

INCONEL 600 TECHNICAL DATA

Type Analysis

Element	Min	Max
Carbon	--	0.10
Nickel	72.0 min	
Chromium	14.0	17.0
Iron	6.00	10.00
Silicon	--	0.50
Manganese	--	1.00
Sulfur	--	0.015
Copper	--	0.50

Description

Alloy 600 is a nonmagnetic, nickel-based high temperature alloy possessing an excellent combination of high strength, hot and cold workability, and resistance to ordinary form of corrosion.

This alloy also displays good heat resistance and freedom from aging or stress corrosion throughout the annealed to heavily cold worked condition range.

Applications

Some typical applications are:

- Barge and tank truck liners
 - Carburizing atmospheres
 - Ethylene dichloride crackers
 - Furnace trays, mufflers, hangers
 - Gasoline stabilizer production
 - MgCl₂ evaporates
 - Phenol condensers
 - Soap manufacture
 - Titanium dioxide
 - Vegetable and fatty acid vessels
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Corrosion Resistance

The high chromium content of alloy 600 raises its oxidation resistance considerably above that of pure nickel, while its high nickel content provides good corrosion resistance under reducing conditions.

This alloy exhibits high levels of resistance to stress and salt water, exhaust gases, and most organic acids and compounds.

Average Physical Properties

Physical Properties	°F	British Units	°C	Metric Units
Density	Room	0.304 lb./cubic in.	Room	8.43g/cubic cm
Electrical Resistivity	70 200 400 600 800	40.6 microhm-in. 40.9 41.5 42.2 43.0	21 93 204 316 427	1.03 microhm-m 1.04 1.05 1.07 1.09
Mean Coefficient of Thermal Expansion	70-200 70-400 70-600 70-800	7.4 microinches/in.-°F 7.7 7.9 8.1	21-93 21-204 21-316 21-427	13.3 x 10 ⁽⁻⁶⁾ m/m·K 13.9 14.2 14.6
Thermal Conductivity	70 200 400 600 800	103 Btu-in./ft ² ·hr.-°F 109 121 133 145	21 93 204 316 427	14.8 W/m·K 15.7 17.4 19.2 20.9
Modulus of Elasticity	Room	30.0 x 10 ⁽⁶⁾ psi	Room	207 GPa

Heat Treatment

Alloy 600 is not an age hardening alloy; cold working is the only available means of hardening. Softening by annealing begins at about 1600°F (871°C), and is reasonably complete after 10 to 15 minutes of heating at 1800°F (982°C). Above this temperature, grain growth may be objectionable, although very brief heating at 1900°F will cause complete softening without undue grain growth. Since the rate of cooling has no effect on the softening, the material may be water quenched or air cooled.

Workability

Hot Working/Forging

Low sulfur reducing furnace atmospheres should be used in forging. Major hot working should be done between 2300/1850°F, while light working may be continued as low as 1600°F. No hot working should be attempted between 1600/1200°F due to lower ductility in that range.

Machinability

Alloy 600 is machinable in both the hot worked and annealed conditions. Because considerable heat is generated in machining this alloy, high-speed steel, cast nonferrous or cemented carbide tools should be used. The tools should be kept sharp.

Lathe turning speeds with high-speed and nonferrous tools are 35/45 sfm (0.18/0.23 m/s); speeds with cemented carbide tools are 100/175 sfm (0.51/0.89 m/s). (This data should be used as a guide for initial machine setup only. The figures used are averages. On certain work, the nature of the part may require adjustment of speeds and feeds.)

Sulfur-based oil should be used as a lubricant, but should be completely removed before the machined part is exposed to elevated temperatures, as in welding.

Cold Working

For higher properties, alloy 600 can be cold worked below 1200°F (649°C).

Welding

Alloy 600 can be joined by the usual welding, brazing, and soldering process.

Typical Mechanical Properties

Typical Mechanical Properties

Various forms and conditions

Form and Condition	Tensile Strength		0.2% Yield Strength		% Elongation in 2"	% Reduction of Area	Rockwell Hardness
	ksi	MPa	ksi	MPa			
Rod and Bar							
Cold-drawn							
Annealed	80-100	552-689	25-50	172-345	55-35	70-60	65-85B
As-drawn	105-150	724-1034	80-125	552-862	30-10	60-30	90B-30C
Hot rolled							
Annealed	80-100	552-689	30-50	207-345	55-35	70-60	65-85B
As-rolled	85-120	586-827	35-90	241-621	50-30	65-50	75-95B
Hot-finished	80-120	586-827	35-90	241-621	50-30	65-50	75-95B
Strip							
Annealed	80-100	552-689	30-45	207-310	55-35	----	84B max.

Average Room Temperature Tensile Data

Form	Condition	Ultimate Tensile Strength, Ksi (MPa)	Yield Strength at 0.2% offset, Ksi (MPa)	Elongation in 2 in. (50.8mm) or 4D, percent
Sheet	Annealed	98 (676)	42 (290)	40
Plate	Annealed	95 (655)	41 (283)	45
Bar/Billet	Annealed	95 (655)	41 (283)	45
Sheet, Plate, Strip, Bar	Annealed	80 (550)*	35 (240)*	30*

* - minimum

Typical Elevated Temperature Tensile Properties

Temperature		Tensile Strength		0.2% Yield Strength		% Elongation in 2"
°F	°C	ksi	MPa	ksi	MPa	
600	316	90.5	624	31.0	214	46
800	427	88.5	610	29.5	203	49
1000	538	84.0	579	28.5	196	47
1200	649	65.0	448	26.5	183	39
1400	760	27.5	190	17.0	117	46
1600	871	15.0	103	9.0	62	80
1800	982	7.5	52	4.0	28	118

Stress Rupture Properties

Temperature		Stress to Produce Rupture in:					
°F	°C	10 hours		100 hours		1000 hours	
		ksi	MPa	ksi	MPa	ksi	MPa
Cold Drawn, Annealed-3 Hours/1750°F (954°C)/Air Cooled							
1000	538	74	510	50	345	34	234
1200	649	34	234	23	159	14.5	100
1400	760	13	90	8.4	58	5.6	39
1600	871	7.5	52	4.8	33	3	21
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	2.4	17	--	--
Hot Rolled, Annealed-2 Hours/1650°F (899°C)							
1350	732	20	138	13.5	93	9.2	63
1600	871	8.1	56	5.3	37	--	--
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	1.4	10	--	--
Solution Annealed-20 Hours/2050°F (1121°C)/Air Cooled							
1350	732	19	131	14	97	9.8	68
1500	816	11.5	79	8	55	5.6	39
1600	871	8	55	5.3	37	--	--
1800	982	4.4	30	2.8	19	1.8	12
2000	1093	2.1	14	1.4	10	--	--

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