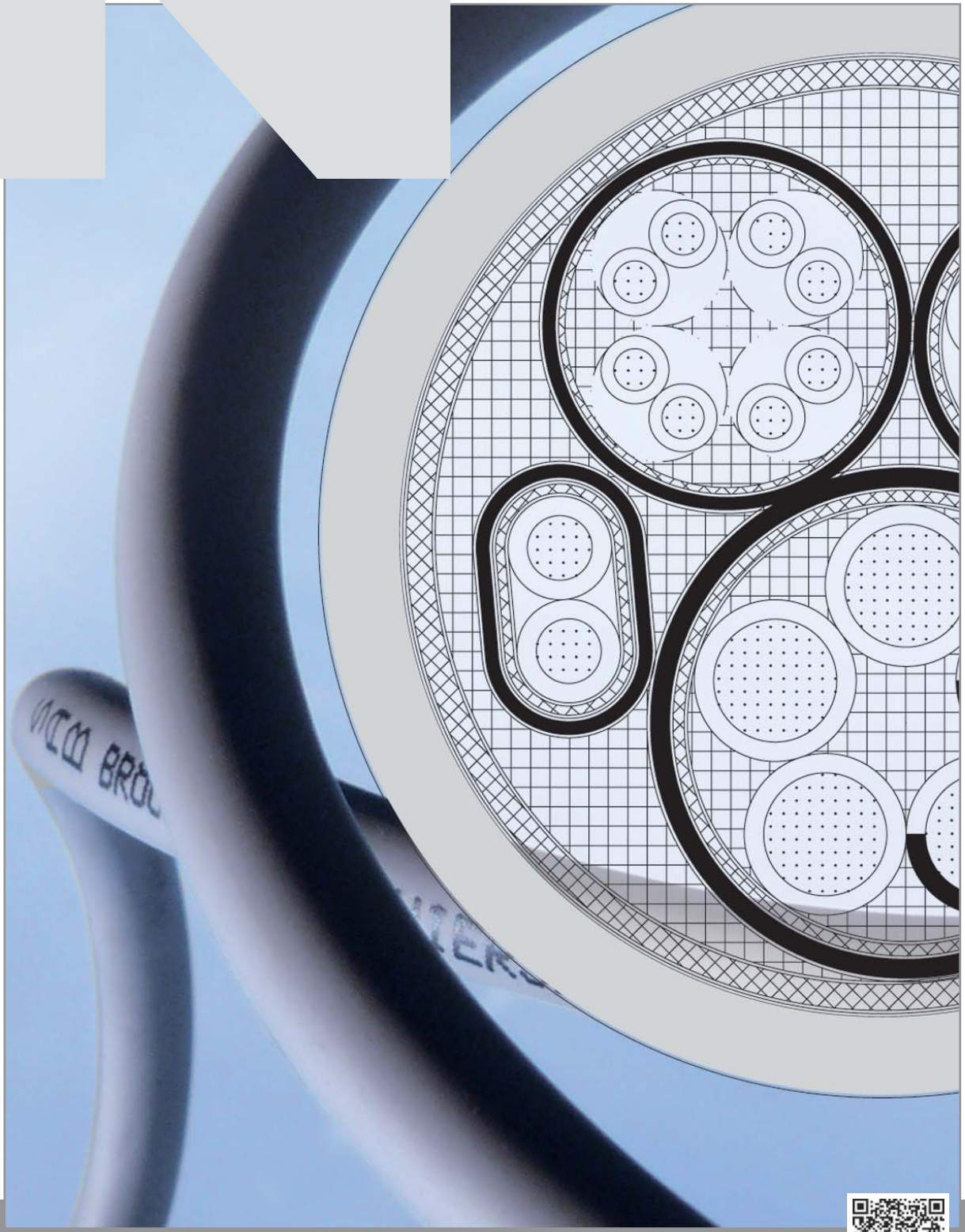
N Technical Data



CONTENT

- Please note that all technical data are not binding and can be modified due to new developments.

SABIX® - thermoplastic material on a Polyolefine base

This material has several outstanding characteristics. As registered trademark of SAB BRÖCKSKES GmbH & Co. KG, SABIX® combines progressive cable technology with highest security for the user. When used properly, there is no health risk associated with SABIX®. SABIX® products are completely recyclable and can be reused after decomposition.

Standard halogen-free cables offer a large degree of safety to humans, nature, buildings and machinery, but do have a large disadvantage - they are often too unflexible to compete with PVC in all applications. This is not the case with SABIX®. SABIX® possesses several technical advantages compared with PVC.

The outstanding characteristics of the SABIX® - material types depending on the modifications are:

- oil resistant acc. to DIN VDE + EN
- flexible at low temperatures up to -40°C
- heat resistant up to +125°C
- suitable for outdoor application
- extremely flexible
- very good capacitance values
- increased abrasion resistance
- fully recyclable
- low smoke density acc. to DIN VDE, IEC, BS + EN
- flame retardant and self-extinguishing acc. to DIN VDE, IEC + EN
- halogen-free acc. to DIN VDE + IEC
- UL / CSA

Exemplary application fields

SABIX®- single cores, wiring and multi core cables: switchboard construction, devices of communication technique, household appliances, generators, transformers and machine construction, rail technique, …

SABIX®- control and connection cables: automation technique, automobile industry, machine construction, rail technique, conveyor technique, industrial plant construction, steel and iron industry, refrigeration and air conditioning technology, car washes, truck hoists, supply cable between frequency converter and servo motor, …

SABIX®- data cables: telecommunication technique, electronics for data processing systems, weighing devices, office machines, for increased requirements on transmission characteristics and crosstalk attenuation, …

SABIX®- Rail: single cores, control and data cables for the internal wiring of rail vehicles acc. to DIN EN 45545-2, …

SABIX®- BlueLine - cables for ship building: BLueLine Data - data cables, BlueLine Control - control cables, BlueLine Power - supply cable for flexible application lower deck as well as for the protected laying on deck of ships without permanent contact with oil and fuel.

SABIX®- ULTRA - permanent flexible with highest fire protection: as festoon cables for polar cranes in nuclear power plants, in rail technique, as sensor cable at the vehicle chassis, as cable chain cable with medium mechanical stress, as flexible control cable at entry doors, …

Polyurethane (PUR) - Thermoplastic Elastomere

Polyurethane has become increasingly important in the cable industry over the past years. This material shows at certain temperatures mechanical characteristics similar to rubber. The combination of thermoplastic and elastic characteristics has led to the description TPE thermoplastic elastomere. Here at SAB BRÖCKSKES GmbH & Co KG, we use PUR on a Polyether base as sheath material. In addition to standard Polyurethane, thanks to constant development between SAB BRÖCKSKES and the plastic industry, the following types of PUR are also available:

- PUR semi-mat (low adhesion)
- PUR mat (rough surface, low adhesion)
- PUR flame protected
- PUR halogen-free and flame protected

Mechanical characteristics

The insulation materials of the cables are usually not subject to high mechanical stress. Sheaths, on the other hand are heavily used. This is especially true for flexible control and connection cables which are often pulled over sharp corners and rough surfaces. This can lead to cuts which are accentuated when the cable is stretched during flexible use. Compressive stress caused by squashing and impacting from tools and machines can also occur. The most important mechanical characteristics of PUR are:

- high tensile strength
- high tear resistance
- notch resistance
- abrasion resistance
- alternate bending resistance
- impact resistance
- flexibility at low temperatures

Chemical characteristics

The chemical resistance depends upon many factors such as chemical type, reaction time, temperature, volume, concentration and of course the type of Polyurethane used. In comparison with many other materials, such as rubber or PVC, PUR has a better resistance against chemical reaction. The outstanding chemical characteristics are:

- very good resistance against mineral oils
- good resistance against alcohol-free benzine
- good resistance during storage in water
- good resistance against many solvents

The danger of decomposition through microbes exists with Polyurethane on a Polyester base after prolonged exposure to dampness and warmth. The Polyurethane on a Polyether base used by SAB is resistant to microbic decomposition. Etherpolyurethane and Esterpolyurethane can be differentiated by the saponification value (VZ).

- Etherpolyurethane (resistant) - VZ ≤ 200
- Esterpolyurethane (non-resistant) - VZ ≥ 350

After prolonged exposure to warm water or tropical climates, Polyurethane on a Polyester base will undergo a chemical reaction. The result is a weakening of mechanical strength. SAB Polyurethane on a Polyether base is relatively more resistant to hydrological break-down.

Etherpolyurethane is weather and ozone resistant in all climates. Discolouration by sunlight is possible, but this will not affect performance.

Exemplary application fields of PUR insulated cables

For control devices, for example machine tools, assembly lines, conveyor systems and production lines, machine and plant construction, conveyor technique (among others hoisting platforms and transport systems), automobile industry, handling and automation technique, iron, steel and chemical industry, electric tool construction (for example lawn mowers, edge cutters, hedge trimmers), in brick and cement works, electric hand-held equipment (for example drilling machines, angle grinders and other electric tools), industrial painter´s shops, water treatment systems, automobile and coal, iron and steel industry, …

Polyvinylchloride (PVC) - Thermoplastic material

The application areas for this thermoplast in the plastics industry are diverse. There are various types of PVC used in the wire and cable industry. National (DIN VDE) and International (IEC) Standards Authorities have specified PVC parameters for the different PVC mixtures. The characteristics of standardized PVC mixtures for the cable industry are defined under the following DIN VDE standards, for example:

- PVC - insulation mixture VDE 0207 part 363-3, EN 50363-3
- PVC - sheath mixture VDE 0207 part 363-4, EN50363-4

PVC that hardens after polymerisation is not suitable for insulating and protecting wires and cables. The necessary mechanical, thermal and electrical levels can only be reached with the addition of complements such as:

- softeners
- stabilisers
- filler materials
- slip additives

Materials

1. SAB special PVC (Y)

Our special PVC (YA and YM) are used for insulation and sheathing purposes. PVC type YA is used for core insulation and is particularly flexible and has very good electrical characteristics. PVC type YM sheath material has good mechanical characteristics and high flexibility.

The temperature range is as follows:

Fixed laying: -40° up to +70°C
Flexible application: + 5° up to +70°C

2. SAB cold resistant PVC (YK)

Cold resistant PVC shows good flexibility and mechanical strength even at sub-zero temperatures. It can also be exposed to various weather influences.

The temperature range is as follows:

Fixed laying: -40° up to +70°C
Flexible application: -20° up to +70°C

3. SAB heat resistant PVC (YW)

Heat resistant PVC can resist temperatures up to +105 °C. The insulation and sheath materials possess good electrical and mechanical values and have very good heat resistance. The highest valid operational temperature on the conductor itself according to DIN VDE 0207 is +90 °C. Any application above this temperature reduces the usable life.

The temperature range is as follows:

Fixed laying: -40° up to +90°C
Flexible application: + 5° up to +90°C
Short time use: up to +105°C

4. SAB oil resistant PVC (YOE)

Our YOE PVC mixtures are oil resistant according to DIN VDE 0281 part 1, mixture TM5. Usually used as a sheath material, it can also be used as insulation.

The temperature range is as follows:

Fixed laying: -40° up to +70°C
Flexible application: + 5° up to +70°C

PVC can be classified as inflammable due to its chemical composition. SAB PVC compounds fulfil the criteria regarding burning characteristics according to EN 60332-1-2 (IEC 60332-1-2), UL, VW1, CSA FT1 and FT2. Halogen is however released during a fire, which is a danger to humans, nature, buildings and machines. In addition, PVC control and data cables are not designed for outdoor use.

Exemplary application fields of PVC insulated cables

For control devices, for example machine tools, conveyor belts, assembly and production lines and in plant and switchboard construction, devices and equipment of communication technique, household appliances, generators, transformers and machine construction. They are equally used for control units, electric, installation and packing technique, textile and wood processing as well as machine tool construction. Further application fields are electric and data processing, in cleaning devices, automobile industry, automation technique, press and tool construction. Other fields of use are machine construction for paper and printing industry, surface treatment, iron and steel industry, bottling plants, chemical industry, for intrinsically safe circuits, at control devices in hazardous areas, CNC centres, lamps and lightning technique, …

Besilen® - Elastomere on a siliconecaoutchouc base

Besilen® is a registered trademark of SAB BRÖCKSKES GmbH & Co KG. It is a specially developed Silicone rubber-based material with good electrical characteristics and heat resistance. In addition to our standard Besilen® product range, we also produce specialised products that meet requirements such as:

- notch resistance for better mechanical strength
- higher temperature resistance + 250 °C
- Besilen® mixture compatible for the food industry
- conductive Besilen® for antistatic conductance

Mechanical characteristics

Vulcanised Besilen®, produced with a 50-60 A shore hardness is particularly elastic with excellent mechanical strength. A further interesting characteristic of Besilen® is that it does not stick to adhesive surfaces.

