

STANDARD TECHNICAL SPECIFICATION COVER SHEET

Specification No.: ENG-EHV-2027 R1

Specification Name: Technical Specification for 11KV Polymeric Pin Insulator (5KN)

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1. SCOPE

The Specification covers the technical requirements of design, manufacture, test at manufacturer's works, packing & forwarding, supply and unloading at store/ site of 11 kV Pin polymer insulator 5 KN used in 11 kV Overhead lines.

2. APPLICABLE STANDARDS

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian, International Standards and shall conform to the regulations of the local authorities:

Ref. IS	Description
IEC: 61109	Definition, test methods and acceptance criteria for composite insulators for A.C. overhead lines above 1000V
IEC: 61952	Insulators for overhead lines – Composite line post insulators for alternative current systems with a nominal voltage greater than 1 000 V
IS: 2071/ IEC: 60060-1	Methods of High Voltage Testing
IS: 2486	Specification for Insulator fittings for Overhead power Lines with a nominal voltage greater than 1000V
IS: 13134/ IEC: 60815	Guide for the selection of insulators in respect of polluted condition
IS 8263/IEC: 60437	Methods of RI Test of HV insulators.
IS: 4759	Hot dip zinc coatings on structural steel & other allied products
IS: 2629	Recommended Practice for Hot, Dip Galvanization for iron and steel
IS: 2633	Testing of Uniformity of Coating of zinc coated articles
IS:6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles
STRI Guide 1.92/1	Hydrophobicity Classification Guide
ASTM D 578-05	Standard specification for glass fiber strands

3. CLIMATIC CONDITIONS OF THE INSTALLATION:

SL.NO.	CONDITONS	VALUES
1	Max. altitude above sea level	1200m
2	Max. Ambient Temperature	50 °C
3	Max. Daily average ambient temp	35 °C
4	Min Ambient Temp	0 °C
5	Maximum temperature attainable by an object exposed to sun	60 °C

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6	Maximum Humidity	95%
7	Minimum Humidity	10%
8	Average No. of thunderstorm days per annum	70
9	Average Annual Rainfall	150 cm
10	Average No. of rainy days per annum	120
11	Thermal Resistivity of soil	150 Deg. Ccm/W
12	Wind Pressure	126 kg/sq. m up to an elevation of 10 meter.
14	Earthquakes of intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
15	Earthquakes of intensity in vertical direction	equivalent to seismic acceleration of 0.15g
16	Wind velocity	300 km/hr.

Environmentally, some of the regions, where the work will take place include coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators. Some places are in heavily industrial polluted areas. Therefore, Outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive and humid coastal atmosphere.

The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months. The design of equipment and accessories shall be suitable to withstand seismic forces corresponding to an acceleration of 0.1 g.

4. GENERAL TECHNICAL REQUIREMENTS:

- i) The Composite insulators will be used on lines on which the conductor will be ACSR/AAAC of size up to 100 Sq.mm. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.
- ii) Insulator shall be suitable for 3 Phase, 50 Hz effectively earthed 11KV Overhead Distribution System in a moderately/heavily polluted atmosphere.
- iii) **Bidder must be indigenous manufacturer and supplier of Composite insulator of rating 11kV** or above or must have developed proven in house technology and manufacturing process for composite insulators of above rating or possess technical collaboration/association with the manufacturer of composite insulators of rating 11kV or

above. The Bidder shall furnish necessary evidence in support of the above along with the bid which can be in the form of certification from Utilities concerned, or any other documents to the satisfaction of the Owner.

- iv) Insulators shall have weather sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the commendation of IEC- 60815/ IS: 13134.
- v) The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

$$\pm (0.04d + 1.5) \text{ mm when } d \leq 300 \text{ mm}$$

$$\pm (0.025d+6) \text{ mm when } d > 300 \text{ mm}$$

Where, d being the dimensions in millimetres for diameter, length or creepage distance as the case may be. **However, no negative tolerance shall be applicable to creepage distance.**

- vi) The composite insulators including the end fitting connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.
- vii) All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

SL. NO.	TECHNICAL PARTICULARS	DESIRED VALUE
1	Type of insulator	11 kV Polymeric composite Pin Insulator
2	Reference Standard	IEC 61109
3	Material of FRP Rod	Boron free ECR
4	Name of material used in manufacture of the insulator with class/grade	High voltage grade Silicone rubber Wacker-Germany, Dow Corning-USA
(a)	Material of housing weather sheds (silicon content)	Silicon content of minimum 40% by weight
5	Material of End Fittings	SGCI /MCI/FORGED STEEL
6	Material of sealing compound	RTV Silicon
7	Colour of sheds	Grey

