



**TITLE:**  
**SPECIFICATION FOR  
TELECOMMUNICATION DROP  
WIRE**

<b>Doc. No.</b>	KP1/6C.1/13/TSP/05/034
<b>Issue No.</b>	1
<b>Revision No.</b>	0
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0.1 Circulation List

COPY NO.	COPY HOLDER
1	Manager, Standards
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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2016-01-21	New Issue	Nancy Wairimu Michael Apudo	Dr. Eng. Peter Kimemia

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**FOREWORD**

This specification has been prepared by the Standards Department of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) .The specification lays down requirements for telecommunication drop wire. It is intended for use by KPLC in purchasing this item.

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

**1. SCOPE**

- 1.1. This specification covers telecommunication drop wires designed for use in wiring of telecommunication equipment or industrial and consumer electronic equipment. The shape may be in oval/dumbbell shape to aid in separation of conductors.
- 1.2. This specification covers a black communication cable of 1.02mm diameter 2-core parallel construction as per KS 04-1230-1.
- 1.3. The specification stipulates the minimum requirements for telecommunication drop wire, 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 and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the items for The Kenya Power & Lighting Company.
- 1.4. The specification does not purport to include all the necessary provisions of a contract.

**2. REFERENCES**

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

- IEC 60189-1: Low frequency cables and wires with PVC insulation and PVC sheath -- Part 1: General test and measuring methods
- IEC 60332: Tests on electric cables under fire conditions – Part 1: Tests on a single vertical insulated wire or cable – Part 3: Tests on bunched wires and cables
- IEC 60344: Guide to the Calculation of Resistance of Plain and Coated Copper Conductors of Low-frequency Cable and Wires

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- IEC 60028: International Standard of resistance for copper
- IEC 60304: Standard colours for insulation for low-frequency for cables wires
- ISO 105: Textiles - Tests for colour fastness - Part A01: General principles of testing
- ISO 4892-2: Plastics- Method of Exposure to Laboratory Light Sources – Part 2: Xenon Arc lamps
- KS 04-1230-1,3: Low frequency cables and wires with PVC insulation and PVC sheath -- Part 1: General requirements and measuring: Part 3: Equipment wires.
- KS 04-765: Kenya standards for resistance of copper

**3. TERMS AND DEFINITIONS**

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

**4. REQUIREMENTS**

**4.1. Service Conditions**

4.1.1. The equipment wires shall be suitable for continuous use outdoors in tropical areas at:

- a) Altitudes of up to 2,200m above sea level,
- b) Humidity of up to 95%,
- c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C
- d) Heavy saline conditions along the coast.
- e) Pollution: Design pollution level to be taken as “*Heavy*” (Pollution level III) for inland and “*Very Heavy*” (Pollution level IV) for coastal applications in accordance with IEC 60815.
- f) Isokeraunic level: 180 thunderstorm days per year

4.1.2. The cable should be suitable for laying in cable ducts and in air.

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**4.2. Material and Construction**

**4.2.1. Conductor**

**4.2.1.1. Conductor material** - The conductor shall be made of plain annealed high conductivity copper with the following properties measured at 20<sup>0</sup>C in accordance with KS 04-765 and/or IEC 60028 :

- a) Volume resistivity – 0.017241Ωmm<sup>2</sup>/m,
- b) Density – 8.89g/cm<sup>3</sup>,
- c) Linear expansion – 0.000017/<sup>0</sup>C
- d) Coefficient of variation of resistance – 0.00393/<sup>0</sup>C,
- e) Mass resistivity – 0.15328Ωg/m<sup>2</sup>.

**4.2.1.2. Type of conductor** – The conductor shall consist of a single strand, circular in section.

**4.2.1.3. Conductor finish** – The conductor shall be plain.

**4.2.1.4. Conductor dimensions** – The conductor designation shall be by its nominal cross-sectional area and nominal conductor diameter as per Table 1.

**4.2.1.5. Conductor continuity** – The conductor shall be drawn in one piece.

**4.2.2. Insulation**

**4.2.2.1. Composition** – The insulating material shall be PVC or its copolymers or both suitably compounded to meet the requirements of general-purpose insulation for 70<sup>0</sup>C operation in accordance with KS 04-1230-1.

**4.2.2.2. Thickness** – The insulation shall be perfectly continuous having a thickness as uniform as possible and not less the values specified in Table 1.

The minimum thickness of the insulation shall be measured in accordance with the method specified in clause 4.4.1.2 of KS 04-1230-1 or in accordance with the method specified in clause 2.2.1.1 of IEC 60189-1.

