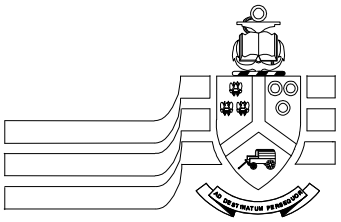

University of Pretoria

Department of Chemical Engineering

Guidelines for Writing Technical Reports and Papers

2006

Contents

1 Introduction

Most of the writing done by engineers consists of reports and papers. The purpose of these is to transfer information to the reader. Different readers will have different requirements from a report or a paper. A managing director will probably not have time to read the report but will be interested in the most important results and recommendations. Somebody paging through a technical journal needs to establish quickly whether a paper is of importance to him/her. Once this has been determined, the reader may be interested in checking the information in the finest detail: What was done? How was it done? What was it done with?

The most important problems experienced by technical writers are concerned with the structure (format) of their writing and with meeting the demands of accuracy, brevity and clarity.

This guideline aims to prescribe a rigid structure for writing technical reports and papers and to assist the writer by detailing the exact requirements of the different sections of a report/paper. The guidelines are formal requirements of the Department of Chemical Engineering for all reports from practical training reports to PhD dissertations. For detailed information about postgraduate studies, please refer to Buys (2003), which is available online from `http://www.ais.up.ac.za/ebit/guides/research_guide.pdf`. Note that the department's style guidelines still apply.

The writer should make use of good judgement to link the style and structure prescribed by this guide to areas not covered by the guide. This means that the written work should form a cohesive whole even when not directly prescribed.

2 Format

Papers and reports typically consist of editorial information, the introduction, the body of the report, (under headings such as theory, literature, experimental, results and discussion) conclusions, recommendations and a reference section. If necessary, and only if necessary, appendices are added.

Typical basic outlines for reports and papers are shown in figures 1 and 2 respectively. For details of actual requirements, refer to chapter 3 of this guide.

2.1 Font and spacing

A font that is large enough to remain legible after being reduced in size (for instance, when printing two pages per page) should be used. A font size similar to Arial 12 or Times New Roman 14 is the minimum size that will be accepted. Garamond 14, CG Times 13 and Courier New 12 are examples of acceptable fonts and sizes. Please compare the font

Editorial Information

Cover

Title page

Synopsis & keywords

Acknowledgements

Contents

Nomenclature list

1. INTRODUCTION

2. LITERATURE (THEORY)

3. EXPERIMENTAL

3.1 Apparatus

3.2 Planning (Experimental Design)

3.3 Methods

4. RESULTS (or RESULTS AND DISCUSSION)

5. DISCUSSION

6. CONCLUSIONS (or CONCLUSIONS AND RECOMMENDATIONS)

7. RECOMMENDATIONS

8. REFERENCES

9. APPENDICES

Figure 1: Format for reports – In a major report it is customary to start every section (Results, Recommendations etc) on a new page.

Editorial Information

Title

Author

Synopsis & keywords

Nomenclature list

1. INTRODUCTION
2. THEORY (LITERATURE)
3. EXPERIMENTAL
4. RESULTS (or RESULTS AND DISCUSSION)
5. DISCUSSION
6. CONCLUSIONS (or CONCLUSIONS AND RECOMMENDATIONS)
7. RECOMMENDATIONS
8. ACKNOWLEDGEMENTS (if any)
9. REFERENCES
10. APPENDICES (not likely)

Figure 2: Format for papers. In a paper every section is not necessarily started on a new page. Conserve space as much as possible.

size of the type of font that you prefer to work in with these guidelines, keeping in mind that different fonts may appear differently sized even when they have the same point size selected in a word processor – refer to Appendix A1.3 of Mandersloot (2003), especially the table on page 184.

As an example, consider the following two lines where fonts are compared with

- the same "M" height M Arial M Times M Courier M Palatino
- the same "x" height x Arial x Times x Courier x Palatino

A line spacing of $1\frac{1}{2}$ (specified in the paragraph format section of the word processing program) is prescribed with double that spacing between paragraphs.

2.2 Math

Mathematical symbols are treated as shown in the following example:

The height h was measured as a function of time t. The relationship between h and t was found to be

$$h(t) = h_0 - \lambda t \tag{1}$$

It was also determined that the velocity $\mathbf{v}$ was a function of the position $\mathbf{x}$ given by $f(\mathbf{v}) = \beta\mathbf{x} + \sin(\alpha)$ and that in general $h_{\max} \leq 5$ m.

Dynamic analysis showed that the system could be represented by

$$G(s) = \frac{1}{s+1}\begin{bmatrix} 3 & \log b \\ 2 & 1{,}1 \end{bmatrix}$$

Therefore, the model was revised to

$$\frac{\partial f}{\partial t} = 5t + g(t) \quad \frac{\mathrm{d}g}{\mathrm{d}t} = t + f(t) \quad A = \int_a^b f(t)\mathrm{d}t$$

A deeply nested equation:

$$s = \sin\left\{\arctan\left[5 + \sqrt{x + cos\left(\frac{\beta}{1+\beta} + \pi\right)}\right]\right\}$$

Notes:

- Scalar variables (h, t, s) are *italicised* lower case.
- Vector variables ($\mathbf{v}$, $\mathbf{x}$) are **bold** lower case, but not italicised.
- Matrix variables (G) are upper case and *italicised*. Matrices are shown as above, with block brackets.

