Engineering Design

Types:

Size

Location

Position (assembly)

•Working drawings must show dimensions, sizes and locations to serve as a construction documents and legal contracts

•The techniques of dimensioning are based on ANSI (American National Standard Institute)

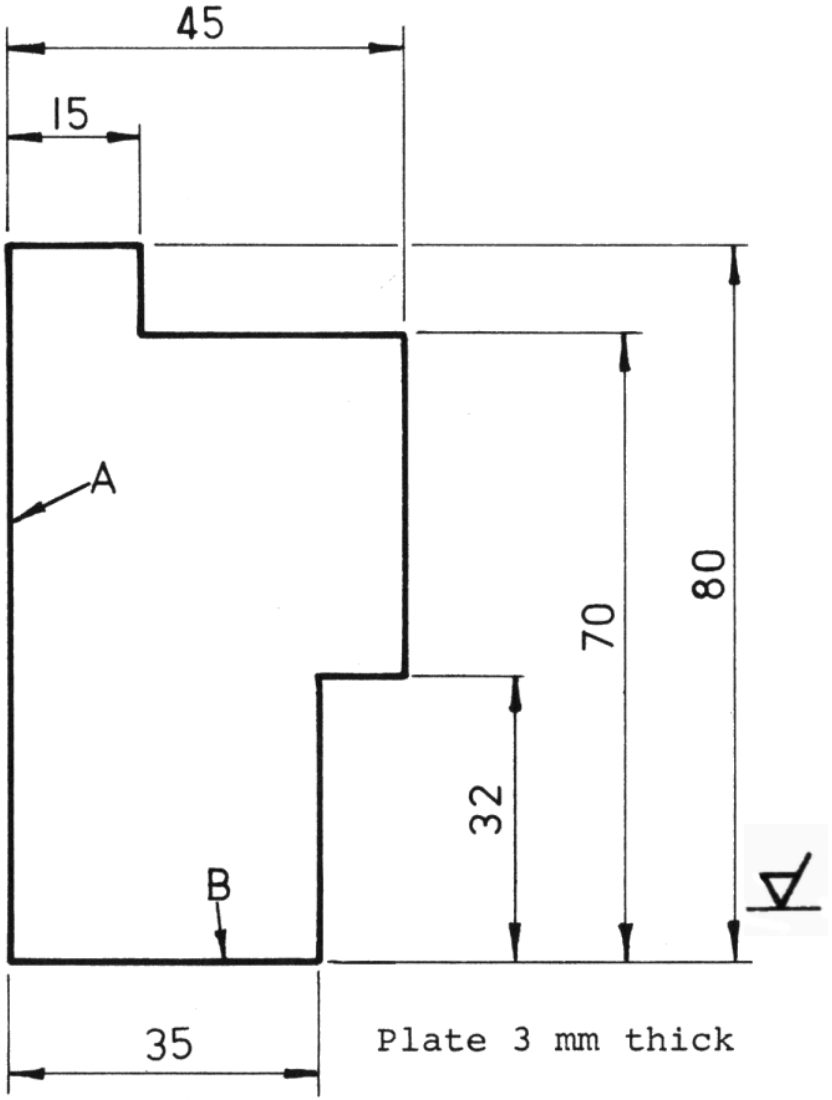
•SI units are universally supported

•Round off dimensions in whole numbers without fraction

Engineering Design

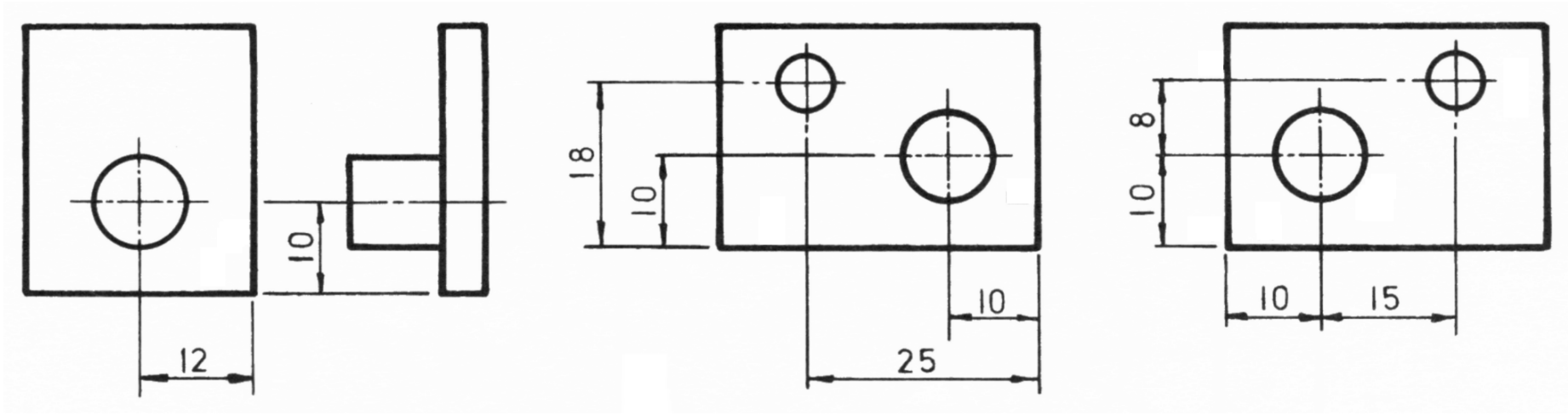
Types: Sizes

Used to describe heights, widths, diameters, etc.



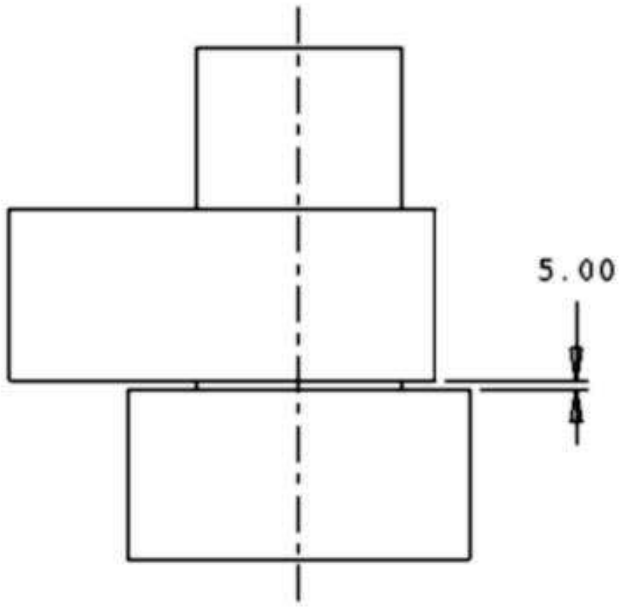
Types: Location

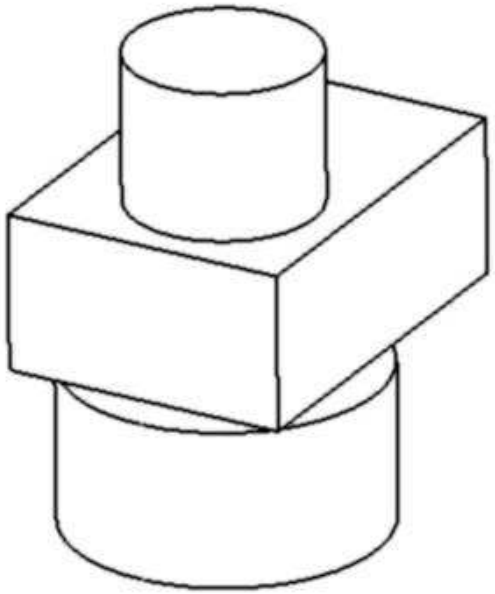
Used to place various features of a component relative to each other, such as a hole centre line to a reference surface.



