



UNIVERSITY OF  
KWAZULU-NATAL

---

INYUVESI  
YAKWAZULU-NATALI

# GUIDE FOR WRITING TECHNICAL REPORTS

DISCIPLINE OF MECHANICAL  
ENGINEERING

May 2015

## **Acknowledgement**

Adapted from the *Guide for Writing Technical Reports* (Third Edition, 2007) by AH Basson and TW von Backström of the Faculty of Engineering, University of Stellenbosch, by Michael Brooks and Fran Saunders. Our thanks go to Professor Basson for generously allowing us to use their material.

## **Abstract**

This guide provides guidelines to engineering students for writing technical reports, theses, and dissertations. It provides a discussion of the content of the various main elements of a technical report and gives the recommended format. Important elements of good microstructure and style plus practical guidelines for the compilation of a technical report are also provided. The guide concludes with a checklist that can be used to eliminate general mistakes. The appendices provide guidelines for the content of reports on experiments, designs and calculations, guidelines for thesis proposals, use of SI units, and use of the Harvard referencing method.

## TABLE OF CONTENTS

	<b>Page</b>
1. INTRODUCTION	5
2. THE PROCESS OF COMPILING A TECHNICAL REPORT	5
3. EXTERNAL STRUCTURE	5
3.1 Sequence of Main Sections	5
3.2 Cover Page	6
3.3 Title Page	6
3.4 Abstract	6
3.5 Dedication	7
3.6 Acknowledgements	7
3.7 Table of Contents	7
3.8 List of Tables and List of Figures	7
3.9 Nomenclature	7
3.10 Introduction	7
3.11 Central Chapters	8
3.12 Conclusions	8
3.13 Tables and Figures	9
3.14 Appendices	10
3.15 References	10
3.15.1 The alphabetical system	10
3.15.2 The numerical system	10
3.16 Bibliography	10
4. MICROSTRUCTURE	10
5. STYLE	11
6. LAYOUT	11
6.1 Font, Page Numbering and Headings	11
6.2 Equations	12
7. CHECKLIST	13
8. CONCLUSION	14
9. APPENDIX A	
GUIDELINES FOR THE DOCUMENTATION OF EXPERIMENTS	15
A1 Principles	15
A2 Introduction or introductory chapters	15
A3 Experimental setup	15
A4 Experimental procedure	15
A5 Measured results	16
A6 Conclusions	16
10. APPENDIX B	
GUIDELINES FOR THE DOCUMENTATION OF DESIGNS	17
B1 Purpose and principles	17
B2 Assignment and background	17
B3 Specification	17

	B4	Concept development	17
	B5	Analysis and/or testing of performance	17
	B6	Technical definition of product	18
11.	APPENDIX C		
	GUIDELINES FOR THE DOCUMENTATION OF DERIVATIONS AND CALCULATIONS		19
	C1	Introduction	19
	C2	Nomenclature	19
	C3	Sample calculations	19
	C4	Paragraphing	19
	C5	Layout of equations and numerical values	19
	C6	Traceability	20
12.	APPENDIX D – OMITTED		21
13.	APPENDIX E		
	GUIDELINES FOR THE USE OF SI UNITS		22
	E1	Introduction	22
	E2	Writing style	22
	E3	Basic units, prefixes, and derived units	22
	E4	Decimal point or comma?	23
14.	APPENDIX F		
	REFERENCING AND PLAGIARISM		24
	F1	What is meant by referencing?	24
	F2	When should you give a reference?	24
	F3	When is a reference not needed?	24
	F4	Why should you give references?	24
	F5	How do you reference?	24
	F6	Steps for referencing	25
	F7	Examples of references according to the Harvard method	25
	F8	What is plagiarism?	27

## **1. INTRODUCTION**

The majority of engineering tasks include the writing of technical reports and since they need to summarise information for a specific group of readers in an accessible way, they need to be as concise, accurate, and complete as possible.

The objective of this guide is to assist engineering students in report writing during their studies, and also to prepare students for report writing and papers in engineering practice. The term 'reports' includes theses and dissertations.

## **2. THE PROCESS OF COMPILING A TECHNICAL REPORT**

The first question in the planning process should be 'Who is the target reader?' In engineering practice, this can be a client, a colleague, a manager, or a junior. In academic writing it is usually the examiner. The author must ensure that sufficient background and detail are given to convince the examiner who may be an independent person and not involved in the work being reported.

When academic writing is aimed at an examination process it will greatly benefit the author to study the outcomes or assessment criteria.

The process of writing a technical report begins with planning the work on which the report is based. Even at an early stage, tasks can be broken down into elements which could become sections or chapters in the report. The final sequence will not necessarily correspond with the order in which the work was done, but will be determined by the desired structure of the report.

Begin writing the report as soon as possible. Draft the table of contents early in the process since it provides an overview of the entire document, and during the writing process, gives an indication of which sections still need to be done.

