	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

3.023 Impact (see 3.033).
3.024 Bending.
3.025 Torsion and shear (see 3.035).
3.0251 Shear ultimate strength of hand forgings, Table 3.0251.
3.026 Bearing (see also 3.036).
3.0261 Bearing property reductions for thick plate, Table 3.0261.
3.0262 Pin bearing strength of plate in the T651 Condition, Table 3.0262.
3.0263 Bearing strength of hand forgings, Table 3.0263.
3.027 Stress concentration.
3.0271 Notch properties.
3.02711 Strength of sheet containing shallow cracks, Figure 3.02711.
3.0272 Fracture toughness (see Appendix C).
3.02721 Results of fracture toughness tests on plate in the T651 Condition, Table 3.02721.
3.02722 Plane strain fracture toughness for various thicknesses of T651 plate, Table 3.02722.
3.02723 Plane strain fracture toughness of hand forgings and extrusions, Table 3.02723.
3.02724 Plane strain fracture toughness of plate tested in several directions, Table 3.02724.
3.028 Combined properties.

3.03 Mechanical Properties at Various Temperatures
3.031 Tension.
3.0311 Stress-strain diagrams (see also 3.0211).
3.03111 Stress-strain curves for alloy in T6 Condition at various temperatures, Figure 3.03111.
3.03112 Stress-strain curves for clad sheet in T6 Condition at room and elevated temperatures, Figure 3.03112.
3.03113 Stress-strain curves for sheet in T6 Condition at low temperatures, Figure 3.03113.
3.0312 Typical tensile properties at various temperatures for alloy in T6 Condition, Figure 3.0312.
3.0313 Effect of exposure and test temperature on tensile properties of alloy in T6 Condition, Figure 3.0313.
3.0314 Effect of exposure and test temperature on tensile properties of clad sheet in T6 Condition, Figure 3.0314.
3.0315 Effect of low test temperature on tensile properties of sheet and bar in T6 Condition, Figure 3.0315.
3.03151 Mechanical properties of bar at low temperatures, Table 3.03151.
3.0316 Effect of low temperatures on tensile properties and hardness of forgings in T6 Condition, Figure 3.0316.
3.0317 Effect of test temperature on F_{tu}, F_{ty} and F_{cy} of clad sheet in T6 Condition, Figure 3.0317.
3.0318 Effect of exposure on room temperature tensile properties of T6 forged rod, Figure 3.0318.
3.0319 Effect of exposure on room temperature tensile properties of T6 rolled and drawn rod, Figure 3.0319.
3.032 Compression (see also 3.0317).
3.0321 Stress-strain diagrams.
3.03211 Stress-strain curves in compression for clad sheet in T6 Condition at room and elevated temperatures, Figure 3.03211.
3.0322 Effect of exposure and test temperature on compressive yield strength of clad sheet in T6 Condition, Figure 3.0322.
3.033 Impact.
3.0331 Effect of low temperatures on Charpy V impact properties of plate, Figure 3.0331.
3.034 Bending (see 3.024).
3.035 Torsion and shear.
3.0351 Effect of exposure and test temperature on shear strength of clad sheet in T6 Condition, Figure 3.0351.
3.0352 Effect of low temperature on shear strength of sheet in T6 Condition, Figure 3.0352.
3.0353 Effect of test temperature on F_{bru}, F_{bry} and F_{su} of clad sheet in T6 Condition, Figure 3.0353.
3.036 Bearing (see also 3.0353).
3.0361 Effect of exposure and test temperature on bearing properties of clad sheet in T6 Condition, Figure 3.0361.
3.037 Stress concentration.
3.0371 Notch properties.
3.03711 Effect of low test temperatures on notched and smooth sheet in T6 Condition, Figure 3.03711.
3.03712 Effect of low temperature on tensile and sharp notch properties of sheet in T6 Condition, Figure 3.03712.
3.03713 Effect of low test temperature on notch strength and fracture toughness of sheet in T6 Condition, Figure 3.03713.
3.03714 Effect of low temperature on tensile and notch properties of sheet in the T6 Condition, Figure 3.03714.
3.0372 Fracture toughness (see also 3.03713). (See Appendix C.)
3.03721 Fracture test data for thin walled cylinders tested at -320 F, Table 3.03721.
3.038 Combined properties.

3.04 Creep and Creep Rupture Properties
3.041 Creep and creep rupture curves for alloy in T6 Condition 212-600 F, Figure 3.041.
3.042 Short time total strain curves for clad sheet in T6 Condition at 300 to 600 F, Figure 3.042.
3.043 Isochronous stress-strain curves in tension for alloy in T6 Condition at 400 F, Figure 3.043.

3.05 Fatigue Properties
3.051 Typical fatigue strength of alloy in T4 and T6 Conditions, Table 3.051.
3.052 Average stress range diagrams for bar and extrusions in T6 Condition, Figure 3.052.
3.053 Stress range diagrams for smooth and notched bar in T6 Condition, Figure 3.053.
3.054 Scatter band of fatigue data for smooth and notched hand forged bar in T6 Condition, Figure 3.054.
3.055 S-N curves for alloy tested in air and in simulated sea water, Figure 3.055.

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

3.056 Effect of strain cycling on fatigue life in T6 bar, Figure 3.056.

3.057 Effect of low temperature on smooth and notched fatigue strength in sheet, Figure 3.057.

3.058 Effect of low temperatures on strain cycle fatigue of bar, Figure 3.058.

3.059 Scatter band for fatigue crack growth data for sheet, Figure 3.059.

3.0510 Scatter band for fatigue crack growth data for hand forgings, Figure 3.0510.

3.0511 Scatter band for fatigue crack growth data for forgings, Figure 3.0511.

3.06 Elastic Properties
(See also Table 3.03151.)

3.061 Poisson's ratio (elastic and plastic), Table 3.061.

3.062 Modulus of elasticity, E.

3.0621 Bare products,
Condition O, T4 and T6; E = 10.6×10^3 ksi,
Clad products,
Condition O, T3, T4 and T6; E = 10.5×10^3 ksi (13).

3.0622 Effect of temperature on E and E_c, Figure 3.0622.

3.0623 Compression modulus, E_c is approximately 2 percent higher than tension modulus, E (13).

3.0624 Elastic moduli in tension and compression for hand forgings tested in several directions, Table 3.0624.

3.063 Modulus of rigidity.

3.0631 Design value at RT. G = 4.0×10^3 ksi (5).

3.064 Tangent modulus.

3.0641 Typical tangent modulus curves for clad sheet at room temperature, Figure 3.0641.

3.0642 Tangent modulus curves in compression for clad sheet in T6 Condition at room and elevated temperatures, Figure 3.0642.

3.0643 Typical tangent modulus curves for extrusions and rolled products at room temperature, Figure 3.0643.

3.065 Secant modulus.

4. FABRICATION
(See also 2024 alloy.)

4.01 Forming

4.011 General. The alloy exhibits good forming characteristics, superior to alloys such as 7075 but inferior to 6061 alloy. In the O Condition, its formability is comparable to 2024-O, and the W Condition is slightly better than 2024-W.

4.012 Forming operations may be performed in the freshly quenched (W) Condition and maximum formability is attained immediately after quenching within about 20 minutes. If refrigeration is used the following maximum holding times are suggested:

RT	20 minutes
32 F	24 hours
20 F	3 days
Zero F	7 days

4.0121 For mild operations, the alloy can be formed in the T3 or T4 Conditions, but this involves die allowances for "springback" and general inconvenience as compared with forming in the W Condition.

4.0122 Material in T6 Condition has very limited formability at room temperature and is comparable to 7075-T6. Hot forming at 350–700 F may be used to advantage for T6 Condition but time at temperature should be limited to the values given in Figure 4.0122.

4.01221 Maximum time at various temperatures for hot forming sheet in T-6 condition, Figure 4.01221.

4.0123 Hot forming in W or T4 Conditions is permissible only if subsequently aged to T6 Condition and offers little advantage over hot forming in T6 Condition.

4.013 Forging.

4.0131 The 2014 alloy is widely used as a forging alloy and it has forging characteristics superior to 7075 or 7079 alloys. Starting temperature 875 F maximum, finishing temperature 600 F minimum. Maximum temperature should not be exceeded to prevent hot shortness, particularly in hammer forging.

4.014 Bending.

4.0141 Approximate bend radii for 90 degree cold bend, Table 4.0141.

4.02 Machining and Grinding

4.021 This alloy is readily machined in all conventional machining operations. Best machinability is obtained in the hardest temper. In the softer tempers, alloy tends to be somewhat gummy.

4.022 Typical grinding operations use a wheel of type A46KV at a speed of 6000 feet per minute and table speed of 60 feet per minute. A down feed of about 0.001 inch per pass will give a rough finish. A fine finish is produced at 0.0005 inch per pass. A water base emulsion is used as the grinding fluid.

4.023 Removal of material by either electro-chemical milling (ECM) or chemical milling may be successfully accomplished.

4.03 Joining

4.031 General. The heat treatable alloys, such as 2014, are slightly more difficult to weld than the nonheat treatable aluminum alloys. However, with proper precautions, refined techniques and close control of variables, the 2014 alloy is satisfactorily welded by both fusion and resistance techniques.

4.032 Fusion welding is usually accomplished by GTA or GMA welding methods using 4043 or 2319 aluminum alloy filler wire when required. Generally, the alloy is used in the "as welded" condition, with the weld joint about twice the thickness of the base metal to compensate for the lower strength in this condition. Stress corrosion tests have indicated that "as welded" joints have superior corrosion resistance to joints aged after welding. The strength of welded joints is apparently reduced

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

by porosity and mismatch of parts and these factors should be held to a minimum wherever possible. Strength of joints may also be impaired by repair welding.

4.0321 Effect of welding speed on tensile strength of GTA welds, Figure 4.0321.

4.0322 Combined effect of porosity and mismatch for GTA welded sheet, Figure 4.0322.

4.0323 Effect of cryogenic temperatures on tensile properties of weldments and parent metal sheet in T6 Condition, Figure 4.0323.

4.0324 S-N fatigue curves for GTA butt-welded sheet at room and cryogenic temperatures, Figure 4.0324.

4.033 Resistance welding of 2014 alloy is successfully accomplished but requires special practices. Spot welds are best made in heat treated material. Spot welding of annealed material is not recommended. Corrosion resistance of clad material is good but resistance of bare material is poor.

4.034 Brazing and soldering of 2014 products are not recommended.

4.04 Surface Treatment

4.041 Alloy is available as Alclad sheet and plate which have a high resistance to surface corrosion and which may be used without additional protective coatings for many applications (47) (48).

4.042 A wide variety of surface treatments may be employed to protect and improve surface appearance. These include mechanical, chemical and electrochemical finishes and organic, porcelain and paint coatings. Detailed information on surface protection is available from the producers of aluminum alloys (47) (48).

