**DOCUMENT NO. KP1/13D/4/1/TSP/05/003**

Kenya Power

# SINGLE-CORE CABLES, WITH STRANDED ALUMINIUM CONDUCTORS, PVC INSULATED AND PVC SHEATHED – SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd.
August 2021

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## 0.1 CIRCULATION LIST

| COPY NO. | COPY HOLDER |
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| 1 | Manager, Standards |
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## REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved Standards, addressed to the Manager, Standards Department, are welcome.

## 0.2 AMENDMENT RECORD

| Rev No. | Date (yy-mm-dd) | Description of Change | Prepared by (Name & Signature) | Approved by (Name & Signature) |
|---|---|---|---|---|
| Issue 2 Rev 0 | 2021-08-16 | Cancels and replaces the earlier edition dated 2002/09/06 | S. Nguli | Dr. Eng. Peter Kimemia |
| | | | | |

## FOREWORD

This Specification has been prepared by the Standards Department of the Kenya Power and Lighting Company Plc (KPLC) and it lays down requirements for Low voltage(06/1.0kV) Single-Core Cables, With Stranded Aluminum Conductors, PVC Insulated and PVC Sheathed. It is intended for use by KPLC in purchasing the cables.

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

This specification stipulates the minimum requirements for single-core cables, with stranded aluminum conductors, PVC insulated and PVC sheathed acceptable for use in the company and it shall be the responsibility of the supplier and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC.

The manufacturer shall exhibit good workmanship and good engineering practice in the manufacture of the single-core cables, with stranded aluminum conductors, PVC insulated and PVC sheathed for KPLC.

Users of KPLC specifications are responsible for its correct interpretation and application.

Specifications in this series are:

(i) KP1/3CB/TSP/05/001: Specification for Aluminum 4/C PVC insulated steel Wire Armored cable

The following are members of the team that developed this specification:

| Name | Department |
|---|---|
| Stephen Nguli | Standards |

## 1. SCOPE

1.1. This Specification is for Low voltage(06/1.0kV) Single-Core Cables, With Stranded Aluminum Conductors, PVC Insulated and PVC Sheathed power cables for operation at voltages of 600 Volts to sheath, 1000 Volts between conductors and highest system voltage of 1200 Volts for use in KPLC distribution network operated at 50Hz.

1.2. 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.

1.3. The specification stipulates the minimum requirements for low voltage single-core cables, with stranded Aluminum conductors, PVC insulated and PVC sheathed ( referred to as "single core low voltage aluminium 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 Plc.

1.4. The single core low voltage aluminium cables shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the bidder's guarantee in a manner acceptable to the KPLC,

1.5. The specification is for the following sizes of 0.6 /1.0 kV cables;

1 x 300 mm² S/C AL / PVC / PVC.

1 x 630 mm² S/C AL / PVC / PVC.

***Note***: *The cable to be procured shall be specified in the tender*

## 2. NORMATIVE REFERENCES

The following standards contain provisions which through reference in this text constitute provisions of this specification. For dated editions, the cited edition shall apply; for undated editions, the latest edition of the referenced document shall apply.

For this specification, the definitions and abbreviations given in the reference standards shall apply.

IEC 60502-1: Power Cables with extruded insulation and their accessories for rated voltages from 1kV ($U_m$=1.2kV) up to 30kV ($U_m$=36kV)- Part 1: Cables for rated voltages of 1 kV ($U_m$ = 1.2 kV) and 3 kV ($U_m$ = 3.6 kV)

| | |
|---|---|
| IEC 60228: | Conductors of insulated cables. |
| IEC 60332-1: | Tests on Electric Cables Under Fire Conditions Part 1: Test on a Single Vertical Insulated Wire or Cable |
| ISO 9001:2015 | Quality management systems — Requirements |

*Note*: Unless otherwise stated, the latest editions (including amendments) apply.

## 3. Terms and Definitions

For the purpose of this specification the definitions given in IEC 60228 and IEC 60502-1 apply together with the following;

AL: Aluminum
PVC: Polyvinyl chloride

## 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 up to 95%, saline conditions, altitudes of up to 2200m above sea level and Isokeraunic level of 180 thunderstorm days).
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 70°C.
e) Permissible short circuit temperature shall be 160°C (for short-circuit duration of 5s as per IEC 60502).

