Kuwait University
College of Engineering & Petroleum
Mechanical Engineering Department

Civil

Lab A
ME-372

Experiment # 1

Experiment Title

Conducted On: April 20, 2008

By

Your Name(s) here	Your ID here
Your Name(s) here	Your ID here
Your Name(s) here	Your ID here

January 29, 2018

On my honor I pledge that this work of mine does not violate the University provisions on academic misconduct. By signing below, I certify that I understand the University Policies on academic misconduct and that when an act of academic misconduct is committed, all parties involved are in violation.

Signature:

Abstract

The abstract is a brief (approx. 250 words) condensation of the report. It summarizes the objectives and found results of the experiment and acts as a quick reference for people who do not wish to read the entire report. In your abstract, specifically and concretely state your findings; do not vaguely describe what you set out to do. Your abstract should summarize, not introduce.
Do not explain why the study is done in the abstract and you should focus on your contributions to the understanding and solution of your project problem, which belongs to the introduction. Describe each of the following in one or two sentences.

- What was done?
- How it was done?
- What are the significant results?

Writing style
In general, do not use "I", "we", "he", or "she" in technical writing. Always use passive voice and past tense.

Number of significant digits
If you report a temperature of 100.002 C, it suggests that the temperature error is less than 0.001 C. You should present your results with the right number of significant digits to represent the accuracy of your experiments and model simulations.

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Nomenclature

Alphabetic list of symbols used throughout the report to describe scientific icons. English alphabets come first, followed by Greek symbols. Capital letters should precede small letters in the same symbol.

Introduction:

The Introduction section briefly outlines why the experiment is important and how the information obtained might be used; what you did and why did you do it? You can use figures and information from any reference (e.g., books, papers, magazines, or internet) to better explain the experiment. This section should provide information that the reader can use to understand the experiment and results without having to consult other reference. When you are discussing more than one experiment, each experiment will have its own subtitle in the introduction. In the introduction try to describe the following:

- State background the experiment
- State the need for the study or experiment
- Clearly define the problem and discuss the objectives (purpose of the experiment)
- Outline overall approach

Subtitle 1:

Here you can write about your subtitle 1.

Subtitle 2:

Here you can write about your subtitle 2.

Subtitle 3:

Here you can write about your subtitle 2.

Objectives:

The Objective section lists the specific technical goals of the work. It should be written in past tense, passive voice. For example:

The objectives of this experiment were:

1. To determine whether the wear volume of a high carbon steel rod on a stainless steel plate is a linear function of sliding distance.
2. To determine the wear coefficient for these materials in the unlubricated condition.

Theoretical Background:

The Technical discussion addresses the theoretical aspects of the work. It covers necessary definitions of terms and any relevant information to explain the physical phenomena that are being studied such as assumptions, equations, and suggested solution techniques. For a well written theoretical background you need to do the following:

- You should clearly state your assumptions and support them quantitatively, e.g., assuming a laminar flow requires that you give a quantitative proof, in this case Reynolds number.
- Describe the model development; give the major equations, but leave detailed algebra to the appendix. This part should be written as a mixture of equations and text and not just a list of equations.
- Describe algorithm for getting your answers from your equations first and then the numerical scheme used but leave program listing in an appendix
- Discuss numerical parameters (e.g., step size in integrating differential equations);
- Specify boundary/initial conditions

Experimental Details (set up and procedure)::

This section is divided into four parts.

(1) Materials:

- Lists the specifications for the material(s) being studied.

(2) Specimens:

- Describes the types of specimens used and always includes a detailed engineering drawing of each type of specimen.

(3) Equipment:

- Lists the equipment used to perform the experiment.
- Refer to the schematic and explain the overall operation.
- Give dimensions of the apparatus. Point out the relationship between the laboratory device and the actual device.
- State what are being measured and give detailed information of the transducers and measurement systems only if they are uncommon devices.
- Give accuracy and frequency response of the transducers.
- Discuss the calibration procedure; details should be in the appendix, not in the main text.

