
	TP SOUTHERN ODISHA DISTRIBUTION LIMITED, BERHAMPUR		
	TECHNICAL SPECIFICATION		
Doc. Title	SPECIFICATION FOR 33 KV POLYMER DISC INSULATOR		
Doc. No	ENG-EHV-031-01	Eff. Date: 01/03/2021	
Rev. No	01	Page 1 of 14	
Prepared by:	Reviewed by:	Approved By:	Issued By:

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Initiator		HOG (ENGINEERING)	
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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 33 KV Ball and Socket Disc Polymer Insulator complete with all the accessories for trouble free and efficient performance.

2. APPLICABLE STANDARDS:

- a) IEC: 61109: Definition, test methods and acceptance criteria for composite insulators for A.C. overhead lines above 1000V.
- b) IS: 2071/ IEC: 60060-1: Methods of High Voltage Testing
- c) IS: 2486/ IEC: 60120/IEC: 60372: Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements locking devices
- d) IEC: 60575: Thermal Mechanical Performance test and mechanical performance test on string insulator units.
- e) IS: 13134/ IEC: 60815: Guide for the selection of insulators in respect of polluted condition.
- f) IEC: 60433: Characteristics of string insulator units of the long rod type
- g) IS: 14329-1995: Malleable Iron Castings
- h) IS: 60437: Methods of RI Test of HV insulators
- i) STRI guide 1.92/1: Hydrophobicity Classification Guide.
- j) CISPR:18-2 part: Radio interference characteristics of overhead power lines and high-voltage equipment
- k) IS: 8263/ IEC: 260437: Methods of RI Test of HV Insulators
- l) ANSI C29 13-2000: Standard for insulators – Composite- Distribution Dead-end type
- m) IS: 4759/ISO: 1459/ ISO: 1461: Hot dip zinc coatings on structural steel & other allied products.
- n) IS: 2629/ISO: 1461(E): Recommended Practice for Hot, Dip Galvanization for iron and steel.
- o) IS: 6745/ISO: 1460: Determination of Weight of Zinc Coating on Zinc coated iron and steel articles.
- p) IS: 3203/ISO: 2178: Methods of testing of local thickness of electroplated coatings.
- q) IS: 2633: Testing of Uniformity of Coating of zinc coated articles.
- r) ASTM D 578-05: Standard specification for glass fiber strands.
- s) ASTM E 1131-03: Standard test method for compositional analysis by Thermo-gravimetric
- t) IS: 4699: Specification for refined secondary zinc

3. CLIMATIC CONDITIONS:

The material shall be suitable for following climatic conditions,

- | | |
|--|--------|
| 1. Maximum altitude above sea level | 1,000m |
| 2. Maximum ambient air temperature | 50°C |
| 3. Maximum daily average ambient air temperature | 35°C |
| 4. Minimum ambient air temperature | 0°C |

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5. Maximum relative humidity 95%
6. Average number of thunderstorm days per annum (isokeraunic level) 70
7. Average number of rainy days per annum 120
8. Average annual rainfall 150cm
9. Earthquakes of an intensity in horizontal direction - equivalent to seismic acceleration of 0.3g
10. Earthquakes of an intensity in vertical direction - equivalent to seismic acceleration of 0.15g
(g being acceleration due to gravity)
11. Wind velocity: 300 km/hr, 200 km/hr and 160 km/hr.

Environmentally, some of the regions, where the work will take place includes 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 design of equipment and accessories shall be suitable to withstand seismic forces corresponding to an acceleration of 0.1 g.

4. GENERAL TECHNICAL REQUIREMENTS:

Sl. No.	Description	Unit	Requirements		
1	Type of Insulator		Polymeric 33 kV Ball and Socket Disc Insulator (70 KN)	Polymeric 33 kV Ball and Socket Disc Insulator (90 KN)	Polymeric 33 kV Ball and Socket Disc Insulator (120 KN)
2	Standard according to which the insulators manufactured and tested		IEC 61109		
3	Material of housing and weather sheds		High Voltage Grade Silicone Rubber		
(a)	Material of Core (FRP rod)		ECR BORON FREE		
(b)	Material of end fittings		SGI Cast/Forged Steel		
(c)	Sealing compound for end fittings		Silicone Sealant		
4	Color of housing		Grey		
5	Electrical characteristics				

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(a)	Nominal System Voltage	kV	33
(b)	Highest System Voltage	kV	36
(d)	Rated Frequency	Hz	50
(e)	Dry power frequency withstand voltage	kV	95
(f)	Wet power frequency withstand voltage	kV	75
(g)	Dry lightning impulse withstand voltage	kV _P	Positive - 170KV _P Negative – 180KV _P
(h)	Visible Discharge Test Voltage	kV	27
(i)	Inclined plane tracking and erosion resistance of housing	kV	4.5kV for 360 minutes
(j)	FRP rod leakage current at 175 V/mm	mA	<0.05mA
K)	Dry Lighting impulse Flashover voltage	KV	Positive - 210KV Negative - 230KV
L)	RIV at 1MHZ when energized at 10KV	Micro volt	<70Micro volt
6.	Other Physical & Dimensional requirements		
(a)	Dia of FRP Rod	mm	16
(b)	Dia of Weather Sheds	mm	110
(c)	No. of Weather Sheds	Nos.	8
(d)	Method of fixing sheds to housing		Injection Molding
(e)	Type of sheds		Aerodynamic

