

CarTech® Custom 631 (17Cr-7Ni) Stainless

Identification

UNS Number

• S17700

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.09 %	Manganese (Maximum)	1.00 %
Phosphorus (Maximum)	0.040 %	Sulfur (Maximum)	0.040 %
Silicon (Maximum)	1.00 %	Chromium	16.00 to 18.00 %
Nickel	6.00 to 7.75 %	Aluminum	0.75 to 1.50 %
Iron	Balance		

General Information

Description

CarTech Custom 631 (17Cr-7Ni) stainless is a semi-austenitic, precipitation-hardening stainless steel that provides high strength when sufficiently cold drawn and then aged. Corrosion resistance is similar to CarTech 304. CarTech Custom 631 (17Cr-7Ni) is designed to provide an austenitic structure in the annealed condition with excellent cold drawability. To achieve age-hardening properties, CarTech Custom 631 (17Cr-7Ni) must be cold drawn.

Applications

CarTech Custom 631 (17Cr-7Ni) stainless may be considered in high-strength wire applications such as car antennae and springs.

Scaling

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

Corrosion Resistance

Carpenter Custom 631 (17Cr-7Ni) stainless has good resistance to atmospheric corrosion. Its resistance to some acids and corrosive products is comparable to that of Type 304 stainless.

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 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	Sour Oil/Gas	Moderate
Humidity	Excellent		

Properties

Physical Properties

Specific Gravity

Condition A 7.81

Condition CH 900 7.67

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Density

Condition A	0.2820 lb/in ³
Condition CH 900	0.2770 lb/in ³

Mean CTE

70 to 200°F, Condition A	8.50 x 10 ⁻⁶ in/in/°F
70 to 400°F, Condition A	9.00 x 10 ⁻⁶ in/in/°F
70 to 600°F, Condition A	9.50 x 10 ⁻⁶ in/in/°F
70 to 800°F, Condition A	9.60 x 10 ⁻⁶ in/in/°F
70 to 200°F, Condition CH 900	6.10 x 10 ⁻⁶ in/in/°F
70 to 400°F, Condition CH 900	6.20 x 10 ⁻⁶ in/in/°F
70 to 600°F, Condition CH 900	6.40 x 10 ⁻⁶ in/in/°F
70 to 800°F, Condition CH 900	6.60 x 10 ⁻⁶ in/in/°F

Mean Coefficient of Thermal Expansion

Temperature Range		Condition A		Condition CH 900	
70°F to	21°C to	10 ⁻⁶ in/in/°F	10 ⁻⁶ cm/cm/°C	10 ⁻⁶ in/in/°F	10 ⁻⁶ cm/cm/°C
200	93	8.5	15.3	6.1	11.0
400	204	9.0	16.2	6.2	11.2
600	316	9.5	17.1	6.4	11.5
800	482	9.6	17.3	6.6	11.9

Electrical Resistivity

Condition A	481.0 ohm-cir-mil/ft
Condition CH 900	504.0 ohm-cir-mil/ft

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties – Carpenter Custom 631 (17Cr-7Ni)

.276" (7.01mm) Round Wire, Batch Annealed

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2 inches (50.8 mm)	% Reduction of Area
Ksi	MPa	Ksi	MPa		
31.6	218.0	110.0	759.0	40.0	61.0

Heat Treatment

Annealing

Heat to 1900/2000°F (1038/1093°C) and quench in water. Typically, hardness as annealed is Rockwell B85. This heat treatment is commonly referred to as Condition A.

Hardening

After cold reduction (Condition C), heat to 900°F (482°C), 1 h, air cool (Condition CH 900). Typically, hardness in the CH 900 condition is Rockwell C45.

Workability

Hot Working

Carpenter Custom 631 (17Cr-7Ni) stainless can be readily forged, hot rolled, hot headed and upset.

For hot working, heat uniformly to 2100/2300°F (1149/1260°C). Preheating to an intermediate temperature is not required. Do not forge below 1700°F (927°C). Forging can be air cooled without danger of cracking.

For maximum corrosion resistance, annealing after hot working is required.

Cold Working

Carpenter Custom 631 (17Cr-7Ni) stainless is readily cold worked by conventional methods. Cold working causes martensitic transformation resulting in a significant increase in magnetic permeability.

Once the proper cold reduction practice has been established, Carpenter Custom 631 (17Cr-7Ni) can be age-hardened.

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Machinability

Carpenter Custom 631 (17Cr-7Ni) stainless machines similarly to Type 302, producing long, gummy chips. To protect the tools, a chip breaker is useful. Since Carpenter Custom 631 (17Cr-7Ni) work hardens rapidly, glazing can be prevented by keeping the tools cutting. Increasing the feed and reducing the speed will be helpful.

Following are starting point feeds and speeds for Carpenter Custom 631 (17Cr-7Ni).

Typical Machining Speeds and Feeds – Carpenter Custom 631 (17Cr-7Ni) 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	C2	350	450	.015
.025	M42	100	.007	C3	400	525	.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	C2	75	.001	.0015	.002	.0015	.001	.001	.001
		275	.004	.0055	.007	.005	.004	.0035	.0035

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	70	C2	90	.003	.005	.008	.012	.015	.018

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	50-60	.001	.002	.004	.007	.010	.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	10-20	15-25	25-30

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	75	.004	.002	.003	.010	C2	270	.001	.002	.003	.005

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
M1, M7, M10	12-25

Broaching

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

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 Custom 631 (17Cr-7Ni) stainless 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 needed, a welding consumable of similar composition as Carpenter Custom 631 (17Cr-7Ni) should be considered. If weld strength is not necessary, then consider a standard austenitic stainless consumable, such as E/ER 308.

Resistance to intergranular corrosion can be restored by a post-weld annealing treatment.

Other Information

Applicable Specifications

- ASTM A564

Forms Manufactured

- Wire-Rod

Technical Articles

- [Passivating and Electropolishing Stainless Steel Parts](#)

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