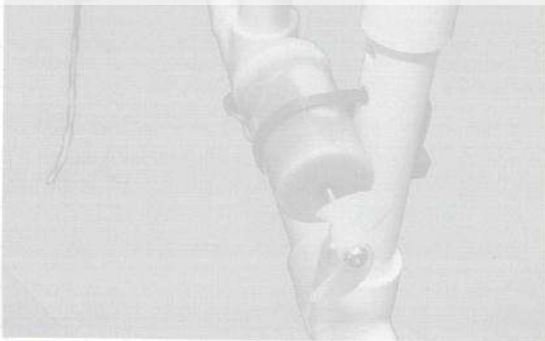


Team RoboPerch

## The SeaPerch Engineering Notebook Challenge

### Table of Contents

- I. Facts Regarding the SeaPerch Engineering Notebook Challenge
- II. What is an Engineering Notebook?
- III. Required Content, Format, and Limitations
- IV. The Engineering Design Process Brief
- V. Saving from common programs to a PDF file



What's good? No additional parts required. Low cost.

What could be improved?  
Would be better if motors were easily relocatable without having to drill new holes.

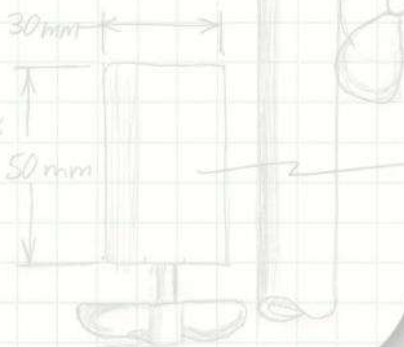
#### Constraints

- 1) Low cost
- 2) Mount must be easy to make from readily available parts.
- 3) Motors must mount in two different orientations

#### Information we need

- 1) Motor canister size:  
30mm diameter  
50mm long

- 2) 1/2" PVC pipe diameter:  
21.3mm



Motor mounted

## The SeaPerch – Engineering Notebook Challenge

### I. Facts Regarding the SeaPerch Engineering Notebook Challenge

1. Purpose: To demonstrate student understanding of engineering principles and design concepts.
2. The SeaPerch ROV and engineering notebook must be solely a product of the students' own efforts, ideas, and designs.
3. The SeaPerch Engineering Notebook replaces the Poster Challenge. *Due to space limitations at this year's venue, teams should NOT bring posters/trifold boards as there will be nowhere to display them.*
4. Teams should use a physical notebook throughout the SeaPerch project to document the engineering design process and specific steps they take in designing and modifying the SeaPerch ROV to complete the National SeaPerch Challenge pool events. Since teams may have started the project before they knew about the Engineering Notebook Challenge, they may have to create the notebook from notes and discussions among team members.
5. The physical notebook can consist of hand sketches, photos, computer-aided design (CAD) drawings, handwritten notes, and graphs. Photos, CAD drawings, and other computer generated entries should be taped to the notebook page and labeled.
6. The SeaPerch Engineering Notebook will be submitted electronically as a Portable Document Format (PDF) file. The physical notebook pages can be scanned or photographed and inserted into a single PDF file. This can be accomplished using presentation or word processing software such as Google Slides, Microsoft PowerPoint, OpenOffice Impress, Apple Keynote, Google Docs, Microsoft Word, OpenOffice Writer, or any other program that is capable of saving or printing documents in the PDF format.



### I. Facts Regarding the SeaPerch Engineering Notebook Challenge (continued)

7. The notebooks will be judged online and top place teams will be notified at least 14 days prior to the National Challenge. Top place teams will give an oral presentation before a panel of judges and compete for awards in their respective divisions. While only the top place teams will be required to bring their notebooks, it is suggested that all teams bring the team's engineering notebook in order to showcase their ideas.
8. The Engineering Notebook is not intended to document the construction of the standard SeaPerch ROV.

## II. What is an Engineering Notebook?

Engineering Notebooks are used by engineers to:

- Document their ideas and steps taken to solve engineering problems and engineering design projects
- Provide a legal document that can be used as proof of invention for products they design.

Engineering Notebooks are sometimes referred to as an Engineer's Notebook, Design Notebook, Laboratory Notebook, or Inventor Notebooks. The purpose of the notebooks is to carefully and systematically track and analyze progress and results.

