

Lot 1-XLPE Cables and Lot 2- PVC Cables.

1.0 Scope

This specification covers the design, manufacture and testing of cables at manufacture's work before dispatch, packing and transportation to BPC stores.

2.0 Design Criteria

2.1 Standards

The cables under this specification shall comply with the requirements of latest edition of the following standards including amendments:

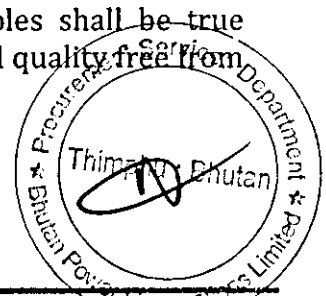
IEC: 60183, 60227, 60502, 60885, 50480 IS (Indian standards): 1554 (Part-I) IS: 1753 IS: 3961 Part-II IS: 3975 IS: 4905, IS: 5831, IS: 7098 (Part- III), IS: 7098 (Part-II), IS: 7098 (Part-I), IS: 8130, IS: 10418, IS: 10810, ASTM D 2863, IEEE-383, IEC-332 (Part-I), IEC-754 (Part-I), ASTM D - 2843, SS-4241475, (Swedish standard)

2.2 Cable Design

- i) The cables shall be suitable for installation in a monsoon area having 100% relative humidity and low temperature which is likely to accelerate rusting in steel. However for the reference ambient temperature may be taken as 40° C with the relative of 100%. The galvanizing of steel armour has to be of the highest quantity for such an ambient condition.
- ii) The cable shall operate with the following requirements.
 - a) Maximum continuous conductor temperature and allowable conductor temperature during short circuit shall be taken as 70°C and 160°C respectively for PVC insulated and 90°C and 250°C respectively in case of XLPE insulated cable.
 - b) Frequency variation $\pm 5\%$, voltage variation $\pm 10\%$ and combined frequency and voltage variation of $\pm 10\%$.
- iii) Amongst the various standards given above, for design, stringent conditions specified in the above standards shall be applicable.

2.3 General Technical Requirement

- i) The cables shall be suitable for laying in racks, ducts, covered trenches, conduits and underground buried installation with chances of flooding by water.
- ii) Cables shall be designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.
- iii) The aluminium/copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be of uniformly good quality free from defects. All aluminium used in the cables shall be of H2 grade.

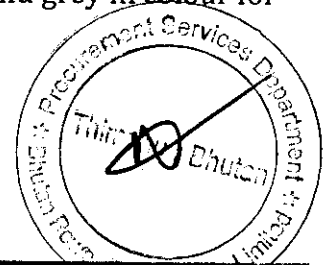


- iv) Aluminium conductor used in power cables shall have tensile strength of more than 100N/sq. mm. The conductor of control cables shall be manufactured from plain annealed copper. All the conductors shall be multi-stranded.
- v) PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90°C and short circuit conductor temperature of 250°C.
- vi) The cable cores shall be laid up with fillers between the cores wherever necessary. It should not stick to insulation and inner sheath. All the cables, other than single core un-armoured cable shall have distinct extruded PVC inner sheath black in colour as per IS 5831.
- vii) The fillers and inner sheath shall be of non-hygrosopic flame retardant material shall be softer than insulation and outer sheath shall be suitable for the operation temperature of the cable.
- viii) The armouring shall be of galvanized steel as follows:

Calculated nominal size & diameter of cable under armour	Type of armour
a) Upto 13 mm	1.4 mm dia GS wire
b) Above 13 up-to 25 mm	0.8 mm thick GS strip/1.6 mm dia GS wire
c) Above 25 up-to 40 mm	0.8 mm thick GS strip/2.0 mm dia GS wire
d) Above 40 up-to 55 mm	1.4 mm thick GS strip/2.5 mm dia GS wire
e) Above 55 up-to 70 mm	1.4 mm thick GS strip/3.15 mm dia GS wire
f) Above 70 mm	1.4 mm thick GS strip/4 mm dia GS wire

The gap between armour wire/strip shall not exceed one armour wire/strip space and there shall be no cross over/over-riding of armour wire/strip. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire/strip. Zinc rich paint shall be applied on armour joint surface.

