	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

1. GENERAL

Inconel alloy 706 is a precipitation-hardenable nickel-iron-chromium alloy with characteristics similar to those of Inconel 718, except that Inconel 706 has improved machinability. It has high strength ranging from cryogenic to 1300 F. It also has good resistance to oxidation and corrosion over a broad range of temperatures and environments.

Fabrication of the alloy is enhanced by its good formability and weldability. It has excellent resistance to postweld strainage cracking. (1, p 113)

1.01 Commercial Designation
Inconel Alloy 706

1.02 Alternate Designations
Allvac I-706, Simalloy 706. (10, p 37)

1.03 Specifications
AMS Specifications, Table 1.03

1.04 Composition
Table 1.04

1.05 Heat Treatment
1.051 Specified by producer: 1800 F, 1 hr, AC + 1550 F, 3 hrs, AC + 1325, 8 hrs, FC to 1150 F + 1150 F, 8 hrs, AC.
1.052 Heat treatment used by test laboratory (1) for property evaluation: 1800 F, 2 hrs, AC + 1550 F, 3 hrs, AC + 1325, 8 hrs, FC to 1150 F, + 1150 F, 18 hrs, AC.
1.053 Optimum heat treatment for 1200 F tensile and creep rupture properties: 1625-1675 F, 1 hr, AC + 1325 F, 8 hrs, FC at 100 F per hr to 1150 F, + 1150 F, 8 hrs, AC.
1.054 Effect of solution treatment temperature on grain size, Figure 1.054.
1.055 Effect of various stabilization aging sequences on the tensile properties of fine-grain forged bar at RT and 1200 F, Table 1.055.
1.056 Mechanical properties of alloy using commercial heat treatment, Table 1.056.
1.057 Mechanical properties of alloy using optimized heat treatment, Table 1.057.

1.06 Hardness
See also 4.032.
1.061 Effect of aging time on hardness, Figure 1.061.
1.062 Effect of cold reduction on hardness, with comparison to two other commonly used alloys, Figure 1.062.
1.063 Effect of aging temperature on hardness, with comparison to two other commonly used alloys, Figure 1.063.

1.07 Forms and Conditions Available
See also Table 1.03.
1.071 Bars, forgings, rings, sheet, strip, plate.

1.08 Melting and Casting Practice

1.09 Special Considerations
1.091 Similar to Inconel 718 with improved machinability. (1, p 113)
1.092 Alloy has good formability and weldability. (1, p 113)
1.093 High solution treatment temperature of 1800 F, chosen for compatibility with high temperature brazing, dissolves all the age hardening phases of the alloy, and causes a coarse grain size and supersaturated matrix, resulting in low creep rupture ductility. For optimum room temperature and 1200 F tensile properties, as well as 1200 F creep rupture properties, solution treatment of 1625 F to 1675 F, 1 hr, AC + subsequent aging at 1325 F, 8 hrs + 1150 F, 8 hrs have been determined as optimum. If high solution treatment temperature is necessary (for example for brazing) an intermediate stabilization age at 1550 F, 4-8 hrs gives best combination of properties. (1, p 2153, 2160)

2. PHYSICAL PROPERTIES AND ENVIRONMENTAL EFFECTS

2.01 Thermal Properties
2.011 Melting range: 2435 F to 2500 F. (2, p 17)
2.012 Phase changes.
2.0121 Time-temperature transformation diagram for alloy solution annealed at 2000 F, followed by aging at various times and temperatures, Figure 2.0121.
2.0122 Effect of (Cb + Ti) content on phases present after one hour hold at elevated temperature, followed by air cooling, Figure 2.0122.
2.013 Thermal conductivity, Figure 2.013.
2.014 Thermal expansion, Figure 2.014.
2.015 Specific heat, Figure 2.015.

2.02 Other Physical Properties
2.021 Density: 0.292 lb/in.^{3}, 8.08 g/cm^3. (2, p 17)
2.022 Electrical properties.
2.023 Magnetic properties.
2.024 Emittance.
2.025 Damping capacity.

2.03 Chemical Environments
See also 3.053.
2.031 Alloy has good resistance to oxidation and corrosion over a broad range of temperatures and environments. (1, p 113)

2.04 Nuclear Environments

3. MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties
See also Table 1.056.
3.011 AMS Specifications for tensile properties at RT Table 3.011.
3.012 See also AMS Specifications for additional requirements on hardness, grain size and notch behavior.

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

3.02 **Mechanical Properties at Room Temperature**

3.021 Tension – stress/strain diagrams – tension properties. See also 3.0311 and 3.0312.

3.0211 Effect of heat treatment on tensile properties and fracture toughness, Table 3.0211.

3.022 Compression, see 3.032.

3.023 Impact.

3.0231 Charpy V Impact tests in longitudinal and transverse directions, Table 3.0231.

3.024 Bending.

3.025 Torsion and shear.

3.0251 Shear strength in longitudinal and transverse directions, Table 3.0251.

3.026 Bearing.

3.027 Stress concentration.

3.0271 Notch properties. See Figure 3.0371.

3.0272 Fracture toughness. See Table 3.0211.

3.03 **Mechanical Properties at Various Temperatures**

3.031 Tension – stress-strain diagrams, tension properties.

3.0311 Stress-strain diagrams.

3.03111 Longitudinal tensile stress-strain curves at RT to 1200 F, Figure 3.03111.

3.03112 Transverse tensile stress-strain curves at RT to 1200 F, Figure 3.03112.

3.0312 Tensile properties.

3.03121 Producer's estimates of tensile properties of bar at room and elevated temperatures, Figure 3.03121.

3.03122 Effect of aging on tensile properties at temperatures from -320 F to 900 F, Figure 3.03122.

3.03123 Effect of test temperature on tensile properties of bar, Figure 3.03123.

3.03124 Effect of temperature on tensile yield strength of alloy heat treated for optimized creep rupture properties, with comparison to other well-known alloys, Figure 3.03124.

3.03125 Effect of temperature on ultimate tensile strength of alloy heat treated for optimized creep rupture properties, with comparison to several other well-known alloys, Figure 3.03125.

3.032 Compression – stress strain diagrams, compression properties.

3.0321 Stress-strain diagrams.

3.03211 Typical compressive stress-strain curves in longitudinal direction from RT to 1200 F, Figure 3.03211.

3.03212 Typical compressive stress-strain curves in transverse direction from RT to 1200 F, Figure 3.03212.

3.0322 Compressive properties.

3.03221 Effect of test temperature on compressive yield strength, Figure 3.03221.

3.03 Impact.

3.034 Bending.

3.035 Torsion and shear.

3.036 Bearing.

3.037 Stress concentration.

3.0371 Effect of aging on notch tensile strength, K_t = 6.0, at temperatures from -320 F to 900 F, Figure 3.0371.

3.038 Combined properties.

3.04 **Creep and Creep Rupture Properties**

3.041 Producer's estimates of creep and creep rupture strengths at 1200 to 1400 F, Figure 3.041.

3.042 Effect of solution treatment temperature on ductility in creep rupture test at 1200 F, 100 ksi, Figure 3.042.

3.043 Effect of solution treatment temperature on creep rupture time at 1200 F, 100 ksi, Figure 3.043.

3.044 Creep and creep rupture at 800 F, 1000 F, and 1200 F of bar, Figure 3.044.

3.05 **Fatigue Properties**

3.051 Axial fatigue, R = 0.1 of unnotched material at RT, 600 F, and 1000 F, Figure 3.051.

3.052 Axial fatigue, R = 0.1, of notched bar, K_t = 3.0, at RT, 600 F, and 1000 F, Figure 3.052.

3.053 Effect of temperature on the low cycle fatigue life in air and in vacuum, Figure 3.053.

3.06 **Elastic Properties**

3.061 Poisson's ratio.

3.062 Modulus of elasticity.

3.0621 Effect of test temperature on tensile and compressive elastic modulus, Figure 3.0621.

3.0622 Dynamic modulus of elasticity, Figure 3.0622.

3.063 Modulus of rigidity.

3.064 Tangent modulus.

3.0641 Typical compressive tangent modulus in longitudinal direction from RT to 1200 F, Figure 3.0641.

3.0642 Typical compressive tangent modulus in transverse direction from RT to 1200 F, Figure 3.0642.

4. FABRICATION

4.01 **Forming**

4.011 Hot workability.

4.0111 Because of lower flow stress than Inconel 718, Inconel 706 has better malleability. Nil-ductility and nil-tensile strength temperatures are higher, indicating that Inconel 706 has a better hot working range.

