



The Kenya Power & Lighting  
Co. Ltd.

TITLE:

**SPECIFICATION FOR  
ALUMINIUM  
CONDUCTORS STEEL  
REINFORCED  
(BARE & PVC COVERED)**

Doc. No.

KPLC1/3CB/TSP/06/022

Issue No.

1

Revision  
No.

1

Date of  
Issue

2011-03-24

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**ANNEX A:** *Guaranteed Technical Particulars (to be filled and signed by the Manufacturer and submitted together with copies of manufacturer's catalogues, brochures, drawings, technical data, sales records, customer reference letters, details of manufacturing capacity & experience and copies of type test certificates and type test reports for tender evaluation)*

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**0.1 Circulation List**

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Procurement Manager
Electronic copy (pdf) on KPLC 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 1 Rev 1	2011-03-24	Reviewed requirements on grease and packing	S. Kimiti 	

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## 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 Conductors Steel Reinforced (ACSR), Bare and PVC covered. It is intended for use by KPLC in procurement of the conductors.

### 1. SCOPE

1.1. This specification is for Aluminium Conductors Steel Reinforced for high voltage overhead power distribution lines.

1.2. This specification covers the following conductor sizes:

75 Sq. mm Aluminium Conductor, Steel Reinforced, Bare

75 Sq. mm Aluminium Conductor, Steel Reinforced, PVC Covered.

150 Sq. mm Aluminium Conductor, Steel Reinforced, Bare

150 Sq. mm Aluminium Conductor, Steel Reinforced, PVC Covered.

The specification also covers inspection and test of the conductors 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 Conductors Steel Reinforced (ACSR) acceptable for use in the company and it shall be the responsibility of the Manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the conductors for KPLC.

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

### 2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply and shall be complied with by the manufacturer/supplier.

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IEC 61089 Round wire concentric lay overhead electrical stranded conductors.

BS 215: Aluminium Conductors and Aluminium Conductors Steel - Reinforced for Overhead Power Transmission. Part2: Aluminium conductors, steel – reinforced.

BS 2627: Wrought Aluminium for Electrical Purposes. Wire.

BS 4565: Galvanized Steel Wire for Aluminium Conductor Steel Reinforced.

BS 6485: PVC Covered Conductors for Overhead Power Lines.

### 3. TERMS AND DEFINITIONS

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

### 4. REQUIREMENTS

#### 4.1. SERVICE CONDITIONS

The 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 heavy saline conditions along the coast and isokeraunic levels of up to 180 thunderstorm days per year.

#### 4.2. MATERIALS

4.2.1. Aluminium wires used in the construction of the conductor shall be material G1E in the H9 condition as specified in BS 2627.

4.2.2. The galvanized steel wires used in the construction of the conductor shall be of the standard strength grade as per BS 4565.

4.2.3. The PVC covering shall conform to the Type TI 1 compound specified in BS 6485.

#### 4.3. CONSTRUCTION

##### 4.3.1 Bare Conductor

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4.3.1.1 The conductor shall be manufactured as per BS 215 Part 2.

4.3.1.2 The conductor shall be concentrically stranded, with successive layers in opposite lay, but such that the outermost layer shall be in the right hand spiral (Z).

4.3.1.3 The wires in each layer shall be evenly and closely stranded. The complete conductor and its layers shall be firm and solid. The lay ratio shall not exceed 13.

4.3.1.4 In conductors having multiple layers of aluminium wires (e.g 150sqmm ACSR), the lay ratio of any aluminium layer shall be not greater than the lay ratio of the aluminium layer immediately beneath it.

4.3.1.5 Steel wires shall be formed during stranding so that they remain inert when the conductor is cut.

4.3.1.6 A neutral grease shall be applied between and over the layers of steel wires only. This shall be as shown in Figure C.2 of IEC 61089.

4.3.1.7 It shall be demonstrated during factory inspection/tests that good workmanship has been exercised in the manufacture of the complete conductor and that caging problems shall not arise during stringing.

