# TECHNICAL SPECIFICATION

## FOR

## 3Cx16+25 Sq.mm
## LT XLPE AB CABLE

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## LT AERIAL BUNCHED CABLE
## TECHNICAL SPECIFICATION FOR 3CX16+25 Sq.mm LT XLPE AB CABLE

**1. SCOPE :**

This specification covers the requirements of ISI marked Cross Linked Polyethylene insulated (XLPE) Aluminium Cables twisted over a central bare Aluminium alloy messenger wire (along with associated accessories) for use on LT overhead lines in Rural/ Urban Electrification System.

The designation of the LT XLPE AB Cables are :

3 Core x 16+25 Sq.mm

The first part of the designation refers to the number and size (nominal cross sectional area) of the phase conductor and the last part to size of the bare AAA messenger.

**2) LT Aerial Bunched Cables:**

2.1. Electrical Data :

1) The rated voltage of the cables shall be 0.6/1kV.
2) Highest system voltage : 1.2 kV.
3) Test voltage : a) 2.5 kV / 50 Hz/ 5 min for routine tests.
   b) 4 kV / 50 Hz/ 4 Hrs. for type tests.
4) Max short circuit current for 1 Sec. 1.0 KA.
5) Current carrying capacity at different ambient air temperatures of different sizes of phase conductors are tabulated at Annexure – III.

**2.2. APPLICABLE STANDARDS:**

Unless otherwise stipulated in this specification the following standards as amended from time to time shall be applicable.

i) IS : 8130 – 1984 for Aluminium conductors for insulated electric cables (flexibility as per class II)
ii) IS :14255-1995 Aerial Bunched cable for working voltage up to and including 1100 Volts.
iii) IS : 398 (Part-IV) 1994 : For all Aluminium Alloy Conductors (AAC) for overhead transmission purposes.

A.B Cable meeting any other alternative equivalent international standards ensuring equal or better quality than the standards mentioned above and complying with this technical specification shall also be acceptable. In case the tenders wish to offer materials conforming to other standards a copy of such standard (English version only) adopted shall invariably be enclosed to the bid.

**2.3. GENERAL :**

2.3.1. The insulated phase conductors shall be twisted around the bare aluminium alloy messenger wire, which shall take all the mechanical stress. The messenger wire shall also serve as the earth-cum-neutral wire.

**2.4. PHASE CONDUCTORS :**

2.4.1. The 16 Sq.mm phase conductor shall be of Aluminium round stranded and compacted **(The flexibility is as per IS-8130-1984 class-II)**, 25 Sq.mm messenger wire shall be round stranded and suitably compacted and outer diameter shall be within the limits specified in Annexure-I.

2.4.2. The phase conductors shall be insulated with black weather resistant Cross Linked Polyethylene (XLPE) suitable to 1100 V insulation. The insulated conductors shall generally conform to the standards (i) & (ii) quoted in clause 2.2 above.

**2.4.3. CONDUCTORS :**

The properties of the Aluminium wires before stranding shall be as below.

Tensile strength not less than 90 $N/mm^2$

Resistivity at 20 Deg. C not exceeding 0.02845 Ohm per meter.

The outer layer in standard conductor shall have a right handed direction of lay (Z), the surface of the conductors shall be smooth.

**2.5. INSULATION :**

2.5.1. Material : The insulation shall be black weather – resistant Cross Linked Polyethylene (XLPE).

2.5.2. Phase Identification : Durable and clearly visible longitudinal ridges shall be provided as follows on each insulated conductors as indicated in Figure – 5 for identification phases.

For 3 Core Cable 1,2,3

Approx. ridge dimensions are :

- Width = 1.00 mm
- Height = 0.4 mm
- Distance between consecutive ridges = 2.7 mm.

**2.6. Messenger (Neutral Conductor )** :

The messenger shall be an All Aluminium Alloy conductor composed of 7 Wires each 2.34 mm Dia drawn from rod, which is manufactured in a continuous casting and rolling procedure. The properties for the individual wires before stranding shall be.

- Tensile strength not less than 278 N/mm2
- Resistivity at 20 Deg. C not exceeding 0.0328 ohm Sq.mm/m
- Density at 20 Deg. C 2.7 Kg/cubic – dm.

No joints are allowed in the messenger except those made on the base rod or wire before final drawing. The messenger shall be round, stranded and compacted to have smooth round surface.

The messenger takes all the mechanical stress and also serves as neutral conductor.

