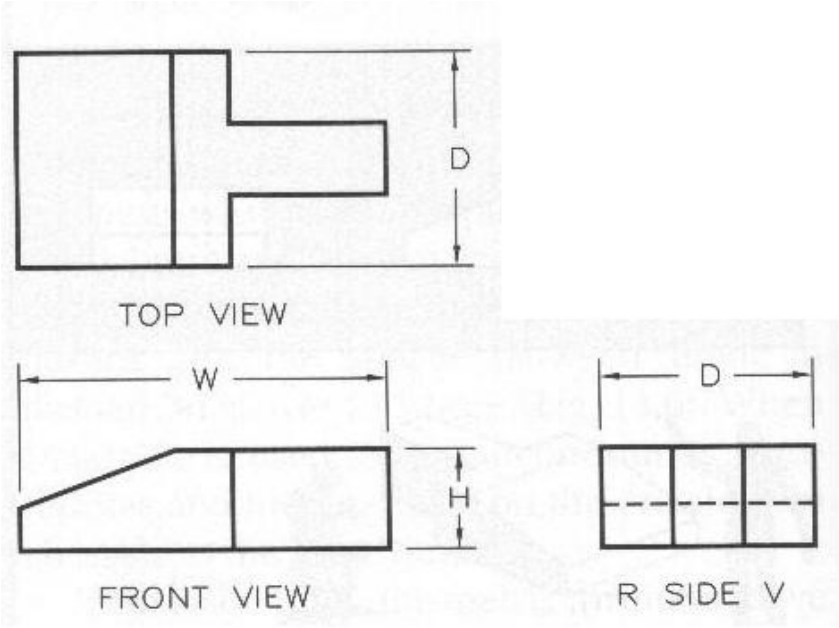
ECOR 1010
Lecture 6

Engineering Graphics - 2

Standard Drawing Layout

- The standard arrangement for a technical drawing is a three-view orthographic projection:
  - Top view is located above front view
  - Right view is located to the right of frontview
- The views must be aligned



Orthographic Projection - Lines

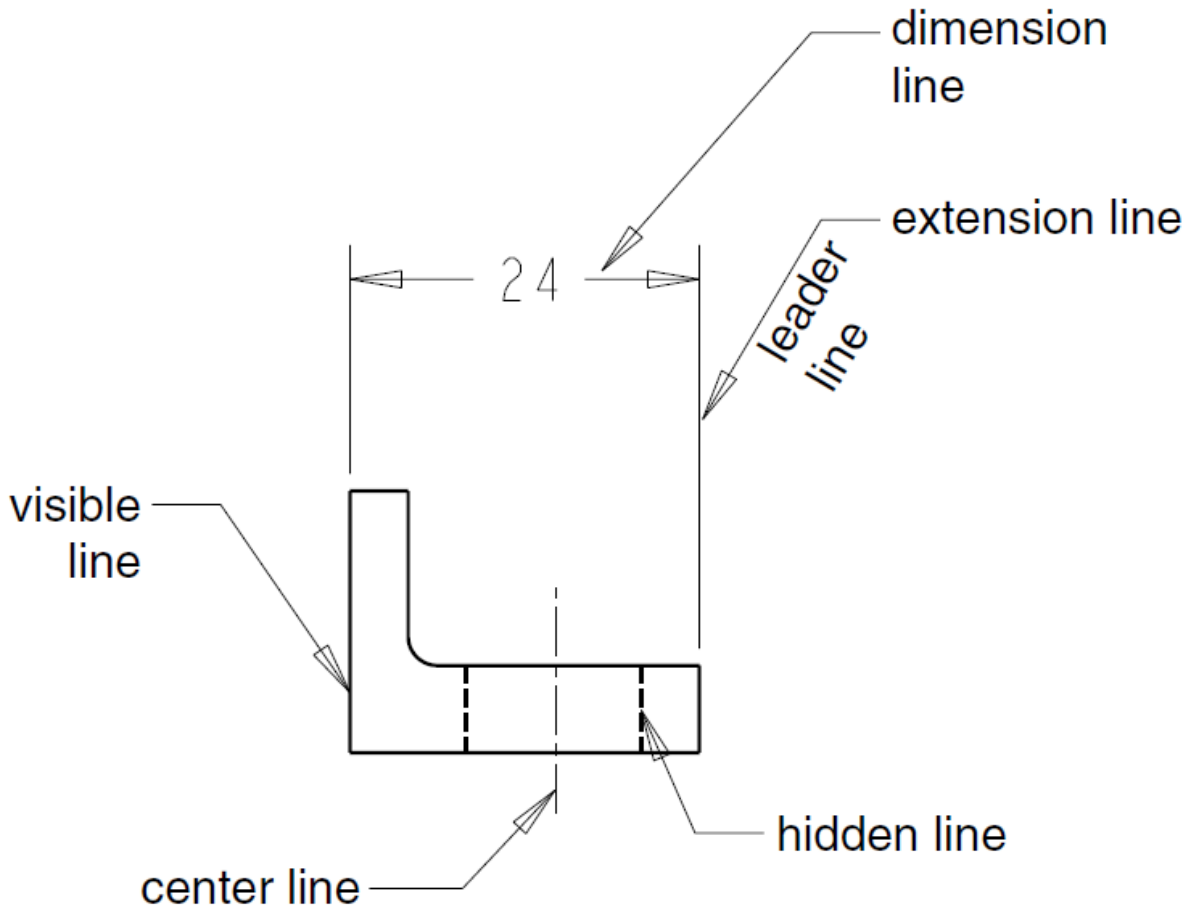
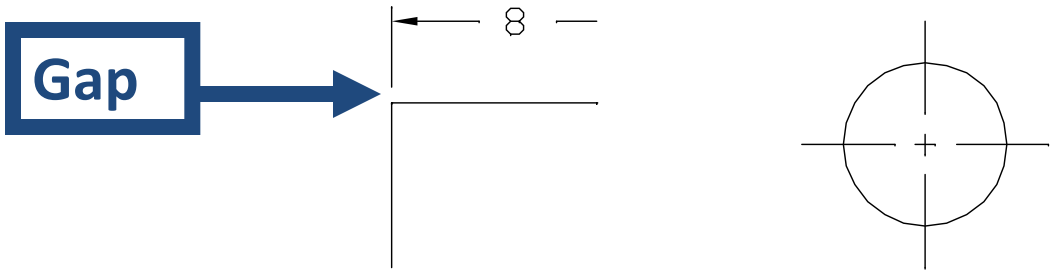


Figure 14.3 Types of lines used in drawings.

Extension and Centre Lines

- Conventions:
  - Leave a gap between the end of an extension line and the object to which it refers (a)
  - The short dashes of crossing perpendicular centre lines form a small cross (b)



(a)

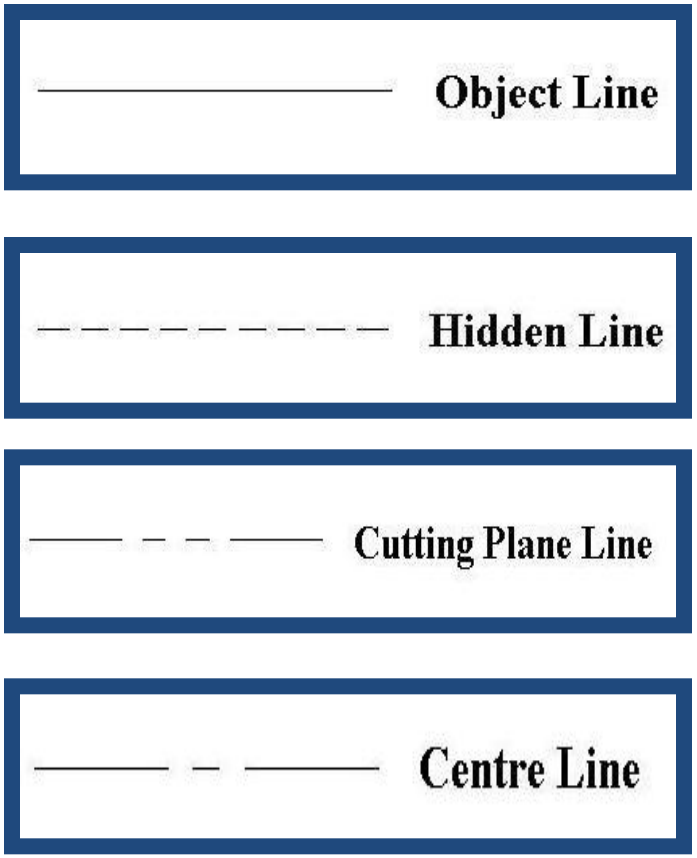
(b)

Orthographic Projection - Lines

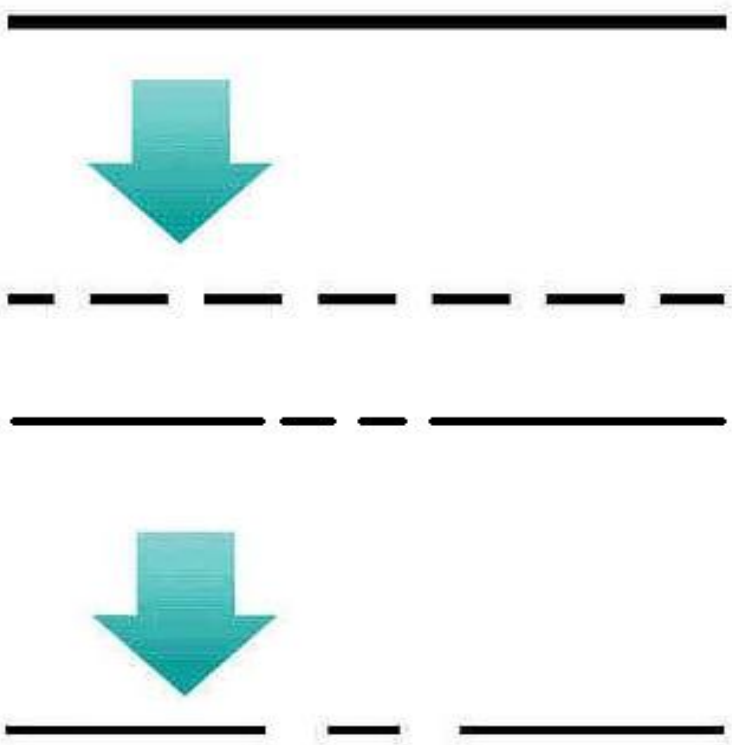
- When two or more lines coincide, there is a convention called ‘precedence of lines’ to establish which is visible
  - Visible object lines
  - Hidden lines and cutting plane lines
  - Centre lines
  - Extension & leader lines

Line Types

- **Object Lines:** indicate all visible edges of an object; must stand out and be apparent to the eye
- **Hidden Lines:** shows object lines that are hidden from view
- **Cutting Plane Lines:** indicates edge view of an imaginary cutting plane
  - Define section views
- **Centre Lines:** indicates centres of holes and symmetrical features of an object



Line Type Precedence

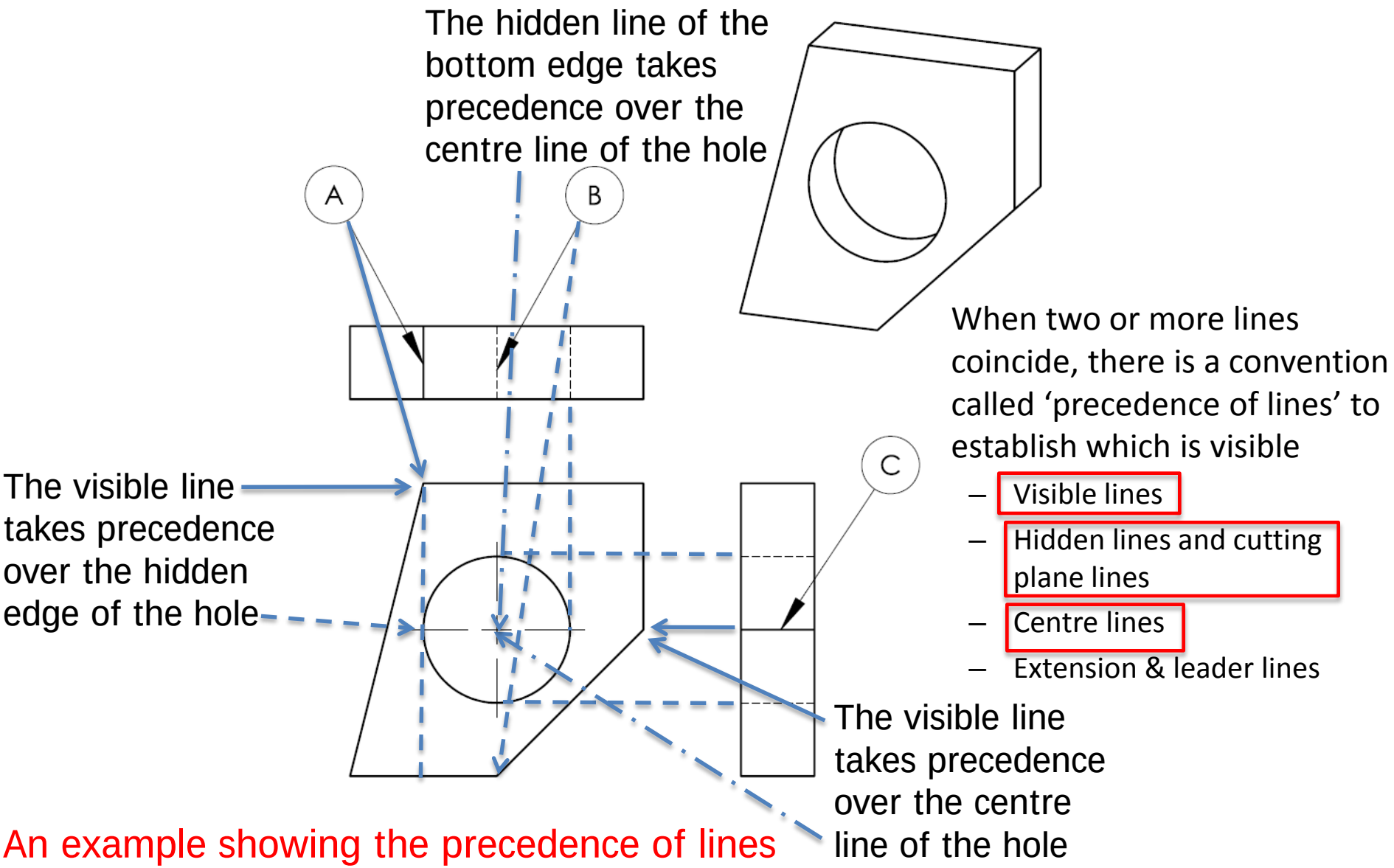


VISIBLE LINE takes precedence over all other lines

HIDDEN LINE
and
CUTTING PLANE LINE
take precedence over center lines

CENTER LINE does not have precedence

Orthographic Projection - Lines



When two or more lines coincide, there is a convention called 'precedence of lines' to establish which is visible

- Visible lines
- Hidden lines and cutting plane lines
- Centre lines
- Extension & leader lines

