Specification No.ELRS/Spec/PR/0022

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIFICATION FOR LED MARKER LIGHT FOR ELECTRIC, DIESEL ELECTRIC AND DIESEL HYDRAULIC LOCOMOTIVES OF INDIAN RAILWAYS

Specification No.ELRS/Spec/PR/0022 (REV-1 Oct -2004)

RESEARCH DESIGNS & STANDARD ORGANISATION
MANAK NAGAR, LUCKNOW – 226 011

CONTANTS

CHAPTER 1- GENERAL

1.0 OBJECTIVE & SCOPE:

Marker lights are provided on locomotive to meet requirements of GR & SR which stipulates as under:

a. A train shall not be worked at night or in thick, foggy or tempestuous weather impairing visibility or in long tunnels, unless the engine carries an electric headlight of an approved design and, **in addition, two oil or electric white marker lights.**

b. An engine employed exclusively on shunting at stations and yards shall, at night or during thick, foggy or tempestuous weather impairing visibility, display such headlights as are prescribed by the Railway Administration and **exhibit two red marker lights in front and in rear.**

c. **In case the electric headlight fails** or a train has to be worked with the engine running tender foremost in an emergency, **the engine shall display the two oil or electric white marker lights referred to in sub-rule (1)** pointing in the direction of movement and the train shall run at a speed prescribed by special instructions.

Marker light with incandescent lamps were adopted. The incandescent lamps, however, have a low life and need frequent maintenance. With development of high luminance LEDs, their use was considered for marker lights to obtain advantage of higher life and higher brightness.

Earlier specification No. ELRS/Spec/PR/0022 Oct 2002 for LED marker lights has been reviewed to make it comprehensive ensuring higher standard of performance and reliability of marker lights in service on locomotives. This specification, thus, supersedes the earlier specification

1.1 DEFINITIONS:

RDSO	- Research Designs & Standards Organisation
Tenderer	- Firm/companies participating in the tender
Supplier	- The qualified tenderer for supply of the equipment
Railways	- Indian Railways Administration
CLW	- Chittaranjan Locomotive Works

1.2 REFERENCE TO VARIOUS SPECIFICATIONS:

(i) IS: 616 Safety requirements for mains operated electronics.
(ii) IEC-60571(1998-02) General requirements and tests for electronic equipment used on Rail vehicles. (Second Edition)
(iii) IEC-61000 : EMC Testing
(v) RDSO spec no ELRS/SPEC/SI/0015 (Latest) for " Reliability of Electronics used in Rolling stock application"

1.3. **SUPPLIER'S RESPONSIBILITY:**

The supplier's responsibility will extend to the following:

1.3.1 Supply of detailed instructions for installation of the equipment on the locomotive. Supplier shall also depute his representative for ensuring correct installation of first two equipments in the locomotive at each location (shed / CLW).

1.3.2 Supplier shall arrange Commissioning, testing & field trials of the prototype equipment in service jointly with RDSO and will depute team of engineers to Railway field units for this purpose.

1.3.3 The marker light unit is required to service a life of 10 years. The supplier shall quote for spares, which may be required for satisfactory maintenance of the unit for a period of 3 years after completion of warranty period.

1.3.4 The supplier will be required to enter into a contract with the user railway for repair of electronic cards employed (if any) and shall indicate repair charges for the cards. The repaired card will have warranty of one year.

1.3.5 The design shall be developed as per requirement given in the specification. The detailed design shall be submitted to RDSO for scrutiny and approval of the design features before commencing of the manufacturing. The suppliers shall, however, be responsible for performance of complete system.

1.3.6 **Warranty:** The supplier shall be responsible for any damage to equipment provided in the locomotive due to defective design, materials, workmanship upto a period of 18 months after commissioning on the locomotive or 24 months from the date of supply, which ever is earlier. The supplier shall replace within one month, such equipment during the warranty period at his cost. The period of warranty will be extendable in case of recurring problems attributable to defective design, material or manufacturing. The supplier's liability in this respect of any complaints, defects and /or claim shall be limited to the furnishing and installation of replacement parts free of any charge.