- Neutral conductor over all dia (max) 6.5.mm
- D.C resistance at 20 Deg. C (max) 1.38 mm ohms/km.
- Min. breaking load 7.0 KN.

**2.7. DESIGN** :

The cable consists of one to three black weather resistant Cross Linked Polyethylene (XLPE) insulated aluminium phase conductor's stranded around a bare all aluminium alloy messenger which is also the neutral conductor. The construction data are specified in Annexure – I.
The detailed design drawings shall be submitted along with the bid documents.

**2.8**. The resistance of the phase conductors and the messenger are determined with direct current and the same are corrected to 20 Deg. C using the formula and co-efficient given in clause-5 of the standard IEC 2.8 B. The values obtained shall not exceed the resistance give in Annexure-2.

**2.9. POLYETHYLENE INSULATION** :

The polyethylene insulation shall generally conform to IS-14255/1995. the following properties shall be guaranteed by the supplier. For methods of testing IS:10810 (relevant parts) may be referred.

| | | |
|---|---|---|
| Tensile strength. | = | Min 12.5 N/Sq.mm. |
| Percentage elongation | = | Not less than 200. |
| Hot set percentage elongation under Load | = | Max 175% |
| Permanent set | = | Max 15% |

Volume Resistivity of insulation

| | | |
|---|---|---|
| At 27 Deg. C. | = | $1 \times 10^{13}$ ohm cm (min) |
| At 70 Deg. C | = | $1 \times 10^{11}$ ohm cm (min) |
| Shrinkage at 115 Deg. C 24 Hrs max. | = | 4% |

**2.10. TESTS ON LT AB CABLE :**

2.10.1. Type Tests as per Cl.10.1 and 11.4 of IS:14255/1995:

a) Tests on phase/street light conductor
   - i) Tensile Test
   - ii) Wrapping Test
   - iii) Resistance Test

b) Tests on messenger conductor
   - i) Breaking Load
   - ii) Elongation Test
   - iii) Resistance Test

c) Physical Test for XLPE Insulation
   - i) Tensile strength and elongation at break
   - ii) Hot Set index
   - iii) Shrinkage Test
   - iv) Ageing in Air
   - v) Water absorption (Gravimetric)

d) Test for thickness of insulation
e) Insulation resistance (volume resistivity)
f) High voltage test
g) Bending test on complete cable

2.10.2. ACCEPTABLE / ROUTINE TESTS as per Cl.10.2 of IS:14255/1995 and P.O:

a) Tensile tests for phase/street light conductor
b) Wrapping Test for phase/street light conductor
c) Breaking load test for messenger conductor
d) Elongation test for messenger conductor.
e) Conductor resistance test.
f) Test for thickness of insulation.
g) Tensile strength and elongation at break
h) Insulation resistance test
i) High voltage test
j) Hot Set

2.11. BENDING TEST ON THE COMPLETE CABLE :

The test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180 Deg. The cycle of these operations shall then be repeated more. The diameter of the mandrel shall be 10 (D+d).

Where D= actual diameter of the cable (ie., minimum circumscribing circle diameter in mm)
d= actual diameter of the conductor in mm.
No cracks visible to the naked eye are allowed.

2.12. PACKING AND MARKING :

The Cable shall be wound on non-returnable wooden drums conforming to IS:10418/1982 with latest amendment thereof. The ends of the cable shall be sealed by means of non-hygroscopic sealing materials. The drum shall be marked with the following.

a. Manufacturer's Name or Trade Mark.
b. Type of cable and voltage grade.
c. Drum number or identification number.
d. Number of cores and size of cable.
e. Number and length of pieces of cable in each drum.
f. Gross / Net mass of the cable.
g. Direction of rotation of drum. (By means of an arrow).

2.12.2. The drums shall be of such construction as to assure delivery of conductor in the field free from displacement and damaged and should be able to withstand all stresses due to handling and the stringing operation so that cable surface is not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lagged on the drums.

2.12.3. The cable drum should be suitable for wheel mounting.

2.12.4. The mass of finished cable in a drum (without mass of drum) of various designations shall not exceed by more than 10% of the following values.

| Designation | Gross mass. |
|---|---|
| 3 x 16 + 25 Sq.mm | 800 Kg |

2.13. The min. length of each cable shall be 1 Km.

While longer length shall be acceptable, shorter lengths not less than 500 Mtrs. shall be acceptable to the extent of 10% of the size wise ordered quantity only.