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(f)	Minimum Creepage distance(25mm per KV)	mm	900		
(g)	Minimum Failing load	KN	70	90	120

5. GENERAL CONSTRUCTION

Polymeric Insulators shall be designed to meet the high 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

Core shall be a glass-fiber 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 fiber (minimum 80%) and shall exhibit both high electrical integrity and high resistance to acid corrosion. FRP Rod Diameters Should be minimum 16mm for 70KN ball and socket insulator. 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

5.2 POLYMER HOUSING:


The FRP rod shall be covered by a seamless sheath of high voltage grade Silicone rubber housing. It shall be one- piece housing using only Injection Molding process to cover the core. Primer should be used to bond the housing with FRP rod. The housing shall be designed to provide the necessary creepage distance and protection against environmental influences. Housing shall conform to the requirements of IEC 61109/93-93 with latest amendments. 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. 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.

5.3 WEATHERSHEDS

The composite polymer weather sheds made of high voltage grade Silicone rubber polymer shall be molded 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 strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The Weather sheds should have silicon content of minimum 30% by weight. The interface, if any, between sheds and sheath (housing) shall be free from voids. Housing and weather shed material shall have tensile strength of 3 MPa with 400% elongation minimum and tear strength of 16N/mm.

5.4 HARDWARE FITTINGS:

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- a) Ball pin and socket couplings: Ball pin and socket shall be of forged steel and dimensions are as specified in IS 2486 (Part-2): 1989. Insulator metal caps shall be made of malleable cast iron conforming to IS 14329: 1995.
- b) 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.
- c) All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS 2629-1985. The Zinc to be used for galvanizing shall conform to grade Zn 99.99 as per IS 209-1992. The Zinc coating shall be uniform, smoothly adherent, reasonably bright, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball fittings are 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 as-


- (a) Name & Trade mark of the manufacturer
- (b) Month and year of manufacture
- (c) Minimum failing load in KN
- (d) "TPSODL" Name should be mentioned on each insulator.

7. TESTS:

7.1 TYPE TESTS OF COMPLETE POLYMER INSULATORS

- (a) Dry lightning impulse withstand voltage test.
- (b) Wet power frequency test.
- (c) Mechanical failing load test.
- (d) Radio interference test.
- (e) Mechanical performance test
U.V Resistance as per ASTM G 53: 1000 Hrs - UV Light for 8 Hours and condensation for 4 hours in a continuous cycle. Elongation to be limited to 20% (% Elongation to break before and after the test).
- (f) Salt Fog test: On insulators for 1000 hours as per IEC.
- (g) Galvanization test.
- (h) Visual examination.
- (i) Verification of dimensions.
- (j) Bending test.
- (k) Verification of the locking system or the tightness of the interface between end fitting and insulator housing.

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- (l) Assembled core load time test.
- (m) Determination of the average failing load of the core of the assembled insulator.

7.2 TYPE TESTS ON SILICONE RUBBER

- (a) Tensile Strength & Elongation
- (b) Tear Strength
- (c) Inclined Plane Tracking & Erosion
- (d) Volume resistivity
- (e) Dielectric Strength
- (f) Dielectric Constant
- (g) Density
- (h) Hardness
- (i) Arc Resistance
- (j) Silicone content
- (k) Flammability
- (l) Resistance to weathering & UV.
- (m) Limiting oxygen index test.
- (n) Specific gravity.

7.3 TYPE TESTS ON FRP RODS

- (a) Verification of dimensions.
- (b) Specific Gravity
- (c) Glass Content
- (d) Water Diffusion Test
- (e) Hardness
- (f) Dye Penetration Test.
- (g) Flexural strength.
- (h) Water absorption.
- (i) Brittle fracture resistance test.
- (j) Visible discharge test.
- (k) Dry lightning impulse withstand voltage test.
- (l) Wet power frequency withstand voltage test.
- (m) Power Arc test.
- (n) Accelerated weathering test.
- (o) Tracking & erosion test.


7.4 TYPE TESTS ON END FITTINGS

- (a) Thickness of Zinc Coating
- (b) Uniformity of Zinc Coating
- (c) Micro-structural of metal fitting.

7.5 DESIGN TEST

For composite insulators it is essential to carry out design test as per clause 4.1 of IEC 61109 / 92-93 with latest amendments. The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology). When a composite insulator is submitted to the

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design tests, the result shall be considered valid for the whole class of insulators, which are represented by the one tested and having the following characteristics:

- The materials for the core, and sheds and same manufacturing method;
- The material of the fittings, the same design, the same method of attachment;
- Polymer insulator should have greater layer thickness of the shed material over the core (including a sheath where used);
- Polymer insulator should have smaller ratio of the highest system voltage to insulation length;
- Polymer insulator should have smaller ratio of all mechanical loads to the smallest core diameter between fittings
- Polymer insulator should have greater diameter of the core.

