Designation: E1159 – 15

Standard Specification for Thermocouple Materials, Platinum-Rhodium Alloys, and Platinum[1]

This standard is issued under the fixed designation E1159; 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.

1. Scope

1.1 This specification covers non-insulated platinum-rhodium alloys (weight percent composition), and platinum thermoelements that meet the requirement of Specification E230 and NIST Monograph 175.[2]

1.2 This specification does not cover platinum and platinum-rhodium materials, that require a higher purity than specified in 5.1, such as used for temperature coefficient of resistance (TCR) measurements or standards type calibration. For requirements of this superior quality, it is suggested that suppliers of precious metals be contacted.

1.3 *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 The following documents of the issue in force on the date of material purchase form a part of this specification to the extent referenced herein.

2.2 *ASTM Standards:*[3]

B561 Specification for Refined Platinum

B616 Specification for Refined Rhodium

E207 Test Method for Thermal EMF Test of Single Thermoelement Materials by Comparison with a Reference Thermoelement of Similar EMF-Temperature Properties

E220 Test Method for Calibration of Thermocouples By Comparison Techniques

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

E344 Terminology Relating to Thermometry and Hydrometry

3. Terminology

3.1 *Definitions*— The definitions given in Terminology E344 apply to terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *thermocouple type, n*—a nominal thermoelectric class of thermoelement materials that, used as a pair, have a standardized relationship and tolerance between relative Seebeck EMF and temperature, physical characteristics, and an assigned type letter designator and color code.

3.2.1.1 *Discussion*—Letter designators and color codes are defined in the United States by ANSI/ASTM E230. Descriptions of letter designators and color codes may also be found in ASTM MNL-12.[4]

4. Ordering Information

4.1 Orders for material under this specification shall include the following:

4.1.1 ASTM designation and date of issue,

4.1.2 Thermocouple type (3.2.1),

4.1.3 Thermoelement diameter and tolerance (5.5),

4.1.4 Annealing requirements (5.4),

4.1.5 Quantity required (5.6, 5.7),

4.1.6 Specify standard or special tolerance on the initial value of EMF vs. temperature,

4.1.7 Calibration requirement (5.8),

4.1.8 Chemical analysis (7.2.1),

4.1.9 Certified test results (7.2.2), and

4.1.10 Statement of compliance (7.2.3).

5. Requirements

5.1 *Purity*—The purity of platinum for use in the negative thermoelement of Type R and Type S thermocouples shall be Grade 99.99, as specified in Specification B561.

[1] This specification is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.04 on Thermocouples.

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[2] "Temperature-Electromotive Force Reference Functions and Tables for the Letter-Designated Thermocouple Types Based on the ITS-90," NIST Monograph 175 and Supplement 1. Available from NIST, U.S. Dept. of Commerce, Gaithersburg, MD 20899.

[3] 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.

[4] *Manual on the Use of Thermocouples in Temperature Measurement*, ASTM MNL-12, Fourth Edition, ASTM, April 1993. (Revision of STP 470B).

5.1.1 The purity of platinum, before alloying, for use in the positive thermoelement of Type R, S, and both thermoelements of Type B shall be Grade 99.99, as specified in Specification B561.

5.1.2 The purity of rhodium, before alloying, for use in the positive thermoelement of Type R, S, and both thermoelements of Type B shall be Grade 99.95, as specified in Specification B616.

5.1.3 In the case of a conflict between the material composition and the EMF output of the thermoelement, the calibration requirement of Specification E230 shall govern.

5.2 *Physical Condition*—All material to be supplied shall consist of continuous lengths which shall be free of kinks and shall be round and smooth. Any pits or dents that exceed 10 % of the diameter shall be cause for rejection of the material.

5.3 *Cleanliness*— After material has been processed to its final diameter and prior to subsequent anneal, it shall be cleaned to remove all dirt, lubricant, fingerprints, or other foreign residue. This state of cleanliness shall be maintained throughout testing and throughout any further work and shipment.

