Professional Engineers Ontario

Engineering Report Guide

Engineering Report Guidelines

1. General Remarks

For applicants seeking registration by Professional Engineers Ontario through the examination route, the presentation of a report involving an engineering problem is normally the final academic requirement. The purpose of the report is to demonstrate to the Academic Requirements Committee the applicant's ability to define a proposition, to develop it logically and accurately, to apply engineering principles to its solution and to draw conclusions or make recommendations from the study. This is embodied in a document which must be guaranteed as an original work of the author, and which must be an acceptable professional report.

The first step in preparing a report and perhaps the most difficult, but rather essential part, is to establish the report's objectives. The objective may be a statement of truth to be demonstrated, or an operation to be performed. The operation may be concerned with existing equipment, or with design of new equipment.

The report itself need not prove originality of ideas, but the applicants must demonstrate their ability to appreciate, present, differentiate between, and draw conclusions from observations and ideas, in an integrated operation.

Reasonable modifications of the definition of a report will be accepted. Discussion and judgement of opposed theories or methods, or a discussion of the practicality of its application, may be accepted. However, the coverage of the particular subject available in textbooks will not normally be considered to satisfy the requirements of a report. It is the current state of the art, the novel, or the contentious characteristics, that is expected to be explored in the report.

2. Submission Instructions

A. Engineering Report Synopsis: The Synopsis for the Engineering Report must be submitted for the approval of the Academic Requirements Committee before the applicant may proceed with the Engineering Report. The Synopsis must be submitted by email to the applicant's assigned Admissions Representative.

B. Engineering Report: After the Synopsis has been approved and the report has been written, a printed version of the Engineering Report with a cheque or money order for the Engineering Report fee must be mailed to the applicant's assigned Admissions Representative. In addition, the applicant must email a copy of their Engineering Report to their assigned Admissions Representative. Please ensure that the assigned Admissions Representative receives the hard-copy and soft-copy reports by the assigned deadline.

3. Preparing an Engineering Report Synopsis

The **Synopsis** must be submitted for the approval of the Academic Requirements Committee before the applicant may proceed with the **Report**. The Synopsis should contain: The Title of the Report, the Abstract, which is then followed by a preliminary Table of Contents.

1. **The Title** should define closely the field of knowledge or practice with which the author has concern, and describe what the work reported is about. Titles should be concise, descriptive and specific

(maximum 15 words). Do not use abbreviations in titles. A subtitle is generally not required but may be used to clarify the objective. The Title page format is similar to the Engineering Report's title page and must include the Statement of Originality per the Engineering Report Preparation (see Appendix).

2. **The Abstract** should not be longer than two pages (400 words). It must convince the Academic Requirements Committee that the applicant can develop a proposition which will demonstrate ability to survey the field, analyze data, and draw conclusions. It should include: i) a clear statement of the objectives and expected outcomes, ii) an indication of the engineering principles that may be applied, iii) a concise description of the actual investigation undertaken, and the methodology used.
3. **The Table of Contents** should be a concise preliminary table of contents which conforms to the sample format in the Engineering Report Preparation (Appendix).

4. Preparing an Engineering Report

The Engineering Report should be typed, one and half or double spaced, on one side of 8 ½" X 11" bond paper. The document should be properly bound. While no rigid rules of format are specified, it is recommended that one or more of the numerous books on technical reports be consulted.

Normally, a final document would contain:

a) a title page and date;
b) a signed declaration of authorship;
c) a table of contents;
d) a summary of the report and conclusions;
e) the body of the report, suitably subdivided;
f) a list of the technical literature cited;
g) a list of acknowledgements and sources of information.

The length of the report will depend on the topic developed but it is suggested that it be about 5,000 words or twenty-five typewritten pages (not including tables and graphs).

