32.26 During summer operation, a 70% effective sensible heat recovery device pre-cools $8000cfm$ of outside air at $95°F$ and 65% relative humidity. $10,000cfm$ of exhaust air at $75°F$ and 50% relative humidity is available for use. What is the temperature of the supply air after pre-cooling?

A. $75°F$

B. $78°F$

C. $81°F$

D. $84°F$

Sketch the sensible Heat Recovery device and label the airstreams. Consider the $95°F$ entering outside air as State 1, the pre-cooled supply air of unknown temperature as State 2, and the entering $75°F$ exhaust air as State 3. There is no need to consider the exhaust air leaving the device after accepting heat from the outside air stream.

$$T_1 \longrightarrow T_2$$

$$T_4 \longleftarrow T_3$$

For a *sensible* heat recovery device, there is no need to consider humidity as there is no latent heat being transfered. The process is strictly limited to sensible heat transfer driven by the difference in temperature between the two streams. There is also no need to consider the flow rates. The device effectiveness is has been given and may be assumed to incorporate the effects of the flow rates being different between the two sides of the heat exchanger.

Express the effectiveness as the ratio of the actual ΔT for the outside air stream as compared to the maximum ΔT theoretically possible. Solve for the leaving supply air temperature, T_2.

$$\varepsilon = \frac{T_1 - T_2}{T_1 - T_3}$$

$$T_2 = T_1 - \varepsilon\left(T_1 - T_3\right)$$

$$T_2 = 95°F - 0.7\left(95°F - 75°F\right) = 81°F$$

Answer C