

TECHNICAL SPECIFICATION OF 3 X 70 SQ. MM 11KV XLPE CABLE

1.0 SCOPE

This specification covers design manufacture, inspection, testing and supply to destinations at MVVNL/ PuVVNL/ PVVNL/ DVVNL/KESCO Under UPPCL of 11 KV 3 x 70 Sq. mm. XLPE cable for use with effectively earthed distribution system of U. P.

2.0 SYSTEM DETAILS

Voltage grade (KV) of cable required	:	6.35/11
Service Voltage	:	11 KV
Highest Voltage	:	12 KV
Earthing System	:	Solidly Earthed
B.I.L. for Cable	:	75 KV for 11 KV Grade
Frequency	:	50 C/S

3.0 11KV XLPE POWER CABLE

The material shall conform in all respect to the relevant Indian Standard Specification with latest amendments thereto.

Indian Standard No.	Title	Internationally
IS-7098 Part-II/1985	Specification for Cross Linked Polyethylene insulated PVC Sheathed cables for working voltages from 3.3 kV up to and including 33 kV.	IEC: 502 (1983)
IS-5831/1984	PVC insulation and sheath of electric cables.	IEC: 502 (1983)
IS- 8130/1984	Specification for Conductor for insulated electric Cables and Flexible cords.	IEC: 228 (1978)
IS- 10418/1982	Specification for cable drum.	
IS-3975/1970	Armour for cables	
IS-10810/1984	Method of test for cables	
IS -3961	Recommended current rating for cables	

The cable shall be 11KV Grade high conductivity stranded compacted circular aluminum conductor 3 core. XLPE insulated, extruded inner PVC sheathed, galvanized steel strip armored with overall separate extruded PVC outer sheath conforming generally to IS : 7098 (Part-II) 1985 and amendment there of suitable for 11KV 3 phase 50 Hz earthed system.

3.1 Two distinct sheaths i.e. inner and outer shall be provided. Outer sheathing shall be designed to afford high degree of Technical protection and shall also be heat, oil, chemicals and weather resistant. Common acids, alkali's and saline solutions shall not have adverse effect on the material used for PVC outer sheathing.

3.2 The cable should be suitable for laying in covered trenches and / or buried direct underground.

4.0 CONDUCTOR

The conductor shall be made from stranded aluminum to form compact circular conductor having resistance within limits as specified in table-2 of IS : 8130/1984 and any amendment thereof.

Minimum guaranteed weight of Aluminium used in the cable shall be 569.00 Kg/KM.

5.0 CONDUCTOR SHIELD

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 “Strand Effect” prevents to a great extent air ionization on the surface of the conductor.

6.0 INSULATION

The XLPE insulation shall be suitable for specified 11KV 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 shall give very smooth interface between semi-conducting screen and insulation. The insulation of the cables shall be of high standard quality and conform to Clause 11 to IS : 7098 (Part-II) 1985 or latest amendment thereof.

7.0 INSULATION SHEILD

To confine electrical field to the insulation, insulation screening consisting of two parts, namely metallic (non magnetic) and non metallic (semi conducting) shall be provided. The non-metallic semi conducting shield shall be put over the insulation of each core. The insulation shield shall be extruded in the same operation as the conductor shield and insulation by triple extrusion process. The insulation shield shall be bonded and strippable on adequate heat treatment. Metallic shield shall be provided over non-metallic portion as per provision of clause 12.4 of IS : 7098 (part-II) 1985 and amendment thereof.

8.0 INNER SHEATH

The sheath shall be suitable to withstand the operating conditions and the desired temperature rating of the cable. It shall be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded PVC (ST-2) type. The binding tape used over the laid up cores shall not be construed as part of the inner sheath. The inner sheath shall conform to the provisions of IS : 7098 (Part-II)/1985 or latest amendment thereof.

9.0 ARMOUR

Galvanized steel strip armoring shall be provided. The dimensions of steel strip shall be as per table 4 of IS : 7098 (Part-II) 1985 and its latest amendment and strip shall conform to latest provisions of IS : 3975 : 1988 and amendment thereof.

10.0 OUTER SHEATH

Extruded PVC outer sheath of Yellow colour types ST-2 as per IS : 5831/1984 and its latest amendment shall be applied over armoring with suitable additives to prevent attack by rodent and termites and its thickness shall be in accordance with Clause 17.32 of IS : 7098 (Part-II) 1985 and latest amendment thereof.

