CARPENTER ELECTRIFICATION®

DATASHEET

TEMPERATURE COMPENSATOR 32 (TYPE 1)

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Nickel**	32.50 %	**Manganese**	0.60 %
Silicon	0.25 %	**Carbon**	0.12 %		

Forms manufactured

Bar-Rounds	**Strip**

Description

Temperature Compensator 32 (Type 1) is a 32% nickel-iron alloy whose magnetic permeability decreases at a controlled rate with an increase in temperature. It has been used in electrical circuits to compensate for the effect of variations in ambient temperature. The alloy has been especially useful where compensation is required over a wide range of temperatures, and particularly at high temperatures, as in the shunt used in automobile voltage regulators that are located close to the engine under the hood.

Key Properties:

- Precisely controllable magnetic permeability
- Operates over a wide temperature range
- Stability at low temperature

Markets:

- Consumer
- Industrial

Applications:

- Voltage regulator shunts
- Speedometer shunts
- Tachometer shunts

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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.

Stability at low temperature

Tests have been conducted on Temperature Compensator 32 (Type 1) at as low as -112°F (-80°C). After prolonged cooling at this temperature, no change has been found in magnetic properties. This indicates no transformation at low temperatures and that the temperature permeability characteristics are reversible.

Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	8.12	—
DENSITY	—	0.2930 lb/in^3	—
MEAN SPECIFIC HEAT	—	0.1200 Btu/lb/°F	—
MEAN COEFFICIENT OF THERMAL EXPANSION	77 to 122°F (25 to 50°C)	1.30 x 10^{-6} in/in/°F	1.30 x 10^{-6} length/length/°C
	77 to 212°F (25 to 100°C)	1.98 x 10^{-6} in/in/°F	1.98 x 10^{-6} length/length/°C
	77 to 392°F (25 to 200°C)	4.28 x 10^{-6} in/in/°F	4.28 x 10^{-6} length/length/°C
	77 to 572°F (25 to 300°C)	6.00 x 10^{-6} in/in/°F	6.00 x 10^{-6} length/length/°C
	77 to 752°F (25 to 400°C)	7.00 x 10^{-6} in/in/°F	7.00 x 10^{-6} length/length/°C
	77 to 932°F (25 to 500°C)	7.61 x 10^{-6} in/in/°F	7.81 x 10^{-6} length/length/°C
THERMAL CONDUCTIVITY	—	79.79 Btu-in/hr/ft^2/°F	—
MODULUS OF ELASTICITY (E)	—	22.0 x 10^3 ksi	—
ELECTRICAL RESISTIVITY	70°F	480.0 ohm-cir-mil/ft	—
TEMPERATURE COEFFICIENT OF ELECTRICAL RESISTIVITY	32 to 212°F	7.00 x 10^{-4} Ohm/Ohm/°F	—
INFLECTION TEMPERATURE	—	210°F	—
CURIE TEMPERATURE	—	390°F	—
MELTING RANGE	—	2600°F	—

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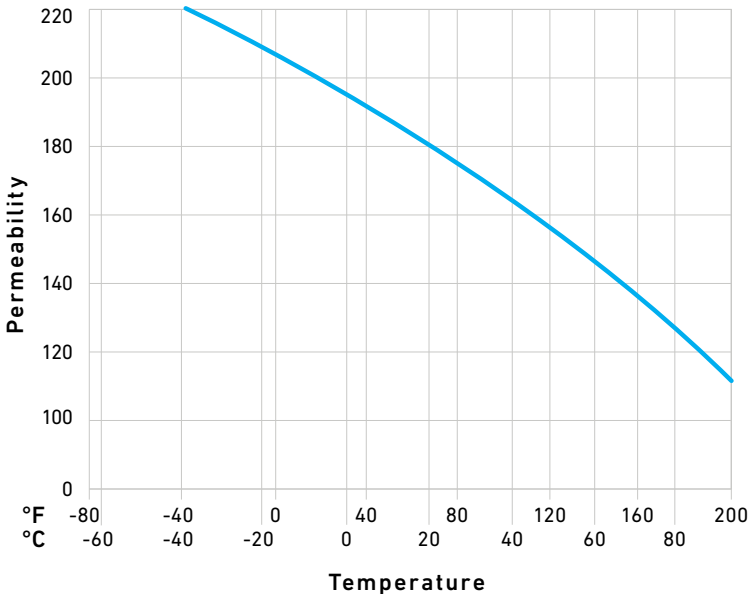
Magnetic properties

