GRAPHIC AIDS

How can you convey numerical and graphical information effectively? Think about the information you have and the message you want to communicate:

Tables - excellent way to present numeric, non-numeric, and mixed numeric/non-numeric information to an audience.
Learn more about tables

Plots - excellent way to present the relationship between two sets of numbers.
Learn more about plots

Sketches - excellent way to convey information about physical systems.
Learn more about sketches

General Reference: Reep, D. C. (2009). *Technical Writing: Principles, Strategies, and Readings, 7th Edition*. Pearson Education Inc., p. 128 – 146.

Return to Main Page

Tables

Tables can be an excellent means to present numeric, non-numeric, and mixed numeric/non-numeric information to an audience. Characteristics of effective tables in engineering communications include:

- Labels (learn more)
- Position (learn more)
- Discussion (learn more)
- Numbers – Significant Digits and Uncertainty (learn more)
- Format Elements - Colors and Fonts (learn more)

- Example of poor engineering table
- Example of good engineering table

Return to Table Page
Return to Main Page

Tables –LABELS

- **Caption**
  - Unique Number for Identification
    - Each table is given a unique number, the numbers being in sequential order of discussion and in the standard table number format (I, II. III, IV, … -OR- 1, 2, 3, 4, …..).
    - Reference to a table by number is a proper noun and requires capitalization:
      - Correct: The time of each event is given in Table 1.
      - Incorrect: The time of each event in given in table 1.
  - Positioned ABOVE and Descriptive
    - Table caption positioned above the table and is descriptive (uniquely identifies what information a reader will find in that specific table).
      - Example of a non-descriptive title that is improperly positioned
      - Example of a descriptive title that is properly positioned
- **Column/Row**
  - Meaningful, legible column labels (and row labels if appropriate) must be included
  - Each column and row label must include units
    - Example of improper column label
    - Example of proper column label

Return to Table Page
Return to Main Page

Tables –POSITION

- Table is separated from text using a line space above and below.
  - Example of improper line spaces
  - Example of correct use of line spaces
- Table fits on a single page.
  - A series of small tables may be better than one large table.

Tables – DISCUSSION

- Discuss it or remove it!
- Each table that is included is discussed in the body of the document.
    - Remove each table that is not discussed.
- Each table that is discussed in the body of the document is included
    - Each table this discussed is positioned shortly after it is first discussed.

Return to Table Page
Return to Main Page

Tables –NUMBERS

- **Significant Digits** - every number is given in appropriate significant digits.
  - Three things to remember --- significant digits, significant digits, and significant digits.
    - Example of too many significant digits
    - Example of correct significant digits
- **Uncertainty** – The uncertainty is reported for every, and it is given in appropriate significant digits.
    - Example of reporting uncertainty

Return to Table Page
Return to Main Page

Tables – FORMAT ELEMENTS

- Fonts, font emphasis, shading, and color should be used ONLY if they enhance the message you want to communicate.
- Too MANY DIFFERENT fonts **IS** ***distracting***
- Use font emphasis selectively
  - Units are often *italicized*
  - Column/row labels are often in **bold**
- Shading can help highlight important information
- Color can be overdone
- Shading and color that cannot be reproduced using a non-color printer or copy machine must be avoided if you expect your reader to print the document.

Return to Table Labels Page
Return to Main Page

Table Labels - IMPROPER CAPTION

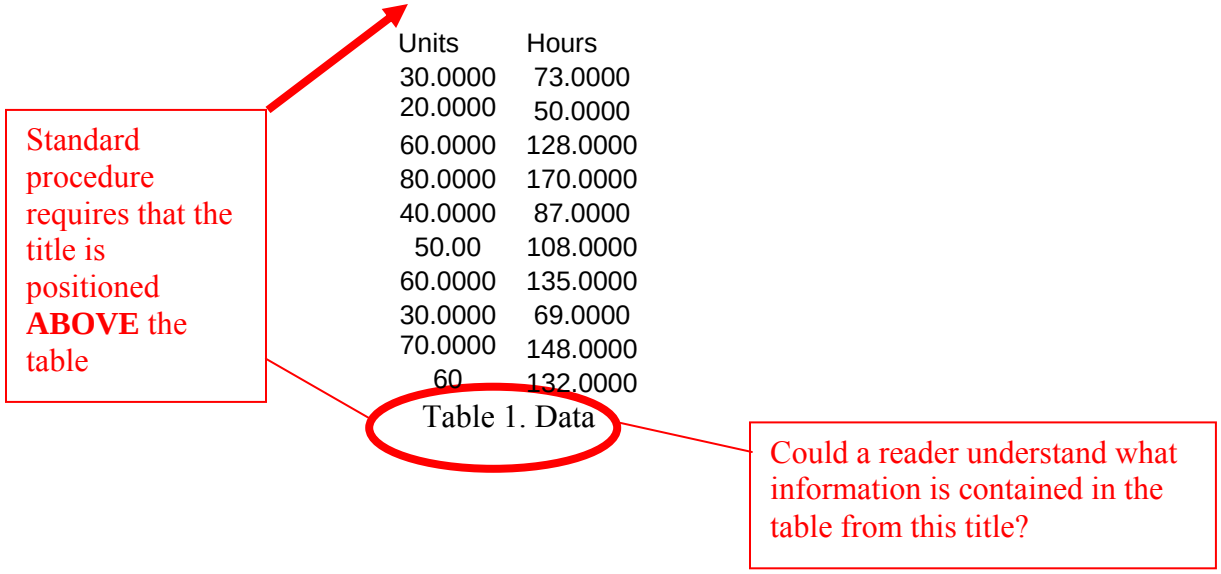


Table Labels - PROPER CAPTION

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Units	Hours
30.0000	73.0000
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

The reader has good idea of what information is contained in the table.