- ix) Suitable chemicals shall be added to the outer sheaths of all cables to protect them from rodent and termite attack. These chemicals shall not have any harmful effect on the human being.
- x) The normal current rating of all PVC insulated cables shall be as per IS-3961 and should suit the duty requirements for which it is intended.
- xi) Outer sheath shall be of PVC black in colour for power cables and grey in colour for control cables.

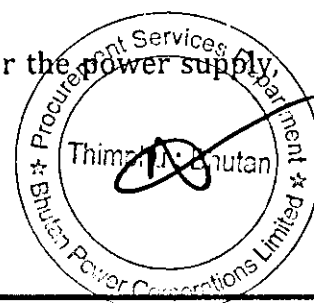


- xii) Cores of the cables of up-to 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted:
- 1 core - Red, Black, Yellow & Blue
 - 2 core - Red & Black
 - 3 core - Red, Yellow & Blue
 - 4 core - Red, Yellow, Blue & Black
 - 5 core - Red, Yellow, Blue, Black & Grey
- xiii) For reduced neutral conductors the core shall be black.
- xiv) For cables having more than 5 cores, core identification shall be done by numbering insulation of core sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). All the numbers shall be of same colour, which shall contrast with the colour of insulation. The colour of the insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.
- xv) In addition to manufacturer's identification on cables as per IS/IEC, following marking shall also be embossed over outer sheath.
- a) Cable size and voltage grade.
 - b) Sequential marking of length of the cable in meters at every one meter. The embossing shall be progressive, automatic, on line and marking shall be legible and indelible.
- xvi) Allowable tolerance on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets.
- xvii) In plant repairs to the cables shall not be accepted.
- xviii) Identification of cores - the insulated cores of HT and LT power cables shall be identified by coloured code. The control cables shall have identification by means of indelible printing of numbers on its cores at intervals not more than 75 mm. At least 20% cores shall be kept as spares in the multi core control cables.

3.0 General Constructional Requirements

3.1 General

The power cables, control cables, PVC cables are required for the power supply, control and protection of various equipment.



3.2 Type Of Cable

The cable shall be multi core/single core (XLPE), PVC and any polymeric/elastomeric insulation type as specified in the Price Schedule.

3.3 Conductor

The cable conductor shall be made from stranded copper/aluminium to form compact conductor having a resistance within the limits specified in IS: 8130. All the cables of size 25mm² and above shall have sector shaped conductors. The minimum no. of strands in conductor shall be 7 (seven) except as otherwise specified. Power cables shall be of stranded aluminium conductor with a minimum size 6 mm² and the control cables shall be stranded copper (electrolytic) conductor with a minimum size of 2.5 mm².

3.4 Conductor (Shield)

The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation; the semi-conducting polymer shall be cross-linked for XLPE cables.

3.5 Insulation

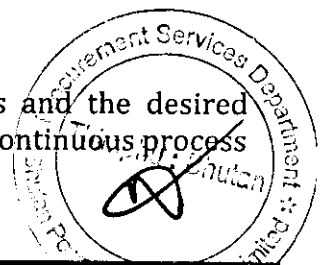
The insulation of the cable shall be extruded type and shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cables shall be of high standard quality. The minimum volume resistivity of the PVC insulation of all the PVC insulated cables shall be 1×10^{14} ohm cm at 27° C and 1×10^{11} ohm cm at 70° C.

3.6 Insulation Shield

In cables to confine electrical field to the insulation, a non-magnetic semi-conducting shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion/process. The cable insulation shield shall be strippable. Metallic screening of appropriate size as per the cable fault level given in this specification shall be provided. Copper tape shall be wrapped helically with 100% coverage. Appropriate shall be 0.04mm.

3.7 Sheath

The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness and applied by a continuous process



to produce a sheath of consistent quality free from all defects. PVC sheath shall be extruded.

- i) The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals.
- ii) The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness.
- iii) The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of type ST2 compound of IS: 5831. The thickness of outer sheath shall be as per amendment no.1 of table 5 of IS: 7098 Part-2 (Column 3 & 5 for both armoured and un-armoured cables).
- iv) The dimensions of the insulation, inner sheath and armour materials shall be governed by values given in Tables 2, 3 & 4 (Method 3) of IS: 7098 Part-II.

