Inconel 718 Alloy

The **Inconel 718 alloy** offers high strength and resistance to corrosion properties at the various temperatures from -423oF to 1300oF. The age hardened alloy is easily formed. The welding properties and resistance to cracking are excellent. An easy to form and economical inconel 718 alloy offers high tensile strength, fatigue strength, creeping resistance and stress rupturing properties that are widely useful in the different applications.

Chemical composition of Inconel 718 Alloy

Ni	Cr	Fe	No (& Ta)	Mo	Ti	Al	Co	C	Mn	Si	P	S	B	Cu
50-55	17-21	Bal	4.75-5.50	2.80-3.30	0.65-1.15	0.20-0.80	1	0.08	0.35	0.35	0.015	0.015	0.006	0.30

Physical Properties of Inconel 718 Alloy

Density of annealed alloy 718	0.296 lb/in3
Density of annealed and aged alloy 718	0.297 lb/in3
Melting Point	2300-2437oF, 1260-1336oC
Specific Heat at 70oF, Btu/lb oF	0.104 (435)
Curie Temperature of annealed welding alloy	<-320 oF , <-196oC
Curie Temperature annealed and aged alloy	-170oF (-112oC)
Permeability at 200 oersted and 70oF of Annealed Material	1.0013

The modulus of elasticity offered by **Inconel 718 alloy** at the low temperature is shown below:

Temperature, oF	Modulus of Elasticity, ksi x 10(3)		Poisson's Ratio
	Young's Modulus	Torsional Modulus	
-308	31.3	12.5	0.25
-86	30.6	11.8	0.30
70	29.0	11.6	0.29
100	29.8	11.5	0.30
200	29.4	11.3	0.31

The thermal features of **Inconel 718 alloy** at the various temperatures are shown below:

Temp, oF	Thermal Conductivity, BTU•in/ft 2 •h•oF		Electrical Resistivity, A ohm circ mil/ft, Ann. 1800oF/1 hr	Mean Linear Expansion, in/in/oF x 10-6
	Ann. 1800°F/1 hr	Ann. + Aged		
70	77	79	753	-
200	86	87	762	7.31
400	98	100	772	7.53
600	111	112	775	7.74
800	123	124	784	7.97
1000	135	136	798	8.09
1200	147	148	805	8.39

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Mechanical Properties of Inconel 718 alloy

The mechanical features, modulus of elasticity and other features vary on the base of chemical composition and environments in which the alloy is subjected.

The room temperature mechanical properties of Inconel 718 alloy are shown in the following table:

Heat Treatment	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %	Reduction of Area %
As-Rolled	140.0	85.7	46	58
1750°F/1 hr	140.0	83.0	45	49
1950°F/1 hr	117.5	48.5	58	64
1750°F/1 hr, Age	208.0	180.0	21	39
1950°F/1 hr, Age	194.0	157.0	23	34

Metallurgy

To get the highest potential from alloy 718, it is used in the solution annealed and precipitated toughened form. It is hardened by precipitation of second phase of the metal. The alloy precipitation is obtained by heat work up to 1100oF to 1500oF. To perform the metallurgical processes, the presence of aging metals like aluminum, titanium and niobium is important in the solution phase. For instance if these metals are precipitated in other phase, the required precipitation doesn't occur as desired. Then full strength from the alloy cannot be obtained. Therefore initially the alloy should be heat processed. The recommended heat processing methods for Inconel alloy 718 welding wire are explained as following:

1. Solution annealed at 1700-1850oF followed by the quick quenching often in the water as well as precipitation toughening at 1325oF for 8 hours, furnace quenching to 1150oF for the complete aging for 18 hours and then air quenching is performed.
2. Solution annealing at 1900oF to 1950oF then quick quenching, often in the presence of water and precipitaton toughening is performed at 1400oF for 10 hours. The furnace quenching to 1200oF sustained at 1200oF for the complete aging period of 20 hours subsequent to air quenching.

