



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 1 of 14	

TABLE OF CONTENTS

0.1 Circulation List

0.2 Amendment Record

FOREWORD

1. SCOPE
2. REFERENCES
3. TERMS AND DEFINITIONS
4. REQUIREMENTS
5. TESTS AND INSPECTION
6. MARKING AND PACKING
7. DOCUMENTATION

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED INSULATORS

(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)

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 2 of 14	

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Head of Department Standards
2	Head of Department Procurement
Electronic copy (pdf) on KPLC server currently: http://172.16.1.40/dms/browse.php?fFolderId=23	

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
2	2010-02-20	1. Changed title scope, reference & content to PIN type insulator 2. Included letters KPLC in marking	Eng. Simon Kimitel	Godfrey Gathige
Issue 1 Rev 0	2015-01-21	Replaces Issue 2 Rev. 1; KPLC1/3CB/TSP/04/012	Michael Apudo	Dr. Eng. Peter Kimemia

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 3 of 14	

FOREWORD

This specification has been prepared by the Standards Department in collaboration with Network Management Division both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for 11kV porcelain insulators for industrial/inland installations. It is intended for use by KPLC in purchasing the insulators.

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

1. SCOPE

- 1.1. This specification is for porcelain insulators for use on overhead power distribution lines operating at a nominal voltage of 11kV, with the maximum operating voltage of 12kV and frequency of 50Hz.
- 1.2. The specification covers 11kV porcelain insulators (complete with spindle/pilot pin) to be used in industrial/inland installations.
- 1.3. 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.
- 1.4. The specification stipulates the minimum requirements for 11kV porcelain insulators (c/w spindle/pilot pin) 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.

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: Insulators for overhead lines with a nominal voltage above 1000 V -- Part 1: Ceramic or glass insulator units for a.c. systems. Definitions, test methods and acceptance criteria.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21

Page 4 of 14

- IEC 60815: Selection and dimensioning of high-voltage insulators intended for use in polluted conditions -- Part 1: Definitions, information and general principles – Part 2: Ceramic and glass insulators for a.c. systems
- ISO 1461: Metallic Coatings – Hot dip galvanized coatings on fabricated ferrous products – Requirements.
- ISO 898-2: Mechanical properties of fasteners made of carbon steel and alloy steel -- Part 2: Nuts with specified property classes -- Coarse thread and fine pitch thread
- BS 137: Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000V a.c. – Part 2: Requirements
- BS 3288: Insulators and conductor fittings for overhead power lines - Part 2: Specification for selected limits of size.
- BS 3643: ISO metric screw threads. - Part 2: Specification for selected limits of size.
- BS 4464: Specification for spring washers for general engineering and automobile purposes. Metric series
- PD 970: Wrought steels for mechanical and allied engineering purposes — Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels
- ANSI C29.6: Wet process porcelain insulator- High voltage pin type

3. TERMS AND DEFINITIONS

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

Effective thread - the thread, after galvanizing or after being given any other suitable anti-corrosion protection, and shall take a nut for the distance stated.

REQUIREMENTS

4.1. SERVICE CONDITIONS

The insulators shall be suitable for continuous operation outdoors in tropical areas and installations in areas located in:

- (i) Close proximity to an industrial pollution source - site pollution severity (SPS) of class E6 (heavy) as per IEC 60815-1 clause 8.
- (ii) Humidity of up to 95%,

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 5 of 14	

- (iii) Average ambient temperature of +35 ° C.
- (iv) Altitude of not more than 2200m above sea level.

4.2. DESIGN AND CONSTRUCTION

- 4.2.1. The insulator shall consist of a wet processed porcelain part and a galvanized steel spindle complete with nuts, ring and spring washer.
- 4.2.2. The insulator shall have a standard or open profile with shed inclinations between 14° - 24° for the shed top angle and 8° - 16° for the shed bottom angle conforming to IEC 60815-2 requirements and Fig. 2.
- 4.2.3. The insulator shall be tie-top type with spindle / pilot pin base and shall be suitable for both vertical and horizontal mounting; classified as a class B insulator in accordance with IEC 60383.
- 4.2.4. The insulator shall have a cemented zinc thimble pin-hole thread suitable for M22 large steel head spindle as per BS 3288-2. The insulator shall be supplied complete with the steel spindle or pilot pin suitable for mounting on steel crossarm . The spindle shall have components and dimensions as per Fig. 1b.
- 4.2.5. Both the spindle and pilot pin shall be a single piece obtained by the process of forging with no joints. They shall not be made by joining, welding, shrink-fitting or any other process from more than one piece of material.
- 4.2.6. They shall be of good finish, free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided and that the collar or the seating surface of the metal base shall bed down correctly on to the cross-arm when fixed to that through a hole and diameter of which is 2 mm greater than the diameter of the shank.
- 4.2.7. The threads of nuts and tapped holes shall be cut after galvanizing and shall be well oiled or greased. All other threads shall be formed before galvanizing.
- 4.2.8. Threads shall be compatible for use with pin insulators as per BS 137 with a coarse pitch series with thread tolerance class 6g for external threading and 6H for internal threading in accordance with BS 3643-2 prior to galvanizing.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



