SUPPLY CHAIN MANAGEMENT

THIRUVANANTHAPURAM

SPECIFICATION

220KV, 120KN, 90KN & 110KV, 120KN, 90KN, 70KN COMPOSITE POLYMER INSULATORS

APPLICABLE TO KSEBL	DOC. NO.: **SCM-SPEC/XT/ 220kV 110kV Composite Polymer Disc Insulators**
	EFF. DATE: **31/05/2021**

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Technical Specification and Evaluation Committee for Transmission Material

(i) Document Approval & Control Status

	Compiled by	Verified by	Approved by
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Date	01/05/2021	14/05/2021	27/05/2021
Signature	**Sd/-**	**Sd/-**	**Sd/-**

(ii) Amendments and History

Sec. #	*Rev. #*	*Date*	*History of Change*

1. PURPOSE:

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **220kV & 110kV Composite Polymer Disc Insulators** in a professional manner

2. SCOPE:

The Scope of this document is to inform and alert all relevant stakeholders including KSEBL. Public, KSERC etc regarding the current specifications and historical changes adopted in specifications of **220kV & 110kV Composite Polymer Disc Insulators** used in field by KSEBL

3. RESPONSIBILITY :

The Executive Engineer (T), Office of Chief Engineer, Supply Chain Management shall compile and take necessary steps to publish the specification in KSEBL website and shall inform relevant stakeholders regarding updates and revisions

4. PROCEDURE FOR REVISION:

Modifications if any, in the technical specification will be incorporated as **Revisions.** Any changes in values, minor corrections in pages, incorporation of small details etc. will be considered as Minor Modification. **The Revisions due to minor modifications will be assigned as Rev. No.0.1, 0.2 etc.**

A complete updation of the technical specification will be considered as Major modification. **The Revisions due to major modifications will be assigned as Rev. No.1.0, 2.0 etc.**

All the details of regarding the revisions (both minor and major) will be incorporated in **"(ii)-Amendments and history"** above.

The concerned officers, in consultation with the Technical Committee will review and suggest changes required and the revision suggestion will be approved by **Chief Engineer (SCM).** Those who notice any discrepancy or have any suggestion regarding revision, may bring the matter to the attention of Chief Engineer (SCM) in writing or through e-mail id:**cescm@kseb.in**

KSEB കേരളത്തിന്റെ ഊർജ്ജം	**SUPPLY CHAIN MANAGEMENT** Thiruvananthapuram			
	TECHNICAL SPECIFICATION **220KV, 120KN, 90KN & 110KV, 120KN, 90KN, 70KN COMPOSITE POLYMER INSULATORS**			
	Doc. #: **SCM-SPEC/XT/Composite Polymer Insulator**	Rev.#: 0		Effective Date 31/05/2021

CONTENTS

TECHNICAL SPECIFICATION FOR SILICON RUBBER HOUSED COMPOSITE INSULATORS

1.0. **SCOPE:-**

1.1. This specification covers design, manufacturing, testing, inspection, packing and supply of Silicon Rubber housed composite of 110kV & 220kV tension & suspension type Insulators for satisfactory preparation on various transmission lines and Sub-stations and Generating Stations situated in any part of Kerala state.

1.2. Now, here under, where composite insulator is mentioned, describes only Silicon Rubber housed composite insulators.

1.3. These insulators are to be used as insulating part on single circuit or double circuit lattice tower structures single/double suspension & tension(dead end) for 220 / 132 / structures for transmission lines. The configuration on structure may be single or double insulators per phase at required locations.

1.4. The Bidder should be original manufacturer of the SIR housed composite insulators and shall have all the facilities to manufacture 70kN/90KN/120KN and higher sizes of composite insulators. This will be pre-qualifying requirement as a “Bidder”

2.0. SERVICE CONDITIONS:-

The composite insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under following tropical conditions.

1	Location	:	In Kerala State
2	Maximum ambient air temperature	:	50^0 C
3	Minimum ambient air temperature	:	15^0 C
4	Daily average temperature	:	35^0 C
5	Average number of thunder storm days/annum	:	50

6	Maximum relative humidity	:	100%
7	Average annual rain fall	:	3000 mm
8	Maximum wind pressure	:	130kg/m2
9	Maximum altitude above mean sea level	:	1000mt
10	Seismic level – Horizontal acceleration	:	0.5g
11	Average number of rainy days per annum	:	90 days

Note :- Moderately hot and humid tropical climate conducive to rust and fungus growth. The climate conditions are also prone to wide variations in ambient condition. Smoke is also present in the atmosphere. Heavy lightning also occurs from October to January.

3.0. SYSTEM PARTICULARS:-

3.1. Electrical system Data:-

Sl. No.	Particulars	220kV	110kV
a)	System Voltage (KV rms)	220	110
b)	Maximum Voltage (KV rms)	245	123
c)	Lightning impulse withstand voltage (dry & wet) kVp	1050	550
d)	Power frequency withstand voltage (wet) kV rms	460	230
e)	Short circuit level (KA)	40	31.5
f)	Frequency – Hz 1) Normal 2) Maximum 3) Minimum	 50 51.5 47	 50 51.5 47
g)	Number of circuits	Single/Double	Single/Double
h)	Normal span - m	350	350
i)	Wind span - m	385	385

j)	Weight span-m 1) Maximum 2) Minimum	 525 -100	 525 -100
k)	Factor of safety	4	4
l)	Neutral Grounding	Effectively earthed	Effectively earthed
m)	Ball socket dia in mm Suspension/Tension	16mm for 90kN & 20mm for 120kN	16mm for 70kN, 90kN & 20mm for 120kN
n)	Length of AF insulator string in mm 220/110 kV for suspension location	2030	1305
o)	Length of AF insulator string in mm 220/110 kV for Tension location	2175	1305
p)	Minimum failing load (kN) for 220/110kV for Suspension/ Tension type	90/120	70/ 90/ 120
q)	Minimum creepage distance in mm	7595	4495

4.0. STANDARDS:-

The Manufacturer should confirm the product with following Indian Standard, International Standards containing latest revisions, amendments, changes adopted.

