

מאפייני כבלים במתח נמוך וגבוה

סגל אריאל

Power Cables

Table 5.1.5
PROTODUR cables (PVC insulation) with copper conductor

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm^2	1.5	2.5	4	6	10
	3	Shape and type of conductor		RE	RE	RE	RE	RE
	9	Thickness of insulation	mm	0.8	0.8	1.0	1.0	1.0
	16	Thickness of outer sheath	mm	1.8	1.8	1.8	1.8	1.8
	17	Overall diameter of cable	mm	13	14	17	18	20
	19	Weight of cable	kg/km	250	310	485	600	810
Mechanical properties	20	Minimum bending radius	mm	156	168	204	216	240
	21	Perm. pulling force with cable grip	N	300	500	800	1200	2000
	22	Perm. pulling force with pulling head	N	300	500	800	1200	2000
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	24	d.c. resistance/unit length at 20 °C	Ω/km	12.1	7.41	4.61	3.08	1.83
	31	Reference diameter of cable	mm	12.8	13.8	15.9	17.1	19.0
Laying direct in ground	32	Current-carrying capacity	A	26	34	44	56	75
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	38	Ohmic losses per cable	kW/km	29.4	30.7	32.0	34.7	36.9
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.053	0.959	0.877	0.805	0.717
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	0.696	0.684	0.662	0.650	0.633
	44	Inductance/unit length per conductor	mH/km	0.366	0.340	0.339	0.321	0.301
Installation in free air	32	Current-carrying capacity	A	18.6	25	33	42	57
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	38	Ohmic losses per cable	kW/km	15.0	16.6	18.0	19.5	21.3
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.053	0.959	0.877	0.805	0.717
	43	Thermal resistance of the air	Km/W	1.615	1.519	1.358	1.278	1.171
	44	Inductance/unit length per conductor	mH/km	0.366	0.340	0.339	0.321	0.301
	48	Minimum time value	s	42	65	95	132	199
Short-circuit	49	Rated short-time current of conductor (1s)	kA	0.173	0.288	0.460	0.690	1.15

NYY 4×... 0.6/1 kV (U_m=1.2 kV)

16 RE	25 RM	35 SM	50 SM	70 SM	95 SM	120 SM	150 SM	185 SM	240 SM	300 SM	400 SM
1.0	1.2	1.2	1.4	1.4	1.6	1.6	1.8	2.0	2.2	2.4	2.6
1.8	1.8	1.8	1.9	2.1	2.2	2.4	2.5	2.7	2.9	3.1	3.4
22	28	26	30	33	38	42	46	53	59	65	74
1100	1700	1750	2300	3150	4250	5300	6450	8650	11100	13700	17400
264	336	312	360	396	456	504	552	636	708	780	888
3200	5000	7000	10000	14000	19000	24000	30000	37000	48000	60000	80000
3200	5000	7000	10000	14000	19000	24000	30000	37000	48000	60000	80000
1.38	0.870	0.627	0.463	0.321	0.231	0.183	0.148	0.119	0.0902	0.0719	0.0562
1.15	0.727	0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470
21.3	25.7	25.8	29.6	33.4	37.9	41.7	45.7	50.7	56.8	62.2	71.0
98	129	156	185	228	274	313	352	398	464	525	602
1.38	0.870	0.627	0.463	0.321	0.232	0.184	0.150	0.120	0.0925	0.0747	0.0597
39.6	43.4	45.8	47.6	50.1	52.2	54.1	55.7	57.2	59.7	61.8	64.9
0.636	0.560	0.446	0.438	0.390	0.363	0.350	0.337	0.336	0.315	0.303	0.289
0.615	1.463	1.461	1.407	1.358	1.308	1.270	1.234	1.192	1.147	1.111	1.058
0.285	0.280	0.271	0.270	0.262	0.261	0.256	0.256	0.256	0.254	0.254	0.251
75	102	126	152	193	238	276	315	361	430	493	575
1.38	0.870	0.627	0.463	0.321	0.232	0.184	0.150	0.120	0.0925	0.0747	0.0597
23.2	27.2	29.9	32.1	35.9	39.4	42.1	44.6	47.0	51.3	54.5	59.2
0.636	0.560	0.446	0.438	0.390	0.363	0.350	0.337	0.336	0.315	0.303	0.289
1.065	0.912	0.898	0.804	0.726	0.653	0.603	0.559	0.513	0.466	0.432	0.386
0.285	0.280	0.271	0.270	0.262	0.261	0.256	0.256	0.256	0.254	0.254	0.251
294	388	498	699	850	1029	1221	1465	1696	2012	2392	3126
1.84	2.87	4.02	5.75	8.05	10.9	13.8	17.2	21.3	27.6	34.5	41.2

