



To: Students in Mechanical Engineering Classes with Report Writing Requirements  
From: Professor Peter Avitabile  
Date: 7 January 2006  
RE: Report Writing Tips & Guidelines & Common Mistakes Encountered

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Technical writing is a difficult, but very important task that must be mastered. There are two types of reports that are generally required in the Mechanical Engineering Curriculum:

- 1) the short memo report
- 2) the long formal report

Both of these have similar sections but are also very different in several regards. Before the report formats are outlined, there are several general aspects of writing and presentation that need to be presented. These are the use of references, equations, tables, plots, figures and common editorial mistakes made.

## **REFERENCES**

References are generally listed by Author, Publication, date (or other detailed information). The references are made in the main body of the text, starting with the number 1, and enclosed in brackets [ ]. Notice that in the example below that the first reference is made with the author's name whereas in the second case just the reference number is included in the text – both are acceptable variations.

As an example .....

As stated in Wheeler and Ganji [1], digital sampling must occur greater than twice the maximum frequency of interest when performing the FFT [2]. This is true for frequency domain representations of data. However, the sampling for collecting raw time data must be in excess of 10 to 20 times the maximum frequency of interest [3] when the data to be collected is only to be used for time representations.

and at the end of the report .....

References

1. Wheeler, A.J. Ganji, A.R. "Introduction to Engineering Experimentation, 1<sup>st</sup> Edition, Prentice-Hall, New Jersey, ISBN 0-13-337411-4.
2. Cooley, J.W. & Tukey, J.W., "An Algorithm for Machine Computation of Complex Fourier Series", Math. of Comp., 1965, 19(90), pp 297-301.
3. Avitabile, P., "Basics of Spectrum Analysis/Measurements and the FFT Analyzer", UMASS Lowell Class Notes for ME 22.403, Spectrum Analysis 082702



## EQUATIONS

Equations should be prepared with an Equation Editor and should contain the proper use of superscripts and subscripts and matrix/vector notation as needed. In the text, the equations should be numbered, starting with the number 1, when referenced and enclosed in parentheses ( ); equations are only referenced *after* first introduced in the text. The equation itself should generally be on a separate line with the equation number to the right of the equation (and preferably right justified). Some examples of equations are shown below for reference.

$$\{y\} = [\{x\} \quad \{1\}] \begin{Bmatrix} a \\ b \end{Bmatrix} = [\text{coef}] \begin{Bmatrix} a \\ b \end{Bmatrix} \quad (1)$$

$$\text{SLOPE} = \frac{dy}{dx} = \frac{\Delta y}{\Delta x} = \frac{y_{i+1} - y_{i-1}}{x_{i+1} - x_{i-1}} \quad (2)$$

## TABLES

Tables are an orderly, organized presentation of data. The table will generally contain several columns of data that are organized with a label at the top of each column. Although not necessary, the table may contain borders and lines separating various parts of the data. A table label is always presented at the top of the table – not at the bottom. Tables are referenced in the main body of the document *before* the table is reached in the document. A sample table is shown below.

Table 1: Strain Gage Data Collected for Loading and Unloading Beam

Weight	Down mV	Up mV	Down uStrain	Up UStrain
47.8	4.5	7.3	42.37	68.74
147.8	13.0	16.5	122.41	155.37
247.8	22.0	25.6	207.16	241.05
347.8	31.1	34.7	292.84	326.74
447.8	40.1	43.8	377.59	412.43
547.8	49.3	48.4	464.22	455.74
647.8	58.2	58.5	548.02	550.85
747.8	67.2	67.5	632.77	635.59
847.8	76.2	76.5	717.51	720.34
947.8	85.2	85.2	802.26	802.26

## PLOTS & FIGURES

Plots and figures are an important part of presentation of material. In general, the plots should always completely stand-alone. That means that there should be a sufficient amount of material to completely describe the plot independent of the text in the document; the reader should be able to interpret most of the plot without having to read the text associated with the plot.

