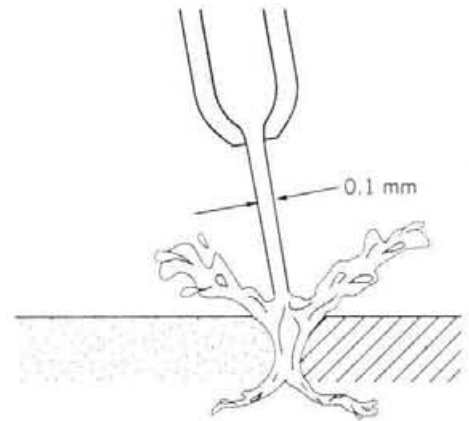
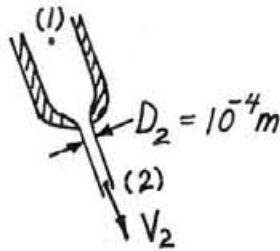


3.49

3.49 Small-diameter, high-pressure liquid jets can be used to cut various materials as shown in Fig. P3.49. If viscous effects are negligible, estimate the pressure needed to produce a 0.10-mm-diameter water jet with a speed of 700 m/s. Determine the flowrate.



■ FIGURE P3.49

$$\frac{p_1}{\rho} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\rho} + \frac{V_2^2}{2g} + z_2 \quad \text{where } V_1 \approx 0, z_1 \approx z_2, \text{ and } p_2 = 0$$

$$\text{Thus } p_1 = \frac{1}{2} \rho V_2^2 = \frac{1}{2} (999 \frac{\text{kg}}{\text{m}^3}) (700 \frac{\text{m}}{\text{s}})^2 = \underline{\underline{2.45 \times 10^5 \frac{\text{kN}}{\text{m}^2}}}$$

Also,

$$Q = V_2 A_2 = 700 \frac{\text{m}}{\text{s}} \left[ \frac{\pi}{4} (10^{-4} \text{ m})^2 \right] = \underline{\underline{5.50 \times 10^{-6} \frac{\text{m}^3}{\text{s}}}}$$