Several problems with this table remain!

Tables - IMPROPER COLUMN LABEL

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Units	Hours
30.0000	73.0000
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

The reader has no idea of what you mean by units.

The reader suspects that hours label relates to a time measurement, but it can be more clearly communicated.

Several problems with this table remain!

Tables - Proper Column Label

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

(number) **Widgets**	*(Hours)* **Production Time**
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

The reader understands that column indicates number of Widgets.

The reader understands that column indicates production time in units of hours.

Several problems with this table remain!

Tables - IMPROPER LINE SPACES

Blah, blah.

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Units	Hours
30.0000	73.0000
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

Difficult to see difference between table and caption.

Difficult to see difference between table caption and text.

Difficult to see difference between table and text.

Blah, blah.

Table - CORRECT USE OF LINE SPACES

Blah, blah.

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Easy to see difference between table caption from text.

Easy to see difference between table and caption.

Units	Hours
30.0000	73.0000
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

Several problems with this table remain

Easy to see difference between table and text.

Blah, blah.

Return to Table Numbers Page

Return to Main Page

Tables – TOO MANY SIGNIFICANT DIGITS

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Widgets are meaningful in integer units. It makes no since to talk about half a widget since it can't be sold until it is complete. This table conveys that one-ten thousandth (0.0001) is meaningful!

(number) **Widgets**	*(Hours)* **Production Time**
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.0000	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60.0000	132.0000

This column suggests that 0.0001 of an hour (about 0.4 s) is meaningful!

Tables – CORRECT SIGNIFICANT DIGITS

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

This table conveys that only integer values of widgets is meaningful.

(number) **Widgets**	*(Hours)* **Production Time**
20	50.0
60	128.0
80	170.0
40	87.0
50	108.0
60	135.0
30	69.0
70	148.0
60	132.0

This column suggests that time is measured to a precision of 0.1 of an hour (6 min).

Tables – REPORTING UNCERTAINTY

Table I. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

Now the reader clearly understands that the precision of the number of widgets is 1 and the precision of hours of production time is 0.1

(number) **Widgets**	*(Hours)* **Production Time**
20 ± 1	50.0 ± 0.1
60 ± 1	128.0 ± 0.1
80 ± 1	170.0 ± 0.1
40 ± 1	87.0 ± 0.1
50 ± 1	108.0 ± 0.1
60 ± 1	135.0 ± 0.1
30 ± 1	69.0 ± 0.1
70 ± 1	148.0 ± 0.1
60 ± 1	132.0 ± 0.1

Hint: use the insert symbol feature of WORD and EXCEL to obtain the ± symbol

Return to Table Page
Return to Main Page

Poor Engineering Table

Units	Hours
30.0000	73.0000
20.0000	50.0000
60.0000	128.0000
80.0000	170.0000
40.0000	87.0000
50.00	108.0000
60.0000	135.0000
30.0000	69.0000
70.0000	148.0000
60	132.0000

Table 1. Data

Good Engineering Table

Table 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widgets-R-US.

The data has been sorted from smallest to largest in terms of the number of widgets. This approach allows the reader to observe the increase in production time required for larger number of widgets.

(number) **Widgets**	*(Hours)* **Production Time**
20 ± 1	50.0 ± 0.1
60 ± 1	128.0 ± 0.1
80 ± 1	170.0 ± 0.1
40 ± 1	87.0 ± 0.1
50 ± 1	108.0 ± 0.1
60 ± 1	135.0 ± 0.1
30 ± 1	69.0 ± 0.1
70 ± 1	148.0 ± 0.1
60 ± 1	132.0 ± 0.1

The cell border feature of EXCEL has been used to group the data. The reader can easily see the three entries for 60 widgets produced

Return to Main Page

Plots

Plots are an excellent way to graphically convey the influence of an independent variable(s) on a dependent result:

The independent variable is typically set as part of an experiment.
The dependent variable is typically measured during the experiment.

