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MINISTRY OF LABOR AND SKILLS

BASIC WELDING WORK LEVEL – I

Based on March, 2022, Curriculum Version 1

Module Title: Interpreting Drawings and Sketches

Module code: IND BWW1 M01 0322

Nominal duration: 100 Hours

Prepared by: Ministry of Lab our and Skill

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Addis Ababa, Ethiopia

Table of Contents

Acknowledgment

Ministry of labor and Skills wishes to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

I. Introduction to the Module

This module covers the competencies required to read and interpret drawings and sketches. It requires interpretations of standard drawings by using symbols, dimensional tolerances and notations.

This module is designed to meet the industry requirement under the Welding occupational standard, particularly for the unit of competency of Interpret Drawings and Sketches.

This module covers the units:

- Technical Drawing
- Views, Standard Symbols and Lines
- Interpret Technical Drawing

Learning Objective of the Module

- Use technical drawing
- Apply views, standard symbols and lines
- Use rule of Interpreting technical drawing

II. Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
1. Read the identified reference book for Examples and exercise

Unit one: Technical drawing

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

- drawing tools and equipment
- drawing against job requirements
- Check and validate drawing version
- technical instructions

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

- use drawing tools and equipment
- drawing against job requirements
- determine drawing version
- Apply technical instructions

1.1. Drawing tools and equipment

1.1.1 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.

1.1.2. Technical Drawings

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

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

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.

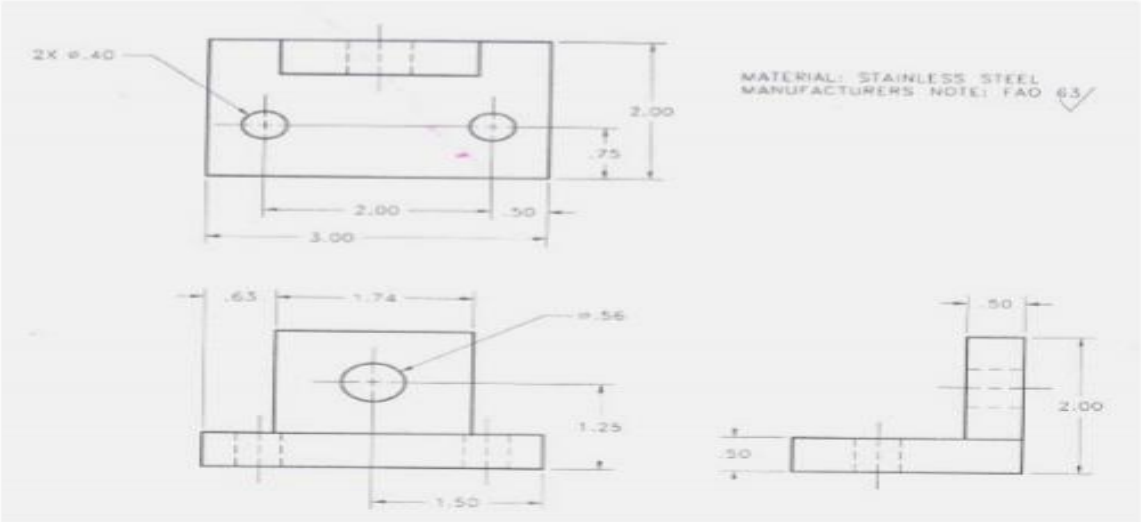

Fig 1.1.1 dimensions,

1.1.2. Types of drawing tools and equipment

a) **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.

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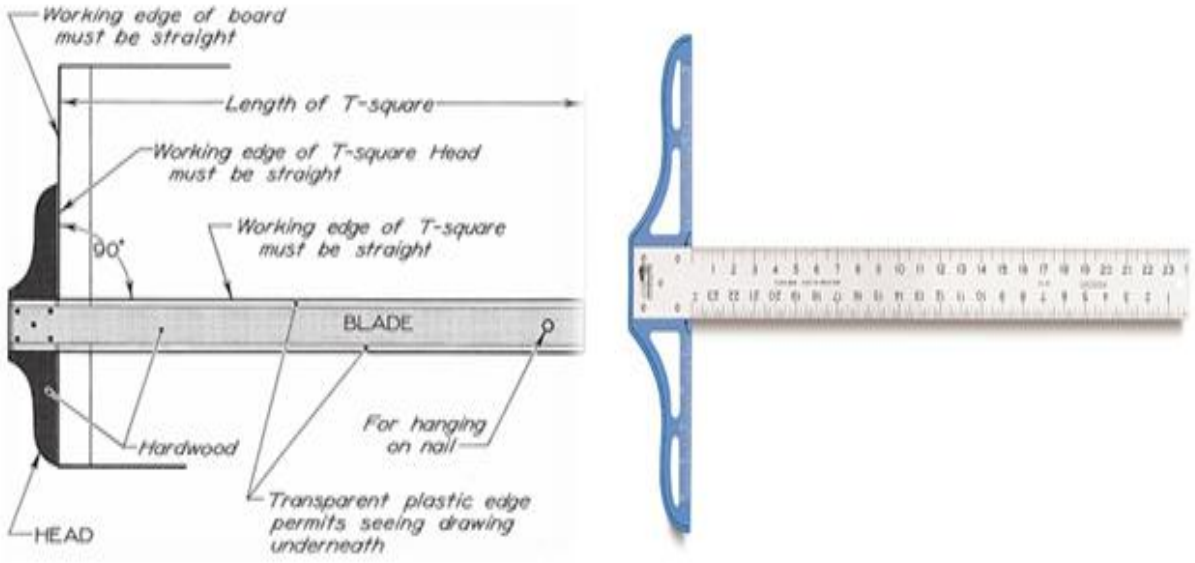


Fig 1.2.1. T-square

a. 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.

Figure. Drawing Board

b. Compass

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.

Figure Compass

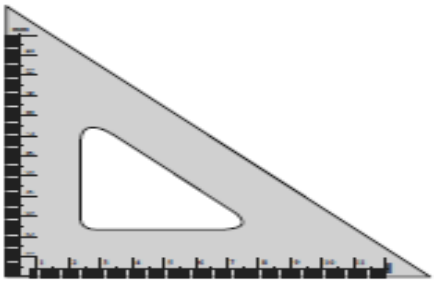
C. Divider

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.

Figure Divider

d. Triangles (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.



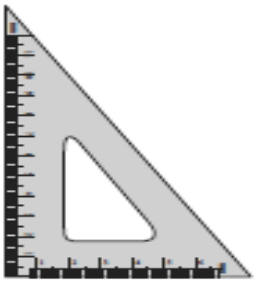


Fig. *(a): 45 Set Square* *Fig. (b): 30|60 Set Square*

e. 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

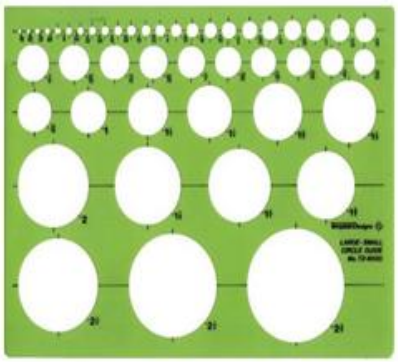


Figure circle Temple

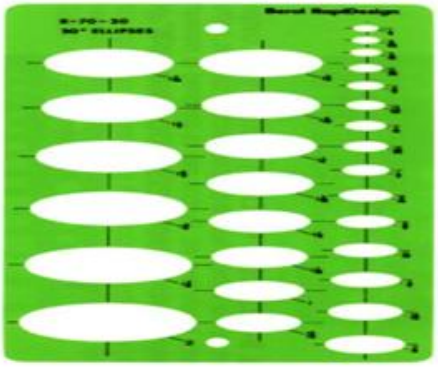


Figure ellipse Temple

f. 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**.

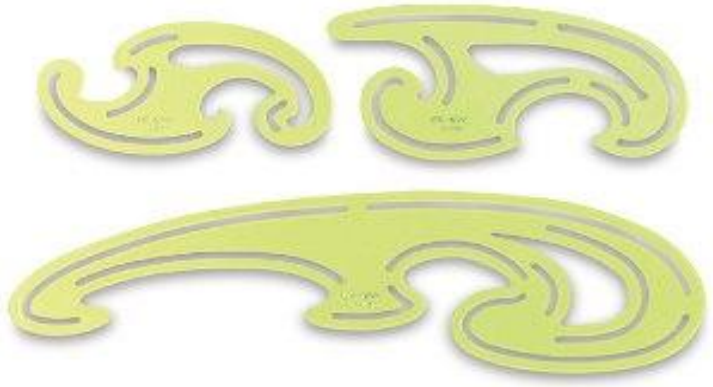


Figure French curves and flex curve

g. 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.