Triple heat treatment simplifies hot working. With a two-step treatment, rupture ductility has to be developed through hot working, finish-forging temperatures must be low; and annealing can be no more than 1750 F for 1 hr. In the three-step treatment, hot-working steps are reduced, annealing can be at 1800 F, and good smooth and notch-bar rupture ductility is achieved. With higher forging temperatures, tool life is improved, and parts can be produced closer to final dimensions. Thus machining is decreased, and raw material costs are reduced. (8, p 23, 24)

4.0112 Forging practice, Table 4.0112.

4.012 Cold working.

4.0121 Cold formability of Inconel 706 is superior to that of alloy Inconel 718 and similar to that of 300-series stainless steels. Its cold-forming behavior can be estimated by its work-hardening characteristics (8, p 24).

Ni	
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

4.02 Machining and Grinding

4.021 Inconel 706 can be cut at higher speeds than Inconel 718. Not only is the abrasiveness reduced, but horsepower requirements are lower. Little difference exists between the machinability of annealed and annealed, aged alloy 706. Possibly the intense shearing action of the cutting tool work hardens chips and cut surfaces to the same level (from 460 to 520 khn) without regard to the starting hardness of the base material (182 khn) for annealed base material and 425 khn for annealed (and aged material).

4.022 Comparative machinability of Inconel Alloys 706 and 718, Table 4.022.

4.03 Joining

4.031 To have good weldability the alloy has to be soft when in the annealed condition and respond slowly to age hardening. Welds should show no underbead cracking or fissuring of the base metal or strain-age cracking during aging or in service. Use of a relatively low (1800 F) annealing temperature assured freedom from strain-age cracking. An appropriate balance of those elements which are responsible for age hardening produced an alloy that was soft when annealed and age-hardened slowly. Inconel 706 has the same sluggish response as Inconel 718 but is softer (see Figure 1.063).

Freedom from strain-age cracking was demonstrated by the Pierce-Miller repair-weld test. Alloy 706 sheet from two heats and ranging from 0.040 in. to 0.089 in. was used as starting material. Samples were annealed at 1850 F or 1950 F in a continuous annealing furnace, or at 1750 F (950 C), or 1950 F for 1 hr in a laboratory furnace. The alloy 706 specimens were attached to Inconel alloy 718 plate (7/8 in. thick) base plates, and Inconel alloy 706 was used as filler metal. Aging conditions: 1350 F for 8 hr, furnace cool 100 F per hr to 1150 F, hold for 8 hr, and air cool.

The procedure in these tests is anneal, weld, age, repair-weld, and re-age. No cracking occurred after any of these operations. After such encouraging results, similar tests were conducted on much heavier material – 1.125 in. thick plate, and a 1 in. thick forging. The samples were annealed at 1750 F for 1 hr, air cooled, and welded to a 1-1/2 in. thick base plate of alloy 718. Filler metal of 718 was manually applied in several layers to fill a circular groove in the center of each sample. The assemblies were aged (same as for the preceding tests), and sectioned across the groove for tensile tests. No fissuring or cracking occurred. Good joint efficiency was achieved, with the transverse test failing in the weld metal.

4.032 Hardness survey in region of weld interface for butt-welded joint, Figure 4.032.

4.033 Properties of circle patch welds in hot rolled plate and forging 1 in. thick or over, with effects of several heat treatments, Table 4.033.

4.04 Surface Treating

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13. Aerospace Material Specification AMS 5702 (November 15, 1971)
14. Aerospace Material Specification AMS 5703 (November 15, 1971)
15. Aerospace Material Specification AMS 5705 (November 15, 1971)
16. Aerospace Material Specification AMS 5706 (November 15, 1971)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

Alloy	Inconel 706	
Form	Bars, Forgings, Rings	
AMS	HT	Application
5701	1800 F ST	High strength at cryogenic temperatures and RT, good machinability; HT after welding to produce required properties.
5702	1750 F ST	High resistance to creep and creep rupture up to 1300 F, oxidation resistance to 1800 F, good machinability, HT after welding to produce required properties.
5703	1750 F ST + 1550 F, 3 hrs, AC + 1325, 8 hrs, FC to 1150 F at 100 F per hr + 1150 F, 8 hr AC	High resistance to creep and creep rupture up to 1300 F, oxidation resistance to 1800 F, and good machinability.
Form		Sheet, Strip, Plate
5705	1800 F ST	High strength at cryogenic temperatures and RT, for short time use up to 1000 F, good machinability, HT after welding to produce reg. properties.
5706	1750 F ST	High resistance to creep and creep rupture to 1300 F, oxidation resistance to 1800 F, good machinability; HT after welding to produce required properties.

TABLE 1.03 AEROSPACE MATERIAL SPECIFICATIONS (11, 12, 13, 14, 15)

Alloy	Inconel 706	
	Percent	
	Min	Max
Carbon	–	0.06
Manganese	–	0.35
Silicon	–	0.35
Phosphorus	–	0.020
Sulfur	–	0.015
Chromium	14.5	17.50
Nickel	39.0	44.00
Cb + Ta	2.50	3.30
Titanium	1.50	2.00
Aluminum	–	0.40
Boron	–	0.006
Copper	–	0.30
Iron	Balance	–

TABLE 1.04 COMPOSITION (11, 12, 13, 14, 15)

Alloy	Inconel 706							
Form	Forged bar, 7/8 in. sq, Fine Grain, Machined to 0.252 in. dia							
Condition	1800 F, 1 hr, AC + Stabilization As Indicated + 1325 F, 8 hrs, FC at 100 F per hr to 1150 F + 1150 F, 8 hrs, AC							
	RT				1200 F			
Stabilization Treatment	F_{ty}	F_{tu}	e, 1 in.	RA	F_{ty}	F_{tu}	e, 1 in.	RA
1550 F, 4 hrs, AC	150	187	18	31	125	148	25	64
1550 F, 8 hrs, AC	147	186	18	29	113	142	33	63
1550 F, 16 hrs, AC	136	185	19	22	112	135	26	64
1625 F, 2 hrs, AC	143	188	24	36	110	140	32	63
1625 F, 4 hrs, AC	136	185	22	35	111	140	29	64
1625 F, 8 hrs, AC	127	183	19	30	107	138	28	65
1650 F, 2 hrs, AC	143	190	24	40	106	135	35	65
1650 F, 4 hrs, AC	138	189	23	36	–	138	32	61
1650 F, 8 hrs, AC	131	188	21	32	103	136	30	60
1675 F, 2 hrs, AC	143	187	23	43	115	145	30	63
1675 F, 4 hrs, AC	141	189	22	34	107	136	33	54
1675 F, 8 hrs, AC	133	182	23	35	107	143	27	62
Typical Commercial Spec								
1550 F, 3 hrs, AC	130 Min	170 Min	12 Min	15 Min	110 Min	135 Min	12 Min	15 Min

TABLE 1.055 EFFECT OF VARIOUS STABILIZATION AGING SEQUENCES ON THE TENSILE PROPERTIES OF FINE-GRAIN FORGED BAR AT RT AND 1200 F 5, p 2155)

Ni
37 Fe
16 Cr
2.9 Cb
1.8 Ti

Inconel 706

Alloy	Inconel 706		
Condition	Forged to Grain Size Shown and Heat Treated: 1800 F, 1 hr, AC + 1550 F, 3 hrs, AC + 1325 F, 8 hrs, AC 100 F/hr to 1150 F + 1150 F, 8 hrs, AC		
Property	Fine Grain, Avg of 3 Heats(a)	Coarse Grain, Avg of 3 Heats(b)	Typical Specified Mechanical Properties
70 F Tensile			
F_{tu}, ksi	190	182.3	170
F_{ty}, ksi	148.3	146	130
e, 2 in., percent	21.7	20	12
RA, percent	40	38	15
1200 F Tensile			
F_{tu}, ksi	148.3	138.7	135
F_{ty}, ksi	127	117.3	110
e, 2 in., percent	23	24	12
RA, percent	57	57	15
Creep Rupture (1200 F, 100 ksi)			
Rupture Life, hr	197.7	32.3	23
e, percent	8.7	3.7	4.0
RA, percent	15	5.7	–

(a) As-Forged Grain Size ASTM 9/10, as HT Grain Size ASTM 5/6.
(b) As-Forged Grain Size ASTM 2/3, as HT Grain Size ASTM 4/5.