Effective engineering plots are characterized by:

- Labels (learn more)
- Position (learn more)
- Discussion (learn more)
- Numbers – Significant Digits and Uncertainty (learn more)
- Format Elements - Colors and Fonts (learn more)

- Example of poor engineering plot
- Example of good engineering plot

Plots –LABELS

- **Caption**
  - Plots are labeled as figures. They are not labeled as plots or graphs.
  - Unique Number for Identification
    - Each figure is given a unique number, the numbers being in sequential order of discussion and in the standard figure number format (1, 2, 3, 4, …..).
    - Reference to a figure by number is a proper noun and requires capitalization:
      - Correct: The relationship between production time and number of widgets produced is given in Figure 1.
      - Incorrect: The relationship between production time and number of widgets produced is given in figure 1.
  - Positioned BELOW and Descriptive
    - Figure caption positioned below the figure and is descriptive (uniquely identifies what information a reader will find in that specific figure).
      - Example of a non-descriptive title that is improperly positioned
      - Example of a descriptive title that is properly positioned
- **Axes**
  - Title – meaningful, legible axis title that includes units
  - Numeric Scale – numeric scale must be identified with correct significant digits
  - Tick Marks – inside axis
  - Grid Lines – only if they help communicate information
  - Example of good axis labels
- **Data Points**
  - Experimental data represented as data points with no line connecting the data points
    - Uncertainty show as error bars
  - Unique data points for each data series
  - A legend or series labels given if more than one data series
- **Lines**
  - Theoretical results and curve fits are represented by lines without any data points.
    - Trend line label meaningful
    - R-squared value of curve-fit given
    - Example of good label on trend line

Return to Plot Page
Return to Main Page

Plots –POSITION

- Figure is separated from text using a line space above and below.
  - Example of improper line spaces
  - Example of correct use of line spaces
- Figure fits on a single page.

Return to Plot Page
Return to Main Page

Plots –DISCUSSION

- Discuss it or remove it!
- Each figure that is included is discussed in the body of the document.
    - Remove each figure that is not discussed.
- Each figure that is discussed in the body of the document is included
    - Each figure this discussed is positioned shortly after it is first discussed.

Return to Plot Page
Return to Main Page

Plots –NUMBERS

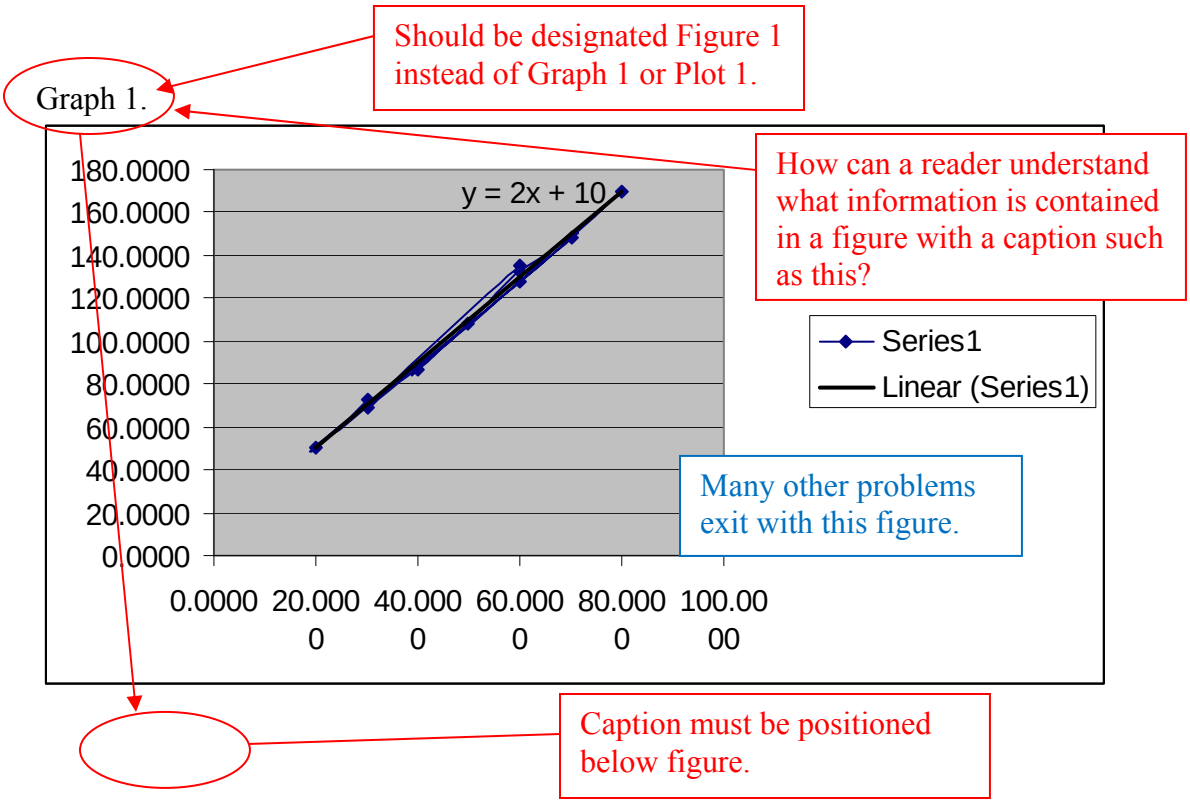
- **Significant Digits** - every number is given in appropriate significant digits.
  - Three things to remember --- significant digits, significant digits, and significant digits.
    - Example of too many significant digits
    - Example of correct significant digits
- **Uncertainty** – Experimental measurements contain uncertainty. This uncertainty is shown with error bars.
    - There is no easy way to put error bars on a plot. Students are encouraged to experiment with available methods.
    - Example of error bars on a plot.

