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Indian Standard

**SPECIFICATIONS FOR PARTICULAR TYPES
OF WINDING WIRES**

**PART 53 AROMATIC POLYIMIDE (ARAMID) TAPE WRAPPED RECTANGULAR
COPPER WIRE, TEMPERATURE INDEX 220**

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NATIONAL FOREWORD

This Indian Standard (Part 53) which is identical with IEC 60317-53 (1999) 'Specifications for particular types of winding wires — Part 53 : Aromatic polyimide (aramid) tape wrapped rectangular copper wire, temperature index 220' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendations of the Winding Wires Sectional Committee (ET 33) and approval of the Electrotechnical Division Council.

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English text of the International Standard has been retained while adopting it as an Indian Standard, and as such the page numbers given here are not the same as in IEC Publication.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their places are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 60172 (1987) Test procedure for the determination of the temperature index of enamelled winding wires	IS 5825 : 1993 Test procedure for the determination of the temperature index of enamelled winding wires (<i>first revision</i>)	Identical
IEC 60317-0-2 (1990) Specifications for particular types of winding wires — Part 0 : General requirements — Section 2 : Enamelled rectangular copper wire	IS 13730 (Part 0/Sec 2) : 1993 Specifications for particular types of winding wires: Part 0 General requirements, Section 2 Enamelled rectangular copper wire	do
IEC 60851 (series) Methods of test for winding wires	IS 13778 (series) Methods of test for winding wires	do
ISO 3 : 1973 Preferred numbers — Series of preferred numbers	IS 1076 (Part 1) : 1985 Preferred numbers : Part 1 Series of preferred numbers (<i>second revision</i>)	do

The concerned Technical Committee responsible for the preparation of this standard has reviewed the provisions of the following International Standard and decided that it is acceptable for use in conjunction with this standard:

(Continued on third cover)

Indian Standard

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES

PART 53 AROMATIC POLYIMIDE (ARAMID) TAPE WRAPPED RECTANGULAR COPPER WIRE, TEMPERATURE INDEX 220

1 Scope

This part of IEC 60317 specifies requirements for tape wrapped rectangular copper winding wire of temperature index 220. The insulation consists of one or more wrappings of aromatic polyamide (aramid) tape of various thicknesses.

NOTE – For this type of wire, the heat shock test is inappropriate and therefore a heat shock temperature cannot be established. Consequently, a class based on the requirements for temperature index and heat shock temperature cannot be specified.

The temperature in degrees Celsius corresponding to the temperature index is not necessarily that at which the wire is recommended to be operated and this will depend on many factors, including the types of equipment involved.

The range of nominal conductor sizes covered by this standard is:

- | | | | | |
|--------------|------|---------|------|-----------|
| – width: | min. | 2,00 mm | max. | 16,00 mm; |
| – thickness: | min. | 0,80 mm | max. | 5,60 mm. |

The specified combinations of width and thickness as well as the specified ratio width/thickness are given in table 1.

When reference is made to winding wire according to this standard, the following information should be given:

- reference to IEC 60317-53;
- dimensions of the conductor;
- reference should also be made to the number and thickness of the papers used and to the degree of overlap, as agreed between purchaser and supplier.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60317. For dated references subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60317 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60172:1987, *Test procedure for the determination of the temperature index of enamelled winding wires*

IEC 60317-0-2:1997, *Specifications for particular types of winding wires – Part 0: General requirements – Section 2: Enamelled rectangular copper wire*

IEC 60819-3-3:1991, *Specification for non-cellulosic papers for electrical purposes – Part 3: Specifications for individual materials – Sheet 3: Unfilled aramid (aromatic polyamide) papers*

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

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

3 Terms, definitions and general notes on methods of test

3.1 Terms and definitions

For the purpose of this part of IEC 60317, the following terms and definitions apply.

3.1.1

class

thermal performance of a wire expressed by the temperature index and the heat shock temperature

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

grade

range of thickness of the insulation of a wire

3.1.6

insulation

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

3.1.7

nominal conductor dimension

designation of the conductor size in accordance with IEC 60317-0-2, clause 4

3.1.8

winding wire

wire used for winding a coil to provide a magnetic field

3.1.9

wire

conductor coated or covered with an insulation

3.2 General notes on methods of test

All methods of test used in this part of IEC 60317 are given in IEC 60851.

