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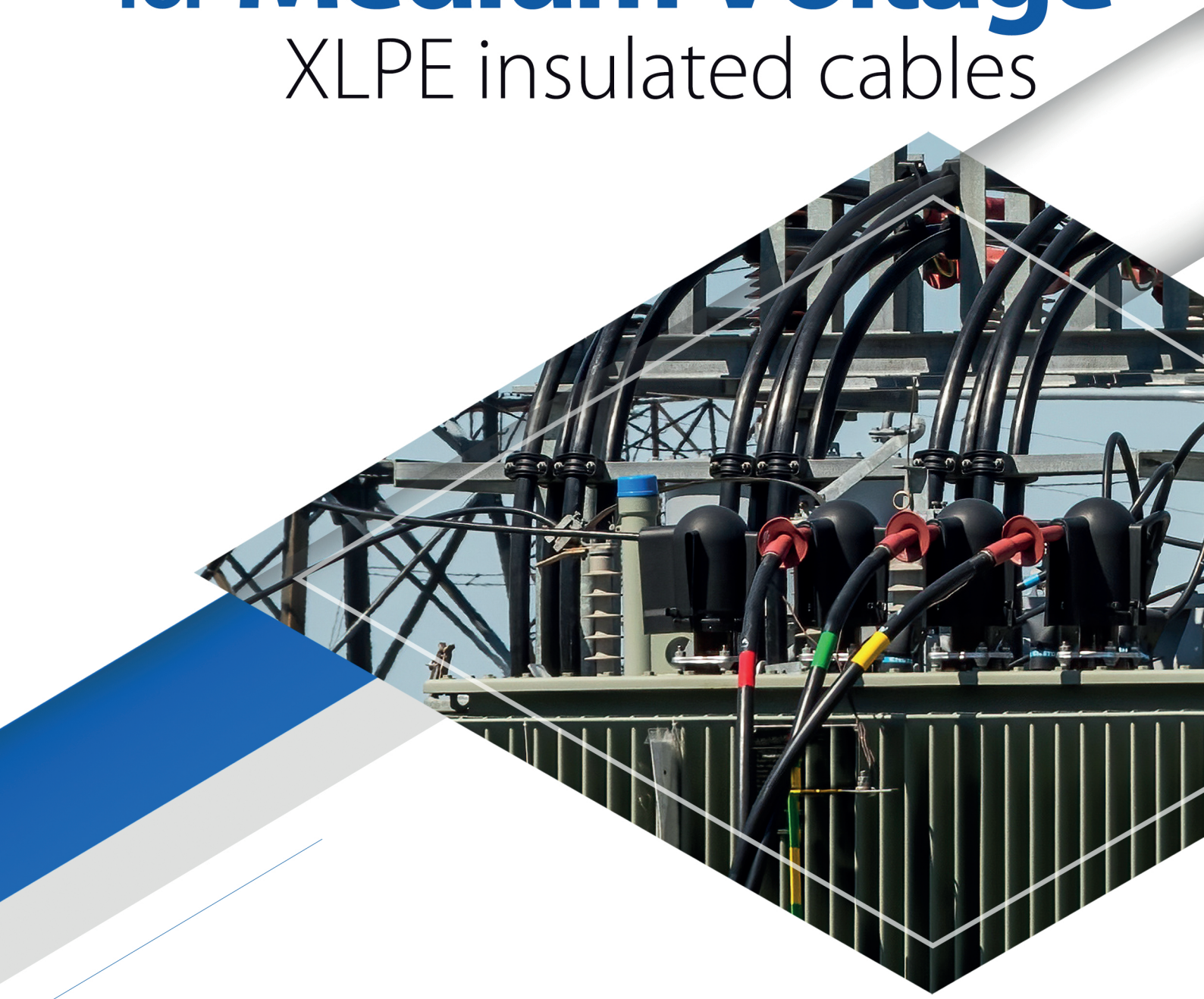
Technical Data for Medium Voltage

XLPE insulated cables



Kabelwerk EUPEN AG

Contents

Technical Data for Medium Voltage XLPE insulated cables

Scope

This document contains the general technical properties of our medium voltage power cables according to IEC 60502-2.

Individual properties like rated voltage, cable code denomination, colour code of cores and outer sheaths, marking on cables etc. are given in specific type documentation respectively in the specific project documentation.

1. Conductors

The conductors of our cables, copper (Cu) or aluminium (Al), are in accordance with the requirements of the IEC 60228.
For the construction details and the conductor resistance limits see following tables:

1.1 Max. DC conductor resistance at 20 °C acc. to IEC 60228 class 2

Nominal area of conductor	Minimum number of wires		Max. DC conductor resistance at 20 °C	
	Cu	Al	Cu	Al
mm²	circular stranded compacted	circular stranded compacted	Ω/km	Ω/km
25	6	6	0,727	1,20
35	6	6	0,524	0,868
50	6	6	0,387	0,641
70	12	12	0,268	0,443
95	15	15	0,193	0,320
120	18	15	0,153	0,253
150	18	15	0,124	0,206
185	30	30	0,0991	0,164
240	34	30	0,0754	0,125
300	34	30	0,0601	0,100
400	53	53	0,0470	0,0778
500	53	53	0,0366	0,0605
630	53	53	0,0283	0,0469