Sl. No	Description	Indian/ International standards
1	Specification for zinc	IS:209-1992/BS:3436
2	Method of chemical analysis of slab Zinc	IS:406-1991/ BS: 3436
3	Composite Insulators for AC over head power lines with a nominal voltage greater than 1000V	IEC:61109 - 1992
4	Method of High voltage testing	IS:2071/IEC 60060-2010

5	Specification for insulator fittings for over head power lines with a nominal voltage greater than 1000V General requirement and tests, Dimensional requirements, Locking devices	IS:2486 part-1-1993, part 2-1989, part3 – 1991/IEC:575, BS:3288, IEC- 6020, IEC-60372
6	Recommended practice for Hot Dip Galvanisation for iron and steel	IS:2629 – 1990, ISO-1461(E)
7	Testing of uniformity of coating of zinc coated articles	IS:2633-1992
8	Determination of weight of Zinc coating on zinc coated iron and steel articles	IS:6745-1990,BS:443-1969, ISO 1460-1973
9	Method of RI Test of HV insulators	IS:8263– 1990, IEC-60437 NEMA Publication No.07/ 1964 CISPR
10	Methods of switching impulse test on HV insulators	IS:8269 – 1990, IEC-60506
11	Salt fog pollution voltage withstand test	IEC-60507
12	Guide for the selection of insulators in respect of polluted conditions	IEC-60815
13	Tests of insulators of Ceramic material or glass for over head lines with a nominal voltage greater than 1000V	IEC- 60363
14	Insulators for over head lines - Composite line post insulators for AC systems with a nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria	IEC -61952

However, in an event of supply of insulators conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the standards proposed by the Bidder and those specified in this document will be provided by the Supplier to establish equivalence.

5.0. GENERAL REQUIREMENT:-

The design, manufacturing, processes, testing, tolerances and inspection of composite insulators shall confirm to the following.

5.1. Language and units.

5.1.1. All correspondence, literature, drawings and markings shall be in the English language.

5.1.2. Dimension shall be in the SI (Metric System) units. Manufacturer should mention the standard adopted for Dimensioning & tolerance principals considered for design.

6.0. DESIGN AND MATERIAL REQUIREMENT:-

6.1. **Core:-** The core shall be glass-fibre reinforced epoxy resin rod (FRP) of high strength. Both, glass fibre and resin shall be optimized in the FRP rod. Glass fibres with low content in alkalies shall be boron free E glass or Boron free electrically corrosion resistance (ECR) glass. Use of resin with hydrolysis trend due to water penetration should be prevented i. e. matrix of the FRP rod shall be Hydrolysis resistant. Suitability of Epoxy matrix as well as interface between matrix and fibres is to be considered as design parameter to prevent brittle fracture. The FRP rod should be void free and shall be manufactured through Pultrusion Process. Diameter of FRP rod should be greater than or equal to 20mm.

6.2. **Housing:-** The core of the composite insulator shall be completely covered by a continuous housing consisting of a sheath-weather shed. The weather sheds shall be moulded as part of the sheath (injection moulding process). The track resistance of housing and shed material shall be class 1A4.5 according to IEC: 60587. The strength of the weather shed to interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing. The metal fittings shall be installed on the rod prior to moulding of the shed controlling moulding lines.

The base polymer shall be 100% Silicon Rubber prior to the addition of reinforcing fillers. The thickness of compounding material on core should be minimum 3 mm. Manufacturer should furnish a description of its Quality Assurance Programme including fabrication, testing and inspection for any material (i.e. rubber & Polymer Compound), components (i.e. rod) or hardware (i.e. end fittings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer. Insulator should have hermetically sealed structure in which the housing material is moulded to cover the interface between the end fittings and the FRP rod. This seal should never be broken during testing or otherwise.

6.3. **End fittings:-** The composite insulators shall be socket and ball type with the necessary coupling arrangement such that pin shall move freely in the socket but do not get disengaged while in service under various operating and atmospheric conditions.

The socket & ball type metal end fittings shall be designed to transmit the mechanical load to the core & the end fittings shall maintain uniform and consistent mechanical strength Material and methods used in the fabrication of metal parts shall be selected to provide good toughness and ductility. Metal end fittings shall be made from a quality malleable cast iron or forged steel or Spheroidal Graphite Iron(SGI) and shall be hot dipped galvanized in accordance with IS 2629. Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, slivers, slag, blow-holes shrinkage defects and localized porosity. The attachment to the FRP rod shall be performed with a symmetrically controlled through Pultrusion process.

Crimping method control by acoustic method that compresses the metal radially onto the rod without damage to the rod fibres or resin matrix while providing a strength equal to or greater than the defined and specified ultimate strength to the insulator. The material used in

fittings shall be corrosion resistant. Nominal dimensions of the pin, ball and socket interior shall be in accordance with the standard shown at cl. no. 4. No joints in ball & socket or pin will be allowed. The finished surface shall be smooth and shall have a good performance The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection. The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either sound or vision transmission. 16mm for 70 & 90kN, 20mm for 120kN. **End fitting should be crimped first and then Silicon rubber housing should be molded over it.**

6.4. GRADING RINGS:- Grading rings shall be provided when system voltages are equal to or greater than 220 KV. For 220 KV transmission, grading ring is to be provided at energized end only. For 400 KV transmission, grading ring is to be provided at both ends of an insulator. All grading rings and brackets shall be designed as an integral part of the insulator assembly with a positive mounting system that allows mounting in only one position. The design of the grading ring shall be such that ring can only be mounted with its orientation towards the weather sheds for maximum RIV and corona control. Grading rings shall be designed in such a manner that the rings can be readily installed and removed with hot line tools without disassembling any other part of the insulator assembly. Grading ring height (is the distance from the end of the end fitting to the top of corona ring) should be so selected that maximum field minimizes & uniformly distributed along the insulator. Manufacturer should provide reports of successful electrical field modeling testing for the specific insulator design. The EFM should be three dimensional with results containing drawing depicting the electric field in various colors, each of a different voltage level. The result of this study should show that the voltage field surrounding the composite insulator is optimum along the entire length of insulator, with the effected hot

end of the insulator being a critical location. The threshold at which corona may or may not be present should be defined as a figure in kV/mm for the designed insulator.

7.0. VERIFICATION OF HOUSING MATERIAL:-

The manufacturer should provide written verification about housing material, for which base polymer shall be 100% Silicon Rubber prior to the addition of reinforcing fillers considered will provide satisfactory performance in the particular environment mentioned at Cl.No.2. It shall meet following requirements.

Be homogenous, impermeable, with no fissures, bubbles and strange materials inclusions.

Be designed in order to avoid formation of localized discharges and to prevent interfaces humid penetration.

Be resistant to corona, KV radiation, ozone, atmospheric contamination, water penetration and power arcs.

