

TECHNICAL SPECIFICATION FOR 1.1 kV CROSS-LINKED POLYETHYLENE INSULATED (HEAVY DUTY) ARMoured PVC SHEATHED UG CABLE.

1.0 SCOPE:

The scope of this specification covers the design, manufacture, stage inspection at work, inspection and testing of finish cables at manufacturers works, testing at independent test house, packing, transport and delivery to consignee address of 1.1 kV stranded aluminum, XLPE insulated heavy duty armoured and sheathed power cable for working voltages up to and including 1100 volts underground cables as per specified construction.

2.00 TECHNICAL REQUIREMENT:

1.1 kV grade, 90° C rating heavy duty power cable with stranded circular shaped aluminum conductor cross linked polyethylene insulated inner sheathed of extruded PVC, galvanized steel strip (formed wires) armoured and PVC ST-2 overall sheathed.

The cable should be suitable for use in solidly earthed system.

3.00 STANDARDS:

- 3.01 The 1.1 kV UG cable shall, in general meet the requirements of the latest edition of the Bureau of Indian Standards (Generally refereed as IS), IS: 7098 (Part-I) 1988 (Reaffirmed 2005).
- 3.02 The cables and components in general shall meet the requirements of the following standards with **latest up to date amendments** or equivalent international standards.

IS:7098 (Part-I)	1988	:	Specification for cross linked polyethylene insulated PVC sheathed cables.
IS:8130	2013 (RA 2018)	:	Specifications for conductors for insulated Electric Cables.
IS:3975	1988	:	Specification for mild steel wires, strips and tapes for armouring of cables.
IS:10810 (Part 1 to 64)	1984to 2003	:	Specification for test on cables.
IS:5831	1984	:	Specification for PVC insulation and sheath of electric cables.
IS:10418	1982	:	Specification for drums for electric cables.
IS:10462	1983	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: part 1 elastomeric and thermoplastic insulated cable.

- 3.03 The 1.1 kV underground cables shall be manufactured to the highest standard quality, best workmanship with scientific material management and quality control. The bidder shall furnish the quality plan, giving in detail the quality control procedures/management system.
- 3.04 The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.
- 3.05 Cable complying with other internationally accepted standards such as IEC, VDE, IPCEA etc., will also be considered in case they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard/standards adopted and furnish a copy of English version of the latest revision of standard(S) along with a tender and shall clearly bring the salient features for comparison.
- 3.06 In case of any conflict between the referred specification code or standards and this technical specification, the latter shall prevail to the extent of such difference.
- 3.07 1.1kV Grade Power Cables to be supplied under this package shall be ISI approved and marked as such. Non-compliance of above shall not be accepted.
- 3.08 However, if cable to be supplied under this specification are manufactured outside India and conform to other internationally accepted equivalent or superior standards the above clause shall not be applicable.

4.00 DESIGN CRITERIA:

- 4.01 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions described in the technical specification.
- 4.02 Any technical feature, not specifically mentioned here, but is necessary for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under technical deviations schedule only in the offer made by the bidder, giving technical reasons and justifying the need to incorporate these features.
- 4.03 For continuous operation of the cables, at specified rating the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90° C under normal operation and 250° C under short-circuit conditions.
- 4.04 The cables in service will be subject to daily load cycles of two peaks during day, morning peak and evening peak, with reduced loading during the nights.
- 4.05 The materials used for sheaths shall be resistant to oils, acids, alkalies and chemicals.
- 4.06 The cables shall have the mechanical strength required during handling and laying.
- 4.07 The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.

- 4.08 The cables shall be designed to have a minimum useful life span of forty years (40 years).
- 4.09 Core identification: the core identification for cables shall be provided, by suitable means, like, by application of coloured stripes or any numerals or by printing on the cores as per Clause-10 of IS: 7098 Part I/1988.
- 4.10 For identification coloured stripes, red, yellow & blue colours shall be used to identify the phase conductors & black to identify reduced neutral conductor.

5.00 MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:

- 5.01 Cross linking of the insulation material (Pre compounded polyethylene) shall be conforming to IS: 7098 Part-I /1988.
- 5.02 The conductor shall be of extruded semi conducting compound. The insulation screen shall consist of the non-magnetic metallic part. The XLPE insulation and the shields for conductor and insulation shall be extruded in one operation.

