THE POWER IS WITHIN .....

HIGH VOLTAGE CABLES

HIGH VOLTAGE CABLES

Cross Linked Polyethylene Cable i.e. XLPE Cable was developed in late 1970 to overcome the susceptibility of PILC Cables to ingress of moisture. Hence the advent of XLPE cables marked the beginning of a gradual but steady replacement of Paper Cables in almost all voltage applications.

The excellent thermal properties of XLPE Cable permit maximum continuous conductor operating temperature of 90 C and short circuit temperature of 250 C. Moreover, it has low dielectric loss, which does not vary much over the entire operating temperature range. These characteristics, along with the low dielectric constant, make XLPE Cable particularly suitable for high voltage applications. Given below are additional outstanding features.

HIGH CONTINUOUS CURRENT RATING:

Its ability to withstand higher operating temperature of 90° C enables much higher current rating than those of PVC or PILC cables.

HIGH SHORT CIRCUIT RATING:

Maximum allowable conductor temperature during short circuit of 250° C is considerably higher than for PVC or PILC Cables resulting in greater short circuit withstand capacity.

HIGH EMERGENCY LOAD CAPACITY:

XLPE Cables can be operated even at 130° C during emergency, therefore in systems, where cables are installed in parallel; failure of one of two cables will not bring down the system capacity for some time.

LOW DIELECTRIC LOSSES:

XLPE Cables have low dielectric loss angle. Moreover, these losses occur continuously in every charged cable whether it carries load or not. Hence use of XLPE Cable at higher voltage would result in considerable saving in costs.

LOWER CHARGING CURRENTS:

The charging currents are considerably lower permitting close setting of protection relays.

EASY LAYING AND INSTALLATION:

Low weight and small bending radii make laying and installation of cable very easy. The cable requires less supports due to low weight.

HIGH SAFETY:

Cables have High safety against mechanical damage and vibrations.

APPLICATIONS:

1 Used extensively in all power generating plants and industrial plants.

2 Used in chemical and fertilizer units where cables are exposed to chemical corrosion.

3 Used in heavy industries where severe load fluctuations occur.

4 Used in systems where there are frequent over voltages.

5 Used at higher ambient temperatures on account of their higher operating temperatures.

6 Used even under most difficult cable route conditions such as city distribution network.

DESIGN AND CONTRUCTION

CONDUCTOR

The conductors made from E.C. grade aluminum wires, are stranded together and compacted. All sizes of conductors of single or three core cables are circular in shape.

Conductor construction and testing comply to IS 8130-1984 as amended up to date.

Cables with copper conductor can also be offered.

CONDUCTOR SCREENING

Conductor screening is employed for all cables above 3.3 KV grade in the form of a semi conducting extrusion over the conductor.

XLPE INSULATION

High quality XLPE unfilled insulating compound of natural color is used for insulation. Insulation is applied by extrusion process and is chemically cross-linked by silane process.

INSULATION SCREENING

The cables rated above 3.3 KV are provided with insulation shielding over the insulation. The screening is provided with an extruded layer of semi conducting compound. Over the semi conducting covering, a metallic screen in the form of copper tape is provided.

CORE SHIELDING

XLPE insulation and insulation shielding are all extruded in one operation by a special process. This process ensures perfect bonding of inner and outer shielding with insulation. The bond prevents the formation of cavities at the surface of the conductor when the cable is subjected to bends. The void formation, at the interface of the semi conducting layer and insulation, too is eliminated even during heating and cooling cycles in the operation.

INNER SHEATH (COMMON COVERING)

In case of multi core cables, cores are stranded together with suitable non-hygroscopic fillers in the interstices and provided with common covering of plastic tapes wrapping. As an alternative to wrapped inner sheath, extruded PVC inner sheath can also be provided.

ARMOURING:

Armouring is applied over the inner sheath and normally comprise of galvanized Steel Wire or galvanized Steel Strips for multi core Cables. For Mining use and other special applications, double Wire/Strip armoured cables with Tinned Copper wires can also be offered. Single core armoured cables are provided with non-magnetic armour consisting of hard drawn flat or round aluminum wires.

OUTER SHEATH:

A tough Outer Sheath of Heat Resisting PVC compound (Type ST2) as per IS - 5831 is extruded over the armouring in case of armoured cables or over non-magnetic metallic tape covering the insulation or over the non-magnetic metallic part of insulation screening in case of unarmoured single core cables. This is always black in color for best resistance to outdoor exposure. The Outer Sheath is embossed with "Gloster", the voltage grade and the year of manufacture.

CORE IDENTIFICATION

The Core identification complies with the requirements of IS-7098 (Part II) as shown below:

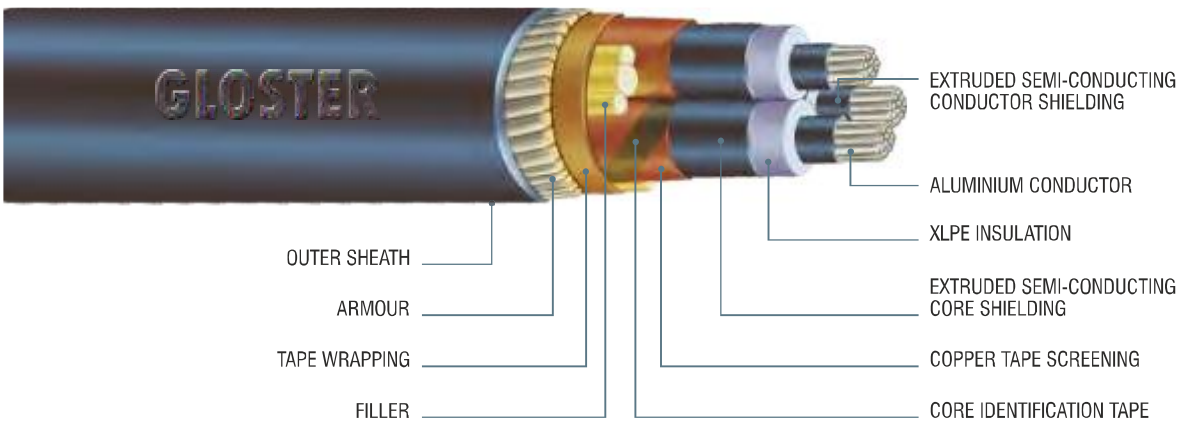
- By numerals (1, 2, 3) printed on cores. OR
- By colored strips applied on the cores.

TESTING AND QUALITY ASSURANCE

XLPE Cables are manufactured under advanced manufacturing and testing facilities. The cables are type tested and routine tested in accordance with IS - 7098 (Part - II) 1985.

The following tests are carried out as routine tests on every length of cables manufactured:

a) Conductor resistance test
b) Partial discharge tes
c) High Voltage test



TEST VOLTAGES :

The following test voltage is applied between conductor and screen / armour:

VOLTAGE RATING OF CABLES	TEST VOLTAGE
1.9/3.3 or 3.3/3.3KV	10 KV (rms) for 5 Minutes
3.8/6.6 KV (E)	12 KV (rms) for 5 Minutes
6.35/11 KV (E)	17 KV (rms) for 5 Minutes
11/11 KV (UE)	28 KV (rms) for 5 Minutes
12.7/22 KV (E)	32 KV (rms) for 5 Minutes
19/33 KV (E)	48 KV (rms) for 5 Minutes

In order to achieve consistency in quality, in addition to above tests, rigorous quality control measures are effected at every stage of production. Accordingly every batch of raw materials and process cables are tested to check for their physical and electrical properties.

OPERATING CHARACTERISTICS :

The construction data and current rating of cables with aluminum conductor are shown in tables. These are based on standard conditions of installations as provided below:

Maximum continuous operating conductor temperature for XLPE Cables	=90° C
Standard ground temperature	=30° C
Ambient air temperature	=40° C
Thermal Resistivity of soil	=150° C
Depth of laying (for cables laid direct in ground)	3.3 KV To 11 KV =0.90 m. 22 KV To 33 KV =1.05 m.