2.14. MARKING OF CABLE :

All the cables shall have the following marking embossed on the insulated phase conductors for identification : **AP_ PDCL**, XXXX (XXXX is purchase order number) in addition to manufacturer's name and year of manufacture at regular intervals of not more than one meter.

**3.** The Companies are requested to furnish the valid BIS certificate along with the Bid. Without which, the bidder shall be treated as non responsive.

4.0 TESTING EQUIPMENT :

The following guidelines are issued for completion of inspections.

- All the testing equipment for testing the offered material shall be available in good condition.
- The testing equipment shall be calibrated yearly at any of the NABL labs and a certificate to this effect made available to the inspection officer.
- If the testing equipment is not available as indicated above, the third party inspection officers will not carryout the inspection till the above stipulations are complied with and subsequent visits charges for inspection of the material shall be borne by the supplier.

The third party inspecting officers are entrusted with the work of capacity, inspection of the factory covering the various manufacturing and testing equipment available, sources of purchase of raw material, quality control, man power available etc.

The bidders are requested to extend full support to the third party agencies wherever they want to conduct the capacity inspection of the factory.

**ANNEXURE – I**

**THE CONSTRUCTIONAL DATA AND DIMENSIONS OF LT AERIAL BUNCHED CABLES.**

| Number and cross sectional area of conductors | Phase conductor | | | | Messenger | | Complete cable. | |
|---|---|---|---|---|---|---|---|---|
| | Number & sectional area. | Diameter of un insulated conductor | Insulation thickness in | Over all dia of conductors | Diameter of un insulated conductor. | Tensile strength (approx) | Overall diameter (approx.) | Total mass (approx.) |
| Sq.mm | Sq.mm | Max. mm | Mm | Mm | mm | Min Kg. | Mm | Kg/mm |
| 3x16+25 | 3x16 | 4.8 | 1.2 | 7.2 | 6.0 | 7.0 | 19 | 250 |

**ANNEXURE - II**
**D.C. RESISTANCE AND INSULATION OF LT AB CABLE.**

| Nominal cross sectional area of conductor. | No. of strands. | DC resistance at 20Deg. C ohm/km/max. | | Insulation thickness average min.mm |
|---|---|---|---|---|
| 16 Aluminium | 7 | 1.910 | -- | 1.2 |
| 25 Al. Alloy | 7 | -- | 1.38 | Bare |

Note :

1. The average value of the thickness of the insulation shall not be less than the specified average value.

2. The thickness at any place may be less than the specified average value, provided that the difference does not exceed 0.1 mm + 0.1(t1) of the specified average value.

3. For thickness of insulation six measurements are made radially on a piece of insulation, as far as possible equally spaced around the circumference but not on the ridges.

**ANNEXURE – III**

**APPROX. CURRENT CARRY CAPACITY ( in Amps) OF PHASE CONDUCTORS AT DIFFERENT AMBIENT AIR TEMPERATURE**

| No. and area of conductor | $0^0$ C | $+5^0$ C | $+10^0$ C | $+15^0$ C | $+20^0$ C | $+25^0$ C | $+30^0$ C | $+35^0$ C | $+40^0$ C | $+45^0$ C | $+50^0$ C | $+55^0$ C | $+60^0$ C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CURRENT CARRYING CAPACITY IN AMPS. | | | | | | | | | | | | | |
| 3X16+25 Sq.mm | 94 | 90 | 88 | 84 | 80 | 76 | 72 | 68 | 64 | 60 | 54 | 48 | 40 |