1.3.7 The supplier shall be responsible for carrying out all the modifications at his cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per technical specification. For any technical decision the final authority from the purchaser's side is RDSO.

1.3.8 **Training:** The supplier shall arrange for training to IR personnel in maintenance and trouble shooting of the system supplied. One day training for three persons per location is to be arranged by the supplier in the field of maintenance and troubleshooting. The supplier shall furnish the syllabus and schedule of training programme to RDSO as part of design proposal. Training will be arranged free of cost. Suitable training material will be supplied to the participants.

1.3.9 The supplier shall supply the write up and the elaborate manual for maintenance and trouble shooting free of cost to IR for easy maintenance. Two set of manuals will be supplied each shed/shop or one set per 10 nos. of equipment supplied.

1.4 **RAILWAYS' RESPONSIBILITY:**

Railway will be responsible for following:

1.4.1 Labour, consumables and electrical energy required for erection, testing & commissioning of the equipment.

1.4.2 The wages and allowances as well as the cost of the passage to and from the place of training for railway personnel only.

1.4.3 The installation of marker light units on locomotives and connections of lamp units and marker control units. Interconnecting cables shall be supplied by railways.

1.5 **DOCUMENTATION:**

1.5.1 Documents to be submitted with offer: The tenderer shall submit the following information with the offer in printed form and digital format and compiled in a booklet. Offer with incomplete information may not be considered.

(a) System design, Salient features and advantages of the offered system, Schematic Circuit, Functional Description, Protection scheme. A summary sheet of important data required is placed at Annexure-B.
(b) Man-machine interface: Details of switches, indications and fault diagnostic feature.
(c) BOM (Bill Of Material), Data sheets for components/devices and other equipment proposed for use
(d) Mechanical interface diagram (Outline General Arrangement), assembly drawings of complete unit, mounting arrangement and weight.
(e) Clause by clause compliance
(f) Details of technical support and training offered
(g) Supply experience, Logistics proposed for warranty support
(h) Recommended list of spares with cost for 3 years maintenance after warranty
(i) List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair.
(j) QAM (Quality Assurance Manual), QAP (Quality Assurance Plan)
(k) Test protocol with procedure of testing.
(l) ISO 9000 certification.
(m) Details of infrastructure, manufacturing and testing activities in line with guidelines issued vide RDSO spec no.- ELRS/SPEC/SI/0015 (Latest).

1.5.2 The successful tenderer shall submit Following documents after award of contract.

(a) Technical documentation explaining the complete scheme, characteristics, diagnostics, protection and control etc.
(b) Detailed drawings of each system/sub-system with interface details in CAD format..
(c) Vendor list for subsystems
(d) Operation and Maintenance manual.
(e) Spares catalogue

1.5.3 DOCUMENTS FOR FUTURE REFERENCE: The tenderer shall submit 4 set of final design, BOM (Bill Of Material), mechanical drawing, approved test procedure etc. to RDSO, incorporating corrections, if any, during the design approval process. one set duly approved will be returned to the tenderer. These documents will require to be shown to the inspecting authorities/ railway representative on demand.

1.6 **PROTOTYPE APPROVAL AND PERMISSION FOR BULK MANUFACTURING**:

1.6.1 The successful tenderer shall submit a prototype sample for inspection/testing and approval by RDSO before undertaking the bulk manufacture. A copy of internal test results should accompany the inspection call.

1.6.2 The supplier shall undertake bulk manufacturing incorporating modifications/ improvements as may be considered necessary in course of service trials and as directed by RDSO within the framework of the specification. In case of major change, the unit shall be type tested again.

1.7 Any deviations to this specification considered necessary to improve performance, reliability of the unit or for any other reason, should be furnished by tenderer with details and full particulars for consideration of purchaser. Unless such deviations are accepted in final contract, the provision of this specification will be binding on the contractor

1.8 **INFRINGEMENT OF PATENT RIGHTS:**

Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing equipment and any other factor, which may cause such dispute. The responsibility to settle any issue lies with the supplier.

