31.15. **Model:** The 100 W rating is for operating at 120 V.

Solve: A standard bulb uses $\Delta V = 120$ V. We can use the power dissipation to find the resistance of the filament:

$$P = \frac{\Delta V^2}{R} \Rightarrow R = \frac{\Delta V^2}{P} = \frac{(120 \text{ V})^2}{100 \text{ W}} = 144 \text{ } \Omega$$

But the resistance is related to the filament's geometry:

$$R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} \Rightarrow r = \sqrt{\frac{\rho L}{\pi R}} = \sqrt{\frac{(9.0 \times 10^{-7} \text{ } \Omega \text{ m})(0.070 \text{ m})}{\pi(144 \text{ } \Omega)}} = 1.18 \times 10^{-5} \text{ m } = 11.8 \text{ } \mu\text{m}$$

The filament's diameter is $d = 2r = 23.6 \text{ } \mu\text{m}$.