

**WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY
LIMITED**
(A Govt. of West Bengal Enterprise)

**TECHNICAL SPECIFICATION FOR
XLPE ARMoured ALUMINUM 3 CORE CABLE SUITABLE
FOR**

NON-EFFECTIVELY EARTHED 33 KV SYSTEM

MAY'2026

TECHNICAL SPECIFICATION FOR XLPE CABLE SUITABLE FOR USE IN NON-EFFECTIVELY EARTHED 33 KV SYSTEM

1. SCOPE :

- 1.1 The specification covers the design, manufacture, testing, supply and delivery in proper packed condition of different grades of 1 or 3 core, Aluminum Conductor, Cross-linked polyethylene (XLPE) insulated, PVC sheathed, Armoured, screened Power Cables.

2. DEVIATION :

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the 'Deviation Schedule' with reasons duly supported by documentary evidences and advantages of such deviation. Such deviation suggested may or may not be accepted. But deviations not mentioned in 'Deviation Schedule' will not be considered afterwards.

3. LOCATION :

- 3.1 The Cables may be laid buried directly in ground at a depth of one meter in average, anywhere in West Bengal and terminated for outdoor connection to a power transformer or to overhead lines.
- 3.2 The Cables may also be laid within covered cable trenches, in cable racks or open air ladder trays etc. for certain portions of lengths.

4.0 SYSTEM DETAILS :

- 4.1 Voltage grade (KV) of cable required :: 19/33
- 4.2 Service Voltage :: 33 KV
- 4.3 Highest Voltage :: 36 KV
- 4.4 Earthing System :: Delta connected system earthed through Earthing transformer
- 4.5 B.I.L. For Cable :: 170 KV for 33 KV Grade
- 4.6 Fault Level (Maxm.) :: See Clause 7.06
- 4.7 Frequency :: 50 C./S

5.0 WEATHER CONDITION :

- 5.1 Monsoon prevails generally from the month of June to October with showers sometimes heavy, acidic, smoky, industrial and foggy.
- 5.2 Maximum ambient temperature :: 50 degree C.
- 5.3 Minimum ambient temperature :: 4 degree C
- 5.4 Thermal resistance of soil :: 150 degree C-Cm/Watt
- 5.5 Maximum Daily average ambient temp :: 40 degree C
- 5.6 Maximum relatively humidity :: 100.00%
- 5.7 Average rainfall per annum :: 200 cm

5.1 Monsoon prevails generally from the month of June to October with showers sometimes heavy, acidic, smoky, industrial and foggy.

5.8 Maximum height above the Sea level :: 1000 Meters

6.0 STANDARDS:

6.1 The Cable shall conform to the following standards to the extent of WBSEDCL's requirement is fulfilled.

- 1) IS: 7098 (Part-II) : Specification for cross-linked polyethylene Insulated PVC (2011) and its latest amendment Sheathed Cables for working Voltages from 3.3 KV up to and including 33 KV
- 2) IS:8130-1984 : Specification for Conductors for insulated electric cables and flexible cords
- 3) IS:5831-1984 : PVC insulation & sheath of electric cables
- 4) IS: 3975-1970 : Armour for cables (for 3 Core)
- 5) IS:10810-1984 : Methods of test for Cables.
- 6) IS:10418-1982 : Cable Drums for Electric Cables.

6.2 The cable, joints, outdoor termination and their accessories and fittings may conform to other Indian and/or equivalent Standards or important publications to improve upon their performance, but shall not fall short of the requirement of this specification. The tenderer shall clearly indicate such standards in their offers.

7.0 ELECTRICAL CHARACTERISTICS & PERFORMANCE:

7.01 Description of Cables:

a) 19/33 KV Grade:

Stranded compacted circular Aluminum (H4 Grade) Conductor, shielded with black extruded semi-conducting compound XLPE insulated, core shielded with black extruded semi-conducting compound, black semi-conducting tape and a copper tape, coloured strips having Red, Yellow & Blue for core identification, shielded cores laid up with fillers, binder taped and **Black extruded PVC (Type ST-2) inner sheath**, single layer of galvanized flat steel strip armoured and **Green extruded PVC (Type ST-2), overall sheathed**, conforming generally to IS:7098(Part-II) and its latest amendments.