1.9 **FIELD TRIALS:**

After successful completion of type tests, the equipments shall be subjected to field service trials for a minimum period of six months. The number of trial equipments and venue shall be as agreed between the purchaser and the supplier. The installation and commissioning of the equipments for field trials shall be carried out by the supplier.

CHAPTER 2- TECHNICAL REQUIREMENT

2.0 Each locomotive will be provided with Four marker lights, consisting red and white LEDs lamps, two at each end. The marker light unit must have the highest reliability under severe environmental conditions of operation of locomotives i.e, dust, humidity, high ambient temperature, shocks and vibrations, electrical switching surges, Electro Static Discharge, variations in supply voltage etc.

It being a safety requirement of operation, the marker light unit must have the high standard of reliability under severe environmental conditions such as dust, humidity, high ambient temperature, shocks and vibrations, electrical switching surges in supply system, variations in supply voltage etc. encountered in locomotive operation.

2.1 The marker light unit shall comprise of red & white Lamps Unit Consisting of high intensity LED lamps assembly with its current regulator, provided in suitable water proof enclosure (IP65), window toughened front glass.

2.2 **TYPE OF SYSTEMS IN RAILWAYS:-**

2.2.1 The supply voltage on Electric, Diesel-Electric and Diesel-Hydraulic locomotives are different. Therefore, this specification cover three types of systems :

- System type E - For electric locomotives and EMUs.
- System type D - For Diesel-electric locomotives and DMUs.
- System type DH - For Diesel-Hydraulic locomotives

2.2.2 Power supply voltage and voltage variation for above three types is as under:

	SYSTEM VOLTAGE – DC (Volts)		
	Type E	Type D	Type DH
Maximum	136	90	30
Nominal	110	72	24
Minimum	70	45	16

2.2.3 The marker unit should work satisfactorily for the voltage range indicated in clause 2.2.2 above. There should not be any damage to the equipment at voltages less than the minimum specified value for an indefinite period.

2.3 **LAMP UNIT:-**

2.3.1 Marker lamps unit shall be cluster of 20 high intensity red & 20 high intensity white LEDs used in equally distributed cluster in rounded profile. LEDs giving min 7^{o} view angle, arranged in series and parallel circuits to ensure average forward current and peak forward current through LED's limited to 20mA and 30 mA respectively. The manufacturer will submit design details to prove that

current through LED's does not exceed the limits. The current regulation shall be better than 0.5% for the full working voltage range as per clause no. 2.2.2 checked at lamp terminal unit. It should work at nominal loco control voltage i.e. 110V for E type, 72V for D type and 24V for DH type locos.

2.3.2 The wattage of marker lght should not more than 5 watt at rated voltage as per clause 2.2.2

2.3.3 The RED LEDs used in lamp unit shall be of type HLMP – ED-16-VX000 of Agilent Technologies or equivalent with following parameters at an ambient temperature of 25º C:

SYMBOL	PARAMETER	**TEST CONDITION**	MIN.	TYP.	MAX.	UNIT
V_F	Forward Voltage	I_F = 20 mA	--	1.9	2.4	V
V_R	Reverse voltage	I_R = 100 µA	--	5	--	V
I_R	Reverse Current	V_R= 5 V	--	--	100	µA
ψP	Dominant Wavelength	I_F = 20 mA	--	630	635	nm
	Junction Temp.	-	--	130	-	^{o} C.
$2\theta_{1/2}$	Half Intensity Angle	I_F = 20 mA	--	15	--	Deg.
Iv	Luminous intensity	I_F=20mA	--	5.5	--	cd
I_F	Forward current	--	--	20	50	mA

The WHITE LEDs used in lamp unit shall be of type NSPW- 500 BS of Nichia Corporation of Japan or equivalent with following parameters at an ambient temperature of 25 degree C.

SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
V_F	Forward Voltage	I_F = 20 mA	--	3.6	4.0	V
V_R	Reverse voltage	I_F = 100 µA	--	5	--	V
I_R	Reverse Current	V_R= 5 V	--	--	50	µA
$2\theta_{1/2}$	Half Intensity Angle	I_F = 20 mA	--	20	-	Deg.
Iv	Luminous intensity	I_F=20mA	--	5.6	--	cd
I_F	Forward current	--	--	20	50	mA

2.3.4 The lamps shall be operated through switch provided on the driver's desk in loco cab for Diesel locomotives as well as Electric locomotives.

2.3.5 The marker light shall have built in reverse input polarity protection. Fuse of suitable rating shall be provided on the lamps in fuse holder. A suitable surge protection shall also be provided for high voltage spikes. The surges of the order of 2 KV are expected in the system.

2.3.6 The marker lamp housing shall be fabricated from 1.6 mm MS sheet. The mounting shall be done through screws to fit in existing marker light housing on locomotive.

2.3.7 The lamp unit with LEDs mounted on PCB shall be sealed from the front with 5 mm toughened glass and suitable gaskets to ensure no entry of dust and water under operating conditions.

2.3.8 A suitable epoxy/DMC moulded connector shall be fitted on the LED lamp unit for connecting power supply.

2.3.9 The electronic components must "Burn-in" to eliminate infant mortality in components including semi-conductor devices as per Appendix A.

2.3.10 All the LEDs shall be connected such that failures of one LED does not affect any other LED. For this purpose a resistance/Zener diode shall be provided across each LED.

2.3.11 The display area of lamp shall have diameter of 120mm for electric and 130mm dia. for diesel electric and diesel hydraulic locomotives unless specified otherwise.

2.4 PERFORMANCE REQUIREMENTS:-

2.4.1 Marker light being safety item should have high degree of reliability under all conditions of operations.

2.4.2 Marker light – both aspects white/red shall be clearly visible from a distance of 2 kms at night.

2.4.3 The LED marker light shall meet the lux requirements as follows, when measured in forward direction over entire range of input voltage as indicated in clause 2.2.2:

Lamp	Lux level at 1 Meter	Lux level at 3 Meters
RED	75 LUX	7 LUX
WHITE	75 LUX	7 LUX

2.5 **VISIBILITY:-**

The clear visibility of marker light shall not be less than 2 kms at night.

2.6 **CONSTRUCTION:-**

2.6.1 Each locomotive will be provided with 2 sets of marker lights on front and 2 sets on rear. One set consists of pair of red/white marker lamps. RED and WHITE LED marker lamp assemblies will be housed in two separate housing on electric locomotives but on diesel locomotives RED & WHITE LEDs will form one cluster and same will be housed in single housing provided on two sides both in front and rear.

2.6.2 The marker light shall be so designed that it fits in the existing housing of marker lights on locomotives. The outline dimensions of marker light housing for electric loco are given in Annexure –'A' and the same are indicated in Annexure – 'B' & 'C' for diesel electric loco.

2.6.3 **Interchangeability and deviations.**

The LED marker light will be mounted in existing housing and it will ensure its **interchangeability with existing incandescent lamp marker lights**. Increase in overall dimension and mounting dimensions shall not be allowed.

Deviation from the standard could be considered for improved performance. However, complete particulars with technical justification for deviation shall be furnished and got approved by RDSO.

2.7 **GENERAL DESIGN FEATURES:-**

2.7.1 The marker unit should use only solid-state devices of industrial grade.

2.7.2 All PCB should be wave soldered.

2.7.3 The electronics should be suitable for rolling stock application in heavily EMI polluted environment.

2.7.4 The wires/cables used for internal construction of the unit shall be of PTFE insulation and multi-strand copper conductors.

2.7.5 The resistance of less than 0.5 W shall not be used. Wattage rating of any resistor shall not be less than twice the load at 70^0C under worst operating condition

2.7.6 In view of limited space available in the locomotive, the equipment shall be design as compact as possible.

2.7.7 In order to ensure high reliability, the guidelines indicated in the Specification No. ELRS/Spec/SI/0015 -"Reliability of electronics used in rolling stock application" should be implemented to the extent possible. A reference should be made in the tender offer to the relevant clauses, which are not followed, and relaxation is required.