TITLE:
**SPECIFICATION FOR 11kV
 PORCELAIN INSULATORS
 (complete with spindle)**

Part 2: Industrial / Inland
 Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21

Page 6 of 14

4.3. MATERIALS

4.3.1. Insulating material

- 4.3.1.1. The insulating material shall be good commercial-grade wet-processed porcelain conforming to ANSI C29-6, 1996. The porcelain shall be sound, free from flaws and blemishes, thoroughly vitrified, smoothly glazed and of uniform brown colour when finished.
- 4.3.1.2. The insulator shall be free from stresses due to expansion and contraction in any part which may lead to deterioration. No chemical reaction between materials due to contact (e.g. between cement and metal fittings) shall be allowed.
- 4.3.1.3. The under surface and grooves of sheds or skirts shall be easy cleaning. Sheds shall be substantially symmetrical in shape without appreciable warping.

4.3.2. Spindle

- 4.3.2.1. The spindle shall be of galvanized steel complying with any grade of steel with reference symbol P, minimum tensile strength of 550 MPa and surface hardness of more than 160 HV in accordance with PD 970.
- 4.3.2.2. The nuts used in the spindle shall be two (2) in number and shall conform to property 4.8 of ISO 898-2 and one spring washer conforming to BS 4464.
- 4.3.2.3. All ferrous parts shall be hot dip galvanized in accordance with ISO 1461 with minimum mean coating mass of 395 g/m² (minimum mean coating thickness of 55µm).
- 4.3.2.4. The threads on head of the spindle shall be steel large type reference 16 as per BS 3288-2 and Fig. 1a. They shall screw into a thimble or equivalent component fixed in the pin hole of the insulator.
- 4.3.2.5. The spindle shall be large type reference number 29, with dimensions as per Table 1 and Fig. 1b and shall be in accordance with BS 3288-2

Table 1: Dimensions of insulator pin with large steel heads as per BS 3288-2 and Fig. 1b

