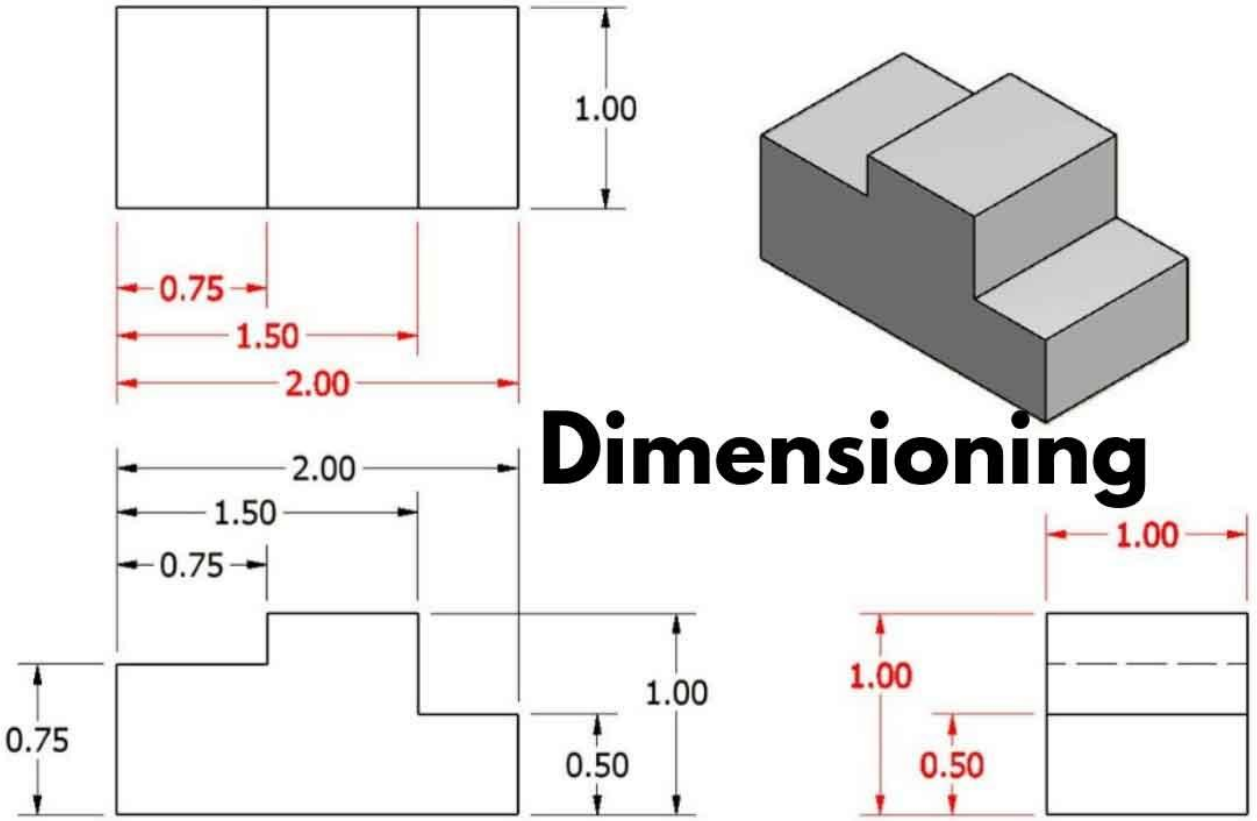


Dimensioning

EGD-ME101-18

Swarn Singh

DIMENSIONING

BIS (SP 46: 2003) defines dimension as a numerical value expressed in appropriate units of measurement and indicated graphically on technical drawings with lines, symbols & notes.

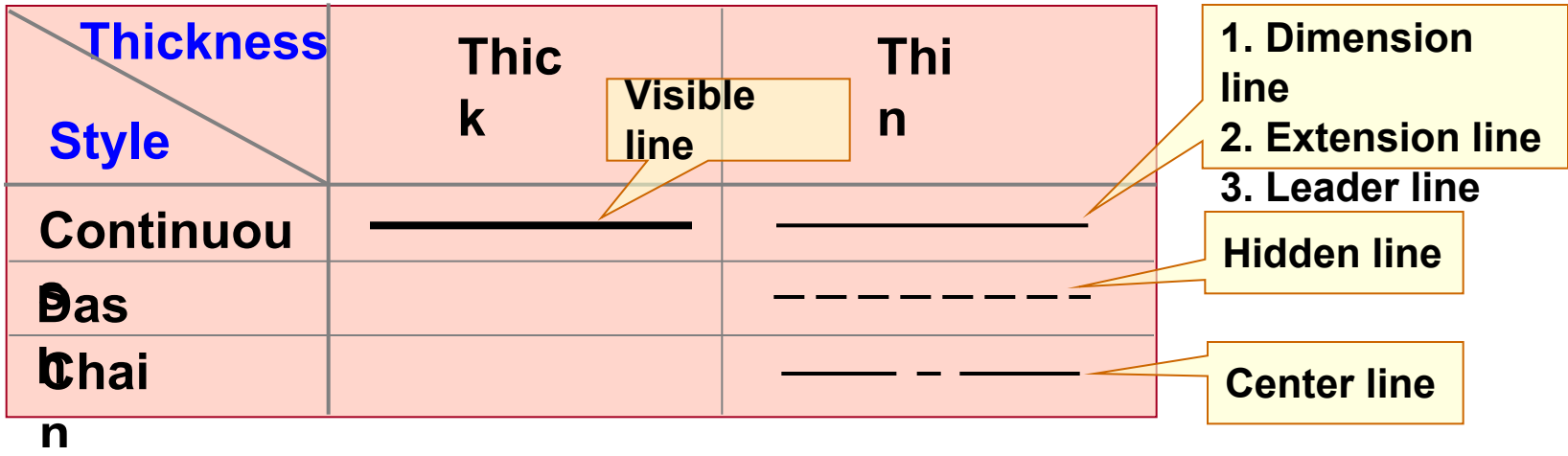
Features of Dimensioning

1. Units of measurement – length (mm), angles (degrees °)
2. Symbols – incorporated to indicate specific geometries
3. Notes – to give specification to particular feature or specific information necessary during manufacturing of the job

Elements of Dimensioning

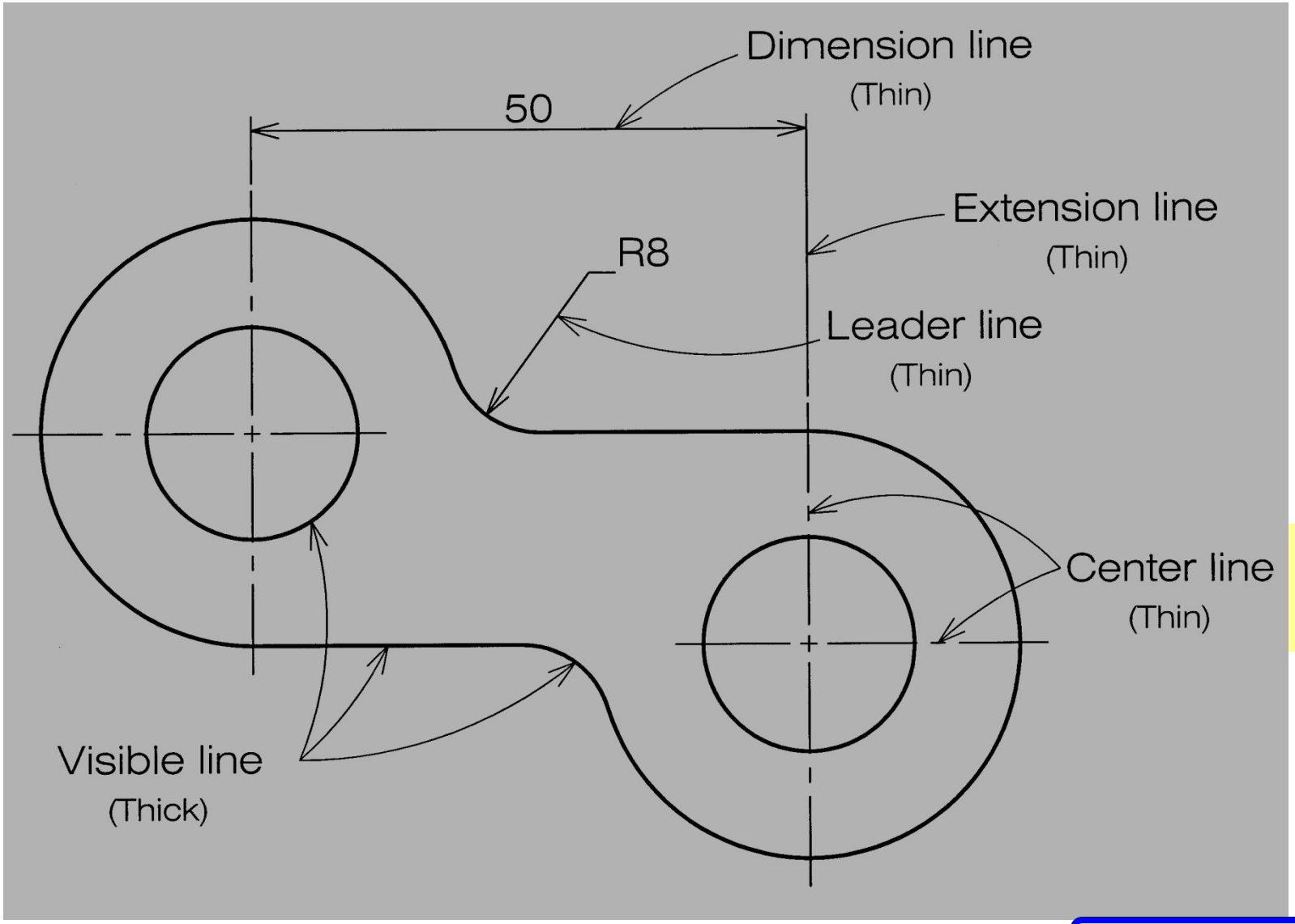
- Object lines
- Extension lines
- Dimension lines
- Leader lines

