INTRODUCTION TO ENGINEERING DRAWING

Engineering drawing is a two dimensional representation of three dimensional objects. In general, it provides necessary information about the shape, size, surface quality, material, manufacturing process, etc., of the object. It is the graphic language from which a trained person can visualize objects. Graphical means of expression of technical details without the barrier of a language.

ENGINEERING DRAWING IS THE LANGUAGE OF ENGINEERS.

Drawing Instruments-

The Instruments and other aids used in drafting work are listed below:

- Drawing board
- Set squares
- French curves
- Templates
- Mini drafter
- Instrument box
- Protractor
- Set of scales
- Drawing sheets
- Pencils

Drawing Board: Until recently drawing boards used are made of well seasoned softwood of about 25 mm thick with a working edge for T-square/ mini-drafters are used which can be fixed on any board. The standard size of board depends on the size of drawing sheet size required.

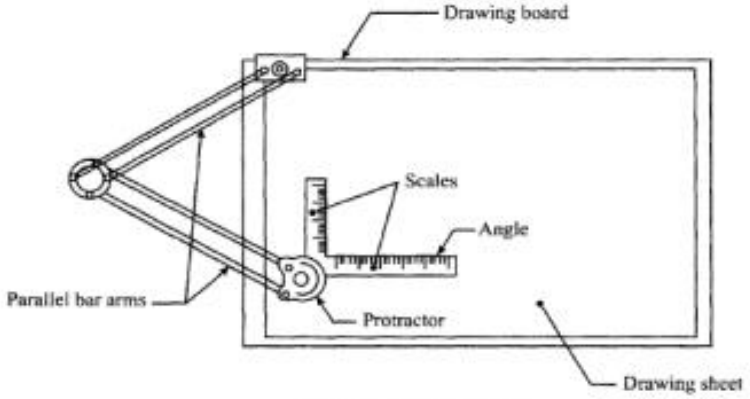
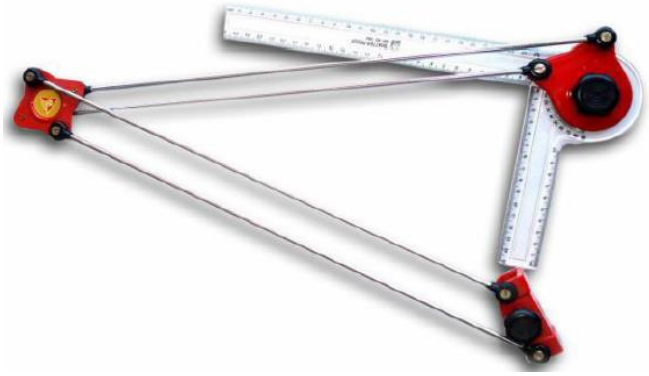
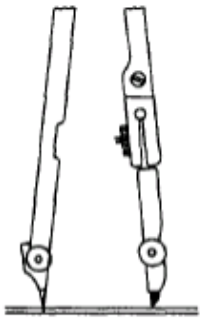


Fig. 1.1 Mini-draughter

Mini-Drafter: Mini-drafter consists of an angle formed by two arms with scales marked and rigidly hinged to each other .It combines the functions of T-square, set-squares, scales and protractor. It is used for drawing horizontal, vertical and inclined lines, parallel and perpendicular lines and for measuring lines and angles.



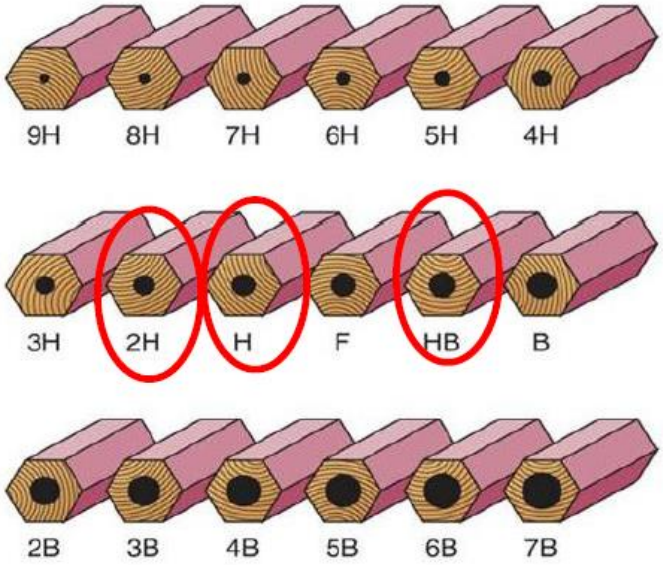
Instrument Box: Instrument box contains 1. Compasses, 2. Dividers and 3. Inking pens. What is important is the position of the pencil lead with respect to the tip of the compass. It should be at least 1 mm above as shown in the fig. because the tip goes into the board for grip by 1 mm.



(a) Sharpening and position of compass lead

(b) Position of the lead leg to draw larger circles

Pencils: Pencils with leads of different degrees of hardness or grades are available in the market. The hardness or softness of the lead is indicated by 3H, 2H, H, HB, B, 2B, 3B, etc. The grade HB denotes medium hardness of lead used for general purpose. The hardness increases as the value of the numeral before the letter H increases. The lead becomes softer, as the value of the numeral before B increases.



HARD

The hard leads are used for construction lines on technical drawings.

MEDIUM

The medium grades are used for general use on technical drawings. The harder grades are for instrument drawings and the softer for sketching.

