# PROTOLON(SMK)-LWL (N)TSKCGEWOEU

## Medium voltage reeling cable with fiber optics




### Application

Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or 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 and large moving equipment.

### Global data

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|---|---|
| Brand | FEICHUN PROTOLON(SMK)-LWL |
| Type designation | (N)TSKCGEWOEU |
| Standard | Based on DIN VDE 0250-813 |
| Certifications / Approvals | GOST-R |

### Notes on installation

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| Notes on installation | Preparation of fibre-optics requires special skills and use of elaborate tools. It is therefore recommended that performance of this work is entrusted to our customer service (Factory assembly). Please provide the connection dimensions. |

### Design features

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|---|---|
| Conductor | Conductor and earth conductor made of electrolytic copper tinned, very finely stranded, class FS (refer also to DIN VDE 0295) |
| Insulation | PROTOLON HS<br>High grade special compound based on high-quality EPR (at least 3GI3); improved mechanical and electrical characteristics (refer also to DIN VDE 0207, Part 20). |
| Electrical field control | 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) |
| Core identification | Natural coloured insulation with black semiconductive layer |
| Optical Fiber | Fibre core diameter: 62.5, 50 or 9µm; diameter across the cladding: 125µm; diameter over the coating: 250µm.<br>Design available with 6,12, 18 or 24 fibres. |

| Fibre class: | G50/125µm | G62,5/125µm | E9/125µm |
|---|---|---|---|
| Type: | Graded-index fibre | Graded-index fibre | Monomode fibre |
| - Attenuation at 850 nm: | <2,8 dB/km | <3,3 dB/km | - |
| - Attenuation at 1310 nm: | <0,8 dB/km | <0,9 dB/km | <0,4 dB/km |
| - Attenuation at 1550 nm: | - | - | <0,3 dB/km |
| - Bandwidth at 850 nm: | >400 MHz | >400 MHz | - |
| - Bandwidth at 1300 nm: | >1200 MHz | >600 MHz | - |
| - Numerical aperture: | 0,2 ± 0,02 | 0,275 ± 0,02 | 0,14 ± 0,02 |
| - Chromatic dispersion at 1300 nm: | - | - | <3,5 ps/nm km |
| - Chromatic dispersion at 1550 nm: | - | - | <3,5 ps/nm km |

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| Fiber coding | Specially developed color code for identification of the individual fibres |
| Fiber covering | Hollow core with filling compound, Basic material: ETFE, Compound: 7YI 1, Natural color |
| Core arrangement | Three core design with cradle separator in the centre, earth conductor splitted into 2 parts positioned in two interstices.<br>Optical element: six tubes, laid up around a central support element, with one, two or three optical fibers in each, positioned in the third interstice. |
| Sheath system | - PROTOFIRM Sandwich - double layer inner sheath:<br>Special compound based on EPR, quality at least 5GM3, also served as water barrier, color: red;<br>- Anti-torsion braid:<br>Reinforced braid made of polyester threads, in a vulcanized bond between the sheaths, resulting in high strength of the sheath system;<br>- PROTOFIRM Sandwich - double layer outer sheath:<br>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 high grade rubber compounds based on PCP, quality at least 5GM5, colour: bright red/red. |
| Marking | PROTOLON (SMK) LWL (N)TSKCGEWOEU<br>(number of cores)x(cross-section) (rated voltage) (year of manufacture) (serial number) |

## Electrical parameters

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|---|---|---|---|---|
| Rated voltage | 3.6/6 kV | 6/10 kV | 8.7/15 kV | 12/20 kV |
| Max. permissible operating voltage AC | 4.2/7.2 kV | 6.9/12 kV | 10.4/18 kV | 13.9/24 kV |
| Max. permissible operating voltage DC | 5.4/10.8 kV | 9/18 kV | 13.5/27 kV | 18/36 kV |
| AC test voltage | 11 kV | 17 kV | 24 kV | 29 kV |
| EMC | This design exhibits an extremely low interference level as a result of use a symmetrical three-core design with very narrow manufacturing rates. | | | |
| Data transmission | Special design with fibre-optics for trouble free data transmission at high data rates. | | | |
| Current Carrying Capacity description | According to DIN VDE 0298, Part 4. Higher values are permissible in specific cases (please consult the manufacturer). | | | |

