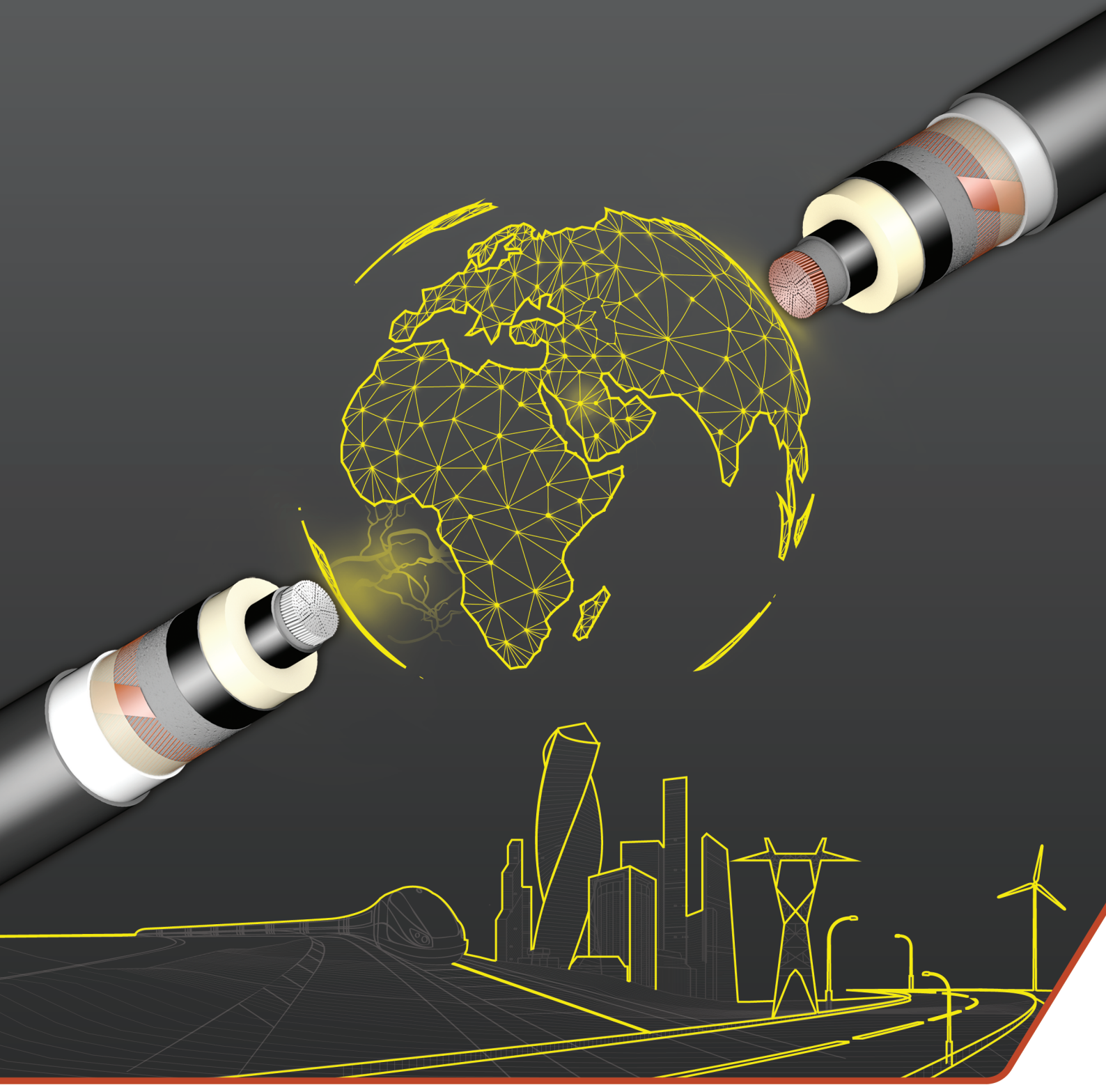
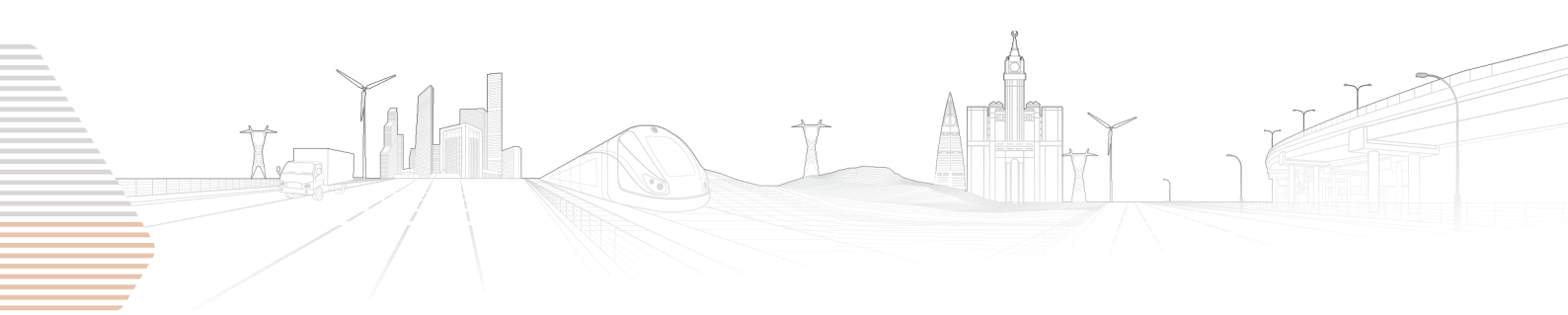
HV & EHV
POWER CABLES



مجموعة كابلات الرياض
Riyadh Cables Group



INTRODUCTION

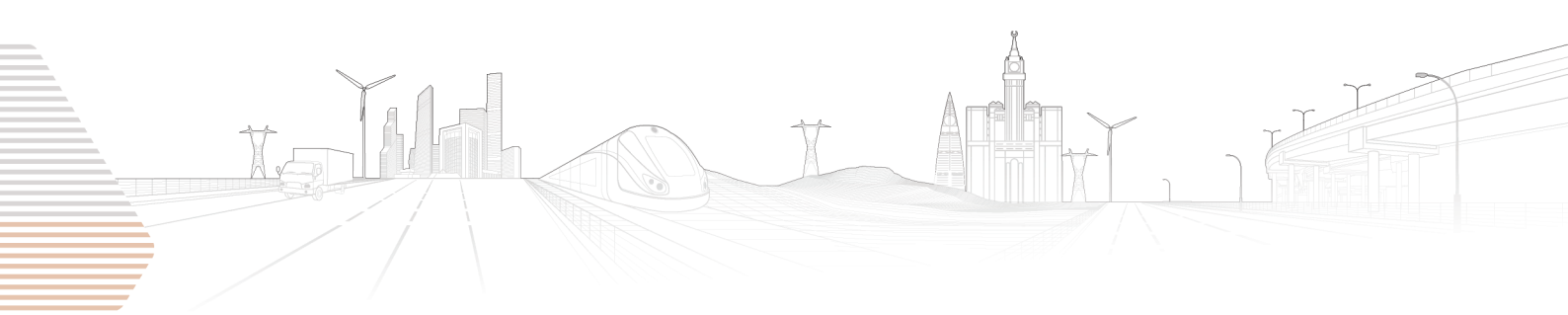
Riyadh Cables started production of Medium voltage cables in 1986 and High Voltage Cables in 1994 and has supplied huge quantities of Medium Voltage Cables while in the High Voltage cables, the cumulative quantity exceeds 1000's of kms in both 132 kV and 69 kV cables.

High and Extra High Voltage cables from 66 kV to 380 (420) kV with different constructions and material manufactured by Riyadh Cables Group has been successfully type tested.

Long-term tests were also performed both at Riyadh Cables Laboratories and King Saud University (6 months, 1 year, 2 years) to prove the high quality of RC&M manufactured cables. Breakdown tests with different constant voltages and time gave the result that cables designed at a stress of 13 kV/mm can survive more than 30 years which gives an indication that RC&M high voltage cables can be designed at a stress level of 8 kV/mm for High Voltage Cables and 12 kV/mm for Extra High Voltage Cables with a good safety margin other than the values which were considered during evaluation.

Type tests and prequalification tests for 1x2500 mm² 230/380 (420) kV cable with BRUGG accessories are finalized successfully in 2019.

Riyadh Cables have qualified engineers and the required software to design high voltage circuits based on local conditions. Current rating, Induced voltage, Short circuit current for conductor and screen are computed to meet customers' requirements, positive, negative and zero sequence impedance are computed for Engineering purposes and Network protection.



RESEARCH AND DEVELOPMENT

The company has a realistic approach towards improvement and development of its products, therefore, it has established a Research and Development team whose main objectives are:

- Selection of the best raw material for cables after long term and short term testing and after in-depth analysis and review.

- Co-ordinate with other research bodies both in the Kingdom and World, to study cable phenomenon such as cable aging and insulation de-gradation and provide measures to minimize this effect.

- Co-ordinate with the local electric utilities in order to optimize the most economical cable construction taking into consideration their needs and local environment conditions.

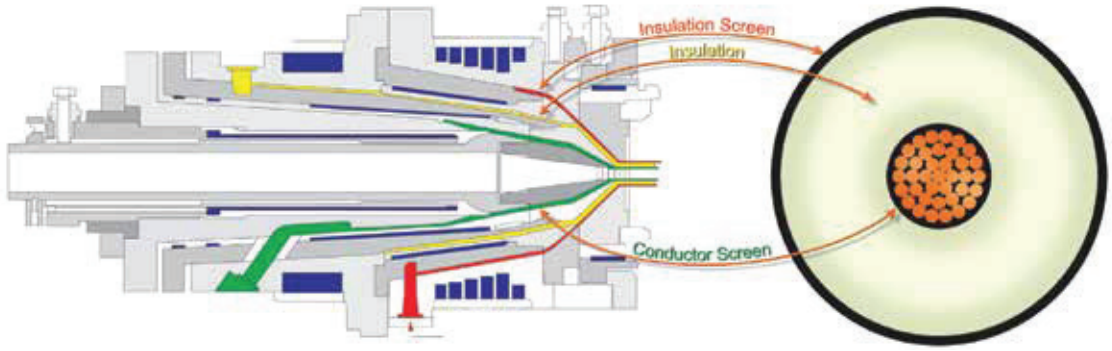
HIGH VOLTAGE & EXTRA HIGH VOLTAGE CABLES

The rapid development of the Solid Dielectric Cables manufacturing had lead to the substitution of the traditional impregnated paper and oil filled cables almost entirely by Cross-linked polyethylene (XLPE) Cables for voltages up to 380 kV or above due to the great technical and economic advantages of XLPE cables. In comparison, XLPE Cables have lower weight, better thermal properties and reduced installation and maintenance costs. Environmentally, XLPE Cables have great advantage since the risk of oil leakage in non-existent. The excellent electrical and mechanical properties of XLPE make it a most suitable insulating material. Since the early 1960's great quantities of XLPE Cables have been installed around the world by virtue of its proven reliability, simplicity and overall system economy.

