Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	15-SDMS-02 Rev. 01
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15-SDMS-02

REV. 01

SPECIFICATION

FOR

OVERHEAD LINE POLYMER INSULATORS

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1.0 SCOPE

This SEC Distribution Materials Specification (SDMS) specifies the minimum technical requirement for design, materials, manufacturing, testing, and performance of the following polymer insulators:

1.1 13.8 & 33 KV Line post type insulators.

1.2 13.8 & 33 KV Suspension/Tension type insulators.

1.3 13.8 & 33 KV Interphase Spacer type insulators.

These insulators are intended to be used in the overhead line distribution system of the Saudi Electricity Company (SEC) mainly in coastal and highly polluted areas.

2.0 CROSS REFERENCES

2.1 This SDMS shall always be read in conjunction with SEC General Specification No. 01-SDMS-01 (Latest Revision) titled General Requirements for all Equipment/Materials, which shall be considered as an integral part of this SDMS.

2.2 For service conditions/system parameters refer to SEC General Specification No. 01-SDMS-01 (Latest Revision).

2.3 This SDMS shall also be read in conjunction with SEC Purchase Order or Contract Schedules and the Scope of Work and Technical Specifications for projects, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/material covered in this SDMS. In case of any deviation, the vendor/ manufacturer may propose equipment/ material, conforming to an alternate code or standard.

However, the provisions of SEC standards shall supersede the provisions of these alternate standards in case of any difference.

IEC 60273	Characteristics of Indoor and Outdoor Post Insulators for Systems With Nominal Voltages Greater than 1000V.
IEC 60437	Radio Interference Test on High Voltage Insulators.
IEC 60471	Dimensions of Clevis and Tongue Couplings of String Insulator Units.
IEC 60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC 60575	Thermal – Mechanical Performance Test and Mechanical Performance Test on string insulator units.
IEC60720	Characteristics of line post insulators.
IEC /TS 60815-1	Selection and dimensioning of high voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and principles.
IEC /TS 60815-3	Selection and dimensioning of high voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a. c. systems.
IEC 60587	Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion.
IEC 61109	Insulators for overhead lines – composite suspension and tension Insulators for AC systems with nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria.
IEC 61466-1	Composite String Insulator Units for Overhead lines with Nominal Voltage Greater Than 1000V – Part 1: Standard Strength Classes and End Fittings.
IEC 61466-2	Composite String Insulator Units for Overhead Lines with Nominal Voltage Greater Than 1000V-Part 2: Dimensional and electrical characteristics.

IEC 61467	Insulators for overhead lines-Insulator strings and sets for lines with nominal voltage greater than 1000V-AC power arc tests.
IEC 61952	Insulators for overhead lines – Composite line post insulators for A. C. systems with a nominal voltage greater than 1000V-Definitions, test methods and acceptance criteria.
IEC TS 62073	Guidance on the measurement of wettability of insulator surfaces.
IEC 62217	Polymeric HV insulators for indoor and outdoor use– General definitions, test methods and acceptance criteria.
IEC TR 62039	Selection guide for polymeric materials for outdoor use under HV stress.
NEMA C29.1	Test methods for electrical power insulators.
NEMA C29.13	Insulators Composite – Distribution Dead End Type.
NEMA C29.18	Insulators Composite – Distribution Line Post Type.
ASTM A153/A/153M	Standard specification for Zinc coating (Hot Dip) on iron and steel hardware.
ASTM-D2240	Standard Test Method for Rubber Property – Durometer Hardness.
BS 3288	Insulators and Conductor Fittings for Overhead Power Lines (Parts 1 and 2).
BS 729	Galvanizing.
IEEE Std. 957	IEEE Guide for Cleaning Insulators.
IEEE Std. 987	IEEE Guide for Application of Composite Insulators.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General

4.1.1 All types of insulators shall meet or exceed the requirements of this specification in all respects and shall consist of a single piece of silicon rubber together with the core and its metal parts to form a rigid assembly.

4.1.2 Manufacturer's drawings, as required in 01-SDMS-01, shall show the outline of the insulators together with all pertinent dimensions. Any variations in these dimensions due to manufacturing tolerances shall be indicated.

4.2 Design Criteria

4.2.1 Unless otherwise specified, the insulators shall be manufactured and tested in accordance with the relevant standards mentioned in clause No.3.

4.2.2 All types of insulators should be designed according to the system parameters and service conditions given in specification 01-SDMS-01.

4.2.3 All types of insulators shall have the mechanical, electrical and insulation class ratings as given in the technical data schedules of this SDMS.

4.2.4 The design shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to any deterioration. Precautions shall be taken to avoid any chemical reaction between insulator parts and fitting material.

