

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



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

**Spécifications pour types particuliers de fils de bobinage –  
Partie 35: Fil brasable de section circulaire en cuivre émaillé avec polyuréthane,  
classe 155, avec une couche adhérente**

<https://standards.iteh.ai/catalog/standards/iec/953b3723-0446-411c-9f3b-1d13b2ba73b3/iec-60317-35-2013>



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –**

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

FOREWORD

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**IEC 60317-35 edition 2.1 contains the second edition (2013-10) [documents 55/1416/FDIS and 55/1437/RVD] and its amendment 1 (2019-06) [documents 55/1691/CDV and 55/1741/RVC].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. 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.

A list of all 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 20 and 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 the base publication and its amendment will remain unchanged until the stability 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,
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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).

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## 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. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60317-0-1:2013, *Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire*

#### 3 Terms, definitions, general notes and appearance

##### 3.1 Terms and definitions

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

##### 3.2 General notes

###### 3.2.1 Test methods

Subclause 3.2.1 of IEC 60317-0-1:2013 applies. In case of inconsistencies between IEC 60317-0-1:2013 and this part of IEC 60317, the latter 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 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.

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### **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 mm	Grade 1B		Grade 2B	
	Minimum average force to failure N	Minimum force to failure of each measurement N	Minimum average force to failure N	Minimum force to failure of each measurement 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**

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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  $(390 \pm 5)$  °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  $(390 \pm 5)^\circ\text{C}$ .~~ 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  $(390 \pm 5)^\circ\text{C}$ .~~ 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  $(200 \pm 2)^\circ\text{C}$  and the suggested temperature for polyvinyl butyral bonding enamel is  $(170 \pm 2)^\circ\text{C}$ .

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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  $(155 \pm 2)^\circ\text{C}$  and the suggested temperature for polyvinyl butyral bonding enamel is  $(90 \pm 2)^\circ\text{C}$ .

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

<sup>a</sup> 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  $(2,7 \pm 0,1)$  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  $(155 \pm 2)$  °C and the suggested temperature for polyvinyl butyral bonding enamel is  $(90 \pm 2)$  °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.