This product has been updated to incorporate all changes shown in the comments on the webpage and email comments as of February, 2 2018. If you have purchased this product prior to this date and wish for the latest version then please email Justin Kauwale at contact@engproguides.com.

Question & Solution 5: The statement, "The airflow rate is 2,000 CFM." has been added to the question.

Question 7: Solution C was edited to read, "(C) 127".

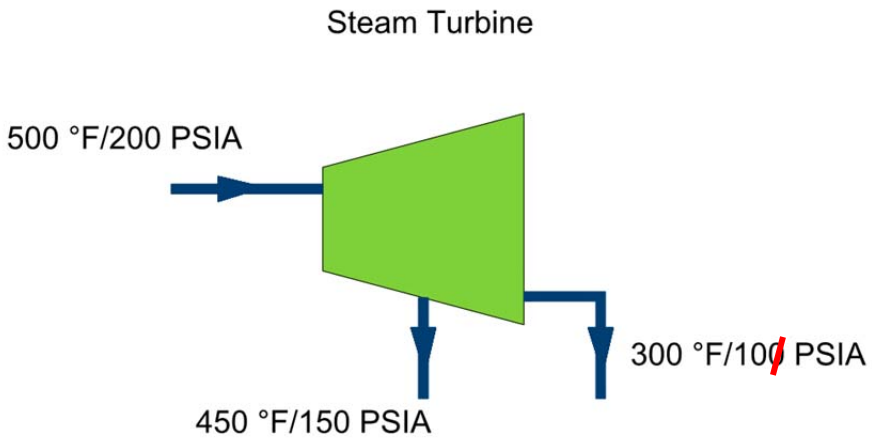
Solution 7: The solution was edited as shown in red below.

$$V_t = 10{,}000\ gallons \frac{\left(\left(\frac{0.0161\frac{ft^3}{lb}}{0.016\frac{ft^3}{lb}}\right) - 1\right) - 3 * 6.5\ x\ 10^{-6}\frac{in}{in\ F} * (30\ F)}{1 - \frac{24.7\ psia}{44.7\ psia}}$$

$$V_t = 126.6\ gallons$$

The correct answer is most nearly, **(C) 127 gallons**.

Solution 8: The output condition has been edited to read, 300 F/10 PSIA.



QUESTION 5

A 50 ft long, 20” x 20”, cold supply air duct is insulated and is located outdoors. The duct carries air at a design temperature of 55 F DB/54 F WB. The outdoor air design temperature is 90 F/87% RH. The heat transfer rate from the duct is 20 Btu/h-ft^2. The heat capacity of air is 0.24 Btu/lbm-F. What is the temperature at the end of the duct run? The airflow rate is 2,000 CFM.

(A) 55 °F

(B) 58 °F

(C) 60 °F

(D) 61 °F

QUESTION 6

The flue gas of a boiler is analyzed and shown to have the following approximate percentages by volume: 10.8% CO_2, 4.6% O_2 and 84% N_2. The fuel is propane gas (commercial) and there is negligible CO. What is the percent excess air? The P/A ratio is 0.9.

(A) 10%

(B) 15%

(C) 20%

(D) 25%

QUESTION 7

A diaphragm, expansion tank shall be provided for a chilled water system that operates at a design temperature of 45 F. The minimum pressure at the tank is 10 psig and the maximum pressure at the tank is 30 psig. The expansion tank is located at the return line to the pump. The pump provides an addition of 100 psig of pressure. The total volume of water in the chilled water system is 10,000 gallons and the piping is steel. The maximum temperature of the chilled water is 75 F. What is the size of the expansion tank?

(A) 15 gallons

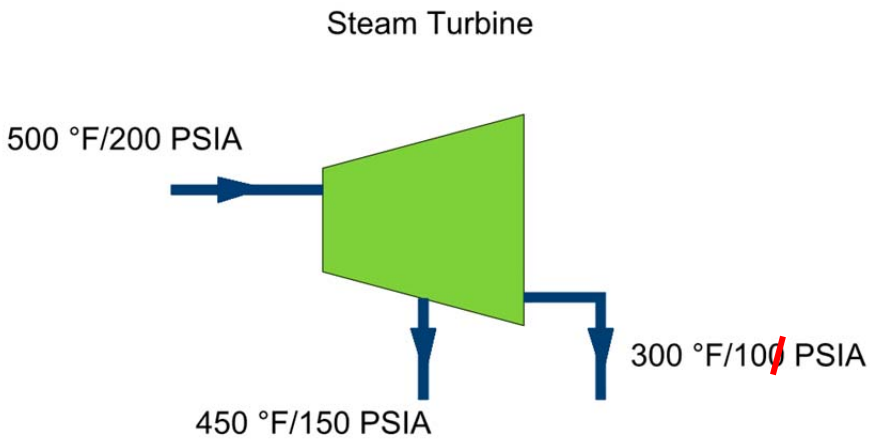
(B) 75 gallons

(C) 127 gallons

(D) 245 gallons

QUESTION 8

A steam turbine diagram is shown below, which of the following names best describes the turbine?



(A) Condensing, single extraction turbine

(B) Condensing, double extraction turbine

(C) Backpressure, single extraction turbine

(D) Backpressure, double extraction turbine

SOLUTION 5

A 50 ft long, 20" x 20", cold supply air duct is insulated and is located outdoors. The duct carries air at a design temperature of 55 F DB/54 F WB. The outdoor air design temperature is 90 F/87% RH. The heat transfer rate from the duct is 20 Btu/h-ft^2. The heat capacity of air is 0.24 Btu/lbm-F. What is the temperature at the end of the duct run? The airflow rate is 2,000 CFM.

