Chalmers University of Technology
Centre for Language and Communications
Updated March 14, 2009

Writing guidelines for reports, BSc theses, and MSc theses at Chalmers University of Technology

Table of Contents

1. Introduction

A normal part of the tasks assigned engineers is to present the results of investigative analyses and projects orally as well as in writing. In order to accomplish this, the information gathered needs to be structured in such a way as to make it clear and intelligible to the recipient. The exact formulation of reports naturally varies; however, there are some widely accepted norms and conventions for how to formulate and present such reports. These norms make up the basis of the guiding principles for these writing guidelines for presenting reports, BSc theses, and MSc theses at Chalmers.

These writing guidelines are provided for the benefit of a number of educational programmmes at Chalmers. There are, of course, variations between the various disciplines. However, there are many overall features in common for all disciplines. Thus, our first and foremost purpose is to provide a general framework for reporting on laboratory work, experimental work, product development work, design work, and various types of related projects at Chalmers.

For the Chalmers programmes, there are principally two types of reports – laboratory reports and project reports. Laboratory reports present and discuss one or several laboratory experiments and are as a rule less comprehensive than the project reports which document more comprehensive studies, such as research projects, BSc or MSc theses, degree projects, literature surveys, and feasibility or pilot studies. The reason for presenting both laboratory and project reports in these guidelines is partly because the overall principles are similar, partly because the laboratory reports may make up an essential part of an overall project and for this reason, it may be used as an attachment to the project report.

Our guidelines begin with a brief description of the two most commonly used types of reports and what differentiates these two documents from each other. In Chapter 2, there is an overview of the components and functions of the two major kinds of reports in the form of a table (see Table 1). The chapter concludes with a brief discussion of language and style and other factors that influence the formulation of a report. Chapter 3 treats the formalities of reports, including page formats, fonts and the treatment of figures. In the concluding section, you will find instructions and advice regarding the listing of sources and references.

Of course these guidelines are limited in scope and there are numerous additional publications and sources for further reading and instructions. We recommend for

instance *Writing the successful thesis and dissertation – Entering the conversation* by Irene L. Clark or *How to do a research project – A guide to undergraduate students* by Colin Robson. There are also specifically technically oriented publications like *Technical Communication* by Mike Markel or *Technical Communication – A reader-centered approach* by Paul V Anderson.

2. Report writing and types of reports

Technical reports are written whenever engineering work is being undertaken. Writing, reading and evaluating various types of reports is thus a common feature of the careers of most engineers. The purpose of a report is to present the results of an investigative project and how these results have been reached. The presentation is made by means of words, pictures, models, tables, diagrams, figures, etc. In many cases, the report is the only tangible product of an investigative analysis. Regardless of the calibre of the actual investigative work, the report is the key tangible proof of the quality of the work undertaken and as a rule, the report is what is being evaluated. Thus, a poorly written report often means that the job itself is also considered to be of poor quality.

Scientific and technical reports are characterized by the common feature of being focused on a certain subject without any deviations from this subject. An important means by which such deviations or transgressions are avoided is to clearly define the problem to be solved and then proceed to carefully analyse the assignment at hand. The problem is then formulated for the purpose of communicating what has been examined and, accordingly, what the report is all about. The aim of the report occupies a core feature of the assignment since it to a great extent affects such items as the selection of the investigative method used, the presentation of the results and the project discussion.

When it comes to presenting the aim or purpose, it is important to differentiate between the purpose of the report, the goal of the coursework and the objectives of laboratory experiments. For example, one of the goals of a course might be to teach its students to work in project teams. Thus, this is a goal of a course but is not something that should be mentioned in a project report, partly because is it irrelevant to the readers, partly because the report as a whole has a totally different purpose — presenting, discussing and/or arguing in favour of the results of the research project being presented.

Another factor that makes a report legible and easily understood is a clear structure. A

clear and logical division of its contents helps the reader gain an understanding of the contents of the report already at the initial reading. The structure of the report helps the reader identify sections that are of particular interest.

As mentioned in the introduction, there are two major types of reports: laboratory reports and project reports. However, this statement conveys a somewhat simplified picture of the situation since it is actually a matter of a sliding scale when it comes to the scope of the report—a scale from the mere reporting of results (sometimes termed "protocols"), to the somewhat more encompassing laboratory report all the way to the more comprehensive project report. The following section will provide a more thorough description of the main features of the various types of reports written at Chalmers.

2.1. Laboratory journals

Students and researchers must document the experiments and laboratory tests undertaken. As a general rule, all these documents are collected into something called a laboratory journal that is often made up of a bound booklet or its equivalent. This laboratory journal forms the basis of certain sections of the laboratory or project reports but as discussed in section 2.2, these two types of documents are expected to be more comprehensive and, furthermore, they have a different purpose.

The appearance of the journal and the rules for creating it differ from workplace to workplace. In addition, there are often requirements to keep electronic laboratory journals. An important reason for the existence of such laboratory journals and why they need to be accurate is the prevailing patent legislation, which greatly differs between Europe and the U.S.

2.2 Designing and structuring laboratory and project reports

The laboratory report describes and discusses several laboratory experiments. The major difference between a laboratory journal and a laboratory report is that the writer of the laboratory report tries to place his or her laboratory test or experiment into a larger scientific context by illustrating how the documentation contributes to advancing the knowledge within the particular scientific field.

As mentioned in the introduction, the project report documents a larger piece of work. Most such reports have a similar main structure but project reports are of a somewhat different character, which in part influences content and structure. For example, certain reports are based on somebody's own laboratory work and experiments that are then described in a chapter entitled "Experiments". Reports that are not based on someone's

own experiments but primarily on literature surveys or summaries do not feature chapters entitled “Experiments”, but the approach is instead described in a chapter entitled “Method”.

Table 1 provides an overview of the various components expected to be found in a laboratory report and/or a project report. Note that a laboratory report may be used as an attachment to a larger project report and is, therefore, of interest to the written presentation required to qualify for the BSc or MSc degrees. It is also important to note that the table shows “components” and “functions” for the different parts of a report. The **headings used in the table are only general designations, implying that it is up to the writer to work on the actual formulation of the headings to make them more informative** than headings such as “Materials” or “Results”.

