

**University of Massachusetts Lowell**  
**Continuing Studies and Corporate Education**



**GUIDELINES ON**  
**HOW TO WRITE MEMORANDUM TECHNICAL REPORTS**

**College of Engineering**  
**Writing Improvement Workshop**  
**Falmouth 203A**  
**November 2006**

Some people rarely have to write anything...

Of course this does not apply to you. You have chosen the life of a technical professional. Engineers, scientists, and technical specialists of every kind must convey the results of their thinking, their research, their *work* in writing.

The ability to convey your ideas clearly, logically, and convincingly has a direct influence on your career progress. At a more basic level, if your colleagues and superiors understand your ideas and are convinced of their soundness, those ideas will find support. Your proposals and plans will be adopted.

These guidelines won't make a great writer out of you, but they will help you present your technical work logically and effectively. The aim is to make the guidelines so useful you will keep them handy at your first job.

These guidelines are designed to help you write memorandum (memo) reports. Memo reports are aimed at highly informed readers, who do not need background information or extensive detail. For example, the only reader may be the writer's immediate supervisor, who is thoroughly informed about the reasons for collecting the data, or the readers may be colleagues who are familiar with your work.

The memo report begins with a heading at the top of the first page as follows:

**To:** Instructor's Name  
**From:** Author  
**Subject:** A Descriptive Title

**Date:**  
**Section:**  
**Partner(s):**

Note: There is no cover page or title page.

The only challenge in the heading is to choose a descriptive title for the Subject.

### **Subject**

*Pick your subject title with care;* make it descriptive. A well chosen subject heading can provide much useful information to the reader and save you the trouble of having to insert that information into the text. What is more important, it gives you an opportunity to grab the attention of the reader and avoid having your memo report end up in the reader's waste basket. For example:

#### **Instead of**

Reynolds Number  
Kirchhoff's Laws  
Testing of XYZ Bolts

#### **Choose**

Reynolds Number as a Predictor of Fluid Flow Type  
Verification of Kirchhoff's Laws  
Suitability of XYZ Bolts for Frimble Assemblies

The **Body of the Report** consists of just three sections:

**SUMMARY**  
**EXPERIMENTAL APPROACH**  
**DISCUSSION OF RESULTS**

Very often in technical reports **attachments**, or **appendices**, are added as supplementary reference materials, should the reader choose to see them.

Let's explore the three sections of the memo report in detail.

### **SUMMARY**

The memorandum report should open with a short paragraph or two that summarizes the **purpose** (technical objectives), **scope** of the investigation or design exercise, including the method used to get the results, the **conclusions or findings** and any **recommendations**.

Note: There is no separate "Conclusions" section in the memo report. The conclusions are given in the Summary. This format allows the reader to get a complete overview by reading only the Summary, and not the entire report. Remember, the Summary is self-contained, so don't refer to other parts of the report here, such as Figures, Appendices, etc.

Here's how to begin: Write the heading **Summary**, then **answer three questions** for the reader:

**1. What were the technical (not the academic) objectives? (purpose)**

**2. What did the experiment or design exercise consist of? (scope)**

**3. What were the conclusions or findings?**

Occasionally a fourth question may need answering: *What do you recommend?*

Here are some examples of Summaries for memo reports:

**Example 1:**

*The purpose of this experiment was to determine how well the Reynolds number predicts the type of fluidflow in a pipe. The analysis was based on a visual examination of the type of flow through a system consisting of water, a dye, and a straight glass pipe fitted with a feed tube for the dye. Visual judgments of the types of flow (laminar, transitional, and turbulent) were compared with theoretically expected flow types. The analysis showed that the Reynolds number is (or is not) a reliable predictor of the type of flow in the pipe.*

**Example 2:**

*The objective of this test was to determine whether XYZ bolts can be used in our new Encabulator assemblies. Twenty bolts were subjected to tensile loads on an Olney tensile machine, and the breaking loads were analyzed using the Gaussian distribution law. The data show that the bolts are suitable for use in our standard assemblies but not in our special, high-performance assemblies.*

**Example 3:**

*This test was performed to decide whether our new Encabulator assemblies could be anchored by XYZ bolts, samples of which you submitted last week. The results are based on breaking load data that were obtained with an Olney tensile machine and then subjected to Gaussian distribution analysis. Tensile tests on the sample of 20 XYZ bolts submitted show that the bolts will be suitable for our standard assemblies but not for our special, high-performance assemblies. Because the samples may not have been representative, however, more tests should be conducted before a final decision is made.*

Here are some tips for answering questions one (purpose) and two (scope):

**A Brief Explanation of Purpose and Scope**

The **purpose** statement tells the reader why you did the investigation. It sometimes explains why the work is important enough to investigate and always tells what the specific *technical objectives* were.

