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MECHANICAL-PROPERTY DATA
7007 ALUMINUM

Plate (-T6E136)

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Materials Application Review
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7007-T6E136

7007 has been developed over the past 3 years by ALCOA under Contract NAS 8-5452. It shows promise as a tough, readily weldable aluminum alloy and could possibly replace the alloy 2219, which is currently used in space vehicles. Further development work is planned, particularly concerned with the effort to improve the weld properties of this alloy.

The -T6E136 treatment was selected to provide the optimum combination of strength and notch toughness.

The nominal composition of 7007 is as follows: 0.10 Cu, 0.2 Mn, 1.8 Mg, 0.12 Cr, 6.5 Zn, 0.04 Ti, 0.12 Zr, and 0.40 max Si + Fe.

7007 Data(a)

Condition: -T6E136
 Thickness: 0.250-Inch Plate

Properties	Temperature, F			
	-320	-105	RT	300
<u>Tension</u>				
F _{tu} (longitudinal), ksi	98.1	83.3	72.9	51.2
F _{tu} (transverse), ksi	90.2	78.4	69.1	50.1
F _{ty} (longitudinal), ksi	83.8	73.2	68.8	49.4
F _{ty} (transverse), ksi	77.5	70.1	65.2	49.5
e _t (longitudinal), percent in 2 in.	16.0	13.7	14.0	20.2
e _t (transverse), percent in 2 in.	13.8	13.2	15.8	20.7
E _t (longitudinal), 10 ⁶ psi	10.8	10.7	10.1	9.7
E _t (transverse), 10 ⁶ psi	10.8	11.1	10.0	9.3
<u>Compression</u>				
F _{cy} (longitudinal), ksi	119.0	119.7	111.2	95.4
F _{cy} (transverse), ksi	119.0	119.0	111.2	103.2
E _c (longitudinal), 10 ⁶ psi	12.1	11.7	10.8	10.6
E _c (transverse), 10 ⁶ psi	12.2	11.9	11.0	10.6
<u>Shear^(b)</u>				
F _{su} (longitudinal), ksi	U ^(c)	U	46.2	U
F _{su} (transverse), ksi	U	U	44.7	U
<u>Impact (Charpy V-notch), ft-lb</u>	U	3.6	4.2	U
<u>Fracture Toughness, K_{Ic}, ksi √in.</u>	U	U	No pop-in ^(d)	U

Properties	Temperature, F			
	-320	-105	RT	300
Axial Fatigue (transverse)(e)				
Unnotched, R = 0.1				
10 ³ cycles, ksi	95	U	73	59
10 ⁵ cycles, ksi	82	U	53	45
10 ⁷ cycles, ksi	72	U	39	27
Notched (K _t = 3.0), R = 0.1				
10 ³ cycles, ksi	65	U	52	50
10 ⁵ cycles, ksi	31	U	20	17
10 ⁷ cycles, ksi	20	U	16	11
	Temperature, F			
	RT	300	500	
Creep (transverse)				
0.2% plastic deformation 100 hr, ksi	NA(c)	18.2	2.9	
0.2% plastic deformation 1000 hr, ksi	NA	11.3	1.9	
Stress Rupture (transverse)				
Rupture 100 hr, ksi	NA	27.5	5.3	
Rupture 1000 hr, ksi	NA	19.6	3.6	
Stress Corrosion				
80% F _{ty} , 1000 hr max.	No cracks(f)	U	U	
Coefficient of Thermal Expansion(g)				
12.2 x 10 ⁻⁶ in./in./F (68-212 F)				
13.8 x 10 ⁻⁶ in./in./F (68-392 F)				
Density(g) 0.101 lb/in.³				

(e) Data are average of triplicate tests conducted at Battelle under the subject contract unless otherwise indicated. Fatigue, creep, and stress-rupture values are from data curves generated using the results of a greater number of tests.

(b) Single shear sheet type specimens, full thickness.

(c) U = unavaliable; NA = not applicable.

(d) Fatigue-cracked single-edge-notched specimens (1/4 x 3 x 12 in.) tested in tension. No pop-in detected. Load-strain curves were analyzed by the secant offset method as outlined in ASTM 410 and proved to be invalid tests.

