Technical Datasheet

CarTech® SCF 260™ Alloy

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.04 %	**Manganese**	16.00 to 19.00 %
Phosphorus (Maximum)	0.050 %	**Sulfur (Maximum)**	0.050 %
Silicon (Maximum)	1.00 %	**Chromium**	18.00 to 21.00 %
Nickel (Maximum)	3.50 %	**Molybdenum**	1.50 to 3.00 %
Nitrogen	0.50 to 0.80 %	**Iron**	Balance

General Information

Description

CarTech SCF 260 alloy is an austenitic, nitrogen-strengthened stainless steel. It can be considered for down-hole applications in the oil and gas industry including but not limited to drill collars, stabilizers, and MWD/LWD housings.

CarTech SCF 260 alloy possesses an excellent combination of strength including rotating fatigue, and corrosion resistance in chloride environments. In addition, a special ID treatment applied to hollow bars has been shown to enhance stress-corrosion cracking resistance.

The controlled chemistry of this alloy has provided a PREN of higher than 35, yielding superior pitting corrosion resistance. Careful control of chemistry and processing results in fewer grain-boundary carbides and increased strength.

This alloy is capable of high strength, improved chloride pitting corrosion, and enhanced fatigue properties compared to competitive Cr-Mn-N alloys.

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.*

Nitric Acid	Good	Sulfuric Acid	Moderate
Phosphoric Acid	Moderate	Acetic Acid	Good
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Good
Sea Water	Good	Sour Oil/Gas	Moderate
Humidity	Excellent		

Typical Pitting Corrosion Resistance—Carpenter SCF 260™ Alloy

Warm worked bar, longitudinal orientation, samples taken from 1" below final bar surface.

Alloy	YS	UTS	Pitting Potential (m Volts recorded at current shown)		
			50u A/cm²	100u A/cm²	200u A/cm²
Carpenter SCF 260™ alloy*	159 ksi	181 ksi	746.1	770.8	840.3
Competitor Cr-Mn-N Stainless**	153 ksi	164 ksi	261.9	269.8	285.7

Test Solution: Nitrogen purged 8% Cl (as NaCl) at room temperature.
Stirred solution at 20-23°C (68-73°F), initial pH of 6.8-7.0, scan rate at 0.1 m volts/sec.
Higher potential is indicative of higher pitting resistance.
*Test specimen from 5.0" round solid bar
**Test specimen from 7.0" round solid bar

Properties

Physical Properties

Specific Gravity	7.76	
Density	0.2800	lb/in³
Mean Specific Heat (79 to 240°F)	0.1180	Btu/lb/°F
Mean CTE		
77 to 212°F	8.85	x 10 $^{-6}$ in/in/°F
77 to 350°F	9.11	x 10 $^{-6}$ in/in/°F
77 to 392°F	9.34	x 10 $^{-6}$ in/in/°F
77 to 482°F	9.57	x 10 $^{-6}$ in/in/°F
77 to 572°F	9.75	x 10 $^{-6}$ in/in/°F
77 to 662°F	9.96	x 10 $^{-6}$ in/in/°F
77 to 752°F	10.2	x 10 $^{-6}$ in/in/°F
77 to 842°F	10.4	x 10 $^{-6}$ in/in/°F
77 to 932°F	10.5	x 10 $^{-6}$ in/in/°F
77 to 1022°F	10.7	x 10 $^{-6}$ in/in/°F

Mean Coefficient of Thermal Expansion

Temperature Range		10^{-6}/°F	10^{-6}/K
77°F to	25°C to		
212	100	8.85	15.95
350	150	9.11	16.41
392	200	9.34	16.84
482	250	9.57	17.26
572	300	9.75	17.59
662	350	9.96	17.98
752	400	10.16	18.33
842	450	10.35	18.68
932	500	10.52	18.98
1022	550	10.67	19.25

Thermal Conductivity		
73°F	95.57	BTU-in/hr/ft²/°F
122°F	98.84	BTU-in/hr/ft²/°F
212°F	104.6	BTU-in/hr/ft²/°F
392°F	114.9	BTU-in/hr/ft²/°F
572°F	124.5	BTU-in/hr/ft²/°F
752°F	133.0	BTU-in/hr/ft²/°F

Thermal Conductivity

Test Temperature		Btu-in/ ft²•h•°F	W/m•K
°F	°C		
73	23	95.57	13.8
122	50	98.84	14.3
212	100	104.62	15.1
392	200	114.90	16.6
572	300	124.51	18.0
752	400	133.01	19.2

Modulus of Elasticity (E)	27.7	x 10 ^{3} ksi
Electrical Resistivity (70°F)	441.0	ohm-cir-mil/ft

Magnetic Properties

Carpenter SCF 260 alloy is essentially nonmagnetic in both the annealed and warm-worked conditions. Magnetic field deviation does not vary more than ±0.05 micro-Tesla from a uniform field.