Table 5.1.3
PROTODUR cables (PVC insulation) with copper conductor

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm^2	1.5	2.5	4	6	10
	3	Shape and type of conductor		RE	RE	RE	RE	RE
	9	Thickness of insulation	mm	0.8	0.8	1.0	1.0	1.0
	16	Thickness of outer sheath	mm	1.8	1.8	1.8	1.8	1.8
	17	Overall diameter of cable	mm	12	13	16	17	19
	19	Weight of cable	kg/km	220	270	420	510	670
Mechanical properties	20	Minimum bending radius	mm	144	156	192	204	228
	21	Perm. pulling force with cable grip	N	225	375	600	900	1500
	22	Perm. pulling force with pulling head	N	225	375	600	900	1500
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	24	d.c. resistance/unit length at 20 °C	Ω/km	12.1	7.41	4.61	3.08	1.83
	31	Reference diameter of cable	mm	12.0	12.9	14.8	15.9	17.6
Laying direct in ground	32	Current-carrying capacity	A	25	34	44	55	75
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	38	Ohmic losses per cable	kW/km	27.1	30.7	32.0	33.4	36.9
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.079	0.973	0.888	0.810	0.717
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	0.706	0.695	0.673	0.662	0.645
	44	Inductance/unit length per conductor	mH/km	0.343	0.317	0.316	0.298	0.278
Installation in free air	32	Current-carrying capacity	A	18.2	24	32	41	56
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	14.5	8.87	5.52	3.69	2.19
	38	Ohmic losses per cable	kW/km	14.4	15.3	16.9	18.6	20.6
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.079	0.973	0.888	0.810	0.717
	43	Thermal resistance of the air	Km/W	1.697	1.598	1.435	1.352	1.242
	44	Inductance/unit length per conductor	mH/km	0.343	0.317	0.316	0.298	0.278
	48	Minimum time value	s	44	70	101	138	206
Short-circuit	49	Rated short-time current of conductor (1s)	kA	0.173	0.288	0.460	0.690	1.15

NYY-O 3×... 0.6/1 kV (U_m=1.2 kV)

16	25	35	50	70	95	120	150	185	240	300	400
RE	RM	SM	SM	SM	SM	SM	SM	SM	SM	SM	SM
1.0	1.2	1.2	1.4	1.4	1.6	1.6	1.8	2.0	2.2	2.4	2.6
1.8	1.8	1.8	1.8	2.0	2.1	2.2	2.3	2.5	2.7	2.9	3.1
20	25	23	26	30	34	36	40	47	52	57	64
900	1400	1350	1750	2400	3250	4000	4900	6550	8500	10450	13150
240	300	276	312	360	408	432	480	564	624	684	768
2400	3750	5250	7500	10500	14250	18000	22500	27750	36000	45000	60000
2400	3750	5250	7500	10500	14250	18000	22500	27750	36000	45000	60000
1.38	0.870	0.627	0.463	0.321	0.231	0.183	0.148	0.119	0.0902	0.0719	0.0562
1.15	0.727	0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470
19.6	23.5	23.0	25.8	29.6	33.5	36.1	40.4	44.4	50.1	54.9	61.6
98	128	155	184	225	271	309	348	394	458	516	591
1.38	0.870	0.627	0.463	0.321	0.232	0.184	0.150	0.121	0.0928	0.0752	0.0603
39.6	42.8	45.2	47.1	48.8	51.1	52.8	54.5	56.2	58.4	60.1	63.2
0.632	0.556	0.440	0.406	0.379	0.352	0.328	0.322	0.313	0.304	0.293	0.272
0.628	1.498	1.507	1.461	1.407	1.357	1.327	1.283	1.245	1.197	1.161	1.115
0.262	0.257	0.248	0.247	0.238	0.238	0.233	0.233	0.233	0.231	0.231	0.228
74	100	122	149	188	232	268	308	354	419	480	560
1.38	0.870	0.627	0.463	0.321	0.232	0.184	0.150	0.121	0.0928	0.0752	0.0603
22.6	26.1	28.0	30.9	34.1	37.4	39.7	42.7	45.3	48.9	52.0	56.7
0.632	0.556	0.440	0.406	0.379	0.352	0.328	0.322	0.313	0.304	0.293	0.272
1.135	0.978	0.982	0.894	0.798	0.720	0.675	0.616	0.570	0.515	0.477	0.432
0.262	0.257	0.248	0.247	0.238	0.238	0.233	0.233	0.233	0.231	0.231	0.228
302	404	532	727	895	1083	1295	1532	1764	2119	2523	3295
1.84	2.87	4.02	5.75	8.05	10.9	13.8	17.2	21.3	27.6	34.5	41.2

