TRATOS

CABLES FOR A MOVING WORLD

TRATOS HIGH VOLTAGE®

IEC 60840

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INDEX

TRATOS HIGH VOLTAGE® IEC 60840

HIGH VOLTAGE CABLES BASED ON IEC 60840

STANDARDS AND QUALITY SYSTEM

STANDARDS

Cables manufactured based on:

IEC 60228 . . . . Conductors of insulated cables
IEC 60287 . . . . Electric cables - Calculation of the current rating.
IEC 60840 . . . . Power cables with extruded insulation and their accessories for rated voltage above 30 kV (Um=36 kV) up to 150 kV
. . . . (Um=170 kV). Test methods and requirements.
IEC 61443 . . . . Short-circuit temperature limits of electric cables with rated voltages above 30 kV (Um=36 kV).
IEC 62067 . . . . Power cables with extruded insulation and their accessories for rated voltage above 150 kV (Um=170 kV) up to 500
. . . . kV (Um=550 kV). Test methods and requirements.
IEC 60853 . . . . Calculation of the cyclic and emergency current rating of cables.
IEC 60885 . . . . Electrical test for electric cables
HD 632 . . . . Power cables with extruded insulation and their accessories for rated voltage above 36 kV (Um=42 kV) up to 150 kV (Um=170 kV). Part 1- General test requirements. Part 1 is based on IEC 60840, and follows that standard closely. HD 632 is completed with a number of parts and subsections for different cables intended to be used under special conditions which can vary nationally in Europe.

STANDARDS AND QUALITY SYSTEM

QUALITY SYSTEM

Tratos aim to work closely with customers to find better, more environmentally friendly solutions to their challenges.
We are committed to our vision and strategy to serve all our internal and external customers by providing high quality services and products. Tratos is an established industry leader in the design, manufacture and supply of cables and products and to maintain this leading position we are committed at every level to providing our customers with quality services and products at a competitive price. As a commercial enterprise we are aware of the importance of satisfying our customers and of the financial impact of which nonconformities may have on our profitability. For these reasons we are committed to complying with all customer requirements and specifications both legal and statutory requirements. Our Quality Management System has been audited and approved by two independent, Internationally recognized and accepted authorities: BSI and AENOR-IQNET (E), in accordance to BS EN ISO 9001:2015 covering the production, purchasing of raw materials design and final test including various document types. The Tratos Quality Management system is under frequent regular surveillance by inspectors working for the Certification Autorities.

ENVIRONMENTAL SYSTEM

Our Environmental Management System has been audited and approved by two independent, Internationally recognized and accepted authorities:
BSI and AENOR-IQNET (E), in accordance to BS EN ISO 14001:2015 covering the production, purchasing of raw materials design and final test including various document types. The Tratos Quality Management system is under frequent regular surveillance by inspectors working for the Certification Autorities.

ENERGY MANAGEMENT SYSTEMS

By complying with the BS EN ISO 50001:2018 Tratos follows a systematic approach in achieving continual improvement of energy performance and the Energy Management Systems (EnMS).
The BS EN ISO 50001:2018 is a standard issued by the International Standard Organization (ISO) which outlines the requirements for establishing, implementing, maintaining and improving an energy management system (EnMS).

CIRCULAR ECONOMY

The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance. EMAS is open to every type of organisation eager to improve its environmental performance. It spans all economic and service sectors and is applicable worldwide.

AWARDS

Tratos cables are made with award winning Tratos-JBA® compound. Tratos UK Ltd has won a **Queen's Award for Enterprise - Innovation** for its technologically advanced Tratos-JBA® compound.

STANDARDS AND QUALITY SYSTEM

HEALTY & SAFETY SYSTEM

Oince its decision to create a board post dedicated to furthering best practice for Health and Safety, international cable manufacturer Tratos is celebrating receipt of ISO 45001.
ISO 45001 sets out the minimum requirements for occupational health and safety management best practice and helps companies achieve the maximum return for employees, operations and customers.

REACH, WEEE & ROHS

Tratos is fully compliant with the **REACH**. This is a European Union regulation concerning the **Registration, Evaluation, Authorisation and restriction of Chemicals**. It came into force on 1st June 2007 and replaced a number of European Directives and Regulations with a single system. REACH applies to substances manufactured or imported into the EU in quantities of 1 tonne or more per year. Generally, it applies to all individual chemical substances on their own, in preparations or in articles . To summarise, REACH makes the cable industry directly responsible for assessing and managing the risks posed by chemicals and providing safety information to their users.

