



**NICCO
CORPORATION
LIMITED**

MV-XLPE CABLES





Control Room of CCV Line



Continuous Catenary Vulcanising (CCV) Extrusion Platform



Partial Discharge Test



About Nicco

For over 6 decades NICCO Cables have provided vital inputs for various key sectors of Indian Industries. As demand for Electric Power has increased in the successive Five Year Plans of the Government of India NICCO has kept pace with it not only by developing its own know-how for extending and updating its product range but also by setting up a New Unit with most modern machineries & equipments at Baripada in Orissa. Today NICCO's Shyamnagar factory and the other factory at Baripada together cover most conceivable needs of cables, wires & conductors: XLPE insulated Power Cables upto and including 66 kV : PVC insulated Power Cables upto 6.6 kV, and control cables ; Railway Signalling cables, Heat Resistant PVC insulated cables for high temperature use, rubber, thermoplastic and elastomeric insulated flexible cables for use in aviation, locomotives, mines, domestic and farm wiring, industrial wiring, welding, instrumentation, space research, furnace, fire risk areas (FRS), boiler wiring, Communications Cables, Data Transmission Cables etc. including the conventional AAC & ACSR conductors for overhead power transmission, are just a few items of NICCO's wide range of products to mention.

To meet the demanding requirements of higher performance standard of cables, a new plant to manufacture, for the first time in India, New Generation cables embodying state-of-the art ELECTRON BEAM IRRADIATION is now in operation at the Company's Shyamnagar Factory.

The R&D Department of the Company is recognised by the Ministry of Science & Technology, Government of India. Research and Development work of the company is now in progress on Extra High Voltage cables upto 220 kV including their accessories.

NICCO's continuous endeavour to perfect product quality has earned for it complete confidence of all its customers at Home and also in the International Market.

The company has extensive marketing network covering all the principal Cities in India.



ISO:9002 certification has been awarded to Company's factories at Baripada and ISO:9001 to Shyamnagar. Company's Baripada factory is a proud recipient of the Environmental Management Systems Certification ISO:14001.

Introduction

Cross-Linked Polyethylene (XLPE) has been recognised worldwide as an ideal dielectric for wires and cables since its commercial application began around 1960.

It has excellent mechanical, electrical and thermal properties surpassing those of conventional polymeric dielectrics. The superior properties of XLPE have led to lower insulation thickness and reduced cable weight and dimensions when compared to other conventional plastomeric or elastomeric insulations.

Since the mid-sixties, XLPE cables have brought a revolution in the field of cables and have progressively replaced conventional paper insulated and other extruded dielectric cables. The superior performance of XLPE cables have led the cablemakers to choose this solid dielectric cable in preference to pressurised supertension cables.

In line with worldwide trends, NICCO introduced this new technology in 1984 by installing a plant at Baripada in Orissa which is most sophisticated plant available for manufacture of XLPE cables by the Dry Cure process.

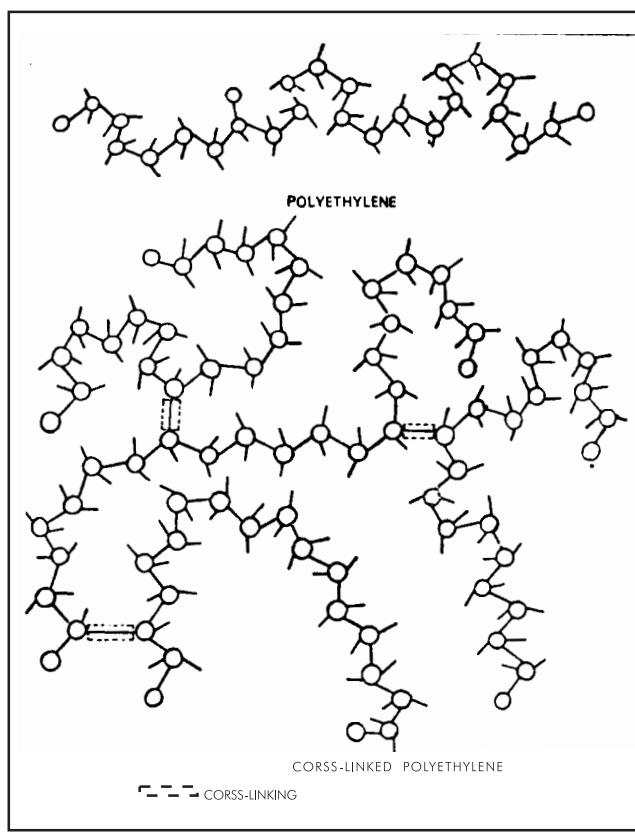
NICCO XLPE cables are available for the complete range required for transmission & distribution of electricity – with conductor sizes ranging from 16 sq.mm. to 1000 sq.mm. and voltage rating upto and including 66 kV, conforming to Indian as well as various other national and international standards.

This publication gives details of dimensions, weights, current ratings and other technical data of NICCO XLPE Cables upto and including 33 kV conforming to IS : 7098 (part II).

Due to continuous innovation in design of cables and changes in the specifications, the figures quoted in this Publication are subject to change without notice.

Properties and Advantages

XLPE is an abbreviation of Cross-Linked Polyethylene. This has been recognised world wide as an excellent dielectric for wires and cables. It first went into commercial production in 1960. Polyethylene which is a thermoplastic material is converted into a thermosetting material by a process similar to vulcanisation of rubber. By crosslinking, the linear chain structure of polyethylene is changed into three-dimensional network structure. By this change, polyethylene which has outstanding dielectric properties is made resistant to extremes of temperature. The high resistance to heat deformation and ageing in hot air provide important advantage in cable ratings and is of special significance at locations where the ambient temperature is high. These, along with better resistance to environmental stress cracking and low dielectric constant make XLPE Cables particularly suitable for high voltage applications.



A Few striking features of XLPE Cables :

High Continuous Current Ratings :

Higher continuous operating temperature of 90°C for conductor permits XLPE Cables to withstand higher current ratings than PVC or PILC Cables.

High Short Circuit Ratings :

Maximum allowable continuous temperature during short circuit is 250°C , which is vastly increased as compared to PVC or PILC Cables.

Little Deformation at High Temperature:

Under combined heat and mechanical pressure XLPE suffers less deformation compared to other solid dielectrics.

High Emergency Load Capacity :

XLPE cables can be operated at 130°C during emergency. This should not exceed 2 hours a day,

100 hrs. per year or 500 hrs. during the lifetime of the cable. Due to this 20% higher current than the specific rating may be carried for this period.

Low Dielectric Loss :

The dielectric loss angle of XLPE is much lower than conventional dielectric. The dielectric losses are quadratically dependent on the voltage. Hence use of XLPE Cables at higher voltages would generate considerable saving in costs.

Low Charging Currents :

The charging currents are considerably lower than other dielectrics. This permits close setting of protection relays.

Lighter Weight :

XLPE Cables are easier to handle because of its light weight. The small bending radii makes laying and installation of cables very easy.

Manufacture

The NICCO XLPE Cables are manufactured in its sophisticated modern plant at Baripada, Orissa. Manufacture of XLPE cables require great skill at all stages of processing. The extrusion should be smooth, homogeneous and free from objectionable voids and contaminations. Material handling systems are designed so as to ensure minimum contamination. For high voltage cables, conductors and insulation shields should be uniform, smooth and must adhere to insulation without any void, imperfection or contamination. **This is ensured by the triple extrusion using single (common) crosshead extrusion technique and Drycure inert gas cured cross linking process.** The cables are manufactured and tested in accordance with IS : 7098.

Advantage of Dry Curing Process :

Higher Production Speed
Virtually free from micro voids and moisture.
Higher Working Stress.
Higher ac impulse voltage breakdown characteristics.

Conductor

The conductors are made from electrical grade aluminium wires and are stranded together and compacted. Conductor construction and testing comply to IS : 8130. **Cables with copper conductor can also be made.**

Insulation

High quality XLPE compounds of natural colour is used for insulation. Insulation is applied by the Triple Extrusion Process and is chemically cross-linked in continuous vulcanising process.

Shielding

XLPE Cables rated above 3.3 kV are provided with both conductor shielding and insulation shielding, consisting of extruded semiconducting compound. Additionally, insulation shield is provided with metallic tape shield over the extruded semiconducting shield.

Inner Sheath

In case of multicore cables, cores are laid together with suitable fillers in the interstices and provided with common tape covering. Alternatively, an extruded inner sheath is provided.

