



TITLE:  
**SPECIFICATION FOR LOW  
VOLTAGE INSULATORS  
(Shackle Insulators, LV)**

Doc. No.	KPLC1/3CB/TSP/04/011
Issue No.	1
Revision No.	2
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**0.1 Circulation List**

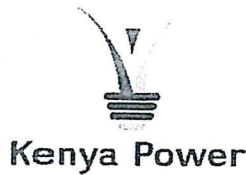
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**0.2 Amendment Record**

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 1 Rev 1	2010-04-16	Revised requirements on marking & GTP	S Kimiti	G Owuor
Issue 2 Rev 0	2015-05-18	Cancel and replaces Issue 1 Rev 1 dated 2010-04-16 & all previous issues	Nancy Wairimu	Dr. Eng. Peter Kimemia

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**FOREWORD**

This specification has been prepared by the Standard Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for low voltage (shackle) insulators. It is intended for use by KPLC in purchasing the low voltage (shackle) insulators.

The manufacturer 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 low voltage (shackle) insulators for use on overhead power distribution lines operating at voltage  $U/U_m$  of 600/1000 Volts and frequency of 50Hz.
- 1.2. The specification also covers inspection and test of the low voltage (shackle) 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 low voltage (shackle) insulators acceptable for use in the company (KPLC) and it shall be the responsibility of the Manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the low voltage (shackle) insulators for KPLC.
- 1.4. The specification does not purport to include all the necessary provisions of a contract

**2. REFERENCES**

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

- IEC 60383-1: Insulators for overhead lines with nominal voltage above 1000V- Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptable criteria.
- IEC 60672-2 & 3: Ceramic and glass insulating materials – part 2: methods of test;- part 3: specification for individual materials.
- IEC 60071-1: Insulation co-ordination – part 1: Definitions, principles and rules.
- ENA TS 43-93: Line insulators.
- RAL : Colour chart.

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IEC 60815: Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles

**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**

The low voltage (shackle) insulator shall be designed and constructed for continuous outdoor operation in tropical areas and harsh climatic conditions including areas exposed to:

- a) Sea spray along the coast, with SPS class d (heavy), Example E5 as per IEC 60815;
- b) Humidity up to 90%;
- c) Average ambient temperature of +30°C with minimum of -1°C and a maximum of +40°C and
- d) Altitudes of not more than 2200m above sea level.

**4.2. MATERIALS AND CONSTRUCTION**

4.2.1. The insulating material shall be made from grade C- 120 ceramic material or equivalent complying to IEC 60627-3 standard and shall have the following properties:

**Table 1: Properties of grade C-120 ceramic material (Aluminous porcelain)**

properties	Unit	C-120
Maximum open (apparent) porosity	Vol %	0.0
Minimum bulk density	Mgm <sup>-3</sup>	2.3
Minimum flexural strength (glazed)	MPa	110
Minimum resistance to thermal shock	K	150
Minimum electric strength	kV mm <sup>-1</sup>	20
Minimum withstand voltage	kV	30
Maximum dissipation factor at 20°C (48 Hz to 62Hz)	10 <sup>-3</sup>	25
Minimum volume of resistivity in terms of temperature(dc) at 30°C	Ωm	10 <sup>11</sup>

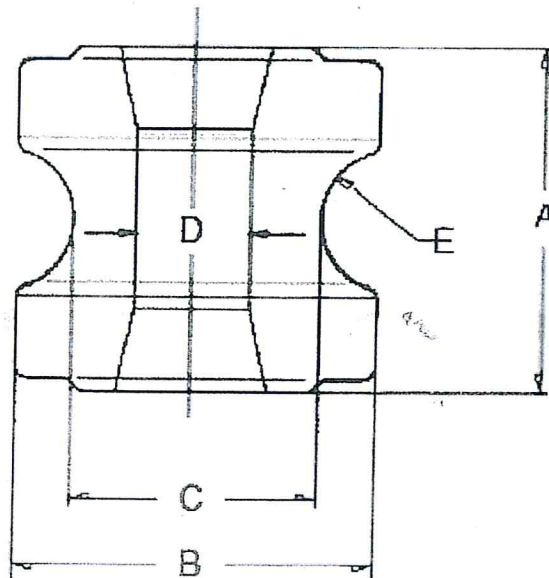
4.2.2. The porcelain shall be sound, free from flaws and blemishes, smoothly glazed and of uniform brown colour complying to RAL 8016 as per RAL colour chart when finished.