4.2.5 Suspension/tension insulators shall be Clevis type ANSI class 52-4

4.2.6 The creepage distance shall be 40 mm/KV for all types of polymeric insulators.

4.2.7 The diameter of the polymeric insulator sheds shall not exceed 200 mm.

4.2.8 The three types of polymeric insulators (line post, suspension/tension insulators and Interphase Spacer) with creepage distance based on 40 mm/KV shall be as follows:

- With total creepage distance of 552 mm for 13.8 kV.

- With total creepage distance of 1320 mm for 33kV.

4.3 Materials

4.3.1 The complete polymeric insulators shall consist of a Fiberglass Reinforced Plastic (FRP) core having superior electrical and mechanical performance, sheath (housing), sheds and mechanical fittings.

4.3.2 To reduce the risk of brittle fracture the FRP core of polymeric insulators shall be electrical corrosion resistant (ECR) glass rod that shall achieve the specified electrical and mechanical characteristics. The FRP core shall be resistant against hydrolysis under service conditions.

4.3.3 The polymeric insulators sheath and sheds material shall have a chemical structure of 100 percent silicone rubber before adding fillers. The finished product shall be ultraviolet (UV) radiation exposure resistant. The finished product shall not be affected by atmospheric conditions due to weather, proximity to the coast, fumes, ozone, acids, alkalis, dust or rapid changes in air temperature. There should be no material degradation such as development of surface cracks and increase in surface hardness, etc.

4.3.4 Metal parts shall be made of a good commercial grade of malleable iron, ductile iron or steel, galvanized in accordance with specification 01-SDMS-01 latest revision.

4.3.5 The track resistance of the sheath and shed materials shall meet the requirements of IEC 60587 Method 1 Class 1A4.5 or 1B4.5 or Method 2 Class 2A4.5.

4.3.6 The sheath and shed materials of insulators fabricated from high temperature vulcanized silicone rubber shall have a Shore 'A" hardness of not less than 60.

4.4 Construction

4.4.1 The polymeric insulator surface shall be shaped and spaced for effective natural cleaning and effective use of creepage distance for coastal and desert conditions.

4.4.2 The polymeric insulators shall be of alternating shed design with aerodynamic type profile and without any under-ribs. Sheds shall be at intervals to provide optimum electrical performance and shed design shall provide a protected bottom surface that tends to keep dry in wet conditions.

4.4.3 The contours of the metal and polymer parts shall be such as to eliminate areas of high electrical stress concentrations.

4.4.4 The polymeric insulator core shall be electrically and mechanically sound, free of cracks and voids, foreign substances and manufacturing flaws. The design shall be such as to ensure that the core is totally encapsulated and fully sealed, from live end to earthed end, by the insulating material to prevent ingress of moisture. If any adhesive substances are used as sealers, they shall not be exposed to environmental conditions.

4.4.5 There shall be no holes or splits in the housing at any point along the length of the insulators.

4.4.6 The strength of the silicone rubber to FRP core and shed to sheath interface shall be greater than the tearing strength of the silicone rubber.

4.4.7 The insulators shall be of sufficient length to provide the required creepage distance and the electrical performance in one single unit. Inline coupling of two or more units shall not be acceptable. No radial joints shall be made along the length of the sheath regardless of the distance between end fittings. The sheath shall be extended inside the end fittings to protect and hermetically seal the fiberglass core from moisture. The interface between the FRP core and end fittings shall be sealed to effectively eliminate the possibility of moisture ingress for the life of the insulator. A level of redundancy in design shall be demonstrated.

4.4.8 The polymeric insulators thickness of the sheath or shed covering over the core shall be greater than 3.0 mm.

4.4.9 The contours of metal parts of polymeric insulators shall be such as to eliminate areas of high electrical stress concentrations.

4.4.10 The polymeric insulators shall be capable of withstanding high pressure power washing.

4.4.11 The polymeric suspension/tension/ Interphase Spacer insulator end fittings shall be designed to transmit the mechanical load to FRP core and to develop uniform and consistent mechanical strength of the insulators.

4.4.12 The polymeric insulator end fittings shall be attached to the FRP core through compression crimping process so that the end fittings uniformly transmit the mechanical load to the FRP core. The crimping process shall be controlled by a specific method such as Acoustic Emission Detector to ensure that there is no damage to the core during the compression crimping operation.

4.4.13 The end fittings of the polymeric insulators after complete assembly with the FRP core shall be coaxial with one another.

4.4.14 The insulator shall be radio interference free at operating voltage.

4.4.15 All ferrous components except those made of stainless steel shall be galvanized.

4.5 Mounting

4.5.1 Line Post Insulator

a. The line post insulator bottom and the stud shall be serrated to lock the stud against loosening due to line vibration as shown in attached drawings.

b. The stud for the line post insulator shall be hot- dip galvanized in accordance with appropriate industry standard and complete with nuts and washers for steel crossarm mounting. The size and dimensions are given in the attached drawing No. 5.