3.8 Armour

Hard drawn aluminium wire armouring/galvanized steel tape/wire armouring shall be used for single core and multi core cable, respectively. The hard drawn aluminium wire for armour shall be of H4 grade, as per IS: 8130 (having tensile strength above 150 N/mm²). The diameter of the aluminium wire shall be as per the table for the dimensions of the galvanized steel wire armour given in the relevant standard.

3.9 Serving/Cutter Sheath

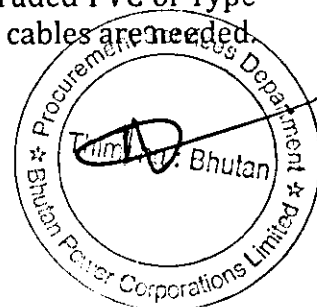
Extruded PVC serving as per IS: 5831 or as specified otherwise shall be applied over the armouring with suitable additives to prevent attack by rodent and termites. All serving must be given anti-termite treatment.

3.10 Construction

Cable shall have suitable fillers laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the operating temperature of the cable and compatible with the insulating material. All materials shall be new, unused and of finest quality. Workmanship shall be neat, clean and of highest grade.

(a) 33kV and 11 kV System – Power Cable

The cable shall be 33 kV and 11 kV (earthed system) grade, heavy duty, stranded aluminium conductor, XLPE insulated, provided with conductor screening and insulation screening, galvanized steel wire/strip armoured, extruded PVC of Type ST2 outer sheathed, as per system requirement, wherever these cables are needed. The cables shall conform to IS: 7098 (Part II) or IEC 60502-2.



- (b) **415V System**
The cable shall be 1.1 kV, grade, heavy duty, stranded aluminium conductor, PVC Type-A Insulated galvanized steel, wire/strip armoured, extruded PVC type ST1 outer sheathed.
- (c) **Control Cables**
The cable shall be 1.1 kV grade, heavy duty, multi core stranded (7 wires) tinned copper (annealed) conductor, PVC Type-A insulated, galvanized steel wire/strip armoured, flame retardant low smoke (FPLS) extruded PVC of type-ST1 outer sheathed. The following sizes shall be used.

4.0 Cable Drums

- 4.1 LV and control cables shall be supplied in non-returnable wooden drums. HV cables shall be supplied in a steel drum. The covers with wood is acceptable. The wood used for construction for the drum shall made from hard wood, be properly seasoned, sound and free from defects. Wood preservative shall be applied to the entire drum.
- 4.2 Bidder shall indicate in the offer the standard length for each size of power and control cable which can be furnished on one drum. The cable length per drum shall be subject to tolerance of $\pm 0.5\%$ of the standard drums length. The bidders shall take into consideration the wastages in the pricing and quote accordingly. IS tolerance shall not be applicable.

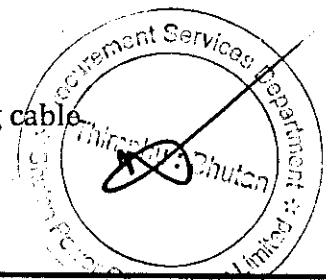
However the cable drums shall be selected so those through joints are eliminated. Typical drum lengths shall be as follows:

a)	33/11kV grade Power Cables up to 300 sq.mm	250 m
b)	1.1 kV grade cables:	
--	Including and above 240 mm ²	250 m
--	Below 240 mm ² size and up to 150 sq.mm	500 m
--	Below 150 mm ² size and up to 50 sq.mm	1000 m
--	Below 35 mm ² sizes	2000 m

- 4.3 A layer of PVC sheet shall be applied to the surfaces of the drums and over the outer most cables layer. A clear space of at least 40 mm shall be left between the cables and the logging.

- 4.4 Each drum shall have the following information stencilled on it in indelible ink:

- i. Contract/specification No.
- ii. Name and address of the consignee
- iii. Makers name and address
- iv. Drum No.
- v. Size of cable, code name and length of cable in meter
- vi. Gross weight of the drum with protective lagging including cable
- vii. Weight of the empty drum with protective lagging.



