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AUTHORITY

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MECHANICAL-PROPERTY DATA
BERYLLIUM

Cross-Rolled Sheet

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Notices

BERYLLIUM SHEET (CROSS-ROLLED)

Beryllium is a light-weight, high-modulus metal that is advantageous for specific aerospace applications. Beryllium does not have the ductility of the more common light metals; however, current production of this material by powder metallurgical techniques results in a metal that can be used.

This material has limited formability at room temperature; however, formability is considerably increased at elevated temperature.

Brazing, mechanical joining, and welding techniques have been used to a limited extent in fabricating beryllium. For each method of joining, specific, detailed procedures must be followed.

Beryllium is available in vacuum-hot-pressed blocks, cross-rolled sheet, strip, plate, wire, and as extrusions and forgings.

Particles of beryllium and its compounds are toxic. Special precautions must be taken in that no inhalation occurs.

BERYLLIUM SHEET DATA[a]

Condition: Cross-Rolled[b]
Thickness: 0.020-0.063 inch

Properties	Temperature, F			
	RT	400	600	800
Tension				
F_{tu} (longitudinal), ksi	75.0	57.9	46.0	37.3
F_{tu} (transverse), ksi	76.3	56.0	45.9	37.3
F_{ty} (longitudinal), ksi	55.4	48.9	41.2	36.6
F_{ty} (transverse), ksi	54.0	47.8	41.4	36.6
e_t (longitudinal), percent in 1 in.	8	41	43	23
e_t (transverse), percent in 1 in.	14	35	40	22
RA (longitudinal), percent	U[c]	U	U	U
E_t (longitudinal), 10^6 psi	43.1	39.8	36.8	31.3
E_t (transverse), 10^6 psi	41.6	40.2	36.1	31.6
Compression				
F_{cy} (longitudinal), ksi	58.3	52.7	48.0	39.8
F_{cy} (transverse), ksi	57.8	52.7	46.2	39.3
E_c (longitudinal), 10^6 psi	42.5	39.8	39.3	38.1
E_c (transverse), 10^6 psi	40.8	40.7	40.0	38.7
Impact (V-notch Charpy)	U[c]	U	U	U
Fracture Toughness (K_{Ic})[d]	(No pop-in)[d]	U	U	U
Bend, min. radius	(Fracture)	U	32T	10T

BERYLLIUM SHEET DATA (Continued)

Properties	Temperature, F RT	400	600	800
Shear				
F_{su} (longitudinal), ksi	34.8	U	U	U
F_{su} (transverse), ksi	33.4	U	U	U
Axial Fatigue (Transverse)				
Unnotched, R = 0.1[(e)]				
10^3 cycles, ksi	76	57	58	U
10^5 cycles, ksi	61	56	49	U
10^7 cycles, ksi	50	43	40	U
K_t = 3.0, R = 0.1				
10^3 cycles, ksi	67	67	67	U
10^5 cycles, ksi	33	31	27	U
10^7 cycles, ksi	28	20	17	U
Creep (Transverse)				
0.5% elongation 100 hr, ksi	NA[(c)]	43	42	20
0.5% elongation 1000 hr, ksi	NA	42	40	15
Stress Rupture (Transverse)				
Rupture 100 hr, ksi	NA	48	42	27
Rupture 1000 hr, ksi	NA	44	39	20
Stress Corrosion				
80% F_{ty}, 1000 hr max.	(No cracks)[(f)]	U	U	U
Coefficient of Thermal Expansion, in./in./F				
(77-212 F) 6.4 x 10^6[(g)]				
(77-800 F) 8.3 x 10^6[(h)]				
Density, lb/in.^{3} 0.066[(g)]				

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

(b) All specimens etched: 20 percent nitric acid, 1 percent sulfuric acid by volume, water balance (temperature 80-90 F) to remove any surface damage or residual stresses caused by machining.

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

(d) Fatigue cracked center notched specimen 3 x 12 inch. Fracture data not reliable – specimens failed at grip ends and in bolt holes.

