Technical Datasheet

CarTech® 304/304L Project 70®+ Stainless

Identification

U.S. Patent Number

- 5,512,238

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 10.50 %	**Iron**	Balance

General Information

Description

CarTech 304/304L Project 70+ Stainless is an improved-machining version of conventional type 304/304L stainless.

Customers may be able to attain machining speed improvements of up to 50% and higher over AISI type 304/304L. CarTech 304/304L Project 70+ Stainless has reduced tool wear and increased machine speeds and feeds to help improve productivity and reduce part costs. It is a good general purpose product for simple as well as complex parts at a wide range of machining speeds.

CarTech 304/304L Project 70+ Stainless meets most industry specifications for Type 304/304L. It 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 Project 70+ PDB® Stainless combines the superior machinability of CarTech Project 70+ stainless with improved straightness and half-standard dimensional tolerances. This precision drawn bar has been used successfully in a variety of machining operations including CNC Swiss-type screw machines.

A special consumable remelted, non-free-machining version of CarTech 304 stainless called CarTech 304-SCQTM stainless, is available. This special grade is advantageous for use in thin sections under high pressure or vacuum, or to achieve optimum surface quality after electropolishing. Contact Carpenter for details.

Applications

CarTech 304/304L Project 70+ Stainless may 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 Project 70+ Type 304/304L stainless 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
Thermal Conductivity (212°F)	113.0	BTU-in/hr/ft²/°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– Project 70+ Type 304/304L stainless

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	85	586	60	70	--	--
800	427	21	145	61	421	37	66	--	--
1000	538	19	131	55	379	36	69	17	117
1200	649	17	117	45	310	32	66	7	48
1400	760	14	97	30	207	33	55	2	14
1600	871	10	69	20	138	40	52	--	--

Typical Room Temperature Mechanical Properties– Project 70+ Type 304/304L stainless

1" (25.4 mm) round bar, annealed 1950°F (1066°C), water quenched.

Condition	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Rockwell B Hardness at Midradius	Charpy V-Notch Impact Strength	
	ksi	MPa	ksi	MPa				ft-lb	J
Annealed	36	248	86	593	70	70	84	238*	323*
Annealed + Cold Drawn	74	510	103	710	50	76	97	134	182

*Specimen did not fracture completely. Tensile specimens from center of bar; impact specimens from mid-radius location.

Heat Treatment

Annealing

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

Hardening

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

Workability

Hot Working

Project 70+ Type 304/304L stainless 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.

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.

For optimum forgeability, Type 304/304L Forging Quality can be considered.

Cold Working

Project 70+ Type 304/304L stainless 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 Project 70+ Type 304/304L stainless can be materially increased by cold working.

Machinability

Project 70+ Type 304/304L stainless is chemically balanced and processed to provide optimum machinability in a Type 304/304L analysis without using full resulfurization as is done in the Type 303 analyses.

The alloy machines with chip characteristics between those of conventional Type 304/304L and Type 303. Although the chips may not be as stringy as those of conventional Type 304/304L, the use of chip curlers or breakers is still advised. Since the austenitic stainless steels work harden rapidly, heavy positive feeds should be used.

Following are starting point feeds and speeds for Project 70+ Type 304/304L stainless.

Typical Machining Speeds and Feeds—Project 70+ Type 304/304L stainless

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 HS Tools			Carbide Tools (Inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm) Uncoated	Speed (fpm) Coated	Feed (ipr)
.150	M48, T15	140	.0180	C2	470	600	.0180
.025	M48, T15	171	.0084	C3	530	660	.0084

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
Micro-Melt® Powder HS	Carbide Tools		Cut-Off Tool Width (inches)				Form Tool Width (inches)		
			1/16	1/8	1/4	1/2	1	1½	2
M48, T15		124	.0018	.0024	.0024	.0024	.0018	.0012	.0012
	C2	468	.0048	.0066	.0084	.0060	.0048	.0042	.0042

Rough Reaming

Micro-Melt® Powder Tools		Carbide Tools		Feed (ipr) Reamer Diameter (inches)					
Tool Material	Speed (fpm)	Tool Material	Speed (fpm)	1/8	1/4	1/2	1	1½	2
M48, T15	124	C2	130	.0036	.0060	.0096	.0144	.0180	.0216

Drilling

Tools									
Tool Material	Speed (ipm)	Feed (inches per revolution) Nominal Hole Diameter (inches)							
		1/16	1/8	1/4	1/2	3/4	1	1½	2
M42	78-98	.0012	.0024	.0048	.0084	.0120	.0204	.0252	.0300
C2-Uncoated	120	--	.002	.004	.006	.0085	.0096	.0113	.0113
C2-Coated	130	--	.002	.004	.006	.0085	.0096	.0113	.0113

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
T15, M42	11-13	16-29	26-39	39-46

Milling, End—Peripheral

Depth of Cut (inches)	Micro-Melt® Powder HS 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	M48, T15	140	.0012	.0024	.0036	.0048	C2	358	.0012	.0024	.0036	.0060

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
T15, M42	19-50

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
T15, M42	20	.0036

Additional Machinability Notes

Figures used for all metal removal operations are average 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.

This alloy is available in an enhanced precision drawn bar product. Learn more about the Project 70+ PDB stainless family at Carpenter's MachiningZone.com.

Weldability

Project 70+ Type 304/304L stainless 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 alloys can be welded without danger of loss of corrosion resistance due to intergranular carbide precipitation. Usually the alloys can be used in the as-welded condition; however, for service in the most severe environments, the welded structure should be reannealed after welding.

Where a filler metal is required, AWS E/ER308L or E/ER347 welding consumables should be considered.

Other Information

Applicable Specifications

Project 70+ Type 304/304L, Type 304-SCQ and Project 70+ PDB Type 304/304L stainless meet most standard industry and government specifications for Type 304/304L.

- AMS 5639
- AMS 5647
- AMS-QQ-S-763
- ASTM A193
- ASTM A276
- ASTM A479
- ASTM F899
- QQ-S-763

Forms Manufactured

- Bar-Flats
- Bar-Hexagons
- Bar-Rounds
- Bar-Squares
- Wire
- Wire-Rod
- Wire-Shapes

Technical Articles

- A Designer's Manual On Specialty Alloys For Critical Automotive Components
- How to Passivate Stainless Steel Parts
- Improved Stainless Steels for Medical Instrument Tubing
- Invar Alloy-There's Profit to be Made in Machining This Popular, High Tech Material
- New Drop-In Version of 15Cr-5Ni Alloy Offers Superior Machinability, Meets AMS Specs
- New Stainless Hand Tools Have High Strength, Toughness for Service in Corrosive or Clean Room Environments
- Passivating and Electropolishing Stainless Steel Parts
- Selecting Alloys for Severely Corrosive Environments
- Selecting New Stainless Steels for Unique Applications
- Selecting Optimal Stainless Steels for Bio-Pharmaceutical Service
- Selecting Stainless Steels for Valves
- Specialty Stainless Solves Galling, Contamination Problems of Threaded Parts for Semiconductor Industry
- Steels for Strength and Machinability
- Two Galling Resistant Stainless Steels Used for Bridge Hinge Pins

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