RYERSON UNIVERSITY
Faculty of Engineering, Architecture and Science

Department of Mechanical and Industrial Engineering

Department Guidelines for:

Lab Reports
Project Reports
Engineering Drawings

Prepared by:
Dr. V. Chan, P.Eng.
May 7th, 2007

Revised by:
Prof. R. S. Budny, P.Eng.
Oct. 22nd, 2010

With contributions from
Professors: R. Budny, A. Fung, F. Salustri

1. Guidelines to Writing Lab Reports

Lab reports are based on the centuries old "Scientific Method," where fundamental theories of science, upon which engineers base their designs on, are observed, tested and verified. Your ability to effectively communicate your (or your group's) results determines your effectiveness as a future professional engineer.

The **layout** of the report:

1) Cover Page - with names of group members (see template).
2) Summary – 1 paragraph summary of the lab, on it's own page, last sentence should be the major conclusion.
3) Introduction – Introduce the objectives of the experiment.
4) Apparatus – Equipment used for the experiment.
   - Instrumentation used.
   - Materials used during the experiment.
   - If the lab manual has these descriptions, refer to these pages or detail any differences between the lab manual and actual apparatus used in the lab.
5) Procedure
6) Results – including Figures and Tables
7) Discussion
8) Conclusions
9) References
10) Appendices
   - mathematical analysis
   - spreadsheets
   - original lab notes, observations
   - other essential information

The **format** of the report is as follows:

- Typed - Reports are to be typed, 12pt font, Times New Roman, 1" margins, although the mathematical analysis can be hand written neatly.
- Paper – use plain white 8.5" x 11" paper. Reports handed in on the back of paper bags, paper towels, folds cape, etc., will NOT be marked.
- Page Numbering – all pages except the cover should be numbered. The summary should be numbered with a roman number "ii", regular Arabic numbers (1,2,3…) should follow from the introduction.
- Headings – should be used to delineate the different sections of the lab report. The introduction should be numbered "1. Introduction" with subsequent sections numbered consecutively.
- References – all citations made in the text of the report, figures and tables that are not your lab results (ie. From the textbook) must also be cited. Use square brackets [#] after your citation, and number them consecutively, for example:

  Heinz Ketchup is a non-Newtonian fluid [3].

- Under Ryerson Policy #60, failure to properly cite references may result in a charge of academic misconduct and a disciplinary notice on your university record.

- Equations - within the main body of the report must be typed and numbered, for example:

$$\sigma_{\cdot} = \frac{\pi\ E}{(L/r)^2} \qquad \text{Eq. 2.3}$$

- Use "engineering" exponential format when necessary (ie. powers of 3), for example:

E = 200,000 can be written as $E = 200 \times 10^3$

- Except when dealing with non-dimensional numbers, all numbers in the report must have units. Remember to use the proper number of significant digits. Use the SI prefix when using SI units, for example:

$P_x = 378.6$ MPa

Tables:

Tables should be numbered consecutively, with a caption placed above the table. The table and caption should be centered in the page. The caption should be concise, but fully describe the data in the table. Raw data is usually tabulated in the appendix, with only the data summary appearing in the main body of the lab report. Tables must be referenced in the text before appearing in the report. The word "Table" should be capitalized in the text. Make sure that the columns in the table have their decimal points aligned and that units are used. If the data for the table is from a source, make sure you reference the data. For example:

The rain in Spain falls mainly on the plain. Yearly rainfall totals are summarized in Table 6 below.