2.7.8 The identification details, rating, model No.etc. printed on components shall not be erased by manufacturer.

2.8 **PROTECTION:-**

2.8.1 The current regulator provided in lamp unit shall have over current protection. The lamp shall have built-in reverse polarity protection and input fuse protection.

2.8.2 The marker unit will have high efficiency, i.e. losses in circuit will be minimum and total power consumption of unit will be declared under Appendix – B and will be tested during type test.

2.9 **MARKING:-**

The following shall be punched on each of the unit on the anodised aluminium plate on control unit and lamp unit.

1. Manufacturer's Name
2. Serial Number
3. Year of built.
4 Input voltage & current on lamp unit.
6 LED type/make on lamp unit.

CHAPTER III

ENVIRONMENTAL CONDITIONS

3.1 The equipment should function satisfactorily under the following environmental conditions. Which are encountered where equipment will be expected to work.

3.1.1

a) Maximum temperature
} Stabled Locomotive under sun : 70 deg. C
} On board Working loco under sun. : 55 deg. C
b) Minimum temperature : 0 deg. C
c) Average temperature : 47 deg. C

3.2 **Humidity:** Up to 100% during rainy season.

3.3 **Altitude:** Up to 1200 m above mean sea level.

3.4 **Rainfall:** Very heavy in certain areas. The loco equipment shall be designed suitably.

3.5 **Environment:** Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/cm^3. In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.

3.6. **Coastal area:** The equipment shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition will be as follows:

a) Maximum pH value : 8.5.
b) Sulphate : 7 mg per litre.
c) Max. concentration of chlorine : 6 mg per litre.
d) Maximum conductivity :130 micro siemens /cm

3.7 **Vibration and shocks:** The equipment shall be designed to withstand without damage, vibration and shock as generally encountered in the locomotives and shall confirm to the standards as per tests specified in IEC-60571 and are as under:-

{i} Max. vertical acceleration: - 1.0g.
(ii) Max. longitudinal acceleration: - 3.0g.
(iii) Max. transverse acceleration: - 2.0g.

The vibrations are of the sine wave and the frequency of the vibration is between 1Hz and 5OHz. The amplitude 'a' expressed in mm is given as a function of 'f' by the equation.

a= 25/f for values of 'f' from 1 Hz to 10 Hz.
a= 250/f square, for values of 'f' exceeding 10 Hz and up to 50 Hz.

3.7.1 In the direction corresponding to longitudinal movement of the vehicle, the equipment is subjected for two minutes to 50Hz vibrations of such a value that the maximum acceleration is equal to 3g (amplitude a= 0.3mm)

3.8 **Electromagnetic and Radio Frequency Interference Pollution** – High degree of electromagnetic pollution is anticipated in locomotive through high voltage contactor operation and RFI produced through walkee talkee hand set of the driver's, where the equipment will be mounted. Necessary precaution should be taken in this regard.

CHAPTER 4 - SCOPE OF SUPPLY

4.1 Scope of work

4.1.1 The scope under this specification covers design, development manufacture, supply, training and commissioning of the "Marker lamp" of electric and diesel electric locomotives.

4.1.2 The following will be scope of supply.

Sl no.	Items	Oty.
1.	Marker lamp unit	4 no.
2.	One set of additional fuses	As required

a) One set per 5 units subject to minimum two sets of users maintenance & troubleshooting manual.

b) List of spare parts along with cost for maintenance of system for 3 years. (Optional)

c) Cost of annual maintenance contract. (Optional)

d) Cost of card repair. (Optional)

CHAPTER 5 - INSPECTION

5.1 The whole of the material or fittings used in the construction of the equipment shall be subjected to inspection by the Inspecting official and shall be to his entire satisfaction.

5.2 The inspecting official shall have the power to :-

5.2.1 Adopt any means he may consider necessary to satisfy himself that all the materials or fittings specified are actually used throughout the construction.