Return to Plot Page
Return to Main Page

Plots –FORMAT ELEMENTS

- Fonts, font emphasis, shading, and color should be used ONLY if they enhance the message you want to communicate.
- Too MANY DIFFERENT fonts **IS** ***distracting***
- Use font emphasis selectively
  - Units are often *italicized*
  - Column/row labels are often in **bold**
- Shading can help highlight important information
- Color can be overdone
- Shading and color that cannot be reproduced using a non-color printer or copy machine must be avoided if you expect your reader to print the document.

Plots –IMPROPER CAPTION



Return to Plot Labels Page

Return to Main Page

Plots –PROPER LABELS, NUMBERS, AND FORMAT ELEMENTS

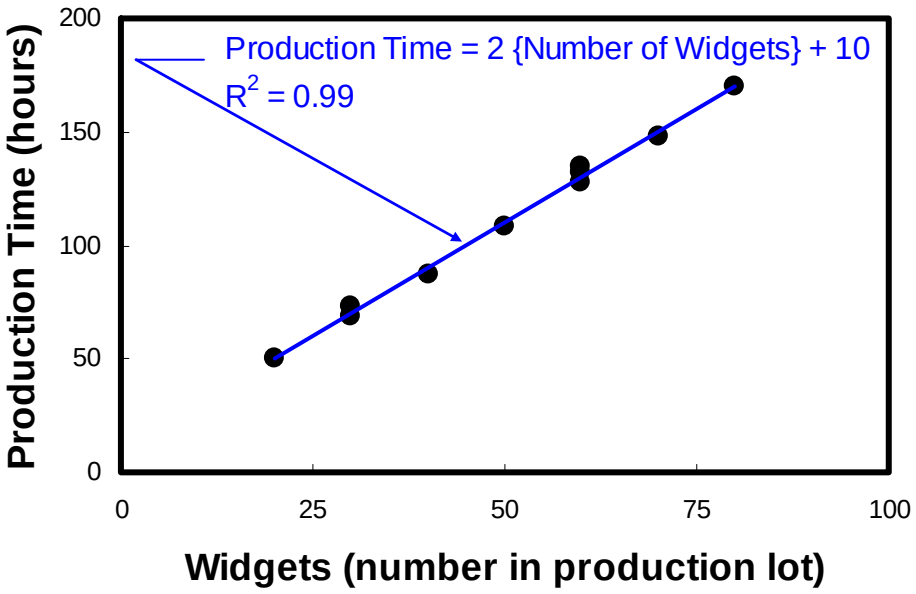


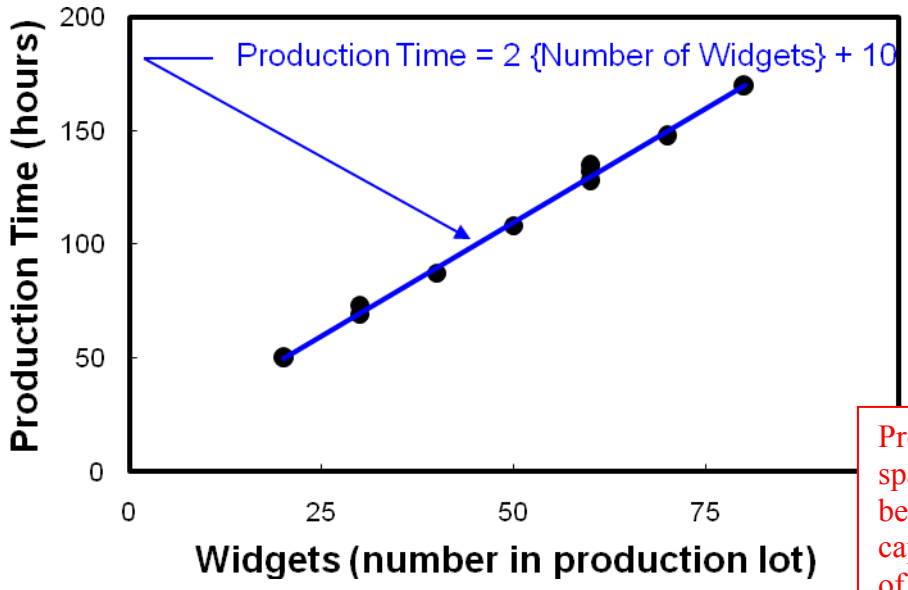
Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Return to Plot Position Page

Return to Main Page

Plots –IMPROPER LINE SPACES

Blah, blah.



Problem with line space occurs between the caption and body of document

Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Blah, blah.

Plots –PROPER LINE SPACES

Blah, blah.

