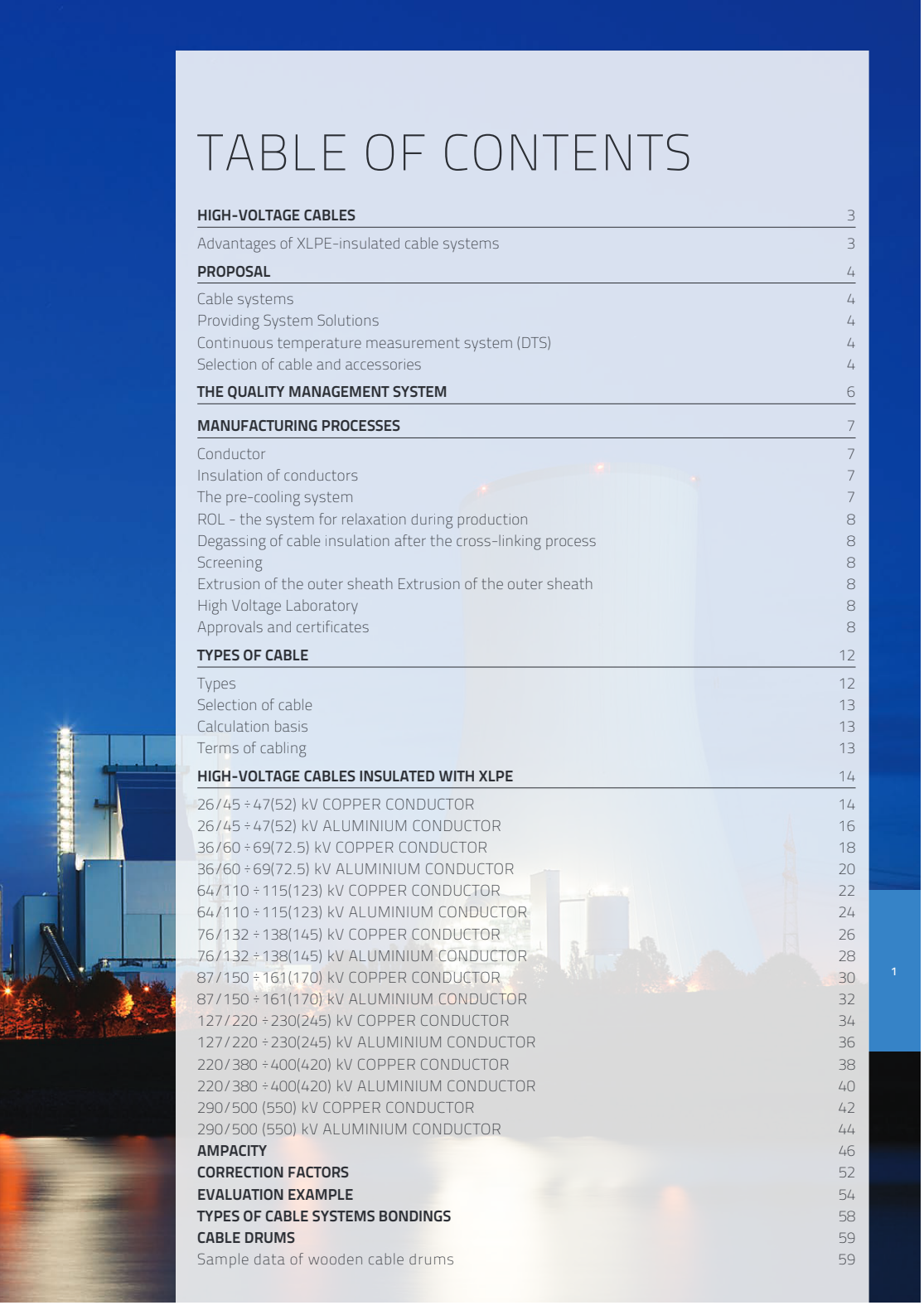
THE PATHWAY TO POWER

HIGH AND EXTRA HIGH VOLTAGE CABLES

TFKable



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Experience and Innovation

HIGH-VOLTAGE CABLES

Today we are all part of a highly mechanised society, we habitually utilise technologies for business and daily life that would have been thought impossible only 10 years ago. Living in such an industrial world it is easy to forget that the most essential element, that allows all of these technologies to function, is a reliable supply of energy. We take it for granted, but without a safe and efficient energy infrastructure, the industrialised world would cease to function. The efficient and reliable transmission of electricity is crucial. The higher the voltage, the greater the need for efficiency and safety. If a high voltage cable fails it can be disastrous. Therefore, choosing a cable brand with a proven track record of manufacturing excellence and reliability is of the utmost importance.

The transmission of high voltage electricity through a network of cable systems has always been a technological challenge. However that challenge becomes even greater when transmission through overhead lines is unacceptable and an underground system must be adopted.
When a cable is laid in the ground, the insulation becomes of paramount importance. The current's natural inclination is to return to earth and so the conductor must be well insulated to prevent losses. Historically, HV fluid impregnated multi-layered paper dielectric cables were installed, and whilst having a proven history of reliable use, they required a much greater degree of system design complexity. Provisions had to be made for oil tanks and calculations of the hydraulic oil flow had to be taken into consideration. Additionally, the systems need a continual maintenance regime as any oil leaks from these cables raised serious environmental concerns and possible cable failure.
The development of a reliable method of crosslinking polyethylene has meant that the use of a paper taped dielectric has become all but obsolete.
The use of cross-linked polyethylene proved to be a breakthrough. Not only is it a more cost effective solution, these cable systems require little, if any, regular maintenance.
XLPE cable systems allow for efficient transmission of energy, whilst having a comparatively low degree of design and installation complexity. This technology has gradually been developed to enable the creation of cable systems working with a voltage up to 500 kV.

The main advantages of underground XLPE insulated cable circuits include:

- Low electrical losses,
- Easier installation,
- High degree of reliability and safety,
- Minimal impact on the environment,
- No unsightly cable towers in populated centres or areas of natural beauty,
- Lower magnetic field than overhead lines,
- Elimination of cable oil leaks into the environment,
- Modern manufacturing methods mean each stage, of insulating process is reported and fully traceable.

For over 20 years TELE-FONIKA Kable have been manufacturing high and extra high voltage cables at its factory in Bydgoszcz. Since the first Nokia Maillfer CCV line was installed in 1998, this plant has seen extensive investment in new plant and testing facilities. Currently, it has 7 operational Nokia Mailleffer CCV lines, with plans to increase this to 8 over the next year. This will mean that the Bydgoszcz factory has
the largest high voltage production capacity in Europe.

The current position of the company TELE-FONIKA Kable is the result of continuous research, development and innovation of machinery, combined with the use of high-quality materials. We work with the best cable accessory manufacturers, which ensures that the cable systems we provide are reliable and of the highest quality.
The experiences gained from the manufacture, supply and installation of over 3,000 km of high voltage cables, and their continued operation in over 40 countries around the world, allow us to create a comprehensive offer corresponding to the most demanding users.

PROPOSAL

Cable systems

Starting from the first installation in 1992 of 110kV XLPE cable system in Poland, TELE-FONIKA Kable has extensive experience in offering high voltage cable systems in the international market.

Over the past 20 years TELE-FONIKA Kable has completed over 200 HV cable systems projects. Using this experience we are able to offer advice and support for turnkey projects such as cable system selection, the routing of the cable circuit, installation of equipment as well as post installation testing.

Providing System Solutions

Our experienced and highly qualified engineers are able to offer advice and consultancy services to meet with customer requirements:

- Design and optimisation of cable structures, including the calculation of current-carrying capacity and other important electrical parameters,
- Preparation of complex proposals of high voltage systems, covering; the supply of cable and accessories, installation and post-installation testing,
- Consultancy on the design of cable systems: selection of accessories, optimization of working conditions of the cable, etc.

Continuous temperature measurement system (DTS)

TELE-FONIKA Kable can offer high voltage cable systems with an inbuilt facility to enable the continuous measurement of cable temperature based on DTS technique (Distributed Temperature Sensing). In this technique the temperature sensing function is performed by a fibre placed in a protective tube which is laid within the copper wire screen during cable manufacture.

This solution negates the need to lay an additional DTS cable at the installation stage, and with the correct selection of accessories, can connect the monitoring apparatus directly to the cable.

Selection of cable and accessories

TELE-FONIKA Kable can offer many different variations of cable designs to meet your requirements. We have the design resource to enable you to select the cable and equipment necessary to meet the specific technical and operational parameters that your cable systems require, including:

- Selection of conductor cross sections, based on the required current carrying capacity of the cable circuit,
- Selection of the metallic sheath's nominal cross section, based on the required short-circuit current capacity duration,
- Advice on laying the cable circuit:
  – The distance between parallel circuits
  – Cable alignment (flat/trefoil arrangements)
  – Depth of cable laying, taking into account the soil thermal resistivity,
  – Ducts and their length
- Selection of variants and quantities of cable equipment/accessories is based on the given data:
  – Foundation/placement of accessories,
  – Operating conditions of cable accessories.

We work closely with our customers in providing practical efficient solutions.

More than just a cable supplier

THE QUALITY MANAGEMENT SYSTEM

TELE-FONIKA Kable has implemented a Quality Management System compliant with ISO 9001:2008 and Environmental Protection System compliant with ISO 14001:2004.

The all-inclusive management system covers the entire organisational structure of TELE-FONIKA Kable, supporting every department involved in our cable business, from planning, billing, raw materials ordering and processing.

By providing a product that is consistent with previously agreed specifications, and to the highest quality we demonstrate that we care about our the performance of our customer's end product. They in turn can be safe in the knowledge that they have invested in a product that is reliable, safe to use and will be delivered on time.

This control of operating functions in an integrated management system allows us to proceed in an environmentally sound manner, whilst carrying out our agreed objectives and tasks.

We strive to continually improve our operations and processes, never compromising on the quality of our products, customer satisfaction, professionalism or our environmentally sound operations.

MANUFACTURING PROCESSES

The manufacture of high voltage cables with extruded XLPE insulation is a series of processes which require highly specialised plant and extreme precision in operation in order to achieve the rigorous demands of the many and varied specifications. TELE-FONIKA Kable has made huge investment in the highest technology plant available.

Conductors

TELE-FONIKA Kable can manufacture a range of different conductor designs, depending on specified requirements. For current capacity requirements that are satisfied with conductor cross section below 1000 mm^2; stranded, circular, copper or aluminium conductors are available, with the optional addition of a water blocking sealant. Conductors with a cross section above 1000 mm^2 are manufactured as segmented Milliken conductors (RMS).

Insulation of conductors

The basic process of manufacture of extruded insulated cable consists of 'triple extruding' the insulating and screening layers onto the conductor which then passes into a curing tube where the temperature of the extrudate is raised to initiate the chemical crosslinking. When the crosslinking is complete the cable passes into a controlled cooling zone.

The triple extrusion process, applies the conductor screen, insulation and core screen in one operation on to the conductor.
The state of the art technology employed by TELE-FONIKA Kable allows the continuous on-line control of the most important geometrical parameters of each layer, such as thickness, centricity and ovality. This not only means that any deviation is immediately corrected but also guarantees complete traceability at all stages of the extrusion process.

To ensure the highest quality of the finished cable it is essential to ensure the highest possible cleanliness of the raw materials. The tiniest of foreign particles could result in treeing and in the in the most extreme cases contribute to failure of the finished cable The Bydgoszcz plant operates 'R3 technology'; a 'superclean' materials handling system which ensures a completely enclosed dust free environment to handle the granular compounds that feed the three extruders.
In the extrusion process, the polyethylene insulation granules are fed into the extruders from chambers which ensure the highest purity of materials.
Transportation of semi-conductive and insulating materials are executed through separate supply systems.
The purification of insulating polyethylene granules is performed by the air separator, comprising of magnetic separator, ionizer and cascade air sorter. The magnetic separator produces a strong field, separating any metallic impurities from the polythene granules.
The high quality materials that we use for extrusion are sourced from carefully chosen suppliers with a long and proven track record in this industry.
In addition to our strict supplier auditing procedure, a control of each incoming batch of material is performed in our Plant Laboratory.

The pre-cooling system

To prevent the effect of "leakage of insulation", which may appear in the process of its extrusion, a material with low deformation ratio (low sag type) an 'EHT system' is used. EHT Systems provide an introduction of nitrogen for pre-cooling the extruded insulation to the pipe, in which the cross-linking occurs. This process ensures that the resulting tightly controlled concentricity parameters of the manufactured cores are archived.

ROL – a system for relaxation of insulation during the production

The online relaxation unit consists of an additional heated area located in production line cooling zone. The insulation surface is effectively heated up and then cooled down again. This has three main benefits:

- Increases impulse voltage withstand,
- Reduces internal mechanical stresses,
- Minimises shrink-back behaviour.

Degassing of the insulation after the cross-linking process

During the cross-linking process, the decomposition of cross-linking agent (dicumyl peroxide) to the gaseous residual products (by-products) occurs. The insulated core is subjected to a slow degassing process. This process is carried out in specially heating chambers that ensure controlled degassing conditions. The degassing time is a result of the temperature and insulation thickness and is controlled by our plant laboratory Technicians.

Application of the metallic screen

Application of the metallic screen consists of the following stages:

- Applying the semi-conductive tapes with longitudinal moisture blocking under the metallic screen,
- Applying the copper wires screens and separate copper tape,
- Applying the semi-conductive tapes with longitudinal moisture blocking under the metallic screen,
- Aluminium or Copper foil laminate application as a moisture barrier.