An example showing the precedence of lines

Dimensions

- Two fundamental rules for dimensioning:
  - Dimensions must describe the complete geometry of the part
  - Redundant dimensions should be avoided
- More specific rules apply to the type of geometry and the placement, and style of the dimension

Dimensions

- Dimension from visible lines, not hidden features
- Repeated regular identical features may be dimensioned once along with a small note indicating quantity, etc ...
- The designer should locate dimensions in a way to indicate how tolerances accumulate

Dimensions – Example

- The repeated geometry of the holes is indicated by '2x'
- Figure (a) is incorrect.
- Figure (b) shows that the distance between the two holes is important
- Figure (c) shows that the distance from the centre of the right hole to the left edge is important

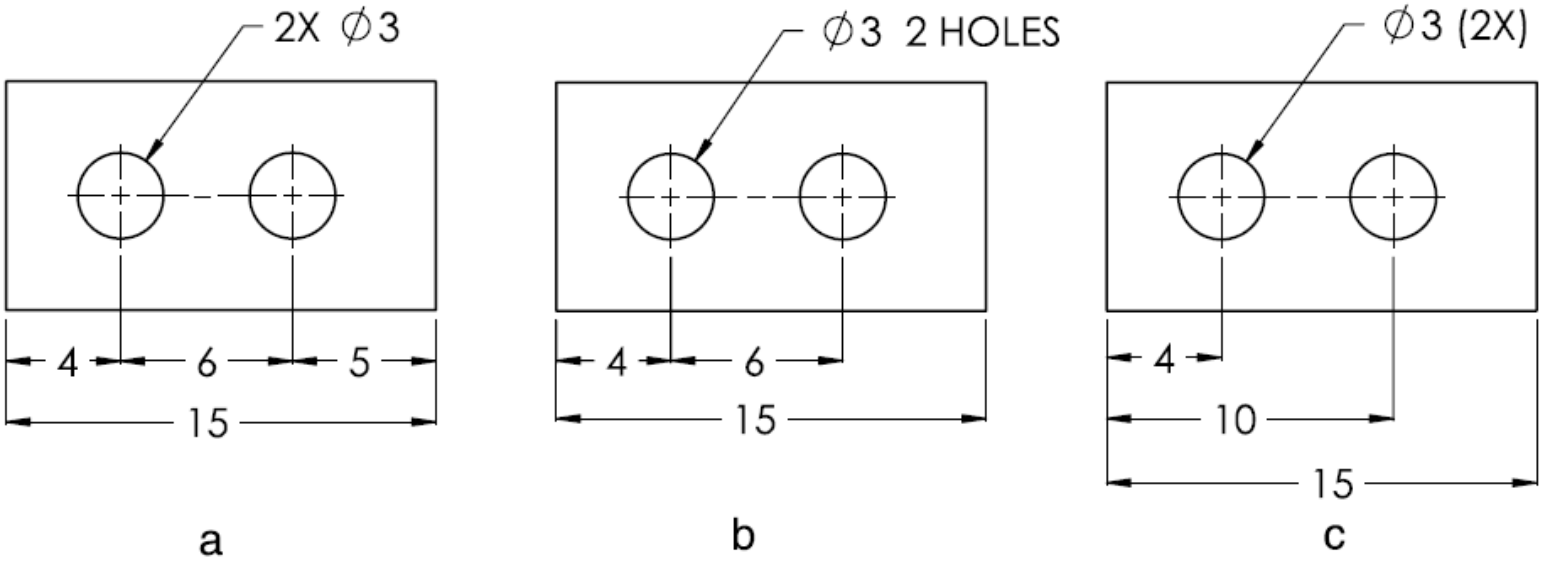


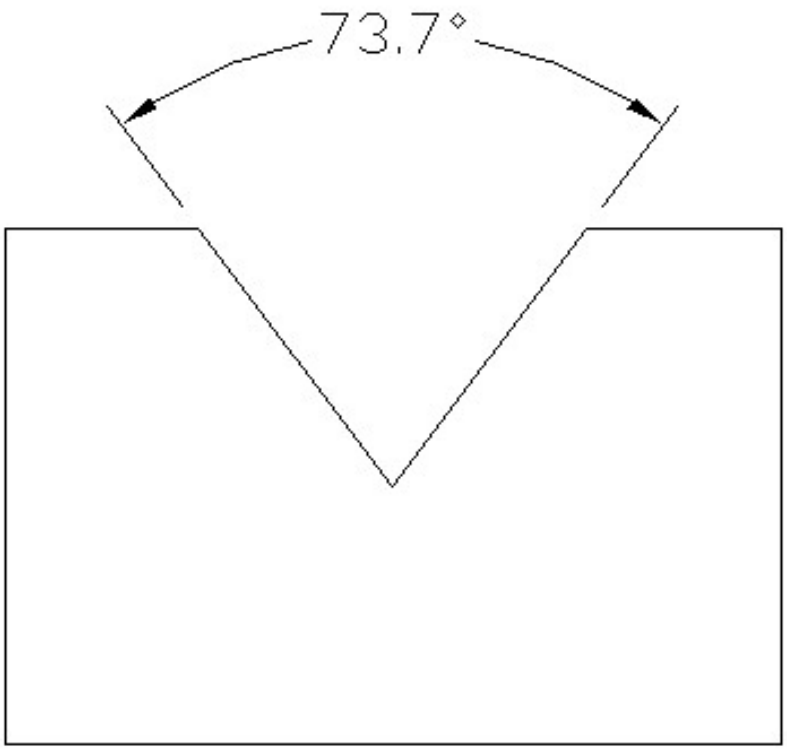
Figure 14.5 (a) An overdimensioned drawing; (b) A dimensioning scheme that emphasizes the 6-mm distance between the holes; (c) A dimensioning scheme that emphasizes the distance from the left edge to each hole.

Dimensions

- Circles and arcs (see previous example):
  - Radii are dimensioned using a leader line with an arrow at the end of the line
    - A capital “R” indicates radius
    - Dimension rounds and fillets with their radii
  - Similarly, a diameter has a leader line with an arrow
    - The symbol ∅ indicates diameter
    - Never dimension holes or cylinders with radii … use diameter
- Angles:
  - Fractional degree measurements can be represented with decimals or minutes and seconds
  - Dimension lines are drawn as arcs

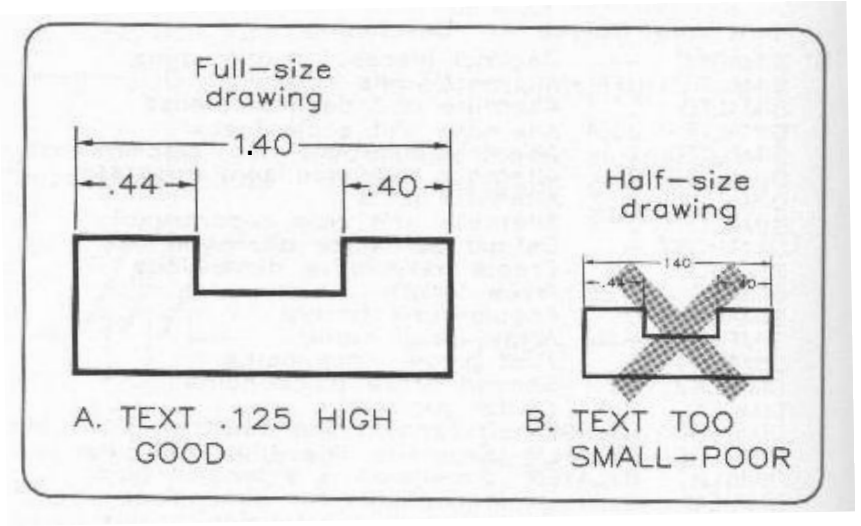
Dimensions

- Angle dimension example:



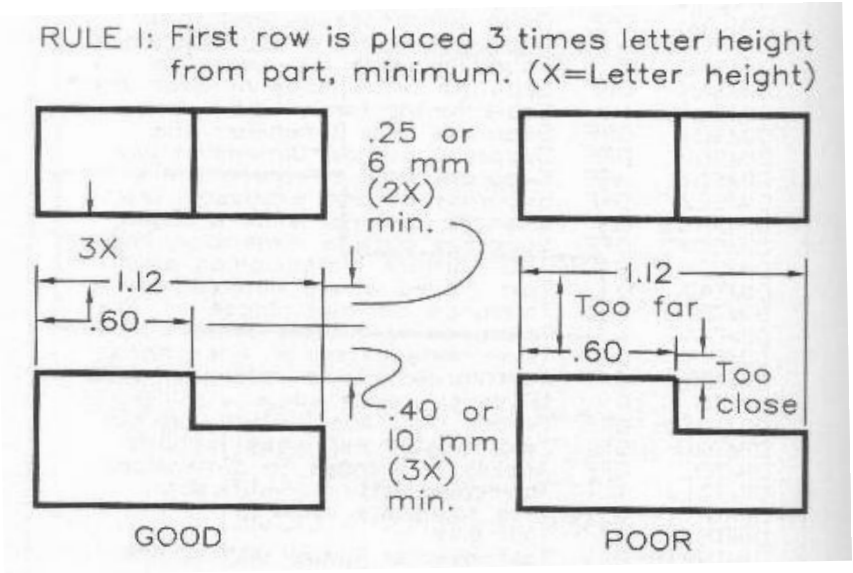
Dimensioning: Rule Zero

- When dimensioning a drawing, set the dimensioning variables so the text is readable when the drawing is printed in its final size
  - In IntelliCAD dimscale is the most useful command for scaling the dimension variables (text size, arrow head size, offsets, etc.)



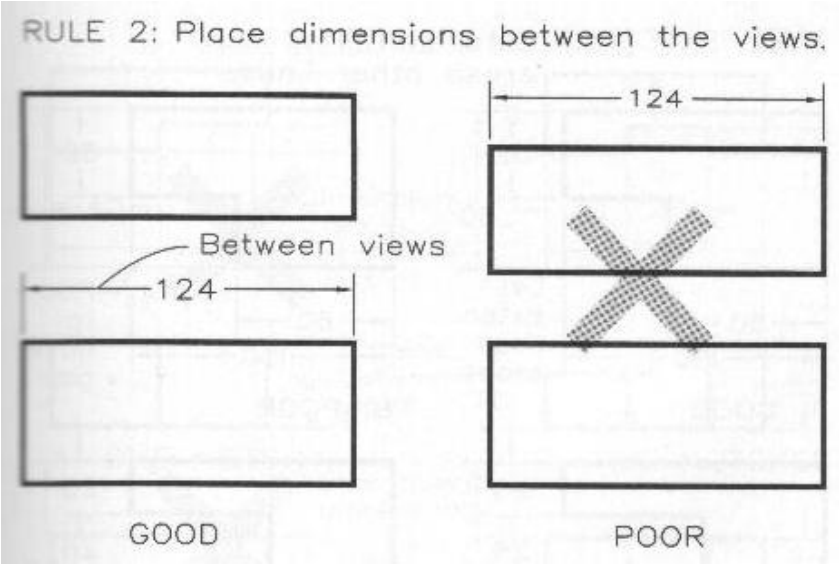
Dimensioning: Rule 1

- The first dimensions should be three times the letter height from the object
- Successive dimensions should be two times the letter height apart