Armouring

Armouring is applied over the inner sheath and it normally comprises flat steel strips for multicore cables. Alternatively, round steel wire armouring can also be offered. Single core armoured cables are provided with non-magnetic armour consisting of hard drawn round aluminium wires.

Outer Sheathing

A tough outer sheath of heat resistant PVC Compound as per IS : 5831 is extruded over the armouring in case of armoured cables, or over the inner sheath in case of unarmoured cables. The outer sheath is usually black in colour for maximum resistance to outdoor exposure.

Testing And Quality Assurance

XLPE Cables are manufactured under strict quality control. Quality is ensured through stagewise checks right from the raw material stage. This is carried on at every stage of manufacture eliminating substandard material at each stage. The company has developed its own Internal Standards and equipped itself with necessary testing equipment and qualified staff to ensure quality of every metre of cable right from the commencement of the manufacturing cycle.

Additional interstage quality checks are carried out as per standard quality control guidelines laid down in Internal Standards covering the different stages of manufacture.

The cables are subjected to type and routine tests in accordance with IS : 7098.

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

- a) Conductor Resistance Test.
- b) Partial Discharge Test
- c) High Voltage Test.

The major Type Tests that are carried out before the cable is delivered for installation include :

- Annealing Test (for copper)
- Tensile Test (for Aluminium)
- Conductor Resistance Test
- Physical tests for insulation
- Physical tests for PVC sheath
- Partial Discharge Test*
- Bending Test*
- Wrapping Test (Aluminium)
- Test for Armour Wires
- Test for thickness of insulation shield & sheath
- Dielectric Power Factor Test**
- Heating Cycle Test*
- Impulse withstand Test*
- High voltage Test

* Applicable only to Screened Cables

** Applicable only to Cables rated at 6.35/11 kV and above.

Partial discharge detection in finished cables :

The quality and life of an XLPE Cable is dependent on complete absence or very minute levels of partial discharge when the cable is charged. For this purpose a highly sensitive detector is employed with the help of which discharges as low as 5 pc/cm can be detected. The noise from supply source is prevented by providing isolating transformer and low pass filters. The complete equipment is housed in a specially shielded room to prevent external noise that would interfere with the measurements.

Flame Retardant, Low Smoke (FRLS) Cables

Introduction

Cables very seldom cause fires, but being an integral part of the total machinery and equipment in a power system, they are subjected to fire-hazards in the event of a fire. Continuous R&D efforts and "End-use Simulation experiments & tests", have enabled formulations of superior cable compounds, which are capable of significantly reducing the hazards of fire-propagation and ensuring lower levels of smoke and evolution of corrosive acid gases.

Typical FRLS Properties exhibited by these Cables :

Minimum oxygen Index	Min. 29
Temperature Index	Min. 250°C
Halogen Acid Gas Generation	Max. 20% (by weight)
Smoke Density Rating	Max. 60%

Flame Retardance withstands flame test as per specification IEC 60332-1, (single cable), IEEE-383 (bunched cable) Swedish Chimney SS-424-14-75, (Class F3 upto cable diameters of 35 mm only).

Construction Details, Dimensions and Weight of 'FRLS' Cables :

The details furnished in the relevant Tables will remain same for 'FRLS' cables, with XLPE insulation. The FRLS Cables will fully conform to IS : 7098 (Part-II)-1985.

Electrical Characteristics, Ratings and Installation Data of FRLS Cables :

There will be no change in the relevant parameters furnished in the various Tables on account of the additional 'FRLS' properties in the PVC sheath of the cables. The cables will fully conform to the electrical test requirements of IS : 7098 (part-II)-1985.

Cable Marking :

The 'FRLS' cables will bear an additional legend 'FRLS' on the sheath, which will be in addition to the relevant Cable-identification and Manufacturer's identification, stipulated in IS : 7098 (Part-II)-1985 and will be marked, similarly.

TEHNICAL DATA OF XLPE CABLES

TABLE : 1

IS : 7098(II) / 1985		
Properties of XLPE	Unit	Value
Average Dielectric constant	—	2.35
Average Dielectric strength	KV/mm	22
Maximum Dielectric loss factor	—	0.004
Minimum Volume Resistivity at 27°C	Ohm-cm	1x10E14
Average Thermal resistivity	°C m/watt	350
Minimum Tensile strength	N/Sq.mm.	12.5
Permissible condutor temperature	°C	90
Emergency overload temperature	°C	130
Permissible short circuit temperature	°C	250

TABLE : 2

STRANDED CONDUCTORS CONFORMING TO CLASS 2 OF IS : 8130-1984

Area of Conductor	Aluminium Conductors			Copper Conductors		
	Minimum Number of strands	Maximum D.C. Res. at 20°C	Maximum A.C. Res. at 90°C	Minimum Number of Strands	Maximum D.C. Res. at 20°C	Maximum A.C. Res. at 90°C
Sq.mm	No.	Ohm/km	Ohm/km	No.	Ohm/km	Ohm/km
50	6	0.641	0.822	6	0.387	0.494
70	12	0.443	0.568	12	0.268	0.342
95	15	0.320	0.410	15	0.193	0.247
120	15	0.253	0.325	18	0.153	0.196
150	15	0.206	0.265	18	0.124	0.160
186	30	0.164	0.211	30	0.0991	0.1280
240	30	0.125	0.161	34	0.0754	0.0990
300	30	0.100	0.130	34	0.0601	0.0802
400	53	0.0778	0.1020	53	0.0470	0.0646
500	53	0.0605	0.0820	53	0.0366	0.0524
630	53	0.0469	0.0650	53	0.0283	0.042
800	53	0.0367	0.0530	53	0.0221	0.0353
1000	53	0.0291	0.0420	53	0.0176	0.0304

TABLE : 3
REACTANCE (AT 50 HZ)

Size in Sq. mm	1 Core Armoured Cable (kV)					3 Core Armoured Cable (kV)				
	3.8/6.6	6.35/11 OR 6.6/6.6	11/11	12.7/22	19/33	3.8/6.6	6.35/11 OR 6.6/6.6	11/11	12.7/22	19/33
	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km
50	0.126	0.131	0.140	0.142	0.154	0.105	0.112	0.123	0.123	0.141
70	0.120	0.125	0.134	0.136	0.148	0.100	0.107	0.118	0.121	0.135
95	0.114	0.118	0.126	0.130	0.141	0.096	0.102	0.112	0.115	0.128
120	0.111	0.116	0.124	0.127	0.136	0.093	0.099	0.109	0.112	0.124
150	0.107	0.111	0.119	0.121	0.131	0.090	0.095	0.104	0.107	0.119
185	0.104	0.109	0.115	0.117	0.126	0.088	0.093	0.101	0.104	0.115
240	0.101	0.105	0.111	0.113	0.122	0.085	0.090	0.097	0.100	0.110
300	0.098	0.101	0.107	0.109	0.119	0.083	0.087	0.094	0.096	0.106
400	0.096	0.098	0.103	0.105	0.114	0.082	0.084	0.091	0.093	0.102
500	0.093	0.094	0.099	0.103	0.110					
630	0.091	0.091	0.098	0.099	0.106					
800	0.089	0.09	0.095	0.096	0.102					
1000	0.088	0.088	0.092	0.093	0.100					

TABLE : 4
CAPACITANCE

Size In	3.8/6.6 kv	6.35/11 OR 6.6/6.6 kv	11/11 kv	12.7/22 kv	19/33 kv
Sq.mm	Mfd/km	Mfd/km	Mfd/km	Mfd/km	Mfd/km
50	0.28	0.24	0.18	0.17	0.14
70	0.31	0.26	0.20	0.19	0.15
95	0.35	0.30	0.22	0.21	0.16
120	0.37	0.32	0.23	0.22	0.17
150	0.41	0.35	0.26	0.24	0.19
185	0.49	0.38	0.28	0.26	0.20
240	0.50	0.42	0.30	0.29	0.22
300	0.53	0.46	0.33	0.31	0.24
400	0.54	0.51	0.37	0.34	0.26
500	0.58	0.57	0.41	0.38	0.29
630	0.63	0.62	0.44	0.41	0.31
800	0.70	0.69	0.49	0.46	0.34
1000	0.76	0.76	0.54	0.50	0.37

