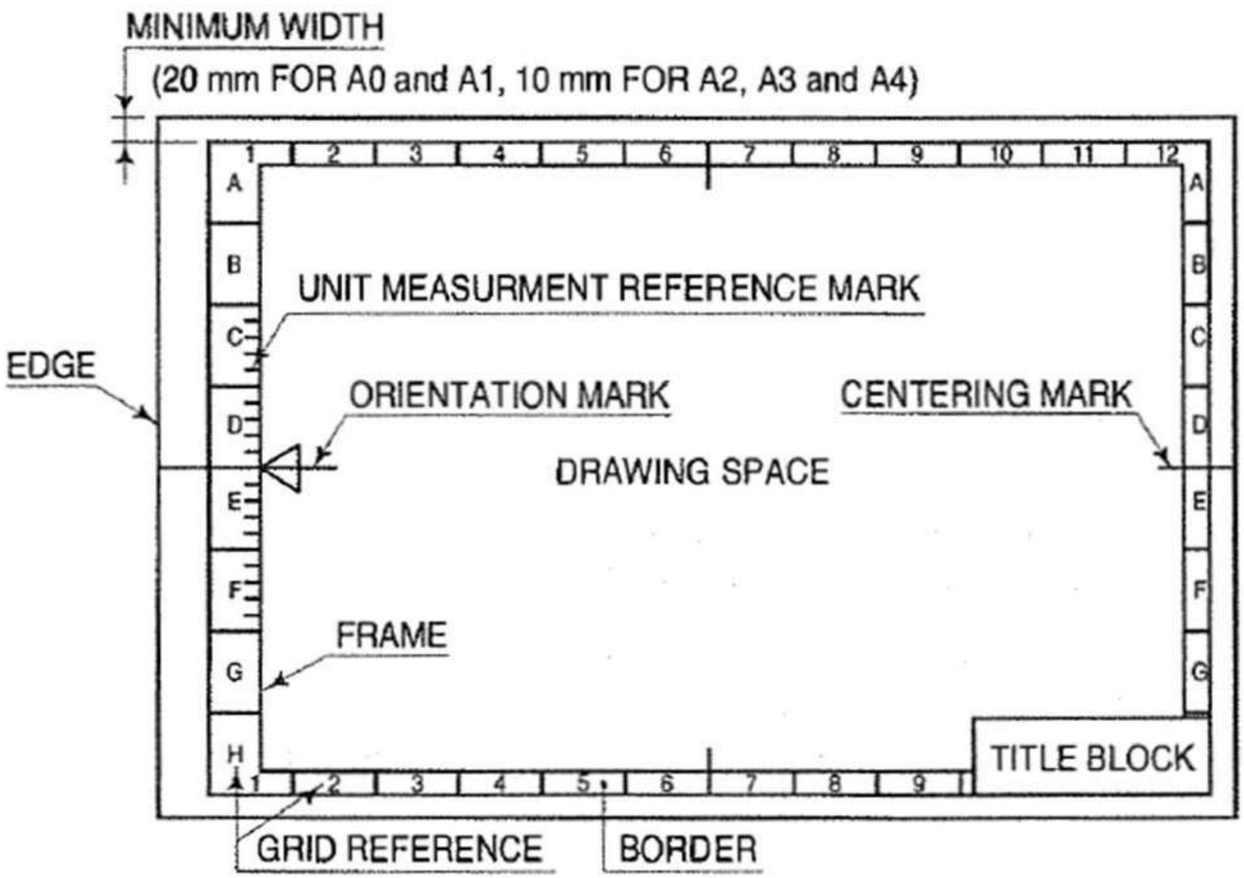
Drawing Sheet Layout

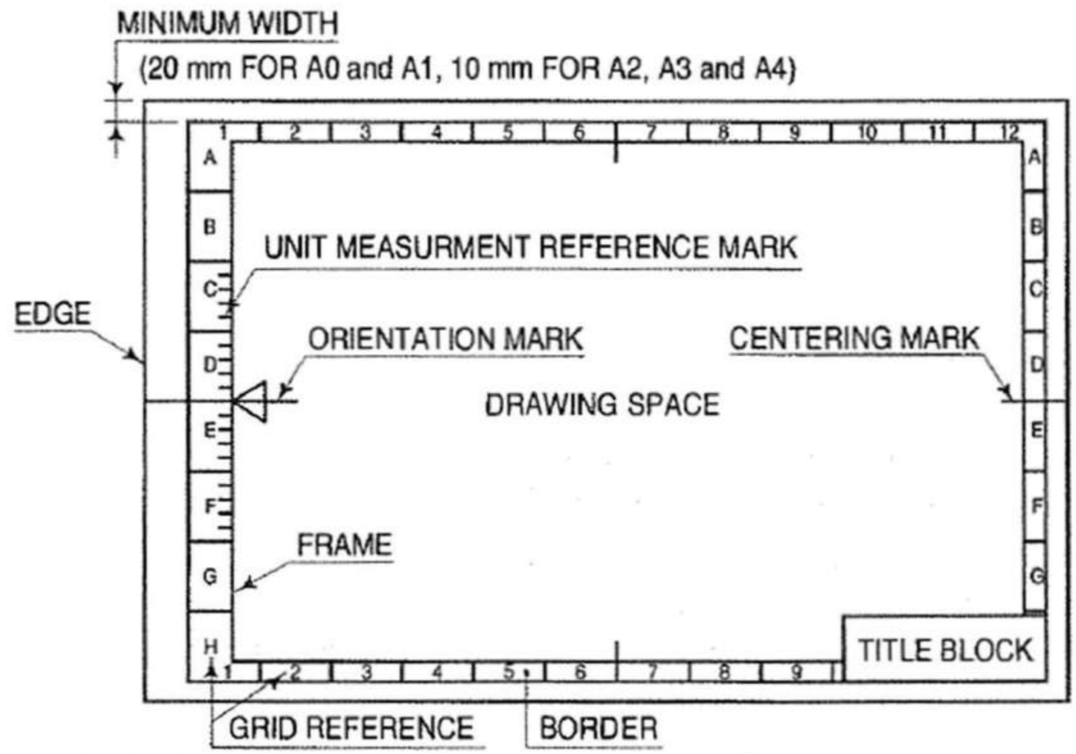
Grid reference system (zones system): **The grid reference system is drawn on the sheet to locate details, alterations or additions. The rectangle of grid along the length should be referred by numbers 1, 2, 3 etc. and along the width by capital letters A, B, C, D etc.**

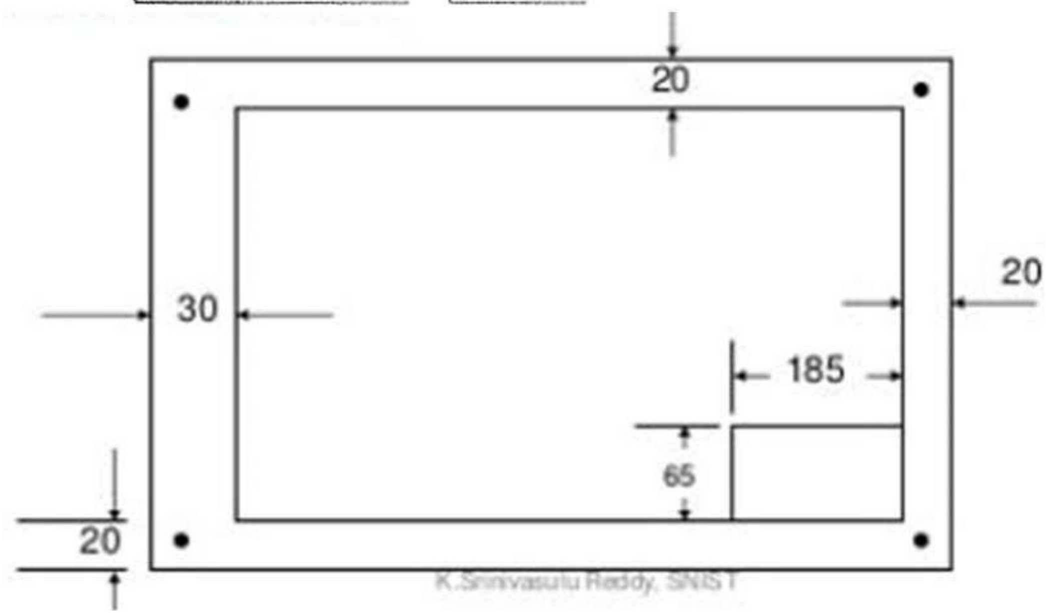


Drawing Sheet Layout

Title Block: Space for the title block must be provided in the bottom right-hand corner of the