6.00 MATERIALS:

- 6.01 Conductor: The conductor shall be of stranded compacted circular or shaped Construction. The material for conductor shall consist of plain aluminium of H2 or H4 grade as per of IS: 8130/2013 with purity of minimum 99.7% and resistivity of $0.028264\Omega/\text{mm}^2$

The No. of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS: 8130/1984.

- 6.02 **INSULATION:** The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS: 7098 Part-I/1988 & BESCOM specifications.
- 6.03 For multicore cables, the interstices at the Centre shall be filled with a non-hygroscopic material. The interstices around the laid-up cores shall be covered with PVC compound type ST 2. This will form the inner sheath for multicores.
- 6.04 **ARMOURING:** The armour shall be galvanized steel strip (formed wires), complying with the requirements of IS: 3975/1988.
- 6.05 **OUTER SHEATH:** The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, conforming to the requirements of Type ST-2 of IS: **5831/1984 (RA 2001)** suitable additives shall be added to give anti termite protection.

7.00 CONSTRUCTION:

- 7.01 The general constructional features of the cables shall be as follows:
- a) Stranded circular shaped Aluminium conductor. Cross linked polyethylene insulation, cross linked shall be conforming to IS: 7098 (Part-I) 1988 with its latest amendment. Extruded PVC inner sheath. Armour (Galvanized steel strip). Outer PVC sheath with anti-termite treatment.

- b) Cables with reduced neutral conductor shall have sizes as given in table-2 of IS: 7098 Part-I/1988.

8.00 CONDUCTOR:

- 8.01** The conductor shall be stranded circular shaped Aluminium wires of H2 or H4 grade plain aluminium wires **as per IS: 8130-2013 with purity of 99.7 % of resistivity $0.028264\Omega/\text{mm}^2$**
- 8.02 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.
- 8.03 Not more than two joints shall be allowed in any one of the single
- 8.04 Forming every complete length of conductor and no joint shall be within 300mm of any other joint in the same layer. The joint shall be made by brazing silver soldering or electric or gas welding.
- 8.05 No joints shall be made in the conductor after it has been stranded.
- 8.06 **INSULATION:** The insulation shall be provided over the conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be confirming of IS:7098-Part I/1988.
- 8.07 **THICKNESS OF INSULATION:** The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 3 of IS: 7098-Part I/1988.
- 8.08 The insulation shall be applied to closely fit on the conductor screen and it shall be possible to remove it without damaging the conductor.

9.00 LAYING UP OF CORES:

- 9.01 For multicore cables, the core shall be laid together with a suitable right hand lay, where necessary the interstices at the centre shall be filled with a non-hygroscopic material.
- 9.02 Inner sheath for Multi core cables:
- 9.03 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST-2 conforming to IS: 5831/1984 or equivalent standard.
- 9.04 The minimum thickness of the inner sheath shall conform to Table 5 of IS: 7098 (Part-I)/1988 or equivalent standard.
- 9.05 The inner sheath shall be so applied that it fits closely on the laid-up cores and it shall be possible to remove it without damage to the insulation.

10.00 ARMOURING: Application

- 10.01 Armouring shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multicore cables.
- 10.02 The armour strip (formed wires) shall be applied as closely as practicable.
- 10.03 The direction of lay of the armour shall be left hand. For double strip armoured cables, this requirement shall apply to the inner layer of strips. The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer and there shall be a separator of suitable non-hygroscopic material.

10.04 **DIMENSIONS:** The dimensions of galvanized steel strip (formed wires) shall conform to table 6 of IS: 7098 (Part-I)/1988. The armour resistivity of 14.5×10^{-6} Ω -cm. (Maximum) as per IS 3975/ 1999 (RA 2004) and tolerances for formed wires shall be $\pm 5\%$ of the nominal dimensions.

10.05 A binder tape may be applied on the armour.

10.06 **JOINTS:** The joints in armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any strip shall be at least 300 mm from the nearest joint in any other armour strip in the completed cable.

11.00 OUTER SHEATH:

11.01 The PVC outer sheath with anti-termite treatment shall be extruded over the armouring for multi core cables and single core cables.

11.02 The colour of the outer sheath shall be black.

11.03 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 8 of IS: 7098 (Part-I) 1988.

