Technical Datasheet CARPENTER TECHNOLOGY

CarTech® 305 Stainless

Identification

UNS Number

- S30500

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.12 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.045 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	17.00 to 19.00 %
Nickel	10.50 to 13.00 %	**Iron**	Balance

General Information

Description

CarTech 305 stainless has been used for severe cold forming operations. The higher nickel content lowers the tendency to work-harden, so that a greater amount of deformation is possible before process annealing is necessary. Having the highest nickel content of the austenitic stainless steels considered to be in the 18-chromium 8-nickel family, CarTech 305 stainless has the lowest rate of strain hardening of these steels.

CarTech 305 stainless has also been used where the finished part must remain nonmagnetic after severe cold working.

CarTech 305 stainless has been used extensively for parts produced by deep drawing. This steel has worked well in automatic eyelet machines when the part was produced without process annealing. CarTech 305 stainless should be considered for cold headed bolts, screws, etc. Because of its nonmagnetic properties, CarTech 305 stainless should also be considered for use in electrical instrumentation.

Scaling

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

Corrosion Resistance

Annealed Carpenter Stainless Type 305 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 800ºF (427ºC) and 1650ºF (899ºC) 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)	Good
Sea Water	Restricted	Sour Oil/Gas	Moderate
Humidity	Excellent		

Properties

Physical Properties

Specific Gravity	7.92	
Density	0.2860	lb/in^3
Mean Specific Heat (32 to 212°F)	0.1200	Btu/lb/°F
Mean CTE (32 to 1200°F)	10.5	x 10^{-6} in/in/°F
Electrical Resistivity (70°F)	455.0	ohm-cir-mil/ft

Magnetic Properties

Magnetic Permeability		
200 Oe, 25.000%	1.0070	Mu
200 Oe, 41.000%	1.0200	Mu
200 Oe, 52.000%	1.0480	Mu
200 Oe, 61.000%	1.1010	Mu
200 Oe, 69.000%	1.1860	Mu
200 Oe, 75.000%	1.2820	Mu
Annealed, 200 Oe	1.0030	Mu

Magnetic Permeability at H = 200 Oersteds

% Cold Reduction	Permeability	% Cold Reduction	Permeability
As annealed	1.003	61	1.101
25	1.007	69	1.186
41	1.020	75	1.282
52	1.048		

Starting material: 0.250" round, annealed wire

Typical Mechanical Properties

Typical Room Temperature and Cryogenic Mechanical Properties
Billet, annealed 1950°F (1066°C), water quench

Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 1" (25.4 mm) or 4D	% Reduction of Area	Charpy V-Notch Impact Strength	
°F	°C	ksi	MPa	ksi	MPa			ft-lb	J
74	23	34	234	79	545	77	82	240*	325*
-100	- 73	47	324	127	876	82	79	217	294
-320	-196	53	365	197	1358	66	69	175	237

*Specimens did not fracture completely. Annealed hardness was Rockwell B 75.

Heat Treatment

Annealing

Heat to 1850/2050ºF (1010/1121ºC) and quench in water. Brinell hardness approximately 156.

Hardening

Cannot be hardened by heat treatment. Hardens very slowly by cold working.

Workability

Hot Working

This steel can be readily forged, hot headed, upset, and riveted. Heat uniformly to 2100/2300ºF (1149/1260ºC). Do not forge below 1700ºF (927ºC). Forgings can be air-cooled, but better corrosion resistance can be obtained if small forgings are water quenched from the hammer. Large pieces should be annealed.

