Using the return humidity ratio and the return dry bulb temperature, use the psychrometric chart again to determine the return relative humidity:

$$\phi_r = 38\% < 60\%$$

Since the return relative humidity is less than the allowable maximum of 60%, the initial assumption that the sensible load would drive the CFM was correct.

Answer C

41.15 **$1000cfm$ of air at $76°F$ and 60% relative humidity is removed from a room. $300cfm$ is cooled to $54°F$ dry bulb and $52°F$ wet bulb. The remaining volume bypasses the cooling coil and is mixed with the conditioned air. What is the relative humidity of the discharge air after mixing?**

A. 58%

B. 63%

C. 65%

D. 68%

Let the leaving coil air condition be considered state 1 and the room/return/bypass air condition be state 2. Both states are fully defined. Use the psychrometric chart to look up the humidity ratio at both states.

$$T_{1,db} = 76°F$$

$$\phi_1 = 60\%$$

$$\omega_1 = .01154 \frac{lb_w}{lb_{da}}$$

$$T_{2,db} = 54°F$$

$$T_{2,wb} = 52°F$$

$$\omega_2 = .0078 \frac{lb_w}{lb_{da}}$$

Since only $300cfm$ goes over the cooling coil, the remaining $700cfm$ is bypassed and mixed with the conditioned air downstream of the cooling coil. For a $1,000cfm$ fan coil unit, this implies that 30% of the air is cooled and 70% gets bypassed. Perform separate mixing calculations to determine the temperature and humidity ratio of the mixed air being supplied to the room:

$$T_m = (.7)\,(76°F) + (.3)\,(54°F) = 69.4°F$$

$$\omega_m = (.7)\left(.01154\frac{lb_w}{lb_{da}}\right) + (.3)\left(.0078\frac{lb_w}{lb_{da}}\right) = .0104\frac{lb_w}{lb_{da}}$$

Use the psychrometric chart once more to find the relative humidity for the mixed air condition which is now fully defined.

$$\phi_m = 68\%$$

Answer D

41.16 At what temperature will moisture begin to condense out of atmospheric air being cooled from $200°F$ and 10% relative humidity?

A. $101°F$

B. $107°F$

C. $109°F$

D. $117°F$

The temperature at which moisture will begin to condense out of air is called the Dew Point Temperature. See dew-point temperature in the reference handbook. Use the high temperature psychrometric chart. The condition is fully defined. Locate the state point, then follow horizontally to the left until reaching the saturation curve to read the dew point temperature.

$$T_{dp} \approx 107°F$$

Answer B

41.17 The combustion products from an industrial process are passed through a heat exchanger for energy recovery at $30psia$. The humidity ratio is $800\frac{grains\ H_2O}{lb_{da}}$. What is the dew point of the exhaust stream?

A. $130°F$

B. $140°F$

C. $150°F$

D. $160°F$

Calculate the humidity ratio of the combustion products. Assume the products are similar to moist air i.e. the mixture is comprised of dry air and water vapor. There are 7,000 grains of moisture per pound of water.

$$\omega = \frac{800grains}{lb_{da}}\left(\frac{1lb_w}{7000grains}\right) = .1143\frac{lb_w}{lb_{da}}$$