BS EN 60317-52:2014

BSI Standards Publication

Specifications for particular types of winding wires

Part 52: Aromatic polyamide (aramid) tape wrapped round copper wire, temperature index 220

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National foreword

This British Standard is the UK implementation of EN 60317-52:2014. It is identical to IEC 60317-52:2014. It supersedes BS EN 60317-52:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/55, Winding wires.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Supersedes EN 60317-52:1999

English Version

Specifications for particular types of winding wires - Part 52: Aromatic polyamide (aramid) tape wrapped round copper wire, temperature index 220 (IEC 60317-52:2014)

Spécifications pour types particuliers de fils de bobinage - Partie 52: Fil de section circulaire en cuivre enveloppé avec un ruban polyamide aromatique (aramide), d'indice de température 220
(CEI 60317-52:2014)

Technische Lieferbedingungen für bestimmte Typen von Wickeldrähten - Teil 52: Runddrähte aus Kupfer, umwickelt mit Band aus aromatischen Polyamiden, Temperaturindex 220
(IEC 60317-52:2014)

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 55/1395/CDV, future edition 2 of IEC 60317-52, prepared by IEC/TC 55 "Winding wires" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60317-52:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-12-21
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-03-21

This document supersedes EN 60317-52:1999.

EN 60317-52:2014 includes the following significant technical changes with respect to EN 60317-52:1999:

– new 3.2.2 containing general notes on winding wire, formerly a part of the scope;

– new 3.3, containing requirements for appearance;

– modification to Clause 15 to delete the note on revisions to IEC 60172;

– new Clause 23, Pin hole test.

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60317-52:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60264 Series	NOTE	Harmonized as EN 60264 Series (not modified).
IEC 60317 Series	NOTE	Harmonized as EN 60317 Series (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
ISO 3	1973	Preferred numbers - Series of preferred numbers	-	-
IEC 60172		Test procedure for the determination of the temperature index of enamelled winding wires	EN 60172	
IEC 60819-3-3	2011	Non-cellulosic papers for electrical purposes - Part 3: Specifications for individual materials - Sheet 3: Unfilled aramid (aromatic polyamide) papers	EN 60819-3-3	2011
IEC 60851	(Series)	Winding wires - Test methods	EN 60851-6	(Series)

CONTENTS

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 52: Aromatic polyamide (aramid) tape wrapped round copper wire, temperature index 220

1 Scope

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

NOTE The heat shock test is inappropriate for this type of wire. 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 range of nominal conductor diameters covered by this standard is:

– 1,600 mm up to and including 5,000 mm;
– the nominal conductor diameters are given in Table 1.

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

IEC 60819-3-3:2011, *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, general notes and appearance

3.1 Terms and definitions

For the purposes of this document, 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
insulation
coating or covering on the conductor with the specific function of withstanding voltage

3.1.5
winding wire
wire used for winding a coil to provide a magnetic field

3.1.6
wire
conductor coated or covered with an insulation

3.2 General notes

3.2.1 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 to the corresponding test numbers in the IEC 60851 series of standards.

In case of inconsistencies between the publication on methods of test and this standard, IEC 60317-52 shall prevail.

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

Unless otherwise specified, all tests shall be carried out at a temperature from 15 °C to 35 °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 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.

3.2.2 Winding wire

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.

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

– reference to IEC 60317-52;
– diameter of the conductor;
– reference should also be made to the number and thickness of the tapes used and to the degree of overlap, as agreed between the purchaser and supplier.

3.3 Appearance

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

The tape covering shall be essentially smooth and continuous, wrapped around the conductor tightly, evenly and free from creases, wrinkles and foreign material when examined with normal vision, as wound on the original spool or reel.

4 Dimensions

4.1 Conductor diameter

The series of preferred nominal conductor diameters shall correspond to series R20 according to ISO 3. The actual values and their tolerances are given in Table 1.