Extrusion of the outer sheath

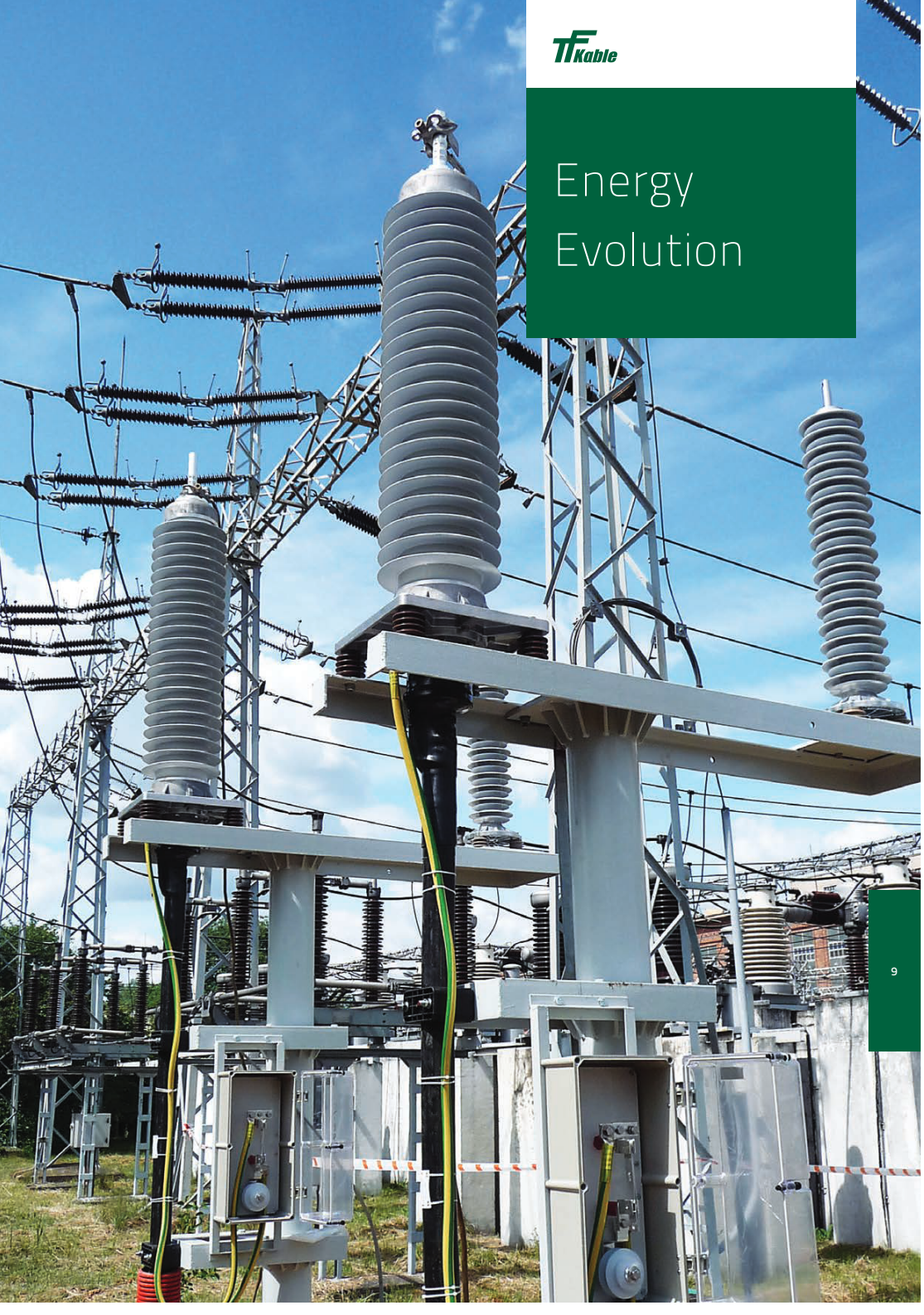
Extrusion of the outer sheath is the last step in the production of high voltage cables. In the case of cables sealed radially, the Al or Cu tape is longitudinally laid under the outer sheath. The laminate foils are covered with a copolymer of ethylene. In the process of extrusion of coating a durable bonding of the metal tape with outer sheath is made.

High Voltage Laboratory

High Voltage Laboratory is equipped with world class measuring equipment that meet the highest standards of quality. Features of our High Voltage Lab allows us to carry out routine testing of cables and cable systems type tests up to 400 kV, in accordance with current international and national standards or according to customer specifications.

Approvals and certificates

Each complete cable system is tested under the supervision of representatives of an independent laboratory, and when positive results are obtained, it receives a confirmation of the technical characteristics and can be used in high voltage networks.
Tests and research carried out in accordance with applicable standards assure full compatibility of cables with the used cable accessories and guarantee their high quality and reliability.



Energy Evolution

Energy friendly environment

» pollution reduction

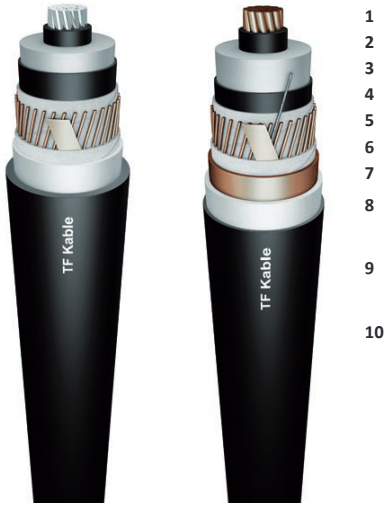
» recycling

» social responsibility

TYPES OF CABLE

Cable constructions are shown in the following figures:

Figure 1: XRUHAKXS-WTC-GC-1T2FM, XRUHKXS, NA2X(FL)2Y, N2X(FL)2Y

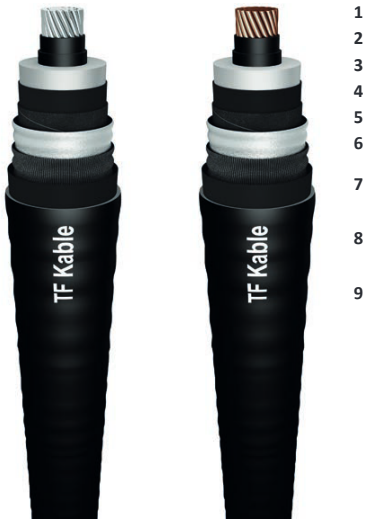


Description of Figure 1

1 – Aluminium (A) or copper conductor (optional watertightness)
2 – Semi-conductive screen extruded on the phase conductor
3 – XLPE insulation
4 – Semi-conductive screen extruded on insulation
5 – Wrapping of semi-conductive water swelling tape
6 – Metallic screen – copper wires and equalizing tapes (optional fibre optic in steel tube)
7 – Wrapping of semi-conductive water swelling tape
8 – Longitudinally applied aluminium (optional copper) tape coated with PE copolymer
9 – Outer sheath – MDPE, HDPE, LSF
10 – Optional semi-conductive layer

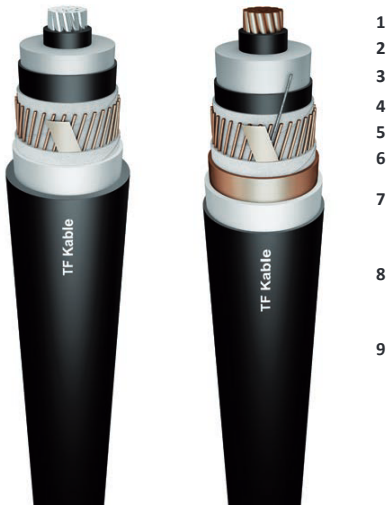
For unusual applications TELE-FONIKA Kable offers you the single-core cables:

Figure 2: XRUHAKXS-WTC-GC, XRUHKXS, NA2X(F)KL2Y, N2X(F)KL2Y, NA2X(F)K2Y, N2X(F)K2Y



Description of Figure 2

1 – Aluminium (A) or copper conductor (optional watertightness)
2 – Semi-conductive screen extruded on the phase conductor
3 – XLPE insulation
4 – Semi-conductive screen extruded on insulation
5 – Wrapping of semi-conductive water swelling tape
6 – Extruded aluminium corrugated sheath (annular type)
7 – Wrapping of bituminous tape
8 – Outer sheath – MDPE, HDPE, LSF
9 – Optional semi-conductive layer



1
2
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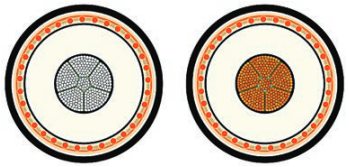
Figure 3: XRUHAKXS-WTC-GC, XRUHKXS, NA2X(F)KL2Y, N2X(F)KL2Y, NA2X(F)K2Y, N2X(F)K2Y

Description of Figure 3

1 – Aluminium (A) or copper conductor (optional watertightness)
2 – Semi-conductive screen extruded on the phase conductor
3 – XLPE insulation
4 – Semi-conductive screen extruded on insulation
5 – Wrapping of semi-conductive water swelling tape
6 – Extruded lead sheath
7 – Wrapping of separator or bituminous tape
8 – Outer sheath: MDPE, HDPE, LSF
9 – Optional semi-conductive layer

Milliken design conductors are applied for cables conductors with cross-sections > 1000 mm^2



Selection of cable

High voltage cables are manufactured based on customer specifications and factory standards.
Cable structures are based on the requirements of IEC standards:
IEC 60287 – Calculation of current-carrying capacity of cables (load factor 100%)
IEC 60853 – Calculation of current-carrying capacity of cables for cyclic load or fault conditions
IEC 61443 – Maximum short circuit temperature for cables for voltages above 30kV
IEC 60228 – Conductors of wires and cables
When selecting cable, specialized software is used to simulate the cable system operation.

Calculation basis

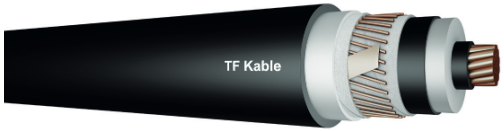
In the soil – the temperature of 20°C , cabling depth 1.0 m, soil thermal resistivity K = 1.0 Km/W, the distance between phases = 2xD.
For cables laid in separate cable culverts the load capacity (current-carrying capacity) is reduced to 90% of values presented in the tables.
In the air – the temperature of 35°C

Terms of cabling

Minimum temperature of laying cable: -20°C for cables < 110 kV and -5°C for cables ≥ 110 kV provided they are soaked immediately before laying (detailed information can be found in the guidelines for laying MV and HV cables).
Minimum bend radius: a value in meters is given in the tables.
The maximum pulling force for the working conductor or with cable grip on external shell: the value in kN is given in the tables.
The minimum diameter of casing pipes: min. 1.5 x D (mm), where D = external diameter of cable in mm.

HIGH-VOLTAGE XLPE CABLES

26/45 ÷ 47 (52) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 60840
2XS(FL)2Y according to IEC 60840
N2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
95RM	$11.5^{+0.20}$	9.0	30.7	35	34.9	41.8	2280	4.8	1.05
120RM	$12.9^{+0.25}$	9.0	32.1	35	36.3	43.2	2560	6.0	1.08
150RM	$14.5^{+0.30}$	9.0	33.7	35	37.9	44.8	2870	7.5	1.12
185RM	$16.0^{+0.30}$	9.0	35.2	35	39.4	46.3	3250	9.3	1.16
240RM	$18.5^{+0.30}$	9.0	37.7	35	41.9	48.8	3850	12.0	1.22
300RM	$20.5^{+0.30}$	9.0	39.7	35	43.9	51.0	4510	15.0	1.28
400RM	$23.5^{+0.30}$	9.0	43.1	35	47.7	55.0	5490	20.0	1.38
500RM	$26.5^{+0.40}$	9.0	46.1	35	50.7	58.2	6610	25.0	1.46
630RM	$30.3^{+0.40}$	9.0	50.1	35	54.7	62.6	8030	31.5	1.57
800RM	$34.6^{+0.50}$	9.0	54.4	35	59.0	67.1	9780	40.0	1.68
1000RM	$38.2^{+0.40}$	9.0	58.4	35	63.4	71.9	11860	50.0	1.80
1200RMS	$42.0^{+0.80}$	9.0	64.7	50	69.7	78.6	14330	60.0	1.97
1400RMS	$45.8^{+0.80}$	9.0	69.0	50	74.0	83.1	16410	70.0	2.07
1600RMS	$49.6^{+1.2}$	9.0	72.8	50	77.8	87.3	18420	80.0	2.18
1800RMS	$53.2^{+1.0}$	9.0	76.4	50	81.4	91.1	21740	90.0	2.28
2000RMS	$55.7^{+1.0}$	9.0	78.9	50	83.9	93.8	22370	100.0	2.35
2500RMS	$62.4^{+1.0}$	9.0	86.6	50	92.6	103.1	28610	125.0	2.58
3000RMS	$68.4^{+1.0}$	9.0	92.6	50	98.6	109.5	33620	150.0	2.74

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
95RM	0.2465	4.64	1.92	0.151	0.087	0.637	0.452
120RM	0.1956	4.48	1.97	0.162	0.081	0.618	0.433
150RM	0.1588	4.34	2.02	0.175	0.077	0.602	0.417
185RM	0.1272	4.22	2.06	0.186	0.073	0.589	0.404
240RM	0.0973	4.07	2.13	0.205	0.068	0.569	0.384
300RM	0.0782	3.97	2.17	0.221	0.064	0.558	0.373
400RM	0.0619	3.83	2.23	0.247	0.061	0.545	0.360
500RM	0.0493	3.74	2.28	0.269	0.057	0.533	0.348
630RM	0.0395	3.64	2.33	0.300	0.053	0.520	0.336
800RM	0.0326	3.56	2.38	0.332	0.050	0.507	0.322
1000RM	0.0277	3.49	2.42	0.362	0.048	0.501	0.316
1200RMS	0.0207	3.42	2.47	0.409	0.048	0.499	0.314
1400RMS	0.0181	3.37	2.49	0.441	0.046	0.493	0.308
1600RMS	0.0163	3.34	2.51	0.469	0.044	0.486	0.302
1800RMS	0.0150	3.31	2.53	0.496	0.042	0.481	0.296
2000RMS	0.0138	3.30	2.55	0.515	0.041	0.478	0.293
2500RMS	0.0119	3.25	2.58	0.572	0.040	0.474	0.289
3000RMS	0.0107	3.22	2.60	0.617	0.039	0.468	0.283

HIGH-VOLTAGE XLPE CABLES

26/45 ÷ 47 (52) kV

ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 60840
A2XS(FL)2Y according to IEC 60840
NA2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
95RM	$11.3^{+0.20}$	9.0	30.5	35	34.7	41.6	1700	3.3	1.04
120RM	$12.5^{+0.20}$	9.0	31.7	35	35.9	42.8	1810	4.2	1.07
150RM	$14.2^{+0.20}$	9.0	33.4	35	37.6	44.5	1950	5.3	1.11
185RM	$15.8^{+0.20}$	9.0	35.0	35	39.2	46.1	2120	6.5	1.15
240RM	$17.9^{+0.10}$	9.0	37.1	35	41.3	48.2	2350	8.4	1.21
300RM	$20.0^{+0.30}$	9.0	39.2	35	43.4	50.5	2610	10.5	1.26
400RM	$22.9^{+0.30}$	9.0	42.5	35	47.1	54.4	3050	14.0	1.36
500RM	$25.7^{+0.40}$	9.0	45.3	35	49.9	57.4	3480	17.5	1.44
630RM	$29.3^{+0.50}$	9.0	49.1	35	53.7	61.4	4040	22.1	1.54
800RM	$33.0^{+0.50}$	9.0	52.8	35	57.4	65.5	4680	28.0	1.64
1000RM	$38.0^{+0.50}$	9.0	58.2	35	63.2	71.7	5600	35.0	1.79
1200RMS	$43.0^{+0.80}$	9.0	66.2	50	71.2	80.1	6910	42.0	2.00
1400RMS	$45.6^{+0.80}$	9.0	68.8	50	73.8	82.9	7600	49.0	2.07
1600RMS	$48.5^{+1.2}$	9.0	71.7	50	76.7	86.0	8340	56.0	2.15
1800RMS	$52.7^{+1.0}$	9.0	75.3	50	80.3	90.0	9160	63.0	2.25
2000RMS	$54.5^{+1.0}$	9.0	77.7	50	82.7	92.4	9820	70.0	2.31
2500RMS	$59.0^{+1.0}$	9.0	83.2	50	89.2	99.5	11470	87.5	2.49
3000RMS	$67.0^{+1.0}$	9.0	91.2	50	97.2	108.1	13900	105.0	2.70

