

THE KENYA POWER AND LIGHTING CO. LTD.

SPECIFICATION for LV SINGLE CORE ALUMINIUM CABLES

REVISION RECORD

REVISION	DESCRIPTION OF REVISION	DATE	APPROVAL
0	1 ST ISSUE	March 1997	
1	2 nd ISSUE	2002-09-06	<i>Edith. bug up</i>

CONTENTS.

Foreword

Introduction

1. Scope
2. References
3. Terms and Definitions
4. Requirements
 - 4.1 Service conditions
 - 4.2 Materials and Construction
 - 4.3 Standard Sizes (Characteristics)
5. Tests
6. Notices
7. Packing

FORE WORD

This standard specification has been prepared by the Research and Development Department of the Planning Research and Performance Monitoring Division, KPLC and lays down specification for LV single core PVC insulated cables.

This specification is intended for procurement of materials and does not include provision of contract.

This specification is based on IEC 502 and BS 6346. It is subject to revision as and when required.

This specification supersedes all specifications for LV single core PVC insulated cables issued before the revision date.

INTRODUCTION

This specification was prepared to establish and promote uniform requirements for Low voltage single core, PVC insulated, steel wire armoured cables. The specification stipulates the minimum requirements for equipment acceptable for evaluation

SINGLE CORE LV ALUMINIUM CABLE (PVC).

1. SCOPE

- 1.1. This specification is for single core, stranded aluminium conductors, polyvinyl chloride (PVC) insulated, armoured, PVC outer sheathed power cables for operation upto and including 600 volts to sheath and 1000 volts between conductors.
- 1.2. This specification is for following cable sizes:-
 - 630 sq. mm Aluminium conductor PVC insulated single core cable
 - 300 sq. mm Aluminium conductor PVC insulated single core cable

2. REFERENCES

The following documents were referred to during the preparation of this specification. In cases of conflict, the provisions of this specification shall take precedence.

Unless otherwise specified, the latest revision, edition and amendments shall apply.

IEC 228(1978):- Conductors of insulated cables

IEC 502:(1983):- Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto 30 kV

IEC 811:- Common test methods for insulating and sheathing materials of electric cables

BS 6346(1969):- PVC - insulated cables for Electricity supply (with 1974 amendments).

3 TERMS AND DEFINITIONS

For the purpose of this specification, the definitions in IEC 228 and IEC 502 shall apply.

4 REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 Operating conditions

The cables shall be suitable for continuous operation in tropical areas with the following atmospheric conditions.

- (a) Altitude: From sea level up to 2200m above mean sea level.

- (b) Humidity: Polluting saline atmosphere in coastal areas and where humidity is 90% and up country area where air is relatively clean and humidity not below 50%.
- (c) Ambient temperatures of +30° C average, (+40° C Max. and -1° C Min).

4.2. MATERIAL AND CONSTRUCTION

- 4.2.1. The cable in general shall be designed and manufactured according to the requirement of IEC 227, IEC228 and BS 6346.
- 4.2.2. The phase conductors of the cable shall be made from circular stranded compact plain aluminium conductor as per IEC 228.
- 4.2.3. The insulation shall be polyvinyl chloride (PVC) complying with the requirement of IEC 502 for type PVC/A and shall be suitable for climatic conditions described.
- 4.2.4. The insulation shall be applied by extrusion process and shall form a compact homogeneous body.
- The insulation shall concentrically cover the conductor
- 4.2.5. Where necessary, the cable shall be cored with suitable non-hydroscopic inner covering and filler to make a substantially circular cable.
- 4.2.6. Extruded oversheath shall be of black polyvinyl chloride (PVC).
- 4.2.7. The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath. Letters and figures, raised and consist of upright block characters. Minimum size of characters not less than 15% of average overall cable diameter.

(i) 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC.

(ii) Year of manufacture.

(iii) Size of cable

(Example: '630 SQ MM 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC 2000')

4.3. STANDARD SIZES AND CHARACTERISTICS

4.3.1 The characteristics of the cables shall comply with the following table

Item		Characteristics
Conductor resistance		Not more than the value indicated
A.C. withstand voltage		To withstand the indicated value for 5 min.
Insulation resistance		Not less than the value indicated.
Tensile strength and elongation	PVC	Tensile strength, minimum 12.5N/mm (1.27 Kg/mm)
	PVC	Elongation , minimum percentage of unaged value 150% 75 - 125%
Ageing requirement*		

* Properties after Ageing in air oven:

temperature	100 ± 2°C
duration of treatment	168 hrs

4.3.2 The standard sizes for the PVC cables shall be as follows:-

Cable size	630 sq. mm	300 sq. mm
Nominal sectional area	630 sq. mm	300 sq. mm
Thickness of insulation	2.8 mm	2.4 mm
Thickness of outer sheath	2.2 mm	2.2 mm
Nominal overall diameter	38.8mm	28.0 mm
Approximate net weight	3400 kg/km	2100 kg/km
Test voltage	3kV/5min	3kV/5min
Maximum d.c. resistance at 20 ⁰ C	0.047 ohms/km	0.1 ohms/km
Maximum a.c. resistance (70 ⁰ C)	0.07 ohms/km	0.133 ohms/km

5. TESTS

- 5.1 The manufacturer shall be responsible for performing or for having performed all the required tests specified in this specification. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.
- 5.2 The cable cores, sheath and completed cable shall be tested in accordance with the requirements of IEC 811 and BS 6346. Test certificates shall be certified by the National Testing or the National Standards Institute of the country of origin. Sample copies for similar material shall be presented with the tender for the purpose of technical evaluation.

Test reports shall be completed and made available for approval before shipment of the materials.

All materials shall be subjected to inspection by KPLC Engineers or her representative at place of manufacture and all routine tests carried out in their presence.

Routine tests shall be carried out by KPLC staff on the material upon delivery to counter check compliance with specification and factory test reports.

6 NOTICES

- 6.1 Draft design and construction drawings shall be submitted to KPLC before the manufacturing of cables commence. KPLC undertake to submit their comments or approval for the drawings within three weeks of receiving the draft copies.
- 6.2 Tenders with substantial deviation but offering superior materials shall be accompanied by detailed descriptive manuals, drawings and certified test reports for the purposed of technical evaluation.
- 6.3 A detailed list & contact address of previous customers shall be submitted with the tender. List of workshop tools and equipment shall also be appended.

7. PACKING

- 7.1 The cable shall be wound on wooden drums such as to prevent damage during transportation. The wooden drums shall be made from treated timber resistant to termite attack.
- 7.2 The following description shall be marked on one flange of the reel
 - (a) Direction of rotation of the reel
 - (b) Type of cable
 - (c) Number of conductors and size
 - (d) Cable Length
 - (e) Net weight and gross weight
 - (f) Manufacturer's name
 - (g) Year of manufacture

END SEPTEMBER 2000



Kenya Power

TITLE:
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33kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
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, LABELLING AND PACKING
7. DOCUMENTATION

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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 testing laboratory for tender evaluation, all in English Language)

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Kenya Power

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33kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 2 of 14

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supply Chain Manager – Procurement
Electronic copy (pdf) on The Kenya Power & Lighting Company 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)
Issue 2 Rev 0	2014-03-31	Cancels and replaces Issue 1 Rev 0 dated 2007- 05-09	S. Kimitei 	G. Owuor

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Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 3 of 14	

FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Distribution Division both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for three core XLPE insulated aluminium cables, 33kV. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for three core, stranded aluminium conductors, XLPE insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 19000 Volts to sheath, 33000 Volts between conductors and highest system voltage of 36000 Volts for use in KPLC distribution network operated at 50Hz.

The specification is for the following sizes of 33kV cables:

3 x 95 mm² AL/XLPE/SWA/PVC

3 x 185 mm² AL/XLPE/SWA/PVC

3 x 300 mm² AL/XLPE/SWA/PVC

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted together with other required details for tender evaluation.

The specification stipulates the minimum requirements for three core XLPE insulated aluminium 33kV cables 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 cables for The Kenya Power & Lighting Company Ltd.

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

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Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 4 of 14

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 60502-2: Power Cables with extruded insulation and their accessories for rated voltages from 1kV ($U_m=1.2kV$) up to 30kV ($U_m=36kV$)- Part 2: Cables for rated voltages from 6kV ($U_m=7.2kV$) up to 30kV ($U_m=36kV$).

IEC 60228: Conductors of insulated cables.

BS 6622: Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation for rated voltages from 3.8/6.6kV to 19/33kV.

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in IEC 60228 and IEC 60502-2 apply, together with the following:

AL: Aluminium
SWA: Steel Wire armour

PVC: Polyvinyl chloride
XLPE: Cross-linked polyethylene

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The cables shall be suitable for the following service conditions and applications:

4.1.1 Cable Application

- The cable shall be a distribution cable for use in outdoors installations and tropical conditions (temperature range of $-1^{\circ}C$ to $+40^{\circ}C$, humidity of upto 95%, saline conditions and altitudes of upto 2200m above sea level).
- The cable shall be suitable for laying in cable ducts and directly in the ground in switching stations, between stations and underground to overhead conversion.
- The cable shall also be suitable for laying on slopes.
- Permissible continuous loading operating temperature shall be $90^{\circ}C$.
- Permissible emergency loading temperature shall be $130^{\circ}C$ for at least 8 hours.

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33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 5 of 14	

f) Permissible short circuit temperature shall be 250°C (for short-circuit duration of 5s as per IEC 60502).

4.1.2 The cables shall be connected to underground system operating at a nominal voltage of 33kV, 50Hz and maximum system voltage of 36kV and are solidly earthed at the transformer neutrals. The short circuit fault level shall be taken as 25kA 3s.

4.1.3 The cables shall have suitable anti-termite protection (details to be submitted by supplier to KPLC for approval before manufacture).

4.1.4 The cable shall have an oversheath with a fire performance that conforms to the requirements IEC standards.

4.1.5 The cable shall be designed for reliable service life of at least 30 years.

4.2. MATERIALS AND CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured to BS 6622, IEC 60502-2 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and the cable shall have continuous operating temperature of 90°C and short circuit temperature of 250°C (5 seconds duration) as per IEC 60502-2.

4.2.2. Conductor



The cable shall be made from circular stranded compacted plain aluminium conductor that conforms to IEC 60228.

4.2.3. Conductor Screen

4.2.3.1 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3.2 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

4.2.4. Insulation

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33kV 3/C AL XLPE SWA PVC**

Doc. No. KP1/3CB/TSP/05/023

Issue No. 2

Revision No. 0

Date of Issue 2014-03-31

Page 6 of 14

4.2.4.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.

4.2.4.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.

4.2.4.3 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

4.2.4.4 Individual cores shall be identified by coloured tape over the insulation and the colours shall be Red, Yellow and Blue.

4.2.5. Insulation Screen

4.2.5.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.

4.2.5.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.

4.2.5.3 A metallic screen shall be applied around each core. The screen shall consist of helically applied overlapped copper tape. An energy absorbing bedding layer should be applied.

4.2.6. Laying-up

4.2.6.1 The cores shall be laid-up with a right hand direction of lay. Fillers of non-hygroscopic material shall be used to form a substantially compact and circular cable.

4.2.6.2 The metallic screens of the three cores shall be in contact with each other.

4.2.7. Armour

4.2.7.1 An extruded separation layer of black polyvinyl chloride (PVC) shall be applied between the laid-up cores and the armour.

4.2.7.2 The armour shall consist of a single layer of round galvanized steel wires applied helically with a left-hand lay.

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Date: 2014-03-31

Date: 2014-03-31



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33kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 7 of 14	

4.2.8. Oversheath

4.2.8.1 There shall be an extruded oversheath of black polyvinyl chloride (PVC) as per IEC 60502-2.

4.2.8.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath.

- (i) 33000 VOLTS XLPE POWER AL CABLE PROPERTY OF KPLC
- (ii) Name of manufacturer
- (iii) Year of manufacture
- (iv) The number of cores, type and nominal area of conductors

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

4.3. STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the XLPE cables shall be as follows:

Conductor nominal sectional area	mm ²	95	185	300
Voltage Designation		19/33 (36) kV		
Conductor shape		compact round stranded		
Thickness of insulation	mm	8.0	8.0	8.0
Thickness of separation layer	mm	1.9	2.1	2.3
Nominal armour wire diameter	mm	2.5	2.5	3.15
Thickness of oversheath, nominal	mm	3.6	3.9	4.3
Power frequency single phase test voltage, 5min	kV	63	63	63
Maximum conductor resistance	Ω/km	0.32	0.164	0.100

Note: The Current Carrying Capacity of the cable in the ground and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A.

4.4. QUALITY MANAGEMENT SYSTEM

4.4.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards,

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33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 8 of 14	

specifications and regulations. The QAP shall be based on and include relevant parts to fulfil 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 cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of cable being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228 and IEC 60502-2. It shall be the responsibility of the supplier to perform or to have performed all the required tests.
- 5.2 Copies of previous test certificates and test reports by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

The type test reports shall include the following as per IEC 60502-2:

- a) Bending test, followed by a partial discharge test;
- b) Tan δ measurement;
- c) Heating cycle test, followed by a partial discharge test;
- d) Impulse test, followed by a voltage test;
- e) Voltage test for 4 h.

As per IEC 60502-2, when type tests have been successfully performed on a type of cable with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied:

- a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;

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Date: 2014-03-31	Date: 2014-03-31



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33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 9 of 14	

b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630 mm² are approved when the cross-sectional area of the previously tested cable is in the range of 95 mm² to 630 mm² inclusive;

c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers will witness these tests at the factory before shipment and shall include the following:

5.3.1 The routine tests as per IEC 60502-2 and are as follows:

- a) Measurement of the electrical resistance of conductors;
- b) Partial discharge test
- c) Voltage test.

5.3.2 The sample tests as per IEC 60502-2 and are as follows:

- a) Conductor examination;
- b) Check of dimensions;
- c) Voltage test;
- d) Hot set test for XLPE insulation and elastomeric sheaths.

In addition to Routine and Sample Tests as per IEC 60502-2, KPLC Engineers will verify the length on a randomly selected drum at the factory during Acceptance Testing.