4.5.2 Suspension/Tension Insulator shall be Clevis type as shown in the attached drawing No. 6.

4.5.3 a. Interphase Spacer insulator insulating rod shall not be twisted even if the unit conductors of a multiple conductor distribution line moves in the opposite phase in the direction of the line.

e. Interphase Spacer insulator shall have a variety of end fittings options depending on the conductor clamping requirements with or without armour rod as shown in the attached drawing No. 7 and 8.

4.6 Marking

4.6.1 Each insulator shall bear permanent marking in English and/or Arabic as per ANSI or IEC Standards, use of stickers/labels is not permitted.
Following information shall be provided:

a. Manufacturer name.
b. Year of manufacturing.
c. Designation number.
d. Cantilever strength (Combined M&E strength suspension insulator).
e. Country of origin.

4.6.2 Crate Marking (English and/or Arabic):

a. Nominal System voltage.
b. Type and number of insulators (Suspension and Line post).
c. SEC purchase order number / contract number.
d. 15-SDMS-02.
e. SEC Item number.
f. Manufacturer's Catalog No.
g. Weight, Kg.
h. Manufacturer's name / Country of origin.

5.0 TESTING AND INSPECTION

All equipment shall be tested for design and type at an SEC approved independent laboratory in accordance with latest standards and as specified herein and test results shall be provided for review and acceptance by SEC.SEC reserve the right to witness any one or all the design / type tests

5.1 Design Tests

5.1.1 Suspension / Tension/ Interphase Spacer Insulators shall be tested per Clause 10 of IEC 61109

a) Tests of interface and connections of end fittings.
b) Tests on shed and housing material.
c) Tests on the core material.
d) Assembled core load-time test.

5.1.2 Post Insulators shall be tested per Clause 10 of IEC 61952)

a) Tests of interface and connections of end fittings.
b) Tests on shed and housing material.
c) Tests on the core material.
d) Assembled core load-time test.

5.2 Type Tests

5.2.1 Electrical

5.2.1.1 Suspension/ Tension /Interphase Spacer Insulators shall be tested per Clause 11.1 of IEC 61109

a) Dry lightning impulse withstand voltage test.
b) Wet power-frequency test.

5.2.1.2 Post Insulators shall be tested per Clause 11.1 of IEC 61952

a) Dry lightning impulse withstand voltage test.
b) Wet power-frequency test.

5.2.2 Mechanical

5.2.2.1 Suspension/ Tension Insulators/ Interphase Spacer shall be tested per Clause 11.2 of IEC 61109

Damage limit proof test of the tightness of the interface between end fittings and insulator housing.

5.2.2.2 Post Insulators shall be tested per Clause 11.2 of IEC 61952 Cantilever failing load test.

5.3 Sample Tests

These tests are optional and shall be performed if requested by SEC.

5.3.1 Suspension/ Tension Insulators/ Interphase Spacer shall be tested per Clause 12 of IEC 61109)

a) Verification of dimensions.
b) Verification of the locking system.
c) Verification of the tightness of the interface between end fittings and insulator housing.
d) Verification of the Specified Mechanical Load (SML).
e) Galvanizing Test.

5.3.2 Post Insulators shall be tested per Clause 12 of IEC 61952

a) Verifications of dimensions.
b) Galvanizing Test.
c) Verification of Specified Cantilever Load (SCL).

5.4 Routine Tests

5.4.1 Suspension/ Tension Insulators/ Interphase Spacer tests shall be carried out per Clause 13 of IEC 61109

a) Mechanical routine test.
b) Visual examination.

5.4.2 Post Insulators shall be tested per Clause 13 of IEC 61952
a) Tensile/cantilever load test.
b) Visual Examination.

5.5 Special Tests

5.5.1 Salt Fog Test per Clause 7 of IEC 60507 with salt concentration of 224 Kg/m^3 at 20° C.

5.5.2 Torsional Load Test per Clause 7.8 of ANSI C29.13.

5.5.3 Power Arc Test per Clause 7.5 of ANSI C29.13 for suspension/tension insulators or ANSI C29.18 for post insulators.

5.5.4 The resistance of FRP core against brittle fracture shall be proved by a test against stress corrosion. The test shall be similar to mechanical load time test per Clause 10.4.2.2 of IEC 61109 but with simultaneous application of 1mol/l nitric acid HNO_3 directly in contact with the FRP core with a length of not less than 40 mm.

5.6 Inspection

SEC may wish to witness tests or visit the factory during manufacture of any or all Items covered by this specification. Accordingly the supplier shall give the purchaser adequate notice of manufacturing program and tests to be witnessed. SEC may require certificates and data from the manufacturer/supplier on all pertinent aspects of the manufacturing process. However for detailed inspection conditions refer to the latest revision of the SEC general specification No 01-SDMS-01, clause 6 latest revision.