(4) Procedure:

- Is a brief statement of what was done during the experiment?
- Must be written in past tense, passive voice.
- May consist simply of a reference to a standard (e.g., 'The experiment was performed according to ASTM E 8-82').
- List sets of experiments done.

Here are some examples of figure inclusion along with caption format. The figure should be centered. The caption should be centered and automated used the insert caption option. To do this you have to right click the figure and select "insert Caption", and make sure to select Figure. Note that the figure caption is always inserted under the figure (see Figure 1 below). The caption should briefly describe the figure, for example, assuming that the specimen in Figure 1 is used fatigue test, then the proper caption should be "Fatigue test specimen".

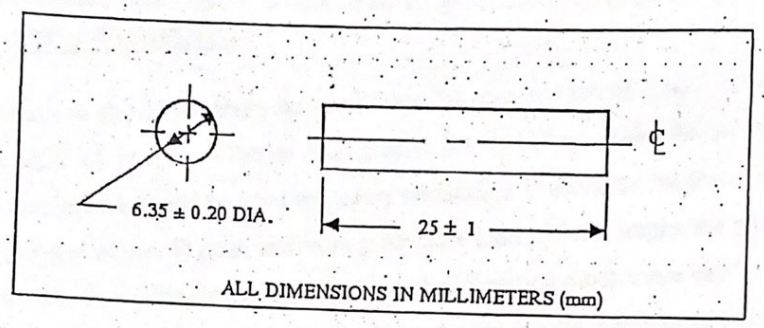

Figure 1: Fatigue test specimen

Here is another example of another figure inclusion. The figure and the caption are centered and the caption is below the figure.

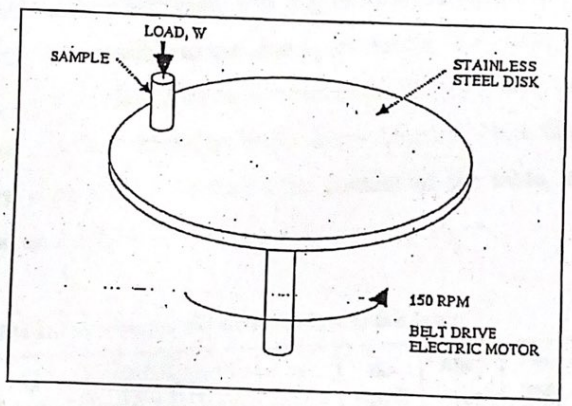

Figure 2: Schematic diagram of wear apparatus

Results and Discussion:

In this section you should present your results and the presentation of results should be as straight-forward as possible. Tables and graphs are excellent tools for summarizing numerical results and should be used whenever applicable. Present the results by referring to the figures and tables, Figures are more preferable than tables. Graphs are much more informative than data tables because patterns can be identified much more easily.

In Table 1 you will find an example of how to list results in tabulated format. Note that the data in the table should be single spaced and the caption of the table should always be above the table. Raw data and sample calculations, which may be lengthy, are of secondary importance, but should be included as an appendix. Note that the table is as compact as possible and as informative as it gets. Units along with symbols are included and given in details. It is possible to use round parenthesis, "( )", instead of the square ones, "[ ]". The text in the table should be centered and size 11. Your table should have a caption that describes the table and should be listed above the table. Note that you should write a paragraph before each table to describe the content of the table, e.g., describing each column, its units, and so on.