1.2 Resistance conversion at a temperature other than 20 °C

For conductor temperatures other than 20 °C the DC resistance shall be calculated with the following formula:

$$R_x = R_0[1 + a\,(T_x - 20)]\ \Omega/km$$

R_x = DC resistance at the temperature T_x (Ω/km)

R_0 = DC resistance at 20 °C (Ω/km)

T_x = conductor temperature (°C)

a = linear resistance temperature coefficient: 0,00393 for copper (K^{-1})
0,00403 for aluminium (K^{-1})

1.3 AC conductor resistance at 50 Hz and at max. conductor temperature rating of 90 °C

Nominal area of conductor	Minimum number of wires		AC conductor resistance at 50 Hz at 90 °C	
	Cu	Al	Cu	Al
mm²	circular stranded compacted	circular stranded compacted	Ω/km	Ω/km
6/10 kV – 20,8/36 kV				
25	6	6	0,931	1,54
35	6	6	0,672	1,12
50	6	6	0,497	0,825
70	12	12	0,345	0,571
95	15	15	0,250	0,414
120	18	15	0,199	0,328
150	18	15	0,164	0,269
185	30	30	0,132	0,215
240	34	30	0,102	0,166
300	34	30	0,083	0,134
400	53	53	0,067	0,106
500	53	53	0,056	0,085
630	53	53	0,041	0,065

Applicable for single-core cables laid in trefoil, laid flat (touching) and for three-core cables. Other configurations on demand.

1.4 Inductive resistance at 50 Hz and capacitance applicable on standard single-core cables without armour (2XSY / 2XS2Y / 2XS(F)2Y / 2XS(FL)2Y / 2XSH / 2XS(F)H / 2XS(FL)H)

Nominal area of conductor	Inductive resistance at 50 Hz			Capacitance
				
mm²	Ω/km (1)	Ω/km (2)	Ω/km (3)	µF/km
6/10 kV				
25	0,138	0,152	0,196	0,209
35	0,129	0,144	0,188	0,236
50	0,124	0,139	0,182	0,260
70	0,117	0,131	0,175	0,297
95	0,111	0,126	0,169	0,336
120	0,107	0,122	0,165	0,366
150	0,105	0,120	0,163	0,397
185	0,101	0,116	0,160	0,435
240	0,098	0,112	0,156	0,485
300	0,095	0,109	0,153	0,534
400	0,093	0,107	0,151	0,592
500	0,090	0,104	0,148	0,667
8,7/15 kV				
25	0,144	0,158	0,202	0,173
35	0,136	0,150	0,194	0,194
50	0,129	0,144	0,187	0,212
70	0,122	0,137	0,180	0,241
95	0,116	0,130	0,174	0,271
120	0,112	0,126	0,170	0,294
150	0,109	0,124	0,167	0,318
185	0,106	0,120	0,164	0,348
240	0,102	0,116	0,160	0,386
300	0,098	0,113	0,156	0,423
400	0,096	0,111	0,154	0,468
500	0,093	0,107	0,151	0,526
12/20 kV				
25	0,151	0,166	0,210	0,144
35	0,141	0,155	0,199	0,169
50	0,134	0,149	0,192	0,185
70	0,127	0,141	0,185	0,209
95	0,120	0,134	0,178	0,234
120	0,116	0,130	0,174	0,253
150	0,113	0,128	0,171	0,273
185	0,109	0,124	0,167	0,297
240	0,105	0,119	0,163	0,329
300	0,101	0,116	0,160	0,360
400	0,099	0,113	0,157	0,397
500	0,095	0,110	0,153	0,445

Nominal area of conductor mm²	Inductive resistance at 50 Hz  Ω/km (1)	 Ω/km (2)	 Ω/km (3)	Capacitance µF/km
18/30 kV				
50	0,145	0,159	0,203	0,145
70	0,136	0,151	0,194	0,162
95	0,129	0,144	0,187	0,180
120	0,124	0,139	0,183	0,194
150	0,121	0,136	0,179	0,207
185	0,117	0,131	0,175	0,225
240	0,112	0,127	0,170	0,247
300	0,109	0,123	0,167	0,269
400	0,105	0,120	0,163	0,295
500	0,101	0,116	0,159	0,328
20,8/36 kV				
150	0,124	0,138	0,182	0,194
185	0,119	0,134	0,177	0,210
240	0,115	0,129	0,173	0,231
300	0,110	0,125	0,169	0,251
400	0,107	0,122	0,165	0,275
500	0,103	0,118	0,161	0,305

(1) Trefoil laid

(2) Flat touching laid

(3) Flat spaced laid with distance = cable-Ø or flat touching ducts with duct-Ø = 2·cable-Ø

1.5 Inductive resistance at 50 Hz and capacitance applicable on standard three-core cables without and with armour (2XSEY / 2XSEYBY / 2XSEYRY / 2XSEH / 2XSEHBH / 2XSEHRH)