- viii. Net weight of the cable.
- ix. Arrow marking of unwinding position of the cable end, lot number.

4.5 Packing shall be sturdy and adequate to protect the cables from any injury due to mishandling or other conditions encountered during transportation handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

5.0 Minimum Technical Requirements.

5.1 Underground Distribution Cable

The standard 33 kV & 11 kV cable for underground distribution is cross-linked polyethylene insulated, PVC sheathed, cable manufactured to IS 7098 Part II or IEC 60502-2. Cables shall be steel wire or steel tape armoured for more than 1 core whereas for single core, armouring shall be aluminium wire or aluminium tape.

The current carrying capacity of buried cables depends on the installation conditions, such as the thermal resistance of the soil and the presence of other cables. Manufacturers provide cable ratings for cable installed under defined conditions, which may not reflect the actual installation conditions in a particular situation. In order to provide for these uncertainties, the maximum design current for any underground cable should generally be limited to 90% of the ratings.

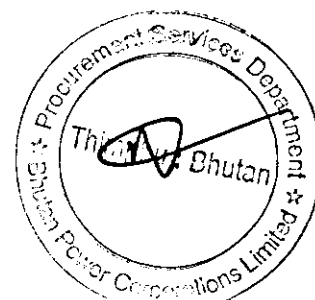
5.2 400 V Cable

BPC's standard 400 V underground cable is aluminium conductor, PVC insulated, PVC sheathed, manufactured to IS 1554 (Part I). Cables are four or two core with the neutral conductor having the same cross sectional area as the phase conductors. Cables shall be steel wire or steel tape armoured for more than 1 core whereas for single core, armouring shall be aluminium wire or aluminium tape.

5.3 Low Voltage Overhead Service Cable

Low voltage overhead service cable shall be 650/1100 V two core or four core stranded copper conductor, PVC insulated, with high conductivity hard drawn copper conductors. The cable shall have an extruded PVC sheath in accordance with IEC 60502-1.

Single core copper cable with a neutral screen is an acceptable alternative to the twin conductor cable currently used. For three phase supplies three core plus neutral screen cable may be used. Neutral screen cable is considered safer for overhead service drops because the neutral conductor completely surrounds the phase conductor.



LOT 3: ACSR Conductors**1.0 General****1.1 Scope of Supply**

This section covers the requirements for the design, manufacture, testing, delivery and unloading at BPC stores of overhead ACSR conductors.

1.2 Standards

The latest edition of the international standards shall apply, in particular:

- BS 215 Aluminium conductors steel reinforced for overhead power transmission
- IEC 888 Zinc coated steel wires for stranded conductors
- IEC 889 Hard drawn aluminium wire for overhead line conductors
- IEC 1089 Round wire concentric lay overhead electrical stranded conductors
- IS 398 (Part II)

1.3 ACSR Conductor**1.3.1 General**

Bare aluminium conductors, steel reinforced (ACSR) are proposed to be used for MV overhead distribution lines. ACSR conductor consists of seven or more aluminium and galvanized steel wires built up in concentric layers. The centre wire is of galvanized steel and the outer layer is of aluminium as per IS: 398 (Part II).

1.3.2 Construction

Construction of conductors shall be as per BS 215. The sizes and properties of the ACSR conductors shall be as given in the table below. The code names given are only for the purpose of easy identification. Conductors with equivalent or superior parameters to those specified herein will be considered acceptable. However, no credit will be given for the same.

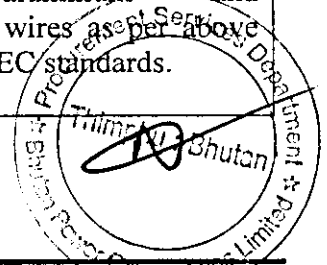
Table 1: Characteristics of Bare Overhead Line Conductors

Parameter	WOLF	DOG	RABBIT
Conductor Type	ACSR		
Nominal area (mm ²)	150	100	50
Aluminium area (mm ²)	158	105	53
Equivalent copper area (mm ²)	96	64	32
Stranding and wire dia (mm)	30/2.59 Al.	6/4.72 Al.	6/3.35 Al.
	7/2.59 Steel	7/1.57 Steel	1/3.35 Steel
Conductor diameter (mm)	18.1	14.2	10.1

