

SIWO-KUL® B10

SIWO-KUL® B10 family MV high temperature flexible cables designed with a PET braid, PUR varnished

Description

SIWO-KUL® B10 cables are required when high flexibility and high temperature conditions are present; they are mainly used in medium-voltage motors and generators for connecting stator coils to the terminal box. They are also vital elements for wind converters, transformers, solar power inverters and other MV/LV cabinets. In drives, silicone decreases copper cross-section and gives flexibility for compactness.

SIWO-KUL® B10 family cables are class 5 single core cables available from 1.1 kV up to 15 kV.

This product family is designed with a **PET braid, PUR varnished** providing our customers much flexibility according to their process (VPI...).

For voltage starting 6,6 kV & cross section above 16 mm², Nexans has developed a specific patented extruded semi conductive silicon layer enabling much lower partial discharge and increasing de facto the life time of our cables.



Construction

- Copper conductor tinned, flexible IEC 60228, class 5
- Tape (up to 16 mm²), Semi-conductive layer (only for 6.6 and 13.8 kV)
- Silicone rubber insulation
- Separator tape
- Protective synthetic yarn braiding, PUR varnished

The **use of silicone rubber**, a high grade corona resistant insulation material, gives the cable **excellent dielectric strength**. The braided synthetic yarn covering, which is applied directly over the insulation, gives the cable, because of its short braiding pitch and high compactness, **an excellent mechanical protection by maintaining good flexibility**.

The operating temperature for continuous service extends from -55°C up to 180°C.

This product family is also part of our Windlink® offer for Wind turbines

Approvals

These cables are UL (Underwriters Laboratories inc.) approved for Appliance Wiring Material (AWM), following styles 3640, 3641, 3642 and 3643, CSA File No.: 036040-0-000.

SIWO-KUL® B10 cables are in compliance with EU directives on the limits of certain metals and waste as defined on ROHS (Restriction of Hazardous Substances) and WEE (Waste from Electrical and Electronic Equipment).









SIWO-KUL® B10 is REACH conform substances benzene, C10-C13).



Standards

International IEC 60092; IEC 60331; IEC 60332-1; IEC 60332-3 Cat.C; IEC 60332-3-24; IEC 60754-1; IEC 60754-2; IEC 61034; IEEE 383; LLOYDS Reg. 91/00126(E1); UIC 895

National BSS 6195-T5-C-D-E-F; CSA C22.2 N° 210-05; DIN VDE 0472; NF F 16-101/BF1

							
Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

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Characteristics

Usage characteristics	
Operating temperature, range	-55 .. 180 °C
Chemical resistance	Good
Oil resistance	Yes
Flame retardant	IEC 60332-1
Fire retardant	IEC 60332-3
Fire resistant	IEC 60331
Gases corrosivity	IEC 60754-1, IEC 60754-2
Smoke density	IEC 61034

Product references for 1.1 kV, Yellow

Nexans ref.	Cross section [mm ²]	Construction type	Conductor diam. [mm]	Nom. outer diam. [mm]	Approx. weight [kg/km]	Max. DC Resist. Cond. 20°C [Ohm/km]
10148822	6	82 x 0.30	2.85	5.4	69	3.39

Product references for 3.3-4.2 kV, Red-Brown

Nexans ref.	Cross section [mm ²]	Construction type	Conductor diam. [mm]	Nom. outer diam. [mm]	Approx. weight [kg/km]	Max. DC Resist. Cond. 20°C [Ohm/km]
10148763	95	456 x 0.50	13.6	19.2	981	0.21
10148766	185	844 x 0.5	19.6	25.1	1798	0.108
10191259	300	1412 x 0.5	25.3	31.2	2917	0.066
60007150	400	-	28.8	35.55	3773	0.0654

Product references for 6.6-7.2 kV, Grey

Nexans ref.	Cross section [mm ²]	Construction type	Conductor diam. [mm]	Nom. outer diam. [mm]	Approx. weight [kg/km]	Max. DC Resist. Cond. 20°C [Ohm/km]
10148777	4	56 x 0.30	2,4	7,55	81	5,09
10148779	10	78 x 0.40	3,8	8,95	145	1,95
10148769	16	119 x 0.40	5,55	11,25	225	1,24
10148771	35	264 x 0.40	8,3	14,1	423	0,565
10148772	50	372 x 0.4	10,1	16,3	584	0,393
10148773	70	342 x 0.50	12,1	18,15	785	0,277
10148780	95	456 x 0.50	13,9	19,9	1006	0,21
10148781	120	576 x 0.50	15,7	21,75	1238	0,16
10148886	150	720 x 0.50	17,6	24,1	1525	0,132