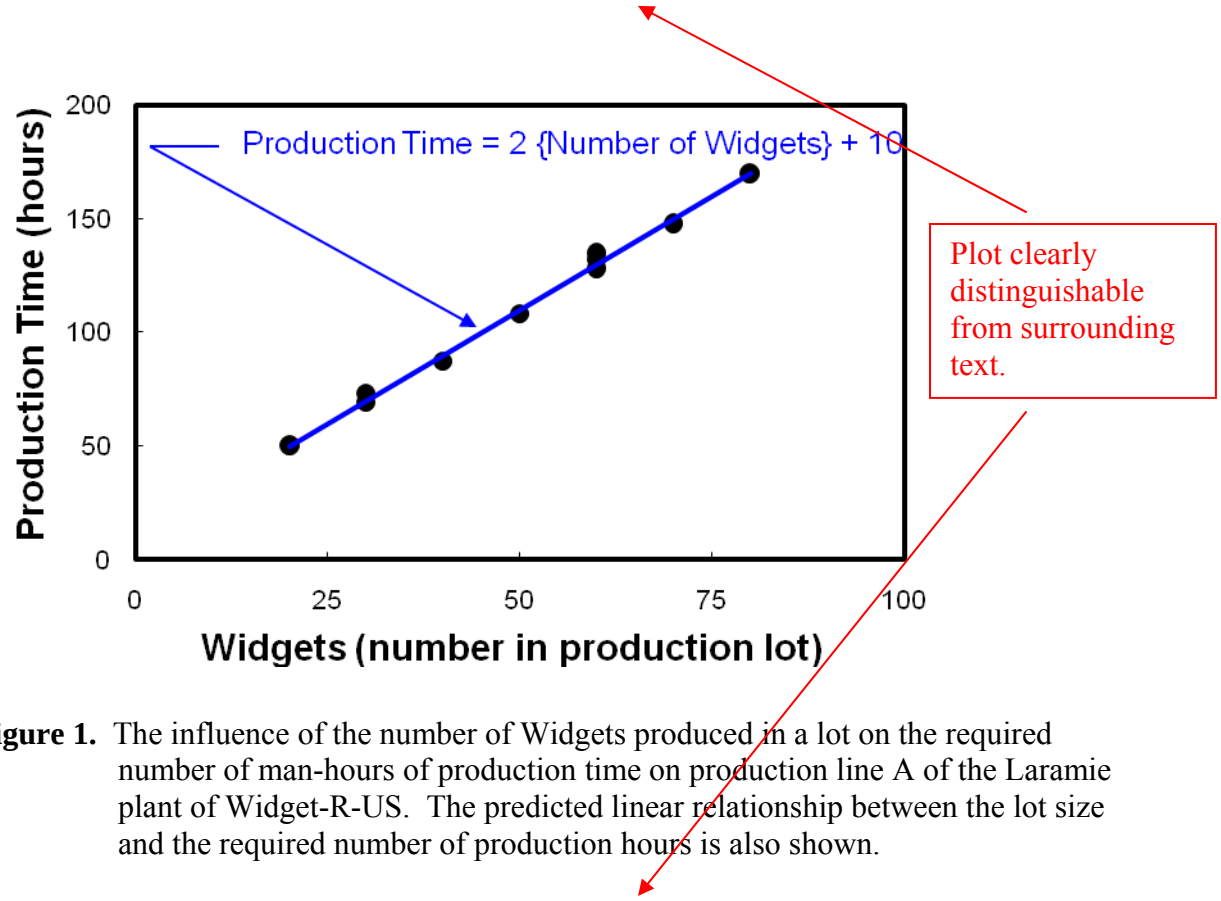


Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Blah, blah.

Plots –TOO MANY SIGNIFICANT DIGITS

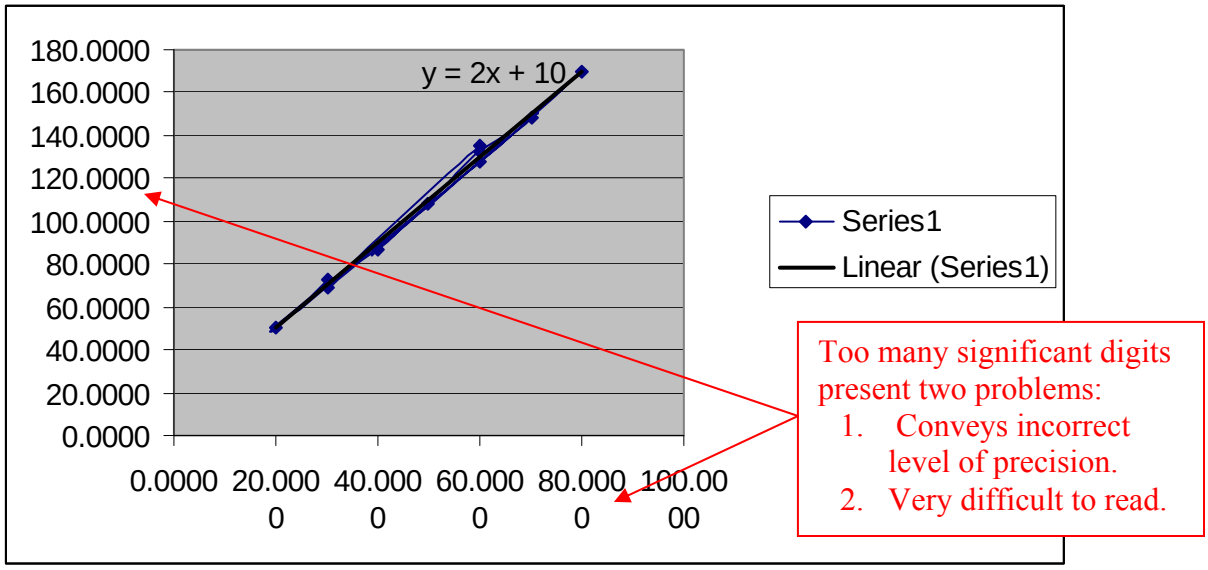


Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Plots –CORRECT SIGNIFICANT DIGITS

