

Chapter 1

Drawing Instruments

1.1 Introduction

Drawing is a graphic language by which communication is accomplished through sketches (drawings). Drawings can be of various types. If compared with verbal or written description, drawings provide a far better idea about the shape, size and appearance of any object or situation or location, that too fairly quickly. From a manufacturing point of view, 2D and 3D drawings are very important and commonly used in engineering industry. Drawings are prepared manually or by using a computer. In 2D view (orthographic projection), one view is not enough to get all the details of the object. So it is necessary to draw the front view, top view, bottom view, right side view and left side view.

To be more useful, in particular from the manufacturing point of view, the sketch or drawing should include dimensions, manufacturing details, materials used, etc. Drawing equipment and instruments are needed to record information on drawing paper or any other suitable surface. Drawing, mainly consisting of straight lines, curves, circles and arcs, is prepared with certain instruments. The quality of the drawing mainly depends on the quality of the instruments, their adjustment, handling and care. Therefore, the equipment must be reliable and accurate, as the same will result in good quality drawing, which will further enhance a student's interest. The correct selection and use of pencils and drawing instruments should be taught throughout the course. Beginners certainly need guidance on the selection and purchase of the drawing instruments and equipment essential for drafting. The various instruments and other drafting equipment are described below.

1.2 List of Draughting Tools

The following is the list of draughting tools which every student must possess:

1. Drawing Board
2. Mini-Draughter

3. Small Instrument Box, containing the following:
 - Large Size Compass
 - Small Bow Compass
 - Large Size Divider
 - Small Bow Divider
4. Set-Squares
5. Set of Scales
6. Protractor
7. French Curves
8. Drawing Sheets
9. Drawing Pencils
10. Paper Fasteners
11. Pencil Sharpener
12. Sand Paper Pad
13. Eraser
14. Duster

Some of these have been explained in greater detail in the subsequent sections.

1.3 Drawing Board

A drawing board is usually made of well-seasoned soft wood. To prevent warping, narrow strips of wood are glued together. Prevention of warping will also be aided by two battens cleated at the bottom side of the board. These battens, also, help give rigidity to the board. One of the edges of the board is used as the working edge (generally made of hard and durable wood) on which the T-square is made to slide. See Fig. 1.1.

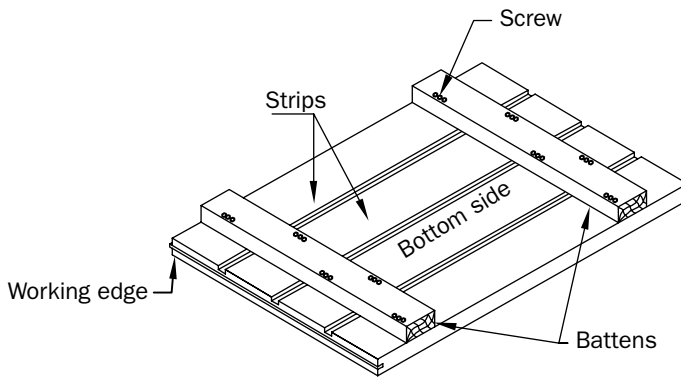


Fig. 1.1 Drawing board

The size of the drawing board will depend upon the size of the drawing sheet to be used. The Bureau of Indian Standards (BIS) recommends the sizes of the drawing board, as given in the Table 1.1.

Table 1.1 Sizes of the drawing board

S.No.	Designation	Size (Length × Breadth × Thickness), mm
1.	B_0	1500 × 1000 × 25
2.	B_1	1000 × 700 × 25
3.	B_2	700 × 500 × 15
4.	B_3	500 × 350 × 15

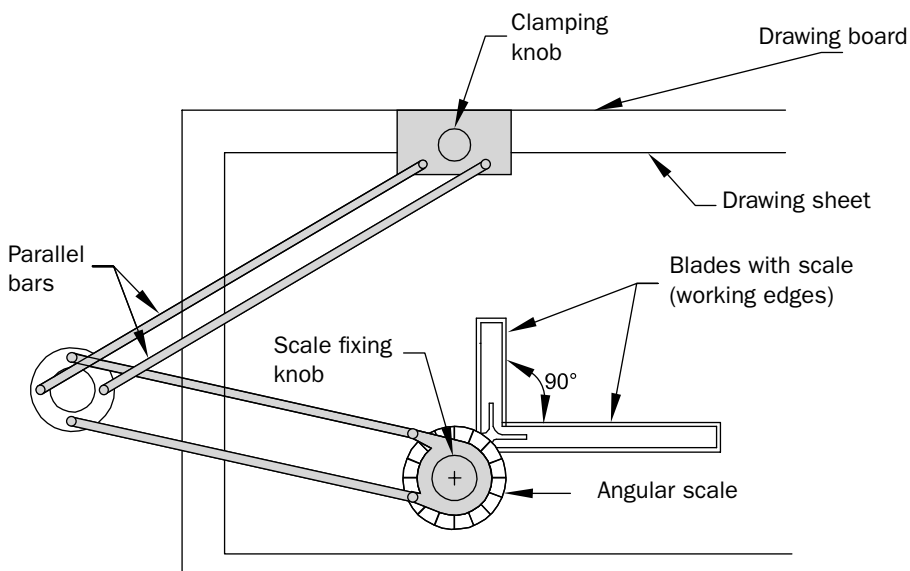
The following points need to be taken care of while handling a drawing board:

- Handle the drawing board carefully so that no dents or holes are made on its surface.
- Check the working edge at regular intervals and correct it, whenever it is found defective.
- Fasten a sheet of paper on the drawing board to keep its surface clean.

