IEC 60317-35

Edition 2.2 2024-06
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

colour inside

Specifications for particular types of winding wires – Part 35: Solderable polyurethane enamelled round copper wire, class 155, with a bonding layer

IEC 60317-35:2013-10+AMD1:2019-06+AMD2:2024-06 CSV(en)

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7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
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9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

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In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 60317-35 has been prepared by IEC technical committee 55: Winding wires.

This second edition constitutes a technical revision.

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

– new 3.2.2 containing general notes on winding wire, formerly a part of the scope;
– revision to references to IEC 60317-0-1:2013 to clarify that their application is normative;
– modification to Clause 15 to remove specific wire specimen sizes;
– consolidation of 17.1 and 17.2 of the solderability requirements;
– new Clause 23, Pin hole test.

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

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This International Standard is to be used in conjunction with IEC 60317-0-1:2013 and its Amendment 1:2019.

The numbering of clauses in this standard is not continuous from Clauses 20 and 30 in order to reserve space for possible future wire requirements prior to those for wire packaging.

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- revised.

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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).

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

Part 35: Solderable polyurethane enamelled round copper wire, class 155, with a bonding layer

1 Scope

This part of IEC 60317 specifies the requirements of solderable enamelled round copper winding wire of class 155 with a dual coating. The underlying coating is based on polyurethane resin, which may be modified providing it retains the chemical identity of the original resin and meets all specified wire requirements. The superimposed coating is a bonding layer based on a thermoplastic resin.

NOTE A modified resin is a resin that has undergone a chemical change, or contains one or more additives to enhance certain performance or application characteristics.

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

– Grade 1B: 0,020 mm up to and including 0,800 mm;
– Grade 2B: 0,020 mm up to and including 0,800 mm.

The nominal conductor diameters are specified in Clause 4 of IEC 60317-0-1:2013.

2 Normative references

~~The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application.~~ 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 60317-0-1[1]:2013, *Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire*.
IEC 60317-0-1:2013/AMD1:2019

3 Terms, definitions, general notes and appearance

3.1 Terms and definitions

~~Subclause 3.1 of IEC 60317-0-1:2013 applies.~~

For the purposes of this document, the terms and definitions given in IEC 60317-0-1 apply.

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

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

[1] There exists a consolidated edition 4.1:2021 that includes IEC 60317-0-1:2013 and its Amendment 1:2019.

3.2 General notes

3.2.1 Test methods

Subclause 3.2.1 of IEC 60317-0-1:2013 and IEC 60317-0-1:2013/AMD1:2019 applies.

In case of inconsistencies between IEC 60317-0-1~~:2013~~ and this ~~part of IEC 60317~~ document, ~~the latter~~ IEC 60317-35 shall prevail.

3.2.2 Winding wire

Class 155 is a thermal class that requires a minimum temperature index of 155 and a heat shock temperature of at least 175 °C.

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

3.3 Appearance

Subclause 3.3 of IEC 60317-0-1:2013 applies.

4 Dimensions

Clause 4 of IEC 60317-0-1:2013 applies.

5 Electrical resistance

Clause 5 of IEC 60317-0-1:2013 and IEC 60317-0-1:2013/AMD1:2019 applies.

6 Elongation

Clause 6 of IEC 60317-0-1:2013 applies.

7 Springiness

Clause 7 of IEC 60317-0-1:2013 applies.

8 Flexibility and adherence

Clause 8 of IEC 60317-0-1:2013 applies.

9 Heat shock

Clause 9 of IEC 60317-0-1:2013 applies. The minimum heat shock temperature shall be 175 °C.

10 Cut-through

No failure shall occur within 2 min at 200 °C.

11 Resistance to abrasion (nominal conductor diameters from 0,250 mm up to and including 0,800 mm)

The wire shall meet the requirements given in Table 1.

For intermediate nominal conductor diameters, the value of the next larger nominal conductor diameter shall be taken.

Table 1 – Resistance to abrasion

Nominal conductor diameter	Grade 1B		Grade 2B	
	Minimum average force to failure	Minimum force to failure of each measurement	Minimum average force to failure	Minimum force to failure of each measurement
mm	N	N	N	N
0,250	2,30	1,95	4,10	3,50
0,280	2,50	2,10	4,40	3,70
0,315	2,70	2,30	4,75	4,00
0,355	2,90	2,50	5,10	4,30
0,400	3,15	2,70	5,45	4,60
0,450	3,40	2,90	5,80	4,90
0,500	3,65	3,10	6,20	5,25
0,560	3,90	3,30	6,65	5,60
0,630	4,20	3,55	7,10	6,00
0,710	4,50	3,80	7,60	6,45
0,800	4,80	4,10	8,10	6,90

12 Resistance to solvents

Test inappropriate.

13 Breakdown voltage

Clause 13 of IEC 60317-0-1:2013 applies. The elevated temperature shall be 155 °C.

14 Continuity of insulation

Clause 14 of IEC 60317-0-1:2013 applies.

15 Temperature index

Clause 15 of IEC 60317-0-1:2013 applies. The minimum temperature index shall be 155.

16 Resistance to refrigerants

Test inappropriate.

17 Solderability

17.1 General

The temperature of the solder bath shall be (390 ± 5) °C. The surface of the tinned wire shall be smooth and free from holes and enamel residues.