Tratos fully subscribes to The **Waste Electrical and Electronic Equipment Directive (WEEE Directive)**, introduced into UK law in January 2007 by the Waste Electronic and Electrical Equipment Regulations 2006. The WEEE Directive aims to reduce the amount of electrical and electronic equipment being produced and to encourage everyone to reuse, recycle and recover it. The WEEE Directive also aims to improve the environmental performance of businesses that manufacture, supply, use, recycle and recover electrical and electronic equipment. TRATOS has enlisted the services of the UK's leading producer compliance scheme, Valpak, whom manage our recycling obligations and also ensure our compliance to the WEEE Regulations and the Waste Batteries and Accumulators Regulations.

Tratos is fully compliant with the **Restriction of Hazardous Substances (RoHS) Regulations**. These Regulations implement EU Directive 2011/65/EU which bans the placing on the EU market of new electrical and electronic equipment containing more than agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants. Tratos fully understands the requirements of the RoHS Directive and ensures that our products, and their components, comply.

CORPORATE SOCIAL RESPONSABILITY

Tratos adoptes a Code of Ethics which adheres to the United Nations Global Compact on human rights, labour standards, protection of the environment and anti corruption measures.
Under this self regulatory code, Tratos will carry out initiatives in the environmental and social fields with special reference to environmental policies and social policies regarding child labour, compulsory labour, health and security, freedom of association and the right to collective bargaining, discrimination, disciplinary procedures, working hours and wages.

APPROVALS

High Voltage cables made by Tratos have been tested and certified by the following Approval Organisations:

KEMA Labs

TECHNICAL INFORMATION

TRATOS® HV - 38/66 kV-(72.5 kV)

Table 1

38/66 (72,5) kV Technical Data Cu/XLPE/AT/HDPE cables

Size csa	Maximum D.C. Conductor resistance at 20°C	Maximum D.C. Screen resistance at 20°C	Capacitance	Charging current	Inductance		Surge Impedance
mm²	Ω/km	Ω/km	µF/km	A/km	Trefoil	Flat	Ω
					mH/km	mH/km	
150	0.1240	0.524	0.17	2.02	0.43	0.66	33.1
185	0.0991	0.524	0.19	2.26	0.41	0.65	31.1
240	0.0754	0.524	0.20	2.38	0.40	0.62	28.8
300	0.0601	0.524	0.22	2.63	0.39	0.60	26.2
400	0.0470	0.524	0.24	2.87	0.37	0.58	24.4
500	0.0366	0.524	0.26	3.10	0.36	0.56	22.5
630	0.0283	0.524	0.29	3.46	0.34	0.54	20.7
800	0.0221	0.524	0.32	3.82	0.34	0.53	18.9
1000	0.0176	0.524	0.38	4.54	0.33	0.52	17.2
1200	0.0151	0.524	0.40	4.78	0.32	0.50	15.8
1400	0.0129	0.524	0.42	5.01	0.31	0.48	14.8
1600	0.0113	0.524	0.45	5.37	0.30	0.47	13.9

Table 2

38/66 (72.5) kV Technical Data Cu/XLPE/Pb/HDPE cables

Size csa	Maximum D.C. Conductor resistance at 20°C	Maximum D.C. Screen resistance at 20°C	Capacitance	Charging current	Inductance		Surge Impedance
mm²	Ω/km	Ω/km	µF/km	A/km	Trefoil	Flat	Ω
					mH/km	mH/km	
150	0.1240	0.6035	0.17	2.02	0.43	0.66	33.1
185	0.0991	0.597	0.19	2.26	0.41	0.65	31.1
240	0.0754	0.5325	0.20	2.38	0.40	0.62	28.8
300	0.0601	0.5062	0.22	2.63	0.39	0.60	26.2
400	0.0470	0.4671	0.24	2.87	0.37	0.58	24.4
500	0.0366	0.4226	0.26	3.10	0.36	0.56	22.5
630	0.0283	0.3852	0.29	3.46	0.34	0.54	20.7
800	0.0221	0.3274	0.32	3.82	0.34	0.53	18.9
1000	0.0176	0.2984	0.38	4.54	0.33	0.52	17.2
1200	0.0151	0.2642	0.40	4.78	0.32	0.50	15.8
1400	0.0129	0.2452	0.42	5.01	0.31	0.48	14.8
1600	0.0113	0.2312	0.45	5.37	0.30	0.47	13.9

TRATOS® HV - 76/132 kV-(145kV)

