

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Specifications for particular types of winding wires –
Part 0-4: General requirements – Glass-fibre wound, resin or varnish
impregnated, bare or enamelled rectangular copper wire**

**Spécifications pour types particuliers de fils de bobinage –
Partie 0-4: Exigences générales – Fil de section rectangulaire en cuivre nu ou
émaillé, guipé de fibres de verre imprégnées de vernis ou de résine**

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.060.10

ISBN 978-2-8322-2975-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

**Part 0-4: General requirements –
Glass-fibre wound, resin or varnish impregnated,
bare or enamelled rectangular copper wire**

FOREWORD

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International Standard IEC 60317-0-4 has been prepared by IEC technical committee 55: Winding wires.

This third edition cancels and replaces the second edition published in 1997, Amendment 1:1999 and Amendment 2:2005. This edition constitutes a technical revision.

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

- a) addition of dimensional requirements for grade 1 enamelled wire in Table 4;
- b) addition of dielectric breakdown requirements for grade 1 enamelled wire in Table 7.

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

FDIS	Report on voting
55/1550/FDIS	55/1565/RVD

Full information on the voting for the approval of this standard 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.

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.

This standard is to be read in conjunction with the IEC 60851 series. The clause numbers used in this standard are identical with the respective test numbers of the IEC 60851 series.

In case of inconsistencies between IEC 60851 and this standard, the latter prevails.

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 publication will remain unchanged until the stability date indicated on the IEC website 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.

INTRODUCTION

This part of IEC 60317 is one of a series which deals with insulated wires used for windings in electrical equipment. The series has three groups 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).

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SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

Part 0-4: General requirements – Glass-fibre wound, resin or varnish impregnated, bare or enamelled rectangular copper wire

1 Scope

This part of IEC 60317 specifies general requirements of glass-fibre wound, resin or varnish impregnated, bare or enamelled rectangular copper wire.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

3 Terms, definitions and general notes on tests and appearance

3.1 Terms and definitions

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

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

grade

range of thickness of the insulation of a wire

3.1.7**insulation**

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

3.1.8**nominal conductor dimension**

designation of the conductor size in accordance with IEC 60317

3.1.9**normal vision**

20/20 vision, with corrective lenses if necessary

3.1.10**winding wire**

wire used for winding a coil to provide a magnetic field

3.1.11**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 part of IEC 60317 are given in the IEC 60851 series of standards.

The clause numbers used in this part of IEC 60317 are identical with the respective test numbers in the IEC 60851 series of standards.

In case of inconsistencies between the publication on test methods and this part of IEC 60317, the latter 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 % 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 it is not 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

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

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

EXAMPLE IEC 60317-31 – 4,00 × 1,00 Grade 2GL1

3.3 Appearance

The fibrous covering shall be essentially smooth and continuous, and free from physical damage and foreign material when examined with normal vision, as wound on the original spool or reel.

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

4 Dimensions

4.1 Conductor dimensions

The dimensions for widths and thickness 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 series according to ISO 3.

Preferred and intermediate sizes are combinations of width and thickness both according to the R 20 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 mm.

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 1.

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 Annex A.

Table 1 – Nominal cross-sectional areas of preferred sizes

Thickness mm	Width																	
	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 ^a)																	
2,00	1,463	1,626	1,785	2,025	2,285	2,585	2,921	3,285	3,705	4,137	4,677	5,237	5,831	6,451	7,109	7,805	8,539	9,313
2,24	1,655	1,842	2,205	2,294	2,582	2,921	3,369	3,785	4,265	4,765	5,285	5,831	6,405	7,005	7,635	8,295	8,985	9,705
2,50	1,863	2,076	2,285	2,585	2,910	3,285	3,785	4,137	4,677	5,237	5,831	6,451	7,109	7,805	8,539	9,313	10,125	10,975
2,80	2,103	2,346	2,585	2,921	3,285	3,705	4,265	4,677	5,237	5,831	6,451	7,109	7,805	8,539	9,313	10,125	10,975	11,865
3,15	2,383	2,661	2,935	3,313	3,723	4,195	4,825	5,307	5,937	6,693	7,389	8,125	8,913	9,753	10,645	11,589	12,585	13,635
3,55	2,703	3,021	3,335	3,761	4,223	4,755	5,465	6,027	6,737	7,589	8,326	9,153	10,065	11,065	12,165	13,365	14,665	16,065
4,00	3,063	3,426	3,785	4,265	4,785	5,385	6,185	7,031	7,931	8,913	9,985	11,153	12,425	13,805	15,295	16,905	18,635	20,495
4,50	3,463	3,876	4,285	4,825	5,410	6,085	6,85	7,737	8,631	9,631	10,70	11,845	13,065	14,365	15,745	17,205	18,755	20,395
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	14,85	16,33	17,89	19,53	21,25	23,065
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	16,93	18,85	20,89	23,06	25,35	27,765
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	31,14	34,64
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	39,14
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	69,14
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	77,54
16,0									31,64	35,48	39,45	44,25	49,85	56,25	63,14	71,14	79,14	88,74

^a Nominal thickness

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	$\pm 0,030$
3,15	6,30	$\pm 0,050$
6,30	12,50	$\pm 0,070$
12,50	16,00	$\pm 0,100$

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 the conductor mm		Corner radius mm
Over	Up to and including	
–	1,00	0,5 nominal thickness
1,00	1,60	0,50 ^a
1,60	2,24	0,65 ^b
2,24	3,55	0,80
3,55	5,60	1,00

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

^a 0,5 mm nominal thickness;
^b 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																	
		Glass-fibre covering over bare conductor						Glass-fibre covering over grade 1 enamelled wire						Glass-fibre covering over grade 2 enamelled wire					
		Single covering (GL1)			Double covering (GL2)			Single covering (grade 1 GL1)			Double covering (grade 1 GL2)			Single covering (grade 2 GL1)			Double covering (grade 2 GL2)		
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	0,10	0,14	0,18	0,21	0,27	0,33	0,16	0,23	0,30	0,27	0,36	0,45	0,23	0,29	0,35	0,35	0,42	0,49
3,15	6,30	0,12	0,16	0,20	0,23	0,30	0,37	0,18	0,25	0,32	0,29	0,39	0,49	0,25	0,31	0,37	0,38	0,45	0,52
6,30	12,50	0,14	0,19	0,24	0,27	0,35	0,43	0,20	0,28	0,36	0,33	0,44	0,55	0,27	0,34	0,41	0,43	0,50	0,57
12,50	16,00	0,17	0,23	0,29	0,31	0,39	0,47	0,23	0,32	0,41	0,37	0,48	0,59	0,30	0,38	0,46	0,46	0,54	0,62

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.

NOTE The minimum increases in dimensions apply only to the increase in thickness.