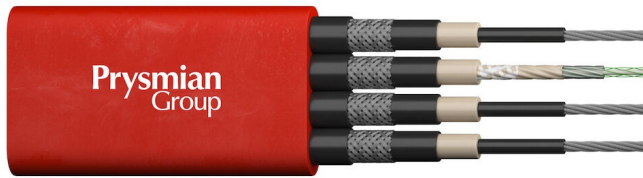


## PROTOLON (FL)-LWL (N)TSFLCGEWOEU 3,6/6KV

Medium voltage flat reeling cable with fibre-optics



Flexible medium voltage flat reeling cable with integrated fiber optics for the combined transmission of energy and data, for application under high mechanical stresses (e.g. dynamic tensile loads, multiple changes of direction within one plane, running over rollers). Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

### STANDARDS / APPROVALS

<b>DIN VDE 0298-4</b>	Electrical parameters
<b>Based on DIN VDE 0250-813</b>	General
<b>DIN EN 60228/ IEC 60228 / VDE 0295</b>	Conductor
<b>Reversed bending; roller bending</b>	Mechanical parameters
<b>DIN EN 60811-404 / IEC 60811-404</b>	Chemical behaviour
<b>HD 2216</b>	Chemical behaviour

### CABLE DESIGN

Conductor	Finely stranded copper, tinned, class 5 PE: individual concentric conductors distributed over the insulation of the three main cores
Inner semi-conducting layer	Yes
-	Semi-conductive EPR
Core insulation material	EPR rubber
-	PROTOLON HS
-	Special compound > 3GI3
Outer semi-conducting layer	Yes
-	Semi-conductive EPR
Core arrangement	Parallel core arrangement; earth conductor splitted and concentrically distributed around each core. Optical Element: six tubes, laid up around a central support element, with one, two or three optical fibers in each.
-	PROTOFIRM
Material outer sheath	Rubber - polychloroprene (PCP)
-	Special compound > 5GM5

### ELECTRICAL PARAMETERS

Rated voltage U <sub>0</sub> /U (Um)	3.6/6 (7.2) kV
Test voltage [kV]	11
Nominal voltage U [V]	6,000

## THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

## CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes

## OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

## 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.

## MECHANICAL PARAMETERS

Permanent tensile strength (rule)	15 N/mm <sup>2</sup>
Travel speed	- Gantry (reeling operation): up to 120 m/min
Bending radius (rule)	Acc. to VDE 0298-3: (Recommendation: applied cable diameter D = 1.5 x height of the flat cable) 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

## CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Height (min) [mm]	Height (max) [mm]	Width (min) [mm]	Width (max) [mm]	Cable weight [kg/km]
3x35+4x25/4E +1x(6G62,5)	20004465	5DK3...	8.3	24.5	27.5	83.5	88.5	3,700
3x50+4x25/4E +1x(6G62,5)	20015923	5DK3035	9.8	23.9	25.9	79.1	84.1	3,980
3x70+4x35/4E +1x(6G62,5)	FL_LWL_6KV_001	5DK3...	11.4	28.7	31.7	97.7	102.7	5,590
3x95+4x50/4E +1x(6G62,5)	20155087	5DK3...	13.3	30.6	33.6	105.3	110.3	6,720

## CABLE PROPERTIES ELECTRICAL / MECHANICAL

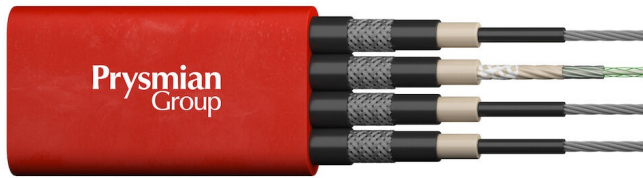
Basic construction	SAP code	External code	Max. tensile strength [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x35+4x25/4E +1x(6G62,5)	20004465	5DK3...	1,575	413	0.565	130
3x50+4x25/4E +1x(6G62,5)	20015923	5DK3035	2,250	389	0.393	162
3x70+4x35/4E +1x(6G62,5)	FL_LWL_6KV_001	5DK3...	3,150	476	0.277	200
3x95+4x50/4E +1x(6G62,5)	20155087	5DK3...	4,275	504	0.21	241

Current carrying capacity acc. VDE 0298-4, cable reeled in 1 layer, at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.