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	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

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Alloy	2014	
Source	(1)	
AMS	Condition	Form
4014B	T651	Plate
4028D	O	Sheet and Plate (bare)
4029E	T6	Sheet (bare)
	T651	Plate (bare)
4121D	T6	Bar, Rods, Wire (rolled, drawn or cold finished)
4133	T6	Forgings
4134A	T4	Die Forgings and Forging Stock
4135K	T6	Die Forgings, Hand Forgings and Forging Stock
4153F	T6	Extrusions

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

TABLE 1.031 AMS SPECIFICATIONS

Alloy	2014		
Form	Military	Federal	ASTM
Sheet and Plate (bare)	-	QQA-250d	B209
Bar, Rod, Wire (rolled or cold finished)	-	QQ-A-225/4c	B211
Bar, Rod, Wire, Shapes (extruded)	-	QQ-A-200/2D	B221
Tube, seamless (extruded)	-	-	B241
Tube, seamless (drawn)	-	-	B210
Forgings and Forging Stock	MIL-A-22771	QQ-A-367g	B247
Impact extrusions	MIL-A-12545	-	-
Sheet and Plate (Alclad)	-	QQ-A-250/3E	B209
Structural shapes (rolled or extruded)	- MIL-A-25994	- -	- B308

TABLE 1.032 SIMILAR SPECIFICATIONS

Alloy	2014		2014		6003		6053	
Source	AMS (1)		(41)		(41)		(41)	
	Core		Core		Cladding		Cladding	
	Percent		Percent		Percent		Percent	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Copper	3.90	5.00	3.9	5.0	-	0.10	-	0.10
Magnesium	0.20	0.80	0.20	0.8	0.8	1.5	1.1	1.4
Manganese	0.40	1.20	0.40	1.2	-	0.8	-	-
Iron	-	1.00	-	0.7	-	0.6	-	0.35
Silicon	0.50	1.20	0.50	1.2	0.35	1.0	-	(a)
Zinc	-	0.25	-	0.25	-	0.20	-	0.10
Chromium	-	0.10	-	0.10	-	0.35	0.15	0.35
Titanium	-	0.15	(b)	0.15	-	0.10	-	-
Other Impurities								
each	-	0.05	-	0.05	-	0.05	-	0.05
total	-	0.15	-	0.15	-	0.15	-	0.15
Aluminum	Remainder		Remainder		Remainder		Remainder	

(a) Silicon 45 to 65 percent of magnesium content.
(b) Zirconium + titanium 0.20 percent maximum.

TABLE 1.04 COMPOSITION

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

Source	(28)
Alloy	2014
Data	Maximum quench delay times (a)
Nominal thickness	Maximum time, seconds
≤ 0.016 in	5
0.017 to 0.032 in	7
0.033 to 0.091 in	10
≥ 0.091 in	15

(a) For immersion type quenching after solution treatment

TABLE 1.0521 MAXIMUM ALLOWABLE QUENCH DELAY TIMES

Source	(13)(24)	
Alloy	2014	
Condition	Brinell scale	Rockwell scale
O	45	H87-98
T4	105	B65-73
T6	135	B80-86

TABLE 1.061 TYPICAL HARDNESS VALUES AT ROOM TEMPERATURES

Source	(41)
Temperature	R. T.
Condition	Thermal Conductivity-Btu-ft. per (hr. sq. ft. F)
O	111.6
T4	77.5
T6	89.2

TABLE 2.013 THERMAL CONDUCTIVITY

Source	(41)
Alloy	2014 and Clad 2014
Product	Available tempers
Bare sheet and plate	O, T3, T4, T451, T6, T651
Clad sheet and plate	O, T3, T4, T451, T6, T651
Wire, rod, bar (rolled or CF)	O, T4, T451, T6, T651
Rod, bar, shapes, tube (extruded)	O, T4, T4510, T4511, T6, T6510, T6511
Drawn tube	O, T4, T6
Forgings	T4, T6, T652

TABLE 1.073 CONDITIONS AVAILABLE

Source	(41)
Condition	Electrical Resistivity at 68F - Microhm inch
O	1.34
T4	2.01
T6	1.69

TABLE 2.0221 ELECTRICAL RESISTIVITY

Source	(25)		
Alloy	2014 - T6		
Form	0.063 in sheet		
Test Data	Resistance to stress corrosion		
Environment	Exposure (days)	Average loss in F_{tu}, percent Unstressed	Stressed 75% of F_{ty}
Inland industrial	365	7	7
Sea coast	365	18	28
3.5% NaCl (alternate immersion)	84	42	55

TABLE 2.033 RESISTANCE TO STRESS CORROSION IN VARIOUS ENVIRONMENTS

Alloy	2014-T6				
Source	(25)				
Test Data	SCR-Highest Sustained Tensile Stress Without Failure, ksi				
Test Direction	Plate	Bar	Extruded Shapes 0.25-1 in.	Extruded Shapes 1.25-2 in.	Hand Forgings
L	45	45	50	45	30
T	30	-	27	22	25
ST	7	15	-	7	7
Test Environment: 3.5 percent NaCl, alternate immersion, 12 weeks SCR - Stress corrosion resistance					

TABLE 2.0331 STRESS CORROSION RESISTANCE OF PLATE, BAR, SHAPES AND FORGINGS IN ALTERNATE IMMERSION TESTS

Source	(13)
Environment	Aqueous Solution of 53 gr. NaCl and 3 gr. H_2O per Liter
Test Data	Electrode Potentials vs 0.1 N Calomel at 25°C
2014-T4	0.69 volt
2014-T6	0.78 volt
Alclad 2014	0.83 volt
Al(99.5 + %)	0.85 volt

TABLE 2.0332 ELECTRODE POTENTIALS OF ALLOY IN VARIOUS CONDITIONS

Al
4.5 Cu
1 Mn
1 Si
0.5 Mg

2014, Clad 2014

Alloy	2014								
Source	(51 - Tables 26 to 29)								
Form	Hand Forgings								
Condition	T652								
Size - (inch)	2 x 8								
Direction	L	LT	ST	L	LT	LT	ST	ST	ST
Exposure stress percent F_{ty} (a)	O	O	O	75	75	50	37	25	12
Range of failure time - days (c)	-	-	-	NF 182	8 to 64	NF 182	NF 84	NF 84	NF 84
Reduction in (b) F_{tu} - percent	5	1	8	8	-	29	21	17	9

(a) Initial stress under constant displacement. Alternate immersion-10 minutes in 3½ percent NaCl and 50 minutes in air. Tests at ambient lab conditions.
(b) Retained F_{tu} following alternate immersion with or without stress.
(c) NF - no failure indicated.

TABLE 2.0333 RESULTS OF ALTERNATE IMMERSION STRESS CORROSION TESTS ON 2 x 8 INCH HAND FORGINGS

Alloy	2014								
Source	(51 - Table 26 to 29)								
Condition	T652 (Hand Forgings)								
Size-(inch)	6 x 24								
Direction	L	LT	ST	L	LT	LT	ST	ST	ST
Exposure stress percent F_{ty} (a)	O	O	O	75	75	50	37	25	12
Range of failure time - days	-	-	-	NF 182	23 to 113	NF 182	4 to 5	10 to 21	NF 84
Reduction in F_{tu} - percent	5	18	20	6	27	-	-	-	23

(a) See Table 2.0233 for details.

TABLE 2.0334 RESULTS OF ALTERNATE IMMERSION STRESS CORROSION TESTS ON 6 x 24 INCH HAND FORGINGS

Source	(41)				
Alloy	2014				
Form	Bar, Wire	Extruded bar tube, shapes	Drawn tube	Sheet and plate	
Condition	0				
Thickness - in	≤8.00 dia	All	All	0.020 to 0.499	0.500 to 1.000
F_{tu}, max -ksi	35	30	32	32	32
F_{ty}, max -ksi	-	18	16	16	-
e, min-percent	12	12	-	16	10

TABLE 3.011 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR VARIOUS PRODUCTS IN THE 0 CONDITION

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Alloy	2014 (Bare)					
Source	(41)					
Form	Flat Sheet		Coiled Sheet	Sheet & Plate	Sheet	
Condition	T3		T4	T42	T6 & T62	
Thickness, (inch)	0.020-0.039	0.040-0.249	0.020-0.249	0.020-1.000	0.020-0.039	0.040-0.249
F_{tu}(min.) - (ksi)	59.0	59.0	59.0	58.0	64.0	66.0
F_{ty}(min.) - (ksi)	35.0	36.0	35.0	34.0	57.0	58.0
e(2in.) - percent (min.)	14	14	14	14	6	7

TABLE 3.012 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR BARE SHEET AND PLATE IN THE T3, T4, T42, T6 and T62 CONDITIONS

Alloy	2014 (Bare)									
Source	(41)									
Form	Plate				Plate					
Condition	T451				T62 & T651					
Thickness, inch	0.250-0.499	0.500-1.000	1.001-2.000	2.001-3.000	0.250-0.499	0.500-1.000	1.001-2.000	2.001-2.500	2.501-3.000	3.001-4.000
F_{tu}(min.) - ksi	58.0	58.0	58.0	57.0	67.0	67.0	67.0	65.0	63.0	59.0
F_{ty}(min.) - ksi	36.0	36.0	36.0	36.0	59.0	59.0	59.0	58.0	57.0	55.0
e(2 in.) - percent (min.)	14	14	12	8	7	6	4	2	2	1

TABLE 3.0121 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR BARE PLATE IN THE T451, T62 and T651 CONDITIONS

Alloy	Alclad 2014									
Source	(41)									
Form	Flat Sheet			Coiled Sheet				Sheet		
Condition	T3			T4				T6 & T62		
Thickness, inch	0.020-0.024	0.025-0.039	0.040-0.249	0.020-0.024	0.025-0.039	0.040-0.128	0.129-0.249	0.020-0.024	0.025-0.039	0.040-0.249
F_{tu}(min.) - ksi	54.0	55.0	57.0	54.0	55.0	57.0	57.0	62.0	63.0	64.0
F_{ty}(min.) - ksi	33.0	34.0	35.0	31.0	32.0	34.0	34.0	54.0	55.0	57.0
e(2in.) - percent (min.)	14	14	15	14	14	15	15	7	7	8

TABLE 3.0122 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR ALCLAD SHEET IN THE T3, T4, T6 AND T62 CONDITIONS

Alloy	Alclad 2014									
Source	(41)									
Form	Plate				Plate					
Condition	T451				T62 & T651					
Thickness, inch	0.250-0.499	0.500-1.000	1.001-2.000	2.001-3.000	0.250-0.499	0.500-1.000	1.001-2.000	2.001-2.500	2.501-3.000	3.001-4.000
F_{tu}(min.) - ksi	57.0	58.0	58.0	57.0	64.0	67.0	67.0	65.0	63.0	59.0
F_{ty}(min.) - ksi	36.0	36.0	36.0	36.0	57.0	59.0	59.0	58.0	57.0	55.0
e(2in.) - percent (min.)	15	14	12	8	8	6	4	2	2	1

TABLE 3.0123 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR ALCLAD PLATE IN THE T451, T62 and T651 CONDITIONS

Al	
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Alloy	2014					
Source	(41)					
Form	Alclad Sheet and Plate					
Condition	T42					
Thickness, inch	0.020-0.024	0.025-0.039	0.040-0.128	0.129-0.249	0.250-0.499	0.500-1.000
F_{tu}(min.)- ksi	54.0	55.0	57.0	57.0	57.0	58.0
F_{ty}(min.)- ksi	31.0	32.0	34.0	34.0	34.0	34.0
e(2 in.)- percent (min.)	14	14	15	15	15	14

TABLE 3.0124 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR ALCLAD SHEET AND PLATE IN THE T42 CONDITION

Alloy	2014	
Source	(41)	
Form	Wire, Rod & Bar (b)	
Condition	T4, T42, T451	T6, T62, T651
Diameter, inch (a)	≤ 8.000	≤ 8.000
F_{tu} (min.) - ksi	55.0	65.0
F_{ty} (min.) - ksi	32.0	55.0
e(2 in. or 4D) min.-percent	16	8
(a) Diameter or least distance between faces		
(b) Rolled or cold finished		

