Flexible power and control cables

CAVOTEC

PROAD029

distributed by the Cavotec Group

Flexible power cables
Flexible control cables

The Cavotec Group

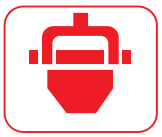
Cavotec is the name of a group of companies specialized in power supply technology for cranes and other industrial equipment. It is formed by 5 manufacturing "Centres of Excellence" located in Canada, France, Germany, Italy and Sweden and by 5 local manufacturing units located in Australia, China, Germany, Sweden and USA.
For distribution of their products and support to customers Cavotec has 22 sales companies which, together with a network of Distributors, serve more than 30 countries on five continents.
Each manufacturing company, no matter where it is located, aims at being a market leader in its field by providing innovative and reliable products to Group customers.
Although they manufacture different products in different countries, they are globally supported and coordinated by the Cavotec Group in their product development and marketing activities.
Each sales company, and each distributor, has a policy aiming at better serving its local market with the full support of the Cavotec Group.

Our aim is to be local everywhere

Great emphasis is put in providing the highest quality not only in the selected products, but also in service and backing to their customers. Our philosophy in fact is to be local everywhere.

Our fields of activity are

Mining, tunnelling



Steel Mills

Airports

Ports, Terminals

Robots, Automation

Offshore

Constructions

Our competence is power supply technology

To be able to offer a comprehensive selection of high quality cables to our customers, the Cavotec Group decided to select specialised manufacturing partners sharing our philosophy concerning the quality level and the service to the customer.
Concerning flexible cables our Group cooperates with partners like Amercable, Baude, Gore, Palazzo, Pirelli and Nexans.
The range of cables sold and serviced includes control cables, power cables, fiber optic cables and Kevlar reinforced cables for high stress applications.

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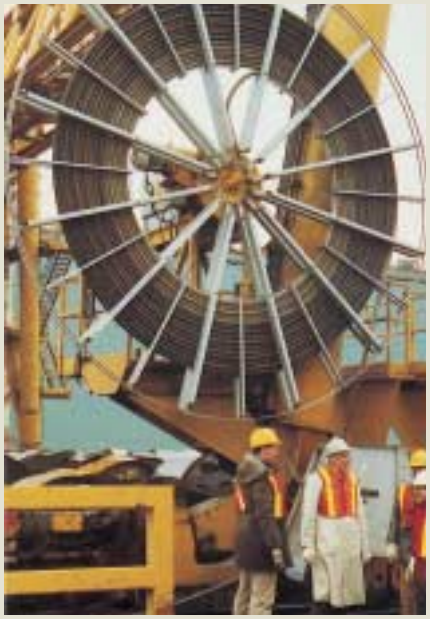
PBELT022

How to choose the right cable for the job.



CABLE003

A large, high speed Cavotec Specimas cable reel mounted on a coil handler running at 180 m/minute.

To illustrate possible questions that arise from using cables in different types of applications we have included below a case study from Palazzo Pirelli. This study is based completely on their technical calculations and experience and is not automatically applicable to other types or brands of cable. In order to be sure of the latest information and any possible changes always contact your cable manufacturer.

Bending is not the only stress present with cables used for heavy duty applications. Mobile cables are subject to other stresses and strains (tensile, twisting etc.) resulting from forced guidance of the cable during the winding and unwinding phases. Consequently the correct choice is vital to ensure a long life of the cable.

Naturally other factors of primary importance must also be taken into consideration. These are:

- Minimum bending radius
- Tensile stress
- Operating speed & acceleration
- Installation height & length
- Ambient Temperature

The following paragraphs provide a detailed examination of these factors for accurate assessment of cable requirements.

Main use
Suitable
Not suitable

Table 1: Palazzo type selection

TYPE OF CABLE	TYPE OF CABLE APPLICATION									
	Festoons	Cable winding reels				Cable tender systems	Guide pulley system	Pendant push buttons	Cable chains	Baskets
		Cable laid on ground or in conduit			Vertical cable					
Operating speed (m/min.max)*	180	180	120	120	120	240	120	—	120	120
PANZERFLEX® PANZERFLEX®- FO (minimum temp. - 20°C)	●	●	●	○	⊗	⊗	⊗	⊗	●	⊗
PANZERFLEX®- K (minimum temp. - 40°C)	●	●	●	○	⊗	⊗	⊗	⊗	●	⊗
PANZERFLEX®- VS (minimum temp. - 20°C)	⊗	○	○	●	●	●	●	●	⊗	⊗
BASKETHEAVYFLEX® (minimum temp. - 20°C)	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	●

Bending radius and overall diameters

Precise calculation of the bending radius is a determining factor for cable reliability. A decrease in minimum bending radius has a major effect on the life of a cable because it causes stretching and internal distortions. Another important factor is the frequency of the cable movements. If movement is slow and infrequent a tighter bending radius can be considered. Special attention should be taken for installations with pulleys or guide-rollers.
Special attention should also be paid to installations where flexing and torsion is present due to the reels being parallel to the line of travel of the machine (see table 2).

Tensile strength

The maximum admissible continuous operating load is calculated by taking the sum of the cross sections of the power conductors (phases + earth of equal cross section) in the cable*. Greater loads will result in permanent elongation of the conductors, which would shorten the life of the cable considerably. For occasional or very infrequent stresses the calculated limit can be exceeded slightly.
For control cables, where the resistant cross section consists of numerous small conductors, special types of cables are available. In special cases, where the pulling strength exceeds the resistance of the conductors, cables are used fitted with strainers or other means such as Kevlar reinforcement.

Operating speed

All cables in this catalogue have been designed, manufactured and tested for the operating speeds commonly in use today. Of course these speeds are only possible if the recommendations made concerning the choice of cable have been observed. Please note that high acceleration in combination with high operating speeds should be taken into account when calculating the tensile stress in the cable.

Coiling on cable reels

Monospiral reels

When using this type of reel the natural tendency of the cable is utilised. Alternatively it is also often possible to position the reel in order to eliminate the use of intermediate pulleys and any changes of direction. This increases the life of the cable and the operating speeds considerably.

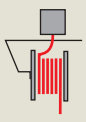
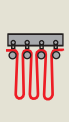
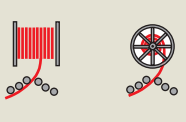
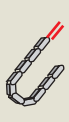
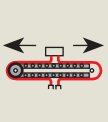
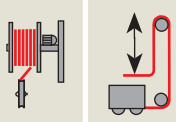
Multi-spiral and multi-layer reels

These types of reels are normally used in cases of long cable length and large diameter cables. With this type of installation, attention must be paid to minimising the use of intermediate pulleys. The current capacity must also be carefully calculated using correction factors for layers and winding.

Spreader cables

Some cables have specially designed to be collected in baskets. With these types of applications a correct design is not only important for good cable treatment but also to avoid operating malfunctions. High stress applications will typically involve long vertical lengths, high speeds combined with lateral movement and a presence of strong winds (typical port conditions). In these cases attention should be paid to ensure that the coiling diameter is no less than 1.5 mtr. and that a guide cone is located in the basket for even coiling of the cable. The shape of the basket and the size and shape of the opening are also important factors. A conical opening at a minimum height of 2 mtr. is recommended. Periodic lubrication of the surface of the cable is necessary to facilitate entry into the basket. Lubricating products that do not cause excessive accumulation of dirt should be used (figure 1 - page 6).

Table 2: Minimum bending radius

OPERATING VOLTAGE	TYPE OF APPLICATION							
Overall diameter of cable DE	Fixed installation	Anchoring reel	Festoons	Cable reels	Baskets	Cable chains	Cable tender systems	Guide pulley systems
								
Voltage ≤ 1000 V								
DE < 8.0 mm	3 x DE	3 x DE		5 x DE	—	4 x DE		7,5 x DE
DE < 12.0 mm	3 x DE	4 x DE		5 x DE	—	4 x DE		7,5 x DE
DE ≤ 20.0 mm	4 x DE	5 x DE		5 x DE	—	5 x DE		7,5 x DE
DE > 20.0 mm	4 x DE	5 x DE		6 x DE	15 x DE	5 x DE		7,5 x DE
Voltage > 1000 V	6 x DE	10 x DE		12 x DE	—	10 x DE		15 x DE

** multiplied by the maximum allowed tensile strength factor*

Other systems of cable movement
The systems most frequently employed are perhaps cable tender systems, pulley systems and cable chains. The first two systems involve high tensile stress whereas the third on a whole does not. Particular attention must be paid to the minimum bending radius and to the distribution of loads between the cables and cable tenders. Cables with a greater cross section should bear the loads and not the control cables that may be present.

Guide pulley and anchoring devices.
When designing these components, care must be taken to observe the recommended minimum bending radius and also the following factors:

Intermediate sheaves used for long cable lengths must be designed with a 'flat bottom profile' in order to avoid torsion. Small, light-weight rollers are preferred to sheave pulleys or wheels. With twin directional cable guides it is preferable to use light-weight, low friction rollers with a rounded bottom profile, as these types of rollers guide the cable in the centre without developing torsion stresses. If possible reduce the number intermediate pulleys and keep changes of direction to a minimum. Where possible rollers instead of pulleys should be used as these have considerably less contact area with the cable. Should the route of the cable require more than one change of direction, the distance between two sheaves or rollers must be greater than 25 times the overall diameter of the cable.

The anchoring systems must be designed to distribute the tensile stress over a wide area of the outer cable sheath. This is in order to prevent localised faults or damage. It is preferable to make the connections at both ends of the installation by using the same method normally adopted for installations with a central feeding point. Both the reel and the feeding point must have a few 'dead' turns of cable before the cable joint. Mobile anchoring points usually consist of ordinary terminals or 'cable grips'. In these cases it is recommended that the tensile load is distributed over a length of cable equal to 20-25 times the overall diameter of the cable. It is also recommendable that an additional loop of cable be left before entry into the terminal box to allow movement. In any case it is absolutely essential for the design of the guide and pulley system to provide adequate protection and reduce effect of slacks and jerks during operation. The overall lifetime and reliability of the cable depends on these conditions being met.

