



**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

**SPECIFICATION OF
TWIN BEAM LED HEADLIGHT FOR ELECTRIC
LOCOMOTIVES AND EMUs**

SPECIFICATION No RDSO/2017/EL/SPEC/0134 (Rev-03)

Issued on: 13.06.2024

Approved By	Signature
PED / PS & EMU	

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

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Status of Revision

SN	Date of Revision	Page No.	Revision	Reasons for Revision
1.	November-2017	All	0	First Issue
2.	April-2019	4,5,6,7,8, 9 & 10	1	<ol style="list-style-type: none"> Maximum and minimum lux requirement in dim mode of head light included to avoiding glare. Maxima lux level in bright mode is also specified. In some of place language is change to have more clarity. Testing requirement to protection against water and dust change as per latest standered. Recovery time after endurance test has been added. Clause 7.4 added to control the quality of the LED. Sample test quantity for acceptance test has been specified in clause no. 11.1. Word cut off voltage has been replaced by operating voltage range.
3.	12.02.2021	6 & 9	2	<ol style="list-style-type: none"> New Para no. 5.12 added for including outline drawings no. SKEL-5042. Details in regard to voltage and time specified for reverse polarity test in Para no. 12.5.
4.	10.06.2024		3	<ol style="list-style-type: none"> Clause no. 2.1.1 modified minimum temperature -15°C instead of 0°C. Clause no. 5.5 modified for specified power supply in head light terminal. In clause no. 6.1, 12.5 & 12.6.3 modified for Lux reduce in dim mode for avoid glare. New para No. 7.5 added for measurement of LED junction temperature. In clause no. 12.6.5 modified to measurement of angle beam in type test.

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GENERAL

1.0 INTRODUCTION

This specification covers construction features, technical requirements and testing procedure for Twin Beam LED Headlight for Electric Locomotives and EMUs.

- 1.1** Headlight is provided in front and rear of Electric Locomotives and EMUs to illuminate track, track-side indication, OHE masts any obstruction/abnormality on track etc. in electrified sections at night time to facilitate Loco pilot 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.

2.0 ENVIRONMENTAL CONDITIONS

- 2.1** The equipment should function satisfactorily under the following environmental conditions which are encountered where equipment will be expected to work.

2.1.1

- a) Maximum temperature
 - } Stabled Locomotive under sun : 70 deg. C
 - } On board Working loco under sun. : 55 deg. C
- b) Minimum temperature : -15 deg. C
- c) Average temperature : 47 deg. C

- 2.2 Humidity:** Up to 100% during rainy season.



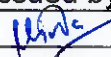
- 2.3 Altitude:** Up to 1200 m above mean sea level.

- 2.4 Rainfall:** Very heavy in certain areas. The equipment shall be designed suitably.

- 2.5 Environment:** The equipment shall be designed for 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.

- 2.6 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

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3.0 **Vibration and Shocks:** The equipment shall conform to IEC-60571 & IEC-61373 (latest)



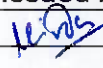
4.0 TERMINOLOGY

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.



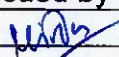
Beam spread: - The angular extent of a beam, in a specified plane passing through the beam axis, which contains all the radius vectors of the polar curve of luminous intensity having lengths greater than 1/10 of the maximum.

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TECHNICAL DETAILS

5.0 General:

- 5.1 The LED head light unit shall consist of two separate independent high intensity LED lamps assembly with their separate driver unit, provided in suitable water proof and dust proof (IP-66) enclosure having toughened front glass.
- 5.2 Operating voltage range is Maximum-138 V, Nominal-110 V, Minimum-85 V.
- 5.3 The LED's shall be connected such that failure of one LED should not affect other LEDs.
- 5.4 The power consumption of LED head light assembly should be not more than 100 watt at nominal voltage.
- 5.5 The input connector of the twin headlight shall be suitable to receive 3 wires Bright (+110V), Dim (+110V) & Common (-110V) 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 less than 10 mm from the housing of the headlight. The creepage distance between live parts and non-current carrying metal parts shall be not less than 15 mm over the surface of insulation.
- 5.6 The headlight assembly shall be operated through the selector switch provided on driver's-desk in following modes: -
- (i) Front Bright
 - (ii) Front Dim
 - (iii) Rear Bright
 - (iv) Rear Dim
- 5.7 This type of headlight shall be suitable for mounting on the front of drivers cab. The twin beam shall be mounted on 3 mm thick common mounting plate with beam adjustment facility. The mounting plate shall be suitably pre-treated and powder coated with grey colour from inside and outside.
- 5.8 The weather proof-sealing gasket provided between the front mounting plate and the casing to make the headlight water tight to prevent entry of rain water shall be made of Neoprene or superior quality rubber.
- 5.9 Glass used for the front cover shall be of the heat resistant toughened (TS type), conforming to IS: 2553 (Part-I)-1990, minimum 4.5 mm thick-transparent of AA quality to IS: 2835 and pass IK-05 impact test.
- 5.10 A terminal block of DMC Glass Fibre Epoxy moulded fire retardant to withstand 200 °C for the connections of incoming supply through PTFE copper cables or