TABLE : 5

CURRENT RATINGS (AC) OF ALUMINUM CONDUCTOR XLPE CABLES (CONFORMING TO

Area	Three Core Armoured Cables												Single Core Aluminium Wire Armoured Cables (Solid Bonded)																				
	Air				Ground				Duct				Air				Ground				Single way duct												
of Con- ductor Sq.mm	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Kv	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv
3.3	11	6.6 - 22 & 33	3.3	6.6 - 22 & 33	3.3	6.6 - 22 & 33	3.3	6.6 - 22 & 33	3.3	6.6 - 22 & 33	3.3	6.6 - 22 & 33	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv
50	145	150	155	135	130	110	115	115	160	165	165	160	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	120	125	120	125	120	120	120
70	185	190	190	165	160	140	140	140	200	205	210	210	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	155	145	150	145	150	145	150
95	225	230	230	195	190	190	165	165	245	245	250	250	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	175	180	175	180	175	170	175
120	155	155	155	265	220	215	185	190	285	290	295	295	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	225	230	225	230	225	200	195
150	295	295	300	245	245	240	210	210	325	325	330	330	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	250	255	250	255	250	220	225
185	340	335	340	280	275	270	235	240	375	380	380	380	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	280	285	280	285	280	250	255
240	400	395	400	320	315	310	270	275	440	440	450	450	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	320	325	320	325	320	290	280
300	460	450	455	360	355	350	305	310	500	500	510	500	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	355	355	345	355	345	320	315
400	535	520	530	410	400	395	350	350	590	580	590	570	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	410	395	400	385	360	350	355
500	620	600	610	465	455	445	400	400	680	660	680	650	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	465	445	430	455	415	400	385
630	800	800	800	740	780	720	710	720	780	780	780	790	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	485	485	485	485	485	470	425
	900	900	900	880	880	880	870	870	970	970	970	960	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	520	530	520	530	520	510	450
	1050	1050	1050	970	970	970	960	960	970	970	970	960	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	590	590	590	590	590	510	450
																											500	445	445	445	445	490	435

TABLE : 5A**CURRENT RATINGS (AC) OF COPPER CONDUCTOR XLPE CABLES (CONFORMING TO IS:7098(II))**

Area of Conductor Sq.mm	Three Core Armoured Cables												Single Core Aluminium Wire Armoured Cables (Solid Bonded)											
	Air				Ground				Duct				Air				Ground				Single way duct			
	3.3 Kv	6.6 - 11 Kv	22 & 33 Kv	3.3 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	3.3 Kv	6.6 - 11 Kv	22 - 33 Kv	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat	Tref oil	Flat
50	190	195	200	170	170	170	170	145	150	150	205	210	215	220	225	225	175	180	175	180	175	160	155	155
70	235	240	245	210	210	205	175	180	180	180	260	265	270	270	275	280	215	220	215	215	190	195	185	190
95	290	295	300	250	250	245	210	215	215	215	315	320	325	330	335	335	255	260	255	255	230	225	230	220
120	330	335	340	283	280	275	240	240	245	245	365	370	375	375	385	380	290	295	290	285	285	255	260	220
150	375	380	385	315	310	305	270	270	275	275	415	420	425	425	430	430	325	325	320	320	315	285	280	270
185	435	430	435	355	350	345	300	305	305	305	475	475	485	480	490	485	360	360	355	355	345	315	320	300
240	510	500	510	410	400	395	350	350	350	350	560	550	570	570	560	570	415	410	410	395	400	390	360	355
300	590	570	580	460	445	440	390	390	390	390	640	620	640	620	650	620	460	460	455	445	420	400	395	380
400	670	650	660	520	500	495	440	440	440	440	730	700	730	690	740	690	510	475	495	455	445	420	435	410
500	770	740	750	570	550	550	495	490	490	490	840	780	830	760	830	750	560	520	550	500	540	480	485	435
630	-	-	-	-	-	-	-	-	-	-	940	850	930	830	920	820	610	560	600	540	580	510	530	465
800	-	-	-	-	-	-	-	-	-	-	1040	910	1010	880	1020	890	660	580	640	550	630	540	570	530
1000	-	-	-	-	-	-	-	-	-	-	1100	940	1090	930	1080	940	680	580	670	650	550	580	495	550

Standard condition of Installation

Mode of Installation

Three core cables

Single core cables

Laid single

Laid tinfoil touching flat and bonded at both ends

90 DegC

250 DegC

Maximum Conductor temperature under continuous operation

Maximum Conductor temperature under short circuit condition

Cables in Air (not exposed to direct sunlight)

Ground Temperature 30 DegC
Ambient air Temperature 40 DegC
Thermal Resistivity of soil 1.5 k m/watt
Depth of laying 900 mm upto 11 kv cables
1050 mm for 22 & 33 kv cables

TABLE : 6
RATING FACTORS FOR VARIATION IN AMBIENT AIR TEMPERATURE
CABLES IN AIR (Not exposed to Direct Sunlight)

Ambient Temperature in Deg C	25	30	35	40	45	50	55	60
Rating Factor	1.16	1.11	1.06	1.00	0.94	0.88	0.81	0.74

TABLE : 7
RATING FACTORS FOR VARIATION IN GROUND TEMPERATURE
CABLES IN GROUND / DUCTS

Ground Temperature in DegC	15	20	25	30	35	40	45	50
Rating Factor	1.12	1.08	1.04	1.00	0.96	0.91	0.87	0.82

TABLE : 8
RATING FACTORS FOR VARIATION IN DEPTH OF LAYING
SINGLE & 3 CORE CABLES IN GROUND OR DUCTS

Depth of Laying (mm)	3.3, 6.6, 11KV Cables		22 & 33 KV Cables	
	Ground	Single way Ducts	Ground	Single way Ducts
900	1.00	1.00	—	—
1050	0.99	0.99	1.00	1.00
1200	0.97	0.98	0.99	0.99
1500	0.95	0.96	0.97	0.98
1800	0.94	0.95	0.95	0.96
2000	0.93	0.94	0.94	0.95
2500	0.91	0.93	0.92	0.94
>=3000	0.90	0.92	0.91	0.93

TABLE : 9

**RATING FATORS FOR VARIATION IN THERMAL RESISTIVITY OF SOIL
(CABLES IN GROUND)**

Size in SQMM	Thermal Resistivity of Soil in Km/Watt											
	1.0		1.2		1.5		2.0		2.5		3.0	
	1 Core	3 Core	1 Core	3 Core	1 or 3 Core	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core
50	1.19	1.16	1.10	1.08	1.00	0.88	0.89	0.80	0.81	0.73	0.75	
70	1.19	1.16	1.10	1.09	1.00	0.88	0.89	0.80	0.81	0.73	0.75	
95	1.19	1.16	1.10	1.09	1.00	0.88	0.89	0.79	0.81	0.73	0.75	
120	1.19	1.16	1.10	1.09	1.00	0.88	0.89	0.79	0.81	0.73	0.75	
150	1.19	1.16	1.10	1.09	1.00	0.88	0.89	0.79	0.81	0.73	0.75	
185	1.19	1.16	1.10	1.09	1.00	0.88	0.89	0.79	0.81	0.72	0.75	
240	1.20	1.19	1.11	1.09	1.00	0.88	0.89	0.79	0.81	0.72	0.75	
300	1.20	1.17	1.11	1.09	1.00	0.87	0.89	0.79	0.81	0.72	0.75	
400	1.20	1.17	1.11	1.09	1.00	0.87	0.89	0.79	0.81	0.72	0.75	
500	1.20	1.17	1.11	1.09	1.00	0.87	0.89	0.79	0.81	0.72	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	-	
Installation : 3 single core cable/one three core cable laid in ground												

TABLE : 9A

**RATING FACTORS FOR VARIATION IN THERMAL RESISTIVITY OF SOIL
(Cables in Ducts)**

Size in SQMM	Thermal Resistivity of Soil in Km/Watt											
	1.0		1.2		1.5		2.0		2.5		3.0	
	1 Core	3 Core	1 Core	3 Core	1 or 3	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core
50	1.12	1.07	1.05	1.04	1.00	0.92	0.93	0.85	0.89	0.80	0.84	
70	1.12	1.08	1.06	1.04	1.00	0.92	0.93	0.85	0.88	0.79	0.83	
95	1.12	1.08	1.06	1.04	1.00	0.92	0.93	0.85	0.88	0.79	0.83	
120	1.12	1.08	1.06	1.04	1.00	0.92	0.93	0.85	0.88	0.79	0.83	
150	1.12	1.09	1.07	1.05	1.00	0.91	0.93	0.84	0.87	0.78	0.83	
185	1.13	1.09	1.07	1.05	1.00	0.91	0.93	0.84	0.87	0.78	0.83	
240	1.13	1.09	1.07	1.05	1.00	0.91	0.93	0.84	0.87	0.78	0.83	
300	1.13	1.09	1.07	1.05	1.00	0.90	0.92	0.83	0.87	0.77	0.82	
400	1.14	1.10	1.08	1.06	1.00	0.90	0.92	0.83	0.87	0.77	0.82	
500	1.14	1.10	1.08	1.06	1.00	0.90	0.92	0.83	0.86	0.77	0.81	
630	1.14	-	1.08	-	-	0.90	-	0.82	-	0.76	-	
800	1.15	-	1.08	-	-	0.90	-	0.82	-	0.76	-	
1000	1.15	-	1.08	-	-	0.90	-	0.82	-	0.76	-	
Installation : - Three single core cable in ducts & Three core cables in single way ducts.												

