

TECHNICAL REPORT GRADE SHEET

1/4

Experiment: Centrifugal Pumps **Project #** _____

Date: _____ **Section #** _____

Report Grade: _____ **Group #** _____

E1: _____ **E2:** _____ **E3:** _____

Criteria	Description	Points Possible	Points Received
Cover Memo or Abstract	Complete. State objectives. Gives precise "big picture" statement of most important results and conclusions. State methods as needed.	10	
Intro. & Objectives	Interesting, relevant. Objectives clear, concise, quantitative, specific to project.	10	
Literature Review	Three research articles. Relevant. Concise but informative summary.	10	
Apparatus and Procedure	Good schematic and discussion thereof. Relates measurements to data needed to meet objectives. No 2 nd person. Not written to operator or technician. Does not assume Instructor has prior knowledge.	10	
Principles/ Equations	Complete and correct. Relates to objectives. Shows physical meaning. Relates to experiments. Equations numbered. Standard symbols used. Sufficient references. Does not assume instructor's prior knowledge.	10	
Experimental Plan	Concise but clear description of the conditions, levels, exact runs performed. Total number of runs.	5	
Results and Discussion	Logical and orderly. Relates to project objectives. Each figure and table called out & discussed thoroughly. Good topic sentences followed by strong paragraphs. Each observation and conclusion supported. Thorough. Does not assume Instructor has prior knowledge. Critical	20	
Conclusions	Supported by Results and Discussion. Consistent w/ Objectives. Repeat quantitative, specific findings. Relevant and useful. Critical Thinking	5	
Literature Cited	Cite all relevant journal articles, books, handbooks, etc. wherever needed in the main body. Use standard (ACS Guide) methods to call out citations. Provide complete bibliographic info. In the Lit. Cited section. No footnotes. Minimize direct quotes. No titles cited in the text.	5	
Appendix I	Copies of Laboratory Notebook pages.	5	
Appendix II	Copy of Sample Calculations.	5	
Appendix III	Copy of three articles cited in Lit Review.	5	
Lab Notebook Appendix	Submit raw data; copy pages from notebook	5	
Documentation Appendix	Document sample calculations; provide sufficient narrative, working equations, units, etc. so that TA can follow the calculations.	5	
Appearance	All required sections. Margins observed. Neat handwriting if necessary. Stapled or clipped. Neat. Conform to Lab Manual instructions	5	

Figures	Informative titles and legends. Only 1 title per fig. Clear symbols and lines. Corrected Excel or PowerPoint defaults. Margins. Large enough to read. No excessive frames or borders. Discuss every figure. Capitalize "Figure x"	5	
Tables	Informative titles and headings. Describe content of tables (columns & rows). Only 3-4 significant digits. Show units. Useful information. Corrected Excel or PowerPoint defaults. Margins. Large enough to read. No excessive frames or borders. Discuss every table. Capitalize "Table y"	5	
Grammar and Spelling	Check verb use with "data." Complete sentences. Homonyms. Apostrophes. Minimal use of possessives. No 2 nd person. Noun / verb agreement.	5	
Digital Report	CD Included with the final report (in a single word document) and all files used to calculate the results recorded.	10	

Required Content

	Valve Coefficients		
1	For the test valve, determine the C_v as a function of valve position in % and compare your results with the manufacturer's data (provided).	4	
2	Make a graph of the results in terms of C_v versus % of full open. Discuss any differences between the two curves.	4	
	Pump Characteristic Curves		
3	For each recorded flow rate do the following: Calculate the pump head in feet of water for pump #1, pump #2 and for the series and parallel configurations of the two pumps. Tabulate your results. Consider why the static and dynamic heads associated with the locations of the gauges and pressure taps in the lines, in relation to the impeller inlet (suction) and outlet (discharge), can be neglected when calculating the pump head.	4	
4	For pumps #1 and #2 only, calculate the pump power in terms of work horsepower (whp) and the electrical horsepower (ehp). Then, calculate the overall, motor, and pump efficiencies in %. Finally, calculate the actual NPSH. Tabulate your results. Note that brake horsepower is obtained from the manufacturer's data sheet.	4	
5	On the same graph, plot the pump head in feet of water vs. flow rate in gpm for pumps #1 and #2. Plot the manufacturer's pump curves on this same graph. Discuss any differences between the two curves.	4	
6	On another graph, plot the pump head in feet of water vs. flow rate in gpm for each pump and for the series and parallel configurations. Discuss the differences between the two curves, especially those for the series and parallel configurations.	4	
7	For pumps #1 and #2 only, make a graph of the pump power associated with each pump in horsepower (hp) versus flow rate in gpm. Plot the corresponding manufacturer's data on this same graph. Discuss the differences between the two curves.	4	
8	For pumps #1 and #2 only, make a graph of the overall (hOA), motor (hm), and pump efficiencies (hp) in % vs. flow rate in gpm. Discuss the differences between the two curves.	4	