Section V- Schedule of Supply

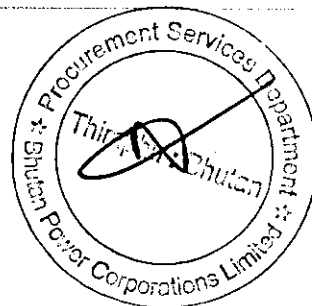
Approximate mass (kg/km)	730	390	210
Minimum breaking load (kN)	69.2	32.7	18.4
DC resistance at 20°C (ohms/km)	0.1831	0.2745	0.5449
AC resistance at 75°C (ohms/km)	0.22	0.33	0.66
Approx inductive reactance (ohms/km)	0.257	0.276	0.397
Approximate voltage drop (mV/A/m) ¹	0.586	0.745	1.334
Full load current - (A) ²	405	291	190

1.	Type of conductor	:	ACSR Panther Conductor.
2.	Applicable standards	:	IS – 398/ IEC 1089, IEC 888, IEC 189.
3.	Nominal area of aluminum	:	200 Sq.mm.
4.	Sectional area of aluminum	:	212.10 Sq.mm.
5.	Total sectional area of aluminum	:	261.50 Sq.mm.
6.	Number of stranding and wire diameter	:	
	a. Aluminum	:	30/3.00 mm.
	b. Steel	:	7/3.00 mm.
7.	Overall diameter of Al + Steel	:	21 mm.
8.	Weight mass of ACSR conductor	:	
	a. Overall weight	:	976.00 Kg/Km.
	b. Weight of Aluminum	:	588.50 Kg/Km.
	c. Weight of steel	:	387.50 Kg/Km.
9.	Calculated resistance at 20°C (maximum.)	:	0.1400 Ohms/Km.
10.	Ultimate tensile strength (minimum).	:	86.58 kN.
11.	Conductor current carrying capacities	:	
	a. Current carrying at 65°C.	:	395 Amps. (Approx.)
	b. Current carrying at 75°C.	:	487 Amps. (Approx.)
12.	Joints in strands	:	
	a. Steel.	:	Not permitted.
	b. Aluminum wires.	:	No joint shall be permitted in the Aluminum wires in outer most layer of ACSR conductor. But permitted in the inner layer such that no two such joints are within 15 meters of each other in the complete stranded conductor.
13.	Materials for construction of ACSR conductor.	:	The conductor shall be constructed of hard-drawn aluminum and aluminized steel wires as per above applicable IS & IEC standards.



Section V- Schedule of Supply

Sl.	Technical Particulars:		
1.	Type of conductor	:	ACSR Zebra Conductor.
2.	Applicable standards	:	IS - 398/ IEC 1089, IEC 888, IEC 189.
3.	Nominal area of aluminum	:	420 Sq.mm.
4.	Sectional area of aluminum	:	428.90 Sq.mm.
5.	Total sectional area of aluminum	:	484.50 Sq.mm.
6.	Number of stranding and wire diameter	:	
	a. Aluminum	:	54/3.18 mm.
	b. Steel	:	7/3.18 mm.
7.	Overall diameter of Al + Steel	:	28.62 mm.
8.	Weight mass of ACSR conductor	:	
	a. Overall weight	:	1621 Kg/Km.
	b. Weight of Aluminum	:	1182 Kg/Km.
	c. Weight of steel	:	439 Kg/Km.
9.	Calculated resistance at 20°C (maximum.)	:	0.06915 Ohms/Km.
10.	Ultimate tensile strength (minimum).	:	121.45 kN.
11.	Conductor current carrying capacities	:	
	a. Current carrying at 65°C.	:	590.00 Amps. (Approx.)
	b. Current carrying at 75°C.	:	737.00 Amps. (Approx.)
12.	Joints in strands	:	
	a. Steel.	:	Not permitted.
	b. Aluminum wires.	:	No joint shall be permitted in the Aluminum wires in outer most layer of ACSR conductor. But permitted in the inner layer such that no two such joints are within 15 meters of each other in the complete stranded conductor.
13.	Materials for construction of ACSR conductor.	:	The conductor shall be constructed of hard-drawn aluminum and aluminized steel wires as per above applicable IS & IEC standards.



