

ENCLOSURES :**DRG. NOS.:** CLW/ES/SK-2/AC/I-1/L
CLW/ES/SK-3/AC/I-1/L
CLW/ES/SK-4/AC/I-1/L

TECHNICAL SPECIFICATION FOR
SPECIFICATION FOR ROOF LINE AND PANTOGRAPH SUPPORT
INSULATORS FOR 25 KV AC ELECTRIC LOCOMOTIVES AND 3-PHASE
ELECTRIC LOCOMOTIVES OF INDIAN RAILWAY

SPECIFICATION NO: CLW/ES/AC/I-1

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ISSUED BY:

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ALTERATION RECORD SHEET

ALT. NO.	DATE	DESCRIPTION	SIGNATURE	REMARKS
A		TEST PROGRAMME OF THE SPECIFICATION RREVISED	SD/-	
B		TORSION TEST IN CL.12.9 ADDED & (II) CEMENTING TEST I.E. CL. 12.10 ADDED	SD/-	
C		REF. D&E OF SK-1 AND REF. D OF SK-2 DELETED	SD/-	
D	JULY'85	SHEET I.E. DRG. NO. CLW/ES/SK-3/AC/I-1/D ADDED	SD/-	
E	7-3-91	SPECIFICATION RE-TYPED IS ORIGINAL TRACINGS IS MISPLACED IN OFFICIAL TRANSACTION.	SD/- 9-3-91	
F	21-4-94	SPECIFICATION DRG. FOR PANTO MOUNTING INSULATOR IS REVISED AGAINST SKETCH NO. CLW/ES/SK-4/AC/I-1 SUPERSEDING SKETCH NO. CLW/ES/SK-1/AC/I-1/C	SD/- 21-4-94	
G	5-7-02	HEX. HD. SCREW FOR PANTO MOUNTING INSULATOR MODIFIED AS M18X40 IN STEAD OF M18X50 (1 NO. PER INSULATOR)	SD/- 5-7-02	
H	12-09-03	PANTO MOUNTING INSULATOR FOR CONVENTIONAL LOCOMOTIVE SHALL BE USED AS PANTO MOUNTING INSULATOR AS WELL AS ROOF LINE INSULATOR FOR THREE PHASE LOCOMOTIVES AS PER CEE/LOCO'S APPROVAL VIDE NOTE NO. ELDD/3728/HK DTD. 02-09-03	SD/- 12-9-03	
I	05-01-17	QTY/LOCO OF 3-PHASE LOCO REVISED IN SHEET NO. 14	SD/- 6-11-17	
J	7-6-17	TOLERANCE OF HIGHT FOR PANTO INSULATOR CORRECTED AS 360(+0.0, -2.0)	07-06-17	
K	01.02.23	REQUIREMENT OF CREEPAGE DISTANCE 1050 MM INCORPORATED IN BOTH TYPE INSULATORS. NECESSARY CURRECTION IN DIA DONE. SGI CASTING ADDED AS ALTERNATIVE OF MCI.	SD/- 02.02.23	
L	14.10.2025	1. Top metal flange (top cap) height dimension at SK-4 to be incorporated as 45 mm to 55 mm subject to minimum torsional failing load of 550 kgf.m 2. Clause no. 13.2 i.e Sampling Tests has been revised.	SD/- 15.10.2025	

Note: Specifications have been digitized and all alterations have been incorporated.

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**SPECIFICATION FOR ROOF LINE AND PANTOGRAPH SUPPORT INSULATORS
FOR 25 KV AC ELECTRIC LOCOMOTIVES AND 3-PHASE ELECTRIC
LOCOMOTIVES****TABLE OF CONTENTS**

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**TECHNICAL SPECIFICATION FOR ROOF LINE AND PANTOGRAPH SUPPORT INSULATORS
FOR 25 KV AC ELECTRIC LOCOMOTIVES AND 3-PHASE ELECTRIC LOCOMOTIVES****1.0 SCOPE:-**

- 1.1 This specification covers the manufacture and supply of Roofline and Pantograph Insulators and Installation on Electric Locomotives of the Indian Railways.

