IS 13730 (Part 44) : 2005
IEC 60317-44 (1997)

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Indian Standard

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES

PART 44 AROMATIC POLYIMIDE TAPE WRAPPED RECTANGULAR COPPER WIRE, CLASS 240

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NATIONAL FOREWORD

This Indian Standard (Part 44) which is identical with IEC 60317-44 (1997) 'Specifications for particular types of winding wires — Part 44 : Aromatic polyimide tape wrapped rectangular copper wire, class 240' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendations of the Winding Wires Sectional Committee (ET 33) and approval of the Electrotechnical Division Council.

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English text of the International Standard has been retained while adopting it as an Indian Standard, and as such the page numbers given here are not the same as in IEC Publication.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60172 (1987) Test procedure for the determination of the temperature index of enamelled winding wires	IS 5825 : 1993 Test procedure for the determination of the temperature index of enamelled winding wires (*first revision*)	Identical
IEC 60317-0-2 (1990) Specifications for particular types of winding wires — Part 0 : General requirements — Section 2 : Enamelled rectangular copper wire	IS 13730 (Part 0/Sec 2) : 1993 Specifications for particular types of winding wires: Part 0 General requirements, Section 2 Enamelled rectangular copper wire	do
IEC 60851 (Series) Methods of test for winding wires	IS 13778 (Series) Methods of test for winding wires	do
ISO 3 : 1973 Preferred numbers — Series of preferred numbers	IS 1076 (Part 1) : 1985 Preferred numbers: Part 1 Series of preferred numbers (*second revision*)	do

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result off a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES

PART 44 AROMATIC POLYIMIDE TAPE WRAPPED RECTANGULAR COPPER WIRE, CLASS 240

1 Scope

This part of IEC 317 specifies the requirements of tape wrapped rectangular copper winding wire of class 240. The insulation consists of one or two wrappings of aromatic polyimide tape.

Class 240 is a thermal class that requires a temperature index of 240 and a heat shock temperature of at least 260 °C.

NOTE – In some countries, e.g. Canada, Russia, USA, this product is assigned a class 220.

The tape is coated on one or both sides with a suitable adhesive, for instance, fluorinated ethylene propylene. After wrapping, the tape is heat-sealed to form a continuous and adherent sheath.

Specific requirements may be subject to contract.

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

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

- width: min. 2,00 mm, max. 16,00 mm;
- thickness: min. 0,80 mm, max. 5,60 mm.

The specified combinations of width and thickness as well as the specified ratio width/thickness are given in IEC 317-0-2.

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

- reference to IEC 60317-44;
- dimension of the nominal conductor (width x thickness);
- grade.

Example: 60317-44 IEC 4,00 mm x 1,00 mm grade A2

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 317. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 317 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International standards.

IEC 172: 1987, *Test procedure for the determination of the temperature index of enamelled winding wires*

IEC 317-0-2: 1990, *Specifications for particular types of winding wires – Part 0: General requirements – Section 2: Enamelled rectangular copper wire*

IEC 851, *Methods of test for winding wires*

ISO 3: 1973, *Preferred numbers – Series of preferred numbers*

3 Definitions and general notes on methods of test

3.1 *Terms and definitions*

For the purpose of this part of IEC 317, the following definitions apply.

3.1.1 **class:** The thermal performance of a wire expressed by the temperature index and the heat shock temperature.

3.1.2 **conductor:** The bare metal after removal of the insulation.

3.1.3 **covering:** A material which is wound, wrapped or braided around a bare or insulated conductor.

3.1.4 **crack:** An opening in the insulation which exposes the conductor to view at the stated magnification.

3.1.5 **grade:** A range of thickness of the insulation of a wire.

3.1.6 **insulation:** A coating or covering on the conductor with the specific function of withstanding voltage.

3.1.7 **nominal conductor dimension:** The designation of the conductor size in accordance with IEC 317.

3.1.8 **winding wire:** A wire used for winding a coil to provide a magnetic field.

3.1.9 **wire:** A conductor coated or covered with an insulation.

3.2 *General notes on methods of test*

All methods of test used in this part of IEC 317 are given in IEC 851.

The clause numbers used in this standard are identical with the respective test numbers of IEC 851.

In case of inconsistencies between IEC 851 on methods of test and this part of IEC 317, 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 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.

4 Dimensions

The dimensions due to the insulation depend upon an agreement between purchaser and supplier. The dimensions in this standard shall be used as a guide in forming that agreement.

4.1 *Conductor dimensions*

See 4.1 of IEC 317-0-2.

4.2 *Tolerance on conductor dimensions*

See 4.2 of IEC 317-0-2.

4.3 *Rounding of corners*

See 4.3 of IEC 317-0-2.

4.4 *Increase in dimensions due to the insulation*

The minimum increase in width or thickness due to the insulation shall be as given in table 1.