SOFT

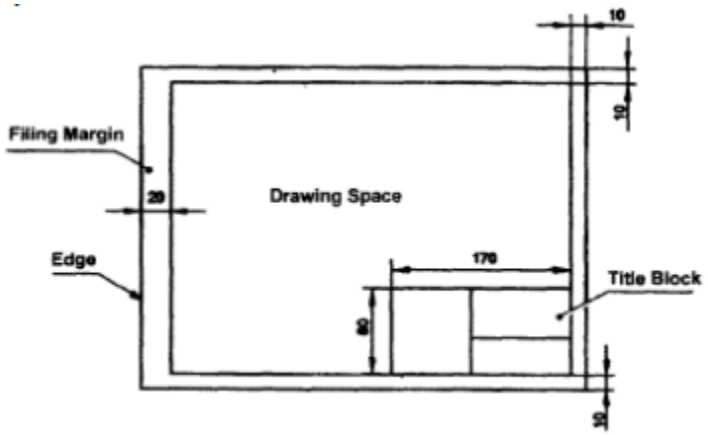
Soft leads are used for technical sketching and artwork but are too soft for instrument drawings.

- HB Soft grade for Border lines, lettering and free sketching
- H Medium grade for Visible outlines, visible edges and boundary lines
- 2H Hard grade for construction lines, Dimension lines, Leader lines, Extension lines, Centre lines, Hatching lines and Hidden lines.

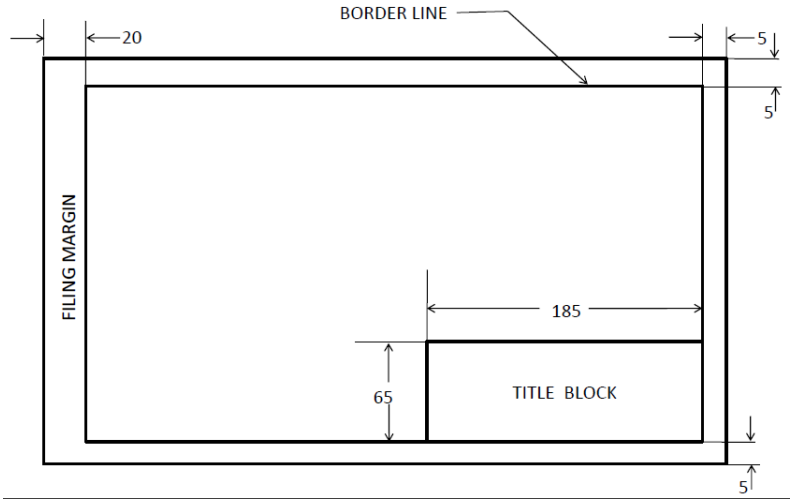
Drawing Sheet: The standard drawing sheet sizes are arrived at on the basic Principal of x: y = 1: 2^ (1/2) and xy = 1 where x and y are the sides of the sheet.

For example AO, having a surface area of 1 Sq.m; x = 841 mm and y = 1189 mm. The successive sizes are obtained by either by halving along the length or doubling the width, the area being in the ratio 1: 2. Designation of sizes is given in the fig. For class work use of A2 size drawing sheet is preferred.

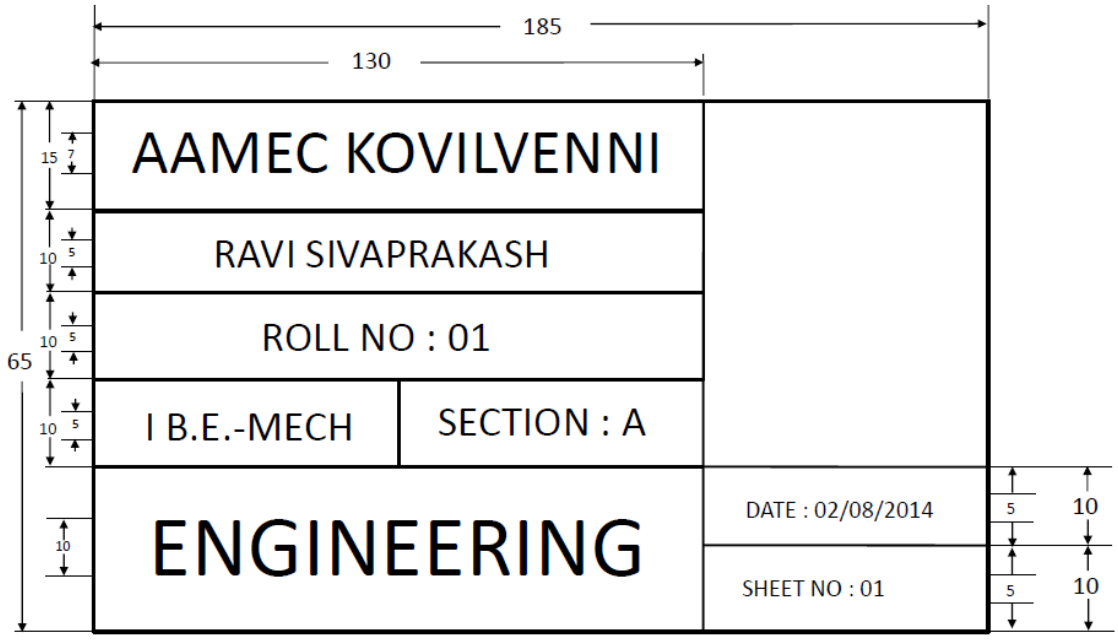
Designation	Dimension, mm Trimmed size
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297

