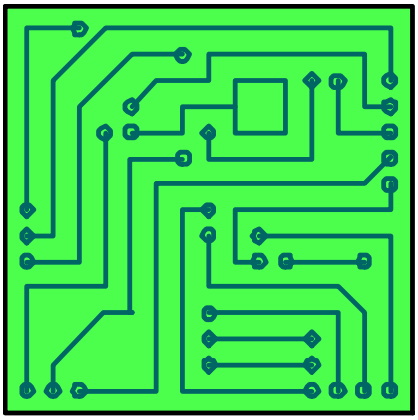
Reading Blueprints



Participant Materials

CAPITAL CAREER CENTER

Igual Oportunidad De Empleo (Equal Opportunity Employer)

Las personas incapacitadas pueden solicitar medios y servicios auxiliares. (Auxilliary services available upon request to persons with disabilities)

AGENDA: Reading Blueprints

Welcome

Training Goals

Introduction to Reading Blueprints

Pre-Test

Talking about Blueprints: Blueprint Layout and Navigation

Discussion: Elements on the Print

Discussion: Views

Looking Back on What We've Learned: Angles

Discussion: Hole Charts

Post-test

Finishing, Looking at Goals

Training Goals

The reason for this training is to give an introduction to Reading Blueprints.

We will have: teacher talks, small group talks, classroom activities, handouts, and stories.

Participants will be able to:

- Describe the patterns of a blueprint and the meaning of each important part
- Talk about the idea of *angles* and how they are used
- Talk about *views* and *drill or hole charts* and their importance
- Name a step-by-step way of reading blueprints

Pre-test: Reading Blueprints

True-False

Directions: Answer each of the following questions by writing "T" if the sentence is true or "F" if the sentence is false (not true) on the blank line to the left of the sentnece.

Example: **T** Customers being happy is important in a quality system.

1) ____The blueprint mapping system helps readers find locations on the print quickly.

2) ____The *title block* has all the important information about the blueprint.

3) ____The *revision block* helps follow changes and make needed changes to the blueprint.

4) ____ Three dimensional things are shown with pictures and multiviews.

5) ____ Printed circuit boards are usually drawn in the *primary* view.

