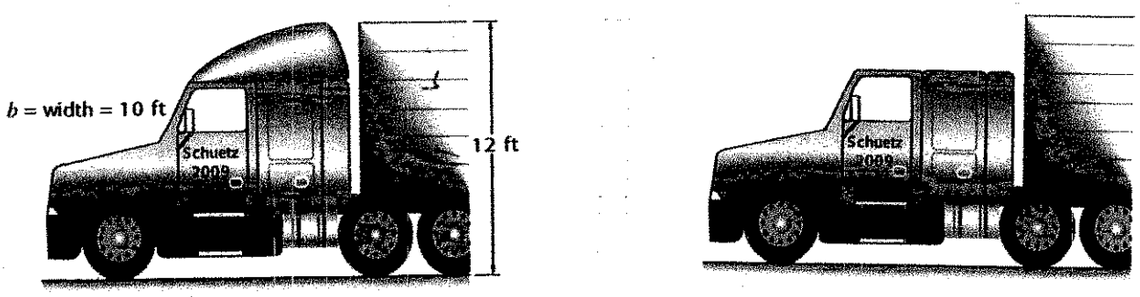
9.68

9.68 As shown in Video V9.13 and Fig. P9.68, the aerodynamic drag on a truck can be reduced by the use of appropriate air deflectors. A reduction in drag coefficient from $C_D = 0.96$ to $C_D = 0.70$ corresponds to a reduction of how many horsepoer needed at a highway speed of 65 mph?



(a) $C_D = 0.70$ (b) $C_D = 0.96$

■ FIGURE P9.68

$\mathcal{P}$ = power = $\mathcal{D}U$ where

$\mathcal{D} = \frac{1}{2}\rho U^2 C_D A$

Thus, $\Delta\mathcal{P}$ = reduction in power

$= \mathcal{P}_b - \mathcal{P}_a$

$= \frac{1}{2}\rho U^3 A\left[C_{D_b} - C_{Da}\right]$

With $U = 65$ mph $= 95.3$ fps,

$\Delta\mathcal{P} = \frac{1}{2}\left(0.00238 \frac{\text{slugs}}{\text{ft}^3}\right)\left(95.3 \frac{\text{ft}}{\text{s}}\right)^3 (10\text{ft})(12\text{ft})\left[0.96 - 0.70\right]$

$= 32{,}100 \frac{\text{ft}\cdot\text{lb}}{\text{s}}\left(\frac{1\ \text{hp}}{550 \frac{\text{ft}\cdot\text{lb}}{\text{s}}}\right) = \underline{\underline{58.4\ \text{hp}}}$