- Standard mathematical functions ($\sin(\alpha)$, $\log b$) and numeric constants are not italicised.
- Numbered equations are centred, with the number in brackets on right margin.
- A font similar to the body text font should be used, so when using a sans-serif font like Arial, the formulae should be sans-serif as well.
- Differential equations are stated using the correct partial derivative symbol ∂ (not a lowercase delta δ) or upright "d"s for partial or total derivatives.
- Integrals are stated using upright "d"s
- Deeply nested equations can use different brackets in the sequence $\{[()]\}$.

2.3 Chemistry

Use the IUPAC naming convention for compounds where possible unless there is a commonly used name (like acetone instead of dimethylketone). Favour using names in the text unless they are inordinately long, when the abbreviation can be used after initially stating the full name. Compound names should be cased normally (starting with upper case at the start of a sentence, and lowercase otherwise).

More information on naming conventions can be retrieved from the IUPAC website (`http://www.iupac.org`), where their automatic naming software (INChI) can also be downloaded.

The correct symbols should be used for chemical reactions, particularly in reversible reactions like

$$\mathrm{A} + 2\mathrm{B} \rightleftharpoons \mathrm{AB_2}$$

2.4 Numbers and units

Numbers are shown with a decimal comma, spaces between thousands and $\times 10^x$ notation rather than computer notation ($1\,023{,}2 \times 10^{-2}$).

SI units should be favoured except where conversion would be uncomfortable (refer to a 20 psi pressure limit rather than 137,895 1 kPa). Units should always be upright to differentiate them from variables ($h = 1\,\mathrm{m}$). Use standard SI prefixes instead of scientific notation unless a large variation in numbers occurs (use 1 nm instead of 1×10^{-9} m).

For more information on the use of SI units see the NIST SI website at `http://www.physics.nist.gov/cuu/Units`

2.5 Figures

Figures are included in the text with no border, and a suitable caption is displayed below the figure as shown in figure 3.

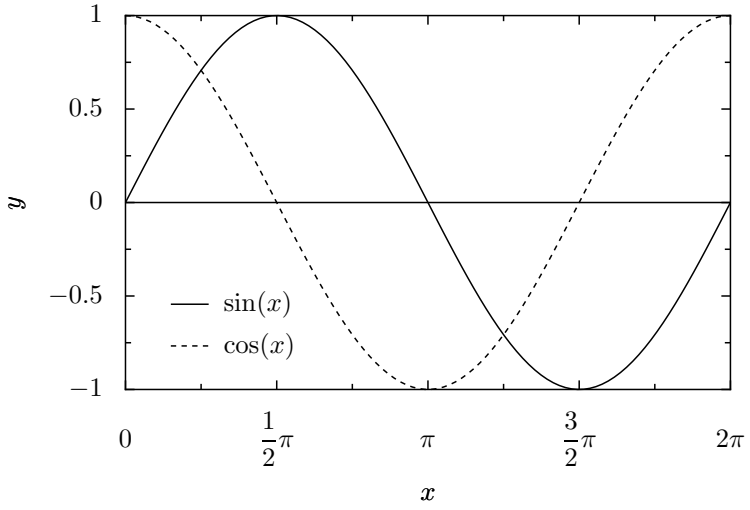

Figure 3: Example of a figure.

Use similar fonts (both size and lettertype) in the figure as in the main text and always ensure that the caption explains the figure in more detail than "A plot of x vs y" – this is visible from the graph. Note the advice in appendix B.

2.6 Tables

Avoid vertical lines in tables as much as possible. The vertical lines of figures should be enough to guide the eye vertically. A slightly thicker line should be used at the top and bottom of the table, with a thin line between the headings and the data.

Table 1: Example of a table (adapted from Fear (2003))

Item		
Animal	Description	Price[b] (R)
Gnat[a]	per gram	13,65
	each	0,01
Gnu	stuffed	92,50
Emu	stuffed	33,33
Armadillo	frozen	8,99

[a] Norwegian blue gnats only
[b] As of 2004

Units should be specified in the heading of a column and longer descriptions included as footnotes below the table.

2.7 Cross-referencing

When referring to items in the same text, use normal casing and the correct number as in the following example:

> As can be seen from figures 1, 2 and 4, there is a strong correlation between heat transfer and Reynolds number. Equation 2 shows the proposed model, while equation 3 has an alternate formulation proposed by Smee (1992). The experimental results are summarised in table 3. Section 4 discusses these results in more detail, while section 5 proposes novel research directions.

Place figures and tables near to their first reference (but definitely after them). *Each and every sketch, figure and table must be referred to in the text.*r

2.8 Abbreviations

Our guidelines are adapted from Burger (1992, 17). All abbreviations are written without periods or spaces (New Testament → NT). Acronyms are written as spoken – capitals are used when the single letters are pronounced (CSIR), normal casing when they are pronounced as a word (Unisa). Try not to use abbreviations unless they are in common use. If an abbreviation is not likely to be understood by the audience, spell it out the first time and introduce the abbreviation in brackets: South African Institute of Chemical Engineers (SAIChE).

3 Structuring the Report/Paper

3.1 Title

The title is a short, *informative* description of the investigation. It must be unambiguous and free of all unnecessary words, but must contain the important keywords describing the investigation.

Many technical journals limit the title to 15 words.

Mandersloot (2003) offers the following advice:

- Avoid insignificant words and especially non-specific words like Investigation, Studies, Evaluating, Estimation, Method, Treatment, Assessment, Modelling, Application etc. In many instances the non-specific word can not be eliminated. In such cases do not start the title with these words – use them somewhere else in the title.