Current carrying capacities for non-continuous operation
In some cases electrical operation is not continuous. In these cases it is therefore advisable to check the values of the operating times so as to determine if the cross section of the cable can be reduced. A typical example of intermittent operating with hoisting equipment consists of repeated cycles where, for example, an operating period of 10 minutes of full load is followed by a longer period without load. These 10 minutes, taken as a percentage of the total duration (DT) of the cycle, provide the load factor. Load factor ED% = (10/DT min) x 100. In this case the current carrying capacity (as calculated in the preceding paragraph) can be increased using the factors given in table 4. For further information and advice please consult our technical department.

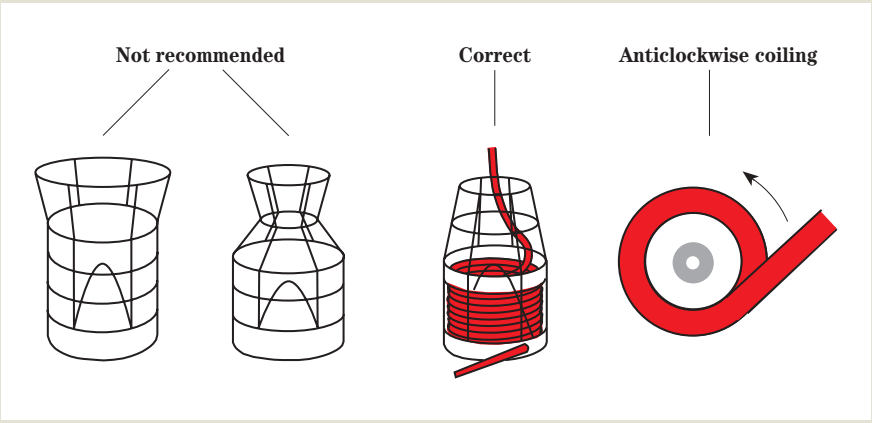


Figure 1. Shape of the basket and direction of coiling.

Table 3: Current carrying capacities for continuous operation

Type of cable	PANZERFLEX® FLEXIFLAT PANZERFLAT® BASKETHEAVYFLEX®	PANZERFLEX®-PANZERFLAT®	
Type of laying	1 cable in air  (for festoons)	1 cable laid on the ground  (for cable reels)	
Cross section mm²	Operating voltage Up to 10 kV A	A	Operating voltage Above 10 kV A
1,5	24	23	—
2,5	32	30	—
4	43	41	—
6	56	53	—
10	78	74	—
16	104	99	105
25	138	131	139
35	171	162	172
50	213	202	215
70	263	250	265
95	317	301	319
120	370	352	371
150	425	404	428
185	485	461	488
240	570	517	—

Insulation: EPR - Conductor temperature: 80°C Ambient temperature: 30°C

Current carrying capacity correction factors

For ambient temperatures other than 30°C

Ambient temperature (°C)	25	35	40	45	50	55	60	65	70	75
Correction factor	1,05	0,95	0,89	0,84	0,77	0,71	0,63	0,55	0,45	0,32

Reel type	Multi-spiral reels				Monospiral reels	
Number of layers on reel	1	2	3	4	Various	Various
Correction factor	0,80	0,61	0,49	0,42	0,8	0,5
Type of cable	Round cables				Round cables	Flat cables

For multi-core cables

Number of conductors loaded	5	7	10	14	19	24	40
Correction factor	0,75	0,65	0,55	0,50	0,45	0,40	0,35

Table 4: Correction factors for intermittent operation

Cross section of cable mm²			1,5	2,5	4	6	10	16	25	35	50	70	95	120	150	185	240	300
Cycle duration		Load factor-ED%	Correction factors															
Load min.	Total DT min.																	
10	17	60%	1,00	1,00	1,00	1,00	1,03	1,07	1,10	1,13	1,16	1,18	1,20	1,21	1,22	1,23	1,24	1,25
10	25	40%	1,00	1,00	1,03	1,04	1,09	1,16	1,23	1,28	1,34	1,38	1,42	1,44	1,46	1,48	1,49	1,50
10	40	25%	1,00	1,02	1,05	1,13	1,21	1,34	1,45	1,53	1,62	1,69	1,74	1,78	1,81	1,82	1,85	1,87
10	50	20%	1,00	1,04	1,11	1,18	1,31	1,45	1,59	1,69	1,79	1,87	1,93	1,97	2,01	2,04	2,10	2,15
10	67	15%	1,00	1,08	1,19	1,27	1,44	1,62	1,79	1,90	2,03	2,13	2,21	2,26	2,30	2,32	2,36	2,39

Voltage drop

The voltage drop should not only be checked for low voltage but also for medium voltage applications. The value is calculated by multiplying the factors K (mV/Am) given in table 5 with the current capacity I (A) of the cable and by the length of the connection L (km). This calculation is valid with sufficient approximation for all voltages where: conductor temperature = 80C; cos φ 0,8; frequency = 50 Hz. Voltage drop (V) = I(A) x L (km) x K(mV/Am).

The factors have been calculated using the formula:

K(mV/Am) = 1,73 x (R cos φ X sen φ)

where: R= Resistance of the conductor (Ω/km) at 50 Hz.

X = cable reactance (Ω/km) at 50Hz.

Values for electrical resistance R (80°C) and for reactance X (calculated for round cables, three phase cores plus earth, but it can also be applied to flat cables) are also given in table 5. It should be noted that for the conductor temperatures of 90°C the resistance R must be multiplied by 1,03 while for a frequency of 60 Hz the resistance X must be multiplied by 1,2 and the value for K (mV/Am) recalculated.

Table 5: Factors for calculation of voltage drop

Nominal cross section of cable	Operating electrical resistance (R) at 80°C, A.C. 50 Hz	Reactance (x) at 50 Hz for three core+earth cables at operating voltage of:						Voltage drop factor k (cosφ = 0,8)
mm²	Ω / km	≤ 1 kV Ω / km	3 kV Ω / km	6 kV Ω / km	10 kV Ω / km	15 kV Ω / km	20 kV Ω / km	mV / Am
1,5	16,95	0,107						23,5
2,5	10,15	0,101						14,2
4	6,29	0,097						8,80
6	4,20	0,091						5,93
10	2,41	0,087	0,098					3,45
16	1,54	0,083	0,096	0,109	0,121			2,24
25	0,986	0,082	0,091	0,104	0,114	0,127		1,46
35	0,700	0,079	0,087	0,099	0,108	0,121	0,131	1,06
50	0,490	0,078	0,083	0,094	0,103	0,114	0,123	0,77
70	0,345	0,076	0,080	0,090	0,098	0,108	0,113	0,57
95	0,260	0,075	0,079	0,088	0,094	0,104		0,45
120	0,205	0,074	0,077	0,085	0,091			0,36
150	0,163	0,074	0,076	0,083	0,089			0,30
185	0,134	0,073	0,074	0,081				0,26
240	0,101	0,072	0,074					0,22

Table 6: Short circuit current

Nominal cross section of cable	**1 second THERMAL LIMIT for all voltage**	**DYNAMIC LIMIT for three core cables operating voltage of:**					
		≤ 1 KV	3 KV	6 KV	10 KV	15 KV	20 KV
(mm²)	kA	(Indicative value) kA					
1,5	0,2						
2,5	0,32						
4	0,51						
6	0,77						
10	1,29						
16	2,06	30	40	45	50	55	
25	3,22	35	43	50	55	60	
35	4,50	40	48	53	60	65	75
50	6,43	45	50	58	63	70	80
70	9,00	50	55	63	68	75	83
95	12,2	55	60	70	75	80	
120	15,4	60	65	72	78		
150	19,3	65	68	75	80		
185	23,8	70	72	80	84		
240	31,0	80					

Thermal limit in case of short circuit
In accordance with VDE Standard 0250 c. 8/75 the admissible thermal limits for short circuit current in heavy cables must be calculated using the following reference values:
• Initial temperature: 80°C (cable under full load)
• final short circuit temperature: 200°C

The short circuit currents (thermal limit) given in table 6 have been calculated using these reference values and are valid for a base time of 1 second. For other time periods, taking into account the protection characteristics of the machine, the value in the table must be divided by the square root of the effective time (in seconds). For different initial and final temperatures (e.g. with 90°C and 250°C admissible according to the EPR norms) the short circuit current thermal limit can be calculated using the following formula:

$$Icc\ (Ka) = \frac{kcc \times \text{cross section } (mm^2)}{\sqrt{t\ (sec.)}}$$

Where the coefficient kcc assumes the following values:

Kcc coefficient table

Final S.C. temperature °C	Initial S.C. temperature (= of the conductor under normal operating condictions)						
	30°C	40°C	50°C	60°C	70°C	80°C	90°C
160°	143	136	129	122	115	107	100
200°	159	153	147	141	135	128	122
250°	176	170	165	159	154	148	143

Dynamic limit in case of short circuit
The electro-dynamic forces generated during short circuit tend to separate single core cables or the cores of three/four cables forcibly. To counteract these forces in single core cables, attention must be paid to the dimensions and spacing of cable brackets and supports. For multi-core cables, used more frequently for heavy duty applications, the cable itself ensures this.

Handling of the cable
Storing and handling the cables on their original drums is recommended in order to prevent any defects. If possible the drums should not be rolled; either on level or uneven ground. If the type of installation and working conditions allow, it is good to roll out the cable along the line of movement of the machine before installation. By doing this you can check if there are any torsions or twist in the entire length of the cable. Appropriate equipment (rollers or pulley devices) should be used taking into account the slight tendency of round cables (especially multi-core ones) to spiral. During this stage any longitudinal twists should be taken out using appropriate actions in order to make sure the cable rewinds correctly on the reel or is properly festooned. The longitudinal reference markings on the cable make this operation easier.

