Technical Writing
For Aviation Maintenance

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Abstract

This document provides a brief tutorial on technical writing for the Aviation Maintenance Technician. The purpose is to provide guidance and examples of common technical report elements and styles to help the author better communicate with the reader. The principle concept behind good technical writing and this tutorial is to make it easy for the reader to understand the material presented.

This tutorial covers items including:

- Audience
- Basic Principles
  - No personal pronouns
  - Use outline style
  - Be concise
- The Mechanics
  - Cover page
  - Table of Contents or Index
  - Page numbers
  - Line spacing
  - Fonts and text effects
  - Use of color
  - Widow/orphan
  - Handwritten/drawn material
  - Abbreviations, Technical Terms and Symbols
  - Computations
  - Figures, Graphs and Tables
  - Supporting Documents and Appendices
  - Citing References
  - Binding

Using this tutorial the Aviation Maintenance Technician should be able to create professional technical reports that will accurately communicate information while avoiding common mistakes.
# CONTENTS

Introduction..............................................................................................................4

Audience.....................................................................................................................5

Basic Principles.........................................................................................................6
  No personal pronouns..............................................................................................6
  Use an outline form.................................................................................................6
  Be concise................................................................................................................7

The Mechanics.........................................................................................................8
  Cover page...............................................................................................................8
  Table of Contents or Index.....................................................................................8
  Page numbers..........................................................................................................8
  Line spacing............................................................................................................9
  Fonts and text effects.............................................................................................9
  Use of color.............................................................................................................9
  Widow/orphan........................................................................................................10
  Handwritten/drawn material..................................................................................11
  Abbreviations, Technical Terms and Symbols.......................................................11
  Computations..........................................................................................................12
  Figures, Graphs and Tables....................................................................................13
  Supporting Documents and Appendices.................................................................16
  Citing References...................................................................................................17
  Binding.....................................................................................................................17

Appendix A...............................................................................................................18
Introduction:

Technical writing is the process of communicating complex ideas in logical, concise and unambiguous terms. The author must always strive to;

**MAKE IT EASY FOR THE READER TO UNDERSTAND THE MATERIAL!**

Often a report is used to persuade the reader (management, the Federal Aviation Administration, etc.) to implement the recommendations of the author. If this is the purpose of the report;

**MAKE IT EASY FOR THE READER TO AGREE WITH THE RECOMMENDATION!**

Too often technical writers are convinced that the material presented is obvious and requires nothing but a basic statement for all to agree with the conclusions. Seldom is this the case.

Additionally, if the information is part of a required record (maintenance record entry, etc.) or other legally binding document it should describe exactly what was done (no more, no less) to protect the writer/maintenance technician from regulatory or legal action. In this case;

**MAKE IT EASY FOR THE READER TO UNDERSTAND WHAT WAS DONE!**

As a professional performing work for compensation what you write is legally binding and if you are ambiguous or leave room for interpretation… well, it’s your livelihood!
Audience:

The author of a technical report must consider the audience. To properly communicate an idea, the level of knowledge of the reader must be understood.

Often the audience is another technical individual who is “conversant in the art”. In this case certain limited assumptions can be made about the background knowledge of the reader. It can generally be assumed that the reader is familiar with the field but that familiarity may not extend to the specific topic presented.

For example, the reader may be an aviation maintenance technician with knowledge of those tasks commonly performed by a mechanic. However, the reader may not be intimately familiar with the system the author is describing, particularly a new or complex system.

If the audience is government, management or a person without the same technical background, a different approach is required. In this case few, if any, assumptions can be made concerning the background knowledge of the reader. This does not imply that the reader is lacking intelligence, only that they may not be a practitioner within the field. A good technical writer can present material that does not “talk down to” a less knowledgeable reader while at the same time brings the reader up to a level of understanding which allows them to act upon the recommendations with confidence and comfort (make it easy...).

Additionally, if the audience is a group you wish to impress (as you always should), be sure your vocabulary, grammar and tone are appropriate. Check your spelling! Not only should you use the spell checker of your word processor, but be certain the spell checker (you) chose the correct word to insert, if you are not sure, look it up! Nothing causes a report to be dismissed faster than one that appears to be written by an inferior author in a professional setting.
Basic Principles:

There are some basic principles for writing reports (or any technical information) in aviation that should be applied.

