

PS 35

- A pump supplies 330 gal/min of a fluid with a density of $61.8 \text{ lb}_m/\text{ft}^3$ and a viscosity of 0.9 cP to a tank vented to the atmosphere. The fluid is pumped at 77 F through a 4-in schedule-40 steel pipe with an equivalent length of pump discharge line of 450 ft. The pipe roughness is 0.000144 ft. What is the head loss due to friction?

PS 35

- $q = 330 \text{ gpm}, \rho = 61.8 \frac{\text{lb}}{\text{ft}^3}, \mu = 0.9 \text{ cP}, t = 77 \text{ F}, p_2 = 1 \text{ atm}, d = 4 \text{ in Sch 40}, L = 450 \text{ ft}, \varepsilon = 0.00014 \text{ ft}, h_f = ?$
- $d = \frac{4.026}{12} = 0.3355 \text{ ft}, A = \frac{\pi}{4(0.3355)^2} = 0.0884 \text{ ft}^2$
- $q = \frac{33}{(7.48)(60)} = 0.7353 \frac{\text{ft}^3}{\text{s}}, v = \frac{q}{A} = \frac{0.7353}{0.0884} = 8.32 \frac{\text{ft}}{\text{s}}$
- $Re = \frac{vd\rho}{\mu} = \frac{(8.32)(0.3355)(61.8)}{(0.9)(6.72 \times 10^{-4})} = 285228$
- $\frac{\varepsilon}{d} = \frac{0.000144}{0.335} = 0.000429; \rightarrow f = 0.018$
- $h_f = \frac{0.018(450)(8.32^2)}{(0.3355)(2)(32.17)} = 25.98 \text{ ft.} \frac{\text{lbf}}{\text{lbm}}$