$$T_{dp,1} = 55.8°F$$

For state 2, since the process line is horizontal, the dew point temperature is the same. Taken together, the dew point and the relative humidity fully define state 2. Obtain the dry bulb temperature at state 2 (after heating).

$$T_{dp,2} = T_{dp,1} = 55.8°F$$

$$\phi_2 = 60\%$$

$$T_{db,2} = 70.4°F$$

Use the sensible heating rule of thumb to calculate the required heating capacity to increase the dry bulb temperature from state 1 to state 2. Note it is not necessary to multiply by the number of fan coil units as the problem asks for the capacity per unit.

$$\dot{Q}_s = 1.08cfm\Delta T$$

$$\dot{Q}_s = 1.08\,(200)\,(70.4 - 62) = 1814\frac{Btu}{hr}$$

Answer A

43.6 A $5000ft^2$ laboratory has 200 occupants in the summer. In addition to the required fresh air, additional outside air at $90°F$ db, $75°F$ wb infiltrates into the building at 1 air change per hour. The building volume is $75,000ft^3$ and the inside design conditions are $72°F$ and 50% RH. What is the total cooling delivered by the ventilation system?

A. $7tons$

B. $8tons$

C. $19tons$

D. $21tons$

The cooling capacity of the ventilation system must be sized for both the minimum fresh air provision and the infiltration.

Look up ventilation rates in the Reference Handbook and find a table with different occupancy categories. Note the minimum ventilation requirements for a laboratory per person and per square foot are:

$$R_p = 10\frac{cfm}{person}$$

$$R_a = .18\frac{cfm}{ft^2}$$

Apply the Ventilation Rate Procedure (VRP). This is simply a matter of accounting for the number of occupants in the building and the amount of area, and using the values previously obtained. The required volume of outside air for ventilation is:

$$\dot{V}_{oa} = (200people)\left(10\frac{cfm}{person}\right) + (5000ft^2)\left(.18\frac{cfm}{ft^2}\right) = 2900cfm$$

Determine the volume flow rate due to infiltration. Use the building volume, air changes per hour (ACH), and convert the time to obtain cfm:

$$\dot{V}_{infiltration} = \left(1\frac{air\ change}{hr}\right)\left(75000\frac{ft^3}{air\ change}\right)\left(\frac{1hr}{60min}\right) = 1250cfm$$

The total volume flow rate of outside air that needs to be cooled is the sum of the ventilation and infiltration:

$$\dot{V}_{total} = \dot{V}_{oa} + \dot{V}_{infiltration} = 2900cfm + 1250cfm = 4150cfm$$

Both the outside and inside conditions are fully defined. Let the outside be state 2 and the inside be state 1. Find the enthalpy for both states:

$$T_{db,1} = 90^\circ F$$

$$T_{wb,1} = 75^\circ F$$

$$h_1 = 38.4\frac{Btu}{lb}$$

$$T_{db,2} = 72^\circ F$$

$$\phi_2 = 50\%$$

$$h_2 = 26.4\frac{Btu}{lb}$$

Use the total cooling rule of thumb to calculate the total cooling delivered by the ventilation system. Convert to refrigeration tons:

$$\dot{Q}_t = 4.5cfm\Delta h$$

$$\dot{Q}_t = 4.5\,(4150)\,(38.4 - 26.4) = 224,100\frac{Btu}{hr}\left(\frac{1ton}{12000\frac{Btu}{hr}}\right) = 18.7tons$$

Answer C