TABLE 1.056 MECHANICAL PROPERTIES OF ALLOY USING COMMERCIAL HEAT TREATMENT (5, p 2154)

Alloy	Inconel 706		
Condition	Forged to Grain Size Shown and Heat Treated: 1650 F, 1 hr AC + 1325 F, 8 hrs, Cool 100 F per hr to 1150 F + 1150 F, 8 hrs, AC		
Property	Fine Grain, Avg of 2 or 3 Heats(a)	Coarse Grain, Avg of 2 or 3 Heats(b)	Typical Specified Minimum Properties
70 F Tensile			
F_{tu}, ksi	198	–	170
F_{ty}, ksi	168	–	130
e, 2 in., percent	17.3	–	12
RA, percent	36.7	–	15
1200 F Tensile			
F_{tu}, ksi	154.7	137.3	135
F_{ty}, ksi	144	125	110
e, 2 in., percent	17	17.7	12
RA, percent	55.7	41.7	15
Creep Rupture (1200 F, 100 ksi)			
Rupture life, hr	220	239.7	23
e, percent	17.5	8.3	4
RA, percent	50.5	16.7	–

(a) As-Forged grain size ASTM 9/10, as HT grain size ASTM 9.
(b) As-Forged grain size ASTM 2/3, as HT grain size ASTM 2/3.

TABLE 1.057 MECHANICAL PROPERTIES OF ALLOY USING OPTIMIZED HEAT TREATMENT (5, p 2158)

Alloy	Inconel 706					
AMS	Thickness, in.	HT	F_{tu}, ksi	F_{ty}, ksi	e, 2 in. or 4D, percent	RA, percent
5701	<2.5	Ppt Hard	170	140	12	15
	2.5< t <4.0		170	135	12	15
5702	<2.5	Ppt Hard	170	130	12	15
	2.5< t <4.0		165	130	12	15
5703	<2.5	Ppt Hard	170	130	12	15
	2.5< t <4.0		165	130	12	15
5705	≤.187	ST	130	80	30	–
	>.187	ST	140	90	30	–
	≤.187	Ppt Hard	175	145	12	–
5706	≤.187	ST	130	80	30	–
	>.187	ST	140	90	30	–
	–	Ppt Hard	170	135	12	–

TABLE 3.011 AMS SPECIFICATIONS FOR TENSILE PROPERTIES AT RT (11, 12, 13, 14, 15)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

Alloy	Inconel 706			
Condition	Heat Treated as Indicated			
	1800 F, ½ hr, AC + 1325 F, 8 hrs, FC to 1150 F, + 1150 F, 8 hrs, AC		1800 F, ½ hr, AC + 1550 F, 3 hrs, AC + 1325 F 8 hrs, FC to 1150 F, + 1150 F, 8 hrs, AC	
	Long	Trans	Long	Trans
F_{tu}, ksi	182	182	181	179
F_{ty}, ksi	153	152	146	144
e, 2 in., percent	26	21	20	16
RA, percent	49	37	29	17
Max Valid K_{Ic}, ksi $\sqrt{in.}$(a)	98	96	93	91

(a) Tested According to SAE AMD 23DD Using a Fatigue-Cracked Specimen of 1 x 2 x 9 in. in size.

TABLE 3.0211 EFFECT OF HEAT TREATMENT ON TENSILE PROPERTIES AND FRACTURE TOUGHNESS (8, p 22)

Alloy	Inconel 706	
Form	6 in. sq press forged in 2 x 6 in. bar	
Condition	HT 1800 F, 2 hrs, AC + 1550 F, 3 hrs, AC + 1325 F, 8 hrs, FC 100 F per hr to 1150 F, + 1150 F, 18 hrs, AC	
Charpy-V Impact Strength, ft-lbs:	Long	Trans
Results From Six Specimens in Longitudinal and Transverse Directions	29.5	26.0
	32.0	26.0
	33.0	28.0
	31.5	26.5
	33.0	25.0
	32.0	27.0

TABLE 3.0231 CHARPY-V IMPACT TESTS IN LONGITUDINAL AND TRANSVERSE DIRECTIONS (1, p 120)

Alloy	Inconel 706	
Form	6 in. sq. press forged to 2 x 6 in. bar	
Condition	HT 1800 F, 2 hrs, AC + 1550 F, 3 hrs, AC + 1325 F, 8 hrs, FC 100 F per hr to 1150 F, +1150 F, 18 hrs, AC	
Ultimate Shear Strength, F_{su}, ksi:	Long	Trans
Results from 4 tests in Longitudinal and Transverse Directions	117.0	117.0
	117.0	117.0
	117.0	117.0
	118.0	118.0

TABLE 3.0251 SHEAR STRENGTH IN LONGITUDINAL AND TRANSVERSE DIRECTIONS (1, p 119)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

Inconel 706
Condition As Shown
A) Coarse Grained Forging Practice (ASTM 2/3)
1) Heat 2000 F
2) Forge to 2 in. sq, reheat as necessary
3) Reheat 2000 F
4) Forge to 1 5/8 in. sq
5) Reheat 2000 F/1 hr
6) Forge ~ 18 in. to 1 ½ in. sq
B) Fine Grained Forging Practice
1) Forge to 1 ½ in. sq as above
2) Heat 2000 F/1 hr
3) Forge 6 to 8 in. of 1 ½ in. sq to 7/8 in. sq

TABLE 4.0112 HAMMER FORGING PRACTICE FOR INCONEL 706 (5, p 2154)

Inconel 706				
Condition As Shown				
Alloy	Carbon, %	Condition	Cutting Speed, sfm	Horsepower per in^3
706	0.01	Annealed	167	1.00
		Annealed and Aged	182	1.00
	0.05	Annealed	137	1.00
		Annealed and Aged	120	1.00
718	0.07	Hot-Rolled	85	1.22

TABLE 4.022 COMPARATIVE MACHINABILITY OF INCONEL ALLOYS 706 AND 718 (8, p 24)

Alloy	Inconel 706				
Welding Conditions	Manual Gas-Tungsten-Arc Using Inconel 718 Weld Metal - (b)				
Test Temp	RT				
	Hot Rolled, 1.125 in. Flat			Forging, 1 in. Thick	
Condition	1750 F, 1 hr, AC (Annealed)	1750 F, 1 hr, AC + 1350 F, 8 hrs, FC to 1150 F + 1150 F, 8 hrs, AC (Ann + Age)	1750 F, 1 hr, AC + Weld + 1350 F, 8 hrs, FC to 1150 F, + 1150 F, 8 hrs, AC (Ann + Weld + Age)	1750 F, 1 hr, AC + 1350 F, 8 FC to 1150 F, + 1150 F, 8 hrs, AC (Ann + Age)	1750 F, 1 hr, AC + Weld + 1350 F, 8 hrs, FC to 1150 F + 1150 F, 8 hrs, AC (Ann + Weld + Age)
F_{tu}, ksi(a)	112	194	173	180	176
F_{ty}, ksi	50	162	146	139	147
e, 2 in. - percent	40	20	12	24	11
RA, - percent	56	38	25	35	19

(a) All Failures in Weld
(b) Patch Welded by Filling a Circular Groove at Center of Sample, According to Pierce-Miller Repair Weld Test

TABLE 4.033 PROPERTIES OF CIRCLE PATCH WELDS IN HOT ROLLED PLATE AND FORGING 1 IN. THICK OR OVER, WITH EFFECTS OF SEVERAL HEAT TREATMENTS (8, p 24)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

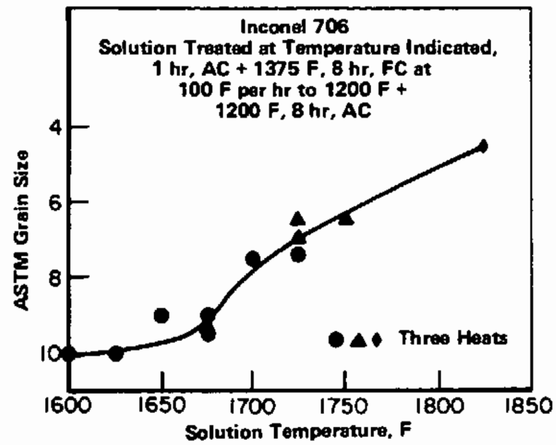

FIGURE 1.054. EFFECT OF SOLUTION TREATMENT TEMPERATURE ON GRAIN SIZE (5, p 2156)

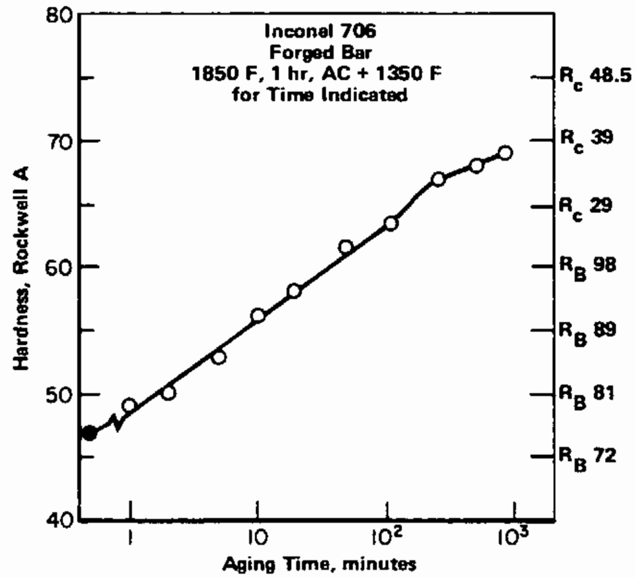

FIGURE 1.061. EFFECT OF AGING TIME ON HARDNESS (4, p 2150)