5.2.2 Visit at any reasonable time and without previous notice, either contractors works or his sub-contractor's works to inspect the manufacturers and the quality of the work at any stage.

5.2.3 To reject any materials or fittings that do not conform to the relevant standard specifications or have not been manufactured in accordance with the approved practices. The rejected materials or fittings shall be marked in a distinguishable manner and shall be disposed off in such manner as the Inspecting Official may direct to avoid its inadvertent use in the product order as per this specification.

5.3 Testing of equipment and fittings shall, as far as possible be carried out at the works of the manufacturers. Testing of bought out components may also be carried out at sub-contractor's premises, if so required. The contractor shall provide free of charge, such materials or fittings as may be required for testing whether at his own or his subcontractor's premises. The test for which facilities are not available may be carried out at RDSO or any other approved laboratory for which the testing charges shall be payable by the supplier.

5.4 The Inspecting Official shall select all the equipments and the fittings required for test and the tests shall be carried out in his presence.

5.5 No material shall be packed or dispatched until the Inspecting Official has passed it. The contractor's responsibility for its efficiency in every way shall remain the same as if the work had been manufactured and tested by him.

5.6 Should any part require alteration or any defect appear during the test or trial the contractor shall be without any extra charges make such alteration or rectify the defects to the satisfaction of the Inspecting Official.

5.7 Copies of Maker's test certificate, guarantee the performance of the equipment shall be supplied in duplicated along with the delivery of each set of equipment.

CHAPTER 6 -TEST

6.1 CATEGORIES OF TEST

6.1.1 **TYPE TEST:** Type test shall normally be carried out on equipment of the approved design. If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source shall be treated as new item for the purpose of conducting type tests.

6.1.2 The type tests shall be repeated once in three years by RDSO. Type test will also be repeated in the following cases.

§ Modification of equipment, which is likely to affect its function.
§ Failure or variations established during type or routine test.
§ Resumption of production after an interruption of more than two years.
§ After supply of 200 units.

6.1.3 **ROUTINE TEST:** Routine test shall be carried out in every equipment of each order.

6.1.4 **ACCEPTENCE TEST:** Acceptance Test shall be carried on 10% of batch quantity subject to minimum of 5 nos. as per table given below.

6.2 Following tests will be carried out on the prototype unit as per relevant IEC specification or mutually agreed test program. Manufacturer will bear the expenses of the tests.

SL NO	TEST	CLAUSE No.	TYPE	ROUTINE TEST	ACCEPTANCE TEST
1.	Visual inspection	6.3	ü	ü	ü
2.	Insulation Resistance	6.4	ü	ü	ü
3.	Di Electric	6.5	ü	ü	ü
4.	Performance test	6.6	ü	ü	ü
5.	Over voltage Test	6.7	ü		ü
6.	Visibility Test	6.8	ü		ü
7.	Voltage Surge Test	6.9	ü		
8.	Lux test	6.10	ü	ü	ü
9.	Measurement of luminous intensity	6.11	ü		
10.	Measurement of dominant wave length	6.12	ü		
11.	Damp heat Test	6.13	ü		
12.	Dry heat Test	6.14	ü		
13.	Cooling Test	6.15	ü		
14.	Salt Mist Test	6.16	ü		
15.	Vibration and shock Test	6.17	ü		
16.	Water tightness test	6.18	ü		ü
17.	Power consumption test	6.19	ü		
18.	Reverse polarity test	6.20	ü	ü	ü
19.	Burn – in Test	6.21	ü		
20	Reliability test	6.22	ü		ü

The following clarifications are issued on the above tests.

6.3 VISUAL INSPECTION:-

The object of visual inspection is to check that the equipment is free from defects and the equipment are as per approved drawing. All the important dimensions will be measured and should be in permissible tolerance. Bill of materials will be submitted. The make, rating of equipments, subassemblies will be checked with the details as per approved design. If a change is needed in make or rating of important equipments, sub-assemblies, it should be intimated and should have approval of RDSO.

