BASIC METAL WORKS

Level-I

Learning Guide 22

Unit of Competence	**Interpret Drawings &Sketches**
Module Title	**Interpreting Drawings and Sketches**
LG Code:	**IND BMW1 M07 LO1-LG-22**
TTLM Code:	**IND BMW1 M07 TTLM 1019v1**

LO1: Identify technical drawing

Instruction Sheet	Learning Guide 22

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Introduction to technical drawing
- Identifying and using tools and equipment
- Checking and validating drawing version
- Confirming and following Instructions

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Check and validate Drawing against job requirements.
- Check and validate Drawing version.
- confirm and follow Instructions are as require **Learning Instructions**

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” in page 5, 17-, 19 and 22 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3” in page 23, 24 and 25 respectively.
6. Do the “LAP test” in page 26 (if you are ready).

Information Sheet-1	Introduction to technical drawing

1.1 Definitions of drawing

Different literatures define drawing in different terms while basically their core message remains the same. For instance, look the following definitions given for drawing on different literatures;

Drawing:-IS a graphic representation of a real thing, an idea, or a proposed design for later manufacture or construction.

- **A graphic** that represents an idea, a concept, or an entity which actually or potentially exists in life.

- A way of communicating all necessary information about an abstraction such as an idea or a concept.

1.2 Types of drawing

There are two basic types of drawings: **Artistic** and **Technical** drawings.

A. Artistic Drawings :

Artistic Drawings range in scope from the simplest line drawing to the most famous paintings. Regardless of their complexity, artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist. In order to understand an artistic drawing, it is sometimes necessary to first understand the artist. Artists often take a subtle or abstract approach in communicating through their drawings, which in turn gives rise to various interpretations.

Fig 1.1. Artistic Drawings

B. Technical Drawings

The technical drawing, on the other hand, is not subtle, or abstract. It does not require an understanding of its creator, only an understanding of technical drawings.

A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications.

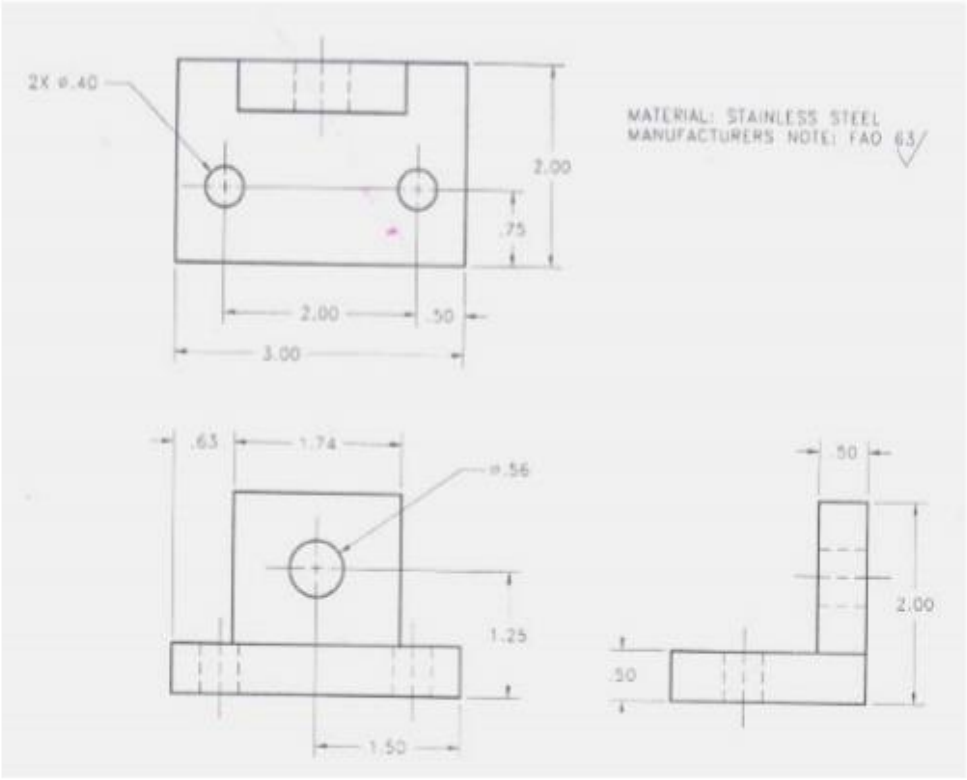


Fig: 1.2 Technical drawing

Self-Check -1	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write the True if the statement is correct answer otherwise write False

1. Drawing is a graphic representation of a real thing, an idea, or a proposed design for later manufacture.
2. Artists some time take a subtle or abstract approach in communicating through their drawings
3. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality
4. Artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist.

Name: _____ Date: _____

Answer Sheet

1._____

2._____

3._____

4._____

Score = _____

Rating: _____

Information Sheet-2	Identifying and using tools and equipment

2.1. Introduction to drawing tools and equipment

The preparation of technical drawing is possible only through knowledge and skill in the use of a variety instruments. With the aid of knowledge and skill practice will bring perfection. The following listed drawing instruments are the basic ones:

2.2. Types of drawing tools and equipment

Drafting equipment like T-square, drawing board or binder, ruler, set squares, compasses, protractors, French curves, templates, eraser, dividers, … etc

1. T-square

T-square is provides a parallel straight edge for the beginning drawing drafter.

It is composed of two parts:

- The head and
- The blade.

The two parts are fastened together at an exact right angle. The blade must be straight and free of any necks and imperfections. Used to draw horizontal lines on the drawing sheet Used to draw vertical lines and slanted lines with the help of additional equipment basically $45^0$and 60^0 set- squares. Draw lines only against the upper edge of the blade. Make sure the head is held against the left edge of the drawing board to guarantee parallel lines.

The uses of T-square are to align the drawing paper to the drawing board, and to draw parallel horizontal lines on the paper.

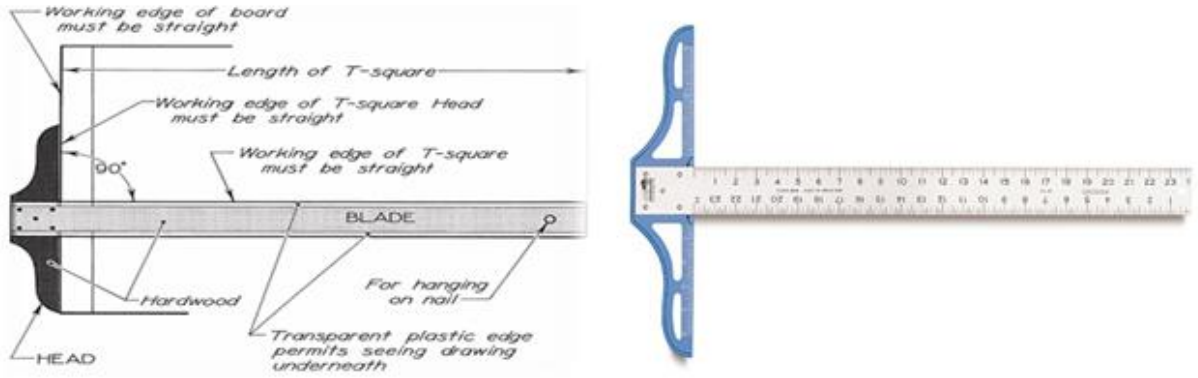


Figure 2.1. T-square

2. Drawing Board

Drawing Board; is Available in a variety of styles and sizes. Most are adjustable up and down, and can tilt to almost any angle from vertical 90^{o} to horizontal. The drawing surface must be clean, flat, smooth, and large enough to accommodate the drawing and some drafting equipment. If a T-square is to be used, at least one edge on the board must be absolutely true. Most quality boards have a metal edge to ensure against warping and to hold the T-square securely.

Figure 2.2. Drawing Board

3. Compass

Drawing Compass History and Types of Compasses

A technical drawing tool named drawing compass is used to draw circles or arcs. This tool is also known as a pair of compasses, or simply as a compass. It can also be used for measuring distances or more precisely distances on the maps. Apart from that, drawing compasses are used in navigation, mathematic, drafting and any many other disciplines. Materials of which compasses are made are usually plastic or metal.

Drawing compass has two parts connected by a hinge so the radius of the circle that is drawn can be adjusted and changed. Usually at the end of one part is a needle and at the end of another is a pencil. First drawing compasses were found in the archeological digging of ancient Rome.

Every drawing compass before the eighteenth century didn't have a pen but a needle instead so it scratches the surface. By the twentieth century, drawing compasses were spread widely throughout the world.

Figure2.3 Compass

4. Divider

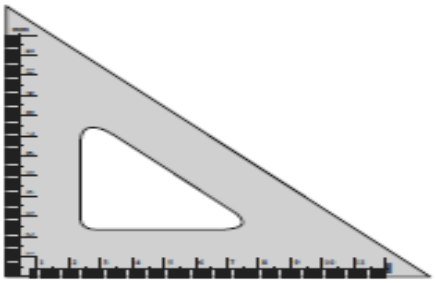
Dividers are similar to compasses, except that both legs are provided with needle points. As with compasses, dividers are available in large and small sizes, Dividers are used to transfer measurements. To step off a series of equal distances, and to divide lines into a number of equal parts A divider is similar to a compass, except that it has a metal point on each leg.It is used to lay off distances and to transfer measurements

Figure2; 4 Divider

5. **Triangles2.5 (Set- square)**

Triangles (setsquares):- They are used to construct the most common angles (i.e. 30^0, 45^0, and 60^0) in technical drawings. The 45^0 x 45^0 and 30^0 x 60^0 triangles are the most commonly used for ordinary work.

Triangles are used in combination with the T square or straightedge to draw vertical and inclined lines. They are usually made of transparent plastic, which allows you to see your work underneath the triangles



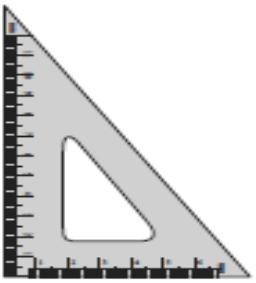
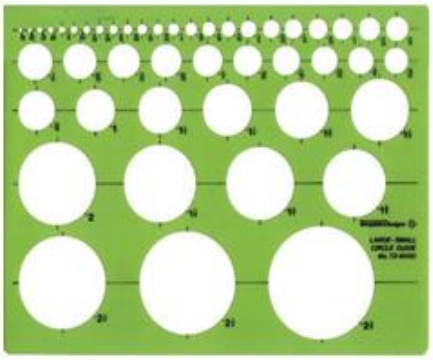


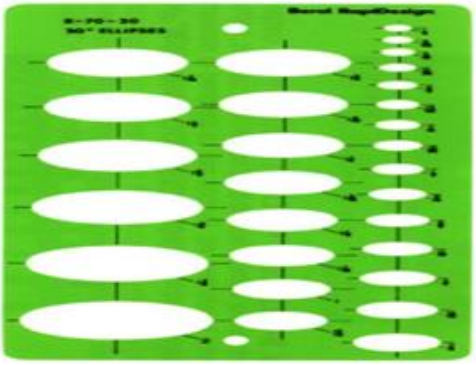
Fig.2;6 *(a): 45 Set Square* *Fig. 2.6 (b): 30|60 Set Square*

6. Drawing Templates

A template is a thin, flat piece of plastic containing various cutout shapes. It is designed to increase the speed and accuracy of the Drafter. Templates are available for drawing is see as following circles, ellipses



See Figure 2:7Circle Template



see Figure2 :8 ellipse template

7. French curves and flex curves

French curves are thin plastic tools that come in assortment of curved surfaces. They are used to produce curved lines that cannot be made by a compass. Most common French curves are actually segments of ellipses, **parabolas** and **hyperbolas**.

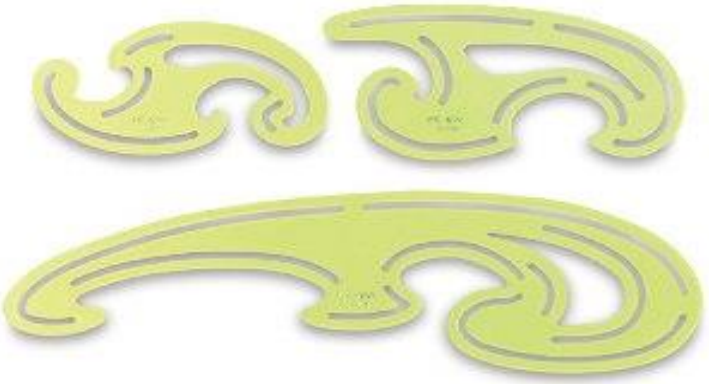


Figure 2;9 French curves and flex curves

8. Protractor

Protractors used to mark or measure angles between 0 and 180°. They are semicircular in shape (of diameter 100mm) and are made of Plastic or celluloid which has more life. Protractors with circular shape capable of marking and measuring 0 to 360° are also available in the market.

Figure.2;9 Protractor

2.3. Drawing Materials

2.3.1. Drawing Paper

They are available in many varieties and good quality paper with smooth surface should be selected for Drawings which are to be preserved for longer time. Recommended Standard *size of drawing sheet*

Designation Size (mm) is.

Designation	Designation mm Trimmed Size
A0	1189 × 841
A1	841 × 594
A2	594 × 420
A3	420 × 297
A4	297 × 210
A5	210 × 148

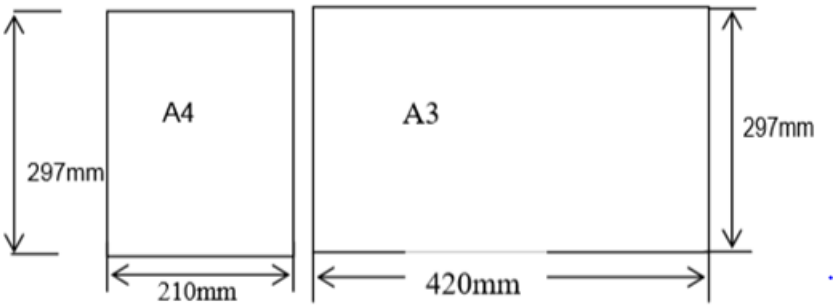


Fig. 2.10.Paper size illustration

2.3.2. Drawing *Pencils:*

The accuracy and appearance of a Drawing depends on the quality of Pencil used to make Drawing.

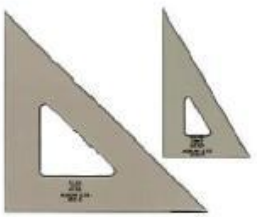
The grade of a Pencil lead is marked on the Pencil. HB denotes medium grade. Increase in hardness is shown by value put in front of H such as 2H, 3H etc., Softer pencils are marked as 2B, 3B, and 4B etc. A Pencil marked 3B is softer than 2B and Pencil marked 4B is softer than 3B and so on. Beginning of a Drawing may be made with H or 2H. For lettering and dimensioning, H and HB Pencils are used.

Figure 2.11. Drawing Pencils

DRAWING TOOLS

DRAWING TOOLS

1. T-Square



2. Triangles

DRAWING TOOLS

3. Adhesive Tape

4. Pencils

DRAWING TOOLS

5. Sandpaper

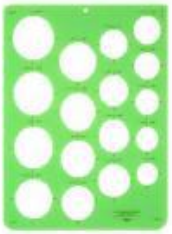
6. Compass

DRAWING TOOLS

7. Pencil Eraser

8. Erasing Shield

DRAWING TOOLS



9. Circle Template

10. Tissue paper

DRAWING TOOLS

11. Sharpener

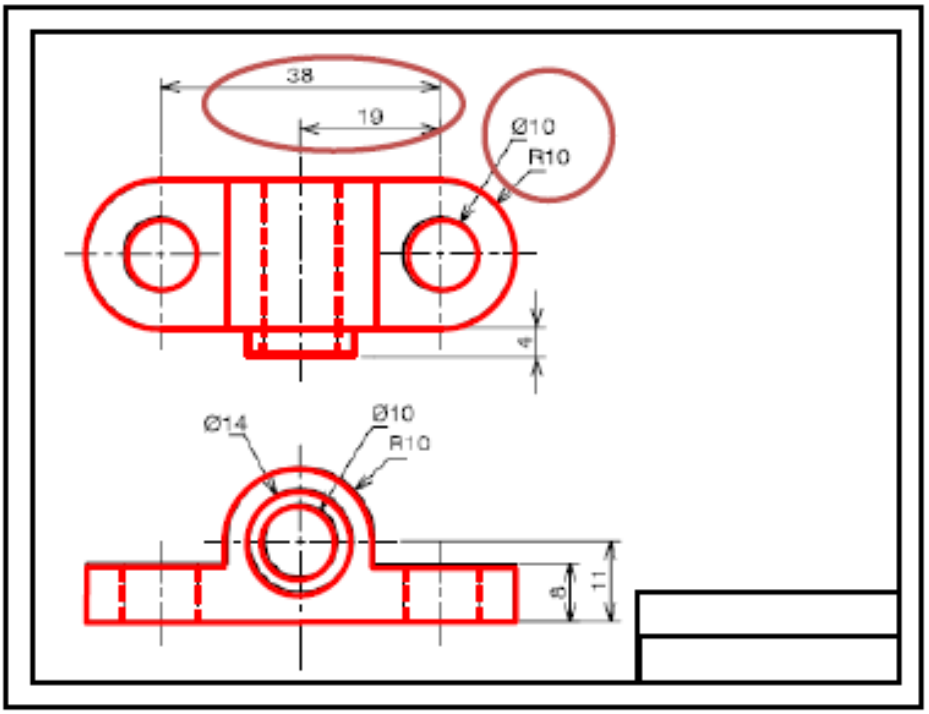
12. Clean paper

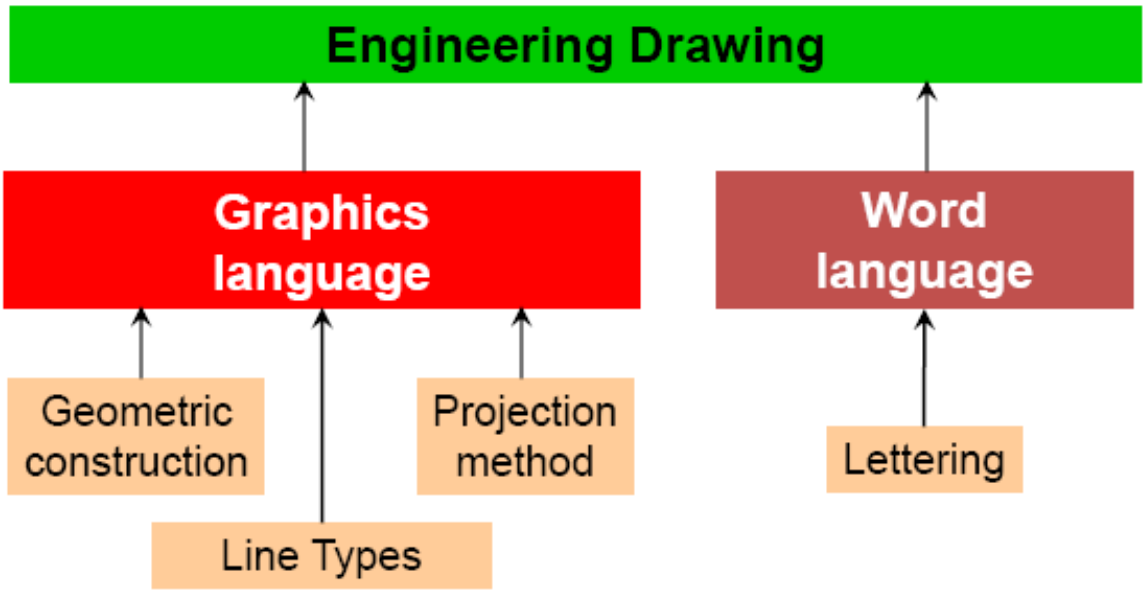
Elements of Engineering Drawing

Engineering drawing is made up of *graphics language* and *word language*.

Graphics language: Describe a shape (mainly).

Word language: Describe an exact size, location and specification of the object.





Lettering in Engineering Drawing

Lettering is used to provide easy to read and understand information to supplement a drawing in the form of notes and annotations. Lettering is an essential element in both traditional drawing and Computer Aided Design (CAD) drawing. Thus, it must be written with:

Legibility – shape & space between letters and words.

Uniformity – size & line thickness.

Types of Lettering

The two types of lettering are:

1. **Double Stroke Lettering**: In Double Stroke Lettering the line width is greater than that of Single Stroke Lettering.

Double Stroke Lettering is further divided into: *a) Double Stroke Vertical Gothic Lettering.*

b) Double Stroke Inclined Gothic Lettering.

A stencil is mostly used when hand drawing double stroked letters.