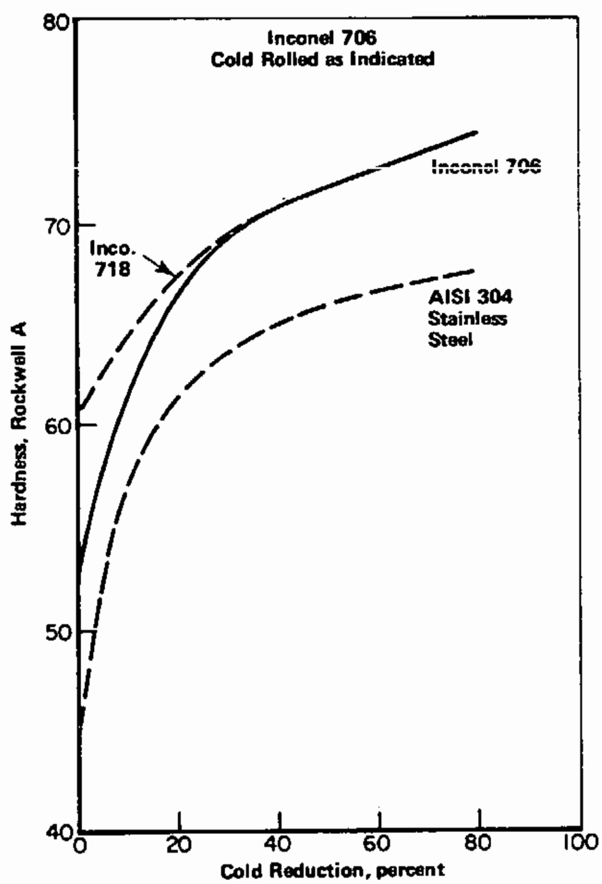

FIGURE 1.062. EFFECT OF COLD REDUCTION ON HARDNESS, WITH COMPARISON TO TWO OTHER COMMONLY USED ALLOYS (8, p 23)

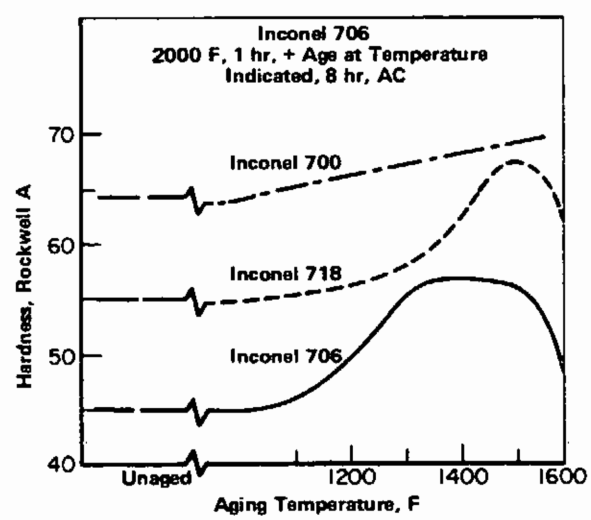

FIGURE 1.063. EFFECT OF AGING TEMPERATURE ON HARDNESS, WITH COMPARISON TO TWO OTHER COMMONLY USED ALLOYS (8, p 24)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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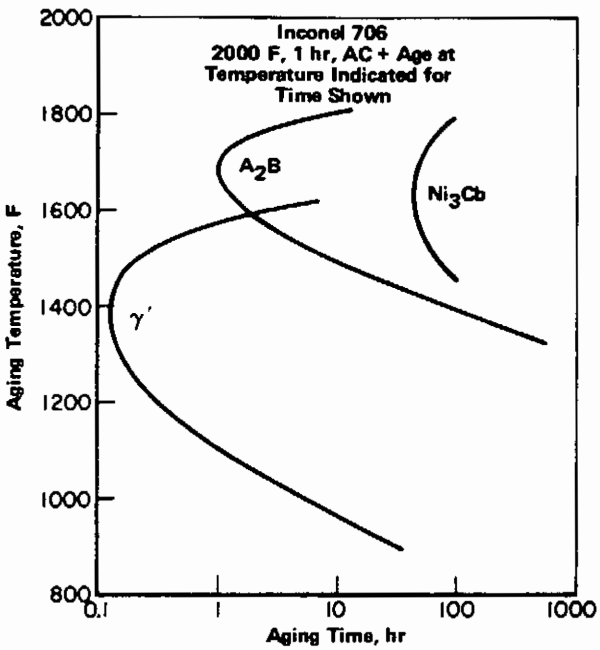

FIGURE 2.0121. TIME-TEMPERATURE TRANSFORMATION DIAGRAM FOR ALLOY SOLUTION ANNEALED AT 2000 F, FOLLOWED BY AGING AT VARIOUS TIMES AND TEMPERATURES (8, p 22)

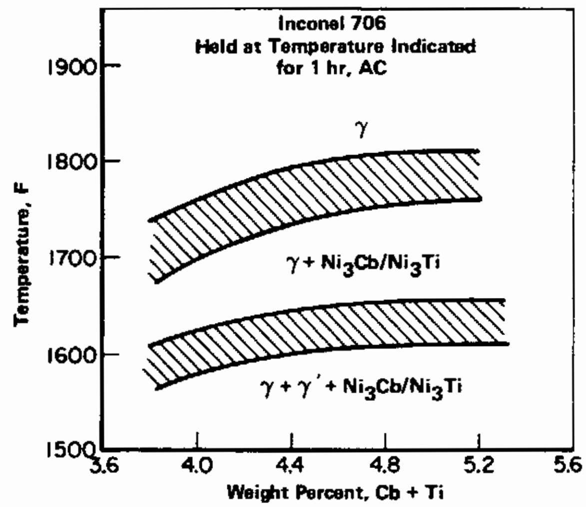

FIGURE 2.0122. EFFECT OF (Cb + Ti) CONTENT ON PHASES PRESENT AFTER ONE HOUR HOLD AT ELEVATED TEMPERATURE, FOLLOWED BY AIR COOLING (11, p 17)

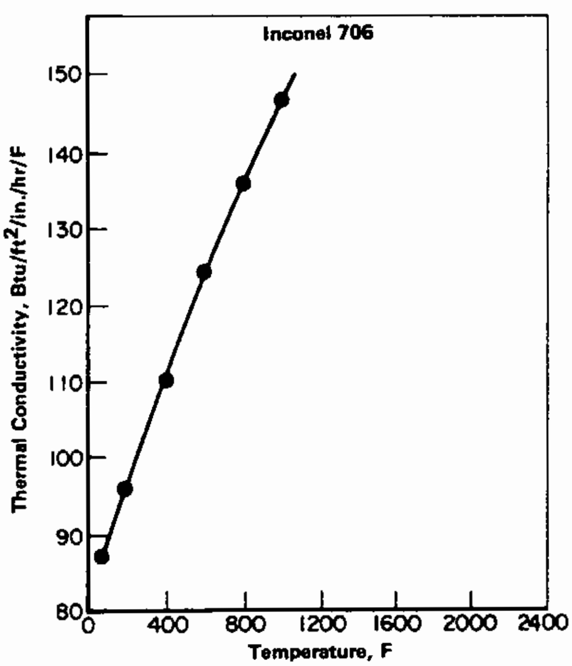

FIGURE 2.013. THERMAL CONDUCTIVITY (2, p 19)