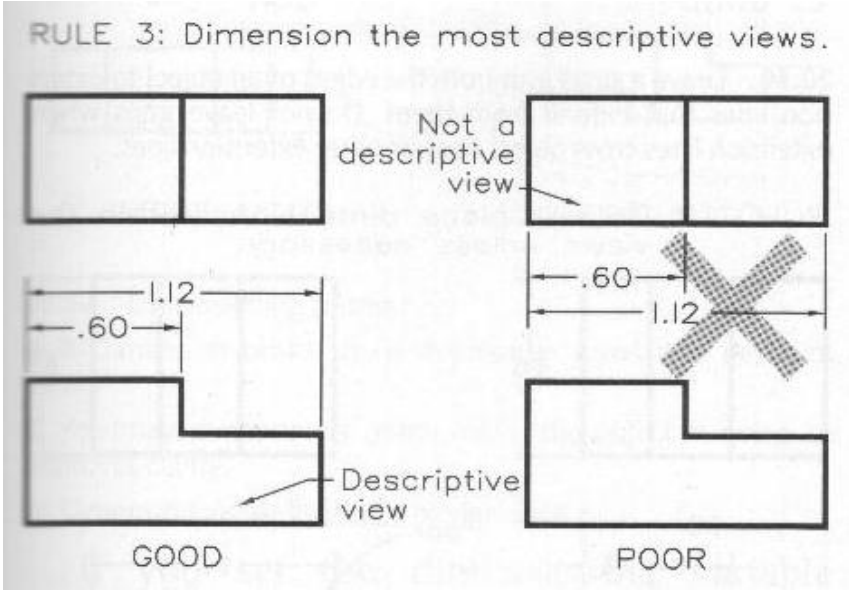
Dimensioning: Rule 2

- Place dimensions between the views sharing the same dimensions



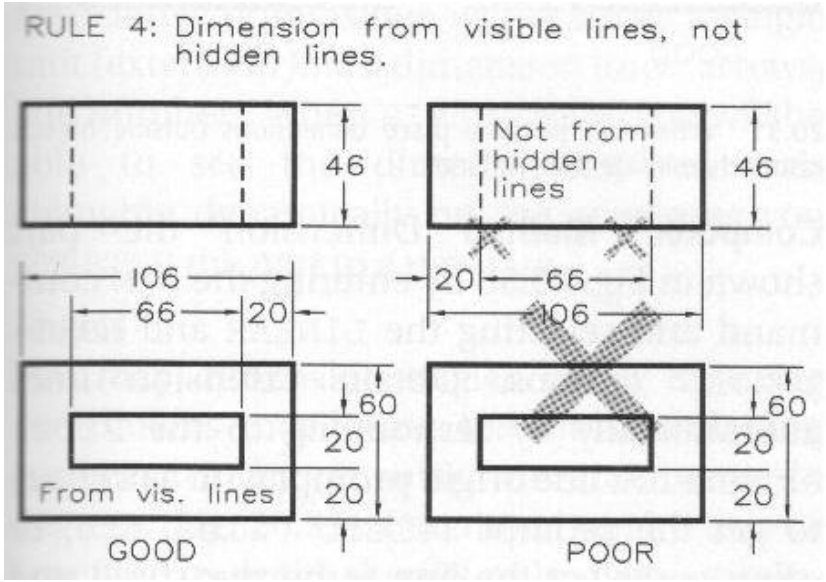
Dimensioning: Rule 3

- Dimension the most descriptive view



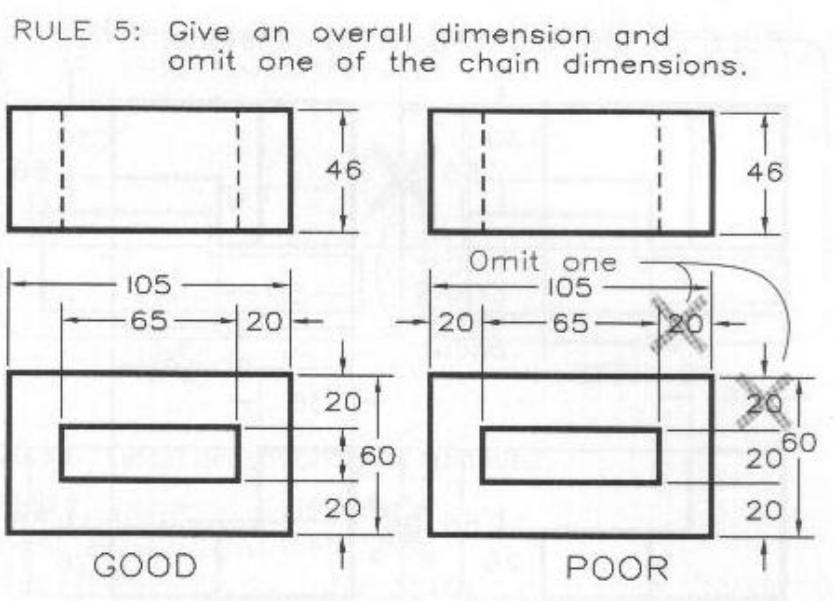
Dimensioning: Rule 4

- Dimension from visible, not hidden features



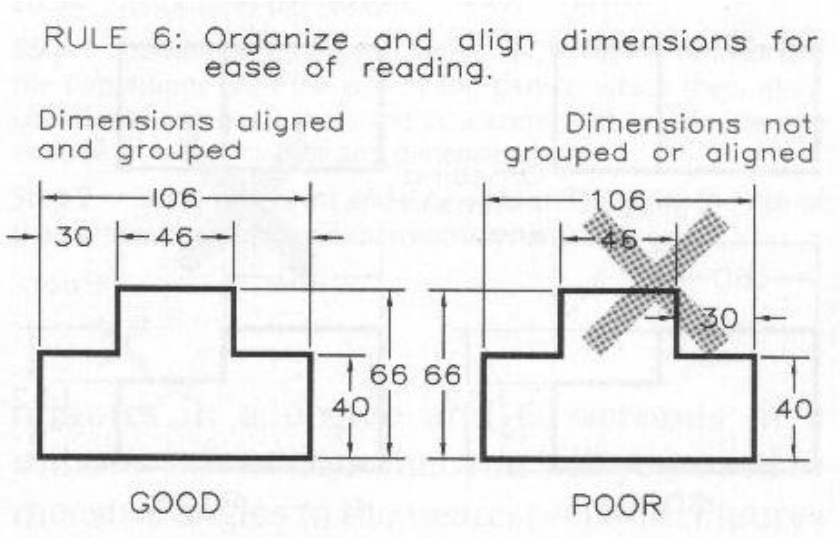
Dimensioning: Rule 5

- Give an overall dimension, omitting the last in a chain of dimensions



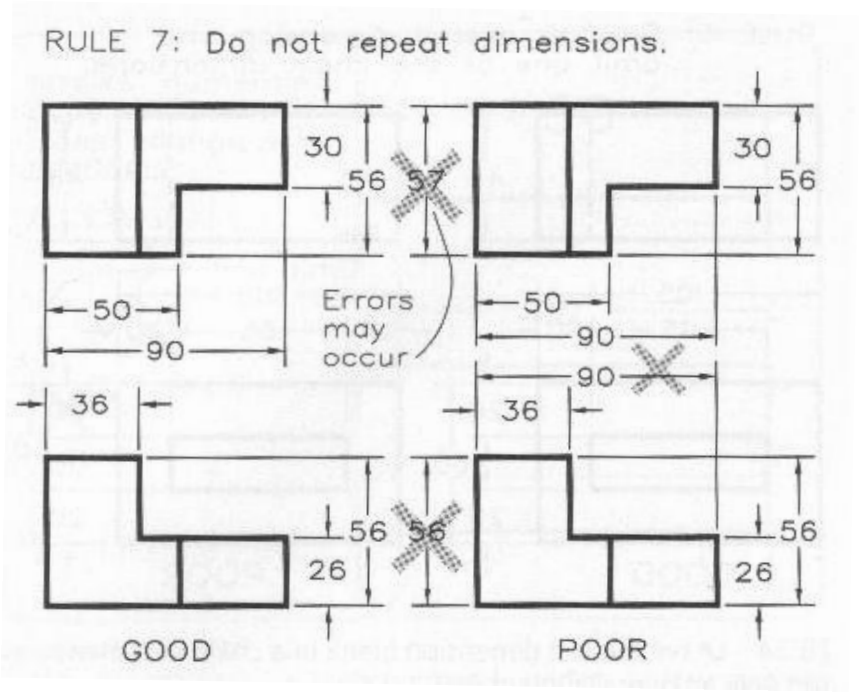
Dimensioning: Rule 6

- Organize the dimensions to reduce clutter in the drawing



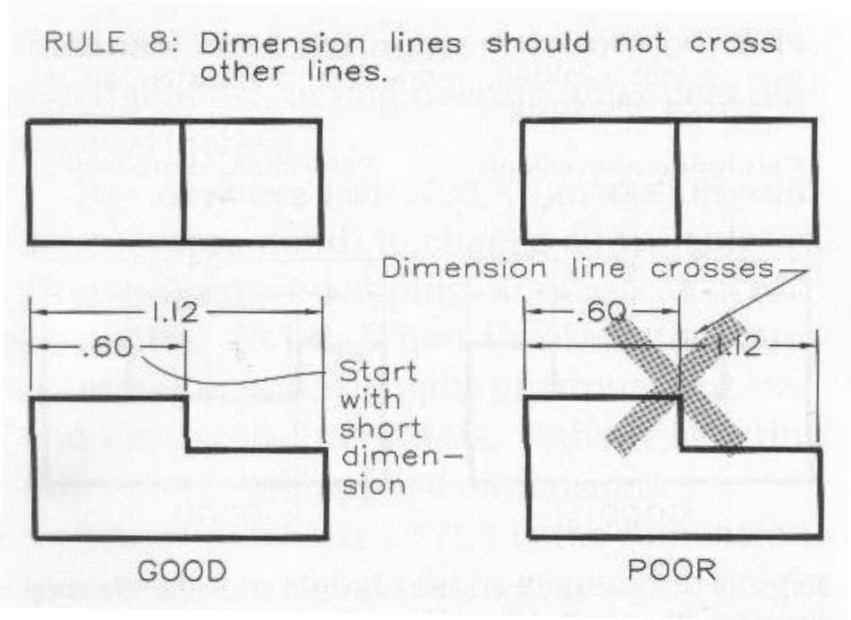
Dimensioning: Rule 7

- To avoid errors and confusion, do not duplicate dimensions



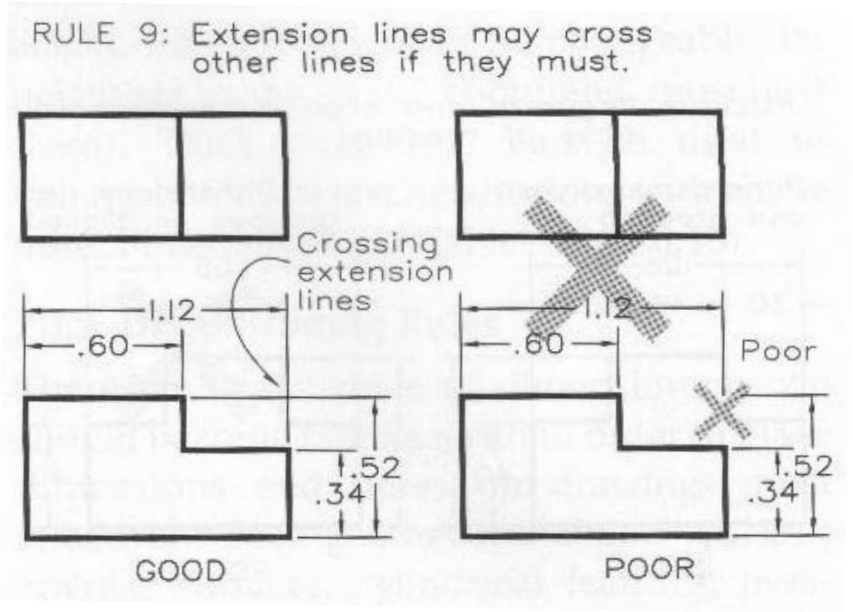
Dimensioning: Rule 8

- Dimension lines never cross any other lines, unless absolutely necessary



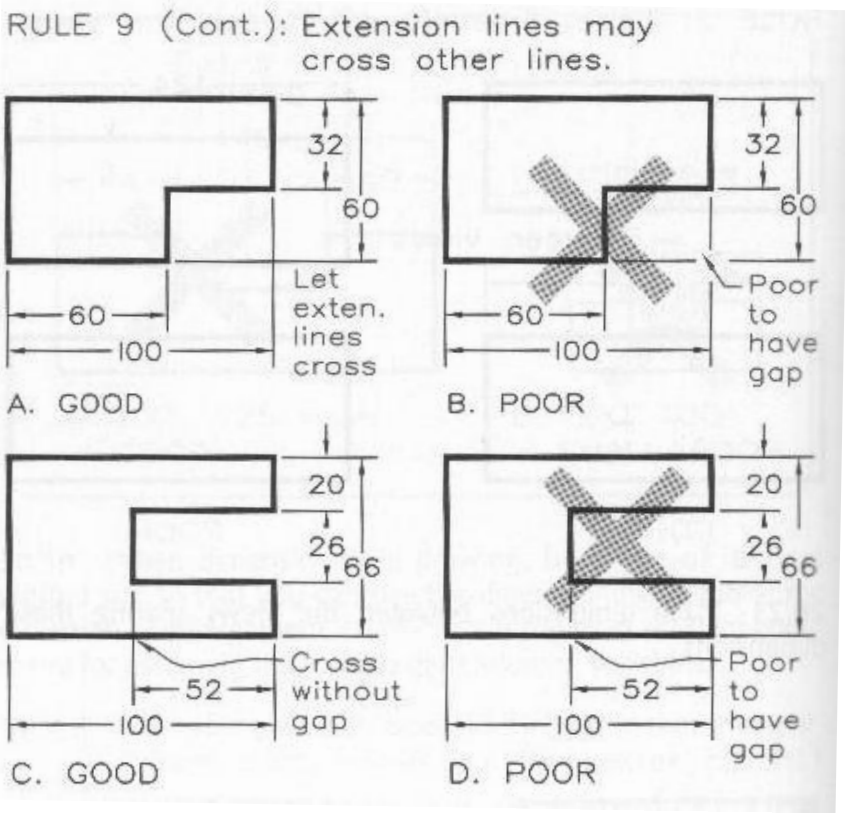
Dimensioning: Rule 9

- Extension lines may cross other extension lines, or object lines, if necessary
- Leave a small gap from the object to the lines that extend from them



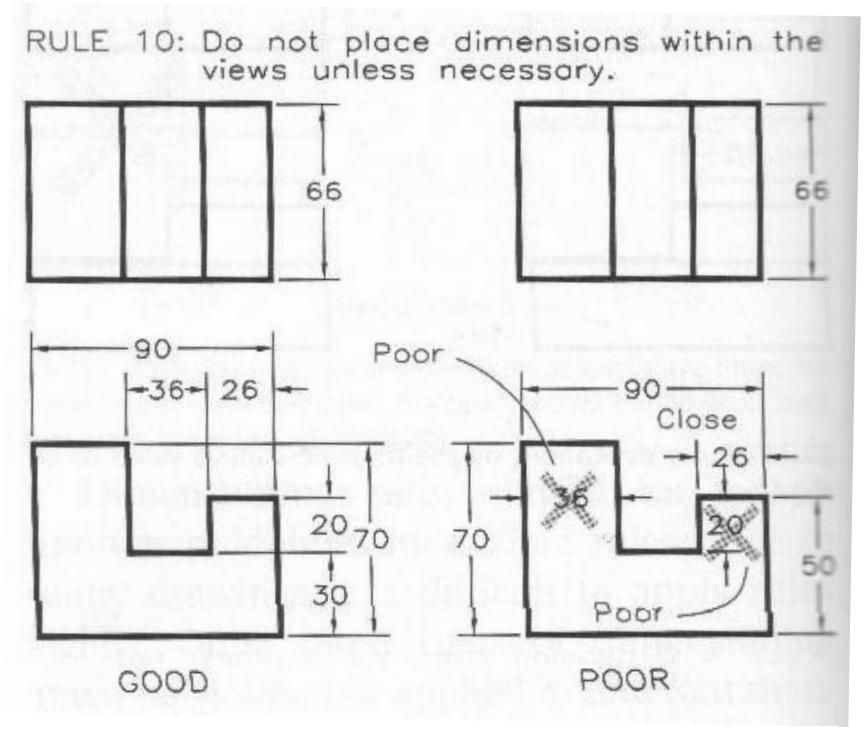
Dimensioning: Rule 9 (Cont)

- Do not leave gaps where extension lines cross object lines or other extension lines



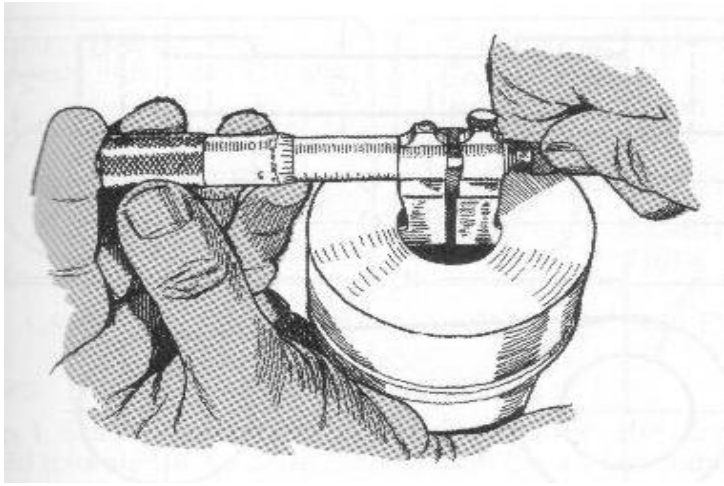
Dimensioning: Rule 10

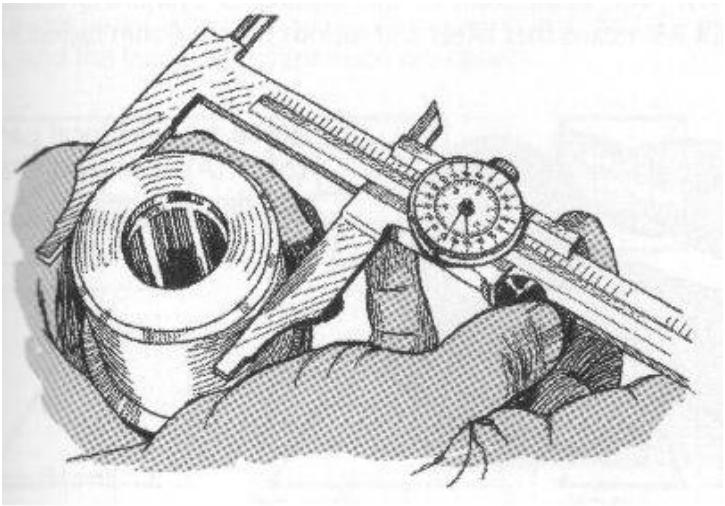
- Where possible place dimensions outside objects

