Homework #3 Pumping VINPLT

1. You are using the MEASUR pump head calculator. The pipe diameter where the discharge pressure gauge is located is measured in 12” diameter pipe. The pump discharge pipe size is 8” diameter. There is an 8” diameter check valve, k = 2.0, just downstream of the pump before the expander. What k value should be used in MEASUR as the loss coefficient for the check valve?

**Answer: k (adjusted) = 2.0 x (12/8)4 = 10.125**

1. Download and install PSAT and Valve tool from: <https://www.energy.gov/eere/amo/downloads/pumping-system-assessment-tool-psat> .

Using Valve Tool evaluate the following valve pressure loss situation. Upstream pipe size: 8” diameter, downstream pipe diameter: 8”; control valve size: 6” diameter; upstream pressure is 89.3 psig; valve Cv is estimated as 462.3 gpm/(psi)0.5; upstream gauge elevation is 3 feet; downstream gauge elevation is 5 feet; flow rate is 1500 gpm; pump efficiency is 75%; motor efficiency is 95%; cost of electricity is $0.08/kWh; the pump operates all of the time; the specific gravity of the hot water pumped is 0.95. What is the annual cost of the valve pressure loss?

**Solution: $6,909/year**



1. Using Valve Tool evaluate the following valve pressure loss situation. Upstream pipe size: 6” diameter, downstream pipe diameter: 6”; control valve size: 4” diameter; upstream pressure is 102.7 psig; valve Cv is taken as 462.3 gpm/(psi)0.5; upstream gauge elevation is 5 feet; downstream gauge elevation is 10 feet; downstream pressure is 82.9 psig; pump efficiency is 75%; motor efficiency is 95%; cost of electricity is $0.08/kWh; the pump operates 6000 hr/yr; the specific gravity of the hot water pumped is 1.0. What is the flow rate?

**Solution: 1,560 gpm**



1. A 200 hp energy efficient motor operates driving a centrifugal pump. Current and voltage measurements are taken: Current phase A = 152.8 amps; phase B = 161.9 amps; phase C = 155.4 amps. The voltage measurements are: voltage B-C = 482.6 volts; voltage A-C = 479.6 volts; voltage A-B = 484.7 volts. The motor rotational speed is 1780 rpm. Use the Motor Performance Calculator in MEASUR to estimate the power factor. Then calculate the kW of electric power the motor is using.

**Solution: From figure below the power factor is 84%. Average current is 156.7 amps; Average voltage is 482.3 volts; the percent full load amps is (156.7/215.36) x 100 = 72.8% (~73%)**

**Then the power is = (482.3 x 156.7 x SQRT(3) x 0.84)/1000 = 109.96 kW**



1. The data below are taken from a pump curve for a speed of 1750 rpm and when plotted will recreate that curve. Input this data into an Excel sheet. Plot the data with flow on the X-axis and head on the Y-axis. Using the pump affinity laws plot out modified pump curves for the following rotational speeds: 1790 rpm; 1600 rpm, 1200 rpm and 800 rpm.





**Solution:**

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