

8.53

8.53 A fluid flows in a smooth pipe with a Reynolds number of 6000. By what percent would the head loss be reduced if the flow could be maintained as laminar flow rather than the expected turbulent flow?

For either laminar or turbulent flow

$$h_L = f \frac{L}{D} \frac{V^2}{2g} \text{ . Thus, with the same } V, L, D, \text{ and } g$$

$$\frac{h_{L \text{ lam}}}{h_{L \text{ turb}}} = \frac{f_{\text{lam}}}{f_{\text{turb}}}$$

$$\text{If the flow is laminar } f_{\text{lam}} = \frac{64}{Re} = \frac{64}{6000} = 0.0107$$

If the flow is turbulent with $Re = 6000$ and $\frac{\epsilon}{D} = 0$, then from the Moody chart (Fig. 8.20) $f_{\text{turb}} = 0.035$

Thus,

$$\frac{h_{L \text{ lam}}}{h_{L \text{ turb}}} = \frac{0.0107}{0.035} = 0.486$$

The headloss would be reduced by

$$(h_{L \text{ turb}} - h_{L \text{ lam}}) / h_{L \text{ turb}} = 1 - 0.486 = 0.514, \text{ or } \underline{\underline{51.4\%}}$$