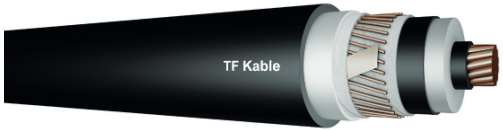
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
95RM	0.4110	4.66	1.91	0.149	0.088	0.640	0.455
120RM	0.3250	4.52	1.96	0.159	0.084	0.625	0.440
150RM	0.2650	4.36	2.01	0.172	0.079	0.607	0.422
185RM	0.2110	4.24	2.06	0.185	0.074	0.590	0.406
240RM	0.1610	4.10	2.11	0.201	0.069	0.574	0.390
300RM	0.1290	3.99	2.16	0.217	0.065	0.562	0.377
400RM	0.1010	3.85	2.22	0.242	0.062	0.548	0.363
500RM	0.0792	3.76	2.27	0.263	0.058	0.536	0.351
630RM	0.0623	3.66	2.32	0.292	0.054	0.523	0.338
800RM	0.0499	3.58	2.36	0.320	0.051	0.512	0.327
1000RM	0.0409	3.50	2.41	0.360	0.048	0.502	0.317
1200RMS	0.0322	3.40	2.48	0.420	0.047	0.498	0.313
1400RMS	0.0278	3.37	2.49	0.440	0.046	0.493	0.308
1600RMS	0.0246	3.35	2.51	0.461	0.044	0.488	0.303
1800RMS	0.0220	3.32	2.53	0.488	0.042	0.480	0.296
2000RMS	0.0201	3.31	2.54	0.506	0.042	0.479	0.294
2500RMS	0.0174	3.27	2.56	0.547	0.042	0.478	0.293
3000RMS	0.0142	3.23	2.59	0.606	0.039	0.469	0.284

HIGH-VOLTAGE XLPE CABLES

36/60 ÷ 69 (72.5) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 60840
2XS(FL)2Y according to IEC 60840
N2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
120RM	$12.9^{+0.25}$	10.0	34.1	35	38.3	45.2	2680	6.0	1.13
150RM	$14.5^{+0.30}$	10.0	35.7	35	39.9	46.8	2990	7.5	1.17
185RM	$16.0^{+0.30}$	10.0	37.2	35	41.4	48.3	3380	9.3	1.21
240RM	$18.5^{+0.30}$	10.0	39.7	35	43.9	51.0	4000	12.0	1.28
300RM	$20.5^{+0.30}$	10.0	41.7	35	45.9	53.2	4670	15.0	1.33
400RM	$23.5^{+0.30}$	10.0	45.1	35	49.7	57.2	5660	20.0	1.43
500RM	$26.5^{+0.40}$	10.0	48.1	35	52.7	60.4	6790	25.0	1.51
630RM	$30.3^{+0.40}$	10.0	52.1	35	56.7	64.6	8210	31.5	1.62
800RM	$34.6^{+0.50}$	10.0	56.4	35	61.0	69.3	9990	40.0	1.73
1000RM	$38.2^{+0.40}$	10.0	60.4	35	65.4	73.9	12060	50.0	1.85
1200RMS	$42.0^{+0.80}$	10.0	66.7	50	71.7	80.8	14580	60.0	2.02
1400RMS	$45.8^{+0.80}$	10.0	71.0	50	76.0	85.3	16670	70.0	2.13
1600RMS	$49.6^{+1.2}$	10.0	74.8	50	79.8	89.3	18670	80.0	2.23
1800RMS	$53.2^{+1.0}$	10.0	78.4	50	83.4	93.3	22030	90.0	2.33
2000RMS	$55.7^{+1.0}$	10.0	80.9	50	85.9	96.0	22670	100.0	2.40
2500RMS	$62.4^{+1.0}$	10.0	88.6	50	94.6	105.3	28940	125.0	2.63
3000RMS	$68.4^{+1.0}$	10.0	94.6	50	100.6	111.7	33970	150.0	2.79

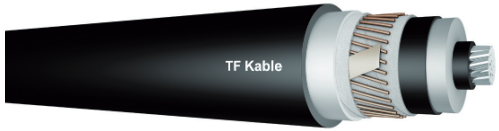
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
120RM	0.1956	5.78	2.39	0.151	0.085	0.627	0.442
150RM	0.1588	5.58	2.46	0.162	0.080	0.611	0.426
185RM	0.1272	5.43	2.51	0.173	0.076	0.597	0.412
240RM	0.0973	5.22	2.59	0.190	0.071	0.578	0.393
300RM	0.0781	5.08	2.64	0.204	0.067	0.566	0.381
400RM	0.0619	4.89	2.72	0.228	0.063	0.553	0.368
500RM	0.0492	4.77	2.78	0.248	0.059	0.540	0.355
630RM	0.0395	4.63	2.85	0.275	0.056	0.527	0.342
800RM	0.0325	4.52	2.92	0.304	0.052	0.514	0.329
1000RM	0.0273	4.43	2.96	0.332	0.050	0.507	0.322
1200RMS	0.0207	4.33	3.03	0.377	0.049	0.504	0.319
1400RMS	0.0181	4.27	3.07	0.403	0.048	0.498	0.313
1600RMS	0.0163	4.22	3.09	0.429	0.046	0.491	0.306
1800RMS	0.0150	4.19	3.12	0.453	0.044	0.486	0.301
2000RMS	0.0138	4.16	3.13	0.470	0.043	0.482	0.297
2500RMS	0.0119	4.10	3.18	0.521	0.042	0.478	0.293
3000RMS	0.0107	4.06	3.20	0.561	0.040	0.472	0.287

HIGH-VOLTAGE XLPE CABLES

36/60 ÷ 69 (72.5) kV



ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 60840
A2XS(FL)2Y according to IEC 60840
NA2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
120RM	$12.5^{+0.20}$	10.0	33.7	35	37.9	44.8	1930	4.2	1.12
150RM	$14.2^{+0.20}$	10.0	35.4	35	39.6	46.5	2080	5.3	1.16
185RM	$15.8^{+0.20}$	10.0	37.0	35	41.2	48.1	2250	6.5	1.20
240RM	$17.9^{+0.10}$	10.0	39.1	35	43.3	50.4	2510	8.4	1.26
300RM	$20.0^{+0.30}$	10.0	41.2	35	45.4	52.5	2760	10.5	1.31
400RM	$22.9^{+0.30}$	10.0	44.5	35	49.1	56.6	3220	14.0	1.42
500RM	$25.7^{+0.40}$	10.0	47.3	35	51.9	59.6	3660	17.5	1.49
630RM	$29.3^{+0.50}$	10.0	51.1	35	55.7	63.6	4230	22.1	1.59
800RM	$33.0^{+0.50}$	10.0	54.8	35	59.4	67.5	4870	28.0	1.69
1000RM	$38.0^{+0.50}$	10.0	60.2	35	65.2	73.7	5810	35.0	1.84
1200RMS	$43.0^{+0.80}$	10.0	68.2	50	73.2	82.3	7160	42.0	2.06
1400RMS	$45.6^{+0.80}$	10.0	70.8	50	75.8	85.1	7860	49.0	2.13
1600RMS	$48.5^{+1.2}$	10.0	73.7	50	78.7	88.2	8610	56.0	2.21
1800RMS	$52.7^{+1.0}$	10.0	77.3	50	82.3	92.0	9420	63.0	2.30
2000RMS	$54.5^{+1.0}$	10.0	79.7	50	84.7	94.6	10120	70.0	2.37
2500RMS	$59.0^{+1.0}$	10.0	85.2	50	91.2	101.5	11760	87.5	2.54
3000RMS	$67.0^{+1.0}$	10.0	93.2	50	99.2	110.1	14210	105.0	2.75

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
120RM	0.3247	5.84	2.37	0.148	0.087	0.634	0.449
150RM	0.2645	5.62	2.44	0.160	0.082	0.616	0.431
185RM	0.2108	5.45	2.50	0.171	0.077	0.599	0.414
240RM	0.1610	5.26	2.57	0.186	0.072	0.583	0.398
300RM	0.1291	5.11	2.63	0.201	0.068	0.569	0.384
400RM	0.1009	4.92	2.71	0.223	0.064	0.556	0.371
500RM	0.0792	4.80	2.77	0.243	0.060	0.543	0.359
630RM	0.0622	4.66	2.84	0.269	0.057	0.530	0.345
800RM	0.0498	4.56	2.89	0.294	0.053	0.518	0.334
1000RM	0.0408	4.44	2.96	0.330	0.050	0.508	0.323
1200RMS	0.0322	4.30	3.04	0.384	0.049	0.503	0.318
1400RMS	0.0278	4.27	3.06	0.402	0.048	0.498	0.313
1600RMS	0.0246	4.24	3.09	0.421	0.046	0.493	0.308
1800RMS	0.0220	4.20	3.11	0.445	0.044	0.485	0.300
2000RMS	0.0200	4.17	3.13	0.461	0.043	0.484	0.299
2500RMS	0.0173	4.13	3.16	0.498	0.043	0.482	0.297
3000RMS	0.0142	4.07	3.20	0.552	0.040	0.473	0.288

HIGH-VOLTAGE XLPE CABLES

64/110 ÷ 115 (123) kV

COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 60840
2XS(FL)2Y according to IEC 60840
N2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
150RM	$14.5^{+0.30}$	17.0	51.5	95	57.3	65.4	5100	7.5	1.64
185RM	$16.0^{+0.30}$	17.0	52.4	95	58.2	66.3	5470	9.3	1.66
240RM	$18.5^{+0.30}$	16.0	52.5	95	58.3	66.4	5900	12.0	1.66
300RM	$20.5^{+0.30}$	15.0	52.5	95	58.3	66.4	6410	15.0	1.66
400RM	$23.5^{+0.30}$	14.0	53.5	95	59.3	67.4	7180	20.0	1.69
500RM	$26.5^{+0.40}$	14.0	56.5	95	62.3	70.6	8360	25.0	1.77
630RM	$30.3^{+0.40}$	14.0	60.5	95	66.3	75.0	9860	31.5	1.88
800RM	$34.6^{+0.50}$	14.0	64.8	95	70.6	79.5	11690	40.0	1.99
1000RM	$38.2^{+0.40}$	14.0	68.4	95	74.2	83.3	13710	50.0	2.08
1200RMS	$42.0^{+0.80}$	14.0	74.7	95	80.5	90.2	16180	60.0	2.26
1400RMS	$45.8^{+0.80}$	14.0	79.0	95	84.8	94.7	18330	70.0	2.37
1600RMS	$49.6^{+1.2}$	14.0	82.8	95	88.6	98.9	20400	80.0	2.47
1800RMS	$53.2^{+1.0}$	14.0	86.4	95	92.2	102.7	23790	90.0	2.56
2000RMS	$55.7^{+1.0}$	14.0	88.9	95	94.7	105.4	24470	100.0	2.64
2500RMS	$62.4^{+1.0}$	14.0	96.6	95	103.4	114.7	30870	125.0	2.87
3000RMS	$68.4^{+1.0}$	14.0	102.6	95	109.4	121.1	35990	150.0	3.03

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
150RM	0.1587	6.78	2.30	0.124	0.103	0.678	0.493
185RM	0.1271	6.65	2.33	0.127	0.098	0.661	0.476
240RM	0.0972	6.64	2.59	0.142	0.088	0.631	0.446
300RM	0.0780	6.71	2.88	0.157	0.082	0.610	0.425
400RM	0.0617	6.77	3.23	0.180	0.074	0.586	0.401
500RM	0.0490	6.56	3.31	0.195	0.070	0.571	0.386
630RM	0.0391	6.34	3.40	0.215	0.065	0.556	0.372
800RM	0.0321	6.15	3.49	0.236	0.061	0.541	0.356
1000RM	0.0272	6.02	3.55	0.253	0.058	0.531	0.346
1200RMS	0.0205	5.83	3.65	0.284	0.057	0.526	0.341
1400RMS	0.0180	5.74	3.70	0.305	0.054	0.519	0.334
1600RMS	0.0161	5.66	3.75	0.323	0.052	0.511	0.327
1800RMS	0.0148	5.60	3.78	0.340	0.050	0.505	0.320
2000RMS	0.0136	5.56	3.81	0.352	0.049	0.501	0.316
2500RMS	0.0117	5.45	3.87	0.390	0.047	0.495	0.310
3000RMS	0.0105	5.38	3.91	0.418	0.045	0.488	0.303

HIGH-VOLTAGE XLPE CABLES

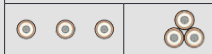
64/110 ÷ 115 (123) kV

ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 60840
A2XS(FL)2Y according to IEC 60840
NA2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
150RM	$14.2^{+0.20}$	17.0	51.2	95	57.0	64.9	4160	5.3	1.62
185RM	$15.8^{+0.20}$	17.0	52.2	95	58.0	66.1	4330	6.5	1.65
240RM	$17.9^{+0.10}$	16.0	51.9	95	57.7	65.8	4400	8.4	1.65
300RM	$20.0^{+0.30}$	15.0	52.0	95	57.8	65.9	4510	10.5	1.65
400RM	$22.9^{+0.30}$	14.0	52.9	95	58.7	66.8	4730	14.0	1.67
500RM	$25.7^{+0.40}$	14.0	55.7	95	61.5	69.8	5210	17.5	1.75
630RM	$29.3^{+0.50}$	14.0	59.5	95	65.3	73.8	5840	22.1	1.85
800RM	$33.0^{+0.50}$	14.0	63.2	95	69.0	77.9	6560	28.0	1.95
1000RM	$38.0^{+0.50}$	14.0	68.2	95	74.0	83.1	7460	35.0	2.08
1200RMS	$43.0^{+0.80}$	14.0	76.2	95	82.0	91.7	8780	42.0	2.29
1400RMS	$45.6^{+0.80}$	14.0	78.8	95	84.6	94.5	9510	49.0	2.36
1600RMS	$48.5^{+1.2}$	14.0	81.7	95	87.5	97.6	10310	56.0	2.44
1800RMS	$52.7^{+1.0}$	14.0	85.3	95	91.1	101.4	11160	63.0	2.54
2000RMS	$54.5^{+1.0}$	14.0	87.7	95	93.5	104.0	11900	70.0	2.60
2500RMS	$59.0^{+1.0}$	14.0	93.2	95	100.0	111.1	13670	87.5	2.78
3000RMS	$67.0^{+1.0}$	14.0	101.2	95	108.0	119.5	16210	105.0	2.99

