

**Bluepri
nt
Readin
g**

A. ALPHABET OF

LINES

- Universal language for designers, engineers, & production personnel.
- Uses lines, numbers, symbols and illustrations.




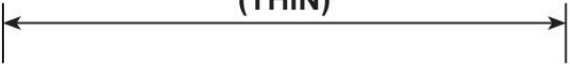






Different Blueprint Forms:

- Drawings for fabrication (Standardized symbols for mechanical, welding, construction, electrical wiring and assembly).
- Sketches (Illustrate an idea, technical principle or function).

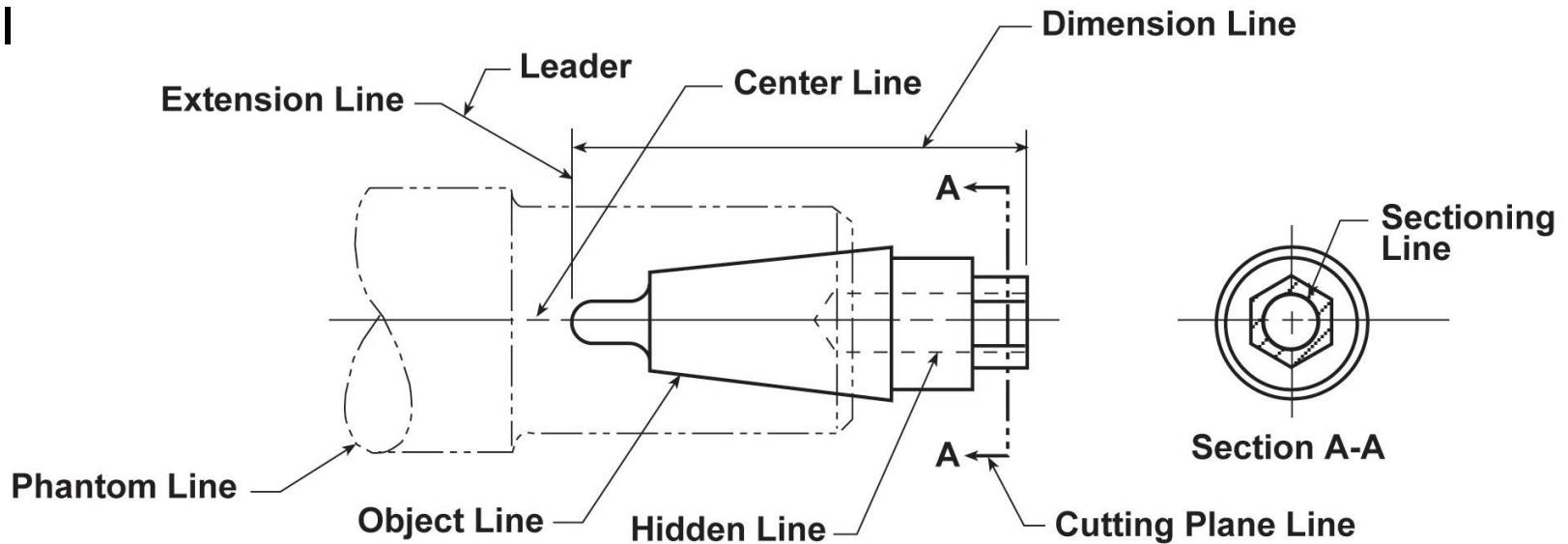
Lines are made in definite standard forms: (all have specific meaning)

- Thickness of a line (thick or thin)
- Solid
- Broken
- Dashed

A. ALPHABET OF LINES

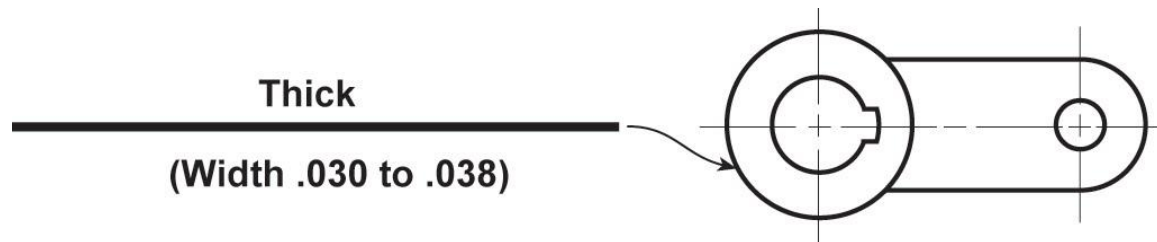
BASIC LINES	LINE CHARACTERISTICS
① Visible (Object) Line	 <p>(THICK)</p>
② Hidden Line	 <p>(THIN)</p>
③ Center Line	 <p>(THIN)</p>
④ Extension and Dimension Line	 <p>(THIN)</p>
⑤ Cutting Plane Lines (Shows Direction of Viewing Plane)	 <p>(THICK)</p>  <p>(THICK)</p>
⑥ Section Line	 <p>(THIN)</p>
⑦ Break Lines	 <p>(THICK) (FOR SHORT BREAKS)</p>  <p>(THIN)</p>
⑧ Phantom Line	 <p>(THIN)</p>

A. ALPHABET OF LI



1. Object Lines:

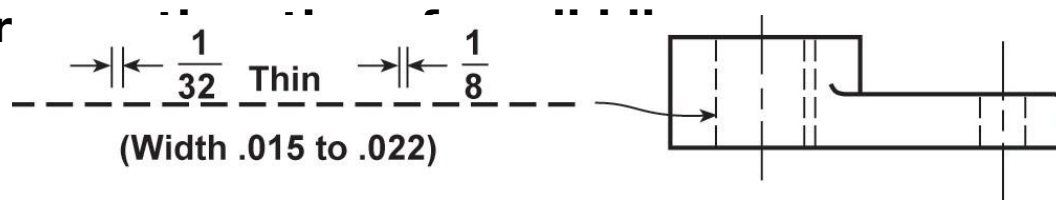
- **Thick solid lines - outline all surfaces visible to the eye.**
- **Form basis for comparing weight and composition of other lines.**



A. ALPHABET OF LINES

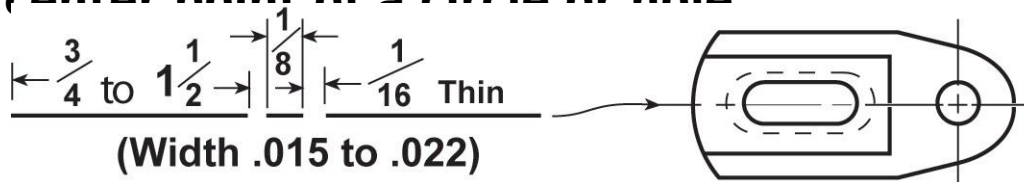
2. Hidden (invisible) Lines:

- Short, evenly spaced dashes.
- Outline invisible or hidden surfaces.
- Always begin with a dash in contact with line at start except when dash would for



3. Center Lines:

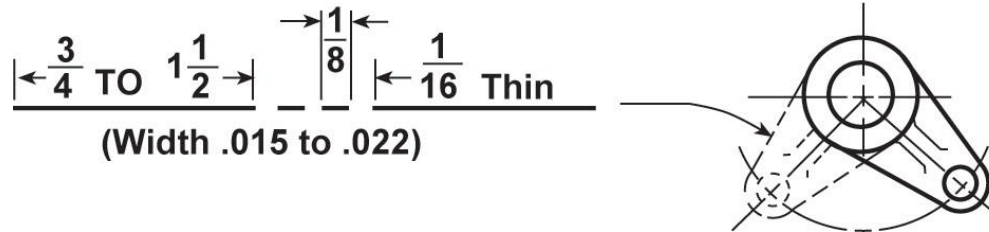
- Alternating long and short, evenly spaced dashes (long dash at each end).
- Short dash where center lines intersect.
- Same weight as invisible lines.
- Indicate central axis of an object or part.
- Indicate center point of a circle or hole



A. ALPHABET OF LINES

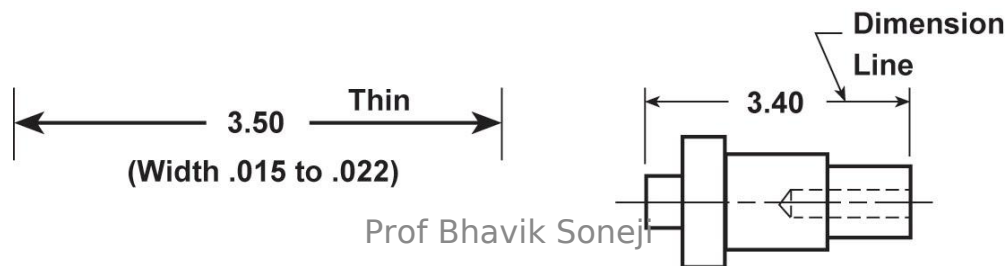
4. Phantom Lines:

- Thin lines.
- Indicate alternate positions of parts of an object.
- Shows repeated details or location of absent parts.
- One long and two evenly-spaced short dashes (long dash at each end).



5. Dimension Lines:

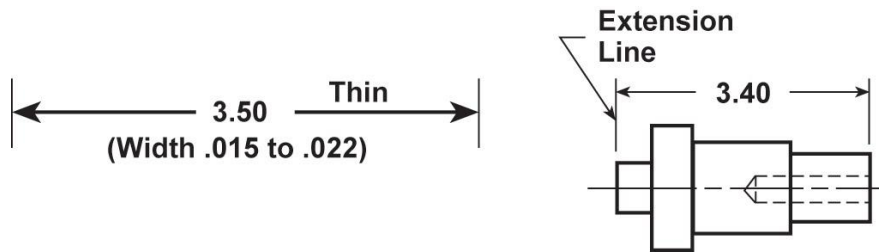
- Short, solid lines.
- Indicate distance between two points.
- Arrowheads at each end.
- Broken to insert dimensions.



A. ALPHABET OF LINES

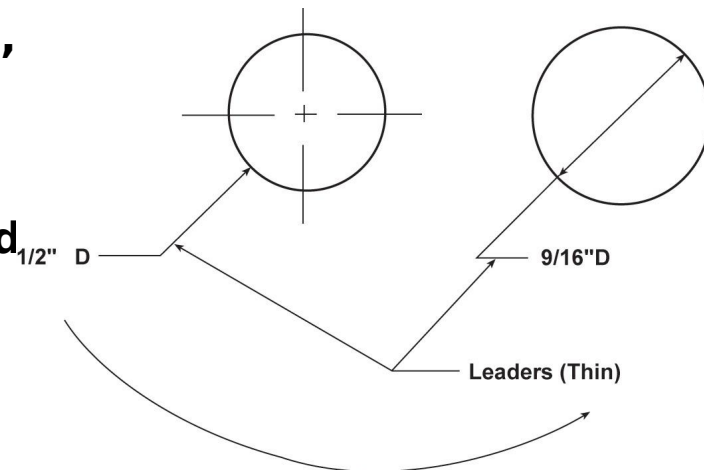
6. Extension Lines:

- Short, solid lines used to show limits of dimensions.
- Placed inside or outside the outline of an object.
- Extend from an outline or surface, but do not touch it.
- Same weight as invisible lines.



