

9.104

9.104 A light aircraft with a wing area of 200 ft^2 and a weight of 2000 lb has a lift coefficient of 0.40 and a drag coefficient of 0.05 . Determine the power required to maintain level flight.

For equilibrium $\mathcal{L} = W = 2000 \text{ lb} = C_L \frac{1}{2} \rho U^2 A$

or $2000 \text{ lb} = (0.40) \frac{1}{2} (0.00238 \frac{\text{slugs}}{\text{ft}^3}) U^2 (200 \text{ ft}^2)$

Hence,

$$U = 145 \frac{\text{ft}}{\text{s}}$$

Also, $\mathcal{P} = \text{power} = \mathcal{D} U$, where

$$\mathcal{D} = C_D \frac{1}{2} \rho U^2 A = (0.05) \frac{1}{2} (0.00238 \frac{\text{slugs}}{\text{ft}^3}) (145 \frac{\text{ft}}{\text{s}})^2 (200 \text{ ft}^2) = 250 \text{ lb}$$

Note: This value of \mathcal{D} could be obtained from

$$\frac{W}{\mathcal{D}} = \frac{\mathcal{L}}{\mathcal{D}} = \frac{C_L}{C_D} = \frac{0.40}{0.05} = 8, \text{ or } \mathcal{D} = \frac{W}{8} = \frac{2000 \text{ lb}}{8} = 250 \text{ lb}$$

Thus,

$$\mathcal{P} = 250 \text{ lb} (145 \frac{\text{ft}}{\text{s}}) = 3.63 \times 10^4 \frac{\text{ft} \cdot \text{lb}}{\text{s}} \left(\frac{1 \text{ hp}}{550 \frac{\text{ft} \cdot \text{lb}}{\text{s}}} \right) = \underline{\underline{65.9 \text{ hp}}}$$