7.02 Voltage Grade: 19/33KV (For 33 KV System)

7.03 Size of Cable : 95 sq. mm.
185 sq.mm.
240 sq.mm.
300 sq.mm.
400 sq.mm.
500 sq.mm.

7.04 Service Voltage : 33 KV

7.05 Maxm. Conductor temp. : 90 degree C at maxm. continuous current.

7.06	Permissible Maxm. Short Ckt. Current for conductors	33 K.V System
		1) 47.1 KA for 1Sec for 33 KV 500 sq.mm
		2) 37.6 KA for 1Sec for 33 KV 400 sq.mm
		3) 28.2 K.A (1612 MVA) for 1Sec for 33 KV 300 Sq mm
		4) 22.56 K.A (1289 MVA) for 1Sec for 33 KV 240 Sq mm
		5) 17.39 K.A (994 MVA) for 1Sec for 33KV 185 Sq mm
	Permissible Combine Earth fault Current including Copper tapes & Armour for 1Sec (combining 3 cores)	Combined Earth Fault Current Min 9.7KA for 1 sec. without altering of copper tape thickness as per clause no. 7.12. Considering Cu tape width, thickness & overlapping percentage as 50mm (min), 0.06mm (min) & 10% overlap (min.) respectively. Steel Strip Armour of Trapezium cross section with dimensions 4.0, 3.4 & 0.8 (distance between parallel sides) mm and 61 numbers of strip. (Calculation must be enclosed by the bidder)

7.07	Maximum Permissible emergency overload temp. at 25% overload to 100 hrs. per year or 500 hrs. in life of Cable	:	130° C.
7.08	Maxm. Permissible short circuit Temperature	:	250° C
7.09	Conductor Material	:	Material to IS: 8130, H4 Grade Aluminium Conductor, stranded compacted circular
7.10	Conductor screening	:	Extruded, cross linked, semi-conducting compound of 1.0 mm.(minimum) thickness for 33 KV .
7.11	Insulation	:	XLPE of thickness, 8.8 mm. (Nominal) for 33 KV
7.12	Insulation Screening : For 33 KV	::	Combination of black extruded bonded type semi-conducting compound 0.5mm (Minimum) & semi-conducting tape as the non-metallic part and are easily removable during jointing & termination operations. Annealed copper 50 X0.06 mm (minimum) thick tape (with 100% coverage) lapping as metallic part (Minimum 10% Overlapping).
7.13	Inner Sheathing	:	Black extruded PVC Type ST-2 compound for 33 KV and thickness shall be as per relevant IS.
7.14	Armouring	:	Single layer of galvanized flat steel strips for 33 KV (3 Core) as per IS. Armour Coverage Percentage for cables shall be minimum 90% as per IS: 7098: (Part-2) 2011 with Amendment no. 1 March 2015.
7.15	Overall Sheathing	:	Coloured PVC Type ST-2 compound to IS:5831, extruded for 33 KV (green). Thickness shall be as per ISS.

7.16	Approx length of Cable in a Drum & tolerance in quantity.	:	250 meters with a tolerance of $\pm 5\%$ per drum for 3-Core. However the tolerance shall be restricted upto $\pm 2\%$ on the quantity mentioned per lot in the delivery schedule of purchase order except the last lot. But overall tolerance limit of the total delivered quantity shall be minus (-) 1% against item wise purchase ordered quantity for each Purchase Order and the same shall be taken care of while offering last lot of inspection.
7.17	End Sealing	:	H.S. Caps (See Clause 8.11) (Heat Shrinkable)
7.18 a)	Max. tan-delta at room temp., at nominal Phase to Neutral Voltage (U_0)	:	0.004
b)	Maxm. Increment of tan-delta between 0.5 U_0 to 2 U_0 at room temp	:	0.002
7.19	Partial Discharge Value	:	10 pC (Max ^m .) at 1.73 U_0 for Routine/Acceptance Test and 5 pC (Max ^m .) for Type Test as per IS: 7098(II)/2011.
7.20	Impulse Tests	:	170 KV for 33 KV as per IS: 7098 (Part-II)/ 2011.
7.21	H.V. Tests between Conductors & Screen/Armour	:	63 KV (rms) for 33 KV for 5 minutes as per IS7098 (Part-II): 2011.
7.22	Maximum D.C Resistance per KM	:	As per relevant I.S.S

