



WBSEDCL

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED

(A Govt. of West Bengal Enterprise)

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TECHNICAL SPECIFICATION FOR HT AB CABLE (amended on 01.06.2017)

TECHNICAL SPECIFICATIONS FOR X-LINKED POLYETHYLENE INSULATED AND PVC SHEATHED H.T. (11KV) AERIAL BUNCHED CABLES

1.0 SCOPE:

This specification covers design, manufacture, testing at manufacturer's works before despatch, transportation, supply and delivery of 11 KV grade XLPE insulated, screened all Aluminium conductor and PVC sheathed Power Cables, manufactured with dry cure technology with CCV system HT Aerial Bunched Cables for overhead lines.

2.0 LOCATION

11KV Aerial bunched Cables are composite Cable especially intended for overhead line use in forest areas where tree clearance poses a serious problem and in other cases where it is difficult to get clearance for bare conductor lines. The said cable will be used within the State of West Bengal under WBSEDCL area.

3.0 CLIMATIC AND ISOCERAUNIC CONDITIONS:

Maximum ambient temperature - 50°C
 Minimum ambient temperature - 4°C
 Thermal resistance of soil - 150°C –cm/watt
 Maximum daily average ambient temperature: 45°C
 Maximum relative humidity- 100%
 Average rainfall per annum-200 cm
 Maximum height above the sea level -1000 meter
 Maximum wind pressure/wind speed: 150 kg/sq. m/50m/sec
 Average no. of thunderstorm days per annum: 200

4.0 COMPOSITION & DESCRIPTION OF THE CABLE:

The composite cable shall comprise three single-core Power cables twisted around Aluminium Alloy a bare messenger wire, which will carry the weight of cable.

Single-core Power cables should consists of stranded compacted Circular Aluminium Conductor screened with Black extruded semi-conducting Compound, natural coloured XLPE insulated core screened with Black extruded semi-conducting compound and one layer of copper tape and covered with Black extruded PVC.

Bare Messenger Conductor shall be stranded **non-compacted** Circular aluminium alloy conductor & will carry the weight of the cable. It **shall have smooth surface** to avoid damage to the outer insulating sheath of single core phase cables twisted around the messenger.

Aluminium Alloy wires shall be tested as per IS: 398(Part-IV)/1994.

5.0 DESCRIPTION OF THE CABLE

Description			
11KV (E) Grade Aerial Bunched Cable with 3(three) Power Cores {Stranded, compacted Circular Aluminium Conductor screened with Black extruded semi-conducting Compound, natural coloured XLPE insulated core screened with Black extruded semi-conducting compound and one layer of copper tape and covered with Black extruded PVC (Core identification by colour tape marking red, yellow & blue with colour tape placed longitudinally under the copper tape)} and one bare Messenger wire shall be Stranded non- compacted circular Aluminium Alloy conductor. The Cable should conform to IS: 8130-1984, IS:398(Part-IV)-1994, IS:7098(Part-II)-2011 & IS: 5831-1984 with up to date amendments, if any.	Sl. No.	Designation	
	1.	3x35+1x70 sq mm	
	2.	3x50+1x70 sq mm	
	3.	3x70+1x70 sq mm	
	4.	3x95+1x70 sq mm	
	5.	3x95+1x80 sq mm	
	6.	3x120+1x125 sq mm	
	7.	3x150+1x148 sq mm	

6.0 RATED VOLTAGE:

The rated voltage of the cables shall be 6.35KV/11KV and the maximum operating voltage shall be 12 KV.

7.0 APPLICABLE STANDARDS:

Unless otherwise stipulated in this specification, the following standard with **latest amendment** shall be applicable:

IS:7098 (Part-II)-2011 and its amendment	Specification for Cross linked polyethylene insulated thermoplastic sheathed Cables- for working voltages from 3.3 KV up to and including 33 KV.
IS : 8130-1984 and its amendment	Specification for Conductors for Insulated Electric Cables and flexible Cords.
IS : 398 (Part-IV)-1994 and its amendment	Specification for Aluminium Conductors for overhead Transmission purposes: Aluminium Alloy Stranded Conductors (Aluminium-Magnesium- Silicon type)
IS:10418-1982 and its amendment	Specification for Drums for Electric Cables
IS: 5831-1984 and its amendment	Specification for PVC insulation and Sheath of Electric Cables.

