



Standard Test Method for Thermoelectric Power of Electrical-Resistance Alloys¹

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^{ε1} NOTE—Section 10 was added editorially in June 1994.

1. Scope

1.1 This test method covers the determination of the thermoelectric power of a metal or alloy with respect to copper when the temperatures of the junctions lie between 0 and 100°C.

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.*

1.3 The values stated in inch-pound units are the preferred unit. The values in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

B 3 Specification for Soft or Annealed Copper Wire²

3. Terminology

3.1 *thermoelectric power, Q*—the electromotive force in an electric circuit consisting of two metals when the junctions between them have a difference in temperature of 1°C.

3.1.1 *Discussion*—Experimentally, it has been found that the thermoelectric power of two metals is not a constant but depends on the mean temperature of the junctions. However, over a range of temperature from 0 to 100°C it is usually sufficient to assume that the thermoelectric power is independent of temperature so that for this range of temperature:

$$Q = E/(t' - t)$$

where:

E = the electromotive force developed in the circuit,

t' = the higher temperature at one junction, °C, and

t = the lower temperature at the other junction, °C.

4. Significance and Use

4.1 The purpose of this method is to determine the suitability of different metals for use in resistance apparatus in

which a low thermoelectric power is desired. As most electric circuits are largely composed of copper, the thermoelectric power of a resistance metal will generally be measured against copper.

5. Test Specimen

5.1 The metal or alloy to be tested shall be in the form of sheet, ribbon, or wire and the test specimen shall be of such length that the two ends can be readily maintained at different temperatures. At each end of the specimen a copper lead of convenient size shall be fastened. These leads shall make good electrical contact with the specimen, such as that obtained by welding, brazing, or soldering. Slight impurities in the copper have a negligible effect on the thermoelectric power.

NOTE 1—When necessary to specify the quality of the copper leads, reference should be made to Specification B 3.

6. Procedure

6.1 *Measurement of Temperature*—As a matter of precaution, the average temperature used in determining the thermoelectric power shall be approximately the same as that to which the material will be subjected in practice, and in no case shall the temperature difference between the two junctions be less than 20°C. The temperature at each of two junctions shall be measured by a device that is sufficiently accurate to determine the temperature difference within 5%. A convenient method for determining the temperatures of the junctions is to immerse each junction in separate oil baths maintained at the desired temperatures. Baths that are stirred and the temperatures of which are thermostatically controlled are to be preferred. However, beakers of oil which are supported by blocks of metal, sand baths, or other means may be used, provided the thermal capacity of these assemblies is such that when the heat is cut off their temperatures will decrease at rates less than 0.2°C/min. The temperature of the oil in each bath may be determined either by a calibrated mercury thermometer or by a calibrated thermocouple. If the oil is not stirred, the junctions shall be placed in close proximity to the temperature-measuring instrument. To ensure that the temperatures of the junctions shall not be influenced by heat of conduction along the specimen, the length of each specimen from the junction to the point where it leaves the surface of the oil shall not be less than 10 times the minimum cross-section dimension of the resistance material, nor less than 100 times the minimum cross

¹ This test method is under the jurisdiction of ASTM Committee B-4 on Metallic Materials for Thermostats and for Electrical Resistance, Heating, and Contacts and is the direct responsibility of Subcommittee B04.01 on Electrical Contact Materials.

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² *Annual Book of ASTM Standards*, Vol 02.03.