1 GENERAL

Aluminum alloy 7475 is primarily an aerospace alloy used in a heat treated condition. It is usually available as bare or clad sheet or as plate, but on occasions extrusions and forgings have been made for special applications in place of its sister alloys, 7075 and 7175.

Alloy 7475 is basically a high purity version of 7075, i.e., it contains lower iron and silicon, and has marginally lower upper limits on copper and magnesium. Special proprietary processing may sometimes be given to 7475. The limits on chemical composition reduce the amounts of second phase constituents, which result in higher fracture toughness at the same level of strength and corrosion resistance. In over-aged tempers, for example, T7x, 7475 is resistant to exfoliation and stress corrosion. Most aerospace applications are for components requiring high strength and toughness at temperatures up to 300 F.

1.01 Commercial Designation

7475 aluminum alloy.

1.02 Alternate Designation

UNS A97475.

1.03 Specifications

7475-T7351 plate: AMS 4202 (33)
7475-T651 plate: AMS 4090 (34)
7475-T7651 plate: AMS 4089 (35)
7475-T61 sheet: AMS 4084 (36)
7475-T761 sheet: AMS 4085 (37).

1.031 Explanation of temper designations. In the temper designations listed above, the first letter, "T", refers to a solution heat treated and aged condition, as distinct from work hardened, "H", or annealed, "O", or other conditions. The first digit which follows T, "6 or 7", refers to the degree of aging. Peak strength is designated by 6, whereas 7 indicates an over-aged temper in which some strength has been sacrificed for toughness, or corrosion or stress corrosion resistance. These tempers may be subdivided by a second digit, "6 or 3", in which case, T76 is usually stronger and is achieved with a shorter age than T73. The final temper digit, "1", indicates that the material has been stretched after solution heat treatment and before aging, to relieve residual stresses. In other products, "2" denotes stress relief by compression. Other intermediate digits refer to other processing steps that may be proprietary, and may differ from one supplier to another.

1.04 Composition

Aluminum Association composition limits, Table 1.04.

1.05 Heat Treatment

Details of the heat treatment should be obtained, when required, from the specific supplier of the material due to possible differences in fabrication history, and consequent differences in response to heat treatments.

1.06 Hardness

1.061 T61 sheet: R_B 89.
T761 sheet: R_B 85.
T7351 plate: R_B 76 to 85.
(See also Figure 3.02723.)

1.07 Forms and Conditions Available

Alloy 7475 is available as sheet (up to 0.25-inch thick) in both bare and clad forms, in either T61 or T761 tempers. It is also available in T7351, T7651, T76351, and T651 plate up to approximately 4 inches in thickness, and in extruded rods for the manufacture of cartridge cases. Producers and aerospace companies have also investigated the availability of 7475 structural forgings and extrusions; however, the data are not found in the open literature.

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

There has been a considerable amount of successful development work on superplastic 7475 sheet, and it is likely that it will be available commercially in the near future. (See also Section 1.094.)

1.08 Melting and Casting Practices

1.081 The alloy can be melted and alloyed in oil-fired or electric-induction furnaces and cast into ingot molds of any desired shape for subsequent working into sheets, plates, or extrusions.

1.09 Special Considerations

1.091 The alloy loses both room and elevated temperature strength rapidly with increasing holding times at temperatures above 300 F (1).

1.092 The improved toughness and exfoliation resistance of this alloy over 7075 depends on maintaining the lower limits of silicon, iron, manganese, and titanium (3). (See Tables 3.02110 and 3.02725.)

1.093 As has been reported for other heat treated aluminum alloys in heavy sections, strength, hardness, and fracture toughness vary through the thickness. (See Figures 3.02722 and 3.02723.) Care should be taken so that property comparisons are made at similar test sample locations, and that the data used are relevant to the section used in service.

1.094 When fabricated by special (patented) practices, 7475 sheet can be superplastic at strain rates around 2×10^{-4} and temperatures around 950 F. Elongations of approximately 650 percent have been reported (24) in 7475 sheet suitable for forming (see Table 3.0215). Subsequent T6 properties of superplastically formed components were reported (25) to be satisfactory (see Figures 3.0216 and 3.0217), with only slight degradation due to cavitation. Fatigue properties of formed sheet are comparable to those of conventional sheet in the T6 temper (see Figure 3.05114).

2 PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties

2.011 Melting range, 890 to 1180 F (approximately).
2.012 Phase changes, none in the alpha phase.
2.0121 Time-temperature-transformation diagrams.

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

2.0122 In the as-cast or annealed condition, the alpha matrix contains a coarse second phase of $MgZn_2$, which goes into solution during solution heat treatment. Artificial aging causes the formation first of Guinier-Preston zones high in zinc. Subsequently, particularly at aging temperatures above 300 F, finely divided precipitates of $MgZn_2$ and $MgZn_2Al_2$ appear. With overaging (stabilization), copper also precipitates in finely divided form. The low composition limits for silicon, iron, manganese, and titanium limit the formation of secondary insoluble phases to very small amounts. The smaller amounts of such secondary phases account for the good fracture toughness and corrosion resistance of this alloy (3, 7).

2.013 Thermal conductivity.

2.0131 The thermal conductivity, K, of this alloy is closely similar to that of 7075 in comparable tempers:
T61 and T651: 80 Btu/ft/hr/ft^2/F at 77 F
T761 and T7651: 90 Btu/ft/hr/ft^2/F at 77 F
T7351: 94 Btu/ft/hr/ft^2/F at 77 F.

2.014 Thermal expansion.

2.0141 Essentially the same as for 7075 in comparable tempers. Design value: 12.9×10^{-6} in. per in. per F in the range 68 to 212 F.

2.015 Specific heat.

2.0151 Essentially the same as for 7075 in comparable tempers:
T7351: 0.21 Btu/lb/F at 212 F
T61, T651, T761, and T7651: 0.23 Btu/lb/F at 212 F.

2.016 Thermal diffusivity.

2.02 Other Physical Properties

2.021 Density: 0.101 lb per in.^{3}.

2.022 Electrical properties, Table 2.022.

2.0221 Variation in electrical conductivity with tensile yield strength in 7475 plate, Figure 2.0221.

2.023 Magnetic properties, alloy is not magnetic.

2.024 Emissivity.

2.0241 Essentially the same as 7075 alloy in comparable tempers. (See 7075 Alloy, Code 3207, Section 2.016.)

2.03 Chemical Properties

2.031 The alloy is subject to general corrosion, similar to 7075 alloy (Code 3207), in marine and other corrosive atmospheres. In such environments, or where good surface appearance is a requirement, alclad material, anodizing, or painting is recommended (1).

2.032 In the T61 condition, the alloy is susceptible to stress corrosion cracking and the susceptibility is decreased significantly by over-aging to the T761 or T7351 condition. Susceptibility in the T61 condition is similar to 7075-T6 and in the T761 condition it is similar to 7075-T76 (1, 2). (See 7075, Code 3207, Sections 2.0311 through 2.0315.)

2.0321 Crack-growth rates for fatigue precracked specimens of 7475 plate exposed for 202 days to marine atmosphere at Daytona Beach, Florida, Figure 2.0321.

2.0322 Crack growth for fatigue precracked specimens of 7475 plate exposed for 202 days to marine atmosphere at Daytona Beach, Florida, Figure 2.0322.

2.0323 Crack growth for fatigue precracked specimens of 7475 plate immersed for 162 days in salt-chromate solution, Figure 2.0323.

2.0324 Estimated SL threshold stress intensity and K_{Iscc} for double cantilever beam specimens of 7475 plate, Table 2.0324.

2.0325 Stress corrosion behavior of superplastically strained 7475-T6 sheet, Table 2.0325.

2.033 7475 alloy is slightly susceptible to exfoliation corrosion in the T61 condition but highly resistant in the T761 condition. In a temper-for-temper comparison, the exfoliation resistance of 7475-T61 and T761 sheet is better than that of 7075-T6 and T76 sheet (1, 2, 3).

2.04 Nuclear Properties
(See 7075, Code 3207, Section 2.041.)

3 MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties

3.011 AMS specified mechanical properties.

3.0111 AMS specified tensile properties for T7351 plate, Table 3.0111.

3.0112 AMS specified fracture toughness for T7351 plate, Table 3.0112.

3.0113 AMS specified tensile properties of T651 plate, Table 3.0113.

3.0114 AMS specified fracture toughness for T651 plate, Table 3.0114.

3.0115 AMS specified tensile properties for T7651 plate, Table 3.0115.

3.0116 AMS specified fracture toughness for T7651 plate, Table 3.0116.

3.0117 AMS specified tensile properties and fracture toughness for T651 sheet, Table 3.0117.

3.0118 AMS specified tensile properties and fracture toughness for T7651 sheet, Table 3.0118.

3.012 Design mechanical properties for 7475-T6 and -T76 sheet and plate, Table 3.012.

3.013 Design mechanical properties for 7475-T7351 plate, Table 3.013.

3.02 Mechanical Properties at Room Temperature

3.021 Tension.

3.0211 Stress-strain diagrams.

3.02111 Stress-strain curves for sheet in T61 condition, Figure 3.02111.

3.02112 Stress-strain curves for sheet in T761 condition, Figure 3.02112.

3.02113 Stress-strain curves for alclad sheet in T61 condition, Figure 3.02113.

3.02114 Stress-strain curves for alclad sheet in T761 condition, Figure 3.02114.

3.02115 Stress-strain curves for 1.5-inch plate in T7351 condition, Figure 3.02115.

3.02116 Stress-strain curves for 1.5-inch plate in T651 condition, Figure 3.02116.

3.0212 Typical tensile properties of bare and alclad sheet, Table 3.0212.

3.0213 Effect of exposure time at various elevated temperatures on the room temperature tensile properties of sheet in T61 condition, Figure 3.0213.

3.0214 Effect of exposure time at various elevated temperatures on the room temperature tensile properties of sheet in T761 condition, Figure 3.0214.

3.0215 Tensile elongation of superplastic 7475 sheet at various strain rates at 900 F and 960 F, Table 3.0215.

3.0216 Room temperature tensile properties of 7475-T6 sheet after uniaxial superplastic tensile deformation, Figure 3.0216.

3.0217	Room temperature properties of 7475-T6 sheet after superplastic plane strain tensile deformation, Figure 3.0217.
3.0218	Typical mechanical properties of 7475-T7351 plate, Table 3.0218.
3.0219	Mechanical properties of 7475-T651 plate, Table 3.0219.
3.02110	Effect of alloy purity on the mechanical properties of 7075/7475, Table 3.02110.
3.02111	Mechanical properties of 1.5-inch thick 7475 plate in various tempers, Table 3.02111.
3.022	Compression.
3.0221	Stress-strain diagrams.
3.02211	Compressive stress-strain curves for sheet in T61 condition, Figure 3.02211.
3.02212	Compressive stress-strain curves for sheet in T761 condition, Figure 3.02212.
3.02213	Compressive stress-strain curves for alclad sheet in T61 condition, Figure 3.02213.
3.02214	Compressive stress-strain curves for alclad sheet in T761 condition, Figure 3.02214.
3.02215	Typical compression stress-strain curves for 7475-T7351 plate, Figure 3.02215.
3.02216	Typical compression stress-strain curves for 7475-T7651 plate, Figure 3.02216.
3.02217	Typical compression stress-strain curves for 7475-T651 plate, Figure 3.02217.
3.0222	Compressive properties.
3.02221	Compressive yield strength of sheet, Table 3.02221.
3.02222	Compressive strength of T7475-T7351 plate of various thicknesses, Table 3.02222.
3.023	Impact.
3.0231	Room temperature Charpy V-notch results: 17.1 ft-lbs (longitudinal) and 5.9 ft-lbs (transverse). (Average of five specimens of T7351 plate 2-inch thick.) (14)
3.024	Bending.
3.025	Torsion and shear.
3.0251	Shear strength of sheet, Table 3.0251.
3.0252	Shear strength of plate, Table 3.0252.
3.026	Bearing.
3.0261	Bearing strength of sheet in various heat treated conditions, thicknesses, and orientations, Table 3.0261.
3.0262	Bearing properties of 7475-T7351 plate in various thicknesses, Table 3.0262.
3.027	Stress concentration.
3.0271	Notch properties.
3.02711	Residual strength (gross area stress at maximum load) of bare and alclad sheet as a function of original crack length, Figure 3.02711.
3.02712	Residual strength (gross area stress at maximum load) of sheet as a function of crack length at instability, Figure 3.02712.
3.02713	Fracture strength of center cracked panels of various widths in T761 condition, Table 3.02713.
3.02714	Fracture strength of center cracked specimens of various thicknesses in T61 condition, Table 3.02714.
3.02715	Plane stress fracture toughness K_c of 7475-T61 and -T761 sheet relative to tensile yield strength, Figure 3.02715.
3.02716	Correlations between notched tensile yield ratio (NYR) and K_{Ic} for 7075 and 7475 plate in T651, T7651, and T7351 tempers, Figure 3.02716.
3.0272	Fracture toughness. (See also Section 3.0.1.)
3.02721	Plane strain fracture toughness of 7475-T7351 plate of various thicknesses, Table 3.02721.
3.02722	Toughness variations through the thickness of 2-inch thick 7475-T7351 plate, Figure 3.02722.
3.02723	Toughness variations through the thickness of 2.75-inch thick 7475-T7351 plate, Figure 3.02723.
3.02724	Plane strain fracture toughness of 1.5-inch thick 7475-T7651 plate, Table 3.02724.
3.02725	Effect of alloy purity on the plane strain fracture toughness of 7075-T73511 and -T76511 extrusions, Table 3.02725.
3.02726	Plane strain fracture toughness K_{Ic} of 7475-T7351 plate produced from January 1976 to August 1978 by two U.S. producers, Table 3.02726.
3.028	Combined properties.

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

3.03	Mechanical Properties at Various Temperatures
3.031	Tension.
3.0311	Stress-strain curves.
3.0312	Tensile properties.
3.03121	Sheet.
3.031211	Effect of low temperatures on tensile properties of sheet in T61 condition, Figure 3.031211.
3.031212	Effect of low temperatures on tensile properties of sheet in T761 condition, Figure 3.031212.
3.031213	Effect of elevated temperatures, after various holding times at temperature, on tensile properties of sheet in T61 condition, Figure 3.031213.
3.031214	Effect of elevated temperature, after various holding times at temperature, on tensile properties in T761 condition, Figure 3.031214.
3.031215	Tensile properties of longitudinal and transverse sheet specimens in T61 condition from -50 to 200 F, Figure 3.031215.
3.031216	Tensile properties of longitudinal and transverse sheet specimens in T761 condition from -50 to 200 F, Figure 3.031216.
3.03122	Plate.
3.031221	Tensile properties of longitudinal and transverse plate specimens in T7651 condition in the temperature range -65 F to +200 F, Figure 3.031221.
3.031222	Tensile properties of longitudinal and transverse plate specimens in T7351 condition at elevated temperatures, Figure 3.031222.
3.032	Compression.
3.0321	Stress-strain curves.
3.0322	Compressive yield strength and elastic modulus as a function of temperature, Figure 3.0322.
3.033	Impact.
3.034	Bending.
3.035	Torsion and shear.
3.036	Bearing.
3.037	Stress concentration.
3.0371	Notch properties.
3.0372	Fracture toughness.
3.03721	Plane strain fracture toughness as a function of temperature for T7651 plate, Figure 3.03721.
3.038	Combined properties.

3.04	Creep and Creep-Rupture Properties
3.041	Sheet.
3.0411	Creep and creep-rupture curves for T761 and T61 sheet at 75 F and 212 F, Figure 3.0411.
3.042	Plate.
3.0421	Creep-rupture and creep deformation curves for T7351 plate at 250 F, 350 F, and 500 F, Figure 3.0421.

