8.31 We are asked in this problem to determine the maximum load that may be applied to a cylindrical low carbon-nickel alloy component that must survive 10,000 h at 538°C. From Figure 8.30, the stress corresponding to 10^4 h is about 70 MPa (10,000 psi). Since stress is defined in Equation 6.1 as $\sigma = F/A_0$, and for a cylindrical specimen, $A_0 = \pi \left(\dfrac{d_0}{2} \right)^2$, then

$$F = \sigma A_0 = \sigma \pi \left(\frac{d_0}{2} \right)^2$$

$$= \left(70 \text{ x } 10^6 \text{ N/m}^2 \right)(\pi) \left(\frac{19.1 \text{ x } 10^{-3} \text{ m}}{2} \right)^2 = 20{,}000 \text{ N} \quad (4420 \text{ lb}_f)$$