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Electrical data

Conductor Resistance

Resistance formula:

$$R = p \frac{L}{A}$$

R = resistance in ohm per phase

p = specific resistance $\frac{\text{Ohm} \cdot \text{mm}^2}{\text{m}}$

A = conductor area mm², L = conductor length, m

Resistance as a function of temperature:

$R = R_0 (1 + \alpha (t\text{-}20\ °C))$

R = Resistance at t=20°C, t = conductor temperature °C, α = 0,00393 for copper

Conductor resistance tinned annealed copper 250V, 0,6/1kV, 1,8/3(3,6)kV.

In accordance with IEC 60228, class 2. Tinned stranded annealed copper conductors for single core and multi-core cables 250V, 0,6/1kV and 1,8/3kV

Nominal conductor area	No. of wires and diameter of wires	Approx. diam.	Max. resistance pr km	
			20°C	90°C
mm²	mm	mmØ	ohm	ohm
0,5	7x 0,30	0,9	36,7	46,8
0,75	7x 0,37	1,1	24,8	31,6
1	7x 0,43	1,3	18,2	23,2
1,5	7x 0,53	1,6	12,2	15,6
2,5	7x 0,67	2,0	7,56	9,64
4	7x 0,85	2,6	4,70	5,99
6	7x 1,05	3,2	3,11	3,97
10	7x 1,35	4,1	1,84	2,35
16	7x 1,71	5,2	1,16	1,48
25	7 x 2,13	6,6	0,734	0,936
35	19x 1,53	7,7	0,529	0,675
50	19x 1,80	9,1	0,391	0,499
70	19x 2,17	10,9	0,270	0,344
95	37x 1,80	12,6	0,195	0,249
120	37x 2,03	14,2	0,154	0,196
150	37x 2,27	15,9	0,126	0,161
185	37x 2,52	17,7	0,100	0,128
240	61x 2,24	20,2	0,0762	0,0972
300	61x 2,52	22,6	0,0607	0,0774
400	91x 2,36	26,0	0,04475	0,0596
500	91x 2,64	29,0	0,0369	0,0463
630	127x 2,52	32,8	0,0286	0,0359

Conductor resistance, tinned annealed copper conductor

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3,6/6(7,2)kV, 6/10(12)kV, 8,7/15(17,5)kV, 12/20(24)kV and 18/30(36)kV.

In accordance with IEC 60228, class 2. Compressed tinned stranded annealed copper conductors for single core and multicore cables 3,6/6kV, 6/10kV, 8,7/15kV, 12/20(24)kV and 18/30(36)kV.

Nominal conductor area	No. of wires and diameter of wires *)	Approx. diam.	Max. resistance pr km	
			20°C	90°C
mm²	mm	mmØ	ohm	ohm
16	7x 1,71	5,2	1,16	1,48
25	7 x 2,14	6,5	0,734	0,936
35	19x 1,53	7,4	0,529	0,675
50	19x 1,80	8,8	0,391	0,499
70	19x 2,17	10,3	0,270	0,344
95	37x 1,80	12,1	0,195	0,249
120	37x 2,03	13,6	0,154	0,196
150	37x 2,27	15,1	0,126	0,161
185	37x 2,52	16,8	0,100	0,128
240	61x 2,24	19,1	0,0762	0,0972
300	61x 2,52	21,5	0,0607	0,0774

*) Diameter of wires before compressing

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Wire gauge conversion table

US Standard cross-section to square millimetres

U.S. Standard	Equivalent cross-section mm²	Nearest available cross-section mm²
20 AWG	0.519	0.5 – 0.75
18	0.823	1.0
16	1.31	1.5
14	2.08	2.5
12	3.31	4
10	5.26	6
8	8.37	10
6	13.30	16
4	21.15	25
2	33.62	35
1	42.41	50
1/0	53.49	50 - 70
2/0	67.23	70
3/0	85.01	95
4/0	107.2	120
250 MCM	126.7	120 - 150
300	152.0	150
350	177.3	185
400	202.7	185
450	228.0	185-240
500	253.4	240
550	278.7	240 – 300
600	304.0	300
650	329.4	300
700	354.7	300 – 400
750	380.0	400
800	405.4	400
850	430.7	400
900	456.0	400
950	481.4	400
1000	506.7	400 – 630
1250	633.4	630
1500	760.0	800
1750	886.7	800 – 1000
2000	1013.4	1000

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Current ratings for 250V and 0,6/1kV cables in fixed installations.

