SPECIFICATION No ELRS/SPEC/PR/0024

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIFICATION OF TWIN BEAM HEADLIGHT WITH 24V HALOGEN LAMPS FOR ELECTRIC & DIESEL ELECTRIC LOCOMOTIVES, EMU/DMU.

SPECIFICATION No ELRS/SPEC/PR/0024 (REV-1 Sep -2004)

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

CONTANTS

CHAPTER - I

GENERAL

1.0 INTRODUCTION

This specification covers construction features, technical requirements and testing procedure for "Twin Beam Headlight fitting with halogen lamps" for Electric & Diesel Electric locomotives, EMU and DMU. The twin beam headlight will be fed from DC-DC Converter which to be procured separately to RDSO Specification No.ELRS/Spec/DC-DC Converter/0021, Rev.'1'

1.1 Headlight is provided in front and rear of Locomotives / EMUs/ MEMUs/DMUs to illuminate track and OHE mast in electrified sections at night time for driver to look for any obstruction/abnormality on track etc. to facilitate him to take necessary action for ensuring safe and efficient operation of the train, noting down mast numbers and also to warn other persons on ground of incoming train for their safety.

1.2 Locomotives on Indian Railways have traditionally been provided with a headlight with single reflector and 32V, 250 W incandescent lamps on either end of Locomotives/ EMUs/ MEMUs/ DMUs to RDSO specification No. EL/TL/41-1984. This headlight has been fed through step down transformer (RTPR) on electric and HLPR on diesel-electric locomotives. However, lately there has been considerable development in the field of energy efficient light/ sources and their power supplies. Locomotive imported recently were provided with twin sealed beam headlights. Indian Railways also considered adoption of indigenous Twin Beam Headlight assembly using Halogen lamps and DC/DC converter and specification No. ELPS/SPEC/HL/01:JULY 1997 for "Twin Sealed Beam Headlight assembly using 24 V Halogen dual filament lamps and DC/DC converter" retrofitable in the existing headlight cutout of electric locomotives was initially prepared for its indigenous development, tests & trials. Also, specification No. RDSO/PE/Spec/Genl/0007-99 (Rev.0), September, 1999 for diesel electric loco was also issued and since then Twin Beam Headlight has been adopted on locomotives on regular basis which has been confirmed vide Railway Board letter No.99/Elect(TRS)/113/20 Pt.II, dated 23.12.2002.

1.3 Twin beam headlight works on 24V supply from DC-DC Converter connected to locomotive battery. Efficient working of system DC-DC Converter is an important item and since it involves electronic components and circuits requiring different expertise a separate specification No.ELRS/Spec/DC-DC Converter/0021 has been issued. This has been done with an objective to delink procurement of DC-DC Converter from that of headlight, as two items are distinctly different in technology and manufacturing base. Procurement of headlight and DC-DC Converter from different manufacturers is expected to improve quality and reliability of both the equipments.

Since specification for DC-DC Converter has already been issued and its procurement is not necessarily to be combined with headlight fitting, it is logical that Headlight fitting is covered under separate specification. As such, separate specification for headlight fitting was issued in supersession of combined Specification No. ELPS/SPEC/HL/01:JULY 1997 & RDSO/PE/SPEC/GENL/0007-99 of Headlight fitting and DC-DC Converter.

This revision is being issued to incorporate the focusing the arrangements of twin beam head light and to improve the reliability.

1.4 SUPPLIER'S RESPONSIBILITY:

The supplier's responsibility will extend to the following:

1.4.1 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).

1.4.2 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.

1.4.3 The head light is required to service a life of 35 years. The supplier shall quote for spares, which may be required for satisfactory maintenance of the unit for a period of 1 years after completion of warranty period.

1.4.4 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.

1.4.5 **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 supply and installation of replaced parts free of cost.

1.4.6 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.

1.4.7 **Training:** The supplier shall arrange 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.

1.4.8 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.

1.5 RAILWAYS' RESPONSIBILITY:

Railway will be responsible for following:

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

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

1.5.3 For installation of head light, interconnecting cables shall be supplied by Railways.

1.6 DOCUMENTATION:

1.6.1 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) BOM (Bill Of Material), Data sheets for components/devices and other equipment proposed for use

(c) Mechanical interface diagram (Outline General Arrangement), assembly drawings of complete unit, mounting arrangement and weight.