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

4.1.3 The cable shall have an oversheath with a fire performance that conforms to the requirements IEC 60332-1-2.

4.1.4 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 IEC 60502-1 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 70°C and short circuit temperature of 160°C (5 seconds duration) as per IEC 60502-2.

### 4.2.2. Conductor

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

### 4.2.3. Insulation

4.2.3.1 The insulation shall be extruded layer of Polyvinyl Chloride (PVC) - Type (PVC/A) to IEC 60502-1.

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

4.2.3.3 The core color shall be Red.

### 4.2.4. Oversheath

4.2.4.1 There shall be an extruded layer of Polyvinyl Chloride (PVC) - Type (ST1) to IEC 60502-1.

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

(i) 1000 VOLTS PVC 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 single core low voltage aluminium cables shall be as per table 1

**Table 1: Cable Sizes and Technical Characteristics.**

| | | | |
|---|---|---|---|
| Conductor nominal sectional area | $mm^2$ | 300 | 600 |
| Voltage Designation, $U_o/U/U_m$ | kV | 0.6/1.0/1.2) | |
| Conductor shape | Stranded circular aluminum | | |
| Thickness of insulation | mm | 2.4 | 2.8 |
| Thickness of oversheath, nominal | mm | 2.2 | 2.2 |
| Approximate overall diameter | mm | 29.7 | 41.9 |
| Test Voltage (after installation), d.c. | kV/5 min | 5 | 5 |
| Maximum conductor resistance at 20 °C | Ω/km | 0.100 | 0.0469 |
| Maximum conductor resistance at 70 °C | Ω/km | 0.1233 | 0.0630 |
| Approx. Weight | Kg/km | 1300 | 2520 |
| Recommended Drum Length | m | 1000 | 500 |

***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.*

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## APPENDICES

### APPENDIX A: TESTS AND INSPECTION (NORMATIVE)

A.1. The cables and their accessories shall be manufactured and tested shall be inspected and tested in accordance with the requirements of this specification, IEC 60228, IEC 60502-1 and other applicable IEC standards listed in clause 2 and the requirements of this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the relevant tests.

A.2. **Type Tests:** Test reports to IEC 60502-1 for the cables and accessories to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers (2) will witness the following tests at the factory before shipment:

a) Conductor examination
b) Measurement of electrical resistance of conductor
c) Measurement of thickness of insulation and oversheath
d) Measurement of diameters
e) Voltage test

A.3. If the sample from any length selected for the tests fails in any of the tests above, further samples shall be taken from two further lengths of the same batch and subjected to the same tests *as* those in which the original sample failed. If both additional samples pass the tests, the other cables in the batch from which they were taken shall be regarded as having complied with the requirements of this specification. If either fail, this batch of cables shall be regarded as having failed to comply and shall be rejected.

A.4. The test certificates shall be from an accredited reputable independent testing laboratory, acceptable to the purchaser. Proof of accreditation by a national/international authority shall be forwarded with the offer. Test reports shall be complete including all the pages as issued by the testing authority. *Submission of only parts of test reports shall not be acceptable.*

A.5. Copies of previous type test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 or ILAC accredited independent laboratory) shall be submitted with the tender for evaluation (all in English Language). A copy of accreditation certificate for the laboratory shall also be submitted.

## APPENDIX B: QUALITY MANAGEMENT SYSTEM

B.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, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2015.

B.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2015 certificate shall be submitted with the tender for evaluation.

B.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.

## APPENDIX C: FACTORY ACCEPTANCE TESTS

C.1. Kenya Power shall conduct compulsory inspection of the cables at the manufacturer's factory, and thereafter post-delivery to selected sites, installation, testing, and commissioning.

C.2. Upon completion of manufacturing, the single core low voltage aluminium cables shall be subject to acceptance tests at the manufacturer's works before dispatch. shall be witnessed by two or more Engineers appointed by The Kenya Power and Lighting Company Plc (KPLC).