Operating temp. range
-55 .. 180 °C



Chemical resistance
Good



Oil resistance
Yes



Flame retardant
IEC 60332-1



Fire retardant
IEC 60332-3



Fire resistant
IEC 60331



Gases corrosivity
IEC 60754-1, IEC 60754-2



Smoke density
IEC 61034

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N e x a n s ref.	Cross section [mm ²]	Construction type	Conductor diam. [mm]	Nom. outer diam. [mm]	Approx. weight [kg/km]	Max. DC Resist. Cond. 20°C [Ohm/km]
10148885	185	844 x 0.5	19,6	26,1	1844	0,108
10148947	240	1120 x 0.5	21,8	28,3	2355	0,082
10209275	300	1412 x 0.5	25,3	32,0	2948	0,066

Product references for 13.8-15.0 kV, Black

N e x a n s ref.	Cross section [mm ²]	Construction type	Conductor diam. [mm]	Nom. outer diam. [mm]	Approx. weight [kg/km]	Max. DC Resist. Cond. 20°C [Ohm/km]
10187643	6	82 x 0.30	2,85	11,0	151	3,39
10148869	10	78 x 0.40	3,8	12,05	205	1,95
10148870	16	119 x 0.40	5,55	13,95	288	1,24
10148871	25	188 x 0.40	7,1	15,5	390	0,795
10148872	35	264 x 0.40	8,3	16,7	497	0,565
10148873	50	372 x 0.4	10,1	18,5	655	0,393
10148874	70	342 x 0.50	11,85	20,35	864	0,277
10148875	95	456 x 0.50	13,9	22,1	1093	0,21
10148876	120	576 x 0.50	15,7	23,95	1332	0,16
10148877	150	720 x 0.50	17,6	26,5	1637	0,132
10148891	185	844 x 0.5	19,6	28,5	1966	0,108
10148986	240	1120 x 0.5	21,8	30,7	2486	0,082
10152024	300	1412 x 0.5	25,3	34,4	3110	0,066

Chemical properties of the high grade Silicone rubber used

	Immersion medium	Time (d)	Temp. (°C)	Hardness change points	Tensile change (%)	Elongation change (%)	Volume change (%)	Suitability
General oils	ASTM N°1 Oil	3	25	nil	---	---	nil	G
	ASTM N°1 Oil	7	150	-6	+8	nil	+8	G
	ASTM N°3 Oil	3	24	-5	---	---	+15	S
	IRM-902 Oil	3	23	-5	-12	-14	+5	S
	IRM-903 Oil	3	23	-12	-7	-11	+18	S
Automotive fluids	AMOCO Super 10W-30	250h	150	-18	-21	5	+23	S
	Wagner 21B Brake Fluid	7	24	-5	---	---	+5	G
	Delco Supreme 550	70h	150	-4	-25	nil	+4	S
Hydraulic Fluids	Aerosafe 2300 (Staufert)	70h	25	-12	-26	-17	+21	S
	Skydrol 500B (Monsanto)	70h	70	-9	-17	+3	+10	S
Transformer oils	Askerol Transformator Oil	35	24	nil	-20	-15	+10	S
	Interteen Transformer Oil	3	24	-5	-10	-5	+10	G
Special oils	ANG 15 Industrial grease	3	24	-10	nil	nil	+10	G