Dimensions in mm							
A	ØB	ØC	ØD	ØE	F	(RG)	X*
230	50	25	37	22	6	13	50

*Dimension X to be 50mm screwed 45mm

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21

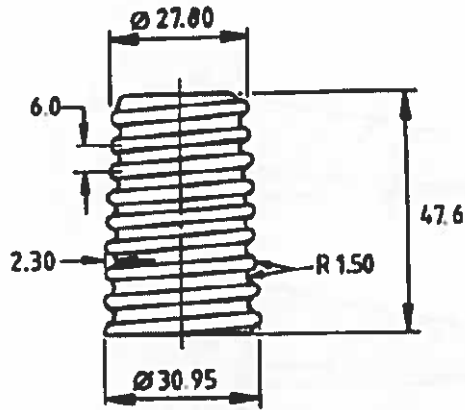


Fig 1a: Head of spindle
Large steel head

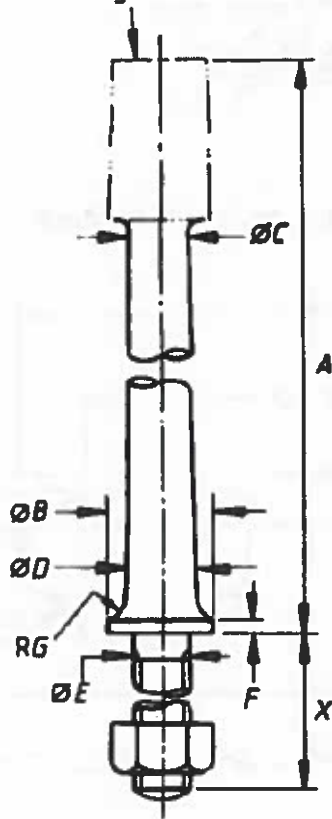


Fig 1b: Spindle with large steel head

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2015-01-21

Date: 2015-01-21

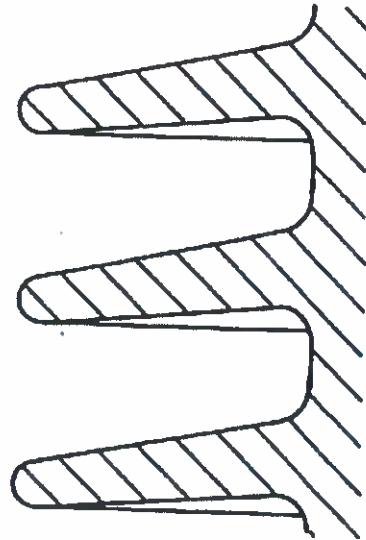
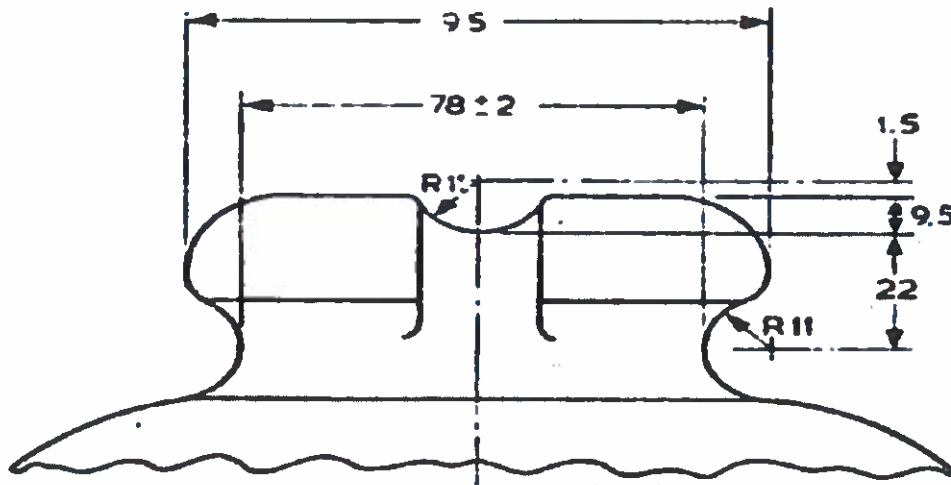


Fig 2: Typical "open" profiles for Pin Insulators



All dimensions are in millimetres

NOTE: Tolerance in accordance with BS 137 i.e. $(0.04d + 1.5)$ mm, where d is the dimension shown on the drawing.

Fig. 3: Typical head of an 11kV porcelain insulator

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2015-01-21	Date: 2015-01-21

- 4.3.2.6. The stalk length of spindle (Fig. 1b) shall be measured above the seating face of the collar and the shank length of the line pins (Fig. 1b) shall be measured below the seating face of the collar. The effective thread of 50 mm shank shall be not less than 45 mm.
- 4.3.2.7. The dimensions of a typical head of an 11kV porcelain insulator shall be as per Fig.3 and the various ratings shall be as shown in Table 2.

Table 2: The mechanical and electrical characteristics of the insulators as per IEC 60383

S/No	Particulars	Required values
1.	Minimum failing load (bending)	12.5 kN
2.	Tie top radius	11mm
3.	Total height	250mm
4.	Specific creepage distance	25mm/kV
5.	Minimum total creepage distance	300mm
6.	Minimum dry arcing distance	311mm
7.	Visible discharge test	9kV
8.	Minimum power frequency withstand voltage, Wet	50kV (r.m.s.) 50Hz 60s
9.	Minimum lightning impulse withstand voltage, Dry	95kV (peak) 1.2/50µs
10.	Radio Interference noise level at standard test voltage – 7.5 kV (IEC60437-1997)	30 dB
11.	Maximum RIV value at standard test voltage – 7.5 kV	100 µV
12.	Minimum average coating mass (thickness) for bolts, nuts and washers	395 g/m ² (55µm)
13.	Spindle size	M22 suitable for steel cross-arm 10mm thick
14.	Maximum weight	12kg

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.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed: 

Signed: 

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 10 of 14	

5. TESTS AND INSPECTION

5.1. Type tests, sampling tests and routine tests shall be done in accordance with the requirements of IEC 60383, IEC 60815-1 & 2, BS 3288, BS 137, ISO 1461, BS 3643, BS 4464, ANSI C29.6, PD 970, ISO 898-2 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).

Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated:

- a) Verification of dimensions
- b) Dry lightning impulse withstand tests
- c) Wet power-frequency withstand voltage tests
- d) Mechanical failing load tests
- e) Thermal-mechanical performance tests

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

5.3. 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.