Regardless of the order of the report, a chapter or an appendix should be written as soon as that part of the work has been completed, for example when some apparatus has been developed or set up, when a theory has been derived, when a computer programme has been written, or when a set of readings has been taken.

Remember that writing is an integral part of the thought process: it helps define and order ideas, and derive conclusions on which further planning can be based.

## **3. EXTERNAL STRUCTURE**

Professional technical reports are characterised by a scientific approach, a specific structure, and formal style. The recommended structure is outlined and discussed below.

### **3.1 Sequence of main sections**

- Cover or Title page
- Abstract
- Dedication
- Acknowledgements
- Table of contents
- List of tables
- List of figures
- Nomenclature

Introductory chapter(s)  
Central chapters  
Conclusions  
References\*  
Appendices

\* If there are references in the appendices, do not forget to include them in the reference list.

The external structure not only relates to the sequence of the elements, but also to the relationships between them, and to the importance and length of each. The introduction must not be too long, and the central chapters must not be overpowered by the appendices. The conclusion should logically follow from the central chapters.

### 3.2 Cover page

The cover page protects and identifies the report and must also contain the following essential information:

Title of the report  
Initials + surname  
Student number  
Date  
Supervisor  
Course code  
Emblem of the university

The title has to be carefully considered:

- Think about the reader's first impressions.
- Include important key words.
- Leave out words that are not essential.
- Avoid meaningless expressions and longwinded descriptions.
- Make every word count.

### 3.3 Title Page

Under certain circumstances a separate title page may be used, although this is rare. If used, this contains all the information given on the cover page (except for the emblem), plus the status of the report (terms of reference), for example 'Experimental Techniques Report: Project 1' or 'Final Report for Mechatronic Project 478.'

### 3.4 Abstract

A short, technical summary of 100 to 150 words indicating the contents and most important findings. It gives the reader an *overview* and kindles interest (or not).

Guidelines:

- The abstract conveys key elements of the objective and context, and the most important methods, findings, and recommendations. It is a description of what the reader will find inside the report including a brief technical summary of the main findings.
- Be as economical as possible; every word counts.
- The abstract is usually the last part to be written.
- It should not contain references.
- It should not contain personal insights that add no value to the technical content.

In certain technical environments an Executive Summary replaces the abstract. It is usually one page long and provides sufficient quantitative information for a manager to identify the most important decisions arising from the report, and to grasp the extent and impact of the latter.

**Note that an abstract is purely technical and should not include personal insights (“I learnt a lot”) or other non-technical language.**

### **3.5 Dedication**

In theses this may appear as a short sentence, in the middle of a separate page, in which the document is dedicated to a friend, family member, or acquaintance. **It is not used in short technical reports.**

### **3.6 Acknowledgements**

On a separate page the author may acknowledge people or organisations directly involved in the financing, execution, and presentation of the project. This list may include technicians, for example.

### **3.7 Table of Contents**

The table of contents starts on a new page with a heading: “Contents” or “Table of Contents” followed by the main levels of headings and page numbers. Appendices must also be listed, each with their title and page number. **The headings may not go beyond three decimal numbers, for example 3.1.2 is the most sub-headings shown in the table of contents, and not 3.1.2.2.**

### **3.8 List of Tables and List of Figures**

These lists, arranged according to table and figure numbers, each start on a new page and indicate the relevant page numbers in the right-hand column. The titles must be descriptive enough to facilitate identification and must correspond to the titles used in the text.

### **3.9 Nomenclature**

The list of symbols must start on a new page: all the ordinary symbols are listed first, followed by superscripts and subscripts. Finally list auxiliary symbols for example overbar and underscore for vectors and averages, or accent marks for time-dependent components. Acronyms and abbreviations are listed last.

The following order must be used:

- Firstly all Roman letters (in alphabetical order, with the capital letter of each symbol before the small letter, for example “A” followed by “a” followed by “B”).
- Then all the Greek symbols (in the order of the Greek alphabet, capital letters before small letters).
- Finally the symbols that begin with numbers, in numerical order.

Units may be given in the nomenclature section. In a short document this section may be omitted (and explained in the text). A consistent set of symbols should be used. If equations are taken from sources that use symbols different from the set selected for the report, the former must be ‘translated’ into the selected set.

### **3.10 Introduction**

The introduction provides:

- The context in which the report originated and how it links to or differs from preceding or related work.

- Limitations that may have been placed on the work through choice or external circumstances.
- The purpose of the report: problems examined and specific objectives.
- The motivation: why the work was undertaken.
- **NB: the objectives should be stated in such a way that the conclusion section can answer the following question: 'Have the stated objectives been reached?'**

If relevant, the introduction may contain a general overview of previous work done in the field plus definitions of words and expressions that have specific meanings in the document. An overview of the chapters within the report is sometimes also provided.

### 3.11 Central Chapters

The structure of the central chapters depends on the content of the report. Typical cases are given in the appendices.

