Technical Datasheet

CarTech® 440A Stainless

Identification

UNS Number

• S44002

Type Analysis

Single figures are nominal except where noted.

Carbon	0.60 to 0.75 %	**Manganese (Maximum)**	1.00 %
Phosphorus (Maximum)	0.040 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	16.00 to 18.00 %
Molybdenum (Maximum)	0.75 %	**Iron**	Balance

General Information

Description

This high-carbon high-chromium martensitic stainless steel is designed to provide stainless properties with excellent hardness. It has moderate corrosion resistance as-annealed which has permitted its use in mild environments.

In some respects it behaves similarly to tool steels. CarTech 440A stainless attains a hardness of Rockwell C 56 and maximum toughness when heat treated. CarTech 440A stainless has been used for pivot pins, dental and surgical instruments, cutlery, valve parts, etc. This steel makes fair permanent magnets.

Elevated Temperature Use

Carpenter Stainless Type 440A is not usually recommended to elevated temperature applications since corrosion resistance is reduced when used in the annealed condition or hardened and tempered above about 800ºF (427ºC).

Corrosion Resistance

Carpenter Stainless Type 440A has corrosion resistance generally similar to that of Type 410. It has resisted corrosion from mild atmospheres, fresh water, steam, ammonia, many petroleum products and organic materials, and several mild acid environments.

Carpenter Stainless Type 440A has a moderate degree of corrosion resistance in the annealed condition, which has made it useful for such parts as pivot pins where the points only are hardened. Better corrosion resistance is obtained by hardening and tempering below about 800ºF (427ºC).

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	Moderate	Sulfuric Acid	Restricted
Phosphoric Acid	Restricted	Acetic Acid	Restricted
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Restricted
Humidity	Good		

Properties

Physical Properties

Specific Gravity	7.68	
Density	0.2770	lb/in³
Mean Specific Heat (32 to 212°F)	0.1100	Btu/lb/°F

Mean CTE (32 to 212°F)	5.60	x 10 -6 in/in/°F
Electrical Resistivity (70°F)	361.0	ohm-cir-mil/ft

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties
Hardened 1900°F (1038°C), oil quench, tempered 600°F (316°C)

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Brinell Hardness
ksi	MPa	ksi	MPa			
240	1655	260	1793	5	20	512

Heat Treatment

Annealing

For maximum softness, this steel should be heated uniformly to 1550/1600ºF (843/871ºC). Soak and cool very slowly in the furnace. Brinell approximately 223. Intermediate or process annealing treatment---heat uniformly to 1350/1400ºF (732/760ºC). May be cooled in the furnace or air cooled. Brinell hardness about 230.

Hardening

Preheat to 1400/1500ºF (760/816ºC), then heat to 1850/1950ºF (1010/1066ºC); soak; quench in warm oil or cool in air. Do not overheat. When overheated, full hardness cannot be obtained.

Tempering

Hardness of approximately Rockwell C56/57 will be obtained on this steel. To remove peak stresses and yet retain maximum hardness temper at least one hour at 300/350ºF (148/176ºC).

Typical Hardness
1" (25.4 mm) round, hardened 1900°F (1038°C), oil quench, tempered one hour

Tempering Temperature		Rockwell C Hardness
°F	°C	
300	149	56/57
400	204	56
500	260	54
600	315	51/52
700	371	51
800	427	50

For maximum corrosion resistance, this steel should not be tempered above 800°F (427°C).

Workability

Hot Working

This steel should be handled like high-speed tool steel. Preheat to 1400/1500ºF (760/816ºC), then heat slowly and uniformly to 1900/2200ºF (1038/1204ºC). Do not forge below 1700ºF (927ºC), and reheat as often as necessary. Cool in a furnace if possible or in warm dry lime or ashes. Anneal after forging; cool to room temperature before annealing.

Cold Working

If annealed for maximum softness, this steel can be moderately cold formed, headed and upset.

Machinability

For most machining operations, this steel cuts best when in the dead soft annealed condition. Due to its high carbon content it machines somewhat like high-speed steel. The use of carbide or ceramic tools is suggested. Because chips are tough and stringy, chip curlers and breakers are important.

Following are typical feeds and speeds for Carpenter Stainless Type 440A.

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)
.015	T15	75	.015	C6	325	375	.015
.025	M42	80	.007	C7	400	500	.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	Carbide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
M2		55	.001	.001	.0015	.001	.001	.001	.0005
	C6	205	.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
T15	65	C2	85	.003	.006	.010	.015	.018	.021

Drilling

Tool Material	Speed (fpm)	High Speed Tools: Feed (inches per revolution) Nominal Hole Diameter (inches)							
		1/16	1/8	1/4	1/2	3/4	1	1 ½	2
T15,M42	45-55	.001	.003	.006	.010	.014	.017	.021	.025

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	5-12	8-15	10-20	15-25

Milling, End-Peripheral

Depth of Cut (inches)	High Speed Tools						Carbide Tools					
	Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in) 1/4	1/2	3/4	1-2	Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in) 1/4	1/2	3/4	1-2
.050	M2, M7	75	.001	.002	.003	.004	C6	240	.001	.002	.004	.006

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M1, M7, M10	10-20

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
T15, M42	15	.002

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.

Grinding and Polishing

In cutlery applications, grinding and polishing are very important. Carpenter Stainless Type 440A works well in these operations but considerable care must be used not to overheat since the corrosion resistance may be lowered.

Weldability

Because of its high hardness capability, this steel is seldom welded. However, if welding is necessary, the parts should be preheated and maintained at about 500ºF (260ºC), welded, and then immediately given a 6-8 hour anneal at 1350/1400ºF (732/760ºC) with a slow furnace cool. The parts should not be allowed to cool below 500ºF between welding and annealing. High welding heat inputs should be used. To obtain mechanical properties in the weld similar to the base metal, welding consumables of like composition should be considered. Otherwise, AWS E/ER309 should be considered.

Other Information

Applicable Specifications

- AMS 5631
- ASTM A276
- ASTM A314
- ASTM A473
- ASTM A580
- ASTM F899
- QQ-S-763

Forms Manufactured

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

Technical Articles

- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Blade Alloys 101: What You Need to Know About the Alloys Used for Knife Blades
- How to Passivate Stainless Steel Parts
- Passivating and Electropolishing Stainless Steel Parts
- Selection of High Strength Stainless Steels for Aerospace, Military and Other Critical Applications
- Unique Properties Required of Alloys for the Medical and Dental Products Industry

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