Technical Datasheet CARPENTER TECHNOLOGY

CarTech® 347 Stainless

Identification

UNS Number

• S34700

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.08 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.045 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	17.00 to 19.00 %
Nickel	9.00 to 13.00 %	**Columbium + Tantalum**	10 X C Minimum
Iron	Balance		

General Information

Description

CarTech 347 stainless is a columbium/tantalum stabilized austenitic stainless steel. Like CarTech 321 stainless, it has superior intergranular-corrosion resistance compared to typical 18-8 type alloys. Since columbium and tantalum have stronger affinity for carbon than chromium, carbides of those elements tend to precipitate randomly within the grains instead of forming continuous patterns at the grain boundaries. CarTech 347 stainless should be considered for applications requiring intermittent heating between 800ºF (427ºC) and 1650ºF (899ºC).

CarTech 347 stainless should be considered for use in aircraft collector rings and exhaust manifolds, expansion joints and high temperature chemical process equipment.

Scaling

The safe scaling temperature for continuous service is 1600ºF (871ºC).

Corrosion Resistance

Annealed Carpenter Stainless Type 347 is resistant to atmospheric corrosion, foodstuffs, sterilizing solutions, many organic chemicals and dyestuffs, and a wide variety of inorganic chemicals. It has excellent intergranular-corrosion resistance.

For optimum corrosion resistance, surfaces must be free of scale, lubricants, foreign particles, and coatings applied for drawing and heading. After fabrication of parts, cleaning and/or passivation should be considered.

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	Moderate
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Good
Sea Water	Restricted	Sour Oil/Gas	Moderate
Humidity	Excellent		

Properties

Physical Properties

Specific Gravity	7.89	
Density	0.2850	lb/in³
Mean Specific Heat (32 to 212°F)	0.1200	Btu/lb/°F

Mean CTE (32 to 1200°F)	10.4	x 10^{-6} in/in/°F
Modulus of Elasticity (E)	28.0	x 10^{3} ksi
Electrical Resistivity (73°F)	433.0	ohm-cir-mil/ft

Typical Mechanical Properties

Typical Elevated Temperature Mechanical Properties
Annealed condition

Test Temperature		Short-Time Tensile Tests						Creep Tests	
		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Stress for 1% Creep in 10,000 Hours	
°F	°C	ksi	MPa	ksi	MPa			ksi	MPa
70	21	37	255	90	620	50	65	—	—
200	93	36	248	84	579	45	70	—	—
300	149	35	241	78	538	42	72	—	—
400	204	30	207	76	524	38	74	—	—
500	260	28	193	74	510	36	71	—	—
600	316	25	172	72	496	35	72	—	—
700	371	23	159	68	469	35	72	—	—
800	427	22	152	66	455	35	70	—	—
900	482	21	145	63	434	34	69	—	—
1000	538	21	145	59	407	34	65	17	117
1100	593	20	138	55	379	35	67	13	90
1200	649	20	138	48	331	36	67	7	48
1300	704	20	138	40	276	36	70	5	34
1400	760	19	131	31	214	37	70	2	14
1500	816	17	117	25	172	40	70	2	14
1600	871	15	103	20	138	40	70	1	7
1700	927	12	83	15	103	45	72	—	—
1800	982	—	—	12	83	50	75	—	—
1900	1038	—	—	10	69	60	77	—	—

Typical Room Temperature Mechanical Properties
1" (25.4 mm) round bar, annealed 1900°F (1038°C)

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Brinell Hardness	Izod Impact Strength	
ksi	MPa	ksi	MPa				ft-lb	J
37	255	90	621	50	65	150	110	149

Typical Stress Rupture Strength
Annealed condition

Test Temperature		Stress for Rupture in			
		1,000 Hours		10,000 Hours	
°F	°C	ksi	MPa	ksi	MPa
1100	593	30	207	22	152
1200	649	18	124	11	76
1300	704	11	76	5	34
1400	760	7	48	—	—
1500	816	5	34	—	—

Heat Treatment

Annealing

Heat to 1850/2000ºF (1010/1093ºC) and quench in water. Brinell hardness approximately 150.