## Chemical parameters

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|---|---|
| Resistance to oil | Acc. to DIN EN 60811-404 and DIN VDE 0473-811-404, paragraph 10 |
| Weather resistance | Unrestricted use outdoors and indoors, resistant to ozone, UV and moisture. |
| Water resistance | According to HD 2216 |

## Thermal parameters

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| Max. permissible temperature at conductor | 90 °C |
| Max. short circuit temperature of the conductor | 250 °C |
| Ambient temperature for fixed installation | min -50 °C ; max +80 °C |
| Ambient temperature in fully flexible operation | min -35 °C ; max +80 °C |

## Mechanical parameters

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|---|---|
| Max. tensile load on the conductor | 20 N/mm² |
| Max. tensile load on the conductor during acceleration | Up to 30 (acc. to DIN VDE 0298 part 3: 15 N/mm²) N/mm² |
| Torsional stress | ± 25 °/m |
| Min. bending radius | Acc. to DIN VDE 0298 part 3 |
| Min. distance with S-type directional changes | 20 x D (cable diameter) |
| Travel speed | - Gantry (reeling operation): no restriction. For speeds beyond 240 m/min it is recommended to consult the cable manufacturer |
| Additional tests | Reversed bending test, torsional stress test |

## Rated voltage 3.6/6 kV

| Number of cores x cross section | Part number | MLFB Number | Conduc-tor diameter max. mm | Earth conduc-tor diameter max. mm | Outer diameter min. mm | Outer diameter max. mm | Bending radius free moving min. mm | Weight (ca.) kg/km | Permis-sible tensile force max. N | Dynamic tensile force max. N | Con-ductor resis-tance at 20°C max. Ω/km | Current carrying capacity (1) A | Short Circuit Current (conduc-tor) kA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3x25 + 1x25 + 1x(12E9LWL) | | 5DK3081 | 7.1 | 5 | 39.9 | 42.9 | 429 | 2570 | 1500 | 2250 | 0.8 | 131 | 3.58 |
| 3x35 + 1x25 + 1x(12E9LWL) | 20004468 | 5DK3082 | 8.3 | 5 | 42 | 45 | 450 | 2990 | 2100 | 3150 | 0.57 | 162 | 5.01 |
| 3x50 + 1x25 + 1x(12E9LWL) | 20004469 | 5DK3083 | 9.9 | 5 | 44.8 | 47.8 | 478 | 3660 | 3000 | 4500 | 0.39 | 202 | 7.15 |
| 3x70 + 1x35 +1x (12E9LWL) | 20004470 | 5DK3084 | 11.8 | 5.9 | 49.9 | 53.9 | 539 | 4740 | 4200 | 6300 | 0.28 | 250 | 10.01 |
| 3x95 + 1x50 +1x (12E9LWL) | 20004471 | 5DK3085 | 13.8 | 7.2 | 54.8 | 58.8 | 588 | 5920 | 5700 | 8550 | 0.21 | 301 | 13.59 |
| 3x120 + 1x70 +1x (12E9LWL) | 20008293 | 5DK3086 | 15.4 | 8.3 | 58.2 | 62.2 | 622 | 7130 | 7200 | 10800 | 0.16 | 352 | 17.16 |
| 3x150 + 1x70 +1x (12E9LWL) | 20007743 | 5DK3100 | 17.2 | 8.3 | 63.5 | 67.5 | 675 | 8500 | 9000 | 13500 | 0.13 | 404 | 21.45 |

Design with 12,18 or 24 fibers and/or G50 or E9 types available upon request.
(1) Nominal current carrying capacity for rubber cables laid on a surface, at 30°C ambient temperature (see also VDE 0298-4, Table 15).

