Technical Datasheet CARPENTER

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Custom 450® Stainless

Identification

UNS Number

- S45000

Type Analysis

Carbon	0.05 %	**Manganese**	1.00 %
Phosphorus	0.030 %	**Sulfur**	0.030 %
Silicon	1.00 %	**Chromium**	14.00 to 16.00 %
Nickel	5.00 to 7.00 %	**Molybdenum**	0.50 to 1.00 %
Copper	1.25 to 1.75 %	**Columbium/Niobium**	0.35 to 0.75 %
Iron	72.14 to 77.14 %		

General Information

Description

Custom 450® stainless is a martensitic age-hardenable stainless steel which exhibits very good corrosion resistance (similar to that of Stainless Type 304) with moderate strength (similar to that of Stainless Type 410). The alloy has a yield strength somewhat greater than 100 ksi (689 MPa) in the annealed condition, but is easily fabricated. A single-step aging treatment develops higher strength with good ductility and toughness.

This stainless can be machined, hot-worked, and cold-formed in the same manner as other martensitic age-hardenable stainless steels. A particular advantage is ease of welding and brazing.

Custom 450 stainless is generally supplied in the annealed condition, requiring no heat treatment by the user for many applications. Because it has corrosion resistance like Type 304 stainless but three times the yield strength, it has been used in applications where Type 304 was not strong enough. On the other hand, it has also replaced Type 410 stainless directly on a strength basis where Type 410 had insufficient corrosion resistance. Mechanical properties will depend on the aging temperature selected.

Selection

There are a number of other alloys that are available for specific applications.

Grade: Custom 630 stainless
Characteristic: Similar to Custom 450 stainless, but must be aged prior to use. It cannot be used in the solution-annealed condition.

Grade: 15Cr-5Ni stainless
Characteristic: Similar to Custom 630 stainless, but has better transverse ductility and toughness.

Grade: Pyromet® Alloy 350
Characteristic: Depending on heat treatment, can have an austenitic structure for best formability, or a martensitic structure, for higher strength up to intermediate elevated temperatures.

Grade: Pyromet Alloy 355
Characteristic: Similar to Pyromet Alloy 350 but with a lower ferrite content.

Elevated Temperature Use

Custom 450 stainless shows excellent resistance to oxidation up to approximately 1200°F (649°C). Significant aging occurs when annealed material is heated to 700°F (371°C) and higher.

Long-term exposure to elevated temperatures can result in reduced toughness in precipitation hardenable stainless steels. The reduction in toughness can be minimized in some cases by using higher aging temperatures. Short exposures to elevated temperatures can be considered, provided the maximum temperature is at least 50°F (28°C) less than the aging temperature.

Corrosion Resistance

Custom 450 stainless has resisted atmospheric corrosion including salt water atmospheres. It shows excellent resistance to rusting and pitting in 5% and 20% salt spray at 95°F (35°C). Tests in hot concentrated nitric acid show corrosion resistance approaching that of Type 304.

Optimum corrosion resistance for this alloy is obtained in the annealed condition. However, age hardening results in only a slight change.

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.

Sour Service:
Custom 450 stainless has acceptable resistance to sulfide stress cracking at Rockwell C 31 maximum hardness per NACE MR-01-75, "Sulfide Stress Cracking Resistant Metallic Materials for Oil field Equipment." Refer to the current document for details on acceptable conditions. A comparison is made for alloys heat treated in accordance with MR-01-75 requirements. Threshold stresses are intended for comparative purposes only and should not be used as design stress level.

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	Sour Oil/Gas	Moderate
Humidity	Excellent		

Effect of Aging on Typical Corrosion Resistance in Acid Solutions

Condition	Rockwell C Hardness	48-Hour Corrosion Rate in mpy		
		20% nitric acid at 200°F (93°C)	5% sulfuric acid at 75°F (24°C)	50% acetic acid boiling
A	30	2	1	1
H 900	41	2	1	1
H 1000	37	2	3	1
H 1150	30	2	9	1

Typical Corrosion Resistance of Various Stainless Steels in Acid Solutions

Alloy	Rockwell Hardness	48-Hour Corrosion Rate in mpy		
		20% nitric acid at 200°F (93°C)	5% sulfuric acid at 75°F (24°C)	50% acetic acid boiling
Type 410	C 45	8	1732*	266*
Type 431	C 45	3	1402*	43*
17Cr-4Ni	C 42	2	2	3
Custom 450	C 41	2	1	1
Type 304	B 80	1	11	1

*Several or all of subsequent 48-hour test periods showed nil rate.