6.0 PACKING AND SHIPMENT

In addition to the applicable items per 01-SDMS-01 latest revision, packing and shipping of the insulators shall conform to the following:

a. All parts shall be carefully packed for transport in such a manner that they are protected against mechanical damage and climatic conditions during transportation or storage.

b. Suppliers shall contact Materials Supply Department for additional packing, handling and shipment instructions, as applicable.

c. Packing marking shall be as per clause 4.6.2 of this specification.

7.0 GUARANTEE

7.1 Supplier shall guarantee the polymeric insulators against all defects arising out of faulty design, workmanship, or defective material for a period of two (2) years from date of delivery.

7.2 If no exceptions are taken to this specification and no list of deviation is submitted, it shall be deemed that in every respect the offered insulators conform to this specification. SEC interpretation of this specification shall be accepted.

8.0 SUBMITTALS

8.1 Submittals required with tender:

8.1.1 The vendor shall complete and return one copy of the attached technical data schedule and clause by clause compliance statement to this specification with quotation.

8.1.2 Detailed dimensional drawing of insulators.

8.1.3 Type test certificates.
8.1.4 Catalogues.

8.2 Submittals required following award of contract are given below.

8.2.1 Manufacturing schedule, progress report and test schedule.

8.2.2 Test reports.

9. TECHNICAL DATA SCHEDULE

9.1 LINE POST INSULATOR 13.8 kV CREEPAGE DISTANCE 552 mm

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDER DATA
1	NOMINAL SYSTEM VOLTAGE	kV	13.8	
2	INSULATING MATERIAL		SILICONE RUBBER	
3	COLOUR OF INSULATOR		GRAY	
4	NUMBER OF SHEDS		BY VENDOR	
5	TIE TOP RADIUS SIDE TIE RADIUS NECK DIAMETER	mm mm mm	25 25 73	
6	TOTAL LENGTH	mm	305 ± 5	
7	SHED DIAMETER	mm	<200	
8	MIN. CREEPAGE /KV	mm	40	
9	TOTAL CREEPAGE DISTANCE	mm	552	
10	DRY ARCING DISTANCE	mm	241	
11	CANTILEVER STRENGTH	KN	12.5	
12	FLASH OVER VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE –VE	Kv	 110 85 180 205	
13	WITHSTAND VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE –VE	Kv	 90 65 150 150	
14	MAX. R.I. VALUE AT TEST VOLTAGE OF 22 KV	µV	100	
15	STUD SIZE		M20	
16	COMPLETE WITH STUDS		SHORT STUD	
17	WEIGHT OF INSULATOR	Kg	BY VENDOR	
18	MARKING		BY VENDOR	

9. TECHNICAL DATA SCHEDULE

9.2 LINE POST INSULATOR 33 kV CREEPAGE DISTANCE 1320 mm.

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDER DATA
1	NOMINAL SYSTEM VOLTAGE	KV	33	
2	INSULATING MATERIAL		SILICONE RUBBER	
3	COLOUR OF INSULATOR		GRAY	
4	NUMBER OF SHEDS		BY VENDOR	
5	TIE TOP RADIUS SIDE TIE RADIUS NECK DIAMETER	mm mm mm	25 25 73	
6	TOTAL LENGTH	mm	510 ± 5	
7	SHED DIAMETER	mm	<200	
8	MIN. CREEPAGE /KV	mm	40	
9	TOTAL CREEPAGE DISTANCE	mm	1320	
10	DRY ARCING DISTANCE	mm	438	
11	CANTILEVER STRENGTH	KN	12.5	
12	FLASH OVER VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE -VE	kV	 175 150 290 380	
13	WITHSTAND VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE -VE	kV	 160 135 250 250	
14	MAX. R.I. VALUE AT TEST VOLTAGE OF 44 KV	µV	200	
15	STUD SIZE		M20	
16	COMPLETE WITH STUDS		SHORT STUD	
17	WEIGHT OF INSULATOR	Kg	BY VENDOR	
18	MARKING		BY VENDOR	

9. TECHNICAL DATA SCHEDULE

9.3 SUSPENSION/TENSION / INTERPHASE SPACER INSULATOR 13.8 kV CREEPAGE DISTANCE 552 mm.

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDER DATA
1	NOMINAL SYSTEM VOLTAGE	kV	13.8	
2	INSULATING MATERIAL		SILICONE RUBBER	
3	COLOUR OF INSULATOR		GRAY	
4	NUMBER OF SHEDS		BY VENDOR	
5	TOTAL LENGTH	mm	BY VENDOR	
6	SHED DIAMETER	mm	<200	
7	MIN. CREEPAGE /KV	mm	40	
8	TOTAL CREEPAGE DISTANCE	mm	552	
9	DRY ARCING DISTANCE	mm	241	
10	TENSION STRENGTH	KN	70	
11	FLASH OVER VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE –VE	Kv	 110 85 180 205	
12	WITHSTAND VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE –VE	Kv	 90 65 150 150	
13	MAX. R.I. VALUE AT TEST VOLTAGE OF 22 KV	µV	100	
14	WEIGHT OF INSULATOR	Kg	BY VENDOR	
15	MARKING		BY VENDOR	

