

H.V. Reeling Cables 3 to 30 kV with Integrated Fibre-Optics



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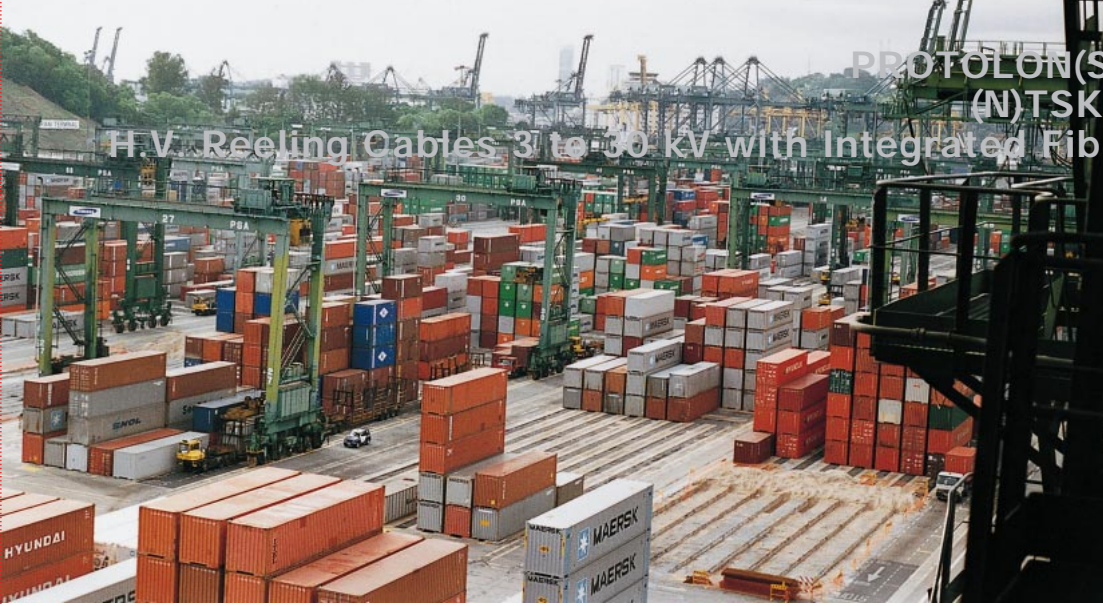
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Selection and dimensioning criteria

Refer to Section 4 for further details



	Type	PROTOLON(SMK) LWL		Page	4/2
	Type designation	(N)TSKCGEWÖU		Page	4/3
	Approvals/standards	DIN VDE 0250, Part 813, MSHA-P		Pages and	4/4 4/5
	Application	Flexible H.V. reeling cable, also suitable for festoon systems, for combined power and data transmission, with high to extreme mechanical stresses, e.g. high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses. Mainly for mobile equipment, e.g. fast-moving container cranes, cranes, large mobile equipment and excavators. Also for applications to which DIN VDE 0168 and 0118 apply: Open-cast and underground mining.		Pages and	4/6 4/7
Electrical parameters	Rated voltage	$U_0/U = 1.8/3 \text{ kV to } 18/30 \text{ kV}$		Pages to	4/8 4/13
	Maximum permissible operating voltage in AC systems	$U_0/U = 2.1/3.6 \text{ kV to } 20.8/36 \text{ kV}$			
	Maximum permissible operating voltage in DC systems	$U_0/U = 2.7/5.4 \text{ kV to } 27/54 \text{ kV}$			
	AC test voltage	6.0 kV to 43.0 kV according to DIN VDE 0250, Part 813			
	Current-carrying capacity	According to DIN VDE 0298, Part 4 Higher values are permissible in specific cases. Please consult the manufacturer			
	Data transmission	As special design with fibre-optics for absolute immunity of data transmission from interference at high data transmission rates.			
	EMC	This design exhibits an extremely low interference level as a result of use of a symmetrical three-core design with very narrow manufacturing tolerances.		Pages and	4/12 4/13
Optical parameters	Transmission data of the fibre-optics	Graded-index fibre 50/125	Graded-index fibre 62.5/125	Monomode fibre E9/125	
	Max. attenuation at wavelength 850 nm	2.8 dB/km	3.3 dB/km	–	
	Max. attenuation at wavelength 1300 nm	0.8 dB/km	0.9 dB/km	0.4 dB/km	
	Max. attenuation at wavelength 1550 nm	–	–	0.3 dB/km	
	Bandwidth at 850 nm and 1300 nm	> 400 MHz	> 400 MHz	–	
	Numerical aperture	0.200 ± 0.02	0.275 ± 0.02		
	Chromatic dispersion at 1300 nm	–	–	< 3.5 ps/nm km	
	Chromatic dispersion at 1550 nm	–	–	< 18 ps/nm km	