(d) Clause by clause compliance

(e) Details of technical support and training offered

(f) Supply experience, Logistics proposed for warranty support

(g) Recommended list of spares with cost for 3 years maintenance after warranty

(h) List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair.

(i) QAM (Quality Assurance Manual), QAP (Quality Assurance Plan)

(j) Test protocol with procedure of testing.

(k) ISO 9000 certification.

(l) Details of infrastructure, manufacturing and testing activities in line with guidelines issued vide RDSO spec no.- ELRS/SPEC/SI/0015 (Latest).

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1.6.2 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

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1.6.3 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.

1.7 PROTOTYPE APPROVAL AND PERMISSION FOR BULK MANUFACTURING:

1.7.1 The successful tenderer shall submit a prototype sample for inspection/testing and approval by RDSO before undertaking the bulk manufacture whenever he is either executing order for the first time or against an order where change / revision of specification/ design is involved. A copy of internal test results should accompany the inspection call.

1.7.2 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.

1.8 Any deviations to this specification considered necessary to improve per-formance, 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.

1.9 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.

1.10 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.

1.11 INFRASTRUCTURAL REQUIREMENTS:

The manufacturer should have following minimum infrastructure for the manufacturing and supply of twin beam head light.

i) Power press machine

ii) Spot welding machine

iii) Electric welding machine

iv) Electric grinders

v) Testing jigs for alignment of the twin beam head light.

vi) Temperature controlled Dry heat test chamber.

vii) ISO 9001 : 2000 Certification,

Sub vendors supplying critical components such as toggle / rotary switches, cables, thimbles, MOSFETs, Choke/transformer, terminal strips/blocks of DMC/epoxy etc. may also be got cleared by RDSO.

1.12 IMPORTANT DOCUMENTS REFERRED IN THIS SPECIFICATION

1	IS: 616	Safety requirements for mains operated electronics or related apparatus for household and similar general use.

1.13 TERMINOLOGY

For the purpose of this specification, following definitions shall apply:

Beam: - A distribution of radiation characterized by a concentration of luminous flux within a small solid angle substantially greater than the concentration in directions outside the solid angle.

Beam Axis: - It is the line through the effective light centre of the headlight in the principal direction of the beam. The principal direction may be found by taking the centre of the solid angle subtended at the effective light centre of the headlight and bounded by the intensity vectors equal to 90% of maximum intensity.

Beam spread: - The angular extent of a beam, in a specified plane passing through the beam axis, which contains all the radius vectors of the polar curve of luminous intensity having lengths greater than 1/10 of the maximum.

CHAPTER II

TECHNICAL DETAILS

2.0 TECHNICAL REQUIREMENTS

2.1 The Twin beam headlight with 24V halogen lamps shall be suitable for fitment on newly built electric and diesel electric locos, EMU & DMU and retrofitable on existing locomotives EMU & DMU without any major need for modification to the housing. Any such changes, if needed shall be advised by the manufacturer of halogen headlight fitting.

2.2 Each locomotive shall be provided 2 nos. headlights one on each end. Each headlight shall consist of two beams complete with reflector, front cover having toughened glass, lamp, lamp holder, input connector, arrangement for keeping 2 nos. spare halogen lamps.

2.3 Each beam will consist of the following:

Parabolic Reflector with 4 mm thick heat-treated lens/glass.

(i) Halogen lamp of 24V having two filaments 100/90 W, with holder type H4 P45t., one filament of 100 W for normal and other filament of 90 W for the dipper operation of the headlight.

(ii) Lamp holder fixing by spring loaded arrangement.

(iii) The bulb should be of following make

a) MICO
b) PHONIX
c) HALONIX
d) GE
e) PHILIPS
f) SYLVANIYA
g) AUTOPAL

2.4 Each beam to be used shall be of maximum diameter and suitable to fit in the housing with parabolic design. The beam shall be sealed type with lamp replacement facility, from rear of the head light through spring loaded lamp holder/lamp of robust design. The headlights shall be suitable for lamp replacement from inside the cab of the locomotive and also from front of the locomotive by providing a suitable hinge type arrangement on base plate of headlight.