Hardening

Can only be hardened by cold working.

Stabilizing

When temperatures up to about 1600ºF (871ºC) are expected in service, a stabilizing treatment at 1550/1650ºF (843/899ºC) may be used to provide optimum intergranular corrosion resistance.

Workability

Hot Working

Carpenter Stainless Type 347 is readily forged, hot headed, riveted and upset. Because of its high red-hardness, more power for a given reduction is required than with mild steel.

Forging

Heat uniformly to 2100/2250ºF (1149/1232ºC). Do not forge below 1700ºF (927ºC). Forgings can be air-cooled. For full corrosion resistance, forgings must be water quenched or annealed.

Cold Working

Carpenter Stainless Type 347 is readily fabricated by cold working. Being extremely tough and ductile, it responds to deep drawing, bending, forming and upsetting. After cold working, it is slightly magnetic. The tensile strength and hardness of Carpenter Stainless Type 347 can be significantly increased by cold working.

Machinability

Like all austenitic steels, Carpenter Stainless Type 347 machines with tough and stringy chips. Rigidly supported tools, with as heavy a cut as possible, should be used to prevent glazing. Moderate cold working can improve machined surface finish.

Following are typical feeds and speeds for Carpenter Stainless Type 347.

Typical Machining Speeds and Feeds – Carpenter Stainless Type 347 and 348

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)	High Speed Tools			Carbide Tools (Inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm)		Feed (ipr)
					Uncoated	Coated	
.150	T15	85	.015	C2	350	450	.015
.025	M42	100	.007	C3	400	520	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
High Speed Tools	Carbide Tools		Cut-Off Tool Width (inches)				Form Tool Width (inches)		
			1/16	1/8	1/4	1/2	1	1 ½	2
M2		80	.001	.0015	.002	.0015	.001	.001	.001
	C2	300	.004	.0055	.007	.005	.004	.0035	.0035

Rough Reaming

High Speed		Carbide Tools		Feed (ipr) Reamer Diameter (inches)					
Tool Material	Speed (fpm)	Tool Material	Speed (fpm)	1/8	1/4	1/2	1	1 ½	2
M7	70	C2	90	.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	50-60	.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
M1, M2, M7, M10	8-15	10-20	15-25	25-30

Milling, End-Peripheral

Depth of Cut (inches)	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	75	.001	.002	.003	.004	C2	270	.001	.002	.003	.005

Tapping

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

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M7	15	.003

When using carbide tools, surface speed feet/minute (SFPM) can be increased between 2 and 3 times over the high-speed suggestions. Feeds can be increased between 50 and 100%.

Figures used for all metal removal operations covered are average. 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.

Additional Machinability Notes

When using carbide tools, surface speed feet/minute (sfpm) can be increased between 2 and 3 times over the high speed suggestions. Feeds can be increased between 50 and 100%.

Figures used for all metal removal operations covered are average. 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 Stainless Type 347 can be satisfactorily welded by the shielded fusion and resistance welding processes. Oxyacetylene welding is not recommended, since carbon pickup in the weld may occur. Since austenitic welds do not harden on air cooling, the welds should have good toughness. When a filler metal is required, AWS E/ER347 welding consumables should be considered. To decrease the susceptibility to hot cracking, keep heat inputs, base metal dilution, and joint restraint to a minimum. The alloy can be used in the as-welded condition; however, for elevated temperature service, a postweld stabilizing treatment should be considered.

Other Information

Applicable Specifications

- ASME SA479
- ASTM A479
- QQ-S-763

Forms Manufactured

- Bar-Rounds
- Billet
- Strip
- Wire
- Wire-Rod

Technical Articles

- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Alloy Selection for Cold Forming (Part I)
- Alloy Selection for Cold Forming (Part II)
- How to Select the Right Stainless Steel or High Temperature Alloy for Heading

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