5.4 Sampling (as per IEC 60502-2)

5.4.1 Samples shall be selected as per Table 1 and IEC 60502-2 for other lengths.

Table 1: Number of samples for sample tests

Cable length				Number of samples
Multicore cables		Single-core cables		
Above km	Up to and including km	Above km	Up to and including km	
2	10	4	20	1
10	20	20	40	2
20	30	40	60	3
30	40	60	80	4
40	50	80	100	5

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Date: 2014-03-31

Date: 2014-03-31



Kenya Power

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33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 10 of 14	

5.4.2 If any sample fails in any of the tests, two further samples shall be taken from the same batch and subjected to the same test or tests in which the original sample failed. If both additional samples pass the tests, all the cables in the batch from which they were taken shall be regarded as complying with the requirements of this specification. If either of the additional samples fails, the batch from which they were taken shall be regarded as failing to comply.

5.5 During delivery of the cables, 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/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 The finished cable shall be wound in one continuous length on metallic drum such as to prevent damage during transportation and handling. The drums shall be lagged with wood all round to prevent damage to the cable.

6.2 Each drum shall have one continuous length of 500m, 400m and 300m for cable sizes 3x95mm², 3x185mm² and 3x300mm² respectively. The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the drum length of cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:

- a) The manufacturer's name;
- b) The type and rating of cable;
- c) The conductor cross-sectional area in mm²;
- d) The length of the cable, in metres;
- e) The year of manufacture;
- f) The gross mass and net mass, in kilogram;
- g) The instructions for handling and use (in English Language);
- h) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

Note: The cable shall have been marked in accordance with clause 4.4

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33kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 11 of 14

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 information shall include the following:

- a) Guaranteed Technical Particulars signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;
- e) Copies of required 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) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.

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

- a) Guaranteed Technical Particulars,
- b) Design Drawings and construction details of the cable,
- c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the cables,
- f) Manufacturer's undertaking to ensure adequacy of the design,
- g) Packaging details (including packaging materials and length on drum).

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 identify of the manufacturer (as per manufacturer's authorization submitted during tendering)

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33kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 12 of 14

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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, 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 testing laboratory for tender evaluation, all in English Language)

Tender No..... Bidder's Name & Address

CLAUSE	Description	Bidder's offer
	Name and address of the Manufacturer	
	Country of manufacture	
	Manufacturer's Letter of Authorization	
	Model/Type Reference No. of the offered cable	
	Manufacturer's warranty and guarantee for the offered cable	
1	Scope: a) Design, manufacture, test, ship and deliver 3/C Aluminium XLPE insulated 33kV cables to KPLC store/site as per terms of contract b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Co. Ltd	a) b)
2	Applicable standards	
3	Terms and definitions	
4.1.1	Cable Application	
4.1.2	System Conditions	
4.1.3	Anti-termite protection	
4.1.4	Fire Performance (indicate applicable IEC standards)	
4.1.5	Minimum Design Service Life	
4.2.1.1	Applicable Standards	
4.2.1.2	Continuous Operating Temperature	
	Short Circuit Temperature (five seconds duration)	
4.2.2	Conductor	
4.2.3	Conductor Screen	
4.2.4.1	Insulation	
4.2.4.2	Insulation application	

Issued by: Head of Section, Technical Stds & Specs

Authorized by: Head of Department, R&D

Signed:

Signed:

Date: 2014-03-31

Date: 2014-03-31



Kenya Power

TITLE:
SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No. KP1/3CB/TSP/05/023

Issue No. 2

Revision No. 0

Date of Issue 2014-03-31

Page 13 of 14

CLAUSE	Description	Bidder's offer
4.2.4.3	Insulation Colour	
4.2.4.4	Individual Cores	
4.2.5	Insulation Screen (4.2.5.1 – 3)	
4.2.6	Laying-up	
4.2.7.1	Separation Layer	
4.2.7.2	Armour	
4.2.8.1	Oversheath	
4.2.8.2	Embossing on Oversheath	
4.3	Conductor nominal sectional area, mm ²	
	Voltage Designation	
	Conductor shape	
	Thickness of insulation, mm	
	Thickness of separation layer, mm	
	Armour wire diameter, mm	
	Thickness of oversheath, mm	
	Approximate overall diameter, mm	
	Power frequency withstand voltage of cable	
	Test Voltage (after installation), d.c., kV/5min	
	Maximum conductor resistance, Ω/km	
	Current carrying capacity	In air In duct
4.4.1	Quality Assurance Plan	
4.4.2	Manufacturer's Declaration of Conformity to Reference Standards	
	Copy of Manufacturer's ISO 9001:2008 Certificate	
4.4.3	Customer sales records and customer reference letters submitted to support the offer.	
5.1	Test Standard	
	Responsibility of carrying out tests	
5.2	Copies of Type Test Certificates & Type Test Reports to IEC 60502-2	
	a) Bending test, followed by a partial discharge test;	
	b) Tan δ measurement;	
	c) Heating cycle test, followed by a partial discharge test;	
	d) Impulse test, followed by a voltage test;	
e) Voltage test for 4 h		
5.3	Tests to be witnessed by KPLC Engineers at factory before shipment	

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Authorized by: Head of Department, R&D

Signed:

Signed:

Date: 2014-03-31

Date: 2014-03-31



Kenya Power

TITLE:
SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 14 of 14	

CLAUSE	Description	Bidder's offer
	1. Routine tests to IEC 60502-2	
	a) Measurement of the electrical resistance of conductors;	
	b) Partial discharge test	
	c) Voltage test.	
	2. Sample tests to IEC 60502-2	
	a) Conductor examination;	
	b) Check of dimensions;	
	c) Voltage test;	
	d) Hot set test for XLPE insulation and elastomeric sheaths	
	e) Verification of the length on a randomly selected drum	
5.4	Sampling	Sample size Acceptance criteria
5.5	Inspection & test of cable during delivery before acceptance to KPLC stores/site	
6.1	Cable Drums & Wooden Lagging	
6.2	Number of lengths on Drum Total Length of Cable on Drum	
6.3	Cable end plug sealing & securing on drum	
6.4	Marking on Cable Drum Flange	
7.1	Documents submitted with tender for evaluation	
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	
-	Manufacturing capacity of similar cable (Qty per month)	
-	Manufacturer's experience	
-	Statement of compliance to Tender Specifications	
-	Deviations from Tender Specifications	

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

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Signed:	Signed:
Date: 2014-03-31	Date: 2014-03-31

TSP/05/016



The Kenya Power & Lighting
Co. Ltd.

**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 1 of 10	

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

ANNEX A: Statement of Compliance and Technical Particulars

Issued by: Research & Development Department	Authorized by: Research & Development Manager
Signed:	Signed:
Date: 2008-03-31	Date: 2008-03-31



The Kenya Power & Lighting
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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 2 of 10	

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supplies Manager
3	Stores & Stock Control Manager
4	Technical Services Manager
5	Distribution Manager
6	Assistant Manager, Technical Audit

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)

Issued by: Research & Development Department	Authorized by: Research & Development Manager
Signed:	Signed:
Date: 2008-03-31	Date: 2008-03-31



The Kenya Power & Lighting
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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 3 of 10	

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for PVC Insulated Wiring and Auxilliary Cables. It is intended for use by KPLC in purchasing the cables.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the cables for KPLC. The manufacturer shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification

1 SCOPE

This standard specifies requirements for PVC Insulated Wiring and Auxilliary Cables.

It covers the following:

- a) PVC-insulated, non-sheathed cable for internal wiring, single core, copper
- b) PVC-insulated flexible cables and cords, copper
- c) PVC-insulated, PVC-sheathed cable with or without circuit protective conductor, flat twin, copper
- d) Multi-core auxiliary cables with copper conductors

Note: KPLC Stores Codes and Descriptions for the various sizes are in Appendix B attached.

2 REFERENCES

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

- IEC 60228: Conductors of insulated cables.
- KS 04-194: Kenya Standard Specification for PVC insulated cables for electricity supply.
- KS 04-192: Kenya Standard Specification for PVC insulated flexible cables and cords of rated voltage U_0/U up to and including 450/750V.
- KS 04-453: Kenya Standard Specification for PVC insulated cables (non-armoured) for electric power & lighting.

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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 4 of 10	

- BS 6346: British Standard Specification for PVC insulated cables for electricity supply.
- BS 6360: British Standard Specification for conductors in insulated cables and cords.
- BS 6004: British Standard Specification for PVC-insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring.
- BS 6500: British Standard Specification for Flexible cords rated up to 300/500V, for use with appliances and equipment intended for domestic, office and similar environments.

3 DEFINITIONS

The definitions given in the reference standards shall apply.

4 REQUIREMENTS

4.1 Service Conditions

The cables shall be suitable for continuous operation in tropical areas at altitudes of up to 2200m above sea level, humidity of up to 90%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C.

4.2 Design and Construction

4.2.1 (a) Conductors for the cables shall comply with IEC 60228.

(b) PVC-insulated single core and flat twin cables shall be designed and constructed to KS 04-453 and BS 6004.

(c) Flexible cables and cords shall be designed and constructed to KS 04-192 and BS 6500.

(d) Multi-core cables (armoured) shall be designed and constructed to KS 04-194 and BS 6346.

4.2.2 The cables shall be suitable for wiring, metering, control and other auxiliary applications (including underground) and where the combination of ambient temperature and temperature rise due to load results in a conductor temperature not exceeding 70°C.

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The Kenya Power & Lighting
Co. Ltd.

**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 5 of 10	

- 4.2.3 The cables shall be suitable for 240/415V 50Hz system.
- 4.2.4 The conductors shall be plain annealed copper conductors complying with IEC 60228. The conductor shape, number and nominal diameter of wires shall be as per Tables 2, 3, 4, 5 and 6.
- 4.2.5 The insulation shall be PVC compound complying with standards given in 4.2.1 above. It shall be applied by an extrusion process and shall form a compact homogeneous body.
- 4.2.6 The cores of all cables shall be identified by colours or numbers in accordance with the following sequence:

Table 1: Core identification

Type	Colours/Numbers
Single-core	Red, Black, Blue, Green or Grey
Twin-core	Red, Black
Three-core	Red, Yellow, Blue
Four-core	Red, Yellow, Blue, Black
Five-core and above (auxiliary cables)	Numbers 1, 2, 3, 4, 5.....upwards

Note: (1) The colours Red, Yellow and Blue are intended to indicate phase conductors and Black the neutral conductor.

2) The numbers shall be black printed on white cores. The interval between adjacent numbers on the same core shall not exceed 75mm.

- 4.2.7 Laying up, bedding, oversheath, armour and all tolerances shall be in accordance with design standards given in 4.2.1.

4.3 Characteristics

The cables shall be of the following characteristics:

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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 6 of 10	

Table 2: PVC insulated, non-sheathed, single-core cable with stranded copper conductors

Nominal conductor area (mm ²)	Number and size of wires (No/mm)	Thickness of insulation (mm)	Nominal overall diameter (mm)	Max d.c. resistance at 20°C (ohm/km)
1.0	1/1.13	0.6	2.5	18.1
1.5	1/1.38	0.8	2.9	12.1
2.5	7/0.67	0.8	3.8	7.41
4.0	7/0.85	1.0	4.3	4.61
6.0	7/1.04	1.0	4.9	3.08
10	7/1.35	1.0	6.8	1.83
35	19/1.53	1.2	10.3	0.524

Table 3: Twin PVC-insulated, PVC-sheathed cables with copper conductors (with or without earth)

Number & Nominal conductor area (mm ²)	Number and size of wires (No/mm)		Thickness of insulation (mm)	Thickn-ess of sheath (mm)	Nominal overall dimensions (mm)		Max d.c. resistance at 20°C (ohm/km)
	Phase	Earth			Lower limit	Upper limit	
2 x 1.5	1/1.38	-	0.7	0.9	4.5x7.2	5.6x8.8	12.1
2 x 1.5	1/1.38	1/1.0	0.7	0.9	4.4x8.2	5.4x9.6	12.1
2 x 2.5	7/0.67	-	0.8	1.0	5.2x8.6	6.6x10.5	7.41
2 x 2.5	7/0.67	7/0.67	0.8	1.0	5.2x9.8	6.6x12.5	7.41

Note: The minimum insulation resistance at 70°C for the 2 x 1.5 and 2 x 2.5 cables in Table 3 above shall be 0.011MOhm.km and 0.010MOhm.km respectively.

Table 4: PVC insulated PVC sheathed circular flexible cord with copper conductors

Number of cores & nominal cross sectional area of conductor mm ²	Thickness of insulation mm	Thickness of outer sheath, mm	Overall diameter (range), mm	Max resistance at 20°C (ohm/km)	Minimum insulation resistance at 70°C Mohm.km
3 X 0.75	0.6	0.8	6.4 – 8.0	26.0	0.011
3 X 1.0	0.6	0.8	6.8 – 8.4	19.5	0.010
3 X 2.5	0.8	1.1	9.6 – 12.0	7.98	0.009

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The Kenya Power & Lighting
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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 7 of 10	

Table 5: Armoured cables 600/1000V with copper conductors

Nominal conductor area (mm ²)	Number & size of wires (No./mm)	Thickness of insulation, mm	Diameter of armour wire, mm	Overall diameter, mm	Max resistance at 20°C (ohm/km)
2.5 (two-core)	7/0.67	0.7	0.9	13.6	7.41
2.5 (three-core)	7/0.67	0.7	0.9	14.1	7.41
2.5 (four-core)	7/0.67	0.7	0.9	15.0	7.41

Table 6: 600/1000V Auxilliary Cables with copper conductors (armoured)

Number of cores	Conductor		insulation thickness mm	extruded bedding mm	Armour diameter mm	Over sheath mm	Approx. overall diameter mm
	Area mm ²	No/ mm					
5 7 12	1.5	1/1.38	0.6	0.8	0.9 0.9 1.25	1.4 1.4 1.5	13.8 14.5 18.6
5 7 12 19	2.5	7/0.67	0.7	0.8 1.0	0.9 1.25 1.25 1.6	1.5 1.5 1.6 1.7	16.3 18.0 22.4 26.6

5 TESTS AND INSPECTION

- 5.1 The cables shall be inspected and tested in accordance with design standards listed in clause 4.2.1 and the requirements 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 (for similar cables) certified by the National Testing/ Standards Authority of the country of manufacture or its accredited testing laboratory shall be submitted with the tender for the purpose of technical evaluation, all in English.

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Authorized by: Research & Development Manager

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The Kenya Power & Lighting
Co. Ltd.

**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 8 of 10	

- 5.3 In the case of Tender award Test Reports for the cables manufactured for the purchaser (KPLC) shall be submitted to KPLC for approval before shipment/delivery. KPLC shall be invited by the supplier to witness the tests at the factory.
- 5.4 On receipt of the goods the purchaser (KPLC) may perform or have performed any of the tests specified in order to verify compliance with specification.
- 5.5 The supplier shall replace without charge to KPLC cables which upon examination or test fail to meet any of the requirements in the specification.