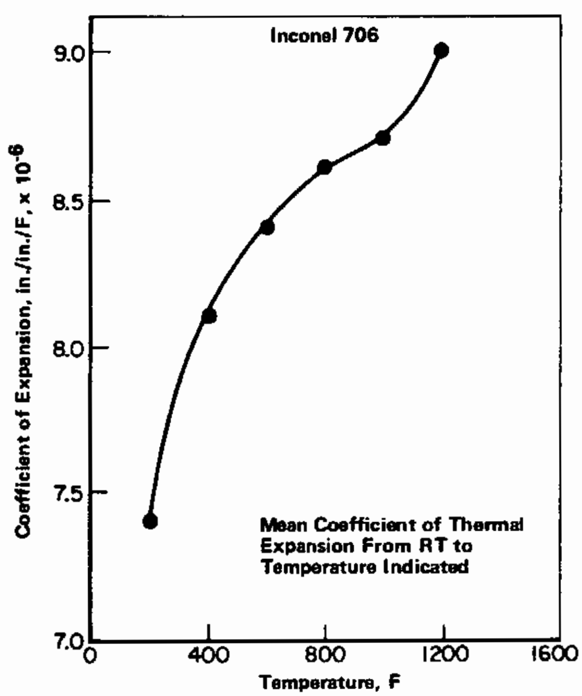

FIGURE 2.014. MEAN COEFFICIENT OF THERMAL EXPANSION (2, p 20)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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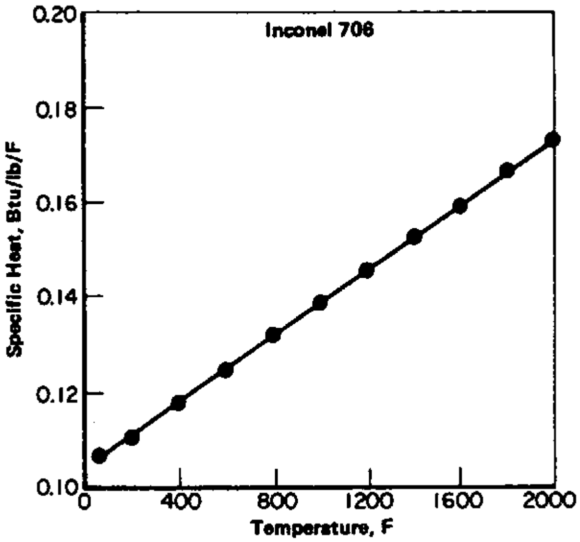

FIGURE 2.015 SPECIFIC HEAT (2, p 19)

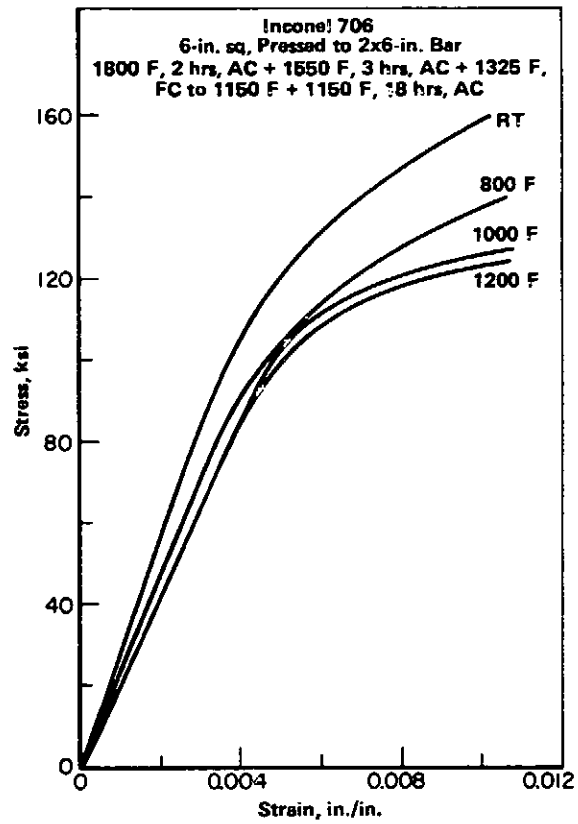

FIGURE 3.03111 LONGITUDINAL TENSILE STRESS-STRAIN CURVES AT RT TO 1200 F (1, pp 113, 125)

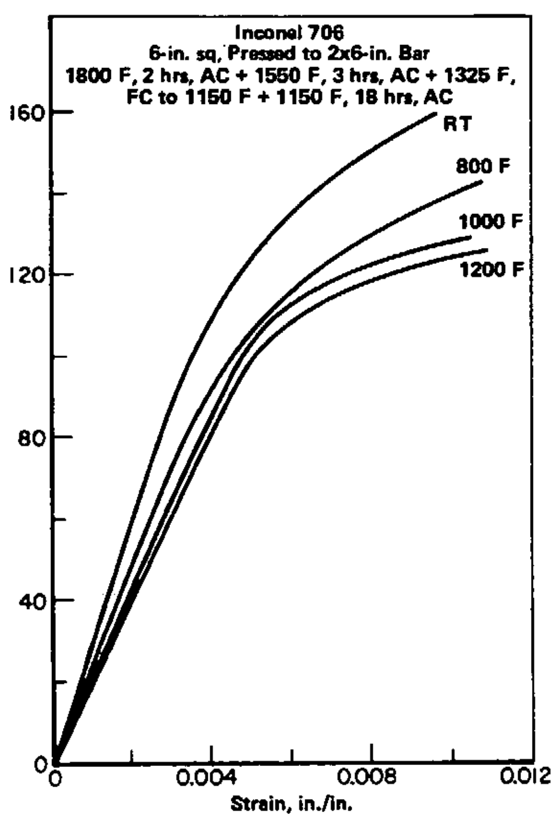

FIGURE 3.03112 TRANSVERSE TENSILE STRESS-STRAIN CURVES AT RT TO 1200 F (1, pp 113, 126)

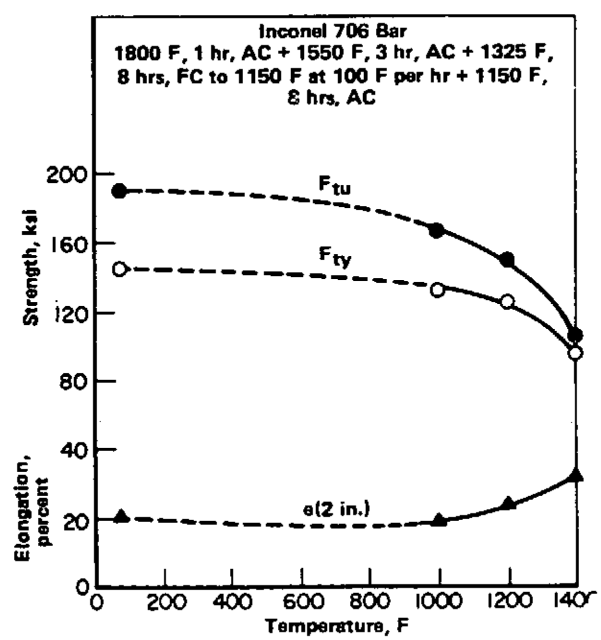

FIGURE 3.03121 PRODUCER'S ESTIMATES OF TENSILE PROPERTIES OF BAR AT ROOM AND ELEVATED TEMPERATURES (2, pp 16, 17, 22-24)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

Inconel 706

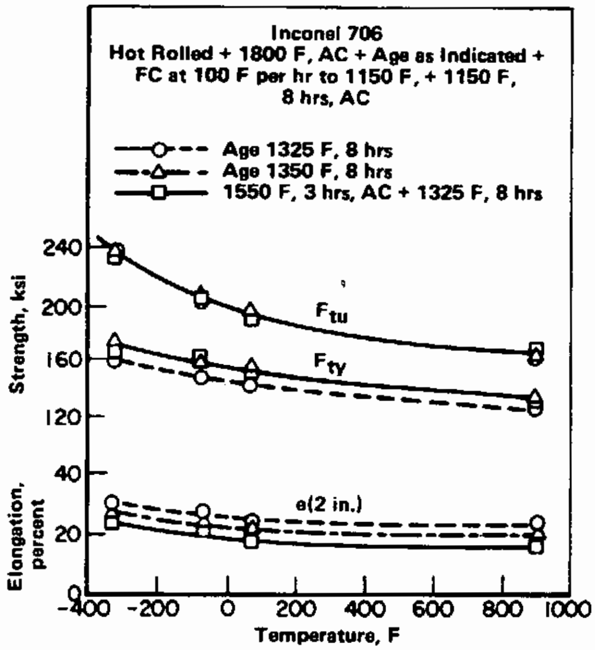

FIGURE 3.03122 EFFECT OF AGING ON TENSILE PROPERTIES AT TEMPERATURES FROM −320 TO 900 F (8, p 23)

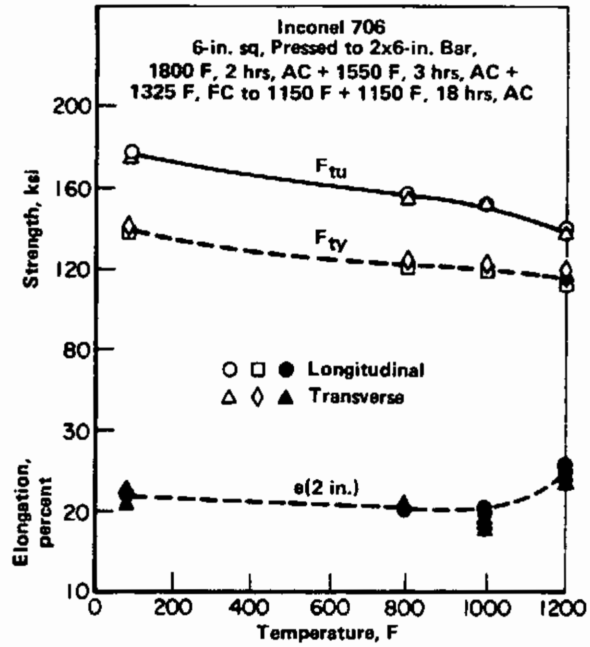

FIGURE 3.03123 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF BAR (1, pp 113 129)