Table 3

76/132 (145) kV Technical Data Cu/XLPE/AT/HDPE cables

Size csa	Maximum D.C. Conductor resistance at 20°C	Maximum D.C. Screen resistance at 20°C	Capacitance	Charging current	Inductance		Surge Impedance
mm^2	Ω/km	Ω/km	µF/km	A/km	Trefoil	Flat	Ω
					mH/km	mH/km	
150	0.1240	0.193	0.13	3.11	0.50	0.69	42.6
185	0.0991	0.193	0.14	3.35	0.48	0.67	45.8
240	0.0754	0.193	0.15	3.59	0.46	0.65	41.2
300	0.0601	0.193	0.16	3.83	0.44	0.63	37.0
400	0.0470	0.193	0.17	4.07	0.42	0.60	33.1
500	0.0366	0.193	0.19	4.55	0.40	0.58	30.1
630	0.0283	0.193	0.21	5.03	0.39	0.56	27.9
800	0.0221	0.193	0.23	5.51	0.36	0.55	25.9
1000	0.0176	0.193	0.26	6.23	0.35	0.53	23.6
1200	0.0151	0.193	0.27	6.47	0.35	0.51	21.8
1400	0.0129	0.193	0.29	6.94	0.34	0.50	20.6
1600	0.0113	0.193	0.31	7.42	0.33	0.49	19.6

Table 4

76/132 (145) kV Technical Data Cu/XLPE/Pb/HDPE cables

Size csa	Maximum D.C. Conductor resistance at 20°C	Maximum D.C. Screen resistance at 20°C	Capacitance	Charging current	Inductance		Surge Impedance
mm^2	Ω/km	Ω/km	µF/km	A/km	Trefoil	Flat	Ω
					mH/km	mH/km	
150	0.1240	0.4935	0.13	3.11	0.50	0.69	42.6
185	0.0991	0.4840	0.14	3.35	0.48	0.67	45.8
240	0.0754	0.4458	0.15	3.59	0.46	0.65	41.2
300	0.0601	0.4137	0.16	3.83	0.44	0.63	37.0
400	0.0470	0.3853	0.17	4.07	0.42	0.60	33.1
500	0.0366	0.3545	0.19	4.55	0.40	0.58	30.1
630	0.0283	0.3260	0.21	5.03	0.39	0.56	27.9
800	0.0221	0.2917	0.23	5.51	0.36	0.55	25.9
1000	0.0176	0.2709	0.26	6.23	0.35	0.53	23.6
1200	0.0151	0.2417	0.27	6.47	0.35	0.51	21.8
1400	0.0129	0.2257	0.29	6.94	0.34	0.50	20.6
1600	0.0113	0.2198	0.31	7.42	0.33	0.49	19.6

CURRENT RATING FOR XLPE CABLE SYSTEMS

IMPORTANT NOTE: The values provided are for estimating puposes only, please request a data sheet for more accurate values before placing an order

RATING FACTORS

Rating factors for cross section area of the metal screen of single core cables.
The rating factor is applicable to single-core cables in flat and trefoil formation.

Table 5

38/66 (72.5) kV Copper conductors					
Size csa	Trefoil solidly bonded			Laid flat solidly bonded	
mm^2	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	410	405	510	410	385
185	460	445	580	460	425
240	530	520	680	525	485
300	600	570	770	585	540
400	690	630	890	650	600
500	760	700	1020	725	670
630	850	780	1160	800	740
800	940	860	1330	875	815
1000	1025	940	1460	945	875
1200	1140	1045	1595	1010	935
1400	1200	1100	1680	1035	960
1600	1265	1165	1771	1070	995

Table 6

38/66 (72.5) kV Copper conductors					
Size csa	Trefoil single point bonded			Laid flat single point bonded	
mm^2	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	410	415	495	430	410
185	460	470	565	485	465
240	535	545	665	565	535
300	605	615	765	640	605
400	685	705	885	730	690
500	775	800	1015	835	785
630	875	905	1170	950	890
800	975	1035	1340	1080	1030
1000	1065	1160	1490	1195	1135
1200	1265	1360	1755	1375	1305
1400	1370	1470	1915	1480	1400
1600	1450	1550	2045	1570	1490

CURRENT RATING FOR XLPE CABLE SYSTEMS

Table 7

38/66 (72.5) kV Aluminium conductors					
Size csa	**Trefoil solidly bonded**			**Laid flat solidly bonded**	
mm²	**Laid direct**	**In ducts**	**In air**	**Laid direct**	**In ducts**
	A	A	A	A	A
150	320	320	400	325	300
185	360	350	450	365	340
240	415	415	550	420	390
300	475	460	600	470	435
400	550	520	705	530	495
500	610	580	820	600	555
630	690	650	940	670	625
800	780	770	1100	750	700
1000	860	810	1220	820	770
1200	910	855	1270	855	800
1400	970	910	1365	910	855
1600	1010	945	1415	935	880