6.3.1 Check for general workmanship fitting, finish and mounting arrangement as per approved drawing of purchaser.

6.3.2 Check for proper water tight fitting of LED lamp unit.

6.3.3 Check terminals, switches, indications, type number etc. as per approved drawing.

6.3.4 The requirement listed in the latest reliability specification (ELRS/SPEC/SI/0015) for quality of PCB and other hard ware will be checked and confirmed clause by clause.

6.3.5 Check from supplier record that the unit has been subjected to "burn in" procedure and there was no failure of any component. In case there was a failure of any component, check that the card has been again subjected to "burn in" test.

6.4 INSULATION RESISTANCE:--

The insulation resistance with 500 V megger shall be more than 50 M ohms at 70 % RH for all the circuits. The period of the test should not les than 60 sec.

The following minimum requirements at the highly humid condition is to be ensured as per given below.

- 110 V circuit and earth : 20 M Ohms
- Control electronics and earth : 10 M Ohms
- Screen to earth : 10 M Ohms
- Lamp unit to earth : 10 M Ohms

6.5 DIELECTRIC TEST:-

The voltage as per following table shall be applied for 1 minute between shorted connections and metallic supporting frame the test shall be considered as unsatisfactory if either a disruption discharge of flash over occur or dielectric equipment trips before 1 minute during the test.

	Type E/EU	Type D	Type DH
50 Hz, Ac rms Voltage	1500	1000	500

6.6 **PERFORMANCE TEST:-**

Connect the marker unit to variable DC supply source and vary the voltage from minimum to maximum as specified in clause 2.2.2 and check the working of RED and WHITE LED lamps and check whether all parameters are within prescribed limits**.** The marker lamp should draw no current with application of reverse input voltage on terminals of marker light unit.

6.7 OVER VOLTAGE TEST:-

1.8 times the nominal system voltage shall be applied to the unit for two minutes and the unit shall work satisfactorily after the test.

6.8 **VISIBILITY TEST:-**

The equipment will be checked to verify that it meets the visibility requirement laid in clause 2.5.

6.9 SURGE TEST:-

The test shall be conducted as per IEC-60571, clause 10.2.6.2. The surge pulse shall be 1.8 kV, 1.2/50 micro Sec

6.10 **LUX TEST:**-

The marker light shall be energised from a variable DC input power supply. The lux shall be measured in axial direction with lamp unit on at rated voltage. The value of measured lux shall not be less than 75 lux at one meter and 7 lux at 3 meter for RED and WHITE lamps under specified conditions. The average forward current through LEDs shall not be more than 20 mA. The variation in lux level will not be more than 5% over voltage range as specified in clause 2.2.2.

6.11 **MEASUREMENT OF DOMINANT WAVE LENGTH:-**

The dominant wave length of LEDs shall conform to clause 2.3.3. The dominant wave length shall lie at (630-635) nm for red LEDs.

6.12 **MEASUREMENT OF LUMINOUS INTENSITY TEST:-**

The LEDs used in lamp unit shall conform to clause 2.3.3 to meet the requirement of luminous intensity. The luminous intensity of LEDs shall not be less than 5.5 and 5.6 candella (cd) at 20 mA for RED and WHITE LEDs respectively.

6.13 DAMP HEAT TEST:-

Damp heat test shall be done keeping the equipment in deenergised condition. It is to be ensured that the RH of the oven should be between 80 to

100% during the above test. The temperature of the equipment is to be raised from ambient to 55ºC in 2 hours and kept at that temperature for 6 hours. The temperature of the equipment 55ºC should be brought down to ambient (recovery period) in 3 hours. The cycle is to be repeated at least two times and carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

6.14 DRY HEAT TEST:-

The temperature of the equipment is to be raised to 75ºC at the rate of 1º c at 1.5 minute and to be kept at that temperature for 6 hours. In this test equipment should be in energised condition and check the working of the system. Cool it to the room temperature (recovery period 3 hrs) and carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

6.15 COOLING TEST:-

Bring down the temperature of the equipment to 0º ± 2 and keep it at the temperature for 2 hours and the carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test after the recovery period of 3 hrs.

