Technical Datasheet

CarTech® Temperature Compensator "30"® Alloy (Types 2, 3

Type Analysis

Single figures are nominal except where noted.

Carbon	0.12 %	**Manganese**	0.60 %
Silicon	0.25 %	**Nickel**	30.00 %
Iron	Balance		

General Information

Description

CarTech Temperature Compensator "30"® alloy is a 30% nickel-iron alloy whose magnetic permeability decreases at a controlled rate with increase in temperature. The alloy has been used in electrical circuits to compensate for the effect of variations in ambient temperature. Three types of CarTech Temperature Compensator "30" are available, each having different temperature-permeability characteristics which are controlled precisely by special processing, heat treatment and composition balance.

These materials could be considered for use in "shunt" applications. A shunt is a conductor joining two points in a magnetic line circuit and forming a desired circuit or path through which some of the magnetic lines pass. At low temperatures the magnet is strong but the shunt, having high permeability, diverts a portion of the "flux" (magnetic current) away from the gap. As temperature increases the pole strength of the magnet decreases, but the permeability of the shunt decreases, so less flux is diverted through the shunt.

If the shunt is properly designed, the flux in the gap can be held constant over a fairly wide temperature range, thereby compensating for temperature changes.

CarTech Temperature Compensator "30" alloy operates over a temperature range from -60/160°F (-51/71 °C).

Applications

The three different types of this alloy have been used as shunts in watt-hour meters, speedometers, tachometers, voltage regulators and similar electrical instruments.

Stability at Low Temperature

Tests have been made as low as -112°F (-80°C). After prolonged cooling at this temperature, no change has been found in magnetic properties of the three types of on Carpenter Temperature Compensator "30" alloys. This indicates no transformation at low temperatures and that the temperature permeability characteristics are reversible.

Properties

Physical Properties

Specific Gravity	8.20	
Density	0.2960	lb/in³
Mean Specific Heat	0.1200	Btu/lb/°F

Mean CTE

77 to 122°F	5.11	x 10 -6 in/in/°F
77 to 212°F	6.00	x 10 -6 in/in/°F
77 to 392°F	7.61	x 10 -6 in/in/°F
77 to 572°F	8.33	x 10 -6 in/in/°F
77 to 752°F	8.72	x 10 -6 in/in/°F
77 to 932°F	9.05	x 10 -6 in/in/°F

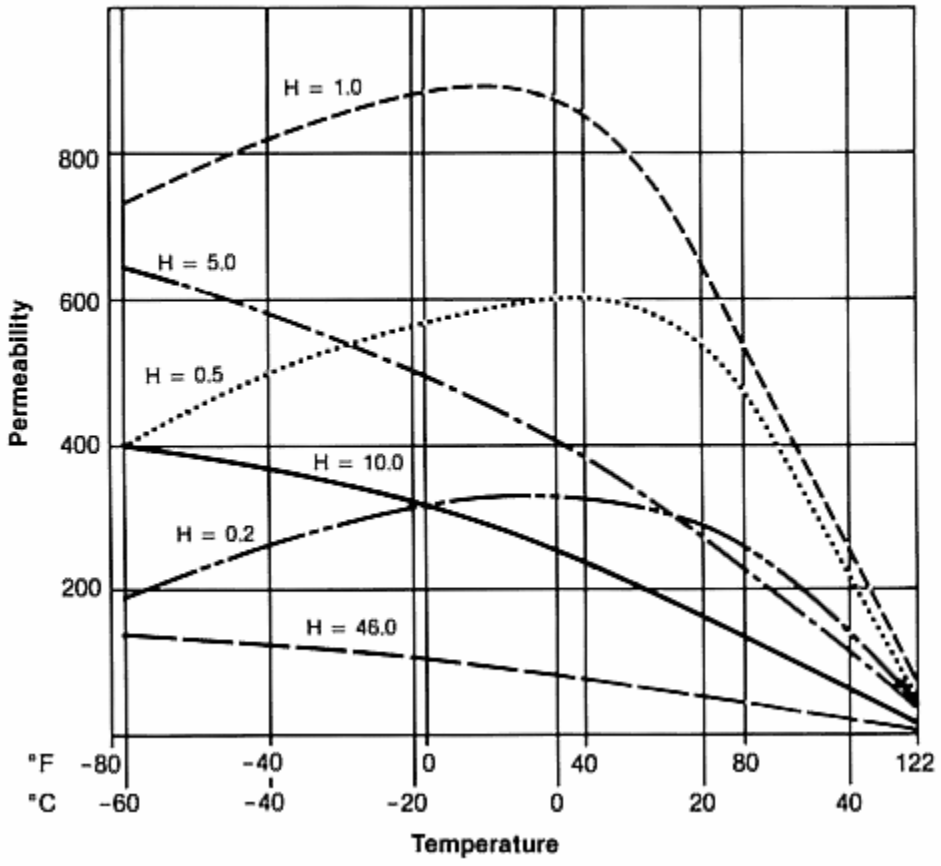
Mean coefficient of thermal expansion

Temperature		Coefficient	
77°F to	25°C to	10^{-6}/°F	10^{-6}/°C
122	50	5.11	9.2
212	100	6.0	10.8
392	200	7.61	13.7
572	300	8.33	15.0
752	400	8.72	15.7
932	500	9.05	16.3

