GENERAL DIMENSIONING STYLES

Some of the fundamental rules and practices for general dimensioning used in CAD drawings are discussed next.

UNITS OF MEASURE

Two types of linear dimensioning are used in CAD drawings: **SI (Metric) Linear Units** and **U.S. Customary Linear Units**. For angular dimensioning, you can use degrees, minutes, or seconds type dimensioning. These dimensioning types are discussed next.

SI (Metric) Linear Units

The SI linear units are used in engineering drawings as millimeter dimensioning.

U.S. Customary Linear Units

The U.S. Customary linear units are used in engineering drawings as decimal inch dimensioning.

Identification of Linear Units

The drawings where all dimensions are in millimeters or inches, individual identification of linear units is not required. However, the drawing should contain a note stating, "UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS (or IN INCHES, as applicable)."

Combination of SI (Metric) and U.S. Customary Linear Units

If some inch dimensions are shown on a millimeter dimensioned drawing, the abbreviation IN shall follow the inch values. If some millimeter dimensions are shown on an inch-dimensioned drawing, the symbol mm shall follow the millimeter values.

Angular Units

Angular dimensions can be expressed in both degrees and decimal parts of a degree. It is further divided in three types: Degrees (°), Minutes (‘), and Seconds (“). All these types of angular units are represented in Figure 1.

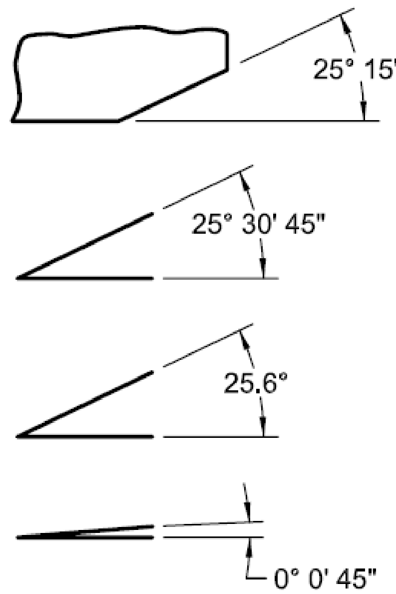


Figure 1 Preview of Angular units

TYPES OF DIMENSIONING

Mainly two types of dimensioning are used in CAD drawings: Millimeter Dimensioning and Inch Dimensioning. These two dimensioning types are discussed next.

Millimeter Dimensioning

1. Where the dimension is less than one millimeter, a zero precedes the decimal point, refer to Figure 2.
2. Where the dimension is a whole number, neither the decimal point nor zero is added, refer to Figure 2.
3. Where the dimension exceeds a whole number by a decimal fraction of one millimeter, the last digit to the right of decimal point is not followed by zero, refer to Figure 2.

Inch Dimensioning

1. A zero is not added before the decimal point for values less than one, refer to Figure 3.
2. Zero added to the right of decimal is tolerance specific. It should be used only if needed, refer to Figure 3.

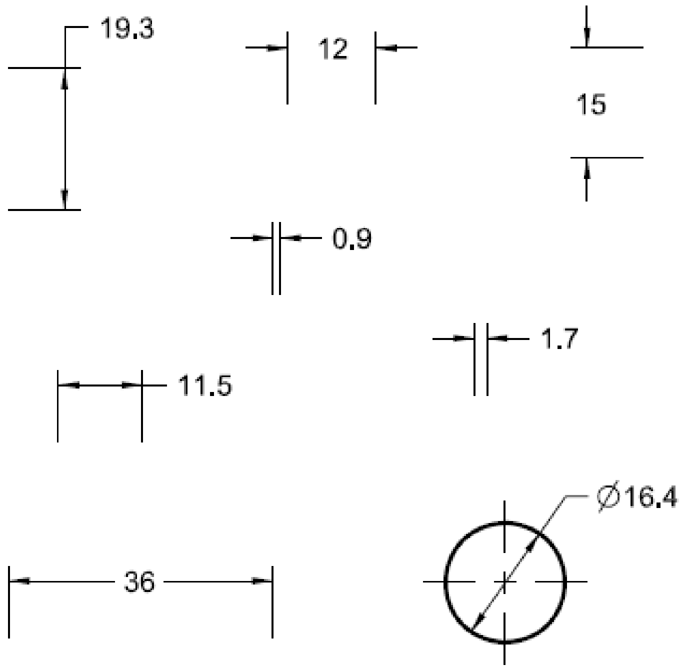


Figure 2 *Preview of Millimeter dimensioning*

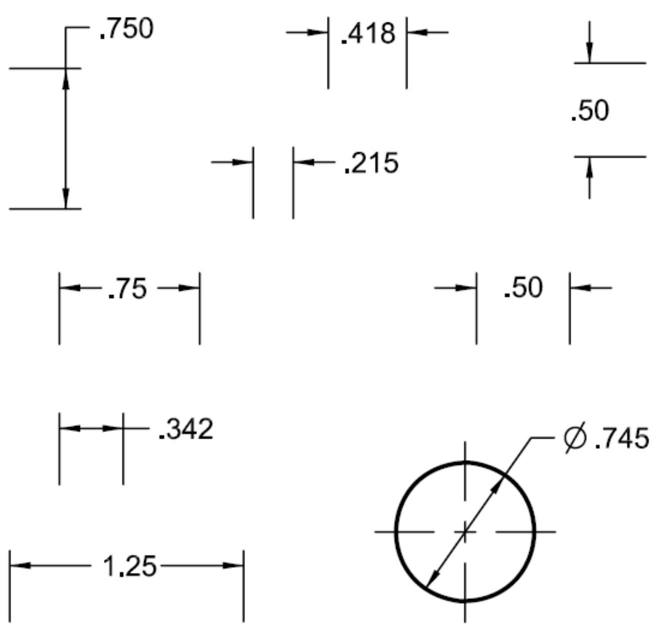


Figure 3 *Preview of Inch dimensioning*

APPLICATION OF DIMENSIONS

Dimensions are applied by means of dimension lines, extension lines, chain lines, or a leader from a dimension, note, or specification directed to the appropriate feature. General notes are used to convey additional information. Different types of dimensions representations are discussed next.