SHORT CIRCUIT RATING OF HT XLPE CABLES :

Thermally admissible short circuit current are depicted in the graph below:-

Full load conductor temperature prior to short circuit 90° C

Maximum short circuit conductor temperature: 250 C

Formula $I_k = 0.094\ A/\sqrt{t}$

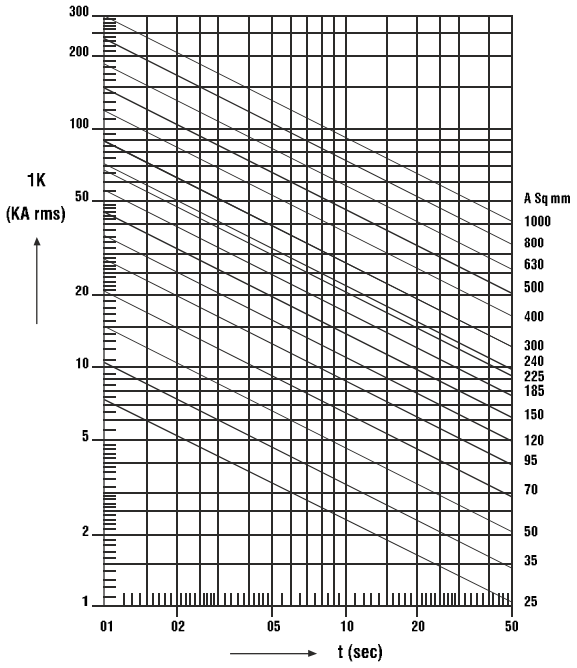
I_k: Short Circuit Current In KA (rms)

t: Duration of short circuit in seconds

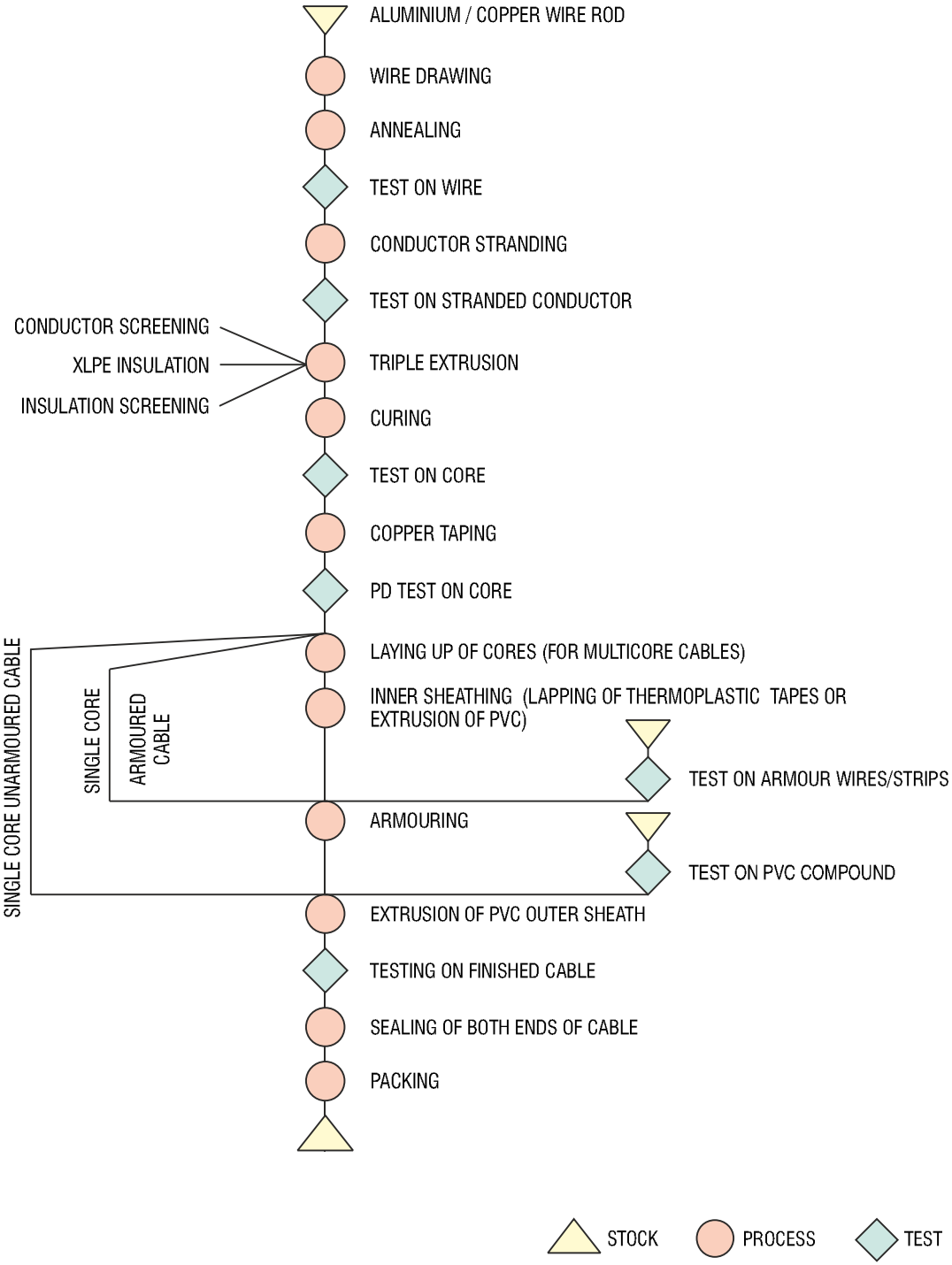
A: Area of aluminum conductor in mm^2

Short circuit ratings of cables for one-second duration is given in Table 14.

For any other duration of **t** seconds divide the value given in the respective table by ($\sqrt{t}$).



FLOW CHART FOR MANUFACTURING PROCESSES AND QUALITY CONTROL CHECKS FOR XLPE CABLES CONFORMING TO IS: 7098 (PART - II) 85



3.3 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, UNSCREENED, ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 1

Nominal area of conductor	UNARMOURED CABLE				HARD DRAWN ALUMINIUM WIRE ARMOUR					CURRENT RATING	
	Nominal thickness of insulation	Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal thickness of insulation	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	mm	kg/km	Amps	Amps
25	2.2	1.8	14.4	240	2.5	1.4	1.24	16.8	330	97	104
35	2.2	1.8	15.4	310	2.5	1.4	1.24	17.8	380	115	127
50	2.2	1.8	16.5	370	2.5	1.4	1.4	19.3	450	136	153
70	2.2	1.8	18.0	470	2.5	1.6	1.4	21.4	560	166	192
95	2.2	2.0	20.0	610	2.5	1.6	1.4	23.0	670	196	237
120	2.2	2.0	21.6	720	2.5	1.6	1.4	24.5	770	225	275
150	2.2	2.0	23.0	850	2.5	1.6	1.4	25.7	870	253	317
185	2.2	2.0	24.7	1010	2.5	1.6	1.4	27.5	1010	285	362
240	2.2	2.0	27.0	1250	2.5	1.6	1.56	30.0	1230	330	433
300	2.2	2.0	29.0	1490	2.5	1.6	1.56	32.2	1440	373	504
400	2.2	2.2	32.4	1890	2.6	2.0	1.56	36.0	1780	427	598
500	2.4	2.2	36.0	2360	2.8	2.0	1.56	39.7	2170	485	694
630	2.6	2.2	39.6	2940	3.0	2.0	1.72	43.6	2700	551	815
800	2.8	2.4	44.5	3720	3.3	2.0	1.88	48.6	3360	625	969
1000	3.0	2.6	49.1	4630	3.5	2.5	2.04	54.3	4320	692	1103