11.0 CONSTRUCTION

11.1 The cable shall have suitable PVC fillers laid up with insulated cores to provide substantially circular cross section before the inner sheath is applied. The fillers shall be suitable for operating temperature of the cable and compatible with the insulating material.

11.2 All materials used in the manufacture of cable shall be new unused and of finest quality. All materials shall comply with the applicable provisions of the tests of the specification. IS. Indian Electricity Rules Indian Elect. Act and any other applicable statutory provisions rules and regulations.

11.3 The PVC material used in the manufacture of cable shall be of reputed make. No recycling of the PVC is permitted. The purchaser reserves the right to ask for documentary proof of the purchases of various materials to be used for the manufacture of cable and to check that the manufacturer is complying with quality control.

12.0 WORKMANSHIP AND QUALITY ASSURANCE

The workmanship shall be neat, clean and of highest grade/quality.

13.0 CURRENT RATING

13.1 The cable will have current rating and de-rating factors as per relevant Indian Standards.

13.2 The one-second short circuit current rating shall be 6.60 KA.

13.3 The current rating shall be based on maximum conductor temperature of 90⁰C with ambient site conditions specified in General Requirement of Specification for continuous operation at the rated current.

14.0 OPERATION

14.1 Cable shall be suitable for laying in ducts and direct in ground

14.2 Cables shall have heat and moisture resistant properties. These shall be of type and design with proven record of distribution network service.

15.0 LENGTHS

The cables shall be supplied in standard drum lengths i.e. 500 \pm 5% Meters. Non-standard length of not less than 100 meters is acceptable. Total Non-standard length should not exceed 5% of the ordered quantity.

16.0 PACKING

The cable shall be supplied on non-returnable wooden drums of heavy standard construction conforming to IS : 10418 : 1982 and latest amendment thereof and being suitable for transport by goods train or truck and for storage at site. The wood used for construction of the drums shall be properly seasoned and wood preservative shall be applied to the entire drum.

All ferrous parts shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage. Each drum shall have the following information marked on it with indelible ink along with other important information including technical data.

- (i) PuVVNL, Speci. No. EAV-
- (ii) Consignee & Destination Railway Station.
- (iii) Trade name or trademark, if any.
- (iv) Name of the manufacturer.
- (v) Nominal sectional area of the conductor of the cable.
- (vi) Drum no.
- (vii) No. of cores
- (viii) Type of cable & voltage for which it is suitable.
- (ix) Gross weight of the drum (approx.)
- (x) Length of cable in the drum with individual lengths if more than one.
- (xi) Net weight of the cable.
- (xii) ISI certification mark, if available.

A layer of waterproof paper shall be applied to the surface of the drum and over the outer cable layer. A clear space of at least 40 mm. shall be left between the cable and the laggings. The packing shall be adequate to protect the cable from damage in transit and contractor shall be responsible for it and make good at his own expenses any and all damages due to improper packing etc.

17.0 IDENTIFICATION MARKING

For the identification of individual cores, colored strips of red, yellow and blue colors shall be used to identify phase conductors.

The manufacturer shall emboss following information on outer sheath of cable at the interval of one meter length throughout the length of the cable.

- (i) Property of MVVNL/ PuVVNL/ PVVNL/ DVVNL/ KESCO
- (ii) Name of manufacturer
- (iii) Year of Manufacture
- (iv) Specification No.
- (v) Voltage grade and size of cores.

18.0 TEST CERTIFICATE

As per Clause No. 1.2.4. of Instruction to tenderers

19.0 TEST TO BE PERFORMED AS PER IS: 7098 (PART-II)/IS:8130/1984 AND ITS AMENDMENT

19.A Type Test:

All the tests mentioned below are to be made as per details given in IS: 10810

A. Tests on conductor

- (i) Tensile Test (for Aluminium)
- (ii) Wrapping Test (for Aluminium)
- (iii) Resistance Test.