8.0. BALL AND SOCKET DESIGNATION:-

The dimensions of the Ball and Socket shall be 16mm designation for 70kN & 90kN and 20mm designation for 120KN & 160KN insulators in accordance with the standard dimensions stated in IEC:120/IS:2486 (Part-II)

9.0. DIMENSIONAL TOLERANCE OF COMPOSITE INSULATORS:-

The tolerance on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows:

± (0.04 d + 1.5) mm when d = 300 mm. with max of 50mm for 120kN and ±39mm for 70/90kN

± (0.025 d + 6) mm when d > 300 mm.

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

10.0. INTERCHANGEABILITY:-

The composite insulators including the ball socket connections shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IS/IEC standards.

11.0. CORONA AND RI PERFORMANCE:-

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.

12.0. MARKINGS:-

Each insulator shall be legibly and indelibly marked with the following details as per IEC–61109.

a) Name or trademark of the manufacturer.

b) Voltage and Type.

c) Month and year of manufacturing.

d) Minimum failing load / guaranteed mechanical strength in kilo Newton followed by the word 'KN' to facilitate easy identification.

e) Country of manufacture.

f) KSEBL

For above, kV-KN & Type of Insulator (e.g. "110 KV 70 KN S" for 110 kV 90 KN Suspension and 110kV 90kN T for 110kV 90kN Tension) shall be marked on end fittings with embossing or with indelible ink. Also placement of corona controlling, in accordance with EFM test report, shall be marked on end fitting for appropriate placement of ring.

13.0. PACKING:-

All insulators shall be packed in strong Core pipe packing with maximum 1 no. of insulators in one pack. The size of the packing shall be supportive to handling ease. The packing shall be suitable for out door storage and stacking under wet climate during rainy season. The packing shall be of sufficient strength to withstand rough handling during transit, storage and stacking at site and subsequent handling in the field.

Suitable cushioning, protective padding, or Dunn age or spacers shall be provided to avoid direct contact of insulators with to prevent damage or deformation during transit and handling. Long insulators shall be supported intermediate to avoid bending. Boards shall be tightly in contact to avoid access by small animals like rat. Each consignment shall be accompanied by a detailed packing list containing the following:

a) Name of consignee
b) Details of the consignment
c) P.O. No. & Date
d) Destination
e) Total weight of consignment
f) Sign showing upper/ lower side of the crate
g) Handling and unpacking instructions
h) Bill of materials indicating contents of each package.

All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each Core pipe packing shall have all the markings stenciled on it in indelible ink.

The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

14. INSPECTION, TESTS AND STANDARDS:-

14.1 Proto type or Design or Type: To evaluate core material, housing material, core assembly (core & end fittings), interfaces and connections of sample insulators.

Inspection includes the performance of acceptance, type and design tests. KSEBL reserves the right to carry out design and type tests to check conformity of the material with the proto type unit previously approved.

KSEBL reserves the right to attend the tests and perform inspections in any stage of the supply, appoint its officers for inspection at any stage of the approved manufacturing schedule. Inspection and tests scheduled to happen during manufacture shall be informed to KSEBL at least 10 days in advance. The manufacturer shall assure KSEBL's inspector the right to being fully acquainted with installations and apparatus, check calibrations, be present at the tests, check results and in case of doubt, perform new inspections and claim the repetition of any test.

14.2 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected, tested, and necessary dispatch instructions are issued in writing, except for the cases where waiver of inspection is granted by competent authority of the

Purchaser and even in this case also, written dispatch instructions will be issued. Any dispatches before the issue of Dispatch Instructions in writing will be liable for rejection and non acceptance of the materials by the consignee.

14.3 The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

14.4 The sample taken from any numbers of packing for carrying out any type of tests will be to the suppliers account.

14.5. TESTS:-

14.5.1. The following type, acceptance, routine tests, any tests specifically demanded by the purchaser and tests during manufacture shall be carried out on the insulator material free of cost. For the purpose of this clause:

14.5.1.2. Type tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this specification. These tests shall have to be carried out at the Government Approved Testing Laboratory. Purchaser reserves the right to specify the name of the laboratory also, if so felt. The Type test reports shall not be older than Seven years and shall be valid till validity of offer.

14.5.1.3. Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot. These tests shall be carried out at the manufacturer's works in presence of Purchaser's representative before the dispatch of the materials to the site.

14.5.1.4. Routine Tests shall mean those tests which are to be carried out on each of the Insulator to check requirements which are likely to vary during production. These tests shall be carried out by the manufacturer on each insulator and shall have to furnish these reports to the Purchaser's representative during his visit for acceptance tests.

14.5.1.5. Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the supplier to ensure the desired quality of the end. product to be supplied by him, including all Quality Control checks and Raw Materials testing.

14.5.1.6. The standards to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as specified as mutually agreed between the Bidder and the purchaser in the Quality Assurance Programme.

14.5.1.7. For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in the "Guaranteed Technical Particulars", of his proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

TYPE TEST:- The type test reports obtained from CPRI/ ERDA/ Govt. owned NABL Lab are acceptable.

14.5.2 On the complete composite Insulator with Hardware Fittings:

a) Power frequency voltage withstand test with corona control rings /grading ring and arcing horns under wet condition IEC:383-1993

b) Impulse voltage withstand test under dry condition.-IEC:3831993

c) Wet switching Impulse withstand voltage.- For 400KV only IEC:61109-1992

d) Salt-fog pollution withstand test - Annexure-A

e) Grading device test- Applicable to 220KV and above voltage class

f) Electrical Field Modeling test (EFM) - Applicable to 220KV and above voltage class

g) Power arc test- Applicable to 220KV and above voltage class

All the above type test shall be conducted on Single 'I' suspension and Double tension insulator along with hardware fittings. (Separate test results for 220kV 90kN & 220kV 120kN and 110kV Insulators are to be submitted)

14.5.3. On Composite Insulator Units

(a) Tests on interfaces and connections IEC:61109-1992

i) Dry Power Frequency Voltages Test

ii) Sudden Load Release Test

iii) Thermal Mechanical Test

iv) Water immersion

v) Steep Front Impulse Voltage Test

(b) Assembled Core Load -Time Tests- IEC:61109-1992

i) Average Falling Load of the Core of the assembled Insulator

ii) Control of the slope of the strength-time curve of the Insulator

(c) Test of Housing IEC:61109-1992

i) Tracking and Erosion test.

