

8.54

8.54 Air at standard temperature and pressure flows through a 1-in.-diameter galvanized iron pipe with an average velocity of 8 ft/s. What length of pipe produces a head loss equivalent to (a) a flanged 90° elbow, (b) a wide-open angle valve, or (c) a sharp-edged entrance?

$$l_{eq} = \frac{K_L D}{f}, \text{ where with } Re = \frac{VD}{\nu} = \frac{(8 \frac{ft}{s})(\frac{1}{12} ft)}{1.57 \times 10^{-4} \frac{ft^2}{s}} = 4.25 \times 10^3 \text{ Thus, with } \\ \frac{\epsilon}{D} = \frac{0.0005 ft}{(1/12 ft)} = 0.006 \text{ (see Table 8.1) we obtain } f = 0.045 \text{ (Fig. 8.20)} \\ \text{Thus, } l_{eq} = \frac{K_L (\frac{1}{12} ft)}{0.045} = 1.852 K_L \text{ or } \begin{array}{l} \text{a) } 90^\circ \text{ elbow: } K_L = 0.3 \text{ or } l_{eq} = \underline{\underline{0.556 ft}} \\ \text{b) globe valve: } K_L = 2 \text{ or } l_{eq} = \underline{\underline{3.70 ft}} \\ \text{c) sharp entrance: } K_L = 0.5 \text{ or } l_{eq} = \underline{\underline{0.926 ft}} \end{array}$$