Transfer onto reels
If working conditions do not allow the previous described method, the cable should be transferred directly from the original drum to the cable reel. Undesired twists and torsions that have a negative effect on the cable should be eliminated during this operation. The transfer must be direct with no intermediate guides (rollers, pulleys, twin-directional rollers etc.) and with no changes of direction or inversions of the original direction of winding on the delivery drum (see figure 3). Most cables are manufactured with right-hand lay-up of the conductors (both for power and control cables). It is important to remember therefore that when winding onto multi-spiral reels the first turn must be with the cable against the right flange of the reel. This will have the effect of exploiting the natural tendency of a cable under traction to move to the right and will keep subsequent turns close together (see figure 4).

Installation in spreader-baskets
With cables designed for installing in baskets, the right hand lay-up of the cores means that cables must be introduced into the bottom of the basket, coiling in an anticlockwise direction, unwinding from the outer layer of the original drum. In order to facilitate basket coiling and uncoiling operations, the outer surface of the cable should be periodically lubricated with a suitable product (such as silicone grease) designed to prevent any adhesion of dirt, dust or other matter.

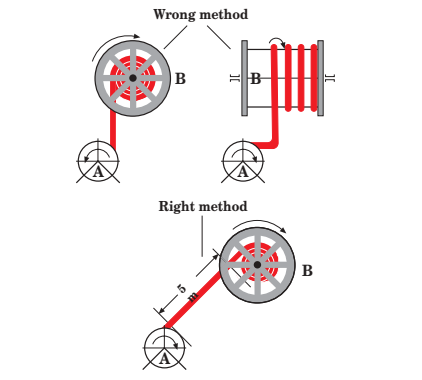


Figure 3. Transfer of cable from original delivery drum A to the cable winding reel B.

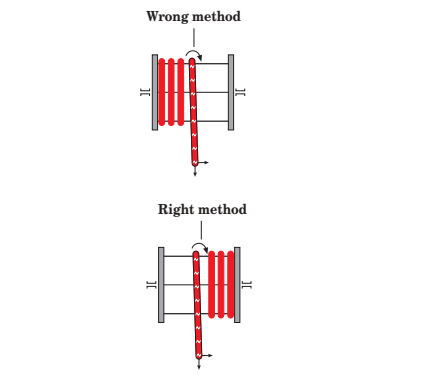


Figure 4. Winding of cable onto multi-spire reel.


Southampton

Panzerflex® 1kV; low voltage power cable

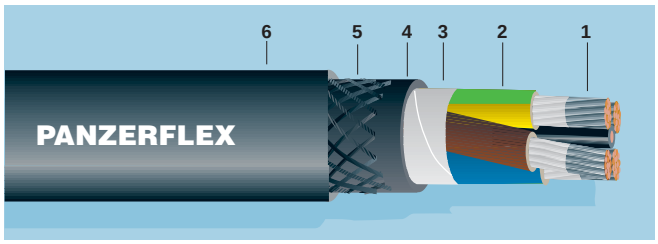
Ratings and Specifications
VDE 0250, Part 814

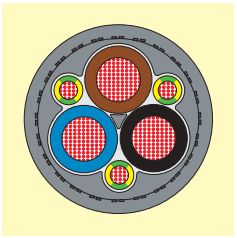
Rated and test voltages

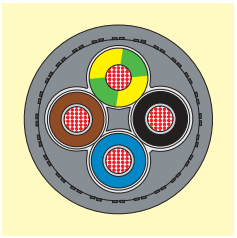
Rated voltage Uo/U	0,6/1	kV A.C.
Max voltage Um	0,7/1,2	kV A.C.
Max voltage Um	0,9/1,8	kV D.C.
Test voltage	2,5	kV A.C.

Temperature ratings
+ 90°C Maximum conductor temperature
– 20°C Minimum conductor temperature

Applications
Panzerflex® special flexible heavy duty power cables have been developed for use on moving installations where there are high torsional and tensile stresses, ambient conditions are harsh or there is danger of abrasion and crushing.
Typical applications for Panzerflex® are mobile installations on all types of harbour cranes, container cranes, ship-unloaders, mobile harbour cranes, deck cranes, stacker & reclaimers, trippers, mining & tunnelling equipment and mobile generator sets.







Construction & Characteristics
PANZERFLEX® 1 kV

1 *Flexible tinned stranded copper conductor*
2 *EPR rubber compound insulation*
3 *Tape*
4 *Polychloroprene based compound inner sheath*
5 *Antitwisting protection of synthetic yarns*
6 *Black polychloroprene based compound outer sheath*

DIMENSIONAL DATA

PANZERFLEX® 1 kV					
	Number of cable cores 3 + 3		Number of cable cores 4		
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
1,5	–	–	14,3	280	120
2,5	–	–	17,2	410	200
4	–	–	20,0	550	320
6	–	–	21,5	680	480
10	–	–	25,5	1030	800
16	–	–	30,0	1470	1280
25	–	–	35,0	2130	2000
35	–	–	39,0	2750	2800
50 (10)*	44,5	3310	44,5	3700	4000
70 (16)*	49,3	4340	49,0	4840	5600
95 (16)*	52,3	5500	56,5	6470	7600

PANZERFLEX® 1 kV					
	Number of cable cores 3 + 3		Number of cable cores 4		
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
120 (25)*	59,4	6970	63,2	8280	9600
150 (25)*	61,5	8130	68,7	9950	12000
185 (35)*	67,2	9820	74,9	11800	14800
240 (50)*	76,1	12680	–	–	–
25 (2,5)*	–	–	–	–	–
35 (2,5)*	–	–	–	–	–
35 (2,5)*	–	–	–	–	–

* The cross section indicated in the brackets is that of each minor conductor of 3 + 3.

Panzerflex® 1kV; low voltage control cable

Ratings and Specifications
VDE 0250, Part 814

Rated and test voltages

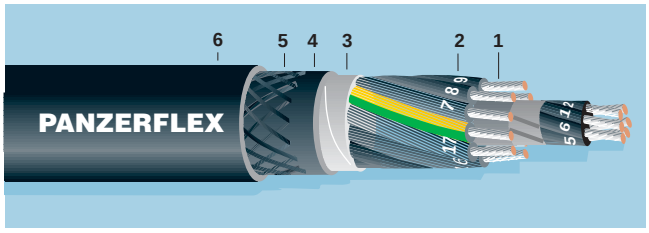
Rated voltage Uo/o	0,6/1	kV A.C.
Max voltage Um	0,7/1,2	kV A.C.
Max voltage Um	0,9/1,8	kV D.C.
Test voltage	2,5	kV A.C.

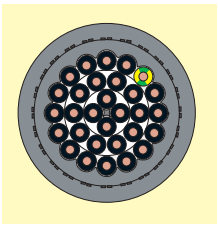
Temperature ratings

+ 90°C	Maximum conductor temperature
– 20°C	Minimum ambient temperature during work

Applications

Panzerflex® special, flexible control cables have been developed for use on moving installations where there are high torsional and tensile stresses and ambient conditions are harsh. Panzerflex® low voltage control cable has been especially designed for vertical reeling applications with high lifting heights. Typical applications for Panzerflex® control cables are mobile installations on all types of harbour cranes, container cranes, ship-unloaders, stacker & reclaimers, trippers, mobile generator sets and mining & tunnelling equipment, while Panzerflex® is especially suited for use on vertical reeling installations on mobile harbour cranes, ship-to-shore container cranes and large bridge cranes.





Construction & Characteristics
PANZERFLEX® 1kV (control)

1 *Flexible tinned stranded copper conductor*
2 *EPR rubber compound insulation*
3 *Tape*
4 *Polychloroprene based compound inner sheath*
5 *Antitwisting protection of synthetic yarns*
6 *Black polychloroprene based compound outer sheath*

DIMENSIONAL DATA

PANZERFLEX® 1 kV			
Nominal cross section n x mm²	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
7 x 1,5	19,1	490	158
12 x 1,5	22,3	680	270
18 x 1,5	25,3	890	405
24 x 1,5	29,4	1140	540
30 x 1,5	31,5	1360	675
36 x 1,5	33,5	1540	810
7 x 2,5	21,2	660	263
12 x 2,5	24,8	910	450
18 x 2,5	30,2	1270	675
24 x 2,5	33,6	1680	900
30 x 2,5	35,4	1890	1125
36 x 2,5	38,4	2250	1350
7 x 4	24,2	890	420
12 x 4	28,6	1280	720
18 x 4	34,3	1840	1080
19 x 2,5+5 x 1 (C)	34,0	1650	713
19 x 2,5+5 x 1,5 (C)	34,0	1680	713
25 x 2,5+5 x 1,5 (C)	36,0	1890	938

Panzerflex® VS; low voltage control cable vertical application

Ratings and Specifications
VDE 0250, Part 814

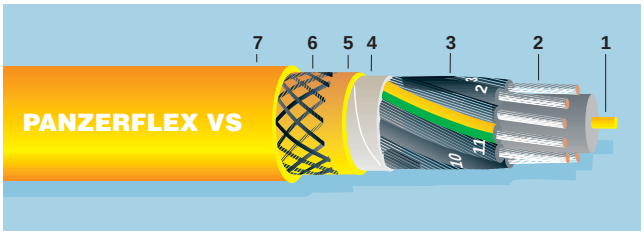
Rated and test voltages

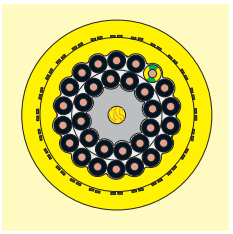
Rated voltage Uo/U	0,6/1	kV A.C.
Max voltage Um	1,2	kV A.C.
Max voltage Um	1,8	kV D.C.
Test voltage	2,5	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 20°C	Minimum ambient temperature during work

Applications
Panzerflex VS has been specially developed and designed in order to provide a specific solution for vertical applications where small dimensions and light weight are necessary. Typical applications for Panzerflex VS control cables are mobile installations on all types of harbour cranes, container cranes, ship unloaders, stackers & reclaimers, trippers, mobile generator sets and mining & tunnelling equipment. The Panzerflex VS is especially suited for use on vertical reeling installations on mobile harbour cranes, ship-to-shore container cranes and large bridge cranes.