Table 1: Here you should write the title of this table

Q [L/min]	y [mm]	$\dot{m}$ [kg/s]	u [m/s]	u_0 [m/s]	$\dot{m}u_o$ [N]	F [N]	F_a [N]
14	10	0.233	2.971	2.853	0.666	0.666	0.392
18	22	0.300	3.820	3.729	1.119	1.119	0.863
22	36	0.367	4.669	4.594	1.685	1.685	1.413
26	53	0.433	5.517	5.455	2.364	2.364	2.080
30	74	0.500	6.366	6.312	3.156	3.156	2.904
34	95	0.567	7.215	7.167	4.061	4.061	3.728
38	118	0.633	8.064	8.021	5.080	5.080	4.630

Most of the times, data from the each table are plotted on a graph. In some experiments, not all data are plotted and hence the author should evaluate and discuss the experimental results from that table. This should be done in a paragraph below the table. The results are compared to expected, theoretical, or published results, and reasons for deviation are suggested. Trends and patterns in the results should be indicated and evaluated. Students should also include a statement about sources of error in the results being discussed.

Figures and graphs should be labeled well enough to act as a standalone and self-explanatory document. Scales should be chosen such that the resultant curve is as large as the page permits. All figures and graphs should be referred to in text before their appearance in the report and must follow the following rules:

- All graphs must have a self-explanatory caption that describes the figure.
- Axes should be labeled properly (symbol and units are required). Use symbols for experimental data points and lines for theoretical predictions.
- If you have more than one curve in the same figure, each curve should be marked clearly and distinctly using different line types, symbols and must be referred to using a legend.
- Figures must be numbered properly and captioned. The caption must be centered and placed below the figure.

An example of a graph is shown in Figure 1. Before each figure you should have a paragraph describing the figure, e.g., describing the x-axis, the y-axis, the different curves, e. g., dashed line, solid line, and so on. For example, to describe Figure 1, one can write the following:

"Figure 1 shows the relation between the out-of-plane displacement at the center of the plate, $w^{\circ}(0,0)$, with the edge displacement, Δ. The *y*-axis shows the deflection at the center of the plate whereas the *x*-axis shows the edge-displacement; both are normalized by the plate thickness, H. It can also be seen that there are two curves in Figure 1; the solid line represent the stable solution whereas the dashed line represents the unstable solution. The two inserts show the deflected plate configuration along the corresponding path."

Note that in the above paragraph we did not describe the behavior of the graph nor the nature of the relation between the out-of-plane deflection and the edge-displacement. The paragraph only describes the content of the figure.

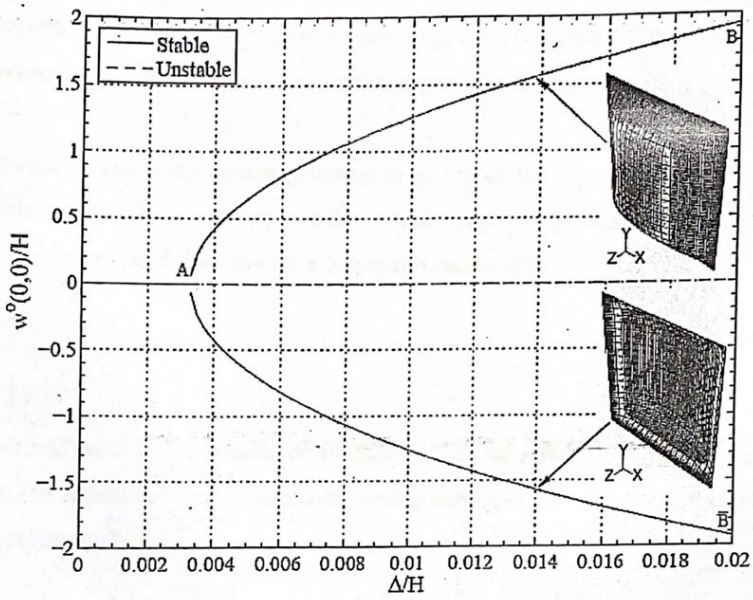

Figure 3: Out-of-plane deflection vs. edge displacement for SS-SS $[(20/-20)_2]_S$ square plate with ν restrained on loaded edges, free on unloaded edges