TABLE 3.013 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR COLD FINISHED WIRE, ROD AND BAR

Alloy	2014								
Source	(41)								
Form	Extruded Wire, Rod, Bar and Shapes								
Condition	T4, T4510 T4511	T42	T6, T6510, T6511				T62		
Area-in.^{2}	All	All	All	All	≤ 25	25-32	All	≤ 25	25-32
Thickness, in.	All	All	≤ 0.499	0.500-0.749	≥ 0.750	≥ 0.750	≤ 0.749	≥ 0.750	≥ 0.750
F_{tu}(min.)-ksi	50.0	50.0	60.0	64.0	68.0	68.0	60.0	60.0	60.0
F_{ty}(min.)-ksi	35.0	29.0	53.0	58.0	60.0	58.0	53.0	53.0	53.0
e(2 in.)-percent (min.)	12	12	7	7	7	6	7	7	6

TABLE 3.014 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR EXTRUDED WIRE, ROD, BAR AND SHAPES

Alloy	2014							
Source	(41)							
Form	Drawn Tube							
Condition	T4, T42				T6, T62			
Wall Thickness, in.	0.018 to 0.024	0.025 to 0.049	0.050 to 0.259	0.260 to 0.500	0.018 to 0.024	0.025 to 0.049	0.050 to 0.259	0.260 to 0.500
F_{tu}(min.)-ksi	54	54	54	54	65	65	65	65
F_{ty}(min.)-ksi	30	30	30	30	55	55	55	55
e(2 in. or 4D)								
A percent (min.)	10	12	14	16	7	7	8	9
B percent (min.)	-	10	10	12	-	6	7	8
A - Elongation for a full section specimen								
B - Elongation for a cut-out specimen								

TABLE 3.015 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR DRAWN TUBE

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Alloy	2014								
Source	(41)								
Form	Extruded Tube								
Condition	T4, T4510 T4511	T42	T6, T6510, T6511				T62		
Area-in.^{2}	All	All	All	All	≤25	25-32	All	≤25	25-32
Wall Thickness, in.	All	All	≤0.499	0.500-0.749	≥0.750	≥0.750	≤0.749	≥0.750	≥0.750
F_{tu}(min.)-ksi	50.0	50.0	60.0	64.0	68.0	68.0	60.0	60.0	60.0
F_{ty}(min.)-ksi	35.0	29.0	53.0	58.0	60.0	58.0	53.0	53.0	53.0
e(2 in. or 4D)-percent(min.)	12	12	7	7	7	6	7	7	6

TABLE 3.016 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR EXTRUDED TUBE

Alloy	2014									
Source	(41)									
Form	Die Forgings									
Condition	T4		T6							
Thickness, in.	≤4		≤1		>1 thru 2		>2 thru 3		>3 thru 4	
Orientation	A	B	A	B	A	B	A	B	A	B
F_{tu}(min.)-ksi	55.0	-	65.0	64.0	65.0	64.0	65.0	63.0	63.0	63.0
F_{ty}(min.)-ksi	30.0	-	56.0	55.0	56.0	55.0	55.0	54.0	55.0	54.0
e(2 in. or 4D) percent(min.)	11	-	6	3	6	2	6	2	6	2
Brinell Hardness(a)	100	-	125	-	125	-	125	-	125	-

A Specimen axis parallel to direction of grain flow
B Specimen axis not parallel to direction of grain flow
(a) 500 kg load - 10 mm ball

TABLE 3.017 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR DIE FORGINGS

Alloy	2014										
Source	(41)										
Form	Hand Forgings										
Condition	T6										
Thickness, in.	≤2.000		2.001 - 3.000			3.001 - 4.000			4.001 - 5.000		
Orientation	L	T	L	T	ST	L	T	ST	L	T	ST
F_{tu} (min.)-ksi	65.0	65.0	64.0	64.0	62.0	63.0	63.0	61.0	62.0	62.0	60.0
F_{ty} (min.)-ksi	56.0	56.0	56.0	55.0	55.0	55.0	55.0	54.0	54.0	54.0	53.0
e(2 in. or 4D) percent (min.)	8	3	8	3	2	8	3	2	7	2	1

TABLE 3.018 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR T6 HAND FORGINGS UP TO 5 INCHES THICK

Alloy	2014								
Source	(41)								
Form	Hand Forgings								
Condition	T6								
Thickness, in.	5.001 - 6.000			6.001 - 7.000			7.001 - 8.000		
Orientation	L	T	ST	L	T	ST	L	T	ST
F_{tu}(min.)-ksi	61.0	61.0	59.0	60.0	60.0	58.0	59.0	59.0	51.0
F_{ty}(min.)-ksi	53.0	53.0	53.0	52.0	52.0	52.0	51.0	51.0	51.0
e(2 in. or 4D) percent (min.)	7	2	1	6	2	1	6	2	1

TABLE 3.0181 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR T6 HAND FORGINGS 5 INCHES TO 8 INCHES THICK

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Alloy	2014										
Source	(41)										
Form	Hand Forgings										
Condition	T652										
Thickness, in.	≤ 2.000		2.001 - 3.000			3.001 - 4.000			4.001 - 5.000		
Orientation	L	T	L	T	ST	L	T	ST	L	T	ST
F_{tu}(min.)-ksi	65.0	65.0	64.0	64.0	62.0	63.0	63.0	61.0	62.0	62.0	60.0
F_{ty}(min.)-ksi	56.0	56.0	56.0	55.0	52.0	55.0	55.0	51.0	54.0	54.0	50.0
e(2 in. or 4D) percent(min.)	8	3	8	3	2	8	3	2	7	2	1

TABLE 3.0182 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR T652 HAND FORGINGS UP TO 5 INCHES THICK

Alloy	2014								
Source	(41)								
Form	Hand Forgings								
Condition	T652								
Thickness in.	5.001 - 6.000			6.001 - 7.000			7.001 - 8.000		
Orientation	L	T	ST	L	T	ST	L	T	ST
F_{tu}(min.)-ksi	61.0	61.0	59.0	60.0	60.0	58.0	59.0	59.0	57.0
F_{ty}(min.)-ksi	53.0	53.0	50.0	52.0	52.0	49.0	51.0	51.0	48.0
e(2 in. or 4D) percent(min.)	7	2	1	6	2	1	6	2	1

TABLE 3.0183 ALUMINUM ASSOCIATION MECHANICAL PROPERTY LIMITS FOR T652 HAND FORGINGS 5 INCHES TO 8 INCHES THICK

Source	(41)						
Alloy	Wrought products						
Form	2014			Clad 2014			
Condition	0	T4*	T6**	0	T3	T4*	T6**
F_{tu}, typ - ksi	27	62	70	25	63	61	68
F_{ty}, typ - ksi	14	42	60	10	40	37	60
F_{su}, typ - ksi	18	38	42	18	37	37	41
e, typ-percent	18	20	13	21	20	22	10
Hardness, BHN	45	105	135	-	-	-	-

*Also T451
**Also T651

TABLE 3.0213 TYPICAL MECHANICAL PROPERTIES AT ROOM TEMPERATURE

Alloy	2014								
Source	(51 - Table 2)								
Form	Hand Forgings								
Size - in.	2 x 8			4 x 8			6 x 24		
Direction	L	LT	ST	L	LT	ST	L	LT	ST
F_{cy} - ksi	69	70	69	66	65	69	58	62	59

TABLE 3.0222 COMPRESSIVE YIELD STRENGTH FOR HAND FORGINGS TESTED IN SEVERAL DIRECTIONS

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Alloy	2014								
Source	(51, Table 2)								
Form	Hand Forgings								
Condition	T652								
Size - in.	2 x 8			4 x 8			6 x 24		
Direction	L	LT	ST	L	LT	ST	L	LT	ST
F_{su} - ksi	44	44	-	40	41	40	43	39	39

TABLE 3.0251 SHEAR ULTIMATE STRENGTH OF HAND FORGINGS

Source	(55)
Thickness, inches	Bearing Property Reduction, percent 1.001–6.000
F_{bru} (e/D = 1.5)	15
F_{bru} (e/D = 2.0)	10
F_{bry} (e/D = 1.5)	5

TABLE 3.0261 BEARING PROPERTY REDUCTIONS FOR THICK PLATE WHERE THE STRESS CONDITION APPROXIMATES THE LONGITUDINAL OR LONG-TRANSVERSE EDGE-WIRE ORIENTATIONS

Alloy	2014 - T651		2 in. rolled plate (a)		
Source	(46)				
Pin Diameter (inch)	Edge Distance (in.)	e/D ratio (approx.)	Plate Thickness (in.)	Bearing Strength F_{bru} (ksi)	Bearing Yield Strength F_{bry} (ksi)
0.2503	0.501	2	0.152	152.6	109.2
	0.501	2	0.1252	140.4	106.9
	0.501	2	0.103	147.6	109.1
	0.375	1.5	0.150	109.2	98.5
	0.375	1.5	0.1226	102.8	94.6
	0.375	1.5	0.095	109.5	98.9
(a) All specimens taken in rolling direction.					

TABLE 3.0262 PIN BEARING STRENGTH OF ALLOY PLATE IN THE T651 CONDITION

Alloy	2014							
Source	(51, Table 2)							
Form	Hand Forgings							
Condition	T652							
Size - in.	2 x 8		4 x 8		5 x 10		6 x 24	
Direction	L	LT	L	LT	L	LT	L	LT
F_{bru} - ksi (e/D = 1.5)	101	101	89	91	93	89	90	86
F_{bry} - ksi (e/D = 1.5)	88	89	86	87	83	84	81	80
F_{bru} - ksi (e/D = 2)	123	130	124	122	117	123	118	118
F_{bry} - ksi (e/D = 2)	102	100	103	102	95	99	100	99

TABLE 3.0263 BEARING STRENGTH OF HAND FORGINGS

Al
4.5 Cu
1 Mn
1 Si
0.5 Mg

2014, Clad 2014

Alloy	2014-T651 2 in. Rolled Plate (a)				
Source	(46)				
Specimen Type	ASTM Compact Tension Fracture Toughness (b)				
Specimen Description	Initial Fatigue Load A - max. lbs. B - min. lbs.	Fatigue Cycles	Average Fatigue Crack Length in.	Loading Rate lbs/sec	K_{IC} ksi $\sqrt{in.}$
Straight Cut	A = 990 B = 110	26,000	0.085	16	24.3
Chevron	A = 1010 B = 100	72,000	0.077	17	25.6
Chevron	A = 1000 B = 100	76,000	0.107	16	23.5
Chevron	A = 1000 B = 100	64,000	0.098	154	25.1
Chevron	A = 1100 B = 150	57,500	0.113	154	25.5
Chevron	A = 1020 B = 100	98,000	0.071	166	23.7

(a) All specimens were taken in the rolling direction.
(b) Tests conducted according to ASTM E399-72. Specimens were 0.625 inches thick.