Basic Line Types & Name according to application



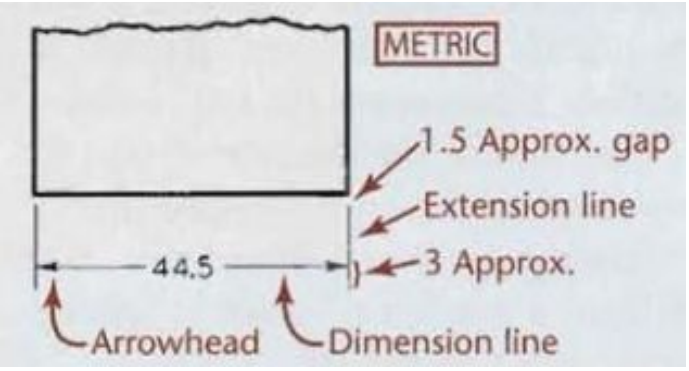
1. Visible line — represent features that can be seen in the current view.
2. Dimension line
   Extension line
   Leader line — indicate the sizes and location of features.
3. Hidden line — represent features that <u>can not be seen</u> in the current view.
4. Center line — represents symmetry, path of motion, centers of circles,

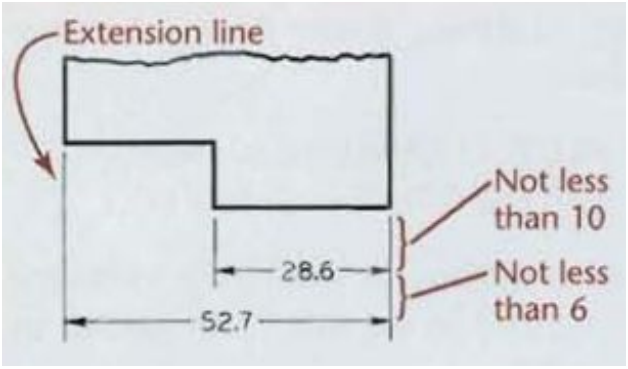
Example

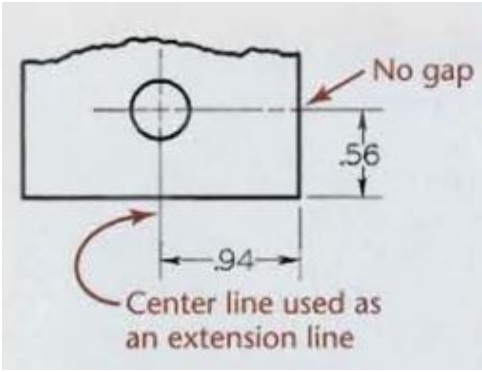


Contents

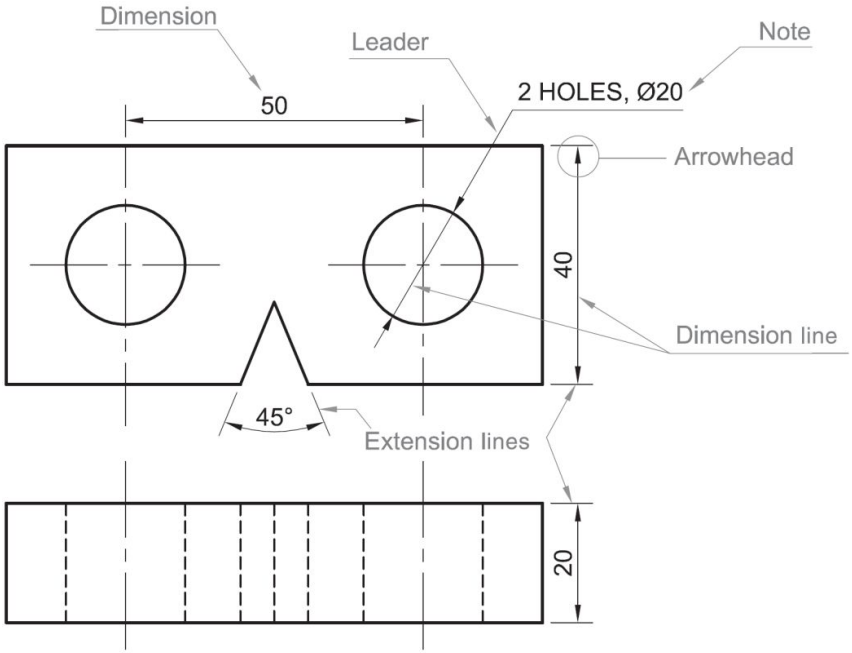
Elements of dimensioning	Definition
Object line	A line on the drawing whose length is to be shown is called an object line. In case of angles 2 lines forming angle will be object lines.
Extension line	An extension line is a thin continuous line drawn perpendicular to an object line. It extends by about 3 mm beyond the dimension line
Dimension line	Dimension line is drawn between 2 extension lines parallel to the object line. One dimension line represents one dimension. For angles a curved dimension line as arc with center at the vertex of angle is drawn. It is terminated by arrowheads touching the extension lines
Center line	A center-line is a thin, dark line alternating long and short dashes. Center-lines are commonly used as extension lines in locating holes and other symmetrical features. When extended for dimensioning. Center-lines cross over other lines of the drawing without gaps. Always end center-lines using a long dash.