Construction & Characteristics PANZERFLEX® VS

1 *Kevlar® central strainer*
2 *Very flexible tinned stranded copper conductor*
3 *EPR rubber compound insulation*
4 *Tape*
5 *Polychloroprene based compound inner sheath*
6 *Antitwisting protection of synthetic yarns*
7 *Yellow polychloroprene based compound outer sheath*

DIMENSIONAL DATA

PANZERFLEX® VS			
Nominal cross section	Max. overall diam.	Net weight	Max. Contin. Safe Reeling Tension
n x mm²	mm	kg/km	N
7 x 1,5	20,4	600	2000
12 x 1,5	26,2	980	2000
18 x 1,5	26,4	1040	2000
24 x 1,5	30,5	1320	2000
30 x 1,5	34,1	1690	2000
36 x 1,5	34,8	1750	2000
7 x 2,5	22,9	790	2000
12 x 2,5	30,2	1300	2000
18 x 2,5	31,3	1500	2000
24 x 2,5	35,8	1920	2000
30 x 2,5	39,9	2360	2000
36 x 2,5	40,6	2530	2000
7 x 4	25,6	1020	2000
12 x 4	34,4	1750	2000
18 x 4	36,4	2050	2000


REEL5052

A typical application for specially designed vertical control cables such as Panzerflex® VS.

Panzerlite®; low voltage control cable

Rated and test voltages

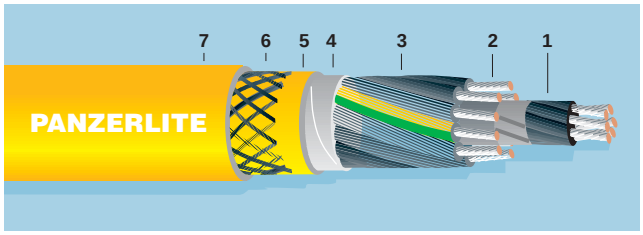
Rated voltage Uo/U	0,6/1	kV A.C.
Max voltage Um	1,2	kV A.C.
Max voltage Um	1,8	kV D.C.
Test voltage	2,5	kV A.C.

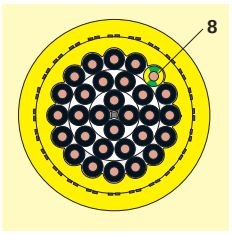
Temperature ratings

+ 90°C	Maximum conductor temperature
– 30°C	Minimum ambient temperature during work

Applications

Panzerlite has been specially developed and designed in order to provide a specific solution for all different types of applications where small dimensions and light weight are an absolute necessity. Typical applications for Panzerlite control cables are mobile installations on all types of harbour cranes, container cranes, ship unloaders, stackers & reclaimers, trippers, mobile generator sets and mining & tunnelling equipment.





Construction & Characteristics PANZERLITE®

1 *Kevlar® central strainer*
2 *Extra flexible tinned stranded copper conductor*
3 *Insulation of special tecnopolymer*
4 *Tape*
5 *Inner sheath made of special polyurethane PUR*
6 *Antitwisting Kevlar® braid*
7 *Yellow outer sheath made of special polyurethane PUR*
8 *Eatrh*

CABLE006

DIMENSIONAL DATA

PANZERLITE®			
Nominal cross section	Max. overall diam.	Net weight	Max. Contin. Safe Reeling Tension
n x mm²	mm	kg/km	N
18 x 2,5	23,0	770	2000*
37 x 2,5	32,3	1500	4000
42 x 2,5	33,5	1650	4000

** available on request with 4000N*

Cable reeling installation using Panzerflex® power and control cables at work on a stacker.

Cordaflex™ (SMK); low voltage control cable

Ratings and Specifications
VDE 250, Part 814

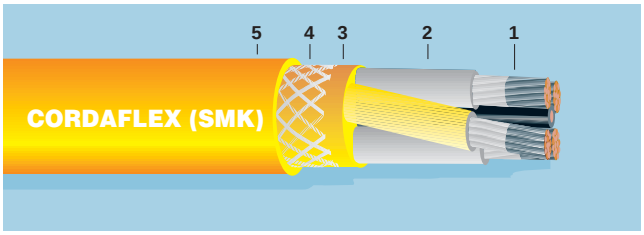
Rating and test voltages

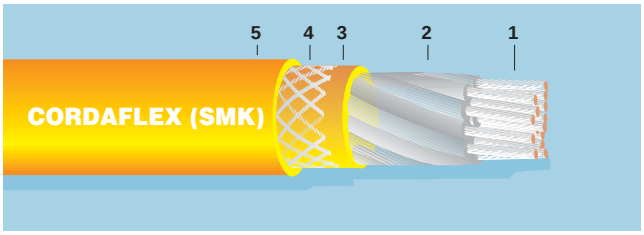
Rated voltage Uo/U	0,6/1	kV A.C.
Max voltage Um	0,7/1,2	kV A.C.
Max voltage Um	0,9/1,8	kV D.C.
Test voltage	2,5	kV A.C.

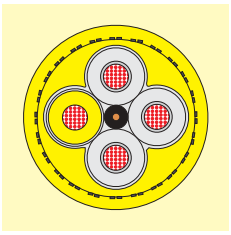
Temperature ratings

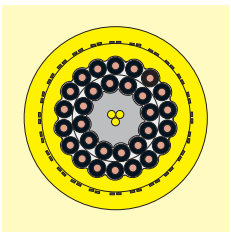
+ 90°C	Maximum conductor temperature
– 35°C	Minimum ambient temperature during work (flexible)
– 50°C	Minimum ambient temperature during work (fixed)

Applications
The CORDAFLEX™ (SMK) is a flexible reeling cable, specifically designed to address the high mechanical stress associated with high speed operation and/or multiple cable deflection in the cable payout. Applications include monospiral reels, level wind reels, cable tenders, sheave guided systems etc. for use on container cranes, RMG's, magnet cranes, stacker/reclaimers and much more.
This cable is also suited for use in mines on shuttle cars, excavators or other harsh applications. For vertical reeling applications we recommend a special design, CORDAFLEX™ (SMK)-V, which is available with an integrated central messenger increasing the maximum continuous safe reeling tension.









Construction & Characteristics
CORDAFLEX (SMK)

1 Conductor
2 Insulation
3 Inner sheath
4 Anti-torsion braid
5 Outer sheath

DIMENSIONAL DATA

CORDAFLEX™ (SMK)			
Nominal cross mm²	Max. overall mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
12 x 1,5	23,4	710	540
18 x 1,5	23,3	760	810
24 x 1,5	26,8	990	1080
30 x 1,5	29,6	1220	1350
36 x 1,5	29,5	1260	1620
44 x 1,5	32,5	1530	1980
56 x 1,5	37,9	2050	2520
18 x 2,5	25,3	1005	1350
24 x 2,5	29,2	1320	1800
30 x 2,5	32,4	1660	2250
36 x 2,5	32,3	1720	2700
44 x 2,5	37,1	2230	3300
56 x 2,5	43,1	2940	4200

CORDAFLEX™ (SMK)-V Reinforced			
Nominal cross mm²	Max. overall mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
49 x 1 (20kN)	29,6	1260	3200
24 x 2,5 (20kN)	29,2	1340	3600
30 x 2,5 (20kN)	32,4	1680	4100
44 x 2,5 (20kN)	37,1	2280	5100
56 x 2,5 (20kN)	43,1	3030	6000
48 x 1,5 (50kN)	40,3	2060	4860
48 x 2,5 (50kN)	46,1	3000	6300

Note: Cordaflex (SMK) is also available in other control cable designs and in a full range of 1kV power cables

Basketheavyflex®; low voltage control cable

Rated and test voltages

Rated voltage Uo/U	0,3/0,5	kV A.C.
Max voltage Um	0,5	kV A.C.
Max voltage Um	0,8	kV D.C.
Test voltage	2	kV A.C.

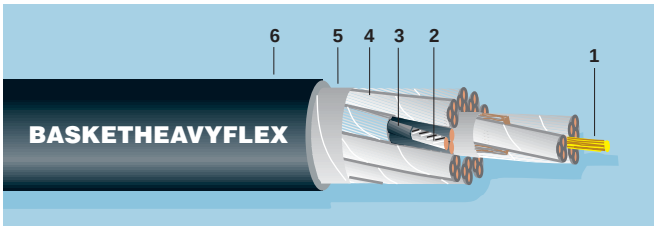
Temperature ratings

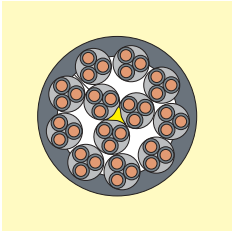
+ 90°C	Maximum conductor temperature
– 20°C	Minimum ambient temperature during work

Applications

BasketHeavyFlex® special, flexible control cables have been developed for use on spreader installations using baskets where there are high torsional stresses. Its particular design and the use of a rubber outer sheath makes the cable very suitable for these type of applications and gives a long life to the cable.

Typical applications for BasketHeavyFlex® control cables are spreader installations on all types of harbour cranes, container cranes, mobile harbour cranes and large bridge cranes.





