

Technical Reference



Insulation Options

Insulation Thickness

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Electrical Characteristics of Single Core Cables

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Insulation Options

Either PVC, XLPE or EPR can be offered upon request

Insulation Thickness

Nominal thickness of PVC/A insulation

Nominal cross-sectional area of conductor mm ²	Nominal thickness of insulation at rated voltage U ₀ /U (Um)	
	0.6/1 (1.2) kV mm	1.8/3 (3.6) kV mm
1.5 and 2.5	0.8	-
4 and 6	1.0	-
10 and 16	1.0	2.2
25 and 35	1.2	2.2
50 and 70	1.4	2.2
95 and 120	1.6	2.2
150	1.8	2.2
185	2.0	2.2
240	2.2	2.2
300	2.4	2.4
400	2.6	2.6
500 to 800	2.8	2.8
1 000	3.0	3.0

Nominal thickness of cross-linked polyethylene (XLPE) insulation

Nominal cross-sectional area of conductor mm ²	Nominal thickness of insulation at rated voltage U ₀ /U (Um)	
	0.6/1 (1.2) kV mm	1.8/3 (3.6) kV mm
1.5 and 2.5	0.7	-
4 and 6	0.7	-
10 and 16	0.7	2.0
25 and 35	0.9	2.0
50	1.0	2.0
70 and 95	1.1	2.0
120	1.2	2.0





Nominal cross-sectional area of conductor mm ²	Nominal thickness of insulation at rated voltage U ₀ /U (Um)	
	0.6/1 (1.2) kV mm	1.8/3 (3.6) kV mm
150	1.4	2.0
185	1.6	2.0
240	1.7	2.0
300	1.8	2.0
400	2.0	2.0
500	2.2	2.2
630	2.4	2.4
800	2.6	2.6
1 000	2.8	2.8

Nominal thickness of ethylene propylene rubber (EPR) and hard ethylene propylene rubber (HEPR) insulation

Nominal cross-sectional area of conductor mm ²	Nominal thickness of insulation at rated voltage U ₀ /U (Um)			
	0,6/1 (1,2) kV		1.8/3 (3.6) kV mm	
	ERP mm	HEPR mm	ERP mm	HEPR mm
1,5 and 2,5	1,0	0,7	-	-
4 and 6	1,0	0,7	-	-
10 and 16	1,0	0,7	2,2	2,0
25 and 35	1,2	0,9	2,2	2,0
50	1,4	1,0	2,2	2,0
70	1,4	1,1	2,2	2,0
95	1,6	1,1	2,4	2,0
120	1,6	1,2	2,4	2,0
150	1,8	1,4	2,4	2,0
185	2,0	1,6	2,4	2,0
240	2,2	1,7	2,4	2,0
300	2,4	1,8	2,4	2,0
400	2,6	2,0	2,6	2,0
500	2,8	2,2	2,8	2,2
630	2,8	2,4	2,8	2,4
800	2,8	2,6	2,8	2,6
1 000	3,0	2,8	3,0	2,8





Mechanical Characteristics of Insulation Materials

Mechanical characteristics of insulating compounds with copper conductor
 (before and after aging)

Designation of compounds	Unit	PVC/A	EPR		HEPR		XLPE	
			0,6/1(1,2) kV cables	All other cables	0,6/1(1,2) kV cables	All other cables	0,6/1(1,2) kV cables	All other cables
Maximum conductor temperature in normal operation	°C	70	90	90	90	90	90	90
Without ageing (IEC 60811-1-1,) Tensile strength, minimum Elongation-at-break, minimum	N/ mm ² %	12,5 150	4,2 200	4,2 200	8,5 200	8,5 200	12,5 200	12,5 200
After ageing without conductor Treatment:								
– temperature	°C	100	135	135	135	135	135	135
– tolerance	°C	±2	±3	±3	±3	±3	±3	±3
– duration	h	168	168	168	168	168	168	168
Tensile strength a) value after ageing, minimum b) variation a, maximum	N/ mm ² %	12,5 ±25	– ±30	– ±30	– ±30	– ±30	– ±25	– ±25
Elongation-at-break: a) value after ageing, minimum b) variation a, maximum	% %	150 ±25	– ±30	– ±30	– ±30	– ±30	– ±25	– ±25
After ageing with copper conductor followed by the tensile test b Treatment:								
– temperature	°C	–	135	–	135	–	135	–
– tolerance	°C	–	±3	–	±3	–	±3	–
– duration	h	–	168	–	168	–	168	–
Tensile strength: Variation a, maximum	%	–	±30	–	±30	–	±30	–
Elongation-at-break: Variation a, maximum	%	–	±30	–	±30	–	±30	–
After ageing with copper conductor followed by bending test (only if the tensile test is not practicable) b Treatment:								
– temperature	°C	–	150	–	150	–	150	–
– tolerance	°C	–	±3	–	±3	–	±3	–
– duration	h	–	240	–	240	–	240	–
Results to be obtained		–	No cracks	–	No cracks	–	No cracks	–