TABLE 3.02721 RESULTS OF FRACTURE TOUGHNESS TESTS ON PLATE IN THE T651 CONDITION

Alloy	2014										
Source	(50)										
Condition	T651										
Form	Plate										
Thickness-in.	1	1.5				1.75		2.5	5		
Direction	TL	TL	LT	LS	TS	LT	TL	LT	LT	TL	SL
F_{ty} - ksi	66	63	67	67	63	68	66	64	59	58	55
K_{IC} - ksi $\sqrt{in.}$	20	19	19	24	22	22	23	24	22	19	18

TABLE 3.02722 PLANE STRAIN FRACTURE TOUGHNESS FOR VARIOUS THICKNESSES OF T651 PLATE

Alloy	2014									
Source	(51, Table 22)									
Condition	T652								T8510	
Form	Hand Forgings								Extrusions	
Size-in.	2 x 8		4 x 16			5 x 20			-	
Direction	LT	TL	LT	TL	SL	LT	TL	SL	LT	TL
F_{ty} - ksi	67	65	62	59	67	61	57	56	-	-
K_{IC} - ksi in.	25	19	34	23	19	29	20	18	29	18

TABLE 3.02723 PLANE STRAIN FRACTURE TOUGHNESS OF HAND FORGINGS AND EXTRUSIONS

Alloy	2014				
Source	(54, Table 9)		(52)		
Condition	T651				
Form	Plate				
Thickness-in.	2.0		1.8.		
Direction	LT	SL	LT	LS	SL
F_{ty}-ksi	64	60	66	66	63
K_{IC}-ksi $\sqrt{in.}$	23	19	20	23	17

TABLE 3.02724 PLANE STRAIN FRACTURE TOUGHNESS OF PLATE TESTED IN SEVERAL DIRECTIONS

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

Alloy	2014		
Source	(49)		
Form	1.0 in. Bar Stock		
Condition	T6		
Test Temperature, F	80F	-320F	-452F
F_{tu} - ksi	77.5	86.1	118.5
F_{ty} - ksi	70.4	75.5	102.5
Tensile Ductility, D(a)	0.38	0.26	0.016
Modulus of Elasticity, E(b)	10.78	11.86	11.92
Poisson's Ratio, μ	0.321	0.337	0.335
(a) $D = \ln \frac{100}{100-RA}$			
(b) 1000 ksi			

TABLE 3.03151 MECHANICAL PROPERTIES OF BAR AT LOW TEMPERATURES

Alloy	2014-T6				
Source	(44)				
Specimen	Thin-Walled Cylinders (c)				
	Specimen Thickness t(in.)	Crack Depth a(in.)	Crack Length 2c(in.)	Fracture Stress σ_H (ksi)	Apparent Fracture Toughness K_Q(ksi$\sqrt{in.}$)
Outside - surface crack	0.061	0.025	0.096	85.3	23.5
		0.040	0.100	80.7	23.1
		0.050	0.114	74.1	22.8
		0.025	0.140	80.7	24.0
		0.039	0.240	72.9	27.3
		0.042	0.240	66.9	25.0
		0.041	0.300	61.3	23.6
		0.047	0.340	56.0	22.8
		0.044	0.370	58.4	23.1
		0.060	0.380	49.9(a)	18.0(b)
		0.041	0.450	55.5	22.0
		0.024	0.500	73.7	23.5
		0.039	0.955	46.9	18.4
		0.034	1.000	47.9	17.4
Inside - surface crack	0.061	0.022	0.442	73.9	22.8
	0.061	0.042	0.985	46.8	17.3
No crack	0.060	0	0	90.2	-
Through the thickness crack	0.062	0.062	0.154	66.0	-
	0.062	0.062	0.481	40.2	-
	0.061	0.061	1.012	23.6	-
(a) Leakage occurred at 41.0 ksi (b) Computed using stress at leakage (c) Tested at -320F					

TABLE 3.03721 FRACTURE TEST DATA FOR THIN WALLED CYLINDERS TESTED AT -320F

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

Source	(5, p. 78)(6)(18, p. 83)								
Form	All								
Temp RT	Method	Stress Ratio		Stress Concentration	Fatigue Strength - ksi at Cycles				Ref
Condition		A	R		10^5	10^6	10^7	10^8	$5x10^8$	
T4	Rot beam	∞	-1	Smooth K = 1	42	34	27	22	20	(18)
T6				Smooth K = 1	39	30	24	19	18	(6)
				Notched K = 8	21	14	10	9	9	(5)

TABLE 3.051 TYPICAL FATIGUE STRENGTH OF ALLOY IN T4 AND T6 CONDITIONS

Source	(26)	
Alloy	2014-T6	
Property	Poisson's Ratio (elastic and plastic values)	
Form	0.125 in sheet (a)	
Grain Direction	μ, elastic	μ, plastic
Longitudinal	0.33	0.48
Transverse	0.27	0.52

(a) Purchased in the form of clad, heat treated sheet. Cladding removed prior to testing

TABLE 3.061 POISSON'S RATIO

Alloy		2014	
Source		(51, Table 21)	
Form		Hand Forgings (a)	
Condition		T652	
Direction	L	LT	ST
E_T - 1000 ksi	10.40	10.49	10.40
E_C - 1000 ksi	10.74	10.89	10.75
(a) Average values from 2 to 6 inch thick sections.			

TABLE 3.0624 ELASTIC MODULI IN TENSION AND COMPRESSION FOR HAND FORGINGS TESTED IN SEVERAL DIRECTIONS

Source	(3)			
Alloy	2014			
Data	Approximate bend radii for 90 degree cold bend (a)			
Form	Sheet			
Thickness-in	1/16	1/8	1/4	1/2
0	0	0	0 - 1t	3 - 5t
T3	2 - 4t	3 - 5t	4 - 6t	5.5- 8t
T4	2 - 4t	3 - 5t	4 - 6t	5.5- 8t
T6	3 - 5t	4 - 6t	6 -10t	8 -11t

(a) Radii for various thickness sheet in terms of thickness, t

TABLE 4.0141 APPROXIMATE BEND RADII FOR 90 DEGREE COLD BEND

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

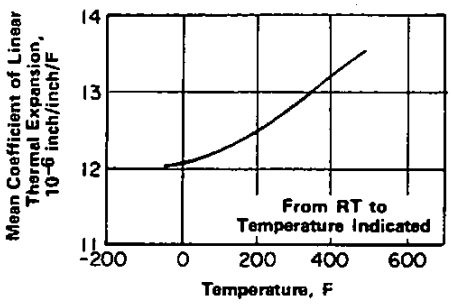


FIGURE 2.014. THERMAL EXPANSION (4, p. 35)

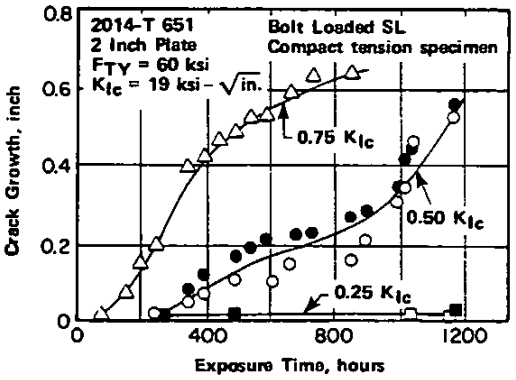


FIGURE 2.0335. CRACK GROWTH OF PLATE IN A SALT-DICHROMATE-ACETATE SOLUTION (3.5% NaCl+0.02M $Na_2Cr_2O_7$+0.07M $NaC_2H_3O_2$+ $HC_2H_3O_2$ TO PH OF 4) (54, Fig. 35)

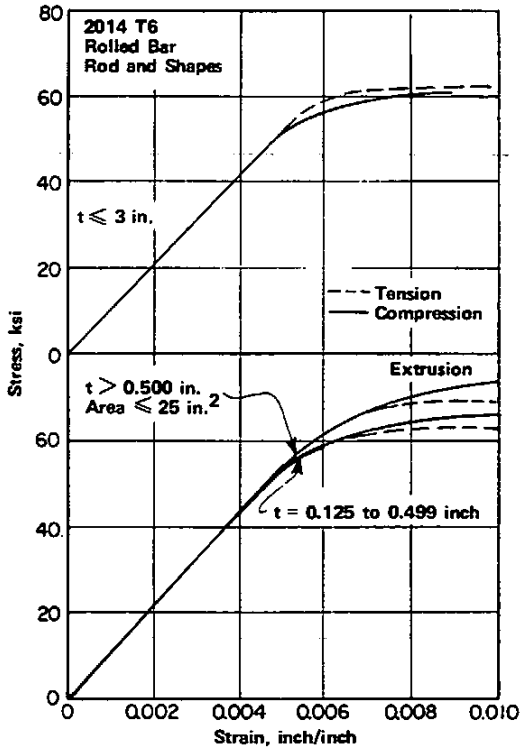


FIGURE 3.02111. STRESS-STRAIN CURVES IN TENSION AND COMPRESSION FOR BAR AND EXTRUSIONS IN T6 CONDITION (5, p. 86, 88)

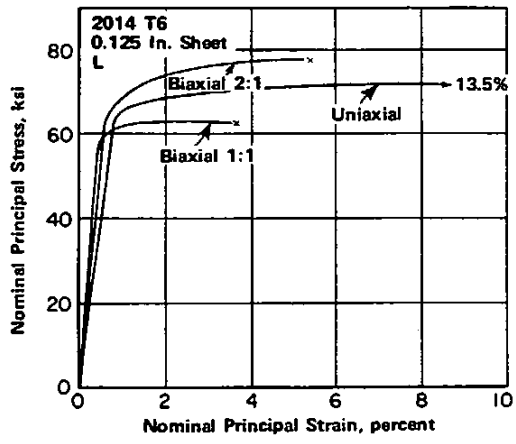


FIGURE 3.02112. TYPICAL UNIAXIAL AND BI-AXIAL STRESS-STRAIN CURVES FOR SHEET IN T6 CONDITION (26)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

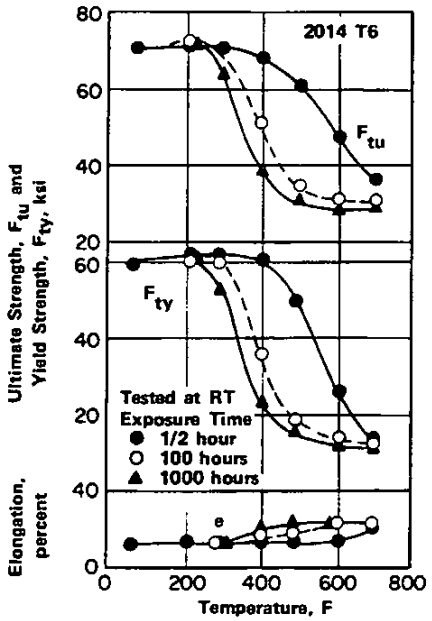


FIGURE 3.0212. EFFECT OF EXPOSURE TO ELEVATED TEMPERATURE ON ROOM TEMPERATURE TENSILE PROPERTIES OF ALLOY IN T6 CONDITION (6)

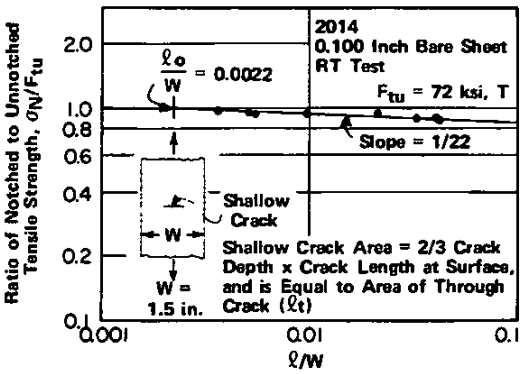


FIGURE 3.02711. RATIO OF NOTCHED TO UNNOTCHED TENSILE STRENGTH OF SHEET CONTAINING SHALLOW CRACKS (27)