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

(f) Alternate immersion, 3-1/2 percent NaCl, 3-point loading bend test.

(g) Values from Reference (1).

(h) Values from Reference (2).

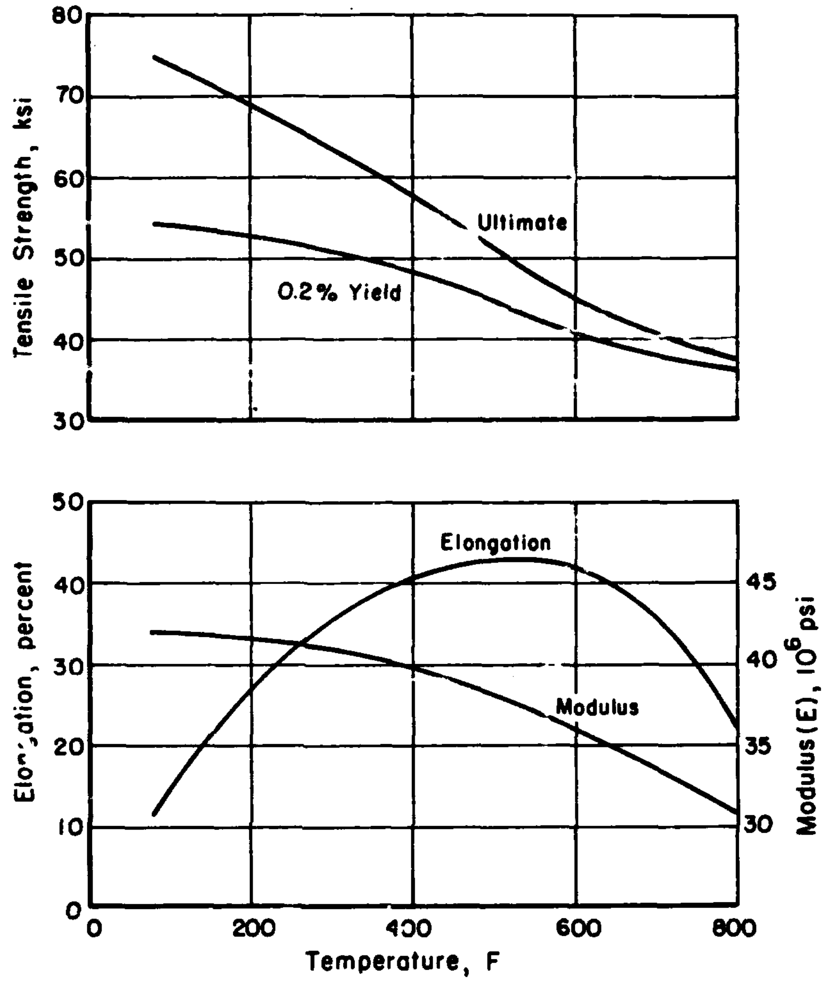

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF CROSS-ROLLED BERYLLIUM SHEET