Table 1. Components and functions of laboratory and project reports

COMPONENT/HEADING	FUNCTIONS – *WHAT SHOULD BE INCLUDED?*
Title page	Title, author, course, instructor, tutor/advisor, date
Preface	May contain background materials on why the report has been written and a thank you to those who have been helpful during the course of the work. The preface can be omitted and is not necessary other than in larger reports in which thanks are expressed to companies and individuals that have made the research work possible.
Abstract	Offers a quick way for the reader to decide whether the report is relevant for him/her and whether it contributes important knowledge/key results/valuable scientific methods. The abstract should contain the purpose or problem dealt with, results, conclusions, as well as methods or theory if relevant and space permits.
Table of contents	Shows chapter headings of the report. *References/Bibliography* and *attachments* are neither numbered nor considered to be chapters.
List of abbreviations	Lists the abbreviations of subject-specific terms used during the course of the work, as well as symbols and notations of equations. If possible, use generally accepted abbreviations.
Introduction	The introduction places the report into a wider context and points to its relevance and newsworthiness. It functions as an introduction to the entire report and should give the reader the necessary information required to understand its contents.

	The introduction usually has a *statement of purpose* that is often connected to a *background statement* or a brief history of the subject. In many cases, the statement of purpose is closely related to the *formulation or approach to a problem* which is important for both readers and authors to be able to fully use the report. It should also include something about the scope of the investigation or experiment, as well as why certain limitations have been made. Further, the *method* should also be included but only for the purpose of noting the type of scientific inquiry undertaken. The methodology selected is developed in other sections of the report. It is customary to state the *background, purpose* and *method* as mandatory functions of the introduction. At times, key results are also highlighted already in the introduction. The introduction is the first page that is numbered.
Theory	The theoretical framework to understand the phenomenon/product treated by the laboratory test or report. Also noted here are how experiments/reports connect to or are influenced by the related theoretical framework or the theoretical background of the choices made during the course of the work.
Introduction/Theory	In certain cases, primarily for brief laboratory reports, it might be valuable to combine the two functions of "Introduction" and "Theory" into one section. Check with your supervisor.
Materials and Experimentation/Method	*Materials* describe the components that make up the laboratory experiments conducted, as well as other materials used. Do not omit anything; however, the text should be concise and to the point rather than completely exhaustive. Thus, try to highlight and describe core sections of, for example, laboratory instructions (e.g. instruments, instrument settings, chemical concentrations) and specifications of requirements in the main text. Do not list everything but rather add lengthy instructions or protocols as attachments and refer back to them. The purpose of the *Materials* and *Experimentation/Methodology* sections is to be able to recreate a laboratory experiment or to be able to evaluate a project against the background of the choice of methodology or approach to complete the project. *Materials* and *Method* can also make up two separate sections or chapters.

Results **Computations** **Primary data**	Conveys results of observations and computer-aided analyses/measurements. Results are usually presented in the form of figures, tables, graphs or photos, but it is critical to also provide them with adequate comments to illustrate the significance of the results, as well as possible deviations or unexpected results. The section on Results should also consist of text that connects the illustrations. Depending on the type of experiment or method, authors should note and justify computations and formulas on which interpretations of results and computer-aided analyses are based. In certain cases, primary data should also be included to make results meaningful and to be able to discuss them. Primary data is unprocessed data measurements. **Note** this is not applicable to all individual cases. Check with your supervisor.
Discussion	This section deals with the results in relationship to theory and methodology and is evaluated based on the introductory statement of purpose. The discussion also comprises the expected results indicated by the literature referenced (theory, method, database) and explains individual specific results and data measurements. Also deviating or unexpected results and data should be identified and explained by referring for instance to materials, theory, and procedure. In addition, the discussion should connect to or refer back to the introduction and the rationale for the research.
Results and Discussion	In certain situations, the two ”results” and ”discussion” functions may be combined into a single section of a report. Please consult your supervisor regarding this option.
Conclusions	This is where experiments or project conclusions are presented against the background of discussions and presentations of results and by frequently referring back to the introduction of the report. For many investigative projects, it is also common for conclusions to end on recommendations or future work. **Note** that in some reports, the "Discussion" and "Conclusion" sections are combined. Please consult your supervisor.
References and sources	Literature used in the report (e.g. books, articles, databases) must always be referenced. Separate directions for how to formulate lists of source materials are provided in Chapter 3.6.

	The website of the Chalmers Library gives clear instructions on how to proceed. There are several different systems for dealing with source materials, such as the Harvard and the Vancouver systems. The key thing is to be consistent in the formatting of source references regardless of the specific system used.
Attachments	Attachments are where materials required to complete the documentation of the laboratory test or project report are placed, including material not appropriate for inclusion into the main section of the report. Attachments should be adapted to the format of the report. Examples of materials to be placed into attachments: laboratory instructions, risk analyses, extensive specifications of requirements, spectra and diagrams, excerpts of programme codes, protocols and bulky data. Consult your supervisor.

Consequently, project and laboratory reports have in principle the same overall structure but as a rule, project reports are more comprehensive. However, this does not imply that the two types of reports only differ when it comes to scope. Expectations and purposes of the two types of reports are different and, therefore, working with them makes different demands on the authors. What follows are a few examples of differences between laboratory reports and project reports:

- The project report has a different and larger readership than the laboratory report, something that carries with it other expectations.
- Frequently, a larger amount of secondary materials or literature references are used in writing project reports, which may render the selection of relevant literature references more challenging.
- Since the project report is lengthier and in many cases features a broader formulation of the problem investigated than the laboratory report, it can at times be difficult to focus the contents of the project report in such a way that it only covers facts that are relevant to the purpose being addressed. Further, the larger scope makes it necessary to make a larger number of strategic choices regarding the structure of the text.
- Both in laboratory and project reports, authors should strive towards placing their own work into a larger context by showing how they contribute new knowledge to the particular field of scientific inquiry about which they are writing. However, this is of greater importance and should be paid greater attention in a project report than in a laboratory report, something that is reflected in the scope of the introductory and discussion sections and the

connections made between them.