The size of title block recommended is 185 mm x 65 mm as recommended by BIS

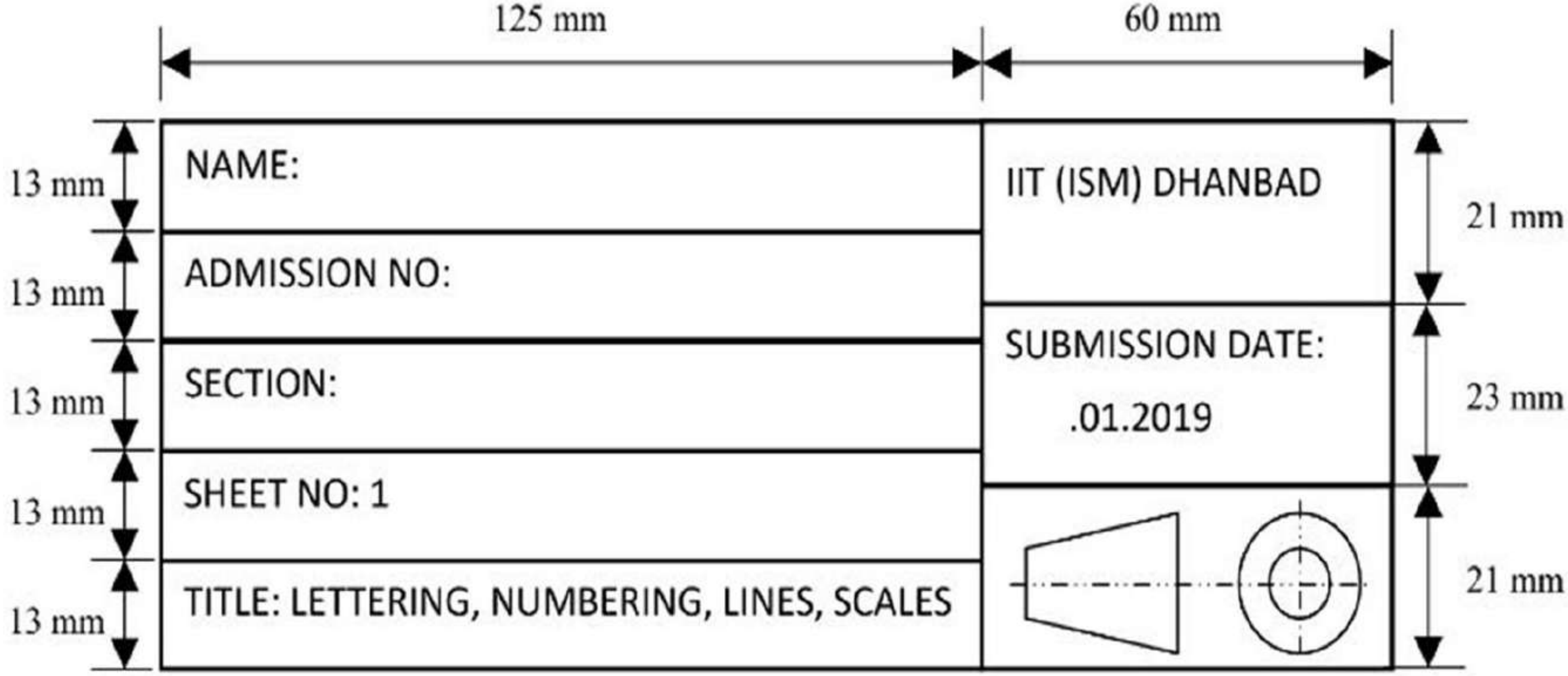




Drawing Sheet Layout

Particulars of the Title Block:

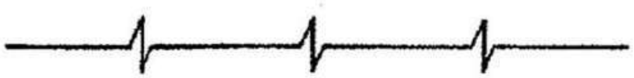
Name of the firm; Title of the drawing; Scale;
Symbol for the method of projection; Drawing number;
Initials with dates of persons who have designed, drawn, checked, and approved;
Sheet number and total number of drawing sheets of the object.



Lines and Pencils

Lines	Pencil
Initial work and construction lines	H
Outlines, dotted lines, section-plane lines, dimension lines, arrowheads	2H
Centre lines, section lines	3H or 4H