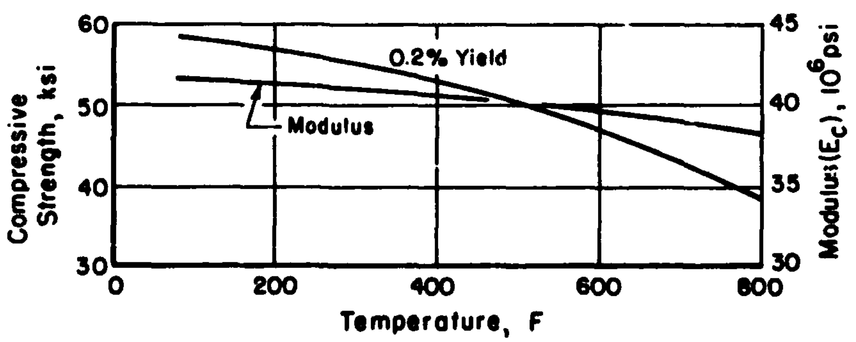

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSIVE PROPERTIES OF CROSS-ROLLED BERYLLIUM SHEET

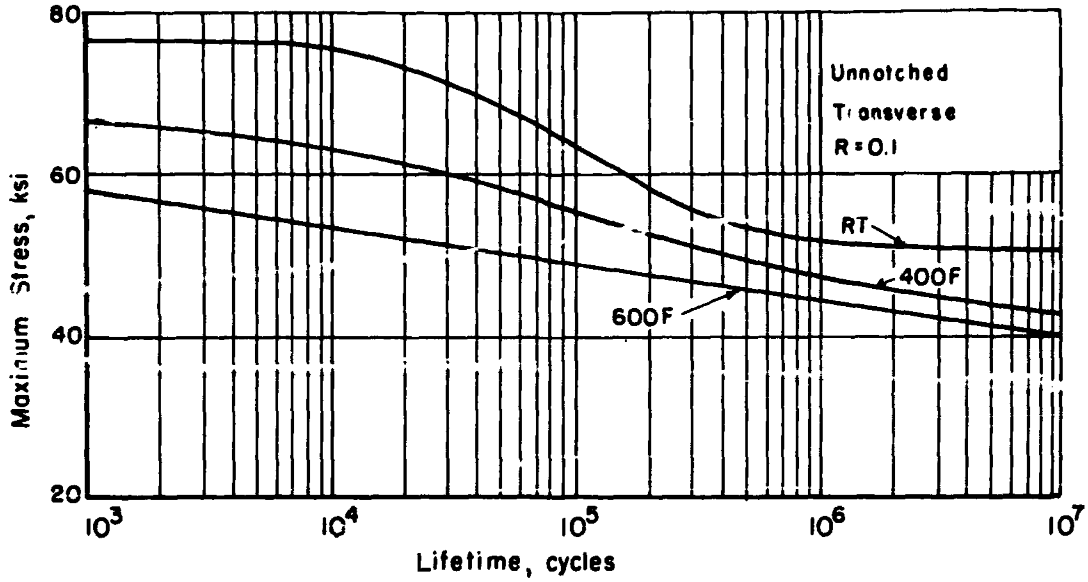

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR CROSS-ROLLED BERYLLIUM SHEET