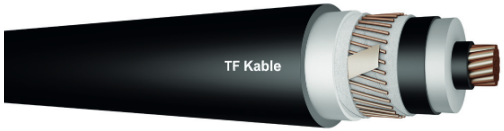
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
150RM	0.2645	6.82	2.29	0.122	0.105	0.683	0.498
185RM	0.2107	6.67	2.33	0.127	0.105	0.684	0.499
240RM	0.1609	6.71	2.57	0.139	0.090	0.637	0.452
300RM	0.1290	6.76	2.86	0.155	0.083	0.615	0.430
400RM	0.1008	6.82	3.21	0.177	0.076	0.590	0.406
500RM	0.0790	6.62	3.29	0.191	0.071	0.575	0.390
630RM	0.0620	6.39	3.38	0.210	0.067	0.560	0.375
800RM	0.0496	6.21	3.46	0.228	0.063	0.547	0.362
1000RM	0.0405	6.02	3.55	0.252	0.058	0.532	0.347
1200RMS	0.0321	5.80	3.67	0.291	0.056	0.525	0.340
1400RMS	0.0277	5.74	3.70	0.304	0.055	0.519	0.334
1600RMS	0.0244	5.68	3.73	0.318	0.053	0.513	0.328
1800RMS	0.0219	5.61	3.77	0.335	0.050	0.504	0.319
2000RMS	0.0199	5.57	3.80	0.347	0.050	0.503	0.318
2500RMS	0.0172	5.49	3.84	0.373	0.049	0.500	0.315
3000RMS	0.0140	5.40	3.90	0.412	0.046	0.489	0.304

HIGH-VOLTAGE XLPE CABLES

76/132 ÷ 138 (145) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 60840
2XS(FL)2Y according to IEC 60840
N2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
185RM	$16.0^{+0.30}$	18.0	54.4	95	60.2	68.5	5680	9.3	1.71
240RM	$18.5^{+0.30}$	17.0	54.5	95	60.3	68.6	6120	12.0	1.72
300RM	$20.5^{+0.30}$	16.0	54.5	95	60.3	68.6	6630	15.0	1.72
400RM	$23.5^{+0.30}$	16.0	57.5	95	63.3	71.8	7610	20.0	1.80
500RM	$26.5^{+0.40}$	16.0	60.5	95	66.3	75.0	8810	25.0	1.88
630RM	$30.3^{+0.40}$	16.0	64.5	95	70.3	79.2	10320	31.5	1.98
800RM	$34.6^{+0.50}$	16.0	68.8	95	74.6	83.9	12200	40.0	2.10
1000RM	$38.2^{+0.40}$	16.0	72.4	95	78.2	87.7	14250	50.0	2.19
1200RMS	$42.0^{+0.80}$	16.0	78.7	95	84.5	94.4	16730	60.0	2.36
1400RMS	$45.8^{+0.80}$	16.0	83.0	95	88.8	99.1	18940	70.0	2.48
1600RMS	$49.6^{+1.2}$	16.0	86.8	95	92.6	103.1	21010	80.0	2.58
1800RMS	$53.2^{+1.0}$	16.0	90.4	95	96.2	106.9	24420	90.0	2.67
2000RMS	$55.7^{+1.0}$	16.0	92.9	95	98.7	109.6	25120	100.0	2.74
2500RMS	$62.4^{+1.0}$	16.0	100.6	95	107.4	118.9	31570	125.0	2.97
3000RMS	$68.4^{+1.0}$	16.0	106.6	95	113.4	125.3	36730	150.0	3.13

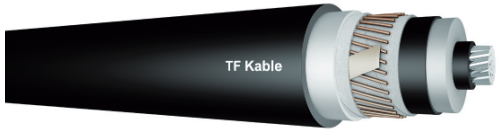
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
185RM	0.1271	7.62	2.58	0.123	0.100	0.667	0.482
240RM	0.0972	7.58	2.85	0.136	0.090	0.637	0.452
300RM	0.0780	7.64	3.15	0.151	0.084	0.617	0.432
400RM	0.0617	7.33	3.25	0.164	0.079	0.599	0.414
500RM	0.0489	7.09	3.34	0.177	0.074	0.583	0.398
630RM	0.0391	6.82	3.44	0.195	0.069	0.567	0.383
800RM	0.0320	6.60	3.53	0.213	0.064	0.552	0.367
1000RM	0.0270	6.45	3.60	0.229	0.061	0.541	0.356
1200RMS	0.0205	6.24	3.70	0.255	0.060	0.535	0.351
1400RMS	0.0179	6.12	3.76	0.274	0.057	0.528	0.343
1600RMS	0.0161	6.03	3.81	0.290	0.055	0.520	0.335
1800RMS	0.0147	5.96	3.85	0.305	0.053	0.513	0.328
2000RMS	0.0135	5.91	3.87	0.316	0.052	0.509	0.324
2500RMS	0.0116	5.79	3.95	0.348	0.050	0.502	0.318
3000RMS	0.0104	5.71	3.99	0.374	0.047	0.494	0.310

HIGH-VOLTAGE XLPE CABLES

76/132 ÷ 138 (145) kV



ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 60840
A2XS(FL)2Y according to IEC 60840
NA2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
185RM	$15.8^{+0.20}$	18.0	54.2	95	60.0	68.3	4540	6.5	1.71
240RM	$17.9^{+0.10}$	17.0	53.9	95	59.7	67.8	4580	8.4	1.70
300RM	$20.0^{+0.30}$	16.0	54.0	95	59.8	67.9	4690	10.5	1.70
400RM	$22.9^{+0.30}$	16.0	56.9	95	62.7	71.0	5140	14.0	1.78
500RM	$25.7^{+0.40}$	16.0	59.7	95	65.5	74.0	5640	17.5	1.85
630RM	$29.3^{+0.50}$	16.0	63.5	95	69.3	78.2	6310	22.1	1.96
800RM	$33.0^{+0.50}$	16.0	67.2	95	73.0	82.0	7030	28.0	2.05
1000RM	$38.0^{+0.50}$	16.0	72.2	95	78.0	87.5	7990	35.0	2.19
1200RMS	$43.0^{+0.80}$	16.0	80.2	95	86.0	96.1	9370	42.0	2.40
1400RMS	$45.6^{+0.80}$	16.0	82.8	95	88.6	98.9	10120	49.0	2.47
1600RMS	$48.5^{+1.2}$	16.0	85.7	95	91.5	102.0	10930	56.0	2.55
1800RMS	$52.7^{+1.0}$	16.0	89.3	95	95.1	105.8	11810	63.0	2.65
2000RMS	$54.5^{+1.0}$	16.0	91.7	95	97.5	108.4	12560	70.0	2.71
2500RMS	$59.0^{+1.0}$	16.0	97.2	95	104.0	115.3	14350	87.5	2.88
3000RMS	$67.0^{+1.0}$	16.0	105.2	95	112.0	123.9	16980	105.0	3.10

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
185RM	0.2107	7.65	2.57	0.122	0.100	0.669	0.484
240RM	0.1609	7.67	2.83	0.134	0.092	0.643	0.458
300RM	0.1290	7.69	3.13	0.148	0.085	0.621	0.436
400RM	0.1008	7.39	3.23	0.161	0.080	0.602	0.417
500RM	0.0790	7.15	3.32	0.174	0.075	0.587	0.402
630RM	0.0620	6.88	3.41	0.190	0.070	0.572	0.387
800RM	0.0495	6.68	3.50	0.206	0.066	0.558	0.373
1000RM	0.0404	6.46	3.60	0.228	0.061	0.542	0.357
1200RMS	0.0321	6.19	3.72	0.262	0.059	0.534	0.349
1400RMS	0.0277	6.12	3.76	0.273	0.057	0.528	0.343
1600RMS	0.0244	6.06	3.79	0.285	0.056	0.522	0.337
1800RMS	0.0218	5.98	3.84	0.301	0.053	0.513	0.328
2000RMS	0.0198	5.93	3.86	0.311	0.052	0.511	0.326
2500RMS	0.0171	5.84	3.92	0.323	0.051	0.507	0.323
3000RMS	0.0139	5.73	3.98	0.368	0.048	0.496	0.312

HIGH-VOLTAGE XLPE CABLES

87 / 150 ÷ 161 (170) kV

COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 60840
2XS(FL)2Y according to IEC 60840
N2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
240RM	$18.5^{+0.30}$	21.0	62.9	95	68.7	77.6	7050	12.0	1.94
300RM	$20.5^{+0.30}$	20.0	62.9	95	68.7	77.6	7560	15.0	1.94
400RM	$23.5^{+0.30}$	19.0	63.5	95	69.3	78.2	8290	20.0	1.96
500RM	$26.5^{+0.40}$	19.0	66.5	95	72.3	81.4	9520	25.0	2.04
630RM	$30.3^{+0.40}$	19.0	70.5	95	76.3	85.6	11070	31.5	2.14
800RM	$34.6^{+0.50}$	19.0	74.8	95	80.6	90.3	12990	40.0	2.26
1000RM	$38.2^{+0.40}$	19.0	78.4	95	84.2	94.1	15080	50.0	2.35
1200RMS	$42.0^{+0.80}$	19.0	84.7	95	90.5	100.8	17620	60.0	2.52
1400RMS	$45.8^{+0.80}$	19.0	89.0	95	94.8	105.5	19870	70.0	2.64
1600RMS	$49.6^{+1.2}$	19.0	92.8	95	98.6	109.5	21980	80.0	2.74
1800RMS	$53.2^{+1.0}$	19.0	96.4	95	102.2	113.3	25420	90.0	2.83
2000RMS	$55.7^{+1.0}$	18.0	96.9	95	102.7	113.8	25780	100.0	2.85
2500RMS	$62.4^{+1.0}$	18.0	104.6	95	111.4	123.3	32330	125.0	3.08
3000RMS	$68.4^{+1.0}$	18.0	110.6	95	117.4	129.7	37530	150.0	3.24

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
240RM	0.0971	7.56	2.51	0.121	0.099	0.662	0.477
300RM	0.0779	7.52	2.74	0.132	0.092	0.641	0.457
400RM	0.0616	7.48	3.00	0.146	0.084	0.616	0.431
500RM	0.0489	7.21	3.09	0.157	0.079	0.600	0.415
630RM	0.0389	6.91	3.19	0.172	0.074	0.583	0.398
800RM	0.0318	6.67	3.28	0.188	0.069	0.567	0.382
1000RM	0.0269	6.50	3.35	0.201	0.066	0.555	0.370
1200RMS	0.0204	6.26	3.45	0.224	0.064	0.549	0.364
1400RMS	0.0178	6.13	3.51	0.239	0.061	0.540	0.355
1600RMS	0.0160	6.03	3.56	0.253	0.059	0.532	0.347
1800RMS	0.0147	5.94	3.60	0.266	0.057	0.525	0.340
2000RMS	0.0135	6.15	3.87	0.287	0.054	0.516	0.331
2500RMS	0.0115	6.01	3.94	0.316	0.052	0.510	0.325
3000RMS	0.0103	5.92	4.00	0.339	0.050	0.501	0.317

HIGH-VOLTAGE XLPE CABLES

87/150 ÷ 161 (170) kV

ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 60840
A2XS(FL)2Y according to IEC 60840
NA2XS(FL)2Y according to DIN VDE 0276-632

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
240RM	$17.9^{+0.10}$	21.0	62.3	95	68.1	76.8	5510	8.4	1.92
300RM	$20.0^{+0.30}$	20.0	62.4	95	68.2	76.9	5620	10.5	1.92
400RM	$22.9^{+0.30}$	19.0	62.9	95	68.7	77.6	5840	14.0	1.94
500RM	$25.7^{+0.40}$	19.0	65.7	95	71.5	80.6	6360	17.5	2.02
630RM	$29.3^{+0.50}$	19.0	69.5	95	75.3	84.6	7050	22.1	2.12
800RM	$33.0^{+0.50}$	19.0	73.2	95	79.0	88.5	7810	28.0	2.21
1000RM	$38.0^{+0.50}$	19.0	78.2	95	84.0	93.9	8820	35.0	2.35
1200RMS	$43.0^{+0.80}$	19.0	86.2	95	92.0	102.5	10270	42.0	2.56
1400RMS	$45.6^{+0.80}$	19.0	88.8	95	94.6	105.3	11050	49.0	2.63
1600RMS	$48.5^{+1.2}$	19.0	91.7	95	97.5	108.4	11890	56.0	2.71
1800RMS	$52.7^{+1.0}$	19.0	95.3	95	101.1	112.2	12810	63.0	2.81
2000RMS	$54.5^{+1.0}$	18.0	95.7	95	101.5	112.6	13230	70.0	2.82
2500RMS	$59.0^{+1.0}$	18.0	101.2	95	108.0	119.5	15050	87.5	2.99
3000RMS	$67.0^{+1.0}$	18.0	109.2	95	116.0	128.1	17710	105.0	3.20

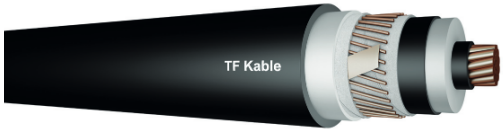
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
240RM	0.1609	7.64	2.49	0.119	0.101	0.668	0.483
300RM	0.1290	7.58	2.72	0.130	0.094	0.646	0.461
400RM	0.1008	7.54	2.99	0.144	0.085	0.619	0.434
500RM	0.0789	7.27	3.07	0.154	0.081	0.604	0.419
630RM	0.0619	6.98	3.16	0.168	0.076	0.587	0.402
800RM	0.0494	6.75	3.25	0.182	0.071	0.573	0.388
1000RM	0.0403	6.50	3.34	0.200	0.066	0.556	0.371
1200RMS	0.0320	6.21	3.47	0.229	0.063	0.547	0.362
1400RMS	0.0276	6.13	3.51	0.239	0.062	0.541	0.356
1600RMS	0.0244	6.06	3.55	0.249	0.060	0.534	0.349
1800RMS	0.0218	5.97	3.59	0.262	0.057	0.525	0.340
2000RMS	0.0198	6.18	3.85	0.283	0.055	0.519	0.334
2500RMS	0.0171	6.07	3.91	0.303	0.054	0.515	0.330
3000RMS	0.0139	5.94	3.98	0.333	0.050	0.503	0.318

