NOTE: IN PROBLEMS 6.100–6.110, MINOR LOSSES ARE *INCLUDED*.

6.101 In Fig. P6.101 a thick filter is being tested for losses. The flow rate in the pipe is 7 m^3/min, and the upstream pressure is 120 kPa. The fluid is air at 20°C. Using the water-manometer reading, estimate the loss coefficient *K* of the filter.

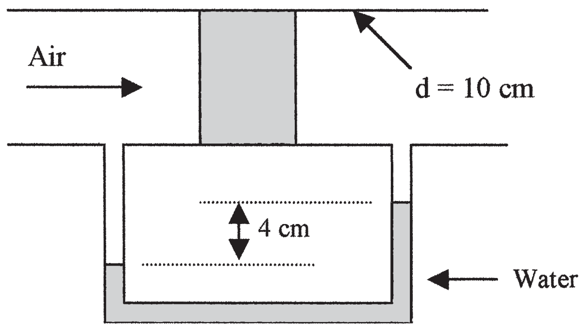

Fig. P6.101

Solution: The upstream density is $\rho_{air} = p/(RT) = 120000/[287(293)] = 1.43\ kg/m^3$. The average velocity *V* (which is used to correlate loss coefficient) follows from the flow rate:

$$V = \frac{Q}{A_{pipe}} = \frac{7/60\ m^3/s}{(\pi/4)(0.1\ m)^2} = 14.85\ m/s$$

The manometer measures the pressure drop across the filter:

$$\Delta p_{mano} = (\rho_w - \rho_a)gh_{mano} = (998 - 1.43\ kg/m^3)(9.81\ m/s^2)(0.04\ m) = 391\ Pa$$

This pressure is correlated as a loss coefficient using Eq. (6.78):

$$K_{filter} = \frac{\Delta p_{filter}}{(1/2)\rho V^2} = \frac{391\ Pa}{(1/2)(1.43\ kg/m^3)(14.85\ m/s)^2} \approx \mathbf{2.5} \quad \textit{Ans.}$$

6.102 A 70 percent efficient pump delivers water at 20°C from one reservoir to another 20 ft higher, as in Fig. P6.102. The piping system consists of 60 ft of galvanized-iron 2-in pipe, a reentrant entrance, two screwed 90° long-radius elbows, a screwed-open gate valve, and a sharp exit. What is the input power required in horsepower with and without a 6° well-designed conical expansion added to the exit? The flow rate is 0.4 ft^3/s.