Most of the times students will be requested to plot data from a given table on a graph and listed in the report. Students should evaluate and discuss the experimental results in each graph below the graph. The results are compared to expected, theoretical, or published results, and reasons for deviation are suggested. Trends and patterns in the results should be indicated and evaluated. The student must also include a statement about sources of error in the experiment. In brief, one should follow this list when discussing a table of a graph:

- Compare Theoretical Results with Experiment.
- See if theoretical results produce the same features as the direct observations of the experiment (e.g., pressure versus time curve).
- Plot theoretical curve on the same graph as the experimental points.
- Account for and explain discrepancy or differences.
- Discuss assumptions/idealizations used in the development of the model and how they affect the theoretical predictions (e.g., do they result in an overestimate? An underestimate?)
- Do not blame the discrepancy on instrumentation. If you knew the instrumentation was inadequate, you should not have wasted your time in making the measurement in the first place.

- When discussing sources of error in the experimental measurements, be quantitative. Estimate or calculate percentage error as a result of measurement.
- Present model applications and engineering design if required.

In the case you have more than one experiment in the report; you repeat the above procedure for each experiment. In summary, you have table and graphs that are described in a paragraph above each and discussed in a paragraph below each.

Subtitle 1:

Here you should write the discussion of subtitle 1. You can refer to figures that you have included in the results section. Figures concerning subtitle 1 should always come before those of experiment 2.

Subtitle 2:

Here you should write the discussion of subtitle 2 and refer to its figures that you have included in the results section.

Conclusions:

The conclusion is a summary of your experimental findings discussed in the discussion section and it can be done in one of two formats. It can either be written as a series of numbered statements drawn from the experimental results, or as a single paragraph discussing the findings. Furthermore, the conclusions should correspond to the purpose of the experiment as stated in the Objective section and must be supported by the experimental results. In general, ask yourself what are the new information that I learned from this experiment? What did the experiment tell you? How good is the model? Does it fall within the upper/lower bound of the results?

If applicable, present recommendations for what further work are needed (optional). Usually recommendations are given within the conclusion section and should list improvements in the experiment which would help to better achieve the goals stated in the Objective section.

Acknowledgements:

Here you should acknowledge all help provided during the experiment and writing process.

References:

The Reference section is used to list references which were directly quoted or paraphrased in the report. Copied figures must also be referenced. The number beside a given reference corresponds to the number placed at the end of the given quote or paraphrasing. Entries in the reference section are in the order that they occur in the text. Some examples are as follows:

Book:

[1] Author, A. A., Author, B. B., & Author, C. C. *Title of book: Subtitle.* (Edition [if not first]). Place of publication, Publisher, Year.

Example:

[1] Ernest Rabinowicz. *Friction and Wear of Materials*. New York: John Wiley & Sons, pp. 136-137, 1965.

[2] AD. Sarkar. *Wear of Metals.* Oxford: Pergamon Press, pp. 46-47, 1976.

Paper:

[1] Author's surname, initials. "Title of article". *Title of Journal*, volume number (issue number), page numbers, Month and Year of publication.

Example:

[1] M.-L. Dano and M.W. Hyer. "Thermally-Induced Deformation Behavior of Unsymmetric Laminates". *International Journal of Solids & Structures*, 35(17):2101–2120, June 1998.

Website:

[1] Author(s), (year of publication or last update). Title of page [type of medium]. Available: URL [Date Accessed]

Appendix:

In order to prevent the body of the report from becoming too crowded and also to present material that may not be immediately relevant to the report, appendices may be used. For example, detailed procedures, data, derivations and sample calculations may be included here. The appendix section, however, has often been misused as a "dumping" area for equations and data tables. That is not appropriate. There should be text description on the equations and tables.

Appendices are for details that your reader may need in order to reproduce your work. Essential derivations, governing equations, key assumptions and definitions DO NOT belong in the Appendices; they belong to the main text. Details of calibrations and procedures DO belong in Appendices.