2.0 SERVICE CONDITIONS

- 2.1 As the insulators covered by the specification are mounted on locomotives, they shall be subject to considerable vibrational and buffing shocks during services.
- 2.2 The insulators shall be suitable for working satisfactorily in an ambient temperature varying from 0 to 50°C and a maximum relative humidity of 100%.

3.0 DEVIATIONS

- 3.1 Any deviation from the standards laid down with a view to improve the performance may be given due consideration provided full particulars with justifications, thereof, are furnished, it may however, be noted that the necessity to ensure interchangeability with the existing insulators increase in the overall and mounting dimensions shall not be allowed normally.

4.0 APPROVAL OF SAMPLES

- 4.1 The supplier shall make available one prototype of the insulators proposed to be supplied by him for inspection and tests at his works and provide necessary testing and measuring apparatus and facilities for carrying out the test.
- 4.2 After the above tests, if it is considered necessary by the Dy. Chief Electrical Engineer (Design) / Chittaranjan Locomotive Works to carry out any further tests or trials of the prototype at Chittaranjan the supplier shall arrange for the same. Dy. Chief Electrical Engineer (Design) / CLW imply their authorize representative also.
- 4.3 Any shortcomings or defects in the design and workmanship of the insulators shall be pointed out after the tests, to enable the manufacturer to incorporated the necessary improvement before bulk manufacture is commenced.
- 4.4 Any testing and approval by the purchaser of the prototype shall in no way relieve the supplier of his responsibilities under the terms of the contract for the insulators supplied.
- 4.5 The supplier shall not offer the insulators to the Inspector authorized under contract until the prototype has been finally approved.

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5.0 CONDITIONS OF CONTRACT

- 5.1 The standard I.R.S. conditions of contract will be applicable for supply of the equipment.
- 6.0 **Technical Documents and Drawings to be furnished by the supplier as part of the contract.**
- 6.1 The following drawings and documents shall be supplied by the supplier: -
- (1) Type Test Report
 - (2) Routine test report along with each set
 - (3) Detailed drawings showing assembly of the insulators.

7.0 GUARANTEE

- 7.1 The supplier shall give a guarantee of clear 12 months on the insulators from the date of commissioning of the locomotive and any damage or defect noticed during the period due to defective material or workmanship, will be replaced by the supplier free of cost.

8.0 SUBMISSION OF TENDER QUOTATION

- 8.1 All tender documents including the quotation shall be submitted in duplicate including any correspondence till a contract is finalized.
- 8.2 The tenderers are permitted to quote for alternative designs for the insulators. For such deviations full particulars shall be furnished.
- 8.3 Quotations shall not be considered complete unless all information is furnished and are therefore liable to be rejected.
- 8.4 Copies of drawings and type test report if available.

9.0 TECHNICAL SPECIFICATION

- 9.1 The pantograph and roofline insulators shall be manufactured to the overall dimensions and mounting centers indicated in the drawings attached to this specification and shall fully comply with the mechanical and electrical characteristics indicated below.
- 9.2 The pantograph mounting insulator convert by this specification shall be used to support the pantograph in AC Electric Locomotives.

1)	Power frequency Flashover values	Panto mounting insulators	Roofline insulators
a)	Dry	130 KV r.m.s.	130 KV r.m.s.
b)	Wet	88 KV r.m.s.	88 KV r.m.s.