The clause numbers used in this standard are identical with the respective test numbers of IEC 60851.

In case of inconsistencies between IEC 60851 on methods of test and this standard, IEC 60317-53 shall prevail.

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

Unless otherwise specified, all tests shall be carried out at a temperature between 15 °C and 35 °C and a relative humidity of 45 % 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.

4 Dimensions

As there are many varied constructions of this type of wire, the dimensions due to the insulation are subject to agreement between purchaser and supplier and shall be clearly stated in the purchase order.

4.1 Conductor dimensions

The dimensions for widths and thickness of conductors of winding wires with rectangular cross-section recommended in this standard shall correspond to the R20 and R40 series of ISO 3.

Preferred sizes are combinations of width and thickness both according to the R20 series.

Intermediate sizes are combinations of width or thickness according to the R20 series with the other dimension according to the R40 series. Combinations of width and thickness according to the R40 series are not allowed.

This standard covers:

- widths from 2,00 mm up to and including 16,00 mm;
- thicknesses from 0,80 mm up to and including 5,60 mm.

NOTE 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 R40 series may be used. The ratio width/thickness should be within the specified limits and combinations of R40. R40 is 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 2.

NOTE 2 – Dimensions according to the R20 series are printed in larger type.

The nominal cross-sectional areas for preferred sizes are given in table 2 and the nominal cross-sectional areas for intermediate sizes are given in annex A.

4.2 Tolerance on conductor dimensions

The conductor dimensions shall not differ from the nominal values by more than the tolerance given in table 1.

Table 1 – 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 $\pm 25\%$.

Table 3 – Corner radii

Nominal thickness of conductor mm		Corner radius
Over	Up to and including	mm
	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 conductors with a width greater than 4,8 mm may be:

* 0,5 nominal thickness;
** 0,8 mm.

4.4 Minimum increase in dimensions due to the insulation

If there is no agreement, the minimum increase in width or thickness due to the insulation shall not be less than the values calculated using the following formula:

$$2 \sum T_{\min,i} n_i$$

where $T_{\min,i}$ is the minimum thickness of the paper in the layer number i and n_i is determined by the degree of overlap in that layer:

- for overlaps of 0 % up to, but not including, 50 % $n = 1$;
- for overlaps of 50 % up to, but not including, 66 % $n = 2$;
- for overlaps of 66 % up to, but not including, 75 % $n = 3$.

Minimum thickness is calculated from the values given in table 1 of IEC 60819-3-3 where the permissible deviation of the central thickness value is:

- for nominal thickness 0,05 mm $\pm 20\%$;
- for nominal thicknesses 0,08 mm and greater $\pm 15\%$.

EXAMPLE 1 For a construction using two layers of 0,05 mm paper with 50 % overlap:

$$T_{\min,1} = 0,04 \text{ mm and } n_1 = 2$$

$$T_{\min,2} = 0,04 \text{ mm and } n_2 = 2$$

Therefore, the minimum thickness due to the insulation equals:

$$2(0,04 \times 2 + 0,04 \times 2) \text{ mm} \\ = 0,320 \text{ mm}$$

EXAMPLE 2 For a construction using one layer of 0,05 mm paper with an overlap of 55 % followed by two layers of 0,08 mm paper with no overlap

$$T_{\min.1} = 0,04 \text{ mm}, n_1 = 2$$

$$T_{\min.2} = 0,068 \text{ mm}, n_2 = 1$$

$$T_{\min.3} = 0,068 \text{ mm}, n_3 = 1$$

Therefore, the minimum thickness due to the insulation equals:

$$\begin{aligned} &2(0,04 \times 2 + 0,068 \times 1 + 0,068 \times 1) \text{ mm} \\ &= 0,432 \text{ mm} \end{aligned}$$

4.5 Maximum overall size

If there is no agreement, the overall dimensions shall not exceed the sum of the maximum conductor dimensions given in 4.2 and the maximum increase in dimensions due to the insulation which is calculated using the formula given below.

Before wrapping, the conductor shall be completely free from copper dust and other extraneous matter.