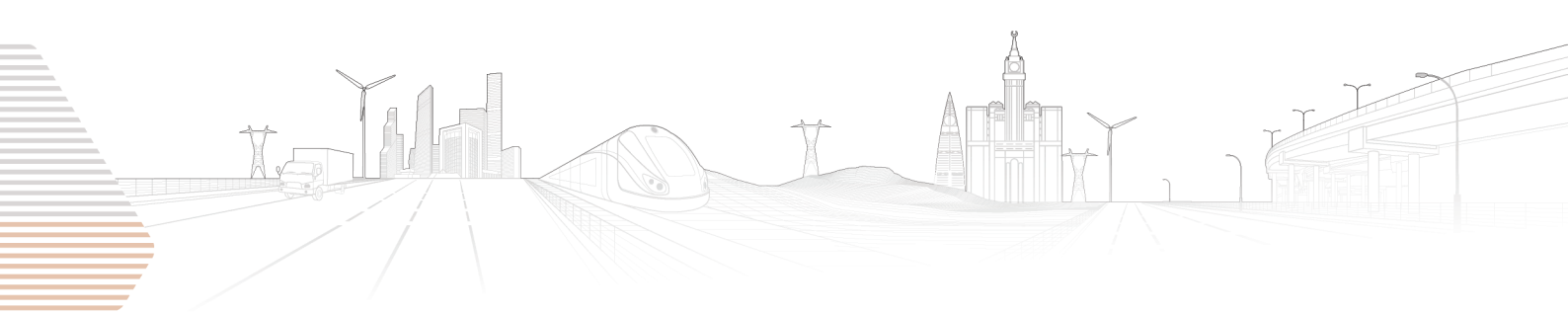
Riyadh Cables (RCGC), a leader in Modern Cables Industry was the first cable manufacturer to use the state-of-the-art "Dry Curing and Dry Cooling of Organic peroxide XLPE" Cable production technology in the Middle East. RCGC started production of Medium Voltage cables in 1986. Production of 69 kV cables began in 1991. The extensive experience RCGC earned supported by the "Licensing Agreement for the Know-How and Technical Assistance" with BRUGG KABEL AG lead to production of high voltage cables greater than 69 kV in 1994 and Extra High Voltage XLPE cables "1x2500 mm² 380 kV" in 2016.

In 2004, based on the cumulative experience gained by Riyadh Cables Group in High Voltage Cable Production and System Installation and for more flexibility with accessory suppliers, Riyadh Cables took the decision to continue High Voltage Cable Production on its own. While in 2015, Riyadh Cables has signed with the same company "BRUGG KABEL AG" an agreement for the production of 380 kV cables under their license with all necessary know-how.

High Voltage and Extra High Voltage XLPE cables manufactured by Riyadh Cables meet the standard specifications of Saudi Electric Companies and Electricity Corporation as well as Saudi Arabian Standards and various other National & International Standards, particularly standards of GCC Countries and other Arab Countries, to satisfy market requirements both at home and abroad.



TRIPLE CROSSHEAD



DESIGN PHILOSOPHY

High Voltage cables from 66 kV to 380 (420) kV with different constructions and material manufactured by Riyadh Cables Group have been successfully type tested.

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Type tests and prequalification tests for 1x2500 mm² 230/380 (420) kV cable with BRUGG accessories are finalized successfully in 2019 in KEMA.

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SUPERVISION AND CERTIFIED PROFESSIONAL JOINTERS

Experienced engineers provide supervision and certified professional jointers perform the required cable laying and accessory installations. To cope with International awareness Riyadh Cables have purchased an HVAC site test systems, which provide more accurate results about the installation and workmanship quality without affecting the system at any point.

SPECIAL FEATURES OF HIGH & EX
VOLTAGE CABLES MANUFACTUREI
RIYADH CABLES GROUP

I. MATERIAL:

1) Super smooth inner semi-conducting layer where electrical stres value. This shall improve the cable electrical characteristics, cabl and extend the lifetime of cable..

2) Super-clean XLPE insulation material as contamination is one o water-tree initiation in the insulation material. The level of cleanl the requirements specified in AEIC CS9 and ICEA S-108-720..

3) For Watertight constructions, water swellable tapes shall be provic strand layers and over conductor to prevent ingress of water a axis in case of cable failure due to any reason.

4) For watertight constructions, water swellable tapes under and c shall be used to prevent ingress of water longitudinally, in cas outer sheath. Also, water swellable tapes shall keep the cable int that triggering of water trees shall be considerably minimized.

5) For Radial Watertight constructions, Polyethylene Laminated 0.2 mm thickness is provided to prevent radial water penetrati material might allow water to diffuse in very small quantities with and this shall affect the cable performance in the long run. Th laminate consists of an aluminum tape with co-polymer lamina During extrusion of PE sheath the extruded sheath will fuse w lamination of metal-polyethylene laminate to form one unit. T radial watertight construction and shall effectively seal the unde cable perfectly preventing penetration of moisture into the cable. sheath is provided with smooth thickness to meet the short circuit combination with copper wire screen for high short circuit levels.

6) Outer sheath of high-density polyethylene (HDPE), which can resi on the cable while pulling and it is also the best polymeric mater barrier.

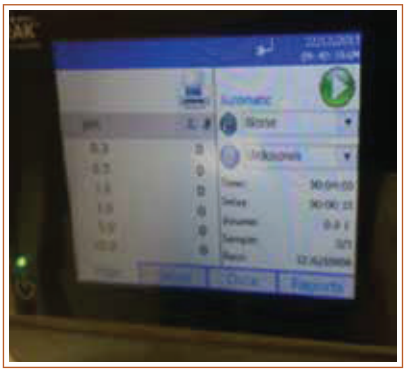
II. PROCESSING:

1) Clean Room, Material Handling and Conveying System:

Riyadh Cables Group uses the most sophisticated state of the art system available in the world in the CCV lines to supply the materials to these lines. All CCV materials are fed to extruders by gravitation. The connection between the material box and to the extruder hopper is made in the clean room. The material is handled in completely closed system where the cleanness level is as high as that of the materials' supplier. The surrounding area at the material connection with production equipement is very clean. It is continuously monitored via particle counter, actual measurments show that the area is at Class 100 of ASTM.

In addition, there is a high power magnet and a wind shifter above the insulation extruder. The magnet (>15000 Gauss), stops any metallic steel contaminant if present in the material. The wind shifter removes any powder in the granules, possibly generated during shipment. This powder is collected in a bin and the content is inspected at the end of each run.



2) Triple Extrusion:

Riyadh Cables employs state-of-the-art triple cross-head extrusion where the conductor screen, insulation and insulation screen are extruded simultaneously by means of a triple cross-head which has the following advantages:

- Uniform insulation structure.
- Ensures extremely accurate layer thickness
- Ensures high purity in the frontier limit between the semi-conductive layers and insulation
- Provides optimal fusion of the individual layers without contamination.
- Ensures a firm bond and smooth interface between caech layer thus improving electrical properties.
- Prevents unforeseen damage to the conductor or insulation screen during manufacturing process.

ACTUAL CCV LINE TRIPLE CROSSHEAD & CONTROL UNITS

3) Dry Curing (Peroxide Curing):

The Insulated conductor is fed into the crosslinking zone where a computer calculated and controlled heat treatment takes place in a dry inert gas (nitrogen) pressurized atmosphere (dry curing).

Cross-linking is done by agent di-cumyl peroxide (DCP). Cross-linking takes place in the CCV Tube under heated and pressurized Nitrogen where DCP decomposes into two radicals which react with Polyethylene thereby causing cross linking.

Peroxide is already mixed at the material supplier's plant with the proper balance of Anti-oxidant and Peroxide to ensure the required thermal stability and optimum curing level. Therefore, no mixing whatsoever is done at Riyadh Cables, this will prevent any problems, which might occur due to the unbalanced mixing of the material in the production stage as some other manufacturers do. Un-packing and handling of the material is also done in similar super clean environment at RCGC details of which are given in this catalogue.

The mixing ratio is about 1 to 1.5 PHR with very small amount of anti-oxidant. The cross-link residual is gas, which defuses out of the insulation gradually. Other residuals are Acetophone and Cumyl-alcohol, which are in very low ratio. Research in this regard has proven that this material has very good effect on the insulation such as:

a) It improves the breaking strength when inclusion occurs in XLPE material.
b) It slows water tree growth in the XLPE material under service.
c) Curing is done in heated and pressurized nitrogen which reduces micro voids and moisture content in the insulation and ensures enhanced and stable breakdown strength.

4) Dry Cooling/Water Cooling:

The hot cross-linked core passes into the cooling part of the line to be cooled in a dry inert gas (Nitrogen) or pressurized water atmosphere.

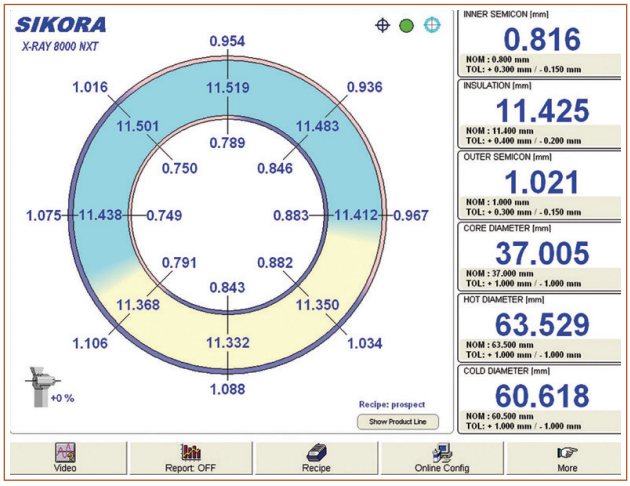
Curing under pressure enhances elimination of micro voids and moisture content in the insulation and ensures enhanced and stable breakdown strength and uniform insulation structure.

5) Quality Control:

Performing very strict quality control during processing such as using X-ray unit for thickness measurement in continuous mode for all extruded layers. This arrangement also facilitates recording of the trend every two seconds. The unit continuously scans **360° geometry** of the cable and displays maximum, minimum and eccentricity of all three layers separately. Any deviation between specified values and measured values are recorded and adjusted automatically.