4.3.1.8 The completed conductor shall be free from dirt, grit, excessive amounts of drawing oil and other foreign deposits. No grease shall be accepted on the outer layer.

**4.3.2 PVC Covered Conductor**

4.3.2.1 PVC covered conductors shall be manufactured in accordance with BS 6485.

4.3.2.2 The material, construction and physical properties of the conductor shall, after covering, conform to BS 215 Part 2 and clause 4.3.1 of this specification.

4.3.2.3 The PVC covering shall conform to the Type TI 1 compound as per BS 6485.

4.3.2.4 The colour of the covering shall be BLACK; all other properties shall be as per BS 6485.

4.3.2.5 When tested in accordance with BS 6485, the thickness of the PVC covering at any point shall be not less than 1.6mm.

**4.4. CONDUCTOR SIZES AND CHARACTERISTICS**

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- 4.4.1 The sizes for the aluminium and steel wires used in the construction of the conductors and the conductors sizes shall be as follows:-

CONDUCTOR	Bare (Racoon)	PVC Covered	Bare (Wolf)	PVC Covered
Nominal Area of Aluminium (mm <sup>2</sup> )	75	75	150	150
Approximate overall diameter of bare conductor (mm)	12.3	12.3	18.13	18.13
Overall diameter of covered conductors (mm)	-	16.3	-	22.2
Stranding No/mm Al. St.	6/4.09	6/4.09	30/2.59	30/2.59
	1/4.09	1/4.09	7/2.59	7/2.59
Calculated maximum d.c. resistance at 20°C (ohm/km)	0.3633	0.3633	0.1828	0.1828
Calculated minimum breaking load (kN)	27.4	27.4	69.2	69.2
Approximate mass of conductor (kg/km) – excluding mass of grease	318	460	726	920

**Note:** The current carrying capacities of each conductor shall be stated by the manufacturer in Annex A attached. The applicable installation conditions shall also be specified.

- 4.4.2 Variation in diameter shall not exceed  $\pm 1\%$  for aluminium wires and  $\pm 2\%$  of steel wires.

## 5. TESTS AND INSPECTION

- 5.1. The conductors shall be inspected and tested in accordance with the requirement of BS 215-2 (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

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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 215-2, BS 6485 and this specification:

**5.3.1 Aluminium Conductor, Steel-Reinforced, Bare:**

ALUMINIUM WIRES	STEEL WIRES	COMPLETE CONDUCTOR
1. Tensile test	1. Determination of stress at 1% elongation	1. Lay ratio of each layer
2. Wrapping test	2. Tensile test	2. Tensile strength
3. Resistivity test	3. Wrapping test	3. Measurement of weight
	4. Galvanising test	4. Resistance test

**5.3.2 Aluminium Conductor, Steel-Reinforced, PVC Covered:**

- a) The aluminium wires and steel wires shall be tested in accordance with BS 215-2 and clause 5.3.1 above.
- b) The following tests shall be carried out on the PVC covered conductor in accordance with BS 6485:
1. Spark Test
  2. High Voltage Test
  3. Conductor Resistance
  4. Insulation Resistance Test
  5. Thickness of PVC Covering
  6. Conductor Examination and Test

**5.3.3 Construction/Workmanship:**

The Manufacturer shall demonstrate during factory inspection/tests that the complete conductor is of good workmanship and that caging problems shall not arise during stringing.

- 5.4. Test reports shall be completed for the above tests and submitted to KPLC for approval before shipment/delivery of the conductor.

