AERIAL BUNDLED CONDUCTOR ACCESSORIES

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In order to keep abreast of progress in industry, Kenya standards shall be regularly reviewed. Suggestions for improvement to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.
AERIAL BUNDLED CONDUCTOR ACCESSORIES

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FOREWORD

This Kenya Standard has been prepared by the Conductors and Cables Technical Committee, under the direct supervision of the Electrical Industry Standards Committee, and it is in accordance with the procedures of the Bureau.

The standard specifies requirements for accessories for low voltage overhead lines using aerial bundled conductors (ABC).

In the preparation of this Kenya Standard, assistance was derived from a Kenya Power Specification TSP/05/012. Acknowledgement is made for the assistance derived from this source.
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SPECIFICATION FOR AERIAL BUNDLED CONDUCTOR ACCESSORIES

1 Scope

1.1 This specification is for accessories for low voltage overhead power lines using Aerial Bundled Conductors (ABC). The lines are constructed on wooden and round concrete poles.

1.2 The accessories shall be suitable for low voltage Aerial Bundled Conductors consisting of cross-linked polyethylene (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:
   i. Aerial Bundled Cables consisting of bare or insulated strain bearing neutral messenger wire.
   ii. Aerial Service Cables
b) Current-carrying Connectors and Joints.
d) Cable Ties for use with Aerial Bundled Conductors.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60695-2-11
IEC 61089
BS EN50483
NFC 33-040,041
3 Definitions

For the purpose of this standard the following definitions together with the definitions in KS 2650 shall apply:

aerial-bundled conductors (or ABC or bundle)

insulated conductors twisted together to form a cable that is intended to be suspended between structures

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 bundled conductors as referenced in KS 2650:2016.
4.2.2. Materials

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

a) Of adequate strength for the intended application of the accessories and free from any defects that impair performance.

b) 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

c) 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 KS 355:1982 (2015). 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.

4.2.5. Fastening

All threaded fastenings that form part of the fittings shall have ISO metric threads of the preferred sizes given in KS 219:1981 (1991) and at least two full threads shall project clear of the locking device when it is tightened.

4.2.6. Fire Retardation

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.
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 should consist 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:
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 PI ESA 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

<table>
<thead>
<tr>
<th>Neutral messenger cross-sectional area mm²</th>
<th>Diameter mm</th>
<th>Breaking Load (min)kN</th>
<th>Slip load kN</th>
<th>Weight kg/10 pcs (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-35</td>
<td>4-11</td>
<td>10</td>
<td>2</td>
<td>3.2</td>
</tr>
<tr>
<td>50-70</td>
<td>12-14</td>
<td>16.6</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>95-120</td>
<td>4-16</td>
<td>20</td>
<td>5</td>
<td>4.12</td>
</tr>
</tbody>
</table>

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 a typical suspension clamp is 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.

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.
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.

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 KS 355:1982 (2015).

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 KS 355:1982 (2015) 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.
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
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 KS 2650:2016.

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 KS 355:1982 (2015).

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.
4.3.5. Stainless steel strap and buckles

4.3.5.1. The stainless steel strap shall consist of:

   a) 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.

   b) 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 clamps specified in this specification.

   c) 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.

   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.

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.
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 16mm² to 120mm² and for service cables of either copper or aluminium with cross-section area in the range 1.5mm² to 25mm².

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.

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 weather-proof 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 LVABC 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 the 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.

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. 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 BS EN 50483-1.

4.4.2.3. The design shall also withstand working temperatures for installation from -10°C up to +60°C and operation experience with temperature from -20°C up to +75°C.

4.4.23. 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 SO2 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.
Fig. 5: Illustration of typical Insulated Piercing Connectors

4.4.2.4. Sizes

<table>
<thead>
<tr>
<th>Application</th>
<th>Terminals</th>
<th>Size Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPC for customer/Street Light service</td>
<td>Main</td>
<td>16mm² to 120 mm²</td>
</tr>
<tr>
<td></td>
<td>Tap</td>
<td>1.5mm² to 25 mm²</td>
</tr>
<tr>
<td>IPC for ABC to DB Connection or Service</td>
<td>Main</td>
<td>16mm² to 120 mm²</td>
</tr>
<tr>
<td></td>
<td>Tap</td>
<td>4mm² to 35 mm²</td>
</tr>
<tr>
<td>IPC for ABC to ABC Tee Connection</td>
<td>Main</td>
<td>25mm² to 120 mm²</td>
</tr>
<tr>
<td></td>
<td>Tap</td>
<td>4mm² to 35 mm²</td>
</tr>
<tr>
<td>IPC for bare main (Al/Cu) to Main connections</td>
<td>Main</td>
<td>25mm² to 120 mm²</td>
</tr>
<tr>
<td></td>
<td>Tap</td>
<td>25mm² to 95 mm²</td>
</tr>
</tbody>
</table>
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.