Construction & Characteristics BASKETHEAVYFLEX®

1. ***Kevlar®*** *central strainer*
2. *Extrafine tinned stranded copper conductor*
3. *EPR rubber compound insulation*
4. *Three cores laid-up with fillers and tape*
5. *Tape around the core assembly with fillers*
6. *Black CSP based compound outer sheath*

DIMENSIONAL CONDUCTOR DATA

CONDUCTOR				
Nominal cross section	Max D.C. electrical resistance at 20°C	Maximum strands diameter	Nominal conductor diameter	Nominal insulation diameter
mm²	Ohm/km	mm	mm	mm
2,5	8,21	0,16	2,0	3,8
3,3	6,11	0,16	2,5	4,0

BASKETHEAVYFLEX ® CABLE			
Nominal cross -section n x mm²	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
8 x 3 x 2,5	41,0	2600	1200
12 x 3 x 2,5	44,5	3100	1800
14 x 3 x 2,5	50,4	3650	2100
16 x 3 x 2,5	51,5	4100	2400
8 x 3 x 3,3	41,0	2700	1584
12 x 3 x 3,3	44,5	3300	2376
14 x 3 x 3,3	50,4	3850	2772
16 x 3 x 3,3	51,5	4300	3168

CraneMAX; low voltage control cable

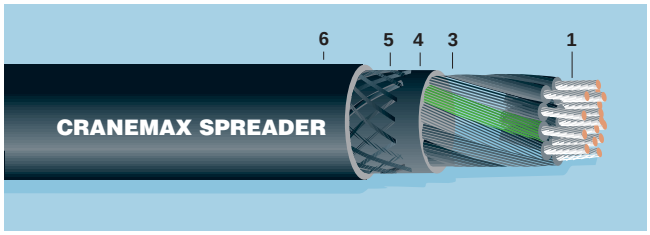
Ratings and Specifications
ASTM B-172; ASTM B-33

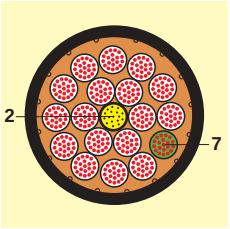
Rated and test voltages

Rated voltage Uo/U	0,6	kV A.C.
Max voltage Um	0,6	kV A.C.
Max voltage Um	0,9	kV D.C.
Test voltage	3	kV A.C.

Temperature ratings
+ 90°C Maximum conductor temperature
– 40°C Minimum ambient temperature during work

Applications
AmerCable's Crane*Max* Spreader cables are designed to deliver safe trouble free performance on vertical cable reels at temperatures from -40°C to +50°C at speeds up to 250 m/min. These multi-conductor cables are especially designed for use with monospiral and level wind reels on container cranes, log handling cranes, gantry cranes, stacker/reclaimers and other similar lifting equipment. They are suitable for outdoor use in ports, shipyards, lumber mills, steel mills and mines.
Please note that this cable is designed and built according to US standards.





Construction & Characteristics
CRANEMAX
1 *Conductor*
2 *Central Strength Member*
3 *Insulation*
4 *Inner sheath*
5 *Aramid reinforcement*
6 *Outer sheath*
7 *Ground*

DIMENSIONAL DATA

CRANEMAX				
AWG	Nominal cross section n x mm²	Max. overall diam. mm	Net weight kg/Km	Max. Continuous Safe Reeling Tension N
14	18 x 2,5	25,3	966	6200
14	24 x 2,5	28,0	1057	7200
14	37 x 2,5	32,5	1726	8000
14	44 x 2,5	35,2	2329	8800
12	18 x 4	27,7	1292	6600
12	24 x 4	30,4	1629	7500
12	37 x 4	34,3	2366	8300
12	44 x 4	38,9	2769	9300


CABLE012

A Cavotec Specimas cable reel working at ± 200 m/min on a P&H log-handling crane for Federal Paper Board, in Augusta USA.

Goreflex; low voltage control cable

Rating and test voltages

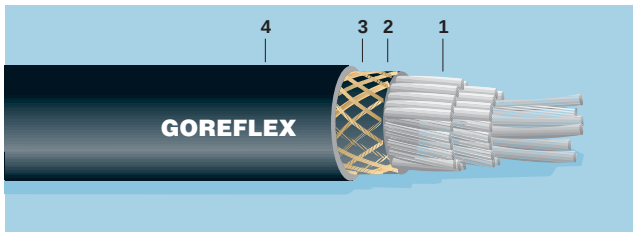
Rated voltage Uo/U 0,6 kV A.C.
Test voltage 3,5 kV D.C.

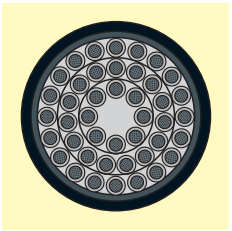
Temperature ratings

+ 90°C Maximum conductor temperature
– 30°C Minimum ambient temperature during work

Applications

Goreflex low voltage control cables for spreader applications are subjected to harsh operating conditions, extreme mechanical loading and very diverse ambient conditions. Goreflex spreader cables have an acceleration of 2,5 m/sec and a speed of > 200m/min. In addition they have a high tensile strength with an extreme low elongation (> 10 specific insulation resistance) while remaining very low in weight due to their innovative design. Goreflex cables are suited to a wide range of applications and are in use at ports and terminals world-wide.





Construction & Characteristics

GOREFLEX

1 Flexible copper conductor
2 Inner sheath
3 Polymere braid
4 Outer sheath

DIMENSIONAL DATA

GOREFLEX*			
Nominal cross section n x mm²	Max. overall diam. mm	Net weight kg/m	Max. Continuous Safe Reeling Tension N
18 x 2,5	23,5	0,7	3000
30 x 2,5	27,5	1,18	4000
36 x 2,5	29,5	1,40	6500
44 x 2,5	31,8	1,70	6500

** All standard bus cables can be implemented*

CABLE014

A typical application port for high strenght Goreflex cables.

Semoflex; low voltage control cable

Ratings and Specifications
VDE 6510

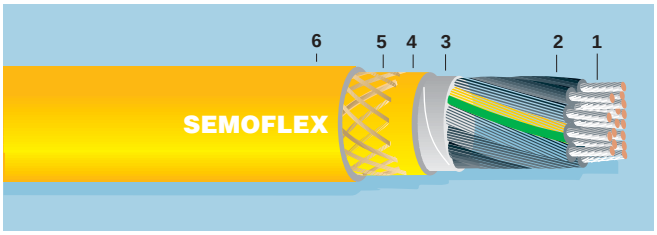
Rating and test voltages

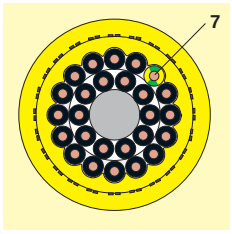
Rated voltage Uo/U	0,6/1	kV A.C.
Test voltage	4	kV A.C.

Temperature ratings

+ 80°C	Maximum conductor temperature
– 50°C	Minimum ambient temperature during work

Applications
The Semoflex Drum cable is ideally suited for use in dry and damp areas, explosive environments and for various heavy duty outdoor applications such as hoisting gears, transportation systems, motorised cable reels, rail traction motors and even agricultural machinery where high mechanical stresses are involved.





Construction & Characteristics
SEMOFLEX®

1. *Flexible tinned stranded copper conductor*
2. *Semocore® conductor insulation*
3. *Tape*
4. *Polyurethane inner sheath*
5. *Textile braids*
6. *Polyurethane outer sheath*
7. *Earth*

DIMENSIONAL DATA

SEMOFLEX			
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
4 x 1,5	10,2	157	150
5 x 1,5	10,8	176	190
7 x 1,5	12,9	245	265
12 x 1,5	18,4	337	450
18 x 1,5	18,6	526	675
24 x 1,5	21,3	662	900
30 x 1,5	24,6	901	1125
36 x 1,5	25,4	934	1350
42 x 1,5	26,5	1.056	1575
24 x 1,5 Bd	23,2	680	1260
36 x 1,5 Bd	29,0	953	1890
42 x 1,5 Bd	29,5	1.192	2200
49 x 1,5 Bd	32,6	1.508	2580

SEMOFLEX			
Nominal cross section mm²	Max. ovrall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
4 x 2,5	11,7	208	250
5 x 2,5	12,7	263	315
7 x 2,5	14,8	327	440
12 x 2,5	20,4	533	750
18 x 2,5	21,1	725	1125
24 x 2,5	24,8	988	1500
30 x 2,5	27,6	1.242	1875
36 x 2,5	28,2	1.325	2250
42 x 2,5	31,4	1.511	2625
50 x 2,5	34,7	2.134	3125
24 x 2,5 Bd	26,4	1.000	2100
30 x 2,5 Bd	28,8	1.299	2625
36 x 2,5 Bd	32,4	1.411	3150
42 x 2,5 Bd	33,5	1.637	3675
49 x 2,5 Bd	38,0	2.156	4280
4 x 4	12,5	270	400
5 x 4	14,3	362	500
4 x 6	16,9	409	600
5 x 6	17,8	511	750
7 x 6	20,9	715	1050

SEMOFLEX			
Nominal cross section mm²	Max. ovrall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
4 x 10	19,6	633	1000
5 x 10	20,9	766	1250
7 x 10	25,8	1.044	1750
4 x 16	23,8	936	1600
5 x 16	25,5	1.173	2000
4 x 25	27,7	1.483	2500
4 x 35	30,1	2.115	3500
3 x 50 + 3 x 25/3	34,9	2.606	3750
3 x 70 + 3 x 35/3	39,0	3.060	5250
3 x 95 + 3 x 50/3	on request		
3 x 120 + 3 x 70/3	on request		
4 x 16 + 4 x 2,5	23,8	1.048	2050
19 x 2,5 + 5 x (1,5)ec	25,2	970	1375
25 x 2,5 + 5 x (1,5)ec	27,7	1.170	1750

Buflex - TP; low voltage power cable

Rating and test voltages

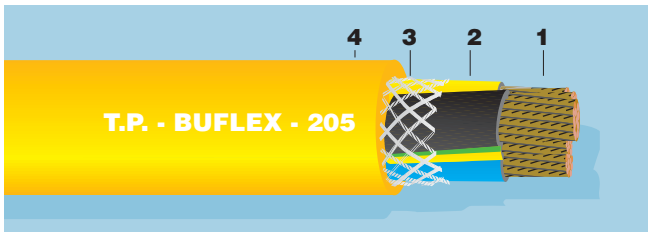
Rated voltage Uo/U	0,6/1	kV A.C.
Max voltage Um	1,2	kV A.C.
Test voltage	3,5	kV A.C.