## Rated voltage 6/10 kV

| Number of cores x cross section | Part number | MLFB Number | Conduc-tor diameter max. mm | Earth conduc-tor diameter max. mm | Outer diameter min. mm | Outer diameter max. mm | Bending radius free moving min. mm | Weight (ca.) kg/km | Permis-sible tensile force max. N | Dynamic tensile force max. N | Con-ductor resis-tance at 20°C max. Ω/km | Current carrying capacity (1) A | Short Circuit Current (conduc-tor) kA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3x25 + 2x25/2 + 1x(6G62,5) | 20004548 | 5DK4081 | 7.1 | 5 | 40.7 | 43.7 | 437 | 2640 | 1500 | 2250 | 0.8 | 131 | 3.58 |
| 3x35 + 2x25/2 + 1x(6G62,5) | 20004549 | 5DK4082 | 8.3 | 5 | 42.7 | 45.7 | 457 | 3060 | 2100 | 3150 | 0.57 | 162 | 5.01 |
| 3x50 + 2x25/2 + 1x(6G62,5) | 20004550 | 5DK4083 | 9.9 | 5 | 46.1 | 49.1 | 491 | 3730 | 3000 | 4500 | 0.39 | 202 | 7.15 |
| 3x70 + 2x35/2 + 1x(6G62,5) | 20004551 | 5DK4084 | 11.8 | 5.9 | 51.1 | 55.1 | 551 | 4870 | 4200 | 6300 | 0.28 | 250 | 10.01 |
| 3x95 + 2x50/2 + 1x(6G62,5) | 20004552 | 5DK4085 | 13.8 | 7.2 | 56.1 | 60.1 | 601 | 6070 | 5700 | 8550 | 0.21 | 301 | 13.59 |
| 3x120 + 2x70/2 + 1x(6G62,5) | 20006945 | 5DK4086 | 15.4 | 8.3 | 60.9 | 64.9 | 649 | 7500 | 7200 | 10800 | 0.16 | 352 | 17.16 |
| 3x150 + 2x70/2 + 1x(6G62,5) | 20004553 | 5DK4087 | 17.2 | 8.3 | 64.8 | 68.8 | 688 | 8670 | 9000 | 13500 | 0.13 | 404 | 21.45 |
| 3x185 + 2x95/2 + 1x(6G62,5) | 20007673 | 5DK4088 | 19 | 9.8 | 69.3 | 73.3 | 733 | 10290 | 11100 | 16650 | 0.11 | 461 | 26.46 |
| 3x240 + 2x120/2 + 1x(6G62,5) | 20035801 | 5DK4090 | 21.8 | 11 | 76.7 | 80.7 | 807 | 12960 | 14400 | 21600 | 0.08 | 540 | 34.32 |
| 3x300 + 2x150/2 + 1x(6G62,5) | | 5DK4091 | 24.4 | 12 | 84.2 | 89.2 | 892 | 15880 | 18000 | 27000 | 0.07 | 620 | 42.9 |

Design with 12,18 or 24 fibers and/or G50 or E9 types available upon request.
(1) Nominal current carrying capacity for rubber cables laid on a surface, at 30°C ambient temperature (see also VDE 0298-4, Table 15).

## Rated voltage 8.7/15 kV

| Number of cores x cross section | Part number | MLFB Number | Conductor diameter max. mm | Earth conductor diameter max. mm | Outer diameter min. mm | Outer diameter max. mm | Bending radius free moving min. mm | Weight (ca.) kg/km | Permissible tensile force max. N | Dynamic tensile force max. N | Conductor resistance at 20°C max. Ω/km | Current carrying capacity (1) A | Short Circuit Current (conductor) kA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3x25 + 2x25/2 + 1x(6G62,5) | 20004664 | 5DK5078 | 7.1 | 5 | 43.5 | 46.5 | 465 | 2890 | 1500 | 2250 | 0.8 | 139 | 3.58 |
| 3x35 + 2x25/2 + 1x(6G62,5) | 20004667 | 5DK5082 | 8.3 | 5 | 46.1 | 49.1 | 491 | 3380 | 2100 | 3150 | 0.57 | 172 | 5.01 |
| 3x50 + 2x25/2 + 1x(6G62,5) | 20004668 | 5DK5083 | 9.9 | 5 | 50.5 | 54.5 | 545 | 4260 | 3000 | 4500 | 0.39 | 215 | 7.15 |
| 3x70 + 2x35/2 + 1x(6G62,5) | 20004669 | 5DK5084 | 11.8 | 5.9 | 55.2 | 59.2 | 592 | 5350 | 4200 | 6300 | 0.28 | 265 | 10.01 |
| 3x95 + 2x50/2 + 1x(6G62,5) | | 5DK5*** | 13.8 | 7.2 | 60.9 | 64.9 | 649 | 6700 | 5700 | 8550 | 0.21 | 319 | 13.59 |
| 3x120 + 2x70/2 + 1x(6G62,5) | | 5DK5*** | 15.4 | 8.3 | 64.4 | 68.4 | 684 | 7870 | 7200 | 10800 | 0.16 | 371 | 17.16 |
| 3x150 + 2x70/2 + 1x(6G62,5) | | 5DK5*** | 17.2 | 8.3 | 68.8 | 72.8 | 728 | 9130 | 9000 | 13500 | 0.13 | 428 | 21.45 |
| 3x185 + 2x95/2 + 1x(6G62,5) | | 5DK5*** | 19 | 9.8 | 74.1 | 78.1 | 781 | 10920 | 11100 | 16650 | 0.11 | 488 | 26.46 |
| 3x240 + 2x120/2 + 1x(6G62,5) | | 5DK5*** | 21.8 | 11 | 80.8 | 84.8 | 848 | 13560 | 14400 | 21600 | 0.08 | 574 | 34.32 |
| 3x300 + 2x150/2 + 1x(6G62,5) | | 5DK5*** | 24.4 | 12 | 87.7 | 92.7 | 927 | 16510 | 18000 | 27000 | 0.07 | 660 | 42.9 |