8	Rated system voltage	11 KV
9	Highest system voltage	12 KV
10	Dry Power Frequency Withstand voltage	70 KV
11	Wet Power Frequency Withstand voltage	35 KV
12	Dry Power Frequency Flashover Voltage	75kV
13	Wet Power Frequency Flashover Voltage	45kV
14	Dry Lightning Impulse withstand voltage	Positive: 75 KV Negative: 75 KV
15	Dry Lightning Impulse Flashover voltage	Positive: 95 KV Negative: 95 KV
16	RIV at 1 MHz when energized at 10 KV / 30 KV (rms) under dry condition	< 50 microvolt/As per Type tested design
17	Creepage distance (min)	320 mm
18	Min Failing load/ SCL (Specified cantilever Load)	5 KN
19	Dia of FRP Rod	24 mm
20	Length of FRP Rod (min)	200 mm /Type Tested Design
21	Dia of weather sheds	≥90 mm / Type tested design
22	Thickness of housing	3 mm
23	Dry arc distance(min)	165 mm
24	Method of fixing sheds to housing	Injection moulding
25	Visible Discharge Voltage	9 kV
26	Type of sheds	Aerodynamic
27	Dia of bottom end fitting	M-20
28	Thread length of bottom end fitting	150 mm (Min)
29	Dia of conductor groove	18 mm
30	Neck diameter	To be furnished by Bidder
31	Height of the insulator	To be furnished by Bidder
32	FRP rod leakage current at 175 V/mm	<0.05 mA
33	Weight of the insulator	0.8 +/- 0.1 kg / Type tested design

5. GENERAL CONSTRUCTIONS:

Polymeric Insulators shall consist of THREE parts, at least two of which are insulating parts:

- (a) Core- the internal insulating part
- (b) Housing- the external insulating part
- (c) Metal end fittings.

5.1 CORE

It shall be a glass-fibre reinforced epoxy resin rod of high strength (FRP rod). Glass fibres and resin shall be optimized in the FRP rod. Glass fibres shall be Boron free electrically corrosion resistant (ECR) glass fibre and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free. Electrically Corrosion Resistant (ECR) grade fibre glass reinforced plastic (FRP) rod having at least 80% fibres by weight.

5.2 POLYMER HOUSING:

The FRP rod shall be covered by a seamless sheath of high voltage grade Silicone rubber housing of thickness 3mm minimum. It shall be one- piece housing using only Injection Moulding process to cover the core. The housing shall be designed to provide the necessary creepage distance and protection against environmental influences, external pollution and humidity. Housing shall conform to the requirements of IEC 60815 with latest amendments. All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating condition. It shall be extruded or directly moulded on core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer.

Sheath material in the bulk as well as in the sealing / bonding area shall be free from voids.

5.3 WEATHERSHEDS

The composite polymer weather sheds made of high voltage grade Silicone rubber polymer shall be moulded as part of the sheath and shall be free from imperfections. It should protect the FRP rod against environmental influences, external pollution and humidity. The weather sheds should have **silicon content of minimum 40% by weight**. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath

(housing) shall be free from voids. Housing and weather sheds material shall have tensile strength of 3 Mpa with 300% elongation minimum and tear strength of 13 N/mm.

5.4 HARDWARE FITTINGS:

End fitting transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminium alloy. Metal end fitting shall be suitable for pin type hardware support of respective specified mechanical load and shall be hot dip galvanized in accordance with IS 2629. They shall be connected to the rod by means of a controlled compression technique. The outer of end fittings should be machined to make the surface uniform round to ensure effective sealing when housing is moulded over it. The material used in fittings shall be corrosion resistant. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be properly attached to the core by a coaxial or hexagonal compression process & should not damage the individual fibres or crack the core. The gap between fittings and sheath shall be sealed by flexible silicone elastomeric compound or silicone alloy compound sealant, system of attached of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof. The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IS: 2486 - Part-II. Outer portion of Pin should be Zinc sleeved with minimum 99.95% purity of Electrolytic high-grade zinc. Bottom end fitting should be single unit without any joints. Nuts as per IS 1363 (P-III) and spring washer shall be as per IS 3063 with Latest amendments if any, Nuts and spring washer shall be hot dip galvanized. The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The pin insulator shall not engage directly with hard metal.

6. MARKING:

Each insulator shall be legibly and indelibly marked (embossing/engraved) to show the following:

- a) Name & Trade mark of the manufacturer
- b) Voltage Grade
- c) Year of manufacture
- d) Minimum failing load in KN
- e) "TPCODL/TPNODL/TPWODL/TPSODL" Name should be mentioned on each insulator

7. TESTS

The bidder shall be required to submit complete set of the following test reports along with the offer: -

7.1 ACCEPTANCE TESTS

- i) Verification of dimensions
- ii) End Sealing test (FRP rod and Silicone rubber housing)
- iii) Visual examination (Free from voids, cavity, foreign particle and scratch/nick spot)
- iv) Verification of the locking system or the tightness of the interface between end fitting and insulator housing
- v) Galvanizing Test
- vi) Verification of the specified mechanical load
- vii) Bending Load Test
- viii) Dry Power Frequency Withstand Voltage Test
- ix) Wet Power Frequency Withstand Voltage Test
- x) Analysis of material properties of housing material
- xi) Analysis of material properties of Core material

7.2 ROUTINE TESTS

- i) Visual examination (Free from voids, cavity, foreign particle and scratch/nick spot)
- ii) Mechanical Load Test (bending/cantilever)

7.3 TYPE TESTS

A) For Insulators

- i. Dry Power Frequency Withstand Voltage Test
- ii. Dry Power Frequency Voltage Flashover Test
- iii. Dry lightning impulse withstand voltage test.
- iv. Wet Power Frequency Withstand Voltage Test
- v. Wet Power Frequency Voltage Flashover Test
- vi. Mechanical failing load test.
- vii. Salt fog test: On insulators for 1000 hr as per IEC
- viii. Galvanization test

ix. Radio interference test.