9. TECHNICAL DATA SCHEDULE

9.4 SUSPENSION/TENSION / INTERPHASE SPACER INSULATOR 33 kV CREEPAGE DISTANCE 1320 mm.

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDER DATA
1	NOMINAL SYSTEM VOLTAGE	KV	33	
2	INSULATING MATERIAL		SILICONE RUBBER	
3	COLOUR OF INSULATOR		GRAY	
4	NUMBER OF SHEDS		BY VENDOR	
5	TOTAL LENGTH	mm	BY VENDOR	
6	SHED DIAMETER	mm	<200	
7	MIN. CREEPAGE /KV	mm	40	
8	TOTAL CREEPAGE DISTANCE	mm	1320	
9	DRY ARCING DISTANCE	mm	438	
10	TENSION STRENGTH	KN	70	
11	FLASH OVER VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE -VE	kV	 175 150 290 380	
12	WITHSTAND VOLTAGE POWER FREQUENCY (DRY) POWER FREQUENCY (WET) IMPULSE +VE IMPULSE -VE	kV	 160 135 250 250	
13	MAX. R.I. VALUE AT TEST VOLTAGE OF 44 KV	μV	200	
14	WEIGHT OF INSULATOR	Kg	BY VENDOR	
15	MARKING		BY VENDOR	

