



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**  
  
**Low Voltage Overhead Line  
Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 1 of 40	

## 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:** *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)*

**ANNEX B:** **SCHEDULE OF TENDERERS EXPERIENCE**

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



TITLE:  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

Doc. No. KP1/6C/13/TSP/05/012

Issue No. 2

Revision No. 0

Date of Issue 2016-02-04

Page 2 of 40

**0.1 Circulation List**

COPY NO.	COPY HOLDER
1	Manager, Standards
Electronic copy (pdf) on Kenya Power server ( <a href="http://172.16.1.40/dms/browse.php?fFolderId=23">http://172.16.1.40/dms/browse.php?fFolderId=23</a> )	

**0.2 Amendment Record**

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2016-02-03	Cancel and replaces issue No. 1 dated 2014/11/12	Michael Apudo	Dr. Eng. Peter Kimemia

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**  
  
**Low Voltage Overhead Line  
Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>

Page 3 of 40

## FOREWORD

This specification has been prepared by the Standards Department in collaboration with Street Lighting Department, both of The Kenya Power and Lighting Company Limited abbreviated as KPLC. It lays down requirements for Accessories for Low Voltage Overhead Lines using Aerial Bunched Conductors (ABC). The Specification is to be used by KPLC for procurement of the LV ABC accessories.

### 1. SCOPE



- 1.1 This specification is for accessories for low voltage overhead power lines using Aerial Bunched Cables (ABC). The lines are constructed on wooden and pre-stressed round concrete poles.
- 1.2 The accessories shall be suitable for low voltage aerial bunched cables consisting of XLPE insulated aluminium phase conductors and bare or insulated aluminium alloy strain-bearing neutral messenger wire.
- 1.3 The specification covers the following categories of Low Voltage ABC accessories:
  - a) Strain and Suspension Fittings for Aerial Bunched Cables consisting of bare or insulated strain bearing neutral messenger wire.
  - b) Strain and Suspension Fittings for Aerial Service Cables
  - c) Current-carrying Connectors and Joints.
  - d) Cable Ties for use with Aerial Bunched Cables.

*Note: The sizes shall be as per the schedule of requirements in the tender.*

The specification also covers inspection and tests of the accessories as well as schedule of Guaranteed Technical Particulars (GTP) to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for Accessories for Low Voltage Overhead Power Lines using Aerial Bunched Cables (ABC) acceptable for use in the company and it shall be the responsibility of the Suppliers and Manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the accessories for KPLC.

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

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04





**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
**Low Voltage Overhead Line  
 Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 4 of 40	

**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.

- ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- ISO 898-1: Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — coarse thread and fine pitch thread
- IEC 60695-2-11: Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products
- BS EN 50483: Test requirements for low voltage aerial bunched cable accessories
  - Part 1: Generalities;
  - Part 2: Tension and suspension clamps for self-supporting system;
  - Part 3: Tension and suspension clamps for neutral messenger system;
  - Part 4: Connectors;
  - Part 5: Electrical ageing test;
  - Part 6: Environmental testing.
- BS 2782-6: Method 630A - Methods of testing plastics. Dimensional properties; Determination of thickness by mechanical scanning of flexible sheet.
- UL 94: Standard specification for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing
- PIESA 1018-5: Fittings and connectors for low voltage overhead power lines using aerial bunched conductors
- NFC 33-040: Suspension Equipment for Overhead distribution with Bundle assembled cores, of rated voltage 0.6/1 kV
- NFC 33-041: Anchoring devices for Overhead Distribution with bundle assembled cores, of rated voltage 0.6/1 kV
- NFC 33-042: Service Anchoring devices for overhead and underground services with insulated cables, of rated voltage 0.6/1 kV
- NFC 33-020: Insulation piercing connectors for overhead distributions and services with bundle assembled cores, of rated voltage 0.6/1kV.

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
 Low Voltage Overhead Line  
 Fittings (ABC)

<b>Doc. No.</b>	KP1/6C/13/TSP/05/012
<b>Issue No.</b>	2
<b>Revision No.</b>	0
<b>Date of Issue</b>	2016-02-04

Page 5 of 40

NFC 33-021: Pre-insulated compression type connecting equipment for Overhead Distributions and Services with bundle assembled cores, of rated voltage 0.6/1 kV.

PIESA 1020: Cable ties for use with low-voltage aerial bundled conductors

### 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 LV ABC accessories shall be suitable for continuous operation outdoors in tropical areas at:

- a) Altitudes of up to 2200m 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, in direct sunlight and
- d) Heavy saline conditions along the coast.
- e) Isokeraunic level: 180 thunderstorm days per year

#### 4.2. General Requirements (*applicable to all accessories*)

##### 4.2.1. Range of Accessories

4.2.1.1. The accessories shall comply fully with requirements of PIESA 1018 standards besides the individual standards of manufacture referred to on each item.

4.2.1.2. The accessories shall be suitable for low voltage aerial bunched cables consisting of XLPE insulated aluminium phase conductors (16mm<sup>2</sup>, 35mm<sup>2</sup>, 70mm<sup>2</sup> and 120mm<sup>2</sup>) and bare or insulated aluminium alloy strain-bearing neutral conductor (25mm<sup>2</sup>, 54.6mm<sup>2</sup> & 70mm<sup>2</sup>) of the following minimum mechanical characteristics:

**Table 1: Cable sizes**

Aerial Bunched Cable (core sizes in mm <sup>2</sup> )	Minimum Breaking Load of Neutral Conductor (kN)
1x25+ 2x16	7.0
1x54.6 + 3x70	16.6
1x70 + 3x120	20.0

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**  
**Low Voltage Overhead Line  
Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>

Page 6 of 40

4.2.1.3. The low voltage distribution network shall be constructed on wooden poles or round pre-stressed concrete poles and the diameter at the point of mounting shall be between 170 to 230 mm.

#### 4.2.2. Materials

Materials used in the manufacture of accessories covered by this specification shall be:

- Of adequate strength for the intended application of the accessories and free from any defects that impair performance.
- Compatible with the cable materials such that there is no detrimental effect on the cable or the accessories as a result of their association and
- Compliant with the physical and electrical requirements of this specification and retain these characteristics during the normal life of the accessories whilst in an outdoor environment.

#### 4.2.3. Protection against Corrosion

All ferrous parts of accessories shall be hot-dip galvanized (heavy duty) in accordance with ISO 1461. Ferrous parts shall not be electroplated.

#### 4.2.4. Protection against Ultra-Violet Radiation


All components of accessories shall be manufactured from ultra-violet stabilized material. Details of the offered material shall be submitted

#### 4.2.5. Fastening

All threaded fastenings that form part of the fittings shall have ISO metric threads of the preferred sizes given in ISO 4016 and at least two full threads shall project clear of the locking device when it is tightened

#### 4.2.6. Fire Retardation

Unless otherwise specified in schedule A, all non-metallic components of fittings shall satisfy the glow-wire test requirements specified in IEC 60695-2-11. The glow-wire temperature shall be 550°C and shall be applied for 30 s.

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04

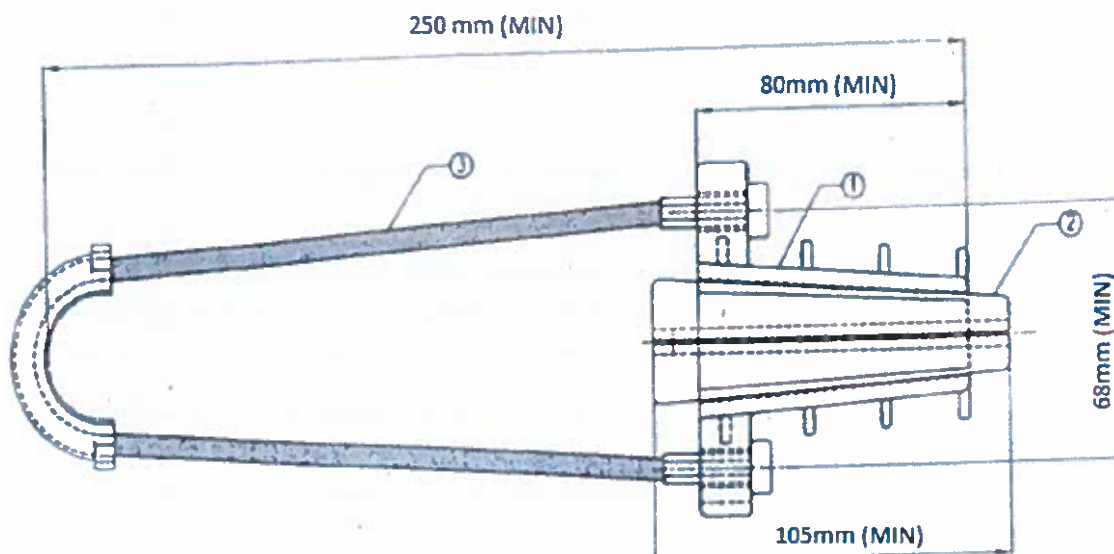
**4.2.7. Finish**

All accessories shall be free from sharp edges, burrs and swarf. The insulating materials used in the manufacture of the accessories shall be black.

