Technical Datasheet

CarTech® TrimRite® Stainless

Identification

UNS Number

• S42010

Type Analysis

Single figures are nominal except where noted.

Carbon	0.15 to 0.30 %	**Manganese (Maximum)**	1.00 %
Phosphorus (Maximum)	0.040 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	13.50 to 15.00 %
Nickel	0.25 to 1.00 %	**Molybdenum**	0.40 to 1.00 %
Iron	Balance		

General Information

Description

CarTech TrimRite stainless is a hardenable martensitic stainless steel that provides a moderately high level of corrosion resistance, hardness up to Rockwell C 51, good cold formability and ease of heat treatment, all of which combine to provide an alloy which has been used for many applications such as fasteners, especially self-drilling types, cutlery, food processing equipment, valve parts, gauges, guides, shafting, conveyor chain and instruments.

CarTech TrimRite stainless has also been used in medical and surgical applications for cutting and scraping tools.

The alloy can be hot worked, cold worked, machined and heat treated using the same equipment and methods used for Type 410 stainless steel.

CarTech TrimRite stainless is balanced to be fully martensitic in the hardened condition and is magnetic in all conditions.

In laboratory tests, self-drilling fasteners of CarTech TrimRite stainless heat treated to Rockwell C 50 have shown good drilling capability. At a constant drill load of 35 pounds and a speed of 2500 rpm, No. 8 x 3/4" self-drilling fasteners drilled through 0.062"-thick cold-rolled 1010 carbon steel at Rockwell B 80 in 3.0 seconds or less.

Elevated Temperature Use

Carpenter TrimRite stainless is not usually recommended for elevated temperature applications, since corrosion resistance and toughness will be reduced if the alloy is heated above about 700/800°F (371/427°C) after hardening and tempering as recommended.

Corrosion Resistance

Laboratory tests have shown TrimRite stainless to have better corrosion resistance than Types 410, 420 and 440 in a number of environments. It has good resistance to rusting and corrosion by atmospheric conditions and various chloride-containing environments. Cones of TrimRite stainless ground with 400 grit paper and passivated in 20% nitric acid containing 2% sodium dichromate showed a high level of corrosion resistance when tested for 22 hours in copper acidified salt spray (ASTM B368-CASS test) and also when tested for 200 hours in 95°F (35°C), 5% neutral salt spray (ASTM B117).

Additionally, the alloy has good resistance to mild atmospheres, mild chemicals, most foodstuffs and many petroleum products.

For maximum corrosion resistance parts must be free of scale, foreign particles, free iron and surface imperfections which can trap foreign material and contribute to pitting and crevice corrosion, especially in the presence of chlorides. The presence of any of these conditions will decrease the resistance to rusting in accelerated corrosion tests. Finished parts should be passivated.

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	Sodium Hydroxide	Moderate
Salt Spray (NaCl)	Moderate	Sea Water	Restricted
Humidity	Moderate		

Properties

Physical Properties

Specific Gravity	7.75	
Density	0.2800	lb/in³
Mean Specific Heat (32 to 212°F)	0.1100	Btu/lb/°F
Mean CTE (32 to 212°F)	5.61	x 10^{-6} in/in/°F
Modulus of Elasticity (E)	29.0	x 10^{3} ksi
Electrical Resistivity (70°F)	335.0	ohm-cir-mil/ft

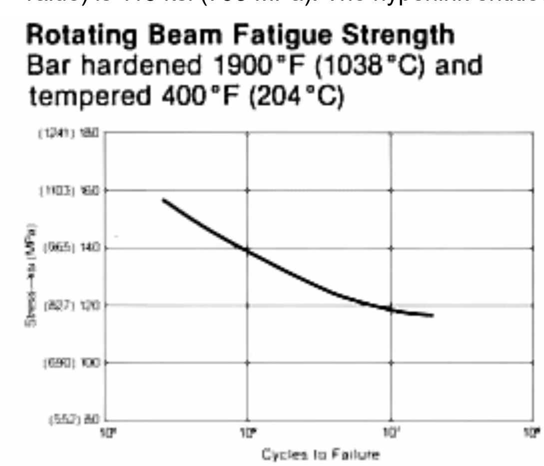
Typical Mechanical Properties

Annealed:
The hyperlink entitled "Typical Room Temperature Mechanical Properties" shows typical mechanical properties for annealed TrimRite stainless wire, strip, and bar. In the annealed condition, relatively low hardness, tensile and yield strengths are conductive to cold forming.

Hardened + Tempered:
Typical properties and the effect of tempering are shown in the hyperlinks entitled "Typical Room Temperature Mechanical Properties of Bar, Typical Room Temperature Mechanical Properties of Strip". To avoid loss in toughness, tempering temperatures should not exceed 600°F (316°C).

