

# CarTech® NiMark® Alloy 250

## Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.03 %	Manganese (Maximum)	0.10 %
Phosphorus (Maximum)	0.010 %	Sulfur (Maximum)	0.010 %
Silicon (Maximum)	0.10 %	Nickel	18.50 %
Molybdenum	4.85 %	Cobalt	7.50 %
Titanium	0.40 %	Aluminum	0.10 %
Calcium (Maximum)	0.05 %	Boron (Maximum)	0.003 %
Zirconium (Maximum)	0.03 %	Iron	Balance

## General Information

### Description

CarTech NiMark alloy 250 is a low-carbon, nickel-cobalt-molybdenum high temperature alloy capable of attaining yield strengths in excess of 240 ksi (1655 MPa) through a simple, low temperature heat treatment. This alloy exhibits good ductility at high strength levels and is readily welded.

CarTech NiMark alloy 250 is one of a family of "maraging" nickel steels which is martensitic yet ductile in the solution treated condition and attains ultrahigh tensile strength by aging at temperatures in the range of 850/950°F (454/510°C).

## Corrosion Resistance

**Important Note:** The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.

Humidity	Restricted	
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## Properties

### Physical Properties

Specific Gravity	8.02
Density	0.2900 lb/in <sup>3</sup>
Mean CTE	
75 to 200°F	5.40 x 10 <sup>-6</sup> in/in/°F
75 to 300°F	5.40 x 10 <sup>-6</sup> in/in/°F
75 to 400°F	5.69 x 10 <sup>-6</sup> in/in/°F
75 to 500°F	5.82 x 10 <sup>-6</sup> in/in/°F
75 to 600°F	5.89 x 10 <sup>-6</sup> in/in/°F
75 to 700°F	5.96 x 10 <sup>-6</sup> in/in/°F
75 to 800°F	6.04 x 10 <sup>-6</sup> in/in/°F
75 to 900°F	6.13 x 10 <sup>-6</sup> in/in/°F

# CarTech® NiMark® Alloy 250

## Mean coefficient of thermal expansion

Temperature Range		Coefficient	
75°F to	24°C to	10 <sup>-6</sup> /°F	10 <sup>-6</sup> K <sup>-1</sup>
200	93	5.40	9.72
300	149	5.40	9.72
400	204	5.69	10.24
500	260	5.82	10.48
600	316	5.89	10.60
700	371	5.96	10.73
800	427	6.04	10.87
900	482	6.13	11.03

Modulus of Elasticity (E)

27.5 x 10<sup>3</sup> ksi

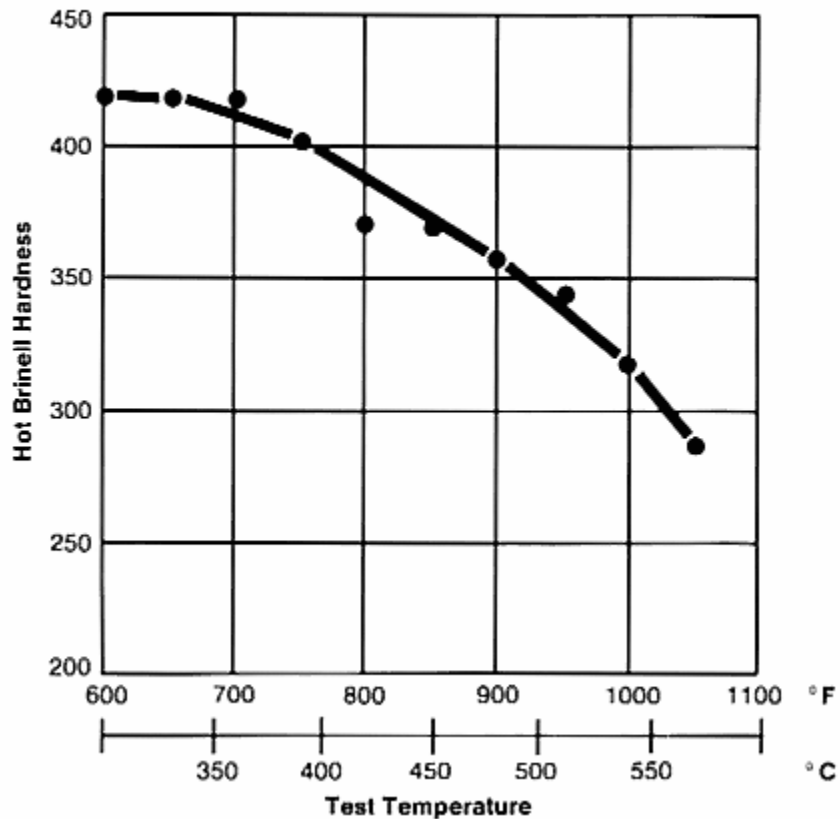
Electrical Resistivity (70°F)

300.0 ohm-cir-mil/ft

## Typical Mechanical Properties

### Hot Brinell Hardness vs. Test Temperature — NiMark Alloy 250

Solution treated at 1500°F (816°C) 30 min., air cooled, aged 2 hours at 950°F (510°C).