- non-adhesive
- hydrophobic

If Besilen® cables are used in tube systems it is important that these are ventilated and open, otherwise the mechanical strength of Besilen® will be reduced.

Chemical characteristics

The chemical composition of Besilen®, which deviates from standard rubber types, gives our product several outstanding characteristics including for example:

- outstanding hot air resistance
- extreme flexibility at low temperatures (down to -40 °C)
- resistant to decompostion from substances such as alcohol and high molecular oils, plant and animal fats, diluted acids, softeners, chlophen, alkalis and salt solutions
- oxygen resistant
- ozone-proof
- halogen-free
- weather resistant

Electrical characteristics

The electrical characteristics of Besilen® even at room temperature lie alongside the best known elastic insulation materials. Because of its heat resistance, Besilen® insulated cables and wires can withstand approx. 50% more electric pressure under continuous use than regular rubber insulation. This allows weight and room-saving cable construction. An outstanding safety feature of Besilen® insulation is the insulating layer of silicic acid (SiO2) during fire.

Dielectric constant:	approx. 3.2 (at 800 Hz)
Specific volume resistance:	min. 10^{12} Ω x cm
Breakdown voltage:	20 kV/mm

Current-carrying capacity (Iz) of cables with increased heat resistance in ambient temperatures above 50 °C

Ambient temperature up to °C	150	155	160	165	170	175
Current-carrying capacity (Iz) of the values in below-shown table	100 %	91 %	82 %	71 %	58 %	41 %

In ambient temperatures up to 150 °C Besilen® insulated cables can be charged acc. to VDE 0298 T4 06/13 table 11, colum 2 and 5.
See table current-carrying capacity page N/36.

Exemplary application fields of Besilen® cables

For rail technique, temperature measurement technique, smelteries, steel and power plants as well as rolling mills. They are equally used in lightning industry, cement, glass and ceramic treatment, refrigeration and air conditioning technique, sauna construction, foundries, plastic processing industries as well as plastic processing machine construction. Further applications are in heating devices, cookeries, thermo and process technique, engine construction, dust removal systems, ventilator construction, system heating technique, wood and paper processing, electronic industries, drive technology, switchboards and distributors, textile machine construction, …

ETFE - ethylene tetrafluorethylene

ETFE has got excellent mechanical characteristics, an elevated hardness and tensile strength are combined with chemical resistance and electric and thermal characteristics of other fluoro-plastics with especially high demands as for example on:

- high chemical and solvent resistance
- cold and heat resistance
- elevated tensile strength and pressure resistance
- good electric and insulation characteristics with low dielectric values almost independent on frequency
- operating temperature from approx. -90°C up to +135 °C

FEP - fluorinated ethylene-propylene copolymer

This material belongs to the fusible fluoroplastics and can be extruded. It has got a bigger friction coefficient and a lower permanent operating temperature than PTFE. FEP offers the following characteristics:

- excellent temperature resistance
- deep temperature flexibility
- very good resistance against oils and chemicals
- good electric insulating characteristics with almost frequency independent dielectric characteristics
- operating temperature from approx. -90°C up to +180°C

PFA - perfluoroalkoxy copolymer

This fluoroplastic material has got a good chemical resistance, a broad application temperature range as well as a very good resistance against ageing and weather conditions. Furthermore, it shows a low friction resistance and a good electrical insulation with especially high demands as for example on:

- high demands on chemical and solvent resistance
- high degree of resistance
- excellent temperature resistance and deep temperature flexibility
- good electrical insulation characteristics with low almost frequency independent dielectric characteristics
- operating temperature from approx. -90°C up to +250°C (short term +260°C)

Exemplary application fields of ETFE, FEP and PFA cables

ETFE: For high frequency, broadband and telecommunication technique, coaxial and micro wave technology. High data speed together with exact information transmission, chemical industry, furnace construction, brick works, heating devices, …

FEP: For ship building for example in machine rooms on ships or as connection cable for engine control, high frequency and broadband technique as well as telecommunication technique, coaxial and micro wave technology. High data speed together with exact information transmission, chemical industry, furnace construction, brick works, heating devices, …

PFA: For high frequency, broadband and telecommunication technique, coaxial and micro wave technology. High data speed together with exact information transmission, chemical industry, furnace construction, brick works, heating devices, …

Abbreviations key for harmonized/international cables

Fundamental type

H = harmonized type
A = nationally recognised type

Nominal voltage

01 = 100 Volts
03 = 300/300 Volts
05 = 300/500 Volts
07 = 450/750 Volts

Materials

B = Ethylene propylene rubber
E = PE Polyethylene
J = Fibre-glass braiding
N = Chloroprene rubber
Q = Polyurethane
R = Rubber
S = Silicone rubber
T = Textile braiding
V = PVC
V2 = PVC +90°C
V3 = PVC flexible at low temperatures
V5 = PVC increased oil resistant
X = XPE, cross linked PE

Additions

C4 = copper wire braiding
H = divisible flat cable
H2 = non-divisible flat cable
H6 = non-divisible flat cable for elevators
H8 = helix cable

Types of conductor

U = single wire
R = multi wire
K = fine strands (fixed laying)
F = fine strands (flexible use)
H = extra fine strands (flexible use)
D = fine strands for welding cable
E = extra fine strands for welding cable

Earth wire

X = without green-yellow earth wire
G = with green-yellow earth wire

Abbreviations key according to DIN VDE and with reference to DIN VDE (SAB BRÖCKSKES standard)

Fundamental type

N = national standard
Bi = Besilen® (Silicone)
Ö = PVC control cable
S = Cable track cable
SL = Servo cable
SABIX® = halogen-free material on a Polyolefin base
Li = strands (data cable
AGL = Compensating cable
ThL = Extension cable

Insulation

Y = PVC
YK = cold resistant PVC
2G (Bi) = Besilen® (Silicone)
12Y = mod. TPE
G = Rubber
2Y = PE (Polyethylene)
GL = Fibre-glass
SABIX® = halogen-free material

Screening/Armouring

P = steel wire protection
S = steel wire braiding
C = copper braiding
V = stainless steel braiding
D = copper wrapping
ST = static screen

Specials

Z = numbered control cable
A = single core
F = flexible
(E) = intrinsically safe (blue)
(TR) = transparent outer sheath
(B) = drain wire
PU = Polyurethane

Sheath materials

YOE = oil resistant PVC
YW = heat resistant PVCg
11Y = PUR (Polyurethane)
HM4 = halogen-free thermoplast
SABIX® = halogen-free material

Other materials as mentioned under insulation

Earth wire

J = with green-yellow earth wire
0 = without green-yellow earth wire

INSULATION AND SHEATH MATERIAL CHARACTERISTICS

Material	Abbre-viation	Temperature range/ flexible	Flame retar-dance	Tensile strength N/mm²	Elon - gation at break %	Abrasion resist-ance	Dielectric constant at 800 Hz approx.	Specific resist-ance Ω x cm	Break-down voltage kV/mm	Radiation resist-ance cJ/kg
PVC special	Y	+5/+70 °C	good	15	250	medium	4,0	10^{13}	12	8×10^{7}
PVC cold resistant	Y K	-20/+70 °C	good	15	250	medium	4,0	10^{13}	12	8×10^{7}
PVC heat resistant	Y W	+5/+105 °C	good	18	200	medium	3,5	10^{13}	18	8×10^{7}
PVC oil resistant	YOE	+5/+70 °C	good	15	250	medium	4,0	10^{13}	12	8×10^{7}
PUR halogen-free	11 Y	-40/+90 °C	moderate	30	400	very good	6,0	10^{12}	20	5×10^{7}
PE	2 Y	-40/+70 °C	moderate	20	500	good	2,4	10^{17}	100	7×10^{6}
TPE	12 Y/ 13 Y	-40/+90 °C (up to +135 °C)	moderate	30	500	good	3,3	10^{14}	30	1×10^{7}
Besilen®	2 G	+180 °C	good	7	200	moderate	3,2	10^{15}	20	2×10^{7}
FEP	6 Y	+ 180 °C	very good	20	250	good	2,1	10^{18}	20	5×10^{6}
PFA	–	+ 250 °C	very good	20	250	good	2,1	10^{18}	20	2×10^{6}
ETFE	7 Y	+150 °C	very good	45	250	good	2,6	10^{16}	30	5×10^{7}
SABIX® * on basis of PP	–	-40/+90 °C	–	30	500	good	2,3	10^{16}	30	–
SABIX® FRNC* on basis of PO	–	-40/+90 °C	very good	9	125	moderate	4,7	10^{14}	–	5×10^{7}
SABIX® ** reticulated	–	-40/+125 °C	very good	12	125	moderate	5,0	–	–	–

The values in this table are approximates and are not complete.
(Technical modification subject to alteration)

* depending on type
** electron beam reticulated types

Data cables – electrical characteristics

Cross-section in mm²	0,14	0,25	0,34	0,50	0,75	1,00	1,50
max. conductor resistance at 20 °C in Ω/ km acc. to DIN VDE 0812	148,0	79,9	58,0	38,9	26,0	19,5	13,3
Capacitance core/core approx. nF/km for…							
…PVC	120	120	130	140	150	170	190
…TPE-E	100	100	120	120	150	150	170
…PE	60	60	80	90	90	100	110
…SABIX® 336	70	70	70	80	90	100	110

Screened data cables – electrical characteristics

Cross-section in mm²	0,14	0,25	0,34	0,50	0,75	1,00	1,50
max. conductor resistance at 20 °C in Ω/ km acc. to DIN VDE 0812	148,0	79,9	58,0	38,9	26,0	19,5	13,3
Capacitance core/core approx. nF/km for…							
…PVC	50	50	55	55	60	60	60
…TPE-E	40	50	50	50	60	70	70
…PE	20	20	20	20	20	20	20
…SABIX® 336	30	30	30	30	30	30	35

The mentioned values are approximate values. Capacitance is dependent on cable constructions, screenings and wall thickness of the insulation and, therefore, can be different from above mentioned data.

Data cables – construction of strands

For example, item groups 0305, 0315, 0345, 5305, 5315, 5345, 6305, 6315, 6345, …

nominal cross section	no. of wires x diameter of wires
0,14 mm²	≈ 18 x 0,11 mm Ø
0,25 mm²	≈ 14 x 0,16 mm Ø
0,34 mm²	≈ 7 x 0,26 mm Ø
0,50 mm²	≈ 15 x 0,21 mm Ø
0,75 mm²	≈ 23 x 0,21 mm Ø
1,00 mm²	≈ 30 x 0,21 mm Ø
1,50 mm²	≈ 28 x 0,26 mm Ø

