Technical Datasheet

CarTech® 416BQ Stainless (No. 5 BQ)

Identification

UNS Number

• S41600

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.15 %	**Manganese (Maximum)**	1.25 %
Phosphorus (Maximum)	0.060 %	**Sulfur (Minimum)**	0.150 %
Silicon (Maximum)	1.00 %	**Chromium**	12.00 to 14.00 %
Iron	Balance		

General Information

Description

CarTech 416 BQ stainless is a balanced version of standard CarTech 416 stainless steel capable of producing a minimum hardness of Rockwell C 40 when bright hardened. The high hardness capability is obtained through very close chemistry and structure control. Although capable of high hardness, CarTech 416 BQ stainless is nearly machinable as CarTech 416 stainless. It can be cut rapidly and cleanly with regular metal cutting tools, and can be freely ground and polished.

All of the same applications for CarTech 416 stainless (No. 5) can be handled by CarTech 416 BQ stainless (No. 5 BQ), particularly those requiring good bright hardening characteristics. Examples of uses have included cutters in food processing equipment, shafts, axles, gears, pinions, etc.

Scaling

The safe scaling temperature for continuous service is 1200°F (649°C).

Corrosion Resistance

Carpenter Stainless Type 416 BQ is suggested for corrosion resistance to mild atmospheres, fresh water, steam, ammonia, many petroleum products and organic materials and several mild acid environments. A polished finish is not necessary, but a smoother surface is helpful in providing added corrosion resistance.

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

Properties

Physical Properties

Specific Gravity	7.64	
Density	0.2760	lb/in³
Mean Specific Heat (32 to 212°F)	0.1100	Btu/lb/°F
Mean CTE (32 to 1200°F)	6.50	x 10^{-6} in/in/°F

Electrical Resistivity (70°F)	343.0 ohm-cir-mil/ft

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties
1¾" (34.9 mm) round bar, hardened 1800°F (982°C), ½ hour, oil quench, tempered 1 hour

Tempering Temperature		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area	Charpy V-Notch Impact Strength		Rockwell C Hardness
°F	°C	ksi	MPa	ksi	MPa			ft/lb	J	
300	149	159	1096	206	1420	13	40	20	27	43
500	260	152	1048	195	1344	13	45	25	34	42
700	371	158	1089	195	1344	14	45	25	34	42
900	482	163	1124	198	1365	14	50	13	18	41
1000	538	148	1020	174	1200	15	50	15	20	38
1100	593	105	724	125	862	17	55	60	81	28
1200	649	90	621	110	758	18	55	75	102	22

Heat Treatment

Annealing

Heat uniformly to 1300/1400°F (704/760°C); soak, remove from furnace and cool in air. Brinell approximately 212. For maximum softness anneal from a temperature of 1500/1650°F (816/900°C) and cool in furnace. Brinell approximately 170.

Hardening

Heat to 1750/1850°F (954/1010°C), soak at heat, cool as appropriate. The more rapid the cooling rate, the higher the resultant hardness.

Tempering

Temper to obtain hardness and mechanical properties desired.

Tempering this alloy in the range of 750/1050°F (399/566°C) results in decreased impact strength and also reduced corrosion resistance (the nature and extent of which vary with the media involved). However, tempering in this range is sometimes necessary to obtain the strength and ductility properties required. In many applications and environments, the reduced impact strength is not necessarily detrimental, and the corrosion resistance is only mildly reduced or even unaffected.

Workability

Hot Working

Carpenter Stainless Type 416 BQ can be readily hot headed and drop forged. Heat uniformly to 2100/2250°F (1149/1232°C); forge and cool in air. Cool large forgings slowly in dry lime or ashes. Trim hot if possible; otherwise anneal and trim cold. Do not forge below 1700°F (927°C).

Cold Working

Carpenter Stainless Type 416 BQ will withstand moderate cold work, but is not recommended for severe cold upsetting. The major applications for this steel are in parts that are machined to shape.

Machinability

Carpenter Type 416 BQ cuts freely because of the addition of sulfur. In automatic screw machines, it machines similar to 1144.

Following are typical feeds and speeds for Carpenter stainless Type 416 BQ.

Typical Machining Speeds and Feeds – Carpenter Stainless Type 416BQ (No. 5BQ)

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 High Speed Tools			Carbide Tools (Inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm) Uncoated	Speed (fpm) Coated	Feed (ipr)
.150	M48, T15	192	.015	C6	615	765	.015
.025	M48, T15	204	.007	C7	665	815	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr) Cut-Off and Form Tools Width (inches)						
Micro-Melt Powder HS Tools	Carbide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
M48, T15		162	.0015	.002	.0025	.002	.0015	.001	.001
	C6	420	.004	.005	.007	.005	.004	.0035	.0035

Rough Reaming

Micro-Melt Powder HS Tools		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
M48, T15	150	C2	145	.005	.008	.013	.018	.022	.025

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
M42	95-110	.001	.003	.006	.010	.014	.017	.021	.025
C2 Coated	240	.001	.003	.006	.0085	.0119	.0136	.0158	.0158

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
M7, M10	10-20	15-30	25-40	35-45

Milling, End-Peripheral

Depth of Cut (inches)	Micro-Melt Powder 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	M48, T15	156	.001	.002	.004	.005	C6	350	.001	.002	.005	.007

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M7, M10	20-45

Broaching

Micro-Melt Powder High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M7	30	.004

Additional Machinability Notes

Figures used for all metal removal operations covered are 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.

Weldability

Carpenter Stainless Type 416 BQ is not recommended for welding.

Other Information

Applicable Specifications

- AMS 5610
- ASTM A582
- MIL-W-52263
- QQ-S-764

Forms Manufactured

- Bar-Hexagons
- Bar-Rounds
- Billet
- Wire
- Wire-Rod

Technical Articles

- How to Passivate Stainless Steel Parts
- Passivating and Electropolishing Stainless Steel Parts

Edition Date: 01/08/03

Visit us on the web at www.cartech.com