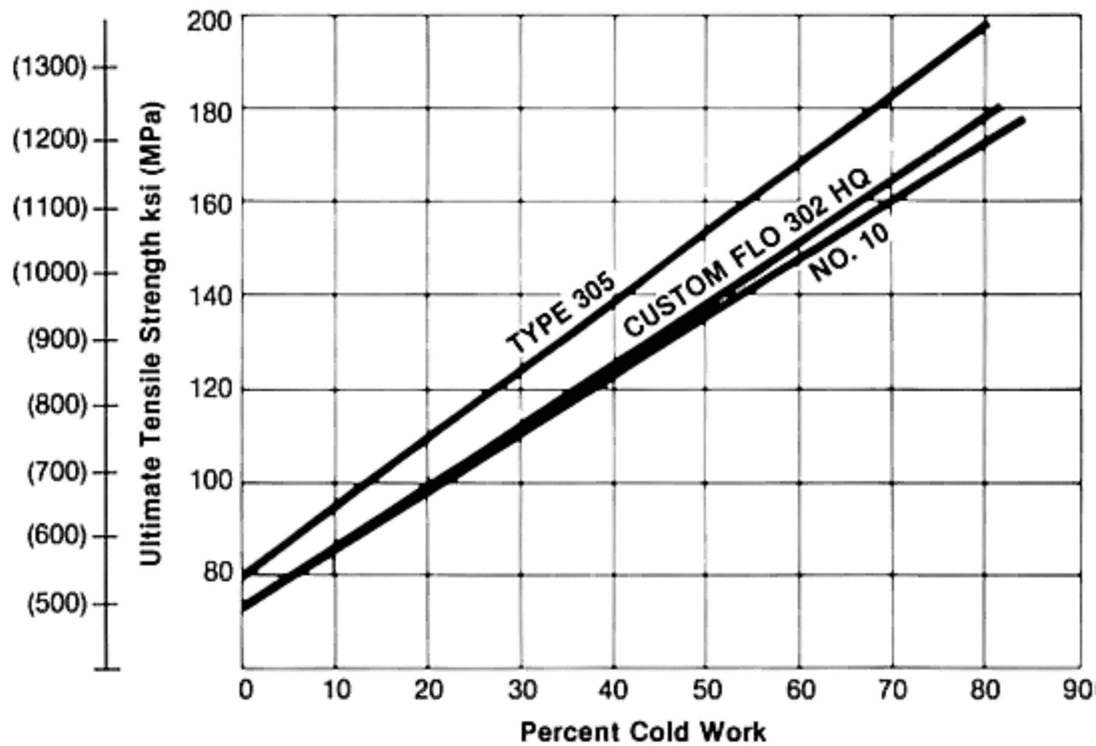
Cold Working

Because of its slow rate of work hardening, Carpenter Stainless Type 305 lends itself very well to cold working operations, such as blanking, forming, deep drawing, heading and spinning.

Comparative Ultimate Tensile Strength

% Cold Work	Carpenter No. 10 Type 384		Carpenter Type 304		Carpenter Type 305	
	ksi	MPa	ksi	MPa	ksi	MPa
As annealed	75	517	85	586	80	552
10	84	579	104	717	93	641
20	98	675	124	855	113	779
40	130	896	168	1158	150	1034
60	156	1076	200	1379	173	1193
80	176	1213	220	1517	190	1310

Rate of Work Hardening of Popular Austenitic Cold Heading Grades



Machinability

Carpenter Stainless Type 305 machines with a tough, stringy chip. To prevent glazing, keep the tools cutting. Increasing the feed and slowing the speed will be helpful. Machined surface finish can be somewhat improved by moderated cold working.

Following are typical feeds and speeds for Carpenter Stainless Type 305.

Typical Machining Speeds and Feeds – Carpenter Stainless Type 305

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	525	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
			Cut-Off Tool Width (inches)				Form Tool Width (inches)		
High Speed Tools	Car-bide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
M2		75	.001	.0015	.002	.0015	.001	.001	.001
	C2	275	.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
M7, M10	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 305 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/ER308 welding consumables should be considered. Resistance to intergranular corrosion can be restored by a postweld annealing treatment.

Other Information

Applicable Specifications

- AMS 5685
- ASTM A193
- ASTM A314
- ASTM A320
- ASTM A473
- ASTM A580

Forms Manufactured

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

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
- How to Select the Right Stainless Steel or High Temperature Alloy for Heading
- Passivating and Electropolishing Stainless Steel Parts

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