**4.2.2.3. Application** – The insulation shall be applied to fit closely to the conductor without adhering to it.

The stripping properties of the insulation shall be checked in accordance with the method specified in clause 4.4.3.1 of KS 04-1230-1 or in accordance with the method specified in 3.4.1 of IEC 60189-1.

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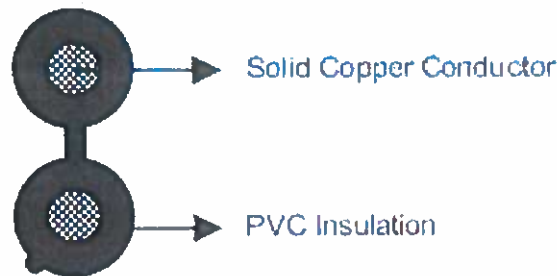
It shall be possible to strip the insulation from the conductor easily without damage to the conductor.

4.2.2.4. **Colour** – The insulated conductors shall be coloured by one colour. Colours shall correspond reasonably with the standard shown in IEC 60304.

Colour fastness to daylight, checked according to ISO Standard 105, shall be rated at not less than standard 4, prolonging the exposure until the contrast is equivalent to grade 4 on the grey scale.

The choice of colours or combination of colours shall be made black.

4.2.3. The construction of the conductors shall be a pair of two insulated conductors as per Fig. 1.



**Fig. 1: Pair of insulated conductors**

4.2.4. **Identification of insulated conductors** – Identification of insulated conductors shall be in accordance with 4.2.2.4 above.

### 4.3. Mechanical Properties of Equipment Wire

#### 4.3.1. Conductor

Elongation at break of the bare conductor shall be not less than 15.0% as per KS 04-1230-3. Compliance shall be checked by measuring the elongation at break in accordance with the method specified in 3.3 of IEC 60189-1.

#### 4.3.2. Insulation

4.3.2.1. The insulation shall have adequate mechanical strength elasticity. These properties shall remain sufficiently constant during normal use. Compliance shall be checked before and after accelerated ageing by measuring the tensile strength and the

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elongation at break on samples of the insulation in accordance with the method specified in 3.3 of IEC 60189-1.

4.3.2.2. The accelerated ageing conditioning is specified in 4.1 of IEC 60189-1.

4.3.2.3. The median of the measured values of tensile strength shall be not less than 12.5 N/mm<sup>2</sup> (12.5 MPa). (See Notes 1 and 2 hereafter). The median of the measured values of elongation at break shall be not less than 125 % for single-colour insulation, whose minimum thickness is 0.3 mm or less.

4.3.2.4. Moreover, the difference between the median values for tensile strength and elongation obtained before and after accelerated ageing shall not exceed 20 % of the median values before ageing.

**NOTES:**

1. *The values specified for tensile strength and for elongation at break are independent and non-concomitant minima. An insulation with one characteristic of near-minimum value should present a value well above the minimum for the other characteristic.*
2. *The median value is the middle value if an odd number of values is obtained or the average of the two middle values if an even number of values is obtained. The test results should have been arranged in sequence of increasing values.*

**4.4. Thermal stability and climatic requirements for drop wire**

**4.4.1. Measurement of insulation shrinkage after over-heating of conductor**

The insulation shall not shrink unduly when soldering the conductor. Compliance shall be checked in accordance with the method specified in 4.6 of IEC 60189-1. The measured shrinkage shall be not more than 4 %.

**4.4.2. Resistance to flame propagation**

Resistance to flame propagation shall be checked in accordance with the method specified in 4.3.1 of IEC 60189-1.

**4.4.3. Heat shock test**

The insulation shall withstand variations in temperature without suffering damage. Compliance shall be checked in accordance with the method specified in 4.5.1 of IEC 60189-1. The insulation shall show no cracks.

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**4.4.4. UV resistance**

The PVC compound shall be treated with anti-UV chemicals to prevent UV attack by sunlight. When exposed to a light of wavelength of 300nm to 400nm with an irradiance of  $60 \pm 2 \text{ W/m}^2$  at a black standard temperature of  $65 \pm 3^\circ\text{C}$  and a humidity of 50% for a period of 102 min day, the insulation shall not fail. UV stability shall be tested in accordance to ISO 4892-2 method A.

4.4.5. Permissible continuous loading operating temperature shall be  $70^\circ\text{C}$  and short circuit temperature of  $160^\circ\text{C}$ .