6 MARKING

6.1 End Marking

The end at which the sequence of core colours or core numbers is clockwise shall be marked red and the other end shall be marked green.

6.2 Embossing

The external surface of the cable shall be embossed follows:

- (i) Electric Cable
- (ii) Voltage Rating
- (iii) Property of KPLC
- (iv) Manufacturer's Name
- (v) Standard to which the Cable Complies

The letters and figures shall be raised and shall consist of upright block characters with maximum size of 13mm and minimum size of 3mm.

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The Kenya Power & Lighting
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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.	1
Revision No.	0
Date of Issue	2008-03-26
Page 9 of 10	

APPENDIX A: Statement of Compliance (to be filled and signed by the Manufacturer for all clauses and submitted together with copies of catalogues, drawings, technical data and test reports for tender evaluation)

Clause Number	Bidder's offer	Manufacturer's catalogue, drawing, technical data or tests report Reference Page to support the offer.

NB: - This schedule does not in any way substitute for detailed information required elsewhere in the specification.

Stamp and Signature of Manufacturer and Date

Issued by: Research & Development Department	Authorized by: Research & Development Manager
Signed:	Signed:
Date: 2008-03-31	Date: 2008-03-31



The Kenya Power & Lighting
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**SPECIFICATION FOR PVC
INSULATED WIRING AND
AUXILLIARY CABLES**

Issue No.

1

Revision
No.

0

Date of
Issue

2008-03-26

Page 10 of 10

APPENDIX B: KPLC STORES CODES

CODE	DESCRIPTION	Table No. in Specification
108618	CABLE, BLACK/RED, PVC, 7/1.04, 6.0MM ² , S/C, COPPER	Table 2
108620	CABLE, RED/BLACK, PVC, 19/1.53, 35MM ² , S/C, COPPER	Table 2
108628	CABLE, PVC, PVC, TWIN WITH EARTH, 1.5MM ² , COPPER	Table 3
108629	CABLE, PVC, PVC, TWIN, 2.5MM ² , COPPER	Table 3
108642	CABLE, BLACK, PVC, 7/0.67, 2.5MM ² , S/C, COPPER	Table 2
108643	CABLE, BLUE, PVC, 7/0.67, 2.5MM ² , S/C, COPPER	Table 2
108644	CABLE, GREEN, PVC, 7/0.67, 2.5MM ² , S/C, COPPER	Table 2
108645	CABLE, GREY, PVC, 7/0.67, 2.5MM ² , S/C, COPPER	Table 2
108646	CABLE, RED, PVC, 7/0.67, 2.5MM ² , S/C, COPPER	Table 2
108649	CABLE, FLEXIBLE, PVC, PVC, 3/CORE, 1.0MM ² , COPPER	Table 4
108829	CABLE, PVC, 7/CORE, 7/0.67, 2.5MM ² , SWA, COPPER	Table 6
108830	CABLE, PVC, 12/CORE, 7/0.67, 2.5MM ² , SWA, COPPER	Table 6
108840	CABLE, PVC, 2/CORE, 7/0.67, 2.5MM ² , SWA, COPPER	Table 5
108848	CABLE, PVC, 4/CORE, 7/0.67, 2.5MM ² , SWA, COPPER	Table 5
108698	CABLE, PVC, 19/CORE, 7/0.67, 2.5MM ² , SWA, COPPER	Table 6
108907	CABLE, PVC, PVC, S/C, 1.5MM ² SOLID, COPPER	Table 2
108920	CABLE, FLEXIBLE, PVC, PVC, 4/CORE, 2.5MM ² , COPPER	Table 4
108940	CABLE, GREEN, PVC, 7/1.04, 6.0MM ² , S/C, COPPER	Table 2
108917	CABLE, 10MM ² S/C COPPER PVC (Black) LV	Table 2

Issued by: Research & Development Department

Authorized by: Research & Development Manager

Signed:

[Signature]

Signed:

[Signature]

Date:

2008-03-31

Date:

2008-03-31

TITLE:

SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)

The Kenya Power & Lighting
Co. Ltd.

Doc. No. KPLC/13CB/TSP/06/021

Issue No. 1

Revision No. 0

Date of Issue 2008-04-01

Page 1 of 7

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, LABELLING AND PACKING

ANNEX A: Technical Particulars (to be filled and signed by the Manufacturer for all clauses and submitted together with catalogues, brochures, drawings, technical data and test reports for tender evaluation)

Issued by: Head of Section, Tech Stds & Specs

Authorized by: Research & Development Manager

Signed: 

Signed: 

Date: 2008-04-07

Date: 2008-04-07

TITLE

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

The Kenya Power & Lighting
Co. Ltd.

Des. No. KEP&L/STDS/TS/101/00

Issue No. 1

Revision 0

Date of Issue 2008-04-07

Page 17

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supplies Manager
3	Stores & Stock Control Manager
4	Distribution Manager
5	Assistant Manager, Technical Audit

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)

Issued by: Head of Section, Tech Stds & Specs

Authorized by: Research & Development Manager

Signed: *[Signature]*

Signed: *[Signature]*

Date: 2008-04-07

Date: 2008-04-07

The Kenya Power & Lighting
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TITLE

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

Doc. No. KPLC/3CB/TSP/06/02

Issue No. 1

Revision No. 0

Date of issue 2008-04-01

Page 1 of 7

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for All Aluminium Conductors (soft drawn). It is intended for use by KPLC in purchasing the conductors.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the conductors for KPLC. 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 All Aluminium conductors (soft drawn) intended for use on low voltage overhead power distribution lines.
- 1.2 The specification covers the following conductor sizes
- 50 sq. mm All Aluminium Conductor (soft drawn) Polyvinyl Chloride (PVC) covered
 - 100 sq. mm All Aluminium Conductor (soft drawn) Polyvinyl Chloride (PVC) covered

2. REFERENCES

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

- BS 215: Specification for Aluminium Conductors and Aluminium Conductors with Steel Reinforcement for Overhead Power Transmission. Part 1: Aluminium Stranded Conductors.
- BS 6485: PVC Covered Conductors for Overhead Power Lines.
- BS 6746: Specification for PVC insulation and sheath of electric cables.
- BS 2627: Specification for Wrought Aluminium for Electrical Purposes Wire

Issued by: Head of Section, Tech Stds & Specs

Authorized by: Research & Development Manager

Signed: *[Signature]*

Signed: *[Signature]*

Date: 2008-04-07

Date: 2008-04-07

TITLE

Doc. No: KPLCL/Specs/01/02-027

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

Issue No: 1

Revision: 0

No.:

Date of Issue: 2008-04-07

Issue:

Page:

The Kenya Power & Lighting
Co. Ltd.

3. TERMS AND DEFINITIONS

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

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The conductors shall be suitable for continuous outdoor operation in tropical areas at altitudes of up to 2200m above sea level, humidity of up to 90% average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and sea, saline conditions along the coast.

4.2. MATERIALS

Aluminium wires used in the construction of the conductor shall be soft drawn as per BS 2627.

4.3 CONSTRUCTION

4.3.1 The conductor shall be manufactured as per BS 215 part 1

4.3.2 The conductor shall be concentrically stranded, with successive layers in opposite lay but such that the outer layer shall be in the right hand spiral (+). Variation in diameter shall not exceed $\pm 1\%$ of aluminium wires

The wires in each layer shall be evenly and closely stranded

4.3.3 The conductor shall have an inner insulation of red PVC Type 112 to BS 6746 and over sheath of black PVC compound Type TM2 to BS 6746 and shall be applied by extrusion.

The insulation shall have a thickness of not less than 0.5mm with cover strength of not less than 0.8mm.

4.4. STANDARD SIZES

The Standard Sizes for the aluminium wires used in the construction of the conductors and the conductors sizes shall be as follows -

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Authorized by: Research & Development Manager

Signed:

[Signature]

Signed:

[Signature]

Date:

2008-04-07

Date:

2008-04-07

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Doc. No. KPLC1/3CB-TSP/08/021

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

Issue No. 1

Revision No. 0

Date of issue 2008-04-01

The Kenya Power & Lighting
Co. Ltd.

Page 6 of 7

CONDUCTOR	units	50 sq mm	100 sq. mm
Nominal Area of Aluminium	mm ²	50	100
Approximate overall diameter	mm	9.30	13.17
Overall diameter of covered conductors.	mm	11.7	16.0
Stranding	No/mm	7/3.10	7/4.30
Maximum d.c. resistance at 20°C	Ω/km	0.5419	0.2702

5. TESTS AND INSPECTION

- 5.1. The conductors shall be inspected, sampled and tested in accordance with the requirement of BS 215-1 (Bare Conductors), BS 6485 (PVC Covered Conductors) and 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 Type Test and Routine Test Reports issued by the National Testing/ Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited laboratory) shall be submitted with the offer for evaluation (all in English Language). A copy of the accreditation certificate for the laboratory shall also be submitted. Any translations of certificates and test reports into English shall be certified by the Testing Authority.
- 5.3. The following tests shall be done at the manufacturer's works in the presence of KPLC Engineers (2) and in accordance with BS 215-1, BS 6485 and this specification

a) The aluminium wires shall be tested in accordance with BS 215-1 and the following

ALUMINIUM WIRES	COMPLETE CONDUCTOR
1. Tensile test	1. Lay ratio of each layer
2. Wrapping test	2. Tensile strength
3. Resistivity test	3. Measurement of weight
	4. Resistance test

b) The following tests shall be carried out on the PVC covered conductor in accordance with BS 6485:

- 1. Spark Test
- 2. Conductor Resistance

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Authorized by: Research & Development Manager

Signed: *[Signature]*

Signed: *[Signature]*

Date: 2008-04-07

Date: 2008-04-07

TITLE:

Doc. No. KPLC/SCS/SP/0302

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

Rev. No. -

Revision C

No.

Date of Issue 2008-04-01

Issue

The Kenya Power & Lighting
Co. Ltd.

3. Thickness of PVC Covering
4. Conductor Examination and Test
5. PVC material

c) Construction/workmanship: The Manufacturer shall demonstrate during factory inspection/tests that the complete conductor is of good workmanship

- 5.4. Test reports shall be completed for the above tests and submitted to KPLC for approval before shipment/delivery of the conductor.
- 5.5. On receipt of the conductors the purchaser (KPLC) may perform or have performed any of the tests specified in order to verify compliance with specification

The manufacturer shall replace without charge to KPLC conductors, which upon examination, test or use, fail to meet any of the requirements in the specification

6. MARKING AND LABELLING

- 6.1 The complete conductor shall be packed on wooden drums such as to prevent damage during transportation. The wooden drums shall be made from treated timber resistant to termite attack.
- 6.2 The actual length of conductor on a drum shall not be less than the length indicated on the drum.
- 6.3 Both ends of every drum length of conductor shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. Brackets shall be secured to the drum to prevent mechanical damage
- 6.4 The following information shall be marked (in a permanent manner on one flange of the reel:
 - (a) Direction of rotation of the reel
 - (b) Type of conductor and size (cross-sectional areas in mm²)
 - (c) The length of the conductor, in metres
 - (d) Gross weight and net weight (kg)
 - (e) Manufacturer's name
 - (f) Year of manufacture
 - (g) KPLC Order Number
 - (h) The instructions for handling and use (in English Language)
 - (i) The words "PROPERTY OF KENYA POWER & LIGHTING CO"

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Authorized by: Research & Development Manager

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[Signature]

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Date:

2008-04-07

Date:

2008-04-07

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TITLE:

**SPECIFICATION FOR
ALL ALUMINIUM
CONDUCTORS
(Soft Drawn)**

Doc. No. KPLC13CB/TSP/06 021

Issue No. 1

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Date of Issue 2008-04-01

Page 1 of 7

ANNEX A: Technical Particulars (to be filled and signed by the Manufacturer for each size offered and submitted together with catalogues, brochures, drawings, technical data and test reports for tender evaluation)

TENDER NO......

Description	Guaranteed Technical Particulars for Conductor offered
1 Type and Size	
2 Service Conditions	
3 Materials Aluminium (condition/grade) PVC Insulation (type and thickness) PVC Sheath (type and thickness)	
4 Construction & Standard	
5 Nominal area of aluminium mm ²	
6 Overall diameter of bare conductor, mm	
7 Overall diameter of covered conductor, mm	
8 Stranding, No./mm Aluminium Tolerance on diameter	
9 Maximum d.c. resistance at 20°C, ohm/km	
10 Minimum breaking load, kN	
11 Approximate mass of conductor, kg/km	
12 Current carrying capacity, A (state applicable conditions)	
13 Packing, Marking & Length on drum	
14 List test reports submitted (indicate test report numbers, date, Testing Institution and their contact addresses)	
15 Manufacturer's Guarantee and Warranty	
16 List catalogues, brochures, technical data, drawings and customer sales records submitted to support the offer	
17 List Acceptance Tests to be witnessed by KPLC Engineers at the factory	
18 Statement of compliance to specification	

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

Note: This schedule does not in any way substitute for detailed information required elsewhere in the specification.

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Authorized by: Research & Development Manager

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Date: 2008-04-07

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TITLE:

SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE

Doc. No.

KP/13CB/TSP/05/001

Issue No.

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Revision
No.

0

Date of
Issue

2013-04-30

Page 1 of 16

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. SEALING, MARKING AND PACKING
7. DOCUMENTATION

ANNEX A: Guaranteed Technical Particulars (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 previous five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)

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TITLE:

SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE

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Issue No.	4
Revision No.	0
Date of Issue	2013-04-30
Page 2 of 16	

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Procurement Manager
Electronic copy (pdf) on Kenya Power server (currently: Network→stima-fprnt-001→techstd&specs)	

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 4 Rev 0	2013-04-30	Cancel and replaces 3rd Issue Rev 2 dated 2003-07-02	S. Kimitai <i>[Signature]</i>	G. Owuor <i>[Signature]</i>

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Kenya Power

TITLE:

**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.

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Issue No.

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Revision
No.

0

Date of
Issue

2013-04-30

Page 3 of 16

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Aluminium 4-core, PVC insulated, steel wire armoured cables. It is intended for use by KPLC in purchasing the cables.

1. SCOPE

1.1 This specification is for four core, stranded and compacted circular aluminium conductors, PVC insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 600 Volts to sheath, 1000 Volts between conductors and highest system voltage of 1200 Volts for use in KPLC distribution network.