All plots must have axes labeled (with appropriate units when necessary). The plot needs to have a legend if multiple lines exist on the plot. The plot also must have a label to describe the plot. Since plots may be copied, it is important to be able to view the plot in black & white – even though it was originally prepared in color. The scales in the plots should consist of a reasonable numbering scheme. The data should be printed on a scale to best represent the data. The data should be the main focus of the plot and should use “white space” effectively. A sample plot showing proper format is presented below for reference. (Note that the plot below does not satisfy the B&W requirement.) Do not make sloppy plots – this is a sure way to lose valuable points on reports. (Appendix A contains a set of plots that have been submitted in previous years that clearly show poorly constructed plots – plots of this type are guaranteed to cause loss of points on project reports.)

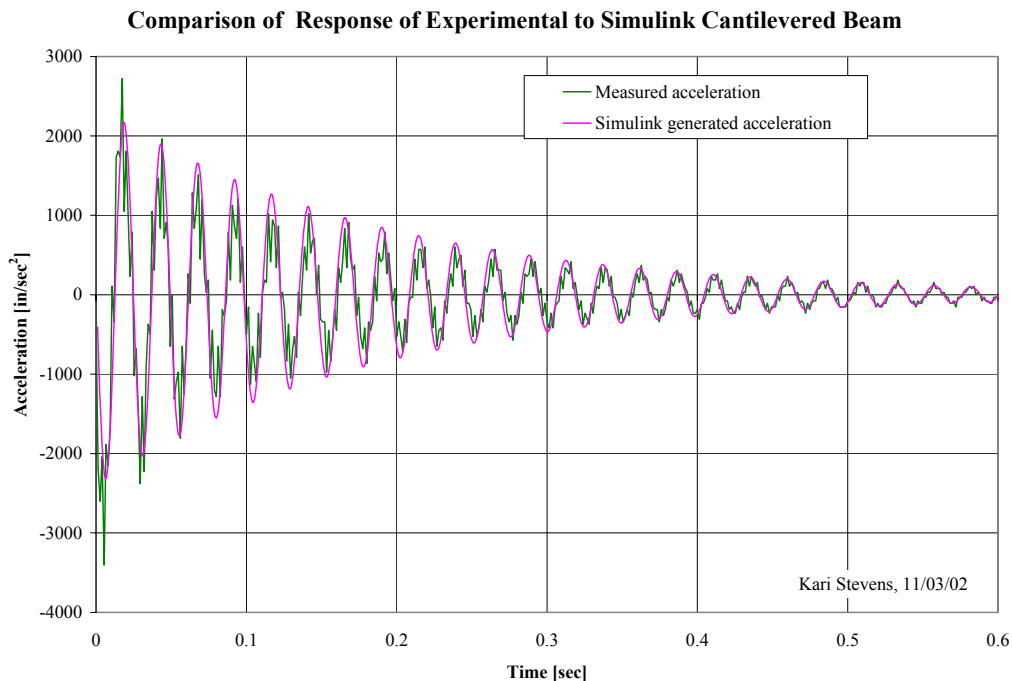


Figure 1: Comparison of Analytically Derived Cantilever Response and Laboratory Measured Response



## **EDITORIAL BLUNDERS**

There are many common editorial blunders that are typically made in writing reports that need to be avoided. Appendix B contains a list of some of the common blunders. (This list is a compilation of editorial mistakes from several sources and there may be similar statements in various sections.)

## **REPORT FORMATS**

While there may be some variation (due to individual or course preference), the basic parts of a short memo report and a long formal report are identified below. Each of the different sections are described in the following sections.

### Short Memo Report

Introduction  
Discussion of Procedures or Methods Used  
Results Obtained and Analysis Performed  
Summary/Conclusions/Recommendations  
References  
Appendices