Also included in the CCV line is the “Twin Rot System” one of the latest in manufacturing technology, which ensures superior control of eccentricity and eliminates the possibility of pear-drop as the cable rotates during manufacture.

Use of very sophisticated software for temperature adjustment in the curing zone of CCV line ensures optimum XLPE characteristics.



INSULATING COMPOUNDS FOR CABLE

Insulating Compound		Maximum conductor temperature °C	
		Normal Operation	Short circuit (Max. duration 5 s)
Low density thermoplastic polyethylene	(PE)	70	130 [1)]
High density thermoplastic polyethylene	(HDPE)	80	160 [1)]
Cross-linked polyethylene	(XLPE)	90	250
Ethylene-propylene rubber	(EPR)	90	250
High modulus or hard grade ethylene--propylene rubber	(HEPR)	90	250

[1)] For PE and HDPE, short circuit temperature up to 20 °C in excess of those shown may be acceptable with suitable semi-conducting layers over the conductor and the insulation and by agreement between manufacturer and purchaser.

Over sheathing compounds for cables

Over sheathing Compound	Abbreviated designation	Maximum conductor temperature In normal operation °C
Polyvinyl chloride (PVC)	ST_1	80
	ST_2	90
Polyethylene	ST_3	80
	ST_4	90

Tand requirements for insulating compounds for cables

Designation of compound (see 4.2)		PE	HDPE	EPR/HEPR	XLPE
Maximum tan δ	10^{-4}	10	10	50	10[1)]

[1)] For cables produced with an XLPE compound containing special additives, the maximum tan δ is $50x10^{-4}$

Test voltages of HV Cables as per IEC 60840

1	2	3	4[a]	5[a]	6[a]	7[a]	8[a]	9[a]	10[b]
Rated voltage	Highest voltage for equipemet	Value of *Uo* for determination of test voltage	voltage test of 9.3	Partial discharge test of 9.2 and 12.4.4	Tan Measurement of 12.4.5	Heating cycle voltage test of 12.4.6	Lightning impulse voltage test of 10.12 , 12.4.7and 13.2.5	Voltage test of 12.4.7	Voltage test after installation of 16.3
U	U_m	*Uo*	*2.5 Uo*	*1.5 Uo*	*Uo*	*2 Uo*		*2.5 Uo*	
kV	kV	kV	kV	kV	kV	kV	kV	kV	kV
45 to 47	52	26	65	39	26	52	250	65	52
60 to 69	72.5	36	90	54	36	72	325	90	72
110 to 115	123	64	160	96	64	128	550	160	128
132 to 138	145	76	190	114	76	152	650	190	132
150 to 161	170	87	218	131	87	174	750	218	150

[a] If necessary, these test voltages shall be adjusted as stated in 12.4.1.
[b] If necessary these test voltages shall be adjusted as stated in 16.3.

Test voltages of EHV Cables as per IEC 62067

1	2	3	4[a]		5[a]	6[a]	7[a]	8[a]	9[a]	10[b]	11
Rated voltage	Highest voltage for equipemet	Value of *Uo* for determination of test voltage	voltage test of 9.3		Partial discharge test of 9.2 and 12.4.4	Tan Measurement of 12.4.5	Heating cycle voltage test of 12.4.6	Impulse lightning voltage test of 10.12 , 12.4.7.2 and 13.2.5	Voltage test after impulse voltage test of 12.4.7.2	switching impulse voltage test of 12.4.7.1	Voltage test after installation of 16.3
U	U_m	U_o	Voltage[b]	*Duration[b]*	*1.5 Uo*	*Uo*	*2 Uo*		*2 Uo*		
kV	kV	kV	kV	min	kV	kV	kV	kV	kV	kV	kV
220 to 230	245	127	318	30	190	127	254	1050	254	-	180
275 to 287	300	160	400	30	240	160	320	1050	320	850	210
330 to 345	362	190	420	60	285	190	380	1175	550	950	250
380 to 400	420	220	440	60	330	220	440	1425	440	1050	260
500	550	290	580	60	435	290	580	1550	580	1175	320

a. If necessary, these test voltages shall be adjusted as stated in 12.4.1.
b. A threshold limit of 27 kV/mm to 30 kV/mm should not be exceeded for some insulations (as specified by the supplier), in order to avoid any possible weakening of the insulation prior to delivery which might later cause a failure in service. At the voltage test of 9.3, for example for rated voltage 330 kV to 500 kV, the voltage is lowered, combined with a longer testing time in order to avoid too high stresses. For insulations where a threshold limit is not a problem, the supplier may increase the test voltage and reduce the testing time. However, the duration should be at least 30 min.

Subject to agreement between manufacturer and purchaser, the voltage test of 9.3 may be replaced by a test at lower voltage and longer duration, even if the maximum stress in the insulation

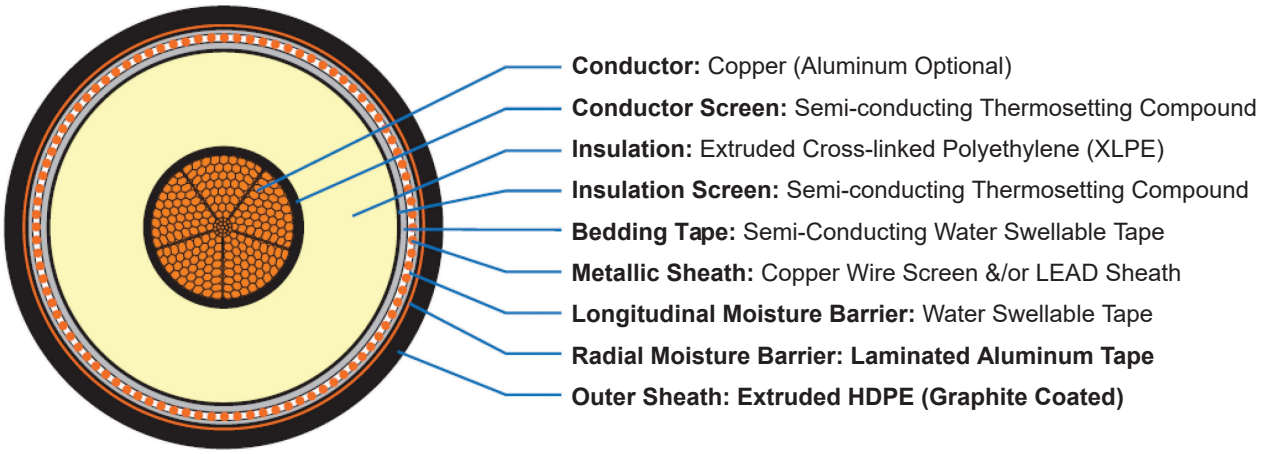
Routine, Sample & Type Test Requirements of HV & EHV Cables according to IEC 60840 & IEC 62067

No.	Description of the Test	Test Designation			
		Routine	Sample	Type	
				Elec.	Non Elec.
1.	Partial discharge test.	√		√	
2.	Voltage test	√		√	
3.	Electrical test on non-metallic sheath (if required)	√			
4.	Conductor examination		√		√
5.	Measurement of electrical resistance of conductor	√	√		
6.	Measurement of thickness of insulation and non-metallic sheaths		√		√
7.	Measurement of thickness of metallic sheaths		√		√
8.	Measurement of diameters (if required)		√		
9.	Hot set test for XLPE insulation		√		√
10.	Measurement of capacitance		√		
11.	Check on insulation thickness of cable for electrical type tests				√
12.	Bending test followed by partial discharge test			√	
13.	Tangent Delta Measurement			√	
14.	Heating cycle voltage test, followed by partial discharge test			√	
15.	Switching impulse voltage test (required for Um □ 300 kV) *				√ *
16.	Impulse withstand test followed by a power frequency voltage test			√	
17.	Resistivity of semiconducting layers			√	
18.	Determining the mechanical properties of insulation before and after ageing.				√
19.	Determining the mechanical properties of non-metallic sheath before and after ageing.				√
20.	Ageing tests on pieces of complete cable to check compatibility				√
21.	Loss of mass test on PVC sheath				√
22.	Pressure test at high temperature on sheaths				√
23.	Tests on PVC sheaths at low temperature				√
24.	Heat shock test for PVC sheaths				√
25.	Carbon black content of PE sheaths				√
26.	Shrinkage test for XLPE insulation **				√ **
27	Test under fire conditions (if required)				√
28.	Water penetration test.		√		√
29.	Tests on components of cables with longitudinally applied metal foil		√		√
30.	Shrinkage test for PE sheath				√

* Not Applicable to HV Cables.
** Not Applicable to EHV Cables.

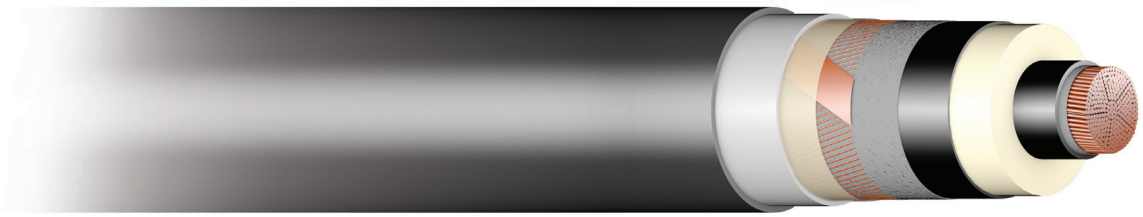
TYPICAL HV/EHV CABLE DESIGN

High Voltage Cables and Extra High Voltage Cables are usually single core. The Basic Design is shown below:



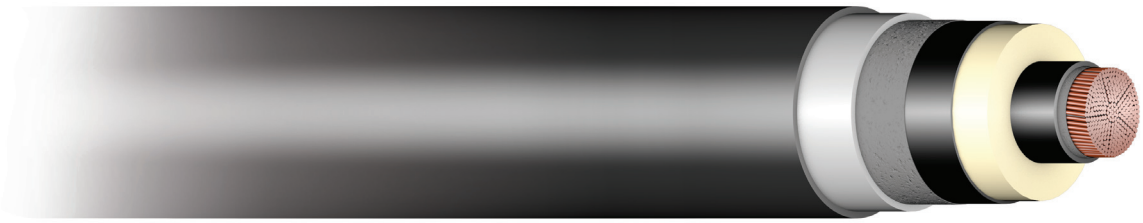
Conductor water tightness is achieved by applying water swellable tapes between conductor strand layers and a moisture impervious layer of semi-conducting water swellable tape over conductor.