11.04 The outer sheath shall withstood the thermal stability for a period not less than **80 minutes**.

12.00 IDENTIFICATION:

12.01 The outer sheath shall have the following information embossed or indented on it, the manufacturer's name or trademark, the voltage grade, the year of manufacture and the letters —BESCOM. The identification shall repeat every 300/350 mm along the length of the cable.

13.00 CABLE DRUMS:

13.01 Cables shall be supplied in Non-returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound and free from defects, wood preservative shall be applied to the entire drum.

13.02 Standard length of each size of power cable to be supplied by the bidder shall be 500/1000 **meters**. The cable length per drum shall be 500/1000 meters. The cable length power drum shall be subjected to a tolerance of $\pm 5\%$ of the standard drum's lengths. Acceptance of smaller lengths of cables are subjected to approval of purchaser. Smaller lengths of less than 100 **metres** will not **be** accepted.

13.03 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.

13.04 A clear space of at least 40 mm shall be left between the cables and logging.

13.05 The cable drum shall carry KST marking with the following information stenciled on both sides of the drum. A tag containing the same information shall also be attached to the leading end of the cable.

- a. Reference to the Indian Standards.
- b. Manufacturer's Name, Brand Name or Trade Name.
- c. Purchase's name, contract No. and date.
- d. Type of cable and voltage grade.
- e. Number of cores.
- f. Nominal cross section area of the conductor.

- g. Cable code.
- h. Length of the cable on the drum.
- i. Number of lengths on drum.
- j. Direction of rotation of drum (by means of an arrow).
- k. Net and gross weight.
- l. Country of manufacture.
- m. Year of manufacture.

13.06 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 cables ends shall be sealed with good quality heat shrinkable caps so as to eliminate ingress of water during transportation and erection.

14.00 QUALITY ASSURANCE PLAN:

14.01 The successful bidder shall submit following information to the owner:

14.02 Test certificates of the raw materials and bought out accessories.

14.03 Statement giving list of important raw materials, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

14.04 List of manufacturing facilities available.

14.05 Level of automation achieved and lists of areas where manual processing exists.

14.06 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

14.07 List of testing equipments available with the bidder for final testing of equipment along with valid calibration reports.

14.08 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

14.09 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

15.00 Guarantee

15.01 The supplier of cables shall guarantee overall satisfactory performance of the cables minimum 5 years.

15.02 At least three copies of type test reports shall be furnished. One Copy shall be returned duly certified by the owner, only after which the commercial production of the concerned material shall start.

15.03 Copies of acceptance test reports shall be furnished in at least Three (3) copies. One copy shall be returned duly certified by the Owner, only after which the materials shall be dispatched.

15.04 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

- 15.05 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

16.00 INSPECTION

- 16.01 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where cable, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.
- 16.02 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain cables manufactured in 3-4 consecutive weeks.
- 16.03 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.
- 16.04 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the later case also the material shall be dispatched only after satisfactory testing specified here in has been completed.
- 16.05 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection, if such materials are later found to be defective.

- 17.00 QUALITY CONTROL:** The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

The Bidder shall arrange for inspection by the purchaser, during manufacture, if so desired by the purchaser to verify the quality control process of the Bidder.

18.00 TYPE TESTS:

- 18.01 The successful bidder the each member of consortium shall conduct all type tests as per IS: 7098 (Part-I) 1988, with latest up to date amendments or equivalent international standard and supplies made only after approval of test reports from the purchaser.
- 18.02 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

- 18.03 The successful bidder shall give FIFTEEN days advance notice for inspections and witnessing of tests by the purchaser or his representative.
- 18.04 “On receipt of the specified lots of LT XLPE UG cables from the factory at site/stores by BESCO, a team consisting of one person from the supplier, one person from BESCO shall select a sample of sufficient size, as per relevant ISS and conduct all type tests at CPRI/ERDA only. Payment of type testing charges will be considered after the receipt of satisfactory results.

In case of failure, the entire lot will be rejected and another sample will be referred to Bureau of Indian Standards (BIS) as a complaint for assessment of quality of the manufacturer.” In the mean while the supplier/Manufacturer shall have to replace the entire lot with good quality Cables.