(e) "R" represents the algebraic ratio of minimum to maximum stress in one cycle; that is, $R = \frac{\sigma_{min}}{\sigma_{max}}$. "K_t" represents the Neuber-Peterson theoretical stress-concentration factor.

(f) Three-point bend test. Alternate immersion 3-1/2 percent NaCl. No cracks appeared.

(g) Values from Reference (1).

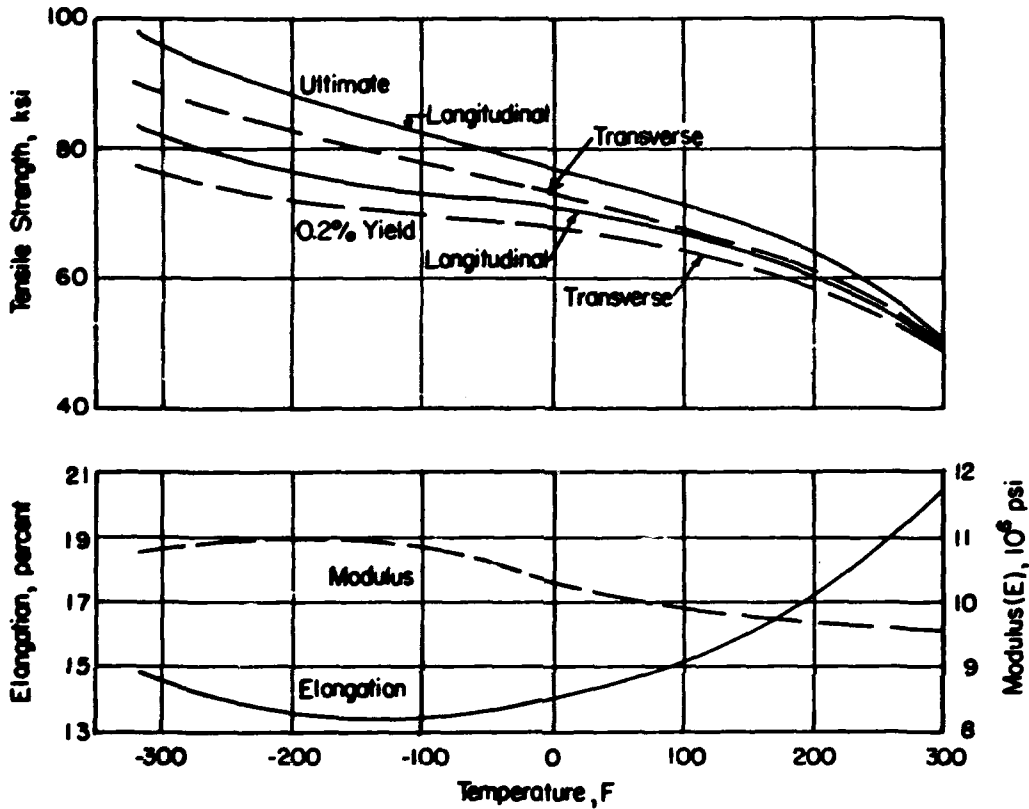


FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF 7007-T6E136 ALUMINUM ALLOY PLATE

