

# Current carrying capacity

of RADOX® 125 single core and multi core cables

## Scope

The following tables referring to RADOX connecting leads and multicore cables give 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 standard 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. For a safe layout of apparatus and components it is recommended to carry out a test with the installed connecting lead or cable under service conditions.

## Definitions

Current load	current passed through the cable during operation
Continuous operation	an operation with constant current whose duration is at least long enough to allow the system to reach thermal equilibrium, but may then go on indefinitely
Current rating	maximum permissible current under determined operating
Permissible operating temperature	maximum permissible temperature on the conductor in continuous operation
Wire	insulated single core
Cable	bundle with jacket with one ore more insulated single cores
Conductor temperature	temperature of the surface of the core material

## General remarks

The current rating of a cable depends on the conductor cross section, on the cable design, on the characteristics of the insulation materials, on the installation conditions and, for larger cross sections, on the frequency (skin and proximity effects). Also, additional heating effects due to higher ambient temperatures, due to heating elements and due to bunching of cables have to be taken into account.

The conductor cross section has to be selected in such a way that the actual current load does not exceed the current rating, i.e. the conductor temperature does not exceed the permissible operating temperature. The determining factor is the appropriate, most unfavourable operating condition, encountered during operation over the whole length of the cable.

## Current rating under service conditions I in A

$$I = I_N \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_4 \cdot f_5$$

I in A Current rating for continuous operation under service conditions

$I_N$  in A Current rating for continuous operation under standard conditions

$f_1$  Reduction factor for increased ambient temperature

$f_2$  Conversion factor for deviated conductor temperature, acc. to. temperature index, IEC 60216 (20 000 h)

$f_3$  Reduction factor for multicore cables

$f_4$  Reduction factor for increased frequency

$f_5$  Reduction factor for banded cables

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## Standard conditions for current rating ( $I_N$ [A])

The tabled values for the current rating were calculated according to IEC 60287 for the following standard conditions:

- Continuous operation
- Single circuit for 3-phase current, single conductor for 1-phase current
- 30 °C ambient temperature and sufficiently large and ventilated spaces, whose ambient temperature is not appreciably increased by the heat coming from the cables.
- 120 °C conductor temperature
- Frequency up to 200 Hz

Installation in air, unrestricted heat dissipation, means that the following installation conditions are observed:

- Distance of the cables from the wall, from the floor, from the ceiling > cable diameter
- Distance between two adjacent power circuits > 2 x cable diameter
- Vertical distance between power circuits laid one upon another for individual cables > 2 x cable diameter and for layers of cables > 200 mm
- Perforated tray with a perforation > 30 % of the total surface

Open trays are continuous supports with vertical sides, but without cover. A possible perforation accounts for < 30 % of the total surface.

Closed ducts are entirely closed. Pipes belong to this category also. The max. filling degree is 60 %.

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

PVC, CR	70 °C
PE-X, EPR	90 °C
RADOX 125	120 °C
RADOX 155	135 °C

## Life time expectation

If crosslinked 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 temperature. RADOX® 125 for example has a life span of 20 000 h at a conductor temperature of +120 °C, which is approx. 2.5 years. If it is used at another temperature, life time expectations are as follows:

Example RADOX 125, i.e. 120 °C / 20 000 h

160 °C	1 250 h
150 °C	2 500 h
140 °C	5 000 h
130 °C	10 000 h
120 °C	20 000 h
110 °C	40 000 h
100 °C	80 000 h
90 °C	160 000 h
80 °C	320 000 h

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## Reduction factors for increased ambient temperature ( $f_1$ )

Ambient temp. °C	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
Reduction factor $f_1$	1	0.97	0.94	0.91	0.88	0.85	0.82	0.78	0.75	0.71	0.67	0.62	0.58	0.53	0.47	0.41	0.33	0.22

## Reduction factors for different permissible conductor temperature ( $f_2$ )

Conductor temp. °C	135	120	110	100	90	80
Reduction factor $f_2$	1.04	1	0.96	0.91	0.85	0.79

## Reduction factors for multicore cables ( $f_3$ )

No. of cores in cable	3	4	5	7	8	10	14	16	19	20	24	27	33	40	61
Reduction factor $f_3$	1.0	0.80	0.75	0.65	0.62	0.55	0.50	0.48	0.45	0.44	0.40	0.39	0.37	0.35	0.30