1.2 This specification covers the following cable sizes:

4 x 25 mm² AL/PVC/SWA/PVC
4 x 70 mm² AL/PVC/SWA/PVC
4 x 120 mm² AL/PVC/SWA/PVC
4 x 185 mm² AL/PVC/SWA/PVC
4 x 300 mm² AL/PVC/SWA/PVC

1.3 The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for Aluminium 4-core PVC insulated, steel wire armoured cables acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good engineering practice, adherence to the specification, applicable standards and applicable regulations as well as ensuring good workmanship in the manufacture of the cables for The Kenya Power & Lighting Company.

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

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No. KP1/3CB/TSP/05/001

Issue No. 4

Revision No. 0

Date of Issue 2013-04-30

Page 4 of 16

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.

- BS 6346: 600/1000V and 1900/3300V armoured electric cables having PVC insulation;
- IEC 60502-1: Power cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV) - Part 1: Cables for rated voltages from 1kV (Um=1.2kV) up to 3kV (Um=3.6kV);
- IEC 60228: Conductors for insulated cables;
- IEC 60811-1-1: Common test methods for insulating and sheathing materials of electric cables:-
Part 1: Methods for general application;
Section 1: Measurements of thickness and overall dimensions - Tests for determining the mechanical properties;
- KS 04-187: Specification for conductors of insulated cables.

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in BS 6346, IEC 60228, IEC 60502-1 and KS 04-187 apply, together with the following:

- Al: Aluminium
PVC: Polyvinyl Chloride
SWA: Steel Wire Armour

4. REQUIREMENTS

4.1 SERVICE AND SYSTEM CONDITIONS

4.1.1 Cable Application

- a) The cable shall be a distribution cable for use in outdoors installations and tropical conditions (temperature range of -1°C to +40°C, humidity of upto 90% and saline conditions along the coast).

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.

KP1/3CB/TSP/05/001

Issue No.

4

Revision
No.

0

Date of
Issue

2013-04-30

Page 5 of 18

- b) The cable shall be suitable for laying in cable ducts and in the ground in power stations and customer installations.
- c) The cable shall also be suitable for laying on slopes.
- d) Permissible continuous loading operating temperature shall be 70°C.

4.1.2 Operating Voltage

The rated operating voltage (U_0/U), required by this specification is 600/1000 V at 50Hz a.c.

4.2. CABLE CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured in accordance with requirements of IEC 60228 and IEC 60502-1 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and suitable for the continuous operating temperature of the cable of 70°C and short circuit temperature of 160°C (5 seconds max duration) as per IEC 60502-1.

4.2.2. Conductors

The cable shall be made from stranded circular compact plain aluminium conductors, class 2 in accordance with IEC 60228 and KS 04-187, and as specified in the table 1 in clause 4.3 of this specification.

4.2.3. Insulation

4.2.3.1 Material

The insulation shall be extruded dielectric of type PVC/A in accordance with the requirements of IEC 60502-1.

The insulation shall be applied by extrusion to form a compact and homogeneous layer.

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.	KP1/3CB/TSP/05/001
Issue No.	4
Revision No.	0
Date of Issue	2013-04-30
Page 6 of 16	

4.2.3.2 Insulation Thickness

The average thickness of insulation when determined in accordance with IEC 60811-1-1, shall not be less than the nominal values given in table 1 of clause 4.3 as appropriate, and the smallest of the measured values shall not fall below the nominal value by more than (10%+0.1mm).

4.2.3.3 Identification of Cores

Cores shall be identified by colouring throughout the insulation material. Colours of the cores shall be in the following sequence:- Red, Yellow, Blue and Black.

Black colour shall be used only for Neutral.

4.2.4. Laying up

Cores shall be laid up with a right hand direction of lay. Non-hygroscopic fillers shall be applied integrally with the bedding of armoured cable to form a compact and circular cable.

A plastic binder tape shall be applied over the laid up cores of the cable.

There shall be no adhesion between the bedding of armoured cable or the sheath and insulation. Where the bedding or sheath is applied integrally with fillers, it shall be possible to strip it from the cable without damaging the insulation.

4.2.5. Bedding

4.2.5.1 Material

Bedding of four core cables shall comprise of extruded layers of polymeric material compatible with the underlying insulation and suitable for use at the operating temperatures of the cable.

The bedding shall not adhere to the underlying cores.

4.2.5.2 Bedding Thickness

The average thickness of the bedding, when determined in accordance with IEC 60811-1-1 shall not be less than the nominal value given in table 1 of clause 4.3 as

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.

KP1/3CE/TSP/05/001

Issue No.

4

Revision
No.

0

Date of
Issue

2013-04-30

Page 7 of 16

appropriate and the smallest of the measured values shall not fall below the nominal value by more than (20%+0.2mm).

4.2.6. Armour

4.2.6.1 General

Armour for the four core cable shall comprise a single layer of circular galvanized steel wires. The armour wires shall be applied helically with a left hand lay and shall fully comply with the requirements of BS 6346 and IEC 60502-1.

4.2.6.2 Wire diameter

The nominal diameter of the wires shall be as specified in clause 4.3 table 1.

4.2.6.3 Electrical Resistance

When measured and corrected to 20^o C, the electrical resistance of the armour of the completed cable shall not exceed the appropriate value given in clause 4.3 table 1.

4.2.7. Outer Sheath

4.2.7.1 General

The outer sheath of the cable shall comprise an extruded layer of BLACK PVC in accordance with the requirements of BS 6346. The PVC shall be of type ST1 with maximum conductor temperatures in normal operations of 80^oC as per the requirements of IEC 60502-1.

4.2.7.2 Thickness

The average thickness of the outer sheath, when determined in accordance with IEC 60811-1-1, shall be not less than the nominal value given in table 1 of clause 4.3 as appropriate and the smallest of the measured values shall not fall below the nominal value by more than (20%+0.2mm).

4.2.7.3 Marking

The external surface of the cable shall be legibly embossed with the following information on two lines running parallel to the length of the cable, approximately equally spaced around the circumference of the cable.

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.	KP1/3CB/TSP/05/001
Issue No.	4
Revision No.	0
Date of Issue	2013-04-30
Page 8 of 16	

Electric Cable 600/1000 V Manufacturers Name Description of Cable
PROPERTY OF KPLC

For example, for 4-core, 25mm², PVC insulated cable manufactured by manufacturer XYZ, the legend would read as follows: Electric Cable 600/1000V XYZ 4x25mm² AL PVC/SWA/PVC PROPERTY OF KPLC

Note: The bedding material is not included in the PVC/SWA/PVC naming convention.

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm. In addition, each cable shall be sequentially marked by indelible printing, indenting or other suitable means, at 1m intervals, to indicate the approximate length of cable remaining on the drum. The numbers shall start with 001, 1m from the inner end of cable and continue every metre to the outer end.

4.3. STANDARD SIZES AND CHARACTERISTICS

Table 1: Mechanical and Electrical characteristics of standard sizes of PVC cables

Conductor nominal sectional area	mm ²	25	70	120	185	300
Number of cores		4	4	4	4	4
Voltage Designation U _o /U (U _m)		600/1000 (1200) V				
Conductor shape		Stranded shaped compacted				
Nominal insulation thickness	mm	1.2	1.4	1.6	2.0	2.4
Bedding thickness	mm	1.0	1.2	1.4	1.6	1.6
Average outer sheath thickness	mm	1.8	2.1	2.4	2.6	3.0
Armour wire diameter	mm	1.6	2.0	2.5	2.5	2.5
Armour wire resistance at 20 ^o C	Ω/km	2.1	1.2	0.71	0.59	0.47
Minimum number of wires in the conductor	no	6	12	15	30	30
Minimum diameter of the conductors	mm	5.6	9.3	12.3	15.3	19.7
Maximum diameter of the conductors	mm	6.5	10.2	13.5	16.8	21.6
Outer diameter of cable	mm	27.8	39.2	49.3	59	72
Maximum conductor resistance at 20 ^o C	Ω/km	1.2	0.443	0.253	0.164	0.100
Minimum insulation resistance of cable for 1000m at 20 ^o C	MΩ	10	10	10	10	10
Approximate weight of cable	Kg/Km	1440	2830	4650	6440	9240
Approximate length of cable on drum	m	3000	2000	1000	750	500

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SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE

Doc. No.

KP1/3CB/TSP/05/001

Issue No.

4

Revision
No.

0

Date of
Issue

2013-04-30

Page 9 of 16

Note:

The Current Carrying Capacity of the cable underground, in ducts and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A

Table 2: Mechanical characteristics of Insulating and Sheathing compounds (before and after ageing)

Designation of compound	Unit	PVC/A	ST1
Maximum conductor temperature in normal operation	°C	70	80
Without ageing (IEC 60811-1-2, sub clause 9.1)			
Tensile strength, minimum	N/mm ²	12.5	12.5
Elongation-at-break, minimum	%	150	150
After ageing in air oven IEC 60811-1-2, sub clause 8.1 After ageing without conductor Treatment			
> Temperature	°C	100	100
> Tolerance	°C	±2	±2
> Duration	h	168	168
Tensile strength			
> Value after ageing, minimum	N/mm ²	12.5	12.5
> Variation, maximum	%	±25	±25
Elongation-at-break			
> Value after ageing, minimum	%	150	150
> Variation, maximum	%	±25	±25

5. TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, BS 6346, IEC 60811-1-1 and IEC 60502-1. It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.
- 5.2 Copies of previous Type Tests 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. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender (all in English Language)

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.	KP1/3CB/TSP/05/001
Issue No.	4
Revision No.	0
Date of Issue	2013-04-30
Page 10 of 16	

5.2.1 Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall include the following:

5.2.1.1 Electrical Type Tests

- a) Insulation resistance measurement at ambient temperature tests.
- b) Insulation resistance measurement at maximum conductor temperature test.
- c) Voltage test for 4h.
- d) Impulse test for completed cable.

5.2.1.2 Non Electrical Type Tests

5.2.1.2.1 Mechanical strength tests for PVC/A insulation and ST1 over sheath.

- a) Tensile strength and elongation-at-break tests: without ageing; after ageing in an air, oven and after ageing of pieces of complete cable.

5.2.1.2.2 Thermoplastic properties of insulation and over sheath.

- a) Hot pressure tests (indentation) test.
- b) Behavior at low temperatures tests.

5.2.1.2.3 Heat shock tests

5.2.1.2.4 Water absorption tests

5.2.2 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers will witness tests at the factory before shipment.

5.2.3 Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with BS 6346, IEC 60228, IEC 60502-1, this specification and shall include the following:

5.2.3.1 Routine Tests

- a) Spark test on cores.
- b) Spark test on over sheath of armoured cables.
- c) Voltage test on completed cables.
- d) Insulation resistance tests.

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No. KP1/3CB/TSP/05/001

Issue No. 4

Revision No. 0

Date of Issue 2013-04-30

Page 11 of 18

- e) Conductor resistance tests.
- f) Armour resistance tests.

5.2.3.2 Sample Tests

- a) Measurement of insulation thickness
- b) Measurement of extruded bedding and over sheath thickness
- c) Conductor examination – physical tests and check of dimensions

6. SEALING, PACKING AND MARKING

6.1 Sealing

Before dispatch, the ends of the cable shall be sealed with closing fitting PVC end caps to prevent the ingress of water during transportation and storage.

The sealing shall enclose the oversheath completely.

6.2 Packing

Cables shall be wound on to non-returnable wooden drums, close battened to prevent damage during transportation or storage. The wood shall be treated to resist biological attacks. The drums shall have wooden lagging all round, with no gaps.

Each drum shall contain only one continuous length of cable which shall be of the length indicated in table 1, clause 4.3 above in length. The actual length of cable shall not be less than the length indicated on the drum

Both ends of the cable shall be secured to the drum to prevent mechanical damage

6.3 Marking

6.3.1 Each drum shall be legibly and indelibly marked with the following information on the flange:

- a) The manufacturer's trade name;
- b) The year of manufacture.
- c) The rated voltage of the cable, 600/1000 (1200) V
- d) The type of cable. For example AL 4 core PVC/SWA/PVC;
- e) The conductor cross-sectional areas in mm²;

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No. KP1/3CB/TSP/05/001

Issue No. 4

Revision No. 0

Date of Issue 2013-04-30

Page 12 of 16

- f) The length of the cable, in metres;
- g) The identifying serial number;
- h) The words "NOT TO BE LAID FLAT" or a suitable pictogram;
- i) An arrow and words, "ROLL THIS WAY", on each flange of the drum to indicate in which direction the drum shall be rolled in order to prevent the cable from unwinding.
- j) A capital letter "T" approximately 50mm high surrounded by a circle with an approximate outside diameter of 65mm, if the wood has been treated to resist biological attack.
- k) The gross mass of the drum and net mass cable, in kilogram;
- l) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

6.3.2 The following information shall be printed on a suitable label. This label shall be firmly attached to one of the flanges of the drum:

- a) The year of manufacture;
- b) The rated voltage of the cable 600/1000 V;
- c) The type of cable. For example 4-core PVC/SWA/PVC;
- d) The conductor size in mm²;
- e) The length of the drum in metres;
- f) The gross mass of the cable and drum in Kg.
- g) An identifying serial number;
- h) The purchasers name. For example, "PROPERTY OF KENYA POWER & LIGHTING CO."
- i) The order number;
- j) Any other contract particulars.

Note: The cable shall have been marked in accordance with clause 4.2.7.3

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation.

- a) Guaranteed Technical Particulars;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;
- e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025; the Type Test Reports shall not be more than five years old.

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TITLE:

**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No. KP1/3CB/TSP/05/001

Issue No. 4

Revision No. 0

Date of Issue 2013-04-30

Page 13 of 16

f) Copy of accreditation certificate for the testing laboratory.

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

- a) Guaranteed Technical Particulars,
- b) Design drawings and construction details of the cable,
- c) Quality Assurance Plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the cables,
- f) Manufacturer's undertaking to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards in the manufacture of the cables for KPLC,
- g) Packaging details (including packaging materials, lagging and length on drum).

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TITLE:

**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No. KP1/3CB/TSP/05/001

Issue No. 4

Revision No. 0

Date of Issue 2013-04-30

Page 14 of 16

ANNEX A: Guaranteed Technical Particulars (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, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)

Table 3: Guaranteed Technical Particulars.