Table 6. Yearly rainfall on Spanish plains [3]

Year	East Plain (mm)	West Plain (mm)	North Plain (mm)	South Plain (mm)
1983	23.4	43.5	10.2	32.3
1984	34.2	51.2	12.3	37.2
1986	29.4	64.8	9.0	28.9
1987	32.1	55.1	14.2	31.2[a]

[a]footnotes about the data are placed under the table

Figures:

Subjects that are graphical in nature; diagrams, graphs, charts, flow charts, photos are termed "figure". Figures should be numbered consecutively, with a caption placed below the figure. The figure and caption should be centered in the page. The caption should be concise, but fully describe the figure. Figures must be referenced in the text

before appearing in the report. The word "Figure" should be capitalized in the text. If your are graphically displaying data, the independent variable is plotted on the X-axis, with the dependent variable plotted on the Y-axis. Make sure that the axis are clearly labeled, with what was measured, quantity measured and the units used. If the data for the figure is from a source, make sure you reference the data. For example:

The rain in Spain falls mainly on the plain. Yearly rainfall totals are summarized in Figure 6 below.

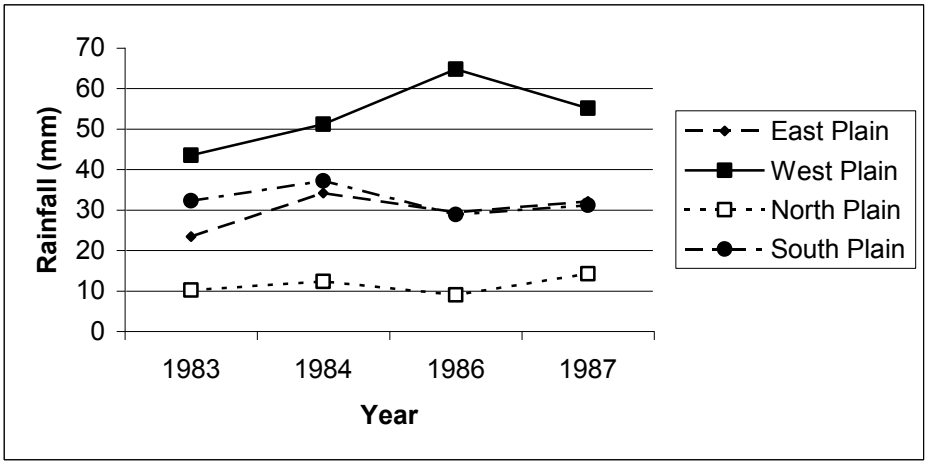


Figure 6. Yearly rainfall on Spanish plains [3]

Sample "References" page

9. References

[1] S Motavalli and Jorge Valenzuela, A system for reverse engineering of prismatic parts using orthographic images, Int. J. Computer Integrated Manufacturing, 1998, Vol. 11, No. 2, pp103-110.

[2] K.H. Lee, H.P. Park, Automated inspection planning of free-form shape parts by laser scanning, Robotics and Computer Integrated Manufacturing, 2000, Vol. 16, pp201-210.

[3] J. Mauricio, S.T. Motta, G.C. de Carvalho, R. S. McMaster, Robot calibration using a 3D vision-based measurement system with a single camera, Robotics and Computer Integrated Manufacturing, 2001, Vol. 17, pp487-497.

Sample Lab Report Cover

RYERSON UNIVERSITY

Faculty of Engineering, Architecture and Science

Department of Mechanical and Industrial Engineering

Program: Mechanical Engineering/Industrial Engineering

Pick only one of: Mechanical or Industrial, (erase the other one)

Course Number	
Course Title	
Semester/Year	Fall 2010
Instructor	

Lab Report No.

Report Title	

Section No.	
Group No.	
Date of Lab	
Due Date	

Name	Student ID	Signature*
	xxxx12345	

(Note: remove the first 4 digits from your student ID)

**By signing above you attest that you have contributed to this submission and confirm that all work you have contributed to this submission is your own work. Any suspicion of copying or plagiarism in this work will result in an investigation of Academic Misconduct and may result in a "0" on the work, an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: http://www.ryerson.ca/senate/policies/pol60.pdf.*

Do not remove this paragraph!

