

Winding wires — Test methods —

Part 5: Electrical properties

The European Standard EN 60851-5 + A1:1997, with the incorporation of amendment A2:2004, has the status of a British Standard

ICS 29.060.10

National foreword

This British Standard is the English language version of EN 60851-5 + A1:1997 + A2:2004. It was derived by CENELEC from IEC 60851-5:1996 and incorporates amendment 1:1997 and amendment 2:2004. It supersedes BS 6811-2.5:1992 which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 18, an inside back cover and a back cover.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 October 1998

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Amendments issued since publication

Amd. No.	Date	Comments
15301	11 August 2004	See national foreword

ISBN 0 580 30427 2

Descriptors: Electric wire, winding, insulated wire, electrical property

English version

Winding wires — Test methods — Part 5: Electrical properties

(includes amendments A1:1997 and A2:2004)
(IEC 60851-5:1996 + A1:1997 + A2:2004)

Fils de bobinage — Méthodes d'essai —
Partie 5: Propriétés électriques
(inclut les amendements A1:1997 et A2:2004)
(CEI 60851-5:1996 + A1:1997 + A2:2004)

Wickeldrähte — Prüfverfahren —
Teil 5: Elektrische Eigenschaften
(enthält Änderungen A1:1997 und A2:2004)
(IEC 60851-5:1996 + A1:1997 + A2:2004)

This European Standard was approved by CENELEC on 1996-10-01; amendment A1 was approved by CENELEC on 1997-03-11 and amendment A2 was approved by CENELEC on 2004-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 55/474A/FDIS, future edition 3 of IEC 60851-5, prepared by IEC TC 55, Winding wires, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60851-5 on 1996-10-01.

This European Standard supersedes HD 490.5 S2:1991.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-07-01

Annexes designated “normative” are part of the body of the standard.

In this standard, Annex ZA is normative.

Annex ZA has been added by CENELEC.

Foreword to EN 60851-5:1996/A1:1997

The text of document 55/542/FDIS, future amendment 1 to IEC 60851-5:1996, prepared by IEC TC 55, Winding wires, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60851-5:1996 on 1997-03-11.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-12-01

Foreword to amendment A2

The text of document 55/903A/FDIS, future amendment 2 to IEC 60851-5:1996, prepared by IEC TC 55, Winding wires, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60851-5:1996 on 2004-07-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2005-04-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2007-07-01

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Introduction

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

- a) methods of test (IEC 60851);
- b) specifications (IEC 60317);
- c) packaging (IEC 60264).

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;
- A_2 Test 23: Pin hole. A_2

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 reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of IEC 60851. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60851 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. Members of the IEC and ISO maintain registers of currently valid International Standards.

IEC 60851-1:1996, *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 formula:

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

where

A_2 t is the actual temperature in degrees Celsius during the measurement;

α is the temperature coefficient in K^{-1} . A_2

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

- A_2 — for copper: $\alpha_{20} = 3,96 \times 10^{-3} \text{ K}^{-1}$;
- for aluminium: $\alpha_{20} = 4,07 \times 10^{-3} \text{ K}^{-1}$. A_2

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

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;
- $\overline{A_2}$ 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; $\overline{A_2}$
- 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. $\overline{A_2}$

4.3 Enamelled round wire with a nominal conductor diameter up to and including 0,100 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 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 — Loads applied to the wire

Nominal conductor diameter mm		Load
Over	Up to and including	N
—	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

4.4 Enamelled round wire with a nominal conductor diameter over 0,100 mm up to and including 2,500 mm

4.4.1 Test at room temperature

A₂ A straight piece of wire, approximately 400 mm in length, with the insulation removed at both ends, shall be twisted back on itself for a distance of (125 ± 5) mm on the twisting device as shown in Figure 2. The ends of the wire shall be joined, and the load applied with the number of twists, as given in Table 3. The loop at the end of the twisted section shall be cut at two places to provide a maximum spacing between the cut ends. Any bending to ensure adequate separation between the two wire ends shall avoid sharp bends or damage to the coating.

The test voltage shall be applied according to 4.1 between the conductors of the wires.

Five specimens shall be tested. The five single values shall be reported. **A₂**

Table 3 — **A₂** Loads applied to the wire and number of twists **A₂**

Nominal conductor diameter mm		Load	Number of twists
Over	Up to and including	N	
0,100	0,250	0,85	33
0,250	0,355	1,70	23
0,355	0,500	3,40	16
0,500	0,710	7,00	12
0,710	1,060	13,50	8
1,060	1,400	27,00	6
1,400	2,000	54,00	4
2,000	2,500	108,00	3