- To maximise impact, start the title with the most significant issue – the Action or (more specific) the Subject of the action. For example: "Optimisation for the design of dividing wall columns" is of interest to those who are considering using such a column, therefore it calls for a title: "Dividing wall column optimisation"

- Constrain the title to the main issues. For example "Adding value to SA raw materials – selective synthesis of thymol from m-cresol over zeolite catalysts" does not cover raw materials (plural) but one only. Mention this side issue in the text, but choose a title like "Selective m-cresol conversion to thymol over zeolite catalysts" or better "M-cresol to thymol; selective conversion over zeolite catalysts".

  The semi-colon (or even the colon) is a very useful tool for turning titles around.

3.2 Editorial information

3.2.1 Reports

The title of the report and the name(s) of the author(s) appear on the *cover*. This may be on specially textured paper or simply the outermost page of the report. Compare this to a published book. In the case of reports written for a specific university course (eg CPY 311, CLB 320) the course code is displayed at the bottom right hand corner of the cover. Laboratory reports and similar documents would normally not require a cover – the first page is then the title page.

The first page is the title page on which the title and the author's name again appear, as well as additional information like the name of the institution, company or authority under whose name the report is published and the date. For university reports the student's number and the course name and code will be given. In the case of formal academic dissertations and for some laboratory reports, the university prescribes the

Title of Report

A Student

CXX323

Title of Report

A Student
20232329

Synopsis
Scope
Main findings
Main conclusions
Keywords: a, b, c

Sinopsis

i

Contents

Nomenclature
b constant s
v velocity km/h

Greek
ρ Density kg/m^3

ii

1. Introduction
Background
Problem statement
Purpose
Method
(see 3.4)

1

2. Theory
Summary of the state of the art, including ample references (see 3.5)

2

3. Experimental
Aparatus
Planning
Methods
(see 3.6)

3

4. Results
Supporting evidence, most important results first. Use graphs and tables where possible. (see 3.7)

4

5. Discussion
Explain the observed correlations between variables (see 3.8)

5

6. Conclusions and Recommendations
Main findings
No new information (see 3.9 and 3.10)

6

7. References
Complete list of references in text. Not a reading list (see 3.11)

8

Figure 4: Report format at a glance

format of the title page. The information is arranged intelligently to create a balanced impression. The cover and title page are not numbered.

The *synopsis* appears on the very next page, to enable the cursory reader to find out immediately what the main findings and recommendations (if any) are. If a translated synopsis is given and both do not fit on one page, the translated synopsis must start on a new page. *Keywords* appear immediately after the synopsis. See section 3.3 for detailed requirements regarding a synopsis and keywords.

If the author wishes to thank persons or other instances, this is done on the following page under the heading *acknowledgement(s)* Acknowledgements.

The table of contents is given on the following page under the heading *Contents*. Each chapter or section is assigned a number and the number of the page on which the chapter starts is shown. The page on which the introduction starts is page number 1. Use a decimal numbering system for the headings of chapters, paragraphs and sub-paragraphs. Avoid subdivisions with more than four digits (eg 1.2.3.4.5). Such further divisions can be done in the text (but not shown in the table of contents) with an alphabetical notation. The table of contents does not include an item "Contents".

After the table of contents the nomenclature list is given (in alphabetical order) under the heading *Nomenclature*. All symbols used are defined and the units are given. Greek characters, subscripts and superscripts are tabulated separately. This list is generally only required if several equations are employed in the text. The nomenclature list does not include abbreviations, acronyms etc.

The pages on which the editorial information (synopsis, ... nomenclature) appears are numbered with small roman numerals (i, ii, ...). These pages are also indicated in the table of contents. The headings (synopsis, contents, nomenclature etc) of the editorial information are not numbered.

3.2.2 Papers (Journal Articles)

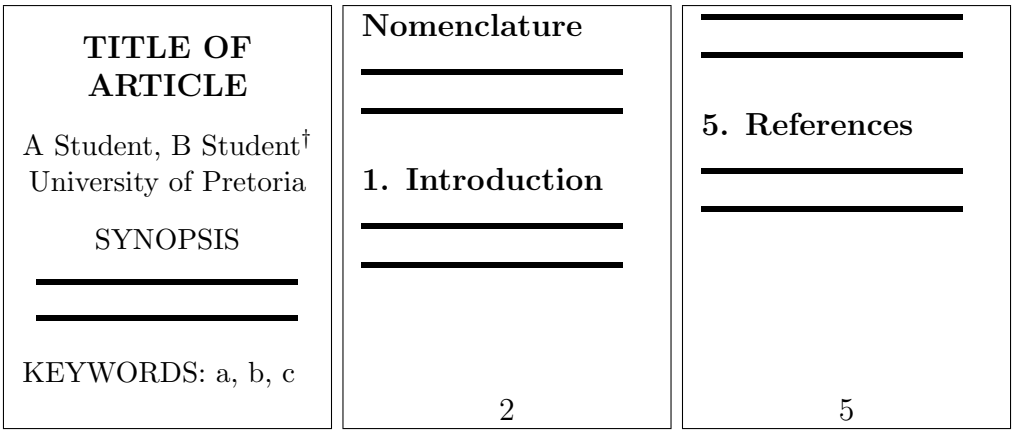

Figure 5: Paper format at a glance

A paper does not have a cover. The title page should contain the following:

- The title in capitals, centred and not underlined.
- Name/names of author(s), company affiliation(s) and address of the author to whom correspondence must be addressed.
- A heading "SYNOPSIS" centred, followed by the synopsis of 100 to 200 words.
- A heading "KEYWORDS:" at the left margin, followed (on the same line) by the keywords (generally no capitals).

Nothing else appears on the title page. The information on the title page is arranged to form a balanced layout.

