Technical Datasheet

CarTech® 18Cr-2Ni-12Mn Stainless

Identification

UNS Number

• S24100

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.15 %	**Manganese**	11.00 to 14.00 %
Phosphorus (Maximum)	0.060 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	16.50 to 19.00 %
Nickel	0.50 to 2.50 %	**Nitrogen**	0.20 to 0.45 %
Iron	Balance		

General Information

Description

CarTech 18Cr-2Ni-12Mn is a high-manganese, nitrogen-strengthened austenitic stainless steel that provides substantially higher yield and tensile strengths than CarTech 304 stainless and has general-corrosion resistance between that of CarTech 430 and CarTech 304 stainless. The corrosion resistance of CarTech 18Cr-2Ni-12Mn approaches that of CarTech 304 in some environments. It can be welded, machined and cold worked using the same equipment and methods used for the conventional 300 series austenitic stainless steels. The alloy is nonmagnetic in the annealed condition and remains nonmagnetic after cold working to high-strength levels. CarTech 18Cr-2Ni-12Mn provides an excellent combination of toughness, ductility, strength, corrosion resistance and fabricability.

CarTech 18Cr-2Ni-12Mn has been used for applications where corrosion resistance approaching CarTech 304 is adequate but where the strength or magnetic permeability to CarTech 304, after cold working, is unsuitable. CarTech 18Cr-2Ni-12Mn has been used in such applications as weld studs, self-tapping screws, industrial screens, springs, wire products, antenna, cables, pole line hardware, worm screws, and pump shafts.

Scaling

The safe scaling temperature for continuous service is 1600ºF (871ºC).

Corrosion Resistance

Carpenter 18Cr-2Ni-12Mn has good resistance to atmospheric corrosion. Its resistance to some acids and corrosive products is comparable to that of Type 304.

Intergranular corrosion may be a problem if the material is heated between 800ºF (427ºC) and 1650ºF (899ºC) 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 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	Restricted
Phosphoric Acid	Restricted	Acetic Acid	Moderate
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Good
Sea Water	Restricted	Humidity	Excellent

Typical Corrosion Properties
Annealed condition

Environment	Time of Test	Average Corrosion Rate	
		Carpenter 18Cr-2Ni-12Mn	Type 304
10 w/o formic acid-boiling	3 periods—48 hrs. ea.	80 mpy	24 mpy
50 w/o acetic acid-boiling	3 periods—48 hrs. ea.	0.2 mpy	11 mpy
20 w/o HNO_3—200°F (93°C)	3 periods—48 hrs. ea.	1.5 mpy	1.1 mpy
5 w/o H_2SO_4—176°F (80°C)	3 periods—48 hrs. ea.	248 mpy*	85 mpy*
10 w/o $FeCl_3$—R.T.	—	Similar to Type 304	

*passive in 2nd and 3rd periods (i.e., less than 1 mpy)

Properties

Physical Properties

Specific Gravity	7.75	
Density	0.2800	lb/in³
Mean CTE (70 to 1000°F)	10.3	x 10^{-6} in/in/°F
Modulus of Elasticity (E)	29.0	x 10^{3} ksi
Electrical Resistivity (70°F)	421.0	ohm-cir-mil/ft

Typical Mechanical Properties

Carpenter 18Cr-2Ni-12Mn will find the greatest application at ambient temperature; however, the alloy is suitable for service over a wide range of temperatures from -300ºF to 1000ºF (-184ºC to 538ºC).

Typical Room Temperature Mechanical Properties
Annealed condition

Section Size	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 1" (25.4mm) or 4D	% Reduction of Area	Charpy V-Notch Impact Strength		Hardness Rockwell B
	ksi	MPa	ksi	MPa			ft-lb	J	
4"(101.6mm) square	65	448	116	800	65	75	240	325	95
1"(25.4mm) round	65	448	120	827	65	75	240	325	96
0.250"(6.35mm) round	68	469	122	841	65	75	—	—	97

Typical Room Temperature Tensile Properties of Cold-Drawn Wire
Wire annealed before cold drawing

Wire Diameter		% Cold Work	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 1"(25.4mm)	% Elongation in 2"(50.8mm)	% Reduction of Area
in.	mm		ksi	MPa	ksi	MPa			
0.250	6.35	0	68	469	122	841	65	58	76
0.235	5.97	10	108	745	142	979	52	42	74
0.222	5.64	20	132	910	168	1158	40	30	71
0.208	5.28	30	154	1062	187	1289	30	21	68
0.195	4.95	40	177	1220	206	1420	22	14	64

Heat Treatment

Annealing

Heat to 1900/1950ºF (1038/1066ºC) and water quench, or rapidly cool as with other austenitic stainless steels. Typical hardness as annealed is approximately Rockwell B 95.

Hardening

Cannot be hardened by heat treatment. Can be hardened only by cold work.

