PROBLEM 1.49

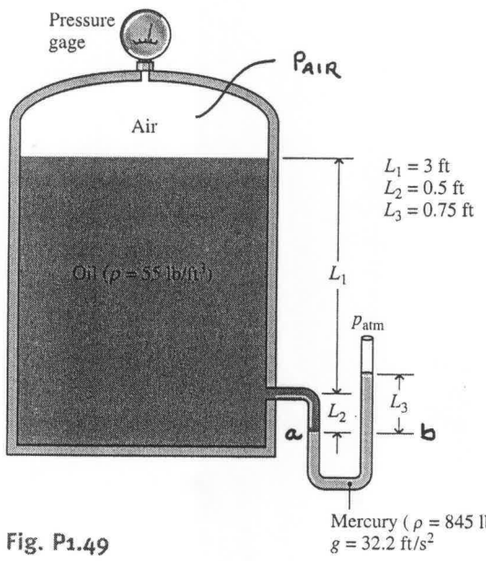

Fig. P1.49

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

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

We also have

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

and

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

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

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

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

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

Calculating,

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

(rounded)

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