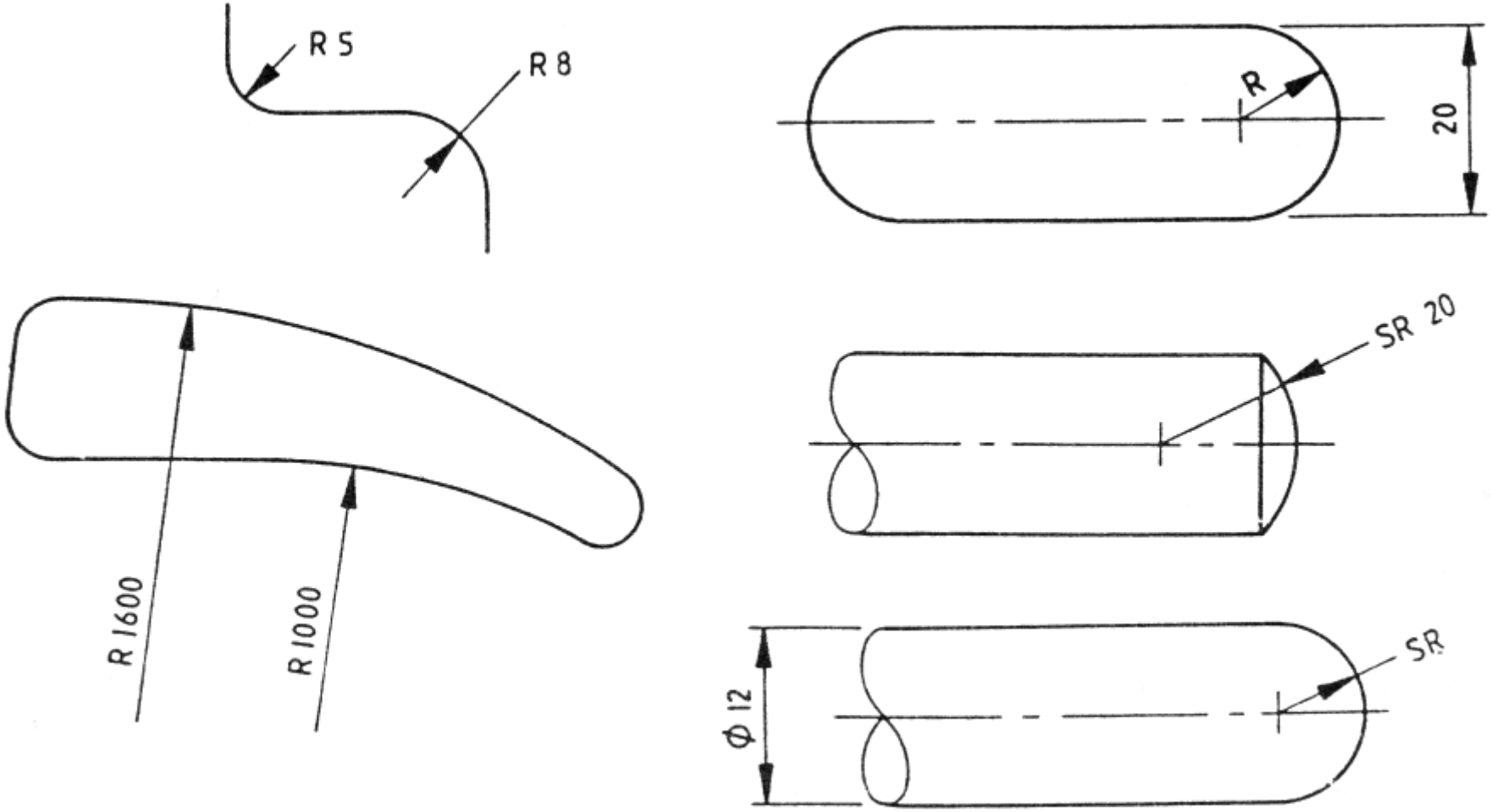
Types: Position

Used for parts that fit together requiring a certain degree of accuracy.

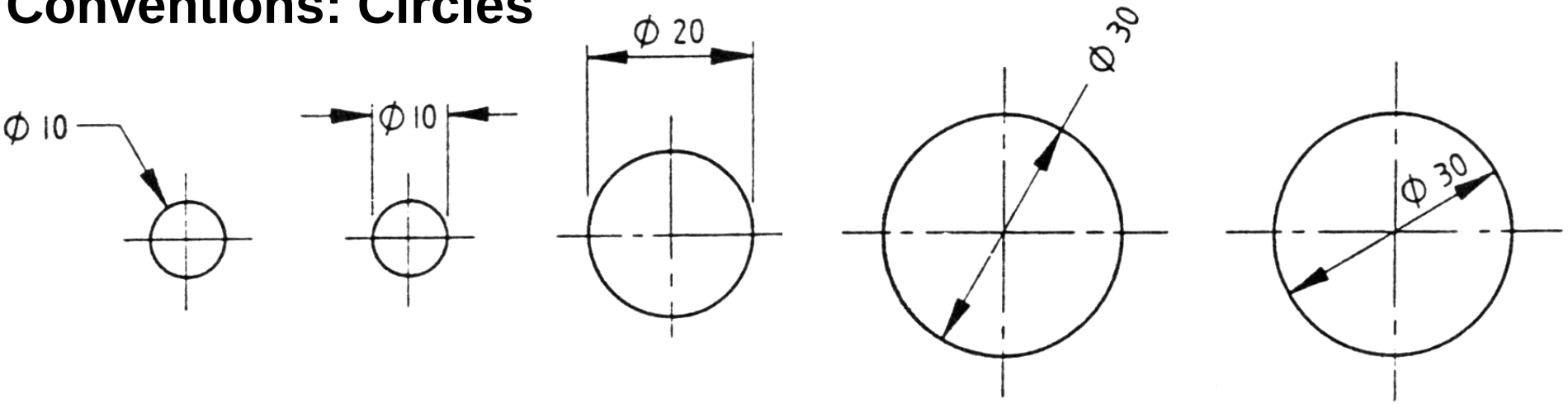




Conventions: Radii



Conventions: Circles

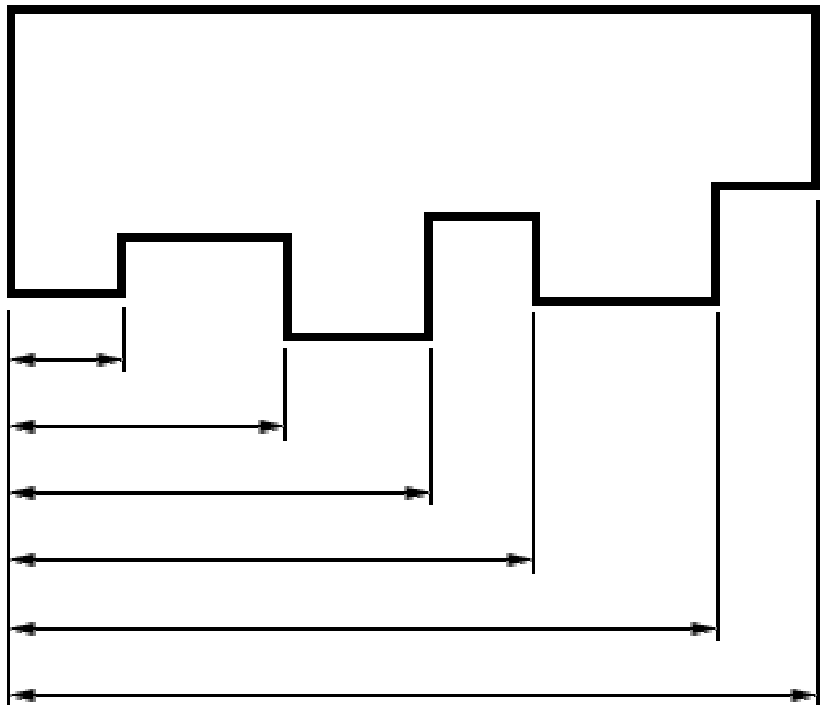


Circles on engineering drawings are usually either spheres, holes or cylinders of some description.

