Technical Datasheet

CarTech® X-750 Alloy

Identification

UNS Number

• N07750

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.08 %	**Manganese (Maximum)**	0.30 %
Sulfur (Maximum)	0.010 %	**Silicon (Maximum)**	0.50 %
Chromium	14.00 to 17.00 %	**Copper (Maximum)**	0.50 %
Cobalt (Maximum)	1.00 %	**Titanium**	2.25 to 2.70 %
Aluminum	0.40 to 1.00 %	**Columbium + Tantalum**	0.70 to 1.20 %
Nickel + Cobalt (Minimum)	70.00 %	**Iron**	5.00 to 9.00 %

*Cobalt concentration is a "If determined."

General Information

Description

CarTech X-750 alloy is a precipitation -hardenable alloy which is highly resistant to chemical corrosion and oxidation and has high stress-rupture strength and low creep rates under high stresses at temperatures up to 1500°F (816°C) after suitable heat treatment.

Applications

This alloy has been used in applications such as high temperature structural members for gas turbines, jet engine parts, nuclear power plant applications, heat-treating fixtures, forming tools, and extrusion dies.

Corrosion Resistance

Pyromet Alloy X-750 possesses excellent resistance to chloride ion stress-corrosion cracking. It exhibits satisfactory resistance to numerous oxidizing environments. The alloy has similar corrosion resistance to Pyromet Alloy 600 in many media.

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

Properties

Physical Properties

Density	0.3000	lb/in³
Mean Specific Heat		
77 to 212°F	0.1000	Btu/lb/°F
77 to 1652°F	0.1300	Btu/lb/°F

Specific heat	Btu/lb•°F	kJ/kg•K
77/212°F (25/100°C)	0.10-0.11	0.42-0.46
77/1650°F (25/899°C)	0.13	0.54

Mean CTE	
80 to 200°F	6.70 x 10^{-6} in/in/°F
80 to 600°F	7.50 x 10^{-6} in/in/°F
80 to 1000°F	7.90 x 10^{-6} in/in/°F
80 to 1200°F	8.10 x 10^{-6} in/in/°F
80 to 1600°F	9.00 x 10^{-6} in/in/°F

Coefficient of Thermal Expansion

Temperature		10^{-6}/°F	10^{-6}/°C
80°F to	26.7°C to		
200	93	6.7	12.1
600	316	7.5	13.5
1000	538	7.9	14.2
1200	649	8.1	14.6
1600	871	9.0	16.2

Thermal Conductivity		
300°F	117.0	BTU-in/hr/ft²/°F
600°F	142.0	BTU-in/hr/ft²/°F
1000°F	184.0	BTU-in/hr/ft²/°F
1200°F	199.0	BTU-in/hr/ft²/°F
1400°F	218.0	BTU-in/hr/ft²/°F
1600°F	245.0	BTU-in/hr/ft²/°F

Thermal Conductivity

Temperature		Btu-in/ft²•hr•°F	W/m•K
°F	°C		
300	149	117	16.9
600	316	142	20.5
1000	538	184	26.5
1200	649	199	28.7
1400	760	218	31.4
1600	871	245	35.3

Modulus of Elasticity (E)		
80°F	31.0	x 10^{3} ksi
500°F	28.7	x 10^{3} ksi
1000°F	25.0	x 10^{3} ksi
1350°F	21.0	x 10^{3} ksi
1501°F	18.5	x 10^{3} ksi

Modulus of Elasticity

Temperature		psi x 10^{6}	MPa x 10^{3}
°F	°C		
80	26.7	31.0	213.7
500	260.0	28.7	197.9
1000	538.0	25.0	172.4
1350	732.0	21.0	144.8
1500	816.0	18.5	127.6

Electrical Resistivity		
73°F, Hot Rolled	764.0	ohm-cir-mil/ft
73°F, Solution Treated	716.0	ohm-cir-mil/ft
73°F, Solution Treated + Aged	746.0	ohm-cir-mil/ft

