TABLE 8.1 Generalized Fatigue Strength Factors for Ductile Materials

a. 10^6-cycle strength (endurance limit)[a]

Bending loads: $S_n = S'_n C_L C_G C_S$
Axial loads: $S_n = S'_n C_L C_G C_S$
Torsional loads: $S_n = S'_n C_L C_G C_S$

where S'_n is the R. R. Moore, endurance limit,[b] and

		Bending	Axial	Torsion
C_L	(load factor)	1	1	0.58
C_G	(gradient factor): diameter < (0.4 in. or 10 mm)	1	0.7 to 0.9	1
	(0.4 in. or 10 mm) < diameter < (2 in. or 50 mm)[c]	0.9	0.7 to 0.9	0.9
C_S	(surface factor)	See Figure 8.13		

b. 10^3-cycle strength[d]

Bending loads: $0.9S_u$
Axial loads: $0.75S_u$
Torsional loads: $0.9S_{us}$[e]

Note: 1. For all biaxial loading except torsion, convert actual stresses to an *equivalent bending stress* using the distortion energy theory. Then relate this equivalent stress to the *bending fatigue strength*.

2. For other than 50 percent reliability, multiply S_n by C_R. (10^3-cycle strength is usually not multiplied by C_R.)

3. Reliability factors, C_R, corresponding to an 8 percent standard deviation of the endurance limit are as follows: $C_R(50\%) = 1.000$, $C_R(90\%) = 0.897$, $C_R(95\%) = 0.868$, $C_R(99\%) = 0.814$, $C_R(99.9\%) = 0.753$. For example, for 99% reliability we shift -2.326 standard deviations, and $C_R = 1 - 2.326(0.08) = 0.814$.

[a] For materials not having the endurance limit, apply the factors to the 10^8 or 5×10^8-cycle strength.

[b] $S'_n = 0.5S_u$ for steel, lacking better data.

[c] For (2 in. or 50 mm) < diameter < (4 in. or 100 mm) reduce these factors by about 0.1. For (4 in. or 100 mm) < diameter < (6 in. or 150 mm), reduce these factors by about 0.2.

[d] No corrections for gradient or surface are normally made, but the experimental value of S_u or S_{us} should pertain to sizes reasonably close to those involved.

[e] $S_{us} \approx 0.8S_u$ for steel; $S_{us} \approx 0.7S_u$ for other ductile metals.

$$\sigma_e = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2}$$

or

$$= \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$$