(1) Nominal current carrying capacity for rubber cables laid on a surface, at 30°C ambient temperature (see also VDE 0298-4, Table 15).
Design with 12,18 or 24 fibers and/or G50 or E9 types available upon request.

## Rated voltage 12/20 kV

| Number of cores x cross section | Part number | MLFB Number | Conductor diameter max. mm | Earth conductor diameter max. mm | Outer diameter min. mm | Outer diameter max. mm | Bending radius free moving min. mm | Weight (ca.) kg/km | Permissible tensile force max. N | Dynamic tensile force max. N | Conductor resistance at 20°C max. Ω/km | Current carrying capacity (1) A | Short Circuit Current (conductor) kA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3x25 + 2x25/2 + 1x(6G62,5) | 20004701 | 5DK5531 | 7.1 | 5 | 46.6 | 49.6 | 496 | 3200 | 1500 | 2250 | 0.8 | 139 | 3.58 |
| 3x35 + 2x25/2 + 1x(6G62,5) | 20004702 | 5DK5533 | 8.3 | 5 | 50.1 | 54.1 | 541 | 3880 | 2100 | 3150 | 0.57 | 172 | 5.01 |
| 3x50 + 2x25/2 + 1x(6G62,5) | | 5DK5*** | 9.9 | 5 | 54.1 | 58.1 | 581 | 4670 | 3000 | 4500 | 0.39 | 215 | 7.15 |
| 3x70 + 2x35/2 + 1x(6G62,5) | 20168072 | 5DK5*** | 11.8 | 5.9 | 58.2 | 62.2 | 622 | 5640 | 4200 | 6300 | 0.28 | 265 | 10.01 |
| 3x95 + 2x50/2 + 1x(6G62,5) | | 5DK5*** | 13.8 | 7.2 | 64 | 68 | 680 | 7050 | 5700 | 8550 | 0.21 | 319 | 13.59 |
| 3x120 + 2x70/2 + 1x(6G62,5) | | 5DK5*** | 15.4 | 8.3 | 68 | 72 | 720 | 8360 | 7200 | 10800 | 0.16 | 371 | 17.16 |
| 3x150 + 2x70/2 + 1x(6G62,5) | 20161633 | 5DK5*** | 17.2 | 8.3 | 73.3 | 77.3 | 773 | 9840 | 9000 | 13500 | 0.13 | 428 | 21.45 |
| 3x185 + 2x95/2 + 1x(6G62,5) | | 5DK5*** | 19 | 9.8 | 77.2 | 81.2 | 812 | 11410 | 11100 | 16650 | 0.11 | 488 | 26.46 |
| 3x240 + 2x120/2 + 1x(6G62,5) | | 5DK5*** | 21.8 | 11 | 85.1 | 90.1 | 901 | 14440 | 14400 | 21600 | 0.08 | 574 | 34.32 |
| 3x300 + 2x150/2 + 1x(6G62,5) | | 5DK5*** | 24.4 | 12 | 91.3 | 96.3 | 963 | 17810 | 18000 | 27000 | 0.07 | 660 | 42.9 |

Design with 12,18 or 24 fibers and/or G50 or E9 types available upon request.
(1) Nominal current carrying capacity for rubber cables laid on a surface, at 30°C ambient temperature (see also VDE 0298-4, Table 15).