**Note:** *Never mention the academic objectives* (e.g., to learn how to use an oscilloscope), but tell the reader the technical or economic reasons for doing the investigation. Most investigations have practical goals, for example, to improve a method or process, to identify optimal conditions, to improve process quality, to see whether a design will meet performance specifications, to validate physical properties or behavior, to improve safety, to name just a few. Concentrate on these objectives. Once you have identified the technical objectives, the rest of the report tells how and whether or not you achieved them.

The **scope** statement does two things for the reader. It defines the **boundaries** (or limits) of the investigation, and it gives the **criteria** or standards on which your judgments were based. The scope statement narrows the problem and provides focus for the investigation. It also forms the basis for the conclusions. Here's an example of a purpose and scope statement with the scope information underlined:

*The advantages of transporting solids through a pipeline in the form of a water slurry are well known. However, these advantages are often offset by a lack of water for the pipeline and by the added cost incurred in separating and drying the solid material at the destination point. The purpose of this study was to examine and compare the transport of two types of coal: an anthracite typical of the Pennsylvania region and a low sulfur bituminous coal common to the Powder River Basin. Engineering data were developed from a pilot plant system, and delivered costs to various destinations were estimated.*

**Tip:** Notice that *past tense* was used when referring to the specific study. That's consistent; the experiment or study took place in the past.

## Conclusions and Recommendations

Conclusions are the answers to the questions (or solutions to the problems) raised in the Purpose and Scope. The conclusions are your judgments, opinions, and interpretations of the results. Here's an example of conclusions:

*Changes in all three process conditions affect the hardness of plastic parts, but in different ways. Increasing the cure rate and immersion time improves hardness. Increasing the temperature improves hardness to a point, but at temperatures greater than 650 degrees F, hardness deteriorates.*

The *number of conclusions* must be the same as the *number of objectives* stated in the purpose and scope. (For example, if you had two objectives, you should have two conclusions.) If the two numbers don't agree, either you stated your objectives incorrectly or the conclusions don't focus clearly on the objectives, or you are confusing findings (facts) with judgments (interpretation of facts).

Recommendations are what *courses of action* you advise the reader to take based on your conclusions. For example, if your experiment was intended to test mathematical models against actual experimental results, do you (based on your findings) recommend using the models? Under what conditions? Sometimes your recommendations must be negative; for example, "Based on the experimental results, the use of Ohm's Law to determine the resistance of an electrical component is not recommended." You also may recommend changes in the equipment and/or procedure to get more accurate results when repeating the experiment. Be sure your recommendations are a logical follow-up to your conclusions.

## EXPERIMENTAL APPROACH

This section of the report has two subheadings:

### Equipment and Materials Procedure

To help the reader, please use these subheadings (as well as the main headings) in your report.

In the *Equipment and Materials* section you should list (and, in some cases, describe) what you used to get your results. The key is to provide just the *right amount of detail* for the reader. For example, in some cases the reader may need to know the make and model number of a piece of equipment, and in other cases that information may be unimportant. Perhaps the reader needs to know the special characteristics or features of the equipment or materials. You must judge. Just remember: too much detail bores the reader and makes your report amateurish; not enough detail confuses and frustrates, and can even irritate the reader.

The *Equipment & Materials* section nearly always contains a schematic or diagram of the experimental setup. Make sure the diagram shows all the items mentioned in the text. The diagram also should have a *title* and *figure number*, be *referred* to in the text, and be *located* as close after the reference as possible (*not* in an appendix).