Table 8

38/66 (72.5) kV Aluminium conductors					
Size csa	**Trefoil single point bonded**			**Laid flat single point bonded**	
mm²	**Laid direct**	**In ducts**	**In air**	**Laid direct**	**In ducts**
	A	A	A	A	A
150	315	320	380	335	320
185	360	365	440	380	360
240	415	425	520	440	415
300	470	480	595	500	470
400	540	550	695	575	540
500	615	630	810	655	615
630	705	720	940	755	705
800	800	830	1100	865	825
1000	890	940	1240	975	925
1200	965	1005	1340	1045	980
1400	1020	1065	1425	1120	1050
1600	1085	1130	1530	1175	1100

CURRENT RATING FOR XLPE CABLE SYSTEMS

Table 9

76/132 (145) kV Copper conductors					
Size csa	Trefoil solidly bonded			Laid flat solidly bonded	
mm²	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	395	400	505	385	365
185	450	460	570	435	405
240	515	530	670	490	435
300	580	600	755	550	510
400	665	690	860	615	565
500	730	760	995	675	620
630	815	850	1120	730	675
800	895	940	1280	805	745
1000	970	1025	1405	870	810
1200	1050	1140	1495	920	885
1400	1100	1200	1560	940	900
1600	1150	1265	1635	965	935

Table 10

76/132 (145) kV Copper conductors					
Size csa	Trefoil single point bonded			Laid flat single bonded	
mm²	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	410	420	505	405	385
185	460	470	575	450	425
240	530	540	670	520	485
300	600	515	755	575	540
400	690	705	870	640	600
500	760	785	995	715	670
630	850	880	1145	785	730
800	940	1000	1315	865	810
1000	1025	1120	1435	930	875
1200	1140	1235	1580	995	925
1400	1200	1300	1660	1020	980
1600	1265	1265	1750	1055	1000

CURRENT RATING FOR XLPE CABLE SYSTEMS

Table 11

76/132 (145) kV Aluminium conductors					
Size csa	Trefoil solidly bonded			Laid flat solidly bonded	
mm^2	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	300	300	380	325	300
185	345	335	440	365	335
240	400	395	520	415	385
300	450	435	585	460	425
400	515	485	685	520	470
500	580	550	810	570	525
630	660	620	930	635	585
800	745	730	995	705	665
1000	825	805	1120	760	745
1200	890	850	1340	770	755
1400	935	895	1385	840	810
1600	995	945	1475	860	825

Table 12

76/132 (145) kV Aluminium conductors					
Size csa	Trefoil single point bonded			Laid flat single point bonded	
mm^2	Laid direct	In ducts	In air	Laid direct	In ducts
	A	A	A	A	A
150	315	320	375	330	315
185	360	365	435	370	355
240	415	425	510	435	400
300	470	480	585	495	440
400	542	550	680	575	505
500	615	630	790	645	580
630	705	720	910	740	645
800	800	830	1050	845	790
1000	890	940	1190	955	875
1200	965	1005	1270	1025	930
1400	1020	1065	1340	1120	1020
1600	1085	1130	1425	1175	1075

BASIS OF CURRENT RATINGS

Table 13

Standard depth of laying	1.0m
Thermal resistivity of soil	1.2K.m/W
Standard ground temperature	15°C
Ambient air temperature	25°C
Maximum conductor temperature	90°C

Table 14

Rating factors for depth of laying	
Laying depth	Rating factor
(m)	
1.0	1.0
1.2	0.95
1.5	0.93
2.0	0.89
2.5	0.88
3.0	0.86

Table 15

Cables buried directly in soil	
Trefoil Single point bonded	Three single-core cables laid touching throughout in trefoil formation only one end of screen earthed
Trefoil bonded at both ends	Three single-core cables laid touching throughout in trefoil formation both ends of screen earthed
Flat Single point bonded	Three single-core cables laid with a clearance of one cable diameter in horizontal flat formation only one end of screen earthed
Flat bonded at both ends	Three single-core cables laid with a clearance of one cable diameter in horizontal flat formation both ends of screen earthed

Table 16

Cables buried in Ducts	
Trefoil Single point bonded	Three single-core cables laid in single way ducts Ducts touching throughout in trefoil formation only one end of screen earthed
Trefoil bonded at both ends	Three single-core cables laid in single way ducts Ducts touching throughout in trefoil formation both ends of screen earthed
Flat Single point bonded	Three single-core cables laid in single way ducts with a clearance between ducts of one cable diameter in horizontal flat formation only one end of screen earthed
Flat bonded at both ends	Three single-core cables laid with a clearance between ducts of one cable diameter in horizontal flat formation both ends of screen earthed

BASIS OF CURRENT RATINGS

Table 17

Temperature de-rating factors for Ground temperature									
Ground temperature °C	10	15	20	25	30	35	40	45	50
Rating factor (Maximum conductor temperature 90 °C)	1.03	1.00	0.96	0.93	0.89	0.85	0.81	0.77	0.73