The pages are numbered from the title page using ordinary (Arabic) numerals. The title page is usually not numbered, so the second page is number 2. If a nomenclature list is used, this appears at the top of page two, followed directly by the introduction. If the headings are numbered, number 1 is assigned to the *Introduction*.

The remaining sections proceed as for a report. The theory section of an article is usually more brief than in a report, as the readership of the journal will typically be familiar with the subject matter.

3.3 Synopsis and keywords

The synopsis is complementary to the title and is read together with the title. All the elements which appear in the title need therefore not be repeated in the synopsis. The purpose of the synopsis is to summarise the

- scope of the investigation,
- main findings and
- main recommendations (if any).

If the scope is not clear from the title, it can usually be defined with a one sentence objective statement. If the purpose of the investigation is not clear from the title and the main findings, this is also mentioned. The synopsis must, however, not contain phrases like "An investigation was launched . . . ", ". . . is discussed" or "In this report/paper . . . is given/discussed/described . . . ".

Important numerical information must be included in the synopsis. Use bullets to emphasise important points. Use paragraphs where appropriate.

Keywords are used in information retrieval systems. During a search of this nature papers with a certain keyword or combination of keywords are selected. Choose a maximum of five words to characterise the report, and choose them carefully.

eg KEYWORDS: small, letters, same, line

3.4 Introduction

The purpose of the introduction is to put the reader in the position where the author was before he/she started the investigation.

The following usually appear in the introduction

- Background
- Problem statement
- Purpose of the investigation (objective statement)
- Method (very, very brief), scope and/or limitations

In principle, only enough background should be given to enable the reader to understand the problem statement. The problem should be stated in such a way that the objective can be understood. It is sometimes wise to combine the problem and objective statement if the objective is simply to solve the problem.

In general, the problem statement outlines the justification for the investigation. For example: "The problem is a shortage of potassium for the manufacture of explosives; the purpose of the investigation was to determine the feasibility of a filtration technique to purify a locally available raw material containing potassium."

The method, scope and limitations are mentioned only. For that no more than a few sentences will be required. Further details can be given in the body of the report. For example: "The efficiency is determined experimentally in a laboratory scale investigation. Because of compressed air limitations, the investigation is limited to 300 kPa." or "The number of swimming pools in the Pretoria municipal area was determined from aerial photographs. Indoor pools are, therefore, not included." The limitation statement is not a list of excuses why some things were done badly or not at all. It is not a list of shortcomings in apparatus, etc.

3.5 Theory or literature

A chapter on literature is included if more comprehensive background is required than can conveniently be given in the introduction. This background will include information of which the reader is probably not aware and which is required to understand the report, to justify the investigation and to follow arguments and mathematical models or expositions. A review of relevant literature *must* be given in all project reports, laboratory investigations and dissertations.

It is totally undesirable to rewrite major portions of eg a laboratory guide or textbooks, or to give detailed derivations of equations. Show only a summary of the current state of the art. Referencing must be used to indicate the source of each statement or data and each equation or derivation used in the literature chapter.

The literature section for a paper will of necessity be less comprehensive than for a full report. It should, however, always convince the reader that the investigation method and the experimental design were justified and that these were guided by the existing level of knowledge on the subject. The literature section should not be a survey of all the literature published on the topic. Only the relevant literature should be discussed. Never use the heading Literature "Survey" for this section.

3.6 Experimental

3.6.1 Reports

In reports the apparatus, planning and experimental methods are described in some detail. These can be included in one paragraph or each can be assigned a separate paragraph. The description and/or references must be complete enough to enable the informed reader to repeat the experimental work.

Apparatus Describe the apparatus used. Use sketches and give dimensions if necessary. Give equipment type and model number if very specialised equipment is used. Do not present the apparatus as a "shopping list", use full sentences.

Planning Name the independent variables and justify the choice. Justify the range of values investigated for the independent variables used. Show and justify the choice of dependent (or measured) variables. Show the experimental design. There are a number of good books on experimental design, among others one by Hicks (1982). Note that "experimental design" is not the design or choice of equipment or the experimental setup. It concerns the variables in the experiment, not the hardware.

Methods Without using an idiot recipe style, describe the methods used in the experimental work and analysis. Use references freely; also references to standard methods and techniques eg methods of chemical analysis.

3.6.2 Papers

The experimental section in a paper is as brief as possible, but it must still be informative. In many cases the three sections (Apparatus, Planning and Methods) will be combined. Less detail will be given and referencing will be generous – but try not to reference the full report on which the paper is based.

3.7 Results

If it is immaterial to logic and flow of argument, report the most important results first. Use graphical and tabular presentation judiciously (see appendix **??** for more detail). Do not, in the same report, show the same data graphically and in tabular form. Indicate important points to the reader. It often makes more sense to report the results and immediately discuss their significance. In such instances change the heading to "Results and discussion". The discussion chapter will then automatically disappear.

In reports, illustrate data manipulation using complete sample calculations. If it is feasible (for example in laboratory reports) sample calculations are placed here, but mostly these are placed separately in an appendix and referred to here. In the case of large projects, make meaningful subdivisions so that results do not disappear in the variety of data, calculations etc.

Note: Generally it is a good idea to subdivide the results section. Sub-headings assist greatly in providing structure to a report or paper.

In papers, data manipulation and sample calculations are not generally shown. It may at times be necessary to tell the reader (in principle) how the observed values were manipulated to arrive at the information presented.

3.8 Discussion

The results of most technical projects are in the form of correlations between different variables. The correlations must be explained using accepted theories and mechanisms. In the case of research projects new theories or mechanisms must be formulated. From the viewpoint of the project leader's evaluation, this is a very important chapter. It gives an indication of the author's insight into the problem.