Typical Results for Precracked Cantilever Beam Stress-Corrosion-Cracking Tests
Condition H 900

Test Media	Stress Intensity		Time to Fail
	ksi √in	Mpa √m	
Air	22.5	24.7	-
Air	23.7	26.0	-
3.5% NaCl (pH 3.6) at 75°F (24°C)	18.7	20.6	No failure in 1800-hr. test
3.5% NaCl (pH 3.6) at 75°F (24°C)	20.6	22.6	No failure in 1200-hr. test

Typical Results for U-Bend Stress-Corrosion Tests

Form	Condition	Rockwell C Hardness	Orientation	No. of Specimens Tested	Environment	Results
0.105" (2.67mm) strip	H 900	43	L to rolling direction	5	5% Salt Spray 95°F (35°C)	No cracking in 290-day test
0.105" (2.67mm) strip	H 900	43	T	4	5% Salt Spray 95°F (35°C)	No cracking in 290-day test
0.105" (2.67mm) strip	H 1000	39	L	5	5% Salt Spray 95°F (35°C)	No cracking in 290-day test
0.105" (2.67mm) strip	H 1000	39	T	4	5% Salt Spray 95°F (35°C)	No cracking in 290-day test
1-1/32" (26.2mm) round bar	H 900	40	L	5	5% Salt Spray 95°F (35°C)	No cracking in 220-day test
1-1/32" (26.2mm) round bar	H 1000	37	L	5	5% Salt Spray 95°F (35°C)	No cracking in 220-day test
0.125" (3.18mm) strip	H 900	41	T	5	Kure Beach, 80° Lot	No cracking in 15 years

Typical Stress-Corrosion-Cracking Resistance per NACE TM-01-77 (a)

Alloy	Condition	0.2% Yield Strength		Ultimate Tensile Strength		Rockwell C Hardness	Threshold Stress Level (b) as Percent of Yield Strength
		ksi	MPa	ksi	MPa		
Custom 450®	H 1150	82	565	132	910	28	52
17Cr-4Ni	H 1150M	107	738	132	910	29	30
Type 410	Hardened and Tempered 1200°F (649°C) + 1150°F (621°C)	94	648	115	793	20.5	15

(a) 5 w/o sodium chloride + 0.5 w/o acetic acid solution continuously purged with hydrogen sulfide at 75°F (24°C).

(b) The maximum tensile strength at which no failures occurred in 720 hours.

References:

(1) Burns, D.S., "Laboratory Test for Evaluating Alloys for H_2S Service," *H_2S Corrosion in Oil and Gas Production – A Compilation of Classic Papers,* eds. R.N. Tuttle and R.D. Kane, NACE, Houston, Texas, 1981.

(2) Pressouyre, G.M., Bretin, L., and Zmudzinski, C., "New Steels for Use in H_2S Environments," Corrosion 81, Paper No. 181, April 1981.

Typical Stress-Corrosion-Cracking Resistance in 3.5% NaCl (pH5.2), at 75°F (24°C)
Condition H 900

Applied Stress		Results
ksi	MPa	
169	1165	No failure in 1100-hour test
140	676	No failure in 1100-hour test