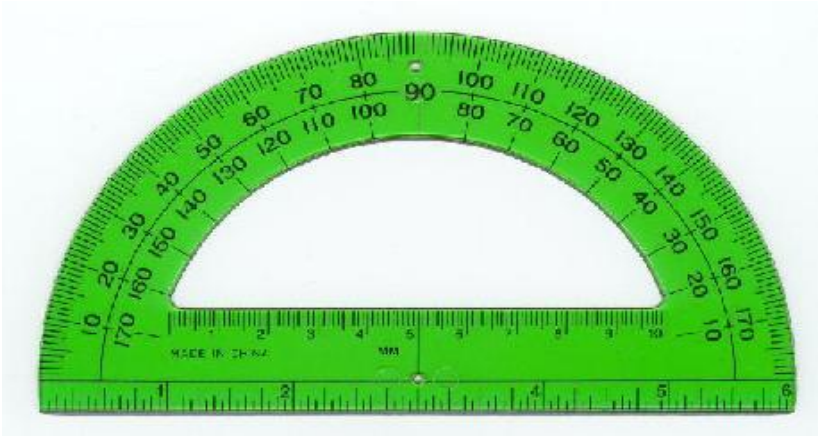


Figure. Protractor

1.1.3. Drawing Materials

a. 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)

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

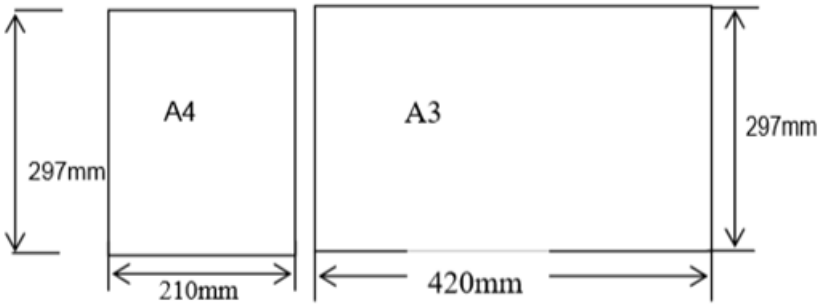


Fig. Paper size illustration

b. Drawing Pencils:

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

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. Drawing Pencils

1.1. Drawing against job requirements

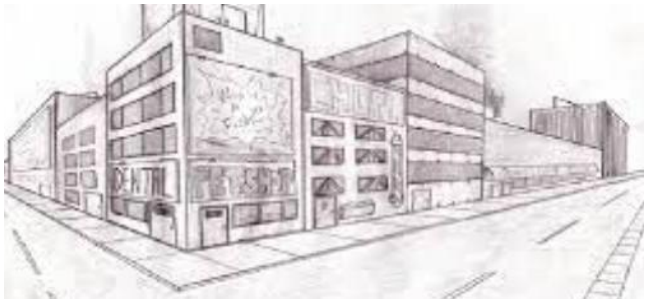
1.2.1. Perspective

Perspective drawing is a technique to create the linear illusion of depth. As objects get further away from the viewer they appear to decrease in size at a constant rate. The box in the sketch below appears solid and three dimensional due to the use of perspective.

What are the 3 rules of perspective drawing?

In order to understand human perception, there are three important tools for perspective drawing:

The horizon line, **vanishing points**, and **vanishing lines.**



1 One **point perspective by sneaky lightning on Deviant Art**

1.2.2. Exploded view

An exploded view 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.

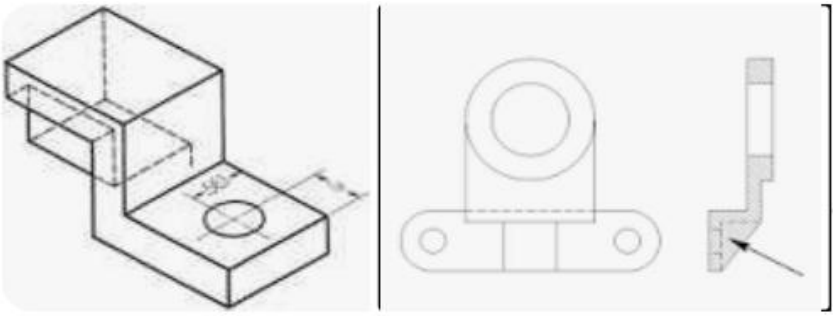
The exploded view drawing is used in parts catalogs, assembly and maintenance manuals and other instructional material.

The projection of an exploded view is usually shown from above and slightly in diagonal from the left or right side of the drawing

1.2.3. Hidden view technique

Hidden lines in a drawing represent the edges where surfaces meet but are not directly visible. Hidden lines are omitted from pictorial drawings unless they are needed to make the drawing clear

Hidden lines are used to show surfaces that are not directly visible. All surfaces must be shown in all views. If an edge or surface is blocked from view by another feature, it is drawn using a hidden line.



1.3. 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.

1.4. Technical instructions

a. Confirming and following Instructions

b. 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 somewhat 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

c. Standards

BS ISO 7200 Technical Drawings- Title Blocks identifies the title block requirements to be used on engineering drawings. 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 elsewhere 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

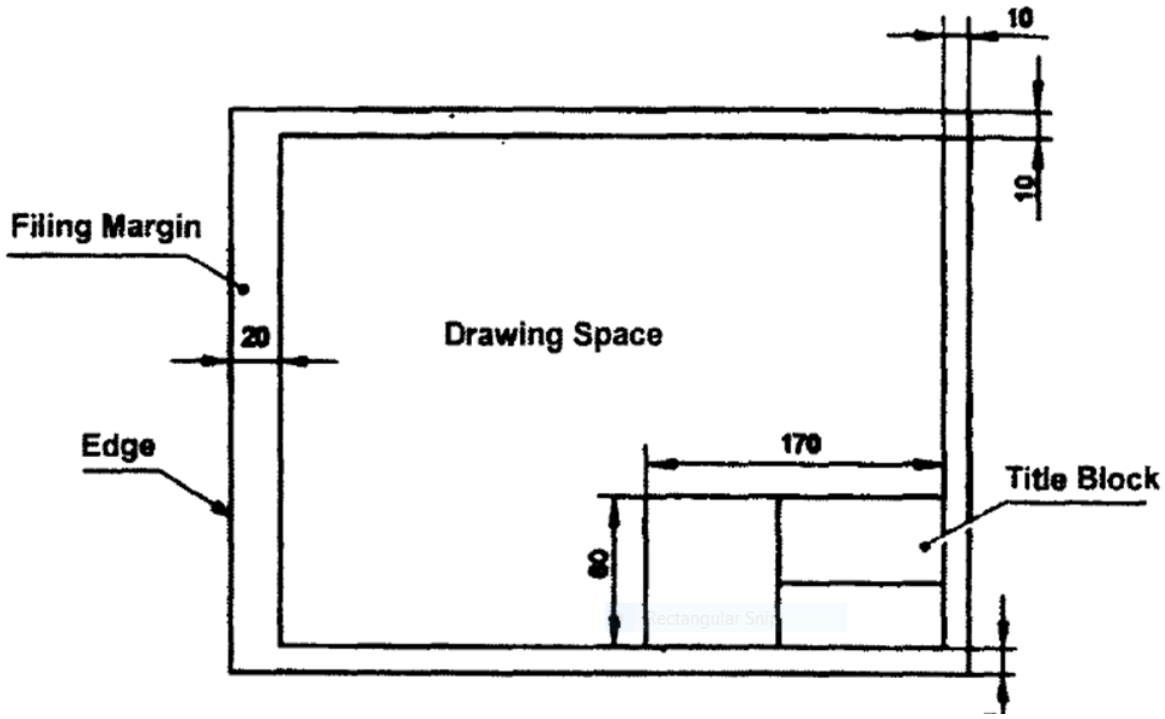


Figure.1.4.2. Title Block

Self Check -1	Written Test

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

Part I: 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

Party II <u>Choose the correct answer from the following Questions</u>

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

Operation Sheet-1

- **Operation Title**: **Drawing Title Block**
- **Purpose:** To practice and demonstrate the knowledge and skill require to know how to use Drawing Template and Title Block
- **Instruction:** Use the given step below to apply the tools and equipment during drawing
- **Tools and requirement:**
  - HB drawing pencil lead
  - 4H drawing pencil lead
  - 45º x 90º triangle
  - 30º x 60º triangle
  - Eraser
  - T-square
  - Drafting pens
- **Procedure in doing the task**