Table 18

Temperature de-rating factors for Ambient temperature										
Ambient temperature °C	10	15	20	25	30	35	40	45	50	55
Rating factor (Maximum conductor temperature 90 °C)	1.1	1.07	1.04	1.00	0.96	0.92	0.87	0.83	0.78	0.73

Table 19

Rating factors for ground thermal resistivity							
Thermal resistivity Km/W	0.7	1.0	1.2	1.5	2.0	2.5	3.0
Factor	1.2	1.08	1.0	0.9	0.79	0.70	0.65

CURRENT RATING FOR XLPE CABLE SYSTEMS

OVERLOAD CAPACITY

An XLPE cable may be overloaded up to 105°C. Singular emergency events are not expected to have any significant impact on the service life of the cable. The number of and the duration of overloads should be kept low, though. Cyclic and emergency ratings can be calculated based on IEC publication 60853.

SHORT-CIRCUIT CURRENTS

During short circuit events the maximum allowable temperature in conductor or screen/metallic sheath is determined by the adjoining insulation and sheath materials. This is specified in IEC 61443 “Short circuit temperature limits of electric cables with rated voltage above 30 kV (Um=36 kV). The dynamic forces between the conductors must be taken into account for cable installations.

Maximum short circuit currents due to thermal restrictions. The thermal energy developed during a short-circuit is determined by the short-circuit magnitude and duration. For design purposes, an equivalent short-circuit current with a duration of 1 sec is used according to formula below. This formula is valid for a short-circuit duration of 0.2 to 5.0 sec.

$I_{sh} = I_1 / \sqrt{t_{sh}}$ (kA)

Where:

I_{sh}	short-circuit current during time tsh	
I_1	short-circuit current rating during 1 second	(Hz)
t_{sh}	short-circuit duration	(sec)

For XLPE insulated conductors the maximum allowable short circuit temperature is 250oC.

* See the 1 second value in tables 20 for the conductor and in Table 21 for the metallic screen.

Table 20

Max. short-circuit current on the conductor during 1 s, kA				
Conductor temperature before the short-circuit				
Cross section	Aluminium conductor		Copper conductor	
mm²	65°C	90°C	65°C	90°C
35	3,6	3,3	5,5	5,0
50	5,2	4,7	7,8	7,2
70	7,2	6,6	11,0	10,0
95	9,8	9,0	14,9	13,6
120	12,4	11,3	18,8	17,2
150	15,5	14,2	23,5	21,5
185	19,2	17,5	29,0	26,5
240	24,8	22,7	37,6	34,5
300	31,1	28,3	47,0	42,9
400	41,4	37,8	62,7	57,2
500	51,8	47,2	78,4	71,5
630	65,2	59,5	98,7	90,1
800	82,8	75,6	125	114
1000	104	94,5	157	143
1200	124	113	188	172
1400	145	132	219	200
1600	166	151	251	229
2000	207	189	313	286
per mm²	0,104	0,0945	0,157	0,143

CURRENT RATING FOR XLPE CABLE SYSTEMS

Copper screens may reach a temperature of 250°C without damaging adjacent insulating material. With an initial temperature of 50°C this corresponds to a current density of 165 A/ mm2 during 1s (both higher and lower current densities may be allowed if other conditions apply).

Lead sheath temperatures of up to 210°C are permitted in connection with short circuit events. With an initial temperature of 50°C this corresponds to a current density of 28 A/mm2 during 1 s.

Table 21

Max. short-circuit current on the screen during 1 s, kA			
Metallic screen cross section, mm2		Metallic screen temperature before the short-circuit	
Copper screen	Lead sheath	50°C	70°C
35	206	5.8	5.4
50	295	8.3	7.7
95	560	16	15
150	884	25	23
300	1768	50	46
per mm^2 Cu	-	0.165	0.153
-	per mm^2 Pb	0.028	0.026

DYNAMIC FORCES DURING SHORT CIRCUIT EVENTS

In addition to the thermal stresses, the dynamic forces in the cables and accessories during a short circuit event must also be considered.
The dynamic effect of parallel conductors carrying current is responsible for the dynamic force.
The dynamic force between two conductors, can be calculated as:

$$F = 0{,}2/S) \cdot I^2_{peak} \qquad \text{(kA)}$$

Where:

I_{peak}	Short-circuit current RMS	(kA)
S	Centre to centre spacing between conductors	(m)
F	Maximum force	(N/m)

FORMULAE

FORMULA FOR CAPACITANCE

$C = \varepsilon_r / [18 \cdot \ln(r_0/r_1)]$ (µF/km)

Where:

ε	relative permittivity of the insulation	
r_0	external radius of the insulation	(mm)
r_1	radius of conductor, including screen	(mm)
ε_r XLPE	2.5 (Value from IEC 60287)	