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- 4.2.3. The low voltage (shackle) insulator shall be made from moulding technique and turning. This shall ensure tolerance to DIN 40680 standard.
- 4.2.4. The low voltage (shackle) insulator shall be free from stresses due to expansion and contraction in any part which may lead to deterioration.
- 4.2.5. The hole in the low voltage (shackle) insulator shall be smoothly radiused to present an even bearing surface to the steel bolt.
- 4.2.6. The low voltage (shackle) insulator shall be of reel type in accordance with Fig.1 and provisions of ENA TS 43-93 standard in terms of design and dimensions.

**4.3. GENERAL CHARACTERISTICS**

The dimensional, mechanical and electrical characteristics of the low voltage (shackle) insulator shall be as shown in Fig. 1 and table 2:-

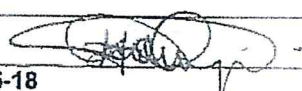


**Fig. 1: A typical low voltage insulator (shackle insulator)**

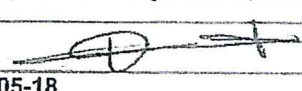
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**Table 2: General Characteristics of a low voltage (shackle) insulator**

Dimensions		Tolerance as per DIN 40680	
	Height (A)	65mm	± 2%
	Diameter (B)	76mm	
	Diameter (C)	44mm	
	Diameter (D)	17.5mm	± 0.45%
	Conductor groove radius (E)	9.5mm	± 0.30%
Electrical characteristics			
Minimum	Power frequency flashover voltage (wet)	10kV	
	Power frequency flashover voltage (dry)	20kV	
	Nominal specific creepage distance	25mm/kV <sup>2</sup>	
Mechanical characteristics			
	Minimum falling load	15kN	
Weight			
	Maximum weight per piece	0.5kg	

**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 requirements will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
- 4.4.2. The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications shall be submitted with the tender for evaluation.

**5. TESTS AND INSPECTION**

- 5.1. The finished low voltage (shackle) insulator shall be inspected and tested in accordance with IEC 60383-1, IEC 60672-2 & 3, IEC 60071-1, ENA TS 43-93 standards and all provisions of this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.
- 5.2. Copies of previous Test Reports conforming to clause 4 requirements for the low voltage (shackle) insulator, 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. The accreditation certificate for the third party testing laboratory shall also be submitted with the tender (all in English Language). Copies of type test reports to be submitted with the tender (by the bidder) for evaluation shall be as stated below:
  - a) Verifications of dimensions and weight;
  - b) Mechanical falling load;

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- c) Porosity test;
- d) Wet power frequency flashover voltage test;
- e) Dry power frequency flashover voltage test;
- f) Flexural strength test;
- g) Electric strength test;
- h) Bulk density test;
- i) Voltage withstand test;
- j) Dissipation factor at 20°C;
- k) Volume of resistivity at 30°C.

**NOTE:** Any translations of certificates and test reports into English language shall be signed and stamped by third party testing laboratory that carried out the tests.