  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 1	**Practical Demonstration**

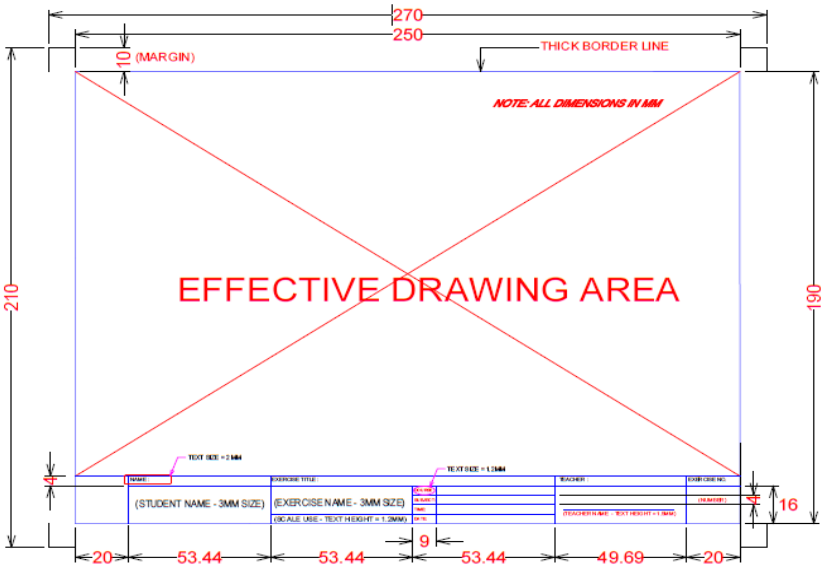
Name: _____ Date: _____

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



Unit 2: Identify Views, Standard Symbols and Line

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

- alphabet of lines
- uses of the alphabet of lines
- orthographic and isometric drawing
- orthographic and isometric views
- Drawing codes an symbols

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:

- Define alphabet of lines
- uses alphabet of lines
- apply orthographic and isometric drawing
- use orthographic and isometric views
- use codes an symbols

2.1. Alphabet of lines

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.

2.1.1. 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

2.1.2. Dimensioning

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.

1. Accuracy: correct values must be given.
2. Clearness: dimensions must be placed in appropriate positions.
3. Completeness: nothing must be left out, and nothing duplicated.
4. Readability: the appropriate line quality must be use for legibility.

♦ Dimension line is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end.

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

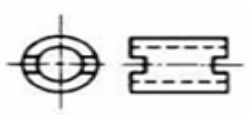
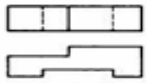
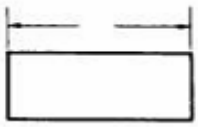
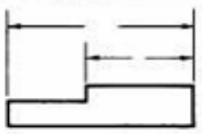
2.2. Use alphabet of lines

2.2.1. Explain 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	

2.3. Orthographic and isometric drawing

2.3.1. 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

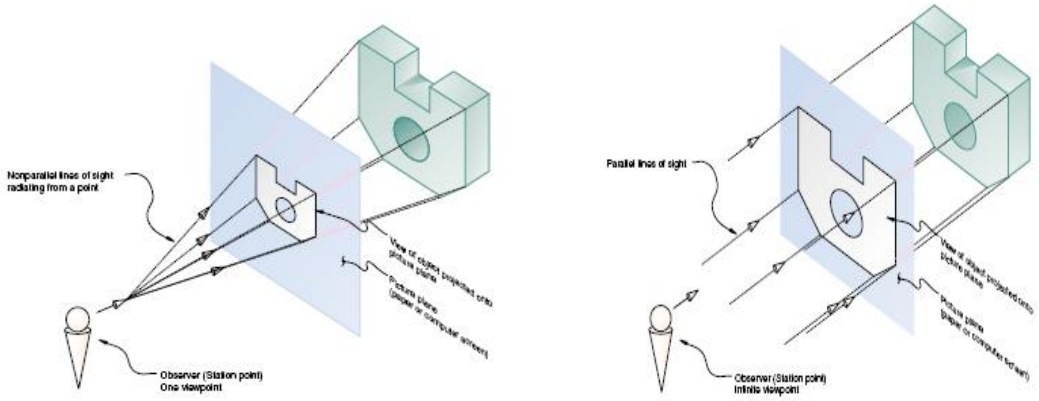


Fig: 2.3.1. Classification of projections (perspective and Parallel projection)

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

2.3.2. Orthographic projection

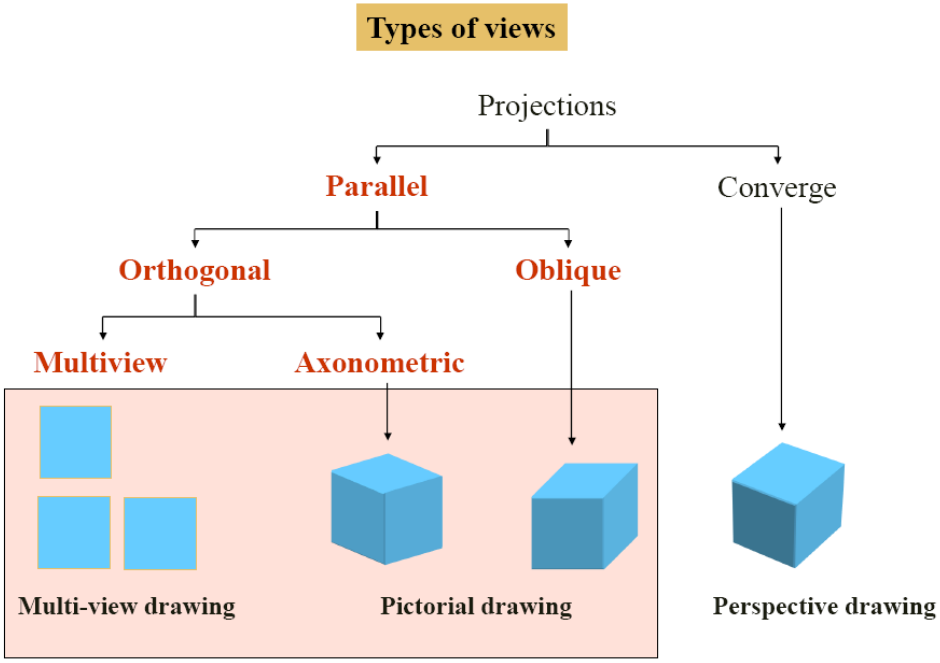
Orthographic is a system of views of an object formed by projectors from the object perpendicular to the desired planes of projection. Orthographic Projections are a technical drawing in which different views of an object are projected on different reference planes observing perpendicular to respective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



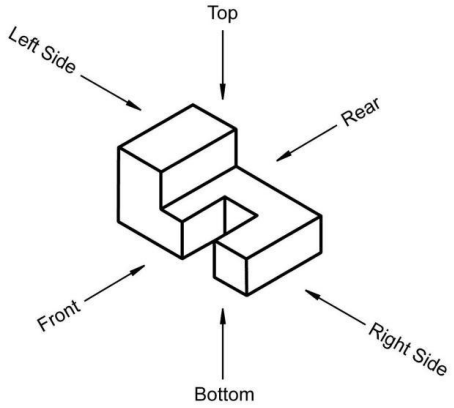
There are three principal projection planes. That is to say:

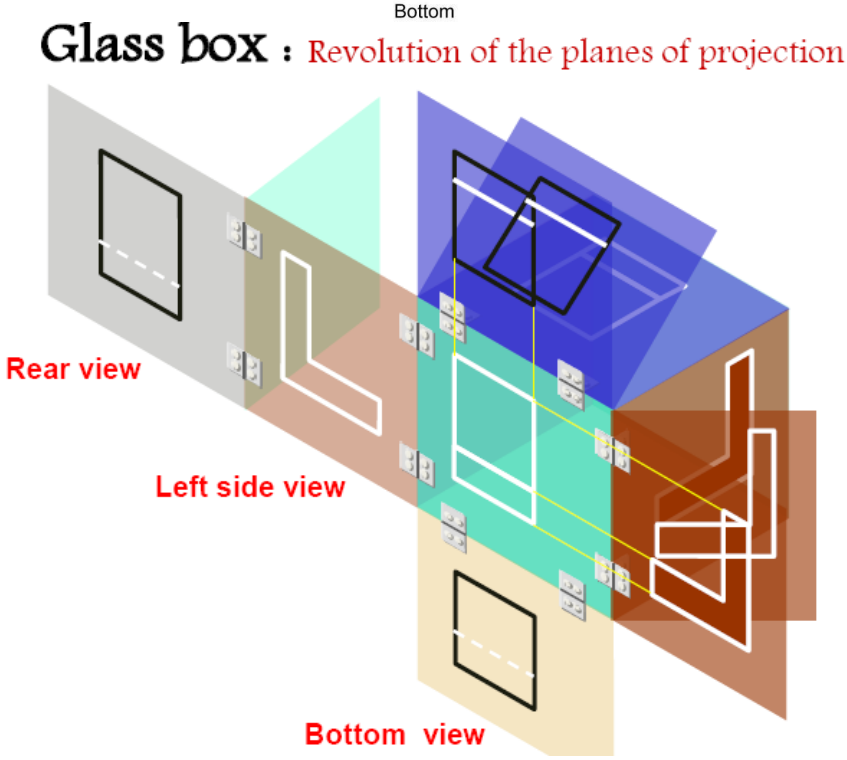
- Horizontal projection plane (H.P)
- Frontal projection plane (F.P)

Profile projection plane (P.P)

2.3.3. 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..





2.4. Orthographic and isometric views

2.4.1. Orthographic projection

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. In 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

2.4.2. Steps in visualizing an orthographic projection

A. Visualize by looking at the actual object or picture of the object.
B. To obtain views, project the lines of sight to each plane of projection from all points on the object.

C. Rotate all planes until they align with frontal plane of projection.

D. Visualize the six possible views of the object that are revolved into the same planes on a drawing surface.

E. Inspect views and determine those needed to adequately represent the object

Views possible in orthographic projection

A. Top
B. Bottom
C. Front
D. Rear
E. Right side
F. Left side

Principal views in orthographic projection

A. Top
B. Front

C. Right side

(**NOTE:** Other views may be used if needed to show features that are hidden in the principal views.)

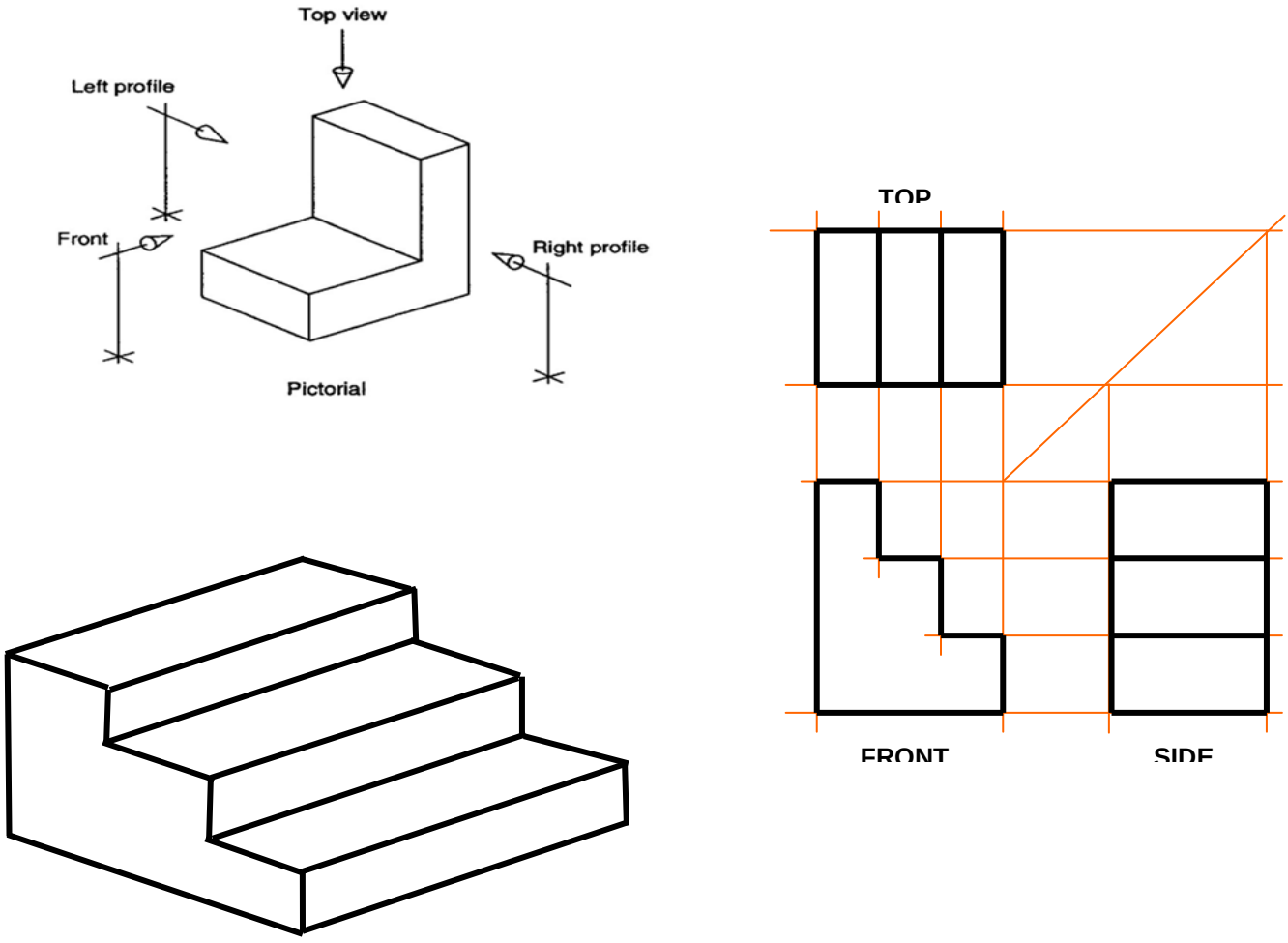


Figure2.4. (Multi-view drawing)

2.4.3. 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.

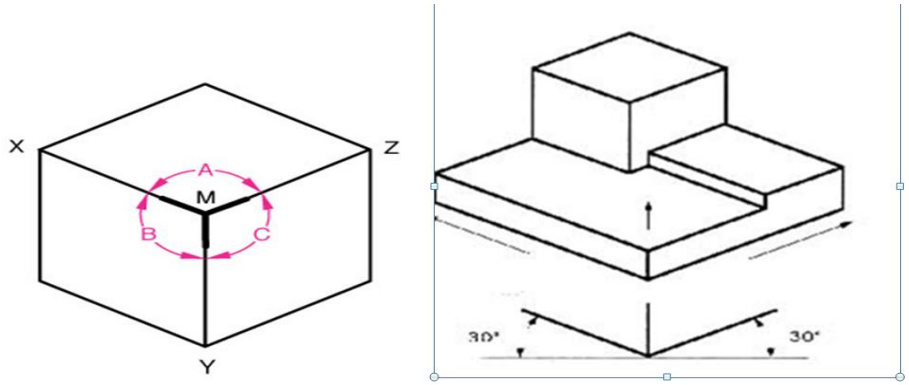


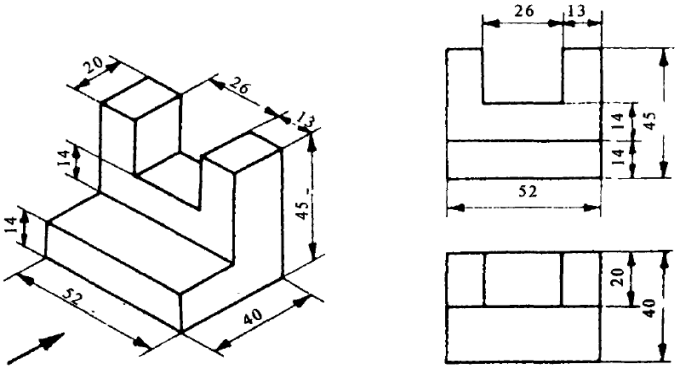
Fig 2.4.3. Isometric Drawing

2.4.4. 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; 2.4.4. First angle drawing representation

2.5. Drawing symbols & Codes

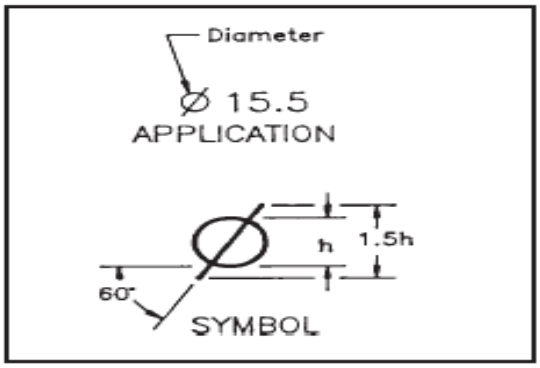
2.5.1. Symbols

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.