Riyadh Cables' Standard Design with Copper Wire Screen and Laminated Aluminum Tape



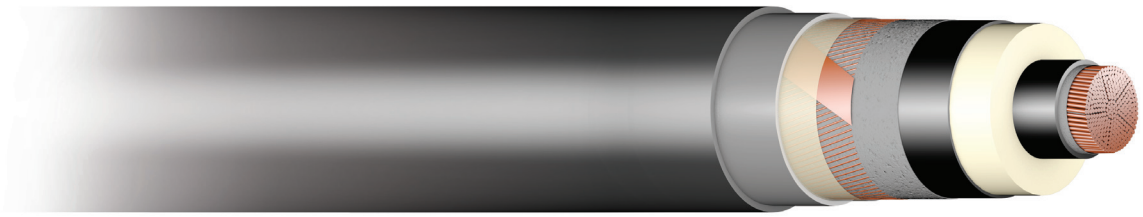
- Radial water sealing is achieved by corrosion resistant metal co-polymer laminate.
- Longitudinal water sealing is achieved by water swellable tapes applied under and over the copper wire screen.

Riyadh Cables Watertight Design with Lead Screen



- Longitudinal water sealing is achieved by water swellable tapes applied under lead sheath.
- Radial water sealing achieved by extruded lead sheath.

Riyadh Cables Standard Design with Copper Wire Screen and Lead sheath



- Longitudinal water sealing is achieved by water swellable tapes applied under and over copper wire screen (under lead sheath).
- Radial water sealing is achieved by Extruded Lead Sheath.

DESIGN PHILOSOPHY

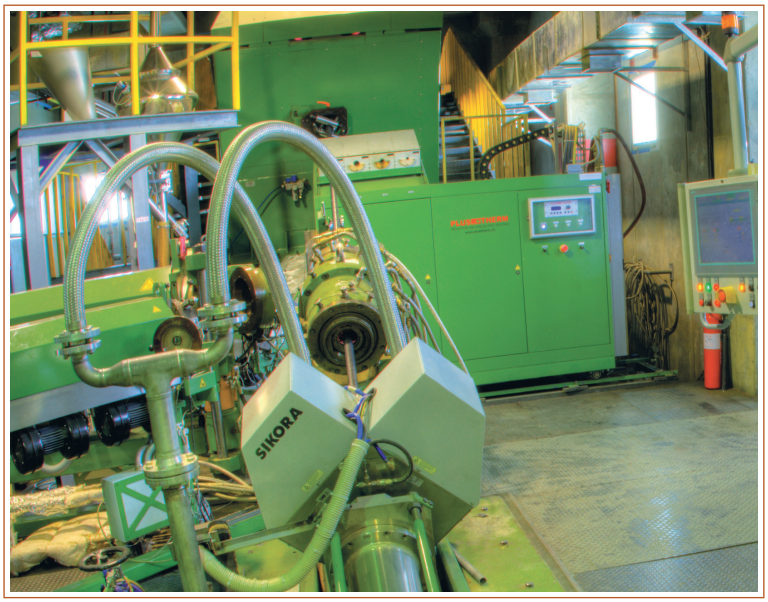
Conductors:

Conductors are made of Copper or Aluminum. Conductors up to and including cross-sectional areas of 1000 mm² are of round stranded compacted type. However 1000 mm² conductor is provided in Milliken design as per some customers' requests. Conductors of cross-sectional areas 1200 mm² up to 3000 mm² are of Milliken design i.e. 4 or 5 segments with or without a central round conductor assembled together to form an overall round section. This is in order to reduce the skin effect and ensure better compaction and flexibility. Conductors comply in design and properties with IEC 60228. Conductor formation comprises mainly of drawing and stranding. Wires of required diameter are drawn in drawing machines and stranding is performed in stranding machines. In-Process Quality Control monitors the specified requirements to ensure the quality of the conductor.

Semi-Conductive Screens and Insulation:

The inner semi-conductive layer (conductor screen), XLPE insulation and the outer semi-conductive layer (insulation screen) are applied simultaneously over the compacted conductor by triple extrusion.

Extrusion of the above is performed in continuous caternary vulcanizing (CCV) line specially designed to manufacture high and extra high voltage cables. Each component of the line has been carefully selected to ensure the best quality product.



Material and Material Handling:

Specifically chosen, approved standard quality super clean material for high voltage cables and ultra clean for extra high voltage cables from the world renowned leading manufacturers of XLPE material is used along with super smooth material for semiconductive screens as the compounds should meet strict standards of cleanliness.

Utmost precaution is taken to ensure cleanliness during handling and conveying of the material. A clean room material handling and conveying system designed by German companies specialized in clean room technology is installed which ensures a cleanliness better than Class 100 of ASTM.

QUALITY CONTROL AND TESTING

High and Extra High voltage cables are subjected to continuous monitoring. Tests start from the time of receiving the raw material right through various stages of production until final testing.

Routine Tests, Sample tests and Type tests (when required) are carried out in accordance with IEC, AEIC and other related International Standards.

Riyadh Cables has equipped itself with the most modern laboratories and equipment including the following test fields:

- Routine test field with a large shielded enclosure for carrying out high voltage tests, partial discharge measurements up to 500 kV at a noise level below 2 pC and for measurements of tangent delta.
- High Voltage Laboratory containing basically a 2400 kV impulse generator, 400 kV AC test system extendable up to 800 kV and heating equipment for conducting sample tests, type tests on high voltage cables and accessories, long-term tests and tests to determine breakdown data.
- Extra High Voltage Laboratory for electrical system type test which includes: AC test system 800 kV, Impulse generator 2400 kV, Load cycle system 6000A to carry out electrical type test for MV,HV & EHV cables system (up to 3000 mm²) in very large shielded room to ensure high accuracy in cable system testing.

TECHNICAL INFORMATION:

Cable Losses:

Cable losses can be divided as current dependent and voltage dependent.

Voltage dependent losses arise in the di-electric due to change of polarity in the alternating field.

Di-electric loss per unit length in each phase is given by:

$W_d = \omega C U_0^2 \tan\delta$ (W/m)

Note: for current rating purposes, dielectric losses are usually considered for cables with Uo ≥ 127 kV.

Current dependent cable losses comprise of the following:

- Ohmic conductor losses
- Losses due to skin effect
- Losses due to proximity effect
- Losses in metallic sheath

Ohmic conductor losses: These are dependent on the material and temperature and are calculated as follows:

$Wc = I^2 R$ (W/m)

where:
I is the load current in amperes,
R is the a.c. resistance of conductor at operating temperature and calculated as:

$R = R_{20}[1+\alpha(t-20)]$
α = 0.00393for Copper
α = 0.00403for Aluminium
t = temperature in ^oC

Losses due to skin effect:

These are caused by the displacement of the current into the outer areas of the conductor and increase approximately with the square of the frequency. These can be reduced by special conductor constructions (Milliken conductors). The losses can make up to 8 to 17% of the ohmic losses of the conductor for cross-sections between 500 mm² to 3000 mm².

Losses due to proximity effect:

These are caused by parallel conductors laid close together i.e., by magnetic fields. If the cables are laid far apart, the effect can be reduced to 10% of the ohmic conductor losses even for large conductor cross-sections.

Sheath Losses:

Power loss in sheath or screen are caused by eddy currents and induced sheath current

Eddy current losses are induced in all tubular metallic sheaths adjacent to the conductor especially in presence of large conductor currents.

Induced sheath current:

Because the metal sheath of a single core cable is linked much more closely to the alternating magnetic field of its own conductor than to the alternating current field of the other two phase conductors, the result is an induced voltage along the length of the cable. This amounts to approximately 60 to 150 V/km per kA of the conductor current for practical installation purpose. If the sheath is bonded at both ends, this results in a longitudinal sheath current, circulating current, with corresponding extra losses in the sheath.

If longitudinal sheath resistance R_m is known, the following formula can be used to determine sheath current I_m.

$$X_m = \omega \times 0.2 \times \ln\left(\frac{2S}{d_m}\right) \times 10^{-3}$$

$$U_i = X_m \, I \, L$$

$$Z_m = \sqrt{R_m^{\,2} + X_m^{\,2}}$$

$$I_m = \frac{U_i}{Z_m}$$

Where

X_m	=	Mutual reactance of sheath (Ω/km)
S	=	Spacing between cable axis (mm)
d_m	=	mean diamete of sheath (mm)
U_i	=	induced voltage in sheath (kV)
Z_m	=	sheath impedance (Ω/km)
I	=	Phase current (kA)

Sheath losses are calculated as follows:

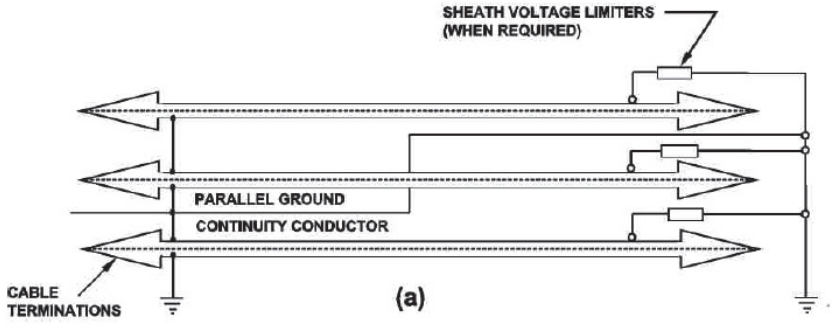
$$Ws = I_m^{\,2} + R_m$$

Bonding Systems:

In addition, extra losses can arise as a result of magnetic reversal on ferrous materials in the vicinity if the cable. Sheath losses may influence the ampacity of the cables considerably. These can be reduced by grounding the sheath at one end only, in which case the free cable end has to be fitted with over voltage protection. The disadvantage of the one side grounding is that the zero sequence impedance rises considerably, possibly leading to interference problems with nearby tele-communication cables. Another method for reducing sheath losses is cross-bonding.

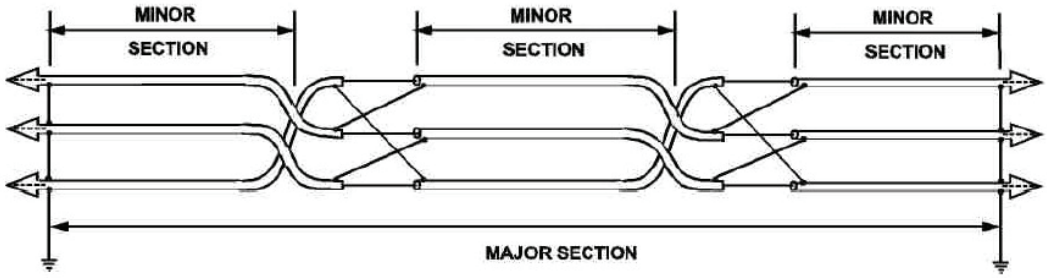
Single point Bonding:

In case the actual circuit is too small to accommodate one or two lengths, single point bonding can be adopted where the sheath is directly bonded at oneend and is bonded through an SVL at the other end. In this case there shall be no circulating currents but, there shall be induced voltage at one end, the value of which can be computed. Induced voltage here can be treated in a similar way as for crossbonding system. In case of fault, the maximum acceptable induced voltage depends on outer sheath characteristics and in such case a ground continuity conductor is required to carry the earth fault and also help in reducing the induced voltage during earth fault conditions (Figure a).



