Independent Study Final Report Requirements
Hertzberg, Spring 1999

The final report is a very important document, for several reasons. Most importantly for you, it will document what you have done and learned throughout the semester, and will form a large part of your grade. However, the report is intrinsically important for other people as well. Your report will be read by other students who will continue your project or a related project, perhaps months or years after you have left. So it's important that *everything* in the report be explained completely and clearly, from the science and physics underlying the experiments and equipment to where to go to buy a particular type of connector. In addition, your report will be kept on file in the ME Department, so that the type and level of your work will be known. Your report may also serve as an example to students considering independent study themselves. Please keep in mind that your target audience will range from engineering students who may not know anything about the combustion labs to students as familiar with the project as you are, who are looking for a specific detail. As you work through the project, keep a list of information you wish you had from a previous group's report, and include that info in your report.

You will hand in the final report twice. The first time, your report will be edited (not 'corrected', because you are the expert) and given back to you for revision. This is an important process that all technical writing has to go through, often more than once. The first version should *not* be a 'rough' draft. It should be able to stand as a final version. Your group may have a few more things to add before the end of the semester, but this first version of the report should be able to stand alone.

The final report (one per group) will be due in lieu of a final exam. You'll work with me to come up with mutually agreeable due dates. Here are some format requirements:

- SPELLCHECK both versions.
- Double-space, to make it easy to edit.
- It should follow the format described below. Follow the formal report rules from MCEN 3027 for additional requirements not listed here, i.e. figure numbers and placement, etc. The page limitations from MCEN 3027 do not apply.
- It should be easy to photocopy, and be **unbound**. Also, **don't use color** unless absolutely necessary. If it is needed, supply four extra copies of the color items.
- Hand in four copies of the second version.
- Hand in the marked up first version along with the second.
- Hand in diskettes containing data, photographic negatives, videotapes, lab notebooks, etc. with the second version. Make sure each diskette has a file and/or label that explains what is in each file. Label the diskettes Mac or PC.
- Return any books you've borrowed from me (or no grade!).

Depending on what your project is, you may write a journal style article and/or an operations manual or a design description. You may update portions of a previous group's manual or report. You won't be asked to duplicate previous work, and the goal is to have

a better document at the end. All reports and manuals should have a title page, introduction, results (or body), and conclusion.

Here are a couple of good references to use if you have questions about technical writing. Both books are small, and inexpensive, so I recommend you buy them at some point.

Strunk Jr., W., and White, E.B., *The Elements of Style*, Third Edition, Macmillan pub.,1979.

Booth, V., *Communicating in Science; Writing a scientific paper and speaking at scientific meetings*, Second Ed., Cambridge University Press, 1993.

The Format

1) Title Page: The title itself should be at the top and should be Concise, Complete, Comprehensible and Correct (the 4 C's). Next list the team members. Below that give the date, then the instructors' names, followed by the organization.

2) Abstract: There are two types of abstract; indicative and descriptive. The indicative type 'indicates' what will be in the report, without detailing the contents ("This report contains information about..."). The descriptive type is a version of the report in miniature ("The important results are..."). Use the descriptive type for this report. Make the abstract self-contained, and do not refer to any figures or references.

Minimum: three sentences. One sentence of introduction, stating what was done in terms of the goals (i.e. "The frequency response of the Micronics model XYZ digital multimeter was measured" or "The dependence of a thermocouple's time response on wire diameter was determined"). One sentence describing how this was accomplished. One sentence giving the QUANTITATIVE results. ("Measurements indicated that the response decreased at a rate of 10 db/octave above 10 Khz")

Maximum: 1/2 page.

3) Introduction: This section is to orient the reader to the project, and gives the context of the work at several levels, beginning with the general, and then becoming more specific at the end.

Begin by stating the need for the main experiment or project, in a broad context. Then describe your specific project, and how it relates to the overall goals. This section often includes a summary of work by others in the field, including previous group's findings. Be sure to include a description of the physics of the problem, and feel free to use computer-generated sketches to illustrate what you mean. If equations are used, explain where they come from. Use real references to back you up, such as books and journal articles (saying that Robin gave you the formula is not good enough). Number the references in order of use (see Reference section for more details). End with a brief statement of the work

accomplished and conclusions reached, and describe the rest of the report in outline (This report will include a description of the apparatus, and present evidence that the vortex ....). The introduction can make up to half of the report.

