

15. LT upto (1100 V) XLPE Insulated

1.0 SCOPE:

- 1.1 The scope of this specification covers the design, manufacture inspection and testing the finished ISI marked LT (1100 volts, 31/2 x25 Sq.mm to 400 Sq.mm stranded, compact aluminum conductor, with XLPE insulated, PVC inner sheathed, galvanized steel strip armored/unarmoured and overall PVC sheathed Black colour cable conforming to IS:7098 /88 with latest amendments and as per specification detailed.

2.0 RATED VOLTAGE:

- 2.1 The rated voltage of the cable shall be 1100 Volts AC with the highest system voltage of 1100 Volts between phases of the effectively earthed three-phase transmission system.
- 2.2 The cables shall be capable of operating continuously under the system frequency variation of ± 3 Hz, voltage variation of $\pm 10\%$ and a combined frequency – voltage variation of $\pm 10\%$.

3.0 APPLICABLE STANDARDS:

- i) Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable:
- 1 IS 7098 (Part 2)-Cross-linked Polyethylene insulation for Cables.
 - 2 IS 8130-Conductors for insulated electrical cables and flexible cords.
 - 3 IS 10810(series)-Methods of tests for cables.
 - 4 IS 10418-Drums for electric cables.
 - 5 IS 3975-Specification for mild steel wires, strips and tapes for armouring of cables.
 - 6 IS 5831-Specification for PVC insulation sheath for electric cables.
- 1 IS 10462-Fictitious calculation method for determination of dimensions of protective coverings of cables Part 1 - Elastomeric and thermoplastic insulated cables.
- ii) The cables manufactured to any other International Standards like BSS, IEC or equivalent standards not less stringent than Indian Standards are also acceptable. In such cases the Manufacturer shall enclose a copy of the equivalent international standard, in English language.

4.0 CONSTRUCTION:

- 4.1 **Conductor:** - The cable conductor shall be made from stranded aluminum to form compact sector shaped conductor having resistance within the limits specified in IS:8130/1984 and any amendment thereof. The wires shall be laid up together with a suitable right hand lay. Stranded Class 2 – as per the IS:8 130 / IEC 60228/ BS 6360 standards.
- 4.2 **Insulation:** - The insulation shall be cross linked polyethylene applied by extrusion and shall be steam (wet) cured as per IS:7098(1)1988 and curing in hot water tank/bath is not accepted.:

Sl.No.	Properties	Requirements
1.	Tensile Strength	12.5N/mm ² , Min.
2.	Elongation to break	200 percent, Min
3.	Aging in air oven: a) Treatment: Temperature: Duration: b) Tensile Strength variation: c) Elongation variation:	135 \pm 3°C 7 days \pm 25 percent, Max \pm 25 percent, Max
4.	Hot set:	

	a) Treatment: Temperature: Time under load Mechanical stress b) Elongation under load c) Permanent elongation (set) after cooling	200±3°C 15 min 20N/cm ² 175 percent, Max 15 percent, Max
5.	Shrinkage: a) Treatment: Temperature Duration b) Shrinkage	130±3°C 1 hour 4 percent, Max
6.	Water absorption (Gravimetric): a) Treatment: Temperature: Duration b) Water absorbed	85±2°C 14 days 1 mg/cm ² , Max
7.	Volume Resistivity a) at 27°C b) at 70°C	1x10 ¹⁴ ohm-cm, Min 1x10 ¹³ ohm-cm, Min
8	Thermal Resistivity	350 degrees C cm/W
9	Powerfactoratmaximumconductor temperature	0.008
10	Dielectric strength	22 kV/mm

4.3.1 The XLPE insulation should be suitable for specified 1.1 KV system voltage.

4.3.2 The manufacturing process shall ensure that insulations shall be free from voids.

4.3.3 The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions.

4.3.4 The insulation of the cable shall be high stranded quality, specified in IS:7098 (Part-II/1985). Withstand continuous conductor temperature of 90 deg C, which means higher continuous rated current carrying capacity.

4.3.5 The cables can operate even at conductor temperature of 130 deg C continuously and 250 deg C during a Short Circuit condition

4.4 SHEATH :

The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded as per IS:7098 (Part – I/1988). IEC:60502 Part– I,BS:6622, LSOH to BS:7835.

4.5 ARMOUR :

Armoring shall be applied over the inner sheath with single galvanized steel complying with the requirements of IS:3975/1979. The dimensions of the galvanized strip shall be as specified in table 4 of the IS:7098/Part-I/1988. The armour wire shall be applied as closely as practicable. The direction of the lay of the armour shall be left hand. The joints in armour wire shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire shall be atleast 300mm from the nearest joint in any other armour wire in the complete cable and shall be as per IS:7098 Part 1, IS: 3975.

The cable without armoring shall also be accepted of type detailed in price schedule.

4.6 OUTER SHEATH : Extruded PVC ST2, outer sheath as per IS:5831/1984, IS:7098

Part 1, IEC:60502 Part – 1, BS:6622, LSOH to BS:78 35. shall be applied over armoring with suitable additives to prevent attack by rodents and termites. Outer sheathing shall be designed to offer high degree of mechanical protection and shall also be heat, oils, chemicals, abrasion and weather resistant. Common acids, alkalis, saline solutions etc., shall not have adverse effects on the PVC sheathing

material used.

4.7 The cables should be suitable for use in solidly earthed system.

4.8 The power cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The Manufacturer shall furnish the quality plan, giving in detail the quality control procedure / management system.

4.9 The cable shall be suitable for laying in covered trenches and/or buried underground to meet the outdoor application purposes.

4.10 **The parameters of the LT power cables to be supplied shall be as specified below**

Nom. cross sectional area (Sq.mm)	Nom. Thickness of XLPE Insulation mm main core	Armoured			Max.DC Conductor Resistance at 20°C (ohm/km)	AC current rating	
		Nom. Steel Armour size (mm)	Approx. Overall dia. (mm)	Approx. Weight (kg/km)		In air (amps)	In Grpund (amps)
25	0.90	4 X 0.8	22.8	821.0	1.200	95	97
35	0.90	4 X 0.8	24.9	961.0	0.868	117	116
50	1.00	4 X 0.8	28.1	1195.0	0.641	140	134
70	1.10	4 X 0.8	33.0	1569.0	0.443	176	167
95	1.10	4 X 0.8	35.8	1903.0	0.320	221	199
120	1.20	4 X 0.8	39.0	2303.0	0.253	258	227
150	1.40	4 X 0.8	42.9	2720.0	0.206	294	255
185	1.60	4 X 0.8	47.5	3276.0	0.164	339	287
240	1.70	4 X 0.8	52.7	4048.0	0.125	402	333
300	1.80	4 X 0.8	58.4	4872.0	0.100	461	375
400	2.00	4 X 0.8	65.6	6101.0	0.0778	542	426

4.11 The short circuit current of the LT cable to be as specified below

Sq.mm of LT Cable	Short Circuit Current(KA)
25	2.420
35	3.370
50	4.790
70	6.680
95	9.030
120	11.400
150	14.200
185	17.500
240	22.600
300	28.200
400	37.600

5.0 **SYSTEM DETAILS:**

General Technical particulars

Nominal system voltage (rms) (U)	0.44KV
Highest system voltage (rms) (U_m)	1.1 KV
Number of Phase	3
Frequency	50Hz
Variation in Frequency	+/- 3%
Type of Earthing	Solidly Earthed
Total relay & circuit breaker Operating time	15 – 20 cycles

6.0 CLIMATIC CONDITIONS:

(a) Maximum ambient air temperature (in shade)	45°	C
(b) Maximum ambient air temperature (under sun)	50°	C
(c) Maximum daily average ambient air temperature	35°	C
(d) Maximum yearly average ambient air temperature	30°	C
(e) Maximum humidity	100%	
(f) Altitude above M.S.L.	Up to 1000M	
(g) Average No. of thunder storm days per annum	50	
(h) Average No. of dust storm days per annum	Occasional	
(i) Average No. of rainy days / annum	90	
(j) Average Annual Rain fall	925mm	
(k) Normal tropical monsoon period	4 months	
(l) Maximum wind pressure	150 kg/Sq.M	

7.0 DESIGN CRITERIA:

- i. The cables that are covered in these specifications are intended for use outdoor , under the climatic conditions and installation conditions described in the technical specification.
- ii. 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.
- iii. The cables in service will be subject to daily load cycles, of two peaks during a day; morning peak and evening peak, with around 25% to 50% loading during the nights.
- iv. The materials used for outer sheaths shall be resistant to oils, acids and alkalis.
- v. The cables shall have the mechanical strength required, during handling and laying.
- vi. The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.
- vii. The cables shall be designed to have a minimum useful life span of Thirty-five years.
- viii. The detailed design drawings shall be submitted along with Purchase order.

