

INTERNATIONAL STANDARD



Specifications for particular types of winding wires –
Part 0-8: General requirements – Polyester glass-fibre wound **unvarnished
and fused**, or resin or varnish impregnated **or not impregnated**, bare or
enamelled rectangular copper wire



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Part 0-8: General requirements – Polyester glass-fibre wound **unvarnished**
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

**Part 0-8: General requirements – Polyester glass-fibre
wound ~~unvarnished and fused~~, or resin or varnish impregnated
~~or not impregnated~~, bare or enamelled rectangular copper wire**

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60317-0-8 has been prepared by IEC technical committee 55: Winding wires.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

- a) revision to the title of the standard indicating that the glass fibre covering is fused and unvarnished;
- b) revision to subclause 3.2 adding winding wire requirements for the fibrous covering and a list of covering classifications;
- c) revision to subclause 3.3 requirements for appearance;
- d) revision to subclause 8.2, adherence test requirements.

The text of this standard is based on the following documents:

FDIS	Report on voting
55/1784/FDIS	55/1796/RVD

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

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

A list of all the parts in the IEC 60317 series, published under the general title *Specifications for particular types of winding wires*, can be found on the IEC website.

The numbering of clauses in this standard is not continuous from Clauses 21 through 30 in order to reserve space for possible future wire requirements prior to those for wire packaging.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

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INTRODUCTION

This Part of IEC 60317 ~~is one~~ forms an element of a series of standards which deals with insulated wires used for windings in electrical equipment. The ~~series~~ set of standards has three ~~groups~~ series describing:

- 1) *Winding wires – Test methods* (IEC 60851);
- 2) *Specifications for particular types of winding wires* (IEC 60317);
- 3) *Packaging of winding wires* (IEC 60264).

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

Part 0-8: General requirements – Polyester glass-fibre wound **unvarnished and fused**, or resin or varnish impregnated ~~or not impregnated~~, bare or enamelled rectangular copper wire

1 Scope

This part of IEC 60317 specifies the general requirements of polyester glass-fibre wound **fused, unvarnished**, or resin or varnish impregnated ~~or not impregnated~~, bare, or **grade 1 or grade 2** or enamelled rectangular copper **winding wires**.

The range of nominal conductor dimensions is given in **4.1** and in the relevant specification sheet.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60851 (all parts), *Winding wires – Test methods*

ISO 3:~~1973~~, *Preferred numbers – Series of preferred numbers*

3 Terms, definitions and general notes on tests and appearance

3.1 Terms and definition

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1 coating

material which is deposited on a conductor or wire by a suitable means and then dried and/or cured

3.1.2 conductor

bare metal after removal of the insulation

3.1.3 covering

material which is wound, wrapped or braided around a bare or insulated conductor

3.1.4

crack

opening in the insulation which exposes the conductor to view at the stated magnification

3.1.5

enamelled wire

wire coated with an insulation of cured resin

3.1.6

fused

state of polyester fibres after having been melted then re-solidified for support/adherence of glass fibres

3.1.7

grade

range of thickness of the insulation of a wire

3.1.8

insulation

coating or covering on the conductor with the specific function of withstanding voltage

3.1.9

nominal conductor dimension

designation of the conductor size in accordance with IEC 60317 (all parts)

3.1.10

normal vision

20/20 vision, with corrective lenses, if necessary

3.1.11

winding wire

wire used for winding a coil to provide a magnetic field

3.1.12

wire

conductor coated or covered with an insulation

3.2 General notes

3.2.1 Methods of test

All methods of test to be used for this document are given in the IEC 60851 series.

The clause numbers used in this document are identical with the respective test numbers in the IEC 60851 series.

In case of inconsistencies between the IEC 60851 series and this document, IEC 60317-0-8 shall prevail.

Where no specific range of nominal conductor dimensions is given for a test, the test applies to all nominal conductor dimensions covered by the specification sheet.

Unless otherwise specified, all tests shall be carried out at a temperature from 15 °C to 40 °C and a relative humidity from ~~45~~ 25 % to 75 %. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow the specimens to reach stability.

The wire to be tested shall be removed from the packaging in such a way that the wire will not be subjected to tension or unnecessary bends. Before each test, sufficient wire should be discarded to ensure that any damaged wire is not included in the test specimens.