### Longitudinal Charpy V-Notch Properties—NiMark Alloy 250

Test Temperature		Impact Energy	
°F	°C	ft-lb	J
100	38	23	31
0	-18	21	28
-100	-73	18	24
-200	-129	15	20

**Typical Elevated Temperature Tensile Strength—NiMark Alloy 250**

Test Temperature		Tensile Strength	
°F	°C	ksi	MPa
800	427	210	1448
900	482	185	1276
1000	538	160	1103

**Typical Room Temperature Mechanical Properties — NiMark Alloy 250**

Bars under 4" (102 mm) diameter, treated 1500°F (816°C) 30 min., air cooled and aged 900°F (482°C) 2 hours, air cooled.

**Longitudinal Room Temperature Properties as Heat Treated**

Tensile Strength		Yield Strength		% Reduction of Area	% Elongation in 4D	Hardness Rockwell C
ksi	MPa	ksi	MPa			
255	1758	250	1724	62	12	49

Notched tensile strength to unnotched tensile strength is greater than ..... 1

Fatigue Life — endurance limit

ksi ..... 115

MPa ..... 793

**Note:** Transverse orientation strength is similar to longitudinal values while ductility is approximately 80% of longitudinal values

**Typical Room Temperature Mechanical Properties**

**Large-Section Sizes — NiMark Alloy 250**

Treated 1500°F (816°C) 30 min., air cooled and aged 900°F (482°C) 3 hours, air cooled.

Section Size		Direction of Test	Yield Strength 0.2%		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area	Rockwell C Hardness
in <sup>2</sup>	mm <sup>2</sup>		ksi	MPa	ksi	MPa			
12	7742	Transverse	237	1634	242	1669	10	43	49
		Longitudinal	238	1641	243	1675	12	54	49
9	5806	Transverse	242	1669	246	1696	10	44	49
		Longitudinal	243	1675	247	1703	12.5	58	49
6	3871	Transverse	246	1696	250	1724	10	46	49
		Longitudinal	247	1703	251	1731	13	59	49

**Hot Hardness—NiMark Alloy 250**

Solution treated 1500°F (816°C), 30 minutes, aged 950°F (510°C), 2 hours at heat prior to testing.

Test Temperature		Hardness BHN
°F	°C	
600	316	418
650	343	418
700	371	418
750	399	401
800	427	370
850	454	370
900	482	356
950	510	343
1000	538	318
1050	566	287
1100	593	250

## Heat Treatment

### Annealing

Annealing and solution treating are performed simultaneously by heating to 1500°F + 50°F (816°C + 28°C) for a minimum of 30 minutes at temperature, followed by air cooling to room temperature.

### Deformation (Size Change) in Hardening

Size change during heat treatment:

Solution treated 1500°F (816°C), 60 min.

in/in -0.0021

mm/mm -0.053

Following aging at 900°F (482°C), 3 hours

in/in -0.0001

mm/mm -0.002

### Age

This alloy is usually aged at 900°F (482°C) for a minimum of 3 hours and air cooled.

## Workability

### Machinability

NiMark alloy 250 is readily machined in the solution treated (annealed) condition. Limited machining can be performed in the fully treated condition. Hardness in the annealed condition is typically Rc 30.

### Weldability

NiMark alloy 250 can be welded using conventional welding methods and electrodes of approximately the same composition as the base material. Preheating is not required.

## Other Information

### Applicable Specifications

- AMS 6521
- MIL-S-46850

### Forms Manufactured

- Bar-Rounds
- Strip
- Wire
- Billet
- Weld Wire

### Technical Articles

- [A Guide to Etching Specialty Alloys for Microstructural Evaluation](#)
- [New Requirements for Ferrous-Base Aerospace Alloys](#)
- [Toughness Index for Alloy Comparisons](#)
- [Trends in High Temperature Alloys](#)

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