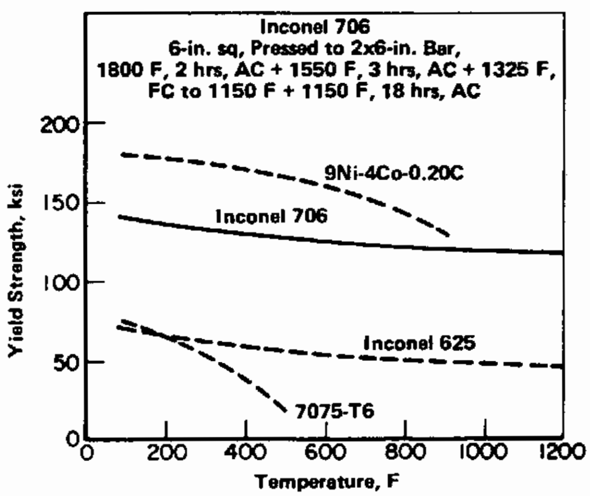

FIGURE 3.03124 EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF ALLOY HEAT TREATED FOR OPTIMIZED CREEP RUPTURE PROPERTIES, WITH COMPARISON TO OTHER WELL-KNOWN ALLOYS (1, p 113, 134)

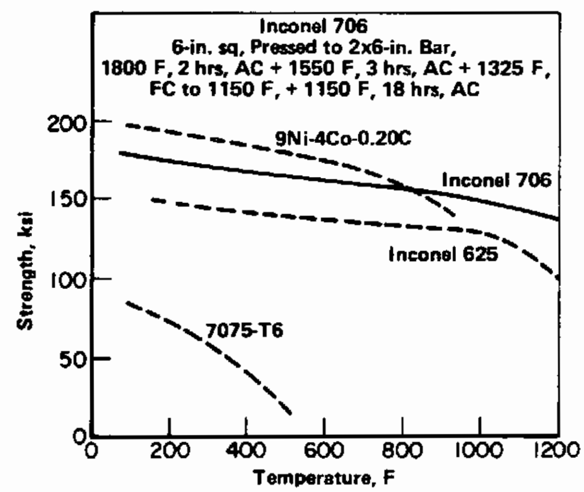

FIGURE 3.03125 EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF ALLOY HEAT TREATED FOR OPTIMIZED CREEP-RUPTURE PROPERTIES, WITH COMPARISON TO SEVERAL OTHER WELL-KNOWN ALLOYS (1, pp 113, 133)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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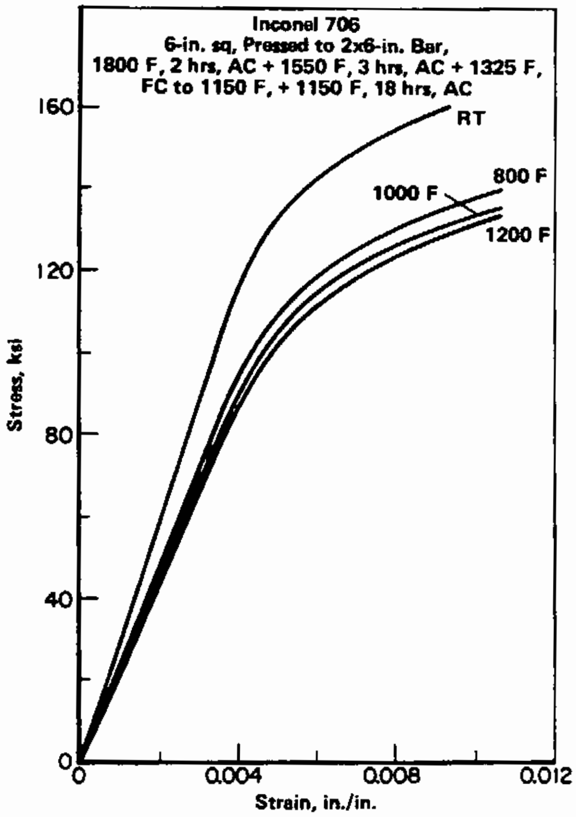

FIGURE 3.03211 TYPICAL COMPRESSIVE STRESS-STRAIN CURVES IN LONGITUDINAL DIRECTION FROM RT TO 1200 F (1, pp 113, 127)

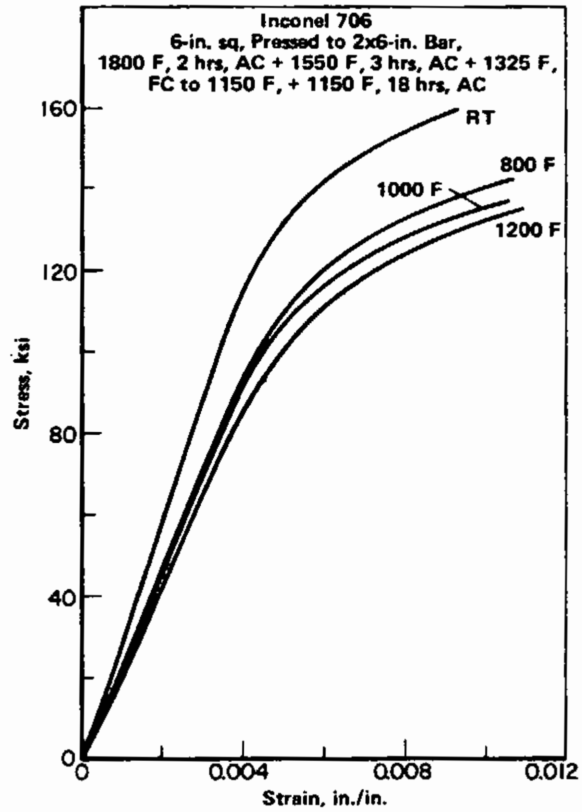

FIGURE 3.03212 TYPICAL COMPRESSIVE STRESS-STRAIN CURVES IN TRANSVERSE DIRECTION FROM RT TO 1200 F (1, pp 113, 128)

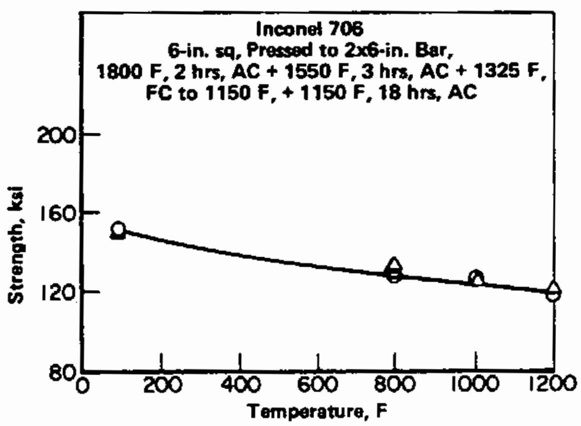

FIGURE 3.03221 EFFECT OF TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH (1, pp 113, 129)