**4.3. Strain and Suspension Fittings For Insulated Strain Bearing Neutral Conductor**

**4.3.1. Strain Clamp – Dead End Clamp**

- 4.3.1.1. The strain clamp shall conform to the standard BS EN 50483: Part 2 & 3, NFC 33-040, NFC 33-041 and the design shall be as per Fig. 1.
- 4.3.1.2. The clamps shall be designed to anchor LV-ABC cables with insulated neutral messenger and suitable for use at the terminal poles, section poles and at road crossings to carry the tension at the end of the line.
- 4.3.1.3. The clamp shall consists of an aluminium alloy corrosion resistant casted body of minimum 300MPa, bail of stainless steel and self-adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation and shall be of weather and Ultra-Violet resistant polymer..
- 4.3.1.4. The clamp shall be installed properly with no losable part in the process of clamping arrangement. It shall not be possible to assemble the clamp in an incorrect manner and it shall not slip or release the supporting conductor during normal use.



**Fig. 1: Typical Strain Clamp complete with bracket**

Key:

- 1. Body
- 2 Wedge
- 3. Bail Assembly

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 8 of 40

- 4.3.1.5. A suspension fitting shall hold the supporting conductor without any slippage when the conductor is subjected to a force equal to 2.0 % of breaking force. It shall be designed to release the supporting conductor by failure at a vertical load of approximately 8 kN as per PIESA 1018-3 clause 4.6.
- 4.3.1.6. The clamps shall be fixed to the pole by eye hook (*clause 4.3.3*) or bracket (*clause 4.3.4*).
- 4.3.1.7. Ultimate tensile strength and slip load of the clamp shall not be less than the values stated in the Table 1 below.
- 4.3.1.8. The clamp shall have at least two bolts for tightening and the hooking end shall be provided with hot dip galvanized nut and bolts with safety locks.

**Table 1: Strain clamp – dead end clamp sizes**

Neutral messenger cross-sectional area mm <sup>2</sup>	Diameter mm	Breaking Load (Min)kN	Slip Load kN	Weight Kg/10pcs (approximate)
25 -35	4 - 11	10	2	3.2
50 - 70	12 - 14	16.6	3	3.4
95 - 120	14 - 16	20	5	4.12

**4.3.2. Suspension Clamp**

- 4.3.2.1. The clamp shall conform to the standard BS EN 50483-3 and NFC 33 040 in design and approximate dimensions shall be as per Fig. 2.
- 4.3.2.2. The clamps shall be designed to suspend LV-ABC cables with insulated neutral messengers. The neutral messengers shall be fixed by an adjustable grip device. A movable link shall allow longitudinal and transversal movement of the clamp body.
- 4.3.2.3. The clamp shall be installed properly with no losable part in the process of clamping arrangement.
- 4.3.2.4. The clamps and the movable links shall be made of weather and Ultra Violet resistant glass fiber reinforced polymer of at least 1.5mm thick and shall provide an additional insulation between the cable and the pole.
- 4.3.2.5. Clamps shall be fixed to the pole by eye hook (*clause 4.3.3*) or bracket (*clause 4.3.4*) and shall be of a type which can be installed without the use of specialized tools.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

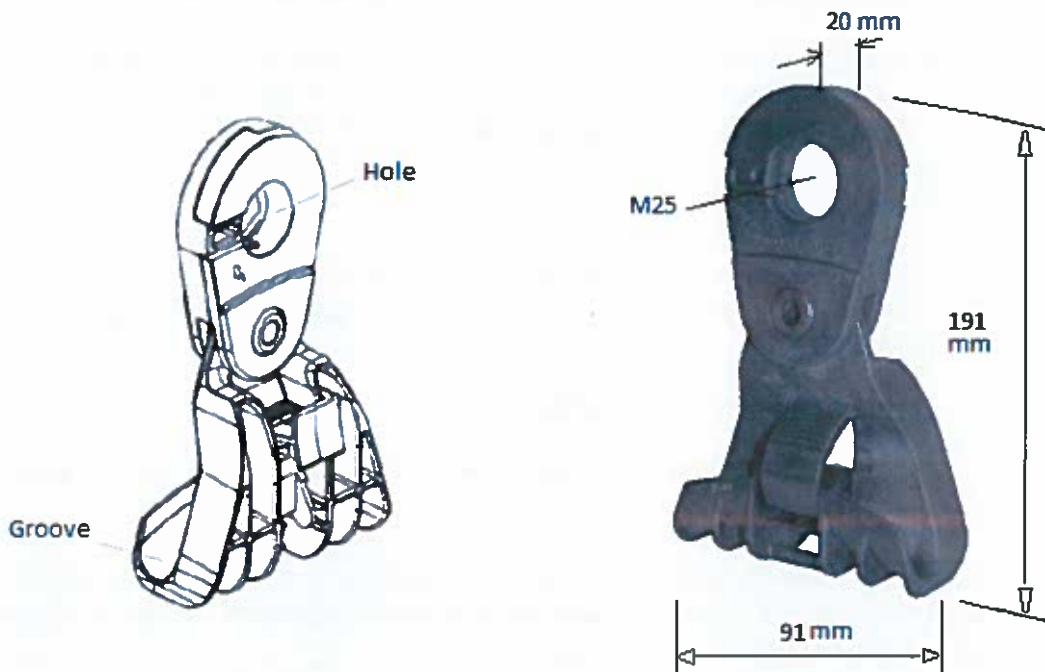
**Signed:**

**Date: 2016-02-04**

**Date: 2016-02-04**



- 4.3.2.6. The ultimate tensile strength and maximum allowable load of the clamp shall not be less than the values stated in Table 2.
- 4.3.2.7. The clamp shall sustain a maximum angle of deviation of 60° of the conductors and shall hold the supporting conductor without any slippage to within 5% of the specified breaking force of the supporting conductor.



**Fig. 2b: Typical drawing of Type 1-LV Suspension Clamp for use with bracket and hook**

**Table 2: Suspension Clamp Sizes**

Neutral messenger cross-sectional area mm <sup>2</sup>	Groove Diameter mm	Breaking load kN	Maximum allowable load kN	Hole diameter mm	Weight Kg/10pcs
25 -35	6 - 11	4.5	15	25	0.8
50 - 70	12 - 16	16.6	20	25	1.5
95 - 120	15 - 17.5	20	30	25	2.5

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.**

**KP1/6C/13/TSP/05/012**

**Issue No.**

**2**

**Revision No.**

**0**

**Date of Issue**

**2016-02-04**

Page 10 of 40

**4.3.3. Suspension/ Dead End Eye Hook (wood and concrete)**

- 4.3.3.1. Suspension/dead-end eye hooks shall be suitable for mounting through wood poles (by single bolt) and attachment to pre-stressed round concrete poles by use of universal pole clamps. The diameter at the point of mounting shall be 170 to 230mm.
- 4.3.3.2. Eye hooks shall be designed as to hold both suspension clamps and dead-end clamps and shall be of wood type or concrete type to be installed with the pole clamps.
- 4.3.3.3. Eye hooks shall be made of forged hot dip galvanized steel (as per clause 4.2.3). The manufacture shall not involve cold bending or welding (or both). They shall be supplied complete with nuts and two washers as follows:
- a) Eye Hook for use as a through bolt for wood poles - Fig 3a
    - (i) Nut M20 x 2
    - (ii) Round washer M20 x 2 of 5mm thickness
    - (iii) Square curved washer M20 x 2 of 5mm thickness
  - b) Open and closed Eye Hook for use with universal clamps – Fig. 3b & c
    - (i) Nut M20 x 2
    - (ii) Round washer M20 x 2 of 3mm thickness
    - (iii) Square washer M20 x 2 of 3mm thickness
- 4.3.3.4. The bolts and nuts shall be corrosion resistant and the galvanization shall conform to ISO 1461 standard.
- 4.3.3.5. Suspension/dead-end eye hooks shall be manufactured from grade 4.8 material in accordance with ISO 898-1 whereas nuts shall be manufactured from grade 5 material in accordance with ISO 898-1.
- 4.3.3.6. External threads shall not be undercut. Galvanizing shall be of type C of ISO 1461 whereas internal threads shall be undercut to suit matching galvanized components and shall be treated with an acceptable rust inhibitor. Galvanizing of nuts shall precede threading.
- 4.3.3.7. The ultimate tensile strength (UTS) of the eye hook shall be 20 KN. The design and dimensions shall be as per Fig. 3a, b & c.

**Issued by: Head of Section, Standard Development**

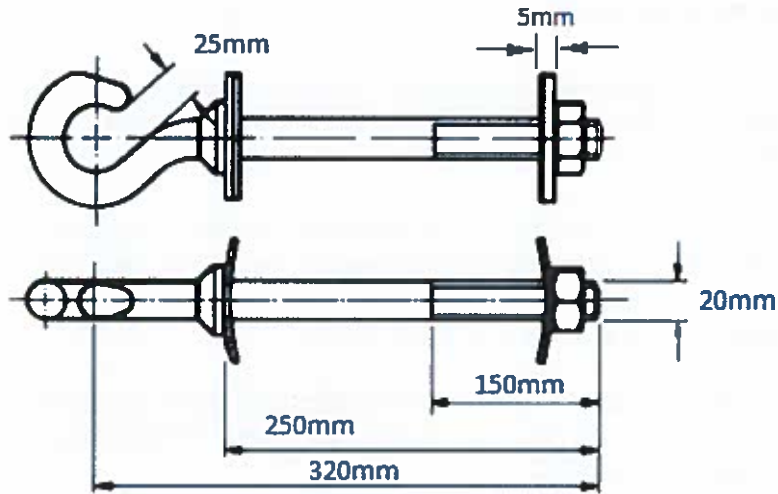
**Authorized by: Head of Department, Standards**