5.4. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with IEC 60383, IEC 60815-1 & 2, BS 3288, BS 137, ISO 1461, BS 3643, BS 4464, ANSI C29.6, PD 970, ISO 898-2 and this specification and shall include the following:

- a) Verification of dimensions
- b) Temperature cycle test
- c) Mechanical failing load test
- d) Porosity test
- e) Galvanizing test
- f) Visual inspection
- f) Electrical tests - Wet power-frequency withstand voltage tests, Dry lightning impulse withstand tests and Radio interference tests.

5.5. 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.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 11 of 14	

6. MARKING AND PACKING

6.1 MARKING

The following information shall be marked indelibly and legibly and in a permanent manner on the porcelain portion of each insulator in English Language:

- Name or trade mark of the manufacturer;
- Type Reference Number and Specified Mechanical Failing Load;
- Year of manufacture;
- Batch or serial number;
- The letters 'KPLC PROPERTY'

6.2 PACKING

6.2.1 The insulators shall be packed in wooden crates which are reinforced and held closely by external steel strip bindings. Each crate shall be internally braced to permit stacking and the steel strip bindings shall be designed to keep the crate firmly closed and permit easy and rapid opening at time of installation.

The crates shall then be stacked on sturdy wooden 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.

6.2.2 Instructions for storage, handling and installation shall be included in each package, all in English Language.

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:

- 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;

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 12 of 14	

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 indication 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).*

-----SPACE LEFT BLANK-----

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



TITLE:
**SPECIFICATION FOR 11kV
 PORCELAIN INSULATORS
 (complete with spindle)**

Part 2: Industrial / Inland
 Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21

Page 13 of 14

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED INSULATORS *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, 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)*

TENDER NO.BIDDER'S NAME & ADDRESS

Clause	Description	Guaranteed Technical Particulars for insulators offered
	Name of Manufacturer & Country of manufacture of the insulators being offered	specify
	Type/Model Reference Number	specify
1	Scope: 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 KPLC	specify
2	Design standards complied with	specify
3	Terms and Definitions	specify
4	Requirements	
4.1	Service conditions	specify
4.2	Design & Construction	
	Insulator components	specify
	Insulator shed profile	specify
	Insulator mounting	specify
	Threads profile of insulator.	specify
4.3	Materials	
4.3.1	Insulating material	specify
4.3.2	Spindle dimensions	Attach drawings
4.3.2.7	RATINGS:	
	Nominal System Voltage & Frequency	specify
	Maximum System Voltage	specify
	Minimum Failing Load (bending)	Prove compliance through tests reports
	Tie top radius	specify
	Total height	specify
	Specific creepage distance	specify
	Minimum total creepage distance	specify
	Minimum dry arcing distance	specify
	Power Frequency Withstand Voltage, rms (50Hz 60s, wet)	specify
	Impulse Withstand Voltage, peak (1.2/50µs, dry)	specify

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21



Kenya Power

TITLE:
**SPECIFICATION FOR 11kV
PORCELAIN INSULATORS
(complete with spindle)**

Part 2: Industrial / Inland
Installations

Doc. No.	KP1/3CB/TSP/04/013-2
Issue No.	3
Revision No.	0
Date of Issue	2015-01-21
Page 14 of 14	

	Radio Interference noise level at standard test voltage – 7.5 kV (IEC60437-1997)	specify
	Maximum R.I. value at test voltage of 7.5 kV	specify
	Minimum average coating mass (thickness) for bolts, nuts and washers	specify
	Stud Size	specify
	Stud suitable for?	specify
	Weight.	specify
4.5	Quality Management System	
	Quality Assurance Plan	provide
	Copy of ISO 9001:2008 Certificate	provide
	Manufacturer's experience	provide
	Manufacturing Capacity (units per month)	provide
	List of previous customers	provide
	Customer reference letters	provide
5.1	Test standards and responsibility of carrying out tests	provide
5.2	Copies of Type Test Reports submitted with tender	provide
5.3	Acceptance tests to be witnessed by KPLC at factory before shipment	provide
5.4	Test reports to be submitted by supplier to KPLC for approval before shipment	provide
5.5	Replacement of rejected insulators	specify
6.1	Marking	specify
6.2	Packing	specify
7.1	Documents submitted with tender	provide
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	provide
	Statement of compliance to specification	provide

.....
Manufacturer's Name, Signature, Stamp and Date

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2015-01-21

Date: 2015-01-21