2. Guidelines to Writing Design Project Reports

Design project reports are similar to lab reports. They usually differ in that they are used to communicate to a wider audience. (ie. non-scientific/engineering people) One of the biggest complaints that we get from people working in industry is the inability of young engineers to communicate effectively with non-engineers.

The **layout** of a design report:

1) Cover Page - with names of group members (see template).
2) Executive Summary – 1 paragraph summary of the project, on its own page, last sentence should be the major conclusion.
3) Table of Contents
   - List of Figures
   - List of Tables
   - Nomenclature
4) Introduction – Introduce the objectives of the project.
5) Literature Review – Literature on the design problem.
   - Current solutions to the design problem.
6) Body – Your design solutions
   - In depth analysis of why your design solutions are better
   - Assembly drawings
7) Conclusions & Recommendations
8) References
9) Appendices
   - mathematical analysis
   - detail drawings
   - spread sheets
   - other essential information

The **format** of the report is as follows:

- Typed - Reports are to be typed, 12pt font, Times New Roman, 1" margins, 1.5 line spacing, although the mathematical analysis can be hand written neatly.
- Paper – use plain white 8.5" x 11" paper. Reports handed in on the back of paper bags, paper towels, folds cape, etc., will NOT be marked.
- Page Numbering – all pages except the cover should be numbered. The summary, tables of contents, list of figures, list of tables, nomenclature, should be numbered with a roman number "ii", regular Arabic numbers (1,2,3…) should follow from the introduction.
- Headings – see lab report section
- References – see lab report section
- Equations – see lab report section
- Tables and Figures – see lab report section

Hints for writing reports

- Write in the 3rd person active (ie. don't use "I", "we", "us", etc.).
  - Don't write: "I carried out the analysis."
  - Write: "An analysis was preformed."
- Use technical names and proper nouns.
- Don't include reams of raw data in the body of the document, put them in the appendix.
- Place figure and tables in the text just after where they are discussed. Do not put a table or figure in the text that is not actually referred to by the text.
- Do not overuse acronyms (especially stay away internet/text messaging ones). Include all acronyms and mathematical symbols in a nomenclature (located between the Table of Contents and Introduction sections).
- PROOFREAD YOUR WORK! Ask yourself: does this make sense? Can I make this clearer?
- Have a friend or family member read your work.
- Use your grammar checker.

For more detailed help on writing, see:

The Writing Centre

LIB 272B inside the Library (main floor) in the Ronald D. Besse Learning Commons
Telephone 979-5000, ext. 7192
Website: www.ryerson.ca/writingcentre

Sample Project Report Cover

RYERSON UNIVERSITY

Faculty of Engineering, Architecture and Science

Department of Mechanical and Industrial Engineering

Program: Mechanical Engineering / Industrial Engineering

Pick only one of: Mechanical or Industrial, (erase the other one)

Course Number	
Course Title	
Semester/Year	Fall 2010
Instructor	

Design Project Report

Report Title	

Section No.	
Group No.	
Submission Date	
Due Date	

Name	Student ID	Signature*
	xxxx12345	

(Note: remove the first 4 digits from your student ID)

**By signing above you attest that you have contributed to this submission and confirm that all work you have contributed to this submission is your own work. Any suspicion of copying or plagiarism in this work will result in an investigation of Academic Misconduct and may result in a "0" on the work, an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: http://www.ryerson.ca/senate/policies/pol60.pdf.*

Do not remove this paragraph!

3. Guidelines for Preparing Engineering Drawings

Effective communication is essential for an engineer. Graphical communication through the use of engineering drawings is a large part on how we transmit our design ideas to other engineers and technicians.