Guidelines:

- Every chapter should focus on one topic, in other words, it should have a clear purpose. The title of the chapter normally reflects the purpose.
- The contents of the chapters must remain strictly linked to the purpose of the report. Information of secondary importance should be placed in the appendices.
- The following structure within chapters corresponds to the scientific approach:
  - Introduction: purpose of the chapter and how it links with the purpose of the report
  - Underlying or simplified assumptions
  - Analytical or numerical theory used, or the procedure for the investigation
  - Measured results, results of analysis, or results of observations (verifiable results)
  - Processing of results: methods and answers (objective)
  - Interpretation of results (subjective, but critical and well-motivated)
  - Conclusions: usefulness and importance of results; how the results contribute to achieving the purpose of the report
- The central chapters do not usually follow the chronological sequence of the project.
- In keeping with the scientific approach, each statement must satisfy one of the following:
  - The statement is obviously true.
  - The statement is proven in the report.
  - The statement is motivated in the report.
  - If a statement is sourced from elsewhere, a reference is given with the statement.
- Each conclusion drawn at the end of the report must be corroborated in the central chapters.

### 3.12 Conclusions

This section makes it clear to what extent the purpose of the report has been achieved and which findings were made. All statements must be supported in the report.

Guidelines:

- Summarise the purpose of and motivation for the report.

- Clarify to what extent the purpose was achieved. To this end provide a summary for each section of the report to indicate how the section contributed to the overall attainment.
- Summarise the most important findings, methods, and techniques.
- Discuss the implications of the findings and indicate contributions made by the report.
- Provide suggestions for further work, if appropriate.
- Do not include personal insights – the conclusion is purely technical.

### 3.13 Tables and Figures

Tables are used for quantitative comparisons where appropriate. Figures (drawings, sketches, graphs, and photos) are used to illustrate qualitative information. Figures are numbered as a single series and tables as another.

General guidelines for tables and figures:

- Each table and figure must have a caption, comprising a number and description, for example 'Figure 2: An oscilloscope.' **Table captions are placed above the table and those for figures below them.** The chapter number may be incorporated in the table or figure number (for example Table 2.1 or Figure 3.3).
- Each table and figure must first be referred to in the text of the report **before it appears.**
- Tables and figures must be placed on the page where the first reference is made to them, or as soon as possible thereafter.
- If a table or figure needs to be rotated to fit on the page, the bottom part should face the right-hand side of the page.
- Tables and figures must be separated from the main text by at least one open line above and below the table or figure.
- **Capital letters must be used** when a table or figure is being referred to: Table 2 and Figure 5. The abbreviation "Fig." may be used in the captions for figures.
- The text in the tables and the writing accompanying figures must add value to the report. **Do not include photographs or figures that contain text which cannot be read.**

Guidelines for tables:

- Each column, and sometimes also every row, must have a title, with units, if applicable.
- Tables consisting of a few rows will not impede comfortable reading and can be inserted in the main text. Larger tables should preferably be placed in the appendices.

Guideline for figures:

- Figures should not be distorted or made difficult to read. All text must be legible.

Guidelines for graphs:

- Use graphs particularly when trends are shown or series of data compared.
- Graphs containing data for comparison must combine the data in the same figure to facilitate direct comparison for the reader. Limit the quantity of information in graphs so that different symbols can be clearly distinguished.
- Graphs should be formatted with similar marker styles and line colours, particularly if the same variables are being plotted repeatedly.
- Most readers intuitively expect the independent variable on the horizontal axis, and the dependent variable on the vertical axis.
- Axes of graphs must be named in words, in conjunction with units.

- Every graph must have a caption (figure number and description) below it. **Do not duplicate this caption above the graph or inside the graph pane – be aware of this when using software like Excel.**
- **All graphs must be formatted identically, that is, ensure that each graph has the same font size, line thickness, label format and so on.**
- The inside graph area where the data appear should be enclosed within a border, but omit the frame around the entire graph.

### 3.14 Appendices

- Detail that disturbs the flow of the main text, and particularly detail that does not form an integral part of the main text, must preferably be provided in the appendices. Examples are detailed descriptions of apparatus, computer programs, lists of unprocessed data, sample calculations, and commercial data sheets.
- Every appendix must have a descriptive title.
- The appendices are numbered “Appendix A”, “Appendix B” and so on.
- References in the appendices refer to the list of references at the end of the report, unless each appendix has a separate list of references.

### 3.15 References

- The purpose of references is to indicate the origin of statements that are not general knowledge in the field, to acknowledge the work of others, and to provide sources for readers who might want to obtain further information.
- No references may be included in the list to which you have *not* referred in the report, and vice versa.
- There are various methods of referencing although only one alphabetical and one numerical system are considered in this guide.

#### 13.15.1 The alphabetical system

At UKZN the alphabetical system is to be preferred - see Appendix F for more detail. An important advantage of the alphabetical system is that the references are independent of each other; new references can be included in the process of writing without influencing the rest.

#### 13.15.2 The numerical system

References in the text are indicated by numbers (in the order of their first appearance) in square brackets, and arranged numerically in the list of references without regard for the names of the authors or the date of publication. The references are formulated similarly to the alphabetical system except that the year of publication is placed at the end of the reference or, if there are page numbers, just before the page numbers.