1 Item	2 Description	Units	3 Schedule 1 (KPLC)	4 Schedule 2 (Tenderer)
1	Manufacturer		Specify	
2	Country of manufacture		Specify	
3	Name and address of Bidder		Specify	
4	Service conditions			
	a) Cable application		Specify	
	b) Operating voltage	V	Specify	
5	Cable construction			
	a) Design			
	• Standards applicable		Specify	
	• Materials characteristics		Specify	
	b) Conductors types	mm ²	25, 70, 120, 185, 300	
	c) Insulation			
	• Materials		PVC/A	
	• Insulation thickness	mm	Specify	
	• Identification of cores	no	Specify	
	d) Laying up		Specify	
	e) Bedding			
	• Bedding material		Specify	
	• Bedding thickness	m	Specify	
	f) Armour			
	• Armour material		Galvanized steel	
	• Armour wire diameter	mm	Specify	
	• Armour wire electrical resistance at 20°C	Ω/km	Specify	
	g) Outer sheath			

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**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.

KP1/3CB/TSP/05/001

Issue No.

4

Revision
No.

0

Date of
Issue

2013-04-30

Page 15 of 16

	<ul style="list-style-type: none"> Outer sheath material 		PVC type ST1	
	<ul style="list-style-type: none"> Thickness 	mm	Specify	
	<ul style="list-style-type: none"> Marking 		Specify	
6	Standards and Characteristics			
	a) Conductor nominal x-sectional area	mm ²	Specify	
	b) Number of cores	no	Specify	
	c) Voltage designation U ₀ /U(U _m)	V	Specify	
	d) Conductor shape		Specify	
	e) Nominal insulation thickness	mm	Specify	
	f) Inner sheath thickness	mm	Specify	
	g) Average sheath thickness	m	Specify	
	h) Armour wire thickness	mm	Specify	
	i) Number of wires in the conductor	no	Specify	
	j) Average diameter of the conductors	mm	Specify	
	k) Outer diameter of conductors	mm	Specify	
	l) Maximum conductor resistance at 20°C	Ω	Specify	
	m) Minimum insulation resistance of cable for 1000m at 20°C	MΩ	Specify	
	n) Approximate weight of cable	Kg	Specify	
	o) Approximate length of cable on drum	m	Specify	
	p) Current carrying capacity			
	<ul style="list-style-type: none"> air 	A	Specify	
	<ul style="list-style-type: none"> duct 	A	Specify	
	<ul style="list-style-type: none"> underground 	A	Specify	
	q) Power frequency withstand voltage	V	Specify	
7	Copies of type test reports to be submitted with tender for evaluation		As per clauses 5.2.1.1 and 5.2.1.2	
8	List of Tests to be witnessed by KPLC Engineers at the factory before shipment		As per clauses 5.2.3.1 and 5.2.3.2	
9	Embossing of the cable over sheath (parameters to be indicated and method of marking)		Specify	
10	Marking of cable drum (parameters to be indicated and method of marking)		Specify	
11	Packing (treated wooden drum and lagging)		Specify	

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TITLE:

**SPECIFICATION FOR ALUMINUM
4-CORE PVC INSULATED,
STEELWIRE ARMoured CABLE**

Doc. No.	KP1/3CB/TSP/05/001
Issue No.	4
Revision No.	0
Date of Issue	2013-04-30
Page 16 of 16	

12	Length of cable on the drum (shall be in one continuous length)	Specify		
13	Installation and technical manuals to be provided during delivery	Specify		
14	List of catalogues, brochures, drawings, technical data and customer sales records submitted to support the offer.	Specify		
15	Statement of compliance to tender specifications	Specify		
16	Deviations from tender specifications	Specify		
17	Inspection/Tests by KPLC during delivery before acceptance to stores/site.	Specify		

NB: - This schedule does not in any way substitute for detailed information required elsewhere in the specification.

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

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Kenya Power

TITLE:

SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

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, LABELLING AND PACKING
7. DOCUMENTATION

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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 testing laboratory for tender evaluation, all in English Language)

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SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 2 of 14

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supply Chain Manager – Procurement
Electronic copy (pdf) on The Kenya Power & Lighting Company 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)
Issue3 Rev 0	2014-03-31	Cancel and replaces Issue 2 Rev 0 dated 2012- 11-05	S. Kimitei 	G. Owuor

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11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 3 of 14	

FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Distribution Division both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for three core XLPE insulated aluminium cables, 11kV. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for three core, stranded aluminium conductors, XLPE insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 6350 Volts to sheath, 11000 Volts between conductors and highest system voltage of 12000 Volts for use in KPLC distribution network operated at 50Hz.

The specification is for the following sizes of 11kV cables:

3 x 95 mm² AL/XLPE/SWA/PVC

3 x 185 mm² AL/XLPE/SWA/PVC

3 x 300 mm² AL/XLPE/SWA/PVC

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted together with other required details for tender evaluation.

The specification stipulates the minimum requirements for three core XLPE insulated aluminium 11kV cables 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 cables for The Kenya Power & Lighting Company Ltd.

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

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Date: 2014-03-31

Date: 2014-03-31



Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 5 of 14

f) Permissible short circuit temperature shall be 250°C (for short-circuit duration of 5s as per IEC 60502).

4.1.2 The cables shall be connected to underground system operating at a nominal voltage of 11kV, 50Hz and maximum system voltage of 12kV and are solidly earthed at the transformer neutrals. The short circuit fault level shall be taken as 25kA 3s.

4.1.3 The cables shall have suitable anti-termite protection (details to be submitted by supplier to KPLC for approval before manufacture).

4.1.4 The cable shall have an oversheath with a fire performance that conforms to the requirements IEC standards.

4.1.5 The cable shall be designed for reliable service life of at least 30 years.

4.2. MATERIALS AND CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured to BS 6622, IEC 60502-2 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and the cable shall have continuous operating temperature of 90°C and short circuit temperature of 250°C (5 seconds duration) as per IEC 60502-2.

4.2.2. Conductor

The cable shall be made from circular stranded compacted plain aluminium conductor that conforms to IEC 60228.

4.2.3. Conductor Screen

4.2.3.1 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3.2 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

4.2.4. Insulation

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Date: 2014-03-31



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11kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 6 of 14

4.2.4.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.

4.2.4.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.

4.2.4.3 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

4.2.4.4 Individual cores shall be identified by coloured tape over the insulation and the colours shall be Red, Yellow and Blue.

4.2.5. Insulation Screen

4.2.5.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.

4.2.5.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.

4.2.5.3 A metallic screen shall be applied around each core. The screen shall consist of helically applied overlapped copper tape. An energy absorbing bedding layer should be applied.

4.2.6. Laying-up

4.2.6.1 The cores shall be laid-up with a right hand direction of lay. Fillers of non-hygroscopic material shall be used to form a substantially compact and circular cable.

4.2.6.2 The metallic screens of the three cores shall be in contact with each other.

4.2.7. Armour

4.2.7.1 An extruded separation layer of black polyvinyl chloride (PVC) shall be applied between the laid-up cores and the armour.

4.2.7.2 The armour shall consist of a single layer of round galvanized steel wires applied helically with a left-hand lay.

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Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 7 of 14

4.2.8. Oversheath

4.2.8.1 There shall be an extruded oversheath of black polyvinyl chloride (PVC) as per IEC 60502-2.

4.2.8.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath.

- (i) 11000 VOLTS XLPE POWER AL CABLE PROPERTY OF KPLC
- (ii) Name of manufacturer
- (iii) Year of manufacture
- (iv) The number of cores, type and nominal area of conductors

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

4.3. STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the XLPE cables shall be as follows:

Conductor nominal sectional area	mm ²	95	185	300
Voltage Designation		6.35/11 (12) kV		
Conductor shape		compact round stranded		
Thickness of insulation	mm	3.4	3.4	3.4
Thickness of separation layer	mm	1.5	1.7	1.9
Nominal armour wire diameter	mm	2.5	2.5	3.15
Thickness of oversheath, nominal	mm	2.8	3.2	3.6
Approximate overall diameter	mm	62.6	74.1	86.8
Power frequency test voltage, 5 min	kV	42	42	42
Maximum conductor resistance	Ω/km	0.32	0.164	0.100

Note: The Current Carrying Capacity of the cable in the ground and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A.

4.4. QUALITY MANAGEMENT SYSTEM

4.4.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards,

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**SPECIFICATION FOR CABLE
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Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 8 of 14

specifications and regulations. The QAP shall be based on and include relevant parts to fulfil 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 cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of cable being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228 and IEC 60502-2. It shall be the responsibility of the supplier to perform or to have performed all the required tests.

5.2 Copies of previous test certificates and test reports by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

The type test reports shall include the following as per IEC 60502-2:

- a) Bending test, followed by a partial discharge test;
- b) Tan δ measurement;
- c) Heating cycle test, followed by a partial discharge test;
- d) Impulse test, followed by a voltage test;
- e) Voltage test for 4 h.

As per IEC 60502-2, when type tests have been successfully performed on a type of cable with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied:

- a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;

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**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 9 of 14	

- b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630 mm² are approved when the cross-sectional area of the previously tested cable is in the range of 95 mm² to 630 mm² inclusive;
- c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers will witness these tests at the factory before shipment and shall include the following:

- 5.3.1 The routine tests as per IEC 60502-2 and are as follows:
 - a) Measurement of the electrical resistance of conductors;
 - b) Partial discharge test
 - c) Voltage test.

- 5.3.2 The sample tests as per IEC 60502-2 and are as follows:
 - a) Conductor examination;
 - b) Check of dimensions;
 - c) Voltage test;
 - d) Hot set test for XLPE insulation and elastomeric sheaths.

In addition to Routine and Sample Tests as per IEC 60502-2, KPLC Engineers will verify the length on a randomly selected drum at the factory during Acceptance Testing.

5.4 Sampling (as per IEC 60502-2)

5.4.1 Samples shall be selected as per Table 1 and IEC 60502-2 for other lengths.

Table 1: Number of samples for sample tests

Cable length				Number of samples
Multicore cables		Single-core cables		
Above km	Up to and including km	Above km	Up to and including km	
2	10	4	20	1
10	20	20	40	2
20	30	40	60	3
30	40	60	80	4
40	50	80	100	5

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Date: 2014-03-31



Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 10 of 14

5.4.2 If any sample fails in any of the tests, two further samples shall be taken from the same batch and subjected to the same test or tests in which the original sample failed. If both additional samples pass the tests, all the cables in the batch from which they were taken shall be regarded as complying with the requirements of this specification. If either of the additional samples fails, the batch from which they were taken shall be regarded as failing to comply.

5.5 During delivery of the cables, 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/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 The finished cable shall be wound in one continuous length on metallic drum such as to prevent damage during transportation and handling. The drums shall be lagged with wood all round to prevent damage to the cable.

6.2 Each drum shall have one continuous length of 500m, 400m and 300m for cable sizes 3x95mm², 3x185mm² and 3x300mm² respectively. The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the drum length of cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:

- a) The manufacturer's name;
- b) The type and rating of cable;
- c) The conductor cross-sectional area in mm²;
- d) The length of the cable, in metres;
- e) The year of manufacture;
- f) The gross mass and net mass, in kilogram;
- g) The instructions for handling and use (in English Language);
- h) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

Note: The cable shall have been marked in accordance with clause 4.4

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Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 11 of 14

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 information shall include the following:

- a) Guaranteed Technical Particulars signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;
- e) Copies of required 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) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.

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

- a) Guaranteed Technical Particulars,
- b) Design Drawings and construction details of the cable,
- c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the cables,
- f) Manufacturer's undertaking to ensure adequacy of the design,
- g) Packaging details (including packaging materials and length on drum).

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 identify of the manufacturer (as per manufacturer's authorization submitted during tendering)

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11kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 12 of 14	

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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, 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 testing laboratory for tender evaluation, all in English Language)

Tender No..... Bidder's Name & Address

CLAUSE	Description	Bidder's offer
	Name and address of the Manufacturer	
	Country of manufacture	
	Manufacturer's Letter of Authorization	
	Model/Type Reference No. of the offered cable	
	Manufacturer's warranty and guarantee for the offered cable	
1	Scope: a) Design, manufacture, test, ship and deliver 3/C Aluminium XLPE insulated 11kV cables to KPLC store/site as per terms of contract b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Co. Ltd	a) b)
2	Applicable standards	
3	Terms and definitions	
4.1.1	Cable Application	
4.1.2	System Conditions	
4.1.3	Anti-termite protection	
4.1.4	Fire Performance (indicate applicable IEC standards)	
4.1.5	Minimum Design Service Life	
4.2.1.1	Applicable Standards	
4.2.1.2	Continuous Operating Temperature Short Circuit Temperature (five seconds duration)	
4.2.2	Conductor	
4.2.3	Conductor Screen	
4.2.4.1	Insulation	
4.2.4.2	Insulation application	

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Date: 2014-03-31

Date: 2014-03-31



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 11KV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 13 of 14	

CLAUSE	Description	Bidder's offer
4.2.4.3	Insulation Colour	
4.2.4.4	Individual Cores	
4.2.5	Insulation Screen (4.2.5.1 – 3)	
4.2.6	Laying-up	
4.2.7.1	Separation Layer	
4.2.7.2	Armour	
4.2.8.1	Oversheath	
4.2.8.2	Embossing on Oversheath	
4.3	Conductor nominal sectional area, mm ²	
	Voltage Designation	
	Conductor shape	
	Thickness of insulation, mm	
	Thickness of separation layer, mm	
	Armour wire diameter, mm	
	Thickness of oversheath, mm	
	Approximate overall diameter, mm	
	Power frequency withstand voltage of cable	
	Test Voltage (after installation), d.c., kV/5min	
	Maximum conductor resistance, Ω/km	
	Current carrying capacity	In air In duct
4.4.1	Quality Assurance Plan	
4.4.2	Manufacturer's Declaration of Conformity to Reference Standards	
	Copy of Manufacturer's ISO 9001:2008 Certificate	
4.4.3	Customer sales records and customer reference letters submitted to support the offer.	
5.1	Test Standard	
	Responsibility of carrying out tests	
5.2	Copies of Type Test Certificates & Type Test Reports to IEC 60502-2	
	a) Bending test, followed by a partial discharge test;	
	b) Tan δ measurement;	
	c) Heating cycle test, followed by a partial discharge test;	
	d) Impulse test, followed by a voltage test;	
	e) Voltage test for 4 h	
5.3	Tests to be witnessed by KPLC Engineers at factory before shipment	

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**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 14 of 14	

CLAUSE	Description	Bidder's offer
	1. Routine tests to IEC 60502-2	
	a) Measurement of the electrical resistance of conductors;	
	b) Partial discharge test	
	c) Voltage test.	
	2. Sample tests to IEC 60502-2	
	a) Conductor examination;	
	b) Check of dimensions;	
	c) Voltage test;	
	d) Hot set test for XLPE insulation and elastomeric sheaths	
	e) Verification of the length on a randomly selected drum	
5.4	Sampling	
	Sample size	
	Acceptance criteria	
5.5	Inspection & test of cable during delivery before acceptance to KPLC stores/site	
6.1	Cable Drums & Wooden Lagging	
6.2	Number of lengths on Drum	
	Total Length of Cable on Drum	
6.3	Cable end plug sealing & securing on drum	
6.4	Marking on Cable Drum Flange	
7.1	Documents submitted with tender for evaluation	
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	
-	Manufacturing capacity of similar cable (Qty per month)	
	Manufacturer's experience	
-	Statement of compliance to Tender Specifications	
-	Deviations from Tender Specifications	

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

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THE KENYA POWER AND LIGHTING CO. LTD.