Table 5.1.1b
PROTODUR cables (PVC insulation) with copper conductor

Three-phase operation at 50 Hz

				4	6	10	16	25
Design	2	Nom. cross-sectional area of conductor	mm^2					
	3	Shape and type of conductor		RE	RE	RE	RE	RM
	9	Thickness of insulation	mm	1.0	1.0	1.0	1.0	1.2
	16	Thickness of outer sheath	mm	1.8	1.8	1.8	1.8	1.8
	17	Overall diameter of cable	mm	9	9	10	11	13
	19	Weight of cable	kg/km	125	155	200	265	395
Mechanical properties	20	Minimum bending radius	mm	135	135	150	165	195
	21	Perm. pulling force with cable grip	N	200	300	500	800	1250
	22	Perm. pulling force with pulling head	N	200	300	500	800	1250
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	24	d.c. resistance/unit length at 20 °C	Ω/km	4.61	3.08	1.83	1.15	0.727
	31	Reference diameter of cable	mm	7.85	8.36	9.15	10.1	11.9
Laying direct in ground	32	Current-carrying capacity	A	59	73	97	125	161
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	38	Ohmic losses per cable	kW/km	19.2	19.6	20.6	21.5	22.6
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.193	1.058	0.904	0.772	0.670
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	3.428	3.398	3.354	3.305	3.222
	44	Inductance/unit length per conductor	mH/km	0.944	0.904	0.856	0.811	0.761
Installation in free air	32	Current-carrying capacity	A	45	56	77	102	137
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	38	Ohmic losses per cable	kW/km	11.2	11.6	13.0	14.3	16.3
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.193	1.058	0.904	0.772	0.670
	43	Thermal resistance of the air	Km/W	2.467	2.347	2.186	2.022	1.784
	44	Inductance/unit length per conductor	mH/km	0.623	0.595	0.563	0.535	0.514
	48	Minimum time value	s	51	74	109	159	215
Short-circuit	49	Rated short-time current of conductor (1s)	kA	0.460	0.690	1.15	1.84	2.87

NYY 1×... 0.6/1 kV (U_m=1.2 kV

35	50	70	95	120	150	185	240	300	400	500
RM	RM	RM	RM	RM	RM	RM	RM	RM	RM	RM
1.2	1.4	1.4	1.6	1.6	1.8	2.0	2.2	2.4	2.6	2.8
1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.1
14	16	17	19	21	23	25	28	30	34	38
495	650	850	1150	1400	1700	2050	2650	3300	4150	5250
210	240	255	285	315	345	375	420	450	510	570
1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
0.627	0.463	0.321	0.231	0.183	0.148	0.119	0.0902	0.0719	0.0562	0.0438
0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470	0.0366
13.0	14.6	16.3	18.3	19.8	21.7	23.7	26.6	29.2	33.0	36.4
192	227	278	332	377	423	478	555	626	716	813
0.627	0.463	0.321	0.231	0.184	0.149	0.119	0.0912	0.0732	0.0579	0.0461
23.1	23.9	24.8	25.5	26.1	26.7	27.3	28.1	28.7	29.7	30.5
0.592	0.551	0.476	0.443	0.402	0.385	0.369	0.342	0.333	0.312	0.299
3.176	3.115	3.055	2.991	2.946	2.893	2.841	2.771	2.713	2.635	2.570
0.729	0.702	0.668	0.643	0.621	0.604	0.587	0.564	0.549	0.528	0.512
168	204	258	318	370	424	489	584	672	789	916
0.627	0.463	0.321	0.231	0.184	0.149	0.120	0.0916	0.0736	0.0584	0.0465
17.7	19.3	21.4	23.4	25.2	26.8	28.6	31.2	33.2	36.4	39.0
0.592	0.551	0.476	0.443	0.402	0.385	0.369	0.342	0.333	0.312	0.299
1.662	1.519	1.389	1.268	1.189	1.105	1.030	0.938	0.870	0.788	0.727
0.497	0.489	0.473	0.466	0.458	0.454	0.451	0.445	0.443	0.439	0.436
280	388	475	576	679	808	924	1091	1287	1660	1924
4.02	5.75	8.05	10.9	13.8	17.2	21.3	27.6	34.5	41.2	51.5

