

KS

KOREAN INDUSTRIAL STANDARD

Methods of Test for Enamelled Copper and Enamelled Aluminium Wires

KS C 3006 : 1986

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Methods of Test for Enamelled Copper and Enamelled Aluminium Wires

1. Scope

This Korean Industrial Standard specifies methods of test for various kinds of enamelled copper and enamelled aluminium wires.

Remark The units and numerical values given in { } in this standard are in accordance with the customary units and are the standard values.

2. Kinds of Tests

The kinds of tests are as given in Table 1.

Table 1

Class	Clause of test method to apply	Class	Clause of test method to apply
Appearance	4.	Resistance to solvent	14.
Dimensions	5.	Resistance to chemicals	15.
Pin hole	6.	Solderability	16.
Uniformity	7.	Bonding	17.
Flexibility	8.	Resistance to refrigerant	18.
Adherence	9.	Conductor resistance	19.
Resistance to abrasion	10.	Elongation	20.
Dielectric breakdown	11.	Sponginess	21.
Resistance to softening	12.	Temperature index	22.
Resistance to thermal shock	13.		

3. Test Conditions

Unless otherwise specified, the test shall be carried out under ordinary temperature and ordinary humidity (temperature $20 \pm 15^{\circ}\text{C}$, humidity $65 \pm 20\%$) specified in **KS A 0006**.

Normative References : See page 23.

4. Appearance

The wire shall be examined, as wound on bobbin, for existence of flaw and stain, by naked eye to determine its appearance.

5. Dimensions

The dimensions shall be measured using a measuring apparatus of minimum scale $\frac{1}{1000}$ mm. However, a micrometer (measuring pressure : 3.92 to 5.88 n {400 to 600 gf} specified in **KS B 5202** may be used for a wire the specified dimension of which is in place of $\frac{1}{100}$ mm.

The measurements of overall diameter or overall size, conductor diameter or conductor size as well as thickness of film shall be made as follows :

(1) Round Wire

Take a test piece of about 15 cm in length, measure the diameters at 3 points spaced nearly equal; express the mean value of these measured values as the overall diameter. Next, remove the film at the place where the overall diameter has been measured by a suitable method which will not attack the conductor, measure the conductor diameter by the same method as that for the overall diameter, and expressed the mean value as the conductor diameter.

And express the thickness of film as $\frac{1}{2}$ of the difference between overall diameter and conductor diameter.

(2) Rectangular Wire

Take a test piece of about 30 cm in length, measure the dimensions at 3 places at spacing of about 10 cm, and express the mean value of each measured values as the dimensions. Next remove the film at the places where the overall dimensions have been measured by a suitable method which will not attack the conductor, measure the conductor dimensions by the same method as that for the overall dimensions, and expressed the mean value of each measured values as the conductor dimensions.

Express the thickness of film in conductor thickness direction and width direction as $\frac{1}{2}$ of the difference between overall thickness and conductor thickness and as $\frac{1}{2}$ of the difference between overall width and conductor width, respectively.

6. Pin Hole

Take a test piece of about 1.5 m in length for conductor diameter of 0.06 mm or less and about 6 m in length for conductor diameter of 0.07 mm or more, carry out heat treatment for about 10 min in a thermostatic oven kept at a specified temperature (if not specified, the temperature shall be $125 \pm 3^\circ\text{C}$).

After heat treatment, without bending nor stretching, dip the test piece in 0.2% sodium chloride aqueous solution added with proper quantity of alcohol solution of 3%

phenolphthalein, about 1 m in length for conductor diameter of 0.06 mm or less, and about 5 m in length for conductor diameter of 0.07 mm or more, apply d.c. 12 v for 1 min, by making the solution as positive and conductor of test piece as negative, and then examine the number of pin holes generated.