(d) Test for the Core Material IEC:61109-1992

I) Dye Penetration Test

ii) Water Diffusion Test

(e) Brittle fracture resistance test -Annexure-A

(f) Multi stress test for 5000 hours as per Annex C-IEC:1109

(g) Mechanical load time test IEC:61109-1992 Clause 6.4

14.5.4. On Silicone material:-

(a) Flammability test IEC:61109-Amd.1**or** Test as per UL94.

(b) Recovery of Hydrophobicity test- Annexure-A

(c) Silicon Content

14.6. Acceptance Tests:- Acceptance tests shall be performed per ANSI C29.11, IEC: 611091992 and KSEBL Specifications.

a) Verification of Dimensions

b) Verification of Locking System

c) Verification of tightness of interface between end fittings and insulator housing and of specified mechanical load.

d) Galvanizing Test

e) Silicone content test.

f) Tracking & Erosion Test as per IEC:60587 1A4.5.

g) Dye Penetration Test

h) Brittle Fracture Resistance Test

The tests at (e) and (f) above shall be performed on weather shed cut from insulators one from each type offered for inspection in each lot. The test (g) above shall be performed on one additional sample randomly selected from each type offered for inspection in each lot by clearing housing material. The test (h) above shall be performed on one additional sample randomly selected from each type offered for inspection in each lot by clearing housing material. The prepared sample shall be properly signed & sealed by KSEBL inspector & test shall be performed at NABL accredited laboratory. Report shall be submitted in original to KSEBL for the verification and issuing of dispatch clearance to the consignee.

The Insulators used for (c) above shall be disposed by cutting insulators in pieces in presence of purchaser Inspector. In the event of failure of the sample to satisfy the acceptance test(s) specified in 14.6 above, the retest procedure shall be as per IEC61109.If the bidder is not having facility for in-house testing, the tests shall be carried out at third party NABL laboratory, and the report shall be submitted.

14.7 **Routine Tests:-** The following tests shall be performed on every insulator produced as per IEC:61109-1992.

(a) Mechanical Test: Every insulator shall withstand for a period not less than 1 0 seconds a tensile load equal to or greater than its Routine Test Load (50% of the Specified Mechanical Load).

(b) Visual Examination: Every insulator shall be examined to ensure its conformance to the manufacturer's drawing. Superficial polymer surface defects of an area less than 25square millimeters (total area not to exceed 2% of total Insulator surface area) and depth less than 1 mm shall be acceptable.

14.8. Tests during Manufacture:- On all components as applicable

(a) Chemical analysis of Zinc used for galvanizing Annexure-A

(b) Chemical analysis, Hardness test and Magnetic

Particle inspection for forgings Annexure-A

(c) Tracking and erosion test on insulating material IEC: 60587

14.9. Additional Tests:-

14.9.1. The Purchaser reserves the right of getting done any other test(s) of reasonable nature carried out at Purchaser's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications. In such case all the expenses will be to Suppliers account.

14.9. Sample Batch for Type

14.9.1. The Bidder shall offer at least 10% of the ordered quantity or 300 nos. whichever is higher, for selection of samples required for conducting all the type tests.

14.9.2. The Bidder is required to carry out all the acceptance tests successfully in the presence of Purchaser's representative before dispatch of the selected sample to the testing laboratory for type test.

15.0. TEST REPORTS:-

15.1. Copies of type test reports shall be furnished in at least two (2) copies along with one original. One copy shall be returned duly certified by the purchaser only after which the material already inspected i.e. the materials manufactured for selection of sample for type test, shall be dispatched on receipt of Dispatch Instructions from the Chief Engineer (SCM), KSEBL, Corporate Office, Vydyuthi Bhavanam, Thiruvananthapuram.

15.2 Record of routine test reports shall be maintained by the Bidder at hisorks for periodic inspection by the purchaser's representative.

15.3. Test Certificates of test during manufacture shall be maintained by the Bidder. These shall be produced for verification as and when desired by the Purchaser.

16.0. TEST FACILITIES:-

16.1. The following additional facilities shall be available at Supplier's works:-

a) Calibration Reports from Government approved testing laboratory of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.

b) Finished insulator shall be checked for dimension verification and surface finish separately.

c) The bidder should have all the routine and acceptance testing facilities, in house **in accordance with IEC: 383 & 61109.Manufacturers of foreign origin shall, in addition to theabove, also have arrangements in India, either at works of their authorized representative/licenses or in the NABL Testing:- lab. like CPRI, IISC, ERDA etc. for conducting sampling test in accordance with IEC : 383 & 1109.**

17.0. QUALITY ASSURANCE PLAN:-

17.1. The bidder shall invariably furnish following information along with his offer, failing which his offer shall be rejected.

i) Statement giving list of important raw materials, proposed to be used in the manufacture of the insulator against this Specification, names of sub suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in presence of Bidder's representative as routine and / or acceptance during production and on finished goods, copies of test certificates.

ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

iii) The Purchaser reserves the right for factory inspection to verify the facts quoted in the offer. If any of the facts are found to be misleading or incorrect the offer of that Bidder will be out rightly rejected and he may be black listed.

iv) Special features provided to make it maintenance free.

v) Bidder shall also submit the Field Quality Plan (FQP) along with Technical Bid.

17.2. The bidder shall also submit following information to the purchaser along with the technical Bid.

i) List of raw materials as well as bought out accessories, and the name of suppliers of raw materials as well as bought out accessories.

ii) Type test certificates of the raw material and bought out accessories.

iii) Quality assurance plan (QAP) with hold points for purchaser's inspection.

17.3. The Bidders shall submit the routine test certificates of all the bought out items, accessories etc.

18.0. DOCUMENTATION:-

18.1. Two sets of type test reports, duly approved by the Purchaser shall be submitted by the Bidder, before commencement of supply. A copy of acceptance and routine test certificates, duly approved by the purchaser shall accompany the dispatch consignment.

18.2. **The bidder shall submit the detailed drawings in triplicate for the offered insulators well within the commencement period for approval.**

The manufacturing of the insulator shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the insulator prior to the approval of the drawing shall be at supplier's risk.

18.3. Approval of drawings etc. by the purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The insulator shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards in vogue on the day of opening of the Technical Bid and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance there with.

19.0. DRAWINGS:-

All the bidders have to submit the detailed drawings for Composite long rod (Silicon Rubber) insulator with the offer. In the event of an order the successful bidder shall submit the drawings stated above in triplicate for approval during the commencement period to CE (SCM) KSEBL. The set of approved drawings shall be submitted in soft copy in Auto CAD format.

