Technical Datasheet

CarTech® 304/304L Stainless

Identification

UNS Number

• S30400/S30403

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.03 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.045 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	18.00 to 20.00 %
Nickel	8.00 to 12.00 %	**Iron**	Balance

General Information

Description

CarTech 304/304L is a low-carbon version of CarTech 304.

In this low-carbon austenitic alloy, control of carbon to a maximum of 0.03% has been shown to minimize carbide precipitation during welding. Customers have reported the use of this steel in corrosive service in the as-welded condition.

CarTech 304/304L is suggested for applications requiring a moderate level of improvement in machinability for shorter runs of less complex parts, particularly at larger bar diameters.

Manufacturers interested in realizing the potential economic benefits and lower costs associated with higher machining speeds and lower cycle times should consider CarTech 304/304L Project 70®+ stainless.

Customers have reported that CarTech 304/304L Project 70+ stainless offers significantly improved machinability characteristics over generic 304/304L. This includes up to 50% and higher machining speeds with improved finishes and longer tool life.

Applications

CarTech 304/304L stainless should be considered for use in a wide range of food processing, dairy and dyeing industry applications, such as pipelines, buckets, sterilizers and other types of preparation and processing equipment.

Scaling

The safe scaling temperature for continuous service is 1600°F (871°C).

Corrosion Resistance

Annealed Carpenter Stainless Type 304/304L has proven to be resistant to atmospheric corrosion, foodstuffs, sterilizing solutions, many organic chemicals and dyestuffs, and a wide variety of inorganic chemicals.

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	7.90	
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
Electrical Resistivity (73°F)	433.0	ohm-cir-mil/ft

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties—Stainless Type 304/304L
Annealed condition

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area	Brinell Hardness	Izod Impact Strength	
ksi	MPa	ksi	MPa				ft-lb	J
28	193	75	517	60	70	150	110	149

Heat Treatment

Annealing

Heat to 1850/2050°F (1010/1121°C) and quench in water. Brinell hardness approximately 150.

Hardening

Cannot be hardened by heat treatment. Can be hardened only by cold working.

Workability

Hot Working

Carpenter Stainless Type 304/304L can be readily forged, hot headed, riveted and upset. Because of its high hot hardness, more power for a given reduction is required than with mild steel.

Forging

To forge, heat uniformly to 2100/2300°F (1149/1260°C). Do not forge below 1700°F (927°C). Forgings can be air cooled without danger of cracking.

For full corrosion resistance, forgings must be annealed.

Cold Working

Carpenter Stainless Type 304/304L 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 304/304L can be materially increased by cold working.

Machinability

Carpenter Stainless Type 304/304L machines with chip characteristics that are tough and stringy. The use of chip curlers or chip breakers is advised. Since the austenitic stainless steels work harden rapidly, heavy positive feeds should be used.

Following are typical feeds and speeds for Carpenter Stainless Type 304/304L.

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) Uncoated	Speed (fpm) Coated	Feed (ipr)
.150	T15	85	.0010	C2	350	450	.0010
.025	M42	100	.0050	C3	400	525	.0005

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 1/2	2
M2		75	.0010	.0015	.0017	.0015	.0010	.0005	.0005
	C6	275	.0040	.0055	.0070	.0050	.0018	.0015	.0011

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 1/2	2
M42	70			.0025	.0040	.0050	.0100	.0120	.0150
		C2	85	.0025	.0040	.0050	.0100	.0120	.0150

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 1/2	2
M2, M42	50-60	.0005	.0015	.0020	.0040	.0070	.0100	.0120	.0150

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
M2, M42	6-12	10-17	15-22	20-28

Milling, End–Peripheral

Depth of Cut (inches)	High Speed Tools						Carbide Tools					
	Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (inches)				Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (inches)			
			1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2
.050	M2, M42	75	.0005	.0015	.0020	.0030	C2	250	.0005	.0015	.0020	.0040

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M2, M42	10-20

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M42	15	.0020

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 304/304L can be satisfactorily welded by the shielded fusion and resistance welding processes. Since austenitic welds do not harden on air cooling, the welds should have good toughness.

Oxyacetylene welding is not recommended since carbon pickup in the weld may occur.

The alloy can be welded without danger of loss of corrosion resistance due to intergranular carbide precipitation. Usually the alloy can be used in the as-welded condition; however, for service in the most severe environments, the welded structure should be reannealed.

Where a filler metal is required, AWS E/ER 308 or E/ER 347 welding consumables should be considered.

Other Information

Applicable Specifications

- AMS 5639
- AMS 5647
- AMS 5697
- ASTM A182
- ASTM A193
- ASTM A276
- ASTM A314
- ASTM A320
- ASTM A479
- MIL-S-862
- QQ-S-763
- QQS-W-423

Forms Manufactured

- Bar-Hexagons
- Bar-Rounds

Technical Articles

- A Designer's Manual On Specialty Alloys For Critical Automotive Components
- Alloy Selection for Cold Forming (Part I)
- Alloy Selection for Cold Forming (Part II)
- New Ideas for Machining Austenitic Stainless Steels
- New Stainless for Fasteners Combines Corrosion Resistance, High Hardness and Cold Formability
- Selecting Optimal Stainless Steels for Bio-Pharmaceutical Service
- Selecting Stainless Steels for Valves
- Selection of High Strength Stainless Steels for Aerospace, Military and Other Critical Applications
- Specialty Alloys And Titanium Shapes To Consider For Latest Medical Materials Requirements
- Stainless Steel Rebar For Concrete Reinforcement: An Update And Selection Guide
- Steels for Strength and Machinability

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