Engineering Lab Reports and Technical Writing

Dr. Chris Andrews

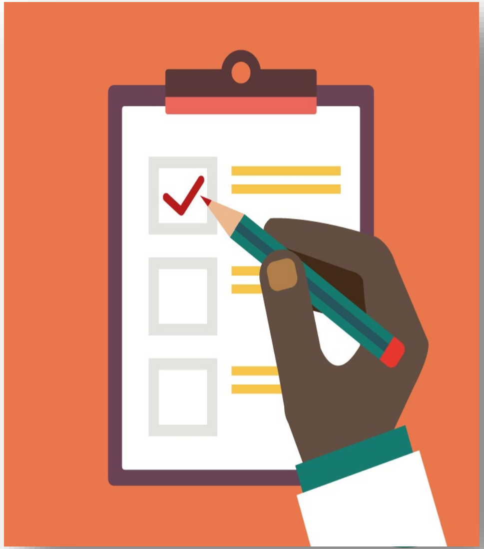
Objectives

Accreditation Board for Engineering and Technology (ABET) Student Learning Outcomes:

- An ability to communicate effectively with a range of audiences.

Goals for this course:

- To invite you to begin to change the ways you think about writing, especially writing as a professional.
- To help you recognize strategies that will improve the writing you are doing or will do, to make it more effective for your readers.



ABET says when you graduate from this program, you should have the ability to communicate effectively with a range of audiences.

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Why does effective communication matter?

When/why do you think engineers use writing?

ENGINEERS WRITE. A LOT.

% of Engineers' Workday Spent Writing

First Few Years	~30%
Middle Management	~50%–70%
Senior Management	~70%–95%

Source: Silyn-Roberts (1998). JPIEE 124.1.

Engineers spend between **20%** and **40%** of their workday writing; this figure increases as they move up the career ladder.

Source: Leydens, (2008). IEEE Transactions 51.3

Writing is a Tool for Doing

Think of writing as part of your tool collection.

Instead of considering yourself as just "writing something," consider that you are "using writing" to do something.

Writing is a Tool for Doing

When we think of writing as using tool(s) to do . . .

- What are we "doing" with a lab report or project proposal or a progress report or _____?
- How will others use what we produce?
- How does that affect our choices and uses of the tools we use to produce?

Writing for grades vs. Writing in the workplace

Achieve College Goals	Achieve Workplace Goals
• Show your professor you did the work correctly or mastered subject matter	• Communicate information to audiences who need to use it
• Get a good grade	• Document, explain, or justify your work for other professionals
• Single reader: the professor	• Variety of readers: professionals and stakeholders

Technical writing

Technical writing uses simple, direct language and document design features to convey information to audiences.

1. Write to your audience(s). What do they need? What do they know? What do they not know?
2. Get to the point.
3. Put information where your readers expect it to be.
4. Label everything. (Sections, Figures, Tables, Equations, Lists)
5. Explain visuals or data before you show them.

WRITE TO YOUR AUDIENCE

- What are you doing with a lab report? What do different parts of a report do?
- How is a lab report analogous to communicating you would do on the job?
- Who might use a lab report? For what purposes?

Abstract	
Introduction	
Theory / Background	
Equipment / Procedure	
Data / Calculations Results	
Discussion / Analysis	
Conclusions	

GET TO THE POINT: ABSTRACT 1

This lab report will break down into details the procedure taken to develop the plate and shaft two part assembly. Explanations and figures will aid in the rendition of the report. This experiment improved the understanding of machining, tolerances, and the expectations of co-working machinists in future work. The purpose of this experiment was to create a two part aluminum plate and shaft made from Aluminum 6061 - T6511 that can withstand a 10 ft.-lbf torque applied to the end of the shaft without inducing relative motion. To complete this objective, and interference fit between the shaft and plate with precise tolerances would have to be met so that the two part system would complete the task.

GET TO THE POINT: ABSTRACT 2

The objective of the lab was to build an assembly that was able to withstand a 10-ft-lbf torque applied at the end of the shaft without turning. Two pieces of 6061-T6 Aluminum were used for this project. It was necessary to follow the guideline dimensions, which are provided in the theory section. Also, it was necessary to consider the tolerances and use three important manufacturing processes: cutting, milling, and drilling. A band saw, a milling machine, and a lathe were employed to accomplish this. In optimal conditions, the contact pressure wouldn't exceed the yield strength of the material we used. Though the assembly passed the text, it sustained more contact pressure than anticipated. Further investigation may need to be done into the implications of this.

