Technical Datasheet

CarTech® CTX-3 Alloy

Identification

UNS Number

• N19907

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.05 %	**Manganese (Maximum)**	0.50 %
Phosphorus (Maximum)	0.015 %	**Sulfur (Maximum)**	0.015 %
Silicon (Maximum)	0.50 %	**Chromium (Maximum)**	0.50 %
Nickel	37.00 to 39.00 %	**Copper (Maximum)**	0.50 %
Cobalt	13.00 to 15.00 %	**Titanium**	1.25 to 1.75 %
Aluminum (Maximum)	0.25 %	**Columbium + Tantalum**	4.50 to 5.50 %
Boron (Maximum)	0.012 %	**Iron**	Balance

General Information

(Pyromet Alloy 907)

Description

CarTech CTX-3 alloy is a high strength, precipitation hardenable superalloy which exhibits a low coefficient of thermal expansion over a broad temperature range. This alloy also possesses high hot hardness and good thermal fatigue resistance.

CarTech CTX-3 alloy is weldable, brazable, and can be chromium plated.

This material offers significant improvement in notched stress-rupture strength over CarTech CTX-1 alloy. Retained hot-cold work is not required for good stress rupture properties and, in contrast to CarTech CTX-1 alloy, is not affected by stress orientation.

Applications

CarTech CTX-3 alloy has been used for compressor and exhaust casings, seals and other gas turbine engine components. It also has excellent characteristics . . . and should be considered . . . for applications such as:

Ordnance hardware
Gauge blocks
Rocket engine thrust chambers
Steam turbine blades
Springs
Die casting dies

In addition, this material could be considered for use in applications requiring resistance to thermal fatigue in noncorrosive environments.

Corrosion Resistance

Pyromet alloy CTX-3 contains only residual levels of chromium in order to achieve the desired expansion properties. As a result, it is readily oxidized and should be coated to prevent oxidation. Chromium plating may be used.

Properties

Physical Properties

Specific Gravity	8.28	
Density	0.2991	lb/in³

Mean CTE	
77 to 500°F	4.25 x 10^{-6} in/in/°F
77 to 700°F	4.15 x 10^{-6} in/in/°F
77 to 780°F	4.20 x 10^{-6} in/in/°F

Mean coefficient of thermal expansion
Treated 1800°F (982°C) 1 hr, AC plus 1425°F (774°C) 12 hr, cooled at 100°F (56°C)/hr to 1150°F (621°C), held 8 hr, AC

Temperature Range		Coefficient	
°F	°C	microinches/inch • °F	micrometers/meter • °C
77-500	25-260	4.25	7.70
77-700	25-371	4.15	7.50
77-780*	25-416*	4.20	7.50

*Inflection temperature - approx. 780°F (416°C)

Modulus of Elasticity (E) (In Tension)	23.2 x 10^{3} ksi
Inflection Temperature	780 °F

Magnetic Properties

Pyromet alloy CTX-3 is ferromagnetic from below room temperature to approximately 750°F (399°C). Above 750°F (399°C) it is essentially nonmagnetic.

Typical Mechanical Properties

Typical Mechanical Properties when Heat Treated for Optimum Mechanical Properties - Pyromet Alloy CTX-3
Room Temperature Tensile Properties

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
ksi	MPa	ksi	MPa		
120	830	172	1180	14	23

Tensile Properties at 1000°F (538°C)

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
ksi	MPa	ksi	MPa		
98	673	151	1040	16	39

Stress Rupture Life @ 1000°F/120 ksi (538°C/828 MPa) - 210 hours.*

*Note on Stress Rupture Properties: K_t = 2, low stress ground samples. (Properties are degraded if lathe-turned notches are used.)

Typical Mechanical Properties when Heat Treated for Optimum Properties if Brazing Cycles Over 1800°F (982°C) are to be Employed - Pyromet Alloy CTX-3
Room Temperature Tensile Properties

0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
ksi	MPa	ksi	MPa		
110	760	168	1160	9	14

Stress Rupture Life @ 1000°F/110 ksi (538°C/758 MPa) - 2000 hours.*

*Note on Stress Rupture Properties: K_t = 2, low stress ground samples. (Properties are degraded if lathe-turned notches are used.)

Heat Treatment

The optimum heat treatment of Pyromet alloy CTX-3 varies with property requirements:

Heat Treatment for Optimum Mechanical Properties

Warm worked material is solution treated at 1800°F (982°C) for 1 hour and air cooled. Age at 1425°F (774°C) for 12 hours, furnace cool at 100°F (56°C) per hour to 1150°F (621 °C) for 8 hours, then air cool.

Heat Treatment for Optimum Properties if Brazing Cycles Over 1800°F (982°C) are to be Employed

Warm worked material is solution treated prior to brazing at 1900°F (1038°C) for 1 hour and air cooled. Age at 1475°F (802°C) for 16 hours, furnace cool at 100°F (56°C) per hour to 1150°F (621 °C) for 8 hours. Air cool after the brazing cycle.

Note that properties are generally degraded relative to material heat treated for optimum mechanical properties.

Workability

Hot Working

Forging is typically performed at 1900°F (1038°C).

Properties appear to be improved if finish forging is carried out at approximately 1700°F (927°C) and with 40-50% reduction, resulting in a warm worked structure prior to solution annealing.

Machinability

Pyromet alloy CTX-3 can be machined in either the solution treated or the age hardened condition. Machine tools should have ample power and rigidity and speeds should be slow. Machinability is similar to Pyromet alloy 718.

Higher cutting speeds and longer tool life are attainable in the solution treated condition.

Weldability

Welding characteristics are similar to Pyromet alloy 718. Loss of high temperature strength and ductility in the welded area and heat-affected zones are not as severe as in Pyromet alloy CTX-1, however, some loss can be expected.

Brazing

Brazing at 1800°F (982°C) results in higher mechanical properties than brazing at 1900°F (1038°C) or above.

Other Information

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- Bar-Shapes
- Billet
- Wire

Technical Articles

- New Requirements for Ferrous-Base Aerospace Alloys

Edition Date: 08/01/1990

Visit us on the web at www.cartech.com