EXTRA HIGH VOLTAGE XLPE CABLES

127 / 220 ÷ 230 (245) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 62067
2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
400RM	$23.5^{+0.30}$	24.0	73.9	150	80.5	90.1	10180	20.0	2.25
500RM	$26.5^{+0.40}$	23.0	74.9	150	81.5	91.1	11180	25.0	2.28
630RM	$30.3^{+0.40}$	22.0	76.9	150	83.5	93.3	12520	31.5	2.33
800RM	$34.6^{+0.50}$	22.0	81.2	150	87.8	97.8	14460	40.0	2.45
1000RM	$38.2^{+0.40}$	22.0	84.8	150	91.4	101.6	16590	50.0	2.54
1200RMS	$42.0^{+0.80}$	22.0	90.7	150	97.3	108.1	19170	60.0	2.70
1400RMS	$45.8^{+0.80}$	22.0	95.0	150	101.6	112.6	21440	70.0	2.82
1600RMS	$49.6^{+1.2}$	22.0	98.8	150	105.4	116.6	23590	80.0	2.92
1800RMS	$53.2^{+1.0}$	22.0	102.4	150	109.0	120.6	27110	90.0	3.02
2000RMS	$55.7^{+1.0}$	22.0	104.9	150	111.5	123.3	27860	100.0	3.08
2500RMS	$62.4^{+1.0}$	22.0	112.6	150	119.8	132.0	34370	125.0	3.30
3000RMS	$68.4^{+1.0}$	22.0	118.6	150	125.8	138.6	39690	150.0	3.47

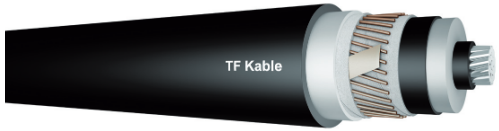
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
400RM	0.0615	9.35	3.28	0.127	0.094	0.644	0.459
500RM	0.0488	9.23	3.56	0.140	0.087	0.622	0.437
630RM	0.0388	9.09	3.89	0.157	0.080	0.600	0.415
800RM	0.0317	8.75	4.01	0.171	0.075	0.583	0.398
1000RM	0.0267	8.51	4.09	0.182	0.071	0.570	0.386
1200RMS	0.0204	8.19	4.22	0.201	0.068	0.562	0.378
1400RMS	0.0178	8.01	4.30	0.214	0.066	0.553	0.368
1600RMS	0.0159	7.86	4.36	0.226	0.063	0.544	0.360
1800RMS	0.0146	7.74	4.42	0.237	0.061	0.537	0.352
2000RMS	0.0134	7.67	4.45	0.245	0.059	0.532	0.348
2500RMS	0.0114	7.47	4.55	0.269	0.057	0.523	0.338
3000RMS	0.0102	7.34	4.62	0.288	0.054	0.515	0.330

EXTRA HIGH VOLTAGE XLPE CABLES

127 / 220 ÷ 230 (245) kV



ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 62067
A2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
400RM	$22.9^{+0.30}$	24.0	73.3	150	79.9	89.3	7690	14.0	2.23
500RM	$25.7^{+0.40}$	23.0	74.1	150	80.7	90.3	8010	17.5	2.26
630RM	$29.3^{+0.50}$	22.0	75.9	150	82.5	92.1	8470	22.1	2.30
800RM	$33.0^{+0.50}$	22.0	79.6	150	86.2	96.2	9300	28.0	2.41
1000RM	$38.0^{+0.50}$	22.0	84.6	150	91.2	101.4	10330	35.0	2.54
1200RMS	$43.0^{+0.80}$	22.0	92.2	150	98.8	109.6	11810	42.0	2.74
1400RMS	$45.6^{+0.80}$	22.0	94.8	150	101.4	112.4	12620	49.0	2.81
1600RMS	$48.5^{+1.2}$	22.0	97.7	150	104.3	115.5	13490	56.0	2.89
1800RMS	$52.7^{+1.0}$	22.0	101.3	150	107.9	119.3	14450	63.0	2.98
2000RMS	$54.5^{+1.0}$	22.0	103.7	150	110.3	121.9	15250	70.0	3.05
2500RMS	$59.0^{+1.0}$	22.0	109.2	150	116.4	128.4	17080	87.5	3.21
3000RMS	$67.0^{+1.0}$	22.0	117.2	150	124.4	137.0	19870	105.0	3.43

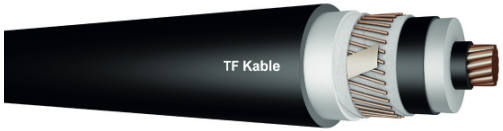
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
400RM	0.1007	9.44	3.26	0.125	0.095	0.647	0.463
500RM	0.0788	9.32	3.54	0.138	0.088	0.627	0.442
630RM	0.0619	9.19	3.86	0.154	0.081	0.604	0.419
800RM	0.0493	8.87	3.97	0.166	0.077	0.589	0.404
1000RM	0.0402	8.52	4.09	0.182	0.071	0.572	0.387
1200RMS	0.0320	8.12	4.25	0.206	0.068	0.561	0.376
1400RMS	0.0276	8.01	4.29	0.214	0.066	0.554	0.369
1600RMS	0.0243	7.90	4.34	0.223	0.064	0.547	0.362
1800RMS	0.0217	7.78	4.40	0.234	0.061	0.537	0.352
2000RMS	0.0197	7.71	4.44	0.241	0.060	0.534	0.350
2500RMS	0.0170	7.55	4.51	0.259	0.058	0.529	0.344
3000RMS	0.0138	7.37	4.60	0.283	0.055	0.516	0.332

EXTRA HIGH VOLTAGE XLPE CABLES

220/380 ÷ 400 (420) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 62067
2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
630RM	30.3 $^{+0.40}$	32.0	98.5	150	105.7	116.9	16090	31.5	2.92
800RM	34.6 $^{+0.50}$	31.0	100.8	150	108.0	119.4	17850	40.0	2.99
1000RM	38.2 $^{+0.40}$	30.0	102.4	150	109.6	121.2	19760	50.0	3.03
1200RMS	42.0 $^{+0.80}$	28.0	102.7	150	109.9	121.5	21390	60.0	3.04
1400RMS	45.8 $^{+0.80}$	27.0	105.0	150	112.2	124.0	23390	70.0	3.10
1600RMS	49.6 $^{+1.2}$	27.0	108.8	150	116.0	128.0	25610	80.0	3.20
1800RMS	53.2 $^{+1.0}$	27.0	112.4	150	119.6	131.8	29150	90.0	3.33
2000RMS	55.7 $^{+1.0}$	27.0	114.9	150	122.1	134.5	29950	100.0	3.36
2500RMS	62.4 $^{+1.0}$	27.0	122.6	150	129.8	142.8	36500	125.0	3.57
3000RMS	68.4 $^{+1.0}$	27.0	128.6	150	135.8	149.2	41880	150.0	3.73

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
630RM	0.0386	12.16	4.26	0.127	0.094	0.645	0.460
800RM	0.0314	11.88	4.57	0.140	0.087	0.622	0.438
1000RM	0.0264	11.77	4.87	0.151	0.082	0.606	0.421
1200RMS	0.0203	11.96	5.44	0.169	0.076	0.586	0.401
1400RMS	0.0177	11.95	5.80	0.185	0.072	0.573	0.388
1600RMS	0.0158	11.71	5.90	0.194	0.069	0.563	0.378
1800RMS	0.0145	11.51	5.98	0.204	0.067	0.555	0.370
2000RMS	0.0133	11.38	6.03	0.210	0.065	0.550	0.365
2500RMS	0.0113	11.05	6.18	0.230	0.062	0.539	0.354
3000RMS	0.0101	10.83	6.28	0.245	0.059	0.529	0.345

EXTRA HIGH VOLTAGE XLPE CABLES

220/380 ÷ 400 (420) kV

ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 62067
A2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
630RM	$29.3^{+0.50}$	32.0	97.5	150	104.7	115.9	12030	22.1	2.90
800RM	$33.0^{+0.50}$	31.0	99.2	150	106.4	117.8	12630	28.0	2.95
1000RM	$38.0^{+0.50}$	30.0	102.2	150	109.4	121.0	13490	35.0	3.03
1200RMS	$43.0^{+0.80}$	28.0	104.2	150	111.4	123.0	14060	42.0	3.08
1400RMS	$45.6^{+0.80}$	27.0	104.8	150	112.0	123.8	14560	49.0	3.10
1600RMS	$48.5^{+1.2}$	27.0	107.7	150	114.9	126.9	15490	56.0	3.17
1800RMS	$52.7^{+1.0}$	27.0	111.3	150	118.5	130.7	16510	63.0	3.27
2000RMS	$54.5^{+1.0}$	27.0	113.7	150	120.9	133.3	17360	70.0	3.33
2500RMS	$59.0^{+1.0}$	27.0	119.2	150	126.4	139.2	19160	87.5	3.48
3000RMS	$67.0^{+1.0}$	27.0	127.2	150	134.4	147.8	22080	105.0	3.70

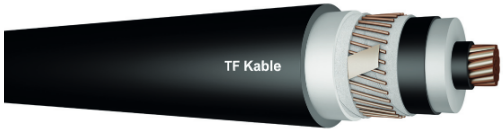
ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
630RM	0.0617	12.29	4.22	0.125	0.096	0.650	0.465
800RM	0.0491	12.06	4.52	0.136	0.090	0.630	0.445
1000RM	0.0399	11.79	4.87	0.151	0.083	0.607	0.422
1200RMS	0.0319	11.84	5.48	0.173	0.076	0.584	0.399
1400RMS	0.0275	11.96	5.80	0.184	0.072	0.573	0.388
1600RMS	0.0243	11.77	5.87	0.192	0.070	0.566	0.381
1800RMS	0.0216	11.57	5.95	0.201	0.067	0.555	0.370
2000RMS	0.0196	11.44	6.01	0.207	0.066	0.552	0.367
2500RMS	0.0169	11.19	6.12	0.221	0.064	0.545	0.360
3000RMS	0.0137	10.88	6.26	0.241	0.059	0.532	0.347

EXTRA HIGH VOLTAGE XLPE CABLES

290/500 (550) kV



COPPER CONDUCTOR
XRUHKXS according to ZN-TF-530; IEC 62067
2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
1000RM	$38.2^{+0.40}$	35.0	114.4	150	122.6	135.0	22360	50.0	3.38
1200RMS	$42.0^{+0.80}$	34.0	116.7	150	124.9	137.5	24440	60.0	3.44
1400RMS	$45.8^{+0.80}$	33.0	119.0	150	127.2	140.0	26500	70.0	3.50
1600RMS	$49.6^{+1.2}$	32.0	120.8	150	129.0	142.0	28400	80.0	3.55
1800RMS	$53.2^{+1.0}$	31.0	122.4	150	130.6	143.6	31570	90.0	3.59
2000RMS	$55.7^{+1.0}$	31.0	124.9	150	133.1	146.3	32420	100.0	3.66
2500RMS	$62.4^{+1.0}$	30.0	129.6	150	137.8	151.4	38390	125.0	3.76
3000RMS	$68.4^{+1.0}$	30.0	135.6	150	143.8	157.8	43860	150.0	3.95

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		μF/km	Ω/km	mH/km	
1000RM	0.0262	13.80	5.36	0.141	0.089	0.627	0.442
1200RMS	0.0202	13.63	5.69	0.153	0.084	0.611	0.426
1400RMS	0.0176	13.53	6.03	0.165	0.080	0.597	0.412
1600RMS	0.0158	13.53	6.36	0.177	0.076	0.584	0.399
1800RMS	0.0144	13.60	6.71	0.189	0.072	0.572	0.387
2000RMS	0.0132	13.44	6.77	0.194	0.070	0.567	0.382
2500RMS	0.0112	13.40	7.20	0.214	0.065	0.551	0.366
3000RMS	0.0100	13.13	7.32	0.228	0.062	0.541	0.356

EXTRA HIGH VOLTAGE XLPE CABLES

290/500 (550) kV

ALUMINIUM CONDUCTOR
XRUHAKXS according to ZN-TF-530; IEC 62067
A2XS(FL)2Y according to IEC 62067

Cross section of conductor	Diameter of conductor	Insulation		Metallic screen		D_e Outer diameter of cable	Cable weight	Maximum pulling force	Minimal bending radius
		Nominal thickness	Diameter over insulation	Cross section	Diameter over screen				
mm^2		mm		mm^2	mm	mm	kg/km	kN	m
1000RM	$38.0^{+0.50}$	35.0	114.2	150	122.4	134.8	16090	35.0	3.37
1200RMS	$43.0^{+0.80}$	34.0	118.2	150	126.4	139.2	17190	42.0	3.48
1400RMS	$45.6^{+0.80}$	33.0	118.8	150	127.0	139.8	17670	49.0	3.50
1600RMS	$48.5^{+1.2}$	32.0	119.7	150	127.9	140.7	18230	56.0	3.52
1800RMS	$52.7^{+1.0}$	31.0	121.3	150	129.5	142.5	18910	63.0	3.56
2000RMS	$54.5^{+1.0}$	31.0	123.7	150	131.9	145.1	19800	70.0	3.63
2500RMS	$59.0^{+1.0}$	30.0	126.2	150	134.4	147.8	21000	87.5	3.70
3000RMS	$67.0^{+1.0}$	30.0	134.2	150	142.4	156.2	23990	105.0	3.91

ELECTRICAL DATA

D_e - Cable diameter
Cables in flat formation - distance between cables 2 x D_e
Cables in trefoil formation - distance between cables D_e

Cross section of conductor	Resistance of conductor 90°C	Electrical field stress at the		Capacitance	Zero reactance	Inductance	
		conductor screen	insulation				
mm^2	Ω/km	kV/mm		µF/km	Ω/km	mH/km	
1000RM	0.0398	13.82	5.35	0.140	0.090	0.628	0.444
1200RMS	0.0319	13.49	5.73	0.156	0.083	0.608	0.424
1400RMS	0.0275	13.55	6.02	0.164	0.080	0.597	0.413
1600RMS	0.0242	13.61	6.33	0.174	0.077	0.586	0.402
1800RMS	0.0216	13.67	6.68	0.186	0.072	0.572	0.388
2000RMS	0.0196	13.51	6.74	0.192	0.071	0.569	0.384
2500RMS	0.0169	13.58	7.12	0.207	0.067	0.557	0.372
3000RMS	0.0136	13.19	7.29	0.225	0.063	0.543	0.358

AMPACITY

Copper 26/45÷47 (52) kV, 36/60÷69 (72.5) kV

Current rating for single-core cables - amperes																
Cross section of conductor																
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
95RM	285	340	275	330	275	325	270	325	310	415	295	400	265	360	265	360
120RM	325	390	305	370	310	370	305	365	355	480	335	455	305	415	300	410
150RM	365	440	340	415	350	415	340	410	405	545	380	515	345	470	340	465
185RM	415	495	380	460	390	470	385	460	460	625	425	580	395	540	390	530
240RM	480	575	425	520	455	545	440	535	545	740	490	675	465	635	455	625
300RM	540	650	465	570	515	615	495	600	625	850	545	755	530	730	515	710
400RM	620	745	510	625	585	700	560	675	730	985	615	855	615	845	595	820
500RM	705	850	550	685	660	795	625	755	845	1145	685	955	710	975	680	935
630RM	805	970	595	740	740	895	695	845	980	1330	755	1060	815	1120	770	1070
800RM	905	1090	630	790	825	1000	760	930	1125	1535	825	1170	925	1275	865	1205
1000RM	995	1210	660	825	900	1090	815	1005	1255	1720	880	1255	1025	1420	945	1325
1200RMS	1155	1395	660	830	1065	1285	900	1105	1470	1995	915	1305	1235	1695	1075	1505
1400RMS	1250	1510	675	855	1145	1385	950	1170	1615	2195	955	1370	1345	1850	1150	1620
1600RMS	1335	1615	690	870	1210	1470	985	1220	1745	2380	990	1425	1445	1995	1215	1715
1800RMS	1410	1705	700	885	1270	1540	1015	1260	1865	2545	1020	1470	1535	2120	1275	1800
2000RMS	1485	1800	710	900	1325	1610	1045	1300	1980	2700	1045	1505	1615	2235	1320	1875
2500RMS	1630	1980	725	920	1430	1750	1095	1370	2205	3015	1095	1585	1780	2470	1430	2020
3000RMS	1760	2145	740	940	1520	1865	1135	1420	2425	3325	1135	1645	1925	2685	1505	2150