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

3.05 **Fatigue Properties**

3.051 Conventional fatigue properties.

3.0511 Constant fatigue life diagram for smooth axially loaded sheet specimens, Figure 3.0511.

3.0512 Constant fatigue life diagram for notched axially loaded sheet specimens, Figure 3.0512.

3.0513 Constant fatigue life diagram for smooth axially loaded alclad sheet specimens, Figure 3.0513.

3.0514 Constant fatigue life diagram for notched axially loaded alclad sheet specimens, Figure 3.0514.

3.0515 Axial fatigue life of smooth and notched specimens of 0.090-inch alclad sheet, Figure 3.0515.

3.0516 Axial fatigue life of smooth and notched specimens of 0.200-inch alclad sheet, Figure 3.0516.

3.0517 Axial fatigue life of smooth and notched specimens of 0.250-inch alclad sheet, Figure 3.0517.

3.0518 Axial fatigue life of smooth and notched longitudinal and transverse specimens of 1.5-inch thick 7475-T7651 plate, Figure 3.0518.

3.0519 Axial load fatigue lives of longitudinal and transverse smooth and notched specimens of 7475-T7351 and -T651 plate 1.5-inch thick, Figure 3.0519.

3.05110 Axial load fatigue lives of transverse smooth and notched specimens of 7475-T7351 and 7475-T651 plate 1.5-inch thick, Figure 3.05110.

3.05111 Axial stress fatigue life of 7475-T7351 plate in the transverse direction, Figure 3.05111.

3.05112 Axial stress fatigue life of notched specimens of 7475-T7351 plate in the transverse direction at elevated temperature, Figure 3.05112.

3.05113 Axial stress fatigue life of specimen of 1.5-inch thick 7475-T7651 plate, Figure 3.05113.

3.05114 Axial fatigue life of smooth specimens of 7475-T6 superplastically strained sheet, Figure 3.05114.

3.052 Fatigue crack-growth rates.

3.0521 Fatigue crack-growth rate of bare and alclad sheet, Figure 3.0521.

3.0522 Fatigue crack-growth rate of alclad sheet panels of various sizes at 75 F and -65 F, Figure 3.0522.

3.0523 Fatigue crack-growth rates for 0.125-inch thick specimen of 7475-T761 sheet in LT orientation–constant load tests, Figure 3.0523.

3.0524 Fatigue crack-growth rates for 0.125-inch thick specimen of 7475-T761 sheet in TL orientation–constant load tests, Figure 3.0524.

3.0525 Fatigue crack-growth rates for high and low copper content 7475-T7 plate, Figure 3.0525.

3.0526 Fatigue crack-growth rates for 1.5-inch thick specimen of 7475-T7651 plate in air and 3.5 percent salt water, Figure 3.0526.

3.0527 Fatigue crack-growth rates for 7475-T651 and -T7351 plate, Figure 3.0527.

3.0528 Fatigue crack-growth rates for 1.25-inch thick specimen of 7475-T73 plate, Figure 3.0528.

3.0529 Fatigue crack-growth rates for 7475-T7351 and -T651 plate in air and 3.5 percent NaCl solution, Figure 3.0529.

3.05210 Fatigue crack-growth rates for 7475-T7 in 0.25-inch thick plate containing a high (2.2 percent) copper content, Figure 3.05210.

3.05211 Fatigue crack-growth rates for 1.5-inch thick specimen of 7575-T7351 plate in air, Figure 3.05211.

3.06 **Elastic Properties**

3.061 Poisson's ratio.

3.062 Modulus of elasticity. (See also Tables 3.012, 3.013, 3.0215, and 3.02222 and Figures 3.031222 and 3.0322.)

3.0621 Tensile and compressive elastic modulii of 7475-T61 and -T761 sheet, Table 3.0621.

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5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475	
	Percent	
Composition	Min	Max
Si	–	0.10
Fe	–	0.12
Cu	1.2	1.9
Mn	–	0.06
Mg	1.9	2.6
Cr	0.18	0.25
Zn	5.2	6.2
Ti	–	0.06
Others		
Each	–	0.05
Total	–	0.15
Al	Remainder	

TABLE 1.04 ALUMINUM ASSOCIATION COMPOSITION LIMITS (1, 33-37)

Alloy	7475			
Form	Sheet		Plate	Extrusions
Temper	T61	T736	T7351	T73511
Electrical Conductivity, percent IACS	35.1	38.4	44.1	40.2
megaohms/in.^{3}	0.516	0.565	–	–
Electrical Resistivity, microohm/in.	1.94	1.77	–	–

TABLE 2.022. ELECTRICAL PROPERTIES (3,10,11,19)

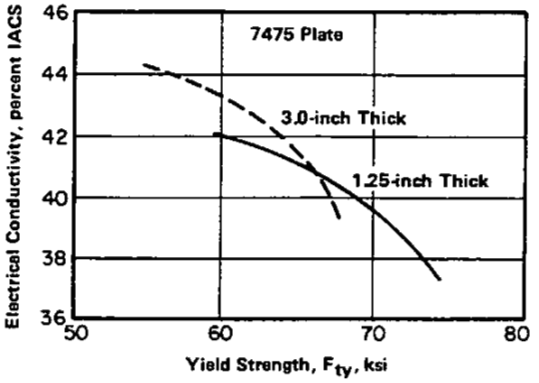


FIGURE 2.0221. VARIATION IN ELECTRICAL CONDUCTIVITY WITH TENSILE YIELD STRENGTH IN 7475 PLATE (10)

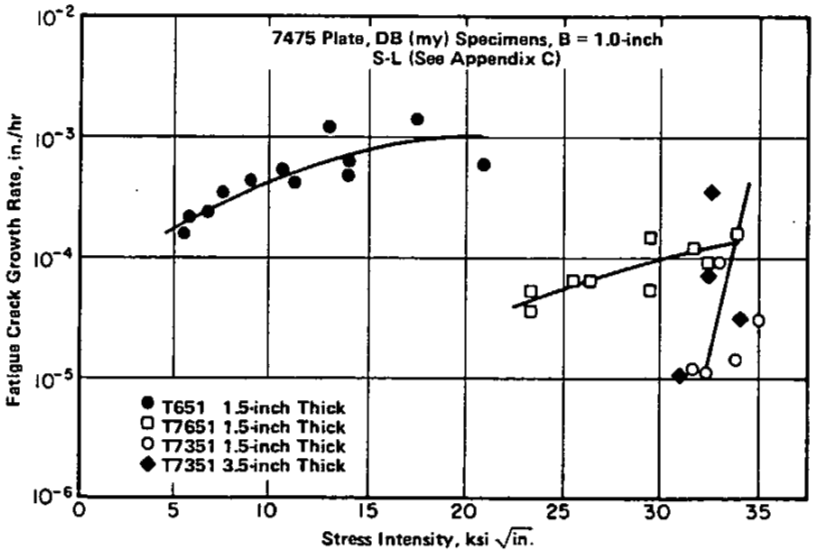


FIGURE 2.0321. CRACK-GROWTH RATES FOR FATIGUE PRECRACKED SPECIMENS OF 7475 PLATE EXPOSED FOR 202 DAYS TO MARINE ATMOSPHERE AT DAYTONA BEACH, FLORIDA (22)

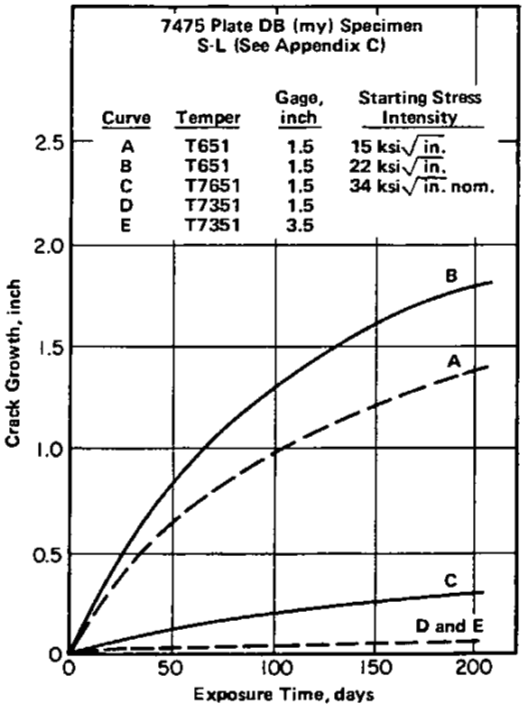


FIGURE 2.0322. CRACK GROWTH IN FATIGUE PRECRACKED SPECIMENS OF 7475 PLATE EXPOSED FOR 202 DAYS TO MARINE ATMOSPHERE AT DAYTONA BEACH, FLORIDA (22)

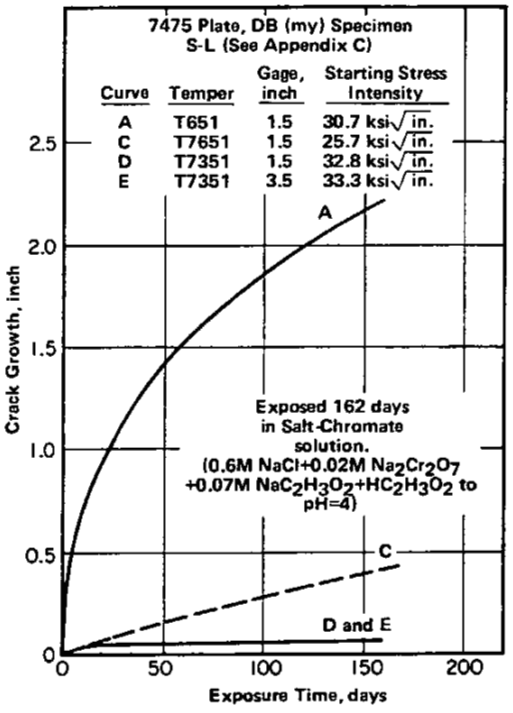


FIGURE 2.0323. CRACK GROWTH IN FATIGUE PRECRACKED SPECIMENS OF 7475 PLATE IMMERSED FOR 162 DAYS IN SALT-CHROMATE SOLUTION (22)

Al
5.6 Zn
2.2 Mg
1.5 Cu
0.21 Cr
Low Si
Fe
Mn
Ti

7475 Al

Alloy	7475		
Form	Plate		
Orientation	S-L		
		K_{Iscc}, ksi√in.(a)	
Thickness, inch	Temper	Salt-Chromate(b) Solution	Marine Atmosphere at Daytona Beach, 6 months
1.5	T651	<4	<5
1.5	T7651	<15	<22
1.5	T7351	~33	~32
3.5	T7351(c)	~30	~32

(a) At 4 x 10^{-9} in./sec crack-growth rate.
(b) See Figure 2.0323 for composition of salt-chromate solution.
(c) Nominal S-L K_{Ic} = 43.5 ksi√in. in laboratory air.

TABLE 2.0324. ESTIMATED S-L THRESHOLD STRESS INTENSITY, K_{Iscc}, FOR DOUBLE CANTILEVER BEAM SPECIMENS OF 7475 PLATE (22)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475-T6				
Form	1.5-inch x 0.5-inch Superplastic Sheet(a)				
Test Material Treatment	Grain Diameter, μm		Sheet Thickness, inch	No. of Specimens Tested	Survived Exposure, percent
	L and LT	ST			
As Processed to Fine Grain Size + 1 hr at 961 F, + T6 Heat Treat	14.5	7.7	0.079	26	73
Same as Above	11.1	6.0	0.04	16	75
Same as Above + Slow Heat Up to Recrystallization Temperature	40.0	12.0	0.04	8	75
As Processed to Fine Grain Size, + Superplastic Uniaxial Strain, ($\bar{\epsilon}$ = 0.96, $\dot{\epsilon}$ = 2x10^{-4} sec^{-1}, Temp = 961 F) + T6 Heat Treatment	19.5	8.8	0.04	2	50
Same as Above with $\bar{\epsilon}$ = 1.28	20.4	9.2	0.04	2	100

(a) Specimen is bent elastically in a teflon jig to an outer fiber stress of 49.3 ksi, immersed in 3.5 percent NaCl solution for 10 minutes, immersed for 50 minutes in air. Humidity was not controlled and specimen was nonstandard.

TABLE 2.0325. STRESS CORROSION BEHAVIOR OF SUPERPLASTICALLY STRAINED 7475-T6 SHEET (31)

Alloy	7475-T7351			
Form	Plate			
Thickness, t, inch	Direction	F_{tu}, ksi	F_{ty}, ksi	e (2-inch), percent
0.25 < t < 1.500	L	68	57	10
	T	68	57	9
t = 1.500	L	68	57	10
	T	68	57	9
	ST	64	53	4
1.500 < t ≤ 2.000	L	67	55	10
	T	67	55	8
	ST	64	52	4
2.000 < t ≤ 2.500	L	66	54	10
	T	66	54	8
	ST	64	52	4
2.500 < t ≤ 3.000	L	65	53	10
	T	65	53	8
	ST	62	50	3
3.000 t ≤ 3.500	L	63	51	10
	T	63	51	8
	ST	61	48	3
3.500 < t ≤ 4.000	L	61	48	9
	T	61	48	7
	ST	59	46	3

TABLE 3.0111. AMS SPECIFIED TENSILE PROPERTIES FOR T7351 PLATE (33)

Alloy	7475-T7351	
Form	Plate	
Thickness, t, inch	Orientation	K_{Ic}, ksi $\sqrt{in.}$
$0.749 < t \leq 4.000$	L-T	38
$0.749 < t \leq 4.000$	T-L	32
$2.750 < t \leq 4.000$	S-L	25

TABLE 3.0112. AMS SPECIFIED FRACTURE TOUGHNESS FOR T7351 PLATE (33)

Alloy	7475-T651			
Form	Plate			
Thickness, t, inch	Direction	F_{tu}, ksi	F_{ty}, ksi	e (2-inch), percent
$0.250 \leq t \leq 0.499$	L	77	67	9
	LT	78	67	9
$0.499 < t \leq 1.000$	L	77	68	8
	LT	78	68	8
$1.000 < t \leq 1.500$	L	76	67	6
	LT	77	67	6

TABLE 3.0113. AMS SPECIFIED TENSILE PROPERTIES FOR T651 PLATE (34)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475-T651
Form	Plate
Orientation	K_{Ic}, ksi $\sqrt{in.}$[a]
L-T	30
T-L	28

(a) Crack length is not less than 1.5 inch and specimen thickness is equal to plate thickness.

TABLE 3.0114. AMS SPECIFIED FRACTURE TOUGHNESS FOR T651 PLATE (34)

Alloy	7475-T7651			
Form	Plate			
Thickness, t, inch	Direction	F_{tu}, ksi	F_{ty}, ksi	e (2-inch), percent
$0.250 \leq t \leq 0.499$	L	70	60	9
	LT	71	60	9
$0.499 < t \leq 1.000$	L	69	59	8
	LT	70	59	8
$1.000 < t \leq 1.500$	L	69	59	6
	LT	70	59	6

TABLE 3.0115. AMS SPECIFIED TENSILE PROPERTIES FOR T7651 PLATE (35)

Alloy	7475-T7651
Form	Plate
Orientation	K_{Ic}, ksi $\sqrt{in.}$[a]
L-T	33
T-L	30

(a) Crack length is not less than 1.5 inch and specimen thickness is equal to plate thickness.

TABLE 3.0116. AMS SPECIFIED FRACTURE TOUGHNESS FOR T7651 PLATE (35)

Alloy	7475-T651			
Form	Sheet			
Thickness, t, inch	F_{tu}, ksi[a]	F_{ty}, ksi[a]	e (2-inch), percent[a]	K_Q, ksi $\sqrt{in.}$[b]
≥ 0.040	75	64	9	–
$0.040 \leq t \leq 0.125$	–	–	–	75
$0.125 < t \leq 0.249$	–	–	–	60

(a) Tensile test direction was not specified.
(b) K_Q was determined for L-T direction using M(T) specimen (W = 16 inch and B = sheet thickness) and procedure described in AMS 4084.