2. **Single Stroke Lettering:** Thickness in single stroke lettering is obtained by a single stroke of pencil or ink pen. It is further divided into:

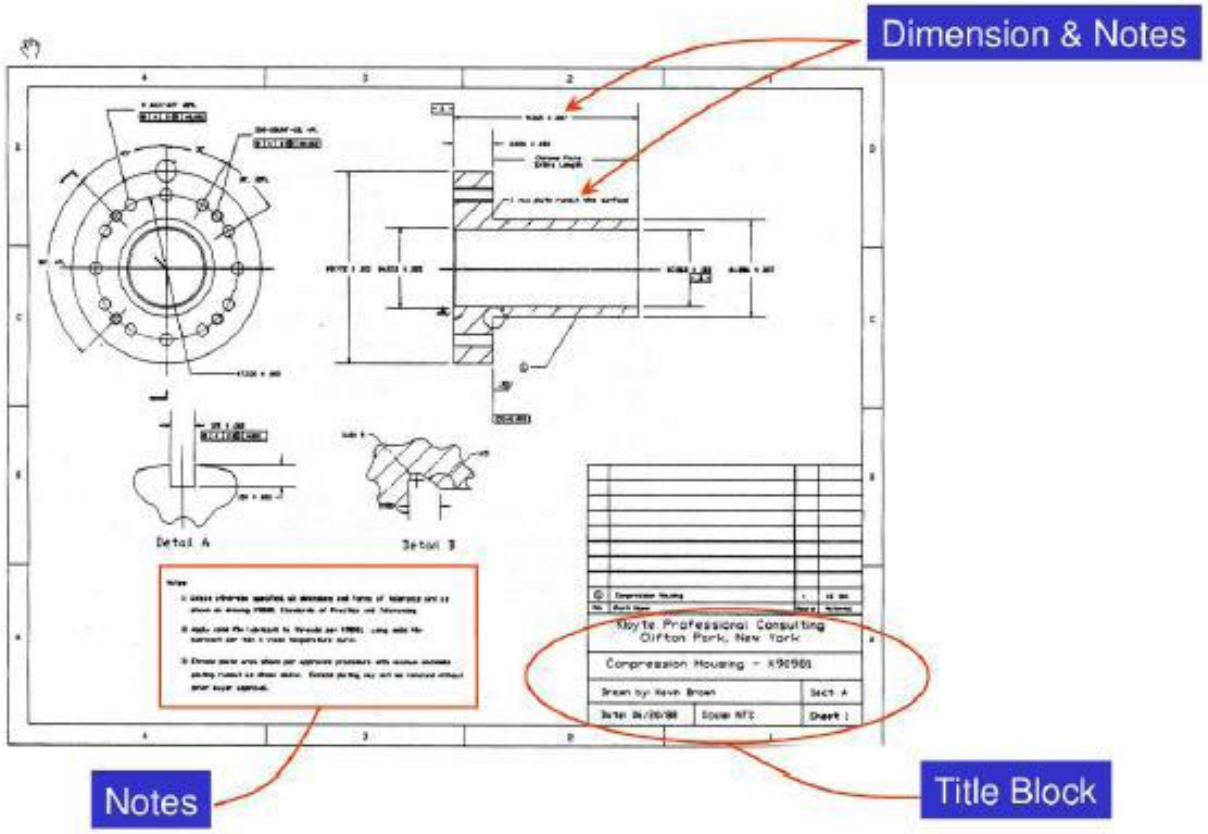
(a) Single Stroke Vertical Gothic Lettering.

(b) *Single Stroke Inclined Gothic Lettering.*

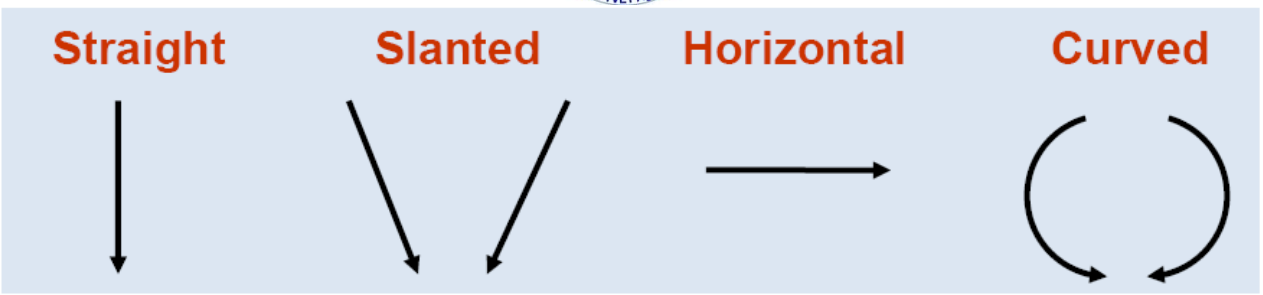
Conventions (Agreements) for Lettering

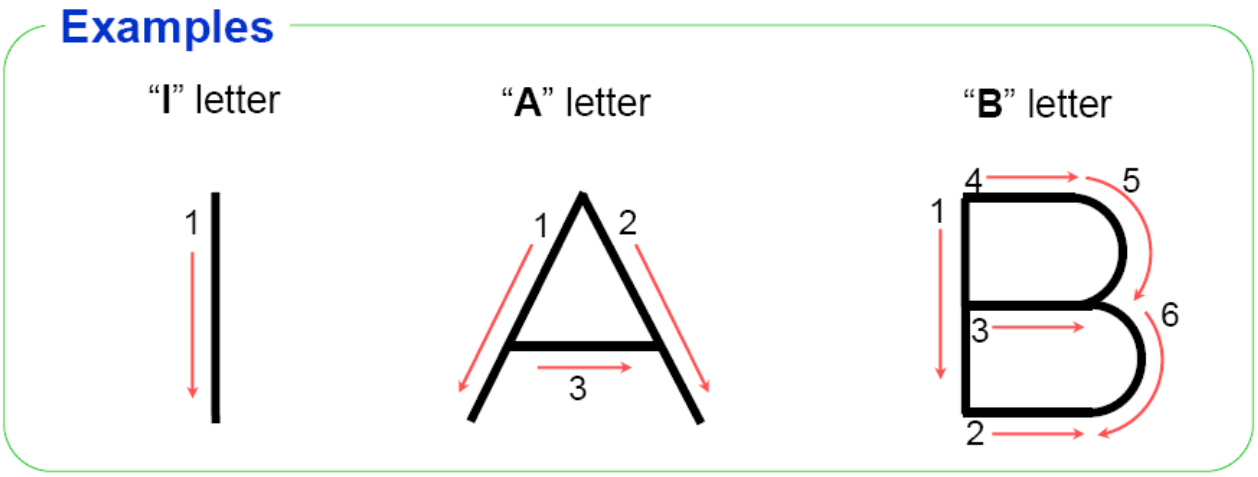
- Use all **CAPITAL LETTERS.**
- Use ***even pressure*** to draw **precise, clean lines**.
- Use ***one stroke*** per line.
- **Horizontal Strokes** are drawn ***left to right***.
- **Vertical Strokes** are drawn ***downward***.
- **Curved strokes** are drawn ***top to bottom*** in one continuous stroke on each side.
- Use The ***Single-stroke, Gothic Style of Lettering***.
- Always ***Skip A Space*** Between **Rows Of Letters**.
- Always Use ***Very Light Guide Lines***.
- **Fractions** Are Lettered ***Twice the Height Of Normal Letters***.
- **Fraction Bars** Are Always ***Drawn Horizontal***.
- Use a ***Medium Lead*** For ***Normal Lettering.***
- Use a ***Hard Lead*** For Drawing ***Guide Lines***.

Placement of Text on Engineering Drawings



Basics of Single Stroking

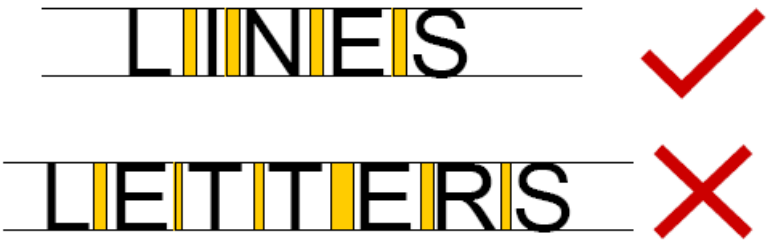




Spacing

Uniformity in spacing of letters is a matter of equalizing spaces by eye.

- The background area between letters, not the distance between them, should be approximately equal.
- Words are spaced well apart, but letters within words should be spaced closely.



For either upper case or lower-case lettering, make the spaces between words approximately equal to a capital O.

Self-Check -2	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Choose the correct answer from the following Questions

1. _____is a kind of technical drawing instruments used to prepare drawings

A. set squares B. French curve

C. T-square D. all

2. Which one is used to mark or measure angles between 0 and 180

A. Protractor B. Divide

C. ellipse template D. Circle Template

3. _____is a thin, flat piece of plastic containing various cutout shapes

A. Tamplate B. French curve set squares

C. T-square D. curve set squares

4. Which one of the following is the largest size of drawing sheets

A. A4 B. A0

C. A5 D. all

Name: _____ Date: _____

Answer Sheet

1._____

2._____

3._____

4._____

Score = _____

Rating: _____

Information Sheet-3	Checking and validating drawing version

3.1 Checking and validating drawing version

Drafting standard and drawing management system has been established, a drawing validation process must exist to ensure compliance with corporate standards.

Oftentimes this consists of one or more drafters or checkers performing drawing audits from within AutoCAD software using various tools like Check Standards,

This process can be time-consuming and costly especially when a large amount of drawings must be processed within a short time period.

Several third-party applications exist to assist with this process but most require an extensive setup and an external database.

Validation should take place from the early to the final stages of our product lifecycle and even after the release of the final solution.

The most commonly used methods are surveys/questionnaires, usability tests, card sorting, eye-tracking, A/B tests and a continuous monitoring of how users are responding and interacting with your product even after every release.

Self-Check -3	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Choose the correct answer from the following Questions

1. Drafting standard and drawing management system has been establish to

   A. validation process must exist to ensure standards.

   B. for time-consuming

   C. A&B

   D all

2. one or more drafters or checkers performing drawing audits By using

   A. AutoCAD software B. drawing C. using various tools like Check Standards

   D.A&C E. all

3. Validation should not take place from the early to the final stages of our product lifecycle

   A. True B. False C. A&B are not answer D. none

Name: _____ Date: _____

Answer Sheet

1._____
2._____
3._____
4._____

Score = _____

Rating: _____

Information Sheet-4	Confirming and following Instructions

4.1. **Confirming and following Instructions**

4.1.1. Title Blocks

The Title block is a boxed area containing general information about the part in the drawing. The main purpose of the title block is that it contains important text information about the part such as company name, drawing number, part number and other pertinent information. Different companies may have some what different formats for their title blocks, but most of the time the title block is located in the lower right corner of the drawing sheet

4.1.2. *Standards*

BS ISO 7200 Technical Drawings- Title Blocks identifies the title block requirements to be used on engineering drawings. the drawing sheet size should be in accordance with "BS EN **ISO**5457 TD- Sizes and layout of drawing sheets

A title block is the form on which the actual drawing is a section. The title block includes the border & the various sections for providing quality, administrative and technical information. The importance of the title block cannot be minimized as it includes all the information which enables the drawing to be interpreted, identified and archived

The title should include sufficient information to identify the type of drawing e.g. general arrangement, or detail. It should also clearly describe in a precise way what the drawing portrays

The notes below relate to the title boxes included on in the title block to convey the necessary information the standard drawing sizes and layouts are described else where The basic requirements for a title block located at the bottom right hand corner of a drawing are :

1. The registration or ID number
2. The drawing title
3. The Legal Owner of the Drawing

These items should be written in a rectangle which is at the most 170mm wide. The tile block should also include boxes for the legal signatures of the originator and other persons involved production of the drawing to the required quality. In other forms of title block , the title block contains the following information.

- the name of the company or organization

- the title of the drawing
- the drawing number, which is generally a unique filing identifier
- the scale
- the angle of projection used, either first or third, generally shown symbolically
- the signature or initials of the draftsman, checker, approving officer, and issuing officer, with the respective dates
- other information as required

The drawing should also include a symbol identifying the projection. The main scale and the linear dimension units if other than "mm" Mechanical drawings should list the standards use for: indicating the surface texture:

welds general tolerances and geometric tolerances, as notes referring directly the the relevant standards or a general note referring to the BS 8888. (BS 8888 lists all of the relevant standards.) BS 8888 should really only be referenced if the drawing is in full accordance

The drawing title block should indicate the date of the first revision. In separate boxes to the title block the current revision with an outline description of the revision should be

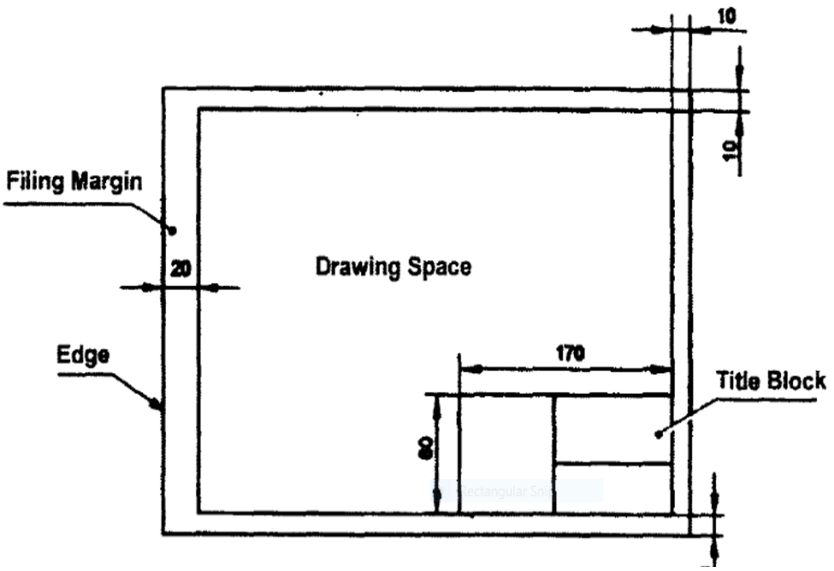


Figure.1:1: Title Block

Self-Check -4	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Choose the correct answer from the following Questions

1. The main purpose of the title block is

A. it contains Information Company name C. A&B are correct

B. it contains information drawing number D. none

2. The basic requirements for a title block located at the bottom right hand corner of a drawing are

A. The registration or ID number B. The drawing title

C. The Legal Owner of the Drawing D. All

3, which one is true information about a title block from the listed blow?

A. the name of the company or organization

B. the title of the drawing

C. the drawing number

D. all

Answer Sheet

_____

_____

_____

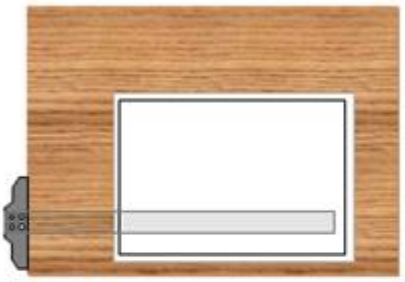
_____

Score = _____

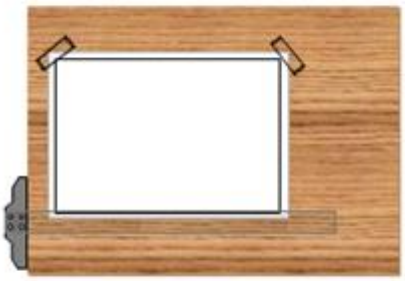
Rating: _____

Operation Sheet-1	**Methods of Using Drawing instruments (Fastening Paper to Drafting Board)**

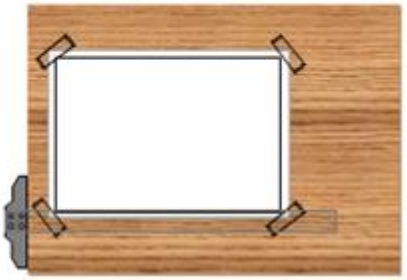
The steps of fastening Paper to Drafting Board are as follows:



1. Place the paper close to the table's left edge.
2. Move the paper until its lower edge place about the top edge of T-square.



3. Align the top edge of the paper with T-square blade.
4. Attach the paper's corners with tape

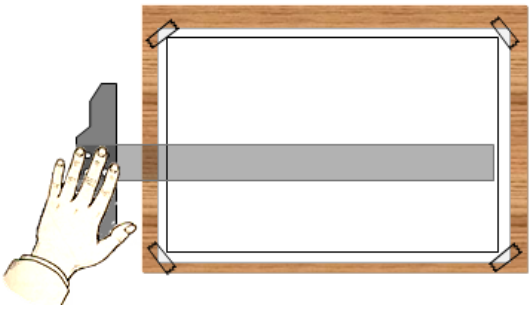


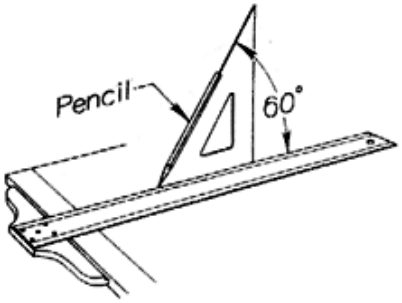
5. Move T-square down to smooth the paper
6. Attach the remaining paper's corners with tape

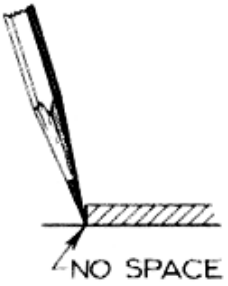
Operation Sheet-2	**Methods of Using Drawing instruments: T-Square, Set-square, Compass.**

Procedures to Draw a Horizontal, parallel, perpendicular Lines are:

1. Press the T-square head against the left edge of the table.
2. Smooth the blade to the right.
3. . Lean the pencil at an angle about 60^{o} with the paper in the direction of the line and slightly “toed in”.
4. Draw the line from left to right while rotating the pencil slowly







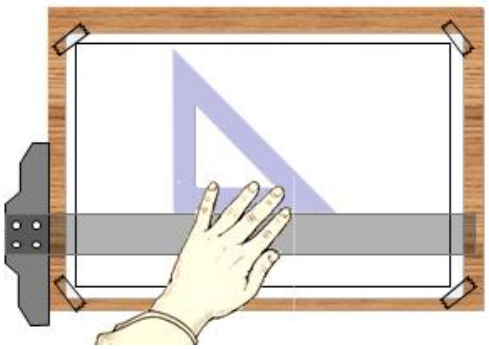
Procedures to Draw a Vertical, parallel, perpendicular Line are:

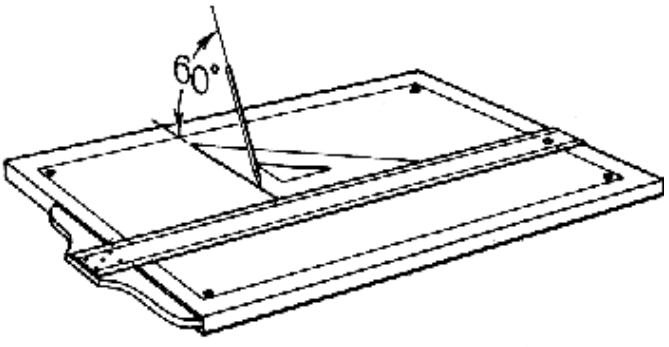
1. Set T-square as before Place any triangle on T-square edge.

2. Slide your left hand to hold both T-square and triangle in position.

3. . Lean the pencil to the triangle.

4. Draw the line upward while rotating the pencil slowly..





Operation Sheet-3	Drawing Template and Title Block

Operation Title: **Drawing Template and Title Block**

Procedure:

Step1. Set up your drawing paper on top of the drawing board.

Step2. Use the drawing template format given to you by your teacher.

Step3. Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step4. Using the basic drawing instruments and materials, perform the drawing task in the given following problems given in the Lap Test below.

Step5. Use appropriate pencil lead in your drafting works.

Step6. You may submit your finish work once you are true but should be within the time specified for submission.

