-Introduction

One of the best ways to communicate one's is through some form of picture or drawing. This is especially true for the engineering. The purpose of this guide is to give you the basics of engineering sketching and drawing.

We will treat sketching and drawing as one. Sketching generally means freehand drawing. Drawing usually means using drawing instruments, from compasses to computers to bring precision to the drawings.

Before any further information about the engineering drawing, we should be considered the most important measuring distance system to drawing. There are two main systems for measuring distances and weight, the Imperial system of measurement and the Metric system of measurement. The metric system is a system of measurement that uses the meter, liter, and gram as base units of length (distance), capacity (volume), and weight (mass) respectively.

Length: Millimeter (mm), Decimeter (dm), Centimeter (cm), Meter (m), and kilometer (km) are used to measure how long or wide or tall an object is. Examples include measuring the thickness or length of debit card, length of cloth, or distance between two cities.

Table 1 Length by the Metric System

Kilometer (km)	Hectometer (hm)	Decameter (dam)	Meter (m)	Decimeter (dm)	Centimeter (cm)	Millimeter (mm)
1000	100	10	1	1/10	1/100	1/1000

We will concentrated on the **instrumental drawing**.

This drawings are made by means of various instruments. The quality of drawing depends to a large extent on the quality, adjustment and care of the instruments.

1- Drawing Paper

Drawing paper is the paper, on which drawing is to made. All engineering drawing are made on sheets of paper had defined sizes. Their symbols with letter (A), the use of standard size saves paper and ensures convenient storage of drawings.

Table 1.1 Description of the size of drawing paper.

Symbol	Dimensions
A0	1891*841mm
A1	841*594mm
A2	594*420mm
A3	420*297mm
A4	297*210mm
A5	210*148mm
A6	148*105mm

2- Triangles

They are used to construct the most common angles (i.e. 30^0, 45^0, 60^0) in technical drawings. The 45^0*45^0 and 30^0* 60^0 triangles are the most commonly used for ordinary work. They are shown in the figure below.

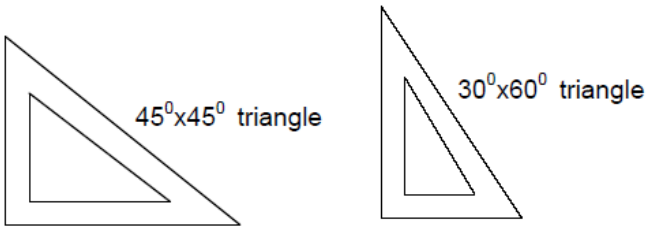


Figure 1.2 triangles or set squares

3- T-square

It is used primarily to draw horizontal lines and guiding the triangles when drawing vertical and inclined lines. It is manipulated by sliding the working edge (inner face) of the head along the left edge of the board until the blade is in the required position.

Figure 1.3 T-square

4- French curve

It is used to draw irregular curves that are not arcs. The shape varies according to the shape of irregular curve.

Figure 1.4 French curve

5- Protractor

It is used for laying out and measuring angle. The simplest protractor comprises a semicircular disk graduated in degrees from 0^0 to 180^0, it usually have two sets of numbers going in opposite directions. Be careful which one you use!

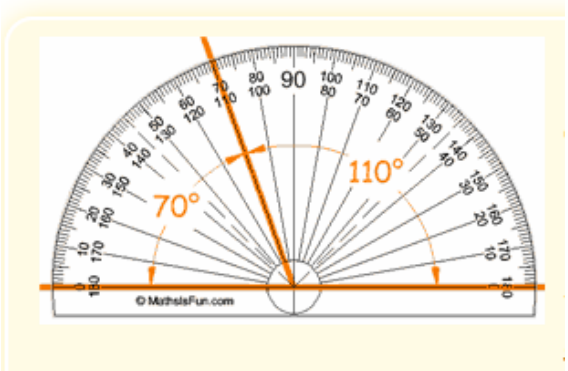


Figure 1.5 Protractor

6- Scale (ruler)

A number of kinds of scales are available for varied types of engineering design. Figure 1.6 Scale with beveled edges graduated in mm are usually used.

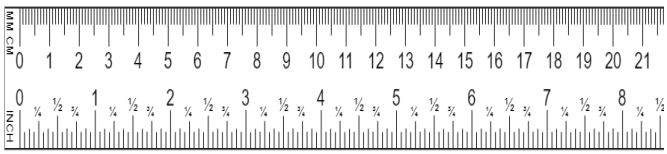


Figure 1.6 Ruler

7- Pencil

The grade of pencil to be used for various purpose depends on the type of line desired, the kind of paper employed, and the humidity, which affects the surface of the paper. Standards for line quality usually will given the selection. Well- sharpened with leads of various degrees of hardness (H) such as:9H, 8H, 7H and 6H (hard); 5H and 4H (medium hard); 3H and 2H (medium); and h and F (medium soft).

Table 1.7 Grade of pencil (lead) and their application.

Lead	Task
6H	Is used for light construction line.
4H	Is used for re-penciling light finished (dimension lines, centre lines, and invisible object lines)
2H	Is used for visible object lines
F and H	Are used for all lettering and freehand work.

8- Compass or pair of compasses

It is used to draw circles and arcs both in pencil and link. It consist of two legs pivoted at the top. One leg is equipped with a steel needle attached with a screw, and other shorter legs is, provided with a socket for detachable inserts.

Figure 1.8 Compass

9- Divider

Used chiefly for transferring distance and occasionally for dividing spaces into equal parts. i.e. for dividing curved and straight lines any number of equal parts, and for transferring measurements.