Current carrying capacities in continuous service at maximum rated temperature of 90°C.
In accordance with IEC 60092-352 (2005) Annex B, Table B.4. Ambient temperature 45°C

Conductor area mm²	1-core Amp	2-core Amp	3-4 core Amp
1	18	15	13
1,5	23	20	16
2,5	30	26	21
4	40	34	28
6	52	44	36
10	72	61	50
16	96	82	67
25	127	108	89
35	157	133	110
50	196	167	137
70	242	206	169
95	293	249	205
120	339	288	237
150	389	331	273
185	444	377	311
240	522	444	366
300	601	511	420
400	719	611	503
500	827	703	579
630	955	812	669

For cables with more than 4 cores, the current ratings are given by the following formula:

$$I = \frac{I_1}{\sqrt[3]{N}}$$

I_1 = current rating for single core
N = number of cores

No. of cores	1,5 mm² Amp	2,5 mm² Amp
5	13	18
7	12	16
12	10	13
19	9	11
24	8	10
37	7	9

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Current rating for 1,8/3(3,6)kV, 3,6/6(7,2)kV, 6/10(12)kV, 8,7/15(17,5)kV, 12/20(24)kV and 18/30(36)kV cables in fixed installations.

Current carrying capacities in continuous service at maximum rated temperature of 90°C.
In accordance with IEC 60092-352 (2005) Annex B, Table B.4.

Conductor area mm²	1-core Amp	2-core Amp	3-4 core Amp
16	96	82	67
25	127	108	89
35	157	133	110
50	196	167	137
70	242	206	169
95	293	249	205
120	339	288	237
150	389	331	273
185	444	377	311
240	522	444	366
300	601	511	420
400	719	-	-
500	827	-	-
630	955	-	-

The tabled current ratings must be adjusted for ambient air temperatures other than 45°C.

Appropriate rating factors are:

Ambient air temp. °C	35	40	45	50	55	60	65	70	75	80
Rating factors	1,10	1,05	1,00	0,94	0,88	0,82	0,74	0,67	0,58	0,47

Short circuit ratings

The following short circuit currents are for cables normally operating at a maximum conductor temperature of 85°C.

The theoretical temperature that arises in the conductor during a short circuit, which is used as a basis of the calculation, is 250°C. EPR and XLPE insulation are capable of withstanding short term temperatures up to 250°C.The short circuit currents for copper conductors given in the table are values for one second, for other durations the current may be calculated from the following formula:

$$I_t = \frac{I}{\sqrt{t}}$$

I_t = short ciricut current for t sec. (Amp),
I = short circuit current for one sec. (Amp),
t = short circuit duration (sec.)

The duration of the short circuit based on these assumptions should be between 0,2 sec. and 5 sec.

Conductor area mm²	Current 1 second amperes	Conductor area mm²	Current 1 second amperes
1,0	140	70	9800
1,5	210	95	13300
2,5	350	120	16800
4	560	150	21000
6	840	185	25900
10	1400	240	33600
16	2240	300	42000
25	3500	400	56000
35	4900	500	70000
50	7000	630	88200

Reactance

The reactance of a cable operating in an AC system depends on many factors, including, in particular, the axial spacing between conductors and the proximity and magnetic properties of adjacent steelwork. The former is known for multicore cable, but may vary for single core cables depending upon the spacing between them and their disposition when installed. Reactance of cables in certain disposition when installed. Reactance of cables in certain dispositions remote from steelwork are calculable and are shown. The tabulated values are for cables with circular conductors. The value for a sector-shaped conductor should be taken as 90% of the calculated value.

Induction for 2-, 3- and 4- conductor cables is given by the formula:

$$L = 0{,}2 * \left(\ln \left(\frac{2a}{d} \right) + 0{,}25 \right) * 10^{-6}$$

L = Induction in H/m and phase, a = Axial space between conductors in mm.
d = conductor diameter in mm.
Reactance for 2-, 3- and 4-conductor cables is given by the formula:

$$X = 2 * \pi * f * L * l$$

X = Reactance in ohm pr. Phase, f = frequency in Hz, L = Induction in H/m and phase
l = Conductor length in meter.

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Reactance Values for Cables

Power and control cables. RFOU 0,6/1 kV

Cross-section mm²	2-, 3- and 4 cores ohm/km 60 Hz	50 Hz	1- core* ohm/km 60 Hz	50 Hz
1,5	0,132	0,110		
2,5	0,123	0,103		
4	0,115	0,096		
6	0,108	0,090		
10	0,101	0,084		
16	0,096	0,080	0,139	0,116
25	0,095	0,079	0,134	0,112
35	0,092	0,076	0,127	0,106
50	0,092	0,076	0,123	0,103
70	0,091	0,075	0,120	0,100
95	0,088	0,073	0,116	0,097
120	0,086	0,072	0,113	0,094
150	0,087	0,072	0,110	0,092
185	0,086	0,072	0,109	0,091
240	0,086	0,072	0,109	0,090
300	0,086	0,071	0,107	0,089

*) Reactance for 1-conductor cables given at Three- foil formation

Power and control cables, BFOU 0,6/1 kV.