LAP Test	Practical Demonstration

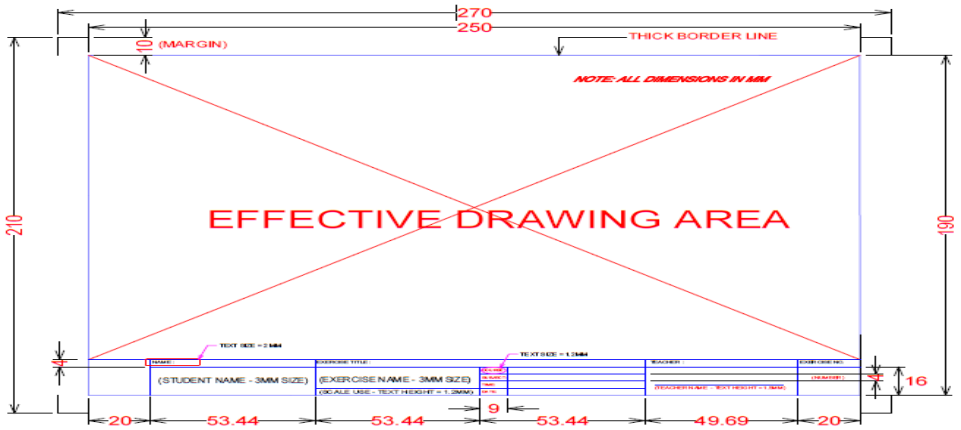
Name: _____ Date: _____

Time started: _____ Time finished: _____

***Instructions**:*

Using the drawing instrument, you are required to do the following exercises:

Task1 : Create the drawing template (Title Block), shown with the following dimensions

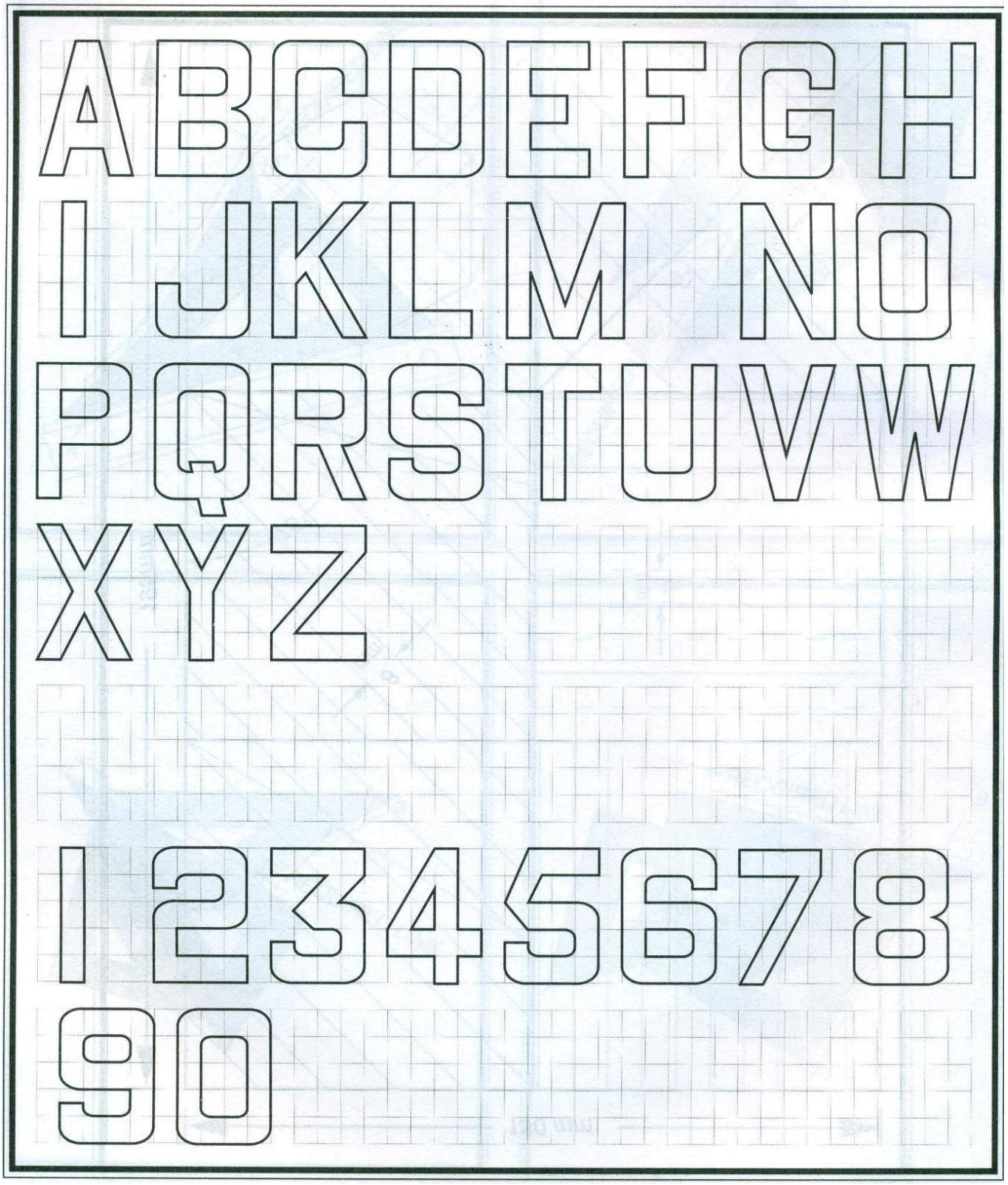


- Section Lines = 0.5 mm HB
- Visible Lines = 0.7 mm HB
- Hidden Lines = 0.5 mm HB
- Centerlines = 0.5 mm HB
- Construction Lines = 0.5 mm 2H

Request from your teacher the following materials.

- HB drawing pencil lead
- 4H drawing pencil lead
- 45º x 90º triangle
- 30º x 60º triangle
- Eraser
- T-square
- Drafting pens
- Drawing table
- Drawing papers

Task 2:- Perform/drawing Lettering A to Z and 0 to 9 of the required paper



List of Reference Materials

1. **Jenson, Cecil** Howard, Engineering drawing and design,1925,4th ed.,Macmillan/Mc Gram-Hill
2. . **Louis Gary Lamit**, Descriptive Geometry,1981,1st ed.,Prentice-Hall
3. Frederick E.,Technical Drawing,1958,4thed.,The Macmillan Company
4. David L.Goetsch et al, Technical drawing,1994,3rd ed., Delmar Publishers Inc.
5. A text book of engineering drawing, B.Gupta. Nasaka Pashakar publisher
6. V.B. Sikka ,A course in civil engineering drawing ,1998,4th ed.
7. T. Jeyapoovan, Engineering Drawing with autocad 2000, Vikas publishing

BASIC METAL WORKS

Level-I

Learning Guide 23

Unit of Competence	**Interpret Drawings &Sketches**
Module Title	**Interpreting Drawings and Sketches**
LG Code:	**IND BMW1 M07 LO2-LG-23**
TTLM Code:	**IND BMW1 M07 TTLM 1019v1**

LO2: Identify views, standard symbols and line

Instruction Sheet	Learning Guide 23

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying alphabet of lines
- Explaining uses of the alphabet of lines
- Identifying and explaining symbols & Codes
- Identifying Orthographic and isometric drawing

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- Orthographic and isometric drawing are identified.
- Orthographic and isometric views are explained.
- Alphabets of line are identified.
- Uses of the alphabet of lines are explained.
- Codes and symbols are correctly identified and explained according to drawing standards.

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” in page 32, 34, 40, 53 and 58 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1,” in page 59.
6. Do the “LAP test” in page 60 (if you are ready).

Information Sheet-1	Identifying alphabet of lines

1.1. The Alphabet of Lines in Technical Drawing

Lines in technical drawings are part of a specialized graphic language that is standardized throughout industry. Each type of line has a very precise symbolic meaning.

Types of lines in order of preference

- Visible (object/feature) lines
- Section lines/crosshatch line
- Break lines
- Cutting plane lines
- Dimension lines
- Hidden lines
- Extension lines/lead lines
- Centerlines

Line type	Thickness		Example	Application
	Fine	Thick		
Continuous thick	0.35	0.50		Visible outlines, existing features, cut edges, general line work
Continuous medium	0.25	0.35		Used where another level of line weight would assist the delineation e.g. internal line work, notes
Continuous thin	0.18	0.25		Fictitious outlines, imaginary intersections and projections, hatching, dimensions, break lines
Dashed thick	0.35	0.50		Hidden outlines and edges
Dashed thin	0.18	0.25		
Chain thick	0.35	0.50		Indication of special surface requirements or (sometimes with a text component) to indicate pipelines and services
Chain thin	0.18	0.25		Center lines, motion paths, indication of repeated detail

Figure 2: 1 line type and application

Self-check-1	Written test

Directions: Answer all the questions listed below Use the Answer sheet provided in the next page:

choose the correct answer from the following Questions

1. Which Lines is not included in technical drawing?

A. Break lines C. Cutting plane lines

B. Dimension lines D. none

2. From the following listed blow one line have 0.50 thicness

A. Continuous thick C. Cutting plane lines

B. Continuous medium D. Hidden lines

3. From the following listed blow one line not have 0.50 thicness

A. Continuous thick C. chain thick

B. Continuous medium D. dash thick

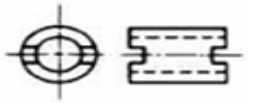
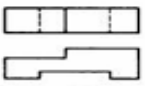
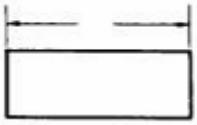
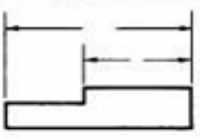
Information Sheet-1	Explaining uses of the alphabet of lines

2.1 Explaining uses of the alphabet of lines

Correct usage of this "alphabet of lines" is essential whether you use traditional drafting methods or CAD. Line weight is the thickness of the line. Construction lines and guide lines are very light, easily erased lines used to block in the main layout. Visible lines are the edges or "outlines" of an object. They are drawn as solid lines with a thick/heavy weight.

All other lines contrast with the visible lines by having either a thinner weight and/or a combination of dashes. Lines are straight elements that have no width, but are infinite in length (magnitude), and they can be located by two points which are not on the same spot but fall along the line. Lines may be straight lines or curved lines. A straight line is the shortest distance between two points. It can be drawn in any direction.

If a line is indefinite, and the ends are not fixed in length, the actual length is a matter of convenience. If the end points of a line are important, they must be marked by means

NAME	CONVENTION	DESCRIPTION AND APPLICATION	SAMPLE
CENTER LINES		THIN LINES MADE UP OF LONG AND SHORT DASHES ALTERNATELY SPACED AND CONSISTENT IN LENGTH USED TO INDICATE SYMMETRU ABOUT AN AXIS AND LOCATION OF CENTERS	
VISIBLE LINES		HEAVY UNBROKEN LINES USED TO INDICATE VISIBLE EDGES OF AN OBJECT	
HIDDEN LINES		MEDIUM LINES WITH SHORT EVENLY SPACED DASHES USED TO INDICATE CONCEALED EDGES	
EXTENSION LINES		THIN UNBROKEN LINES USED TO INDICATE EXTENT OF DIMENSIONS	
DIMENSION LINES		THIN LINES TERMINATED WITH ARROWS HEADS AT EACH END USED TO INDICATE DISTANCE MEASURED	

Self-Check -2	Written Teste

Directions: Answer all the questions listed below Use the Answer sheet provided in the next page:

Choose the correct answer from the following Questions

1._____is alphabets of line used to show center of axis

A. object line C. center line

B. section line D. extension line

2. which one is heavy and unbroken line used to indicate visible edges of an objects

A. section line B. Extension line

C. visible line D. dimension line

3. _____is straight elements that have no width

A. Lines B. Symbol C. straight D. None

PART II Write the True if the statement is correct other wise write False

1. A straight line is the shortest distance between two points.
2. Lines may be straight lines or curved lines.

Name: _____ Date: _____

Answer Sheet

_____

_____

_____

_____

Score = _____

Rating: _____

Information Sheet-3	Identifying and explaining symbols & Codes

3.1. Identifying and explaining symbols & Codes

3.1.1. Symbols

Permit consistency in the way dimensions and tolerances are specified, and each symbol has a clearly defined meaning. Symbols take less time to apply on a drawing than would be required to state the same requirements with words. The symbols also require considerably less space.

The symbols are presented in two groups for easier use of this section as a reference. General dimensioning symbols are shown first. Some of these symbols are also used in tolerance specifications. The second sets of symbols are used for tolerances.

Symbol sizes are shown in the figures as values proportional to the letter '**h**'. The letter '**h**' represents the predominant character height on a drawing. If a symbol dimension is shown as 1.5h, and the predominant character height on the drawing is to be 3mm, then the symbol dimension is 4.5mm (1.5 x 3mm).

Symbol proportions defined in the standard are recommendations.

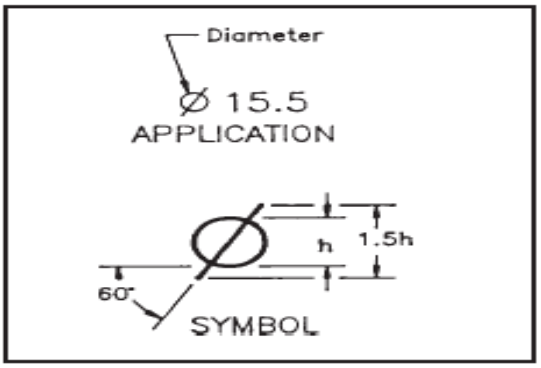
Some companies find it desirable to vary from the recommended proportions for improved microfilm reproduction capability. Symbol proportions within a company, and certainly within a single drawing, should be consistent

Symbols are not generally used in text or notes lists. Abbreviations and symbol names are used in text or notes.

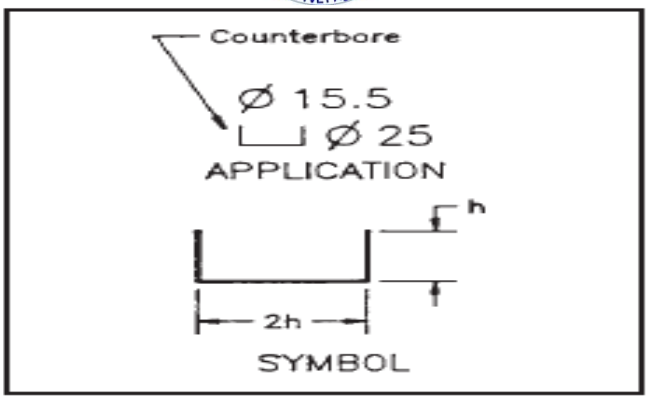
General symbols

General symbols are used with dimensions to clarify the requirement defined by a dimension value and to minimize the number of words or abbreviations placed on a drawing.

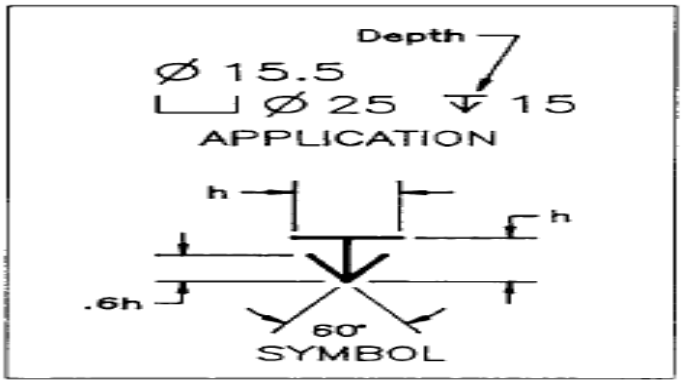
1. **Diameter**:- A diameter symbol is placed in front of any dimension value that is a diameter.



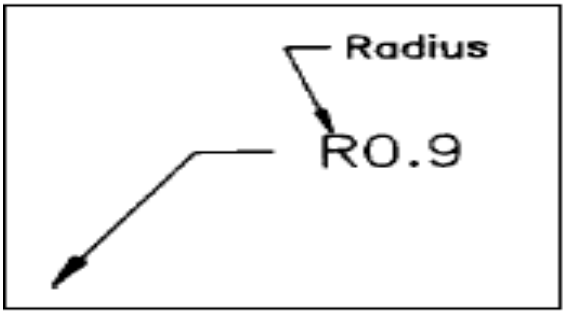
2. **Counter bore Symbol**:- A **counter bore** symbol combined with a diameter symbol is placed in front of a specified counter bore or spot face diameter.



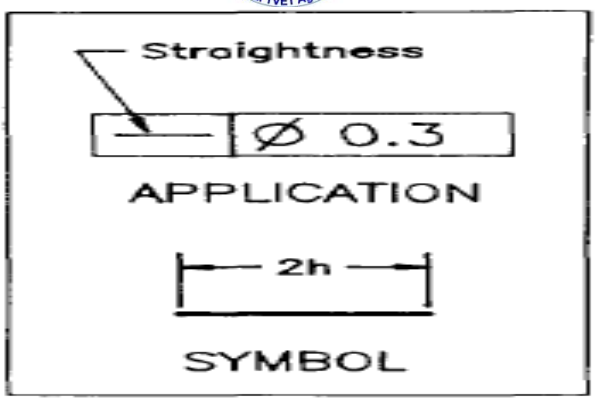
3. **Depth**:- A downward-pointing arrow is used for the depth symbol, and it is placed in front of the depth value in such applications as for counter bore and hole depths.



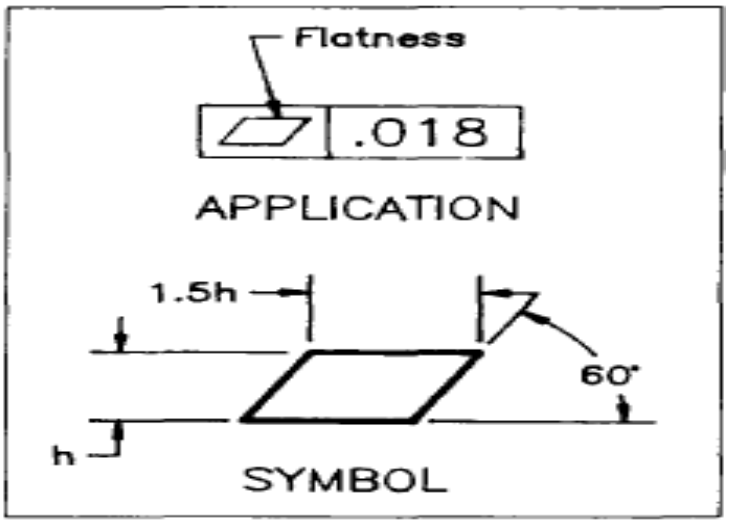
4. **Radius**:- *The letter **R** is placed in front of any value that indicates a radius dimension.*



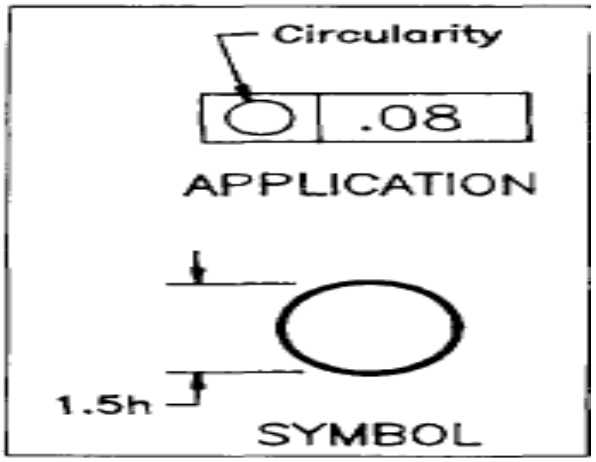
5. **Straightness**:- A **straight line** is used to indicate a Straightness requirement. It is only applied in a feature control frame, and maybe used to control straightness of surface elements. It may also be used to control the straightness of an axis or center plane.



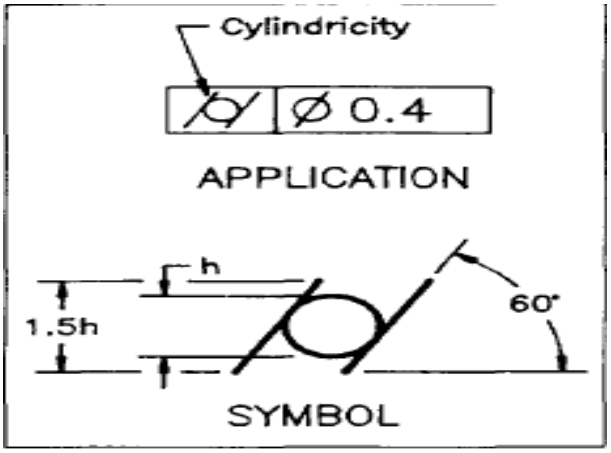
6. **Flatness**:- The **flatness** symbol appears as an oblique view of a square surface. See Figure 13. This symbol is used in feature control frames and is only used to control the form variations on flat features.



7. **Circularity:- Circularity** is indicated by a circle. It controls the amount of form error permitted on the surface of a circular feature at individual cross sections.



