



Designation: B 193 – 00

Standard Test Method for Resistivity of Electrical Conductor Materials¹

This standard is issued under the fixed designation B 193; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the determination of the electrical resistivity of metallic electrical conductor material. It provides for an accuracy of $\pm 0.30\%$ on test specimens having a resistance of $0.00001\ \Omega$ ($10\ \mu\Omega$) or more. Weight resistivity accuracy may be adversely affected by possible inaccuracies in the assumed density of the conductor.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

A 111 Specification for Zinc-Coated (Galvanized) “Iron” Telephone and Telegraph Line Wire²

A 326 Specification for Zinc-Coated (Galvanized) High Tensile Steel Telephone and Telegraph Line Wire²

B 9 Specification for Bronze Trolley Wire³

B 105 Specification for Hard-Drawn Copper Alloy Wires for Electric Conductors³

B 298 Specification for Silver-Coated Soft or Annealed Copper Wire³

B 355 Specification for Nickel-Coated Soft or Annealed Copper Wire³

B 415 Specification for Hard-Drawn Aluminum-Clad Steel Wire³

B 566 Specification for Copper-Clad Aluminum Wire³

B 800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Temper³

2.2 NIST Document:

NBS Handbook 100—Copper Wire Tables⁴

3. Resistivity

3.1 *Resistivity* (Explanatory Note 1) is the electrical resistance of a body of unit length, and unit cross-sectional area or unit weight.

3.2 *Volume Resistivity* is commonly expressed in ohms for a theoretical conductor of unit length and cross-sectional area; in inch-pound units in $\Omega\cdot\text{cmil}/\text{ft}$ and in acceptable metric units in $\Omega\cdot\text{mm}^2/\text{m}$. It may be calculated by the following equation:

$$\rho_v = (A/L)R$$

where:

ρ_v = volume resistivity, $\Omega\cdot\text{cmil}/\text{ft}$ or $\Omega\cdot\text{mm}^2/\text{m}$,

A = cross-sectional area, cmil or mm^2 ,

L = gage length, used to determine R , ft or m, and

R = measured resistance, Ω .

3.3 *Weight Resistivity* is commonly expressed in ohms for a theoretical conductor of unit length and weight. The method for calculating weight resistivity, based on resistance, length, and weight measurements, of a test specimen is given in Explanatory Note 2.

4. Apparatus

4.1 Resistance shall be measured with a Kelvin-type double bridge or a potentiometer if the resistance of the specimen is below $1\ \Omega$. If it is $1\ \Omega$ or more, a Wheatstone bridge may be used. Where applicable, a Hoopes conductivity bridge may be used.

5. Test Specimen

5.1 The test specimen may be in the form of a wire, strip, rod, bar, tube, or shape. It shall be of uniform cross section throughout its length within $\pm 0.75\%$ of the cross-sectional area. Wherever possible it shall be the full cross section of the material it represents, if the full cross section is such that the uniformity of the cross-sectional area can be accurately determined.

5.2 The test specimen shall have the following characteristics:

5.2.1 A resistance of at least $0.00001\ \Omega$ ($10\ \mu\Omega$) in the test length between potential contacts,

5.2.2 A test length of at least 1 ft or 300 mm,

¹ This test method is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.02 on Methods of Test and Sampling Procedure.

Current edition approved Oct. 10, 2000. Published December 2000. Originally published as B 193 – 44 T. Last previous edition B 193 – 95.

² Annual Book of ASTM Standards, Vol 01.06.

³ Annual Book of ASTM Standards, Vol 02.03.

⁴ Available from the National Institute of Standards and Technology (NIST), Gaithersburg, MD 20899.