Included in such a notebook is important information on the following areas:

- Clearly articulated project or problem to be solved
- Project constraints and parameters
- Detailed design ideas
- Procedures to implement and test the designs
- Test results
- Recommendations for design modifications
- The design – test – modification cycle
- Proposed future steps

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Resources:

MIT Dept. of Mechanical Engineering, Instructions for Using Your Laboratory Notebook  
<http://web.mit.edu/me-ugoffice/communication/labnotebooks.pdf>

OSU College of Arts and Sciences, GUIDELINES FOR KEEPING A GOOD LABORATORY NOTEBOOK <https://goo.gl/1Z7rkZ> (Google Shortened URL)



### III. Required Content , Format, and Limitations

The SeaPerch Engineering Notebook should include the following:

#### 1. Front matter

##### A. Cover/Title Page

- a) Project Title
- b) Team Number and Team Name
- c) Photo of final ROV
- d) Date the notebook was completed

##### B. Team Information Page

- a) School or club name
- b) School district (if applicable)
- c) City and State
- d) Name and email address of teachers, coaches, mentors, and advisors
- e) Team member names, grade levels, and role in the project. Use first names only for students. If two or more students have the same first name, use an identifying letter following the first name.

##### C. Table of Contents Page

- A. List page title or description and page numbers.
- B. Reference citations of research such as books, articles, and website addresses.

## The SeaPerch – Engineering Notebook Challenge

### III. Required Content, Format, and Limitations (continued)

#### 2. Design and Testing Documentation (Engineering Design Process)

##### Section

- A. Provide details of each step taken in the engineering design process using the SeaPerch Challenge pool events as the project problem/goal.
- B. Provide sketches, drawings, charts, and other graphics and written documentation describing solution and design concepts, design iterations, tests performed, and test results.
- C. Include engineering and scientific terms and concepts to demonstrate that the team understands the challenges of constructing and operating an underwater ROV.
- D. All pages should be numbered and listed in the Table of Contents.

---

#### Mandated Format and Limitations for the SeaPerch Engineering Notebook:

- Submitted online as a Portable Document Format (PDF) file
- PDF files must use the following naming convention:  
**Team #\_School Name Team Name**  
example: 124MS\_Wabash\_\_Robonuts.pdf
- Submit to: address to be determined
- Must be submitted between: dates to be determined
- Maximum of 6MB in size
- Formatted as 8-1/2" x 11" pages
- No more than 24 pages including the cover/title page, team information page, and table of content page.
- The PDF file may not contain videos, animated GIFs, or other dynamic content.



## IV. The Engineering Design Process Brief



The Engineering Design Process is a repeating set of steps used to solve engineering problems and projects.

Throughout the design process previous steps are revisited to correct and improve the design.

*(Some presentations of the Engineering Design Process may include additional main steps and may refer to the steps shown here using different terms.)*

As part of the Engineering Design Process, engineers often do the following:

### Ask:

- Define the problem or project
- Define the constraints, parameters, rules, etc.
- Research existing solutions

### Imagine:

- Brainstorm and discuss possible solutions
- Document ideas
- Create conceptual design drawings

### Plan:

- Create detailed design drawings
- Document fabrication steps and procedures
- Document test plans

### Create:

- Create prototypes (models)

### Test:

- Follow the test plans to test the prototypes.
- Document test results

*Repeat previous steps to improve the design*

## IV. The Engineering Design Process Brief - Example

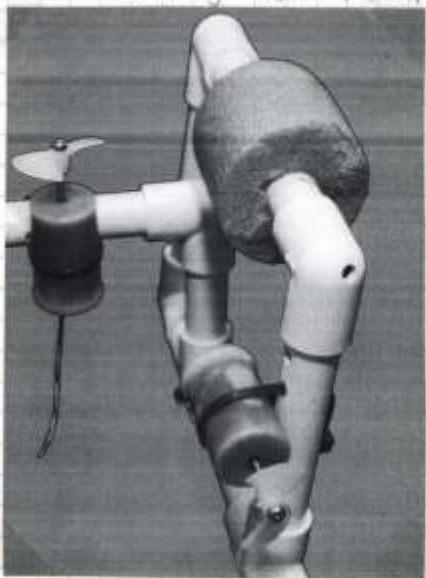
This provides an example of what entries in an Engineering Notebook might look like for an engineering assignment. The example follows the engineering design process (while not explicitly stating the steps).

