

CarTech® 303 Stainless

Identification

UNS Number

• S30300

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.12 %	Manganese (Maximum)	2.00 %
Phosphorus (Maximum)	0.200 %	Sulfur (Minimum)	0.150 %
Silicon (Maximum)	1.00 %	Chromium	17.00 to 19.00 %
Nickel	8.00 to 10.00 %	Iron	Balance

General Information

Description

CarTech 303 stainless is a free-machining stainless steel. The addition of sulfur to this 18-8 chrome-nickel stainless steel, which is ordinarily tough and difficult to machine, enhances the alloy's machinability to the degree that it can be readily utilized for producing parts on automatic screw machines at about 70% of the speed of C1212. This sulfur modification has led to widespread acceptance and use of this grade in the screw machine industry.

Manufacturers interested in further improvement in machinability to realize potential economic benefits and lower costs associated with higher machining speeds and lower cycle times should consider CarTech 303 Project 70®+ stainless.

Customers have reported that CarTech 303 Project 70®+ stainless offers significantly improved machinability characteristics over the generic 303 stainless. This includes up to 50% and higher machining speeds with improved finishes and longer tool life.

Applications

CarTech 303 stainless should be considered for use in applications such as shafts, valve bodies, valves, valve trim, and fittings. This steel possesses nongalling properties that make disassembly of parts easy-and help to avoid scratching or galling in moving parts. It is not recommended for vessels containing gases or liquids under high pressures.

Scaling

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

Corrosion Resistance

Annealed Carpenter Stainless Type 303 is resistant to atmospheric corrosion, foodstuffs, sterilizing solutions, many organic chemicals and dyestuffs, and a wide variety of inorganic chemicals.

Intergranular corrosion may be a problem if the material is heated between 800°F (427°C) and 1650°F (899°C) or cooled slowly through that range.

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)	Moderate
Sea Water	Restricted	Humidity	Excellent

Properties

Physical Properties

Specific Gravity	7.83
Density	0.2830 lb/in ³
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 Elevated Temperature Mechanical Properties—Stainless Type 303 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	35	241	90	621	50	55	—	—
800	427	21	145	61	421	35	51	—	—
1000	538	19	131	55	379	34	55	17	117
1200	649	17	117	45	310	30	54	7	48
1400	760	14	97	30	207	31	45	2	14
1600	871	10	69	20	138	34	43	—	—

Typical Room Temperature Mechanical Properties—Stainless Type 303 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	Impact Strength			
ksi	MPa	ksi	MPa				Izod	Charpy V-Notch		
ksi	MPa	ksi	MPa	ft-lb	J	ft-lb	J			
35	241	90	621	50	55	160	80	108	70	95

Heat Treatment

Annealing

Heat to 1850/1950°F (1010/1066°C) and quench in water. Brinell hardness approximately 160.

Hardening

Cannot be hardened by heat treatment. Upon being cold worked, this alloy increases in strength and hardness.

Workability

Hot Working

Carpenter Stainless Type 303 can be forged and hot upset successfully. After hot working, material should be annealed.

Forging

Heat uniformly to 2100/2300°F (1149/1260°C). Do not forge below 1700°F (927°C). Forgings can be air cooled, but better corrosion resistance can be obtained by quenching small forgings in water from the hammer. Large pieces should be annealed.

Cold Working

Carpenter Stainless Type 303 will withstand only a moderate amount of cold working.

Machinability

Carpenter Stainless Type 303 machines easily with a brittle chip. Grinding and polishing operations have been satisfactorily performed.

Following are typical feeds and speeds for Carpenter Stainless Type 303.

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	M2	100	.0100	C2	450	550	.0150
.025	M3	120	.0050	C2	500	650	.0070

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	C2	90	.0010	.0015	.0020	.0020	.0010	.0010	.0005
		300	.0035	.0045	.0070	.0050	.0045	.0035	.0025

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	85	C2	100	.0045	.0060	.0090	.0110	.0150	.0180
				.0045	.0060	.0090	.0110	.0150	.0180

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, M40	70-90	.0005	.0025	.0050	.0080	.0100	.0150	.0170	.0200

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	9-14	14-22	22-30	30-35

Milling, End-Peripheral

Depth of Cut (inches)	High Speed Tools						Carbide Tools					
	Tool Material	Speed (fpm)	Feed (ipr) Cutter Diameter (inches)				Tool Material	Speed (fpm)	Feed (ipr) Cutter Diameter (inches)			
			1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2
.050	M2, M42	.25	.0050	.0015	.0070	.0040	C6	330	.0010	.0015	.0040	.0050

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M2, M42	15-40

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipr)
M2, M42	15	.0025

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%.

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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 303 is not recommended for welding. The high sulfur content may cause hot cracking, and when welding to a stainless steel with a lower sulfur content, may cause the weld to shift off center. If these alloys must be welded, consider AWS E/ER312 welding consumables with stringer beads using a minimum heat input and minimum base metal dilution.

Other Information

Applicable Specifications

- AMS 5640
- ASTM A581
- MIL-S-52263
- QQ-S-764
- ASTM A314
- ASTM A582
- MIL-S-862

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- Bar-Hexagons
- Bar-Squares

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 \(Part II\)](#)
- [How to Passivate Stainless Steel Parts](#)
- [New Drop-In Version of 15Cr-5Ni Alloy Offers Superior Machinability, Meets AMS Specs](#)
- [Passivating and Electropolishing Stainless Steel Parts](#)

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