Nominal area of conductor	Inductive resistance at 50 Hz		Capacitance
	Unarmoured	Armoured	
mm²	Ω/km	Ω/km	µF/km
6/10 kV			
16	0,128	0,141	0,183
25	0,119	0,131	0,209
35	0,112	0,123	0,236
50	0,107	0,118	0,260
70	0,101	0,111	0,297
95	0,096	0,106	0,336
120	0,093	0,103	0,366
150	0,091	0,100	0,397
185	0,088	0,097	0,435
240	0,085	0,093	0,485
300	0,083	0,091	0,534
400	0,081	0,089	0,592
8,7/15 kV			
16	0,140	0,154	0,143
25	0,127	0,140	0,173
35	0,119	0,131	0,194
50	0,114	0,125	0,212
70	0,107	0,118	0,241
95	0,102	0,112	0,271
120	0,099	0,108	0,294
150	0,096	0,105	0,318
185	0,093	0,102	0,348
240	0,089	0,098	0,386
300	0,087	0,095	0,423
400	0,084	0,093	0,468
12/20 kV			
25	0,136	0,150	0,144
35	0,125	0,138	0,169
50	0,120	0,131	0,185
70	0,112	0,124	0,209
95	0,107	0,117	0,234
120	0,103	0,113	0,253
150	0,100	0,110	0,273
185	0,097	0,106	0,297
240	0,093	0,102	0,329
300	0,090	0,099	0,360
400	0,088	0,096	0,400

Nominal area of conductor mm²	Inductive resistance at 50 Hz Unarmoured Ω/km	 Armoured Ω/km	Capacitance µF/km
18/30 kV			
35	0,141	0,155	0,127
50	0,132	0,145	0,145
70	0,124	0,136	0,162
95	0,117	0,129	0,180
120	0,113	0,124	0,194
150	0,109	0,120	0,207
185	0,105	0,116	0,225
240	0,101	0,111	0,247
300	0,098	0,108	0,269
400	0,095	0,104	0,295

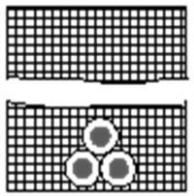
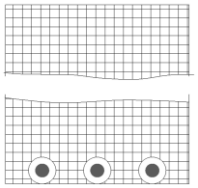
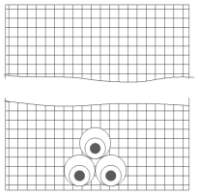
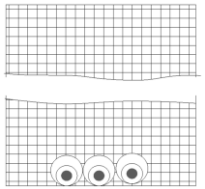
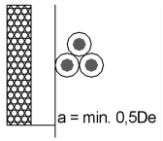
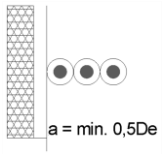
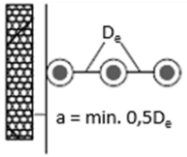
2. Current ratings

2.1 Generally

The following information is based on the standard IEC 60502-2 Annex B and does not claim to be complete. In case of doubt, the IEC standard shall be consulted.

The current ratings in this document are based on following installation conditions:

- Max. conductor temperature: 90 °C
- Ambient temperature (air): 30 °C
- Ground temperature: 20 °C
- Laying depth: 0,8 m
- Thermal resistivity of soil: 1,5 K·m/W
- Thermal resistivity of earthenware ducts: 1,2 K·m/W
- Without effects of solar or other infra-red radiation.
- Screen bonded at both ends
- Balanced three-phase load at 50 Hz

Nominal area of conductor	Buried direct in the ground		In single-way ducts		In air		
	Trefoil	Flat spaced (*)	Trefoil ducts	Flat touching ducts	Trefoil	Flat touching	Flat spaced
							
mm²	A	A	A	A	A	A	A
16	109	113	103	104	125	128	150
25	140	144	132	133	163	167	196
35	166	172	157	159	198	203	238
50	196	203	186	188	238	243	286
70	239	246	227	229	296	303	356
95	285	293	271	274	361	369	434
120	323	332	308	311	417	426	500
150	361	366	343	347	473	481	559
185	406	410	387	391	543	550	637
240	469	470	447	453	641	647	745
300	526	524	504	510	735	739	846
400	590	572	564	571	845	837	938
500	650	672	604	661	940	930	1043
630	730	754	678	742	1100	1088	1200

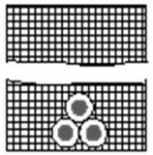
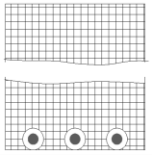
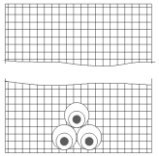
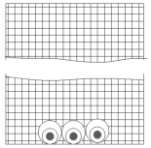
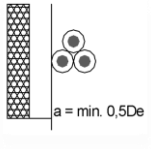
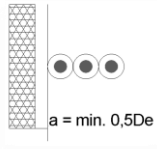
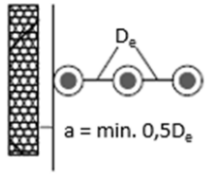
(*) Distance between cables = D_e (D_e = Cable outer-Ø)

Derating factor for all cables with alu tape armour: 0,98

Derating factor for all cables with alu wires armour ≤ 300 mm² conductor cross-section: 0,9

Derating factor for cables with alu wires armour > 300 mm² conductor cross-section: 0,85

These derating factors are only applicable for cables laid in trefoil. For flat laid systems, special derating factors are available on request.