9	For pumps #1 and #2 only, make a graph of the pump efficiencies (<i>hp</i>) in % vs. flow rate in gpm. Compare your results with the manufacturer's data, noting that the efficiencies reported by the manufacturer on the data sheets are pump efficiencies. Discuss any differences between the two curves.	4	
10	Make a graph of the actual NPSH for each pump. On the same graph, plot the manufacturer's data on the required NPSH. Discuss any differences between the two curves.	4	
	System Curve and System Operating Point		
11	From the measured pressure differential across the chemical process valve, calculate the K-values corresponding to the two different positions of the valve.	4	
12	Calculate the cross sectional areas for the different components and tubing. These calculations are based on internal diameter for tubing and nominal size for a component. For example, since the system flow meter is of 1" nominal size, its cross sectional area is 0.00545 ft ² .	4	
13	Look up the needed K-values in the reference literature. For instance, V-5 is a 1" globe valve with a K value that can be found in Perry's Chemical Engineers Handbook, 7th Edition, Table 6-4.	4	
14	In a spreadsheet, range the values of water flow rate from 0.1 to 10 gpm in increments of 0.2 gpm.	4	
15	Calculate water flow rate in ft ³ /sec.	4	
16	Calculate the velocity [ft/sec] for each size tubing and component.	4	
17	Calculate the Reynolds number for each size tubing and component.	4	
18	terms of laminar or turbulent flow regimes. The K-values used are for turbulent flow only.	4	
19	Evaluate the friction factor for each size tubing by:	4	
20	Evaluating the roughness factor [ϵ] for the tubing inside diameter.	4	
21	Calculating ϵ/d .	4	
22	Using the Moody Chart, and obtaining values of the friction factor for each point in your spreadsheet, or recognize that the values of the friction factor are very close for each tubing size and vary linearly within the range of the Reynolds number. Enter the high and low values of the friction factor in the spread sheet and perform linear regression to obtain an equation to calculate the values of the Friction Factor for a given Reynolds number or just enter these values manually into your spreadsheet.	4	
23	Calculate the head loss for each tubing size.	4	
24	Calculate the head loss for each component using its K-value. Recall that the chemical process valve has two different K-values, which gives rise to two different system curves.	4	

25	For each position of the chemical process valve, sum all the head losses for each water flow rate and tabulate the results.	4	
26	From the measured pressure differentials across pump #2, obtained in Part III for the two different chemical process valve positions, calculate the operating point in terms of pump head in feet of water and tabulate these values with the corresponding flow rates in gpm.	4	
27	For pump #2 only, plot the head in feet of water vs. flow rate in gpm. On this same graph, plot both theoretical system curves in terms of total head loss in feet of water vs. water flow rate in gpm. Also, on this same graph, plot both experimentally measured operating points (calculated in step 13) in terms of pump head in feet of water vs. water flow rate in gpm. Discuss the intersections of the pump curve with the two theoretical system curves, and the two experimental operating points.	4	
	<u>Critical Thinking and Discussion</u>		
28	A description of the major components of a centrifugal pump with a discussion of the function that each part performs.	4	
29	Compare and contrast static head, static lift, and discharge head.	4	
30	What effect does the magnetic drive have upon the pump efficiency?	4	
31	What would happen if the actual NPSH fell below the NPSH required for the pump?	4	
32	Is the required NPSH the same for both pumps?	4	
33	How does the fluid temperature affect the NPSH?	4	
34	How are the values of C_v and K related for the 1" globe valve, V-5? What if any are the units associated with these constants?	4	
35	Will the system operating point ever fall off the pump curve? Explain.	4	
	Total	280	
	Percentage of Total		