Properties

Physical Properties	
Specific Gravity	
Condition A	7.75
Condition H 900	7.76
Density	
Condition A	0.2800 lb/in^3
Condition H 900	0.2800 lb/in^3
Mean Specific Heat	
Condition H 900, 73°F, 216°F	0.1140 Btu/lb/°F
Mean Coefficient of Thermal Expansion	
75°F, 200°F, Condition A	5.88 x 10^{-6} in/in/°F
75°F, 300°F, Condition A	5.62 x 10^{-6} in/in/°F
75°F, 400°F, Condition A	5.68 x 10^{-6} in/in/°F
75°F, 500°F, Condition A	5.80 x 10^{-6} in/in/°F
75°F, 600°F, Condition A	5.91 x 10^{-6} in/in/°F
75°F, 700°F, Condition A	5.98 x 10^{-6} in/in/°F
75°F, 800°F, Condition A	6.09 x 10^{-6} in/in/°F
75°F, 900°F, Condition A	6.13 x 10^{-6} in/in/°F
75°F, 1000°F, Condition A	6.08 x 10^{-6} in/in/°F
75°F, 1100°F, Condition A	6.17 x 10^{-6} in/in/°F
75°F, 200°F, Condition H 900	6.00 x 10^{-6} in/in/°F
75°F, 300°F, Condition H 900	5.80 x 10^{-6} in/in/°F
75°F, 400°F, Condition H 900	5.91 x 10^{-6} in/in/°F
75°F, 500°F, Condition H 900	6.04 x 10^{-6} in/in/°F
75°F, 600°F, Condition H 900	6.22 x 10^{-6} in/in/°F
75°F, 700°F, Condition H 900	6.25 x 10^{-6} in/in/°F
75°F, 800°F, Condition H 900	6.37 x 10^{-6} in/in/°F
75°F, 900°F, Condition H 900	6.48 x 10^{-6} in/in/°F
75°F, 1000°F, Condition H 900	6.53 x 10^{-6} in/in/°F
75°F, 1100°F, Condition H 900	6.53 x 10^{-6} in/in/°F

Mean Coefficient of Thermal Expansion

Temperature		Condition A		Condition H 900	
75°F to	24°C to	10^{-6}/°F	10^{-6}/K	10^{-6}/°F	10^{-6}/K
200	93	5.88	10.58	6.00	10.80
300	149	5.62	10.12	5.80	10.44
400	204	5.68	10.22	5.91	10.64
500	260	5.80	10.44	6.04	10.87
600	316	5.91	10.64	6.22	11.20
700	371	5.98	10.76	6.25	11.25
800	427	6.09	10.96	6.37	11.47
900	482	6.13	11.03	6.48	11.66
1000	538	6.08	10.94	6.53	11.75
1100	593	6.17	11.11	6.53	11.75

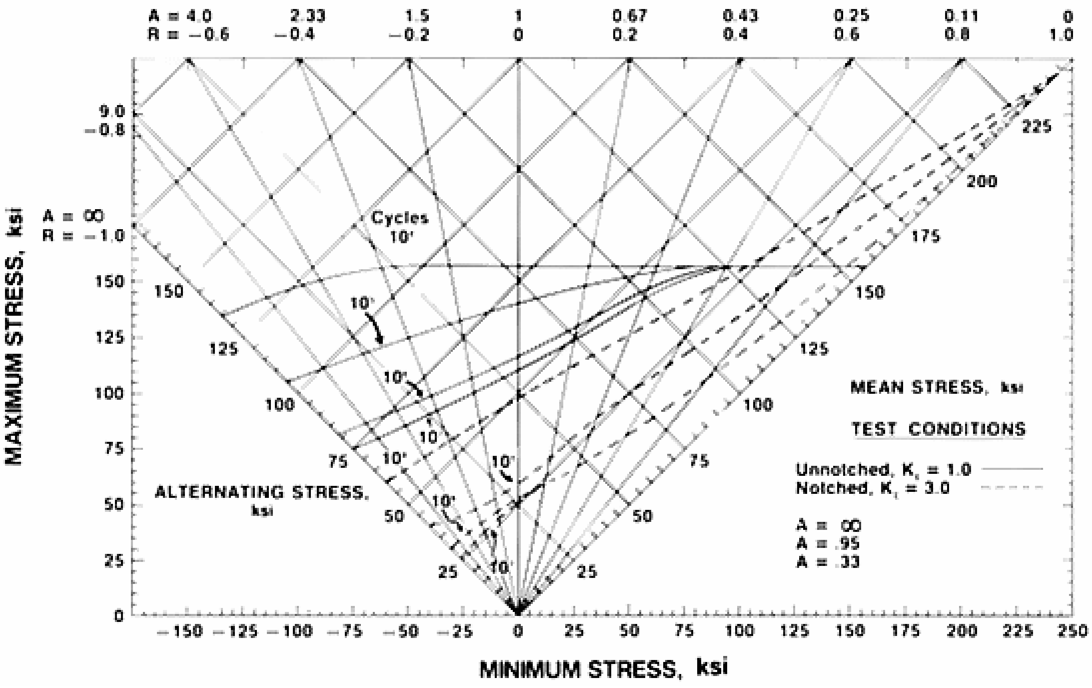
Thermal Conductivity	
73°F, Condition H 900	104.0 BTU-in/hr/ft^2/°F
212°F, Condition H 900	110.0 BTU-in/hr/ft^2/°F
392°F, Condition H 900	126.0 BTU-in/hr/ft^2/°F
572°F, Condition H 900	138.0 BTU-in/hr/ft^2/°F
752°F, Condition H 900	147.0 BTU-in/hr/ft^2/°F
932°F, Condition H 900	169.0 BTU-in/hr/ft^2/°F