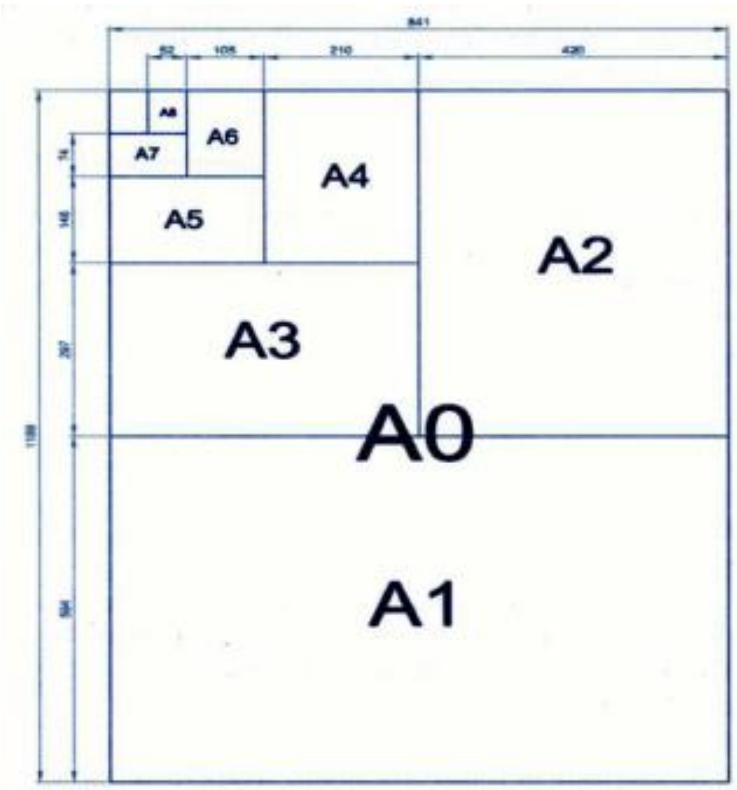


Sheet Layout



Title Block





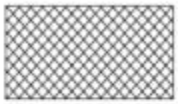
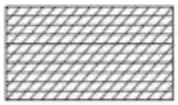
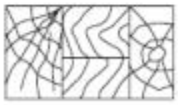
Title Block: The title block should lie within the drawing space at the bottom right hand comer of the sheet. The title block can have a maximum length of 170 mm and width of 65mm providing the following information.

- Title of the drawing.
- Drawing number.
- Scale.
- Symbol denoting the method of projection.
- Name of the firm, and
- Initials of staff, who have designed, checked and approved.

Lines: In Engineering Graphics, the details of various objects are drawn by different types of lines. Each line has a definite meaning and sense to convey.

- **Visible Outlines, Visible Edges (Continuous wide line**s): the lines drawn to represent the visible outlines/ visible edges / surface boundary lines of objects should be outstanding in appearance.
- **Dimension Lines (Continuous narrow Lines):** Dimension Lines are drawn to mark dimension.
- Extension Lines (Continuous narrow Lines): There are extended slightly beyond the respective dimension lines.
- **Construction Lines (Continuous narrow Lines):** These are drawn for constructing drawings and should not be erased after completion of the drawing.
- **Hatching / Section Lines (Continuous Narrow Lines):** These are drawn for the sectioned portion of an object. These are drawn inclined at an angle of 45° to the axis or to the main outline of the section.
- **Center Lines (Long-Dashed Dotted Narrow Lines):** These are draWn at the center of the drawings symmetrical about an axis or both the axes. These are extended by a short distance beyond the outline of the drawing.
- **Border Lines:** Border Lines are continuous wide lines of minimum thickness 0.7 mm.

Line description and Representation	Applications
Continuous narrow line B ———	Dimension lines, Extension lines
	Leader lines, Reference lines
	Short centre lines
	Projection lines
	Hatching
	Construction lines, Guide lines
	Outlines of revolved sections
	Imaginary lines of intersection
Continuous narrow freehand line C ~~~	Preferably manually represented termination of partial or interrupted views, cuts and sections, if the limit is not a line of symmetry or a center line[4].
Continuous narrow line with zigzags A —/\/\—	Preferably mechanically represented termination of partial or interrupted views, cuts and sections, if the limit is not a line of symmetry or a center line[4].
Continuous wide line ———	Visible edges, visible outlines
	Main representations in diagrams, maps, flow charts
Dashed narrow line D — — — — — —	Hidden edges
	Hidden outlines
Long-dashed dotted narrow line E ——. ——. ——	Center lines / Axes, Lines of symmetry
	Cutting planes (Line 04.2 at ends and changes of direction)
Long-dashed dotted wide line F ——. ——. ——	Cutting planes at the ends and changes of direction outlines of visible parts situated in front of cutting plane

Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc.
Liquids		Water, Oil, Petrol, Kerosene, etc.
Wood		Wood, Plywood, etc.
Concrete		A mixture of Cement, Sand and Gravel

LETTERING

Lettering is used as writing of titles, sub-titles, dimensions, etc., on a drawing.

Importance of Lettering: To undertake production work of an engineering component as per the drawing, the size and other details are indicated on the drawing. This is done in the form of notes and dimensions.

Lettering should be done freehand with speed.

Size of Letters:

- Size of Letters is measured by the height h of the CAPITAL letters as well as numerals.
- Standard heights for CAPITAL letters and numerals recommended by BIS are given below: 1.8, 2.5, 3.5, 5, 6, 10, 14 and 20 mm

Guide Lines: In order to obtain correct and uniform height of letters and numerals, guide lines are drawn, using 2H pencil with light pressure. HB grade conical end pencil is used for lettering. The following are some of the guide lines for lettering.