Nominal area of conductor	Buried direct in the ground		In single-way ducts		In air		
	Trefoil	Flat spaced (*)	Trefoil ducts	Flat touching ducts	Trefoil	Flat touching	Flat spaced
							
mm²	A	A	A	A	A	A	A
16	84	88	80	81	97	99	116
25	108	112	102	103	127	130	153
35	129	134	122	123	154	157	185
50	152	157	144	146	184	189	222
70	186	192	176	178	230	236	278
95	221	229	210	213	280	287	338
120	252	260	240	242	324	332	391
150	281	288	267	271	368	376	440
185	317	324	303	307	424	432	504
240	367	373	351	356	502	511	593
300	414	419	397	402	577	586	677
400	470	466	451	457	673	676	769
500	530	546	504	537	773	776	919
630	600	646	554	617	883	886	1089

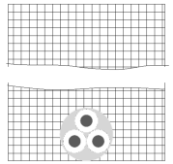
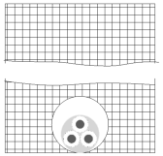
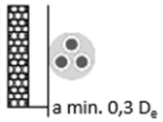
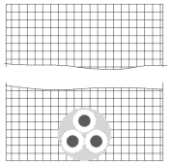
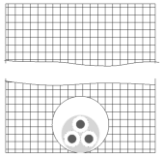
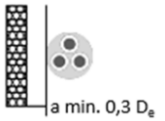
(*) Distance between cables = D_e (D_e = Cable outer-Ø)

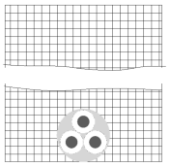
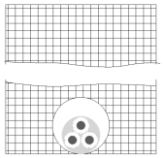
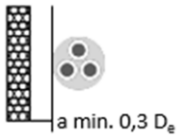
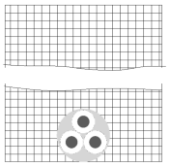
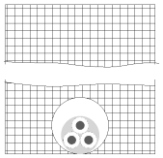
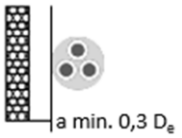
Derating factor for all cables with alu tape armour: 0,98

Derating factor for all cables with alu wires armour ≤ 300 mm² conductor cross-section: 0,9

Derating factor for cables with alu wires armour > 300 mm² conductor cross-section: 0,85

These derating factors are only applicable for cables laid in trefoil. For flat laid systems, special derating factors are available on request.

Nominal area of conductor	Unarmoured			Armoured		
	Buried direct in ground	In a buried duct	In air	Buried direct in ground	In a buried duct	In air
						
mm²	A	A	A	A	A	A
16	101	87	109	101	88	110
25	129	112	142	129	112	143
35	153	133	170	154	134	172
50	181	158	204	181	158	205
70	221	193	253	220	194	253
95	262	231	304	263	232	307
120	298	264	351	298	264	352
150	334	297	398	332	296	397
185	377	336	455	374	335	453
240	434	390	531	431	387	529
300	489	441	606	482	435	599
400	553	501	696	541	492	683

Nominal area of conductor	Unarmoured			Armoured		
	Buried direct in ground	In a buried duct	In air	Buried direct in ground	In a buried duct	In air
						
mm²	A	A	A	A	A	A
16	78	67	84	78	68	85
25	100	87	110	100	87	111
35	119	103	132	119	104	133
50	140	122	158	140	123	159
70	171	150	196	171	150	196
95	203	179	236	204	180	238
120	232	205	273	232	206	274
150	260	231	309	259	231	309
185	294	262	355	293	262	354
240	340	305	415	338	304	415
300	384	346	475	380	343	472
400	438	398	552	432	393	545

2.2 Correction factors for specific installation conditions

For conditions different from the base conditions see 2.1, appropriate correction factors shall be applied.
If more than one correction factor is applicable, the factors have to be multiplied to determine the total applicable rating factor.

2.2.1 Correction factors for ambient air temperatures other than 30 °C

Max. conductor temperature °C	Ambient air temperature °C							
	20	25	35	40	45	50	55	60
90	1,08	1,04	0,96	0,91	0,87	0,82	0,76	0,71

2.2.2 Correction factors for ambient ground temperatures other than 20 °C

Max. conductor temperature °C	Ambient ground temperature °C							
	10	15	25	30	35	40	45	50
90	1,07	1,04	0,96	0,93	0,89	0,85	0,80	0,76

2.2.3 Correction factors for depths of laying other than 0,8 m for direct buried cables

Depth of laying m	Single-core cables Nominal conductor size		Three-core cables
	≤ 185 mm²	> 185 mm²	
0,5	1,04	1,06	1,04
0,6	1,02	1,04	1,03
1	0,98	0,97	0,98
1,25	0,96	0,95	0,96
1,5	0,95	0,93	0,95
1,75	0,94	0,91	0,94
2	0,93	0,90	0,93
2,5	0,91	0,88	0,91
3	0,90	0,86	0,90

2.2.4 Correction factors for depths of laying other than 0,8 m for cables in ducts

Depth of laying	Single-core cables		Three-core cables
	Nominal conductor size		
m	≤ 185 mm²	> 185 mm²	
0,5	1,04	1,05	1,03
0,6	1,02	1,03	1,02
1	0,98	0,97	0,99
1,25	0,96	0,95	0,97
1,5	0,95	0,93	0,96
1,75	0,94	0,92	0,95
2	0,93	0,91	0,94
2,5	0,91	0,89	0,93
3	0,90	0,88	0,92