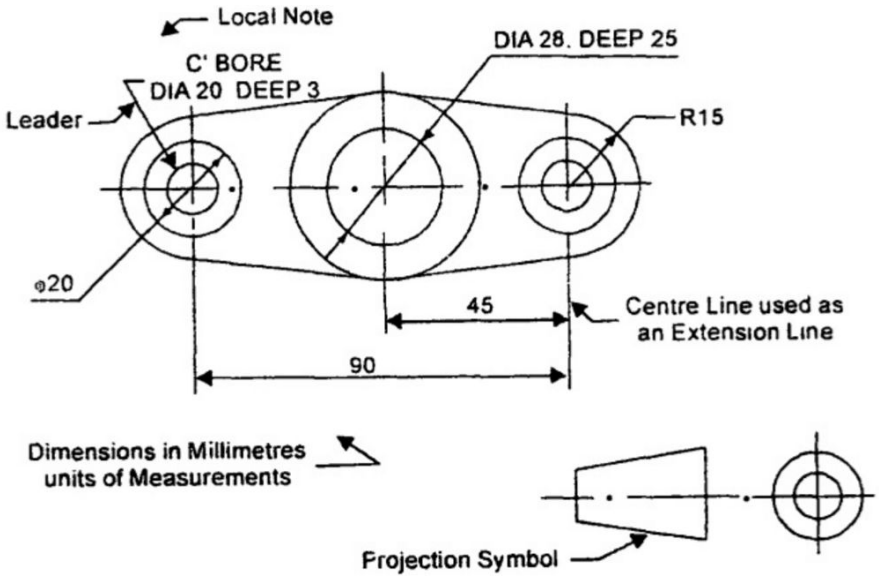


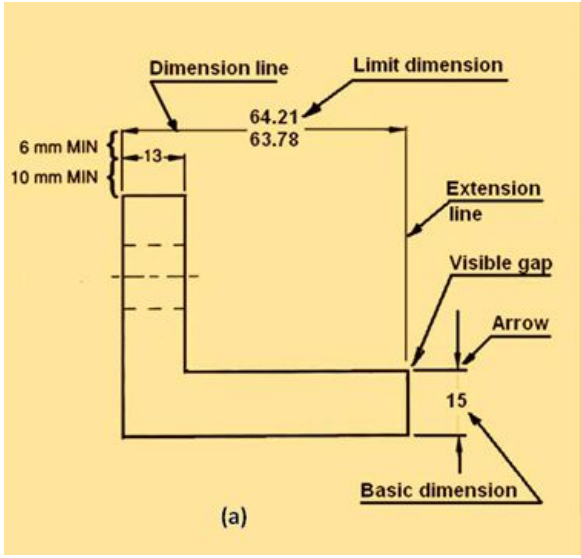


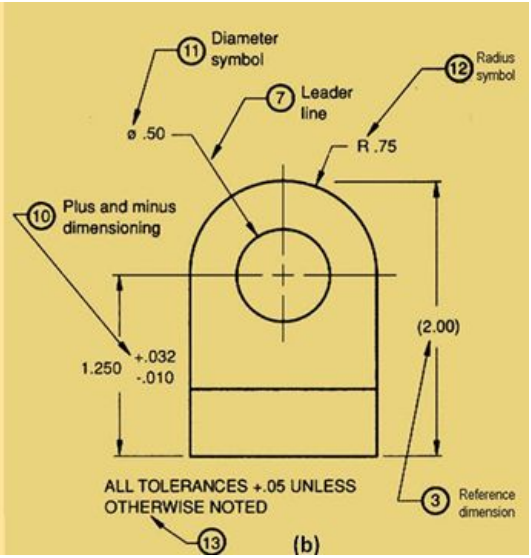


Examples for elements of dimensioning

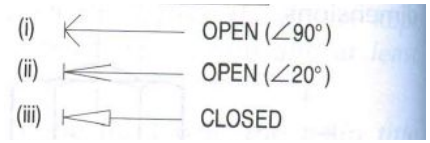


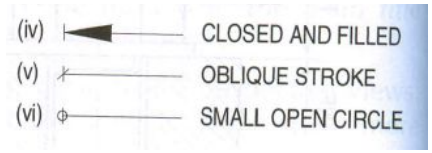


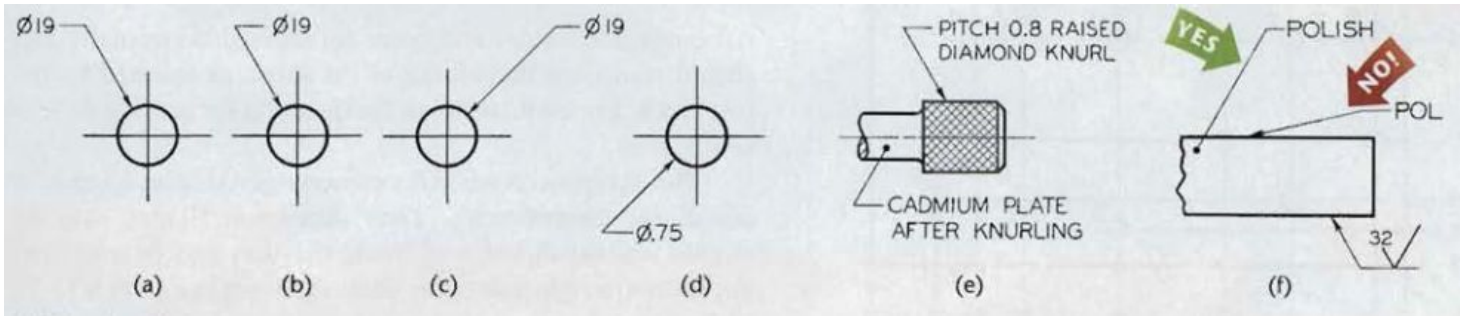


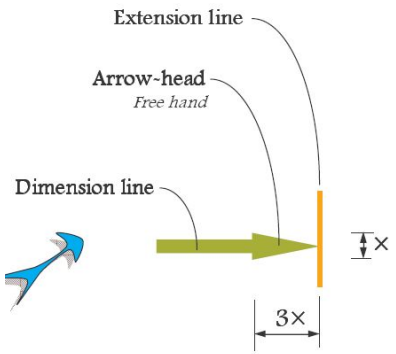


Elements of dimensioning	Definition
Leader line	A leader or a pointer is a thin continuous line connecting a note or a dimension figure with the feature to which it applies. Never drawn vertical of horizontal but at some angle. A dot is used instead of an arrowhead if the leader ends inside the object.
Arrowheads	An arrowhead is placed at each end of a dimension line. Its pointed end touches an extension line. The size of an arrowhead should be proportional to the length of the dimension line. The length of the arrowhead should be about three times its maximum width.
Dimension	Placed near the middle and above the dimension lines or at the center of dimension lines by breaking them. As all dimensions of a drawing are in the same unit, instead of unit a note (ALL DIMENSIONS IN MM) preferable at the left hand side of title block is written. Dimension text should be uniform for all features.



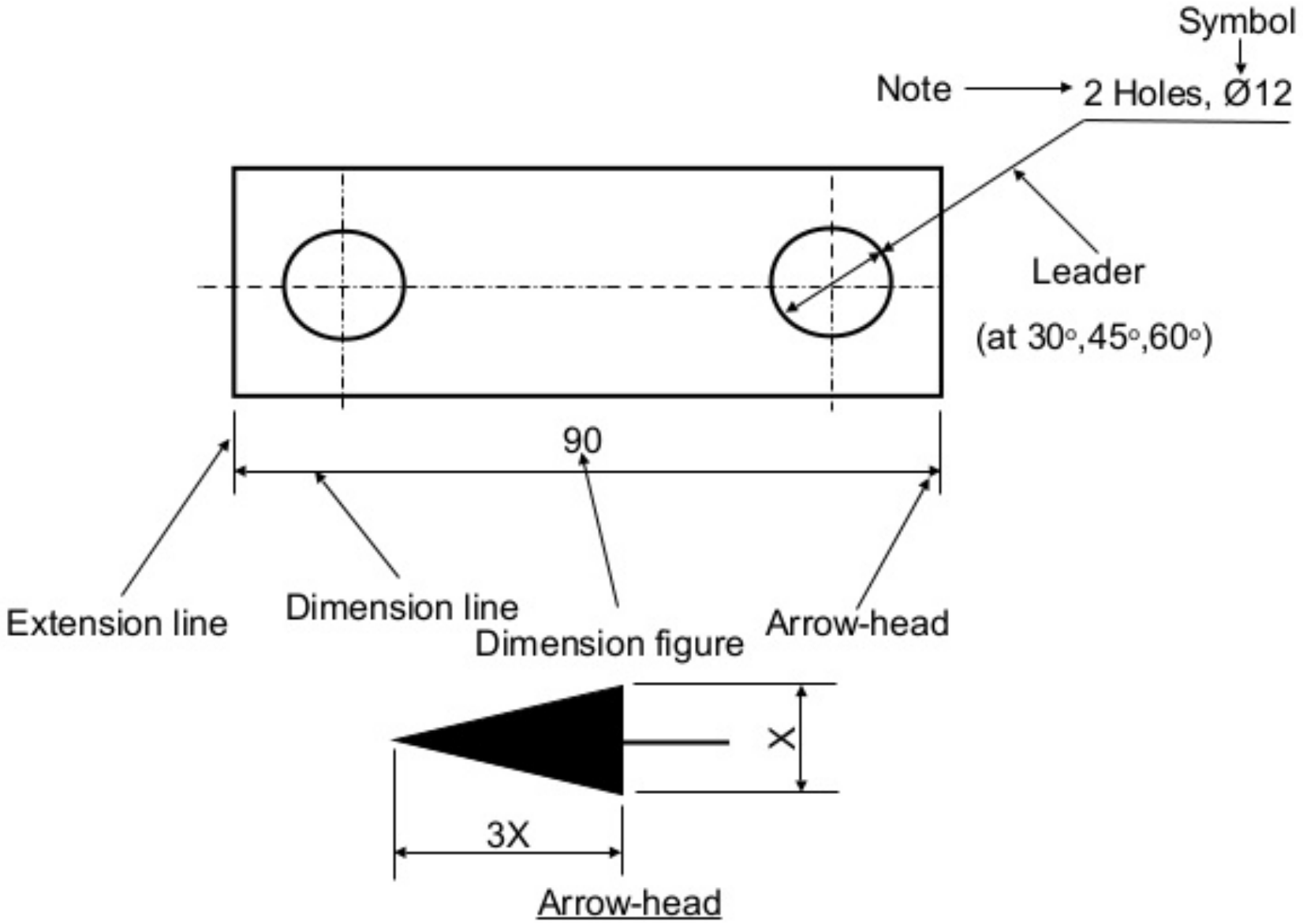






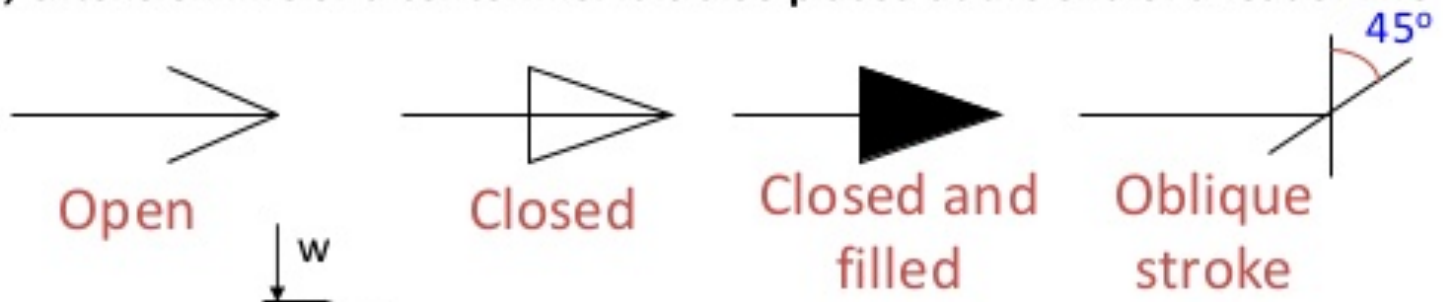
×= 3mm for usual drawings
= 4~5mm for larger drawings

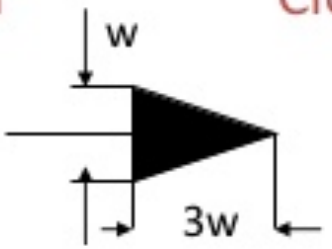
Notations of Dimensioning



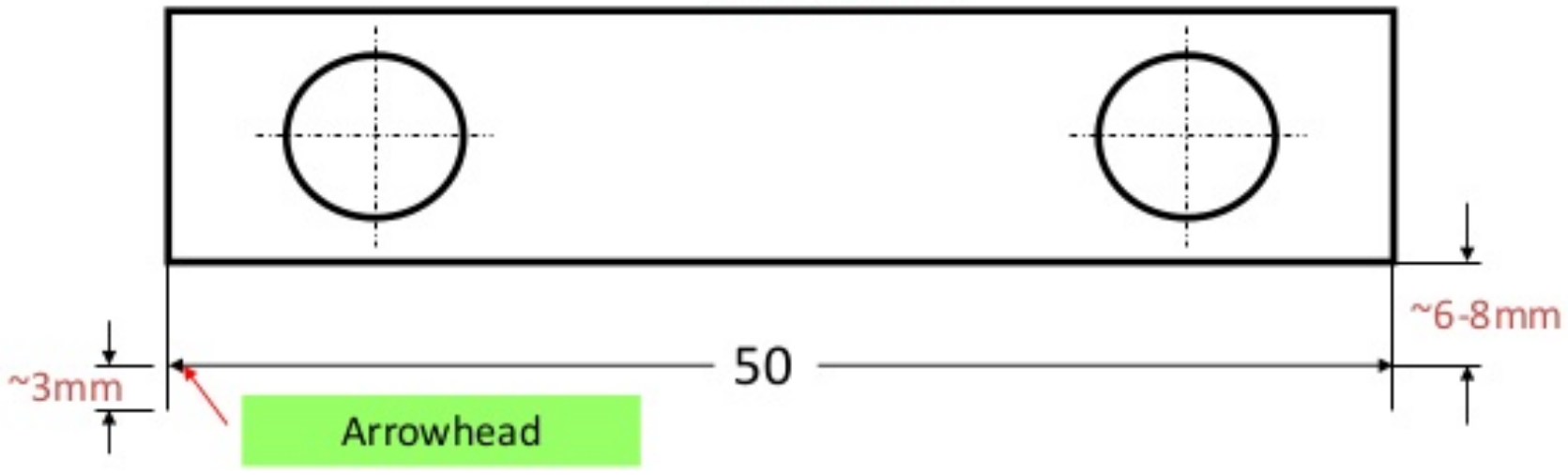
Arrowheads and dimension line positioning

- A dimension line is placed at least 6-8 mm away from an outline and from each other
- An extension line extends ~3mm beyond a dimension line
- Arrowhead – Placed at each end of a dimension line, its pointed end touches an outline, extension line or a centerline. It is also placed at the end of a leader line





Size of the arrowhead should be proportional to the length of the dimension line



Best practices for dimension & extension lines

1. The shorter dimensions are nearest to the object outline.
2. Dimension lines should not cross extension lines as in Figure (b), which results from placing the shorter dimensions outside. Note that it is perfectly satisfactory to cross extension lines (Figure a), but they should not be shortened (Figure c).
3. Dimension lines should not cross each other & any other lines of the object. However extension lines can cross both (fig 1).
4. A dimension line should never coincide with or extend from any line of the drawing (Figure d).