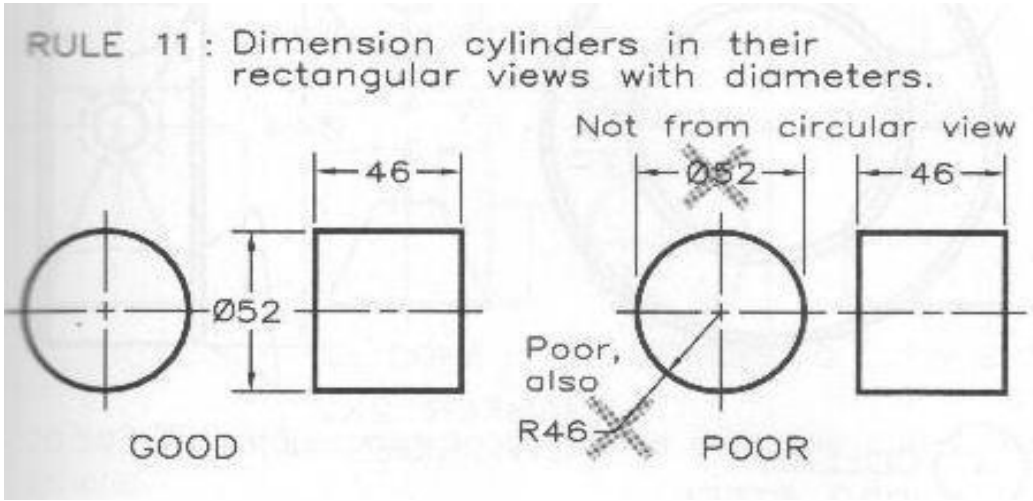


Dimensioning: Rule 11

- Dimension the diameter of cylinders in rectangular view
  - External calipers measure the diameter of a cylinder
  - Internal calipers measure the diameter of holes
- Radii cannot be measured

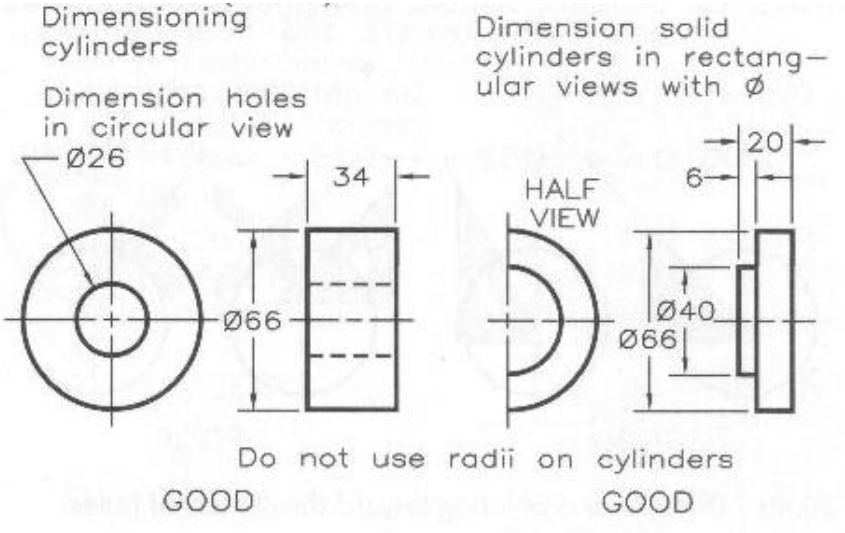






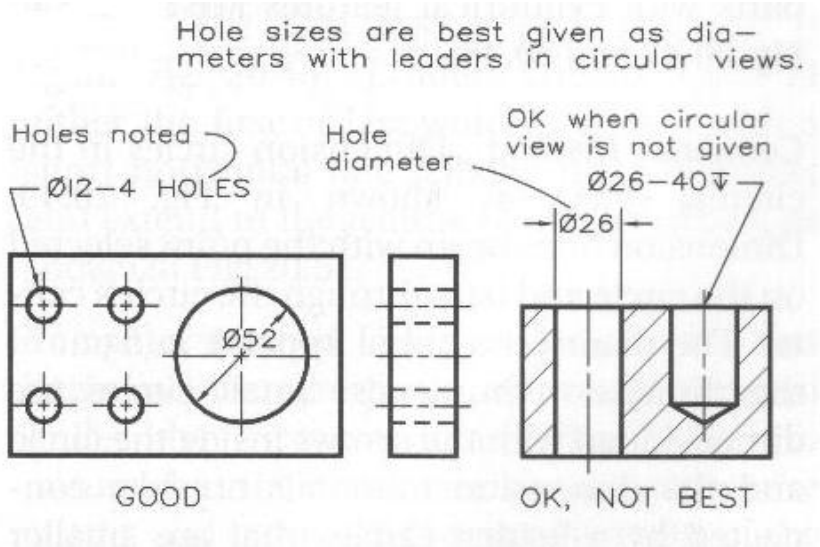
Dimensioning: Rule 12

- Dimension circular holes in the view where they look like holes

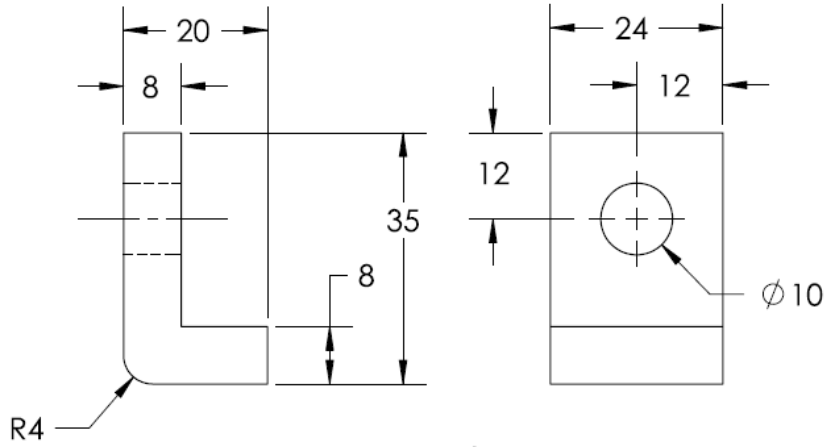


Dimensioning: Rule 12 (Cont)

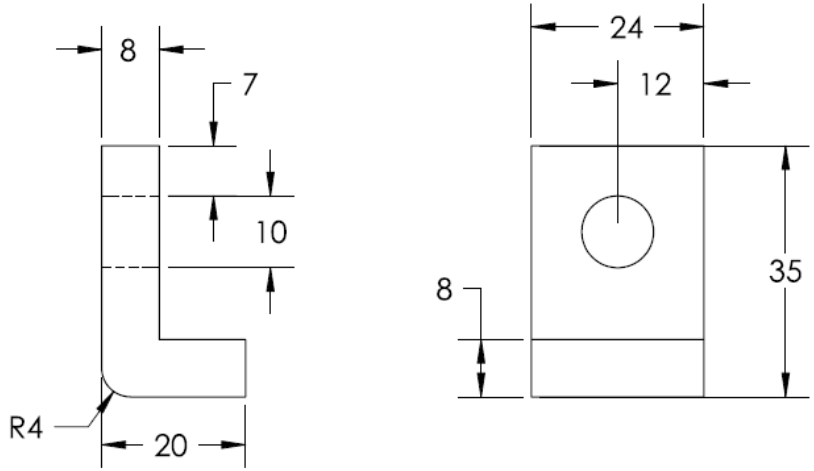
- Dimension circular holes in the view where they look like holes



Dimensioning - Example



correct



poorly dimensioned

Figure 14.7 Properly and improperly dimensioned drawings.

Orthographic Projection

- Advantages
  - Able to contain a high degree of detail
  - Angle and length measurements can be made on all views (exceptions do exist)
- Disadvantages
  - Effort is needed to interpret the object
  - Many conventions must be followed – not as easy as the other three

Drawing Layout Conventions

- Layout possibilities other than three-view exist for orthographic drawings
- Sometimes, only two views are necessary
- The same rules still apply to these projections
    - For example, the views must be aligned
- The designer must choose the best layout to convey the information in the most effective way possible

Orthographic – Section Views

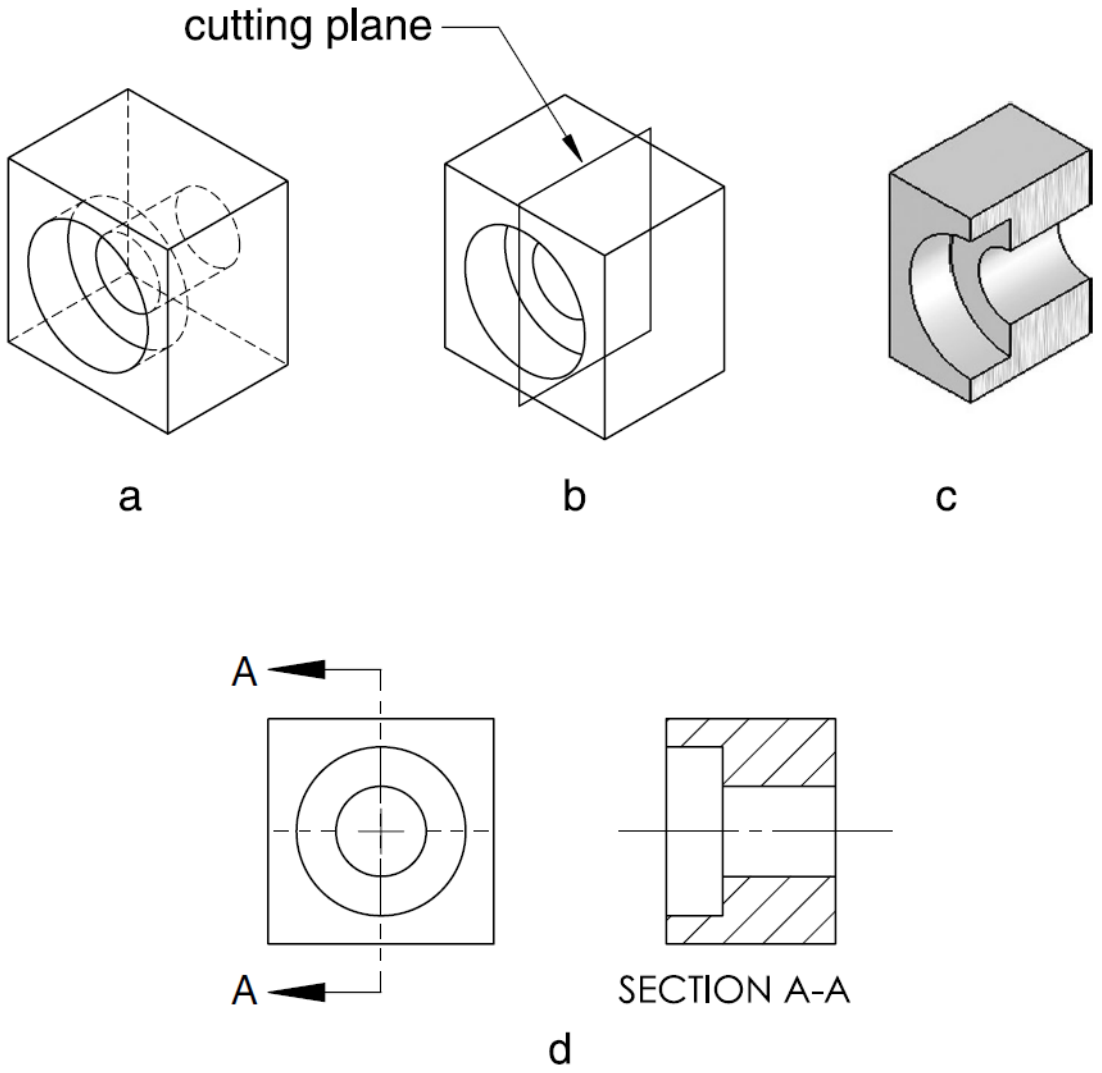
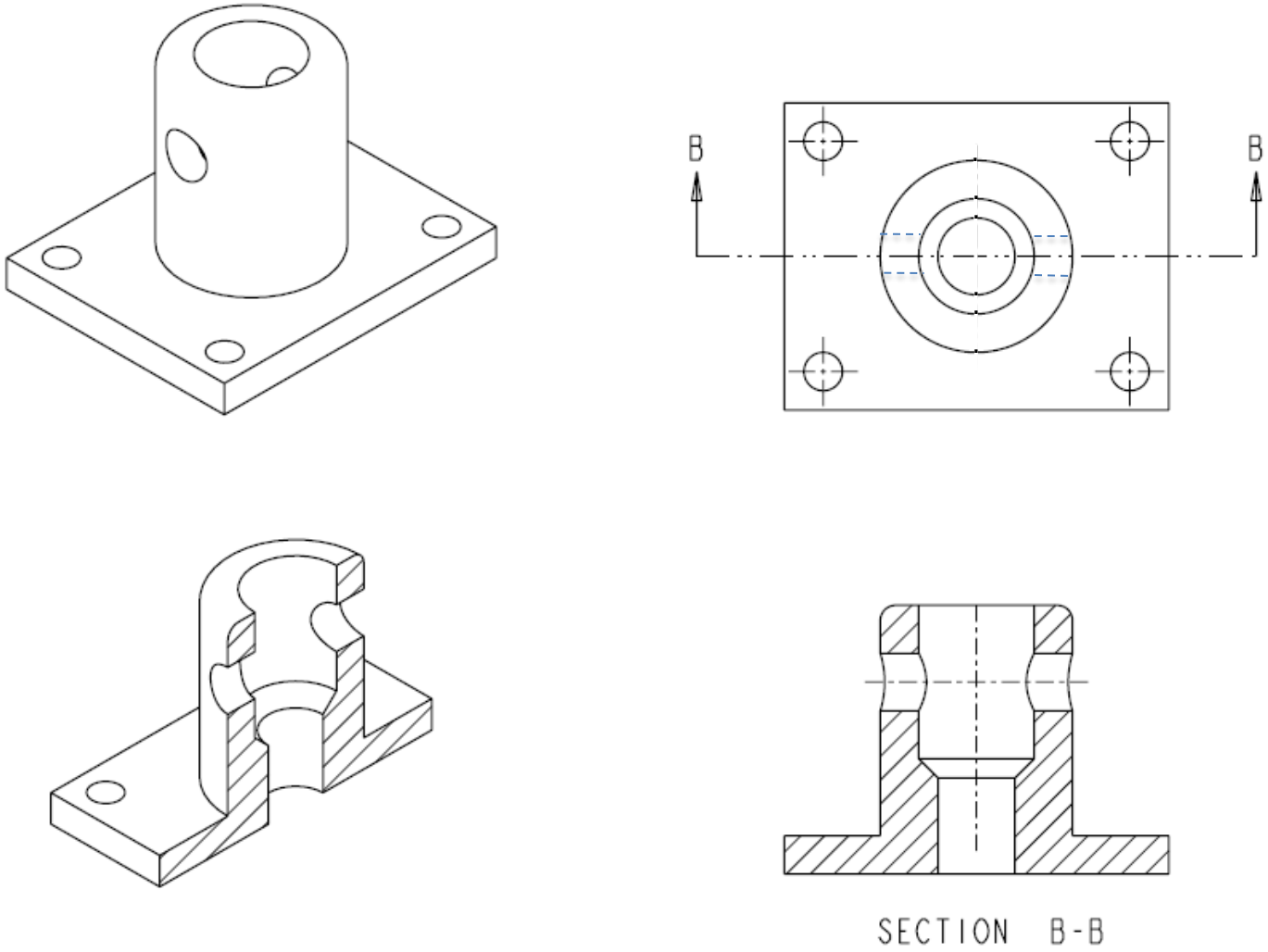


