MECHANICAL-PROPERTY DATA
2021 ALUMINUM

Plate (-T8E31)

Issued by

Air Force Materials Laboratory
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Wright-Patterson Air Force Base, Ohio

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Prepared by

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This data sheet was prepared by Battelle Memorial Institute under Contract AF 33 (615)-2494. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Design Information Development". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of mechanical data. The program was assigned to the Structural Materials Engineering Division at Battelle under the supervision of Mr. Walter S. Hyler. Project engineer was Mr. Omar Deel. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Marvin Knight, project engineer.

Notices

2021 Aluminum

2021 is a newly developed, weldable, high-strength aluminum alloy. It has been developed as a candidate material for cryogenic structure and tankage applications with particular reference to the requirements of liquid-propellant space boosters. Preliminary studies have shown that this alloy is suitable for fabrication in plate thicknesses and compares favorably with other high-strength aluminum alloys in resistance to corrosion and stress-corrosion cracking.

2021 is not yet commercially available.

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(5 pp) (5 fig.) (1 tbls.) (0 ret.)

2021 Data[a]

Condition: -T8E31
Thickness: 0.250 in. Plate

Properties	Temperature, F -320	-105	RT	300
Tension				
F_{tu} (longitudinal), ksi	85.4	74.3	69.7	55.9
F_{tu} (transverse), ksi	88.6	77.1	73.5	56.8
F_{ty} (longitudinal), ksi	71.0	60.5	58.2	51.6
F_{ty} (transverse), ksi	71.2	59.8	59.5	51.5
e_t (longitudinal) percent in 2 in.	13.8	17.2	14.8	13.5
e_t (transverse), percent in 2 in.	11.0	11.5	10.8	12.0
E_t (longitudinal), 10^6 psi	11.6	11.3	10.1	9.0
E_t (transverse), 10^6 psi	11.7	10.8	10.4	9.5
Compression				
F_{cy} (longidutinal), ksi	74.2	63.1	62.3	56.4
F_{cy} (transverse), ksi	77.3	65.4	63.7	57.6
E_c (longitudinal), 10^6 psi	12.3	11.7	11.0	10.0
E_c (transverse), 10^6 psi	12.2	11.6	11.2	10.2
Shear[b]				
F_{su} (transverse), ksi	U[c]	U	45.0	U
F_{su} (transverse), ksi	U	U	46.8	U
Impact (V-notch Charpy)	U	U	U	U
Fracture Toughness, K_{Ic}, ksi $\sqrt{in.}$	U	U	No pop-in[d]	U
Axial Fatigue (transverse)[e]				
Unnotched, R = 0.1				
10^3 cycles, ksi	94	U	80	68
10^5 cycles, ksi	80	U	60	48
10^7 cycles, ksi	59	U	39	20

Properties	Temperature, F			
	-320	-105	RT	300
Notched (K_t = 3.0), R = 0.1				
10^3 cycles, ksi	75	U	57	46
10^5 cycles, ksi	33	U	25	19
10^7 cycles, ksi	20	U	15	11

	Temperature, F		
	RT	300 F	500 F
Creep (transverse)			
0.2% elongation, 100 hr, ksi	NA(c)	33	7.7
0.2% elongation, 1000 hr, ksi	NA	27	5.0
Stress Rupture (transverse)			
Rupture 100 hr, ksi	NA	36	10.4
Rupture 1000 hr, ksi	NA	29	5.5
Stress Corrosion			
80% F_{ty}, 1000 hr max.	Failed(f)	U	U

Coefficient of Thermal Expansion

13.2×10^{-6} in./in./F (68-212 F)(g)

Density 0.101 lb/in.^{3}(g)

(a) 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 specimen, full thickness.

(c) U, unavailable; NA, not applicable.

(d) Fatigue-cracked single-edge-notched specimen (1/4" x 3" 12") tested in tension. No pop-in detected.

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

(f) Three-point bend test. Alternate immersion 3-1/2% NaCl. All specimens failed. First signs of cracking appeared within 24 hours. Elapsed time between first signs of cracking and failure was 4 days.

(g) Values from private communication with ALCOA.