8.0 MANUFACTURE PROCESS:

Cross-linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS: 7098 (Part – II) and the proof of purchase of the above insulating material shall be submitted and is to be offered for stage inspection..

9.0 MATERIALS:

- 9.1 **Conductor:** -The conductor shall be of stranded construction. The material for conductor shall consist of the plain aluminum of H2 or H4 grade as per clause – 3 of IS 8130/ 1984.
- 9.2 The minimum number of wires shall be 53 for circular compacted 400 sq. mm aluminum conductor as per table – 2 of IS 8130/ 1984.

10.0 CORE IDENTIFICATION:

- 10.1. The core identification for 31/2 core cables shall be provided, by suitable means, like, by application of individual colour or colored stripes, or by numerals or by printing on the cores as per clause 13 of IS: 7098 - Part 2
- 10.2. For identification of different coloring of XLPE Insulation, or by using colored strips, red, yellow and blue colors respectively shall be used to identify the phase conductors.

11.0 LAYING UP OF CORES:

The cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non- hygroscopic material.

12.0 INNER SHEATH (COMMON COVERING):

- 12.1 The laid up cores shall be provided with inner sheath applied either by extrusion. It shall be ensured that the shape is as circular as possible. 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.

- 12.2 The thickness of the inner sheath (common covering) shall be given as follows:

CALCULATED DIAMETER IN MM OVER LAID UP CORES [REF IS 10462 (PART 1)]		THICKNESS OF INNER SHEATH (Min) mm
Over	Up to and including	
—	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	—	0.7

- 12.3 When one or more layers of binder tapes are applied over the laid up cores, the thickness of such tapes shall not be construed as a part of inner sheath.

13.0 ARMOURING:

- 13.1 Armouring shall be single strip steel wire applied over the inner sheath as closely as practicable. The direction of the lay of the armour shall be left hand.
- 13.2 The armour shall consist of galvanized strip steel The dimensions of the galvanized steel wires shall be 4 X 0.8 mm (Nominal)
- 13.3 The joints in the armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in the wire shall be at least 300-mm from the nearest joint in any other wire in the complete cable.
- 13.4 Manufacturers shall furnish the calculation / data sheet for the short circuit carrying capability of the Armour.

14.0 OUTER SHEATH:

- 14.1 The outer sheath shall be applied by extrusion. It shall be applied over the armouring shall consist of poly-vinyl chloride (PVC) compound, conforming to the requirements of type ST-2 of IS 5831. Suitable additives

shall be added to give anti termite protection.

- 14.2 _ The minimum thickness of the PVC outer sheath shall be as per IS:10462 and as detailed.

Calculated diameter under the outer sheath [IS 10462 Part 1] – mm		Nominal thickness of the outer sheath (ts) - mm
Over	Up to and including	
–	15	1.24
15	25	1.40
25	35	1.56
35	40	1.72
40	45	1.88
45	50	2.04
50	55	2.20
55	60	2.36
60	65	2.52
65	70	2.68
70	75	2.84
75	–	3.0

14.3 **IDENTIFICATION:**

The outer sheath shall have the following information embossed or indented on it; ISI marking, the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "DDUGJY, Name of Employer" The identification shall repeat every 300/350mm along the length of the cable. Outer sheath of cable shall be black in permanent colour.

15.0 **INSPECTION AND QUALITY CONTROL:**

The Manufacturer 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 Manufacturer shall arrange, for inspection by the purchaser, during manufacture with one month advance notice for verifying the various stage inspections as specified in the quality assurance plan enclosed to verify the quality control process of the Manufacturer.

16.0 **TYPE TESTS:**

Type test certificates from Accredited NABL Testing Laboratories for 1.1 kV XLPE, shall be submitted along with Purchase order. The Type Tests should have been conducted not later than 5 years as on the date of supply.

- 16.1 Stage wise Inspection: The Manufacturer shall offer the stage wise inspection as detailed in the in the quality assurance plan

- 16.2 All acceptance tests shall be conducted in the presence of the Employer's representative.

- 16.3 The supplier shall give 10 days advance notice for inspections, and witnessing of tests by the Employer representative.

- 16.4 The following type tests shall be conducted on the cable.

Sl. No.	Test	Requirement	Test method Ref Part no of IS: 10810
a)	Tests on conductor		
i)	Tensile test	IS:8130	2

	ii) Wrapping test	IS:8130	3
	iii) Resistance test	IS:8130	4
b)	Tests for armoured wires and strips	Clause 15.2 & IS:3975	36 to 42
c)	Test for thickness of insulation and sheath	Clause 4.3, 14.2 & 16.2	6
d)	Physical tests for insulation:	Clause 4.2	
	i) Tensile strength and elongation at break		7
	ii) Aging in air oven		11
	iii) Hot test		30
	iv) Shrinkage test		12
	v) Water absorption (gravimetric)		33
e)	Physical tests for outer sheath	IS: 5831	
	i) Tensile strength and elongation at break		7
	ii) Aging in air oven		11
	iii) Shrinkage test		12
	iv) Hot deformation		15
f)	High voltage test	Clause 22.7	45
g)	Flammability test	Clause 22.8	53

17.0 ACCEPTANCE TEST:

17.1 The sampling plan for acceptance test shall be as per IS 7098 part -II, Appendix 'A'.

17.2 The following shall constitute the acceptance test.

- a. Tensile test for aluminum.
- b. Wrapping test for aluminum.
- c. Conductor resistance test.
- d. Test for thickness of insulation.
- (xiii) Test for thickness of inner and outer sheath.
- (xiv) Hot-set test for insulation.
- (xv) Tensile strength and elongation at break test for insulation and outer sheath.
- (xvi) High voltage test.
- (xvii) Insulation resistance (volume resistivity) test.

18.0 ROUTINE TEST:

The following shall constitute routine tests:

- o Conductor resistance test.
- o High voltage test.

19.0 DETAILS OF TESTS:

19.1 Unless otherwise mentioned in this specification, the tests shall be carried out in accordance with appropriate part of IS: 10810.

19.2 High Voltage Test at room temperature:
The cables shall withstand a voltage of 3KV AC (rms) at a frequency of 40 to 60 Hz or an AC voltage of 7.2KV , between conductors and between conductors and ECC (if any) for a period of 5 minutes each test connection.

19.3 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.

Employer reserves the right to select a random sample of 1.1 kV UG cable from the Manufacturer's end which are ready to dispatch and also ongoing cable laying works and the same samples will be sent to any testing laboratory as desired by Employer. If the testing results are found to be not satisfactory

Employer reserves the right to reject the entire batch of cable received and insists for replacement of material free of cost. The decision of Employer in this regard is final.

20.0 PACKING:

20.1 The cables, as per specified delivery lengths, shall be securely wound /packed in non-returnable wooden drums, capable of withstanding rough handling during transport by Rail, Road, etc. The packing should withstand storage conditions in open yards. The cable drums shall conform to IS 10418-1982 or equivalent standard. The dimensional drawings of wooden drums shall be furnished with the Purchase order. The drum shall be provided with circumferential lagging of strong wooden planks. The end of the cable shall be sealed with good quality heat shrink sealing caps. The sufficiently required additional sealing caps shall be supplied for use of testing during laying and jointing at site and to seal spare lengths of cable. The packing should be able to withstand the rigorous of transport. The following information in bold letters in English shall be painted on the flanges.

- a. Name & Address of the manufacturer, Trade name/Trade mark/Brand
- b. ISI Marking
- c. Size of cable (Cross section) rated voltage, standard, insulation, cable code, drum No., and year of manufacture.
- d. Length of cables (Meters)
- e. Direction of rolling
 - i) Net weight (in Kg)
 - ii) Gross weight (in Kg)
 - iii) Owners purchase order reference.

21.0 SEALING OF CABLE ENDS ON DRUMS:

21.1 The cable ends shall be sealed properly so that ingress of moisture is completely prevented. The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable or push-on or Tapex or cold shrinkable type 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 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

21.2 The three cores should have an overall heat shrinkable or push-on or Tapex or cold shrinkable type 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.

22.0 CABLE LENGTHS:

The cables shall be supplied in continuous lengths of 500 m or more with 5% tolerance and cable shall on the wooden drums only.

23.0 QUANTITY TOLERANCE:

A +3% tolerance shall be allowed on the ordered quantity including 300-m cable as spare.

24.0 MARKING:

24.1 The packed cable drum shall carry the following information, clearly painted or stenciled.

- a. The letters 'DDUGJY, Name of Employer'
- b. Reference to Standard and ISI mark.
- c. Manufacturer's Name or trade mark.
- d. Type of cable & voltage grade.
- e. Number of cores.
- f. Nominal cross- sectional area of conductor.
- g. Cable code.
- h. Length of cable on the drum.
- i. Direction of rotation.
- j. Gross weight.
- k. Country of Manufacture.