In the hardened condition, this alloy has hardness and tensile strength comparable to Type 420 but possesses the higher ductility expected for Type 410. The table shown in the hyperlink entitled "Typical Room Temperature Mechanical Properties for Type 410 and Type 420 Bar" is used for comparison.

Typical Fatigue Strength:
Fatigue strength determined by a rotating beam test for bar tempered at 400°F (204°C), Rockwell C 50. Endurance limit (typical value) is 115 ksi (793 MPa). The hyperlink entitled "Rotating Beam Fatigue Strength" shows the fatigue data for TrimRite stainless.



Typical Room Temperature Mechanical Properties
Annealed Condition

Product Form	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation	% Reduction of Area	Rockwell B Hardness
	ksi	MPa	ksi	MPa			
Wire	57	393	94	648	35	68	92
Bar	54	372	88	607	28	66	88
Strip	50	345	88	607	26	—	88

Typical Room Temperature Mechanical Properties for Type 410 and Type 420 Bar

Mechanical Properties	Type 410		Type 420	
	Annealed	Hardened*	Annealed	Hardened*
0.2% Yield Strength				
ksi	50	150	55	215
MPa	345	1035	380	1482
Ultimate Tensile Strength				
ksi	85	190	95	250
MPa	586	1310	656	1724
% Elongation (in 4D)	35	15	25	8
% Reduction of Area	75	55	55	25
Rockwell Hardness	B 83	C 42	B 94	C 52

*Hardened plus tempered 400°F (204°C)

Typical Room Temperature Mechanical Properties of Bar

Tempering Temperature[1]		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area	Rockwell C Hardness	Charpy V-Notch Impact Strength	
°F	°C	ksi	MPa	ksi	MPa				ft-lb	J
400	204	185	1276	250	1724	14	45	50	14	19
500	260	172	1186	235	1620	15	50	47	16	22
600	316	172	1186	235	1620	15	50	47	13	18
700*	371	178	1227	237	1634	14	50	48	10	14
850*	454	190	1310	240	1655	14	48	48	5	7
950*	510	176	1213	248	1710	15	50	49	7	9

[1]Hardened 1900°F (1038°C), 1/2 hr., oil quench plus tempered 2 hr., air cool.
*See comment above.

Typical Room Temperature Mechanical Properties of Strip

Condition	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	Rockwell Hardness
	ksi	MPa	ksi	MPa		
Annealed	50	345	88	607	26	B 88
Tempered 300°F (149°C)[1]	179	1234	288	1986	9	C 55
Tempered 350°F (177°C)[1]	180	1241	270	1862	9	C 54
Tempered 400°F (204°C)[1]	183	1262	260	1793	10	C 52

[1]Hardened 1900°F (1038°C) 1/2 hr., fan air cool plus tempered 2 hr., air cool.

Heat Treatment

Annealing

Heat uniformly to 1350/1400°F (732/760°C) for two to four hours on heat---remove from furnace and cool to room temperature. The hardness will be approximately Rockwell B 88/90 or equivalent. For lowest hardness (Rockwell B 82/87) heat to 1560°F (850°C) one to two hours on heat, cool in the furnace at a rate not exceeding 50°F (28°C) per hour to 1200°F (650°C), and then remove from the furnace and cool in air to room temperature.

Hardening

Carpenter TrimRite stainless readily lends itself to heat treating in both batch and continuous types of heat treating furnaces. For the maximum attainable hardness of Rockwell C 49/52 the alloy should be heated to 1900°F (1040°C) and rapidly cooled to room temperature by quenching in oil or by forced air or gas cooling. Fifteen minutes on heat at 1900°F (1040°C) is generally adequate for screws, clips, pins, wire and other small parts. A longer time (up to a maximum of about one hour) is required for larger sections. When heat treating in a protective atmosphere, nitrogen or argon with a dew point no higher than -40°F (-40°C) is suggested. Dissociated ammonia is considered unsuitable because of the risk of nitriding the work and the resulting reduction in corrosion resistance.

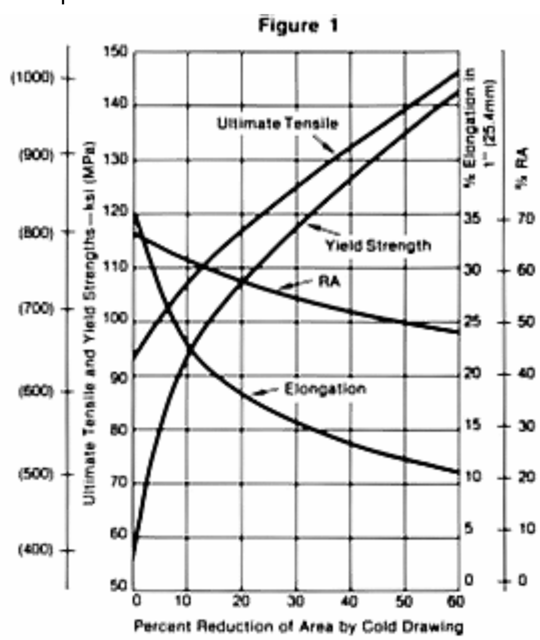
Tempering

After hardening, parts should be tempered one to two hours at 350/400°F (177/204°C). When less than maximum hardness is required parts may be tempered up to 600°F (316°C).

