8.17 This problem asks that we compute the maximum and minimum loads to which a 15.2 mm (0.60 in.) diameter 2014-T6 aluminum alloy specimen may be subjected in order to yield a fatigue life of 1.0 x 10^8 cycles; Figure 8.34 is to be used assuming that data were taken for a mean stress of 35 MPa (5,000 psi). Upon consultation of Figure 8.34, a fatigue life of 1.0 x 10^8 cycles corresponds to a stress amplitude of 140 MPa (20,000 psi). Or, from Equation 8.16

$$\sigma_{\max} - \sigma_{\min} = 2\sigma_a = (2)(140 \text{ MPa}) = 280 \text{ MPa} \quad (40{,}000 \text{ psi})$$

Since σ_m = 35 MPa, then from Equation 8.14

$$\sigma_{\max} + \sigma_{\min} = 2\sigma_m = (2)(35 \text{ MPa}) = 70 \text{ MPa} \quad (10{,}000 \text{ psi})$$

Simultaneous solution of these two expressions for $\sigma_{\max}$ and $\sigma_{\min}$ yields

$$\sigma_{\max} = +175 \text{ MPa} \quad (+25{,}000 \text{ psi})$$
$$\sigma_{\min} = -105 \text{ MPa} \quad (-15{,}000 \text{ psi})$$

Now, inasmuch as $\sigma = \dfrac{F}{A_0}$ (Equation 6.1), and $A_0 = \pi\left(\dfrac{d_0}{2}\right)^2$ then

$$F_{\max} = \frac{\sigma_{\max}\pi d_0^2}{4} = \frac{(175 \text{ x } 10^6 \text{ N/m}^2)(\pi)(15.2 \text{ x } 10^{-3} \text{ m})^2}{4} = 31{,}750 \text{ N} \quad (7070 \text{ lb}_f)$$

$$F_{\min} = \frac{\sigma_{\min}\pi d_0^2}{4} = \frac{(-105 \text{ x } 10^6 \text{ N/m}^2)(\pi)(15.2 \text{ x } 10^{-3} \text{ m})^2}{4} = -19{,}000 \text{ N} \quad (-4240 \text{ lb}_f)$$