Table 5.1.1a
PROTODUR cables (PVC insulation) with copper conductor

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	4	6	10	16	25
	3	Shape and type of conductor		RE	RE	RE	RE	RM
	9	Thickness of insulation	mm	1.0	1.0	1.0	1.0	1.2
	16	Thickness of outer sheath	mm	1.8	1.8	1.8	1.8	1.8
	17	Overall diameter of cable	mm	9	9	10	11	13
	19	Weight of cable	kg/km	125	155	200	265	395
Mechanical properties	20	Minimum bending radius	mm	135	135	150	165	195
	21	Perm. pulling force with cable grip	N	200	300	500	800	1250
	22	Perm. pulling force with pulling head	N	200	300	500	800	1250
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	24	d.c. resistance/unit length at 20 °C	Ω/km	4.61	3.08	1.83	1.15	0.727
	31	Reference diameter of cable	mm	7.85	8.36	9.15	10.1	11.9
Laying direct in ground	32	Current-carrying capacity	A	50	62	82	105	136
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	38	Ohmic losses per cable	kW/km	13.8	14.2	14.7	15.2	16.1
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.193	1.058	0.904	0.772	0.670
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	5.252	5.177	5.069	4.952	4.756
	44	Inductance/unit length per conductor	mH/km	0.459	0.431	0.399	0.371	0.350
Installation in free air	32	Current-carrying capacity	A	36	46	62	83	111
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	5.52	3.69	2.19	1.38	0.870
	38	Ohmic losses per cable	kW/km	7.1	7.8	8.4	9.5	10.7
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	1.515	1.356	1.172	1.013	0.889
	43	Thermal resistance of the air	Km/W	4.028	3.818	3.536	3.252	2.840
	44	Inductance/unit length per conductor	mH/km	0.459	0.431	0.399	0.371	0.350
	48	Minimum time value	s	80	110	168	240	328
Short-circuit	49	Rated short-time current of conductor (1s)	kA	0.460	0.690	1.15	1.84	2.87

NYY 1×... 0.6/1 kV (U_m=1.2 kV)

35 RM	50 RM	70 RM	95 RM	120 RM	150 RM	185 RM	240 RM	300 RM	400 RM	500 RM
1.2	1.4	1.4	1.6	1.6	1.8	2.0	2.2	2.4	2.6	2.8
1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.1
14	16	17	19	21	23	25	28	30	34	38
495	650	850	1150	1400	1700	2050	2650	3300	4150	5250
210	240	255	285	315	345	375	420	450	510	570
1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
0.627	0.463	0.321	0.231	0.183	0.148	0.119	0.0902	0.0719	0.0562	0.0438
0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470	0.0366
13.0	14.6	16.3	18.3	19.8	21.7	23.7	26.6	29.2	33.0	36.4
163	193	237	284	323	363	411	477	537	612	689
0.627	0.463	0.321	0.232	0.184	0.150	0.121	0.0930	0.0754	0.0607	0.0495
16.7	17.3	18.1	18.7	19.2	19.8	20.4	21.2	21.7	22.7	23.5
0.592	0.551	0.476	0.443	0.402	0.385	0.369	0.342	0.333	0.312	0.299
4.650	4.512	4.380	4.242	4.148	4.039	3.933	3.796	3.684	3.538	3.421
0.333	0.325	0.309	0.302	0.294	0.290	0.287	0.281	0.279	0.275	0.272
136	166	210	259	301	345	398	475	545	636	730
0.627	0.463	0.321	0.232	0.184	0.150	0.121	0.0930	0.0754	0.0607	0.0495
11.6	12.8	14.2	15.6	16.7	17.9	19.1	21.0	22.4	24.6	26.4
0.792	0.742	0.648	0.606	0.553	0.531	0.511	0.475	0.463	0.436	0.419
2.634	2.392	2.175	1.974	1.843	1.706	1.584	1.435	1.326	1.194	1.097
0.333	0.325	0.309	0.302	0.294	0.290	0.287	0.281	0.279	0.275	0.272
428	586	718	869	1027	1221	1396	1649	1957	2555	3030
4.02	5.75	8.05	10.9	13.8	17.2	21.3	27.6	34.5	41.2	51.5