### 3.16 Bibliography

A bibliography is a list of sources, usually books, that provide a broad background to the topic, but to which no reference has been made. Only comprehensive technical reports such as some theses, have a bibliography.

## 4. MICROSTRUCTURE

Chapters and paragraphs also have structure. Each chapter must have an introduction, central section, and conclusion. Paragraphs can be more varied but each paragraph deals with one main idea, and must link to previous and following paragraphs. Both chapters and paragraphs serve specific purposes.

Guidelines for paragraphs:

- Paragraphs longer than about 10 lines tend to become clumsy.
- It's a good idea to start a paragraph with a theme sentence; the sentence that states the purpose of the paragraph.
- Be aware of the fact that paragraphs serve different purposes: they can be introductory, explanatory, linking or concluding.
- Sentences in each paragraph need to be coherent and logically linked. (Examples of markers used for linking include: "except for", "therefore" and "for example").

**Always approach your writing from the point of view of the reader: will the reader understand what you have written?**

## 5. STYLE

The language used in technical reports is formal and concise. You are advised to read Strunk, W & White, E B, 1979, *The Elements of Style*, 3<sup>rd</sup> Edition, MacMillan, New York.

Guidelines:

- Avoid the use of "I". Write in the third person, or refer to "the author(s)".
- Make sure that every sentence contains a subject and a verb, sometimes also an object.
- Use commas sparingly.
- Use active sentence construction rather than passive.
- Use the present tense for something that is still valid, and the past tense for something that happened in the past or is no longer valid.
- Use the correct word. The reader's confidence in the technical ability of the author can be impaired if the correct terms are not used.
- Avoid sweeping statements; they indicate uncertainty and lack of knowledge.
- Avoid waffling and irrelevant appendices; it wastes the reader's time.
- Remember engineers are interested in results: what was done, how was it done, what did it mean?
- Mention problems or mistakes only if it will prevent repetition.
- The technical level of the language must be adapted for the target reader. The target reader of undergraduate reports is a final year student in Mechanical or Mechatronic Engineering at another university.
- Explain less-known abbreviations for example CARS – "Coherent Anti-Stokes Raman Spectroscopy" when used for the first time.
- Common abbreviations should preferably be written out ("for example" rather than "e.g.").
- Bulleted lists are seldom used in technical reports; only use them when all the items in a list are of equal importance and when the sequence is not important.

## 6. LAYOUT

### 6.1 Font, Page Numbering and Headings

Tables 1 and 2 give the particulars of preferred formatting schemes for technical reports.

The pages of the chapters and appendices must be numbered in the centre or to the right at the bottom of the page. The start of Chapter 1 must be page 1. For pages before this use Roman numerals (i, ii, iii, iv...).

The format for the headings of chapters, sections, and subsections, must be the consistent throughout. Use this guide as a template if possible. Avoid using more than three levels of headings. **Note: use the same font for the main text and the headings. Keep the layout, use of capital letters in the headings, and space between the paragraphs, consistent throughout.**

**Table 1: Preferred page layouts**

Paper size	Margins	
	Single sided L/R [mm]	T/B [mm]
A4	30/30	26/44
A5	17/17	22/22

**Table 2: Preferred letter sizes**

Font	Paper size	Letter height [pt]	Line spacing [pt]
Times New Roman	A4	11	single
Arial or Calibri	A4	11	single

## 6.2 Equations

Equations must be numbered sequentially, either 1, 2 ..., or per chapter 1.1, 1.2 ... and 2.1, 2.2 ... The second method makes it easier to write chapters independently of one another.

With regard to the formatting of equations the rest of this section is not applicable if typesetting programs, such as LaTeX, are used for word processing, as these if programs format equations automatically.

The two acceptable formats for equations are illustrated in the next two equations:

$$A/b = x^2 / (u + v)^{0.5} \tag{1}$$

$$\frac{A}{b} = \frac{x^2}{(u + v)^{1/2}} \tag{2}$$

Occasionally long equations are more easily dealt with by dividing them up, for example in equations (3) to (5):

$$A = x^2 \quad (3)$$

$$b = (u + v)^{0.5} \quad (4)$$

$$y = A/b \quad (5)$$

Note that the letters representing variables or constants must be in italics, while functions (such as the trigonometric functions) and units must not be in italics, as in the following examples:

$$x = \cos \Theta \quad (6)$$

$$g = 9.81 \text{ m/s}^2 \quad (7)$$

$$a_i = \omega^2 R_i \quad (8)$$

$$\alpha_1 = 20 \text{ rad/s} \quad (9)$$

In equation (8), the subscript  $i$  is also a variable and therefore is written in italics, while the subscript 1 in equation (9) is not a symbol, and is therefore not written in italics

A space should be left between parameters that are multiplied. An “x” should not be used for a normal multiplication, since it can be confused with a symbol or the cross product operator.

$$Nu = C Re^n Pr^{1/3} \quad (10)$$

All equations must be indented by at least 10 mm. It is often neater when all the “=” signs on a page are placed below one another, although a large number of successive equations that each consist of more than one line look better if they begin in the same distance from the left. A space must be left on either side of each “=”.