3.8 / 6.6 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED,SCREENED, ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 2

Nominal area of conductor	Nominal thickness of insulation	UNARMOURED CABLE			HARD DRAWN ALUMINIUM WIRE ARMOUR				CURRENT RATING	
		Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	2.8	1.8	18.0	350	1.6	1.40	21.3	520	97	106
35	2.8	2.0	19.3	420	1.6	1.40	22.3	580	115	130
50	2.8	2.0	20.4	470	1.6	1.40	23.4	650	135	156
70	2.8	2.0	22.0	570	1.6	1.40	25.1	760	166	196
95	2.8	2.0	23.6	660	1.6	1.40	26.7	870	197	239
120	2.8	2.0	25.1	770	1.6	1.40	28.2	990	224	286
150	2.8	2.0	26.4	860	1.6	1.56	29.8	1120	252	318
185	2.8	2.0	28.0	1000	1.6	1.56	31.7	1280	284	368
240	2.8	2.2	31.0	1230	2.0	1.56	35.0	1560	329	440
300	3.0	2.2	33.3	1460	2.0	1.56	37.5	1820	372	509
400	3.3	2.2	36.8	1790	2.0	1.72	41.3	2220	427	602
500	3.5	2.4	40.8	2220	2.0	1.88	45.5	2720	484	699
630	3.5	2.4	44.0	2670	2.0	1.88	48.7	3210	550	817
800	3.5	2.6	48.5	3290	2.5	2.04	54.1	4050	620	965
1000	3.6	2.8	52.9	4010	2.5	2.20	58.8	4920	690	1096

● Above data are approximate and subject to manufacturing tolerance. ● Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards. ● Approximate weight of cables are only for the purpose of transportation. ● Packing length tolerance +/- 5%. ● Longer lengths as per customer requirement.

6.35 / 11 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED / ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 3

Nominal area of conductor	Nominal thickness of insulation	UNARMOURED CABLE			HARD DRAWN ALUMINIUM WIRE ARMOUR				CURRENT RATING	
		Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	3.6	2.0	20.0	420	1.6	1.40	23.0	600	97	107
35	3.6	2.0	21.0	470	1.6	1.40	24.0	660	115	134
50	3.6	2.0	22.0	530	1.6	1.40	25.0	730	135	160
70	3.6	2.0	23.5	630	1.6	1.40	26.6	830	165	200
95	3.6	2.0	25.0	740	1.6	1.40	28.3	960	197	245
120	3.6	2.0	26.7	850	1.6	1.56	30.2	1100	224	286
150	3.6	2.0	28.0	940	1.6	1.56	31.4	1210	251	324
185	3.6	2.2	30.0	1110	2.0	1.56	34.5	1440	283	373
240	3.6	2.2	32.4	1310	2.0	1.56	36.6	1670	328	445
300	3.6	2.2	34.5	1520	2.0	1.56	38.1	1900	371	513
400	3.6	2.2	37.5	1820	2.0	1.72	42.0	2270	425	603
500	3.6	2.4	41.0	2240	2.0	1.72	45.3	2690	484	705
630	3.6	2.4	44.0	2690	2.0	1.88	48.1	3230	550	821
800	3.6	2.6	48.6	3300	2.5	2.04	54.3	4100	623	964
1000	3.6	2.8	52.8	4010	2.5	2.20	58.8	4920	690	1094

11 / 11 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED / ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 4

Nominal area of conductor	Nominal thickness of insulation	UNARMOURED CABLE			HARD DRAWN ALUMINIUM WIRE ARMOUR				CURRENT RATING	
		Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	5.5	2.0	23.8	560	1.6	1.40	26.8	770	97	112
35	5.5	2.0	24.8	620	1.6	1.40	27.8	840	115	137
50	5.5	2.0	25.9	690	1.6	1.56	29.3	940	136	165
70	5.5	2.0	27.5	790	1.6	1.56	31.0	1060	166	206
95	5.5	2.0	29.1	910	2.0	1.56	33.3	1220	198	250
120	5.5	2.2	31.0	1050	2.0	1.56	35.2	1390	225	291
150	5.5	2.2	32.3	1160	2.0	1.56	36.5	1510	252	330
185	5.5	2.2	34.2	1310	2.0	1.56	38.3	1680	285	379
240	5.5	2.2	36.3	1530	2.0	1.72	40.8	1960	330	450
300	5.5	2.2	38.4	1750	2.0	1.72	43.0	2210	373	518
400	5.5	2.4	41.8	2110	2.0	1.88	45.6	2620	427	608
500	5.5	2.4	45.0	2500	2.5	2.04	51.0	3280	486	709
630	5.5	2.6	48.5	3020	2.5	2.04	53.5	3720	553	822
800	5.5	2.8	53.0	3670	2.5	2.20	58.9	4580	628	964
1000	5.5	2.8	56.9	4350	2.5	2.36	62.7	5270	697	1090

● Above data are approximate and subject to manufacturing tolerance. ● Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards. ● Approximate weight of cables are only for the purpose of transportation. ● Packing length tolerance +/- 5%. ● Longer lengths as per customer requirement.

12.7 / 22 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED / ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 5

Nominal area of conductor	Nominal thickness of insulation	UNARMOURED CABLE			HARD DRAWN ALUMINIUM WIRE ARMOUR				CURRENT RATING	
		Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
35	6.0	2.0	25.8	660	1.6	1.40	29.0	900	114	143
50	6.0	2.0	26.9	730	1.6	1.56	30.4	990	134	167
70	6.0	2.0	28.5	840	1.6	1.56	32.1	1110	164	207
95	6.0	2.2	30.5	990	2.0	1.56	34.9	1320	195	253
120	6.0	2.2	32.0	1110	2.0	1.56	36.4	1460	221	291
150	6.0	2.2	33.5	1220	2.0	1.56	37.7	1580	250	333
185	6.0	2.2	35.3	1370	2.0	1.56	39.4	1760	280	380
240	6.0	2.2	37.4	1590	2.0	1.72	42.0	2040	326	450
300	6.0	2.2	39.6	1820	2.0	1.72	44.1	2290	367	521
400	6.0	2.4	42.7	2180	2.0	1.88	47.6	2700	420	616
500	6.0	2.6	46.4	2620	2.5	2.04	52.1	3380	478	709
630	6.0	2.6	49.6	3100	2.5	2.04	55.2	3900	530	770
800	6.0	2.8	54.0	3730	2.5	2.20	60.1	4700	590	920
1000	6.0	3.0	58.2	4500	2.5	2.36	64.1	5490	640	980

19 / 33 KV, SINGLE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED / ARMOURED / UNARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 6

Nominal area of conductor	Nominal thickness of insulation	UNARMOURED CABLE			HARD DRAWN ALUMINIUM WIRE ARMOUR				CURRENT RATING	
		Nominal thickness of sheath	Approx overall dia of cable	Approx wt of cable	Nominal dia of Aluminium wire	Minimum thickness of outer sheath	Approx overall dia of cable	Approx wt of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
50	8.8	2.2	33.0	1040	2.0	1.56	37.3	1400	135	170
70	8.8	2.2	34.7	1160	2.0	1.56	38.9	1540	165	212
95	8.8	2.2	36.3	1300	2.0	1.72	40.9	1730	196	258
120	8.8	2.2	37.8	1430	2.0	1.72	42.4	1880	223	297
150	8.8	2.2	39.0	1550	2.0	1.72	43.7	2020	250	339
185	8.8	2.4	41.3	1770	2.0	1.88	46.0	2270	282	386
240	8.8	2.4	43.6	2010	2.0	1.88	48.2	2530	326	464
300	8.8	2.6	46.1	2300	2.5	2.04	51.7	3050	369	526
400	8.8	2.6	48.9	2650	2.5	2.04	54.6	3450	423	617
500	8.8	2.8	52.6	3120	2.5	2.20	58.5	4020	481	713
630	8.8	2.8	55.7	3640	2.5	2.36	62.0	4630	530	770
800	8.8	3.0	60.2	4340	2.5	2.36	66.2	5330	590	920
1000	8.8	3.2	64.5	5120	3.15	2.52	72.0	6380	640	980