7. Leaders:

- Indicate part or area to which numbers, notes, or references apply.
- Solid lines.
- Usually terminate in a single arrowhead.

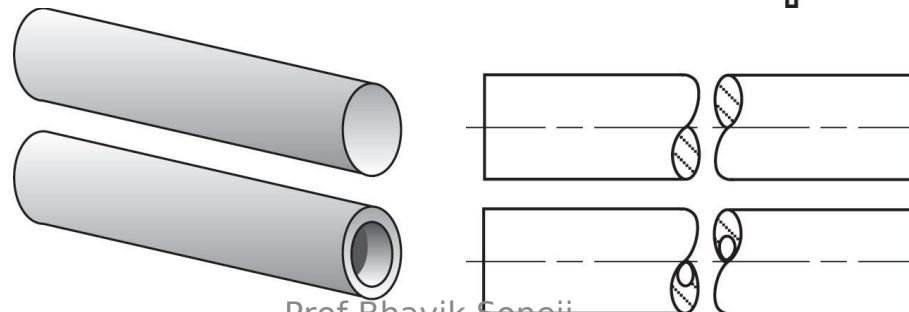
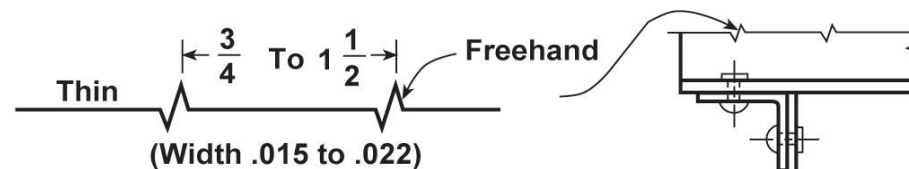
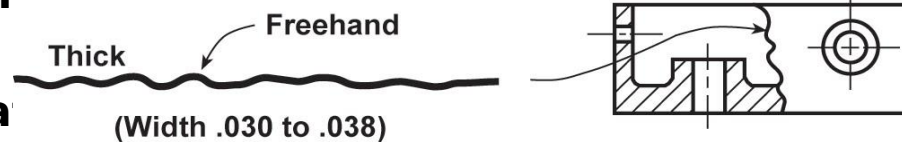


A. ALPHABET OF LINES

8. Break Lines:

- Can be long or short.
- Indicate that part is broken out to clearly show part or area beneath part.
- Also used to reduce size of drawing of long part w/uniform cross-section.
- Short breaks indicated by solid, thick, freehand lines.
- Long breaks indicated by solid thin ruled lines broken by freehand zigzags.

• Breaks on sha

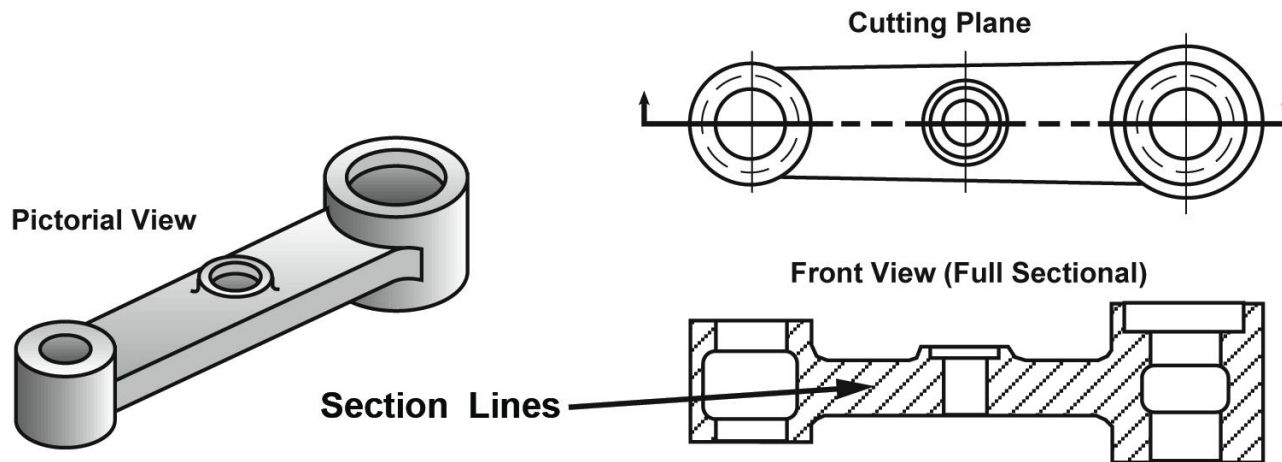


A. ALPHABET OF

LINES Section (crosshatch)

Lines:

- Distinguish between two parts that meet at a given point.
- Each part lined or hatched in different direction.
- Thin, parallel lines approx 1/16 in. apart at 30, 45 or 60 degrees.



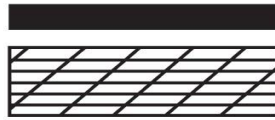
A. ALPHABET OF LINES

9. Section (crosshatch) Lines

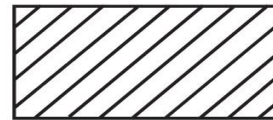
(con't.) Also used to depict specific types of common manufacturing materials



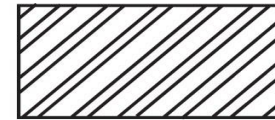
Cast Iron



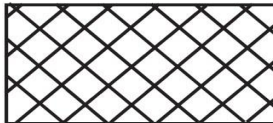
Electric Insulation



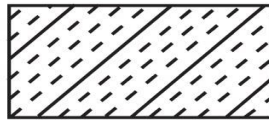
Rubber



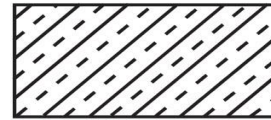
Steel



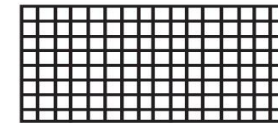
Sound & Heat Insulation



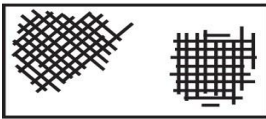
Magnesium Alloy



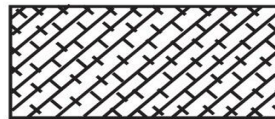
Bronze, Brass Copper



Electrical Windings



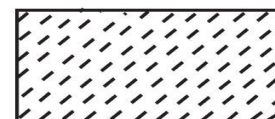
Fabric or Screen



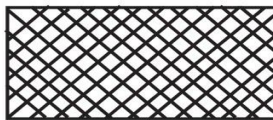
Aluminum & Alum. Alloy



Transparent Material



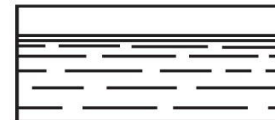
Porcelain Glass



Zinc, Lead Babbitt



Wood



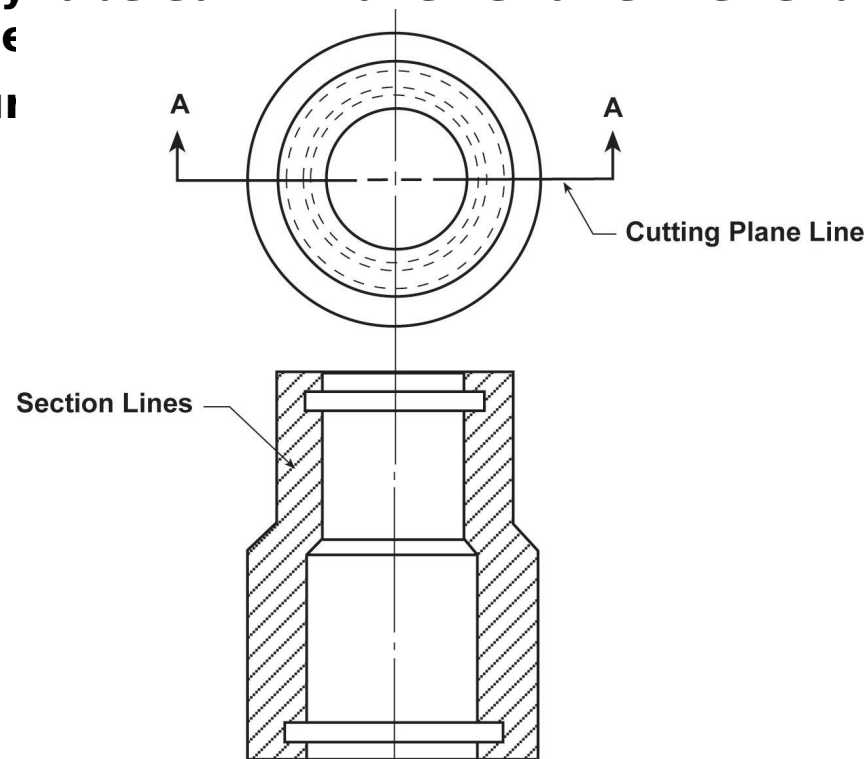
Liquids

A. ALPHABET OF LINES

10 Cutting Plane

Lines: Heavy dash followed by two shorter dashes.

- Each end has a short line at right angle to cutting plane line, with arrowheads pointing in direction from which cut surface is viewed.
- Usually labeled with a letter at either end to identify cut surface
- Cut sur



ALPHABET OF LINES

EXERCISE

Practice exercise in student workbook.

1. Match the following (write the letter of the correct definition on line to the left):

 B

Object line

A. Used when it is not necessary to show all of a part.

 G

Hidden line

B. The lines which show the visible parts in a view.

 E

Center line

C. Used in combination with a cutting plane line to depict the structure of an object.

 inner

 I

Phantom line

D. Used to show the location of a cut for a sectional view or the direction from which a view is taken.

 A

 F

Break line

E. Shows the course through which center travels.

 D

Extension line

F. A thin line that extends from the part or feature being dimensioned.

 C

Cutting plane

G. Used to indicate edges, intersections, etc., that are behind other features of the part.

 H

Section line

H. Used in conjunction with extension lines to indicate a linear distance.

 distance.

 Dimension line

I. Shows alternate positions of parts and also the location of parts that

*

parts that

Check your answers!

11

ALPHABET OF LINES

EXERCISE Practice exercise in student workbook.

