Ualloy718 (Alloy 718)

Alloy 718 refers to Inconel 718 , UNS N07718 belongs to nickel based alloy.
The body-centered square γ "phase and the face-centered cubic γ" phase are the main strengthening phases. It has high strength, plasticity and excellent corrosion resistance in a wide medium and cryogenic temperature range from-253 to 700°C(-487 -1292°F).

Inconel718| Alloy 718 Chemical Composition

	Ni	Fe	Mn	C	Si	S	Cr	Al	Ti	Nb+Ta	Mo	P	Co	Pb	Se	Bi	Ca	B	Mg
Min	50	Balance					17	0.4	0.8	4.87	2.8								
Max	55		0.35	0.045	0.35	0.01	21	0.6	1.15	5.2	3.3	0.01	1	0.001	0.0005	0.00005	0.003	0.006	0.006

Inconel718| Alloy 718 Material Properties

Grade	Density	Melting Point	Mechanical Properties				
			Tensile strength	Yield Strength	Elongation	Reduction of area	Hardness
						Thickness≤10in(254mm)	Thickness＞10in(254mm)	
120K	8.193	1321-1393°C 2410-2359°F	1034Mpa min 150KSI	827-1000Mpa 120-145Ksi	20	35	25	32-40HRC
140K			1138Mpa min 165KSI	965-1034Mpa 140-150Ksi	20	35	25	34-40HRC

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150K			1207Mpa min 175KSI	1034-1207Mpa 150-175Ksi	20	35	25	35-45HRC

Inconel718| Alloy 718 Impact

QTC Cross-section Thickness in. (mm)	Orientation	Minimum Average ft-lbs (J)			Minimum Single ft- lbs (J)			Minimum Lateral Expansion in. (mm)		
		120K	140K	150K	120K	140K	150K	120K	140K	150K
<3 (76)	Longitudinal	50 (68)			45 (61)			0.015 (0.38)		
⩾3(76) through 10 (254)	Transverse	35 (47)			30 (41)			0.015 (0.38)		
>10 (254)	Transverse	30 (41)			27 (37)			0.015 (0.38)		

Inconel718| Alloy 718 Applications

Pumps
Wellhead completion equipment
Hangers
Valve stem

Inconel718| Alloy 718 Thermal Conductivity

θ/°C	11	100	200	300	400	500	600	700	800	900	1000
W/(m·°C)	13.4	14.7	15.9	17.8	18.3	19.5	21.2	22.8	23.6	27.6	30.4

Inconel718| Alloy 718 Coefficient of Thermal Expansion

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θ/°C	20-100	20-200	20-300	20-400	20-500	20-600	20-700	20-800	20-900	20-1000
α	11.8	13	13.5	14.1	14.4	14.8	15.4	17.0	18.4	18.7

Inconel718| Alloy 718 Modulus of Elasticity

θ/°C	20	100	200	300	400	450	500	550	600	650	700
E/GPa	204	/	/	181	176	/	160	160	150	146	141

Inconel718| Alloy 718 Structure-Phase Transition Temperature

γ "phase is the main strengthening phase, and its peak stable temperature is 650°C, the initial solid solution temperature is 840-870°C, and the complete solid solution temperature is 950°C.

γ 'phase is also the strengthening phase of the alloy718, but the amount is less than γ' phase, its precipitation temperature is 600°C, the complete dissolution temperature is 840°C.

δ phase: Initial precipitation temperature of is 700°C, precipitation peak temperature is 940°C, the dissolution begins at 980°C, and the complete dissolution temperature is 1020°C.

Inconel718| Alloy 718 Heat Treatment

API 6ACRA-2015	Solution	Age Hardening
120K	1870 °F to 1925 °F (1024 °C to 1052 °C), hold 1 hr. to 2.5 hrs., Cool at rate equivalent to air cool or faster.	1425 °F – 1475 °F (774 °C to 802 °C) for 6-8 hrs (cool in air, inert gas, water, polymer or oil to ambient temperature).

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140K		1400 °F – 1475 °F (760 °C to 802 °C) for 6-8 hrs (cool in air, inert gas, water, polymer or oil to ambient temperature)
150K		1292 °F – 1382 °F (700 °C to 750 °C) for 8 hrs minimum, furnace cool to 1112 °F – 1202 °F (600 °C to 650 °C) and hold for 8 hrs minimum (air cool).

Inconel718| Alloy 718 machining

Despite its excellent fatigue resistance, oxidation resistance, and corrosion resistance, machining of alloy 718 is not a simple task. It belongs to the hardest of nickel-based alloys and Inconel 718 is a typically process-sensitive alloy.

The main problems are: poor thermal conductivity, high cutting temperature, large cutting force, serious work hardening phenomenon, more hard points, low processing efficiency, serious tool wear, high cutting cost.

Process	SMM	SFM
Turning	40-55	130-180
Drilling	35-50	110-160
Parting	25-35	80-110

Inconel718| Alloy 718 Machining Tool

Tool Type	Application

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High Spped Steel	Complex surface processing Low cutting speed
High Speed Steel Containing Cobalt	
Carbide Cutting Tool	The cutting speed is higher than that of high speed steel
	Semi-finishing and finishing
Silicon nitride ceramics	Continuous cutting
PCBN tool	Continuous cutting

Inconel718| Alloy 718 etchant for macrostructure

Macrostructure examination-Approved etchants	
Option	Composition
A: Canada's Etchant	100ml H2SO4, 100ml HF, 50ml HNO3, 400ml H2O Etch at 160℉ to 180℉ （71℃ to 82℃）
B: Aqua Regia	200ml HCl, 100ml HNO3
C: Kalling's No.2 (Waterless Kalling's)	200ml Methanol, 200ml HCl, 10g CuCl2
D: Hydrochloric-Peroxide	H2O2(30%) 100ml, HCl 200ml, H2O 300ml Remove stains with 50% HNO3
E: Dilute Heated Aqua Regia	250 ml HCl, 10 to 20ml HNO3 Etch at 140℉ to 165℉ （60℃ to 74℃）

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Inconel718| Alloy 718 etchant for microstructure

Microstructure examination-Approved etchants	
Option	Composition
A:Kalling's No.2 (Waterless Kalling's) B: Seven Acids	200ml Methanol, 200ml HCl, 10g CuCl2 300ml HCl, 60ml HNO3, 60ml H3PO4, 30ml 40%HF, 30ml H2SO4, 30g FeCl3(anhydrous), 60ml CH3COOH, 300 ml H2O
C: diluted Glyceregia	10 ml glycerol, 150ml HCl, 15ml HNO3
D: Bromine-Methanol	Clean in HCl before etching in immersed 1% to 3% Bromine, Methanol
E: Nitric-HCl Option	10ml HNO3, 60ml HCl Composition
A:Kalling's No.2 (Waterless Kalling's)	200ml Methanol, 200ml HCl, 10g CuCl2 300ml HCl, 60ml HNO3, 60ml H3PO4, 30ml 40%HF, 30ml H2SO4, 30g FeCl3(anhydrous), 60ml CH3COOH, 300 ml H2O

Inconel is a trademark of high-performance nickel-based alloys developed by Special Metals Corporation.

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