3.9 Conclusions (findings)

This chapter is a resumé of all the conclusions already drawn in the discussion chapter. There will consequently be some repetition. The most important conclusions must be mentioned first, unless this leads to bad logic or loss of argument. No new material, information or conclusions may be introduced at this point.

All the objectives of the investigation, as stated in the *Introduction*, must be addressed here. All conclusions mentioned here, must have been discussed beforehand. All conclusions must be based on results.

3.10 Recommendations

Findings may lead to actions which should be considered. The recommended actions are summarised as recommendations. All recommendations must be justified or justifiable

from the conclusions. Do not include the word recommendations in the heading if there are no recommendations to be made. If the scope of the recommendations does not justify it, the recommendations can be combined with the conclusions in one chapter.

3.11 References

References should not be confused with headings like "Bibliography" or "Further reading", which frequently appear in non-technical reports. All references must be referred to in the text. Technical reports and papers do not contain headings like "Bibliography".

3.11.1 General

With the exception of generally known facts, all statements that are not your own must be provided with a reference. Never create the impression that ideas, arguments, facts or conclusions are your own unless this is true. Plagiarism is a serious academic felony. Students are often unclear as to what constitutes plagiarism. A good rule of thumb is to reference *everything* that you did not create yourself, *and* any statements that you may have thought of yourself but may be controversial or counter-intuitive. At an underground level it is highly unlikely that a student will come up with something that has not been researched before. If you have not found supporting references, you have probably not looked hard enough. For more information, browse the University's plagiarism site at `http://www.ais.up.ac.za/plagiarism`.

References are typically used to

- justify statements and findings
- enable the reader to consult the original source and
- acknowledge the author(s) for a specific contribution (Burger, 1992)

The following statement need not be referenced: " . . . at the conclusion of the Second World War in 1945 . . . "

Consult the original source as far as possible, since it will usually contain the most accurate account of the findings and limitations of a certain study. If, however, this is not possible (or if it is not available) the original source can be cited as follows:

"Paul (quoted in Strathmann, 1988) found that . . . ". Quotes from another person's work must clearly be shown as such, with reference to the source. In our field of science direct quotations are seldom used; exceptions are possibly found in review articles or in articles with a qualitative or speculative tendency. When citing indirectly, only the direct source (the one you read) is included in the list of references.

See Appendix A for a detailed discussion on reference methods.

3.12 Appendices

3.12.1 Reports

The previous chapters form the core of the report. A good reporter will arrange them to form a logical overview of the project. To achieve this it is usually necessary to exclude raw data, cumbersome calculations, supporting results (for example standardising of equipment) and documentary material (eg graphs used in calculations and computer programmes) from the main body of the report. Such material is then put in appendices as appropriate paragraphs and subparagraphs.

Only one aspect is treated per appendix. Each appendix is provided with a number and descriptive heading and is indicated by page number in the table of contents. Every appendix must be mentioned in the text.

Appendices should not contain unedited graphs, tables or figures. The symbols and language used in the appendices must be the same as in the rest of the report. If computer programmed results are used in appendices these must preferably be in the same letter type as the rest of the report. Printouts of eg statistical data must be edited (or retyped) to eliminate unnecessary information and undefined variables.

It is important to provide the reader with information about the items in the appendix – explain why they were included and clear up some of the more confusing aspects of the items. An appendix is not a place to "dump" information of only peripheral interest to the reader.

3.12.2 Papers

Only in exceptional cases will a paper contain an appendix. Such an appendix should preferably not be more than one page and will not necessarily start on a new page.

4 Writing technical reports and papers

4.1 Preparation

Never simply start writing. Disciplined preparation is essential (Johnson, 1967).

4.1.1 Analyse the problem

Ask yourself certain questions and answer them as well as possible

- Exactly what information do I wish to convey in this report?
- What is the most logical order in which I can present this information?
- For which group of readers am I writing?

- What background information can I assume these readers already possess?

4.1.2 Plan a comprehensive scheme

It will serve as your guide for writing

Make as many subdivisions as possible

Determine the hierarchy of headings. Bear in mind that in any scheme material will be separated into divisions and subdivisions which, by definition, will be equal to or subordinate to one another

4.2 Writing sequence

Although the title appears first and after that the synopsis, keywords, list of symbols, introduction etc, a report/paper is not written in this sequence.

The *Introduction* is written first. Give the background, problem statement, purpose of the investigation and scope of the investigation (See section 3.4). After that the *Main body* of the report (See sections 3.5 to 3.8 and the *Appendices* (See section 3.12) are completed.

The next important chapter is the *Conclusions and recommendations*. (See sections 3.9 and 3.10). The conclusions are already justified in the main body of the report. Everything that is stated in the *Introduction* as an aim/purpose must be addressed in the conclusions. It is totally unacceptable to make unsubstantiated statements in this section. It is usually necessary to revise, refine or even rewrite the *Introduction* at this point.

Now that the scope of the report is fixed and the conclusions are properly formulated, the *Synopsis* is written. (See section 3.3)

The very last job to be done is the formulation of the *Title*. Write down a few titles and choose the best one (See section 3.1)

4.3 Editorial care

4.3.1 Sentence and paragraph construction

The so-called fog index can be used to quantify the readability of a piece of prose. It is based on sentence length and the use of multi-syllable words. The longer the average length of the sentence, the less readable the report becomes. Try to keep the average sentence length under 15 to 20 words. Use simple explanatory sentences. Where long sentences are required, ensure that these are not confusing. Avoid vagueness, unnecessary words and words that do not say exactly what the author means.

A paragraph consists of a number of sentences on a single topic or around a single theme. This theme is usually identified early on in the paragraph.

