8.16 We are asked to determine the fatigue life for a cylindrical 2014-T6 aluminum rod given its diameter (6.4 mm) and the maximum tensile and compressive loads (+5340 N and –5340 N, respectively). The first thing that is necessary is to calculate values of σ_{max} and σ_{min} using Equation 6.1. Thus

$$\sigma_{max} = \frac{F_{max}}{A_0} = \frac{F_{max}}{\pi \left(\dfrac{d_0}{2}\right)^2}$$

$$= \frac{5340 \ N}{(\pi)\left(\dfrac{6.4 \ x \ 10^{-3} \ m}{2}\right)^2} = 166 \ x \ 10^6 \ N/m^2 = 166 \ MPa \quad (24,400 \ psi)$$

$$\sigma_{min} = \frac{F_{min}}{\pi \left(\dfrac{d_0}{2}\right)^2}$$

$$= \frac{-5340 \ N}{(\pi)\left(\dfrac{6.4 \ x \ 10^{-3} \ m}{2}\right)^2} = -166 \ x \ 10^6 \ N/m^2 = -166 \ MPa \quad (-24,400 \ psi)$$

Now it becomes necessary to compute the stress amplitude using Equation 8.16 as

$$\sigma_a = \frac{\sigma_{max} - \sigma_{min}}{2} = \frac{166 \ MPa - (-166 \ MPa)}{2} = 166 \ MPa \quad (24,400 \ psi)$$

From Figure 8.34, for the 2014-T6 aluminum, the number of cycles to failure at this stress amplitude is about 1 x 10^7 cycles.