TEMPERATURE VS FLUX DENSITY AT VARIOUS HIGH MAGNETIZING FIELD STRENGTHS, LINES PER CM²

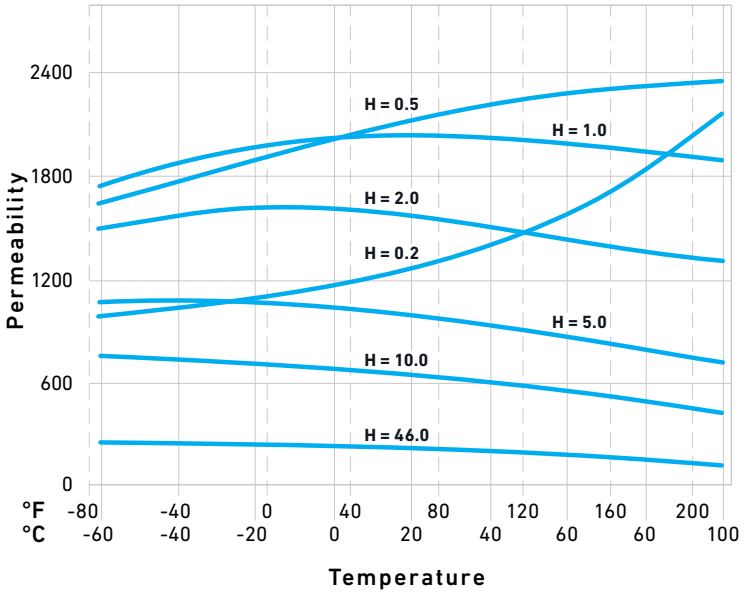
TEMPERATURE		H = 46 Oe (kG)	H = 500 Oe (kG)	H = 1000 Oe (kG)
°F	°C			
-76	-60	10.45	11.65	12.40
-40	-40	9.90	11.00	11.75
-4	-20	9.35	10.40	11.20
32	0	8.70	9.75	10.60
68	20	8.05	9.10	10.00
77	25	7.80	8.90	9.80
104	40	7.25	8.28	9.15
140	60	6.53	7.40	8.36
176	80	5.45	6.45	7.38
194	90	4.80	5.93	6.92
212	100	4.30	5.50	6.42

TYPICAL TEMPERATURE-PERMEABILITY CURVE
H = 46 Oe



> TEMPERATURE COMPENSATOR 32 (TYPE 1)

TYPICAL TEMPERATURE-PERMEABILITY CURVES AT VARIOUS MAGNETIZING FORCES BELOW 46 Oe



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INDUCTION		
°F	**Oe**	**G**
212	46	4300
194	46	4800
176	46	5450
212	500	5500
194	500	5930
212	1000	6420
176	500	6450
140	46	6530
194	1000	6920
104	46	7250
176	1000	7380
140	500	7400
77	46	7800
68	46	8050
104	500	8280
140	1000	8360
32	46	8700
77	500	8900
68	500	9100
104	1000	9150
-4	46	9350
32	500	9750
77	1000	9800
-40	46	9900
68	1000	10000
-4	500	10400
-76	46	10500
32	1000	10600
-40	500	11000
-4	1000	11200
-76	500	11700
-40	1000	11800
-76	1000	12400

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Typical mechanical properties

AS ANNEALED									
TENSILE STRENGTH		YIELD STRENGTH 0.2% OFFSET		ELONGATION IN 2 IN (50.8 MM)		HARDNESS	MODULUS OF ELASTICITY	
ksi	MPa	ksi	MPa	%		ROCKWELL B	psi X 10^4	MPa X 10^3
70	483	40	276	35		75	22.0	152.0

Workability

Cold working	Temperature Compensator 32 (Type 1) 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 treatment. Cold working stresses produced by forming or drawing can be eliminated and temperature permeability properties can be restored by heating to 1800 to 1850°F (982 to 1010°C) for two to five minutes at heat followed by a cooling rate equivalent to an air cool.

For additional information, please contact your nearest sales office:
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