CLEVELAND ELECTRIC LABORATORIES
Thermocouples & Sensing Solutions since 1920

Thermocouple Codes: Conductor Combinations and Characteristics

ANSI CODE	CONDUCTOR COMBINATIONS		TEMP. RANGE	LIMITS OF ERROR			APPLICATION INFORMATION
	POSITIVE + LEG	NEGATIVE – LEG		RANGE (°F)	STANDARD	SPECIAL	
TYPE **J**	IRON (magnetic) WHITE +	CONSTANTAN RED –	32 to 1400°F (0 to 760°C)	32 to 530 530 to 1400	±4°F ±0.75%	+2°F ±.4%	Suitable for vacuum, reducing, or inert atmospheres. Reduced life in oxidizing atmosphere. Iron oxidizes rapidly above 1000°F (538°C) so only heavy gauge wire is recommended for high temperature. Bare elements should not be exposed to sulfurous atmospheres above 1000°F (538°C).
TYPE **K**	CHROMEL YELLOW +	ALUMEL (magnetic) RED –	32 to 2300°F (0 to 1260°C)	32 to 530 530 to 2300	±4°F ±0.75%	±2°F ±.4%	Recommended for continuous oxidizing or neutral atmospheres. Mostly used above 1000°F (530°C). Subject to failure if exposed to sulfur. Preferential oxidation of chromium in positive leg at certain low oxygen concentrations causes "green rot" and large negative calibration drifts most serious in the1500-1900°F range.
TYPE **T**	COPPER BLUE +	CONSTANTAN RED –	32°F to 700°F (0 to+370°C)	32 to 200 200 to 700	±2°F ±0.75%	±1°F ±.4%	Useable in oxidizing, reducing, or inert atmospheres, as well as vacuum. Not subject to corrosion in moist atmospheres.
TYPE **E**	CHROMEL PURPLE +	CONSTANTAN RED –	32 to 1600°F (0 to 871°C)	32 to 600 600 to 1600	±3°F ±0.5%	±2°F ±0.4%	Recommended for continuously oxidizing or inert atmospheres. Highest thermoelectric output of common calibration.
TYPE **S** TYPE **R**	PLATINUM- 10% Rhodium BLACK PLATINUM- 13% Rhodium +	PLATINUM RED PLATINUM –	32 to 2700°F (0 to 1480°C)	32 to 1000 1000 to 2700	±2.7°F ±0.25%	±1°F ±0.1%	Recommended for high temperature. Must be protected with non-metallic protection tube and ceramic insulators. Continued high temperature usage causes grain growth which can lead to mechanical failure. Negative calibration drift caused by rhodium diffusion to pure leg as well as from rhodium volatilization.
TYPE **B**	PLATINUM- 30% Rhodium GREY +	PLATINUM 6% Rhodium RED –	1600 to 3100°F (871 to 1705°C)	1600 to 3100	±0.5%	±0.25%	Same as S & R but output is lower. Also less susceptible to grain growth and drift.
TYPE **N**	NICROSIL ORANGE +	NISIL (magnetic) RED –	32 to 2300°F (0 to 1260°C)	32 to 530 530 to 2300	±4°F ±0.75%	±2°F ±0.4%	Nicrosil/Nisil nickel-based thermocouple alloy used primarily at high temperature (up to 2300°F). While not a direct replacement for Type K, Type N provides better resistance to oxidation at high temperature and longer life in applications where sulfur is present.
TYPE **C**	TUNGSTEN 5% Rhenium GREEN +	TUNGSTEN 26% Rhenium RED –	32 to 4200°F (0 to 2330°C)	32 to 800 800 to 4200	±8°F ±1.0%		This refractory metal thermocouple may be used at temperatures up to 4200°F (2315°C). As it has no oxidation resistance its use is restricted to vacuum, hydrogen or inert atmospheres.

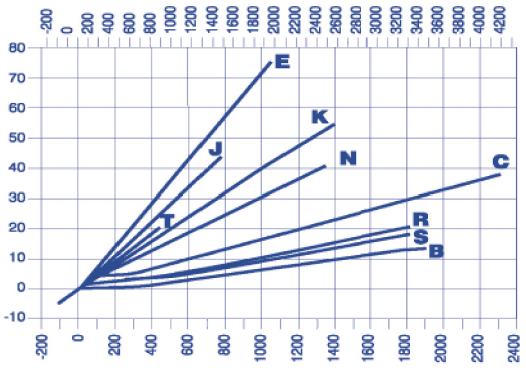
** Special tolerances for temperatures below 32°f are difficult to validate due to limited available information. The following values for **Types E and T** thermocouples are suggested as a guideline for discussion between the customer and Cleveland Electric Labs.

Tolerance values for **Type J** thermocouples at temperatures below 32°f and special tolerances for Type K thermocouples below 32°F are not given due to the nature of the material.

Type E -320 to 32°F ± 2°F or ±0.5% (whichever is greater)
Type T -320 to 32°F ± 1°F or ±0.8% (whichever is greater)

Temperature in °F

THERMOCOUPLE TEMPERATURE EMF GRAPH



Temperature in °C

ANSI SYMBOL

T Copper vs. Constantan
E Chromel vs. Constantan
J Iron vs. Constantan
K Chromel vs. Alumel
S Platinum 10% Rhodium vs.Platinum
R Platinum 13% Rhodium vs.Platinum
B Platinum 30% Rhodium vs. Platinum 6% Rhodium
N Nicrosil vs. Nisil
C Tungsten 5% Rhenium vs. Tungsten 26% Rhenium

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