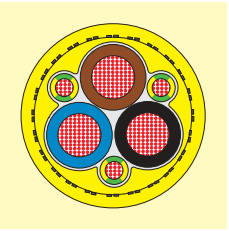
Temperature ratings

+ 90°C	Maximum conductor temperature
– 30°C	Minimumambient temperature during work

Buflex-TP cables are designed for power supply connections to all types of mobile equipment and vehicles used in quarrying, open-cast mining and other large scale civil engineering operations.
The unique Buflex® cables diameter is achieved by splitting the earth conductor and laying it in the angles formed by the assembly of the three phase conductors. This original design results in a smaller diameter than a four cable conductors cable i.e. a cable 3 x 120 mm^2 + 3 x 25 mm^2 (earth conductors) has the same diameter as a 4 x 95 mm^2 cable.

Applications





Construction & Characteristics
BUFLEX-TP

1 *Conductor*
2 *XLPE or TPR insulation*
3 *Tape*
4 *PUR outer sheath*

DIMENSIONAL DATA

BUFLEX-TP			
Nominal cross section n x mm^2	Max. overall diam. mm	Net weight kg/m	Max. Contin. Safe Reeling Tension N
3x 25+3 G6	23,0	1.044	1500
3x 35+3 G6	26,0	1.409	2100
3x 50+3 G10	30,0	2.006	3000
3x 70+3 G16	35,0	2,921	4200
3x 95+3 G16	41,0	3.650	5700
3x 120+3 G25	44,0	4.660	7200
3x 150 + 3 G25	50,0	5.810	9000
3x 185 + 3 G35	54,0	7.000	11100
3x 240+ 3 G50	62,0	9.300	14400

MINING11

Thanks to its high resistance to abrasion Buflex TP is used in many mining and tunneling applications.

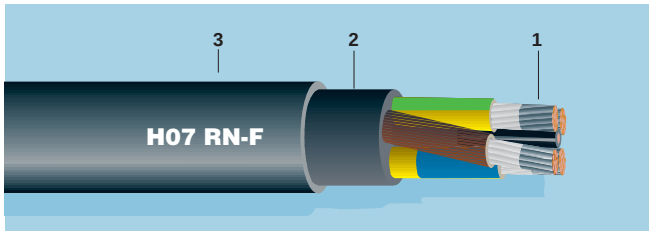
H07 RN-F; flexible low voltage rubber cable

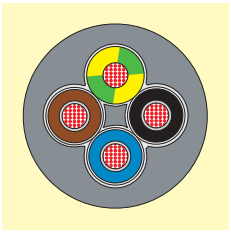
Rating and test voltages

Rated voltage Uo/U 0,5/0,8 kV A.C.
Test voltage 2,5 kV A.C.

Temperature ratings

+ 70°C Maximum conductor temperature
– 30°C Minimum ambient temperature during work





Construction & Characteristics
H07 RN-F

1 *Flexible tinned stranded copper conductor*
2 *EPR rubber compound insulation*
3 *Black polychloroprene based compound sheath*

DIMENSIONAL DATA

H07 RN-F			
Number of cores x cross section mm²	Max diameter of wires mm	Diameter mm	Weight of cable kg/km
1 x 1,50	0,26	6,5	55
1 x 2,50	0,26	7,2	70
1 x 4	0,31	8,2	100
1 x 6	0,31	9,5	125
1 x 10	0,41	11,2	195
1 x 16	0,41	12,7	280
1 x 25	0,41	14,5	405
1 x 35	0,41	16,3	525
1 x 50	0,41	18,8	705
1 x 70	0,51	21,0	970
1 x 95	0,51	24,0	1265
1 x 120	0,51	26,0	1565
1 x 150	0,51	29,0	1940
1 x 185	0,51	31,0	2335
1 x 240	0,51	34,3	2975
1 x 300	0,51	38,0	3655
1 x 400	0,51	42,0	4685
1 x 500	0,51	46,5	5855
2 x 1,0	0,21	9,3	90
2 x 1,50	0,26	10,2	130
2 x 2,50	0,26	12,0	185
2 x 4	0,31	13,5	255
2 x 6	0,31	16,0	330
2 x 10	0,41	21,3	585
2 x 16	0,41	24,3	835
2 x 25	0,41	28,3	1220
3G1,0	0,21	10,1	120
3G1,5	0,26	11,1	155
3G2,5	0,26	13,0	255
3G4	0,31	14,5	310
3G6	0,31	17,2	410
3G10	0,41	22,8	720
3G16	0,41	26,0	1040
3G25	0,41	30,3	1525

H07 RN-F			
Number of cores x cross section mm²	Max diameter of wires mm	Diameter mm	Weight of cable kg/km
3G35	0,41	33,8	1955
3G50	0,41	39,3	2635
3G70	0,51	44,3	3555
3G95	0,51	49,0	4695
3G120	0,51	53,3	5745
3G150	0,51	60,0	7175
3G185	0,51	65,0	8600
3G240	0,51	73,3	11030
3G300	0,51	81,0	13750
4G1,0	0,21	11,1	150
4G1,5	0,26	12,0	190
4G2,5	0,26	14,0	280
4G4	0,31	16,3	390
4G6	0,31	19,3	520
4G10	0,41	24,8	895
4G16	0,41	28,3	1290
4G25	0,41	33,5	1930
4G35	0,41	37,5	2480
4G50	0,41	43,3	3335
4G70	0,51	48,8	4545
4G95	0,51	54,8	6040
4G120	0,51	59,25	7335
4G150	0,51	66,3	9175
4G185	0,51	71,8	11035
4G240	0,51	81,5	14150
4G300	0,51	90,0	17650
5G1,0	0,21	12,0	185
5G1,5	0,26	13,3	235
5G2,5	0,26	15,3	340
5G4	0,31	17,8	485
5G6	0,31	21,3	640
5G10	0,41	27,3	1095
5G16	0,41	31,3	1595
5G25	0,41	37,0	2385

Panzerflex®-L; medium voltage power cable

Ratings and Specifications
VDE 0250 part 814

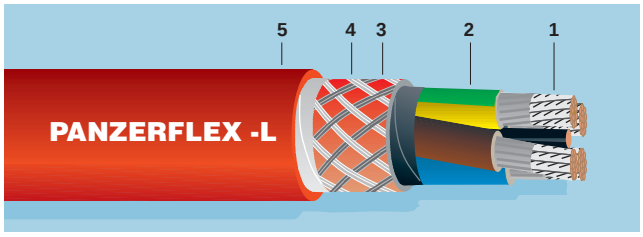
Rated and test voltages

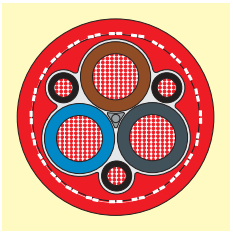
Rated voltage Uo/U	3,6/6	kV A.C.
Max voltage Um	7,2	kV A.C.
Test voltage	11	kV A.C.
Rated voltage Uo/U	6/10	kV A.C.
Max voltage Um	12	kV A.C.
Test voltage	17	kV A.C.
Rated voltage Uo/U	8,7/15	kV A.C.
Max voltage Um	18	kV A.C.
Test voltage	24	kV A.C.
Rated voltage Uo/U	12/20	kV A.C.
Max voltage Um	24	kV A.C.
Test voltage	32	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 25°C	Minimum ambient temperature during work

Applications
The new Panzerflex®-L* medium voltage cable has been developed and designed to meet the ever increasing demanding needs of the market in terms of reliability, speed and performance. The increase of the lengths, speed and acceleration requires more robust and at the same time lighter cables, whilst the smaller dimension can result in savings on equipment costs, transport and operating space. Typical applications for this cable are mobile installations on all types of harbour cranes, container cranes, ship unloaders, stackers & reclaimers, trippers, mobile generator sets and mining & tunnelling equipment.





Construction & Characteristics
PANZERFLEX® - L

1 *Phase conductor*
2 *Earth conductor*
3 *PCP inner sheath*
4 *Textile Anti-twisting braid*
5 *PCP outer sheath*

DIMENSIONAL DATA

PANZERFLEX®-L									
	A.C. Rated voltage 6 kV		A.C. Rated voltage 10 kV		A.C. Rated voltage 15 kV		A.C. Rated voltage 20 kV		
Nominal cross section n x mm²	Max. overall diam. mm²	Net weight kg/km	Max. overall diam. mm²	Net weight kg/km	Max. overall diam. mm²	Net weight kg/km	Max. overall diam. mm²	Net weight kg/km	Max. Continuous Safe Reeling Tension N
3 x 25 + 3 x 10	45,90	2742	47,6	2915	52,4	3377	58,0	3989	1500
3 x 35 + 3 x 10	48,90	3317	50,6	3484	56,6	4124	61,0	4638	2100
3 x 50 + 3 x 10	51,70	3845	54,7	4166	59,5	4697	63,9	5236	3000
3 x 70 + 3 x 16	57,00	5024	58,9	5220	63,7	5807	69,7	6610	4200
3 x 95 + 3 x 16	61,00	6041	62,8	6250	69,3	7101	73,7	7703	5700
3 x 120 + 3 x 25	67,00	7588	68,8	7819	73,7	8480	79,5	9370	7200
3 x 150 + 3 x 25	71,20	8793	73,0	9033	–	–	–	–	–
3 x 185 + 3 x 35	74,30	10078	77,4	10574	–	–	–	–	–

** Old version of PANZERFLEX is available on request.*

Panzerflex®-L FO; medium voltage power cable with optical fibre

Rating and test voltages

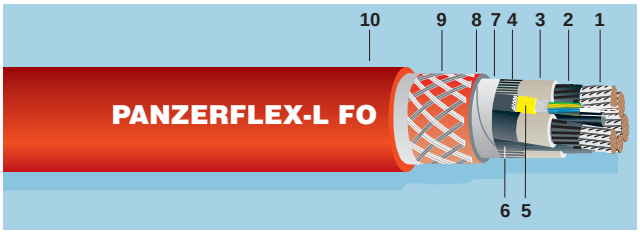
Rated voltage Uo/U	6/10	kV A.C.
Max voltage Um	12	kV A.C.
Test voltage	17	kV A.C.
Rated voltage Uo/U	8,7/15	kV A.C.
Max voltage Um	18	kV A.C.
Test voltage	24	kV A.C.
Rated voltage Uo/U	12/20	kV A.C.
Max voltage Um	24	kV A.C.
Test voltage	32	kV A.C.

