37.38 A radiator is designed for $100°F$ entering air and $150°F$ leaving air. The inlet water is expected to enter at $212°F$ and leave at $195°F$. The radiator may be treated as a counterflow heat exchanger with a heat transfer surface area of $10ft^2$ and an overall coeffieient of heat transfer of $11\frac{Btu}{hr \cdot ft^{2} \cdot °F}$. What is the rate of heat transfer?

A. $5000\frac{Btu}{hr}$

B. $8100\frac{Btu}{hr}$

C. $8500\frac{Btu}{hr}$

D. $10,500\frac{Btu}{hr}$

Calculate the log mean temperature difference for the radiator modeled as a Counterflow heat exchanger. Draw the heat exchanger and label the temperatures.

$$Hot\,Fluid:\ 212°F \longrightarrow 195°F$$

$$Cold\,Fluid:\ 150°F \longleftarrow 100°F$$

Define one *physical* side of the heat exchanger as 'A' and the other side as 'B' and determine the respective temperature differences.

$$\Delta T_A = 212°F - 150°F = 62°F$$

$$\Delta T_B = 195°F - 100°F = 95°F$$

Use the formula below to calculate the log mean temperature difference.

$$LMTD_{counterflow} = \frac{\Delta T_A - \Delta T_B}{ln\left(\frac{\Delta T_A}{\Delta T_B}\right)}$$

$$LMTD_{counterflow} = \frac{62°F - 95°F}{ln\left(\frac{62°F}{95°F}\right)} = 77.3°F$$

Calculate the heat transfer for the heat exchanger:

$$\dot{Q} = UA\Delta T_{lm} = \left(11\frac{Btu}{hr \cdot ft^2 \cdot °F}\right)\left(10ft^2\right)\left(77.3°F\right) = 8506\frac{Btu}{hr}$$

Answer C