

8.22 For this problem we are given, for three identical fatigue specimens of the same material, σ_{\max} and σ_{\min} data, and are asked to rank the lifetimes from the longest to the shortest. In order to do this it is necessary to compute both the mean stress and stress amplitude for each specimen. Since from Equation 8.14

$$\sigma_m = \frac{\sigma_{\max} + \sigma_{\min}}{2}$$

$$\sigma_m(\text{A}) = \frac{450 \text{ MPa} + (-150 \text{ MPa})}{2} = 150 \text{ MPa}$$

$$\sigma_m(\text{B}) = \frac{300 \text{ MPa} + (-300 \text{ MPa})}{2} = 0 \text{ MPa}$$

$$\sigma_m(\text{C}) = \frac{500 \text{ MPa} + (-200 \text{ MPa})}{2} = 150 \text{ MPa}$$

Furthermore, using Equation 8.16

$$\sigma_a = \frac{\sigma_{\max} - \sigma_{\min}}{2}$$

$$\sigma_a(\text{A}) = \frac{450 \text{ MPa} - (-150 \text{ MPa})}{2} = 300 \text{ MPa}$$

$$\sigma_a(\text{B}) = \frac{300 \text{ MPa} - (-300 \text{ MPa})}{2} = 300 \text{ MPa}$$

$$\sigma_a(\text{C}) = \frac{500 \text{ MPa} - (-200 \text{ MPa})}{2} = 350 \text{ MPa}$$

On the basis of these results, the fatigue lifetime for specimen B will be greater than specimen A which in turn will be greater than specimen C. This conclusion is based upon the following $S-N$ plot on which curves are plotted for two σ_m values.