Mech 220
Engineering Graphics
TECHNICAL DRAWINGS:
DIMENSIONING & TOLERANCING
1/3

Fall 2017-18

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Mech 220: 1st LECTURE

TECHNICAL DRAWING: REMEMBER?????

TECHNICALDRAWING is a "formatted document that specifies the required attributes of a part to be manufactured or produced".

DRAWING ATTRIBUTES:

1. **GEOMETRIC:**

   dimensions & tolerances

   factors of form (flatness, squareness..)

2. **CONSTRUCTION:**

   material, assembly, finish,..

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DIMENSIONING

- Dimensions are used to describe the sizes and relationships between features in your drawing.
- Dimensions are used to produce or built parts, inspect the resulting parts and determine if they are acceptable.
- Drawings with dimensions and notes often serve as construction documents and legal contracts.
- ANSI Y14.5M-1994 is the current standard. Other standards may apply.

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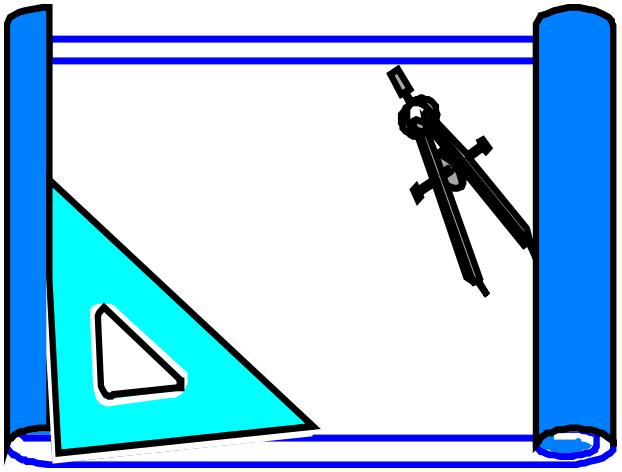
Standards for Your Career Field



- Standards are different in different career areas.
- Mechanical Civil, Electrical, Construction, and other areas follow similar practices, but the precision in measurements characterizes each trade.
- Dimensioned drawings are a part of a contractual document.

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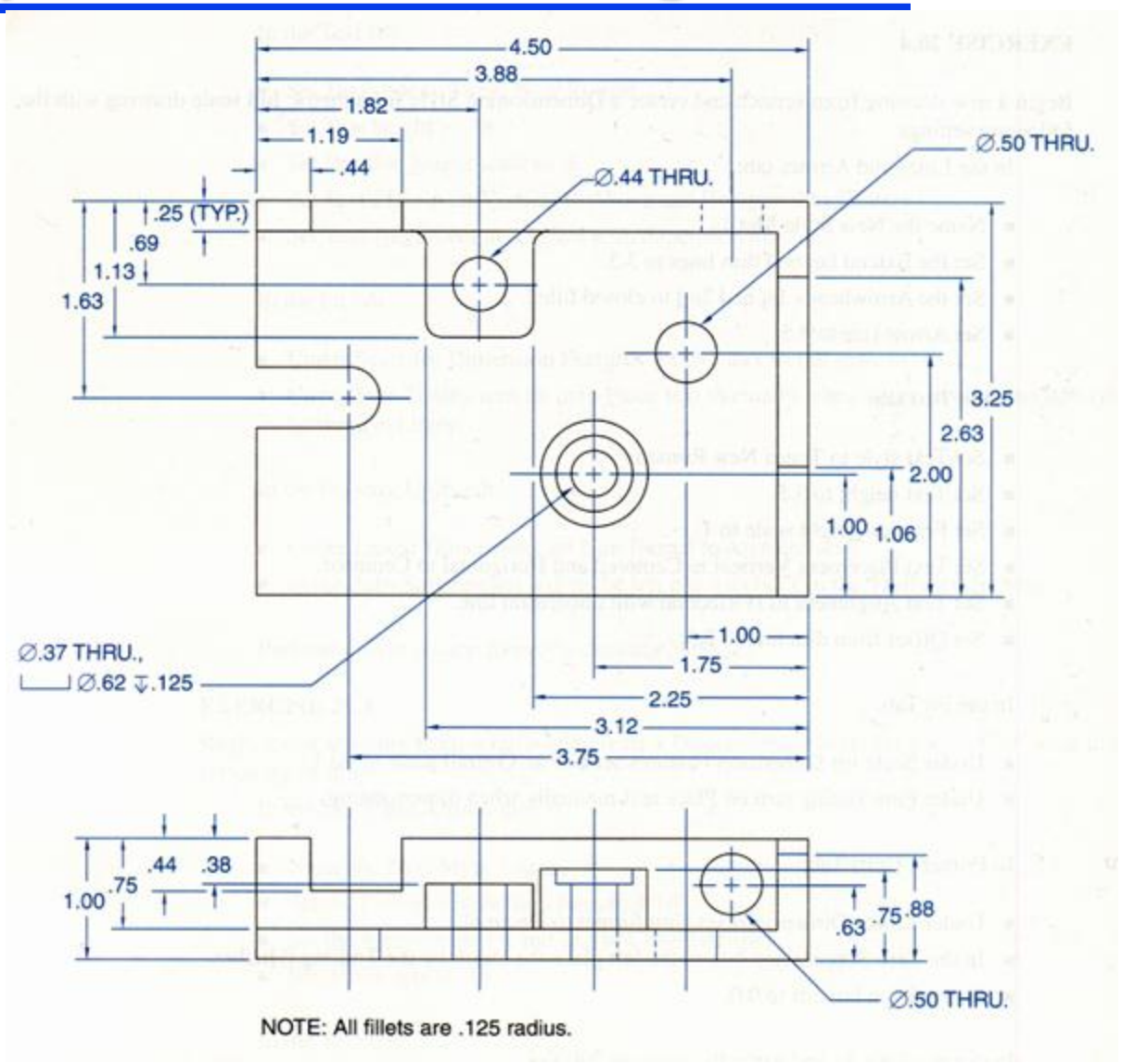
DIMENSIONING

Example of a properly dimensioned drawing

- Every Object has three dimensions describing each of the geometric shapes making up the object “height, width and depth”.
- Selecting the dimension position requires more consideration than selecting dimension