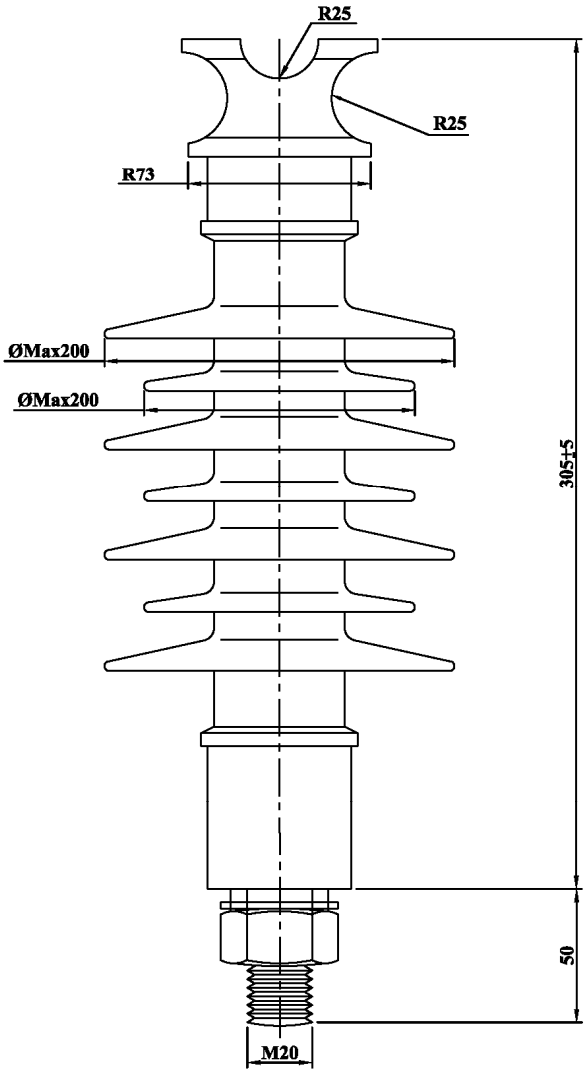


FIG.1-POST INSULATOR 13.8 KV CREEPAGE 552

Note: Number Of Sheds May Vary

All DIMENSIONS ARE IN MILLIMETERS

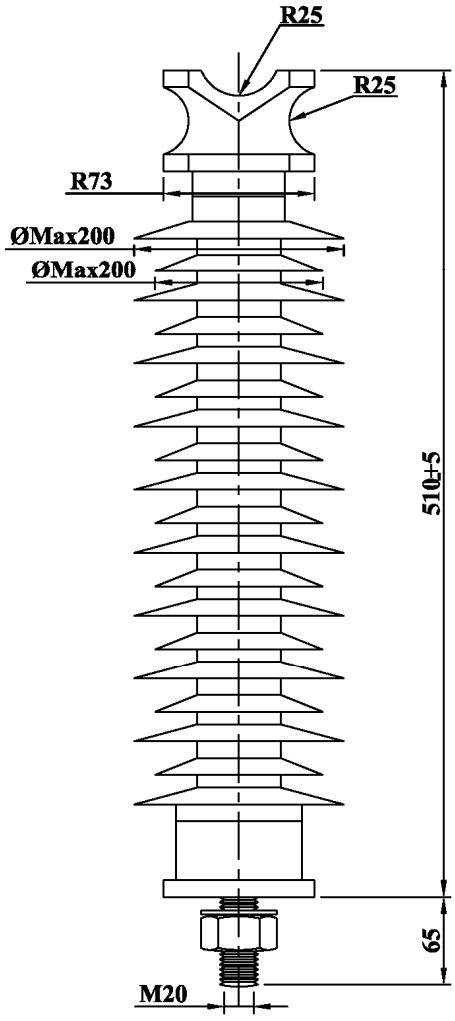


FIG.2-POST INSULATOR 33 KV CREEPAGE 1320

Note: Number Of Sheds May Vary

All DIMENSIONS ARE IN MILLIMETERS

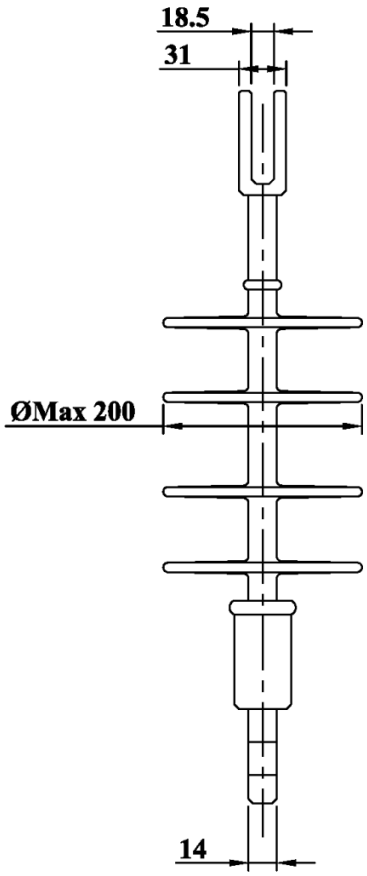


FIG.3-SUSPENSION INSULATOR 13.8 KV CREEPAGE 552