Magnetic permeability of warm-worked material is less than 1.01 based on the Fluxmetric Method.

ASTM A342 (field strength-200 oersteds): 1.002

Typical Mechanical Properties

Rotating Beam Fatigue Test Results have exceeded 400,000 cycles when tested at 80ksi stress level. Material condition was warm-worked bars, longitudinal orientation, 1" below the final bar surface.

**Minimum Room Temperature Mechanical Properties—
Carpenter SCF 260™ Alloy**
Warm worked bar, longitudinal orientation, sampling from 1" below final bar surface

Solid/Hollow Bar OD		0.2% Yield Strength		Ultimate Tensile Strength		% Elong. In 4D	% Reduc. of Area	Charpy V-Notch Impact Strength	
Inches	mm	ksi	MPa	ksi	MPa			ft-lb	J
3.5 – 8.25	88.9 – 210	140	965	150	1034	18	50	61	81

Typical Room Temperature Mechanical Properties—Carpenter SCF 260™ Alloy
Warm worked bar, longitudinal orientation, samples taken from 1" below final bar surface.

Bar Size		0.2% Yield Strength		Ultimate Tensile Strength		% Elong. In 4D	% Reduc. of Area	Charpy V-Notch Impact Strength	
Inches	mm	ksi	MPa	ksi	MPa			ft-lb	J
5.0	120.7	160	1103	182	1255	23	68	176	239
8.0	203.2	150	1034	164	1131	27	72	172	233

Heat Treatment

Annealing

Carpenter SCF 260 alloy is generally used in the as-forged, warm-worked condition. However, if annealing is desired, heat to 1900/2100°F (1040/1150°C), hold for one hour per inch of thickness, and water quench. The strength will be lower in the annealed condition.

Workability

Machinability

Following are starting point feeds and speeds for Carpenter SCF 260 alloy.

Typical Machining Speeds and Feeds – Carpenter SCF 260™ Alloy

The speeds and feeds in the following charts are conservative recommendations for initial setup. Higher speeds and feeds may be attainable depending on machining environment.

Turning—Single-Point and Box Tools

Depth of Cut (Inches)	Micro-Melt® Powder High Speed Tools			Carbide Tools (inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm)		Feed (ipr)
					Uncoated	Coated	
.150	M2	55	.015	C6	250	300	.015
.025	T15	70	.007	C7	300	350	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
			Cut-Off Tool Width (Inches)				Form Tool Width (Inches)		
Micro-Melt® Powder HS Tools	Car-bide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
T15		40	.001	.001	.0015	.0015	.001	.0007	.0007
	C6	140	.004	.0055	.0045	.004	.003	.002	.002

Rough Reaming

Micro-Melt® Powder HS Tools		Carbide Tools (inserts)		Feed (ipr) Reamer Diameter (inches)					
Tool Material	Speed (fpm)	Tool Material	Speed (fpm)	1/8	1/4	1/2	1	1 ½	2
M7	60	C2	80	.003	.005	.008	.012	.015	.018

Drilling

High Speed Tools									
Tool Material	Speed (fpm)	Feed (inches per revolution) Nominal Hole Diameter (inches)							
		1/16	1/8	1/4	1/2	3/4	1	1 ½	2
T15,M42	45-50	.001	.002	.004	.007	.010	.012	.015	.018

Die Threading

FPM for High Speed Tools				
Tool Material	7 or less, tpi	8 to 15, tpi	16 to 24, tpi	25 and up, tpi
M42	4 - 8	6-10	8-12	10-15

Milling, End-Peripheral

Depth of Cut (Inches)	Micro-Melt® Powder High Speed Tools						Carbide Tools					
	Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in)				Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in)			
			1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2
.050	M2, M7	65	.001	.002	.003	.004	C2	245	.001	.002	.003	.005

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M1, M7, M10	12 – 25

Broaching

Micro-Melt® Powder High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M7	10	.003

Additional Machinability Notes

Figures used for all metal removal operations covered are starting points. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Weldability

Carpenter SCF 260 alloy can be readily joined by the standard electric-arc welding methods. Welding consumables of matching composition are not currently available; however, other stainless steel consumables can be considered depending on the application.

Other Information

Forms Manufactured

- Bar-Rounds
- Hollow Bar
- Multi-Dimensional Bar

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