## 7. CHECKLIST

While you are finalising the report, check each of the following:

- Did I communicate clearly and unambiguously what the reader needs to know in order to understand the subject, or did I write lazily and selfishly with little regard for how the content may be misinterpreted?
- Did I avoid loose or non-technical language?
- Do the conclusions follow logically from the central chapters?
- Is the structure acceptable? Are important aspects given enough emphasis? Are unimportant aspects given too much?
- Is each word, phrase, sentence, paragraph, section, and chapter necessary? Is everything in the correct place? Can the figures be better combined?
- Is there clear transition between sections, and between chapters?
- Have all the tables, figures, and appendices been included?
- Is the sequence correct?

- Are tables and figures referred to first in the text before they appear?
- Are titles for the report, for the headings of chapters, for sections, tables, and figures striking and to the point?
- Is the use of capital letters in titles consistent?
- Do the table of contents, references, and lists of tables and figures correspond to the content of the report?
- Is the pagination accurate?
- Are the axes of the graphs correctly named, and their units given? Are there units in the column headings of the tables?
- Have all the graphs and tables been formatted consistently?
- Has the same font type and size been used throughout?
- Has the paragraph text been justified?
- Does the abstract indicate how the project originated, why it was done, what was intended, how it was done, and what the outcome was?
- Is the list of references complete, accurate, and written according to the prescribed format?

## **8. CONCLUSION**

This guide has explained the appropriate format for technical reports as required in the Discipline of Mechanical Engineering at UKZN and provides helpful hints for structuring and compiling a report. Students who follow the guidelines will be able to compile professional technical reports.

## APPENDIX A

### GUIDELINES FOR THE DOCUMENTATION OF EXPERIMENTS

#### A.1 Principles

One of the fundamental requirements of the scientific approach is reproducible experimental results. Documentation of experiments must therefore contain all the information required for repeating the experiments. Such a large amount of information is typically only recorded in internal laboratory reports while reduced information is given in most other reports. In all cases the guideline is that sufficient detail be provided to make the results credible. In theses, the theoretical foundations of the experiment are also discussed.

The nature and purpose of the experiment will therefore determine which topics must be considered for inclusion in a report. Measured results must be clearly distinguished from interpretations and conclusions. The former are usually objective and cannot be questioned (except in terms of accuracy), and the latter are subjective.

Guidelines on inclusions:

#### A.2 Introduction or introductory chapters

- the purpose of the experiment
- how the experiment contributes to the objectives of the project or thesis
- the actual situation that is being simulated in the experiment
- the physical properties that are investigated
- simplifications made or approaches used with respect to the actual situation
- theoretical motivation
- identification of dependent and independent parameters
- known analytical solutions of similar cases
- dimensional analyses
- Order of magnitude analyses

#### A.3 Experimental setup

- Drawings of purpose-built apparatus, including:
  - detailed dimensions
  - schematic layout drawings
  - positions of measuring points
  - possible environmental influences
- Complete specifications for the equipment used, including:
  - Manufacturer, model number, series number
  - Settings for the equipment used
  - Calibration certificates with dates and the person or organisation responsible for calibration
- Documentation of won calibrations

#### A.4 Experimental Procedure

- Preparations
  - Sequence of adjustment of independent variables
  - Warming up or time for stabilisation after change
  - Sequence and frequency of measurements
  - Provision for reproducibility and accuracy
  - Zero measurement before and after runs

### **A.5 Measured results**

- Complete raw data:
  - Sometimes included in an appendix, attachment, separate report, or CD
  - Units must be documented
  - Distinguish between set, chosen, or measured
  - Environmental conditions
- Estimation of accuracy, reproducibility, and resolution of measurements.

### **A.6 Conclusions**

- Interpretation of the results is sometimes subjective; the credibility of the results must be critically evaluated
- Comparison with theoretical or other published data
- Discussion of results: emphasise the most important results and point out unexpected results.

## APPENDIX B

### GUIDELINES FOR THE DOCUMENTATION OF DESIGNS

#### B.1 Purpose and principles

Professional accountability is very important in design reports. The document must bear proof that the engineer executed the design with appropriate care and judgement. The information must be presented in a way that facilitates review and evaluation by a third party.

The main purpose of the design must be reflected in the report, namely that the needs of the client were correctly interpreted and that the chosen design meets the specified needs.

It should also be possible to use the design report as a basis for later changes or improvements to the product. Engineers who undertake further development should not have to repeat any of the design work previously done.

The following guidelines highlight aspects present in most design reports; the level of detail will be determined by different circumstances:

#### B.2 Assignment and background

- The designer's assignment: all relevant clients must be identified.
- The scope/ boundaries/extent of the project and how it interfaces with other projects.
- Time framework.
- Design team.