## PROTOLON (FL)-LWL (N)TSFLCGEWOEU 6/10KV

Medium voltage flat reeling cable with fibre-optics



Flexible medium voltage flat reeling cable with integrated fiber optics for the combined transmission of energy and data, for application under high mechanical stresses (e.g. dynamic tensile loads, multiple changes of direction within one plane, running over rollers). Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

### STANDARDS / APPROVALS

<b>DIN VDE 0298-4</b>	Electrical parameters
<b>Based on DIN VDE 0250-813</b>	General
<b>DIN EN 60228/ IEC 60228 / VDE 0295</b>	Conductor
<b>DIN EN 60811-404 / IEC 60811-404</b>	Chemical behaviour
<b>Reversed bending; roller bending</b>	Mechanical parameters
<b>HD 2216</b>	Chemical behaviour

### CABLE DESIGN

Conductor	Finely stranded copper, tinned, class 5 PE: individual concentric conductors distributed over the insulation of the three main cores
Inner semi-conducting layer	Yes
-	Semi-conductive EPR
Core insulation material	EPR rubber
-	PROTOLON HS
-	Special compound > 3GI3
Outer semi-conducting layer	Yes
-	Semi-conductive EPR
Core arrangement	Parallel core arrangement; earth conductor splitted and concentrically distributed around each core. Optical Element: six tubes, laid up around a central support element, with one, two or three optical fibers in each.
-	PROTOFIRM
Material outer sheath	Rubber - polychloroprene (PCP)
-	Special compound > 5GM5

### ELECTRICAL PARAMETERS

Rated voltage $U_0/U$ (Um)	6/10 (12) kV
Test voltage [kV]	17
Nominal voltage U [V]	10,000

## THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

## CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes

## OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

## 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.

## MECHANICAL PARAMETERS

Permanent tensile strength (rule)	15 N/mm <sup>2</sup>
Travel speed	- Gantry (reeling operation): up to 120 m/min
Bending radius (rule)	Acc. to VDE 0298-3: (Recommendation: applied cable diameter D = 1.5 x height of the flat cable) 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

## CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Height (min) [mm]	Height (max) [mm]	Width (min) [mm]	Width (max) [mm]	Cable weight [kg/km]
3x35+4x25/4E +1x(12E9)	20042601	5DK4507	8.3	25.3	28.3	86.7	91.7	3,910
3x35+4x25/4E +1x(6G62,5)	20170482	5DK4504	8.3	25.3	28.3	86.7	91.7	3,910
3x50+4x25/4E +1x(6G62,5)	20024635	5DK4253	9.8	27.8	30.8	94.1	99.1	4,810
3x50+4x50/4E +1x(18E9)	20096290	5DK4506	9.8	28.2	31.2	95.7	100.7	4,810
3x70+4x35/4E +1x(6G62,5)	20004644	5DK4...	11.4	29.5	32.5	100.9	105.9	5,800
3x95+4x50/4E +1x(6G62,5)	20165662	5DK4515	13.3	31.4	34.4	108.5	113.5	5,940

## CABLE PROPERTIES ELECTRICAL / MECHANICAL

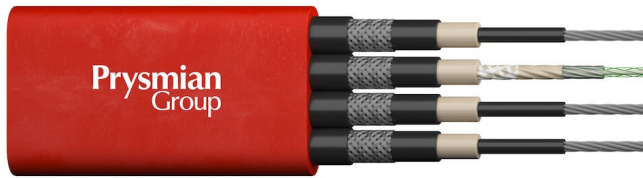
Basic construction	SAP code	External code	Max. tensile strength [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x35+4x25/4E +1x(12E9)	20042601	5DK4507	1,575	425	0.565	130
3x35+4x25/4E +1x(6G62,5)	20170482	5DK4504	1,575	425	0.565	130
3x50+4x25/4E +1x(6G62,5)	20024635	5DK4253	2,250	462	0.393	162
3x50+4x50/4E +1x(18E9)	20096290	5DK4506	2,250	468	0.393	162
3x70+4x35/4E +1x(6G62,5)	20004644	5DK4...	3,150	488	0.277	200
3x95+4x50/4E +1x(6G62,5)	20165662	5DK4515	4,275	516	0.21	241

Current carrying capacity acc. VDE 0298-4, cable reeled in 1 layer, at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.