Substance	Concentr. %	Temp. °C	PVC	SABIX® on basis of PP	SABIX® FRNC on basis of PO	PUR	PE	Besilen®	FEP	PFA	ETFE
Acetone		20	–	+	–	–	+	o	+	+	+
Alum		20	+	+	n.e.	+	+	–	+	+	+
Ammonia	25	20	+	+	n.e.	o	+	+	+	+	+
Aniline		50	–	+	–	–	+	+	+	+	+
Benzine		20	–	–	o	+	–	o	+	+	+
Benzol	100	50	–	+	–	–	–	–	+	+	+
Boric acid	sat.	20	+	+	n.e.	+	+	+	+	+	+
Break fluid		100	o	o	–	–	n.e.	+	+	+	+
Butter		50	+	o	o	o	+	+	+	+	+
Carbon tetrachloride	100	20	+	–	–	–	–	–	+	+	+
Caustic soda	50	50	+	+	o	+	+	–	+	+	+
Chlorobenzine		30	–	n.e.	–	–	o	–	+	+	+
Citric acid		20	+	+	+	o	+	+	+	+	+
Copper salt		20	+	+	+	+	+	+	+	+	+
Destilled water		100	o	+	o	o	+	–	+	+	+
Destilled water		20	+	+	+	+	+	+	+	+	+
Detergent lye	2	100	–	+	o	–	n.e.	–	+	+	+
Dichlormethane	100	20	–	n.e.	–	–	+	–	+	+	+
Dichlorodifluoromethane		20	–	n.e.	o	+	o	–	+	+	+
Diethyl ether		20	o	+	o	+	+	–	+	+	+
Diethylene glycol		50	+	+	o	+	+	+	+	+	+
Ethylene chloride		50	–	n.e.	–	–	+	o	+	+	+
Ethylene glycol		100	o	+	–	–	n.e.	+	+	+	+
Gear oil		100	+	o	–	o	–	o	+	+	+
Glycerine	all	50	+	+	o	+	+	+	+	+	+
Hydraulic oil		20	+	+	+	+	–	–	+	+	+
Hydrochloric acid	concentr.	20	–	+	+	–	+	–	+	+	+
Machine oil		20	–	o	+	+	–	+	+	+	+
Mercury salt		20	–	+	+	–	+	+	+	+	+
Methanol		50	+	+	o	–	+	+	+	+	+
Motor oil		120	–	o	–	–	–	+	+	+	+
Nitrobenzene	100	50	–	+	–	–	+	+	+	+	+
Nitric acid		20	–	+	+	–	+	–	+	+	+
Olive oil		50	+	+	–	+	+	+	+	+	+
Phenol from tar (Tectal)		20	+	+	o	–	n.e.	–	+	+	+
Potassium chloride	sat.	20	+	+	+	n.e.	+	+	+	n.e.	n.e.
Potassium nitrate		20	+	+	+	o	+	+	+	+	+
Pure acetic acid	concentr.	50	–	+	–	–	+	+	n.e.	n.e.	n.e.
Silver salts		20	+	+	+	+	+	+	+	+	+
Sodium chloride	50	20	+	+	+	+	+	+	+	+	+
Sulphuric acid	50	50	+	+	–	–	+	–	+	+	+
Tartaric acid	sat.	20	+	+	+	n.e.	+	+	+	+	+
Trichlorethylene	100	50	–	–	–	–	–	+	+	+	+

Reference:

This information is the result of our many years of experience and has been compiled to the best of our knowledge. However, we would like to point out that they are not binding and a final assessment can only be made under normal working conditions.

– = poor resistance
o = average resistance
+ = good resistance
n.e. = not existing

Colour code with reference to DIN 47100

core no.	basic colour	1st ring	2nd ring	core no.	basic colour	1st ring	2nd ring
1	white			32	yellow	blue	
2	brown			33	green	red	
3	green			34	yellow	red	
4	yellow			35	green	black	
5	grey			36	yellow	black	
6	pink			37	grey	blue	
7	blue			38	pink	blue	
8	red			39	grey	red	
9	black			40	pink	red	
10	violet			41	grey	black	
11	grey	pink		42	pink	black	
12	red	blue		43	blue	black	
13	white	green		44	red	black	
14	brown	green		45	white	brown	black
15	white	yellow		46	yellow	green	black
16	yellow	brown		47	grey	pink	black
17	white	grey		48	red	blue	black
18	grey	brown		49	white	green	black
19	white	pink		50	brown	green	black
20	pink	brown		51	white	yellow	black
21	white	blue		52	yellow	brown	black
22	brown	blue		53	white	grey	black
23	white	red		54	grey	brown	black
24	brown	red		55	white	pink	black
25	white	black		56	pink	brown	black
26	brown	black		57	white	blue	black
27	grey	green		58	brown	blue	black
28	yellow	grey		59	white	red	black
29	pink	green		60	brown	red	black
30	yellow	pink		61	black	white	
31	green	blue					

Core identification acc. to HD 308

Identification of cores in cables and flexible cords by colours

no. of cores	cables with green-yellow earth wire	cables without green-yellow earth wire
2-cores	–	blue - brown
3-cores	green-yellow - blue - brown	brown - black - grey
4-cores	green-yellow - brown - black - grey	blue - brown - black - grey
5-cores	green-yellow - blue - brown - black - grey	blue - brown - black - grey - black

Core indentification with numbers acc. to EN 50334

Marking inscription for identification of cores of electric cables (number printing).
Other core colours are allowed except green and yellow.

SAB colour code for RTD connection cables

2-cores	red - white
3-cores	red - red - white
4-cores	red - red - white - white
6-cores	red - red - white - white - black - black

(up to 4 conductors acc. to DIN IEC 60751, 6 conductors deviating from standard)

Colour-coding to customer specification is also possible!

Colour code US 1

core no.	basic colour	1st ring	2nd ring	core no.	basic colour	1st ring	2nd ring
1	black			7	orange		
2	white			8	yellow		
3	red			9	violet		
4	green			10	grey		
5	brown			11	pink		
6	blue			12	beige		

Colour code US 2

core no.	basic colour	1st ring	2nd ring	core no.	basic colour	1st ring	2nd ring
1	black			26	orange	black	white
2	white			27	blue	black	white
3	red			28	black	red	green
4	green			29	white	red	green
5	orange			30	red	black	green
6	blue			31	green	black	orange
7	white	black		32	orange	black	green
8	red	black		33	blue	white	orange
9	green	black		34	black	white	orange
10	orange	black		35	white	red	orange
11	blue	black		36	orange	white	blue
12	black	white		37	white	red	blue
13	red	white		38	black	white	green
14	green	white		39	white	black	green
15	blue	white		40	red	white	green
16	black	red		41	green	white	blue
17	white	red		42	orange	red	green
18	orange	red		43	blue	red	green
19	blue	red		44	black	white	blue
20	red	green		45	white	black	blue
21	orange	green		46	red	white	blue
22	black	white	red	47	green	orange	red
23	white	black	red	48	orange	red	blue
24	red	black	white	49	blue	red	orange
25	green	black	white	50	black	orange	red

Colour code US 3

pair no.	colour combination		pair no.	colour combination	
1	black	paired with red	20	white	paired with yellow
2	black	paired with white	21	white	paired with brown
3	black	paired with green	22	white	paired with orange
4	black	paired with blue	23	blue	paired with yellow
5	black	paired with yellow	24	blue	paired with brown
6	black	paired with brown	25	blue	paired with orange
7	black	paired with orange	26	brown	paired with yellow
8	red	paired with white	27	brown	paired with orange
9	red	paired with green	28	orange	paired with yellow
10	red	paired with blue	29	violet	paired with orange
11	red	paired with yellow	30	violet	paired with red
12	red	paired with brown	31	violet	paired with white
13	red	paired with orange	32	violet	paired with green
14	green	paired with white	33	violet	paired with blue
15	green	paired with blue	34	violet	paired with yellow
16	green	paired with yellow	35	violet	paired with brown
17	green	paired with brown	36	violet	paired with black
18	green	paired with orange	37	grey	paired with white
19	white	paired with blue			

Colour code US 4

core no.	basic colour	1st ring	2nd ring	core no.	basic colour	1st ring	2nd ring
1	black			29	white	brown	orange
2	brown			30	white	brown	yellow
3	red			31	white	brown	green
4	orange			32	white	brown	blue
5	yellow			33	white	brown	violet
6	green			34	white	brown	grey
7	blue			35	white	red	orange
8	violet			36	white	red	yellow
9	grey			37	white	red	green
10	white			38	white	red	blue
11	white	black		39	white	red	violet
12	white	brown		40	white	red	grey
13	white	red		41	white	orange	yellow
14	white	orange		42	white	orange	green
15	white	yellow		43	white	orange	blue
16	white	green		44	white	orange	violet
17	white	blue		45	white	orange	grey
18	white	violet		46	white	yellow	green
19	white	grey		47	white	yellow	blue
20	white	black	brown	48	white	yellow	violet
21	white	black	red	49	white	yellow	grey
22	white	black	orange	50	white	green	blue
23	white	black	yellow	51	white	green	violet
24	white	black	green	52	white	green	grey
25	white	black	blue	53	white	blue	violet
26	white	black	violet	54	white	blue	grey
27	white	black	grey	55	white	violet	grey
28	white	brown	red				

Colour code US 5

pair no.	colour combination	pair no.	colour combination
1	black paired with red	27	brown paired with yellow
2	black paired with white	28	violet paired with red
3	black paired with green	29	violet paired with white
4	black paired with blue	30	violet paired with green
5	black paired with brown	31	violet paired with blue
6	black paired with yellow	32	violet paired with brown
7	black paired with orange	33	violet paired with yellow
8	red paired with green	34	violet paired with orange
9	red paired with white	35	violet paired with grey
10	red paired with blue	36	violet paired with black
11	red paired with yellow	37	grey paired with red
12	red paired with brown	38	grey paired with white
13	red paired with orange	39	grey paired with green
14	green paired with blue	40	grey paired with blue
15	green paired with white	41	grey paired with brown
16	green paired with brown	42	grey paired with yellow
17	green paired with orange	43	grey paired with orange
18	green paired with yellow	44	grey paired with black
19	white paired with blue	45	white/black paired with red
20	white paired with brown	46	white/black paired with green
21	white paired with orange	47	white/black paired with blue
22	white paired with yellow	48	white/black paired with brown
23	blue paired with brown	49	white/black paired with yellow
24	blue paired with orange	50	white/black paired with orange
25	blue paired with yellow	51	white/black paired with violet
26	brown paired with orange		

OIL RESISTANCE

1. Test method

- acc. to VDE 0473 Teil 811-404
- corresponds to EN 60811-404
- corresponds to IEC 60811-404

2. Requirements

	TMPU acc. to EN 50363-10-2 VDE 0207 part 363-10-2	acc. to SAB internal standard	TM5 acc. to VDE 0207 part 363-4 EN 50363-4
Characteristics after storage in mineral oil IRM 902 (ASTM No. 2)			
Test temperature	100°C	70°C	90°C
Period of storage in oil	7 days	7 days	7 days
Mechanical values after storage in oil			
max. deviation of tensile strength	± 40%	± 40%	± 30%
max. deviation of elongation at tear	± 30% (min. 300% effective)	± 40%	± 30%

MUD RESISTANCE

The following test parameters are valid for the different reference liquids:

Drilling fluid	Test Fluid	Temperature	Storing Period
Water based mud	Calcium Bromide Brine	70°C	56 d
Oil based mud	Carbo Sea	70°C	56 d
Ester based mud	Accolade Base	70°C	56 d
Mineral oil type	IRM 902	100°C	7 d
Mineral oil type	IRM 903	100°C	7 d

Selected types of our PUR materials accomplish the tests acc. to MUD resistance acc. to IEC 60092-350, IEC 61892-4 and NEK TS 606.

Information about SAB drums

Cable diameter [mm]	Disposable spool Flange material Barrel material Spool Ø [mm]	x K K 200	– wood wood 500	– wood wood 710	– wood wood 800	– wood wood 1000	– wood wood 1200	– wood wood 1400	– wood wood 1600
	Barrel Ø [mm] Width Ø [mm] Winding Height Volume (tot.) [L] Security dist. [mm]	110 163 40 3,50 10	200 440 150 72,50 30	350 400 180 119,80 40	400 400 200 150,70 40	500 560 250 329,80 50	600 700 300 593,70 50	700 660 350 761,90 100	800 850 400 1281,70 100
	Volume [L]	2,50	53,00	86,20	112,50	246,30	467,30	492,40	881,20
1,50 1,70 1,90 2,20 2,50		690 570 470 370 300	– 11560 9630 7540 6070	– – – – –	– – – – –	– – – – –	– – – – –	– – – – –	– – – – –
3 4		220 130	4420 2650	7180 4310	– –	– –	– –	– –	– –
5 6 7 8		90 – – –	1770 1470 1080 830	2870 2390 1760 1350	3750 3130 2300 1760	– – 5030 3850	– – – –	– – – –	– – – –
9 10 11 12		– – – –	660 480 400 340	1060 780 650 550	1390 1020 850 720	3040 2240 1870 1580	– 4250 3540 3000	– – – –	– – – –
13 14 15 16		– – – –	290 250 220 –	470 410 360 320	620 540 470 410	1350 1170 1030 910	2570 2220 1950 1720	– – 2050 1810	– – – –
17 18 19 20		– – – –	– – – –	280 250 230 210	370 330 300 270	800 720 650 590	1530 1370 1230 1110	1610 1440 1300 1170	– – – 2100
21 22 23 24		– – – –	– – – –	– – – –	240 220 200 190	530 490 450 410	1010 920 850 780	1070 970 890 820	1910 1740 1600 1470
25 26 27 28		– – – –	– – – –	– – – –	170 – – –	380 340 320 300	720 650 600 560	760 690 640 590	1360 1230 1140 1060
29 30 32 34		– – – –	– – – –	– – – –	– – – –	280 260 – –	520 490 – –	550 520 450 400	990 920 810 720
36 38 40 45		– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	360 320 290 230	640 580 520 410

Information about RoHS
Absence of harmful substances acc. to RoHS II - directive 2011/65/EU and commission delegated directive (EU) 2015/863 amending annex II to directive 2011/65/EU as well as GefStoffV annex IV - no. 24

The components of the indicated items are free of harmful substances according to the above mentioned directives as well as hazardous material regulation annex IV no. 24 medium of flame protection. This means that for the following substances based on the guidelines as well as on the requirements of SAB Bröckskes GmbH & Co. KG, the following quantity and content limits were specified, below which a declaration can be dropped:

► lead	< 0,1 %
► mercury	< 0,1 %
► cadmium	< 0,01 %
► hexavalent chromium	< 0,1 %
► polybrominated biphenyl (PBB)	< 0,1 %
► polybrominated diphenyl ether (PBDE)	< 0,1 %
► decabromo diphenyl ether (DecaBDE)	< 0,1 %
► di(2-ethylhexyl) phthalate (DEHP)	< 0,1 %
► benzyl butyl phthalate (BBP)	< 0,1 %
► dibutyl phthalate (DBP)	< 0,1 %
► diisobutyl phthalate (DIBP)	< 0,1 %
► pentabrominated diphenyl ether	< 0,1 %
► octabrominated diphenyl ether	< 0,1 %

Information about REACH
European regulation for the registration, assessment, admission and limitation of chemical substances (regulation (EC) no. 1907/2006)

With the help of this regulation for chemicals REACH, it is controlled how and why manufacturers, importing companies, final users and retailers have to examine, assess, declare and register chemical substances. The European Chemicals Agency (ECHA) published a list of especially harmful substances that is subject to a current updating.