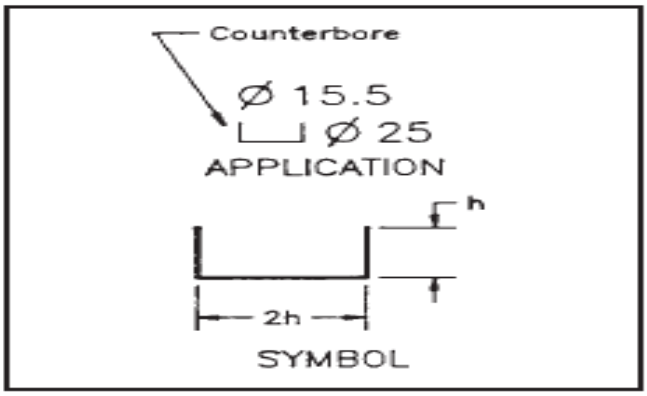
2.5.2. General symbols

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.

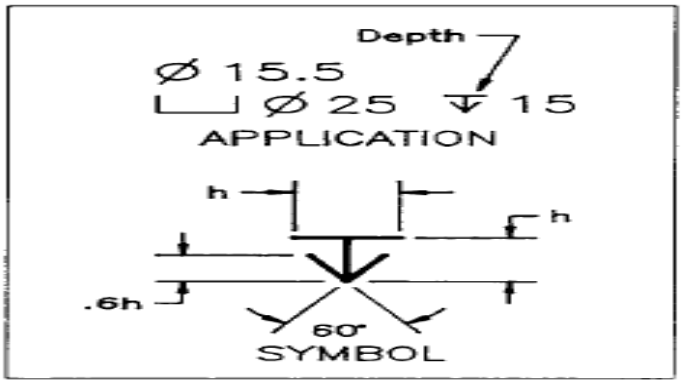
a) Diameter:-A diameter symbol is placed in front of any dimension value that is a diameter.



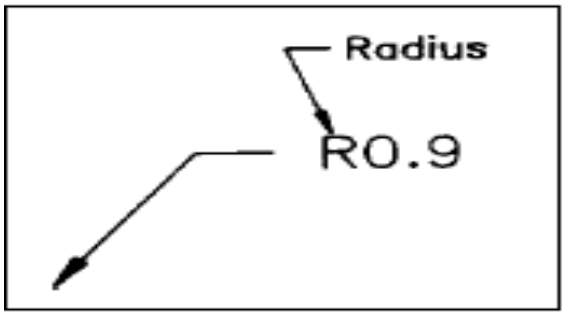
b) Counter bore Symbol:- A **counter bore** symbol combined with a diameter symbol is placed in front of a specified counter bore or spot face diameter.



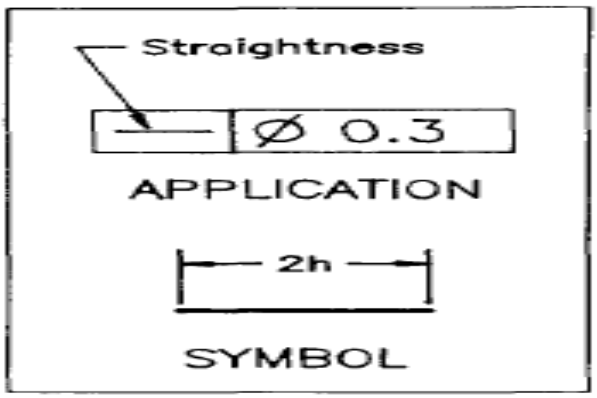
c) Depth:-A downward-pointing arrow is used for the depth symbol, and it is placed in front of the depth value in such applications as for counter bore and hole depths.



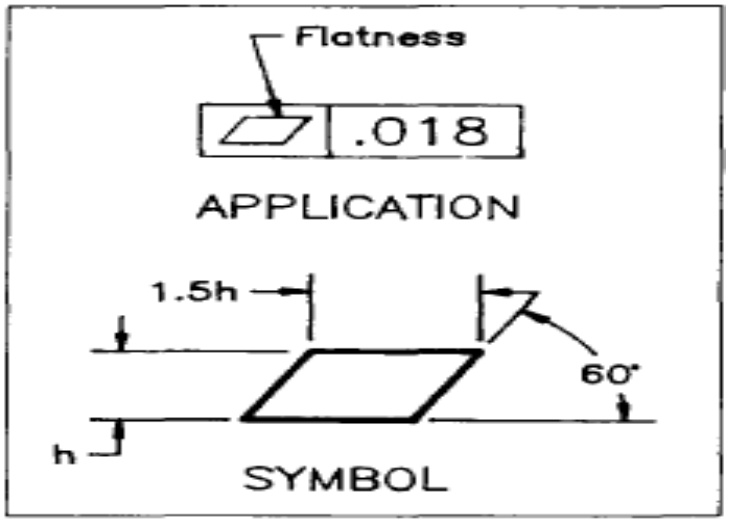
d) Radius:-*The letter **R** is placed in front of any value that indicates a radius dimension.*



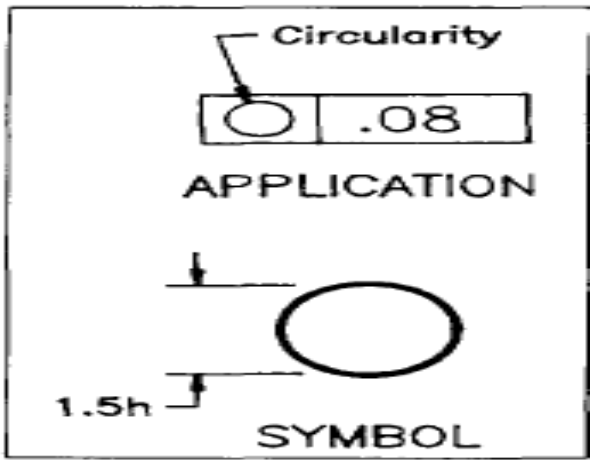
e) Straightness:-A **straight line** is used to indicate a Straightness requirement. It is only applied in a feature control frame, and maybe used to control straightness of surface elements. It may also be used to control the straightness of an axis or center plane.



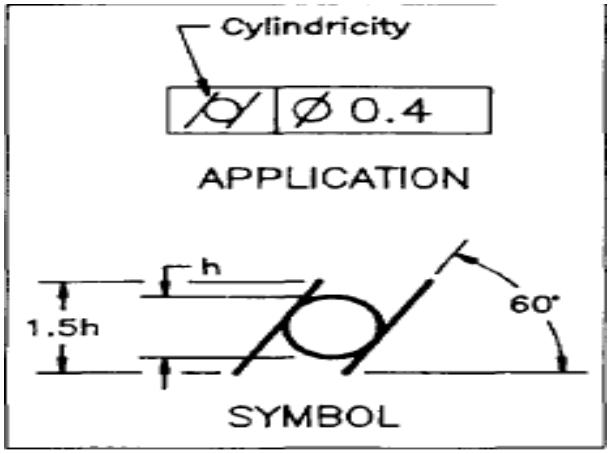
f) Flatness:-The **flatness** symbol appears as an oblique view of a square surface. See Figure 13. This symbol is used in feature control frames and is only used to control the form variations on flat features.



g) 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.



h) Cylinder city:-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



Self-Check -2

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

Part I 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

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

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

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

D. All above answer are correct

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

A. set squares B. French curve

C. T-square D. all

5. 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 cutouts shapes

A. Template 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

Operation Sheet 2

- **Operation title: - Procedure** how to draw One Point Perspective
- **Purpose:** To practice and demonstrate the knowledge and skill require **Procedure** how to draw One Point Perspective
- **Instruction:** Use the given steps below the tools and equipment one point perspective drawing
- **Procedures in doing the task**

Step1. Set up the 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.