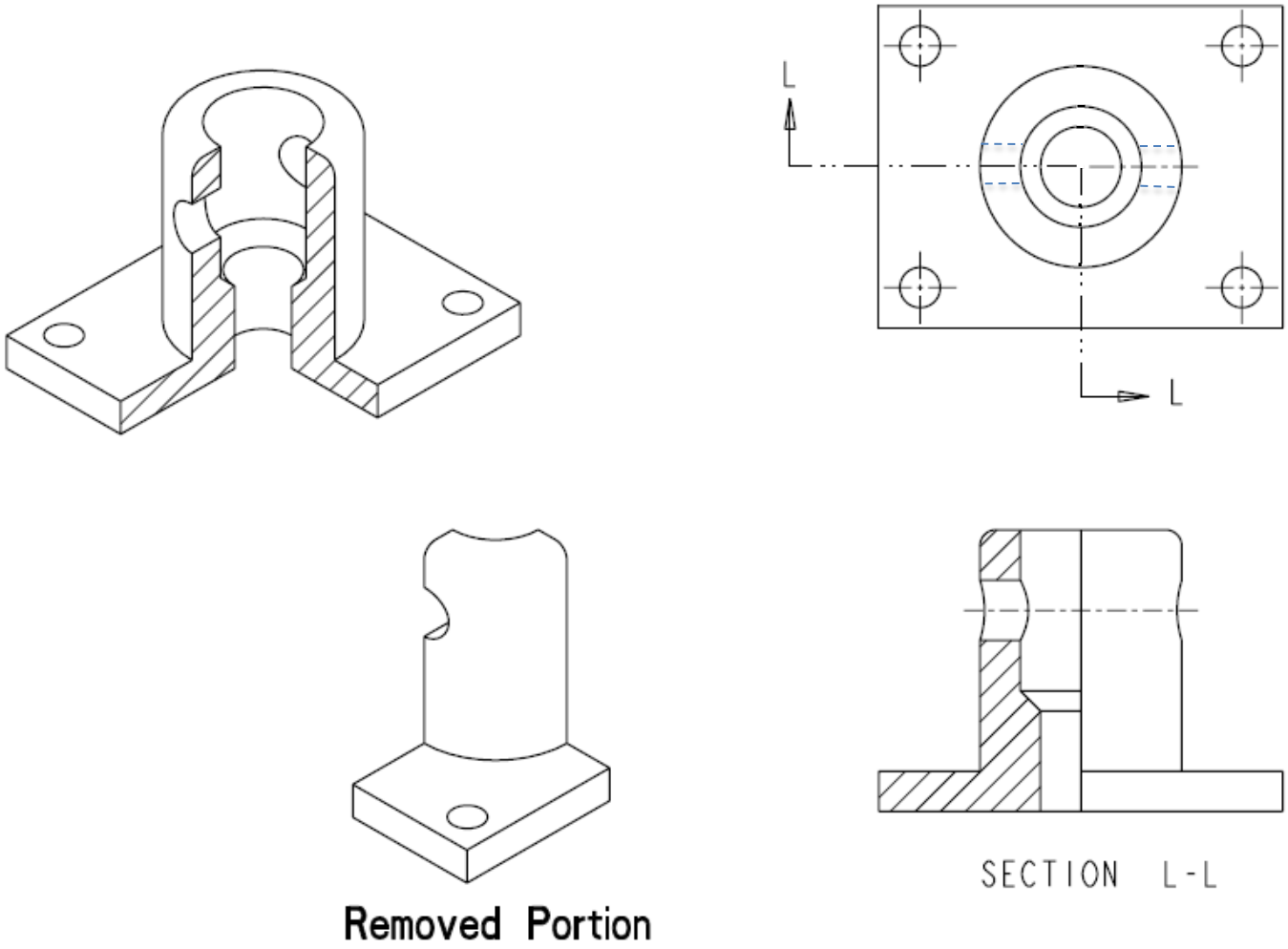
Figure 14.10 Creating a section view.

Orthographic – Section Views



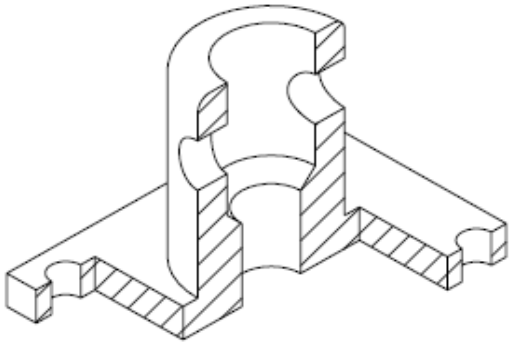
Corrected ***Figure 14.11*** The full section is the orthographic view at the lower right.

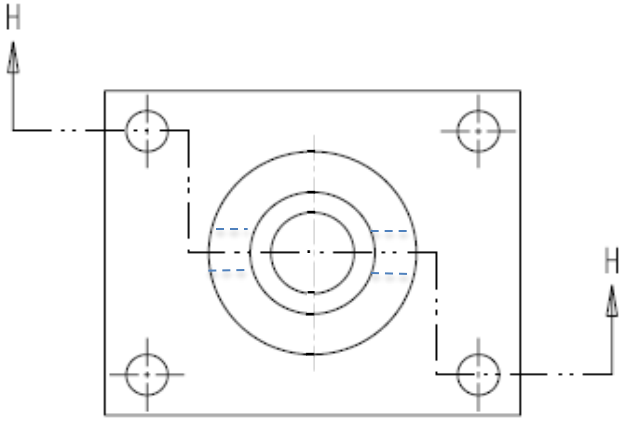
Orthographic – Section Views

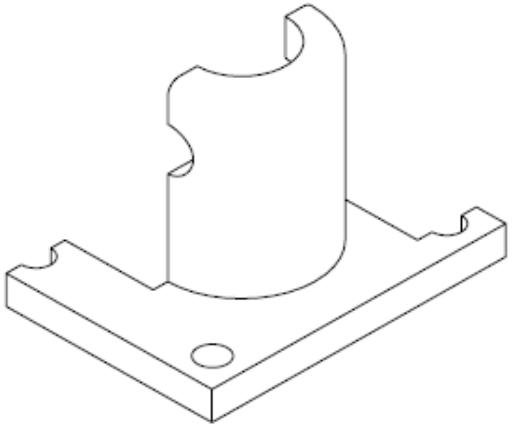


Corrected ***Figure 14.12*** The half section is the orthographic view at the lower right.

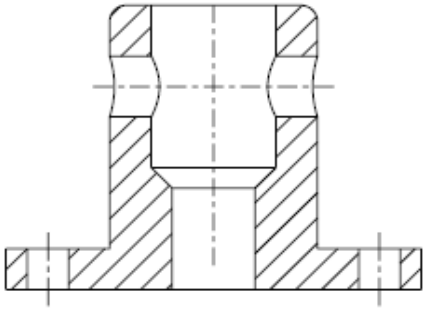
Orthographic – Section Views







Removed Portion



SECTION H-H

Corrected ***Figure 14.14*** The offset section is the orthographic view at the lower right. Note that the horizontal holes in the cylindrical upper portion of the part have curved edges in the section view due to the shape of the part, whereas the vertical holes in the flat flange at the bottom of the part have straight edges.

Orthographic – Section Views

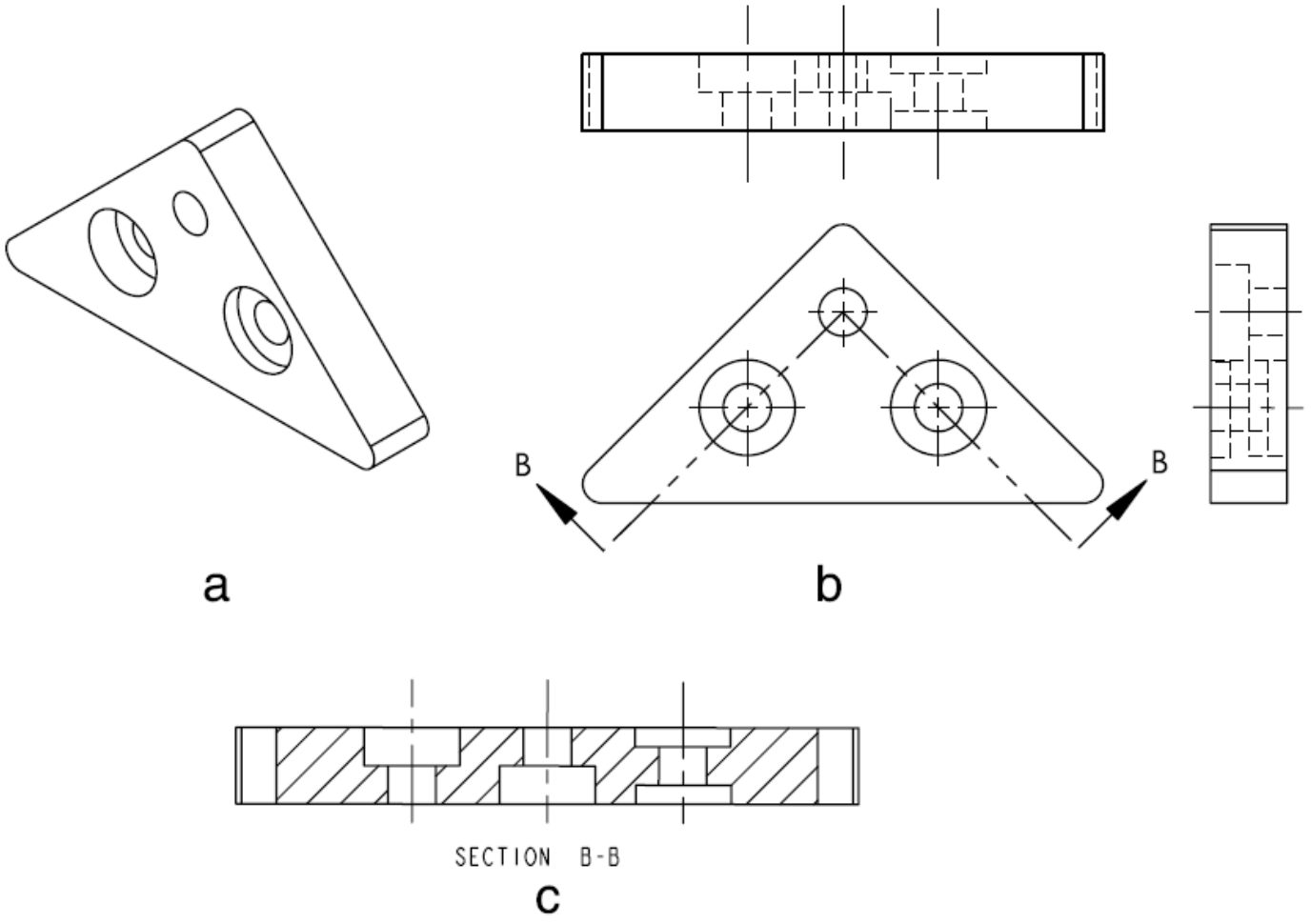
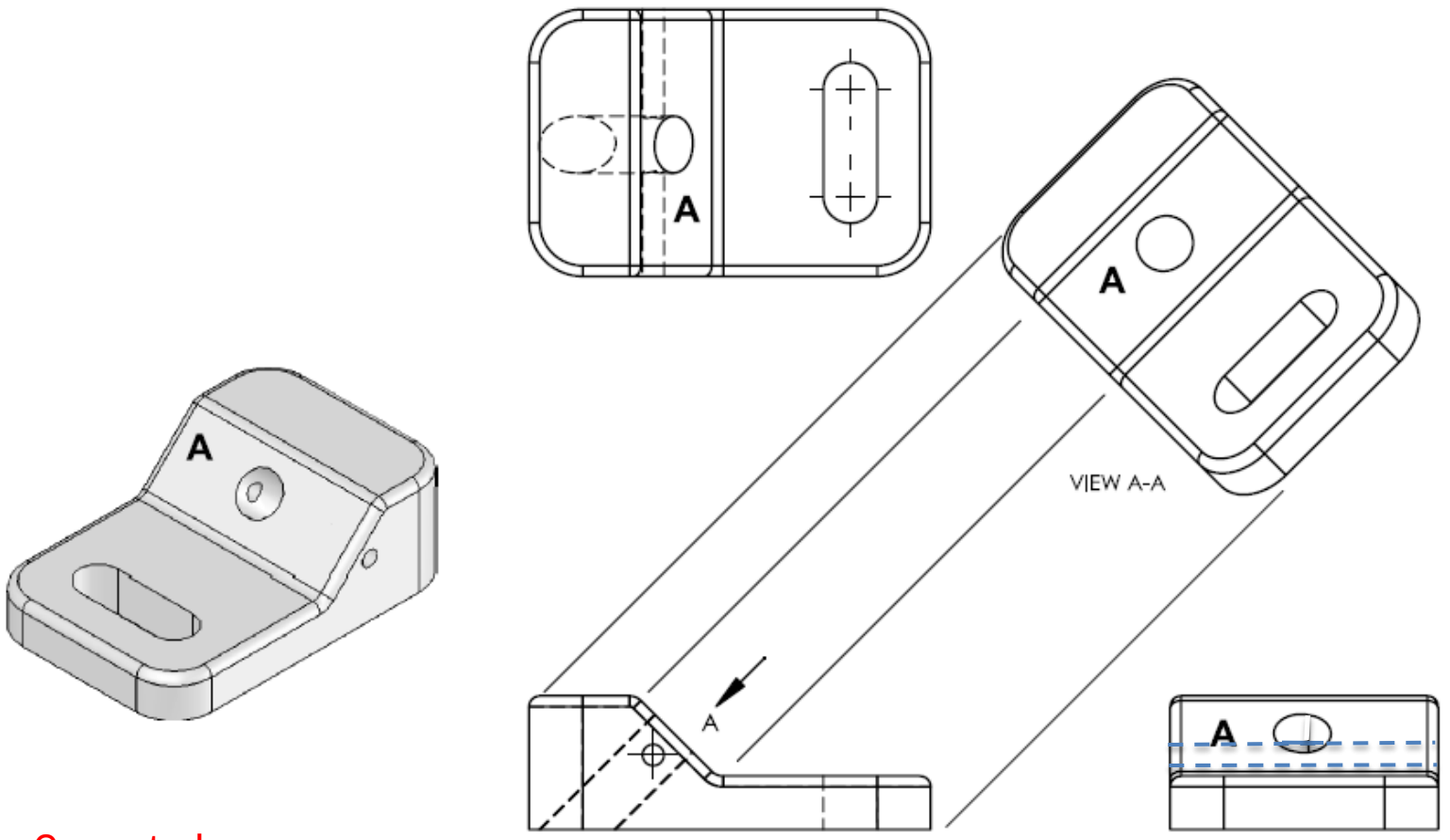


Figure 14.15 The aligned section is shown in (c).

