



Kenya Power

TITLE:

**SPECIFICATION FOR 11kV
COMPOSITE PIN INSULATORS
- Coast Application**

Doc. No.

KP1/3CB/TSP/04/017 - 1

Issue No.

2

Revision
No.

0

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(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data & calculations, sales records for past five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the third party testing laboratory for tender evaluation, all in English Language)

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0.1 Circulation List

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0.2 Amendment Record

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Issue 2	2016-06-03	1. Special creepage distance for coastal installations 2. Altitudes of up to 1000m above sea level	Eng S.Nguli	Dr Eng. P. Kimemia

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FOREWORD

This specification has been prepared by the Standards Department in collaboration with Network Division and Coast Region Management all of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for 11kV composite pin insulators for coastal installations. It is intended for use by KPLC in purchasing the insulators.

The supplier shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification.

1. SCOPE

- 1.1. This specification is for composite pin insulators for use on overhead power distribution lines operating at a nominal voltage of 11kV; frequency of 50Hz and in areas which are in the direct vicinity of the coast and are exposed to sea spray or very strong and polluting winds from the sea, but in some cases, depending on topography, they can be as far as 50 km inland.
- 1.2. The specification also covers inspection and test of the insulators as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.
- 1.3. The specification stipulates the minimum requirements for 11kV composite pin insulators acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the insulators for The Kenya Power & Lighting Company Ltd.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification shall take precedence.

ISO 1461: Metallic Coatings – Hot dip galvanized coatings on fabricated ferrous products – Requirements.

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- ISO 48: Rubber, vulcanized or thermoplastic -- Determination of hardness (hardness between 10 IRHD and 100 IRHD),
- IEC 60507: Artificial pollution tests on high-voltage insulators to be used on a.c. systems
- IEC 60437: Radio interference test on high-voltage insulators
- IEC 60587: Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion
- IEC 61109: Composite insulators for a.c. overhead lines with a nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria.
- IEC 60815: Selection and dimensioning of high-voltage insulators intended for use in polluted conditions -- Part 1: Definitions, information and general principles -- Part 3: Polymer insulators for a.c. systems
- IEC 60383: Insulators for overhead lines with a nominal voltage above 1000V.

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1. Environmental conditions

The insulators shall be suitable for continuous operation outdoors in tropical areas with the following conditions:

- a) Altitudes of up to 1000m above sea level,
- b) Humidity of up to 95%,
- c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C,

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- d) Pollution: Design pollution level to be taken as “Heavy” (Pollution level III) for inland and “Very Heavy” (Pollution level IV) for coastal applications in accordance with IEC 60815.
- e) Isokeraunic level: 180 thunderstorm days per year

NOTE: The level of galvanizing for all ferrous parts and materials used shall be suitable for these conditions.

4.1.2. System requirements

The following system requirements shall be taken into account for the selection and dimensioning of outdoor insulation.

- | | |
|--|---------------------------|
| a) Type of system | Alternating Current (a.c) |
| b) Maximum operating voltage across insulation | |
| i) Phase-to-earth, $U_{ph-e} (U_m/\sqrt{3})$: | 6.9 kV |
| ii) Phase-to-phase voltage $U_{ph-ph} (U_m)$: | 12 kV |
| c) Imposed performance voltage requirements ($2.5U_m/\sqrt{3}$): | 17.5 kV |

4.2. DESIGN AND CONSTRUCTION

4.2.1. Design

- 4.2.1.1. The composite pin insulator shall be of type A in accordance with IEC 60383 and shall be designed, manufactured and tested to IEC 61109, IEC 60815-3 and other applicable /latest IEC standards and the requirements of this specification.
- 4.2.1.2. The composite pin insulator shall have a core and insulating housing and weather-shed housing both manufactured by the same manufacturer and forged steel hardware components for attaching it to the support and conductor.
- 4.2.1.3. The insulator shall be an open shed profile type with excellent self-cleaning properties and a provision for easy cleaning when maintenance is required.

4.2.2. Materials

4.2.2.1. Core

- 4.2.2.1.1. The insulator core shall be made of brittle fracture-resistant electrical grade epoxy / vinyl ester / isopolyester based fiberglass rod to achieve maximum failing load. The

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core shall be mechanically and electrically sound, free from voids, foreign substances and manufacturing flaws.

4.2.2.1.2. The insulator design shall ensure that the core is totally encapsulated and fully sealed, from the live to the earthed ends, by the insulating material from the environment, in order to avoid ingress of moisture. If any tacky substances are used as sealers, they shall not be exposed to environmental influence.