3.2.2 Winding wire

The fibre covering shall consist of a combination of polyester and glass fibres. The glass fibres shall be electrical-grade continuous-filament glass yarn. The polyester fibre shall be a high-grade yarn resulting from the linear polymerization of ethylene glycol and terephthalic acid. The maximum content by weight of polyester fibre in the yarn shall not exceed 50 %.

The coating shall be characterized by the following different grades of thickness:

- PG1, bare conductor with 1 layer of polyester glass fibre or 2 layers of finer polyester glass fibres that together, comply with the dimensional requirements in Table 1;
- PG2, bare conductor with 2 layers of polyester glass fibre;
- Grade 1 PG1, enamelled grade 1 (grade 1) with 1 layer of polyester glass fibre (PG1);
- Grade 1 PG2, enamelled grade 1 (grade 1) with 2 layers of polyester glass fibre (PG2);
- Grade 2 PG1, enamelled grade 2 (grade 2) with 1 layer of polyester glass fibre (PG1);
- Grade 2 PG2, enamelled grade 2 (grade 2) with 2 layers of polyester glass fibre (PG2).

When reference is made to a winding wire according to a standard of the IEC 60317 series, the following information is ~~included~~ given in the description:

- reference to IEC specification;
- nominal conductor dimensions in millimetres (width × thickness);
- grade.

EXAMPLE IEC 60317-60 – 4,00 × 1,00 Grade 2PG1.

3.3 Appearance

The fibrous covering shall be essentially smooth and ~~continuous~~ uniform as agreed upon between customer and supplier in accordance with good commercial practice, and free from physical damage and foreign material when examined with normal vision, as wound on the original spool or reel. Fibres shall be bound to the underlying enamelled or bare wire.

NOTE Evidence of physical damage includes gashes, broken fibre strands, and the like.

4 Dimensions

4.1 Conductor dimensions

The dimensions for widths and thicknesses of conductors of winding wires with rectangular cross-section recommended in this part of IEC 60317 shall be in accordance with Table 1, and are taken from the R 20 ~~and R 40~~ series according to ISO 3:1973.

Preferred sizes are combinations of width and thickness both according to the R 20 and R 40 series.

Intermediate sizes are combinations of width or thickness according to the R 20 series with the other dimension according to the R 40 series.

This part of IEC 60317 covers:

- widths from 2,00 mm up to and including 16,00 mm;

- thicknesses from 0,80 mm up to and including 5,60 mm¹.

For thickness over 5,60 mm up to and including 10 mm and for widths over 16 mm up to and including 25 mm where, for technical reasons, additional sizes may be needed, the R 40 series shall be used. The ratio width/thickness shall be within the specified limits and combinations of R 40 and R 40 are not allowed in the case of additional sizes.

The ratio width/thickness shall be greater than or equal to 1,4:1 and shall not exceed 8:1.

The actual values of dimensions are given in Table 1².

The nominal cross-sectional areas for preferred sizes are given in Table 1 and the nominal cross-sectional areas for intermediate sizes are given in Table A.1 of Annex A.

¹) ~~For thicknesses over 5,60 mm up to and including 10 mm and for widths over 16 mm up to and including 25 mm where, for technical reasons additional sizes may be needed, the R 40 series shall be used. The ratio width/thickness shall be within the specified limits and combinations of R 40; R 40 is not allowed in the case of additional sizes.~~

²) ~~Dimensions according to the R 20 series are printed in larger type.~~

Table 1 – Nominal cross-sectional areas of preferred sizes

[illegible]

* 0,5 nominal thickness.