TABLE 3.0117. AMS SPECIFIED TENSILE PROPERTIES AND FRACTURE TOUGHNESS FOR T651 SHEET (36)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475-T7651			
Form	Sheet			
Thickness, t, inch	F_{tu}, ksi(a)	F_{ty}, ksi(a)	e (2-inch), percent(a)	K_Q, ksi$\sqrt{in.}$(b)
$t \geq 0.040$	71	60	9	–
$0.040 \leq t \leq 0.125$	–	–	–	80
$0.125 < t \leq 0.249$	–	–	–	70

(a) Tensile test direction was not specified.
(b) K_Q was determined for L-T direction using M(T) specimen (W = 44 inch and B = sheet thickness) and procedure described in AMS 4085.

TABLE 3.0118. AMS SPECIFIED TENSILE PROPERTIES AND FRACTURE TOUGHNESS FOR T7651 SHEET (37)

Alloy	7475									
Form	Sheet	Plate			Sheet			Plate		
Condition	T61	T651			T761			T7651		
Thickness, in.	0.040-0.249	0.250-0.499	0.500-1.000	1.001-1.499	0.040-0.062	0.063-0.187	0.188-0.249	0.250-0.499	0.500-1.000	1.001-1.499
Basis	S	S	S	S	S	S	S	S	S	S
Mechanical properties:										
F_{tu}, ksi										
L	74	77	77	76	71	70	69	70	69	69
LT	75	78	78	77	71	71	71	71	70	70
F_{ty}, ksi										
L	65	67	68	67	61	60	60	60	59	59
LT	64	67	68	67	60	60	60	60	59	59
F_{cy}, ksi										
L	64	67	68	66	60	59	58	60	59	59
LT	68	70	71	70	63	63	63	63	62	62
F_{su}, ksi	45	44	43	40	43	42	41	41	39	37
F_{bru}*, ksi										
(e/D=1.5)	120	113	113	111	112	112	111	104	103	103
(e/D=2.0)	154	144	144	142	143	143	142	136	134	134
F_{bry}*, ksi										
(e/D=1.5)	97	91	93	91	90	90	90	82	81	81
(e/D=2.0)	110	106	107	106	104	104	104	97	95	95
e, percent										
LT	9	9	8	6	9	9	9	9	8	6
E, 10^3 ksi	10.0	10.2			10.0			10.2		
E_c, 10^3 ksi	10.5	10.6			10.5			10.6		
G, 10^3 ksi	3.8	3.9			3.8			3.9		
μ	0.33	0.33			0.33			0.33		

(a) Bearing values are "dry pin" values.

TABLE 3.012. DESIGN MECHANICAL PROPERTIES OF 7475-T6 AND -T76 SHEET AND PLATE (28)

Alloy	7475-T7351						
Form	Plate						
Thickness, in.	0.250-1.000	1.001-1.500	1.501-2.000	2.001-2.500	2.501-3.000	3.001-3.500	3.501 4.000
Basis	S	S	S	S	S	S	S
Mechanical properties:							
F_{tu}, ksi							
L	68	68	67	66	65	63	61
LT	68	68	67	66	65	63	61
ST	...	64[a]	64	64	62	61	59
F_{ty}, ksi							
L	57	57	55	54	53	51	48
LT	57	57	55	54	53	51	48
ST	...	53[a]	52	52	50	48	46
F_{cy}, ksi							
L	56	55	53	52	51	48	45
LT	59	59	57	55	54	52	49
ST	...	59[a]	57	56	55	53	50
F_{su}, ksi	39	39	40	40	40	39	37
F_{bru},[b] ksi							
(e/D = 1.5)	98	98	102	101	99	96	93
(e/D = 2.0)	127	127	132	130	128	124	120
F_{bry},[b] ksi							
(e/D = 1.5)	78	78	82	80	79	76	71
(e/D = 2.0)	93	93	95	93	92	88	83
e, percent							
L	10	10	10	10	10	10	9
LT	9	9	8	8	8	8	7
ST	...	4[a]	4	4	3	3	3
E, 10^3 ksi	10.3						
E_c, 10^3 ksi	10.6						
G, 10^3 ksi	3.9						
μ	0.33						

(a) Values applicable to 1.500 inch thickness only.
(b) Bearing values are "dry pin" values.

TABLE 3.013. DESIGN MECHANICAL PROPERTIES OF 7475-T7351 PLATE (32)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

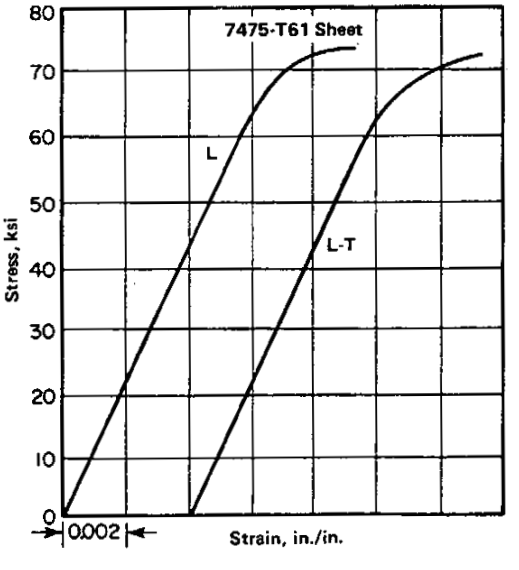


FIGURE 3.02111. STRESS-STRAIN CURVES FOR SHEET IN T61 CONDITION (1)

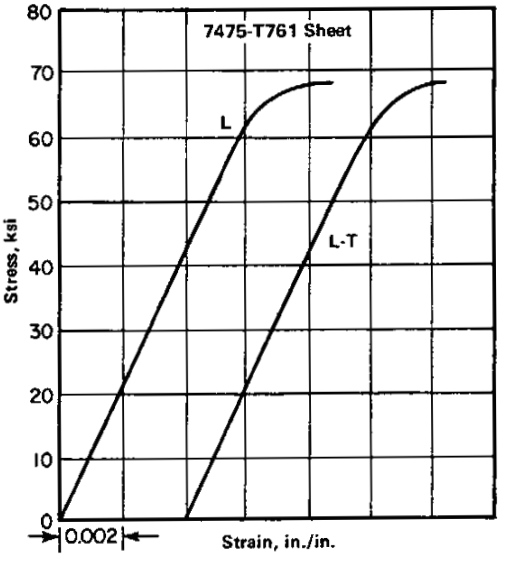


FIGURE 3.02112. STRESS-STRAIN CURVES FOR SHEET IN T761 CONDITION (1)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

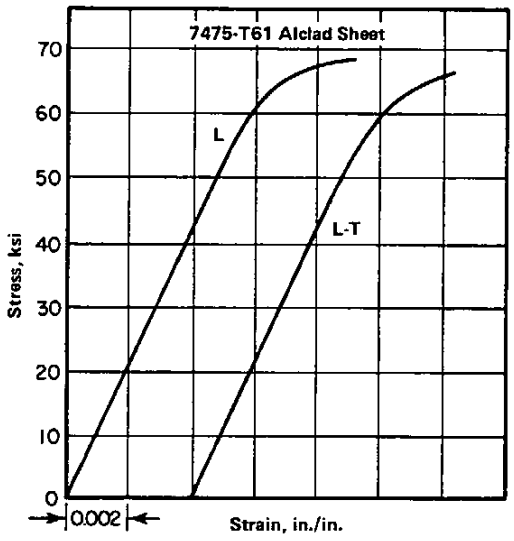


FIGURE 3.02113. STRESS-STRAIN CURVES FOR ALCLAD SHEET IN T61 CONDITION (1)

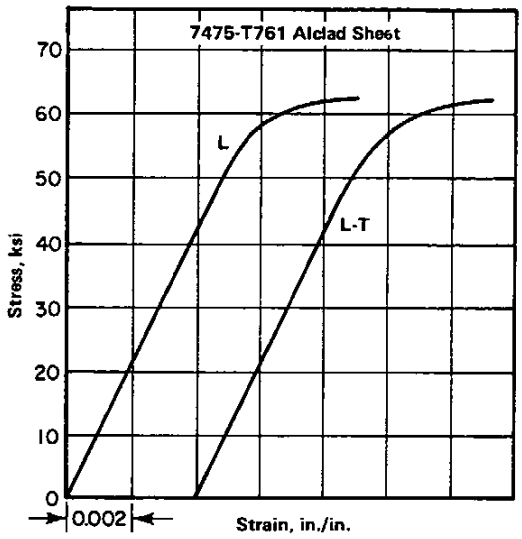


FIGURE 3.02114. STRESS-STRAIN CURVES FOR ALCLAD SHEET IN T761 CONDITION (1)

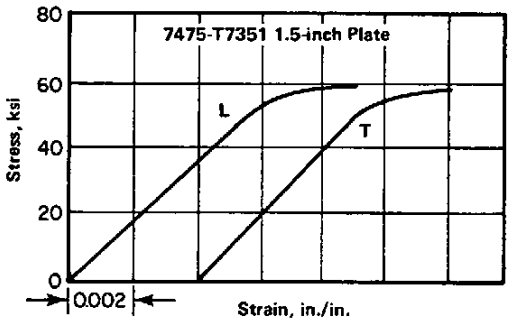


FIGURE 3.02115. STRESS-STRAIN CURVES FOR 1.5-INCH PLATE IN T7351 CONDITION (29)

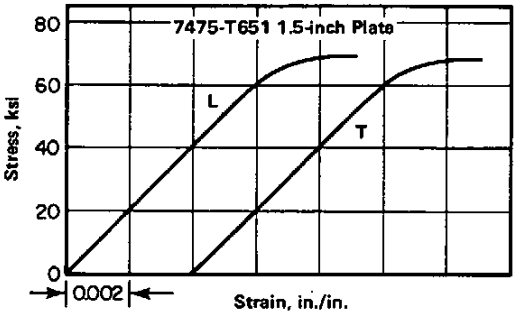


FIGURE 3.02116. STRESS-STRAIN CURVES FOR 1.5-INCH PLATE IN T651 CONDITION (29)

Alloy	7475							
Form	Bare Sheet						Alclad Sheet	
Condition	T61			T761			T61	T761
Thickness, inch	0.040	0.125	0.249	0.040	0.125	0.249	0.040-0.249	0.040-0.249
F_{tu}, ksi								
L	82.3	80.8	80.7	80.6	74.5	75.0	77.5	71.0
LT	80.6	81.3	82.0	78.6	75.6	76.2	77.5	–
F_{ty}, ksi								
L	76.6	75.6	76.4	74.0	66.6	67.4	72.5	61.0
LT	72.5	72.8	74.2	71.0	65.2	67.1	70.0	–
e (2-inch), percent								
L	10.8	12.2	13.2	10.8	12.0	13.8	12.5	12.0
LT	11.0	12.2	13.2	10.8	11.8	14.0	13.0	–

TABLE 3.0212. TYPICAL TENSILE PROPERTIES OF BARE AND ALCLAD SHEET (1,2,6)

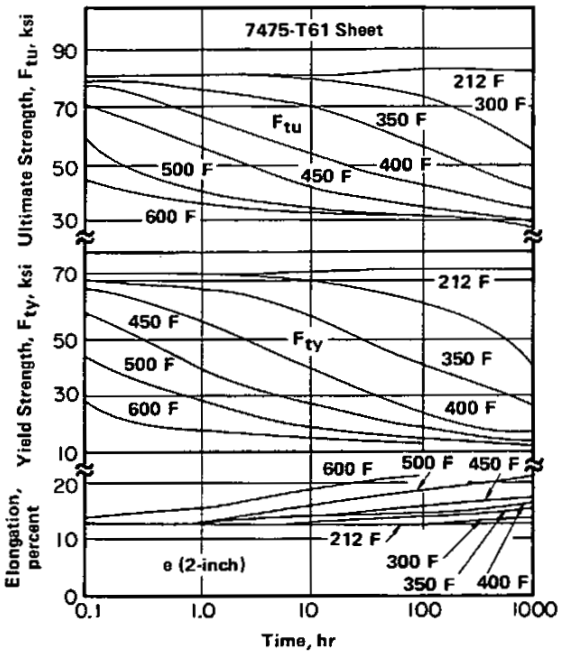


FIGURE 3.0213. EFFECT OF EXPOSURE TIME AT VARIOUS ELEVATED TEMPERATURES ON ROOM TEMPERATURE TENSILE PROPERTIES OF SHEET IN T61 CONDITION (1)

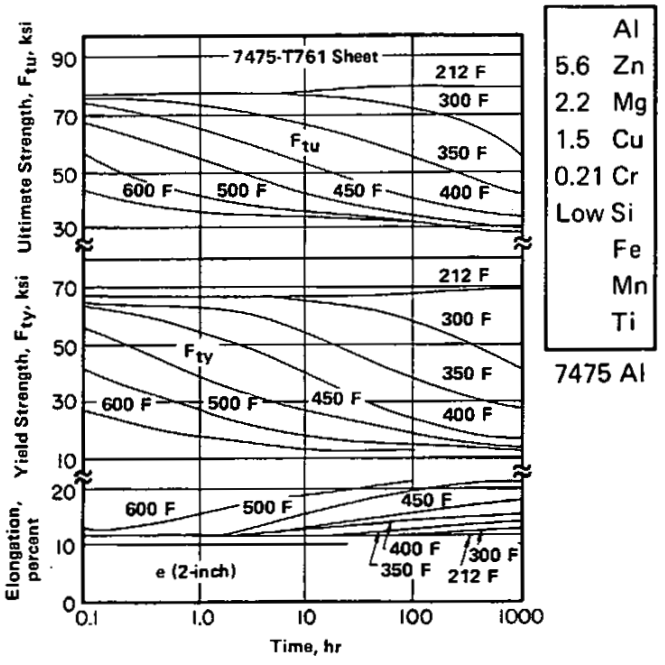


FIGURE 3.0214. EFFECT OF EXPOSURE TIME AT VARIOUS ELEVATED TEMPERATURES ON ROOM TEMPERATURE TENSILE PROPERTIES OF SHEET IN T761 CONDITION (1)

Alloy	7475-T6		
Form	Superplastic Sheet		
Orientation	Temp, F	Strain Rate, sec^{-1}	e, percent
L	900	10^{-2}	150
LT		10^{-2}	100
L		$5x10^{-3}$	125
LT		$5x10^{-3}$	200
L		10^{-3}	200
LT		10^{-3}	175
L		$2x10^{-4}$	306
LT		$2x10^{-4}$	200
L	960	10^{-2}	118
LT		10^{-2}	100
L		$5x10^{-3}$	200
LT		$5x10^{-3}$	175
L		10^{-3}	275
LT		10^{-3}	>450
L		$2x10^{-4}$	650
LT		$2x10^{-4}$	525
L		$5x10^{-5}$	425

TABLE 3.0215. TENSILE ELONGATION OF SUPERPLASTIC 7475 SHEET AT VARIOUS STRAIN RATES AT 900 F AND 960 F (24)

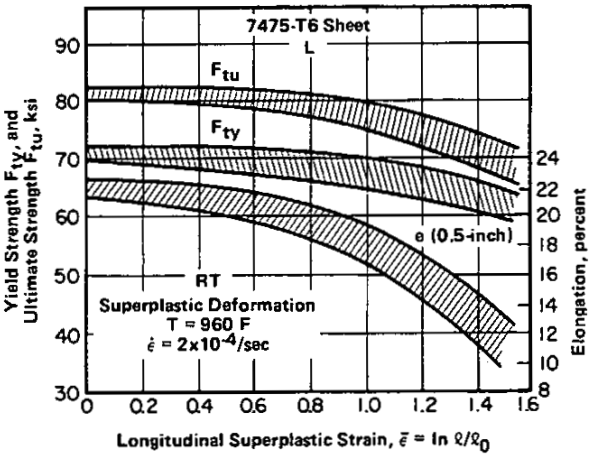


FIGURE 3.0216. ROOM TEMPERATURE TENSILE PROPERTIES OF 7475-T6 SHEET AFTER UNIAXIAL SUPERPLASTIC TENSILE DEFORMATION (25)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