One or more tapes may be applied. Combinations of different types, different thickness and degree of overlap shall be agreed between the purchaser and the supplier.

The tape shall be wrapped round the conductor tightly, evenly and free from creases and wrinkles.

Where adhesive is used to secure the loose ends of the tape, it shall be compatible with the insulation system in use.

The formula for calculating the maximum increase due to the insulation is:

$$2 \sum (n_i + 1) T_{\max.i}$$

where

n_i is determined by the degree of overlap in accordance with 4.4 in layer number i ;

$T_{\max.i}$ is the maximum paper thickness as calculated in accordance with 4.4 in that layer.

EXAMPLE: For a construction using two 0,05 mm thick tapes wrapped on a conductor of nominal width 4,000 mm and thickness 1,000 mm with a 50 % overlap the maximum overall size is

– width

$$\begin{aligned} &[4,050 + 2[(2 + 1)0,06 + (2 + 1)0,06]] \text{ mm} \\ &= (4,050 + 0,72) \text{ mm} \\ &= 4,770 \text{ mm} \end{aligned}$$

– thickness

$$\begin{aligned} &[1,030 + 2[(2 + 1)0,06 + (2 + 1)0,06]] \text{ mm} \\ &= (1,030 + 0,72) \text{ mm} \\ &= 1,750 \text{ mm} \end{aligned}$$

5 Electrical resistance

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

The maximum value of resistance shall not be 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 radii, 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 the values given in table 4.

Table 4 – Elongation requirements

Nominal thickness of the conductor mm		Minimum elongation %
Over	Up to and including	
—	2,500	30
2,500	5,600	32

7 Springiness

The wire shall not exceed the maximum springback of 5,5°.

8 Flexibility and adherence

Because of the great variation in the number and the thickness of papers applied, the requirements for flexibility shall be agreed between purchaser and supplier at the time of placing the order.

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

At least four out of five specimens shall not break down at a voltage less or equal to 11,8 kV/mm, based on half the minimum increase in size due to the paper.

14 Continuity of insulation

Test inappropriate.

15 Temperature index

The method of test shall be in accordance with IEC 60172.

NOTE – IEC 60172 is currently being revised and modified to address this particular wire.

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 hydrolysis and transformer oil

Test inappropriate.

21 Loss of mass

Test inappropriate.

30 Packaging

The kind of packaging may influence certain properties of the wire, for example springiness. 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 or placed in containers. No spool shall contain more than one length of wire unless agreed 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 also be agreed between the purchaser and supplier.

Where wires are delivered in coils, the dimensions and the maximum mass of such coils and any additional protection shall be agreed between purchaser and supplier.

Labels shall be securely attached to the flange of each spool and (where applicable) containers or coils and shall include the following information:

- a) manufacturer's name, trade mark and/or IEC 60317-53;
- b) type of wire and insulation;
- c) net mass of wire;
- d) dimensions of wire;
- e) date of manufacture.

Annex A
(informative)