Thickness <div></div>																		
mm	0,80	0,90	1,00	1,12	1,25	1,40	1,60	1,80	2,00	2,24	2,50	2,80	3,15	3,55	4,00	4,50	5,00	5,60
	Corner radius (0,5 mm*)			Corner radius (0,5 mm*)				Corner radius (0,65 mm*)			Corner radius (0,65 mm*)			Corner radius (1,0 mm*)				
2,00	1,463	1,626	1,785	2,025	2,285	2,585												
2,24	1,655	1,842	2,205	2,294	2,582	2,921	3,369											
2,50	1,863	2,076	2,285	2,585	2,910	3,285	3,785	4,137										
2,80	2,103	2,346	2,585	2,921	3,285	3,705	4,265	4,677	5,237									
3,15	2,383	2,661	2,935	3,313	3,723	4,195	4,825	5,307	5,937	6,693								
3,55	2,703	3,021	3,335	3,761	4,223	4,755	5,465	6,027	6,737	7,589	8,326							
4,00	3,063	3,426	3,785	4,265	4,785	5,385	6,185	6,831	7,637	8,597	9,451	10,65						
4,50	3,463	3,876	4,285	4,825	5,410	6,085	6,85	7,737	8,631	9,717	10,70	12,05	13,63					
5,00	3,863	4,326	4,785	5,385	6,035	6,785	7,785	8,637	9,637	10,84	12,18	13,45	15,20	17,20				
5,60	4,363	4,866	5,385	6,057	6,785	7,625	8,745	9,717	10,84	12,18	13,45	15,13	17,09	19,33	21,54			
6,30	4,903	5,496	6,085	6,841	7,660	8,605	9,865	10,98	12,24	13,75	15,20	17,09	19,30	21,82	24,34	27,49		
7,10		6,216	6,885	7,737	8,660	9,725	11,15	12,42	13,84	15,54	17,20	19,33	21,82	24,66	27,54	31,09	34,64	
8,00			7,785	8,745	9,785	10,99	12,59	14,04	15,64	17,56	19,45	21,85	24,65	27,85	31,14	35,14	39,14	43,94
9,00				9,865	11,04	12,39	14,19	15,84	17,64	19,80	21,95	24,65	27,80	31,40	35,14	39,64	44,14	49,54
10,0					12,29	13,79	15,79	17,64	19,64	22,04	24,45	27,45	30,95	34,95	39,14	44,14	49,14	55,14
11,2						15,47	17,71	19,80	22,04	24,79	27,46	30,81	34,73	39,21	43,94	49,54	55,14	61,86
12,5	Not recommended							19,79	22,14	24,64	27,64	30,70	34,45	38,83	43,83	49,14	55,39	61,64
14,0	Ratio width/thickness over 8:1								24,84	27,64	31,00	34,45	38,65	43,55	49,15	55,14	62,14	69,14
16,0									31,64	35,48	39,45	44,25	49,85	56,25	63,14	71,14	79,14	88,74
* Nominal thickness.																		
NOTE Dimensions according to R 20 series are printed in larger type.																		

* Nominal thickness.

NOTE Dimensions according to R 20 series are printed in larger type.

4.2 Tolerance on conductor dimensions

The conductor dimensions shall not differ from the nominal values by more than the tolerance given in Table 2.

Table 2 – Conductor tolerances

Nominal width or thickness of the conductor mm		Tolerance mm
Over	Up to and including	
–	3,15	± 0,030
3,15	6,30	± 0,050
6,30	12,50	± 0,070
12,50	16,00	± 0,100

4.3 Rounding of corners

The arc shall merge smoothly into the flat surfaces of the conductor and the strip shall be free from sharp, rough and projecting edges. The conductor shall have corner radii complying with Table 3. The specified radii shall be maintained within ±25 %.

Table 3 – Corner radii

Nominal width or thickness of the conductor mm		Corner radius mm
Over	Up to and including	
–	1,00	0,5 nominal thickness
1,00	1,60	0,50*
1,60	2,24	0,65**
2,24	3,55	0,80
3,55	5,60	1,00

NOTE If agreed between purchaser and supplier, the corner radii for wires with a width greater than 4,8 mm may be:

* 0,5 mm nominal thickness

** 0,8 mm

4.4 Increase in dimensions due to the insulation

The increase in width or thickness due to the insulation shall be as specified in Table 4.