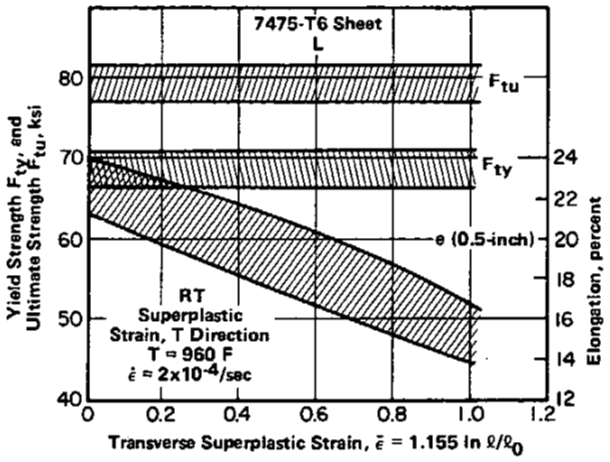


FIGURE 3.0217. ROOM TEMPERATURE PROPERTIES OF 7475-T6 SHEET AFTER SUPERPLASTIC PLANE STRAIN TENSILE DEFORMATION (25)

Alloy	7475-T7351						
Form	Plate						
Thickness, inch	Source	Direction	F_{tu}, ksi	F_{ty}, ksi	e (2-inch), percent	RA, percent	E, x 10^6 psi
0.5	15(d)	L	71.0	62.3	18	45	–
		T	73.4	63.8	14	29	–
0.75	15(d)	L	72.5	63.8	16	46	10.32
		T	73.2	63.7	14	37	10.41
1.25(a)	10	L	72.9	62.3	13	–	–
		T	71.9	61.0	11	–	–
		ST	65.7	58.1	4	–	–
1.5(a)	17	L	71.6	59.5	15	48	–
		T	70.0	58.9	17	52	–
1.75(b)	15(d)	L	72.6	61.8	15	41	–
		T	72.8	61.9	13	33	–
		ST	70.8	58.1	9	22	–
2.0(c)	14	L	72.1	62.9	18	48	10.2
		T	73.2	62.4	15	35	9.80
2.0	13	ST	71.0	59.0	14	–	–
2.25(b)	13	L	70.6	59.7	15	41	–
		T	71.6	60.2	12	28	–
		ST	69.7	57.2	8	18	–
2.75(b)	13	L	68.9	58.2	15	43	–
		T	70.4	58.8	12	26	–
		ST	68.5	54.8	10	19	–
3.0(a)	10	L	68.0	56.8	13	–	–
		T	68.2	55.8	10	–	–
		ST	65.2	52.9	5	–	–
3.0	13	ST	64.0	54.0	4.5	–	–
3.5(b)	15(d)	L	66.8	55.6	15	40	10.13(e)
		T	68.2	56.0	11	26	10.34(e)
		ST	67.6	54.2	9	16	10.23(e)
3.5(a)	10	T	68.1	57.0	14	–	–
4.0(b)	15(d)	L	64.0	52.6	15	41	–
		T	65.9	53.7	11	20	–
		ST	64.8	52.1	8	11	–

Note: Test locations in accordance with ASTM B557; test in accordance with ASTM E8.

(a) Average of triplicate specimens.
(b) Average of two lots.
(c) Average of duplicate specimens.
(d) Results are for "current practice" only, except for 4-inch plate from an earlier production practice.
(e) One lot.

TABLE 3.0218. TYPICAL MECHANICAL PROPERTIES OF 7475-T7351 PLATE (10,13,15,17)

Alloy	7475-T651					
Form	Plate					
Thickness, inch	Source	Direction	F_{tu}, ksi	F_{ty}, ksi	e, percent	RA, percent
1.5	17	L	78.7	70.9	16	37
		T	82.5	69.8	14	28
1.0	16	L	88.6	79.7	10	22
		T	84.9	75.7	11	26

TABLE 3.0219. MECHANICAL PROPERTIES OF 7475-T651 PLATE (17,16)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy			7075 (a)(7475) -T73511 and -T76511												
Form			1.5-inch x 4.5-inch Extrusions												
			F_{tu}, ksi			F_{ty}, ksi			e, percent			RA, percent			Conductivity, percent
Purity	Fe, percent	Si, percent	L	T	ST	L	T	ST	L	T	ST	L	T	ST	IACS
			T73511 (19)												
High	0.08	0.03	77.7	73.1	69.7	68.6	63.0	57.8	14.8	13.1	8.7	41.7	29.2	13.7	40.2
Medium	0.19	0.10	77.0	72.3	69.8	68.4	62.9	58.8	13.3	12.3	9.0	32.7	23.5	8.3	40.7
Low	0.26	0.14	73.9	70.2	67.0	65.3	60.9	57.2	12.7	11.7	6.5	31.9	20.8	8.0	40.0
			T76511 (20)												
High	0.08	0.03	82.5	76.6	75.7	73.1	66.6	62.5	11	10	9	23	16	14	
Medium	0.19	0.10	83.2	76.7	77.7	74.5	67.8	64.1	10	8	8	19	15	9	
Low	0.26	0.14	80.1	73.7	73.2	71.6	65.8	62.8	11	8	5	20	10	8	

(a) This high purity version is expected to behave similarly to 7475; results are included to show the effect of alloy purity.

TABLE 3.02110. EFFECT OF ALLOY PURITY ON THE MECHANICAL PROPERTIES OF 7075/7475 (19,20)

Alloy	7475-T6, -T76, -T73(a)		
Form	1.5-inch Thick Plate		
	Transverse		
Temper	F_{tu}, ksi	F_{ty}, ksi	e, percent
T6	82.6	78.9	13
T76	74.9	65.5	13
T73	67.3	56.0	14

(a) Production T6 plate, portions of which were aged in the laboratory to T76 and T73.

TABLE 3.02111. MECHANICAL PROPERTIES OF 1.5-INCH THICK 7475 PLATE IN VARIOUS TEMPERS (22)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

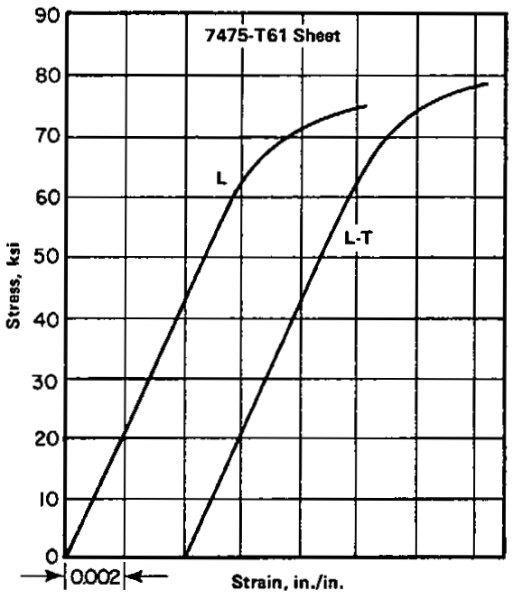


FIGURE 3.02211. COMPRESSIVE STRESS-STRAIN CURVES FOR SHEET IN T61 CONDITION (1)

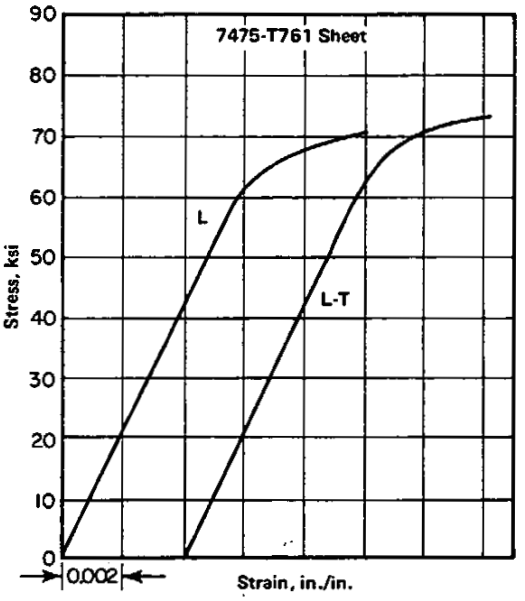


FIGURE 3.02212. COMPRESSIVE STRESS-STRAIN CURVES FOR SHEET IN T761 CONDITION (1)

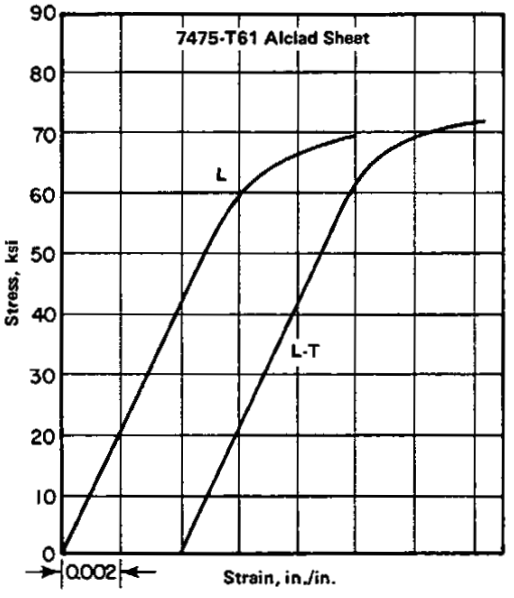


FIGURE 3.02213. COMPRESSIVE STRESS-STRAIN CURVES FOR ALCLAD SHEET IN T61 CONDITION (1)

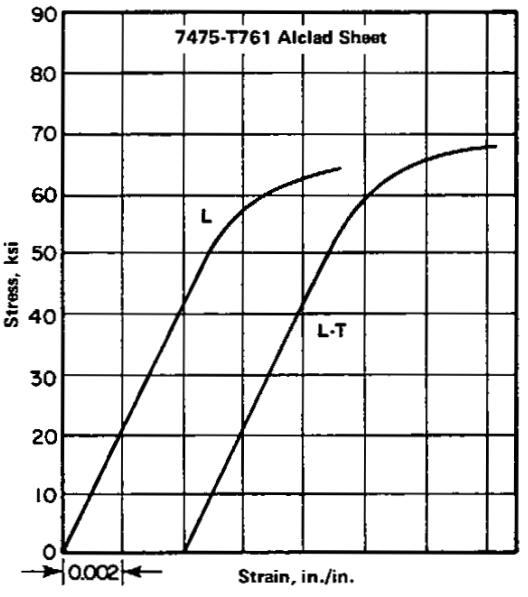


FIGURE 3.02114. COMPRESSIVE STRESS-STRAIN CURVES FOR ALCLAD SHEET IN T761 CONDITION (1)

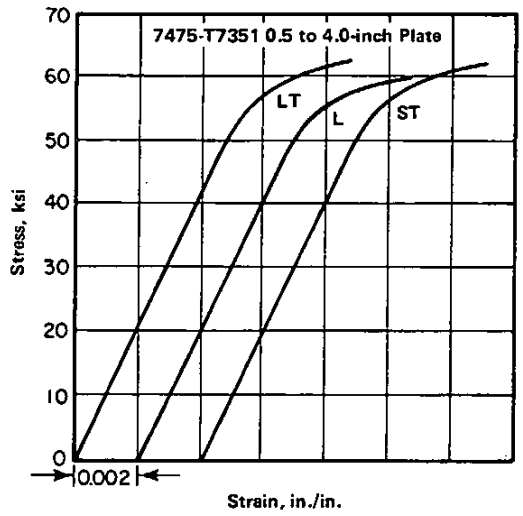


FIGURE 3.02215. TYPICAL COMPRESSION STRESS-STRAIN CURVES FOR 7475-T7351 PLATE (32)

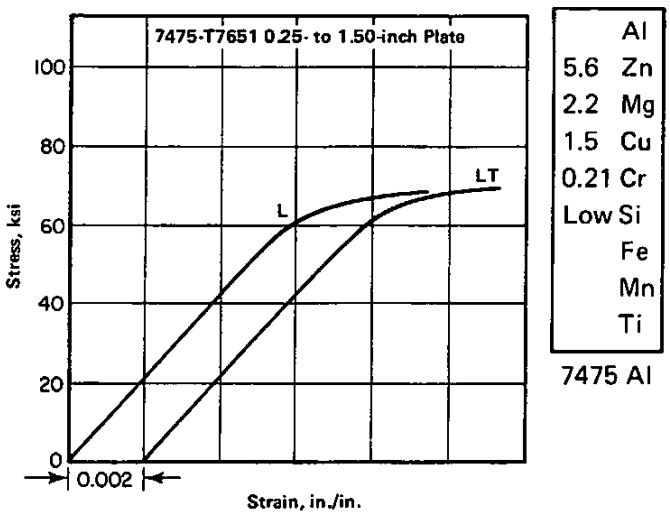


FIGURE 3.02216. TYPICAL COMPRESSION STRESS-STRAIN CURVES FOR 7475-T7651 PLATE (38)

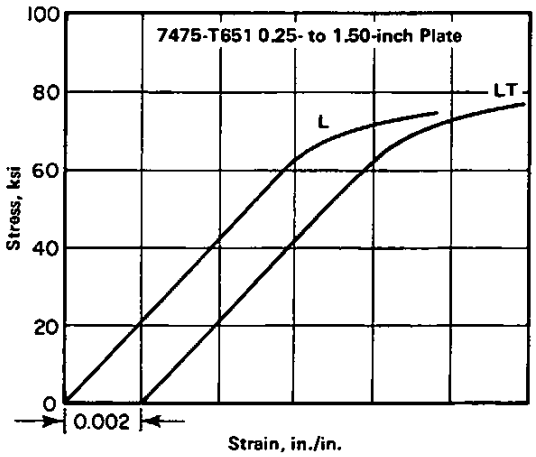


FIGURE 3.02217. TYPICAL COMPRESSION STRESS-STRAIN CURVES FOR 7475-T651 PLATE (38)

Alloy	7475-T61 and -T761	
Form	Sheet	
	T61	T761
Specimen Orientation	F_{cy}, ksi	F_{cy}, ksi
L	73.8	67.9
LT	77.6	70.8

TABLE 3.02221. COMPRESSIVE YIELD STRENGTH OF SHEET (2)

Alloy	7475-T7351		
Form	Plate		
Thickness, inch	Orientation	F_{cy}, ksi	Compressive Modulus, E_c, x 10^3 psi
0.50	L	62.3	–
	LT	66.6	–
0.75	L	63.4	10.69
	LT	66.6	10.81
3.50	L	53.8	10.48
	LT	58.3	10.80
	ST	58.8	10.60

TABLE 3.02222. COMPRESSIVE STRENGTH OF 7475-T7351 PLATE OF VARIOUS THICKNESSES (15)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475-T61 and -T761	
Form	Sheet	
Specimen Orientation	T61 F_{su}, ksi	T761 F_{su}, ksi
L	51.8	48.2
LT	52.2	47.9

TABLE 3.0251. SHEAR STRENGTH OF SHEET (2)

Alloy	7475-T7351	
Form	Plate	
Thickness, inch	Orientation	F_{su}, ksi
0.50	L	43.9
	LT	43.6
0.75	L	42.6
	LT	42.1
3.50	L	42.5
	LT	41.8
	ST	37.5

TABLE 3.0252. SHEAR STRENGTH OF PLATE (15)