2.5 The input connector of the twin headlight shall be suitable to receive 3 wires to each lamp (total 6 wires) along with one earth wire suitably terminated at

earth terminal provided on the fitting. The clearance of the live parts of the connector shall not be lees than 10 mm from the housing of the headlight.

2.6 The headlight assembly shall be operated through the selector switch provided on driver's-desk as shown in the schematic wiring diagram No. RDSO SKEL 4409 in following modes: -

(i) Front Bright
(ii) Rear Bright
(iii) Front Dim
(iv) Rear Dim

2.7 The reflector of beams shall be of superior quality to render optimum performance. Glass reflectors may also be used.

2.8 **General:** - The headlight beams shall be of pre- focussed type with totally enclosed construction complete with reflector, lamp holder, terminals, and front glass etc. It shall be simple in design, easy in maintenance and operation and robust / rugged in construction. All of its components shall be rust and corrosion resistant and the complete assembly shall be water- tight and splash proof after fitment on the locomotive. The base plates for headlight shall be circular for conventional locomotive and elliptical for WAP-4 and WAG-7 locomotives and newly build diesel locomotives.

2.9 This type of headlight shall be suitable for mounting on the front of drivers' cab. The twin beams shall be mounted on 3 mm thick common mounting plate with beam adjustment facility. Each beam direction shall be independently adjustable with three mounting screw to set twin parallel, coherent beam suitably directed in front of the locomotive. The lamp holder with electrical connection etc. shall be provided from back of the headlight.

2.10 The weather proof-sealing gasket shall be made of Neoprene or superior quality rubber and to be provided between the front mounting plate and the casing to make the headlight watertight to prevent entry of rain water.

2.11 A suitable vent hole shall be provided at the back of the casing to neutralised the air pressure developed in the headlight assembly.

2.12 Headlight assembly shall be provided with additional toughened glass to protect beam lens from direct hit. The glass cover assembly shall be openable from the front side. A Bird Guard in front of the headlight shall be provided. The bird guard shall be made from 3-mm thick MS Strips of 25mm width/ with spacing of not less than 80 mm. However the arrangement and drawing of bird guard shall have the approval of RDSO.

2.13 Mounting plate thickness shall be 3 mm. Glass shield shall be mounted with aluminum cast frame of minimum 10 mm thickness. The collar of mounting plate will be 6 to 8 mm on the circular base main headlight with neoprene gasket of 12 mm thick. Rear side of the main headlight shall be openable

with knurled nut locking arrangement. The housing shall have mounting arrangement for two spare lamps. The weight of main headlight shall be around 13 kg. (Approximately).

2.14 Mounting arrangement for headlight for locomotives shall be of suitable for face mounting.The diameter and PCD of the fixing holes shall be as follows:-

	Electric Loco /EMU/DMU	**Diesel Loco**
P.C.D.	450 mm.	390 mm
Hole diameter	8 mm.	10 mm
No. of holes	8 Nos.	6 Nos.

2.15 **Glass and Gasket**: -

Glass used for the front cover shall be of the heat resistant, toughened (TS type), 6.0 mm thick transparent of AA quality and conforming to IS: 2553 (Part-I)-1990. A 12 mm thick weather proof sealing gasket of neoprene rubber or superior quality shall be provided for the glass.

2.16 **Terminals Block/Terminal Connector** :

A terminal block of **DMC** Glass Fiber Epoxy moulded fire retardant to withstand 200 deg. c. for the connections of incoming supply through PTFE copper cables of suitable size shall be mounted in the headlight housing, close to the cable entry point The material shall pass the flammability test as per relevant specification. The terminal block shall be free from blowholes and cracks. The nut, bolt, stud washer shall be of stainless steel. It shall be readily accessible and shall be positioned to avoid the possibility of accidental contact during maintenance. Terminal block shall be stud type suitable to receive ring type cable sockets.

2.17 **Creepage Distance**:

The creepage distance between live parts and non-current carrying metal parts shall be not less than 15 mm. over the surface of insulation.

2.18 **Clearance Distance**:

The clearance distance in air between live parts and non-current carrying parts shall be not less than 10 mm.