1. NO PERSONAL PRONOUNS!

The use of I, me, we, us, etc. is not part of a good technical document. The reader does not care what you did, only what was done (yes, it is a cruel, uncaring world).

The technical report is not a journal of your day; it is a description of the work that was accomplished. This technique also provides a personal detachment to your writing which can aid in concentrating on the description of the work.

Example:

Poor form;
“I looked in the maintenance manual to find the instructions for changing the tire and then me and my lab partner changed it.”

Good form;
“The right main tire was changed in accordance with Cessna 100 Series Maintenance Manual, chapter 3, paragraph 5a-d.”

If the reader wishes to contact you, your name appears at the beginning of the report or, in the case of a maintenance record, by your signature and certificate number. Relax, the reader can find you (which may not be a positive thing).

The only exception to this principle would be in a case where the results presented were entirely based on your actions. In this instance your participation in the process can be included, but limit such references to the pertinent details.

Example:

“As the project consultant, my analysis of the available data reveals…..”

2. USE AN OUTLINE FORM!

This is the logical part. The use of headings to subdivide the report makes it easier for the reader to find the information they need without reading the entire report (WHAT!?, they’re not reading your entire, excellent report?? Geez!). Curiously, it also helps the author organize their thoughts and results which can simplify the writing process. Certainly headings and subheadings can be overused, so use only those necessary for the reader to find important information quickly.

If the report is following a published process, specification or set of instructions that lists the information needed, use this list as the outline for the report, IN THE ORDER IT APPEARS! Generally, the reader will be familiar with the process or will be referencing it to see that it was followed. If your report follows the order of the published process, it makes it easy for the reader to determine that you complied with the process.

If you are reporting the results of a contract for work (or in the case of school, an assignment), use the contract (assignment) format as the outline. The person reading the report will be looking for the information in the order it was listed in the contract.
Example:
An example report is contained in Appendix A.

3. BE CONCISE!

Only that information necessary to communicate the idea should be in the report. Long, rambling narratives seldom please the reader. The shorter the report, the more likely it is to be read and the recommendations heeded.

Caution:
Concise does not mean incomplete. All required information must be included in adequate detail to communicate the complete idea to the reader. It is a balancing act, too little information fails to communicate, too much information will cause the reader to lose interest.

Note:
If a required item of a report is unavailable, not applicable, inappropriate, or for any reason will not be included, provide an explanation of why it is not in the report. In the case of a procedure, contract or assignment do not leave the reader wondering why the material is not in the report, tell them!

If the report is long and detailed, it is beneficial to include an Abstract or Executive Summary (see below). The abstract/summary appears as the first item of the report (after the cover page) and summarizes the process used and the results achieved.
The Mechanics:

Cover Page

A cover page is a necessary addition for a busy reader. People whose job it is to collect and read reports always have a large number of them on their desk. If the report has a cover page with the title, your name and any other pertinent information (such as the project name) in large bold letters it makes it easier for the reader to organize their work, which often gets your report noticed. Do not include too much information on the cover page as the purpose is to allow the reader to quickly organize their work space, nothing more.

Example:
The cover page of this document serves as an example.

Abstract/Executive Summary

A reader will quickly become frustrated if they must read through a significant portion of your lengthy report only to find that it is not relevant to their needs. This is where an Abstract or Executive Summary can be a great help. The Abstract/Summary quickly summarizes the process used and the results achieved. This part of the report should stand alone and not require the reader to search for information. You may certainly reference material in the report as a way of pointing the reader to additional information but it should not be necessary for the reader to do so. This section should be as short as possible but still communicate the essence of the report, the standard being no more than one page. The Abstract/Summary makes it easier for the reader to determine the relevance of the report.

Example:
The Abstract at the front of this document serves as an example.

Table of Contents or Index

If a report is lengthy it must include a Table of Contents (TOC) or an Index which makes it easier for the reader to quickly locate information. If the author has properly used an outline form with section headings, the TOC or index will be easy to compile using those headings as entries.

Example:
The TOC of this document serves as an example.

Page Numbers

Yes, you need them. If the document has multiple pages you will need to have page numbers so your reader can find information and to build your TOC.