Alloy	7475-T61 and -T761					
Form	Sheet					
Condition	Thickness, inch	Specimen Orientation	F_{bru}, ksi e/D=1.5	F_{bru}, ksi e/D=2.0	F_{bry}, ksi e/D=1.5	F_{bry}, ksi e/D=2.0
T61	0.040	L	127.3	166.4	101.0	116.8
		LT	126.5	165.6	101.7	117.0
	0.125	L	133.3	164.8	114.3	130.4
		LT	132.9	165.6	114.2	130.8
	0.249	L	129.2	166.6	110.8	128.4
		LT	129.3	164.9	110.0	129.8
T761	0.040	L	123.8	161.0	95.8	113.8
		LT	123.4	165.6	98.6	114.5
	0.125	L	121.8	151.7	103.0	117.8
		LT	119.6	152.0	102.8	119.1
	0.249	L	119.1	151.3	100.2	116.0
		LT	118.6	151.6	99.0	118.7

TABLE 3.0261. BEARING PROPERTIES OF SHEET IN VARIOUS HEAT TREATED CONDITIONS, THICKNESSES, AND ORIENTATIONS (2)

Alloy	7475-T7351				
Form	Plate				
Thickness, inch	Orientation	F_{bru}, ksi e/D=1.5	F_{bru}, ksi e/D=2.0	F_{bry}, ksi e/D=1.5	F_{bry}, ksi e/D=2.0
0.50	L	112.6	145.7	91.1	114.8
	LT	114.3	143.7	95.2	112.5
0.75	L	107.7	140.3	88.5	108.3
	LT	108.2	138.3	89.6	104.2
3.50	L	105.9	139.6	84.3	100.4
	LT	109.2	136.7	90.8	101.5

TABLE 3.0262. BEARING PROPERTIES (FLATWISE) OF 7475-T7351 PLATE IN VARIOUS THICKNESSES (15)

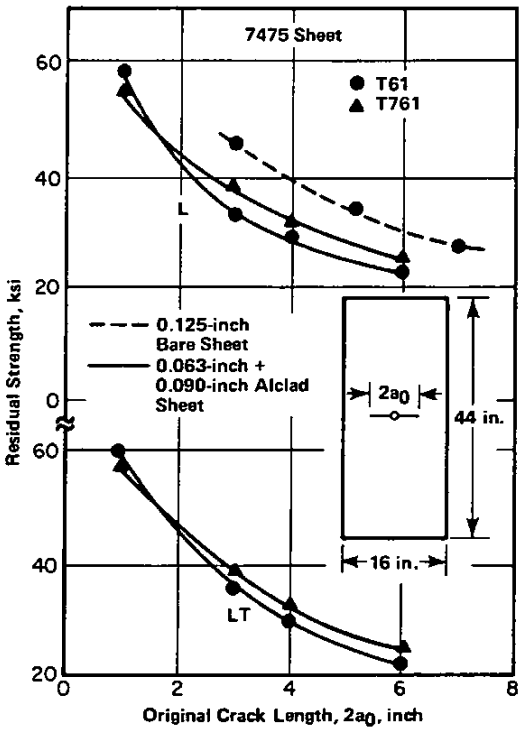


FIGURE 3.02711. RESIDUAL STRENGTH (GROSS AREA STRESS AT MAXIMUM LOAD) OF BARE AND ALCLAD SHEET AS A FUNCTION OF ORIGINAL CRACK LENGTH (1,3)

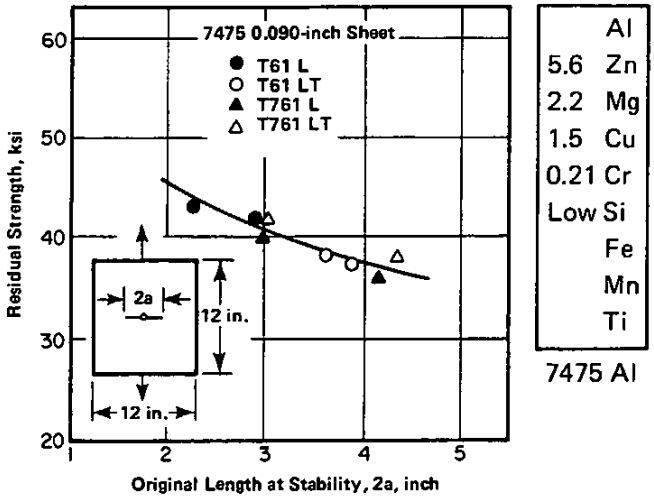


FIGURE 3.02712. RESIDUAL STRENGTH (GROSS AREA STRESS AT MAXIMUM LOAD) OF SHEET AS A FUNCTION OF CRACK LENGTH AT INSTABILITY (4)

Crack length at instability in this instance is the length of the crack, measured by a calibrated instrumented beam displacement gage, when the maximum load is reached. Beyond this point, crack growth accelerates, and fracture occurs with no increase in load.

Alloy		7475-T761				
Form		0.063-inch Alclad Sheet				
Orientation		Long Transverse				
F_{ty}, ksi	Panel Width (W), inch	Total Crack Length, inch: Initial ($2a_0$)	Total Crack Length, inch: Critical (2a)(a)	$\frac{2a_0}{W}$	Fracture Stress, ksi: Gross(b)	Fracture Stress, ksi: Net(c)
64	36	3.6	5.3	0.10	45.2	53.2
64	36	7.2	9.5	0.20	33.1	45.0
64	36	10.8	13.0	0.30	27.2	41.5
64	48	9.6	11.8	0.20	31.2	41.3
59	120	20.0	22.1	0.167	27.2	33.2
62	120	30.0	32.1	0.25	18.1	24.7

(a) Critical crack length is the length of the crack, measured optically to the nearest 0.1 inch, when the maximum load is reached. Beyond this point, crack growth accelerates and fracture occurs with no increase in load.
(b) Based on total uncracked cross sectional area of panel.
(c) Based on net cross sectional area of panel at section of critical crack.

TABLE 3.02713. FRACTURE STRENGTH OF CENTER CRACKED PANELS OF VARIOUS WIDTHS IN T761 CONDITION(5)

Alloy		7475-T61				
Form		Alclad Sheet				
Orientation		Long Transverse				
F_{ty}, ksi	Specimen, inch: Width (W)	Specimen, inch: Thickness	Original Crack Length ($2a_0$), inch	$\frac{2a_0}{W}$	Fracture Stress, ksi: Gross(a)	Fracture Stress, ksi: Net(b)
69.2	7.50	0.087	2.55	0.34	37.2	56.3
69.2	7.50	0.088	2.50	0.33	39.0	58.5
70.4	7.49	0.250	2.55	0.34	28.1	42.5
70.4	7.50	0.250	2.50	0.33	26.6	40.0
70.6	7.49	0.190	2.50	0.33	30.1	45.0
70.6	7.49	0.190	2.50	0.33	34.6	52.0

(a) Based on uncracked cross sectional area of specimen.
(b) Based on net cross sectional area of specimen at section of original crack.

TABLE 3.02714. FRACTURE STRENGTH OF CENTER CRACKED SPECIMENS OF VARIOUS THICKNESSES IN T61 CONDITION (6)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

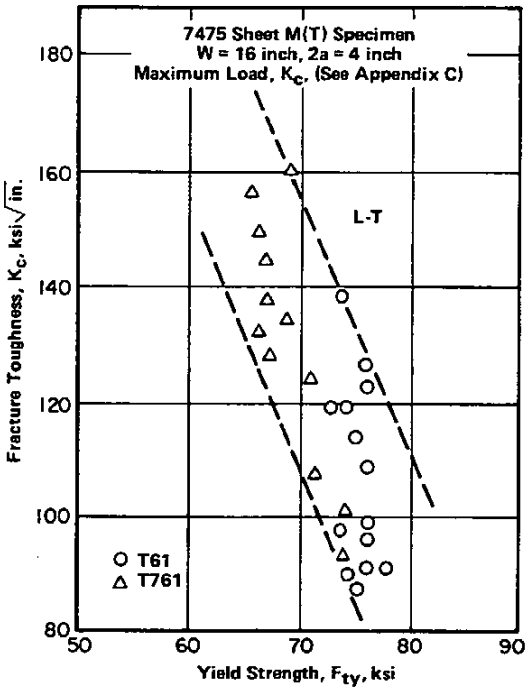


FIGURE 3.02715. PLANE STRESS FRACTURE TOUGHNESS K_C OF 7475-T61 AND -T761 SHEET RELATIVE TO TENSILE YIELD STRENGTH (23)

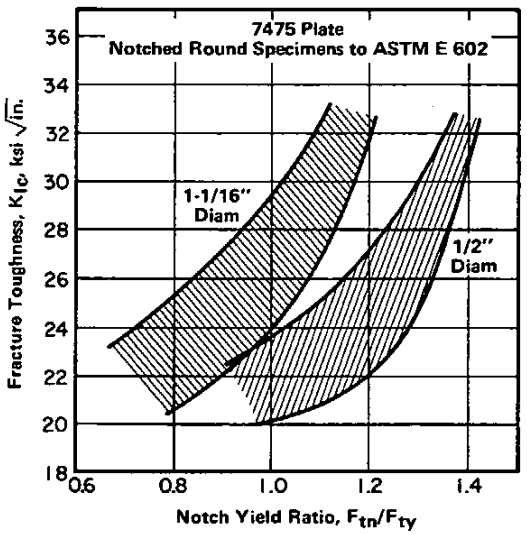


FIGURE 3.02716. CORRELATIONS BETWEEN NOTCHED TENSILE YIELD RATIO (NYR) AND K_{Ic} FOR 7075 AND 7475 PLATE IN T651, T7651, AND T7351 TEMPERS (31)

Alloy	7475-T7351			
Form	Plate			
Thickness, inch	Source	K_{Ic}, or meaningful K_Q[a], ksi$\sqrt{in.}$[b] L-T	T-L	S-L
1.5	10	38.0 (1.0)	28.8 (1.0)	24.3 (0.5)
	17	–	–	35.1 (0.5)
	30	–	–	38.5 (0.5)
1.75	15(c)	–	39.5 (1.75)	–
	26	47.5 (1.7)	–	–
2.0	39	52.7 (2.0)	40.5 (1.25)	–
2.25	15(c)	48.7 (2.25)	37.2 (2.25)	–
2.75	15(c)	48.4 (2.74)	37.7 (2.74)	33.3 (1.0)
	26	–	–	37.0 (1.0)
3.0	10	36.7 (1.25)	27.7 (1.25)	27.0 (1.0)
	26	44.8 (2.5)	34.2 (2.5)	32.6 (1.0)
3.5	15(c)	50.2 (3.0)	37.0 (3.0)	32.5 (1.25)
	26	49.0 (2.5)	33.7 (2.5)	33.4 (1.0)
4.0	15(c)	45.0 (3.0)	32.8 (2.0)	30.2 (1.5)

(a) According to ASTM B645.
(b) Figures in parentheses are the thickness of the ASTM E399 CT specimen, B (inch). See text section 1.093.
(c) Results are for "current practice" only, except for 4-inch plate from an earlier production practice.

TABLE 3.02721. PLANE STRAIN FRACTURE TOUGHNESS OF 7475-T7351 PLATE OF VARIOUS THICKNESSES (10,12,17,26,39)

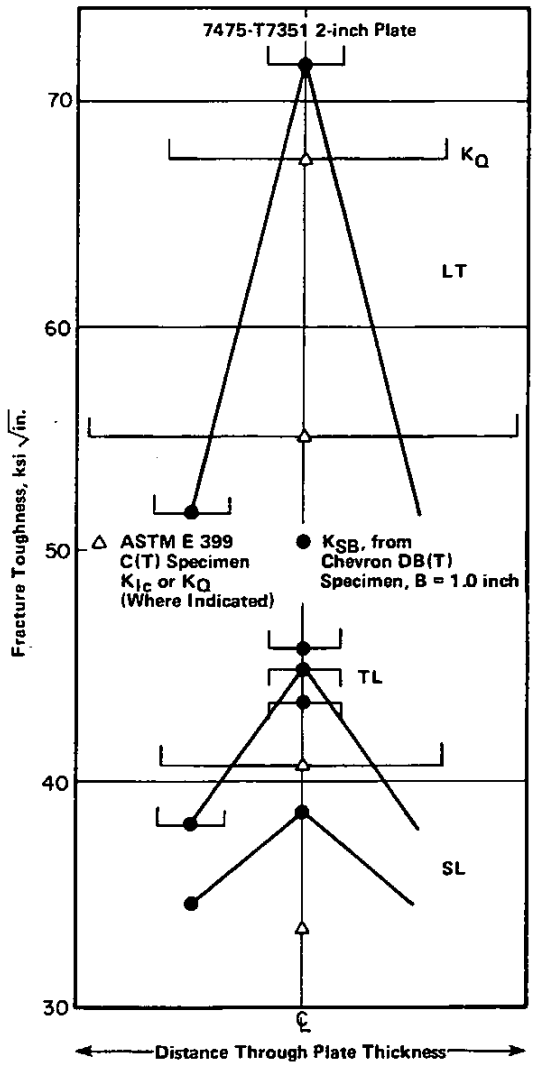


FIGURE 3.02722. TOUGHNESS VARIATIONS THROUGH THE THICKNESS OF 2-INCH THICK 7475-T7351 PLATE (26)

Length of horizontal bars denotes the thickness of material sampled by the toughness test specimen. According to AMS1704.

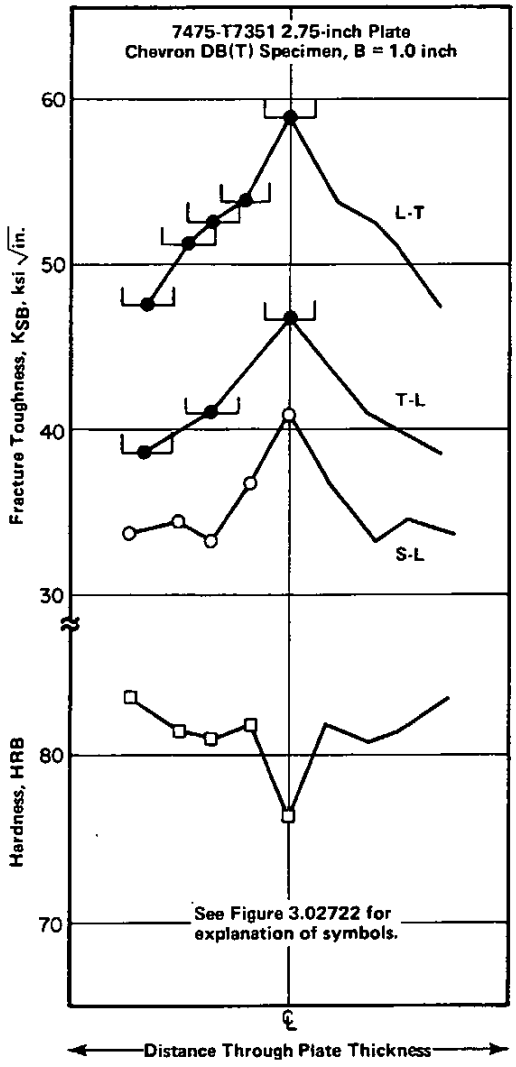


FIGURE 3.02723. TOUGHNESS VARIATIONS THROUGH THE THICKNESS OF 2.75-INCH THICK 7475-T7351 PLATE (39)

Al
5.6 Zn
2.2 Mg
1.5 Cu
0.21 Cr
Low Si
Fe
Mn
Ti

7475 Al

Alloy	7475-T7651
Form	1.5-inch Plate
Orientation	K_{Ic}, ksi √in.
L-T	49.2
T-L	44.2
S-L	38.3 (Invalid, K_Q)

TABLE 3.02724. PLANE STRAIN FRACTURE TOUGHNESS OF 1.5-INCH THICK 7475-T7651 PLATE (17)

Alloy	7075-T73511[a] and -T76511				
Form	1.5- x 4.5-inch Extrusions				
Purity	Fe, percent	Si, percent	Orientation	T73511 K_{Ic}, ksi √in.[b]	T76511 K_{Ic}, ksi √in.[b]
High	0.08	0.03	L-T	43.0	37.0
			T-L	30.0	26.0
Medium	0.19	0.10	L-T	30.6	35.0
			T-L	21.9	23.0
Low	0.26	0.14	L-T	27.3	26.0
			T-L	21.7	18.0

(a) These high purity samples are expected to behave similarly to 7475.
(b) Average of two tests.