Team RoboPerch

RoboGuy  
1/23/17

1 Engineering Assignment  
Design a new motor mount for the SeaPerch ROV

Existing Motor Mount Design



Q: How are the motors mounted on the standard SeaPerch ROV?

A: Holes are drilled in the pipes. The motors are attached to the pipes using cable ties thread through the holes in the pipe and wrapped around the motor canister

What's good? No additional parts required. Low cost.

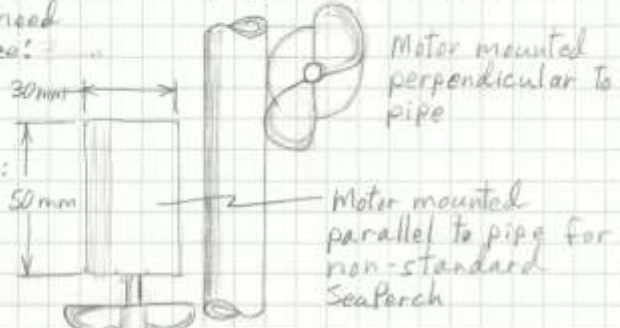
What could be improved? Would be better if motors were easily relocatable without having to drill new holes

Constraints:

- 1) Low cost
- 2) Mount must be easy to make from readily available parts.
- 3) Motors must mount in two different orientations

Information we need

- 1) Motor canister size:  
30mm diameter  
50mm long
- 2) 1/2" PVC pipe diameter:  
21.3mm



Motor mounted perpendicular to pipe

Motor mounted parallel to pipe for non-standard SeaPerch

Photographs are taped to the pages.

Each page is numbered, dated, and the “engineer’s” name is listed.



Existing solutions are examined. Constraints are listed. Relevant data is recorded.



## IV. The Engineering Design Process Brief - Example

Team RoboPerch  
Robo Guy  
1/23/17

2 Engineering Assignment  
Design a new motor mount for the SeaPerch ROV

First design idea - modify a standard  $\frac{1}{2}$ " PVC Tee to mount motor in either of two orientations

① Drill out to same ID as socket\*  
ID is smaller in middle

② Cut body of Tee as shown.

③ Cut to remove bottom section of long part of Tee

④ File all edges to remove sharp edges

~ See next page for additional procedures ~

Modifications



A possible solution is stated. In this example the conceptualization and planning overlap.

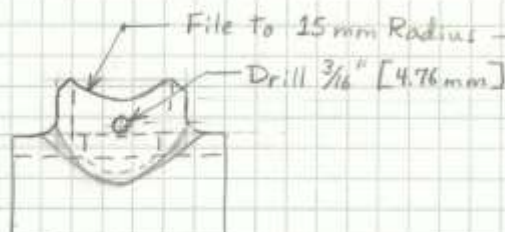


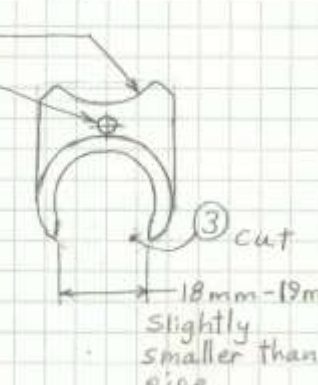
## IV. The Engineering Design Process Brief - Example

3

Team RoboPerch  
Robo Guy ☺  
1/24/17


**Engineering Assignment**  
Design a new motor mount for the SeaPerch ROV





⑤ Cut curves to size of motor canister.

⑥ Drill holes for cable ties



Finished motor mount

Tools used:  
Ruler  
Marker  
Hacksaw  
File  
Drill  
Sandpaper

Standard Tee and Finished motor mount



A prototype is created and documented.