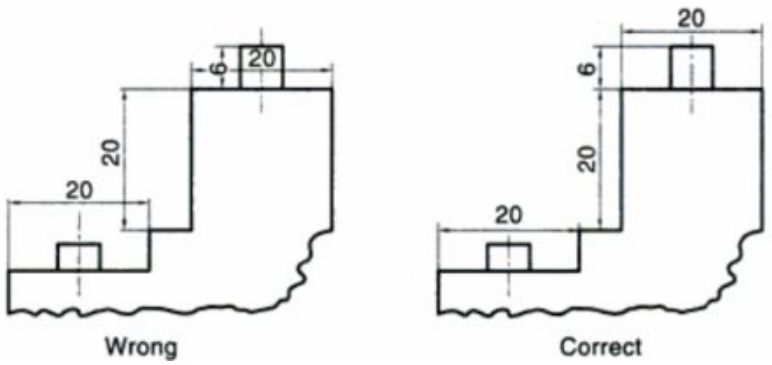
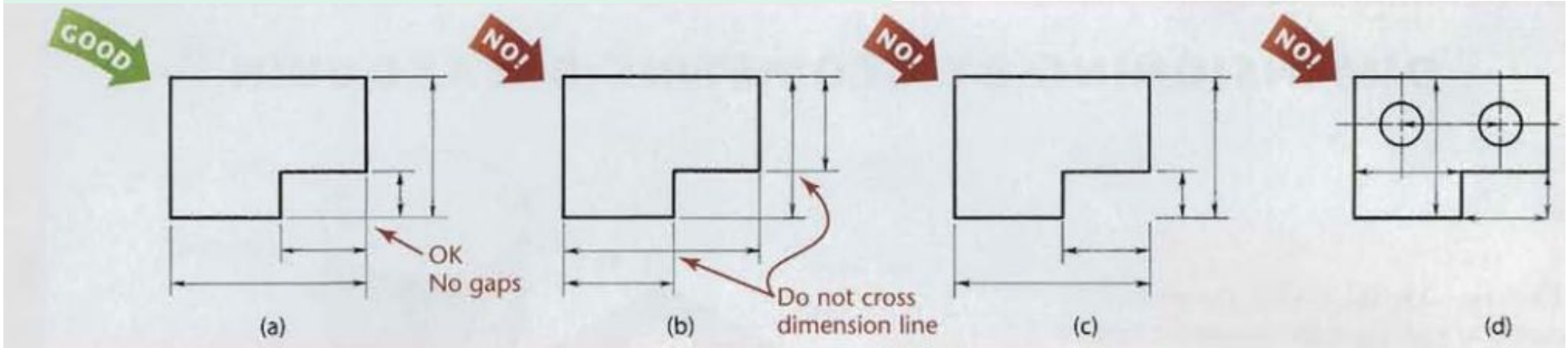
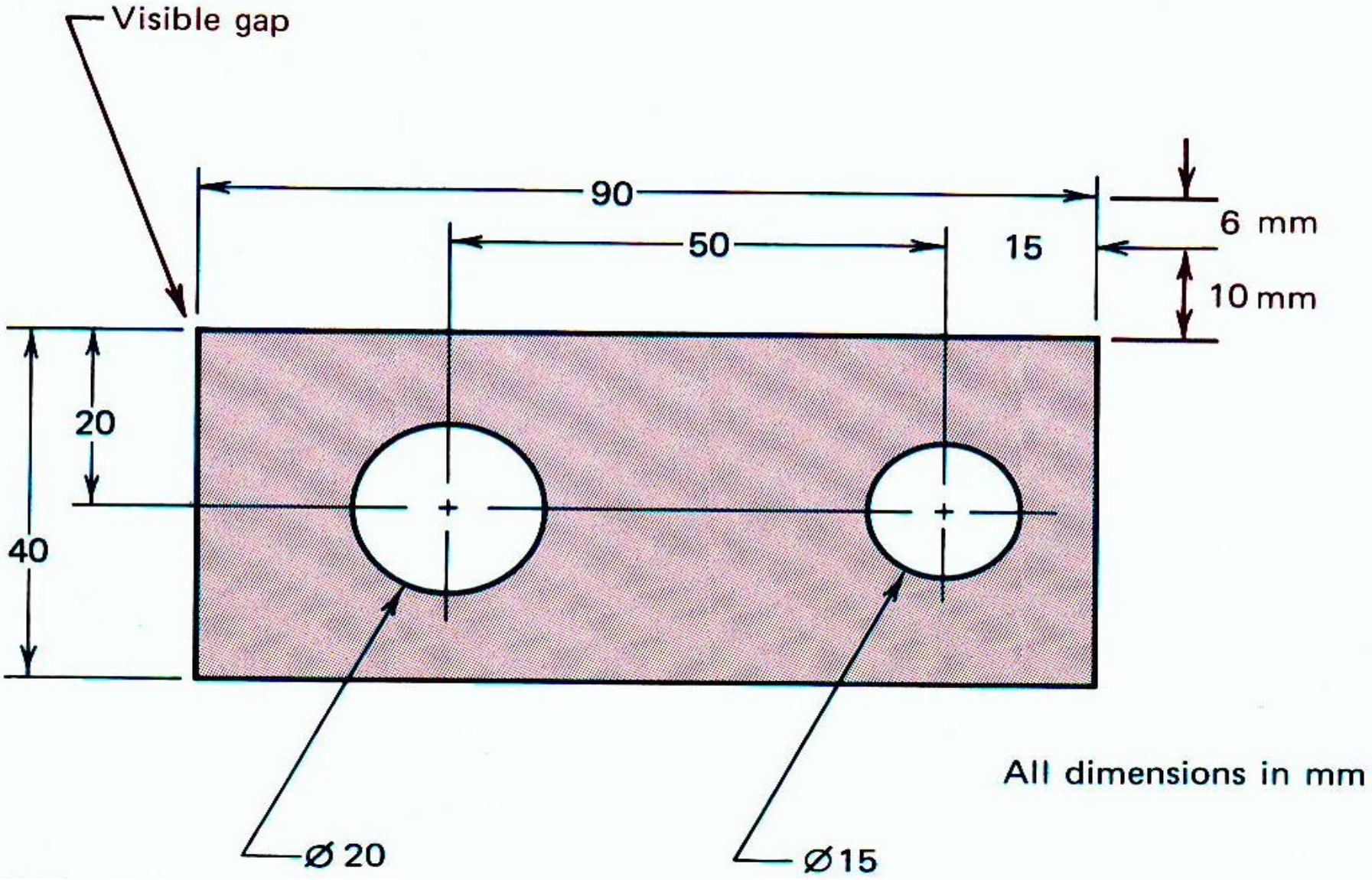


Fig 1



DIMENSIONING



Best practices for dimension & extension lines

5. Dimensions should be lined up and grouped together as much as possible, as in Figure 2a, and not as in Figure 2b.
6. In some cases, extension lines and center-lines must cross visible lines of the object (Figure 3a). When this occurs, gaps should not be left in the lines (Figure 3b).

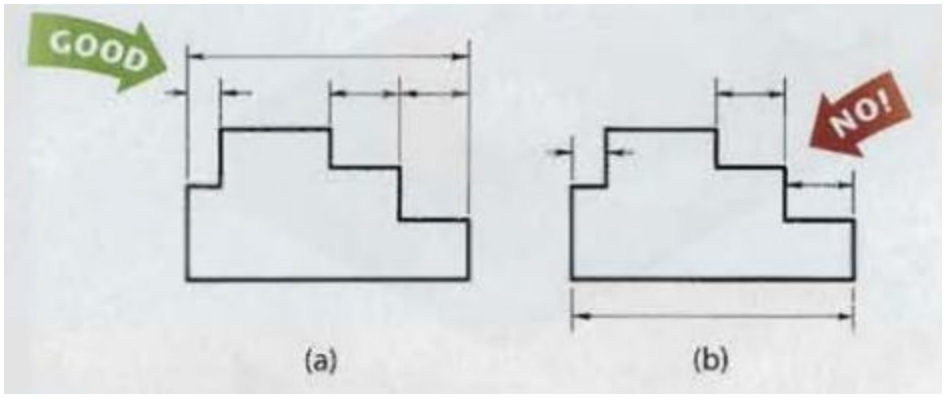


Fig 2

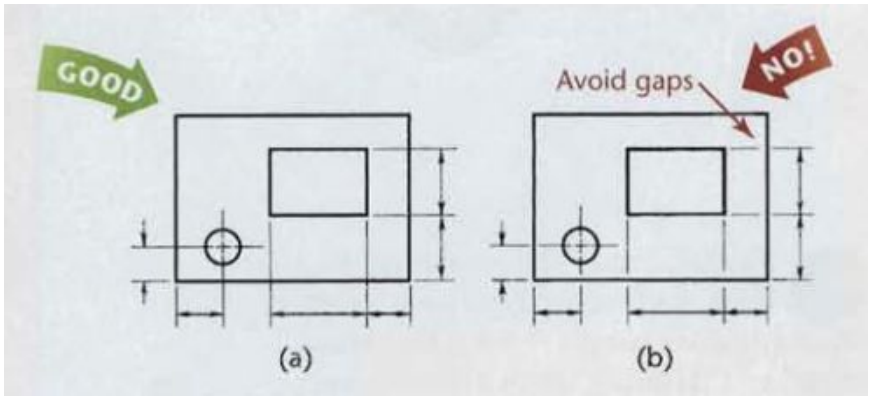
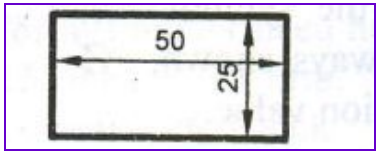
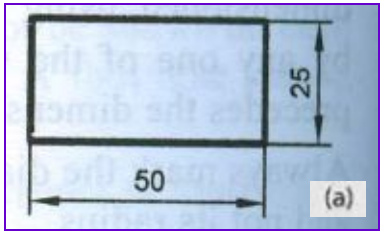
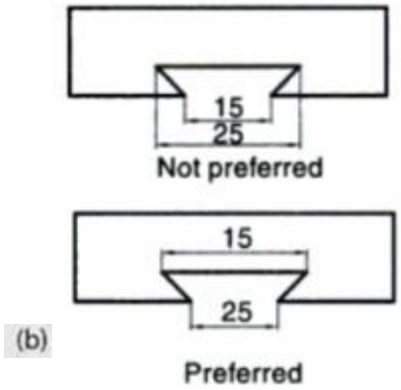