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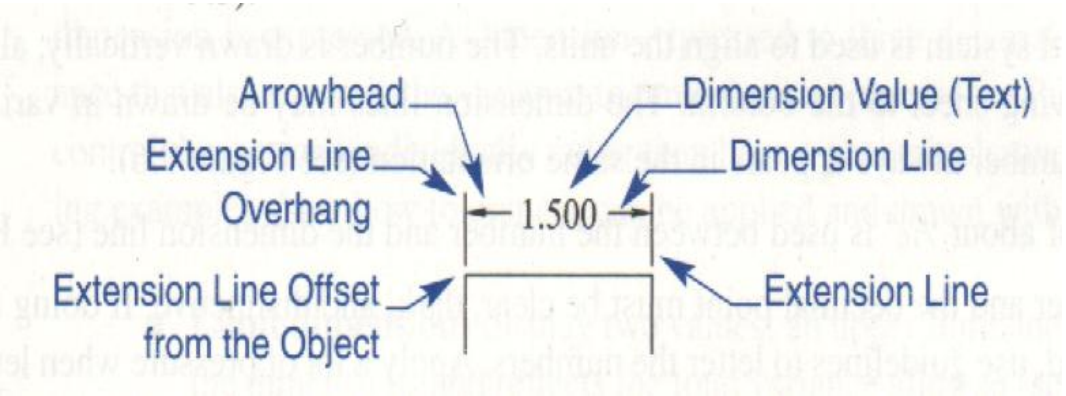
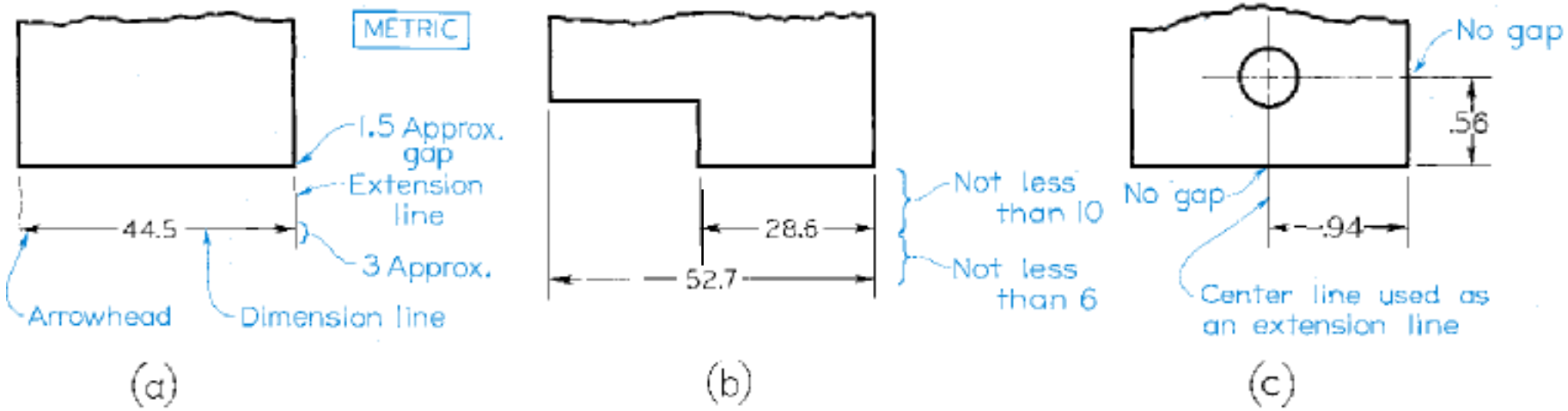
DIMENSIONING

anatomy of a dimension

- Dimension line, Extension line, Leader, Dimension offset or gap, Centerline,
- Finish mark, Dimension value
- Baseline dimensioning, Chained dimensioning





THE DIMENSION VALUE

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DIMENSIONING:

What is a dimension?

- **DIMENSIONS: the linear or angular sizes of a component specified on the part drawing.**

- **ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE) is the leading authority on standards in the U.S.**

  Publication Y14.5-1994 defines a dimension as:

  > **"numerical value expressed in appropriate units of measure and indicated on a drawing and in other documents along with lines, symbols, and notes to define the size or geometric characteristic; or both, of a part or part feature".**

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DIMENSIONING:

the dimension value –English units

- **ENGLISH UNITS are based on the inch (”) unit.**

Other common English units are the foot and the mil. Where:

1 foot = 12 inches

1’ = 12”

for example 0.5’ = 6”

1 mil = 0.001 inches = 1/1000 of an inch

for example 50 mils = 0.050”

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DIMENSIONING:

the dimension value –SI units

- **SI (System International) UNITS are based on the meter (m) unit.**

Other common SI units are the cm and the mm. Where:

1 m = 100 cm

& 1 m = 1000 mm

for example 50 mm = 5 cm = 0.05 m

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DIMENSIONING:

the dimension value – Linear Dimension Types

- Decimal 15.50”
- Engineering 1’-3.50”
- Architectural 1’-3 1/2”
- Fractional 15 1/2”
- Scientific 1.550E+01

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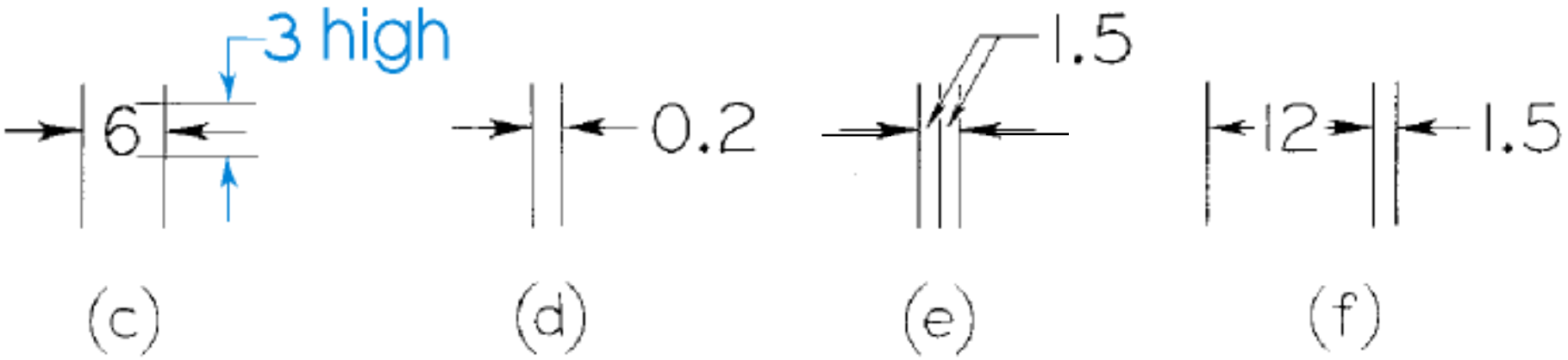
DIMENSIONING:
Dimension Values



- Values should be lettered in a vertical or inclined style.
- The common practice is to leave a space in the dimension line for the dimension value.
- The dimension height should be not less than 0.125" when dealing with English system of units or 3mm when dealing with the SI system.