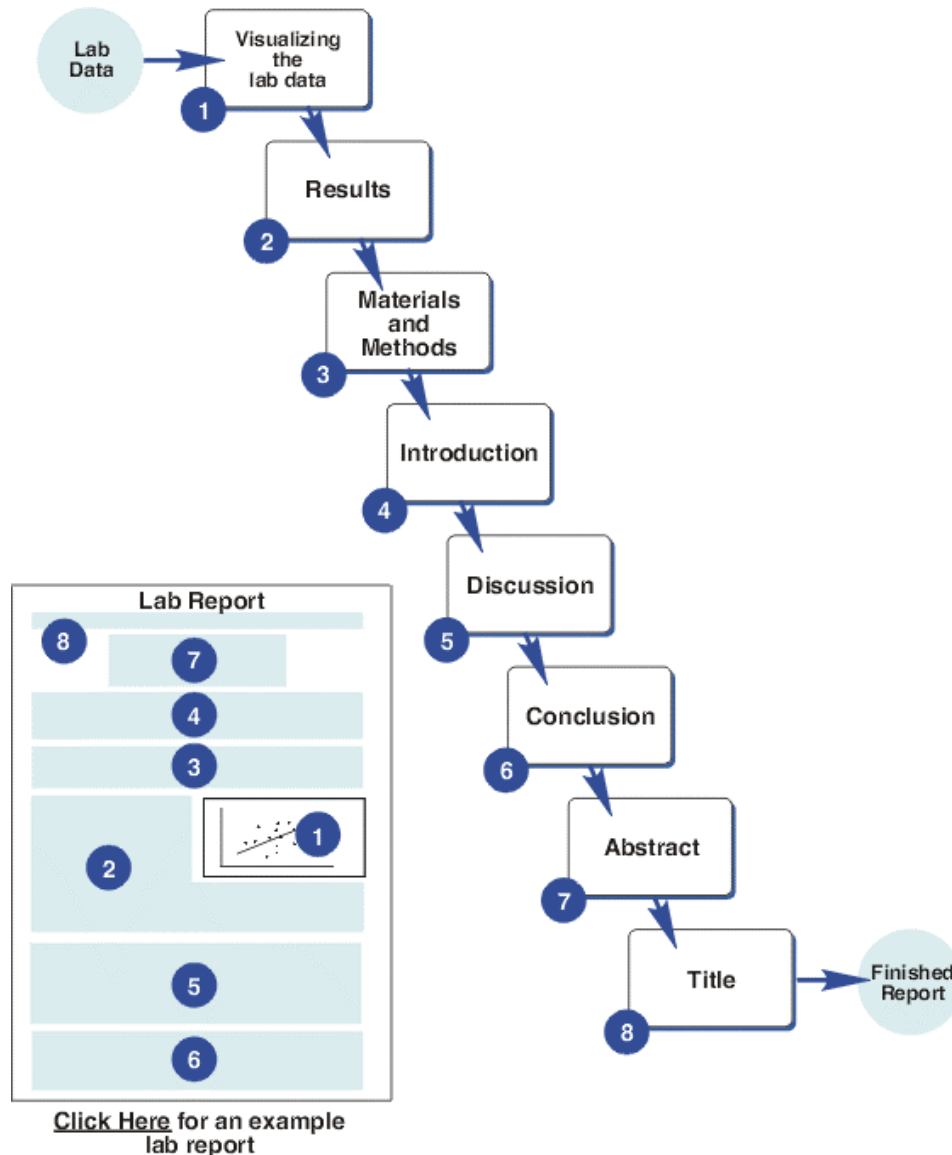
### Long Formal Report

Abstract  
Table of Contents  
Introduction  
Theory/Literature Review  
Discussion of Procedures or Methods Used  
Results Obtained and Analysis Performed  
Summary/Conclusions/Recommendations  
References  
Appendices

An important item to realize is that a reader will typically not read your document in the order in which the topics are presented above. For instance, a long format report might be read in the following order.

First, the Abstract will be read. The reader wants to determine if the subject matter is of interest. Second, if the reader is interested, the next section to be read might be the Summary or Conclusions. The reader is likely trying to determine if this is something new and of interest or something with which the reader is familiar. Third, if the reader is interested, either the Introduction or Theory section will be reviewed next. The reader is now interested and is starting to determine additional information in greater depth. If the reader is still interested, then the balance of the report will be read. But note that the reader may not ever look at the appendices. The appendices will be reviewed if there is detail that is not clearly described in the report or if there are omissions or other anomalies that the reader needs to clarify.

Now realizing how a reader may review a report, the actual development of the report is quite different (and in most cases is the reverse order of how the report is actually read. While a report can be generated in any order, there is an advantage to developing the report as shown in the schematic below. This enables the logical flow of how data is collected, processed and formulated into the laboratory report. While the diagram was obtained from [www.ncsu.edu/labwrite](http://www.ncsu.edu/labwrite) which had an excellent description of the development of a laboratory report, that web site may not exist any longer.