2. Draw the following lines:

1. **Object line** 

2. **Cutting plane line** 

3. **Short break line** 

4. **Extension and dimension lines** 

5. **Hidden lines** 

6. **Section line**

7. **Center line** 

8. **Long break line** 

9. **Phantom line** 

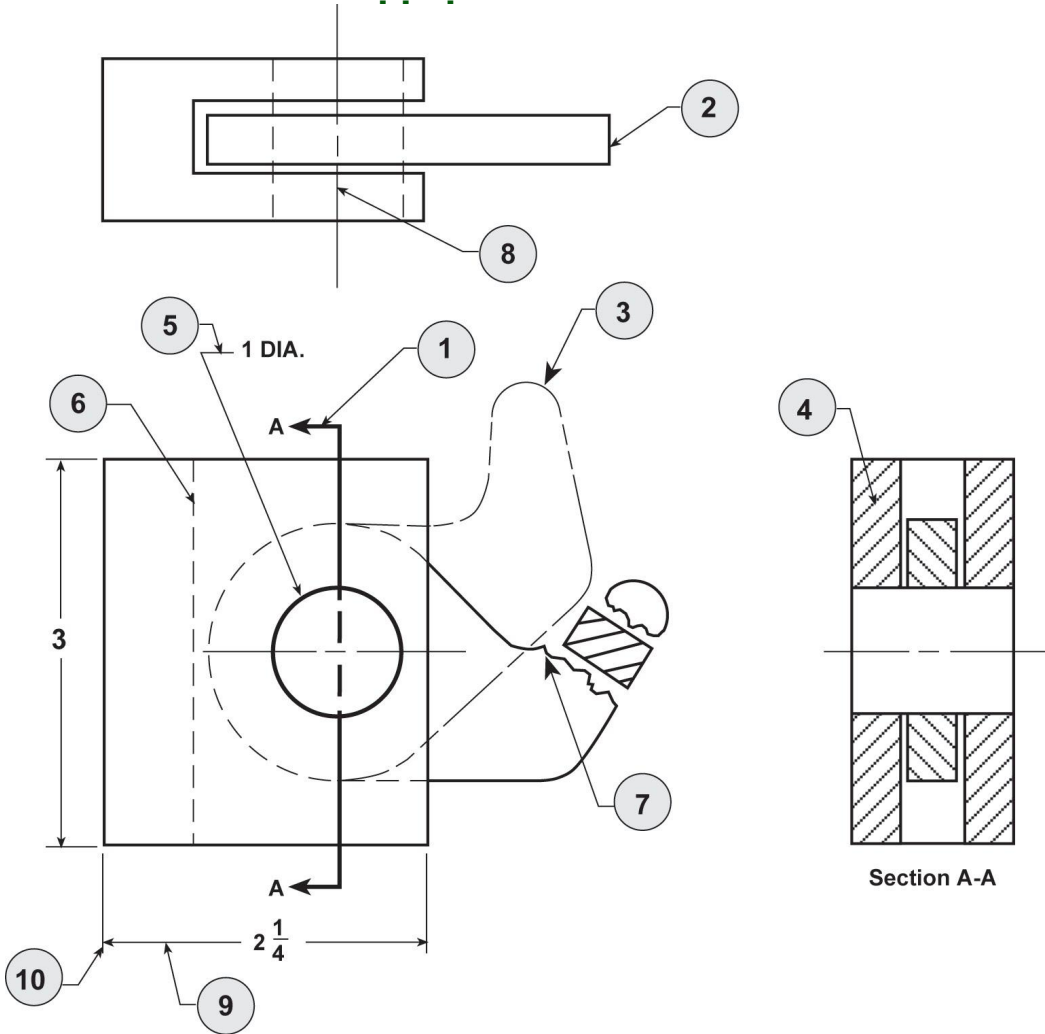
Check your answers!

ALPHABET OF LINES

EXERCISE

Practice exercise in student workbook.

3. Identify the ten lines found on the drawing below by writing the correct name of each in the



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. **Extension Line**

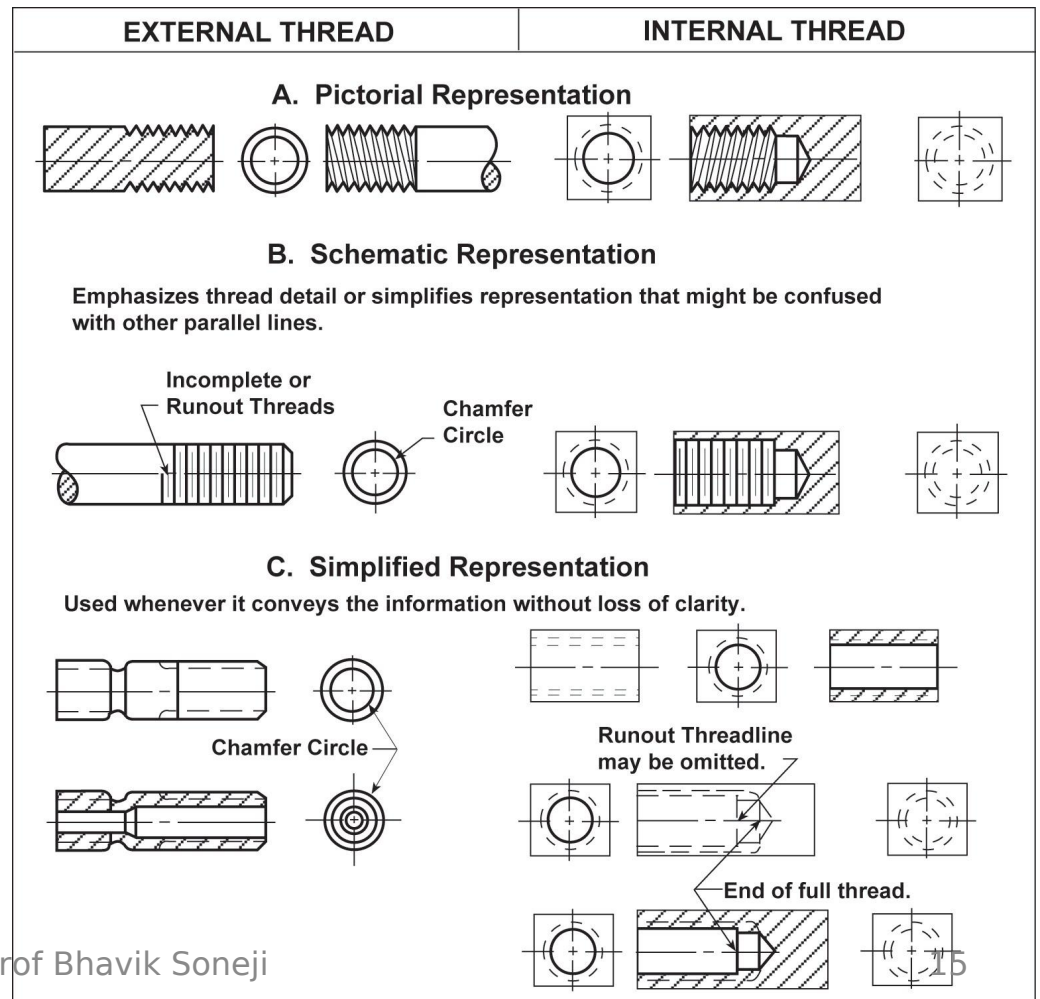
*

B. SYMBOLS AND TERMINOLOGY

1. Thread Representation:

- True representation difficult because of detail required.
- Three types of conventions or accepted practices.

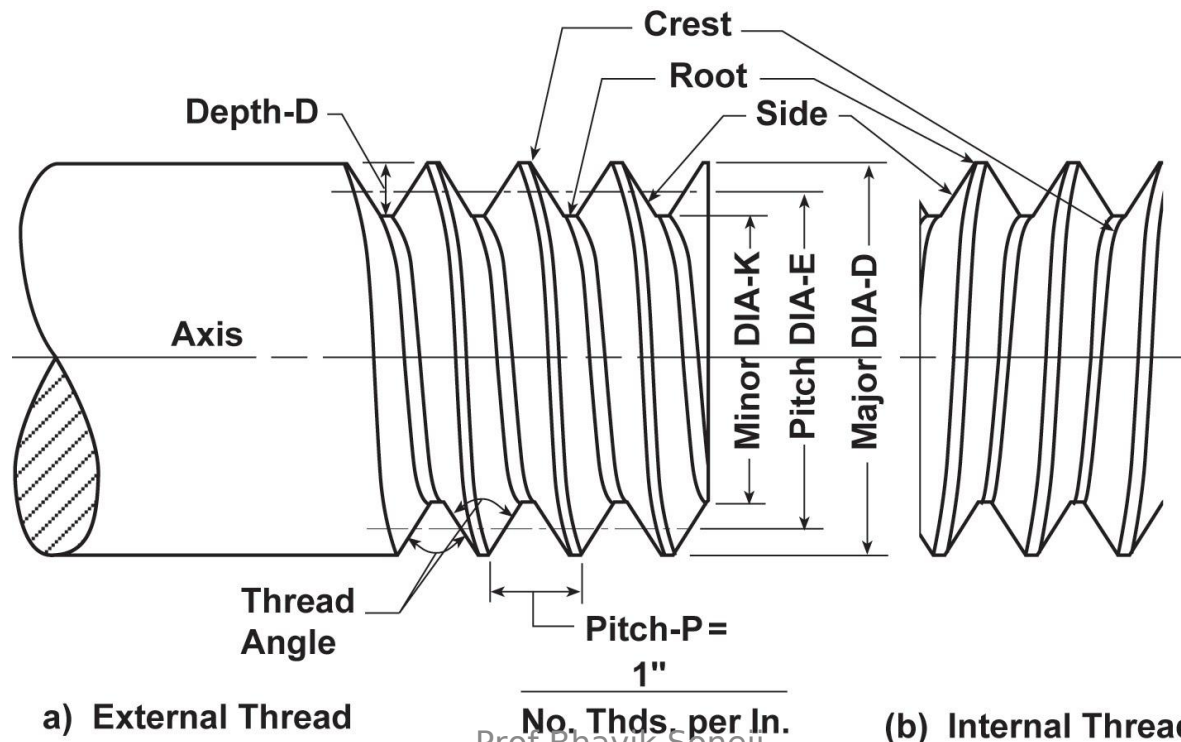
- ◇ Pictorial
- ◇ Schematic
- ◇ Simplified Presentation



B. SYMBOLS AND TERMINOLOGY

1. Thread Representation:

- Descriptive terms to identify specific thread arrangements.
- Diameter-pitch combinations.
- ◇ Coarse
- ◇ Fine
- ◇ Extra Fine
- ◇ Unified Pitch (8, 12, 16 thread)