FORMULA FOR DIELECTRIC LOSSES

$W = (U^2/3) \cdot 2\pi f \cdot C \cdot \tan(\delta)$ (W/km)

Where:

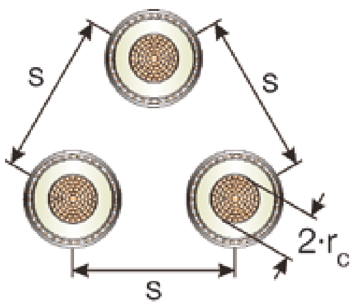
U	rated voltage	(k/V)
f	frequency	(Hz)
C	capacitance	(µF/km)
tan(δ)	loss angle	

FORMULA FOR INDUCTANCE

$L = 0{,}05 + 0{,}2 \cdot \ln(K \cdot s/r_c)$ (mH/km)

Where:

K =1	trefoil formation	
K =1,26	flat formation	
s	distance between conductor axes	(mm)
r_c	conductor radius	(mm)

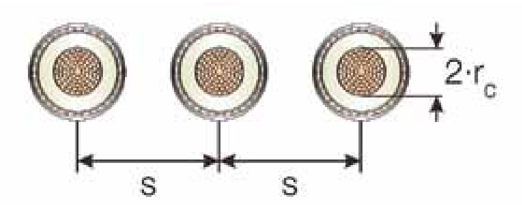


FORMULA FOR INDUCTANCE

$X = 2\pi f \cdot (L/1000)$ (Ω/km)

Where:

f	frequency	(Hz)
L	inductance	(mH/km)



FORMULAE

FORMULA FOR ELECTRIC STRESS

Conductor screen:

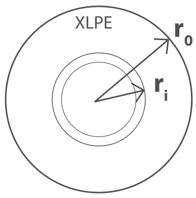
$\mathbf{E_{max} = U_0 / [r_i \ln (r_0/r_i)]}$ (kV/km)

Insulation screen:

$\mathbf{E_{min} = U_0 / [r_0 \ln (r_0/r_i)]}$ (kV/km)

Where:

r_i	radius of conductor screen
r_0	radius of XLPE insulation
U_0	voltage across insultaion



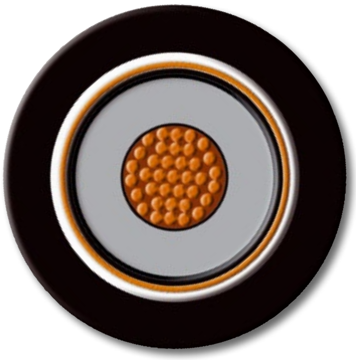
HIGH VOLTAGE CABLES BASED ON IEC 608040

TRATOS® HV - 38/66 kV-(72.5 kV)

CU/XLPE/AT/HDPE

Tratos HV cable is used for the transmission and distribution of electric power and is suitable for installation in ducts, trenches or direct buried underground or within buildings. These cables are ideal for use to connect wind farms and other renewable energy to existing grid systems.

FEATURES AND PERFORMANCES



CONSTRUCTION

- **Conductor:** stranded circular or segmantal compacted copper
- **Conductor screen:** semi-conducting layer
- **Insulation:** XLPE
- **Insulation screen:** non metallic - semi-conducting layer and copper wire as metallic
- **Tape:** non-conductive water blocking
- **Tape:** copolymer aluminum tape
- **Outer sheath:** HDPE sheathed with graphite coating or extruded semi-conducting layer
- **Standard colour:** black
- **Marking:** ELECTRIC CABLE 38/66kV + TRATOS Cable type + Cable Size (e.g. "1x150") COMMODITY CODE IEC 60840 + lot production + year + metre marking

STANDARDS

- Design and Tested: IEC 60228, 60840 and 60811

Size csa	Tratos Part Number	Nominal Conductor diameter	Thickness Conductor screen	Thickness Insulation	Thickness Core screen	Nominal core diameter	Nominal diameter screen wire	Area of copper wire screen	Thickness of Aluminium Copolymer Tape	Nominal thickness of HDPE sheath	Approximate overall diameter
mm²		mm	mm	mm	mm	mm	mm	mm²	mm	mm	mm
150		14.4	1.0	9	1.0	38.4	2.0	35	0.2	3.5	49.8
185		15.6	1.0	9	1.0	39.6	2.0	35	0.2	3.5	51.0
240		18.3	1.0	9	1.0	42.3	2.0	35	0.2	3.5	53.7
300		20.6	1.0	9	1.0	44.6	2.0	35	0.2	3.5	56.0
400		22.9	1.0	9	1.0	46.9	2.0	35	0.2	3.5	58.3
500		26.4	1.0	9	1.0	50.4	2.0	35	0.2	4	62.8
630		29.8	1.0	9	1.0	53.8	2.0	35	0.2	4	66.2
800		36.0	1.0	9	1.0	60.0	2.0	35	0.2	4	72.4
1000		38.2	1.5	9	1.2	63.6	2.0	35	0.2	4	76.0
1200		42.8	1.5	9	1.2	68.2	2.0	35	0.2	4.5	81.6
1400		46.4	1.5	9	1.2	71.8	2.0	35	0.2	4.5	85.2
1600		48.9	1.5	9	1.2	74.3	2.0	35	0.2	4.5	87.7