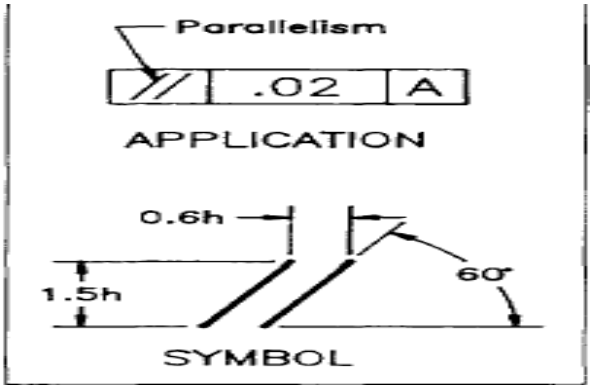
8. **Cylindricity**:- This symbol is a circle with two parallel lines drawn tangent to the circle. It is used to control the surface errors on a cylindrical feature. It simultaneously



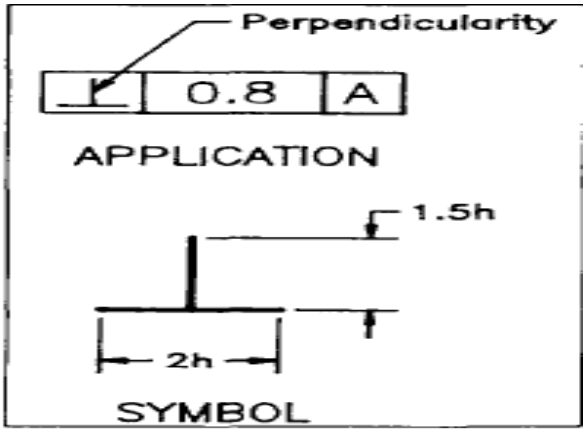
9. **ORIENTATION -** Orientation **tolerance** symbols include **parallelism, perpendicularity,** and **angularity:**

- **Parallelism**–*;*

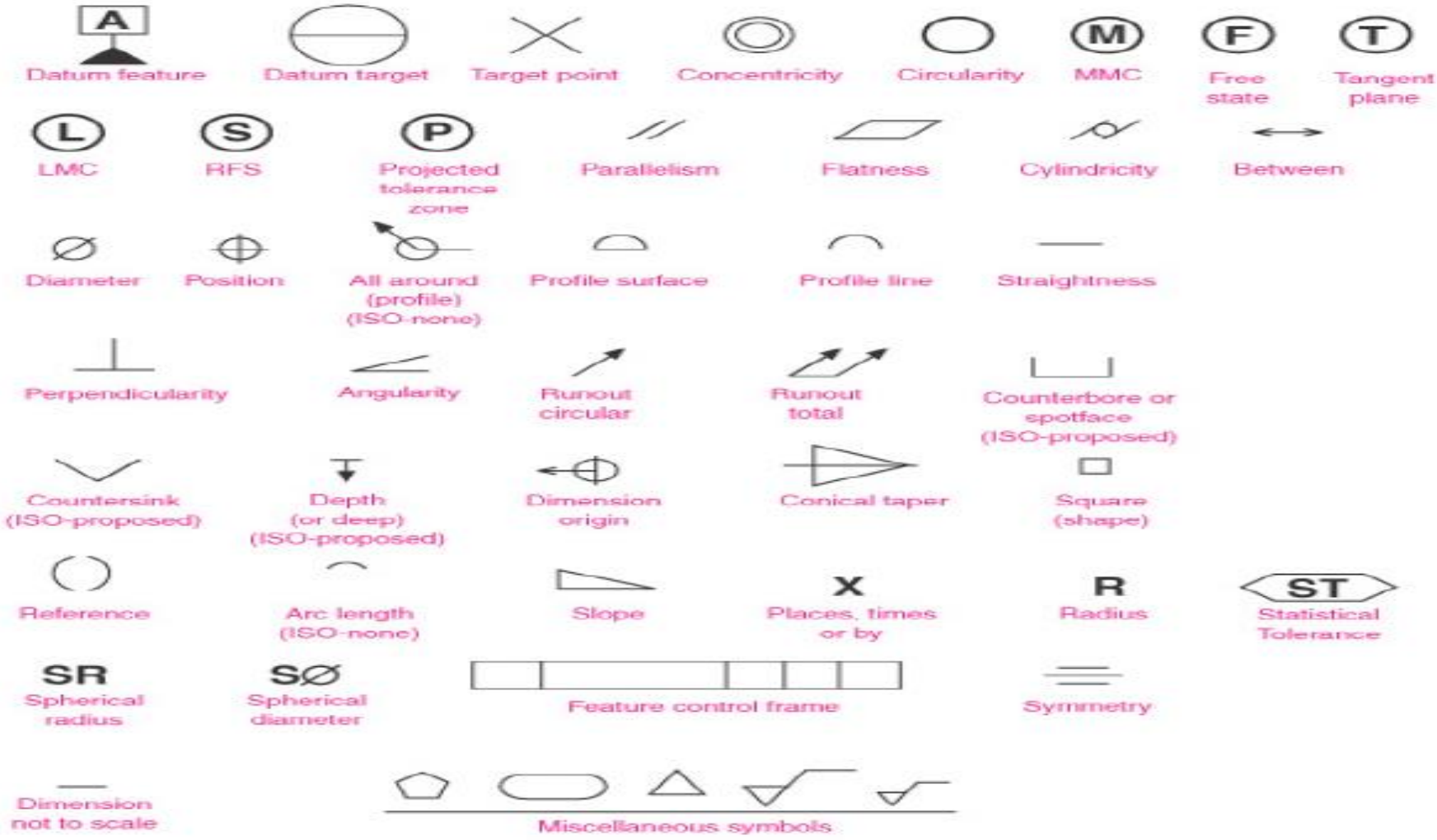
Parallelism is indicated by two parallel straight line



- **Perpendicularity** – Perpendicularity is indicated by two perpendicular lines



Examples of symblos



Self-Check -3	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

choose the correct answer from the following Questions

1. _____is used to control the surface errors on a cylindrical feature
   A. Cylindricity C. angularity.
   B. perpendicularity D. all
2. _____IS clarify the requirement defined dimension value and minimize the number of words or abbreviations place on a drawing.
   A. Cylindricity B. angularity.
   C. General symbols D . none
3. Counter bore symbol combine with a diameter symbol is place in _____of a specified counter bore.
   A. Front B. Spot
   C. Top D . A&B
4. Orientation tolerance symbol includes:
   A. Parallelism C. angularity.
   B. perpendicularity D. all

Name: _____ Date: _____

Answer Sheet

_____
_____
_____
_____

Score = _____

Rating: _____

Information Sheet-4	Identifying Orthographic and isometric drawing

1.1. PROJECTION

A projection is a drawing or representation of an entity on an imaginary plane or planes. It consist four components: The actual object that the drawing or projection represents The eye of the viewer looking at the object The imaginary projection plane (Viewers drawing paper Imaginary lines of sight called projectors

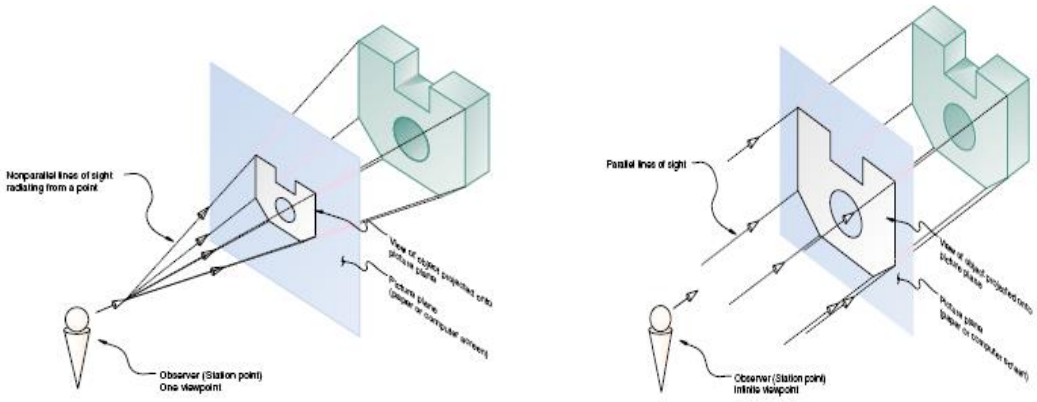


Fig: 4.1. **Classification of projections (perspective and Parallel projection)**

Two broad projection types are viable with different further classifications. These are:

- Parallel projection
- Perspective projection
- Parallel projection:

It is a projection where imaginary projection lines will not converge as a point on the viewer's eye. This implies that, all projection lines are either parallel or perpendicular to each other. There are three main types of parallel projection system illustrated below:

- Orthographic projection
- Axonometric projection.
- Oblique projections

1.2. Orthographic projection

Orthographic is a system of views of an object formed by projectors from the object perpendicular to the desired planes of projection. Orthographic Projections are a technical drawing in which different views of an object are projected on different reference planes observing perpendicular to respective reference plane.

Different Reference planes are;

- Horizontal Plane (HP)
- Vertical Plane (VP)
- Side or Profile Plane (PP)

Different views are;

- ✓ Front View (FV) –Projected on VP
- ✓ Top View (TV) –Projected on HP
- ✓ Side View (SV) –Projected on PP

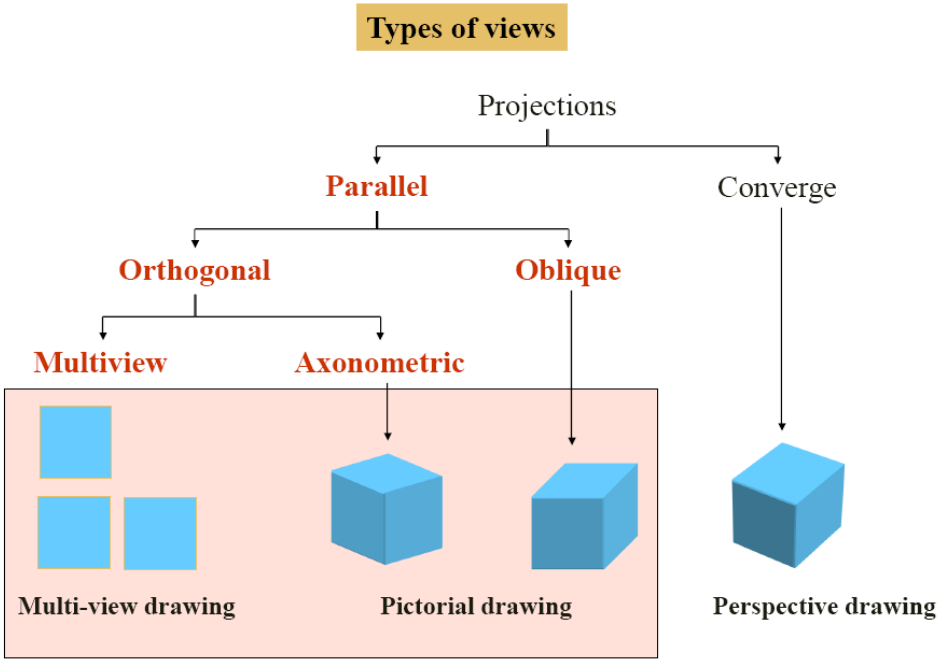
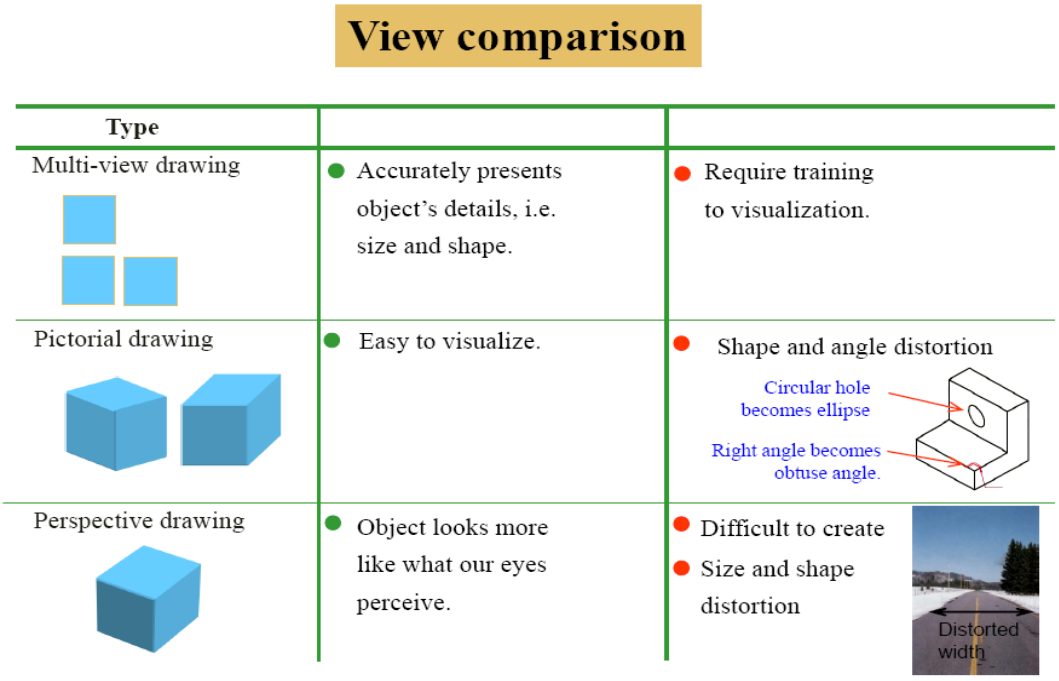


Fig 4.2: Types and position of views



There are three principal projection planes. That is to say:

- Horizontal projection plane (H.P)
- Frontal projection plane (F.P)
- Profile projection plane (P.P)

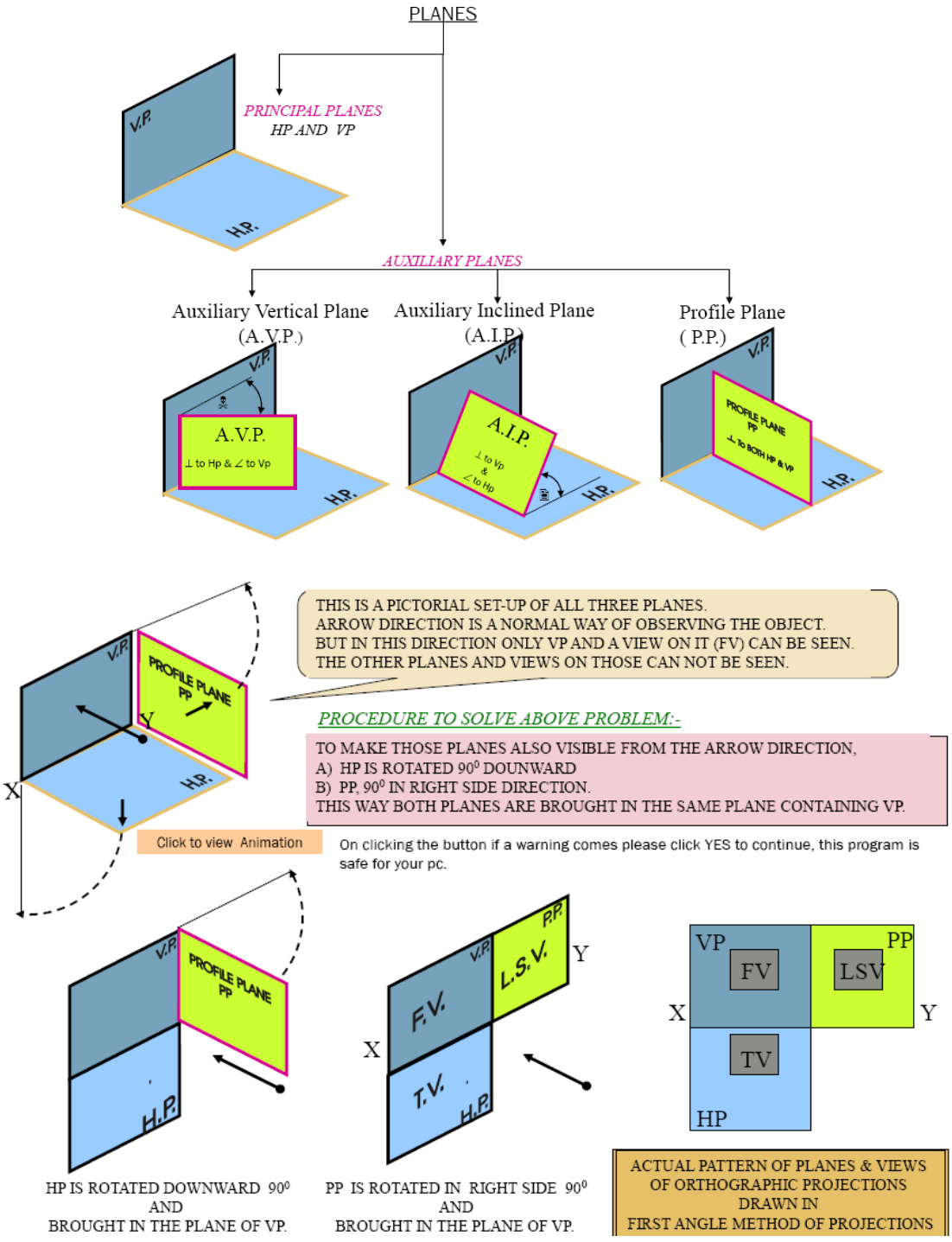
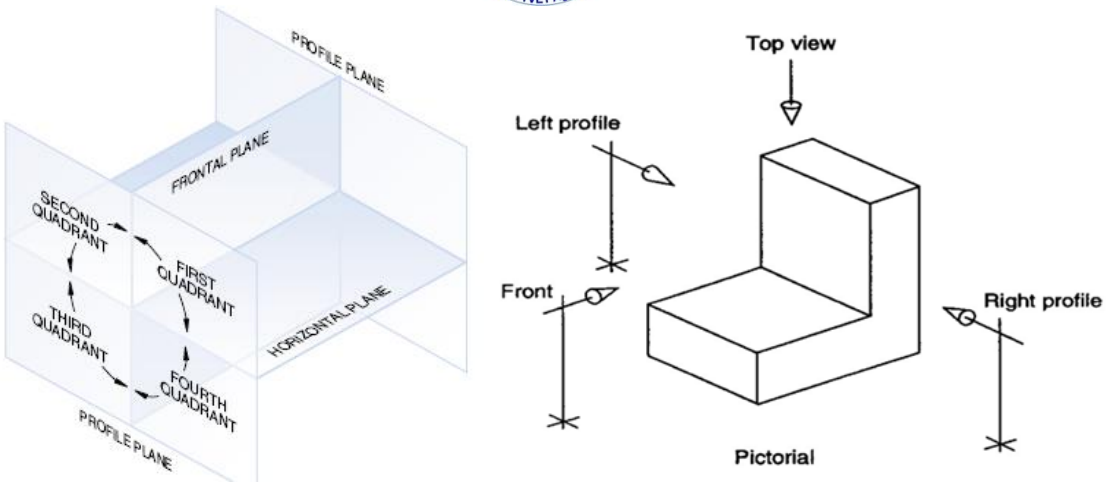


Fig.4.3.Pattern of Planes and Views (First angle Projection)



For the above object we can have orthographic projection as follow

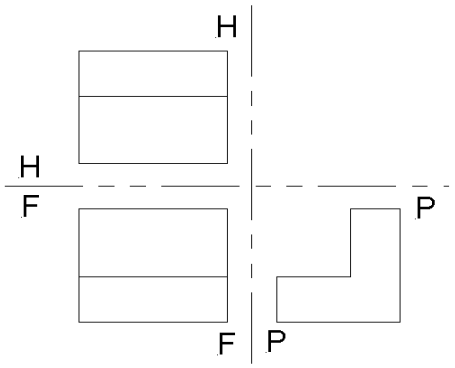


Figure4 .3 (Multi-view drawing)

Orthographic projection could be defined as any single projection made by dropping perpendiculars to a plane. In short, orthographic projection is the method of representing the exact shape of an object by dropping perpendiculars from two or more sides of the object to planes, generally at right angles to each other; collectively, the views on these planes describe the object completely.

Descriptive geometry is basically the use of orthographic projection in order to solve for advanced technical data involving the spatial relationship of points, lines, planes, and solid shapes. The most common means of understanding these types of orthographic projection is The Glass Box method.