~~17.1~~17.2 Nominal conductor diameters up to and including 0,100 mm

~~The temperature of the solder bath shall be (390 ± 5) °C.~~ The maximum immersion time shall be 2 s.

~~The surface of the tinned wire shall be smooth and free from holes and enamel residues.~~

~~17.2~~17.3 Nominal conductor diameters over 0,100 mm

~~The temperature of the solder bath shall be (390 ± 5) °C.~~ The maximum immersion time (in seconds) shall be the following multiple of the nominal conductor diameter (in millimetres) with a minimum of 2 s.

Grade 1B	Grade 2B
12 s/mm	16 s/mm

~~The surface of the tinned wire shall be smooth and free from holes and enamel residues.~~

18 Heat or solvent bonding

18.1 Heat bonding

18.1.1 Heat bonding strength of a helical coil

18.1.1.1 At room temperature

The specimens shall be prepared according to the test method, and the temperature of the oven for bonding shall be fixed as agreed between purchaser and supplier for the different types of bonding enamels. The suggested temperature for polyamide bonding enamel is (200 ± 2) °C and the suggested temperature for polyvinyl butyral bonding enamel is (170 ± 2) °C.

Results: when testing the specimens according to the test method, under the action of load specified in Table 2, no turns (other than possibly the first and the last) shall separate.

18.1.1.2 At elevated temperature

The specimens shall be prepared and shall be conditioned as described in the test method.

The elevated temperature shall be fixed as agreed between purchaser and supplier for the different types of bonding enamels. The suggested temperature for polyamide bonding enamel is (155 ± 2) °C and the suggested temperature for polyvinyl butyral bonding enamel is (90 ± 2) °C.

Results: when testing the specimens according to the test method, under the action of load specified in Table 2, no turns (other than possibly the first and the last) shall separate.

Table 2 – Loads

Nominal conductor diameter mm		Load N	
Over	**Up to and including**	**Room temperature**	**Elevated temperature**
–	0,050	a	a
0,050	0,071	0,05	0,04
0,071	0,100	0,08	0,06
0,100	0,160	0,12	0,08
0,160	0,200	0,25	0,19
0,200	0,315	0,35	0,25
0,315	0,400	0,70	0,55
0,400	0,500	1,10	0,80
0,500	0,630	1,60	1,20
0,630	0,710	2,20	1,70
0,710	0,800	2,80	2,10

[a] For nominal conductor diameters up to and including 0,050 mm, the test method and requirements shall be agreed between purchaser and supplier.

18.1.2 Bond strength of a twisted coil

18.1.2.1 General

This test shall be considered only as a special test and is applicable to the diameter 0,315 mm.

18.1.2.2 At room temperature

When preparing a test specimen of diameter 0,315 mm according to the test method, the time shall be 30 s and the current shall be fixed as agreed between purchaser and supplier. The suggested value for polyamide or polyvinyl butyral bonding enamel is (2,7 ± 0,1) A.

Results: when testing the specimens according to the test method, under the action of the deflection force of 100 N, the specimen shall not break.

18.1.2.3 At elevated temperature

The specimens of diameter 0,315 mm shall be prepared according to the test method using the parameters listed in 18.1.2.2 and shall then be conditioned as described in the test method.

The elevated temperature shall be fixed as agreed between purchaser and supplier. The suggested temperature for polyamide bonding enamel is (155 ± 2) °C and the suggested temperature for polyvinyl butyral bonding enamel is (90 ± 2) °C.

Results: when testing the specimens according to the test method, under the action of the deflection force of 10 N, the specimen shall not break.

18.2 Solvent bonding

~~Test required but not yet under consideration.~~

No requirements apply.

19 Dielectric dissipation factor

Test inappropriate.

20 Resistance to transformer oil

Test inappropriate.

21 Loss of mass

Test inappropriate.

23 Pin hole test

Clause 23 of IEC 60317-0-1:2013 applies.

30 Packaging

Clause 30 of IEC 60317-0-1:2013 applies.

Bibliography

IEC 60264 (all parts), *Packaging of winding wires*

IEC 60317 (all parts), *Specifications for particular types of winding wires*

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

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3.2 General notes

3.2.1 Test methods

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3.2.2 Winding wire

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

3.3 Appearance

Subclause 3.3 of IEC 60317-0-1:2013 applies.

4 Dimensions

Clause 4 of IEC 60317-0-1:2013 applies.

5 Electrical resistance

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6 Elongation

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7 Springiness

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8 Flexibility and adherence

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0,280	2,50	2,10	4,40	3,70
0,315	2,70	2,30	4,75	4,00
0,355	2,90	2,50	5,10	4,30
0,400	3,15	2,70	5,45	4,60
0,450	3,40	2,90	5,80	4,90
0,500	3,65	3,10	6,20	5,25
0,560	3,90	3,30	6,65	5,60
0,630	4,20	3,55	7,10	6,00
0,710	4,50	3,80	7,60	6,45
0,800	4,80	4,10	8,10	6,90

12 Resistance to solvents

Test inappropriate.

13 Breakdown voltage

Clause 13 of IEC 60317-0-1:2013 applies. The elevated temperature shall be 155 °C.

14 Continuity of insulation

Clause 14 of IEC 60317-0-1:2013 applies.

15 Temperature index

Clause 15 of IEC 60317-0-1:2013 applies. The minimum temperature index shall be 155.

16 Resistance to refrigerants

Test inappropriate.