Tolerances and Temperatures

Table 1 Tolerances on Initial Values of Emf vs. Temperature

NOTE 1 Tolerances in this table apply to new essentially homogeneous thermocouple wire, normally in the size range 0.25 mm to 3 mm in diameter (No. 30 to No. 8 Awg) and used at temperatures not exceeding the recommended limits of Table 2. If used at higher temperatures these tolerances may not apply.

NOTE 2 The Fahrenheit tolerance is 1.8 times larger than the °C tolerance at the equivalent °C temperature. Note particularly that percentage tolerances apply only to temperatures that are expressed in °C.

NOTE 3 ***Caution:*** Users should be aware that certain characteristics of thermocouple materials, including the emf versus temperature relationship, may change with time in use; consequently, test results and performance obtained at time of manufacture may not necessarily apply throughout an extended period of use. Tolerances given in this table apply only to new wire or MI cable or thermocouples as delivered to the user and ***do not allow for changes in characteristics with use.*** The magnitude of such changes will depend on such factors as wire size, temperature, time of exposure, and environment. It should be further noted that due to possible changes in homogeneity, attempting to recalibrate ***used*** thermocouples is likely to yield irrelevant results, and is not recommended. However, it may be appropriate to compare used thermocouples ***in-situ*** with new or known good ones to ascertain their suitability for further service under the conditions of the comparison.

	Temperature Range		Tolerances—Reference Junction 0°C (32°F)			
			Standard Tolerances		Special Tolerances	
Thermocouple Type	°C	°F	°C (whichever is greater)	°F	°C (whichever is greater)	°F
T	0 to 370	32 to 700	±1 or ±0.75%	Note 2	±0.5 or 0.4%	Note 2
J	0 to 760	32 to 1400	±2.2 or ±0.75%		±1.1 or 0.4%	
E	0 to 870	32 to 1600	±1.7 or ±0.5%		±1 or ±0.4%	
K or N	0 to 1260	32 to 2300	±2.2 or ±0.75%		±1.1 or ±0.4%	
R or S	0 to 1480	32 to 2700	±1.5 or ±0.25%		±0.6 or ±0.1%	
B	870 to 1700	1600 to 3100	±0.5%			
T[A]	–200 to 0	–328 to 32	±1 or ±1.5%		[B]	
E[A]	–200 to 0	–328 to 32	±1.7 or ±1%		[B]	
K[A]	–200 to 0	–328 to 32	±2.2 or ±2%		[B]	

[A] Thermocouples and thermocouple materials are normally supplied to meet the tolerances specified in the table for temperatures above 0°C. The same materials, however, may not fall within the tolerances given for temperatures below 0°C in the second section of the table. If materials are required to meet the tolerances stated for temperatures below 0°C the purchase order must so state. Selection of materials usually will be required.

[B] Special tolerances for temperatures below 0°C are difficult to justify due to limited available information. However, the following values for Types E and T thermocouples are suggested as a guide for discussion between purchaser and supplier:

Type E –200 to 0°C ±1°C or ±0.5% (whichever is greater) **Type T** –200 to 0°C ±0.5°C or ±0.8% (whichever is greater)

Initial values of tolerance for Type J thermocouples at temperatures below 0°C and special tolerances for Type K thermocouples below 0°C are not given due to the characteristics of the materials.

Table 2 Suggested Upper Temperature Limits for Protected Thermocouples

NOTE 1 This table gives the recommended upper temperature limits for the various thermocouples and wire sizes. These limits apply to protected thermocouples: that is, thermocouples in conventional closed-end protection tubes. They do not apply to sheathed thermocouples having compacted mineral oxide insulation.

NOTE 2 The temperature limits given here are intended only as a guide to the user and should not be taken as absolute values nor as guarantees of satisfactory life or performance. These types and sizes are sometimes used at temperatures above the given limits, but usually at the expense of stability or life or both. In other instances, it may be necessary to reduce the given limits in order to achieve adequate service. ASTM MNL-12[C] and other literature sources should be consulted for additional application information.

	Upper Temperature Limit for Various Wire Sizes (Awg), °C (°F)					
Thermocouple Type	No. 8 Gauge 3.25 mm (0.128 in)	No. 14 Gauge 1.63 mm (0.064 in)	No. 20 Gauge 0.81 mm (0.032 in)	No. 24 Gauge 0.51 mm (0.020 in)	No. 28 Gauge 0.33 mm (0.013 in)	No. 30 Gauge 0.25 mm (0.010 in)
T		370 (700)	260 (500)	200 (400)	200 (400)	150 (300)
J	760 (1400)	590 (1100)	480 (900)	370 (700)	370 (700)	320 (600)
E	870 (1600)	650 (1200)	540 (1000)	430 (800)	430 (800)	370 (700)
K and N	1260 (2300)	1090 (2000)	980 (1800)	870 (1600)	870 (1600)	760 (1400)
R and S				1480 (2700)		
B				1700 (3100)		

[C] "Manual on the Use of Thermocouples in Temperature Measurement," ASTM MNL-12, 1993.

Tables courtesy ASTM