8.0 GENERAL TECHNICAL REQUIREMENTS:

8.1 DETAILS OF SINGLE-CORE POWER CABLE

The cable conductors shall be H4 grade class 2 Aluminium Conductors complying with the requirements as specified in IS-8130-1984 **with latest amendments**.

The conductor shall be stranded compacted circular. Conductor shall be clean & reasonably uniform in size and shape and its surface shall be free from sharp edges.

Not more than two joints shall be allowed in any of the wires forming every complete length of conductor and no joint shall be within 300 mm. of any other joint in the same layer. Joints shall be brassed, silver soldered or electric or gas welded. No joint shall be made in the conductor, once it has been stranded.

Three Power Cores should be identified by colour tape marking (Red, Yellow & blue) **with colour tape placed longitudinally under the copper tape**.

8.2 Conductor Screen

The conductor screen shall be non metallic & shall consists of a layer of extruded semi-conducting cross linked polyethylene (XLPE) compound of thickness not less than 0.5 mm.

8.3 Insulation of XLPE

The insulation shall be of cross linked polyethylene (XLPE) of nominal insulation thickness 3.6 mm. conforming to the physical, electrical and ageing properties of IS: 7098 (Part-II)-2011.

Cross-linking should be done by exposure to peroxide with **Nitrogen Curing CCV Line only** method with intention to ensure lowest tree formation. Only natural unfilled compound shall be used for insulation.

XLPE insulation shall be done by method of extrusion. The insulation shall be so applied that it fits closely on the conductor (or conductor screening or barrier, if any) and it shall be possible to remove it without damaging the conductor.

The XLPE conductor shall be suitable for use where the combination of ambient temperature and temperature rise due to load, including temperature on exposure to direct sunlight results in conductor temperature not exceeding the following:

Normal continuous Operation	Short circuit Operation
90°C	250°C

8.4 Insulation Screen

The insulation screening shall consist of two parts; namely metallic & non metallic.

Non metallic part shall consist of a layer of extruded semi-conducting compound and shall be applied directly over the insulation of each core. Thickness of non-metallic part should be 0.6 mm.

The metallic part shall be non magnetic and shall be applied over the non-metallic part of insulation screening of individual core. Metallic screening material shall be annealed Copper tape. Thickness of Copper tape should be minimum 0.06 mm.

8.5 Outer Sheath

Over the metallic screen the Cable shall be provided with extruded PVC outer sheath. The composition of the PVC compound for outer sheath shall be Type ST2 of IS-5831-1984 **with latest amendments**. The colour of the outer sheath shall be black. The nominal & minimum thickness of the sheath shall not be less than the standard values specified in the table No. 7 of IS-7098(Part-II)/2011. Outer surface of the Cable shall be ultra-violet Ray resistant.

9.0 Dimensional And Electrical Data

The standard sizes and technical characteristics for Single Core Power Cable is given below:

Nominal Cross sectional Area of Al. Conductor (sq. mm)	Maximum DC resistance at 20°C ohm/km	Minimum no. of Strand	Nominal thickness of insulation (mm)	Max. Short Circuit Current for 1 sec. (KA)
35	0.868	6	3.6	3.4
50	0.641	6	3.6	4.72
70	0.443	12	3.6	6.7
95	0.32	15	3.6	8.96
120	0.253	15	3.6	11.32
150	0.206	15	3.6	14.16

Note : The resistance values given in the Table are the max. permissible one.

10.0 DETAILS OF MESSENGER (NEUTRAL CONDUCTOR)

Bare Messenger Conductor shall consist of aluminium alloy wires. Aluminium Alloy Wires shall be tested as per IS:398(Part-IV) /1994 **with latest amendments**.

Messenger Conductor shall be Stranded **non-compacted** Circular & **shall have smooth round surface** to avoid damage to the outer insulating sheath of single core phase cables twisted around the messenger.

There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wires before finally drawing.