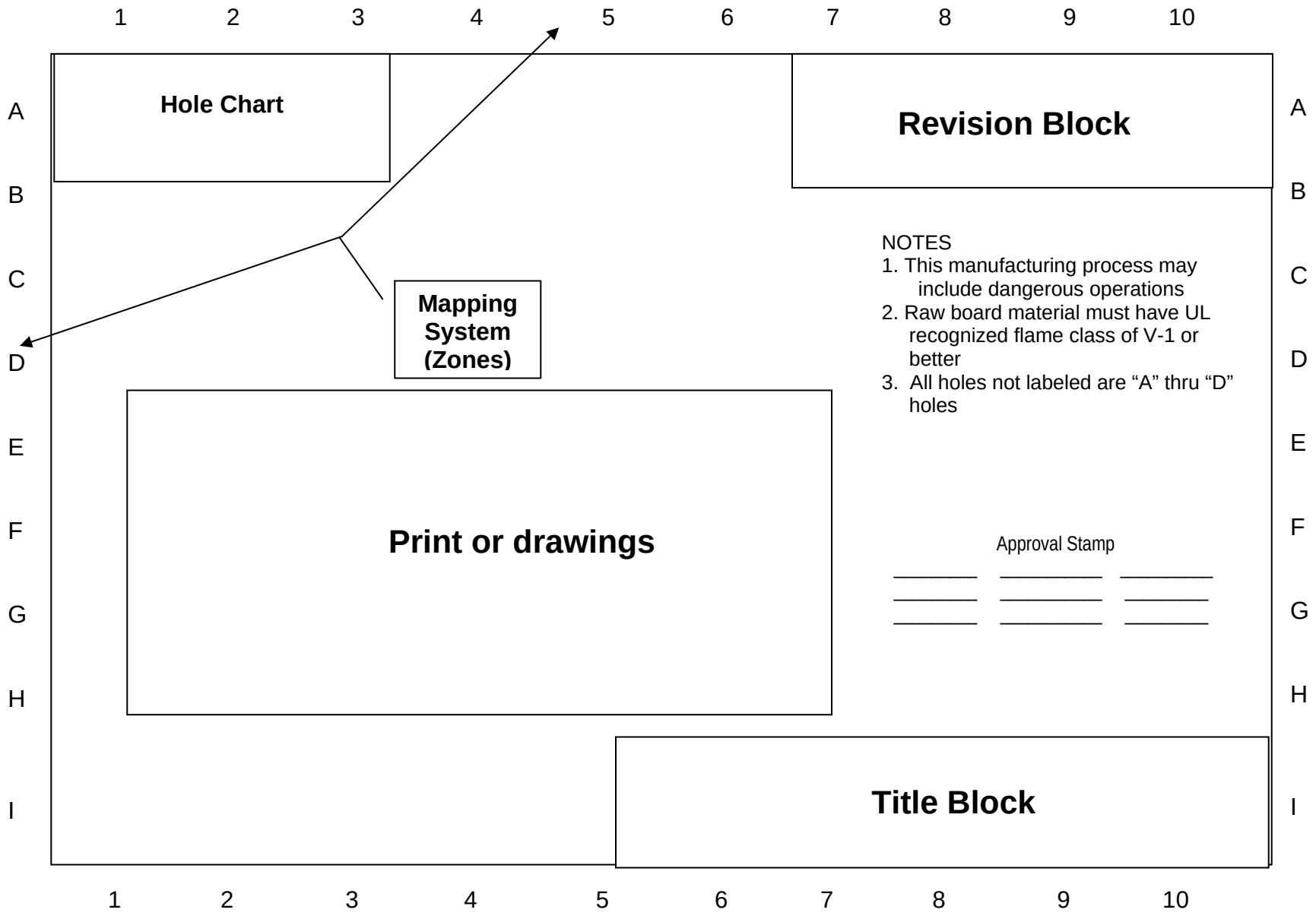
6) ____ Angles are measured in centimeters.

7) ____ Measurement of angles begins with a full circle – 360 degrees.

8) _____ A *right angle* is exactly 90 degrees.

9) _____ A datum is a way to look at information: a location of measurement of space in a particular direction (like length, height, or width).

Blueprint Layout



Blueprint Layout

Directions: Use Handout #4 to follow along during talking about the parts of a blueprint.

Reason for a Blueprint:
The reason for a blueprint is to share instructions for building a product. Lines, lettering and symbols on a blueprint give right information. This information is good for all who read it.

Mapping System (Zone)

The mapping systems is important because it helps find points on the map quickly.

Some drawings have a **mapping system**, also called *zones*. The mapping system includes the numbers (1- 10) along the top and bottom margins and the letters (A - I) along the left and right margins. A margin is the empty space at the side of a printed page. The numbers and letters let the reader find a location on the map easily.

- On the sample blueprint, what is found at C-8?
- What is found at A-1?

Title Block

The title block is important because it has all the main and important information about the print. Read the title block first.

The **Title Block** is found in the **lower right corner** and has all the main information about the print:

- Company name
- Confidential statement
- Special spaces and measurements
- Sheet Size
- Drawing number
- Part name
- Material
- Scale (the size of the drawing)
- Drafter Signature
- Checker Signature
- Engineer Signature

Blueprint Layout -continued

Revision Block *The revision block is important for finding information about changes to the print.*	The **revision block** has a history of all the changes or *revisions* made to the blueprint. The revision block has: • A revision symbol, number or letter • Description of the change • Drawer's name – who made the change • Date of the change
Notes *Notes give instructions, directions or information about the part or processes with the part.*	**Notes** can be put anywhere on a print but usually they are written on the right side of the print near the revision block. There are two types of notes: *general* and *specific*. General notes are written and talk about the whole print. Specific notes refer to a particular part of the print.
Hole Chart *Drilled holes are often needed to make a good quality product.*	The **hole chart** or *drill chart* gives certain measurements and information on all the holes drilled on a circuit board or part. Information like the identification number and finished hole size are included on the hole chart.