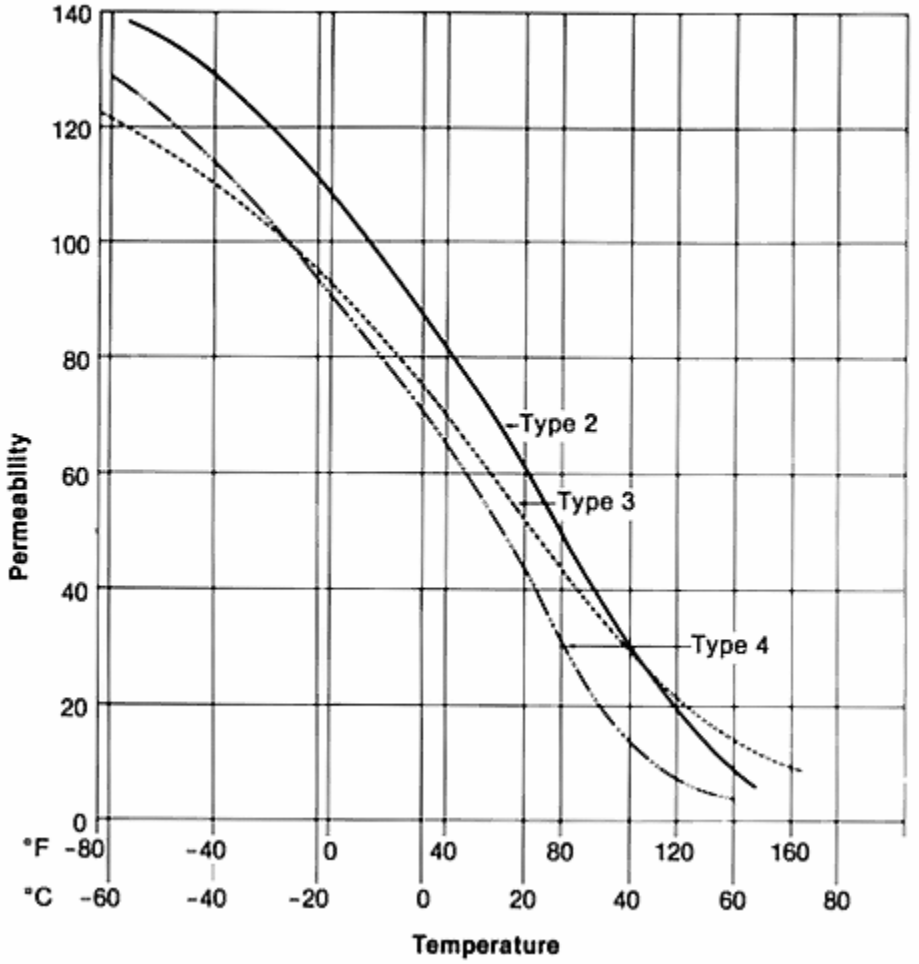
Thermal Conductivity	79.79	BTU-in/hr/ft²/°F
Modulus of Elasticity (E) (Annealed)	22.0	x 10^{3} ksi
Electrical Resistivity (70°F)	480.0	ohm-cir-mil/ft
Temperature Coeff of Electrical Resist (32 to 212°F)	7.00	x 10^{-4} Ohm/Ohm/°F
Curie Temperature	300	°F
Melting Range	2600	°F

Magnetic Properties

Typical Temperature-Permeability Curves · Carpenter Temperature Compensator "30" Alloy (Type 2)
At various magnetizing forces below 46 oersteds



Typical Temperature-Permeability Curves · Carpenter Temperature Compensator "30" Alloy (Types 2, 3 and 4)
H = 46 oersteds



Typical Mechanical Properties

Typical Mechanical Properties · Carpenter Temperature Compensator "30" Alloy
As annealed

Tensile Strength		Yield Strength 0.2% offset		% Elongation in 2" (50.8 mm)	Hardness Rockwell B	Modulus of Elasticity	
ksi	MPa	ksi	MPa			psi x10⁶	MPa x10³
70	483	40	276	35	70	22.0	152.0

Workability

Cold Working

Carpenter Temperature Compensator "30" (Types 2, 3 and 4) can be readily blanked and formed in the annealed condition. If cold forming is required, the magnetic properties will change but can be restored by heat treating. Cold working stresses produced by forming or drawing can be eliminated and temperature permeability properties can be restored by heating to 1800/1850°F (982/1010°C) two to five minutes at heat followed by a cooling rate equivalent to an air cool.

Other Information

Forms Manufactured

- Bar-Rounds
- Strip

Technical Articles

- A Simplified Method of Selecting Soft Magnetic Alloys
- Soft Magnetic Alloys with Improved Corrosion Resistance

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