WHY ARE WE HERE? INTRODUCTION 1

Introduction

The aim of this lab experiment was to get familiar with machining tolerances, gain a better understanding for material performance, and to develop a respect for the art of machining. To achieve the desired results the team created a two part assembly that included aluminum plate and an aluminum shaft. This assembly had to be machined to specific tolerances. The plate needed the center hole to be within a tolerance of +0.8 thousandths of an inch and and 0.0 thousandths of an inch. The shaft had to be within +1.9 thousandths of an inch and 1.4 thousandths of an inch. The shaft was threaded using a tap so that a screw could be inserted full length without damaging the threads. The shaft was notched to pass a 10 ft.lb$_f$ torque test. It should be noted that the torque test was actually closer to 12 ft.lb$_f$. The aluminum plate was also out of spec due to the factory dimensions not equal to the 3.00 inches.

WHY ARE WE HERE? INTRODUCTION 2

INTRODUCTION:

The objectives of this experiment were to create an assembly meeting given specifications, as well as to test the capability of the interference fit used to secure the two pieces together. Interference fits, or press fits, are common means of combining independent parts. The testing of the assembly was of paramount importance to product creation. Discovering the product is defective through experimentation is cheaper and potentially less destructive than learning of its deficiencies after installation into a more extensive system.

What are our expectations for procedures?

Once both parts were finished, the shaft and plate are pressed into each other with a 20 ton hydraulic press shown in Figure 8. Finally the shaft was placed back onto the mill to have the front end of the shaft notched off for testing. The shaft was notched from the top 0.156" deep and 0.625" along the shaft from the front end.

What are our expectations for procedures?

Assembly

1. A press of 20 ton of capacity was used to insert the 0.759" diameter side of the shaft into the center hole of the plate. (See Figure 19)
2. The assembly was set in the Enco milling machine, with a 200 RPM velocity.
3. A 0.625" (± 0.005") length by 0.156" (± 0.005") height notch was machined at the end of the 1" diameter side of the shaft.
4. The assembly was attached to a 1ft lever with a 1.1 lb_f hanger and a 10 kg disk attached to the end. (See Figure 20)
5. Finally, a punching kit and a ball-peen hammer were used to stamp the semester and the names of the group members. (See Figure 21)

Label Everything & Explain Visuals

The main concept used in this experiment is the machining of the plate and shaft, and measuring the material removal rate per unit of time. Material was removed by drilling, using the mill to face the plate, and bring the plate and shaft to the right dimensions, and the lathe shaped and removed the material needed for the shaft.

$$MRR = (\frac{\pi D^2}{4}) f N$$

Where:

D is diameter of the hole

f is feed rate, the distance the drill penetrates per unit revolution

N is the rotational speed of the drill

Label Everything & Explain Visuals

smoothness of the cuts. It was assumed that no chatter would occur. An equation that was very helpful for this experiment was the contact pressure equation, using interference values. This equation can be used since the shaft and the plate are made of the same material (6061-T6 Aluminum).

$$P = \frac{E\delta}{2d^3}\left[\frac{(d_o^2-d^2)(d^2-d_i^2)}{d_o^2-d_i^2}\right] \quad (1)$$

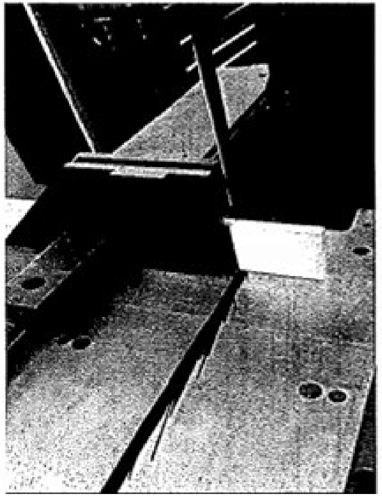
Where P is the contact pressure, $\delta$is the interference, d is the shaft diameter, d This equation is used when the shaft and the plate are made of the same material. Above formula came from Budynas [1].

Label Everything & Explain Visuals

EQUIPMENT

The two pieces of material were cut using a bandsaw. The bandsaw has one blade moving up and down vertically at a desired speed and feed rate. These large teeth are not ideal for a nice finish surface, therefore excess material was left on to shave off with the milling machine.

FIGURE (1): Bandsaw cuts the first piece of material off of the stock bar.