The REACH regulation affects mainly manufacturers of raw materials and retailers of chemicals. The company SAB Bröckskes GmbH & Co. KG is as manufacturer of cables and temperature measuring sensors except from a registration acc. to REACH.

After intensive discussions with our raw material suppliers, we can assume acc. to our present state of knowledge that there are no chemicals in our products that are listed as harmful substances (Substances of Very High Concern) in a concentration of more than 0,1% acc. to the current EC list (ECHA-list).

Furthermore, we dispose of safety data sheets for all raw materials and additives that are contained in our products and from which dangers could arise. Those safety data sheets are continuously updated and controlled regarding the adherence to the REACH regulation.

If a substance acc. to REACH is identified that gives reason for concern, we will immediately initiate appropriate measures in order to substitute the material in question.

Information about GADSL
Global Automotive Declarable Substance List

The global Automotive Declarable Substance List (GADSL) is a list containing possible harmful substances and defining those by limit values. Thus the GADSL is more extensive than the regulation on forbidden chemicals or the REACH regulation, describing substances that have to be declared or have already been forbidden.

The GADSL is the result of worldwide efforts of industry to harmonize the communication and exchange of information regarding the application of harmful substances with regard to the coming decades. The GADSL aims at simplifying the recycling of the product after its service life.

The Global Automotive Declarable Substance List (GADSL) is a list including substances used in automotive parts. It is the result of the worldwide and long lasting efforts of representatives in automobile industry to simplify communication and information exchange regarding the use of certain chemical pure substances in automotive parts. The GADSL contains forbidden substances as well as those that have to be declared and is a medium to realize further measurements for example the later material recycling of old cars in the EC including the guideline 2000/53/EG.

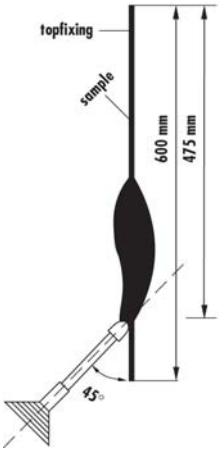
Declaration for the application of so-called conflict metals

We dispose of written declarations of our sub-suppliers that the products delivered don´t contain so-called conflict metals (especially no tin) which were dug in the Democratic Republic of the Congo or its neighbouring countries.

The above mentioned indications are based on the information of our wire and strand suppliers.

Tests on electric and optical fibre cables under fire conditions

Description	EN 60332-1-2 acc. to IEC 60332-1-2	EN 60332-2-2 acc. to IEC 60332-2-2
	Tests for vertical flame propagation for a single insulated wire or cable - procedure for 1-kW pre-mixed flame	Tests for vertical flame propagation for a single small insulated wire or cable - procedure for diffusion flame
Length of specimen	600 mm	600 mm
Burner	acc. to IEC 60332-1-1	acc. to IEC 60332-2-1
Test temperature	1 kW flame	defined by the stipulated setting of the flame length
Position of specimen	vertical	vertical
Position of flame	45° to vertical specimen	45° to vertical specimen
Duration of flame	see table 1	20 seconds
Conditions	Cable must be self-extinguishing. The damage or carbonization may only reach max. 50 mm under the upper fixing clamp.	Cable must be self-extinguishing. The damage or carbonization may only reach max. 50 mm under the upper fixing clamp.



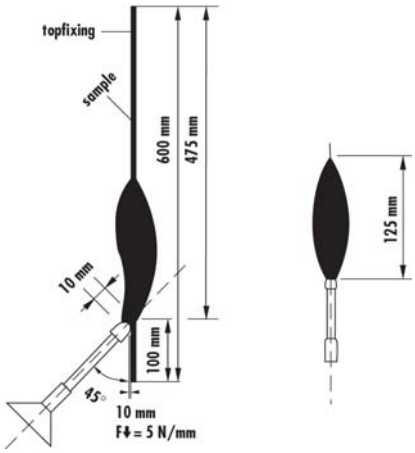


Table 1

outer diameter *) of specimen in mm	Duration of flaming in seconds
D ≤ 25	60
25 < D ≤ 50	120
50 < D ≤ 75	240
D > 75	480

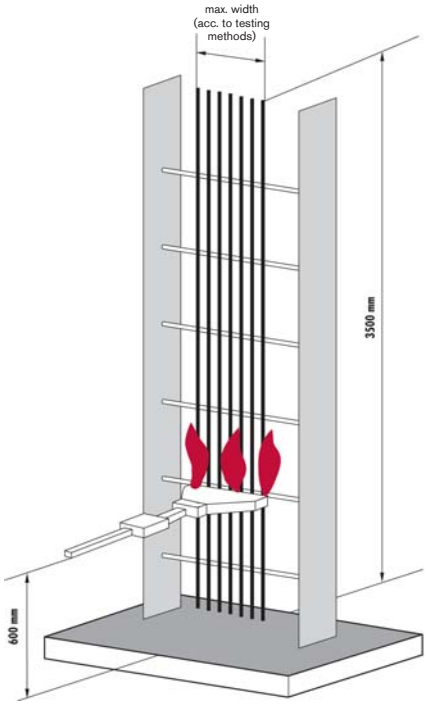
*) If cables or insulated cables are tested that are not round (e.g. flat twin cables) their dimensions is to be measured and an equivalent diameter must be calculated from this.

Examination of the vertical flame length of vertical extended bundle of wires and insulated cables

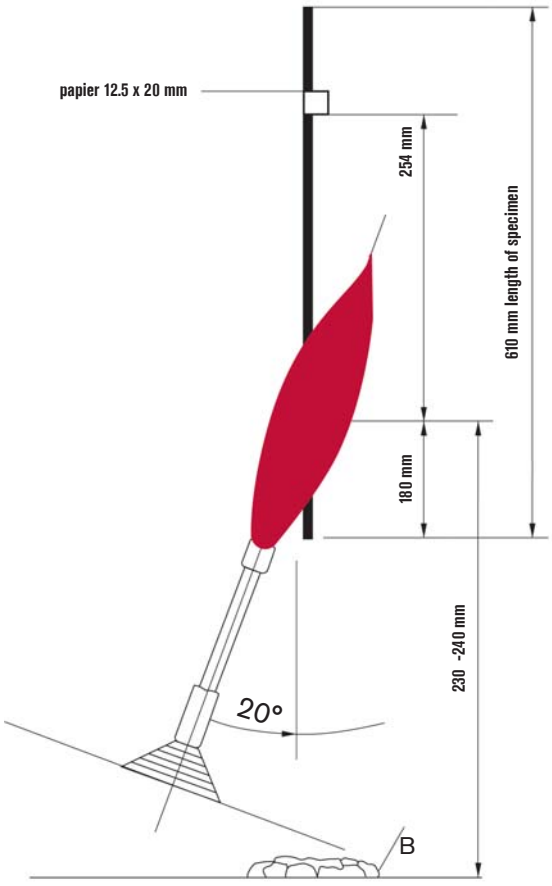
Description	IEC 60332-3-..., EN 60332-3-...
Length of specimen	3500 mm
Burner	Flat burner (Ribbon gas burner of American Gas Furnace Co.)
Test temperature	defined by stipulated flow of gas and air
Position of specimen	vertical
Position of flame	horizontal
Duration of flaming	Category A, B: 40 minutes Category C, D: 20 minutes
Conditions	The burned portion of the sample must not be longer than 2.5 m measured from the bottom edge of the burner, as far as not otherwise specified in the relevant standards.

	EN 60332-	IEC 60332-
Category A – 7 l/m	3 - 22	3 - 22
Category B – 3,5 l/m	3 - 23	3 - 23
Category C – 1,5 l/m > 12 mm cable-ø	3 - 24	3 - 24
Category D – 0,5 l/m ≤ 12 mm cable-ø	3 - 25	3 - 25

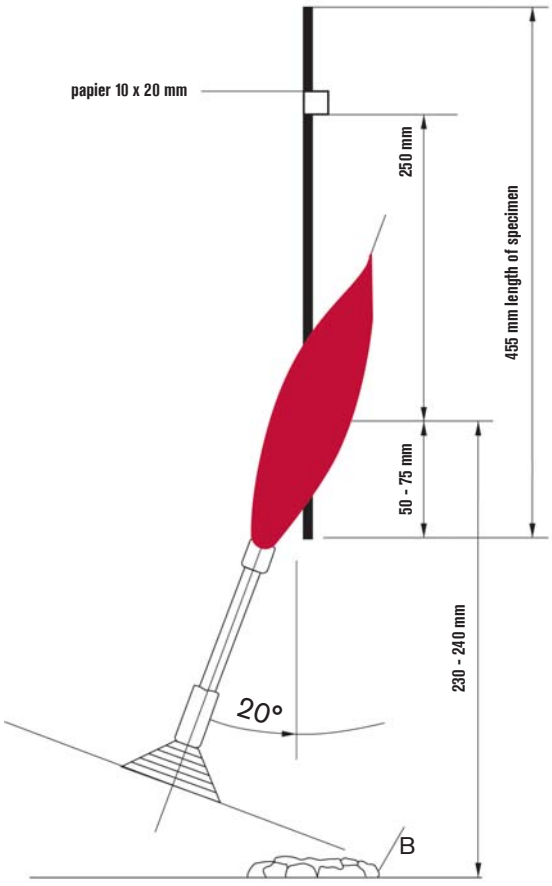
Volume percent of non metallic material per meter.



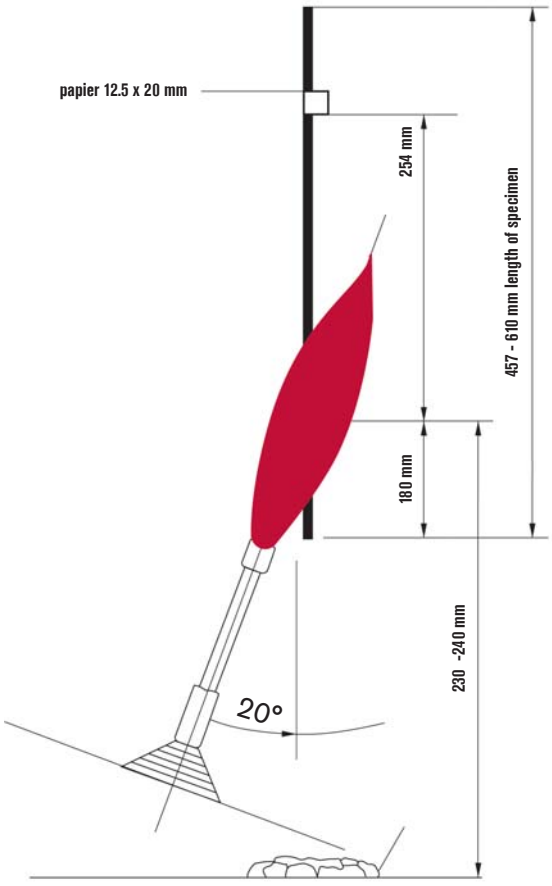
Description	UL 1581 section 1080 - reference to standard UL 2556, section 9.4 (VW-1 Flame Test)
Length of specimen	610 mm
Burner	Bunsen burner with additional air supply (Tirril gas burner) ø 9.5 mm
Test temperature	500 W flame
Position of specimen	vertical
Position of flame	20° to vertical specimen
Duration of flaming	5 x 15 seconds with at least 15 seconds flaming break
Conditions	Paper max. 25% carbonized. The specimen may keep on burning for max. 1 minute after any application. Material dropping must not ignite the cotton (B) lying under the specimen.



