

JIS

JAPANESE INDUSTRIAL STANDARD

**Testing method for electrical
resistance-temperature
characteristics of metallic
resistance materials**

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**In the event of any doubt arising,
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Testing method for electrical resistance-temperature characteristics of metallic resistance materials C 2526-1994

1. Scope This Japanese Industrial Standard specifies the testing method for variation of resistance with temperature and the temperature coefficient of resistance of metallic resistance materials and the like.

Remarks: The following standards are cited in this Standard:

JIS Z 8401 Rules for rounding off of numerical values

JIS Z 8703 Standard atmospheric conditions for testing

2. Definitions For the purpose of this Standard the following principal definitions apply:

- (1) metallic resistance materials Conductive metallic materials whose electrical resistance characteristics are utilized.
- (2) conductor-resistance The electric resistance (Ω) per unit length in longitudinal direction of electrical conductor having uniform cross-sectional area. In general, it means electric resistance per meter (Ω/m) or electric resistance per kilometer (Ω/km).

Symbol of conductor-resistance: R_c

- (3) volume resistivity The electric resistance per unit cross-sectional area and unit length (Ω/m). It is sometimes simply called "resistivity". Symbols of volume resistivity are as given below:

Symbol of volume resistivity: ρ

Symbol of volume resistivity at temperature $t^\circ\text{C}$: ρ_t

- (4) primary temperature coefficient and secondary temperature coefficient When the variation of electric resistance of electric conductor with temperature is obtained as a quadratic function of temperature, the coefficient of the first temperature term is called the primary temperature coefficient and the coefficient of the second temperature term is called the secondary temperature coefficient. In general, the following symbols are used for temperature coefficients:

Symbol of primary temperature coefficient at temperature $t^\circ\text{C}$: α_t

Symbol of secondary temperature coefficient: β

- (5) mean temperature coefficient The variation (rate) of electric resistance of electric conductor with temperature divided by the temperature difference in a prescribed temperature range. In general, the following symbols are used for temperature coefficient:

Symbol of mean temperature coefficient: $\bar{\alpha}$

Symbol of mean temperature coefficient between $t_a^\circ\text{C}$ and $t_b^\circ\text{C}$ ($t_a < t_b$): $\bar{\alpha}_{a,b}$

- (6) resistance ratio The value indicating the ratio of the resistance R_t at a given temperature $t^{\circ}\text{C}$ to the resistance R_{t_0} at the reference temperature $t_0^{\circ}\text{C}$: $\frac{R_t}{R_{t_0}}$

It is mainly used for indicating the resistance characteristics of wires for thermometric resistance elements, electric heating wires, general resistance wires, and the like.

- (7) maximum-resistance temperature The temperature at which the resistance becomes maximum within the applicable temperature range.

Symbol of maximum-resistance temperature: $t_{\max}$

- (8) 4-terminals 4-terminals used by attaching two terminals at each end of the test piece and using the pair of inside terminals as voltage terminals and the pair of outside terminals as current terminals.
- (9) measuring conductor The conducting wire which connects the terminals of the test piece to the measuring instrument.

3. Test piece

3.1 Sampling method of test piece Test pieces shall be cut from the product and used for testing as they are. Where the product as it is cannot be used as a test piece for reasons of its dimensions, test pieces separately taken from the intermediate process of the same melting lot shall be used. Test pieces shall be made by suitable means, for example, by drawing in the case of a wire or bar, or by cutting in the longitudinal direction in the case of a strip or sheet.

3.2 Method of conditioning test piece Test pieces shall be conditioned as follows:

- (1) Those test pieces prepared by drawing or cutting separately from the product shall be removed strains caused by drawing or cutting by a suitable heat treatment.
- (2) Where the surface of the test piece is covered with an oxide film or insulation covering, the metal surface shall be exposed by removing the films or covering at both ends of the test piece.
- (3) Test pieces of resistance materials required to have precisely defined characteristics shall be subjected to a heat treatment suitable for the respective materials to remove mechanical strains caused by bending work or the like.
- (4) Unnecessary tension or bending shall not be exerted on the test pieces taken.

They shall be carefully handled to prevent stains, dust, or the like from attaching.

- (5) The test piece of nickel chromium heating material may be subjected to such heat treatment if the user requires heat treatment, that the material is maintained at approximately 800°C for 30 min and then cooled by air (since nickel chromium heating material reduces its resistance by several percent when rapidly cooled in finishing annealing).

3.3 Dimensions of test piece The dimensions of test pieces shall be 4 mm or under in diameter for wires or bars, and 4 mm or under in width for strips or sheets.

3.4 Resistance of test piece The resistance of the test piece shall, as a rule, be $0.1\ \Omega$ or higher, and its length should desirably be as long as possible.

3.5 Shape of test piece The shape of the test piece shall be as follows: