

Given:

A car engine with a power output of 65 hp has a thermal efficiency of 24%.

Required:

Determine the fuel consumption rate of this car if the fuel has a heating value of 19,000 Btu/lbm.

Solution:

The net work output of the engine is defined as

$$W'_{\text{net,out}} := 65\text{hp} = 165388 \cdot \frac{\text{Btu}}{\text{hr}}$$

The thermal efficiency of the engine is defined as

$$\eta_{\text{th}} := 24\% = 0.24$$

The heating value of the car's fuel is defined as

$$\text{HV} := 19000 \frac{\text{Btu}}{\text{lbm}}$$

The heat supplied to the engine may then be found from the definition of thermal efficiency. This is shown below.

$$\eta_{\text{th}} = \frac{W'_{\text{net,out}}}{Q'_H} \quad \text{or} \quad Q'_H := \frac{W'_{\text{net,out}}}{\eta_{\text{th}}} = 689117 \cdot \frac{\text{Btu}}{\text{hr}}$$

The fuel consumption rate is then given by

$$m'_{\text{fuel}} := \frac{Q'_H}{\text{HV}} = 36.27 \cdot \frac{\text{lbm}}{\text{hr}}$$