B) For Silicon rubber

- i.* Tensile Strength
- ii.* Elongation
- iii.* Tear Strength
- iv.* Inclined plane Tracking & Erosion resistance test
- v.* Volume Resistivity
- vi.* Dielectric constant
- vii.* Dielectric Strength
- viii.* Density
- ix.* Hardness
- x.* Arc Resistance
- xi.* Silicone Content
- xii.* Flammability
- xiii.* Limiting oxygen index test
- xiv.* Resistance to weathering & UV.
- xv.* Specific gravity

C) For FRP rods

- i.* Verification of dimensions
- ii.* Specific Gravity
- iii.* Glass Content
- iv.* Water Diffusion Test
- v.* Hardness
- vi.* Dye Penetration Test
- vii.* Flexural Strength
- viii.* Brittle fracture resistance test.

8. TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at **CPRI/ERDA** as per the relevant IS/IEC. For High voltage Silicone rubber material used for Polymer housing and FRP Rod the test are conducted at ERDA/CIPET/CPRI/Any Govt. owned NABL Accredited Lab as per the relevant standards. TPCODL/ TPWODL/ TPNODL/ TPSODL/TATA-POWER reserves the right to allow any other NABL accredited lab report

under exceptional circumstances after due diligence/ scrutiny by DISCOM. Type tests should have been conducted during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable, same shall be carried out without any cost implication to TPCODL/ TPNODL/ TPWODL/ TPSODL.

9. PRE-DISPATCH INSPECTION:

The material shall be subject to inspection by a duly authorized representative of the TPCODL/TPNODL/TPWODL/TPSODL. Inspection may be made at any stage of manufacture at the discretion of the purchaser and the equipment, if found unsatisfactory as to workmanship or material, the same is liable to rejection. Bidder shall grant free access to the places of manufacture to TPCODL/TPNODL/TPWODL/TPSODL's representatives at all times when the work is in progress. Inspection by the TPCODL/TPNODL/TPWODL/TPSODL or its authorized representatives shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specifications. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by TPCODL/ TPNODL/ TPWODL/ TPSODL.

Following documents shall be sent along with material.

- a) Test reports
- b) MDCC issued by TPCODL/TPNODL/TPWODL/TPSODL
- c) Invoice in duplicate
- d) Packing list
- e) Drawings & catalogue
- f) Guarantee / Warrantee card
- g) Delivery Challan
- h) Other Documents (as applicable).

10. INSPECTION AFTER RECEIPT AT STORES:

The material received at TPCODL/TPNODL/TPWODL/TPSODL, Odisha store will be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection and one copy of the report shall be sent to Engineering department.

11. GUARANTEE:

Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Company up to a period of 18 months from the date of commissioning or 24 months from the date of last supplies made under the contract, whichever is earlier, supplier shall be liable to undertake to replace/rectify such defects at his own costs. within mutually agreed timeframe, and to the entire satisfaction of the Company, failing which the Company will be at liberty to get it replaced/rectified at supplier's risks and costs and recover all such expenses plus the Company's own charges (@ 20% of expenses incurred), from the supplier or from the "Security cum Performance Deposit" as the case may be.

The bidder shall further be responsible for 'free replacement' for another period of THREE years from the end of guarantee period for any 'latent defects' if noticed by the company.

12. PACKING:

Supplier shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport and be packed in such a manner so as to protect the equipment from damage in transit. The material used for packing shall be environmentally friendly. All insulators shall be packed in strong corrugated box of min. 7 ply duly palette or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season. Each wooden case / crate / corrugated box shall have all the markings stencilled on it in indelible ink. The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

13. TENDER SAMPLE:

Bidder shall submit the sample of material during submission of Bids.

14. QUALITY CONTROL:

The bidder shall submit with the offer Quality Assurance Plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. The Purchaser's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections. The bidder shall ensure that the material supplied is as per the Guaranteed Technical Particulars as specified in the specifications.

15. TESTING FACILITIES:

Bidder shall have adequate in-house testing facilities for carrying out all routine tests & acceptance tests as per relevant International / Indian standards.

16. MANUFACTURING ACTIVITIES:

The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity. This bar chart should be in line with the Quality assurance plan submitted with the offer.

17. SPARES, ACCESSORIES AND TOOLS

Not applicable.

18. DRAWINGS AND DOCUMENTS

Following drawings and documents shall be submitted in line with the requirement of Tender specifications:

- a) Completely filled in Schedule "A" Guaranteed Technical Particulars & Schedule "B" Deviations
- b) Work Experience details
- c) Type test certificates.
- d) Drawing 1 set of Hard Copy & Soft copy PDF File containing complete information about manufacturing.

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19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS

Bidder to submit completely clause wise compliance of this specification.

20. SCHEDULE "B" DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation