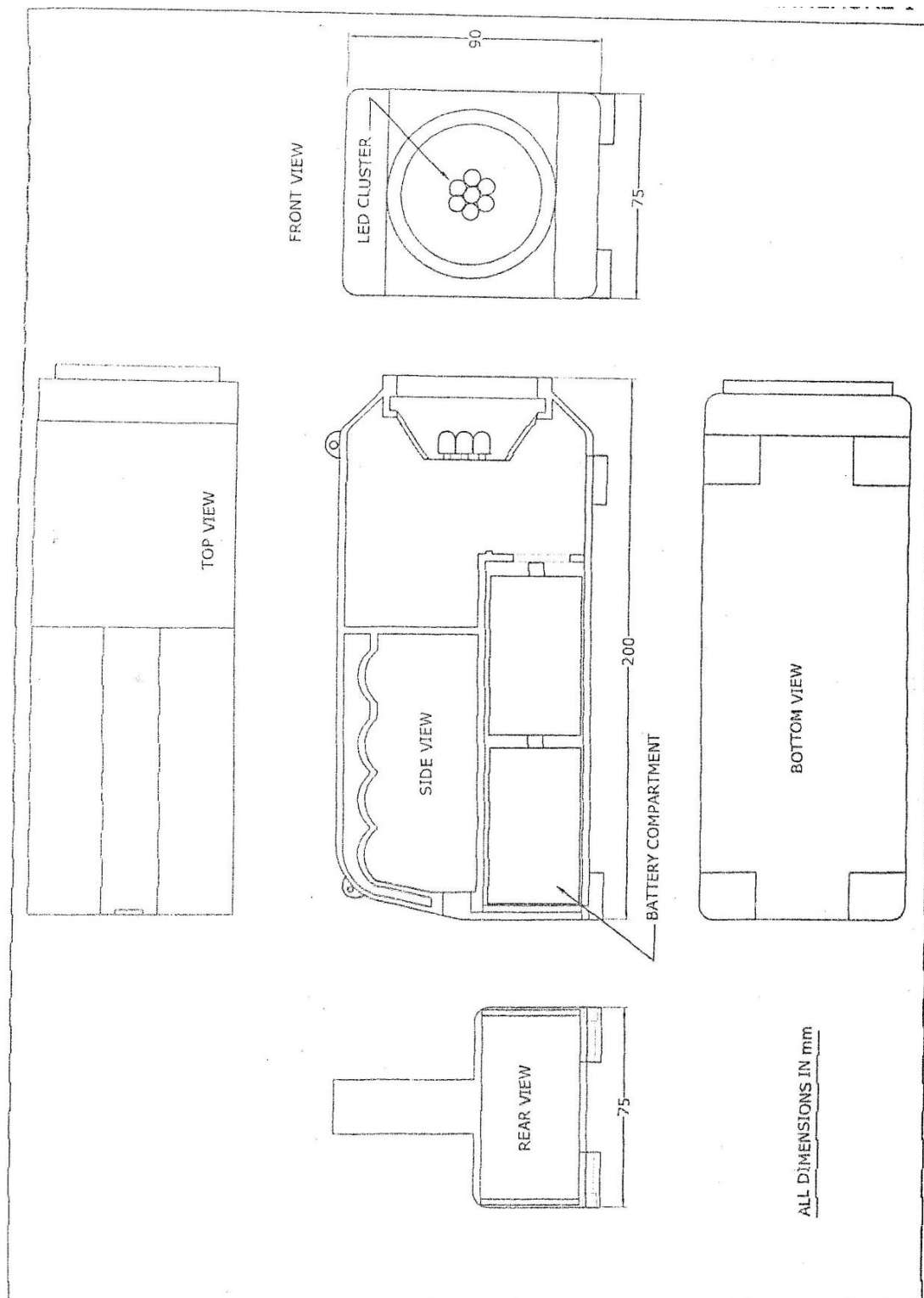
Indian Railway shall not be responsible for infringement of patent rights due to similarity in design, manufacturing process, use of components used in design, development & manufacturing of Battery operated LED based torch light cum flashing hand signal lamp and any other factors which may cause such dispute.