Mechanical Characteristics of Jacket Materials

Mechanical characteristics of sheathing compounds (before and after aging)

Designation of compounds	Unit	ST1	ST2	ST3	ST7	ST8	SE1
Maximum conductor temperature in normal operation	°C	80	90	80	90	90	85
Without ageing (IEC 60811-1-1)							
Tensile strength, minimum	N/mm ²	12,5	12,5	10,0	12,5	9,0	10,0
Elongation-at-break, minimum	%	150	150	300	300	125	300
After ageing in an air oven (IEC 60811-1-2)							
Treatment:							
– temperature (tolerance ±2 °C)	°C	100	100	100	110	100	100
– duration	h	168	168	240	240	168	168
Tensile strength:							
a) value after ageing, minimum	N/mm ²	12,5	12,5	–	–	9,0	–
b) variation a, maximum	%	±25	±25	–	–	±40	±30
Elongation-at-break:							
a) value after ageing, minimum	%	150	150	300	300	100	250
b) variation a, maximum	%	±25	±25	–	–	±40	±40

Mechanical characteristics for PVC sheathing compounds

Designation of compound	Unit	ST1	ST2
Use of the PVC compound		Sheath	
Loss of mass in an air oven (IEC 60811-3-2)			
Treatment:			
– temperature (tolerance ±2 °C)	°C h	–	100
– duration		–	168
Maximum loss of mass	g/cm ²	–	1,5
Pressure test at high temperature (IEC 60811-3-1)			
- temperature (tolerance ±2 °C)	°C	80	90
Behaviour at low temperature a (IEC 60811-1-4)			
Test to be carried out without previous ageing:			
- cold bending test for diameter <12,5 mm	°C	–15	–15
- temperature (tolerance ±2 °C)			
Cold elongation test on dumb-bells:			
- temperature (tolerance ±2 °C)	°C	–15	–15
Cold impact test:			
- temperature (tolerance ±2 °C)	°C	–15	–15
Heat shock test (IEC 60811-3-1)			
Treatment:			
– temperature (tolerance ±3 °C)	°C	150	150
– duration	h	1	1





Mechanical characteristics of thermoplastic PE sheathing compounds

Designation of compounds	Unit	ST3	ST7
Density (IEC 60811-1-3)			
Carbon black content (for black oversheaths only) (IEC 60811-4-1) Nominal value Tolerance	% %	2,5 ±0,5	2,5 ±0,5
Shrinkage test (IEC 60811-1-3) Treatment: – temperature (tolerance ±2 °C) – heating, duration – heating, cycles Maximum shrinkage	°C h %	80 5 5 3	80 5 5 3
Pressure test at high temperature (IEC 60811-3-1) – temperature (tolerance ±2 °C)	°C	–	110

Mechanical characteristics of halogen free sheathing compound

Designation of compound	Unit	ST8
Behaviour at low temperature a (IEC 60811-1-4) Test to be carried out without previous ageing: – cold bending test for diameter <12,5 mm – temperature (tolerance ±2 °C)	°C	-15
Cold elongation test on dumb-bells: – temperature (tolerance ±2 °C)	°C	-15
Cold impact test: – temperature (tolerance ±2 °C)	°C	-15
Pressure test at high temperature (IEC 60811-3-1) – temperature (tolerance ±2 °C)	°C	80
Water absorption (IEC 60811-1-3) Gravimetric method: Treatment: – temperature (tolerance ±2 °C) – duration Maximum increase of mass	°C h g/ cm ²	70 24 10