● *Above data are approximate and subject to manufacturing tolerance.* ● *Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards.* ● *Approximate weight of cables are only for the purpose of transportation.* ● *Packing length tolerance +/- 5%.* ● *Longer lengths as per customer requirement.*

1.9 / 3.3 KV & 3.3 / 3.3 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, UNSCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 7

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	2.2	0.3	1.6	1.56	30.2	1360.0	4.0x0.80	1.40	28.2	1070.0	93	97
35	2.2	0.3	1.6	1.56	32.3	1600.0	4.0x0.80	1.56	30.7	1260.0	111	119
50	2.2	0.4	2.0	1.56	35.7	2070.0	4.0x0.80	1.56	33.3	1550	132	148
70	2.2	0.4	2.0	1.56	39.1	2470.0	4.0x0.80	1.56	36.7	1870	160	185
95	2.2	0.4	2.0	1.72	43.0	2740.0	4.0x0.80	1.72	40.7	2250	192	225
120	2.2	0.5	2.0	1.88	46.7	3410.0	4.0x0.80	1.72	44.0	2660	218	253
150	2.2	0.5	2.5	2.04	50.9	4280.0	4.0x0.80	1.88	46.3	3080	245	290
185	2.2	0.5	2.5	2.04	54.8	4890.0	4.0x0.80	2.04	51.4	3600	275	330
240	2.2	0.6	2.5	2.20	60.1	5790.0	4.0x0.80	2.20	56.7	4410	318	400
300	2.2	0.6	2.5	2.36	65.1	6690.0	4.0x0.80	2.20	61.3	5100	360	453
400	2.2	0.7	3.15	2.68	73.4	8890.0	4.0x0.80	2.52	68.5	6370	410	530

3.8 / 6.6 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 8

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	2.8	0.4	2.00	1.72	38.4	2260.0	4.0x0.80	1.56	36.0	1640	94	100
35	2.8	0.4	2.00	1.72	40.6	2510.0	4.0x0.80	1.72	38.5	1880	111	121
50	2.8	0.5	2.00	1.88	43.6	2840.0	4.0x0.80	1.72	41.0	2120	130	145
70	2.8	0.5	2.00	1.88	47.0	3240.0	4.0x0.80	1.88	45.0	2540	160	181
95	2.8	0.5	2.50	2.04	51.8	4140.0	4.0x0.80	1.88	48.5	2970	191	221
120	2.8	0.6	2.50	2.20	55.6	4770.0	4.0x0.80	2.04	52.0	3440	217	254
150	2.8	0.6	2.50	2.20	58.4	5210.0	4.0x0.80	2.20	55.0	3900	243	290
185	2.8	0.6	2.50	2.36	62.6	5960.0	4.0x0.80	2.20	57.8	4250	274	330
240	2.8	0.7	3.15	2.52	69.2	7670.0	4.0x0.80	2.36	64.5	5310	317	390
300	3.0	0.7	3.15	2.68	74.9	8810.0	4.0x0.80	2.52	70.2	6280	358	450
400	3.3	0.7	4.00	3.00	84.9	11720.0	4.0x0.80	2.84	78.6	7790	408	525

● Above data are approximate and subject to manufacturing tolerance. ● Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards. ● Approximate weight of cables are only for the purpose of transportation. ● Packing length tolerance +/- 5%. ● Longer lengths as per customer requirement.

6.6 / 6.6 KV & 6.35 / 11 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 9

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	3.6	0.4	2.0	1.72	42.0	2540.0	4.0x0.80	1.72	40.0	1940	93	100
35	3.6	0.5	2.0	1.88	44.8	2890.0	4.0x0.80	1.72	41.5	2020	111	121
50	3.6	0.5	2.5	2.04	48.4	3600.0	4.0x0.80	1.88	45.0	2400	130	145
70	3.6	0.5	2.5	2.04	52.0	4100.0	4.0x0.80	1.88	47.9	2700	160	181
95	3.6	0.6	2.5	2.20	56.0	4660.0	4.0x0.80	2.04	52.0	3180	191	221
120	3.6	0.6	2.5	2.36	59.5	5270.0	4.0x0.80	2.20	54.9	3660	217	254
150	3.6	0.6	2.5	2.36	62.4	5770.0	4.0x0.80	2.20	59.0	4260	243	290
185	3.6	0.7	3.15	2.52	68.0	7220.0	4.0x0.80	2.36	61.9	4640	274	330
240	3.6	0.7	3.15	2.68	73.2	8260.0	4.0x0.80	2.52	67.1	5400	317	390
300	3.6	0.7	3.15	2.84	78.0	9300.0	4.0x0.80	2.68	72.0	6300	357	450
400	3.6	0.7	4.00	3.00	86.3	11990.0	4.0x0.80	2.84	78.1	7580	408	525

11 / 11 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 10

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
25	5.5	0.5	2.50	2.04	52.0	3860	4.0x0.80	1.88	49.0	2570.0	94	100
35	5.5	0.5	2.50	2.20	55.0	4210	4.0x0.80	2.04	51.0	2820.0	112	121
50	5.5	0.6	2.50	2.20	57.5	4550	4.0x0.80	2.20	54.0	3130.0	131	145
70	5.5	0.6	2.50	2.36	61.0	5250	4.0x0.80	2.20	57.8	3560.0	160	181
95	5.5	0.6	3.15	2.52	66.4	6560	4.0x0.80	2.36	61.8	4100.0	191	221
120	5.5	0.7	3.15	2.52	70.0	7190	4.0x0.80	2.52	65.0	4620.0	217	257
150	5.5	0.7	3.15	2.68	73.0	7810	4.0x0.80	2.52	67.2	5030.0	243	221
185	5.5	0.7	3.15	2.84	77.2	8640	4.0x0.80	2.68	71.1	5690.0	273	331
240	5.5	0.7	3.15	3.00	82.2	9760	4.0x0.80	2.84	76.3	6630.0	316	390
300	5.5	0.7	4.00	3.00	88.6	12010	4.0x0.80	3.00	82.5	7520.0	357	448
400	5.5	0.7	4.00	3.00	94.8	13640	4.0x0.80	3.00	88.6	8890.0	408	523

● Above data are approximate and subject to manufacturing tolerance. ● Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards. ● Approximate weight of cables are only for the purpose of transportation. ● Packing length tolerance +/- 5%. ● Longer lengths as per customer requirement.