B. Tests for armouring Wires strips.

C. Test for thickness of insulation (eccentricity) and sheath

D. Physical test for insulation.

- (i) Tensile strength and elongation at break.
- (ii) Ageing in air oven.
- (iii) Hot test.
- (iv) Shrinkage test
- (v) Water absorption (Gravimetric)

E. Physical tests for outer sheath

- (i) Tensile strength and elongation at break.
- (ii) Ageing in air oven.
- (iii) Shrinkage test.
- (iv) Hot deformation.
- (v) Heat shock.
- (vi) Loss of mass in air oven.
- (vii) Thermal stability.

F. Partial discharge test.

G. Bending test.

H. Dielectric power factor test.

- (i) As a function voltage.
- (ii) As a function of temperature.

I. Insulation resistance (Volume resistivity) Test.

J. Heating cycle test.

K. Impulse with stand test.

L. High voltage test.

M. Flammability test.

N. Test on extruded semi conducting screen : volume resistivity

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.

- a) P.D. Test.
 - b) Bending Test followed by P.D. Test.
 - c) Dielectric power factor as a function of voltage.
 - d) Dielectric power factor as a function of temperature.
 - e) Heating cycle test followed by dielectric power factor as a function of voltage and P.D. tests.
 - f) Impulse withstand test and
 - g) High voltage test
- If a sample fails in test (g) one more sample shall be taken for this test, preceded by tests (b) & (e).

19.B 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 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, and
- i) Insulation resistance (VOLUME RESISTIVITY) TEST
- j) Test for cross linking extruded semiconducting screen.

19.C 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.

- a) Conductor resistance test.
- b) Partial discharge test on full drum length.
- c) High voltage test

20.0 CHARECTERISTIC OF CABLE
Guaranteed Technical For 11 KV, XLPE cable Various Sizes

Sl. No.	PARTICULARS	Size Unit	11kV 3x70 sq mm	11kV 3x120 sq mm	11kV 3x185sq mm	11kV 3x300sq mm
1	Manufacturer's name and address.					
2	Location of factory.					
3	Standard to which cable conform.		IS:7098 (Part-II) with up to date amendment	IS:7098 (Part-II) with up to date amendment	IS:7098 (Part-II) with up to date amendment	IS:7098 (Part-II) with up to date amendment
4	CONDUCTOR DETAILS					
a)	Material compositions class as per IS: 8130		H2 grade Alu. As per IS 8130/1984	H2 grade Alu. As per IS 8130/1984	H2 grade Alu. As per IS 8130/1984	H2 grade Alu. As per IS 8130/1984
b)	Shape of stranded conductor.		Stranded compacted Circular	Stranded compacted Circular	Stranded compacted Circular	Stranded compacted Circular

c)	Number of strands in each core (Min.)	No.	12	15	30	30
d)	Diameter of each strand.	mm.	Dia of wires shall be suitable select to meet DC resistance of cond. As per class -2 requirements of IS 8130/1984	Dia of wires shall be suitable select to meet DC resistance of cond. As per class -2 requirements of IS 8130/1984	Dia of wires shall be suitable select to meet DC resistance of cond. As per class -2 requirements of IS 8130/1984	Dia of wires shall be suitable select to meet DC resistance of cond. As per class -2 requirements of IS 8130/1984
e)	Nominal cross section area of each core	Sq.mm	70	120	185	300
f)	Guaranteed weight of Alum. per Km. (Min.)	Kg/Km	569	975	1504	2439
5	CONDUCTOR SCREENING					
a)	Material		Semiconducting Compound by extrusion	Semiconducting Compound by extrusion	Semiconducting Compound by extrusion	Semiconducting Compound by extrusion
b)	Thickness (Min.)	mm.	0.3	0.3	0.3	0.3
c)	Continuos working temperature	oC	90°C	90°C	90°C	90°C
6	INSULATION					
a)	Material with ref. of ISS		XLPE confirming to IS : 7098 PT-2/2011	XLPE confirming to IS : 7098 PT-2/2011	XLPE confirming to IS : 7098 PT-2/2011	XLPE confirming to IS : 7098 PT-2/2011
b)	Thickness of insulation (Min.)	mm.	3.14	3.14	3.14	3.14
c)	Thickness of Insulation (Nom)	mm	3.6	3.6	3.6	3.6
d)	Tensile strenth before ageing (MIN)	N/MM 2	12.5	12.5	12.5	12.5
e)	Elongation at break	PERCENT	200	200	200	200
7	INSULATION SCREENING					
a)	Material					
	(i) Semi conducting part		Extruded semiconducting compound As per IS : 7098 (Pt-II) 2011	Extruded semiconducting compound As per IS : 7098 (Pt-II) 2011	Extruded semiconducting compound As per IS : 7098 (Pt-II) 2011	Extruded semiconducting compound As per IS : 7098 (Pt-II) 2011
	(ii) Metallic part		Copper Tape	Copper Tape	Copper Tape	Copper Tape
b)	Thickness for;					
	(i) Semi conducting part min/nom	mm.	0.3 min/0.5 nom	0.3 min/0.5 nom	0.3 min/0.5 nom	0.3 min/0.5 nom
	(ii) Metallic Part (Min.)	mm.	0.035 (min.)	0.035 (min.)	0.04	0.04
8	INNER SHEATH					
a)	Material		PVC Type ST -2	PVC Type ST -2	PVC Type ST -2	PVC Type ST -2
b)	Thickness (Min.)	mm.	0.5	0.6	0.7	0.7
c)	Extruded or wrapped		Extruded ST-2	Extruded ST-2	Extruded ST-2	Extruded ST-2
9	Filler material.		Non Hygroscopic PVC fillers	Non Hygroscopic PVC fillers	Non Hygroscopic PVC fillers	Non Hygroscopic PVC fillers