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## Annexure-I

### **TYPICAL SKETCH FOR RECTANGULAR SHAPED HAND SIGNAL LAMP**

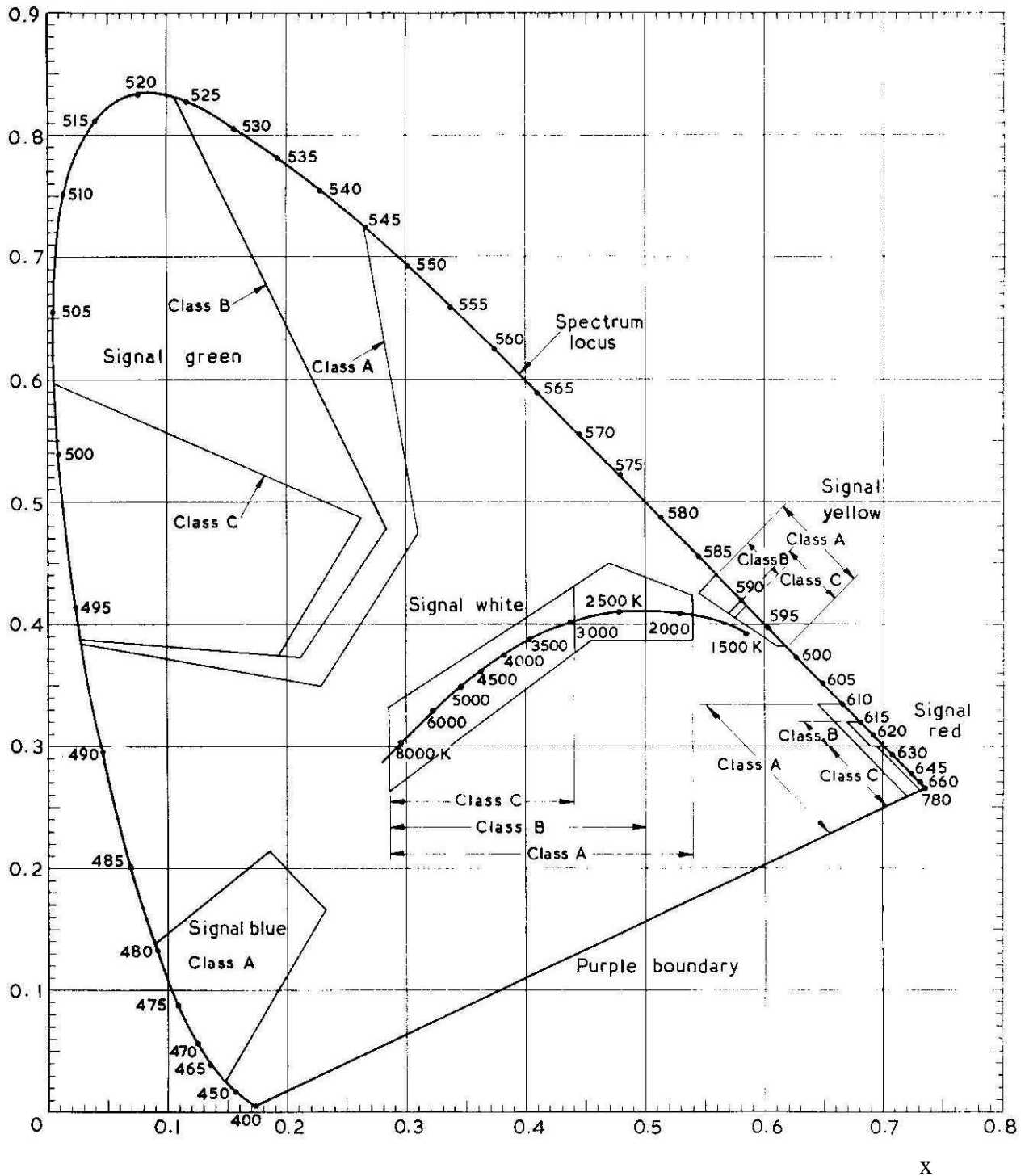


Note: HS Lamp with body in cylindrical shape may also be considered depending upon the merits of design.

## Annexure II

BS 1376 : 1974

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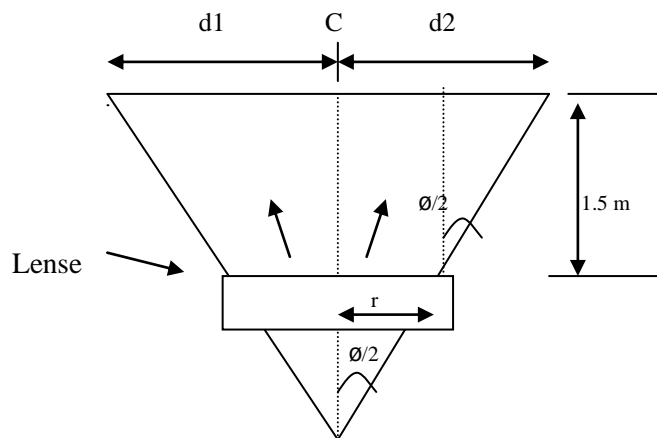


Chromaticity limits for signal colours

### ANNEXURE - III

#### Measurement procedure for Optical parameters (i.e., Dispersion Angle, illumination & Colour co-ordinates)-

1. Light up the aspect at the nominal voltage on 6 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 meters  
( $d = (d_1 + d_2) / 2$ )
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  $\tan^{-1} \frac{d-r}{1.5} = \theta/2$
4. 'r' is the distance from center of the unit to the outer most LED provided in the unit.



5. Dispersion Angle =  $\theta$
6. Illumination shall be measured at 1.5 m from LED signal lighting unit in axial direction (i.e. at point C).
7. Colour co-ordinates shall be measured at 1.5 m from LED signal lighting unit in axial direction (i.e. at point C).

#### Note-

All measurements shall be done in a dark room with spectrometer or Chromometer suitable for measurement of colour co-ordinates & illumination of LEDs.