4.2.2.2. Housing and Weathersheds

4.2.2.2.1. The material used for the housings shall be manufactured from base polymer - reinforced high temperature vulcanized (HTV) silicone rubber based on dimethyl siloxane, which exhibit hydrophobicity with the capability to transfer hydrophobicity to the layer of pollution.

NOTE:

- i) *The silicon rubber shall be treated with additive packages to modify their behavior for satisfactory performance in an outdoor polluted environment. The additives (fillers) shall include but not limited to anti-tracking agents, ultra-violet screens and stabilizers, antioxidants, ionic scavengers, etc.*
- ii) *Proof of the type of base polymer used and the additives shall be provided to support the tender during evaluation.*

4.2.2.2.2. The reinforced HTV silicone rubber shall have a Shore 'A" hardness of not less than 60 as per ISO 48 and 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.

4.2.2.2.3. A minimum sheath thickness of 3.0 mm of silicone rubber shall be extruded or injection moulded on the reinforced fiberglass rod. The polymer sleeve and weather-shed insulating material shall have a chemical structure of 100 percent silicone rubber before fillers are added.

4.2.2.2.4. The silicone rubber shall be firmly bonded to the rod, be seamless, smooth and free from imperfections. The strength of the silicone rubber to rod interface shall be greater than the tearing strength of the silicone rubber.

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- 4.2.2.2.5. The weather-sheds shall be firmly bonded to the sheath, vulcanized to the sheath or moulded as part of the sheath and be seamless smooth and free from imperfections. The strength of the silicone rubber weather-shed to sheath interface shall be greater than the tearing strength of the silicone rubber.
- 4.2.2.2.6. Weather-sheds shall be at intervals to provide optimum electrical performance and the weather-shed designs shall provide a protected bottom surface that tends to keep dry in wet conditions.
- 4.2.2.2.7. The insulator shall be capable of withstanding high pressure power washing. A power wash test shall be performed on polymer insulators to demonstrate that the units can be power washed. This test shall be a water spray at a shed seam of approximately 3m from the insulators. The spray shall be a solid stream through a 6mm diameter nozzle at 3.79Mpa for a period of ten minutes. There shall be no signs of water entering through or under the outside weather-shed into the core or at the polymer hardware interface into the core.
- 4.2.2.2.8. The gap between hardware base and housing shall be sealed by an elastomer with permanent elasticity. The sealing shall stick permanently to the surface of the material as well as to the housing.

4.2.3. Finish

- 4.2.3.1. The pin insulators shall be supplied complete with necessary hardware such as galvanized steel pin with nut spring washer and a lock nut for mounting the insulator to the channel iron cross arms as shown in Fig. 1.
- 4.2.3.2. The finished product shall be of high resistance to moisture, high salinity, ultraviolet radiation, high temperatures and tropical sunshine conditions.
- 4.2.3.3. The final colour of the insulator housing shall be GREY.
- 4.2.3.4. The under surface and grooves of sheds or skirts shall be easy cleaning. Sheds shall be substantially symmetrical in shape without appreciable warping.
- 4.2.3.5. The top and side grooves shall be galvanized steel and be designed to accept conductor sizes in the range 7 – 18.2mm overall diameter.

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4.2.4. Galvanizing

- 4.2.4.1. All steel hardware components shall be galvanized after they are machined, bent or worked on in any manner. The zinc coating shall adhere tightly to the surface of the base metal. The zinc coated parts shall not have any un-coated spots.

- 4.2.4.2. The coating shall be uniform and free from blisters, flux, black spots, dross, tear drop edges, flaking zinc, rough appearance and in general shall be smooth, clean and unscarred when received. The minimum thickness of the coating of the steel or iron base shall conform to ISO 1461 and Table 1.

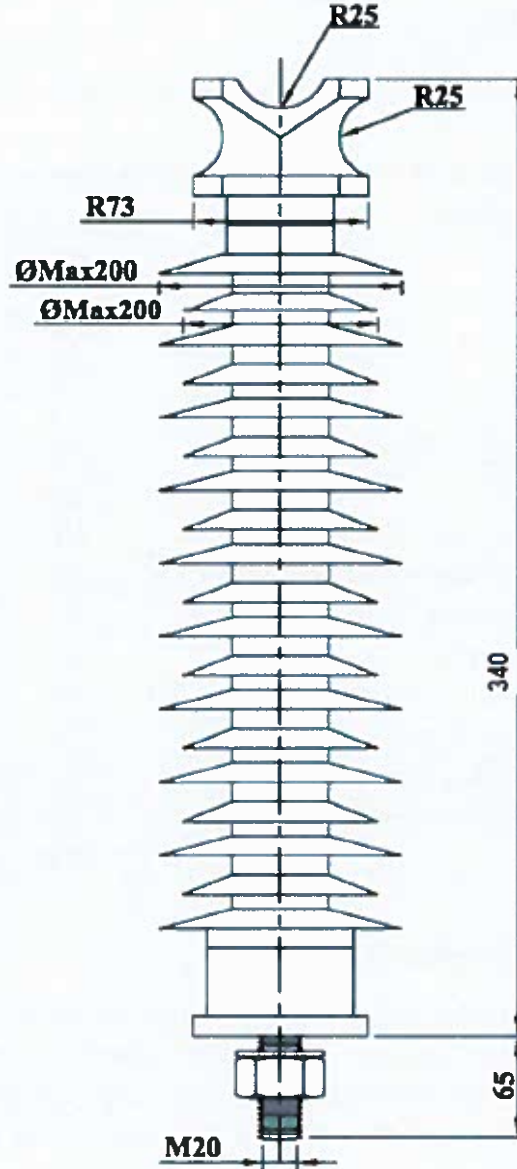
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Dimensions in millimeters