Fig 3

7. Dimensions should be placed outside the views (a). Placed inside if more clear and readable (b).







Best practices for arrowheads & centerlines

1. Arrowheads should ordinarily be drawn within the limits of the dimensioned feature. But when the space is too narrow, they may be placed outside (fig 4)

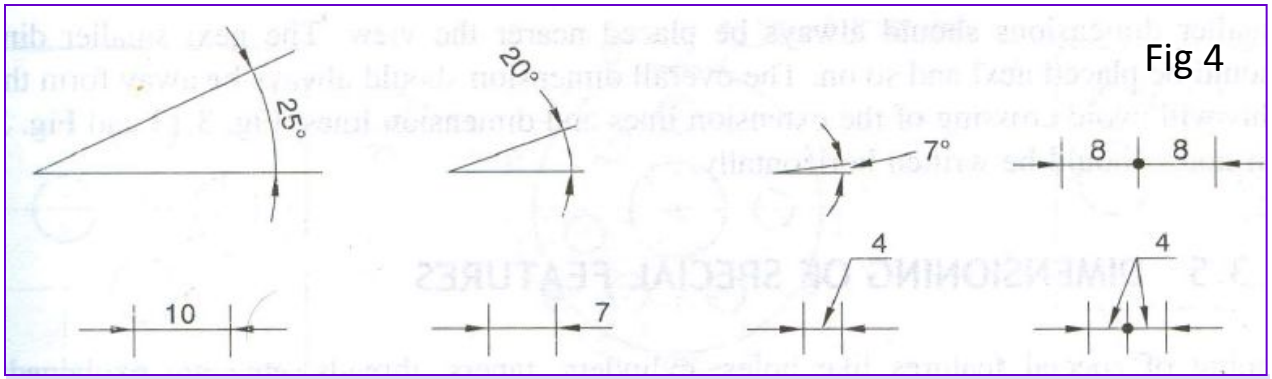


Fig 4

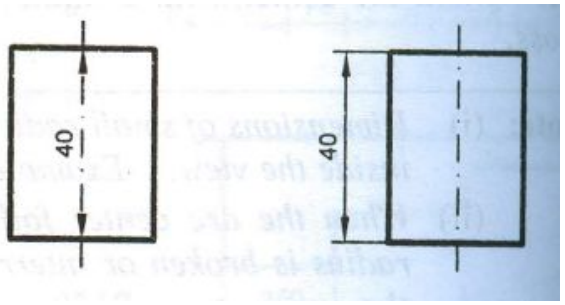


Fig 5a

1. Center line(axis) itself shall not be used as a dimension line with arrowheads as its ends. Fig 5a
2. Center line(axis) itself shall not be used as a dimension line with arrowheads as its ends. Fig 5b

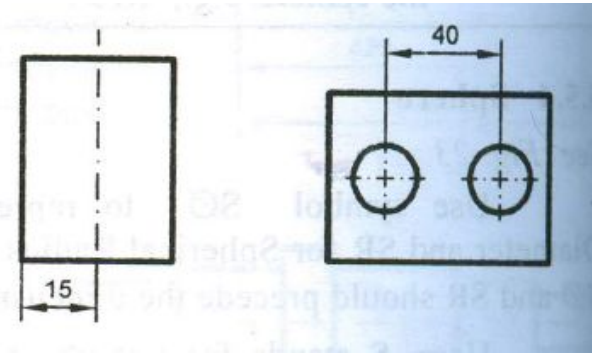


Fig 5b

3. Center-lines should not extend from view to view.

Best practices for dimensions

1. All dimensions must be given. There should not be need for calculation, assumption or direct measurement for any dimension. Dimension should be on feature's best view.
2. Each dimension should be given only once. No dimension should be redundant / superfluous (repeated) (fig 6). Not even on another view (fig 7) or by different ways.

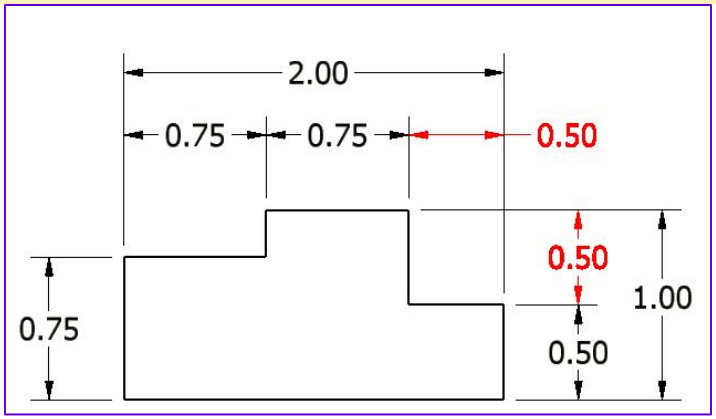


Fig 6

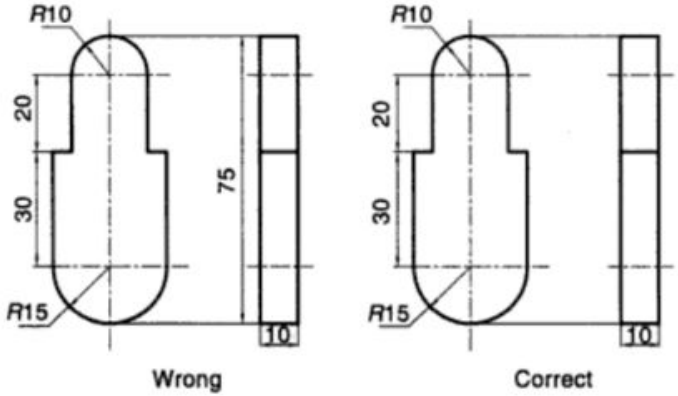
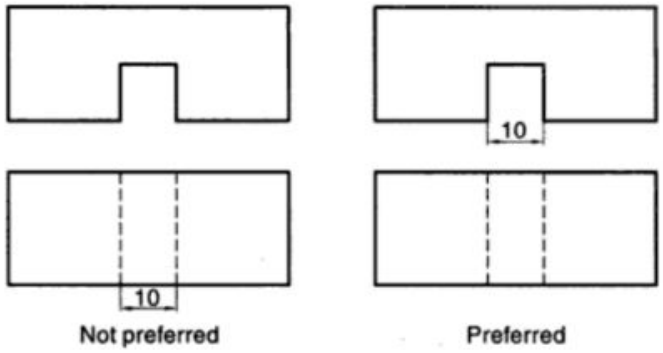


Fig 7

3. Dimensions shall be given to visible lines and not to hidden lines
4. Each feature is dimensioned and positioned where its shape shows.



Best practices for dimensioning pictorial view

1. Principal lines are dimensioned in pictorial view. Dimension and extension lines are drawn in directions that are parallel to the principal lines. For non-principal lines, its coordinates, in the direction parallel to the principal lines are given. (fig L)

Fig L

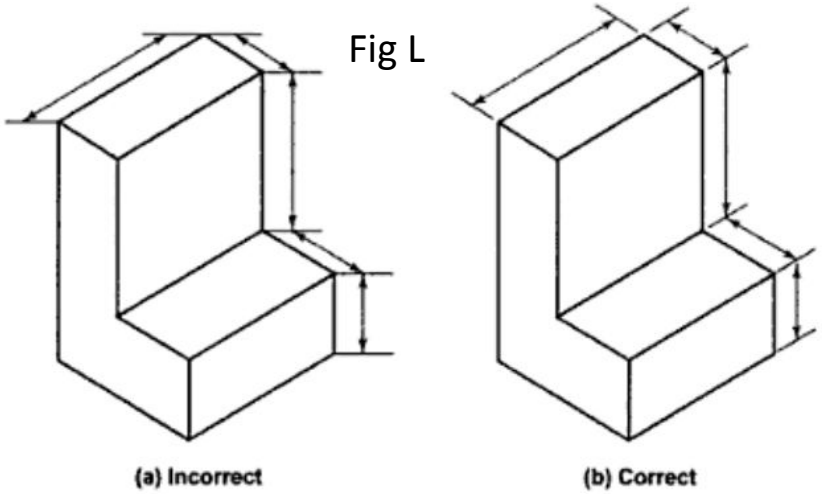
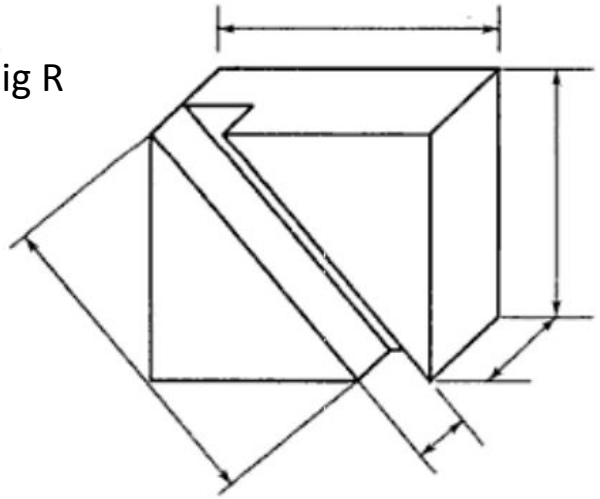


Fig R

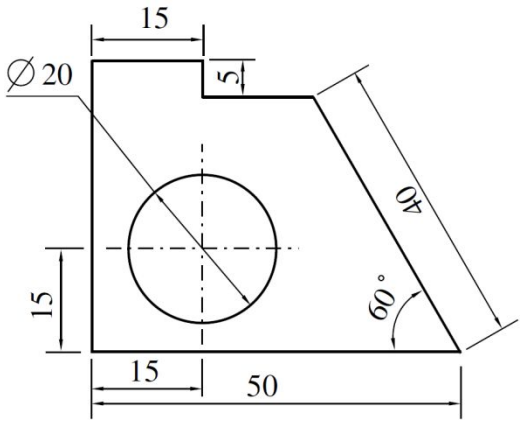


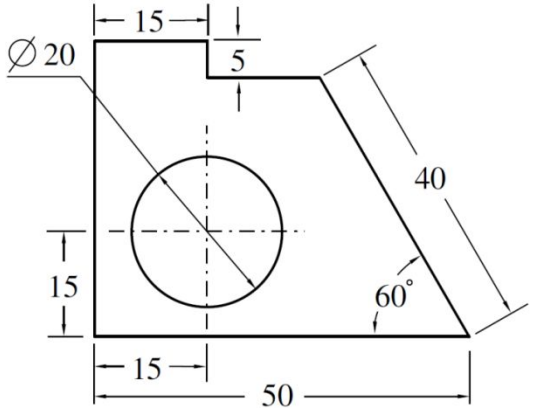
2. In case of oblique parallel projections, along with principal lines, those lines which are projected with true length are also dimensioned. In those cases, extension lines are drawn perpendicular to dimension lines. (fig R)

Systems of dimensioning

For placing the dimensions on the drawing, following systems can be adopted.