4.3.2 Hierarchy of headings

The chapters are the most important divisions and are numbered with single digits. Further divisions are done in decimal notation. Make sure that the numbering reflects the importance of the heading.

If it is elected not to number chapter and paragraph headings, the hierarchy must be clear from the letter type (capital, bold, lower case, etc). Try not to underline headings.

5 Editing

The process used for editing is also used for marking of the student's report or paper. It forms the basis of the report editing checklist given in the study guides. This checklist is also used as a mark sheet in the Department. It is the responsibility of the author to scrutinise and grade his/her report in the same manner (or to have it done) before it is submitted to the main reader. A good author will wait a few days after writing the report before doing this exercise.

Read the **introduction** first. Does it place the investigation in context, i.e. does it give background, problem statement, purpose/aim, limitations and scope of the investigation? See section 3.4. Now read the **conclusions**. Do the conclusions link directly with the aims/purpose as set in the introduction? Are the most important conclusions offered first? Is there a reason why not? Are the conclusions clear and unambiguous? See section 3.9.

The reader should now have a good idea of the success of the investigation. Page through the report and look at the **headings**. Is the hierarchy of headings correct, i.e. do the numbers or letter type indicate the importance of the heading? Is it clear that all the important aspects are included? See section 4.3.2.

Now the **report** is read in its entirety, starting at the introduction. Note the content of each sentence and group of sentences (text analysis) to ensure that the text appears in the correct place in the report. (A trained editor will already have done Ax text analysis on the introduction and conclusions at the first reading).

After text analysis one may find that :

- there are results in the introduction
- discussion is included in the part of the report that deals with experimental work
- new experimental details are included in the discussion
- discussion is included in the section that contains conclusions
- some of the conclusions are not based on results

- some of the recommendations do not flow from conclusions

Also take care to include the following issues:

Judge the author's use of the theory and literature chapter(s). Is there a critical analysis of the relevant literature and theory? Are the criteria used during the investigation properly identified? Has a decent experimental design been done? See section 3.6.

Are results properly arrived at and presented? Are graphical presentations used efficiently? Note the significance of data and the correctness of sample calculations. See section 3.7. Gauge the author's insight from the discussion, the interpretation of the results and significance of relationships and correlations. Is evaluation done using criteria that are identified in the literature? Are valid conclusions drawn? Has new material been introduced in the conclusions?

The reader should now be well acquainted with the investigation and can analyse the **synopsis** and the **title**. Are the main findings, main recommendations and (if necessary) the purpose and scope of the investigation clear from the synopsis? Do the title and synopsis form a unit? Is the title short and informative? See sections 3.1 and 3.3.

Is the report prepared with the necessary editorial care? Note neatness, balanced page layout, care of language, spelling errors, integrity with respect to numbering, grammatical parallelism of headings and lists, sentence and paragraph construction, reference technique and the correct application of conventions with regard to figure and table titles. A trained editor will have noticed most of these errors during the first reading of the report.

Does the report serve its **purpose**? Is the report **accurate**, **brief** and **clear**? Is the development logical? Is the style acceptable?

It is strongly recommended that the report be read by a friend or colleague for a final check on spelling errors and readability.

References

Burger, M (1992) *Reference Techniques*. University of South Africa.

Buys, A (2003) *Research guide for postgraduate students*. University of Pretoria.

Fear, S (2003) "Publication quality tables in latex."

Hicks, CR (1982) *Fundamental Concepts in the Design of Experiments*. Holt Saunders, New York, 3rd ed.

Johnson, TP (1967) "Fast functional writing: Organizae the report for wast writing, easy reading." *Chemical Engineer*, 6, 30.

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Organisation, IS (1987) "Documentation biographic references content form and structure." Tech. rep., ISO, Genéve.

A Reference methods

Two very popular reference methods are the Harvard method and the augmented Harvard method. Guidelines for the use of these methods are contained in the International Standards Organisation (ISO) guideline ISO 690 (Organisation, 1987). Burger (1992) discusses these methods from the perspective of a South African user.

In brief, the Harvard method quotes an author in the text by means of a surname and the year of the publication, eg "... was found. (Smith, 1975)". The references are then given in alphabetical order (according to the surname of the primary author) in the reference list. In the augmented Harvard method the text will contain a digit which coincides with the position of the source in the reference list, e.g. "... was found. [21]". The references are then given in numerical order in the list of references. Although the augmented Harvard method is mostly used in scientific publications, we will, for practical reasons, use the ordinary Harvard method in this department.

In practice a researcher/author will decide in which journal he/she wishes to publish and will then adopt the reference style of that journal. Usually instructions/guidelines for authors appear at the back of a journal, sometimes only in the December or January issue of the journal. Nevertheless, it is recommended that you scan the journal for a paper with a decent list of references and use it as your model.

A.1 Policy of the Department of Chemical Engineering

A.1.1 References in the text

In the general case the following are placed in brackets at the point of referencing in the text.