**Signed:**

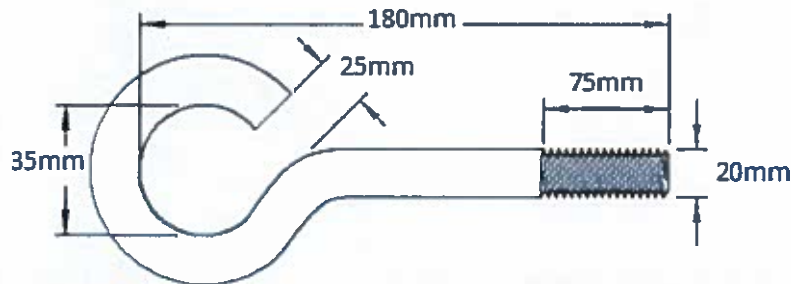
**Signed:**

**Date: 2016-02-04**

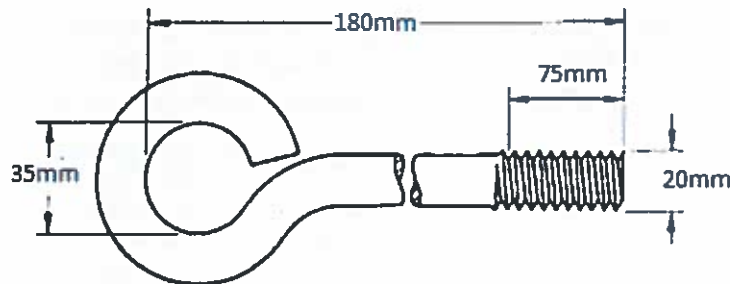
**Date: 2016-02-04**



**Fig 3a: Eye Hook for use as a through bolt for wood poles**



**Fig 3b: Open Eye Hook for use with universal and suspension clamps**



**Fig 3c: Closed Eye Hook for use with universal and suspension clamps**

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**



**Signed:**

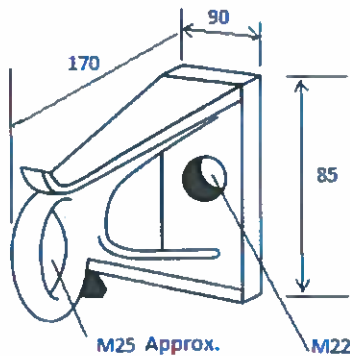


**Date: 2016-02-04**

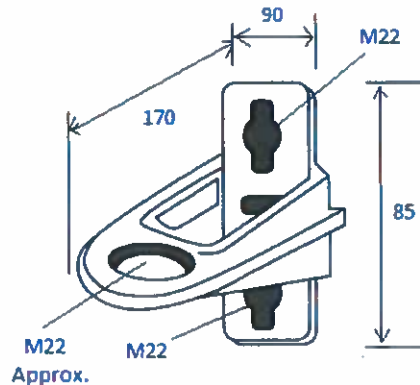
**Date: 2016-02-04**

**4.3.4. Suspension/Strain Bracket**

- 4.3.4.1. The suspension/strain brackets shall be designed as per Fig 4a and 4b. The manufacturer shall provide the technical data for the dimensions necessary to withstand the minimum tensile strengths of the ABC cables referred to in clause 4.2.1.1, Table 1.
- 4.3.4.2. They shall be made of high strength corrosion resistant aluminium alloy with a tensile strength of not less than 300MPa and shall be suitable for use in wood poles (using pole bolts) and concrete poles (using galvanized steel straps or universal clamps).The galvanization shall be hot dip as per ISO 1461.
- 4.3.4.3. Fixing of the brackets shall be by 1 bolt M20 or 2 stainless steel straps of 20mm x 0.7 mm. The maximum line deviation angles shall be 30° towards the pole and up to 50° pulling away from the pole



**Fig. 4A Typical Suspension bracket**



**Fig. 4B: Typical Strain bracket**

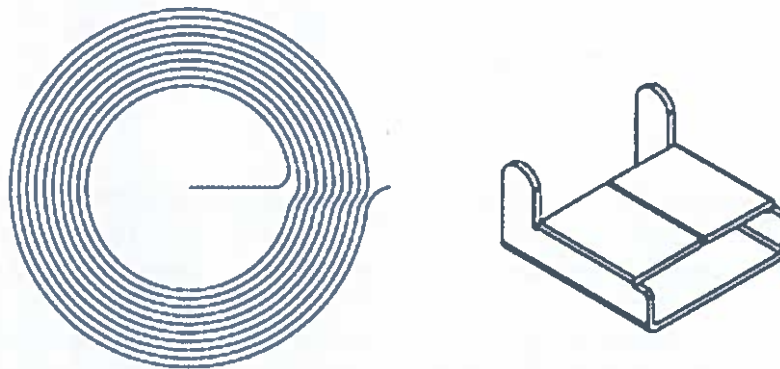
**4.3.5. Stainless steel strap and buckles**

- 4.3.5.1. The stainless steel strap shall consist of:
- Stainless steel strap of size 20mm ±0.2 x 0.7mm ±0.05 mm and shall have tensile strength of 7.5KN min., elongation 30% Min, finish 2B, and the stainless steel material shall be of high mechanical strength, corrosion and wear resistant as per AISI SS 202.
  - Tensile strength of strap is to be min 7.5KN to be tested on a loop with buckle. Number of loops for mounting the bracket on pole to be allocated as per load requirement for dead-end and suspension clamp specified in this specification.
  - Minimum two loops of 0.75 meter each with one buckle to be considered for attaching the brackets to the poles. For dead-end or suspension pole bracket a total of 1.5 meter of stainless steel strap and two buckles are required.

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04

- d) The stainless steel buckle to suit above strap shall be used to tension and fix it. It shall have a slot width of not less than 20.5 mm x 1.5 mm.
- e) The Buckle shall be made from AISI SS 304 of thickness not less than 1.2 mm.
- f) Buckles should be supplied in plastic bags containing 100 pcs per bag

4.3.5.2. Type tests on stainless steel Straps and Buckles shall consist of Chemical Analysis Test Report of Composition. In addition the stainless steel Strap should have been type tested for Tensile Strength and Ultimate Elongation. These shall be submitted with the tender for purposes of tender evaluation.





**Fig. 5: Stainless Steel Strap Roll and Buckle (typical)**

**4.4. Current-Carrying Connectors**

**4.4.1. General requirements**

- 4.4.1.1. The connectors shall connect cables designed to IEC 61089 and shall be designed and tested in accordance with BS EN 50483-4 and Class A requirements as defined in BS EN 50483-5. They shall also fully withstand the type tests prescribed in BS EN 50483-1, PIESA 1080-5.
- 4.4.1.2. The connectors shall be suitable for use with ABC conductors of aluminium construction with conductor cross-section area in the range 16mm<sup>2</sup> to 120mm<sup>2</sup> and for service cables of either copper or aluminium with cross-section area in the range 1.5mm<sup>2</sup> to 25mm<sup>2</sup>.
- 4.4.1.3. The connectors design shall allow them to be fitted without having to dismantle their individual components. All segments of the connector shall be held captive when opened for fitting to the conductors.

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 14 of 40

- 4.4.1.4. All connectors shall be such that their current-carrying capacity is greater than that of the larger conductor to which they are intended to be connected.
- 4.4.1.5. In addition to Clause 4.2.2, materials used in the manufacture of the connectors shall be of a quality that ensures that the material does not split and does not deteriorate from its intended state during the application process.
- 4.4.1.6. The connectors shall be designed to withstand physical and chemical processes expected in service i.e. oxidation, galvanic corrosion, thermal expansion etc. They shall be UV protected.

**4.4.2. Insulation Piercing Connectors**

**4.4.2.1. General**

- 4.4.2.1.1. The insulating piercing connectors (IPC) shall be designed and tested in accordance with BS EN 50483-1&4, PIESA 1018-5 and NFC 33-020. The design shall be weatherproof for aluminium and/or copper main and branch conductors.
- 4.4.2.1.2. The IPC shall be applicable in the process of replacing the bare conductors with LV ABC cables to reduce power theft and line losses by providing a proper method of service connection from ABC cables to consumers without damaging the cable.
- 4.4.2.1.3. Removal of bare conductor, stringing of LV ABC cable and re-establishing the service connections shall be done as a simultaneous process.
- 4.4.2.1.4. In this regard the IPC shall be used for:-  
a) Providing 1-2 service connections from 30 metres away from the pole,  
b) providing supply to Junction/ Distribution Box from ABC cable  
c) Establishing Tee connection from LV ABC to LV ABC cables.
- 4.4.2.1.5. This IPC shall not be exposed to any bare conductor in the environment during connection. The design of the connectors shall ensure total weather and moisture proof so that no water or moisture can enter through the pierced holes on to the cable insulation.
- 4.4.2.1.6. For individual connectors, the torque required for different conductor sizes shall be stated in the equipment by the manufacturer.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

**Signed:**

**Date: 2016-02-04**

**Date: 2016-02-04**



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 15 of 40

**4.4.2.2. Construction**

- 4.4.2.2.1. The connectors shall be totally insulated with no loose parts. They shall be totally weather and moisture proof so that no water or moisture can enter through the pierced holes on the cable insulation.
- 4.4.2.2.2. The connectors shall work at 30 cm under water bath for 30 minutes, and when tested at an applied voltage of 4 KV for 1 minute, there shall be no flashover/ failure and moisture ingress in it in accordance with EN 50483-1.
- 4.4.2.2.3. The design shall also withstand working temperatures for installation from -10°C upto +60°C and operation experience with temperature from -20°C up to +75°C.