Note: Number Of Sheds May Vary

All DIMENSIONS ARE IN MILLIMETERS

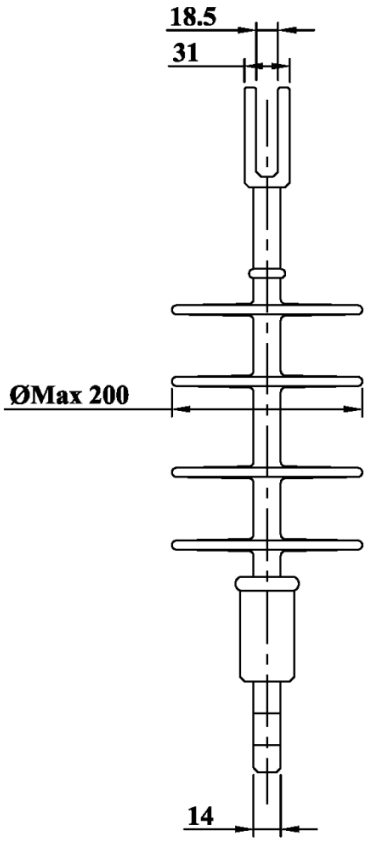


FIG.4-SUSPENSION INSULATOR 33 KV CREEPAGE 1320

Note: Number Of Sheds May Vary

All DIMENSIONS ARE IN MILLIMETERS

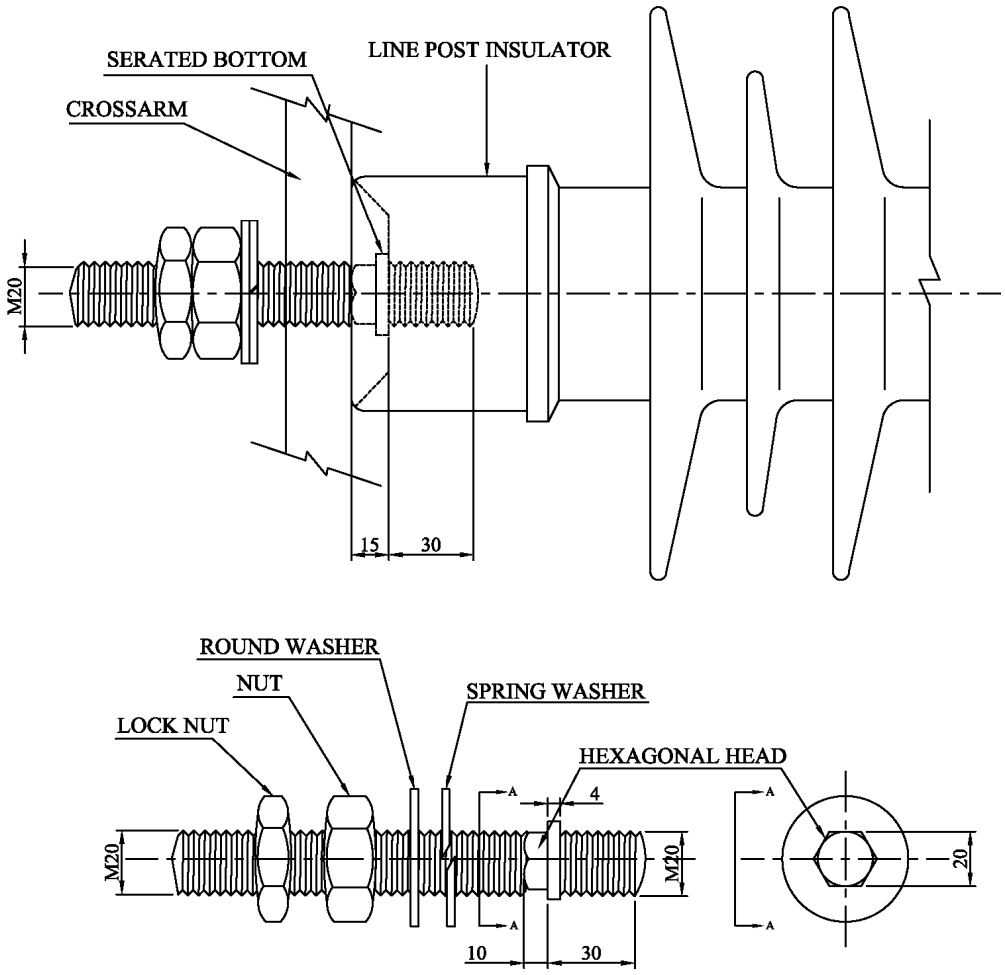
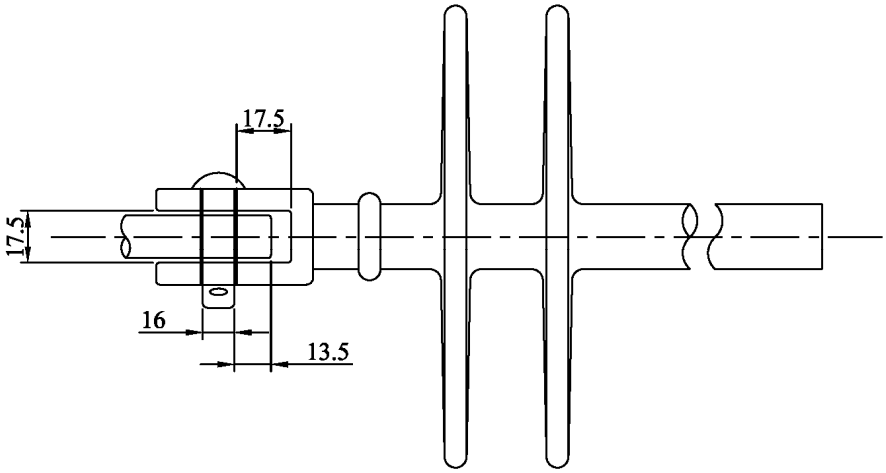
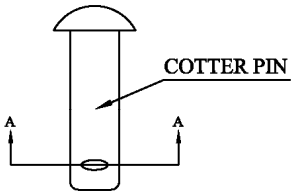
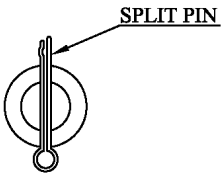