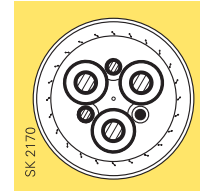
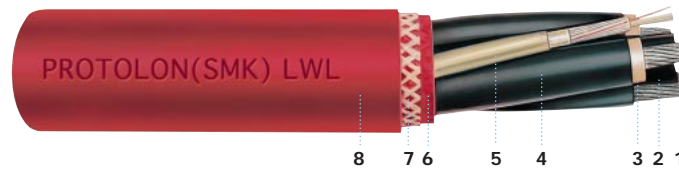
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Thermal parameters	Ambient temperature	- 35 °C to + 60 °C	Pages and	4/14
	<ul style="list-style-type: none"> Fully flexible operation Fixed installation 	- 50 °C to + 80 °C		4/15
	Maximum permissible operating temperature of the conductor	90 °C		
	Short-circuit temperature of the conductor	250 °C		
Mechanical parameters	Tensile load	Up to 20 N/mm ²	Page	4/16
	Torsional stresses	± 25 °/m	Page	4/16
	Minimum bending radii	According to DIN VDE 0298, Part 3	Page	4/17
	Minimum distance with S-type directional changes	20 x D (cable diameter)		
	Travel speed		Page	4/18
	<ul style="list-style-type: none"> Gantry (reeling operation) Trolley 	No restriction. For travel speeds > 180 m/min, the cable manufacturer should be consulted Up to 120 m/min. Consult the manufacturer for higher speeds		
Additional tests	Reversed bending test, torsional stress test	Page	4/19	
Chemical parameters	Resistance to oil	Given to DIN VDE 0473, Part 811-2-1, Para. 10	Page	4/21
	Weather resistance	Unrestricted use outdoors and indoors, resistant to ozone, UV and moisture		
	Water compatibility	According to HD 2216		
Note on installation	Preparation of fibre-optics requires special skills and use of elaborate tools. It is therefore recommended that performance of this work be entrusted to our customer service. (Assembly at works) Please give the connection dimensions.			

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



Design feature

Refer to Section 4 for further details →

Type	PROTOLON(SMK) LWL		4/2
Conductor and protective-earth conductor (refer also to DIN VDE 0295)	Electrolytic copper tinned, very finely stranded, class "FS"	Pages and	4/22 4/23
Insulation (refer also to DIN VDE 0207, Part 20)	PROTOLON HS Newly developed special compound based on high-quality EPR (at least 3GI3); improved mechanical and electrical characteristics	Pages to	4/24 4/26
Field control	For designs from 3 to 30 kV: inner semiconductive layer of EPR, outer semiconductive layer of modified NBR, capable of being stripped when cold and thus extremely easy to prepare (Easy Strip design)	Page	4/27
Core identification	From 3.6/6 kV: natural coloured insulation with black semiconductive layer		
Fibre-optics	Fibre core diameter: 62.5, 50 or 9 µm, diameter across the cladding: 125 µm diameter over the coating: 250 µm		
Fibre covering	Hollow core with filling compound, basic material ETFE		
Identification of the fibres	Specially developed colour code for identification of the individual fibres	Page	4/28
Arrangement of the cores/fibres	Six cores, laid-up in one layer with either one or three fibres specially laid-up around the central GFK supporting element	Page	4/29
Covering of the laid-up fibres	Special material		
Core	Standard for reeling fibre-optic cables: Conductive EPR shaped core for additional stability		
Core arrangement	Laid-up with length of lay $7 \times D$ (core diameter), three-core design, protective-earth conductor split into 2 and fibre-optic element in the outer filler	Pages and	4/28 4/29
Sheath system	<ul style="list-style-type: none"> ● PROTOFIRM Special: First sheath Newly developed special compound based on EPR, quality at least 5GM3, also serving as water barrier, colour: red 	Pages to	4/24 4/26
	<ul style="list-style-type: none"> ● Anti-torsion braid: reinforced braid made of polyester threads, in a vulcanized bond between the sheaths. Resulting in high strength of the sheath system 	Page	4/30
	<ul style="list-style-type: none"> ● PROTOFIRM Sandwich: 2nd and 3rd sheath A sheath system with a unique combination of flexibility and robustness has been achieved through the use of a new sandwich structure. Abrasion and tear-proof special rubber compounds based on PCP. Quality at least 5GM5, colour: bright red/red 	Pages to	4/24 4/26
Marking	PROTOLON(SMK) LWL (N)TSKCGEWÖU (number of cores) x (cross-section) (rated voltage) (year of manufacture) (serial number)	Page	4/31

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Selection data

Number of cores and nominal cross-section mm ²	Main conductor diameter (guidance value) mm	Protective-earth conductor diameter (guidance value) mm	Overall diameter of cable (guidance value) mm		Approx. net weight for 1000 m kg	Maximum permissible tensile force N
			Min. value	Max. value		