The dimension refers to the diameter, and the diameter symbol is ∅.

Conventions: Parallel

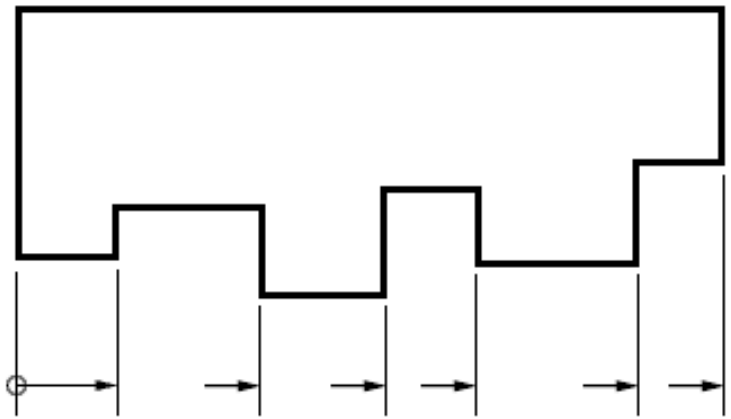
Parallel dimensioning consists of several dimensions originating from one projection line.



Conventions: Superimposed Running

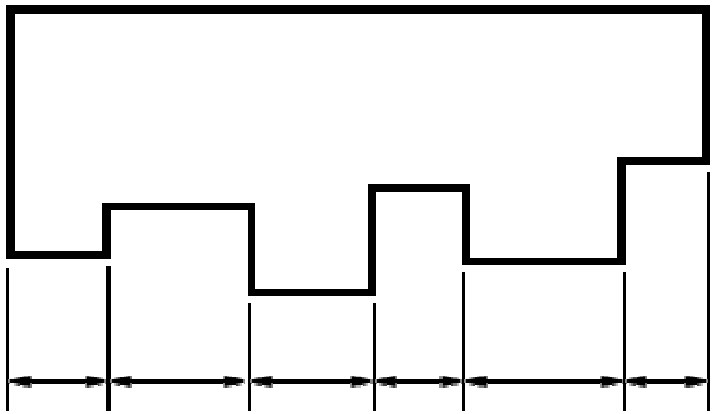
Superimposed running dimensioning simplifies parallel dimensions in order to reduce the space used on a drawing. The common origin for the dimension lines is indicated by a small circle at the intersection of the first dimension and the projection line. In general all other dimension lines are broken.

The dimension note can appear above the dimension line or in-line with the projection line



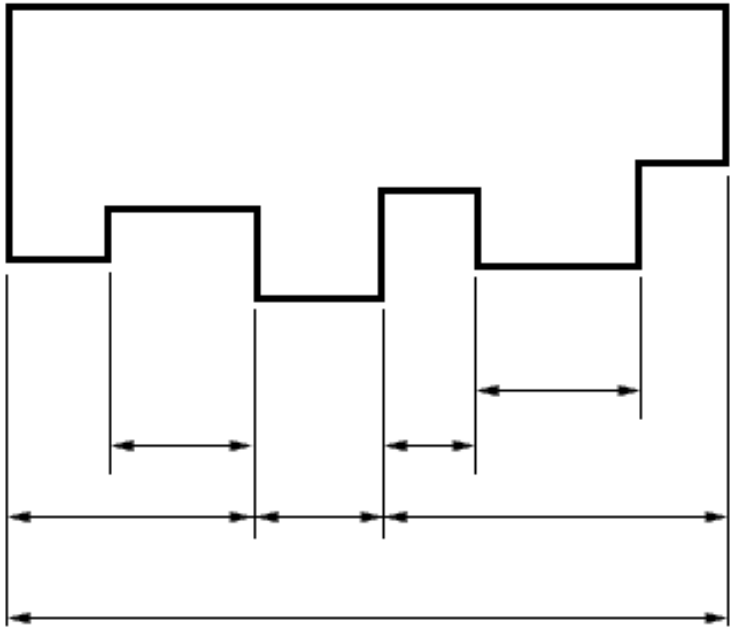
Conventions: Chain

Chains of dimension should only be used if the function of the object won't be affected by the accumulation of the tolerances. (A tolerance is an indication of the accuracy the product has to be made to. Tolerance will be covered later).



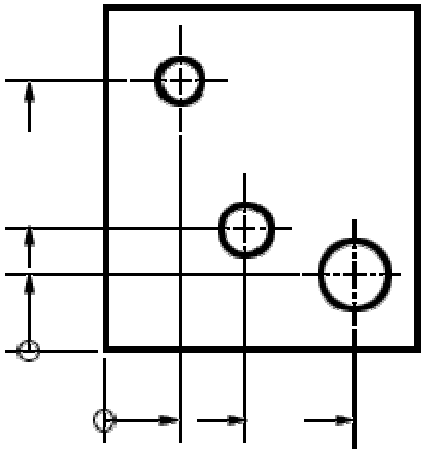
Conventions: Combined

A combined dimension uses both chain and parallel dimensioning.

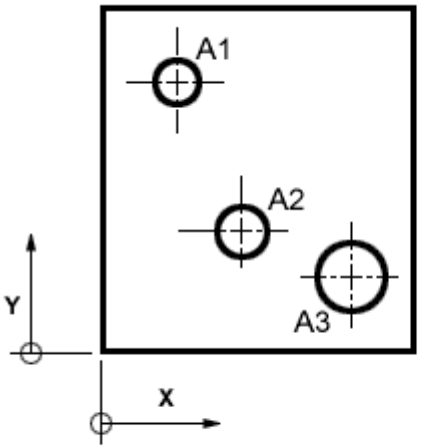


Conventions: Co-ordinates

Two sets of superimposed running dimensions running at right angles can be used with any features which need their centre points defined, such as holes.



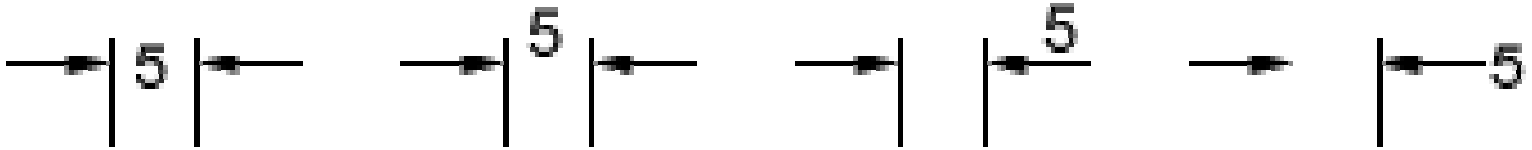
It is also possible to simplify co-ordinate dimensions by using a table to identify features and positions.



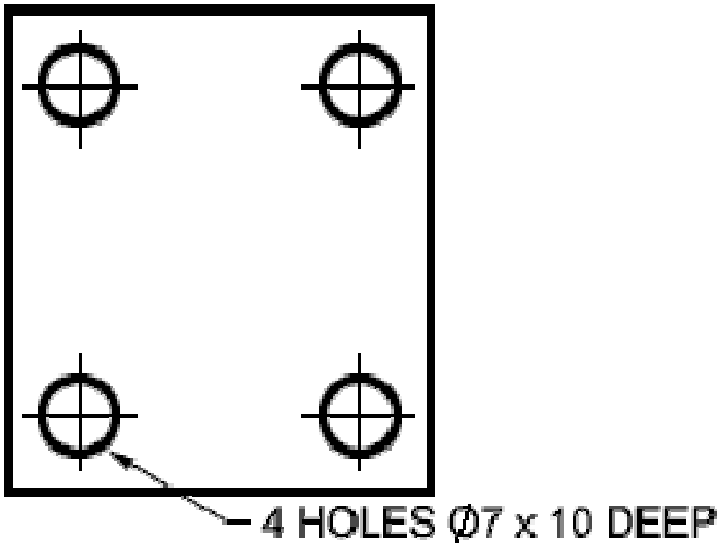
HOLE	X	Y	⌀
A1	100	25	25
A2	50	40	15
A3	100	20	15

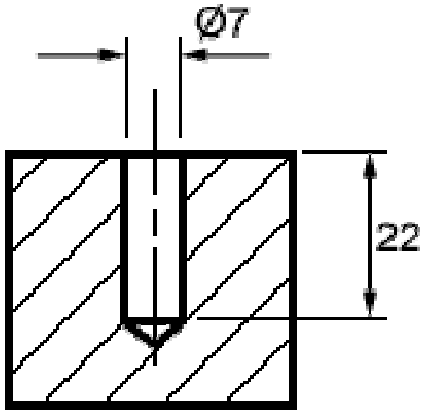
Conventions: Small features

When dimensioning small features, placing the dimension arrow between projection lines may create a drawing which is difficult to read. In order to clarify dimensions on small features any of the above methods can be used.



