Calculate the total pressure drop for the longest run in feet of head. This is the minimum head pressure that must be added by the pump set.

$$h_A = h_f + h_{AHU} + h_{chillers}$$

$$h_A = 9.6ft + 17.24ft + 15ft \approx 44ft$$

Answer B

47.44 A 75% efficient fuel pump supplies $50gpm$ of No. 2 diesel fuel ($SG = 0.88$). The differential pressure across the pump is $30psi$. The motor driving the pump is 82% efficient. What is the electrical demand to run the pump?

A. $930W$

B. $1.1KW$

C. $1.2KW$

D. $1.4KW$

First determine the hydraulic horsepower produced by the pump, then use the efficiencies to determine the electrical demand to run the pump.

The specific gravity is required only when the differential pressure is given in feet of head. When the pressure added by the pump is already in *psi*, select the formula for Water Horsepower that uses ΔP directly. For this formula, the units for the flow rate, Q, must be *gpm*. The units for differential pressure, ΔP, must be *psi*.

$$whp = \frac{Q\Delta P}{1714}$$

$$whp = \frac{(50)(30)}{1714} = 0.875hp$$

The brake horsepower, *bhp*, is the water horsepower divided by the pump efficiency.

$$bhp = \frac{whp}{\eta_{pump}}$$

The electrical demand, $\dot{W}$, is the brake horsepower divided by the motor efficiency.

$$\dot{W} = \frac{bhp}{\eta_{motor}}$$

By substitition the electrical demand can be expressed as the water horsepower divided by both the pump and motor efficiencies. Calculate the power required to run the pump. Convert units to KW.

$$\dot{W} = \frac{whp}{\eta_{pump}\eta_{motor}}$$

$$\dot{W} = \frac{0.875hp}{(0.75)(0.82)}\left(0.7457\frac{KW}{hp}\right) = 1.06KW$$

Answer B

47.45 A 90% efficient pump normally delivers $50gpm$ of $50°F$ chilled water at a head of $20ft$ of water with a rotational speed of $900rpm$. What is the percent increase in brake horsepower required to increase the volume flow rate by 10%? Assume the pump is oversized and has sufficient capacity in reserve to deliver the additional flow.

A. 10%

B. 21%

C. 33%

D. 46%

Refer to the Pump Affinity Laws. Change in speed and change in volume flow rate are proportional. Therefore, when the volume flow inceases by 10%, the speed also increases by 10%. Establish the ratio of new to old volume flow rate and speed.

$$\frac{Q_2}{Q_1} = \frac{N_2}{N_1} = 1.1$$

The percent increase in brake horsepower is a function of the cube of the change in speed (or volume flow rate).

$$\frac{bhp_2}{bhp_1} = \left(\frac{N_2}{N_1}\right)^3 = (1.1)^3 = 1.33$$

Therefore, a 33% increase in power is required to support a 10% increase in the speed / volume flow rate.

Note there is no need to caclulate the actual brake horsepower to determine the percent change. The specific value of various parameters given are additional information not required to answer the fundamental question put forth, which is purely an application of the pump affinty laws.

Answer C

47.46 $100gpm$ of a liquid with a specific gravity of 0.8 is supplied by a pump operating with a differential pressure of $10psi$. What is the hydraulic horsepower?

A. $0.2hp$

B. $0.3hp$

C. $0.5hp$