Operating temp. range
-55 .. 180 °C



Chemical resistance
Good



Oil resistance
Yes



Flame retardant
IEC 60332-1



Fire retardant
IEC 60332-3



Fire resistant
IEC 60331



Gases corrosivity
IEC 60754-1, IEC 60754-2



Smoke density
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	Delco N°9	5	100	-10	---	---	+10	G
	Turbo Oil N°35	3	71	-10	-10	-15	+10	S
	Gear Oil - Ucon	3	150	nil	---	---	nil	G
Solvents	Acetone	7	24	-10	---	---	+25	S
	Butyl Alcohol (Butanol)	7	24	-10	---	---	+15	S
	Diacetone Alcohol	5	24	-5	---	---	+5	G
	Ethyl Alcohol	7	24	-5	---	---	+5	G
Silicone Fluids	200 Fluid / 6000 centistokes	1	24	-5	-10	nil	+5	G
	Dow Corning 510 Fluid	3	24	-15	---	---	+35	BS
	Dow Corning 550 Fluid	3	24	-5	---	---	+10	G
Silicone Greases	Dow Corning 44L Grease	7	150	---	---	---	+15	S
	Heat Sink Compound 304	7	150	-9	---	---	+11	S
Food Products	Beer	22h	70	nil	---	---	nil	G
	Butter	22h	70	-5	---	---	nil	G
	Cola Syrup	1	24	nil	nil	nil	nil	G
	Coffee	7	83	-5	-15	nil	nil	S
	Orange Syrup	1	24	nil	nil	+5	nil	G
	Scotch Whisky	1	24	nil	nil	-5	nil	G
	Spry Shortening	5	150	-5	-15	-15	nil	G
	Tab Concentrate	1	24	nil	nil	+5	nil	G
	Vegetable Oil	1	200	-5	-30	-25	+5	G
	Vinegar	1	24	nil	-5	nil	nil	G
	Water	7	24	nil	---	---	nil	G
	Water	14	100	nil	---	---	+5	G
Acids	Acetic Acid (5%)	7	24	-5	---	---	+5	G
	Acetic Acid Glacial	7	24	-5	---	---	+5	G
Bases	Ammonium Hydroxide (sat.)	7	24	nil	---	---	nil	G
	Sodium Hydroxide (10%)	7	24	-5	---	---	nil	G
Salts	Sodium Carbonate (2%)	7	24	-5	---	---	nil	G
	Calcium Silicate (10%)	1	150	nil	nil	nil	+5	G
	Ethylene Glycol (50%)	7	83	nil	nil	+10	nil	G
	Ethylene Glycol Mixture	7	100	-1	-2	+2	+5	G
	Polyglycol (Dow 80-6)	7	24	-5	---	---	+5	G
	Polystyrene (expandable)	7	24	nil	+5	10	nil	G
	Sulfur Dioxide (dry gas)	7	24	-5	---	---	nil	G
	Salt water (sea water)	7	23	nil	nil	nil	nil	G

These indications about Chemical resistance are provided for information only and are in no way binding.



Operating temp.
range
-55 .. 180 °C



Chemical
resistance
Good



Oil resistance
Yes



Flame
retardant
IEC 60332-1



Fire retardant
IEC 60332-3



Fire resistant
IEC 60331



Gases corrosivity
IEC 60754-1, IEC
60754-2



Smoke
density
IEC 61034

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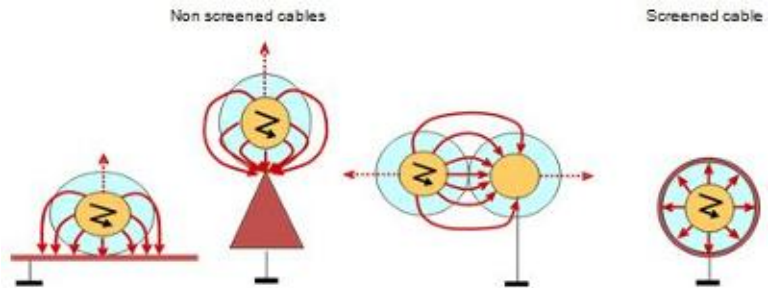
Installation notes cables Siwo-Kul

Unlike installing medium voltage cables which are screened following to the norm, Siwo-Kul is a non-screened connection cable.

To avoid problems with the corona effect, we recommend **minimum installing distances** between the cables Siwo-Kul and the earth.

The corona effect is the ionization of air around the conductor due to the electric field generated by high voltage.

Below figures of the electric field, depending to the arrangement and shape of the earth.