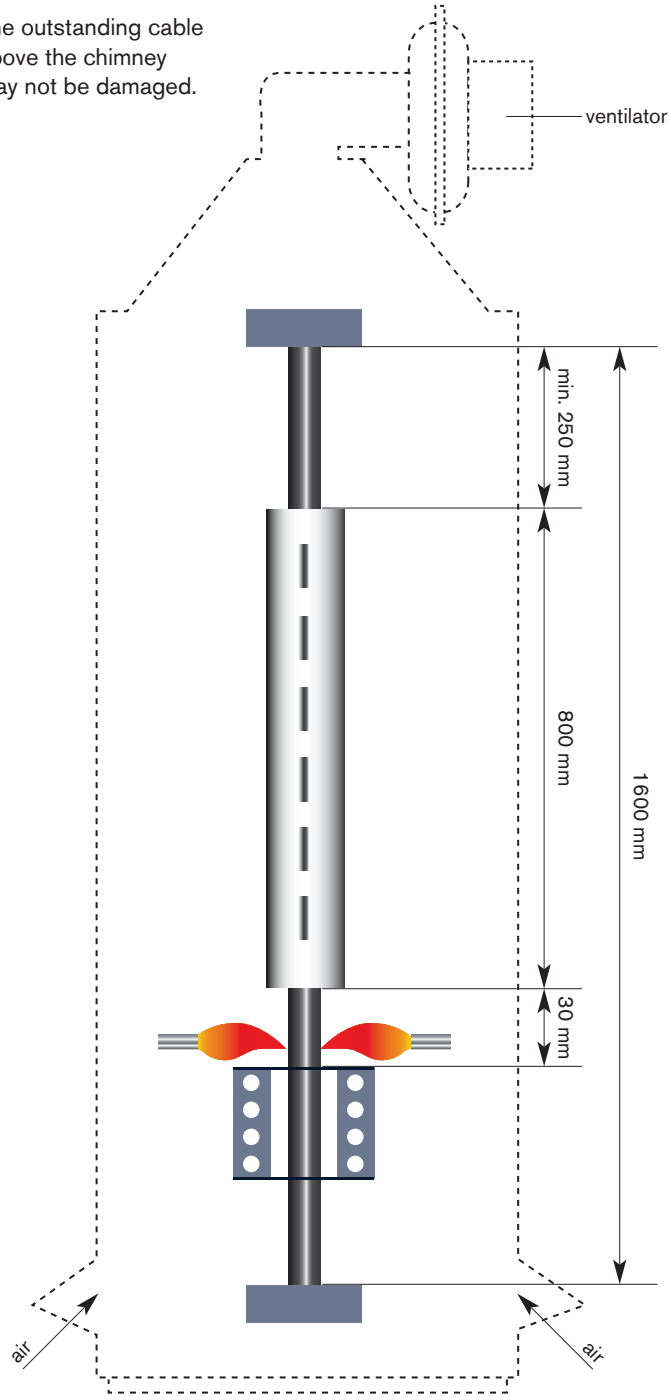
Description	UL 1581 section 1061 (Cable Flame Test)
Length of specimen	455 mm
Burner	Bunsen burner with additional air supply (Tirril gas burner) ø 9.5 mm
Test temperature	500 W flame
Position of specimen	vertical
Position of flame	20° to vertical specimen
Duration of flaming	3 x 60 seconds with 30 seconds between each flaming
Conditions	Paper max. 25% carbonized. The specimen may keep on burning for max. 1 minute after the last application. Material dropping must not ignite the cotton (B) lying under the specimen.



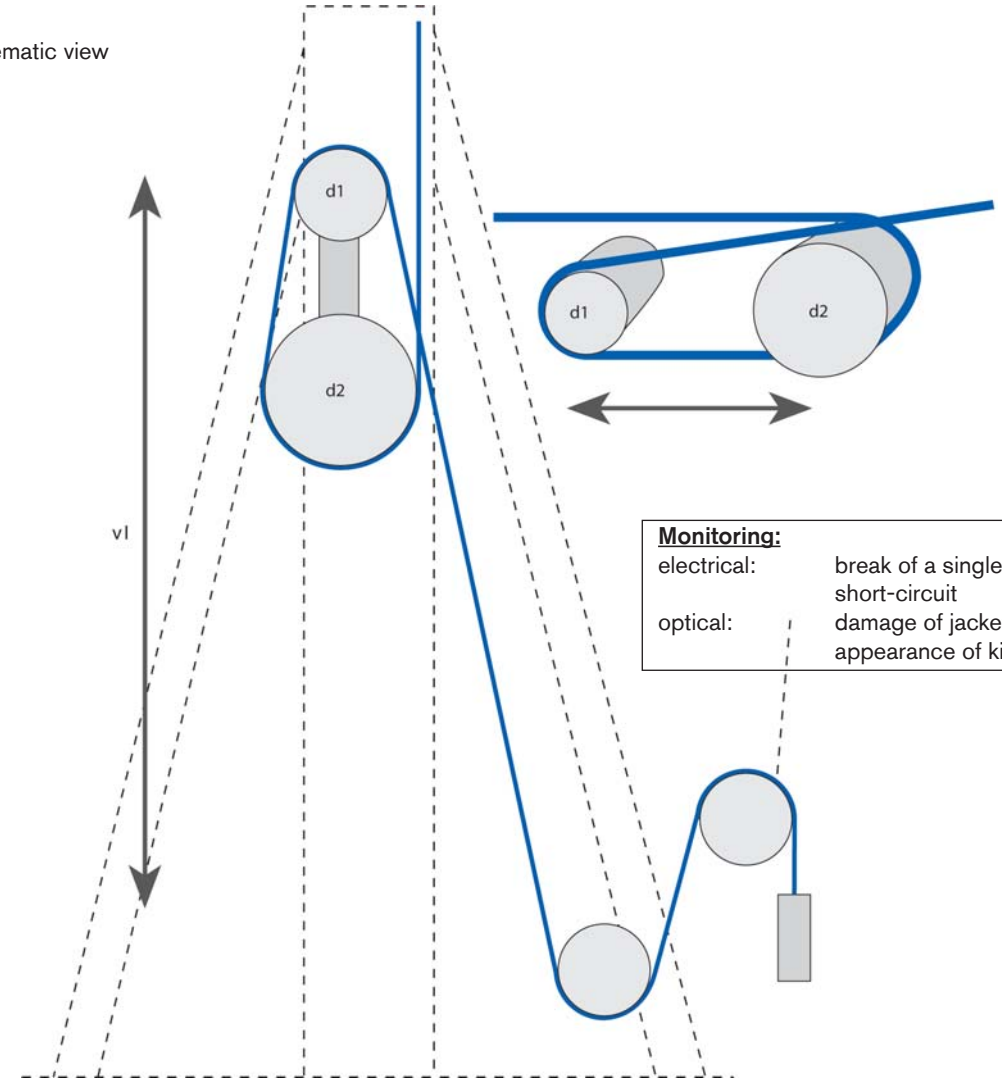
Description	UL 1581 section 1060 (Vertical Flame and FT1 Test)
Length of specimen	45 - 610 mm
Burner	Bunsen burner with additional air supply (Tirril gas burner) ø 9.5 mm
Test temperature	500 W flame
Position of specimen	vertical
Position of flame	20° to vertical specimen
Duration of flaming	5 x 15 seconds with each 15 seconds flaming break
Conditions	Paper max. 25% carbonized. The specimen may keep on burning for max. 1 minute after the last application.



Description	NF C 32-070 »C1«
Length of specimen	1600 mm
Test temperature	+830 °C ±50 °C
Position of specimen	vertical in the chimney
Duration of test	30 minutes
Conditions	The outstanding cable above the chimney may not be damaged.



schematic view



Monitoring:

electrical:	break of a single conductor short-circuit
optical:	damage of jacket, appearance of kinks

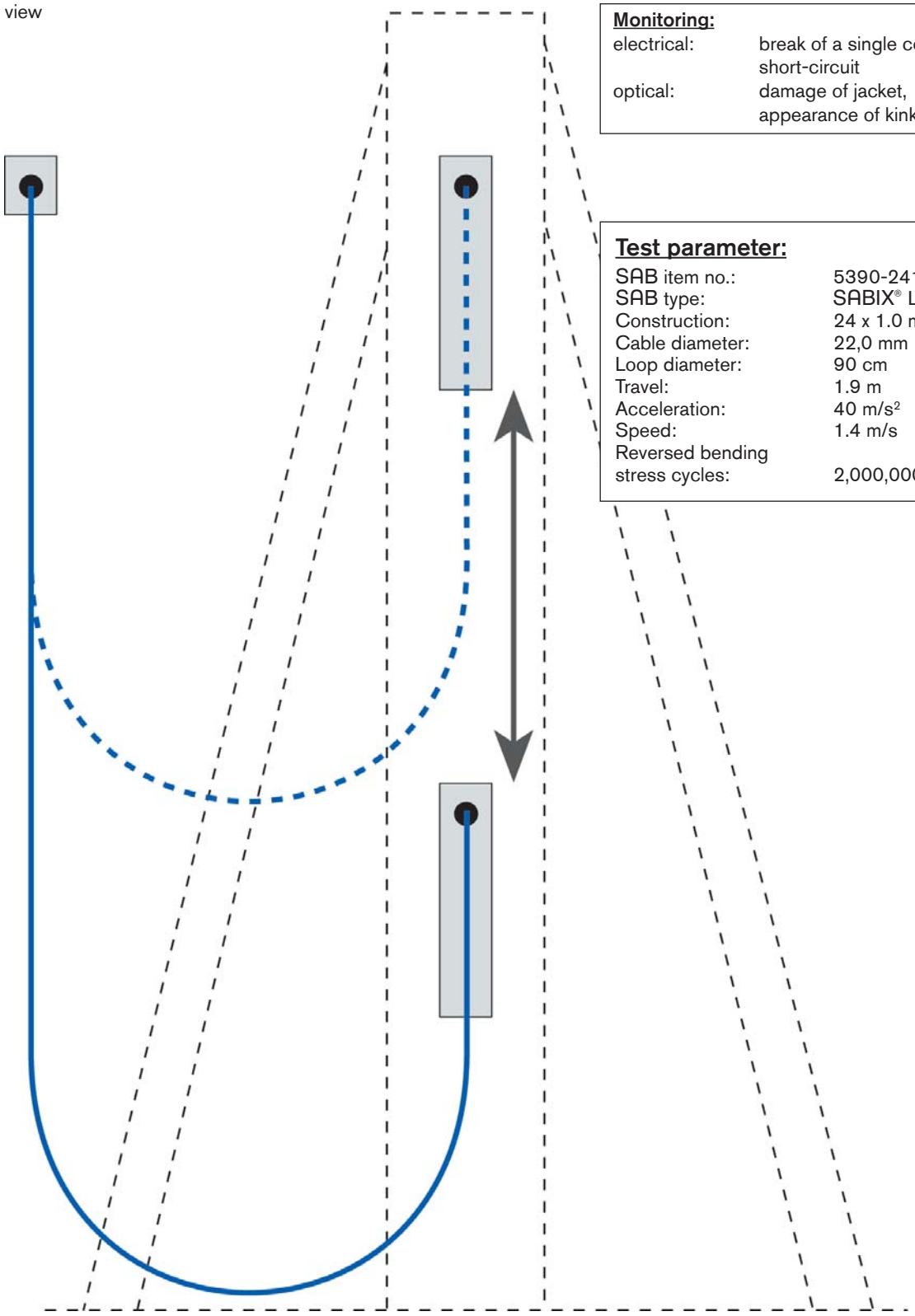
Test parameter:

Acceleration:	40 m/s²		Bending radius:	variable
Travel vl:	1900 mm		Load:	variable
Cable length in motion:	2700 mm		Roll-ø d1:	variable
Speed:	1.4 m/s		Roll-ø d2:	variable
No. of bendings:	18 per min			

Test findings	S 200 (12 x 1.0 mm²)	S 90 (12 x 1.0 mm²)	S 86 (12 x 1.0 mm²)
Bending radius during test:	4.3 x d	3.6 x d	3.5 x d
Travel :	1.9 m	1.9 m	1.9 m
Acceleration :	40 m/s²	40 m/s²	40 m/s²
Temperature during test:	+10°C up to +22°C	+10°C up to +22°C	+10°C up to +22°C
Speed :	1.4 m/s	1.4 m/s	1.4 m/s
Dimension :	10.4 mm	12.5 mm	12.9 mm
Roll diameter d1:	90 mm	90 mm	90 mm
Roll diameter d2:	125 mm	125 mm	125 mm
No. of bendings:	**17.438.485**	**2.929.730**	**2.508.904**

Life cycle test SABIX® Lift

schematic view



Monitoring:

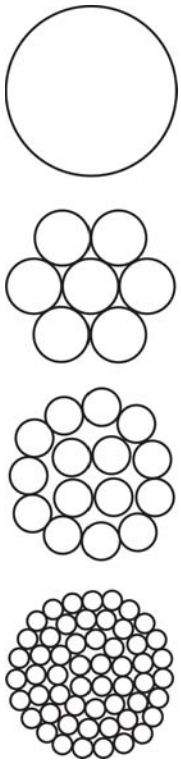
electrical:	break of a single core short-circuit
optical:	damage of jacket, appearance of kinks

Test parameter:

SAB item no.:	5390-2410
SAB type:	SABIX® Lift
Construction:	24 x 1.0 mm²
Cable diameter:	22,0 mm
Loop diameter:	90 cm
Travel:	1.9 m
Acceleration:	40 m/s²
Speed:	1.4 m/s
Reversed bending stress cycles:	2,000,000

European conductor stranding acc. to VDE 0295, IEC 60228, EN 60228

cross-section mm²	DIN VDE 0295 class 5/IEC 60228 No. of wires	max. wire-ø mm/mil	DIN VDE 0295 class 6/IEC 60228 No. of wires	max. wire-ø mm/mil
0.14*			≈ 18 x 0.11	
0.25*	≈ 14 x 0.16		≈ 32 x 0.11	
0.34*	≈ 7 x 0.26		≈ 42 x 0.11	
0.50	≈ 15/17 x 0.21		≈ 28 x 0.16	
0.75	≈ 23 x 0.21		≈ 42 x 0.16	
1.00	≈ 30 x 0.21		≈ 56 x 0.16	
1.50	≈ 27-29 x 0.26		≈ 84 x 0.16	
2.50	≈ 46 x 0.26		≈ 140 x 0.16	
4.00	≈ 52 x 0.31		≈ 224 x 0.16	
6.00	≈ 78 x 0.31		≈ 186 x 0.21	
10.00	≈ 77 x 0.41		≈ 320 x 0.21	
16.00	≈ 122 x 0.41		≈ 504 x 0.21	
25.00	≈ 190 x 0.41		≈ 760 x 0.21	
35.00	≈ 272 x 0.41		≈ 1083 x 0.21	
50.00	≈ 400 x 0.41		≈ 703 x 0.31	
70.00	≈ 543 x 0.41		≈ 988 x 0.31	
95.00	≈ 484 x 0.51		≈ 1340 x 0.31	
120.00	≈ 589 x 0.51		≈ 1680 x 0.31	
150.00	≈ 740 x 0.51		≈ 2122 x 0.31	
185.00	≈ 902 x 0.51		≈ 1472 x 0.41	
240.00	≈ 1220 x 0.51		≈ 1910 x 0.41	
300.00	≈ 1525 x 0.51			



* with reference to IEC 60228

Comparsion of European and American conductor sizes

Nominal cross section of copper conductors

mm²	AWG/ MCM	mm²	AWG/ MCM	mm²	AWG/ MCM	mm²	AWG/ MCM	mm²	AWG/ MCM	mm²	AWG/ MCM
0.08	= 28	0.50	= 20	2.50	= 14	16.00	= 6	70.00	= 2/0	185.00	= 350
0.14	= 26	0.75	= 19	4.00	= 12	25.00	= 4	95.00	= 3/0	240.00	= 450
0.25	= 24	1.00	= 18	6.00	= 10	35.00	= 2	120.00	= 4/0	300.00	= 550
0.34	= 22	1.50	= 16	10.00	= 8	50.00	= 1	150.00	= 250		

General conversion table

Length

from	to	formula
zoll/inch(in)	millimeter(mm)	in x 25,4 = mm
millimeter(mm)	zoll/inch(in)	mm x 0,03937 = in
foot(ft)	meter(m)	ft x 0,3048 = m
meter(m)	foot(ft)	m x 3,218 = ft
mile(mi)	kilometer(km)	mi x 1,609 = km
kilometer(km)	mile(mi)	km x 0,662 = mi

Temperature

from	to	formula
Fahrenheit(F)	Celsius(C)	(F-32) x 0,56 = C
Celsius(C)	Fahrenheit(F)	C x 1,8 + 32 = F

Weights

from	to	formula
pound(lb)	kilogram(kg)	lb x 2,205 = kg
kilogram(kg)	pound(lb)	kg : 2,205 = lb

American conductor stranding

AWG = actual cross section in mm² and conductor resistance

AWG is shown below with its exact equivalent value in mm² and diameter (mm).
The table on the previous page shows commercially used equivalent values, which are approximations.

AWG Number	Cross Section mm²	Ø mm	Conductor resistance Ω/km
1000 MCM	507	29.3	0.036
900	456	27.8	0.04
750	380	25.4	0.048
600	304	22.7	0.061
550	279	21.7	0.066
500	253	20.7	0.07
450	228	19.6	0.08
400	203	18.5	0.09
350	177	17.3	0.10
300	152	16.0	0.12
250	127	14.6	0.14
4/0	107.2	11.68	0.18
3/0	85.0	10.40	0.23
2/0	67.4	9.27	0.29
0	53.4	8.25	0.37
1	42.4	7.35	0.47
2	33.6	6.54	0.57
3	26.7	5.83	0.71
4	21.2	5.19	0.91
5	16.8	4.62	1.12
6	13.3	4.11	1.44
7	10.6	3.67	1.78
8	8.34	3.26	2.36
9	6.62	2.91	2.77
10	5.26	2.59	3.64
11	4.15	2.30	4.44
12	3.31	2.05	5.41
13	2.63	1.83	7.02

4/0 is also known as 0000; 1 mil = inch = 0.0254 mm
*Shown in MCM (circular mills) for bigger cross sections

AWG Number	Cross Section mm²	Ø mm	Conductor resistance Ω/km
14	2.08	1.63	8.79
15	1.65	1.45	11.2
16	1.31	1.29	14.7
17	1.04	1.15	17.8
18	0.8230	1.0240	23.0
19	0.6530	0.9120	28.3
20	0.5190	0.8120	34.5
21	0.4120	0.7230	44.0
22	0.3240	0.6440	54.8
23	0.2590	0.5730	70.1
24	0.2050	0.5110	89.2
25	0.1630	0.4550	111.0
26	0.1280	0.4050	146.0
27	0.1020	0.3610	176.0
28	0.0804	0.3210	232.0
29	0.0646	0.2860	282.0
30	0.0503	0.2550	350.0
31	0.0400	0.2270	446.0
32	0.0320	0.2020	578.0
33	0.0252	0.1800	710.0
34	0.0200	0.1600	899.0
35	0.0161	0.1430	1125.0
36	0.0123	0.1270	1426.0
37	0.0100	0.1130	1800.0
38	0.00795	0.1010	2255.0
39	0.00632	0.0897	2860.0

1 CM = 1 Circ. mil = 0.0005067 mm²
1 MCM = 1000 Circ. mils = 0.5067 mm²

UL/CSA current-carrying capacity for flexible cables

Hook-up wire at ambient temperature up to 30 °C

AWG	cross section mm²	current-carring capacity
24	0.21	3.5
22	0.33	5.0
20	0.52	6.0
18	0.82	9.5
16	1.31	20
14	2.08	24
12	3.32	34

AWG	cross section mm²	current-carring capacity
10	5.26	52
8	8.35	75
6	13.29	95
4	21.14	120
3	26.65	154
2	33.61	170
1	42.38	180

Correction-factors at ambient temperature over 30°C

For temperatures over 30 °C, multiply the current-carring capacity in the tables times correction-factor (f) to obtain the allowable current.

Ambient temperature °C	current-carring capacity values of tables correction-factors (f)
31 - 35	0.91
36 - 40	0.82
41 - 45	0.71
46 - 50	0.58

Multi conductor cables at ambient temperature up to 30°C

AWG	cross section mm²	current-carring capacity A (no. of cores)				
		up to 3	4 -6	7 - 24	25 - 42	43 & above
24	0.21	2	1.6	1.4	1.2	1.0
22	0.33	3	2.4	2.1	1.8	1.5
20	0.52	5	4.0	3.5	3.0	2.5
18	0.82	7	5.6	4.9	4.2	3.5
16	1.31	10	8.0	7.0	6.0	5.0
14	2.08	15	12.0	10.5	9.0	7.5
12	3.32	20	16.0	14.0	12.0	10.0

AWG	cross section mm²	current-carring capacity A (no. of cores)				
		up to 3	4 -6	7 - 24	25 - 42	43 & above
10	5.26	30	24	21	18	15
8	8.35	40	32	28	24	20
6	13.29	55	44	38	33	27
4	21.14	70	56	49	42	35
3	26.65	80	64	56	48	40
2	33.61	95	76	66	57	47
1	42.38	110	88	77	66	55

The laying of cables in cable tracks has to be done carefully. In general the following points have to be considered:

1. It is recommended to lay the cables separately side by side. In case that cables with different diameters are laid on top of each other or side by side, we recommend the use of separators. For big and heavy cables (for example 4 x 35 mm²) multi core cables are not suitable for many applications and single cores are recommended.

2. The cables should be movable in the track. There must be at least 10%- 20% of the cable diameter as free space between the cables and the internal dimensions of the cable track for safety reasons.

3. Please observe that the cables pass the bend radius without being forced. In case of several cable layers, the cables need a corresponding clearance among each other in the bend so that relative movements of the cables among each other and in the chain are possible. In principle the cables must be able to move freely lengthwise at any time and there shall be no tensile force on the cable in the radius. After a short operating time it is recommended to control in regular intervals the position of the cable - particular with long travel paths (control must be executed in push and pull direction). Furthermore, it has to be paid attention to an efficient installation and aspects of wear.

4. A torsion-free laying of the cables in the cable track has to be observed (non-rotational). Therefore, the cables have to be unwound from reels before being installed. (Do not lift off the cables in loops). The ideal case is to take the cable directly from the drum. The cable imprint can't be used for a torsion free adjustment of the cable, as the imprint runs slightly helical around the cable due to production reasons.

5. The weight arrangement in the cable track or in the links has to be done symmetrically. Heavy cables have to be laid towards the outside of the cable track and the smaller ones in the middle. After the rupture of the chain, all cables have to be exchanged due to excessive elongation.

6. All cables have to be strain-relieved at the fixed point and at the driver, at least at the movable end of the chain. For use in long chains (sliding application), please contact our staff as there are no general regulations. It has to be observed with clamping that there is only large-surface pressure on the outer jacket. Careful clamping avoids any squeezing of the conductors and at the same time any displacement of the cable. It has to be avoided to move the cable up to the fixing point. The distance between the final point of the flexion to the fixing point should be as large as possible (10 - 20 x cable diameter are taken as relaxation zone).

7. In general only cable track cables should be used. The allowed bending radius of SAB BRÖCKSKES cables has to be strictly observed. The information on the minimum bending radius for the cables are based on the application at normal temperatures (approx. 20°C). Under circumstances other bending radii can be recommended. The choice of a bigger radius as the minimum radius will have a positive effect on the service life.

The trouble-free and long service life of reeling cables requires the adherence to certain installation guidelines.

The cable shall be wound directly from the supplied drum to the reeling drum. The complete unwinding of the cable isn' t necessary. A straight torsion-free guiding has to be observed. Equally the cable has to be fixed and connected torsion-free. The indicated min. bending radius has to be adhered to.