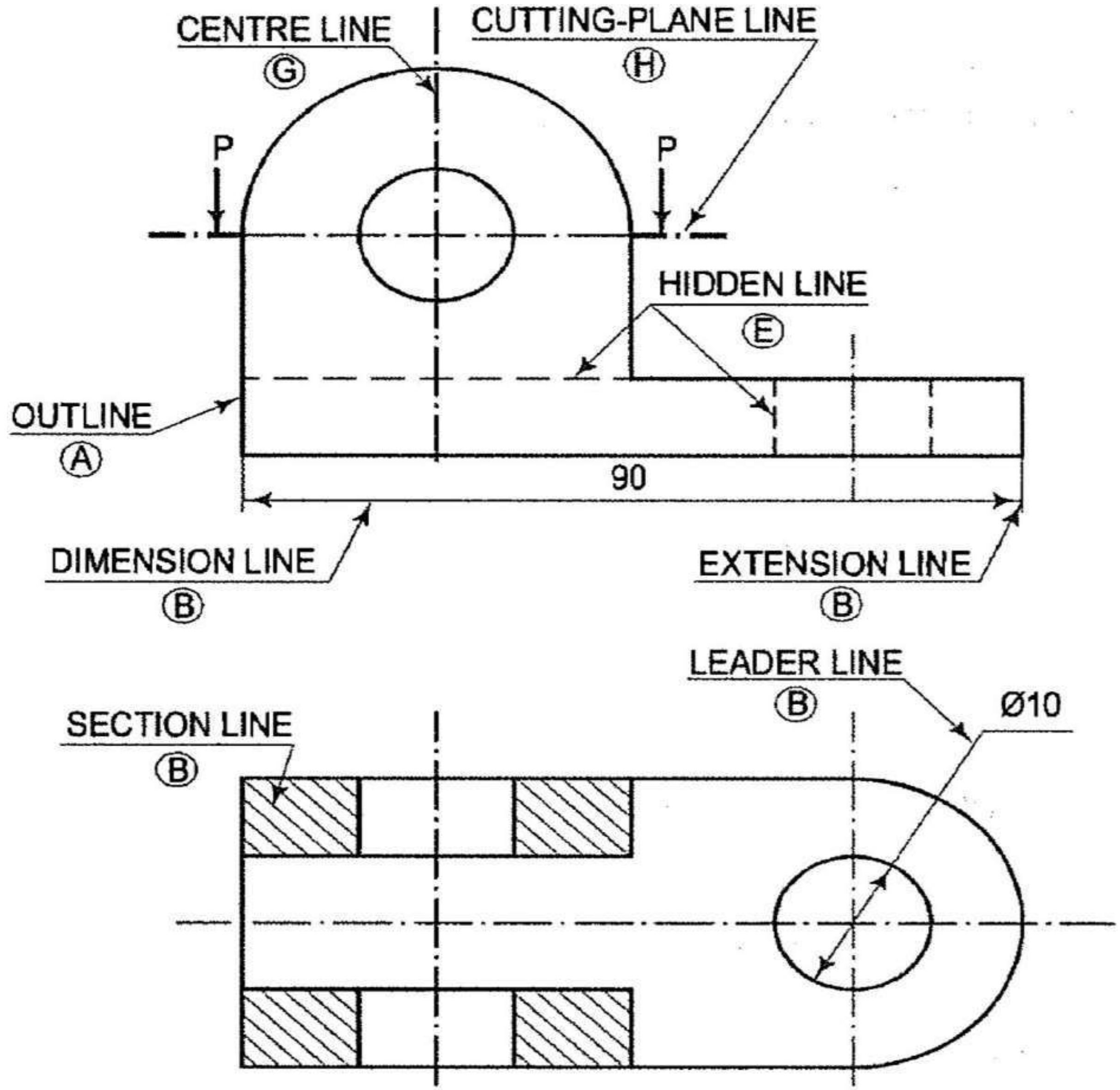
Type of Lines

Line	Description	General applications
A 	Continuous thick or Continuous wide	Visible outlines, visible edges; crests of screw threads; limits of length of full deph thread,lines of cuts and section arrows; parting lines of moulds in views; main representations in diagrams, maps, flow charts; system lines(structural metal engg.)
B 	Continuous thin (narrow) (straight or curved)	Imaginary lines of intersection; grid, dimension, extension, projection, short centre, leader, reference lines; hatching; outlines of revolved sections; root of screw threads; interpretation lines of tapered features; framing of details; indication of repetitiv details;
C 	Continuous thin (narrow) freehand	Limits of partial or interrupted views and sections, if the limit is not a chain thin line
D 	Continuous thin (narrow) with zigzags (straight)	Long-break line

Type of Lines

	Line	Description	General applications
E		Dashed thick (wide)	Line showing permissible of surface treatment
F		Dashed thin (narrow)	Hidden outlines; hidden edges
G		Chain thin Long-dashed dotted (narrow)	Centre line; lines of symmetry; trajectories; pitch circle of gears, pitch circle of holes,
H	THICK THIN THICK	Chain thin (narrow) with thick (wide) at the ends and at changing of position	Cutting planes
J		Chain thick or Long-dashed dotted (wide)	Indication of lines or surfaces to which a special requirement applies
K		Chain thin double-dashed or long-dashed double-dotted (narrow)	Outlines of adjacent parts Alternative and extreme positions of movable parts Centroidal lines Initial outlines prior to forming Parts situated in front of the cutting plane

Application of Different Lines: Example



Lettering and Numbering

Writing of titles, dimensions, notes and other important particulars on a drawing is called lettering. Lettering and numbering should, be done properly in clear, legible and uniform style.

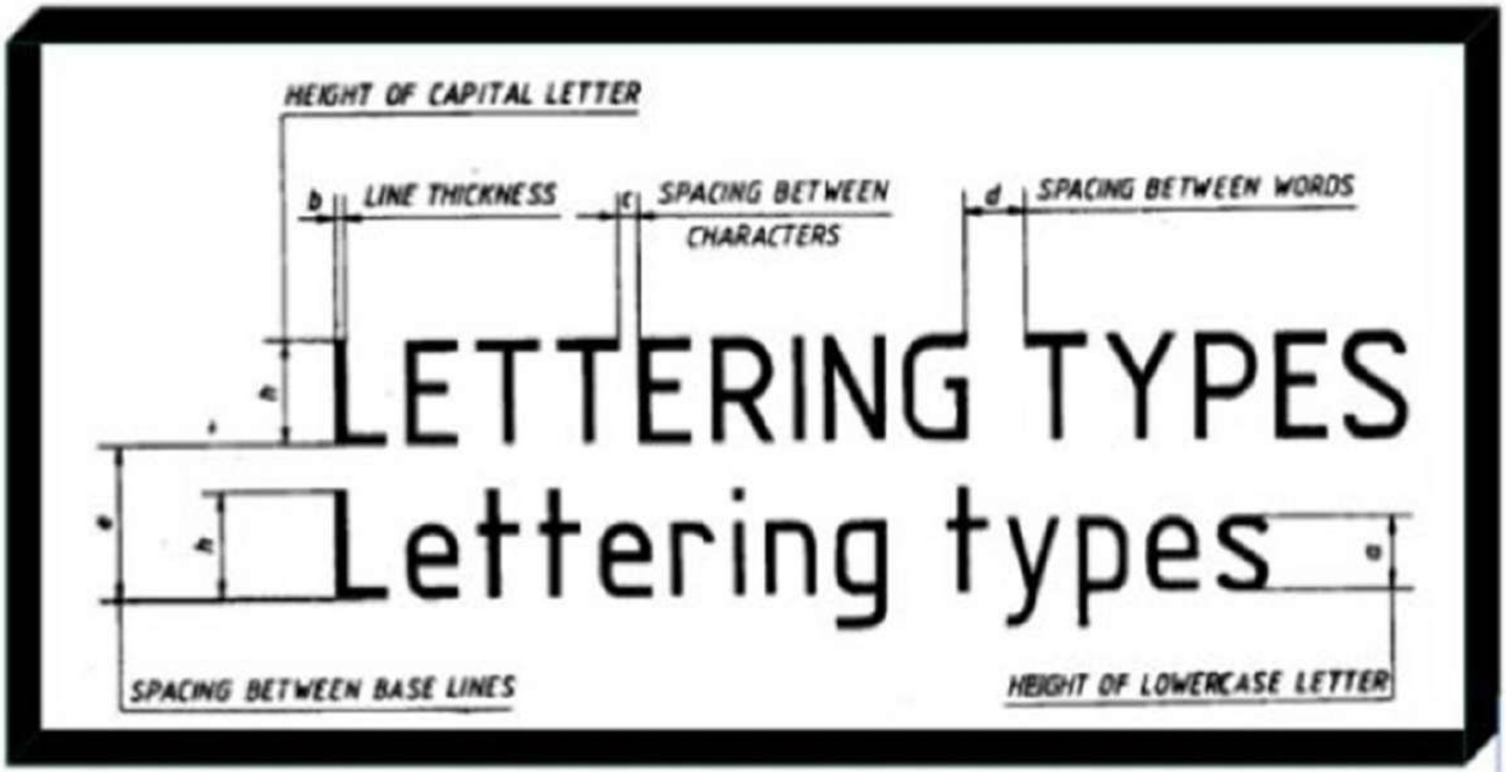
Single-stroke letters: The Bureau of Indian Standards (IS : 9609-2001) recommends single-stroke lettering for use in engineering drawing. These are the simplest forms of letters and are usually employed in most of the engineering drawings.

Single-stroke letters are of two types Vertical and Inclined.

The main titles are generally written in 6 - 8 mm size, sub-titles in 3 - 6 mm size, notes, dimension figures etc. in 3 - 5 mm size. The drawing number in title block is written in 10 -12 mm size.

Lettering types

- **Lettering A** - Height of the capital letter is divided into 14 equal parts
- **Lettering B** - Height of the capital letter is divided into 10 equal parts



Heights of Letters and Numerals

- Height of the capital letters is equal to the height of the numerals used in dimensioning

- Height of letters and numerals - different for different purposes

Sr. No.	Item	Size (mm)
1	Name of the company	**10**, 14, 20
2	Drawing numbers, letters denoting section planes	**10**, 14
3	Title of the Drawing	**7**, 10
4	Sub-titles and heading	5, **7**
5	Dimensioning, Notes, Schedules, Material list	3.5, **7**
6	Alteration entries and tolerances	3.5

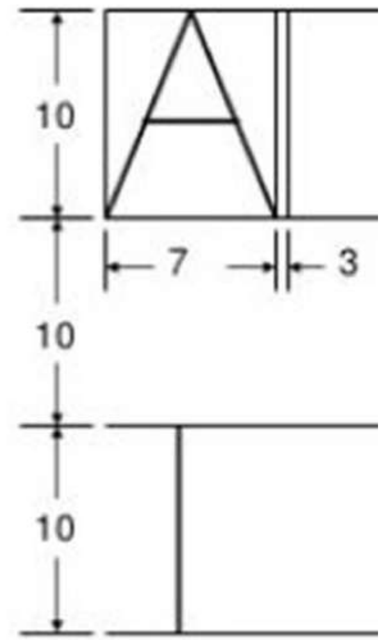
Specifications of A -Type Lettering

Specifications	Value	Size (mm)						
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 b/n words	d = (3/7)h	1.05	1.5	2.1	3	4.2	6	8.4
Min. spacing b/n baselines	e = (10/7)h	3.5	5	7	10	14	20	28

Specifications of B -Type Lettering

Specifications	Value	Size (mm)						
Capital letter height	h	2.5	3.5	5	7	10	14	20
Lowercase letter height	a = (7/10)h	-	2.5	3.5	5	7	10	14
Thickness of lines	b = (1/10)h	0.25	0.35	0.5	0.7	1	1.4	2
Spacing between characters	c = (1/5)h	0.5	0.7	1	1.4	2	2.8	4
Min. spacing b/n words	d = (3/5)h	1.5	2.1	3	4.2	6	8.4	12
Min. spacing b/n baselines	e = (7/5)h	3.5	5	7	10	14	20	28

Lettering and Numbering



Vertical Single-stroke Letters

Lettering and Numbering

Inclined Single-stroke Letters

- Inclined letters are lean to the right, the slope being 75º with the horizontal.