12.7 / 22 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 11

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
35	6.0	0.6	2.50	2.20	57.0	4570	4.0x0.80	2.04	53.5	3170	110	132
50	6.0	0.6	2.50	2.36	59.1	4910	4.0x0.80	2.20	56.0	3520	129	157
70	6.0	0.6	2.50	2.36	63.5	5430	4.0x0.80	2.36	60.0	4010	158	194
95	6.0	0.7	3.15	2.52	69.0	6870	4.0x0.80	2.36	63.7	4560	188	224
120	6.0	0.7	3.15	2.68	72.4	7540	4.0x0.80	2.52	67.0	5100	213	257
150	6.0	0.7	3.15	2.68	75.2	8160	4.0x0.80	2.68	70.4	5630	239	292
185	6.0	0.7	3.15	2.84	79.5	8990	4.0x0.80	2.68	73.3	6030	269	332
240	6.0	0.7	4.00	3.00	86.2	11250	4.0x0.80	2.84	79.4	7230	312	390
300	6.0	0.7	4.00	3.00	90.8	12390	4.0x0.80	3.00	84.3	8200	352	448
400	6.0	0.7	4.00	3.00	96.9	14030	4.0x0.80	3.00	90.5	9520	402	523

19 / 33 KV, THREE CORE, ALUMINIUM CONDUCTOR, XLPE INSULATED, SCREENED, ARMOURED AND PVC SHEATHED CABLES CONFORMING TO IS : 7098 (PART - 2)

TABLE - 12

Nominal area of conductor	Nominal thickness of insulation	Nominal thickness of inner sheath	ROUND GALVANISED STEEL WIRE ARMOURED				FLAT GALVANISED STEEL STRIP ARMOURED				CURRENT RATING	
			Nominal diameter of round wire	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Nominal dimensions of flat strip	Minimum thickness of outer sheath	Approx overall diameter of cable	Approx weight of cable	Direct in ground 30°C	In Air 40°C
Sq mm	mm	mm	mm	mm	mm	kg/km	mm	mm	mm	kg/km	Amps	Amps
50	8.8	0.7	3.15	2.68	74.7	7540	4.0x0.80	2.52	69.6	5010	130	158
70	8.8	0.7	3.15	2.84	78.4	8240	4.0x0.80	2.68	73.3	5580	158	198
95	8.8	0.7	3.15	3.00	82.2	8960	4.0x0.80	2.84	77.0	6130	188	236
120	8.8	0.7	4.00	3.00	87.0	10880	4.0x0.80	2.84	80.3	6780	214	270
150	8.8	0.7	4.00	3.00	90.0	11570	4.0x0.80	3.00	83.5	7360	239	293
185	8.8	0.7	4.00	3.00	93.9	12420	4.0x0.80	3.00	86.4	7680	270	348
240	8.8	0.7	4.00	3.00	98.0	13630	4.0x0.80	3.00	91.2	9050	312	408
300	8.8	0.7	4.00	3.00	103.2	14850	4.0x0.80	3.00	96.7	9740	352	449
400	8.8	0.7	4.00	3.00	109.4	16610	4.0x0.80	3.00	101.5	11010	402	522

● Above data are approximate and subject to manufacturing tolerance. ● Conductor constructions are indicative only and will be such that requirement of conductor resistance is complied as per relevant IS standards. ● Approximate weight of cables are only for the purpose of transportation. ● Packing length tolerance +/- 5%. ● Longer lengths as per customer requirement.

STRANDED CONDUCTOR FOR INSULATED CABLES CONFORMING TO IS:8130

TABLE - 13

Nominal size of conductor	STRANDED CONDUCTOR CLASS - 2					
	Number of Wires in Conductors				Maximum dc Resistance Conductor at 20°C	
	Circular Conductor (non-compacted)		Circular Conductor Shaped Conductor		Plain Copper	Aluminium
Sq.mm	Copper	Aluminium	Copper	Aluminium	Ohm / km	Ohm / km
25	7	7	7	7	0.727	1.200
35	7	7	7	7	0.524	0.868
50	19	19	7	7	0.387	0.641
70	19	19	19	19	0.268	0.443
95	19	19	19	19	0.193	0.320
120	19	19	19	19	0.153	0.253
150	19	19	19	19	0.1240	0.206
185	37	37	37	37	0.0991	0.164
240	37	37	37	37	0.0754	0.125
300	37	37	37	37	0.0601	0.1000
400	59	59	59	59	0.0470	0.0778
500	59	59	59	59	0.0366	0.0605
630	59	59	59	59	0.0283	0.0469
800	59	59	59	59	0.0221	0.0367
1000	91	91	91	91	0.0176	0.0291

SHORT CIRCUIT RATING OF XLPE INSULATED HEAVY DUTY CABLES (FOR ONE SECOND DURATION)

TABLE - 14

Nominal size of conductor	ALUMINIUM CONDUCTOR	COPPER CONDUCTOR
Sq.mm	K.Amp.	K.Amp.
25	2.350	3.580
35	3.290	5.010
50	4.700	7.150
70	6.580	10.010
95	8.930	13.590
120	11.280	17.160
150	14.100	21.450
185	17.390	26.460
240	22.560	34.320
300	28.200	42.900
400	37.600	57.200
500	47.000	71.500
630	59.220	90.090
800	75.200	114.300
1000	94.000	143.000

AC RESISTANCE TO CIRCULAR / COMPACTED CONDUCTORSFOR INSULATED CABLES CONFORMING

TABLE - 15

Nominal Area	Number of wires		Max A C resistance at 90°C (Copper)	AC resistance at 90°C (Aluminum)
	Circular Conductor	Compacted Conductors		
Sq mm	mm	mm	(ohm/km)	(ohm/km)
25	7	7	0.927	1.5400
35	7	7	0.669	1.1100
50	19	7	0.494	0.8220
70	19	19	0.343	0.5680
95	19	19	0.247	0.4110
120	19	19	0.197	0.3250
150	19	19	0.161	0.2650
185	37	37	0.130	0.2110
240	37	37	0.0966	0.1620
300	37	37	0.0769	0.1300
400	59	59	0.0602	0.1020
500	59	59	0.0468	0.0804
630	59	59	0.0369	0.0639
800	59	59	0.0285	0.0518
1000	91	91	0.0227	0.0432

CALCULATED VALUE OF REACTANCE FOR THREE CORE CABLES

TABLE - 16

Nominal area	Reactance (ohms/km) (at 50Hz)					
(Sq mm)	3.3 KV	3.8/6.6 KV	6.35/11 KV	11/11 KV	12.7/22 KV	19/33 KV
25	0.098	0.120	0.125	0.140	-	-
35	0.094	0.114	0.119	0.134	0.137	-
50	0.086	0.110	0.114	0.128	0.131	0.146
70	0.084	0.101	0.105	0.118	0.121	0.138
95	0.081	0.097	0.101	0.112	0.115	0.128
120	0.078	0.094	0.098	0.108	0.111	0.124
150	0.076	0.092	0.095	0.105	0.108	0.120
185	0.075	0.088	0.091	0.101	0.103	0.115
240	0.073	0.086	0.088	0.097	0.099	0.110
300	0.072	0.085	0.086	0.094	0.096	0.106
400	0.071	0.084	0.083	0.091	0.093	0.102

CALCULATED VALUE OF REACTANCE FOR THREE SINGLE CORE CABLES (CABLES IN TREFOIL TOUCHING)

TABLE - 17

Nominal area	3.8/6.6 KV		6.35/11 KV		11/11 KV		12.7/22 KV		19/33 KV	
(Sq mm)	Un Arm	Arm.	Un Arm	Arm.	Un Arm	Arm.	Un Arm	Arm.	Un Arm	Arm.
25	0.139	0.149	0.146	0.164	0.154	0.164	-	-	-	-
35	0.132	0.142	0.137	0.156	0.146	0.156	0.149	0.158	-	-
50	0.125	0.133	0.128	0.147	0.138	0.147	0.140	0.149	0.153	0.161
70	0.117	0.127	0.121	0.139	0.130	0.139	0.133	0.14	0.144	0.152
95	0.111	0.121	0.115	0.133	0.124	0.132	0.126	0.134	0.137	0.145
120	0.106	0.116	0.111	0.127	0.119	0.126	0.121	0.13	0.131	0.140
150	0.104	0.113	0.108	0.124	0.115	0.124	0.117	0.126	0.128	0.135
185	0.101	0.109	0.105	0.12	0.112	0.120	0.114	0.122	0.123	0.130
240	0.0977	0.105	0.101	0.117	0.108	0.116	0.11	0.118	0.119	0.126
300	0.0955	0.104	0.0976	0.113	0.104	0.112	0.106	0.113	0.115	0.122
400	0.094	0.102	0.0952	0.11	0.102	0.109	0.103	0.11	0.111	0.117
500	0.0928	0.0998	0.0931	0.107	0.0983	0.105	0.1	0.107	0.108	0.113
630	0.0899	0.0964	0.0901	0.104	0.0956	0.102	0.0969	0.103	0.104	0.111
800	0.0881	0.0938	0.0876	0.0998	0.0917	0.0971	0.0934	0.0997	0.0995	0.105
1000	0.0854	0.0918	0.0857	0.0983	0.0899	0.0959	0.0911	0.097	0.0967	0.102

