Technical Datasheet

CarTech® 617 Alloy

Identification

UNS Number

• N06617

Work Number

• 2.4663

Type Analysis

Single figures are nominal except where noted.

Carbon	0.05 to 0.15 %	**Manganese (Maximum)**	1.00 %
Sulfur (Maximum)	0.015 %	**Silicon (Maximum)**	1.00 %
Chromium	20.00 to 24.00 %	**Nickel**	Balance
Molybdenum	8.00 to 10.00 %	**Copper (Maximum)**	0.50 %
Cobalt	10.00 to 15.00 %	**Titanium (Maximum)**	0.60 %
Aluminum	0.80 to 1.50 %	**Boron (Maximum)**	0.006 %
Iron (Maximum)	3.00 %		

General Information

Description

CarTech 617 alloy is a corrosion and oxidation-resistant, high temperature nickel-chromium-cobalt-molybdenum alloy. CarTech 617 alloy is solid-solution strengthened by Co and Mo. Oxidation resistance is imparted through the chromium and aluminum additions.

Typical applications have included gas turbine engine ducting and combustion liners. In addition, the alloy has been specified to a lesser degree by the chemical processing industry due to its resistance to numerous types of aqueous corrosive environments.

Corrosion Resistance

Pyromet Alloy 617 has withstood a wide range of oxidizing and reducing corrosive environments. Pyromet 617 is highly resistant to natural atmospheres that include industrial and marine environments. The high nickel and chromium content plus aluminum addition offer resistance to oxidizing environments whereas molybdenum improves resistance under reducing conditions. Additionally, pitting and crevice corrosion resistance are improved by molybdenum. At high temperatures, these elements confer protection from oxidation and carburization.

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	Excellent	Sulfuric Acid	Good
Phosphoric Acid	Excellent	Acetic Acid	Excellent
Sodium Hydroxide	Excellent	Salt Spray (NaCl)	Excellent
Sea Water	Excellent	Sour Oil/Gas	Excellent
Humidity	Excellent		

Properties

Physical Properties

Density	0.3020	lb/in³
Mean Specific Heat	0.1000	Btu/lb/°F

Mean CTE	
200°F	7.00 x 10 -6 in/in/°F
400°F	7.20 x 10 -6 in/in/°F
600°F	7.40 x 10 -6 in/in/°F
800°F	7.60 x 10 -6 in/in/°F
1000°F	7.70 x 10 -6 in/in/°F
1200°F	8.00 x 10 -6 in/in/°F
1400°F	8.40 x 10 -6 in/in/°F
1600°F	8.70 x 10 -6 in/in/°F
1800°F	9.00 x 10 -6 in/in/°F
2000°F	9.20 x 10 -6 in/in/°F

Mean Coefficient of Thermal Expansion – Pyromet® Alloy 617

Temperature		Coefficient	
°F	°C	10^{-6}/°F	10^{-6}/°C
78	26	-	-
200	93	7	12.6
400	204	7.2	13.0
600	316	7.4	13.3
800	427	7.6	13.7
1000	538	7.7	13.9
1200	649	8	14.4
1400	760	8.4	15.1
1600	871	8.7	15.7
1800	982	9	16.2
2000	1093	9.2	16.6

Thermal Conductivity	
78°F	94.00 BTU-in/hr/ft²/°F
200°F	101.0 BTU-in/hr/ft²/°F
400°F	113.0 BTU-in/hr/ft²/°F
600°F	125.0 BTU-in/hr/ft²/°F
800°F	137.0 BTU-in/hr/ft²/°F
1000°F	149.0 BTU-in/hr/ft²/°F
1200°F	161.0 BTU-in/hr/ft²/°F
1400°F	173.0 BTU-in/hr/ft²/°F
1600°F	185.0 BTU-in/hr/ft²/°F
1800°F	197.0 BTU-in/hr/ft²/°F
2000°F	209.0 BTU-in/hr/ft²/°F

Thermal Conductivity – Pyromet® Alloy 617

Test Temperature		Btu-in/ft² · hr · °F	W/m · K
°F	°C		
78	26	94	14
200	93	101	16
400	204	113	16
600	316	125	18
800	427	137	20
1000	538	149	22
1200	649	161	24
1400	760	173	26
1600	871	185	26
1800	982	197	28
2000	1093	209	30

Poisson's Ratio

70°F	0.300
200°F	0.300
400°F	0.300
600°F	0.300
800°F	0.300
1000°F	0.300
1200°F	0.300
1400°F	0.300
1600°F	0.300
1800°F	0.310
2000°F	0.320

Poisson's Ratio – Pyromet® Alloy 617

Test Temperature		Poisson's Ratio
°F	°C	
70	26	0.30
200	93	0.30
400	204	0.30
600	316	0.30
800	427	0.30
1000	538	0.30
1200	649	0.30
1400	760	0.30
1600	871	0.30
1800	982	0.31
2000	1093	0.32

Modulus of Elasticity (E)	
74°F	30.6 x 10 ³ ksi
200°F	30.0 x 10 ³ ksi
400°F	29.0 x 10 ³ ksi
600°F	28.0 x 10 ³ ksi
800°F	26.9 x 10 ³ ksi
1000°F	25.8 x 10 ³ ksi
1200°F	24.6 x 10 ³ ksi
1400°F	23.3 x 10 ³ ksi
1600°F	21.9 x 10 ³ ksi
1800°F	20.5 x 10 ³ ksi
2000°F	18.8 x 10 ³ ksi