- Drawing numbers, title block and letters denoting cutting planes, sections are written in 10 mm size.
- Drawing title is written in 7 mm size.
- Hatching, sub-titles, materials, dimensions, notes, etc., are written in 3.5 mm size.
- Space between lines = 3/4 h
- Space between words may be equal to the width of alphabet M or 3/5 h.

Procedure for Lettering:

1. Thin horizontal guide lines are drawn first at a distance ' h' apart.
2. Lettering Technique: Horizontal lines of the letters are drawn from left to right. Vertical, Inclined and curved lines are drawn from top to bottom.
3. After lettering has been completed, the guidelines are not erased.

Specifications	Value	Size						
Capital Letter Height	h	2.5	3.5	5	7	10	14	20
Lowercase Letter Height	a = (5/7) h	-	2.5	3.5	5	7	10	14
Thickness of Lines	b = (1/14) h	0.18	0.25	0.35	0.5	0.7	1	1.4
Spacing between Characters	c = (1/7) h	0.35	0.5	0.7	1	1.4	2	2.8
Min.Spacing between words	d = (3/7) h	1.05	1.5	2.1	3	4.2	6	8.4
Min. Spacing between Base Lines	e = (10/7) h	3.5	5	7	10	14	20	28

Recommended Size (height h) of Letters / Numerals	
Main Title	5 mm, 7 mm, 10 mm
Sub-Titles	3.5 mm, 5 mm
Dimensions, Notes, etc.	2.5 mm, 3.5 mm, 5 mm

Lettering Standards

1.Standard heights for lettering are 3.5, 5, 7 & 10 mm.

2.Ratio of height to width, for most of the letters is approximately 5:3.

3.However for M and W, the ratio is approximately5:4

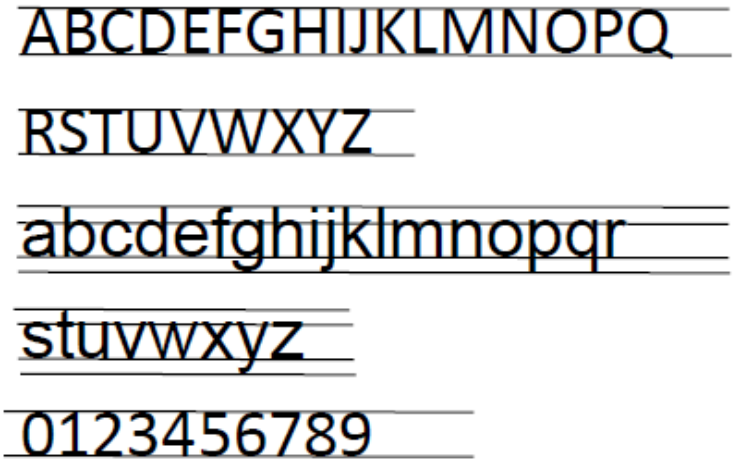
Lettering StandardsDifferent sizes of letters are used for different purposes:

1.Main title -7 (or) 10 mm

2.Sub-titles -5 (or) 7 mm

3.Dimensions, notes etc. -3.5 (or) 5 mm.

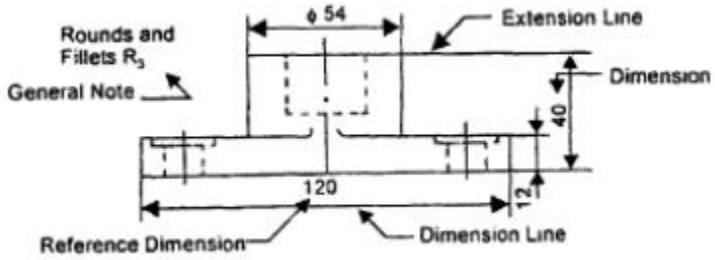
Single Stroke Letters



Lettering Standards

1. Vertical letters are preferable.
2. Guide lines -2H pencil lettering -HB pencil
3. Spacing between two letters 1/5thof the height of the letters.
4. Space between two words 3/5thof the height of the letters.

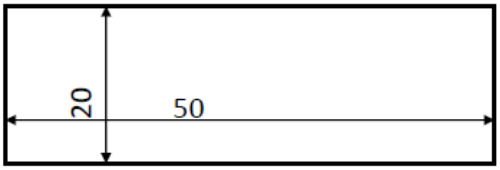
Dimensioning: Drawing of a component, in addition to providing complete shape description, must also furnish Information regarding the size description. These are provided through the distances between the Surfaces, location of holes, nature of surface finish, type of material, etc. The expression of these Features on a drawing, using lines, symbols, figures and notes is called dimensioning.

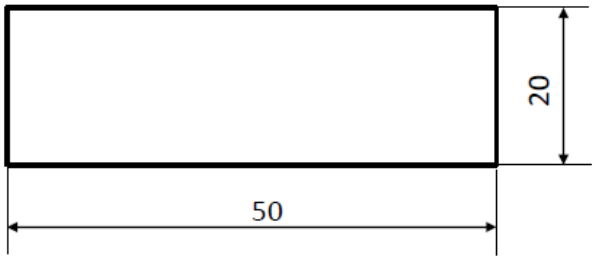


General Principles

1. All dimensions should be detailed on a drawing.
2. No single dimension should be repeated except where unavoidable.
3. Mark the dimensions outside the drawing as far as possible.
4. Avoid dimensioning to hidden lines wherever possible.
5. The longer dimensions should be placed outside all intermediate dimensions, so that dimension lines will not cross extension lines.