The series of intermediate diameters from which the user may select intermediate nominal conductor diameters, when required for technical reasons, shall correspond to series R40 according to ISO 3. The actual values and their tolerances are given in Annex A.

The conductor diameter shall not differ from the nominal diameter by more than the limits given in Table 1.

Table 1 – Conductor diameters

Nominal conductor diameter mm	Tolerance ± mm	Nominal conductor diameter mm	Tolerance ± mm
1,600	0,016	3,150	0,032
1,800	0,018	3,550	0,036
2,000	0,020	4,000	0,040
2,240	0,022	4,500	0,045
2,500	0,025	5,000	0,050
2,800	0,028		
NOTE The dimensions of intermediate nominal conductor diameters for R40 series are given in Annex A.			

4.2 Out of roundness of conductor

The difference between the minimum and maximum diameter, at any one point, shall not be more than the figure given in columns 2 and 4 of Table 1.

4.3 Minimum increase in diameter due to insulation

The minimum increase in diameter due to the insulation shall not be less than the values calculated using the following formula:

$$2 \Sigma T_{\text{min}.i} n_i$$

where

$T_{\text{min}.i}$ is the minimum thickness of the tape in 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, and including 75 % $n = 3$.

Minimum thickness shall be calculated from the values given in Table 1 of IEC 60819-3-3:2011 where the permissible deviation of the central thickness value is:

– for nominal thickness 0,05 mm ± 20 %

– for nominal thicknesses 0,08 mm and greater ± 15 %.

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

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

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

Therefore, the minimum increase 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 tape with an overlap of 55 % followed by two layers of 0,08 mm tape 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 increase due to the insulation equals:

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

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.

4.4 Maximum overall diameter

The overall diameter shall not exceed the sum of the maximum conductor diameter given in Table 1 and the maximum increase in diameter due to the insulation which is calculated using the formula given below.

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.

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:

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

where

n_i is determined by the degree of overlap in accordance with 4.3 in layer number i;

$T_{max.i}$ is the maximum paper thickness as calculated in accordance with 4.3 in that layer.

See the example given in Annex B.

5 Electrical resistance

No resistance values are specified.

The nominal resistance at 20 °C is given in Annex C.

6 Elongation

The elongation at fracture shall be in accordance with the values given in Table 2.

Table 2 – Elongation requirements

Nominal conductor diameter mm		Minimal elongation
Over	Up to and including	%
–	2,500	30
2,500	5,000	32

7 Springiness

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

8 Flexibility and adherence

The covering shall not expose the conductor nor shall it show any tearing or appreciable loosening when the wire is wrapped round a mandrel of six times its nominal diameter.

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 than or equal to 11,8 kV/mm, based on half the minimum increase in diameter due to the tape.

NOTE The method is described in IEC 60851-5 for round wires of sizes greater than 2,500 mm.

14 Continuity of insulation

Test inappropriate.

15 Temperature index

The method of test shall be in accordance with IEC 60172. The minimum temperature index shall be 220.

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 to transformer oil

Test inappropriate.

21 Loss of mass

Test inappropriate.

23 Pin hole test

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 or container 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 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 60317-52;
b) type of wire and insulation;
c) net mass of wire;
d) dimensions of wire;
e) date of manufacture.

Annex A
(informative)

Nominal conductor diameters for intermediate sizes (R40)

Intermediate nominal conductor diameters in Table A.1 are those which the user may select only for technical reasons.

