

Physical Properties of Thermoelement Materials

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Thermoelement Material

Property	J Iron	J, C, T Constantan	T Copper	K, E Chromel	K Alumel	N Nicrosil	N Nisil	R Pt13% Rh	J Pt10% Rh	R,E Platinum	B Pt30% Rh	B Pt6% Rh
Melting point (solidus temp.) °C °F	1490 2715	1220 2228	1083 1981	1427 2600	1399 2550	1420 2590	1330 2425	1860 3380	1850 3362	1769 3216	1927 3501	1826 3319
Resistivity $\mu\Omega\cdot\text{cm}$ at 0°C at 20°C $\Omega\cdot\text{cmil/ft}$ at 0°C at 20°C	8.57 9.67 51.5 58.2	48.9 48.9 294.2 294	1.56 1.724 9.38 10.37	70 70.6 421 425	28.1 29.4 169 177	97.4 97.8	32.5 34.6	19.0 19.6 114.3 117.7	18.4 18.9 110.7 114.0	9.83 10.4 59.1 62.4	19.0	17.5 106
Temperature coefficient of resistance , $\Omega/\Omega\cdot^\circ\text{C}$ (0 to 100°C)	65×10^{-4}	-0.1×10^{-4}	4.3×10^{-4}	4.1×10^{-4}	23.9×10^{-4}	13.3×10^{-4}	12.1×10^{-4}	15.6×10^{-4}	16.6×10^{-4}	39.2×10^{-4}	13.3×10^{-4}	20.6×10^{-4}
Coefficient of thermal expansion in./in. °C (20 to 100°C)	11.7×10^{-6}	14.9×10^{-6}	16.6×10^{-6}	13.1×10^{-6}	12.0×10^{-6}			9.0×10^{-6}	9.0×10^{-6}	9.0×10^{-6}		
Thermal conductivity at 100°C Cal-cm/s-cm ² ·°C BTU-ft/h-ft ² ·°F	0.162 39.2	0.0506 12.2	0.901 218	0.046 11.1	0.071 17.2	0.0358 8.67	0.0664 16.07	0.088 21.3	0.090 21.8	0.171 41.4		
Specific heat at 20°C, cal/ g·°C	0.107	0.094	0.092	0.107	0.125	0.11 8.52	0.12 8.70			0.032		
Density g/cm ³ lb/in ³	7.86 0.284	8.92 0.322	8.92 0.322	8.73 0.315	8.60 0.311	0.3078	0.3143	19.61 0.708	19.97 0.721	21.45 0.775	17.60 0.636	20.55 0.743
Tensile strength (annealed) MPa psi	345 50,000	552 80,000	241 35,000	655 95,000	586 85,000	690 100,000	621 90,000	317 46,000	310 45,000	138 20,000	483 70,000	276 40,000
Magnetic attraction	strong	none	none	none	moderate	none	none	none	none	none	none	none

Nominal Chemical Composition of Thermoelements

	Iron	Constantan	Copper	CHROME [®]	ALOMEGA [®]	Omegalloy [®] Nicrosil	Omegalloy [®] Nisil	Platinum 13% Rhodium	Platinum 10% Rhodium	Pure Platinum	Platinum 30% Rhodium	Platinum 6% Rhodium
N=Neg P=Pos	JP	JN, TN EN ^a	TP	KP, EP	KN	NP	NN	RP	SP	RN, SN	BP	BN
Element Nominal Chemical Composition, %												
Iron	99.5	...	...	...	...	...	...	...	...	...	...	...
Carbon	<i>b</i>	...	...	...	...	...	...	...	...	...	...	...
Manganese	<i>b</i>	...	...	...	2	...	...	...	...	...	...	...
Sulfur	<i>b</i>	...	...	...	...	...	...	...	...	...	...	...
Phosphorus	<i>b</i>	...	...	...	...	...	...	...	...	...	...	...
Silicon	<i>b</i>	...	...	...	1	1.4	4.4	...	...	...	...	...
Nickel	<i>b</i>	45	...	90	95	84.4	95.5	...	...	...	...	...
Copper	<i>b</i>	55	100	...	...	...	...	...	...	...	...	...
Chromium	<i>b</i>	...	...	10	...	14.2	...	...	...	...	...	...
Aluminum	...	...	...	...	2	...	...	...	...	...	...	...
Platinum	...	...	...	...	...	...	...	87	90	100	70.4	93.9
Rhodium	...	...	...	...	...	...	...	13	10	...	29.6	6.1
Magnesium	...	...	...	...	...	...	0.15	...	...	...	...	...

^aTypes JN, TN and EN thermoelements usually contain small amounts of various elements for control of thermal emf, with corresponding reductions in the nickel or copper content, or both.

^bThermoelectric iron (JP) contains small but varying amounts of these elements.



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