- l. Year of Manufacture.
- m. Purchase order and date.
- n. Address of consignee.

25.0 GUARANTEED TECHNICAL PARTICULARS:

The manufacturer, shall furnish the guaranteed technical particulars of the cable offered in the GTP format provided.

26.0 DRAWING & LITERATURE:

- (i) The following shall be furnished along with the tender
 - Cross sectional drawings of the cables, giving dimensional details.
- 1 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.

27.0 GUARANTEE: The cable manufactured shall be guaranteed for the period of 18 months from the date of receipt at stores.

28.0 The Manufacturer shall furnish a copy of valid BIS licence for ISI marking without which the cable shall not be accepted.

GUARANTEED TECHNICAL PARTICULARS FOR 1.1 KV

	Manufacturer's Name		
	Class of Power Cable		
1	Name of the Manufacturer and country of origin		.
2	Country of Manufacture		.
3	Type of cable / cable code		.
4	Applicable standard		.
	Voltage		.
5	a. Rated Nominal voltage		.
	b) Rated Maximum voltage		.
6	Suitability for :		.
	a. Earthed system		.
	Conductor		.
	a) Nominal cross section (sq.mm)		.
	b) Material		.
7	c) Shape		.
	d) Diameter of conductor (mm)		.
	e) Number of wires per conductor (Nos.)		.
	f) Nominal diameter of wire in conductor (mm)		.
8	Insulation XLPE		.
	a) Curing process (furnish details separately)		.
	b) Material/Composition		.
	c) Dia over insulation		.
			.
	i. Nominal (mm)		.
	ii. Average (mm)		.

	iii. Minimum (mm)		
9	Inner sheath		
	a) Type / composition		
	b) Material		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
10	Armouring		
	a) Material		
	b) Dia of wire		
	Nom. (mm)		
	Min. (mm)		
11	Outer sheath		
	a) Type / composition		
	b) Material		
	c) Nominal thickness		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
12	Anti-thermite treatment to outer sheath		
	a) Material		
	External overall dia of cable		
	Short circuit rating of conductor 90 deg. C operating temperature for 1 Sec.		
13	Minimum cable bending radius (in terms of cable diameter)		
14	Permissible maximum tension		
15	Continuous current rating under specified insulation conditions at conductor temperature of 65 deg. C and 90 deg. C.		
16	Ground Temperature 30 deg. C		
17	Thermal resistivity of soil 150 deg. C CM/W		
18	Depth of laying 200 mm		
19	Ambient Air temperature 40 deg. C		
20	No. of circuits 1 OR 2		
21	Spacing between two circuits		
22	Formation		
23	Maximum permissible conductor temperature for continuous operation under specified installation conditions (deg. C)		
24	Conductor temperature at rated current (deg. C)		
25	Basic impulse level at conductor temperature of 90 deg. C (KV)		
26	Impulse wave shape		
27	Power frequency with stand voltage (KV)		
28	Tan Delta at 50 Hz (at U.KV and 90 (-5/+10) deg. C		
29	Sheath voltage at max. load		

30	Withstand voltage of sheath on spark test		
31	Permissible short circuit current ratings of conductor		
	i) 0.1 Sec KA		
	ii) 0.2 Sec KA		
	iii) 0.5 Sec KA		
	iv) 1.0 Sec KA		
32	Conductor resistance DC & AC		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 105 deg. C (d.c)/A.C. ohm/KM over load temp) a.c. (ohm)		
33	Equivalent star resistance at 50 Hz of 3 phase current		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 10% continuous overload temperature (ohm/KM)		
34	Star reactance at 50 hz (ohm/KM)		
	Approximate impedance at 50 hz per KM		
	a. at 20 deg. C ohm/KM		
	b. at 90 deg. C ohm/KM		
	c. at 10% continuous overload temperature (ohm/KM)		
35	Self electrostatic capacitance per phase (Micro farad/KM)		
36	Maximum power factor at charging KVA of cables when laid direct in ground at normal voltage & frequency		
	at ambient Temperature		
	at Maximum conductor Temperature		
37	Impedance		
	a) Positive and negative sequence impedance (ohm/KM)		
	b) Zero sequence impedance (ohm/KM)		
	c) Zero sequence data		
38	Series reactance / Resistance		
	a) Series resistance (ohm/KM)		
	1 Series reactance (ohm/KM)		
	2 Shunt capacitive reactance (ohm/KM)		
39	Sheath resistance at 20 deg. C ohm/KM		
40	Surge impedance of cable (ohm/KM)		

	IR value at ambient temperature per KM		
	Maximum magnitude of partial discharge at 1.5 U.o		
	At Ambient Temperature (Po)		
	At High Temperature (Po)		
	Losses per Km.		
	NOTE : (i) Cable Conductor size 400 sq. mm		
41	Total 3 phase dielectric loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	b) Total 3 phase resistive loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	c) Total 3 phase sheath / screen loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive load KW/KM on each circuit		
42	d) Other losses due to reinforcement		
43	One circuit alive KW/KM		
	Both circuits alive KW/KM on each circuit		
44	Total losses		
	i. One circuit alive KW/KM		
	ii. Both circuits alive KW/KM		
	Charging current at rated voltage per Km (Amps)		
45	Short circuit capacity of conductor for one second at 90 deg. C prior to short circuit and 250 deg. C during short circuit (KA)		
	Screening factor of cable for calculating interference on control and communication cables :		
	Approximate value of attenuation of carrier current signals operating over a frequency range		
46	i. 50 KC/s- dB/KM		
	ii. 100 KC/s- dB/KM		
	iii. 150 KC/s- dB/KM		
	iv. 200 KC/s- dB/KM		
	Shipping weight and size of cable drum		
47	a) Size of Drum		
	i. Dia of Drum (M)		
	ii. Width of Drum (M)		
	iii. Gross Weight (Kgs)		
	iv. Length of cable per Drum(M)		
	v. Weight of Cable (Kg/M)		

Current Rating Factor

Particulars	Single Point Bonded		Both End Bonded	
	65 deg. C Amps	90 deg C Amps.	65 deg. C Amps	90 deg. C Amps
Current Rating conductor size 400 Sq. mm				
a) In Ground				
i. Of each circuits (when both the circuits alive)				
b) In Duct				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				
c) In pipe, one cable per pipe.				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				
d) In Air				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				

Derating Factors

1.VARIATION IN GROUND TEMPERATURE :

Ground Temperature (deg. C) :	15	20	25	30	35	40	45
Rating Factor							

2.VARIATION IN DEPTH OF LAYING :

Depth of Laying (Meters):	0.7	0.9	1.0	1.2	1.3	1.5	
Rating Factor							

3.VARIATION IN THERMAL RESISTIVITY OF SOIL

Thermal Resistivity of Soil : (deg. C cm/watt)	100	120	150.0	200	250		
Rating Factor							

4.VARIATION IN AIR TEMPERATURE :

Air Temperature (deg. C) :	25	30	35	40	45	50	55
Rating Factor							

5.VARIATION DISTANCE (MM) :

Axial Distance (mm) Between circuits :	100	200	300.0	400	600	800	
Rating Factor							

16. LT Aerial Bunched Cables for LT Lines

(APPLICABLE FOR LT AB CABLE WITH XLPE INSULATION ONLY)

1. SCOPE:

This specification covers XLPE insulated Aluminum cable twisted over a central bare Aluminum Alloy messenger wire for use of L.T. Over-Head lines in Rural Electrification System. The Aerial Bunched cable and messenger wire should be conforming to IS.

(Sizes: of the cable)

- (i) 3 x 50 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (ii) 3 x 35 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (iii) 3 x 25 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (iv) 3 x 16 sq. mm + 1 x 25 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (v) 2 x 35 sq. mm + 1 x 16 sq. mm
- (vi) 2 x 25 sq. mm + 1 x 16 sq. mm

2. RATED VOLTAGE:

The rated voltage of the AB cables shall be 1100 volts

3. APPLICABLE STANDARDS:

Unless otherwise stipulated in this specification the following Standards shall be applicable.

- i) IS – 14255/1995 : ABC cables 1100 volts.
- ii) IS – 8130/1984 : Conductors for insulated cables.
- iii) IS – 398/Pt.IV/1994: Aluminium alloy conductor.
- iv) IS – 10418/1982 : Drums for electric cables

4. GENERAL:

The AB cable covered under this specification should be suitable for use on three phase, 4 wire earthed system for working voltage up to 1100 V. It should confirm the relevant standards stated above and others if applicable.