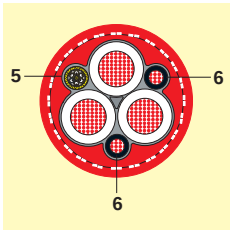
Temperature ratings

+ 90°C Maximum conductor temperature
– 20°C Minimum ambient temperature during work

Applications

Panzerflex®-L FO medium voltage flexible power cables with optical fibres have been developed for use on moving installations where there are high torsional and tensile stresses ambient conditions are harsh and where there is a need to transmit data and signals through optical fibres. Typical applications for Panzerflex®-L FO cables are reeling installations on ship-to-shore container cranes, ship-unloaders, stacker & reclaimers, heavy mining & tunnelling equipment and other large electrical machines.





Construction & Characteristics
PANZERFLEX®- L FO

1 *Flexible tinned stranded copper conductor*
2 *Semiconducting tape or layer*
3 *EPR core insulation*
4 *Semiconducting layer*
5 *Fibre optic element**
6 *Ground conductor*
7 *Tape*
8 *PCP Inner sheath*
9 *Textile braid*
10 *PCP outer sheath*

DIMENSIONAL DATA

PANZERFLEX®-L FO							
	A.C. Rated voltage 10 kV		A.C. Rated voltage 15 kV		A.C. Rated voltage 20 kV		
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Continuous Safe Reeling Tension N
3 x 25 + 2 x 16 + 6FO	50,0	2975	52,4	3365	58,0	4138	1500
3 x 35 + 2 x 16 + 6FO	50,6	3472	56,6	4112	61,0	4803	2100
3 x 50 + 2 x 16 + 6FO	54,7	4164	59,5	4695	63,9	5411	3000
3 x 70 + 2 x 25 + 6FO	58,9	5190	63,7	5777	69,7	6814	4200
3 x 95 + 2 x 25 + 6FO	62,8	6219	69,3	7070	–	–	5700
3 x 120 + 2 x 35 + 6FO	68,8	7755	73,7	8378	–	–	7200
3 x 150 + 2 x 35 + 6FO	73,0	8969	79,2	9882	–	–	9000
3 x 185 + 2 x 50 + 6FO	77,4	10343	82,3	11091	–	–	11100

** Fibre optic elements are available in sizes 62,5/125 and 50/125*
Note: attenuation on PANZERFLEX®-L FO complete at 850 nm: ≤ 5 dB/km

Panzerflat®; medium voltage flat reeling cable

Rating and test voltages

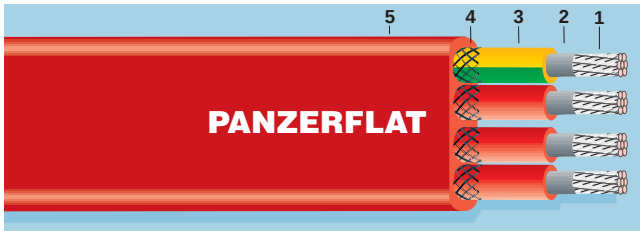
Rated voltage Uo/U	3	kV A.C.
Max voltage Um	7,2	kV A.C.
Test voltage	11	kV A.C.
Rated voltage Uo/U	6	kV A.C.
Max voltage Um	12	kV A.C.
Test voltage	17	kV A.C.

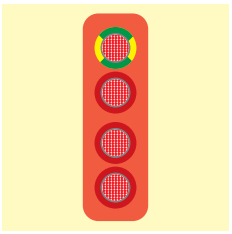
Temperature ratings

+ 90°C Maximum conductor temperature
– 20°C Minimum ambient temperature during work

Applications

Panzerflat medium voltage flat flexible power and control cables have been especially designed for festooning and horizontal applications on mobile installations. Typical applications for Panzerflat medium voltage are harbour cranes, container cranes, festooning installations, ship-unloaders, stackers and reclaimers, large mining and tunnelling equipment and reeling installations on all types of bridge cranes.





Construction & Characteristics
PANZERFLAT

1 *Tinned copper wire conductor*
2 *Semi-conductive layer*
3 *EPR compound insulation*
4 *Tinned copper braided screen on power cores*
5 *Rubber outer sheath*

DIMENSIONAL DATA

PANZERFLAT					
Nominal cross section n x mm²	Nominal conductor diameter mm²	Max DC elec. resistence at 20°C Ohm/km	Max. overall dimension* mm	Net weight kg/km	Max. Continuous Safe Reeling Tension N
3 kV					
4 x 35	12,9	0,565	75 x 26	3925	2100
4 x 50	14,2	0,393	80 x 28	5678	3000
4 x 70	16,1	0,277	88 x 30	5860	4200
6 kV					
4 x 35	16,4	0,565	84 x 29	4777	2100
4 x 50	17,7	0,393	86 x 30	5290	3000
4 x 70	19,6	0,277	99 x 33,5	6975	4200
4 x 95	21,4	0,210	104 x 40	8241	5700
6 kV + FO					
4 x 35 + 6FO	16,4	0,565	94 x 29	6020	2100
4 x 50 + 6FO	17,7	0,393	98,5 x 33	7090	3000

Note: the 6FO type has a 62,5/125 fibre optic element.
** Maximum overall dimensions are calculated within a tolerance of ± 2,5*

Protolon™ (SMK); medium voltage power cable

Ratings and Specifications
VDE 250, Part 813
VDE 0168/0118

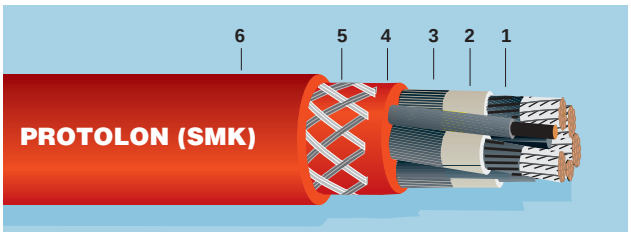
Rating and test voltages

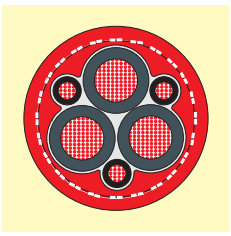
Rated voltage Uo/U	3,6/6	kV A.C.
Max voltage Um	4,2/7,2	kV A.C.
Test voltage	11	kV A.C.
Rated voltage Uo/U	6/10	kV A.C.
Max voltage Um	7,2/12	kV A.C.
Test voltage	17	kV A.C.
Rated voltage Uo/U	8,7/15	kV A.C.
Max voltage Um	10,4/18	kV A.C.
Test voltage	24	kV A.C.
Rated voltage Uo/U	12/20	kV A.C.
Max voltage Um	13,9/24	kV A.C.
Test voltage	29	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 35°C	Minimum ambient temperature during work (flexible)
– 50°C	Minimum ambient temperature during work (fixed)

Applications
The PROTOLON™ (SMK) is a medium voltage reeling cable, specifically designed to withstand extremely high mechanical stresses associated with high travel speed, dynamic tensile loads or torsional stresses. Applications include container cranes, shiploaders, stacker/reclaimers, RMG's, log handling cranes and much more. PROTOLON™ (SMK) is also suitable for mining applications like bucket wheel excavators or tunneling equipment. If application parameters exceed specified values in the technical tables, please consult your local Cavotec office.





Construction & Characteristics
PROTOLON (SMK)

1 *Conductor*
2 *Insulation*
3 *Outer semiconductive layer*
4 *Inner sheath*
5 *Anti-torsion braid*
6 *Outer sheath - Sandwich system*

DIMENSIONAL DATA

PROTOLON™ (SMK)									
	A.C. Rated voltage 3,6/6 kV		A.C. Rated voltage 6/10 kV		A.C. Rated voltage 8,7/15 kV		A.C. Rated voltage 12/20 kV		
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	net weight kg/km	Max. Contin. Safe Reeling Tension N
3 x 25 + 3 x 25/3	41,4	2380	41,4	2380	44,8	2670	47,8	2940	1500
3 x 35 + 3 x 25/3	43,9	2880	43,9	2880	47,4	3130	50,4	3420	2100
3 x 50 + 3 x 25/3	47,4	3480	47,4	3480	50,9	3810	55,8	4300	3000
3 x 70 + 3 x 50/3	53,4	4740	53,4	4740	56,9	4990	59,9	5300	4200
3 x 95 + 3 x 50/3	57,7	5660	57,7	5660	61,2	6070	65,6	6660	5700
3 x 120 + 3 x 70/3	61,2	6830	61,2	6830	66,1	7480	69,1	7870	7200
3 x 150 + 3 x 70/3	66,5	8180	66,5	8180	69,9	8630	73	9060	9000
3 x 185 + 3 x 95/3	70,4	9660	70,4	9660	73,8	10140	78,3	10850	11000

Protolon™ (SMK) LWL; medium voltage power cable with optical fibre

Ratings and Specifications
VDE 0250 part 813
VDE 0168/0118

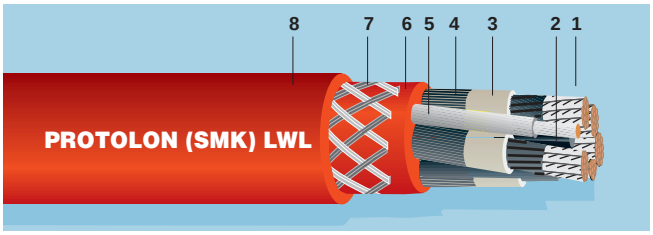
Rating and test voltages

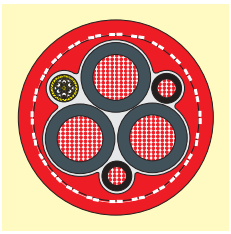
Rated voltage Uo/U	3,6/6	kV A.C.
Max voltage Um	4,2/7,2	kV A.C.
Test voltage	11	kV A.C.
Rated voltage Uo/U	6/10	kV A.C.
Max voltage Um	7,2/12	kV A.C.
Test voltage	17	kV A.C.
Rated voltage Uo/U	8,7/15	kV A.C.
Max voltage Um	10,4/18	kV A.C.
Test voltage	24	kV A.C.
Rated voltage Uo/U	12/20	kV A.C.
Max voltage Um	13,9/24	kV A.C.
Test voltage	29	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 35°C	Minimum ambient temperature during work (flexible)
– 50°C	Minimum ambient temperature during work (fixed)

Applications
The PROTOLON™ (SMK) LWL is a medium voltage reeling cable, specifically designed to withstand extremely high mechanical stresses associated with high travel speed, dynamic tensile loads or torsional stresses. PROTOLON™ (SMK) LWL features an integrated fiber optic element consisting of 6 or 18 optical fibers for transmission of control signals, voice, video and other data signals. Applications include container cranes, shiploaders, stacker/reclaimers, RMG's, log handling cranes and much more. PROTOLON™ (SMK) LWL is also suitable for mining applications like bucket wheel excavators and tunneling equipment. If PROTOLON™ (SMK) LWL cables are damaged they are easily repaired by qualified personnel, so it can be used again within its nominal parameters without restrictions.
If application parameters exceed specified values in the technical tables, please consult your local Cavotec office.