DIMENSIONING:

the dimension value- proper drafting

PROPER DRAFTING OF THE DIMENSION VALUE

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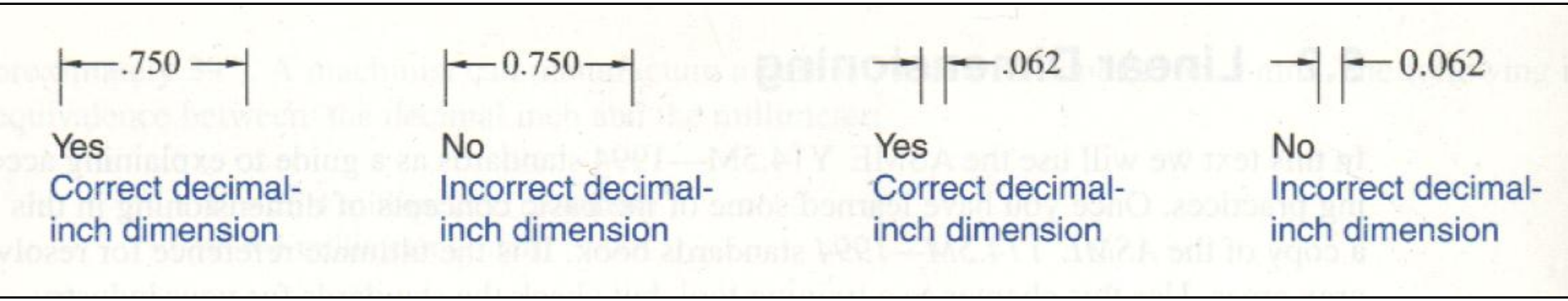
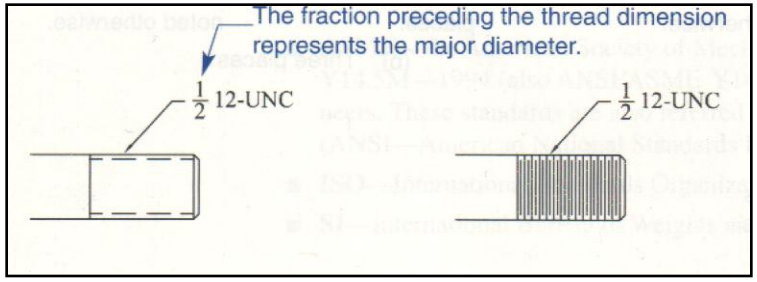
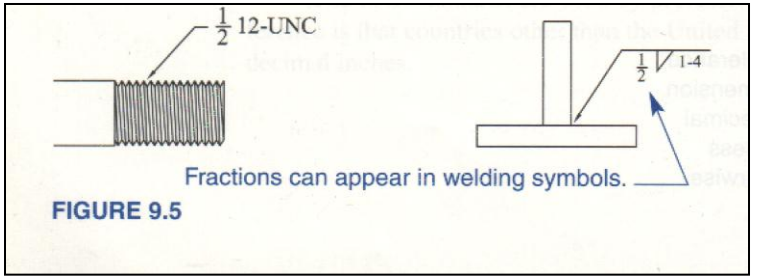
DIMENSIONING

the dimension value- proper drafting for *English* units



1) Do not use a zero before the dimension if value < 1





2) Do not use fractions unless it calls symbols (thread, welding, etc..)

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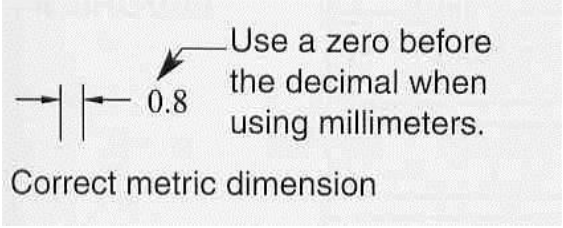
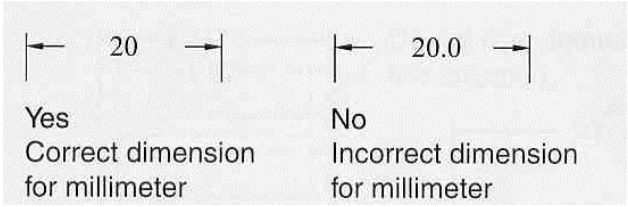
DIMENSIONING

the dimension value- proper drafting for *metric* units

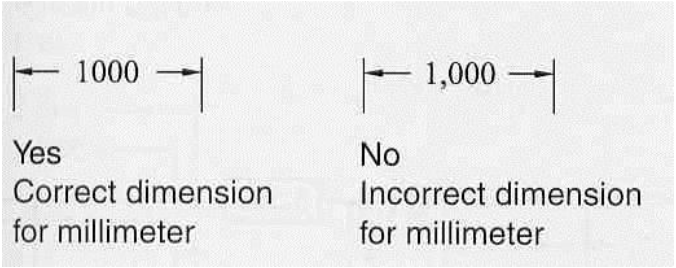
1) Do use a zero before the dimension if value < 1



2) Do not use a digit if value is exact



3) Do not use commas



DIMENSIONING:

dimension line and extension line

DIMENSION LINE

and

EXTENSION LINE

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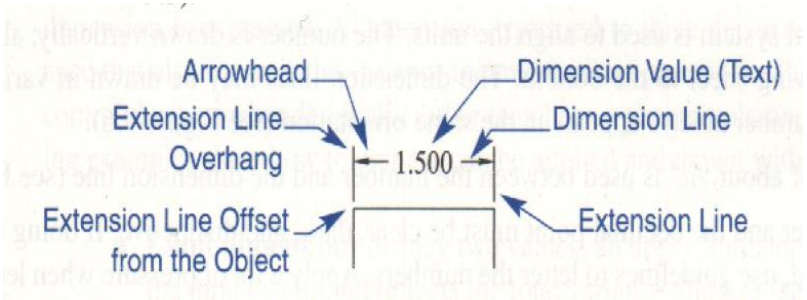
DIMENSIONING:



- Extension Lines should not Touch the outline of the view but should start about 1/16' from the outline of the object and extend about 1/8' beyond the last dimension line.
- Extension lines should not be broken where they cross each other or an outline of the view.
- Where a measurement between centers is shown, the center lines are continued to serve as extension lines.
- Extension lines for an angular dimension are shown with one of the extension lines used for a linear dimension.