The phase conductor shall be 50 mm², 35 mm², 25 mm² and 16 mm² XLPE insulated and the neutral conductor should be 35 mm², 25 mm² and 16 mm² XLPE insulated whereas messenger conductor should be Bare heat treated aluminium silicon containing 0.5% magnesium and approximately 0.5% silicon conforming to IS: 398 (Part-IV):1979 and its latest amendment, if any.

5. PHASE & NEUTRAL CONDUCTORS:

- 5.1 The phase & neutral conductor shall be provided cross linked poly ethylene insulation applied by extrusion. The thickness of insulation shall not be less than 1.2 mm up to 35mm² and shall not be less than 1.5 mm for above 35mm² at any point and insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor. The insulated conductors shall generally conform to the standards IS-14255:1995.
- 5.2 The phase conductors shall be provided with one, two & three 'ridges' for easy identification.
- 5.3 The tensile strength of the aluminum wire used in the conductor shall not be less 90 N/mn².
- 5.4 The standard size and technical characteristics of the phase conductors shall be as shown in the Table-1.

TABLE-I

Nominal Sectional area in mm ²	No. of Strands	Diameter of Compacted conductor in mm	Approx. Mass Kg/KMs.	Max. DC Resistance at 20°C (Ohm/km)	Insulation Thickness in mm
1	2	3	4	5	6
16	7	4.4	42	1.91	1.2
25	7	5.5	65	1.20	1.2
35	7	6.8	95	0.868	1.2
50	7	7.9	127	0.641	1.5

NOTE: 1) The resistance values given in col.5 are the max. permissible.

1 Tolerance of + 5% is allowable on dimension.

6. MESSENGER WIRE:

- 6.1 The bare messenger wire shall be of aluminium alloy generally conforming to IS-398/Pt.IV/94 composed of 7 strands and shall be suitable compacted to have smooth round surface to avoid damages to the overall insulation of phase & neutral conductor twisted around the messenger.
- 6.2 There shall be no joint in any wire of the stranded messenger Conductor except these made in the base rod or wires before final drawing.
- 6.3 The sizes and other technical characteristics of the messenger wire shall be as given in the Table No.2.

TABLE -2

Nominal Sectional Area in mm ²	No. of strands	Diameter of Compacted conductor in mm	Approx. Mass Kgs/KMs	Max .DC Resistance
1	2	3	4	5
25	7	5.8	65	1.380
35	7	6.8	95	0.986

NOTE: while limiting values in col. 3 is to be guaranteed a tolerance of + 5% will be permissible.

7. XLPE INSULATION:

The insulation shall generally confirm to IS-7098(Part-II):85

Sr.No.	Property	Requirement
1	Tensile Strength	12.5 N / mm ² Min
2	Elongation at break	200 % Min.
3	Ageing in air over	
a	Treatment: Temperature & duration	135 ± 3°C & 7 days
b	Tensile strength variation	± 25% Max.
c	Elongation variation	± 25% Max.

Sr.No.	Property	Requirement
4	Hot Set	
a	Treatment temperature, Time Under load, mechanical stresses	200 ± 3°C, 15 minutes 20 N /cm ² .
b	Elongation under load	175 % max.
c	Permanent elongation (set) after cooling	15 % Max
5	Shrinkage	
a	Treatment temperature duration	130 ± 3°C For 1 hour
b	Shrinkage	4% Max
6	Water absorption (Gravimetric)	
a	Treatment– Temp.	85 ± 2°C
	Duration	14 days
b	Water absorbed	1 mg. / cm ² max.

8. TYPE TEST:

A. Test for Phase/Street Light Conductors

- (i) Tensile Test (IS-8130)
- (ii) Wrapping Test (IS-8130)
- (iii) Conductor Resistance Test (IS-8130)

B. Test for Messenger:

- (i) Breaking load test (to be made on finished conductor) -(IS-398/ Pt.IV/ 1994 with latest revision)
- (ii) Elongation test (IS - 398 / Pt.IV/1994)
- (iii) Resistance test (IS - 398 / Pt. IV /1994)
- (iv) If insulated , the test of insulation as per relevant IS will be applicable

C. Physical test for XLPE insulation

- (i) Tensile strength and Elongation at break
- (ii) Ageing in air oven
- (iii) Hot set test
- (iv) Shrinkage test
- (v) Water absorption (Gravimetric)
- (vi) Carbon black 1. Content & 2. Dispersion

D. Test for thickness of insulation

E. Insulation Resistance (Volume Resistivity) Test

F. High Voltage Test

Note: The Manufacturer should submit the entire above type test of Govt. of India's approved Laboratory along with their offer.

Optional Test:

Bending test on the completed cable:

Bending test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180°. The cycle of this operation shall be then repeated twice.

The diameter of mandrel shall be 10 (D+d).

Where

D = Actual diameter of cable (i.e. the min. circumscribing diameter in mm) d = Actual diameter of the phase conductor in mm

No cracks visible to the naked eye are allowed.

9. ACCEPTANCE TESTS:

Tests for Phase / Street Light Conductors:

- a. Tensile test (for Phase / Street light conductor)
- b. Wrapping test (for Phase / Street light conductor)
- c. Breaking load test for messenger conductor
- d. Elongation test for messenger conductor
- e. Conductor Resistance test
- f. Test for thickness of insulation
- g. Tensile strength and elongation at break test
- h. Hot set test (For XLPE insulation)
- i. Insulation Resistance test
- j. High voltage test

10. PACKING MARKING:

- 10.1 The LT AB cable shall be wound in non returnable drums conforming to IS-10418/1982 "Specification for Reels and Drums for bare wire" of the latest version thereof. The drums shall be marked with the following:

- a) Manufacturers name
- b) Trade mark if any
- c) Drum number
- d) Size of Conductor
- e) Size of Messenger
- f) Voltage grade
- g) Number of lengths of pieces of Cable in each drum
- h) Gross mass of the packing
- i) Net mass of Cable
- j) ISI mark

- 10.2 The drums shall be of such a construction as to assure delivery of conductor in field free from displacement and damage and should be able to withstand all stresses due to handling and the stringing operation so that cable surface not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lugged on the drums

- 10.3 The cable drums should be suitable for wheel mounting.

11. STANDARD LENGTH:

The standard length of drum will be 500 metre with $\pm 5\%$

Non-standard Length:

Non standard length not less than 50% of the standard length shall be accepted to the extent of 10% of the ordered quantity.

12. INSPECTION:

All tests and inspections shall be made at the place of manufacturer unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

13. EXPERIENCE:

The manufacturer must have some experience of manufacturer and supply of this cable to any Electricity Board. Copy of order executed and performance report may be submitted along with the offer.

14. TYPE TEST CERTIFICATES:

The duly attested copy of Type Test Certificate of the offered sizes of AB cable, as per IS: 14255/1995 with latest amendment/revision be submitted from any Govt. approved laboratory along with the offer. In absence of type test certificate, offer will be liable to be ignored/rejected without any further correspondence [at Purchaser's (Employer) discretion]. Type Test Certificate shall not be more than Five Years Old from Date of supply.

15. SUBMISSION OF ISI LICENSE FOR IS14255:1995

The Manufacturer are required to submit duly attested photo copy of the valid ISI License up to the date of delivery for supply of these AB cables/wires and they should also submit GTP failing which, the offer would be ignored.

16. IMPORTANT:

In absence of valid ISI License/GTP duly filled in/and copy of type test certificate of Govt. approved Laboratory, duly attested by authorized person, offer will be liable to be ignored without any further correspondence.

17. ISI MARKING:

The material supplied shall be conforming to Indian Standard Specification and also with ISI marking as applicable and even after inspection of the lot, if the materials received at site is found without ISI marking, the lot shall be rejected and no further correspondence shall be entertained in this regard.

GUARANTEED TECHNICAL PARTICULARS (G.T.P.)

