1. You are designing a pumping station and have been asked to size the impellor from pump C-3311.

The system step is as follows: the discharge line is a 21-inch diameter PVC pipe with an assumed constant friction factor of f = 0.014. The length of the piping is 2300 ft with an elevation gain of 40 ft and an exit loss (K=1.0).. The pump station is located near sea level and the temperature of the flow stream is 50 degrees F. The 2-ft diameter PVC suction pipe is expected to be approximately 40 ft long (f=0.014) and will contain 3 elbows (minor loss, K = 0.9/elbow) and a square edge entrance (K = 0.5). The electric motor's efficiency is 83%.

Find:

a. From the attached C-3311 pump performance curve, select a suitable impeller. (State any assumptions and state the criteria used for selecting an impeller). Draw your system curve on the pump curve.
b. Determine the flow rate in the system with the pump you selected.
c. What is the total head that the pump adds to the system (water horsepower)?
d. What is the efficiency of the pump?
e. At the efficiency you found in part D, what is the minimum horsepower requirement of the motor (ie: what is the brake horsepower).
f. What is the line power required (in kW) for the motor?
g. If the cost of electricity is $0.07/kWhr (kilowatt hour), what is the cost of operation for each pump for one-year if it operates on average 10 hours a day?
h. Water is often sold in units of volume. What is the pump's power cost for pumping 10,000 gallons?
i. Relative to the water surface, were can the pump be placed (think NPSH)?

throat
cavitate

Graduate students:

j. What is the real friction factor?
k. Qualitatively (no number needed), explain how this would change your analysis.

2. Assuming that you use the same pump/impellor as in problem #1. However, now a maximum flow, Q = 5000 gpm is required, so a valve is placed at the end of the line to control the flow rate. Determine:
   a. The minor loss coefficient required to throttle the flow
   b. The headloss due to only the valve and lost power (kW)

3. Undergrad:

original Rotation = 1750

   a. A variable speed drive has been connected to the pump. If you rotate the pump at R = 1500 RPM, what is the flow rate (Q) and head (H), in the system. For this problem (in excel), plot the original pump and system curve and the new curve at R = 1500 RPM.

1750

Graduate

   a. Create a spreadsheet to plot the original pump curve and system curve. Develop your spreadsheet to find the correct rotation speed to deliver Q = 5000 gpm.
   b. Compute the power and electrical cost required for Q = 5000 gpm for 10 hrs/day for 1 year with an electrical cost of $0.07/kWhr and a motor efficiency of 83%.
   c. Given that the variable speed drive cost $35,000 and the net interest rate i = 6.5% would you recommend that the variable speed drive be purchased or should the valve be used? Explain why.

C-3311	IMPELLER PERFORMANCE CURVES	WASTEWATER	SECTION 3	PAGE 2
			SUPERSEDES 2/88	ISSUED 12/91

IMPELLER CODE
832
3 VANE IMPELLER

CAUTION:

DO NOT SELECT A DUTY POINT ON THE DASHED PORTION OF A PERFORMANCE CURVE. INTERMITTENT OPERATION (SHORT PERIODS) IS ACCEPTABLE HOWEVER.

FOR AN INDIVIDUAL PERFORMANCE GUARANTEE CURVE, CONTACT YOUR LOCAL ITT FLYGT REPRESENTATIVE.

HEAD (-) HYDRAULIC END EFFICIENCY (%) AND (---) POWER LIMITS