#### B.3 Specification

- The specifications (engineering requirements) that the product had to satisfy.
- A derivation of the specifications from the needs of the client (for example QFD).
- Comparison with competing products.

#### B.4 Concept development

- Indicate that all relevant aspects have been taken into consideration, for example by providing a functional analysis. Indicate that all reasonable concepts were considered.
- Provide a well-motivated elimination and selection of concepts. Discuss the most important selection factors and, if relevant, why other "obvious" concepts were not selected.
- Describe the selected concept in terms of function and layout.

#### B.5 Analysis and/or testing of performance

- Prove that *all* the engineering requirements were met.
- For each aspect:
  - Explain the aspect that was considered.
  - Explain all assumptions, simplifications, and approaches.
  - Use explanatory sketches (indicate the notations).
  - Provide the analysis or describe the test, as well as the results.
- State conclusions explicitly, in other words, does the analysis or test indicate that all requirements were met?
- Also follow guidelines for the documentation of calculations (given in Appendix C).

**B.6 Technical definition of product**

- Provide a complete description, for example a set of assembly and detail drawings with bills of materials.
- Provide a precise description or specification of bought out components or subsystems, including the supplier, catalogue number, and main dimensions or main performance parameters (for example 3 kW induction motor).

## APPENDIX C

### GUIDELINES FOR THE DOCUMENTATION OF DERIVATIONS AND CALCULATIONS

#### C.1 Introduction

A few broad guidelines are provided here. For greater detail, consult Gillman, L *Writing Mathematics Well, A Manual for Authors*, The Mathematical Association of America, 1987.

#### C.2 Nomenclature

- List all symbols and their specific meaning. If necessary, refer to a figure that illustrates the symbol.
- Be consistent: use the same symbol for the same variable throughout, even if your sources differ.
- Use commonly used symbols.
- Eliminate unnecessary symbols. Nomenclature is given to ease the reader's task.

#### C.3 Sample calculations

- Repetitive instances: show one calculation in its entirety, and only input values and answers for the rest.
- If own computer programs or spreadsheet calculations were used, provide all the equations and a sample calculation. If iterated, only show the final iteration.
- If software applications (such as FEM or CFD) were used, provide the complete input values and options used. Provide sample calculations of a simple, relevant case, as well as a comparison with analytical results, to demonstrate accurate application of the software.
- Explain how the results were interpreted.

#### C.4 Paragraphing

- Inform the reader about the aim of the calculation or derivation, and the route followed (for example "To eliminate  $\beta$ , substitute (2.3) into (2.5)"). Provide direction-indicating words, for example "If" or "Then the dynamic pressure can be expressed as follows:"]
- Explicitly state the conclusion in words after the calculation, for example: "The calculated safety factor is lower than the selected limit."
- Equations must form part of the sentence. Symbols represent a word or a phrase and must fit into the flow of the sentence, for example "=" represents "is equal to" or "which is equal to".
- Use normal punctuation if the equation forms part of the sentence. If the placing of a full stop after an equation becomes confusing, change the structure of the sentence.
- Do not start a sentence with a symbol.
- Put spaces before and after "=", as well as between letters that represents different parameters. Do not use a full stop (".") or an "x" to indicate multiplication, unless it refers to a dot product or cross product in vector algebra.

#### C.5 Layout of equations and numerical values

- Every equation can be numbered or, alternatively, only the last one in a derivation.
- Use a consistent numbering style, throughout the report or appendix for example 1, 2, 3..... or 1.1, 1.2, 2.1, 2.2, 2.3.....

- The number of the equation must be placed in the right-hand margin (use a right tab).
- Start 10 – 15 mm from the left margin.
- Place all “=” signs underneath one another if the equations are short enough.
- Calculations; first give the equation in symbols, then with the values substituted, and then the answer (WITH THE UNITS). Leave out the intermediate steps.
- Derivations: state the assumptions expressly, say when previous equations are substituted, and only show the most important intermediate steps.
- The number of digits must ALWAYS be in proportion to the accuracy. The number 2.13242 implies a precision of 0,001%.
- Provide a unit for each number, except inside quotations.
- Use the technically correct and generally used forms of units, for example mm AND NOT cm, and stress MPa or  $10^6$  Pa.
- Use SI wherever possible (see Appendix E).

### **C.6 Traceability**

- Provide the sources of each equation unless it is general knowledge. If conservation laws are used, only provide their name, for example, “Energy conservation gives the following:”
- Provide the sources of all material properties.

**APPENDIX D - OMITTED**

## APPENDIX E

### GUIDELINES FOR THE USE OF SI UNITS

#### E.1 Introduction

South Africa changed to the use of SI units in the 1960s. This system is generally used in Europe and increasingly in North America. The following references are valuable:

- The International System of Units, 7<sup>th</sup> ed, 1988.
- SABS M33a, The International Metric System.
- Els, DNJ, 2003, Guide for the use of the International System of Units, dept of Mechanical Engineering, Stellenbosch University.