A typical Engineering Drawing package includes:

1. Assembly Drawing(s)
2. Parts list
3. Detailed Drawings:
    a. Individual parts (1 drawing for each part)
    b. Flow and process charts
    c. Electrical schematics
    d. Piping diagrams
    e. HVAC drawings

All drawings must be printed on white paper, have a border and title block with the title, drawing scale, author's name, and date, such as on Figure 1 below. Other pertinent information should also be included (ie. company name, general tolerance data, fabrication notes.) On larger sheets of paper, the title block is always on the lower right hand corner. Large engineering drawings should always be folded such that the lower right hand corner is visible when folded. Depending to the type of drawing and company policy, you may need to leave a space in the title block for the engineer to append their signature or to place their Professional Engineer's Seal.

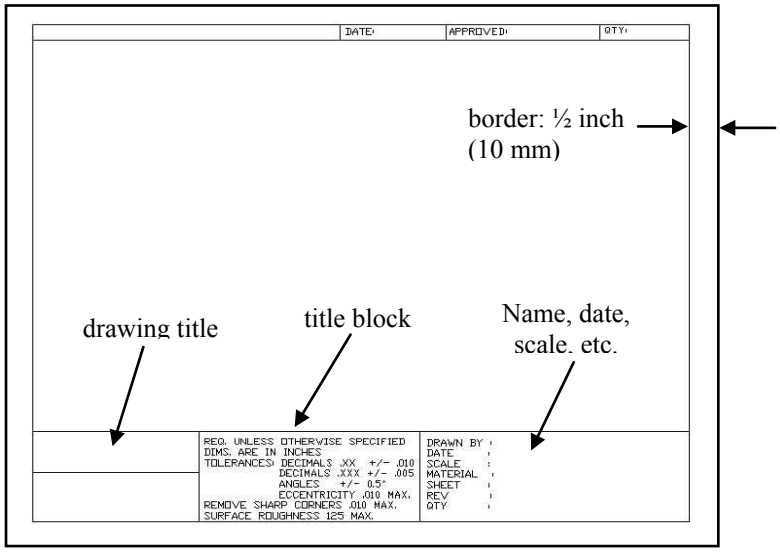


Figure 1 Standard drawing with border and title block – A-sized paper

For Imperial units (inches) use a standard scale of 1:1, 1:2, 1:4, 1:12, 1:16, 1:24, 1:48. For metric units (mm's) use a standard scale of 1:1, 1:1, 1:5, 1:10, 1:20, 1:25, 1:50, 1:100.

3.1 Assembly Drawings

Assembly drawings are required to communicate to the end user or the machinist how the design is put together by showing all the individual parts required, such as in Figure 2. For complex assemblies, often multiple sub-assembly drawings are required. Each part is identified in the assembly with a leader line and the part number in a circle. If the design requires multiple drawings, the drawing number is identified in the bottom half of the circle, such as in Figure 3.