TABLE : 10

**GROUP RATING FACTOR FOR SINGLE CORE CABLE IN TREFOIL CIRCUITS
LAID ON OPEN RACKS IN AIR**

No. of Racks	No. of circuits per rack (1 trefoil dia apart)		
	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

TABLE : 11
**GROUP RATING FACTOR FOR SINGLE CORE CABLE IN TREFOIL CIRCUITS
LAID ON OPEN RACKS IN AIR**

No. of Racks Gap between racks : 300 mm	No. of cables per rack (1 OD apart)				
	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

No. of Racks Gap between racks : 300 mm	No. of cables per rack (Cables touching)				
	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

TABLE : 12
**RATING FACTORS FOR GROUPING OF MULTICORE CABLES
LAID DIRECT IN GROUND IN TIER FORMATION**

Spacing	Formation of cables				
	No. of Tiers Cables per tier	2		3	
		2	3	3	
Cables touching 150 mm		0.60	0.51	0.43	
300 mm		0.64	0.55	0.46	
		0.69	0.60	0.50	

TABLE : 13
GROUP RATING FACTORS FOR SINGLE & THREE CORE CABLE CIRCUITS IN GROUND

Number of cables In touching	Spacing between trefoil group or cable centres, mm									
			200		400		600		800	
	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal
1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	
2	0.76	0.79	0.83	0.86	0.87	0.90	0.90	0.92	0.92	0.94
3	0.64	0.67	0.72	0.77	0.79	0.82	0.83	0.86	0.86	0.89
4	0.58	0.61	0.67	0.72	0.75	0.79	0.80	0.83	0.84	0.87
5	0.53	0.56	0.63	0.68	0.71	0.76	0.77	0.81	0.81	0.85
6	0.50	0.53	0.60	0.65	0.69	0.74	0.76	0.80	0.80	0.84
7	0.47	0.50	0.58	0.63	0.67	0.72	0.74	0.78	0.79	0.83
8	0.45	0.48	0.56	0.61	0.66	0.71	0.73	0.78	-	-
9	0.43	0.46	0.55	0.60	0.65	0.70	0.73	0.77	-	-
10	0.42	0.44	0.54	0.59	0.64	0.69	-	-	-	-
11	0.41	0.43	0.53	0.58	0.64	0.69	-	-	-	-
12	0.40	0.42	0.52	0.57	0.63	0.68	-	-	-	-

Installation : 1) Single core cable in single way ducts in trefoil.
2) Three core cable in single way ducts in horizontal formation.

TABLE : 14
GROUP RATING FACTORS FOR CIRCUITS IN SINGLE WAY DUCTS

Number of cables In touching	Spacing between duct / trefoil group centres, mm									
			200		400		600		800	
	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal	Trefoil	Horizontal
1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core	3 Core	1 Core
2	0.81	0.85	0.85	0.89	0.89	0.92	0.91	0.94	0.93	0.95
3	0.69	0.75	0.75	0.81	0.81	0.86	0.84	0.89	0.87	0.91
4	0.64	0.70	0.69	0.76	0.77	0.83	0.82	0.87	0.85	0.89
5	0.59	0.65	0.65	0.73	0.74	0.80	0.79	0.85	0.83	0.88
6	0.56	0.62	0.63	0.70	0.72	0.78	0.78	0.84	0.82	0.87
7	0.53	0.59	0.60	0.68	0.70	0.77	0.77	0.82	0.81	0.86
8	0.51	0.57	0.59	0.67	0.69	0.76	0.76	0.82	—	—
9	0.49	0.55	0.57	0.65	0.68	0.75	0.75	0.81	—	—
10	0.48	0.54	0.56	0.64	0.67	0.74	—	—	—	—
11	0.47	0.52	0.55	0.63	0.66	0.74	—	—	—	—
12	0.46	0.51	0.54	0.62	0.66	0.73	—	—	—	—

Installation : 1) Single core cable in single way ducts in trefoil.
 2) Three core cable in single way ducts in horizontal formation.

TABLE : 15
PERMISSIBLE SHORT CIRCUIT CURRENT RATINGS OF XLPE CABLES

Area of Conductor in sq.mm	Short circuit Rating for one second in K Amp rms	
	Aluminium	Copper
50	4.70	7.15
70	6.58	10.01
95	8.93	13.59
120	11.28	17.16
150	14.10	21.45
185	17.39	26.46
240	22.56	34.32
300	28.20	42.90
400	37.60	57.20
500	47.00	71.50
630	59.22	90.09
800	75.20	114.40
1000	94.00	143.00

Initial conductor temperature = 90 Deg. C

Final conductor temperature = 250 Deg. C

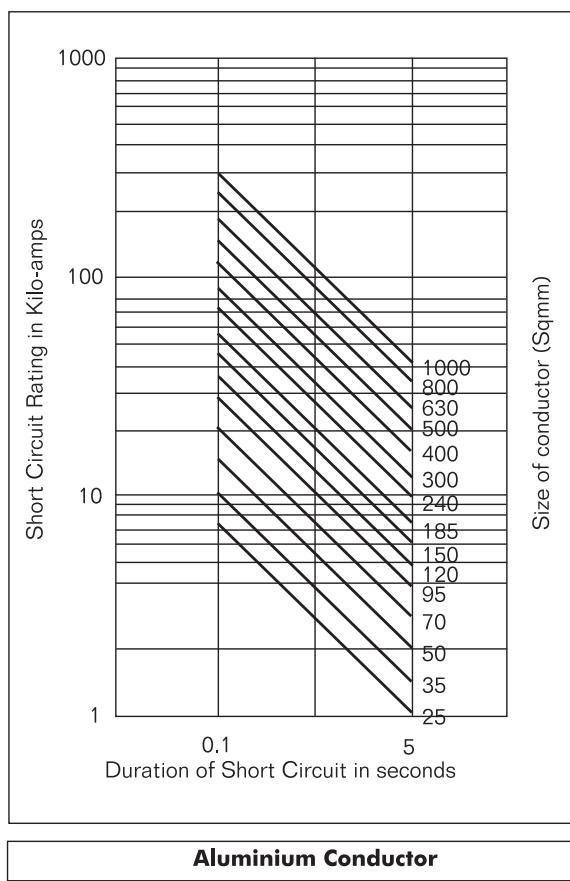
For duration other than one second the short circuit current carrying capacity may be calculated as

$$I_{SC} = I/\sqrt{t} \quad \text{Where} \quad I_{SC} = \text{Short circuit current during time } t, \text{ in amperes}$$

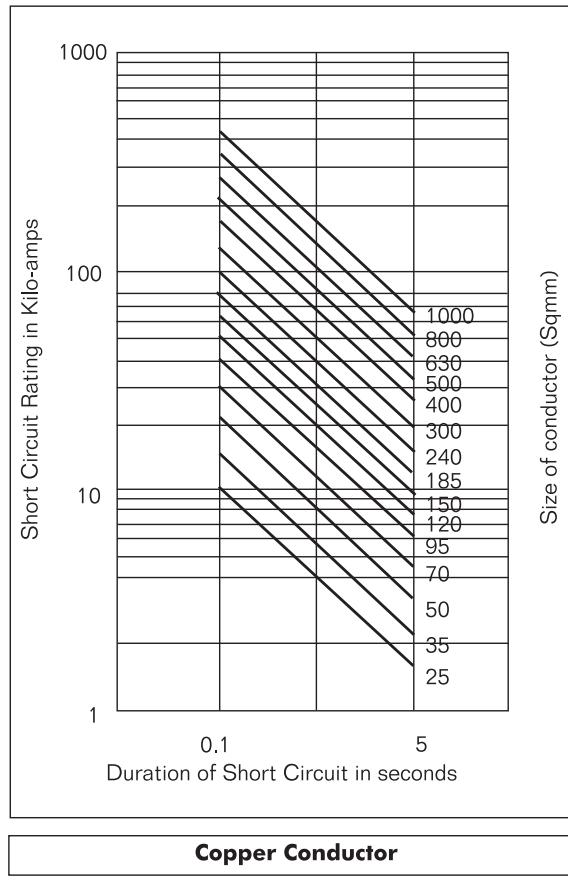
I = Short circuit current during one second in amperes

t = Short circuit current duration in seconds (Max. 5 seconds.)

