ENGINE HEAT REJECTION CALCULATION

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September 20, 2010

(DISCLAIMER: This worksheet is shared only as an example and should be used with caution. The calculations are not guaranteed to be error free.)

GOAL: To calculate the max required temperature of the engine coolant entering the engine, given the coolant flow rate, engine heat rejection, and resulting temperature of the coolant leaving the engine.

A. DEFINE UNIT FOR MEASURING TEMPERATURE DIFFERENCES

$\Delta F = 0.55555555555\,K$

B. SPECIFY THE COOLANT PROPERTIES

$c_p = 0.865\,\frac{BTU}{lb\,\Delta F}$ (specific heat for 50% Ethylene Glycol Solution at 93.3 deg C)

$\rho = 8.3441\,\frac{lb}{gal}$ (density for 50% Ethylene Glycol Solution at 93.3 deg C)

C. SPECIFY THE MAIN ENGINE HEAT REJECTION DATA

$q = 88716\,\frac{BTU}{min}$ (heat rejection)

$GPM_{main} = 180\,\frac{gal}{min}$ (coolant flow rate)

$T_{out} = 192\,°F$ (temperature out of the engine and into the heat exchanger)

D. CALCULATE MAX ALLOWED TEMPERATURE INTO THE ENGINE

After specifying all the input values above, the following formula may be used to calculate the temperature differential:

$$\Delta T = \frac{q}{GPM_{main} \cdot c_p \cdot \rho}$$ (formula for calculating temperature differential)

The resulting temperature differential is:

$\Delta T = 68.29\,\Delta F$ (temperature differential)

This temperature diffential may be used to calculate the temperature into the engine using the formula below:

$T_{in} = T_{out} - \Delta T$ (formula for calculating temperature into the engine)

Therefore, the max allowed temperature into the engine is:

$\boxed{T_{in} = 123.71\ °F}$ (max allowed temperature into the engine)