Dimension Lines

The dimensions should have proper offset extension values. There should also have proper arrowhead size, refer to Figure 4. Further methods and applications of drawing are discussed next.

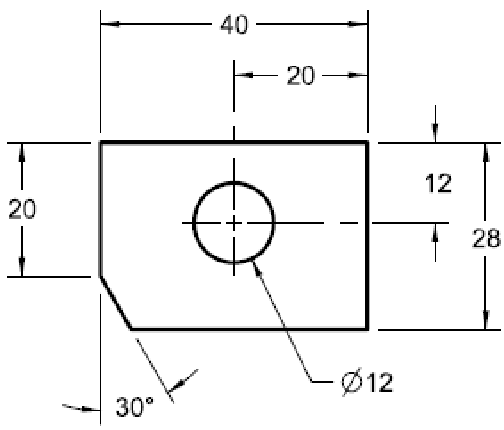


Figure 4 *Preview of extended dimension lines*

Alignment of Dimensions

Dimension lines should be proper aligned and grouped for uniform appearance, refer to Figure 5.

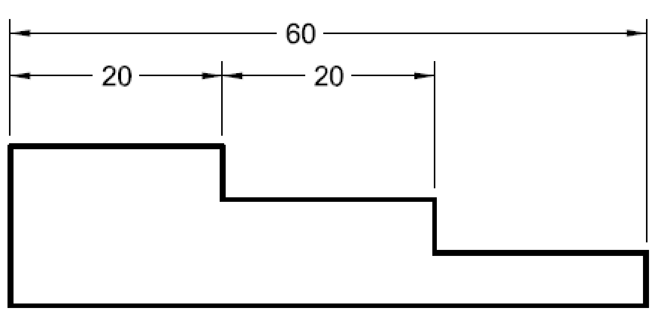


Figure 5 *Preview of dimensioning alignment*

Spacing between Dimensions

The space between the first dimension line and the part outline should not be less than 10 mm and the succeeding dimension lines should not be less than 6 mm, refer to Figure 6.

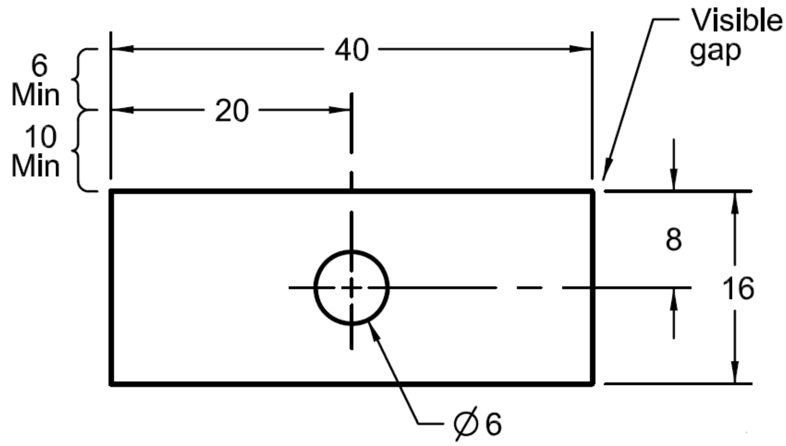


Figure 6 *Spacing between dimensions*

Angle Dimensions

The dimension line of an angle is an arc drawn with its center at the apex of the angle. The arrowheads terminate at the extensions of two sides, refer to Figure 1.

Crossing Dimension Lines

Crossing dimension lines should be avoided. Where unavoidable, the dimension lines are unbroken.

Extension (Projection) Lines

Extension lines are used to indicate the extension of a surface or point to a location preferably outside the part outline. It starts with a short visible gap from the outline of the part and extends beyond the outermost related dimension line, refer to Figure 4. Different types of extension line representations are discussed next.

Projection of Extension Lines

If the space is limited for dimensioning, then the extension lines may be drawn at an oblique angle for clear visibility, refer to Figure 7.

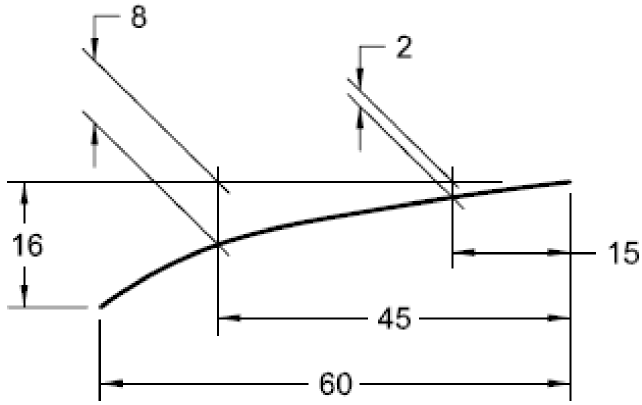


Figure 7 Oblique Extension Lines dimensions

Crossing Extension Lines

Wherever practicable, extension lines should neither cross one another nor cross dimension lines. If the extension lines cross arrowheads or dimension lines close to arrowheads, a break in the extension line is permissible, refer to Figure 8.

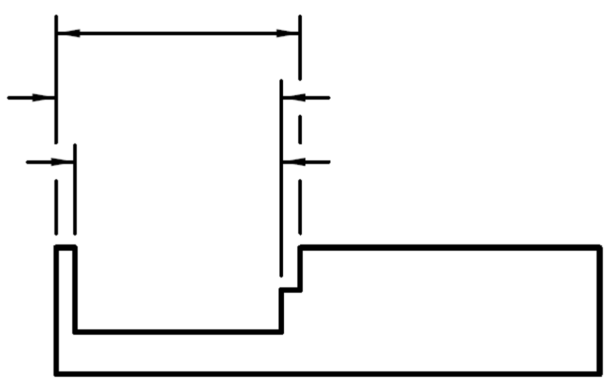


Figure 8 Breaks in Extension Lines of dimensions

Locating Points or Intersections

If the dimension is given from a radii corner, there should be an intersection point on that corner, refer to Figure 9.