Diagrams, illustrations, etc. should be clearly and properly identified. It is preferable to locate graphs, diagrams, etc. necessary for the understanding of the text at the place where reference to them is made**.**

5. Grading of an Engineering Report

Submitted reports are examined by persons, usually professional engineers, who are recognized authorities in the area of engineering to which the report applies. While these examiners may use their own rating scheme, PEO suggests the following aspects of the report be examined and graded:

a) Introduction, Objective: Statement of the problem, clarification of the need and requirements.
b) Approach and Methods: Critical literature review; Engineering concepts and theories; Methods, models and tools.
c) Analysis, Synthesis, Testing, Design: Use of modern concepts and methods for data gathering, testing, analysis and synthesis; testing and validation; results interpretation; appropriateness of inference/deductions.
d) Results and Conclusions: Critical evaluation of results, Recommendations and conclusions
e) Technical Writing and General Organization: Technical writing (grammar, spelling, clarity), cover page and nomenclature, Figures, Illustrations, Tables, Abstract and Table of Contents, References and Appendices.

Please note that the final pass mark is 50 percent.

Appendix

Engineering Report Preparation Instructions

1. Introduction

The purpose of this document is to provide some guidelines for the preparation of engineering reports. Applicants should follow the format and instructions given in the PEO "Engineering Report Guidelines" and this document.

The PDF (portable document format) file of the report (a single PDF file) should be submitted for review. The size of PDF file should not exceed 10Mb.

2. General Recommendations

Binding: The final reports should be bound in a professional manner, e.g., spiral binding. Simply stapling the pages or using a three-ring binder is not acceptable.

Typing: Applicants are expected to type the report in a word processor using either double or 1.5 spacing for the text. Footnotes may be single spaced. Printing can be on either one side or both sides of the page.

Paper: Standard 8 ½ ″ x 11″ (letter size) white bond paper should be used for all text, diagrams, figures, tables, etc.

Oversized Pages: If it is necessary to include a table or illustration that is larger than the standard letter size paper, it may be folded carefully into the report. In that case, the oversize page should be unfolded easily after binding.

Typeface (Font): The entire report should be in the same type style. Standard Serif style typefaces such as Times New Roman are recommended. A font size in the range of 11 to 12 points (or 11 to 12 characters per inch) is recommended.

Margins: At least a 1 inch margin from the left-hand, right-hand, top and bottom edges of the paper is recommended. To allow for some types of binding, it may be advisable to increase the left-hand margin to 1½ inches. These margins should be applied to the text and all illustrative material. Justified text should be used in the report.

Paragraph Structure: To improve readability, it may be preferred to leave an additional line space between paragraphs. Depending on the style preferred, the author may choose not to use an additional line space between paragraphs, but it should be consistent throughout the report.

Equations: Equations should be typed and enumerated sequentially in parentheses so that they can be referenced in the text. For example

$$f = ma \tag{1}$$

where f, m and a are respectively the force, mass, and acceleration as given in equation (1).

Equations should not be forward referenced, and should not be referred to as "equation given below" or "equation given above". All parameters and symbols must be defined when they are used in the text/equation for the first time. A typical engineering textbook may be consulted to see how it is done. In addition, all parameters and symbols should be defined in the nomenclature.

Errors and Corrections: The report should be free of spelling, grammatical and technical errors. Careful proofreading is essential. If an error is found after the report is printed and bound, it is acceptable to submit a loose sheet of "Errata".

Spelling: Canadian spelling of words should be used throughout the report.

Units: The use of the International System of Units (SI, metric units) is preferred. If desired, a quantity may appear with the equivalent British units in parentheses following the SI value, e.g., 746 W (0.707 BTU). It should be noted that meter and millimeter are SI units while centimeter and decimeter are not. Units should be included in tables and graphs. Data are meaningless without the appropriate units. Mixed unit systems or non-SI unit systems should be avoided in the report.

Writing Style: The report should be logically structured. Emphasis should be placed on clarity. An overly technical document is not preferred at the Bachelor of Engineering degree level of report. Meanings can usually be conveyed more powerfully in simple terms.

Technical reports should be written in the third person. For example, it is improper to write (in the first person): "I (or we) measured the water temperature using a thermocouple." Instead, one should write, "The water temperature was measured using a thermocouple."