In order to perform the machining, forming or welding of Inconel 718, it is taken in the mill annealing or stress relieved form and then formed in the malleable form. Subsequent to fabrication, the heat processing is essential on the base of particular specification.

Annealing and aging of Inconel 718

The annealing at 1700oF to 1850oF with the aging processing is necessary for heat processing of inconel 718 when the blend of rupturing strength and ductility are considered. The maximum room temperature tensile strength and yield strength are also based on this processing. Moreover due to the growth of fine grain, it provides large fatigue strength.

The alloy 718 obtained in this form meets the following criteria: 1900oF to 1950oF annealing with the particular aging to get the tensile controlled operations as it develops the excellent transverse ductility in the heavy parts. The high impact strength and lower temperature notch tensile strength are obtained.

The rate of furnace quenching during aging is not significant however the rate of 100oF per hour is recommended in few cases. The suggested complete period should be calculated. The features of the heat processed alloy are noticed. Due to annealing for half hour at the variable temperatures, the effect on the grain size is observed. The aging sensitivity of Niobium-aluminum-titanium toughened **Inconel 718 alloy** is comparatively lesser than the aluminum-titanium toughened alloys. Therefore in most of the specifications, Inconel 718 can be heated and quenched by aging temperature limit at the standard paces while retaining the sleekness and ductility.

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Inconel 718 - Resistance to corrosion

Inconel 718 alloy provides excellent resistance to corrosion in the diverse environments. It offers similar resistance to that of nickel chromium alloy.Due to presence of nickel it offers significant resistance to the organic and inorganic compounds. The alloy 718 gives excellent resistance to acidity and alkaline media and chloride ion stress corrosion cracking. Due to presence of chromium it is capable to adhere in oxidizing conditions and sulfur compounds. Molybdenum element gives resistance to pitting corrosion in the various conditions.

Popular heat processing

We produce the Inconel alloy 718 products for employing in the oil based applications. It is manufactured by following the NACE specification that requires the solution annealed and aged alloy to fulfill the utmost toughness requirements of 40 Rockwell. Inconel 718 is solution heat processed at 1850oF to 1900oF and then its aging is performed at 1450oF for 6-8 hours and then it is air quenched.

Tensile Characteristics of Inconel 718

Different proprietary heat processes are used for Inconel alloy 718 on the base of needed features. The heating methods are often extended to meet the demand of clients.

The following table determines the mechanical features of this material:

Condition	Diameter, in.(mm)	Tensile Strength, ksi (Kg/cm2)min.	Yield Strength, ksi (Kg/cm2)		Elongation in 2 in. (50.8 mm) or4D% minimum	Reduction of Area, % Min.	Impact Strength, ft•lb (Kg•m) min. aver.
			Min.	Max.			
Cold worked, solution annealed & aged	0.5 (12.7) to 3 (76.2),	150 (10,545)	120 (8436)	140 (9842)	20	25	40 (5.55)
Hot worked solution annealed & aged	0.5 (12.7) to 8 (203.2),	150 (10,545)	120 (8436)	140 (9842)	20	25	40 (5.55)
Hot worked solution annealed & aged	8 (203.2) to 10 (254)	150 (10,545)	120 (8436)	140 (9842)	20	25	40 (5.55)

The features of hot rolled round Inconel 718 alloy that is annealed at temperature of 1750o or 1950oF are shown in the following table:

Annealing Temp, oF	Test Orientation	Tensile Strength, Ksi	Yield strength, ksi	Elongation, %	Reduction of Area, %	Hardness
1750	L	135.5	77.5	45	49	-
1950	L	114.0	50.4	62	65	-
1750	L	117.5	55.0	53	52	90 Rb
1950	L	112.5	48.0	60	63	87 Rb
1750	L	125.5	71.5	45	49	97 Rb
1950	L	115.0	47.0	59	65	85 Rb

The room temperature tensile properties of Inconel 718 bar are shown in the following table:

Heat Treatment	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %	Reduction of Area %
As-Rolled	140.0	85.7	46	58
1750°F/1 hr	140.0	83.0	45	49
1950°F/1 hr	117.5	48.5	58	64
1750°F/1 hr, Age	208.0	180.0	21	39
1950°F/1 hr, Age	194.0	157.0	23	34

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The properties offered by the two unlike annealing and aging procedures in the hot rolled inconel 718 material are shown in the following table:

Temp, oF	Test Orientation	Tensile Strength,ksi	Yield Strength,ksi	Elongation, %	Reduced Area %	Hardness, Rc
Heat Treatment: 1750°F/1 hr, A.C. + 1325°F/8 hr, F.C. to 1150°F, Hold at 1150°F for Total Aging Time of 18 hr						
Room	Longitudinal	199.5	178.0	15.0	24.0	44
Room	Transverse	198.5	173.5	12.0	16.0	40
Heat Treatment: 1950°F/1 hr, A.C. + 1400°F/10 hr, F.C. to 1200°F, Hold at 1200°F for Total Aging Time of 20 hr						
Room	Longitudinal	197.0	164.0	17.0	23.0	44
Room	Transverse	192.0	165.0	19.0	24.0	44

The results of straight aging at 1325oF for 8 hours and then furnace cooling to 1150oF, kept at 1150oF for the complete aging period of 18 hours on the different configurations are shown in the following table:

Specimen	Tensile Strength, ksi	Yield Strength, ksi	Elongation,%	Reduced Area, %	Hardness, Rc
0.65625-in.diam.	206.5	189.5	19.0	34.5	42
0.625-in.-Diam.	206.5	179.5	22.0	45.5	41
0.625-in.-Diam	210.0	184.0	22.0	44.5	42
13/16-in.-Diam	209.0	181.0	22.0	43.0	43
1.25- x 1.25-in. Flat	227.5	210.0	17.0	40.8	44
1.5- x 175-in. Flat	215.0	172.0	19.0	35.0	42

The features of cold treated sheet that is aged at 1325oF for 8 hours then furnace cooling to 1150oF and sustained at this temperature for the complete aging period of 18 hours are described as following:

Thickness, in	Cold Reduction, %	Condition	Tensile Strength, ksi	Yield Strength, ksi
0.025	27	As Cold-Rolled	155.0	130.0
0.050	21	As Cold-Rolled	138.0	112.0
0.093	18	As Cold-Rolled	140.5	115.0
0.125	26	As Cold-Rolled	158.5	137.0
0.125	23	As Cold-Rolled	140.5	120.0
0.074	18.5	As Cold-Rolled	145.0	116.5
0.062	28	As Cold-Rolled	159.5	134.0

The following table shows the results of heat processing as described by AMS 5997 on the Inconel 718 that is used in the different thickness:

Thickness, in	Tensile Strength, ksi	Yield Strength, Ksi	Elongation, %
0.010	192.5	172.5	17
0.012	204.0	169.5	19
0.015	198.0	162.0	19
0.016	196.0	163.5	19
0.018	196.5	155.5	21
0.021	202.5	169.0	20
0.025	199.0	162.5	20
0.031	197.0	160.0	21

Essentially the hardness is not noticed in the initial 2-3 minutes of subjecting the specimen. This is a sufficient time for air quenching of Inconel 718 after welding or annealing. The Al-Ti toughened alloy gets adequate content to get the strength in the equal time instants.

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Elevated and low temperature features

The following table describes the room temperature features of hot rolled annealed and aged plate:

Temperature, oF	Tensile strength, ksi	Yield strength, ksi	Elongation %
600	183.5	163.0	16
1000	173.0	156.0	16
1200	160.0	148.0	15
1300	146.0	140.0	8

Cold Processing Properties

The elevated temperature tensile strength features of cold processed Inconel 718 sheet are shown as following:

Temperature, oF	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %
1000	119.5	55.5	43.0
1200	120.0	72.0	32.0
1400	103.0	64.5	7.0
1600	74.5	52.5	39.0

The room temperature tensile properties of cold treated sheet in annealed and aged form as per AMS 5596 standards:

Thickness, in	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %	Hardness, Rc
0.187	205	177	20	44
0.156	207	180	20	44
0.125	206	178	19	44
0.100	209	183	19	44
0.063	205	179	19	44

Impact strength of Inconel 718

The impact strength of Inconel 718 at room temperature are shown in the following table:

Diameter, inch	Tensile strength				Charpy V-Notch Reduction of Area, Impact Strength, ft•lb
	Tensile Strength, ksi	Yield strength, ksi	Elongation, %	Reduced Area %	
Heat Treatment: 1750°F/1 hr, A.C. + Aged 1325°F/8 hr, F.C. to 1150°F, Hold at 1150°F for Total Aging Time of 18 hours					
0.625	208.0	180.0	21.0	39.0	18.5
1	209.0	174.0	20.0	24.8	10.0
1.5	204.0	165.5	19.0	24.5	11.0
8	209.0	183.5	17.0	32.0	13.0
12	196.0	165.0	25.0	39.1	24.0

This table also shows the influence of annealing at 1750oF and aging at temperature of 1325oF for 8 hours then furnace cooling to 1150oF. It is retained at this temperature for 18 hours against annealing at 1950oF and aging at 1400oF for 10 hours then furnace cooling to 1200oF for 20 hours

The impact strength of pancake forging are described as following:

Sample	Tensile Strength, ksi	Yield Strength, ksi	Elongation in 2" %	Reduced Area, %	Charpy Keyhole Impact Strength, ft•lb
Radial center, top edge	182.0	159.0	10	10.5	-
Radial center, center	196.0	160.0	24	33.0	-
Radial center, bottom edge	186.5	159.5	16	19.0	-
Tangential, top edge	209.0	181.0	19	27.5	17-21

Fatigue Strength

The fatigue strength of annealed and aged Inconel 718 alloy that is heated at 1750oF and 1325oF for 8 hours then furnace quenching to 1150oF and hold at this temperature for 18 hours are shown in the following table:

Form	Tensile Features				Grain size	Fatigue Strength, ksi		
	Tensile strength, ksi	Yield Strength, ksi	Elongation, %	Reduction of Area, %		10(6) Cycles	10(7) Cycles	10(8) Cycles
Annealed	143.0c	99.5c	32c	32	0.0023c	74.0	67.5	66.5
Annealed and Aged	191.25	169.5	10.5	20	0.0021	77.5	71.0	69.5

The following table shows fatigue strength of hot annealed and aged Inconel 718 plate:

Heat Treatment	Rotation	Tensile Features				Grain size	Fatigue Strength, ksi		
		Tensile strength	Yield Strength	Elongation, %	Reduced Area,%		10-6 Cycles	10-7 Cycles	10-8 Cycles
Annealed	L	132.5	58	46	46.6	0.0008	73	70	70
Annealed and Aged	L	201.5	159.5	26	46	0.0005	96	81	78
	T	199.0	158	24	38	0.0007			
Annealed and Aged	T	202.0	160.5	26	44.5	0.0015	96	88	85
	T	197.5	159	24	41	0.0009	91	82	77
Annealed and Aged	T	196.5	158	27	48.5	0.0008			

The forging of Inconel 718 is done if fatigue strength is a prime factor. It can be used in the annealed form instead of annealed and aged form.

Machining of Inconel 718

The Inconel 718 alloy can be readily machined however the strength and work toughening features should be considered while choosing and using the precise apparatus alloys and design, processing speed and quenchers. When machining in the age toughened form, the strip offers the enhanced finish, chip performance on the chip breaker tools are enhanced. If annealed alloy is used, it provides more convenient machining and extended tool life.

Hot Forging

The hot forging is done in 1650oF to 2050oF temperature. In the end process of alloy 718, it is processed evenly in the gradually reducing temperature, finishing with low reduction at 1650oF to 1750oF.