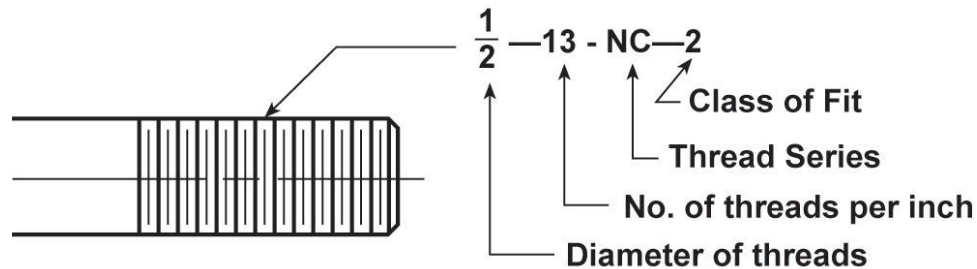


B. SYMBOLS AND TERMINOLOGY

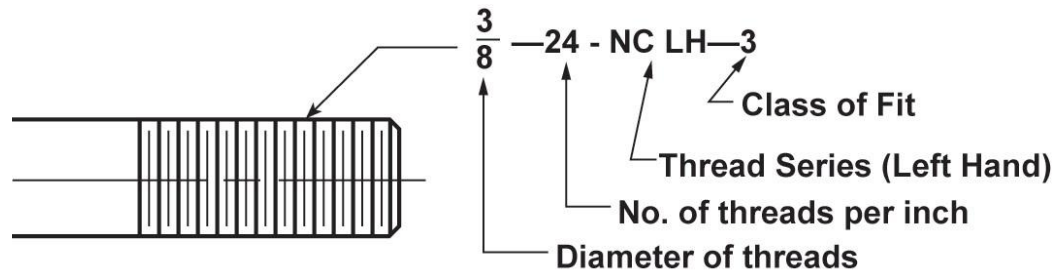
1. Thread Representation:

- **Different thread specifications:**

- ◇ **Diameter**
- ◇ **Number of threads per inch**
- ◇ **Thread Series (National Coarse/Fine/Extra Fine, Square, Acme, Pipe)**
- ◇ **Class of Fit (loose to theoretically perfect)**



Unless otherwise specified, threads are assumed to be right-handed.



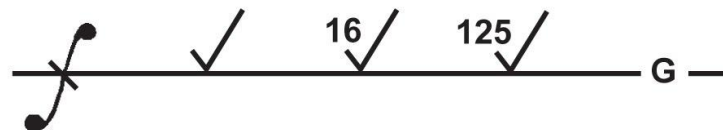
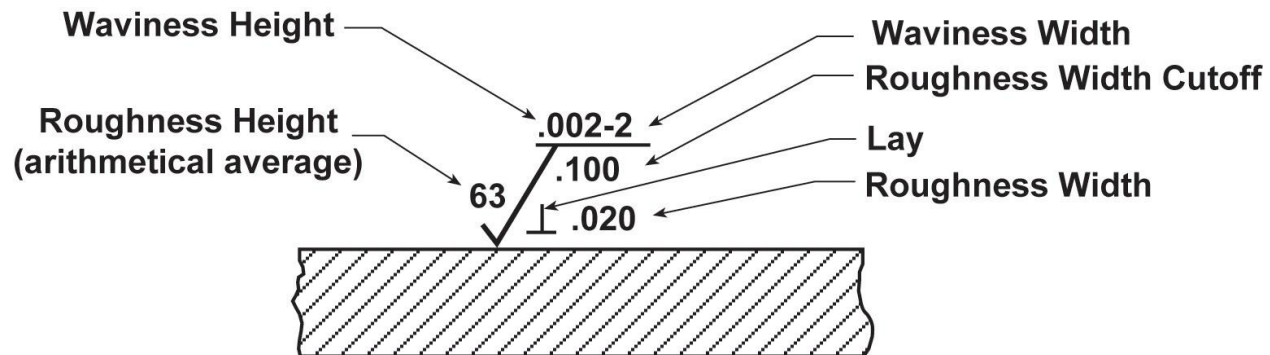
B. SYMBOLS AND TERMINOLOGY

2. Finish

Symbol: “Finished Surface” - Any surface requiring removal of material to improve:

- ◇ Size
- ◇ Geometry
- ◇ smoothness
- **“Finished Surface” - Done by different processes:**

- ◇ planing
- ◇ milling
- ◇ turning
- ◇ broaching
- ◇ grinding



B. SYMBOLS AND TERMINOLOGY

3. Fillets and

Rounds:

• Designed into parts to:

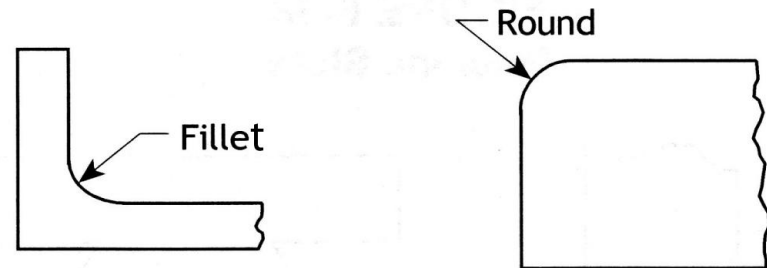
- ✧ Strengthen a shoulder
- ✧ Enhance appearance of a corner
- ✧ Remove sharp edges

• Fillets:

- ✧ Allow additional metal in inner intersection
- ✧ Rounding out internal corner increases strength

• Rounds (or Radius):

- ✧ Made by rounding off external edge
- ✧ Improves appearance
- ✧ Prevents chipping of sharp edges



B. SYMBOLS AND TERMINOLOGY

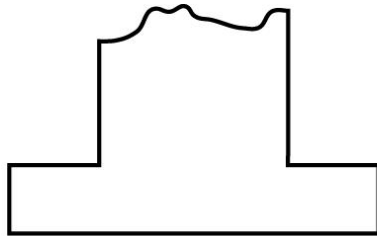
4. Machine

Slots:

Used as means to secure parts during milling

- Two main types:

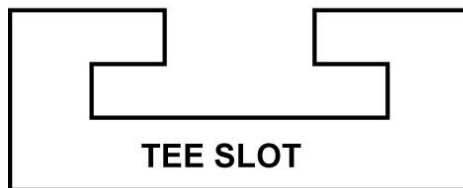
- ✧ Tee Slots
- ✧ Dovetails



Fits Tee Slot



Fits Dovetail



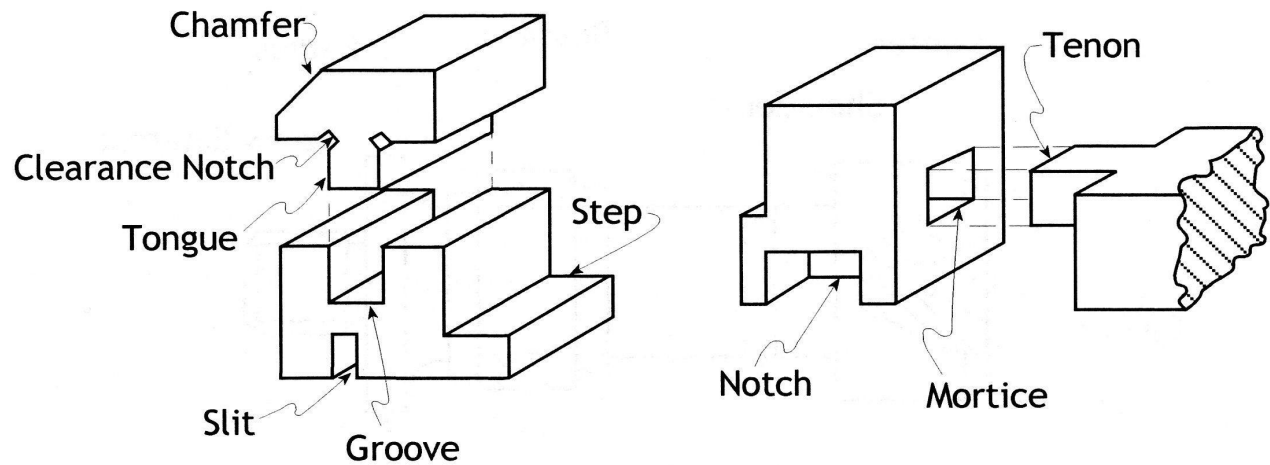
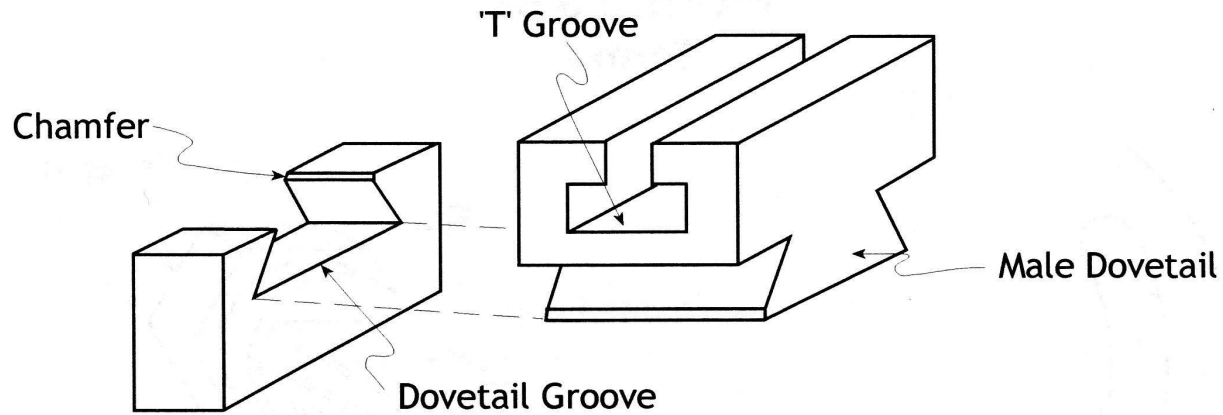
As on milling machine table



As on lathe cross slide assembly

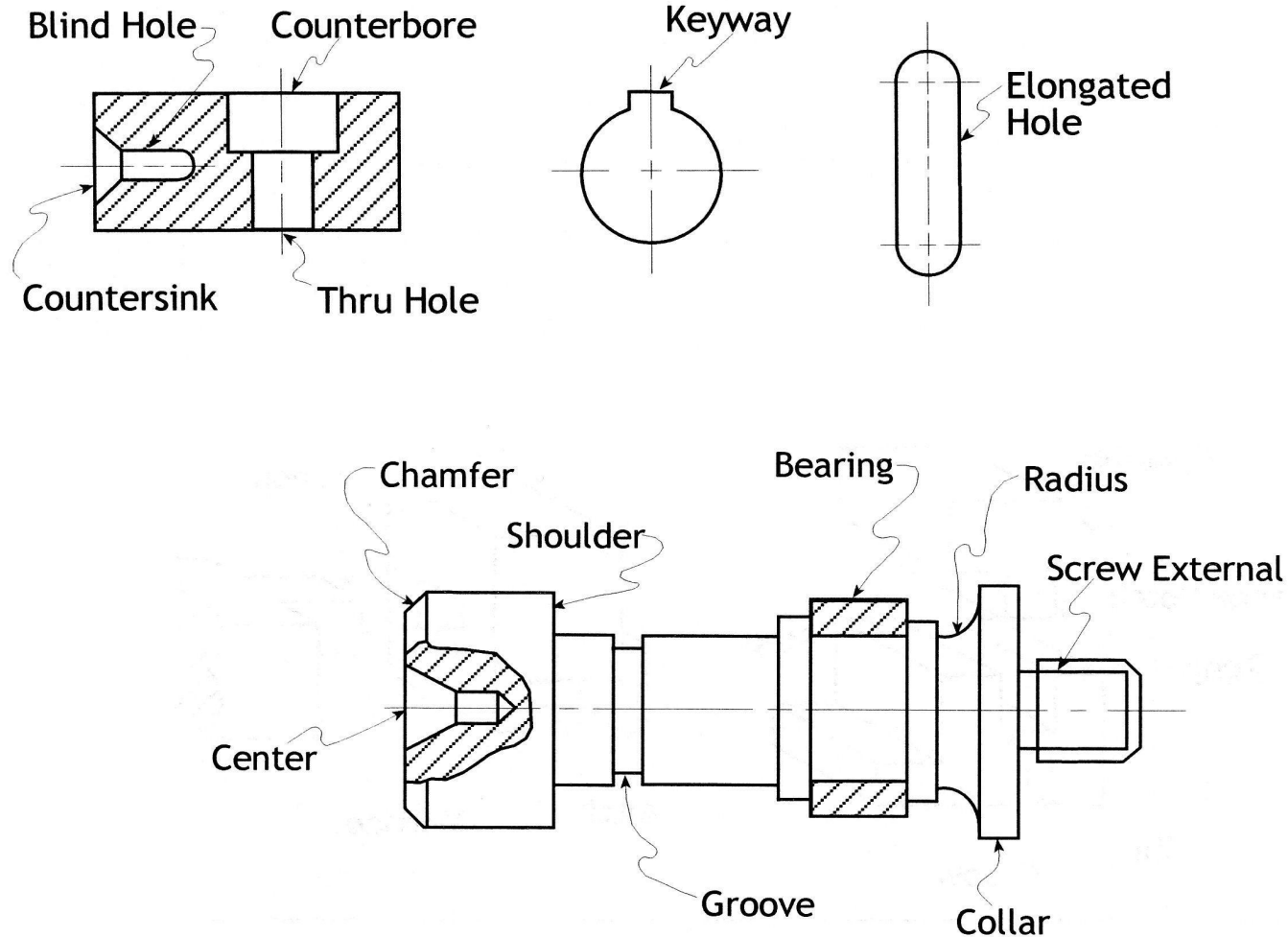
B. SYMBOLS AND TERMINOLOGY

Terms used with



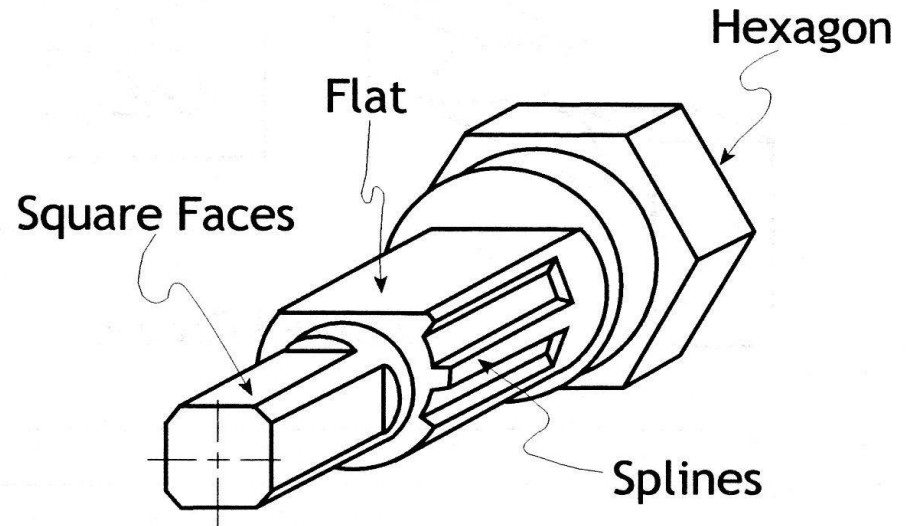
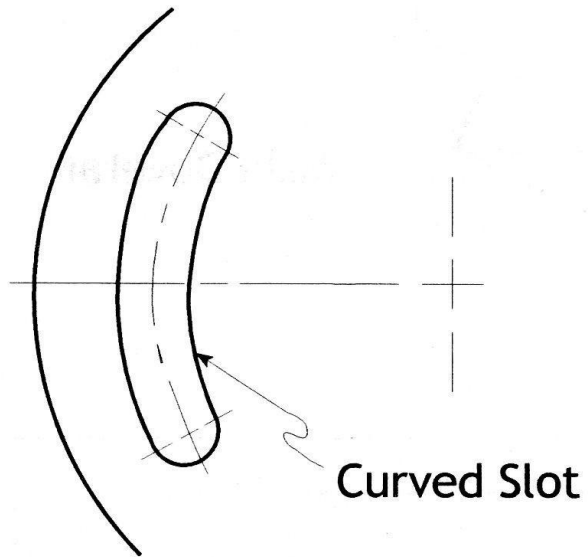
B. SYMBOLS AND TERMINOLOGY

Terms used with blueprints



B. SYMBOLS AND TERMINOLOGY

Terms used with blueprints



B. SYMBOLS AND TERMINOLOGY

5. Title

Blocks:

- **Usually located in lower right hand corner of drawing.**
- **Contains information needed for manufacturing.**
- **Block format varies from company to company.**
- **Includes important information without cluttering up drawing.**
- **Title Blocks often divided into following general sections:**
 - ✧ **Company Name and Location**
 - ✧ **Part Name**
 - ✧ **Part Number (die number, forging number, etc.)**
 - ✧ **Drawing Number**
 - ✧ **Scale (size of drawing as compared to actual size of part.**
 - ✧ **Assembly Drawing Number**
 - ✧ **Drafting Room Record**
 - ✧ **Material Callouts**
 - ✧ **Stock Form and/or size**
 - ✧ **Tolerances**
 - ✧ **Shop Notes**
 - ✧ **Drawing Revisions**

B. SYMBOLS AND TERMINOLOGY

5. Title Blocks: Sample Assembly Drawing of Connecting Rod

1473708 - NUT

OIL HOLE FOR CYLINDER WALL LUBRICATION

ROD MUST BE SUPPORTED SO THAT THE WEIGHT CHECK FOR BALANCING OPERATIONS IS MADE AT THE BORE CENTER LINES

1482026 - ROD (C)

BEARING LOCATING NOTCHES

(A) (B)

1480990 - BOLT
1480991 - BOLT } OPTIONAL

STAMP ROD NUMBER HERE BEGINNING WITH #1 AT FRONT OF ENGINE

1481061

REFER TO 1481074 FOR WEIGHT CONTROL INFORMATION

WT. LBS.

DATE	SYM.	REVISION RECORD	AUTHORITY	DR.	CK.
8-15-81		RELEASED			
3-13-82	A	1480956 - BOLT REMOVED	R31205		
3-13-82	B	1480990-91 - BOLT & "OPTIONAL" ADDED	R31205		
3-13-82	C	1482026 - ROD WAS 1480994	R31205		

DO NOT SCALE
.010 EACH WAY CAN BE ALLOWED ON DIMENSIONS NOT OTHERWISE SPECIFIED.
FINISH ALLOWANCE— F₁ = .02 F₂ = .04 F₃ = .06 ETC.

DWG. DATE	7-19-81	DR.	R. EBERLINE
SCALE	FULL	CK.	<i>Atchae</i>
REFERENCE	1468288	APPR.	<i>R</i> <i>H&B</i>
		APPR.	<i>R. L. Johnson</i>
		APPR.	<i>MB</i>

MATERIAL SPEC.

NAME
ROD INFORMATION DRAWING
ENGINE CONNECTING

PART NO.
1481061

B

B. SYMBOLS AND TERMINOLOGY

6. Bill of

NO.	PART NAME	REQD	MATL
1	HOUSING, CHARGER CONSOLE	1	PLSTC
2	PLATE, CHASSIS	1	STEEL
3	TRANSFORMER	1	STOCK
4	RECTIFIER	1	STOCK
5	LEADS, BLACK	3	STOCK
6	LEAD, RED	1	STOCK
7	LINE CORD	1	STOCK
8	STRAIN RELIEF	1	STOCK
9	SPLICE	2	STOCK
10	RIVET	2	STOCK
11	SWITCH	1	STOCK
12	SOCKET	1	STOCK
13	LAMP	1	STOCK
14	RESISTOR	1	STOCK
15	RECEPTACLE	2	STOCK
16	STRIPS, CONTACT	2	COP.
17	WINDOW	1	PLSTC
18	FOOT	4	STOCK
19	SCREW	4	STOCK
20	LABEL, MODEL	1	STOCK
21	LABEL, CHARGER CONSOLE	1	STOCK
22	LABEL, UL LISTING	1	STOCK

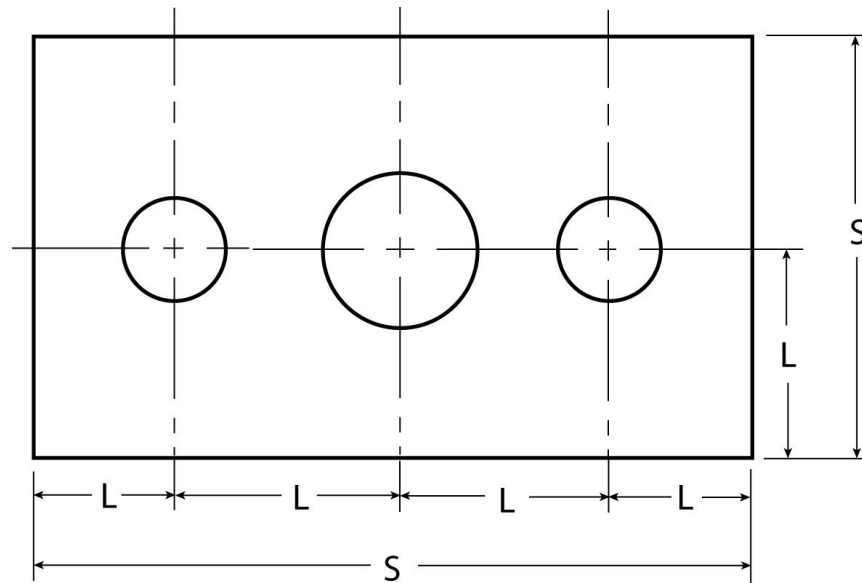
B	REDRAWN	11-8-81	JKH
A	NEW UL LABEL	2-1-80	JKH
FIGURE	REVISION	DATE	BY (CHK'D)
DRAWN	2		
DATE	2-10-79	PIERCE CORPORATION RIVER FALLS, WISCONSIN	
CHK'D		DATE	TITLE
		4-11-79	CHARGER CONSOLE
3 P.L.C. DFC		DATE	
4 P.L.C. DFC	AR 4/14/79	DATE	
ANGULAR		DATE	
DESCRIPTION	SCALE	SIZE	DRAWING NO.
	FULL	C	10037-01

B. SYMBOLS AND TERMINOLOGY

7. Dimension

Types

- Two main types: (Size, Location)
- Fractional Dimensions used on parts not requiring a high degree of accuracy.
 - ✓ Usually no smaller than 1/64 of an inch.
- Decimal Dimensions used to indicate high degree of accuracy.
 - ✓ Can be as accurate as one ten-thousandth (.0001) of an inch.