Table 5.2.1a
PROTOTHEN X cables (XLPE insulation) with copper conductor

כבל בעלי סיכוך משותף 6/10kV

N2XS2Y

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	25 RM	35 RM	50 RM	70 RM	95 RM	120 RM	150 RM	185 RM	240 RM	300 RM	400 RM	500 RM
	3	Shape and type of conductor		16	16	16	16	16	16	25	25	25	25	35	35
	5	Nom. cross-sectional area of screen	mm²												
	9	Thickness of insulation	mm	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
	16	Thickness of outer sheath	mm	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	17	Overall diameter of cable	mm	23	24	26	27	29	30	32	33	36	39	42	45
	19	Weight of cable	kg/km	720	830	970	1200	1450	1700	2050	2450	3000	3600	4500	5550
Mechanical properties	20	Minimum bending radius	mm	345	360	390	405	435	450	480	495	540	585	630	675
	21	Perm. pulling force with cable grip	N	1250	1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
	22	Perm. pulling force with pulling head	N	1250	1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
Electrical properties	23	d.c. resistance/unit length at 90 °C	Ω/km	0.927	0.668	0.493	0.342	0.246	0.195	0.158	0.126	0.0961	0.0766	0.0599	0.0467
	24	d.c. resistance/unit length at 20 °C	Ω/km	0.727	0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470	0.0366
	25	Operating capacitance/unit length	μF/km	0.203	0.225	0.249	0.283	0.315	0.345	0.374	0.406	0.456	0.495	0.558	0.613
	26	Charging current	A/km	0.370	0.410	0.450	0.510	0.570	0.630	0.680	0.740	0.830	0.900	1.01	1.11
	28	Earth fault current	A/km	1.11	1.23	1.35	1.53	1.71	1.89	2.04	2.22	2.49	2.70	3.03	3.33
	30	Electric field strength at the conductor	kV/mm	2.40	2.30	2.20	2.20	2.10	2.10	2.00	2.00	2.00	1.90	1.90	1.90
	31	Reference diameter of cable	mm	22.9	24.0	25.2	26.9	28.5	30.0	31.5	33.1	35.6	37.6	40.8	43.6
Installation in ground	32	Current-carrying capacity	A	157	187	221	269	321	364	406	457	528	593	665	745
	33	Permissible transmission power	MVA	2.72	3.24	3.83	4.66	5.56	6.30	7.03	7.92	9.15	10.3	11.5	12.9
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	0.931	0.672	0.497	0.345	0.250	0.199	0.164	0.132	0.102	0.0831	0.0686	0.0563
	36	Eff. a.c. resistance/unit length at 20 °C	Ω/km	0.731	0.528	0.390	0.271	0.197	0.157	0.129	0.105	0.0814	0.0666	0.0557	0.0462
	38	Ohmic losses per cable	kW/km	22.9	23.5	24.3	25.0	25.7	26.3	27.0	27.6	28.5	29.2	30.3	31.2
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.706	0.640	0.581	0.515	0.466	0.428	0.393	0.363	0.325	0.299	0.262	0.238
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	3.974	3.918	3.860	3.782	3.713	3.652	3.594	3.535	3.448	3.383	3.285	3.206
	44	Inductance/unit length per conductor	mH/km	0.480	0.455	0.434	0.409	0.391	0.377	0.364	0.353	0.338	0.329	0.315	0.306
	45	Resistance/unit length in zero-phase seq.system	Ω/km	1.595	1.390	1.251	1.129	1.051	1.009	0.767	0.742	0.717	0.700	0.536	0.525
	46	Reactance/unit length in zero-phase seq.system	Ω/km	0.555	0.549	0.544	0.539	0.536	0.533	0.285	0.283	0.281	0.279	0.171	0.169
	47	Reduction factor		0.556	0.559	0.562	0.565	0.568	0.571	0.416	0.418	0.421	0.423	0.325	0.327
Installation in free air	32	Current-carrying capacity	A	163	198	237	295	358	413	469	535	633	722	830	949
	33	Permissible transmission power	MVA	2.82	3.43	4.10	5.11	6.20	7.15	8.12	9.27	11.0	12.5	14.4	16.4
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	0.931	0.672	0.497	0.345	0.250	0.199	0.164	0.132	0.102	0.0831	0.0687	0.0564
	38	Ohmic losses per cable	kW/km	24.7	26.3	27.9	30.0	32.0	33.9	36.0	37.8	41.0	43.3	47.3	50.8
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.869	0.794	0.726	0.652	0.595	0.550	0.508	0.473	0.427	0.396	0.350	0.318
	43	Thermal resistance of the air	Km/W	1.559	1.492	1.426	1.343	1.274	1.215	1.162	1.111	1.040	0.989	0.918	0.864
	44	Inductance/unit length per conductor	mH/km	0.480	0.455	0.433	0.409	0.391	0.377	0.364	0.353	0.338	0.329	0.315	0.306
	48	Minimum time value	s	214	284	405	512	640	767	930	1087	1307	1570	2111	2524
Short-circuit	49	Rated short-time current of conductor (1s)	kA	3.57	5.00	7.15	10.0	13.6	17.2	21.4	26.5	34.3	42.9	57.2	71.5
	50	Rated short-time current of screen (1s)	kA	3.3	3.3	3.3	3.3	3.3	3.3	5.1	5.1	5.1	5.1	7.1	7.1

Table 5.2.3b
PROTOTHEN X cables (XLPE insulation) with copper conductor — N2XS2Y 1×.../.. 18/30 kV (U_m=36 kV)