LAP Test 2	**Practical Demonstration**

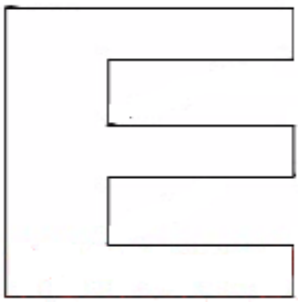
Name: _____ Date: _____

Time started: _____ Time finished: _____

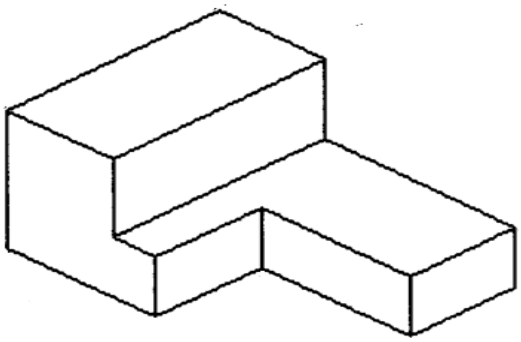
Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hours.

1. **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)



Unit Three: Interpret Technical Drawing

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

- component assembly or object projections
- dimensions and material requirements
- drawing symbols and codes

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, up on completion of this learning guide, you will be able to:

- apply component assembly or object projections
- use dimensions and material requirements
- Apply drawing symbols and codes

3. Component, assembly or object projections

3.1. 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.

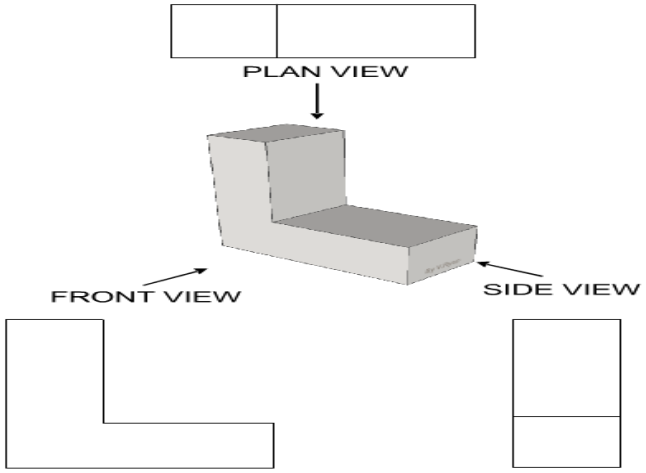
3.1.1. First angle projections

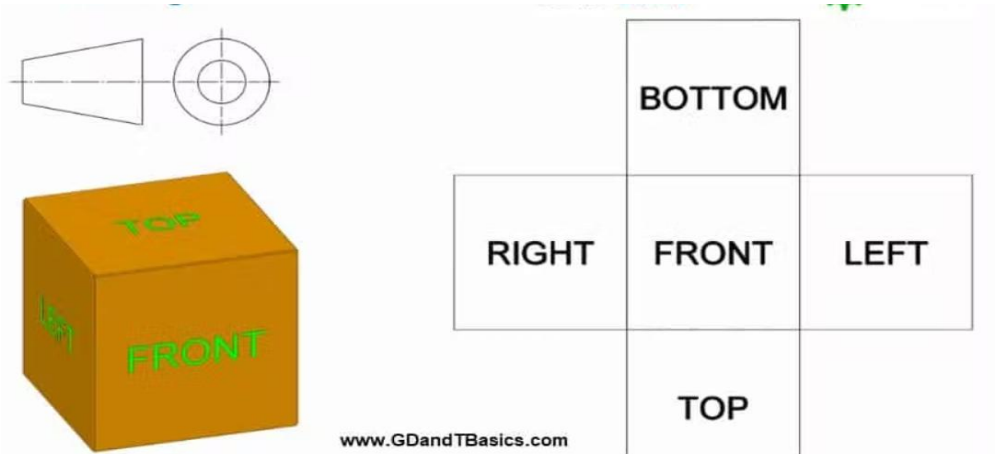
In the first angle projection, the object is placed in the 1st quadrant. The object is positioned at the front of a vertical plane and top of the horizontal plane. First angle projection is widely used in India and European countries. The object is placed between the observer and projection

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

MPORTANT: There are two ways of drawing in orthographic - *First Angle* and *Third Angle*. They differ only in the position of the plan, front and side views. Below is an example of **First Angle** projection.

The front, side and plan views have drawn around the 3D shape. However this is not the correct way of drawing them as they are not in the right positions.

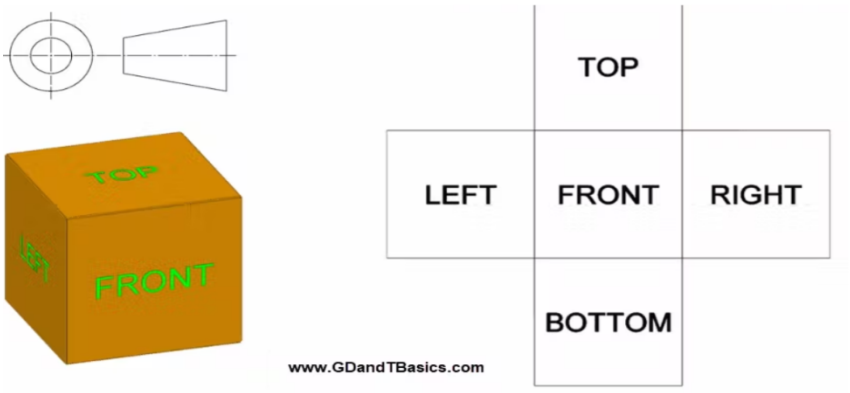




First Angle Projection Views

3.1.2. Third angle projections

In third-angle projection, the view of a component is drawn next to where the view was taken. In first-angle projection, the view is drawn on the other end of the component, at the opposite end from where the view was taken.

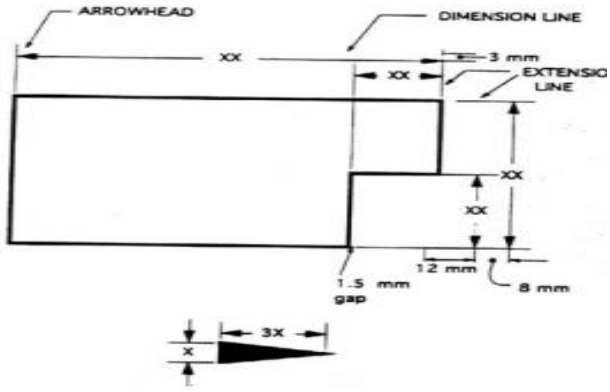


3.1.2. Third Angle Projection Views

3.2. Dimensions and material requirements

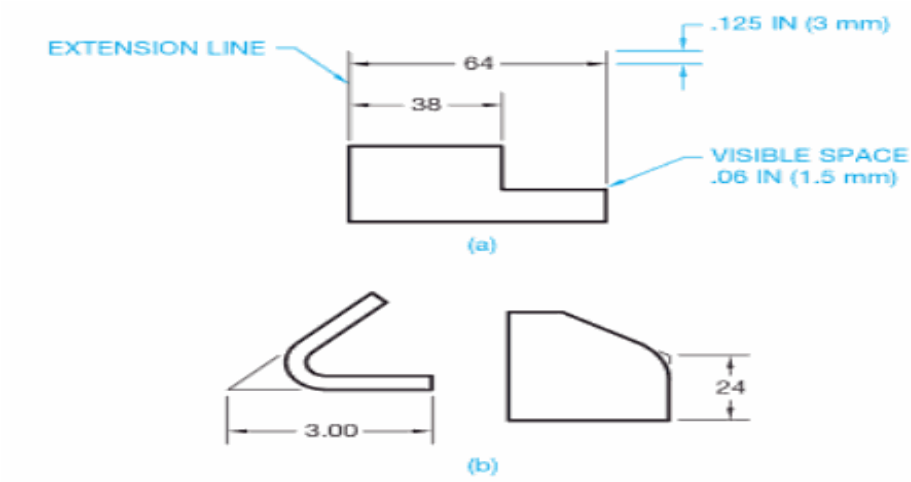
Detail drawing is expected to provide not only the complete shape description of the part, but also furnish size description. This is provided in the form of distance between the surfaces, location of holes, kind of finish, type of material, etc. These features are illustrated on a drawing by the use 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.