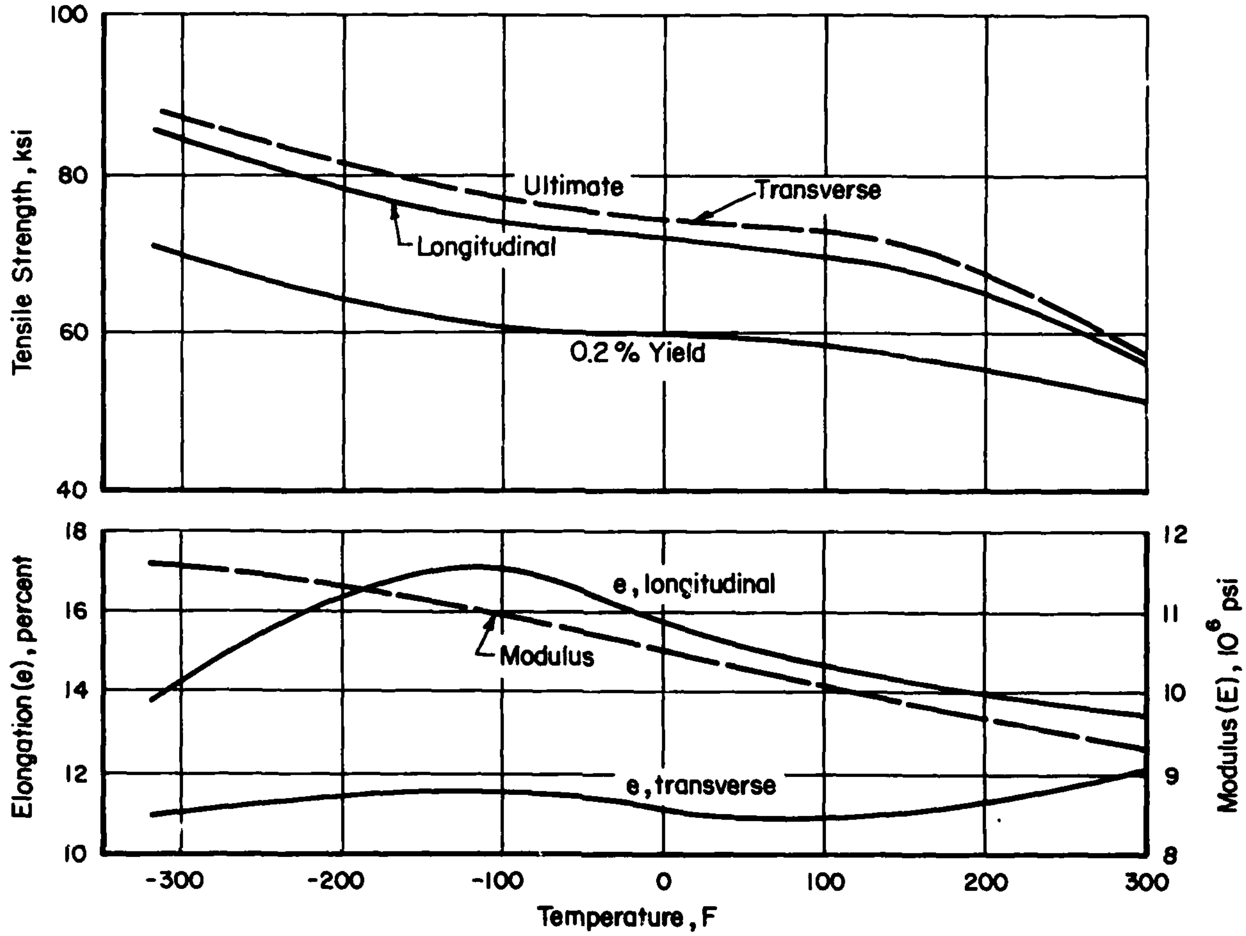

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF 2021-T8E31 ALUMINUM ALLOY PLATE