Mechanical characteristics of elastomeric sheathing compound

Designation of compound	Unit	SE1
Oil immersion test followed by a determination of the mechanical properties (IEC 60811-2-1 and IEC 60811-1-1) Treatment: – oil temperature (tolerance ± 2 °C) – duration Maximum variation aof: a) tensile strength b) elongation-at-break	°C H % %	100 24 ± 40 ± 40
Hot set test (IEC 60811-2-1) Treatment: – temperature (tolerance ± 3 °C) – time under load – mechanical stress Maximum elongation under load Maximum permanent elongation after cooling	°C min N/cm ² % %	200 15 20 175 15

Electrical Characteristics of Single Core Cables

PVC insulation, PVC sheath cables with copper conductor

LOW VOLTAGE SINGLE CORE CABLE
LINEAR RESISTANCE, REACTANCE AND
VOLTAGE DROP PVC INSULATED (85°C)

SIZE mm ²	Direct Current Resistance at 20°C, Ohm/Km	Direct Current Resistance at 85°C, Ohm/Km	Alternating Current Resistance at 85°C, Ohm/Km	Reactance Ohm / Km	Impedance Ohm / Km	Voltage Drop (Phase to Phase) V/A.Km
1.5	12.1	15.19	15.19	0.165	15.19	21.22
2.5	7.41	9.30	9.30	0.149	9.30	13.04
4	4.61	5.79	5.79	0.143	5.79	8.17
6	3.08	3.87	3.87	0.134	3.87	5.5
10	1.83	2.3	2.3	0.132	2.3	3.32
16	1.15	1.444	1.444	0.124	1.449	2.13
25	0.727	0.913	0.913	0.121	0.921	1.39
35	0.524	0.658	0.658	0.115	0.668	1.031
50	0.387	0.486	0.467	0.111	0.499	0.79
70	0.268	0.336	0.337	0.105	0.353	0.576
95	0.193	0.242	0.244	0.103	0.265	0.445
120	0.153	0.192	0.194	0.100	0.218	0.373





SIZE mm ²	Direct Current Resistance at 20°C, Ohm/Km	Direct Current Resistance at 85°C, Ohm/Km	Alternating Current Resistance at 85°C, Ohm/Km	Reactance Ohm / Km	Impedance Ohm / Km	Voltage Drop (Phase to Phase) V/A.Km
150	0.124	0.156	0.158	0.100	0.187	0.323
185	0.0991	0.1244	0.1272	0.099	0.161	0.279
240	0.0754	0.0947	0.0978	0.097	0.138	0.236
300	0.0601	0.0754	0.0800	0.096	0.124	0.210
400	0.0470	0.0590	0.0626	0.094	0.113	0.184
500	0.0366	0.0459	0.0504	0.092	0.105	0.165
630	0.0283	0.0355	0.0413	0.091	0.100	0.152

XLPE insulation, LSF sheath cables with copper conductor

LOW VOLTAGE SINGLE CORE CABLE

LINEAR RESISTANCE, REACTANCE

AND VOLTAGE DROP XLPE INSULATED (90°C)

SIZE mm ²	Direct Current Resistance at 20°C, Ohm/Km	Direct Current Resistance at 90°C, Ohm/Km	Alternating Current Resistance at 90°C, Ohm/Km	Reactance Ohm / Km	Impedance Ohm / Km	Voltage Drop (Phase to Phase) V/A.Km
1.5	12.1	15.43	15.43	0.165	15.43	21.43
2.5	7.41	9.45	9.45	0.149	9.45	13.85
4	4.61	5.88	5.88	0.143	5.88	8.3
6	3.08	3.93	3.93	0.134	3.93	5.58
10	1.83	2.333	2.333	0.132	2.337	3.37
16	1.15	1.466	1.466	0.124	1.471	2.16
25	0.727	0.927	0.927	0.121	0.935	1.41
35	0.524	0.668	0.669	0.115	0.679	1.046
50	0.387	0.493	0.494	0.111	0.506	0.8
70	0.268	0.342	0.343	0.105	0.359	0.584
95	0.193	0.246	0.248	0.103	0.269	0.451
120	0.153	0.195	0.197	0.1	0.221	0.377
150	0.124	0.158	0.16	0.1	0.189	0.326
185	0.0991	0.126	0.129	0.099	0.163	0.282
240	0.0754	0.0961	0.0993	0.097	0.139	0.238
300	0.0601	0.0766	0.0812	0.096	0.126	0.212
400	0.047	0.0599	0.0636	0.094	0.114	0.186
500	0.0366	0.0467	0.0513	0.092	0.105	0.167
630	0.0283	0.0361	0.042	0.091	0.1	0.153