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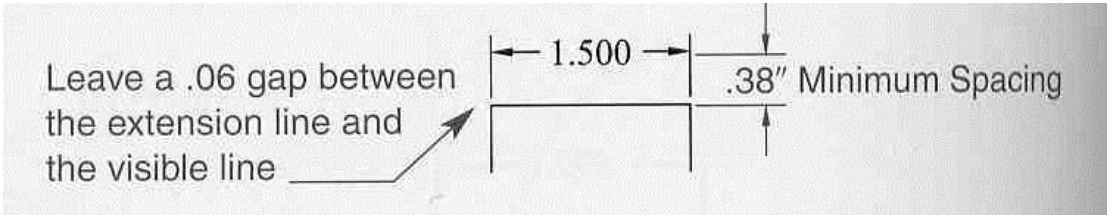
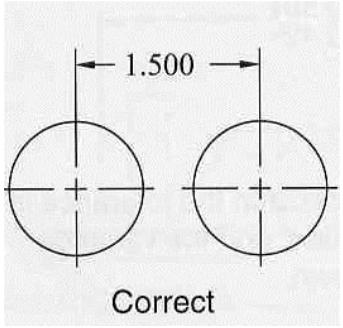
DIMENSIONING

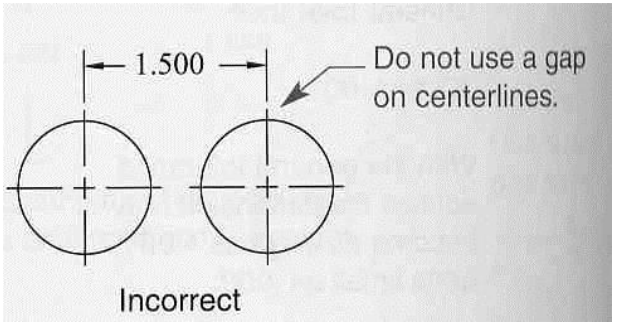
dimension line - proper drafting

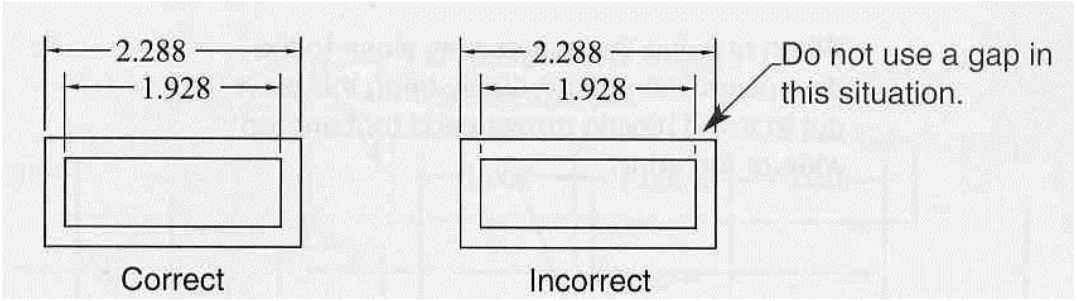
GRAND RULE



EXCEPTIONS







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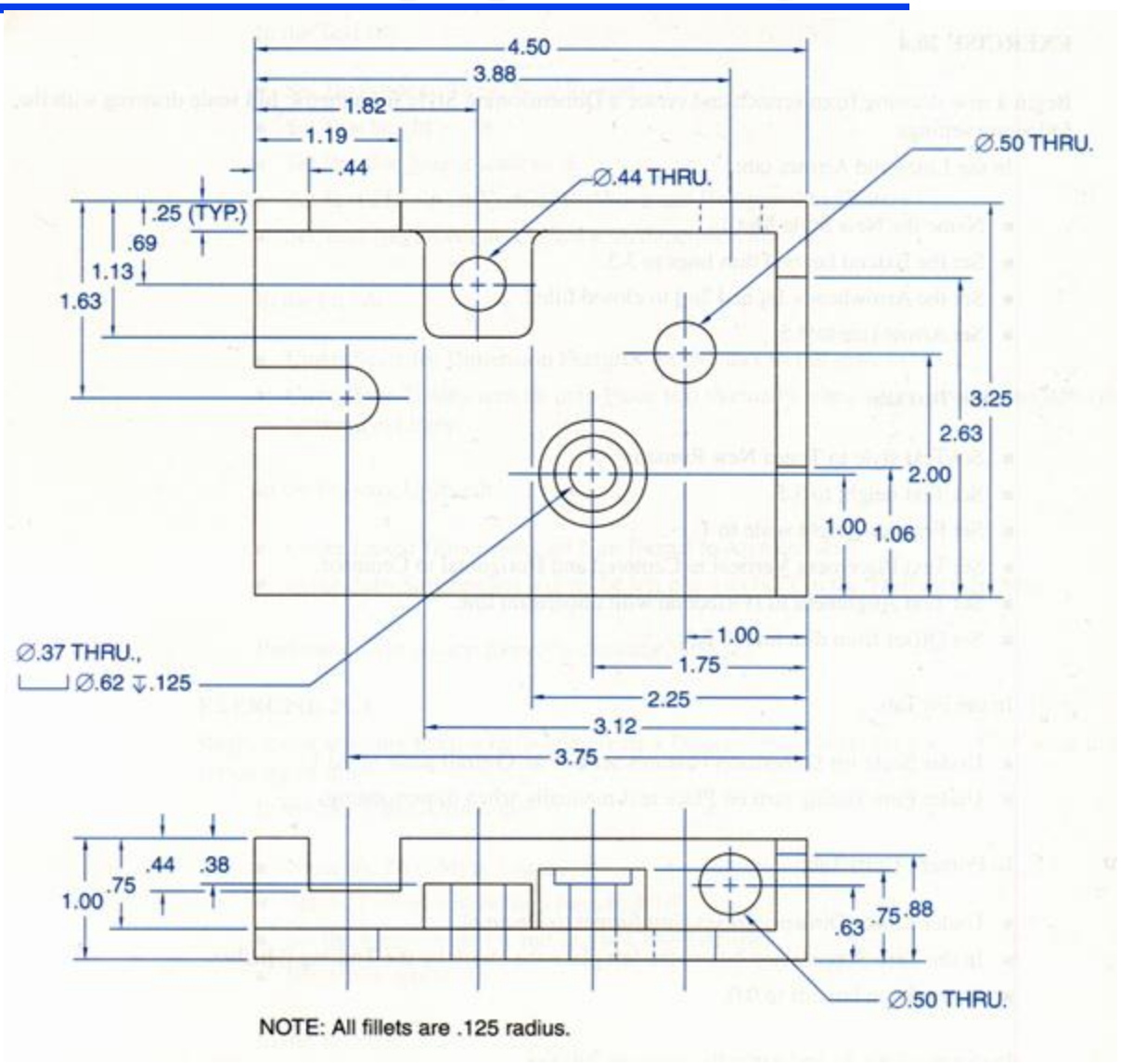
DIMENSIONING