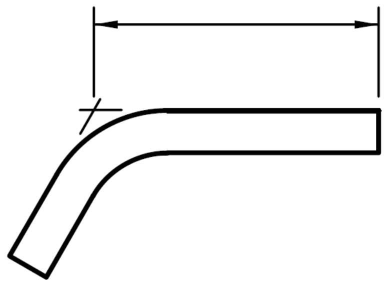


Figure 9 Locating point for dimension

Limited Length or Area Indication

If you need to indicate a limited length or area of a surface for additional treatment or consideration, then the extent of these limits may be indicated by using a chain line. Use of these dimension types is discussed next.

Chain Lines

In an appropriate view or section, a chain line is drawn parallel to the surface profile at a short distance from it. Dimensions are added for length and location. If applied to a surface of revolution, the indication may be shown on one side only, refer to Figure 10.

Omitting Chain Line Dimensions

If the chain line clearly indicates the location and extent of the surface area, dimensions may be omitted, refer to Figure 11.

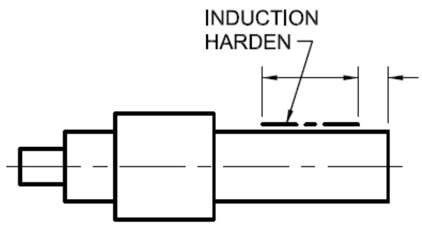


Figure 10 Chain line dimension

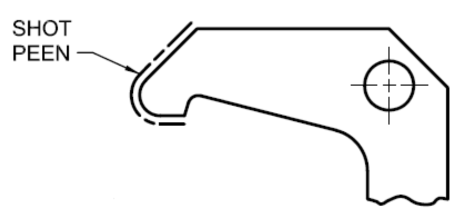


Figure 11 Omitting Chain line dimension

Area Indication Identification

When the desired area is shown on a direct view of the surface, then the area will be located using a section boundary, refer to Figure 12.

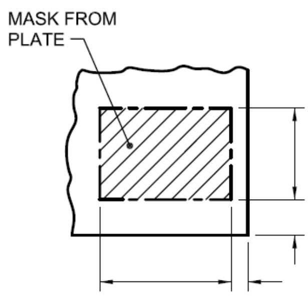


Figure 12 Dimension for area indication

Leaders (Leader Lines)

A leader is used to direct a dimension, note, or symbol to the intended place on the drawing. A leader is represented by an arrowhead and should be inclined straight line. Two or more leaders to adjacent areas on the drawing should be drawn parallel to each other. Various ways to represent leaders in a drawing is discussed next.

Leader-Directed Dimensions

Leader-directed dimensions are specified individually to avoid complicated leaders, refer to Figure 13. When too many leaders would impair the legibility of the drawing, letters or symbols should be used to identify features, refer to Figure 14.

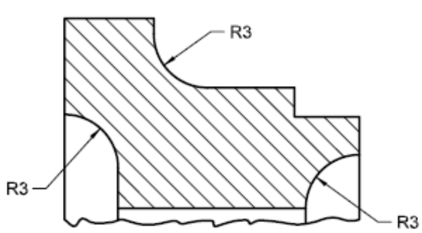


Figure 13 Leader-Directed Dimensions

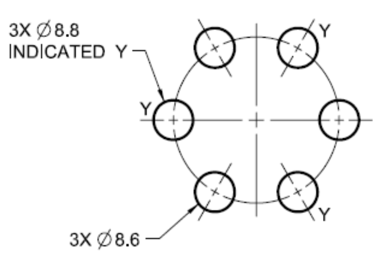


Figure 14 Minimizing Leaders

Leader-Circle and Arc

When a leader is directed to a circle or an arc, its direction should be radial, refer to Figure 15.

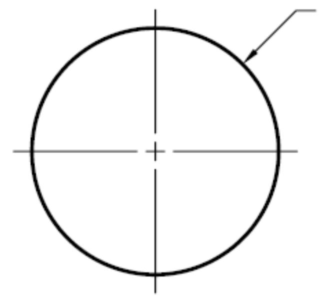


Figure 15 *Leader style for circle and arc*

Reading Direction

Every drawing should be in a standard format that could be easily readable. Reading direction for different specifications of drawing is given next.

Notes

Notes should be placed to read from the bottom of the drawing with regard to the orientation of the drawing format.

Dimensions

Dimensions shown with dimension lines and arrowheads should be placed to read from the bottom of the drawing.

Baseline Dimensioning

Baseline dimensions can be used for better visibility of dimensions. They are shown aligned to their extension lines and read from the bottom or right side of the drawing, refer to Figure 16.

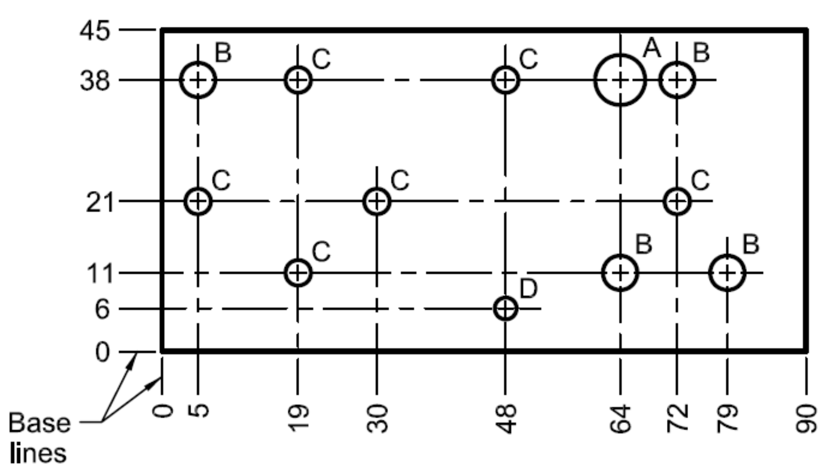


Figure 16 *Baseline dimensioning*

Feature Control Frames
Feature control frames should be placed to read from the bottom of the drawing.