2.3 Language and style

Scientific papers and reports are traditionally associated with a neutral language style; in other words, statements are supported by quoting the sources consulted or the results of your experiments or investigations conducted, thereby avoiding subjective comments by merely stating your own opinions.

The scientific report is also characterized by being stringent. A stringent text is concentrated on the subject at hand without deviating from the aim of the report and the limitations under which it is written. This conciseness also implies that you look for the most effective ways of expressing the contents of the report by avoiding any unnecessary wordiness that might give the report a colloquial style.

A unit instrumental to making the text concise and logically presented is the paragraph. A paragraph consists of several sentences kept together by a common subject or theme. This theme is summarised by means of a topic sentence that is often the first sentence of a paragraph. Remaining sentences further develop and specify what was stated in the topic sentence. Thus, a paragraph must not consist of a single sentence because it is rare for a single sentence to express so many new facts that these facts cannot be transferred to the previous or following paragraph. Single sentence paragraphs make the text choppy with the result that readers are unable to understand the sentences and the reasoning that belong together.

Paragraphs are marked by *double-spacing*, as seen in this document, or alternatively, by means of *indentation*. By dividing reports into paragraphs, the writer communicates to the reader how the report contents are connected. A new paragraph signals to the reader that the contents and thought processes of the author are transferred from one point to another.

In order for the paragraph to help making the text clear and legible, it is not sufficient for the paragraph to be well-written even if this is a good beginning. The paragraphs making up the full text of the report must also be logically tied together. Otherwise, there is a risk that the text will turn into a long list of different opinions, thoughts and facts without making up a coherent whole.

In order for the arguments to be as clear and effective as possible, the text must have coherence devices that highlight and clarify the connection both within and between paragraphs. There are a range of linguistic phenomena that contribute giving a text its coherence, such as repetitions, synonyms and antitheses. Of particular significance to scientific writing are the so-called linking terms or phrases that clarify the logical coherence between sentences and paragraphs. Words that denote the following belong to this category:

- **reason and conclusion**: since, because, for this reason, consequently, leading to, as a result of.
- **comparison or antithesis**: on the one hand/on the other hand, on the contrary, however, in contrast to, as a comparison, like, similarly as, despite, in the same way.
- **example**: as an example, for example, in other words, among other things.
- **time**: as an introduction, while, at the same time, finally, in conclusion.
- **repetition**: as mentioned before, as mentioned in chapter X.X.
- **summary**: all in all, in summary.

If this type of devices are missing in the text, it becomes not only more difficult to read the text, but also to understand its contents since the reader must resort to guesswork to figure out how the various parts of the text are connected. (Please note that most commercial writing handbooks have more extensive lists of linking devices).

By using linking terms, you will thus be able to emphasize a number of logical connections, giving authors a larger choice of ways in which to structure the texts of their reports. An obvious advantage is that as a writer, you will more easily avoid writing nothing but a chronological account of your project. In other words, a report should accurately reflect what has been accomplished during the course of the work without creating a long list of the sequence in which things have been done. Such chronological lists run the risk of giving reports the flavor of travel itineraries (i.e. first, we went …, then we travelled…, then we met…); consequently, they become repetitive and not very interesting to read.

You run the greatest risk of ending up with this type of text as you write the chapter on methodology. To avoid this possibility, first of all reflect on the question whether it is necessary to present things in the precise order in which they took place. When reporting on experiments, this might be necessary, but it is frequently not the case. Instead, it is more important to try to show *how* you have proceeded and what the key parts of this investigative process have been. The purpose of the chapter on

methodology is not to render a precise account of your own work process but rather how you have collected the data on which the text is based. To partially avoid the problem of making the text repetitive, consider toning down the accounts of the specific individuals who have conducted the work. For example, consider the way the following paragraph is written:

> I measured the relative humidity of the test specimens at number of times during the trial period. I conducted the initial measurement already a week upon casting and thereafter, I conducted continuous measurements during the trial period. The measuring equipment I used consisted of HMP44 measuring gauges with an accuracy of +-2% in the 0-90% interval and +-3% between 90-100%, which I placed into the test specimens, in addition to a VAISALA HMI41 hand indicator with a measurement error of +-0.1% that I connected each time I conducted my measurements.

The above paragraph can be written with greater impact in the following way:[1]

> Measurements of the relative humidity of the test specimens were continuously conducted during the entire trial period starting a week upon casting. The measuring equipment consisted of HMP44 measuring gauges with an accuracy of +-2% in the 0-90% interval and +-3% between 90-100%, which were placed into the test specimens, in addition to a VAISALA HMI41 hand indicator with a measurement error of +-0.1% that was connected each time the measurements were conducted (Translated from Törn, 2005: 44).

In the second version of the text, the methodology is more effectively presented since it focuses on how the author has gone about his work rather than on who has done it.

The example above excerpted from Törn also illustrates another tendency of written reports—different parts have different communicative purposes—something that affects the language used in the report. For example, several studies have shown obvious differences in the use of tense as well as active vs. passive form in different parts of a text (Heslot 1982, Hanania & Akhtar 1985, Biber et al. 1998, Taylor 2001). As an example, the methodology chapter excerpted above is characterized by past tense and the passive verbal form. This pattern is particularly explicit in studies based on experiments, such as chemistry and biology studies, but the tendency is the same in all

[1] The first version has been edited to illustrate some superfluous details in writing a chapter on the scientific technique utilized. The second version is the original text that has been translated from a thesis project written at Chalmers.

fields of science (Taylor 2001: 17). In the chapter on research results, the use of tense varies but in contrast to the section on methodology, active verbal forms are more common than passive forms. The present tense is most commonly used in the introductory and discussion sections, probably because these sections describe the current scientific knowledge available in the field investigated, in addition to the consequences of the results obtained and how much the knowledge has been advanced as a result of the study (Biber et al. 1998: 125, Taylor 2001: 17). For the same reason, the introductory and discussion sections of the report often feature a larger proportion of literature references than do other chapters (Swales & Feak, 2004).

