

Guidelines for Laboratory Reports

AME 21241 – Mechanics of Solids

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Identification

Please make sure to put your student identification number on the first page of your lab report. Your name is optional, but may also be included.

Abstract

After you have written your report, write a short abstract. A well-written abstract will summarize each of the following sections of your report in a few sentences. To do this, you must write it *last*, as it is difficult to summarize what you haven't said yet. Include numerical values for the key results. Although written last, place the abstract *before* the objectives in the final report.

1. Introduction and Objectives

The introduction should give some rationale for performing the experiment. For example, in the beam bending experiment, the rationale might be to determine how the measured strains in the beam are related to the shear force and bending moment.

Objectives describe the purpose of the experiment. Note that the purpose is not “to *learn how* to perform an experiment, but to *experimentally measure X property of Y material*. The objective of the first experiment, for example, might be:

The objective of this experiment was to measure and compare the elastic modulus, yield strength, and failure strength of two steel alloys.

It may be useful in some cases to enumerate several objectives:

The goals of this experiment are to 1) determine the elastic modulus; 2) determine the yield strength; 3) determine the ultimate strength; and 4) determine the hardness of alloys.

Your objectives can usually be boiled down to one or two sentences.

2. Methods

Describe the procedure(s) that was used to obtain the data. Much of this information can be obtained from the lab hand out and from the information provided by the TA. Your methods should assume that the reader has not performed the experiment, and is not in your class. As such, you must describe the apparatus sufficiently for the reader to duplicate your experiment. For example, “the equation given by the TA” isn't helpful to a reader who doesn't have access to your TA, and “equation 2 in the handout” assumes that the reader has the handout.

At the same time, you should also assume that the reader has the same level of engineering knowledge that you have. As such, you do not have to explain that stress is F/A or strain is $du(x)/dx$. It is sufficient to state that the area of the specimen was measured, and that the loads and displacements were converted to stress and strain based on the measured area and length. Similarly, you do not have to explain what a 3-point bending test is, or provide references for Hooke's law or the Bernoulli-Euler beam equations.

Do not give extraneous details on how to use the apparatus ("Next push the green button."). Assume that the reader seeking to duplicate your work would have access to the manuals for the equipment, or could read a textbook on strain gages, or will take a course to learn these skills. An example Methods section for the first lab might be (do not use this verbatim in your report):

Methods

Heat-treated and cold rolled steel specimens were tested in tension to failure on an ATS screw-driven testing machine. Prior to testing, the diameter and length of the specimen were measured using a caliper and a ruler (Table 1). The axial load was measured using a load cell and the tensile strain was measured by an extensometer attached to the specimen. The displacement was also monitored using an LVDT.

Tension was applied to the specimen in displacement control at 0.1 in/min until it reached 1% strain and then returned to 0 load. Displacement was then applied at the same rate to 10% strain. At 10% strain, the extensometer was removed to avoid damage, and loading was continued until the specimen fractured.

Following testing, the stress-strain history was plotted using both the measured strain from the extensometer and that calculated from the LVDT measurements. The elastic modulus for each curve was calculated from the initial slope using a least squares fit in Matlab. The 0.2% offset yield stress was also calculated (Fig 1).

These three paragraphs describe the important features of your method: you measured the specimen dimensions, you performed a load-unload cycle, then loaded the specimen to fracture. Also note that it is written entirely in the past tense, because you have already done it.

If you have difficulty describing the methods in a few paragraphs, consider making tables, diagrams or a flow chart of the steps. Note that figures and tables are referred to parenthetically within a sentence that points out something about them.

3. Results

Provide the results of the experiments, specifically providing the data that you stated you would report in your Objectives. **DO NOT** write, "The results are shown in Figure 1," or other similarly meaningless sentences. Instead, point out the important result that is illustrated by the figure or table. If there are a number of important points demonstrated in a single graph, you might refer to it multiple times. Some interesting ways to refer to figures and tables are:

Initially, the applied force increased linearly with displacement, but then became nonlinear at about 37 ksi as shown in Figure 1.

The maximum elongation of the hot rolled specimen was X%, and that for the cold rolled specimen was Y% (Figure 2).

Table X: The table title should be a phrase that briefly describes the contents

Experimental Group	Ultimate Tensile Stress (MPa)	Elastic Modulus (GPa)
A ¹	35.1	7.5
B	40.2	8.9

¹Include footnotes to define any abbreviations or nomenclature that is not common or well known



Figure Y: The figure caption should briefly describe the contents of the figure.

Figure 1: An example of a table (top) and figure (bottom) with appropriate formatting and captions.

Both the modulus and yield stress of the two steel alloys tested here were in agreement with published values (Table 1).

As a rule, do not refer the reader to a figure or a table without telling them what to look for. Otherwise, they may not see the important information that you intended to impart to them. Conversely, all figures and tables should be referenced at some point in your text. If you do not refer to a graph or table in the text, then its contents are presumably not important. Thus, if you include one of the requested plots or tables in your report without referring to it in the text, it will be graded equivalently to not including it at all. All Tables and Figures should include a title or figure caption, respectively (Fig. 1).

You should be able to present your results in one or two sentences for each of the items listed under Report Guidelines in the lab handouts.

4. Discussion

Use this section to make comparisons with theoretical or known results. For example, if the guidelines tell you to “Comment on the results, and try to explain any differences”, do so in the discussion. If there are discrepancies between your results and the expected results, discuss the possible reasons for them and how these errors might have been avoided or compensated for. Discuss the theories and phenomena that explain your results, such as: “In a four-point bending test the shear in the beam is zero, resulting in zero principal stresses at the neutral axis. This is not the case in three-point bending.” Last, discuss any limitations or sources of error in your analysis.

At the end of the discussion section, briefly state your conclusions for the laboratory. The discussion need not be earth shattering, or a dissertation on solid mechanics. The conclusions should concisely state the major findings of the laboratory.

5. References

References should be cited using the standard ASME format (Author, Year), and references should be listed alphabetically at the end of the report.

A typical bibliography entry should look like:

Niebur, GL, 2005, "Guidelines for laboratory reports," *Journal of Laboratory Report Writing*, v. 1, n. 1, pp 1-4

6. Tables

Place all tables together, in the order they are referenced in the text, immediately following your references. Remember to include captions.

7. Figures

Place all figures together, in the order they are referenced in the text, immediately following the tables.

Page limits

Your report should be a *maximum* of six pages of double spaced text with 1" margins, and a minimum of a 12 pt. font, exclusive of tables, figures, and references. That is, tables and figures do not count against your page limit. **Place all tables and figures at the end of your text.**

You should not feel compelled to fill the full six pages, as the reports will not be graded by weight. Typically, you should be able to write your objectives and methods in a single page, and the results and discussion should be about one page each. You will receive a 10% grade reduction if you exceed the six-page limit.

Lab Report Score Sheet

Please attach to the end of your lab report.