ALUMINIUM 26/45÷47 (52)kV, 36/60÷69 (72.5) kV

Current rating for single-core cables - amperes																
Cross section of conductor															
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
95RM	220	265	215	260	210	255	210	250	235	320	230	315	205	280	205	275
120RM	250	300	245	290	240	285	235	285	275	370	265	360	235	320	235	320
150RM	280	340	270	325	270	320	265	320	310	420	300	405	265	365	265	360
185RM	320	385	305	365	305	365	300	360	360	485	340	460	305	415	305	415
240RM	370	445	345	420	355	425	345	420	420	570	395	540	360	490	355	485
300RM	420	505	385	465	400	480	390	470	485	655	445	610	415	565	405	555
400RM	485	580	430	525	455	550	445	535	565	765	505	695	480	660	470	645
500RM	555	665	455	580	520	625	505	610	660	890	575	790	560	765	545	745
630RM	635	765	520	640	595	715	570	690	770	1045	645	895	650	890	625	865
800RM	725	870	560	695	670	810	635	770	890	1210	715	1000	745	1025	715	985
1000RM	815	980	600	745	750	905	700	850	1025	1395	790	1110	850	1175	805	1115
1200RM	885	1070	595	745	805	975	730	895	1135	1545	810	1145	935	1290	865	1205
1200RMS	930	1115	610	760	865	1045	775	945	1185	1600	835	1175	1005	1375	920	1275
1400RMS	1010	1210	630	790	935	1125	825	1010	1300	1755	875	1240	1100	1500	995	1375
1600RMS	1085	1300	650	815	1000	1200	870	1065	1410	1905	915	1295	1185	1625	1060	1475
1800RMS	1160	1385	665	840	1065	1280	910	1120	1535	2075	950	1355	1280	1755	1130	1575
2000RMS	1225	1470	675	850	1115	1345	945	1160	1625	2200	980	1395	1355	1855	1180	1650
2500RMS	1335	1600	695	875	1205	1455	1000	1230	1780	2410	1020	1460	1480	2030	1270	1775
3000RMS	1540	1855	720	910	1360	1645	1085	1345	2105	2855	1090	1570	1710	2355	1415	2000

COPPER 64/110÷115 (123) kV, 87/150÷161 (170) kV

Current rating for single-core cables - amperes																
Cross section of conductor															
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
150RM	360	435	325	395	345	415	335	405	390	520	360	490	350	470	345	465
185RM	410	490	355	435	390	465	375	450	445	595	405	545	400	540	390	525
240RM	475	570	395	485	450	545	430	520	530	710	465	630	470	635	455	615
300RM	540	645	430	525	510	615	480	580	610	815	515	705	535	725	510	700
400RM	615	740	465	570	580	700	535	650	705	950	570	790	620	840	585	800
500RM	700	845	500	615	660	795	595	725	815	1100	630	875	715	970	660	910
630RM	800	965	530	660	745	900	660	805	945	1275	695	970	820	1120	750	1030
800RM	900	1090	560	695	830	1005	715	880	1085	1465	755	1055	930	1275	835	1155
1000RM	995	1205	580	725	910	1105	765	945	1215	1650	800	1130	1035	1415	905	1265
1200RMS	1150	1385	615	765	1065	1285	845	1045	1420	1910	865	1225	1225	1670	1030	1435
1400RMS	1245	1505	630	785	1145	1385	885	1100	1555	2095	840	1285	1335	1825	1100	1535
1600RMS	1330	1610	640	805	1215	1470	920	1145	1680	2270	940	1335	1435	1965	1155	1625
1800RMS	1405	1700	655	820	1270	1545	945	1175	1795	2430	970	1380	1520	2085	1205	1700
2000RMS	1480	1790	660	830	1330	1615	970	1210	1900	2575	990	1415	1605	2200	1250	1770
2500RMS	1625	1975	680	855	1440	1755	1010	1270	2120	2880	1040	1490	1765	2435	1340	1900
3000RMS	1760	2145	695	870	1520	1880	1135	1315	2330	3175	1080	1550	1915	2650	1415	2015

ALUMINIUM 64/110÷115 (123) kV, 87/150÷161 (170) kV

Current rating for single-core cables - amperes																
Cross section of conductor															
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
150RM	280	335	265	320	265	320	260	315	300	400	285	385	270	365	265	360
185RM	315	380	295	355	300	360	295	355	345	460	325	435	310	415	305	410
240RM	370	440	330	400	350	420	3400	410	410	545	375	510	365	490	355	480
300RM	420	500	370	450	395	475	385	465	470	630	430	580	415	560	405	550
400RM	480	575	400	490	455	545	430	520	550	735	480	655	485	655	465	635
500RM	550	660	435	535	520	625	485	590	640	855	535	735	560	760	535	730
630RM	635	760	475	585	595	715	545	665	745	1000	600	825	650	885	610	840
800RM	720	865	510	630	670	810	605	740	860	1155	660	920	750	1015	695	955
1000RM	810	980	540	670	750	905	665	815	990	1335	725	1010	855	1165	780	1075
1200RM	885	1065	560	695	810	980	705	865	1095	1475	770	1080	935	1275	840	1165
1200RMS	925	1110	575	710	860	1035	740	905	1140	1530	790	1105	995	1350	890	1225
1400RMS	1005	1205	590	735	930	1120	785	960	1250	1675	830	1165	1085	1475	955	1315
1600RMS	1080	1295	610	755	995	1200	825	1010	1355	1820	865	1215	1175	1595	1015	1405
1800RMS	1155	1390	625	775	1060	1280	860	1060	1475	1980	905	1275	1265	1725	1075	1500
2000RMS	1220	1465	635	790	1115	1340	890	1095	1560	2095	930	1310	1335	1820	1125	1565
2500RMS	1330	1595	650	815	1205	1455	935	1155	1710	2300	970	1375	1460	1990	1200	1680
3000RMS	1535	1850	680	850	1365	1655	1010	1255	2020	2720	1040	1480	1695	2315	1335	1880

COPPER 127/220 ÷ 230 (245) kV

Current rating for single-core cables - amperes																
Cross section of conductor															
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
400RM	605	730	460	655	570	690	515	630	680	910	565	775	610	825	570	780
500RM	690	935	490	605	645	785	570	700	785	1055	625	860	700	950	645	885
630RM	785	950	520	645	730	890	630	775	915	1230	685	955	805	1100	725	1005
800RM	885	1075	550	685	815	995	680	845	1045	1415	750	1045	915	1255	805	1120
1000RM	975	1190	575	710	895	1090	725	900	1170	1585	795	1115	1015	1395	875	1225
1200RMS	1125	1365	600	750	1035	1260	790	985	1365	1840	865	1210	1195	1635	980	1375
1400RMS	1220	1480	620	770	1115	1360	825	1030	1495	2015	905	1270	1305	1785	1045	1470
1600RMS	1300	1580	630	785	1180	1445	850	1070	1615	2180	940	1325	1400	1920	1100	1550
1800RMS	1375	1675	640	800	1240	1520	875	1100	1720	2330	965	1365	1485	2040	1145	1620
2000RMS	1445	1765	650	810	1295	1590	895	1125	1825	2475	990	1400	1565	2155	1180	1680
2500RMS	1585	1940	670	835	1400	1730	930	1175	2035	2770	1045	1480	1725	2385	1265	1805
3000RMS	1715	2105	685	858	1495	1850	960	1215	2235	3050	1085	1540	1870	2595	1330	1905

ALUMINIUM 127/220 ÷ 230 (245) kV

Current rating for single-core cables - amperes																
Cross section of conductor															
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
400RM	470	570	395	480	445	540	420	510	530	705	470	635	475	640	455	620
500RM	540	650	430	525	510	615	470	570	615	825	525	720	550	745	520	710
630RM	620	750	465	575	580	705	525	645	720	965	590	810	640	865	595	815
800RM	705	855	500	615	660	800	580	710	830	1115	650	900	735	995	670	925
1000RM	795	965	530	655	735	895	635	780	955	1285	715	995	835	1140	750	1040
1200RM	865	1050	550	685	795	965	670	830	1050	1420	760	1060	915	1255	810	1130
1200RMS	905	1090	565	695	840	1015	700	860	1095	1470	785	1090	970	1315	850	1175
1400RMS	980	1185	580	720	910	1100	735	910	1200	1610	825	1145	1060	1440	910	1265
1600RMS	1055	1275	600	740	970	1180	770	955	1300	1750	860	1200	1140	1555	965	1345
1800RMS	1130	1365	615	760	1035	1255	805	1000	1415	1900	900	1260	1235	1680	1025	1430
2000RMS	1190	1440	625	775	1085	1320	825	1030	1495	2010	925	1295	1300	1775	1065	1490
2500RMS	1295	1570	640	800	1170	1425	865	1080	1640	2210	970	1360	1420	1940	1140	1600
3000RMS	1495	1815	670	835	1330	1625	930	1165	1935	2610	1040	1470	1650	2260	1260	1780

COPPER 220/380 ÷ 400 (420) kV, 290/500 (550) kV

Current rating for single-core cables - amperes																
Cross section of conductor																
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
630RM	740	915	520	650	690	855	600	750	835	1135	675	940	760	1045	700	975
800RM	835	1030	545	685	765	955	650	820	960	1305	740	1035	860	1190	780	1090
1000RM	920	1140	565	715	840	1050	690	880	1070	1465	790	1115	955	1330	845	1195
1200RMS	1055	1305	595	750	965	1205	745	950	1250	1705	860	1215	1120	1550	945	1340
1400RMS	1135	1415	605	770	1030	1295	775	990	1370	1875	900	1275	1215	1690	1005	1435
1600RMS	1210	1510	615	780	1090	1370	795	1025	1485	2030	935	1330	1305	1820	1055	1515
1800RMS	1275	1595	620	795	1140	1440	810	1050	1585	2175	960	1370	1385	1940	1100	1580
2000RMS	1335	1675	630	805	1190	1505	830	1075	1680	2310	985	1410	1460	2045	1140	1645
2500RMS	1460	1845	640	820	1280	1635	855	1120	1880	2600	1030	1480	1610	2275	1210	1765
3000RMS	1575	1995	655	840	1360	1745	880	1155	2065	2860	1070	1545	1745	2475	1275	1865

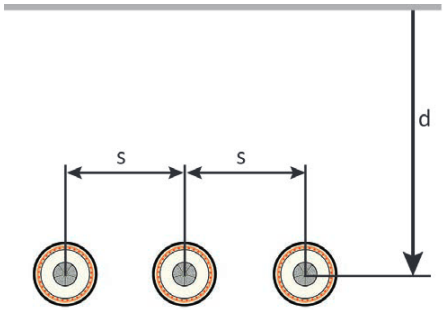
ALUMINIUM 220/380 ÷ 400 (420) kV, 290/500 (550) kV

Current rating for single-core cables - amperes																
Cross section of conductor																
	Configurations															
	SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends		SPP; CB		Both-ends	
	Cables in earth								Cables in air							
mm²	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C	65°C	90°C
630RM	585	720	460	570	545	675	500	620	660	890	570	785	600	820	570	785
800RM	665	820	490	615	615	765	550	690	760	1030	660	880	685	945	640	890
1000RM	750	925	520	655	690	855	600	755	870	1185	700	975	785	1080	720	1005
1200RM	810	1005	540	680	740	925	635	800	960	1310	745	1045	860	1190	775	1090
1200RMS	845	1045	550	695	780	970	655	830	1005	1365	765	1070	905	1245	810	1135
1400RMS	915	1135	565	715	840	1045	690	880	1100	1495	805	1135	985	1360	870	1225
1600RMS	980	1215	580	735	895	1115	720	915	1195	1625	845	1190	1065	1470	925	1305
1800RMS	1050	1300	590	750	950	1190	745	955	1300	1770	880	1245	1150	1595	975	1385
2000RMS	1105	1370	600	765	995	1250	765	985	1375	1875	910	1285	1210	1680	1015	1450
2500RMS	1195	1490	615	785	1070	1345	800	1030	1520	2075	950	1265	1325	1850	1085	1555
3000RMS	1375	1720	640	815	1205	1530	850	1110	1790	2450	1025	1465	1535	2155	1205	1740

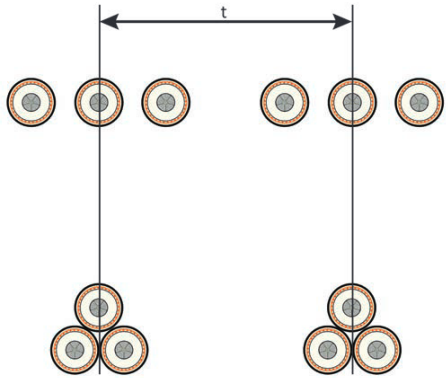
SPB - Single Point Bonding
CB - Cross-bonding Both-ends
BE - Both-ends bonding

CORRECTION FACTORS

WAY OF DIMENSIONING



Laying depth to the cable axe "d"
Distance between cable axes "s"



Distance between circuit axes "t"

LAYING DEPTH IN EARTH

Tables below represent correction factors which can be used to evaluate cable ampacity according to different natural and installation conditions.