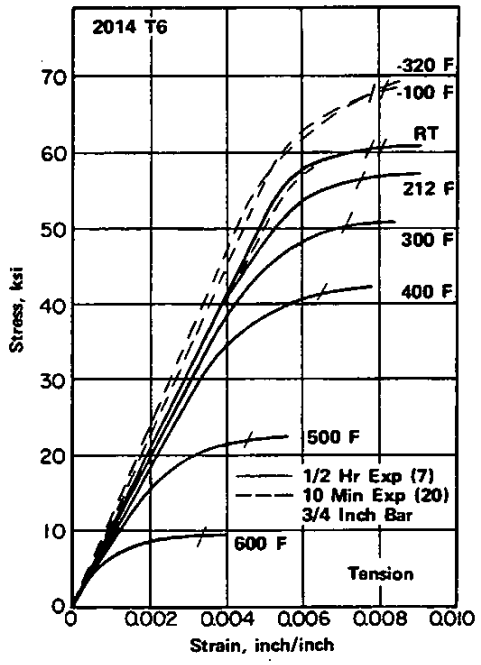


FIGURE 3.03111. STRESS STRAIN CURVES FOR ALLOYS IN T6 CONDITION AT VARIOUS TEMPERATURES (20, p. 12-18)

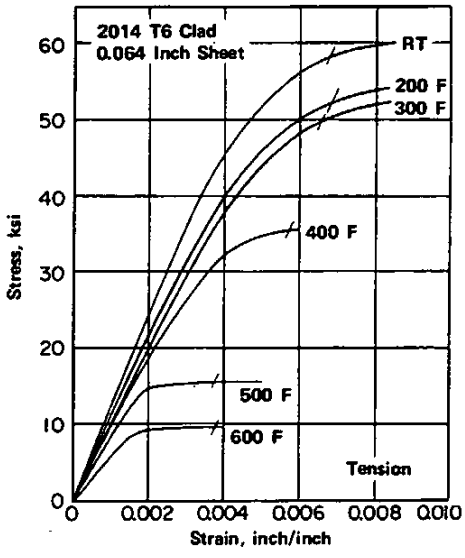


FIGURE 3.03112. STRESS-STRAIN CURVES FOR CLAD SHEET IN T6 CONDITION AT ROOM AND ELEVATED TEMPERATURES (8, p. 115-120)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

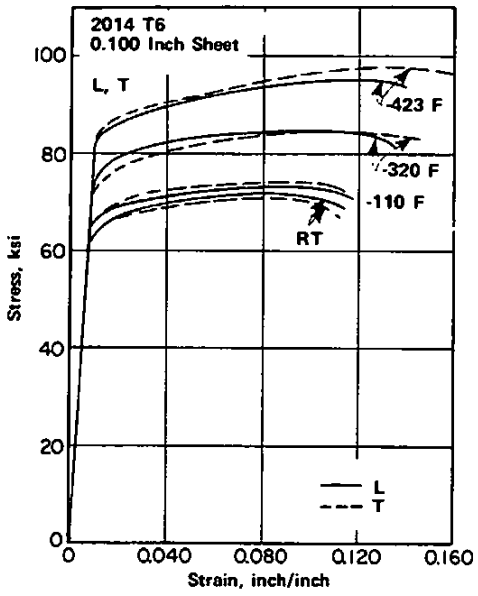


FIGURE 3.03113. STRESS-STRAIN CURVES FOR SHEET IN T6 CONDITION AT LOW TEMPERATURES (29)

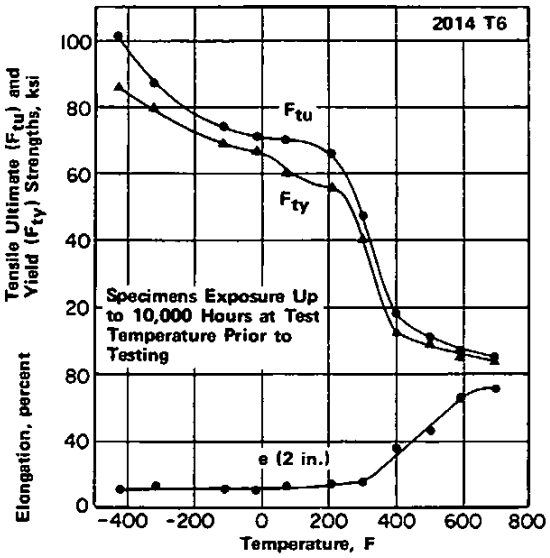


FIGURE 3.0312. TYPICAL TENSILE PROPERTIES AT VARIOUS TEMPERATURES FOR ALLOY IN T6 CONDITION (30)

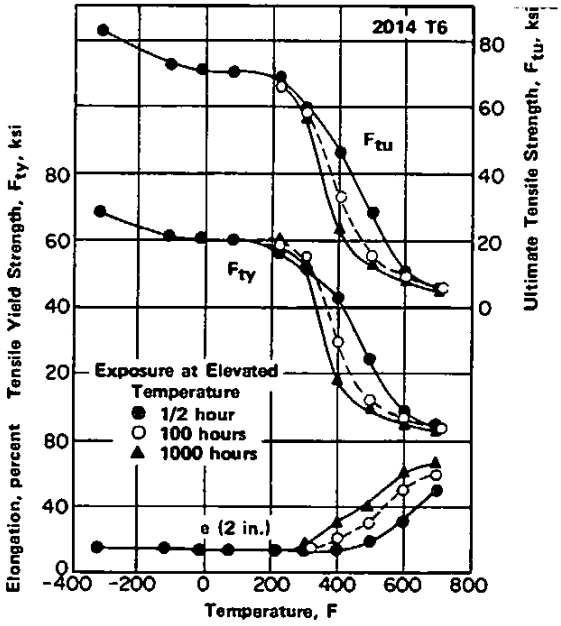


FIGURE 3.0313. EFFECT OF EXPOSURE AND TEST TEMPERATURE ON TENSILE PROPERTIES OF ALLOY IN T6 CONDITION (6)

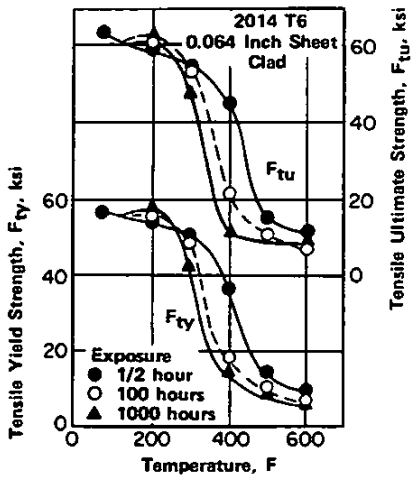


FIGURE 3.0314. EFFECT OF EXPOSURE AND TEST TEMPERATURE ON TENSILE PROPERTIES OF CLAD SHEET IN T6 CONDITION (8, p. 91)

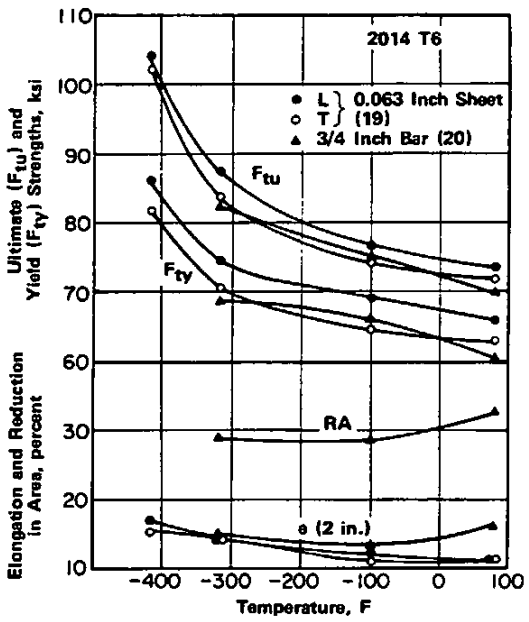
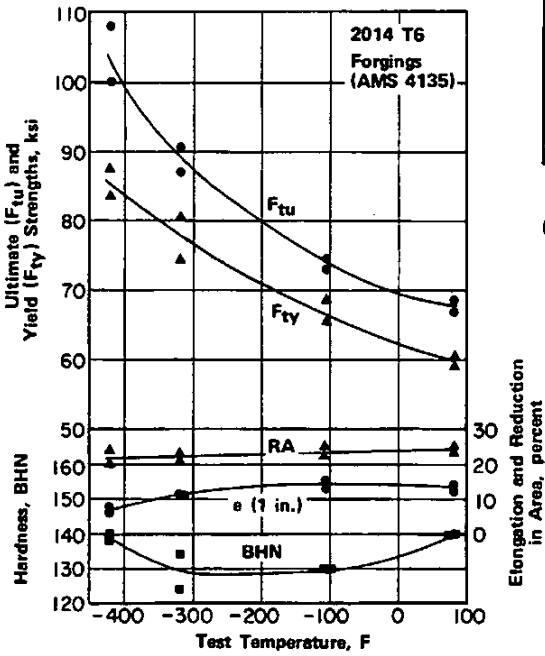


FIGURE 3.0315. EFFECT OF LOW TEST TEMPERATURES ON TENSILE PROPERTIES OF SHEET AND BAR IN T6 CONDITION (19, p. 14) (20, p. 8)



Al	
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014, Clad 2014

FIGURE 3.0316. EFFECT OF LOW TEMPERATURES ON TENSILE PROPERTIES AND HARDNESS OF FORGINGS IN THE T6 CONDITION (31)

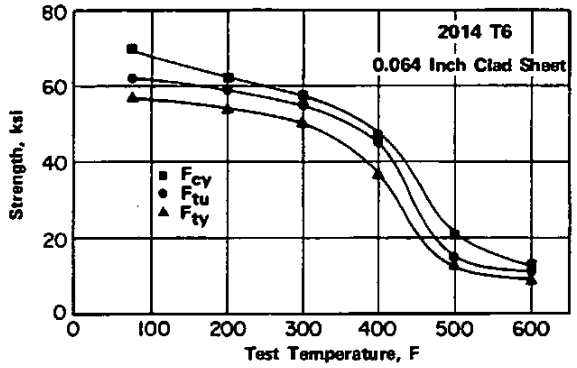


FIGURE 3.0317. EFFECT OF TEST TEMPERATURE ON STRENGTH, F_{TU}, F_{TY} AND F_{CY}, OF CLAD SHEET IN T6 CONDITION (8)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

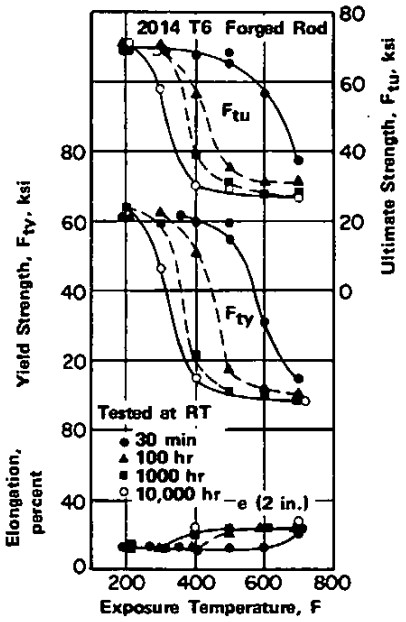


FIGURE 3.0318. EFFECT OF EXPOSURE ON ROOM TEMPERATURE TENSILE PROPERTIES OF T6 FORGED ROD (34)