dimension line and extension line - proper drafting

VERSATILITY IN ARRANGING:

DIMENSIONS, DIMENSION LINES, EXTENSION LINES

- **This versatility is allowed when there is not enough room for the arrows or dimensions.**



DIMENSIONING:

arrowhead

ARROWHEAD

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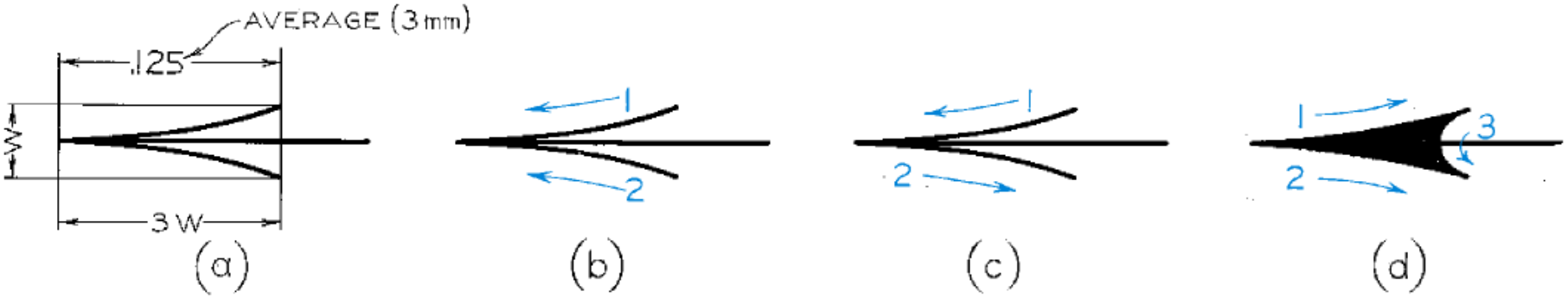
DIMENSIONING:
Dimensioning Technique

- Arrowheads are required to be placed on the ends of a dimension line or at the end of leader line for notes.
- The arrow head size is proportional to the text height "3W".



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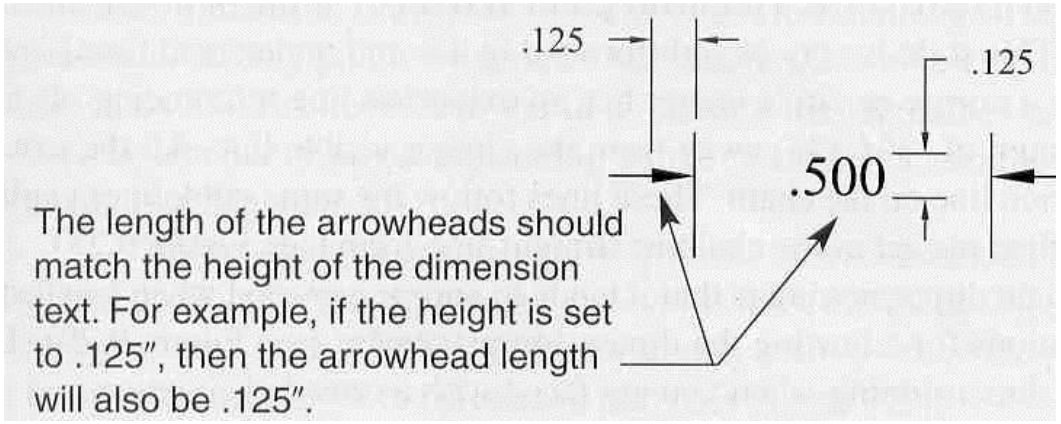
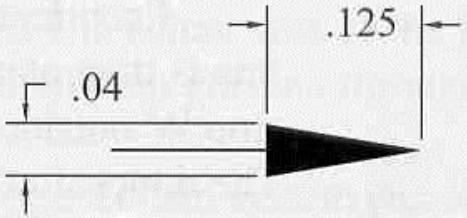
DIMENSIONING

arrow head - proper drafting

GRAND RULE



The length of the arrowheads should match the height of the dimension text. For example, if the height is set to .125″, then the arrowhead length will also be .125″.



A typical arrowhead's width is one-third of its length. In this example .12″ x $\frac{1}{3}$ = .04″.

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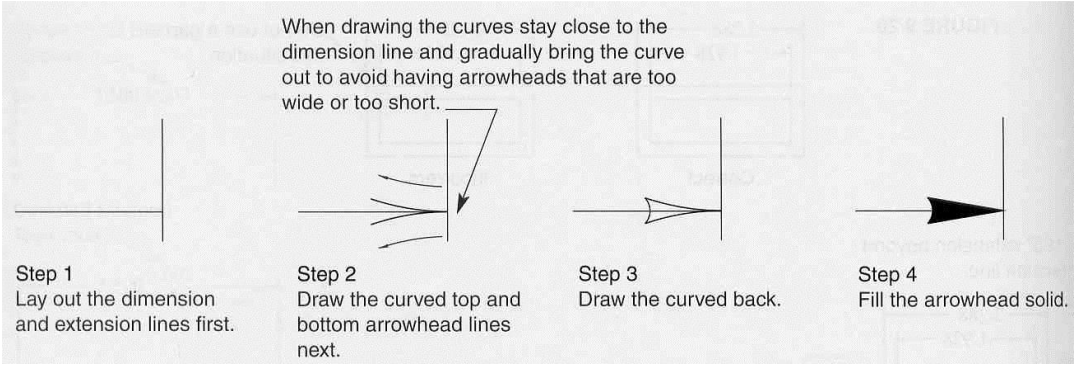
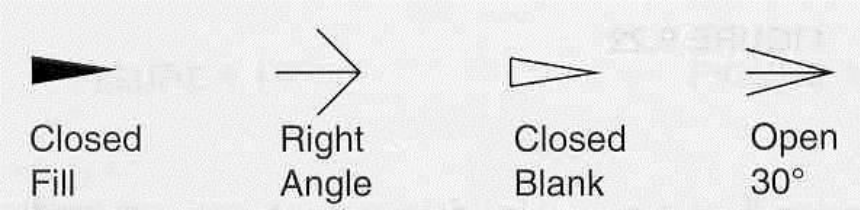
DIMENSIONING