Table 4 – Increase in dimensions

Nominal width of the conductor mm		Increase in dimensions mm																	
		Polyester-glass fibre covering over bare conductor					Polyester-glass fibre covering over grade 1 enamelled wire					Polyester-glass fibre covering over grade 2 enamelled wire							
		Single covering (PG1)			Double covering (PG2)			Single covering (grade 1 PG1)			Double covering (grade 1 PG2)			Single covering (grade 2 PG1)			Double covering (grade 2 PG2)		
Over	Up to and incl.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.
—	3,15	0,08	0,12	0,16	0,19	0,25	0,31	0,14	0,21	0,27	0,25	0,34	0,42	0,20	0,27	0,33	0,31	0,40	0,48
3,15	6,30	0,10	0,14	0,18	0,21	0,28	0,35	0,16	0,23	0,29	0,27	0,37	0,46	0,22	0,29	0,35	0,33	0,43	0,52
6,30	12,50	0,11	0,16	0,21	0,22	0,30	0,38	0,17	0,25	0,32	0,28	0,39	0,49	0,23	0,31	0,38	0,34	0,45	0,55
12,50	16,00	0,12	0,18	0,24	0,24	0,32	0,40	0,18	0,27	0,35	0,30	0,41	0,51	0,24	0,33	0,41	0,36	0,47	0,57
NOTE-1 The maximum increase in thickness or width due to the insulation may be exceeded, provided the overall thickness or width of the insulated wire does not exceed the sum of the maximum thickness or width of the bare wire plus the maximum increase in dimension given in the table above.																			
NOTE-2 The minimum increases in dimensions apply only to the increase in thickness.																			

4.5 Overall dimensions

4.5.1 Nominal overall dimensions

The nominal overall dimensions shall be calculated as the sum of the nominal bare ~~conductor~~ dimension and the nominal increase in dimension due to the insulation.

4.5.2 Minimum overall dimensions

The minimum overall dimensions shall be calculated as the sum of the minimum bare ~~conductor~~ dimension and the minimum increase in dimension due to the insulation.

4.5.3 Maximum overall dimensions

The maximum overall dimensions shall be calculated as the sum of the maximum bare ~~conductor~~ dimension and the maximum increase in dimension due to the insulation.

5 Electrical resistance

The resistance of the wire shall be expressed as the DC resistance at 20 °C. The method used shall provide an accuracy of 0,5 %.

The maximum value of resistance shall be not greater than the value calculated for the minimum tolerated cross-sectional area of the conductor resulting from the minimum dimensions in thickness and width and the maximum for the corner radius, and with a resistivity of $1/58 \Omega \text{ mm}^2 \text{ m}^{-1}$.

One measurement shall be made.

6 Elongation

The elongation at fracture shall be in accordance with Table 5.

Table 5 – Elongation

Nominal thickness of the conductor mm		Minimum elongation %
Over	Up to and including	
–	2,50	30
2,50	5,60	32

7 Springiness

The wire shall not exceed the maximum springback of:

- 5,0° for polyester-glass fibre covered bare wires
- 5,5° for polyester-glass fibre covered enamelled wires

8 Flexibility and adherence

8.1 Mandrel winding test

The covering shall show no crack after the wire has been bent flatwise and edgewise on a mandrel with a diameter as specified in Table 6.

Table 6 – Mandrel winding

Wire bent on		Mandrel diameter
Width	Sizes up to and including 8 mm	10 × width
	Sizes over 8 mm	15 × width
Thickness	All sizes	10 × thickness

Specimens showing no crack or opening shall meet the requirements of Clause 13.

8.2 Adherence test

8.2.1 Fibre covered bare wires

The specimen shall be elongated 20 %. ~~There shall be no loss of adhesion of the fibre covering.~~ There shall be no loosening, fraying or detachment of the covering except at the point of rupture.

8.2.2 Fibre covered enamelled wires

The specimen shall be elongated 20 %. ~~There shall be no loss of adhesion either of the fibre covering or the enamel.~~ There shall be either no loosening, fraying or detachment of the covering and no cracks visible in the coating without removing the glass-fiber covering.

9 Heat shock

Test inappropriate.

10 Cut-through

Test inappropriate.

11 Resistance to abrasion

Test inappropriate.

12 Resistance to solvents

Test inappropriate.

13 Breakdown voltage

The wire shall meet the requirements of Table 7.