5.3.1 Prior to any testing, cleanliness of the material shall be verified by wiping with a cotton swab. Any indication of oil, dirt, or discoloration after wiping shall be cause for rejection of the spool from which the sample was taken.

5.4 *Annealing*—Prior to any testing or shipment, material equal to or greater than 0.25 mm (0.010 in.) in diameter shall be annealed by heating to at least 1000°C in air for a minimum of 1 minute. Material smaller than 0.25 mm (0.010 in.) in diameter shall be supplied in the hard drawn temper unless otherwise specified in the ordering information.

5.5 *Diameter*—Sizes may range from 0.05 mm (0.002 in.) to 1.5 mm (0.060 in.). Required size shall be stated in the ordering information. Supplier's practice on tolerance shall apply unless otherwise stated in the ordering data (4.1.3). Any localized necking or bulging of the conductor beyond tolerance limits shall be cause for rejection.

NOTE 1—Tolerances may vary from supplier to supplier.

5.6 *Length*—Quantity of material supplied shall meet the requirements of the ordering data. Only a single continuous length may be placed on any one spool. Splicing of wires is prohibited.

5.7 *Weight*—Purchaser may alternatively request material by weight (grams or troy ounces) instead of length. All other requirements of this section shall be met. If weight is specified, a statement of weight/unit length accurate to within 1 % shall be supplied for each item.

5.8 *Thermocouple Calibration*—Sample thermocouples made from the specified thermoelements shall be calibrated according to the procedures set forth in Test Method E220. The thermocouple shall conform to the appropriate table in Specification E230. They shall meet the tolerance on the initial value of EMF vs. temperature as specified in the tolerance requirement of the ordering information given in Section 4 and listed in Table 1 of Specification E230. Roll length shall be limited to 610 m (2000 feet) for wire lot calibration.

5.8.1 *Sample Length*— The lengths of thermoelements to be tested shall be approximately 1 m (3 ft.) taken from each end of the spool or coil.

5.8.2 *Calibration Temperature*—Unless otherwise specified with the order, the sample thermocouple shall be calibrated at a single temperature of 1200 ± 100°C.

5.8.3 *Alternative Calibration Method* —A thermoelement calibration versus a suitable secondary reference thermoelement, may be specified as an option in the ordering information. A description of this method can be found in Test Method E207.

5.8.3.1 Unless otherwise specified with the order, the thermoelement material shall be such that, when calibrated at a single temperature of 1200°C, a difference in the initial value of EMF vs. temperature of no greater than 10 microvolts may be present between the beginning and the end of the thermoelement lot when tested in accordance with Test Methods E207 and E220.

5.8.3.2 The thermoelements shall be such that, when matched as a thermocouple, the EMF output shall meet the tolerance on the initial value of EMF vs. temperature as specified in 4.1.6.

6. Rejection

6.1 *Purchaser Test Results*—The purchaser may perform tests and inspection to verify that the delivered material meets the contract requirements. Failure to pass the purchaser's inspection and test may be cause for rejection.

6.2 The suppliers test results and inspection report may also be used as a basis of acceptance or rejection. Failure of suppliers to meet the contract requirements may be cause for rejection.

7. Identification and Certification

7.1 *Material Identification*—The supplier shall maintain sufficient records to ensure identification and traceability of all raw materials, verifying that all material used is in compliance with 5.1.

7.2 *Material Certification*—When required, the supplier shall furnish with the shipment the following certification and statements:

7.2.1 Certified chemical analysis of the material from which the material was made,

7.2.2 Certified results of tests performed on the material supplied in accordance with this specification and the ordering documents, and

7.2.3 A statement of compliance that the material meets requested requirements of this specification.

8. Keywords

8.1 platinum; rhodium; thermoelement; thermocouple materials; type B; type R; type S