- 5.3. The low voltage (shackle) insulator shall be subject to acceptance tests at the manufacturer's works before dispatch. Acceptance tests shall be witnessed by two engineers appointed by the Kenya Power and Lightning Company Limited (KPLC). Routine and sample Test Reports for the low voltage (shackle) insulators to be supplied shall be submitted to KPLC for approval before deliver of the goods.
- 5.4. Tests to be witnessed by KPLC Engineers at the factory shall be in accordance with IEC 60383-1, IEC 60672-2 & 3, IEC 60071-1, ENA TS 43-93 standards and all provisions of this specification and shall include:
- a) Verifications of dimensions and weight;
  - b) Mechanical falling load;
  - c) Wet power frequency flashover voltage test;
  - d) Dry power frequency flashover voltage test;
  - e) Electric strength test;
  - f) Voltage withstand test;
- 5.5. On receipt of the low voltage (shackle) insulator KPLC will inspect them and may perform any of the relevant tests in order to verify compliance with the specification. The manufacturer shall replace without charge to KPLC, low voltage (shackle) insulators which upon examination, test or use fail to meet any or all of the requirements in the specification.

**6. MARKING AND PACKING**

**6.1 MARKING**

The following information shall be marked indelibly and legibly on the porcelain portion of each low voltage (shackle) insulator in English language:

- a) Name or trademark of the manufacturer;
- b) Reference number and specified mechanical falling load;
- c) Year of Manufacture;
- d) Batch or serial number;
- e) The letters "Property of KPLC".

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## 6.2 PACKAGING

- 6.2.1. The low voltage (shackle) insulators shall be packed in wooden crates which are reinforced and held closed by external steel bands. Each crate shall be internally braced to permit stacking and the steel wire bindings shall be designed to keep the crate firmly closed and permit easy and rapid opening at time of installation.
- 6.2.2. The crates shall then be stacked on sturdy wood pallet. The assembly shall be held tightly in place with steel bands and protected against moisture by a complete covering of heat-shrinkable polyethylene film.
- 6.2.3. Instructions for storage, handling and installation shall be included in each package, all in English Language.

## 7.0. 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:
- Guaranteed Technical Particulars fully filled and signed by the manufacturer;
  - Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
  - Sales records for previous five years and reference letters from at least four of the customers;
  - Details of manufacturing capacity and the manufacturer's experience;
  - Copies of required type test certificates and type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
  - Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
  - Manufacturer's warranty and guarantee;
  - 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:
- Guaranteed Technical Particulars fully filled and signed by the manufacturer;
  - Design drawings & construction details of the low voltage (shackle) insulators including 3-D views;
  - 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.

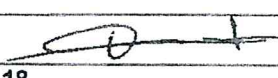
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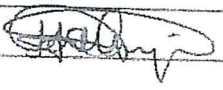
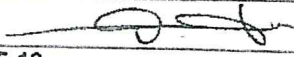
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The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008;

- d) Test Program to be used after manufacture;
- e) Marking details and method to be used in marking each low voltage (shackle) 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 low voltage (shackle) 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 drawing number, parts list with material details & 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 .....

Clause	Description	KPLC REQUIREMENTS	Bidders offer (indicate full details of the values offered)
	Name of Manufacturer		state
	Country of manufacture		State
	Type/Model Reference Number		State
1	Scope		state
2	Design standards complied with		state
3	Terms and Definitions		state
4	Requirements		
4.1	Service condition		state
	Insulator colour	RAL 8016	
	Maximum open (apparent) porosity	0.0%	
	Minimum bulk density	2.3	
	Minimum flexural strength (glazed)	110	
	Minimum resistance to thermal shock	150	
	Minimum electric strength	20	
	Minimum withstand voltage	30	
	Maximum dissipation factor at 20°C (48 Hz to 62Hz)	25	
	Minimum volume of resistivity in terms of temperature(dc) at 30°C	10 <sup>11</sup>	
4.3	<b>General characteristics</b>		
	<b>Dimensions</b>		
	Height (A)	65mm (±2%)	
	Diameter (B)	76mm (±2%)	
	Diameter (C)	44mm (±2%)	
	Diameter (D)	17.5mm (±0.45%)	
	Conductor groove radius (E)	9.5mm (±0.3%)	
	<b>Electrical characteristics</b>		
	Min. Nominal specific creepage distance	25kV/mm <sup>2</sup>	

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