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This temperature range is essential to ensure the high ductility in the stress rupture operations when alloy is annealed and aged. While heating for hot processing, the Inconel 718 alloy is recommended to bring at the temperature permitted to absorb the short time to ensure the symmetry. To inhibit the duplex grain configuration inconel 718 must be provided with the even reductions. The symmetric reductions of minimum 20% are implemented for open die processing and minimum 10% for closed die processing. The components should be air cooled from hot processing point than water cooling.

Precautions are important to inhibit the overheating of alloy through heat formation while processing. The Inconel 718 alloy should be reheated when any section is quenched lower to 1650oF. The former heating devices and dies to 500oF is preferred. The cracks observed on the alloy's surface should be removed immediately.

The elevated temperature fatigue strength of hot rolled bar:

Test Temperature, oF	Fatigue Strength, ksi			
	10(5) Cycles	10(6) Cycles	10(7) Cycles	10(8) Cycles
Room	132.0	101.0	92.0	90.0
600	115.0	110.0	110.0	110.0
1000	111.0	102.0	95.0	90
1200	100.0	94.0	88.0	72

Super Plastic Fabrication

The alloy 718 is particularly forged for the super plastic production process. It can be cold forged by the standard processes that are utilized for manufacturing steel and stainless steel. With its strength, the Inconel 718 alloy becomes superior resistant to bending in the hot forging as compare to the other alloy materials. The comparative resistance is observed in roll gap at 20% reduction. It is readily hot treated when high potential equipment is utilized.

The following table shows the significance of hot forging at temperatures 1650oF to 1750oF to obtain the high ductility in the extensive forging for high stress based applications:

Temp, oF	Heating method	Grain Size	Smooth Bar				Notch Bar Life in hr
			Life, Hrs	Elongation, %	Reduced Area, %	Hardness, Rc	
2050	A	20% 0.5, 30% 4.5, 40% 6.5, 10% 9	193.5	3	6.5	45	16.2
	B	100% 1.5	209.5	4	8.5	46	16.5
1950	A	70% 8, 30% 3	274.5	7	9	45	55.1
	B	60% 3, 30% 8, 10% 7	291.4	8	10	45	56.7
1850	A	95% 4.5, 5% 9	193.3	11	16	46	123.9
	B	35% 4.5, 60% 9, 5% 7	231.6	10	13	46	99.2
1750	A	20% 6, 20% 7, 60% 10	121.3	13	22	46	131.4
	B	40% 7, 55% 9, 5% 5	248.3	14	16	46	179.6

Creeping strength of Inconel 718

To get the essential creeping resistance, the Inconel 718 is annealed at 1700oF to 1850oF and aged at 1325oF for 8 hours and furnace cooling to 1150oF, sustaining for 18 hours.

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Welding features of Inconel 718

The Inconel 718 alloy is readily welded through gas tungsten arc welding through Inconel filler metal 718. The list of constituents of Inconel 718 filler metal is shown as following:

Nickel (plus Cobalt)	50.00-55.00
Copper	0.30 max.
Manganese	0.35 max
Iron	Remaining
Silicon	0.35 max
Carbon	0.08 max
Sulfur	0.015 max
Titanium	.0.65-1.15
Aluminum	0.20-0.80
Niobium (plus Tantalum)	4.75-5.50
Chromium	17.0-21.0
Molybdenum	2.80-3.30
Phosphorus	0.015 max.
Cobalt	1.00 max.
Boron	0.006 max.

The mechanical characteristics of welded metal materials are shown as following:

Filler Metal Diameter, in	Heat Treatment	Tensile Strength, Ksi	Yield Strength, (ksi	Elongation, %	Reduction of Area, %
0.045	1750°F, Age	180.25	148.50	7.8	12.3
0.045	1750°F, Age	169.50	144.00	7.8	12.0
0.09375	1750°F, Age	174.50	145.25	7.7	12.5
0.062	1750°F, Age	174.50	152.00	4.9	7.0
0.062	1750°F, Age	180.00	144.00	12.6	18.0

The above table shows the effects of post welding treatment on tensile strength. The maximum room temperature ductility is received through annealing at 1950oF before aging. The mild response of Inconel 718 to age toughening strengthens the components that undergo welding and directly age toughened without moderate stress relief.

