

OPERATING INSTRUCTIONS

Mounted Resistance Spools No. 83041

1. Purpose

The Mounted Resistance Spools is a practical device designed for students to investigate a relationship between length, diameter, resistivity and resistance of conducting wires made of different diameters, lengths, and material. Students use a sensitive multimeter selected to measure resistance or a Wheatstone bridge to measure the resistances of the different spools.

2. Description

The device consists of five wound spools of wire attached at terminal posts. The resistances of the spools can be measured separately or together. The copper wire on the second spool is of the same material and length as the first, but of different diameter. A third spool has wire of the same material and diameter as the first, but of different length, while the fourth spool has the same length as the third, but half its diameter. The last spool is wound with a conductor of the same length and diameter as the first, but of copper-nickel "midohm" instead of copper.

3. Theory

The resistance R of a wire depends on:

1. the material properties of the conductor
2. the length of the wire
3. the diameter of the wire
4. the temperature of the wire

For a given temperature, this relationship can be expressed by:

$$R = \rho l / A = 4\rho l / \pi d^2 \quad (1)$$

where ρ = resistivity (a property of the wire alloy)
 l = wire length
 A = cross-sectioned area of the wire
 d = wire diameter

4. Operation

Measure the resistance of the wire on the first spool. It should measure about 0.5Ω . Given that the second spool has wire of the same length but one-half of the diameter, predict the resistance of the second spool and then measure the resistance.

The wire on the third spool has the same diameter as the wire on the first spool but twice the length. Predict its resistance; then measure it.

The wire on the fourth spool has half the diameter and twice the length of wire on the first spool. Predict its resistance and then measure it.

From the four measurements made above, calculate the resistivity of copper ρ from Equation (1). How does it compare with the $1.72 \mu \Omega\text{-cm}$ value of commercial, annealed copper?

The fifth spool of wire is the same length and diameter as the wire on the first spool, but is made of a "midohm" alloy of 77% copper and 23% nickel. Measure its resistance and compare its resistivity to that of copper. Which is a better conductor?

5. Maintenance

The Mounted Resistance Spools needs no special maintenance. If you should experience any difficulty with this device, please contact Central Scientific Company, giving details of the problem. To ensure better service, please do not return any item to Central Scientific Company until we have sent you authorization.

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