Note : For large currents, the force between the conductors must be considered especially for single core cables installations.



Aluminium Conductor



Copper Conductor

DIMENSIONS AND WEIGHT

TABLE : 16
SINGLE CORE XLPE CABLES 3.8 / 6.6 kV

No. of Crores & Sizes SQMM	Nom INSL Thick MM	Unarmoured Cable						Armoured Cable						
		Nom OSH	Appx Thi Dia	Appx Net WT/KM	STD Pkg	Appx Net WT/KM	STD Pkg	Nom ARM	Min Osh	Appx Thi Dia	Appx Net WT/KM	STD Pkg	Appx Net WT/KM	
				Aluminium		Copper					Aluminium		Copper	
		MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR
1X50	2.8	2.0	21	500	500	800	500	1.6	1.40	25	650	500	950	500
1X70	2.8	2.0	23	600	500	1000	500	1.6	1.40	27	750	500	1150	500
1X95	2.8	2.0	24	700	500	1250	500	1.6	1.40	28	850	500	1400	500
1X120	2.8	2.0	26	800	500	1500	500	1.6	1.40	30	950	500	1700	500
1X150	2.8	2.0	27	900	500	1800	500	1.6	1.56	32	1100	500	2000	500
1X185	2.8	2.0	29	1000	500	2150	500	1.6	1.56	33	1250	500	2350	500
1X240	2.8	2.2	32	1250	500	2750	500	2.0	1.56	37	1550	500	3000	500
1X300	3.0	2.2	34	1500	500	3350	500	2.0	1.56	39	1800	500	3650	500
1X400	3.3	2.2	38	1850	500	4200	500	2.0	1.72	43	2200	500	4550	500
1X500	3.5	2.4	42	2250	500	5250	500	2.0	1.72	46	2600	500	5600	500
1X630	3.5	2.4	45	2750	500	6700	500	2.0	1.88	51	3200	500	7100	500
1X800	3.5	2.6	50	3350	500	—	—	2.5	2.04	56	4000	500	—	—
1X1000	3.6	2.8	54	4100	500	—	—	2.5	2.20	61	4800	500	—	—

TABLE 17
SINGLE CORE XLPE CABLES 6.35 / 11 kV

No. of Cores Sizes	Nom INSL Thick	Unarmoured Cable						Armoured Cable						
		Nom Thi OSH	Appx Dia	Appx Net	STD Pkg	Appx Net	STD Pkg	Nom Dia ARM	Min Thi Osh	Appx Dia	Appx Net	STD Pkg	Appx Net	
					Aluminium		Copper					Aluminium		
SQMM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR
1X50	3.6	2.00	23	550	500	850	500	1.6	1.40	27	700	500	1000	500
1X70	3.6	2.00	25	650	500	1050	500	1.6	1.40	28	800	500	1200	500
1X95	3.6	2.00	26	750	500	1350	500	1.6	1.40	30	900	500	1500	500
1X120	3.6	2.00	28	850	500	1600	500	1.6	1.56	32	1050	500	1800	500
1X150	3.6	2.00	29	1000	500	1850	500	1.6	1.56	34	1200	500	2100	500
1X185	3.6	2.20	31	1150	500	2250	500	2.0	1.56	36	1400	500	2550	500
1X240	3.6	2.20	34	1350	500	2850	500	2.0	1.56	38	1650	500	3150	500
1X300	3.6	2.20	36	1600	500	3450	500	2.0	1.56	41	1900	500	3750	500
1X400	3.6	2.20	39	1900	500	4250	500	2.0	1.72	44	2250	500	4600	500
1X500	3.6	2.40	42	2300	500	5250	500	2.0	1.72	47	2650	500	5600	500
1X630	3.6	2.40	46	2800	500	6750	500	2.0	1.88	51	3250	500	7150	500
1X800	3.6	2.60	50	3400	500	—	—	2.5	2.04	56	4000	500	—	—
1X1000	3.6	2.80	55	4150	500	—	—	2.5	2.20	61	4800	500	—	—

TABLE : 18
SINGLE CORE XLPE CABLES 11 / 11 kV

No. of Cores Sizes	Nom INSL Thick	Unarmoured Cable						Armoured Cable						
		Nom Thi OSH	Appx Dia	Appx Net	STD Pkg	Appx Net	STD Pkg	Nom Dia ARM	Min Thi Osh	Appx Dia	Appx Net	STD Pkg	Appx Net	
					Aluminium		Copper					Aluminium		
SQMM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR
1X50	5.5	2.0	27	750	500	1000	500	1.6	1.56	32	900	500	1200	500
1X70	5.5	2.0	29	800	500	1250	500	1.6	1.56	33	1050	500	1450	500
1X95	5.5	2.0	30	950	500	1500	500	1.6	1.56	35	1150	500	1750	500
1X120	5.5	2.2	32	1100	500	1800	500	2.0	1.56	37	1350	500	2100	500
1X150	5.5	2.2	34	1200	500	2100	500	2.0	1.56	38	1500	500	2400	500
1X185	5.5	2.2	35	1350	500	2500	500	2.0	1.56	40	1650	500	2800	500
1X240	5.5	2.2	38	1600	500	3050	500	2.0	1.72	43	1950	500	3400	500
1X300	5.5	2.2	40	1850	500	3650	500	2.0	1.72	45	2200	500	4050	500
1X400	5.5	2.4	43	2200	500	4550	500	2.0	1.88	48	2600	500	4950	500
1X500	5.5	2.4	46	2550	500	5550	500	2.0	1.88	51	3000	500	6000	500
1X630	5.5	2.6	50	3150	500	7100	500	2.5	2.04	56	3750	500	7700	500
1X800	5.5	2.8	55	3750	500	—	—	2.5	2.20	61	4450	500	—	—
1X1000	5.5	2.8	59	4500	500	—	—	2.5	2.20	65	5200	500	—	—

DIMENSIONS AND WEIGHT

TABLE : 19
SINGLE CORE XLPE CABLES
12.7 / 22 kV

No. of Cores & Sizes	Nom INSL Thick	Unarmoured Cable							Armoured Cable						
		Nom OSH	Appx Thi	Appx Dia	STD Net	Appx OSH	STD Pkg	Nom ARM	Min Dia	Appx Osh	Appx Net WT/KM	STD Pkg	Appx Net WT/KM	STD Pkg	
		WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	
		Aluminium				Copper				Aluminium				Copper	
SQMM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR	
1X50	6.0	2.0	29	800	500	1100	500	1.6	1.56	33	1000	500	1300	500	
1X70	6.0	2.0	30	900	500	1300	500	1.6	1.56	34	1100	500	1500	500	
1X95	6.0	2.2	32	1050	500	1600	500	2.0	1.56	37	1300	500	1900	500	
1X120	6.0	2.2	34	1150	500	1900	500	2.0	1.56	38	1450	500	2200	500	
1X150	6.0	2.2	35	1300	500	2200	500	2.0	1.56	40	1600	500	2500	500	
1X185	6.0	2.2	37	1450	500	2550	500	2.0	1.56	41	1750	500	2900	500	
1X240	6.0	2.2	39	1700	500	3150	500	2.0	1.72	44	2050	500	3550	500	
1X300	6.0	2.2	41	1900	500	3750	500	2.0	1.72	46	2300	500	4150	500	
1X400	6.0	2.4	44	2300	500	4650	500	2.0	1.88	49	2700	500	5050	500	
1X500	6.0	2.6	48	2700	500	5700	500	2.5	2.04	54	3300	500	6300	500	
1X630	6.0	2.6	52	3250	500	7200	500	2.5	2.04	58	3900	500	7850	500	
1X800	6.0	2.8	56	3900	500	—	—	2.5	2.20	62	4600	500	—	—	
1X1000	6.0	3.0	61	4700	500	—	—	2.5	2.36	66	5400	500	—	—	

TABLE : 20
SINGLE CORE XLPE CABLES 19 / 33 kV

No. of Cores & Sizes	Nom INSL Thick	Unarmoured Cable							Armoured Cable						
		Nom OSH	Appx Thi	Appx Dia	STD Net	Appx OSH	STD Pkg	Nom ARM	Min Dia	Appx Osh	Appx Net WT/KM	STD Pkg	Appx Net WT/KM	STD Pkg	
		WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	WT/KM	
		Aluminium				Copper				Aluminium				Copper	
SQMM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR	
1X50	8.8	2.2	35	1150	500	1400	500	2.0	1.56	40	1400	500	1750	500	
1X70	8.8	2.2	37	1250	500	1650	500	2.0	1.56	41	1550	500	2000	500	
1X95	8.8	2.2	38	1400	500	1950	500	2.0	1.72	43	1750	500	2300	500	
1X120	8.8	2.2	40	1500	500	2250	500	2.0	1.72	45	1900	500	2600	500	
1X150	8.8	2.2	41	1650	500	2550	500	2.0	1.72	46	2050	500	2950	500	
1X185	8.8	2.4	43	1850	500	3000	500	2.0	1.72	48	2200	500	3350	500	
1X240	8.8	2.4	46	2100	500	3600	500	2.0	1.88	50	2550	500	4000	500	
1X300	8.8	2.6	48	2400	500	4250	500	2.5	2.04	54	3000	500	4850	500	
1X400	8.8	2.6	51	2800	500	5150	500	2.5	2.04	57	3400	500	5750	500	
1X500	8.8	2.8	54	3250	500	6250	500	2.5	2.20	60	3900	500	6900	500	
1X630	8.8	2.8	58	3850	500	7750	500	2.5	2.20	64	4550	500	8450	500	
1X800	8.8	3.0	63	4500	500	—	—	2.5	2.36	68	5250	500	—	—	
1X1000	8.8	3.2	67	5350	500	—	—	3.15	2.52	74	6400	500	—	—	

CONSTRUCTION OF SINGLE CORE CABLES

Unarmoured	Armoured
1. Conductor (Al/Cu) 2. Conductor Screen 3. XLPE Insulation 4. Insulation Screen 5. Copper Tape Screening 6. Outer sheath (PVC) : Black	1. Conductor (Al/Cu) 2. Conductor Screen 3. XLPE Insulation 4. Insulation Screen 5. Armouring (Al.Wire) 6. Outer sheath (PVC) : Black

TABLE : 21
ARMOURED TAPED INNER SHEATH XLPE CABLES 3 CORE 3.8 / 6.6 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		
			WT/KM	WT/KM	Aluminium		Copper		WT/KM	WT/KM	Aluminium		Copper					
SQ.MM	MM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	KGS	MTR	KGS	MTR				
3X50	2.8	0.5	4X0.8	1.72	42	2350	500	3300	500	2.00	1.88	45	3100	500	4000	500		
3X70	2.8	0.5	4X0.8	1.88	46	2750	500	4050	500	2.00	1.88	48	3500	500	4750	500		
3X95	2.8	0.5	4X0.8	1.88	49	3200	500	4950	500	2.50	2.04	53	4450	500	6200	500		
3X120	2.8	0.6	4X0.8	2.04	53	3700	500	5950	500	2.50	2.2	57	5000	500	7250	500		
3X150	2.8	0.6	4X0.8	2.20	57	4200	500	6900	500	2.50	2.2	60	5550	500	8300	250		
3X185	2.8	0.6	4X0.8	2.20	60	4750	500	8150	500	2.50	2.36	64	6250	500	9700	250		
3X240	2.8	0.7	4X0.8	2.36	66	5700	500	10200	500	3.15	2.52	71	8050	500	12550	250		
3X300	3.0	0.7	4X0.8	2.52	72	6750	500	12350	250	3.15	2.68	77	9300	250	14950	250		
3X400	3.3	0.7	4X0.8	2.84	80	8200	500	15400	250	4.00	3.00	86	12200	250	19400	250		

TABLE : 22
ARMOURED TAPED INNER SHEATH XLPE CABLES 3 CORE 6.35 / 11 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		
			WT/KM	WT/KM	Aluminium		Copper		WT/KM	WT/KM	Aluminium		Copper					
SQ.MM	MM	MM	MM	MM	KGS	MTR	KVS	MTR	MM	MM	KGS	MTR	KGS	MTR				
3X50	3.6	0.5	4X0.8	1.88	47	2700	500	3600	500	2.50	2.04	50	3900	500	4800	500		
3X70	3.6	0.5	4X0.8	1.88	50	3100	500	4400	500	2.50	2.04	54	4350	500	5600	500		
3X95	3.6	0.6	4X0.8	2.04	54	3650	500	5400	500	2.50	2.20	57	5000	500	6750	500		
3X120	3.6	0.6	4X0.8	2.20	57	4100	500	6350	500	2.50	2.20	61	5550	500	7750	500		
3X150	3.6	0.6	4X0.8	2.20	61	4600	500	7300	500	2.50	2.36	64	6100	500	8850	500		
3X185	3.6	0.7	4X0.8	2.36	64	5250	500	8700	500	3.15	2.52	69	7550	500	11000	350		
3x240	3.6	0.7	4X0.8	2.52	70	6200	500	10750	500	3.15	2.68	75	8750	500	13250	350		
3X300	3.6	0.7	4X0.8	2.68	75	7200	500	12800	250	3.15	2.84	80	9900	500	15550	250		
3x400	3.6	0.7	4X0.8	2.84	81	8450	500	15650	250	4.00	3.00	88	12500	250	19750	250		

TABLE : 23
ARMOURED TAPED INNER SHEATH XLPE CABLES 3 CORE 11 / 11 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA ARM	MIN THI OSH	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		
			WT/KM	WT/KM	Aluminium		Copper		WT/KM	WT/KM	Aluminium		Copper					
SQ.MM	MM	MM	MM	MM	KGS	MTR	KVS	MTR	MM	MM	KGS	MTR	KGS	MTR				
3X50	5.5	0.6	4X0.8	2.20	56	3650	500	4600	500	2.50	2.20	60	5050	500	5950	500		
3X70	5.5	0.6	4X0.8	2.20	59	4100	500	5350	500	2.50	2.36	63	5600	500	6850	500		
3X95	5.5	0.6	4X0.8	2.36	63	4650	500	6400	500	3.15	2.52	68	6900	500	8650	500		
3X120	5.5	0.7	4X0.8	2.36	66	5150	500	7400	500	3.15	2.52	72	7550	500	9800	500		
3X150	5.5	0.7	4X0.8	2.52	70	5750	500	8450	500	3.15	2.68	75	8300	500	11000	250		
3X185	5.5	0.7	4X0.8	2.68	74	6400	500	9800	250	3.15	2.84	79	9100	500	12500	250		
3X240	5.5	0.7	4X0.8	2.84	79	7450	500	11950	250	3.15	3.00	85	10300	250	14800	250		
3X300	5.5	0.7	4X0.8	3.00	85	8500	250	14100	250	4.00	3.00	91	12650	250	18300	200		
3X400	5.5	0.7	4X0.8	3.00	90	9750	250	16950	250	4.00	3.00	97	14200	250	21450	200		

DIMENSIONS AND WEIGHT

TABLE : 24
ARMOURED TAPED INNER SHEATH XLPE CABLES 3 CORE 12.7 / 22 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		NOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	
			ARM	OSH		WT/KM		WT/KM			ARM	OSH		WT/KM		WT/KM		ARM
					Aluminium		Copper						Aluminium		Copper			
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KVS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR		
3X50	6.0	0.6	4X0.8	2.20	59	4000	500	4900	500	2.50	2.36	63	5450	500	6400	500		
3X70	6.0	0.6	4X0.8	2.36	63	4450	500	5750	500	2.50	2.36	66	6050	500	7300	500		
3X95	6.0	0.7	4X0.8	2.36	66	5000	500	6750	500	3.15	2.52	71	7450	500	9200	500		
3X120	6.0	0.7	4X0.8	2.52	70	5550	500	7800	500	3.15	2.68	75	8150	500	10350	500		
3X150	6.0	0.7	4X0.8	2.68	73	6200	500	8900	500	3.15	2.68	78	8750	500	11450	500		
3X185	6.0	0.7	4X0.8	2.68	77	6800	500	10200	250	3.15	2.84	82	9550	500	13000	250		
3X240	6.0	0.7	4X0.8	2.84	83	7900	500	12400	250	4.00	3.00	89	12050	250	16550	250		
3X300	6.0	0.7	4X0.8	3.00	88	8900	250	14550	250	4.00	3.00	94	13250	250	18900	200		
3X400	6.0	0.7	4X0.8	3.00	93	10200	250	17450	200	4.00	3.00	100	14850	250	22050	200		