Typically if the document is only 1-5 pages in length a TOC is not needed. In this case the preferable format for page numbers is:

X of Y (1of 3)

This tells the reader the length of the document so that there is no doubt that the report is complete.

With longer reports standard page numbers are appropriate. Their location on the page is often a matter of preference but most readers will be looking for them at the bottom of the page, either centered or in the right hand corner. If the report is meant to be printed on double sided pages then the left hand page needs the number centered or in the left corner. Centered page numbers provide the most flexibility if you are unsure how the report will be printed.
Line Spacing

In general, reports that are to be widely distributed and intended for reading only (such as a required record) can and should use single line spacing. If the document is to be edited or commented on (such as an assignment) by the reader, using double spaced lines leaves room for the reviewer to write-in their comments.

Example:

Poor form;
Aircraft parked in the hangar must have the wheels chalked to prevent movement. Additionally, the battery must be removed to prevent electrical damage.

Good form;
Aircraft parked in the hangar must have the wheels (SP) “chocked” chalked to prevent movement. Additionally, the battery must be removed to prevent electrical damage.

Fonts and Text Effects

Word processors have a nearly limitless number of fonts and text effects that can be added to a document. Technical authors must resist using any fonts that are decorative and use limited text effects for emphasis of important points. A good technical report is meant to communicate information therefore a font that is plain and easy to read, such as Times New Roman or Arial, is preferred.

Font size should also be considered. Fonts smaller than 10 point are often difficult to read particularly if your audience is older (don’t laugh, you’ll find out why soon enough). Typically 10 – 12 point is comfortably readable while effectively using the space available on each page. Larger font sizes can be used for title pages and major section headings but should typically be no more than 2 – 4 points larger than the main font used.

Text effects should be used sparingly. Typically only italics, bolds and underlines are needed to add emphasis to important information. The idea behind these affects is to draw the reader’s attention to the important information. Overuse of these effects (or any effect) will cause the reader to ignore them and likely miss the information the author wants to emphasize.

Example:

Poor form;
“Use standard fonts for the main text and limited italic, bold and underline to emphasize key points.”

Good form;
“Use standard fonts for the main text and limited italics, bold and underline to emphasize key points.”

Use of Color

For many years the use of color was discouraged as reproducing documents with color was expensive and not always available. Now that color printers and copiers are more common, and many documents remain
in electronic form, using color is more acceptable. The author is cautioned to again consider the audience and intended use of the report. If the report is likely to be printed on paper for use in the field the printing/copying may not be in color. If there is some confidence that color reproduction will be available, then use it.

Regardless of the availability of color reproduction, the author should consider using additional methods to illustrate important information that is independent of color.

Example:
In color:

![Color Diagram](image)

In black and white:

![Black and White Diagram](image)

**Widow/Orphan**

The concept of widow/orphan is that some parts of a report should not be separated across a page break. Some paragraphs, calculations, figures and section headings can become confusing if they are separated. This separation can cause the reader to miss key elements and slow their reading.

Before finalizing a report, scan the sections that are at the beginning and end of each page to see that important information is not “widowed or orphaned”. If any are found, “force” the material together by adding blank lines or reorganizing the material to keep the important information on the same page.
Example:

Poor form;

**Final Results:**

--------------------------------------------------page break--------------------------------------------------

The final results indicate the need for further study…

Good form;

--------------------------------------------------page break--------------------------------------------------

**Final Results:**

The final results indicate the need for further study…

**Handwritten/drawn Material**

Even with computers and all their capabilities, occasionally you may need to include handwritten notes, sketches, etc. in a technical report. Just because it is handwritten does not relieve the author of adhering to all of the elements of good technical writing. Everything contained in this tutorial applies to good technical writing regardless if it is *typed or handwritten*!

If the material can only be presented in handwritten/drawn form and the version you have is rough or hard to read/view, do not be lazy, *recopy the material neatly*. Remember, the reader will be making decisions based on your report and will expect the material to be professionally presented.

**Keep in mind:**

- The material presented must *communicate information* to the reader.
- It must be neat, readable and professional, *recopy it if necessary*!
- If it can be typed instead of handwritten, do it!
- If it can be illustrated on a computer rather than hand drawn, do it!