## **BRIEF DESCRIPTION OF REPORT SECTIONS**

The following sections give a very brief description of each section typically found in a report. (NOTE: In this first edition only a very brief description is given. This will be expanded in future revisions of this document to give more detailed information.)

### Abstract

The abstract is a summary of the entire project or experiment. The purpose is to provide readers with a quick condensation, highlighting the important points. This allows the reader to decide if the particular report is worth reading at the present time. Note that specific results are not reported in the abstract nor is there any reference to specific references in this section.

### Table of Contents

The table of contents lists the various sections of the report in logical order. This section also contains a list of all figures and tables in the report.

### Introduction

The introduction is a section that presents the problem at hand. What is the purpose of the analysis or experiment. Many times the introduction presents what others have done in the area of concern, what has and has not worked well; references to previous work is appropriate in this section. The introduction leads the reader up to the point of the current work that is being considered to improve, correct or rectify approaches taken by others.

### Theory/Literature Review

This section identifies the methodology upon which the analysis or experiment is based. This may identify the work of others as well as newly developed techniques, approaches or theories.

### Discussion of Procedures/Methods Used

The procedures and/or methods used contains exactly that. This section should briefly describe the approach taken. There should not be detailed extreme depth in procedures used or analyses performed. Long excessive detail will generally bore the reader. This type of detail is best provided in an appendix. Only the important features of the procedure or method used need be described.



### Results Obtained and Analyses Performed

This section identifies the actual results obtained or analyses performed. Again, excessive detail should be placed in an appendix. Only the important information necessary for the reader to understand, in general, what has been observed is necessary. The details, if needed, can be viewed in the appendix.

### Summary/Conclusions/Recommendations

This section may be just the summary or just the conclusions or just the recommendations or combinations thereof. It depends on the particular report and the end goal of the report. However, this section(s) must answer questions that were posed in the introduction. While summary and conclusion statements are typical in most reports, the recommendations is a critical part of many reports. The recommendations help the reader to determine what, if anything, should be done in the future to improve on the procedures or methods used. Another important item is that the Summary/Conclusion should never introduce information that has not been presented in the body of the report.

### References/Bibliography

The references and/or bibliography should be complete and follow proper literary formats. The references need to all be referenced from the main body of the report.

### Appendices

The appendices contain logically grouped sections that contain significant detail so the reader can probe further into the data or analyses performed. The appendices may also contain large sets of tabular data, detailed computer output results, detailed procedures utilized, etc.