## Reduction factors for increased frequency ( $f_4$ )

Frequency Hz*	400	600	800	1000	2000	3000	4000	5000	10 000
Copper conductor cross section mm <sup>2</sup>	faktors $f_4$								
1.5	1	1	1	1	1	1	1	1	1
2.5	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	0.98
6	1	1	1	1	1	1	1	0.99	0.93
10	1	1	1	1	1	1	0.96	0.93	0.82
16	1	1	1	1	1	0.95	0.91	0.87	0.76
25	1	1	1	1	0.94	0.88	0.83	0.80	0.69
35	1	1	1	0.98	0.89	0.82	0.77	0.74	0.64
50	1	1	0.97	0.94	0.83	0.76	0.72	0.69	0.59
70	1	0.95	0.91	0.88	0.77	0.71	0.67	0.63	0.54
95	0.98	0.93	0.88	0.84	0.73	0.67	0.63	0.60	0.51
120	0.94	0.88	0.84	0.80	0.69	0.64	0.60	0.57	0.48
150	0.90	0.85	0.80	0.77	0.66	0.61	0.57	0.54	0.46
185	0.88	0.82	0.77	0.74	0.64	0.58	0.54	0.52	0.44
240	0.85	0.77	0.72	0.69	0.60	0.54	0.51	0.48	0.41
300	0.79	0.73	0.69	0.66	0.57	0.52	0.48	0.46	0.39
400	0.75	0.69	0.65	0.63	0.54	0.49	0.46	0.44	0.37

\* We recommend that you use a special conductor design for frequencies > 800 Hz and cross sections > 25 mm<sup>2</sup> (waveguide design).

# Current carrying capacity

of RADOX® single cores

Installation method	Connecting lead in free air or perforated tray										
Number of simultaneous loaded conductors on each tray											
	1	2	3	4	6	8	10	16	20	4	6
Reduction factor $f_5$	1	0.87	0.81	0.78	0.75	0.74	0.73	0.72	0.71	0.71	0.62
Copper conductor cross section mm <sup>2</sup>	Current carrying capacity A										
0.50	19	16.4	15.3	14.7	14.2	14.0	13.8	13.6	13.4	13.4	11.7
0.75	24	20.8	19.4	18.6	17.9	17.7	17.4	17.2	17.0	17.0	14.8
1.0	29	24.8	23.1	22.2	21.4	21.1	20.8	20.5	20.2	20.2	17.7
1.5	36	31	29	28	27	26	26	26	25	25	22
2.5	49	43	40	38	37	36	36	35	35	35	30
4	66	57	53	51	49	49	48	47	47	47	41
6	85	74	69	67	64	63	62	61	61	61	53
10	121	105	98	94	91	90	88	87	86	86	75
16	163	142	132	127	122	121	119	117	116	116	101
25	219	191	177	171	164	162	160	158	155	155	136
35	272	237	220	212	204	201	199	196	193	193	169
50	344	299	279	268	258	255	251	248	244	244	213
70	439	382	356	342	329	325	320	316	312	312	272
95	523	455	424	408	392	387	382	377	371	371	324
120	621	540	503	484	466	460	453	447	441	441	385
150	723	629	586	564	542	535	528	521	513	513	448
185	825	718	668	644	619	611	602	594	586	586	512
240	996	867	807	777	747	737	727	717	707	707	618
300	1150	1001	932	897	863	851	840	828	817	817	713
400	1473	1282	1194	1149	1105	1091	1076	1061	1046	1046	914

Continuous current rating

conductor temperature 120 °C, ambient temperature 30 °C



8	10	16	20	4	6	8	10	16	20	4	6	8	10	16	20
0.57	0.53	0.47	0.45	0.67	0.59	0.54	0.50	0.45	0.43	0.71	0.58	0.52	0.48	0.41	0.38

10.8	10.0	8.9	8.5	12.7	11.2	10.2	9.5	8.5	8.1	13.4	11.0	9.8	9.1	7.7	7.2
13.6	12.7	11.2	10.8	16.0	14.1	12.9	12.0	10.8	10.3	17.0	13.9	12.4	11.5	9.8	9.1
16.2	15.1	13.4	12.8	19.1	16.8	15.4	14.3	12.8	12.3	20.2	16.5	14.8	13.7	11.7	10.8
20	19	17	16	24	21	19	18	16	15	25	21	19	17	15	14
28	26	23	22	33	29	26	24	22	21	35	28	25	23	20	19
38	35	31	30	44	39	36	33	30	28	47	38	34	32	27	25
49	45	40	38	57	50	46	43	38	37	61	49	44	41	35	32
69	64	57	54	81	71	65	61	54	52	86	70	63	58	50	46
93	86	77	73	109	96	88	82	73	70	116	95	85	78	67	62
125	116	103	99	147	129	118	110	99	94	155	127	114	105	90	83
155	144	128	122	182	160	147	136	122	117	193	158	141	131	112	103
196	182	162	155	230	203	186	172	155	148	244	200	179	165	141	131
250	233	206	198	294	259	237	220	198	189	312	255	228	211	180	167
298	277	246	235	350	309	282	262	235	225	371	303	272	251	214	199
354	329	292	279	416	366	335	311	279	267	441	360	323	298	255	236
412	383	340	325	484	427	390	362	325	311	513	419	376	347	296	275
470	437	388	371	553	487	446	413	371	355	586	479	429	396	338	314
568	528	468	448	667	588	538	498	448	428	707	578	518	478	408	378
656	610	541	518	771	679	621	575	518	495	817	667	598	552	472	437
840	781	693	663	987	870	796	737	663	634	1046	855	766	708	604	560