Thermal Conductivity - Condition H 900

Test Temperature		Btu·in/ft²·h·°F	W/m·K
°F	°C		
73	23	104	15.0
212	100	110	16.4
392	200	126	18.2
572	300	138	19.9
752	400	147	21.3
932	500	169	24.4

Poisson's Ratio	
Condition H 900	0.290
Modulus of Elasticity (E)	
Condition A	28.0 x 10^3 ksi
Condition H 900	29.0 x 10^3 ksi
Modulus of Rigidity (G)	
Condition H 900	11.2 x 10^3 ksi
Electrical Resistivity	
70.0°F, Condition A	597.0 ohm-cir-mil/ft
70.0°F, Condition H 900	509.0 ohm-cir-mil/ft
Typical Mechanical Properties	

Typical Constant Life Fatigue Diagram for Custom 450 Stainless Bar in the H 1050 Condition at Room Temperature (Axial tests using longitudinal specimens)



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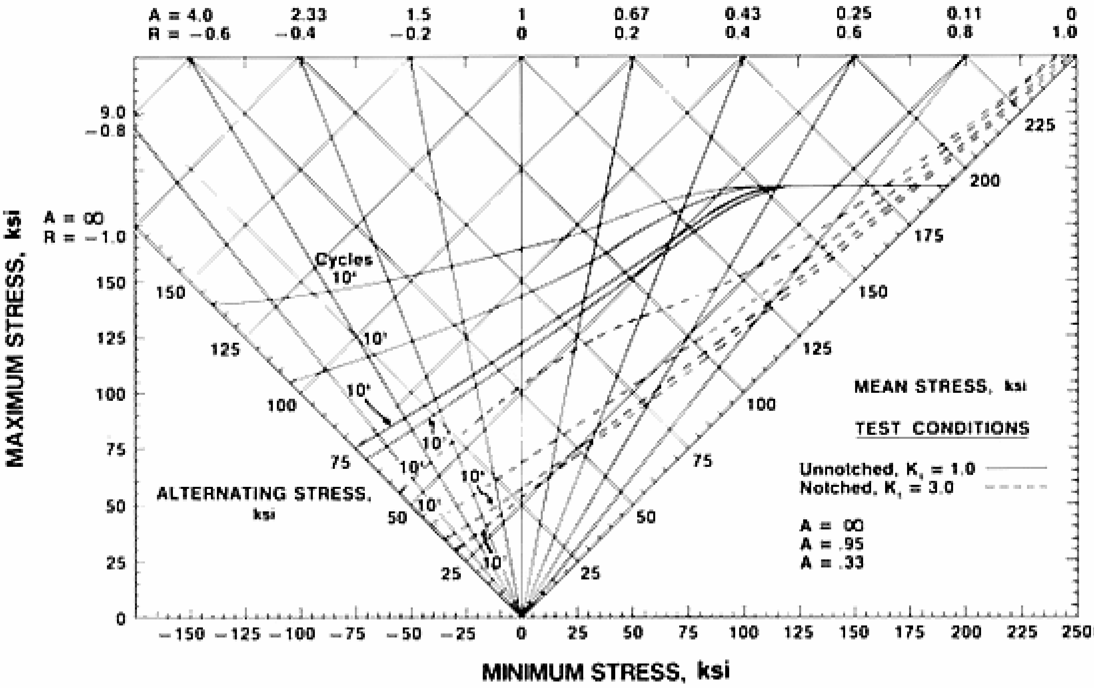
(Axial tests using longitudinal specimens)