2.2.5 Correction factors for soil thermal resistivities other than 1,5 K·m/W for direct buried single-core cables

Nominal area of conductor mm²	Values of soil thermal resistivity K·m/W						
	0,7	0,8	0,9	1	2	2,5	3
16	1,29	1,24	1,19	1,15	0,89	0,82	0,75
25	1,30	1,25	1,20	1,16	0,89	0,81	0,75
35	1,30	1,25	1,21	1,16	0,89	0,81	0,75
50	1,32	1,26	1,21	1,16	0,89	0,81	0,74
70	1,33	1,27	1,22	1,17	0,89	0,81	0,74
95	1,34	1,28	1,22	1,18	0,89	0,80	0,74
120	1,34	1,28	1,22	1,18	0,88	0,80	0,74
150	1,35	1,28	1,23	1,18	0,88	0,80	0,74
185	1,35	1,29	1,23	1,18	0,88	0,80	0,74
240	1,36	1,29	1,23	1,18	0,88	0,80	0,73
300	1,36	1,30	1,24	1,19	0,88	0,80	0,73
400	1,37	1,30	1,24	1,19	0,88	0,79	0,73
500	1,37	1,30	1,24	1,19	0,88	0,79	0,73
630	1,37	1,30	1,24	1,19	0,88	0,79	0,73

2.2.6 Correction factors for soil thermal resistivities other than 1,5 K·m/W for single-core cables in buried ducts

Nominal area of conductor mm²	Values of soil thermal resistivity K·m/W						
	0,7	0,8	0,9	1	2	2,5	3
16	1,20	1,17	1,14	1,11	0,92	0,85	0,79
25	1,21	1,17	1,14	1,12	0,91	0,85	0,79
35	1,21	1,18	1,15	1,12	0,91	0,84	0,79
50	1,21	1,18	1,15	1,12	0,91	0,84	0,78
70	1,22	1,19	1,15	1,12	0,91	0,84	0,78
95	1,23	1,19	1,16	1,13	0,91	0,84	0,78
120	1,23	1,20	1,16	1,13	0,91	0,84	0,78
150	1,24	1,20	1,16	1,13	0,91	0,83	0,78
185	1,24	1,20	1,17	1,13	0,91	0,83	0,78
240	1,25	1,21	1,17	1,14	0,90	0,83	0,77
300	1,25	1,21	1,17	1,14	0,90	0,83	0,77
400	1,25	1,21	1,17	1,14	0,90	0,83	0,77
500	1,25	1,21	1,17	1,14	0,90	0,83	0,77
630	1,25	1,21	1,17	1,14	0,90	0,83	0,77

2.2.7 Correction factors for soil thermal resistivities other than 1,5 K·m/W for direct buried three-core cables

Nominal area of conductor mm²	Values of soil thermal resistivity K·m/W						
	0,7	0,8	0,9	1	2	2,5	3
16	1,23	1,19	1,16	1,13	0,91	0,84	0,78
25	1,24	1,20	1,16	1,13	0,91	0,84	0,78
35	1,25	1,21	1,17	1,13	0,91	0,83	0,78
50	1,25	1,21	1,17	1,14	0,91	0,83	0,77
70	1,26	1,21	1,18	1,14	0,90	0,83	0,77
95	1,26	1,22	1,18	1,14	0,90	0,83	0,77
120	1,26	1,22	1,18	1,14	0,90	0,83	0,77
150	1,27	1,22	1,18	1,15	0,90	0,83	0,77
185	1,27	1,23	1,18	1,15	0,90	0,83	0,77
240	1,28	1,23	1,19	1,15	0,90	0,83	0,77
300	1,28	1,23	1,19	1,15	0,90	0,82	0,77
400	1,28	1,23	1,19	1,15	0,90	0,82	0,76
500	1,28	1,23	1,19	1,15	0,90	0,82	0,76
630	1,28	1,23	1,19	1,15	0,90	0,82	0,76

2.2.8 Correction factors for soil thermal resistivities other than 1,5 K·m/W for three-core cables in ducts

Nominal area of conductor mm²	Values of soil thermal resistivity K·m/W						
	0,7	0,8	0,9	1	2	2,5	3
16	1,12	1,11	1,09	1,08	0,94	0,89	0,84
25	1,14	1,12	1,10	1,08	0,94	0,89	0,84
35	1,14	1,12	1,10	1,08	0,94	0,88	0,84
50	1,14	1,12	1,10	1,08	0,94	0,88	0,84
70	1,15	1,13	1,11	1,09	0,94	0,88	0,83
95	1,15	1,13	1,11	1,09	0,94	0,88	0,83
120	1,15	1,13	1,11	1,09	0,93	0,88	0,83
150	1,16	1,13	1,11	1,09	0,93	0,88	0,83
185	1,16	1,14	1,11	1,09	0,93	0,87	0,83
240	1,16	1,14	1,12	1,10	0,93	0,87	0,82
300	1,17	1,14	1,12	1,10	0,93	0,87	0,82
400	1,17	1,14	1,12	1,10	0,92	0,86	0,81
500	1,17	1,14	1,12	1,10	0,92	0,86	0,81
630	1,17	1,14	1,12	1,10	0,92	0,86	0,81