Electrical Resistivity

Condition	ohm-cir mil/ft	microhm-mm
	At Room Temperature	
Hot Rolled	764	1270
Solution Treated	716	1190
Solution Treated & Aged	746	1240

Melting Range 2540 to 2600 °F

Typical Mechanical Properties

Bar Stock:
Treatment #1
Solution treatment 2100°F (1149°C), 2 to 4 hrs., air cool
Intermediate age 1550°F (843°C), 24 hrs., air cool
Final age 1300°F (704°C), 20 hrs., air cool

Test Temperature		Short-Time Tensile Properties Tests					
		Yield Strength 0.2% offset		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
°F	°C	ksi	MPa	ksi	MPa		
70	21.1	92	634	161	1110	22	30
1000	538.0	83	572	140	965	20	30
1200	649.0	82	565	120	827	10	21
1400	760.0	68	469	80	552	10	22
1500	816.0	45	310	47	324	20	32

Stress-rupture data—Treatment #1

Test Temperature		Stress for Rupture in*					
		10 Hours		100 Hours		1000 Hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1100	593	130	896	110	758	90	621
1200	649	90	621	80	552	69	476
1350	732	60	414	49	338	38	262
1500	816	34	234	26	179	16	110

*Approximate values

Treatment #2
Stress equalization 1625°F (885°C), 24 hrs., air cool
Precipitation age 1300°F (704°C), 20 hrs., air cool

Test Temperature		Short-Time Tensile Properties Tests					
		Yield Strength 0.2% offset		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
°F	°C	ksi	MPa	ksi	MPa		
70	21.1	125	862	178	1227	23	35
800	427.0	112	772	162	1117	23	34
1000	538.0	111	765	157	1082	22	31
1200	649.0	110	758	142	979	10	15
1400	760.0	96	662	99	683	10	15

Heat Treatment

Pyromet alloy X-750 is austenitic under all conditions. The alloy is heat treated by several different methods depending upon the application or requirement. Two common treatments are:

1. For maximum creep, relaxation and rupture strength at temperatures above 1100°F (593°C):

Solution Treatment - 2100°F (1149°C), 2 to 4 hrs., air cool
Intermediate Age - 1550°F (843°C), 24 hrs., air cool
Final Age - 1300°F (704°C), 20 hrs., air cool

2. For highest room temperature yield strength and tensile ductility:

Stress Equalization - 1625°F (885°C), 24 hrs., air cool
Precipitation Age - 1300°F (704°C), 20 hrs., air cool

Workability

The furnace temperature should be 2100°F (1149°C) - for optimal starting temperatures of 1950/2000°F (1066/1093°C). For service below 1100°F (593°C), higher strength can be obtained by combining some cold work with heat treatment because the effects are additive.

Machinability

Pyromet alloy X-750 work hardens quickly and is more difficult to machine than most standard ferritic and martensitic alloys. The alloy is most easily machined in the stress-equalized condition. Because specific cutting forces are high, the machine tools used must have ample power and the cutting speed should be slow. The tools must have smooth finishes, be sharp, and be very rigid. To avoid work hardening, a continuous, smooth cutting action should be maintained; thus, the machines must have a minimum of backlash and the tool and workpiece must be rigidly supported. If at all possible, avoid very small cuts and feeds.

Weldability

Pyromet alloy X-750 should be welded in the stress-equalized condition, 1625°F (885°C) heat treatment, and solution treated and age hardened after welding has been completed. If this is not practical, the alloy should be welded in the solution-treated condition and age hardened after welding with or without the inclusion of a short-period stress-relieving treatment at 1625°F (885°C). Weld joints, because of softening of the alloy within the heat-affected zone, should be located where lower creep properties are required.

Other Information

Applicable Specifications

- AMS 5667
- AMS 5668
- AMS 5669
- AMS 5670
- AMS 5671
- MIL-N-8550 Condition E

Forms Manufactured

- Bar-Rounds
- Billet
- Strip

Technical Articles

- Trends in High Temperature Alloys

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