In discussing the *Procedure*, tell your reader what steps were taken to get the results. Do not give your reader a set of instructions on how to recreate the procedure. The procedure is meant to explain how you arrived at your results. Use passive voice, e.g., "Pressure readings were recorded." Remember the earlier comments about level of detail. Omit all details not relevant to the results. The procedure may be written in paragraph form or as a list of numbered steps. Remember, the experiment took place in the past, so use *past tense*. Lastly, never introduce **results** in the procedure.

## DISCUSSION OF RESULTS

This section does two things: it *reports* your results and, at the same time, gives your *interpretation* of them. Begin this section by reporting your results supported by tables or graphs if appropriate, then ask, "What do the results tell me about my objective(s)? Which tables or graphs relate to which objective? Do the results confirm theoretical expectations? If not, why not? How reliable are these data?" (Remember, insert each table or graph as close after the text reference as possible.)

Explain whether your results (as they relate to your objectives) agree with what you expected them to be based on your understanding of the underlying theory or technology. Show either the reason(s) for expecting certain results or the reason(s) for any disagreements between your results and what you expected. In addition, comment on any ideas you might have for improving the experiment, for example, a better experimental setup or a change in the procedure that would simplify the work, give it a broader application, yield more accurate data, etc.

The “discussion” should not be simply a long list of what went wrong with the experiment. Tell your reader what happened and give your analysis. Be careful not to go too far and get into conclusions; they belong in the Summary.

**Note:** For ease of editing, print the text of your *first draft double-spaced*. Be sure to indent the first line of each new paragraph. The second draft can be single-spaced or double-spaced depending on what your instructor prefers. Appendices or attachments are *always* single-spaced.

## APPENDICES or ATTACHMENTS

Complete the report by attaching any *useful* appendix material as needed —sample calculations, derivation of an equation, specifications of equipment, etc. Don't think of this section as a suitcase into which is stuffed everything that was not used in the rest of the report. Appendices provide information to only a few readers who need to probe deeply into the details. Appendices **do** contain such things as computer printouts, tables of data that support the graphics used in the body of the report, sample calculations, raw data, complicated formulas and equations needed to support the conclusions but not necessary to understand them, and reprints from other documents. Appendices **do not** contain figures that show the apparatus, or tables that give the results; they belong in the body of the report.

Remember, each appendix is *optional* for the reader. Thus you must help the reader decide whether or not to read each appendix. Do this by giving each appendix a **letter and a title** and by **referring** to each appendix at the proper places in the body of your report.

Page numbers, figure numbers, and table numbers contain the letter of each appendix. If Appendix A has three pages, number them A-1, A-2, A-3. If Appendix B has two figures, number them B-1, B-2, etc.

## HANDLING TABLES AND FIGURES

What is the difference between tables and figures? A *table* is any display of information arranged in rows and columns. A *figure* is anything else (e.g., map, diagram, drawing, photo, schematic, graphic aid, and chart). Here are guidelines for handling tables:

- *Refer to every table and figure in the text. Give the reader some idea of what the table or figure contains, and locate the table or figure as close as possible following the reference.* Sample references include: “The results are shown in Figure 1, (See Table 1 for experimental results.).” Capitalize the T in Tables and F in Figures. Spell out Figure; don't use “Fig.”
- Give each table and figure a *descriptive title*. Table numbers and titles (headings) go *above* the tables. Figure numbers and titles go *below* the figures.
- In **table titles** (headings) capitalize the first letter of each word and all other words *except*: articles (a, an, the), conjunctions (and, as, but, if, or, nor) and prepositions (at, by, for, in, of, off, on, out, to, up). **Figure titles** are treated as sentences. Capitalize the first word in the figure title, but all other words except proper nouns are in lower case. Put a period at the end of each figure's title.
- Tables and figures in the **appendices** contain the letter of the appendix, for example, Table A-1, Figure B-3.

## ABBREVIATIONS

- *Be consistent.* Don't use sq ft on one page and ft<sup>2</sup> on another.
- Always use the *singular form*, even if the value suggests the plural (e.g., 50 lb, not 50 lbs; 10 amp, not 10 amps).
- *Omit periods* after abbreviations (ft, ml, cm). The only exception is if the abbreviation is a word. Use in. for inches, for example.
- *Spell out* words that are *too short* to abbreviate (ohm, ton, mil).
- Make certain the reader *understands* the abbreviation; if there is any doubt, spell out the term the first time you use it, followed by the abbreviation in parentheses.