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- | | Power frequency
withstand values | Panto mounting insulators | Roofline insulators |
|----|-------------------------------------|--|--|
| 2) | | | |
| a) | Dry | 120 KV r.m.s. at 50 C/S for one minute | 120 KV r.m.s. at 50 C/S for one minute |
| b) | Wet | 80 KV r.m.s at 50 C/S for one minute | 80 KV r.m.s.. at 50 C/S for one minute |
| 3) | 50% impulse withstand value | | |
| a) | Positive polarity | } 200 KV | 200 KV |
| b) | Negative polarity | | |
| 4) | Mechanical strength | | |
| a) | Tensile strength | 3500 Kg. | 3500 Kg. |
| b) | Bending strength | 1000 Kg. | 370 Kg. |
| c) | Torsion test | see sheet 9 clause 12.9 III* | |
- 9.3 The porcelain used shall be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze shall be brown in colour.
- 9.4 The insulator shall be assembled with metal fitting by means of cement. Cement used in the construction of the insulator shall not cause fracture by expansion of loosening by construction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fitting and its thickness shall be as uniform as possible. Cement used shall be Portland cement.
- 9.5 Each insulator shall be legibly and indelibly marked to shown the following: -
- Name and trade mark of the manufacturer.
 - Month and year of manufacture.
- 10.0 STANDARD**
- 10.1 The insulators shall be manufactured generally conforming to I.S. specification No. 4318-1993 except where otherwise modified herein (For polluted zones only).
- 11.0 DRAWINGS**
- 11.1 The following drawing form part of this specification wherein the overall limiting dimensions and mounting centre's shall be obligatory.
- CLW/ES/SK-2/AC/I-1 & 2) CLW/ES/SK-4/AC/I-1

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TEST PROGRAMME**12.0 TYPE TESTS**

The Insulators shall be subjected to the following type tests: -

12.1 Power Frequency Flashover test: -**a) Dry**

At the beginning of the test a voltage of 60 KV shall be applied and the voltage increased progressively and uniformly upto the point of flashover. The flashover shall not occur at value less than 130 KV r.m.s.

b) Wet

The insulator under test shall be sprayed for five minutes with water of resistivity equivalent to 10,000 ohms/cm. with a tolerance of $\pm 10\%$ on the resistivity. The spray shall be fine and regular and shall fall at an angle of 45° to the horizontal at a rate of 3 mm of water per minute.

At the end of five minutes with the spray continuing, a sudden voltage of 50 KV r.m.s. shall be applied and then progressively increased until flashover occurs. The flashover shall not occur at a value less than 88 KV.

12.2 Power Frequency withstand test:-**a) Dry**

A voltage of 50 KV r.m.s. 50 C/S shall be applied to the insulator under test suddenly and the voltage raised progressively and uniformly so as to reach the value of 120 KV in 30 seconds. The voltage of 120 KV shall be maintained for one minute. During the test no break down or flashover nor deterioration of the insulator shall be noticed.

b) Wet

This shall be carried out under conditions identical to the power frequency flashover (wet) test.

A voltage of 80 KV R.M.S. shall be applied suddenly at the end of five minutes of spraying and then progressively and uniformly increased to 80 KV within about 30 seconds and maintained thereafter for one minute.

During the test no breakdown of flashover nor deterioration of the insulators shall be noticed.

12.3 Impulse withstand test on two insulators

10 positive wave surges and 10 negative wave surges of shape 1 by 50 microseconds and of 200 KV peak value shall be applied to the specimen during which period it shall not flashover nor breakdown.

The interval between two successive surges shall neither be less than 2 seconds nor more than 30 seconds.

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If a breakdown of the interval insulation should appear or if more than one flashover occurs, the insulator shall be deemed to be defective.

If only one flashover occurs, ten more surges shall be applied and if during the last ten surges no breakdown, flashover nor deterioration is noted, the insulator shall be deemed as good.

If a visual observation is not enough to check if any breakdown or deterioration has occurred a dry voltage withstand test may be given.

12.3.2 Impulse flashover test – test to be carried out as per IS:4318-1993, Cl. 9.4.

12.4 **Visible Discharge test (Power frequency voltage)**

The test room shall be darkened and a period of five minutes shall be allowed for the observer to become accustomed to darkness. A power frequency test voltage of 35 KV r.m.s. shall be applied and maintained at this value for five minutes. During this time, observation shall be made and there shall be no sign of visible corona. Test arrangement shall be as per Cl. 9.2. of IS:4318-1993.