Table 1 – Minimum increases due to the insulation

Single tape		Double tape	
Grade	Minimum increase in dimensions due to the insulation mm	Grade	Minimum increase in dimensions due to the insulation mm
A1	0,100	B1	0,200
A2	0,130	B2	0,260
A3	0,170	B3	0,340
A4	0,210	B4	0,430
A5	0,260	B5	0,510

4.5 *Maximum overall dimensions*

The overall dimensions shall not exceed the sum of the maximum conductor dimensions given in 4.2 and the maximum increase in dimensions due to the insulation given in table 2.

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

One or two tapes may be applied with a degree of overlapping agreed upon between purchaser and supplier.

The tape shall be wrapped on the conductor, tightly, evenly and free from creases or wrinkles, with the adhesive on the inside.

After wrapping, the tape shall be heat-sealed by suitable means to form an adherent and continuous sheath.

Table 2 – Maximum increases due to the insulation

Single tape		Double tape	
Grade	Maximum increase in dimensions due to the insulation mm	Grade	Maximum increase in dimensions due to the insulation mm
A1	0,140	B1	0,280
A2	0,180	B2	0,360
A3	0,240	B3	0,480
A4	0,300	B4	0,600
A5	0,340	B5	0,680

Example: The maximum overall dimensions of a wire with a nominal conductor width of 4,000 mm and a conductor thickness of 1,000 mm, insulated with a single tape to grade A.3 (including adhesive) are:

for the width: 4,050 mm + 0,240 mm = 4,290 mm; and

for the thickness: 1,030 mm + 0,240 mm = 1,270 mm.

5 Electrical resistance

The resistance of the wire shall be expressed as the d.c. resistance at 20 °C. The method used shall provide an accuracy of 0,5 %.

The maximum value of resistance shall be not greater than the value calculated for the minimum tolerated cross-sectional area of the conductor resulting from the minimum dimensions in thickness and width and the maximum for the corner radius, with a resistivity of $1/58\ \Omega\ mm^2m^{-1}$.

One measurement shall be made.

6 Elongation

The elongation at fracture shall be in accordance with the values given in table 3.

Table 3 – Elongation requirements

Nominal thickness of the conductor mm		Minimum elongation
Over	Up to and including	%
–	2,500	30
2,500	5,600	33

7 Springiness

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

8 Flexibility and adherence

8.1 *Mandrel winding test*

The covering shall show no crack or delamination after the wire has been bent flatwise and edgewise on a mandrel with a diameter four times the width and thickness, respectively.

8.2 *Adherence test*

The wire shall be stretched by 15 % for a single taped wire or by 10 % for a double taped wire.

The distance of loss of adhesion shall be less than one times the conductor width.

9 Heat shock

The wire shall be stretched by 15 % for a single taped wire or by 10 % for a double taped wire.

The covering shall show no crack.

The minimum heat shock temperature shall be 260 °C.

10 Cut-through

When using a nominal round conductor diameter of 1,600 mm, no failure shall occur within 2 min at 450 °C.

11 Resistance to abrasion

Test inappropriate.

12 Resistance to solvents

Test inappropriate.

13 Breakdown voltage

At least four of the five specimens tested shall not break down at a voltage less than or equal to that given in table 4.

Table 4 – Breakdown voltage

Nominal conductor thickness mm		Minimum breakdown voltage (r.m.s.)			
		Single tape		Double tape	
Over	Up to and including	Grade	Voltage V	Grade	Voltage V
1,600	5,600	A1	1 500	B1	2 500
		A2	2 000	B2	3 000
		A3	2 300	B3	3 500
		A4	2 600	B4	4 200
		A5	3 000	B5	5 000

14 Continuity of insulation

The method of test and requirement may be agreed upon between purchaser and supplier.

15 Temperature index

The test shall be carried out in accordance with IEC 172 on specimens made from aromatic polyimide tape wrapped round wire having a nominal conductor diameter of 1,600 mm.

The minimum temperature index shall be 240 and the time to failure at the lowest test temperature shall not be less than 5 000 h.

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 transformer oil

Test inappropriate.

21 Loss of mass

Test inappropriate.

30 Packaging

The kind of packaging may influence certain properties of the wire, for example springback. Therefore the kind of packaging, for example the type of spool, shall be agreed upon between purchaser and supplier.

The wire shall be evenly and compactly wound on spools or placed in containers. No spool or container shall contain more than one length of wire unless agreed to by 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 to by purchaser and supplier.

Where wires are delivered in coils, the dimensions and the maximum weights of such coils shall be agreed upon between purchaser and supplier. Any additional protection for coils shall also be agreed upon between purchaser and supplier.

Labels shall be securely attached to the flange of each spool and (where applicable) containers and shall include the following information:

a) manufacturer's name and/or trade mark;

b) type of wire and insulation;

c) net mass of wire;

d) dimension(s) of wire and grade of insulation;

e) date of manufacture.

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