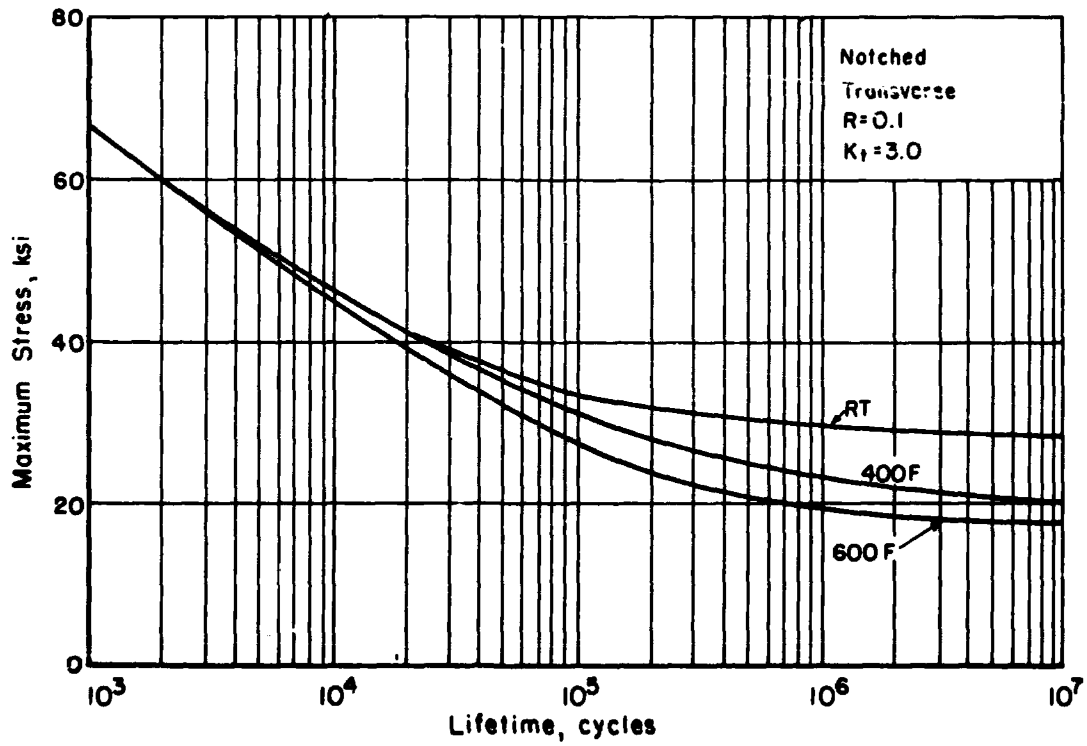

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) CROSS-ROLLED BERYLLIUM SHEET

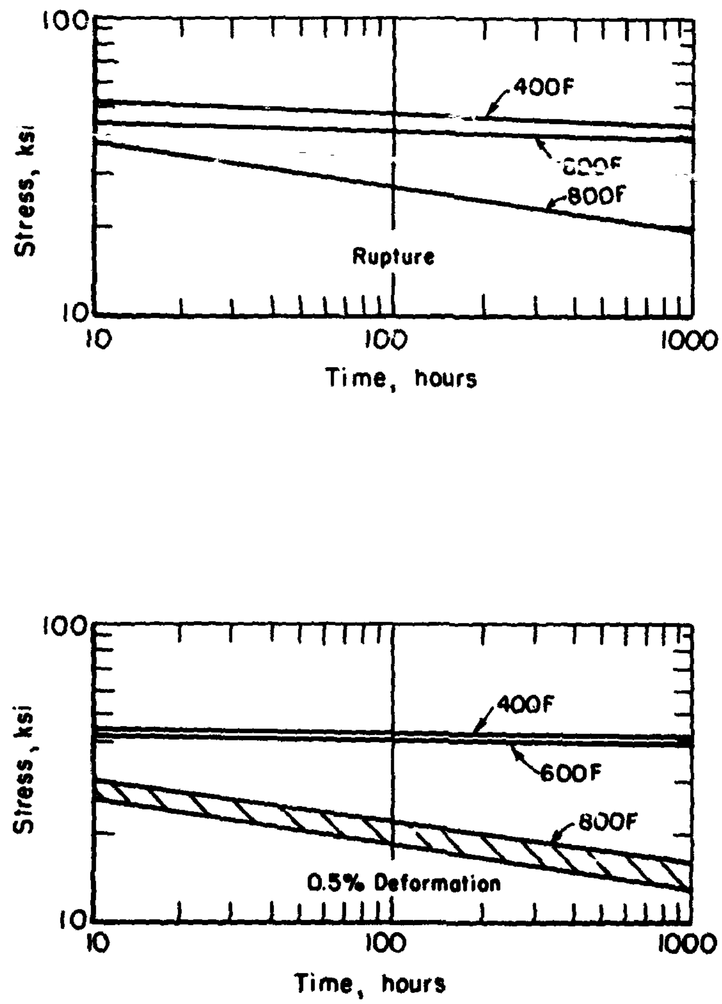

FIGURE 5. STRESS-RUPTURE AND 0.5% DEFORMATION CURVES FOR CROSS-ROLLED BERYLLIUM SHEET

REFERENCES

(1) "Metallic Materials and Elements for Aerospace Vehicle Structures", MIL-HDBK-5A (February 8, 1966).

(2) "Beryllium Properties and Products", Bulletin 2100, The Beryllium Corporation (September, 1965).