Workability

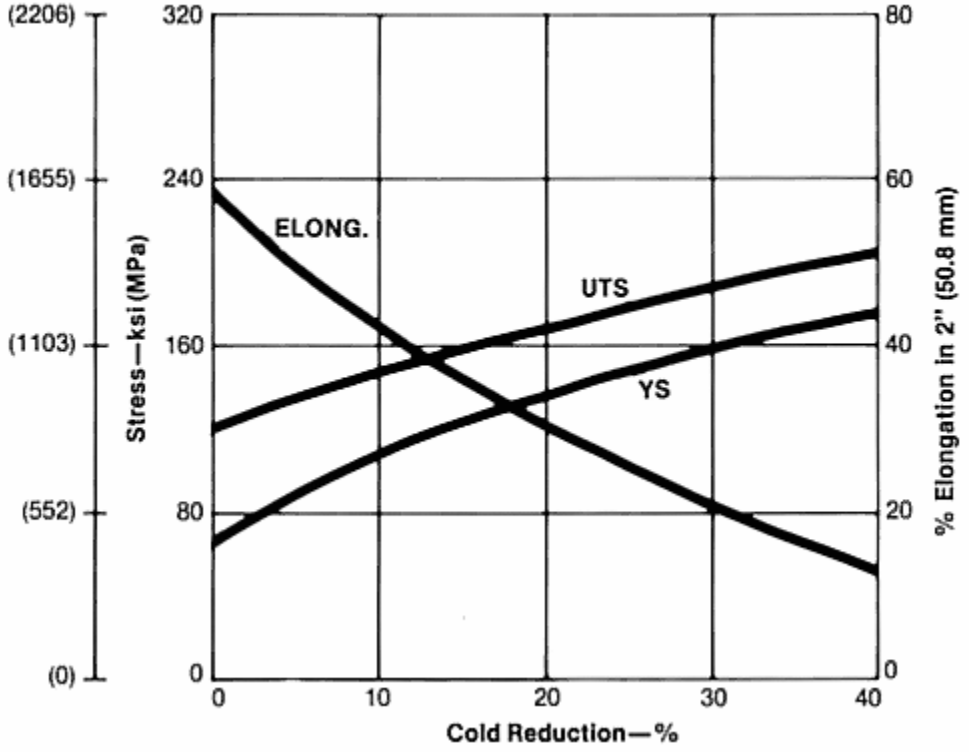
Hot Working

Carpenter 18Cr-2Ni-12Mn can be forged, hot-rolled, hot-headed and upset. Because of its higher strength, greater force than for Type 304 is required. For hot working, heat uniformly to 2100/2200ºF (1149/1204ºC). Preheating to an intermediate temperature is not required. For maximum corrosion resistance, annealing after hot working is required. For some applications, water quenching of small forgings from the hammer may be adequate and serve to eliminate the need for annealing.

Cold Working

Carpenter 18Cr-2Ni-12Mn can be cold formed by drawing, bending, upsetting and stamping. Because of its higher strength and work-hardening rate, the force required is greater than for Types 302, 304 or 316. The high work-hardening rate can be used to advantage when cold working to increase strength; i.e., less reduction is required to achieve high levels of strength.

The Effect of Cold Work on the Typical Tensile Properties of Wire



Machinability

Carpenter 18Cr-2Ni-12Mn has a machinability rating about 41% of AISI 1212. Slow to moderate speeds, moderate feeds and rigid tools should be considered. Chips tend to be tough and stringy. Chip curlers or breakers are helpful. Use a sulfurized cutting fluid, preferable of the chlorinated type.

Following are typical feeds and speeds for Carpenter 18Cr-2Ni-12Mn.

Typical Machining Speeds and Feeds – Carpenter 18Cr-2Ni-12Mn

The speeds and feeds in the following charts are conservative recommendations for in
setup. Higher speeds and feeds may be attainable depending on machining environm

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	72	.015	C6	250	300	.015
.025	M48, T15	84	.007	C7	300	350	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
			Cut-Off Tool Width (Inches)			Form Tool Width (Inches)			
Micro-Melt® Powder HS Tools	Carbide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
M48, T15		54	.001	.001	.0015	0015	.001	.0007	.0007
	C6	192	.004	.0055	.004	.004	.003	.002	.002

Rough Reaming

Micro-Melt® Powder High Speed 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	72	C2	80	.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
M42	45-55	.001	.002	.004	.007	.010	.012	.015	.018
C2 Coated	140	.0005	.002	.004	.006	.0077	.0088	.0098	.0098

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	4-8	6-10	8-12	10-15

Milling, End-Peripheral

Depth of Cut (inches)	Micro-Melt® Powder 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	M48, T15	78	.001	.002	.003	.004	C2	245	.001	.002	.003	.005

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M7, M10	12-25

Broaching

Micro-Melt® Powder High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M48, T15	12	.0030

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.

Weldability

Carpenter 18Cr-2Ni-12Mn can be satisfactorily welded by the shielded fusion and resistance welding processes. Oxyacetylene welding is not recommended, since carbon pickup in the weld may occur. When a filler metal is required, consider AWS E/ER240 welding consumables which should provide welds with strength approaching that of the base metal. If high weld strength is not necessary, then consider E/ER308. Resistance to intergranular corrosion can be restored by a postweld annealing treatment.

Other Information

Applicable Specifications

- ASTM A276 (Grade XM-28)
- ASTM A313 (Grade XM-28)
- ASTM A580 (Grade XM-28)

Forms Manufactured

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

Technical Articles

- Selecting Stainless Steels for Valves

Edition Date: 5/17/13

Visit us on the web at www.cartech.com