Project 70+® Type 303 Stainless

Identification

U.S. Patent Number

- 5,482,674

UNS Number

- S30300

Type Analysis

Carbon (Maximum)	0.12 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.200 %	**Sulfur (Minimum)**	0.150 %
Silicon (Maximum)	1.00 %	**Chromium**	17.00 to 19.00 %
Nickel	8.00 to 10.00 %	**Iron**	Balance

General Information

Description

Project 70+® Type 303 stainless is an improved-machining version of Carpenter Stainless No. 8 (Type 303), the first chrome-nickel, free-machining stainless steel ever produced.

Customers may be able to attain average machining speed improvements of 50% and higher over stainless AISI Type 303. Project 70+ Type 303 stainless has been designed to reduce tool wear and increase machine speeds and feeds to help improve productivity and reduce part costs. It is a good general purpose product for simple as well as complex parts at a wide range of machining speeds.

Applications

Project 70+ Type 303 stainless may be considered for use in applications such as shafts, valve bodies, valves, valve trim, and fittings. This steel possesses nongalling properties that make disassembly of parts easy and help to avoid scratching or galling in moving parts. It is not recommended for vessels containing gases or liquids under high pressures.

Scaling

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

Corrosion Resistance

Annealed Project 70+ Type 303 stainless 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 800°F (427°C) and 1650°F (899°C) 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 5-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	Moderate
Phosphoric Acid	Moderate	Acetic Acid	Moderate
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Moderate
Sea Water	Restricted	Humidity	Excellent

Properties

Physical Properties

Specific Gravity

--	7.83

Density	
--	0.2830 lb/in³

Mean Specific Heat	
--	0.1200 Btu/lb/°F

Mean Coefficient of Thermal Expansion	
--	10.4 x 10^{-6} in/in/°F

Electrical Resistivity	
--	433.0 ohm-cir-mil/ft

Typical Mechanical Properties

Typical Elevated Temperature Mechanical Properties—Project 70+® Type 303 stainless
Annealed Condition

Test Temperature		Short-Time Tensile Tests						Creep Tests	
		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Stress for 1% Creep in 10,000 Hours	
°F	°C	ksi	MPa	ksi	MPa			ksi	MPa
70	21	35	241	90	621	50	55	—	—
800	427	21	145	61	421	35	51	—	—
1000	538	19	131	55	379	34	55	17	117
1200	649	17	117	45	310	30	54	7	48
1400	760	14	97	30	207	31	45	2	14
1600	871	10	69	20	138	34	43	—	—

Typical Room Temperature Mechanical Properties—Project 70+® Type 303 stainless
1" (25.4 mm) Round Bar, Annealed 1900°F (1038°C)

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Brinell Hardness	Impact Strength			
							Izod		Charpy V-Notch	
ksi	MPa	ksi	MPa				ft-lb	J	ft-lb	J
35	241	90	621	50	55	160	80	108	70	95

Heat Treatment

Annealing

Heat to 1850/1950°F (1010/1066°C) and quench in water. Brinell hardness approximately 160.

Hardening

Cannot be hardened by heat treatment. Upon being cold worked, this alloy increases in strength and hardness.

Workability

Hot Working

Project 70+ Type 303 stainless can be forged and hot upset successfully. After hot working, material 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

Project 70+ Type 303 stainless will withstand only a moderate amount of cold working. Where a free-machining grade is required for parts which involve cold-forming operations, Type 303 Se stainless or 302HQ-FM® stainless can be considered.

Machinability

Following are starting point feeds and speeds for Project 70+ Type 303 stainless.

Typical Machining Speeds and Feeds—Project 70+® Type 303 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)	Micro-Melt® Powder HS Tools			Carbide Tools (Inserts)			
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm) Uncoated	Speed (fpm) Coated	Feed (ipr)
.150	M48, T15	171	.0180	C2	580	700	.0180
.025	M48,T15	202	.0084	C2	680	800	.0084

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
Micro-Melt® Powder HS Tools	Carbide Tools		Cut-Off Tool Width (inches)				Form Tool Width (inches)		
			1/16	1/8	1/4	1/2	1	1½	2
M48, T15		156	.0018	.0024	.0030	.0024	.0018	.0018	.0012
	C2	507	.0048	.0060	.0096	.0072	.0060	.0048	.0036

Rough Reaming

Micro-Melt® Powder HS		Carbide Tools		Feed (ipr) Reamer Diameter (inches)					
Tool Material	Speed (fpm)	Tool Material	Speed (fpm)	1/8	1/4	1/2	1	1½	2
M48, T15	140	C2	143	.0060	.0096	.0156	.0216	.0264	.0300

Drilling

Tools									
Tool Material	Speed (ipm)	Feed (inches per revolution) Nominal Hole Diameter (inches)							
		1/16	1/8	1/4	1/2	3/4	1	1-½	2
Micro-Melt® Powder HS M48, T15	91-130	.0012	.0036	.0072	.0120	.0168	.0204	.0252	.0300
C2-Uncoated	180	--	.003	.006	.0085	.0119	.0136	.0158	.0158
C2-Coated	200	--	.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
M42	13-20	20-33	33-46	46-52

Milling, End—Peripheral

Depth of Cut (inches)	Micro-Melt® Powder HS Tools						Carbide Tools					
	Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (inches)				Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (inches)			
			1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2
.050	M48, T15	202	.0012	.0024	.0048	.0060	C2	449	.0012	.0024	.0060	.0084

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
T15, M42	25-56

Broaching

Micro-Melt® Powder HS Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
T15, M48	33	.0048

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

Project 70+ Type 303 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 these alloys must be welded, consider AWS E/ER 312 welding consumables with stringer beads using a minimum heat input and minimum base metal dilution.

Other Information

Applicable Specifications

Project 70+ Type 303 stainless meets all standard industry and government specifications for Type 303.

- AMS 5640
- ASTM A320
- ASTM A581
- ASTM A582

Forms Manufactured

- Bar-Flats
- Bar-Hexagons
- Bar-Rounds
- Bar-Squares
- Wire
- Wire-Rod
- Wire-Shapes

Technical Articles

- How to Passivate Stainless Steel Parts
- New Ideas for Machining Austenitic Stainless Steels
- New Powder Metal Alloy Bridges Gap Between High Speed Steel and Tungsten Carbide
- Selecting Stainless Steels for Valves

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