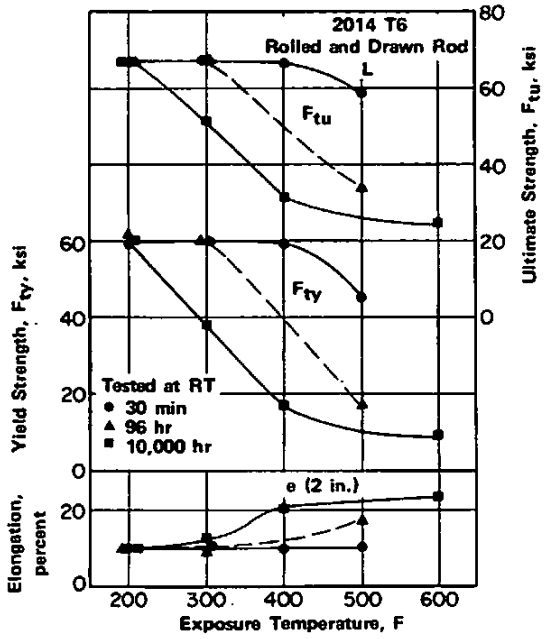


FIGURE 3.0319. EFFECT OF EXPOSURE ON ROOM TEMPERATURE TENSILE PROPERTIES OF T6 ROLLED AND DRAWN ROD (34)

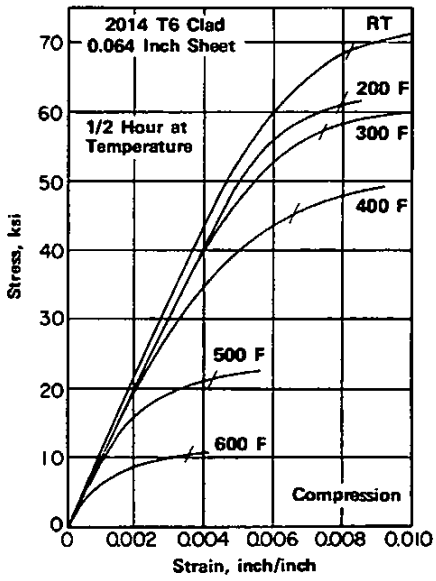


FIGURE 3.03211. STRESS-STRAIN CURVES IN COMPRESSION FOR CLAD SHEET IN T6 CONDITION AT ROOM AND ELEVATED TEMPERATURES (8, p. 121-126)

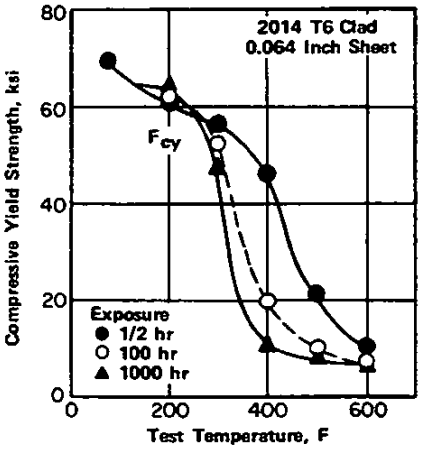


FIGURE 3.0322. EFFECT OF EXPOSURE AND TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF CLAD SHEET IN T6 CONDITION (8, p. 92)

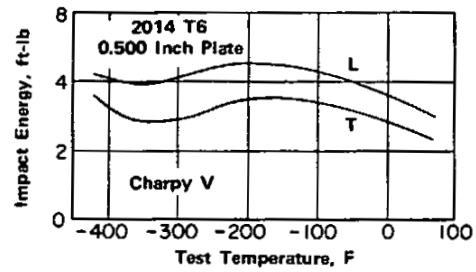


FIGURE 3.0331. EFFECT OF LOW TEMPERATURES ON CHARPY V IMPACT PROPERTIES OF PLATE (29)

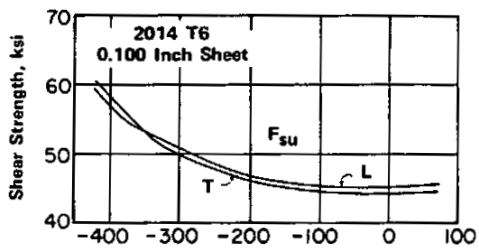


FIGURE 3.0352. EFFECT OF LOW TEMPERATURE ON SHEAR STRENGTH OF SHEET IN T6 CONDITION (29)

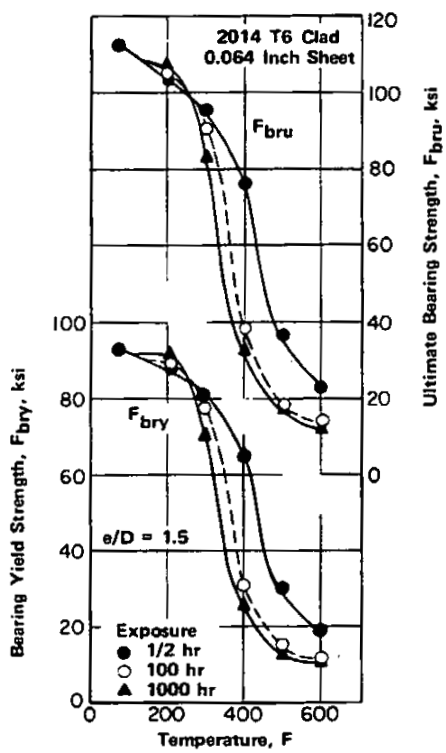


FIGURE 3.0361. EFFECT OF EXPOSURE AND TEST TEMPERATURE ON BEARING PROPERTIES OF CLAD SHEET IN T6 CONDITION (8, p. 93)

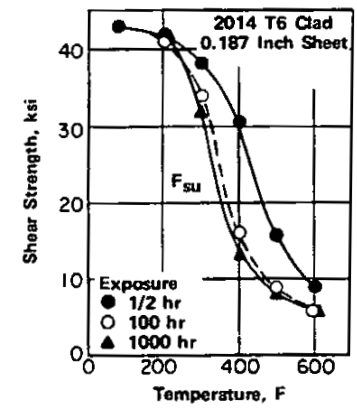


FIGURE 3.0351. EFFECT OF EXPOSURE AND TEST TEMPERATURE ON SHEAR STRENGTH OF CLAD SHEET IN T6 CONDITION (8, p. 95)

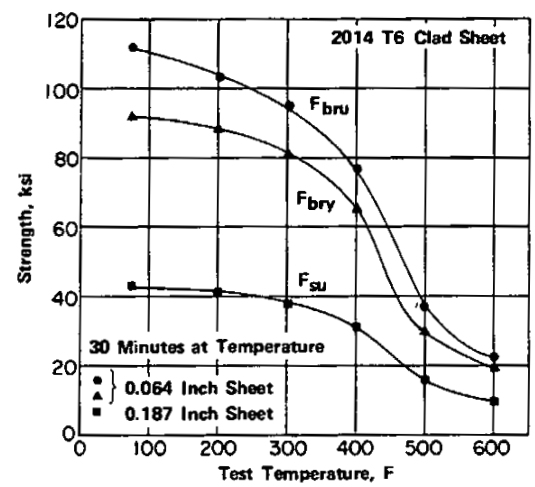


FIGURE 3.0353. EFFECT OF TEST TEMPERATURE ON F_{BRU}, F_{BRY} AND F_{SU} OF CLAD SHEET IN T6 CONDITION (8)

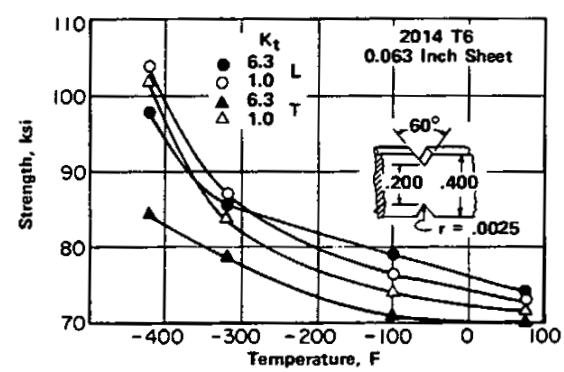


FIGURE 3.03711. EFFECT OF LOW TEST TEMPERATURES ON NOTCHED AND SMOOTH SHEET IN T6 CONDITION (19, p. 14)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

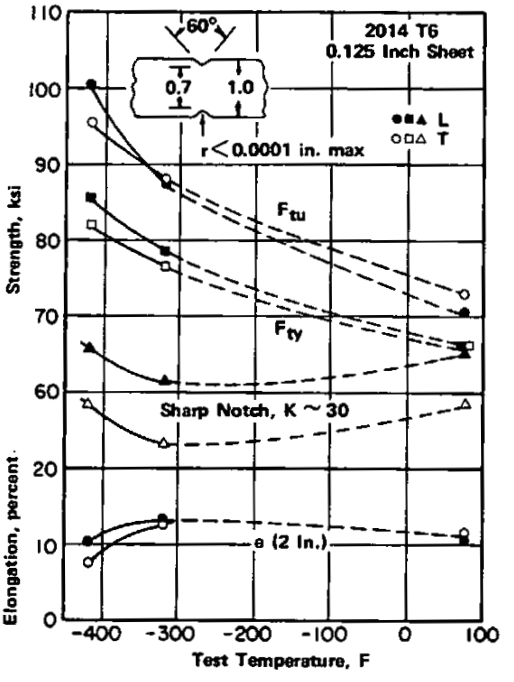


FIGURE 3.03712. EFFECT OF LOW TEMPERATURES ON TENSILE AND SHARP NOTCH PROPERTIES OF SHEET IN T6 CONDITION (32)

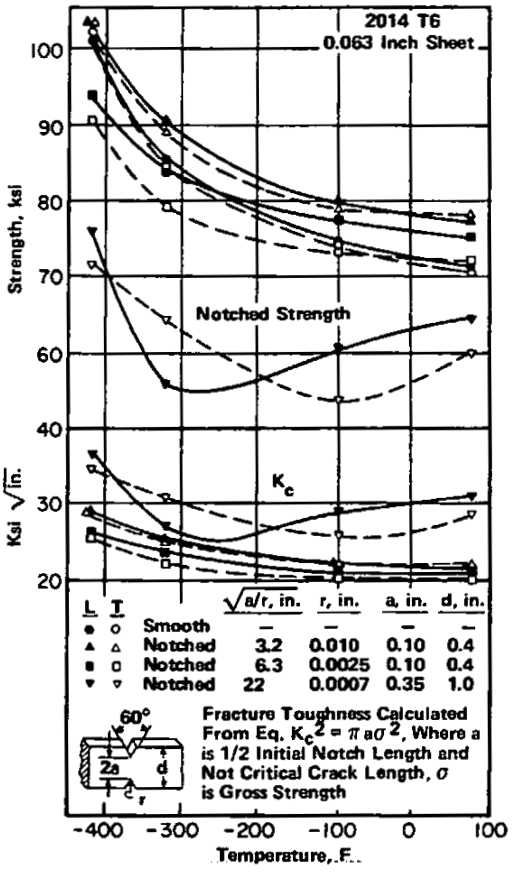


FIGURE 3.03713. EFFECT OF LOW TEST TEMPERATURES ON NOTCH STRENGTH AND FRACTURE TOUGHNESS OF SHEET IN T6 CONDITION (21, p. 190-195)