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- 5.5. On receipt of the conductors KPLC may perform any of the tests specified in order to verify compliance with the 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, LABELLING AND PACKING**

- 6.1 The complete conductor shall be packed on wooden drums such as to prevent damage during transportation and handling. The wooden drums shall be made from treated timber resistant to termite attack. The drums shall be firm, with wooden lagging and any collapsed drums shall be rejected during delivery.
- 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. Both ends 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 mm<sup>2</sup>)
  - (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.**"

**Note:** *The schedule in Annex A does not in any way substitute for detailed information required elsewhere in the specification.*

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**ANNEX A: Guaranteed Technical Particulars** (to be filled and signed by the Manufacturer and submitted together with copies of manufacturer's catalogues, brochures, drawings, technical data, sales records, customer reference letters, details of manufacturing capacity & experience and copies of type test certificates and type test reports for tender evaluation)

**TENDER NO.** .....

	Description	Guaranteed Technical Particulars for Conductor offered
1	Type and Size	
2	Service Conditions	
3	Materials	Aluminium Steel PVC Covering Grease
4	Construction & Standard	Bare conductor PVC covered conductor
5	Nominal area of aluminium, mm <sup>2</sup>	
6	Overall diameter of bare conductor, mm	
7	Overall diameter of covered conductor, mm	
8	Stranding, No./mm	Aluminium Steel Tolerance on diameter
9	Maximum d.c. resistance at 20°C, ohm/km	
10	Minimum breaking load, kN	
11	Mass of conductor, kg/km	Complete conductor Mass of grease only
12	Current carrying capacity, A (state applicable conditions)	
13	Packing, Marking & Length on drum	Packing Marking Length on drum
14	List test reports submitted (indicate test report numbers, date, Testing Institution and contact addresses)	
15	Manufacturer's Guarantee and Warranty	
16	List catalogues, brochures, technical data, drawings, customer sales records, customer reference letters, manufacturer's experience and capacity 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**

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Values of  $k$  are given in table C.1 for four cases of grease applications, a grease density of  $0,87 \text{ g/cm}^3$ , and a minimum fill factor of  $0,70$ :

Case 1: Steel core only greased (figure C.2).

Case 2: All the conductor is greased except the outer layer (figure C.3).

Case 3: All the conductor is greased including the outer layer (figure C.4).

Case 4: All the conductor is greased except the outer surface of the wires in the outer layer (figure C.5).

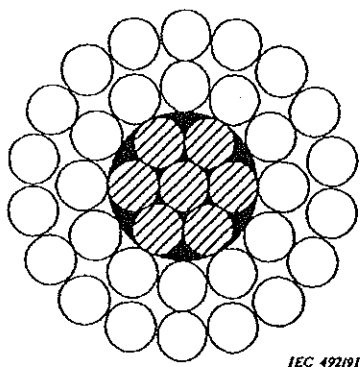


Figure C.2

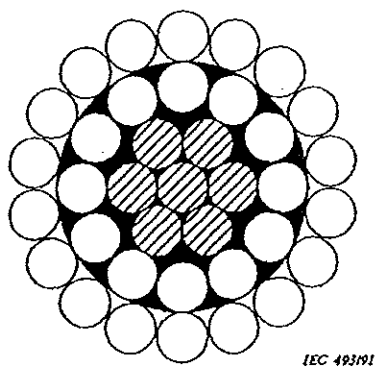


Figure C.3

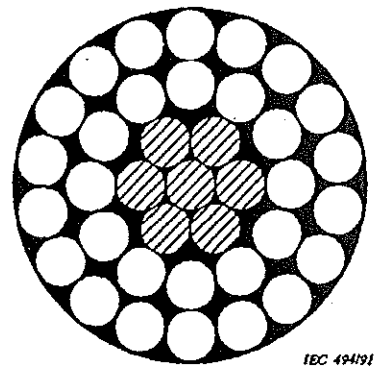


Figure C.4

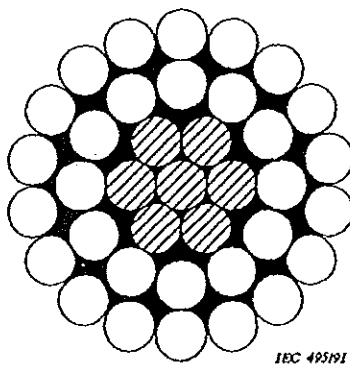


Figure C.5

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