Conventions: Holes



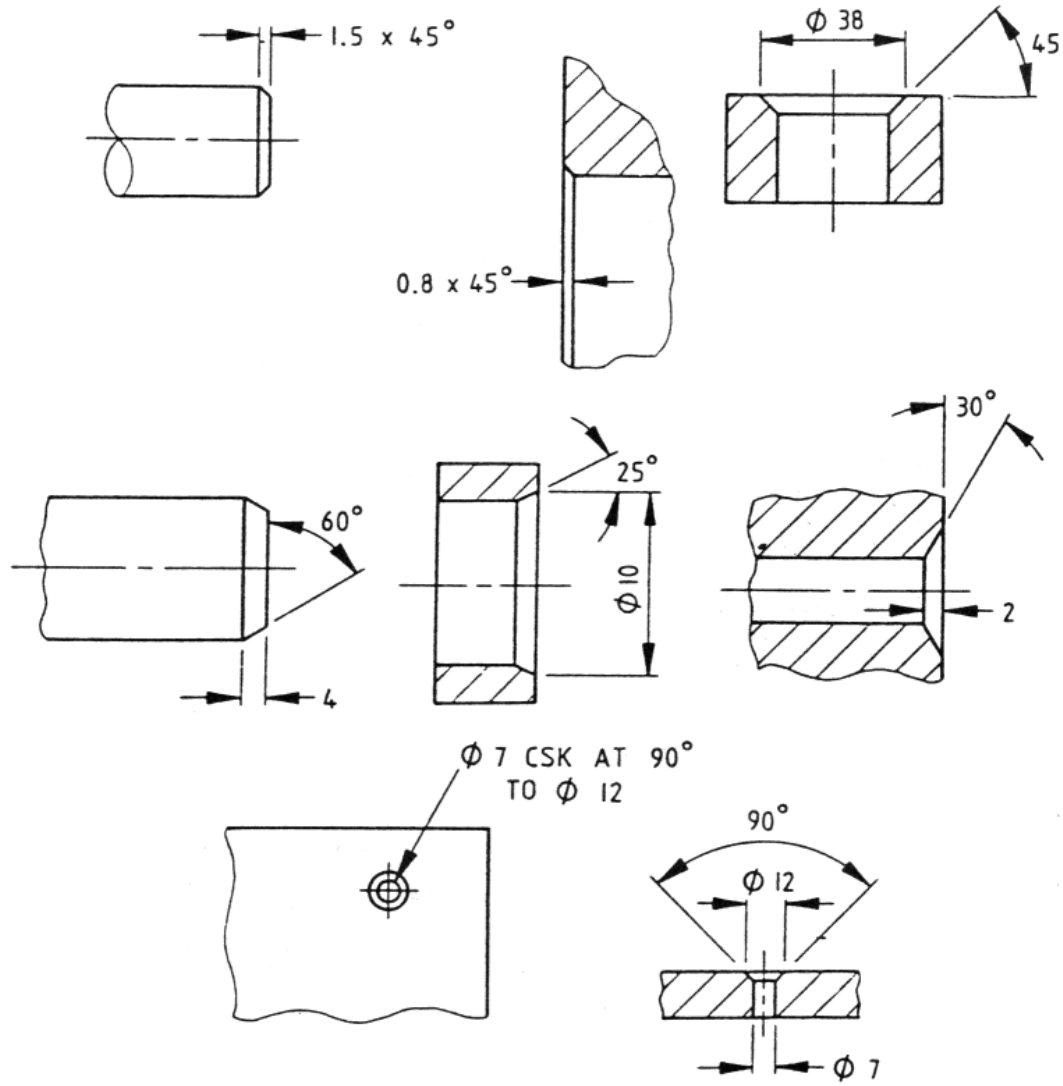


When dimensioning holes the method of manufacture is not specified unless they necessary for the function of the product. The word hole doesn't have to be added unless it is considered necessary. The depth of the hole is usually indicated if it is isn't indicated on another view. The depth of the hole refers to the depth of the cylindrical portion of the hole and not the bit of the hole caused by the tip of the drip.

