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(JCMA)

**Winding wires—Test methods—
Part 5: Electrical properties**

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In the event of any doubts arising as to the contents,
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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by the Japan Electric Wire & Cable Makers' Association (JCMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently, **JIS C 3003:1999** and **JIS C 3006:1999** have been withdrawn and replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or utility model right.

This Standard has been established for the purpose of standardization of test methods of enameled wires and fibre or paper insulated wires, and with the aim of harmonizing **JIS** test standards with relevant **IEC** standards. In deliberations carried out on harmonization of this Standard with **IEC** standard, however, it was anticipated that some of the changes from the conventionally applied **JIS** specifications, being so significant, would cause confusion in the market. Therefore, as a transitional measure, this Standard was decided to be established mainly as an **IEC** harmonized standard, but with **IEC** test specifications partially replaced with the conventional **JIS** test specifications. Establishment of this Standard is aimed at gaining consensus in the market in harmonization with the **IEC** standards. In the next revision of this Standard, efforts for a full harmonization will be made.

JIS C 3216 series consists of the following 6 parts under the general title “*Winding wires—Test methods*”:

Part 1: General

Part 2: Determination of dimensions

Part 3: Mechanical properties

Part 4: Chemical properties

Part 5: Electrical properties

Part 6: Thermal properties

Winding wires—Test methods— Part 5: Electrical properties

Introduction

This Japanese Industrial Standard has been prepared based on the fourth edition of **IEC 60851-5** published in 2008. Some of the technical contents of the said International Standard, however, are modified in this Standard as a transitional measure until consensus of harmonization with **IEC** can be gained in the market.

The portions given dotted underlines and Annex JA are the matters not contained in the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

The requirements are given in the particular standards which cite this Standard.

1 Scope

This Standard specifies the methods of test for electrical properties of enamelled copper wires, enamelled aluminium wires, fibre or paper insulated copper wires and fibre or paper insulated aluminium wires, that are used for winding wires.

The general notes on methods of test are given in **JIS C 3216-1**.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60851-5:2008 *Winding wires—Test methods—Part 5: Electrical properties* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 2320 *Electrical insulating oils*

JIS C 3216-1 *Winding wires—Test methods—Part 1: General*

NOTE : Corresponding International Standard: IEC 60851-1 *Winding wires—Test methods—Part 1: General* (MOD)

3 Electrical resistance

Electrical resistance shall be expressed by the d.c. resistance at 20 °C of 1 m of wire, using a measuring instrument providing a precision of 0.5 % or better. For bunched wires a length of up to 10 m shall be used and the ends shall be soldered before the measurement so that the terminals of the measuring instrument and the wire under test can be brought into contact with each other.

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 equation:

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

where, t : actual temperature during the measurement (°C)
 α : temperature coefficient (K⁻¹)

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

For copper: $\alpha = 3.96 \times 10^{-3} \text{ K}^{-1}$

For aluminium: $\alpha = 4.07 \times 10^{-3} \text{ K}^{-1}$

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

4 Breakdown voltage

The breakdown voltage shall be measured in accordance with the following procedure. The method described in **JA.4** may be applied upon agreement between the purchaser and the supplier.

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 1.34 to 1.48;
- the test power source 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 ± 1) mm in diameter, mounted as shown in figure 1, 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 and approximately 0.02 mm in thickness;
- 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 ± 2) mm, and (25 ± 1) mm in diameter.

4.3 Enamelled round wire with a nominal conductor diameter up to and including 0.100 mm

A straight piece of wire specimen 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.