The combined efficiency near 100% is described in the following table:

Tensile Strength, ksi	Yield Strength, Ksi	Elongation in 1 ln.,%	Reduction of Area,%
183.0	159.5	8	19.0
183.5	158.5	7	16.0
186.5	162.0	6	12.8
185.5	163.0	6	21.0
184.0	163.0	6	16.5
192.5	166.0	6	17.5

The silver braze compounds produce stress rupturing in the Inconel alloys. If Inconel 718 is cold processed and precipitated toughened silver brazing should not be utilized. The brazing alloys incorporate cadmium that aggravates the cracking.

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Weld Tensile characteristics

The room temperature features of welds that receive low temperature anneal and age can be compared with the outcomes of elevated temperature anneal and aging in the above and below tables:

Sample	Postweld Heat Processing	Tensile Strength, Ksi	Yield Strength, Ksi	Elongation in 0.5 ln., %	Reduction of Area, %
All-Weld Metal	Direct Age	174.50	139.25	18.3	21.5
	1950°F/1 hr, Age	185.75	155.50	22	31.8
Transverse	Direct Age	183.50	149.50	12	24.8
	1950°F/1 hr, Age	192.25	160.75	17.3	23.5

The weld annealed Inconel 718 at 1950oF for 15 minutes and aged at 1400oF for 10 hours then furnace quenching is performed at 1200oF and sustained at this temperature for 20 hours. The features of weld annealed alloy are shown as following:

Weld	Tensile Strength, Ksi	Elongation ln 1 in., %
Argon Torch Gas; Helium Root Gas		
1	188.00	11.7
2	184.20	10
3	184.50	10
4	190.20	14.3
5	192.70	17.3
	Average 187.92	12.7
Helium Torch Gas; Argon Root Gas		
6	189.20	11.7
7	191.00	15.3
8	187.80	12.7
9	191.70	18.3

The welding is done through gas tungsten arc process by using Filler metal 718. These weld components perform efficiently in the deformation and radiographic analysis. The enhanced outcomes are noticed when helium is utilized for torch gas. The high strength of butt welded sheet in heated and welded zone is shown as following. The welding sections are heat processed at low temperature:

Treatment of Weld	Notch Strength, ksi	
	Heat-Affected Zone	Weld
Aged	154.0	129.0
	183.8	133.5
Annealed	175.0	132.3
1800°F/1 hr and Aged	163.3	136.0

The elevated temperature heat processing has provided the excellent hardness of to the basic metal are highly reliable and cross the notch to sleek bar tensile ratio of 1.30 at the temperatures from -423oF to 1200oF. The analytical info is shown as following:

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Specimen	Tensile Strength, ksi	Yield Strength, Ksi	Elongation, %	Reduction of Area, %	Notch Tensile Strength, ksi	Notch/Unnotch Tensile Strength Ratio
Parent Metal	197.5	163.8	25.5	38.5	272.8	1.38
Weld	189.7	165.6	19.3	38.1	263.1	1.39
-423°F	245.9	203.6	22.5	33.1	323.8	1.32
Parent Metal	237.9	201.0	19.7	30.7	308.7	1.30

The efficiency of weld joints is almost 93% at -423oF and it becomes 95% at the room temperature and very high temperatures up to 1200oF.

Fatigue strength characteristics of welded Inconel 718 alloy

The welded components are observed to possess room temperature fatigue strength about 62.5 ksi. These are made of hot treated annealed plate, connected through Inconel filler metal 718 through gas tungsten arc process. The specimen was aged at 1325oF for 8 hours and analyzed. It is found that Inconel 718 alloy possess fatigue strength of 89.0 ksi.