10	ARMOURING					
a)	Material		Galvanised Steel strips as per IS : 3975	Galvanised Steel strips as per IS : 3975	Galvanised Steel strips as per IS : 3975	Galvanised Steel strips as per IS : 3975
b)	Diamension of flat Armouring strip	mm x mm	4x0.80 (+/-)10%	4x0.80 (+/-)10%	4x0.80 (+/-)10%	4x0.80 (+/-)10%
c)	Wt. of Zinc coating	Kg./Km	As per IS : 3975	As per IS : 3975	As per IS : 3975	As per IS : 3975
11	OUTER SHEATH					
a)	Material		EXTRUDED PVC Type ST-2 of IS : 5831/1984 Yellow	EXTRUDED PVC Type ST-2 of IS : 5831/1984 Yellow	EXTRUDED PVC Type ST-2 of IS : 5831/1984 Yellow	EXTRUDED PVC Type ST-2 of IS : 5831/1984 Yellow
b)	Thickness of sheath (min).	mm.	1.88	2.2	2.36	2.68
c)	Colour of Sheeth		Yellow	Yellow	Yellow	Yellow
d)	Tensile strenth before ageing (Min)	N/mm2	12.5	12.5	12.5	12.5
e)	Elongation at break		150%	150%	150%	150%
12	i) Weight of finished cable (Approx.)	Kg/Km	2900	3900	5000	6800
	ii) Overall outer diameter of cable		48 mm Approx	55 mm Approx	62 mm approx	72 mm approx
13	Standard delivery length	Meter	500mtr	500mtr	500mtr	500
14	Tolerance in stranded drum length of the cable.	%	±5%	±5%	±5%	±5%
15	Gross weight of drum including cable (Approx.)	Kg.	As per manufacturer standard	As per manufacturer standard	As per manufacturer standard	As per manufacturer standard
16	Recommended depth of laying	mm	1050	1050	1050	1050
17	Short circuit current for duration of short circuit of 1 sec.	kA	6.6	11.3	17.4	28.32
18	Voltage drop per 1000 Mtr. length at rated current..					
a)	When laid directly in around.	Volt/ Km	As per specification	As per specification	As per specification	As per specification
b)	When laid directly in covered trenches.	Volt/ Km	As per specification	As per specification	As per specification	As per specification
c)	When laid directly in Air	Volt/ Km	As per specification	As per specification	As per specification	As per specification
19	Impulse voltage withstand	KV	75	75	75	75
20	Continuous current rating for standard IS 3961 & standard condition when laid					
	i) Direct in ground	amp	161	216	273	354
	ii) In ducts	amp	139	188	240	312
	iii) In air	amp	184	256	330	441

