Technical Datasheet

CarTech® 901 Alloy

Identification

UNS Number

• N09901

AISI Number

• 681 and 682

DIN Number

• 2.4662

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.10 %	**Manganese (Maximum)**	1.00 %
Silicon (Maximum)	0.60 %	**Chromium**	11.00 to 14.00 %
Nickel	40.00 to 45.00 %	**Molybdenum**	5.00 to 7.00 %
Copper (Maximum)	0.50 %	**Titanium**	2.35 to 3.10 %
Aluminum (Maximum)	0.35 %	**Boron**	0.010 to 0.020 %
Iron	Balance		

General Information

Description

CarTech 901 alloy is a chromium nickel-iron base superalloy designed for high strength and corrosion resistance in the temperature range of 1000/1400°F (538/760°C). It is hardened by the precipitation of nickel, titanium and aluminum compounds of the Ni3 (Al, Ti) type.

Applications

CarTech 901 alloy has been used for components in aircraft and gas turbines, such as turbine rotors, compressor discs, hubs, and shafts.

Corrosion Resistance

Pyromet alloy 901 has good corrosion resistance to the atmospheres normally found in jet engine operations. It has slightly lower scaling resistance than such alloys as AISI Types 309 and 310 stainless steels.

Properties

Physical Properties

Density	0.2970	lb/in³
Mean CTE		
80 to 200°F	7.75	x 10 $^{-6}$ in/in/°F
80 to 400°F	7.85	x 10 $^{-6}$ in/in/°F
80 to 600°F	8.02	x 10 $^{-6}$ in/in/°F
80 to 800°F	8.27	x 10 $^{-6}$ in/in/°F
80 to 1000°F	8.50	x 10 $^{-6}$ in/in/°F
80 to 1200°F	8.79	x 10 $^{-6}$ in/in/°F
80 to 1400°F	9.15	x 10 $^{-6}$ in/in/°F
80 to 1500°F	9.43	x 10 $^{-6}$ in/in/°F

Mean coefficient of thermal expansion

Temperature		Coefficient	
80°F to	26.7 °C to	10^{-6}/°F	10^{-6}/°C
200	93	7.75	13.9
400	204	7.85	14.1
600	316	8.02	14.4
800	427	8.27	14.9
1000	538	8.50	15.3
1200	649	8.79	15.8
1400	760	9.15	16.5
1500	816	9.43	17.0

Thermal Conductivity		
109°F	93.00	BTU-in/hr/ft²/°F
333°F	99.00	BTU-in/hr/ft²/°F
476°F	107.0	BTU-in/hr/ft²/°F
680°F	113.0	BTU-in/hr/ft²/°F
855°F	122.0	BTU-in/hr/ft²/°F
1000°F	127.0	BTU-in/hr/ft²/°F
1200°F	134.0	BTU-in/hr/ft²/°F
1400°F	142.0	BTU-in/hr/ft²/°F

Thermal conductivity

Temperature		Btu-in/ft² • hr • °F)	W/m • K
°F	°C		
109.4	43	93	13.4
333	167	99	14.3
476	246	107	15.4
680	360	113	16.3
855	457	122	17.6
1000	538	127	18.3
1200	649	134	19.3
1400	760	142	20.5

Modulus of Elasticity (E)		
75°F	29.9	x 10 ³ ksi
400°F	28.5	x 10 ³ ksi
600°F	26.5	x 10 ³ ksi
800°F	25.9	x 10 ³ ksi
1000°F	24.2	x 10 ³ ksi
1200°F	22.1	x 10 ³ ksi

Modulus of elasticity

Temperature		psi x 10^6	MPa x 10^3
°F	°C		
75	23.9	29.9	206
400	204	28.5	197
600	316	26.5	183
800	427	25.9	179
1000	538	24.2	167
1200	649	22.1	152

Melting Range	2250 to 2580	°F

Magnetic Properties

Magnetic Permeability (200 Oe)	1.0080	Mu

Typical Mechanical Properties

Creep Strength—Pyromet Alloy 901

Solution Treated: 2000°F (1093°C), 2 hours, water quenched. Stabilized: 1425°F (774°C), 4 hours, air cooled. Aged: 1350°F (732°C), 24 hours, air cooled.

Test Temperature		Stress to Produce 0.1% Creep in 100 Hrs.	
°F	°C	ksi	MPa
1000	538	105	724
1200	649	73	503
1400	760	27	186

Stress Rupture Strength—Pyromet Alloy 901

Solution Treated: 2000°F (1093°C), 2 hours, water quenched. Stabilized: 1425°F (774°C), 4 hours, air cooled. Aged: 1350°F (732°C), 24 hours, air cooled.

Test Temperature		Stress to Produce Rupture in					
		10 Hours		100 Hours		1000 Hours	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
1000	538	–	–	120	827	100	689
1200	649	96.5	665	90	621	75	517
1350	732	60	414	51	352	33	228
1500	816	35	241	22.5	155	11	76

Typical Tensile Properties—Pyromet Alloy 901

Solution Treated: 2000°F (1093°C), 2 hours, water quenched. Stabilized: 1425°F (774°C), 4 hours, air cooled. Aged: 1350°F (732°C), 24 hours, air cooled.

Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area
°F	°C	ksi	MPa	ksi	MPa		
70	21.1	125.0	862	175	1207	15.0	19.0
800	427	116.5	803	159	1096	16.0	25.5
1000	538	113	779	156	1076	17.0	29.0
1200	649	117	807	150	1034	14.0	21.0
1300	704	114	786	130	896	11.5	15.5
1400	760	102.5	707	107.5	741	9.0	14.5
1500	816	79	545	81	558	13.0	20.0

Heat Treatment

Solution Treatment

1800/2025°F (982/1107°C), hold 2 hours at heat, and water quench.

Age

1300/1375°F (704/746°C), hold for 24 hours, and air cool.

Stabilizing

1400/1475°F (760/802°C), hold 2 to 4 hours, and air cool.

Workability

Hot Working

Pyromet alloy 901 is forged between 2050°F (1121°C) and 1850°F (1010°C). Light hot work may be continued down to 1600°F (871°C), but not below. Metal temperature should not exceed 2050°F (1121°C) during rapid working.

Billets should be charged into a hot furnace and heated rapidly through the precipitation hardening range.

Machinability

Pyromet alloy 901 can be successfully machined in all heat treated conditions. Best machinability is provided by over aging. However, partial aging, as by air cooling from a solution treatment, may be satisfactory for most applications. Drilling and tapping may require the lowest possible hardness, i.e., water quenched from a solution treatment. For turning, high speed steel tool bits should be adequate, but cemented carbide tools may be more cost effective if the alloy is in the hardened (fully aged) condition.

It is important that machine set-ups be as rigid as possible. Care must be exercised to obtain a positive cutting action at all times because "glazing" and work hardening of surfaces will hinder additional machining.

Weldability

Pyromet alloy 901 can be welded by the inert-gas-arc method. It is difficult to weld. All welding should be done in the solution treated condition. Cold worked parts should be re-solution treated before welding. A re-solution treatment is recommended after welding before stabilizing and aging.

Other Information

Applicable Specifications

AMS 5660 and 5661
PWA 1022
PWS 1003
GE B50A305

- AMS 5660
- AMS 5661

Forms Manufactured

- Bar-Rounds
- Billet
- Strip
- Wire

Technical Articles

- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Selection of Age-Hardenable Superalloys
- Trends in High Temperature Alloys

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