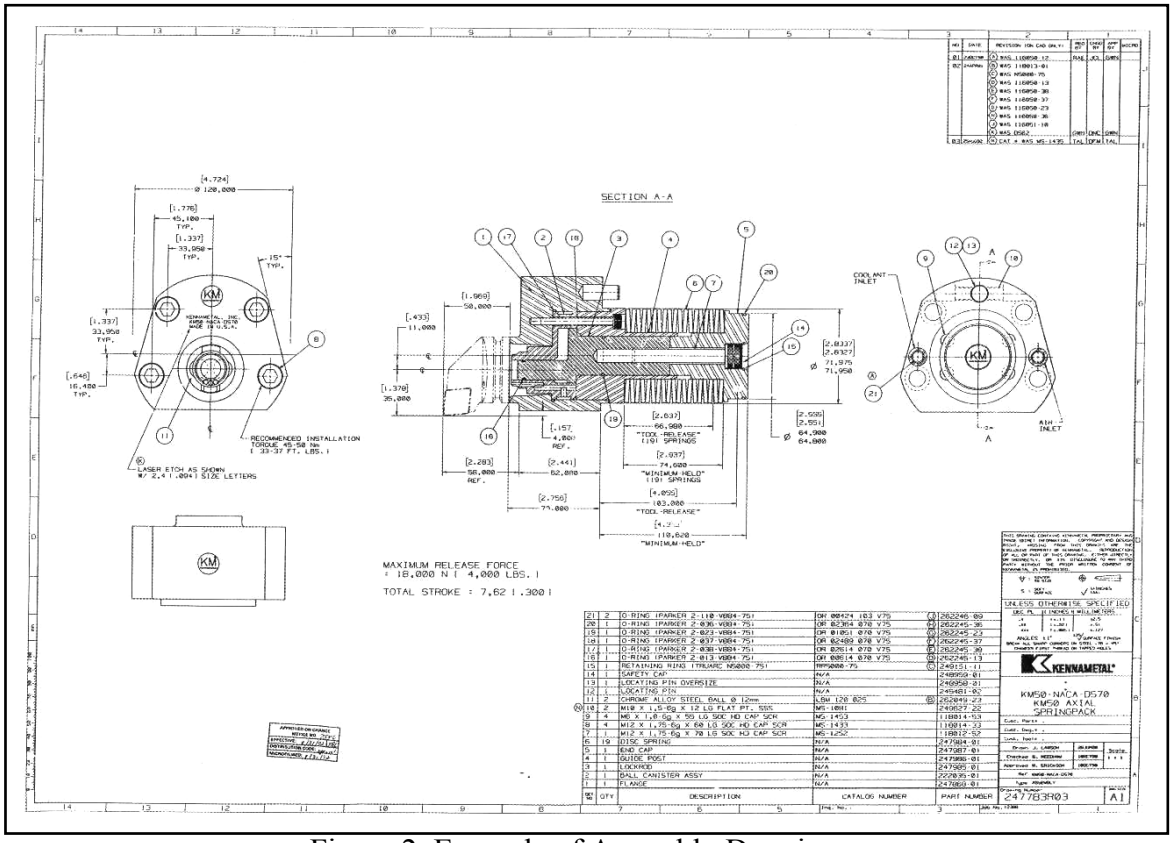


Figure 2 Example of Assembly Drawings
ref: Fundamentals of Graphics Communication, 4th ed.,
G. Bertoline & E. Wiebe, McGrawHill, 2004, p488.

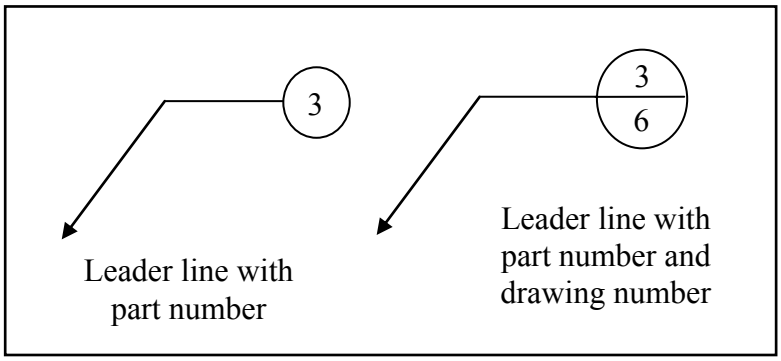
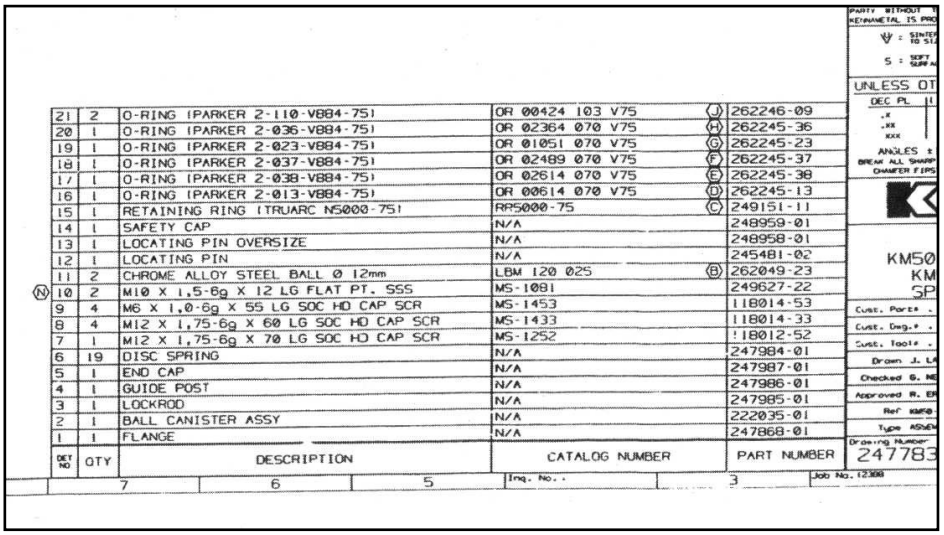