Nominal cross-sectional areas for preferred and intermediate sizes

Table A.1 – Nominal cross-sectional areas

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-sectional area mm ²	Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-sectional area mm ²	
2,00	0,80	*	1,463	2,50	1,25	0,5	2,910	
	0,85	*	1,545		1,32	0,5	3,085	
	0,90	*	1,626		1,40	0,5	3,285	
	0,95	*	1,706		1,50	0,5	3,535	
	1,00	*	1,785		1,60	0,5	3,785	
		1,06	0,5	1,905		1,70	0,65	3,887
		1,12	0,5	2,025		1,80	0,65	4,137
		1,18	0,5	2,145	2,65	0,80	*	1,983
		1,25	0,5	2,285		0,90	*	2,211
		1,32	0,5	2,425		1,00	*	2,435
		1,40	0,5	2,585			1,12	0,5
	2,12	0,80	*	1,559		1,25	0,5	3,098
0,90		*	1,734		1,40	0,5	3,495	
1,00		*	1,905		1,60	0,5	4,025	
		1,12	0,5	2,160		1,80	0,65	4,407
		1,25	0,5	2,435	2,80	0,80	*	2,103
		1,40	0,5	2,753		0,85	*	2,225
2,24	0,80	*	1,655	0,90		*	2,346	
	0,85	*	1,749	0,95		*	2,466	
	0,90	*	1,842	1,00	*	2,585		
	0,95	*	1,934		1,06	0,5	2,753	
	1,00	*	2,025		1,12	0,5	2,921	
		1,06	0,5	2,160		1,18	0,5	3,089
		1,12	0,5	2,294		1,25	0,5	3,285
		1,18	0,5	2,429		1,32	0,5	3,481
		1,25	0,5	2,585		1,40	0,5	3,705
		1,32	0,5	2,742		1,50	0,5	3,985
	1,40	0,5	2,921		1,60	0,5	4,265	
	1,50	0,5	3,145		1,70	0,65	4,397	
	1,60	0,5	3,369		1,80	0,65	4,677	
2,36	0,80	*	1,751		1,90	0,65	4,957	
	0,90	*	1,950		2,00	0,65	5,237	
	1,00	*	2,145	3,00	0,80	*	2,263	
		1,12	0,5		2,429	0,90	*	2,526
		1,25	0,5		2,735	1,00	*	2,785
	1,40	0,5	3,089			1,12	0,5	3,145
	1,60	0,5	3,561		1,25	0,5	3,535	
2,50	0,80	*	1,863		1,40	0,5	3,985	
	0,85	*	1,970		1,60	0,5	4,585	
	0,90	*	2,076		1,80	0,65	5,037	
	0,95	*	2,181		2,00	0,65	5,637	
	1,00	*	2,285	3,15	0,80	*	2,383	
		1,06	0,5		2,435	0,85	*	2,522
		1,12	0,5		2,585			
		1,18	0,5	2,736				

* 0,5 mm nominal thickness.

Table A.1 (continued)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	
mm	mm	mm	mm ²	mm	mm	mm	mm ²	
3,15	0,90	*	2,661	3,75	0,80	*	2,863	
	0,95	*	2,799		0,90	*	3,201	
	1,00	*	2,935		1,00	*	3,535	
	1,06	0,5	3,124		1,12	0,5	3,985	
	1,12	0,5	3,313		1,25	0,5	4,473	
	1,18	0,5	3,502		1,40	0,5	5,035	
	1,25	0,5	3,723		1,60	0,5	5,785	
	1,32	0,5	3,943		1,80	0,65	6,387	
	1,40	0,5	4,195		2,00	0,65	7,137	
	1,50	0,5	4,510		2,24	0,65	8,037	
	1,60	0,5	4,825	2,50	0,8	8,826		
	1,70	0,65	4,992	4,00	0,80	*	3,063	
	1,80	0,65	5,307		0,85	*	3,245	
	1,90	0,65	5,622		0,90	*	3,426	
	2,00	0,65	5,937		0,95	*	3,606	
	2,12	0,65	6,315		1,00	*	3,785	
	2,24	0,65	6,693		1,06	0,5	4,025	
	3,35	0,80	*		2,543	1,12	0,5	4,265
		0,90	*		2,841	1,18	0,5	4,505
1,00		*	3,135		1,25	0,5	4,785	
1,12		0,5	3,537		1,32	0,5	5,065	
1,25		0,5	3,973	1,40	0,5	5,385		
1,40		0,5	4,475	1,50	0,5	5,785		
1,60		0,5	5,145	1,60	0,5	6,185		
1,80		0,65	5,667	1,70	0,65	6,437		
2,00		0,65	6,337	1,80	0,65	6,837		
2,24		0,65	7,141	1,90	0,65	7,237		
3,55	0,80	*	2,703	2,00	0,65	7,637		
	0,85	*	2,862	2,12	0,65	8,117		
	0,90	*	3,021	2,24	0,65	8,597		
	0,95	*	3,179	2,36	0,8	8,891		
	1,00	*	3,335	2,50	0,8	9,451		
	1,06	0,5	3,548	2,65	0,8	10,05		
	1,12	0,5	3,761	2,80	0,8	10,65		
	1,18	0,5	3,974	4,25	0,80	*	3,263	
	1,25	0,5	4,223		0,90	*	3,651	
	1,32	0,5	4,471		1,00	*	4,035	
	1,40	0,5	4,755		1,12	0,5	4,545	
	1,50	0,5	5,110		1,25	0,5	5,098	
	1,60	0,5	5,465		1,40	0,5	5,735	
	1,70	0,65	5,672		1,60	0,5	6,585	
	1,80	0,65	6,027		1,80	0,65	7,287	
	1,90	0,65	6,382		2,00	0,65	8,137	
	2,00	0,65	6,737		2,24	0,65	9,157	
	2,12	0,65	7,163	2,50	0,8	10,08		
	2,24	0,65	7,589	2,80	0,8	11,35		
	2,36	0,8	7,829					
2,50	0,8	8,326						