Approval Stamp *It is important to have a record of who helped with checking changes.*	For quality control and to be able to find information, the **approval stamp** is a history of who checked the print to be sure it was right and to look at any changes made.

In-Class Activity

Directions: Draw a line from the name of the blueprint word (or words) in Column B to the right description in Column A.

Column A	Column B
1. This helps readers to easily find a location on the blueprint.	**NOTES**
2. This part of the blueprint has all of the main and important information.	**HOLE CHART**
3. This part of the blueprint is for being able to find changes to the print.	**APPROVAL STAMP**
4. This chart organizes information about the holes that are drilled on the part or circuit board.	**REVISION BLOCK**
5. This part is the record of names and dates of those who check the prints to be sure they are right.	**TITLE BLOCK**
6. This is a list of information or directions about the print.	**MAPPING SYSTEM**

What are *views* and why are they important?

There are certain ANSI guidelines for drawing three dimensional objects on drawings and blueprints.

Reading a drawing of a three dimensional object on a blueprint will take practice. By using lines and pictures in an exact way, objects are shown in *pictorial* and *multiviews*.[1]

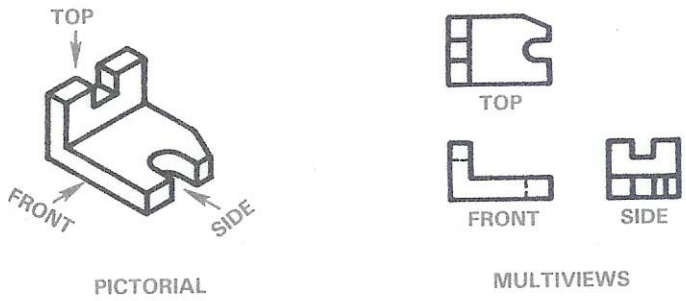


Figure 5–3 Pictorial vs multiview.

In this drawing, the pieces in Figure 5.3 above are put together to make the whole. On a blueprint, the pieces will have exact instructions and dimensions for building the part.

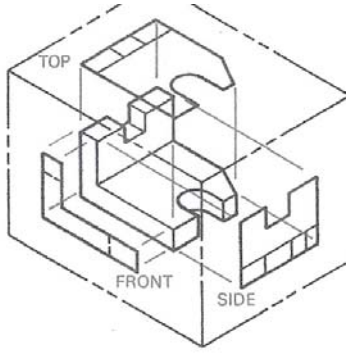


Figure 5–4 Glass box.