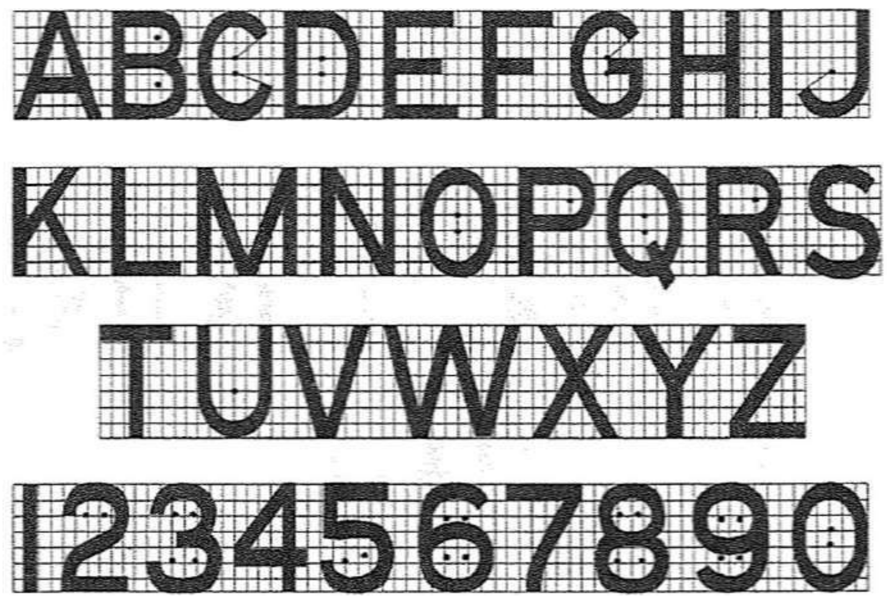
- lettering is generally done in capital letters

Lettering and Numbering

Gothic letters: Stems of single-stroke letters, if given more thickness, form gothic letters. These are mostly used for main titles of ink-drawings.

The outlines of the letters are first drawn with the aid of instruments and then filled-in with ink.

The thickness of the stem may vary from 1/5 to 1/10 of the height of the letters.



Dimensioning

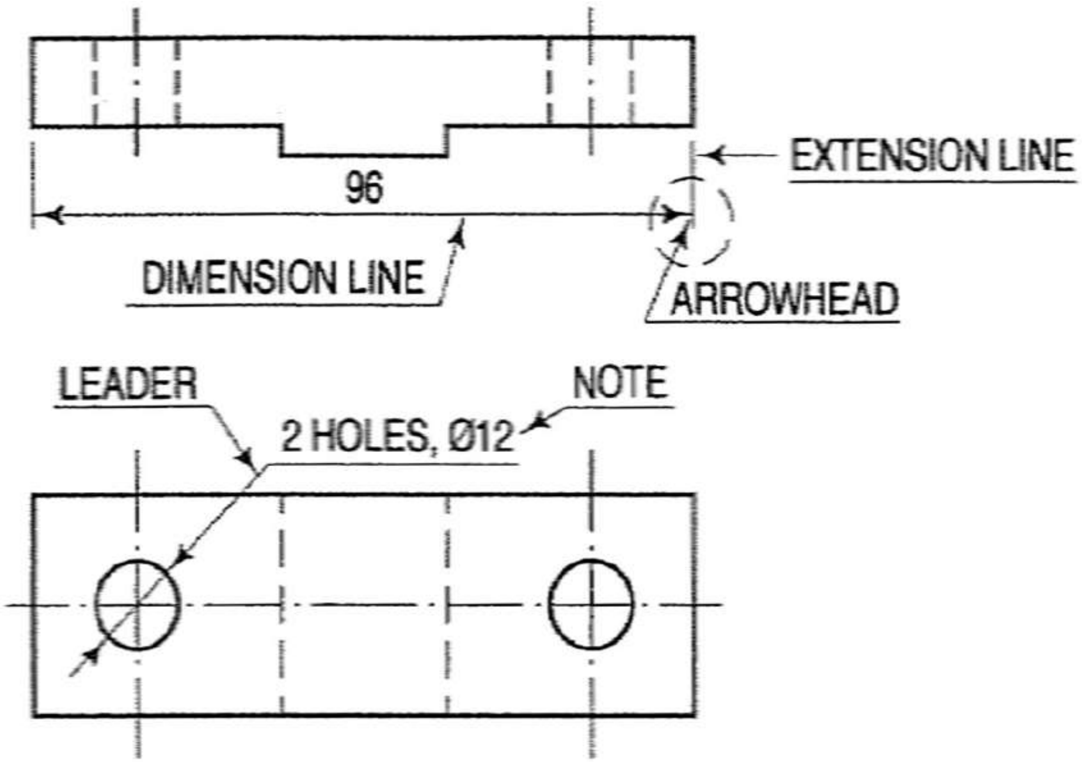
Dimension line: Dimension line is a thin continuous line. It is terminated by arrowheads touching the outlines, extension lines or centre lines.

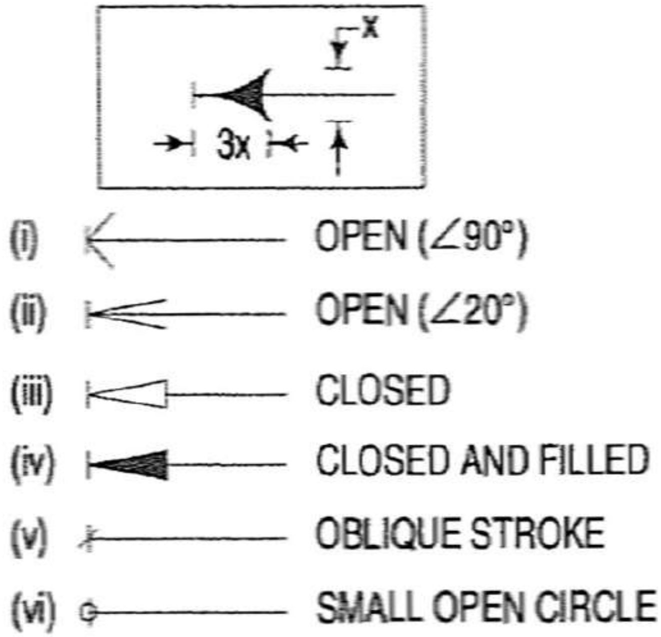
Extension line: An extension line is a thin continuous line drawn in extension of an outline. BIS recommended a gap of about 1 mm between the extension line and an outline or object boundary. It extends by about 3 mm beyond the dimension line.

