

# **A Guide for writing Technical and Scientific Papers**

## **-The disposition of the paper-**

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**KEEP THESE INSTRUCTIONS ALWAYS NEAR YOU IN THE OFFICE!**

# A Guide for Technical and Scientific Papers

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## Abstract

This paper was first presented at the Scientific Round Table Discussion held at Fragblast 8 in Chile 2006 and has after that been revised by the Fragblast International Organizing Committee to be used for submission of papers to Fragblast Symposia starting with Fragblast 10 in India. Writing a technical or scientific paper is an art and requires attention. In many cases established rules are not followed and this makes it difficult to read and to utilise the content in a reasonable time. A clear structure of how to write a paper will facilitate the whole planning of a project and the review of the paper and therefore these instructions should be read both in advance of a project and also before the writing of a paper. The quality of papers accepted are also dependent on the reviewer's knowledge of how to check abstracts and papers and therefore two Excel sheets has been added to these instructions to be used both by the reviewers and also the authors to see if the abstract or the whole paper fulfils the rules for publication. To the presented rules here should be added the rules that each specific publisher gives for font, headings, figures, tables etc. Dependent on the character of paper different hints will be more important than others.

## INTRODUCTION

Why is scientific writing and reviewing of papers important?

As reviewers of papers to Journals, Conferences, Symposia, Tech Licentiate and Doctoral Thesis we have found the following answers.

1. It makes the communication between researchers more effective.
2. The rejection rate of papers from journals and conferences will be reduced.
3. The capacity of a reviewer of papers will increase considerably and the reviewer will be more satisfied not having to reject so many papers.
4. The reviewed person will also be more confident, when the rules in this guide are used, that he or she is reviewed in a standardized manner. The evaluation criteria used by the reviewer should therefore also be open to the reviewed person. Appendices 1 and 2.
5. More papers of high quality will be published and the development of science will increase.
6. Using the structure given here, when you are writing a technical- or research reports, in your company, you can easily transform the report to a scientific paper by cutting and adding text. However, often companies have developed its own layout of reports different from the layout for writing scientific papers.
7. Using the instructions for scientific writing given here, as a checklist in the planning phase of a project in your company, this will insure that no information will be missing when you start to write your paper.

When discussing instructions for writing a paper, we must keep in mind that we are talking about three levels.

1. The *legal aspects* of publishing a paper. These kinds of instructions are given by each journal. Normally given in a single page. 1 page.

2. The *formal instructions* like text type, text height, use of capitals and italics etc. This information is also normally accessible on Internet for each journal. For the publisher Taylor & Francis it is given on its homepage, [www.tanf.co.uk](http://www.tanf.co.uk). 7,5 pages.
3. The *planning of the paper* and the principal content under each headline. This part is covered by this paper because it is normally not covered by the publisher. 8 pages.

Totally it will be 10 pages to read but for most researchers it probably would not be necessary to read all pages. Start to read that part where you believe you are not knowledgeable enough and if you find that there is lot of good information, please continue to read as long as you learn something new.

## PLANNING OF AN TECHNICAL OR SCIENTIFIC PAPER

### General rules

The work should be presented in such a manner that the readers understand the content in a short time. *You are obliged to make it as comfortable to the reader as possible.* If not, the reader will get tired, bored and stops reading. Some authors think they shall make a variation of the text by using as many synonymous words as possible. This is really a catastrophe because this makes the reader uncertain.

Don't use local terms or terms only used in your country. Every new term that is not known to the reader will make reading more difficult and reduces the speed of reading.

Start the writing as early as possible e.g. already when you are working with the literature review. It is a tedious work to write a paper, especially for an inexperienced person.

### Writing style

1. Use simple straight and clear language.
2. Brief, short and clear sentences are effective. Still vary the length of sentences.
3. Avoid complicated constructions.
4. The use of "we" or "one" may be convenient if accepted by the journal.
5. Unnecessary repetition of words or phrases is detrimental because of its hypnotic influence (the reader starts to sleep).
6. Never vary wording by using different terms for the same entity ("transient recorder", "digital oscilloscope").

### Sources used for this publication

The following hints of scientific writing were taken mainly from Prof Lundberg 1988 and his handwritten notes and these notes were completed by the following members of the International Organizing Committee of Fragblast (International Symposia on Rock Fragmentation by Blasting): William Fourny USA, Hans Peter Rossmannith, Austria, Sushil Bhandari, India, Claude Cunningham, South Africa, Finn Ouchterlony, Sweden and Alex Spathis, Australia.