Technical information and Guaranteed Technical Particulars (G.T.P.) for LT Aerial Bunched Cable (XLPE insulated only) of sizes:

- (i) 3 x 50 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (ii) 3 x 35 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (iii) 3 x 25 sq. mm + 1 x 35 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (iv) 3 x 16 sq. mm + 1 x 25 sq. mm insulated neutral cum messenger + 1 x 16 sq. mm
- (v) 2 x 35 sq. mm + 1 x 16 sq. mm
- (vi) 2 x 25 sq. mm + 1 x 16 sq. mm

PART – A

Manufacturer has to confirm following important requirements:

Sr. No.	Particulars	confirmation
1	AB Cable shall be manufactured and supplied Confirming to IS: 14255/1995 with latest Amendment if any	Yes
2	Cable drums/label shall bear ISI Mark	Yes
3	ISI License shall remain valid till order is Completed	Yes
4	Colour of XLPE Insulation – Black	
4a	3 x 50 + 1 x 35 + 1 x 16	Yes
4b	3 x 35 + 1 x 35 + 1 x 16	Yes
4c	3 x 25 + 1 x 35 + 1 x 16	Yes
4d	3 x 16 + 1 x 25 + 1 x 16	Yes
4e	2 x 35 + 1 x 16	Yes

4f	2 x 25 + 1 x 16	Yes
5	Shape – compacted	Yes
6	Standard length in case 500 mtrs± 5 % tolerancelonger length acceptable	Yes
7	Non-Standard length 50% of Std. length up to 10%of ordered quantity	Yes
8	Packing shall contain only one Length.	Yes
9	Packing material: Wooden drums as per IS: 10418/1982 duly painted	Yes
9a	3 x 50 + 1 x 35 + 1 x 16	Yes
9b	3 x 35 + 1 x 35 + 1 x 16	Yes
9c	3 x 25 + 1 x 35 + 1 x 16	Yes
9d	3 x 16 + 1 x 25+ 1 x 16	Yes
9e	2 x 35 + 1 x 16	Yes
9f	2 x 25 + 1 x 16	Yes
10	Following shall be embossed on cable & Markingon drum shall be as per IS: 14255/1995	Yes
10a	Purchaser (Employee)	Yes
10b	1100 Volts	Yes
10c	IS:14255/1995	Yes
10d	Year of manufacture	Yes
10e	Trade Mark	Yes
11	Conductor –	
11a	For Phase 16 mm ² ,25 mm ² , 35 mm ² & 50 mm ² Alluminium as per IS8130/1984	Yes
11b	For Messenger wire 25 mm ² & 35 mm ² AlluminiumAlloy as per IS 398/Pt.IV/1994	Yes
12	Maximum Conductor resistance at 20°CFor Phase Conductor	
12a	16 mm ² Conductor – 1.91 Ohm/KM	Yes
12b	25 mm ² Conductor – 1.20 Ohm/KM	Yes
12c	35 mm ² Conductor – 0.868 Ohm/KM	Yes
12d	50 mm ² Conductor – 0.641 Ohm/KM	Yes
	For messenger conductor	
12e	25 mm ² Conductor – 1.380 Ohm/KM	Yes
12f	35 mm ² Conductor – 0.986 Ohm/KM	Yes
13	XLPE Insulation thickness for AB Cable	
13a	3 x 50 mm ² + 1 x 35 mm ² + 1 x 16 mm ² -1.5 mm	Yes
13b	3 x 35 mm ² + 1 x 35 mm ² + 1 x 16 mm ² - 1.2 mm	Yes
13c	3 x 25 mm ² + 1 x 35 mm ² + 1 x 16 mm ² -1.2 mm	Yes
13d	3 x 16 mm ² + 1 x 25 mm ² + 1 x 16 mm ² -1.2 mm	Yes
13e	2 x 35 mm ² + 1 x 16 mm ² - 1.2 mm	Yes
13f	2 x 25 mm ² + 1 x 16 mm ² - 1.2 mm	Yes

14	Volume resistivity of insulation	
14a	At 27°C – 1×10^{13} Ohm-cm. Min	Yes
14b	At 70°C – 1×10^{11} Ohm-cm. Min	Yes
15	Tensile strength of Insulation & sheath -12.5 N/mm ² Min.	Yes
16	Elongation at break of Insulation and Sheath –200% Min.	Yes
17	Overall tolerance in supply of ordered total quantity shall be $\pm 2\%$ (Plus and minus two %)	Yes

PART- B

Manufacturer has to furnish below details about material for information:

Sr. No.	Particulars				confirmation
1	ISI License for IS:14255/1995				Yes
1a	Number				
1b	Date of expiry				
2	Approximate weight of 1000 meters length (Weightin Kgs.)				
2a	Size of cable	Alum.	Alu. Alloy	XLPE	Total
	3 x 50 mm ² + 1 x 35 mm ² + 1 x 16 mm ²				
	3 x 35 mm ² + 1 x 35 mm ² + 1 x 16 mm ²				.
	3 x 25 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	.	.		.
	3 x 16 mm ² + 1 x 25 mm ² + 1 x 16mm ²				
	2 x 35 mm ² + 1 x 16 mm ²				
	2 x 25 mm ² + 1 x 16 mm ²				.
3	Cable Conductor, Circular Compacted?				Yes

PART – C (ENCLOSURES)

Manufacturers have to enclose following documents and has to confirm for the same

Sr. No.	Particulars	confirmation																												
1	ISI License	Yes																												
2	Proof if applied for renewal of ISI License	Yes																												
3	TYPE TEST CERTIFICATE: Type test certificate from Govt. of India approved Laboratory	Yes																												
	<table border="1"> <tr> <td>Size of AB Cable</td><td>3 x 50 mm² + 1 x 35 mm² + 1 x 16 mm²</td><td>3 x 35 mm² + 1 x 35 mm² + 1 x 16 mm²</td><td>3 x 25 mm² + 1 x 35 mm² + 1 x 16 mm²</td><td>3 x 16 mm² + 1 x 25 mm² + 1 x 16 mm²</td><td>2 x 35 mm² + 1 x 16 mm²</td><td>2 x 25 mm² + 1 x 16 mm²</td></tr> <tr> <td>a Name of Lab. & City Name</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>b T.R. No.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>c Date</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>	Size of AB Cable	3 x 50 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 35 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 25 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 16 mm ² + 1 x 25 mm ² + 1 x 16 mm ²	2 x 35 mm ² + 1 x 16 mm ²	2 x 25 mm ² + 1 x 16 mm ²	a Name of Lab. & City Name							b T.R. No.							c Date							
	Size of AB Cable	3 x 50 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 35 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 25 mm ² + 1 x 35 mm ² + 1 x 16 mm ²	3 x 16 mm ² + 1 x 25 mm ² + 1 x 16 mm ²	2 x 35 mm ² + 1 x 16 mm ²	2 x 25 mm ² + 1 x 16 mm ²																							
	a Name of Lab. & City Name																													
	b T.R. No.																													
c Date																														
4	List of plant and machinery	Yes																												
5	List of testing facility available	Yes																												
6	List of orders pending/executed	Yes																												
6a	with Employer	Yes																												
6b	with agencies other than Sr. no. 6(a)	Yes																												

17. XLPE Power Cables (11kV & 33 kV)

SECTION I

STANDARD TECHNICAL REQUIREMENT

1.0 SCOPE:

This section covers the standard technical requirements of design, manufacturing, testing, packing and dispatching of 11 kV and 33 kV XLPE HT Power Cable.

2.0 APPLICABLE STANDARDS

The materials shall conform to the latest editions of the following Indian/International Standards :

IS 7098 Part 2 : 1985 XLPE insulated PVC sheathed cables For working voltages from 3.3 kV up to and including 33 kV

IS 5831 : 1984 PVC Insulation and Sheath of electric Cables

IS 8130:1984 Conductors for insulated electric cables and flexible cords. IS 613:1984 Copper rods and bars for electrical purposes.

IS 3975:1988 Mild steel wires, formed and tapes for armouring of cable. IS 10810:1984 Method of tests for cables.

IEEE-383:1974 Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.

ASTM-D2843,1993 Standard test method for density of smoke from burning or decomposition of plastics.

ASTM-D2863, 1991 Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).

NEMA-WC5,1992 Thermoplastic Insulated Wire and cable for the transmission and distribution of Electrical Energy.

IEC:754 Test on gases evolved during combustion of electric cables -

(Part-1):1994 Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.

IEC:332 Test on electric cables under fire conditions

(Part I):1993 Test on a single vertical insulated wire or cable. IS 3961 Recommended current rating for cables -

(Part II):1967 PVC insulated and PVC sheathed heavy duty cables.

IS 10418:1982 Drums for electric cables.

3.0 GENERAL REQUIREMENTS

All cables shall be suitable for high ambient, high humid tropical Indian Climatic conditions. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.

Conductor shall be of uniform, of good quality, free from defects Aluminium copper.

Insulation shall be Cross Linked Polyethylene (XLPE) .

For 33 kV and 11 kV cables, conductor screen and insulation screen shall both be extruded, semi-conducting compound and shall be applied along-with XLPE insulation in a single operation by triple extrusion process. Method of curing for 33 kV cable shall be "Dry curing/ gas curing " only, whereas for 11 kV and 3.3 kV cables it shall be "Dry curing/ gas curing / Steam curing".

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS 7098 (Part-II) with latest amendments. The semi conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of insulation. The semi-conducting screens should be effectively cross linked to achieve 90 ° C cable rating. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.

The interface between insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper cable applied in helical form.

Inner sheath - All armoured and multi-core un-armoured cables shall have distinct extruded inner PVC sheath of black colour.

Armouring - Material for armour for Single Core Cable shall be Aluminum wire. For Multicore cable it shall be GS wire / flat. Armouring shall be as per relevant IS and it shall have minimum 90% coverage.

Breaking Load of the joints shall be minimum 95% of the normal armour.