TABLE : 25
ARMOURED TAPED INNER SHEATH XLPE CABLES 3 CORE 19 / 33 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THIN	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		NOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	
			ARM	OSH		WT/KM		WT/KM			ARM	OSH		WT/KM		WT/KM		ARM
					Aluminium		Copper						Aluminium		Copper			
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KVS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR		
3x50	8.8	0.7	4X0.8	2.52	73	5650	500	6550	500	3.15	2.68	78	8250	500	9150	500		
3X70	8.8	0.7	4X0.8	2.68	77	6200	500	7450	500	3.15	2.84	82	8950	500	10250	250		
3X95	8.8	0.7	4X0.8	2.84	80	6850	500	8600	500	3.15	3.00	85	9750	500	11500	250		
3X120	8.8	0.7	4X0.8	2.84	84	7400	500	9650	500	4.00	3.00	90	11650	500	13900	250		
3X150	8.8	0.7	4X0.8	3.00	87	8100	500	10800	500	4.00	3.00	94	12400	250	15100	200		
3X185	8.8	0.7	4X0.8	3.00	90	8750	250	12200	250	4.00	3.00	97	13250	250	16650	200		
3X240	8.8	0.7	4X0.8	3.00	96	9900	250	14400	250	4.00	3.00	102	14650	250	19150	200		
3X300	8.8	0.7	4X0.8	3.00	101	10950	250	16600	250	4.00	3.00	107	15950	250	21600	200		
3X400	8.8	0.7	4X0.8	3.00	106	12350	250	19550	250	4.00	3.00	113	17650	250	24900	200		

TABLE : 26
ARMOURED EXTRUDED INNER SHEATH XLPE CABLES 3 CORE 3.8 / 6.6 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			MOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		MOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	
			ARM	OSH		WT/KM		WT/KM			ARM	OSH		WT/KM		WT/KM		ARM
					Aluminium		Copper						Aluminium		Copper			
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KVS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR		
3X50	2.8	0.5	4X0.8	1.72	44	2450	500	3400	500	2.00	1.88	46	3200	500	4100	500		
3X70	2.8	0.5	4X0.8	1.88	47	2850	500	4150	500	2.00	1.88	50	3650	500	4900	500		
3X95	2.8	0.5	4X0.8	1.88	50	3300	500	5050	500	2.50	2.04	54	4600	500	6350	500		
3X120	2.8	0.6	4X0.8	2.04	54	3750	500	6000	500	2.50	2.20	58	5150	500	7400	500		
3X150	2.8	0.6	4X0.8	2.20	58	4250	500	7000	500	2.50	2.20	61	5700	500	8400	500		
3X185	2.8	0.6	4X0.8	2.20	61	4850	500	8250	500	2.50	2.36	65	6400	500	9800	500		
3X240	2.8	0.7	4X0.8	2.36	67	5750	500	10250	500	3.15	2.52	72	8200	500	12700	500		
3X300	3.0	0.7	4X0.8	2.52	73	6800	500	12450	500	3.15	2.68	78	9450	500	15100	250		
3X400	3.3	0.7	4X0.8	2.84	80	8300	500	15500	500	4.00	3.00	87	12350	500	19600	250		

TABLE : 27

ARMoured EXTRUDED INNER SHEATH XLPE CABLES : 3 CORE 6.35 / 11 KV

No of CORES & SIZES	NOM THICK	Min ISH THIN	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM	MIN	APPX	APPX	STD	APPX	STD	MOM	MIN	APPX	APPX	STD	APPX	STD	APPX	STD
			DIM	THI	DIA	NET	PKG	NET	PKG	DIA	THI	DIA	NET	PKG	NET	PKG	NET	PKG
			ARM	OSH		WT/KM		WT/KM		ARM	OSH		WT/KM		WT/KM		WT/KM	
			Aluminium				Copper				Aluminium				Copper			
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR		
3X50	3.6	0.5	4X0.8	1.88	48	2850	500	3750	500	2.50	2.04	52	4050	500	4950	500		
3X70	3.6	0.5	4X0.8	1.88	51	3200	500	4500	500	2.50	2.04	55	4550	500	5800	500		
3X95	3.6	0.6	4X0.8	2.04	55	3750	500	5500	500	2.50	2.20	58	5100	500	6850	500		
3X120	3.6	0.6	4X0.8	2.20	58	4250	500	6450	500	2.50	2.20	62	5650	500	7900	500		
3X150	3.6	0.6	4X0.8	2.20	62	4700	500	7400	500	2.50	2.36	65	6300	500	9000	500		
3X185	3.6	0.7	4X0.8	2.36	65	5300	500	8750	500	3.15	2.52	70	7700	500	11100	500		
3X240	3.6	0.7	4X0.8	2.52	71	6300	500	10800	500	3.15	2.68	76	8850	500	13350	250		
3X300	3.6	0.7	4X0.8	2.68	76	7250	500	12900	250	3.15	2.84	81	10050	500	15650	250		
3X400	3.6	0.7	4X0.8	2.84	82	8500	500	15700	250	4.00	3.00	89	12700	250	19900	250		

TABLE : 28

ARMoured EXTRUDED INNER SHEATH XLPE CABLES 3 CORE 11 / 11 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			MOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		
			ARM	OSH		WT/KM		WT/KM		ARM	OSH		WT/KM		WT/KM		WT/KM	
			Aluminium		Copper						Aluminium		Copper					
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	KGS	MTR	KGS	MTR			
3X50	5.5	0.6	4X0.8	2.20	57	3750	500	4650	500	2.50	2.20	61	5150	500	6050	500		
3X70	5.5	0.6	4X0.8	2.20	60	4150	500	5450	500	2.50	2.36	64	5700	500	6950	500		
3X95	5.5	0.6	4X0.8	2.36	64	4750	500	6500	500	3.15	2.52	69	7050	500	8800	500		
3X120	5.5	0.7	4X0.8	2.36	67	5250	500	7450	500	3.15	2.52	72	7700	500	9900	500		
3X150	5.5	0.7	4X0.8	2.52	71	5800	500	8550	500	3.15	2.68	76	8350	500	11050	250		
3X185	5.5	0.7	4X0.8	2.68	75	6450	500	9900	250	3.15	2.84	80	9150	500	12600	250		
3X240	5.5	0.7	4X0.8	2.84	80	7500	500	12050	250	3.15	3.00	85	10450	250	14950	250		
3X300	5.5	0.7	4X0.8	3.00	85	8550	500	14200	250	4.00	3.00	92	12800	250	18450	200		
3X400	5.5	0.7	4X0.8	3.00	91	9850	500	17050	250	4.00	3.00	98	14400	250	21600	200		

TABLE : 29

ARMoured EXTRUDED INNER SHEATH XLPE CABLES 3 CORE 12.7 / 22 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG		
			ARM	OSH		WT/KM		WT/KM		ARM	OSH		WT/KM		WT/KM			
			Aluminium		Copper						Aluminium		Copper					
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	KGS	MTR	KGS	MTR			
3X50	6.0	0.6	4X0.8	2.20	60	4050	500	5000	500	2.50	2.36	64	5600	500	6500	500		
3X70	6.0	0.6	4X0.8	2.36	64	4600	500	5850	500	2.50	2.36	67	6150	500	7400	500		
3X95	6.0	0.7	4X0.8	2.36	67	5100	500	6850	500	3.15	2.52	72	7500	500	9250	500		
3X120	6.0	0.7	4x0.8	2.52	71	5650	500	7900	500	3.15	2.68	76	8200	500	10450	500		
3X150	6.0	0.7	4X0.8	2.68	74	6250	500	8950	500	3.15	2.68	79	8850	500	11600	250		
3X185	6.0	0.7	4X0.8	2.68	78	6850	500	10300	500	3.15	2.84	83	9700	500	13100	250		
3X240	6.0	0.7	4X0.8	2.84	83	7950	500	12450	250	4.00	3.00	90	12200	250	16700	250		
3X300	6.0	0.7	4X0.8	3.00	88	9000	500	14650	250	4.00	3.00	95	13400	250	19050	250		
3X400	6.0	0.7	4X0.8	3.00	94	10300	250	17500	250	4.00	3.00	101	15050	250	22250	250		