TABLE 3.02725. EFFECT OF ALLOY PURITY ON THE PLANE STRAIN FRACTURE TOUGHNESS OF 7075-T73511 AND -T76511 EXTRUSIONS (19,20)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

Alloy	7475-T7351		
Form	1.75- to 4.0-inch Plate		
Orientation	L-T	T-L	S-L
Number of Tests	137	81	24
Average, K_{Ic}, ksi$\sqrt{in.}$	49.2	40.9	32.4
Standard Deviation, K_{Ic}, ksi$\sqrt{in.}$	4.5	3.9	1.4
Skewness Coefficient	+0.2	+0.8	-0.4
Actual Minimum Value, K_{Ic}, ksi$\sqrt{in.}$	39.5	34.9	28.0
A Value[a], K_{Ic}, ksi$\sqrt{in.}$	37.4-38.1	30.2-32.9	27.9-27.5
B Value, K_{Ic}, ksi$\sqrt{in.}$	42.5-42.6	34.8-35.3	29.8-29.7
C Value, K_{Ic}, ksi$\sqrt{in.}$	–	–	28.7
D Value, K_{Ic}, ksi$\sqrt{in.}$	–	–	30.3

(a) The lower limit is based on normal distribution and the upper limit is based on Pearson's Type III function (using skewness) – the upper limit is believed to be more realistic.

TABLE 3.02726. PLANE STRAIN FRACTURE TOUGHNESS, K_{Ic}, OF 7475-T7351 PLATE PRODUCED FROM JANUARY 1976 TO AUGUST 1978 BY TWO U.S. PRODUCERS (31)

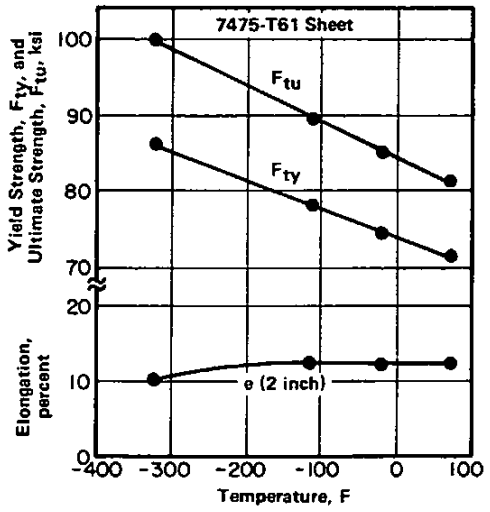


FIGURE 3.031211. EFFECT OF LOW TEMPERATURES ON TENSILE PROPERTIES OF SHEET IN T61 CONDITION (1)

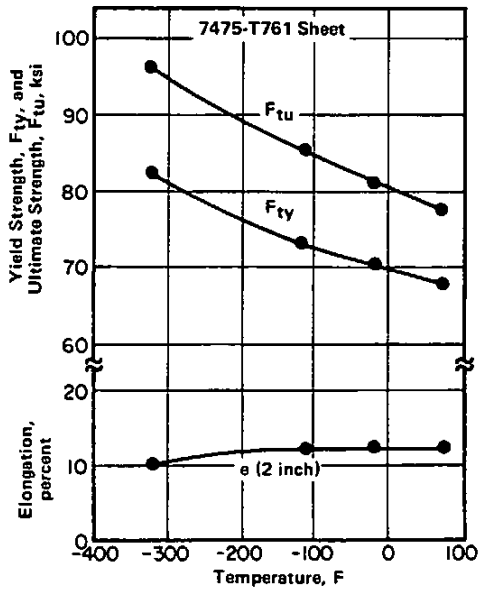


FIGURE 3.031212. EFFECT OF LOW TEMPERATURES ON TENSILE PROPERTIES OF SHEET IN T761 CONDITION (1)

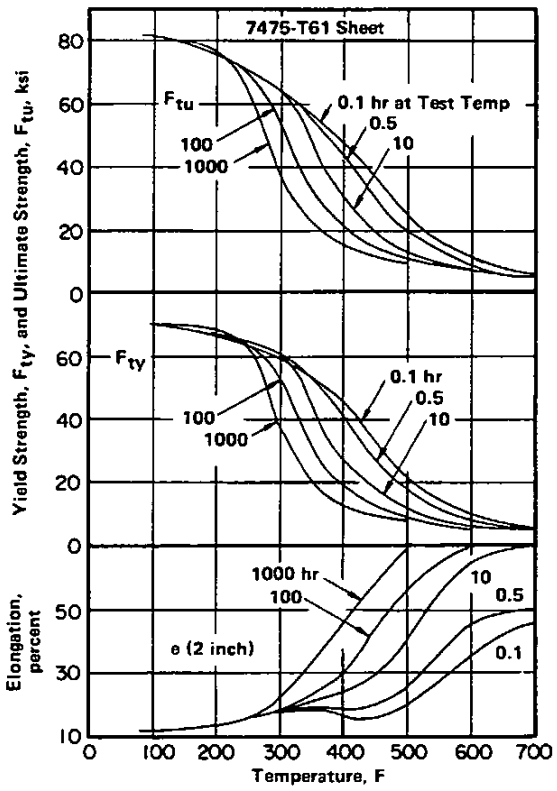


FIGURE 3.031213. EFFECT OF ELEVATED TEMPERATURES, AFTER VARIOUS HOLDING TIMES AT TEMPERATURE, ON TENSILE PROPERTIES OF SHEET IN T61 CONDITION (1)

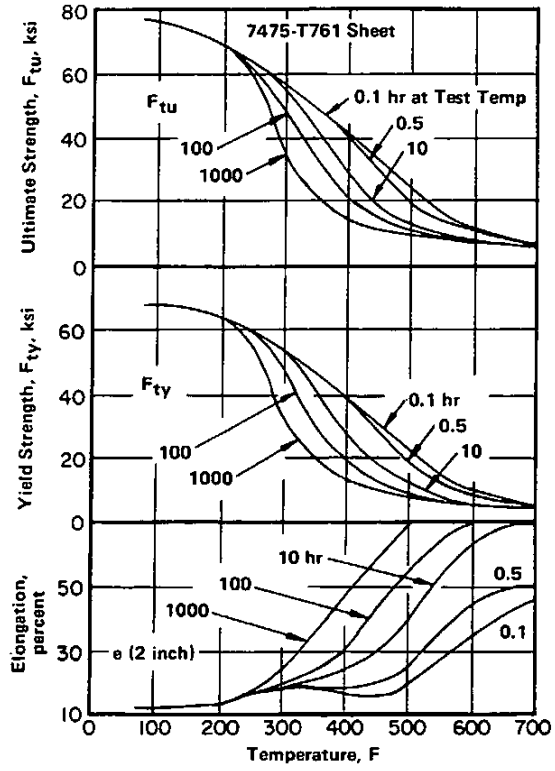


FIGURE 3.031214. EFFECT OF ELEVATED TEMPERATURES AFTER VARIOUS HOLDING TIMES AT TEMPERATURE, ON TENSILE PROPERTIES OF SHEET IN T761 CONDITION (1)

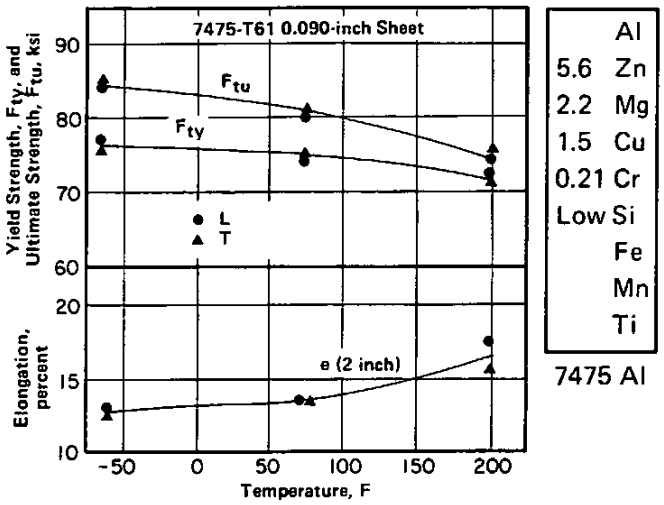


FIGURE 3.031215. TENSILE PROPERTIES OF LONGITUDINAL AND TRANSVERSE SHEET SPECIMENS IN T61 CONDITION FROM -50 TO 200 F (9)

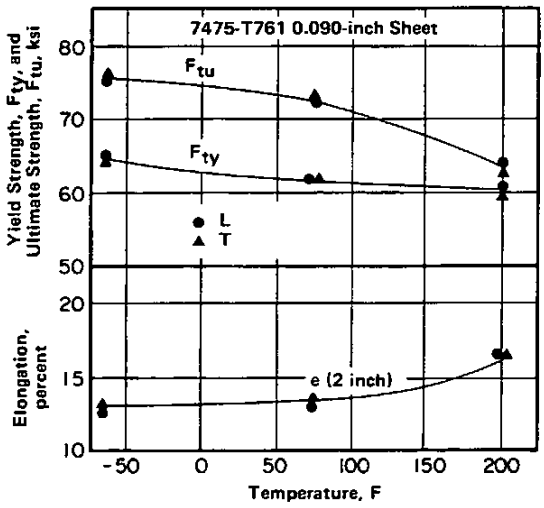


FIGURE 3.031216. TENSILE PROPERTIES OF LONGITUDINAL AND TRANSVERSE SHEET SPECIMENS IN T761 CONDITION FROM -50 TO 200 F (9)

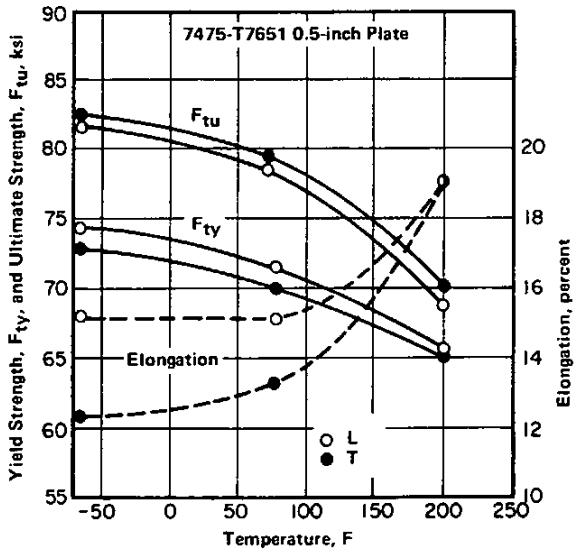


FIGURE 3.031221. TENSILE PROPERTIES OF LONGITUDINAL AND TRANSVERSE PLATE SPECIMENS IN T7651 CONDITION IN THE TEMPERATURE RANGE -65 F TO +200 F (29)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

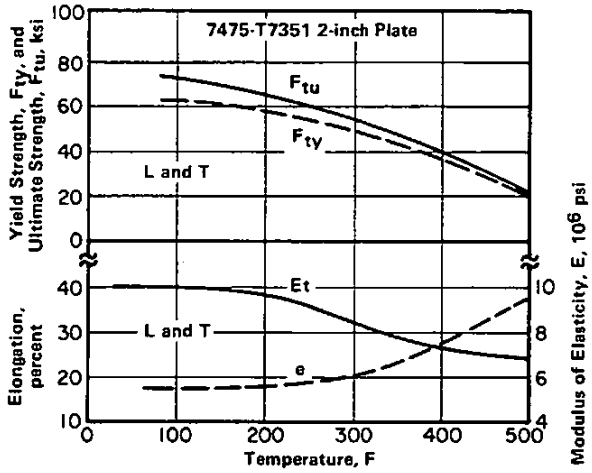


FIGURE 3.031222. TENSILE PROPERTIES OF LONGITUDINAL AND TRANSVERSE PLATE SPECIMENS IN T7351 CONDITION AT ELEVATED TEMPERATURES (14)

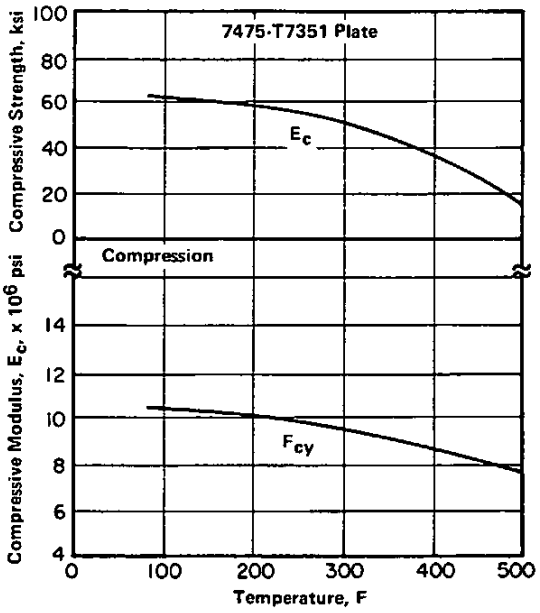


FIGURE 3.0322. COMPRESSIVE YIELD STRENGTH AND ELASTIC MODULUS AS A FUNCTION OF TEMPERATURE (14)

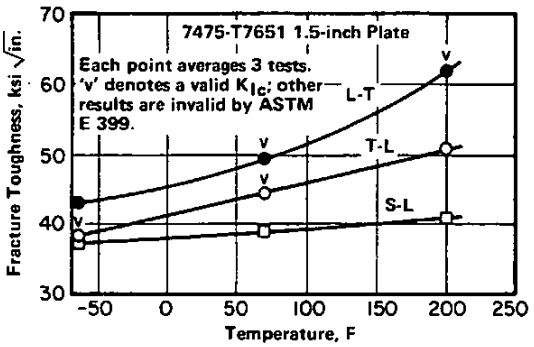


FIGURE 3.03721. PLANE STRAIN FRACTURE TOUGHNESS AS A FUNCTION OF TEMPERATURE FOR T7651 PLATE (29)

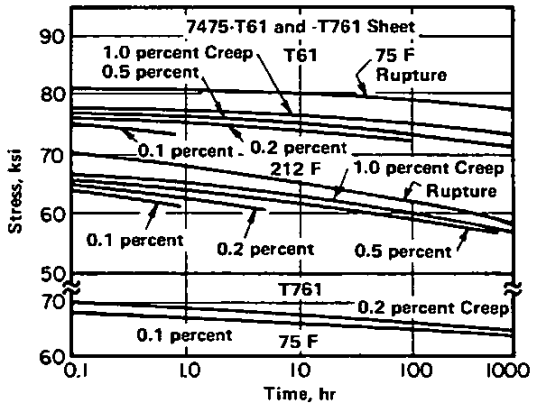


FIGURE 3.0411. CREEP AND CREEP-RUPTURE CURVES FOR T761 AND T61 SHEET AT 75 F AND 212 F (1)