It is, of course, important to point out that what has been discussed so far is indicative of certain tendencies. For this reason, it cannot be unequivocally stated that the entire section on the scientific technique utilized should always be written in the past tense. Similarly, factors like tense and the distinction between the use of passive vs. active voice signal that the communicative purpose differs among the various parts of the report. Since these tendencies exist, they also add to the expectations of readers of how a certain text should be presented. It is sometimes difficult to point to the reason why a certain text does not seem well-written but it may depend on the fact that the use of tense deviates from the pattern most commonly used in a certain section of a report.

Table 2. Tendencies to Allocate Verbal Forms and References in Technical Report Writing (Adapted from Swales & Feak: 223)

	Introduction	Method	Result	Discussion	Conclusion
Present tense	high	low	varying	high	high
Past tense	low	high	varying	low	low
Passive form	low	high	low	high	varying
Active form	high	low	high	low	varying
Reference	high	varying	varying	high	low

There is, of course, a great deal more to be said about the language and style used but it is beyond the scope of these guidelines. If you want to read additional materials on report writing and language styles, we recommend *The Student Writing Manual* published by the Centre for Language and Communication (available at the Cremona bookshop). Also note that many commercial handbooks on writing and technical communication have very comprehensive sections on style.

2.4 Factors to consider in designing a report

Beyond what has been previously mentioned in this chapter, as a writer, you should pay

attention to the following factors in putting together your report:

- The reader
- The type of report
- The scope
- The writing process

A report is a vehicle for communicating and presenting the results of your research. The report is written to convey a message to a reader; consequently, the writer needs to bear in mind the comprehension of his or her readers in writing the report.

There is no generally applicable or standard way in which to structure a report. As a general rule, there are, however, suggested report outlines for presenting preparatory results or for giving a progress report on the work undertaken, in addition to recommended outlines for reports that are more encompassing or exhaustive in terms of their contents. Furthermore, there may be a certain established practice or expectation for how a report should be written for a university educational programme or for a company's R&D department.

There may also be a clear framework for the length of a report; however, the most important thing to consider in terms of the length of a report is that it should be proportional to the scope and significance of the investigation. When an examination appears to become more extensive or time-consuming than anticipated, the report should be divided into several parts. For example, such a course of action might be desirable in instances when the results of research experiments must quickly be communicated to a client for his or her decision-making purposes.

Finally, as a writer, it is important to start writing and gathering materials as early as possible and then actively work with the writing of the report during the course of the research project. Adopting a way of working in which the writing starts at an early stage and where the different parts of the report are edited several times, increases the chances that the report will be concise and that less relevant material relative the purpose of the report will be omitted.

3. Formal aspects of reports

This chapter outlines various formal requirements that need to be respected when presenting research reports. Included are recommendations writers may wish to pay

attention to in formulating their own reports. Please note that there are also additional and general guidelines for the formatting and layout of reports at Chalmers at: http://www.chalmers.se/sections/ar_student/framtagning-av-rapporter [unfortunately it seems not to have been translated yet]

3.1. Title page

To be able to identify a report, the reader requires certain facts, such as the title of the report, author, the department involved, course and date. The title of the report is of paramount importance and should, therefore, have a larger font than other facts presented.

3.2 Page format

There are, of course, many different ways in which to formulate a report but one way that provides readers with an easily understood design is shown in figure 1. The margins of headers and footers may sometimes vary when headers and footers have been inserted into a document.

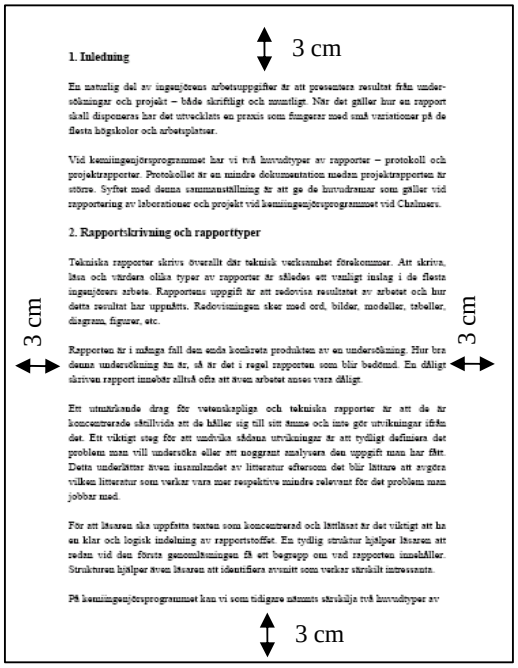


Figure 1. The margins of a report.

3.3 Fonts

Writers should adopt a uniform font for the running text throughout one and the same document. The document you are reading uses *Times New Roman*, a font used in a great many publications and that is recommended also for project reports at Chalmers (although other standard fonts, e.g. *Calibri*, are also possible). The recommended size of

the font is 10, 11, 12 or 13 points. For the running text of the final version of a report, we recommend using 12 points and single-spacing the text. Please note that this text is written with 1,5 spacing.

3.4 Numbering sections and headings

Chapters and sections of technical reports are divided into a number of different levels. There are many different variations of this way of dividing the text. Below you will find a system for organising texts that is frequent and functional:

1. Heading level 1	(Bold text, 13 points)
1.1. Heading level 2	(Bold text, 12 points)
1.1.1. Heading level 3	(Bold text, 11 points)
1.1.1.1. Heading level 4	(Normal text, 12 points)

Heading level 1 should be preceded by two line spaces (i.e. double-spacing) and be followed by a single line space (i.e. single-spacing the document). Remaining heading levels must always be preceded by a line space. The various heading levels correspond to the structural division considered optimally suited to the material and the reader. So normally, you should avoid heading levels that are not followed by any text, as well as heading levels with nothing but a single heading underneath since both of these cases are indicative of insufficient structural clarity.

To create a table of contents and headings, subheadings, etc., it is preferable to let the Word processing software handle this automatically. In this way, headings are easily (automatically) generated as the text is produced.

