Technical Datasheet CARPENTER

Unit Display: English

Print Now

Carpenter Stainless Type 440B

E-Mail Datasheet
Add to My Materials

Identification

UNS Number

- S44003

Type Analysis

Carbon	0.75 to 0.95 %	**Manganese**	1.00 %
Phosphorus	0.040 %	**Sulfur**	0.030 %
Silicon	1.00 %	**Chromium**	16.00 to 18.00 %
Molybdenum	0.75 %	**Iron**	78.23 to 80.43 %

General Information

Description

This high-carbon chromium steel is designed to provide stainless properties with excellent hardness. In some respects it behaves similarly to tool steels. Carpenter Stainless Type 440B attains a hardness of Rockwell C 58 when heat treated and has been used for cutlery, hardened balls and similar parts. This steel makes fair permanent magnets.

Elevated Temperature Use

Carpenter Stainless type 440B is not usually recommended for 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 440B 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.

This grade is used in the hardened plus tempered condition. Optimum corrosion resistance is obtained with a temper 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		
--	7.65	
Density		
--	0.2760	lb/in³
Mean Specific Heat		
32°F, 212°F	0.1100	Btu/lb/°F
Mean Coefficient of Thermal Expansion		
32°F, 212°F	5.60	x 10^{-6} in/in/°F
Electrical Resistivity		
70.0°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			
270	1862	280	1931	3	15	534

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). Air cool. Brinell hardness approximately 241.

Hardening

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 C 58/59 will be obtained. To remove peak stresses and yet retain maximum hardness, temper at least one hour at 300/350ºF (149/177ºCº).

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	58/59
400	204	56/57
500	260	53/54
600	315	53
700	371	54
800	427	54

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 1900/2150ºF (1038/1177ºC). 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. Because chips are tough and stringy, chip curlers and breakers are important.

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

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

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
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)				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	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 440B 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

- 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
- How to Passivate Stainless Steel Parts
- Passivating and Electropolishing Stainless Steel Parts
- Unique Properties Required of Alloys for the Medical and Dental Products Industry

Edition Date: 04/01/1987