Note:

1. Phase to phase voltage drop on a balance three phase circuit.
2. Ambient temperature 40°C, conductor temperature of 75°C and wind speed of 1m/sec.

While it is noted that all the above details such as conductor code names, sizes and other parameters given may not be covered by IEC standards, all other requirements applicable to individual wire/strand and the whole conductor shall conform to these standards.

1.3.3 Galvanizing

The zinc content in the slab zinc and the method of zinc coating shall be as per IEC standards.

The mass of zinc coating shall correspond to Class 1 of IEC 888.

1.3.4 Greasing

The steel cores and the inner layers of aluminium wires (where more than one aluminium layer exists) shall be protected with special grease in order to provide additional protection against corrosion. The grease shall fill the whole space between wires within circumscribed cylinder at inner aluminium layer or at steel core, if the conductor has only one aluminium layer. The application of grease shall correspond to Case 1 of IEC 1089.

The grease shall be chemically neutral with respect to aluminium, zinc and steel. It shall withstand severe weather conditions prevailing in Bhutan and a temperature of 85°C continuously without alteration of its properties. It shall have a drop point of not less than 120°C.

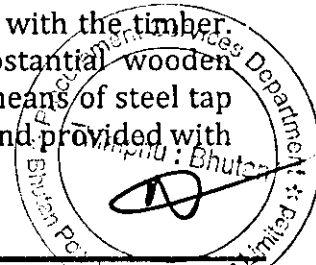
1.3.5 Conductor Drums

Conductors shall be supplied on drums in one continuous length. Maximum length of conductor on each drum shall be 4500 m for Rabbit and 2500 m for Dog and 2000 m for Wolf conductor.

The conductor shall be supplied on non-returnable wooden drum generally conforming to IS: 1778-1961 except where otherwise specified hereafter.

After reeling the conductor, the exposed surface of the outer layer of the conductor shall be wrapped with plastic sheet to protect the conductor from dirt, grit and damaged during transport and handling.

The wooden drums should be treated to an approved international standard by vacuum impregnation with copper-chrome-arsenate (CCA) preservative to resist rotting and termite and fungus attacks. The interior of the drums shall be lined with bituminous paper to prevent the conductor from being in contact with the timber. Drums shall be adequately protected by securely fastening substantial wooden battens around the periphery. These battens shall be secured by means of steel tap bindings. The drums shall be of seasonal hardwood strong enough and provided with



lagging of adequate thickness and strength constructed to protect the conductor against all damages and displacement during transit, storage and subsequent handling at site. Spindle plates to be mounted/fixed on all the conductor drums offered. The conductor ends shall be properly sealed and secured with the help of U-nails or bolts on side of the flanges to avoid loosening of the conductors during transit handling. Each drum shall have the following information stencilled on it in indelible ink:

- a. Contract/specification No.
- b. Name and address of the consignee
- c. Makers name and address
- d. Drum No.
- e. Size of conductor, code name and length of conductor in mtr.
- f. Gross weight of the drum with protective lagging including conductor.
- g. Weight of the empty drum with protective lagging.
- h. Net weight of the conductor.
- i. Arrow marking of unwinding position of the conductor end, lot number.

LOT 4 (HV ABC and Covered AAAC Conductors)

1.0 General

1.1 Scope of supply

This section covers the requirements for the design, manufacture, testing, and delivery and unloading at BPC stores of ABC and Covered AAAC conductors.

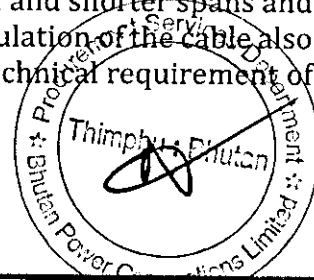
2.0 High Voltage Aerial Bundled Conductor

HV ABC consists of XLPE insulation. It has bearer wire (Messenger wire) which is either of aluminium alloy or steel wire (bare or insulated). The design of ABC shall comprise compacted, stranded, hard drawn aluminium phase conductors with dry cured cross linked polyethylene insulation. The main advantages of HV ABC over bare ACSR conductors are as follows:

- Offers relative resistance to short circuits caused by external forces (wind, fallen branches), unless they abrade the insulation.
- Can stand in close proximity to trees and branches will not generate sparks if it in contact
- Simpler installation, as cross arms and insulators are not required.
- Less cluttered appearance than bare conductors.
- It can be installed in a narrower right-of-way.