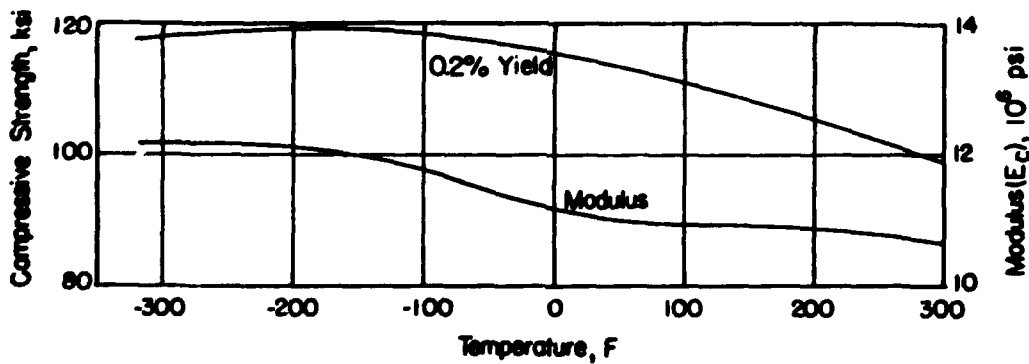


FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSIVE PROPERTIES OF 7007-T6E136 ALUMINUM ALLOY PLATE

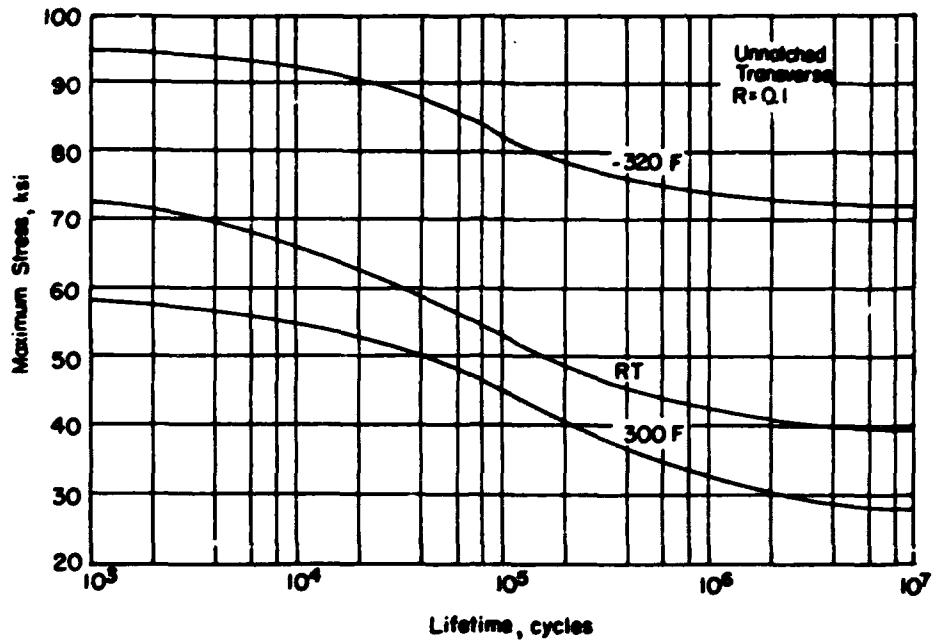


FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR UNNOTCHED 7007-T6E136 ALUMINUM PLATE AT THREE TEMPERATURES

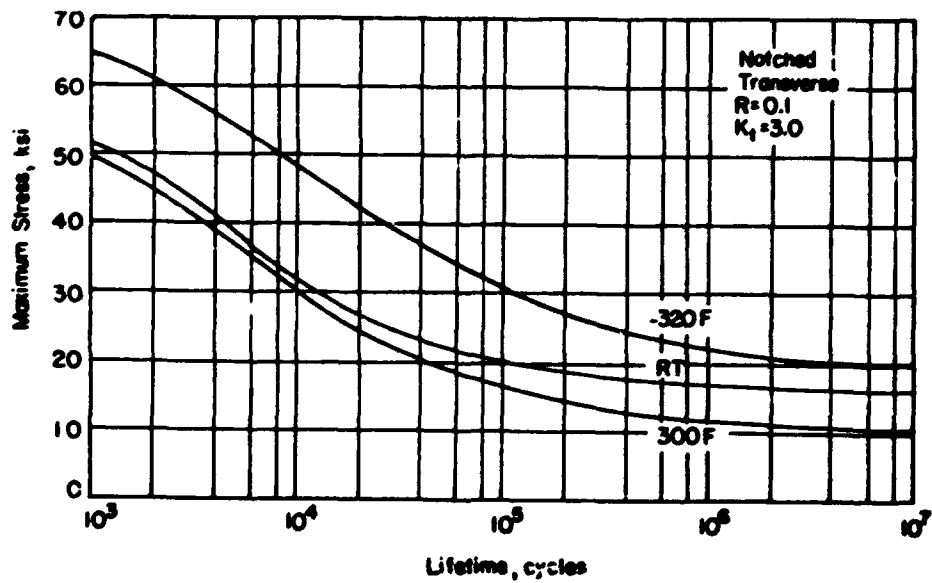


FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED ($K_t = 3.0$) 7007-T6E136 ALUMINUM PLATE AT THREE TEMPERATURES