The technical characteristics of the messenger wire shall be as follows:

Nominal Cross sectional Area of Phase Conductor (sq. mm)	Messenger Conductor (Stranded Al Alloy IS 398 Part-4)			Maximum DC resistance at 20°C (ohm/km)
	Nominal Area of Aluminium Alloy in Messenger Wire (sq. mm)	No. of Strand of Aluminium Alloy	Strand dia. of Aluminium Alloy (mm)	
35	70	7	3.57	0.48
50	70	7	3.57	0.48
70	70	7	3.57	0.48
95	70	7	3.57	0.48
95	80	7	3.81	0.425
120	125	19	2.89	0.27
150	148	19	3.15	0.23

11.0 LAYING UP :

Three Power Cores **having colour tape marking** shall be twisted over bare messenger wire with right hand direction of lay. This will form the Aerial Bunched Cable.

12.0 TESTS:

All the cable sizes i.e. items offered should have been fully type tested as per the relevant standards at any NABL accredited Lab bearing an Accreditation body Logo/Central or State Govt. recognised test house or laboratory.

The bidder shall furnish the type test reports along with the offer. These type tests must have been conducted within last five years prior to date of Bid opening.

The following Type tests shall be carried out on the cables as per Relevant IS & Type tests certificates shall be furnished invariably with the offer.

LIST OF TYPE TESTS :

- a) Resistance Test on Conductor.
- b) Test for thickness of insulation and sheath.
- c) **Physical tests for insulation.**
 - i) Tensile strength and elongation at break.
 - ii) Ageing in air oven.
 - iii) Hot set test.
 - iv) Shrinkage test.
 - v) Water absorption (Gravimetric)
- d) **Physical Test for outer sheath :**
 - i) Tensile Strength and elongation at break.
 - ii) Ageing in on oven.
 - iii) Shrinkage Test.
 - iv) Hot deformation.
 - v) Loss of mass in air oven, heat shock and thermal stability Test
- e) Partial discharge test.
- f) Bending test.
- g) Dielectric Power Factor Test :
 - i) As a function of Voltage.
 - ii) As a function of temperature.
- h) Insulation resistance (volume resistivity) test.
- i) Heat cycle test.
- j) Impulse withstand test.
- k) High Voltage test.
- l) Flammability test.
- m) Cold impact test
- n) **Type test for messenger wire :**
 - i) Ultimate Tensile Strength test on finished wire
 - ii) Resistance Test

ACCEPTANCE TESTS :

The following tests shall be carried out as acceptance tests :

- a) Conductor resistance test for both messenger and **phase** Conductor.
- b) Test for thickness of insulation and sheath of **phase** Conductor.
- c) Partial discharge test (for screened cables only)
- d) High Voltage test.
- e) Hot set test for Insulation
- f) Tensile Strength & elongation at break test for insulation & Sheath
- g) Insulation resistance (volume resistivity) test
- h) Breaking load test on finished wire for Messenger Wire
- i) Resistance Test for Messenger Wire

ROUTINE TEST ;

The following tests shall be carried out as routine tests on all sizes of all drums of un armoured cables by the supplier in presence of the purchaser's representative if so directed by the purchaser and shall be got approved before despatch.

- a) Conductor resistance test (for aluminium)
- b) Partial discharge test (for screened cables only)
- c) High Voltage Test.

Type test/acceptance test/Routine tests and any other tests not covered as stated in different clauses of the specification but required as per relevant Indian Standards shall also to be carried out.

13. INSPECTION :

The Cable shall be inspected at manufacturer's works before despatch as per IS-7098 (Part- II)/2011 (**with latest amendments**). All the acceptance tests embodied in the above shall be performed by the Inspecting Officer. The Manufacturer shall arrange without making any extra charges with all the necessary machinery, apparatus and labour requirement for the testing purpose. The cost requirement for testing shall be to Firm's Account.

6 copies of type test certificate lot wise for each type of cable shall be sent to the purchaser for acceptance. Type test certificate for each lot and routine test certificate for each drum of cables shall be submitted to purchaser for approval before despatch of cables from the works. The test certificate shall be completed with all results.

