6.27 (a) We are asked to compute the magnitude of the load necessary to produce an elongation of 2.25 mm for the steel displaying the stress-strain behavior shown in Figure 6.21. First, calculate the strain, and then the corresponding stress from the plot.

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

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,

$$F = \left(1250 \ \text{x} \ 10^6 \ \text{N/m}^2\right)\left(5.5 \ \text{x} \ 10^{-3} \ \text{m}\right)^2 = 37,800 \ \text{N} \quad (8500 \ \text{lb}_\text{f})$$

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