8.0 **CABLE CONSTRUCTION:**

8.1. XLPE Underground Cable is to be manufactured in continuous vulcanization process at controlled elevated temperature and pressure in inert atmosphere with use of suitable materials for Conductor screening, XLPE main insulation and insulation screening. The Conductor screen, main XLPE insulation and insulation screen are to be simultaneously extruded during the Tripple Extrusion Process of manufacturing and Cured in Dry Nitrogen atmosphere and to be cooled through CCV line. The XLPE Cable in this specification does not have any metal sheath and the short circuit rating of the cable will depend on the conductivity and continuity of the strands of the armour wires which shall be ensured by guarding against corrosion.

8.2. **CONDUCTOR SCREEING:**

A semi-conducting cross-linked polyethylene (XLPE) screening shall be extruded over the conductor to act as an electrical shield which together with the elimination of the so called "Skin Effect" prevents to a great extent air ionization on the surface of the conductor.

8.3. **INSULATION:**

The main insulation of the Cable shall be extruded unfilled, chemically cross-linked polyethylene (XLPE) inert gas cured satisfying the requirement of IS: 7098(Part-II).

8.4. **INSULATING SCREEN:**

The screen shall be made up as given in 7.12. The metal screen eliminates tangential stress of rotating electrostatic field surrounding the conductor and uniform electrical stress in the insulation.

The semi-conducting polyethylene (XLPE) screen shall be extruded over the main polyethylene insulating wall to prevent partial discharge at the surface of the insulation. The copper tape shall be wrapped over the semi conducting tape or extrusion as mentioned earlier for 3 core cables. The metal screen so formed around the cores shall be in contact with one another as the cores are laid up at triangular configuration. For single core cable, Aluminium wire armouring shall constitute the metallic part of insulation screen. Conductor screening, insulation and insulation screening shall be extruded in triple extrusion processes so as to obtain continuously smooth interfaces.

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33KV XLPE insulated 3Core Aluminium Cable for WBSEDCL

- i) The partial discharge level at the surface of the insulation is brought to a minimum.
- ii) There will be no displacement of the semi conducting screen and insulation during expansion and contraction due to load cycles and bending.
- iii) The semi conducting screens are easily removable during jointing and termination operations.

The screened cores shall be laid up with interstices filled with PVC fillers and taped with a binder tape as to obtain a reasonably circular cable.

- e) Nominal section and number of cores.
- f) Month & Year of manufacture.
- g) Inscription for length of cables at 1.0 meter interval on outer sheath by printing/ engraving.
- h) Name of the purchaser : WBSEDCL
- i) Marking "Electric".

8.11. SEALING OF CABLE ENDS :

The cable ends of cable in the wooden/ steel drum for delivery shall be sealed with heat shrinkable caps.

9.0 DRUMS:

The Cable shall be packed in non-returnable wooden. Non-returnable Steel Drum may also be accepted in place of non-returnable Wooden Drum without implication of additional cost,

9.1 The following information shall be marked on each drum.

- a) **Drum identification No.**
- b) **Manufacturer's Name, Trade Name/Trade Mark, if any.**
- c) IS reference i.e 7098 (part-II)/2011
- d) Nominal sectional area of the conductor of the cable.
- e) No. of Cores.
- f) Type of Cable and Voltage Grade with Cable Code.
- g) Colour of outer sheath
- h) Length of the Cable in Cable Drum.
- i) Direction of rotation of Drum (by means of an arrow)
- j) Approximate Weight : Tare : Gross
- k) Month & Year of Manufacture.
- l) Purchase Order No. & date
- m) Month of Delivery
- n) Name of the Purchaser : WBSEDCL

Drums shall be proofed against attack by white ants or termite conforming to IS : 10418. The Drums may also be marked with ISI Certificate Mark, if applicable.