Cross bonding system:

This can be considered when the circuit length can be subdivided into major sections and each major section can be divided into three equal minor sections taking into consideration the reduction in number of joints to a minimum as the weakest point in the circuit is the joint (Figure b).

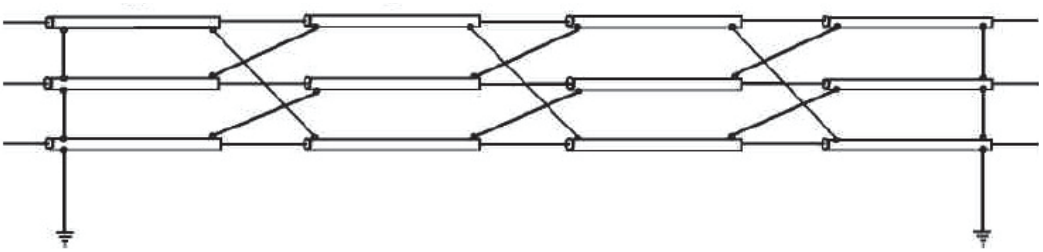


It is possible to reduce the resultant sheath voltage to low levels. Particularly with larger conductor cross-sections and on cable lengths with joints, by carrying cross bonding at about every 1/3rd of the sheath length of each phase in series, reduces the resultant sheath voltage to zero. Even sheath grounded at both ends, reduces the extra sheath losses drastically. The zero sequence impedance is practically of the same low level as in normal both end grounded system.

The cyclic permutation of longitudinal sheath connections results in similar sheath over voltage problems at points where the subdivided sheaths are insulated as in single grounded cable sheath. Therefore, these insulated points will have to be provided with suitable over voltage protection (surge arrestors, non-linear silicon-carbide or zinc oxide resistors)

Continuous Cross bonding system:

This is a type of cross bonding. It is applicable to circuits consisting of at least four minor sections in which the cable metallic sheaths are successively cross-bonded at each joint. At each end of the circuit the sheaths are solidly bonded and grounded (Figure c).



(c)

Mixed System:

Sometimes mixed system i.e., cross-boding and single point bonding in the same circuit can be used where the number of minor sections cannot be divided over 3 such as 4 or 5 sections. Here cross-bonding system can be considered for the first 3 sections and single point bonding used for the other section(s).

CU/XLPE/CUW/LAT/PE - 69 kV (72.5 kV) CABLE

AS PER IEC 60840

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	280	23.2	13.0	53.2	0.2	4.50	73	9300
500	280	26.7	13.0	56.7	0.2	4.50	77	10500
630	280	30.4	13.0	60.4	0.2	4.50	80	12000
800	280	33.7	13.0	63.7	0.2	4.50	84	13800
1000	280	41.5	13.0	73.5	0.2	4.50	95	17000
1200	280	45.5	13.0	77.5	0.2	4.50	99	18900
1600	280	51.6	13.0	84.6	0.2	4.50	106	23100
2000	280	57.0	13.0	90.0	0.2	4.50	112	27200
2500	280	63.0	13.0	96.0	0.2	4.50	118	32300

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	µF/km	Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0626	0.42	0.80	0.21	57.23	43.2	359	431	496	576	652	743
500	0.0366	0.0502	0.40	0.78	0.23	71.54	43.2	391	486	562	646	752	864
630	0.0283	0.0406	0.38	0.75	0.25	90.14	43.2	422	544	635	717	859	999
800	0.0221	0.0337	0.37	0.73	0.26	114.47	43.2	448	601	708	783	967	1138
1000	0.0176	0.0232	0.35	0.69	0.32	143.08	43.2	504	732	843	927	1218	1409
1200	0.0151	0.0202	0.34	0.67	0.34	171.70	43.2	525	787	911	987	1335	1554
1600	0.0113	0.0157	0.33	0.64	0.38	228.93	43.2	560	894	1045	1089	1554	1832
2000	0.0090	0.0130	0.32	0.62	0.41	286.17	43.2	583	980	1157	1166	1742	2081
2500	0.0072	0.0111	0.31	0.60	0.44	357.71	43.2	604	1059	1269	1240	1928	2342

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/CUW/LAT/PE - 69 kV (72.5 kV) CABLE

AS PER IEC 60840 &
NG SA 11-TMSS-01
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	280	23.2	16.5	59.8	0.2	4.50	80	10100
630	280	30.4	16.5	67.0	0.2	4.50	88	13000
800	280	33.7	16.5	70.3	0.2	4.50	91	14800
1000	280	41.5	16.5	79.3	0.2	4.50	100	17900
1200	280	45.5	16.5	83.3	0.2	4.50	104	19900
1600	280	51.6	16.5	90.0	0.2	4.50	111	24200
2000	280	57.0	16.5	95.4	0.2	4.50	117	28300

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
			Inductance (Nominal) mH/km					Close Trefoil		Flat	Close Trefoil		Flat
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	trefoil	Flat	Capacitance (Nominal) µF/km	Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0625	0.44	0.80	0.17	57.23	43.2	363	433	494	580	649	731
630	0.0283	0.0404	0.40	0.75	0.20	90.14	43.2	427	548	632	726	858	983
800	0.0221	0.0335	0.39	0.73	0.22	114.47	43.2	455	605	705	793	963	1117
1000	0.0176	0.0232	0.36	0.69	0.26	143.08	43.2	509	732	840	935	1210	1388
1200	0.0151	0.0202	0.35	0.67	0.28	171.70	43.2	530	788	908	996	1325	1530
1600	0.0113	0.0156	0.34	0.64	0.30	228.93	43.2	564	895	1042	1100	1545	1806
2000	0.0090	0.0130	0.33	0.62	0.33	286.17	43.2	587	980	1153	1178	1730	2051

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

AL/XLPE/CUW/LAT/PE - 69 kV (72.5 kV) CABLE

AS PER IEC 60840 &
NG SA 11-TMSS-01
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	280	30.4	16.5	67.0	0.2	4.50	88	9000
800	280	35.0	16.5	71.6	0.2	4.50	92	9900
1000	280	42.0	16.5	79.8	0.2	4.50	101	11500
1200	280	45.5	16.5	83.3	0.2	4.50	104	12300
1600	280	51.6	16.5	90.0	0.2	4.50	111	14000
2000	280	57.0	16.5	95.4	0.2	4.50	117	15600

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	Inductance (Nominal) mH/km		Capacitance (Nominal) µF/km			Close Trefoil		Flat	Close Trefoil		Flat
			trefoil	Flat		Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0469	0.0627	0.40	0.75	0.20	59.52	43.2	371	442	503	616	691	782
800	0.0367	0.0504	0.38	0.72	0.22	75.59	43.2	404	497	568	692	795	907
1000	0.0291	0.0376	0.36	0.69	0.26	94.48	43.2	450	583	661	806	962	1094
1200	0.0247	0.0320	0.35	0.67	0.28	113.38	43.2	474	634	720	868	1061	1213
1600	0.0186	0.0243	0.34	0.64	0.30	151.17	43.2	515	730	833	978	1253	1443
2000	0.0149	0.0196	0.33	0.62	0.33	188.97	43.2	545	813	933	1067	1427	1656

Laying Conditions

- Ground temperature..... .....: 40 °C
- Ground thermal resistivity..... .....: 2.0 K.m/W
- Laying depth..... .....: 1500 mm
- Air temperature..... .....: 55 °C
- Number of circuits..... .....: 1 circuit
- Distance between conductors (flat)..... .....: 400 mm

CU/XLPE/CUW/LAT/PE - 110 kV (123 kV) CABLE

AS PER IEC 60840 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	280	23.2	20.32	67.8	0.2	4.50	89	11000
500	280	26.7	20.32	71.3	0.2	4.50	92	12300
630	280	30.4	20.32	75.0	0.2	4.50	96	13900
800	280	33.7	20.32	78.3	0.2	4.50	99	15800
1000	280	41.5	20.32	88.1	0.2	4.50	109	19100
1200	280	45.5	20.32	92.1	0.2	4.50	113	21100
1600	280	51.6	20.32	99.2	0.2	4.50	121	25500
2000	280	57.0	20.32	104.6	0.2	4.50	126	29600
2500	280	63.0	20.32	110.6	0.2	4.50	132	34900
3000	280	68.0	20.32	115.6	0.2	4.50	137	40500

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0624	0.46	0.80	0.15	57.23	43.2	367	435	492	585	647	721
500	0.0366	0.0499	0.44	0.78	0.16	71.54	43.2	400	490	557	657	744	835
630	0.0283	0.0402	0.42	0.75	0.18	90.14	43.2	432	551	630	733	853	966
800	0.0221	0.0332	0.40	0.73	0.19	114.47	43.2	461	608	702	802	958	1097
1000	0.0176	0.0232	0.38	0.69	0.22	143.08	43.2	515	734	836	947	1197	1359
1200	0.0151	0.0202	0.37	0.67	0.24	171.70	43.2	536	790	904	1009	1311	1497
1600	0.0113	0.0156	0.36	0.64	0.26	228.93	43.2	571	898	1036	1116	1529	1765
2000	0.0090	0.0130	0.35	0.62	0.28	286.17	43.2	596	981	1146	1198	1709	1998
2500	0.0072	0.0110	0.34	0.60	0.30	357.71	43.2	618	1060	1255	1275	1891	2246
3000	0.0060	0.0097	0.33	0.59	0.32	429.25	43.2	634	1121	1342	1334	2037	2452

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/LEAD/PE - 115 kV (123 kV) CABLES

AS PER IEC 60840
NG SA 11-TMSS-0
Specificatio

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LEAD (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	> 1600	23.2	20.32	67.8	6.5	4.50	98	27000
500	> 1600	26.7	20.32	71.3	6.3	4.50	101	28500
630	> 1600	30.4	20.32	75.0	6.0	4.50	105	29900
800	> 1600	33.7	20.32	78.3	5.8	4.50	108	31800
1000	> 1600	41.5	20.32	88.1	5.2	4.50	116	34900
1200	> 1600	45.5	20.32	92.1	5.0	4.50	120	36800
1600	> 1600	51.6	20.32	99.2	4.7	4.50	127	41200
2000	> 1600	57.0	20.32	104.6	4.5	4.50	132	45400
2500	> 1600	63.0	20.32	110.6	4.3	4.50	137	50700
3000	> 1600	68.0	20.32	115.6	4.1	4.50	142	55700