The shear strength of accumulated filler metal 718 is described in the following table:

Specimen	Shear Strength, ksi	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %	Reduction of Area, %
A	86.0	121.0	73.5	27.0	30.0
B	86.5	120.0	73.4	28.0	26.5
C	80.0	120.0	72.0	30.0	33.8

Stress rupturing properties of Welded Inconel 718

The stress rupturing resistance of welded and basic Inconel 718 alloy at 1200oF to 1300oF temperatures is evaluated in the following table:

Processing of Weld	Temperature, oF	Stress rupturing, ksi	Time, hours	Extension, %	Fracture position
Basic metal annealing and aging	1200	100.0	47.3	85.0	-
	1300	72.5	26.1	11	-
Annealing and aging	1200	100.0	10.8	1	weld
	1300	72.5	9.4	1	Weld
Aging	1200	100.0	16.4	1	weld
	1300	72.5	15.8	2	weld

In the other analysis, the welds processes include aging and aged alloy stands for 0.3 hours when it is aged at 1200oF and it provides 100 ksi stress rupturing strength. On the other side when the alloy is aged at 1300oF, it provides stress strength of 72.5 ksi and it stands for 4.9 hours. The fractures are noticed in the heated zone.

The notch Inconel 718 bar life at temperature 1300oF and 75 ksi is described in the following table:

Specimen	Heat Treatment	Time, hours	Elongation, %	Reduced Area,%	Notch Bar Life,hr
All-Weld Metal	Aged	11.7	4.0		6.0 14.1
	Annealed and Aged	12.2	5.0		7.5 45.5
Transverse Joint	Aged	25.5	4.0	5.0	30.1
	Annealed and Aged	15.3	3.0	8.5	25.1

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Spring Characteristics

The superior relaxation resistance of Inconel 718 alloy is an aspect that makes it purposeful in making springs to be used at temperatures about 1100oF.

Bolting

The Inconel 718 alloy offers an excellent combination of high mechanical strength at the elevated temperatures and superior resistance to oxidation and other corrosion factors. Due to these features it is commonly used in the production of fasteners that need to provide prolonged performance in the diverse conditions.

Metallography of Inconel 718

The Inconel 718 is an age toughen-able austenitic alloy. Its strength is majorly dependent on the precipitation of gamma prime phase while heat processing. The major section of the production of this alloy is based on the adequate heat processing to receive the desired characteristics. The alloy 718 is reinforced in two manners: Solution processing and age toughening, cold processing and age toughening. It is shown in the following table:

Diameter, In	Yield Strength, ksi	Tensile Strength, Ksi	Elongation, %	Hardness, Rc
Cold treated				
0.51	-	-	-	-
0.76	161	178	16	41
1.01	150	176	15	38
1.51	-	-	-	-
Cold Drawn and Aged (1325°F/8 hr, F.C. to 1150°F, hold at 1150°F for total aging time of 18 hr)				
0.51	227	243	11	48
0.76	223	234	11	47
1.01	222	237	11	47
1.51	229	244	11	46
Cold Drawn, Solution Annealed and Aged (1750°F/1 hr, A.C. then 1325°F/8 hr F.C. to 1150°F, hold at 1150°F for total aging time of 18 hr.)				
0.51	168	211	20	42
0.76	165	208	21	42
1.01	165	212	20	42

Heating and pickling of Inconel 718

Inconel 718 Alloy

Heanjia Super Metals Co., Ltd

The Inconel 718 alloy is heated cautiously to keep the incinerator and alloy getting heated at the specific temperature limits. The fuel that is utilized in the furnace should contain less content of sulfur. The specimen taken must be properly clean and dust free. The furnace conditions should be reducing to conduct forging or annealing. When Inconel 718 is heated in the reducing conditions, it produces green-black oxide layer. When it is heated in the oxidizing conditions, massive black layer is created that is tough to clean. Thus proper care should be taken to get only green black layer created.

Applications of Inconel 718

1. Fluid fuel rockets.
2. Rings
3. Casings
4. Fasteners
5. land base gas turbines and cryogenic tankage

Inconel 718 Product Forms Available:

Wire, Wiremesh Screen, Strip, Sheet, Rod, Pipe, Bar, Tubing, Plate, Ribbon, Tape

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