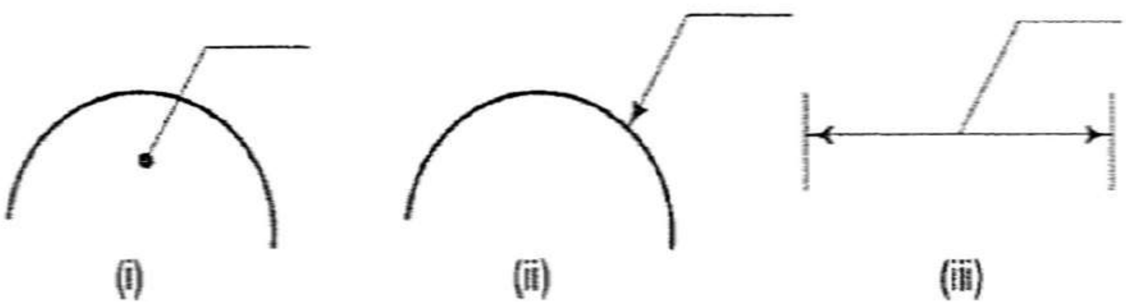
Arrowhead: An arrowhead is placed at each end of a dimension line. Its pointed end touches an outline, an extension line or a centre line. The size of an arrowhead should be about three times its maximum width. Generally closed and filled arrowhead is widely used in engineering drawing.

Leader: A leader or a pointer is a thin continuous line connecting a note or a dimension figure with the feature to which it applies. One end of the leader terminates either in an arrowhead or a dot. The arrowhead touches the outline, while the dot is placed within the outline of the object.