# Current carrying capacity

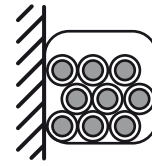
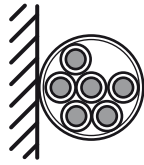
of RADOX® single cores

Installation method	on floor or wall				fixed on a ceiling or under floor							
Number of simultaneous loaded conductors on each tray												
	1	2	3	4	1	2	3	4	5	6	7	8
Reduction factor $f_s$	1	0.87	0.79	0.75	0.95	0.81	0.72	0.68	0.66	0.64	0.63	0.62
Copper conductor cross section $mm^2$	Current carrying capacity A											
0.50	18	15.3	14.2	13.5	17.1	14.5	12.9	12.2	11.9	11.5	11.3	11.1
0.75	23	19.3	17.9	17.0	21.6	18.4	16.3	15.4	15.0	14.5	14.3	14.1
1.0	27	23.0	21.4	20.3	25.7	21.9	19.5	18.4	17.9	17.3	17.1	16.8
1.5	34	29	27	25	32	27	24	23	22	22	21	21
2.5	46	39	37	35	44	38	33	32	31	30	29	29
4	63	53	49	47	59	51	45	43	41	40	39	39
6	81	69	64	61	77	66	58	55	53	52	51	50
10	115	98	91	86	109	93	83	78	76	74	72	71
16	155	132	122	116	147	125	111	105	102	99	98	96
25	208	177	164	156	198	169	150	141	137	133	131	129
35	258	220	204	194	245	209	186	176	171	165	163	160
50	327	278	258	245	310	265	235	222	216	209	206	203
70	417	354	329	313	396	338	300	284	275	267	263	259
95	497	422	393	373	472	402	358	338	328	318	313	308
120	590	501	466	442	560	478	425	401	389	378	372	366
150	687	584	543	515	653	556	495	467	453	440	433	426
185	784	666	619	588	745	635	564	533	517	502	494	486
240	946	804	747	710	899	766	681	643	624	606	596	587
300	1093	929	863	819	1038	885	787	743	721	699	688	677
400	1352	1150	1069	1114	1285	1096	974	920	893	866	852	839

Continuous current rating

conductor temperature 120 °C, ambient temperature 30 °C

in conduit, in a void or in a pipe



≥ 9	1	2	3	4	5	6	7	8	9	10	12	14	16	20
0.61	1	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.38

11.0	14.4	11.5	10.1	9.3	8.6	8.2	7.8	7.5	7.2	6.9	6.5	6.2	5.9	5.5
13.9	18.2	14.5	12.7	11.8	10.9	10.4	9.8	9.4	9.1	8.7	8.2	7.8	7.4	6.9
16.5	22	17.3	15.2	14.1	13.0	12.3	11.7	11.3	10.8	10.4	9.7	9.3	8.9	8.2
21	27	22	19	18	16	15	15	14	14	13	12	12	11	10
28	37	30	26	24	22	21	20	19	19	18	17	16	15	14
38	50	40	35	33	30	29	27	26	25	24	23	22	21	19
49	65	52	45	42	39	37	35	34	32	31	29	28	27	25
70	92	74	64	60	55	52	50	48	46	44	41	40	38	35
94	124	99	87	81	74	71	67	64	62	59	56	53	51	47
127	166	133	117	108	100	95	90	87	83	80	75	72	68	63
158	207	165	145	134	124	118	112	107	103	99	93	89	85	79
199	261	209	183	170	157	149	141	136	131	125	118	112	107	99
254	334	267	234	217	200	190	180	173	167	160	150	143	137	127
303	397	318	278	258	238	227	215	207	199	191	179	171	163	151
360	472	378	330	307	283	269	255	245	236	227	212	203	194	179
419	549	440	385	357	330	313	297	286	275	264	247	236	225	209
478	627	502	439	408	376	357	339	326	314	301	282	270	257	238
577	757	606	530	492	454	431	409	394	378	363	341	325	310	288
666	874	699	612	568	524	498	472	454	437	420	393	376	358	332
825	973	779	682	633	584	555	526	506	487	468	438	419	399	370