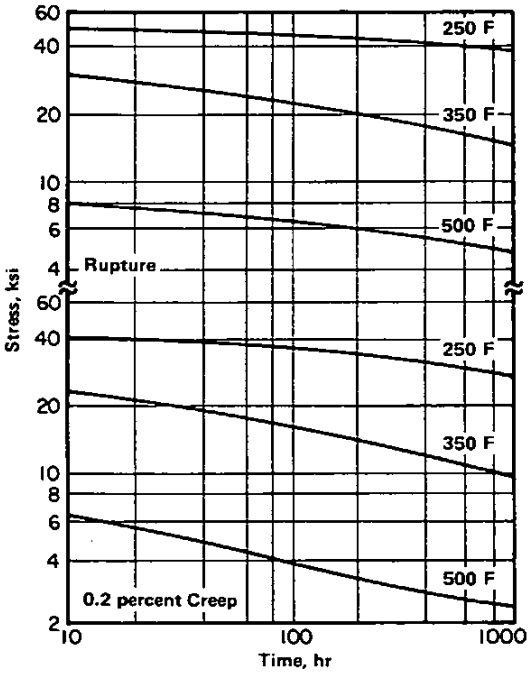


FIGURE 3.0421. CREEP-RUPTURE AND CREEP DEFORMATION CURVES FOR T7351 PLATE AT 250 F, 350 F, AND 500 F (14)

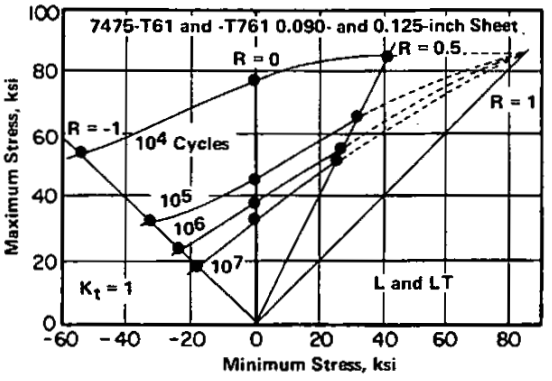
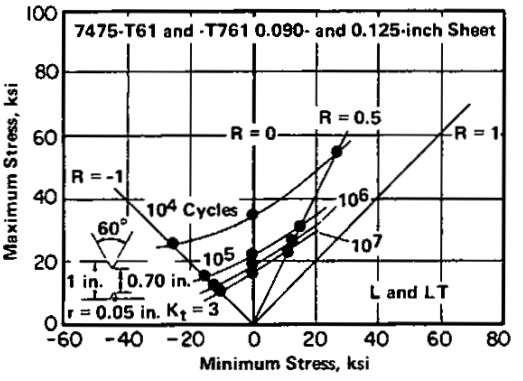


FIGURE 3.0511. CONSTANT FATIGUE LIFE DIAGRAM FOR SMOOTH, AXIALLY LOADED SHEET SPECIMENS (1)



	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

FIGURE 3.0512. CONSTANT FATIGUE LIFE DIAGRAM FOR NOTCHED, AXIALLY LOADED SHEET SPECIMENS (1)

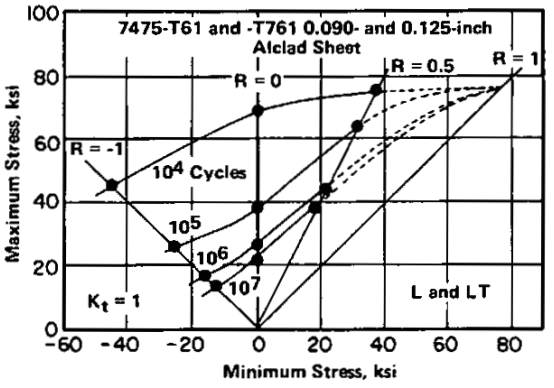


FIGURE 3.0513. CONSTANT FATIGUE LIFE DIAGRAM FOR SMOOTH, AXIALLY LOADED ALCLAD SHEET SPECIMENS (1)

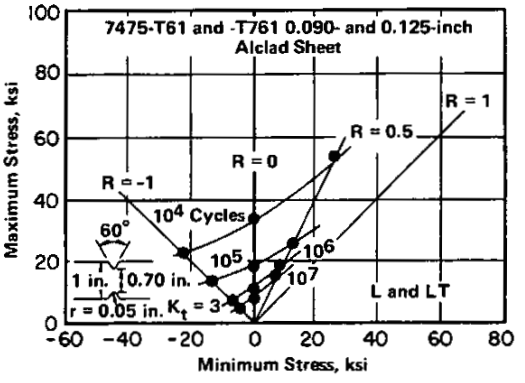


FIGURE 3.0514. CONSTANT FATIGUE LIFE DIAGRAM FOR NOTCHED, AXIALLY LOADED ALCLAD SHEET SPECIMENS (1)

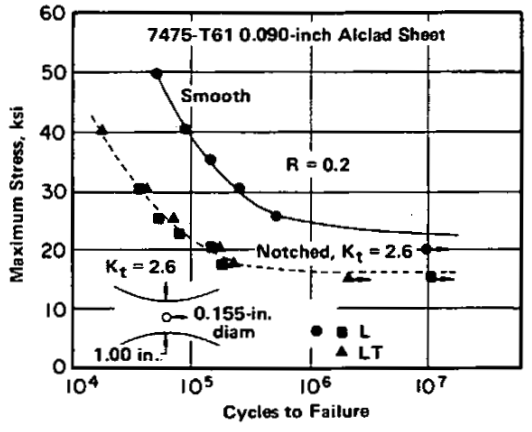


FIGURE 3.0515. AXIAL FATIGUE LIFE OF SMOOTH AND NOTCHED SPECIMENS OF 0.090-INCH ALCLAD SHEET (6)

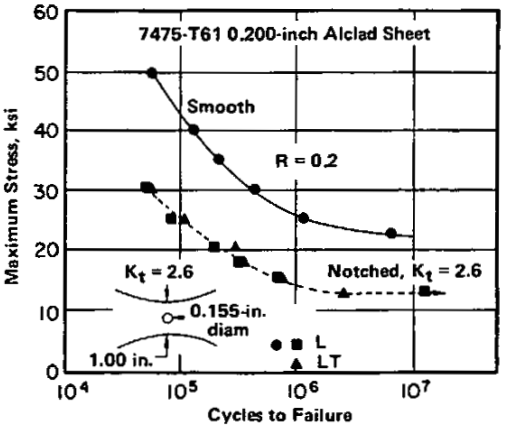


FIGURE 3.0516. AXIAL FATIGUE LIFE OF SMOOTH AND NOTCHED SPECIMENS OF 0.200-INCH ALCLAD SHEET (6)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

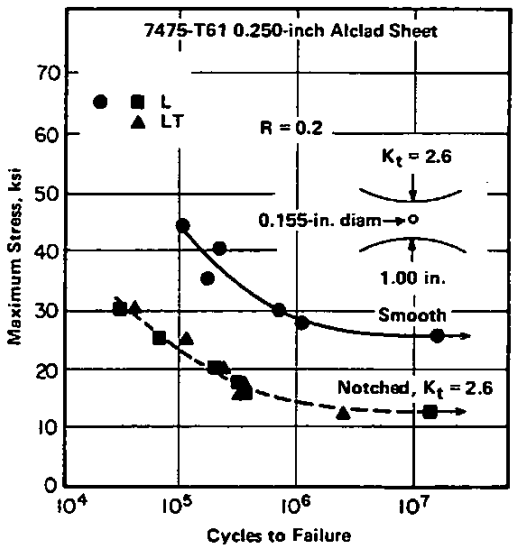


FIGURE 3.0517. AXIAL FATIGUE LIFE OF SMOOTH AND NOTCHED SPECIMENS OF 0.250-INCH ALCLAD SHEET (6)

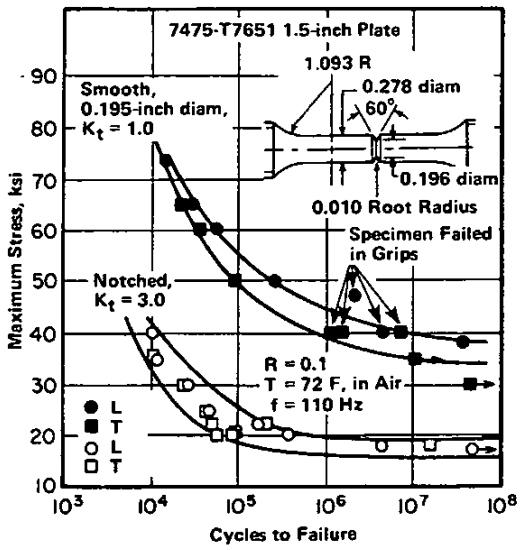


FIGURE 3.0518. AXIAL FATIGUE LIFE OF SMOOTH AND NOTCHED LONGITUDINAL AND TRANSVERSE SPECIMENS OF 1.5-INCH THICK 7475 T7651 PLATE (7)

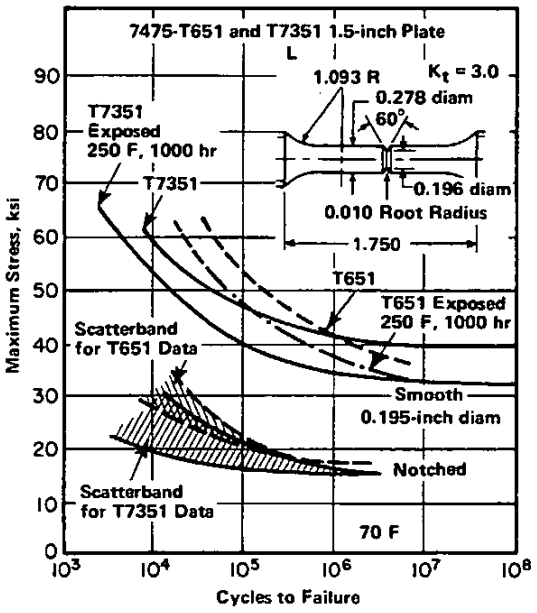


FIGURE 3.0519. AXIAL LOAD FATIGUE LIVES OF LONGITUDINAL AND TRANSVERSE SMOOTH AND NOTCHED SPECIMENS OF 7475-T7351 AND -T651 PLATE (29)

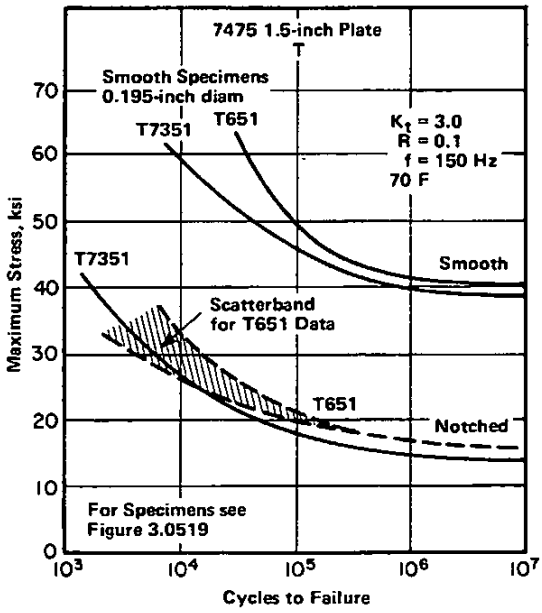


FIGURE 3.05110. AXIAL LOAD FATIGUE LIVES OF TRANSVERSE SMOOTH AND NOTCHED SPECIMENS OF 7475-T7351 AND 7475-T651 PLATE 1.5-INCH THICK (29)

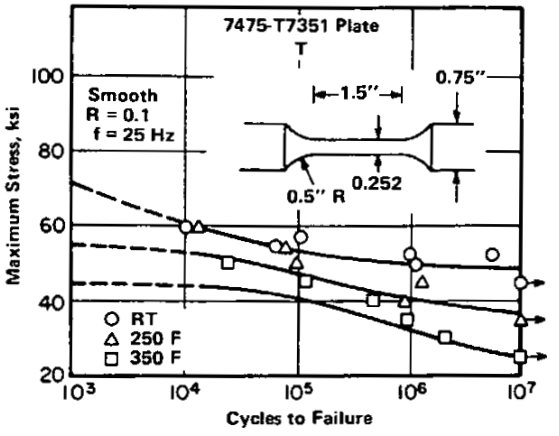


FIGURE 3.05111. AXIAL STRESS FATIGUE LIFE OF 7475-T7351 PLATE IN THE TRANSVERSE DIRECTION (14)

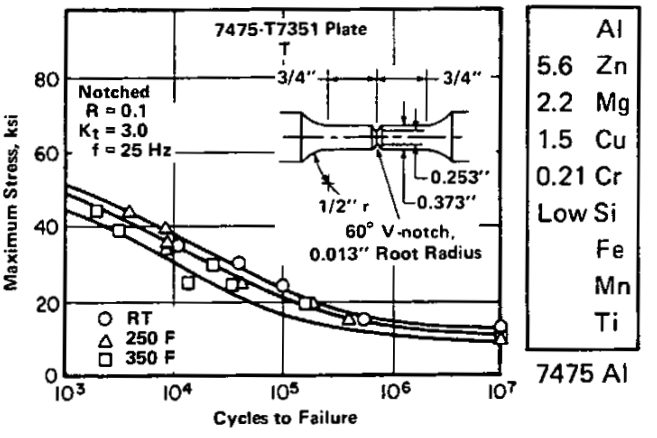


FIGURE 3.05112. AXIAL STRESS FATIGUE LIFE OF NOTCHED SPECIMENS OF 7475-T7351 PLATE IN THE TRANSVERSE DIRECTION AT ELEVATED TEMPERATURE (11)

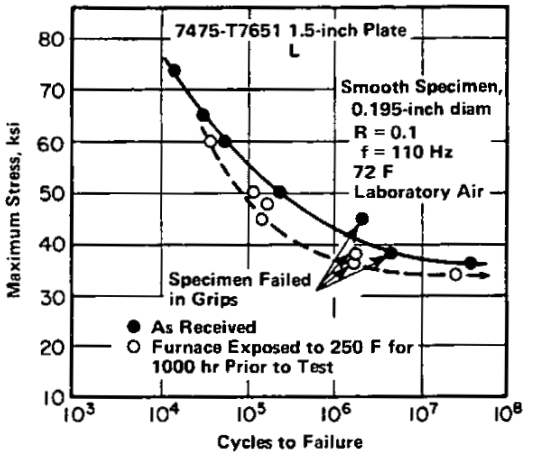


FIGURE 3.05113. AXIAL STRESS FATIGUE LIFE OF SPECIMEN 7475-T7651 PLATE (17)

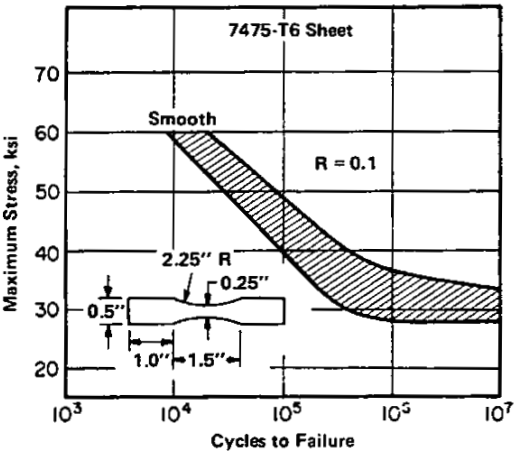


FIGURE 3.05114. AXIAL FATIGUE LIFE OF SMOOTH SPECIMENS OF 7475 T6 SUPERPLASTICALLY STRAINED SHEET (30)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