Aligned system	Unidirectional system
1. Dimensions are placed perpendicular to the dimension line. 2. Horizontal and inclined dimensions can be read from the bottom of the drawing. Vertical dimensions can be read from the right-hand side of the drawing. 3. All dimensions are placed above the midpoint of dimension lines.	1. Dimensions are placed vertically irrespective of dimension lines. 2. All dimensions can be read from the bottom of the drawing. 3. Horizontal dimensions are placed above the midpoint of dimension lines. Vertical and inclined dimensions are placed at the middle of dimension lines by breaking them.



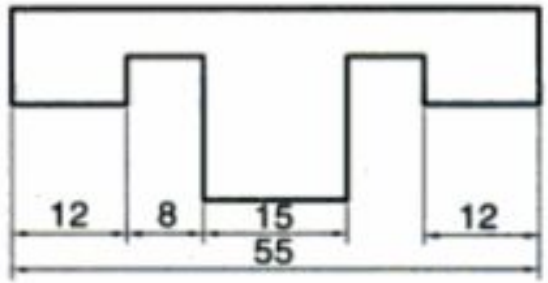


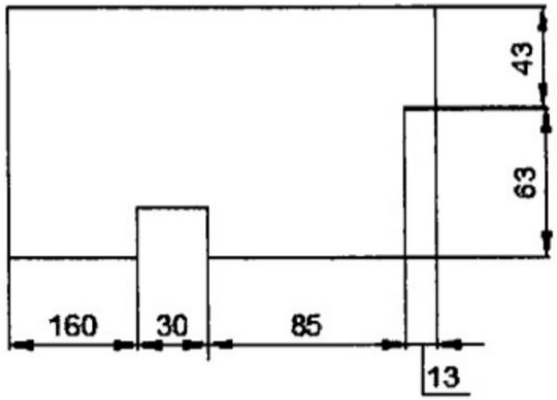
Note

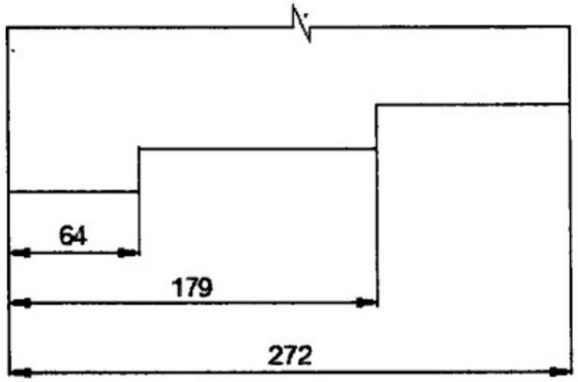
All the dimensions on a drawing must be shown using either Aligned System or Unidirectional System. Two systems should not be mixed on the same drawing.

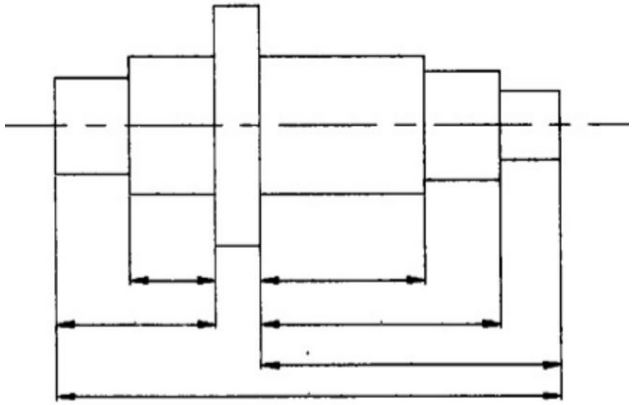
Arrangement of dimensions

Chain dimensioning	Parallel dimensioning	Combined dimensioning
All dimensions are aligned in such a way that an arrowhead of one dimension touches tip-to-tip the arrowhead of adjacent dimension. The overall dimension is placed outside the other smaller dimensions.	All dimensions are shown from a common reference line. All dimensions share a common extension line. This is adopted when dimensions have to be established from a particular datum surface.	Both the methods (chain & parallel) are used on the same drawing
Used when the possible accumulation of tolerances does not endanger the fundamental requirement of the component.	Used where a number of dimensions have a common datum feature	



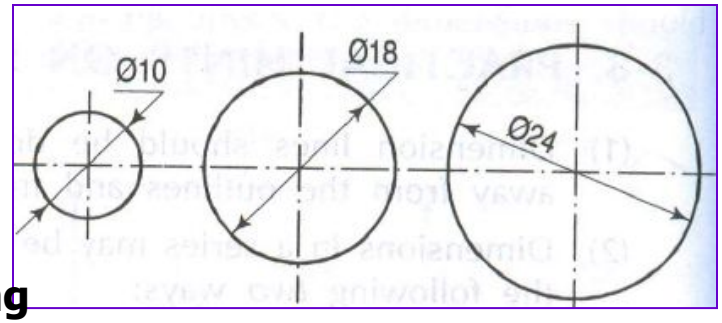






Dimensioning of circular features

1. By diameter instead of radius, precede by Ø symbol, leaders.
2. For more than 1 hole of same Ø, the dim. of a hole with a note will give idea about the dimensions of all the holes. (fig 8a,b) **Hole dimensioning**



If there are different categories (each with same Ø holes) of holes, use reference letters and noted below the view. (fig 8b)

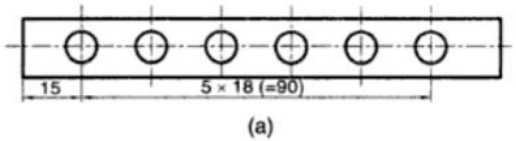
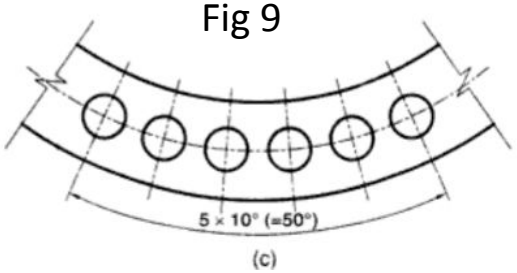
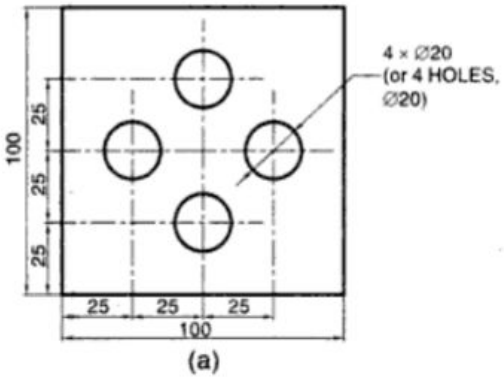


Fig 9





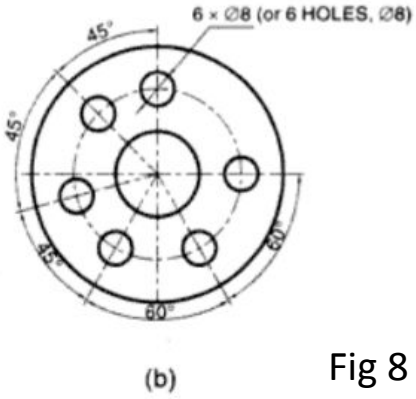
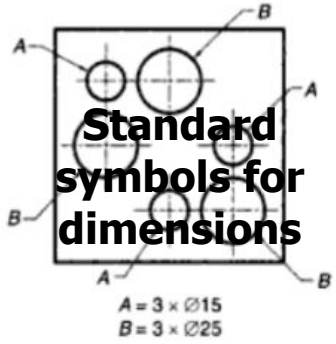


Fig 8



Equispaced holes (fig 9) where 5x18 means 6 holes center-to-center distance 18mm

Dimensioning of arc, fillets, angles & cyl.