Books Author's surname + comma + date of publication + colon + page number e.g. (Smith, 1988: 45)

Journals Author's surname + comma + date of publication e.g. (Smith, 1988).
Include initials if reference is made to more than one Smith e.g. (Smith, RP, 1988).
Special cases:

- If the date of publication is not known, use the copyright year or (if this not known): *sa* [= *sine anno*, no year], e.g. (Smith, *sa*)

- The page number is typically shown when reference is made to a certain place in the book and not when the whole book, an extract from a book or a journal article is referred to.
- Two authors are linked with "&" (Smith & Klein, 1988).
- Three authors – first citation (Smith, Klein & Long, 1988) and at later citings (Smith *et al*, 1988); note the full stop and the comma and that "*et al*" is short for *et alii*, and other.
- More than three authors are treated in the same way as later citations of three authors, e.g. (Smith *et al.*, 1988).
- When the author is already mentioned in the text, the author's name is not repeated, e.g. "Smith (1988) found that ..."
- More than one reference for the same statement: (Smith & Klein, 1988; Peters, 1989) or "Both Smith & Klein (1988) and Peters (1989) found that ...".
- Institutions must be referred to with minimum identification (Department of Energy Affairs, 1978) or (CSIR, 1987: 34).
- If the same author published more than one publication in the same year, the publications are taken up in alphabetical order and marked "a, b, c, etc.", e.g. (Smith, 1988a; Smith, 1988b).
- Secondary references, e.g. when the original reference is not available, are treated as follows: (Smith, quoted by Peters, 1989: 45).
- Unusual author surnames: (Van der Merwe & Day-Lewis, 1990).
- Information taken from an encyclopedia is treated in the same way as a chapter or section in an edited book. The encyclopedia article usually has an author who is cited in the text. An example of a reference entry for this case is given under (b) below.

A.1.2 A note on electronic documents

With the common use of electronic resources and the Internet, it is becoming more difficult to give a single reference for a physical article. There are several standards underway to provide a consistent way of referring to online sources, but the URL (something like `http://www.someaddress.com`) is not the preferred method, as it is not stable, i.e. the same information will not be reliably available from the same URL for any length of time. For this reason, online sources should be quoted only after exhaustive search for a physical

reference has yielded no results. There are very few web sites that exist totally removed from any physical media – if you are referencing a web site for important information, there is a good chance they have referenced their sources and you would do well to consult the original material.

If there is no way to avoid citing a web reference, ensure that you quote the data on which you visited the URL.

A.2 Examples

The cited references appear alphabetically in the reference list according to the name of the first author. Publications of the same author are arranged chronologically and when author and year are the same the sources are quoted alphabetically according to titles and distinguished by alphabetical letters (e.g. 1988a, 1988b).

All the authors are mentioned. (*et al.* is never used in the reference list).

Details of the publications are given in the following sequence: author, year of publication and title; after that it depends on whether the publication is a book, a journal or other work. Most of the options are indicated here as examples.

Book

- Kesting, RE (1972) *Synthetic Polymeric Membranes*, McGraw-Hill, New York.

Paper published in a journal

- Strathmann, H (1981) "Membrane separation processes" *J. Membr. Sci.*, 9 (2), 121 – 189.

Patent

- Henis, JMS and Tripodi, MK (1980a) "Multicomponent membranes for gas separation", *US Patent 4,230,463*, assigned to Monsanto Corporation, US.
- Henis, JMS and Tripodi, M K (1980b) "New method of producing defect- free membranes", *US Patent 4,230,454*, assigned to Monsanto Corporation, US.

Report, thesis or similar

- Janzen, PA (1993) "Clean water supply to rural communities", Zirkon Consultants' report to the Water Research Commission, Pretoria.
- Van't Hof, J (1988) *Wet Spinning of Asymmetric Hollow Fibre Membranes for Gas Separation*, PhD Thesis, University of Twente, Enschede, The Netherlands.

- O'Kelly, C (2001) *Nanofiltration Membranes*, Project Report, Dept Chem Eng, University of Pretoria.

Encyclopaedia or similar

- Gmehling, J and Onken, U (1977 – 1980) "Vapor-liquid equilibrium data collection", Part 1 in Chemistry Data, Parts 1–7, D. Behrens and R. Eckermann (Eds.), Dechema, Frankfurt a.M.

- Peters, S (1991) "Water soluble polymers", in *Ullmann's Encyclopedia of Industrial Chemistry*, A29, Wolff, R (Editor-in-Chief), VCR Vertrieb Publishers, Düsseldorf.

- Smolders, CA (1980) "Morphology of skinned membranes: a rationale from phase separation phenomena", in *Ultrafiltration and Applications*, I Cooper (Ed.), Plenum Press, New York.

Reference in another publication

- Smith, SA quoted by Billiton, RS (1995) ... followed by book, or journal reference.

Personal communication

- Koros, WJ (1992) "Glass transition properties of glassy polymers", Personal Communication, Department of Chemical Engineering, The University of Texas at Austin.

Paper presented at a conference

- Mazur, WH and Jakabhazy, SZ (1991) "Gas Separation Membranes – Now and Tomorrow", paper presented at *The Europe-Japan Congress on Membranes and Membrane Processes*, 23 – 25 May, 1991, Stresa, Italy.

Web page

- Pritzker, TJ (1999) "An early fragment from Nepal", `http://www.ingress.com` [2000, June 8]. The date in the square brackets is the access date.

A.2.1 Important notes

- The references are not numbered. Paragraph spacing is used between references.

- Volume numbers of journal articles are given in italics and the number of the issue (not in italics) follows in brackets. Some journals indicate the issue or volume as a month and then the same rules apply.

- In the titles of journal articles or extracts from books, only the first word is capitalised. In the titles of books or conferences all the key words in the title are capitalised, e.g. *Fundamentals of Heat and Mass Transfer*.

- The patents of Henis & Tripodi above are arranged alphabetically according to title. If the second author had been different, the patents would have been arranged according to the second author.

- In the reference list "and" is used with more than one author, while the "&" is used in the text reference.

- Each of an author's initials is separated from the surname by a comma and followed by a full stop.

- In the reference list it is common to give the first and last page numbers of a journal paper.

- In the reference list the paper numbers of a book are not mentioned – they have already been given in the reference in the text.