S = Size Dimensions

L = Location Dimensions

Prof Bhavik Soneji

B. SYMBOLS AND TERMINOLOGY

7. Dimension

Types

- **Decimal tolerances range from tenths (.10) to ten-thousandths (.0001)**
- **When degree of accuracy is critical - tolerance becomes tighter.**
- **Number of decimal places in a dimension determines tolerance decimal places. For example:**
 - ✓ **Dimension “5.10” - Tolerance “ \pm .02”**
 - ✓ **Dimension “5.100” - Tolerance “ \pm .002”**
- **Angular dimensions used when straight lines are not horizontal or vertical.**
 - ✓ **Expressed in degrees ($^{\circ}$), minutes ($'$), and seconds ($''$)**
 - ✓ **Also expressed in tenths (.01) or hundredths (.01) of a degree**

B. SYMBOLS AND TERMINOLOGY

8. Tolerance

Blocks

- Used to indicate fractional, decimal, and angular tolerances

Tolerances Unless Otherwise Specified			
Fractions	Decimals		Angles
$\pm 1/64''$	$.00 \pm .02''$	$.000 \pm .003''$	$.0 \pm .02^\circ$

- Dimensions add exactness to drawings by expressing:
 - ✓ Lengths
 - ✓ Widths
 - ✓ Heights
 - ✓ Angles

C. VISUALIZATION

Picture or photograph shows object as it appears to the observer.

1. Orthographic Projection - Three or more views or perspectives from a different, or distinct 90° angle.

- ✓ **Front**
- ✓ **Top**
- ✓ **Side**

Views are called Orthographic Projection or Multi-view Drawing.

2. View Arrangement - Six possible views of any object:

- ✓ **Front**
- ✓ **Back**
- ✓ **Top**
- ✓ **Bottom**
- ✓ **Left Side**
- ✓ **Right side**

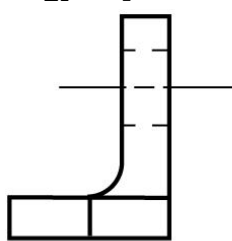
C. VISUALIZATION

2. View

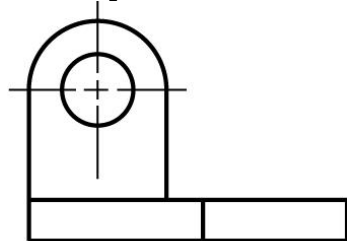
Arrangement

Only difference between “third-angle and first-angle” projection is arrangement of views.

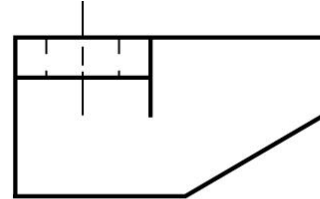
International projection symbols distinguish between



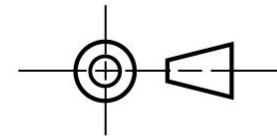
Right-Side View



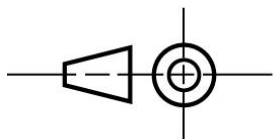
Front View



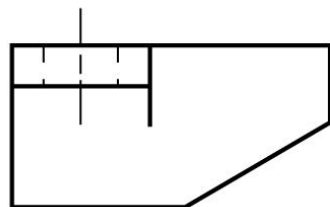
Top View



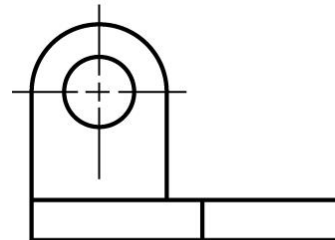
Symbol



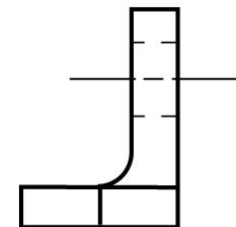
Symbol



Top View



Front View



Right-SideView

First-angle
Projection
(European)

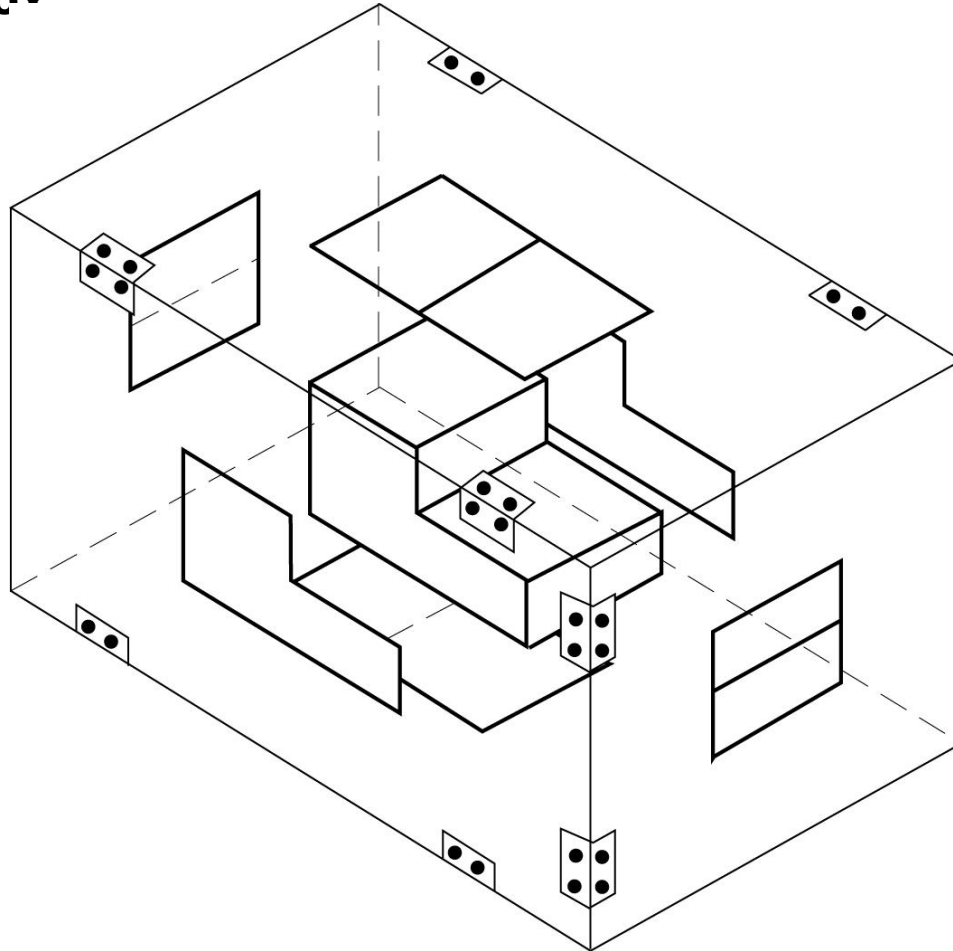
Third-angle Projection
(United States &
Australia)

C. VISUALIZATION

2. View

Arrangement

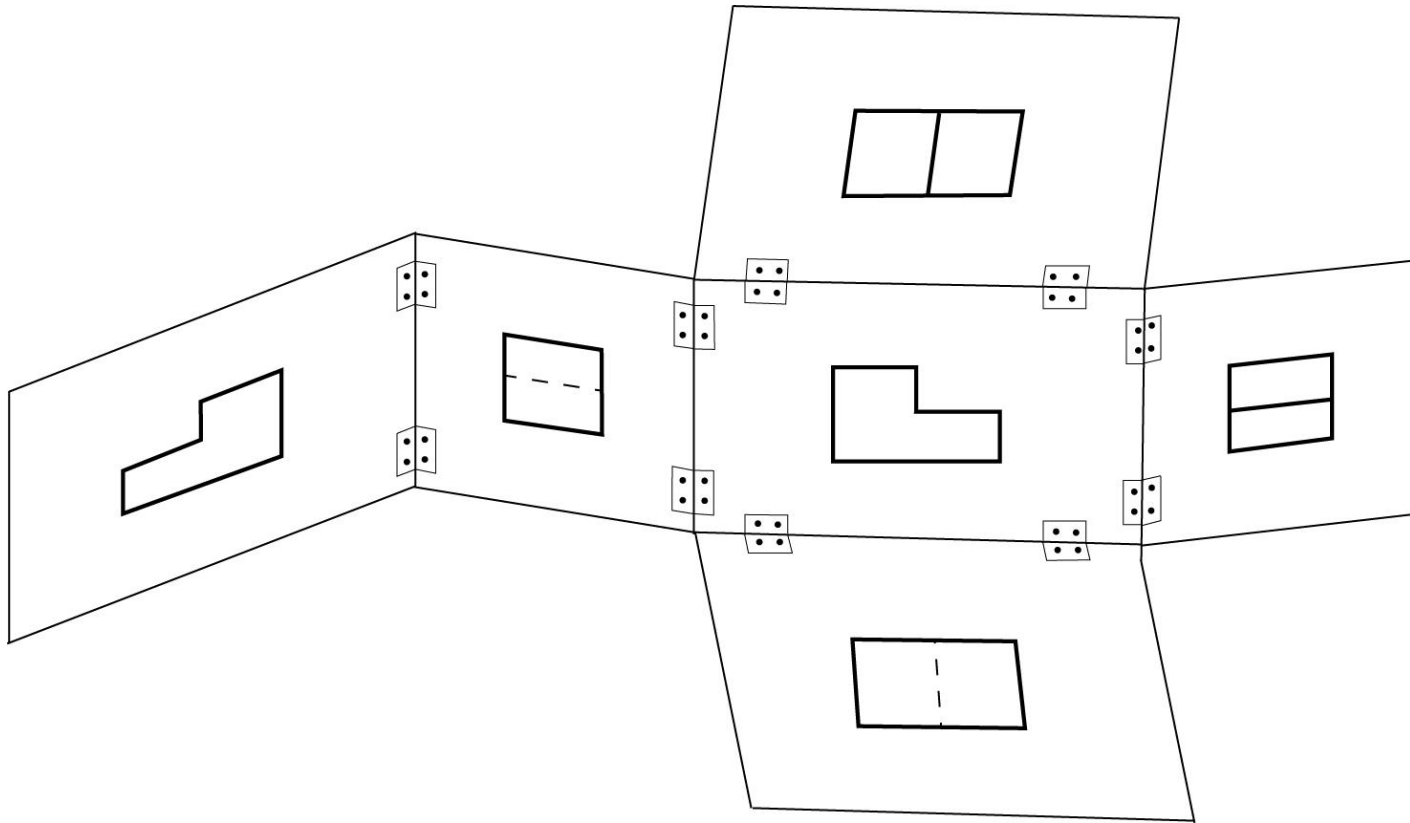
Third-angle projection of part in a glass box



C. VISUALIZATION

2. View

Arrangement
Box flattened into a single
plane.