Label Everything & Explain Visuals

Figures 1 and 2 below show the mechanical drawings that were used as guidelines for machining. To manufacture the shaft and the plate, it was required to pay close attention to the

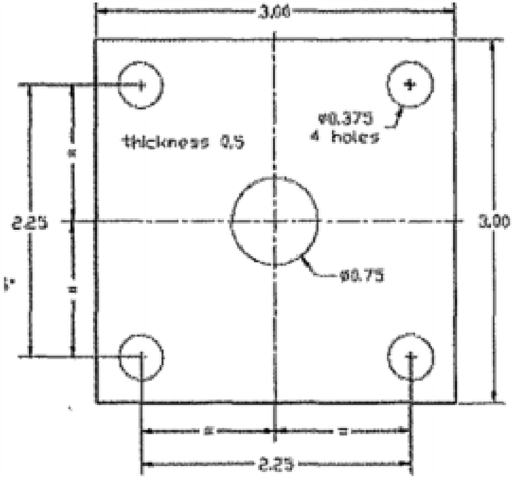


Figure 2. Aluminum plate dimensions

LABEL EVERYTHING & EXPLAIN VISUALS

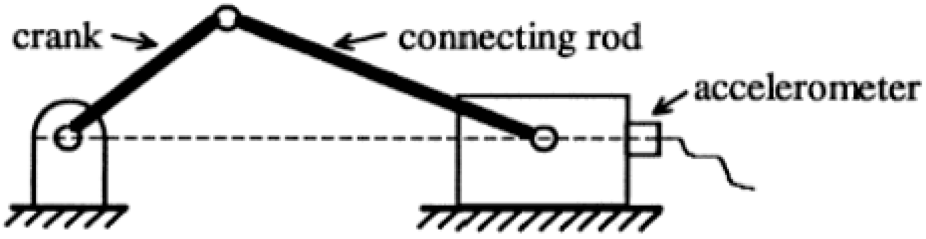


Figure 1 - Slider Crank Mechanism

Table 1— Reduced Data from Vibration Test

Frequency, rad/s	Amplitude, mm
5.6	1.8
12.1	2.5
16.1	3.6
23.5	10.8
38.4	6.3
51.9	4.2
72.0	3.8

Read and Follow Your Specs

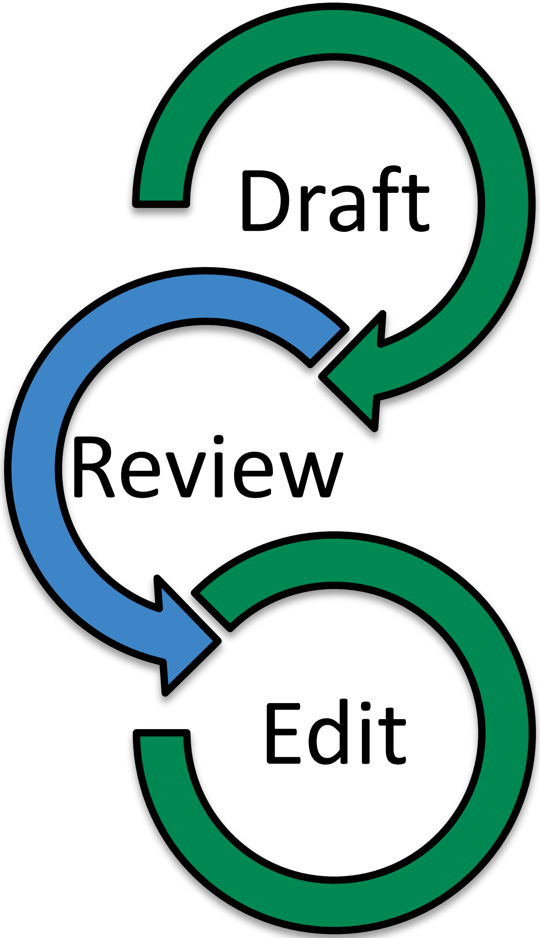
General Lab Report Guidelines

The ability to write professional-quality laboratory reports is an important part of your engineering education. Even the results of a well-designed, well-executed experiment will be of limited use to industry or academia unless it is presented with organization, detail, and clarity. This is also important since the documented results of your work may be in industrial or academic archives for decades, and in many cases your technical ability will be judged on your documented work. The laboratory report guidelines presented provide one method of achieving the objective of a professional-quality laboratory report.

Familiarize yourself with the experiment before coming to the laboratory. Include written comments as the experiment progresses; don't rely on memory in writing your report later. Planning, neatness, and organization are essential ingredients for a successful experiment, and also make the report writing much easier. Try to write the report as soon as possible, while details are still fresh in your mind. Make your report clear and brief, without omitting important details. Copies of diagrams, tables, etc. from handout material may be used where appropriate.

This outline is one method of organizing a laboratory report – be sure to label all sections.

Writing is a Process



For More Information:

Writing as an Engineer or Scientist

www.craftofscientificwriting.com

Online Technical Writing

https://www.prismnet.com/~hcexres/textbook/

REMEMBER…

Writing improvement takes practice and feedback!

Get as much of both as you can.