6.16 SALT MIST TEST:-

The test is to be carried out as per **IEC 60571 clause 10.2.10**.

6.17 VIBRATION SHOCK AND BUMP TEST: -

The test shall be carried out as per IEC-60571, clause 10.2.11 with the equipment mounted and energised as in service.

6.18 **WATER TIGHTNESS TEST:-**

The test shall be carried out as per IEC-60571, clause 10.2.12 as agreed between user and manufacturers, the lamp unit is to be tested for shower test to ensure water tightness of the unit.

6.19 POWER CONSUMPTION TEST :-

Power consumption will be measured under rated condition and will not exceed the declared value as per design.

6.20 **REVERSE POLRITY TEST :-**

The Marker light unit should have built-in reverse polarity protection. The equipment shall function normal after the reverse polarity at input terminals is removed.

6.21 BURN IN TEST:-

The cards used on the equipment will be subjected to burn- in for 75 hours as per the temperature cycle in Annexure-1. The cards will be kept functional during the test. This will be part of internal test by manufacturer, whose results will be submitted during routine testing.

6.22 RELIABILITY TEST :

The reliability can only be determined in actual service. However, the following accelerated endurance tests shall be carried out on the prototype to simulate as close as possible, the service conditions. There shall be no failure during this test.

a) The marker lamp unit shall be mounted in an oven maintained at 75^{O}C.
b) The marker light will be operated at the specified maximum voltage and at 75^{O}C for a period of 100 hours.

APPENDIX "A"

"BURN IN PROCEDURE FOR ELECTRONIC UNIT"

1. Each marker unit containing semi-conductor devices, resistor, capacitor etc. must be "Burn In" to eliminate infant mortality in components. The components are stressed thermally by connecting to power supply bus and running at an elevated ambient of 75^0 C. Burn in is to be completed before final testing of the unit.

2. **BURN IN PROCEDURE**

2.1 The unit shall be connected as per relevant circuit diagram and power supply. Due care should be taken for connection, recording serial number of card, unit, failed component if replaced.

2.2 Power Supply - Based on type of equipment i.e., type "E", "D" or "DH", the voltage should be set corresponding to the rated voltage with tolerance of +10%. The supply bus must be protected by fuse. The use of fast acting fuse is recommended.

2.3 Temperature - The ambient temperature inside the burn in chamber is to be $75^OC \pm 5\%$.

2.4 Duration - Each card/unit is to be given a burn in for a period not less than 72 hours.

2.5 Replacement of Component/Components - During panel testing or after the burn in test, if it is found necessary to replace any component, the device/component failure must be recorded. On completion of the electronic tests on such cards, the card must be treated as "New" and as such must be given a "Burn In" again and retested before releasing the unit. Proper record of failures, if any, must be kept and a certificate must be issued along with the unit giving particulars, i.e., card number, unit number, date of burn in conducted, duration, tested by, passed by, etc.

APPENDIX "B"

INFORMATION TO BE SUPPLIED BY THE MANUFACTURER ALONGWITH THE OFFER

1. Type/Make .....
2. Input Voltage range .....
3. LED lamp current regulation .....
4. Lux measured at 1 meter .....Lux.
   at 3 meters .....Lux.
5. Number of arrays .....
6. Number of LEDs in each array .....
7. Dielectric strength .....
8. Insulation resistance .....M. ohms
9. Operating temperature range .....
10. Power consumption .....
11. Component ratings:

S.No.	Symbol as per circuit diagram	Ratings	Loading under worst conditions	Safety factor	Make and Type No.

12. Circuit diagram .....
13. Dimensional drawing .....
14. Other particulars : The manufacturer may like to furnish details such as:

    Units already manufactured and supplied to impart type test, service performance, if already in service etc.

15. Test results in case the manufacturer has already tested the unit.

Annexure-1

BURN-IN TEST