12.5 **Temperature Cycle Test**

This test shall be carried out in accordance with clause 9.9 of I.S. specification No. 4318-1993.

12.6 **Porosity Test**

This test shall be in accordance with clause 9.12 of I.S. specification No. 4318-1993.

12.7 **Ultrasonic Test**

This test shall be made on the insulating part of the insulator. The frequency of the ultrasonic wave shall be between 0.8 and 5 megacycles per second. The speed of propagation of the waves shall be not less than 4600 meters per second. The test shall be made along (Sec. clause No.14.3) the axis of insulator and if necessary radially. Insulators disclosing cracks and internal flaws of porosity shall be rejected.

12.8 **Galvanizing Test**

The galvanized metal fittings of the insulator shall be tested for the uniformity of galvanization etc. in accordance with IS:2633-1964, section II (Dip test).

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12.9 Tests of mechanical strength

The insulators complete with their hardware's shall withstand the following test loads: -

- i) Tensile strength – 3500 Kg. (for both roofline and pantograph mounting).
- ii) Bending strength - 370 Kg. for roofline insulators, 1000 Kg. for pantograph mounting insulators.
- iii) Torsion Test - (IS:4318-1993: CL-9.10.4) - The insulator shall be subjected to a torsional load avoiding all bending moment. The torsion test load shall be applied gradually, starting from value not greater than half the specified minimum, failing load and failure shall not take place below the specified minimum failing load in Table – 2, CL: 6.1 of IS:4318-1993. The load may then be increased to the failing load, which may be noted for information.

TABLE-2 MINIMUM FAILING LOADS
(CLAUSE – 6.1)

Type	Tension		Tension with 80mm eccentricity load. Kgf.	Bending Kgf. m (moment) of Bending	Torsion Kgf. m (moment) Torsion
	Minimum Kg.	Average three tests Kgf.			
Post Insulator	6800	7000	----	370	550

NOTE: The test load shall gradually be applied starting from a value of equal to half of the guaranteed test load and then shall be increased gradually so as to reach the specified test load in about 60 seconds. This test load shall be maintained for a period of 1 minute and then gradually reduced maintaining the same rate as during its application. In the course of tests, no breakage or deformation of its insulating support shall occur insulators subjected to Mechanical Test shall not from part of the bulk supply.

- 12.10 **Cement Seal Test:** (IS:4318-1993, Cl. 9.11) – The insulator shall be subjected to an axial compressive load of 2000 Kgf. The load shall then be released and the insulator subject to an axial tensile load equal to 45 percent of the minimum tensile failing load. This load shall be truly axial. Without any rotation and the extent of play shall not exceed 0.3 mm.

12.11 Checking of dimensions

The dimensions shall be checked as per drawing attached to the specification and the approved drawing.

12.12 Visual Examination

The insulator shall be inspected as per Clause 9.15 of IS:4318-1993.

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12.13 Weight

The weight of insulators shall be measured.

13.0 Acceptance Test:

The following acceptance tests are to be carried out on insulators in presence of CLW's inspector for bulk inspection.

13.1 Visual Examination

This will be carried out on each insulator in accordance with Cl. 9.15 of IS:4318-1993. It will also be checked that each insulator bars manufacturer's name and the year of manufacture.

13.2 Sampling tests

A sample shall be drawn from each lot offered for inspection. The sample size shall be 1% of the lot size. Any fraction may be rounded off to the next integer number. Following tests shall be done on the samples.

13.2.1 Verification of dimensions

The dimensions shall be checked as per the approved drawing and in accordance with Clause 9.7 of IS:4318-1993.

13.2.2 Power frequency dry withstand test

Same as type tests indicated in Clause No. 12.2(a).

13.2.3 Power frequency wet withstand test

Same as type test indicated in Clause No. 12.2(b).

