

STANDARD TECHNICAL SPECIFICATION COVER SHEET

Specification No.: ENG-HV-2028 R1

Specification Name: Technical Specification for 11KV Polymeric Disc Insulator

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1. SCOPE

This specification covers the technical requirements of design, manufacture, performance, testing at manufacturer's works, packing & forwarding, supply and unloading at store/ site, performance of 11 kV Ball and Socket Disc Polymer Insulator complete with all the accessories for trouble free and efficient performance.

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/IEC	Description
IEC:61109	Definition, test methods and acceptance criteria for composite insulators for A.C. overhead lines above 1000V.
IS:2071/ IEC:60060-1	Methods of High Voltage Testing.
IS:2486/ IEC:60120/ IEC:60372	Specification for Insulator fittings for Overhead Power Lines with nominal voltage greater than 1000V. Ball and socket couplings of string insulator units –Dimensions Locking devices for ball and socket couplings of string insulator units - Dimensions and tests
IEC:60575	Thermal-mechanical performance test and mechanical performance test on string insulator units.
IS: 13134/ IEC: 60815	Guide for the selection of insulators in respect of polluted condition.
IEC: 60433	Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic insulators for AC systems - Characteristics of insulator units of the long rod type.
STRI guide 1.92/1	Hydrophobicity Classification Guide.
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:6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles.
IS:3203	Methods of testing of local thickness of electroplated coatings.
IS:2633	Testing of Uniformity of coating of zinc coated articles.
ASTM D 578-05	Standard specification for glass fibre standards.
IS:4699	Refined secondary zinc
IS:2633	Testing of Uniformity of coating of zinc coated articles.

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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
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.

TPCODL/TPNODL/TPSODL/ TPWODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed up to 300 Km ph. The atmosphere is generally laden with mild acid, dust in suspension during the dry months, and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS:

- i) The Composite insulators will be used on 11kV lines on which the conductor will be ACSR/AAAC of sizes 100 Sq.mm. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind. Insulator shall be suitable for moderately to heavily polluted, Humid & High saline atmosphere.
- ii) 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.

- iii) Insulators shall be suitable for Strain type of load and shall be of B&S type. The diameter of Composite Insulator shall be as per technical specification.
- iv) Insulators shall have 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:
 - $\pm (0.04d + 1.5)$ mm when $d \leq 300$ mm
 - $\pm (0.025d+6)$ mm when $d > 300$ mmWhere, 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.

- viii) The composite insulators offered shall be suitable for use of hotline maintenance technique so that usual hot line operation can be carried out with ease, speed and safety.

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SL. No.	TECHNICAL PARTICULARS	DESIRED VALUE	
		11 kV 70KN	11 kV 45KN
1	Type of Insulator	Polymeric B&S	Polymeric B&S
2	Standard according to which the insulators manufactured and tested.	IEC 61109	IEC 61109
3	Name of material used in manufacture of the insulator with class/grade)	High voltage grade Silicone rubber Wacker-Germany, Dow Corning USA	High voltage grade Silicone rubber Wacker-Germany, Dow Corning USA
(a)	Material of core (FRP rod) (I) E-glass of ECR glass.	ECR BORRON FREE	ECR BORRON FREE
(b)	Material of housing weather sheds (silicon content)	Silicon content of minimum 40% by weight	Silicon content of minimum 40% by weight
(c)	Material of end fittings	SGI/MCI/Forged Steel	SGI/MCI/Forged Steel
(d)	Sealing compound for end fittings	RTV SILICON	RTV SILICON
4	Colour	GREY	GREY
5	Electrical characteristics		
(a)	Nominal system voltage	11 kV	11 kV
(b)	Highest system voltage	12 kV	12 kV
(c)	Dry Power frequency withstand voltage	70 kV	70 kV
(d)	Wet Power frequency withstand voltage	35 kV	35 kV
(e)	Dry flashover voltage	75 kV	75 kV
(f)	Wet flash over voltage	40 kV	40 kV
(g)	Dry lighting impulse withstand voltage		
	(a) Positive	75 kVp	75 kVp
	(b) Negative	75 kVp	75 kVp
(h)	Dry lighting impulse flashover voltage		
	a) Positive	80kVp	80kVp
	b) Negative	80kVp	80kVp
(i)	FRP rod leakage current at 17.5 kV/mm	< 0.05 mA	< 0.05 mA
(j)	RIV at 1 MHz when energized at 10 kV/30kV (rms) under dry condition.	< 50 microvolts	< 50 microvolts

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(k)	Creepage distance (Min.)	320 MM	320 MM
6	Minimum failing load.	70 KN	45KN
7	Dimensions of insulator		
(i)	Weight (Approx.)	1.2 kg	1.2 kg
(ii)	Dia of FRP rod	16 mm	16 mm
(iii)	Length of FRP rod	240 mm /Type Tested Design	240 mm /Type Tested Design
(iv)	Dia of weather sheds	≥90 mm /Type Tested Design	≥90 mm /Type Tested Design
(v)	Thickness of housing	3 mm	3 mm
(vi)	Dry arc distance Dimensioned drawings of insulator (including weight with tolerances in weight)	175 mm	175 mm
8	Method of fixing of sheds to housing (specify). Single mould or Modular construction (injection moulding/compression	Injection Moulding	Injection Moulding
9	Type of sheds	Aerodynamic	Aerodynamic

5. GENERAL CONSTRUCTIONS:

Composite Insulators shall be designed to meet the light quality, safety and reliability and are capable of withstanding a wide range of environmental conditions. 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 fibers and resin shall be optimized in the FRP rod. Glass fibers 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.

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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 weathersheds 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 weathersheds 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 weathersheds material shall have tensile strength of 3 Mpa with 300% elongation minimum and tear strength of 13 N/mm.

5.4 HARDWARE FITTINGS:

- a) 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 Ball and socket type hardware of respective specified mechanical load and shall be hot dip galvanized in accordance with IS 2629.

- b) They shall be connected to the rod by means of a controlled compression technique. 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 fibers or crack the core.
- c) 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.
- d) The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/IS: 2486 - Part-II.
- e) Outer portion of ball or socket should be Zinc sleeved with minimum 99.95% purity of Electrolytic high-grade zinc.
- f) Ball pin and socket couplings: Ball pin and socket shall be of forged steel and dimensions are as specified in IS 2486 (Part-2). Insulator metal caps shall be made of malleable cast iron conforming to IS 14329.
- g) Locking device of the coupling: The security clips to be used as a locking device for ball and socket coupling shall be 'R' shaped hump type or 'W' type as per IS 2486. The locking device shall be resilient, corrosion resistant, and of suitable mechanical strength. Material to be used for 'W' locking clip is phosphor bronze and for 'R' type locking clip is stainless steel. The hardness and temper of material are important for their satisfactory operation. The locking devices shall retain their ability after being operated from the locking to the coupling position at least twenty times at normal temperature. They should be effective at the lowest temperature likely to be encountered in service. Socket for use with W-clips have the lower edge of the rectangular slot at the level of bottom of the socket. The slot is so shaped that it will accept the W-clip and retain it in two distinct positions when operated for coupling and locking. The shape of the W-clip is such that complete withdrawal when moving from the locking to the coupling position prevented.
- h) All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 705 gm/Sq. m, or 100mm min. thickness and shall be in accordance with the requirement of IS: 4759, The zinc used for galvanizing shall be of purity 99.5% as

per IS: 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. Before ball fittings and galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the design dimensional requirements.

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 manufacturing
- 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) Mechanical performance Test
- v) Galvanizing Test
- vi) Mechanical Failing Load Test
- vii) Dry Power Frequency Withstand Voltage Test
- viii) Wet Power Frequency Withstand Voltage Test
- viii) Verification of the locking system or the tightness of the interface between end fitting and insulator housing

7.2 ROUTINE TESTS

- i Visual examination (Free from voids, cavity, foreign particle and scratch/nick spot)
- ii Mechanical Load test
- iii Electrical routine test

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. Damaged Limit Proof Test
- x. 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.

D) For End Fittings

- i) Thickness of Zinc coating
- ii) Uniformity of Zinc Coating

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 CPRI/ERDA/CIPET/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 in certified Test laboratories during the period not exceeding 5 years/Latest CEA guidelines 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 bidder shall get the approved drawing and GTP before start of manufacturing activity. The successful bidder will have to submit details of the offered design & components for approval as per specification. CAT-A/CAT-B is mandatory to start manufacturing.

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 clause wise compliance of the specification
- b) Schedule "B" Deviations
- c) Work Experience details
- d) Type test certificates.
- e) Drawing 1 set of Hard Copy & Soft copy PDF File containing complete information about manufacturing.

19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS

Bidder to submit completely clause wise compliance of this specification

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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