## PROTOLON (FL)-LWL (N)TSFLCGEWOEU 8,7/15KV

Medium voltage flat reeling cable with fibre-optics



Flexible medium voltage flat reeling cable with integrated fiber optics for the combined transmission of energy and data, for application under high mechanical stresses (e.g. dynamic tensile loads, multiple changes of direction within one plane, running over rollers). Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

### STANDARDS / APPROVALS

Based on DIN VDE 0250-813  
 DIN EN 60228/ IEC 60228 / VDE 0295  
 DIN EN 60811-404 / IEC 60811-404  
 HD 2216  
 DIN VDE 0298-4  
 Reversed bending; roller bending

General  
 Conductor  
 Chemical behaviour  
 Chemical behaviour  
 Electrical parameters  
 Mechanical parameters

### CABLE DESIGN

Conductor	Finely stranded copper, tinned, class 5 PE: individual concentric conductors distributed over the insulation of the three main cores
Inner semi-conducting layer	Yes
-	Semi-conductive EPR
Core insulation material	EPR rubber
-	PROTOLON HS
-	Special compound > 3GI3
Outer semi-conducting layer	Yes
-	Semi-conductive EPR
Core arrangement	Parallel core arrangement; earth conductor splitted and concentrically distributed around each core. Optical Element: six tubes, laid up around a central support element, with one, two or three optical fibers in each.
-	PROTOFIRM
Material outer sheath	Rubber - polychloroprene (PCP)
-	Special compound > 5GM5

### ELECTRICAL PARAMETERS

Rated voltage U <sub>0</sub> /U (Um)	8.7/15 (17.5) kV
Test voltage [kV]	24
Nominal voltage U [V]	15,000

## THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

## CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes

## OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

## 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.

## MECHANICAL PARAMETERS

Permanent tensile strength (rule)	15 N/mm <sup>2</sup>
Travel speed	- Gantry (reeling operation): up to 120 m/min
Bending radius (rule)	Acc. to VDE 0298-3: (Recommendation: applied cable diameter D = 1.5 x height of the flat cable) 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes



## CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Height (min) [mm]	Height (max) [mm]	Width (min) [mm]	Width (max) [mm]	Cable weight [kg/km]
3x35+4x25/4E +1x(12E9LWL)	20160309	5DK4...	8.3	29.3	32.3	96.9	101.9	4,628
3x35+4x25/4E +1x(6G62,5LWL)	20213496	5DK5***	8.3	29.3	32.3	96.9	101.9	4,630
3x35+4x25/4E +1x(6G62,5LWL) BLACK	20004696	5DK5435	8.3	29.3	32.3	96.9	101.9	4,630
3x50+4x25/4E +1x(18G50LWL)	20004654	5DK5014	9.8	30	33	102.9	107.9	5,400
3x50+4x25/4E +1x(6G50LWL)	20173321	5DK5010	9.8	30	33	102.9	107.9	5,400
3x50+4x25/4E +1x(6G62,5LWL)	20168452	5DK5...	9.8	30	33	102.9	107.9	5,400
3x70+4x35/4E +1x(6G62,5)	FL_LWL15KV_001	5DK5...	11.4	31.7	33.7	109.7	114.7	6,460

## CABLE PROPERTIES ELECTRICAL / MECHANICAL

Basic construction	SAP code	External code	Max. tensile strength [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x35+4x25/4E +1x(12E9LWL)	20160309	5DK4...	1,575	485	0.565	138
3x35+4x25/4E +1x(6G62,5LWL)	20213496	5DK5***	1,575	485	0.565	138
3x35+4x25/4E +1x(6G62,5LWL) BLACK	20004696	5DK5435	1,575	485	0.565	130
3x50+4x25/4E +1x(18G50LWL)	20004654	5DK5014	2,250	495	0.393	172
3x50+4x25/4E +1x(6G50LWL)	20173321	5DK5010	2,250	495	0.393	172
3x50+4x25/4E +1x(6G62,5LWL)	20168452	5DK5...	2,250	495	0.393	172
3x70+4x35/4E +1x(6G62,5)	FL_LWL15KV_001	5DK5...	3,150	506	0.277	212

Current carrying capacity acc. VDE 0298-4, cable reeled in 1 layer, at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.