Exercise 1.86

A package of aluminum foil contains 50 ft^2 of foil, which weighs approximately 8.0 oz. Aluminum has a density of 2.70 g/cm^3. What is the approximate thickness of the foil in millimeters?

Solution

Density is mass divided by volume.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Volume is area times thickness.

$$\text{Density} = \frac{\text{Mass}}{\text{Area} \times \text{Thickness}}$$

Solve for the thickness.

$$\begin{aligned}
\text{Thickness} &= \frac{\text{Mass}}{\text{Area} \times \text{Density}} \\
&= \frac{8.0 \text{ oz}}{(50 \text{ ft}^2) \times \left(2.70 \frac{\text{g}}{\text{cm}^3}\right)} \\
&= \frac{8.0 \cancel{\text{oz}} \times \frac{1 \cancel{\text{lb}}}{16 \cancel{\text{oz}}} \times \frac{453.59 \text{ g}}{1 \cancel{\text{lb}}}}{\left[50 \cancel{\text{ft}^2} \times \left(\frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}}\right)^2 \times \left(\frac{2.54 \text{ cm}}{1 \cancel{\text{in}}}\right)^2\right] \times \left(2.70 \frac{\text{g}}{\text{cm}^3} \times \frac{1 \text{ cm}}{10 \text{ mm}}\right)} \\
&= \frac{8.0 \times \frac{1}{16} \times 453.59 \cancel{\text{g}}}{50 \times 12^2 \times 2.54^2 \times 2.70 \times \frac{1}{10} \cancel{\text{cm}^3} \times \frac{\cancel{\text{g}}}{\cancel{\text{cm}^3}} \times \frac{1}{\text{mm}}} \\
&\approx 0.018 \text{ mm}
\end{aligned}$$

This assumes that 50 ft^2 has two significant figures.