Cross- section mm²	2-, 3- and 4 core ohm/km 60 Hz	50 Hz	1- core* ohm/km 60 Hz	50 Hz
1,5	0,138	0,115		
2,5	0,129	0,107		
4	0,120	0,100		
6	0,112	0,094		
10	0,105	0,088		
16	0,099	0,082	0,144	0,120
25	0,098	0,081	0,135	0,113
35	0,094	0,078	0,129	0,107
50	0,093	0,078	0,125	0,104
70	0,092	0,077	0,121	0,101
95	0,090	0,075	0,117	0,098
120	0,088	0,073	0,112	0,094
150	0,088	0,073	0,112	0,094
185	0,088	0,073	0,109	0,091
240	0,087	0,072	0,109	0,091
300	0,086	0,072	0,108	0,090

*) Reactance for 1-conductor cables given at Three- foil formation

Medium Voltage Power cables. RFOU 6/10 kV

Cross-section mm²	3 core ohm/km 50 Hz	3 core ohm/km 60 Hz	1- core* ohm/km 50 Hz	1- core* ohm/km 60 Hz
16	0.119	0.143	0.154	0.185
25	0.119	0.143	0.144	0.173
35	0.114	0.137	0.138	0.166
50	0.108	0.130	0.132	0.158
70	0.103	0.124	0.125	0.150
95	0.098	0.118	0.119	0.142
120	0.095	0.114	0.116	0.139
150	0.092	0.111	0.111	0.133
185	0.092	0.111	0.108	0.130
240	0.087	0.104	0.104	0.125
300	0.084	0.101	0.104	0.124
400	-	-	0.090	0.118
500	-	-	0.097	0.117
630	-	-	0.092	0.110

*) Reactance for 1-conductor cables given at Three- foil formation

Medium Voltage Power cables. RFOU 12/20(24)kV.

Cross-section mm²	3 core ohm/km 50 Hz	3 core ohm/km 60 Hz	1-core* ohm/km 50 Hz	1-core* ohm/km 60 Hz
35	0.128	0.153	0.149	0.178
50	0.121	0.145	0.140	0.169
70	0.115	0.135	0.133	0.160
95	0.109	0.131	0.127	0.152
120	0.105	0.126	0.124	0.149
150	0.102	0.122	0.119	0.142
185	0.099	0.118	0.116	0.139
240	0.095	0.114	0.112	0.134
300	-	-	0.108	0.130

*) Reactance for 1-conductor cables given at Three- foil formation

Impedance

Induction for 2-, 3- and 4- conductor cables is given by the formula:

$Z = \sqrt{(R^2 + X^2)}$

Z = Impedansce in ohm pr. phase, R = Resistance at operating temprature in ohm pr. phase.

X = Reactance in ohm pr. phase.

Electrical characteristics for instrumentation and telecommunication cables such as 250 V cables: RFOU and BFOU *according to IEC 60092-376*

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Cables with collective screen

Type	Capacitance, approx. (nF/km)	Inductance, approx, (mH/km)	Resistance at 20°C, max. (Ohm/km)	L/R ratio, (microH/Ohm)
Unshielded pair 0,75 mm²	100	0,67	24,8	14,3
Unshielded triple 0,75 mm²	100	0,67	24,8	14,3
Unshielded pair 1,5 mm²	110	0,63	12,2	26,6
Unshielded triple 1,5 mm²	110	0,63	12,2	26,6
Unshielded pair 2,5 mm²	125	0,59	7,56	39,0
Unshielded triple 2,5 mm²	125	0,59	7,56	39,0

Cables with individually screened pair/triples

Type	Capacitance, approx. (nF/km)	Inductance, approx, (mH/km)	Resistance at 20°C, max. (Ohm/km)	L/R ratio, (microH/Ohm)
Shielded pair 0,75 mm²	110	0,67	24,8	14,3
Shielded triple 0,75 mm²	110	0,67	24,8	14,3
Shielded pair 1,5 mm²	125	0,63	12,2	26,6
Shielded triple 1,5 mm²	125	0,63	12,2	26,6
Shielded pair 2,5 mm²	145	0,59	7,56	39,0
Shielded triple 2,5 mm²	145	0,59	7,56	39,0