2.2.9 Correction factors for groups of three-phase circuits of single-core cables laid direct in ground

Number of cables in group	Spacing between group centers mm				
	Touching	200	400	600	800
2	0,73	0,83	0,88	0,90	0,92
3	0,60	0,73	0,79	0,83	0,86
4	0,54	0,68	0,75	0,80	0,84
5	0,49	0,63	0,72	0,78	0,82
6	0,46	0,61	0,70	0,76	0,81
7	0,43	0,58	0,68	0,75	0,80
8	0,41	0,57	0,67	0,74	-
9	0,39	0,55	0,66	0,73	-
10	0,37	0,54	0,65	-	-
11	0,36	0,53	0,64	-	-
12	0,35	0,52	0,64	-	-

2.2.10 Correction factors for groups of three-core cables in horizontal formation laid direct in ground

Number of cables in group	Spacing between cable centers mm				
	Touching	200	400	600	800
2	0,80	0,86	0,90	0,92	0,94
3	0,69	0,77	0,82	0,86	0,89
4	0,62	0,72	0,79	0,83	0,87
5	0,57	0,68	0,76	0,81	0,85
6	0,54	0,65	0,74	0,80	0,84
7	0,51	0,63	0,72	0,78	0,83
8	0,49	0,61	0,71	0,78	-
9	0,47	0,60	0,70	0,77	-
10	0,46	0,59	0,69	-	-
11	0,45	0,57	0,69	-	-
12	0,43	0,56	0,68	-	-

2.2.11 Correction factors for groups of three-phase circuits of single-core cables laid in single-way ducts

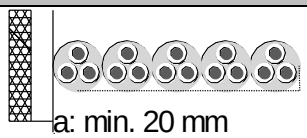
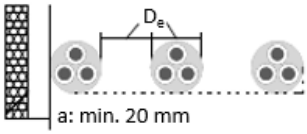
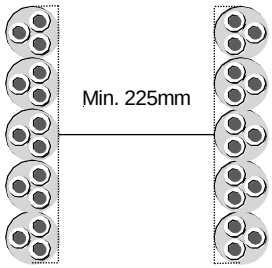
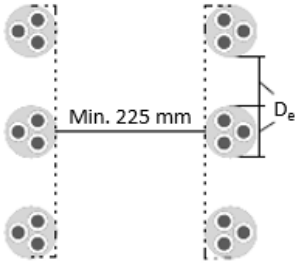
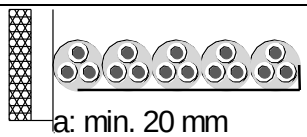
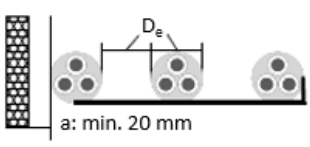
Number of cables in group	Spacing between duct group centers mm				
	Touching	200	400	600	800
2	0,78	0,85	0,89	0,91	0,93
3	0,66	0,75	0,81	0,85	0,88
4	0,59	0,70	0,77	0,82	0,86
5	0,55	0,66	0,74	0,80	0,84
6	0,51	0,64	0,72	0,78	0,83
7	0,48	0,61	0,71	0,77	0,82
8	0,46	0,60	0,70	0,76	-
9	0,44	0,58	0,69	0,76	-
10	0,43	0,57	0,68	-	-
11	0,42	0,56	0,67	-	-
12	0,40	0,55	0,67	-	-

2.2.12 Correction factors for groups of three-core cables in horizontal formation laid in single way-ducts

Number of cables in group	Spacing between duct centers mm				
	Touching	200	400	600	800
2	0,85	0,88	0,92	0,94	0,95
3	0,75	0,80	0,85	0,88	0,91
4	0,69	0,75	0,82	0,86	0,89
5	0,65	0,72	0,79	0,84	0,87
6	0,62	0,69	0,77	0,83	0,87
7	0,59	0,67	0,76	0,82	0,86
8	0,57	0,65	0,75	0,81	-
9	0,55	0,64	0,74	0,80	-
10	0,54	0,63	0,73	-	-
11	0,52	0,62	0,73	-	-
12	0,51	0,61	0,72	-	-

2.3 Reduction factors

2.3.1 Reduction factors for groups of more than one multi-core cable in air (Note 1) – To be applied to the current-carrying capacity for one multi-core cable in free air.

Method of installation (Note 2)		N°. of trays	Number of cables					
			1	2	3	4	6	9
Cables on perforated trays (Note 3)		1	1,00	0,88	0,82	0,79	0,76	0,73
		2	1,00	0,87	0,80	0,77	0,73	0,68
		3	1,00	0,86	0,79	0,76	0,71	0,66
		1	1,00	1,00	0,98	0,95	0,91	-
		2	1,00	0,99	0,96	0,92	0,87	-
		3	1,00	0,98	0,95	0,91	0,85	-
Cables on vertical perforated trays (Note 4)		1	1,00	0,88	0,82	0,78	0,73	0,72
		2	1,00	0,88	0,81	0,76	0,71	0,70
		1	1,00	0,91	0,89	0,88	0,87	-
		2	1,00	0,91	0,88	0,87	0,85	-
Cables on ladder supports, cleats, etc. (Note 3)		1	1,00	0,87	0,82	0,80	0,79	0,78
		2	1,00	0,86	0,80	0,78	0,76	0,73
		3	1,00	0,85	0,79	0,76	0,73	0,70
		1	1,00	1,00	1,00	1,00	1,00	-
		2	1,00	0,99	0,98	0,97	0,96	-
		3	1,00	0,98	0,97	0,96	0,93	-