18.05 The following type tests will be conducted on the cable as per IS: 7098 (Part-I) & BESCO specifications.

- a. Test on conductor.
 - Tensile strength
 - Wrapping test
 - Resistance test
- b. Test on round steel wire/formed steel wire (strip) Armour.
 - i) Dimensional verification
- c) Physical tests on round/formed wire:
 1. Tensile strength
 2. Elongation at break
 3. Torsion test for round wires
 4. Winding test for formed wires
 5. Uniformity of zinc coating
 6. Mass of zinc coating
 7. Resistivity
- d. Test for thickness of XLPE insulation and inner & outer sheaths.
- e. Physical test on XLPE insulation :
 1. Tensile strength and elongation at break
 2. Ageing in air oven
 3. Hot set test
 4. Shrinkage test
 5. Water absorption (gravimetric).
- f. Physical test on outer sheath
 1. Tensile strength and elongation at break
 2. Ageing in air oven
 3. loss of mass in air oven
 4. Shrinkage test
 5. Hot Deformation test
 6. Heat shock test,
 7. Thermal stability
- g. Insulation resistance (volume resistivity) test.
- h. High voltage test.
- i. Flammability test.

18.06 **ACCEPTANCE TEST:**

The sampling plan for acceptance test shall be as per IS: 7098 (Part-I) 1988.

18.07 The following shall constitute the acceptance test.

- a) Tensile test for aluminium.
- b) Wrapping test for aluminium.
- c) Conductor resistance test.
- d) Test for thickness of insulation.
- e) Test for thickness of inner and outer sheath.
- f) Hot-set test for insulation.
- g) Tensile strength and elongation at break test for insulation and sheaths.
- h) High voltage test.
- i) Insulation resistance (Volume resistivity) test.

18.08 The inspecting Officers conducting inspection/acceptance tests at factory shall strictly follow and check facilities as per the check list enclosed.

19.00 ROUTINE TEST:

The following shall constitute routine tests:

- a) Conductor resistance test.
- b) High voltage test.

20.00 SEALING OF CABLE ENDS ON DRUMS:

20.01 The cable ends shall be sealed properly so that ingress of moisture is completely prevented.

20.02 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi-conducting layer on the cores may be removed for about 2mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

20.03 The multi cores should have an overall heat shrinkable cap with adequate end clearance and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

20.04 **CABLE LENGTHS:**

The cables shall be supplied in continuous lengths of 250-500 Mtrs in case of multi core cables with a tolerance of $\pm 5\%$ of drum length.

21.00 GUARANTEED TECHNICAL PARTICULARS:

Guaranteed technical particulars of the cables to be supplied is herewith enclosed.

22.00 SCHEDULE OF DELIVERY:

The details regarding the delivery schedule are given in the Purchase Order/Dispatch instructions.

23.00 DRAWING & LITERATURE:

The following shall be furnished along with the tender.

- a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.
- b) An illustrated literature on the cable, giving technical information on current ratings, cable constants, short circuit ratings, de-rating factors for different types of installation, packing date, weights and other relevant information.

**General Manager El.,
QS&S. BESCO**

SCHEDULE-I

Annexure: TS-1

Schedule requirement of 3.5 Core & 4 core Armoured 1.1kV Aluminium conductor XLPE UG cables as per Table 4 of IS 3961-Part 6 /2016.

1.1kV Three & Half Core Aluminium XLPE Insulated as per IS:7098 (Part-1)					
Armoured Cable					
Cross - Sectional area (Sq mm)	Overall Diameter (mm) Approx	Normal Current Rating in Amps			Short Circuit Current Rating for 1 Sec. duration in K.Amps
		Ground	Duct	Air	Aluminium
4Cx 4	18	35	30	32	0.376
4C x 6	19	46	38	42	0.564
4 Cx 10	21	57	48	54	0.940
4 Cx 16	22	74	61	69	1.50
3.5C x 25	25	95	79	93	2.35
3.5Cx 35	27	114	94	114	3.29
3.5Cx 50	30	134	112	138	4.70
3.5Cx 70	35	164	137	175	6.58
3.5C x 95	38	197	164	213	8.93
3.5Cx 120	42	223	187	249	11.28
3.5C x 150	46	249	209	284	14.10
3.5C x 185	51	282	238	329	17.39
3.5C x 240	56	327	276	392	22.56
3.5C x 300	60	369	312	452	28.20
3.5C x 400	71	420	356	526	37.60
3.5C x 500	79	478	412	612	47.00
3.5C x 600	88	542	468	712	56.20