- When reference is made to a conference the year is shown between brackets after the author and often repeated when the conference dates are given.

It must again be emphasized that these guidelines hold for this Department and that a number of alternative referencing systems are in use. A practical advantage of the Harvard method is that the elimination and addition of references is done without it being necessary to renumber all the references. It is also often easier for the reader if the referenced author is mentioned by name in the text, instead of being identified as a number only.

B Computer specific problems

B.1 Graphic file formats

When graphics are stored on a computer, there are two different approaches that can be taken. We can store information about

- each pixel (picture element) in the image or

- the objects that make up the image (lines, arcs, blocks, etc).

An image described using the pixel approach is termed a *raster* graphic, while images described using the second approach are called *vector* graphics.

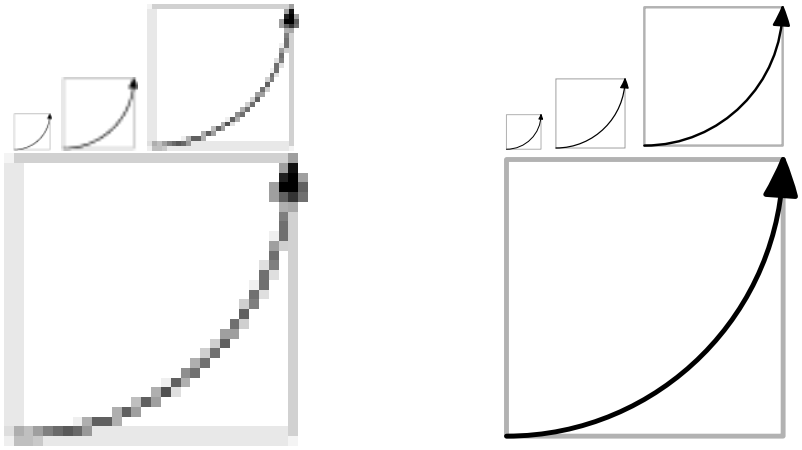

Figure 6: Difference between raster and vector graphics

The difference between raster and vector graphics can easily be seen when enlarging or zooming in on an image as shown in figure 6.

Most of the graphics in an engineering report will be well represented using vector graphics. They work well for plots, graphs and line drawings of equipment. They result in small file sizes and produce high quality output when printed. Examples of file extensions for vector files are EPS, WMF, EMF and Visio files. Raster grapihcs will probably be used exclusively for photographs or screen captures of computer software. Examples of file extensions for raster files are BMP, PNG, GIF, TIFF, and JPG.

When preparing screen captures, another important aspect of graphic file format is the type of compression used. Most common raster file formats are *lossless*, retaining all of the information in the original file. The JPG file format, however, was designed to compress photographs and uses *lossy* compression based on mathematical reduction of the information in the original file. The effect of this compression can be seen in figure 7, where a screenshot was taken and saved as a PNG file and a JPG file.

The routines used to compress the image in JPG are optimised for photographs and should only be used for images with "natural" characteristics, rather than computer generated images.

Most students will incorporate graphics into a word-processor using "copy and paste". This may cause the format of the file to be unknown. It is recommended that all graphics be saved as seperate files and then inserted into the document. This will not only ensure that the document retains a managable size, but make it easier to exchange graphics as well.

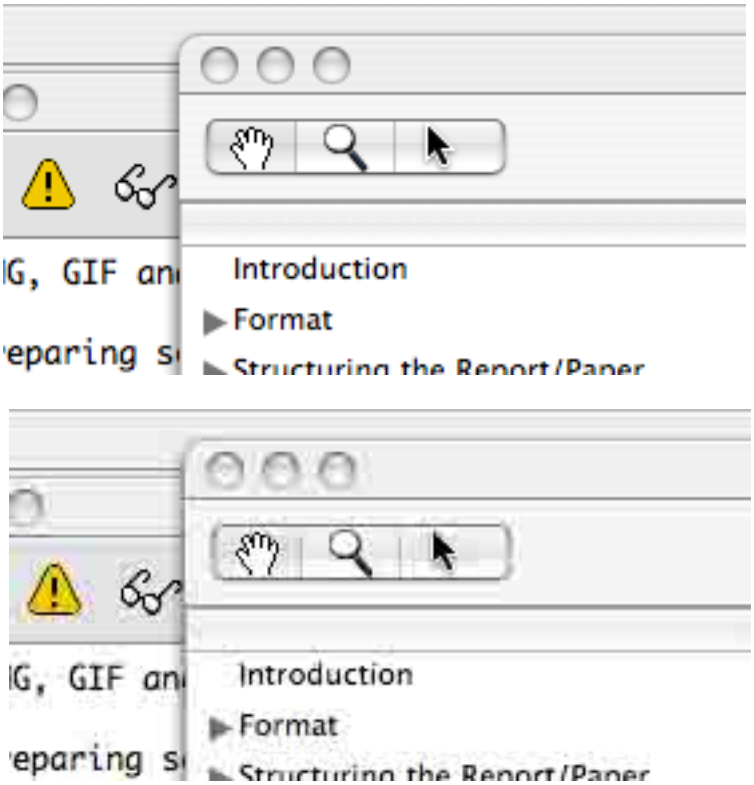

Figure 7: Lossless compression (PNG) vs lossy compression (JPG). Note the noise or "artifacts" in the second image

B.2 Equations

A handy way to get an equation like equation 2

$$e = mc^2 \tag{2}$$

is to set up a style in your word processor containing a centre tab (⊥ on the toolbar) in the centre and a right tab (⌋ on the toolbar).

I need advice from Word users on correct ways of including figures, tables, references and cross-references