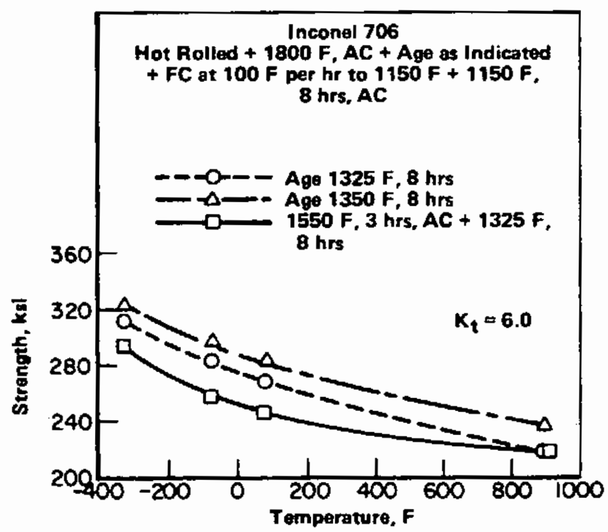

FIGURE 3.0371 EFFECT OF AGING ON NOTCH TENSILE STRENGTH, $K_t = 6.0$, AT TEMPERATURES FROM -320 F TO 900 F (8, p 23)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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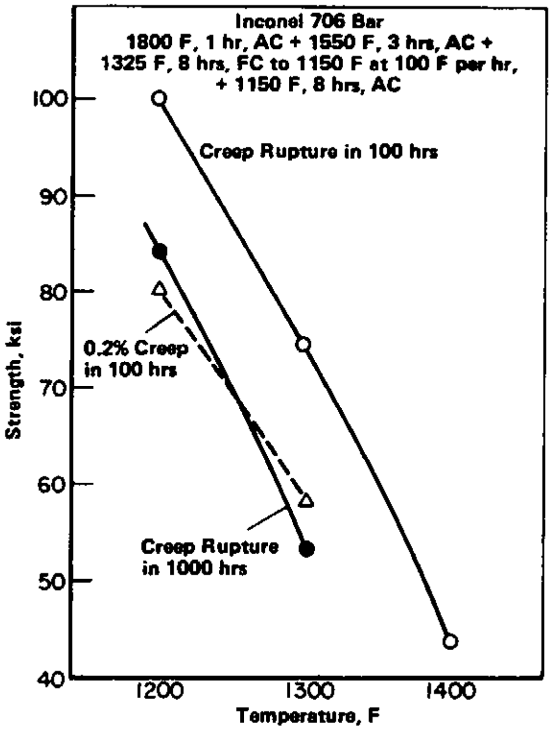

FIGURE 3.041 PRODUCER'S ESTIMATES OF CREEP AND CREEP RUPTURE STRENGTHS AT 1200 F TO 1400 F (2, pp 16, 17, 25-27)

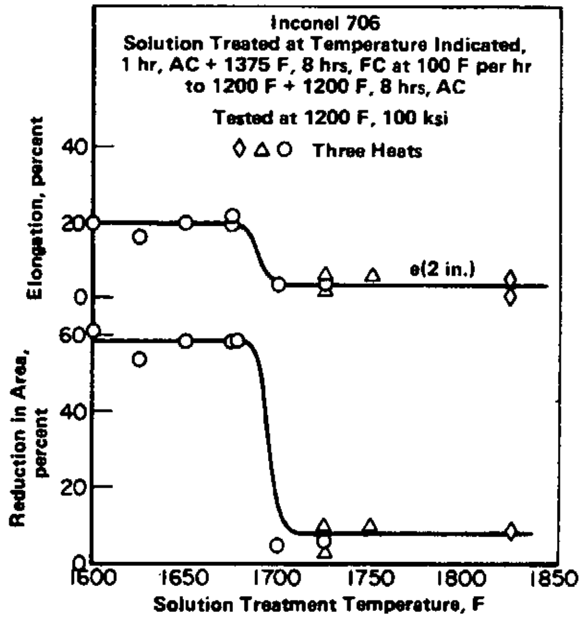

FIGURE 3.042 EFFECT OF SOLUTION TREATMENT TEMPERATURE ON DUCTILITY IN CREEP RUPTURE TEST AT 1200 F, 100 ksi (5, p 2156)

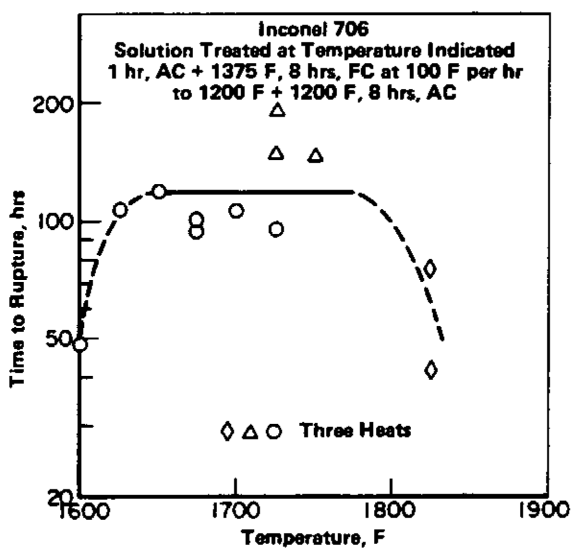

FIGURE 3.043 EFFECT OF SOLUTION TREATMENT TEMPERATURE ON CREEP RUPTURE TIME AT 1200 F, 100 ksi (5, p 2156)

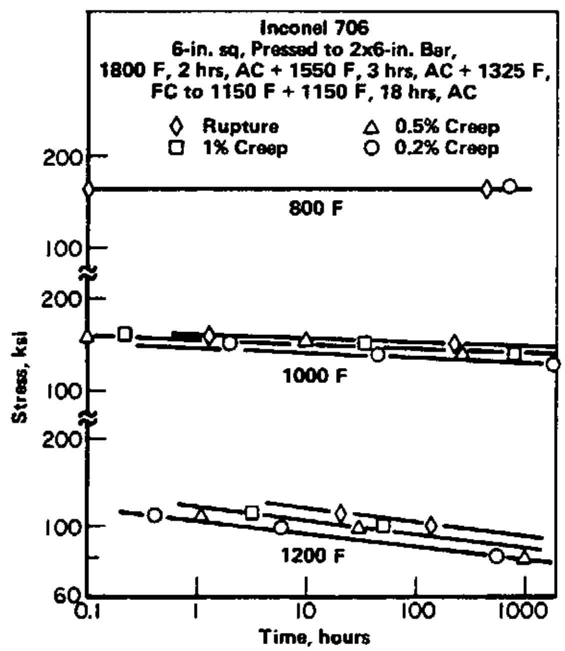

FIGURE 3.044 CREEP AND CREEP RUPTURE AT 800 F, 1000 F, AND 1200 F OF BAR (1, pp 113, 131)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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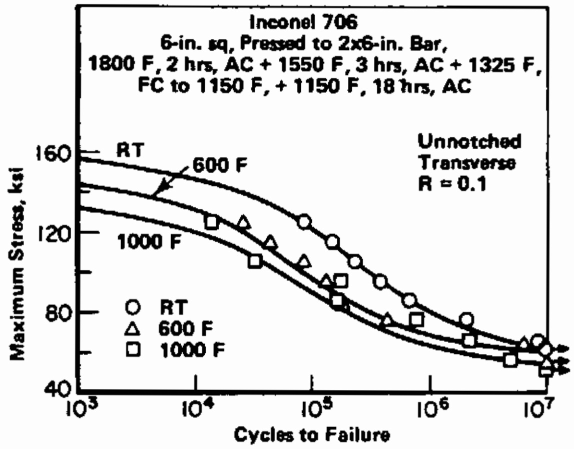

FIGURE 3.051 AKIAL FATIGUE, R = 0.1, OF UNNOTCHED MATERIAL AT RT, 600 F, AND 1000 F (1, pp 113, 130)

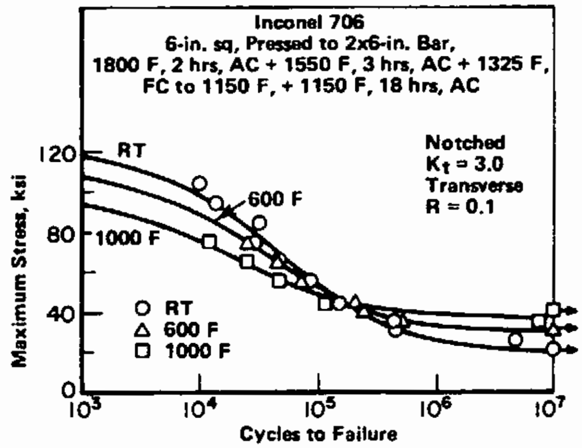

FIGURE 3.052 AXIAL FATIGUE, R = 0.1, OF NOTCHED BAR, K_t = 3.0, AT RT, 600 F AND 1000 F (1, pp 113, 130)

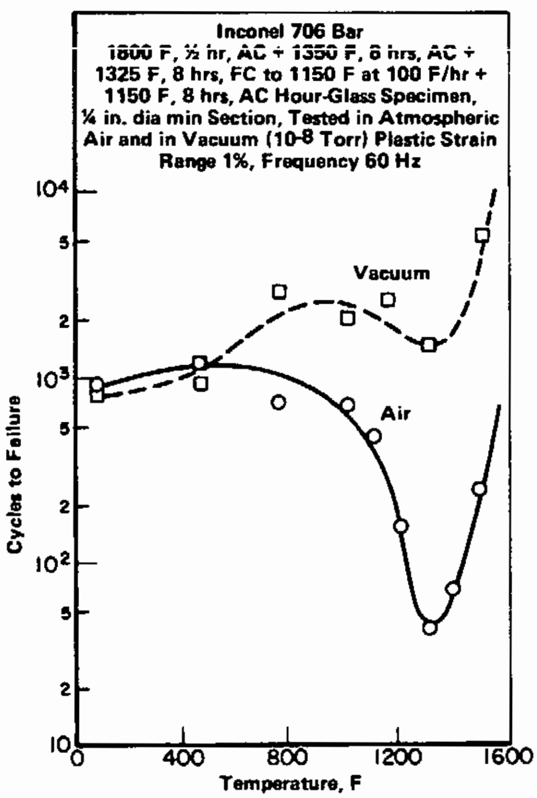

FIGURE 3.053 EFFECT OF TEMPERATURE ON THE LOW CYCLE FATIGUE LIFE IN AIR AND IN VACUUM (9, pp 893 - 894)