## IV. The Engineering Design Process Brief - Example

4


Team RoboPerch

PROPOSED BY: RoboGuy

DATE: 1/25/17


Engineering Assignment  
Design a new motor mount for the SeaPerch ROV

1 The completed motor mount.

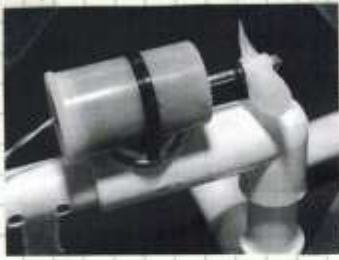


The motor is attached to the motor mount using a cable tie. Because the motor canister is seated in the curved cut of the motor mount it is held in place very rigidly.

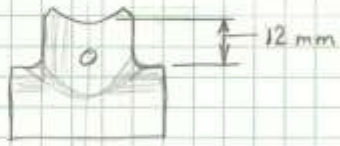
The motor mount is snapped onto the pipe.



Testing in the second position shows that the propeller hits the elbow.



Recommendation:  
The motor support part of the Tee should be longer.



Alternative designs:  
3D printed motor mount



Testing is conducted and the results are documented.

The Engineering Design Process would continue until the desired results are achieved.

This example is not intended to cover the formatting requirements of an Engineering Notebook.

## V. Saving from common programs to a PDF file

Most common programs are capable of saving documents in the Portable Document Format (PDF).

If you are using a program that does not have this capability, you should install a PDF printer such as CutePDF Writer which will allow any program to print to a PDF file.

For Microsoft Word and PowerPoint, go to the File menu and select Save As.

Navigate to the location that you want to save the file into.

Enter the file name.

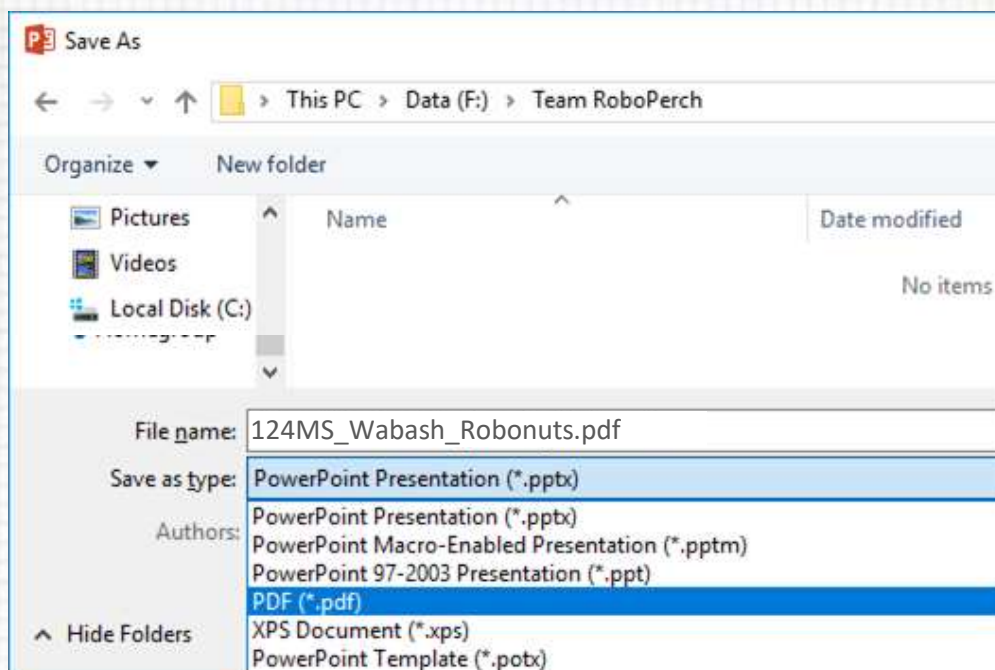
PDF files submitted to SeaPerch.org must use the following naming convention:

**Team #\_School Name\_Team Name**

example: 124MS\_Wabash\_Robonuts.pdf

In the “Save as type” selector, select PDF (\*.pdf).

Click the Save button.





## V. Saving from common programs to a PDF file (continued)

There are various methods for saving Google Docs and Google Slides to a PDF file; only one method is shown here.

Go to the File menu and select Download as and then choose PDF Document (.pdf).

Choose the location to download (save) the PDF file.

PDF files submitted to SeaPerch.org must use the following naming convention:

**Team #\_School Name\_Team Name**

example: 124MS\_Wabash\_Robonuts.pdf