9.2 **Safe Pulling Force:** 30 N/mm^2 (approx. 3 kg/mm^2) for cable pulled by gripping the cable directly with pulling eye on Aluminium area and for cable pulled with stocking should be $P=9D^2$ where P= Pulling force in Newton, D= Outer Diameter of Cable in MM.

10.0 Tests to be performed as per IS: 7098 (Part-II)/2011 & IS:8130/1984 and its amendments.

10.1A Type Test: All the tests mentioned below are to be made as per details given in IS:10810. The party shall submit Type Test report from **CPRI or ERDA or Any NABL accredited third party LAB** as per IS:7098/II/2011 and its latest amendment and other relevant IS/ IEC for each offered item of identical type, voltage grade, size, material and design, carried out **within 5 years** from the due date of opening of tender. Type Test Certificate should bear NABL Logo. Accreditation of NABL LAB should be displayed in the official website of NABL.

- a) Tests on conductor
 - i) Tensile Test (for aluminium)(not applicable for compacted conductor as per IS:8130-1984)
 - ii) Wrapping Test (for aluminium) (not applicable for compacted conductor as per IS:8130-1984)
 - iii) Resistance Test.
- b) Tests for armouring Wires strips.
- c) Test for thickness of insulation and sheath
- d) Physical test for insulation.

- 10.1B The following tests on screened cable shall be performed successively on the same test sample of completed cable, not less than 10m. in length between the test accessories.

- 10.2 **Acceptance Test:** The following shall constitute Acceptance Tests:

- a) Tensile test (for aluminium)
- b) Wrapping test (for aluminium)
- c) Conductor resistance test.
- d) Test for thickness of insulation (eccentricity) and sheath.
- e) Hot set test for insulation.
- f) Tensile strength and elongation at break test for insulation and outer sheath.
- g) P.D.test (for screened cables) only on full drum length.
- h) High Voltage test **(4 hours Test as per IS 7098 (Part 2):2011 Section 20.7.1 with latest amendment no. 2 April 2022 & 5 min test on all samples as per Section 20.7.2 of the said IS.)**
- i) Insulation resistance (VOLUME RESISTIVITY) TEST
- j) Flammability test
- k) Visual marking and length checking in 01 (one) drum of offered lot

10.3 ROUTINE TESTS:

10.3 ROUTINE TESTS:

The routine test shall be carried out on all cables manufactured in accordance with this specification.

The following routine tests shall be made on cable length as specified in the ISS.

- Conductor resistance test.
- Partial discharge test on full drum length.
- High voltage test as per para 7.21

10.4 **TEST WITNESS:**

1. All Tests shall be performed in presence of Purchaser's representative if so desired by the Purchaser.
2. The contractor, shall give at least fifteen (15) days advance notice for witnessing such tests.

11. TEST CERTIFICATE:

- 11.1 Certified copies of all routine tests carried out at Works shall be furnished in Six (6) copies for approval of the purchaser.
- 11.2 The cables shall be dispatched from Works only after receipt of Purchaser's written approval of shop test reports.
- 11.3 Type Test Certificates of the Cable offered shall be furnished. Otherwise the cable shall have to be type tested on similar rating as per Clause – 10 free of any charges to prove the design.

12. **DESCRIPTIVE LITERATURES, TEST RESULTS ETC.:**

The following details for the cable shall be submitted with bid.

- a) Manufacturer's Catalogue giving cable construction details and characteristics.
- b) Manufacturing process in detail for cables highlighting the steps to control.
 - i) Contamination.
 - ii) Formation of water trees.
 - iii) Effects of byproducts of cross-linking.
 - iv) Stress control etc.
- c) Cross section drawing of the cable.
- d) Cable current ratings for different types of installation inclusive of all derating factors due to ambient temperature, grouping etc.
- e) Over-Load characteristics of the cable without endangering the normal life and electrical quality of the insulation.
- f) Complete technical data of the cables.
- g) List of Customers to whom the Cable of similar rating have been supplied.
- h) Copy of Type Test Report carried out within last 5 years from the due date of opening of Tender on similar type of Cable in a NABL accredited/Govt. approved Test House or Laboratory is to be submitted along with the tender otherwise tender may be rejected.