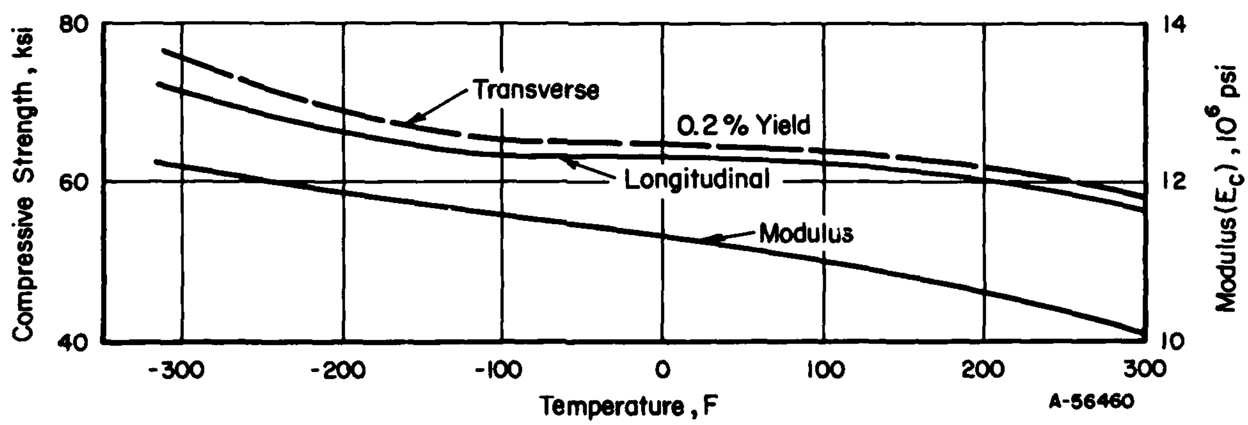

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSIVE PROPERTIES OF 2021-T8E31 ALUMINUM ALLOY PLATE

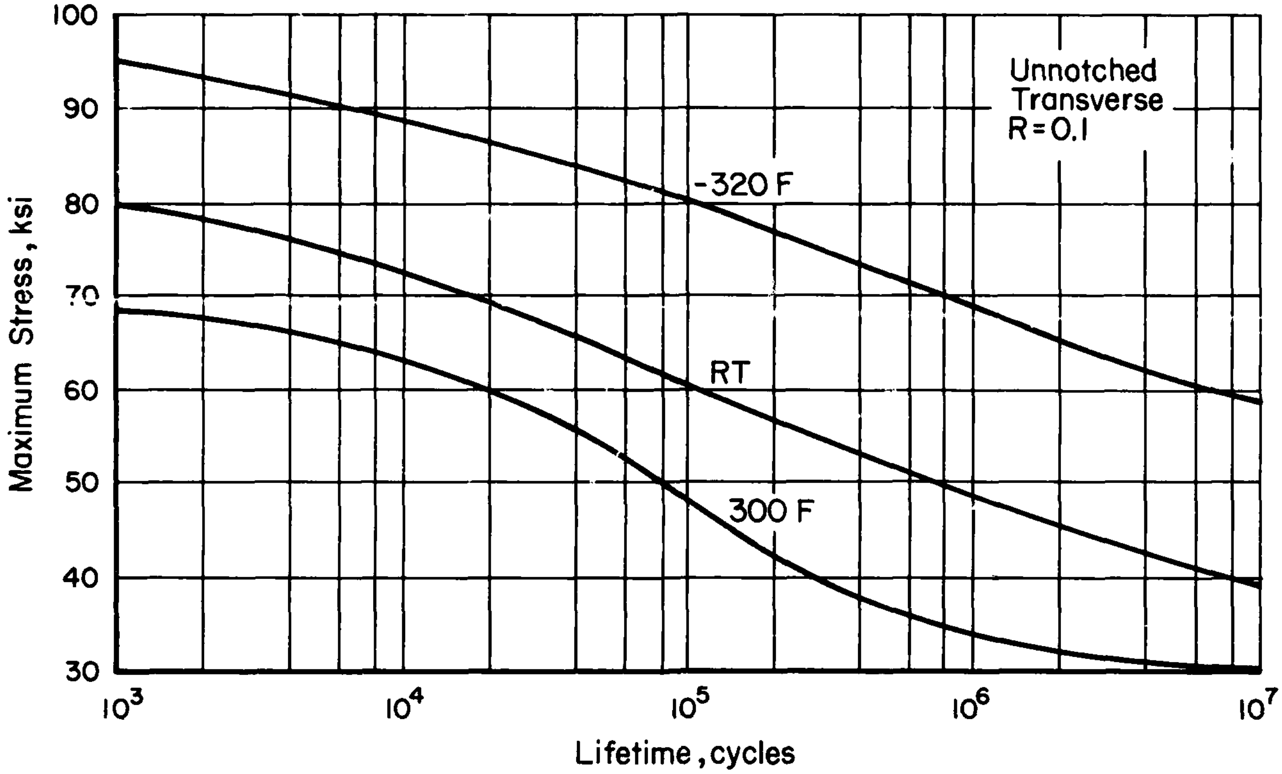