13.2.4 Temperature cycle test

Same as type test indicated in Clause No. 12.5.

13.2.5 Mechanical strength test

Same as type test indicated in Clause No. 12.9

13.2.6 Porosity test

Same as type test indicated in Clause No. 12.6

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14. Routine test

The following routine test shall be carried out on each insulator by the firm.

14.1 Routine Mechanical Load Test

Insulators shall be submitted for a duration of one minute to a tensile load equal to 1600 Kgs. The load shall be applied under the condition prescribed in clause 12.9. Any insulator which fractures or the fittings of which loosen or crack or becomes visibly deformed shall be rejected.

14.2 Routine porosity test

This test shall be made at least once for each batch of insulators under one firing. The insulating part of one or two insulators in each batch shall be provided during manufacture at one extremity with an extension having a diameter at least equal to that of the core and a length of least half of this diameter. After firing this extension shall be cut-off, broken and several fragments selected from the central part and suitably marked, shall be subjected to the test given in Cl. No. 12.6.

14.3 Ultrasonic test

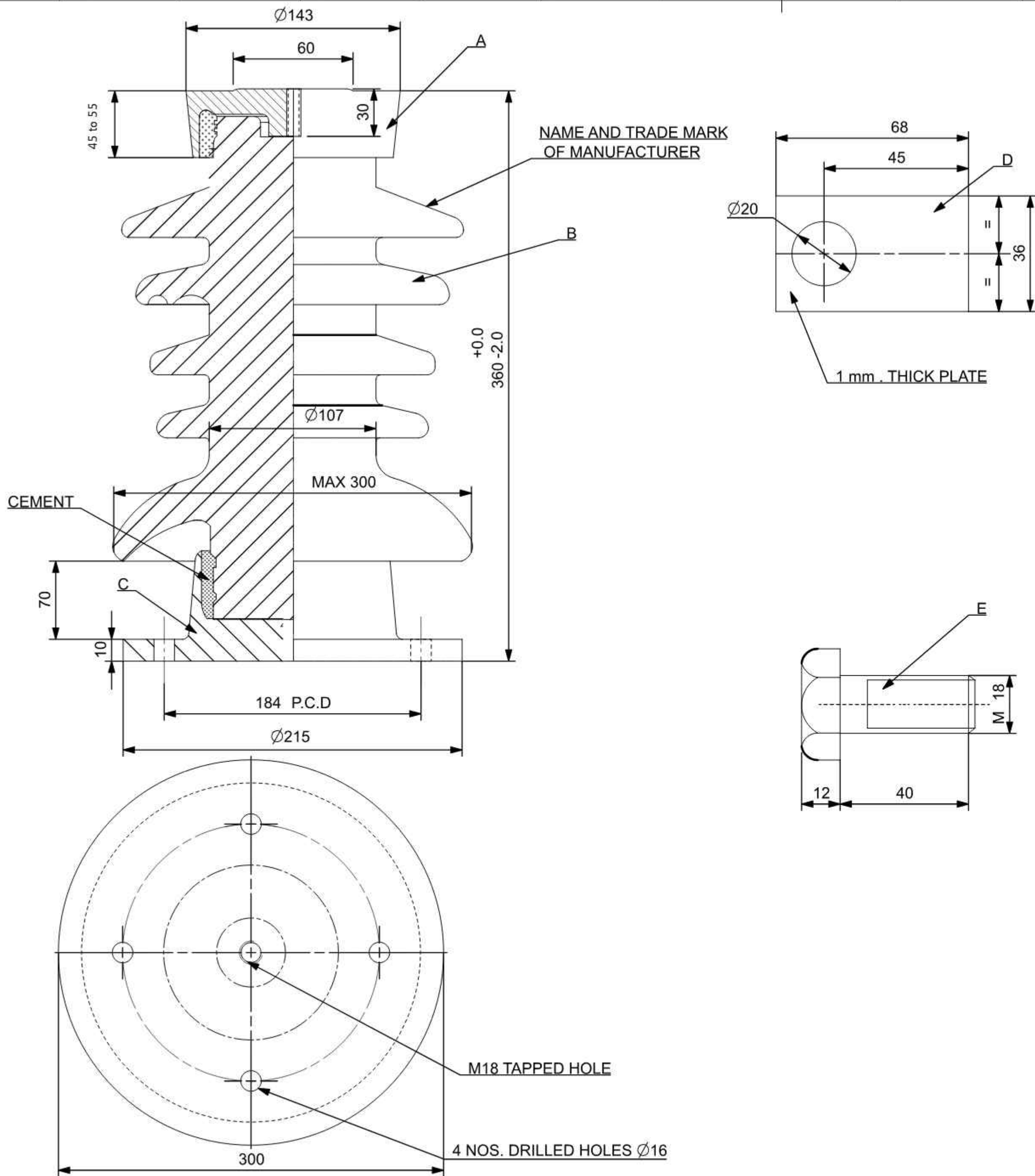
After the porosity test this test shall be conducted as indicated in Cl. No. 12.7.