Construction & Characteristics
PROTOLON (SMK) LWL

1 *Conductor*
2 *EPR cradle separator*
3 *Insulation*
4 *Outer semiconductive layer*
5 *Fibre-optic element**
6 *Inner sheath*
7 *Anti-torsion braid*
8 *Outer sheath - Sandwich system*

DIMENSIONAL DATA

PROTOLON™ (SMK) LWL									
	A.C. Rated voltage 3,6/6 kV		A.C. Rated voltage 6/10 kV		A.C. Rated voltage 8,7/15 kV		A.C. Rated voltage 12/20 kV		
Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Contin. Safe Reeling Tension N
3 x 25 + 2 x 25/2 + 6 LWL	43,7	2610	43,7	2610	46,5	2860	49,6	3150	1500
3 x 35 + 2 x 25/2 + 6 LWL	45,7	3010	45,7	3010	49,1	3330	54,1	3810	2100
3 x 50 + 2 x 25/2 + 6 LWL	49,1	3680	49,1	3680	54,5	4210	58,1	4610	3000
3 x 70 + 2 x 35/2 + 6 LWL	55,1	4810	55,1	4810	59,2	5270	62,2	5640	4200
3 x 95 + 2 x 50/2 + 6 LWL	60,1	6000	60,1	6000	64,9	6640	68	7050	5700
3 x 120 + 2 x 70/2 + 6 LWL	64,9	7410	64,9	7410	68,4	7870	72	8360	7200
3 x 150 + 2 x 70/2 + 6 LWL	68,8	8570	68,8	8570	72,8	9130	77,3	9840	9000
3 x 185 + 2 x 95/2 + 6 LWL	73,3	10160	73,3	10160	78,1	10920	81,2	11410	11100

** Fibre optic elements are available in size 62,5/125µ, 50/125µ and E9/125µ*

CraneMAX; medium voltage power cable

Ratings and Specifications
ASTM B-172; ASTM B-33

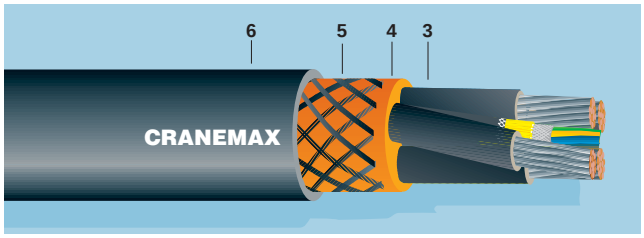
Rating and test voltages

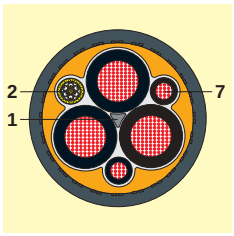
Rated voltage Uo/U	1,2/2,1 kV to 9,0/15	kV A.C.
Max voltage Um	1,2/2,1 kV to 9,0/15	kV A.C.
Max voltage Um	1,5/3,2 kV to 11,3/22,5	kV D.C.
Test voltage	18 to 27	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 40°C	Minimum ambient temperature during work

Applications
AmerCable's High Speed Reeling Cables are designed to provide safe and optimum performance on cable reels operating worldwide at temperatures from -40°C to +50°C at speeds up to 305 m./min. These three conductor cables are specially designed for use with monospiral, level wind and random wind reels on gantry cranes, container cranes, log handling cranes, stacker/reclaimers and other similar lifting equipment. They are suitable for outdoor use in ports, shipyards, lumber mills, steel mills and mines.
Please note that this cable is designed and built according to US standards.





Construction & Characteristics
CRANEMAX

1 *Filler*
2 *Conductor*
3 *Insulation & Extruded conductive shield*
4 *Inner jacket*
5 *Aramid reinforcement*
6 *Outer jacket*
7 *Ground (earth)*
8 *Ground check*

DIMENSIONAL DATA

CRANEMAX								
		A.C. Rated voltage 2,1/6 kV		A.C. Rated voltage 6,1/10 kV		A.C. Rated voltage 10,1/15 kV		
AWG	Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Continuous Safe Reeling Tension N
4	21,5	38,9	2149	40,5	2223	45,6	2609	3780
2	33,6	42,4	2707	44,0	2838	49,0	3256	3780
1	42,4	45,0	3144	46,6	3283	51,7	3720	4670
1/0	53,5	47,7	3653	49,3	3799	55,6	4512	5560
2/0	67,4	50,9	4360	52,5	4444	58,7	5202	6450
3/0	85	53,8	5315	55,4	5483	61,5	6029	7339
4/0	107,2	57,6	6330	59,2	6522	_	_	8229

CraneMAX FO; medium voltage power cable with optical fibre

Ratings and Specifications
ASTM B-172; ASTM B-33

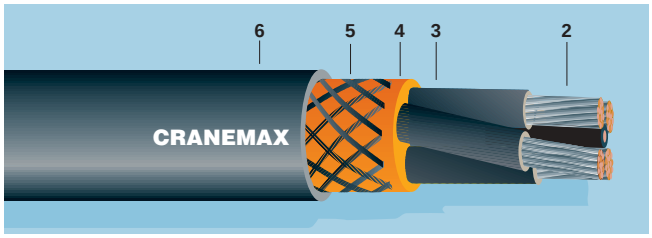
Rating and test voltages

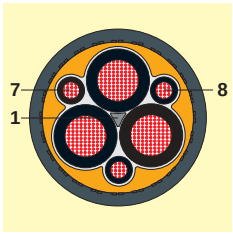
Rated voltage Uo/U	1,2/2,1 kV to 9,0/15	kV A.C.
Max voltage Um	1,2/2,1 kV to 9,0/15	kV A.C.
Max voltage Um	1,5/3,2 kV to 11,3/22,5	kV D.C.
Test voltage	18 to 27	kV A.C.

Temperature ratings

+ 90°C	Maximum conductor temperature
– 40°C	Minimum ambient temperature during work

Applications
AmerCable's High Speed Reeling Cables are designed to provide safe, optimum performance on cable reelers operating worldwide at temperatures from -40°C to +50°C at speeds up to 260 m/min. These cables are for the combined transmission of power and data and are specially designed for use with monospiral, level wind and random wind reelers on gantry cranes, container cranes, log handling cranes, stacker/reclaimers and other similar lifting equipment. They are suitable for outdoor use in ports, shipyards, lumber mills, steel mills and mines.
Please note that this cable is designed and built according to US standards.





Construction & Characteristics
CRANEMAX

1. *Filler*
2. *Fiber optic element*
3. *Insulation & Extruded conductive shield*
4. *Inner jacket*
5. *Aramid reinforcement*
6. *Outer jacket*
7. *Ground (earth)*

DIMENSIONAL DATA

CRANEMAX FO								
		A.C. Rated voltage 2,1/6 kV		A.C. Rated voltage 6,1/10 kV		A.C. Rated voltage 10,1/15 kV		
AWG	Nominal cross section mm²	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. overall diam. mm	Net weight kg/km	Max. Continuous Safe Reeling Tension N
4	21,5	38,9	2127	40,5	2201	45,6	2586	3780
2	33,6	42,4	2685	44,0	2816	49,0	3234	3780
1	42,4	45,0	3122	46,6	3261	51,7	3698	4670
1/0	53,5	47,7	3631	49,3	3777	55,6	4490	5560
2/0	67,4	50,9	4289	52,5	4421	58,7	5181	6450
3/0	85	53,8	5295	55,4	5406	61,5	6007	7339
4/0	107,2	57,6	6305	59,2	6501	_	_	8229

** Fibre optic elements are available in size 62,5/125. 6 fiber bundle is standard. 12 & 18 fiber bundles available on special order*


REGGIANE PACECO

Comparison chart
Metric cross-section – AWG* numbers

To ensure accurate translation between metric cross-sections and American Wire Gauge (AWG) numbers we have included this comparison chart. We do advise however to contact your local Cavotec office in the case of any uncertainty.

Metric nominal cross-section mm^2	mm^2	AWG number
0.75	0.653	**19**
	0.823	**18**
	1.04	**17**
	1.31	**16**
1.5	1.65	**15**
	2.08	**14**
2.5	2.62	**13**
	3.31	**12**
4.0	4.17	**11**
	5.26	**10**
6.0	6.63	**9**
	8.37	**8**
	10.55	**7**
10.0	13.30	**6**
16.0	16.77	**5**
	21.15	**4**
25.0	26.27	**3**
	33.63	**2**
35.0	42.41	**1**
	53.48	**1/0**
50	67.43	**2/0**
70.0	85.03	**3/0**
95.0	107.20	**4/0**
120.0	126.64	**250 MCM**
150.0	152.00	**300 MCM**
	177.35	**350 MCM**
185.00	202.71	**400 MCM**
240.0	253.35	**500 MCM**
300.0	380.00	**750 MCM**
400.0		
500.0	506.71	**1000 MCM**
625.0		

*AWG American Wire Gauge

REELS065

CABLE002