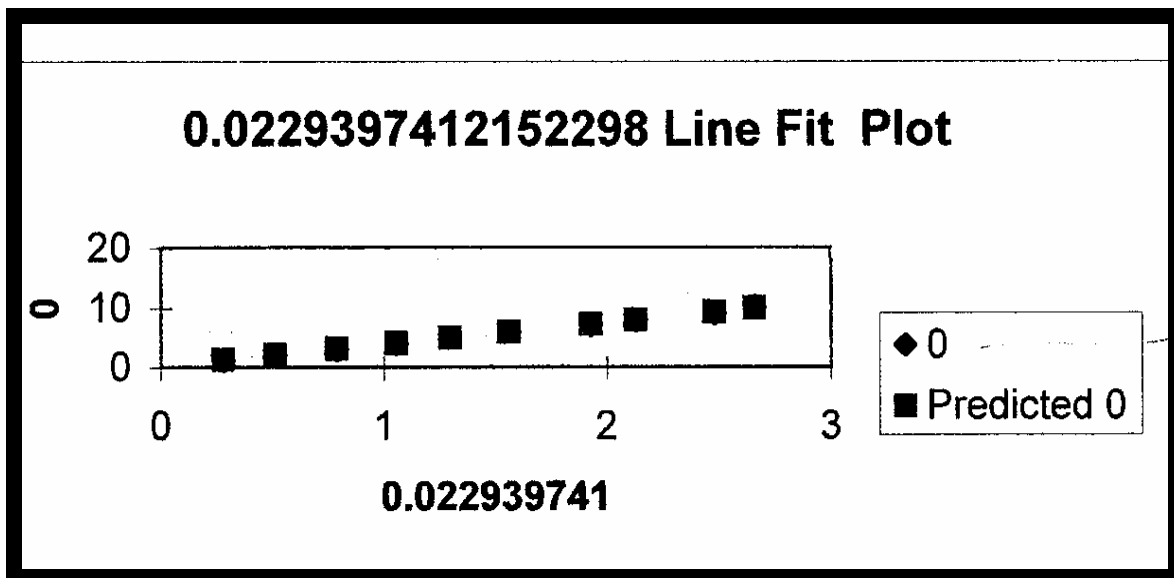
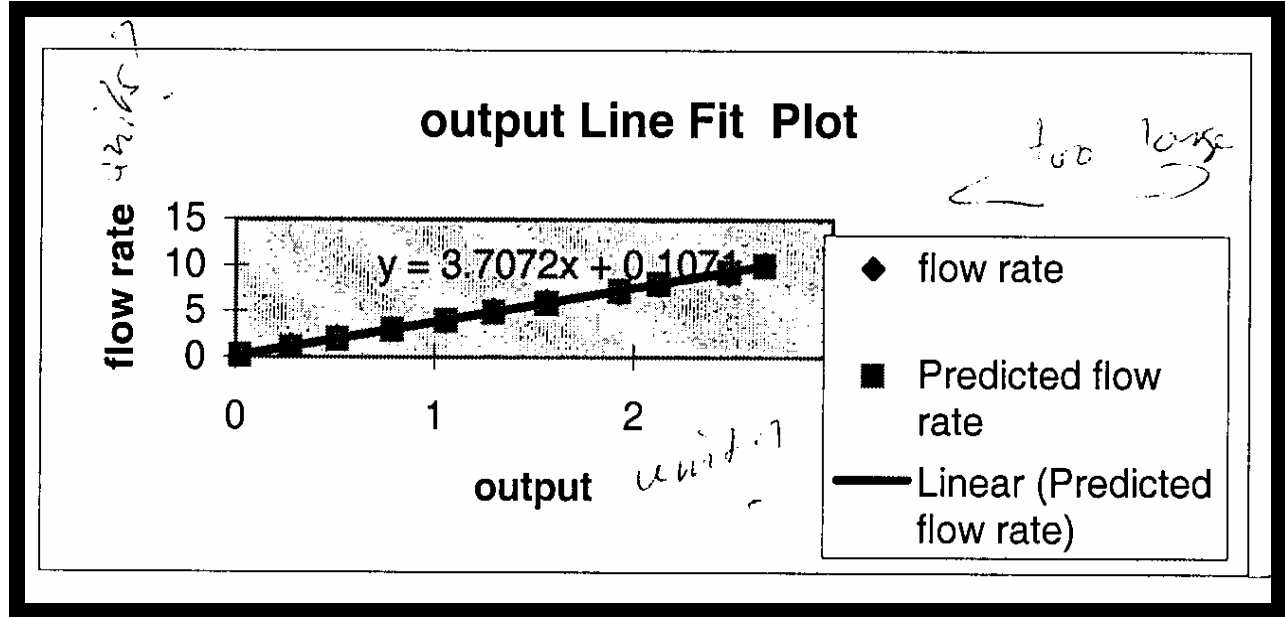