Outer Sheath – It shall be of black colour PVC (type ST2 as per IS 5831) with Cable size and Voltage grade embossed on it. Sequential marking shall be at every 1 (one) Meter distance. Word "FRLS" shall also be embossed on it at every 5 (Five) meter distance.

FRLS Properties - All cable shall be Flame Retardant, Low Smoke (FRLS) type. Outer sheath shall have the following properties –

Acid Gas Generation – Max 20% (as per IEC 754-1)

Smoke density rating: 60% (As per ASTM D 2843)

Flammability test - As per Swedish chimney test F3 as per SEN 4241475

As per IEC 332 part-3 (Category B)

Minimum bending radius shall be 10 D

Repaired cables shall not be acceptable.

4.0 CURRENT RATING OF CABLES

- 1) Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.
- 2) Tables given de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished.
 - Variation in ambient air temperature. - Variation in ground temperature.
 - Depth of laying.

- Cables laid in the ground - Cables laid in trench
 - Cables laid in ducts - Soil resistivity.
 - Grouping of cables.
- 3) The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.
 - 4) The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.
 - 5) Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.
 - 6) Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.
 - 7) It is essential that the accessories which are used in the cable system with mechanical and/or soldered connections are suitable for the temperature adopted for the cables.
 - 8) Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

5.0 CABLE DRUMS

- 5.1 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.
- 5.2 All Power Cables shall be supplied in drum length of 1000 m. Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of $\pm 5\%$. The tolerance allowed on total quantity of each size is as given below.
 - 3.250 meters for cable length upto 10 kms.
 - 3.3100 meters for cable length more than 10 kms. and up to 20 kms.
 - 3.4150 meters for cable length more than 20 kms.

Where the ordered quantity is not multiple of 1000 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

- 5.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 5.4 A clear space of at least 40mm shall be left between the cables and the logging.
- 5.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wordings shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 5.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

6.0 TESTS

- 6.1 Type Tests
The following shall constitute type tests:

- i) Tests on conductor
 - a. Annealing test (for copper)
 - b. Tensile tests (for aluminium)
 - c. Wrapping tests (for aluminium)
 - d. Resistance test
 - ii) Tests for armouring wires/strips
 - iii) Test for thickness of insulation and sheath
 - iv) Physical tests for insulation
 - a. Tensile strength and elongation at break
 - b. Ageing in air oven
 - c. Hot test
 - d. Shrinkage test
 - e. Water absorption (gravimetric)
 - v) Physical tests for out sheath
 - a. Tensile strength and elongation at break
 - b. Ageing in air oven
 - c. Hot test
 - d. Shrinkage test
 - vi) Bleeding and blooming tests (for outer sheath)
 - vii) Partial discharge test
 - viii) Bending test
 - ix) Dielectric power factor test
 - a. As a function of voltage
 - b. As a function of temperature
 - x) Insulation resistance (volume receptivity) tests
 - xi) Heating cycle test
 - xii) Impulse withstand test
 - xiii) High voltage test
 - xiv) Flammability test

6.2 Acceptance tests

The following shall constitute acceptance tests:

- a. Annealing test (for copper)
- b. Tensile test (for aluminium)
- c. Wrapping tests (for aluminium)

- d. Conductor resistance test,
- e. Test for thickness of insulation
- f. Hot set test for insulation,
- g. Tensile strength and elongation at break test for insulation and sheath
- h. Partial discharge test (for screened cables only)
- i. High voltage test and
- j. Insulation resistance (volume resistivity) test

6.3 Routine test

The following shall constitute routine tests:

- i) Conductor resistance test
- ii) Partial discharge test (for screened cables only) and
- iii) High voltage tests.

6.4 Optional tests

Cold impact tests for outer sheath (IS:5831-1984) shall constitute the optional tests.

SECTION II

SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This section of the specification covers project information, site condition, desired Technical parameters and quantity of XLPE Cable.

1.1 Project Information

- a. Customer :
- b. Engineer/Consultant :
- c. Project Location :
- d. Transport facilities
 - i) Nearest Railway station : /Gauge
- ii) Distance from site :
- e. Access Roads :

1.2 SITE CONDITIONS

- (i) Ambient air temp. (max.) °C :
- (ii) Ambient air temp. (min.) °C :
- (iii) Design ambient temp. °C :

- 1.2.1 Relative humidity for design : purposes
- 1.2.2 Height above mean sea level in : meters
- 1.2.3 Earth quake data

- i) Seismic zone : IS:1893-84

ii) Seismic acceleration : As per IS 2.2.4

1.2.4 Wind data

Site Wind Pressure Kg/m² : As per IS 2.3

1.3 System Particulars

Line Voltage (kV)	11/33
Highest System Voltage (kV)	12/36
Number of Circuits	1
Frequency	HZ50
Neutral	effectively earthed
Short circuit level (KA)	22.77 KA, 31.8KA / 22.5KA,45KA

1.4 SPECIFIC TECHNICAL REQUIREMENTS

Technical Parameters of the cable shall be as follows:

S. No.	PARTICULAR	Unit	DATA	DATA
1	Rated Voltage	kV	6.35/11	19.0/33
2	Type of Insulation	-	XLPE	XLPE
3	Single core/ Multi core	-	Single/Three core	Single/Three core
4	Armoured / Unarmoured	-	Armoured	Armoured
5	Material of Conductor	-	Aluminium/Copper	Aluminium/Copper
6	System	-	11 kV Earthed	33 kV Earthed
7	Highest System Voltage	kV	12	36
8	Conductor size	sq. mm	120, 150, 185, 240, 300	150, 185, 240, 300, 400
9	Material		Stranded Aluminium/copper	Stranded Aluminium/copper
10	Shape of Conductor		Circular	Circular
11	Short Circuit Current	kA	13.12 , 18.35 for 3 secs.	13.12, 26.24 for 3 secs
12	Power Frequency Withstand Voltage	KV rms	28	70
13	Lightning Impulse Withstand Voltage	kVp	75	170
14	Continuous Withstand Temperature	Deg C	90	90
15	Short Circuit withstand Temperature	Deg C	250	250
16	Oxygen Index		Min 29 (as per ASTM D 2863)	Min 29 (as per ASTM D 2863)
17	Acid Gas Generation		Max 20% (as per IEC 754-1)	Max 20% (as per IEC 754-1)
18.	Smoke Density Generation		60% (As per ASTM D 2843)	60% (As per ASTM D 2843)
19.	Flammability Test		As per Swedish Chimney test	As per Swedish Chimney test

SECTION-III GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Item Particulars	Unit
---------	------------------	------

1	Manufacturers Name & Address	
2	Country of manufacturer	
3	Type of cable	
4	Applicable standards for manufacturing	
5	Applicable standards for testing	
6	Rated voltage	kV
7	Maximum service voltage	kV
8	Maximum continuous current carrying capacity per cable when laid in air at an ambient air temperature of 50 deg. (single core cables solid bonded)	A
9	Maximum continuous current carrying capacity per cable when laid in ground at a depth of 1.0 m (ground temp. 40 deg. C and soil thermal resistivity of 150 deg.c/watt/cm max. Conductor temp. 90 deg. C) (single core cables solid bonded)	A
10	Maximum continuous current carrying capacity per cable when drawing into duct./pipes (single core cables solid bonded)	A
11	Maximum continuous current carrying capacity per cable when laid in covered RCC trenches at an ambient temperature of 50 Deg. C laying conditions to be specified (Single core cables solid bonded)	A
12	Short circuit withstand capacities for 1 second of (With a	
18	Conductor screen	
i)	Material	
ii)	Nominal thickness	mm
19	XLPE Insulation	
i)	Composition	
ii)	Type of curing	
iii)	Thickness of insulation (nominal)	mm
iv)	Tolerance on thickness	mm
v)	Dielectric constant at normal frequency	
vi)	Specific insulation resistance at 20 deg. C	ohm/km
vii)	Min. Volume resistivity at 20 deg. C	
viii)	Min. volume resistivity at 90 deg. C	
ix)	Min. Tensile strength	kg/sq.cm
x)	Min. Elongation percentage at rupture	%
xi)	Identification of cores	
20	1.2/50 microsecond impulse wave withstand voltage	kVp
21	5 min. power frequency withstand voltage	kV
22	Max. Dielectric stress at the conductor	kV/cm
23	Max. Dielectric stress at the conductor screen	kV/cm
24	Insulation screen	
i)	Material	
ii)	Extruded/wrapped	
iii)	Nominal thickness	mm
iv)	Colour	
25	Metallic screen	
i)	Material / composition	
ii)	Nominal radial thickness / dia	
26	Nominal diameter over metallic screen	mm
27	Nominal radial clearance allowed under metal sheath	mm
28	Type and material of filler	
29	Armour	
i)	Material and type	
ii)	Dia	

18. 1.1 kV Grade Copper Stranded Control Cable

1. SCOPE:

The specification cover the design, manufacture, at manufacturer's works, supply and delivery of Copper Control Cables screened/armoured for use indifferent EHT/HT /Grid Sub-Stations.