4) Experimental description: Journal style reports will have this section. Give an integrated idea of the equipment and how it was used, followed by a description what measurements were made and what conditions were studied. Don't give a list of equipment followed by a "procedure". Save the details for the operations manual.

Begin by referring to a simple schematic of the apparatus (put a more detailed one in the ops manual). Go through a description of apparatus, but limit yourself to the details which were important to the performance of the experiment. End with a complete statement of the measurements made, and the conditions of each test. A table of conditions is permissible here. As each measurement is described, quote an estimate for the uncertainty. Include a derivation of the uncertainty in an appendix. Make no reference to the chronology of the tests, unless this affected the results.

5) Results and Discussion: The results should be presented in an order which presents evidence to support your conclusions. This is usually not the order you made the measurements in! For instance, if you made a bunch of test trying to optimize something, you may have varied one parameter back and forth as you narrowed down on the best value. Present the results ordered according to the parameter, not by the order the measurements were made in. Discuss each result as it is presented. If needed, you can add content at the end that may discuss implications from all the measurements combined.

If you are doing a design/construction project, your primary results are the engineering drawings you made. Discuss the logic behind the design; why you made each choice. Be logical, not chronological.

If you are writing an operations manual, organize your results into sections like Safety, Equipment Descriptions, Procedures, Sources, Troubleshooting, Design details, Cost lists, etc.

Everyone: present the results **graphically**. Put the numerical data on diskette; don't use tables in the paper report.

Before writing this section, prepare your figures, and put them in order. The text of this section will then be centered around describing and discussing these figures. You must discuss all figures that are included. Make sure the figures are numbered in the order they are presented. Each figure should have a figure number and caption on the same sheet of paper as the figure. Make sure the figures are large enough to be useful, particularly if they present quantitative data. If you embed the figures in with the text, put the figure close to where it is first referenced. Also, make sure the figure is large enough to be useful! An alternative to embedding is to put each figure on a separate sheet of paper, and put all the figures at the end, after the reference section, and before any appendix. Putting them at the

end is best if you have any figure that needs a whole page. If you have to put one figure at the end, put them all there. This assembly of figures is part of the paper: it is not an appendix. Putting all figures at the end is the standard format for papers submitted to journals.

6) Conclusions: Many of your readers will only read this section, so begin this section with yet another statement of what was work was done or measurements made, in the context of what the original goal of the study was. Summarize the main findings of the study, and relate them to the goals also. Be quantitative, but do not include too many details. Do not refer to any figures in this section.

End with suggestions of future work to be done. This is particularly important for operation manuals and design/construction reports.

7) References: Give a numbered list of books and reports that you actually refer to in the text. If you read other useful stuff, but don't refer to it specifically, put it in another list called 'bibliography' or 'suggested readings'. The endnote feature in MSWord is good for keeping the numbers of references straight.

Each reference should contain the author, article title, journal title, volume, page numbers, year. Journal titles and book titles should be in italics. Book references should also include the publisher's name in place of the journal title. Look at the reference list at the end of a journal article for examples. Journals have varying reference style, so pick a style and be consistent.

8) Appendices: Most of what students put in appendices would be better elsewhere, like in the report body, or on diskette. Be conservative, and ask if you have questions about where to put information.

In general:
One of the most common pitfalls to be avoided is the use of imprecise language. It is important to use the correct terminology when referring to apparatus, procedures and phenomena. Be careful to use 'the' to describe specific items used in an experiment, while using 'a' to refer to a generic item. When using variables to describe results, give them descriptive subscripts. Either include a list of nomenclature (variable names and definitions) or be sure to define each variable when it is first used.

Oral reports follow basically the same format as the written, but an additional structure is superimposed. "Tell them what you're going to tell them, then tell them, then tell them what you've told them." This means that after introducing yourself, your co-authors and institutions and the title of the talk (using a title slide), the outline of the talk is described (tell them what you're going to tell them). This takes the place of the abstract. Then comes the introduction (including theory), the experimental description, results and discussion (tell them). Your last slide will be a conclusions slide. Begin your conclusions by restating the outline of the talk, and then end with the essence of your results (tell them what you've

told them). You can also use this repetitive structure within the various sections of the talk. This helps refocus the audience's attention. It is also helpful to announce the transitions between sections (“That concludes the experimental description. Now let's look