HIGH VOLTAGE CABLES BASED ON IEC 608040

TRATOS® HV - 38/66 kV-(72.5 kV)

CU/XLPE/PB/HDPE

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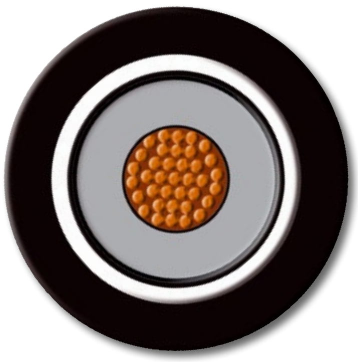
FEATURES AND PERFORMANCES



CONSTRUCTION

- **Conductor:** stranded circular or segmantal compacted copper
- **Conductor screen:** semi-conducting layer
- **Insulation:** XLPE
- **Insulation screen:** non metallic - semi-conducting layer
- **Tape:** non-conductive water blocking
- **Sheath:** lead
- **Outer sheath:** HDPE sheathed with graphite coating or extruded semi-conducting layer
- **Standard colour:** black
- **Marking:** ELECTRIC CABLE 38/66kV + TRATOS Cable type + Cable Size (e.g. “1x150”) COMMODITY CODE IEC 60840 + lot production + year + metre marking

STANDARDS

- Design and Tested: IEC 60228, 60840 and 60811

Size csa	Tratos Part Number	Nominal Conductor diameter	Thickness Conductor screen	Thickness Insulation	Thick-ness Core screen	Nominal core diameter	Nominal thickness of lead	Nominal diameter over lead	Area of Lead Sheath	Nominal thickness of MDPE sheath	Nominal thickness of HDPE sheath	Ap-proximate overall diameter
mm²		mm	mm	mm	mm	mm	mm	mm	mm²	mm	mm	mm
150		14.4	1.0	9.0	1.0	38.4	2.0	44.4	390	3.5	3.5	51.4
185		15.6	1.0	9.0	1.0	39.6	2.0	45.6	401	3.5	3.5	52.6
240		18.3	1.0	9.0	1.0	42.3	2.1	48.5	442	3.5	3.5	55.5
300		20.6	1.0	9.0	1.0	44.6	2.1	50.8	465	3.5	3.5	57.8
400		22.9	1.0	9.0	1.0	46.9	2.2	53.3	504	3.5	3.5	60.3
500		26.4	1.0	9.0	1.0	50.4	2.3	57.0	557	4	4.0	65.0
630		29.8	1.0	9.0	1.0	53.8	2.4	60.6	611	4	4.0	68.6
800		36.0	1.0	9.0	1.0	60.0	2.6	67.2	719	4	4.0	75.2
1000		38.2	1.5	9.0	1.5	64.2	2.7	71.6	789	4	4.0	79.6
1200		42.8	1.5	9.0	1.5	68.8	2.9	76.6	891	4.5	4.5	85.6
1400		46.4	1.5	9.0	1.5	72.4	3.0	80.4	960	4.5	4.5	89.4
1600		48.9	1.5	9.0	1.5	74.9	3.1	83.1	1018	4.5	4.5	92.1

HIGH VOLTAGE CABLES BASED ON ON IEC 608040

TRATOS® HV - 76/132 kV-(145 kV)

CU/XLPE/AT/HDPE

Tratos HV cable is used for the transmission and distribution of electric power and is suitable for installation in ducts, trenches or direct buried underground or within buildings. These cables are ideal for use to connect wind farms and other renewable energy to existing grid systems.

FEATURES AND PERFORMANCES

CONSTRUCTION

- **Conductor:** stranded circular or segmantal compacted copper
- **Conductor screen:** semi-conducting layer
- **Insulation:** XLPE
- **Insulation screen:** non metallic - semi-conducting layer
- **Screen:** copper wire as metallic
- **Tape:** semi-conductive water blocking
- **Tape:** copolymer aluminum tape
- **Outer sheath:** HDPE sheathed with graphite coating or extruded semi-conducting layer
- **Standard colour:** black
- **Marking:** ELECTRIC CABLE 38/66kV + TRATOS Cable type + Cable Size (e.g. “1x150”) COMMODITY CODE IEC 60840 + lot production + year + metre marking