* 0,5 mm nominal thickness.

Table A.1 (continued)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	
mm	mm	mm	mm ²	mm	mm	mm	mm ²	
4,50	0,80	*	3,463	5,00	1,70	0,65	8,137	
	0,85	*	3,670		1,80	0,65	8,637	
	0,90	*	3,876		1,90	0,65	9,137	
	0,95	*	4,081		2,00	0,65	9,637	
	1,00	*	4,285		2,12	0,65	10,24	
	1,06	0,5	4,555		2,24	0,65	10,84	
	1,12	0,5	4,825		2,36	0,8	11,25	
	1,18	0,5	5,095		2,50	0,8	11,95	
	1,25	0,5	5,410		2,65	0,8	12,70	
	1,32	0,5	5,725		2,80	0,8	13,45	
	1,40	0,5	6,085		3,00	0,8	14,45	
	1,50	0,5	6,535		3,15	0,8	15,20	
	1,60	0,5	6,985		3,35	0,8	16,20	
	1,70	0,65	7,287		3,55	0,8	17,20	
	1,80	0,65	7,737		5,30	0,80	*	4,103
	1,90	0,65	8,187			0,90	*	4,596
	2,00	0,65	8,637			1,00	*	5,085
	2,12	0,65	9,177			1,12	0,5	5,721
	2,24	0,65	9,717			1,25	0,5	6,410
	2,36	0,8	10,07			1,40	0,5	7,205
2,50	0,8	10,70	1,60	0,5		8,265		
2,65	0,8	11,38	1,80	0,65		9,177		
2,80	0,8	12,05	2,00	0,65		10,24		
3,00	0,8	12,95	2,24	0,65		11,51		
4,75	0,80	*	3,663	2,50	0,8	12,70		
	0,90	*	4,101	2,80	0,8	14,29		
	1,00	*	4,535	3,15	0,8	16,15		
	1,12	0,5	5,105	3,55	0,8	18,27		
	1,25	0,5	5,723	5,60	0,80	*	4,343	
	1,40	0,5	6,435		0,85	*	4,605	
	1,60	0,5	7,385		0,90	*	4,866	
	1,80	0,65	8,188		0,95	*	5,126	
	2,00	0,65	9,137		1,00	*	5,385	
	2,24	0,65	10,28		1,06	0,5	5,721	
2,50	0,8	11,33	1,12		0,5	6,057		
2,80	0,8	12,75	1,18		0,5	6,393		
3,15	0,8	14,41	1,25		0,5	6,785		
5,00	0,80	*	3,863		1,32	0,5	7,177	
	0,85	*	4,095	1,40	0,5	7,625		
	0,90	*	4,326	1,50	0,5	8,185		
	0,95	*	4,556	1,60	0,5	8,745		
	1,00	*	4,785	1,70	0,65	9,157		
	1,06	0,5	5,085	1,80	0,65	9,717		
	1,12	0,5	5,385	1,90	0,65	10,28		
	1,18	0,5	5,685	2,00	0,65	10,84		
	1,25	0,5	6,035	2,12	0,65	11,51		
	1,32	0,5	6,385	2,24	0,65	12,18		
1,40	0,5	6,785	2,36	0,8	12,67			
1,50	0,5	7,285	2,50	0,8	13,45			
1,60	0,5	7,785	2,65	0,8	14,29			
				2,80	0,8	15,13		

* 0,5 mm nominal thickness.

