

PROBLEM 1.49

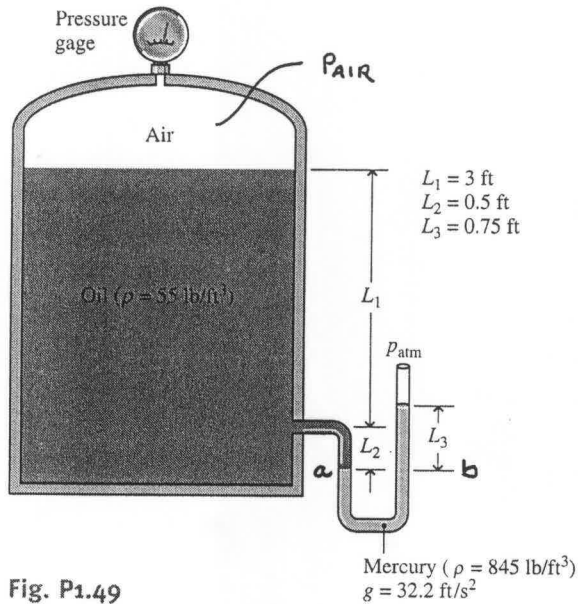


Fig. P1.49

Ignoring the vertical pressure variation of the air trapped above the oil, the gage reads

$$P_{\text{gage}} = P_{\text{AIR}} - P_{\text{atm}} \quad (1)$$

We also have

$$P_a = P_{\text{AIR}} + \rho_o g (L_1 + L_2) \quad (2)$$

and

$$P_b = P_{\text{atm}} + \rho_m g L_3 \quad (3)$$

Then, since $P_a = P_b$, Eqs. (2) and (3) give

$$P_{\text{AIR}} + \rho_o g (L_1 + L_2) = P_{\text{atm}} + \rho_m g L_3$$

$$\Rightarrow P_{\text{AIR}} - P_{\text{atm}} = \rho_m g L_3 - \rho_o g (L_1 + L_2)$$

$$\Rightarrow P_{\text{gage}} = [\rho_m L_3 - \rho_o (L_1 + L_2)] g$$

Calculating,

$$P_{\text{gage}} = \left[(845 \frac{\text{lb}}{\text{ft}^3}) (0.75 \text{ ft}) - (55 \frac{\text{lb}}{\text{ft}^3}) (3.5 \text{ ft}) \right] (32.2 \frac{\text{ft}}{\text{s}^2}) \left| \frac{1 \text{ lbf}}{32.2 \text{ lb} \cdot \text{ft/s}^2} \right| \left| \frac{1 \text{ ft}^2}{144 \text{ in}^2} \right|$$

rounded

$$= 3.06 \frac{\text{lbf}}{\text{in}^2} (\text{gage})$$