CAPACITANCE VALUE OF XLPE INSULATED CABLES (AT 50 HZ)

TABLE - 18

Nominal area	Capacitance (mfd/km)					
(Sq mm)	3.3 KV	3.8/6.6 KV	6.35/11 KV	11/11 KV	12.7/22 KV	19/33 KV
25	0.260	0.237	0.198	0.149	-	-
35	0.293	0.264	0.219	0.163	0.154	-
50	0.330	0.293	0.242	0.178	0.168	0.132
70	0.382	0.336	0.275	0.201	0.189	0.146
95	0.438	0.381	0.310	0.224	0.210	0.162
120	0.484	0.418	0.339	0.243	0.228	0.174
150	0.530	0.454	0.368	0.262	0.246	0.186
185	0.592	0.504	0.407	0.288	0.269	0.203
240	0.666	0.563	0.453	0.319	0.297	0.222
300	0.741	0.586	0.500	0.350	0.326	0.242
400	0.837	0.605	0.560	0.389	0.362	0.267
500	0.864	0.622	0.60	0.40	0.374	0.27
630	0.882	0.680	0.66	0.44	0.410	0.29
800	0.946	0.764	0.74	0.51	0.460	0.34
1000	0.992	0.830	0.830	0.58	0.520	0.37

RATING FACTOR FOR VARIATION IN GROUND AND DUCT TEMPERATURE FOR

TABLE- 19

Temperature ˚C	15	20	25	30	35	40	45	50	55
Rating Factor (Maximum conductor temperature 90˚C)	1.12	1.08	1.04	1.00	0.96	0.91	0.87	0.82	0.78

RATING FACTOR FOR VARIATION IN AMBIENT AIR TEMPERATURE FOR XLPE CABLES

TABLE- 20

Temperature ˚C	25	30	35	40	45	50	55	60
Rating Factor (Maximum conductor temperature 90˚C)	1.16	1.11	1.06	1.00	0.94	0.88	0.81	0.74

RATING FACTOR FOR DEPTH OF LAYING (CABLES LAID DIRECT IN THE GROUND)

TABLE- 21

Depth of Laying Cm	UP TO 11 KV XLPE Cables	22433 KV Cables
90	1.00	-
105	0.99	1.00
120	0.97	0.99
150	0.95	0.97
180	0.94	0.96
200	0.93	0.94
250	0.91	0.93
300 or more	0.90	0.92

GROUP RATING FACTORS FOR CIRCUITS OF THREE SINGLE - CORE CABLES, IN TREFOIL LAID 'DIRECT IN THE GROUND

TABLE - 22

No. of Circuits	Spacing between Trefoil Group Centres (Cm)				
	Touching	20	40	60	80
2	0.76	0.83	0.87	0.90	0.92
3	0.64	0.72	0.79	0.83	0.86
4	0.58	0.67	0.75	0.80	0.84
5	0.53	0.63	0.71	0.77	0.81
6	0.50	0.60	0.69	0.76	0.80
7	0.47	0.58	0.67	0.74	0.79
8	0.45	0.56	0.66	0.73	-
9	0.43	0.55	0.65	0.73	-
10	0.42	0.54	0.64	-	-
11	0.41	0.53	0.64	-	-
12	0.40	0.52	0.63	-	-

RATING FACTORS FOR CABLES LAID ON RACKS IN AIR WITH CABLE TOUCHING, TRAYS ARE IN TIERS SPACED BY 30cm AND CLEARANCE BETWEEN THE WALL AND CABLE IS 25cm

TABLE - 23

No. of Racks	Number of Cables per Rack				
	1	2	3	6	9
1	1.00	0.84	0.80	0.75	0.73
2	1.00	0.80	0.76	0.71	0.69
3	1.00	0.78	0.74	0.70	0.68
6	1.00	0.76	0.72	0.68	0.66

RATING FACTORS FOR THREE SINGLE CORE CABLES IN TREFOIL ON RACKS IN AIR (WITH SPACING BETWEEN CABLES EQUAL TO TWICE THE CABLE DIAMETER)

TABLE - 24

No. of Racks	Number of Cables per Rack		
	1	2	3
1	1.00	0.98	0.96
2	1.00	0.95	0.93
3	1.00	0.94	0.92
6	1.00	0.93	0.90

GROUP RATING FACTORS FOR MULTICORE CABLES IN GROUND HORIZONTAL FORMATION

TABLE -25

Number of Cables in group	Spacing			
	Touching	15 cm	30 cm	45 cm
2	0.78	0.81	0.85	0.88
3	0.68	0.71	0.76	0.79
4	0.61	0.65	0.71	0.75
5	0.56	0.60	0.67	0.72
6	0.53	0.57	0.64	0.69
7	0.50	0.55	0.62	0.67
8	0.48	0.53	0.60	0.66
9	0.46	0.51	0.59	0.65
10	0.45	0.50	0.58	0.64

RATING FACTORS FOR MULTICORE CABLES LAID ON RACKS IN AIR (WITH CABLE SPACING BETWEEN CABLES EQUAL TO DIAMETER OF CABLE)

TABLE - 26

Number of racks	Number of cables per rack				
	1	2	3	6	9
1	1.00	0.98	0.96	0.93	0.92
2	1.00	0.95	0.93	0.90	0.89
3	1.00	0.94	0.92	0.89	0.88
6	1.00	0.93	0.90	0.87	0.86

RATING FACTORS FOR VARIATION IN THERMAL RESISTIVITY OF SOIL FOR THREE SINGLE - CORE CABLES AND THREE CORE XLPE CABLES LAID DIRECT IN THE GROUND

TABLE - 27

Nominal size of conductor	Three single core cables Thermal Resistivity of Soil in C CM/W						Three core cables Thermal Resistivity of Soil in C CM/W					
Sq. mm	100	120	150	200	250	300	100	120	150	200	250	300
25	1.17	1.09	1.00	0.88	0.80	0.74	1.16	1.08	1.00	0.90	0.82	0.75
35	1.18	1.10	1.00	0.88	0.80	0.74	1.16	1.08	1.00	0.90	0.81	0.75
50	1.19	1.10	1.00	0.88	0.80	0.73	1.16	1.08	1.00	0.88	0.81	0.75
70	1.19	1.10	1.00	0.88	0.80	0.73	1.16	1.09	1.00	0.88	0.81	0.75
95	1.19	1.10	1.00	0.88	0.79	0.73	1.16	1.09	1.00	0.88	0.81	0.75
120	1.19	1.10	1.00	0.88	0.79	0.73	1.16	1.09	1.00	0.88	0.81	0.75
150	1.19	1.10	1.00	0.88	0.79	0.73	1.16	1.09	1.00	0.88	0.81	0.75
185	1.19	1.10	1.00	0.88	0.79	0.72	1.16	1.09	1.00	0.88	0.81	0.75
240	1.20	1.11	1.00	0.88	0.79	0.72	1.17	1.09	1.00	0.88	0.81	0.75
300	1.20	1.11	1.00	0.87	0.79	0.72	1.17	1.09	1.00	0.88	0.81	0.75
400	1.20	1.11	1.00	0.87	0.79	0.72	1.17	1.09	1.00	0.88	0.81	0.75
500	1.20	1.11	1.00	0.87	0.79	0.72	1.17	1.09	1.00	0.88	0.81	0.74
630	1.21	1.11	1.00	0.87	0.78	0.72	-	-	-	-	-	-
800	1.21	1.11	1.00	0.87	0.78	0.72	-	-	-	-	-	-
1000	1.21	1.11	1.00	0.87	0.78	0.72	-	-	-	-	-	-

Estimated Voltage Drops in XLPE Cables (Aluminium Conductor) (Voltage drop unit: Volts/Km/Amps)

TABLE- 28

Cores	Cable Sqmm.														
	25	35	50	70	95	120	150	185	240	300	400	500	630	800	1000
Single Core	3.08	2.23	1.65	1.15	0.83	0.66	0.55	0.44	0.35	0.30	0.24	0.23	0.21	0.20	0.18
Multi Core	2.67	1.94	1.44	1.00	0.70	0.56	0.48	0.40	0.30	0.26	0.22	0.20	0.18	----	----

* Above voltage drops (volts/km/amps) to be multiplied with rated current and length of cable in K.M. to calculate total voltage drop in particular length and size of Cables.