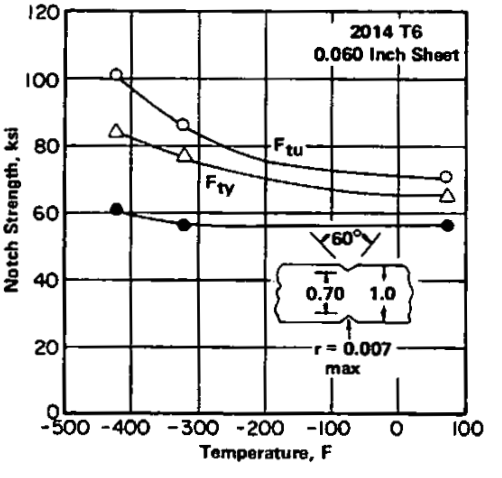


FIGURE 3.03714. EFFECT OF LOW TEMPERATURES ON TENSILE AND NOTCH PROPERTIES OF SHEET IN THE T6 CONDITIONS (45)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

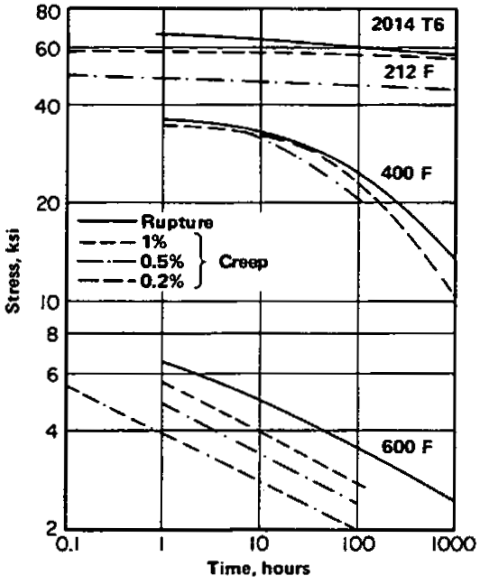


FIGURE 3.041. CREEP AND CREEP RUPTURE CURVES FOR ALLOY IN T6 CONDITION AT 212 TO 600 F (6)

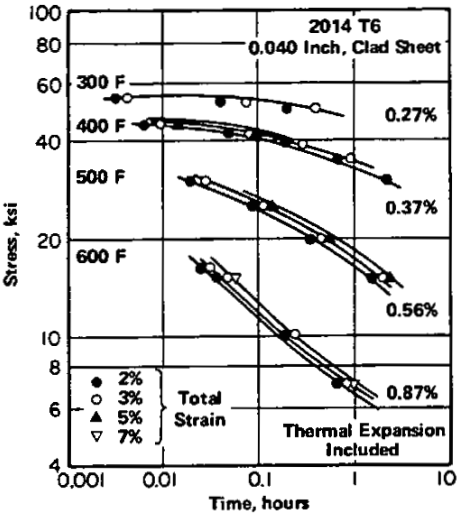


FIGURE 3.042. SHORT TIME TOTAL STRAIN CURVES FOR CLAD SHEET IN T6 CONDITION AT 300 TO 600 F (10, p. 33, 34)

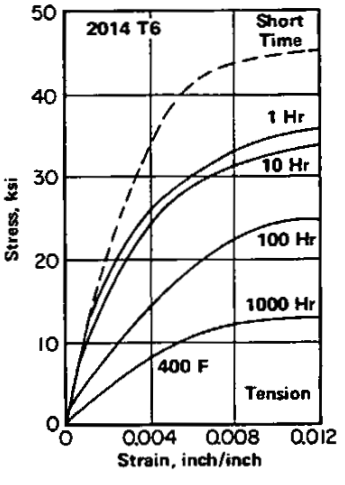


FIGURE 3.043. ISOCHRONOUS STRESS-STRAIN CURVES IN TENSION FOR ALLOY IN T6 CONDITION AT 400 F (9, Fig. 1)

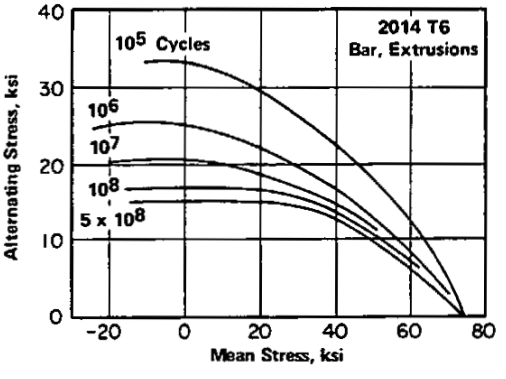


FIGURE 3.052. AVERAGE STRESS RANGE DIAGRAMS FOR BAR AND EXTRUSIONS IN T6 CONDITION (12, p. 966)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

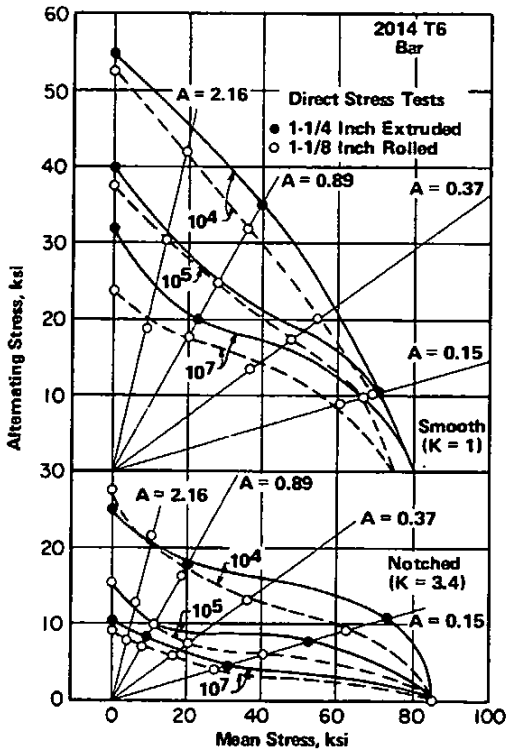


FIGURE 3.053. STRESS RANGE DIAGRAMS FOR SMOOTH AND NOTCHED BAR IN T6 CONDITION (11)

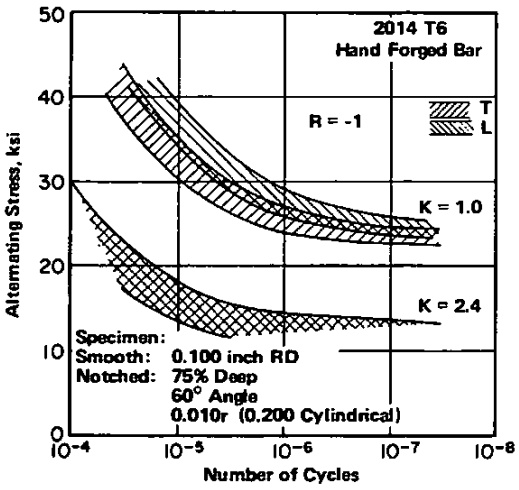


FIGURE 3.054. SCATTER BAND OF FATIGUE DATA FOR SMOOTH AND NOTCHED HAND FORGED BAR IN T6 CONDITION (35)

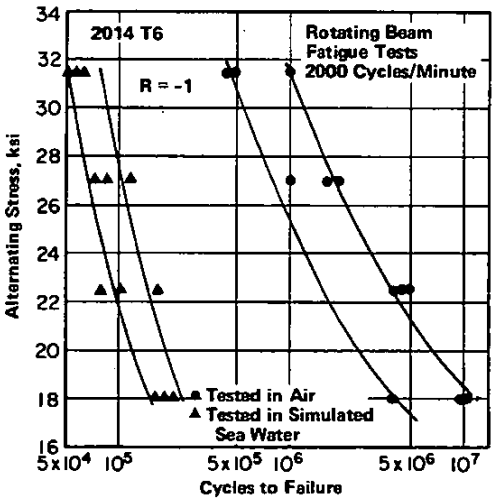


FIGURE 3.055. S-N CURVES FOR ALLOY TESTED IN AIR AND IN SIMULATED SEA WATER (36)

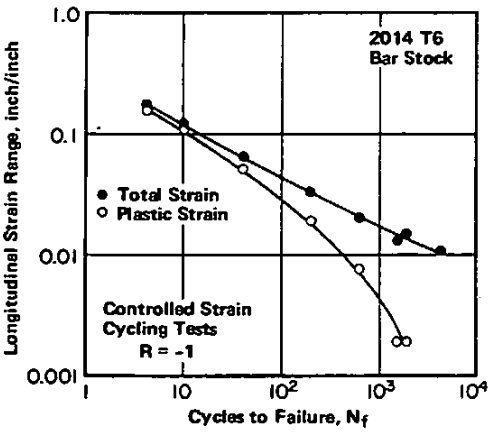


FIGURE 3.056. EFFECT OF STRAIN CYCLING ON FATIGUE LIFE OF T6 BAR (37)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

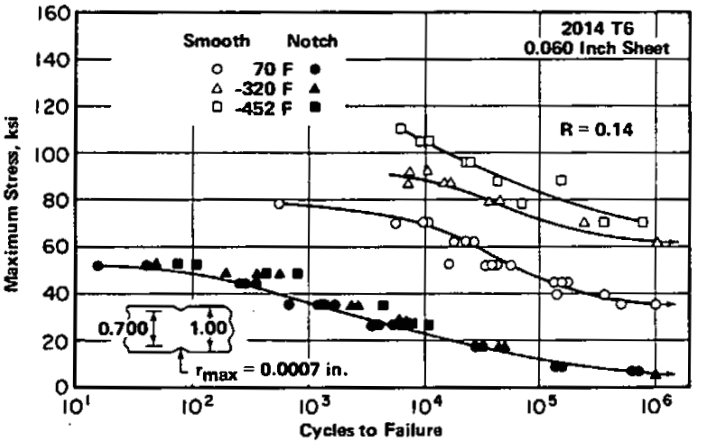


FIGURE 3.057. EFFECT OF LOW TEMPERATURE ON SMOOTH AND NOTCHED FATIGUE STRENGTH OF SHEET (45)

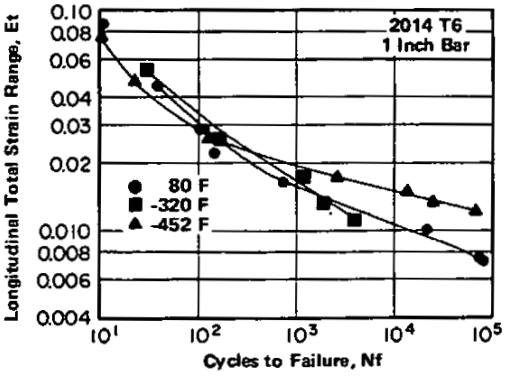


FIGURE 3.058. EFFECT OF LOW TEMPERATURE ON STRAIN CYCLE FATIGUE OF BAR (49)

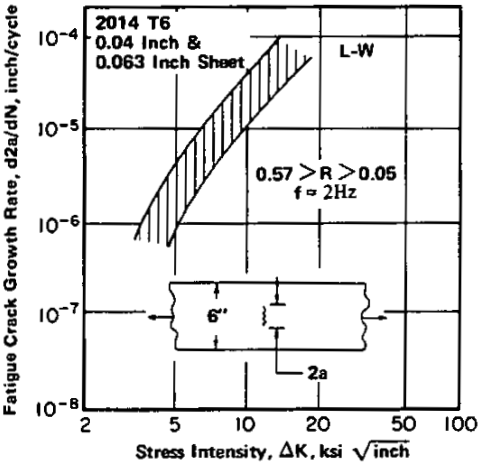


FIGURE 3.059. SCATTER BAND FOR FATIGUE CRACK GROWTH DATA FOR SHEET (53, Figs. NAA3 & NAA4)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