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of lead sheath is based on a short circuit level of 40 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	Inductance (Nominal) mH/km		Capacitance (Nominal) µF/km			Close Trefoil		Flat	Close Trefoil		Flat
			trefoil	Flat		Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0623	0.48	0.80	0.15	57.23	40.2	387	431	493	613	651	729
500	0.0366	0.0497	0.45	0.78	0.16	71.54	40.6	425	484	558	693	747	844
630	0.0283	0.0400	0.44	0.75	0.18	90.14	40.4	463	540	629	778	853	975
800	0.0221	0.0330	0.42	0.73	0.19	114.47	40.5	497	593	700	857	956	1106
1000	0.0176	0.0232	0.39	0.69	0.22	143.08	40.2	567	702	830	1024	1174	1363
1200	0.0151	0.0201	0.38	0.67	0.24	171.70	40.2	594	750	895	1098	1280	1499
1600	0.0113	0.0156	0.37	0.64	0.26	228.93	40.4	641	840	1021	1229	1476	1760
2000	0.0090	0.0129	0.36	0.62	0.28	286.17	40.7	676	908	1123	1331	1636	1987
2500	0.0072	0.0110	0.34	0.60	0.30	357.71	40.9	708	968	1223	1431	1792	2223
3000	0.0060	0.0097	0.34	0.59	0.32	429.25	40.7	732	1018	1301	1509	1921	2421

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/CUW/LAT/PE - 132 kV (145 kV) CABLE

AS PER IEC 60840 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]***	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	280	23.2	21.6	70.4	0.2	5.00	92	11500
500	280	26.7	21.6	73.9	0.2	5.00	96	12800
630	280	30.4	21.6	77.6	0.2	5.00	100	14400
800	280	33.7	21.6	80.9	0.2	5.00	103	16300
1000	280	41.5	21.6	90.7	0.2	5.00	113	19600
1200	280	45.5	21.6	94.7	0.2	5.00	117	21700
1600	280	51.6	21.6	101.8	0.2	5.00	124	26100
2000	280	57.0	21.6	107.2	0.2	5.00	130	30300
2500	280	63.0	21.6	113.2	0.2	5.00	136	35600
3000	280	68.0	21.6	118.2	0.2	5.00	141	41200

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0623	0.46	0.80	0.15	57.23	43.2	368	435	491	584	645	716
500	0.0366	0.0498	0.44	0.78	0.16	71.54	43.2	401	492	556	657	743	830
630	0.0283	0.0401	0.43	0.75	0.17	90.14	43.2	433	552	629	733	852	960
800	0.0221	0.0331	0.41	0.73	0.18	114.47	43.2	461	610	700	802	957	1089
1000	0.0176	0.0232	0.39	0.69	0.21	143.08	43.2	515	735	835	946	1194	1349
1200	0.0151	0.0201	0.38	0.67	0.23	171.70	43.2	536	791	902	1008	1307	1486
1600	0.0113	0.0156	0.36	0.64	0.25	228.93	43.2	572	898	1034	1115	1521	1749
2000	0.0090	0.0129	0.35	0.62	0.27	286.17	43.2	596	984	1144	1196	1704	1982
2500	0.0072	0.0110	0.34	0.60	0.29	357.71	43.2	618	1064	1253	1274	1887	2226
3000	0.0060	0.0097	0.33	0.59	0.31	429.25	43.2	633	1124	1339	1332	2031	2430

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/CUW/LAT/PE - 132 kV (145 kV) CABLE

AS PER IEC 6084

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	280	23.2	18.0	63.2	0.2	4.50	83	10300
500	280	26.7	18.0	66.7	0.2	4.50	87	11600
630	280	30.4	18.0	70.4	0.2	4.50	91	13200
800	280	33.7	18.0	73.7	0.2	4.50	94	15100
1000*	280	41.5	18.0	83.5	0.2	4.50	105	18400
1200*	280	45.5	18.0	87.5	0.2	4.50	109	20400
1600*	280	51.6	18.0	94.6	0.2	4.50	116	24700
2000*	280	57.0	18.0	100.0	0.2	4.50	122	28800
2500*	280	63.0	18.0	106.0	0.2	4.50	128	34100
3000*	280	68.0	18.0	111.0	0.2	4.50	133	39600

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0624	0.44	0.80	0.16	57.23	43.2	365	433	493	582	648	727
500	0.0366	0.0499	0.42	0.78	0.18	71.54	43.2	397	489	559	654	747	844
630	0.0283	0.0403	0.41	0.75	0.19	90.14	43.2	429	549	631	729	856	977
800	0.0221	0.0334	0.39	0.73	0.21	114.47	43.2	457	606	704	796	962	1110
1000	0.0176	0.0232	0.37	0.69	0.25	143.08	43.2	512	734	838	942	1204	1372
1200	0.0151	0.0202	0.36	0.67	0.26	171.70	43.2	533	789	906	1003	1318	1512
1600	0.0113	0.0156	0.35	0.64	0.29	228.93	43.2	569	896	1039	1110	1534	1782
2000	0.0090	0.0130	0.34	0.62	0.31	286.17	43.2	592	981	1149	1189	1719	2021
2500	0.0072	0.0110	0.33	0.60	0.33	357.71	43.2	614	1060	1259	1265	1902	2272
3000	0.0060	0.0098	0.32	0.59	0.35	429.25	43.2	630	1121	1347	1323	2048	2482

Laying Conditions

- Ground temperature.....	40	°C
- Ground thermal resistivity.....	2.0	K.m/W
- Laying depth.....	1500	mm
- Air temperature.....	55	°C
- Number of circuits.....	1	circuit
- Distance between conductors (flat).....	400	mm

AL/XLPE/CUW/LAT/PE - 132 kV (145 kV) CABLE

AS PER IEC 60840 & Generally to
NG SA 11-TMSS-02 Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
500	280	27.0	21.6	74.2	0.2	5.00	96	9800
630	280	30.4	21.6	77.6	0.2	5.00	100	10500
800	280	35.0	21.6	82.2	0.2	5.00	104	11500
1000	280	42.0	21.6	91.2	0.2	5.00	113	13200
1200	280	45.5	21.6	94.7	0.2	5.00	117	14100
1600	280	51.6	21.6	101.8	0.2	5.00	124	15800
2000	280	57.0	21.6	107.2	0.2	5.00	130	17600
2500	280	63.0	21.6	113.2	0.2	5.00	136	19700
3000	280	68.0	21.6	118.2	0.2	5.00	141	21200

- Conductors ≥ 1000 mm² are Milliken.

- 280 mm² CUW screen shall withstand 40.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
			Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	trefoil	Flat	μF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
500	0.0605	0.0794	0.44	0.77	0.16	47.24	43.2	341	391	439	545	591	656
630	0.0469	0.0625	0.43	0.75	0.17	59.52	43.2	375	445	500	618	684	763
800	0.0367	0.0502	0.41	0.72	0.19	75.59	43.2	409	500	565	695	787	885
1000	0.0291	0.0375	0.39	0.69	0.22	94.48	43.2	455	585	657	808	947	1062
1200	0.0247	0.0320	0.38	0.67	0.23	113.38	43.2	480	636	716	872	1046	1177
1600	0.0186	0.0242	0.36	0.64	0.25	151.17	43.2	521	733	828	985	1233	1398
2000	0.0149	0.0196	0.35	0.62	0.27	188.97	43.2	552	816	926	1076	1402	1601
2500	0.0127	0.0169	0.34	0.60	0.29	236.21	43.2	575	880	1004	1151	1545	1778
3000	0.0106	0.0143	0.33	0.59	0.31	283.45	43.2	597	952	1094	1224	1702	1977

Laying Conditions

- Ground temperature.....:	40	°C
- Ground thermal resistivity.....:	2.0	K.m/W
- Laying depth.....:	1500	mm
- Air temperature.....:	55	°C
- Number of circuits.....:	1	circuit
- Distance between conductors (flat).....:	400	mm

CU/XLPE/LEAD/PE - 132 kV (145 kV) CABLES

AS PER IEC 60840 &
NG SA 11-TMSS-02
Specificatior

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LEAD Sheath (Nominal) [mm]***	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
400	> 1600	23.2	21.60	70.4	6.3	5.00	101	27500
500	> 1600	26.7	21.60	73.9	6.1	5.00	105	28900
630	> 1600	30.4	21.60	77.6	5.8	5.00	108	30300
800	> 1600	33.7	21.60	80.9	5.6	5.00	111	32100
1000	> 1600	41.5	21.60	90.7	5.1	5.00	120	35500
1200	> 1600	45.5	21.60	94.7	4.9	5.00	123	37500
1600	> 1600	51.6	21.60	101.8	4.6	5.00	130	41800
2000	> 1600	57.0	21.60	107.2	4.4	5.00	135	46000
2500	> 1600	63.0	21.60	113.2	4.2	5.00	141	51300
3000	> 1600	68.0	21.60	118.2	4.0	5.00	146	56300

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of lead sheath is based on a short circuit level of 40 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section	Parameters					Short Circuit Current		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at	R_{ac} at	Inductance (Nominal)		Capacitance			Close Trefoil		Flat	Close Trefoil		Flat
	20°C	90°C	mH/km		(Nominal)	kA for 1 second							
[mm²]	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
400	0.0470	0.0623	0.48	0.80	0.15	57.23	40.2	388	432	492	611	649	723
500	0.0366	0.0497	0.46	0.78	0.16	71.54	40.5	425	485	557	691	746	838
630	0.0283	0.0400	0.44	0.75	0.17	90.14	40.1	464	541	628	776	850	967
800	0.0221	0.0330	0.43	0.73	0.18	114.47	40.2	499	595	698	855	952	1096
1000	0.0176	0.0232	0.40	0.69	0.21	143.08	40.5	566	704	829	1020	1172	1352
1200	0.0151	0.0201	0.39	0.67	0.23	171.70	40.4	594	751	893	1095	1274	1485
1600	0.0113	0.0156	0.37	0.64	0.25	228.93	40.5	642	841	1018	1226	1470	1743
2000	0.0090	0.0129	0.36	0.62	0.27	286.17	40.7	676	909	1120	1329	1630	1968
2500	0.0072	0.0109	0.35	0.60	0.29	357.71	40.8	707	974	1220	1427	1792	2203
3000	0.0060	0.0097	0.34	0.59	0.31	429.25	40.5	731	1025	1298	1505	1922	2399

