



# Standard Specification for Compacted Mineral-Insulated, Metal-Sheathed, Base Metal Thermocouple Cable<sup>1</sup>

This standard is issued under the fixed designation E585/E585M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification establishes requirements for compacted, mineral-insulated, metal-sheathed (MIMS), base metal thermocouple cable,<sup>2</sup> with at least two thermoelements.<sup>3</sup>

1.2 This specification describes the required material, processing and testing requirements, optional supplementary testing, quality assurance, and verification choices.

1.3 The material of construction includes standard base metal thermoelements, austenitic stainless steel or other corrosion resistant sheath material, and either magnesia (MgO) or alumina (Al<sub>2</sub>O<sub>3</sub>) insulation.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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.*

1.6 *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 The following documents of the latest issue form a part of this specification to the extent specified herein. In the event

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.12 on Thermocouples - Specifications.

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<sup>2</sup> The terms “MIMS cable”, or “thermocouple cable”, or “MIMS thermocouple cable”, or “cable” will be used herein to describe mineral-insulated, metal-sheathed, base metal thermocouple cable.

<sup>3</sup> “Wire” is also used to describe “thermoelements.”

of a conflict between this specification and other specifications referenced herein, this specification shall take precedence.

### 2.2 ASTM Standards:<sup>4</sup>

**A213/A213M** Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes

**A249/A249M** Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes

**A269/A269M** Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

**A632** Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

**B163** Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes

**B167** Specification for Standard Specification for Nickel-Chromium-Aluminum Alloys (UNS N06699) Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696) Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674) and Nickel-Chromium-Molybdenum-Copper Alloy (UNS N06235) Seamless Pipe and Tube

**B423** Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloy Seamless Pipe and Tube

**B516** Specification for Welded Nickel-Chromium-Aluminum Alloy (UNS N06699) and Nickel-Chromium-Iron Alloy (UNS N06600, UNS N06601, UNS N06603, UNS N06025, UNS N06045, UNS N06690, and UNS N06693) Tubes

**E112** Test Methods for Determining Average Grain Size

**E220** Test Method for Calibration of Thermocouples By Comparison Techniques

**E230/E230M** Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

**E235/E235M** Specification for Type K and Type N Mineral-Insulated, Metal-Sheathed Thermocouples for Nuclear or

<sup>4</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

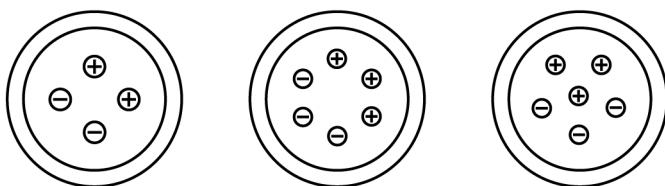


FIG. 1 Examples of Adjacent Configurations

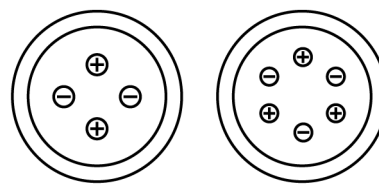


FIG. 2 Examples of Alternating Configurations

for Other High-Reliability Applications

E344 Terminology Relating to Thermometry and Hydrometry

E608/E608M Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples

E780 Test Method for Measuring the Insulation Resistance of Mineral-Insulated, Metal-Sheathed Thermocouples and Mineral-Insulated, Metal-Sheathed Cable at Room Temperature

E839 Test Methods for Sheathed Thermocouples and Sheathed Thermocouple Cable

E1652 Specification for Magnesium Oxide and Aluminum Oxide Powder and Crushable Insulators Used in the Manufacture of Base Metal Thermocouples, Metal-Sheathed Platinum Resistance Thermometers, and Noble Metal Thermocouples

2.3 ANSI Standard:

ANSI B46.1 Surface Texture<sup>5</sup>

### 3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *adjacent thermoelement configuration, n*—thermoelement configuration within a multi-pair cable where two or more positive thermoelements are immediately adjacent to one another around the circular pattern and two or more negative thermoelements are also immediately adjacent to one another around the circular pattern as shown in Fig. 1 (compare with alternating thermoelement configuration in Fig. 2).

3.2.1.1 *Discussion*—By default, a multi-pair cable with a thermoelement in the center must be considered an adjacent configuration.

3.2.2 *alternating thermoelement configuration, n*—thermoelement configuration within a multi-pair cable where positive thermoelements and negative thermoelements alternate around the circular pattern as shown in Fig. 2 (compare with adjacent thermoelement configuration in Fig. 1).

3.2.2.1 *Discussion*—In an alternating thermoelement pattern, there are never two or more positive thermoelements nor two or more negative thermoelements immediately adjacent to one another around the circular pattern.

3.2.3 *lot, n*—a quantity of finished MIMS thermocouple cable manufactured from tubing from the same heat, wire from the same spool and heat, and insulation from the same batch

then assembled and processed together under controlled production conditions to the required final outside diameter.

3.2.4 *raw material, n*—tubing, insulation, and wires used in fabrication of the MIMS thermocouple cable.

### 4. Significance and Use

4.1 *Thermocouple Cable may be used as follows:*

4.1.1 Sheathed thermocouple cable for use in manufacturing thermocouples (see Specification E608/E608M).

4.1.2 Sheathed thermocouple cable for use as extension cable in extremely harsh environments.

### 5. Ordering Information and Basis for Purchase

5.1 The purchasing documents shall specify the following options:

5.1.1 The total length of finished thermocouple cable and the length of each piece of finished thermocouple cable.

5.1.2 The type and quantity of thermoelements, the thermoelement configuration (see 3.2.1 and 3.2.2), and the tolerance range for initial values of emf versus temperature if other than standard (see 6.2). Consult individual manufacturers for the number of thermoelements limited by cable size.

5.1.3 The sheath material (see 7.3) and whether it shall be seamless or welded and drawn. Note that another sheath material may be used with purchaser and producer agreement.

5.1.4 The nominal outside diameter of the sheath (see 6.3).

5.1.5 The composition of mineral oxide insulation (see 7.2). Note that other insulation composition(s) and impurity levels may be used with purchaser and producer agreement.

5.2 Additional requirements may be specified by the purchaser as follows:

5.2.1 The intended operating temperature range of the cable (see 9.8).

5.2.2 The method used to seal the open ends, prior to shipment (see 11.1).

5.2.3 Supplementary testing or material requirements (see Supplementary Requirements).

5.2.4 The quality assurance or verification program requirements or both (see Appendix X1).

5.2.5 Any deviations from this specification or the referenced documents.

### 6. General Requirements

6.1 *MIMS Thermocouple Cable*—Cable shall be in accordance with this specification (see Fig. 3). This figure describes a cable with two thermoelements, but more than two thermoelements may be specified.

<sup>5</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.