Estimating Power Applying the above parameters, we can estimate the power resulting from supercharging using the following calculations.

Example: Let engine power = 116 hp, boost = 6 psi, engine volumetric efficiency (4 valves per cylinder) = 88%, non-intercooled volumetric efficiency = 92%, ambient temperature = 90°F (a standard day), measured air temperature of the compressor discharge = 210°F, and drive-power efficiency = 90%. Then,

$$\textit{Pressure ratio} = \frac{14.7\ \textit{psi} + \textit{boost}}{14.7\ \textit{psi}}$$

$$= \frac{14.7\ \textit{psi} + 6\ \textit{psi}}{14.7\ \textit{psi}} = 1.41$$

$$\textit{Density ratio} = \frac{\textit{original absolute temperature}}{\textit{final absolute temperature}}$$

$$= \frac{460^\circ + 90^\circ}{460^\circ + 210^\circ} = 0.82$$

As indicated earlier in this chapter, the initial pressure ratio and density ratio are frequently inaccurate. A detailed example of a sizing calculation that produces accurate results is given in each of the three chapters on the types of superchargers. However, for the purpose of illustrating the procedure here, we will assume the numbers are correct.

$$\textit{Volumetric efficiencies ratio} = \frac{\textit{supercharger volumetric efficiencies}}{\textit{engine volumetric efficiencies}}$$

$$= \frac{0.92}{0.88} = 1.05$$

Applying these corrections to the engine's original power produces the following:

$$\text{Power} = \textit{original power} \times \textit{new pressure ratio} \times \textit{density ratio} \times \textit{volumetric efficiencies ratio} \times \textit{drive power efficiency}$$

then,

$$\text{Power} = 116 \times 1.41 \times 0.82 \times 1.05 \times 0.9 = 127 \text{ bhp}$$

The reaction to this calculation should be twofold. First is the startling realization that the loss of 18% of the hoped-for power gain (as indicated by the 82% density ratio) is due to intake charge heat. Second is that the pressure ratio gives us a lot to work with if we can figure out how to avoid having it so badly degraded by heat-related density losses.