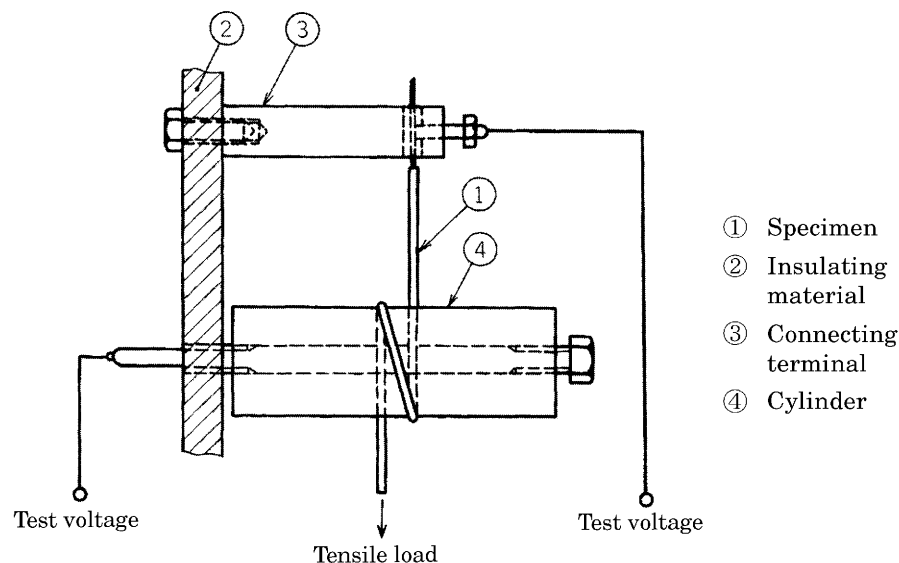


Figure 1 Arrangement of cylinder and specimen for the breakdown voltage test

Table 2 Loads applied to the 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

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.

The applicable size may be changed upon agreement between the purchaser and the supplier.

4.4 Enamelled round wire with a nominal conductor diameter over 0.100 mm up to and including 2.500 mm

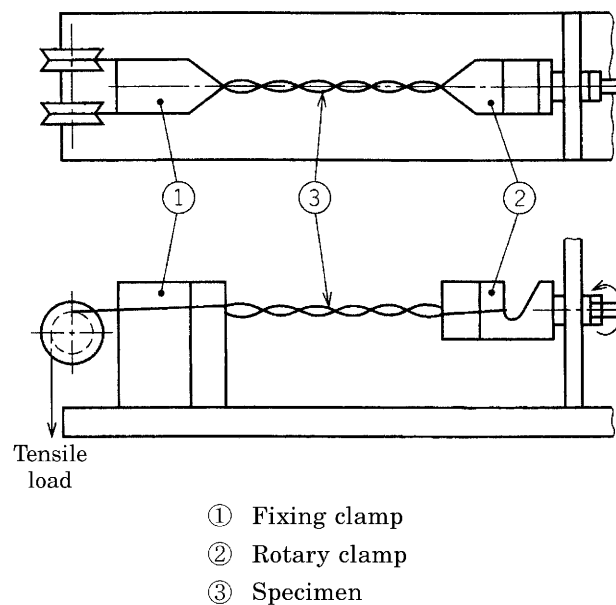
4.4.1 Test at room temperature

A straight piece of wire specimen, 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 the 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.

The applicable size may be changed upon agreement between the purchaser and the supplier.

Table 3 Load and number of twists

Nominal conductor diameter mm		Tensile load N	Number of twists
Over	Up to and including		
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

**Figure 2 Device for twisting the specimen for breakdown voltage test****4.4.2 Test at elevated temperature**

A specimen prepared according to 4.4.1 shall be placed in the oven preheated to the test temperature $\pm 3\text{ }^{\circ}\text{C}$ specified in the particular standard.

The test voltage shall be applied according to 4.1 between the conductors of the wires in not less than 15 min after placing the specimen in the oven. The test shall be completed within 30 min. Five specimens shall be tested. The five single values shall be reported.

4.5 Enamelled round wire with a nominal conductor diameter over 2.500 mm**4.5.1 Test at room temperature**

A straight piece of wire specimen of sufficient length, with the insulation removed at one end, shall be bent around a mandrel of (50 ± 2) mm diameter to obtain a U-bend