The approximate current ratings in column 3 are for the following standard installation conditions.

i)	Maximum conductor temperature for continuous operation	90 Deg. C.
ii)	Ambient air temperature	40 Deg. C.
iii)	Ground temperature	30 Deg. C.
iv)	Thermal resistivity of soil	0.6 to 1.0 K-m/watt
v)	Depth of laying	90 cm
vi)	Maximum conductor temperature at the end of short circuit	250 Deg. C.
vii)	Method of installation	Installed single directly buried in ground

SCHEDULE-II

Annexure: TS-2

For the information of Bidder the important extracts from the Indian Standard IS:7098 (Part 1) 2011; Table-1 Specification for cross linked polyethylene insulated PVC sheathed cables are furnished here for their reference and to supply for the XLPE Cables called for in the bid specification

TABLE-1:- PROPERTIES OF XLPE INSULATION

Sl.No.	Property	Requirement
1	Tensile Strength	12.5 N/Sq.mm., Minimum
2	Elongation at break	200 percent, Minimum.
3	<u>Ageing in air oven:</u> a) <u>Treatment:</u> { Temperature Duration b) Tensile Strength Variation c) Elongation Variation	135 ± 3 Deg. C 7 Days ± 25% Max. However minimum Tensile strength shall be 12.5 N/Sq.mm ± 25% Max. However minimum Elongation shall be 200 percent.
4	<u>Hot Set:</u> a) <u>Treatment:</u> 1. Temperature 2. Time under load 3. Mechanical stress b) Elongation under load c) Permanent Elongation (Set after cooling)	200 ± 3 Deg. C 15 minutes 20 N/Sq.mm. 75 % Max. 10% Max.
5	<u>Shrinkage:</u> a) <u>Treatment:</u> { Temperature Duration b) Shrinkage	130 ± 3 Deg. C 1 Hour 4% Max.
6	<u>Water absorption (gravimetric):</u> a) <u>Treatment:</u> { Temperature Duration a) Water absorbed	85 ± 2 Deg. C 14 Days 1 mg/Sq.cm. Max.
7	<u>Volume resistivity:</u> a) At 27 Deg. C b) At 90 Deg. C	1 x 10 ¹⁴ ohm-cm. Min. 1 x 10 ¹² ohm-cm. Min.

TABLE- 2:- CROSS SECTIONAL AREA OF REDUCED NEUTRAL CONDUCTORS AS PER IS 7098 -1/1988 (RA 2005) (Table 2)

Nom. C/S Area of Main Conductor mmSq	C/s Area of Reduced Neutral conductor
25	16
35	16
50	25
70	35
95	50
120	70
150	70
185	95
240	120
300	150
400	185

TABLE-3:- NOMINAL THICKNESS OF INSULATION AS PER Table 3 of IS 7098-I/1988

Nom. C/S Area of Conductor Sqmm	Nominal thickness of insulation For Single core Armour	Nominal thickness of insulation For Multi-core Armour
25	1.2	0.9
35	1.2	0.9
50	1.3	1.0
70	1.4	1.1
95	1.4	1.1
120	1.5	1.2
150	1.7	1.4
185	1.9	1.6
240	2.0	1.7
300	2.1	1.8
400	2.4	2.0

- 1) Thickness of insulation: The average thickness of insulation shall not be less than the nominal value (ti) specified in Table-3 of IS 7098 (Part-1) of 1988.
- 2) Tolerance on thickness of insulation: The smallest of the measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table-3 by more than 0.1 mm + 0.1 ti.

TABLE-4:- THICKNESS OF INNER SHEATH (All dimensions in mm)
As per Table 5 of IS 7098-I/1988

Calculated diameter over laid up cores (ref. IS 10462 Part 1, 1983) *		Thickness of inner sheath (Min.)
Over	Upto & including	
(1)	(2)	(3)
-	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	-	0.7

(*) Fictitious calculation method for determination, dimensions of protective coverings of cables: Part-I Electrometric and Thermoplastic Cables.

