TABLE 10. FATIGUE STRENGTHS OF HIGH-STRENGTH STEELS FROM PUSH-PULL TESTS AT ELEVATED TEMPERATURES[a]

Material	Test Temp., F	Ultimate Tensile Strength, ksi	Yield Tensile Strength, ksi	Test Conditions[c]	α_r, Stress Range Parameter[b], for Cycles 10^4	10^5	10^6	10^7
D6AC	450	260	175	$\alpha_m = 0$	0.56[d]	0.48	0.40	0.31
				$\alpha_m = \alpha_r$	0.41	0.35	0.31	0.26
	550	230	160	$\alpha_m = 0$	0.65	0.52	0.41	0.33
				$\alpha_m = \alpha_r$	0.44	0.38	0.34	0.29
Vascojet 1000	800	260	200	$\alpha_m = 0$	0.69	0.56	0.42	0.31
				$\alpha_m = \alpha_r$		0.40	0.32	0.23
	1000	230	176	$\alpha_m = 0$	0.75[d]	0.61	0.43	0.26
				$\alpha_m = \alpha_r$		0.39	0.27	0.21

(a) Data are taken from Reference (17).
(b) $\alpha_r \equiv (\sigma)_r/\sigma_u$, $\sigma_m \equiv (\sigma)_m/\sigma_u$, where $(\sigma)_r$, $(\sigma)_m$, σ_u are the semi range, mean, and ultimate tensile stresses, respectively, at temperature.
(c) The cycle rate was 3100 cps.
(d) S-N curve extrapolated to 10^4 cycles.

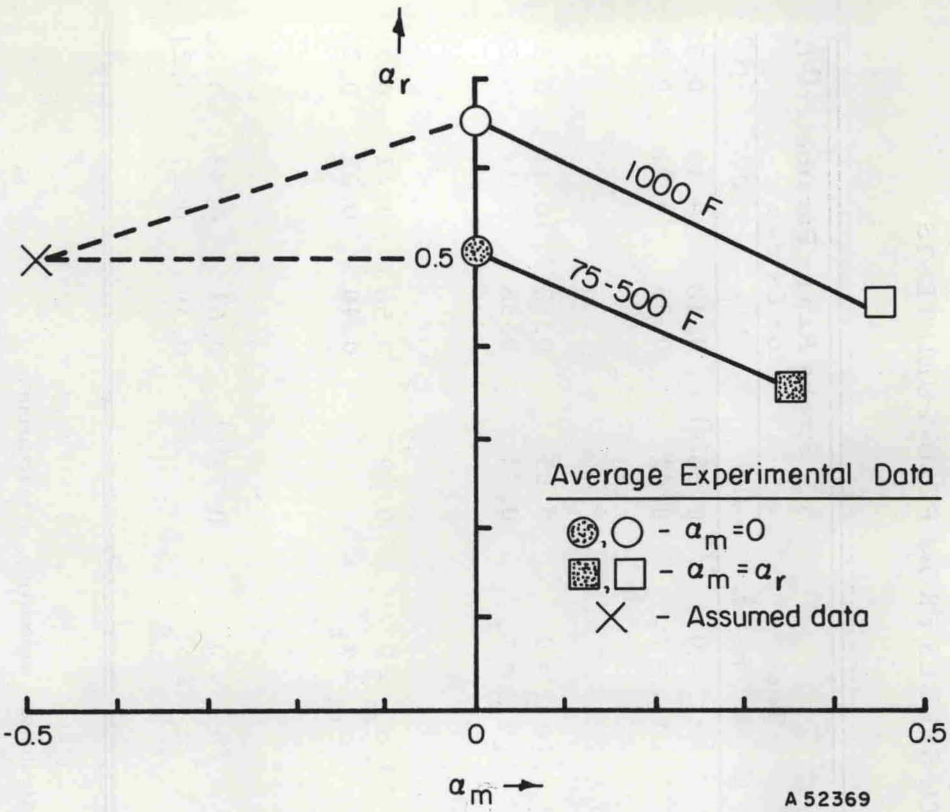

FIGURE 9. FATIGUE DIAGRAM FOR 10^4-10^5 CYCLES LIFE FOR HIGH-STRENGTH STEELS AT TEMPERATURES OF 75 F – 1000 F

α_r and α_m are defined by Equations (13a, b)

The fatigue data available are only for positive and zero mean stresses. However, there is evidence that compressive mean stress may significantly increase the fatigue strength[13, 18]. The reasons for this are thought to be that compression may reduce the detrimental effect of fluid pressure entering minute cracks or voids in the material and the compression may restrain such flaws from growing. Since the liner of a high-pressure container can be precompressed by shrink-fit assembly, an important factor in triaxial fatigue may be the prestress that can be initially provided. Therefore, for 10^4 to 10^5 cycles triaxial fatigue life, α_r and α_m are assumed to be

$$\alpha_r = 0.5, \ \alpha_m = -0.5 \qquad (14a, b)$$

as indicated in Figure 9. With $\alpha_m = -\alpha_r$ the maximum tensile stress at the bore would be zero.

In order to approximate a life of one cycle, it is assumed that

$$\alpha_r = 1.0, \ \alpha_m = 0, \text{ for one cycle} \qquad (15a, b)$$

which represents a cycle between $\pm\alpha_u$, the ultimate strength.