Modulus of Elasticity – Pyromet® Alloy 617

Temperature		Elastic Modulus		Shear Modulus	
°F	°C	10^3 ksi	GPa	10^3 ksi	GPa
74	23	30.6	210.8	11.8	81.3
200	93	30	206.7	11.6	79.9
400	204	29	199.8	11.2	77.2
600	316	28	192.9	10.8	74.4
800	427	26.9	185.3	10.4	71.7
1000	538	25.8	177.8	9.9	68.2
1200	649	24.6	169.5	9.5	65.5
1400	760	23.3	160.5	9	62.0
1600	871	21.9	150.9	8.4	57.9
1800	982	20.5	141.2	7.8	53.7
2000	1093	18.8	129.5	7.1	48.9

Modulus of Rigidity (G)	
74°F	11.8 x 10 ³ ksi
200°F	11.6 x 10 ³ ksi
400°F	11.2 x 10 ³ ksi
600°F	10.8 x 10 ³ ksi
800°F	10.4 x 10 ³ ksi
1000°F	9.90 x 10 ³ ksi
1200°F	9.50 x 10 ³ ksi
1400°F	9.00 x 10 ³ ksi
1600°F	8.40 x 10 ³ ksi
1800°F	7.80 x 10 ³ ksi
2000°F	7.10 x 10 ³ ksi

Electrical Resistivity	
78°F	736.0 ohm-cir-mil/ft
200°F	748.0 ohm-cir-mil/ft
400°F	757.0 ohm-cir-mil/ft
600°F	764.0 ohm-cir-mil/ft
800°F	770.0 ohm-cir-mil/ft
1000°F	779.0 ohm-cir-mil/ft
1200°F	793.0 ohm-cir-mil/ft
1400°F	807.0 ohm-cir-mil/ft
1600°F	803.0 ohm-cir-mil/ft
1800°F	824.0 ohm-cir-mil/ft

Electrical Resistivity – Pyromet® Alloy 617

Temperature		ohm-circ-mil/ft	μΩ•cm (micro-ohm•cm)
°F	°C		
78	26	736	122
200	93	748	124
400	204	757	126
600	316	764	127
800	427	770	128
1000	538	779	130
1200	649	793	132
1400	760	807	134
1600	871	803	133
1800	982	824	137

Melting Range	2430 to 2510 °F

Typical Mechanical Properties

Elevated Temperature Tensile Properties – Pyromet® Alloy 617

Temperature		0.2% Yield Strength		Ultimate Tensile Strength		% Elongation In 4D
°F	°C	Ksi	MPa	Ksi	MPa	
100	38	49	336	109	755	61
200	93	43	297	102	707	60
400	204	36	251	96	663	60
600	316	35	238	93	643	61
800	427	34	234	91	629	63
1000	538	34	235	88	610	64
1200	649	36	250	85	587	60
1400	760	39	272	77	534	52
1600	871	39	269	52	358	43
1800	982	18	125	25	173	69

Stress Rupture Properties – Pyromet® Alloy 617

Test Temperature		Average Stress for Rupture in:					
		100 Hours		1000 Hours		10,000 Hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1100	593	78	537	62	427	50	345
1200	649	57	393	46	317	37	255
1400	760	30	207	22	152	16	110
1500	816	21	145	14	96	10	69
1600	871	13	90	8	55	5	34
1700	927	9	62	6	41	--	--
1800	982	6	41	--	--	--	--
1900	1038	--	--	--	--	--	--
2000	1093	--	--	--	--	--	--

Typical Room Temperature Mechanical Tensile Properties – Pyromet® Alloy 617

Form	Condition	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation In 4D	% Reduction Of Area
		Ksi	MPa	Ksi	MPa		
Plate	Hot Rolled	46.7	322	106.5	734	62	56
Bar	Hot Rolled	46.1	318	111.5	769	56	50
Strip	Cold Rolled	50.9	351	109.5	755	58	-

Heat Treatment

Pyromet Alloy 617 has two basic heat treatments:

(1) High Solution Anneal – 2050 to 2150°F (1121 to 1177°C), air quench or faster.

(2) Process Anneal – 1900°F (1038°C), air quench or faster.

The time at the above temperatures depends on volume and thickness.

Treatment No. 1 is used for product that will be exposed to high-temperature-in-service applications. The coarse grain size offers an improvement in stress rupture properties. To achieve both low-cyclic fatigue and stress-rupture performance, the anneal temperature should be lowered to 2050°F (1121°C).

Treatment No. 2 is applied between cold forming operations where a finer grain size is desired. 1900°F (1038°C) reduces grain growth and improves formability. Due to the high work hardening rate, the alloy should be process annealed between large cold drafts.

Workability

Hot Working

Pyromet Alloy 617 possesses good formability. Heavy reductions may be carried out between 1850 and 2200°F (1010-1205°C). Light reductions can be carried out to temperatures as low as 1700°F (926°C). Work pieces that fall below this temperature should be reheated. Hot forming characteristics are similar to Pyromet Alloy 625.

Cold Working

Pyromet Alloy 617 can be cold formed by standard methods. For best results, a fine grain size condition is preferred. When the material becomes too stiff from cold working, ductility can be restored by process anneals (see previous section).

Machinability

Low cutting speeds, rigid tools and work piece, heavy equipment, ample coolant and positive feeds are general recommendations.

Weldability

Pyromet Alloy 617 is a weldable, nickel-base superalloy. Welding can be accomplished by the gas-shielded processes using a tungsten electrode or a consumable electrode. Postweld heat treatments of the weld are not necessary to maintain corrosion resistance. The weld's mechanical properties follow the same trends as base metal properties. Standard practices such as clean surfaces, good joint alignment, U-joints for thicker sections, etc., should be followed.

Other Information

Applicable Specifications

- AMS 5887
- ASTM B564
- ASTM B166

Forms Manufactured

- Billet

Edition Date: 12/20/10

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