**4.4.2.3. Material**

Material used in the manufacturing process of the components of this product shall be specified in the respective product drawings and shall be summarized as follows:

- a) All the metallic part of the connector shall be corrosion resistant and shall be proven in Salt Fog chamber and Wet SO<sub>2</sub> gas chamber and there shall not be any change in contact resistance, temperature after overloads, load cycling.
- b) The body shall be manufactured from corrosion resistant pure aluminium/aluminium alloy with tensile strength of 300MPa.
- c) The contact plates shall be made of tinned aluminium/copper. The connector teeth shall be factory greased and sealed to retard water or moisture ingress and corrosion.
- d) The insulation material shall be made of weather and Ultra Violet resistance, reinforced polymer in accordance with UL 746-C.
- e) The outer metallic part shall have potential free tightening bolts to allow safe installation on live lines.
- f) The bolts shall be made of "Shear Head" type so that it controls the effective applied torque during installation and break off at a specified torque after establishing proper connection.
- g) The connector shall not have any losable component which may drop and then lost while installation is taking place at overhead conditions. The cable end cap shall be attached to the body.

**Issued by: Head of Section, Standard Development**

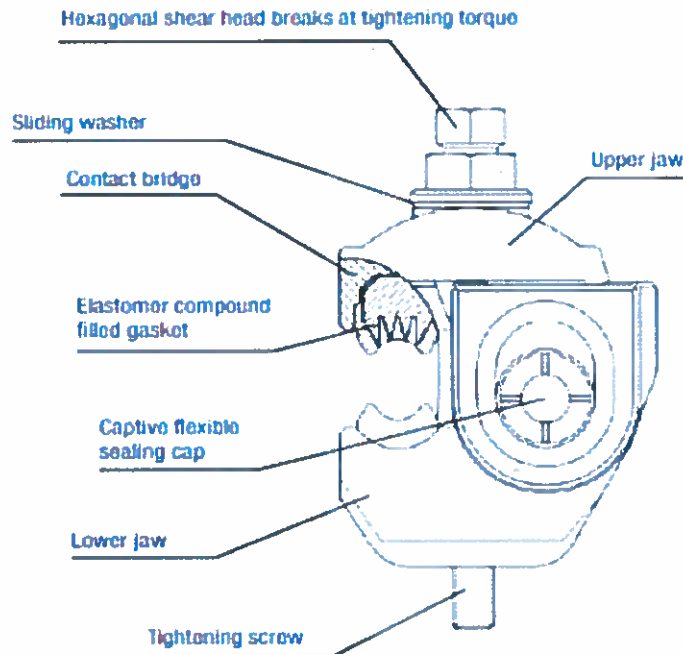
**Authorized by: Head of Department, Standards**

**Signed:**

**Signed:**

**Date: 2016-02-04**

**Date: 2016-02-04**



**Fig. 5: Illustration of typical Insulated Piercing Connectors**

**4.4.2.4. Sizes**

The following sizes shall form part of this specification, and KPLC shall state the needed sizes during tender as per Table 1:

**Table 3: Recommended sizes and intended application**

Application	Terminals	Size Range
IPC for customer/Street Light service	Main	16mm <sup>2</sup> to 120 mm <sup>2</sup>
	Tap	1.5mm <sup>2</sup> to 25 mm <sup>2</sup>
IPC for ABC to DB Connection or Service	Main	16mm <sup>2</sup> to 120 mm <sup>2</sup>
	Tap	4mm <sup>2</sup> to 35 mm <sup>2</sup>
IPC for ABC to ABC Tee Connection	Main	25mm <sup>2</sup> to 120 mm <sup>2</sup>
	Tap	4mm <sup>2</sup> to 35 mm <sup>2</sup>
IPC for bare main (Al/Cu) to Main connections	Main	25mm <sup>2</sup> to 120 mm <sup>2</sup>
	Tap	25mm <sup>2</sup> to 95 mm <sup>2</sup>

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2016-02-04

Date: 2016-02-04





**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.**

**KP1/6C/13/TSP/05/012**

**Issue No.**

**2**

**Revision No.**

**0**

**Date of Issue**

**2016-02-04**

Page 17 of 40

#### 4.4.3. ABC Bolted Connectors

##### 4.4.3.1. Parallel Groove Clamps – Aluminium

This type of bolted connector shall:

- a) Be made from forged aluminium; for aluminium to aluminium connection throughout the conductor range.
- b) The clamps shall have serrated transverse grooves for maximum conductor contact, use hot dip galvanized steel bolts property class 8.8.
- c) They shall utilize Belleville washers to prevent thermal ratcheting under cyclic loads.
- d) The clamps shall be coated with an oxide inhibitor. A proof of the same shall be provided during tendering stage.

##### 4.4.3.2. Bi-metal Parallel Grooves Clamps

4.4.3.2.1. Bi-Metal parallel groove clamps shall be suitable for tapping or joining hard drawn or annealed copper conductor or aluminium overhead conductor type AAC, AAAC or ACSR to the ABC cables.

4.4.3.2.2. Bi-Metal Parallel Groove clamps shall have the following features:

- a) They shall be forged from 99.6% pure aluminium clamp with a friction welded copper insert; clearly marked in blue for making copper conductor connections. The clamps shall have serrated transverse grooves for maximum conductor contact.
- b) One parallel groove shall have a copper inlay impact welded onto the surface of the groove, and the external aluminium to copper interface is sealed by a special compound which prevents interface corrosion;
- c) Slotted bolt holes which allow adjustment to varying conductor sizes in each groove; tightened onto the conductors using hot dip galvanized steel bolts, property class 8.8, galvanized nuts that shall allow the connector to be tightened with the use of a single spanner at higher torques and utilize belleville washers on bolts to prevent thermal ratcheting under cyclic load, maintaining clamping pressure, thus preventing metal creep.
- d) The connectors shall be ultrasonically tested to check bonding between copper inlay and aluminium.
- e) The clamps shall be coated with an oxide inhibitor. A proof of the same shall be provided during tendering stage.

4.4.3.2.3. Typical design and dimensional requirements shall be as per Fig. 6a and b.

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL**  
**BUNCHED CABLES (ABC)**  
**ACCESSORIES**

**Low Voltage Overhead Line**  
**Fittings (ABC)**

**Doc. No.**

**KP1/6C/13/TSP/05/012**

**Issue No.**

**2**

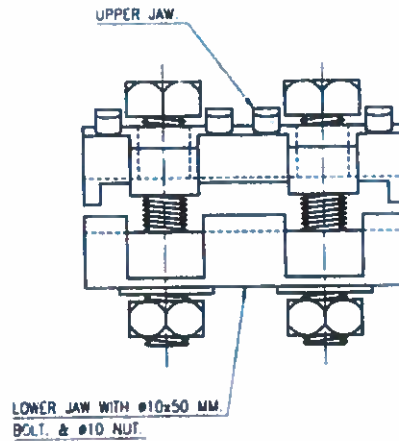
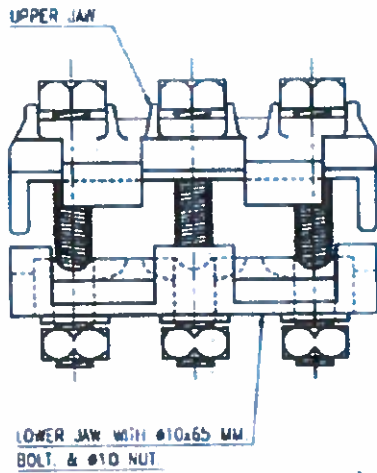
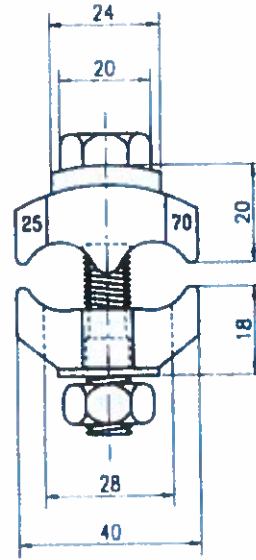
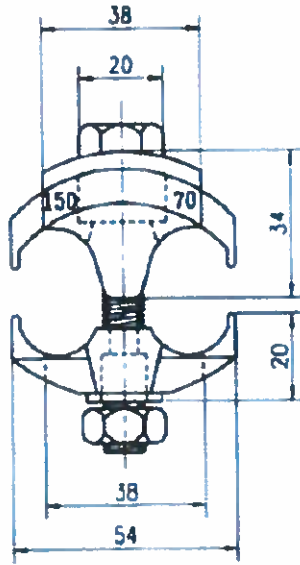
**Revision No.**

**0**

**Date of Issue**

**2016-02-04**

Page 18 of 40



Issued by: Head of Section, Standard Development

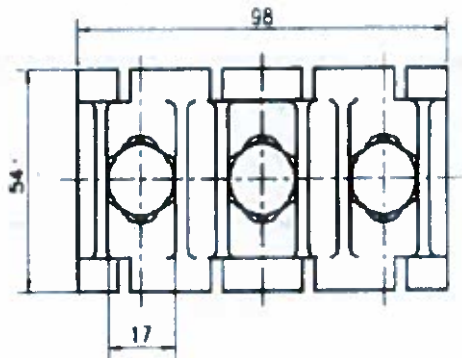
Authorized by: Head of Department, Standards

Signed:

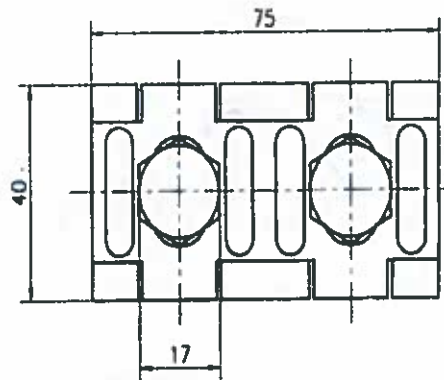
Signed:

Date: 2016-02-04

Date: 2016-02-04



**Fig. 6a: Parallel Groove Aluminium Alloy Clamps for 70-150 mm<sup>2</sup>.**



**Fig. 6b: Parallel Groove Aluminium Alloy Clamps for 16-70 mm<sup>2</sup>.**

**4.4.4. Bi-metallic Lugs**

- 4.4.4.1. The bi-metallic lugs shall be of pre-insulated type i.e. the compression shall be directly made over the insulation but crimping shall not deteriorate the insulation of the sleeve.
- 4.4.4.2. The lugs shall be of waterproof type. For this purpose the lugs shall be equipped with a suitable rubber gasket to prevent ingress of water.
- 4.4.4.3. The lugs shall be pre-filled with any suitable oxide inhibiting compound or silicon grease and their current ratings shall be equivalent to the respective cable/messenger.
- 4.4.4.4. For easy identification, bi-metallic lugs shall have markings indicating size of conductor applicable (or colour coded as per BS EN 50483: Part 5), sequence and location of hexagonal compression indents and dies to be used. Also insulation stripping length shall be indicated on the lugs.
- 4.4.4.5. The current rating of the bi-metallic lugs shall not be less than that of the ABC cable rating.
- 4.4.4.6. The temperature rise at the time of lugging shall not be more than that of the conductor stipulated in the relevant standard IEC 61089.
- 4.4.4.7. Compression of all bi-metallic lugs for both phase and messenger neutral shall be achieved by means of using a single die.
- 4.4.4.8. The design and dimensional requirements shall be as per Fig. 6 and Table 4.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

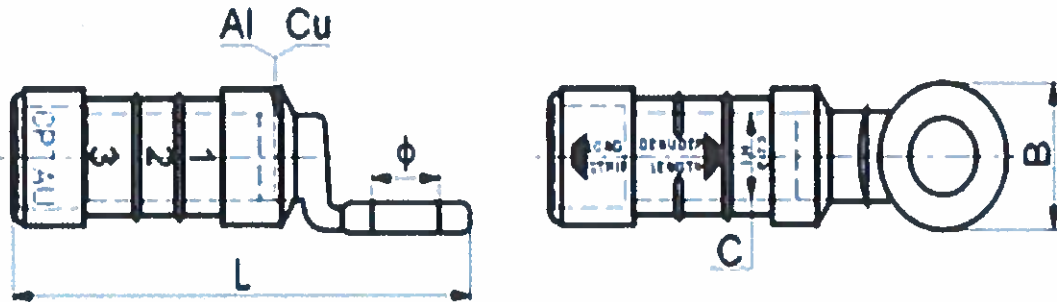


**Signed:**



**Date: 2016-02-04**

**Date: 2016-02-04**



**Fig. 6: Bi-metallic lugs**

**Table 4: Bi-metallic lug sizes**

Cable size (mm <sup>2</sup> )	Dimensions (mm)			Length (mm)
	C	B	$\phi$	
10 - 16	16	20	10.5	98.5
16 - 25	20	24	13	98.5
35 - 50	20	24	13	98.5
50 - 70	20	24	13	98.5
70 - 120	20	24	13	98.5

**4.4.5. Pre-insulated Sleeves**

4.4.5.1. These pre-insulated sleeves shall be used to link together LV insulated overhead lines (ABC cables up to 1 kV).

4.4.5.2. The sleeves shall compose of:

- a) An aluminum (phase) or aluminium alloy (neutral) sleeve with a stop in the middle.
- b) A black thermoplastic sealed tube with a flexible elastomer ring.
- c) Neutral contact grease in the tube which improve the contact area and protect the aluminum against oxidation.

4.4.5.3. The crimping shall be realized on the plastic part according to the marks on the body of the sleeve.

4.4.5.4. The design and the dimensional requirements shall be as per Fig. 7, and Table 5.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

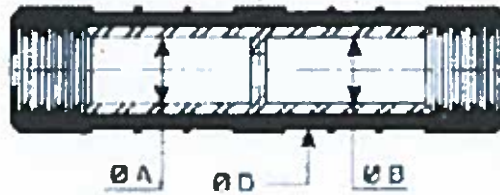


**Signed:**



**Date: 2016-02-04**

**Date: 2016-02-04**



**Fig. 7: Pre-insulated sleeve**

**Table 5: Pre-insulated sleeve sizes**

Cross section mm <sup>2</sup>	Dimensions			Length (mm) L
	ØA mm	ØB mm	ØD mm	
16	5.5	5.5	20	98.5
25	6.5	6.5	20	98.5
35	8	8	20	98.5
50	9	9	20	98.5
70	10.5	10.5	20	98.5
95	12.2	12.2	25	98.5
120	14.2	14.2	25	98.5

**4.4.6. Cable Joint Compound**

- 4.4.6.1. Cable jointing compound shall be made from polyurethane based resin compound, which involves electrical grade potting, especially formulated for use in cable joints. It shall be tested according to BS 2782: Part 6: Method 630A: 1994.
- 4.4.6.2. The resin shall be a blend of complex polyols with selected additives formulated to give a stable product specifically suited to the requirements of a cable jointing compound.
- 4.4.6.3. Pot life shall be controlled to give adequate time for mixing and pouring; the setting shall take place with a gradual increase in viscosity to give a rubber-like solid within about an hour and the hardness shall gradually increase for approximately the next twenty-four hours.
- 4.4.6.4. The joint compound shall be suitable for prevention of oxidation on aluminium surfaces; protect the connection from corrosion and reduce the transition resistance.
- 4.4.6.5. The compound shall contain no skin-irritant ingredients and shall be supplied in tubes of 250g each.
- 4.4.6.6. The expiry date of the joint compound shall be quoted and shall be capable of being stored for not less than 24 months

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
 Low Voltage Overhead Line  
 Fittings (ABC)

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 22 of 40	

**4.5. End Sealing Caps, Core Separators (pairs) and Cable Ties for use with Aerial Bunched Conductors**

**4.5.1. Cable End Sealing Caps**

4.5.1.1. End sealing caps shall be insulated and provide protection against the ingress of moisture and also ensure that the system is fully insulated. They shall be manufactured and tested as per BS EN 50483 and requirements of Table 6.

4.5.1.2. Cable End Sealing Caps shall have the following features:

- a) Quick and foolproof installation using simple tools.
- b) A strong and permanent environmental seal.
- c) Excellent resistance to weathering, moisture contamination & adverse environmental conditions.
- d) Special adhesive lining provides seal on irregular cable sheaths.
- e) Valved end Cap available for pressurized application.

**Table 6: Test requirements for end caps**

No.	Characteristics	Requirement
1	Heat Shrink Material	Cross Linked Polyolefin
2	Tensile Strength	12 N/mm <sup>2</sup> (MPA)
3	Elongation	350%
4	Density	1.20 gm/cm <sup>3</sup>
5	Hardness	50 Shore D
6	Thermal Ageing	10% drop in physical properties
7	Water Absorption	<0.2%
8	Chemical Resistance	To dilute acids & alkalis, Salts etc.
9	Continuous Temperature limit	-40°C to 125°C
10	Shrink Temperature	125°C
11	Degree of protection	IP 68

4.5.1.3. The caps shall be permanent applied, range taking and suitable for installation on 10mm<sup>2</sup>-120mm<sup>2</sup> ABC cables.

4.5.1.4. The caps shall not be push fit as accidental contacts could result in them being removed and exposing the live cores.

4.5.1.5. The end sealing cap design and dimensional requirements shall be as per Fig. 8 and Table 7.

Issued by: Head of Section, Standard Development

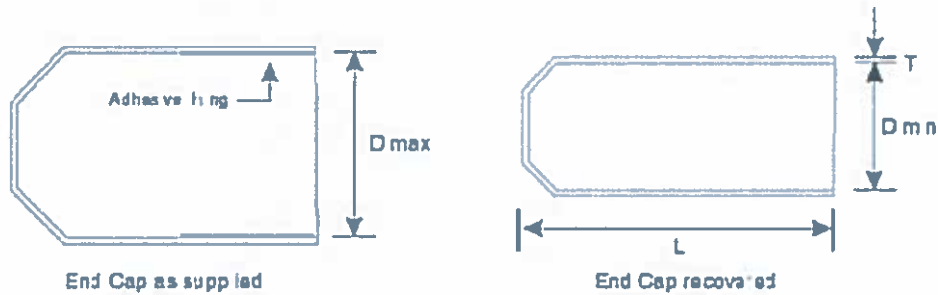
Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**Fig. 8: End Sealing Caps**

**Table 7: End sealing cap sizes**

Cable Range	Dimensions (mm)			
	D max	D min	L	T
10- 16	20	7.5	55	2.5
16 - 35	40	15	90	3.3
25 - 50	55	25	125	3.8
35 - 70	75	35	140	3.8
70 - 120	130	60	160	4.6

**4.5.2. Core Separators (pairs)**

- 4.5.2.1. The core separators shall comprise of two wedges to facilitate the installation of connectors on tensioned ABC cables. The two separators shall be joined together with a nylon cord as per Fig. 9.
- 4.5.2.2. The two separators shall be made from good quality hardened plastic with the shape being capable to positively lock tight in position. They shall be supplied complete with relevant nylon cord.
- 4.5.2.3. The dielectric strength of material used shall be 3 kV/mm for one minute.
- 4.5.2.4. Both sides of the wedge shall have large grooves so that it can easily be inserted in the twisted cable.
- 4.5.2.5. They shall be used for separating phases of aerial bundle conductor during installation of the fittings. The cam action and wedge action shall be incorporated in one unit
- 4.5.2.6. The core separator shall also be used during stringing the ABC cables and in installation of piercing type connectors to the individual core of twisted cable.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**



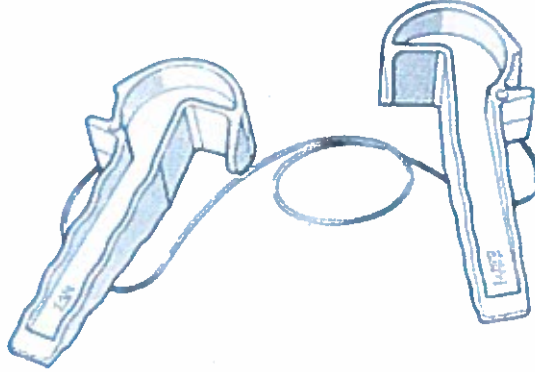
**Signed:**



**Date: 2016-02-04**

**Date: 2016-02-04**

4.5.2.7. The separators shall be inserted in the twist of the cable so that one particular cable shall be separated. The top surface shall also have small grooves for the application of manual force.