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	25	35	50	70	95	120	150	185	240	300	400	500
	3	Shape and type of conductor		RM	RM	RM	RM	RM	RM	RM	RM	RM	RM	RM	RM
	6	Nom. cross-sectional area of screen	mm²	16	16	16	16	16	16	25	25	25	25	35	35
	9	Thickness of insulation	mm	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	16	Thickness of outer sheath	mm	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.6
	17	Overall diameter of cable	mm	33	34	35	36	38	39	41	43	45	48	51	54
	19	Weight of cable	kg/km	1100	1250	1400	1600	1900	2200	2550	2950	3550	4200	5150	6250
Mechanical properties	20	Minimum bending radius	mm	495	510	525	540	570	585	615	645	675	720	765	810
	21	Perm. pulling force with cable grip	N	1250	1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
	22	Perm. pulling force with pulling head	N	1250	1750	2500	3500	4750	6000	7500	9250	12000	15000	20000	25000
Electrical properties	23	d.c. resistance/unit length at 90 °C	Ω/km	0.927	0.668	0.493	0.342	0.246	0.195	0.158	0.126	0.0961	0.0766	0.0599	0.0467
	24	d.c. resistance/unit length at 20 °C	Ω/km	0.727	0.524	0.387	0.268	0.193	0.153	0.124	0.0991	0.0754	0.0601	0.0470	0.0366
	25	Operating capacitance/unit length	μF/km	0.115	0.125	0.136	0.151	0.165	0.178	0.191	0.205	0.227	0.244	0.271	0.295
	26	Charging current	A/km	0.630	0.680	0.740	0.820	0.900	0.970	1.04	1.12	1.24	1.33	1.47	1.61
	28	Earth fault current	A/km	1.89	2.04	2.22	2.46	2.70	2.91	3.12	3.36	3.72	3.99	4.41	4.83
	30	Electric field strength at the conductor	kV/mm	4.10	3.90	3.70	3.50	3.30	3.20	3.10	3.00	2.90	2.90	2.80	2.70
	31	Reference diameter of cable	mm	32.1	33.2	34.4	36.1	37.7	39.2	40.7	42.3	44.8	46.8	50.0	53.0
Installation in ground	32	Current-carrying capacity	A	179	214	251	305	362	410	450	503	576	641	698	774
	33	Permissible transmission power	MVA	9.30	11.1	13.0	15.8	18.8	21.3	23.4	26.1	29.9	33.3	36.3	40.2
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	0.942	0.683	0.508	0.355	0.259	0.208	0.177	0.145	0.114	0.0944	0.0831	0.0695
	36	Eff. a.c. resistance/unit length at 20 °C	Ω/km	0.742	0.538	0.401	0.282	0.206	0.166	0.143	0.118	0.0935	0.0779	0.0702	0.0594
	38	Ohmic losses per cable	kW/km	30.2	31.3	32.0	33.1	34.0	35.0	35.9	36.7	37.9	38.8	40.5	41.6
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.900	0.823	0.753	0.672	0.609	0.561	0.503	0.462	0.410	0.374	0.311	0.277
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	2.653	2.631	2.607	2.575	2.546	2.520	2.494	2.467	2.427	2.396	2.348	2.306
	44	Inductance/unit length per conductor	mH/km	0.800	0.768	0.740	0.705	0.678	0.656	0.632	0.615	0.591	0.575	0.545	0.529
	45	Resistance/unit length in zero-phase seq.system	Ω/km	1.541	1.337	1.199	1.078	1.002	0.961	0.748	0.723	0.698	0.682	0.528	0.517
	46	Reactance/unit length in zero-phase seq.system	Ω/km	0.604	0.596	0.589	0.581	0.576	0.571	0.320	0.317	0.313	0.310	0.195	0.192
	47	Reduction factor		0.597	0.599	0.600	0.603	0.605	0.607	0.456	0.457	0.459	0.461	0.363	0.364
Installation in free air	32	Current-carrying capacity	A	195	237	283	352	427	490	550	625	732	829	927	1047
	33	Permissible transmission power	MVA	10.1	12.3	14.7	18.3	22.2	25.5	28.6	32.5	38.0	43.1	48.2	54.4
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	0.940	0.681	0.506	0.355	0.259	0.208	0.178	0.146	0.116	0.0964	0.0870	0.0739
	35	Mean eff. a.c. resistance/unit length at 90 °C	Ω/km	0.937	0.678	0.504	0.352	0.256	0.205	0.174	0.142	0.112	0.0923	0.0810	0.0680
	38	Ohmic losses per cable	kW/km	35.6	38.1	40.3	43.6	46.7	49.3	52.5	55.4	59.8	63.4	69.6	74.5
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.902	0.824	0.754	0.674	0.610	0.561	0.502	0.460	0.406	0.368	0.301	0.265
	43	Thermal resistance of the air	Km/W	0.775	0.749	0.723	0.690	0.662	0.638	0.614	0.592	0.560	0.537	0.502	0.475
	44	Inductance/unit length per conductor	mH/km	0.709	0.682	0.657	0.630	0.609	0.592	0.574	0.561	0.544	0.533	0.512	0.501
	48	Minimum time value	s	149	198	284	360	450	545	676	797	977	1191	1693	2073
Short-circuit	49	Rated short-time current of conductor (1s)	kA	3.57	5.00	7.15	10.0	13.6	17.2	21.4	26.5	34.3	42.9	57.2	71.5
	50	Rated short-time current of screen (1s)	kA	3.3	3.3	3.3	3.3	3.3	3.3	5.1	5.1	5.1	5.1	7.1	7.1