Orthographic – Auxilary Views



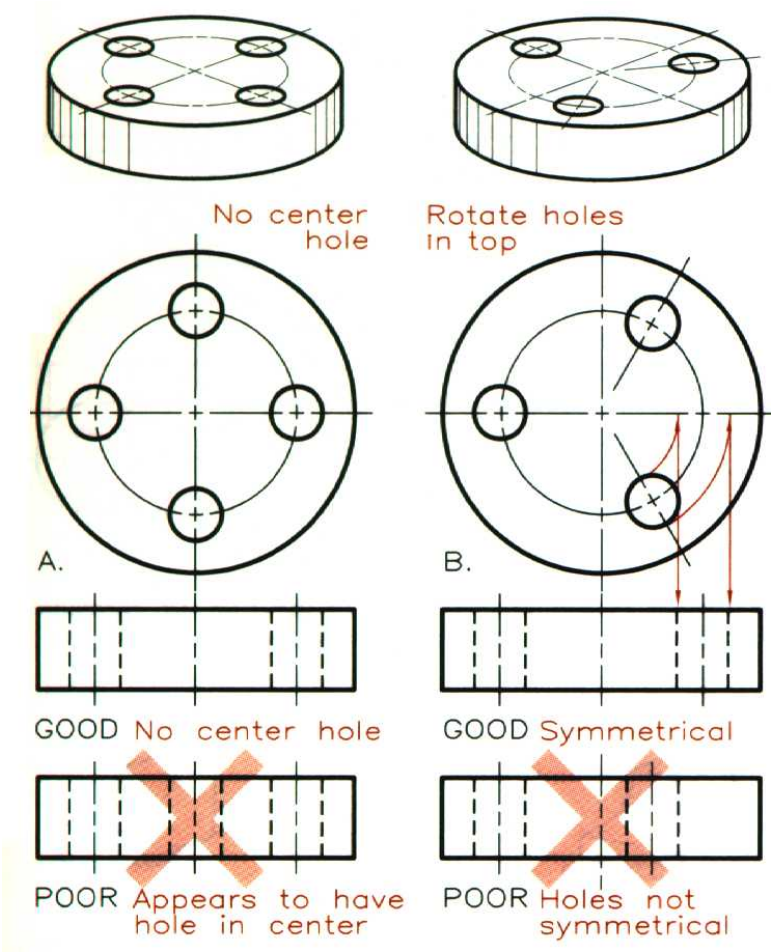
Corrected

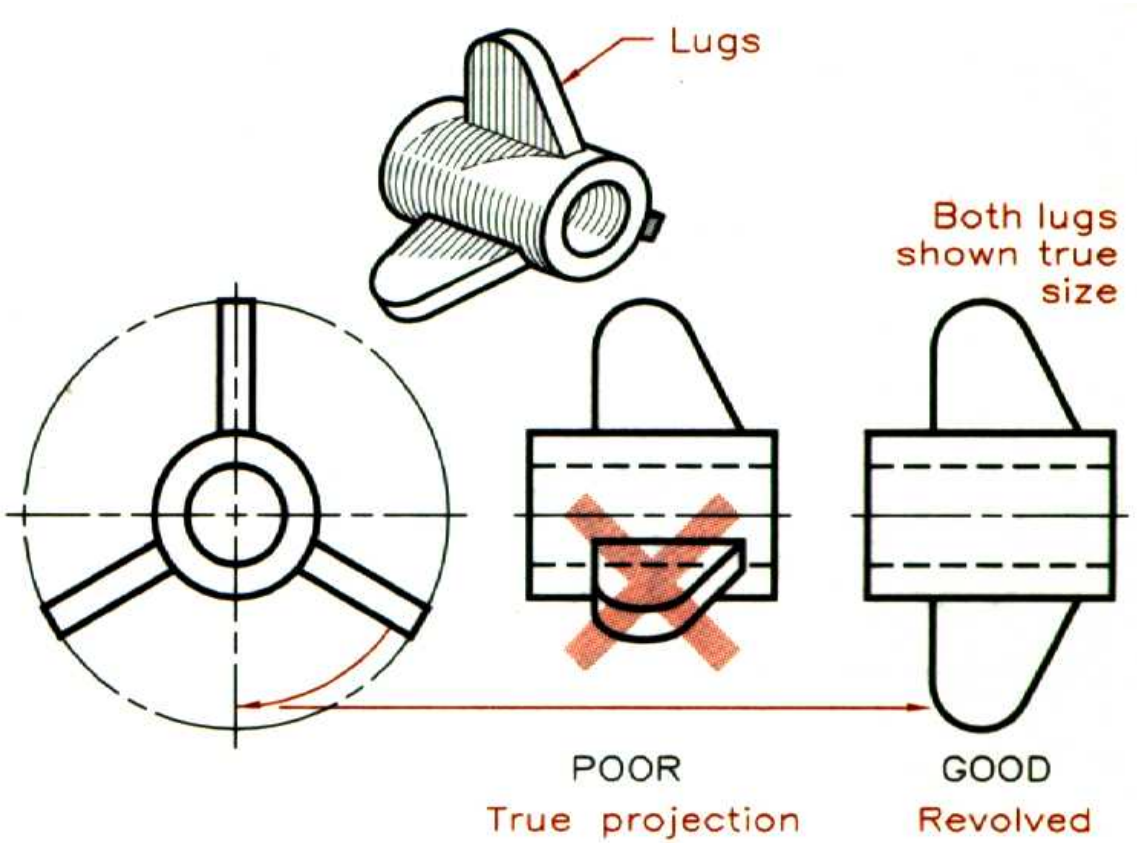
Figure 14.18 Auxiliary view of plane A. The labels A on the isometric projection and on the auxiliary and right views are not included on standard drawings.

Drawing Layout Conventions

- Sometimes, the rules of projection must be violated in order to improve clarity
- EXAMPLE: Symmetrically spaced holes on a circular plate:
  - In the front view, the holes are represented by hidden lines placed at the maximum radial distance from the centre of the plate
  - In the top view, the holes are placed where they physically exist

Drawing Layout Conventions





Drawing Layout Conventions

Applies to other symmetric features such as webs, ribs, and lugs

Orthographic – Threads

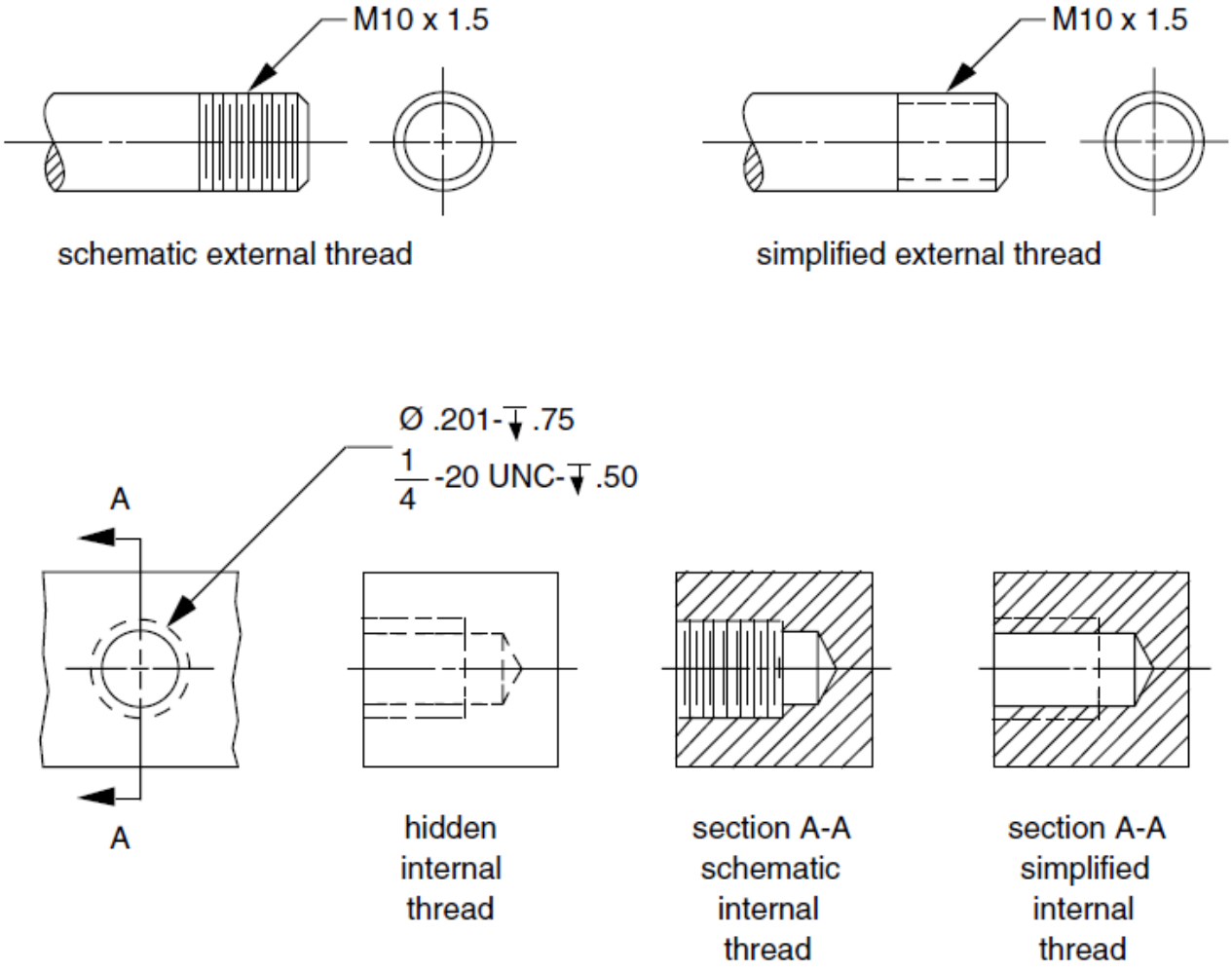
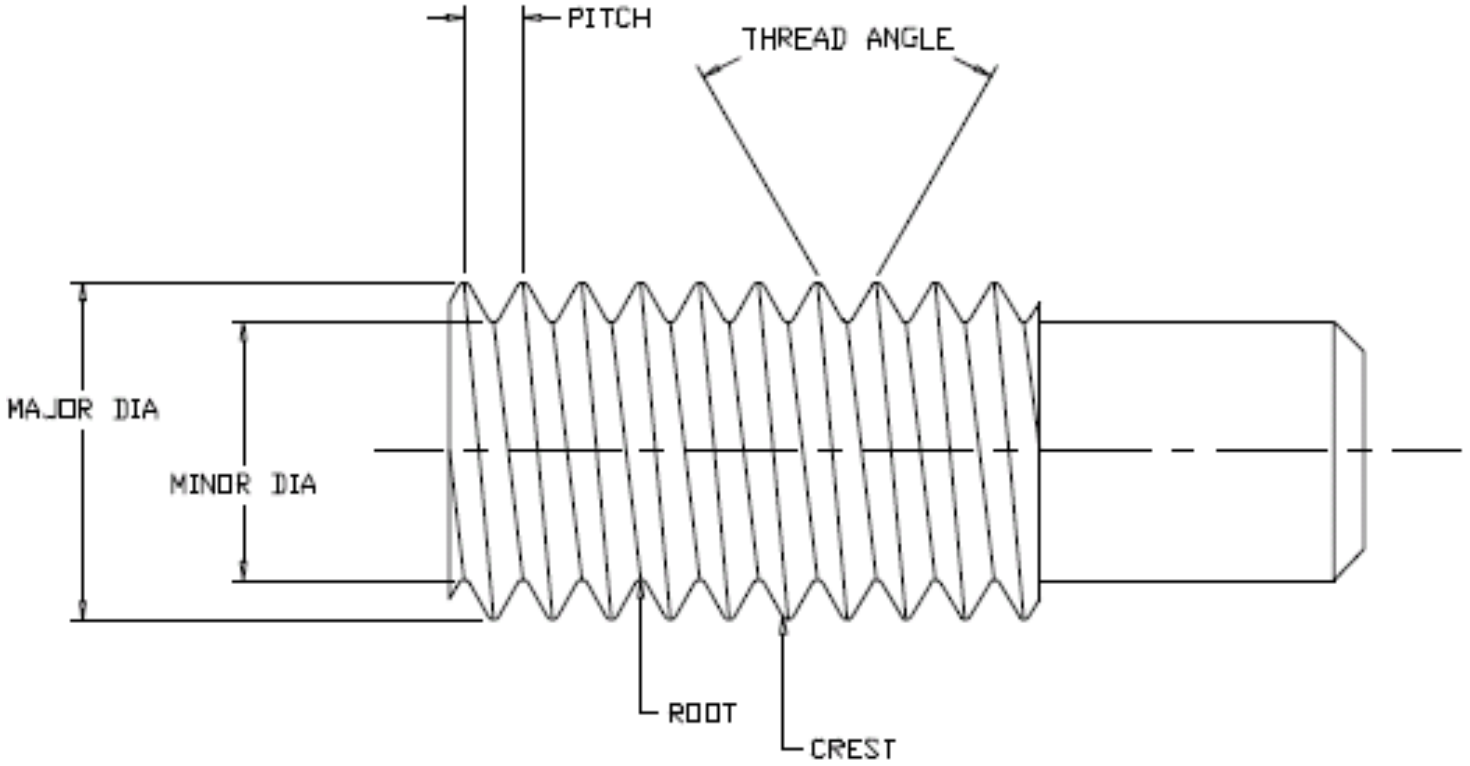
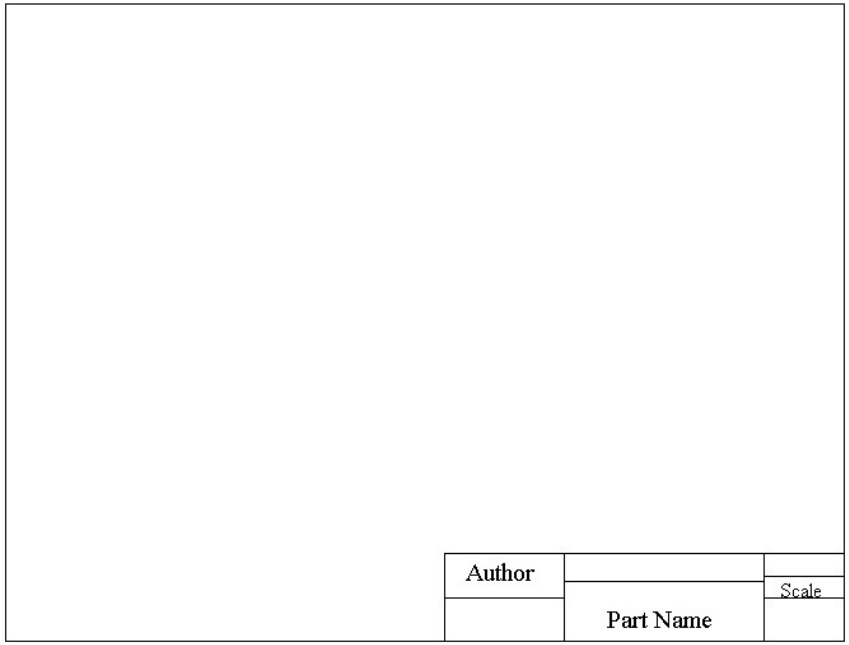


Figure 14.21 Conventions to show screw threads.


