Technical Referrence

Insulation Options

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Insulation Options

EPR and HEPR can be offered upon request

Insulation Thickness

Nominal thickness of PVC/A insulation

Nominal cross-sectional area of conductor	Nominal thickness of insulation at rated voltage U0/U (Um)
mm2	0.6/1 (1.2) kV mm
1.5 and 2.5	0.8
4 and 6	1.0
10 and 16	1.0
25 and 35	1.2
50 and 70	1.4
95 and 120	1.6
150	1.8
185	2.0
240	2.2
300	2.4
400	2.6
500 to 800	2.8
1 000	3.0

Nominal thickness of cross-linked polyethylene (XLPE) insulation

Nominal cross-sectional area of conductor	Nominal thickness of insulation at rated voltage U0/U (Um)
mm2	0.6/1 (1.2) kV mm
1.5 and 2.5	0.7
4 and 6	0.7
10 and 16	0.7
25 and 35	0.9
50	1.0
70 and 95	1.1
120	1.2
150	1.4

Nominal cross-sectional area of conductor	Nominal thickness of insulation at rated voltage U0/U (Um)
mm2	0.6/1 (1.2) kV mm
185	1.6
240	1.7
300	1.8
400	2.0
500	2.2
630	2.4
800	2.6
1 000	2.8

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

Nominal cross-sectional area of conductor	Nominal thickness of insulation at rated voltage U0/U (Um)	
mm^2	0,6/1 (1,2) kV	
	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
25 and 35	1,2	0,9
50	1,4	1,0
70	1,4	1,1
95	1,6	1,1
120	1,6	1,2
150	1,8	1,4
185	2,0	1,6
240	2,2	1,7
300	2,4	1,8
400	2,6	2,0
500	2,8	2,2
630	2,8	2,4
800	2,8	2,6
1 000	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	N/mm^2	12,5	4,2	4,2	8,5	8,5	12,5	12,5
Elongation-at-break, minimum	%	150	200	200	200	200	200	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	N/mm^2	12,5	–	–	–	–	–	–
b) variation a, maximum	%	±25	±30	±30	±30	±30	±25	±25
Elongation-at-break:								
a) value after ageing, minimum	%	150	–	–	–	–	–	–
b) variation a, maximum	%	±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 conducto r 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 Elongation-at-break, minimum	N/mm^2 %	12,5 150	12,5 150	10,0 300	12,5 300	9,0 125	10,0 300
After ageing in an air oven (IEC 60811-1-2) **Treatment:** – temperature (tolerance ±2 °C) – duration **Tensile strength:** a) value after ageing, minimum b) variation a, maximum **Elongation-at-break:** a) value after ageing, minimum b) variation a, maximum	 °C h N/mm^2 % % %	 100 168 12,5 ±25 150 ±25	 100 168 12,5 ±25 150 ±25	 100 240 – – 300 –	 110 240 – – 300 –	 100 168 9,0 ±40 100 ±40	 100 168 – ±30 250 ±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) – duration **Maximum loss of mass**	 °C h g/cm^2	 – – –	 100 168 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 - temperature (tolerance ±2 °C) **Cold elongation test on dumb-bells:** **-** temperature (tolerance ±2 °C) **Cold impact test:** **-** temperature (tolerance ±2 °C)	 °C °C °C	 –15 –15 –15	 –15 –15 –15
Heat shock test (IEC 60811-3-1) **Treatment:** – temperature (tolerance ±3 °C) – duration	 °C h	 150 1	 150 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) **Cold elongation test on dumb-bells:** – temperature (tolerance ±2 °C) **Cold impact test:** – temperature (tolerance ±2 °C)	 °C °C °C	 -15 -15 -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)	°C	100
– duration	H	24
Maximum variation aof:		
a) tensile strength b)	%	±40
elongation-at-break	%	±40
Hot set test (IEC 60811-2-1)		
Treatment:		
– temperature (tolerance ±3 °C)	°C	200
– time under load	min	15
– mechanical stress	N/cm^2	20
Maximum elongation under load	%	175
Maximum permanent elongation after cooling	%	15

Thickness of lapped inner coverings(optional)

The approximate thickness of lapped inner coverings shall be 0,4 mm for fictitious diameters over laid-up cores up to and including 40 mm and 0,6 mm for larger diameters.

Dimensions of the armour wires and armour tapes

The nominal dimensions of the armour wires and armour tapes shall preferably consist of one of the following values:

Round wires:

0,8 -1,25 -1,6 -2,0 -2,5 - 3,15 mm diameter;

Flat wires:

0,8 mm thickness;

Tapes of steel:

0,2 - 0,5 - 0,8 mm thickness;

Tapes of aluminium or aluminium alloy:

0,5 - 0,8 mm thickness.

Correlation between cable diameters and armour dimensions

The nominal diameters of round armour wires and the nominal thicknesses of the armour tapes shall be not less than the values given in Tables 1 and 2, respectively.

Nominal diameter of round armour wires(table 1)

Fictitious diameter under the armour		"Nominal diameter of armour wire
Above mm	Up to and including mm	mm
	10	0.8
10	15	1.25
15	25	1.6
25	35	2.0
35	60	2.5
60		3.15

Nominal thickness of armour tapes(table 2)

Fictitious diameter under the armour		Nominal thickness of tape	
Above mm	Up to and including mm	Steel or galvanized steel mm	Aluminium or aluminium alloy mm
	30	0.2	0.5
30	70	0.5	0.5
70		0.8	0.8

*For flat armour wires and fictitious diameters under the armour greater than 15 mm, the nominal thickness of the flat steel wire shall be 0,8 mm. Cables with fictitious diameters underthe armour up to and including 15 mm shall not be armoured with flat wires.

Round or flat wire armour

The wire armour shall be closed, i.e. with a minimum gap between adjacent wires. An open helix consisting of galvanized steel tape with a nominal thickness of at least 0,3 mm may be provided over flat steel wire armour and over round steel wire armour, if necessary. Tolerances on this steel tape shall refer :

- 5 % for round wires;
- 8 % for flat wires;
- 10 % for tapes.

Double tape armour

When a tape armour and an inner covering are used, the inner covering shall be reinforced by a taped bedding. The total thickness of the inner covering and the additional taped bedding shall 0.4mm/0.6mm plus 0,5 mm if the armour tape thickness is 0,2 mm, and plus 0,8 mm if the armour tape thickness is more than 0,2 mm.

The total thickness of the inner covering and the additional taped bedding shall be not less than these values by more than 0,2 mm with a tolerance of + 20 %. If a separation sheath is required or if the inner covering is extruded, the additional taped bedding is not required.The tape armour shall be applied helically in two layers so that the outer tape is approximately central over the gap of the inner tape. The gap between adjacent turns of each tape shall not exceed 50 % of the width of the tape.

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