A few guidelines for the elimination of common mistakes are given below.

#### E.2 Writing style

- SI units are written in normal letters (not *italics*).
- Abbreviations: lower case, letters, unless derived from a proper name. No full stop after the abbreviation, unless at the end of a sentence.
- Written in full: lower case letters, unless the first word in a sentence
- No plurals.
- Combination of abbreviations:
  - Nm or N.m (space or half-high dot)
  - m/s or m.s<sup>-1</sup>
  - m.kg/(s<sup>3</sup>.A) or m.kg.s<sup>-3</sup>.A<sup>-1</sup>
- Prefixes: become part of the symbol (J kg<sup>-1</sup>) and are never used on their own (correct: 10<sup>6</sup>/m<sup>3</sup>; incorrect: M/m<sup>3</sup>).
- **In all cases you must leave a space between the number and the unit, for example 3.4 km and not 3.4km. The only exceptions to this are the plane degree symbol (for example, it is correct to write 25°) and the % sign (for example, 45%).**

#### E.3 Basic units, prefixes, and derived units

- The SI has 6 basic units: metre, kilogram, second, ampere, degrees Kelvin and candela.
- The following are the preferential prefixes in SABS M33a: tera (T), giga (G), mega (m), kilo (k), milli (m), micro (μ), nano (n), pico (p), femto (f) and atto (a).
- Derived units that are permitted by SI:

plane angle	radian	rad
solid angle	steradian	sr
frequency	hertz	Hz
force	Newton	N
stress, pressure	pascal	Pa
energy, work	joule	J
power	watt	W
electrical charge or flux	coulomb	C
magnetic flux	weber	Wb
electrical potential	volt	V
electrical resistance	ohm	Ω

inductance	henry	H
capacitance	farad	F
conductance	siemens	S
magnetic induction	tesla	T
luminous flux	lumen	lm
illumination	lux	lx

- Non-SI units that are accepted for use together with SI units:

minute	min	60 s
hour	h	
day	d	
degree	°	$(\pi/180) \text{ rad}$
minute	'	$(1/60)^\circ$
second	"	$(1/3600)^\circ$
litre	L	$10^{-3} \text{ m}^3$
metric ton	t	1000 kg

TAKE NOTE: the abbreviation for litre used now is a capital L, and no longer the cursive lower case letter.

#### **E.4 Decimal point or comma?**

The decimal point is preferred in UKZN reports.

## **APPENDIX F**

This appendix was included in the original Stellenbosch Guide by permission of the language Centre at Stellenbosch University and is subject to copyright.

### **REFERENCING AND PLAGIARISM**

#### **F.1 What is meant by referencing?**

- Referencing means that you give credit to the various sources you have used to write your assignment/report/thesis.
- References are cited in the text itself (in-text references) and at the end of the text under “Reference List” or “Sources Used”.
- In-text references are given directly where the reference is made, or at the end of the sentence, paragraph, or quotation.

#### **F.2 When should you give a reference?**

- When you quote an author’s words directly
- When you use someone else’s tables, figures, and/or diagrams.
- When you put an author’s words in your own words (paraphrase)
- When you summarise an author’s ideas (summary)

#### **F.3 When is a reference not needed?**

You do not need to reference if you consider the viewpoints of information that you give to be general knowledge.

How do you define general knowledge?

- If the same information appears in several sources (at least 5) without any references
- If you think your reader will easily be able to find the information in a general information source

#### **F.4 Why should you give references?**

- To avoid plagiarism
- To give credibility to your work
- To acknowledge the authors or sources on which you have based your arguments and research
- To help your readers find the articles, books, or electronic sources you have used
- To show your reader that you have researched the subject of your text extensively
- To show the reader that your research is up to date.

#### **F.5 How do you reference?**

There are several standard methods of referencing. Organisations, scientific journals, and even different departments in the same engineering faculty may use different rules for referencing. It is your responsibility to find out which method is required from you.

Two types are generally used: alphabetical and numerical systems. In the first, references are listed alphabetically according to the author’s name in the reference list, and in the text itself the last name(s) and date of publication are cited where the reference is made. This means you can add or remove references without affecting other references. (The Harvard system is an example).

In the numerical system references are given in a numbered list in the order in which they appear in the text for the first time. In the text itself a reference would be cited in the form of a number only [usually in square brackets].

**The Harvard style (alphabetical) is preferred in Mechanical Engineering, unless your supervisor requires the use of the numbering system.**

### F.6 Steps for referencing

1. Write down the complete biographical data for every source when you use it for the first time.
  - If it is a book note the author/editor, year of publication, title, edition, volume number, place of publication, and publisher. Not all the details will necessarily be applicable for every source.
  - If it is a journal article, record the author's name(s), year of publication, title of the article, title of the journal, volume and issue number, and page numbers.
  - For electronic information, in addition to the above, also include the date on which you accessed the information, the name of the database, or the web address (URL)
2. Insert the citation in the appropriate place in your text (in-text reference): use the author's **last name only** followed by the year of publication.
3. Include in the reference list at the end of the document all the references you have used in your text. This list includes only the sources that you have cited in the text; if you have used other sources but do not refer to them in the text, these are placed in a separate bibliography. When an item has no author it is cited by its title, and ordered in the reference list alphabetically by the first significant word of the title.