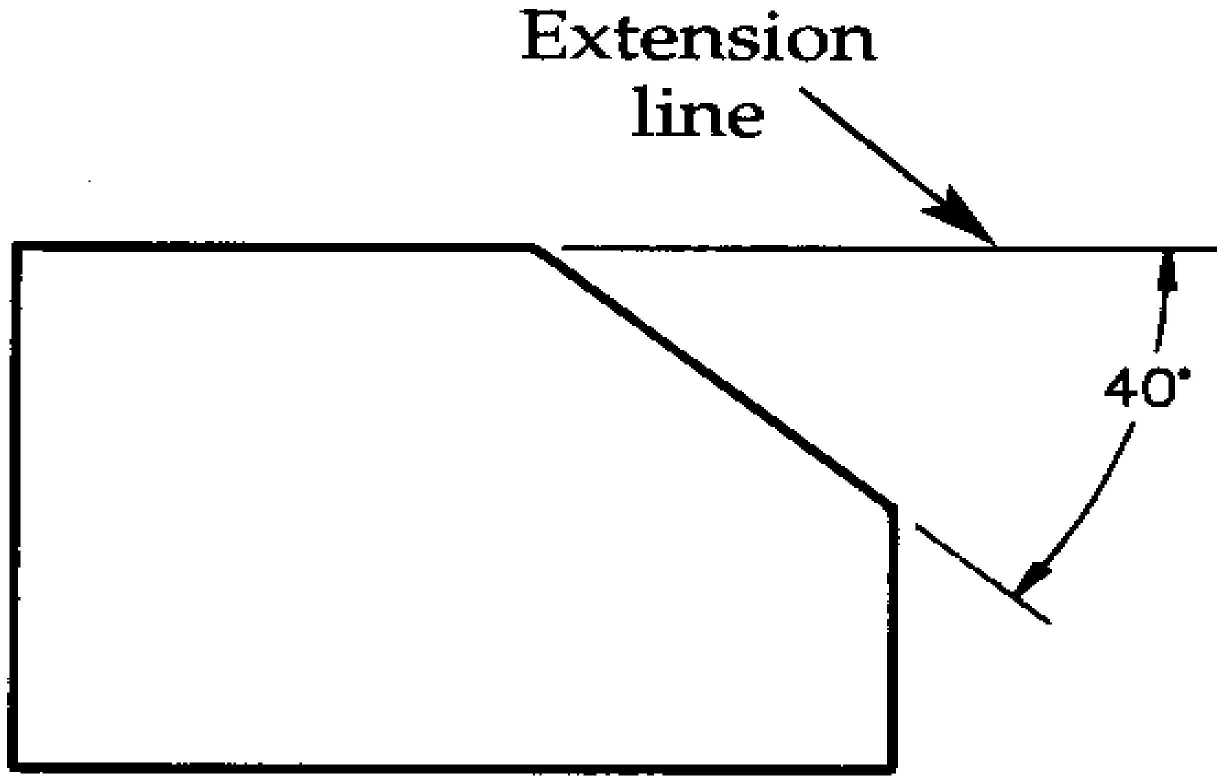
Dimensioning



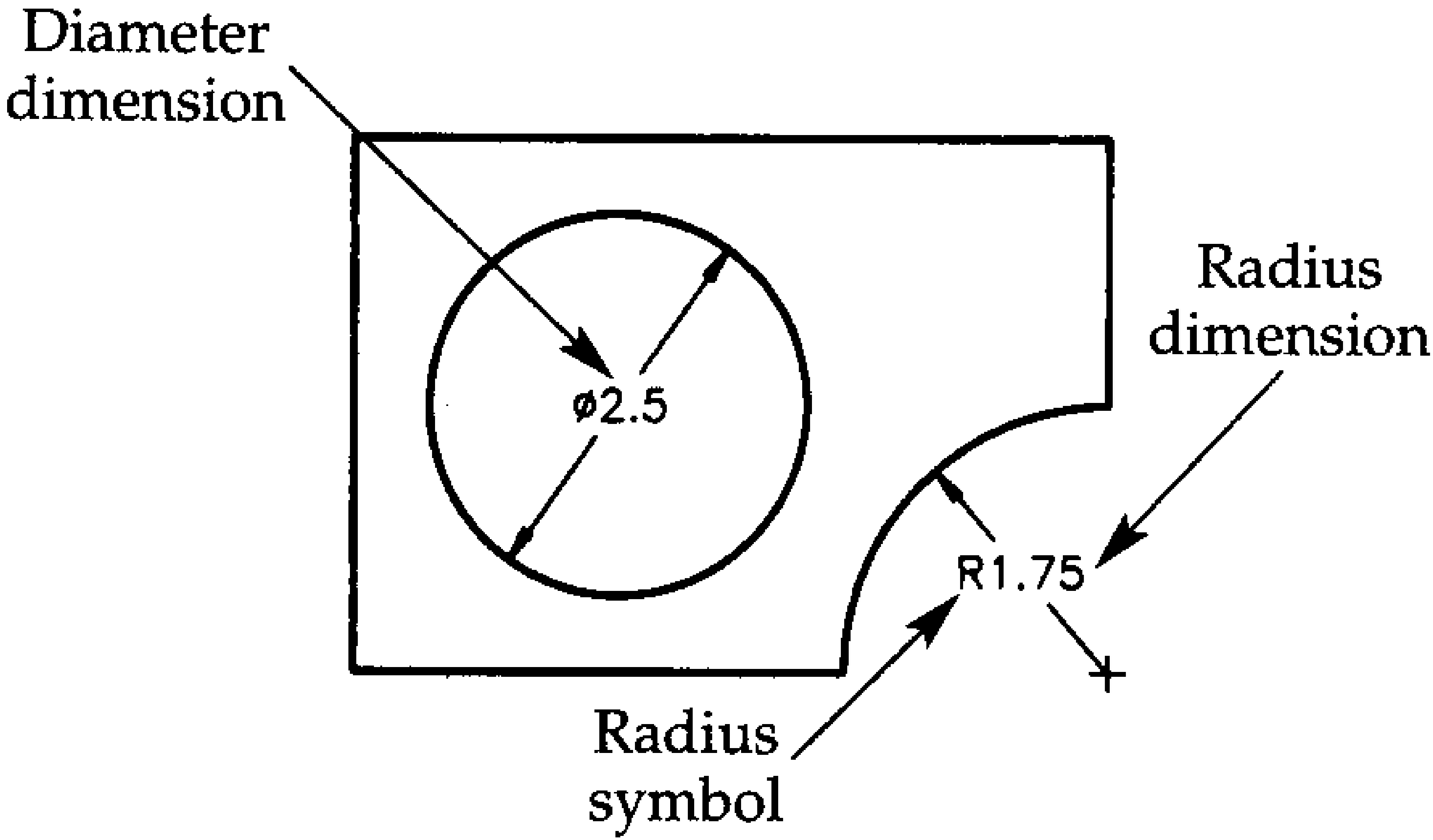




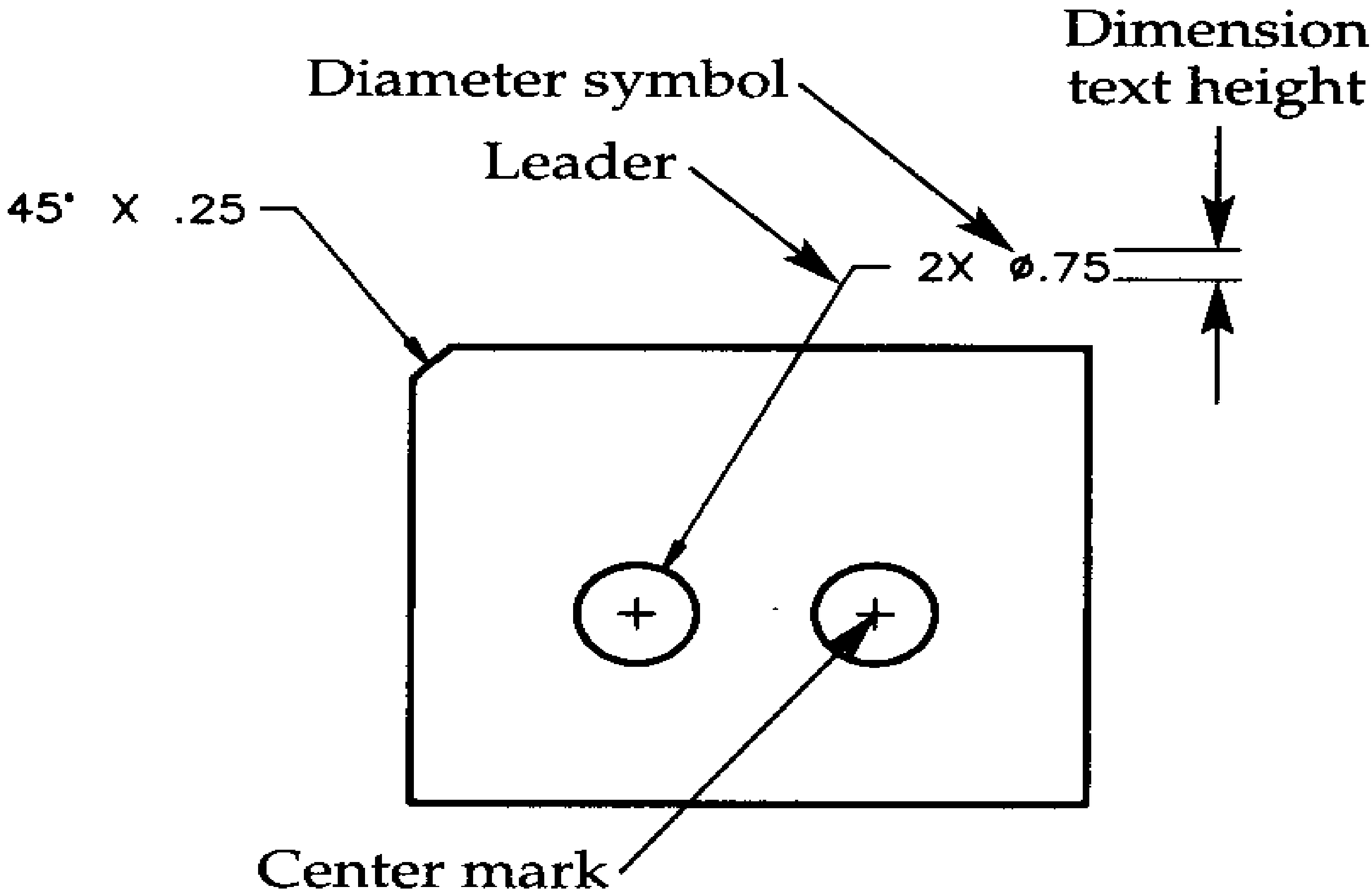
Dimensioning Formats



Dimensioning Formats



Dimensioning Formats



Lecture 1 (Theory)

ENGINEERING GRAPHICS

Scales

A scale is defined as the ratio of the linear dimensions of element of the object as represented in a drawing to the actual dimensions of the same element of the object itself.

It may not be always possible to prepare full-size drawings. They are, therefore, drawn proportionately smaller or larger. When drawings are drawn smaller than the actual size of the objects (as in case of buildings, bridges, large machines etc.), the scale used is said to be a reducing scale (1 : 5). Drawings of small machine parts, mathematical instruments, watches etc. are made larger than their real size. These are said to be drawn on an enlarging scale (5 : 1).

(i)	Reducing scales	1 : 2 1 : 20 1 : 200 1 : 2000	1 : 5 1 : 50 1 : 500 1 : 5000	1 : 10 1 : 100 1 : 1000 1 : 10000
(ii)	Enlarging scales	50 : 1 5 : 1	20 : 1 2 : 1	10 : 1
(iii)	Full size scales			1 : 1

Scales

The scales can be expressed in the following three ways:

Engineer’s scale: **In this case, the relation between the dimension on the drawing and the actual dimension of the object is mentioned numerically, e.g. 10 mm = 5 m. As the drawing becomes old, the engineer's scale may shrink and may not give accurate results.**

Graphical scale: **The scale is drawn on the drawing itself. If the drawing shrinks, the graphical scale will also shrink. Hence, the graphical scale is commonly used in survey maps.**

Representative fraction: **The ratio of the length of the object represented on drawing to the actual length of the object represented is called the Representative Fraction (R.F.).**

Type of Scales

The scales used in practice are classified as:

(1) Plain Scales; (2) Diagonal Scales; (3) Vernier Scales;

Plain Scales: **A plain scale consists of a line divided into suitable number of equal parts, the first of which is sub-divided into smaller parts. Plain scales represent either two units or a unit and its sub-division.**

In every scale,

(i) The zero should be placed at the end of the first main division, i.e. between the unit and its sub-divisions.

(ii) From the zero mark, the units should be numbered to the right and its sub-divisions to the left.

(iii) The names of the units and the sub-divisions should be stated clearly below or at the respective ends.

(iv) The name of the scale (e.g. 1 : 10) or its R.F. should be mentioned below the scale.

Plain Scale: Example

Construct a scale of 1 : 60 to show meters and decimeters and long enough to measure up to 6 meters. Measure 3.7 m distance in the scale.

R.F. of the scale = 1/60

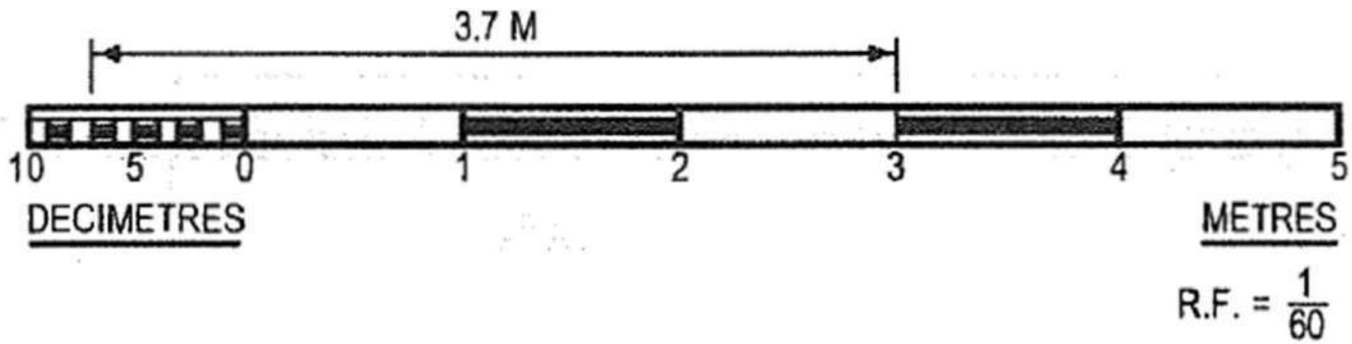
Length of the scale = R.F. × maximum length = 1/60 x 6 m = 10 cm

Draw a line 10 cm long and divide it into 6 equal divisions, each representing 1 m.