20.0. DEVIATIONS:-

20.1 Any deviation to this tender Specification will be out rightly rejected. All the Bidders have to submit this specification duly authenticated without any alterations, additions etc. on each page along with the Technical Bid. Any offer without this will be out rightly rejected.

21.0. MAINTENANCE:-

The insulator shall be capable of high pressure washing at a maximum nozzle pressure of 550psi. The insulators offered shall be suitable for employing Hot Line Maintenance Techniques with required speed, ease and safety.

Sd/-
Chief Engineer (SCM)

ANNEXURE-A

1. 0. Tests on Complete composite Insulator with Hardware Fittings.

1.1. **Salt - fog pollution withstand test:-**

This test shall be carried out in accordance with IEC-60507. The salinity level for composite long rod insulators shall be 160 Kg / m3NACL.

2.0 Composite Long rod Insulator Units-

2.1. **Brittle Fracture Resistance Test:-**

Assembled core with container in middle that contains 1 N HNO3concentric acid, covering the naked rod. The rod should be held at80% of SML for the duration of the test. The rod should not fail within the 96 hour test duration.

2.2 **Recovery of Hydrophobicity Test:-**

(1) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the HC classification. Dry the sample surface.

(2) Treat the surface with corona discharges to destroy the hydrophobicity. This can be done utilizing a high frequency corona tester. Holding the electrode approximately 3 mm from the sample surface slowly move the electrode over an area approximately 1'' x 1''. Continue treating this area for 2-3minutes, operating the tester at maximum output.

(3) Immediately after the corona treatment, spray the surface with water and record the HC classification. The surface should be hydrophilic with an HC value of 6 to 7. If not, dry the surface and repeat the corona treatment for a longer time until an HC of 6 or 7 is obtained. Dry the sample surface.

(4) Allow the sample to recover and repeat the hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

2.3. **Silicone Content Test:-**

Minimum content of silicone as guaranteed by supplier shall be verified through FT-IR spectroscopy & TGA analysis or any other suitable method mutually agreed between KSEBL and supplier Quality Assurance Plan.

3.0. Test on All components (As applicable):-

3.1. Chemical Analysis of Zinc used for Galvanizing. Samples taken from the zinc ingot shall be chemically analyzed as per IS 209-1979. The purity of zinc shall not be less than 99.95%.

3.2 **Tests for Forgings:-**

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Owner in Quality Assurance Programme.

3.3. **Tests on Castings:-**

The chemical analysis, mechanical and metallographic tests and magnetic, particle inspection for castings will be as per the internationally recognized procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Owner in Quality Assurance Programme.

4.0. Grading device test:

4.1. In addition to the electrical design tests, for 220 KV & above class insulator design with applicable grading device test, similar to the following described test:

Grading devices shall be tested using a mechanical shaker with at least a one inch stroke at the grading device and a frequency of no less than three cycles per second for a duration of 2,000,000 cycles. Movement shall be along the long axis of the insulator. The grading device

shall be attached to the shaker in a vertical position. The test shall be considered successful if no movement is detected in the ring with respect to the insulator and there is no physical damage to the grading device and the attachment assembly.

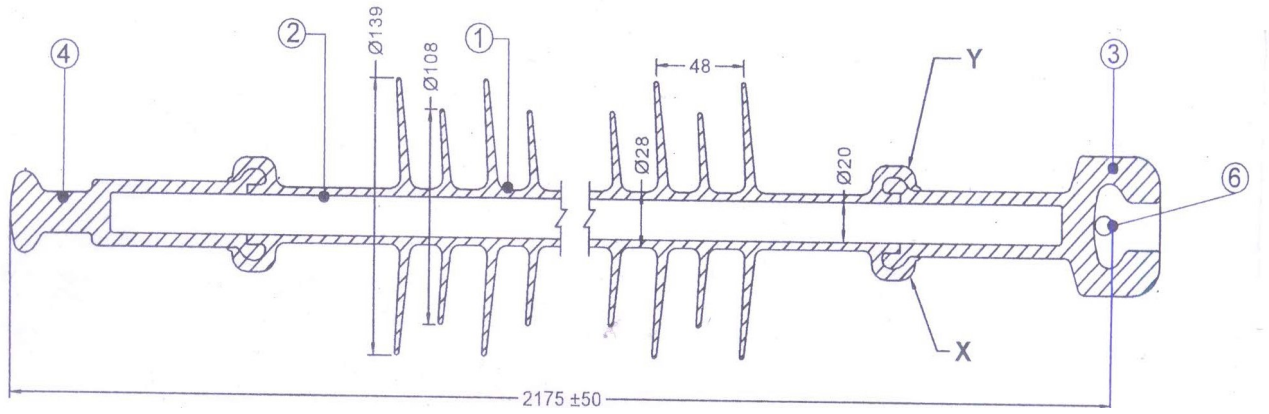
The manufacturer should provide with documentation that the insulator design with applicable grading devices will minimize or eliminate corona discharge activity under wet and dry conditions.

5.0. **Power Arc Test:-**

5.1. One insulator having any one design of end fittings shall be tested for power arc endurance while tensioned horizontally at 3000lb. An arc shall be initiated across the insulator by means of a Copper shorting fuse wire. The arc shall burn 15 to 30 cycles and its current magnitude is determined by ampere- time product (I x T) equal to a minimum of 150kA cycles. Each insulator is only acceptable if there is no exposure of the core, no mechanical separation of the insulator, and no cracks in the housing (As per IEC61467-1997).