Views and Printed Circuit Boards

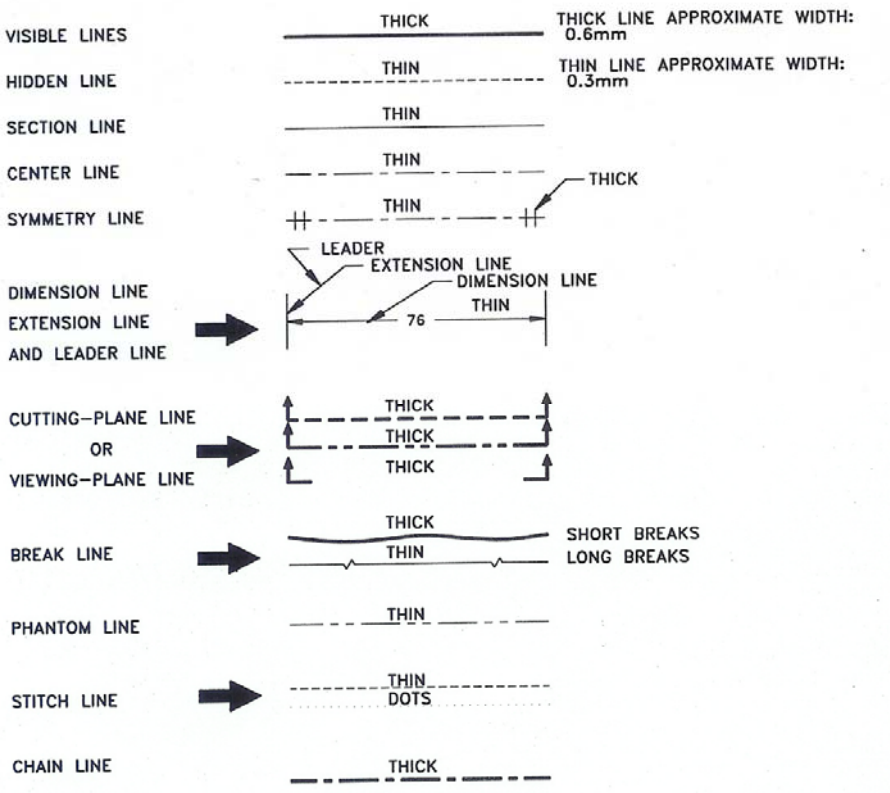
Printed circuit boards are usually drawn from one view – the *primary* view.

- The *primary* view is either the component side (also called front or top) or the back side (also called solder side, far side or bottom).
- *Section* views are used to make clear inside construction. For example, in the layers of a circuit board.
- *Details* are shown by not seen (dashed) lines or "phantom lines" making a circle around the feature. The information in details is often the same information as in *views.*
-

Adapted from David Madsen, Print Reading for Engineering and Manufacturing Technology, 1995

Review: Lines

Instructions for building or assembling three-dimensional objects on a blueprint are shown with different lines and little pictures (called "symbols") that mean different things. Look at the following line chart to prepare for reading a blueprint.



Visible Lines Also called "object lines", or "outlines", describe what you can see on the outside or edge of the object.

Hidden Lines This means what you cannot see on an object. On a circuit board the *hidden line* may mean a feature on the opposite side of the board.

Centerlines Used to show and find the center of circles and arcs. On circuit boards *center lines* locate hole locations.

Extension Lines Used to show how much dimension there is or how far the dimension goes. Extension lines begin with a short space from the object.

Review: Lines-continued

Dimension Lines Shows how long the dimension is. Dimension lines are seen by arrows.

Leader Lines A line used to connect a special "note" to a feature. On circuit boards *leader lines* may direct detail information to certain areas on the drawing.

Phantom Lines On circuit boards, *phantom lines* are mostly used to show details of a feature. For example, to show a certain dimension.

Arrowheads Used to terminate dimension lines.

Cutting Plane Lines These lines show where a section of the drawing is taken out and shown alone as a separate view.

Section Lines These lines show where the cutting plane line has cut through the object.

Break Lines There are two types of break lines – short and long. They are used to shorten an object that is the same over all.

Activity

Directions: Use words from the following list to finish the sentences below.

hidden	extension	arrowhead
object	dimension	phantom

1. The _____is used to end dimension lines.
2. Lines that describe the surface you can see or edge of something are called _____lines.
3. _____lines begin with a short space from the object and show how far the dimension of an object goes.
4. Lines that show an edge that you cannot see on an object are called a _____ lines.
5. _____ lines show how long the measurement is and are shown by an arrowhead.
6. On circuit boards the main line used to show the details of a feature are called _____lines.

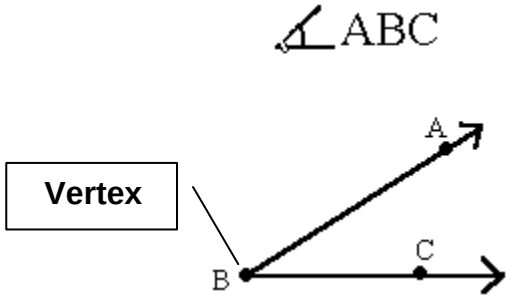
Angles and Angular Measurements

When reading blueprints, being able to read the measurement of an angle may be important. Here are short statements of angles and how they are measured.