Table 7 – Breakdown voltage

Type of insulation		Minimum breakdown voltage (root-mean-square value) (RMS) V
Bare conductor with	Single covering (PG1)	350
	Double covering (PG2)	560
Grade 1 enamelled wire with	Single covering (grade 1 PG1)	1 350
	Double covering (grade 1 PG2)	1 560
Grade 2 enamelled wire with	Single covering (grade 2 PG1)	2 350
	Double covering (grade 2 PG2)	2 560

14 Continuity of insulation

Test inappropriate.

15 Temperature index

The temperature index is dependent on the type of impregnating agent used. The method of test used shall be agreed between purchaser and supplier. The maximum service temperature shall be determined by experience.

16 Resistance to refrigerants

Test inappropriate.

17 Solderability

Test inappropriate.

18 Heat or solvent bonding

Test inappropriate.

19 Dielectric dissipation factor

Test inappropriate.

20 Resistance to transformer oil

Test inappropriate.

21 Loss of mass

Test inappropriate.

23 Pin hole test

Test inappropriate.

30 Packaging

The kind of packaging may influence certain properties of the wire, for example springback. Therefore the kind of packaging, for example the type of spool, shall be agreed between purchaser and supplier.

The wire shall be evenly and compactly wound on spools or placed in containers. In order to reduce the risk of wire damage, the spool with the wire shall be delivered and used with the axis in horizontal position. No spool or container shall contain more than one length of wire unless agreed ~~to by~~ between purchaser and supplier. Marking of the label when there is more than one length and/or identification of the separate lengths in the package shall be agreed ~~to by~~ between purchaser and supplier.

Where wires are delivered in coils, the dimensions and the maximum weights of such coils shall be agreed between purchaser and supplier. Any additional protection for coils shall also be agreed between purchaser and supplier.

Labels shall be attached to each packaging unit as agreed between supplier and user and shall include the following information:

- a) manufacturer's name and/or trade mark;
- b) type of wire and insulation, for instance trade name and/or IEC specification number;
- c) net mass of wire;
- d) nominal dimension(s) of wire and grade of insulation;
- e) date of manufacture.

Annex A

(informative)

Nominal cross-sectional areas for preferred and intermediate sizes

Table A.1 provides nominal cross-sectional areas for preferred and intermediate sizes of rectangular copper bare conductors, from which the user may select intermediate sizes only for technical reasons.

Table A.1 – Nominal cross-sectional areas

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
2,00	0,80	*	1,463
	0,85	*	1,545
	0,90	*	1,626
	0,95	*	1,706
	1,00	*	1,785
	1,06	0,5	1,905
	1,12	0,5	2,025
	1,18	0,5	2,145
	1,25	0,5	2,285
	1,32	0,5	2,425
	1,40	0,5	2,585
2,12	0,80	*	1,559
	0,90	*	1,734
	1,00	*	1,905
	1,12	0,5	2,160
	1,25	0,5	2,435
	1,40	0,5	2,753
2,24	0,80	*	1,655
	0,85	*	1,749
	0,90	*	1,842
	0,95	*	1,934
	1,00	*	2,025
	1,06	0,5	2,160
	1,12	0,5	2,294
	1,18	0,5	2,429
	1,25	0,5	2,585
	1,32	0,5	2,742
	1,40	0,5	2,921
	1,50	0,5	3,145
	1,60	0,5	3,369
2,36	0,80	*	1,751
	0,90	*	1,950
	1,00	*	2,145

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
2,50	1,25	0,5	2,910
	1,32	0,5	3,085
	1,40	0,5	3,285
	1,50	0,5	3,535
	1,60	0,5	3,785
	1,70	0,65	3,887
	1,80	0,65	4,137
2,65	0,80	*	1,983
	0,90	*	2,211
	1,00	*	2,435
	1,12	0,5	2,753
	1,25	0,5	3,098
	1,40	0,5	3,495
	1,60	0,5	4,025
	1,80	0,65	4,407
2,80	0,80	*	2,103
	0,85	*	2,225
	0,90	*	2,346
	0,95	*	2,466
	1,00	*	2,585
	1,06	0,5	2,753
	1,12	0,5	2,921
	1,18	0,5	3,089
	1,25	0,5	3,285
	1,32	0,5	3,481
	1,40	0,5	3,705
	1,50	0,5	3,985
	1,60	0,5	4,265
	1,70	0,65	4,397
	1,80	0,65	4,677
	1,90	0,65	4,957
	2,00	0,65	5,237