C.3. The manufacturer/supplier shall give one months' notice to Kenya Power on intended dates to conduct the Factory Acceptance Tests (FATs). The Supplier shall further provide letters of invitation to the Kenya Power Engineers nominated to attend the FATs

## APPENDIX D: INSPECTION AT DELIVERY POINT

D.1. On receipt of the cables, KPLC shall inspect the single core low voltage aluminium cables for acceptance at stores and may perform or have tests performed to verify compliance of the cables with this specification.

D.2. The supplier shall replace/rectify without charge to KPLC, any equipment which upon examination, test or use, fail to meet any or all of the requirements in this specification.

## APPENDIX E: WARRANTY

E.1. The supplier/manufacturer warrants the purchaser that all goods supplied under this contract shall have no defect arising from design, materials or workmanship.

E.2. A warranty of 60 months from the date of delivery of the single core low voltage aluminium cables to Kenya Power store shall be offered by the manufacturer.

## APPENDIX F: MARKING, LABELING & PACKAGING

F.1. The finished cable shall be wound on metallic drum such as to prevent damage during transportation and handling. The drums shall be protected against corrosion.

F.2. The actual length of cable shall not be less than the length indicated on the drum.

F.3. Both ends of every drum length of cable shall have been sealed (with end caps) to prevent the ingress of water during transportation, storage, handling and installation. Both ends shall be secured to the drum to prevent mechanical damage.

F.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 $mm^2$;
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 KENYA POWER & LIGHTING CO.**"

## APPENDIX G: DOCUMENTATION (NORMATIVE)

G.1. The bidder shall submit its tender complete with technical documents required by Appendix H (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

(i) Guaranteed Technical Particulars signed by the manufacturer;

(ii) Copies of the Manufacturer's catalogues, brochures, and technical data sheets (including ratings) for single core low voltage aluminium cables.

(iii) Detailed drawings and step by step procedure for safe installation and correct commissioning process of the single core low voltage aluminium cables. This

shall include the recommended maximum earthing resistance values for safe operation of the cables

(iv) Sales records for the last five years and at least four customer reference letters;

(v) Details of manufacturing capacity and the manufacturer's experience;

(vi) Copies of required type test reports by a third-party testing laboratory accredited to ISO/IEC 17025;

(vii) Copy of accreditation certificate to ISO/IEC 17025 for the third-party testing laboratory;

(viii) Manufacturers letter of authorization, ISO 9001:2015 certificate and other technical documents required in the tender.

G.2. The successful bidder (supplier) shall submit the following documents/details to the Kenya Power & Lighting Company for approval before manufacture:

(i) Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer;

(ii) Design drawings and technical details;

(iii) Quality assurance plan (QAP) that shall be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation shall 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 9001:2015;

(iv) Detailed test program to be used during factory testing;

(v) Marking details;

(vi) Packaging details (including packaging materials and marking and identification of batches). The manufacturer shall state the maximum acceptable storage duration for the complete single core low voltage aluminium cables, taking cognisance of the service conditions defined in clause 4.1.

(vii) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the single core low voltage aluminium cables for the Kenya Power & Lighting Company.

G.3. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the single core low voltage aluminium cables to KPLC stores.

G.4. Routine and sample test reports to be submitted to Kenya Power for approval before shipment/delivery of the goods.

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## APPENDIX H: GUARANTEED TECHNICAL PARTICULARS (GTPS)

*(to be filled, stamped and signed by the Supplier/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 suppliers' capacity and experience; and copies of complete test certificates and test reports for tender evaluation or approval, all in English Language)*

**Tender No. .....**

**Bidder's Name.....**

| Clause | Description | KPLC Requirement | Supplier's offer |
|---|---|---|---|
| | Manufacturer's name | state | |
| | Manufacturer's letter of Authorization. | Provide a copy | |
| | Scope of supply | state | |
| | Type or designation | state | |
| 2 | Reference standards | state | |
| 4.1.1 | Service conditions | List and specify | |
| 4.1.2 | Cable anti-termite protection | Specify | |
| 4.1.3 | Cable Fire retardant performance and standard (attach Wire glow Type Test Report) | Specify | |
| 4.1.4 | Cable design life | State | |
| 4.2.1.1 | Standard(s) of manufacture | State | |
| 4.2.1.2 | Cable rated continuous operating temperature | State | |
| | short circuit temperature and time | State | |
| | Applicable standard(s) | Specify | |
| 4.2.1.1 | Conductor material and standard | Specify | |
| 4.2.1.2 | Cable continuous operating temperature and short circuit temperature and standard(s) | Specify | |
| 4.2.2 | Conductor material and standard | Specify | |
| 4.2.3.1 | Insulation Material and standard of manufacture | Specify | |
| 4.2.3.2 | Color of insulation | Specify | |