Incidentally, **lab** is an informal word meaning “laboratory.” It should be avoided in formal writing. More importantly, “lab” is *never* used to mean “experiment.” Avoid “max” and “specs;” use “maximum” and “specifications” in writing.

## NUMBERS

The basic rule is to spell numbers one through ten and use numerals for 11 or greater. The same applies to numerical order (seventh, but 27th). There are several exceptions to this rule, however:

- References to pages, Tables, and Figures are expressed in numerals (e.g., as shown in Figure 3).
- Numbers at the beginning of sentences are spelled. Try to rearrange the sentence to avoid this situation, especially if the number requires two or more words to spell out (e.g., three hundred and sixty-nine).
- Use numerals with abbreviated units of measurement (e.g., 8 mm, 9 cu ft).
- When expressing a series of quantities, express them in numerals for uniformity. (For example, the farmer shot 23 quail, 16 sheep, and 2 traveling salesmen.)

Use commas with numbers of four digits or more in tables and with five digits or more in text.

In text, rounded-off values of six or seven digits are usually written, for example, 3 million copies, \$45 billion. Five-digit numbers, however, are either spelled entirely (ten thousand) or shown entirely as numerals (10,000). Never write 10 thousand.

When two numbers come together and one forms a compound adjective, spell the first one or the shorter one to avoid confusion (for example, four 12-foot boards or 200 eight-inch blocks).

## SOME TIPS ON WRITING WELL

First some practical suggestions:

1. *Don't wait until the last minute.* One of Murphy's truest laws is, "Things always take longer than you expect." If you postpone your report until the night before it's due, your report will read and look as if you did it the night before!
2. *Use a word processor.* Computers can help you organize your thoughts. They can find and correct misspelled words, give you access to an on-line thesaurus, and even check grammar and usage. Best of all, they save time when you polish and rewrite. Just remember, make two copies of your work on diskettes. Lastly, be sure to delete your report from any university computer. **You are responsible for ensuring that no one, except your instructor, has access to your report.** Of course, team reports are an exception, but the Workshop does not review reports written by teams.
3. *Study and follow the Guidelines.* Don't try to improvise.
4. *Before you start to write, do a little planning.* Begin by focusing on the *technical purpose* for doing the experiment. Jot down a few notes. What were you trying to prove or discover? What did you *actually* demonstrate? The key to a good report is to put your work in *focus* for the reader. Notice the difference in focus in these two titles and purpose and scope statements from the same experiment.

Example 1 (lacks focus):

### *HEAT EXCHANGE*

*The main purpose of this experiment was to prove that heat exchangers work. Heat exchangers work in many ways, but we were limited to two types. The first worked by having steam run parallel and counter current around the outside of a cold water pipe. The other type used steel plates and corrugated surfaces to exchange the steam's energy and the energy of the cold water. The experiment was limited to pressures between four and ten pounds per square inch. The flow rates of the steam and water were restricted to 20-41 and 265-295 ml/s, respectively.*

Example 2 (well focused):

### *COMPARING TWO TYPES OF STEAM-TO-WATER HEAT EXCHANGERS*

*The exchange of heat between steam and water is probably the most widely practiced heat-transfer operation in use. The main objective of this experiment was to determine and compare the thermal efficiency of two such types of heat exchanger: the traditional two-pipe exchanger and the newer Tranter Superchanger. Other objectives included comparing the overall advantages and disadvantages of each type.*

What's the point?

It's important before you even begin to write to ask the right questions. "Why would an engineer gather these data?" "Why was the work important enough to investigate?" "What are the specific *technical objectives* of the experiment?" Notice the presence or absence of *focus* even in the *titles* of the two examples above.

Technical objectives could include evaluating processes for efficiency (as above), or improving the quality, appearance, or strength of a part. Most investigations have practical goals, for example, to improve a method or process, to identify optimal conditions, to improve process quality, to validate physical properties or behavior, to improve safety, to name just a few.

5. Write your first draft, keeping the following in mind:

Consider your reader. Always remember, your reader did not do the experiment or design exercise. The fact that you know what happened can be a liability, because it can lull you into assuming your reader knows as much as you do. Keep asking yourself whether or not your reader can understand and follow your ideas based on your words on paper. Write in simple, familiar words. Impress your reader with your *ideas*, not your vocabulary. Don't stop the flow of ideas by trying to edit as you write. First get it all on paper; put your draft aside for a time, then make a new beginning by polishing your work carefully.