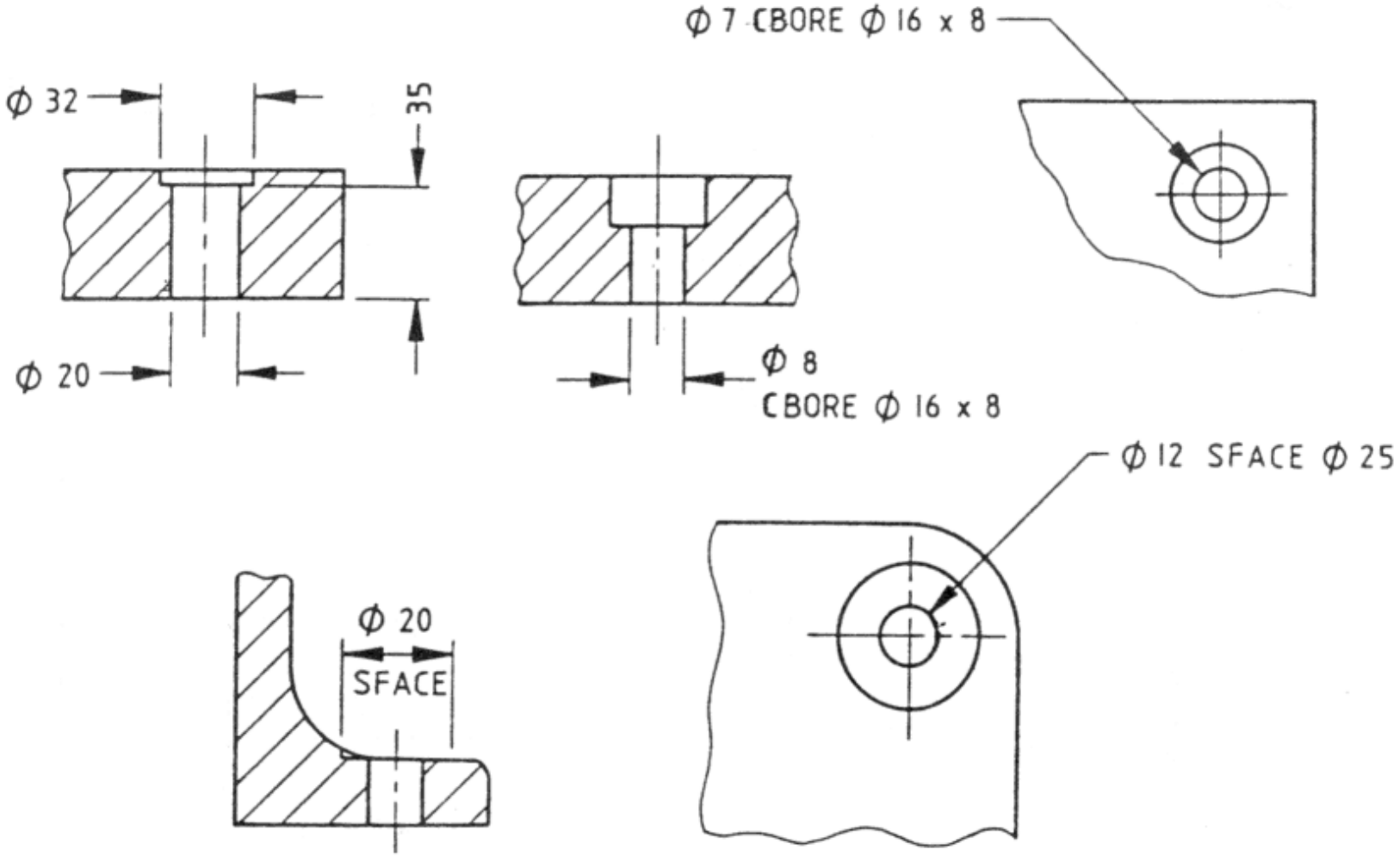
Conventions: Chamfers and Countersinks

Chamfers

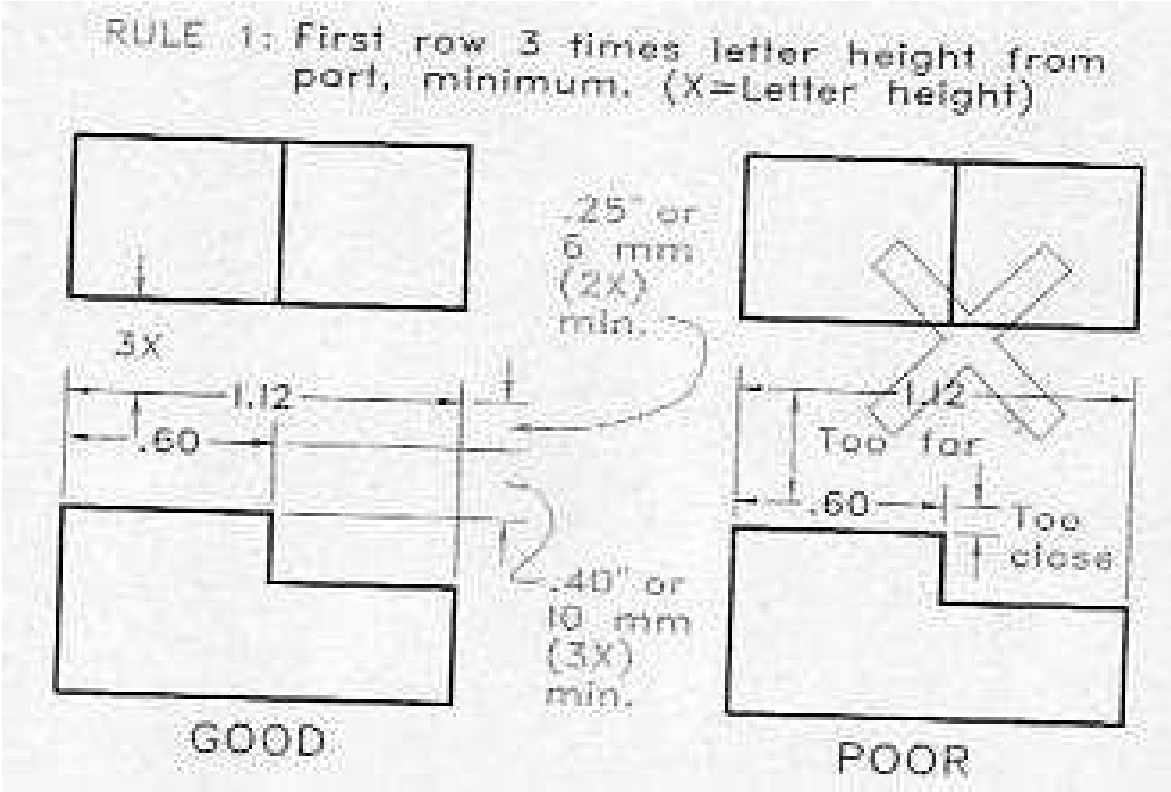
Countersinks



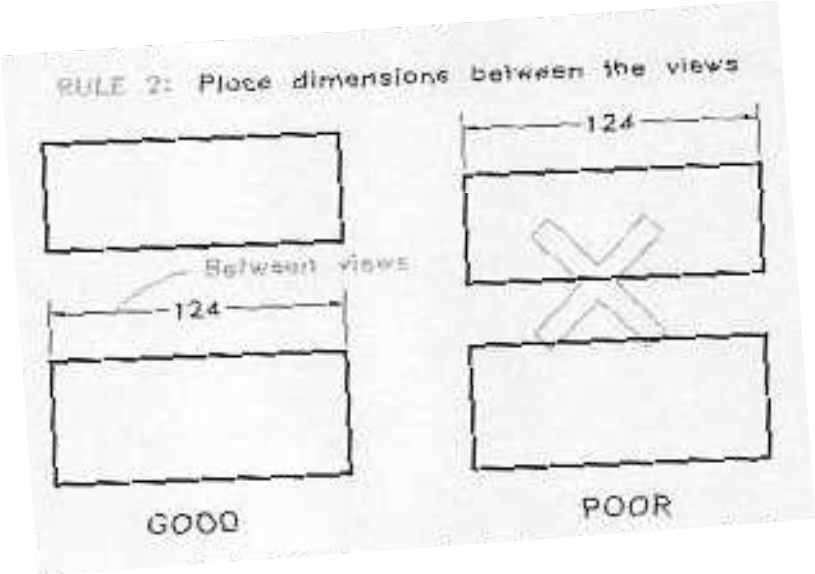
Conventions: Counter bores

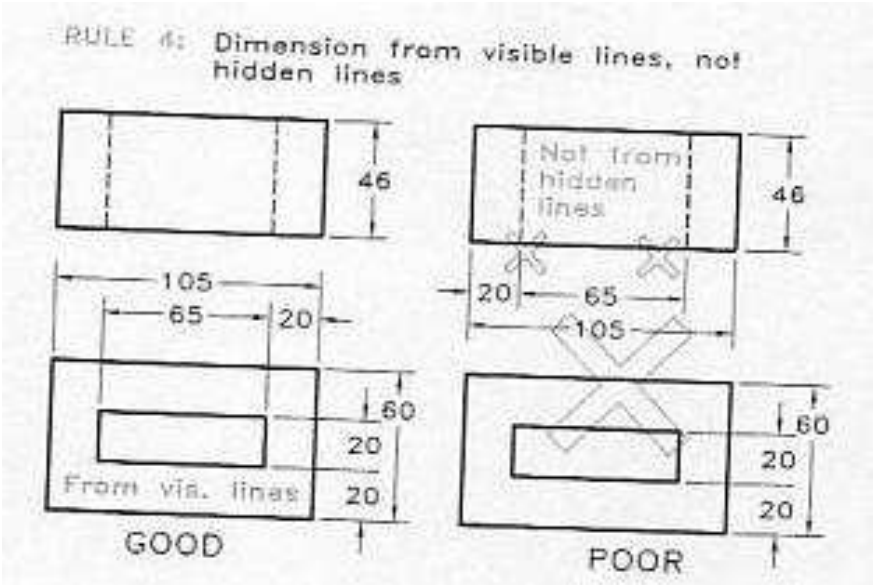


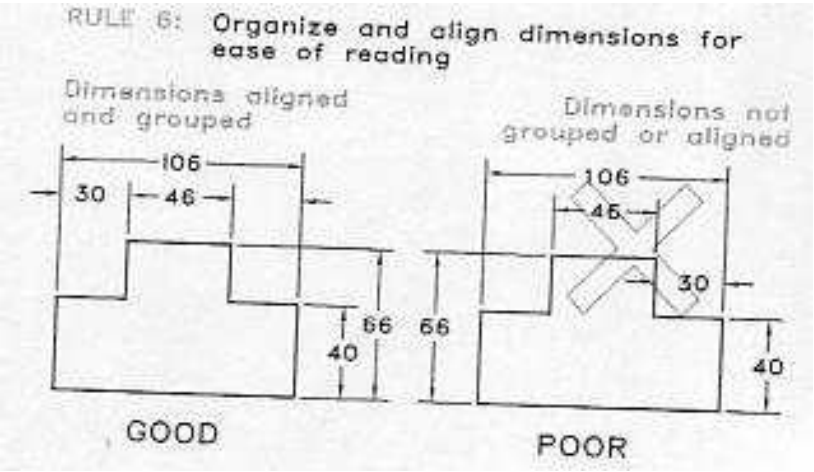
Rules:


RULE 1: First row 3 times letter height from part, minimum. (X=Letter height)
.25" or 6 mm (2X) min.
3X
1.12
.60
.40" or 10 mm (3X) min.
GOOD
1.12
Too far
.60
Too close
POOR

Rules:

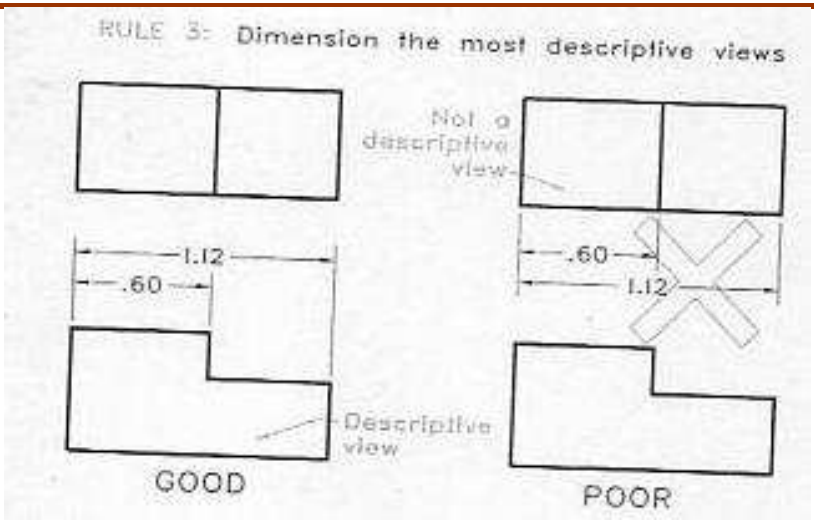

RULE 2: Place dimensions between the views
124
Between views
124
GOOD
POOR

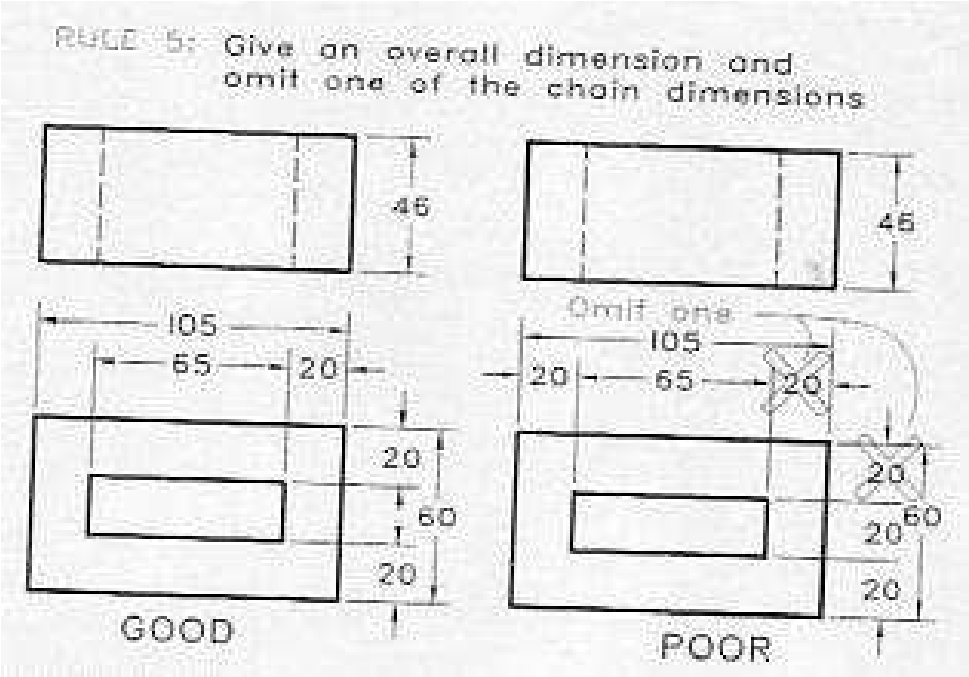

RULE 4: Dimension from visible lines, not hidden lines
46
105
65
20
60
20
20
From vis. lines
GOOD
Not from hidden lines
46
20
65
105
60
20
20
POOR

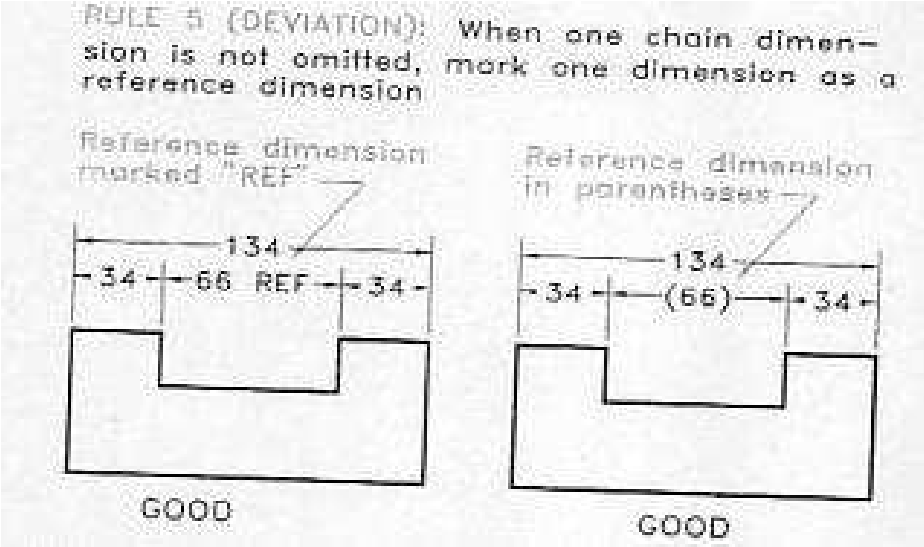

RULE 6: Organize and align dimensions for ease of reading
Dimensions aligned and grouped
106
30
46
66
40
GOOD
Dimensions not grouped or aligned
106
46
30
66
40
POOR

Engineering Design

Rules:

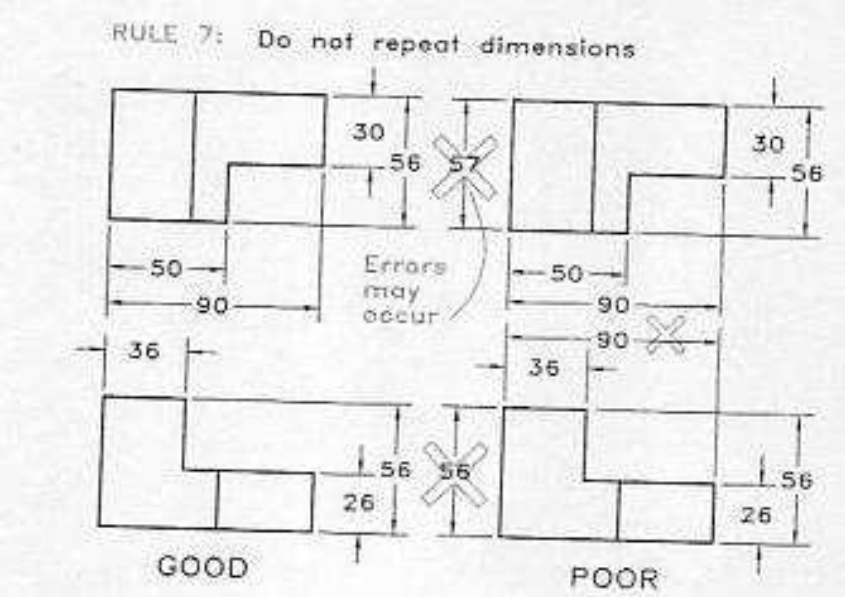


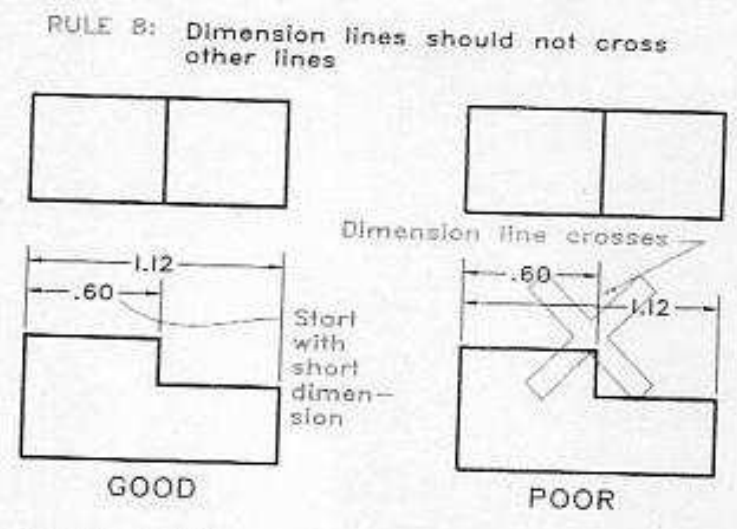


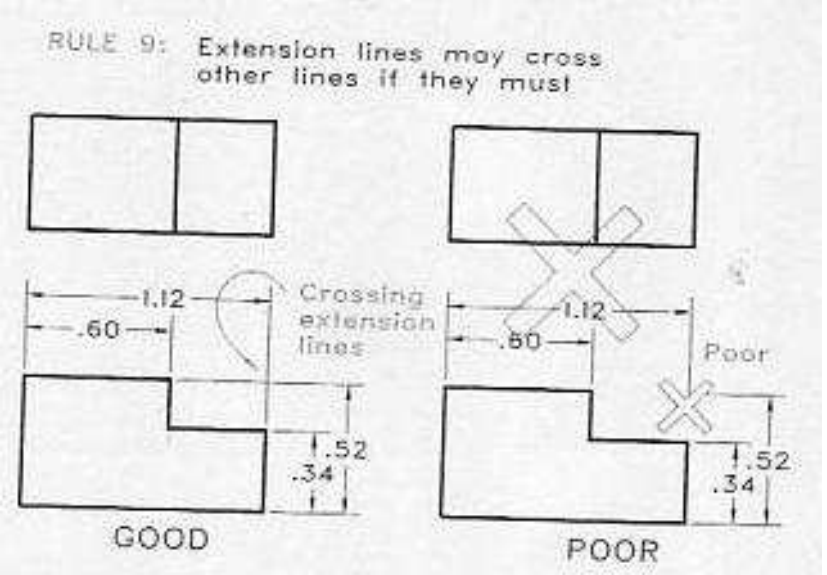


Engineering Design

Rules:

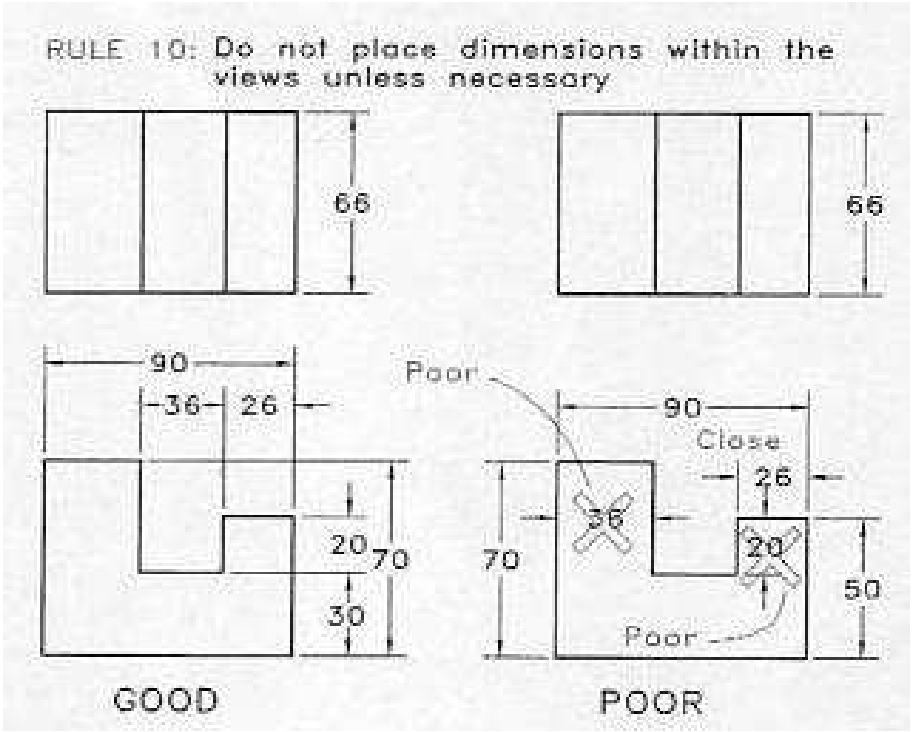


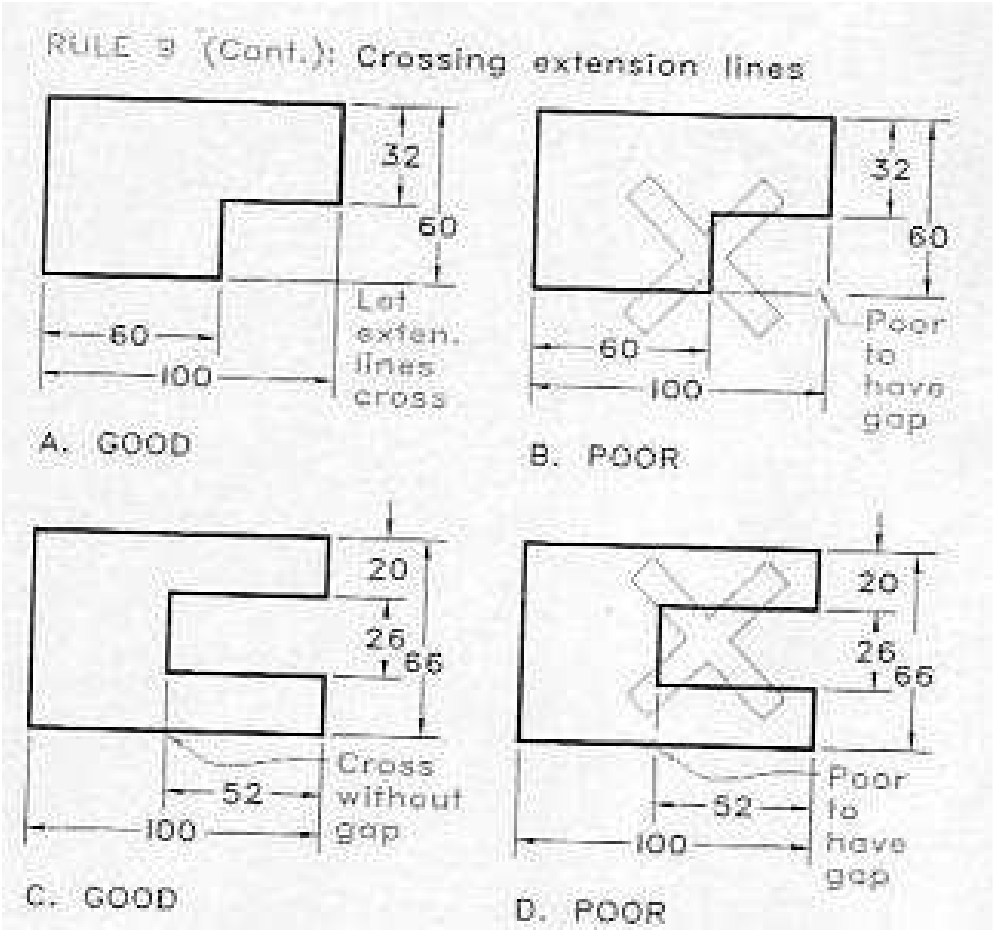




Engineering Design

Rules:





Why:

•Many parts made by different companies at widely separated locations must be interchangeable

•Dimensioning parts within a required range of variations to ensure interchangeabiity is called Tolerancing.