Sd/-
Chief Engineer (SCM)

Drawing of 220kV, 120kN Composite Polymer (Tension) Insulator

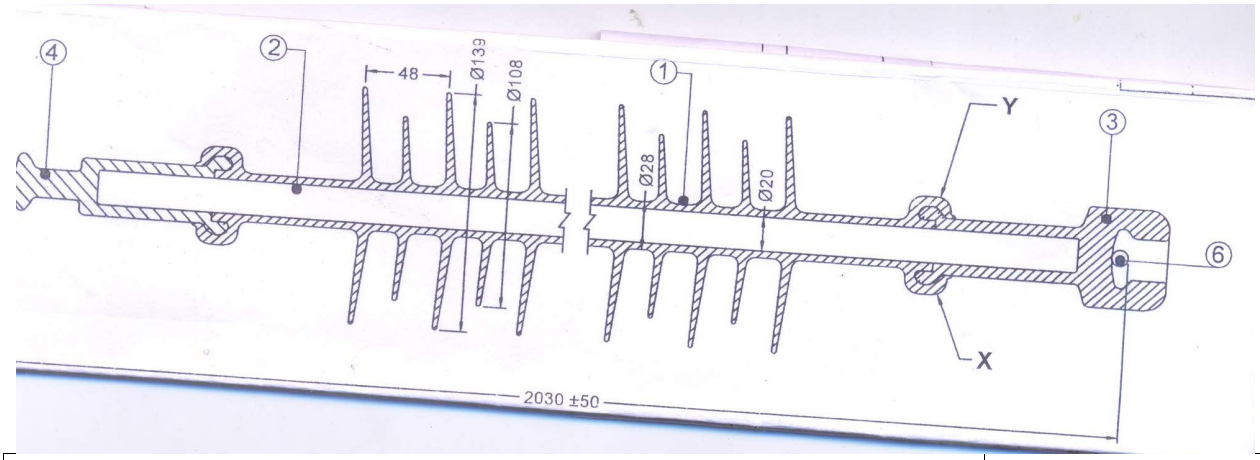


	TECHNICAL PARTICULARS Compliance to IEC 61109 Ed.2.0 & IEC 62217		IEC 60815 Class IV
			120kN
1)	Mechanical Characteristics		
	Specified Mechanical Load	KN	120
	Routine Test Load	KN	60
2)	Dimensional Characteristics		
	Section Length	mm	2175+/-50
	Creepage Distance Min.	mm	7595
	Dry Arc Distance	mm	1933
	Diameter of FRP Rod	mm	Greater than or equal to 20mm
3)	Electrical Characteristics		
	Nominal System Voltage	kV	220

	Highest System Voltage	kV	245
	Wet P.F.Withstand Voltage	kV	≥ 460
	Dry Impulse Withstand Voltage	kV	≥ 1050
	Radio Influence Voltage	kV	≥ 154
4)	End Fitting Details		
	Ball End Fittings – Forged Steel	IEC60120	20
	Socket End Fittings – SG Iron	IEC 60120	20

1)	Silicone Shed Class IV	Silicone	1
2)	ROD	FRP	1
3)	Socket Fitting	S.G.I	1
4)	Ball Fitting	Forged Steel	1
5)	Security Clip	S.S	1

Drawing of 220kV, 90kN Composite Polymer (Suspension) Insulator

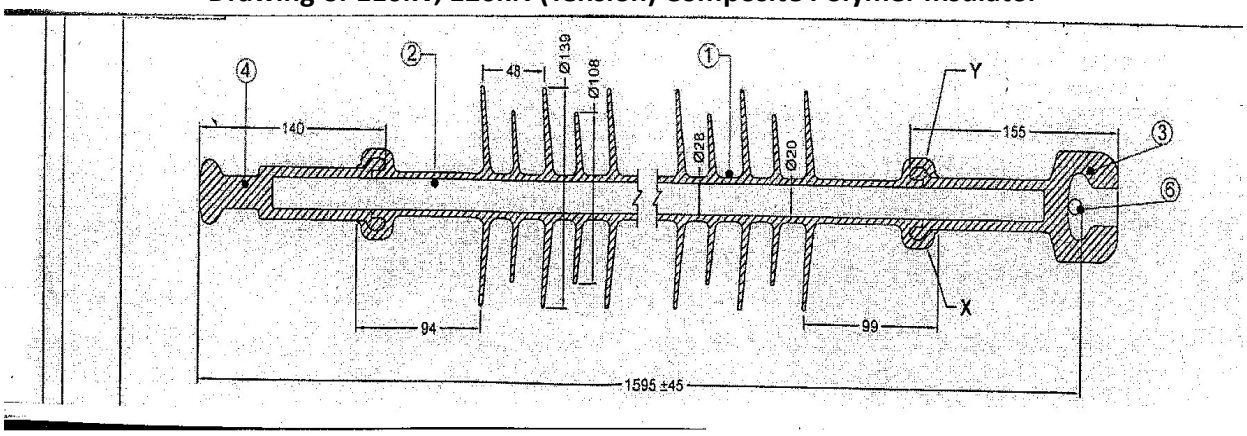


	TECHNICAL PARTICULARS Compliance to IEC 61109 Ed.2.0 & IEC 62217		IEC 60815 Class IV
			90kN
1)	Mechanical Characteristics		
	Specified Mechanical Load	KN	90
	Routine Test Load	KN	45
2)	Dimensional Characteristics		
	Section Length	mm	2030 +/-50
	Creepage Distance Min.	mm	7595
	Dry Arc Distance	mm	1837
	Diameter of FRP Rod	mm	Greater than or equal to 20mm
3)	Electrical Characteristics		
	Nominal System Voltage	kV	220
	Highest System Voltage	kV	245
	Wet P.F.Withstand Voltage	kV	≥ 460
	Dry Impulse Withstand Voltage	kV	≥ 1050

	Radio Influence Voltage	kV	≥ 154
4)	End Fitting Details		
	Ball End Fittings – Forged Steel	IEC 60120	16
	Socket End Fittings – SG Iron	IEC 60120	16

1)	Silicone Shed Class IV	Silicone	1
2)	ROD	FRP	1
3)	Socket Fitting	S.G.I	1
4)	Ball Fitting	Forged Steel	1
5)	Security Clip	S.S	1