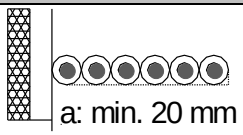
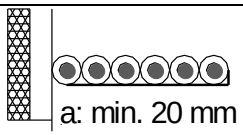
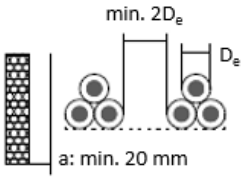
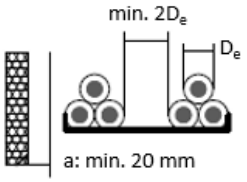
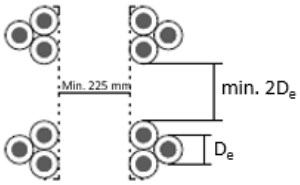
Note 1 Values given are averages for the cable types and range of conductor sizes considered.

Note 2 Factors apply to single layer groups of cables as shown above and do not apply when cables are installed in more than one layer touching each other.

Note 3 Values are given for vertical spacings between trays of 300 mm and at least 20 mm between trays and wall.

Note 4 Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back.

2.3.2 Reduction factors for groups of more than one circuit of single-core cables – To be applied to the current-carrying capacity for one circuit of single-core cables in free air (Note 1)

Method of installation (Note 2)		N°. of trays	Number of three-phase circuits (Note 5)			Use as a multiplier to rating for
			1	2	3	
Perforated trays (Note 3)		1 2 3	0,98 0,96 0,95	0,91 0,87 0,85	0,87 0,81 0,78	Three cables in horizontal formation
Ladder supports, cleats etc. (Note 3)		1 2 3	1,00 0,98 0,97	0,97 0,93 0,90	0,96 0,89 0,86	Three cables in horizontal formation
Perforated trays (Note 3)		1 2 3	1,00 0,97 0,96	0,98 0,93 0,92	0,96 0,89 0,86	Three cables in trefoil formation
Ladder supports, cleats, etc. (Note 3)		1 2 3	1,00 0,97 0,96	1,00 0,95 0,94	1,00 0,93 0,90	Three cables in trefoil formation
Vertical perforated trays (Note 4)		1 2	1,00 1,00	0,91 0,90	0,89 0,86	Three cables in trefoil formation

Note 1 Values given are averages for the cable types and range of conductor sizes considered.

Note 2 Factors apply to single layer of cables or trefoil groups as shown above and do not apply when cables are installed in more than one layer touching each other.

Note 3 Values are given for vertical spacings between trays of 300 mm and at least 20 mm between trays and wall.

Note 4 Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back.

Note 5 For circuits having more than one cable in parallel per phase, each three phases set of conductors should be considered as a circuit for the purpose of this table.

3. Thermic short circuit current rating

The following information concerns only the adiabatic thermic effect of a short circuit.
The mechanical effects (peak short circuit) can be calculated on demand for specific cable types.

The permissible short circuit current in a cable depends on the following parameters:
S = nominal cross section of the relevant cable construction element (conductor, screen, armour…) (mm²)
t = time of short circuit (max. 5 sec for adiabatic heating effect) (sec)
k = specific value depending of the relevant material and the applicable temperature limits. (A · $\sqrt{sec}$ / mm²)
Icc = short circuit current (A)

$$Icc = \frac{S \cdot k}{\sqrt{t}} \qquad S = \frac{Icc \cdot \sqrt{t}}{k}$$

<u>The values hereafter are based on the following limits:</u>

<u>For the conductors (Cu and Al)</u>

Conductor temperature before short circuit: 90 °C
Maximum short circuit temperature: 250 °C

<u>For the copper screens (wire or tape screen)</u>

Maximum short circuit temperature: 350 °C

<u>For the conductors and the screens</u>

k : Copper conductors: 143 A · $\sqrt{sec}$ / mm²
Aluminium conductor: 94 A · $\sqrt{sec}$ / mm²
Copper screen: 204 A · $\sqrt{sec}$ / mm²

t : Conductors: - for short circuit times **t ≠ 1 sec** (max. 5 sec) use the rating factor 1/ $\sqrt{t}$.

Screen: - its short circuit current is based on a non -adiabatic heating.
for short circuit times 0,1 ≤ t < 1 sec use the rating factor 1/ $\sqrt{t}$ with an additional reduction factor 0,94.
for short circuit times 1 ≤ t ≤ 5 sec use the rating factor 1/ $\sqrt{t}$.