1.2.1. The Glass Box method,

Primarily for descriptive geometry problems, requires that the user imagine that the object, points, lines, planes etc are enclosed in a transparent “box”. Each view of the object is

established on its corresponding glass box surface by means of perpendicular projectors originating at each point of the object and extending to the related box surface. The box is hinged so that it can be unfolded on to one flat plane (the paper

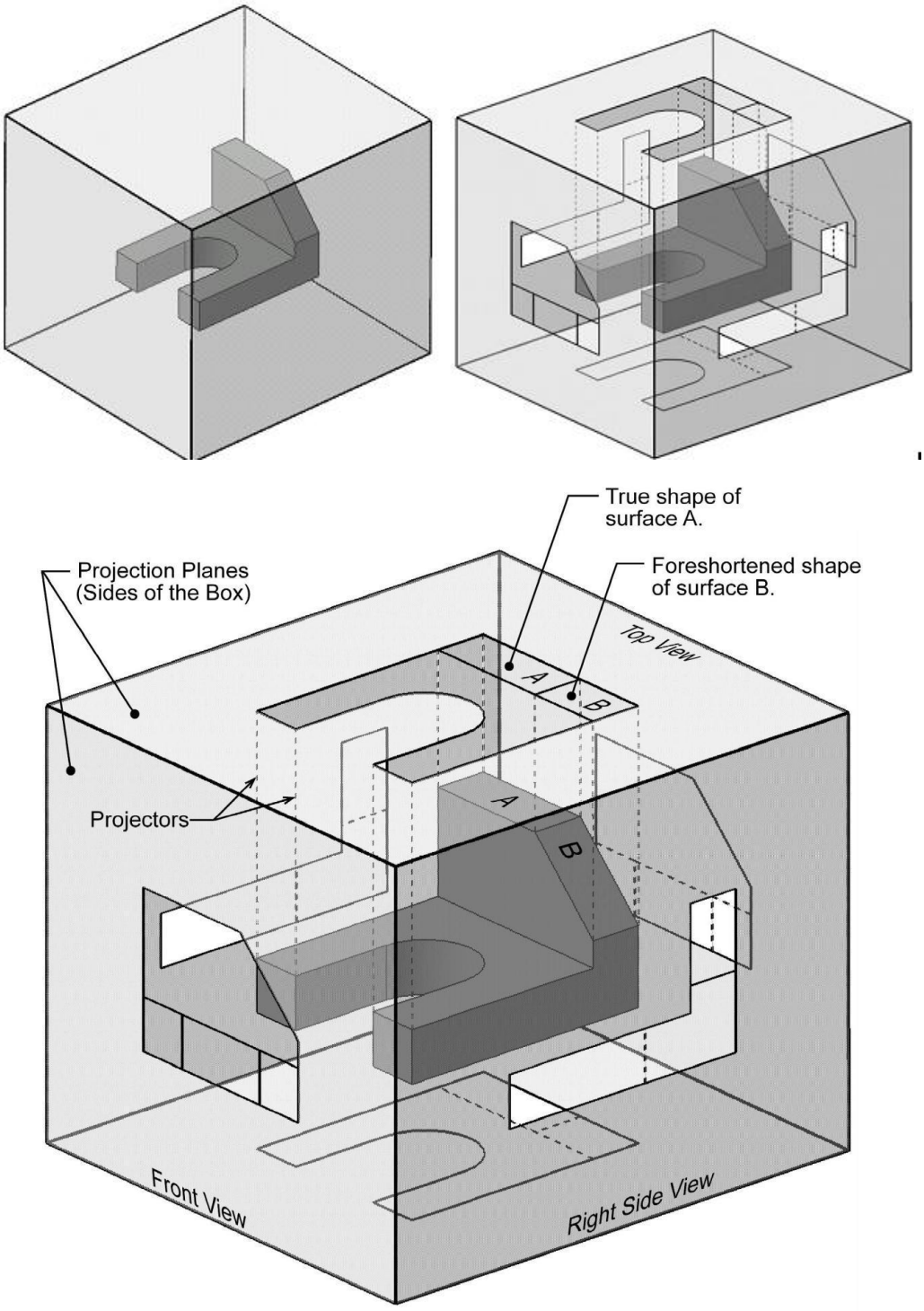
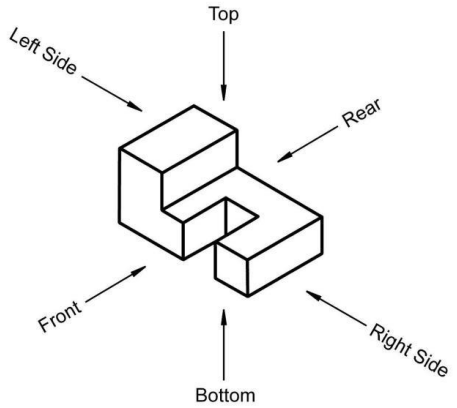
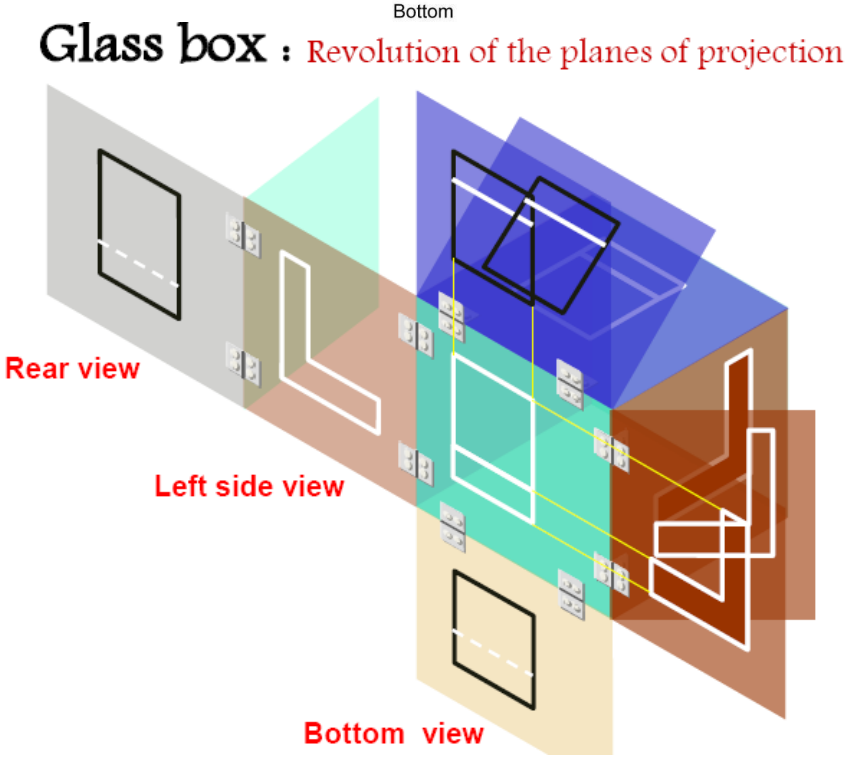


Figure.4.4. Glass box methods/approach

1.2.2. The Six Principal Views

Let us surround the object entirely by asset of six planes, each at fight angles to each other. On these planes, views of the object can be obtained as is seen from the top, front, and right side, left side, bottom and rear. Think now of the six sides, or the plane of the paper. The front is already in the plane of the paper, and the other sides are, as it were, hinged and rotated in position as shown..





The projection on the frontal plane is the front view vertical projection, or front elevation, that on the horizontal plane, the top view, horizontal projection, or plan, that on the side, profile view, side view, profile projection, or side elevation. By reversing the direction of sight, a bottom view is obtained instead of a top view, or a rear view instead of a front view.

The 6 principal views are created by looking at the object, straight on, in the directions indicated

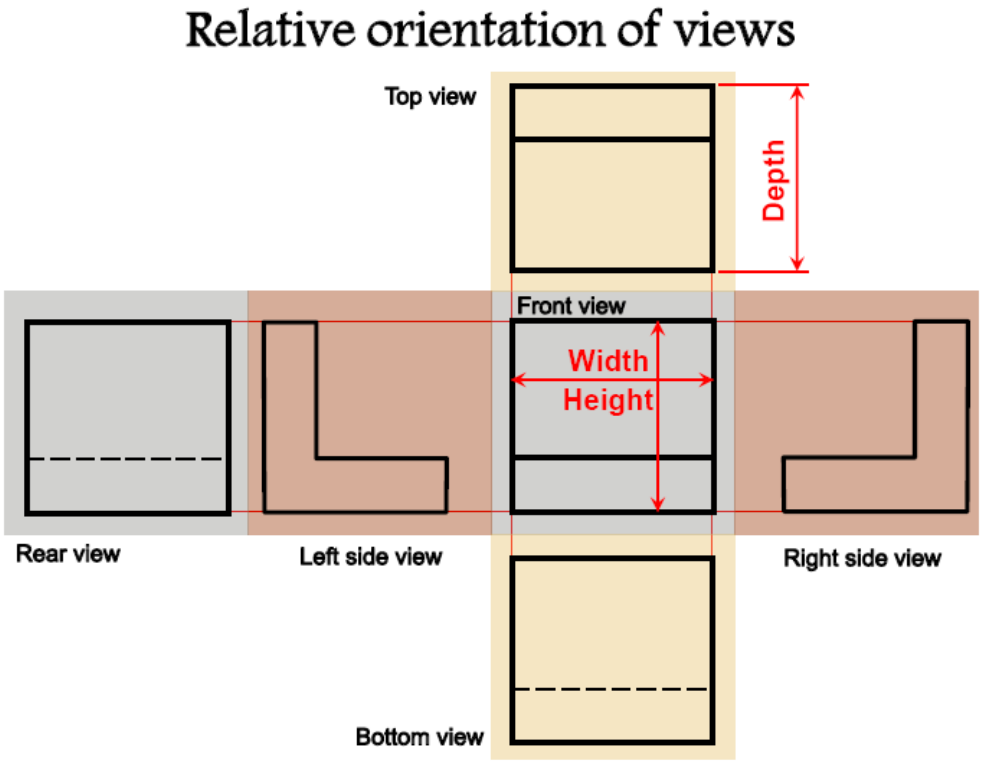
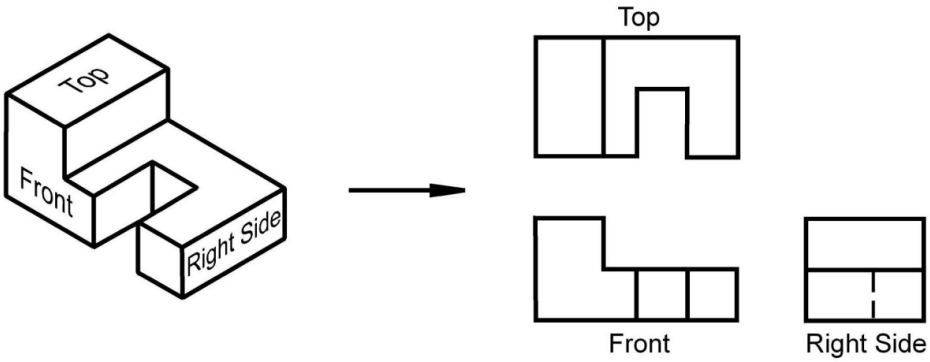


Fig. 4.5. Six Principal Views

Orthographic projection = 2-D representation of a 3-D object.

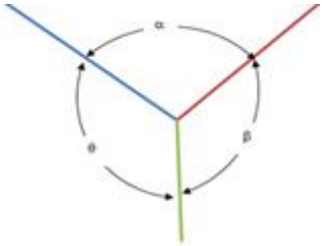


1.3. Axonometric projection:

Axonometric projection is a presentation of a design idea that is accurate and scientifically correct and can be easily understood by persons without technical training. It Is a three dimensional drawing which is named alternatively as Pictorial drawing. Depending on the

angles found between the principal projection planes, we can sub divide it into: isometric, diametric and trimetric projection.

If $\alpha = \beta = \theta$ it is an isometric axonometric projection
If $\alpha \neq \beta = \theta$ it is dimetric axonometric projection
If $\alpha \neq \beta \neq \theta$ it is trimetric axonometric projection



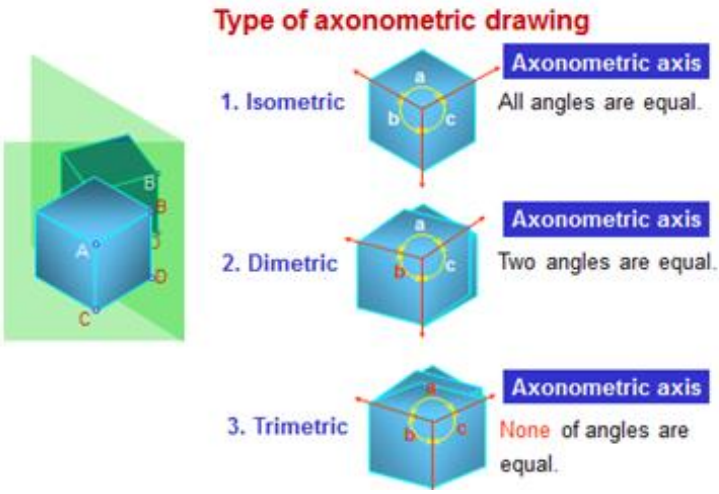


Fig.4.6. types of axonometric drawing

1.3.1. Isometric Drawing

The representation of isometric drawing is one of a family of three-dimensional views called pictorial drawings. In an isometric drawing, the object's vertical lines are drawn vertically, and

the horizontal lines in the width and depth planes are shown at 30 degrees to the horizontal. When drawn under these guidelines, the lines parallel to these three axes are at their true scale) lengths. (Lines that are not parallel to these axes will not be of their true length. Any engineering drawing should show everything: a complete understanding of the object should be possible from the drawing. If the isometric drawing can show all details and all dimensions on one drawing, when all three angles are equal the drawing is classified as a isometric. For example angles A, B and C are equal and are 120^0.

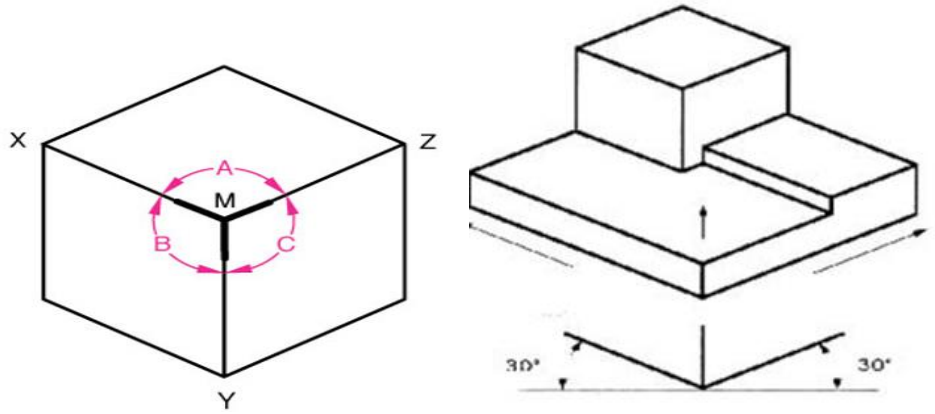


Figure 4.7. Isometric and Isometric drawing

1.4. Perspective

Pictorial drawings used to represent 3-D forms on 2-D media in a manner closest to how we perceive the objects with our eyes. Terms to be familiar with include horizon line (HL), ground line (GL), station point (SP), picture plane (projection plane), and vanishing point (VP). Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object. There are three types of perspective projections: One point, Two-point and Three-point Projections.

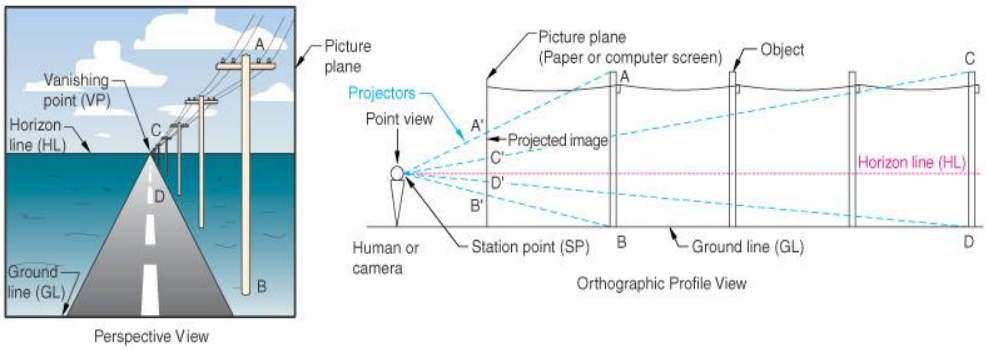


Figure. 4.8. Perspective drawing

1.4.1. One point Perspective projection

In one point Perspective projection all projectors none parallel to each other. When drawing use one point perspective all objects vanish to a common point somewhere on the horizon.

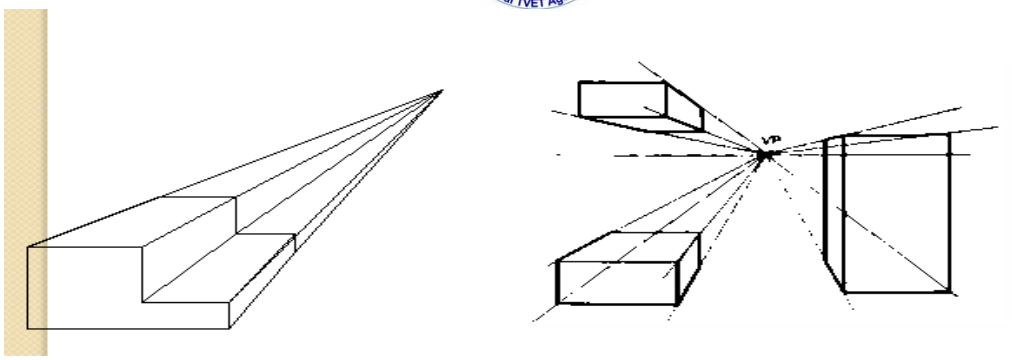


Figure: 4.10.One point Perspective

1.4.2. Two Point perspective projection

The object is placed so that one set of parallel edges is vertical and has no vanishing point, while the two other sets each have vanishing points two point perspective represents a turning or moving aside, a glance to the left or right, an approach to the primary form that is more informal, idiosyncratic and complex, composed as it is two adjacent sides of every object woven into a single perspective view.This view is usually associated with the orientation of the objects, which are simply turned at an angle to the image plane. The two direction points are used for two of the directions it is pointing away from us, giving us ***two point perspective.***

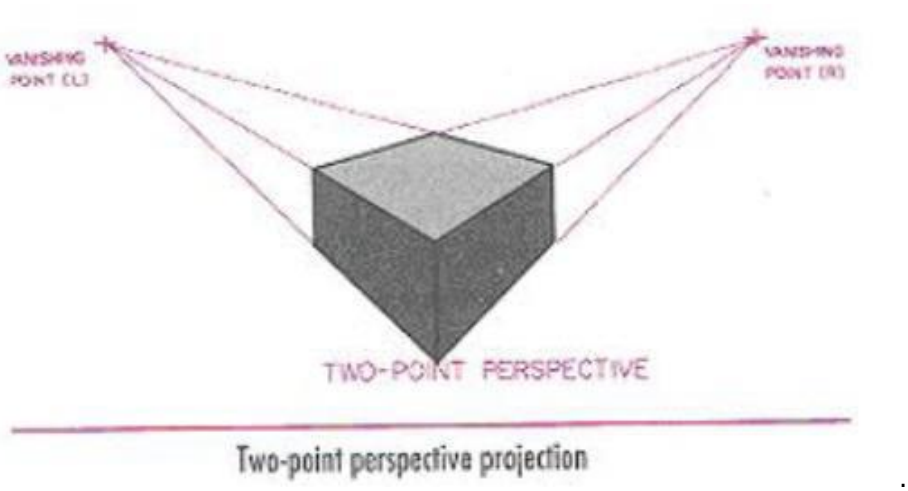


Figure: 4.11. Two Point perspective projections

1.4.3. Three point perspective projection:

The object is placed so that none of its principal edges is parallel to the picture plane. Hence, each of the three sets of principal edges will have a separate vanishing point.

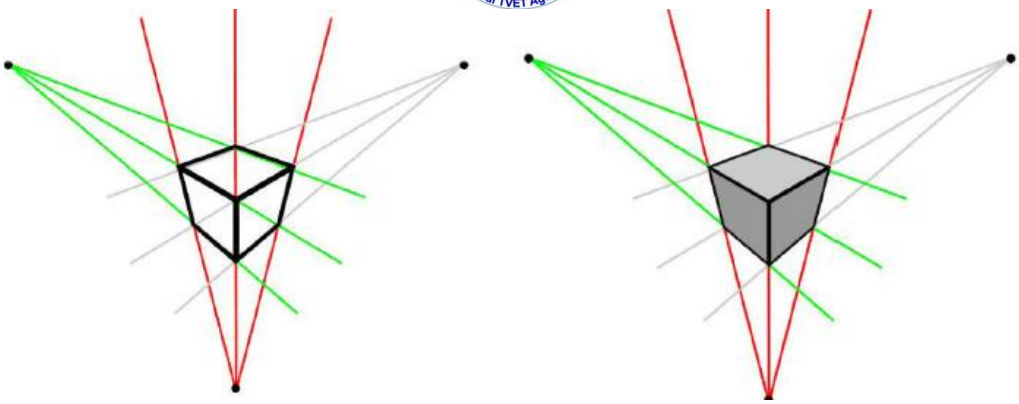


Figure: 4.12. Three point perspective projection

1.5. Exploded drawing

Exploded drawing is a diagram, picture, schematic or technical drawing of an object, that shows the relationship or order of assembly of various parts.

It shows the components of an object slightly separated by distance, or suspended in surrounding space in the case of a three-dimensional exploded diagram. An object is represented as if there had been a small controlled explosion emanating from the middle of the object, causing the object's parts to be separated an equal distance away from their original locations.

The exploded view drawing is used in parts catalogs, assembly and maintenance manuals and other instructional material.