Mark 0 at the end of the first division and 1, 2, 3, 4 and 5 at the end of each subsequent division to its right.

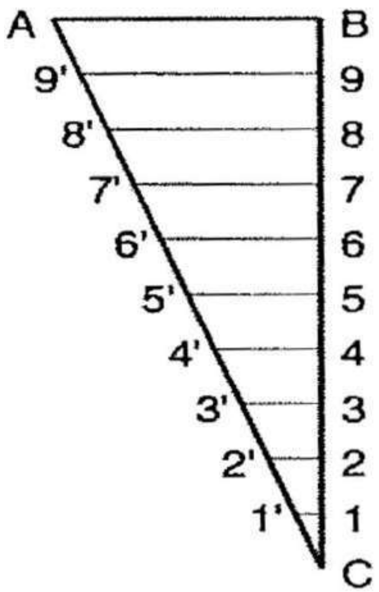
Divide first division into 10 equal sub-divisions, each representing 1 dm.

Mark 3.7 m distance on the scale.



Diagonal Scale

A diagonal scale is used when very minute distances such as 0.1 mm etc. are to be accurately measured or when measurements are required in three units; e.g., dm, cm and mm, or yard, foot and inch.



At one end, say B, draw a line perpendicular to AB and along it, step-off ten equal divisions of any length, starting from B and ending at C.

Number the division-points, 9, 8, 7, ... 1. Join A with C.

Through the points 1, 2 etc. draw lines parallel to AB and cutting AC at 1', 2' etc. It is evident that triangles 1'1C, 2'2 C ... ABC are similar.

Since C5 = 0.5BC, the line 5'5 = 0.5AB.

Similarly, 1'1 = 0.1AB, 2'2 = 0.2AB etc.

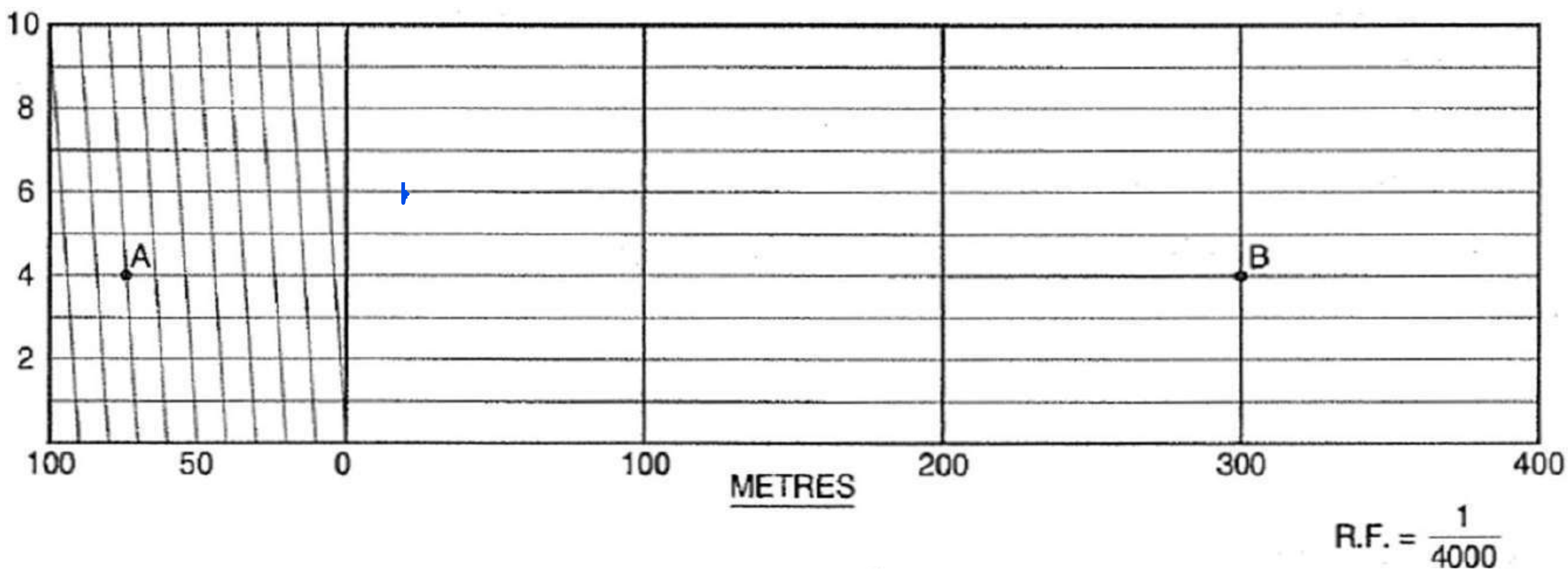
Diagonal Scale: Example

Construct a scale of 1 : 4000 to show meters and long enough to measure up to 500 metres. Show a length of 374 m on scale.

R.F. of the scale = 1/4000

Length of the scale = R.F. × maximum length = 1/4000 x 500 m = 12.5 cm

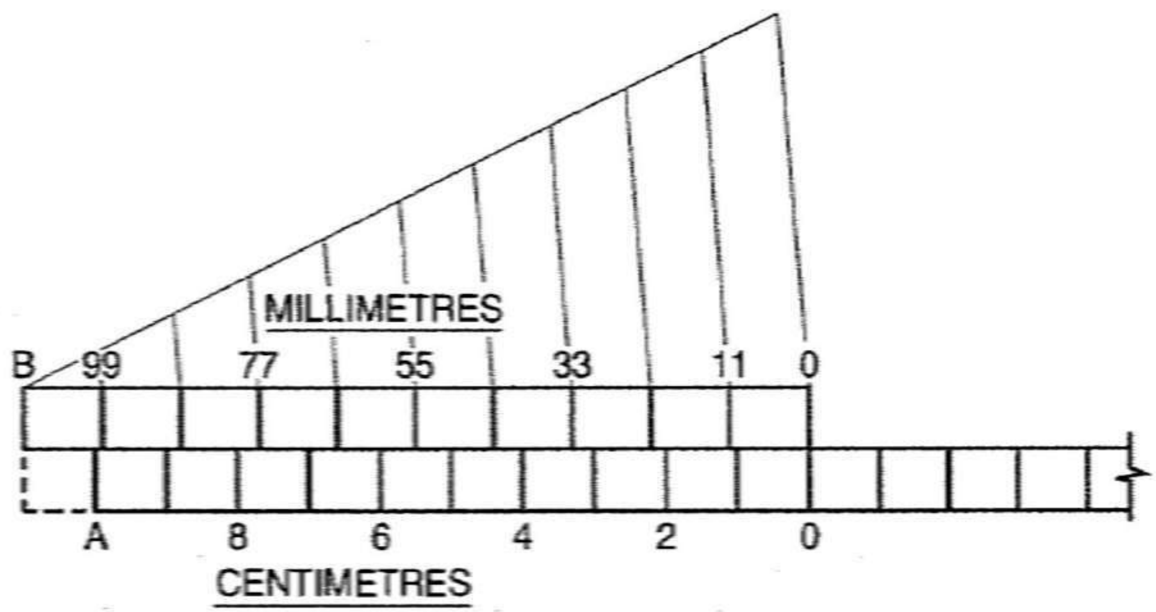
Draw a line 12.5 cm long and divide it into 5 equal divisions, each representing 100 m.



Vernier Scale

Vernier scales, like diagonal scales, are used to read to a very small unit with great accuracy. A vernier scale consists of two parts - a primary scale and a vernier. The primary scale is a plain scale fully divided into minor divisions.

Part of a plain scale in which the length A0 represents 10 cm. If we divide A0 into ten equal parts, each part will represent 1 cm. It would not be easy to divide each of these parts into ten equal divisions to get measurements in millimetres.

