36.36 In a counterflow heat exchanger, the cold fluid increases in temperature from $50°F$ to $100°F$ and the warm fluid is cooled from $180°F$ to $145°F$. What is the logarithmic mean temperature difference?

A. $45°F$

B. $87°F$

C. $115°F$

D. $119°F$

It is valid to use the Reference Handbook formula for Log Mean Temperature Difference. There is also a generalized version of the LMTD equation not provided in the reference handbook which is easier to remember and applies to both Counterflow and Parallel Flow heat exchangers, provided the flow directions are drawn out first. Note the opposite direction for the arrows for a counterflow heat exchanger.

$$Cold\,Fluid:\ 50°F \longrightarrow 100°F$$

$$Hot\,Fluid:\ 145°F \longleftarrow 180°F$$

Define one *physical* side of the heat exchanger as 'A' and the other side as 'B' and determine the respective temperature differences. Conveniently, the assignment of labels A and B turns out to be arbitrary. However, the *direction* of the flows is critical.

$$\Delta T_A = 145°F - 50°F = 95°F$$

$$\Delta T_B = 180°F - 100°F = 80°F$$

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

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

$$LMTD = \frac{95°F - 80°F}{ln\left(\frac{95°F}{80°F}\right)} = 87.3°F$$

Answer B