Figure 3 Example of Leader Lines for Parts

3.2 Parts Lists

Part lists or a "Bill of Materials" is an itemized list of all the parts in the assembly. This list includes not only the custom parts that must be machined, but off the shelf parts as well (pistons, clamps, nuts, bolts, washers, etc), including their catalogue numbers. The parts lists can be added to the assembly drawing (if there is space) or on its own separate drawing sheet. In Figure 4, a close up view of the parts list is show for the assembly.



DET NO	QTY	DESCRIPTION	CATALOG NUMBER	PART NUMBER
21	2	O-RING (PARKER 2-110-V884-75)	OR 00424 103 V75 (J)	262246-09
20	1	O-RING (PARKER 2-036-V884-75)	OR 02364 070 V75 (H)	262245-36
19	1	O-RING (PARKER 2-023-V884-75)	OR 01051 070 V75 (G)	262245-23
18	1	O-RING (PARKER 2-037-V884-75)	OR 02489 070 V75 (F)	262245-37
17	1	O-RING (PARKER 2-038-V884-75)	OR 02614 070 V75 (E)	262245-38
16	1	O-RING (PARKER 2-013-V884-75)	OR 00614 070 V75 (D)	262245-13
15	1	RETAINING RING (TRUARC N5000-75)	RR5000-75 (C)	249151-11
14	1	SAFETY CAP	N/A	248959-01
13	1	LOCATING PIN OVERSIZE	N/A	248958-01
12	1	LOCATING PIN	N/A	245481-02
11	2	CHROME ALLOY STEEL BALL Ø 12mm	LBM 120 025 (B)	262049-23
(N) 10	2	M10 X 1.5-6g X 12 LG FLAT PT. SSS	MS-1081	249627-22
9	4	M6 X 1.0-6g X 55 LG SOC HD CAP SCR	MS-1453	118014-53
8	4	M12 X 1.75-6g X 60 LG SOC HD CAP SCR	MS-1433	118014-33
7	1	M12 X 1.75-6g X 70 LG SOC HD CAP SCR	MS-1252	118012-52
6	19	DISC SPRING	N/A	247984-01
5	1	END CAP	N/A	247987-01
4	1	GUIDE POST	N/A	247986-01
3	1	LOCKROD	N/A	247985-01
2	1	BALL CANISTER ASSY	N/A	222035-01
1	1	FLANGE	N/A	247868-01

Figure 4 Example of a Parts List
ref: Fundamentals of Graphics Communication, 4th ed.,
G. Bertoline & E. Wiebe, McGrawHill, 2004, p488.