Datum Feature Symbols
Datum feature symbols should be placed to read from the bottom of the drawing.

Reference Dimensions
Reference dimensions are shown by enclosing the dimension (or data) within parentheses, refer to Figure 17.

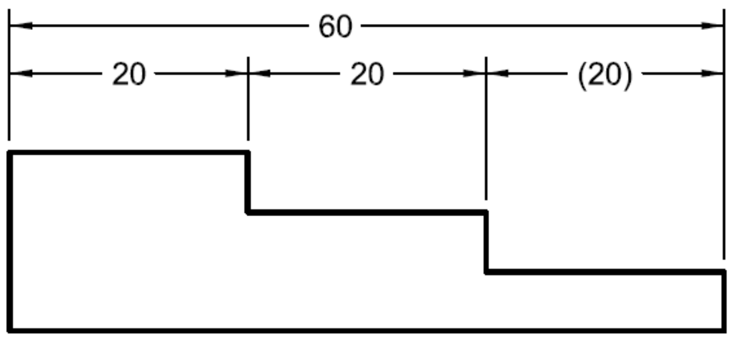


Figure 17 *Reference dimensioning*

Overall Dimensions
If an overall dimension is specified then one of the intermediate dimension is omitted or identified as a reference dimension, refer to Figure 17. If the intermediate dimensions are more important than the overall dimension, then the overall dimensions, if used, will be identified as a reference dimensions, refer to Figure 18.

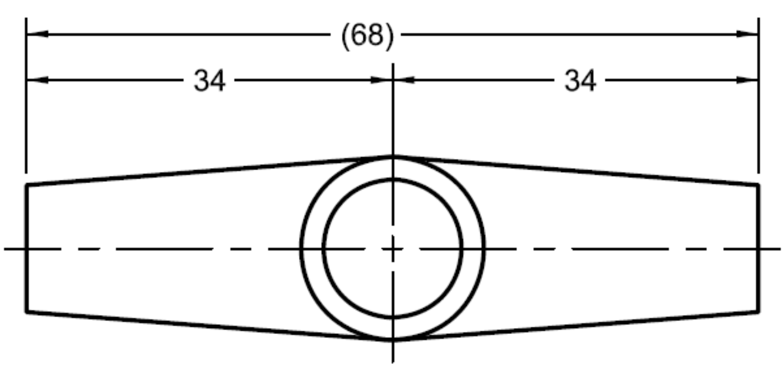


Figure 18 *Overall Reference dimensioning*

Dimensioning Within the Outline of a View

Dimensions are usually placed outside the outline of a view. If the directness of application forces it to be inside, or if the extension lines or leader lines are going to be excessively long, dimensions may be placed within the outline of a view also.

DIMENSIONING FEATURES

The features of some of the dimensioning styles are discussed next.

Diameters

You can use different types of diameter dimensioning for front or side view of a model. Each dimension should have diameter symbol, refer to Figure 19.

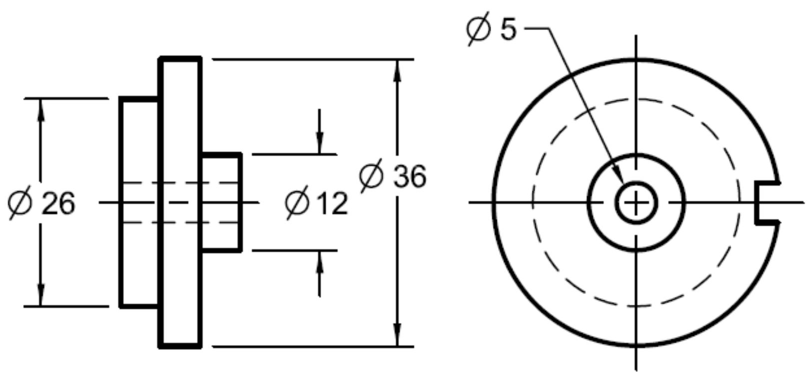


Figure 19 *Dimensioning of diameters*

Radii

You can use different types of radii dimensioning. Each dimension should have radius symbol, refer to Figure 20. Other methods of radii dimensioning are discussed next.

Center of Radius

In case of large radius dimension, radius should be center located and a small cross is drawn at the center, refer to Figure 21.