GROUP RATING FACTORS FOR THREE - CORE CABLES IN HORIZONTAL FORMATION, LAID DIRECT IN THE GROUND

TABLE - 29

No. of Cables	Spacing of Cables (Centre to Centre)				
	Touching	15 Cm	30 Cm	45 Cm	60 Cm
2	0.80	0.84	0.87	0.90	0.91
3	0.68	0.74	0.79	0.83	0.86
4	0.62	0.69	0.75	0.80	0.83
5	0.58	0.65	0.72	0.77	0.80
6	0.55	0.62	0.69	0.75	0.78
7	0.52	0.59	0.67	0.73	0.77
8	0.50	0.57	0.66	0.72	0.75
9	0.48	0.55	0.65	0.71	0.75
10	0.46	0.54	0.64	0.70	0.74
11	0.45	0.53	0.63	0.70	0.74
12	0.44	0.52	0.62	0.69	0.73

GROUP RATING FACTORS FOR THREE - CORE CABLES IN TIER FORMATION, LAID DIRECT IN THE GROUND

TABLE - 30

No. of Cables	No. of Tiers	Spacing of Cables (Centre to Centre)				
		Touching	15 Cm	30 Cm	45 Cm	60 Cm
2	1	0.88	0.84	0.87	0.90	0.91
3	1	0.68	0.74	0.79	0.83	0.86
4	2	0.60	0.66	0.73	0.77	0.79
5	2	0.55	0.61	0.68	0.71	0.73
6	2	0.51	0.57	0.63	0.67	0.69
7	3	0.48	0.54	0.59	0.63	0.64
8	3	0.46	0.51	0.56	0.60	0.61
9	3	0.44	0.48	0.53	0.57	0.58
10	4	0.42	0.47	0.52	0.55	0.56
11	4	0.41	0.46	0.50	0.54	0.55
12	4	0.40	0.45	0.49	0.53	0.54

BENDING RADIUS:

While Installing 'GLOSTER' Cables, the following minimum bending radius should be observed such that the cables, and especially the insulation, are not damaged. Wherever possible, larger bending radii should be used.

RECOMMENDED MINIMUM BENDING RADII
(15 X D) For Single Core Cables up to 11 KV
(20 X D) For Single Core Cables
(15 X D) For Multi Core Cables

Where 'D' is the overall diameter of Cables.

TESTING INSULATION RESISTANCE MEASUREMENT OF CABLE

The voltage rating of I R Tester (Megger) should be chosen as following table:

VOLTAGE GRADE OF CABLES	RATING OF IR TESTER (MEGGER)	VOLTAGE GRADE OF CABLE	RATING OF IR TESTER (MEGGER)
3.3 KV	1000 V	22 KV	2500 V
6.6 KV	1000 V	33 KV	2500 V

TESTING DURING LAYING:

All new cables shall be megger-tested before jointing. After jointing is completed all cables shall be megger-tested.

JOINTING OF CABLE:

The emphasis should be laid on quality and selection of proper cable accessories, proper jointing techniques and skill and workmanship of the working personnel. The quality of joint should be such that it does not add any resistance to the circuit. The materials and techniques employed should give adequate mechanical and electrical protection to the joints under all service conditions. The joint should further be resistant to corrosion and other chemical effects. Termination and jointing of power and control cables shall be done by means of compression methods using solder less tinned copper/Aluminum terminal lugs.

HIGH VOLTAGE TEST:

Cables after jointing and terminations are subjected to dc high voltage test. The recommended test voltage are given in I.S. 1255 - 1983.

The cable cores must be discharge after completion of dc high voltage test.

HT AERIAL BUNCHED CABLES

Applicable Standards :

- REC Specification 64/1993.
- IS 8130: 2013 Conductors for insulated cables.
- IS 398: 1994 Part IV Aluminium alloy conductor.
- IS 7098-Part 2: 2011 used generally for Aerial Bunched Cable.

Conductor:

- Power conductors conform to Grade H4 and Class 2 of IS 8130:2013.
- Messenger conductor :
  Special Aluminium Alloy (usually specially treated Silica, Magnesium alloy & Aluminium Alloy).
  Either stranded circular or compacted circular type.
  Minimum 7 strands.
  Surface of conductor shall be smooth.
- No Lighting conductor envisaged in HT AB Cable.
- No joints permitted in any wire in messenger conductor.
- Direction of outer layer of wires in messenger is right hand.

Insulation:

As per IS : 7098 Part (II)

Identification:

Identification by Ridges like in LT AB Cable on PVC/PE sheathing over copper tape or by R - Y - B below copper tape.

Max Operating Temp :

XLPE: Max 90°C.

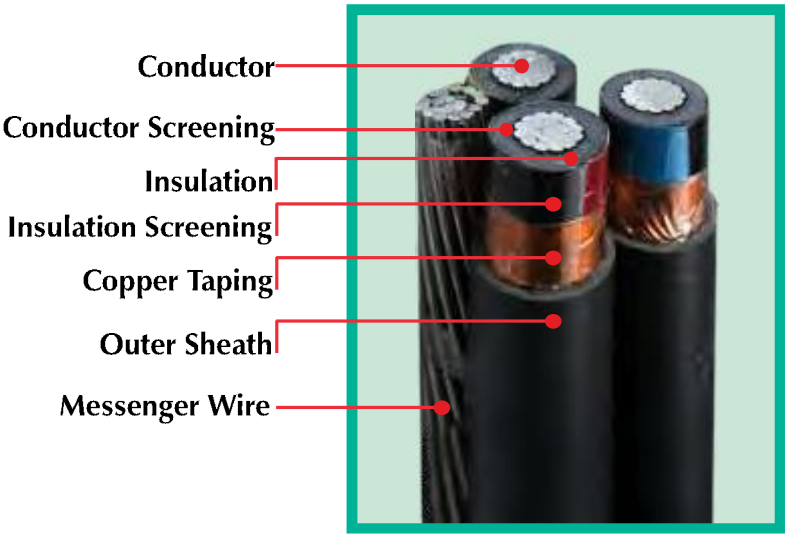
Construction:

The phase conductor are screened with extruded semi conducting layer over the conductor, forming the conductor screen
Suitable Voltage grade XLPE compound is then extruded over conductor screen.
Another semi conducting layer is then extruded over the insulation forming the insulation screen.
Additionally a metallic screen (copper tape) is wrapped over the insulation screen.
Further cores are sheathed with PVC or PE.
Rest of construction is now same as that of LT AB cable.

Routine tests are carried out on each and every length of cable manufactured as per relavant IS specifications.

Manufacturing :

As Per Customer Requirement.



PACKING, HANDLING AND STORAGE

PACKING

Cables are generally received wound on wooden drums, both the ends of the cable being easily accessible for inspection and testing. However short length may be transported in coils without drums with prior intimation to customer.