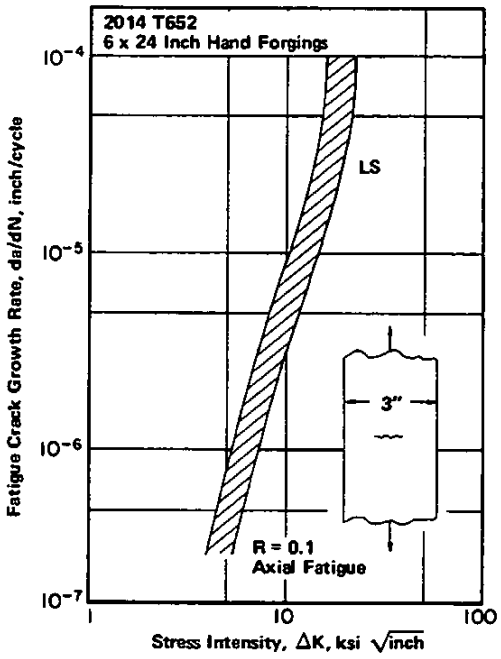


FIGURE 3.0510. SCATTER BAND FOR FATIGUE CRACK GROWTH DATA FOR FORGINGS (51, p. 67)

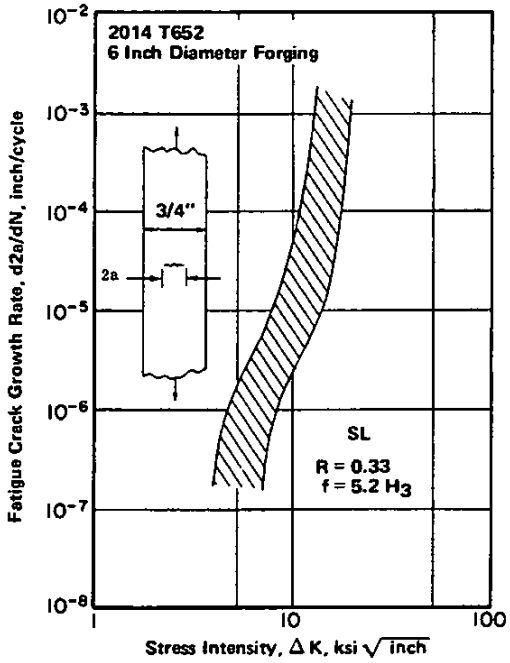


FIGURE 3.0511. SCATTER BAND FOR FATIGUE CRACK GROWTH DATA FOR FORGING (53, Fig. NAA6)

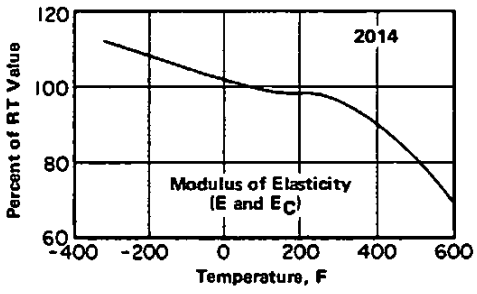


FIGURE 3.0622. EFFECT OF TEMPERATURE ON E AND E_C (5)

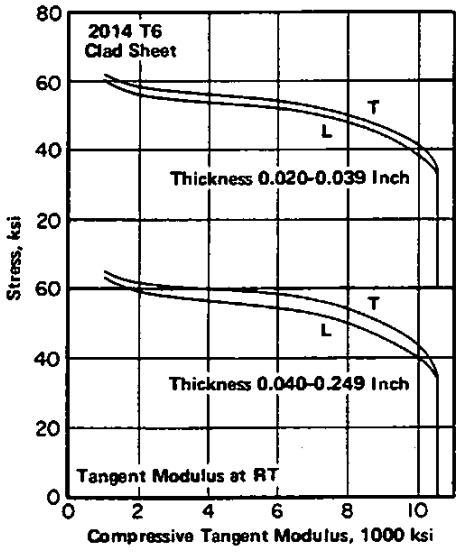


FIGURE 3.0641. TYPICAL TANGENT MODULUS CURVES FOR CLAD SHEET AT ROOM TEMPERATURE (5)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

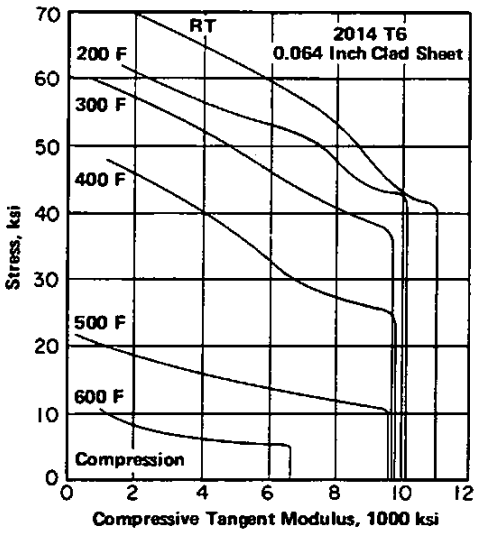


FIGURE 3.0642. TANGENT MODULUS CURVES IN COMPRESSION FOR CLAD SHEET IN T6 CONDITION AT ROOM AND ELEVATED TEMPERATURES (8, p. 183-188)

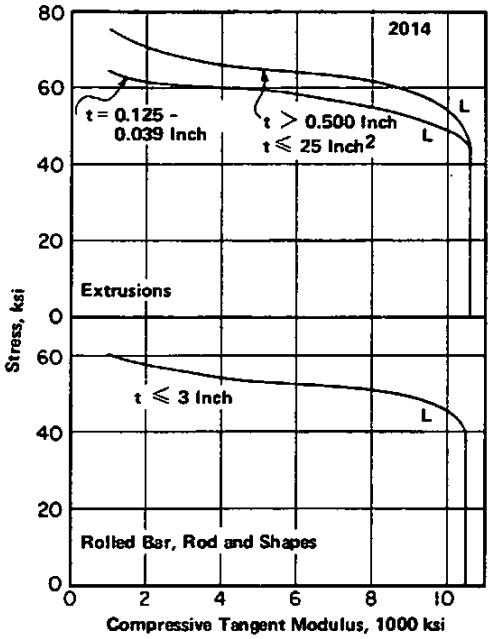


FIGURE 3.0643. TYPICAL TANGENT MODULUS CURVES FOR EXTRUSIONS AND ROLLED PRODUCTS AT ROOM TEMPERATURE (5)

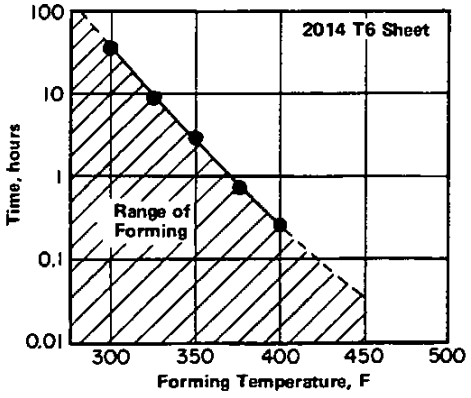


FIGURE 4.0122. MAXIMUM TIME AT VARIOUS TEMPERATURES FOR HOT FORMING SHEET IN T6 CONDITION (17, p. 133)

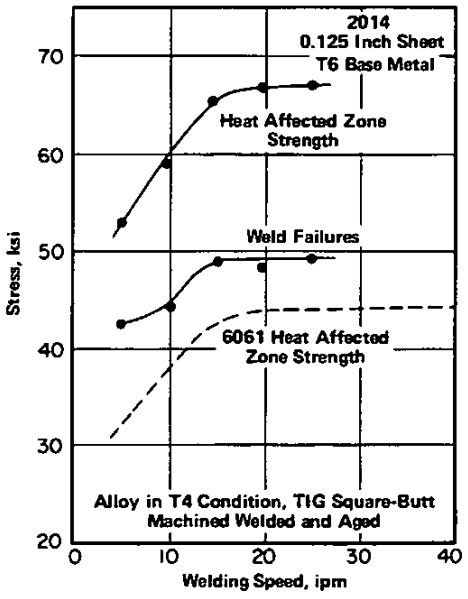


FIGURE 4.0321. EFFECT OF WELDING SPEED ON TENSILE STRENGTH OF GTA WELDS (38)

	Al
4.5	Cu
1	Mn
1	Si
0.5	Mg

2014,
Clad 2014

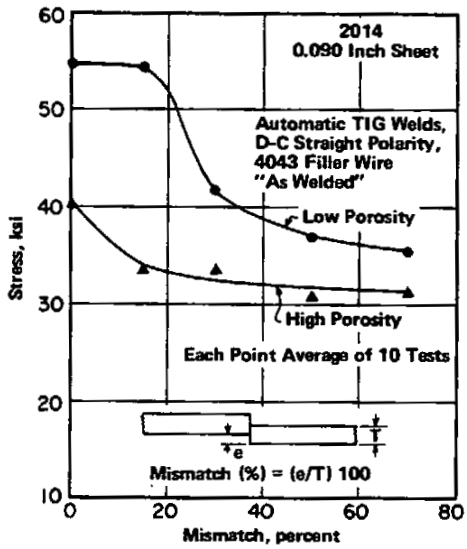


FIGURE 4.0322. COMBINED EFFECT OF POROSITY AND MISMATCH FOR GTA WELDED SHEET (39)

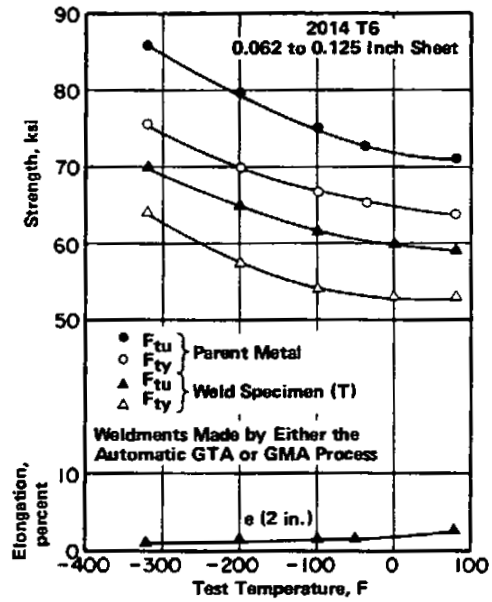


FIGURE 4.0323. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF WELDMENTS AND PARENT METAL SHEET IN T6 CONDITION (33)

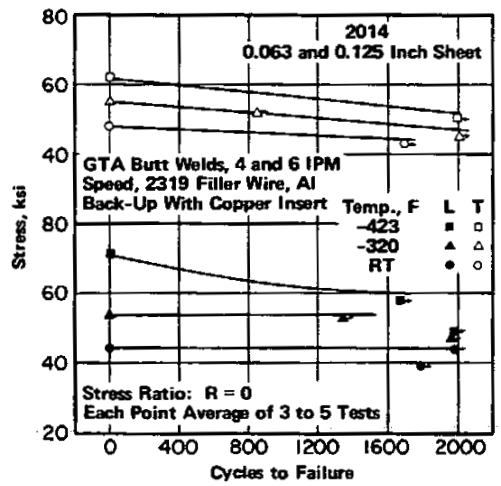


FIGURE 4.0324. S-N FATIGUE CURVES FOR GTA BUTT-WELDED SHEET AT ROOM AND CRYOGENIC TEMPERATURES (21)