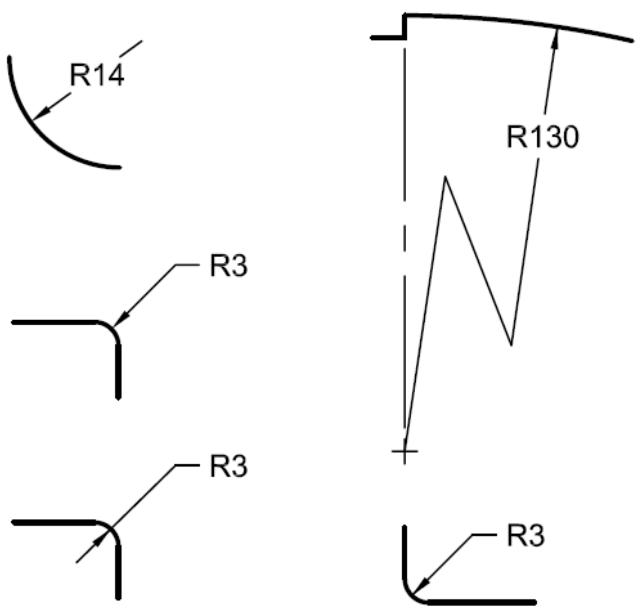


Figure 20 Dimensioning of radius

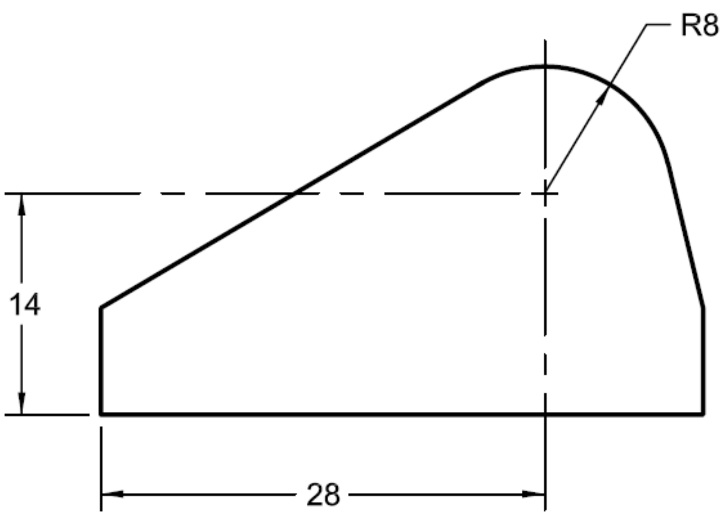


Figure 21 Center located radius dimension

Foreshortened Radii

If the center of a radius is outside the drawing or interferes with another view, the radius dimension line may be foreshortened, refer to Figure 22.

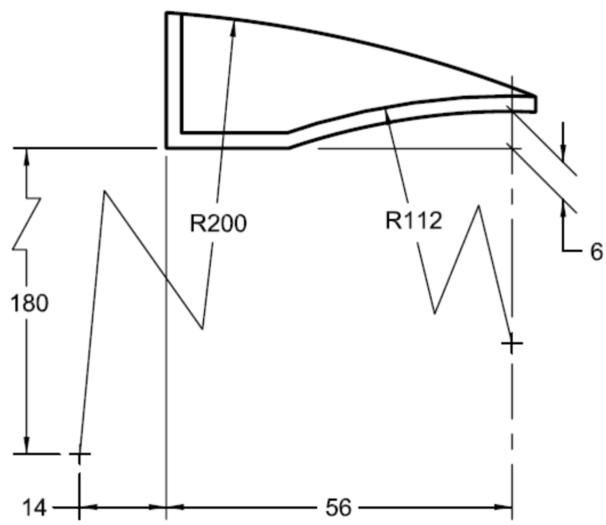


Figure 22 *Foreshortened radius dimension*

True Radius

On a 2D orthographic drawing, where a radius is dimensioned in a view that does not show the true shape of the radius, TRUE can be added before the radius dimension, refer to Figure 23.

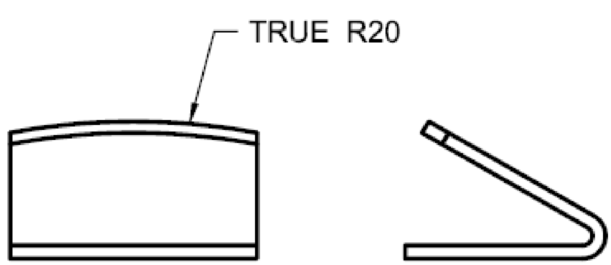


Figure 23 *True radius dimensioning*

Multiple Radii

If a part has a number of radii of the same dimension, a note may be used instead of dimensioning each radius separately.

Spherical Radii

If a spherical surface is dimensioned by a radius, the radius dimension can be preceded by the symbol SR, refer to Figure 24.

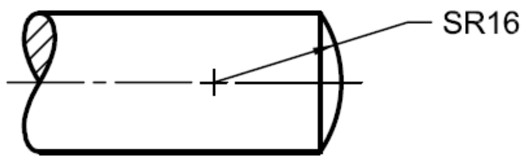


Figure 24 Spherical radius dimensioning

Chords, Arcs, and Angles

For dimensioning of chords or arcs, refer to Figure 25.

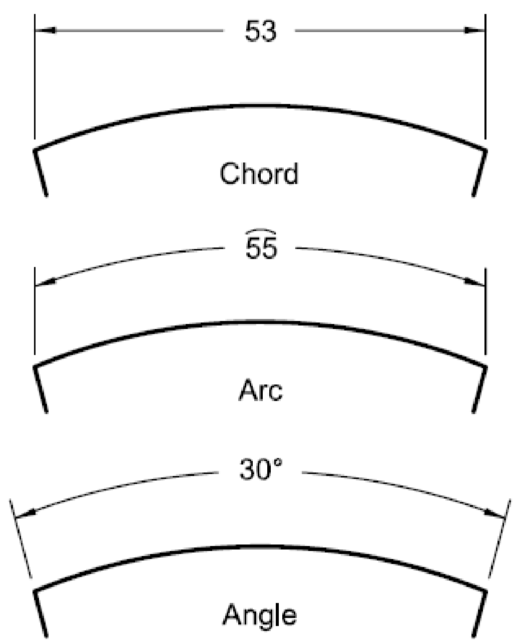


Figure 25 Dimensioning of chords or arcs

Rounded Ends and Slotted Holes

Features having rounded ends, including slotted holes, can be dimensioned as shown in Figure 26. For fully rounded ends, the radii are indicated but not dimensioned. For features with partially rounded ends, the radii can be dimensioned as shown in Figure 27.

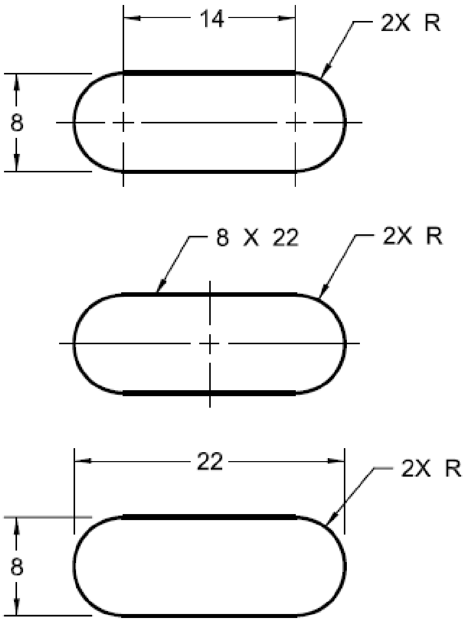


Figure 26 Dimensioning of slot

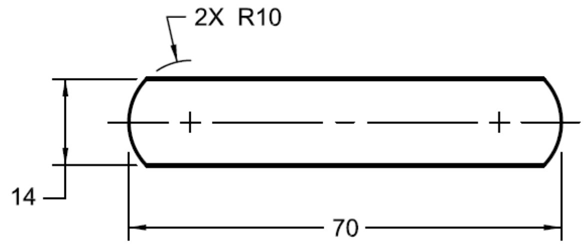


Figure 27 Dimensioning of partially rounded ends slots

Rounded Corners

If the corners are rounded, dimensions define the edges, and the arcs are tangent, refer to Figure 28.