Figure 1: General arrangement for 11kV Composite Pin Insulator

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4.3. CHARACTERISTICS

The mechanical and electrical characteristics of the insulators shall be as per Table 1:-

Table 1: Mechanical and electrical characteristics of the insulators

Characteristics	Units	Ratings
Shed diameter, minimum	mm	142
Total shed height, min	mm	510
Specific creepage distance	mm/kV	31
Creepage distance, min	mm	345
Arcing distance, min	mm	360
Electro-mechanical failing load(cantilever), min	kN	12.5
Rod diameter	mm	20
Power frequency withstand voltage - 50Hz 60s, wet	kV	38
Power frequency withstand voltage - 50Hz 60s, dry	kV	75
Lighting impulse withstand voltage - 1.2/50µs, dry	kV	95
Visible discharge test voltage, min	kV	15
Radio Interference noise level at standard test voltage – 22kV	dB	30 (IEC60437-1997)
Maximum RIV value at standard test voltage – 22kV	µV	100
Mean coating thickness	For iron and steel castings and forgings	g/m ² (µm) 600 (85)
	For bolts, nuts and washers	g/m ² (µm) 375 (54)
Approximate weight	Kg	4.5

4.4. QUALITY MANAGEMENT SYSTEM

- 4.4.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.
- 4.4.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.
- 4.4.3. The bidder shall indicate the delivery time of the insulators, manufacturer's monthly and annual production capacity and experience in the production of the type and size of insulators

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being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for the insulators sold in the last five years together with reference letters from four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

- 5.1. Type tests, sampling tests and routine tests shall be done in accordance with the requirements of IEC 61109, IEC 60815, IEC 60383, IEC 60437, IEC 60507, ISO 1461, and this specification. It shall be the responsibility of the supplier to perform or to have performed all the tests specified.
- 5.2. Copies of Type Test Certificates & Type Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted (all in English language).
- 5.3. Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated:
- a) Tests on interfaces and connections of metal fittings;
 - b) Assembled core load-time test;
 - c) Test of housing: tracking and erosion test. The test reports MUST include resistance to ageing tests (under climate chambers to mimic the conditions – sunshine, salinity, temperature, humidity, spray and so on – typical of tropical climate and those stated in clause 4.1 in addition to the highest system voltage);
 - d) Tests for the core material;
 - e) Visible discharge test;
 - f) Dry lightning impulse withstand voltage test;
 - g) Wet power frequency test;
 - h) One minute rain test/wet flashover test
 - i) Mechanical load-time test and tightness test of the interface between end fittings and insulator housing.
 - j) Chemical composition test for silicon content
 - k) Recovery of hydrophobicity test
 - l) Brittle fracture resistance test

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NOTE: Any translations of certificates and test reports into English language shall be signed and stamped by the third party ISO/IEC 17025 accredited Testing Laboratory that carried out the tests.

- 5.4. The insulators shall be subject to acceptance tests at the manufactures' works before dispatch. Acceptance tests (routine & sample tests) will be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC). Routine and sample test reports for the insulators to be supplied shall be submitted to KPLC for approval before shipment of the goods.
- 5.5. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with IEC 61109, IEC 60815, IEC 60383, IEC 60437, IEC 60507, ISO 1461, and this specification and shall include the following:
 - a) Identification, visual inspection of the insulators and verification of dimensions;
 - b) Verification of the locking system;
 - c) Verification of tightness of the interface between end fittings and insulator housing;
 - d) Verification of the specified mechanical load (SML);
 - e) Electrical tests - Wet power frequency test;
 - f) Galvanizing test (by Gravimetric method).
 - g) Temperature cycle test
 - h) Porosity test
- 5.6. On receipt of the insulators KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to KPLC, insulators which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING AND PACKING

6.1. Marking

- 6.1.1. The following information shall be marked indelibly and legibly and in a permanent manner on each insulator in English Language.
 - (i) Manufacturer's name or trademark;
 - (ii) Manufacturer's type designation;
 - (iii) Specified electrical characteristics;
 - (iv) Specified mechanical load.
 - (v) The letters 'KPLC'.

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6.1.2. All marking shall be by embossing on the insulator housing and marking on metal fittings shall be before galvanizing. The marking shall not affect the performance of the insulator.

NOTE: Markings on loose tags/ties shall not be accepted.

6.1.3. A set of Three (3) installation and technical manuals for the insulators shall be submitted during delivery.

6.2. Packing

6.2.1. All insulators shall be packaged in individual weatherproof packages to protect them against damage during shipping, inland transportation and storage. The packages shall be weatherproof and designed to be removable by hand without cutting.

6.2.2. Each package shall have a packing list and in addition, shall be marked with the following information in English Language.

- a) Descriptive name
- b) Rated voltage
- c) Quantity packed in package
- d) Contract and lot number
- e) Gross weight of packager
- f) Volume of package
- g) Applicable standards
- h) Label "Property of KPLC".

7. DOCUMENTATION

7.1. The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:

- a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for previous five years and reference letters from at least four of the customers;
- d) Details of manufacturing capacity and the manufacturer's experience;

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- e) Copies of required type test certificates and type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
- f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
- g) Manufacturer's warranty and guarantee;
- h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008 certificate and other technical documents required in the tender.

7.2. The successful bidder (supplier) shall submit the following documents/details (from the manufacturer as per tender) to The Kenya Power & Lighting Company for approval before manufacture:

- a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
- b) Design drawings & construction details of the insulators including 3-D views;
- c) Quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008;
- d) Test Program to be used after manufacture;
- e) Marking details and method to be used in marking each insulator;
- f) Manufacturer's undertaking to ensure adequacy of the design, adherence to applicable regulations, standards and specification, ensure good workmanship and good engineering practice in the manufacture of the insulators for The Kenya Power and Lighting Company Limited;
- g) Packaging details (including packaging materials and marking and identification of component packages).

NOTE: *The drawings to be submitted by the supplier to KPLC for approval before manufacture shall be in standard format clearly indicating the drawing number, parts list with material details and quantities, standard of manufacture, ratings, approval details and identity of the manufacturer (as per manufacturer's authorization submitted during tendering).*

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TENDER NO.BIDDER'S NAME & ADDRESS

Clause	Guaranteed Technical Particulars	Bidders' Offer
	Name of Manufacturer & Country of manufacture of the insulators being offered	state
	Type/Model Reference Number	state
1	Scope:	State
2	Design standards complied with	state
3	Terms and Definitions	state
4	Requirements	state
4.1	System conditions	state
4.2	Design and construction	state
4.2.1	Design	specify
4.2.2	Materials	specify
4.2.2.1	Core	specify
4.2.2.2	Housing and weather-sheds	Specify design
4.2.3	Finish	State quality of finish
4.2.4	Galvanizing	specify
4.3	Characteristics	specify
	Nominal system voltage & frequency	State values
	Shed diameter, min	State values
	Unit spacing, min	State values
	Specific creepage distance	State values
	Creepage distance, min	State values
	Arcing distance, min	State values
	Electro-mechanical failing load(cantilever), min	State values
	Coupling designation	State values
	Power frequency withstand voltage - 50Hz 60s, wet	State values
	Power frequency withstand voltage - 50Hz 60s, dry	State values

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	Visible discharge test voltage	State values
	Radio interference level at standard test voltage	State values
	Maximum RIV value at standard test voltage	State values
	Minimum average coating mass (thickness)	State values
	1. For iron and steel castings and forgings	State values
	2. For bolts, nuts and washers	State values
4.5	Quality Management System	
	Quality Assurance Plan	submit
	Copy of ISO 9001:2008 Certificate	submit
	Manufacturer's experience	submit
	Manufacturing Capacity (units per month)	submit
	List of previous customers	submit
	Customer reference letters	submit
5.1	Test standards and responsibility of carrying out tests	specify
5.2	Copies of Type Test Reports submitted with tender	list
5.3	Acceptance tests to be witnessed by KPLC at factory before shipment	list
5.4	Test reports to be submitted by supplier to KPLC for approval before shipment	list
5.5	Replacement of rejected insulators	State compliance
6.1	Marking	specify
6.2	Packing	specify
7.1	Documents submitted with tender	list
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	List
	Statement of compliance to specification	state

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Manufacturer's Name, Signature, Stamp and Date

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