Extension Lines

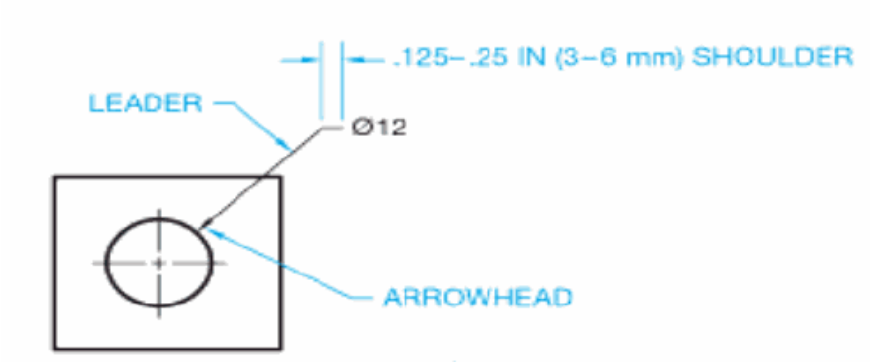
Thin lines used to establish the extent of a dimension. It can also be used to show extension of a surface to a theoretical intersection as shown in (b). Begin 1.5mm from the object and extend to 3mm beyond the last dimension. They should not cross dimension lines.



Leader Lines

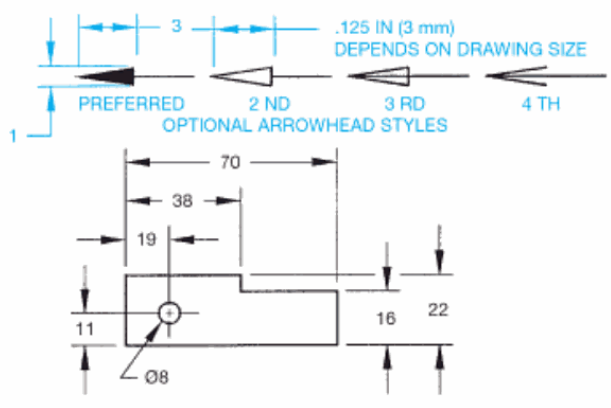
- Thin lines used to connect a specific note to a feature.
- Also used to direct dimensions, symbols, item number and part numbers on a drawing.
- Commonly drawn at ***45, 30 and 60*** degrees.
- Has a ***short shoulder*** (3-6mm) at one end beginning at the center of the vertical height of text, and 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.

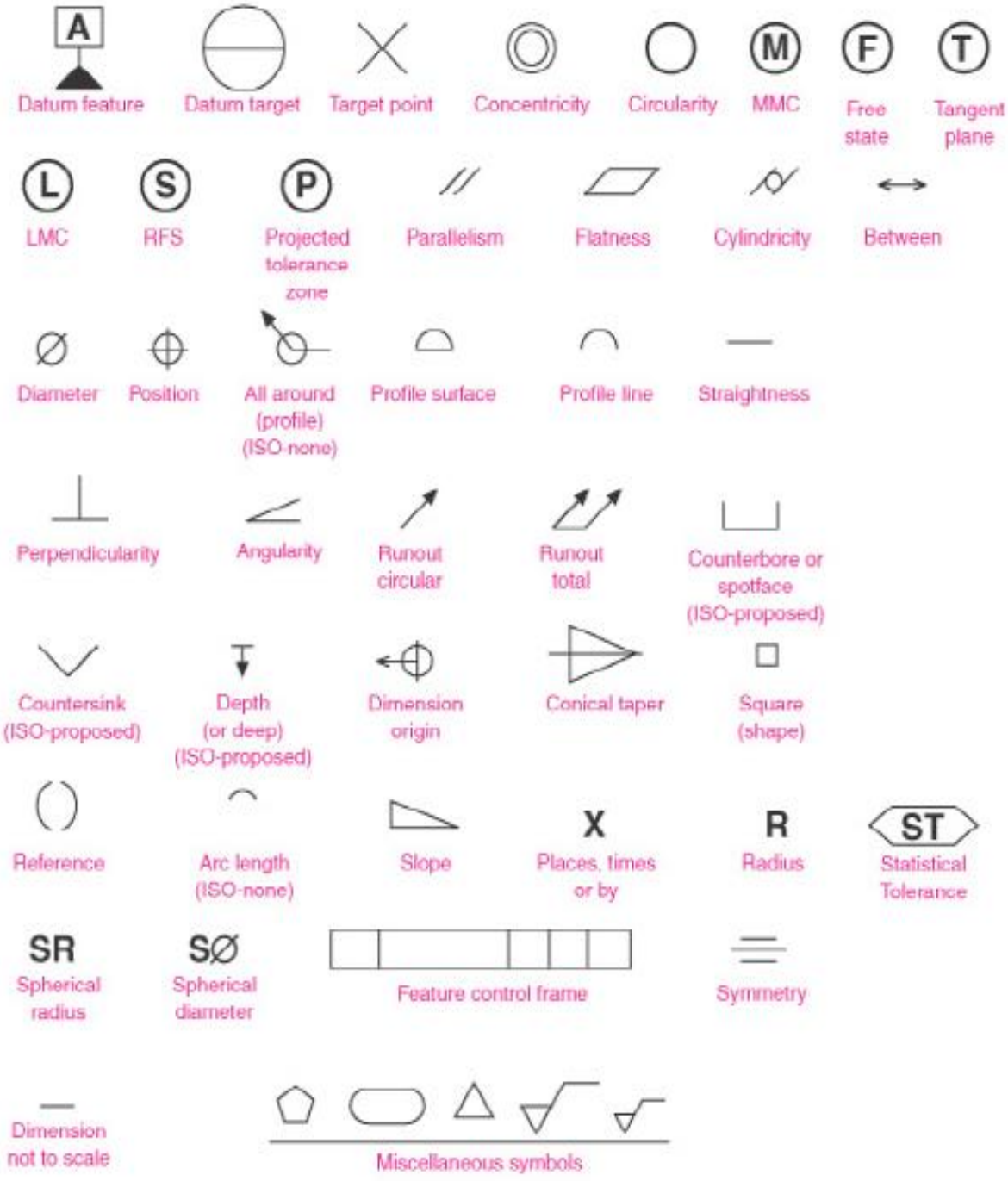


3.3. Drawing symbols and codes

3.3.1. 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.


A
Datum feature
Datum target
Target point
Concentricity
Circularity
M
MMC
F
Free state
T
Tangent plane
L
LMC
S
RFS
P
Projected tolerance zone
Parallelism
Flatness
Cylindricity
Between
Diameter
Position
All around (profile) (ISO-none)
Profile surface
Profile line
Straightness
Perpendicularity
Angularity
Runout circular
Runout total
Counterbore or spotface (ISO-proposed)
Countersink (ISO-proposed)
Depth (or deep) (ISO-proposed)
Dimension origin
Conical taper
Square (shape)
Reference
Arc length (ISO-none)
Slope
X
Places, times or by
R
Radius
ST
Statistical Tolerance
SR
Spherical radius
SØ
Spherical diameter
Feature control frame
Symmetry
Dimension not to scale
Miscellaneous symbols

3.4. Dimensional tolerances, notations according to specifications

3.4.1. 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

3.4.2. Type of tolerances.

a) **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.

