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Part 5: Electrical properties

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



55/2061/CD

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IEC TC 55 : WINDING WIRES

SECRETARIAT:

United States of America

SECRETARY:

Mr Mike Leibowitz

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 2, TC 14

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Safety

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TITLE:

Winding wires - Test methods - Part 5: Electrical properties

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**WINDING WIRES –
TEST METHODS –****Part 5: Electrical properties****FOREWORD**

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International Standard IEC 60851-5 has been prepared by IEC technical committee 55: Winding wires.

Significant revisions to the previous edition include the following points:

- Subclause 4.3.2 modified to expand the conductor size range for the loads applied during cylinder method testing for dielectric breakdown voltage of enameled wires and for fully insulated wires.
- Addition of subclause 5.5 for inline continuity testing of rectangular wire (under consideration).

- 148 This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.
- 149 A list of all the parts in the IEC 60851 series, under the general title *Winding wires – Test*
150 *methods*, can be found on the website.
- 151 The committee has decided that the contents of the base publication and its amendments will
152 remain unchanged until the stability date indicated on the IEC web site under
153 "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the
154 publication will be
- 155 • reconfirmed,
 - 156 • withdrawn,
 - 157 • replaced by a revised edition, or
 - 158 • amended.
- 159
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INTRODUCTION

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164 This part of IEC 60851 forms an element of a series of standards which deals with insulated
165 wires used for windings in electrical equipment. The series has three groups describing

- 166 a) winding wires – Test methods (IEC 60851);
167 b) specifications for particular types of winding wires (IEC 60317);
168 c) packaging of winding wires (IEC 60264).

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WINDING WIRES – TEST METHODS –

Part 5: Electrical properties

1 Scope

This part of IEC 60851 specifies the following tests:

- Test 5: Electrical resistance;
- Test 13: Breakdown voltage;
- Test 14: Continuity of insulation;
- Test 19: Dielectric dissipation factor;
- Test 23: Pin hole.

For definitions, general notes on methods of test and the complete series of methods of test for winding wires, see IEC 60851-1.

2 Normative references

The following referenced documents are indispensable for the application 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 60851-1, *Winding wires – Test methods – Part 1: General*

3 Test 5: Electrical resistance

Electrical resistance is the d.c. resistance at 20 °C of 1 m of wire.

The method used shall provide a precision of 0,5 %.

For bunched wires a length of up to 10 m shall be used and the ends shall be soldered before the measurement. When measuring the resistance to check for an excessive number of broken wires, a length of 10 m of bunched wire shall be used.

If the resistance R_t is measured at a temperature t other than 20 °C, the resistance R_{20} at 20 °C shall be calculated by means of the following formula:

$$R_{20} = \frac{R_t}{1 + \alpha (t - 20)}$$

where

t is the actual temperature in degrees Celsius during the measurement;

α is the temperature coefficient in K⁻¹.

In the temperature range from 15 °C to 25 °C, the temperature coefficient to be used shall be:

– for copper: $\alpha_{20} = 3,96 \times 10^{-3} \text{ K}^{-1}$;

– for aluminium: $\alpha_{20} = 4,07 \times 10^{-3} \text{ K}^{-1}$.

One test shall be made. The electrical resistance shall be reported.

4 Test 13: Breakdown voltage

4.1 Principle

The test voltage shall be an a.c. voltage of 50 Hz or 60 Hz nominal frequency. The test voltage shall be applied at zero and increased at a uniform rate according to Table 1.

Table 1 – Rates of test voltage increase

Breakdown voltage V		Rate of increase V/s
Over	Up to and including	
–	500	20
500	2 500	100
2 500	–	500

An overview of breakdown voltage specimen preparations specified in 4.3 – 4.7 is provided in 4.8.

4.2 Equipment

The following equipment shall be used:

- test transformer with a rated power of at least 500 VA providing an a.c. voltage of an undistorted sine waveform under test conditions, with a peak factor being within the limits of $\sqrt{2} \pm 5 \%$ (1,34 to 1,48) and with a capacity to supply a current of 5 mA with a maximum voltage drop of 2 %;
- fault detection circuit, which operates at a current of 5 mA or more;
- arrangement to provide a uniform rise of the test voltage at the specified rate;
- oven with forced air circulation;
- polished metal cylinder, 25 mm $\pm$ 1 mm in diameter, mounted with its axis horizontal (see Figure 1) and electrically connected to one terminal of the test voltage supply;
- twisting device according to Figure 2, that allows to twist two pieces of wire for a length of 125 mm;
- strips of metal foil, 6 mm in width and pressure sensitive tape, 12 mm in width;
- container with metal shot of stainless steel or nickel-plated iron. The diameter of the shot shall not exceed 2 mm. The shot shall be cleaned periodically by suitable means;
- metal mandrel, 50 mm $\pm$ 2 mm in diameter;
- metal mandrel, 25 mm $\pm$ 1 mm in diameter;
- metal mandrel, 80 mm $\pm$ 3 mm in diameter.

4.3 Enamelled round wire

4.3.1 Grade 1 to grade 3 with a nominal diameter up to and including 0,500 mm

The test is carried out on a cylinder with a diameter of 25 mm $\pm$ 1 mm. A straight piece of wire with the insulation removed at one end shall be connected to the upper terminal as shown in Figure 1 and wound once around the cylinder. A load as specified in Table 2.1 shall be applied to the lower end of the wire to keep the specimen in close contact with the cylinder.

The test voltage shall be applied according to 4.1 between the conductor of the wire and the cylinder. The test shall be carried out at room temperature.

Five specimens shall be tested. The five single values shall be reported.

Table 2.1 – Loads applied to enamelled wire

Nominal conductor diameter mm		Load N
Over	Up to and including	
–	0,018	0,013
0,018	0,020	0,015
0,020	0,022	0,020
0,022	0,025	0,025
0,025	0,028	0,030
0,028	0,032	0,040
0,032	0,036	0,050
0,036	0,040	0,060
0,040	0,045	0,080
0,045	0,050	0,100
0,050	0,056	0,120
0,056	0,063	0,150
0,063	0,071	0,200
0,071	0,080	0,250
0,080	0,090	0,300
0,090	0,100	0,400
0,100	0,160	0,600
0,160	0,250	0,850
0,250	0,355	1,700
0,355	0,500	3,400