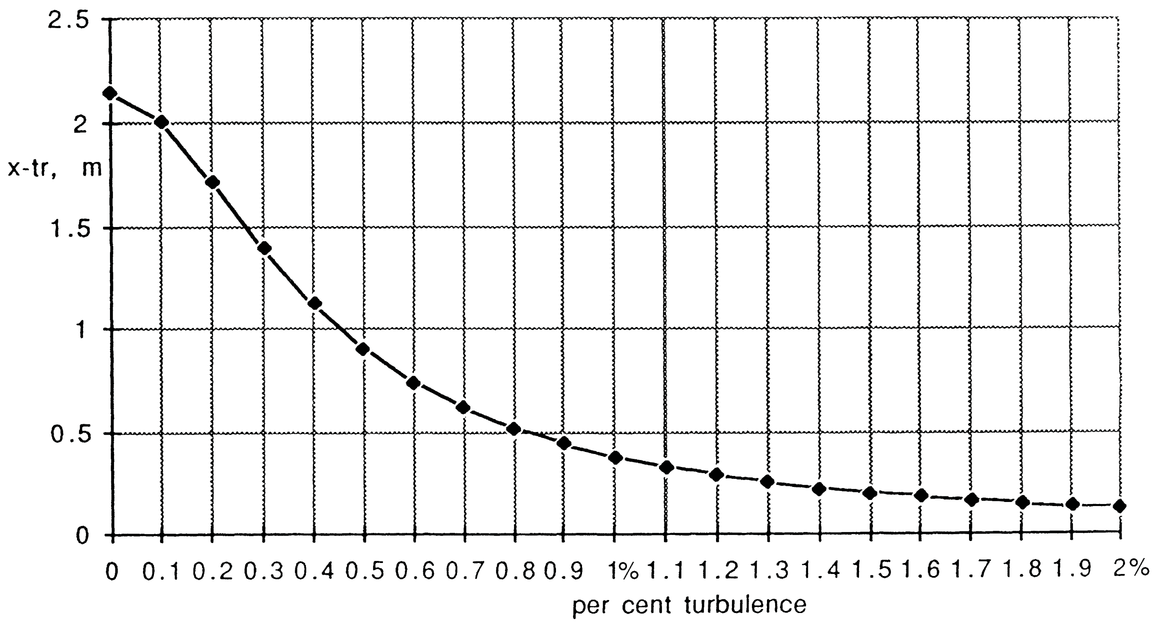

Fig. P6.3

The value of x_{crit} decreases by half (to 1.07 meters) at $\zeta \approx$ **0.42%**. *Ans.*

6.4 For flow of SAE 30 oil through a 5-cm-diameter pipe, from Fig. A.1, for what flow rate in m^3/h would we expect transition to turbulence at (a) 20°C and (b) 100°C?

Solution: For SAE 30 oil take $\rho = 891$ kg/m^3 and take $\mu = 0.29$ kg/m·s at 20°C (Table A.3) and 0.01 kg/m-s at 100°C (Fig A.1). Write the critical Reynolds number in terms of flow rate Q:

$$\text{(a)}\ \ \mathrm{Re}_{crit} = 2300 = \frac{\rho VD}{\mu} = \frac{4\rho Q}{\pi\mu D} = \frac{4(891\ kg/m^3)Q}{\pi(0.29\ kg/m{\cdot}s)(0.05\ m)},$$

$$\text{solve}\quad Q = 0.0293\ \frac{m^3}{s} = \mathbf{106}\ \frac{\mathbf{m^3}}{\mathbf{h}}\quad \textit{Ans.}\ \text{(a)}$$

$$\text{(b)}\ \ \mathrm{Re}_{crit} = 2300 = \frac{\rho VD}{\mu} = \frac{4\rho Q}{\pi\mu D} = \frac{4(891\ kg/m^3)Q}{\pi(0.010\ kg/m{\cdot}s)(0.05\ m)},$$

$$\text{solve}\quad Q = 0.00101\ \frac{m^3}{s} = \mathbf{3.6}\ \frac{\mathbf{m^3}}{\mathbf{h}}\quad \textit{Ans.}\ \text{(b)}$$