TABLE : 30
ARMOURED EXTRUDED INNER SHEATHED XLPE CABLES 3 CORE 19 / 33 kV

No of CORES & SIZES	NOM INSL THICK	Min ISH THI	FLAT STRIP ARMOUR								ROUND WIRE ARMOUR							
			NOM DIM	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	NOM DIA	MIN THI	APPX DIA	APPX NET	STD PKG	APPX NET	STD PKG	APPX NET	STD PKG
			ARM	OSH		WT/KM		WT/KM		ARM	OSH		WT/KM		WT/KM		WT/KM	
						Aluminium	Copper								Aluminium	Copper		
SQ.MM	MM	MM	MM	MM	MM	KGS	MTR	KGS	MTR	MM	MM	MM	KGS	MTR	KGS	MTR	KGS	MTR
3X50	8.8	0.7	4X0.8	2.52	74	5700	500	6600	500	3.15	2.68	79	8400	500	9300	250		
3X70	8.8	0.7	4X0.8	2.68	78	6250	500	7550	500	3.15	2.84	83	9100	500	10350	250		
3X95	8.8	0.7	4X0.8	2.84	81	6950	500	8700	500	3.15	3.00	86	9900	500	11650	250		
3X120	8.8	0.7	4X0.8	2.84	84	7500	500	9750	500	4.00	3.00	91	11750	250	13950	250		
3X150	8.8	0.7	4X0.8	3.00	88	8150	500	10900	250	4.00	3.00	94	12600	250	15300	250		
3X185	8.8	0.7	4X0.8	3.00	91	8850	500	12250	250	4.00	3.00	98	13400	250	16850	200		
3X240	8.8	0.7	4X0.8	3.00	97	9950	250	14450	250	4.00	3.00	103	14850	250	19350	200		
3X300	8.8	0.7	4X0.8	3.00	101	11050	250	16650	250	4.00	3.00	108	16150	250	21800	200		
3X400	8.8	0.7	4X0.8	3.00	107	12450	250	19650	250	4.00	3.00	114	17850	250	25100	200		

CONSTRUCTION OF 3 CORE CABLES :

- | | |
|--------------------------|--------------------------------------|
| 1. Conductor (Al/Cu) | 6. Laying up with fillers |
| 2. Conductor screen | 7. Inner sheath (Wrapped / Extruded) |
| 3. XLPE Insulation | 8. Armour (Flat strip / Round wire) |
| 4. Insulation screen | 9. Outer sheath (PVC) : Black |
| 5. Copper tape screening | |

NOTE :

- a) Packing lengths indicated are standard packing lengths. For other packing lengths please contact our Works.
- b) Data provided above are subject to change because of continuous product improvements. Standard manufacturing tolerances apply to data.
- c) Contract our works for any special cables with –
 - Water tight construction
 - Extra Earth fault capacities
 - FR, FRLS, LSOH Cables etc.

SOME IMPORTANT POINTS FOR CABLE INSTALLATIONS (Follow IS : 1255)

The following are the important points to be taken care of, during cable installations, at site :

1. **General :** The cable should be paid off from the top of the Cable drum, held in the normal position. Sufficient care should be taken to prevent twists, acute bends etc, while laying the Cable.
2. **Minimum Bending Radius :**

Single Core	Multi Core
- Cables from 3.3 kV to 11 kV : 15 D	15 D
- Cables of 22 & 33 kV : 20 D	15 D

D is the overall diameter of the cable
3. **Maximum Pulling Tension during Installation :**
 - Cables having Aluminimum Conductor : 30 N/Sq. mm
 - Cables having Copper Conductor : 50 N/Sq. mm.
4. **Cable Support Spacing** : The disposition of cable support and its spacing should be such, as to prevent undue strain or damage to the cable.
5. **Prevention of Moisture Ingress** : Care should be exercised at site during installation to prevent damage to cable coverings and ends which may cause the ingress of moisture.
6. **Tests after Installations** : Voltage withstand and Insulation Resistance Tests should be conducted on cable after laying or after jointing and terminations. The test method, voltage and duration should be as stipulated in IS:1255-1983, for various voltage grades of the cables.

PRODUCT RANGE

Aircraft & Air Field Cables

Cables for Aircraft Wiring, Instrumentation, Airfield Lighting, Aircraft Starter – Pren. Nyvin cables with PVC, PCP, Nylon or Glass insulation and sheathing. *Conforming to various International Specifications.*

Automobile Cables

Cables for Ignition, Lighting and Steering Column.

Cables For Cranes

Power and Control cables – Elastomeric – EPR or Butyl Rubber (BR), or PVC insulated & sheathed for all types of cranes in steel plants and in other heavy industries. Festooned Cables for Cranes.

Electron Beam Irradiated Cross-linked Cables

For use in Railways, Ships, Aircrafts, Petrochemical Plants, Power Stations, Automobiles, Buildings, Auditoriums, Sub-ways with Temperature range from -65°C to 125°C.

Communication Cables

Polyethylene Insulated Jelly Filled (PIJF) Telephone Cables, Digital Exchange Switching Cables. Plastic Insulated Copper Wire, Screened Flexible Cables for Loud-speaker, Microphone, Public Address System. Self Supporting Polyethylene Insulated & Sheathed Aerial Cable.

Elevator Cables (Lift Cables)

Elastomeric – EPR or Butyl Rubber (BR), Elastomeric or PVC insulated cables with Central Hauser, Braided or Unbraided Flexible Cables for Elevators.

Furnace & High Temperature Cables

Butyl Rubber, EPR, EVA, Varnished, Cambric, Glass Fibre and Asbestos insulated/sheathed and PCP, CSP, Nitrile Rubber, EVA sheathed for Furnace and for High Temperature applications.

Marine Cables (Shipwiring Cables)

Varnished Cambric Insulated, Lead or PVC sheathed armoured/unarmoured cables. Elastomeric (EPR, BR, SBR) insulated, PCP, CSP, Nitrile Rubber, PVC sheathed, Steel Wire/Copper Wire braided/unbraided solid type or flexible type cables for Power, Control, Communication, Lighting applications.

General Cables & Flexible Cords

PVC insulated Wiring Cables for Domestic Wiring, domestic appliances.

Elastomer Insulated Flexible Cords.

PVC Insulated Flexible Cords (light duty).

Elastomer Insulated Heavy Duty Flexible cables.

Welding cables both Copper and Aluminium conductors.

Cables in flat formation & Winding Wires for Submersible Pumps.

Cables for Chemical and Petroleum Plants
CSP Insulated Flexible for coil leads, vehicle wiring and other High Temperature applications.

Power Cables

Cross-linked polythelene (XLPE) Insulated Power Cables upto 66 kV.

PVC insulated armoured and unarmoured cables upto 6.6 kV & control cables.

HR PVC Power cables for maximum temperatures upto 85°C.

Joints, Tapes, Compound and Terminations.

Fire Retardant Low Smoke Cables (FRLS)

Fire Retardant cables with low emission of smoke and toxic fumes both for Power & Control applications.

Fire Survival Cables

Cables with special characteristics in addition to low smoke emission and low halogen properties to maintain the circuit integrity to essential services under severe fire conditions.

Oil Rig Cables/Cables for Oil Exploration

Elastomeric insulated and HOFR sheathed screened and unscreened cables for Rigs.

Seismic cables for Seismic Survey.

Logging cables for Wells.

Submersible cables for Pumps used in Wells.

Mining Cables

PVC insulated/sheathed, XLPE insulated PVC sheathed double wire armoured/single wire armoured cables upto 11 kV for Power Supply applications. Light duty PVC cables for Control, Lighting and Telecommunications.

Elastomeric insulated multicore screened and unscreened HOFR compound (PCP, CSP, Nitrile Rubber-NVRPVC) sheathed with or without pliable wire armoured cables for Coal Face Lighting, Drilling, Remote Control, Coal Cutting in underground mines and in quarries and metaliferous mines.

Shuttle Car cables, Miners' Cap Lamp Flexible, Shot Firing Cables, Submersible cables for pumps in mines, Shaft cables, High Voltage Land Line cables upto 11 kV grade, High Voltage machine Trailing cables upto 11 kV grade.

Cable for Railway Transportation

HRPVC or GPPVC or Elastomeric or CSP Insulated and Sheathed cables for all types of coach wiring. Elastomeric insulated and sheathed locomotive cables for Power and Control applications in Electric and Diesel Locomotives.

PVC insulated screened or un-screened Signalling cables.

Quad cables.

Conductors for Railway Transportation

Grooved Copper Contact (GCC) wires, Cadmium Copper Catenary wires, Jumper wires, Dropper wires for Railway Electrification.

Kapton (Polyimide) Film covered conductors for winding of Traction Motors.

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