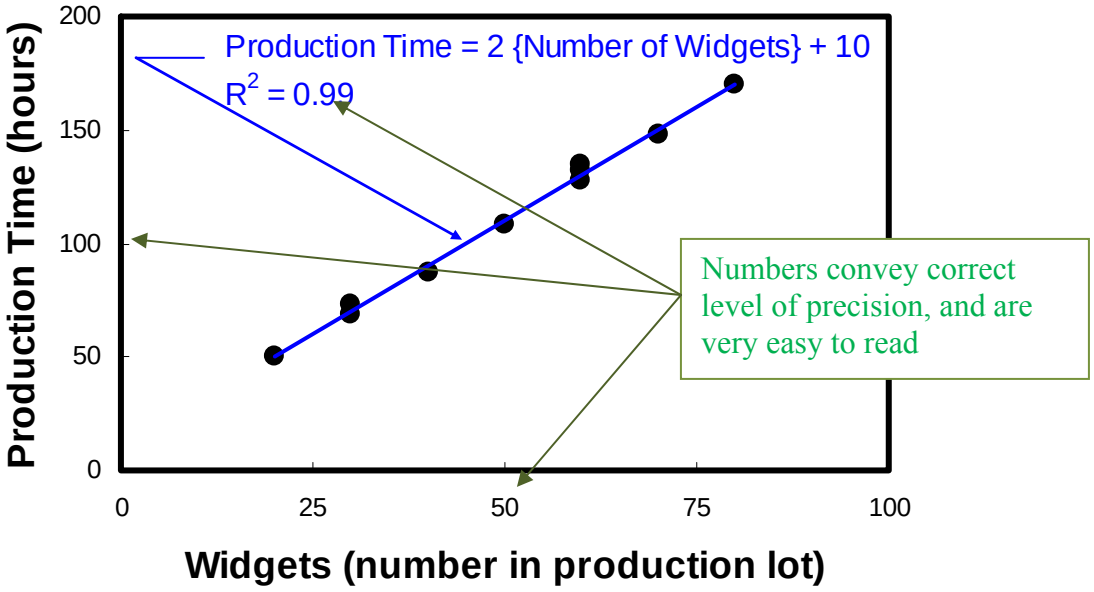
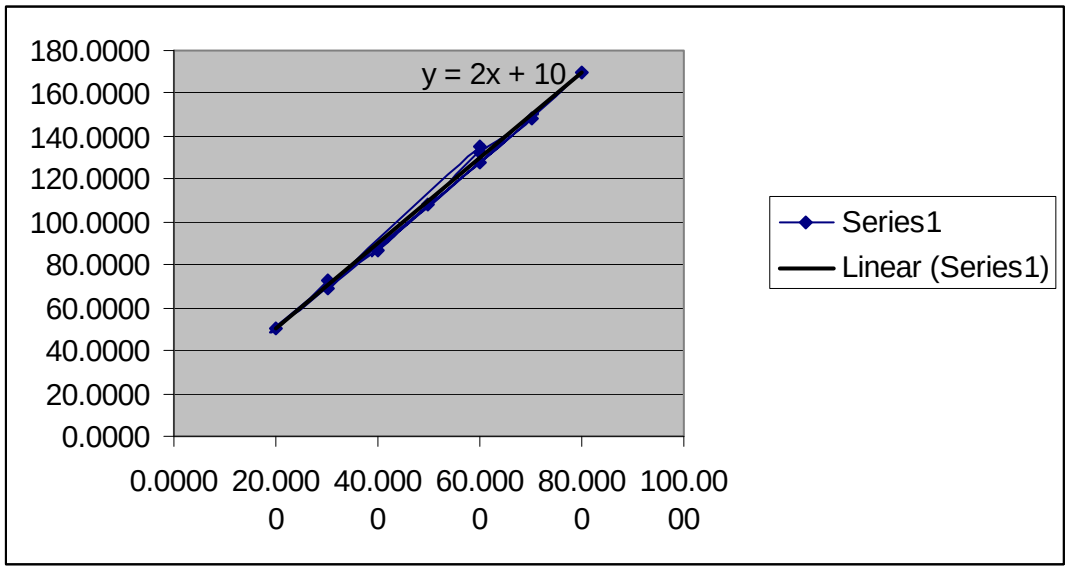


Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Return to Plot Page
Return to Main Page

Poor Engineering Plot

Graph 1.