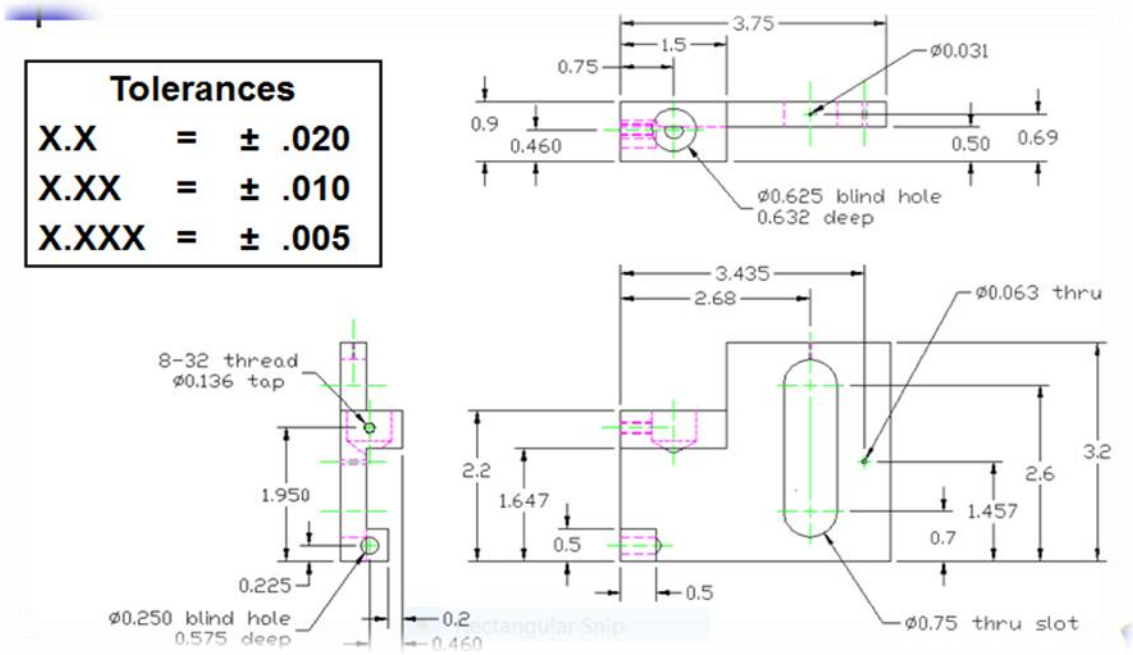


Fig. 3.1. General tolerance

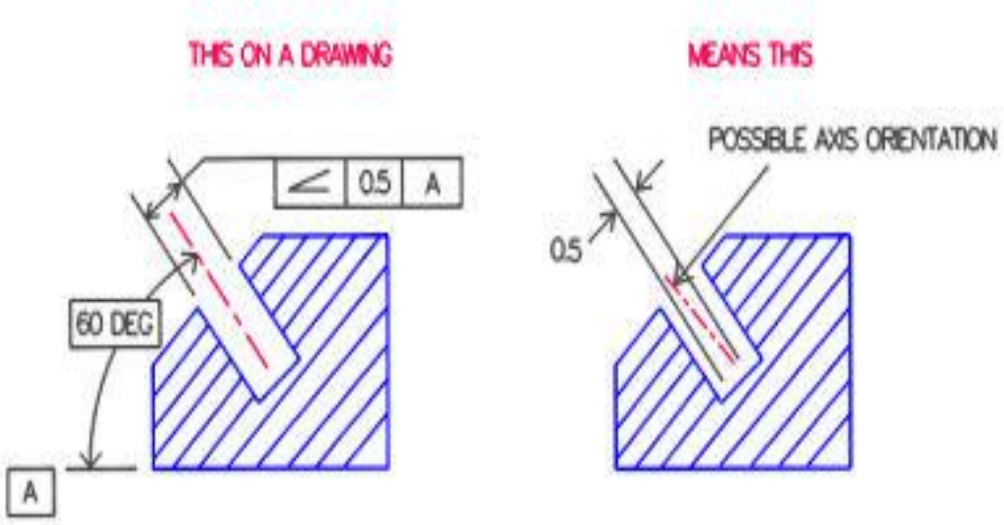
No two manufactured objects are identical in every way. Some degree of variation will exist. Engineers apply tolerances to part dimensions to reduce the amount of variation that occurs. The tolerance may be applied directly to the dimension or indicated by a general note located in the title block of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

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

b) **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

c) **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.

Self-Check -3	**Written test**

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

Parts I **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 specifying for all requirements critical to functioning and interchangeability.

4. Suitable locations on the part, called datum targets

Part II: - <u>choose the best answers</u>

1. **_____ is** approximately 3mm long and 1 mm wide That is, the length is roughly three times the width.

   A. Arrowhead B. An extension line C. a leader D. Dimension line

2. _____ a thin line used to connect a dimension with particular area.

   A. Arrowhead B. An extension line C. a leader D. Dimension line

3. _____ thin lines used to establish the extent of a dimension.

   A. Arrowhead B. **Extension Lines** C. a leader D. Dimension line

Operation Sheet 3	**To perform dimensional Views**

- **Operation title: - How to perform dimensional Views**
- **Purpose:** To measure the dimension of geometrical shape on the given drawing
- **Instruction:** Use the given steps below the tools and equipment to draw dimensional Views
- **Tools and requirement:**
  1. Ruler,
  2. Scale
  3. Pencil

4. Paper

❖ **Procedures in doing the task**

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.

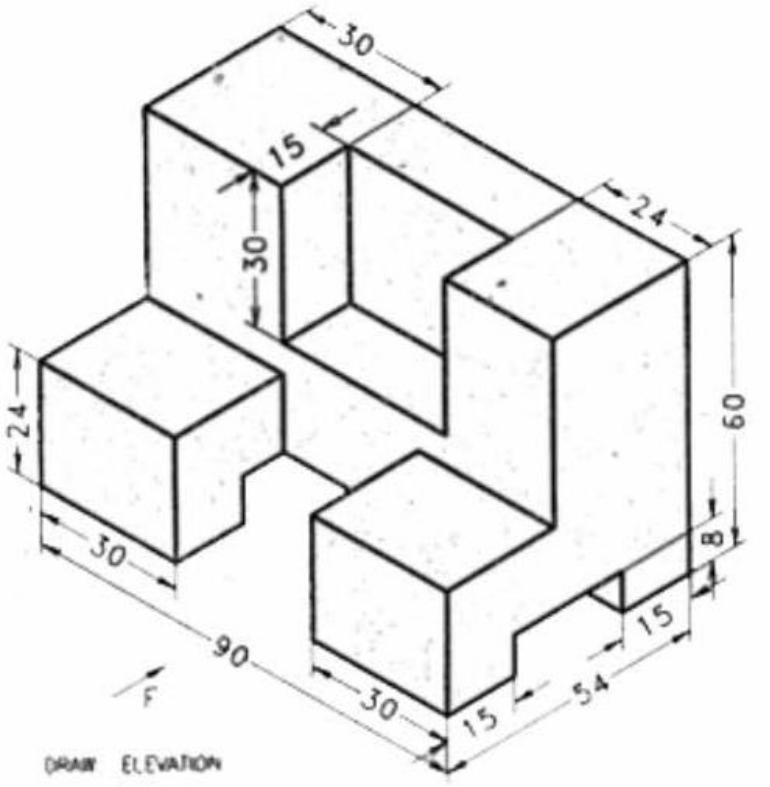
LAP Test 3	**Practical Demonstration**

Name: _____ Date: _____

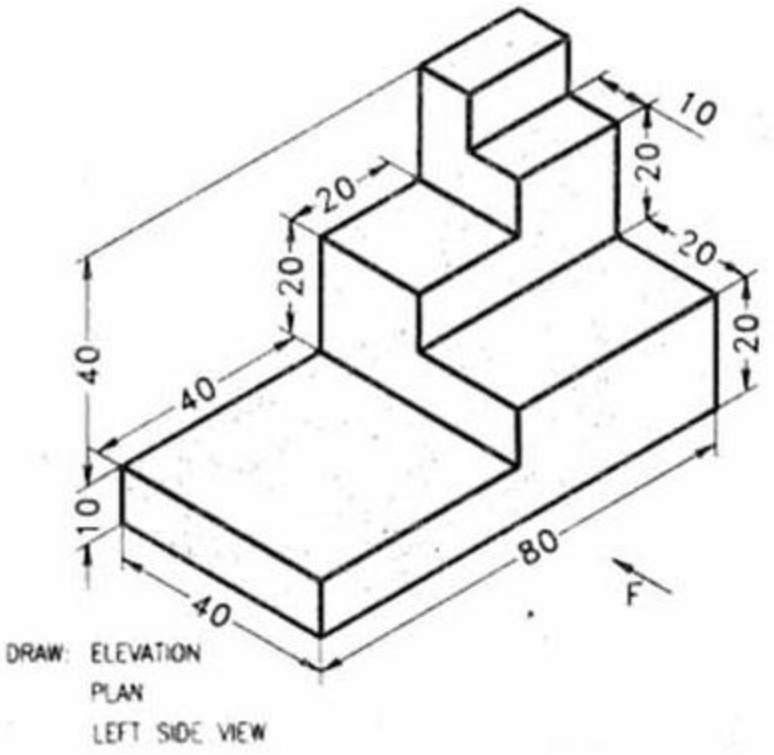
Time started: _____ Time finished: _____

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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Name of trainers who prepared learning, teaching and materials

No	Name	Qualification (Level)	Field of Study	Organization/ Institution	Mobile number	E-mail
1	Adugna Mosisa Ejeta	A(MSC)	Manufacturing Technology	Nekemte Poly Tec.	0911921931	
2	Ermiyas Ambaye Neway	A(MSC)	Manufacturing	Nefas SILK	0911169904	Ambayeermi@

3	Tadele Worku Bidika	A(MSC)	Manufacturing Technology	Asosa Poly Tec.	0913970611	Tadeworku09@gmail.com
4	Wolela Seid	A(MSC)	Manufacturing Technology	Hawasa Poly Tec.	0912134346	Wolelaseid11@gmail.com