6. *Polish for Clarity.* Your first goal is for your reader to understand what you have written. The fact that *you* understand the meaning behind the words is not only irrelevant, it can be a barrier to your working hard to reach your reader. Here are some examples of polishing for clarity:

*Use specific, concrete terms*

Vague: The Superchanger was better than the double-pipe heat exchanger.

Specific: The Superchanger's thermal efficiency was 60% higher than that of the double-pipe heat exchanger.

*Place modifiers as close as possible to the terms they modify*

Ambiguous: After being stored at -30° F, the mechanic tested the battery's starting ability.

Clear: After being stored at -30° F, the battery was tested for starting ability.

*Identify the source of a statement.*

Unclear: It is believed that work stoppage can be avoided.

Clearer: Both union and management believe a work stoppage can be avoided.

*Be sure that references (such as "this") are clear.*

Unclear: The team postponed its study of the security system at the nuclear plant. This was the subject of an uncomplimentary editorial in the local newspaper.

Clear: The team stopped its study of the security system at the nuclear plant. The postponement was the subject of an uncomplimentary editorial in the local newspaper.

*Define terms your reader may not understand*

Jargon: The program was stored in ROM.

Clearer: The program was stored in Read Only Memory (ROM).

7. *Polish for Conciseness.* Conciseness means to express something clearly in the fewest possible words. Every word must work for you. Cut out deadwood. Here are a few examples:

Deadwood: In an emergency situation

Concise: In an emergency

Deadwood: I talked to two different people about the problem.

Concise: I talked to two people about the problem.

Deadwood: Enrollment will continue to increase in the future.

Concise: Enrollment will continue to increase.

Deadwood: The report contains information of a technical nature.

Concise: The report contains technical information.

Deadwood: It is the intention of this report to discuss the effects of computer technology on the design of microprocessors.

Concise: This report explains how computer technology has affected the design of microprocessors.

Deadwood: Shipment of the test equipment took place in May.

Concise: The test equipment was shipped in May.

Deadwood: An innovative, new technique is now available. It consists of...

Concise: A new technique consists of...

8. *Polish for correctness.* A report with errors in spelling, grammar, and punctuation suggests carelessness, which can harm the credibility of the entire report. Read your report over with great care. Test every word and sentence for correctness. Can you find the errors in the sentences below?

The purpose of this lab was to determine the validity of Kirchhoff's voltage laws.

We only tested for thermal efficiency.

The manifold lost it's head of steam.

Because it controls the functioning of the equipment.

Rupture occurred because of to much end load.

After conducting several test runs, the equipment was purchased by the company.

Always check your report for misspelled words

9. *Polish for completeness.* Completeness means providing the reader with all the information needed to understand the report. You can provide that information in a variety of ways: parenthetical definitions, footnotes, glossaries, graphic aids, examples, analogies, background information, appendices, etc. The key is to *analyze your audience's understanding* of your subject and then to provide the exact *level of detail* that will satisfy your audience's needs. Work hard at this because too much detail will bore your audience, and too little will frustrate and annoy them. One key skill that good communicators always develop is the ability to "*become*" their audience as they write or speak.

## The Writing Improvement Workshop

The Engineering Technology Program of Continuing Studies and Corporate Education conducts a formal technical report writing workshop in which an engineering student submits one laboratory report for analysis each semester. A professional communicator reviews the report not just for the correctness of the writing, but also for the student's ability to grasp and enunciate the technical objectives and focus all parts of the report on those objectives. Each student's report is marked up with comments and suggestions, corrections, and commentary to help the student gain an understanding of what must be done to produce a report that meets industry standards. The procedures for reviewing technical reports plus your role and responsibilities in participating in the Workshop are given in Appendix A. The basic checklist used by reviewers in evaluating reports are presented in Appendix B. Check both Appendices; they will help you to have a successful workshop experience