TABLE-5:- DIMENSIONS OF ARMOUR GALVANIZED STEEL ROUND WIRES
AND FORMED WIRES as per Table 6 of IS 7098-I/1988

NOTE: The dimensions of Galvanised steel wires or strips shall be as specified in Table-6 of IS 7098 part I/1988. However, the tolerances for formed wires shall be $\pm 5\%$ of the nominal dimensions.

Calculated diameter for Armour (ref. IS 10462 Part 1, 1983) *		Nominal thickness of steel strip	Nominal diameter of Round wire
Over	Upto & including		
1	2	3	4
a) For all diameter in excess of 13		0.8	Nil
-	13	-	1.40
13	25	0.8	1.60
25	40	0.8	2.00
40	55	1.4	2.50
55	70	1.4	3.15
70	-	1.4	4.00

Note:1. (a) and (b) indicate two methods of practice in the application of armouring.

* Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

TABLE-6:- THICKNESS OF OUTER SHEATH (All dimensions in mm)
AS PER TABLE 8 of IS 7098-I/1988.

Calculated diameter under the outer sheath (ref. IS:10462 Part 1, 1983) *		Nominal thickness of Outer sheath for Un-Armoured Cables.		Minimum thickness of outer sheath for Armoured Cables
Over	Upto & including	Nominal (ts)	Minimum	
1	2	3	4	5
-	15	1.8	1.24	1.24
15	25	2.0	1.40	1.40
25	35	2.2	1.56	1.56
35	40	2.4	1.72	1.72
40	45	2.6	1.88	1.88
45	50	2.8	2.04	2.04
50	55	3.0	2.20	2.20
55	60	3.2	2.36	2.36
60	65	3.4	2.52	2.52
65	70	3.6	2.68	2.68
70	75	3.8	2.84	2.84
75	-	4.0	3.00	3.00

(*) Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

Note: Armoured Cables: The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table-8.

- a) **High Voltage Test at Room Temperature** (Type, Acceptance and Routine Test) The cables shall withstand a voltage of 3 kV AC (rms) at a frequency of 40 to 60 Hz or a DC voltage of 7.2 kV, between conductors and between conductors and ECC (if any) for a period of 5 minutes for each test connection.
- b) **Flammability Test** — Period of burning after removal of the flame shall not exceed 60 seconds and the unaffected (uncharred) portion from the lower edge of the top clamp shall be at least 50 mm.

**General Manager El.,
(QS&S), BESCO.**

LT UG Al. Cable Size & Armour details

Sl.No	Cable size	No. of Core	No. of GI Strip/Wire & Size
1	6 Sqmm,	2 Core,	24 GI Wire - 1.4 mm
2	10 Sqmm,	2 Core,	9 GI Strips - 4 x 0.8 mm
3	10 Sqmm,	4 Core,	9 GI Strips - 4 x 0.8 mm
4	16 Sqmm,	2 Core,	9 GI Strips - 4 x 0.8 mm
5	16 Sqmm,	4 Core,	11 GI Strips - 4 x 0.8 mm
6	25 Sqmm,	2 Core,	12 GI Strips - 4 x 0.8 mm
7	25 Sqmm,	3.5 Core,	12 GI Strips - 4 x 0.8 mm
8	25 Sqmm,	4 Core,	13 GI Strips - 4 x 0.8 mm
9	35 Sqmm,	3.5 Core,	14 GI Strips - 4 x 0.8 mm
10	35 Sqmm,	4 Core,	15 GI Strips - 4 x 0.8 mm
11	50 Sqmm,	3.5 Core,	16 GI Strips - 4 x 0.8 mm
12	50 Sqmm,	4 Core,	17 GI Strips - 4 x 0.8 mm
13	70 Sqmm,	3.5 Core,	18 GI Strips - 4 x 0.8 mm
14	95 Sqmm,	3.5 Core,	21 GI Strips - 4 x 0.8 mm
15	120 Sqmm,	3.5 Core,	23 GI Strips - 4 x 0.8 mm
16	150 Sqmm,	3.5 Core,	25 GI Strips - 4 x 0.8 mm
17	185 Sqmm,	3.5 Core,	28 GI Strips - 4 x 0.8 mm
18	240 Sqmm,	3.5 Core,	30 GI Strips - 4 x 0.8 mm
19	300 Sqmm,	3.5 Core,	32 GI Strips - 4 x 0.8 mm
20	400 Sqmm,	3.5 Core,	39 GI Strips - 4 x 0.8 mm