**Abbreviations, Technical Terms and Symbols**

All professions use abbreviations, technical terms and symbols particular to the field, but their use must be done so as to *not* confuse the reader (remember the audience). Using a large number of abbreviations/terms/symbols may make the author feel they are demonstrating their proficiency within the field but if the reader is confused by this jargon the report is more likely to be dismissed (*make it easy…*).

**Abbreviations:**
The purpose of an abbreviation is to reduce the amount of typing the author has to do. If abbreviations are used, be certain that the abbreviated phrase is spelled out the first time it appears in the report with the abbreviation in parenthesis following. Then use the abbreviation in the remainder of the report.

Example:
The Federal Aviation Administration (**FAA**) is responsible for…

**Technical Terms:**
While technical terms help facilitate communication within the field they can often confuse a less knowledgeable reader, particularly if the term is a common word used with a profession-specific definition. Providing a quick definition when the term first appears helps the continuity of reading by not requiring the reader to stop and look for the definition.
Example:
The control of the puddle (the molten, flowing metal) is the key to proper welding.

Symbols:
Just like technical terms, when symbols are used, provide a definition/name when it first appears.

Example:
\( \Omega \) (omega) is resistance in ohms …

If a large number of abbreviations, terms or symbols are used in a report, summarize them on a page (Glossary, List of Abbreviations or List of Symbols) at the front of the report to allow the reader to quickly, and easily, define the term.

Computations

Including computations is a common part of technical reporting. Presenting computations allows the reader to duplicate your results, which aids in understanding and adds validity to your work.

Long, rambling computations, like long, rambling narratives, will cause the reader to lose interest and possibly dismiss the report. To spare the reader, include one example set of computations showing how you arrived at your data and then present the remaining data as a table or graph (see below). This allows the reader to duplicate the data with the example set or just accept the tabulated results.

Additionally, just because the computations involve mathematics does not exclude the use of text. If an assumption, constant or principle needs to be explained, include text to make it easier for the reader to understand. Computations are as much a part of communicating ideas as is the text of the report, the computations should “tell the story” of how you arrived at your answer.

Example:
The Lift equation is:

\[
L = \frac{1}{2} \rho V^2 SC_L
\]

Where:
- \( L \) = lift in pounds
- \( \rho \) = density in slugs/ft\(^3\) (sea level = 0.00237 slugs/ft\(^3\))
- \( V \) = velocity in ft/sec
- \( S \) = wing area in ft\(^2\)
- \( C_L \) = coefficient of lift (dimensionless)

Always do the following:

**Always**- State the initial conditions for the computations
**Always**- Show the formula you are using in raw form (with variable symbols, not your numbers)
**Always**- State assumptions and constants (and where they come from)
**Always**- Show each step of the computation (even if it is “obvious”)
**Always**- Present the computation in logical order (each step leads to the next)
**Always**- Emphasize the results, both intermediate and final (underline or box)
**Always**- Use units for initial conditions and results
Example:

Problem 1.

A single engine turbojet aircraft is flying at 296 knots true airspeed at sea level. The mass flow rate through the engine is 10 slugs/sec. The exit velocity from the engine is 800 ft/sec. Find:

a. the thrust of the engine \( T \)

b. the propulsive efficiency \( \eta_p \)

Solution to Problem 1.

Initial conditions:
\[ V_1 = 296 \text{ knots; } 296 \text{ kts. } \times 1.69 \text{ ft./sec/kt.} = 500 \text{ ft./sec.}. \]

Sea level density ratio (from Fig. 1.1 in the text) \( \alpha = 1 \) (assumed constant)

Mass flow \( Q \) = 10 slugs/sec.

\[ V_2 = 800 \text{ ft./sec.} \]

a. \[ T = Q (V_2 - V_1) \]

\[ T = 10 \text{ slugs/sec.} \times (800 \text{ ft./sec} - 500 \text{ ft./sec.}) = 3000 \text{ lbs.} \]

b. \[ \eta_p = \frac{2V_1}{V_2 + V_1} = \frac{2(500 \text{ ft./sec.})}{800 \text{ ft./sec.} + 500 \text{ ft./sec.}} \]

\[ \eta_p = 0.77 \text{ or } 77\% \]

Figures, Graphs, and Tables

As has often been said, “a picture is worth a thousand words” and this certainly applies to figures presented in technical reports. A well presented figure can save the author a thousand words of typing, while a poorly presented figure can result in the author writing several thousand words of explanation in the follow-up report.