The projection of an exploded view is usually shown from above and slightly in diagonal from the left or right side of the drawing. (See exploded view drawing of a gear pump to the right: it is slightly from above and shown from the left side of the drawing in diagonal.).

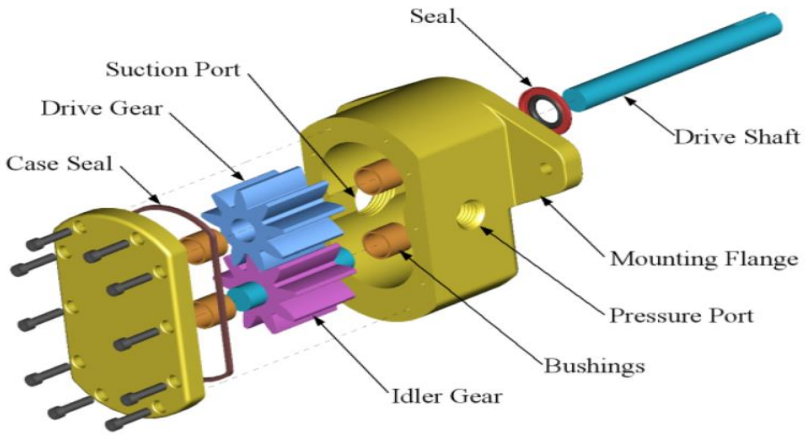
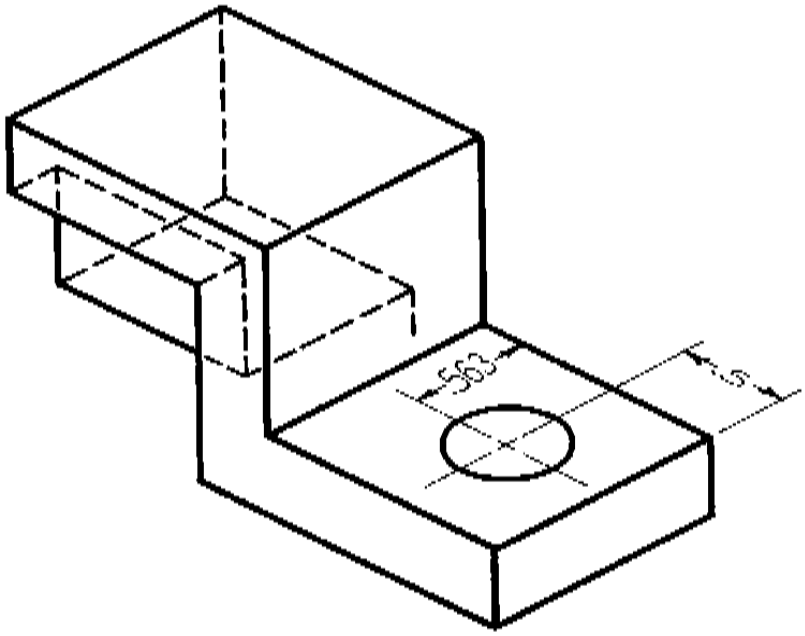


Figure:4.13 Exploded drawing

1.6. Hidden view technique

Hidden lines are not usually shown in isometric sketches unless they are needed to show a feature that would be unclear. Usually the orientation for the isometric drawing should be chosen so that hidden lines aren't needed. Holes are assumed to go completely through the object unless their depth is indicated with a note or with hidden lines.



Figure;4.14. Hidden view technique

Self-Check 4	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Write the true if the statement is correct if not write False

1. Hidden lines are only shown in isometric sketches unless.

2. Exploded drawing is a diagram, picture, schematic or technical drawing of an object

3. Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object.

Name: _____ Date: _____

Answer Sheet

_____

_____

_____

Score = _____

Rating: _____

5. 1. Explaining Orthographic & Isometric views

They are two common standards use in orthographic projection of drawings;

The First Angle Projection (European projection) and

The Third Angle Projection (American projection).

It should be noted that corresponding views are identical in both methods of projection except for their relative positions on the drawing paper.

The following principles of orthographic views are considered in making the drawings:

1. I**n first angle projection**; the Front view on the above and the Top view at the bottom are always in line vertically.
   - The front view and the side view are always in line horizontally.
   - **Each view gives two dimensions;** usually the front view gives length and height, top view gives length and width and side view gives height and width.
- **When the surface is parallel** to a plane its projection on that plane will show its true shape and sizes. When the surface is inclined its projection will be for shortened

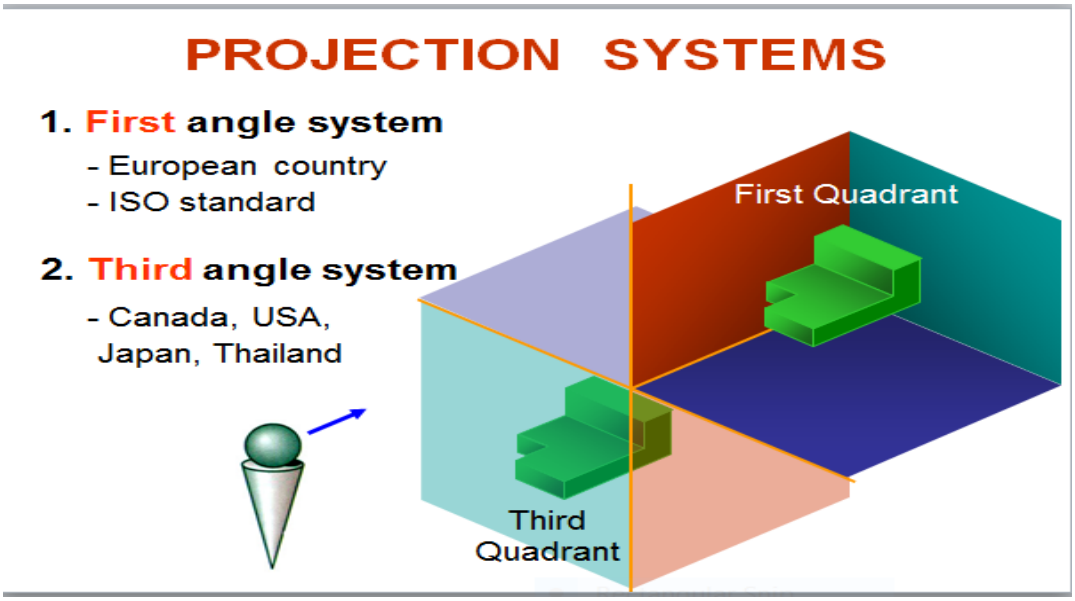
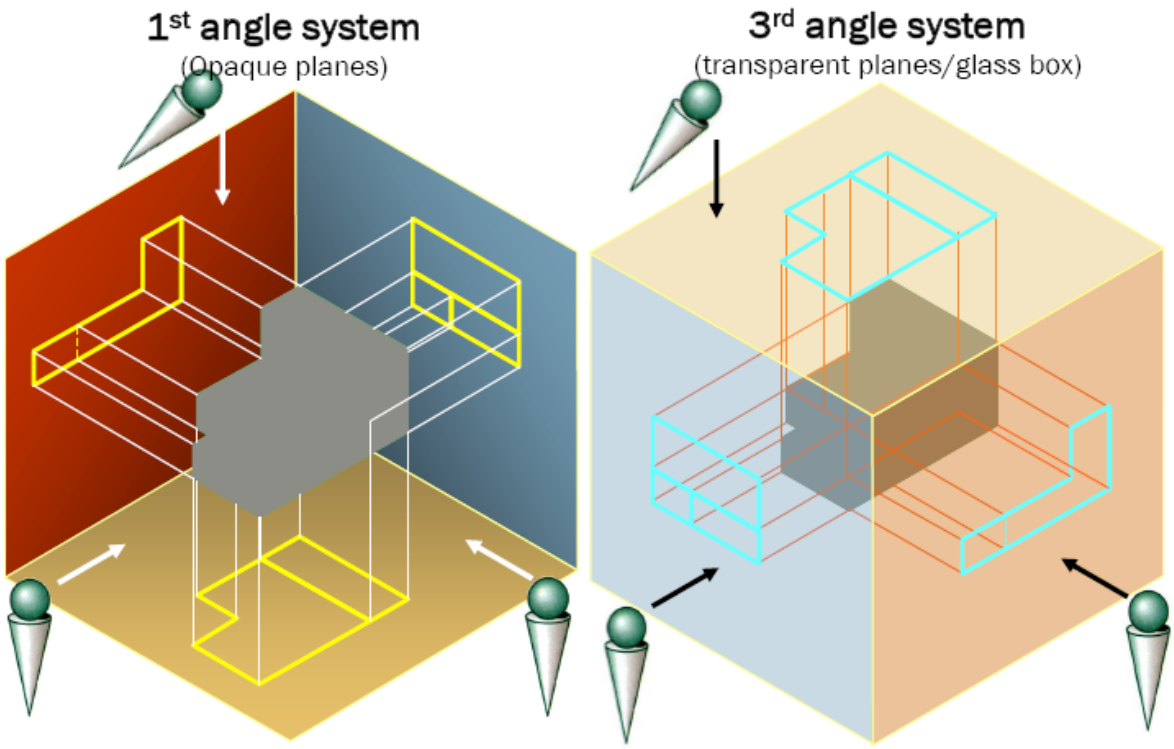
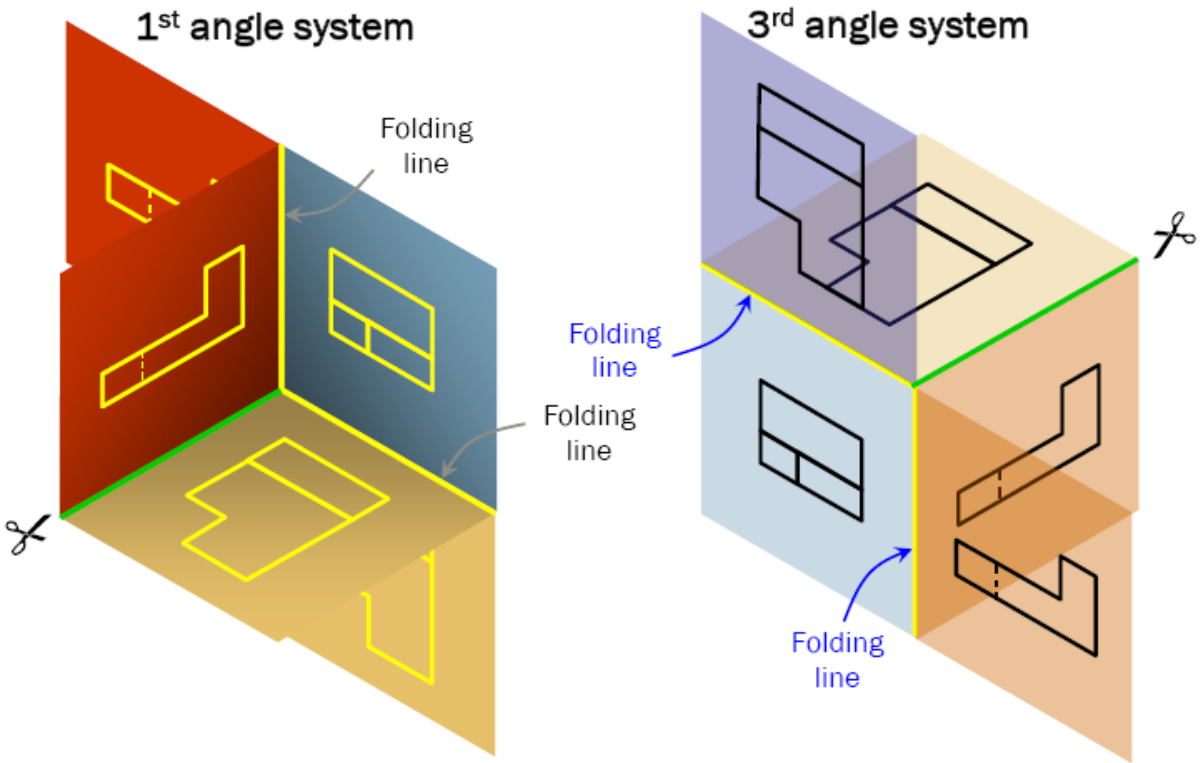


Figure:5.1..First Quadrant

Orthographic views

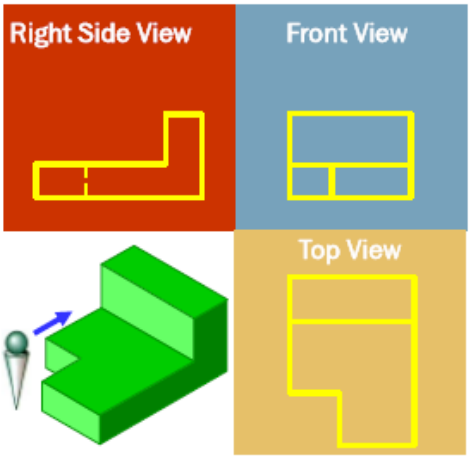


Figure;5.2 First and third angle projection

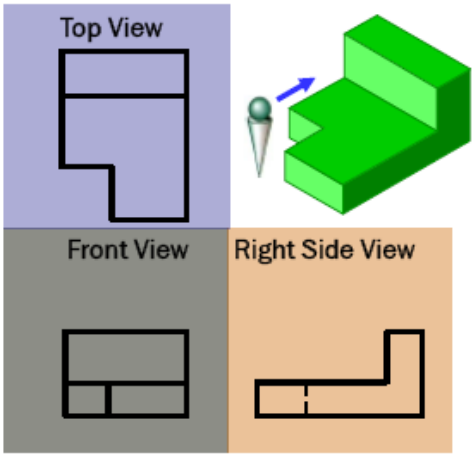


Views arrangement

1st angle system

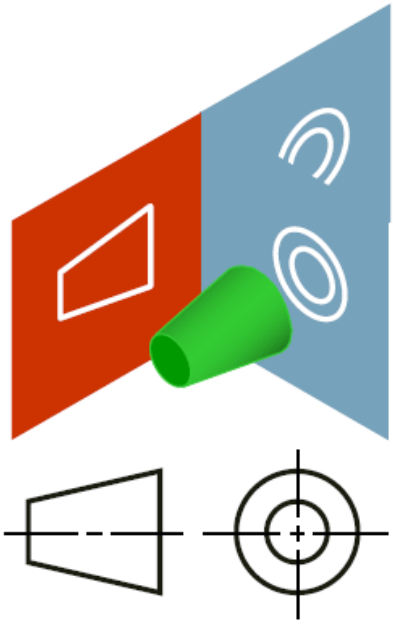


3rd angle system

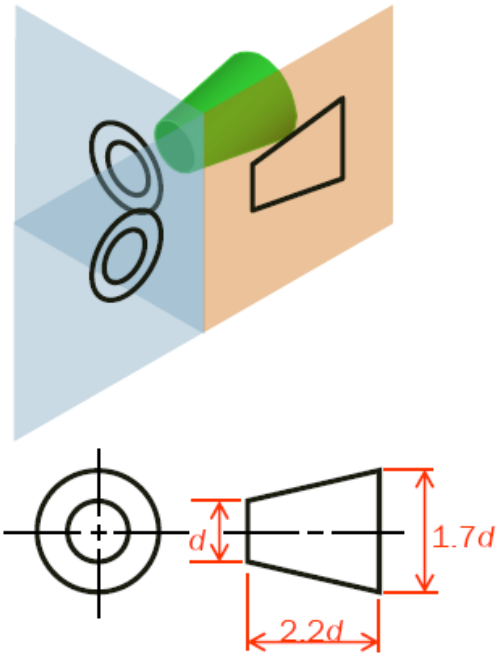


Projection symbols

1st angle system



3rd angle system

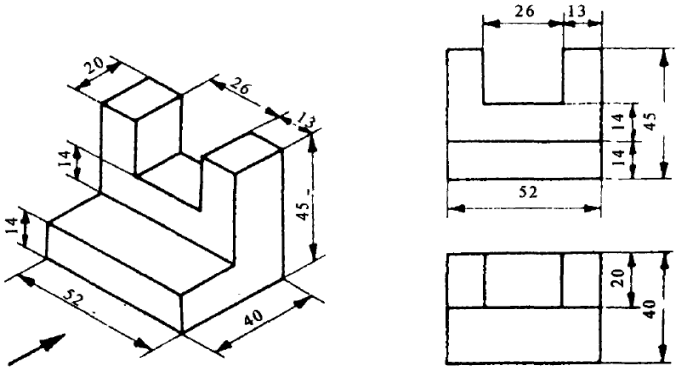


Selection of views

- The number of orthographic views required for clear description of the object is taken as the criteria to select the views. As far as possible least number of views is drawn.
- While selecting the views; the object is placed in such a way the numbers of hidden lines are kept to minimum.
- Front view is drawn seeing the object in a direction is which its length is seen. It is also chosen such that the shape of the object is revealed. The direction of the view is indicated by arrows.

Examples

The isometric views of some objects and their orthographic views are shown in Figure below drawn as per the principles indicated above by using **first Angle projection**



Figure;5.3 first angle drawing representation

Self-Check -5	Written Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

choose the correct answer from the following Questions

1 .One of the following views gives length and width of dimensions

A. side view C. Front view

B. top view D. none

2. Which one of a common standards used in orthographic projection of drawings

A. First Angle Projection B. European projection

C. Third Angle Projection D. all are answer

3 which orthographic views principles are correct in making drawing In first angle projection

B. Front view on the above and the Top view at the bottom

C. front view and the side view are always in line horizontally

D. Front view is drawn seeing the object in a direction is which its length is seen.

E. All above answer are correct

Name: _____ Date: _____

Answer Sheet

_____

_____

_____

Score = _____

Rating: _____

Operation Sheet 1	Identify views, standard symbols and line

Operation Title: To draw One Point Perspective

Procedure:

Step1. Set up the Oslo drawing paper on top of the drawing board.

Step2. Check to see that the paper edges are parallel to the left and bottom edges of the board respectively.

Step3. Properly secure the paper on top of the table by using masking tape or tacks or the likes.

Step4. Using the set of triangles and t-square, draw the border line around the drawing paper, leaving area for the title block at the bottom part.

Step5. Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step6. For normal drafting or lettering use the soft lead pencil (**HB**) for final results. Use the harder lead pencil (**4H**) for guidelines drawing only.

Step7. For inking, drafting pens of 0.1, 0.3 and 0.5 pen points are needed.

Step8 Use the set of triangles, t-square and lead pencil this activity.

Step9. Always remember that construction lines and guidelines are necessary in sketching and drafting, so utilize this knowledge.

Step10. Apply the knowledge on line quality in your work.

Step11. Accuracy and aesthetics always go hand in hand with drafting, so do your work with quality.

Step12. You may submit your finish work once you are true but should be within the time specified for submission.

2. LAP Test	Practical Demonstration

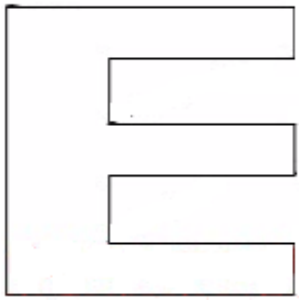
Name: _____ Date: _____

Time started: _____ Time finished: _____

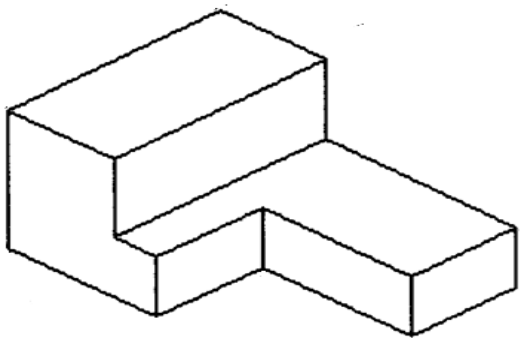
Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hours.

3. You are required to do the following activities as required in the problem.

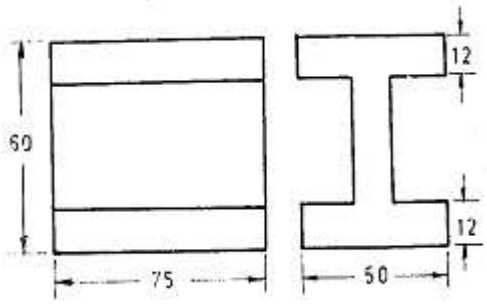
Task 1: Draw the one point perspective view of letter " E " below.