1.Place the dimensions outside the views. (Dimensions of diameter, circle and radius may be shown inside.)

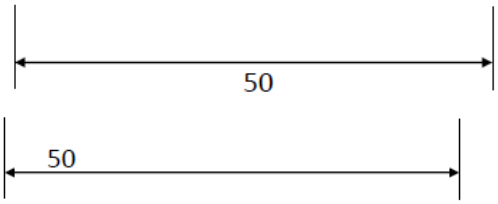


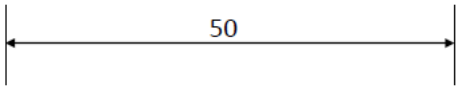


Not Correct

Correct

2.Place the dimension value above the horizontal line near the middle.

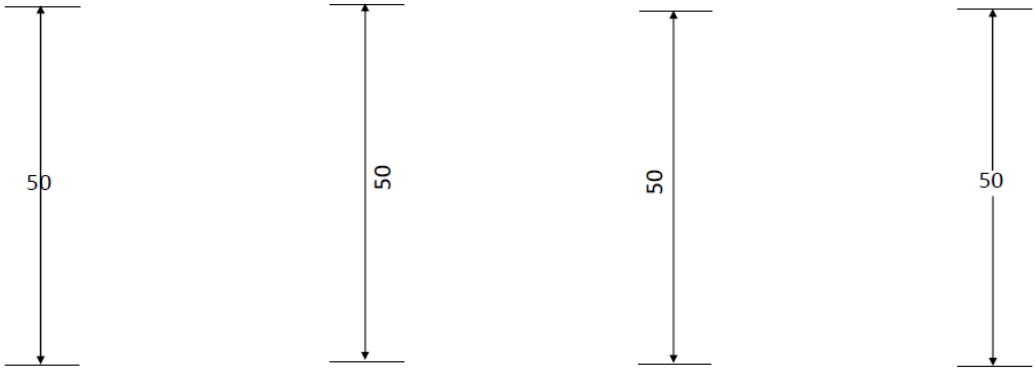




Not Correct

Correct

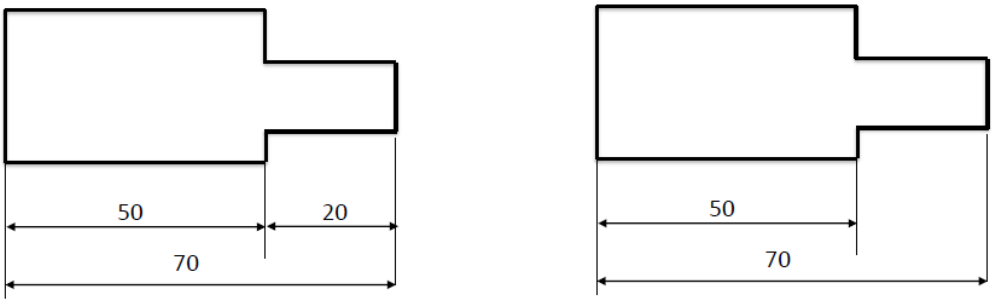
3.Dimensioning a vertical line.



Not Correct

Correct

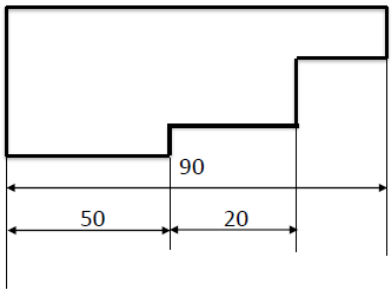
4.When on overall dimension is shown, one of the intermediate dimensions should not be given.



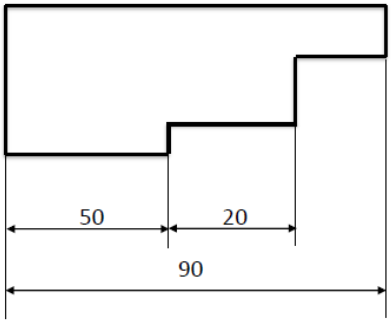
Not Correct

Correct

5.Overall dimensions should be placed outside intermediate dimensions.

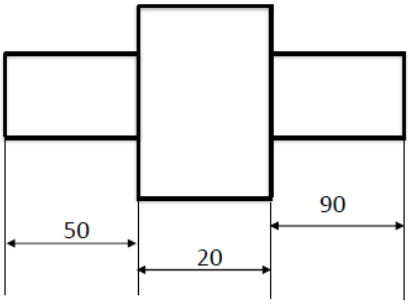


Not Correct

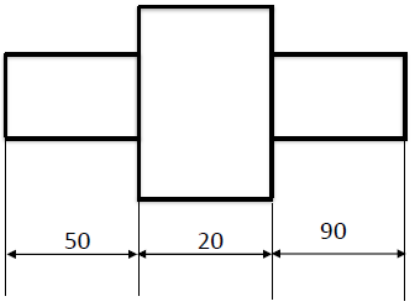


Correct

6.Arrange a chain of dimensions in a continuous line.

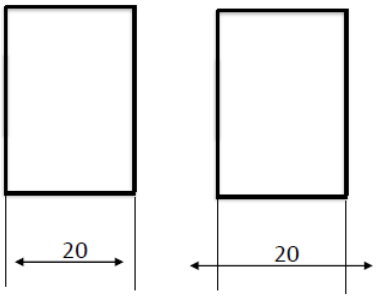


Not Correct

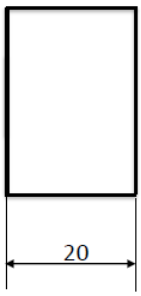


Correct

7.Arrowheads should touch the projection lines.