In case of complete extension of the cable at least 2 windings shall remain on the reeling drum. For fixing the other cable end Kellem grips or large surface clamp connections can be used.

The installation of reeling cables has to be done carefully. They have to be protected against external damage during installation and operation.

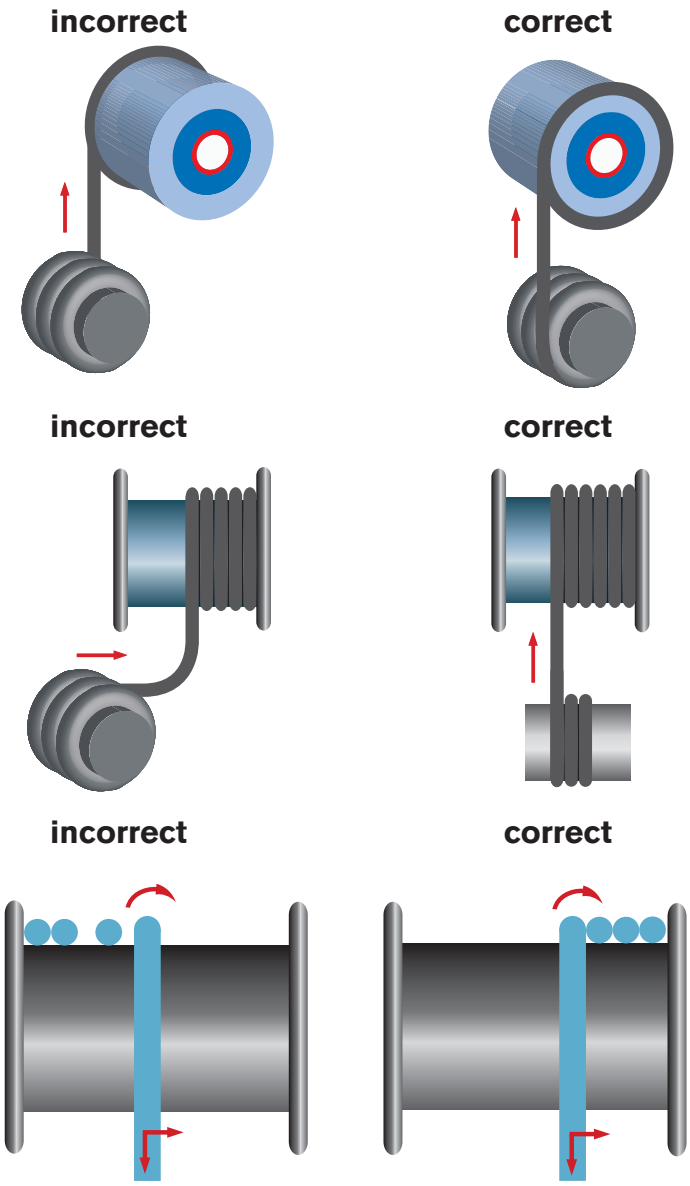
The start of winding of reeling cables on cylinder drums shall be made in stranding direction. Cables with right stranding direction (Z-lay) shall be operated to the right side and vice versa. If the stranding direction isn't known, please contact our technical support for any information.

Without special notice in our catalogue, the tensile stress of the copper conductors shall not exceed 15 N/mm2 (DIN VDE 0298 part 3). In case of higher tensile stress, we recommend to contact our technical support to align the cable construction to the requirements. The max. allowed limit deviations of the tensile stress are to be understood as the sum of the static and dynamic stress.

Reeling cables are generally not appropriate for torsion stress. During operation, however, torsion stress can't be avoided. As a consequence the exceeding of the limit values (generally >± 25°/m) lead to a considerable reduction of service life.

In case of undercutting the smallest allowed min. bending radius, the service life of the cable is reduced.

You will find further information to this subject under „Guidelines for the laying of cables in cable tracks“ (page N/28) as well as „Installation instructions of lift control cables“ (page N/30).



Installation instructions of lift control cables SABIX® Lift and SABIX® Lift ST

Application and use in buildings

1. In case that the cables are placed in shafts, two different methods are recommended:
   - *Placement of cables from machine room*
     The placement of the cables from the machine room has to be executed in a way that the cable is led into the shaft in winding direction. In order to avoid upsetting deformation, it is advisable that a second person is in the pit and enables a perfect installation with the help of a cord.
   - *Placement of the cables from the shank pit or the first stop*
     Herewith, the winding direction for unwinding has to be observed.
     Note: With both methods the pulling-in of the cables has to be done with a minimum of bend. In order to avoid torsion or buckling, the placement of the cable has to be done carefully.
2. In order to guarantee a torsion-free installation, the cable has to be suspended freely for 12 h in the shaft before being finally fixed. The lower cable end is not allowed to lie on or to be in contact with the pit sole. If the cable is longer, the lower cable end (min. 0.3 m above the sole) must be looped or put up with a weight. Any material can be used as weight but it should not come to more than 15 % of the cable weight. After having been suspended the cables shall be marked parallel towards the shaft wall and on the same side. Thus a twist-free fixing of the cable is afterwards possible.

Hanging up of the cable

1. If the cables are pulled into the shaft, they have to be unwound tangentially from the drum. An axial unwinding from the drum causes torsions of the cable and finally can lead to operational disturbances.
2. The free space between lift cabin and shaft bottom shall be big enough and has to be fully used for the loop height of the cable. The cables have to be suspended at the lift cabin in the course of the natural bow.
3. A natural hanging diameter of the loop has to be guaranteed.

Fixing of the cables

1. At any rate large-surface clamps have to be used for the fixing of the cable. The sheath shall not be squeezed , the clamp must be seated firmly on a large surface. There should be at least one suspension at the shaft head and at the lift cabin. Additionally the carrying element has to be supported separately (at both cable ends). In case that the suspended cable length is more than 40 m, an additional suspension should be in the middle of the shaft.
2. The fixing point at the shaft wall has to be at least 2 m above the middle of the travel. At the same time the fixing points of the cables at the lift or at the shaft wall have to be arranged rectangular towards the runoff plane of the cable and with the same distance parallel to the rail axis.
3. With unsteady running behaviour that means the cable moves out of the fall line during operation, the control cable has to be slightly twisted at one of the fixing points until a perfect run of the cable is given.
   Note: Additionally the run of the cable has to be controlled again after the initial operation of the lift.
4. If the lift installation requires the installation of several control cables, it is recommended due to operational reasons that the individual cables have to be hanged up in a way that the different loops have a level difference of approx. 15 cm (hang up step-by-step).
5. The cables are not allowed to be tied up over their suspended length, as otherwise their free run is impeded.

General notes

1. The cables are only allowed to be applied with temperature ranges mentioned in their specifications.
2. The inner bending radius is not allowed to be lower than the cable diameter mentioned in the specification. Furthermore, the given bending radius of the cable (equally mentioned in the cable specification) has to be kept.
3. The max. hang up length is dependant on the corresponding carrying element in the cable (mentioned in the cable specification) and is not allowed to be exceeded.
4. In order to reach a perfect and long service life of the lift control cables, they have to be treated and installed with the utmost care.

The cables manufactured by SAB BRÖCKSKES are only appropriate for the transmission of electric energy for supply and signalling purposes.

First of all the valid construction and installation prescriptions for the corresponding machine or equipment has to be observed. The valid VDE prescription 0100 can be regarded as base. Furthermore, the following security advice has to be observed for the use of cables.

For each cable type you can find under "technical data" information on fields that can also be found under the following standards. Among others these are:

► Nominal voltage, Peak operating voltage	HD 516
► Test voltage	DIN VDE 0250 T1; EN 50525-1 as well as relevant cable standards
► Minimum bending radius	HD 516
► Temperature range	HD 516
► Fire performance	standards of series IEC 60332 as well as relevant cable standards
► Resistances	EN 60811-404 as well as relevant cable standards
► Further special technical data	

The safe application is described under "security requirements" and "boundary conditions".

Under "security requirements" you will find information on fields that can also be found under the following standards. Among others these are:

► Basic requirements	HD 516 pos. 4.1
► General requirements	HD 516 pos. 4.2
► Current-carrying capacity for undisturbed service	DIN VDE 0298 T4 pos. 5
► Operating conditions	DIN VDE 0298 T4 pos. 5.3.1
► Ambient conditions	DIN VDE 0298 T4 pos. 5.3.3
► Requirements for fixed laying	HD 516 pos. 4.3
► Requirements for flexible cables	HD 516 pos. 4.4

Under "boundary conditions" you will find information on fields that can also be found under the following standards. Among others these are:

► Operating conditions	HD 516 pos. 5
► Voltage	HD 516 pos. 5.1
► Current-carrying capacity	HD 516 pos. 5.2
► Current-carrying capacity: tables:	
Capacity, cables with a nominal voltage up to 1000 V and heat resistant cables	DIN VDE 0298 T4 table 11
Conversion factors for deviating ambient temperatures	DIN VDE 0298 T4 table 17+18

Conversion factors for the accumulation on walls, in tubes and conduits, on the floor and at the ceiling	DIN VDE 0298 T4 table 21
Conversion factors for multi-core cables with conductor cross sections up to 10 mm^2	DIN VDE 0298 T4 table 26
► Thermal influences	HD 516 pos. 5.3
► Mechanical stress	HD 516 pos. 5.4
► Tensile load	HD 516 pos. 5.4.1
► Bending load	HD 516 pos. 5.4.2
► Compression stress	HD 516 pos. 5.4.3
► Torsional stress	HD 516 pos. 5.4.4
► Compatibility	HD 516 pos. 5.5
► Application in rooms and in the open air	HD 516 appendix A
► Stress classification	HD 516 appendix B
► Construction of strands	EN 60228 + IEC 60228

■ **Besides the generally known technical rules, please consider especially the following prescriptions for the application of our products:**

VDE…
0100, 0105, 0106, 0108, 0110, 0113, 0116,
0165, 0166, 0170, 0171, 0271, 0298, 0700,
0720, 0727, 0730, 0737, 0740, 0745, 0750,
0800, 0804, 0805, 0839, 0860, 0891, 1000, etc.

► You will find under the individual item groups further instructions and the description of the special application possibilities of our cables.

Security requirements

Basic requirements

Cables can be regarded to be safe in case that they are used for their intended purpose and don't mean any unaccep-table risk for life and real values. If not otherwise specified, insulated cables shall only be used for the transmission and division of electric energy.

General requirements

Cables have to be chosen in a way that they meet the existing voltages and currents occuring in the machines, equipment of appliances or in their parts for which they are applied under any expected operating condition. Cables should be constructed, installed, protected and maintained to avoid any risks and harms.

Carrying capacity for undisturbed service (general info)

The cable section has to be chosen in a way that the given current-carrying capacity never leads to a heating of the conductor over the allowed service temperature. The heating resp. carrying-capacity of a cable depends on the construction, material characteristics and the operating conditions. Additional heating due to a cable accumulation, heating flues, solar radiation, etc. have to considered resp. avoided. The use of covers requires an undisturbed air circulation.

Operating conditions

The temporary flow of current describes the operating conditions. Continuous operation means a constant current which is at least sufficient to reach the thermal equilibrium of the electrical equipment without any other time limit. The capacity values of cables are based on continuous service reaching the allowed operating temperature of the conductor.

Environmental conditions

Environmental conditions are among others characterized by the ambient temperature, heat loss and heat radiation. The ambient temperature is the temperature of the surrounding air, without any load on the respective cable. The reference point is a temperature of + 30 °C. The operating conditions of cables can change by heat loss for example in closed rooms, cable ducts or similar, as well as by heat radiation (e. g. solar radiation).

Conditions and requirements for fixed laying

The fixed laying of cables requires among others:

- The cable shall not be installed in direct or close contact with hot surfaces if they are not suitable for this application.
- Cables are not suitable for direct underground laying.
- Cables have to be fixed properly. The weight of the cable is important for the choice of the fixing distance.
- The used mechanical fixing devices shall not damage the cable.
- Cables that have been used for a long time may be damaged in case of removal. This can be a natural effect due to the ageing of the physical characteristics of insulation and sheath material - they become brittle.