3.5 Tables, figures and equations

Figures, tables and accompanying headings are significant since the most important report findings are presented in the form of tables and figures. This also means that tables/figures play an important role as readers tend to scan a report to gain an initial understanding of its calibre—an activity commonly done by readers as they quickly review the results presented in tables/figures, in addition to the title, introduction and abstract of the report. Thus, presenting visual images of the findings are of major importance for the initial evaluation of a report which might very well be the only such review by a typical reader.

Both tables and figures should be furnished with a heading that introduces the contents of the table/figure. This heading should be specific in order to facilitate reader comprehension of the table/figure. In instances when the visualisation is borrowed from a particular source, this source should naturally be indicated by a footnote. Also note that you might design a figure or table where you use data from many different sources. These sources must then be referenced in the figure or table caption.

The table should be presented in such a way as to provide the reader with an easily understood representation of facts in both rows and columns. The table should be numbered. The text of the heading should be placed *above* the table, according to the example below.

Table 3. Parameter Values for Activity Models Studied, as well as Activity Factors with Diluted Solution to Infinity. Methanol-Water System.

Model	Parameters	$\gamma^{\infty}_{\text{Methanol}}$	$\gamma^{\infty}_{\text{Water}}$
Margules	$A_{\text{Methanol,Water}} = 0.6916$ $B_{\text{Water,Methanol}} = 0.5626$	1.9975	1.7552
van Laar	$A'_{\text{Methanol,Water}} = 0.6908$ $B'_{\text{Water, Methanol}} = 0.5790$	1.9953	1.7843
Wilson	$\Lambda_{\text{Methanol,Water}} = 0.5865$ $\Lambda_{\text{Water,Methanol}} = 0.8400$	2.0009	1.8001

By figure is meant a diagram, a photo, a drawing, etc. The figure must be numbered and furnished with a text *below* the figure (see figure 2).

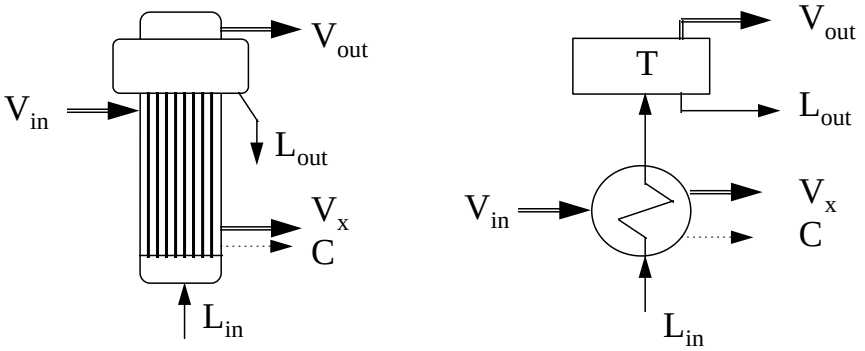


Figure 2. Basic sketch of an evaporation step

Below, you will find two diagrams; one of them is drawn in an exemplary fashion (figure 3); the other is poorly drawn (figure 4). These diagrams illustrate a number of things to consider in creating such a diagram.

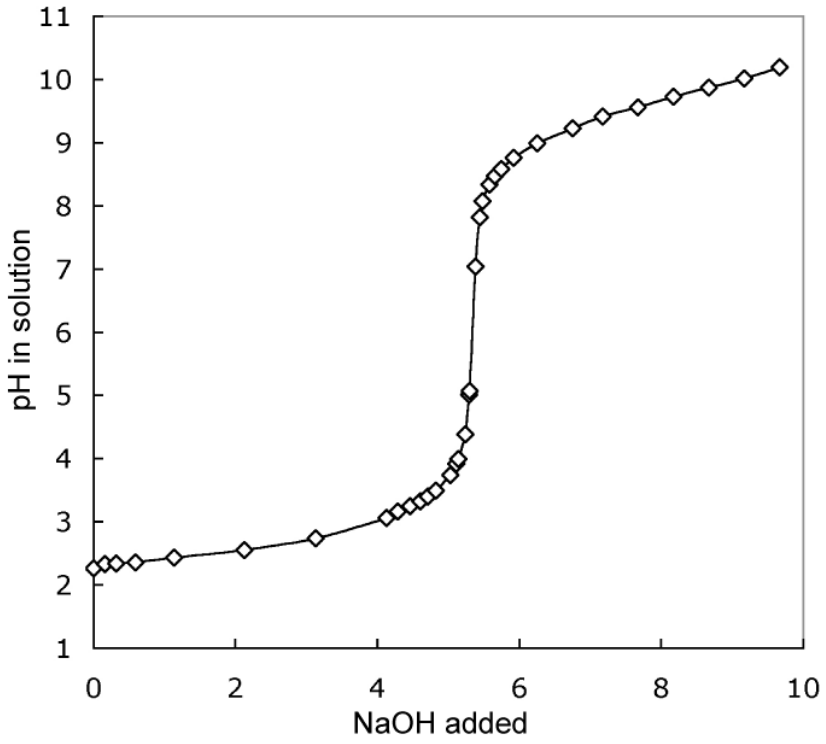


Figure 3. An example of a well-designed diagram.