Typical Cryogenic and Elevated Temperature Mechanical Properties
1" (25.4 mm) round bar

Condition	Test Temperature		0.2% Yield Strength		Ultimate Tensile Strength		Notch Tensile Strength K_t = 10		% Elongation In 4D	% Reduction of Area	Charpy V-Notch Impact Strength	
	°F	°C	ksi	MPa	ksi	MPa	ksi	MPa			ft-lb	J
A	-320	-196	179	1234	207	1427	310	2137	17	47	30	41
H 900			249	1717	260	1793	85	586	5	8	1	1
H 1050			205	1413	223	1538	226	1558	22	58	5	7
H 1150			136	938	219	1510	249	1717	30	55	36	49
A	-100	-73	128	883	158	1089	251	1731	15	50	68	92
H 900			207	1427	216	1489	257	1772	16	56	4	5
H 1050			167	1151	180	1241	283	1951	21	65	41	56
H 1150			96	662	166	1145	240	1655	25	67	66	89
A	0	-18	120	827	148	1020	235	1620	15	53	90	122
H 900			194	1338	205	1413	306	2110	15	57	16	22
H 1050			160	1103	170	1172	267	1841	21	66	64	87
H 1150			93	641	154	1062	220	1517	24	69	85	115
H 900	600	316	138	951	160	1103	—	—	12	48	40	54
H 950			140	965	152	1048	—	—	12	49	50	68
H 1050			125	862	133	917	—	—	14	54	82	111
H 1150			97	669	112	772	—	—	17	62	103	140
H 900	800	427	131	903	150	1034	—	—	12	45	42	57
H 950			130	896	143	986	—	—	12	45	54	73
H 1050			115	793	121	834	—	—	13	49	82	111
H 1150			92	634	106	731	—	—	16	57	98	133
H 900	1050	566	76	524	84	579	—	—	24	75	66	89
H 950			78	538	85	586	—	—	27	74	67	91
H 1050			70	483	78	538	—	—	30	77	83	113
H 1150			67	462	81	559	—	—	26	68	97	132

Typical Double Restrained Shear Strength
1-1/16" (27 mm) Rd. to 12" (305 mm) Sq. sections, Longitudinal

Test Temperature		Condition			
		H 900		H 1050	
°F	°C	ksi	MPa	ksi	MPa
-100	-73	138	952	117	807
RT		122	841	100	690
400	204	103	710	87	600
600	316	95	655	80	552
800	427	85	586	71	490

Typical Double Restrained Shear Strength in Condition A at RT in 87 ksi (600 MPa)