7. Uniformity

The uniformity shall be tested on wires of conductor diameter 0.25 to 2.0 mm. The test piece is set on a testing machine, provided with coiler part which can travel at a constant rate, electrode for applying voltage on the film, and display circuit which can detect and count the defect, and the number of defects for about 30 m in length shall be measured as follows :

(1) Coiling rate

$30 \pm 3 \text{ m / min.}$

(2) Electrode

The electrode is, as shown in Fig. 1, a V-shape grooved sheave made of metal which will not hard to be corroded nor oxidized easily, and guide sheaves of the same size as that of electrode are provided before and behind the electrode so that the test piece in the groove contacts with the electrode though a length of about 25 mm.

(3) Display circuit

The display circuit, when d.c. voltage of 350 to 600 V is applied between conductor of test piece and electrode, shall operate if the resistance is 5 M Ω or less, and not operate if 10 M Ω or more.

Moreover, the circuit shall have counting capability of 600 ± 60 count/min and be capable of recording the number of such operation when measured with base wire.

Unit : mm

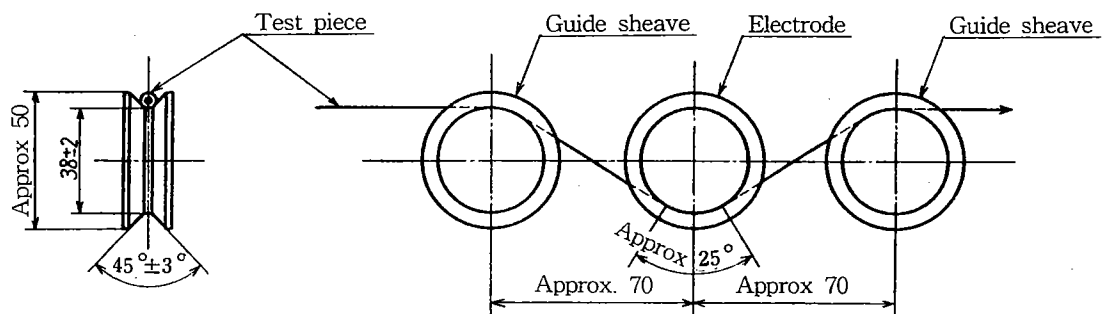


Fig. 1

8. Flexibility

8.1 Round Wire

The flexibility of round wires shall be investigated by elongation for conductor diameter of 0.35 mm or less, and by winding for that of 0.37 mm or more.

(1) Elongation

Take 3 test pieces of about 35 cm in length from the same bobbin, on each test piece mark lines with a gauge length of 250 mm, elongate the specimen to a specified value at a rate of not more than 300 mm/min and then investigate whether visible cracks appear or not, on the film by a magnifying glass of about 15 magnifications (value of least distance of distinct vision divided by focal length of the magnifying glass).

(2) Coiling

Take 3 test pieces of proper length from the same bobbin, concerning each test piece, wound the specimen on its own circumference or on a round bar of smooth surface having a specified diameter for 10 turns, so that the wire will contact closely each other, and then visually check whether visible cracks appear or not on the film.

8.2 Rectangular Wire

For the rectangular wire, the test shall be carried out as follows :

(1) Elongation

Take 3 test pieces of about 35 cm in length, from the same bobbin, on each test piece mark lines with a gauge length of 250 mm, elongate the specimen to a specified value at a rate of not more than 300 mm/min, and then visually check whether visible cracks appear or not on the film.

(2) Bending

Take 2 test pieces of about 20 cm in length from the same bobbin, bent one specimen at the central part through an angle of 180 ° flatwise and the other edgewise along the circumference of round bar having a specified diameter, while the specimen is in the same plane, and then visually check whether visible cracks appear or not on the film.

9. Adherence

The adherence shall be investigated on the conductor of not more than 1.6 mm diameter. Take 3 test pieces of about 35 cm in length, on each test piece mark lines with a gauge length of 250 mm, elongate the specimen at a rate of about 4 m/s until cutting off, and then investigate by a magnifying glass of about 15 magnifications, whether visible cracks appear or not on the film.

