

8.8

8.8 Carbon dioxide at 20 °C and a pressure of 550 kPa (abs) flows in a pipe at a rate of 0.04 N/s. Determine the maximum diameter allowed if the flow is to be turbulent.

For turbulent flow,  $Re = \frac{\rho V D}{\mu} > 4000$ , where  $Q = VA = \frac{\pi}{4} D^2 V$   
 or  $Re = \frac{4 \rho Q D}{\pi \mu D^2} = \frac{4 \rho Q}{\pi \mu D} = 4000$

Thus,  $D = \frac{4 \rho Q}{4000 \pi \mu}$ , where  $\rho Q = 0.04 \frac{N}{s}$  and  $\mu = 1.4 \times 10^{-5} \frac{N \cdot s}{m^2}$  (Table 1.8)

Hence,  $D = \frac{4 (0.04 \frac{N}{s}) (\frac{1}{9.81 \frac{m}{s^2}})}{4000 \pi (1.47 \times 10^{-5} \frac{N \cdot s}{m^2})} = \underline{\underline{0.0883 \text{ m}}}$