3. Illustrative Material

All figures, diagrams, photographs, and graphs (and tables) must be included in the List of Figures (and List of Tables). All figures (and Tables) must be referenced in the text; otherwise there is no point to include the information in the report. The resolution of figures, tables, pictures and all bitmapped elements should be high enough so that each element is legible.

Figures: The term "figure" applies to diagrams, graphs, charts, engineering drawings and photographs. All figures should be numbered and have a descriptive caption, centred below the figure. Figures taken directly from another source must be fully referenced. Figures that are adapted for this report should be referenced as follows: "...after Smith and Jones (1992)" or "… [1]" depending on which format is used for citing references.

Tables: All tables should be enumerated and have a descriptive caption. Caption should be relatively short, if possible, and be centered above the table between the margins. Footnotes can be used to point out details of a column of data or an individual item in the table, e.g., refer to Table 1.

Placement of Figures and Tables: Each figure/table should be included on the same page or the page immediately following the page on which it is first referenced. If this is not possible, it should be placed as close as possible after the reference to the figure/table.

Table 1. Sample table caption.

Reading No.	**Calibration Pressure** (kPa)	**Gauge Pressure** [a] (kPa)	**Temperature** (K)
1	100.10	99.90	298.50
2	50.00	40.00	300.00
3	0.01	0.04	305.11
4	60.50	55.50	400.11[b]

[a] Footnote for a table

[b] Data outside of calibration zone

4. Structure of the Engineering Report

As shown in the sample Table of Contents (refer to Section 6), the recommended order for the sections of a technical report is as follows:

- Title Page
- Statement of Originality

- Acknowledgements
- Abstract
- Table of Contents
- List of Figures
- List of Tables
- Nomenclature
- Body of Technical Report
- References
- Appendices

Title Page: The title must be meaningful and a concise description of the content of the report (maximum of 15 words for report title). The required format for the title page is given in Section 6.

Statement of Originality and Intellectual Property Clearance: The report is regarded as the author's work. Any published (or unpublished) ideas and/or techniques from the work of others must be acknowledged in accordance with the standard referencing practices. A statement on the intellectual property clearance must be included, if applicable. If the report is related to a company's project, the company's approval should be acknowledged.

Acknowledgements: Acknowledgements should be written in the third person, i.e., "The author would like to thank . . ."

Abstract: The abstract is a concise summary of the report that will enable a reader to decide whether or not to read the complete work. The abstract should contain a description of the problem, the methodology used to solve the problem, a summary of the results, and a brief conclusion. The abstract should be written such that the content of the report can be understood without having to read the core body of the report. This means that undefined terms, or symbols, as well as specific references to any part of the report must not be included in the abstract. Normally, an abstract does not exceed 250 words, or one page of text. Often it is best to write the abstract last, when a clear overview of the entire report is available.

Table of Contents: The table of contents is a list of the sections or chapters of the technical report with references to pages of the sections or chapters, refer to Section 6 for an example of a table of contents.

List of Figures and List of Tables: All figures and tables must be listed; refer to Section 6 for the recommended format.

Nomenclature: The nomenclature defines the parameters, symbols and acronyms used in the report. Standardized symbols should be used whenever possible. The parameters should be listed in alphabetical order, lower case followed by upper case. A separate heading is required for symbols, characters and acronyms. A sample nomenclature is included in Section 6.

Structure of Engineering Report: Chapter headings and the structure of the body of the report will depend on the nature of the report. The chapter/section headings shown in the sample Table of Contents (refer to Section 6) are given as an example only. Although the chapter/section headings will depend on the nature of each report, typically the body of the report should include the following as appropriate.

i. A general introduction to the problem being addressed should give the motivation for the current work and the approach being taken, i.e., experimental, theoretical or numerical approach to find a solution to the problem. The introduction should also include an objective statement, clearly indicating the scope of the work of the technical report.

ii. A literature review is a critical evaluation of previously published information directly related to the engineering report. This will include available information found in textbooks, journal papers, magazine articles, theses, conference proceedings, peer-reviewed technical reports, etc. The literature review should inform the reader of the current state-of-the-art of the topics and convince the readers of the need for the current work.