10. Resistance to Abrasion

The abrasion resistance shall be investigated on the conductor of not less than 0.26 mm in diameter under the conditions of temperature $20 \pm 10^\circ$ humidity $65 \pm 15\%$, with the testing machine as shown in Fig. 2. Take 2 test pieces of proper length from the same bobbin, wipe them with clean cloth or paper, fit them separately on the sample stand after straightened by about 1%, elongation by the testing machine.

Next, fix the piano wire specified in KS D 3556, of 0.23 ± 0.01 mm in diameter the surface of which is smooth and free from stain, to the abrasion head, put a load (initial load is desirable 90% of the specified load) on the cradle, set down the abrasion head quietly on the surface of wire and let it travel. Increase the load until the conductor is exposed and the abrasion head is stopped. Read the scale of load arm at this time and let the product of this scale value and load as the load to failure. Carry out the measurement by rotating the wire from the initial position 120° and 240° along the circumference, at each 3 positions for 2 wires, and obtain the mean value and the minimum value.

Further, the construction of testing machine shall, as shown in Fig. 2 consist of abrasion head able to travel at a rate of $400 \text{ mm/min} \pm 10\%$, and sample stand. In the abrasion head, the force applied on the test piece shall be increased when it is travelled from right end to left end, and the force, when travelled from point 1.0 to point 2.0 of the scale shall become twice. The testing machine shall have such function, that a voltage of $6.5 \pm 0.5 \text{ V}$ is applied between test piece and piano wire, and that the machine stops the abrasion head actuated by short circuit current of 5 to 20 mA. The function of circuit shall be such that the abrasion head stops within 3 mm of exposure of conductor by damage of film.

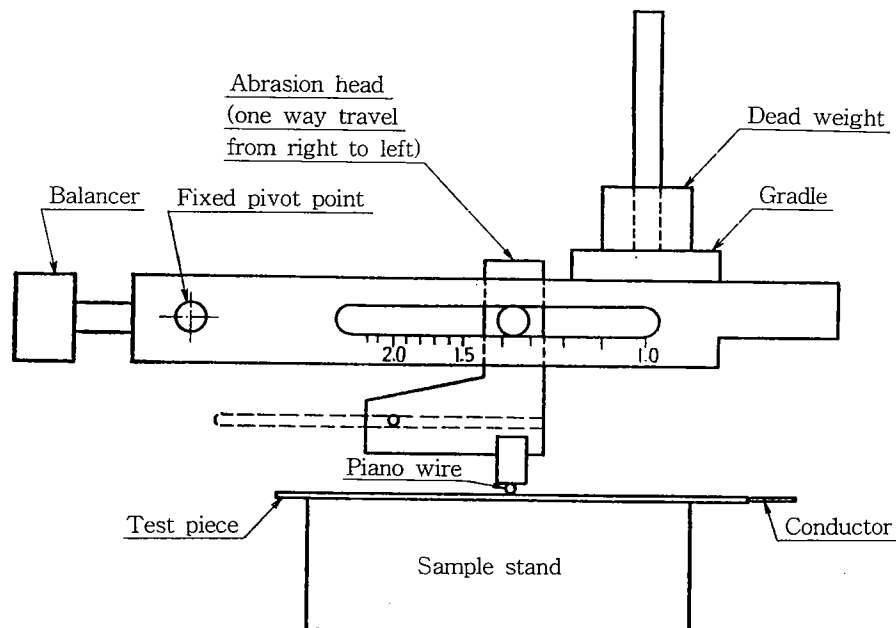


Fig. 2

11. Dielectric Breakdown

The investigation of dielectric breakdown shall be carried out in accordance with metallic cylinder method for the conductor diameter of not more than 0.04 mm, with twist 2 wire method for not less than 0.05 mm, and with metallic foil method for rectangular wires. The test voltage shall be raised at a rate of about 500 v/s as uniform as possible and the dielectric breakdown voltage is measured. If the specimen breaks down within 5 sec however, the rate of voltage increase is lowered so that breakdown occurs after 5 sec or more.