**Fig. 9: Typical drawing of a Core separator.**

**4.5.3. Cable Ties**

4.5.3.1. Cable ties shall be designed as per this specification and tested in accordance with PIESA 1020.

4.5.3.2. The cable tie shall be heavy duty type single piece assembly of minimum loop tensile strength of 550N; advanced pawl and teeth design, with tail finger grips for easier handling and tightening as per Fig. 10.

4.5.3.3. The cable tie shall be at least 9 mm in width, 350 mm usable length measured from the inside of the tie clamp and tapered to facilitate insertion into the tie clamp

4.5.3.4. The cable tie material shall be Polyamide 6.6, coloured black, weather-stabilized and corrosion resistant and shall pass UL 94 V-2 flammability tests.

4.5.3.5. Cable ties shall be of uniform quality and shall be free from sharp edges, irregularities or defects that could affect their performance, reliability or durability.

4.5.3.6. The cable tie shall have a guaranteed minimum serviceable life of 7 years.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

Signed:



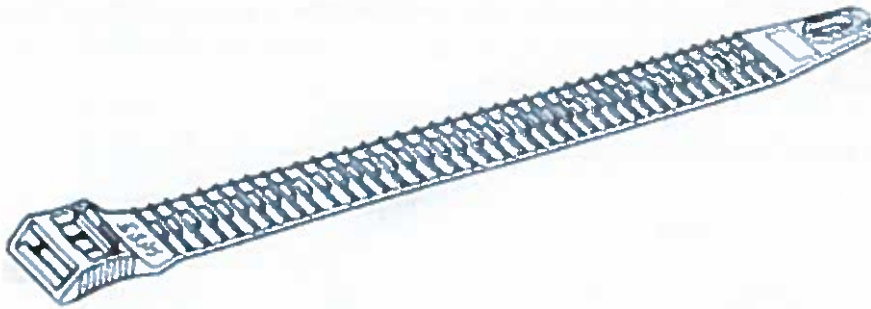
Signed:



Date: 2016-02-04

Date: 2016-02-04





**Fig. 10: Cable tie**



**Table 8: Cable Ties Sizes**

<b>Cable diameter mm</b>	<b>Length mm</b>	<b>Breaking load kN</b>	<b>Weight Kg/10 pcs</b>
16 - 25	132	0.35	1.8
22 - 35	180	0.35	2.6
35 - 50	265	0.51	3.6
50 - 120	360	0.51	5.0

**4.6. Strain and Suspension Fittings for Aerial Service Cables**

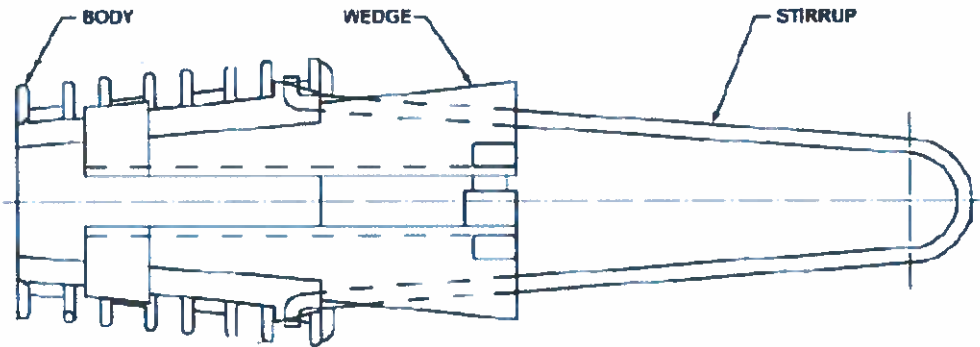
**4.6.1. House Service Strain Clamp**

- 4.6.1.1 The house service strain clamp shall be designed, manufactured and tested to NFC 33-042 and shall be type tested to BS EN 50483: Part 2 & 3 standard requirements.
- 4.6.1.2 The design shall be such that the parts do not separate when the fittings are being installed on the service cable. Any wedges used shall be attached to the clamp body.
- 4.6.1.3 It shall be made from Ultra Violet resistant thermo-plastic body with the wedge made from hot galvanized steel bail conforming to ISO 1461; that can accommodate round cables from 7 to 19 mm diameter.
- 4.6.1.4 Strain fittings shall not slip or release the service cable during normal service and the minimum breaking loads shall be 2.5 kN.
- 4.6.1.5 Strain fittings shall not cause damage to the service cable during normal service. They shall be of a type that can be installed without the use of special tools.

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04

4.6.1.6 The strain fittings shall be suitable for the termination of single phase and three phase service cables of sizes 10 - 16mm<sup>2</sup> and 25mm<sup>2</sup> respectively.(suitable for use for 2x10 - 2x35 mm<sup>2</sup> and 4x16 - 4x25 mm<sup>2</sup> cables)

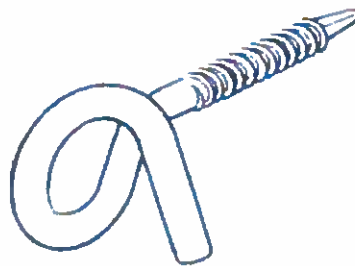
4.6.1.7 The general design of the house strain clamp shall be as per Fig. 11.



**Fig. 11: House service strain clamp.**

**4.6.2 Pigtail Couch Screw**

- 4.6.2.1 Pigtail couch screw shall be suitable for screwing directly into wooden pole and for securing into brick wall when used with P16 plastic wall plug.
- 4.6.2.2 The screws shall have adequately adjusted threads that shall withstand a high pull-out resistance and optimum conditions for the specific field of application.
- 4.6.2.3 The screws shall be made from hot dip galvanized steel with minimum tensile strengths conforming to those of the ABC cables prescribed in clause 4.2.1.1.
- 4.6.2.4 The design requirements shall be as per Fig. 12. The size shall be M16, with the length suitable to withstand the tensile pull strength when secured on the pole.



**Fig.12: Typical Pigtail Screw**

Issued by: Head of Section, Standard Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**  
  
**Low Voltage Overhead Line  
Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 27 of 40	

#### 4.7. Quality Management System

- 4.7.1. The supplier/manufacturer shall submit a quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation of the Low Voltage ABC accessories, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.
- 4.7.2. The Manufacturer's Declaration of Conformity to applicable 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.
- 4.7.3. The bidder shall indicate the delivery time of the Low Voltage ABC accessories, manufacturer's monthly and annual production capacity and experience in the production of the type and size of items being offered.

#### 5.0. TESTS AND INSPECTION

- 5.1. The Low Voltage ABC accessories shall be inspected and tested in accordance with the requirements of ISO 1461, BS 2782-2, BS EN 50482, IEC 60695-2-2 and UL 94 standards and provisions of this specification. 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. A copy of the accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender document (all in English Language)
- 5.3. Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated below:
- a) Strain And Suspension Fittings For Insulated Strain Bearing Neutral Conductor as per BS EN 50483-2 & 3
    - (i) Mechanical tests (breaking load)
    - (ii) Slip tests on cables (no slippage below 300N)
    - (iii) Dielectric voltage test (4kV in air)
    - (iv) Environmental tests (climatic and corrosion)
    - (v) UV protection
  - b) Current-Carrying Connectors as per BS EN 50483-4 & 5, PIESA 1018-5, NFC 33-020 and NFC 33-021
    - (i) Test for mechanical damage to the main conductor

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 28 of 40

- (ii) Branch cable pull-out test
- (iii) Connector bolt tightening test
- (iv) Shear head function test
- (v) Low Temperature impact test
- (vi) Di-electrical voltage test
- (vii) Environmental tests (Corrosion, Salt mist, Gas atmosphere, Immersion, Climatic ageing and electrical ageing tests)
- (viii) UV protection

**c) Cable Ties and End Sealing Caps.**

- (i) Flammability tests
- (ii) Dielectric strength
- (iii) Tensile strength tests
- (iv) UV protection

**5.4.** Routine and sample test reports for the Low Voltage ABC accessories 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.