However the disadvantages were additional cost for the cable itself and shorter spans and maximum use of poles due to increased weight of the cable. The Insulation of the cable also degrades due to direct exposure to sun. Following are minimum technical requirement of HV Aerial Bundled Cable.

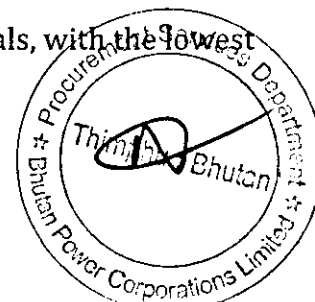
The Minimum Technical Requirement of the HV ABC



Sl. No.	Parameters	Unit	Minimum Requirement	
1	Applicable Standards	IEC 60502-2, IEC 60228 or equivalent standards		
2	Rated Voltage	kV	6.35/11(12)	
3	Conductor			
	Nom. Area of core Conductor	mm ²	50	95
	Conductor Screen Material	Extruded cross-linked semi-conductive		
	Min. Thickness of Conductor Screen	mm	0.3	0.3
4	Insulation			
	Insulation material	XLPE		
	Min. Thickness of Insulation	mm	3.4	3.4
	Min. Thickness of insulation Screen	mm	0.8	0.8
5	Metallic Screen			
	Material	Plain Annealed Copper Wire		
	Size for Conductor Screen	No./mm	26/0.85	26/0.85
6	Sheath			
	Material	Black, High Density Polyethylene (HDPE)		
	Min. Thickness of sheath	mm	1.8	1.8
7	Support Catenary			
	Support Catenary size	No./mm	19/2	19/2
	Material	Aluminium-Clad Steel without insulation		
8	Max. D.C Resistance of cable at 20°C	Ohm/km	0.641	0.320
9	Max. A.C Resistance of cable at 90°C	Ohm/km	0.822	0.411
10	Inductive Reactance of cable at 50Hz	Ohm/km	0.144	0.134
11	Voltage drop (three phase)	mV/A.m	1.45	0.746
12	Continuous current carrying capacity per phase at 90°C conductor tempt & 30°C ambient tempt	Amps	184	280
13	Approximate mass of cable	kg/km	2850	4090
14	Phase cable diameter (Nominal)	mm	25	29

The conductors shall be marked on the external surface with the following:

- Manufacturer's name
- Year of manufacture
- Length in meters marking in sequential numbers at 1 m intervals, with the lowest number at the inner end of the drum.
- Phase marking.



The Bidder shall submit the UV weathering test of the cable (outer sheath) with type test reports.

4.0 AAAC covered overhead conductor

The water blocked covered conductor (CC) should have AAA Conductor material (Alloy 1120) suitable for overhead lines for working voltages 6.35/11 kV and 19/33 kV, 50 Hz. AC system. The cover insulation shall be UV stabilized XLPE insulation. The covered conductors shall be marked on the external surface with the following:

- (a) Manufacturer's name, registered trade name or registered mark
- (b) Year of manufacture
- (c) Length in metres marking in sequential numbers at 1 m intervals, with the lowest number at the inner end of the drum. Any drum length can be started at any integral number with starting metre length is allowed.
- (d) Covered conductor type CC
- (e) Conductor material AAAC, Alloy 1120