Workability

Cold Working

The cold forming characteristics of Carpenter TrimRite stainless in operations such as heading, thread rolling, slotting, extrusion, drawing and flattening are similar to a number of other 400 series martensitic stainless steels. Field trials have shown the cold headability to be only slightly less than Type 410. The hyperlink entitled "The Effect of Cold Work on Room Temperature Tensile Properties" shows the effect of cold work on room temperature tensile properties starting from the annealed condition.



Machinability

TrimRite stainless is normally machined in the annealed condition and is similar to Type 420. Cutting tools must be kept sharp. A coolant consisting of a chlorinated mineral oil with sulfur should be satisfactory for most machining operations.

Following are typical feeds and speeds for TrimRite stainless.

Typical Machining Speeds and Feeds – TrimRite® 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)		Feed (ipr)
					Uncoated	Coated	
.150	T15	85	.015	C6	375	500	.015
.025	M42	100	.007	C7	450	600	.007

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
High Speed Tools	Carbide Tools		Cut-Off Tool Width (inches)				Form Tool Width (inches)		
			1/16	1/8	1/4	1/2	1	1 ½	2
M2		75	.001	.0015	.002	.0015	.001	.001	.001
	C6	275	.004	.005	.006	.005	.004	.003	.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
T15	75	C2	95	.003	.006	.010	.014	.018	.022

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
M7, M10	55-65	.001	.003	.006	.010	.013	.016	.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
M1, M2, M7, M10	5-15	10-25	20-35	25-40

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	100	.001	.002	.003	.004	C6	275	.001	.002	.004	.006

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M1, M7, M10	15-40

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
M2, M7	15	.003

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

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%.

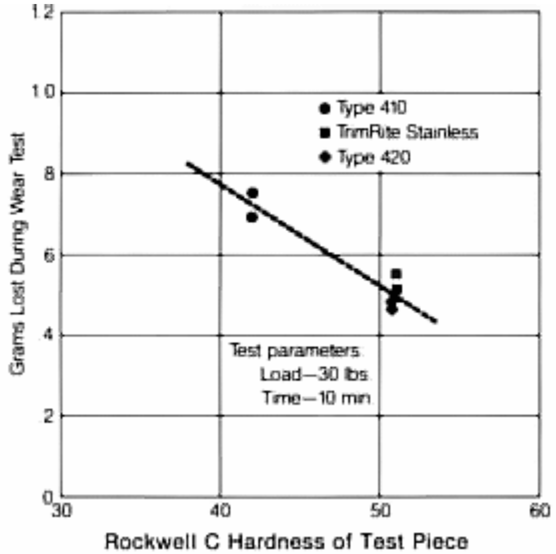
Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustments of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Drill Capacity:
In laboratory tests, self-drilling fasteners of TrimRite stainless heat treated to Rockwell C 50 have shown good drilling capability. At a constant drill load of 35 pounds and a speed of 2500 rpm, No. 8 x 3/4" self-drilling fasteners drilled through 0.062"-thick cold-rolled 1010 carbon steel at Rockwell B 80 in 3.0 seconds or less.

Other Information

Wear Resistance

Dry-sand abrasive wear tests per ASTM G65, Practice B have shown TrimRite Stainless to be equivalent to Type 420.



Descaling (Cleaning)

Prior to Heat Treating

In those cases where metal will not be removed from the surface of the part after heat treating by grinding, machining or some other method, it is imperative that the surface of the steel be cleaned to remove all foreign materials such as soap, oil, grease, coatings including copper, sulfur-bearing compounds and other substances which can react with the metal at a high temperature (e.g., hardening temperature).

Most lubricants and grease can be removed by tumbling or vibratory washing in 140°F (60°C) alkaline solution followed by water rinsing or cleaning in an organic solvent.

When stripping copper after cold heading, parts should be degreased and then stripped in 20% by volume nitric acid at 120/140°F (49/60°C) followed by a thorough water rinse.

After Hardening

After hardening and tempering, parts in a finished condition should be passivated.

Applicable Specifications

- ASTM A276
- ASTM A493

Forms Manufactured

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

Technical Articles

- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- 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
- Improved Stainless Steels for Medical Instrument Tubing
- New Ideas for Machining Austenitic Stainless Steels
- Passivating and Electropolishing Stainless Steel Parts
- Specialty Alloys And Titanium Shapes To Consider For Latest Medical Materials Requirements
- Unique Properties Required of Alloys for the Medical and Dental Products Industry

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