Table 5.5.2
PROTODUR cables (PVC insulation) with aluminium conductor — NAYY 4×... 0.6/1 kV (U_m=1.2 kV)

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	25	35	50	70	95	120	150	185	240
	3	Shape and type of conductor		RE	RE	SE	SE	SE	SE	SE	SE	SE
	9	Thickness of insulation	mm	1.2	1.2	1.4	1.4	1.6	1.6	1.8	2.0	2.2
	16	Thickness of outer sheath	mm	1.8	1.8	1.9	2.1	2.2	2.4	2.5	2.7	2.9
	17	Overall diameter of cable	mm	26	28	30	34	38	42	46	50	56
	19	Weight of cable	kg/km	1050	1250	1350	1850	2300	2800	3300	4050	5050
Mechanical properties	20	Minimum bending radius	mm	312	336	360	408	456	504	552	600	672
	21	Perm. pulling force with cable grip	N	3000	4200	6000	8400	11400	14400	18000	22200	28800
	22	Perm. pulling force with pulling head	N	3000	4200	6000	8400	11400	14400	18000	22200	28800
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	1.44	1.04	0.770	0.532	0.384	0.304	0.247	0.197	0.150
	24	d.c. resistance/unit length at 20 °C	Ω/km	1.20	0.868	0.641	0.443	0.320	0.253	0.206	0.164	0.125
	31	Reference diameter of cable	mm	25.0	27.3	28.2	32.4	36.3	39.9	43.3	48.3	53.6
Laying direct in ground	32	Current-carrying capacity	A	99	119	141	176	211	240	270	307	357
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	1.44	1.04	0.770	0.533	0.385	0.305	0.248	0.198	0.152
	38	Ohmic losses per cable	kW/km	42.4	44.3	45.9	49.5	51.4	52.7	54.3	56.0	58.0
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.576	0.528	0.466	0.405	0.381	0.369	0.359	0.356	0.337
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	1.474	1.439	1.426	1.371	1.325	1.288	1.255	1.212	1.170
	44	Inductance/unit length per conductor	mH/km	0.283	0.274	0.270	0.262	0.261	0.256	0.256	0.256	0.254
Installation in free air	32	Current-carrying capacity	A	78	96	115	148	181	210	238	275	326
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	1.44	1.04	0.770	0.533	0.385	0.305	0.248	0.198	0.152
	38	Ohmic losses per cable	kW/km	26.3	28.8	30.6	35.0	37.8	40.3	42.2	44.9	48.3
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.576	0.528	0.466	0.405	0.381	0.369	0.359	0.356	0.337
	43	Thermal resistance of the air	Km/W	0.934	0.867	0.839	0.745	0.678	0.627	0.586	0.536	0.491
	44	Inductance/unit length per conductor	mH/km	0.283	0.274	0.270	0.262	0.261	0.256	0.256	0.256	0.254
	48	Minimum time value	s	291	376	535	633	780	924	1124	1281	1534
Short-circuit	49	Rated short-time current of conductor (1s)	kA	1.90	2.66	3.80	5.32	7.22	9.12	11.4	14.1	18.2

Table 5.5.3
PROTODUR cables (PVC insulation) with aluminium conductor

NAYCWY 3×.../.. 0.6/1 kV (U_m=1.2 kV)