Type Test (after placement of order) : Besides submission of Type Test Report carried out within last 5 years as per tender specification, type test at the discretion of the ordering authority shall have to be arranged by the successful contractor from any lot offered for inspection sample chosen at random after successful routine test by our inspection team as per relevant ISS from CPRI/NABL accredited Third Party Lab./Govt. recognized Test House or Laboratory in presence of WBSEDCL's representative.

However the necessary cost of the type test charges will be reimbursed to the party on production of necessary supporting documents.

Valid Calibration Certificate of Instruments/equipment used for Testing purpose conducted by NABL accredited Laboratory provided the certificate bears an accreditation body logo. For testing equipment where NABL accreditation is not

j) Documents to be submitted at the time of physical delivery at consignee stores :
The following documents are to be submitted by the venders to the consignee stores at the time of dispatch to stores by the venders :

- a) Copy of Purchase Order
- b) Copy of dispatch instruction
- c) Inspection Test certificate
- d) Guarantee certificate
- e) Proforma Invoice
- f) Calculation Sheet for price variation on the basis of IEEMA as applicable with base date of order
- g) Seal list and packing list
- h) Challan in triplicate
- i) e-Way Bill, if applicable

[Handwritten signatures and dates]

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR
33 KV ARMoured ALUMINIUM XLPE CABLES
(To be filled in by the Supplier)**

1	NAME OF MANUFACTURER	:	
	FACTORY ADDRESS	:	
2	Voltage Grade.	:	19/ 33 KV (for 33 KV sys.)
3	Core & Cross Section No x sq. mm.	:	
4	Type & Designation (as per ISS)	:	A2XFY
5	List of Standards applicable with latest amendment	:	IS: 7098(PT-2) 2011, IS: 8130 -1984, IS:5831 - 1984, IS:3975 - 1999, IS: 10810 - 1984 & IS: 10418 - 1982 and all the said IS with latest amendment
6	System suitable for	:	
a	Service Voltage	:	33KV
b	Neutral Earthing	:	Non-Effectively Earthed System
7	Maximum. Conductor temperature	:	
a	Continuous (in Deg. C)	:	90 Deg C
b	Short time (in Deg.C)	:	250 Deg C
8	Conductor	:	
a	Material to IS-8130(Class/Grade)	:	H4 Grade Aluminium of Class-2
b	Size (Sq.mm.)	:	400 sqmm
c	Nominal diameter of wires in each. Conductor strand before stranding & compaction (mm.)	:	
d	No. of Strand (Approx)	:	
e	Shape of conductor	:	Stranded Compacted Circular
f	Overall Diameter of Conductor after stranding & compaction (mm)	:	
9	Shielding/screening on Conductor	:	
a	Material	:	Black Semi-conducting compound
b	Type	:	Extruded
c	Whether thermosetting?	:	Yes
d	Thickness	:	1.0 mm (Min)
10	Insulation	:	
a	Material	:	XLPE as per IS 7098 PT-II 2011
b	Type	:	Extruded
c	Thickness (mm)	:	8.8mm (nominal)
11	Shielding / screening on insulation	:	
a	Material for Nonmetallic part	:	Combination of black extruded semi-conducting compound & semi-conducting tape
	i) Type	:	Extruded
	ii) Thickness (mm)	:	0.5 mm(min)
b	Material for Metallic part	:	Copper Tape
	i) Thickness (mm)	:	0.06 mm(min)

