

INTERNATIONAL STANDARD



**Specifications for particular types of winding wires –
Part 12: Polyvinyl acetal enamelled round copper wire, class 120**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.



IEC 60317-12

Edition 4.0 2020-06
REDLINE VERSION

INTERNATIONAL STANDARD



**Specifications for particular types of winding wires –
Part 12: Polyvinyl acetal enamelled round copper wire, class 120**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.060.10

ISBN 978-2-8322-8486-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	3
INTRODUCTION	5
1 Scope	6
2 Normative references	6
3 Terms, definitions and , general notes on methods of test and appearance	6
3.1 Terms and definitions	6
3.2 General notes on methods of test	7
3.2.1 Methods of test	7
3.2.2 Winding wire	7
3.3 Appearance	7
4 Dimensions	7
5 Electrical resistance	7
6 Elongation	7
7 Springiness	7
8 Flexibility and adherence	7
9 Heat shock	7
9.1 Nominal conductor diameters up to and including 1,600 mm	8
9.2 Nominal conductor diameters over 1,600 mm	8
10 Cut-through	8
11 Resistance to abrasion (nominal conductor diameters from 0,250 mm up to and including 2,500 mm)	8
12 Resistance to solvents	9
13 Breakdown voltage	9
14 Continuity of insulation	9
15 Temperature index	9
16 Resistance to refrigerants	9
17 Solderability	9
18 Heat or solvent bonding	10
19 Dielectric dissipation factor	10
20 Resistance to transformer oil	10
21 Loss of mass	10
23 Pin hole test	10
30 Packaging	10
Bibliography	11
Table 1 – Heat shock	8
Table 2 – Resistance to abrasion	9

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

Part 12: Polyvinyl acetal enamelled round copper wire, class 120

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 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.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 60317-12 has been prepared by IEC technical committee 55: Winding wires.

This fourth edition of IEC 60317-12 cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

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

- a) modification of the Scope;
- b) addition of reference to transformer oil resistance test method in Clause 20.

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

FDIS	Report on voting
55/1841/FDIS	55/1854/RVD

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

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

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 document 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This Part of IEC 60317 forms an element of a series of standards which deals with insulated wires used for windings in electrical equipment. It is composed of the following series:

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

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES –

Part 12: Polyvinyl acetal enamelled round copper wire, class 120

1 Scope

This part of IEC 60317 specifies the requirements of enamelled round copper winding wires of class 120 with a sole coating based on polyvinyl acetal or polyvinyl formal resin, which ~~may~~ **can** be modified provided it retains the chemical identity of the original resin and meets all specified wire requirements.

NOTE 1 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.

~~Class 120 is a thermal class that requires a minimum temperature index of 120 and a heat shock temperature of at least 155 °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.~~

NOTE 2 Polyvinyl acetal is a general name for a family of thermoplastic vinyl resins produced by the condensation of polyvinyl alcohol with an aldehyde. Examples are polyvinyl acetal, polyvinyl formal and polyvinyl butyral.

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

- Grade 1: 0,040 mm up to and including 2,500 mm;
- Grade 2: 0,040 mm up to and including 5,000 mm;
- Grade 3: 0,080 mm up to and including 5,000 mm.

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

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 60317-0-1:20082013, *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 ~~and~~, general notes ~~on methods of test~~ and appearance

3.1 Terms and definitions

~~For terms and definitions, see 3.1 of IEC 60317-0-1. In case of inconsistencies between IEC 60317-0-1 and this standard, IEC 60317-12 shall prevail.~~

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

3.2 General notes ~~on methods of test~~

3.2.1 Methods of test

~~For general notes on methods of test, see 3.2 of IEC 60317-0-1. In case of inconsistencies between IEC 60317-0-1 and this standard, IEC 60317-12 shall prevail.~~

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 and this document, IEC 60317-12 shall prevail.

3.2.2 Winding wire

Class 120 is a thermal class that requires a minimum temperature index of 120 and a heat shock temperature of at least 155 °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, where the constant K used for the calculation of the number of revolutions for the peel test shall be 175 mm.

9 Heat shock

Clause 9 of IEC 60317-0-1:2013 applies. The minimum heat shock temperature shall be 155 °C.

9.1 Nominal conductor diameters up to and including 1,600 mm

The coating shall show no crack. The mandrel diameter shall be as specified in Table 1.

Table 1 – Heat shock

Nominal conductor diameter mm		Elongation before winding on mandrel %	Mandrel diameter ^b
Over	Up to and including		
–	0,050	20 ^a	0,150 mm
0,050	1,600	–	<i>D</i>
^a Or to the breaking point of the copper until it breaks, whichever is less.			
^b <i>D</i> is the overall diameter of the wire.			

9.2 Nominal conductor diameters over 1,600 mm

Subclause 9.2 of IEC 60317-0-1:2013 applies.

10 Cut-through

No failure shall occur within 2 min at 170 °C.

11 Resistance to abrasion (nominal conductor diameters from 0,250 mm up to and including 2,500 mm)

The wire shall meet the requirements given in Table 2.

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

Table 2 – Resistance to abrasion

Nominal conductor diameter mm	Grade 1		Grade 2		Grade 3	
	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	Minimum average force to failure N	Minimum force to failure of each measurement N
0,250	3,00	2,55	4,90	4,15	5,80	4,90
0,280	3,25	2,75	5,25	4,45	6,25	5,30
0,315 0,320	3,50	2,95	5,65	4,80	6,70	5,70
0,360	3,75	3,20	6,05	5,15	7,20	6,10
0,400	4,05	3,45	6,50	5,50	7,70	6,50
0,450	4,35	3,70	7,00	5,90	8,25	7,00
0,500	4,65	3,95	7,50	6,35	8,85	7,50
0,560	5,00	4,25	8,00	6,80	9,50	8,05
0,630	5,35	4,55	8,60	7,30	10,2	8,65
0,710	5,70	4,85	9,20	7,80	10,9	9,25
0,800	6,10	5,15	9,90	8,40	11,7	9,90
0,900	6,55	5,55	10,6	9,00	12,5	10,6
1,000	7,05	5,95	11,3	9,60	13,3	11,3
1,120	7,60	6,45	12,1	10,2	14,2	12,0
1,250	8,20	6,95	12,9	11,0	15,2	12,9
1,400	8,80	7,45	13,9	11,8	16,4	13,9
1,600	9,45	8,00	14,9	12,6	17,6	14,9
1,800	10,1	8,60	16,0	13,5	18,8	16,0
2,000	10,9	9,20	17,1	14,4	20,2	17,1
2,240	11,7	9,90	18,2	15,4	21,6	18,3
2,500	12,5	10,6	19,4	16,4	23,0	19,5

12 Resistance to solvents

Clause 12 of IEC 60317-0-1:2013 applies.

13 Breakdown voltage

Clause 13 of IEC 60317-0-1:2013 applies. The elevated temperature shall be 120 °C.

14 Continuity of insulation

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

15 Temperature index

Clause 15 of 60317-0-1:2013 applies. The minimum temperature index shall be 120.

16 Resistance to refrigerants

Test appropriate but no requirements specified.

17 Solderability

Test inappropriate.

18 Heat or solvent bonding

Test inappropriate.

19 Dielectric dissipation factor

Test inappropriate.

20 Resistance to transformer oil

~~Test appropriate but no requirements specified.~~

Test according to Clause 6 of IEC 60851-4:2016 appropriate. Test requirements are under consideration.

21 Loss of mass

Test inappropriate.

23 Pin hole test

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

30 Packaging

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