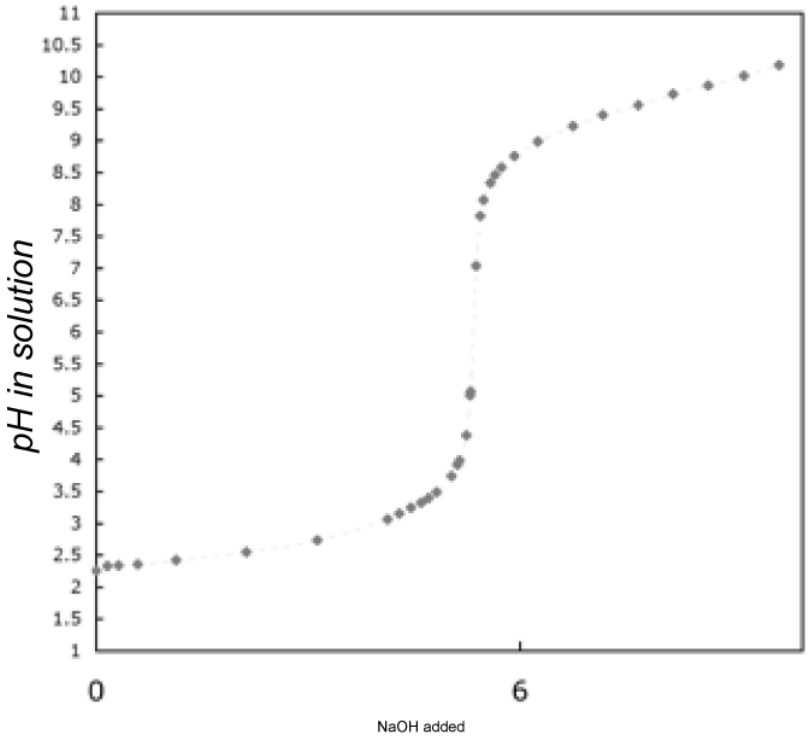


Figure 4. An example of a poorly designed diagram.

Figure 3 works well for the following reasons:

- The line width is fine. Do not use lines sized below 1 point. Also, do not use lines that are too thick.
- The symbols used are clear.
- The fonts are consistent with the size of the headings of the axes.

In contrast to figure 3, figure 4 has the following features: the line width is too narrow, symbols are fuzzy and the fonts and size of the axis headings are inconsistent. In diagrams, you should also try to avoid using grey shades since these are often difficult to discern in printed form on paper. Finally, it is worth noting that the scales of the axes are quite dissimilar concerning the level of detail in figure 4. If you are uncertain which scales to use for a certain figure in a text, please consult your supervisor.

Consequently, clearly drawn figures and explanatory text of headings are necessary in order for the report to be clear and easily readable, but this is not sufficient. It is also

necessary that readers are guided to the precise findings that are of particular importance in a table/figure. Thus, the main text should include clarifying comments to the illustrations to enable the reader to really comprehend the information emphasized by the author. Figures must be clearly relevant to the texts where they are used. In order to obtain such relevance and clarity, at least the following four things are needed:

- A summarizing phrase that refers readers to the illustration. “The basic sketch of an evaporation step used in figure 2 shows that ...”, or: “Figure 2 containing a basic sketch of an evaporation step shows ...”
- Two or three specific details/values/areas in the illustration that should be noted by readers
- An explanation of key findings. ‘Key findings’ are principally those emphasized in comments to the illustrations. The explanation may also mean that findings are related to other literature references or to other experiments
- An explanation of potentially deviating results.

The following figure with accompanying text from research conducted by Thun, Utsi & Elfgren (2003:11; our translation) shows how a comparatively lucid comment to a figure may be presented:

> In Figure 3.1, the results are presented from a static trial using sleeper s30a. The maximum load is 113 kN at a deflection of about 2 mm. This load corresponds to a moment of 22.4 kNm which shows that this sleeper is of the same good/poor quality as remaining red sleepers previously tested (19.2-32.7 kNm, see Thun et al 2001). The remaining static trials conducted show similar curves.

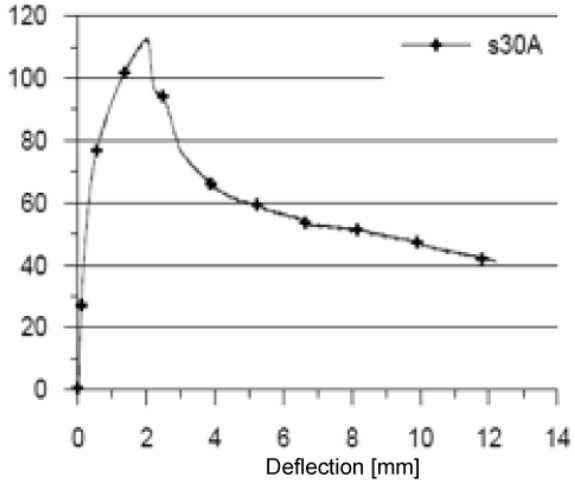


Figure 3.1 Results of a deflection test in sleeper position.

The example above illustrates key parts of a comment since it contains a reference to the figure, a selection of and a focus on a core finding, as well as a connection between this finding and the results of a previous study. The comment is usually placed, as seen in this example, above the actual figure presented. However, there may be reasons, possibly due to space limitations, for dividing up the comment into different parts so that certain parts precede the figure and others follow it.[2]

Besides what we may learn from the example cited from Thun, Utsi & Elfgren (2003:11), many readers expect to gain additional knowledge of where these research findings are leading and the consequence or significance of these findings. The discussion of the conclusions to be drawn may preferably take place in the "Discussion" section of the report. What needs to be clarified in the comments to the illustrations are the research findings and the consequences that influence the next step of a project or experiment and consequently require explanation for the reader to understand the next step or the next illustration.

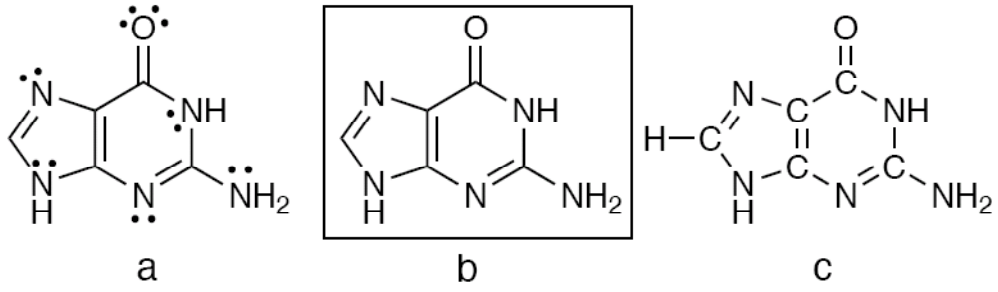
Regarding comments that accompany illustrations, the most important thing is *to comment* and highlight what is of special interest to the reader of the report. At the same time, it is wise to avoid merely repeating the information shown in the tables when writing the body text of the report since this might make readers irritable due to a perception that they are being underestimated. In other words, the initial task of an author is to analyse the information presented in an illustration and then decide what features are to be emphasised so that the reader may comprehend what pieces of information are particularly relevant to the specific report he or she is reading.