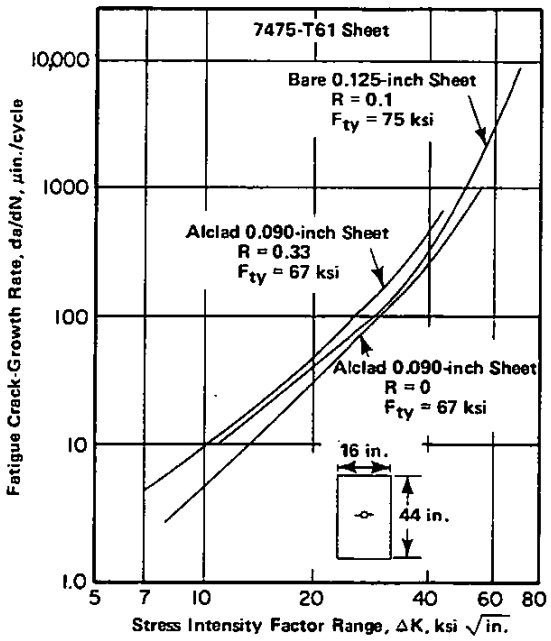


FIGURE 3.0521. FATIGUE CRACK-GROWTH RATE OF BARE AND ALCLAD SHEET (1,3)

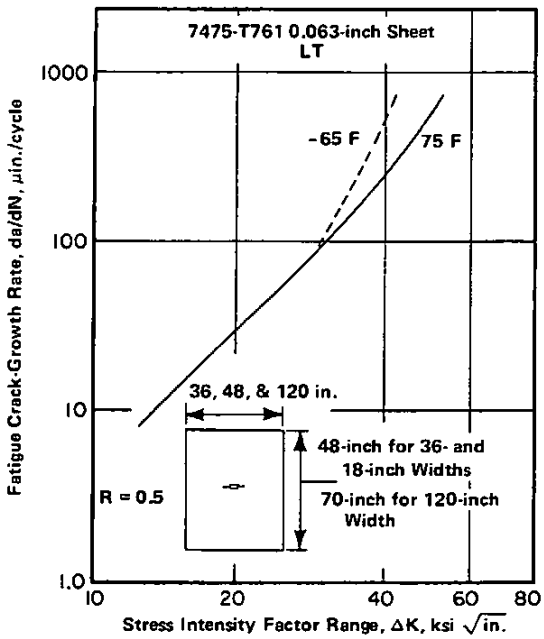


FIGURE 3.0522. FATIGUE CRACK-GROWTH RATE OF ALCLAD SHEET PANELS OF VARIOUS SIZES AT 75 F AND -65 F (5)

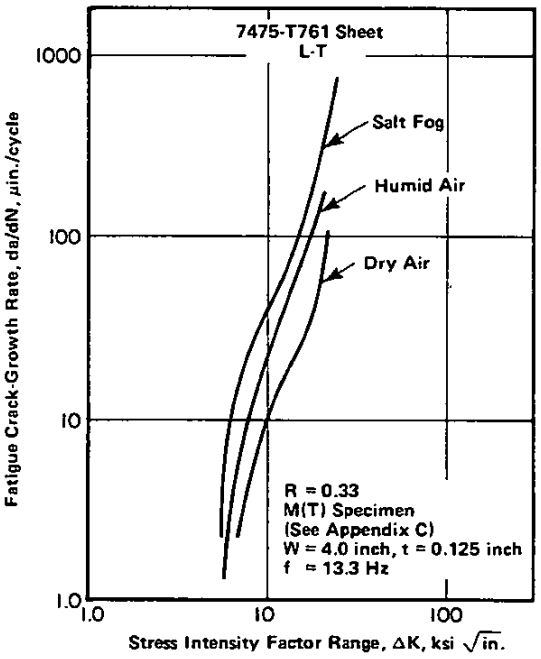


FIGURE 3.0523. FATIGUE CRACK-GROWTH RATES FOR 0.125-INCH THICK SPECIMENS OF 7475-T761 SHEET IN LT ORIENTATION – CONSTANT LOAD TESTS (11)

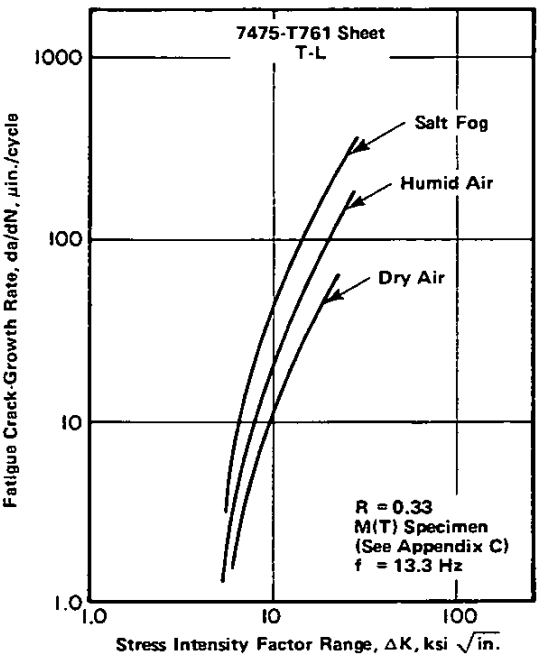


FIGURE 3.0524. FATIGUE CRACK-GROWTH RATES FOR 0.125-INCH THICK SPECIMENS OF 7475-T761 SHEET IN TL ORIENTATION – CONSTANT LOAD TESTS (11)

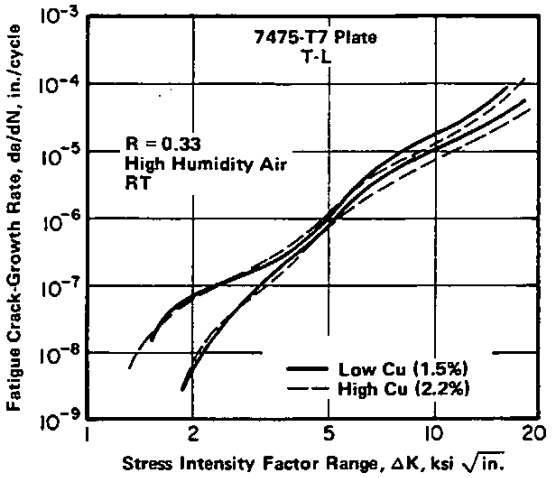


FIGURE 3.0525. FATIGUE CRACK-GROWTH RATES FOR HIGH AND LOW CONTENT COPPER 7475-T7 PLATE (40)

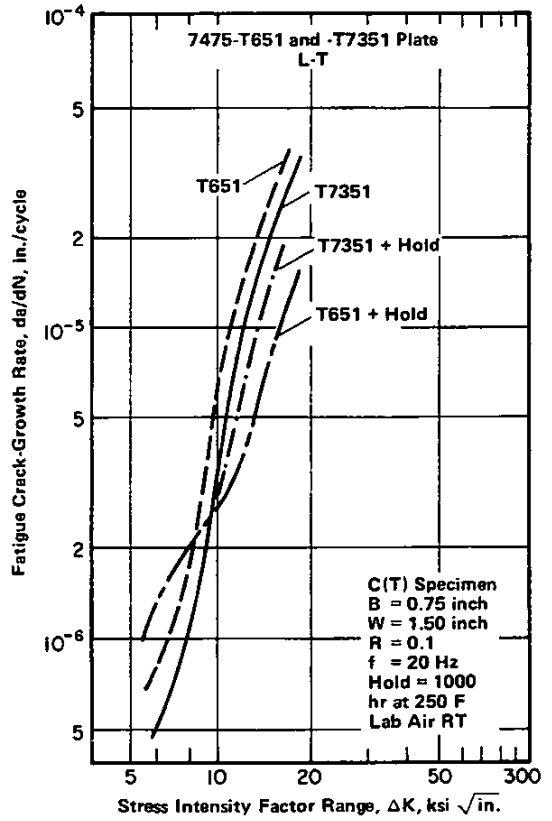


FIGURE 3.0527. FATIGUE CRACK-GROWTH RATES OF 7475-T651 AND -T7351 PLATE (29) (FIGURE 13 AND 14)

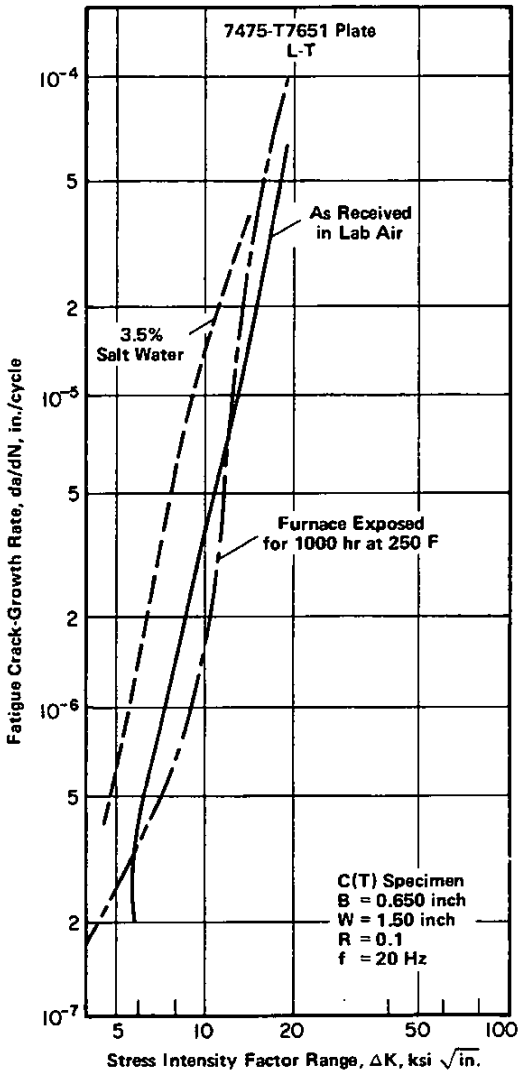


FIGURE 3.0526. FATIGUE CRACK-GROWTH RATES FOR 1.5-INCH THICK SPECIMENS OF 7475-T7651 PLATE IN AIR AND 3.5 PERCENT SALT WATER (17)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

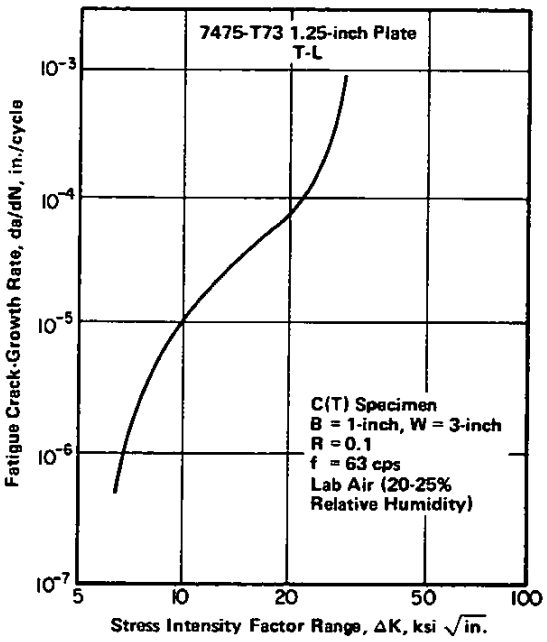


FIGURE 3.0528. FATIGUE CRACK-GROWTH RATES FOR 1.25-INCH THICK SPECIMENS OF 7475-T73 PLATE (10)

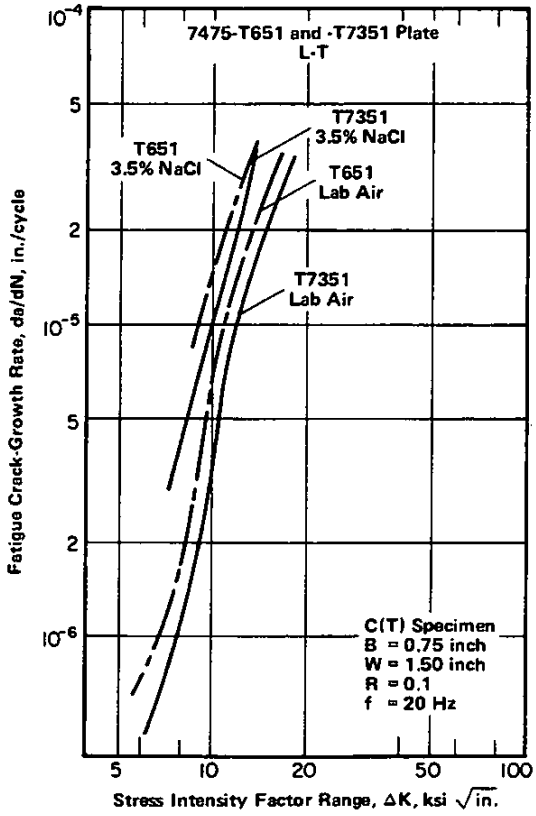


FIGURE 3.0529. FATIGUE CRACK-GROWTH RATES OF 7475-T7351 AND -T651 PLATE IN AIR AND 3.5 PERCENT NaCl SOLUTION (29)

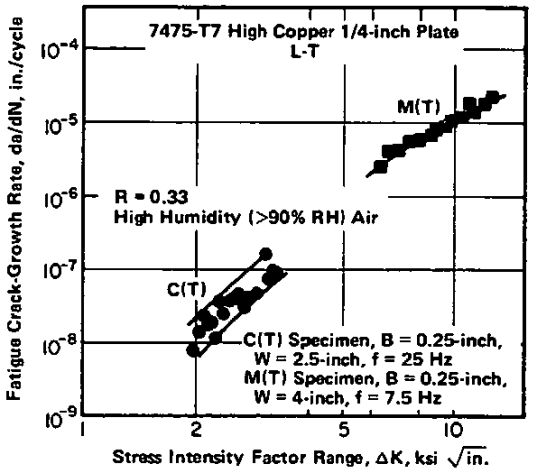


FIGURE 3.05210. FATIGUE CRACK-GROWTH RATES FOR 7475-T7 0.25-INCH THICK PLATE CONTAINING A HIGH (2.2 PERCENT) COPPER CONTENT (40)

	Al
5.6	Zn
2.2	Mg
1.5	Cu
0.21	Cr
Low	Si
	Fe
	Mn
	Ti

7475 Al

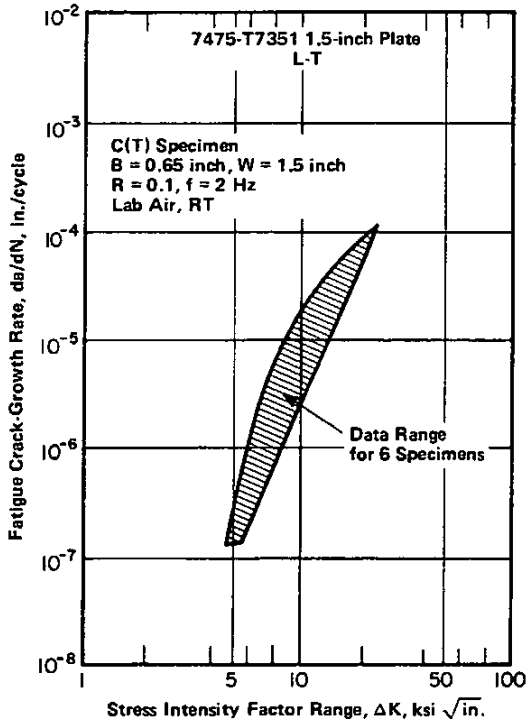


FIGURE 3.05211. FATIGUE CRACK-GROWTH FOR 1.5-INCH THICK SPECIMEN OF 7475-T7351 PLATE IN AIR (28)

Alloy	7475-T61 and -T761		
Form	Sheet		
		Modulus of Elasticity, E, x 10^6 psi	
Orientation	Stress	T61	T761
Longitudinal	Tensile	10.03	10.09
	Compressive	10.46	10.47
Transverse	Tensile	10.03	10.04
	Compressive	10.53	10.53

TABLE 3.0621. TENSILE AND COMPRESSIVE ELASTIC MODULII OF 7475-T61 AND -T761 SHEET (11)