

47.70 $20 \frac{lb_m}{min}$ of $50^\circ F$ air at atmospheric pressure enters an air compressor and exits at $350^\circ F$. What is the power required to drive the compressor?

- A. $34hp$
- B. $40hp$
- C. $114hp$
- D. $142hp$

Consider the air entering the **Compressor** as State 1 and the air exiting the compressor as State 2. Since there is not enough information about State 2 to fully define it, assume the air behaves as an **Ideal Gas with Constant Specific Heats**. Solve for the compressor power and convert units to hp .

$$\dot{W}_{comp} = \dot{m}c_p(T_e - T_i)$$

$$\dot{W}_{comp} = \left(20 \frac{lb}{min}\right) \left(0.24 \frac{Btu}{lb \cdot ^\circ F}\right) (350^\circ F - 50^\circ F) = 1440 \frac{Btu}{min}$$

$$\dot{W}_{comp} = 1440 \frac{Btu}{min} \left(\frac{60min}{1hr}\right) \left(\frac{1KW}{3412 \frac{Btu}{hr}}\right) \left(\frac{1hp}{0.7457KW}\right) = 34hp$$

Answer A

47.71 What is the wet bulb temperature of $150^\circ F$ sea level air with 50% relative humidity?

- A. $123^\circ F$
- B. $126^\circ F$
- C. $135^\circ F$
- D. $138^\circ F$

Use the high temperature **Psychrometric Chart**. Identify the state point which is fully defined since the temperature and relative humidity are both given.

$$T = 150^\circ F$$

$$\phi = 50\%$$

Read the wet bulb temperature from the light gray diagonal lines that run from west-northwest to east-southeast on the chart. Note the wet bulb temperature and enthalpy are not perfectly parallel at high temperature. Special care should be taken to avoid inadvertently reporting the enthalpy value rather than the wet bulb temperature, as $120^\circ F wb$ and $120 \frac{Btu}{lb}$ are close together, and the constant enthalpy lines are heavier and easier to read.

The light gray lines of constant wet bulb temperature are $2^\circ F$ apart. By visual inspection, the state point in consideration is between $125^\circ F wb$ and $126^\circ F wb$.

Answer B