

Problem 1.39

[Difficulty: 1]

1.39 A particular pump has an “engineering” equation form of the performance characteristic equation given by $H \text{ (ft)} = 1.5 - 4.5 \times 10^{-5} [Q \text{ (gpm)}]^2$, relating the head H and flow rate Q . What are the units of the coefficients 1.5 and 4.5×10^{-5} ? Derive an SI version of this equation.

Given: “Engineering” equation for a pump

Find: SI version

Solution:

The dimensions of “1.5” are ft.

The dimensions of “ 4.5×10^{-5} ” are ft/gpm².

Using data from tables (e.g. Table G.2), the SI versions of these coefficients can be obtained

$$1.5 \cdot \text{ft} = 1.5 \cdot \text{ft} \times \frac{0.0254 \text{ m}}{\frac{1}{12} \cdot \text{ft}} = 0.457 \text{ m}$$

$$4.5 \times 10^{-5} \cdot \frac{\text{ft}}{\text{gpm}^2} = 4.5 \cdot 10^{-5} \cdot \frac{\text{ft}}{\text{gpm}^2} \times \frac{0.0254 \text{ m}}{\frac{1}{12} \cdot \text{ft}} \times \left(\frac{1 \cdot \text{gal}}{4 \cdot \text{quart}} \cdot \frac{1 \text{ quart}}{0.000946 \text{ m}^3} \cdot \frac{60 \cdot \text{s}}{1 \text{ min}} \right)^2$$

$$4.5 \cdot 10^{-5} \cdot \frac{\text{ft}}{\text{gpm}^2} = 3450 \cdot \frac{\text{m}}{\left(\frac{\text{m}^3}{\text{s}} \right)^2}$$

The equation is

$$H(\text{m}) = 0.457 - 3450 \cdot \left(Q \left(\frac{\text{m}^3}{\text{s}} \right) \right)^2$$