Figure 1.9 Divider

10- Template

A template is a thin, flat piece of plastic containing various cutout shapes. It is designed to speed the work of the drafter and to make the finished drawing more accurate. Templates are available circles, ellipses, plumbing's , fixture etc. template come in many sizes to fit the scale being used on the drawing. And if should be used wherever possible to increase accuracy and speed. Drawing board is a board whose top surface is perfectly smooth and level on which the drawing paper is fastened.

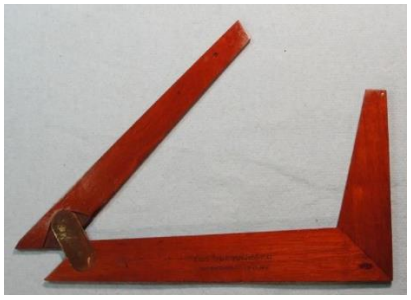
a. Clinograph (Adjustable set square)- its two sides are fixed at 90^0 and the find side can be adjusted at any angle.

b. Rubber or eraser- extra lines or curves which are not required in the drawing are to be rubbed in the drawing work. Erasers are available in many degrees of hardness, size and shape.

c. Eraser shield- it is an important device to protect lines near those being erased. It is made up of thin metal plate in which gaps of different widths and lengths are cut.

d. Tracing paper- it is a thin transparent paper. Figures below it can be seen easily and traced out in pencil ink.

e. Drawing ink- it is used for making drawings in ink on tracing paper.



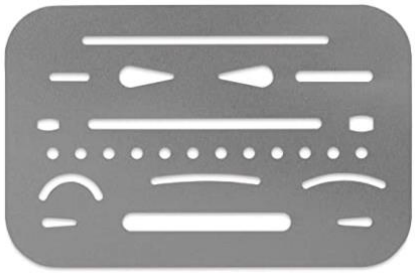


Figure 1.10 a.Clinograph **c. Eraser shield**

11- Adhesive tape

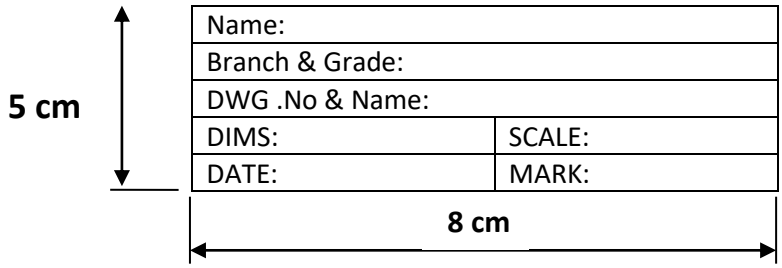
Adhesive tape is a combination of a material and an adhesive film and used to bond or join objects together instead of using fasteners, screws, or welding.

Figure 1.11 Adhesive tape

-How to set Drawing Paper on the White Board

1. The drawing board is conveniently placed on the table with the paper on the board, leaving equal size all rounds, with the T-square edge to the left hand side.
2. Place the T-square on the paper and gently move or slide the T-square to the top edge of the paper. Set the top edge of the paper parallel to the edge of the T-square with the stock of the T-square firmly against the edge of the drawing board on the left-hand side.

3. Hold the paper with four pieces of adhesive tape or two metal clips to hold the paper in position at four corners.
4. Gently slide the T-square down without moving the paper.
5. A border is a line drawn around the inside edge of the paper. Usually this is 10mm from the edge of the paper. It is basically a rectangle drawn precisely and inside this rectangle is the design area. For your note, if want to save your project on the left edge 20-25mm from your paper. A title block is normally drawn at the bottom of the paper.
6. Title block is a rectangular frame that located at bottom of the sheet. It is recommended that space should be provided in all title blocks for such information as description of title of the drawing, dates, designer (drawer), and name of enterprise or educational institute, size (scale).



-Scales

Usually the word scale is used for an instrument used for drawing straight lines. But actually in Engineer's language scale means the proportion or ratio between the dimensions adopted for the drawing and the corresponding dimensions of the object. It can be indicated in two different ways. Example: The actual dimensions of the room say 10m x 8m cannot be adopted on the drawing. In suitable proportion the dimensions should be reduced in order to adopt conveniently on the drawing sheet. If the room is represented by a rectangle of 10cm x 8cm

size on the drawing sheet that means the actual size is reduced by 100 times.

Representing scales: The proportion between the drawing and the object can be represented by **two** ways as follows**:**

1- Scale: 1cm=1m or 1cm=100cm or 1:100

2- Representative fraction:- (RF)=1/100 (less than one) i.e. the ratio between the size of the drawing and the object.

There are 3 types of scales depending upon the proportion it indicates as.

a. **Reducing scale**: When the dimensions on the drawing are smaller than the actual dimensions of the object. It is represented by the scale and RF as

Scale: - 1cm=100cm or 1:100 and by RF=1/100 (less than one)

b. **Full scale**: Sometimes the actual dimensions of the object will be adopted on the drawing then in that case it is represented by the scale and RF as

Scale: - 1cm = 1cm or 1:1 and by R.F=1/1 (equal to one).

c. **Enlarging scale**: In some cases when the objects are very small like inside parts of a wrist watch, the dimensions adopted on the drawing will be bigger than the actual dimensions of the objects then in that case it is represented by scale and RF as

Scale: - 10cm=1cm or 10:1 and by R.F= 10/1 (greater than one)