



Standard Guide for Temperature Electromotive Force (emf) Tables for Non- Letter Designated Thermocouple Combinations¹

This standard is issued under the fixed designation E 1751; 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 guide consists of reference tables that give temperature-electromotive force (emf) relationships for special purpose, limited use, thermocouple combinations that do not have a letter designation.

1.2 Extension wire or compensating extension wires are not covered by this guide. ASTM MNL 12² or thermocouple alloy suppliers should be consulted.

2. Terminology

2.1 Definitions:

2.1.1 For definitions of terms used in this guide see Terminology E 344.

2.2 Definitions of Terms Specific to This Standard:

2.2.1 *matched pairs, n*—a set of positive and negative thermoelements chosen so that a thermocouple fabricated from these thermoelements will match a specified temperature-electromotive force relationship to within a specified tolerance, at the time of first use.

3. Source of Data

3.1 The data in these tables are based on the SI Volt and the International Temperature Scale of 1990.

3.2 All temperature-electromotive force data in Tables 1-18 have been developed from NIST, NRC, and wire manufacturers' data.

3.3 Tables 1-14 give emf values in millivolts to three decimal places (1 μ V) at 1 °C or 1 °F intervals. Tables 15-18 give emf values in microvolts to one decimal place (0.1 μ V) at 1 °C or 1 °F intervals. If greater precision is required, refer to the equation and coefficients listed for each thermocouple alloy.

4. Significance and Use

4.1 These thermocouple combinations have been developed for specific applications by the wire manufacturer(s). If additional information is required, consult ASTM MNL 12 or one

of the following thermocouple manufacturers: Carpenter Technology, Engelhard Corp. Specialty Metals Div., Hoskins Mfg. Co., Johnson Matthey, Sigmund Cohn Corp.

5. Thermocouple Types

5.1 Letter symbols have not been assigned. Identification is made by alloy composition with the thermoelectrically positive material listed first.

5.1.1 Tungsten versus tungsten-26 % rhenium.

5.1.2 Platinel II.³

5.1.3 KP versus gold-0.07 % iron.⁴

5.1.4 Platinum-5 % molybdenum versus platinum-0.1 % molybdenum.

5.1.5 Platinum-40 % rhodium versus platinum-20 % rhodium.

5.1.6 Nickel-18 % molybdenum versus nickel-0.8 % cobalt.⁵

5.1.7 Iridium-40 % rhodium versus iridium.

5.1.8 Gold versus platinum.

5.1.9 Platinum versus palladium.

6. Tolerances on Initial Values of emf versus Temperature

6.1 Tolerances on initial values of emf versus temperature have not been established for the thermocouples in this guide. When required, tolerances on initial values of emf versus temperature should be established by agreement between the consumer and the producer. These thermocouple combinations are supplied typically as matched pairs.

7. Table Information

7.1 The following is a list of emf versus temperature tables included in this guide.

Table Number	Thermocouple Type	Temperature Range
Table 1	Tungsten versus Tungsten-26 % Rhenium	0 °C to 2315 °C
Table 2	Tungsten versus Tungsten-26 % Rhenium	32 °F to 4200 °F
Table 3	Platinel II	0 °C to 1395 °C
Table 4	Platinel II	32 °F to 2543 °F
Table 5	KP versus Gold-0.07 % Iron	-273 °C to 7 °C

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

Current edition approved May 10, 2000. Published August 2000. Originally published as E 1751-95. Last previous edition E 1751-95⁴.

² *Manual on the Use of Thermocouples in Temperature Measurement*, ASTM Manual 12, ASTM, 1993.

³ Trademark of Engelhard Corp., Specialty Metals Division.

⁴ Alloy compositions are expressed in percentages by mass, except for the gold-0.07 % iron alloy, which is given in atomic percent.

⁵ Nickel-18 % molybdenum versus nickel 0.8 % cobalt is supplied by Carpenter Technology as 20 alloy and 19 alloy.