## GUARANTEED TECHNICAL PARTICULARS FOR LT. AERIAL BUNCHED CABLE

| Sl. No. | Particulars | 3C x 16 + 25 Sq.mm. | Details to be furnished by the bidder |
|---|---|---|---|
| 1. | Name of manufacturer. | | |
| 2. | Applicable standard/specification. | IS:14255/95, IS:8130/84, IS:398 (Part-IV)/1994 | |
| 3. | Type of Cable (construction to be described) | Cross linked polyethylene insulated (XLPE) Aluminium AB Cable twisted over a central bare All Aluminium Alloy Messenger Wire. | |
| 4. | Size of Cable. | 3C x 16 + 25 Sq.mm | |
| 5. | Phase Conductor - A1 Portion. | | |
| | i) Material of conductor. | EC Grade Aluminium H2/H4 | |
| | ii) Applicable standard. | IS-8130/1984 Class-2 | |
| | iii) No. of strands. | 7 | |
| | iv) Nominal diameter of strand (mm). | 1.71 mm before stranding | |
| | v) Max. diameter of bare conductor (mm) | 4.70 mm +/- 2% | |
| | vi) Nominal area of cross-section of bare conductor (Sq.mm) | 16 Sq. mm. | |
| | vii) Whether the conductor compacted. | Not applicable (compacted conductor) | |
| | viii) Elongation (%) | Not applicable (compacted conductor) | |
| | ix) Tensile strength (min)/breaking load (KN) | Not applicable (Compacted conductor) | |
| 6 | Phase conductor – Insulation portion. | | |
| | i) Material of insulation. | Cross linked polyethylene | |
| | ii) Insulation thickness (mm) | 1.20 mm | |
| | iii) Diameter of insulated conductor (mm) | Approx. 7.10 mm | |
| | iv) Whether the insulation conforms to the standards specified in the technical specification. | Yes | |
| 7 | Messenger/neutral conductor - AAA portion. | | |
| | i) Material of conductor. | All Aluminium Alloy Conductor | |
| | ii) Applicable standard | IS:14255/1995 and IS:398 Part-IV/1994 | |
| | iii) Number of strands | 7 | |
| | iv) Nominal diameter of strand (mm). | 2.14 mm before stranding | |
| | v) Max. diameter of bare conductor (mm) | 6.00 +/- 2% | |
| | vi) Nominal area of cross-section of bare conductor (Sq.mm) | 25 Sq. mm. | |
| | vii) Lay ratio. | Not applicable for compacting conductor | |
| | viii) Elongation (%) | Min. 4% before stranding | |
| | ix) Tensile strength (min)/breaking load (KN) | Min. 7.0 KN | |
| | Note : Tensile strength of messenger wire is computed by testing individual wires only. | | |

| | | | |
|---|---|---|---|
| 8. | Complete AB Cable | | |
| | i) Overall diameter (mm) | 19.80 mm Approx. | |
| | ii) Total weight (kg/km) | 250 kgs. +/- 2% | |
| | iii) Standard drum length offered (mtrs) and tolerance. | 1000 Mtrs +/- 10%. | |
| | Note : Multiple of standard lengths shall be allowed Longer length shall be acceptable. Shorter lengths not less than 500 mtrs. shall be acceptable to the extent of 10% of the ordered quantity. | -- | |
| | iv) Gross weight of the cable drum | 1000 Kgs +/- 5%. | |
| | v) Code or method of cable identification. | By means of embossing on the insulated phase conductor, AP_ PDCL, XLPE-90 and year of manufacturing at every meter. | |
| 9. | Electrical Data : | | |
| | i) Max. DC resistance of the phase conductor at $20^0$ C | Max. 1.91 Ohms/Km | |
| | ii) Max. DC resistance of the neutral conductor at $20^0$ C | Max. 1.38 Ohm/Km | |
| | iii) AC resistance at – 90 Deg. C phase conductor (ohms/km) | 2.445 Ohm/Km | |
| | iv) AC resistance at – 75 Deg C messenger/ neutral conductor (ohms/km) | 1.653 Ohm/Km | |
| | v) Approx. inductive reactance at 50 Hz. Phase conductor (ohms/km) | 0.055 Ohms/Km | |
| | vi) Approx. inductive reactance at 50 Hz. Messenger/neutral conductor (ohms/km) | As applicable | |
| | vii) Approx. zero sequence reactance at 50 Hz. Per phase (ohms/km): | As applicable | |
| | viii) Short circuit current for 1 Sec. Max. (KA) | 1.472 K.A | |
| | ix) Current carrying capacity (amps) at various ambient temp. deg. of $0^0$ C,$10^0$ C, $20^0$ C,$30^0$ C,$40^0$ C & $50^0$ C | 118, 111, 102, 93, 83, 70 Amps. | |
| 10 | Specification climatic conditions to which AB Cable are manufactured.<br>a) Max. Solar radiation (w/sq.m)<br>b) Min. wind velocity (m/sec.) | <br><br>1164 w/Sq.mm<br>0.611 m/sec. | |
| 11. | Tests. | | |
| | i) Details of type tests and factory tests conducted on each size of AB Cable.<br><br>ii) Whether one complete set of test certificates thereof are enclosed to the bid. | As per IS : 14255/1995 Cl.No.10.1 & 11.4<br><br>Yes | |
| 12. | BENDING RADIUS OF CABLE : | The diameter & mandrel shall be 10 (D+d) | |
| 13. | Any other relevant technical information the bidder may desire to furnish in respect of AB Cable. | Having ISI license is enclosed | |