## APPENDIX A Writing Improvement Workshop Procedures for Reviewing Technical Reports

1. Each Semester you will be asked to submit one laboratory report to be evaluated for format, content, and clarity based on the foregoing guidelines. ***The report must be your own original work.*** Any text from other sources must be shown in quotation marks, and the author and publication must be referenced. Team or group reports are not accepted by the Workshop.
2. ***All reports must be computer printed*** (or typed) **in 12-point type**. The **first draft** text must be **double-spaced**; be sure to **indent** the first line of each new paragraph. The second draft can be single-spaced or double-spaced, depending on what your instructor prefers. **Submit first drafts to your instructor, not to the Workshop. The Workshop does not accept first drafts from students.**
3. A Workshop reviewer, who is a professional in technical writing/editing, will mark up your report with comments, suggestions, corrections, and commentary, showing how the report can be improved to meet industrial standards. The intent is to mark up the report comprehensively, sufficient for you to prepare a second draft without additional help.
4. Your report will be returned to your instructor in time to be returned to you one week after the original submission date.
5. Submit your rewrite plus the original report to your instructor one week later (or at you next class, should no class be held a week later).
6. Your reviewer evaluates the revised report and grades it "pass" or "fail." If the grade is "pass" the revised report and the original report will be returned to the laboratory course instructor for technical review and a numerical grade of your *final draft*.
7. Failure on the second draft will normally result in a grade of zero from the instructor for that laboratory experiment, test, or design exercise.
8. Your reviewer can be reached via e-mail at: **Leonard\_Meuse@uml.edu** Please contact him if you have any questions.

## Checklist of Common Problems With Memo Reports

Following is a list of corrections and recommendations that are made on many reports. Please look your report over. Do any of these problems apply to your report? Numbers in parentheses refer to page numbers in **GUIDELINES ON HOW TO WRITE TECHNICAL REPORTS**.

**FORMAT**

- ☐ Headings need to be the same as in Guidelines. (p. 1)
- ☐ Subject needs to be descriptive and informative. (p. 1)
- ☐ Paragraphs must be indented if report is double spaced.
- ☐ Number the pages.

**TABLES AND FIGURES (p. 4)**

- ☐ Each table and figure must have a number and a title.
- ☐ Refer to tables and figures by number.
- ☐ Tables and figures should closely follow your first reference to them..
- ☐ Capitalize the first letter of the words **Table** and **Figure** when referring to table/figure by number.
- ☐ Graphs are figures.
- ☐ Be consistent.
- ☐ Treat titles according to Guidelines.
- ☐ Something is **shown** in a figure, as opposed to the figure **being** something.
- ☐ Tables and figures show information about the experiment you did in the past.

**SUMMARY SECTION**

- ☐ Technical objective is incorrect. See assignment handout.
- ☐ Technical objective is incomplete. See assignment handout.
- ☐ Summary is incomplete--it needs: (pp. 1-3)
  - technical objective                      scope
  - method                                      conclusions

**EXPERIMENTAL APPROACH (p. 3)**

- ☐ Describe what was done. DO NOT GIVE INSTRUCTIONS.
- ☐ Use past tense. Do not tell how it is done.
- ☐ Use passive voice. Describe what was done. ("The equipment was started," NOT "We started the equipment.")
- ☐ Do not include results in this section.
- ☐ Put calculations in an appendix.

**DISCUSSION OF RESULTS (p. 4)**

- ☐ Revise to focus on the assigned technical objective.
- ☐ Analyze the results. Do not just report the results.
- ☐ Procedure belongs in the Experimental Approach section, not in the Discussion of Results.
- ☐ Include tables and figures, referring to them to explain your results.
- ☐ Use past tense when discussing this experiment.
- ☐ Use present tense when discussing theory.
- ☐ Make it clear when the discussion is about theory and when it is about this experiment.

**APPENDICES (p. 4)**

- ☐ Appendices must be organized by subject and divided into logical sections, not lumped into one "Appendix."
- ☐ Give each appendix an appropriate letter/number and a title.
- ☐ Number pages properly.
- ☐ Give figures and tables appropriate letter/numbers and titles.
- ☐ When referring to a specific appendix, use a capital A for Appendix.
- ☐ Refer to each appendix (or attachment) in the body of the report.

**OTHER**

- ☐ USE SPELLCHECKER.
- ☐ Report lacks professional appearance.
- ☐ Language skills must improve significantly for the report to earn a passing grade.