

# CarTech® 21-12 N Valve Steel

## Identification

UNS Number

• K63017

## Type Analysis

Single figures are nominal except where noted.

<b>Carbon</b>	0.20 %	<b>Manganese</b>	1.75 %
<b>Silicon</b>	0.80 %	<b>Chromium</b>	21.00 %
<b>Nickel</b>	11.50 %	<b>Nitrogen</b>	0.20 %
<b>Iron</b>	Balance		

## General Information

Description

CarTech 21 -12 N valve steel is an austenitic chrome-nickel alloy which offers excellent high temperature strength and hardness as well as corrosion resistance to combustion products. It contains 0.15/0.25 weight % nitrogen for increased high temperature strength.

Applications

The alloy has been used as the head material in two-piece exhaust valves for both diesel and gasoline engines.

## Corrosion Resistance

This alloy offers excellent resistance to oxidation and corrosion by lead oxide, vanadium pentoxide and similar combustion products encountered in automotive piston engines.

## Properties

### Physical Properties

Specific Gravity	7.90
Density	0.2830 lb/in <sup>3</sup>
Mean CTE	
77 to 200°F	8.20 x 10 <sup>-6</sup> in/in/°F
77 to 600°F	8.80 x 10 <sup>-6</sup> in/in/°F
77 to 1000°F	9.60 x 10 <sup>-6</sup> in/in/°F
77 to 1300°F	10.3 x 10 <sup>-6</sup> in/in/°F
77 to 1500°F	10.9 x 10 <sup>-6</sup> in/in/°F

Mean coefficient of thermal expansion

Temperature		Coefficient of Expansion	
77°F to	25°C to	10 <sup>-6</sup> /°F	10 <sup>-6</sup> /°C
200	93	8.20	14.80
600	316	8.80	15.80
1000	538	9.60	17.30
1300	704	10.30	18.50
1500	816	10.90	19.60

Modulus of Elasticity (E) (77°F)	29.0 x 10 <sup>3</sup> ksi
Electrical Resistivity (70°F)	512.0 ohm-cir-mil/ft
Melting Range	2500 to 2550 °F

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## Typical Mechanical Properties

### Elevated Temperature Mechanical Properties—Carpenter 21-12 N Valve Steel

Specimens treated 1900°F (1038°C), water quenched.

Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area	Brinell Hardness	V-Notch Charpy Impact	
°F	°C	ksi	MPa	ksi	MPa				ft-lb	J
77	25	75	517	123.5	852	42	60	241	74	100.0
1200	649	34	234	73	503	32.5	37.5	131	72	98.0
1350	732	29.5	203	52.2	360	33.0	53.0	120	70	95.1
1400	760	28.5	197	50.5	348	24.5	28.0	113	67	91.1
1500	816	27	186	40.5	279	22.0	30.0	72	73	99.0

### Stress Rupture Properties at 1350°F (732°C)—Carpenter 21-12 N Valve Steel

Specimens treated 1900°F (1038°C), water quenched.

	Time to Rupture		
	10 Hrs.	100 Hrs.	500 Hrs.
Stress to produce rupture, psi (MPa) .....	29,000 (196)	18,000 (127)	13,000 (88)
% Elongation, 1" (25.4 mm) .....	26.0	27.0	41.0
% Reduction of Area .....	35.0	28.0	40.0

## Heat Treatment

### Annealing

Heat approximately 1 hour at 1900°F (1038°C), and cool rapidly; resulting hardness 241 Brinell.

### Solution Treatment

For critical applications requiring maximum high temperature strength, forgings can be solution heat treated at 2050/2150°F (1121/1177°C) and water quenched.

### Age

When a slight increase in room temperature hardness is needed, parts can be aged at a temperature of 1375-1425°F for 4-10 hrs, followed by air cooling.

## Workability

### Forging

21-12 N can be readily forged by both upset and extrusion methods at temperatures in the range of 2050/2150°F (1121/1177°C). Do not forge at temperatures above 2200°F (1204°C) or below 1800°F (982°C). Forgings can be rapidly cooled.

### Machinability

The machining properties of this alloy are comparable to the standard 18-8 stainless steels, such as Types 302, 304, etc.

## Other Information

### Forms Manufactured

- Bar-Rounds

### Technical Articles

- [Trends in High Temperature Alloys](#)

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