SPECIFICATION for LV SINGLE CORE ALUMINIUM CABLES

REVISION RECORD

REVISION	DESCRIPTION OF REVISION	DATE	APPROVAL
0	1 ST ISSUE	March 1997	
1	2 nd ISSUE	2002-09-06	<i>[Signature]</i> Aug 01

CONTENTS.

Foreword

Introduction

1. Scope
2. References
3. Terms and Definitions
4. Requirements
 - 4.1 Service conditions
 - 4.2 Materials and Construction
 - 4.3 Standard Sizes (Characteristics)
5. Tests
6. Notices
7. Packing

FORE WORD

This standard specification has been prepared by the Research and Development Department of the Planning Research and Performance Monitoring Division, KPLC and lays down specification for LV single core PVC insulated cables.

This specification is intended for procurement of materials and does not include provision of contract.

This specification is based on IEC 502 and BS 6346. It is subject to revision as and when required.

This specification supersedes all specifications for LV single core PVC insulated cables issued before the revision date.

INTRODUCTION

This specification was prepared to establish and promote uniform requirements for Low voltage single core, PVC insulated, steel wire armoured cables. The specification stipulates the minimum requirements for equipment acceptable for evaluation

SINGLE CORE LV ALUMINIUM CABLE (PVC).

1. SCOPE

- 1.1. This specification is for single core, stranded aluminium conductors, polyvinyl chloride (PVC) insulated, armoured, PVC outer sheathed power cables for operation upto and including 600 volts to sheath and 1000 volts between conductors.
- 1.2. This specification is for following cable sizes:-
 - 630 sq. mm Aluminium conductor PVC insulated single core cable
 - 300 sq. mm Aluminium conductor PVC insulated single core cable

2. REFERENCES

The following documents were referred to during the preparation of this specification. In cases of conflict, the provisions of this specification shall take precedence.

Unless otherwise specified, the latest revision, edition and amendments shall apply.

IEC 228(1978):- Conductors of insulated cables

IEC 502:(1983):- Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto 30 kV

IEC 811:- Common test methods for insulating and sheathing materials of electric cables

BS 6346(1969):- PVC - insulated cables for Electricity supply (with 1974 amendments).

3 TERMS AND DEFINITIONS

For the purpose of this specification, the definitions in IEC 228 and IEC 502 shall apply.

4 REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 Operating conditions

The cables shall be suitable for continuous operation in tropical areas with the following atmospheric conditions.

- (a) Altitude: From sea level up to 2200m above mean sea level.

(b) Humidity: Polluting saline atmosphere in coastal areas and where humidity is 90% and up country area where air is relatively clean and humidity not below 50%.

(c) Ambient temperatures of +30° C average, (+40° C Max. and -1° C Min).

4.2. MATERIAL AND CONSTRUCTION

- 4.2.1. The cable in general shall be designed and manufactured according to the requirement of IEC 227, IEC228 and BS 6346.
- 4.2.2. The phase conductors of the cable shall be made from circular stranded compact plain aluminium conductor as per IEC 228.
- 4.2.3. The insulation shall be polyvinyl chloride (PVC) complying with the requirement of IEC 502 for type PVC/A and shall be suitable for climatic conditions described.
- 4.2.4. The insulation shall be applied by extrusion process and shall form a compact homogeneous body.
- The insulation shall concentrically cover the conductor
- 4.2.5. Where necessary, the cable shall be cored with suitable non-hydroscopic inner covering and filler to make a substantially circular cable.
- 4.2.6. Extruded oversheath shall be of black polyvinyl chloride (PVC).
- 4.2.7. The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath. Letters and figures, raised and consist of upright block characters. Minimum size of characters not less than 15% of average overall cable diameter.

(i) 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC.

(ii) Year of manufacture.

(iii) Size of cable

(Example: '630 SQ MM 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC 2000')

4.3. STANDARD SIZES AND CHARACTERISTICS

4.3.1 The characteristics of the cables shall comply with the following table

Item		Characteristics
Conductor resistance		Not more than the value indicated
A.C. withstand voltage		To withstand the indicated value for 5 min.
Insulation resistance		Not less than the value indicated.
Tensile strength and elongation	PVC	Tensile strength, minimum 12.5N/mm (1.27 Kg/mm)
	PVC	Elongation , minimum percentage of unaged value 150% 75 - 125%
Ageing requirement*		

* Properties after Ageing in air oven:

temperature	100 ± 2°C
duration of treatment	168 hrs

4.3.2 The standard sizes for the PVC cables shall be as follows:-

Cable size	630 sq. mm	300 sq. mm
Nominal sectional area	630 sq. mm	300 sq. mm
Thickness of insulation	2.8 mm	2.4 mm
Thickness of outer sheath	2.2 mm	2.2 mm
Nominal overall diameter	38.8mm	28.0 mm
Approximate net weight	3400 kg/km	2100 kg/km
Test voltage	3kV/5min	3kV/5min
Maximum d.c. resistance at 20° C	0.047 ohms/km	0.1 ohms/km
Maximum a.c. resistance (70°C)	0.07 ohms/km	0.133 ohms/km

5. TESTS

- 5.1 The manufacturer shall be responsible for performing or for having performed all the required tests specified in this specification. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.
- 5.2 The cable cores, sheath and completed cable shall be tested in accordance with the requirements of IEC 811 and BS 6346. Test certificates shall be certified by the National Testing or the National Standards Institute of the country of origin. Sample copies for similar material shall be presented with the tender for the purpose of technical evaluation.

Test reports shall be completed and made available for approval before shipment of the materials.

All materials shall be subjected to inspection by KPLC Engineers or her representative at place of manufacture and all routine tests carried out in their presence.

Routine tests shall be carried out by KPLC staff on the material upon delivery to counter check compliance with specification and factory test reports.

6 NOTICES

- 6.1 Draft design and construction drawings shall be submitted to KPLC before the manufacturing of cables commence. KPLC undertake to submit their comments or approval for the drawings within three weeks of receiving the draft copies.
- 6.2 Tenders with substantial deviation but offering superior materials shall be accompanied by detailed descriptive manuals, drawings and certified test reports for the purposed of technical evaluation.
- 6.3 A detailed list & contact address of previous customers shall be submitted with the tender. List of workshop tools and equipment shall also be appended.

7. PACKING

- 7.1. The cable shall be wound on wooden drums such as to prevent damage during transportation. The wooden drums shall be made from treated timber resistant to termite attack.
- 7.2. The following description shall be marked on one flange of the reel
 - (a) Direction of rotation of the reel
 - (b) Type of cable
 - (c) Number of conductors and size
 - (d) Cable Length
 - (e) Net weight and gross weight
 - (f) Manufacturer's name
 - (g) Year of manufacture

END SEPTEMBER 2000

100

0

3

100



Kenya Power

TITLE:

SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

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, LABELLING AND PACKING
7. DOCUMENTATION

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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 testing laboratory for tender evaluation, all in English Language)

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Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 2 of 14

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supply Chain Manager – Procurement
Electronic copy (pdf) on The Kenya Power & Lighting Company 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)
Issue 2 Rev 0	2014-03-31	Cancel and replaces Issue 1 Rev 0 dated 2007- 05-09	S. Kimitei 	G. Owuor

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TITLE:
**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 3 of 14	

FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Distribution Division both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for three core XLPE insulated aluminium cables, 33kV. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for three core, stranded aluminium conductors, XLPE insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 19000 Volts to sheath, 33000 Volts between conductors and highest system voltage of 36000 Volts for use in KPLC distribution network operated at 50Hz.

The specification is for the following sizes of 33kV cables:

3 x 95 mm² AL/XLPE/SWA/PVC

3 x 185 mm² AL/XLPE/SWA/PVC

3 x 300 mm² AL/XLPE/SWA/PVC

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted together with other required details for tender evaluation.

The specification stipulates the minimum requirements for three core XLPE insulated aluminium 33kV cables 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 cables for The Kenya Power & Lighting Company Ltd.

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

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TITLE:
**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 4 of 14	

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 60502-2: Power Cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV)- Part 2: Cables for rated voltages from 6kV (Um=7.2kV) up to 30kV (Um=36kV).
- IEC 60228: Conductors of insulated cables.
- BS 6622: Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation for rated voltages from 3.8/6.6kV to 19/33kV.

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in IEC 60228 and IEC 60502-2 apply, together with the following:

- AL: Aluminium
- PVC: Polyvinyl chloride
- SWA: Steel Wire armour
- XLPE: Cross-linked polyethylene

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The cables shall be suitable for the following service conditions and applications:

4.1.1 Cable Application

- a) The cable shall be a distribution cable for use in outdoors installations and tropical conditions (temperature range of -1°C to +40°C, humidity of upto 95%, saline conditions and altitudes of upto 2200m above sea level).
- b) The cable shall be suitable for laying in cable ducts and directly in the ground in switching stations, between stations and underground to overhead conversion.
- c) The cable shall also be suitable for laying on slopes.
- d) Permissible continuous loading operating temperature shall be 90°C.
- e) Permissible emergency loading temperature shall be 130°C for at least 8 hours.

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TITLE:

**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 5 of 14

f) Permissible short circuit temperature shall be 250°C (for short-circuit duration of 5s as per IEC 60502).

4.1.2 The cables shall be connected to underground system operating at a nominal voltage of 33kV, 50Hz and maximum system voltage of 36kV and are solidly earthed at the transformer neutrals. The short circuit fault level shall be taken as 25kA 3s.

4.1.3 The cables shall have suitable anti-termite protection (details to be submitted by supplier to KPLC for approval before manufacture).

4.1.4 The cable shall have an oversheath with a fire performance that conforms to the requirements IEC standards.

4.1.5 The cable shall be designed for reliable service life of at least 30 years.

4.2. MATERIALS AND CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured to BS 6622, IEC 60502-2 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and the cable shall have continuous operating temperature of 90°C and short circuit temperature of 250°C (5 seconds duration) as per IEC 60502-2.

4.2.2. Conductor

The cable shall be made from circular stranded compacted plain aluminium conductor that conforms to IEC 60228.

4.2.3. Conductor Screen

4.2.3.1 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3.2 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

4.2.4. Insulation

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Date: 2014-03-31



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TITLE:

**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No. KP1/3CB/TSP/05/023

Issue No. 2

Revision No. 0

Date of Issue 2014-03-31

Page 6 of 14

4.2.4.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.

4.2.4.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.

4.2.4.3 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

4.2.4.4 Individual cores shall be identified by coloured tape over the insulation and the colours shall be Red, Yellow and Blue.

4.2.5. Insulation Screen

4.2.5.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.

4.2.5.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.

4.2.5.3 A metallic screen shall be applied around each core. The screen shall consist of helically applied overlapped copper tape. An energy absorbing bedding layer should be applied.

4.2.6. Laying-up

4.2.6.1 The cores shall be laid-up with a right hand direction of lay. Fillers of non-hygroscopic material shall be used to form a substantially compact and circular cable.

4.2.6.2 The metallic screens of the three cores shall be in contact with each other.

4.2.7. Armour

4.2.7.1 An extruded separation layer of black polyvinyl chloride (PVC) shall be applied between the laid-up cores and the armour.

4.2.7.2 The armour shall consist of a single layer of round galvanized steel wires applied helically with a left-hand lay.

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Date: 2014-03-31

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Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 7 of 14

4.2.8. Oversheath

4.2.8.1 There shall be an extruded oversheath of black polyvinyl chloride (PVC) as per IEC 60502-2.

4.2.8.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath.

- (i) 33000 VOLTS XLPE POWER AL CABLE PROPERTY OF KPLC
- (ii) Name of manufacturer
- (iii) Year of manufacture
- (iv) The number of cores, type and nominal area of conductors

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

4.3. STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the XLPE cables shall be as follows:

Conductor nominal sectional area	mm ²	95	185	300
Voltage Designation		19/33 (36) kV		
Conductor shape		compact round stranded		
Thickness of insulation	mm	8.0	8.0	8.0
Thickness of separation layer	mm	1.9	2.1	2.3
Nominal armour wire diameter	mm	2.5	2.5	3.15
Thickness of oversheath, nominal	mm	3.6	3.9	4.3
Power frequency single phase test voltage, 5min	kV	63	63	63
Maximum conductor resistance	Ω/km	0.32	0.164	0.100

Note: The Current Carrying Capacity of the cable in the ground and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A.

4.4. QUALITY MANAGEMENT SYSTEM

4.4.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards,

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Date: 2014-03-31

Date: 2014-03-31



TITLE:
**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 8 of 14	

specifications and regulations. The QAP shall be based on and include relevant parts to fulfil 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 cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of cable being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228 and IEC 60502-2. It shall be the responsibility of the supplier to perform or to have performed all the required tests.
- 5.2 Copies of previous test certificates and test reports by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

The type test reports shall include the following as per IEC 60502-2:

- a) Bending test, followed by a partial discharge test;
- b) Tan δ measurement;
- c) Heating cycle test, followed by a partial discharge test;
- d) Impulse test, followed by a voltage test;
- e) Voltage test for 4 h.

As per IEC 60502-2, when type tests have been successfully performed on a type of cable with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied:

- a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;

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Date: 2014-03-31	Date: 2014-03-31



TITLE:
SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 9 of 14	

- b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630 mm² are approved when the cross-sectional area of the previously tested cable is in the range of 95 mm² to 630 mm² inclusive;
- c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers will witness these tests at the factory before shipment and shall include the following:

5.3.1 The routine tests as per IEC 60502-2 and are as follows:
 a) Measurement of the electrical resistance of conductors;
 b) Partial discharge test
 c) Voltage test.

5.3.2 The sample tests as per IEC 60502-2 and are as follows:
 a) Conductor examination;
 b) Check of dimensions;
 c) Voltage test;
 d) Hot set test for XLPE insulation and elastomeric sheaths.