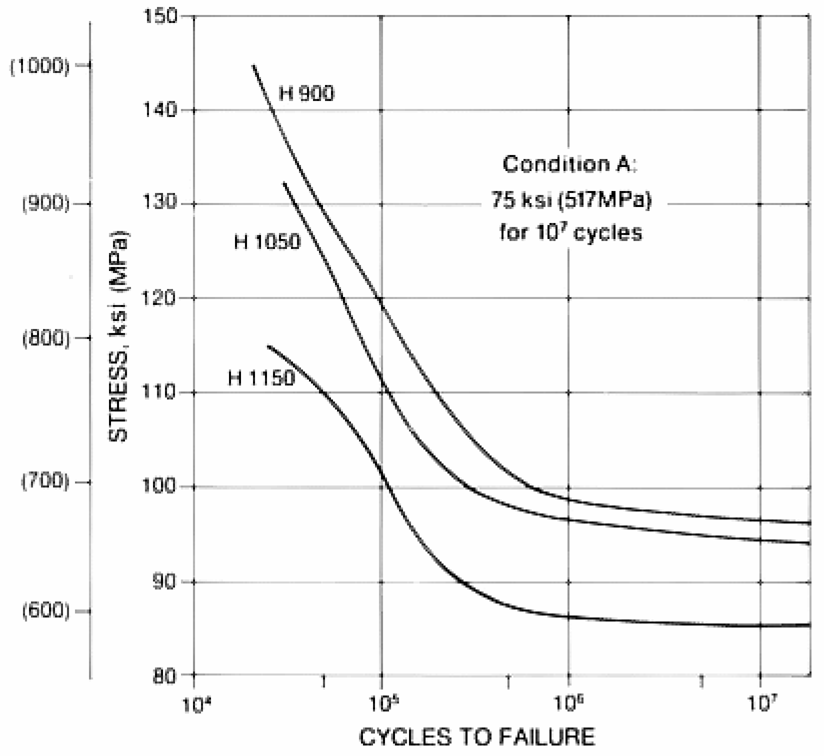
Typical Room Temperature Mechanical Properties
1" (25.4 mm) round bar

Condition	0.2% Yield Strength		Ultimate Tensile Strength		Notch Tensile Strength $K_t = 10$		% Elongation in 4D	% Reduction of Area	Rockwell C Hardness	Charpy V-Notch Impact Strength	
	ksi	MPa	ksi	MPa	ksi	MPa				ft-lb	J
A	118	814	142	979	221	1524	13	50	28	98	133
H 900	188	1296	196	1351	298	2055	14	56	42½	40	54
H 950	184	1269	187	1289	288	1986	16	58	41½	47	64
H 1000	169	1165	173	1193	273	1882	17	63	39	51	69
H 1050	152	1048	160	1103	255	1758	20	66	37	69	94
H 1150	92	634	142	979	209	1441	23	69	28	97	132

Room-Temperature Mechanical Properties – Custom 450® Stainless
0.58" thick strip

Condition	Orientation	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	Rockwell Hardness (HRC)
		ksi	MPa	ksi	MPa		
Strand	L	109	751	140	965	7	28.5
Annealed	T	111	765	142	979	7	-
	L	185	1275	190	1310	8	41.5
H 900	T	187	1289	192	1323	7	-
	L	177	1220	179	1234	9	40.5
H 950	T	179	1234	181	1248	8	-
	L	164	1130	167	1151	11	38
H 1000	T	164	1130	167	1151	10	-
	L	148	1020	156	1075	12	36
H 1050	T	148	1020	156	1075	11	-
	L	117	806	141	972	14	33
H 1100	T	120	827	144	993	13	-
	L	87	600	140	965	14	30
H 1150	T	90	620	140	965	13	-

Typical Rotating Beam Fatigue Strength
R.R. Moore specimens from 1.125" (28.6 mm) rod bar



Heat Treatment

Solution Treatment

Condition A (Solution Treated or Annealed)

Heat to 1875/1925°F (1024/1052°C), hold one hour at heat and cool rapidly. Water quenching or oil quenching is preferred for optimum response to aging, but air quenching is suitable for thin sections.

Custom 450 stainless will normally be supplied from the mill in Condition A, ready for service or for subsequent age-hardening.

Average Size Change (Contraction)
Solution annealed to aged condition

Condition	Contraction in./in. (m/m)	
	Longitudinal	Transverse
H 900	0.0003	0.0007
H 1000	0.0006	0.0008
H 1150	0.0038	0.0040

Age

Condition H 900, H 950, H 1000, H 1050, H 1150 (Precipitation or Age Hardenend)

Tensile strength and yield strength are increased by aging at 900/1050°F (482/566°C) for 4 hours, followed by air cooling. The 900°F (482°C) age produces the optimum combination of strength, ductility, and toughness. Overaging at temperatures up to 1150°F (621°C) increases the ductility and decreases strength.