In case of paper-insulated lead-sheathed cables, both the ends of cables should be protected form moisture by means of plumbed lead caps. In case of PVC and XLPE cables sealed plastic caps or heat shrinkable caps should be used. The cable shall be wound on drums and packed.

The cable drums shall carry the following information either stenciled or contained in a label attached to it.

- Reference of Indian standard,
- Manufacture's name or trade-mark;
- Type of cable and voltage grade;
- Number of cores;
- Nominal cross sectional area of conductor;
- Cable code;
- Length of cable on the drum;
- Number of length on the drum (if more than one);
- Direction of rotation of drum (by arrow);
- Gross mass;
- Country of manufacture
- Year of manufacture
- The cable drums or label may also be marked with ISI Standard mark.

HANDLING

On receipt of cable drums visual inspection of drums should be made ensuring drum packing is original. When unloading the cables, certain precautions should be taken to ensure the safety of the cables:-

a) The cable drums should not be dropped or thrown from railway wagons or trucks during unloading operations as the shock may cause serious damage to cable layers. A crane should be used for unloading of cable drums. When lifting drums with the crane, it is recommended that the lagging should be kept in place to prevent the flanges from crushing on to the cable. If the crane is not available, a ramp should be prepared with approximate inclination of 1:3 or 1:4. The cable drum should be rolled over the ramp by means of ropes and winches. Additionally, a sand bed at the foot of the ramp may be prepared to brake the rolling of the cable drum.

b) Cable should not be dragged along the earth surface.

c) The arrows painted on the flange of the drum indicate the direction in which the drum should be rolled. The cable will unwind and become loose if the drum is rolled in the opposite direction. Improper handling or uncoiling of cable from reels or coils often results in the “springing” of armour of the cable and kinking of the cables both of which are very difficult to be corrected. It reduces effective cable life considerably.

To avoid this, the following steps are to be followed:

i) If the cable is supplied on a reel, it should be mounted on a shaft and cable paid off from the reel while it rotates. Suitable brakes should be applied on the flanges of the reel.

ii) If the cable is supplied in large coils these should be mounted on a turn table with suitable brakes and cable paid off while the turn table rotates.

iii) Small coils of cables can be made to roll along the ground for uncoiling.

iv) Cable should neither be pulled straight from the coil while the coil rests on the ground nor be taken off turning from reel while it is lying on its flange on the ground.

v) Also never allow the reel to rotate at high speed during pay off.

STORAGE

The site chosen for storage of cables should be well drained. Cable should be stored in a dry and covered place to prevent exposure to climatic conditions and wear and tear of wooden drums and it should preferably be on a concrete surface/firm surface, which will not cause the drums to sink and thus lead to flange rot and extreme difficulty in moving the drums.

However cable drum can be stored in uncovered area, but the area should be free from corrosive agents such as chemicals and fumes etc. Also the lagging should be kept in place to avoid cable surface from direct sunrays. The cables stored in hot condition at higher temperature may cause oxidation of outer sheath jacket, whenever a cable length is cut, it should be recapped to avoid ingress of water in the cable.

All drums should be stored in such a manner as to leave sufficient space between them for air circulation. It is desirable for drums to stand on battens placed directly under the flanges. During storage the drum should be rolled to an angle of 90 º once every 3 months, This will avoid collapsing of barrel of drum due to weight pressure continuously in one direction for longer period. In no case, should the drum be stored “on the flat” that is, with flange horizontal.

If it is necessary to rewind a cable on to another drum, the barrel of the drum should have a diameter not less than that of the original drum.

LAYING

The selection of the route should first be decided keeping in view the intermediate and ultimate use of the cable as an intermediate part of the transmission and distribution system.

For transporting the cable drum to site, it is necessary to check the road condition, whether it has loose soil, is marshy, water logged etc.

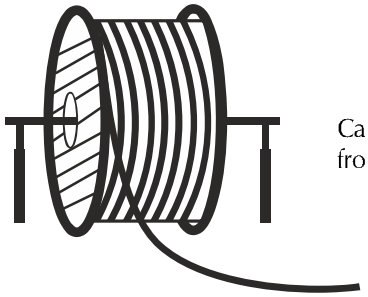
If possible, cables should be laid along the footpath rather than the carriageway. Plans for future building projects should be considered. The route should be away from parallel running gas, water pipes and telephone cables. Also suitable locations for cable joints and end termination should be selected as required.

On receipt of the drum at site, the plank should be removed and the cable is examined for exterior damage, if any. To avoid damage to the protective covering and the insulation the cable must not be pulled across hard and sharp objects.

For laying of cables special cares to be taken to prevent sharp bending, kinking, twisting. Cable should be unwound from drum by proper mounting the cable drum on a cable wheel making sure the spindle is strong enough to carry the weight without bending and that it is lying horizontally in the bearings so as to prevent the drum creeping to one side or the other while it is rotating.

This is incorrect way of pulling the cable & will cause kinks & twist in cable. Shall be avoided at all.

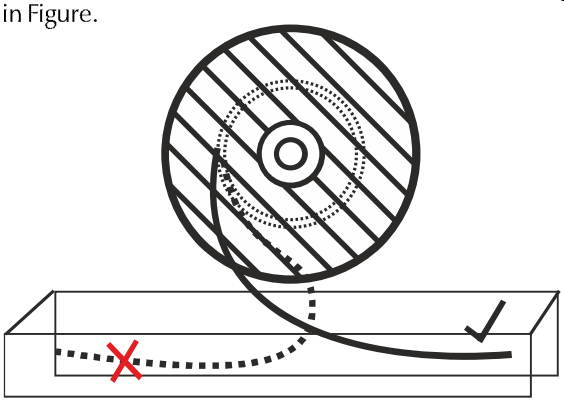
Provision should be made to break the drum to avoid further rolling & buckling of cable during sudden stop. A simple wooden plank can serve this purpose



Cable must be pulled from the top

Cable must not be pulled across hard & sharp object to avoid the damage to the covering & insulation.

Cable must be laid in ducts or trenches as showing in Figure.



However, following salient points are to be considered during laying procedure of cables laid in racks and in build-in trenches.

1. For laying of cables, power cables are to be placed at the bottom most layer and control cables at top most layer.

2. Single core power cable for use on AC system shall be laid in delta formation supported by non-magnetic material. Trefoil clamps of suitable size are to be placed at regular intervals but preferably not more than 800 mm. Axial spacing of two circuits in delta formation shall not be less than 4 times the cable dia. In case of multicore power cables, cables shall be laid side by side, with spacing not less than one cable diameter. However derating factors for cables laid on trenches are to be referred.

Multicore power cables and single core DC circuits may be clamped by means of galvanized mild steel saddles. The saddles shall not be placed at intervals more than 1500 mm. for horizontal and 1200 mm. for vertical runs.

3 Multicore control cables can be laid touching each other on cable racks and wherever required may be taken in two layers. They should be clamped by means of PVC straps both for horizontal and vertical runs, (alternatively, fabricated aluminum clamps may be used) at regular intervals.

4 a) If the cable are buried directly in ground. I.S. 1255 is to be followed for code of practice. However generally cables are laid 1000 mm. below finished ground level at any point of cable run and 75 mm. of sand cushioning to be provided.

b) In loose soil concrete pillar should be provided for as support and hence pipes are recommended to the used for cable path

5 If there is a possibility of mechanical damage, cable should be protected by means of mild steel covers placed on racks.

6 Method of Installation:

- Three Core Cables: Installed independently
- Single Core Cables: Three cables in a trefoil touching each other

7 Maximum safe pulling force (when pulled by pulling eye)

Aluminum conductor cables: 3.0 kg/mm^2
Copper conductor cables: 5.0 kg/mm^2

Proper method of pulling of cable should be used. Refer I.S. 1255-1983, code of practice for installation and maintenance of power cables.