General Technical Parameters

(Please refer to standard GTP enclosed)

1.1kV LT UG XLPE power Cables with H2/ H4 grade Aluminum conductor having purity of 99.7% and maximum resistivity of 0.028264 $\Omega\text{mm}^2/\text{m}$, Insulated through extrusion with high quality clean XLPE Compound (Free from micro voids, moisture content ambers and contaminations) having maximum Hot set value of 75%, Extruded PVC Type ST2 inner sheathed, Armoured with GI strip having strip width and thickness in average tolerance of $\pm 5\%$, maximum resistivity of 14.5 ohms/Km as per IS - 3975 and armouring coverage of 90%, Extruded PVC type ST2 compound outer sheath having minimum thermal stability value of 100 minutes conforming to ID 7098 (Part-1) -1988.

Sl. No.	Particulars	unit	LT UG Cable
1	Cables		
	a) Name of manufacturer		
	b) Place of manufacture		
2	Cable Type		A2XFY
3	Applicable specification & standards voltage Grade		IS: 7098 (Part-1) /1.1kV
4	Suitable for effective Earth/Unearth system		
5	Permissible voltage & frequency variation for satisfactory operation		
6	Continuous current for standard condition as per IS: 3961 Part-6/2016		
	a) In air (45° C)	Amps	
	b) In Ground (30° C)	Amps	
	c) In Duct	Amps	
7	Conductor		
a)	Material		Aluminium conductor H2 OR H4 Grade
c)	Nominal cross sectional area	mm ²	
b)	Form of conductor		Stranded circular, class-2 as per IS:8130
d)	Number of Strands:	Nos	
e)	Diameter of Wire : mm before bunching	mm	
f)	Nominal continuous operation	deg C	
g)	Short circuit condition	deg C	
h)	Maximum DC resistance of the conductor at 20° C	Ω/KM (CR value only for reference)
i)	Sampling batch for test		As per IS 7098-I/1988
j)	Weight of the conductor	Kg/Km	
8	Process of Curing		
9	Insulation:		
a)	Material		High quality clean XLPE compound (Free from micro voids, moisture content ambers and contaminations)
b)	Thickness of Insulation (Nom)	mm	
c)	Minimum thickness of insulation at any one point	mm	

	HOT SET TEST:		
a)	Elongation under load	%	75% (Max)
b)	Maximum Permanent elongation after cooling	%	10% (Max)
c)	Tensile Strength at break minimum	N/mm ²	
d)	Elongation at break	%	
10	Inner Sheath		
a)	Material		PVC compound Type ST-2
b)	Whether Extruded		Extruded
c)	Min Thickness	mm	
d)	Colour of Inner Sheath		
11	Armouring		
a)	Material		Galvanized Steel Strip
b)	Type of armouring		Strip/ Flat
c)	Nominal Dimension of Armour strip as per IS :3975	mm Dimension and ±5% of Tolerance
d)	Minimum Number of Armour wire	 Numbers (Minimum)
e)	Armour Resistivity (Max)	ohm -cm	
f)	Mass of Zinc coating	Gms/M ²	
12	Outer Sheath		
a)	Material		PVC Compound Type ST-2
b)	Whether Extruded		Extruded
c)	Min. thickness of sheath	mm	
d)	Nominal Overall diameter of cable	mm	
e)	Thermal stability test for sheath	Minutes	Minimum 100 Minutes
f)	colour of the outer Sheath		
13	Short circuit withstand capacity		
a)	Short Circuit withstand capacity	KA	
b)	Duration of short circuit	sec	One
14	AC resistance per core at operating Temperature	ohm/km	
15	Reactance Ohm/Km	ohm/km	
16	Capacitance per core	µF/Km	
17	Allowable maximum conductor temperature when carrying current		
	Additional data		
19	Scheme of Identification		
20	Standard Packing Length and Tolerance	Mtrs	500Mts/1000Mtrs ±5%
21	Bending Radius	mm	
22	Scheme of identification of the cable	Manufacturer's name or trade mark, voltage grade, year of manufacture, Project details/DWA/PO No. and the letters BESCOM. The identification shall repeat every 300/350 mm along with length of the cable.	