2.19 **Hinges, catches and locking screws:**

Hinges, catches and locking screws shall be made of material having good corrosion resistance. Otherwise this shall be provided with adequate protection against corrosion. They shall be robust and simple in construction and shall not need use of special tools for opening. Design and fabrication of

covers or other enclosures shall be such that they do not open out due to vibration or during maintenance.

2.20 **Finish**:

The casing and front glass plate shall be suitably pretreated and powder coated with grey colour from inside and outside.

2.21 **Photometric requirements:** The photometric requirements shall be as follows:

2.21.1 The intensity of the beam of light measured in a clear atmosphere, free from dust, smoke and fog at a point in the centre of the beam at ground level, when focussed accurately at a distance of 305 meters shall be not less than 3.2 Lux. This requirement of 3.2 lux at 305 meters has to be met with bird guard fitted on headlight. Photometric readings shall be taken at 305 meters.

2.21.2 The photometric test shall be carried out with bird guard on 10% or minimum two numbers of the lot offered during acceptance tests. The test voltage at lamp terminals shall be maintained as 24.5 +0 –0.1V. The momentary fluctuation of the test voltage during the test shall be not more than ± 1%.

2.21.3 The beam spread will be symmetrical and angle of beam shall not be less than 7 degrees.

2.22 **Marking:**

2.22.1 An anodized aluminium plate carrying following markings shall be fitted on the casing headlight assembly at a suitable place :-

(i) Maker's name and trade mark
(ii) Maker's serial number and year of manufacture.
(iii) Size of the beam.
(iv) Specification No....
(v) System Voltage.
(vi) Type of Beam & Lamp

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 IV

SCOPE OF SUPPLY

4.1 Scope of work

The scope of supply of headlight assembly shall be as under: -

Twin Sealed Beam Headlight system suitable for 24 V Halogen lamps for locomotive shall comprise the following:

Sl no.	Items	Oty.
1.	Twin sealed beam headlight assembly complete with 24 V, 100/90 W Twin filament Halogen lamps	2 Nos. per loco.
2.	24 V, 100/90 W Twin filament Halogen lamps extra fitted in head light assembly per set	2 Nos.
3.	Mounting brackets etc	As required.
4.	All other necessary changeover switches required for Head light operation other than existing switches for head light control in the BL key box of locomotive	As required.

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

CHAPTER V

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 VI

TESTS

6.1 CATEGORIES OF TEST

6.1.1 **TYPE TEST:** Type test shall 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.

6.1.1.1 Type tests are to be repeated in case of any major change is made. In case of minor changes, i.e. change in type, rating of component etc., special test/tests as agreed by user and manufacturer are to be conducted to ensure their suitability and effectiveness of the modifications.

6.1.1.2 Type test should be repeated once in three years by RDSO.

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

6.1.3 **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 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.

6.2.1 The tests to be carried out on complete unit are given in the following table,.

Sl. No.	TESTS	SPEC. CLAUSE NO.	TYPE TEST	ROUTINE TEST	ACCEPT. TEST
1.	Visual Inspection	6.3.1	ü	ü	ü
2.	Insulation resistance test	6.3.2	ü	ü	ü
3.	Dielectric High Voltage Test	6.3.3	ü	ü	ü
4.	Water proof test	6.3.4	ü	ü	ü
5.	Thermal Shock Proof Test for Cover Glass	6.3.5	ü		ü
6.	Endurance test	6.3.6	ü		
7.	Photometric test	6.3.7	ü	ü	ü
8.	Dust Test	6.3.8	ü		
9.	Vibration and shock test	6.3.9	ü		
10.	Dye-penetration test	6.3.10	ü	ü	

6.3 TESTS:

6.3.1 Visual Inspection :-

Materials and finish of all components shall be visually examined for finish and verified for their dimensions and material specification. The manufacturer shall furnish a metallurgical composition certificate for the reflector material.

6.3.2 Insulation resistance test:-

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 less 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

6.3.3 Dielectric High Voltage Test:-

Immediately after insulation resistance test, an ac voltage of 1500 V RMS of sine wave form of 50 Hz shall be applied for one minute between the live parts and frame. The test shall be started at voltage of less than 1/3 of the test voltage and shall be increased gradually to the full test voltage. The high voltage testing equipment shall be set at 20 mA leakage current. Head light shall withstand the voltage without flash over, break down or tripping of supply.