To avoid the problem of electric field concentration, partial discharge and perhaps cable damages, we recommend installation of minimum distances "d" (mm) to the ground, whichever cross section:

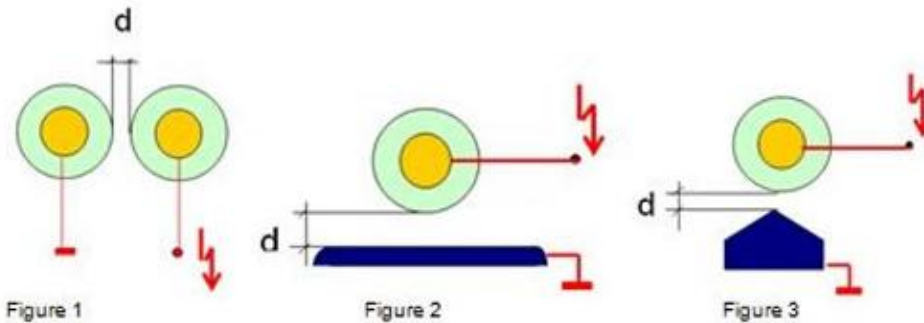


		Figure 1	Figure 2	Figure 3
Siwo-Kul 1.1 kV	d=	0 mm	0 mm	0 mm
Siwo-Kul 3.3 kV	d=	0 mm	2 mm	3 mm
Siwo-Kul 6.6 kV	d=	2 mm	3 mm	4 mm
Siwo-Kul 13.8 kV	d=	5 mm	7 mm	10 mm

Examples of **spacer** used in practice:



Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

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Permissible continuous current (Amperes)

Leiterquerschnitt Section du cond. Section of cond. mm ²	30 °C		60 °C		90 °C		120 °C	
	Umgebungstemperatur Température ambiante Ambient temperatur		Umgebungstemperatur Température ambiante Ambient temperatur		Umgebungstemperatur Température ambiante Ambient temperatur		Umgebungstemperatur Température ambiante Ambient temperatur	
	1.1 / 3.3 kV 1.1 / 4.2 kV	6.6 / 13.8 kV 7.2 / 15 kV	1.1 / 3.3 kV 1.1 / 4.2 kV	6.6 / 13.8 kV 7.2 / 15 kV	1.1 / 3.3 kV 1.1 / 4.2 kV	6.6 / 13.8 kV 7.2 / 15 kV	1.1 / 3.3 kV 1.1 / 4.2 kV	6.6 / 13.8 kV 7.2 / 15 kV
1,5	35	—	30	—	30	—	20	—
2,5	45	—	40	—	35	—	30	—
4	60	55	55	45	50	40	40	35
6	95	85	85	75	75	65	60	55
10	135	120	120	110	105	95	85	75
16	205	185	185	165	160	145	130	120
25	240	225	215	200	185	175	150	145
35	315	290	280	260	245	225	200	185
50	400	365	360	325	310	285	255	230
70	510	460	455	410	395	355	325	290
95	620	560	555	500	480	435	395	355
120	700	625	625	560	540	485	445	395
150	780	695	700	630	605	540	495	440
185	850	765	760	685	660	595	540	485
240	960	865	860	775	745	670	610	545

The indicated amperage values are based on the following assumptions :

- a) Several cables laid in parallel or bunched *).
- b) Conductor temperature = 180 °C.
- c) Without additional cooling. Sufficient natural air flow ensured.
- *) For details see DIN VDE 0298-4: 1998-11

Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

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Short-circuit current

- **Zulässiger thermischer Kurzschlussstrom (A) bei Kurzschlussdauer 1 sec.**
- **Courant (A) de court-circuit permissible pour une durée c.c. de 1 sec.**
- **Permissible short-circuit current (A) for a 1 sec. S.c. time**

- Leiterquerschnitt
- Section du cond.
- Section of cond.
- Leitertemperatur zu Beginn des Kurzschlusses
- Température du conducteur au début du court-circuit
- Conductor temperature at the short-circuit starting

mm ²	30 °C	60 °C	90 °C	120 °C	150 °C	180 °C
6	1'060	950	860	760	640	520
10	1'760	1'590	1'430	1'260	1'070	870
16	2'800	2'500	2'300	2'000	1'700	1'400
25	4'400	4'000	3'600	3'200	2'700	2'200
35	6'200	5'600	5'000	4'400	3'700	3'000
50	8'800	8'000	7'200	6'300	5'400	4'400
70	12'300	11'100	10'000	8'800	7'500	6'100
95	16'700	15'100	13'600	12'000	10'200	8'300
120	21'100	19'100	17'200	15'100	12'800	10'400
150	26'400	23'900	21'500	18'900	16'100	13'100
185	32'600	29'400	26'500	23'300	19'800	16'100
240	42'200	38'200	34'300	30'200	25'700	20'900

These values of current are mentioned for a conductor temperature of 250°C (for all types 1.1 – 13.8 kV).
 Higher values can destroy the semi-conductive layer (types 6.6 und 13.8 kV).