2 GENERAL INFORMATIONS:

The Control Cables are required for the control, protection, instrumentation, auxiliary Power Supply. Each tender must be accompanied by full information required in the bidding schedule together with pertinent manufacturer's literatures, drawings, instruction manuals to enable the purchaser to make an appraisal of the quality and suitability of the materials offered. Failure to comply with the provision may be sufficient reasons to reject the bid.

3 STANDARDS AND REGULATIONS:

All materials shall comply with the applicable provisions of the latest edition of Indian Standards, Indian Electricity Rules, Indian Electricity Act and other applicable statutory provisions, rules and regulations.

The following standards would apply to the specification.

1. IS-1554 (Part-I) – PVC insulated heavy duty.
2. IS-8130-Conductors for PVC insulated Cables.
3. IS-3961 (Part-II) - Recommended current ratings for Cables.
4. IS-5831-PVC insulated and sheath of Electric Cable.
5. Other relevant standards for screening.

4 CLIMATIC AND ISOCERAUNIC CONDITIONS:

4.1 The climatic conditions at site under which the material shall operate

Satisfactory are as follows;

a) Maximum ambient temperature of the air-in shade (°C):	50
b) Minimum temperature of the air in shade (°C):	4
c) Maximum daily average ambient temperature (°C):	45
d) Maximum Yearly average ambient temperature (°C):	30
e) Maximum relative humidity (%):	100
f) Average number of thunderstorm days per annum. :	100
g) Average annual rainfall (cm):	200
h) Maximum wind pressure (Kg/M2):	150
i) Earthquake acceleration (g):	0.04 x 2 g

j) Height above Sea Level (m):

Not exceeding 1000

- 4.2** The material offered shall be suitable for continuous operation at the full rated capacity under the above conditions.

5 DESIGN CRITERIA:

The Cables will be used for control protection and instrumentation, auxiliary Power Supply connections of the various equipment.

- 5.1** The Cable will be laid in ground or on ladder type trays or drawn in conduit in a hot, humid and tropical atmosphere. The trays may be overhead, suspended or run in concrete trenches with removable covers. The tenderer shall indicate clearly the derating factor for the above conditions.

- 5.2** The maximum conductor temperature for various classes and type of cable shall be limited to safe value as per applicable I.S. Cables shall be marked with ISI Certification Mark, if any.

6.0 SPECIFIC DESIGN REQUIREMENTS:

- 6.1** 1100 Volts Grade Heat Resisting (HR) Copper Cables suitable for use where the combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 85 deg.C under normal continuous operation and 160 deg.C under short-circuit condition with stranded annealed copper conductor, HR PVC insulated, HR extruded PVC inner sheathed, round galvanized steel wire armoured (for multicore cable only) and overall HR extruded PVC sheathed shall generally conform to latest revision of IS:1554(Part-I). The cores shall be colour coded as per I.S. for easy identification.

Each Conductor shall consist of multi Strand copper wire for 2.5 sq.mm cross section. Conductor wire shall be stranded. The PVC material for insulation and outer sheathing shall have smooth finish. Armouring shall be of single layer of 1.6/1.4 mm. dia. G.I. Steel Wires strong enough to withstand mechanical stress during handling and shall be resistant to action of oil, acid and alkali. The above cable shall be used for control, identification, inter-link and instrumentation etc.

6.2 CURRENT RATING:

The Cables will have current rating derating factors for an ambient temperature of 45 deg. C and ground cable is required to be taken into consideration. The current ratings shall be based on the maximum temperature 85 deg. C for continuous operation at the rated current.

6.3 OPERATION:

Cables shall be capable of satisfactory operation under Power Supply System frequency variation of + 5% and voltage variation of + 10%.

7 DRUM LENGTH OF CABLES:

- 7.1** The Cables shall be packed in non-returnable wooden drums. The wooden drums should be bearing distinguishing number with following information duly stenciled on the outer side of one flange.

1. Name of the Manufacturer.
2. Normal sectional area of the Conductor of the Cable.
3. Number of Cores.
4. Type of Cable & Voltage for which it is suitable.

5. Length of Cable in this drum.
6. Direction of rotation of Drum (an arrow)
7. Gross Weight.
8. Purchase Order No. & Date.
9. Year of Manufacture.
10. Property of XXXXX (Name of Employer; DDUGJY Projects).
11. Date of Delivery.

7.2 Drums shall be proofed against attack by white ant and termite, Conforming to IS-10418-1982.

7.3 The Cables shall be supplied in Drum lengths of 250/500 Mtr. which shall be subject to tolerance of not more than + 5% and the variation in the total quantity of Cables due to tolerance in individual drum length shall be limited to + 2.5% for all types of Cable. Non-standard drum length shall not be acceptable. However, before packing the Cables on Drums, the successful bidders will be required to obtain *purchaser's approval* for the drum lengths.

7.4 Embossing on the outer sheath of the Cable with marking "Name of Employer; DDUGJY" and length of the Cable in meters at suitable intermittent distance, preferably 1Mtr. should be done.

8 DRAWING DATA & MANUAL:

The following information shall be furnished in triplicate along with the tenders:

- a) Manufacturer's leaflets giving construction details, dimensions and characteristics of different Cables.
- b) Current rating of cables including derating factor due to grouping, ambient temperature and Type of various installations.
- c) Write up sketch illustrating the manufacturer's recommendation for splitting, jointing and termination of different type of cables.
- d) List of customers to whom the cable for similar rating has been supplied.

9 TESTS:

9.1 Routine tests in accordance with the provision of relevant standard specification shall be carried out for each drum of finished cable lengths. Type Tests and acceptance tests on the samples taken on random basis from the lot of cables offered for inspection shall have to be carried out as per relevant Indian Standard Specification to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot.

TYPE TEST REPORTS for the type tests conducted in accordance with IS:1554(Part-I for similar type of Cables (as per Tender Specification) Type Test Report conducted on similar type of Cable from NABL/ Central Govt./ approved Accredited Testing Laboratory within 5 years is to be submitted.

9.2 WITNESSING OF TESTS:

The tabulation for each test result shall contain corresponding I.S. specified limiting figures to facilitate checking of test Results. Six (6) copies of type tests certificate lot-wise for each type of cables should be sent to the Employer for acceptance. Type Test Certificate for each lot and routine test certificate for each drum of cables shall be submitted to the Employer for approval before dispatch of cables from the Works. The test certificates shall be completed with all results.

19. 10kVA 1-Phase, 16 KVA (1/ 3-Phase) & 25 KVA 3-Phase L.T. Distribution Box (with MCCBs)

1 SCOPE:

This specification covers the design, manufacture, inspection, testing at manufacturer place and supply of L.T. Distribution Box with energy meter. Distribution Boxes shall be used for controlling the L.T. feeders from the L.T. side of Distribution Transformers. The system shall be A.C. 3phase, 4 wires, 433V or AC single phase 2 wire, 230V, 50 Hz with effectively grounded neutral.

2 SERVICE CONDITIONS:

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the climatic conditions of the State.

3 SYSTEM DETAILS:

Distribution Boxes are meant for metering, control and protection of Distribution Transformers with relevant parameters as under:

S.No.	Transformer Capacity kVA	Full Current Amps	Incoming Circuit Configuration	Outgoing Circuits Configuration
1	10 KVA (1-Phase)	43 Amp	45 A SPN MCCB	2 x 32A SP MCCB
2	16 KVA (1-Phase)	70 Amp	80 A SPN MCCB	2 x 50 A SP MCCB
3	16 KVA (3-Phase)	22 Amp	25 A TPN MCCB	6 x 16 A SP MCCB
4	25 KVA (3-Phase)	34 Amp	40 A TPN MCCB	6 x 25A SP MCCB

Each Distribution box shall have provision for fixing of three phase tri-vector energy meter/single phase meter for DT metering depending upon capacity and type of transformer, 1No. single pole Neutral (SPN)/Three Pole Neutral (TPN) MCCB at incoming and 2 & 6 Nos. single pole MCCB at outgoing circuit as per above table. Incoming and Outgoing MCCB shall be connected through insulated connectors. Cable from the Distribution Transformer shall be connected to the incoming MCCB through energy meter. Cables from the outgoing terminals of the incoming MCCB shall be connected respectively to the R-Y-B Phase and Neutral terminals of the insulated bus bars or insulated Multiple Outgoing Connectors. Cables from insulated bus bars or insulated Multiple Outgoing Connectors shall be connected to the outgoing MCCBs. Aluminium cable of 16mm² for 10 KVA / 16KVA and 35mm² for 25KVA transformer shall be used. Cable shall be fixed with bus bar or connectors with minimum two screws of size not less than M6. Insulation provided shall be such that no live part including the screws for holding the cable shall be accessible by hand/finger.