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better of suitable size shall be mounted in the headlight housing, close to the cable entry point. 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.



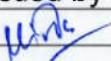
- 5.11 Hinges, catches and locking screws shall be made of material having good corrosion resistance. Otherwise, this shall be provided with adequate protection against corrosion. They shall be robust and simple in construction and shall not need use of special tools for opening. Design and fabrication of covers or other enclosures shall be such that they do not open out due to vibration or during maintenance.
- 5.12 LED head light shall be so designed that, it can be retrofit in place of existing head light of Electric Locomotives & EMUs without need of any change. Most suited outline dimension of LED head light frame for electric locomotive and EMUs are given in drawing no. SKEL-5042 (Attached) for guidance.

6.0 Photometric requirements: The photometric requirements shall be as follows:

- 6.1 The intensity of the complete head light system measured in a clear atmosphere, free from dust, smoke and fog at a point in the centre of lamp unit at ground level, when directed accurately, at distance of 8 meters shall be not less than 7000 lux and not more than 9000 lux in bright mode while in dim mode it should be not be less than 900 lux and not more than 1200 lux. Also at a distance of 305 meter it should not be less than 4.8 Lux in bright mode.
- 6.2 The photometric test shall be carried out on minimum two numbers of the lot offered during acceptance tests. The test voltage at lamp terminals shall be maintained as per clause 5.2. The lux output shall remain $\pm 5\%$.
- 6.3 The beam spread should be symmetrical and angle of beam shall not be less than 7 degrees.

7.0 Technical requirements of LED

- 7.1 LED used should be of SMD (Surface Mounted Diode) / COB (Chip on board) type only.
- 7.2 Color temperature of White color LED shall be 3700K-5000K (White).
- 7.3 Color Rendering Index (CRI) – Greater than or equal to 80.

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7.4 Generally, LED of Nichia / Osram / Samsung / Lumileds / Cree / Avago make only shall be used. The LEDs Used shall be LM-80 & UL certified with 50000 hours or more. Same shall be submitted by manufacturer. If any manufacturer proposed to use LEDs of make other than specified above, the details of make and relevant certificates shall be submitted to RDSO for approval before its use.

7.5 The junction temperature of the LED and through current in the LED should not exceed the specified values given in the LED data sheet which will be verified during prototype testing.

8.0 Technical requirements of electronic components used

The circuit board and electronic components to be used in the LED head light should be of rating / type so as to provide reliable functioning.

8.1 MC PCB (Metal Core PCB) shall be used for mounting of LED's.

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

9.0 Technical requirements of Driver

9.1 Surge protection feature should be provided to ensure that surges do not cause failure of any electronic components of LED head light.

9.2 Heat bearing capacity of driver for LED head light should be provided.

9.3 Minimum efficiency of driver shall be 85%.

10.0 CATEGORIES OF TEST



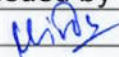
10.1 **TYPE TEST:** Type test shall be carried out on equipment of the approved design. If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source shall be treated as new item for the purpose of conducting type tests.

10.2 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.

11.0 **ROUTINE TEST:** Routine test shall be carried out regular supply orders.

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

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

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SN	TESTS	SPEC. CLAUSE NO.	TYPE TEST	ROUTINE TEST	ACCEPTANCE
1.	Visual Inspection	12.1	✓	✓	✓
2.	Insulation resistance test	12.2	✓	✓	✓
3.	Dielectric High Voltage Test	12.3	✓	✓	✓
4.	Surge Test	12.4	✓		
5.	Reverse Polarity	12.5	✓	✓	✓
6.	Photometric test	12.6	✓	✓	✓
7.	Water Ingress protection test and dust test (IP-66)	12.7	Certificate from NABL /Govt. Lab		
8.	Thermal Shock Proof	12.8	✓	✓	
9.	Dye-penetration	12.9	✓		
10.	Endurance test	12.10	✓		
11.	Vibration and shock test	12.11	✓		

12.0 TESTS:

12.1 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 body material.