Electrical Characteristics of Three Core Cables

PVC insulation, PVC sheath cables with copper conductor

LOW VOLTAGE MULTI CORE CABLE
LINEAR RESISTANCE, REACTANCE AND
VOLTAGE DROP PVC INSULATED (85°C)

SIZE mm ²	Direct Current Resistance at 20°C, Ohm/Km	Direct Current Resistance at 85°C, Ohm/Km	Alternating Current Resistance at 85°C, Ohm/Km	Reactance Ohm / Km	Impedance Ohm / Km	Voltage Drop (Phase to Phase), V/A.Km
1.5	12.1	15.19	15.19	0.165	15.19	21.22
2.5	7.41	9.30	9.30	0.143	9.30	13.04
4	4.61	5.79	5.79	0.132	5.79	8.16
6	3.08	3.87	3.87	0.121	3.87	5.49
10	1.83	2.30	2.30	0.109	2.30	3.3
16	1.15	1.444	1.444	0.106	1.448	2.11
25	0.727	0.913	0.913	0.103	0.919	1.37
35	0.524	0.658	0.658	0.098	0.666	1.014
50	0.387	0.486	0.487	0.098	0.496	0.777
70	0.268	0.336	0.337	0.095	0.351	0.566
95	0.193	0.242	0.244	0.093	0.261	0.435
120	0.153	0.192	0.194	0.091	0.214	0.363
150	0.124	0.156	0.158	0.091	0.182	0.314
185	0.0991	0.1244	0.1272	0.091	0.1564	0.271
240	0.0754	0.0947	0.0978	0.090	0.1329	0.229
300	0.0601	0.0754	0.0800	0.090	0.1204	0.204
400	0.0470	0.0590	0.0626	0.089	0.1088	0.179
500	0.0366	0.0459	0.0504	0.088	0.1014	0.161
630	0.0283	0.0355	0.0413	0.088	0.0972	0.149





XLPE insulation, LSF sheath cables with copper conductor

LOW VOLTAGE MULTI CORE CABLE

LINEAR RESISTANCE, REACTANCE AND VOLTAGE DROP XLPE INSULATED (90°C)

SIZE mm ²	Direct Current Resistance at 20°C, Ohm/Km	Direct Current Resistance at 90°C, Ohm/Km	Alternating Current Resistance at 90°C, Ohm/Km	Reactance Ohm / Km	Impedance Ohm / Km	Voltage Drop (Phase to Phase) V/A.Km
1.5	12.1	15.43	15.43	0.165	15.43	21.55
2.5	7.41	9.45	9.45	0.143	9.45	13.24
4	4.61	5.88	5.88	0.132	5.88	8.28
6	3.08	3.93	3.93	0.121	3.93	5.57
10	1.83	2.333	2.333	0.109	2.336	3.35
16	1.15	1.466	1.466	0.106	1.47	2.14
25	0.727	0.927	0.927	0.103	0.933	1.39
35	0.524	0.668	0.669	0.098	0.676	1.03
50	0.387	0.493	0.494	0.098	0.504	0.786
70	0.268	0.342	0.343	0.095	0.356	0.574
95	0.193	0.246	0.248	0.093	0.264	0.44
120	0.153	0.195	0.197	0.091	0.217	0.37
150	0.124	0.158	0.16	0.091	0.184	0.316
185	0.0991	0.126	0.129	0.091	0.1579	0.273
240	0.0754	0.0961	0.0993	0.09	0.134	0.231
300	0.0601	0.0766	0.0812	0.09	0.1212	0.206
400	0.047	0.0599	0.0636	0.089	0.1094	0.181
500	0.0366	0.0467	0.0513	0.088	0.1019	0.163
630	0.0283	0.0361	0.042	0.088	0.0975	0.15





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