iii. Description of experimental apparatus and procedures is essential. Depending on the nature of the work, descriptions of the apparatus and/or design procedures may appear as a separate chapter/section. Sufficient information should be given to enable interested scholars with similar knowledge to duplicate the reported work. This requires clear, detailed descriptions of the apparatus and procedures. In addition, the technical aspect of the work and justification of the applied engineering principles should be focused on; with a concise discussion of what is done, how it is done and why.

iv. Theoretical derivations of equations from fundamental engineering principles relevant to the report are mandatory to ensure originality of the technical aspects of the work.

v. Presentation, discussion and interpretation of the results are parts of the report writing process.

vi. Summary of the main conclusions and recommendations is required in the finished work. The conclusions must be based on the evidence and findings presented and must be related to the stated objective of the report. New ideas should not be introduced in the conclusions. Depending on the nature of the report, the recommendations stemming from the report may include such items as:

- Actions to be taken based on the findings.
- Methods to improve the results.
- Related areas for future study, i.e., useful extensions of the project.

Numbering of Chapters/Sections: It is recommended that chapters/sections/subsections be numbered using the decimal numbering scheme shown in the sample Table of Contents (refer to Section 6). For example, in this Table of Contents, the first section of Chapter/Section 2 is 2.1 Experimental Apparatus. The subsections of Section 2.1 that relate directly to the details of the experimental apparatus are numbered 2.1.1 and 2.1.2.

Appendices: To keep the main body of the report concise and readable, some information needed for the completeness of the report may be put in an appendix. Examples of information which may be included in appendices are:

- Supporting material that is not central (or essential) to the report.
- Lengthy material that would break the flow of the document (e.g. a long mathematical derivation that is not central to the topic).
- Tabulated data for graphs in the main body of report.
- Detailed sample calculations (e.g., design calculations).
- Flowchart of simulation and/or numerical computational codes.

References: When drawing information from a textbook, article, report, letter or even a conversation, it is essential to acknowledge the authors and/or source. This is done using a citation in the text that refers to a source listed in the "References" section. Information presented without a citation will be attributed to the author. Hence, failure to adequately cite the sources where the information comes from constitutes plagiarism.

The style used for citing references varies greatly depending on the specific field. A journal appropriate to the topic could be referred to in order to adopt a method and use it throughout the report. Alternatively, one of the following procedures may be used:

***Citation Method 1*:** In the text, the publication is referenced using the last name(s) of the author(s). The year of publication is inserted in parentheses immediately following the names of authors. Two examples of usage for this method are:

> The effect of forces on the free vibration of thin plates was studied by Nakamura and Smith (1991). This study showed that **...**
>
> Long ago, it was suggested the adequate heat removal may be the limiting factor in the

development of future high speed circuits (lncropera, 1988).

If there are more than two authors for a single publication, the last name of the first author is followed by "et al." to signify the remaining authors. For example:

In a recent study, Jones et al. (2017) conducted experiments on ...

In the "References" section, the full citation with all of the authors is listed in alphabetical order by the last name of the first author. The following are examples using the Harvard reference style:

Book:

Waldron, K.J., Kinzel, G.L. and Agrawal, S.K., 2016. Kinematics, dynamics, and design of machinery. John Wiley & Sons.

Periodical:

Notash, L., 2017. Wrench Accuracy for Parallel Manipulators and Interval Dependency. *Journal of Mechanisms and Robotics*, *9*(1), p.011008.

Paper in the proceedings of a conference:

ElMaraghy, H., Schuh, G., ElMaraghy, W., Piller, F., Schönsleben, P., Tseng, M. and Bernard, A., 2013. Product variety management. *CIRP Annals-Manufacturing Technology*, *62*(2), pp.629-652.

Patent:

Szabados, B. and Dableh, R., Cooper Technologies Company, 2017. *Methods and systems for controlling addressable lighting units*. U.S. Patent 9,538,625.