Drawing of 110kV, 120kN (Tension) Composite Polymer Insulator

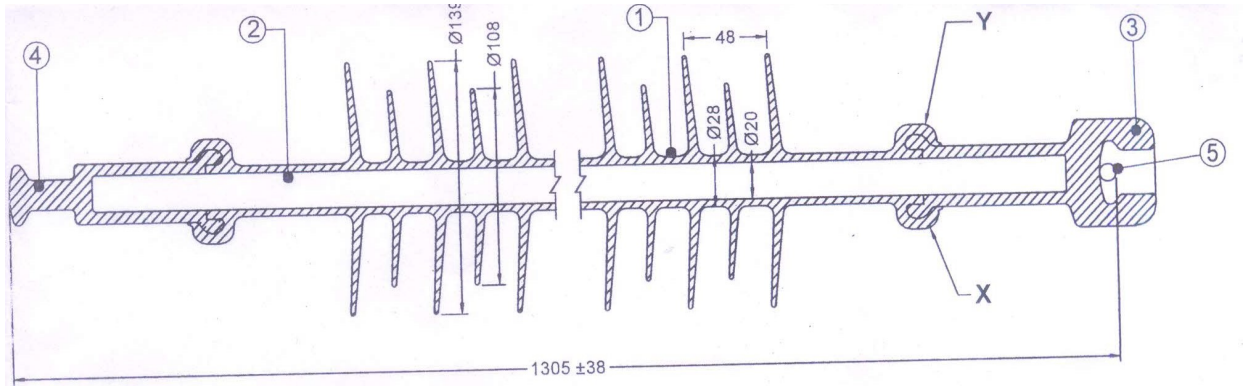


TECHNICAL PARTICULARS Compliance to IEC 61109 Ed.2.0 & IEC 62217			IEC 60815 120kN
Drawing Number			0 985 518
1)	**Mechanical Characteristics**		
	Specified Mechanical Load	KN	120
	Routine Test Load	KN	60
2)	**Dimensional Characteristics**		
	Section Length	mm	1595 +/- 45
	Creepage Distance Min.	mm	4750
	Protected Creepage	mm	2354
	Dry Arc Distance	mm	1420
3)	**Electrical Characteristics**		
	Nominal System Voltage	kV	132
	Highest System Voltage	kV	145
	Wet P.F. Withstand Voltage	kV	325

	Dry Impulse Withstand Voltage	kV	750
	Radio Influence Voltage	kV	105
4)	**End Fitting Details**		
	Ball End Fittings – Forged Steel	IEC 60120	20
	Socket End Fittings – SG Iron	IEC 60120	20

1)	Silicone Shed	Silicone	1
2)	ROD	FRP	1
3)	Socket Fitting	S.G.I	1
4)	Ball Fitting	Forged Steel GR EN&D	1
5)	Corona Ring	Aluminium Alloy	1
6)	Security Clip	S.S	1

Drawing of 110kV, 90kN (Tension) Composite Polymer Insulator

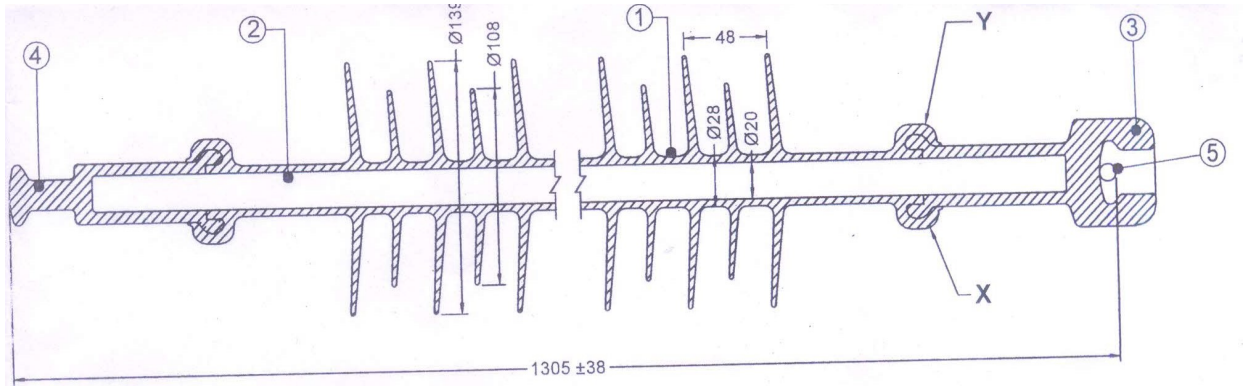


	TECHNICAL PARTICULARS Compliance to IEC 61109 Ed.2.0 & IEC 62217		IEC 60815 Class IV
			90kN
1)	Mechanical Characteristics		
	Specified Mechanical Load	KN	90
	Routine Test Load	KN	45
2)	Dimensional Characteristics		
	Section Length	mm	1305 +/-38
	Creepage Distance Min.	mm	4495
	Dry Arc Distance	mm	1123
	Diameter of FRP Rod	mm	Greater than or equal to 20mm
3)	Electrical Characteristics		
	Nominal System Voltage	kV	110
	Highest System Voltage	kV	145
	Wet P.F.Withstand Voltage	kV	≥ 275
	Dry Impulse Withstand Voltage	kV	≥ 650

	Radio Influence Voltage	kV	≥ 105
4)	End Fitting Details		
	Ball End Fittings – Forged Steel	IEC60120	16
	Socket End Fittings – SG Iron	IEC 60120	16

1)	Silicone Shed Class IV	Silicone	1
2)	ROD	FRP	1
3)	Socket Fitting	S.G.I	1
4)	Ball Fitting	Forged Steel	1
5)	Security Clip	S.S	1

Drawing of 110kV, 70kN (Suspension) Composite Polymer Insulator



	TECHNICAL PARTICULARS Compliance to IEC 61109 Ed.2.0 & IEC 62217		IEC 60815 Class IV
			70kN
1)	Mechanical Characteristics		
	Specified Mechanical Load	KN	70
	Routine Test Load	KN	35
2)	Dimensional Characteristics		
	Section Length	mm	1305 +/-38
	Creepage Distance Min.	mm	4495
	Dry Arc Distance	mm	1123
	Diameter of FRP Rod	mm	Greater than or equal to 20mm
3)	Electrical Characteristics		
	Nominal System Voltage	kV	110
	Highest System Voltage	kV	145
	Wet P.F.Withstand Voltage	kV	≥ 275
	Dry Impulse Withstand Voltage	kV	≥ 650

	Radio Influence Voltage	kV	≥ 105
4)	End Fitting Details		
	Ball End Fittings – Forged Steel	IEC60120	16
	Socket End Fittings – SG Iron	IEC 60120	16

1)	Silicone Shed Class IV	Silicone	1
2)	ROD	FRP	1
3)	Socket Fitting	S.G.I	1
4)	Ball Fitting	Forged Steel	1
5)	Security Clip	S.S	1

Sd/-
Chief Engineer (SCM)

GUARANTEED TECHNICAL PARTICULARS OF

220kV 120kN/90kN Tension / Suspension type Silicone Rubber Housed composite long rod polymer insulator

Sl. No.	Description	Unit	220kV, 120kN Tension	220kV, 90kN Suspension
1.	Manufacturer			
2.	Country of Origin			
3.	Insulator type (e.g. Ball & Socket)			
4.	Voltage Level (kV)			
5.	Guaranteed Mechanical Load (in kN)			
6.	Standard according to which the insulators will be manufactured and tested			