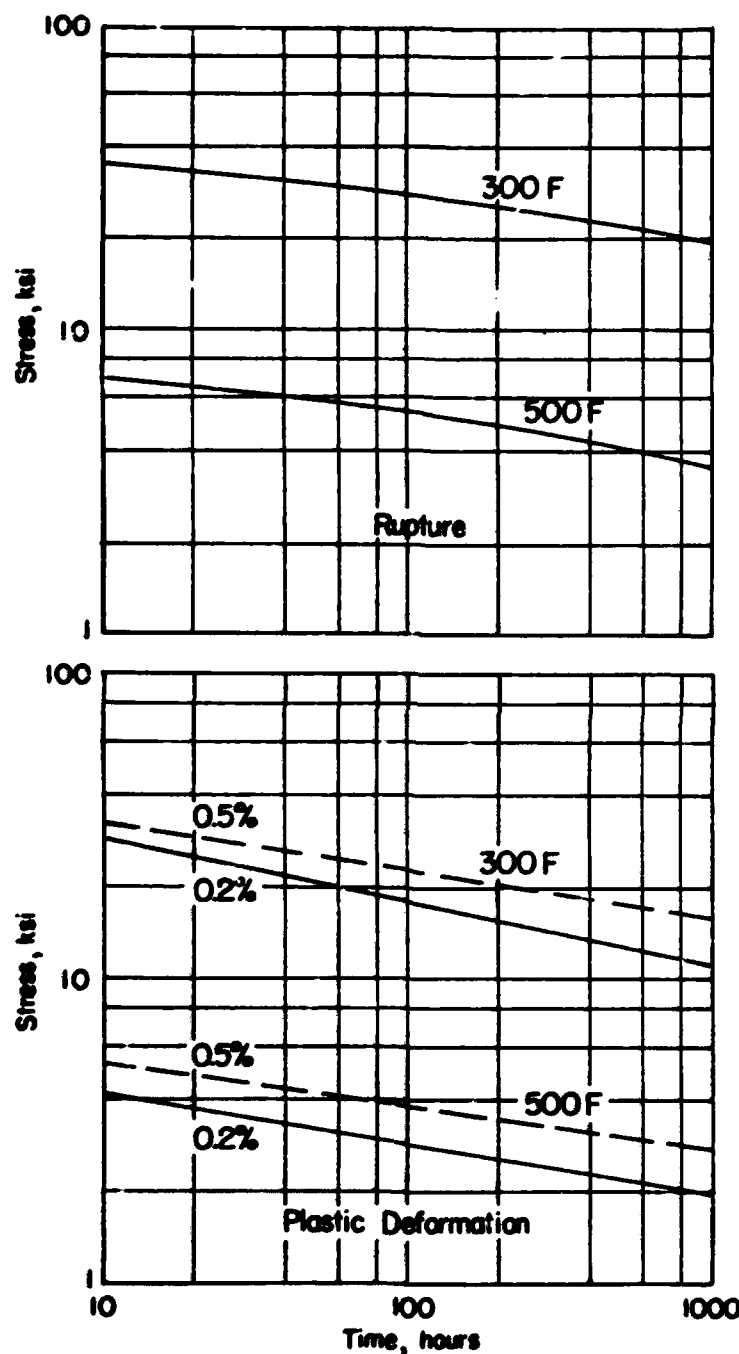


FIGURE 5. STRESS-RUPTURE AND PLASTIC DEFORMATION CURVES FOR 7007-T6E136 ALUMINUM ALLOY PLATE

REFERENCES

- (1) Private communication with ALCOA.
- (2) Westerlund, R. W. , and Rogers, R. W. , Jr. , "Development of a High-Strength Aluminum Alloy, Readily Weldable in Plate Thicknesses, and Suitable for Application at -423 F (-253 C)". Contract NAS 8-5452, Alcoa Research Laboratories (numerous progress reports and annual report dated April 4, 1967).