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	1,12	0,5	2,429
	1,25	0,5	2,735
	1,40	0,5	3,089
	1,60	0,5	3,561
2,50	0,80	*	1,863
	0,85	*	1,970
	0,90	*	2,076
	0,95	*	2,181
	1,00	*	2,285
	1,06	0,5	2,435
	1,12	0,5	2,585
	1,18	0,5	2,736
3,15	0,90	*	2,661
	0,95	*	2,799
	1,00	*	2,935
	1,06	0,5	3,124
	1,12	0,5	3,313
	1,18	0,5	3,502
	1,25	0,5	3,723
	1,32	0,5	3,943
	1,40	0,5	4,195
	1,50	0,5	4,510
	1,60	0,5	4,825
	1,70	0,65	4,992
	1,80	0,65	5,307
	1,90	0,65	5,622
	2,00	0,65	5,937
	2,12	0,65	6,315
	2,24	0,65	6,693
3,35	0,80	*	2,543
	0,90	*	2,841
	1,00	*	3,135
	1,12	0,5	3,537
	1,25	0,5	3,973
	1,40	0,5	4,475
	1,60	0,5	5,145
	1,80	0,65	5,667
	2,00	0,65	6,337
	2,24	0,65	7,141

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
3,00	0,80	*	2,263
	0,90	*	2,526
	1,00	*	2,785
	1,12	0,5	3,145
	1,25	0,5	3,535
	1,40	0,5	3,985
	1,60	0,5	4,585
	1,80	0,65	5,037
3,15	0,80	*	2,383
	0,85	*	2,522
3,75	0,80	*	2,863
	0,90	*	3,201
	1,00	*	3,535
	1,12	0,5	3,985
	1,25	0,5	4,473
	1,40	0,5	5,035
	1,60	0,5	5,785
	1,80	0,65	6,387
	2,00	0,65	7,137
	2,24	0,65	8,037
	2,50	0,8	8,826
4,00	0,80	*	3,063
	0,85	*	3,245
	0,90	*	3,426
	0,95	*	3,606
	1,00	*	3,785
	1,06	0,5	4,025
	1,12	0,5	4,265
	1,18	0,5	4,505
	1,25	0,5	4,785
	1,32	0,5	5,065
	1,40	0,5	5,385
	1,50	0,5	5,785
	1,60	0,5	6,185
	1,70	0,65	6,437
	1,80	0,65	6,837
	1,90	0,65	7,237



Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
3,55	0,80	*	2,703
	0,85	*	2,862
	0,90	*	3,021
	0,95	*	3,179
	1,00	*	3,335
	1,06	0,5	3,548
	1,12	0,5	3,761
	1,18	0,5	3,974
	1,25	0,5	4,223
	1,32	0,5	4,471
	1,40	0,5	4,755
	1,50	0,5	5,110
	1,60	0,5	5,465
	1,70	0,65	5,672
	1,80	0,65	6,027
	1,90	0,65	6,382
	2,00	0,65	6,737
	2,12	0,65	7,163
	2,24	0,65	7,589
	2,36	0,8	7,829
	2,50	0,8	8,326
4,50	0,80	*	3,463
	0,85	*	3,670
	0,90	*	3,876
	0,95	*	4,081
	1,00	*	4,285
	1,06	0,5	4,555
	1,12	0,5	4,825
	1,18	0,5	5,095
	1,25	0,5	5,410
	1,32	0,5	5,725
	1,40	0,5	6,085
	1,50	0,5	6,535
	1,60	0,5	6,985
	1,70	0,65	7,287
	1,80	0,65	7,737
	1,90	0,65	8,187
	2,00	0,65	8,637
	2,12	0,65	9,177
	2,24	0,65	9,717
	2,36	0,8	10,07