Geometry Refresher

Angles are part of basic math called geometry. The meaning of an angle is: the meeting of two lines (lines are called *ray*s in geometry) that have the same endpoint.

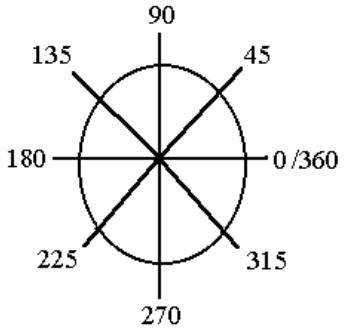
Example: Three letters describe the angle. **A** is one side of the angle, **C** is one side of the angle and **B** is the *vertex* or the common endpoint.



Angles are measured in degrees. The number of degrees tell how wide the angle is. Angles are measured with a tool called a *protractor.*

Angles are measured in degrees ($^\circ$). Measurement of angles begins with the full circle which is 360°. When measuring angles you go counterclockwise (from right to left), starting where the three would be on a clock. That would be *zero angle* because there is nothing in there. Moving to the left around the circle, angles between 0/360 and 90 are called *acute angles.* A 45° angle is an acute angle. A *right angle* is exactly 90°. Continuing counterclockwise, an *obtuse angle* is an angle whose measure is between 90 and 180 degrees. The *straight angle* is exactly 180°.

Example:



Activity

Directions: Read the sentences below and choose one of the correct answers a), b), or c).

1. Angles are part of basic mathematics called
    a) calculus
    b) geometry
    c) algebra

2. Angles are measured in
    a) millmeters
    b) decimal inches
    c) degrees

3. The tool used to measure angles is called a
    a) micrometer
    b) caliper
    c) protractor

4. The point where the two lines of an angle meet is called the
    a) vertex
    b) endpoint
    c) right angle

5. A right angle is exactly
    a) 45 degrees
    b) 360 degrees
    c) 90 degrees

6. Straight angles are exactly
    a) 90 degrees
    b) 180 degrees
    c) 45 degrees

Symbols and Abbreviations:

Here is a list of symbols (little pictures) and abbreviations (a short written way of writing a longer word) often seen on blueprints.

Basic Dimension XXXX	A dimension inside in a rectangular box. Used to tell the meaning of the exact location of a feature on a blueprint.
Datum A or -A-	A location from where dimensions are taken. A reference point. Also referred to as *origin*. The word *datum* or *origin* may be shown on a drawing, however there is a symbol.
Degrees 45°	The unit of measure for angles. There are 360 degrees in a circle. 180 degrees in a line, 90 degrees in a square corner.
Delta X	A flag or triangle drawn around a number. This means a note has to do with a special feature. Usually a part of a leader line or extension line. Some customers use a circle or square around a number to show the delta.
Dia. ∅ Example: ∅4.01	An abbreviation of diameter. The distance from one side of a circle to the other through the center.
MAX .006 MAX	An abbreviation of maximum. Used to show the largest a dimension can be.
MIN .003 MIN	An abbreviation of minimum. Used to show the smallest a dimension can be.
PLCS 14x (14 times or plcs) 14 plcs	An abbreviation for “PLACES”. The number places or times a feature is shown. Uses ‘x” as a symbol.

Symbols and Abbreviations – continued

R R12.5 RAD 12.5	This is the symbol for radius. An abbreviation for radius may appear as RAD. Radius is the distance from the center of a circle to the circumference of a circle.
Ref (23.345) or 23.356 REF	An abbreviation for "REFERENCE." This means that this dimension is only to look at. No tolerance applies. The symbol is to place the dimension in brackets.
Scale 4:1	This word associates the scale of the drawing and has a number ratio such as 4:1 meaning 4 inches =1 inch in actual size. Usually located in the title block for the entire print.