arrow head - proper drafting

MANUAL DRAFTING



DRAFTING w/ AUTOCAD



THE TOLERANCE

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TOLERANCING:

Tolerance Definition

- ANSI Y14.5-1994 quotes that:

  "a Tolerance is the total amount by which a specific dimension is permitted to vary (from nominal) . The tolerance is the difference between the maximum and minimum limits"

- Essentially, a (part's or part feature's) dimension tolerance is set by the design engineer taking into consideration the manufacturing process limitation and CO$T.
- The less variation allowed, the more the part will CO$T to construct.

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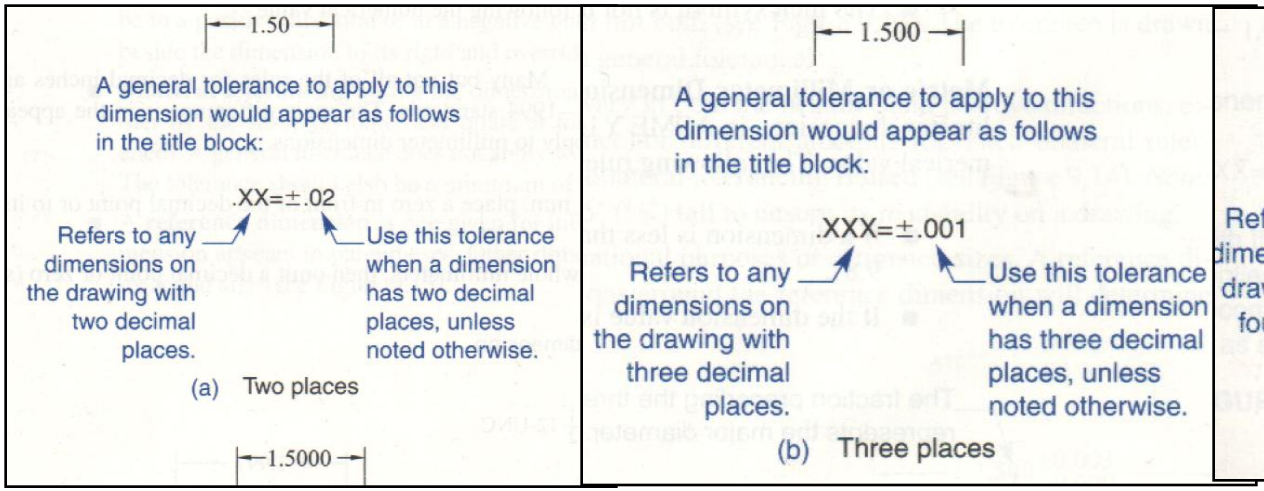
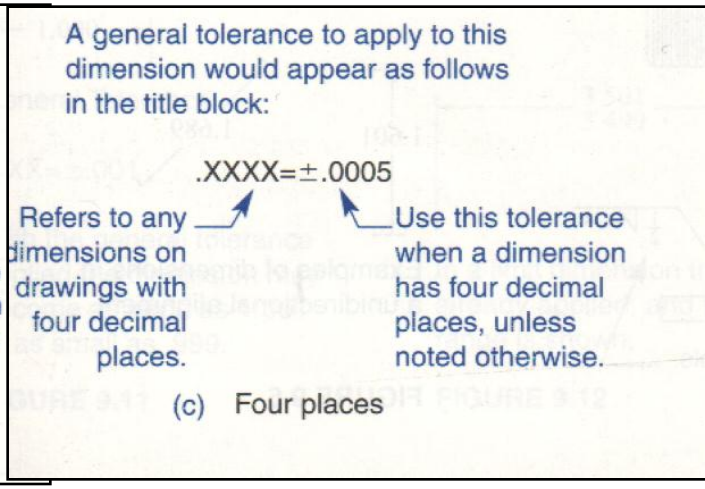
TOLERANCING

the dimension value – tolerance





- **Within the title block of your drawing the general tolerance is shown.**
- **The number of Xs to right of the decimal represents tolerance found in the general tolerance note.**

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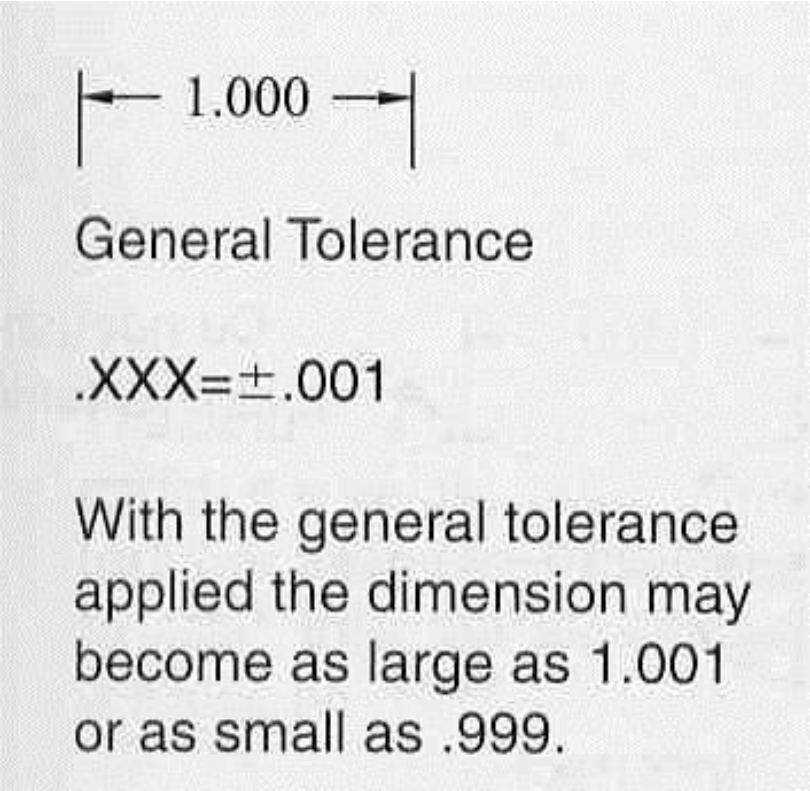
TOLERANCING

the dimension value- types of tolerance

general tolerancing



- **A dimension expressed to three decimal places have a tolerance that controls the variance to three decimal places.**