4 MCCB:

MCCB shall be of reputed make and shall confirm to latest IS. MCCB shall be of fixed rating type. MCCB shall have rated service short circuit breaking capacity of 10 KA at 0.4 P.F. (lag) with rated insulation voltage of 660 V. The time current characteristics of MCCB shall be as per the following details:

Multiple of normal Current Setting	Tripping Time
1.05	More than 2.5 hrs.
1.2	More than 10 minutes and less than 2 hrs.
1.3	Less than 30 minutes
1.4	Less than 10 minutes
Multiple of normal Current Setting	Tripping Time
2.5	Less than 1 minute
6.0	Less than 5 Seconds

For above test, the reference calibration temperature of the MCCB shall be 50°C.

5 ENCLOSURE:

- 1 The enclosure shall be made up of CRCA MS sheet of 18 SWG sheet thickness for 10/16KVA single phase and of 16SWG for 16/26KVA three phase. The manufacturing process of Box shall be Deep Drawn Process. No welding joints in the body / doors of box are permitted in Deep Drawn Process.
- 2 The inside dimensions of Distribution Box shall be 300 x 500 x 160mm for 10 & 16 kVA single phase transformer and 1000 x 500 x 170 mm for 16 & 25 kVA three phase Transformer. However, the dimensions of the box is for reference only, internal clearance as per our requirement shall be strictly maintained. Overall dimensions of the box shall be such that the box will withstand temperature rise limits as per IS and Company's Specification and to have sufficient space for working during maintenance. The size of the box will depend on the size of Electrical components and other relevant provision made in IS:13947/(P1,2&3), IS 2086 and IS:4237 with latest amendment if any. Adequate slope on the top of box (as shown in the drawing) shall be provided to drain out rainwater from the top. The body and door of enclosure shall be individually in one piece without any welding, except for fixing of the accessories like hinges, clamps, mounting clamps, bolts etc. which shall be spot welded or MIG welded only. The door of Distribution box shall be fixed on three tamper proof inside hinges not visible from outside. Hinges shall be welded from inside of the box and door shall be fixed with the two screws in each hinge. Hinges shall be made from 1.6mm MS sheet with hinge pin of diameter 3mm. The hinge pin shall have head on top so that it does not fall down during the normal usage. Base and door shall have flange / collars as shown in drawing. Collar of Base and door shall overlap by minimum 8mm. Rubber gasket shall be provided in between base and doors, such that it provides proper sealing between the door and base of box to avoid ingress of water. Degree of protection shall be **IP- 33** as per IS-13947 (amended up to date). Rubber Gasket shall be fixed with suitable adhesive. Two numbers 'U' shaped latch arrangement shall be provided to Seal the door with body for 10/16KVA single phase and three numbers 'U' shaped latch arrangement shall be provided for 16/25KVA three phase. 2.5mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. Holes provided for sealing & padlock should be aligned when latch is in closed position. 'U' shaped latch arrangement shall be made from 1.6 mm thick MS sheet and shall be welded from inner side of the box. U-latch shall be joined with stainless steel rivet.
- 3 Viewing window opening of 80mm x 90mm shall be provided with toughened glass of 5mm thickness as shown in drawing. Size of glass shall be 100mm x 110mm. Glass shall be provided with a wraparound single piece rubber gasket (without joint) having minimum depth of 8mm made from good quality rubber so that it can withstand weather effect. Glass along with rubber gasket shall be fixed from inside of the door of distribution box with powder coated glass holder made of 20 SWG MS sheet without any welding joint and by draw process. Glass holder shall be fixed with minimum four welded screws & nuts from inside and not visible from outside.
- 4 Mounting arrangement of the meter shall be as shown in the drawing. It should be raised from the base of box by 15mm (minimum). It should be suitable for different makes of meters. Galvanized/Zinc Plated adjustable strip shall be provided on meter mounting arrangement for fixing of the meter. Three mounting MS screws, one for upper hanger (M4 threads x length 12mm) & two (M4 threads x 25 or 35mm length) in moving slotted flat shall be provided for fixing of the meter.
- 5 Two sets of Louvers (One set on each side) shall be provided. The perforated sheet of 20 SWG CRCA MS shall be welded from inside of the louvers.
- 6 The surface of the enclosure shall be properly Pre-treated / Phosphated in a 7-Tank process and shall be applied with a powder coating of about 40 micron thickness. The powder coating shall be of Light Admiralty

Grey colour shade (IS-5:1993 Colour No. 697). Powder coating shall be suitable for outdoor use. Rating and Type of distribution box shall be printed or embossed on the door of the distribution box.

- 7 EC grade Aluminium Bus bars of 100mm² (minimum) for Phase and Neutral, capable of carrying full load current shall be provided. Bus bar shall be completely insulated such that no live part including screws are accessible by hand/finger after fixing of cables. Insulation shall be Fire retardant. Bus bars shall be isolated with respect to body.
- 8 Two earthing bolts of diameter 10mm and 25mm long shall be welded from inside of the box and shall be provided with 2 nuts & washer. Earth marking shall be duly embossed near the earth bolts. There shall be no powder coating on the earthing bolts.
- 9 One No. Incoming & 2 Nos. outgoing cable holes shall be provided as shown in drawing. Cable holes shall be provided with superior quality rubber cable glands of internal diameter 30mm. Rubber glands shall be made such that internal diameter of glands provided for cables should be closed with the rubber film of minimum 1mm thickness. Cable will go through the glands by piercing the film of the glands.
- 10 For mounting of box on pole, four holes shall be provided the back side of the box as shown in drawing.
- 11 Danger marking shall be provided on the box in red color.
- 12 Name of Utility and name of scheme i.e. DDUGJY shall be embossed on the distribution box.
- 13 Each distribution box shall be supplied with proper packing in 3 ply corrugated box.
- 14 Tolerance permissible on the overall dimensions of box shall be $\pm 3\%$.

6 FINISHING OF DISTRIBUTION BOX:

The surface of the box shall be properly pretreated / phosphated in 7-tank process and shall be applied with powder coating. The process facility shall be in house of the manufacturer to ensure proper quality for outdoor application.

7 ACCEPTANCE TESTS :

Following acceptance tests shall be carried out while inspecting lot of material offered.

a Visual Examination:

The Distribution box shall be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.

b Verification of dimensions:

Verification of dimensions, external / internal clearances will be carried out as per technical specifications.

c Verification of fittings:

Components like insulated bus bars, MCCBs, Hinges, Rubber Glands etc will be verified as per technical specification.

d High voltage withstand test at 2.5KV:

The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:

- i Between Live Parts of each insulated bus bar
- ii Between each insulated bus bar and earthing Screw/bolts
- iii On bus bar insulation.
- iv On PVC coating of PVC cables.

There shall not be any puncture or flash over during this test.

e **MCCB:**

Time current characteristics of each rating of MCCB shall be checked as per the requirement of the specifications.

f **Current Carrying Capacity:**

The current of 200 Amp shall be applied for 30 minutes through high current source on each insulated bus bar. There shall not be overheating of the insulated bus bars during this test.

8 TESTING & MANUFACTURING FACILITIES:

The Tenderer must clearly indicate what testing and manufacturing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out all Routine & Acceptance Tests. These facilities should be available to inspection Engineers, if deputed to carry out or witness the tests in the manufacturer's works. The tenderer must have all the in-house testing facilities to carry out the acceptance tests on the Box.

9 TESTS:

The Distribution box shall comply with the requirement of IP33. Each type of LV Switchboard shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards and during manufacture and on completion.

i Routine Test

The tests shall be carried out in accordance with IS 13947 and 8623 include including but not necessarily limited to the following:

- (a) Visual Check
- (b) Verification of Component Rating
- (c) Other Checks
 - i) Easy Accessibility and Maintenance
 - ii) Color Coding provided by colored tapes.
 - iii) Bus bar dimensions
 - iv) Degree of Protection check by paper.
- (d) Dimension check
- (e) Insulation Resistance Tests
- (f) Mechanical Operation Tests
- (g) Bus bar support and clearances
- (h) Continuity of circuits and Function
- (i) Powder Coating
- (j) Overload Release setting of the Circuit Breakers

ii Type Test

The box shall be fully type tested as per the requirement of IS 13947 (Part-1):1993 with latest amendment. The type test shall be carried out from the Govt. approved laboratories duly accredited by National Board of Testing & Calibration Laboratories (NABL) of Govt. of India.

10 Prototype & Drawings:-

The manufacturer has to manufacture the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of box is enclosed herewith.