Arc shown by radius, precede by *R* symbol, center marked by cross, leaders. For large or small arc, center mark is omitted (10)

Cyl. dimensioning

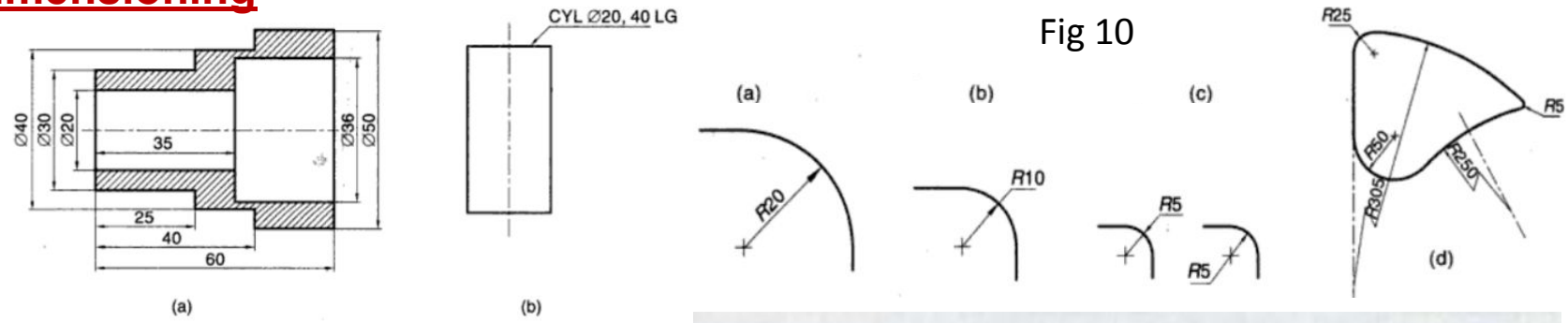
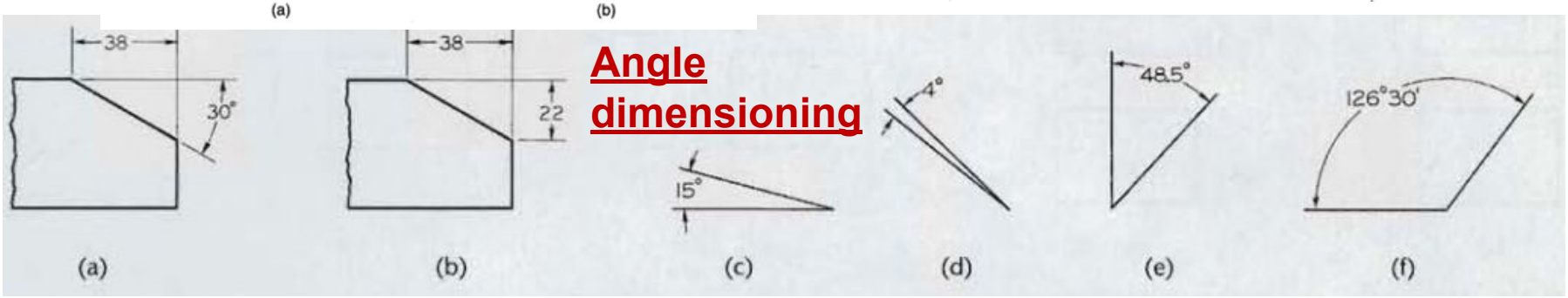


Fig 10

Angle dimensioning

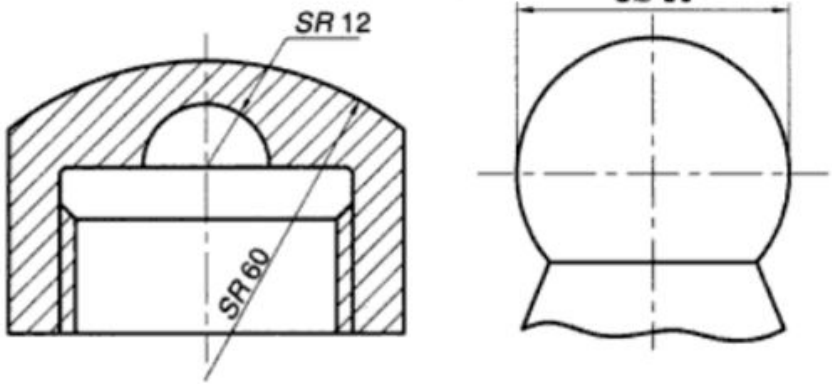


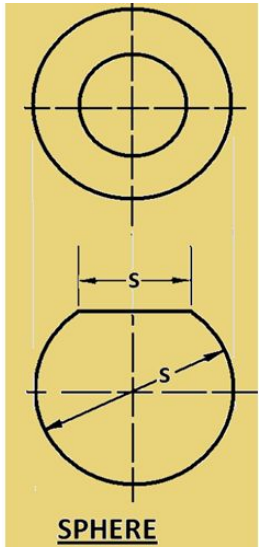
Fillets are of standard size, such as metric R3 and R6. Thus, a note in the or simply lower portion of the drawing is given.

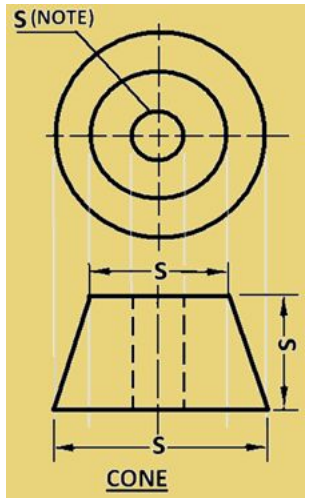
FILLETS R6 AND ROUNDS R3 UNLESS OTHERWISE SPECIFIED or
ALL CASTING RADII R6 UNLESS NOTED or
ALL FILLETS AND ROUNDS R6.

Dimensioning of spherical, conical, tapered

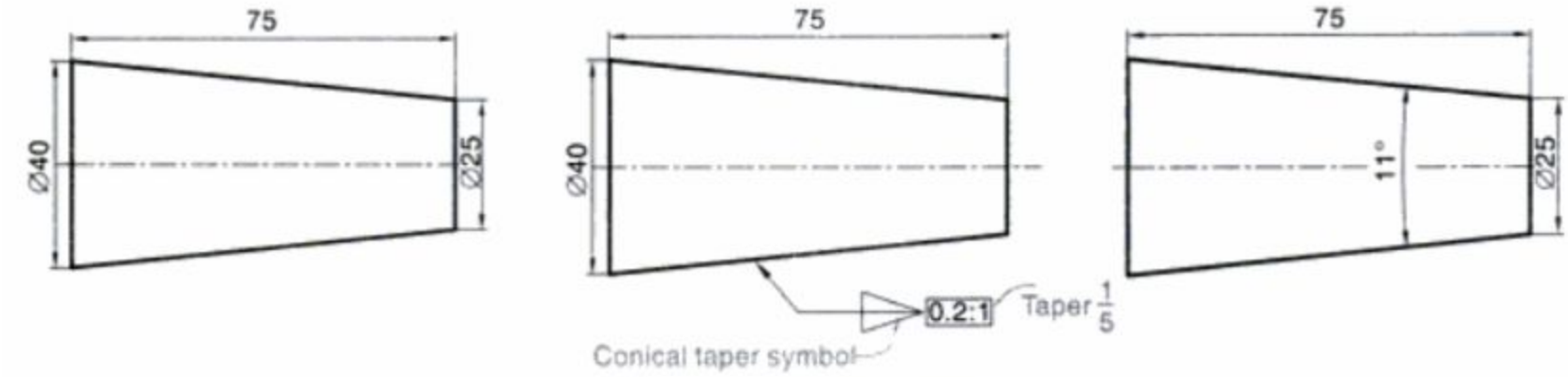
Spherical feature dimensioning



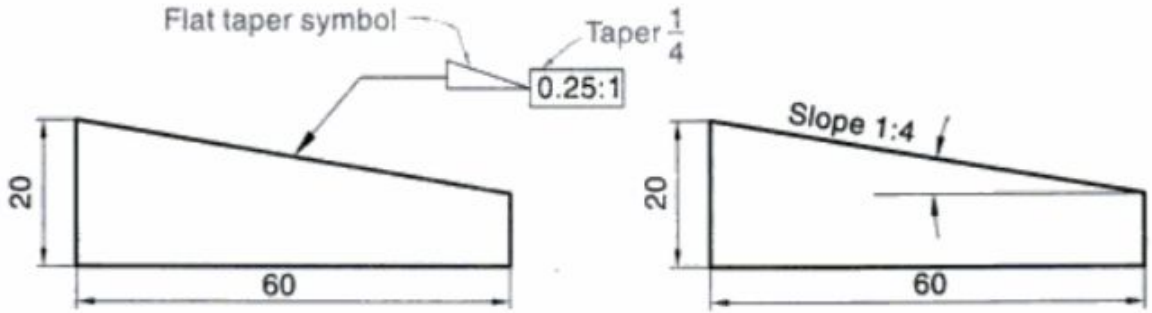




Conical feature dimensioning

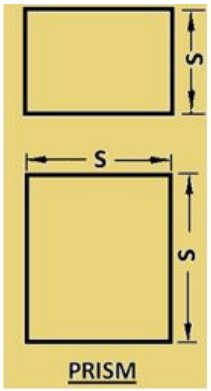


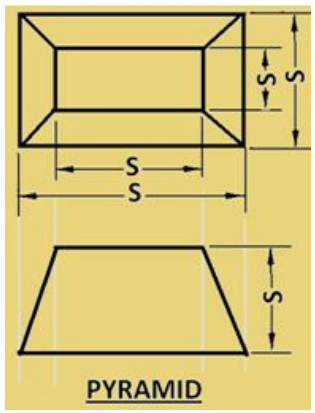
Flat tapered feature dimensioning



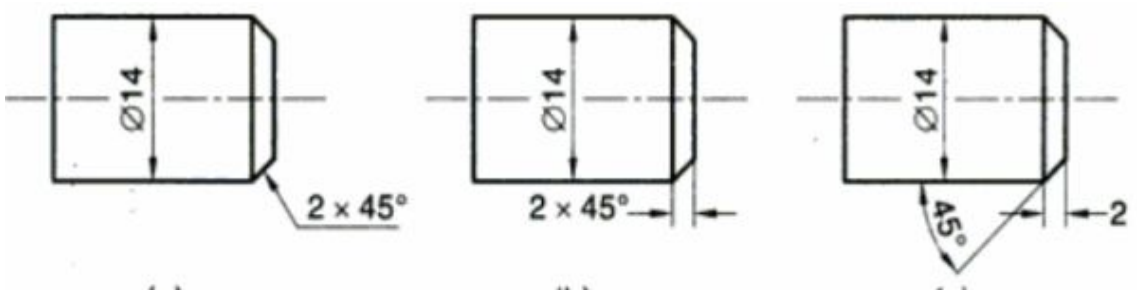
Dimensioning- square, chamfered, countersunk

