Problem 1.48

Given: $F = 18000\,lb$
$d = 2.5\,in$

Find: Oil pressure

Solution:

$p = \frac{F}{A}$ $\quad A = 2.5^2 \cdot \frac{\pi}{4} = 4.9\,in^2$

$p = \frac{18000\,lb}{4.9\,in^2} = 3673.46\,psi$

Problem 1.58

Given: decrease in the volume of Mercury by 1%

Find: Δp (psi and MPa)

Solution:

$$E = \frac{-\Delta p}{\frac{\Delta V}{V}} \rightarrow \Delta p = -E\left(\frac{\Delta V}{V}\right)$$

standard $E = 3590000\,psi$ and $24750\,MPa$

$\Delta p = -(3590000\,psi)\left(\frac{1}{100}\right) = \underline{35900\,psi}$

$\Delta p = -(24750\,MPa)\left(-\frac{1}{100}\right) = \underline{247.5\,MPa}$

Problem 1.63

Given: $d = 0.5\ in$
$L = 42\ in$

Find: Stiffness $\left(\frac{lb}{in}\right)$

Solution:

$$E = \frac{-p}{\frac{\Delta V}{V}} \qquad p = \frac{F}{A} \qquad V = A \cdot L \qquad \Delta V = -A(\Delta L)$$

$$E = \frac{-\frac{F}{A}}{\frac{-A(\Delta L)}{A \cdot L}} \rightarrow -\frac{F}{A} \cdot \frac{A \cdot L}{-A(\Delta L)} = \frac{F L}{A(\Delta L)}$$

$$A = 0.5^2 \cdot \frac{\pi}{4} = 0.196\ in^2$$

$$189000\ \frac{lb}{in^2} = \frac{F \cdot 42\ in}{(0.196\ in^2)(\Delta L)}$$

$$\frac{F}{\Delta L} = \frac{189000\ \frac{lb}{in^2}}{\frac{42\ in}{0.196\ in^2}} \qquad \frac{F}{\Delta L} = \underline{\underline{883.3\ \frac{lb}{in}}}$$

Problem 1.76

Given: 1.00 lb-force

Find: convert to slugs, kilograms, and newtons

Solution:

$$1\ lbf \times \frac{1\ slug}{32.174\ lbf} = \underline{\underline{0.031\ slug}}$$

$$1\ lbf \times \frac{1\ kg}{2.2\ lbf} = \underline{\underline{0.454\ kg}}$$

$$1\ lbf \times \frac{1\ N}{0.224\ lbf} = \underline{\underline{4.464\ N}}$$

Problem 1.92

Given: $d = 150^{mm} = 0.15^{m}$
$w_1 = 2.25^{N}$
$h = 200^{mm} = 0.2^{m}$
$w_2 = 35.4^{N}$

Find: specific gravity of oil

Solution:

$w_{oil} = w_2 - w_1 = 35.4 - 2.25 = 33.15^{N}$

$V = \pi r^2 h = \pi \left(\frac{0.15}{2}\right)^2 \cdot 0.2 = 0.003534^{m^3}$

$\gamma_{oil} = \frac{w_{oil}}{V} = \frac{33.15^{N}}{0.003534^{m^3}} = \underline{9380.3\ \frac{N}{m^3} = 9.38\ \frac{kN}{m^3}}$

$Sg = \frac{\gamma_{oil}}{\gamma_{water}} = \frac{9.38}{9.81} = \underline{0.956}$

Problem 1.107

Given: $SG_{alcohol} = 0.79$

Find: density in $\frac{slugs}{ft^3}$ and $\frac{g}{cm^3}$

Solution

$\rho_a = Sg \cdot \rho_{water} \qquad \rho_a = 0.79 \cdot 1.94\ \frac{slugs}{ft^3}$

$\underline{\rho_a = 1.53\ \frac{slugs}{ft^3}}$

$\rho_a = Sg \cdot \rho_{water} \qquad \rho_a = 0.79 \cdot 1\ \frac{g}{cm^3}$

$\underline{\rho_a = 0.79\ \frac{g}{cm^3}}$