	ii) Width (mm)		50 mm (min)
	iii) Percentage of overlap with coverage		Min. 10% overlap with 100% coverage
c	Fillers and Binder tape		Shielded cores laid up with fillers and nylon thread use as binder tape.
12	Inner - sheath	:	
a	Material	:	Extruded PVC (Black Colour) as per IS:5831/84
b	Type	:	ST2
c	Minimum Thickness of sheath (mm)	:	0.7
d	Extruded/Wrapped	:	Extruded
e	Approx. outside diameter over inner sheath(mm)	:	
13	Armouring	:	
a	Material	:	Galvanised Steel Strip
b	Size	:	(4 mm x 0.8 mm thickness) $\pm 10\%$
c	D.C. resistance at 20 deg.C (Ohm/Km.)	:	
d	Armour Coverage Percentage	:	90%(Min)
14	Overall Sheath	:	
a	Material	:	Extruded PVC (Green Colour) as per IS:5831/84
b	Type	:	ST-2
c	Thickness (mm.)	:	
d	Colour of Sheath	:	Green
15	Approx. overall diameter of the Cable (mm.)	:	
16	Continuous current rating for standard condition, laid direct	:	
a	In ground at temp 30 deg.C	:	
b	In duct at temp 30 deg.C	:	
c	In air at temp 40 deg.C	:	
17	Charging current attracted system voltage A/KM	:	
18	Short Circuit Current in KA (Maxm.)	:	
a	for 1 sec	:	37.6KA
b	for 0.5 sec	:	
19	Combine Earth Fault Current for Screen and Armour in KA for 1 sec	:	9.7KA
20	Electrical Parameters	:	
a	Maxm. D.C. resistance of conductor at 20 deg.C (Ohm/Km)	:	0.0778
b	AC resistance of conductor at 90 deg.C(approx.) (Ohm/Km)	:	
c	Reactance (approx.) (Ohm/Km)	:	
d	Capacitance (approx.) (um/Km)	:	
e	Di-electric losses at rated (Uo/U) system KV, 50 cycles/sec in Watts/KV/Phase)	:	
f	i) tan-delta at 0.5 Uo	:	Tan-delta at Uo shall not exceed 0.004 and increment between 0.5 Uo and 2 Uo shall not be more than 0.002 as per relevant ISS
	ii) tan-Delta at Uo	:	
	iii) tan-Delta at 1.5 Uo	:	
	iv) tan-Delta at 2 Uo	:	
g	Partial discharge value	:	10 PC (max) at test voltage 1.73 Uo for Routine

21	Vol. Resistivity at 27 deg.C(ohm-Cm)	:	Test/Acceptance test & 5pc for Type Test.
22	Recommended minimum bending radius	:	1X10 ¹⁴
23	Derating factor for following ambient temperature in Air/Ground	:	15 x Over all dia. of cable
a	at30 deg. C	:	
b	at35 deg. C	:	
c	at45 deg. C	:	
d	at 50 deg.C	:	
24	Cable Drums	:	
a	Standard Length of Cable/Drum (Mtrs)	:	
b	Net weight of cable/Drum (kg)	:	250±5%
c	Dimension of Drum	:	
d	Shipping weight (Kg) /drum	:	Generally, as per IS: 10418-1982
25	Overall tolerance in total quantity	:	
26	Safe pulling force (Kg.)	:	-1%
27	Details of the protective measures against attack by white ante varmints etc. to the PVC outer sheath during manufacture	:	30 N/sqmm of conductor
28	Type of curing of XLPE insulations	:	Inert Gas (Nitrogen) curing through CCV Line
29	Cut ends of the Cable shall be sealed	:	Heat shrinkable and caps
30	Cable identification & sequential length marking	:	Cable identification by Embossing The following shall be embossed on the outer sheath of the cable throughout the length of cable at 1.0 meter spacing for identification: a) Manufacturer's Name or Trade Mark. b) Type of Cable / Cable Code c) Voltage Grade. d) Type of insulation & Material of conductor (XLPE, Armoured, PVC Aluminium Cable) e) Nominal x-section & and number of cores. f) Month & Year of manufacture. g) Inscription for length of cables at 1.0-meter interval on outer sheath by printing/engraving. h) Name of the purchaser: WBSEDCL i) Marking "Electric"
31	Marking on each drum	:	a) Drum identification No. b) Manufacturer's Name, Trade Name/Trade Mark, if any. c) IS reference i.e 7098 (part-II)/2011 d) Nominal sectional area of the conductor of the cable. e) No. of Cores. f) Type of Cable and Voltage Grade with Cable Code. g) Colour of outer sheath h) Length of the Cable in Cable Drum. i) Direction of rotation of Drum (by means of an arrow) j) Approximate Weight : Tare : Gross k) Month & Year of Manufacture. l) Purchase Order No. & date m) Month of Delivery n) Name of the Purchaser : WBSEDCL

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