1.8/3 kV (N)TSKCGEWÖU

3 x 25 + 2 x 25/2 + 6 LWL	7.1	5.1	43.4	46.4	3530	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	5.1	45.5	48.5	4270	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	5.1	48.9	51.9	5130	3000
3 x 70 + 2 x 35/2 + 6 LWL	11.8	6.0	54.4	58.5	6220	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	7.2	61.0	65.0	7740	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	8.4	66.8	70.8	9100	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	8.4	70.7	74.7	10680	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	9.8	76.3	80.3	12350	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	11.0	82.9	86.9	15430	14400

3.6/6 kV (N)TSKCGEWÖU

3 x 25 + 2 x 25/2 + 6 LWL	7.1	4.2	39.9	42.9	2540	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	4.2	42.0	45.0	2950	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	4.2	44.8	47.8	3560	3000
3 x 70 + 2 x 35/2 + 6 LWL	11.8	5.0	49.9	53.9	4680	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	54.8	58.8	5850	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	58.2	62.2	7030	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	63.5	67.5	8400	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	68.0	72.0	9970	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	75.4	79.4	12670	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	81.6	85.6	15290	18000

6/10 kV (N)TSKCGEWÖU

3 x 25 + 2 x 25/2 + 6 LWL *	7.1	4.2	40.7	43.7	2610	1500
3 x 35 + 2 x 25/2 + 6 LWL *	8.3	4.2	42.7	45.7	3010	2100
3 x 50 + 2 x 25/2 + 6 LWL *	9.9	4.2	46.1	49.1	3680	3000
3 x 70 + 2 x 35/2 + 6 LWL *	11.8	5.0	51.1	55.1	4810	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	56.1	60.1	6000	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	60.9	64.9	7410	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	64.8	68.8	8570	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	69.3	73.3	10160	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	76.7	80.7	12880	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	84.2	89.2	15880	18000

8.7/15 kV (N)TSKCGEWÖU

3 x 25 + 2 x 25/2 + 6 LWL	7.1	4.2	43.5	46.5	2860	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	4.2	46.1	49.1	3330	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	4.2	50.5	54.5	4210	3000
3 x 70 + 2 x 35/2 + 6 LWL	11.8	5.0	55.2	59.2	5270	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	60.9	64.9	6640	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	64.4	68.4	7870	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	68.8	72.8	9130	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	74.1	78.1	10920	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	80.8	84.8	13560	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	87.7	92.7	16510	18000

**PROTOLON(SMK) LWL
(N)TSKCGEWÖU
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Selection data						
Number of cores and nominal cross-section mm ²	Main conductor diameter (guidance value) mm	Protective-earth conductor diameter (guidance value) mm	Overall diameter of cable		Approx. net weight for 1000 m kg	Maximum permissible tensile force N
			Min. value (guidance value) mm	Max. value (guidance value) mm		
12/20 kV (N)TSKCGEWÖU						
3 x 25 + 2 x 25/2 + 6 LWL	7.1	4.2	46.6	49.6	3150	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	4.2	50.1	54.1	3810	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	4.2	54.1	58.1	4610	3000
3 x 70 + 2 x 35/2 + 6 LWL	11.8	5.0	58.2	62.2	5640	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	64.0	68.0	7050	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	68.0	72.0	8360	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	73.3	77.3	9840	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	77.2	81.2	11410	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	85.1	90.1	14440	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	91.3	96.3	17810	18000
14/25 kV (N)TSKCGEWÖU						
3 x 25 + 2 x 25/2 + 6 LWL	7.1	4.2	51.4	55.4	3730	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	4.2	54.5	58.5	4300	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	4.2	58.0	62.0	5070	3000
3 x 70 + 2 x 35/3 + 6 LWL	11.8	5.0	63.5	67.5	6350	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	68.4	72.4	7650	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	73.3	77.3	9190	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	77.2	81.2	10450	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	81.6	85.6	12140	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	89.0	94.0	15150	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	96.2	101.2	18190	18000
18/30 kV (N)TSKCGEWÖU						
3 x 25 + 2 x 25/2 + 6 LWL	7.1	4.2	55.4	59.4	4180	1500
3 x 35 + 2 x 25/2 + 6 LWL	8.3	4.2	58.0	62.0	4720	2100
3 x 50 + 2 x 25/2 + 6 LWL	9.9	4.2	62.9	66.9	5730	3000
3 x 70 + 2 x 35/2 + 6 LWL	11.8	5.0	67.5	71.5	6900	4200
3 x 95 + 2 x 50/2 + 6 LWL	13.8	5.9	73.3	77.3	8420	5700
3 x 120 + 2 x 70/2 + 6 LWL	15.4	7.0	76.7	80.7	9720	7200
3 x 150 + 2 x 70/2 + 6 LWL	17.2	7.0	81.2	85.2	11120	9000
3 x 185 + 2 x 95/2 + 6 LWL	19.0	8.0	86.4	91.4	13120	11100
3 x 240 + 2 x 120/2 + 6 LWL	21.8	9.0	93.0	98.0	15910	14400
3 x 300 + 2 x 150/2 + 6 LWL	24.4	10.0	99.6	104.6	18890	18000