**4.5. Electrical requirements for telecommunication drop wire**

**4.5.1. Electrical resistance of conductor**

The electrical resistance of the conductor measured at a temperature of  $20^\circ\text{C}$ , shall not exceed the value specified in Table 1. The method for measuring the resistance and also for correcting the measured values for length and temperature are specified in 8.1 of IEC 60189-1.

**4.5.2. Dielectric strength**

The insulation shall withstand the application for one minute without breakdown of the voltage specified in Table 1. The method for checking the dielectric strength is specified in 5.2 of IEC 60189-1.

**4.5.3. Insulation resistance**

Insulation resistance measured at a temperature of  $20^\circ\text{C}$  shall be not less than the value specified in Table 1. The method for measuring the insulation resistance is specified in 5.3 of IEC 60189-1.

**4.5.4. Capacitance**

**4.5.4.1. Mutual capacitance**

The mutual capacitance of any pair of conductors shall not exceed 131 nF/km. The method for measurement of mutual capacitance is specified in 5.4 of IEC 60189-1.

**4.5.4.2. Capacitance unbalance**

The capacitance unbalance between any two pairs of different cabling elements shall not exceed 400 pF per 500 m length of cable. The method for measurement of capacitance unbalance is specified in 5.5 of IEC 60189-1.

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**Table 1: Physical and electrical properties of equipment cable as per IEC 60189-1 and KS 04-1230-1**

Sr. No	Property	Requirement	
1	Conductor	Nominal diameter, mm	1.02 (+0.03 or -0.06 )
		Nominal cross-sectional area, mm <sup>2</sup>	0.827
		Maximum resistance at 20 <sup>0</sup> C , Ω/km	56
2	Complete cable	Tensile strength, MPa	151
		Elongation at break, min, %	1.40
3	Insulation	Minimum thickness, mm	1.02
		Nominal insulated conductor diameter, mm	3.06
		Tensile strength, MPa	16.20
		Elongation at break, min %	125
		Insulation shrinkage, min %	4
		Elongation and tensile strength after accelerated ageing, %	< 20
4	Test requirements	Dielectric strength test voltage, V	6,000 a.c or 7,500 d.c
		Minimum insulation resistance at 20 <sup>0</sup> C, MΩ.Km	30
		Maximum average mutual capacitance per pair at 1000Hz, nF/Km	131
		Maximum capacitance unbalance per pair, pF/500m	400
5	Nominal weight, kg/km	46	

#### 4.6. Quality Management System

- 4.6.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the cables physical, tests and documentations, will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
- 4.6.2. The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications shall be submitted with the tender for evaluation.
- 4.6.3. The bidder shall indicate the delivery time of the cables, manufacturer's monthly and annual production capacity and experience in the production of the type and size of the cable being offered. A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers for similar type of the cables sold in the last five years as well as reference letters from customers shall be submitted with the tender for evaluation.

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**5. TESTS AND INSPECTION**

- 5.1. The cable shall be inspected and tested in accordance with the requirements of the IEC 60189-1, KS 04-1230-1 & 3, ISO 105, IEC 60304, IEC 60332 and this specification. It shall be the responsibility of the supplier to perform or to have performed all the tests specified.
- 5.2. Copies of previous Test Reports for the cable issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate for the third party testing laboratory shall also be submitted with the tender (all in English Language).

Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated below and shall be performed in the sequence indicated as follows:

- a) Test for resistance of conductors
  - b) Test for dielectric strength
  - c) Test for insulation resistance at 20<sup>o</sup>C and 70<sup>o</sup>C
  - d) Mutual capacitance test
  - e) Capacitance unbalance test
  - f) Measurement of dimensions
  - g) Tensile tests
  - h) Test for stripping properties of insulation
  - i) Accelerated ageing test
  - j) Pressure test
  - k) Test for resistance to flame propagation
  - l) Cold bend test
  - m) Heat shock test
  - n) Insulation shrinkage test
  - o) Solder test on conductor
- 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 cables. KPLC Engineers will witness tests at the factory before shipment. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with the IEC 60189-1, KS 04-1230-1 & 3, ISO 105, IEC 60304, IEC 60332 and this specification and shall include the following:
- a) Test for resistance of conductors
  - b) Test for dielectric strength
  - c) Test for insulation resistance at 20<sup>o</sup>C and 70<sup>o</sup>C
  - d) Mutual capacitance test
  - e) Capacitance unbalance test
  - f) Measurement of dimensions
  - g) Cold bend test
  - h) Heat shock test
- 5.4. On receipt of the cables, KPLC may perform any of the tests specified in order to verify compliance with this specification. The supplier shall replace without charge to KPLC the

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cable, which upon examination, test or use; fail to meet any of the requirements in the specification.