14.4 Visual Examination

To be carried out as indicated in Clause No. 12.11.

15.0 CLW reserves the right to procure material only from ISO certified firms.

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NOTE:-

1. ALL DIMENSIONS ARE IN mm>
2. UNLESS SPECIFIED A TOLERANCE OF $\pm(0.03d+0.3)$ SHALL BE TAKEN ON ALL DIMENSIONS. D BEING THE DIMENSIONS IN .
3. QTY. PER LOCO 8 NOS.
4. HEX. HEAD SCREW M18X40 AND LOCKING PLATE TO BE SUPPLIED ALONG WITH THE PANTO MOUNTING INSULATOR.
5. CREEPAGE DISTANCE=1050 mm. (K)
6. Top Metal Flange Height dimension to be in the range of 45 mm to 55 mm subject to minimum Torsional failing load of 550 kgf.m (L)

E			HEX, HD. SCREW M18X40	1	STEEL	IS:1364-S-8.8	CAD PLTD.
D			LOCKING PLATE	1	M.S	IS:1079 ST.42	-DO-
C			MOUNTING BASE	1	MALLEABLE CAST IRON OR SGI	IS:2108	GALV.
B			INSULATOR	1	PORCELAIN	IS:731	
A			CAP	1	MALLEABLE CAST IRON OR SGI	IS:2108	GALV.
निर्देश संख्या REF. NO.	सामान्य संख्या C&D NO.	अंग आरेखन संख्या PART DRG. NO.	वर्णन DESCRIPTION	मात्रा QTY.	पदार्थ MATL	विशिष्ट SPECN	प्रति भार कि. ग्रा. WT. EACH IN KG.

डिजाइनर DGN	चित्ररंजन रेल इंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA
जांचा व.अ.अ. CHD SSE	परामर्श REL
समीक्षा व.अ.अ. / व.अ.अ. REVIEWED AEE / SEE	प्रति भार कि. ग्रा. WT. EACH IN KG
अनुमोदित चक्रवर्ती APPROVED DYCEE	वर्णन DESCRIPTION
दिनांक DATE	आरेखन संख्या DRAWING NO.
स्केल SCALE	परिवर्तन संख्या ALTERATION NO.
परिवर्तन संख्या ALT. NO.	पार्श्व OF
प्रमाणित AUTHY	परिष्कार A2

धातु-वैलकन चिह्न मा. मा. : 813 / अ. मा. सं. : 2668 WELDING SYMBOLS TO IS:813 / ISO:2553	अनिर्दिष्ट साध - सीमा मा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768
चरसह - फावता का मान मा. मा. : 3073 / अ. मा. सं. : 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302	पंचांक GRADE NO.
चिह्न SYMBOL	चिह्न SYMBOL

ROUGH MACHINED