Lundberg was earlier, the head of The Div. of Mech. at Luleå Univ. of Tech. He produced many publications in International recognized journals e. g. the International well-known "*Int. Journal of Rock Mechanics and Mining Sciences*".

Another important source was "*Writing a scientific research article*" produced by Columbia University, New York, USA, Internet 2009.

For the time being the following instruction is claimed to be the best known condensed information of how to plan the content of a technical or scientific paper. Much more details could be mentioned, but it is better to leave it, because it will be too difficult for the beginner to remember so much information.

### TITLE

1. Should be clear and descriptive and describe the contents of the paper.
2. The title should be appropriate for the intended audience. Anon 2009.
3. Should serve as a "mini-abstract".
4. Should be brief, 4 to 12 words or preferably not more than 40 characters. Maximum length, one row.
5. Do not use formulas, symbols or acronyms in the title.

6. *Major search terms should be included in the title; essential for your paper to be found.*
7. Avoid insignificant words.
8. Do not overuse words like “New” if you are not sure it is really new. Check with experienced persons if it is new.
9. If applicable, use title and subtitle.

### **AUTHOR or AUTHORS NAMES**

1. The person who did the work and *wrote the paper is generally listed as the first author* of a research paper. Anon 2009.
2. For published articles, other people who made substantial contributions to the work are also listed as authors. Ask the person of permission before you include his/her name as co-author and carefully check the spelling of the name.
3. If there are co-authors a maximum of two co-authors are recommended.
4. Always publish under precisely the same names including given names. Variation in the use of initials should be avoided. Some Journals wants initials for the given names. Anon. 2009. The use of initials instead of one full given name should be avoided.
5. The author or author’s affiliations and countries should also be included and also the email address. This is normally not the rule by most publishers, but you must convince them that we are living in the ages of Internet.
6. Do not include academic or professional titles.

**Keywords:** Scientific writing, scientific paper, scientific article, research article, technical paper, technical article, technical writing and authors guide.

### **ABSTRACT**

1. An abstract, or summary, is published together with a research article, giving the reader a “preview” of what’s to come. Such abstracts may also be published separately in bibliographical sources like Abstract Journals in various languages, and perhaps in companies internal circular’s as well. They allow other scientists to quickly scan the large amount of scientific literature, and it decides which articles you want to read in depth. Anon 2009. **The abstract is therefore the most important part of a paper.** The abstract should be a condensation and concentration of the essential information in the paper.
2. The abstract should be one paragraph, or 200-500 words, which summarizes the *statement of the **problem***, and the ***purpose, methods, results and conclusions** of the paper*. Anon 2009. Use Word/Tools/Word count for the calculationa of number of words. 500 words is about ½ a A-4 page at single row spacing. The abstract must be complete, accurate, objective and clear.
3. It should also include a *hypothesis* and *research strategy* if it is not too complicated to formulate respectively.
4. *The number of tests* should be *quantified* because then the reader is informed if it is a large or a small investigation.
5. Meaningless words like “better fragmentation” which is very subjective must be avoided. A quantification is necessary e.g. to mention the reduction of the mean fragment size.
6. Mention agreement or non-agreement with other researchers result.

7. Express how your paper *contributes to science*. Landes 1966. This will be difficult for young persons who have not studied literature well. Ask an experienced person about help.
8. Avoid text not necessary for the understanding of technical text in the paper.
9. Do not use formulas or special symbols, acronyms, abbreviations, foot notes and references in the abstract.
10. Do not use new terms which is not well known by the readers in the abstract. If you have developed a new important term, please define it in the abstract.
11. It is not easy to include all this information in just a few words. Start by writing a summary that includes whatever you think is important, and then gradually prune it down to size by removing unnecessary words, while still retaining the necessary concepts. Anon. 2009.

## INTRODUCTION

The purpose of the introduction is to tell readers why they should want to read what follows the introduction. This section should provide sufficient background information to allow the reader to understand the context and significance of the problem. SEG 2010.