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.
4.4.3.23. Typical design and dimensional requirements shall be as per Fig. 6a and b.
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.
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 aluminium (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 aluminium 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.
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.
4.5.1. 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.

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Characteristics</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heat Shrink Material</td>
<td>Cross Linked Polyolefin</td>
</tr>
<tr>
<td>2</td>
<td>Tensile Strength</td>
<td>12 N/mm² (MPA)</td>
</tr>
<tr>
<td>3</td>
<td>Elongation</td>
<td>350%</td>
</tr>
<tr>
<td>4</td>
<td>Density</td>
<td>1.20 gm/cm³</td>
</tr>
<tr>
<td>5</td>
<td>Hardness</td>
<td>50 Shore D</td>
</tr>
<tr>
<td>6</td>
<td>Thermal Ageing</td>
<td>10% drop in physical properties</td>
</tr>
<tr>
<td>7</td>
<td>Water Absorption</td>
<td>&lt;0.2%</td>
</tr>
<tr>
<td>8</td>
<td>Chemical Resistance</td>
<td>To dilute acids &amp; alkalis, Salts etc.</td>
</tr>
<tr>
<td>9</td>
<td>Continuous Temperature limit</td>
<td>-40°C to 125°C</td>
</tr>
<tr>
<td>10</td>
<td>Shrink Temperature</td>
<td>125°C</td>
</tr>
<tr>
<td>11</td>
<td>Degree of protection</td>
<td>IP 68</td>
</tr>
</tbody>
</table>

4.5.1.3. The caps shall be permanent applied, range taking and suitable for installation on 10mm²–120mm² 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.
The end sealing cap design and dimensional requirements shall be as per Fig. 8 and Table 7.

![Fig. 8: End Sealing Caps]

Table 7: End sealing cap sizes

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Range</td>
<td>D max</td>
</tr>
<tr>
<td>10 - 16</td>
<td>20</td>
</tr>
<tr>
<td>16 - 35</td>
<td>40</td>
</tr>
<tr>
<td>25 - 50</td>
<td>55</td>
</tr>
<tr>
<td>35 - 70</td>
<td>75</td>
</tr>
<tr>
<td>70 - 120</td>
<td>130</td>
</tr>
</tbody>
</table>

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.

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.

![Cable Tie Image]

**Fig. 10: Cable tie**

**Table 8: Cable Ties Sizes**

<table>
<thead>
<tr>
<th>Cable diameter (mm)</th>
<th>Length (mm)</th>
<th>Breaking load (kN)</th>
<th>Weight (Kg/10 pcs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 - 25</td>
<td>132</td>
<td>0.35</td>
<td>1.8</td>
</tr>
<tr>
<td>22 - 35</td>
<td>180</td>
<td>0.35</td>
<td>2.6</td>
</tr>
<tr>
<td>35 - 50</td>
<td>265</td>
<td>0.51</td>
<td>3.6</td>
</tr>
<tr>
<td>50 - 120</td>
<td>360</td>
<td>0.51</td>
<td>5.0</td>
</tr>
</tbody>
</table>

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.

4.6.1.6 The strain fittings shall be suitable for the termination of single phase and three phase service cables of sizes 10 - 16mm² and 25mm² respectively.(suitable for use for 2x10 - 2x35 mm² and 4x16 - 4x25 mm² cables)

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

![Diagram of House Service Strain Clamp](image)

**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

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:
   a) Manufacturer's trade mark or logo;
   b) Traceability code / batch number;
   c) The minimum and maximum cross section for which the unit is suitable;
   d) Tightening torque or die reference, if applicable;
   e) Country of origin

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.

a) 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.

b) Strain and Suspension Fittings for Aerial Service Cables - shall be packed separately in reinforced wooden boxes firmly secured with metallic straps.

c) Current-carrying Connectors and Joints - shall be packaged individually in plastic bag.

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.