(A) 55 °F

(B) 58 °F

(C) 60 °F

(D) 61 °F

First, navigate to **ASHRAE Fundamentals Chapter 23 Insulation for Mechanical Systems**. There is an equation that calculates the temperature change in a duct. This equation is shown below.

$$t_{change} = 0.2\left(\frac{qPL}{Vc_p\rho A}\right)$$

Next, use your psychrometric chart to find the air density of the air within the duct. $\rho = 0.077\ lb/ft^3$. The outdoor temperatures are already factored with the heat transfer rate. You will also need the air velocity.

$$V = \frac{2000\frac{ft^3}{min}}{\frac{20\ in * 20\ in}{144\ in^2/ft^2}} = 720\frac{ft}{min}$$

$$t_{change} = 0.2 * \left(\frac{20\frac{Btu}{h-ft^2} * 4 * 20\ in * (50\ ft)}{\left(720\frac{ft}{min}\right) * 0.24\frac{Btu}{lbm-F} * \left(0.077\frac{lb}{ft^3}\right) * 20in * 20in}\right)$$

$$t_{change} = 3\ °F$$

The correct answer is most nearly, **(B) 58 F**.

SOLUTION 7

A diaphragm, expansion tank shall be provided for a closed cooling water system that operates at a design temperature of 45 F. The minimum pressure at the tank is 10 psig and the maximum pressure at the tank is 30 psig. The expansion tank is located at the return line to the pump. The pump provides an addition of 100 psig of pressure. The total volume of water in the chilled water system is 10,000 gallons and the piping is steel. The maximum temperature of the chilled water is 75 F. What is the size of the expansion tank?

(A) 15 gallons

(B) 75 gallons

(C) 127 gallons

(D) 245 gallons

For this question, navigate to **ASHRAE Systems and Equipment 2016, Chapter 13 Hydronic Heating and Cooling**. Find the diaphragm expansion tank equation.

$$V_t = V_s \frac{\left(\left(\frac{v_2}{v_1}\right) - 1\right) - 3\alpha\Delta t}{1 - P_1/P_2}$$

First, you need to find the specific volume of water at the lower temperature and higher temperature. There is not much change in the specific volume. These values can be found in ASHRAE Fundamentals 2017, Chapter 1.

$$v_2(75\ F) = 0.0161\frac{ft^3}{lb}; v_1(45\ F) = 0.016\frac{ft^3}{lb};$$

Next, you need the thermal expansion coefficient for steel which is given near the equation above in the same ASHRAE Systems and Equipment Chapter 13.

$$\alpha = 6.5\ x\ 10^{-6}\frac{in}{in\ F}$$

Now, convert the gauge pressures to absolute pressures.

$$P_1 = 10 + 14.7 = 24.7\ psia; P_2 = 30 + 14.7 = 44.7\ psia$$

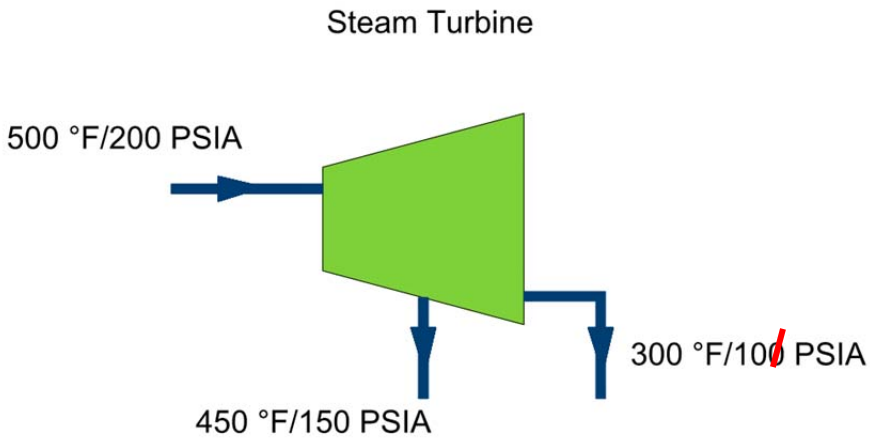
Finally, plug in all the values to the previous equation.

$$V_t = 10{,}000\ gallons \frac{\left(\left(\frac{0.0161\frac{ft^3}{lb}}{0.016\frac{ft^3}{lb}}\right) - 1\right) - 3 * 6.5\ x\ 10^{-6}\frac{in}{in\ F} * (30\ F)}{1 - \frac{24.7\ psia}{44.7\ psia}}$$

$$V_t = 126.6\ gallons$$

SOLUTION 8

A steam turbine diagram is shown below, which of the following names best describes the turbine?



(A) Condensing, single extraction turbine

(B) Condensing, double extraction turbine

(C) Backpressure, single extraction turbine

(D) Backpressure, double extraction turbine

For this problem, you can use your Power Plant Engineering, Chapter 8 Steam Turbines. This chapter gives various types of steam turbines. During the expansion of steam through a turbine, the removal of steam from an intermediate stage is called an extraction. This figure shows a single extraction. A turbine that exhausts at a liquid is called a condensing turbine. These turbines have a built-in condenser. Non-condensing turbines exhaust at higher pressures and the exhaust condition is pressurized steam. Non-condensing turbines are also called backpressure turbines. This figure shows exhaust conditions at a superheated vapor (300 F, 10~~0~~ PSIA). Thus the figure shows a backpressure turbine.

The correct answer is most nearly, **(C) Backpressure, single extraction turbine**.