

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

$$\dot{W}'_{net,out} := 65 \text{ hp} = 1.654 \cdot 10^5 \frac{\text{BTU}}{\text{hr}}$$

The thermal efficiency of the engine is defined as

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

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

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

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

$$\eta_{th} = \frac{\dot{W}'_{net,out}}{\dot{Q}'_H} \quad \text{or} \quad \dot{Q}'_H := \frac{\dot{W}'_{net,out}}{\eta_{th}} = 6.891 \cdot 10^5 \frac{\text{BTU}}{\text{hr}}$$

The fuel consumption rate is then given by

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