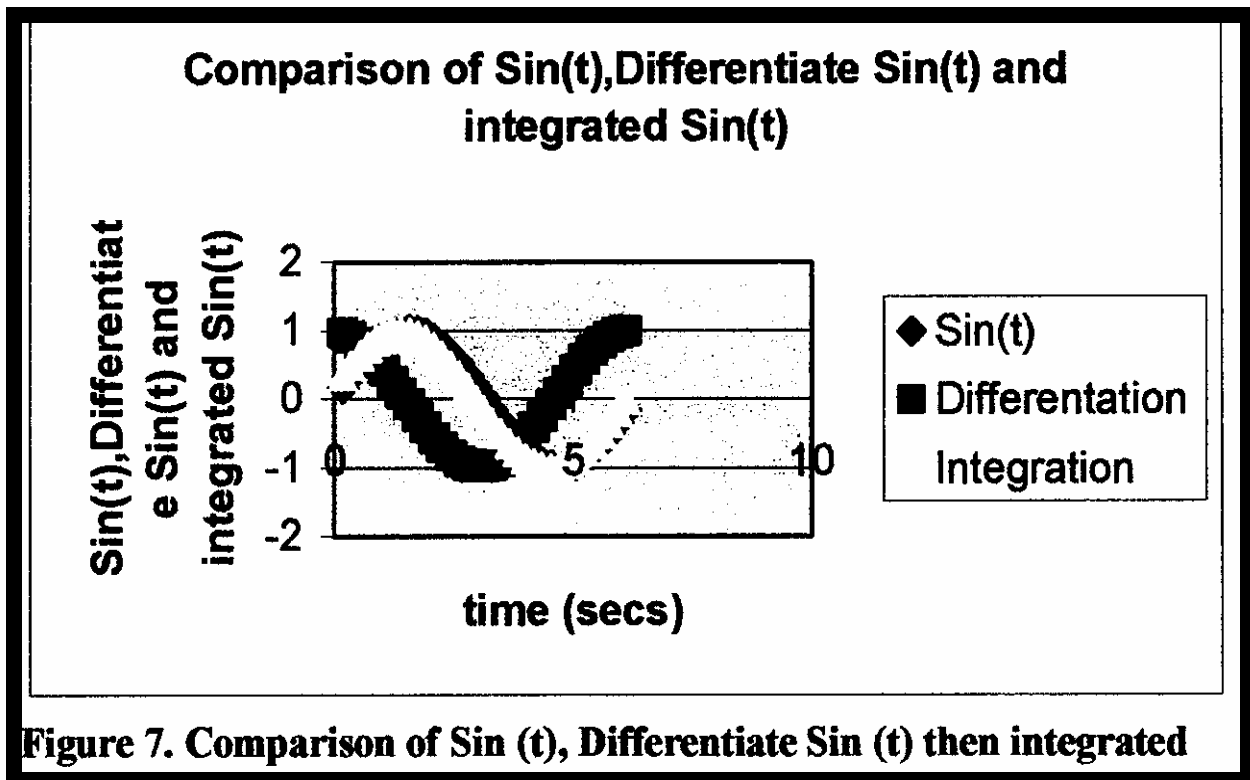
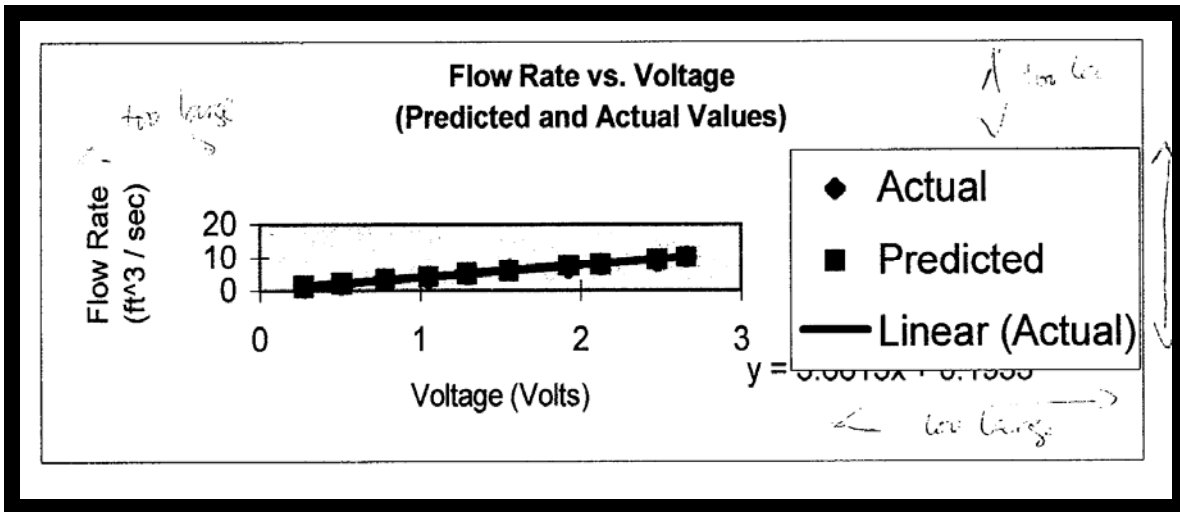
## APPENDIX A