12.2 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 is to be ensured as per given below.



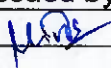
- 110 V circuit and earth : 20 MΩ
- Screen to earth : 10 MΩ
- Lamp unit to earth : 10 MΩ

12.3 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.

12.4 Surge Test:-

The test shall be conducted as per IEC-60571 or (latest). The surge pulse shall be 1.8 Kv, 1.2/50 micro second.

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12.5 Reverse Polarity Test:-

The LED unit should have built-in reverse polarity protection. The reverse polarity test shall be conducted at a Nominal Voltage (110 V DC) for 1 minute. After the test lux level should remain within limit as given below:

- i. Bright mode (at a distance of 8 meter) = 7000 Lux (Min.) and 9000 Lux (Max.)
- ii. Dim mode (at a distance of 8 meter) = 900 Lux (Min.) and 1200 Lux (Max.)

12.6 Photometric Test:-

12.6.1 Test voltage:- LED head light should be tested at maximum, nominal & minimum voltage level as per clause no. 5.2.

12.6.2 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 x 30 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.

12.6.3 During routine/acceptance tests, illumination intensity measurements will be done on headlights, at a distance of 8 meters and it shall not be less than 7000 lux and not more than 9000 lux in bright mode while in dim mode it shall not be less than 900 lux and not more than 1200 lux.

12.6.4 During type test illumination intensity measurement will be done at 305 meter and it shall not be less than 4.8 Lux in bright mode.

12.6.5 Angle of the Beam:-

During type test 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

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point after which the illumination level reaches $1/10^{\text{th}}$ of maximum values. The distance between both the left and right points should be measured as 'x' metre: -

$$\text{Then } \tan A = x/2 \times 1/100$$

The angle 2 A is the angle of the beam

12.6.6 Photometric test shall be done after 15 minute of illumination of LED head light assembly.

12.7 Water Ingress Protection test and Dust test:-

LED head light unit should have IP-66 protection against water and dust. Manufacturer should provide certificate for same from any NABL/Govt. approved lab.

12.8 Thermal Shock Proof Test for Cover Glass:-

Keep the cover glass into 90 ± 2 °C hot water for 10 minutes and then keep it 0 ± 1 °C cold water for 3 minutes. This test shall be repeated four times and the glass shall show no evidence of distress.

12.9 Dye-Penetration Test:-

Dye penetration test for detection of surface defects/cracks on welds shall be conducted as per IS: 3658-1981.

12.10 Endurance test:-



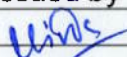
12.10.1 The complete assembly of headlight operated at 1.1 times the rated voltage and kept in a heat chamber at a temperature of 70°C for a period of 5 days (120 hrs) under the normal condition of use. At the completion of this test no deterioration, such as cracks, scorching, discolouring and deformation shall be observed on any other part of the headlight.

12.10.2 Immediately after the endurance duty as per 12.10.1 the headlight is subjected to high voltage test specified in clause 12.3 but with the test voltage reduced to 1000 V. Headlight shall withstand the voltage for one minute to pass the test.

12.10.3 After endurance test as per clause 12.10.1, also head light shall pass photometric test as per clause 12.6.3 after the recovery time of 1 hour.

12.11 Shock and Vibration Test:-

Vibration test shall be carried out as per IEC-61373 or (latest) on complete head light assembly in energized condition. The test results shall be treated as satisfactory if there is no failure/damage noticed. Routine test specified in clause no. 11.2 should be conducted after shock and vibration test.

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13.0 FIELD TRIALS:

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

14.0 DOCUMENTATION:

System design, Schematic Circuit, Functional Description, Protection scheme.

- (a) BOM (Bill of Material), Data sheets for components/devices and other equipment proposed for use.
- (b) Mechanical interface diagram (Outline General Arrangement), assembly drawings of complete unit, mounting arrangement and weight.
- (c) Clause by clause compliance.
- (d) Test protocol with procedure of testing.