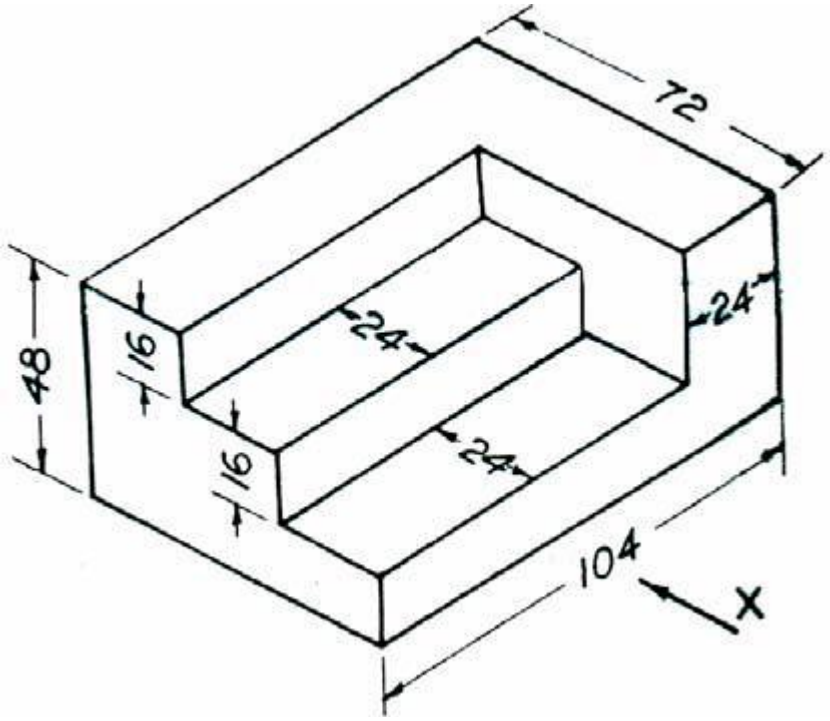
Task 2: Draw the one point perspective view of the isometric figure below.(one to one scale)



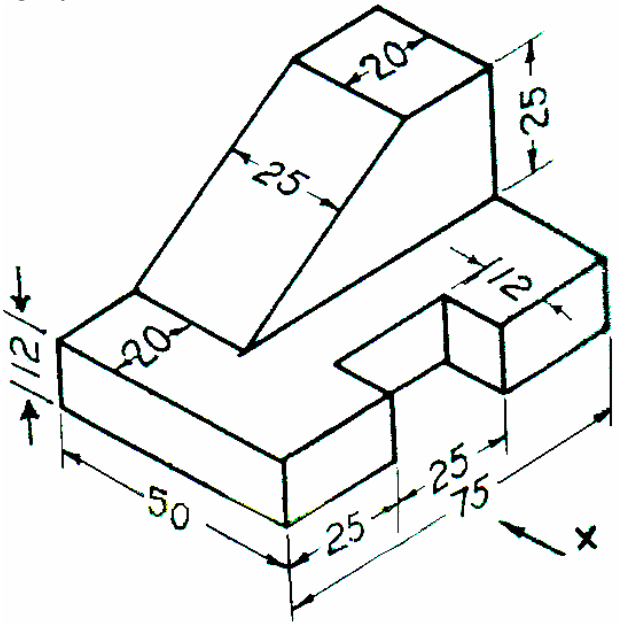
Task 3: - Draw the isometric view of the object whose orthographic projections are given in fig. All dimensions are in mm.



Task 4:- Draw front view, top view and side view of the model shown below by first and third angle projection respectively.



Task 4:- Draw the Orthographic views of the Isometric view shown in the following figure:



Lists of Reference materials

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2. . **Louis Gary Lamit**, Descriptive Geometry,1981,1st ed.,Prentice-Hall
3. Frederick E.,Technical Drawing,1958,4thed.,The Macmillan Company
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5. A text book of engineering drawing, B.Gupta. Nasaka Pashakar publisher
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7. T. Jeyapoovan, Engineering Drawing with autocad 2000, Vikas publishing
8. http://www.aust.edu/civil/lab_manual/ce_100.pdf
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BASIC METAL WORKS

Level-I

Learning Guide-24

Unit of Competence	**Interpret Drawings &Sketches**
Module Title	**Interpreting Drawings and Sketches**
LG Code:	**IND BMW1 M07 LO3-LG-24**
TTLM Code:	**IND BMW1 M07 TTLM 1019v1**

LO3: Interpret technical drawing

Instruction Sheet	Learning Guide 24

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Recognizing Component, assembly or object projections
- Identifying dimensions and material requirements
- Interpreting dimensional *tolerances* and notations.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Recognize Component, assembly or object as required.
- Interpret Drawing symbols and codes appropriately.
- Identify understand and follow dimensions and material requirements as required.

Dimensional tolerances, notations are interpreted according to specifications.

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” in page 67, 72 and 80 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, in page 81
6. Do the “LAP test” in page 82 (if you are ready).

1.1 Recognizing Component, assembly or object projections

Assembly Drawings: A complete assembly drawing is presentation of the product or structure put together, showing all parts in their operational positions. The separate parts come to the assembly department after their manufacturing processes are finished and in this department they are put together according the assembly drawings. Small machining operations may be necessary during assembly process such as drilling, reaming, or hand finishing. For such cases, assembly drawings include a note explaining the required operation and give the dimensions for the alignment or location of the pieces. **Assembly drawings** should include reference letters and numbers representing the different parts.

- **A *unit assembly* (subassembly)** is a drawing of a related group of parts and used to show the assembly of complicated machinery for which it would be practically impossible to show all the features on one drawing. To illustrate; headstock, tailstock, and gearbox unit assemblies should be included in the drawing of a lathe.
- **An *outline assembly* is used** to describe the exterior shape of a machine or structure, so it contains only the primary dimensions. If it is made for catalogs or illustrative purposes, dimensions are often omitted. They are also called as installation drawings.
- **An *assembly working drawing*** includes all the necessary information for producing a machine or structure on one drawing. This requires providing adequate orthographic views together with dimensions.
- **A *diagram drawing* is an assembly showing,** symbolically, installation of equipment and often made in pictorial form.
- The bill of material is a tabulated list placed either on the assembly drawing or on a separate sheet. The list gives the part numbers, names, quantities, material and sometimes stock sizes of raw material, detail drawing number, etc. The term "bill of material" is usually used in structural and architectural drawing whereas the term "part list" is used in machine-drawing practice.

Assembly drawing

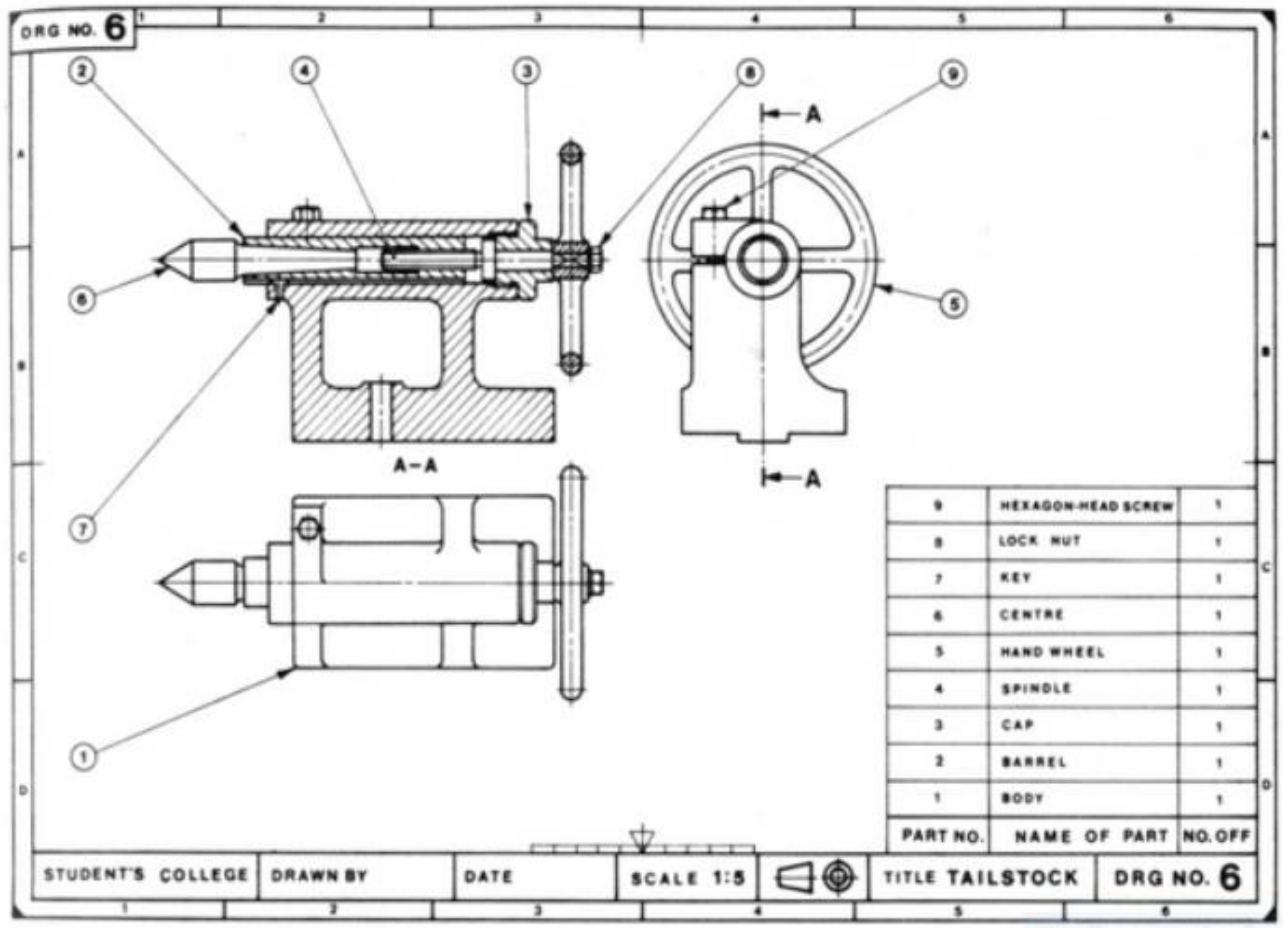


Fig 1.1: Assembly Drawings

Self-Check -1	Written teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write the correct answer if it is True say True if it is False say False

1. Assembly drawings should include reference letters and numbers representing the different parts.

2. **A *unit assembly*** is a drawing of a related group of parts and used to show the assembly of complicated machinery for which it would be practically impossible to show all the features on one drawing.

3. A complete assembly drawing is presentation of the product or structure explodes each other.

Name: _____ Date: _____

Answer Sheet

1. _____

2. _____

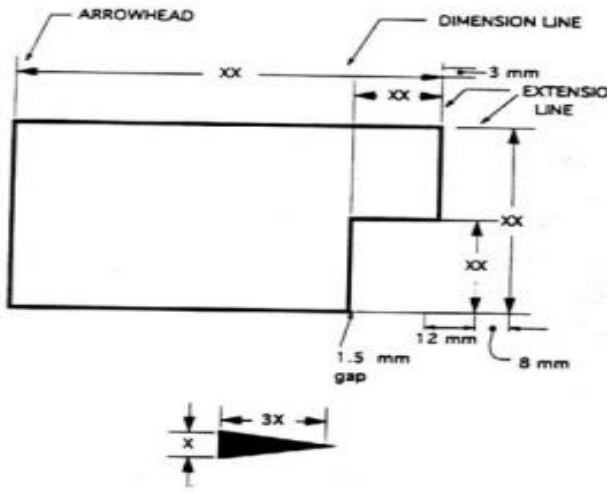
3. _____

Information Sheet-2	Identifying dimensions and material requirements

2.1 identifying dimensions and material requirements

Detail drawing is expected to provide not only the complete shape description of the part, but also furnish size description. This is provided in the form of distance between the surfaces, location of holes, kind of finish, type of material, etc. These features are illustrated on a drawing by the use of lines, symbols, figures, and notes, called dimensioning. Proper dimensioning requires engineering judgment and thorough knowledge of the practices and requirement of the production department.

- **Arrowhead is** approximately 3mm long and 1 mm wide That is, the length is roughly three times the width.
- **An extension line** extends a line on the object to the dimension line. The first dimension line should be approximately 12 mm (0.6 in) from the object. Extension lines begin 1.5mm from the object and extend 3 from the last dimension line.
- **A leader is** a thin line used to connect a dimension with particular area.
- **Dimension line** is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end. It is thin lines capped on the ends with arrowheads and broken along their length to provide a space for the dimension numeral. They indicate length.



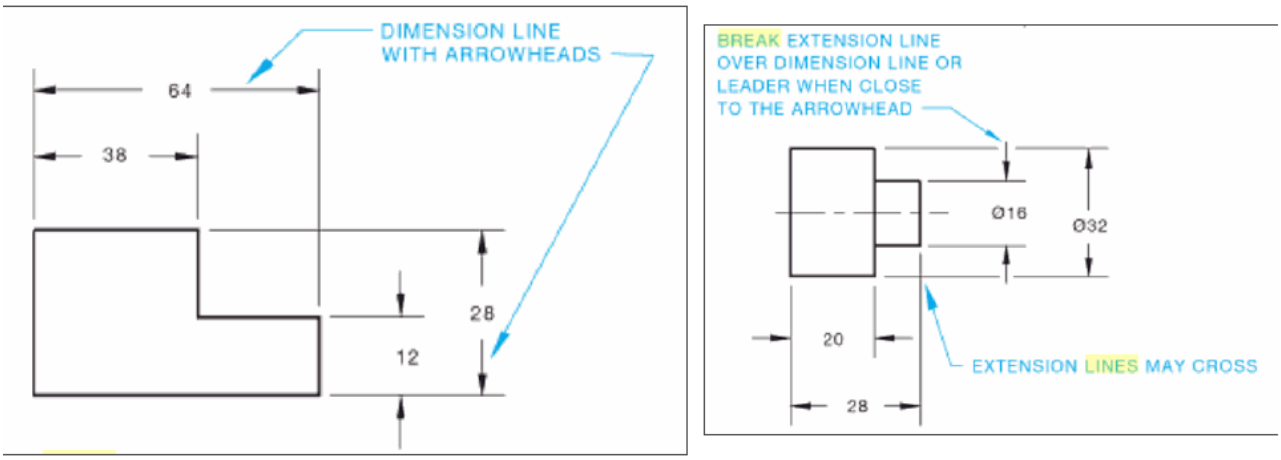
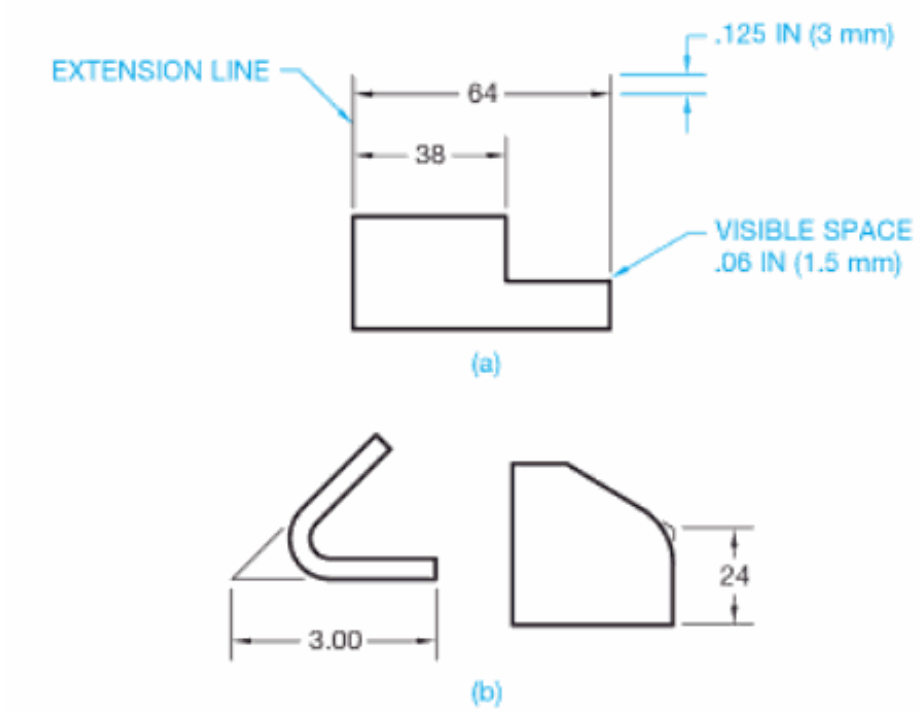


Fig.1.1. Dimensioning representation

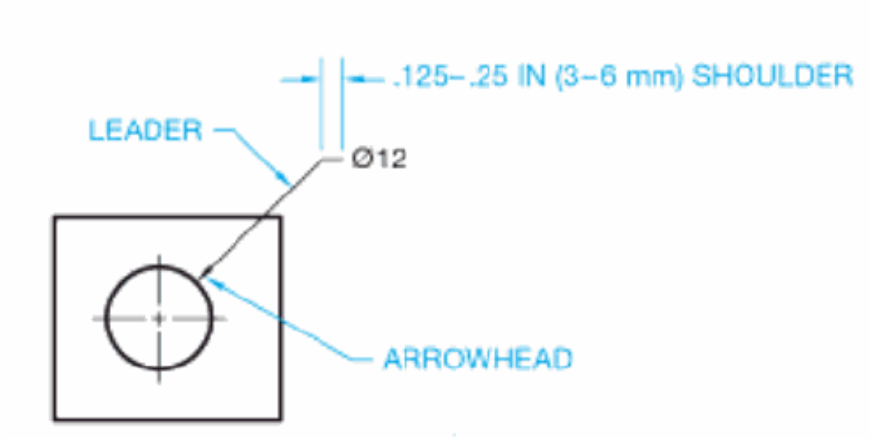
Extension Lines

Thin lines used to establish the extent of a dimension. It can also be used to show extension of a surface to a theoretical intersection as shown in (b). Begin 1.5mm from the object and extend to 3mm beyond the last dimension. They should not cross dimension lines.



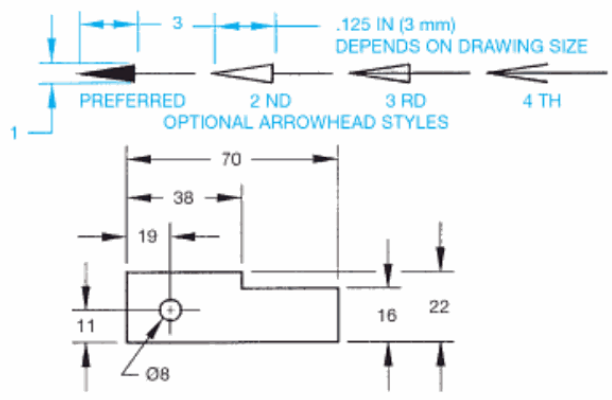
Leader Lines

- Thin lines used to connect a specific note to a feature.
- Also used to direct dimensions, symbols, item number and part numbers on a drawing.
- Commonly drawn at ***45, 30 and 60*** degrees.
- Has a ***short shoulder*** (3-6mm) at one end beginning at the center of the vertical height of text, and a ***standard dimension arrowhead*** at the other end touching the feature.
- Leader lines should not cross each other.
- Leader lines should not be excessively long.
- Leader lines should not be vertical or horizontal.
- Leader lines should not be parallel to dimension lines, extension lines or section lines.



Arrowheads

- Used to terminate dimension lines and leader lines and on cutting-plane lines and viewing plane lines.
- They should be three times as long as they are wide.
- They should be the same size throughout the drawing.
- The filled arrowhead is generally preferred because of its clarity.



Two approved systems indicate dimensions on drawings: the ***aligned dimension*** and the **unidirectional *dimension system***. Select one system of dimensioning to use throughout the drawing. You may show dimensions with either whole numbers and fractions, decimals, or metric units of measure. ALIGNED DIMENSIONS: Drawings made with aligned dimensions have all figures and notes aligned with a dimension line so that all read from the sides or edges of a drawing. The most common are read from the bottom and right side. Aligned dimensions are sometimes referred to as pictorial dimensions.

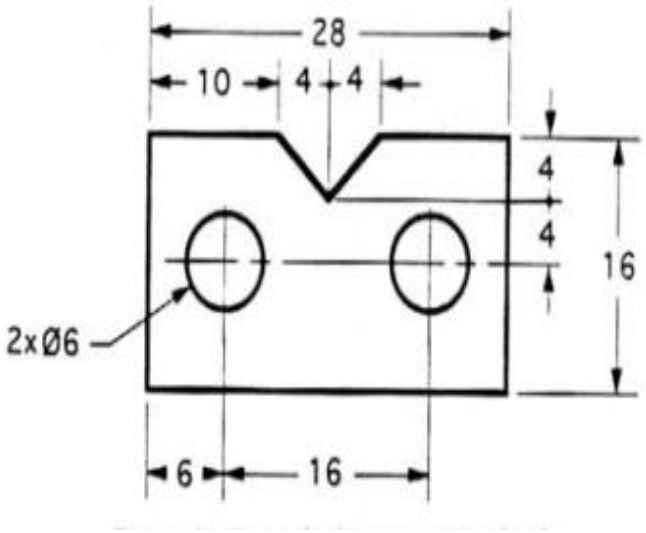


Fig 1.3: unidirectional *dimension system*

Self-Check -2	Written teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write the true if the statement is correct write False if not correct

1. Detail drawing is expected to provide only the complete shape description of the part.
2. The features are illustrated on a drawing by the use of lines, symbols, figures, and notes, Called dimensioning.
3. Dimensioning not requires engineering judgment .

