Answers to suggested problems in Chapter 6

6.3
1.39×10^{-3}

6.5
71.2 GPa

6.6
13.8 mm

6.7
a. 44,850 N
b. 76.25 mm

6.8
9.5 mm

6.9
0.43 mm

6.14
a. 0.325 mm
b. (-)5.9×10^{-3} mm (the diameter will decrease)

6.15
7,800 N

6.16
0.367

6.18
100 GPa

6.21

a. 0.15 mm

b. (-)5.25 x 10^{-3} mm

$$\sigma = \frac{F}{A_0} = \frac{F}{\pi\left(\frac{d_0}{2}\right)^2} = \frac{10{,}000\ \text{N}}{\pi\left(\frac{10 \times 10^{-3}\ \text{m}}{2}\right)^2} = 127\ \text{MPa}\quad (17{,}900\ \text{psi})$$

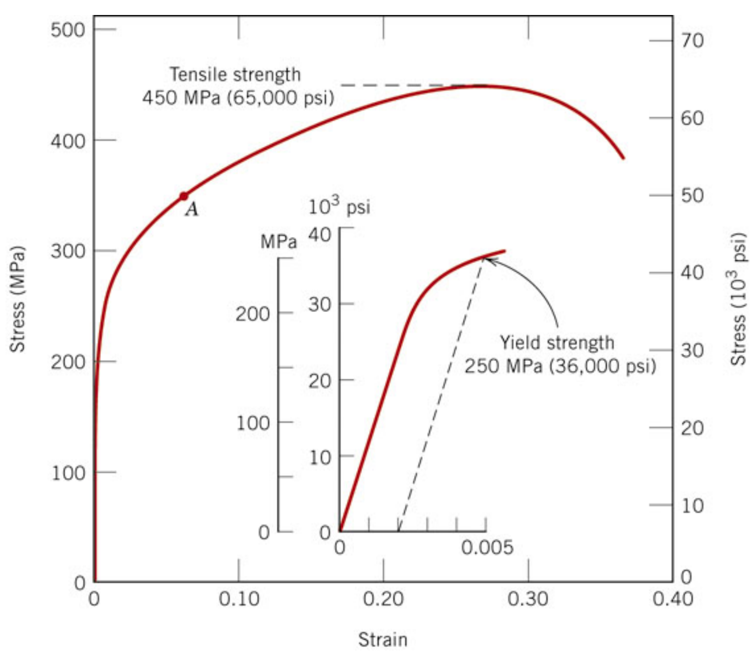
From the stress-strain plot in Figure 6.12, this stress corresponds to a strain of about 1.5 x 10^{-3}. From the definition of strain, Equation 6.2

$$\Delta l = \varepsilon l_0 = \left(1.5 \times 10^{-3}\right)(101.6\ \text{mm}) = 0.15\ \text{mm}\quad (6.0 \times 10^{-3}\ \text{in.})$$

(b) In order to determine the reduction in diameter Δd, it is necessary to use Equation 6.8 and the definition of lateral strain (i.e., $\varepsilon_x = \Delta d/d_0$) as follows

$$\Delta d = d_0\varepsilon_x = -d_0\nu\varepsilon_z = -(10\ \text{mm})(0.35)\left(1.5 \times 10^{-3}\right)$$

$$= -5.25 \times 10^{-3}\ \text{mm}\ (-2.05 \times 10^{-4}\ \text{in.})$$



6.27

$$\varepsilon = \frac{\Delta l}{l_0} = \frac{2.25 \text{ mm}}{375 \text{ mm}} = 0.006$$

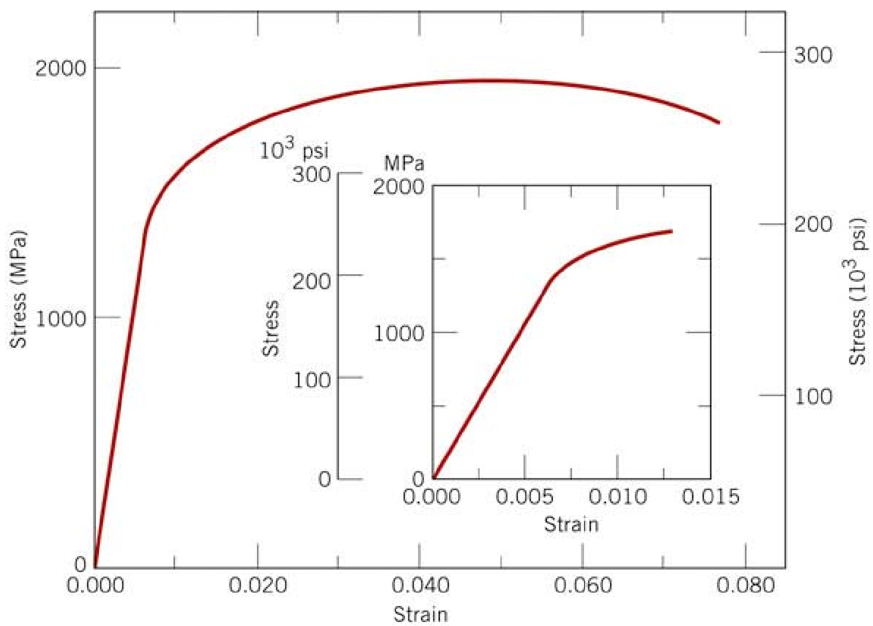
This is within the elastic region; from the inset of Figure 6.21, this corresponds to a stress of about 1250 MPa (180,000 psi). Now, from Equation 6.1

$$F = \sigma A_0 = \sigma b^2$$

in which b is the cross-section side length. Thus,

$$F = (1250 \times 10^6 \text{ N/m}^2)(5.5 \times 10^{-3} \text{ m})^2 = 37,800 \text{ N} \quad (8500 \text{ lb}_f)$$

(b) After the load is released there will be no deformation since the material was strained only elastically.



6.30
HW#5