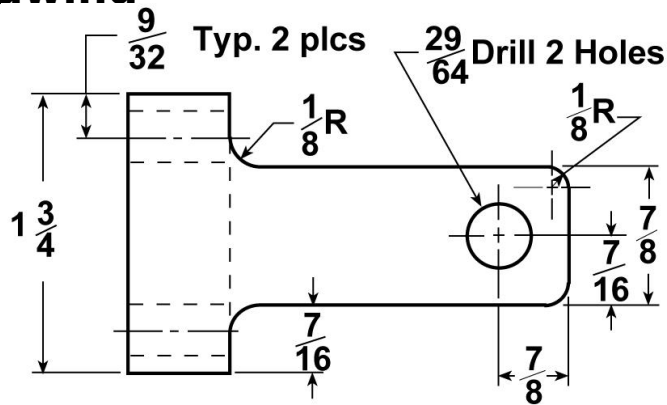


C. VISUALIZATION

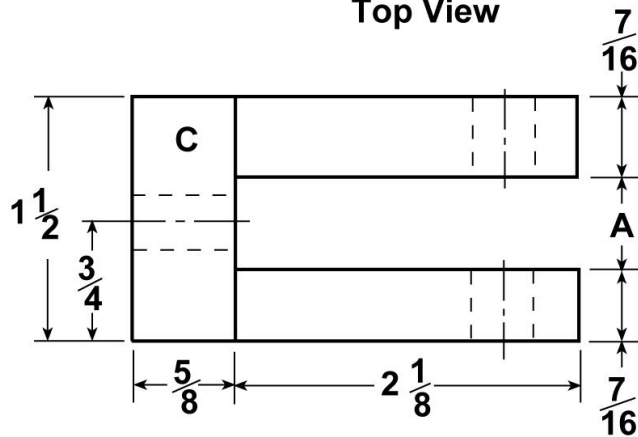
2. View

Arrangement Detail

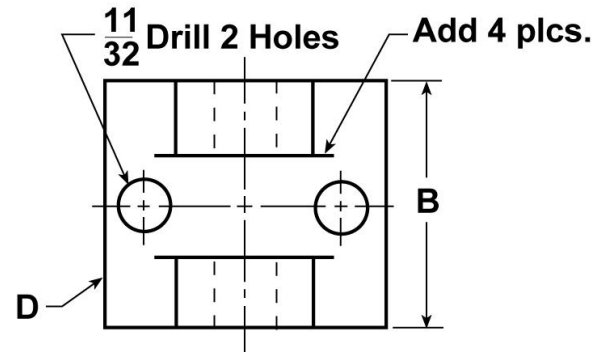
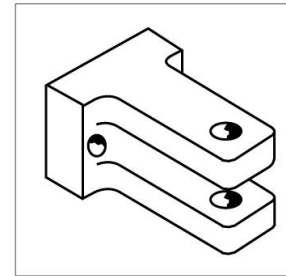
Drawing



Top View



Front View



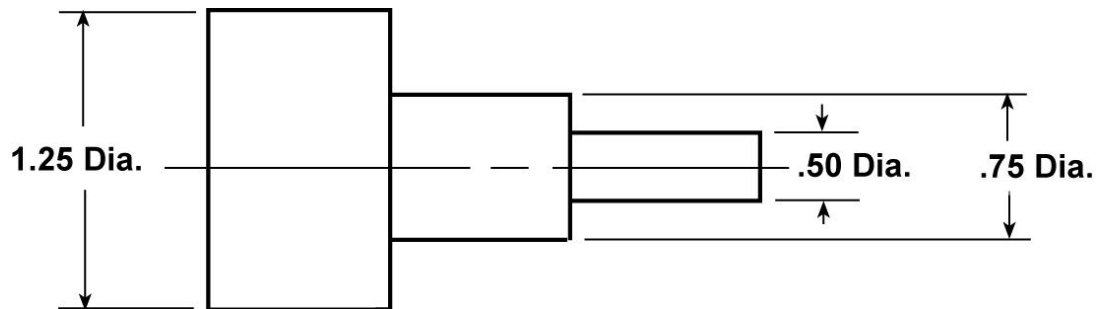
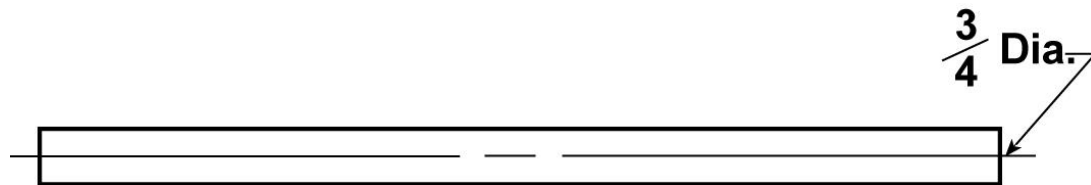
Right Side View

C. VISUALIZATION

2. View

Arrangement

Cylindrical Objects require only one view.



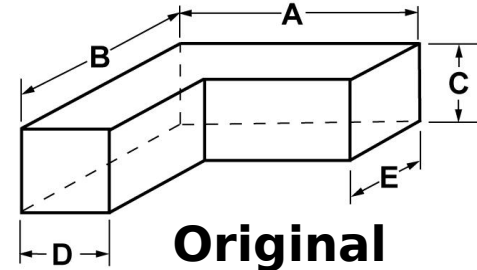
C. VISUALIZATION

2. View

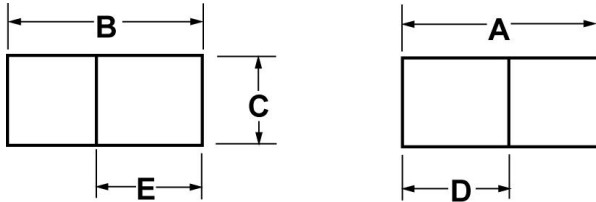
Arrangement

Different views can be selected for one part.

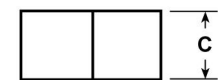
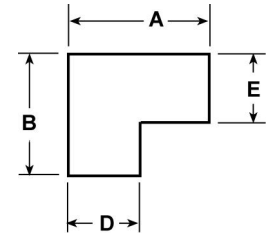
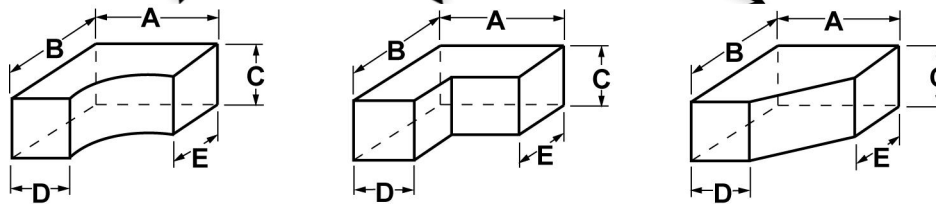
Multiple views required to ensure accuracy.



Original Part



Orthographic View



Top View eliminates confusion

Different parts that could be represented by Orthographic View.

D. SECTIONAL AND AUXILIARY VIEWS

VIEWS

Complex shapes difficult to depict.

Sectional and Auxiliary views provide clearer representation.

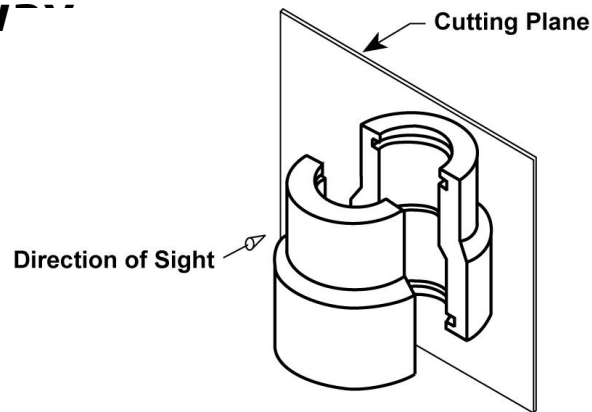
1. Sectional

Views

Used to show complicated interior details.

Used to show difference in materials on assembly drawings.

Sectional view obtained by imagining portion of object has been cut away.



Sectional View

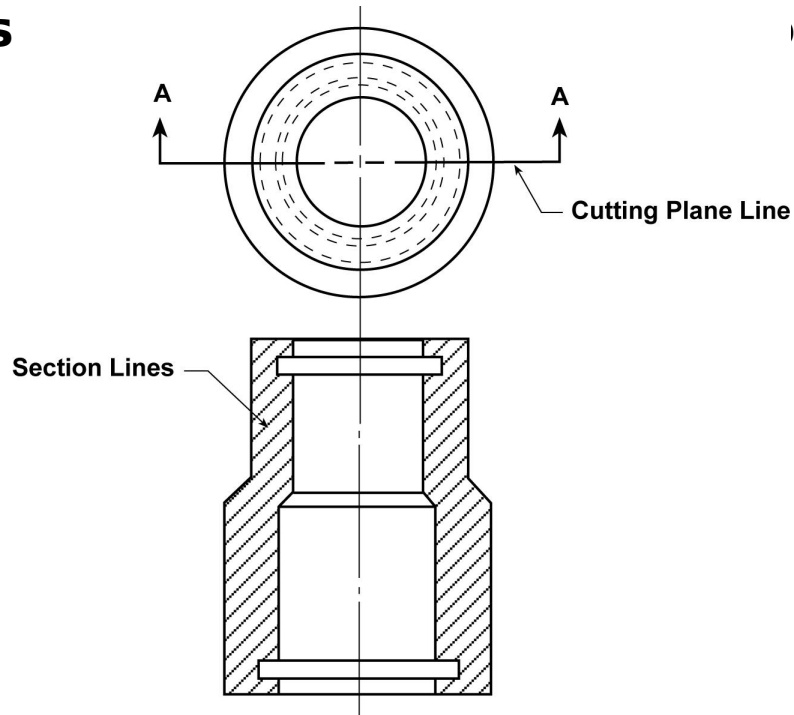
D. SECTIONAL AND AUXILIARY VIEWS

1. Sectional Views

Views

Cutting Plane Line indicates position of imaginary cut.