PITCH
THREAD ANGLE
MAJOR DIA
MINOR DIA
ROOT
CREST

Orthographic – Title Block

- Contains important information about the drawing such as the part name and number, the person who made it and the scale used
  - Usually located in the lower right corner of the drawing
  - All working drawings have a title block!



Orthographic – Title Block

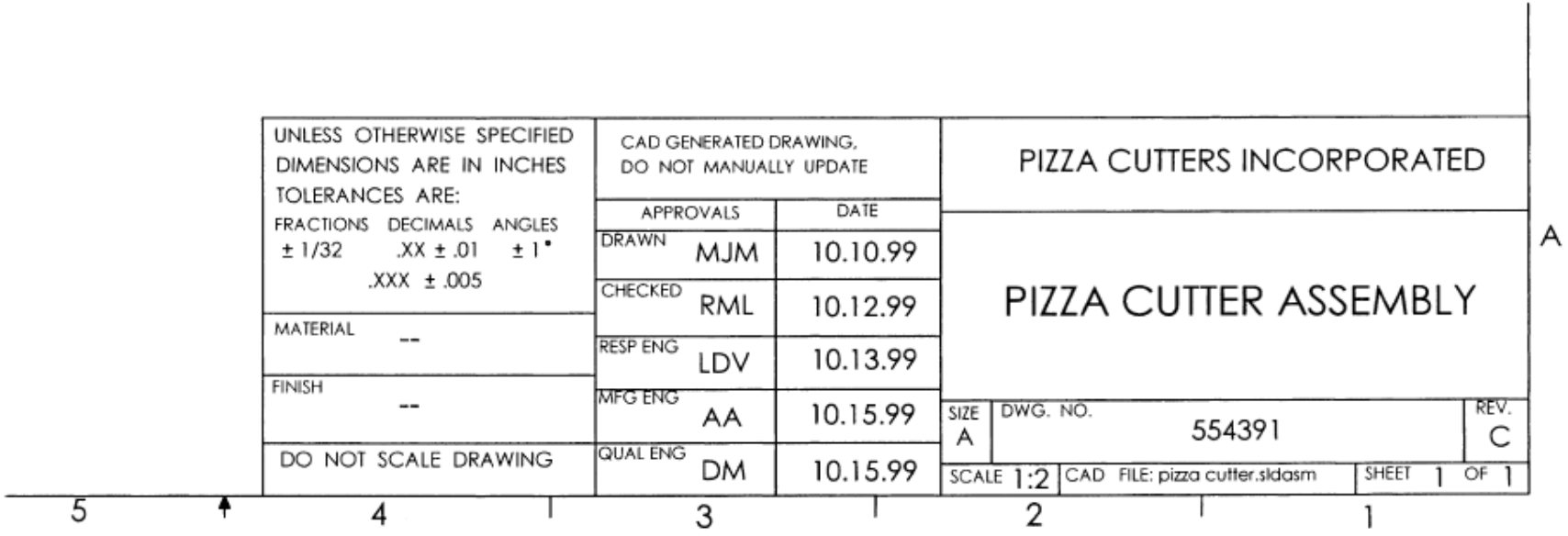
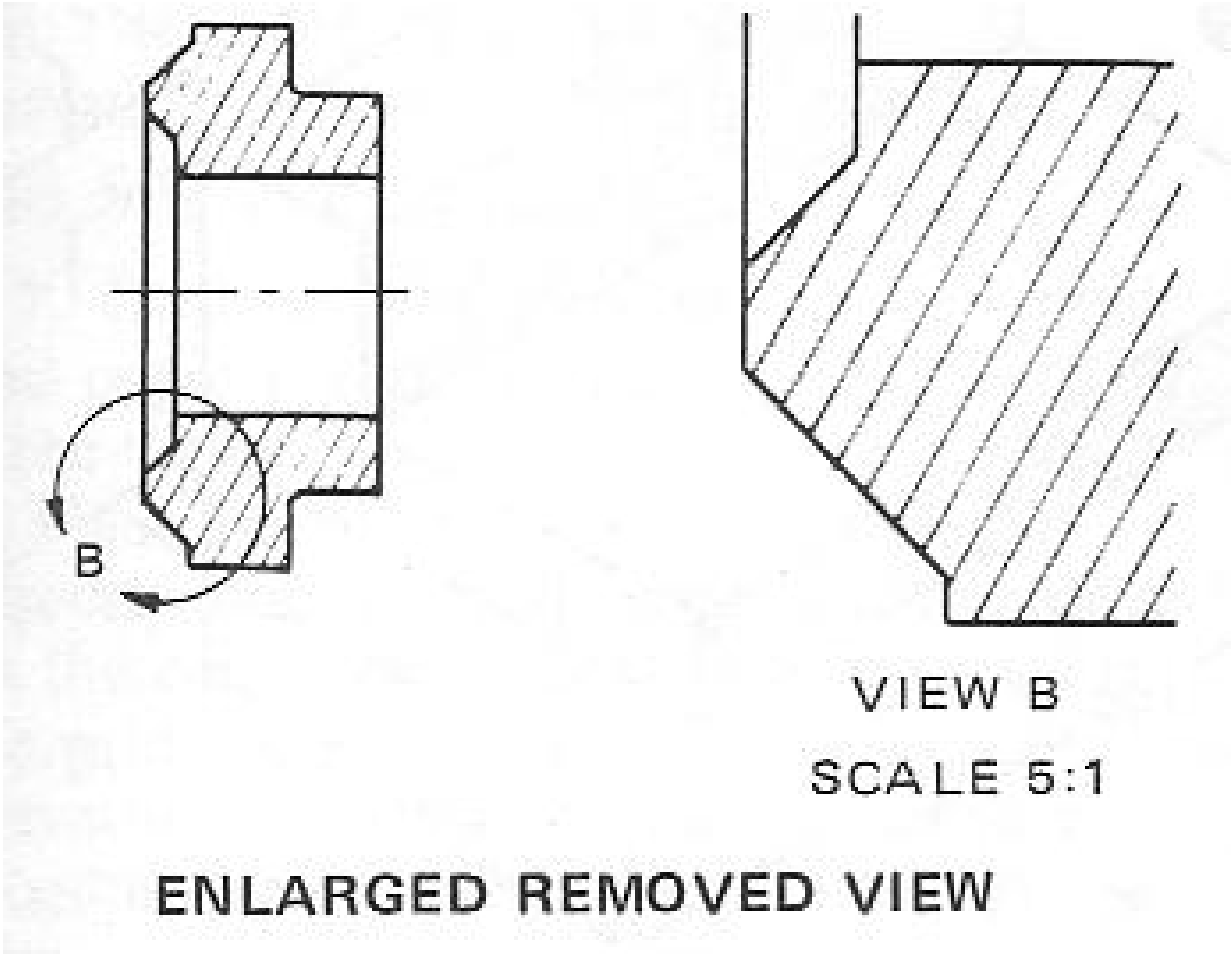
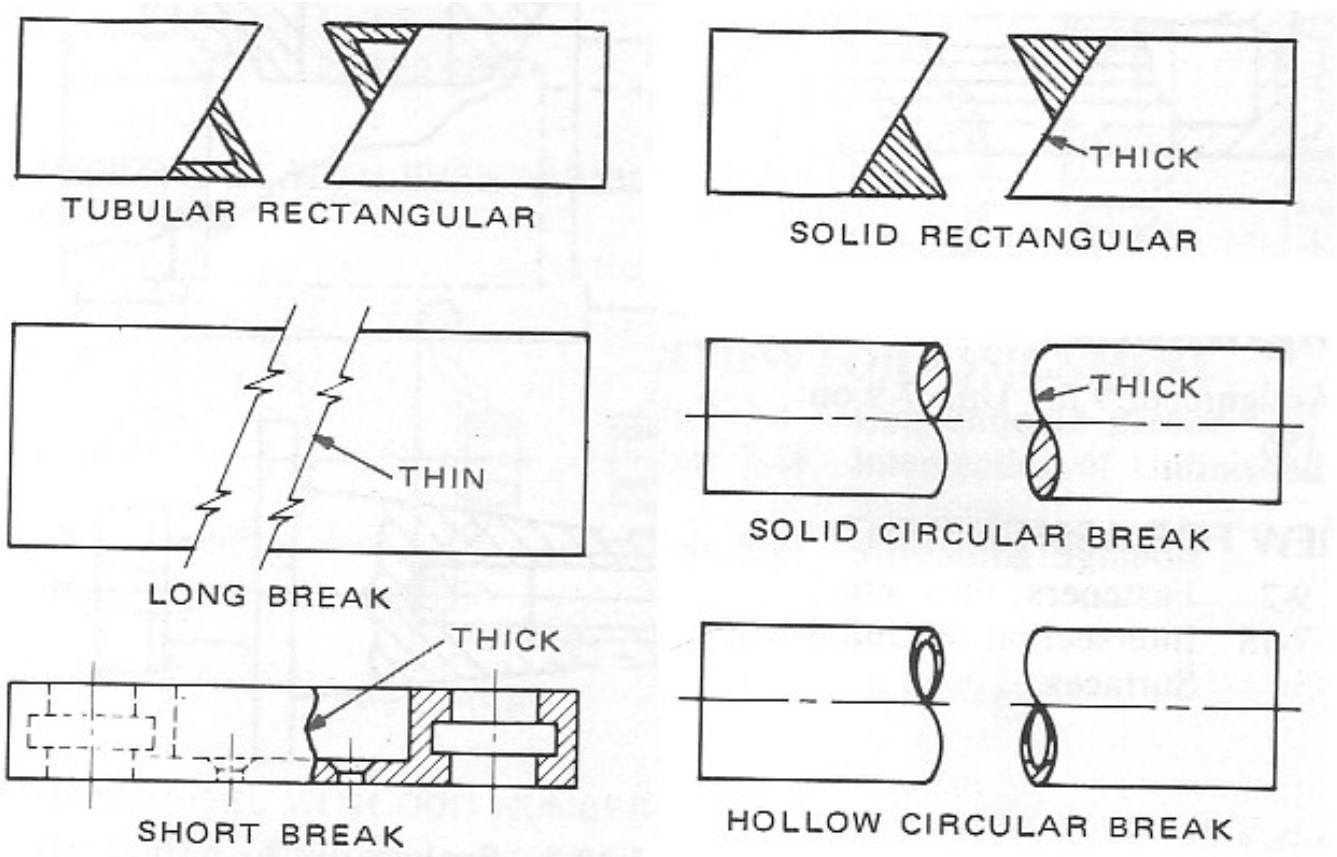


Figure 14.2 A typical title block.

Special Drawing Conventions



Special Drawing Conventions



Conventional breaks.

Orthographic – Example - 1

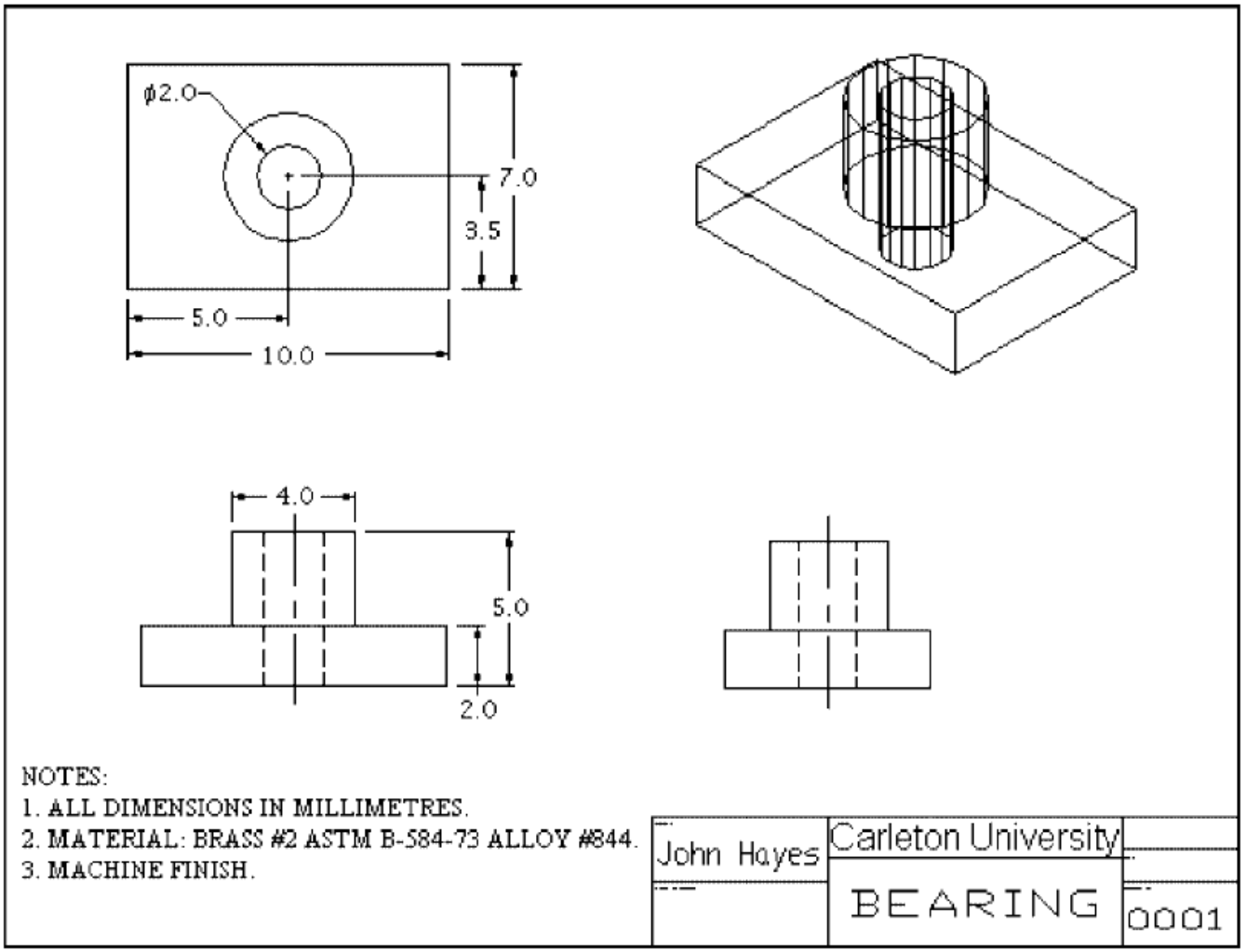


Figure 12.17 A Three-view working (detail) drawing.