**5.5.** Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with of ISO 1461, BS 2782-2, BS EN 50482, IEC 60695-2-2 and UL 94 standards and provisions of this specification and shall include the following:

**a) Strain And Suspension Fittings For Insulated Strain Bearing Neutral Conductor**

- (i) Mechanical tests (breaking load)
- (ii) Slip tests on cables (no slippage below 300N)
- (iii) Dielectric voltage test (4kV in air)
- (iv) Galvanization tests
- (v) Dimensional checks

**b) Current-Carrying Connectors**

- (i) Test for mechanical damage to the main conductor
- (ii) Branch cable pull-out test
- (iii) Connector bolt tightening test
- (iv) Shear head function test
- (v) Di-electrical voltage test
- (vi) Galvanization tests
- (vii) Dimensional checks

**c) Cable Ties and End Sealing Caps.**

- (i) Flammability tests
- (ii) Tensile strength tests
- (iii) Dimensional checks

**5.6.** On receipt of the goods 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 Low

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

**Signed:**

**Date: 2016-02-04**

**Date: 2016-02-04**



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**

**Low Voltage Overhead Line  
Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 29 of 40

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

## 6.0. MARKING AND PACKING

### 6.1. Marking

- 6.1.1 Each item shall be packed in such a manner as to protect it from damage during transportation and storage.
- 6.1.2 Each package shall contain relevant instructions for handling and use printed in the English Language.
- 6.1.3 All products mentioned above shall be engraved indelibly and permanently with the following information:
- Manufacturer's trade mark or logo;
  - Product code or reference;
  - Traceability code / batch number;
  - The minimum and maximum cross section for which the unit is suitable;
  - Tightening torque or die reference, if applicable;
  - Recycling code, if any.
  - Standards to which the item complies
  - The letters 'KPLC'

### 6.2. PACKING

- 6.2.1. The Low Voltage ABC accessories shall be suitably packed separately in reinforced wooden boxes firmly secured with metallic straps and the quantity of items in a package is as in a), b), c), or d) given below.
- Strain and Suspension Fittings for Aerial Bunched Cables consisting of insulated Strain Bearing Neutral Messenger Wire – shall be packed separately in reinforced wooden boxes firmly secured with metallic straps and the quantity of items in a package shall be 100.
  - Strain and Suspension Fittings for Aerial Service Cables - shall be packed separately in reinforced wooden boxes firmly secured with metallic straps and the quantity of items in a package shall be 100.
  - Current-carrying Connectors and Joints - shall be packaged individually in plastic bags before stacked in quantities of 100 in plastic gunny bags.

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

**Signed:**

**Signed:**

**Date: 2016-02-04**

**Date: 2016-02-04**



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
**Low Voltage Overhead Line  
 Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 30 of 40	

d) Cable Ties and End Sealing Caps – shall be packaged in plastic bags to contain moisture and shall remain sealed until ready for use and the quantity of items in a package shall be 100.

6.2.2. Each packing shall be clearly and indelibly marked with the following;

- a) Name of Item
- b) Quantity
- c) Gross Weight
- d) The boxes shall be marked with manufacturer's identification and property class and the words "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) Guaranteed Technical Particulars signed by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data which shall include:
  - (i) Sales records for the last five years and at least four customer reference letters;
  - (ii) Details of manufacturing capacity and the manufacturer's experience;
  - (iii) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
  - (iv) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
  - (v) 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 signed by the manufacturer;
- b) Design Drawings with details of Low Voltage ABC accessories 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. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008
- d) Detailed test program to be used during factory testing;
- e) Marking details and method to be used in marking of the Low Voltage ABC accessories.
- f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed:	Signed:
Date: 2016-02-04	Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
BUNCHED CABLES (ABC)  
ACCESSORIES**



**Low Voltage Overhead Line  
Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 31 of 40	

ensuring good workmanship in the manufacture of the Low Voltage ABC accessories for The Kenya Power & Lighting Company;  
g) Packaging details (including packaging materials).

- 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 Low Voltage ABC accessories to KPLC stores.

----- **BLANK SPACE** -----

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
<b>Signed:</b> 	<b>Signed:</b> 
<b>Date: 2016-02-04</b>	<b>Date: 2016-02-04</b>



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
 Low Voltage Overhead Line  
 Fittings (ABC)

<b>Doc. No.</b>	KP1/6C/13/TSP/05/012
<b>Issue No.</b>	2
<b>Revision No.</b>	0
<b>Date of Issue</b>	2016-02-04

Page 32 of 40

**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)

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

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)	
	Manufacturer's Name and address	State	
	Country of Manufacture	State	
	Bidder's Name and address	State	
	Tendered items	State	
<b>1.0</b>	<b>SCOPE</b>		
	1.1 – 1.3	Specify	
<b>2.0</b>	<b>List standards of manufacture</b>	Specify	
<b>3.0</b>	<b>TERMS AND DEFINITIONS</b>	Specify	
<b>4.0</b>	<b>REQUIREMENTS</b>		
<b>4.1</b>	<b>Service conditions</b>	Specify	
<b>4.2</b>	<b>General Requirements</b>		
4.2.1	Range of accessories	Complies with PIESA 1018-5 standard besides other individual standards	Specify
		Suitable for ABC cable, XLPE insulated, of which phase sizes?	Specify
		Size of insulated aluminium alloy strain bearing neutral conductor	Specify
		Tensile strength of Neutral conductor in kN	Specify
4.2.2	Materials	Adequate strength	Specify
		Free from defects	Specify
		Compatible with cable materials	Specify
		Compliant with the physical and electrical requirements of this specification	Specify
4.2.3	All ferrous parts shall be hot dip galvanized (heavy duty) in accordance with ISO 1461	Specify	
4.2.4	Protection against ultra violet radiation. All components of accessories	Specify	

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04





**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012  
**Issue No.** 2  
**Revision No.** 0  
**Date of Issue** 2016-02-04  
 Page 33 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)		
	shall be manufactured from UV stabilized materials			
4.2.5	Fire retardation: All non-metal components satisfy and pass the glow-wire test	Specify		
4.2.6	Finish: Free from sharp edges, burrs and swarf. All insulating material is black	Specify		
<b>4.3</b>	<b>Strain &amp; Suspension Fittings</b>			
4.3.1	Strain/Dead End Clamp	Drawing and standards of manufacture	Provide drawing	
		Anchors LV ABC cables with insulated neutral messenger. Suitable for section and terminal poles	Specify	
		Material of manufacture of body, wedge and bail	Specify	
		Clamp cannot be assembled incorrectly	Specify	
		Clamp cannot slip or release the supporting conductor in normal use	Specify	
		Clamps fixed to pole by eye hook or bracket	Specify	
		Ultimate tensile strength for	25-35 mm <sup>2</sup>	Specify
			50-70 mm <sup>2</sup>	Specify
			95-120 mm <sup>2</sup>	Specify
		Slip load for	25-35 mm <sup>2</sup>	Specify
			50-70 mm <sup>2</sup>	Specify
95-120 mm <sup>2</sup>	Specify			
	Two bolts provided	Specify		
	Hooking end with hot dip galvanized nut and bolts with safety locks	Specify		
4.3.2	Suspension Clamp	Conforms to BS EN 50483-3 and NFC 33 040	Provide drawing	
		Designed to hang LV-ABC cables with insulated neutral messenger	Specify	
		Neutral messenger fixed by an adjustable grip device	Specify	
		Clamp installed with no losable part in clamping arrangement	Specify	
		Material of manufacture of clamps and links	Specify	
		Fixed to pole by means of eye hook	Specify	
		Ultimate tensile strength	25-35 mm <sup>2</sup>	Specify
			50-70 mm <sup>2</sup>	Specify
			95-120 mm <sup>2</sup>	Specify
Maximum	25-35 mm <sup>2</sup>	Specify		

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)
	allowable load	50-70 mm <sup>2</sup> 95-120 mm <sup>2</sup>
	Maximum angle of deviation of the conductors	Specify
	Holds conductor without slippage to within 5% of breaking force of the supporting conductor	Specify
4.3.3	Suspension/Dead end Eye Hook	Suitable for mounting through wood poles or concrete poles by use of universal pole clamps
	Can hold both suspension clamps and dead end clamps	Specify
	Material of manufacture	Specify
	Corrosion resistant material used and galvanization	Specify
	Ultimate tensile strength	Specify
	Design drawing and dimensions	Provide
4.3.4	Suspension/Strain bracket	Design drawing and technical data and dimensions to withstand minimum tensile strengths of the ABC cables as per clause 4.2.1.1 table 1
	Material of manufacture and tensile strength	Specify
	Suitable for use on wooden and concrete poles	Specify
	Method of galvanization and standard	Specify
	Brackets to be mounted using M20 bolts or 2 stainless steel straps of 20x0.7mm	Specify
	Maximum line deviation angle of 30° towards pole and 50° away from pole	Specify
4.3.5	Stainless steel strap	Dimensions of stainless steel strap
	Tensile strength of steel strap	Specify
	Elongation	Specify
	Finish	Specify
	Length of loops with one buckle	Specify
	Stainless steel buckle slot width	Specify
	Buckle standard and thickness	Specify
	Type tests to include chemical analysis, tensile strength and ultimate elongation	Provide test reports
4.4	<b>Current-Carrying connectors &amp; Joints</b>	
4.4.1	General requirements	Shall conform to BS EN 50483-4 and BS EN 50483-5 class A.
		Withstands the type tests prescribed in BS EN
		Specify