14. SEQUENTIAL MARKING :

Supplier shall provide non-erasable sequential marking of length on any one of phase cores by printing/engraving for each metre of length with sequential marking machine having automatic length measuring meter. The Cable supplied without sequential marking will not be accepted and no deviation shall be allowed under any circumstances

15. PACKING & MARKING :

The Cable shall be supplied in suitable non-returnable wooden drums of suitable size in standard lengths subject to a tolerance of $\pm 5\%$. Manufacture will provide the Multiplying Factor considering the Lay Ratio of the cable to measure the length of cable in a drum. Multiplying factor would be provided in the GTP instead of drum. Sequential length of the core & the declared cable length shall be marked on the cable drum. Generally IS: 7098-II/2011 **with latest amendments** shall be marked on the cable drum.

The Cable shall be wrapped with polythene under wooden covering. Each metre length shall be embossed with the Trade Name of Manufacturer, year of manufacturing, the word ELECTRIC and WBSEDCL or WBSEDCL/IPDS or WBSEDCL/DDUGJY (whichever is applicable). ISI mark Cable shall be preferred.

The ends of the Cable shall be sealed by means of non-hygroscopic sealing material. Each drum shall carry the following information either stencilled on flange or label attached to it

- a) Manufacturer's Name
- b) Trade Mark, if any.
- c) A reference to ISS i.e. IS-7098 (Part-II)/2011.
- d) Length of the Cable on the drum.
- e) Voltage Grade and type of the Cable.
- f) Colour of outer sheath.
- g) Nominal cross-sectional area of the Cable Conductor.
- h) Purchase Order No. & date.
- i) Name and address of Consignee – WBSEDCL or WBSEDCL/IPDS or WBSEDCL/DDUGJY.
- j) Number of Cores.
- k) Gross Weight of packed and net weight of the composite Cable.
- l) Drum No. & its direction of rotation (with an arrow)
- m) Year of Manufacture.

The standard Drum Length will be 250 mtrs. in each Drum for all sizes subject to a maximum tolerance of $\pm 5\%$ **and overall quantity tolerance should be -1%.**

16. LITERATURE AND MANUAL :

To be submitted as per General Terms & Conditions of Contract.

17. GUARANTEED TECHNICAL PARTICULARS :

To be submitted along with Tender documents in triplicate as per format annexed herewith Technical characteristic shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, WBSEDCL shall have right to reject the material.

GTP OF HT AB CABLE

1	Manufacturer's Name & Address	
2	AB Cable Sizes	3X+1X sq. mm
3	Lists of Standard applicable.	IS: 7098 (Part-II)-2011, IS: 8130-1984, IS: 398 (Part-IV)-1994, IS: 10418: 1982, IS: 5831-1984
4	Details of Power Core Conductor	
a)	Material	Aluminium conductor shall be H4 grade complying with the requirements of IS-8130-1984 with up to date amendments
b)	Flexibility Class as per IS : 8130-1984	Class-2
c)	Form of Conductor.	Stranded Compacted Circular
d)	Maximum Continuous Conductor Temperature (in °C)	90°C
e)	Maximum Short time Conductor Temperature (in °C)	250°C
5	Power Core	
a)	No of Core	3
b)	Nominal cross sectional area	
c)	No. of strands	
d)	Strand dia	
e)	Dia of compacted Conductor (mm)	
f)	Insulation Nominal Thickness	
g)	Insulation Minimum Thickness	
h)	Approximate dia over insulation	
i)	Maximum Continuous Load (Amps)	
j)	Maximum Short Circuit. current for 1 sec (KA)	
k)	Identification of Power Cores	By colour tape marking (Red, Yellow & blue)
l)	Max. DC resistance of conductor at 20°C(ohm/km)	
m)	Approx. Mass (Kg/KM)	
6	Bare Messenger Core	
a)	Material	Aluminium Alloy Wires.
b)	No of Core	1
c)	Nominal cross sectional area	
d)	No. of strands	
e)	Strand dia	
f)	Dia. of non- compacted Conductor(mm)	

