INTERNATIONAL

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Standard Specification for Duplex, Base Metal Thermocouple Wire With Glass Fiber or Silica Fiber Insulation[1]

This standard is issued under the fixed designation E574; 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 sets forth the requirements for duplex, types E, J, K, N and T thermocouple wire, insulated with E-glass, S-glass, amorphous silica fiber or polycrystalline fiber.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety problems, 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:*[2]

D1125 Test Methods for Electrical Conductivity and Resistivity of Water

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 shall apply to this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *amorphous silica fiber, n*—continuous filament of heat insulating material whose principal constituent is amorphous silica.

3.2.2 *duplex wire, n*—matched pair of parallel, solid thermoelements, individually insulated (double wrap or braid) with insulating fibers and a fiber braid of the same material overall.

3.2.3 *E-glass, n*—family of calcia-alumina-silicate glasses that are used for general purposes and most electrical applications.

3.2.4 *impregnate, v*—to saturate the fiber insulation of wires with a high-temperature electrical insulating compound to form a moisture barrier around the wires and to inhibit fraying of the fibers.

3.2.5 *polycrystalline fiber, n*—continuous polycrystalline filament of heat insulating material whose composition is alumina, boria, and silica in an approximate ratio of 3:1:2, respectively.

3.2.6 *S-glass, n*—family of magnesia-alumina-silicate glasses with a higher tensile strength and higher softening temperature than E-glass.

4. Significance and Use

4.1 This specification presents the requirements for impregnated and non-impregnated fiber insulated thermocouple wire for normally accepted industrial use, but does not attempt to define such usage.

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[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] 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.

4.2 A supplement contains the requirements for insulated thermocouple wire that will be exposed to high humidity. The purchase order or inquiry shall specify if this supplement is required.

5. Classification

5.1 *Class A–Duplex*—E-glass fiber insulated, impregnated with a high-temperature electrical insulating compound and color coded in accordance with Specification E230.

5.2 *Class B–Duplex*—E-glass fiber insulated (Note 1) not impregnated and not color coded.

5.3 *Class C–Duplex*—Amorphous silica fiber insulated (Note 2) not impregnated and not color coded.

5.4 *Class D–Duplex*—Polycrystalline fiber insulated (Notes 2 and 3) not impregnated and not color coded.

5.5 *Class E–Duplex*—S-glass fiber insulated, impregnated with a high-temperature electrical insulating compound and color coded in accordance with Specification E230.

5.6 *Class F–Duplex*—S-glass fiber insulated (Note 1) not impregnated and not color coded.

NOTE 1—May be heat treated to retard fraying when specified in ordering information (6.1.8).
NOTE 2—Fibers may be pre-treated with an organic compound to facilitate braiding.
NOTE 3—May be heat cleaned after braiding to remove organic compound when specified in ordering information (6.1.8).

6. Ordering Information

6.1 The purchase order shall specify the following information:
6.1.1 Total insulated wire length,
6.1.2 Thermocouple type,
6.1.3 Tolerance on initial values of emf versus temperature (standard or special),
6.1.4 Class of insulation (see Section 5),
6.1.5 Thermoelement diameter (see 7.1.2),
6.1.6 Minimum acceptable continuous length per spool, if applicable,
6.1.7 Supplementary testing, if required (see Supplementary Requirements),
6.1.8 Special requirements (if any),
6.1.9 Deviations or special requirements not covered herein, and
6.1.10 Required documentation (see Section 9).

7. Technical Requirements

7.1 *Insulated Thermocouple Wire:*
7.1.1 *Materials*—Thermoelements shall be solid thermocouple grade materials with a smooth, bright finish (Note 4) and shall be fully annealed prior to insulating.

NOTE 4—An optional copper-flash coating on the iron thermoelement for type J thermocouple material is permitted to prevent rusting. This coating must be applied uniformly so ~~inhomogenicity is not introduced.~~that the final calibration tolerance requirement for the specific insulating material is still met.

7.1.2 *Sizes*—Thermoelements shall be specified in American Wire Gage (AWG) nomenclature. Corresponding thermoelement diameters shall be as listed in Table 1.
7.1.3 *Calibration:*
7.1.3.1 *Standard Method*—When required by the purchase order, calibration of the insulated thermocouple wire shall be performed by one of the procedures described in Test Methods E207 or E220.
7.1.3.2 *Thermoelement Initial Calibration Tolerances* —Standard and special tolerances on initial values of emf versus temperature are given in Table 1 of Specification E230. The purchase order shall specify whether standard or special tolerances are required.

7.2 *Insulation Materials:*

TABLE 1 Maximum Outside Transverse Dimensions of Insulated Wire

Uninsulated Thermoelement Diameter			Maximum Outside Dimensions			
Gage (AWG)	Nominal Diameter		Classes A, B, E and F		Classes C and D	
	mm	(in.)	mm	(in.)	mm	(in.)
20	0.8	(0.032)	2.7	(0.105)	4.5	(0.180)
22	0.6	(0.025)	2.3	(0.090)	4.1	(0.160)
24	0.5	(0.020)	2.1	(0.080)	3.8	(0.150)
30	0.3	(0.010)	1.7	(0.065)	none	