3.1 Interpreting dimensional *tolerances* and notation

The purpose of dimensioning is to provide a clear and complete description of an object. A complete set of dimensions will permit only one interpretation needed to construct the part. Dimensioning should follow these guidelines.

- **Accuracy:** correct values must be given.
- **Clearness:** dimensions must be placed in appropriate positions.
- **Completeness:** nothing must be left out, and nothing duplicated.
- **Readability:** the appropriate line quality must be used or legibility

Type of tolerances.

1. General tolerance

If no tolerances are specified at the dimension level, then general tolerances may be applied by deliberately controlling the number of values past the decimal point on each dimension.

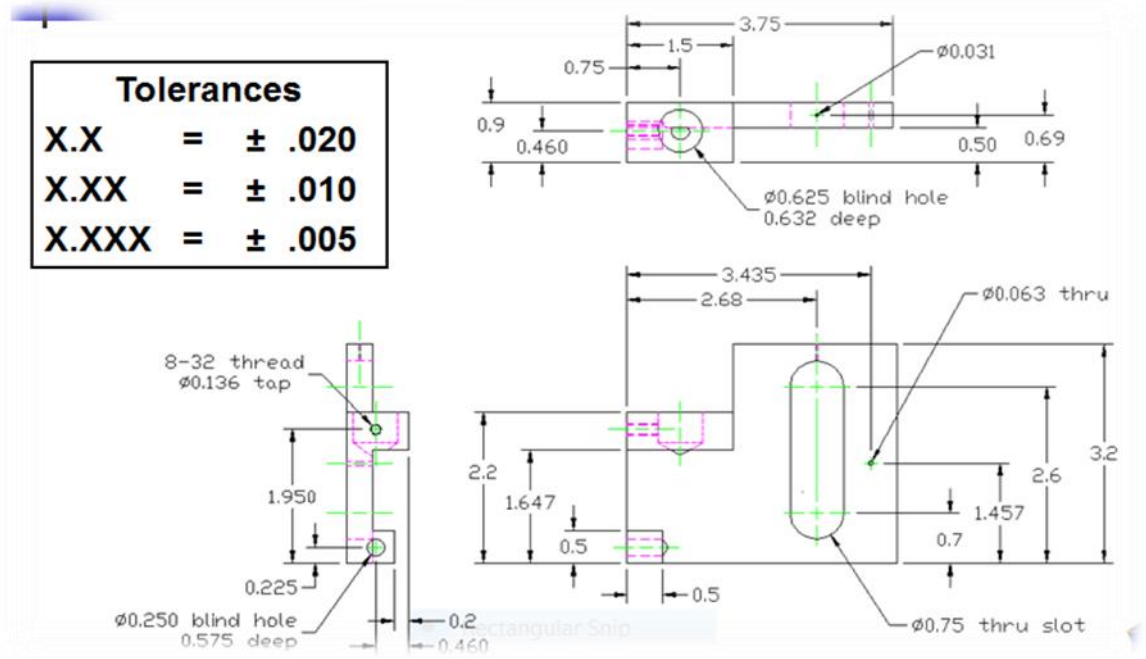


Fig. 3.1. General tolerance

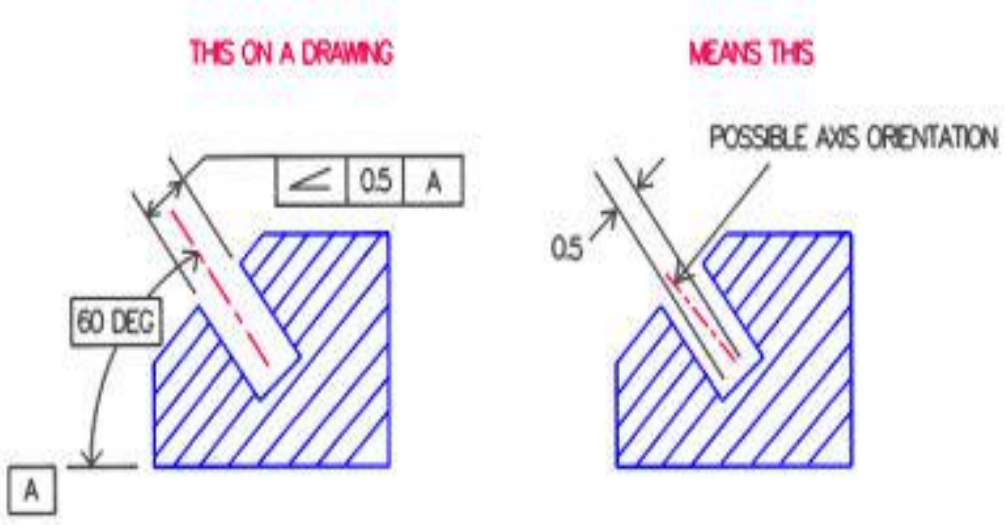
No two manufactured objects are identical in every way. Some degree of variation will exist. Engineers apply tolerances to part dimensions to reduce the amount of variation that occurs. The tolerance may be applied directly to the dimension or indicated by a general note located in the title block of the drawing

A tolerance is an acceptable amount of dimensional variation that will still allow an object to function correctly

1. Angular tolerance

In a mechanical drawing of a part, angularity tolerance allows the designer to specify the degree to which the orientation of an angled part feature may vary.

The angularity symbol is often used to insure that the part can properly mate with another. In GD&T, the degree of permissible variation is not specified as a tolerance on the angle. Rather an indirect method is used where one specifies a tolerance zone at a specified angle from a datum, within which a part feature, axis, or center plane must lie.



Figures: 3.2. Angular tolerances

In the left figure above, the boxed angularity symbol, tolerance and datum are used to control the center axis of an angled hole. The boxed symbols can be read “This axis must lie within two planes 0.5 apart , the planes inclined 60° to surface A”.

In the right figure above, the tolerance zone created is indicated by the parallel lines. This form of angularity tolerance applies only in the drawing view in which the tolerance is specified, and requires the permissible variation to be defined for other views. However, if a diameter symbol were placed in front of the boxed 0.5, this would create a cylindrical tolerance zone which would then apply to all drawing views.

Angularity is used in a tolerance stack when applied to a surface or line element. Angularity refines the orientation of the surface or line element, acting like a flatness control for the purposes of performing a tolerance stack

2. Geometric tolerance

In a typical engineering design and production environment, the designer of a part rarely follows the design to the shop floor, and consequently the only means of communication of the design intent are the design drawings. Problems of validation and interpretation of design arise when the drawings do not clearly reflect what the designer intended, when they do not communicate to manufacturing how the design should be implemented and when the drawings are subjected to a number of different interpretations.

The use of linear tolerances when dimensioning the part can control the size of a product. It is however possible for limits of size to be maintained while the shape of a part or feature deviates significantly from the intended form. To control this deviation, a method of specifying the acceptable tolerance of form is required and this is done using geometric dimensioning and tolerance symbols. These enable the designer to specify on the drawing, the geometry or shape of a component and they provide a precise definition of what constitutes a functionally good part.

Features of a component

Geo- metrical tolerances may be applied to these features. For example, an axis may have straightness or a positional tolerance, a face may have a flatness tolerance and a cylindrical surface may have a circularity tolerance. It may be combined to form other features such as slots, grooves and tongues. Thus, a tongue consists of a pair of parallel plane surfaces with another plane surface at right angles to them, and a median plane. Slots, grooves and tongues may need tolerances of position or symmetry.

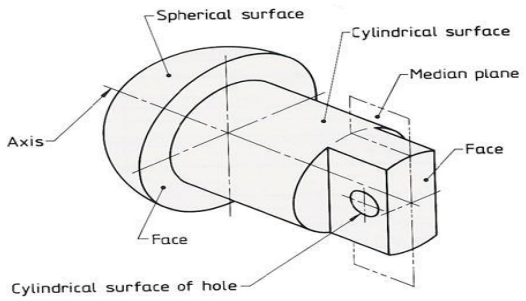


Figure: 3.3 Feature of a Component

Tolerance Frame:

Geometrical tolerances are placed in rectangular frames that are divided into compartments as shown in bellow. In the first compartment from the left the symbol for the characteristic being tolerance is given. The next compartment contains the tolerance value in the units used for linear dimensions. If the tolerance zone is circular or cylindrical the symbol Ø appears before the tolerance value. The third and succeeding compartments contain the. Letters which identify the datum feature or features, where appropriate

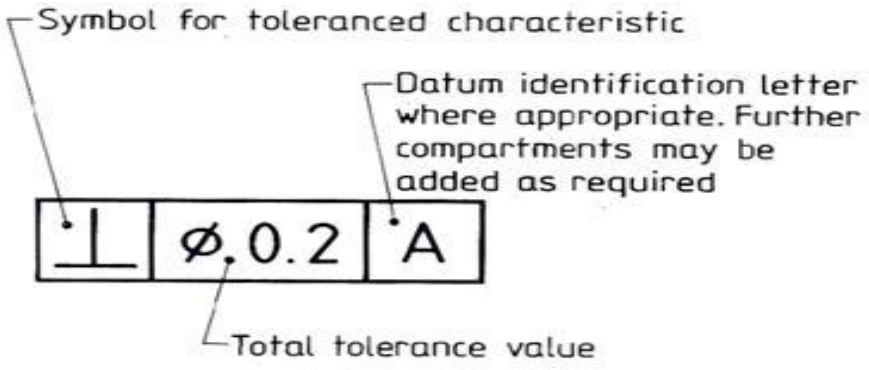


Figure 3.4. Tolerance Frame

The capitol letter “M”, “P” or “E” may appear in the tolerance frame as appropriate, to indicate

- Maximum Material Condition qualification
- Projected Tolerance Zone
- Envelope Requirement

Tolerance Characteristic Symbol:

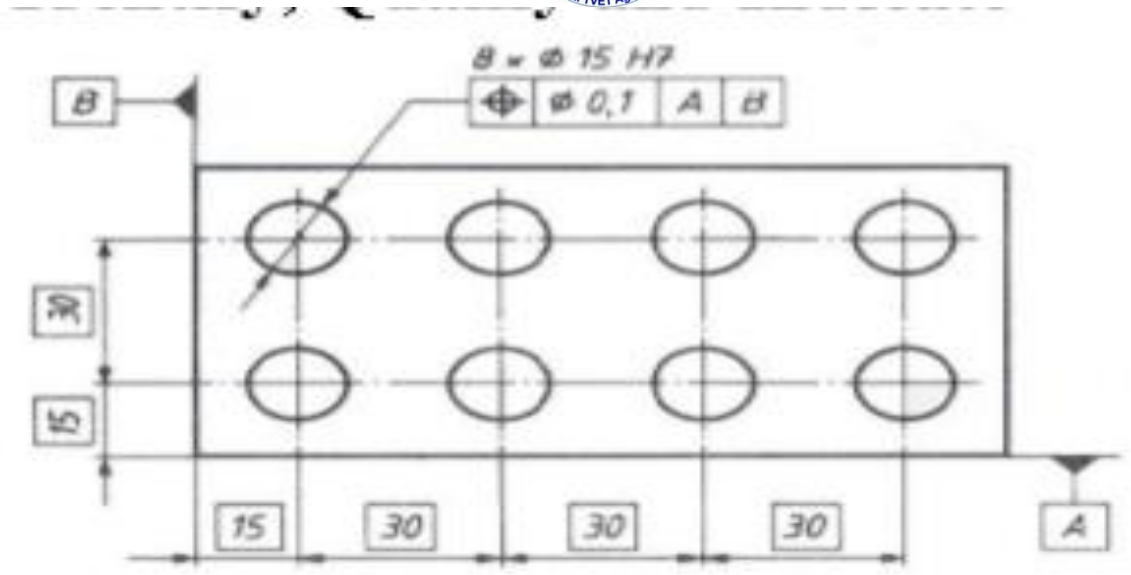
The straightness of an axis, the flatness of a face, etc, are characteristics of features and these are indicated on drawings using the symbols shown in ***bellows***

Features and tolerances		Toleranced characteristics	Symbols
Single features	Form tolerances	Straightness	
		Flatness	
		Circularity	
		Cylindricity	
Single or related features		Profile of any line	
		Profile of any surface	
Related features	Orientation tolerances	Parallelism	
		Perpendicularity	
		Angularity	
	Location tolerances	Position	
		Concentricity and coaxiality	
		Symmetry	
	Run-out tolerances	Circular run-out	
		Total run-out	

Figure: 3.5.Tolerance Characteristic Symbols

Theoretically Exact Dimensions

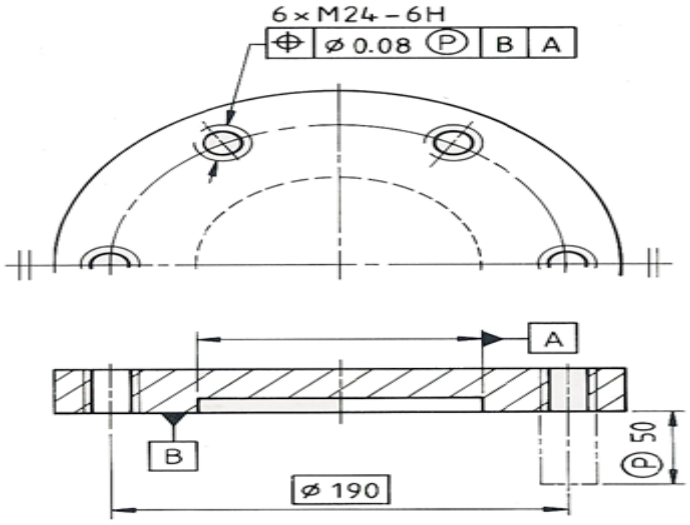
When tolerances of position, profile or angularity are specified for a feature, the ideal position or angle is defined by theoretically exact dimension. These dimensions are enclosed in a rectangular frame, called a box as shown using **the example opposite**



.

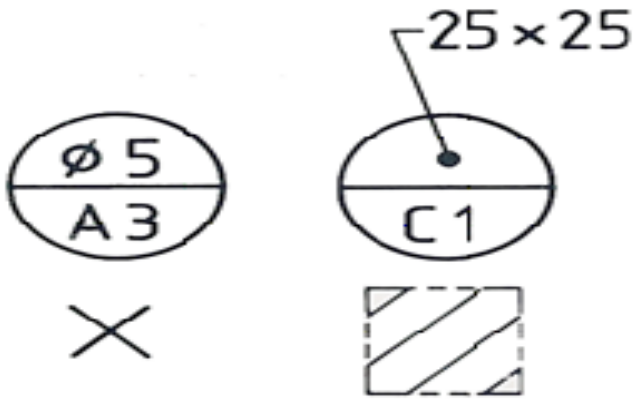
Projected Tolerance Zone:

When indicating the positional tolerance zone for the axis of a hole, the perpendicularity deviations of the axis may be specified also. If the hole is to be used to secure a cylindrical part such as a press-fit pin, the maximum permitted perpendicularity deviation of the hole axis could cause the pin to interfere with the clearance hole in the mating part. This may be avoided by specifying a projected tolerance zone for the axis of the securing hole, as shown opposite.



Datum Targets

If a feature is large, geometrical imperfections may make it impracticable to use its entire surface to establish a datum. To establish practical datums, suitable locations on the part, called datum targets, may be selected and indicated on the drawing.



Self-Check -3	Write Teste

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write true if the statement is correct write False if not correct

1. The purpose of dimensioning is to provide a clear and complete description of an object.

2. Complete set of dimensions will permit only different interpretation needed to construct the part.

3. Geometrical tolerances should be specify for all requirements critical to functioning and interchangeability.

4. Suitable locations on the part, called datum targets.

Name: _____ Date: _____

Answer Sheet

1. _____
2. _____
3. _____

Score = _____

Rating: _____

Operation Sheet 3	To perform dimensional Views

To perform dimensional Views

Procedure:

Step1 Set up your drawing paper on top of the drawing board.

Step2 Use the drawing template format given to you by your teacher.

Step3 Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step4 Using the basic drawing instruments and materials, perform the drawing task in the given following problems 1 to ___ below.

Step5 Use appropriate pencil lead in your drafting works.

Step6 There are two part of problem exercises, Part A – complete the st

Step7 orthographic views by finding the missing line/s given the orthographic views and isometric view;

Step8 Part B – provide the 3 basic orthographic views (top, front and side/end views) given the isometric view.

Step9 You may submit your finish work once you are true but should be within the time specified for submission.

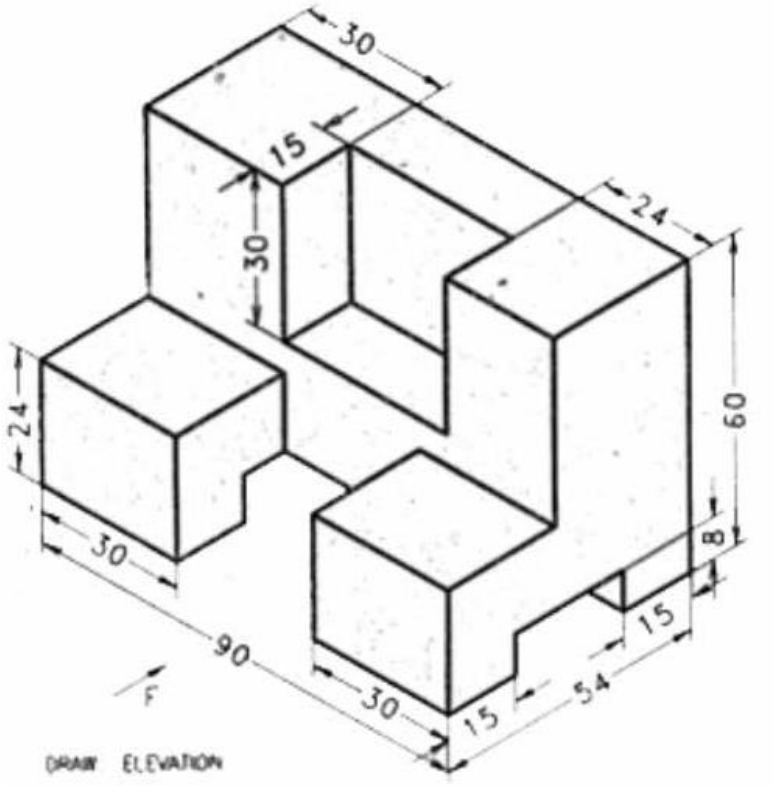
LAP Test	Practical Demonstration

Name: _____ Date: _____

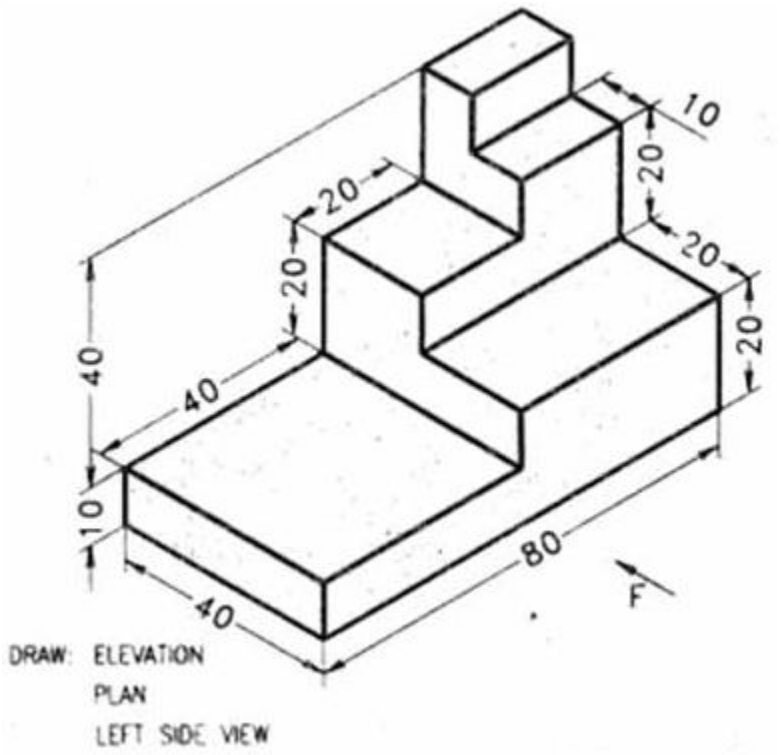
Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hours**. Perform the following tasks**

Task: 1: Draw the orthographic projections needed to fully describe the part. Choose the best view for the front view. Use a scale of 1:1 with 50 mm spacing between the views. Apply all dimensioning style. *Note: All Dimensions in mm.*



Task: 2 draw the orthographic projections needed to fully describe the part. Choose the best view for the front view. Use a scale of 1:1 with 50 mm spacing between the views. Apply all dimensioning style. *Note: All Dimensions in mm.*



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