Table A.1 (continued)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	
mm	mm	mm	mm ²	mm	mm	mm	mm ²	
5,60	3,00	0,8	16,25	6,30	3,75	1,0	22,77	
	3,15	0,8	17,09		4,00	1,0	24,34	
	3,35	0,8	18,21		4,25	1,0	25,92	
	3,55	0,8	19,33		4,50	1,0	27,49	
	3,75	1,0	20,14	6,70	0,90	*	5,856	
	4,00	1,0	21,54		1,00	*	6,485	
6,00	0,80	*	4,663		1,12	0,5	7,289	
	0,90	*	5,226		1,25	0,5	8,160	
	1,00	*	5,785		1,40	0,5	9,165	
					1,60	0,5	10,51	
		1,12	0,5	6,505		1,80	0,65	11,70
		1,25	0,5	7,285		2,00	0,65	13,04
		1,40	0,5	8,185		2,24	0,65	14,65
		1,60	0,5	9,385				
		1,80	0,65	10,44		2,50	0,8	16,20
		2,00	0,65	11,64		2,80	0,8	28,21
		2,24	0,65	13,08		3,15	0,8	20,56
						3,55	0,8	23,24
	6,30	2,50	0,8	14,45		4,00	1,0	25,94
		2,80	0,8	16,25		4,50	1,0	29,29
3,15		0,8	18,35					
3,55		0,8	20,75	7,10		0,90	*	6,216
					0,95	*	6,551	
					1,00	*	6,885	
		4,00	1,0	23,14		1,06	0,5	7,311
		0,80	*	4,903		1,12	0,5	7,737
		0,85	*	5,200		1,18	0,5	8,163
		0,90	*	5,496		1,25	0,5	8,660
		0,95	*	5,791		1,32	0,5	9,157
		1,00	*	6,085		1,40	0,5	9,725
		1,06	0,5	6,463		1,50	0,5	10,44
	1,12	0,5	6,841	1,60		0,5	11,15	
	1,18	0,5	7,219		1,70	0,65	11,71	
	1,25	0,5	7,660		1,80	0,65	12,42	
	1,32	0,5	8,101		1,90	0,65	13,13	
	1,40	0,5	8,605		2,00	0,65	13,84	
	1,50	0,5	9,235		2,12	0,65	14,69	
	1,60	0,5	9,865		2,24	0,65	15,54	
	1,70	0,65	10,35					
	1,80	0,65	10,98		2,36	0,8	16,21	
	1,90	0,65	11,61		2,50	0,8	17,20	
	2,00	0,65	12,24		2,65	0,8	18,27	
	2,12	0,65	12,99		2,80	0,8	19,33	
	2,24	0,65	13,75		3,00	0,8	20,75	
	2,36	0,8	14,32		3,15	0,8	21,82	
	2,50	0,8	15,20		3,35	0,8	23,24	
	2,65	0,8	16,15		3,55	0,8	24,66	
	2,80	0,8	17,09					
	3,00	0,8	18,35		3,75	1,0	25,77	
	3,15	0,8	19,30		4,00	1,0	27,54	
	3,35	0,8	20,56		4,25	1,0	29,32	
	3,55	0,8	21,82					

* 0,5 mm nominal thickness.