FIG.5-STEEL STUD

All DIMENSIONS ARE IN MILLIMETERS



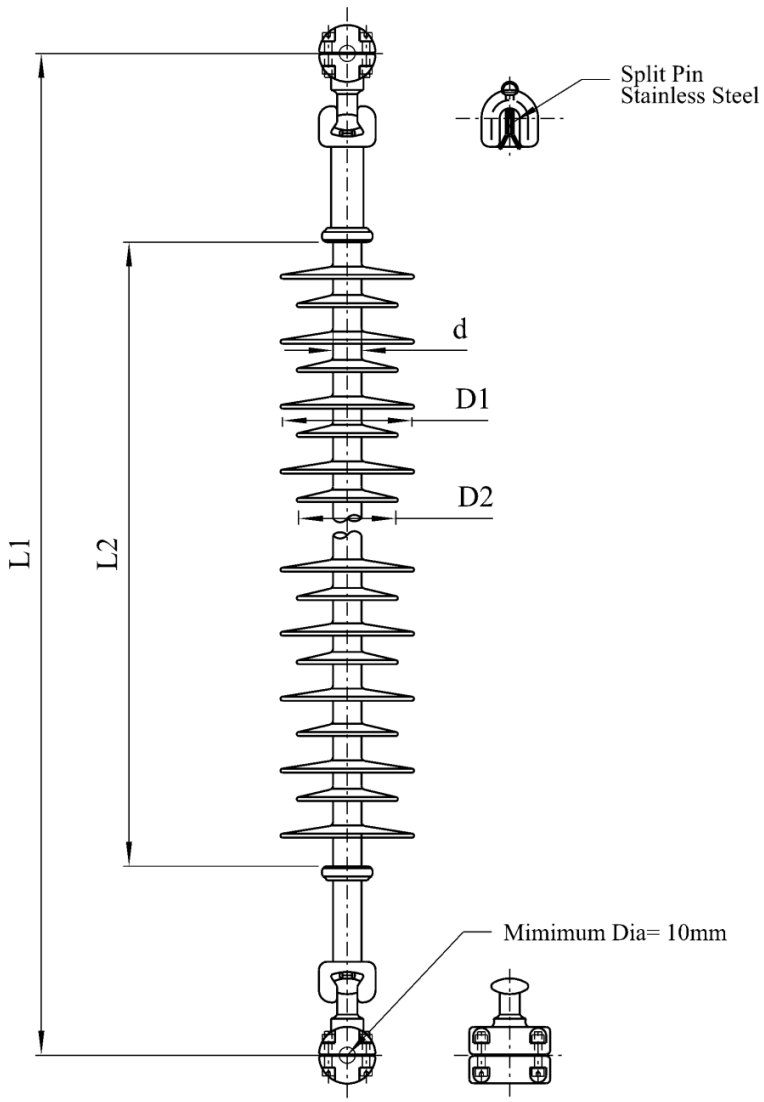




A-A SECTION
SELF LOCKING TYPE SPLIT PIN

FIG.6-SUSPENSION INSULATOR – CLEVIS TYPE

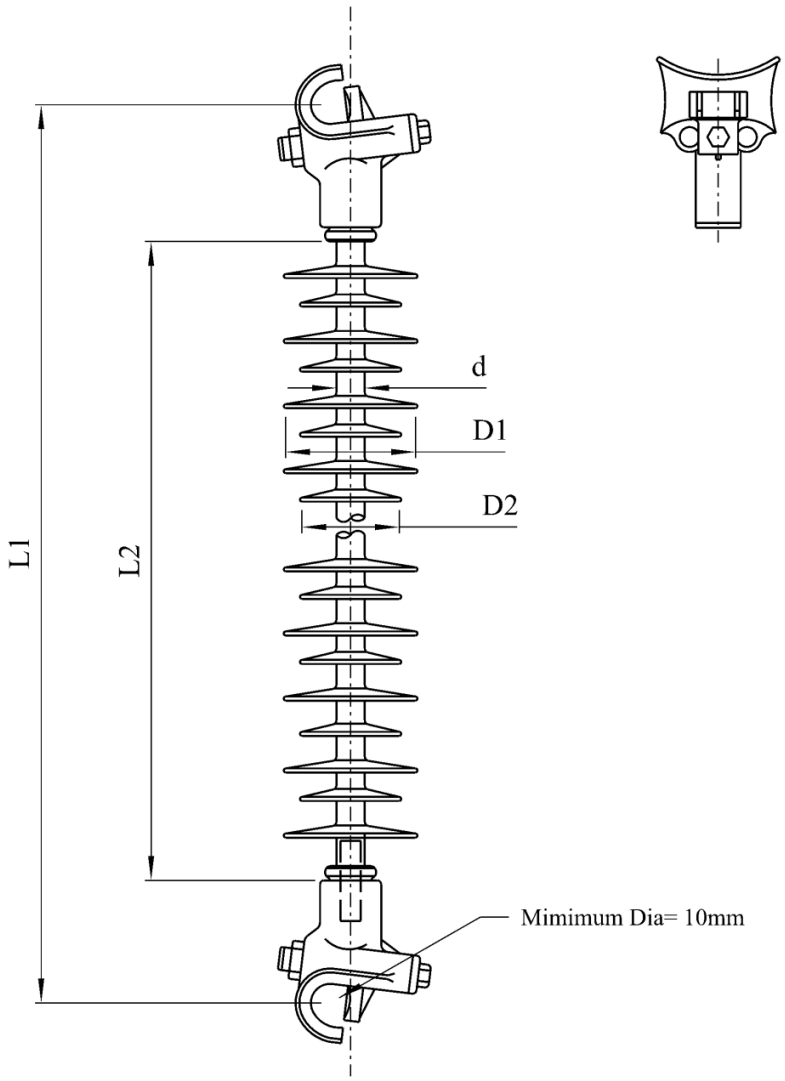
All DIMENSIONS ARE IN MILLIMETERS



Dimensions	L1	L2	D1	D2	d
Minimum	1100	630	115	100	24
Maximum	1200	720	130	100	29

FIG.7- INTERPHASE SPACER

All DIMENSIONS ARE IN MILLIMETERS



Dimensions	L1	L2	D1	D2	d
Minimum	1100	630	115	100	24
Maximum	1200	720	130	100	29

FIG.8-INTERPHASE SPACER

All DIMENSIONS ARE IN MILLIMETERS