ME 322 – Thermodynamics

Unit Conversion Activity

Background:

Keeping track of and working with units is an important component of engineering problem solving. In this activity you will perform a few unit conversions – some in SI units, and some in English units.

Objectives:

1. Use units as a quick way to check answers.
2. Keep track of and cancel units (and conversions) in all hand calculations on assignments.

Problems:

1. The net thermal efficiency (η_o) can be defined by the equation:

$$\eta_o = \frac{1}{-\Delta H * sfc}$$

Where $-\Delta H$ is the heating value of the fuel, and sfc is the specific fuel consumption.

For a particular engine using gasoline fuel ($-\Delta H$ = 42 MJ/kg) the specific fuel consumption is measured to be 248 g/kW*hr. Calculate the net thermal efficiency for this engine.

2. For the same engine, as measured in English units, the values were: $-\Delta H = 1.81 * 10^4$ Btu/lbm, and sfc=0.408 lbm/hp*hr. Calculate the net thermal efficiency for this engine.

1) $\eta_o = \frac{1}{42\ \text{MJ}} \left| \frac{\text{kg}}{248\ \text{g}} \right| \frac{\text{kW}\cdot\text{hr}}{\text{kW}} \left| \frac{1000\ \text{J}}{\text{sec}} \right| \frac{3600\ \text{sec}}{\text{hr}} \left| \frac{1000\ \text{g}}{\text{kg}} \right| \frac{\text{MJ}}{10^6\ \text{J}}$

$= 0.346$

$= 34.6\%$

2) $\eta_o = \frac{1}{1.81 \times 10^4\ \text{Btu}} \left| \frac{\text{lbm}}{0.408\ \text{lbm}} \right| \frac{\text{hp}\cdot\text{hr}}{\text{Btu}} \left| \frac{}{778.169\ \text{ft}\cdot\text{lbf}} \right| \frac{\text{hp}}{550\ \frac{\text{ft}\cdot\text{lbf}}{\text{sec}}} \left| \frac{3600\ \text{sec}}{\text{hr}} \right.$

$= 0.346$

$= 34.6\%$