In addition to Routine and Sample Tests as per IEC 60502-2, KPLC Engineers will verify the length on a randomly selected drum at the factory during Acceptance Testing.

5.4 Sampling (as per IEC 60502-2)

5.4.1 Samples shall be selected as per Table 1 and IEC 60502-2 for other lengths.

Table 1: Number of samples for sample tests

Cable length				Number of samples
Multicore cables		Single-core cables		
Above km	Up to and including km	Above km	Up to and including km	
2	10	4	20	1
10	20	20	40	2
20	30	40	60	3
30	40	60	80	4
40	50	80	100	5

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Date: 2014-03-31

Date: 2014-03-31



Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No. KP1/3CB/TSP/05/023

Issue No. 2

Revision No. 0

Date of Issue 2014-03-31

Page 10 of 14

5.4.2 If any sample fails in any of the tests, two further samples shall be taken from the same batch and subjected to the same test or tests in which the original sample failed. If both additional samples pass the tests, all the cables in the batch from which they were taken shall be regarded as complying with the requirements of this specification. If either of the additional samples fails, the batch from which they were taken shall be regarded as failing to comply.

5.5 During delivery of the cables, 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/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 The finished cable shall be wound in one continuous length on metallic drum such as to prevent damage during transportation and handling. The drums shall be lagged with wood all round to prevent damage to the cable.

6.2 Each drum shall have one continuous length of 500m, 400m and 300m for cable sizes 3x95mm², 3x185mm² and 3x300mm² respectively. The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the drum length of cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:

- a) The manufacturer's name;
- b) The type and rating of cable;
- c) The conductor cross-sectional area in mm²;
- d) The length of the cable, in metres;
- e) The year of manufacture;
- f) The gross mass and net mass, in kilogram;
- g) The instructions for handling and use (in English Language);
- h) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

Note: The cable shall have been marked in accordance with clause 4.4

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Kenya Power

TITLE:

SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 11 of 14

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 information shall include the following:

- a) Guaranteed Technical Particulars signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;
- e) Copies of required 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) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.

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

- a) Guaranteed Technical Particulars,
- b) Design Drawings and construction details of the cable,
- c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the cables,
- f) Manufacturer's undertaking to ensure adequacy of the design,
- g) Packaging details (including packaging materials and length on drum).

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 identify of the manufacturer (as per manufacturer's authorization submitted during tendering)

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SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision
No.

0

Date of
Issue

2014-03-31

Page 12 of 14

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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, 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 testing laboratory for tender evaluation, all in English Language)

Tender No..... Bidder's Name & Address

CLAUSE	Description	Bidder's offer
	Name and address of the Manufacturer	
	Country of manufacture	
	Manufacturer's Letter of Authorization	
	Model/Type Reference No. of the offered cable	
	Manufacturer's warranty and guarantee for the offered cable	
1	Scope: a) Design, manufacture, test, ship and deliver 3/C Aluminium XLPE insulated 33kV cables to KPLC store/site as per terms of contract b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Co. Ltd	a) b)
2	Applicable standards	
3	Terms and definitions	
4.1.1	Cable Application	
4.1.2	System Conditions	
4.1.3	Anti-termite protection	
4.1.4	Fire Performance (indicate applicable IEC standards)	
4.1.5	Minimum Design Service Life	
4.2.1.1	Applicable Standards	
4.2.1.2	Continuous Operating Temperature	
	Short Circuit Temperature (five seconds duration)	
4.2.2	Conductor	
4.2.3	Conductor Screen	
4.2.4.1	Insulation	
4.2.4.2	Insulation application	

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Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/023

Issue No.

2

Revision No.

0

Date of Issue

2014-03-31

Page 13 of 14

CLAUSE	Description	Bidder's offer
4.2.4.3	Insulation Colour	
4.2.4.4	Individual Cores	
4.2.5	Insulation Screen (4.2.5.1 – 3)	
4.2.6	Laying-up	
4.2.7.1	Separation Layer	
4.2.7.2	Armour	
4.2.8.1	Oversheath	
4.2.8.2	Embossing on Oversheath	
4.3	Conductor nominal sectional area, mm ²	
	Voltage Designation	
	Conductor shape	
	Thickness of insulation, mm	
	Thickness of separation layer, mm	
	Armour wire diameter, mm	
	Thickness of oversheath, mm	
	Approximate overall diameter, mm	
	Power frequency withstand voltage of cable	
	Test Voltage (after installation), d.c., kV/5min	
	Maximum conductor resistance, Ω/km	
	Current carrying capacity	In air In duct
4.4.1	Quality Assurance Plan	
4.4.2	Manufacturer's Declaration of Conformity to Reference Standards	
	Copy of Manufacturer's ISO 9001:2008 Certificate	
4.4.3	Customer sales records and customer reference letters submitted to support the offer.	
5.1	Test Standard	
	Responsibility of carrying out tests	
5.2	Copies of Type Test Certificates & Type Test Reports to IEC 60502-2	
	a) Bending test, followed by a partial discharge test;	
	b) Tan δ measurement;	
	c) Heating cycle test, followed by a partial discharge test;	
	d) Impulse test, followed by a voltage test;	
	e) Voltage test for 4 h	
5.3	Tests to be witnessed by KPLC Engineers at factory before shipment	

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TITLE:
SPECIFICATION FOR CABLE
33kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/023
Issue No.	2
Revision No.	0
Date of Issue	2014-03-31
Page 14 of 14	

CLAUSE	Description	Bidder's offer
	1.Routine tests to IEC 60502-2	
	a) Measurement of the electrical resistance of conductors;	
	b) Partial discharge test	
	c) Voltage test.	
	2.Sample tests to IEC 60502-2	
	a) Conductor examination;	
	b) Check of dimensions;	
	c) Voltage test;	
	d) Hot set test for XLPE insulation and elastomeric sheaths	
	e) Verification of the length on a randomly selected drum	
5.4	Sampling	Sample size Acceptance criteria
5.5	Inspection & test of cable during delivery before acceptance to KPLC stores/site	
6.1	Cable Drums & Wooden Lagging	
6.2	Number of lengths on Drum	
	Total Length of Cable on Drum	
6.3	Cable end plug sealing & securing on drum	
6.4	Marking on Cable Drum Flange	
7.1	Documents submitted with tender for evaluation	
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	
-	Manufacturing capacity of similar cable (Qty per month)	
	Manufacturer's experience	
-	Statement of compliance to Tender Specifications	
-	Deviations from Tender Specifications	

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

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Kenya Power

TITLE:

SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

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, LABELLING AND PACKING
7. DOCUMENTATION

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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 testing laboratory for tender evaluation, all in English Language)

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Date: 2014-03-31



Kenya Power

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11kV 3/C AL XLPE SWA PVC

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 2 of 14

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supply Chain Manager – Procurement

Electronic copy (pdf) on The Kenya Power & Lighting Company 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)
Issue3 Rev 0	2014-03-31	Cancel and replaces Issue 2 Rev 0 dated 2012- 11-05	S. Kimiti 	G. Owuor

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Date: 2014-03-31



Kenya Power

TITLE:
**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 3 of 14	

FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Distribution Division both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for three core XLPE insulated aluminium cables, 11kV. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for three core, stranded aluminium conductors, XLPE insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 6350 Volts to sheath, 11000 Volts between conductors and highest system voltage of 12000 Volts for use in KPLC distribution network operated at 50Hz.

The specification is for the following sizes of 11kV cables:

3 x 95 mm² AL/XLPE/SWA/PVC

3 x 185 mm² AL/XLPE/SWA/PVC

3 x 300 mm² AL/XLPE/SWA/PVC

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted together with other required details for tender evaluation.

The specification stipulates the minimum requirements for three core XLPE insulated aluminium 11kV cables 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 cables for The Kenya Power & Lighting Company Ltd.

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

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Date: 2014-03-31

Date: 2014-03-31



Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No. KP1/3CB/TSP/05/008

Issue No. 3

Revision No. 0

Date of Issue 2014-03-31

Page 5 of 14

f) Permissible short circuit temperature shall be 250°C (for short-circuit duration of 5s as per IEC 60502).

4.1.2 The cables shall be connected to underground system operating at a nominal voltage of 11kV, 50Hz and maximum system voltage of 12kV and are solidly earthed at the transformer neutrals. The short circuit fault level shall be taken as 25kA 3s.

4.1.3 The cables shall have suitable anti-termite protection (details to be submitted by supplier to KPLC for approval before manufacture).

4.1.4 The cable shall have an oversheath with a fire performance that conforms to the requirements IEC standards.

4.1.5 The cable shall be designed for reliable service life of at least 30 years.

4.2. MATERIALS AND CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured to BS 6622, IEC 60502-2 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and the cable shall have continuous operating temperature of 90°C and short circuit temperature of 250°C (5 seconds duration) as per IEC 60502-2.

4.2.2. Conductor

The cable shall be made from circular stranded compacted plain aluminium conductor that conforms to IEC 60228.

4.2.3. Conductor Screen

4.2.3.1 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3.2 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

4.2.4. Insulation

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Date: 2014-03-31



Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
11KV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 6 of 14

- 4.2.4.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.
- 4.2.4.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.
- 4.2.4.3 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.
- 4.2.4.4 Individual cores shall be identified by coloured tape over the insulation and the colours shall be Red, Yellow and Blue.

4.2.5. Insulation Screen

- 4.2.5.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.
- 4.2.5.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.
- 4.2.5.3 A metallic screen shall be applied around each core. The screen shall consist of helically applied overlapped copper tape. An energy absorbing bedding layer should be applied.

4.2.6. Laying-up

- 4.2.6.1 The cores shall be laid-up with a right hand direction of lay. Fillers of non-hygroscopic material shall be used to form a substantially compact and circular cable.
- 4.2.6.2 The metallic screens of the three cores shall be in contact with each other.

4.2.7. Armour

- 4.2.7.1 An extruded separation layer of black polyvinyl chloride (PVC) shall be applied between the laid-up cores and the armour.
- 4.2.7.2 The armour shall consist of a single layer of round galvanized steel wires applied helically with a left-hand lay.

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Date: 2014-03-31



Kenya Power

TITLE:
SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 7 of 14	

4.2.8. Oversheath

4.2.8.1 There shall be an extruded oversheath of black polyvinyl chloride (PVC) as per IEC 60502-2.

4.2.8.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath.

- (i) 11000 VOLTS XLPE POWER AL CABLE PROPERTY OF KPLC
- (ii) Name of manufacturer
- (iii) Year of manufacture
- (iv) The number of cores, type and nominal area of conductors

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

4.3. STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the XLPE cables shall be as follows:

Conductor nominal sectional area	mm ²	95	185	300
Voltage Designation		6.35/11 (12) kV		
Conductor shape		compact round stranded		
Thickness of insulation	mm	3.4	3.4	3.4
Thickness of separation layer	mm	1.5	1.7	1.9
Nominal armour wire diameter	mm	2.5	2.5	3.15
Thickness of oversheath, nominal	mm	2.8	3.2	3.6
Approximate overall diameter	mm	62.6	74.1	86.8
Power frequency test voltage, 5 min	kV	42	42	42
Maximum conductor resistance	Ω/km	0.32	0.164	0.100

Note: The Current Carrying Capacity of the cable in the ground and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A.

4.4. QUALITY MANAGEMENT SYSTEM

4.4.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards,

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Date: 2014-03-31

Date: 2014-03-31



TITLE:
SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 8 of 14	

specifications and regulations. The QAP shall be based on and include relevant parts to fulfil 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 cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of cable being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228 and IEC 60502-2. It shall be the responsibility of the supplier to perform or to have performed all the required tests.
- 5.2 Copies of previous test certificates and test reports by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

The type test reports shall include the following as per IEC 60502-2:

- a) Bending test, followed by a partial discharge test;
- b) Tan δ measurement;
- c) Heating cycle test, followed by a partial discharge test;
- d) Impulse test, followed by a voltage test;
- e) Voltage test for 4 h.

As per IEC 60502-2, when type tests have been successfully performed on a type of cable with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied:

- a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;

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Kenya Power

TITLE:

**SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC**

Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision
No.

0

Date of
Issue

2014-03-31

Page 9 of 14

b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630 mm² are approved when the cross-sectional area of the previously tested cable is in the range of 95 mm² to 630 mm² inclusive;

c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers will witness these tests at the factory before shipment and shall include the following:

5.3.1 The routine tests as per IEC 60502-2 and are as follows:

- a) Measurement of the electrical resistance of conductors;
- b) Partial discharge test
- c) Voltage test.

5.3.2 The sample tests as per IEC 60502-2 and are as follows:

- a) Conductor examination;
- b) Check of dimensions;
- c) Voltage test;
- d) Hot set test for XLPE insulation and elastomeric sheaths.

In addition to Routine and Sample Tests as per IEC 60502-2, KPLC Engineers will verify the length on a randomly selected drum at the factory during Acceptance Testing.

5.4 Sampling (as per IEC 60502-2)

5.4.1 Samples shall be selected as per Table 1 and IEC 60502-2 for other lengths.

Table 1: Number of samples for sample tests

Cable length				Number of samples
Multicore cables		Single-core cables		
Above km	Up to and including km	Above km	Up to and including km	
2	10	4	20	1
10	20	20	40	2
20	30	40	60	3
30	40	60	80	4
40	50	80	100	5

Issued by: Head of Section, Technical Stds & Specs

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Signed:

Date: 2014-03-31

Date: 2014-03-31



TITLE:
SPECIFICATION FOR CABLE
11kV 3/C AL XLPE SWA PVC

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 10 of 14	

5.4.2 If any sample fails in any of the tests, two further samples shall be taken from the same batch and subjected to the same test or tests in which the original sample failed. If both additional samples pass the tests, all the cables in the batch from which they were taken shall be regarded as complying with the requirements of this specification. If either of the additional samples fails, the batch from which they were taken shall be regarded as failing to comply.

5.5 During delivery of the cables, 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/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 The finished cable shall be wound in one continuous length on metallic drum such as to prevent damage during transportation and handling. The drums shall be lagged with wood all round to prevent damage to the cable.

6.2 Each drum shall have one continuous length of 500m, 400m and 300m for cable sizes 3x95mm², 3x185mm² and 3x300mm² respectively. The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the drum length of cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:

- a) The manufacturer's name;
- b) The type and rating of cable;
- c) The conductor cross-sectional area in mm²;
- d) The length of the cable, in metres;
- e) The year of manufacture;
- f) The gross mass and net mass, in kilogram;
- g) The instructions for handling and use (in English Language);
- h) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

Note: The cable shall have been marked in accordance with clause 4.4

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**SPECIFICATION FOR CABLE
11KV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 11 of 14	

7. DOCUMENTATION

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- a) Guaranteed Technical Particulars signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;
- e) Copies of required 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) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.