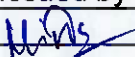
15.0 INFRINGEMENT OF PATENT RIGHTS:

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.

16.0 Marking:

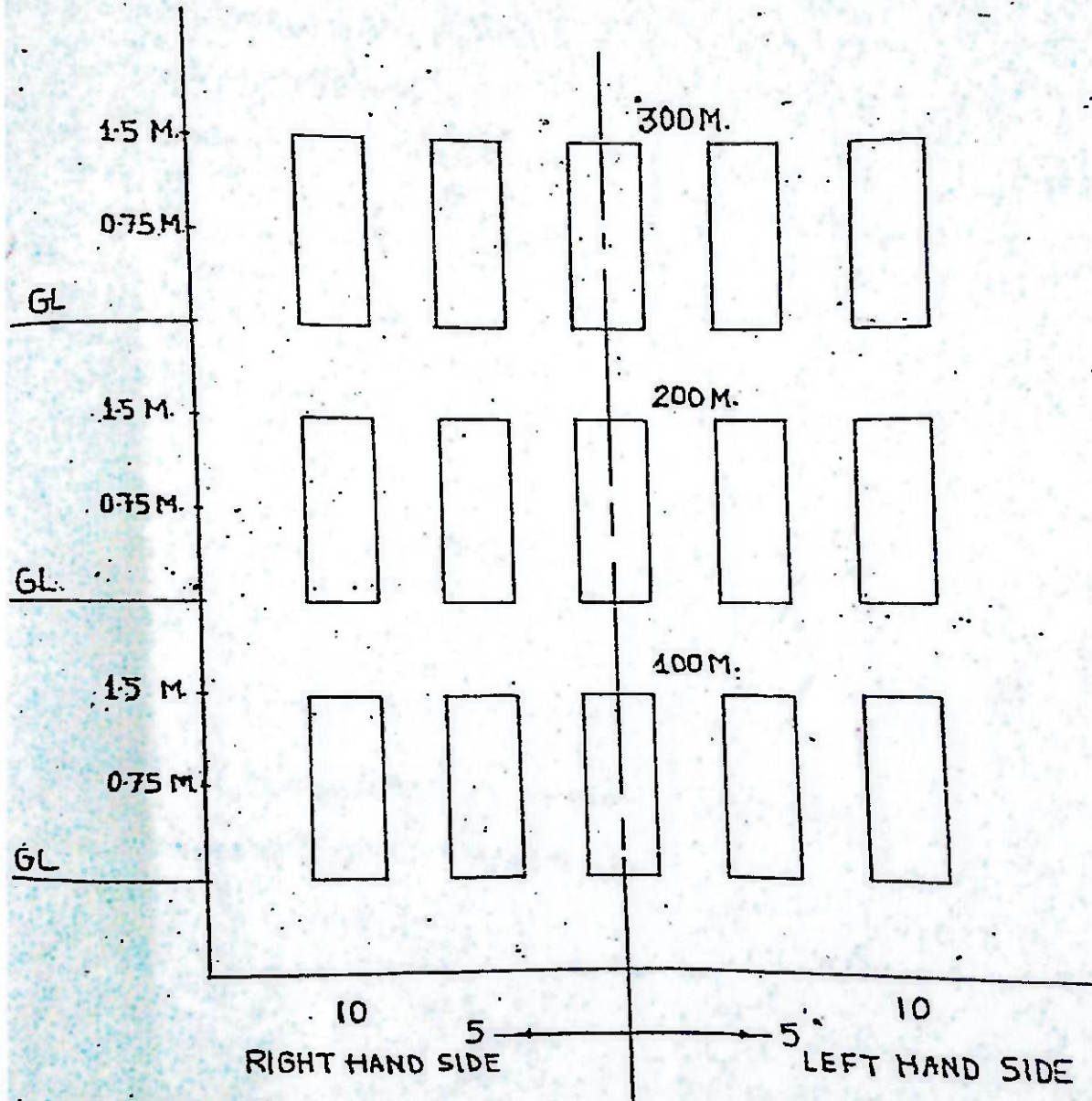
An anodized aluminium plate carrying following markings shall be fitted on the casing headlight assembly at a suitable place:-

- (i) Maker's name and trade mark
- (ii) Maker's serial number and year of manufacture.
- (iii) Specification No.
- (iv) System Voltage.

