Technical Datasheet

CarTech® 302HQ-FM® Stainless

Identification

UNS Number

• S30431

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.06 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.040 %	**Sulfur (Maximum)**	0.140 %
Silicon (Maximum)	1.00 %	**Chromium**	16.00 to 19.00 %
Nickel	9.00 to 11.00 %	**Copper**	1.30 to 2.40 %
Iron	Balance		

General Information

Description

CarTech 302HQ-FM stainless, a modification of CaTech Custom Flo 302HQ stainless, has excellent cold headability, plus machinability approaching Type 303 stainless. It was designed primarily for cold-headed parts that needed to be drilled, slotted, broached, etc. In addition, CarTech 302HQ-FM has been run in bar form on automatic screw machines on parts where thread rolling or cold form tapping operations are critical. It is an austenitic stainless steel and becomes only very faintly magnetic after severe cold working. It can be considered as a substitute for Type 303 and Type 303Se, if specifications permit. (This alloy is not covered by specifications which apply to these or other similar grades at this time.)

Scaling

The safe scaling temperature for continuous service is 1600°F (871 °C).

Corrosion Resistance

Annealed 302HQ-FM® stainless is 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	Humidity	Excellent

Properties

Physical Properties

Specific Gravity	7.89	
Density	0.2850	lb/in³
Mean Specific Heat (32 to 212°F)	0.1200	Btu/lb/°F

Mean CTE	
77 to 200°F	9.54 x 10^{-6} in/in/°F
77 to 400°F	9.67 x 10^{-6} in/in/°F
77 to 600°F	9.92 x 10^{-6} in/in/°F
77 to 800°F	10.2 x 10^{-6} in/in/°F
77 to 1000°F	10.4 x 10^{-6} in/in/°F
77 to 1200°F	10.6 x 10^{-6} in/in/°F

Mean Coefficient of Thermal Expansion

Temperature		10^{-6}/°F	10^{-6}/K
77°F to	25°C to		
200	93	9.54	17.17
400	204	9.67	17.40
600	316	9.92	17.85
800	427	10.19	18.34
1000	538	10.35	18.63
1200	649	10.56	19.00

Thermal Conductivity	
212°F	113.0 BTU-in/hr/ft²/°F
932°F	149.0 BTU-in/hr/ft²/°F

Thermal Conductivity

Test Temperature		Btu•in/ft²•h•°F	W/m•K
°F	°C		
212	100	113	16.3
932	500	149	21.5

Modulus of Elasticity (E)	28.0 x 10^{3} ksi
Modulus of Rigidity (G)	12.5 x 10^{3} ksi
Electrical Resistivity (70°F)	433.0 ohm-cir-mil/ft

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties
1" (25.4mm) round bar, annealed 1900°F (1038°C), water quench

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Rockwell Hardness
ksi	MPa	ksi	MPa			
32	221	74	510	57	74	79

Heat Treatment

Annealing

Heat to 1850/2050°F (1010/1120°C) and quench In water.

Hardening

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

Workability

Hot Working

302HQ-FM stainless can be forged and hot upset successfully. After hot working, it should be annealed.

Forging

Heat uniformly to 2100/2300°F (1149/1260°C). Do not forge below 1700°F (927°C). Forgings can be air-cooled, but better corrosion resistance can be obtained by quenching small forgings in water from the hammer. Large pieces should be annealed.

Cold Working

302HQ-FM stainless is the preferred grade for cold-headed parts which must be machined in secondary operations. Due to its low work-hardening rate, it is the grade to consider for machined parts where roll threading, cold form tapping and other cold-forming operations are used.

Machinability

302HQ-FM stainless has a machinability rating of about 75% of Carpenter Project 70® stainless Type 303 in conventional cutting type operations. It is superior to Project 70 stainless Type 303 in roll threading and cold form tapping machining operations.

For cold form tapping:
Speeds shown for drilling can be used as a starting point. Countersink or chamfer holes for best results. 65% of a full thread form is typically used.

When using carbide tools, surface speed feet/minute (SFM) 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 adjustments 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.

Following are typical feeds and speeds for 302HQ-FM stainless.

Typical Machining Speeds and Feeds – 302HQ-FM® 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)	High Speed Tools			Carbide Tools (Inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm) Uncoated	Speed (fpm) Coated	Feed (ipr)
.150	M2	100	.015	C2	425	525	.015
.025	M3	120	.007	C2	475	600	.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		90	.0015	.002	.0025	.002	.0015	.0015	.001
	C2	300	.004	.005	.007	.006	.005	.004	.003

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	85	C2	105	.003	.005	.008	.012	.015	.018

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
M7, M10	70-90	.001	.003	.006	.010	.014	.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	13-24	22-32	32-38

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	M7	125	.001	.002	.004	.005	C2	340	.001	.002	.005	.007

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M1, M7, M10	20-45

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M7	20	.004

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

Speeds shown for drilling can be used as a starting point. Countersink or chamfer holes for best results. 65% of a full thread form is typically used.

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 adjustments 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

302HQ-FM stainless is not recommended for welding. The high sulfur content may cause hot cracking, and when welding to a stainless steel with a lower sulfur content, may cause the weld to shift off center. If the alloy must be welded, consider AWS E/ER308L welding consumables. The use of stringer beads, minimum heat inputs, and minimum base metal dilution may improve the chances of success.

Other Information

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- 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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