General:
All figures, graphs and tables presented in a report share common formatting rules:

- **Always**- Number the figure/graph/table (Fig. 1, Table 1 …)
- **Always**- Label/title the figure/graph/table
- **Always**- Orient the figure/graph/table as follows (for single sided pages):

Orientation:
When a figure, graph or table is included in a bound report and presented in the landscape orientation it should be oriented on the page such that the reader rotates the binding away from themselves when viewing.
Example:

*For portrait-*

Fig. 1

![Forces Acting on an Aircraft in Flight](image1)

*For landscape-*

Fig. 1  Forces Acting on an Aircraft in Flight

Figures:
The purpose of a figure is to illustrate a complex relationship or event that is not easily described in a concise narrative. Having said that, *figures are not magical* and the author cannot assume the reader will
get the intended information from the figure. No figure in a technical report can stand alone, it will need some explanation (less than a thousand words, hopefully).

The explanation should include what the figure represents, where the reader should look and what information the reader is intended to find. This explanation makes it easy for the reader to understand the figure.

Graphs:
The purpose of a graph is to illustrate the complex relationship of numerical variables. In addition to the items above, a graph needs the following:

- Legend
- Units on the axis
- Notes on any conditions affecting the graph
- Data labels

Example:

Graph 1: Horsepower/Fuel Flow Required for Velocity

Tables:
The purpose of a table is to present large amounts of data in an organized and readily accessible form. Certainly the reader could do the computations and arrive at the same results (see computations above) but
almost always it is the data that is sought. Again, show an example set of computations of how you arrived at your data and then present the remaining data in the table. Label rows and columns as necessary (with units) and again, include a number and title.

Example:
In Problem 4 from H.W. 3, you calculated the values of drag for a 20,000 lb. turbojet aircraft at sea level. The values you found are repeated below. Calculate new values for the aircraft if the weight is now increased to 30,000 lbs.

<table>
<thead>
<tr>
<th>( V_{20,000 \text{ lb}} ) (kts.)</th>
<th>( D_{20,000 \text{ lb}} ) (lbs.)</th>
<th>( V_{30,000 \text{ lb}} ) (kts.)</th>
<th>( D_{30,000 \text{ lb}} ) (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>2074</td>
<td>182.7</td>
<td>1923</td>
</tr>
<tr>
<td>200</td>
<td>1954</td>
<td>300</td>
<td>2948</td>
</tr>
<tr>
<td>400</td>
<td>4809</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( W_1 = 20,000 \text{ lbs.} \)
\( W_2 = 30,000 \text{ lbs.} \)
\( D_1 \) from table above
\( V_1 \) from table above

\[
D_2 = D_1 \left( \frac{W_2}{W_1} \right) = 2074 \text{ lbs.} \left( \frac{30,000 \text{ lbs.}}{20,000 \text{ lbs.}} \right) = 3113 \text{ lbs.}
\]

\[
V_2 = V_1 \sqrt{\frac{W_2}{W_1}} = 150 \text{ kts.} \sqrt{\frac{30,000 \text{ lbs.}}{20,000 \text{ lbs.}}} = 184 \text{ kts.}
\]

Table 1. **Velocity and Drag at 30,000 lbs. compared to 20,000 lbs.**

<table>
<thead>
<tr>
<th>( V_{20,000 \text{ lb}} ) (kts.)</th>
<th>( D_{20,000 \text{ lb}} ) (lbs.)</th>
<th>( V_{30,000 \text{ lb}} ) (kts.)</th>
<th>( D_{30,000 \text{ lb}} ) (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>2074</td>
<td>184</td>
<td>3113</td>
</tr>
<tr>
<td>182.7</td>
<td>1923</td>
<td>224</td>
<td>2885</td>
</tr>
<tr>
<td>200</td>
<td>1954</td>
<td>245</td>
<td>2931</td>
</tr>
<tr>
<td>300</td>
<td>2948</td>
<td>367</td>
<td>4422</td>
</tr>
<tr>
<td>400</td>
<td>4809</td>
<td>490</td>
<td>7212</td>
</tr>
</tbody>
</table>

Supporting Documents and Appendices

As stated above, the purpose of a report is to communicate complex ideas in logical, concise and understandable terms. This process is often the result of a great deal of work and research on the part of the author. Certainly the readers could research the subject or do the work themselves but then, why would they need you?