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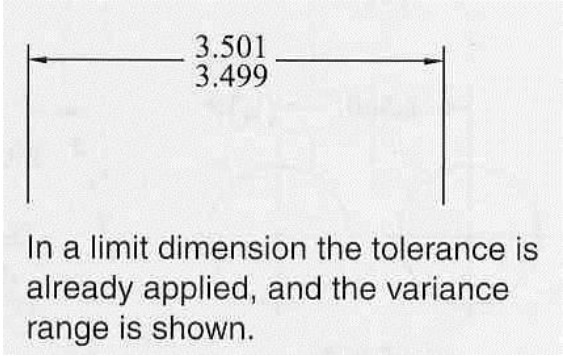
TOLERANCING

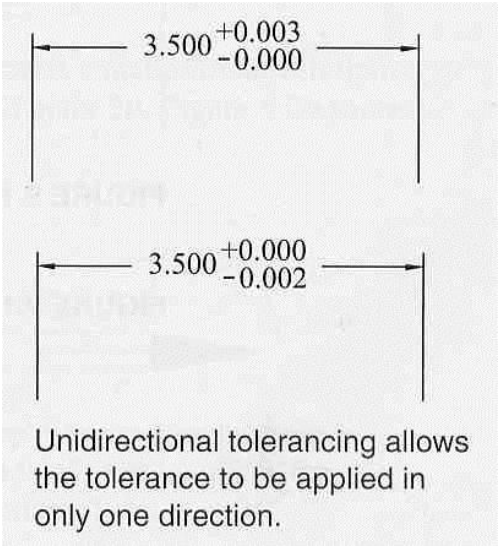
the dimension value- types of tolerance

limit tolerancing



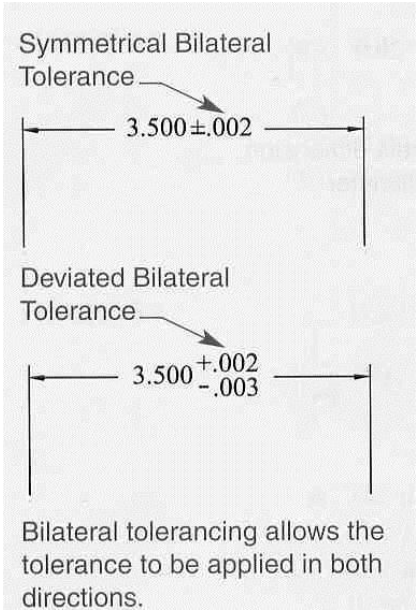
In a limit dimension the tolerance is already applied, and the variance range is shown.

unidirectional tolerancing



Unidirectional tolerancing allows the tolerance to be applied in only one direction.

bilateral tolerancing



Bilateral tolerancing allows the tolerance to be applied in both directions.

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DIMENSIONING

dimensioning & tolerancing - more

BASIC dimension

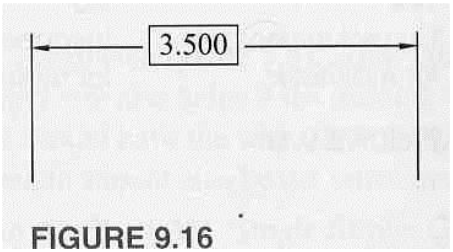

FIGURE 9.16

- **Basic Dimension** is the theoretical exact size, it is enclosed in a rectangle.

Reference dimension

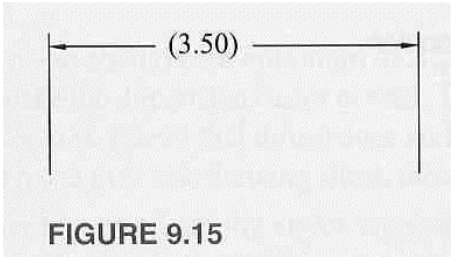

FIGURE 9.15

- **Reference Dimension** is given for information purposes, it appears within parentheses.

Not-to-scale dimension

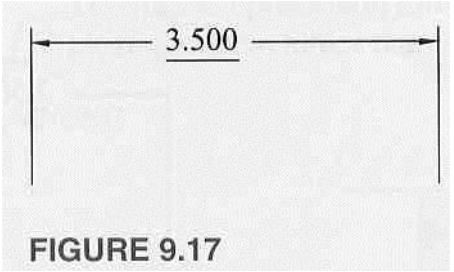

FIGURE 9.17

- **Note to scale** dimension indicates that the dimension is inconsistent with the scale of the drawing

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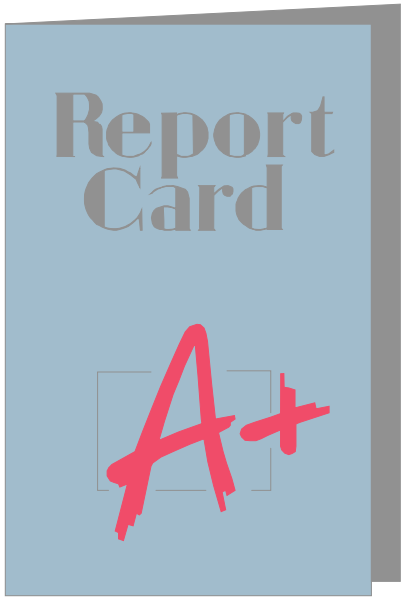
DIMENSIONING:
3 Things for Good Dimensioning



- Good technique of dimensioning
- Good choice of dimensions
- Good placement of dimensions

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DIMENSIONING:
Dimensioning Technique

- Describes how the dimensions in your drawing should look.
- Defined by various standards like ANSI Y14.5-1994.
- Help you create dimensions that are plainly visible and can be easily interpreted.
- Specifies sizes for creating dimensions relative to the paper size of your final plot.