FIGURE 3. AXIAL LOAD FATIGUE RESULTS FOR 2021-T8E31 AT THREE TEMPERATURES

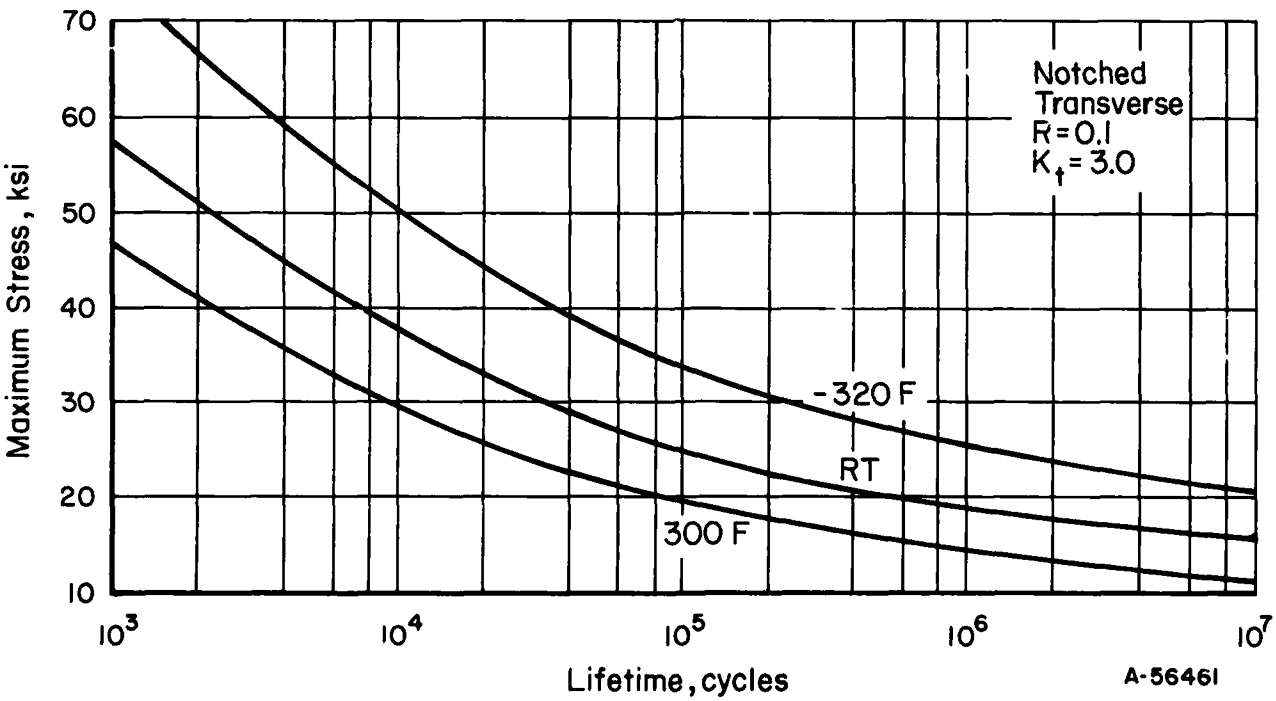

FIGURE 4. AXIAL LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) 2021-T8E31 AT THREE TEMPERATURES