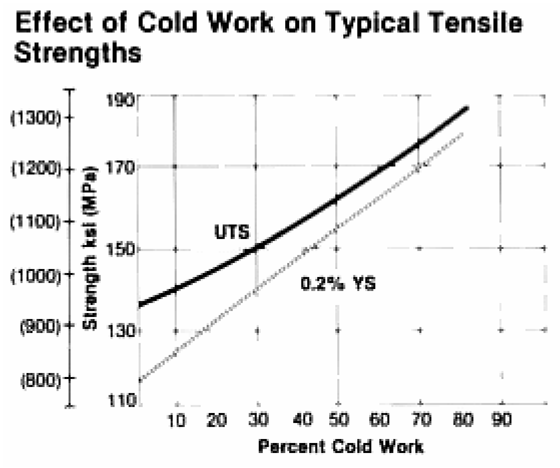
Workability

Hot Working

This alloy is easily hot worked in the temperature range of 1650/2300°F (900/1260°C). The optimum hot-working range is 2100/2150°F (1150/1177°C) for the best combination of ease of working and fine grain size. Cool forgings in air to room temperature and anneal.

Cold Working

The work-hardening rate of Custom 450 alloy is relative low, permitting a good deal of cold reduction without intermediate annealing. Deep-drawing or stretching operations with sharp bends which produce localized elongation are to be avoided.



Machinability

Custom 450 stainless has been machined successfully using the same practices employed with other martensitic stainless steels at comparable hardness levels.

Following are typical feeds and speeds for Custom 450 stainless.

Typical Machining Speeds and Feeds – Custom 450® 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				
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm)			Feed (ipr)
					Brazed	Throw Away	Coated	
Solution Treated								
.150 .025	M2, T5, T15	70 90	.015 .007	C6 C7	250 300	310 350	400 475	.015 .007
Aged H1150 H1100								
.150 .025	M2, T5, T15	65 75	.015 .007	C6 C7	235 250	290 310	350 425	.015 .007
Aged H1000 H1050								
.150 .025	T15, M41, M42, M43, M44	55 65	.015 .007	C6 C7	220 270	250 300	325 375	.010 .005
Aged H900 H950								
.150 .025	T15, M41, M42, M43, M44	35 40	.010 .005	C6 C7	135 170	170 200	225 260	.010 .005

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
Solution Treated									
M2, T15	C6	70 200	.001 .003	.0015 .0045	.002 .006	.0015 .003	.001 .0025	.001 .0025	.0005 .0015
Aged H1100 H1150									
M2, T15	C6	75 200	.001 .003	.0015 .003	.002 .0045	.0015 .003	.001 .002	.001 .002	.0005 .002
Aged H1000 H1050									
T15, M42	C6	60 155	.001 .003	.001 .003	.0015 .0045	.0015 .003	.001 .002	.001 .002	.0005 .002
Aged H900 H950									
T15, M42	C6	30 110	.001 .0025	.001 .0025	.0015 .004	.0015 .0025	.001 .0015	.001 .0015	.0005 .0015

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
Solution Treated									
M7	60	C2	190	.003	.005	.008	.011	.015	.018
Aged H1100 H1150									
M7	65	C2	200	.003	.005	.008	.011	.015	.018
Aged H1000 H1050									
T15	45	C2	150	.003	.004	.006	.010	.013	.016
Aged H900 H950									
T15	35	C2	125	.001	.001	.001	.001	.001	.001

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
Solution Treated									
M1, M10	50	.001	.002	.004	.007	.008	.010	.012	.015
Aged H1100 H1150									
T15, M42	45	.001	.002	.004	.007	.008	.010	.012	.015
Aged H1000 H1050									
T15, M42	35	-	.002	.004	.007	.008	.010	.012	.015
Aged H900 H950									
T15, M42	25	-	.001	.002	.003	.004	.004	.004	.004

