9.69 As shown in Video V9.7 and Fig. P9.69 a vertical wind tunnel can be used for skydiving practice. Estimate the vertical wind speed needed if a 150-lb person is to be able to "float" motionless when the person (a) curls up as in a crouching position or (b) lies flat. See Fig. 9.30 for appropriate drag coefficient data.

For equilibrium conditions

\[ W = \rho g = C_D \frac{1}{2} \rho U^2 A \]

Assume \( W = 160 \text{ lb} \) and \( C_D A = 9 \text{ ft}^2 \) (see Fig. 9.30).

Thus,

\[ 160 \text{ lb} = (\frac{1}{2})(0.00238 \text{ slugs/ft}^2)(U^2)(9 \text{ ft}^2) \quad \text{where} \quad U \approx \frac{5}{3} \text{ ft/s} \]

or

\[ U = \left( \frac{122 \text{ ft}}{5} \right) \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right) \left( \frac{3600 \text{ s}}{1 \text{ hr}} \right) = 83.2 \text{ mph} \]

Note: If the skydiver "curled up into a ball", then \( C_D A = 2.5 \text{ ft}^2 \) (see Fig. 9.30) and \( U = 158 \text{ mph} \).