Here you should,

1. Introduce the reader to the *problem* by giving the background and what *research strategy* has been used to solve the problem. **The research strategy is very seldom mentioned in a paper but it is very important for the planning and understandability of a project.**
2. If a hypothesis could be established (it is not always the case) it should be done and the hypothesis should be tested in the paper.
3. What *question* or *questions* do you want to answer? Why is it interesting to undertake the study? Anon 2009.
4. Mention the **goal** (synonyms: aim, objective or scope) of the work.
5. The introduction should make the reader interested and provide a smooth transition to the rest of the paper.
6. Normally a literature review is included in the introduction, but the Fragblast International Organizing Committee suggests *including a separate chapter for the literature review* in order to avoid a mixture of information.
7. A very brief announcement of research method- or methods, results and conclusions should also be included in the introduction to make the reader interested in reading the whole paper.
8. It is also unfortunate if the goal of the paper appears first at the end of the introduction, which has happened.

The length of the introduction should not be more than 1 page, normally only half page.

## LITERATURE STUDY AND OR STATE OF THE ART

1. A complete literature review should be done. Explain shortly how you have searched the literature. What databases have been used and how many years back do they cover. Mention and comment on important things for your work found in the literature review. If possible it should be a *critical review* but for authors with limited experience it will be very difficult to be critical. Normally there is very little criticism

in existing literature reviews and this is a disadvantage. An experienced eye can see if the criticism is correct or not, so it is very difficult to make good criticism.

2. Try to find the most important works even if they have been done a long time ago. Don't think you should only use new references to have your paper look modern. *The oldest possible reference to a new finding should be given.* By this you mark that you have carefully checked the literature.
3. *When you make a citation to others work, avoid more than one reference in one citation.* Pick the most important and relevant instead.

### **TEST LAYOUT, TEST AREA and TEST PROCEDURE (Material and methods)**

1. The test layout and area should be described by a 3-dimensional Figure.
2. The *test procedure* should be described in such detail that other scientists or engineers could repeat the test and *verify your results*. This is very seldom the case in published papers. The main procedure should be explained, but often it is not enough space to go into all details.
3. *Do not put results in this section.* You may however include preliminary results that were used to design the main experiment that you are reporting on. Anon 2009.
4. Present your material in logical order even if this is not the order of your work.
5. Separate distinctly your own new ideas and findings from anything already known.
6. *Define mathematical and numerical models* so that other scientists will be able to repeat your work and check your results. More detailed items (e.g., heavy mathematics) often are best placed in Appendices. For complex mathematical articles, authors are strongly encouraged to include a Table of symbols.
7. Never change or exclude "strange" data (Cardinal sins). Scientific papers must be objective.
8. The *number of test* needed to get accurate results (within  $\pm 10\%$ ) should at least be estimated. In practise, often all the needed tests can not be made due to limitations of funding.
9. The *accuracy of each individual test instrument* and technical data like frequency response for velocity or acceleration transducers must be stated. Accuracy for the whole measurement system should be given. It may be very difficult to find all this data but the goal should be to find it.

### **TEST RESULTS**

The results section contains applications of the methodology described above. The results of experiments (either physical or computational) are data and can be presented as tables or figures. SEG 2010.

1. All *measured data* should if possible be presented *separate from calculated data*. The result may be presented in form of Figures, Tables, Diagrams, and Alignment Charts etc. together with "Explaining text" given at the top of the Tables and at the bottom for Figures, Diagrams and Alignment Charts.
2. *Draw illustrative figures* to demonstrate the measurement layout. A good method is to start making Figures, Tables, Diagrams, and Alignment Charts before you start the text. This will be the skeleton of your paper.
3. Illustrations should not contain so much information so it will be difficult for the reader to understand them. Too many curves in one diagram should be avoided and diagrams should always include *origin of coordinates*.

4. The results should be commented on and it should be explained if it is fulfilling the hypothesis or not. Summarize your findings in the text. Do not discuss the results or speculate as to why something happened; that goes into the Discussion and Conclusions Chapter.
5. At the end of the result chapter, the result may be shortly summarized.
6. You are not obliged to include all the data but often it is very good to give data in numerical tables if there is not too much data. Anon 2009.
7. Details appearing in figure captions and table heads should not be restated in the text.

**If physical testing has not been done and instead new theory is developed.**

1. Explain before start of developing the new theory why the development is needed.
2. The derivation of new theory must be done in such detail so it can be reviewed regarding correctness.