Orthographic – Example - 2

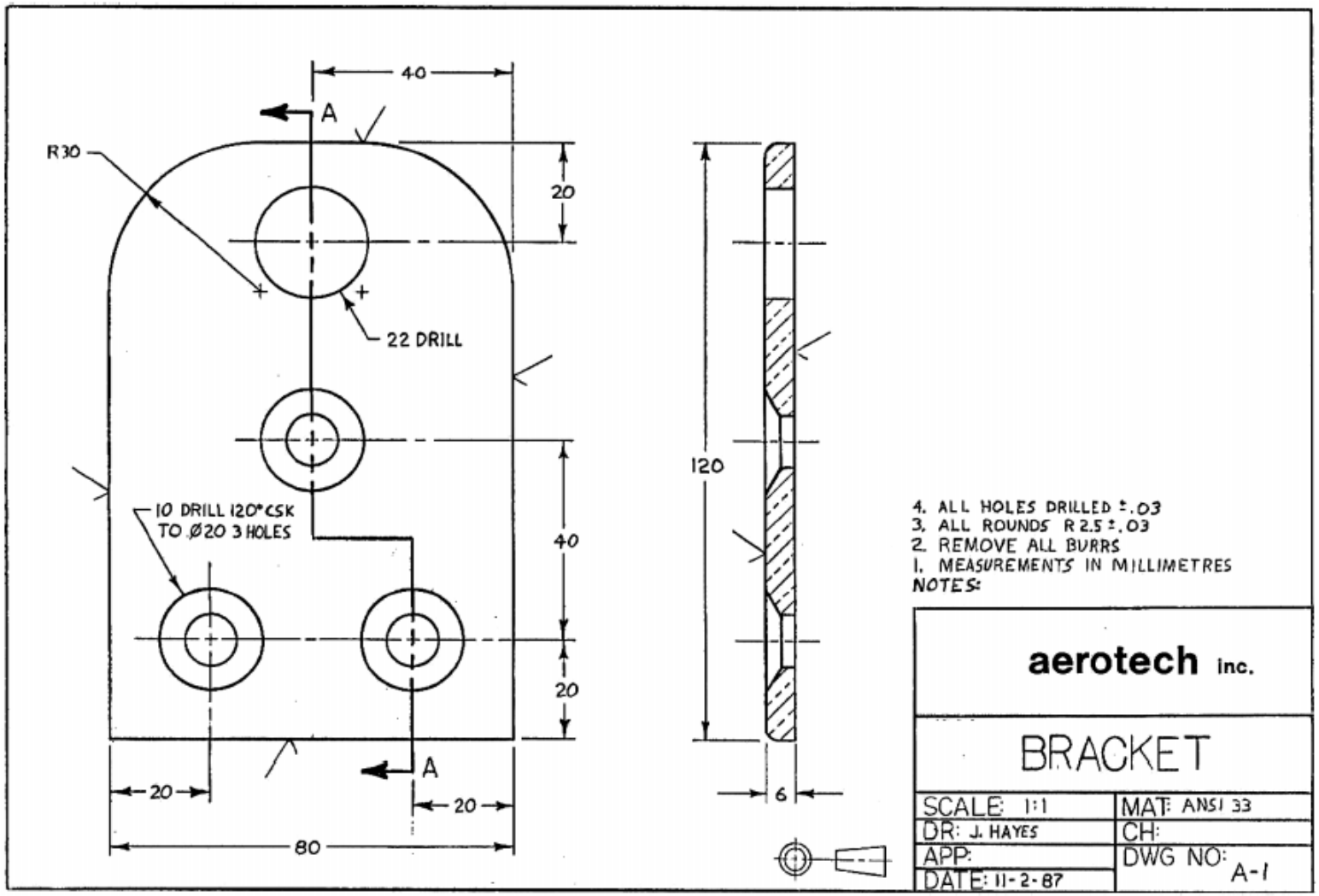


Figure 12.21 Working drawing for a bearing bracket.

Orthographic – Example - 3

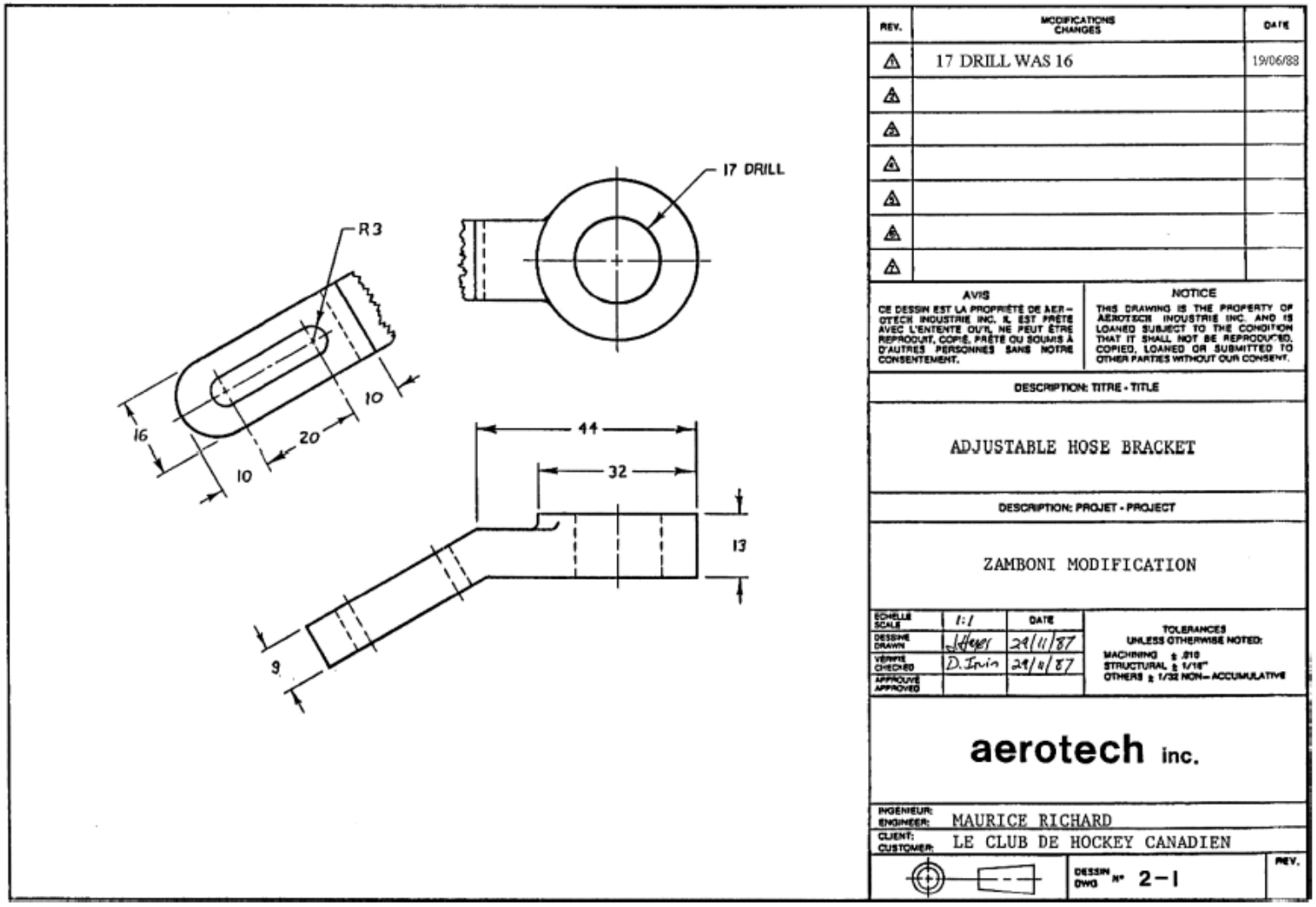
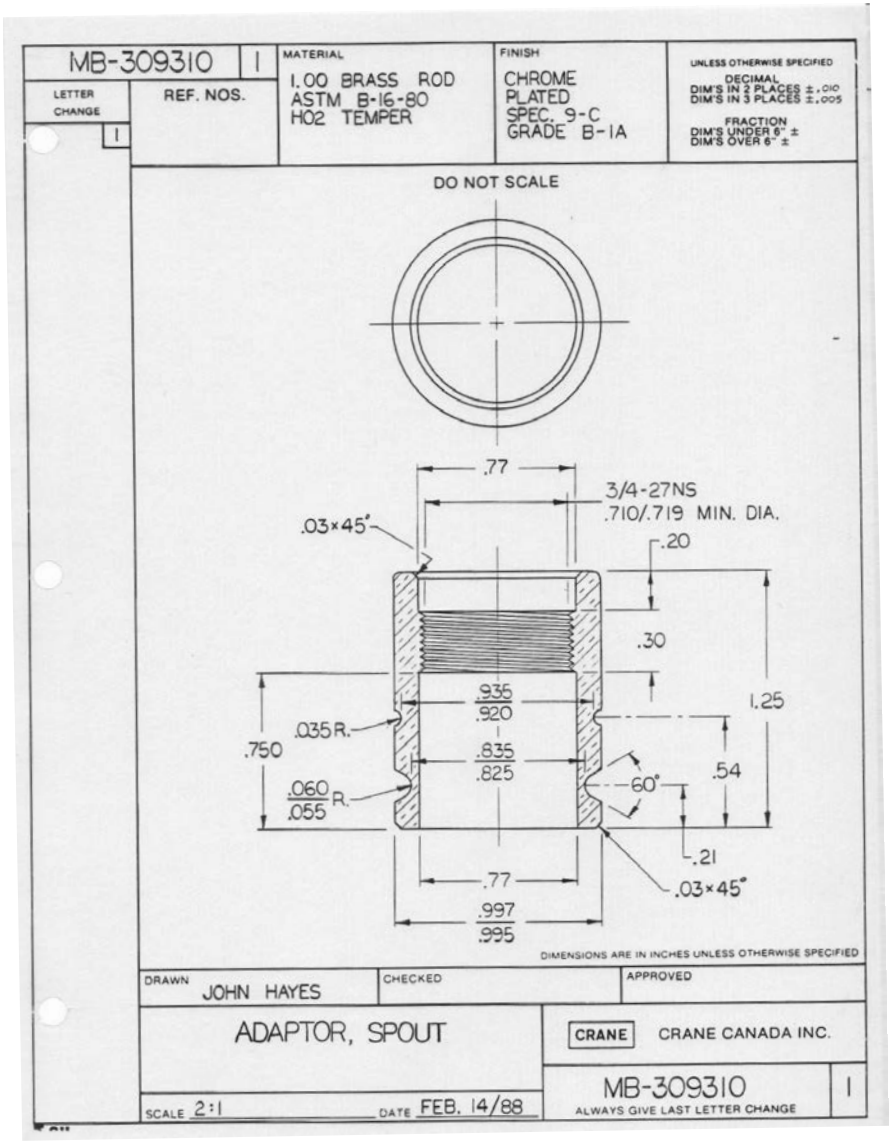
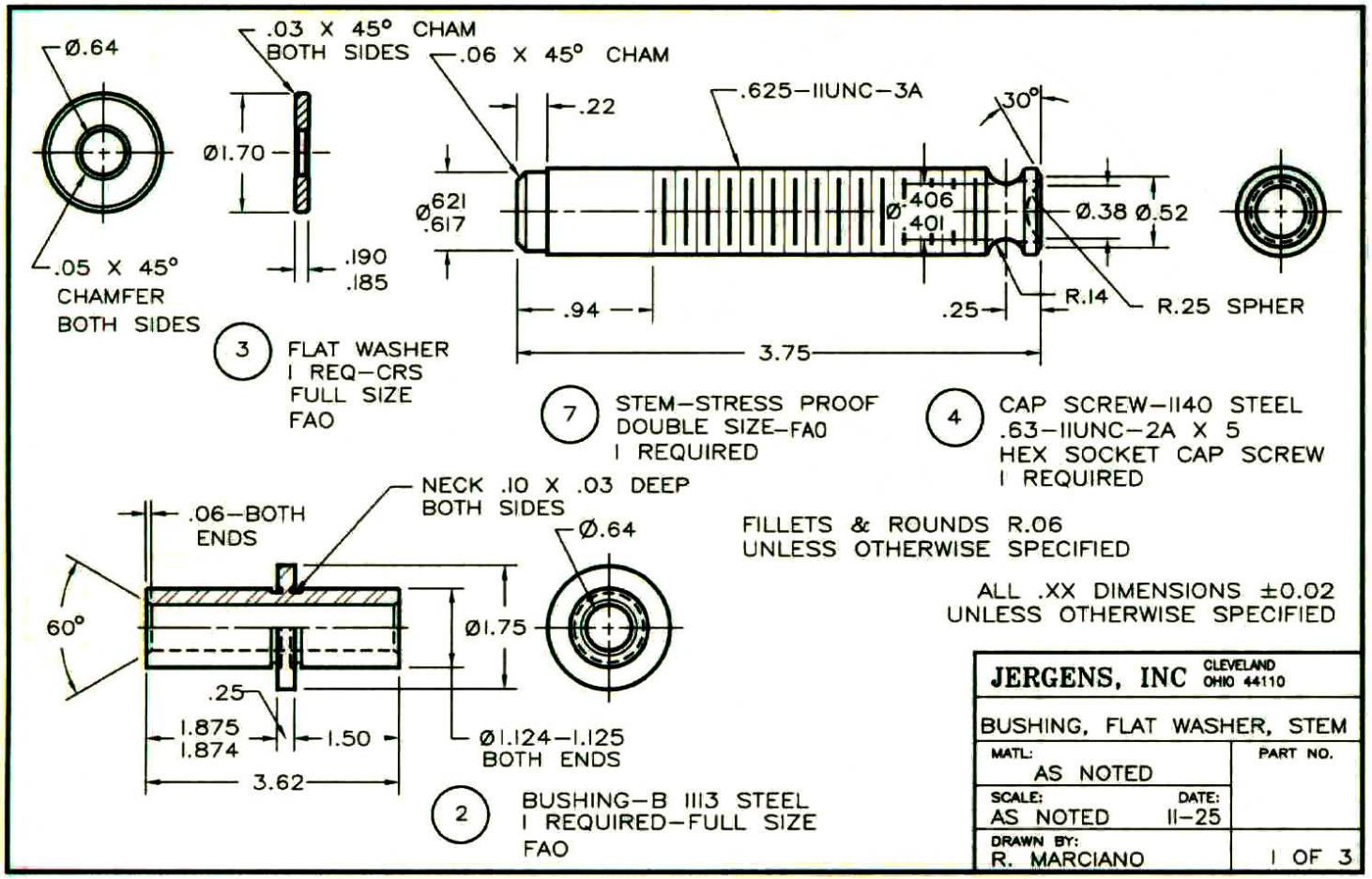


Figure 12.22 Working drawing with an auxiliary view and a revision block.

Orthographic – Example - 4



Orthographic – Example - 5



Reading Assignment

- Have you read Chapters 12 & 14 ?
- Read Chapter 13