Laying Conditions

- Ground temperature.....	40	°C
- Ground thermal resistivity.....	2.0	K.m/W
- Laying depth.....	1500	mm
- Air temperature.....	55	°C
- Number of circuits.....	1	circuit
- Distance between conductors (flat).....	400	mm

AL/XLPE/LEAD/PE - 132 kV (145 kV) CABLES

AS PER IEC 60840 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LEAD Sheath (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
500	> 1600	27.0	21.60	74.2	6.1	5.00	105	25900
630	> 1600	30.4	21.60	77.6	5.8	5.00	108	26300
800	> 1600	35.0	21.60	82.2	5.5	5.00	112	27200
1000	> 1600	42.0	21.60	91.2	5.1	5.00	120	29200
1200	> 1600	45.5	21.60	94.7	4.9	5.00	123	29900
1600	> 1600	51.6	21.60	101.8	4.6	5.00	130	31500
2000	> 1600	57.0	21.60	107.2	4.4	5.00	135	33300
2500	> 1600	63.0	21.60	113.2	4.2	5.00	141	35400
3000	> 1600	68.0	21.60	118.2	4.0	5.00	146	36300

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of lead sheath is based on a short circuit level of 40 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	µF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
500	0.0605	0.0793	0.46	0.77	0.16	47.24	40.7	356	389	440	567	596	663
630	0.0469	0.0625	0.44	0.75	0.17	59.52	40.1	396	440	500	645	686	769
800	0.0367	0.0501	0.42	0.72	0.19	75.59	40.0	435	493	565	731	787	891
1000	0.0291	0.0375	0.40	0.69	0.22	94.48	40.7	490	570	654	856	938	1066
1200	0.0247	0.0320	0.39	0.67	0.23	113.38	40.4	521	616	712	929	1031	1180
1600	0.0186	0.0242	0.37	0.64	0.25	151.17	40.5	574	702	820	1061	1208	1397
2000	0.0149	0.0196	0.36	0.62	0.27	188.97	40.7	614	773	914	1171	1362	1596
2500	0.0127	0.0169	0.35	0.60	0.29	236.21	40.8	645	828	987	1261	1493	1768
3000	0.0106	0.0143	0.34	0.59	0.31	283.45	40.5	677	890	1072	1356	1638	1962

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/CUW/LAT/PE - 230 kV (245 kV) CABLE

AS PER IEC 62067 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]***	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	440	30.4	24.0	82.4	0.2	5.00	106	16600
800	440	33.7	24.0	85.7	0.2	5.00	109	18600
1000	440	41.5	24.0	95.5	0.2	5.00	119	21900
1200	440	45.5	24.0	99.5	0.2	5.00	123	24000
1600	440	51.6	24.0	106.6	0.2	5.00	131	28500
2000	440	57.0	24.0	112.0	0.2	5.00	136	32700
2500	440	63.0	24.0	118.0	0.2	5.00	142	38000
3000	440	68.0	24.0	123.0	0.2	5.00	147	43600

- Conductors ≥ 1000 mm² are Milliken.

- 440 mm² CUW screen shall withstand 63.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	µF/km	Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0283	0.0400	0.44	0.75	0.16	90.14	66.5	440	554	608	741	850	941
800	0.0221	0.0330	0.42	0.73	0.17	114.47	66.5	469	613	676	812	955	1068
1000	0.0176	0.0232	0.40	0.69	0.20	143.08	66.5	524	736	801	959	1188	1320
1200	0.0151	0.0201	0.39	0.67	0.21	171.70	66.5	546	792	864	1023	1300	1453
1600	0.0113	0.0156	0.37	0.64	0.23	228.93	66.5	582	900	986	1135	1516	1711
2000	0.0090	0.0129	0.36	0.62	0.25	286.17	66.5	608	983	1087	1219	1694	1935
2500	0.0072	0.0109	0.35	0.60	0.27	357.71	66.5	630	1064	1186	1299	1876	2172
3000	0.0060	0.0097	0.34	0.59	0.28	429.25	66.5	647	1124	1264	1360	2020	2370

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/LEAD/PE - 230 kV (245 kV) CABLES

AS PER IEC 62067 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]**	Diameter Over Insulation (Approx.) [mm]	Thickness of LEAD Sheath (Nominal) [mm]***	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	≥ 2550	30.4	24.0	82.4	8.5	5.00	119	41900
800	≥ 2550	33.7	24.0	85.7	8.3	5.00	122	44100
1000	≥ 2550	41.5	24.0	95.5	7.5	5.00	130	47100
1200	≥ 2550	45.5	24.0	99.5	7.3	5.00	134	49300
1600	≥ 2550	51.6	24.0	106.6	6.9	5.00	140	53700
2000	≥ 2550	57.0	24.0	112.0	6.6	5.00	145	57800
2500	≥ 2550	63.0	24.0	118.0	6.3	5.00	151	63100
3000	≥ 2550	68.0	24.0	123.0	6.1	5.00	155	68200

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of lead sheath is based on a short circuit level of 63 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen *	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0283	0.0398	0.46	0.75	0.16	90.14	63.2	446	536	605	761	846	952
800	0.0221	0.0328	0.45	0.73	0.17	114.47	63.8	475	586	671	835	946	1078
1000	0.0176	0.0232	0.42	0.69	0.20	143.08	63.0	533	685	789	984	1153	1324
1200	0.0151	0.0201	0.40	0.67	0.21	171.70	63.5	554	729	846	1050	1252	1454
1600	0.0113	0.0155	0.39	0.64	0.23	228.93	63.8	594	807	956	1166	1433	1700
2000	0.0090	0.0129	0.38	0.62	0.25	286.17	63.7	621	866	1044	1255	1582	1913
2500	0.0072	0.0109	0.36	0.60	0.27	357.71	63.7	645	922	1127	1340	1731	2135
3000	0.0060	0.0096	0.35	0.59	0.28	429.25	64.0	664	959	1188	1405	1840	2314

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/CUW/LAT/PE - 380 kV (420 kV) CABLES

AS PER IEC 62067 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Screen Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LAT (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	440	30.4	28.0	90.4	0.2	5.00	114	18000
800	440	33.7	28.0	93.7	0.2	5.00	117	19900
1000	440	41.5	28.0	103.5	0.2	5.00	127	23400
1200	440	45.5	28.0	107.5	0.2	5.00	131	25500
1600	440	51.6	28.0	114.6	0.2	5.00	139	30100
2000	440	57.0	28.0	120.0	0.2	5.00	144	34400
2500	440	63.0	28.0	126.0	0.2	5.00	150	39800
3000	440	68.0	28.0	131.0	0.2	5.00	155	45400

- Conductors ≥ 1000 mm² are Milliken.

- 440 mm² CUW screen shall withstand 63.0 kA for 1 second as per IEC 60949 and ICEA P-45-482

- Thickness of insulation is specified by SEC [NG SA].

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	Inductance (Nominal) mH/km		Capacitance (Nominal) µF/km			Close Trefoil		Flat	Close Trefoil		Flat
			trefoil	Flat		Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0283	0.0399	0.45	0.75	0.14	90.14	66.5	444	556	575	744	844	913
800	0.0221	0.0329	0.44	0.73	0.15	114.47	66.5	474	615	638	817	949	1035
1000	0.0176	0.0232	0.41	0.69	0.18	143.08	66.5	529	737	750	965	1177	1278
1200	0.0151	0.0201	0.40	0.67	0.19	171.70	66.5	551	793	805	1030	1288	1405
1600	0.0113	0.0155	0.39	0.64	0.21	228.93	66.5	588	901	913	1144	1501	1652
2000	0.0090	0.0129	0.37	0.62	0.22	286.17	66.5	614	984	1002	1231	1678	1867
2500	0.0072	0.0109	0.36	0.60	0.24	357.71	66.5	637	1063	1086	1314	1857	2094
3000	0.0060	0.0096	0.35	0.59	0.25	429.25	66.5	654	1124	1152	1376	2001	2282

Laying Conditions

- Ground temperature..... .....: 40 °C
- Ground thermal resistivity..... .....: 2.0 K.m/W
- Laying depth..... .....: 1500 mm
- Air temperature..... .....: 55 °C
- Number of circuits..... .....: 1 circuit
- Distance between conductors (flat)..... .....: 400 mm

CU/XLPE/LEAD/PE - 380 kV (420 kV) CABLES

AS PER IEC 62067 &
NG SA 11-TMSS-02
Specification

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of LEAD Sheath (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	≥ 2550	30.4	28.0	90.4	7.9	5.00	126	43400
800	≥ 2550	33.7	28.0	93.7	7.7	5.00	129	45400
1000	≥ 2550	41.5	28.0	103.5	7.0	5.00	137	48500
1200	≥ 2550	45.5	28.0	107.5	6.8	5.00	141	50700
1600	≥ 2550	51.6	28.0	114.6	6.4	5.00	147	55000
2000	≥ 2550	57.0	28.0	120.0	6.2	5.00	152	59500
2500	≥ 2550	63.0	28.0	126.0	5.9	5.00	158	64700
3000	≥ 2550	68.0	28.0	131.0	5.7	5.00	163	69700

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of lead sheath is based on a short circuit level of 63 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C	R_{ac} at 90°C	Inductance (Nominal) mH/km		Capacitance (Nominal)			Close Trefoil		Flat	Close Trefoil		Flat
	Ω/km	Ω/km	trefoil	Flat	μF/km	Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0283	0.0397	0.47	0.75	0.14	90.14	63.4	450	536	572	761	838	921
800	0.0221	0.0327	0.46	0.73	0.15	114.47	63.7	481	587	633	836	937	1042
1000	0.0176	0.0232	0.43	0.69	0.18	143.08	63.0	539	686	737	988	1142	1279
1200	0.0151	0.0201	0.41	0.67	0.19	171.70	63.3	561	730	788	1055	1241	1403
1600	0.0113	0.0155	0.40	0.64	0.21	228.93	63.0	602	809	884	1176	1422	1639
2000	0.0090	0.0129	0.38	0.62	0.22	286.17	63.6	630	868	959	1266	1569	1843
2500	0.0072	0.0109	0.37	0.60	0.24	357.71	63.3	655	924	1029	1354	1719	2055
3000	0.0060	0.0096	0.36	0.59	0.25	429.25	63.4	672	966	1080	1421	1837	2228

Laying Conditions

- Ground temperature..... .....:	40	°C
- Ground thermal resistivity..... .....:	2.0	K.m/W
- Laying depth..... .....:	1500	mm
- Air temperature..... .....:	55	°C
- Number of circuits..... .....:	1	circuit
- Distance between conductors (flat)..... .....:	400	mm

CU/XLPE/ALS/PE - 380 kV (420 kV) CABLES

AS PER IEC 62067

Dimensional Data

Conductor Cross-section [mm²]	Metallic Sheath Cross-section [mm²]	Diameter of Conductor (Approx.) [mm]	Thickness of Insulation (Nominal) [mm]	Diameter Over Insulation (Approx.) [mm]	Thickness of AL Sheath (Nominal) [mm]	Thickness of Outer Sheath (Nominal) [mm]	Overall Diameter (Approx.) [mm]	Weight of Cable (Approx.) [kg/km]
630	≥ 625	30.4	28.0	90.4	2.1	5.0	113	14900
800	≥ 625	33.7	28.0	93.7	2.1	5.0	116	17000
1000	≥ 625	41.5	28.0	103.5	1.9	5.0	126	20400
1200	≥ 625	45.5	28.0	107.5	1.8	5.0	130	22500
1600	≥ 625	51.6	28.0	114.6	1.7	5.0	137	27000
2000	≥ 625	57.0	28.0	120.0	1.6	5.0	142	31200
2500	≥ 625	63.0	28.0	126.0	1.5	5.0	148	36600
3000	≥ 625	68.0	28.0	131.0	1.5	5.0	153	42200

- Conductors ≥ 1000 mm² are Milliken.