## DISCUSSION

The discussion section should be separate from the conclusion section. Some papers may not require a discussion section. SEG 2010.

1. This part may in special cases be integrated with the presentation of the test result especially if there are several test results that have to be discussed to avoid too much repetition. The discussion is in a separate chapter but it should not be too long, maximum 1 page.
2. Highlight the most significant results. Anon 2009.
3. How do these results relate to the original problem or question?
4. Do the data support your hypothesis? Anon 2009.
5. Are your results consistent with what other investigators have reported? Anon 2009. What is not in agreement with other researchers?
6. If your results were unexpected try to explain why! Anon 2009.
7. Is there another way to interpret the result? Anon 2009.
8. What further research is necessary to answer the questions raised by your results? Anon 2009.
9. Do not overemphasize the importance of your own work or belittle the work by others.
10. How do your results fit into the big picture? Anon 2009.
11. What new knowledge has been found? Anon 2009.
12. Do not use words like “very good agreement”. Quantify the agreement in numerical terms instead.

## CONCLUSIONS

The conclusion section should according to SEG 2010 include;

1. Principles, relationships, and generalizations inferred from the results (but not a repetition of the results).
2. Any exceptions to or problems with those principles, relationships, and generalizations, as indicated by the results.
3. Agreements or disagreements with previously published work.
4. Theoretical implications and possible practical applications of the work

## 5. Conclusions drawn (especially regarding significance).

- Conclusions should only *concern your own new findings* presented in the paper. Often, however, this is not followed.
- Be careful, and *don't generalize too much*. A smart way is to say that conclusions are made only for the test conditions presented in the paper.
- If you have e.g. developed a more accurate fragmentation formula you can't be sure it is really better from a few tests. It is needed to do a large amount of tests in different rock types with different strength conditions and different explosives. It may take many years before a standardization group may recommend a new formula. If the formula have a physical correct basis it should be possible to use the formula both in model-, half- and full scale.
- End with a one-sentence summary of your conclusion, emphasizing why it is relevant. Anon 2009.

The conclusion should not include figures, tables, equations, or reference citations. SEG 2010.

## ACKNOWLEDGEMENTS

Here you should acknowledge,

1. Persons who helped you in the experimental work or was commenting on the manuscript. Anon 2009.
2. Individuals who supported your work significantly in a non-routine manner. The typing of the work by a secretary should not be acknowledged.
3. Organizations that supported your work with money and facilities (generally not your own organization).
4. Do not include anyone who may not want to be associated with your paper. Anon 2009.
5. Be brief, specific, direct and sincere.
6. Avoid extremes of effusive praise. Avoid clichés like “fruitful discussions” etc.

## REFERENCES (LITERATURE CITED)

1. In the text, cite the literature in appropriate places normally by “Surname and publication year within parenthesis”. Anon 2009.
2. The references in the reference list at the end of the paper should normally be cited in alphabetical order. If a new reference is found or a reference is taken away it is an easy operation if the references are not numbered. In that case it is much more complicated. Some conservative Journals still ask for numbered references. Here it is a need for international standard.
3. Include references which are relevant and significant, but not others.
4. All references in the list must be cited in the text. This must be carefully checked when you have finished the writing of your paper.
5. Use original sources.
6. Never include a reference you have not seen.

## APPENDICES

1. Lengthy non-trivial derivations can be inserted here.
2. Descriptions of computer programs.
3. Description of apparatus in detail.
4. Description of accuracy of the total measurement system.

For interested in learning more about publishing, Tyler 1994 can be recommended.

## FIGURES AND TABLES

Each figure and table must be mentioned sequentially in the text of the paper. Each figure must have a caption (Figure text), and each table must have a heading. Captions and headings should be explicit enough that the reader can understand the significance of the illustration or table without reference to the text. SEG 2010

Each illustration and table should be given an Arabic number and should be referred to by that number in the text. In the caption and text, spell out the word *Figure* and capitalize it when a number follows it. In table headings and text, spell out the word *Table* and capitalize it when a number follows it. SEG 2010.

## FOOTNOTES

Footnotes should be avoided unless absolutely essential and then should be held to a minimum. All footnotes introduced in the text of a paper should be numbered consecutively from beginning to the end of the manuscript, including the footnotes for the author affiliations. In the manuscript, each footnote must be inserted at the bottom of the page where the reference appears.

## REFERENCES

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