| | | | | |
|---|---|---|---|---|
| 4.2.3.3 | Core Identification | | Specify | |
| 4.2.4.1-4.2.4.2 | Oversheath | Material and standard(s) | State | |
| | | Anti-termite protection | Specify | |
| | | Fire Resistance | Specify | |
| | | Marking, state parameter to marked and method of marking | Specify | |
| | | Size of characters and intervals of marking | Specify | |
| 4.3 | **RATINGS/CHARACTERISTICS** | | | |
| | Conductor nominal cross-sectional area | | State | |
| | Voltage designation $U_o/U(U_m)$ | | State | |
| | Conductor shape | | State | |
| | Thickness of insulation | | State | |
| | Thickness of oversheath | | State | |
| | Maximum conductor resistance at 20°C | | State | |
| | Maximum conductor ac resistance at 70°C | | State | |
| | Current carrying capacity | In ground (state conditions) | State | |
| | | In air (state conditions) | State | |
| | Test voltage for the cables | | State | |
| | Minimum bending radius of cable(12ϕ) | | State | |
| | Weight per km (kg/km) | | State | |
| | Length of cable per drum(m) | | State | |
| | **APPENDICES** | | | |
| **A** | **TESTS AND INSPECTION (NORMATIVE)** | | State | |
| A.1 | Test standard(s) | | State | |
| A.2 | Type test certificates submitted with tender for evaluation and tests covered | | State/List | |
| A.3 | Mode of sampling during testing and acceptance criteria. | | State | |
| A.4 | Copies of previous type test and routine test reports by the relevant independent /international testing laboratory submitted. | | List | |

| | | | |
|---|---|---|---|
| A.5 | Valid Accreditation Certificate of the Testing Laboratory as per ISO/IEC 17025:2017 Routine test to be witnessed at the factory by KPLC engineers | Attach/ List | |
| B | **Factory Acceptance Tests** | | |
| B1 | Submit QAP for the cable manufacturing | Attach | |
| B2 | Copy of valid ISO 9001: 2015 certificate | Attach | |
| B3 | Manufactures lead in time, monthly & annual production capacity<br>Experience in the production of the type and size of cable being offered. | Specify | |
| | 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 | List | |
| C | **Factory Acceptance Tests** | | |
| C1 | Inspection of cables at manufacturers premises | State compliance | |
| C2 | Acceptance tests of cables at the Factory(FAT) | State compliance | |
| C3 | Manufacturer to provide letters of invitation to KPLC nominated engineers | State compliance | |
| D | **Inspection at Delivery Point** | | |
| D.1. | Inspection of cables at KPLC stores | State compliance | |
| D.2. | Supplier shall replace/rectify without charge to KPLC any cable found not compliant to any specification | State compliance | |
| E | **Warranty** | | |
| E.1. | Warranty that goods are new and without defects | Provide | |
| E.2. | Warranty period | State | |
| F. | **Packaging & Labeling** | | |
| F.1. | Mode of cable Packaging and protection against corrosion | Specify | |

| | | | |
|---|---|---|---|
| F.2. | Length of cable on drum (m) | State | |
| F.3. | Cable sealing at both ends | State | |
| F.4. | Markings on the drum and flange | List | |
| G | **DOCUMENTATION** | | |
| G.1. | Technical documentation submitted with tender | List | |
| G.2. | Documents to be submitted Kenya Power for approval before manufacture/supply | State | |
| G.3. | Submit recommendations for use, detailed user's installation guide, etc. during delivery | State | |
| G.4. | Routine and sample test reports to be submitted to Kenya Power for approval before shipment/delivery of the goods | State | |

***Note*

*Words like 'agreed', Yes; 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.*

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