For different short-circuit values, the maximal current can be calculated by:

$$I(t) = I(1) \times \sqrt{1[\text{sec}] / t[\text{sec}]}$$

$I(t)$ = Short-circuit current for a time t .









$I(1)$ = Short-circuit current for 1 second (see table above).

t = Short-circuit time.

SIWO-KUL™ for special applications

Nexans is able to manufacture special SIWO-KUL® cables to suit special applications.

Copper conductors silver plated

							
Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

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Where built-in copper conductors are exposed to extreme high temperatures, we are able to supply silver plated copper conductors.

The melting point of tin in comparison with silver is as follows:

- Tin: 232°C
- Silver: 962°C

SIWO-KUL® cables cut and equipped with lug



SIWO-KUL® cable 185 mm², 6.6 kV with lug

SIWO-KUL® B10 and SIWO-KUL® B20 cable with very flexible copper conductors



- 70 mm², 342 x 0.50 (Cl. 5)
- 70 mm², 2160 x 0.20 (Cl. 6)

Please send us your enquiry. We will quote tailor suited solutions.

Additional Characteristics SIWO-KUL®

Construction of the cable acc. to Nexans specifications

Thermal properties (of conductor)

Continuous operating temp. -55°C ... +180°C

Intermittent + 220°C









Short time duty 1-5 sec. + 350°C

Mechanical properties

Hardness 65 ... 70 Shore A

Flexibility of cable very good

In case of long time usage at higher temperatures of the SIWO-KUL® cables, the color of the protective braid will change. This is particularly noticeable on the yellow cable 1.1 kV. This alteration of color does not degrade the electrical function of the cable.

							
Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

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In the event of fire, no corrosive and toxic gases will be given off. Hence, damage caused by fire can be kept to a minimum. Compared with other plastic insulated cables, SIWO-KUL® generates only little smoke and is therefore defined as «low smoke grade» according to the «Guideline for fire regulations». Of course, the cable meets the requirements concerning fire propagation specified in IEEE 383 and IEC 60332-3 respectively.

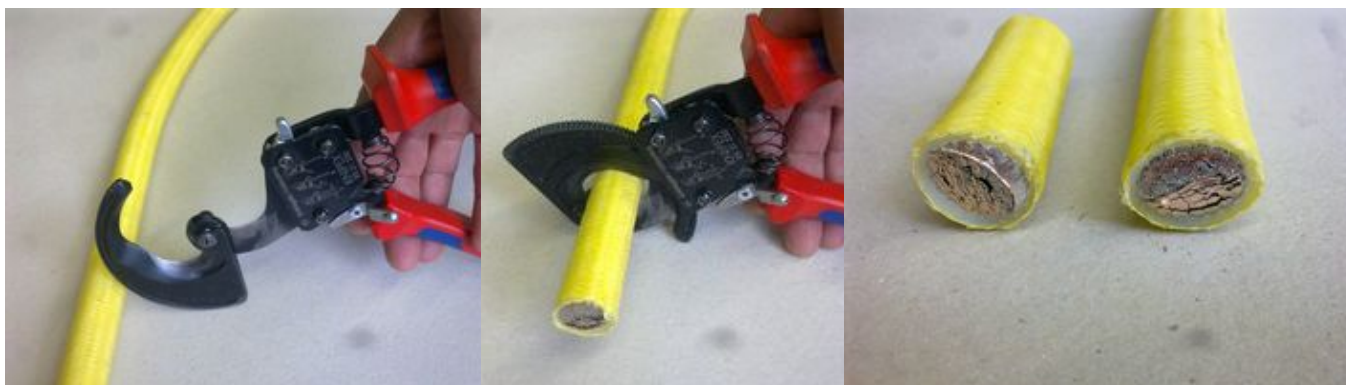
According to the French specification NFF 16.101, this cable is BF1 approved which means that it is in compliance with requirements for cables used in the internal wiring of rail cars.