All fields of engineering have specific needs to visualize data or research findings and the space allocated these guidelines do not permit the inclusion of examples from all such disciplines. However, the type of visual imagery that may cause a problem in reports of this kind is the need to discuss or provide examples of programme code. The recommendation is to minimize the amount of such code in the main section of the report and instead refer this type of data to the attachments. In the event that such code still needs to be shown due to a requirement to highlight and discuss a certain amount of code, another font should be used (e.g. Courier, Unicode or another font that has an

[2] It may be worth noting that the figure is not complete since the y axis has neither a heading nor a unit of measurement.

even distance between the characters). Moreover, a normal indentation of the left margin should be used for these types of illustrations.

Yet another type of figure worth noting is the chemical structure. Below, you will find a guanine molecule drawn in a few different ways. Programmes like ChemDraw or ISISdraw are commonly used for these types of illustrations.



Examples a to c show the following: a) the molecule with all the free pairs of electrons indicated, which is appropriate to use if you are uncertain of the locations of these electrons, (b) the way in which molecules are customarily drawn unless otherwise instructed (note that only hydrogens bound to nitrogen are customarily drawn) and finally, (c) a method of drawing molecules that is only appropriate to use when communicating with non-chemists.

Finally, equations are numbered sequentially in the text and are noted in the document as follows:

$$\ln P_i^o = A_i + \frac{B_i}{T} + C_i \ln T \qquad (1)$$

3.6 References and sources

Using and referring to other sources is a normal and important part of all scientific writing. The sources used are to be referenced in a list of sources and there are at least three reasons why such a list of sources should be included in a research report. First, such a list informs the reader about the materials upon which the report is based; the risk to be accused of plagiarism in thereby reduced. Plagiarism of reports written at

Chalmers is, of course, unacceptable. Second, such listing places your study into a larger context, thereby enhancing the credibility of your work. Finally, it gives readers interested in the subject the opportunity to find other relevant literature on the subject to deepen their understanding of the field. In this context, it is important to document your sources for your own benefit in that such documentation makes it easier for you to return to a source to double-check a fact or to make sure that the contents of the source have been correctly interpreted.

A list of references and sources should be put together according to one of the well-established reference systems, for example Harvard, Oxford, IEEE, APA, MLA or Vancouver. The most commonly used system differs from discipline to discipline and when writing a report, it is advisable to ask your supervisor what system is preferable to use.

A fundamental aspect of all academic and scientific writing is that a list of references and sources becomes irrelevant if readers do not simultaneously know for what information contained in the report a particular reference has been used. For this reason, in the running text as well as the text accompanying figures or table titles, you should also refer to the source when using it. In using the Vancouver system, the introductory sentence of the book *Analysis Methods. Instruments and Techniques* by Flemming Simonsen should be cited and referenced in the following way:

”The key to success for an analysis laboratory is the quality of the finished results delivered to the client.” [1, translated].

In the list of literature references, readers will find the full source listing by turning to the first item listed, which looks as follows:

1 Simonsen. F. Analysteknik. Instrument och metoder. Lund: Studentlitteratur; 2005

Should you wish to refer to the same source again, the number initially designated the source should be used. For example, if we would like to refer to Simonsen again, we would do so by designating the number it was first given, [1]. In the example above, it is worth noting that no italics are used and that the year of the source is listed at the end of the reference.

To illustrate the difference between various reference systems, let us also look at how the same citation and source as above would look according to the Harvard system:

”The key to success for an analysis laboratory is the quality of the finished results delivered to the client.” (Simonsen 2005, p. 7, translated).

In the list of sources, this item would look as follows:

Simonsen, F. 2005. *Analysteknik. Instrument och metoder.* Lund: Studentlitteratur

The major difference between the Harvard and the Vancouver systems is that the Harvard system uses the name of the author to indicate the source and that the list of literature references is, therefore, structured alphabetically instead of numerically.

In chapter 3.6.1 and 3.6.2, general instructions are given for the treatment of references and source materials for print as well as electronic sources. For a more thorough description of the various reference systems, be sure to consult the various electronic resources available. Below you will find a few links to a number of reference systems and some useful resources listed:

On the Chalmers Library website - http://www.lib.chalmers.se/utbildning/webbkurs.xml there is an exhaustive guide to the Harvard system of reference.
The University of Linköping also has a good link to information searches and the treatment of references that also features other useful links: http://www.bibl.liu.se/utbildning/TGV/Tgv.htm
For some general library links to finding commonly used reference systems, please consult:
APA, MLA, Chicago - http://memorial.library.wisc.edu/citing.htm
The University of Sheffield- http://www.shef.ac.uk/library/libdocs/hsl-dvc1.pdf
Vancouver: - http://www.soton.ac.uk/library/infoskills/references/vancouver.html
Oxford - http://www.lib.unimelb.edu.au/cite/sl/index.html
IEEE - http://www.lib.unimelb.edu.au/cite/ieee/index.html

A comprehensive site for references is ReferenCite at The University of Aukland, New Zealand - http://www.cite.auckland.ac.nz/index.php

It should, however, be emphasized that the links above are library links and not the actual publications cited by the various reference systems.

3.6.1. General advice for treating references and sources

To simplify matters, all references are to be written according to one and the same basic pattern, which is further described in more detail depending on the nature of the work assignment. It facilitates matters to think of a reference as if it were put together according to a range of positions (N.B. according to the Vancouver system). The number of such positions varies depending on the type of source consulted. In the following example, a few such positions for a book project are illustrated:

1	2	3	4	5
Author	**Title**	**Place of publication**	**Publishing company**	**Year published**
Simonsen, Flemming	Analysis Methods. Instruments and Techniques.	Lund	Studentlitteratur	2005

Other items worth noting:

- All references are to be listed in sequence in the source listing; in other words, there is no dividing up into books, articles, etc.
- The listing is organized numerically (Vancouver) or alphabetically (Harvard).
- The listing is written using a single line space. In technical reports, items are differentiated by means of an additional line space.
- The reference information about a book is to be found on the front and back pages of the title page, not on the front or back cover pages.