(1) Metallic cylinder method

Take 3 test pieces of about 30 cm in length from the same bobbin, fit each of them to the clamp as shown in Fig. 3, wind the test piece by one the circumference of about 25 mm in diameter cylinder of smooth surface, by applying to the end, shall be apply a suitable a.c. voltage of nearly sinusoidal wave of 50 or 60 Hz between this metallic cylinder and conductor, while the appropriate tensile force given in Table 2 being applied to the end.

Further, the capacity of transformer used for this test shall be 100 VA or more.

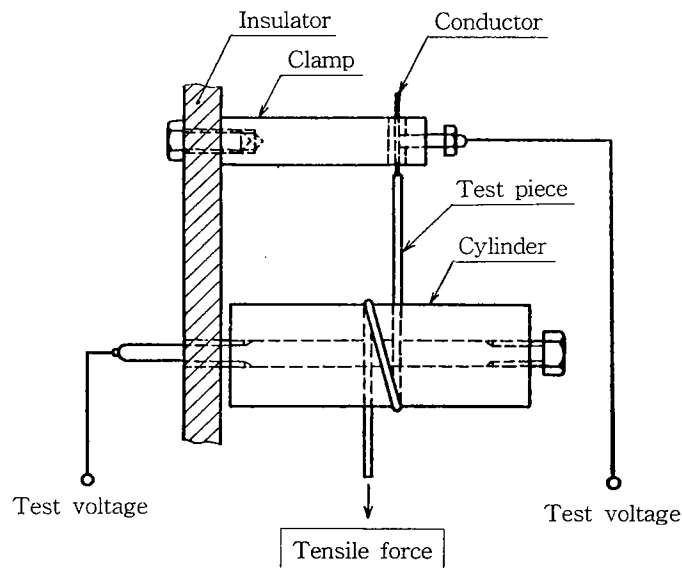


Fig. 3

Table 2

Conductor diameter mm	Tensile force N{gf}
0.02 to 0.025	0.0196{2}
0.03 to 0.04	0.0490{5}

(2) Twist 2 wire method

Take 3 test pieces of about 50 cm in length from the same bobbin, fold each of them into 2, by applying twist it at the portion about 12 cm in length to the number of turns as shown in Table 3, while the appropriate tensile force given in Table 3 being applied, remove the tensile force, cut the folded part, and then apply a suitable a.c. voltage of nearly sinusoidal wave of 50 or 60 Hz between 2 conductors.

Further, the capacity of transformer used for this test shall be 500 VA or more.

Table 3

Conductor diameter mm	Tensile force N(kgf)	No. of twist turns per about 12 cm in length
0.05	0.029 4 {0.03}	50
0.06~0.07	0.049 0 {0.005}	40
0.08~0.11	0.098 0 {0.01}	30
0.12~0.17	0.392{0.04}	24
0.18~0.29	1.18{0.12}	20
0.30~0.45	3.43{0.35}	16
0.50~0.70	4.41{0.45}	12
0.75~1.2	14.7{1.5}	9
1.3~2.0	39.2{4}	6
2.1~3.2	68.6{7}	3

(3) Metallic foil method

Take one test piece of about 30 cm in length, closely wind metallic foil ⁽¹⁾ on the part of about 10 mm, at 4 positions about 50 mm apart each other and then apply a suitable a.c. voltage of nearly sinusoidal wave of 50 or 60 Hz between conductor and metallic foils.

Further, the capacity of transformer used for this test shall be 500 VA or more.

Note ⁽¹⁾ Thickness of metallic foil shall be about 0.02 mm.

12. Resistance to Softening

The measurement of resistance to softening shall be carried out in accordance with ring crossing method for the conductor diameter of not more than 0.19 mm, with crossing method for not less than 0.20 mm and with steel ball method for rectangular wires. Test shall be carried out in such a way that an a.c. voltage of 100 V of nearly sinusoidal wave at 50 or 60 Hz is applied between conductors or between conductor and steel ball, under that condition the temperature is raised at a rate of about 2°C/min, the temperature at the time of short-circuit is measured by fixing thermocouple at the nearest part of the sample. The short circuit current, at that time, is adjusted to 5 to 20 mA.