The author’s job is to do the work and report the results. That said; the inclusion of documentation to support or “back up” your conclusions is always a good idea. Incorporating these documents in the body of the report makes the report difficult to read. Therefore, any supporting documentation, or large amounts of supporting data, needs to be included in an Appendix.

It should go without saying that any information in an appendix must be relevant to the report. Additionally, the information in the appendix must be referenced in the body of the report, otherwise, why is it there?
Example:
“The results of the GAO Maintenance Industry Evaluation Report (Appendix B) illustrates….”

Citing References

If you include the work of someone else in your report, you must give them credit (otherwise it is known as plagiarism). When you have used the work of another person you should enclose any exact wording in quotation marks and then add a number after the text in a superscript. This refers the reader to your list of references or bibliography for the source of the text.

The cited references or bibliography is included at the end of the report on a separate page labeled “References” or “Bibliography”. You can find proper citation methods in any writing style manual but here are several common examples with the general and specific form.

Examples:

Citation within your report:
On page 271 of “Maintenance and Repair”, Kroes states “(book text…)”. ¹ Which also correlates with Rogers statement “(article text…)”. ²

Book:
The general form for citing a book is;
Author. Title of Book. City of Publication: Name of publisher, year of publication.


Article;
The general form for citing an article is;
Author. “Title of Article,” Name of periodical, volume number: page numbers (date)


Additionally, for Internet articles;
The general form for citing an internet article is;
Author, (date – yyyy, month dd). Section Title. Article Title (chapter). Retrieved from web address


Binding

Any multi-page report must have the pages attached to one another. For 1-5 pages a staple may be sufficient but for larger reports a simple binding/cover is needed. As the report is passed from one reader to another un-bound pages will get lost. Additionally, a binding/cover adds a professional appearance to your work which will impress the reader (particularly if the reader is your boss or teacher).

Remember that the cover needs to have all of the elements of the cover page (see above) so that the reader can easily identify your report and organize their work space. Include a title/cover page inside the binding/cover so that if the report is copied, this information will remain with the report.
Appendix A

Lab Report Example
Procedure:
Choose an aircraft (a school aircraft, your aircraft) and remove a fuel sample from all available fuel sumps/sampling points (reference manufacturer’s data). Observe the fuel samples for proper grade and evidence of contamination. Properly dispose of sampled fuel.

The report must include the following information:
- Aircraft make and model
- Aircraft registration number
- Engine make and model
- Approved fuel grade
- Placard fuel grade
- Description of sump/sampling locations
- Fuel grade removed
- Description of contamination observed
- Additionally, there will be fuel samples in the fuels lab. Identify each fuel sample by type/grade and describe any contamination observed.

Evaluation:
The project will be evaluated based on neatness, completeness and coherence. The project will have a cover sheet with course number and name, project number, project name and student's name. As with all projects this should be your best work and be typed/wordprocessed.

Due Date:
The project should be available for evaluation one week after being assigned.
AT 181L
FUEL SYSTEMS
Lab 1
Fuel Sampling

I. M. A. Student

Note that the items appear in the order stated in the assignment.
Aircraft Make and Model
Cessna 172M

Aircraft Registration Number
N0000X

Engine Make and Model
Lycoming O-320-H2A

Approved Fuel Grade
80/87

Placard Fuel Grade
100/130

Description of Sump/Sampling Locations
According to the Cessna 100 Series Maintenance Manual Sec. Pg. Para. there are three sampling locations …… (detail)

Fuel Grade Removed
100LL

Description of Contamination Observed
The first sampling location contained solid particles which appear to be…. (detail)

Lab Samples
Sample 1: Sample one appears to be 100LL with the following contaminates…. (detail)
Sample 2: …. Subheadings where needed.