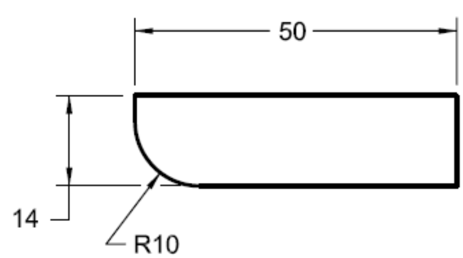


Figure 28 Dimensioning of rounded corners

Outlines Consisting of Arcs

A curved outline consisting of two or more arcs is dimensioned by giving the radii of all arcs and locating the necessary centers with coordinate dimensions. Other radii are located on the basis of their points of tangency, refer to Figure 29.

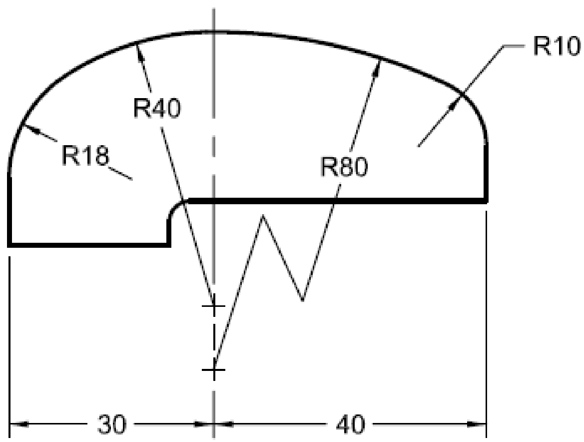


Figure 29 *Dimensioning of circular arc outline*

Irregular Outlines

Circular or non-circular outlines may be dimensioned by using the rectangular coordinate method. Coordinates are dimensioned from base lines, refer to Figure 30. When many coordinates are required to define an outline, the vertical and horizontal coordinate dimensions may be tabulated, refer to Figure 31.

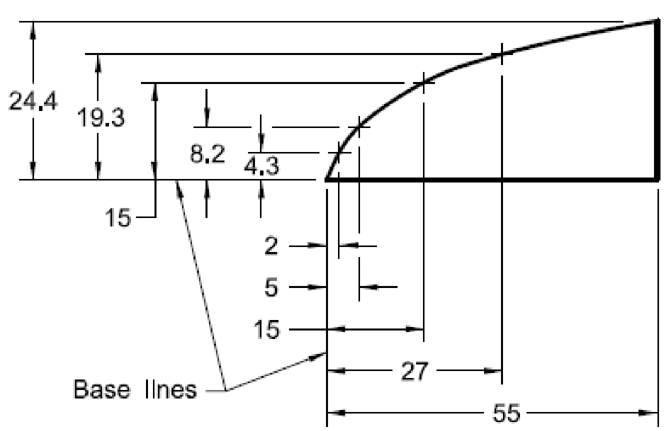
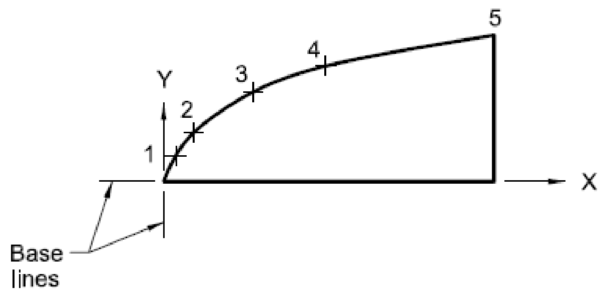


Figure 30 *Dimensioning of coordinate or offset outline*



STATION	1	2	3	4	5
X	2	5	15	27	55
Y	4.3	8.2	15	19.3	24.4

Figure 31 *The tabulated outline dimensions*

Grid System

Curved pieces that represent patterns may be defined by using the grid system with numbered grid lines.

Symmetrical Outlines

Symmetrical outlines may be dimensioned on one side of the center line of symmetry. This method can be used where space limitations occur due to the size of the part, refer to Figure 32.

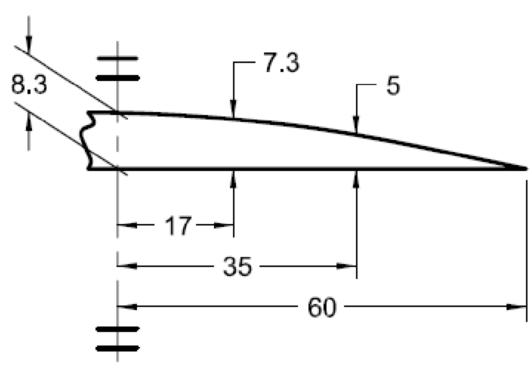


Figure 32 *Dimensioning of symmetric outlines*

Round Holes

For dimensioning of round holes, refer to Figure 33.