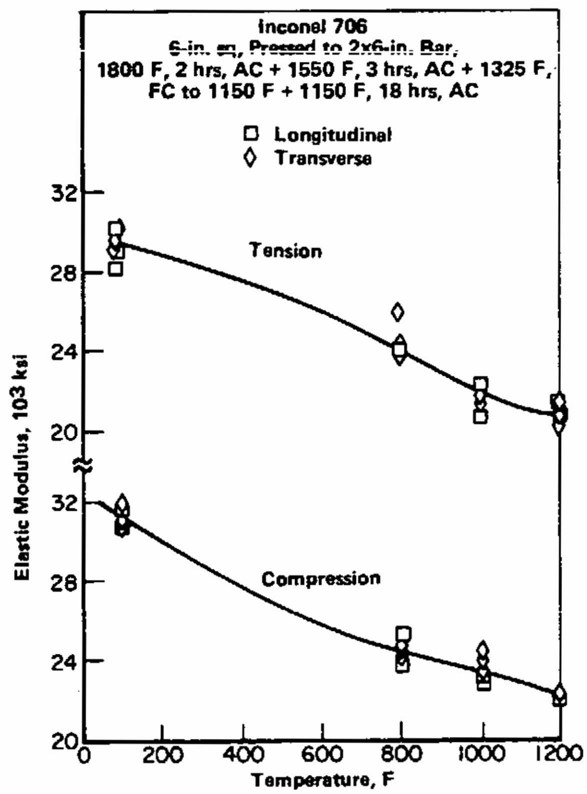

FIGURE 3.0621 EFFECT OF TEST TEMPERATURE ON TENSILE AND COMPRESSIVE ELASTIC MODULUS (1, pp 113, 129)

	Ni
37	Fe
16	Cr
2.9	Cb
1.8	Ti

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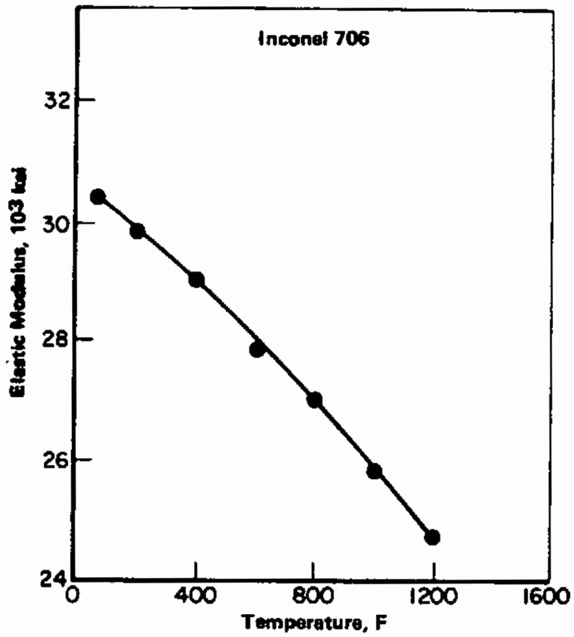

FIGURE 3.0622 DYNAMIC MODULUS OF ELASTICITY (2, p 21)

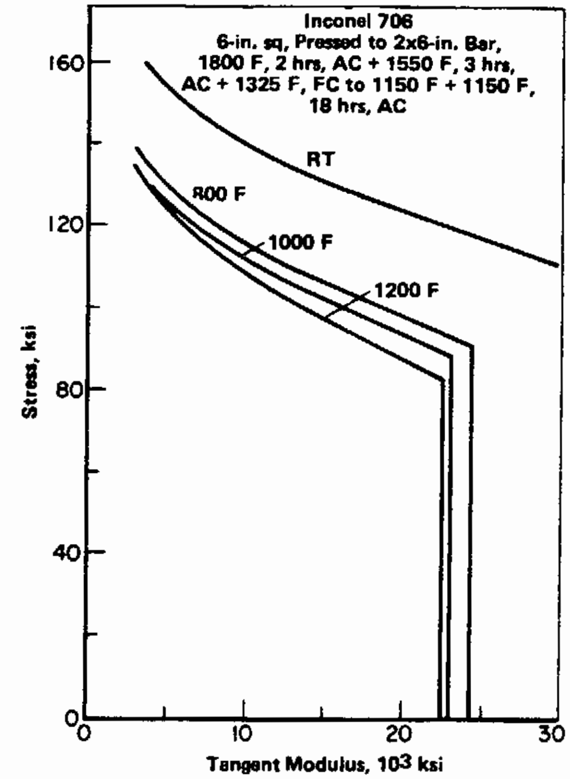

FIGURE 3.0641 TYPICAL COMPRESSIVE TANGENT MODULUS IN LONGITUDINAL DIRECTION FROM RT TO 1200 F (1, pp 113, 127)

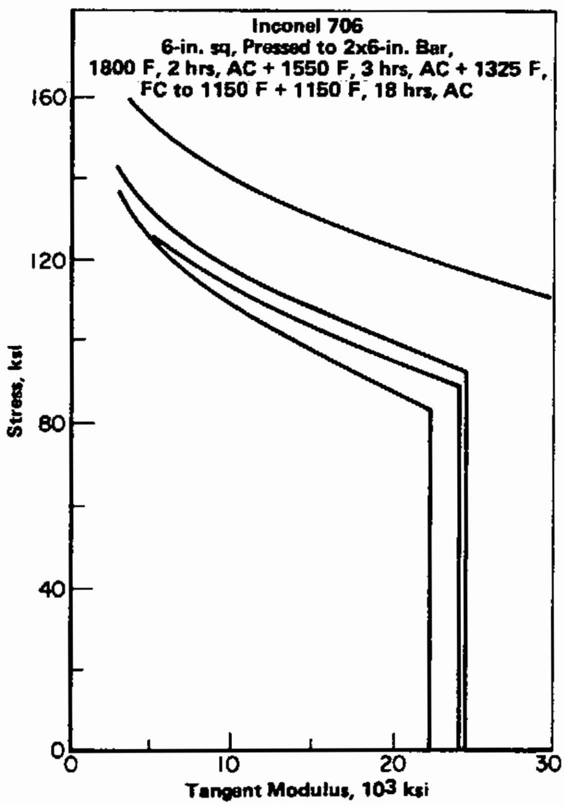

FIGURE 3.0642 TYPICAL COMPRESSIVE TANGENT MODULUS IN TRANSVERSE DIRECTION FROM RT TO 1200 F (1, pp 113, 128)

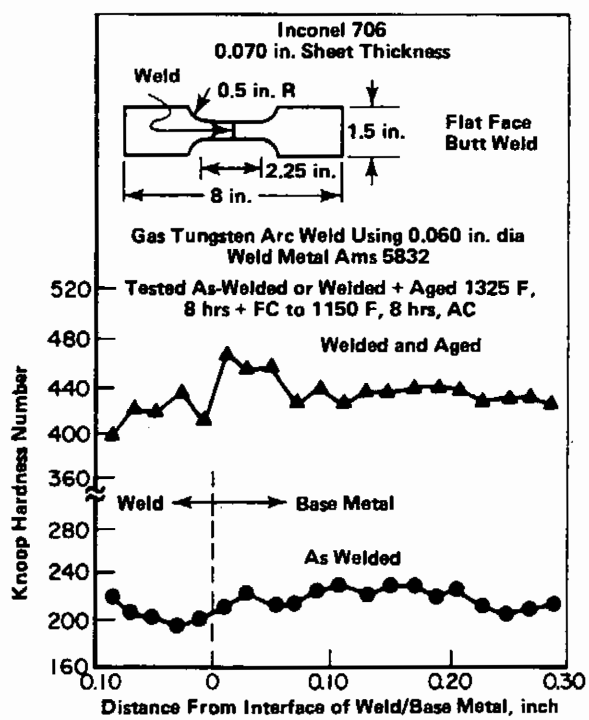

FIGURE 4.032 HARDNESS SURVEY IN REGION OF WELD INTERFACE FOR BUT WELDED JOINT (7, pp 2705, 2723)