Good Engineering Plot

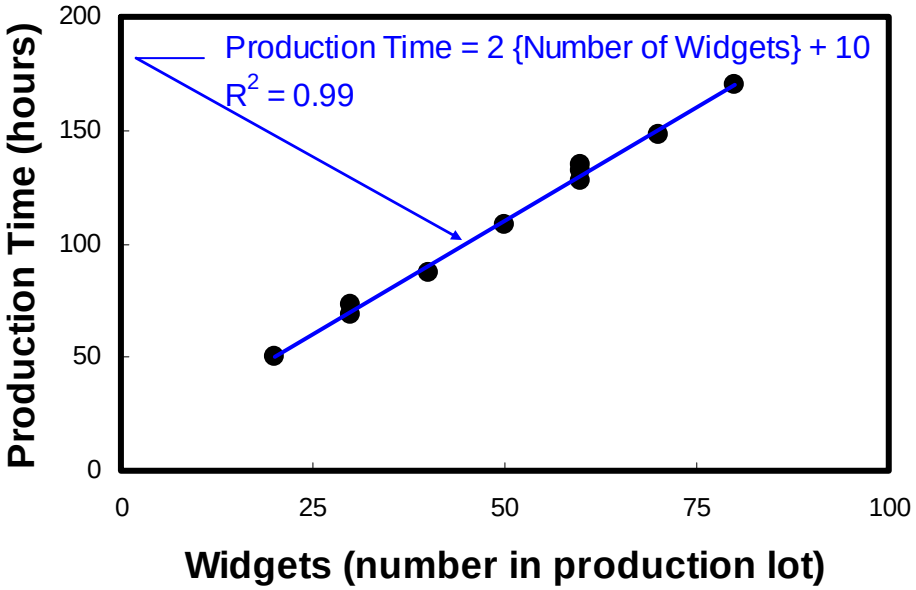


Figure 1. The influence of the number of Widgets produced in a lot on the required number of man-hours of production time on production line A of the Laramie plant of Widget-R-US. The predicted linear relationship between the lot size and the required number of production hours is also shown.

Return to Main Page

Sketches/Illustrations/Drawings

Sketches, illustrations, and drawings are an excellent way to convey information about physical systems. Sketches, illustrations, and drawings are identified as figures. Effective engineering sketches, illustrations, and drawings are characterized by:

- Labels (learn more)
- Position (learn more)
- Discussion (learn more)
- Numbers – Significant Digits and Uncertainty (learn more)
- Format Elements - Colors and Fonts (learn more)

- Example of poor engineering sketch
- Example of good engineering sketch

Sketches –LABELS

- **Caption**
  - Sketches are labeled as figures. They are not labeled as drawings or pictures.
  - Unique Number for Identification
    - Each figure is given a unique number, the numbers being in sequential order of discussion and in the standard figure number format (1, 2, 3, 4, …..).
    - Reference to a figure by number is a proper noun and requires capitalization:
      - Correct: The experimental set-up is given in Figure 1.
      - Incorrect: The experimental set-up is given in figure 1.
  - Positioned BELOW and Descriptive
    - Figure caption positioned below the figure and is descriptive (uniquely identifies what information a reader will find in that specific figure).
- **Text Labels** – every graphic element in a sketch should be labeled with a text box to identify to the reader what that graphic element represents.

Return to Sketch Page
Return to Main Page

Sketch –POSITION

- Figure is separated from text using a line space above and below.
  - Example of improper line spaces
  - Example of correct use of line spaces
- Figure fits on a single page.

Return to Sketch Page
Return to Main Page

Sketch –DISCUSSION

- Discuss it or remove it!
- Each sketch that is included is discussed in the body of the document.
    - Remove each sketch that is not discussed.
- Each sketch that is discussed in the body of the document is included
    - Each sketch this discussed is positioned shortly after it is first discussed.

Return to Sketch Page
Return to Main Page

Sketch –NUMBERS

- **Significant Digits** - every number is given in appropriate significant digits.
  - Three things to remember --- significant digits, significant digits, and significant digits.
- **Uncertainty** – If your sketch contains a number that has uncertainty, that uncertainty must be identified with a ± value.
  - **Hint** – Use the symbol feature of WORD to insert the ± symbol.

Return to Sketch Page

Return to Main Page

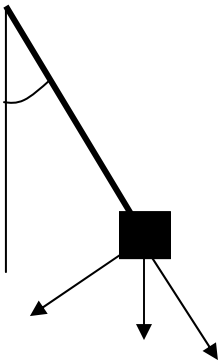
Sketch –FORMAT ELEMENTS

- Fonts, font emphasis, shading, and color should be used ONLY if they enhance the message you want to communicate.
- Too MANY DIFFERENT fonts **IS** ***distracting***
- Use font emphasis selectively
  - Units are often *italicized*
  - Column/row labels are often in **bold**
- Shading can help highlight important information
- Color can be overdone
- Shading and color that cannot be reproduced using a non-color printer or copy machine must be avoided if you expect your reader to print the document.

Return to Sketch Page
Return to Main Page

Sketches –POOR SKETCH CHARACTERISTICS

Drawing 2.