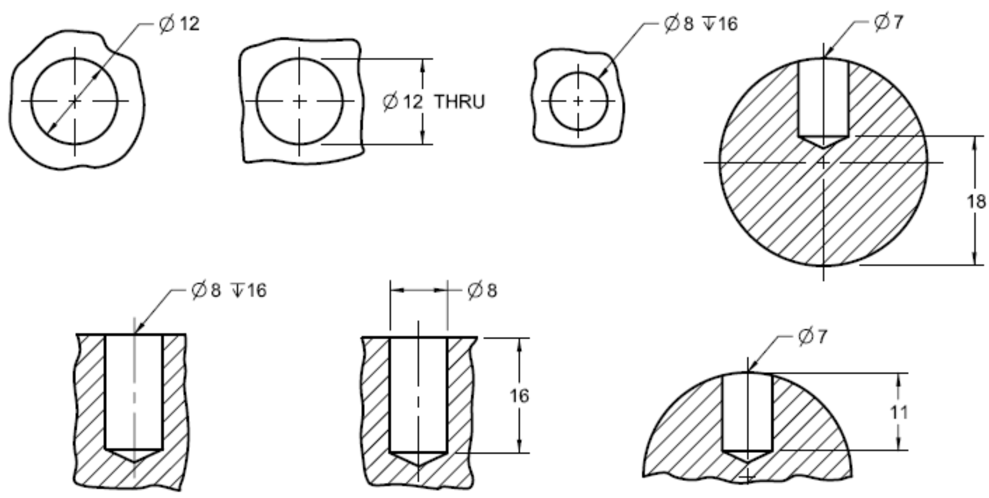


Figure 33 *Dimensioning of round hole*

Counterbored Holes

For dimensioning of counterbored holes, refer to Figure 34. If the holes have multiple counterbore then you can use dimension pattern as shown in Figure 35a. The Description of multi counterbored holes dimension is shown in Figure 35b.

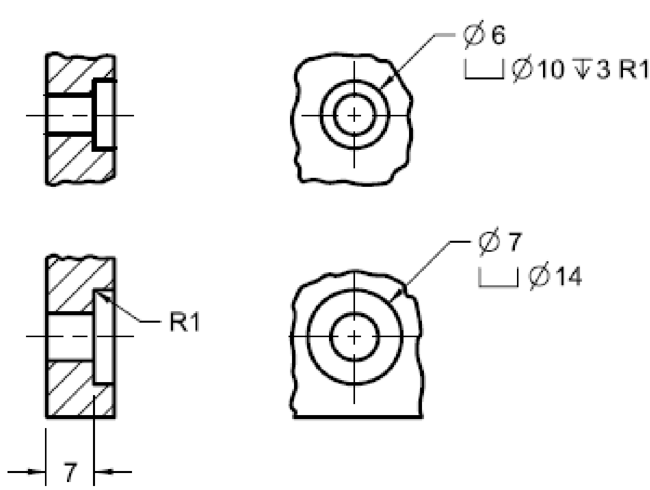


Figure 34 *Dimensioning of counterbored holes*

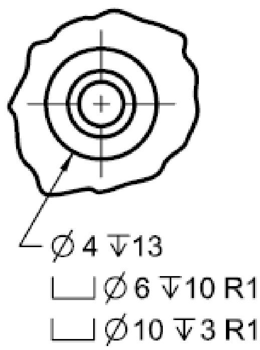


Figure 35a *Dimensioning of multi counterbored holes*

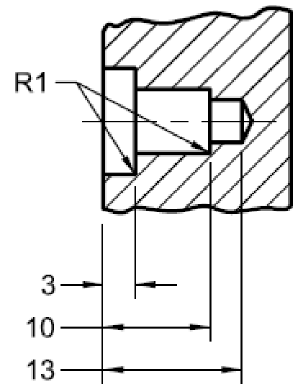


Figure 35b *Description of multi counterbored holes dimension*

Countersunk and Counterdrilled Holes

Refer to Figure 36 and Figure 37 respectively for dimensioning of countersunk and counterdrilled holes.

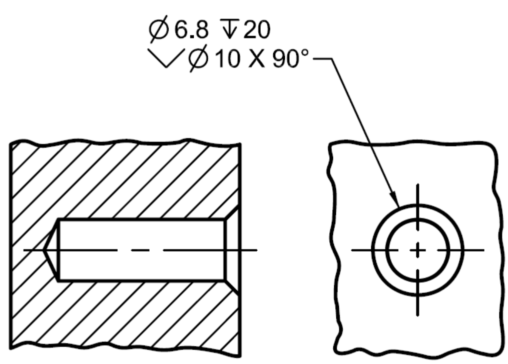


Figure 36 *Dimensioning of countersunk holes*

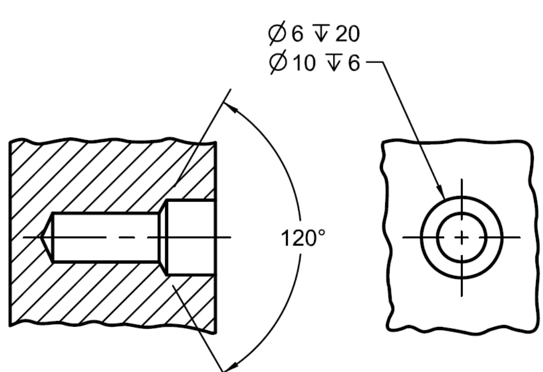


Figure 37 *Dimensioning of counterdrilled holes*

Chamfered and Countersunk Holes on Curved Surfaces

If a hole is chamfered or countersunk on a curved surface, the diameter will be specified on the minor diameter of the chamfer or countersink, refer to Figure 38.