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
Solution Treated				
M1, M2, M7, M10	5 – 12	8 – 15	10 – 20	15 – 25
Aged				
T15, M42	4 – 8	6 – 10	8 – 12	10 – 15

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
Solution Treated												
.050	M2, M7	85	.001	.002	.003	.004	C2	275	.001	.002	.004	.006
Aged H1100 H1150												
.050	M2, M7	80	.001	.002	.003	.004	C2	225	.001	.002	.004	.006
Aged H1000 H1050												
.050	M2, M7	70	.0005	.001	.002	.003	C2	195	.001	.002	.003	.004
Aged H900 H950												
.050	M2, M7	60	.0005	.001	.002	.003	C2	90	.001	.002	.003	.004

Tapping

High Speed Tools	
Tool Material	Speed (fpm)
Solution Treated	
M1, M7, M10	12 – 25
Aged H1100 H1150	
M1, M7, M10	15 – 20
Aged H1000 H1050	
M1, M7, M10	10 - 20
Aged H900 H950	
M1, M7, M10 Nitrided	5 – 15

Broaching

High Speed Tools		
Tool Material	Speed (fpm)	Chip Load (ipt)
Solution Treated		
T15, M42	15	.002
Aged H1100 H1150		
T15, M42	10	.002
Aged H1000 H1050		
T15, M42	8	.002
Aged H900 H950		
T15, M42	8	.002

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 Custom 450 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. Unlike other martensitic stainless steels, no preheating is required to prevent cracking during the welding of this alloy. Normally, the alloy is welded in the solution-annealed condition; however, where high welding stresses are anticipated, it may be advantageous to weld in the overaged (H 1150) condition. If welded in the solution-annealed condition, the alloy can be used as welded or can be aged directly to the desired strength level after welding. However, the optimum combination of strength, ductility and corrosion resistance is obtained by solution annealing the welded part prior to use of aging. If welded in the overaged condition, the part must be solution annealed before aging.

Brazing

The brazing temperature should coincide with the annealing temperature range so that reannealing is not necessary. Brazing materials suitable for Type 304 should be used. See ASTM B 260.

Other Information

Descaling (Cleaning)

Descaling following forging and annealing can be accomplished by acid cleaning or grit blasting. The acid treatment consists of 2 minutes in 50% by volume muriatic acid at 180°F (82°C), followed by 4 minutes in a mixture of 15% by volume nitric acid, plus 3% by volume hydrofluoric acid at room temperature. Water rinse and desmut in 20% by volume nitric acid at room temperature. Repeat cleaning procedure as necessary but decrease the times by 50% (i.e., 1 and 2 minutes, respectively).

The heat tint from aging can be removed by polishing, vapor blasting or pickling 4 or 6 minutes in a mixture of 15% by volume nitric acid, plus 3% by volume hydrofluoric acid, followed by a water rinse. Repeat the acid cleaning procedure if necessary, but decrease the time by 2 to 3 minutes. Desmut in 20% by volume nitric acid at room temperature.

After acid cleaning, bake 1 to 3 hours at 300/350°F (149/177°C) to remove hydrogen.

Applicable Specifications

- AMS 5763
- AMS 5773
- AMS 5863 (Strip)
- ASTM A564 (XM-25)
- ASTM A693 (Strip)
- ASTM A959
- MR0175

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- Bar-Squares
- Billet
- Plate
- Sheet
- Strip
- Weld Wire
- Wire-Shapes

Technical Articles

- A Designer's Manual On Specialty Alloys For Critical Automotive Components
- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Advanced Stainless Offers High Strength, Toughness and Corrosion Resistance Wherever Needed
- 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
- New Ph Stainless Combines High Strength, Fracture Toughness and Corrosion Resistance
- New Stainless Steel for Instruments Combines High Strength and Toughness
- Passivating and Electropolishing Stainless Steel Parts
- Selecting Stainless Steels for Valves
- Selection of High Strength Stainless Steels for Aerospace, Military and Other Critical Applications
- Unique Properties Required of Alloys for the Medical and Dental Products Industry

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