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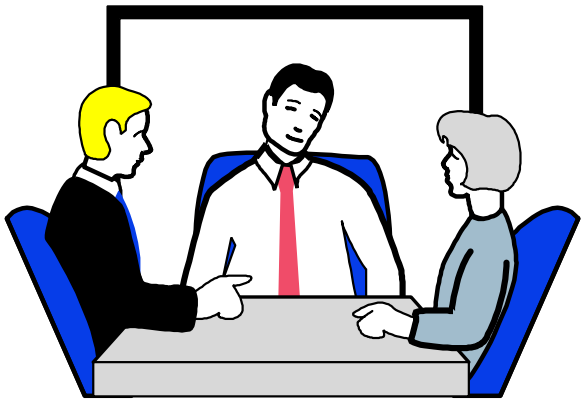
DIMENSIONING:
Placement of Dimensions

- Rules-of-thumb for dimension placement help ensure that others will be able to interpret your drawing
- Where placement practices conflict, remember that your goal is to *clearly communicate* the purpose of the drawing. Use the practice you feel will make the drawing easy to understand.



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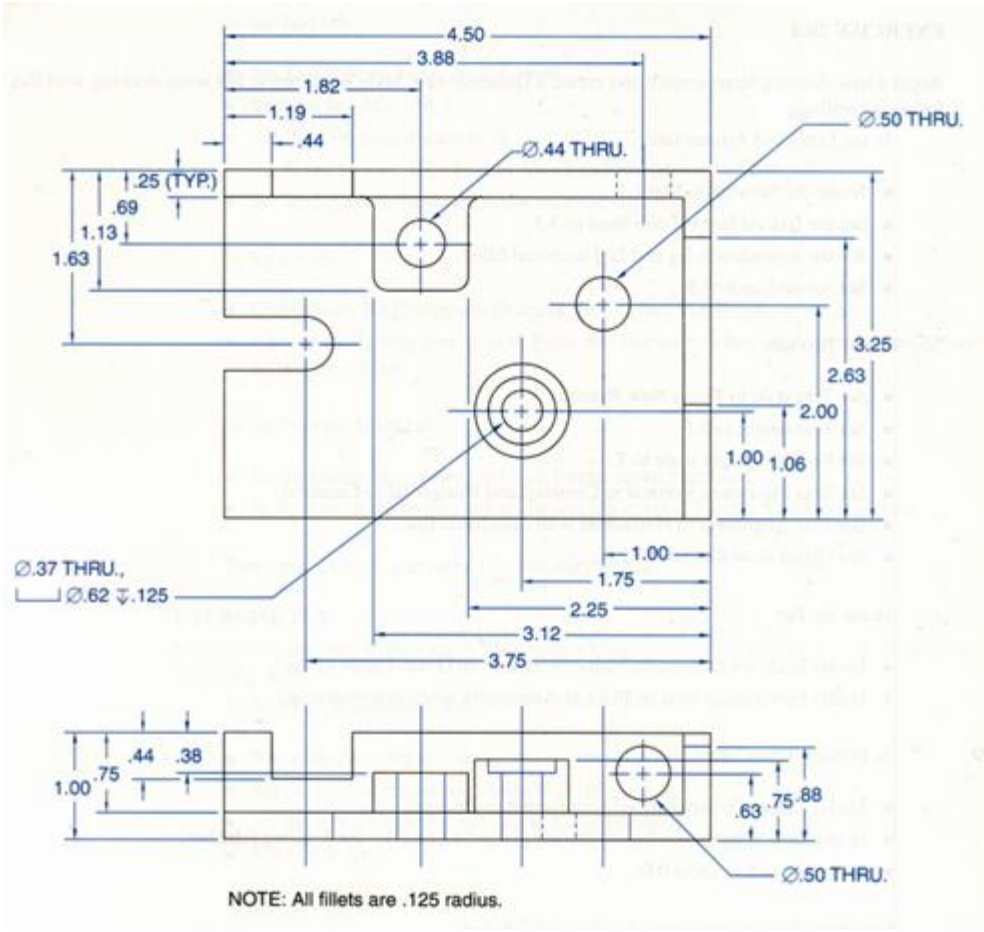
DIMENSIONING:
Placement Practices

- Avoid dimensioning to hidden lines.
- Place dimensions between views when possible.
- Don't "float" dimensions.
- Group dimensions around a central view. Place dimensions where feature shows shape.
- Dimension from or between machined surfaces
- Give overall dimensions where possible.
- Don't dimension to rectangular view centerlines.



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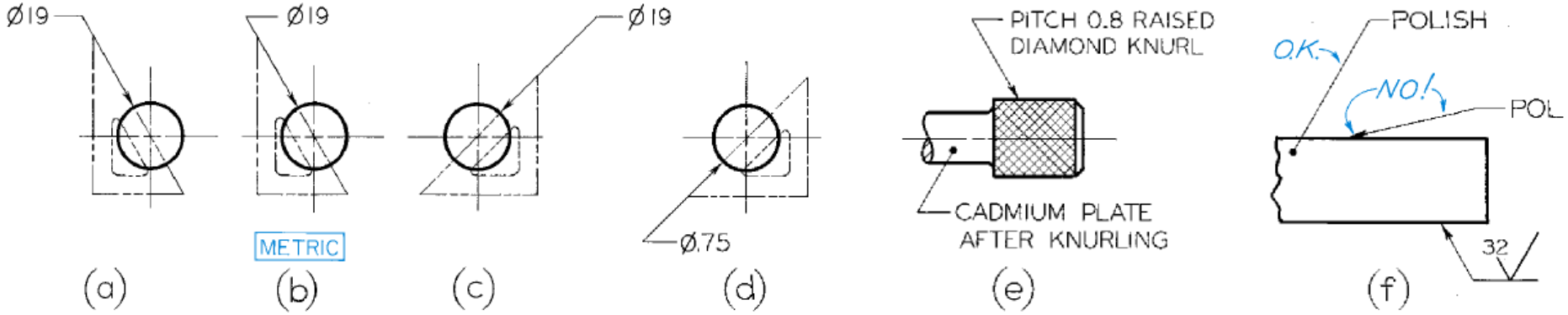
DIMENSIONING:

Leaders



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DIMENSIONING:

Assignment Next Week

- Posted On moodle

Thank you