### F.7 Examples of references according to the Harvard method

<i>Journals</i>	<i>In-text citation</i>	<i>Reference list</i>
Article	As discussed by Winsor (1988)... <b>OR</b> ... as occurs in space-related accidents (Winsor, 1988).	Winsor, D.A. 1988. Communication failures contributing to the Challenger accident: an example for technical communicators. <i>IEEE Transactions on Professional Communication</i> , 31.3, 101-107.
Article – no author	It is a growing problem in the United States (Anorexia nervosa, 1987) ...	Anorexia nervosa. 1987. <i>American Medical Journal</i> , 3, 52-53.
Newspaper or popular magazine	(Venter, 2004)	Venter, I. 2004. Fierce auto rivals make space for collaboration. <i>Creamer Media's Engineering News</i> , 3-9 December, 10.

<b>WWW</b>	<b><i>In-text citation</i></b>	<b><i>Reference list</i></b>
Document on WWW with author	The communication skills of engineers are as important today as ever (Norback et al., 2001)	Norback, JS, Llewellyn, DC and Hardin, JR. 2001. <i>Shop talk 101. Integrating workplace communication into undergraduate engineering curricula</i> [Online]. Available: <a href="http://www.lionhrtpub.com/orms/orms-8-01/norback.html">http://www.lionhrtpub.com/orms/orms-8-01/norback.html</a> . [2005, August 31].
Document on WWW without author	(Guidelines for using charts and graphs, [n.d.])	<i>Guidelines for using charts and graphs</i> . [n.d.]. [Online]. Available: <a href="http://sandhills.edu/english/wordguide/chartadvice.html">http://sandhills.edu/english/wordguide/chartadvice.html</a> . [2005, August 30]

<b><i>Personal communication</i></b>	<b><i>In-text citation</i></b>	<b><i>Reference list</i></b>
Interview	...investigated the method (Smith, 2005).	Smith, G.J. 2005. Personal communication. 31 August, Stellenbosh.
Letter	...was satisfied with the results (Robertson, 2005).	Robertson, A.C. 2005. Personal communication. 1 September, Cape Town.

<b><i>Books</i></b>	<b><i>In-text citation</i></b>	<b><i>Reference list</i></b>
One author	The method was already discussed before (Swart, 1997) ... <b>OR</b> ... Swart (1997) has already discussed the method...	Swart, R.P. 1997. <i>Materials Processing Technology</i> , New York, MacGraw Hill.
Two authors	(Smith and Carpenter, 1995) <b>OR</b> Smith and Carpenter (1995) discuss it in detail....	Smith, A.D. and Carpenter, C.P. 1995. <i>Tool quality and tool life</i> . 2 <sup>nd</sup> ed, London, Longman.
More than two authors	(Houp et al., 1998)	Houp, K.W., Pearsall, T.E. and Tebeaux, E. 1998. <i>Reporting technical information</i> . Boston, Allyn and Bacon.
No author	This was apparently not the case before 1995 (Advertising in the Western Cape, 1990)....	<i>Advertising in the Western Cape</i> . 1990. Cape Town, ABC Publishers.
Editor	(Anderson, 1993)	Anderson, P.K. (ed.). 1993. <i>Encyclopaedia of renewable energy</i> . San Francisco, Pegasus.
Encyclopaedia or dictionary	According to <i>The new James's encyclopaedia for fighting ships</i> (2001)	<i>The new James's encyclopaedia for fighting ships</i> . 2001. London.

	the....	Prentice Hall.
Article or chapter in a book	As discussed by Baxter (2004)...	Baxter, M.M. 2004. Tool wear monitoring, <i>Dynamics of stable turning</i> . C. Carter and B. Smith (eds.), New York, Macmillan, 223-230.

## Notes

Date of publication: When no date of publication is given, use the abbreviation “n.d.”. Note that this should only be done sparingly and should be avoided if possible.

Edition: When the publication is a further or revised edition indicate it with “Revised” or “2<sup>nd</sup> edition”.

It is important to be consistent when you write your in-text citations and your reference list. For example, when you use a comma between the author’s name and the date in your in-text citation, continue to do so for the rest of the document.

### F.8 What is plagiarism?

Plagiarism can be defined as follows: to use another person’s words and ideas as if they were your own.

The following is regarded as plagiarism:

- To steal or borrow another person’s work.
- To pay another person to write an assignment for you.
- To copy directly from a source without acknowledging the source, including pictures, graphs or tables.
- To use another person’s ideas and build on them without giving credit to the original ideas.
- To paraphrase another person’s work word for word.
- To present false data (fabricated, altered, or borrowed without permission).
- To cut and paste from the Internet.

The worst form of plagiarism is committed intentionally.