**6. MARKING AND PACKING**

The wires or cables shall be either wound on reels or coiled and packaged in lengths of 100m and labelled. The label which shall be securely attached on the reel or coil and shall contain the following information;

- a) Name and/or trade mark of manufacturer
- b) Nominal dimensions of the conductor of wire or cable.
- c) Type of wire or cable and voltage rating
- d) Number of cores
- e) Length of cable contained in the reel or coil
- f) Country of manufacture.
- g) Standard of manufacture.
- h) The letter, "Property of KPLC".



**7. DOCUMENTATION**

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

- a) Fully filled clause by clause description of the item on offer as per Annex A (Guaranteed Technical Particulars) and 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 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;
- f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
- g) Manufacturers letter of authorization, quality 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 signed by the manufacturer;
- b) Design Drawings with details of cable to be manufactured for KPLC.
- c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
- d) Detailed test program to be used during factory testing;

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- e) 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 cables for The Kenya Power & Lighting Company;
- f) Packaging details and quantity per package.

7.3. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the cables to KPLC stores

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**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, customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test reports for tender evaluation, all in English Language)

Tender No. ....

Clause number / KPLC Requirements		Bidder's offer (indicate full details of the values offered)	
Manufacturer's Name and address			
Country of Manufacture			
Bidder's Name and address			
Scope			
2. Applicable Standards			
4.1. Service conditions	The equipment wires shall be suitable for continuous use outdoors in tropical areas in humidity of up to 90%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and saline conditions along the coast.	Y/N	
	The cable should be suitable for laying in cable ducts and in air.	Y/N	
	Permissible continuous loading operating temperature shall be 700 C and short circuit temperature of 160°C.	Y/N	
4.2 Material and construction			
Conductor	Conductor material	Specify	
	Properties	Volume resistivity, $\Omega\text{mm}^2/\text{m}$ ,	Attach test report to show the offered values
		Density, $\text{g}/\text{cm}^3$ ,	
		Linear expansion, $^{\circ}\text{C}$	
		Coefficient of variation of resistance, $^{\circ}\text{C}$ ,	
	Mass resistivity, $\Omega\text{g}/\text{m}^2$ .		
	Type of conductor	Specify	
Conductor finish	Specify		
Conductor dimensions	Attached cable drawing		
Conductor continuity			
Physical and electrical properties of equipment cable as per IEC 60189-1 and KS 04-1230-1			

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Clause number / KPLC Requirements		Bidder's offer (indicate full details of the values offered)
Conductor	Nominal diameter, mm	Attach test report to show the offered values
	Nominal cross-sectional area, mm <sup>2</sup>	
	Maximum resistance at 20 <sup>0</sup> C , Ω/km	
Insulation	Minimum thickness, mm	Attach test report to show the offered values
	Maximum diameter, mm	
	Tensile strength, MPa	
	Elongation at break, min %	
	Insulation shrinkage, min %	
	Elongation and tensile strength after accelerated ageing, %	
	Dielectric strength test voltage, V	
Test requirements	Minimum insulation resistance at 20 <sup>0</sup> C, MΩ.Km	
	Maximum average mutual capacitance per pair, nF/Km	
	Maximum capacitance unbalance per pair, pF/500m	
<b>4.4 Quality Management Systems</b>		Specify
4.4.2 – 4.4.3		
<b>5.0 Tests and Inspection</b>		Specify
5.1 – 5.4		
<b>6. Marking &amp; Packaging</b>		Specify
6.1. Marking		Specify
6.2 Packaging		Specify
6.2.1 – 6.2.3		
<b>7. Documentation</b>		Specify
7.1 – 7.3		Manufacturer's Guarantee and Warranty
8.0	Manufacturer's Guarantee and Warranty	Specify
9.0	List catalogues, brochures, technical data and drawings submitted to support the offer.	Specify
10.0	List customer sales records and reference letters submitted to support the offer.	Specify
11.0	List Test Certificates submitted with tender	Specify
12.0	List test reports of cables to be submitted to KPLC for approval before shipment	Specify
13.0	Statement of compliance to specification (indicate deviations if any & supporting documents)	Specify

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

**NOTE:**

The **Guaranteed Technical Particulars (GTP), test reports & their certificates, drawings and/or catalogues** shall form the basis of technical tender evaluation. Bidders shall ensure that the offered values for the item conform to the values in the test reports and their certificates, drawings, catalogue references and/or brochures. Failure to adhere by this requirement shall lead to automatic disqualification at the technical evaluation stage.

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