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

- a) Guaranteed Technical Particulars,
- b) Design Drawings and construction details of the cable,
- c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008
- d) Test Program to be used after manufacture,
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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 identify of the manufacturer (as per manufacturer's authorization submitted during tendering)

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TITLE:
**SPECIFICATION FOR CABLE
 11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 12 of 14	

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(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, 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 testing laboratory for tender evaluation, all in English Language)

Tender No..... Bidder's Name & Address

CLAUSE	Description	Bidder's offer
	Name and address of the Manufacturer	
	Country of manufacture	
	Manufacturer's Letter of Authorization	
	Model/Type Reference No. of the offered cable	
	Manufacturer's warranty and guarantee for the offered cable	
1	Scope: a) Design, manufacture, test, ship and deliver 3/C Aluminium XLPE insulated 11kV cables to KPLC store/site as per terms of contract b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Co. Ltd	a) b)
2	Applicable standards	
3	Terms and definitions	
4.1.1	Cable Application	
4.1.2	System Conditions	
4.1.3	Anti-termite protection	
4.1.4	Fire Performance (indicate applicable IEC standards)	
4.1.5	Minimum Design Service Life	
4.2.1.1	Applicable Standards	
4.2.1.2	Continuous Operating Temperature Short Circuit Temperature (five seconds duration)	
4.2.2	Conductor	
4.2.3	Conductor Screen	
4.2.4.1	Insulation	
4.2.4.2	Insulation application	

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**SPECIFICATION FOR CABLE
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Doc. No.

KP1/3CB/TSP/05/008

Issue No.

3

Revision No.

0

Date of Issue

2014-03-31

Page 13 of 14

CLAUSE	Description	Bidder's offer	
4.2.4.3	Insulation Colour		
4.2.4.4	Individual Cores		
4.2.5	Insulation Screen (4.2.5.1 – 3)		
4.2.6	Laying-up		
4.2.7.1	Separation Layer		
4.2.7.2	Armour		
4.2.8.1	Oversheath		
4.2.8.2	Embossing on Oversheath		
4.3	Conductor nominal sectional area, mm ²		
	Voltage Designation		
	Conductor shape		
	Thickness of insulation, mm		
	Thickness of separation layer, mm		
	Armour wire diameter, mm		
	Thickness of oversheath, mm		
	Approximate overall diameter, mm		
	Power frequency withstand voltage of cable		
	Test Voltage (after installation), d.c., kV/5min		
	Maximum conductor resistance, Ω/km		
	Current carrying capacity	In air In duct	
	4.4.1	Quality Assurance Plan	
4.4.2	Manufacturer's Declaration of Conformity to Reference Standards		
	Copy of Manufacturer's ISO 9001:2008 Certificate		
4.4.3	Customer sales records and customer reference letters submitted to support the offer.		
5.1	Test Standard		
	Responsibility of carrying out tests		
5.2	Copies of Type Test Certificates & Type Test Reports to IEC 60502-2		
	a) Bending test, followed by a partial discharge test;		
	b) Tan δ measurement;		
	c) Heating cycle test, followed by a partial discharge test;		
	d) Impulse test, followed by a voltage test;		
	e) Voltage test for 4 h		
5.3	Tests to be witnessed by KPLC Engineers at factory before shipment		

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 11kV 3/C AL XLPE SWA PVC**

Doc. No.	KP1/3CB/TSP/05/008
Issue No.	3
Revision No.	0
Date of Issue	2014-03-31
Page 14 of 14	

CLAUSE	Description	Bidder's offer
	1. Routine tests to IEC 60502-2	
	a) Measurement of the electrical resistance of conductors;	
	b) Partial discharge test	
	c) Voltage test.	
	2. Sample tests to IEC 60502-2	
	a) Conductor examination;	
	b) Check of dimensions;	
	c) Voltage test;	
	d) Hot set test for XLPE insulation and elastomeric sheaths	
	e) Verification of the length on a randomly selected drum	
5.4	Sampling	
	Sample size	
	Acceptance criteria	
5.5	Inspection & test of cable during delivery before acceptance to KPLC stores/site	
6.1	Cable Drums & Wooden Lagging	
6.2	Number of lengths on Drum	
	Total Length of Cable on Drum	
6.3	Cable end plug sealing & securing on drum	
6.4	Marking on Cable Drum Flange	
7.1	Documents submitted with tender for evaluation	
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	
-	Manufacturing capacity of similar cable (Qty per month)	
	Manufacturer's experience	
-	Statement of compliance to Tender Specifications	
-	Deviations from Tender Specifications	

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

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TITLE:
**SPECIFICATION FOR PVC
INSULATED SINGLE PHASE
CONCENTRIC ALUMINIUM
CABLES (LOW VOLTAGE)**

Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 1 of 10	

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 CABLES

(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, 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 testing laboratory for tender evaluation, all in English Language)

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Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 2 of 10	

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Head of Department, Standards
2	Supply Chain Manager, 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)
Issue 2 Rev 1	2014-09-23	Included size 10mm ² Single Core Concentric Aluminium for single phase customers in SWER system		

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Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 3 of 10	

FOREWORD

This specification has been prepared by the Standards Department in collaboration with The Design Optimization Committee both of The Kenya Power & Lighting Company Ltd (abbreviated as KPLC) and it lays down requirements for PVC Insulated Single Phase Concentric Aluminium Cables (LV). It is intended for use by KPLC in purchasing the cables.

The bid shall be submitted complete with information that confirms satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for PVC insulated single phase concentric cables with circular stranded aluminium conductors for operation up to and including 1000 Volts between phases and 600 Volts to earth. The cable shall have a central phase stranded aluminium conductor insulated with red PVC and concentric layer comprising bare aluminium wires (combined neutral-earth conductor) and outer sheath in black PVC.

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for PVC Insulated Single Phase Concentric Aluminium Cables (LV) acceptable for use in the company (KPLC) 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 cables 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 standard contains provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

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**SPECIFICATION FOR PVC
INSULATED SINGLE PHASE
CONCENTRIC ALUMINIUM
CABLES (LOW VOLTAGE)**

Doc. No.

KP1/3CB/TSP/05/004

Issue No.

2

Revision
No.

1

Date of
Issue

2014-09-23

Page 4 of 10

KS 04-1022:-Kenya Standard Specification for 600/1000V PVC-insulated single-phase concentric cables with copper or aluminium conductors for electricity supply

3. TERMS AND DEFINITIONS

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

4. REQUIREMENTS

4.1 SERVICE AND SYSTEM CONDITIONS

- a) The cable shall be a service cable for continuous operation outdoors and tropical conditions (temperature range of -1°C to $+40^{\circ}\text{C}$, humidity of upto 90% and saline conditions along the coast).
- b) The cable shall be suitable for laying in cable ducts and in air.
- c) Permissible continuous loading operating temperature shall be 70°C .

4.2. MATERIALS AND CONSTRUCTION

4.2.1. The cable shall be designed and manufactured to Kenya Standard KS 04-1022 and the requirements of this specification.

4.2.2. Phase Conductor

4.2.2.1 The phase conductor shall be circular stranded annealed aluminium conductors (class 2) as specified in KS 04-1022. The phase conductor shall have a left-hand direction of lay.

4.2.2.2 The insulation of the phase conductor shall be red PVC compound specified in KS 04-1022. It shall be applied by an extrusion process and shall be spark tested in accordance with KS 04-1022.

4.2.2.3 The thickness of insulation, determined in accordance with KS 04-1022, shall be not less than the value given in Table 1 of this specification and the smallest of the measured values shall not fall below the value given in the said table by more than $(10\% + 0.1\text{mm})$.

4.2.3. Concentric Layer

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Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 5 of 10	

4.2.3.1 The neutral conductor shall be concentric and shall be manufactured from plain annealed aluminium wires in accordance with KS 04-1022. The number of wires and the resistance of the neutral conductor shall comply with Table 1 of this specification.

4.2.3.2 The concentric layer shall be applied with a right hand direction of lay.

4.2.4. Oversheath

4.2.4.1 The oversheath shall be an extruded layer of black PVC compound as specified in KS 04-1022. The oversheath shall be spark tested in accordance with KS 04-1022.

4.2.4.2 The minimum thickness of the oversheath shall not fall below the value given in Table 1 of this specification by an amount more than (15% + 0.1mm).

4.3. STANDARD SIZES AND CHARACTERISTICS

4.3.1 The characteristics of the cables shall comply with Table 1.

Table 1: Characteristics (as per KS 04-1022)

Phase Conductor			Concentric neutral conductor: number. & approx. diameter of wires <u>No./mm</u>	Minimum lay lengths <u>mm</u>	Thickness of oversheath <u>mm</u>	Approximate overall diameter <u>mm</u>	Maximum conductor dc resistance per 1000m of cable at 20°C	
<u>Nominal area mm²</u>	<u>No. & approx dia. of wires mm</u>	<u>Thickness of insulation mm</u>					<u>Phase ohms</u>	<u>Neutral ohms</u>
10	7/1.35	1.55	23/1.13	146.5	1.4	12.21	3.08	1.335
15	7/1.70	1.55	26/1.13	155	1.4	13.34	1.91	1.808
25	7/2.14	1.60	29/1.13	165	1.5	14.88	1.20	1.0586
35	19/1.53	1.65	27/1.35	178	1.6	16.75	0.868	0.7966

4.4. EMBOSSING ON CABLE

The cable shall be embossed with the following information throughout the length of the oversheath.

- a) 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC
- b) Year of Manufacture
- c) Size of Cable

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INSULATED SINGLE PHASE
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CABLES (LOW VOLTAGE)**

Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 6 of 10	

d) Name of Manufacturer

(Example: '16 SQ MM 600/1000 VOLTS PVC AL CABLE PROPERTY OF KPLC 2004' xxx)
'xxx' being the manufacturer's name.

Letters and figures shall be raised and consist of upright block characters which shall be legible. Minimum size of characters shall be 3mm. The gap between the end of one inscription and the beginning of the next shall be not greater than 25mm and the gap between each complete set of markings shall be not greater than 500mm.



An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

5. TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification and KS 04-1022. It shall be the responsibility of the supplier to perform or to have performed the tests specified.
- 5.2 Copies of previous test certificates and test reports by a third party testing laboratory accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate for the testing laboratory shall also be submitted with the tender (all in English Language).
- 5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers (2) will witness these tests at the factory before shipment.
- 5.4 During delivery of the cables, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The manufacturer shall replace/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any or all of the requirements in the specification.

6. MARKING AND PACKING

- 6.1 The finished cable shall be wound in one continuous length on wooden drum such as to prevent damage during transportation and handling. The drums shall be made from treated timber resistant to termite attack and shall be lagged all round to prevent damage to the cable. There shall be no gaps in the wooden lagging around the drum.

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CABLES (LOW VOLTAGE)**

Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 7 of 10	

- 6.2 Each drum shall contain only one continuous length of cable of 2500m in length. The actual length of cable shall not be less than the length indicated on the drum.
- 6.3 Both ends of the cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.
- 6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:
- a) The manufacturer's name;
 - b) The type and rating of cable;
 - c) The conductor cross-sectional area in mm²;
 - d) The length of the cable, in metres;
 - e) The year of manufacture;
 - f) The gross mass and net mass, in kilogram;
 - g) The instructions for handling and use (in English Language);
 - h) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."
- Note: The cable shall have been marked in accordance with clause 4.4*

7. DOCUMENTATION

- 7.1 The bidder shall submit its tender complete with technical documents required by the tender document and 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 and customer reference letters;
 - d) Details of manufacturing capacity and the manufacturer's experience;
 - 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 testing laboratory;
 - g) Manufacturer's warranty and guarantee;
 - h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008/KEBS Diamond Mark certificate and other technical documents required in the tender.

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CONCENTRIC ALUMINIUM
CABLES (LOW VOLTAGE)**

Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 8 of 10	

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 and construction details of the cable,
- c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations.
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the cables,
- f) Manufacturer's undertaking to ensure adequacy of the design, adherence to applicable standards/specification, good workmanship and good engineering practice in the manufacture of the cables for The Kenya Power and Lighting Company Limited,
- g) Packaging details (including packaging materials, lagging and length on drum).

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Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 9 of 10	

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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, sales records, 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 testing laboratory for tender evaluation, all in English Language)

TENDER NO.BIDDER'S NAME & ADDRESS

Description		Bidder's offer
Name and address of the Manufacturer		
Country of manufacture		
Manufacturer's Letter of Authorization		
Model/Type Reference No. of the offered cable		
Manufacturer's warranty and guarantee for the offered cable		
Service conditions & application		
Applicable Standard(s)		
Type and design		
Phase Conductor (material & construction)	Material of phase conductor	
	No. of wires in phase conductor and diameter of each wire	
Neutral Conductor (material & construction)	Material of neutral conductor	
	No. of wires in neutral conductor and diameter of each wire	
Phase Conductor Insulation	Material	
	Colour	
Oversheath (outer sheath)	Material	
	Colour	
	Marking, embossing	
RATINGS/CHARACTERISTICS		
Conductor nominal cross-sectional area		
Voltage designation U _o /U(U _m)		
Conductor shape		
Thickness of insulation		
Thickness of oversheath		

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Date: 2014-09-23

Date: 2014-09-23



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 INSULATED SINGLE PHASE
 CONCENTRIC ALUMINIUM
 CABLES (LOW VOLTAGE)**

Doc. No.	KP1/3CB/TSP/05/004
Issue No.	2
Revision No.	1
Date of Issue	2014-09-23
Page 10 of 10	

Description	Bidder's offer
Maximum phase conductor resistance at 20°C	
Maximum neutral conductor resistance at 20°C	
Current carrying capacity	In air at 40°C In duct at 40°C
Power frequency withstand voltage	
List of Type Test Reports submitted with tender (indicate Test Report Numbers)	
List of Tests to be witnessed by KPLC Engineers at the factory before shipment	
Embossing on the cable oversheath (parameters to be indicated and method of marking)	
Marking on cable drum (parameters to be indicated and method of marking)	
Packaging (wooden drum & lagging)	
Length of cable on drum	
Installation and technical manuals to be provided during delivery	
List of catalogues, brochures, drawings, technical data and customer sales records submitted to support the offer.	
Statement of compliance to Tender Specifications	
Deviations from Tender Specifications	
Inspection/test by KPLC during delivery before acceptance to stores/site	

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

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