Requirements for flexible cables

- Flexible cables should be used for mobile electrical equipment.
- The length of the connection cable has to be chosen in a way that the reaction of short-circuit protective equipment is ensured.
- For mobile electrical equipment the cable should be as short as possible.
- Elevated stress due to tension, pressure, abraison, torsion or knicking has to be avoided.
- The cables shall not be damaged by strain relief or connection devices.
- The cables shall not be layed under carpets or other devices. There is a risk due to elevated thermal covering and mechanical damage due to walking, furniture or operating material.
- The cables shall not be in direct or close contact with hot surfaces.

For further requirements please see HD 516 S2 pos. 4.4

Boundary conditions

Operating conditions

The used cables have to be appropriate for the corresponding operating conditions as well as for the device protection class.

Operating conditions are among others:

- Voltage
- Current
- Safety apparatus
- Cable accumulation
- Type of laying
- Accessibility

The used cables have to be appropriate for all possible external impacts.

External impacts are among others:

- Ambient temperature
- Rain
- Steam or water
- Presence of corrosive, polluting or other chemical bodies
- Mechanical stress (e.g. sharp edges of metal constructions)
- Animals (e.g. rodents)
- Plants (e.g. mould fungus)
- Radiation (e.g. solar radiation)

Note: In this connection it has to be considered that the colour is of greatest importance. The colour black offers much more protection at radiation than all other colours.

Voltages

The nominal voltage of a cable means the voltage for which the cable has been constructed and defines the electrical tests. The nominal voltage is expressed in Volt by the relation of two values Uo/U; Uo is the r.m.s. value of the voltage between external conductor and earth (metal sheathing of the cable or surrounding medium). U is the r.m.s. value between two external conductors of a multi-core cable or of a system of mono-conductor cables. In a system of alternating current (a.c.), the nominal voltage of a cable has to be at least equal to the values Uo and U of the system. In a system of direct-current (d.c.) the nominal voltage of the system shall not be higher than 1.5 times of the nominal voltage of the cable.

Note: The operating voltage of a system is allowed to be continuously 10 % higher than the nominal voltage of the system.

Current-carrying capacity

The nominal cross section of each conductor has to be chosen that the current-carrying capacity is not smaller than the max. constant current, passing the conductor under normal conditions. The limit temperatures to which the current-carrying capacity refers to, shall not be exceeded for the insulation and sheath of the corresponding cable types. A defined condition is also the type of laying of the used cable. This has to be considered for the determination of the allowed load currents. Conditions that have to be considered are among others:

- Ambient temperature
- Cable accumulation
- Type of excess-current protection
- Heat insulation
- Wound up cables
- Current frequency (deviating from 50 Hz)
- Effects of harmonic waves

The current-carrying capacity is not the only criteria for choosing the cable section; furthermore, the requirements for the protection against harmful body currents, overload, short-circuit currents and voltage drop have to be considered. In case that cables are used for a longer period with temperatures exceeding the allowed values, they can be damaged considerably leading to an early failure and an important deterioration of its characteristics.

Current-carrying capacity: Tables

(Extract from VDE 0298 T4 06/13 table: 11, 17, 18, 21, 26 and 27)

Current-carrying capacity, cables with a nominal voltage up to 1000 V and heat resistant cables VDE 0298 T4 06/13 table 11, column 2 and 5

	column 2	column 5
way of laying	in air	on or at surfaces
	mono conductors - rubber insulated - PVC insulated - heat resistant	multi conductor cables (except for house or handheld units) - rubber insulated - PVC insulated - heat resistant
number of charged conductors	1	2 or 3
Nominal section	Capacity	
0,75 mm²	15 A	12 A
1,00 mm²	19 A	15 A
1,50 mm²	24 A	18 A
2,50 mm²	32 A	26 A
4,00 mm²	42 A	34 A
6,00 mm²	54 A	44 A
10,00 mm²	73 A	61 A
16,00 mm²	98 A	82 A
25,00 mm²	129 A	108 A
35,00 mm²	158 A	135 A
50,00 mm²	198 A	168 A
70,00 mm²	245 A	207 A
95,00 mm²	292 A	250 A
120,00 mm²	344 A	292 A
150,00 mm²	391 A	335 A
185,00 mm²	448 A	382 A
240,00 mm²	528 A	453 A
300,00 mm²	608 A	523 A

Conversion factors for deviating ambient temperatures VDE 0298 T4 06/13 table 15, column 4 [1)]

Ambient temperature	Factor
10 °C	1,22
15 °C	1,17
20 °C	1,12
25 °C	1,06
30 °C	1,00
35 °C	0,94
40 °C	0,87
45 °C	0,79
50 °C	0,71
55 °C	0,61
60 °C	0,50
65 °C	0,35

[1)] for cables with a service temperature of max. 70°C at the conductor

Conversion factors for multi-core cables with a nominal section up to 10 mm² VDE 0298 T4 06/13 table 26. With installation in the open air.

No.of the loaded cores	Factor
5	0,75
7	0,65
10	0,55
14	0,50
19	0,45
24	0,40
40	0,35
61	0,30

Conversion factors for deviating ambient temperatures for heat resistant cables VDE 0298 T4 06/13 table 18, column 3 - 6

	column 3	column 4	column 5	column 6
	allowed operating temperature			
	90°C	110°C	135°C	180°C
ambient-temperature	conversion factors, to apply to the capacity of heat resistant cables in table 11, column 2 and 5.			
up to 50 °C	1,00	1,00	1,00	1,00
55 °C	0,94	1,00	1,00	1,00
60 °C	0,87	1,00	1,00	1,00
65 °C	0,79	1,00	1,00	1,00
70 °C	0,71	1,00	1,00	1,00
75 °C	0,61	1,00	1,00	1,00
80 °C	0,50	1,00	1,00	1,00
85 °C	0,35	0,91	1,00	1,00
90 °C	—	0,82	1,00	1,00
95 °C	—	0,71	1,00	1,00
100 °C	—	0,58	0,94	1,00
105 °C	—	0,41	0,87	1,00
110 °C	—	—	0,79	1,00
115 °C	—	—	0,71	1,00
120 °C	—	—	0,61	1,00
125 °C	—	—	0,50	1,00
130 °C	—	—	0,35	1,00
135 °C	—	—	—	1,00
140 °C	—	—	—	1,00
145 °C	—	—	—	1,00
150 °C	—	—	—	1,00
155 °C	—	—	—	0,91
160 °C	—	—	—	0,82
165 °C	—	—	—	0,71
170 °C	—	—	—	0,58
175 °C	—	—	—	0,41

Conversion factors for the accumulation on walls, in tubes and conduits, on the floor and at the ceiling VDE 0298 T4 06/13 table 21	
No. of multi-core cables (2 or 3 current-carrying cores)	Factor
1	1,00
2	0,80
3	0,70
4	0,65
5	0,60
6	0,57
7	0,54
8	0,52
9	0,50
10	0,48
12	0,45
14	0,43
16	0,41
18	0,39
20	0,38

The maximum current-carrying capacity acc. to DIN VDE 0891 part 1, point 7 has to be considered for the application of insulated cables in telecommunications systems and data processing units.

Conversion factors for wound up cables VDE 0298 T4 06/13 table 27					
1	**2**	**3**	**4**	**5**	**6**
no. of layers on one drum	1	2	3	4	5
conversion factors	0,80	0,61	0,49	0,42	0,38
NOTE: for spiral winding the conversion factor of 0,80 is valid.					

Thermal influences

Cables have to be chosen, layed or installed in a way that the expected current heat emission is not impeded and thus does not create any fire risk for adjacent materials. The limit temperatures of the individual cable types are shown in the catalogue. The indicated values shall not be exceeded by the combined effects of internal current heat and environmental conditions.

Mechanical stress

Any possible mechanical stress which could lead to a mechanical damage of the layed cable has to be considered before installation.

Tensile load

The following values for the tensile load of each conductor shall not be exceeded. This is valid for a max. value of 1000 N for the tensile load of each conductor, as far as no other deviating values have been accepted by SAB BRÖCKSKES. 50 N/mm^2 for the installation of cables for fixed laying. 15 N/mm^2 static tensile load for flexible cables and for fixed laying in case that the cables are used for fixed installed electric circuits. Wherever those values are exceeded, it is recommended to use separate strain relief elements or similar. The connection of such a strain relief element with the cable has to be executed without damaging the cable. In case that flexible cables are exposed to dynamic tensile load (including tensile load due to mass reactance, for example on unwinding spools), the allowed tensile load or the duration of wear of the cable have to be agreed upon by the user and SAB BRÖCKSKES. Instructions for the vertical laying of cables without any intermediate fixing are shown under EN 50656-1 pos. 5.6.2.

Bending load

The inner bending radius of a cable has to be chosen in a way that any damage of the cable is avoided. The inner bending radii for the different cable constructions are indicated in table 6 of HD 516. The choice of smaller bending radii than indicated in the cable catalogue has to be agreed upon with SAB BRÖCKSKES.

The stripping of the cable sheath shall not cause any damage to the conductor as otherwise there will be a considerable deterioration of the bending characteristics.

The indicated bending radii are valid for ambient temperatures of (20 ± 10) °C. For other ambient temperatures please contact SAB BRÖCKSKES.

Bendings directly beside external of internal fixing points have to be avoided.

Pressure stress

Any pressure causing a cable damage has to be avoided.

Torsional stress

Flexible cables are generally not appropriate for torsional stress. In cases where torsional stress cannot be avoided, the construction of the cable and the way of laying have to be agreed upon between the user and SAB BRÖCKSKES.

Compatibility

For the choice and laying of cables the following points have to be considered:

- Mechanical and electrical impacts between adjacent electric circuits have to be avoided.
- Heat loss of cables or chemical/physical influences of the cable materials on adjacent materials, for example construction or decoration materials, insulating tubes and fixing devices.
- The influence of the current heat on the conductor material and connections has to be considered.

For further indications please see tables 3A, 3B, 4A and 4B of HD 516.

Room types

- Electric shops of the factory are rooms which are generally used for the operation of electric equipment and the access is only allowed to instructed staff members, for example switch rooms.
- Closed electric shops are rooms which are only used for the operation of electric equipment and are generally locked up. The access is only allowed for instructed staff members, for example closed switch and distribution systems.
- Dry rooms are rooms without any condensation water in which the air is not saturated with humidity, for example living rooms and hotel rooms.
- Damp rooms are rooms in which the safety of the operational devices is affected by humidity, condensation water, chemical or similar influences, for example in large kitchens.

General notes:

Rooms can only be classified in one of the above mentioned types by a careful inspection of the rooms and operational conditions. If there is only much humidity in a certain area of a room but the room is nevertheless dry due to good ventilation, there is no need to classify the room as a damp one.

Application in rooms and in the open air

General:

These terms have to be understood in connection with the boundary conditions (for example min. and max. operating temperatures, influence of ambient temperatures) defined by the construction and the intended application. Terms for application types:

Application in rooms:

The cable is installed or connected to a device which is normally located in a building within "a planned surrounding". The building can be used for business, industrial or living purposes.

Limited application in the open air:

The cable is appropriate for a short-time use in the open air, "planned surrounding" for example lawn mower.

Permanent application in the open air:

The cable has been constructed for different conditions which can occur in the open air "planned surrounding" (including different weather conditions).

Stress classification

The term "stress" describes the use of cables in certain areas, connected to or installed in devices and for certain combinations of external influences which can occur in those areas. On the base of mechanical influences and general expressions the term "stress" has been divided into four categories:

1. **Very light stress**
   Application areas, in which the risk of mechanical damage and stress is very small, for example electric razor

2. **Light stress**
   Application areas, in which the risk of mechanical damage and stress is small, for example hair dryer.

3. **Normal stress**
   Application areas, in which the cables are exposed to small mechanical stress and the risk for mechanical damage is small, for example small stoves.

4. **Heavy stress**
   Application areas, in which the risk of mechanical damage or mechanical stress is of medium impact, for example machines on construction sites.

4a. Heavy stress (only multi-core cables)
Application as before, however in connection with parts of production systems including machine tools and manual mechanical devices, for example in connection with switch boards of a production machine.

Transport and storage

Cable and cords that are not intended for outdoor use must be stored in dry indoor rooms and must also be protected from exposure to direct sunglight there. With outdoor stroage, the ends of cables and cords must be be closed off to prevent the entry of moisture. The ambient temperature during transport and storage is to be in the range from -25°C to +55°C (max. +70°C for not longer than 24 hours). Furthermore, the temperatures indicated in the tables of HD 516 have be considered for storage. Especially in the range of low temperatures, mechanical loading by vibration, shock, bending and twisting is to be avoided.