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	2,00	0,65	7,637
	2,12	0,65	8,117
	2,24	0,65	8,597
	2,36	0,8	8,891
	2,50	0,8	9,451
	2,65	0,8	10,05
	2,80	0,8	10,65
4,25	0,80	*	3,263
	0,90	*	3,651
	1,00	*	4,035
	1,12	0,5	4,545
	1,25	0,5	5,098
	1,40	0,5	5,735
	1,60	0,5	6,585
	1,80	0,65	7,287
	2,00	0,65	8,137
	2,24	0,65	9,157
	2,50	0,8	10,08
	2,80	0,8	11,35
5,00	1,70	0,65	8,137
	1,80	0,65	8,637
	1,90	0,65	9,137
	2,00	0,65	9,637
	2,12	0,65	10,24
	2,24	0,65	10,84
	2,36	0,8	11,25
	2,50	0,8	11,95
	2,65	0,8	12,70
	2,80	0,8	13,45
	3,00	0,8	14,45
	3,15	0,8	15,20
	3,35	0,8	16,20
	3,55	0,8	17,20
5,30	0,80	*	4,103
	0,90	*	4,596
	1,00	*	5,085
	1,12	0,5	5,721
	1,25	0,5	6,410
	1,40	0,5	7,205

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	2,50	0,8	10,70
	2,65	0,8	11,38
	2,80	0,8	12,05
	3,00	0,8	12,95
	3,15	0,8	13,63
4,75	0,80	*	3,663
	0,90	*	4,101
	1,00	*	4,535
	1,12	0,5	5,105
	1,25	0,5	5,723
	1,40	0,5	6,435
	1,60	0,5	7,385
	1,80	0,65	8,188
	2,00	0,65	9,137
	2,24	0,65	10,28
	2,50	0,8	11,33
	2,80	0,8	12,75
	3,15	0,8	14,41
5,00	0,80	*	3,863
	0,85	*	4,095
	0,90	*	4,326
	0,95	*	4,556
	1,00	*	4,785
	1,06	0,5	5,085
	1,12	0,5	5,385
	1,18	0,5	5,685
	1,25	0,5	6,035
	1,32	0,5	6,385
	1,40	0,5	6,785
	1,50	0,5	7,285
	1,60	0,5	7,785
5,60	3,00	0,8	16,25
	3,15	0,8	17,09
	3,35	0,8	18,21
	3,55	0,8	19,33
	3,75	1,0	20,14
	4,00	1,0	21,54
6,00	0,80	*	4,663
	0,90	*	5,226

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	1,60	0,5	8,265
	1,80	0,65	9,177
	2,00	0,65	10,24
	2,24	0,65	11,51
	2,50	0,8	12,70
	2,80	0,8	14,29
	3,15	0,8	16,15
	3,55	0,8	18,27
5,60	0,80	*	4,343
	0,85	*	4,605
	0,90	*	4,866
	0,95	*	5,126
	1,00	*	5,385
	1,06	0,5	5,721
	1,12	0,5	6,057
	1,18	0,5	6,393
	1,25	0,5	6,785
	1,32	0,5	7,177
	1,40	0,5	7,625
	1,50	0,5	8,185
	1,60	0,5	8,745
	1,70	0,65	9,157
	1,80	0,65	9,717
	1,90	0,65	10,28
	2,00	0,65	10,84
	2,12	0,65	11,51
	2,24	0,65	12,18
	2,36	0,8	12,67
	2,50	0,8	13,45
	2,65	0,8	14,29
	2,80	0,8	15,13
6,30	3,75	1,0	22,77
	4,00	1,0	24,34
	4,25	1,0	25,92
	4,50	1,0	27,49
6,70	0,90	*	5,856
	1,00	*	6,485
	1,12	0,5	7,289
	1,25	0,5	8,160

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	1,00	*	5,785
	1,12	0,5	6,505
	1,25	0,5	7,285
	1,40	0,5	8,185
	1,60	0,5	9,385
	1,80	0,65	10,44
	2,00	0,65	11,64
	2,24	0,65	13,08
	2,50	0,8	14,45
	2,80	0,8	16,25
	3,15	0,8	18,35
	3,55	0,8	20,75
	4,00	1,0	23,14
6,30	0,80	*	4,903
	0,85	*	5,200
	0,90	*	5,496
	0,95	*	5,791
	1,00	*	6,085
	1,06	0,5	6,463
	1,12	0,5	6,841
	1,18	0,5	7,219
	1,25	0,5	7,660
	1,32	0,5	8,101
	1,40	0,5	8,605
	1,50	0,5	9,235
	1,60	0,5	9,865
	1,70	0,65	10,35
	1,80	0,65	10,98
	1,90	0,65	11,61
	2,00	0,65	12,24
	2,12	0,65	12,99
	2,24	0,65	13,75
	2,36	0,8	14,32
	2,50	0,8	15,20
	2,65	0,8	16,15
	2,80	0,8	17,09
	3,00	0,8	18,35
	3,15	0,8	19,30
	3,35	0,8	20,56