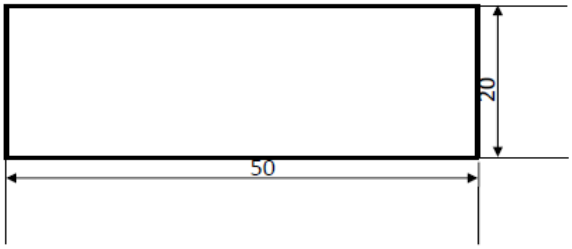


Not Correct

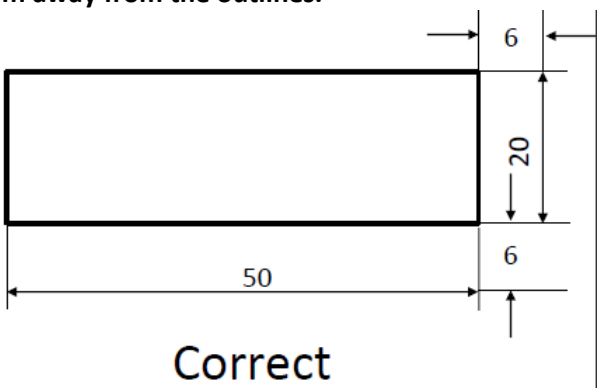


Correct

8. Dimension lines should be placed at least 6 to 10 mm away from the outlines.

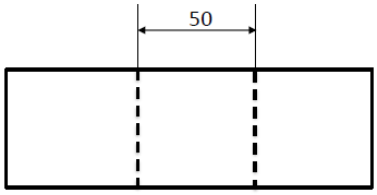


Not Correct

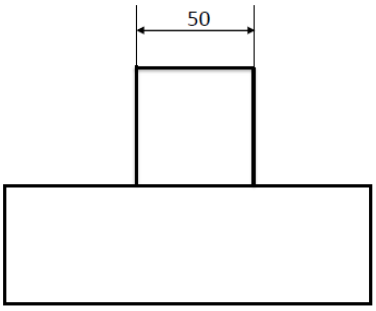


Correct

9.Dimensions are to be given to visible lines and not to hidden lines.

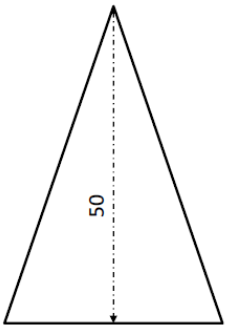


Not Correct

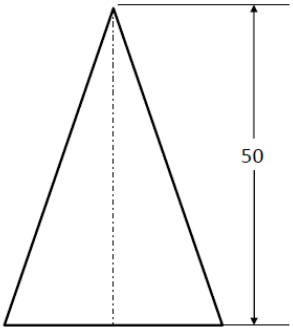


Correct

10.Centre line should not be used as a dimension line.



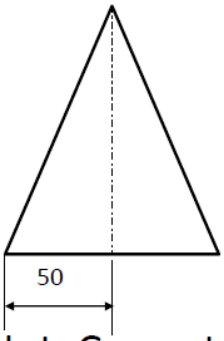
Not Correct



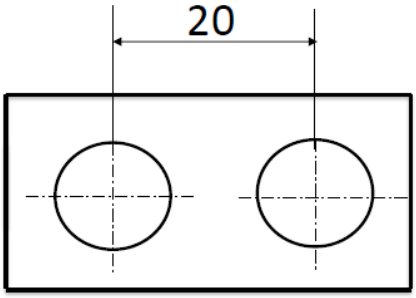
Correct

11.Do not repeat the same dimension in different views.

12.Dimensioning from a centre line should be avoided except when centre line passes through the centre of a hole or a cylinder part.

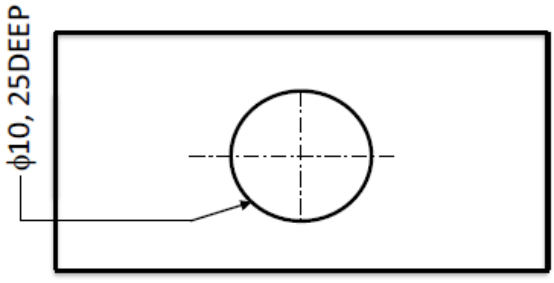


Not Correct

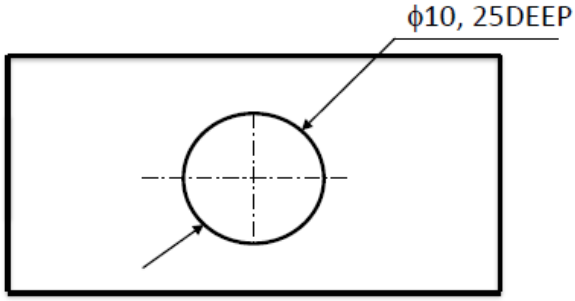


Correct

13.Indicate the depth of the hole as notes written horizontally.