Table A.1 – Conductor diameters (R40)

Nominal conductor diameter mm	Tolerance ± mm	Nominal conductor diameter mm	Tolerance ± mm
1,700	0,017	3,000	0,030
1,900	0,019	3,350	0,034
2,120	0,021	3,750	0,038
2,360	0,024	4,250	0,043
2,650	0,027	4,750	0,048

Annex B
(informative)

Example of tape wrapped wire

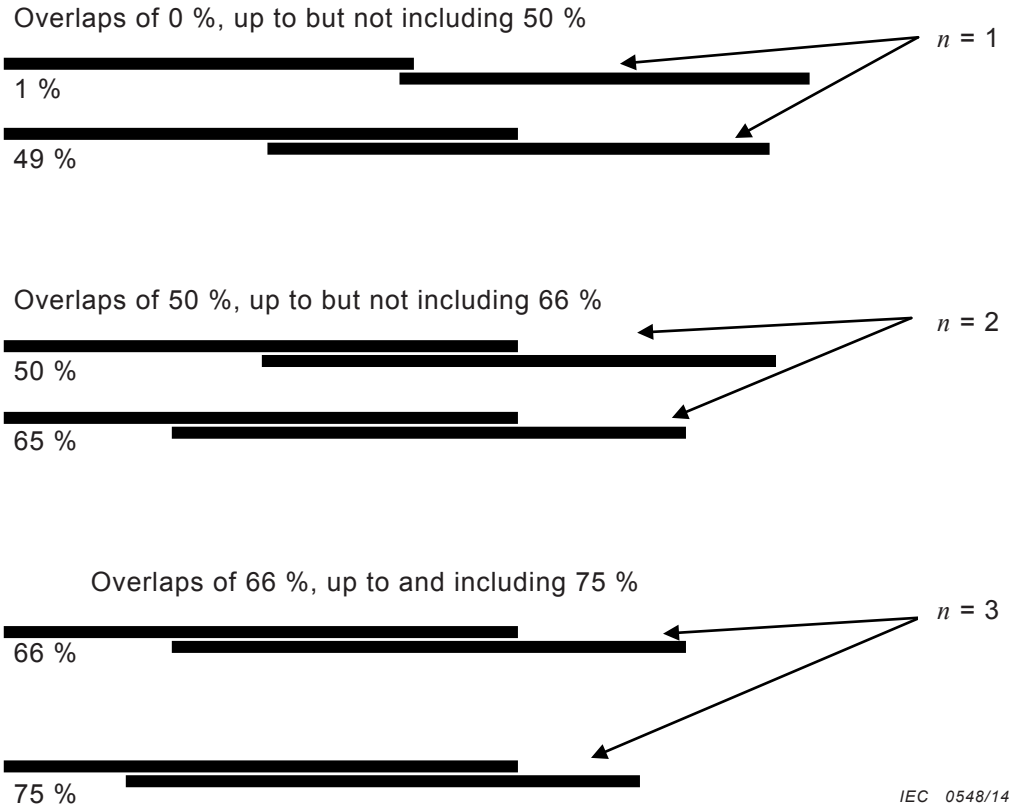
For a construction using two 0,05 mm thick tapes wrapped on a 2,500 mm conductor with 50 % overlap the maximum overall diameter is:

$$[2{,}525 + 2\,[(2 + 1)0{,}06 + (2 + 1)0{,}06]]\ \text{mm} =$$

$$(2{,}525 + 0{,}72)\ \text{mm} =$$

$$3{,}245\ \text{mm}$$

See Figure B.1 for illustrations based on this example.



Where n is determined by the degree of overlap.

Figure B.1 – Illustrations of overlap

Annex C
(informative)

Resistance

The figures for nominal resistance are given in Table C.1 for information only. They are calculated on the basis of the nominal conductor diameter and a nominal resistivity of 1/58,5 $\Omega \cdot mm^2 \cdot m^{-1}$.

Table C.1 – Nominal resistance

Nominal conductor diameter mm	**Nominal resistance** Ω/m
1,600	0,008 502
1,800	0,006 718
2,000	0,005 441
2,240	0,004 338
2,500	0,003 482
2,800	0,002 776
3,150	0,002 193
3,550	0,001 727
4,000	0,001 360
4,500	0,001 075
5,000	0,000 870 6

Bibliography

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

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

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