The Minimum Technical Requirement of the AAAC Covered

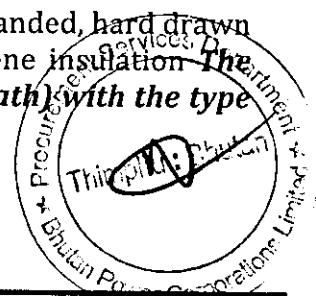
	Units	Conductor size and type	
Applicable Standard	IEC 60502, IEC 60228		
Rated Voltage	kV	6.35/11 kV up to and including 19/33 kV	
Nominal cross-sectional area	mm ²	49.5	111
Stranding and nominal wire diameter	No./mm	7/3.00 (Fluorine)	7/4.5 (Hydrogen)
Conductor Material	Aluminium Alloy 1120		
Cover insulation material	UV stabilized XLPE		
Approximate conductor diameter	mm	9	13.5
Minimum thickness of XLPE cover	mm	3.4	3.4
Approx. overall dia of cable	mm	12.4-14	16.9-18.5
Continuous current rating	Amps	215	290

The Bidder shall submit the UV weathering test for XLPE Insulation result with the bid.

Lot 5 LV Aerial Bundled Conductor

1 General

The design of aerial bundled conductors shall comprise compacted, stranded, hard drawn aluminium phase conductors with dry cured cross linked polyethylene insulation. **The Bidder shall submit the UV Weathering test of the cable (outer sheath) with the type test reports.**

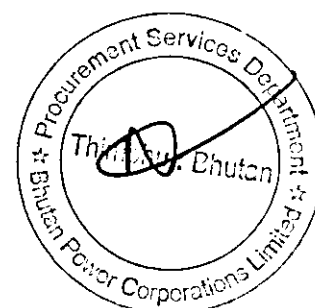


All of the Aerial Bundled Conductors required shall be Fully Supported Cable, where all the equal-sized phase and neutral cores share the mechanical load. The cable shall be XLPE insulated and rated for 0.6/1kV. The bundle shall have a right-hand lay.

Two core cable shall be used for single phase distribution and 4 core cable for three phase. Typical design parameters for the ABC cable used are given in table below:

The Minimum Technical Requirement of the LV ABC

Sl. No.	Cable Size (mm ²)	50		95		120
	Parameter	2 core	4 core	2-core	4-core	4-core
1	Applicable Standard	IEC60502-1 & IEC 60228 OR Equivalent Standards				
2	Rated Voltage (kV)	06/1(1.2)				
3	Nominal conductor diameter (mm)	8.05		11.40		12.90
4	Minimum insulation thickness (mm)	1.5		1.7		1.7
5	Nominal overall diameter (mm)	23.8	28.7	31.8	38.4	42.2
6	Approximate mass (kg/km)	350	700	680	1,350	1660
7	DC resistance at 20°C (ohms/km)	0.641		0.320		0.253
8	AC resistance at 50 Hz 80°C (ohms/km)	0.796		0.398		0.315
9	Inductive reactance at 50 Hz (ohms/km)	0.086	0.093	0.080	0.087	0.0844
10	Voltage drop at 50 Hz, 80°C (mV/A/m)	1.60	1.39	0.81	0.71	0.564
11	Continuous current rating (A)	150	140	230	215	280
	Fault current rating (kA for 1 sec)	4.1		8.3		11.3
	Minimum bending radius core (mm)	65		90		102
	Minimum bending radius cable (mm)	130	160	270	320	352
	Minimum breaking load (kN)	14.0	28.0	26.6	53.2	67.2
	Recommended highest everyday tension (kN)	2.52	5.04	4.79	9.58	12.10
	Recommended maximum working tension (kN)	3.92	7.84	7.45	14.90	18.82



2 Construction

The cores shall form a bundle, which comprise four (and two) single cores of insulated aluminium twisted together, for phase and neutral conductors. The total pull of the line shall be distributed among the four (and two) conductors.

Each core shall be insulated with extruded cross linked polyethylene (XLPE). The three phase conductors shall be indelibly marked with one, two or three, as appropriate or longitudinal ridges formed from the insulation material. The cores shall be twisted together with a right hand lay. The pitch of laying shall be such as to allow easy separation of conductors when making connection but also maintain the bundle cohesion at the angle points on the line route. Cables shall be supplied on drums, in one continuous length.

The conductors shall be marked on the external surface with the following:

- Manufacturer's name
- Year of manufacture
- Length in meters marking in sequential numbers at 1 m intervals, with the lowest number at the inner end of the drum.
- Phase marking.