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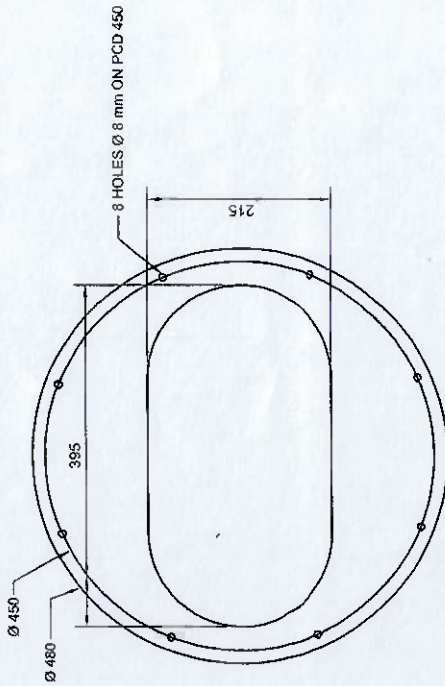
ANNEXURE -A

ANNEXURE - A

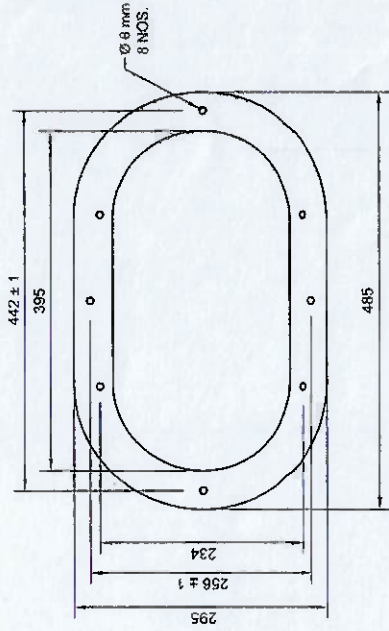


1. MAKE OF LAMP.
2. VOLTAGE MAINTAINED DURING THE TEST
3. CURRENT.
4. INTENSITY OF ILLUMINATION
5. ANGLE OF THE BEAM

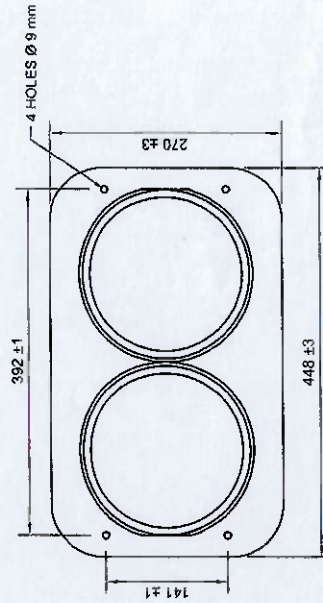
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<i>Raj</i>	<i>341</i>	<i>Mane</i>



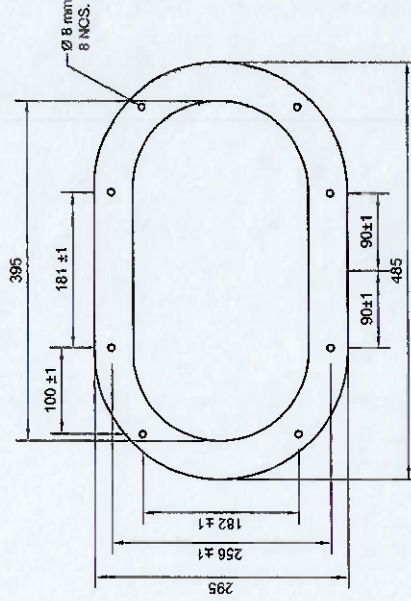
Conventional Locomotive / EMU (Round)



Conventional Locomotive (Oval)



FRONT VIEW
Three Phase Locomotive



Mounting Arrangement For EMU

Note : ALL DIMENSIONS ARE IN mm.

Dt.	12.02.2021
D	P. J. V.
C	10/10/21
File No.	14/6/11-1

STATUS	ALT.	REF. NO.	DESCRIPTION	APPD. BY	DATE

REF.: RDSO/2017/EL/SPEC/0134	SCALE :- NTS	APPROVED BY:- (FOR DG)
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MOUNTING ARRANGEMENT
OF HEAD LIGHT

RDSO. ELECT. DTE.	SKEL- 5042 ALT.- '0'	SUPERSEDED BY
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