7.	Name of material used in manufacture of insulator with class/ grade			
8.	Material of core (FRP rod)			
	i) E-glass of ECR glass			
	ii) Boron content			
9.	Material of Housing & weather – sheds (Silicon content by weight)			
10.	Whether Housing material is moulded to cover the interface between the end fittings and the FRP rod			
11.	Material End Fitting			
12.	Sealing compound for end fittings			

13.	Colour			
14.	Type of Locking device and its material (Clip of SS/Phos. Bronze or better)			
15.	Electrical Characteristic			
16.	Nominal system voltage	KV		
17.	Highest system voltage	KV		
18.	Dry power frequency withstand voltage	kV(rms)		
19.	Wet power frequency withstand voltage	kV(rms)		
20.	Dry Flashover Voltage	kV(rms)		

21.	Wet Flashover voltage	kV(rms)		
22.	Dry lighting impuse withstand voltage	kVp		
	I) Positive			
	ii) Negative			
23.	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition	kV(rms		
24.	Total Minimum Creepage Distance	Mm		
25.	Mechanical Characteristics			

26.	Minimum failing load	KN		
27.	Dimensions of insulators			
28.	Weight	Kgs		
29.	Diameter of FRP rod	mm		
30.	Length of FRP rod	mm		
31.	Dia Weather – Shed	mm		
32.	Thickness of Housing	mm		
33.	Dry arc distance	mm		

34.	Length of AF insulator string for 220/110kV Tension/ Suspension location	mm		
35.	Length of Insulator (in mm)			
36	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/ compression moulding)			
37.	No of weather sheds	Nos		
38.	Type of sheds			
39.	Aerodynamic			
40.	With under-rubs			
41.	Packing details			

42.	Type of packing			
43.	No of insulator in each pack			
44.	Gross weight of package	Kgs		

110kV 120kN Tension type Silicone Rubber Housed composite long rod polymer insulator

Sl. No.	Description	Unit	110 kV 120kN Tension
1.	Manufacturer		
2.	Country of Origin		
3.	Insulator type (e.g. Ball & Socket)		
4.	Voltage Level (kV)		
5.	Guaranteed Mechanical Load (in kN)		
6.	Standard according to which the insulators will be manufactured and tested		
7.	Name of material used in manufacture of insulator with class/ grade		
8.	Material of core (FRP rod)		
	i) E-glass of ECR glass		
	ii) Boron content		

9.	Material of Housing & weather – sheds (Silicon content by weight)		
10.	Whether Housing material is moulded to cover the interface between the end fittings and the FRP rod		
11.	Material End Fitting		
12.	Sealing compound for end fittings		
13.	Colour		
14.	Type of Locking device and its material (Clip of SS/Phos. Bronze or better)		
15.	Electrical Characteristic		
16.	Nominal system voltage	KV	
17.	Highest system voltage	KV	
18.	Dry power frequency withstand voltage	kV(rms)	
19.	Wet power frequency withstand voltage	kV(rms)	
20.	Dry Flashover Voltage	kV(rms)	

21.	Wet Flashover voltage	kV(rms)	
22.	Dry lighting impuse withstand voltage	kVp	
	I) Positive		
	ii) Negative		
23.	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition	kV(rms	
24.	Total Minimum Creepage Distance	Mm	
25.	Mechanical Characteristics		
26.	Minimum failing load	KN	
27.	Dimensions of insulators		
28.	Weight	Kgs	
29.	Diameter of FRP rod	mm	
30.	Length of FRP rod	mm	
31.	Dia Weather – Shed	mm	
32.	Thickness of Housing	mm	

33.	Dry arc distance	mm	
34.	Length of AF insulator string for 220/110kV Tension/ Suspension location	mm	
35.	Length of Insulator (in mm)		
36	Method of fixing of sheds to housing		
	i) Single mould		
	ii) Modular construction		
	(injection moulding/ compression moulding)		
37.	No of weather sheds	Nos	
38.	Type of sheds		
39.	Aerodynamic		
40.	With under-rubs		
41.	Packing details		
42.	Type of packing		

43.	No of insulator in each pack		
44.	Gross weight of package	Kgs	

110kV 90kN & 70KN Tension/ Suspension type Silicone Rubber Housed composite long rod polymer insulator

Sl. No.	Description	Unit	110kV 90kN Tension	110 kV 70kN Suspension
1.	Manufacturer			
2.	Country of Origin			
3.	Insulator type (e.g. Ball & Socket)			
4.	Voltage Level (kV)			
5.	Guaranteed Mechanical Load (in kN)			
6.	Standard according to which the insulators will be manufactured and tested			
7.	Name of material used in manufacture of insulator with class/ grade			
8.	Material of core (FRP rod)			

	i) E-glass of ECR glass			
	ii) Boron content			
9.	Material of Housing & weather – sheds (Silicon content by weight)			
10.	Whether Housing material is moulded to cover the interface between the end fittings and the FRP rod			
11.	Material End Fitting			
12.	Sealing compound for end fittings			
13.	Colour			
14.	Type of Locking device and its material (Clip of SS/Phos. Bronze or better)			

15.	Electrical Characteristic			
16.	Nominal system voltage	KV		
17.	Highest system voltage	KV		
18.	Dry power frequency withstand voltage	kV(rms)		
19.	Wet power frequency withstand voltage	kV(rms)		
20.	Dry Flashover Voltage	kV(rms)		
21.	Wet Flashover voltage	kV(rms)		
22.	Dry lighting impuse withstand voltage	kVp		
	I) Positive			
	ii) Negative			

23.	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition	kV(rms		
24.	Total Minimum Creepage Distance	Mm		
25.	Mechanical Characteristics			
26.	Minimum failing load	KN		
27.	Dimensions of insulators			
28.	Weight	Kgs		
29.	Diameter of FRP rod	mm		
30.	Length of FRP rod	mm		

31.	Dia Weather – Shed	mm		
32.	Thickness of Housing	mm		
33.	Dry arc distance	mm		
34.	Length of AF insulator string for 220/110kV Tension/ Suspension location	mm		
35.	Length of Insulator (in mm)			
36	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/ compression moulding)			
37.	No of weather sheds	Nos		
38.	Type of sheds			
39.	Aerodynamic			

40.	With under-rubs			
41.	Packing details			
42.	Type of packing			
43.	No of insulator in each pack			
44.	Gross weight of package	Kgs		