



Designation: E220 – 19

Standard Test Method for Calibration of Thermocouples By Comparison Techniques¹

This standard is issued under the fixed designation E220; 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 U.S. Department of Defense.

1. Scope

1.1 This test method describes the principles, apparatus, and procedure for calibrating thermocouples by comparison with a reference thermometer. Calibrations are covered over temperature ranges appropriate to the individual types of thermocouples within an overall range from approximately –195 °C to 1700 °C (–320 °F to 3100 °F).

1.2 In general, this test method is applicable to unused thermocouples. This test method does not apply to used thermocouples due to their potential material inhomogeneity—the effects of which cannot be identified or quantified by standard calibration techniques. Thermocouples with large-diameter thermoelements and sheathed thermocouples may require special care to control thermal conduction losses.

1.3 In this test method, all values of temperature are based on the International Temperature Scale of 1990. See Guide E1594.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

E1 Specification for ASTM Liquid-in-Glass Thermometers

E77 Test Method for Inspection and Verification of Thermometers

E230 Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

E344 Terminology Relating to Thermometry and Hydrometry

E452 Test Method for Calibration of Refractory Metal Thermocouples Using a Radiation Thermometer

E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature

E644 Test Methods for Testing Industrial Resistance Thermometers

E1129/E1129M Specification for Thermocouple Connectors

E1594 Guide for Expression of Temperature

E1684 Specification for Miniature Thermocouple Connectors

E1751 Guide for Temperature Electromotive Force (emf) Tables for Non-Letter Designated Thermocouple Combinations

E2846 Guide for Thermocouple Verification

3. Terminology

3.1 *Definitions*—The definitions given in Terminology E344 shall apply to this test method.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *check standard, n*—a measurement instrument or standard whose repeated results of measurement are used to determine the repeatability of a calibration process and to verify that the results of a calibration processes are statistically consistent with past results.

3.2.2 *isothermal block, n*—a piece of solid material of high thermal conductivity used to promote thermal equilibrium between two or more thermometers.

3.2.3 *reference junction compensation, n*—the adjustment of the indication of a thermocouple such that the adjusted indication is equivalent to the emf or temperature that the thermocouple would indicate if the reference junctions were maintained at 0 °C.

3.2.3.1 *Discussion*—In most cases, the thermocouple indication is adjusted by measuring the temperature of a terminal block where the thermocouple is connected, and then adding to the thermocouple emf an additional emf equal to the emf of the

¹ This test method is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.11 on Thermocouples - Calibration.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.