The tested composite insulators shall be identified by a drawing giving all the dimensions with the manufacturing tolerances.

Manufacturer should submit test reports for Design Tests as per IEC – 61109 (clause – 5) along with the bid. Additionally, following tests shall be carried out or reports for the tests shall be submitted after award of contract: UV test: the test shall be carried out in line with clause 7.2 of ANSI C29.13.

In addition, chemical composition test for silicon content would also be added in the testing list.

Acceptance Tests

- Physical & Dimensional Verification of materials.
- Mechanical Load Test
- Galvanizing Tests.
- Bending load test.
- Mechanical performance test.
- Mechanical Failing Load test.
- Dry power frequency withstand voltage test
- Wet power frequency withstand voltage test.

Routine Test-


- Physical & Dimensional Verification of materials.
- Mechanical Load Test
- Identification of Marking

8. TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the 33 KV Ball and Socket Disc Polymer Insulators for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI/ERDA/ NABL Accredited Laboratory as per the relevant standards. Type tests should have been conducted in certified Test laboratories 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 TPSODL.

9. PRE-DISPATCH INSPECTION:

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The material shall be subject to inspection by a duly authorized representative of the 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 TPSODL's representatives at all times when the work is in progress. Inspection by the 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 TPSODL. Following documents shall be sent along with material

- a) Test reports
- b) MDCC issued by TPSODL
- c) TPSODL 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 STORE:

TPSODL Inspectors will inspect the material received at TPSODL Store and shall have right to reject if found different from the reports of the pre-dispatch inspection.

11. GUARANTEE:

Supplier 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 12 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. Supplier shall further be responsible for 'free replacement' for another period of THREE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Company.

12. PACKING AND TRANSPORT:

Supplier shall ensure that all equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner as to protect it from damage in transit.

13. TENDER SAMPLE:

1 insulator sample to be provided during submission of technical bid.

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,

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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.

15. TESTING FACILITIES:

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

16. DRAWINGS AND DOCUMENTS:

Following drawings and documents shall be prepared based on TPSODL specifications and statutory requirements and shall be submitted with the bid:

- Completely filled in Technical Particulars
- General description of the equipment and all components including brochures.
- Experience List
- Type test certificates.

Drawings / documents to be submitted after the award of the contract are as under:

S No.	Description	For Approval	For Review Information	Final Submission
1	Technical Parameters	√		√
2	General Arrangement Drawing	√		√
3	Mounting and fixing arrangement		√	√
4	Instruction for use		√	√
5	QA & QC Plan & Type test certificates	√	√	√

17. GUARANTEED TECHNICAL PARTICULARS:

Bidder shall submit guaranteed technical particulars in the attached format.


Sl. No.	Description	Unit	Requirements		To be furnished by bidder
1	Type of Insulator		Polymeric 33 kV Ball and Socket Disc Insulator (90 KN)	Polymeric 33 kV Ball and Socket Disc Insulator (120 KN)	
2	Standard according to which the insulators manufactured and tested		IEC 61109		

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3	Material of housing and weather sheds		High Voltage Grade Silicone Rubber
(a)	Material of Core (FRP rod)	kV	ECR BORON FREE
(b)	Material of end fittings	Hz	SGI Cast/Forged Steel
(c)	Sealing compound for end fittings		Silicone Sealant
4	Color of housing		Grey
5	Electrical characteristics		
(a)	Nominal System Voltage	kV	33
(b)	Highest System Voltage	kV	36
(d)	Rated Frequency	Hz	50
(e)	Dry power frequency withstand voltage	kV	95
(f)	Wet power frequency withstand voltage	kV	75
(g)	Dry lightning impulse withstand voltage	kV	170
(h)	Visible Discharge Test Voltage	kV	27
(i)	Inclined plane tracking and erosion resistance of housing	kV	4.5kV for 360 minutes
(j)	FRP rod leakage current at 175 V/mm	mA	<0.05mA
6.	Other Physical & Dimensional requirements		
(a)	Dia of FRP Rod	mm	16
(b)	Dia of Weather Sheds	mm	110
(c)	No. of Weather Sheds	Nos.	8
(d)	Method of fixing sheds to housing		Injection Molding

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(e)	Type of sheds		Aerodynamic		
(f)	Minimum Creepage distance	mm	900		
(g)	Minimum Failing load	KN	70	90	120

18. SCHEDULES OF DEVIATIONS:


The Bidders shall set out all deviations from this specification, Clause by Clause in this schedule. Unless specifically mentioned in this schedule, the bidder shall be deemed to confirm the purchaser's specifications. (Format is attached)

(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

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

Seal of the Company.

Designation:

Signature:

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