Under the influence of flames the silicone rubber reduces to silicone oxide, which is an excellent electrical insulator. Because of this chemical reaction a relatively long functional endurance under fire conditions can be achieved. Test according to IEC 60331 and VDE 0472 part 814, at rated voltage, show a function time of at least 30 minutes.

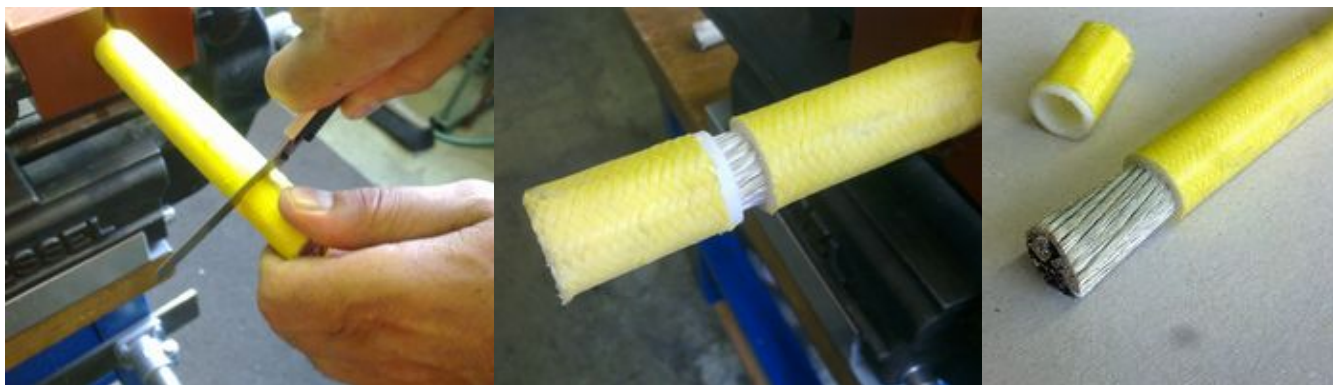
The insulation wall thickness has been designed taking into consideration the high dielectric strength of silicone rubber. The breakdown voltage of the finished cable is at least twice the value of the test voltage. The cable meets the requirements of IUC 895 and, concerning dielectric strength, BSS 6195 Type 5, voltage categories C, D, E and F.

Easy cut and remove of the Siwo-Kul insulation

Cut: Siwo-Kul can be cut easily with adequate pliers:











Remove of the insulation: With a good knife, the braid have to be cut together with the silicone insulation and can be removed properly:



To avoid improperly cutting and opening of the braid, we have 2 tips:

- Burn the filament of the opening braid with a lighter. The filaments will melt and glue together.
- Put an adhesive tape around the cable and cut it in the middle.

							
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Finally, it's also possible to purchase Siwo-Kul-Sil where the braid is gluing on the silicone insulation.

Suitable cable termination for Siwo-Kul 6.6 and 13.8 kV

The flexibility of Siwo-Kul creates inevitably a gap between the termination and the silicone insulation. This gap can be covered with a shrink sleeve, providing a perfect visual finish of termination. However, for voltages of 6.6 and 13.8 kV the phenomenon of electric field at this level is not resolved. This requires the recovery by a semi-conductive material.

The result of our experience leads us to propose **two solutions with several benefits:**



Cable shoe:

- Easy to install. A single operation
- Adapted to each section and tension
- The collar fills the diameter difference between cable shoe and strands, which comes from using of oversized cable shoe for strands











Sleeve:

- Adapted to your usual cable shoes
- Easy instalation
- One size per cross section

About SIWO-KUL®









SI	Isolation S ilikonkautschuk	Insulation silicone rubber
W	W ärmebeständigkeit	Temperature resistance
O	O elbeständigkeit	Oil resistance
K	Schutzgeflecht aus K unstgarn	Protective braid
UL	U eber L ackierung	Varnish coating

							
Operating temp. range -55 .. 180 °C	Chemical resistance Good	Oil resistance Yes	Flame retardant IEC 60332-1	Fire retardant IEC 60332-3	Fire resistant IEC 60331	Gases corrosivity IEC 60754-1, IEC 60754-2	Smoke density IEC 61034

Selling information

Marking

Our SIWO-KUL™ cables have been printed:
 NEXANS SWITZERLAND SIWO-KUL +voltage in kV + section in mm² + Standards + Meter marks

							
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