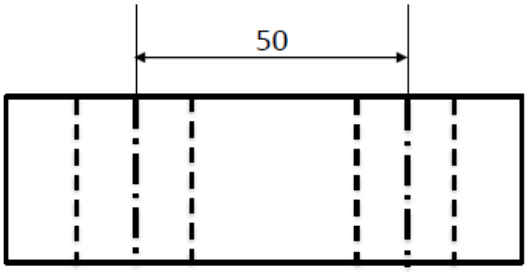


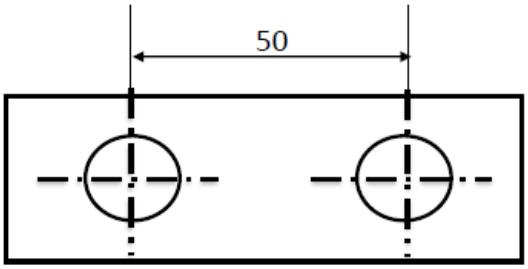
Not Correct



Correct

14.Locate holes in the proper view.

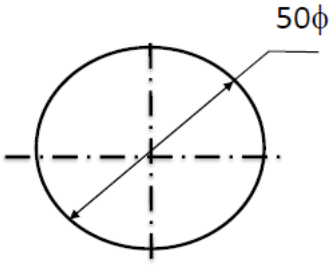


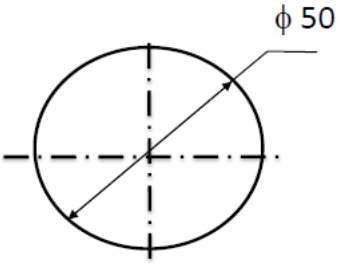


Not Correct

Correct

15.Diameter and radius symbols should be placed before the values.

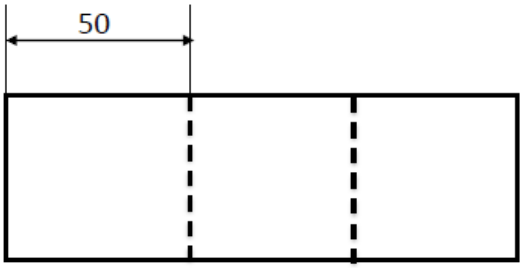


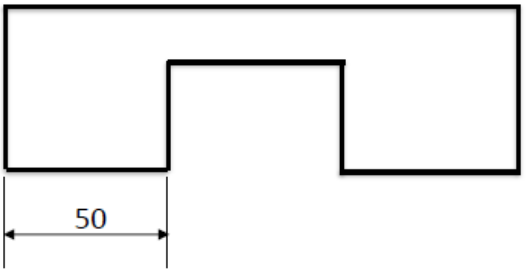


Not Correct

Correct

16.Dimensions are to be given from visible lines and not from hidden lines.

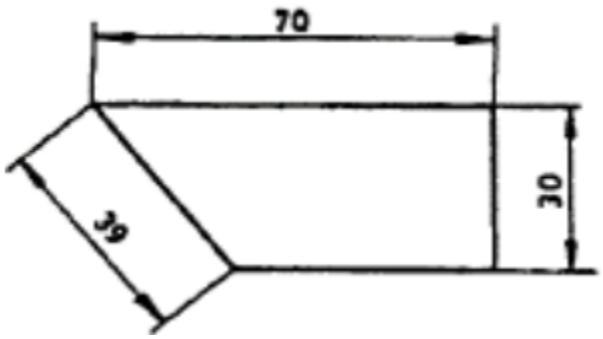




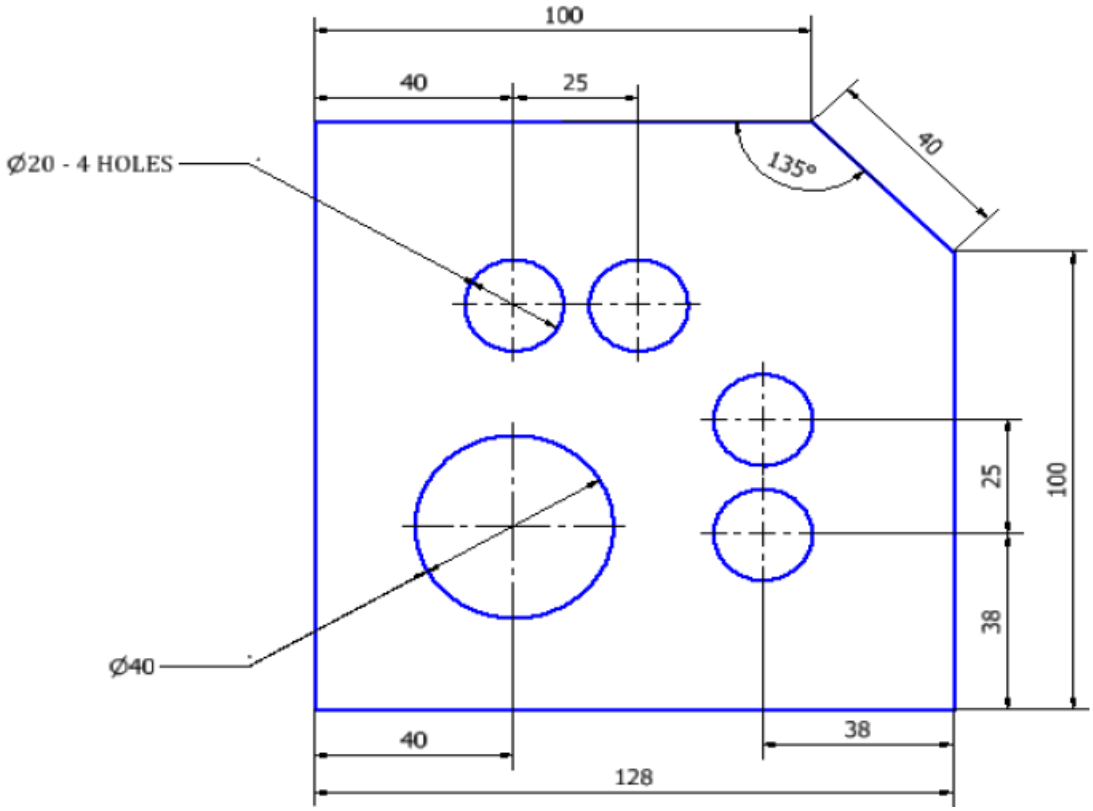
Not Correct **Correct**

Methods of Indicating Dimensions: The dimensions are indicated on the drawings according to one of the following two methods.