Table A.1 (continued)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area
mm	mm	mm	mm ²	mm	mm	mm	mm ²
7,10	4,50	1,0	31,09	8,50	1,12	0,5	9,305
	4,75	1,0	32,87		1,25	0,5	10,41
	5,00	1,0	34,64		1,40	0,5	11,69
					1,60	0,5	13,39
7,50	1,00	*	7,285	1,80	0,65	14,94	
	1,12	0,5	8,185	2,00	0,65	16,64	
	1,25	0,5	9,160	2,24	0,65	18,68	
	1,40	0,5	10,29				
	1,60	0,5	11,79	2,50	0,8	20,70	
				2,80	0,8	23,25	
	1,80	0,65	13,14	3,15	0,8	26,23	
	2,00	0,65	14,64	3,55	0,8	29,63	
	2,24	0,65	16,44				
				4,00	1,0	33,14	
	2,50	0,8	18,20	4,50	1,0	37,39	
	2,80	0,8	20,45	5,00	1,0	41,64	
	3,15	0,8	23,08	5,60	1,0	46,74	
	3,55	0,8	26,08				
8,00	1,00	*	7,785	9,00	1,12	0,5	9,865
	1,06	0,5	8,265		1,18	0,5	10,41
	1,12	0,5	8,745		1,25	0,5	11,04
	1,18	0,5	9,225		1,32	0,5	11,67
	1,25	0,5	9,785		1,40	0,5	12,39
	1,32	0,5	10,35		1,50	0,5	13,29
	1,40	0,5	10,99		1,60	0,5	14,19
	1,50	0,5	11,79				
	1,60	0,5	12,59		1,70	0,65	14,94
					1,80	0,65	15,84
	1,70	0,65	13,24		1,90	0,65	16,74
	1,80	0,65	14,04		2,00	0,65	17,64
	1,90	0,65	14,84		2,12	0,65	18,72
	2,00	0,65	15,64		2,24	0,65	19,80
2,12	0,65	16,60					
2,24	0,65	17,56	2,36	0,8	20,69		
			2,50	0,8	21,95		
2,36	0,8	18,33	2,65	0,8	23,30		
2,50	0,8	19,45	2,80	0,8	24,65		
2,65	0,8	20,65	3,00	0,8	26,45		
2,80	0,8	21,85	3,15	0,8	27,80		
3,00	0,8	23,45	3,35	0,8	29,60		
3,15	0,8	24,65	3,55	0,8	31,40		
3,35	0,8	26,25					
3,55	0,8	27,85	3,75	1,0	32,89		
			4,00	1,0	35,14		
3,75	1,0	29,14	4,25	1,0	37,39		
4,00	1,0	31,14	4,50	1,0	39,64		
4,25	1,0	33,14	4,75	1,0	41,89		
4,50	1,0	35,14	5,00	1,0	44,14		
4,75	1,0	37,14	5,30	1,0	46,84		
5,00	1,0	39,14	5,60	1,0	49,54		
5,30	1,0	41,54					
5,60	1,0	43,94	9,50	1,25	0,5	11,66	
				1,40	0,5	13,09	
				1,60	0,5	14,99	
				1,80	0,65	16,74	
				2,00	0,65	18,64	
				2,24	0,65	20,92	

* 0,5 mm nominal thickness.

Table A.1 (continued)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area		
mm	mm	mm	mm ²	mm	mm	mm	mm ²		
9,50	2,50	0,8	23,20	11,20	1,70	0,65	18,68		
	2,80	0,8	26,05		1,80	0,65	19,80		
	3,15	0,8	29,38		1,90	0,65	20,92		
	3,55	0,8	33,18		2,00	0,65	22,04		
		4,00	1,0		37,14	2,12	0,65	23,38	
		4,50	1,0		41,89	2,24	0,65	24,73	
		5,00	1,0		46,64		2,36	0,8	25,88
		5,60	1,0		52,34		2,50	0,8	27,45
	10,00	1,25	0,5		12,29		2,65	0,8	29,13
		1,32	0,5		12,99		2,80	0,8	30,81
1,40		0,5	13,79		3,00	0,8	33,05		
1,50		0,5	14,79		3,15	0,8	34,73		
1,60		0,5	15,79		3,35	0,8	36,97		
		1,70	0,65	16,64		3,55	0,8	39,21	
		1,80	0,65	17,64		3,75	1,0	41,14	
		1,90	0,65	18,64		4,00	1,0	43,94	
		2,00	0,65	19,64		4,25	1,0	46,74	
		2,12	0,65	20,84		4,50	1,0	49,54	
10,60	2,24	0,65	22,04		4,75	1,0	52,34		
		2,36	0,8	23,05		5,00	1,0	55,14	
		2,50	0,8	24,45		5,30	1,0	58,50	
		2,65	0,8	25,95		5,60	1,0	61,86	
		2,80	0,8	27,45	11,80	1,60	0,5	18,67	
		3,00	0,8	29,45			1,80	0,65	20,88
		3,15	0,8	30,95			2,00	0,65	23,24
		3,35	0,8	32,95			2,24	0,65	26,07
		3,55	0,8	34,95			2,50	0,8	28,95
		3,75	1,0	36,64			2,80	0,8	32,49
	4,00	1,0	39,14			3,15	0,8	36,62	
	4,25	1,0	41,64			3,55	0,8	41,34	
	4,50	1,0	44,14			4,00	1,0	46,34	
	4,75	1,0	46,64			4,50	1,0	52,24	
10,60	5,00	1,0	49,14		5,00	1,0	58,14		
	5,30	1,0	52,14		5,60	1,0	65,22		
	5,60	1,0	55,14	12,50	1,60	0,5	19,79		
	1,40	0,5	14,63			1,70	0,65	20,89	
	1,60	0,5	16,75			1,80	0,65	22,14	
		1,80	0,65		18,72		1,90	0,65	23,39
		2,00	0,65		20,84		2,00	0,65	24,64
		2,24	0,65		23,38		2,12	0,65	26,14
		2,50	0,8		25,95		2,24	0,65	27,64
		2,80	0,8		29,13		2,36	0,8	28,95
	3,15	0,8	32,84			2,50	0,8	30,70	
	3,55	0,8	37,08			2,65	0,8	32,58	
11,20	4,00	1,0	41,54		2,80	0,8	34,45		
	4,50	1,0	46,84		3,00	0,8	36,95		
	5,00	1,0	52,14		3,15	0,8	38,83		
	5,60	1,0	58,50		3,35	0,8	41,33		
		1,40	0,5	15,47		3,55	0,8	43,83	
		1,50	0,5	16,59		3,75	1,0	46,02	
		1,60	0,5	17,71		4,00	1,0	49,14	
						4,25	1,0	52,27	

