Technical Datasheet

CarTech® 600 Alloy

Identification

UNS Number

• N06600

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.10 %	**Manganese (Maximum)**	1.00 %
Sulfur (Maximum)	0.015 %	**Silicon (Maximum)**	0.50 %
Chromium	14.00 to 17.00 %	**Nickel (Minimum)**	72.00 %
Copper (Maximum)	0.50 %	**Iron**	6.00 to 10.00 %

General Information

Description

CarTech 600 alloy is a nonmagnetic, nickel-base high temperature alloy possessing an excellent combination of high strength, hot and cold workability and resistance to ordinary forms of corrosion.

This alloy also displays good heat resistance and freedom from aging or stress corrosion throughout the annealed to heavily cold worked condition range.

Corrosion Resistance

The high chromium content of Pyromet alloy 600 raises its oxidation resistance considerably above that of pure nickel, while its high nickel content provides good corrosion resistance under reducing conditions.

This alloy exhibits high levels of resistance to fresh and salt water, exhaust gases, and most organic acids and compounds.

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	Excellent	Salt Spray (NaCl)	Good
Sea Water	Moderate	Sour Oil/Gas	Moderate
Humidity	Excellent		

Properties

Physical Properties

Specific Gravity	8.43	
Density	0.3070	lb/in³
Mean Specific Heat (77 to 212°F)	0.1090	Btu/lb/°F

Mean CTE		
70 to 200°F	7.40	x 10^{-6} in/in/°F
70 to 400°F	7.70	x 10^{-6} in/in/°F
70 to 600°F	7.90	x 10^{-6} in/in/°F
70 to 800°F	8.10	x 10^{-6} in/in/°F
70 to 1000°F	8.40	x 10^{-6} in/in/°F
70 to 1200°F	8.60	x 10^{-6} in/in/°F
70 to 1400°F	8.90	x 10^{-6} in/in/°F
70 to 1600°F	9.10	x 10^{-6} in/in/°F

Mean coefficient of thermal expansion

70°F to	21°C to	Coefficient	
		10^{-6}/°F	10^{-6}/°C
200	93	7.4	13.3
400	204	7.7	13.9
600	316	7.9	14.2
800	427	8.1	14.6
1000	538	8.4	15.1
1200	649	8.6	15.5
1400	760	8.9	16.0
1600	871	9.1	16.4

Thermal Conductivity	104.0	BTU-in/hr/ft²/°F
Modulus of Elasticity (E)		
Tension and Compression	31.0	x 10^{3} ksi
Torsion and Compression	11.0	x 10^{3} ksi
Electrical Resistivity (77°F)	620.0	ohm-cir-mil/ft
Melting Range	2540	°F

Typical Mechanical Properties

Effect of Cold Reduction on Hardness—Pyromet Alloy 600

% Cold Reduction	Approximate Hardness (Vickers Hardness Number)
0	140
5	170
10	200
20	250
30	275
40	290
50	310
60	315
70	320

Stress Rupture Properties—Pyromet Alloy 600

Temperature		Stress to Produce Rupture in:					
		10 hours		100 hours		1000 hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
Cold Drawn, Annealed—3 Hours/1750°F (954°C)/Air Cooled							
1000	538	74	510	50	345	34	234
1200	649	34	234	23	159	14.5	100
1400	760	13	90	8.4	58	5.6	39
1600	871	7.5	52	4.8	33	3	21
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	2.4	17	—	—
Hot Rolled, Annealed—2 Hours/1650°F (899°C)							
1350	732	20	138	13.5	93	9.2	63
1600	871	8.1	56	5.3	37	—	—
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	1.4	10	—	—
Solution Annealed—20 Hours/2050°F (1121°C)/Air Cooled							
1350	732	19	131	14	97	9.8	68
1500	816	11.5	79	8	55	5.6	39
1600	871	8	55	5.3	37	—	—
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	1.4	10	—	—
2100	1149	1.6	11	1.1	8	—	—

Typical Elevated Temperature Tensile Properties—Pyromet Alloy 600

Temperature		Tensile Strength		0.2% Yield Strength		% Elongation in 2" (50.8 mm)
°F	°C	ksi	MPa	ksi	MPa	
600	316	90.5	624	31.0	214	46
800	427	88.5	610	29.5	203	49
1000	538	84.0	579	28.5	196	47
1200	649	65.0	448	26.5	183	39
1400	760	27.5	190	17.0	117	46
1600	871	15.0	103	9.0	62	80
1800	982	7.5	52	4.0	28	118

Typical Mechanical Properties—Pyromet Alloy 600

Various forms and conditions

Form and Condition	Tensile Strength		0.2% Yield Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Rockwell Hardness
	ksi	MPa	ksi	MPa			
Rod and Bar							
Cold-drawn							
Annealed	80-100	552-689	25-50	172-345	55-35	70-60	65-85B
As-drawn	105-150	724-1034	80-125	552-862	30-10	60-30	90B-30C
Hot rolled							
Annealed	80-100	552-689	30-50	207-345	55-35	70-60	65-85B
As-rolled	85-120	586-827	35-90	241-621	50-30	65-50	75-95B
Hot-finished	85-120	586-827	35-90	241-621	50-30	65-50	75-95B
Wire							
Cold-drawn							
Annealed	80-105	552-724	25-50	172-345	50-25	——	——
Strip							
Annealed	80-100	552-689	30-45	207-310	55-35	——	84B max.

Heat Treatment

Pyromet alloy 600 is not an age hardening alloy; cold working is the only available means of hardening.

Softening by annealing begins at about 1600°F (871°C), and is reasonably complete after ten to fifteen minutes of heating at 1800°F (982°C). Above this temperature, grain growth may be objectionable, although very brief heating at 1900°F (1038°C) will cause complete softening without undue grain growth.

Since the rate of cooling has no effect on the softening, the material may be water quenched or air cooled.

Workability

Hot Working

Low sulfur reducing furnace atmospheres should be used in forging. Major hot working should be done between 2300/1850°F (1260/1010°C), while light working may be continued as low as 1600°F (871 °C). No hot working should be attempted between 1600/1200°F (871/649 °C) due to lower ductility in that range.

Cold Working

For higher properties, Pyromet alloy 600 can be cold worked below 1200°F (649°C).

Machinability

Pyromet alloy 600 is machinable in both the hot worked and annealed conditions. Because considerable heat is generated in machining this alloy, high-speed steel, cast nonferrous or cemented carbide tools should be used. The tools should be kept sharp.

Lathe turning speeds with high-speed and nonferrous tools are 35/45 sfm (0.18/0.23 m/s); speeds with cemented carbide tools are 100/175 sfm (0.51/0.89 m/s). (This data should be used as a guide for initial machine setup only. The figures used are averages. On certain work, the nature of the part may require adjustment of speeds and feeds.)

Sulfur-base oil should be used as a lubricant, but should be completely removed before the machined part is exposed to elevated temperatures, as in welding.

Weldability

Pyromet alloy 600 can be joined by the usual welding, brazing, and soldering processes.

Other Information

Applicable Specifications

- AMS 5540
- AMS 5580
- AMS 5665
- MIL-N-15721
- MIL-N-22986
- MIL-N-22987
- MIL-N-23228
- MIL-N-23229
- MIL-N-6710
- MIL-N-6840
- QQ-W-390

Forms Manufactured

- Bar-Rounds
- Billet
- Strip
- Wire

Edition Date: 02/01/1989