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012  
**Issue No.** 2  
**Revision No.** 0  
**Date of Issue** 2016-02-04  
 Page 35 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)	
	50483-1		
	Suitable for aluminium ABC conductors of range 70mm <sup>2</sup> to 120mm <sup>2</sup> and copper or aluminium service cables of range 10mm <sup>2</sup> to 25mm <sup>2</sup>	Specify	
	Fitted without dismantling individual components	Specify	
	All components held captive when opened for fitting to the conductors.	Specify	
	Current carrying capacity of individual connector components greater than that of conductor	Specify	
	Material shall not split or deteriorate during application process	Specify	
	Can withstand physical and chemical processes in service i.e. oxidation, galvanic corrosion, thermal expansion	Specify	
4.4.2	Insulation Piercing Connectors	Specify	
4.4.2.1	Insulation Piercing Connectors	Designed and tested as per BS EN 504830-1&4 and NFC 33-020.	Specify
		Weatherproof design for aluminium or copper main and branch conductors	Specify
		Moisture or water shall not enter pierced holes on cable insulation	Specify
		Torque required for various conductor sizes to be stated on the equipment	Specify
4.4.2.2	Construction	The connectors are totally insulated with no loose parts.	Specify
		Weatherproof and moisture proof	Specify
		Protects cable against moisture ingress at pierced parts	Specify
		Shall be tested at 30cm under water for 30 min and at an applied voltage of 4KV for 1 minute. No fashover /failure or moisture ingress in accordance with EN 50483-1	Specify
		withstands working temperatures for installation from -10°C to +60°C	Specify
		Withstands operation temperature from -20°C to +75°C	Specify

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**

**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012  
**Issue No.** 2  
**Revision No.** 0  
**Date of Issue** 2016-02-04  
 Page 36 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)	
4.4.2.3	Material	Metallic parts are corrosion resistant and can withstand salt fog chamber and Wet SO <sub>2</sub> gas chamber with no change in contact resistance, temperature after overloads and load cycling	Specify
		Material of manufacture of body and its tensile strength	Specify
		Contact plates material	Specify
		Connector teeth greased and sealed to retard water/moisture ingress and corrosion	Specify
		Material of manufacture of insulation	Specify
		Insulation material is weather and UV resistant	Specify
		Outer metallic part with potential free tightening bolts for safe live line installation	Specify
		Bolts head made of shear head type	Specify
		The connector shall not have losable parts which may drop or get lost in installation	Specify
	Cable end cap attached to the body	Specify	
4.4.2.4	Sizes tendered	Specify	
4.4.3	ABC Bolted connectors	Specify	
4.4.3.1	Parallel Groove Clamp – Aluminium	Made of forged aluminium	Specify
		Have serrated transverse grooves	Specify
		Uses hot dip galvanized steel bolts property class 8.8	Specify
		Have Belleville washers	Specify
	Clamps coated with an oxide inhibitor	Provide proof	
4.4.3.2	Bimetallic Parallel Groove Clamp	Suitable for tapping or joining hard drawn or annealed copper conductor or aluminium overhead conductor type AAC, AAAC, or ACSR to the ABC cables	Specify
		Forged from 99.6% aluminium with a friction welded copper insert clearly marked in blue for making copper conductor connections	Specify
		Have serrated transverse grooves	Specify
		One parallel groove shall have a copper inlay impact welded onto groove surface. The external aluminium to copper surface shall be sealed by a special	Specify

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**

**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012

**Issue No.** 2

**Revision No.** 0

**Date of Issue** 2016-02-04

Page 37 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)
	compound preventing interface corrosion.	
	Have slotted bolt holes	Specify
	Uses hot dip galvanized steel bolts property class 8.8	Specify
	Have Belleville washers	Specify
	Does not experience metal creep	Specify
	Design and dimensional requirements	Provide drawing
4.4.4	Bimetallic lugs	
	Lugs shall be of pre-insulated type	Specify
	Shall be water proof with a rubber gasket	Specify
	Prefilled with suitable oxide inhibiting compound or silicon grease	Specify
	Current ratings equivalent to respective cable/messenger	Specify
	Lugs markings with size of conductor applicable or colour coded	Specify
	Current rating shall not be less than that of the ABC cable rating	Specify
	Temperature rise at time of lugging shall not be more than that of conductor	Specify
	Compression of all bi-metallic lugs be achieved by means of single die	Specify
	Design and dimensional requirement	Provide drawing
4.4.5	Pre-insulated sleeves	
	Aluminium(phase) sleeve or aluminium alloy (neutral) sleeve with stop in middle	Specify
	Insulation material	Specify
	neutral contact grease available	Specify
	Design and dimensional requirements	Provide drawing
4.4.6	Cable Joint Compound	
	Offered cable joint compound and chemical composition	State
	Gives a rubber like solid within an hour of mixing and hardness gradually increases in next 24 hours	Specify
	The compound prevents oxidation on aluminium surfaces, corrosion on connection and reduces the transition resistance	Specify
	Safety of use of the compound on user	Specify
	The expected shelf life and expiry date	Specify

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**

**Low Voltage Overhead Line  
 Fittings (ABC)**

<b>Doc. No.</b>	<b>KP1/6C/13/TSP/05/012</b>
<b>Issue No.</b>	<b>2</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2016-02-04</b>
Page 38 of 40	

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)	
<b>4.5</b>	<b>Cable Ties and End Sealing Caps</b>		
4.5.1	Cable end sealing caps	Quick and foolproof installation using simple tools	Specify
		Strong and permanent environmental seal	Specify
		Excellent resistance to weathering, moisture ingress and environmental pollution	Specify
		Special adhesive provided	Specify
		Valved end cap available for pressurized application	Specify
		Caps shall be permanent cold applied and range taking	Specify
		Shall not be push fit	Specify
		Design and dimensional requirements	Provide drawing
		Heat shrink material	Specify
		Tensile strength	Specify
		Elongation	Specify
		Density	Specify
		Hardness	Specify
		Thermal ageing	Specify
		Water absorption	Specify
		Chemical resistance	Specify
Continuous temperature limit	Specify		
Shrink temperature	Specify		
Degree of protection	Specify		
4.5.2	Core separators	Two wedged core separators joined by nylon cord	Provide drawing
		Material of manufacture	Specify
		Dielectric strength	Specify
		Both sides of the wedge shall be grooved	Specify
		Cam action and wedge action incorporated in one unit	Specify
		Top surface with small grooves for manual force application	Specify
4.5.3	Cable ties	Heavy duty	Specify
		Tensile strength per cable size	Specify
		Pawl and teeth design	Specify
		Tail finger grips present	Specify
		Design and dimensional requirements	Provide drawing
		Material of manufacture and colour	Specify
		Finish	Specify

**Issued by: Head of Section, Standard Development**

**Authorized by: Head of Department, Standards**

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**  
**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012  
**Issue No.** 2  
**Revision No.** 0  
**Date of Issue** 2016-02-04  
 Page 39 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)	
	Service life	Specify	
<b>4.6</b>	<b>Strain &amp; Suspension Fittings for Aerial Services Cables</b>		
4.6.1	House Service Strain clamps	Design	Provide drawing
		Parts shall not separate on installation	Specify
		Material of manufacture of body and wedge	Specify
		Cable sizes in diameter that can be accommodated	Specify
		Strain fittings shall not slip or release service cable.	Specify
		Breaking loads	Specify
		Easy to install without special tools	Specify
		Strain fittings can be used for cable sizes ranging 10-16mm <sup>2</sup> and 25mm <sup>2</sup> single and three phase cables	Specify
4.6.2	4.6.2 Pigtail couch screw	Suitable for screwing directly into wooden pole and for securing into brick wall using P16 plastic wall plugs	Specify
		Threads allow a high pull out resistance	Specify
		Material of manufacture	Specify
		Method of galvanizing	Specify
		Tensile strength	Specify
	Design and dimensional requirements	Provide drawing	
4.7	Quality Management System	State	
	Quality Assurance Plan	State	
	Copy of ISO 9001:2008 Certificate	State	
	Manufacturer's Experience	State	
	Manufacturing capacity (units per month)	State	
	List of previous customers	State	
	Customer reference letters	State	
5.1	Test standards and responsibility of carrying out tests	State	
5.2	Design and construction validated by Type Tests and applicable tests	State	
5.3	Copies of Type Test reports submitted with tender	State	
5.4	Acceptance tests to be witnessed by KPLC at factory before shipment	State	
5.5	Test reports to be submitted by supplier to KPLC for approval before shipment	State	
5.6	Replacement of any rejected equipment or component	State	
6.1	Marking	State	
6.2	Packaging	State	
7.1	Documents submitted with tender	State	
7.2	Documents to be submitted by supplier to KPLC for approval before	State	

Issued by: Head of Section, Standard Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



**TITLE:**  
**SPECIFICATION FOR AERIAL  
 BUNCHED CABLES (ABC)  
 ACCESSORIES**

**Low Voltage Overhead Line  
 Fittings (ABC)**

**Doc. No.** KP1/6C/13/TSP/05/012  
**Issue No.** 2  
**Revision No.** 0  
**Date of Issue** 2016-02-04  
 Page 40 of 40

Clause	Requirements	Bidder's offer (indicate full details of the offered item for each requirement of the specification)
	manufacture	
8.0	Manufacturer's Guarantee and Warranty	State
9.0	Statement of compliance to specification (indicate deviations if any & supporting documents)	State

**ANNEX B: SCHEDULE OF TENDERERS EXPERIENCE**

*The tenderer shall furnish a list of similar orders executed and to whom reference may be made.*

Sr. No.	Name of client	Description of order	Value of order	Period of supply and commissioning	Name and address where reference may be made

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

<b>Issued by: Head of Section, Standard Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed:	Signed:
Date: 2016-02-04	Date: 2016-02-04