19.27 We want to heat the steel wire in order to reduce the stress level from 70 MPa to 17 MPa; in doing so, we reduce the stress in the wire by 70 MPa – 17 MPa = 53 MPa, which stress will be a compressive one (i.e., σ = –53 MPa). Solving for T_f from Equation 19.8 [and using values for E and α_l of 207 GPa (Table 6.1) and 12.0 x 10^{-6} (°C)$^{-1}$ (Table 19.1), respectively] yields

$$T_f \;=\; T_0 - \frac{\sigma}{E\alpha_l}$$

$$=\; 20°C \;-\; \frac{-53\ \text{MPa}}{\left(207\ \text{x}\ 10^3\ \text{MPa}\right)\left[12.0\ \text{x}\ 10^{-6}\ (°C)^{-1}\right]}$$

$$= 20°C + 21.3°C = 41.3°C\ \ (106°F)$$