Report:

Tarasuk, J.D., 1968, The Theory, Design and Operation of Mach-Zehnder Interferometer, Technical Report C-3, Mechanical Engineering Department, University of Saskatchewan

Personal conversation:

Clark, J.A, Ontario Hydro, Toronto, Ontario, Private Communication on December 11, 1993.

Online source:

Wikipedia – The Free Encyclopedia, *Calibration*, https://en.wikipedia.org/wiki/Calibration, accessed June 24, 2017.

***Citation Method 2*:** In the text, each publication is referred to using an Arabic numeral in brackets. Three examples of usage for this method are as follows:

The effect of forces on the free vibration of thin plates was widely studied [1,2]. These studies showed that ...

Long ago, it was suggested the adequate heat removal may be the limiting factor in the development of future high speed circuits [3].

In a recent study, Jones et al. [5] conducted experiments on...

In the "References" section, each publication is listed and enumerated sequentially in the order in which they are referenced in the body of report. For books, journal papers, personal conversations, etc., the same style as given in ***Citation Method 1*** is used.

Page Numbering: The preliminary section (see Section 6) should be numbered using lower Roman numerals at the bottom centre of the page. Pagination begins with the Acknowledgements as page number ii. The title page is page i, but it is not numbered. Starting with the introductory chapter/section, the remainder of the report is numbered with Arabic numerals beginning with 1 and running consecutively to the end of report. Every page in the report must be numbered.

5. Recommended Further Reading

There are several excellent books which focus on Technical Communication. A partial list is given below to supplement this guide. Some of these books contain additional information regarding grammar, style and language usage for technical reports.

1. Ewald, T., 2014. Writing in the Technical Fields: A Practical Guide, 14th Edition, Oxford University Press, ISBN 13: 978-0-19-544908-2.
2. Hart, H., 2009. Engineering Communication, 2nd Edition, Pearson Prentice Hall, ISBN 13: 978-0-13-604420-8.
3. Irish, R. and Weiss, P., 2013. Engineering Communication: From Principles to Practice, 2nd Edition, Oxford University Press, ISBN 13: 978-0-19-544692-0.
4. Lannon, J. M., Gurak, L.J. and Klepp. D., 2015. Technical Communications, 6th Canadian Edition, Pearson Education Canada, ISBN 13: 978-0-205-92584-1.

Care should be taken to follow the specific instructions for the preparation of technical reports given in this guide. It is recommended to consult a couple of engineering technical reports or graduate theses in a public or university library.

6. Engineering Report Sample

To illustrate the recommended style and format of the Engineering Report, a sample Title Page, Table of Contents, List of Figures, List of Tables and Nomenclature are included in the following pages.

Title of Engineering Report

First Name Last Name of Author

Submitted in fulfilment of the requirements of the PEO Engineering Report

Date: September 1, 2020

Statement of Originality: I hereby certify that all the work described within this report is the original work of the author. Any published (or unpublished) ideas and/or techniques from the work of others are fully acknowledged in accordance with the standard referencing practices, and I have obtained the necessary permissions from the company to submit this report.

Table of Contents

List of Figures

List of Tables

Nomenclature

Parameters:

f_x , f_y	Force applied on the apparatus in X- and Y-directions
$\mathbf{f}$	Force vector in the chosen coordinate system
$\mathbf{I}_n$	$n \times n$ identity matrix
m_z	Moment applied on the apparatus about Z-direction
P	Mass center of workpiece
$\mathbf{p}$	Position vector of mass center of workpiece in the chosen coordinate system
v_x , v_y	Translational velocity of mass center of workpiece in X- and Y-directions
$\mathbf{v}$	Translational velocity vector of the mass center of workpiece
$\mathbf{W}$	Weighting matrix
φ	Orientation of workpiece in the chosen coordinate system
$\dot{\varphi}$	Angular velocity of workpiece
$\boldsymbol{\omega}$	Angular velocity vector of workpiece in the chosen coordinate system

Superscripts:

T	Transposed
-1	Ordinary inverse

Symbols:

$\|.\|_2$	2-norm
∂	Partial derivative

Acronyms:

DOF	Degree of freedom
FBD	Free-body diagram