- Thickness of insulation is specified by SEC [NG SA].

- The thickness of Aluminum Sheath is based on a short circuit level of 63 kA for 1 s as per IEC 60949 and ICEA P-45-482

Electrical Data

Conductor Cross-section [mm²]	Parameters					Short Circuit Current kA for 1 second		Continuous Current Rating [Amperes]					
								In Ground			Free Air&Sahded area		
	R_{dc} at 20°C Ω/km	R_{ac} at 90°C Ω/km	Inductance (Nominal) mH/km		Capacitance (Nominal) µF/km			Close Trefoil		Flat	Close Trefoil		Flat
			trefoil	Flat		Conductor	Screen	Both ends	Single/ Cross	Single/ Cross	Both ends	Single/ Cross	Single/ Cross
630	0.0283	0.0399	0.45	0.75	0.14	90.14	63.6	440	508	566	737	801	904
800	0.0221	0.0329	0.44	0.73	0.15	114.47	65.8	470	551	625	809	890	1023
1000	0.0176	0.0232	0.41	0.69	0.18	143.08	65.6	524	637	727	955	1081	1256
1200	0.0151	0.0201	0.40	0.67	0.19	171.70	64.6	545	674	775	1018	1169	1377
1600	0.0113	0.0155	0.38	0.64	0.21	228.93	65.0	581	737	866	1129	1328	1606
2000	0.0090	0.0129	0.37	0.62	0.22	286.17	64.1	606	784	936	1213	1455	1802
2500	0.0072	0.0109	0.36	0.60	0.24	357.71	63.3	627	827	998	1293	1581	2004
3000	0.0060	0.0096	0.35	0.59	0.25	429.25	65.6	644	853	1041	1354	1670	2165

Laying Conditions

- Ground temperature..... .....: 40 °C
- Ground thermal resistivity..... .....: 2.0 K.m/W
- Laying depth..... .....: 1500 mm
- Air temperature..... .....: 55 °C
- Number of circuits..... .....: 1 circuit
- Distance between conductors (flat)..... .....: 400 mm

CORRECTION FACTORS

Variation in Laying Depth of Cables

Laying Depth [m]	Correction factor
0.50	1.19
0.70	1.13
0.90	1.08
1.00	1.06
1.20	1.03
1.50	***1.00***
1.75	0.98
2.00	0.96
2.50	0.93

Soil Thermal Resistivity

Soil Thermal Resistivity [K.m/W]	Correction factor
1.0	1.32
1.2	1.24
1.5	1.13
2.0	***1.00***
2.5	0.90
3.0	0.82

Ground Temperature

Ground Temperature [°C]	Correction factor
5	1.31
10	1.26
15	1.23
20	1.19
25	1.15
30	1.09
35	1.05
40	***1.00***
45	0.95
50	0.89
55	0.84
60	0.78

Ambient Air Temperature

Ambient Air Temperature [°C]	Correction factor
5	1.67
10	1.60
15	1.55
20	1.49
25	1.43
30	1.36
35	1.30
40	1.23
45	1.16
50	1.09
55	***1.00***
60	0.91

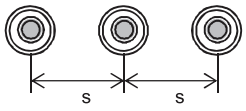
Note: The overall accuracy of correction factors is within ± 2%.

CORRECTION FACTORS

Variation in Phase Spacing of Cables*
Single circuit in flat formation in ground

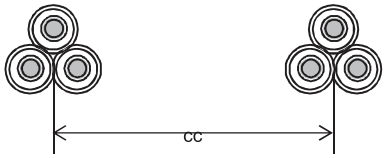
Phase Spacing s [mm]	200	250	300	400	500
Correction factor	0.92	0.95	0.97	1.00	1.02

* Center to center phase spacing



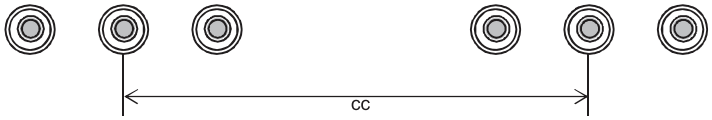
Groups of Circuits in Ground in Trefoil Formation

Distance "cc" between Groups [mm]	Number of Groups						
	2	3	4	5	6	7	8
400	0.80	0.69	0.64	0.60	0.58	0.55	0.54
500	0.82	0.72	0.67	0.62	0.60	0.59	0.57
800	0.86	0.76	0.72	0.69	0.67	0.65	0.64
1000	0.87	0.79	0.75	0.72	0.70	0.69	0.68
1200	0.89	0.81	0.78	0.75	0.74	0.72	0.71
1500	0.90	0.84	0.81	0.79	0.78	0.77	0.76
2000	0.93	0.88	0.86	0.84	0.83	0.82	0.81



Groups of Circuits in Ground in Flat Formation

Distance "cc" between Groups [mm]	Number of Groups						
	2	3	4	5	6	7	8
1250	0.87	0.78	0.75	0.72	0.71	0.69	0.68
1500	0.89	0.81	0.78	0.75	0.74	0.73	0.72
2000	0.91	0.85	0.83	0.81	0.8	0.79	0.78
3000	0.95	0.9	0.89	0.88	0.87	0.86	0.85

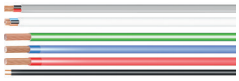


Note: The overall accuracy of correction factors is within ± 3%.

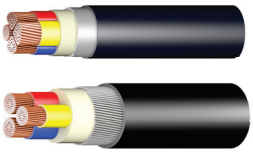
OUR PRODUCTS

Power Cable

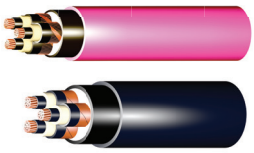
Wires



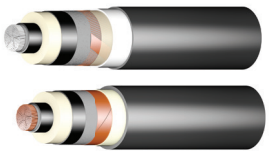
Low Voltage
Lead Sheathed



Medium Voltage
Cables



High Voltage Cables



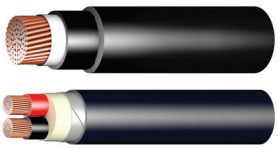
Overhead Lines Conductors

Overhead Lines

Gap Conductor

Fire Retardant Cables

Fire Survival Cable
(fire resistant,
retardant and low
smoke Halogen Free
Cables)



Control Cables

Control Cables

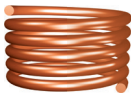
Communication Cables

Telephone Cables

Fiber Optic
Cables

Copper & Aluminum Rods

High Quality
Copper Rods



High Quality
Aluminum Rods

Polymers

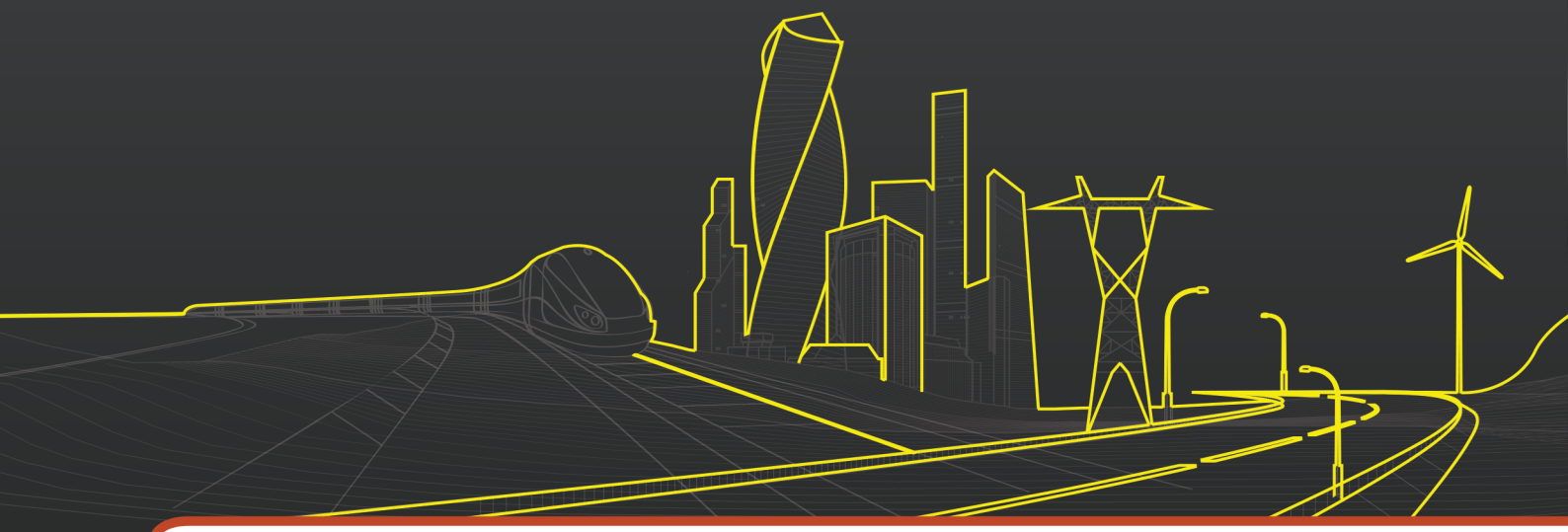
PVC Compounds

LV XLPE Compounds

Wooden & Steel Drums

Wooden & Steel Drums

RIYADH CABLES GROUP



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