

6.26 This problem asks us to determine the deformation characteristics of a steel specimen, the stress-strain behavior for which is shown in Figure 6.21.

(a) In order to ascertain whether the deformation is elastic or plastic, we must first compute the stress, then locate it on the stress-strain curve, and, finally, note whether this point is on the elastic or plastic region. Thus, from Equation 6.1

$$\sigma = \frac{F}{A_0} = \frac{140,000 \text{ N}}{\pi \left( \frac{10 \times 10^{-3} \text{ m}}{2} \right)^2} = 1782 \text{ MPa} \quad (250,000 \text{ psi})$$

The 1782 MPa point is beyond the linear portion of the curve, and, therefore, the deformation will be both elastic and plastic.

(b) This portion of the problem asks us to compute the increase in specimen length. From the stress-strain curve, the strain at 1782 MPa is approximately 0.017. Thus, from Equation 6.2

$$\Delta l = \varepsilon l_0 = (0.017)(500 \text{ mm}) = 8.5 \text{ mm} \quad (0.34 \text{ in.})$$