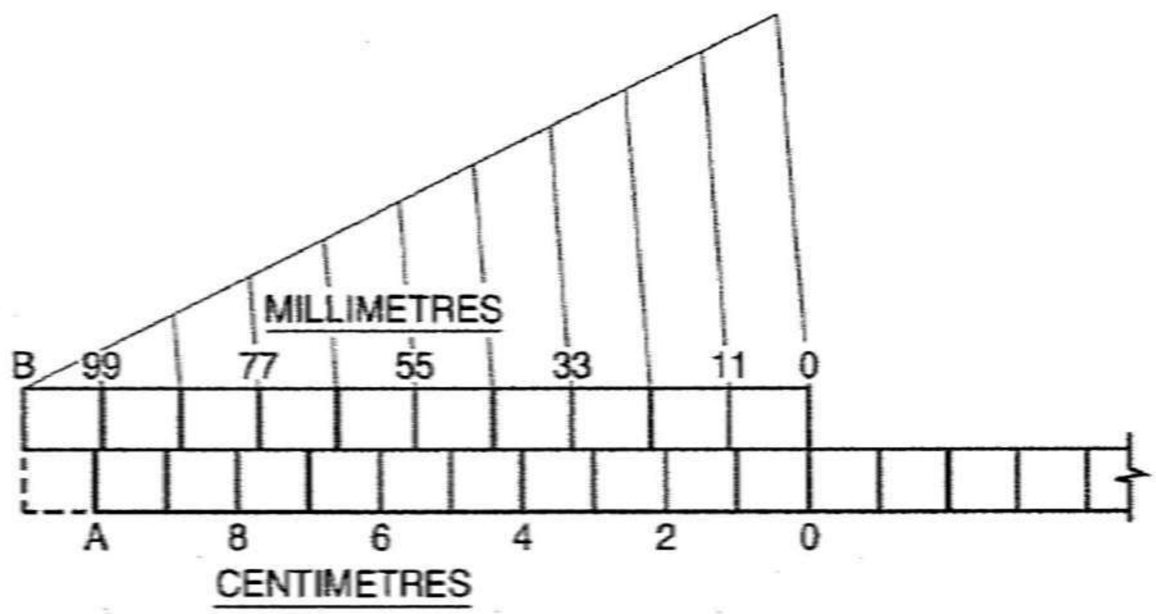


Vernier Scale

Now, if we take a length B0 equal to 10 + 1 = 11 cm and divide it into ten equal divisions, each of these divisions will represent 11/10 = 1.1 cm or 11 mm.

The difference between one division of A0 and one division of B0 will be equal 1.1 - 1.0 = 0.1 cm or 1 mm.

The upper scale B0 is the vernier. The combination of the plain scale and the vernier is the vernier scale.



Vernier Scale: Example

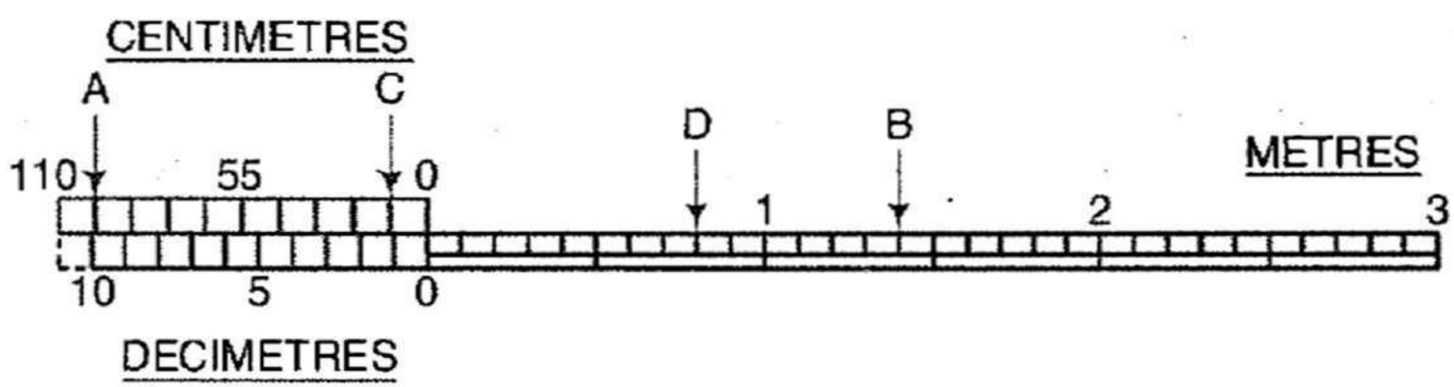
Draw a vernier scale of R.F. = 1/25 to read centimeters up to 4 meters and on it, show lengths representing 2.39 m and 0.91 m.

R.F. of the scale = 1/25

Length of the scale = R.F. × maximum length = 1/25 x 400 cm = 16 cm

Draw a line 16 cm long and divide it into 4 equal divisions, each representing 1 m. Divide each of these parts into 10 equal parts to show decimeters.

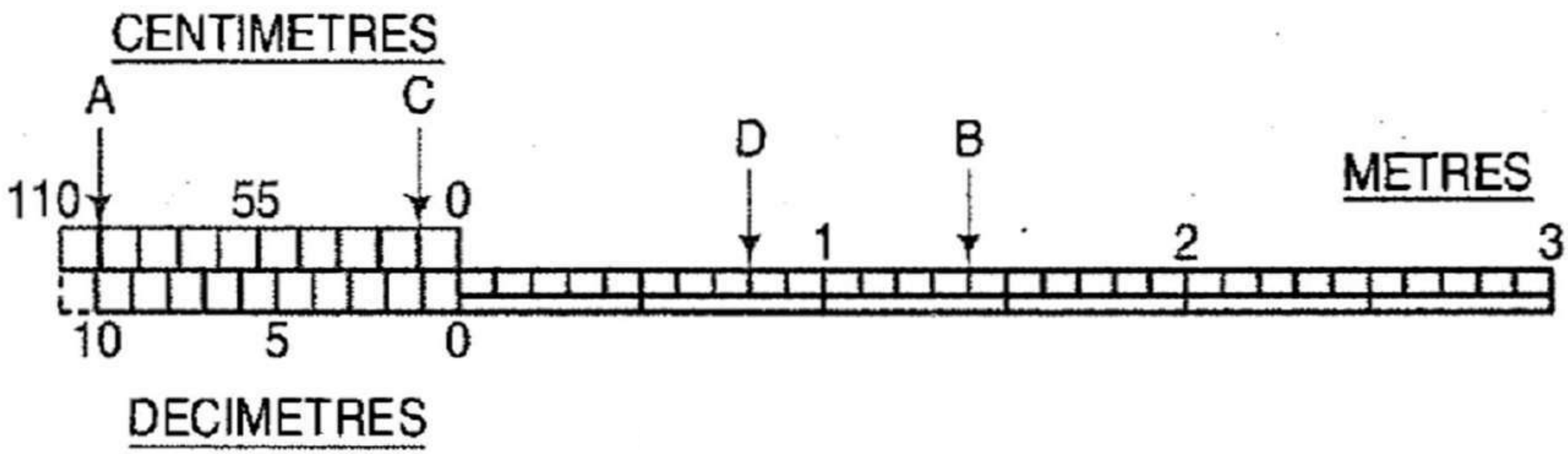
To construct a vernier, take 11 parts of decimeter length and divide it into 10 equal parts. Each of these parts will show a length of 1.1 decimeter or 11 cm.



Vernier Scale: Example

To measure a length representing 2.39 m, place one leg of the divider at A on 99 cm mark and the other leg at B on 1.4 m mark. The length AB will show 2.39 metres (i.e. 0.99 m + 1.4 m = 2.39 m).

Similarly, place one leg of the divider at C on 11 cm mark and the other leg at D on 0.8 m mark. The length CD shows 0.91 metres (i.e. 0.8 m + 0.11 m = 0.91 m).



Reference Videos

https://www.youtube.com/watch?v=n9iQcttWHAo&t=351s

https://www.youtube.com/watch?v=LagNkr-V8M8

https://www.youtube.com/watch?v=u0rmE5SZ9KA&t=409s