LAYING DEPTH IN EARTH

Cross sectional area of conductor	Laying depth							
mm²	m							
	0.5	0.7	0.9	1.0	1.2	1.5	2.0	3.0
150 - 630	1.09	1.04	1.01	1.00	0.98	0.96	0.93	0.90
800 - 1400	1.11	1.05	1.01	1.00	0.98	0.95	0.92	0.88
1600 - 3000	1.12	1.06	1.02	1.00	0.97	0.95	0.91	0.87

THERMAL RESISTIVITY OF EARTH

Cross sectional area of conductor	Thermal resistivity of earth							
mm²	Km/W							
	0.5	0.7	0.9	1.0	1.2	1.5	2.0	3.0
150 - 630	1.26	1.13	1.04	1.00	0.93	0.85	0.76	0.64
800 - 1400	1.30	1.15	1.04	1.00	0.93	0.84	0.74	0.61
1600 - 3000	1.32	1.16	1.05	1.00	0.92	0.84	0.73	0.61

GROUND TEMPERATURE

Cross sectional area of conductor	Thermal resistivity of earth							
mm²	°C							
	5	10	15	20	25	30	35	40
150 - 630	1.10	1.07	1.04	1.00	0.96	0.93	0.89	0.85
800 - 1400	1.10	1.07	1.04	1.00	0.96	0.93	0.89	0.85
1600 - 3000	1.10	1.07	1.04	1.00	0.96	0.93	0.89	0.85

AIR TEMPERATURE (FOR LAYING IN AIR)

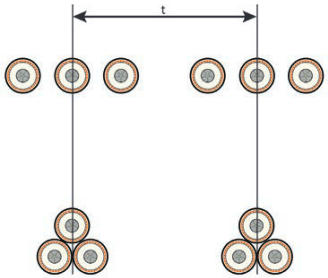
Cross sectional area of conductor	Air temperature							
mm²	°C							
	20	25	30	35	40	45	50	55
150 - 630	1.14	1.10	1.05	1.00	0.95	0.89	0.84	0.78
800 - 1400	1.15	1.10	1.05	1.00	0.95	0.89	0.84	0.77
1600 - 3000	1.15	1.10	1.05	1.00	0.95	0.89	0.83	0.77

DISTANCE BETWEEN CABLE AXES IN FLAT FORMATION

Cross sectional area of conductor	Distance between cables axes in flat formation					
mm^2	mm					
	D	2D	200	300	500	1000
150 - 630	0.95	1.00	1.03	1.07	1.11	1.18
800 - 1400	0.92	1.00	1.02	1.06	1.12	1.20
1600 - 3000	0.90	1.00	1.01	1.05	1.11	1.20
* D - cable outer diameter [m]						

NUMBER OF CIRCUITS AND DISTANCE BETWEEN CIRCUITS AXES

Distance between circuits axes "t"	Cross sectional area of conductor	Number of circuits					
m	mm^2	-					
		1	2	3	4	5	6
0.5	150 - 630	1.00	0.86	0.78	0.74	0.71	0.69
	800 - 1400	1.00	0.83	0.75	0.71	0.67	0.65
	1600 - 3000	-	-	-	-	-	-
1.0	150 - 630	1.00	0.92	0.86	0.83	0.81	0.80
	800 - 1400	1.00	0.90	0.84	0.81	0.79	0.77
	1600 - 3000	1.00	0.89	0.82	0.79	0.77	0.75
1.5	150 - 630	1.00	0.94	0.90	0.89	0.87	0.87
	800 - 1400	1.00	0.93	0.89	0.87	0.85	0.85
	1600 - 3000	1.00	0.93	0.87	0.86	0.84	0.83
2.0	150 - 630	1.00	0.96	0.93	0.92	0.91	0.91
	800 - 1400	1.00	0.95	0.92	0.91	0.90	0.89
	1600 - 3000	1.00	0.95	0.91	0.90	0.89	0.88



CROSS SECTIONAL ARE OF METALLIC SCREEN WITH BOTH-ENDS BONDING

Flat formation						
Cross sectional area of conductor	Metallic screen cross sectional area					
mm^2	mm^2					
	50	95	150	200	250	300
150 - 630	1.04	1.00	0.98	0.99	1.00	1.01
800 - 1400	1.08	1.00	0.97	0.98	1.00	1.02
1600 - 3000	1.08	1.00	0.98	0.99	1.01	1.03

Trefoil formation						
Cross sectional area of conductor	Metallic screen cross sectional area					
mm^2	mm^2					
	50	95	150	200	250	300
150 - 630	1.02	1.00	0.98	0.98	0.97	0.97
800 - 1400	1.04	1.00	0.96	0.94	0.93	0.92
1600 - 3000	1.06	1.00	0.95	0.92	0.91	0.89

LAYING IN DUCTS

Flat formation			
Cross sectional area of conductor	Ducts (wall thickness 20 mm)		
mm^2	Directly in ground	Common, inner diameter 2.16*1.6*D	Individual, inner diameter 1.6*D
150 - 630	1.00	-	0.92
800 - 1400	1.00	-	0.92
1600 - 3000	1.00	-	0.93

Trefoil formation			
Cross sectional area of conductor	Ducts (wall thickness 20 mm)		
mm^2	Directly in ground	Common, inner diameter 2.16*1.6*D	Individual, inner diameter 1.6*D
150 - 630	1.00	0.94	0.93
800 - 1400	1.00	0.95	0.99
1600 - 3000	1.00	0.98	1.01

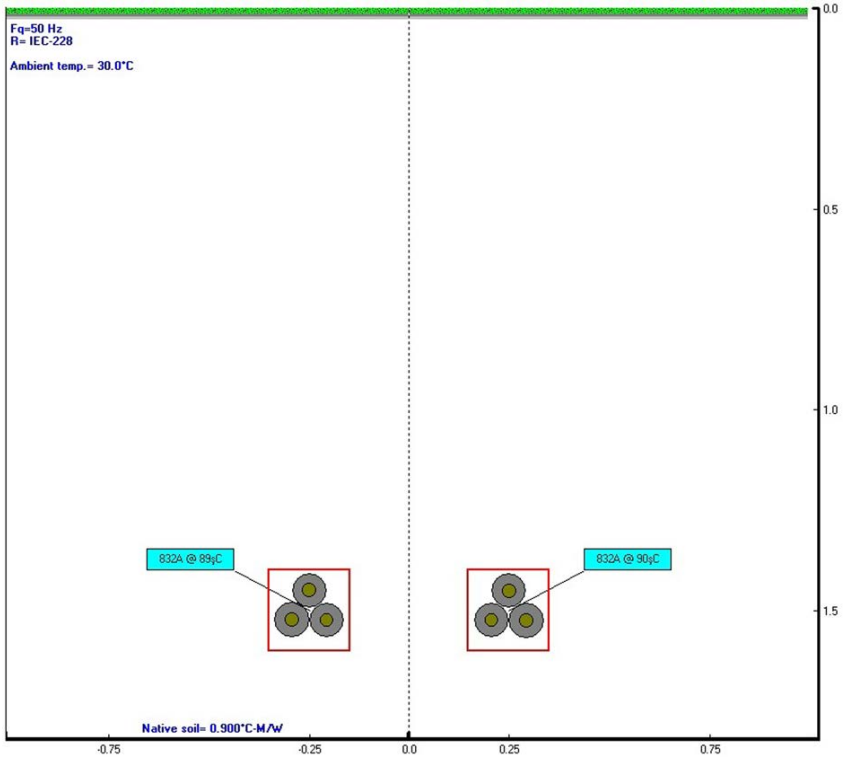
EVALUATION EXAMPLE

Two lines of 110 kV cables:
» Conductor cross sectional area - 1000 mm² Cu
» Metallic screen cross sectional area - 95 mm²
» Laying depth - 1.5 m
» Ground temperature - 30°C
» Earth thermal resistivity - 0.9 Km/W
» Distance between circuit axes - 0.5 m
» Single point bonding
» Trefoil formation (max. conductor temperature 90°C)

Ampacity from catalogue for standard conditions, has to be multiply by correction factors from above tables.

Ampacity from catalogue for standard conditions:
» 1105 [A]
Ampacity adjusted to new natural and instalation conditions:
» 1105 x 0.95 x 1.04 x 0.93 x 0.83 = 843 [A]
Above results are only indicative for conductor cross sectional area preliminary choose. Accurate calculations shall be performed to confirm the assumption.

Evaluation of ampacity performed by CymCap software, for above conditions:



EQUATIONS

DYNAMIC FORCES DURING SHORT CIRCUIT

$$F = \frac{0.2}{s} * I_{max}^2 \ [\mathrm{N/m}]$$

Where:
I_{max} – 2.5 * I_{zw} [kA]
I_{zw} – short circuit current [kA]
s – distance between cable axes [m]
F – maximum force [N/m]

CAPACITANCE

$$C = \frac{\varepsilon_r}{18 * ln\left(\frac{r_e}{r_i}\right)} \ [\mu\mathrm{F/km}]$$

Where:
ε_r – permittivity of the insulation
r_e – external radius of the insulation [mm]
r_i – internal radius of the insulation [mm]
C – capacitance [µF/km]

ELECTRIC STRESS

$$E_{max} = \frac{U_0}{\mathrm{r_1} * \ln\left(\frac{\mathrm{r_e}}{\mathrm{r_i}}\right)} \ [\mathrm{kV/mm}]$$

$$E_{min} = \frac{U_0}{\mathrm{r_e} * \ln\left(\frac{\mathrm{r_e}}{\mathrm{r_i}}\right)} \ [\mathrm{kV/mm}]$$

Where:
r_e – external radius of the insulation [mm]
r_i – internal radius of the insulation [mm]
U_0 – phase to earth voltage [kV]
E_{max} – electric stress on conductor screen [kV/mm]
E_{min} – electric stress on insulation [kV/mm]

PERMISSIBLE SIDE WALL PRESSURE

Maximum permissible side wall pressure should not exceed 10 kN/m

$$P = \frac{F}{R} [\mathrm{kN/m}]$$

Where:
F – pulling force [kN]
R – bending radius [m]
P – side wall pressure [kN/m]

DIELECTRIC LOSS

$$W = 2 * \pi * f * U_o^2 * C * tg\delta \ [\mathrm{W/km}]$$

Where:
f – frequency [Hz]
U_0 – phase to earth voltage [kV]
C – capacitance [µF/km]
$tg\delta$ – loss angle

INDUCTION AND INDUCTIVE REACTANCE

$$L = 2 * ln\left(\frac{k * b}{r_0}\right) * 10^{-1} [mH/km]$$

Where:
k = 1 for trefoil formation; k = 1.26 for flat formation
b – distance between cable axes [mm]
r_0 – mean conductor radius
(depend on number of wires) [mm]

$$X = \frac{2 * \pi * \mathrm{f} * \mathrm{L}}{1000} \ [\Omega/\mathrm{km}]$$

Where:
f – frequency [Hz]
L – inductance [mH/km]
X – inductive reactance [Ω/km]

MAXIMUM SHORT CIRCUIT CURRENT

$$I_{Zt} = \frac{I_{Z1}}{\sqrt{t_z}} \text{ [kA]}$$

Where:
I_{Z1} – maximum short circuit current for duration of 1.0s [kA]
I_{Zt} – maximum short circuit current for duration of tZ [kA]
t_z – short circuit duration [s]

TEST VOLTAGE LEVELS

Rated voltage and corresponding test voltages according to IEC				
	Type test	Routine tests		
Nominal voltage	Impulse voltage	AC voltage test		Partial discharge test at
kV	kV	kV	Duration minutes	kV
45	250	65	30	39
66	325	90	30	54
110	550	160	30	96
132	650	190	30	114
150	750	218	30	131
220	1050	318	30	190
275	1050	400	30	240
330	1175	420	60	285
400	1425	440	60	330
500	1550	580	60	435

MAX. RESISTANCE AND MAX. SHORT-CIRCUITS CURRENT FOR CONDUCTORS

Cross section	Maximum D.C. resistance at 20°C Ω/km		Max. short-circuit current 1s, kA (90°C ÷ 250°C)	
mm²	Copper	Aluminum	Copper	Aluminum
95	0.1930	0.3200	13.8	9.2
120	0.1530	0.2530	17.4	11.6
150	0.1240	0.2060	21.8	14.5
185	0.0991	0.1640	26.8	17.8
240	0.0754	0.1250	34.8	23.1
300	0.0601	0.1000	43.4	28.8
400	0.0470	0.0778	57.8	38.3
500	0.0366	0.0605	72.2	47.8
630	0.0283	0.0469	90.8	60.2
800	0.0221	0.0367	115.3	76.3
1000	0.0176	0.0291	144.0	95.3
1200	0.0151	0.0247	172.7	114.3
1400	0.0129	0.0212	201.4	133.2
1600	0.0113	0.0186	230.1	152.2
1800	0.0101	0.0165	258.8	171.2
2000	0.0090	0.0149	287.4	190.1
2500	0.0072	0.0120	359.1	237.5
3000	0.0062	0.0100	430.8	284.9

LOAD FACTOR

In a three-phase network with **U = 10kV** an apparent power of **10MVA** is to be transmitted.

The operating current $\mathbf{I}_{max}$ is determined from:

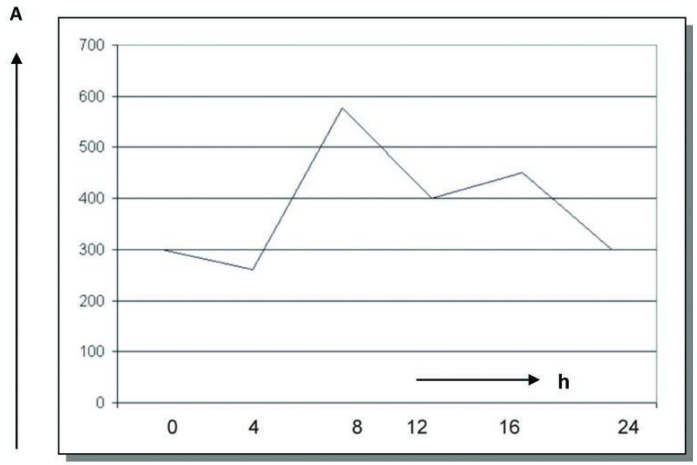
$$I_{\max} = \frac{S}{\sqrt{3}xU} = \frac{10x10^{6}VA}{\sqrt{3}x10x10^{3}V} = 577A$$

From the 24 hour load diagram with the maximum load equal to operating current **I = 577A**, the average load is first calculated. This is done by taking the area below the load curve plotted from current and time values and calculating an average value over the 24 hour period:

$$I_{av} = \frac{4h\frac{300A+260A}{2} + 4h\frac{260A+577A}{2} + 6h\frac{577A+400A}{2} + 4h\frac{400A+450A}{2} + 6h\frac{450A+300A}{2}}{24h} = 403A$$

from this load factor:

$$LF = \frac{I_{av}}{I_{\max}}\frac{403}{577} = 0.7$$

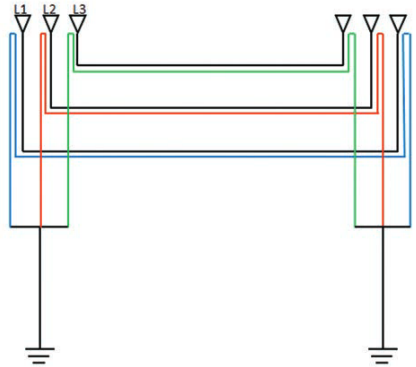


Correction factor											
Cross sectional area of conductor	Load factor										
mm²	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50
150 - 630	1.00	1.03	1.06	1.09	1.12	1.15	1.19	1.22	1.26	1.29	1.33
800 - 1400	1.00	1.03	1.07	1.10	1.14	1.18	1.22	1.26	1.31	1.36	1.41
1600 - 3000	1.00	1.03	1.07	1.11	1.15	1.19	1.24	1.29	1.34	1.39	1.45

TYPES OF CABLE SYSTEM BONDINGS

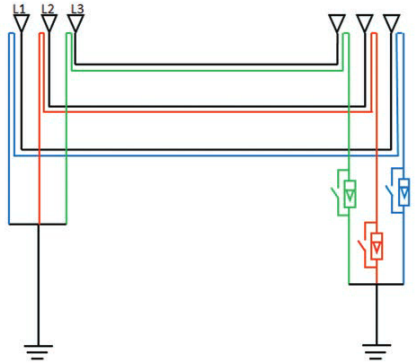
BOTH ENDS BONDING

In both ends bonding, metallic screen of the cable is connected straight to the earth from both sides. Positive effect of such solution is elimination of induced voltage in screen. Drawback of such solution is flow of circulating current to the earth. This will casue losses in the screen, which reduce the cable current ampacity.