### SOME POORLY CONSTRUCTED PLOTS

(from previous classes)







**Figure 7. Comparison of Sin (t), Differentiate Sin (t) then integrated**



## APPENDIX B

### LIST OF SOME COMMON EDITORIAL BLUNDERS AND HELPFUL INFORMATION

(from various sources)



## Things not to do in a Technical memo or report

- Do not use 1<sup>st</sup> person (I, we, me, us) – use a passive tense
- Do not run sentences on and on – more shorter sentences are better
- Do not use 100 words when 10 will do
- Do not use “This” as the subject of a sentence
- Do not editorialize or insert opinions
- Do not use “since” when you mean “because”. “Since” implies temporal dependence.
- Do not end a sentence with a hanging preposition
- Figures and tables should not appear on a page before they are referenced in the text of the report, i.e. do not put figure on page 6 and not talk about it until page 7 or later. Figure can be discussed on page 7 and not show up until the next page or later, but preferably the next page at the latest.
- Do not use contractions—e.g. can’t and don’t
- Never start a sentence with a variable
- Do not use it’s (= it is) when you mean the possessive of it (= its)

## Things to do in a Technical memo or report

- Keep your discussion brief and to the point.
- Number figures consecutively, e.g. Fig. 1, Fig.2, and so on (the same is true for references)
- Any figure that you include in your report should be cited in the body of the report. If you do not discuss the figure, then why is it in your report?
- Use short clear sentences
- Tell what “This” is, e.g. “This graph”
- Know the meaning of the words that you use – precision and accuracy are not the same thing
- Use a comma between the two sentences in a compound sentence
- Use a comma at the end of an introductory prepositional phrase
- Hyphenate compound modifiers, e.g. two 30-KN load cells vs. 30 KN load cells
- Use a table to summarize data. Burying a lot of results amongst a paragraph is confusing. A table lays it all in plain sight.
- Label graphs appropriately, make them a reasonable size and do not use bastard scales
- Use a leading zero in numbers—e.g. **0.1234** as opposed to simply **.1234**
- Number references and refer to them by number in the body of the report
- Cite references and give appropriate credit where it is warranted
- Include page numbers
- The word “data” is plural, so it takes a plural verb—e.g. “the data are in agreement”
- Avoid using “in order to”—it is wordy
- Use superscripts and subscripts as needed—e.g. **10<sup>3</sup>** – not **10^3**, or **A<sub>x</sub>** – not **Ax**
- Either indent new paragraphs or skip a line without indenting, but do not do both
- Do leave a space between a dimension and its units – e.g. 10 ft – not 10ft.
- Figures are always cited at the bottom of the figure whereas tables are cited at the top



### Common Editorial Mistakes (excerpted/edited from Los Alamos Dynamics Summer School)

- Make sure all tables, figures and references are referred to in the main text. These figures should be placed after the paragraph where they are first mentioned
- Do not start a sentence with "This" and then omit the subject.
  - EXAMPLE:
    - "This can be the result of energy dissipation within the material." should read:
    - "This observed response can be the result of energy dissipation within the material."
- Figures must reproduce in black and white.
- Proper use of "Since" and "Because". Since should refer to time, e.g., "Since the founding of our nation..."
- Misuse of since: "Since the mode shapes corresponding to this frequency indicated that Mass 2 experienced the greatest motion, ..." in this example 'Since' should be replaced with 'Because'.
- All graphs must have their axes labeled and the units identified.
- The word "data" is plural. "The data that was collected..." should read, "The data that were collected..."
- Repetitive use of the same word or word form in a sentence. "The floor plates were modeled with shell elements with material properties of aluminum." should read, "The floor plates were modeled with shell elements using aluminum material properties."
- Keep sentence structure as simple as possible. If possible avoid using hyphens, semi-colons and parentheses.
- Consistent number of significant digits. In the following table, mode 1 resonant frequency is reported to 3 significant digits, while the higher resonant frequencies are reported to 5 significant digits. This implies that the higher resonant frequencies can be estimated with much greater accuracy. Note that it may require a detailed statistical analysis to determine just how many significant digits can accurately be reported.