Sketches –GOOD SKETCH CHARACTERISTICS

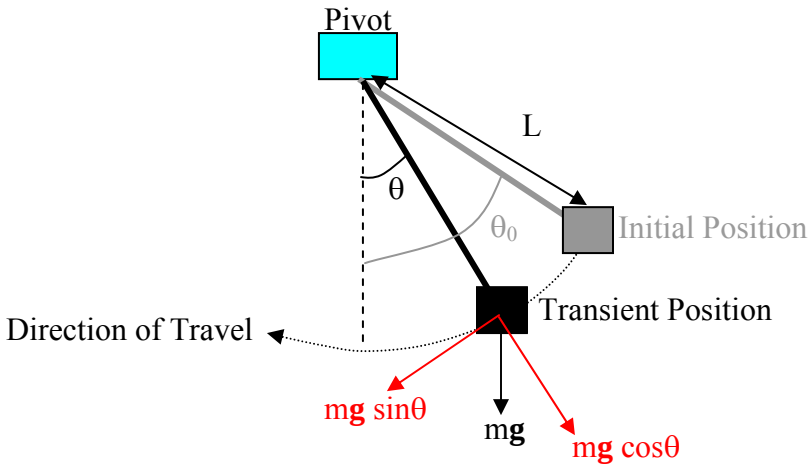
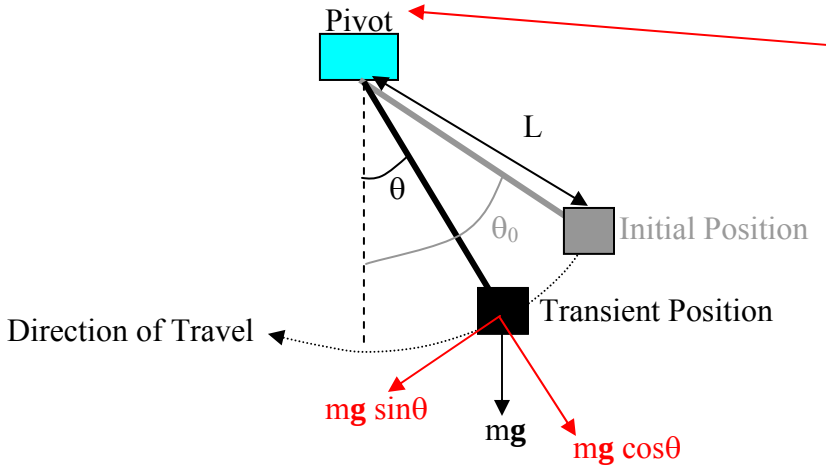


Figure 2. Schematic drawing of a simple pendulum in motion from right to left about a fixed pivot. The initial position is identified by angular displacement θ_0, and the transient position is identified by any angular displacement, θ. The resultant and the component force vector due to gravity are also shown for the transient position.

Sketches –IMPROPER LINE SPACE

Blah, blah.



Text labels are difficult to see.

Figure 2. Schematic drawing of a simple pendulum in motion fro fixed pivot. The initial position is identified by angular the transient position is identified by any angular displa resultant and the component force vector due to gravity are also shown for the transient position.

Caption difficult to separate from body of document.

Blah, blah.

Sketches –PROPER LINE SPACE

Blah, blah.

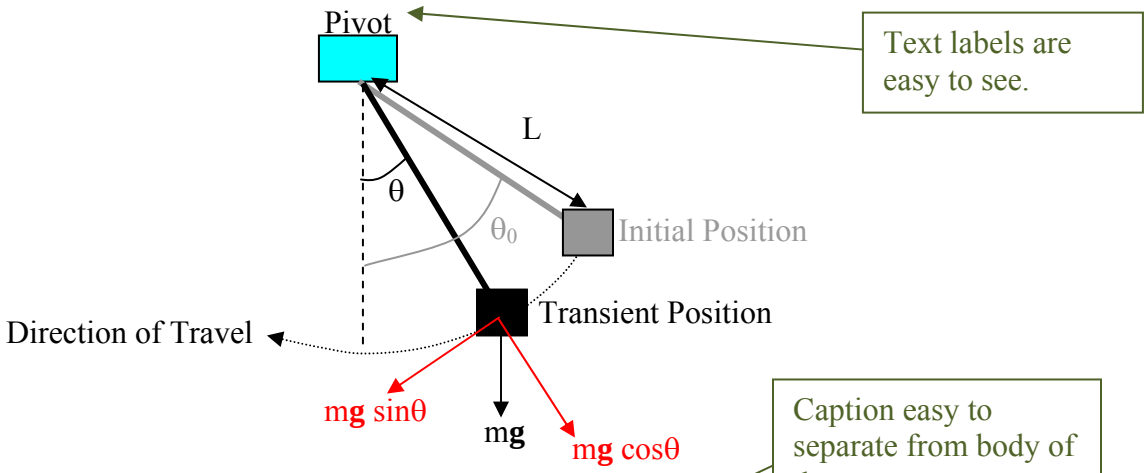


Figure 2. Schematic drawing of a simple pendulum in motion from right to left about a fixed pivot. The initial position is identified by angular displacement θ_0, and the transient position is identified by any angular displacement, θ. The resultant and the component force vector due to gravity are also shown for the transient position.

Blah, blah.