Time of short circuit sec	Max. thermic short circuit current for copper conductors max. kA Nominal area of conductor mm²											
	25	35	50	70	95	120	150	185	240	300	400	500
0,1	11,3	15,8	22,6	31,7	43,0	54,3	67,8	83,7	108,5	135,7	180,9	226,1
0,2	8,0	11,2	16,0	22,4	30,4	38,4	48,0	59,2	76,7	95,9	127,9	159,9
0,3	6,5	9,1	13,1	18,3	24,8	31,3	39,2	48,3	62,7	78,3	104,4	130,5
0,4	5,7	7,9	11,3	15,8	21,5	27,1	33,9	41,8	54,3	67,8	90,4	113,1
0,5	5,1	7,1	10,1	14,2	19,2	24,3	30,3	37,4	48,5	60,7	80,9	101,1
0,6	4,6	6,5	9,2	12,9	17,5	22,2	27,7	34,2	44,3	55,4	73,8	92,3
0,7	4,3	6,0	8,5	12,0	16,2	20,5	25,6	31,6	41,0	51,3	68,4	85,5
0,8	4,0	5,6	8,0	11,2	15,2	19,2	24,0	29,6	38,4	48,0	64,0	79,9
0,9	3,8	5,3	7,5	10,6	14,3	18,1	22,6	27,9	36,2	45,2	60,3	75,4
1,0	3,6	5,0	7,2	10,0	13,6	17,2	21,5	26,5	34,3	42,9	57,2	71,5
1,5	2,9	4,1	5,8	8,2	11,1	14,0	17,5	21,6	28,0	35,0	46,7	58,4
2,0	2,5	3,5	5,1	7,1	9,6	12,1	15,2	18,7	24,3	30,3	40,4	50,6
3,0	2,1	2,9	4,1	5,8	7,8	9,9	12,4	15,3	19,8	24,8	33,0	41,3
4,0	1,8	2,5	3,6	5,0	6,8	8,6	10,7	13,2	17,2	21,5	28,6	35,8
5,0	1,6	2,2	3,2	4,5	6,1	7,7	9,6	11,8	15,3	19,2	25,6	32,0

Time of short circuit sec	Max. thermic short circuit current for aluminium conductors max. kA Nominal area of conductor mm²											
	25	35	50	70	95	120	150	185	240	300	400	500
0,1	7,4	10,4	14,9	20,8	28,2	35,7	44,6	55,0	71,3	89,2	118,9	148,6
0,2	5,3	7,4	10,5	14,7	20,0	25,2	31,5	38,9	50,4	63,1	84,1	105,1
0,3	4,3	6,0	8,6	12,0	16,3	20,6	25,7	31,7	41,2	51,5	68,6	85,8
0,4	3,7	5,2	7,4	10,4	14,1	17,8	22,3	27,5	35,7	44,6	59,5	74,3
0,5	3,3	4,7	6,6	9,3	12,6	16,0	19,9	24,6	31,9	39,9	53,2	66,5
0,6	3,0	4,2	6,1	8,5	11,5	14,6	18,2	22,5	29,1	36,4	48,5	60,7
0,7	2,8	3,9	5,6	7,9	10,7	13,5	16,9	20,8	27,0	33,7	44,9	56,2
0,8	2,6	3,7	5,3	7,4	10,0	12,6	15,8	19,4	25,2	31,5	42,0	52,5
0,9	2,5	3,5	5,0	6,9	9,4	11,9	14,9	18,3	23,8	29,7	39,6	49,5
1,0	2,4	3,3	4,7	6,6	8,9	11,3	14,1	17,4	22,6	28,2	37,6	47,0
1,5	1,9	2,7	3,8	5,4	7,3	9,2	11,5	14,2	18,4	23,0	30,7	38,4
2,0	1,7	2,3	3,3	4,7	6,3	8,0	10,0	12,3	16,0	19,9	26,6	33,2
3,0	1,4	1,9	2,7	3,8	5,2	6,5	8,1	10,0	13,0	16,3	21,7	27,1
4,0	1,2	1,6	2,4	3,3	4,5	5,6	7,1	8,7	11,3	14,1	18,8	23,5
5,0	1,1	1,5	2,1	2,9	4,0	5,0	6,3	7,8	10,1	12,6	16,8	21,0

Time of short circuit sec	Max. thermic short circuit current for copper screen max. kA		
	Nominal area of conductor mm²		
	16	25	35
0,1	9,7	15,2	21,2
0,2	6,9	10,7	15,0
0,3	5,6	8,8	12,3
0,4	4,9	7,6	10,6
0,5	4,3	6,8	9,5
0,6	4,0	6,2	8,7
0,7	3,7	5,7	8,0
0,8	3,4	5,4	7,5
0,9	3,2	5,1	7,1
1,0	3,3	5,1	7,1
1,5	2,7	4,2	5,8
2,0	2,3	3,6	5,0
3,0	1,9	2,9	4,1
4,0	1,6	2,6	3,6
5,0	1,5	2,3	3,2

4. Admissible pulling forces P(N)

a) with pulling head

$P = A \cdot 50$ N/mm² for copper cables

$P = A \cdot 30$ N/mm² for aluminium cables

b) with cable stocking

Force acting on the conductors (without armour):

See a)

Force acting on the outer sheath (without armour or with steel tapes armour):

$P = D_e^2 \cdot 3$ N/mm² (with max. see a))

Force acting on a steel wire armour (round or flat wires)

$P = D_e^2 \cdot 9$ N/mm²

A = Cross section of all conductors in mm² (without screen)

D_e = Cable diameter (mm)

5. Disclaimer

All information given is indicative only and not binding and can be subject to change without notice.

www.eupen.com

Kabelwerk EUPEN AG

Malmedyer Str. 9 - 4700 EUPEN - BELGIUM

Tel.: +32(0)87 59 70 00 e-mail:info@eupen.com http://www.eupen.com ISO Certified Company

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