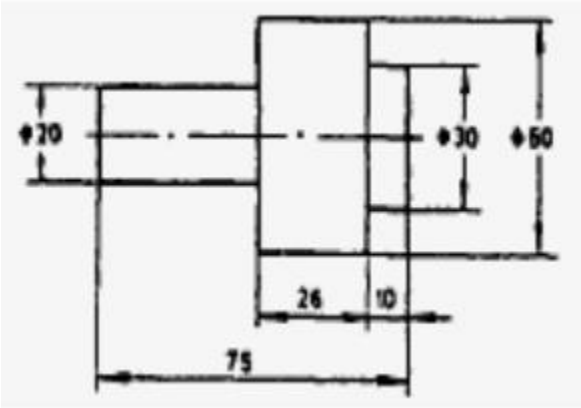
Method - 1 (Aligned method): Dimensions should be placed parallel to and above their dimension lines and preferably at the middle, and clear of the line. Dimensions may be written so that they can be read from the bottom or from the right side of the drawing. Dimensions on oblique dimension lines should be oriented as shown in Fig. and except where unavoidable, they shall not be placed in the 30° zone. Angular dimensions are oriented.



ALIGNED METHOD OF DIMENSIONING



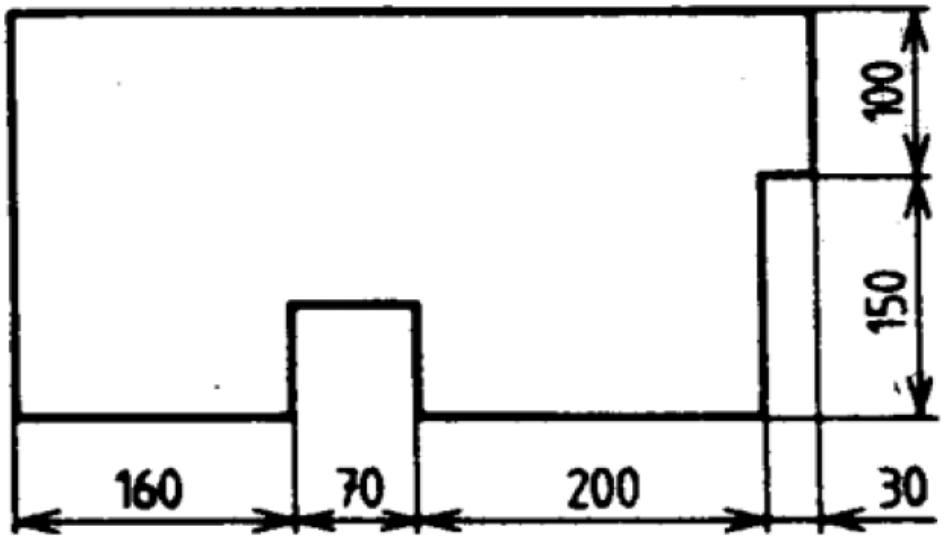
Method - 2 (Uni-directional): Dimensions should be indicated so that they can be read from the bottom of the drawing only. Nonhorizontal dimension lines are interrupted, preferably in the middle for insertion of the dimension. Note: Horizontal dimensional lines are not broken to place the dimension in both cases.



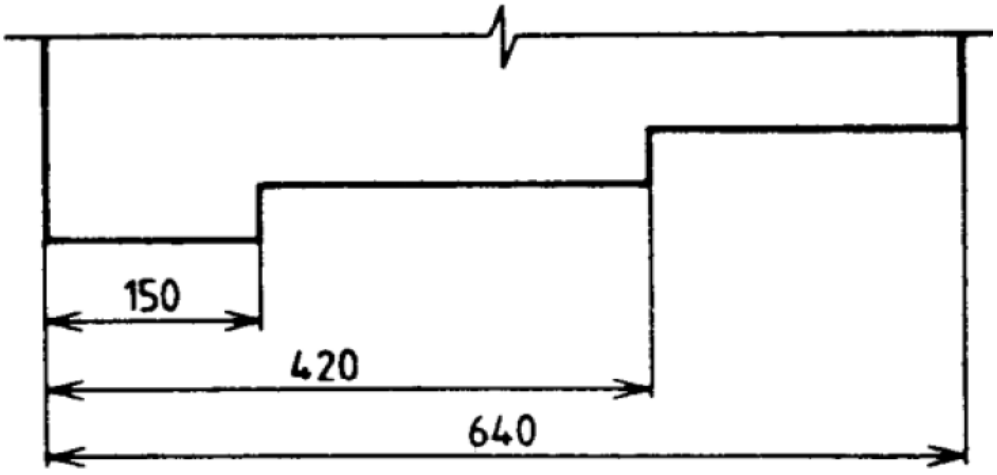
Arrangement of dimensions

1.Chain dimensioning
2.Parallel dimensioning
3.Superimposed running dimensioning

1.Chain dimensioning



2.Parallel dimensioning



3.Superimposed running dimensioning