Technical Datasheet

CarTech® NCF 3015 Alloy

Identification

UNS Number

• S66315

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.08 %	**Manganese (Maximum)**	0.50 %
Phosphorus (Maximum)	0.015 %	**Sulfur (Maximum)**	0.010 %
Silicon (Maximum)	0.50 %	**Chromium**	13.50 to 15.50 %
Nickel	30.00 to 33.50 %	**Molybdenum**	0.40 to 1.00 %
Titanium	2.30 to 2.90 %	**Columbium/Niobium**	0.40 to 0.90 %
Aluminum	1.60 to 2.20 %	**Iron**	Balance

General Information

Description

CarTech NCF 3015 alloy is a precipitation-hardenable, iron-nickel base alloy with mechanical properties between those of the iron-base and the more costly nickel-base alloys that have been used for engine valve applications. The alloy was designed for high strength and corrosion resistance up to 1400°F(760°C).

Applications

Because of its excellent strength and corrosion resistance at elevated temperatures, CarTech NCF 3015 alloy could be considered for engine valve applications. The alloy could also be considered as a replacement for nickel-base superalloys in applications involving the need for strength at elevated temperatures such as fasteners.

Properties

Physical Properties

Density	0.2840	lb/in³
Mean CTE		
77 to 212°F	8.30	x 10 -6 in/in/°F
77 to 392°F	8.70	x 10 -6 in/in/°F
77 to 572°F	8.90	x 10 -6 in/in/°F
77 to 752°F	9.00	x 10 -6 in/in/°F
77 to 932°F	9.20	x 10 -6 in/in/°F
77 to 1112°F	9.30	x 10 -6 in/in/°F
77 to 1202°F	9.30	x 10 -6 in/in/°F
77 to 1292°F	9.30	x 10 -6 in/in/°F
77 to 1382°F	9.70	x 10 -6 in/in/°F
77 to 1472°F	10.2	x 10 -6 in/in/°F

Mean coefficient of thermal expansion

Temperature		Coefficient of Expansion	
77°F to	25°C to	10^{-6}/°F	10^{-6}/°C
212	100	8.3	14.9
392	200	8.7	15.6
572	300	8.9	16.0
752	400	9.0	16.2
932	500	9.2	16.5
1112	600	9.3	16.7
1202	650	9.3	16.8
1292	700	9.3	16.8
1382	750	9.7	17.4
1472	800	10.2	18.3

Modulus of Elasticity (E)		
72°F	29.0	x 10^3 ksi
1200°F	22.0	x 10^3 ksi
1400°F	20.0	x 10^3 ksi

Modulus of elasticity

Temperature		psi x 10^6	MPa x 10^3
°F	°C		
72	22	29	200
1200	649	22	152
1400	760	20	138

Electrical Resistivity (72°F)	643.0	ohm-cir-mil/ft
Melting Range	2400 to 2550	°F

Magnetic Properties

Magnetic Permeability (200 Oe)	1.0170	Mu

Typical Mechanical Properties

Charpy V-Notch Impact Strength—NCF 3015 Alloy

Tests on 0.625" (16 mm) round bar:

Heat treatment: 1922°F (1050°C)/0.5 hour/OQ + 1382°F (750°C)/4 hours/AC

Test Temperature		ft-lb.	J
°F	°C		
70	21	83	113

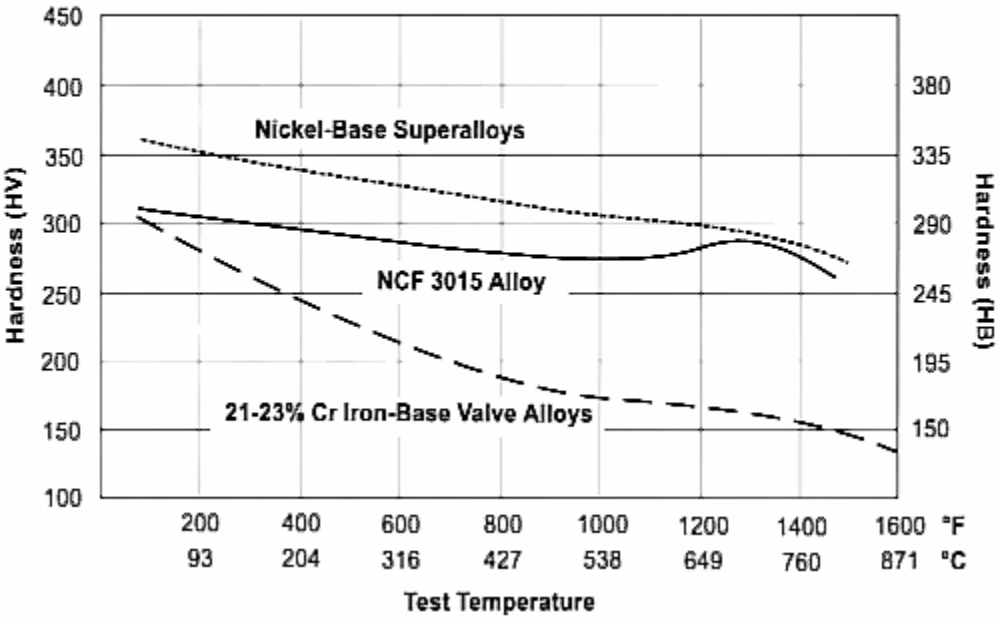
Elevated Temperature Stress Rupture Properties—NCF 3015 Alloy

Tests on 0.625" (16 mm) round bar:

Heat treatment: 1922°F (1050°C)/0.5 hour/OQ + 1382°F (750°C)/4 hours/AC

Test Temperature		Stress to Produce Rupture in:					
		10 Hours		100 Hours		400 Hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1350	732	—	—	55	380	40	276
1500	816	39	269	23	159	—	—

Hardness vs. Temperature—NCF 3015 Alloy
Tests on 0.625" (16 mm) round bar:
Heat treatment: 1922°F (1050°C)/0.5 hour/OQ + 1382°F (750°C)/4 hours/AC



Tensile Properties—NCF 3015 Alloy
Tests on 0.625" (16 mm) round bar:
Heat treatment: 1922°F (1050°C)/0.5 hour/OQ + 1382°F (750°C)/4 hours/AC

Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area
°F	°C	ksi	MPa	ksi	MPa		
70	21	95	655	163	1124	35	54
800	427	90	621	145	1000	34	55
1000	538	89	614	143	986	32	53
1200	649	98	676	138	952	17	20
1400	760	82	565	92	634	—	—

Heat Treatment

Solution Treatment

Heat to 1922°F (1050°C), hold at temperature for a minimum of 30 minutes, then oil quench.

Age

Reheat to 1382°F (750°C), hold at temperature for 4 hours, then air cool.

Workability

Hot Working

NCF 3015 alloy can be forged within the temperature range of 1700/2000°F (927/1093°C). Careful control of the hot working temperature and frictional heat buildup is necessary to avoid hot shortness above 2000°F (1093°C). NCF 3015 alloy is significantly less resistant to deformation at 1700/2000°F (927/1093°C) than nickel-base Pyromet® alloy 751.

Cold Working

Because of higher ductility and lower tensile or compressive strength, the cold workability of NCF 3015 alloy is better than that of precipitation-hardenable nickel-base alloys. Like Pyromet alloy A-286, it is stiffer than austenitic stainless steels and work hardens rapidly.

Grinding and Polishing

The grinding characteristics of NCF 3015 alloy are similar to those of Pyromet alloy 751.

Shearing

For better shearability, it is recommended that the material be cold drawn prior to shearing. Clear shearing is more difficult in the softer as-rolled or solution-treated conditions.

Other Information

Forms Manufactured

- Bar-Rounds
- Strip

Technical Articles

- A Designer's Manual On Specialty Alloys For Critical Automotive Components
- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Carpenter 286-LNi Alloy - A Lower Cost Option for High Temperature Auto and Truck Fasteners
- Selecting High Temperature Alloys for Fasteners in Automotive Exhaust Systems
- Selection of Age-Hardenable Superalloys

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