Square feature dimensioning

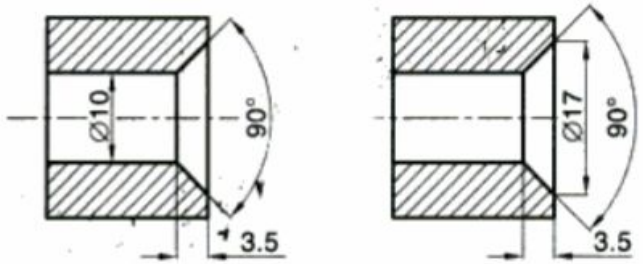




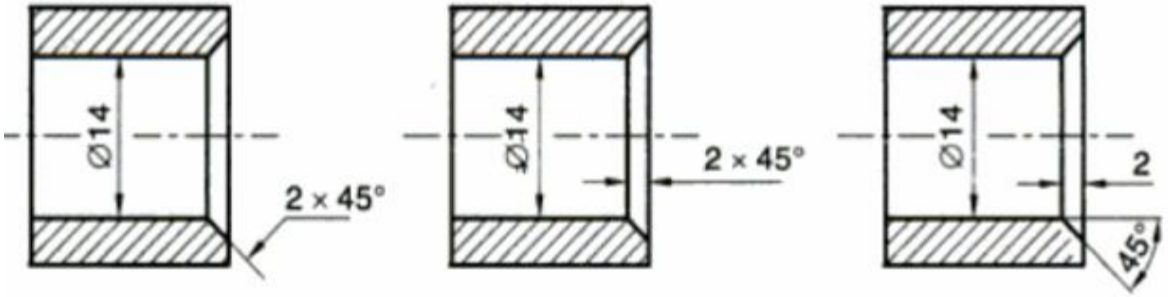
External Chamfer dimensioning

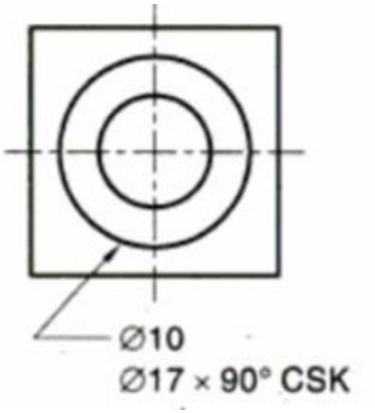


Countersunk dimensioning

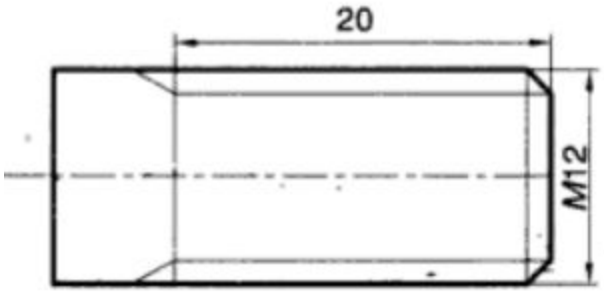


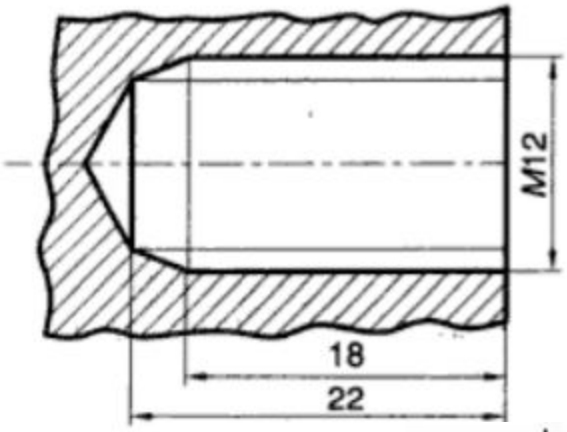
Internal Chamfer dimensioning





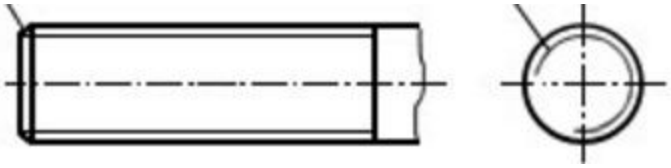
Dimensioning- screw threads



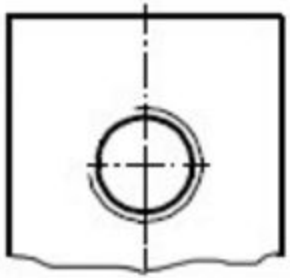


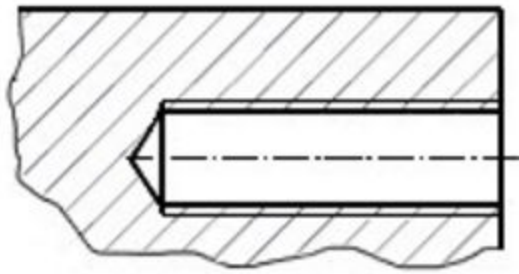
Metric thread
Nominal dia. = 12mm
Depth of drilled hole = 22mm
Threaded length = 18mm

External thread



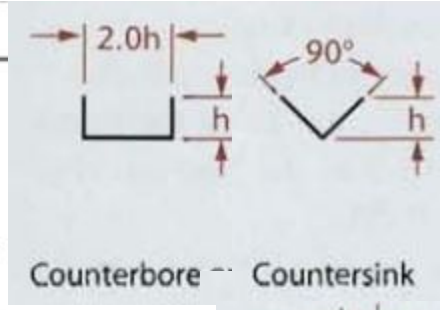
Internal thread



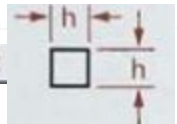


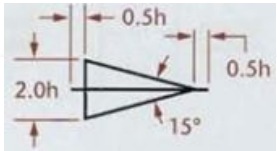
Symbols & abbreviations used in dimensioning

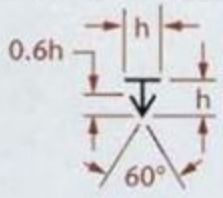
Symbol/Abbreviation	*Meaning*	*Symbol/Abbreviation*	*Meaning*
ϕ	Diameter	LG	Long
$S\phi$	Spherical Diameter	CSK	Countersunk
R	Radius	C'BORE	Counterbore
SR	Spherical Radius	SF or S'FACE	Spotface
□ or SQ	Square		Conical Taper
CYL	Cylinder or Cylindrical		Flat taper
PCD	Pitch Circle Diameter	M	Metric Thread
EQ SP	Equispaced		

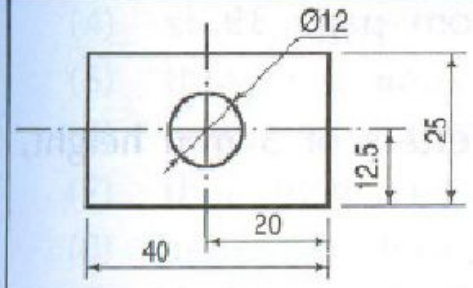
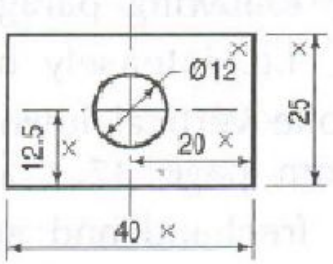
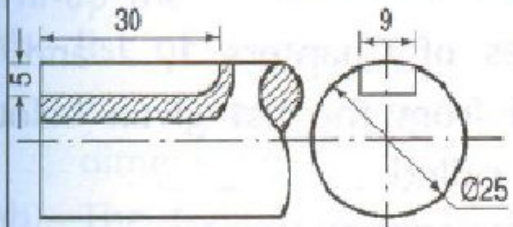
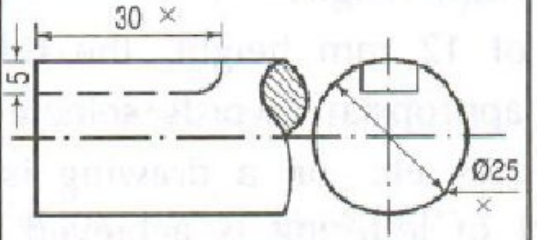
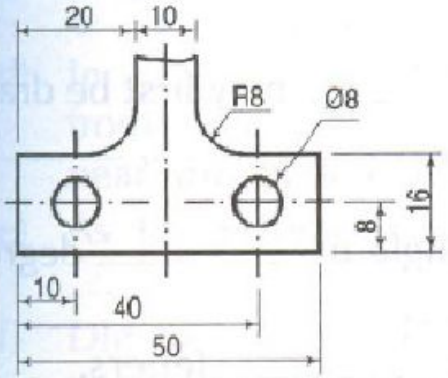
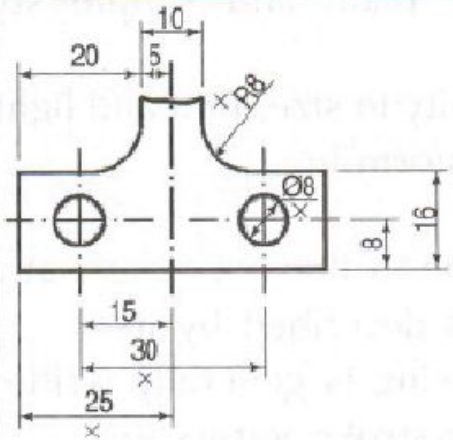


h = Letter height







	CORRECT	INCORRECT	REASONS FOR INCORRECT
(i)	 Dimensions should be placed outside view		1. Arrow head not proportionate. 2. Hole dimension shown in figure. Leader line not ends horizontally. 3. Dimension '40' is too close. 4. Placing dimensions methods mix. Dimension '40' is according to aligned method.
(ii)	 Dim. should be marked from visible outlines		1. A key-way is shown with dotted line where the dimensions are placed. 2. Leader line for the shaft diameter is drawn horizontal touching the boundary line.
(iii)	 Dimensions should be given from the outlines (finished surface) or a centre line of a hole		1. Dimensions are given form the mid-line of the object. 2. Dimensions of holes are shown inside the figure. 3. Dimensions are shown in vertical line. 4. Smaller dimensions (25 mm) precedes the larger dimensions (30 mm). 5. Fillet radius is not shown.

Lines

Visible line

Hidden line

Section line

Center line

Dimension line,
Extension line

Leaders

Cutting-plane
or
Viewing-plane
lines