6.3.4 Water Proof Test:-

The head light assembly shall be subjected to this test in its unpacked condition without any electric feed. One hour water spray test shall be carried out in accordance with IS 9000 Pt. 16) of 1983 (Specification for Basic environmental testing procedures for electronic and electrical items) and at the end of this test, the assembly shall be examined for any visible evidence of water ingress.

6.3.5 Thermal Shock Proof Test for Cover Glass:-

The thermal shock proof-ness of the cover glass shall be tested by operating the headlight in still air until the glass has attained a steady state temperature and then pouring cold water at 10 deg C to 12 deg C on the glass while the lamp is burning. This test shall be repeated four times and the glass shall show no evidence of distress.

6.3.6 Endurance test;-

The headlight shall not deteriorate significantly when operated at a small over voltage, over load or at a somewhat higher ambient temperature than normal.

Compliance is checked by the tests prescribed in clauses 6.3.6.1 and 6.3.6.2.

6.3.6.1 The complete assembly of headlight mounted and connected as for normal use is operated at 1.1 times the rated voltage at a temperature of 70 deg C for a period of 5 days (120 hrs) under the normal condition of use. At the completion of this test no deterioration, such as cracks, scorching, discoloring and deformation shall be observed on reflector surface or any other part of the headlight.

6.3.6.2 Immediately after the endurance duty as per 6.3.6.1, the headlight is subjected to high voltage test specified in clause 6.3.3 but with the test voltage reduced to1000 V. Headlight shall withstand the voltage for one minute to pass the test.

6.3.6.3 After endurance duty as per clause 6.3.6.1, the headlight shall also pass the photometric test as specified under para 6.3.7.

6.3.7 Photometric Test:-

6.3.7.1 Test voltage:- The test voltage at lamp terminals shall be steady set at 24.5 + 0 / - 0.1V. The momentary fluctuation of the test voltage during the test shall be not more than ± 1%. The test shall be conducted both before and after the endurance test.

6.3.7.2 Illumination Intensity: -

The main headlight under test shall be mounted on a test stand which shall be put on one end at the centre line (lengthwise) of the level ground, free from obstruction over an area of 300m x30 m. The height of the axis shall be 3.7 m. above the ground level. Photometric readings shall be taken on each point shown in Annexure-A at

(i) Ground level,

(ii) Height of 0.75 meter above rail level,

(iii) Height of 1.5 meters above rail level.

With above readings, curves of intensity of illumination shall be plotted to obtain the spread over the track.

6.3.7.2.1 During routine/acceptance tests, illumination intensity measurements will be done on headlights at a distance of 8 m and same will not be less than 4800 lux.

6.3.7.3 Angle of the Beam:-

Headlight shall be mounted on a table with beam centre one metre above the ground. Photometric measurement shall be taken in the lateral direction at right angles to the axis of the beam in horizontal plane at one metre height at a distance of 100 metres from the headlight. Move photometer in lateral direction on the left and right so as to read the maximum illumination intensity and locate the point after which the illumination level reaches $1/10^{th}$ of maximum values. The distance between both the left and right points should be measured as `x' metre: -

Then tan A = x/2 x 1/100

The angle 2 A is the angle of the beam

6.3.7.4 The headlight shall comply with the requirement of clause 2.21 as per tests conducted under clause 6.3.7.2 and 6.3.7.3.

6.3.8 Dust Test:-

Dust test shall be done, as per IS 9000 (Part-12) -1981. The test results shall be treated as satisfactory if there is no dust entry into reflector beam assemblies.

6.3.9 Vibration Test:-

Vibration test shall be carried out as per IEC-77 on complete head light assembly in working condition. The test results shall be treated as satisfactory if there is no failure/damage noticed.

6.3.10 Dye-Penetration Test:-

Dye penetration test for detection of surface defects/cracks on welds shall be conducted as per IS: 3658-1981. The consumables required for dye penetration test shall conform to RDSO specification No.M&C/NDT/4/91.

6.3.11 Prototype Test Report:-

Complete prototype test report along-with test program circuit diagram, component details, working of the circuit etc. shall be bounded in booklet form and two copies of booklet shall be submitted to RDSO for record.