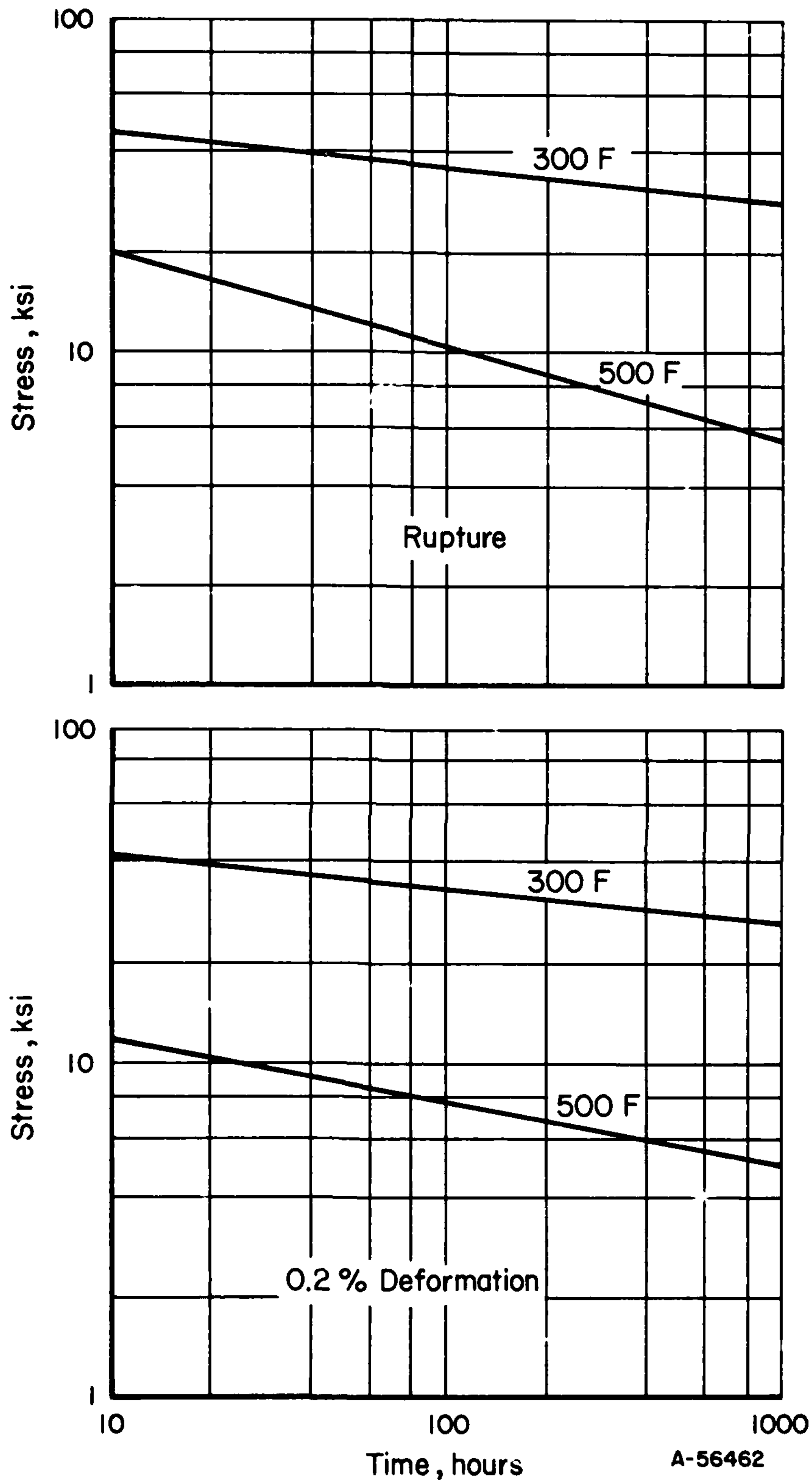

FIGURE 5. STRESS-RUPTURE AND 0.2% PLASTIC DEFORMATION CURVES FOR 2021-T8E31 AT TWO TEMPERATURES