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	50	70	95	120	150	185
	3	Shape and type of conductor		SE	SE	SE	SE	SE	SE
	7	Nom. cross-sectional area of concentric cond.	mm²	50	70	95	120	150	185
	9	Thickness of insulation	mm	1.4	1.4	1.6	1.6	1.8	2.0
	16	Thickness of outer sheath	mm	1.9	2.0	2.2	2.3	2.4	2.6
	17	Overall diameter of cable	mm	29	33	37	40	44	48
	19	Weight of cable	kg/km	1400	1950	2500	2900	3550	4300
Mechanical properties	20	Minimum bending radius	mm	348	396	444	480	528	576
	21	Perm. pulling force with cable grip	N	4500	6300	8550	10800	13500	16650
	22	Perm. pulling force with pulling head	N	4500	6300	8550	10800	13500	16650
Electrical properties	23	d.c. resistance/unit length at 70 °C	Ω/km	0.770	0.532	0.384	0.304	0.247	0.197
	24	d.c. resistance/unit length at 20 °C	Ω/km	0.641	0.443	0.320	0.253	0.206	0.164
	31	Reference diameter of cable	mm	26.2	30.3	34.3	37.3	40.8	44.9
Laying direct in ground	32	Current-carrying capacity	A	142	175	210	240	268	303
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	0.771	0.534	0.387	0.307	0.251	0.202
	38	Ohmic losses per cable	kW/km	46.7	49.1	51.2	53.1	54.2	55.6
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.429	0.386	0.367	0.338	0.339	0.327
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	1.455	1.397	1.348	1.314	1.279	1.241
	44	Inductance/unit length per conductor	mH/km	0.247	0.238	0.238	0.233	0.233	0.233
Installation in free air	32	Current-carrying capacity	A	115	146	179	209	236	272
	34	Eff. a.c. resistance/unit length at 70 °C	Ω/km	0.771	0.534	0.387	0.307	0.251	0.202
	38	Ohmic losses per cable	kW/km	30.6	34.2	37.2	40.3	42.0	44.8
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.429	0.386	0.367	0.338	0.339	0.327
	43	Thermal resistance of the air	Km/W	0.885	0.784	0.708	0.659	0.613	0.566
	44	Inductance/unit length per conductor	mH/km	0.247	0.238	0.238	0.233	0.233	0.233
	48	Minimum time value	s	535	650	797	933	1143	1309
Short-circuit	49	Rated short-time current of conductor (1s)	kA	3.80	5.32	7.22	9.12	11.4	14.1

Table 5.6.2
PROTOTHEN X cables (XLPE insulation) with aluminium conductor

NA2XY 4×... 0.6/1 kV (U_m=1.2 kV)

Three-phase operation at 50 Hz

Design	2	Nom. cross-sectional area of conductor	mm²	25	35	50	95	120	150	185	240
	3	Shape and type of conductor		RE	RE	SE	SE	SE	SE	SE	SE
	9	Thickness of insulation	mm	0.9	0.9	1.0	1.1	1.2	1.4	1.6	1.7
	16	Thickness of outer sheath	mm	1.8	1.8	1.9	2.1	2.3	2.4	2.6	2.8
	17	Overall diameter of cable	mm	24	26	27	35	39	42	47	52
	19	Weight of cable	kg/km	820	1050	1100	1850	2350	2800	3400	4300
Mechanical properties	20	Minimum bending radius	mm	288	312	324	420	468	504	564	624
	21	Perm. pulling force with cable grip	N	3000	4200	6000	11400	14400	18000	22200	28800
	22	Perm. pulling force with pulling head	N	3000	4200	6000	11400	14400	18000	22200	28800
Electrical properties	23	d.c. resistance/unit length at 90 °C	Ω/km	1.54	1.11	0.822	0.410	0.324	0.264	0.210	0.160
	24	d.c. resistance/unit length at 20 °C	Ω/km	1.20	0.868	0.641	0.320	0.253	0.206	0.164	0.125
	31	Reference diameter of cable	mm	23.5	25.8	25.8	33.7	37.8	41.2	45.7	51.0
Laying direct in ground	32	Current-carrying capacity	A	111	133	157	233	266	299	340	395
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	1.54	1.11	0.822	0.411	0.325	0.265	0.211	0.162
	38	Ohmic losses per cable	kW/km	56.9	59.1	60.8	66.9	69.0	71.0	73.3	75.7
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.393	0.358	0.305	0.253	0.250	0.243	0.235	0.228
	41	Fict. thermal resist. of soil for ohmic losses	Km/W	1.498	1.461	1.461	1.355	1.309	1.275	1.234	1.190
	44	Inductance/unit length per conductor	mH/km	0.267	0.260	0.255	0.247	0.246	0.247	0.248	0.245
Installation in free air	32	Current-carrying capacity	A	101	123	147	232	270	308	356	422
	34	Eff. a.c. resistance/unit length at 90 °C	Ω/km	1.54	1.11	0.822	0.411	0.325	0.265	0.211	0.162
	38	Ohmic losses per cable	kW/km	47.1	50.5	53.3	66.3	71.1	75.4	80.4	86.4
	39	Fict. thermal resist. of cable for ohmic losses	Km/W	0.393	0.358	0.305	0.253	0.250	0.243	0.235	0.228
	43	Thermal resistance of the air	Km/W	0.893	0.826	0.818	0.654	0.596	0.555	0.510	0.465
	44	Inductance/unit length per conductor	mH/km	0.267	0.260	0.255	0.247	0.246	0.247	0.248	0.245
	48	Minimum time value	s	244	322	460	667	786	943	1074	1287
Short-circuit	49	Rated short-time current of conductor (1s)	kA	2.35	3.29	4.70	8.93	11.3	14.1	17.4	22.6