A tolerance should be as large as possible without interfering with the function of the part to minimise production costs.

Introduction:

•It is not possible in practice to manufacture products to the exact figures displayed on an engineering drawing

•The accuracy depends largely on the manufacturing process used and the care taken to manufacture a product

•A tolerance value shows the manufacturing department the maximum permissible variation from the dimension

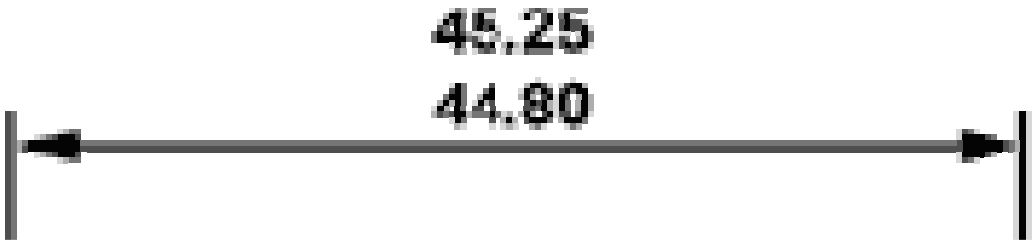
Each dimension on a drawing must include a tolerance value. This can appear either as:

- a general tolerance value applicable to several dimensions. i.e. a note specifying that the General Tolerance +/- 0.5 mm.

- or a tolerance specific to that dimension

Convention:

The method of expressing a tolerance on a dimension as recommended by the British standards is shown below:



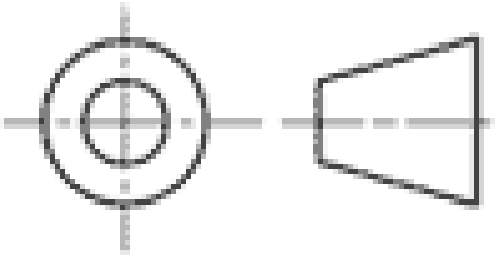
Note the larger size limit is placed above the lower limit.
All tolerances should be expressed to the appropriate number to the decimal points for the degree of accuracy intended from manufacturing, even if the value is limit is a zero for example.

45.25	should not be expressed as	45.25
44.80		44.8

Engineering Design

Layout

All engineering drawings should feature an information box. An example is shown below.

TITLE WHEEL BEARING	
NAME John Smith	CHECKED
VERSION 1.1	DATE 16.10.98
NO NEED TO MEASURE -ALL MEASUREMENTS IN MM	SCALE 1:1
ITI ENGINEERING	

Common Features:

TITLE

The title of the drawing.

NAME

The name of the person who produced the drawing. This is important for quality control so that problems with the drawing can be traced back to their origin.

CHECKED

In many engineering firms, drawings are checked by a second person before they are sent to manufacture, so that any potential problems can be identified early.

VERSION

Many drawings will get amended over the period of the parts life. Giving each drawing a version number helps people identify if they are using the most recent version of the drawing.

DATE

The date the drawing was created or amended on.

Common Features continued ---:

SCALE

The scale of the drawing. Large parts won't fit on paper so the scale provides a quick guide to the final size of the product.

PROJECTION SYSTEM

The projection system used to create the drawing should be identified to help people read the drawing. (Projection systems will be covered later).

COMPANY NAME

Many CAD drawings may be distributed outside the company so the company name is usually added to identify the source.

Features

The previous chapters covered the general aspects of engineering drawing and how to produce a detailed drawing of a single part with all the necessary information to make the part. The assembly of these parts is shown in an assembly drawing also known as a general arrangement.

Features of an assembly drawing

Dimensions
Detailed dimensions required for manufacture are excluded from assembly drawings. But overall dimensions of the assembled object are usually indicated.
If the spatial relationship between parts if important for the product to function correctly then these should also be indicated on the drawing. For example indicating the maximum and minimum clearance between two parts.

Internal Parts
If there are internal assemblies, sectional views should be used.

Feature

Parts list

Each part is given a unique number, indicated on the drawing by a circle with the number in it and a leader line pointing to the part. The leader line terminates in an arrow if the line touches the edge of the component, or in a circle if the line terminates inside the part.

A table of parts should be added to the drawing to identify each part, an example of a parts list is shown below:

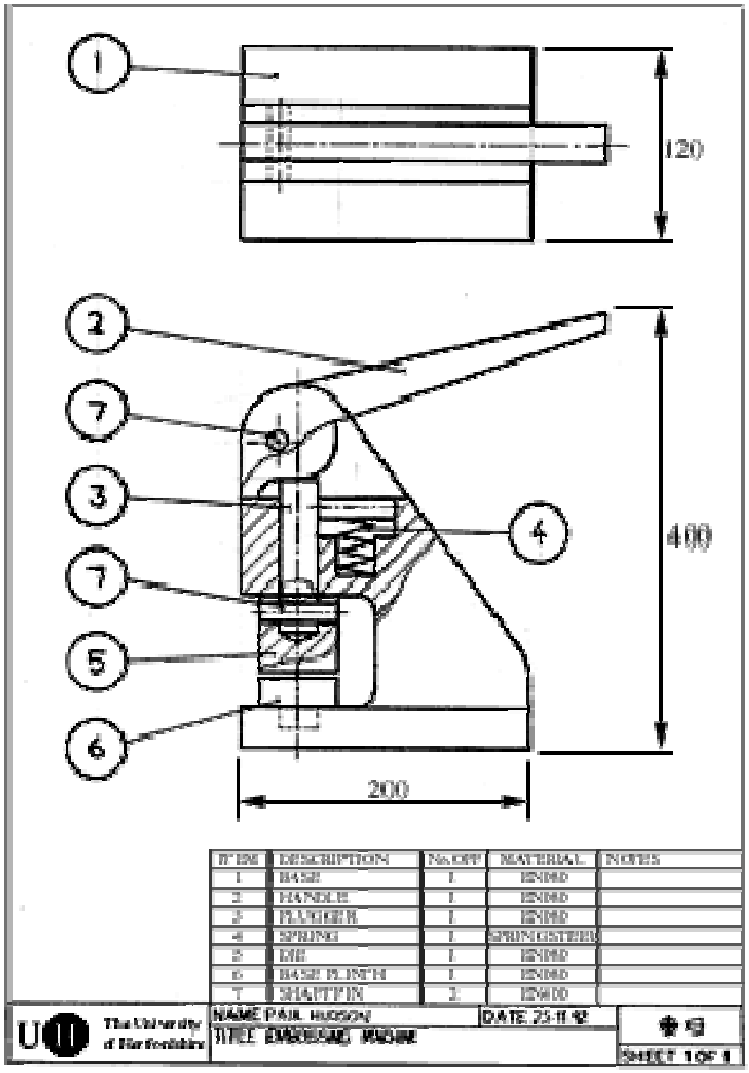
Item No.	Description	Qty	Material	Remarks

Feature

Dimensions

Internal Parts

Part list



Planning:

•Plan how you are going to make best use of the space

•Think about the number of views your drawing will have and how much space you will use of the paper

•Try to make maximum use of the available space

•If a view has lots of detail, try and make that view as large as possible If necessary, draw that view on a separate sheet

•If you intend to add dimensions to the drawing, remember to leave enough space around the drawing for them to be added later

•If you are working with inks on film, plan the order in which you are drawing the lines. For example you don't want to have to place your ruler on wet ink