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TECHNICAL REPORT

Calculation of maximum external diameter of cables for indoor installations

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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CALCULATION OF MAXIMUM EXTERNAL DIAMETER OF CABLES FOR INDOOR INSTALLATIONS

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IEC 60649, which is a technical report, has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, r.f. connectors, r.f. and microwave passive components and accessories

This second edition cancels and replaces the first edition published in 1979. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) new definitions and formulation for diameter calculation.
b) revised values of constants used for the diameter calculation.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
46C/765/DTR	46C/799A/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

CALCULATION OF MAXIMUM EXTERNAL DIAMETER OF CABLES FOR INDOOR INSTALLATIONS

1 Scope

This Technical Report gives guidance for calculation of the overall cable diameter according to the structure and the dimensions of the cable elements.

2 Terms and definitions

For the purposes of this document, the following terms apply.

2.1 General definitions

2.1.1
single conductor
solid conductor

2.1.2
solid conductor within the stranded conductor
strand

2.1.3
stranded conductor
group of assembled strands

2.1.4
cable element
conductor, pair, triple, quad, quintuple or other structure. It may be screened or unscreened

2.1.5
solid conductor shape
circular

2.1.6
all dimensional values are nominal

2.2 Notation

2.2.1
diameter of solid conductor, *d*

2.2.2
diameter of concentric-lay stranded conductor, d_s

2.2.3
diameter of non-concentric-lay stranded conductor, d_{ns}

2.2.4
total number of strands in a stranded conductor, N_s

2.2.5
number of lays in a concentric-lay stranded conductor, *n*

2.2.6
diameter coefficient for non-concentric-lay stranded conductor, k_{ns}

2.2.7
nominal insulation thickness, d_i

2.2.8
tape thickness, d_t

2.2.9
braid wire diameter, d_b

2.2.10
assembly coefficient, K_a

2.2.11
cable element diameter, d_a

2.2.12
core diameter, d_{core}

2.2.13
sheath thickness, d_{sh}

3 Equations and method for calculations

3.1 Diameter of stranded concentric-lay conductor

Stranded concentric-lay is made up of 7, 19, 37, 61, 91 or 127 strands. Each strand has diameter d. The strands are arranged in layers.

For this case N_s can be calculated from equation (1).

$$N_s = 3n^2 + 3n + 1 \quad (1)$$

And d_s from equation (2)

$$d_s = (1+2n)d \quad (2)$$

3.2 The diameter of stranded non concentric-lay conductor can be calculated by equation (3) and Table 1, as follows:

$$d_{ns} = k_{ns}d \quad (3)$$

Table 1 – k_{ns} values

N_s	k_{ns}	N_s	k_{ns}
2	2	26	6,0
3	2,15	27	6,15
4	2,41	28	6,41
5	2,7	29	6,41
6	3	30	6,41
7	3	31	6,7
8	3,31	32	6,7
9	3,62	33	6,7
10	4	34	7,0
11	4	35	7,0
12	4,15	36	7,0
13	4,41	37	7,0
14	4,41	38	7,31
15	4,7	39	7,31
16	4,7	40	7,31
17	5,0	41	7,62
18	5,0	42	7,62
19	5,0	43	7,62
20	5,31	44	8,0
21	5,31	45	8,0
22	5,62	46	8,0
23	5,62	47	8,0
24	6,0	48	8,15
25	6,0	49	8,15

3.3 The overall diameter of insulated solid conductor, D, can be calculated by equation (4).

$$D = d + 2d_i \quad (4)$$

3.4 Diameter of insulated concentric lay stranded conductor D_s can be calculated by equation (5).

$$D_s = d_s + 2d_i \quad (5)$$

3.5 Diameter of insulated non-concentric-lay stranded conductor D_{ns} can be calculated by equation (6).

$$D_{ns} = d_{ns} + 2d_i \quad (6)$$

3.6 Diameter D_t over tape wrapped with an overlap on a core can be calculated by equation (7).

$$D_t = d_{core} + 3d_t \quad (7)$$

3.7 Diameter D_t over tape wrapped without an overlap on a core can be calculated by equation (8).

$$D_t = d_{core} + 2d_t \quad (8)$$

3.8 Diameter D_b over braid screen on a core can be calculated by equation (9).

$$D_b = d_{core} + 4{,}75\ d_b \quad (9)$$

3.9 Overall diameter D_A of cable elements assembly can be calculated by equation (10) and Table 2.

$$D_A = K_a d_a \quad (10)$$

Table 2 – Assembly coefficient (K_a)

Number of cabling elements N	Single conductors	Pairs	Triples	Quads	Quintuples
1	1,0	2,0	2,15	2,41	2,7
2	2,0	3,4	Note 1	Note 1	Note 1
3	2,15	3,65	4,1	4,9	5,6
4	2,41	4,1	4,6	5,5	6,3
5	2,7	4,6	5,2	6,2	7,0
6	3,0	5,1	6,0	6,9	7,8
7	3,0	5,1	6,0	6,9	7,8
8	3,4	5,5	6,5	7,6	8,7
9	3,6	6,0	7,0	8,3	9,4
10	4,0	6,4	7,5	8,8	10,0
>10	1,20 $\sqrt{N}$	1,95 $\sqrt{N}$	2,25 $\sqrt{N}$	2,70 $\sqrt{N}$	3,10 $\sqrt{N}$

NOTE 1 Since these types are rarely manufactured, no coefficient is given.

NOTE 2 It is assumed that elements are identical.

3.10 Overall sheath diameter D_c can be calculated by equation (11)

$$D_c = D_A + 2d_{sh} \quad (11)$$

NOTE The minimum value for the sheath thickness, d_{sh}, is given in the relevant IEC publications concerning indoor installations.