Ends of Cutting Plane Line are bent 90° and terminated with arrow heads to indicate the viewing direction.



Sectional View A-A

Cutting Plane Lines
Prof Bhavik Soneji

D. SECTIONAL AND AUXILIARY VIEWS

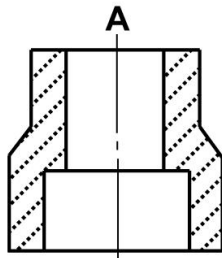
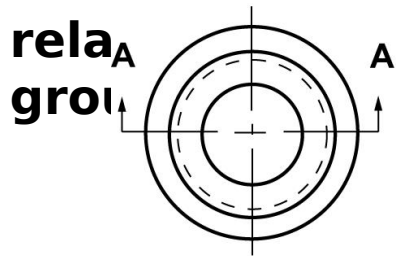
1. Sectional Views

Views

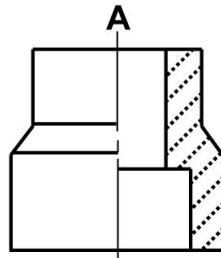
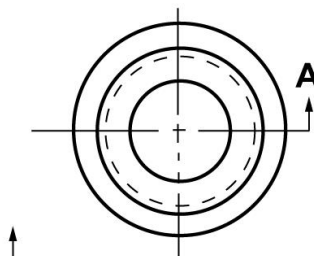
Full Sectional = Cut across entire object, exposes whole inner surface.

Half-Sectional = Places two cutting planes at right angles to each other.

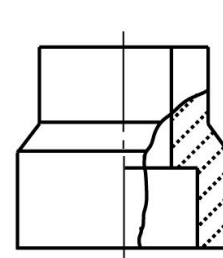
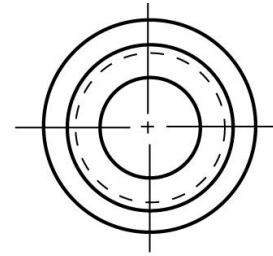
Broken-out or Partial Section = Shows a single, or closely related group of



Section A-A
Full sectional



Section A-A
Half sectional



Broken out or partial

D. SECTIONAL AND AUXILIARY VIEWS

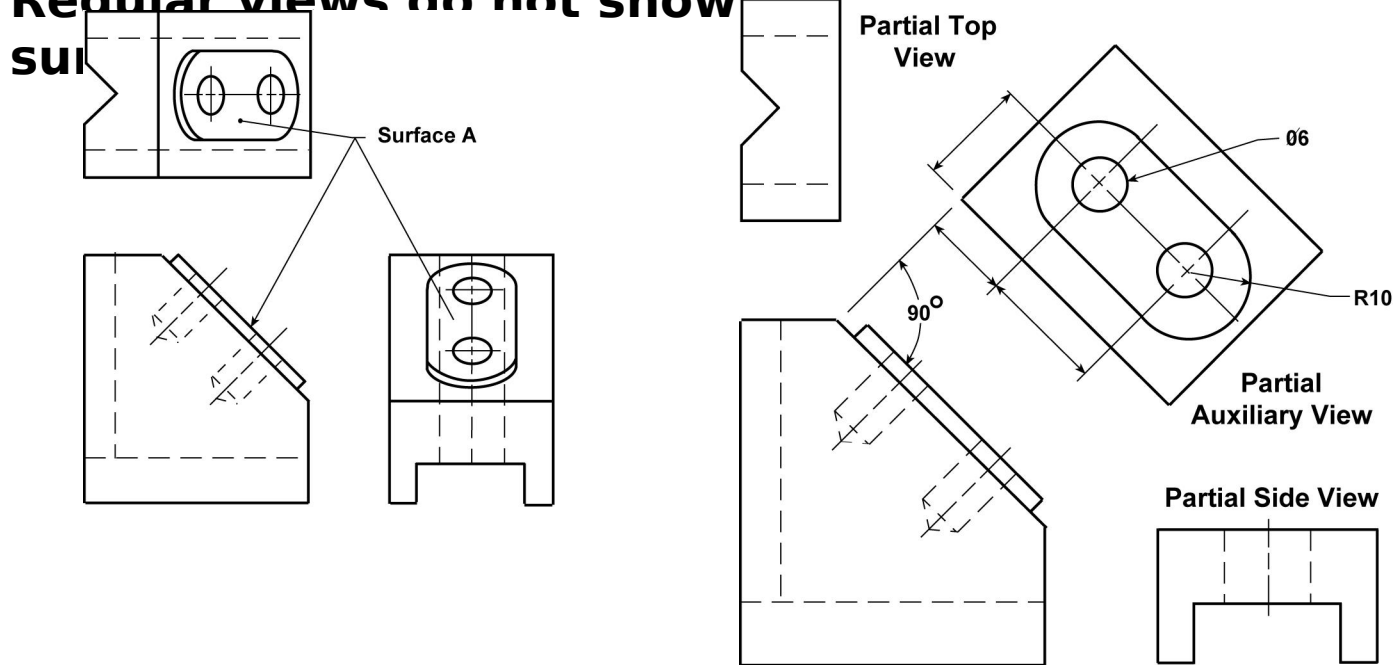
2. Auxiliary Views

Views

Many parts have surfaces not at right angles to Plane of Projection.

Called sloping or inclining surfaces.

Regular views do not show true features of sloping surfaces.



Auxiliary View shows true features of surface.

*

D. SECTIONAL AND AUXILIARY

VIEWS

3. Multi-View

Review

Multi-View Projections illustrate a combination of views.

Primary (front) View determines arrangement of all other views.

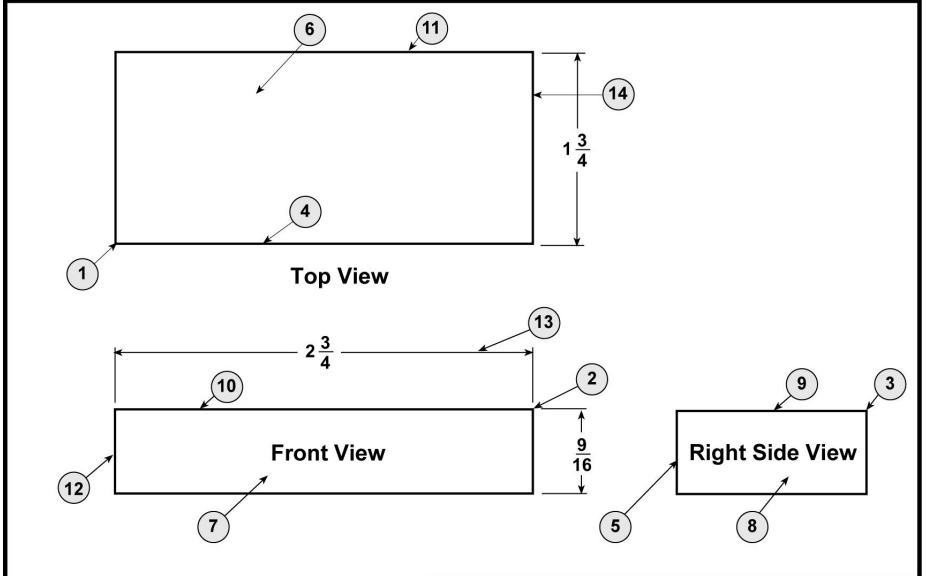
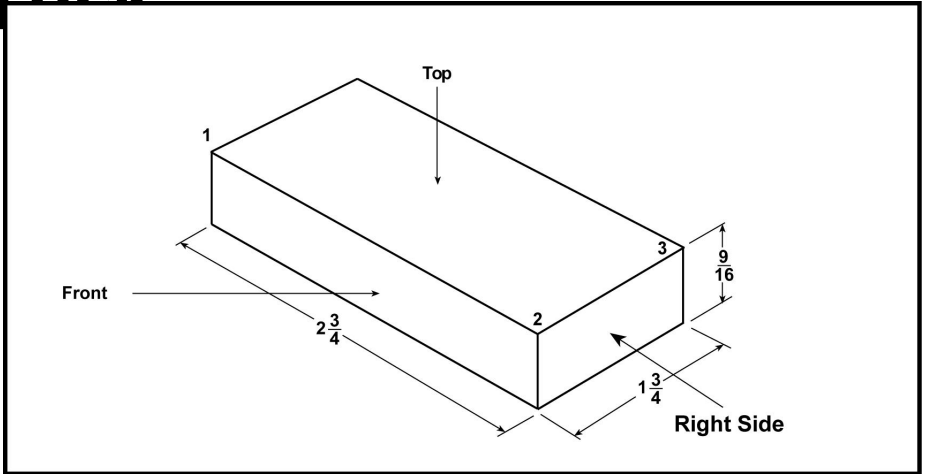
Top, bottom, left, right and back views are developed by projecting lines at 90° angle from front view.

Side Views always placed laterally (to the side) of front view.

Sectional Views reveal object's inner details using cutting plane or break lines.

Auxiliary Views show inclined surface or lines in true size/shape.

EXERCISE 1 - VIEWS AND TITLE BLOCK



Scale: 1/1	Approved	Drawn By: <i>Q/B</i>
Date: 10-3-93	By: <i>Ran BDL</i>	Revised:
Title: Pressure Pad Blank	Drawing No: D-3	
Matl Specs.	Part No.:	Quantity:
M.S.	121-59	2

EXERCISE 1 - VIEWS AND TITLE BLOCK

1. What is the name and part number of the part? **Pressure Pad Blank, 121-59**
2. How many are required? **2**
3. How many views of the part are shown? **4**
4. What is the overall length, height thickness and width? **2 3/4, 9/16, 1**
5. In what two views is length, height and width shown? **Top and Front**
6. If number 6 represents the top surface, what line represents this surface in the front view? **10**
7. If number 8 represents the surface in the right side view, what line represents this surface in the top view? **1** **2**
8. What line in the top view represents the surface 7 of the front view? **5**
9. What line in the right side view represents the front surface of front view? **10**
10. What surface shown does line 10 represent? **1**
11. What line of the front view does point 1 represent? **2**
12. What line of the top view does point 2 represent? **4**
13. What line of the top view does point 3 represent? **1**
14. What kind, or type of line, is line 12? **Left Side Right**
- 15* What kind, or type of line is line 13? **Check your answers**

GLOSSAR Y

Refer to your Student Manual for review and discussion of the Glossary of Blueprint Reading terms.