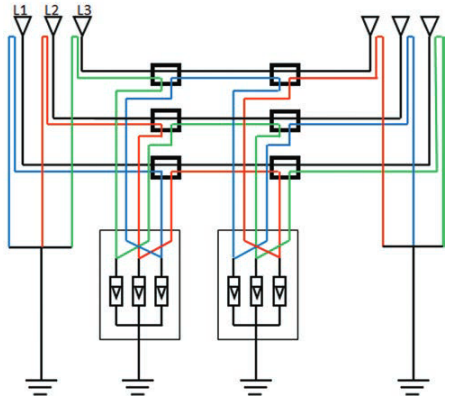
SINGLE POINT BONDING

In single point bonding, metallic screen is connected straight to the earth from one side. Second side is connected to the surge voltage limiter. Positive effect of such solution are elimination of circulating currents and rise of cable current ampacity. Drawback of such solution are presence of induced voltage in screen, which is limits the maximum line length, and increase of costs due to necessity of surge voltage limiter apply.



CROSS BONDING

In cross-bonding cable system is divided into three minor sections. Start and the end of the metallic screen of the cable system is connected straight to earth. At sectionalizing joint screens are cross-connected, and earthed through surge voltage limiters in order to eliminate circulating current and reduce inducted voltage. This way of bonding permits as high cable current ampacity as in single point bonding, and longer line lenghts. Drawback of such solution are additional cost of joints, link boxes and surge voltage limiters.



CABLE DRUMS

SIZES OF WOODEN DRUMS

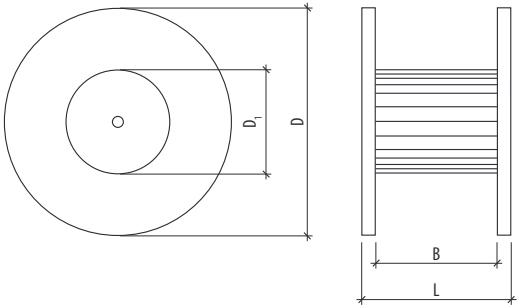
Approximate capacity of wooden cable drums (in metres).

Cable diameter mm	Type of cable drum						
	28	30	32	34	37	40	43
57	1 060	1 420	2 600	2 220	2 890	4 080	4 930
58	1 060	1 420	2 520	2 150	2 820	3 970	4 800
59	1 020	1 380	2 270	2 150	2 820	3 590	4 800
60	1 020	1 380	2 270	2 150	2 750	3 490	4 700
61	970	1 330	2 210	2 090	2 750	3 490	4 300
62	970	1 330	2 210	1 820	2 330	3 400	4 180
63	970	1 330	2 150	1 760	2 330	3 400	4 180
64	970	1 290	1 900	1 760	2 270	2 950	4 080
65	780	1 080	1 840	1 700	2 270	2 950	4 080
66	780	1 030	1 840	1 700	2 200	2 870	3 590
67	780	1 030	1 840	1 700	2 200	2 870	3 590
68	740	1 030	1 790	1 650	2 140	2 790	3 500
69	740	1 000	1 790	1 410	1 830	2 790	3 500
70	740	1 000	1 790	1 410	1 830	2 790	3 500
71	740	1 000	1 520	1 360	1 780	2 390	3 060
72	710	960	1 520	1 360	1 780	2 390	3 060
73	710	960	1 520	1 360	1 720	2 320	2 960
74	710	960	1 470	1 310	1 720	2 320	2 960
75	710	960	1 470	1 310	1 720	2 320	2 960
76	540	740	1 470	1 310	1 660	2 250	2 880
77	540	740	1 420	1 260	1 660	2 250	2 880
78	540	740	1 220	1 260	1 660	1 960	2 570
79	540	740	1 220	1 050	1 340	1 880	2 480
80	540	710	1 220	1 050	1 340	1 880	2 480
81	520	710	1 180	1 010	1 340	1 880	2 480
82	520	710	1 180	1 010	1 290	1 820	2 390
83	520	710	1 180	1 010	1 290	1 820	2 390
84	520	680	1 180	1 010	1 290	1 820	2 390
85	520	680	1 130	970	1 290	1 820	2 390
86	490	680	1 130	970	1 250	1 760	2 030
87	490	680	1 130	970	1 250	1 760	2 030
88	490	650	960	970	1 250	1 500	2 030
89	490	650	920	920	1 250	1 500	2 030
90	490	650		920	1 200	1 440	1 960
91	380	500		920	1 200	1 440	1 960
92	350	500		750	970	1 440	1 960
93	350	470		750	970	1 440	1 960
94	350	470		710	930	1 380	1 890

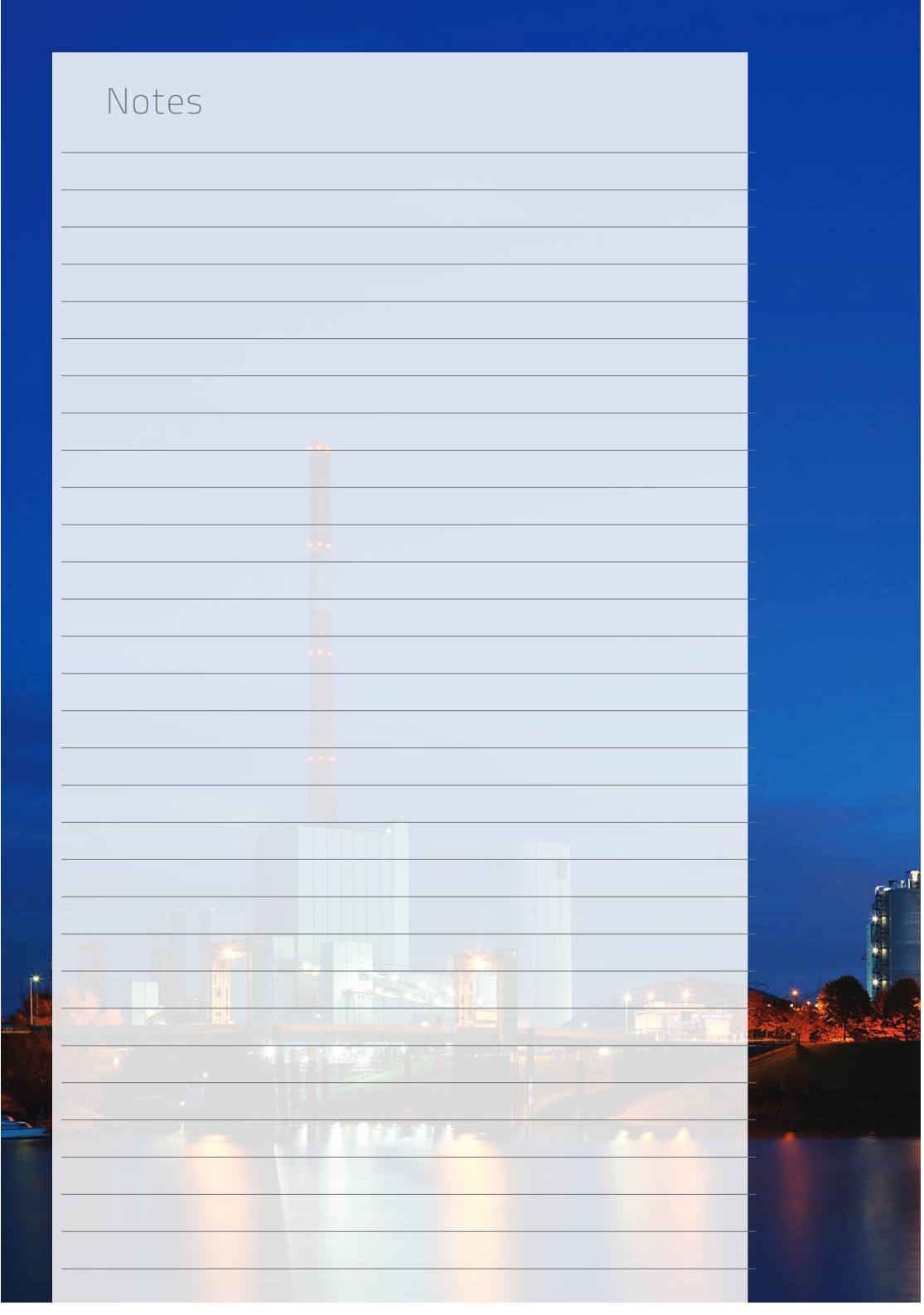
Cable diameter mm	Type of cable drum						
	28	30	32	34	37	40	43
95		470		710	930	1 380	1 630
96		470		710	930	1 380	1 630
97		470		710	930	1 380	1 630
98		470		710	930	1 380	1 630
99		450		670	890	1 330	1 570
100		450		670	890	1 330	1 570
101		450		670	890	1 110	1 570
102		450		670	890	1 110	1 570
103		450		670	890	1 110	1 570
104		450		670	850	1 060	1 500
105		450		670	850	1 060	1 500
106				640	850	1 060	1 500
107				640	850	1 060	1 280
108				640	850	1 060	1 280
109				640	810	1 010	1 220
110				640	810	1 010	1 220
111				490	630	1 010	1 220
112				490	630	1 010	1 220
113				460	630	1 010	1 220
114				460	630	1 010	1 220
115				460	630	1 010	1 220
116					590	960	1 160
117					590	770	1 160
118					590	770	1 160
119					590	770	1 160
120					590	770	1 160
121					590	780	1 160
122					590	780	970
123					560	730	910
124					560	730	910
125					560	730	910
126					560	730	910
127					560	730	910
128					560	730	910
129					560	730	910
130					560	730	910
131					530	690	860

CABLE DRUMS

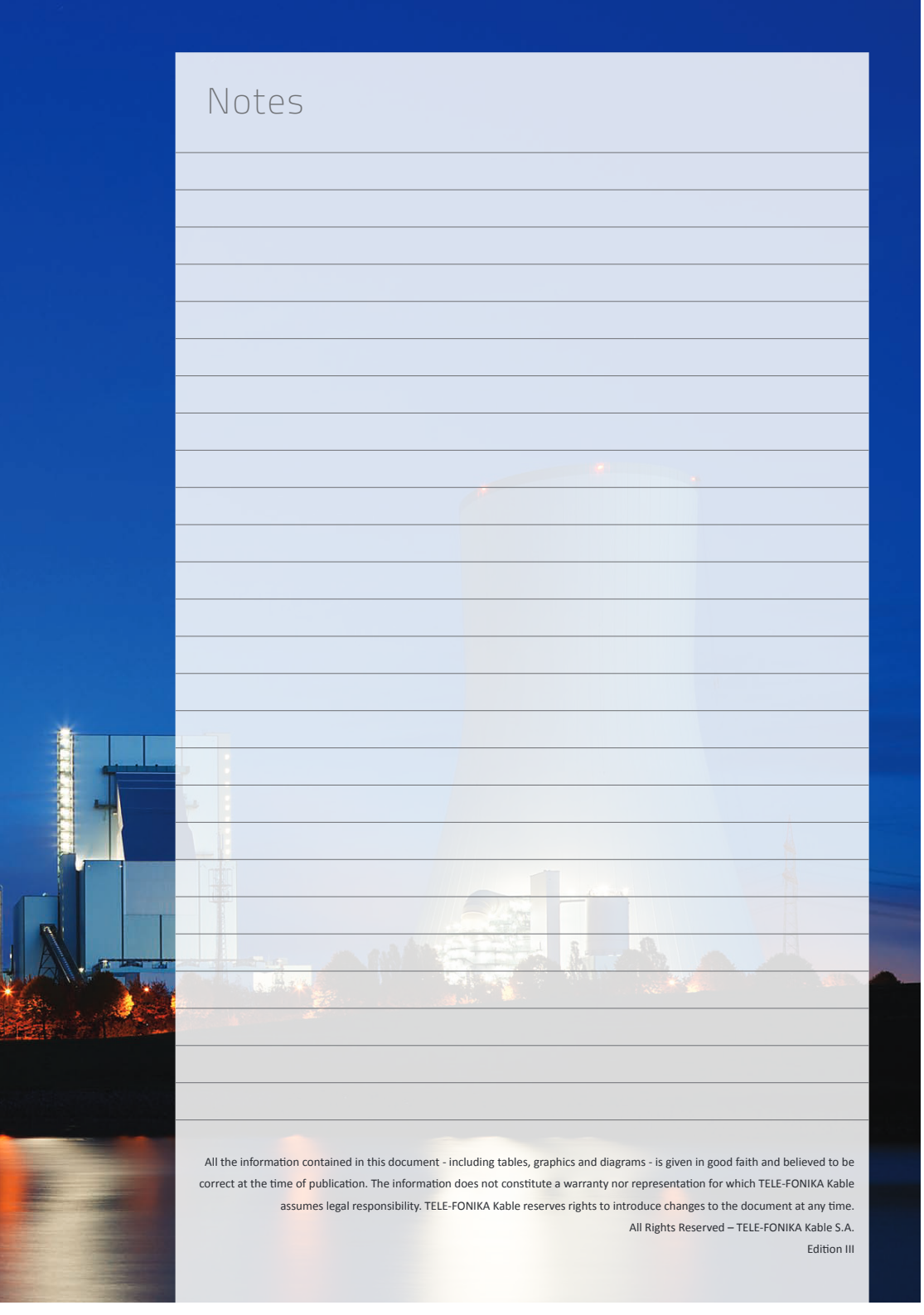
Sizes of wooden cable drums								
Type		28	30	32	34	37	40	43
Ø D	mm	2800	300	3200	3400	3700	4000	4300
Ø D1	mm	1800	2000	1700	2200	2500	2500	2500
B	mm	1400	1700	1800	1800	2100	2100	2100
L	mm	1675	1990	2095	2200	2500	2500	2500
Weight	kg	1370	1798	1814	2500	4250	4690	5170



Note: Figures used are indicative and may vary due to manufacturing tolerances, so should only be used as guidance.



Notes



Notes

Edition III

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