3.6.2 Referencing electronic sources

In contemporary reports, electronic sources are increasingly consulted, both from electronic encyclopedias, journal, databases, and other Internet websites. The principles for the treatment of electronic references are the same as for printed reference materials and there is basically no difference between print and electronic sources. However, the process of referencing electronic sources differs in a couple of ways, which you will find illustrated below. Furthermore, the process of citing electronic sources is not yet as standardized as for print sources, with the consequence that you will witness quite a lot of different ways in which electronic sources are referenced. This is partly because electronic sources are of a different nature and for this reason, it might sometimes be difficult to know how to go about this task. But the most important thing to keep in mind is to be consistent in the way in which you list your electronic sources and to try to list a source as carefully as possible.

In the same way as for print sources, a listing of source materials from an electronic source might be composed of the following number of positions:

1	2	3	4	5
Author	**Title**	**Year of publication**	**Date of retrieving information**	**URL of source**
Hultqvist, Lennart	The Space Voyage Continues.	2001	August 27, 2006	Accessible at: http://www.ne.se

If no author is indicated on the site, as is often the case, you might use the title or the name of the organization as you introduce your source listing. However, avoid being too vague in citing your reference, such as only citing *Wikipedia* and www.wikipedia.com as a source since this would make it much more difficult for the reader to locate the source. In the case when the name of the author is missing but when a title and an organization or agency publishing the text is provided, the source might be noted as follows [on the assumption that the data is retrieved from the Swedish original of the report]:

Swedish Environmental Protection Agency. Nationell miljöövervakning 2006 – miljögiftssamordning. 2006 [retrieved 2006-08-28]. Accessible at: http://www.naturvardsverket.se/

When you use the Harvard reference system and want to refer to the source above in the running text, the address should be omitted and you should instead write Swedish Environmental Protection Agency (2007) or (Swedish Environmental Protection Agency 2007).

Many scholarly journals are today issued electronically and you will want to download articles by means of the library database. It is, however, important to reference a certain scholarly journal article by means of the bibliographical information provided by the article—not the information provided by your search engine. In other words, your search using databases was only a way of locating the article while the reference to the article is given to the scientific journal where it was published, not to the database or its equivalent.

Finally, you will find an example of *a listing of source materials from both print* (e.g. books, articles and patents) *and electronic sources*, according to the Vancouver

reference system. Please note that the listing is numerically, as opposed to alphabetically, organized.

1 Balban A.T, Mocanu M, Simon Z. Charge-Transfer Spectra of Pyrylium Iodides. Tetrahedron. 1964; 20 (1): 119-130

2 Wildman, Steven. Conditional Expectations Communication and the Impact of Biotechnology. I: Braman, Sandra, ed. Biotechnology and Communication. New Jersey; Lawrence Erlbaum Associates; 2004. p. 63-95

3 Abetz, V. ed. Block Copolymers II. Advances in Polymer Science 190, 2005

4 Cotton F.A, Wilkinson G, Gaus P. Basic Inorganic Chemistry. 2nd edition. John New York: Wiley & Sons; 1987

5 Encyclopedia Britannica Online. Computers. 2003 [retrieved: 2004-05-15]. Accessible at: http://www.britannica.com

6 Alimak AB. Förreglingsmaskin för hiss (”Interlocking Device for Lifts”). SE506998. 1998-03-16 [This is an example of referencing a patent. The list varies according to the type of reference system used. The necessary information includes: patent holder, patent title, patent code, date/year.]

References

Anderson, Paul V. 2007. *Technical Communication - A reader-centered approach*. International student edition. Sixth Edition. Boston: Thomson-Wadsworth

Biber, Douglas, Conrad, Susan & Reppen, Randi. 1998. *Corpus linguistics. Investigating Language Structure and Use*. Cambridge: Cambridge University Press.

Clark, Irene L. 2007. *Writing the successful thesis and dissertation – Entering the conversation.* Upper Saddle River: PrenticeHall

Fackspråklig kommunikation i tal och skrift – en handledning för Chalmersstuderande. 2007. Gothenburg: Chalmers University of Technology.

Hanania, E A.S. & Akhtar, K. 1985. 'Verb Form and Rhetorical Function: A Study of MS Theses in Biology, Chemistry and Physics'. *English for Specific Purposes* 16:4: 321-337.

Heslot, J. 1982. 'Tense and Other Indexical Markers in the Typology of Scientific Texts in English'. In Høedt, Jørgen (ed.). *Pragmatics and LSP*: *Proceedings of the 3rd European Symposium on LSP, Copenhagen, August 17-19, 1981*. Copenhagen: Copenhagen School for Economics, 83-104.

Markel, Mike. 2006. *Technical Communication*. Boston & New York: Bedford/St.Martin's.

Robson, Colin. 2007. *How to do a research project – A guide for undergraduate students*. Oxford: Blackwell.

Swales, John & Feak Christine. 2004. *Academic Writing for Graduate Students*, University of Michigan Press.

Thun, Håkan, Utsi, Sofia och Elfgren, Lennart. *Spruckna betongsliprars bärförmåga vid utmattande last ("The Carrying Capacity of Cracked Concrete Sleepers Loaded at the Fatigue Limit").* Luleå: Luleå University of Technology. (Technical report /Luleå University of Technology, 2003:04).

Törn, Jenny. 2005. Golvvärmes inverkan på kemiska emissioner : en studie av betonggolv med limmad PVC-matta ("The Impact of Floor Heating on Chemical Emissions: A Study of Concrete Floors Using Glued PVD Carpeting"). Thesis project, The Department of Civil and Environmental Engineering, 2005:8. Gothenburg: Chalmers University of Technology.

Taylor, Vi Linh. 2001. *Tense Usage in Academic Writing: A Cross-Disciplinary Study*. Unpublished MA thesis. Victoria: University of Victoria.