3.3 Detailed Drawings

It is very hard for a machinist to make a part from a 3-D drawing, so standard 3 view orthographic drawings are always required. Each custom designed part that needs to be machined or fabricated requires a "Detailed Drawing." Each detailed drawing should have enough views (side, front & top) to be able to make the part. Usually two is the minimum number of views. Limit the number of parts on each drawing page such that

the drawing is not cluttered. For an A-sized sheet (8.5" by 11") this is usually only 1 part. Dimension the drawing enough such that the machinist does not need to scale off the drawing, also make sure that you only used the number of decimal places necessary. Rule of thumb: critical dimensions, such as bearing surfaces, hole locations, press fits, etc. go down to 1/1000's of an inch (0.001" or three decimal places), whereas most other surfaces only require a fit down to the a 1/64'th of an inch (~0.01" or two decimal places). Use two decimal places and one decimal place respectively for mm's (metric). Also, remember to add tolerances and GD&T to the drawing where necessary. An example of a detailed drawing for a part is shown in Figure 5.

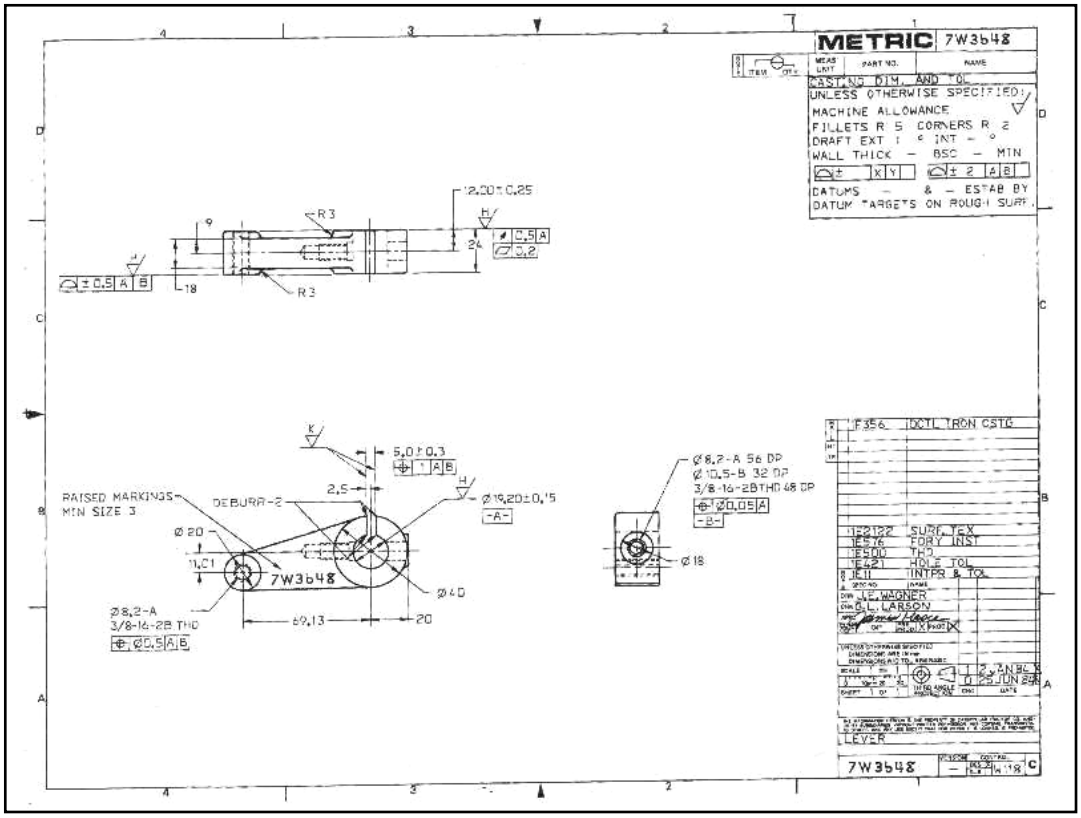


Figure 5 Example of a Detailed Drawing
ref: Fundamentals of Graphics Communication, 4th ed.,
G. Bertoline & E. Wiebe, McGrawHill, 2004, p484.

Other details may also include flow charts, piping diagrams, and plant layouts. Again, enough dimensions should be used on these drawing in order to allow the contractor to fabricate the design.