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	1,40	0,5	9,165
	1,60	0,5	10,51
	1,80	0,65	11,70
	2,00	0,65	13,04
	2,24	0,65	14,65
	2,50	0,8	16,20
	2,80	0,8	18,21
	3,15	0,8	20,56
	3,55	0,8	23,24
	4,00	1,0	25,94
	4,50	1,0	29,29
7,10	0,90	*	6,216
	0,95	*	6,551
	1,00	*	6,885
	1,06	0,5	7,311
	1,12	0,5	7,737
	1,18	0,5	8,163
	1,25	0,5	8,660
	1,32	0,5	9,157
	1,40	0,5	9,725
	1,50	0,5	10,44
	1,60	0,5	11,15
	1,70	0,65	11,71
	1,80	0,65	12,42
	1,90	0,65	13,13
	2,00	0,65	13,84
	2,12	0,65	14,69
	2,24	0,65	15,54
	2,36	0,8	16,21
	2,50	0,8	17,20
	2,65	0,8	18,27
	2,80	0,8	19,33
	3,00	0,8	20,75
	3,15	0,8	21,82
	3,35	0,8	23,24
	3,55	0,8	24,66
	3,75	1,0	25,77
	4,00	1,0	27,54
	4,25	1,0	29,32

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
	3,55	0,8	21,82
7,10	4,50	1,0	31,09
	4,75	1,0	32,87
	5,00	1,0	34,64
7,50	1,00	*	7,285
	1,12	0,5	8,185
	1,25	0,5	9,160
	1,40	0,5	10,29
	1,60	0,5	11,79
	1,80	0,65	13,14
	2,00	0,65	14,64
	2,24	0,65	16,44
	2,50	0,8	18,20
	2,80	0,8	20,45
	3,15	0,8	23,08
	3,55	0,8	26,08
	4,00	1,0	29,14
	4,50	1,0	32,89
	5,00	1,0	36,64
8,00	1,00	*	7,785
	1,06	0,5	8,265
	1,12	0,5	8,745
	1,18	0,5	9,225
	1,25	0,5	9,785
	1,32	0,5	10,35
	1,40	0,5	10,99
	1,50	0,5	11,79
	1,60	0,5	12,59
	1,70	0,65	13,24
	1,80	0,65	14,04
	1,90	0,65	14,84
	2,00	0,65	15,64
	2,12	0,65	16,60
	2,24	0,65	17,56
	2,36	0,8	18,33
	2,50	0,8	19,45

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²
8,50	1,12	0,5	9,305
	1,25	0,5	10,41
	1,40	0,5	11,69
	1,60	0,5	13,39
	1,80	0,65	14,94
	2,00	0,65	16,64
	2,24	0,65	18,68
	2,50	0,8	20,70
	2,80	0,8	23,25
	3,15	0,8	26,23
	3,55	0,8	29,63
	4,00	1,0	33,14
	4,50	1,0	37,39
	5,00	1,0	41,64
	5,60	1,0	46,74
9,00	1,12	0,5	9,865
	1,18	0,5	10,41
	1,25	0,5	11,04
	1,32	0,5	11,67
	1,40	0,5	12,39
	1,50	0,5	13,29
	1,60	0,5	14,19
	1,70	0,65	14,94
	1,80	0,65	15,84
	1,90	0,65	16,74
	2,00	0,65	17,64
	2,12	0,65	18,72
	2,24	0,65	19,80
	2,36	0,8	20,69
	2,50	0,8	21,95
	2,65	0,8	23,30
	2,80	0,8	24,65
	3,00	0,8	26,45
	3,15	0,8	27,80
	3,35	0,8	29,60
	3,55	0,8	31,40
	3,75	1,0	32,89