STANDARDS

- Design and Tested: IEC 60228, 60840 and 60811

Size csa	Tratos Part Number	Nominal Conductor diameter	Thickness Conductor screen	Thickness Insulation	Thickness Core screen	Nominal core diameter	Nominal diameter screen wire	Area of copper wire screen	Thickness of Aluminium Copolymer Tape	Nominal thickness of HDPE sheath	Ap-proximate overall diameter
mm^2		mm	mm	mm	mm	mm	mm	mm^2	mm	mm	mm
150		14.4	1.2	18	1.2	56.2	2.0	95	0.2	4.0	70.6
185		15.6	1.2	18	1.2	57.4	2.0	95	0.2	4.0	71.8
240		18.3	1.2	18	1.2	60.1	2.0	95	0.2	4.0	74.5
300		20.6	1.2	18	1.2	62.4	2.0	95	0.2	4.0	76.8
400		22.9	1.2	18	1.2	64.7	2.0	95	0.2	4.0	79.1
500		26.4	1.2	18	1.2	68.2	2.0	95	0.2	4.5	83.6
630		29.8	1.2	18	1.2	71.6	2.0	95	0.2	4.5	87.0
800		36.0	1.2	18	1.2	77.8	2.0	95	0.2	4.5	93.2
1000		38.2	1.5	18	1.5	81.2	2.5	95	0.2	4.5	97.6
1200		42.8	1.5	18	1.5	85.8	2.5	95	0.2	4.5	102.2
1400		46.4	1.5	18	1.5	89.4	2.5	95	0.2	4.5	105.8
1600		48.9	1.5	18	1.5	91.9	2.5	95	0.2	4.5	108.3

HIGH VOLTAGE CABLES BASED ON IEC 608040

TRATOS® HV - 76/132 kV-(145 kV)

CU/XLPE/PB/HDPE

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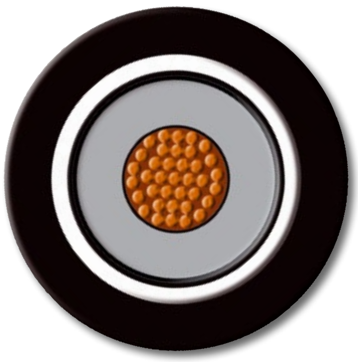
FEATURES AND PERFORMANCES



CONSTRUCTION

- **Conductor:** stranded circular or segmantal compacted copper
- **Conductor screen:** semi-conducting layer
- **Insulation:** XLPE
- **Insulation screen:** non metallic - semi-conducting layer
- **Tape:** semi-conductive water blocking
- **Sheath:** lead
- **Outer sheath:** HDPE sheathed with graphite coating or extruded semi-conducting layer
- **Standard colour:** black
- **Marking:** ELECTRIC CABLE 38/66kV + TRATOS Cable type + Cable Size (e.g. "1x150") COMMODITY CODE IEC 60840 + lot production + year + metre marking

STANDARDS

- Design and Tested: IEC 60228, 60840 and 60811

Size csa	Tratos Part Number	Nominal Conductor diameter	Thickness Conductor screen	Thickness Insulation	Thick-ness Core screen	Nominal core diameter	Nominal thickness of lead	Nominal diameter over lead	Area of Lead Sheath	Thickness of Lead Sheath	Nominal thickness of HDPE sheath	Ap-proximate overall diameter
mm^2		mm	mm	mm	mm	mm	mm	mm	mm^2	mm	mm	mm
150		14.4	1.2	18	1.2	56.2	2.5	63.2	477	2.4	4.0	71.2
185		15.6	1.2	18	1.2	57.4	2.5	64.4	486	2.5	4.0	72.4
240		18.3	1.2	18	1.2	60.1	2.6	67.3	528	2.6	4.0	75.3
300		20.6	1.2	18	1.2	62.4	2.7	69.8	569	2.6	4.0	77.8
400		22.9	1.2	18	1.2	64.7	2.8	72.3	611	2.7	4.0	80.3
500		26.4	1.2	18	1.2	68.2	2.9	76.0	666	2.8	4.5	85.0
630		29.8	1.2	18	1.2	71.6	3.0	79.6	722	2.9	4.5	88.6
800		36.0	1.2	18	1.2	77.8	3.1	86.0	807	3.1	4.5	95.0
1000		38.2	1.5	18	1.5	81.2	3.2	89.6	869	3.2	4.5	98.6
1200		42.8	1.5	18	1.5	85.8	3.4	94.6	974	3.3	4.5	103.6
1400		46.4	1.5	18	1.5	89.4	3.5	98.4	1043	3.4	4.5	107.4
1600		48.9	1.5	18	1.5	91.9	3.5	100.9	1071	3.5	4.5	109.9