g)	Approx. Weight (Kg/KM)	
h)	Max. DC resistance of conductor at 20°C	
i)	Ultimate tensile Strength (Kg)	
j)	Earth fault current carrying capacity for 1 sec (KA)	
k)	Modulus of Elasticity (Kg/cm ² X10 ⁶)	
l)	Co-efficient of linear expansion (per °CX 10 ⁻⁶)	
7	Insulation	
a)	Material	XLPE
b)	Method of application of Insulation	Extrusion
c)	Type of curing of XLPE Insulation Completed Cable.	Nitrogen Curing through CCV line only.
d)	Colour of Insulation	Natural Coloured
8	Conductor Screening	
a)	Material	Semi conducting XLPE Compound
b)	Minimum Thickness	0.5 mm
c)	Method of application	Extrusion
9	Insulation Screening	
A	Non-Metallic Part	
a)	Material	Semi conducting compound
b)	Minimum Thickness	0.6 mm
c)	Method of application	Extrusion
B	Metallic Part	
a)	Material	Annealed Copper Tape
b)	Minimum Thickness	0.06 mm
10	Outer Sheath	
a)	Material	PVC compound of type ST2 of IS 5831-1984
b)	Nominal Thickness	
c)	Method of application	Extrusion
d)	Colour	Black
11	Voltage Grade of Cable	
a)	Maximum operating voltage of the Cable	12 KV
b)	Rated Voltage of the Cable	11 KV
c)	Neutral to Phase voltage	6.35 KV
12	De-rating factor: De-rating factors for variation in Air Temp.	
	Air Temp. 0C	
13	Direction of Laying	Right Hand Direction

14	Completed Cable :	
a)	Approx. overall diameter(mm).	
b)	Approx. Weight(Kg/KM)	
c)	Allowable sag as a percentage of span length at 4 ⁰ C ambient temperature	
15	Cable Drums :	
a)	Standard drum length & tolerance of each drum	250 Mtr, \pm -5%
b)	Dimension of Drum	As per IS:10418-1982
c)	Shipping Weight.	
16	Overall quantity tolerance	-1%
17	Sequential marking	Marking of the sequential length shall be provided on any one of phase conductor by printing/ engraving for each meter of length.
18	Embossing	Each metre length shall be embossed with the Trade Name of Manufacturer, year of manufacturing, ELECTRIC and WBSEDCL or WBSEDCL/IPDS or WBSEDCL/ DDUGJY (whichever is applicable) on any one phase conductor
19	Multiplying Factor considering Lay Ratio of cable to Measure the Length of cable in Drum	

Signature of bidder with official Seal

Similarities between two specification		
	WBSEDCL	IPDs
	Aluminium Alloy bare Messenger Wire	Aluminium Alloy bare Messenger Wire

Difference between two specification			
	WBSEDCL		IPDs
	Non metallic part of Insulation Screen shall consist of a layer of extruded semi-conducting compound		Non metallic part of Insulation Screen shall consist of a layer of extruded semi-conducting compound and/or semiconducting tape.
	Thickness of Copper Tape (metallic part of Insulation Screen) should be minimum 0.06 mm		Thickness of Copper Tape (metallic part of Insulation Screen) should be minimum 0.045 mm
	Outer sheath – Material is PVC of type ST2 of IS 5831-1984 with latest amendment		Outer sheath – Material is Polyethylene of Type ST- 7 of IEC-60502 (Part-II)-2005
	Applicable Standard		Applicable Standard
	IS: 5831-1984 and its amendment	Specification for PVC insulation and Sheath of Electric Cables.	IEC-60502 (Part-II)-2005 Specification for Polyethylene Outer Sheath
	Both polyethylene and PVC are waterproof, but PVC is more so. Additionally, PVC is much more fire-resistant than polyethylene, because the chlorine atoms it releases during a fire inhibit the process of combustion. PVC in its native form is brittle and hard, so it needs to be softened and made flexible by adding other compounds called plasticizers. Polyethylene's properties depend on the type. LDPE is much softer and more malleable than linear polyethylenes such as high-density polyethylene, or HDPE.		
	There is no scope in our spec to include the following details of Messenger Conductor		
	Nominal dia of compacted Conductor		
	Approx. Mass Kg/KM		
	Breaking Load (KN)		
	There is no scope in our spec to include Designation and Parameters of finished Cables		
	Following Type Tests of Outer sheath (Test conducted as per IEC-60502(Part-II)-2005) are not included in our Spec		
	i) Carbon Black Content		
	ii) UV Stability as per ASTM G-53/DIN:53387		