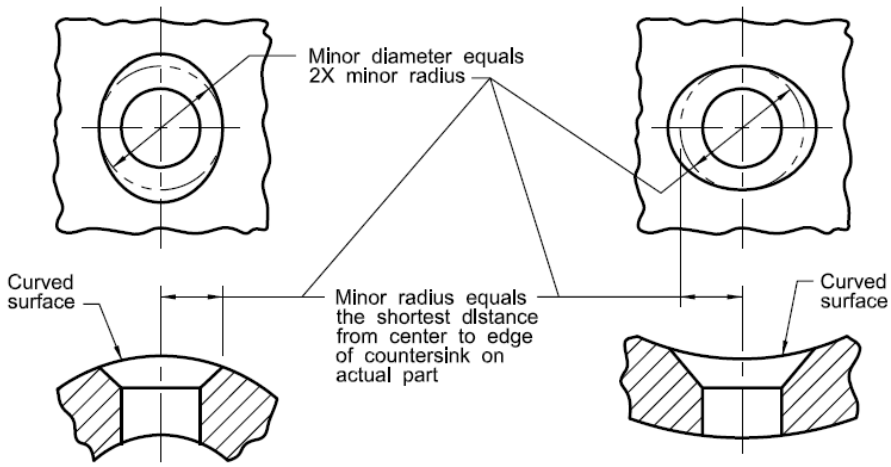


Figure 38 *Dimensioning of countersink on a curved surface*

Spotfaces

If the diameter of the spotfaced surface is specified, either the depth or the remaining thickness of material may be specified. If no depth or remaining thickness of material is specified, the spotface is the minimum depth necessary to clean up the surface to the specified diameter. Where applicable, a fillet radius may be indicated for the spotface. In some cases, such as with a through hole, a notation may be necessary to indicate the surface to be spotfaced, refer to Figure 39a. The Description of spotfaced holes dimension is shown in Figure 39b.

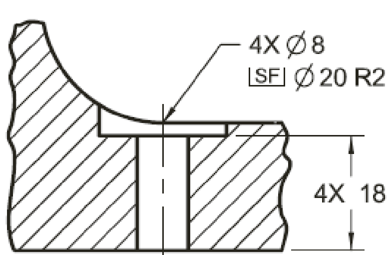


Figure 39a *Dimensioning of spotfaced holes*

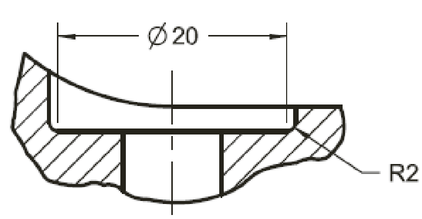


Figure 39b *Description of spotfaced holes dimension*

Machining Centers

Where machining centers are to remain on the finished part, they should be indicated by a note or dimensioned on the drawing.

Chamfers

Chamfers are dimensioned by using a linear dimension and an angle, or by using two linear dimensions, refer to Figure 40. Different types of other chamfer dimensioning methods are discussed next.

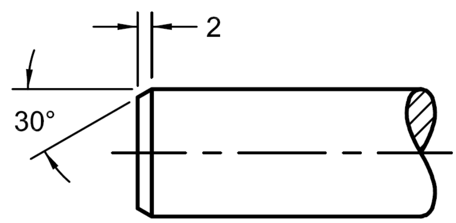


Figure 40 *Chamfer dimensioning*

Chamfers Specified by Note

A note may be used to specify 45° chamfers on perpendicular surfaces, refer to Figure 41.

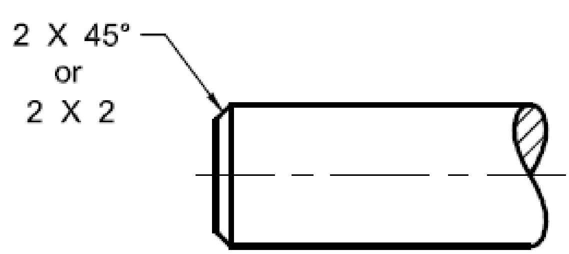


Figure 41 *Dimensioning of 45° chamfer*

Round Holes

When the edge of a round hole is chamfered, then the dimension of the chamfer may be specified using diameter on a shaft, refer to Figure 42.

Non-Perpendicular Intersecting Surfaces

Two acceptable methods of dimensioning chamfers for the surfaces that intersect at other than right angles is shown in Figure 43.

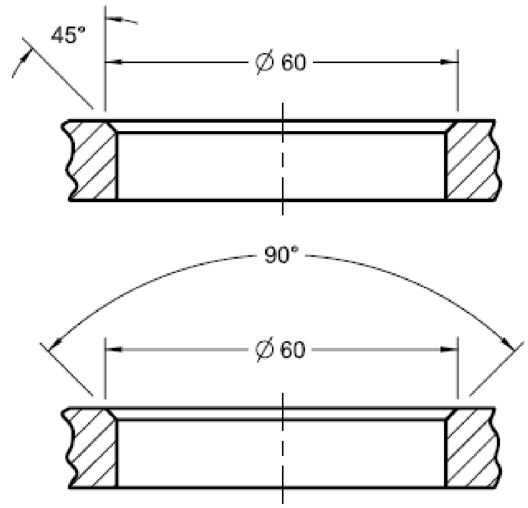


Figure 42 Dimensioning of internal chamfer

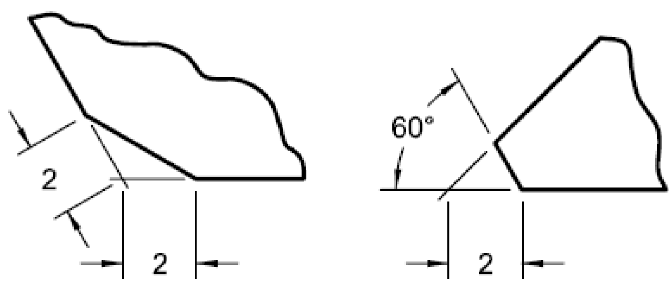


Figure 43 Dimensioning of non-perpendicular intersecting surfaces

Keyseats

Keyseats are dimensioned by width, depth, location, and if required, length. The depth may be dimensioned from the opposite side of the shaft or hole, refer to Figure 44.

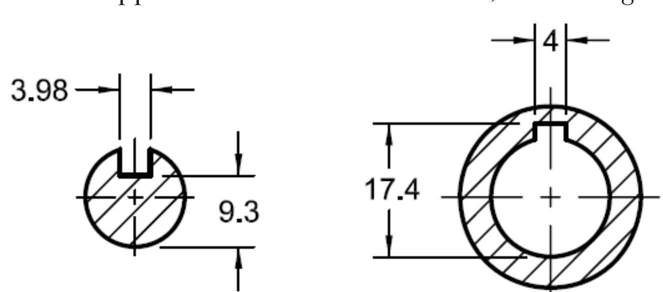


Figure 44 Dimensioning of keyseats