In-Class Activity

Directions: Draw a line from the name of the symbol or abbreviation (a short way to write a word) in Column B to the right meaning in Column A.

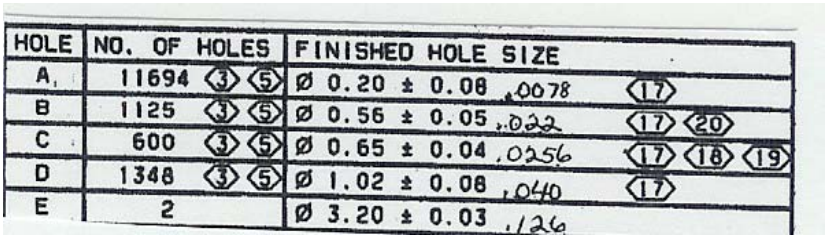
Column A	Column B
1. The unit of measure of angles.	**a. MAX** .006 MAX
2. A note that goes with a special feature.	**b. Ref** (23.345) or 23.356 REF
3. This means that the dimension is only for looking at to learn something.	**c. Delta** 
4. Abbreviation of maximum; a maximum dimension.	**d. Basic Dimension** XXXX
5. Exact place of a feature on a blueprint.	**e. Degrees** 45°
6. Distance from the center of a circle to the distance around a circle.	**f. Datum** A or -A- 
7. A place where a dimension is taken. A reference point.	**g. R** ∅ Example: 4.01∅
8. The number of times a feature happens.	**h. PLCS**

Hole (or Drill) Charts

Holes drilled in printed circuit boards are used for many reasons. Usually there are many holes on any one circuit board. There must be a way to give information about how large and where any special instructions need to be. The *hole chart* or *drill chart* is a way to organize information about holes.

In circuit board manufacturing, hole chart symbols are very different between customer drawings. In the example below, the customer uses letters – A, B, C, D, E— to name the holes on the circuit board. Hole charts may have: diameter, tolerance, how many, and type. Some charts will have more exact information.

Example:



HOLE	NO. OF HOLES	FINISHED HOLE SIZE
A	11694 ⟨3⟩ ⟨5⟩	Ø 0.20 ± 0.08 .0078 ⟨17⟩
B	1125 ⟨3⟩ ⟨5⟩	Ø 0.56 ± 0.05 .022 ⟨17⟩ ⟨20⟩
C	600 ⟨3⟩ ⟨5⟩	Ø 0.65 ± 0.04 .0256 ⟨17⟩ ⟨18⟩ ⟨19⟩
D	1348 ⟨3⟩ ⟨5⟩	Ø 1.02 ± 0.08 .040 ⟨17⟩
E	2	Ø 3.20 ± 0.03 .126

How does this customer name identify the hole types?

Does the customer give information about size?

How many holes do there seem to be of the hole type marked “A”?

Step-by-Step Blueprint Reading

Follow these five general steps when reading a new blueprint:

1. Look at the whole drawing quickly; look at the general way the drawing looks.

2. Study the Title Block to find information like: the part name, part number, tolerances, number of times it has been changed, engineer's name and sheet number.

3. Look at the *views* on the print to get a quick understanding of what is included. Example: What is the size of the part?

4. Quickly read the general *notes* to get a good understanding of what information has to do with the whole drawing

5. Once you have a good general understanding of the whole drawing, study any notes or information that have to do with exact parts of the drawing.

Post-test: Reading Blueprints

True-False

Directions: Answer each of the following questions by marking "T" if the sentence is true or "F" if the sentence is false (not true) on the blank line to the left of the sentence.

Example: **T** Customers being happy is important in a quality system.

1) ____The blueprint mapping system helps readers find locations on the print quickly.

2) ____The *title block* has all the important information about the blueprint.

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