Table A.1 (concluded)

Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area	Nominal width	Nominal thickness	Radius on corners	Nominal cross-sectional area		
mm	mm	mm	mm ²	mm	mm	mm	mm ²		
12,50	4,50	1,0	55,39	14,00	4,75	1,0	65,64		
	4,75	1,0	58,52		5,00	1,0	69,14		
	5,00	1,0	61,64		5,30	1,0	73,34		
	5,30	1,0	65,39		5,60	1,0	77,54		
	5,60	1,0	69,14	15,00	2,00	0,65	29,64		
13,20	1,80	0,65	23,40		2,24	0,65	33,24		
	2,00	0,65	26,04		2,50	0,8	36,95		
	2,24	0,65	29,21			2,80	0,8	41,45	
	2,50	0,8	32,45			3,15	0,8	46,70	
		2,80	0,8			36,41	3,55	0,8	52,70
		3,15	0,8			41,03	4,00	1,0	59,14
		3,55	0,8		46,31	4,50		1,0	66,64
		4,00	1,0		51,94	5,00		1,0	74,14
	4,50		1,0		58,54	5,60		1,0	83,14
	5,00		1,0	65,14	16,00	2,00		0,65	31,64
5,60	1,0		73,06	2,12		0,65	33,56		
14,00	1,80		0,65	24,84		2,24	0,65	35,48	
	1,90	0,65	26,24	2,36		0,8	37,21		
	2,00	0,65	27,64			2,50	0,8	39,45	
	2,12	0,65	29,32			2,65	0,8	41,85	
	2,24	0,65	31,00			2,80	0,8	44,25	
	2,36	0,8	32,49			3,00	0,8	47,45	
		2,50	0,8	34,45		3,15	0,8	49,85	
		2,65	0,8	36,55		3,35	0,8	53,05	
		2,80	0,8	38,65	3,55	0,8	56,25		
		3,00	0,8	41,45	3,75	1,0	59,14		
3,15	0,8	43,55	4,00	1,0		63,14			
3,35	0,8	46,35	4,25	1,0		67,14			
3,55	0,8	49,15	4,50	1,0		71,14			
3,75	1,0	51,64	4,75	1,0		75,14			
	4,00	1,0	55,14	5,00		1,0	79,14		
	4,25	1,0	58,64	5,30		1,0	83,94		
	4,50	1,0	62,14	5,60		1,0	88,74		
	4,00	1,0	55,14						

(Continued from second cover)

International Standard

Title

IEC 60819-3-3 (1991) Specifications for non-cellulosic papers for electrical purposes — Part 3 :
Specifications for individual materials — Sheet 3: Unfilled aramid (aromatic
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