21	Derating factors under various conditions of installation:					
a)	D.C. Resistance per core at 20°C (Max.)	Ohm/K m.	0.443	0.253	0.164	0.100
b)	A.C. Resistance per core at 20°C (Max).	Ohm/K m.	0.567	0.325	0.211	0.130
c)	Reactance per core	Ohm/K m.	0.116	0.102	0.097	0.093
d)	Capacitance per core	Microf/ Km.	0.26	0.31	0.380	0.440
e)	Insulation resistance at 27°C (Min).	M. Oh m/Km	more than 1000 mega ohm	more than 1000 mega ohm	more than 1000 mega ohm	more than 1000 mega ohm
f)	Volume resistivity of insulation at 27°C (Min).	Ohm/K m.	MIN 1X10 ¹⁴	MIN 1X10 ¹⁴	MIN 1X10 ¹⁴	MIN 1X10 ¹⁴
g)	Volume resistivity of insulation at 90°C (Min).		MIN 1X10 ¹²	MIN 1X10 ¹²	MIN 1X10 ¹²	MIN 1X10 ¹²
22..	Maximum partial discharge magnitude at 1.73U _o	PC	10	10	10	10
23..	Maximum cable charging current at normal operating voltage.	Amp/K m.	0.498	0.638048	0.76	0.948
24	Recommended minimum bending radius.	mm.	15XD (where D is overall diameter of the cable)	15XD (where D is overall diameter of the cable)	15XD (where D is overall diameter of the cable)	15XD (where D is overall diameter of the cable)
25	Name of manufacturers of bought out raw materials.					
i)	Aluminium		HINDALCO/BALCO/NALCO	HINDALCO/BALCO/NALCO	HINDALCO/BALCO/NALCO	HINDALCO/BALCO/NALCO
ii)	PVC Compound		As per Company Approved List	As per Company Approved List	As per Company Approved List	As per Company Approved List
iii)	XLPE Compound		As per Company Approved List	As per Company Approved List	As per Company Approved List	As per Company Approved List
iv)	Galvanised steel strip for armouring.		As per Company Approved List	As per Company Approved List	As per Company Approved List	As per Company Approved List
v)	Any other.					

21.0 INSPECTIONS & TESTING

21.1 If successful type test and short circuit withstand test for one second have been carried out the cable of same design, size type and manufacturing process during last five years (counted from the date of tender opening) repetition of these tests is not required provided the manufactured material conforms to IS : 7098 (Part-II) 1985 with latest thereof in respect of type and Short Circuit withstand test.

21.2 On the other hand, if the offered design is not type tested during last five year the sample of the cable marked out of the first lot offered for inspection shall be subjected to short Circuit withstand test for one second and all type tests in accordance with IS : 7098 (Part-II) 1985 and amendments thereof in presence of purchaser's representatives at test houses/institutions mentioned in clause 1.7 of General Requirements of Speciation. All charges fee/transportation

etc. to conduct these tests shall be borne by the contractor. Subsequent inspection and regular supply of material shall commence only after successful type testing and Short Circuit withstand testing and dispatch authorization of first lot from competent authority.

21.3 The purchaser reserves the right to get the cable type tested at any stage during the tendency of contract at its own expenses in any reputed test house mentioned in clause 17. The transportation and arrangement of testing of sample to test laboratory shall be responsibility of the contractor.

21.4 Routine and acceptance tests as laid down in IS : 7098 (Part-II) 1985 with latest amendment thereof shall be carried out by the inspecting officers of the MVVNL/ PuVVNL/ PVVNL/ DVVNL/ KESCO on sample selected at random as per relevant ISS.

In addition to above length check on one drum per inspection lot shall also be carried out by the inspecting of officers for which contractor shall make all necessary arrangements and provide all necessary facilities at his own cost.

22.0 VARIATION IN QUANTITY

The supplied quantity can vary from +20% to -50% of the ordered quantity. The cables offered by the contractor shall conform to the requirement of IS : 7098 (Part-II) 1985 with latest amendment thereof and as per technical particulars enclosed herewith. No other technical particulars or deviation from technical particulars and technical specifications shall be accepted. Any deviations may result in the cancellation of order.

Further, these specifications are subject to the instructions in tenderers. General Technical specifications terms & conditions mentioned in General requirement of Specifications and UPPCL from "B". In case of any ambiguity of technical details given elsewhere the conditions given in technical specifications shall prevail.

Note :-

(1) In case of any contradiction in technical specification as mentioned above, the relevant IS or mentioned in tender which ever is better, shall prevail.

(2) In case of any contradiction in terms & conditions mentioned at more than one place, the terms & conditions to the best advantage of PuVVNL, will prevail.
