Lightweight Electrical Cables RADOX® MFH-S B

Current Carrying Capacity

Table for Inductance and Capacitance

Content

Scope of the documentation

The following tables referring to RADOX cores give an easy and fast support for the layout of apparatus and components.

The following remarks are based on today's state of the art and practical experience as described in the standards IEC 60216, IEC 60287 and IEC 60364. The application of products will frequently vary from the theoretical values of constant ambient temperature, constant current carrying, homogeneous laying and others. That means, in practice the theoretical current carrying will differ from the real values both in a positive as in a negative way.

For a safe layout of apparatus and components it is recommended to carry out a test with the installed wire under service conditions.

The current carrying capacity of electrical cables depends on

- Conductor material (copper, copper alloy, aluminium, steel)
- Surface treatment of the conductor (plain, tinned, silver plated, nickel plated)
- Conductor cross-section
- Thermal capacity of the insulation material
- Ambient temperature (air/ground temperature)
- Installation mode (free in the air, in cable ducts, in earth)
- Accumulation (single core , several cores spaced, bundles)

Maximum permitted conductor temperature for various insulating materials **according to IEC 60216** (20'000 h / 50 % elongation at break)

EP Rubber (EPDM)	90°C
HFFR (SHF)1 or EVA (SHF2)	90°C
RADOX® Elastomer S FH (SHF2, SHF mud)	120°C
Cores RADOX® Type MA14 (RADOX® TI301)	145°C

Life time expectation

If RADOX® insulated wires are used at higher temperatures than indicated by the temperature index of IEC 60216, the life time is reduced accordingly. Analogical, the life time will increase at lower temperatures. RADOX® Type MA14 (RADOX® TI301) for example has a life span of 20'000 h at a conductor temperature of +145°C, which is approx. 2 ½ years. If it is used at another temperature, life time expectations are as follows and compared to a standard Rubber insulation (EPDM) or with standard jacket materials HFFR (SHF1) or EVA (SHF2)

Table 1 Core Insulation Material

Temperatur Conductor	Competitor Insulation Rubber EPDM	RADOX® Type MA14 (RADOX® TI301)
80 °C	40,000 h	1,920,000 h
85 °C	30,000 h	1,280,000 h
90 °C	20,000 h → 2.5 Years	960,000 h → 120 Years
95 °C	15,000 h	640,000 h
100 °C	10,000 h	480,000 h
105 °C	7,500 h	320,000 h
110 °C	5,000 h	240,000 h
115 °C	3,750 h	160,000 h
120 °C	2,500 h	120,000 h
125 °C	1,875 h	80,000 h
130 °C	1,250 h	60,000 h
135 °C	938 h	40,000 h
140 °C	625 h	30,000 h
145 °C	469 h → 21 Days	20,000 h → 2.5 Years
150 °C	313 h	15,000 h
155 °C	234 h	10,000 h
160 °C	156 h	7,500 h
165 °C	117 h	5,000 h
170 °C	78 h	3,750 h
175 °C	59 h	2,500 h

Table 2 Jacket SHF Material

Ambient Temperature	Competitor Jacket HFFR(SHF1) or EVA(SHF2)	RADOX® Elastomer S FH (SHF2, SHF mud)
45 °C	480,000 h	3,840,000 h
50 °C	320,000 h	2,560,000 h
55 °C	240,000 h	1,920,000 h
60 °C	160,000 h	1,280,000 h
65 °C	120,000 h	960,000 h
70 °C	80,000 h	640,000 h
75 °C	60,000 h	480,000 h
80 °C	40,000 h	320,000 h
85 °C	30,000 h	240,000 h
90 °C	20,000 h → 2.5 Years	160,000 h → 20 Years
95 °C	15,000 h	120,000 h
100 °C	10,000 h	80,000 h
105 °C	7,500 h	60,000 h
110 °C	5,000 h	40,000 h
115 °C	3,750 h	30,000 h
120 °C	2,500 h → 4 Months	20,000 h → 2.5 Years
125 °C	1,875 h	15,000 h
130 °C	1,250 h	10,000 h
135 °C	938 h	7,500 h
140 °C	625 h	5,000 h

Max. operating temperature / max. conductor temperature

The continuous operating temperature according to IEC 60216 is that themperature, at which, after 20'000 operating hours, a conductor has a remaining elongation at break of 50 %. The max. operating temperature depends on whether an insulation material is thermoplastic or crosslinked. Most insulation and also jacket materials are thermoplastic, which means, that they melt at elevated temperatures. HFFR has a melting point of approx. +105°C, PVC melts at approx. +140°C. Crosslinked materials cannot melt, i.e. they keep their shape even at very high temperatures. Therefore, even very high current carrying loads, for example during emergency operation, overload or short-circuit, do not immediately destroy the insulation.

The following table shows the rise in temperature of a **0.5 mm² conductor** at increasing current.

Rise of conductor temperature from +30°C to +70°C

Current (A)	134	95	60	42	30	19
Time (s)	0.1	0.2	0.5	1.0	2	5

Continuous current rating (tables)

The following table shows the maximum current rating in A (based on IEC 60287) for various insulating materials at an ambient temperature of +45°C according to IEC 60092-353, for a single core in free air:

Cross-section mm²	PVC (max conductor Temp. 85°C)	EPDM (max conductor Temp. 90°C)	RADOX® Type MA14 (RADOX® TI301; max conductor Temp. 145°C)
0.50	11.5 A	12 A	18 A
0.75	13.5 A	14 A	24 A
1.0	17 A	18 A	28 A
1.5	22 A	23 A	36 A
2.5	29 A	30 A	49 A
4	38 A	40 A	66 A
6	50 A	52 A	87 A
10	69 A	71 A	-
16	93 A	96 A	-

Correction Factors

At higher ambient temperatures and for bundles, correction factors have to be applied. The following tables indicate the correction factors for RADOX®.

Table higher ambient temperatures and for multi-cores according to IEC 60092-353 and IEC 60364-5-52

Ambient temperature	Correction factor
+35°C	1.10
+40°C	1.05
+45°C	1.00
+50°C	0.94
+55°C	0.88
+60°C	0.82
+65°C	0.74
+70°C	0.67
+75°C	0.58
+80°C	0.47
+85°C	0.41
+90°C	0.33

No. of cores	Correction factor
1	1.00
2	0.80
3	0.70
4	0.65
5	0.60
6	0.57
7	0.54
8	0.52
9	0.50
12	0.45
16	0.41
20	0.38
24	0.37
27	0.35
33	0.33
40	0.31
61	0.26

Inductance, Capacitance, L/R ratio

All values are calculated and therefore these values are reference values.

Type	Cross Section	**C** (approx) [nF/km]	**L** (approx) [µH/km]	**L/R$_{loop}$** (approx) [µH/Ω]
Unshielded pair	0.5 mm²	80	510	5
Unshielded pair	0.75 mm²	90	470	10
Shielded pair	0.75 mm²	140	400	10
Unshielded pair	1.0 mm²	170	450	10
Shielded pair	1.5 mm²	155	360	15
Unshielded triple	1.5 mm²	140	515	35
Shielded pair	2.5 mm²	160	340	20
Unshielded pair	4.0 mm²	110	400	40
Unshielded pair	6.0 mm²	145	330	50

Legende

C	Capacitance	[nF/km]
L	Inductance	[µH/km]
R_{Loop}	Loop resistant	[Ω/km]