1.4 Mini-Draughter

It consists of an angle formed by two arms with scales marked and set exactly at right angle to each other. It is designed to combine the functions of T-square, set-squares, protractor and scales. The arms may also be set and clamped at any desired angle by means of an adjusting screw, which has a protractor. See Fig. 1.2.

Mini-Draughter has a mechanism which keeps the two blades always parallel to their original position, whenever they may be moved on the board. Thus by means of it, horizontal, vertical or inclined parallel lines of desired lengths can be drawn anywhere on the sheet, with considerable ease and saving of time.

**Fig. 1.2** Mini-Draughter

1.5 Small Instrument Box

It contains the following instruments:

- Large Size Compass:** It is used for drawing circles and arcs up to 200 mm. It consists of two legs hinged at one end; one leg is so arranged that it can receive either a lead* or a pen, as shown in Fig. 1.3. The needle point should be at least 1 mm larger than the lead or pen point. This is because, when the compass is used the needle point penetrates into the paper and thus the pen or lead touches it at same level (Fig. 1.4). The hardness of the lead used should be the same as that of the pencil work of the drawing. The lead end may be sharpened as shown in Fig. 1.5.

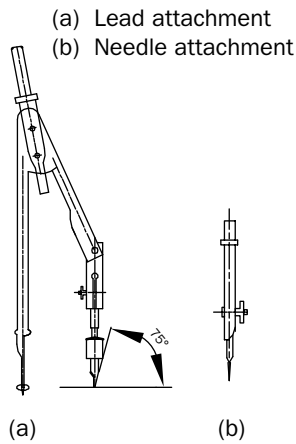


Fig. 1.3 Large size compass with different attachments

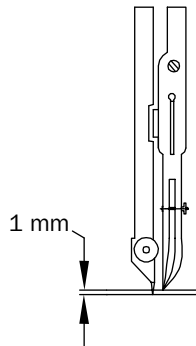


Fig. 1.4 Relative position of compass point

* Although the actual drawing material is graphite (a non-poisonous substance), the popular term used for the material is 'lead'. We are retaining the popular term in this book.

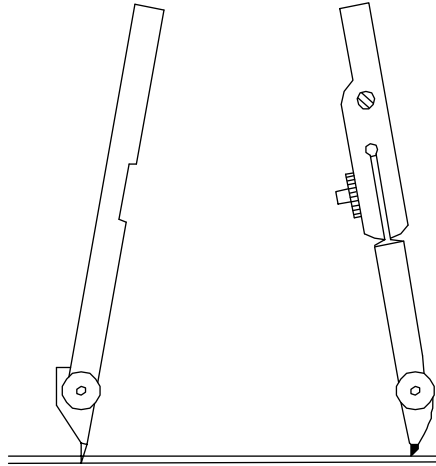


Fig. 1.5 Sharpening of compass lead

- **Small Bow Compass:** It is used for drawing small circles of radius up to 25 mm. This operates on the jackscrew principle by turning a knurled nut at its centre, as shown in Fig. 1.6. In some designs the adjusting nut may be on one side of the compass, as shown in Fig. 1.7.

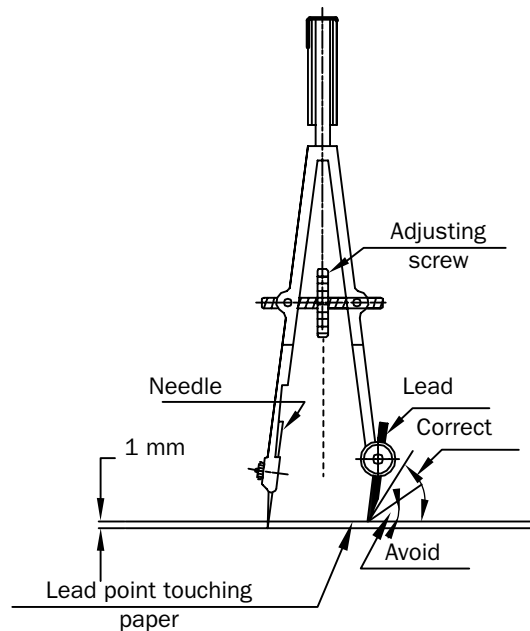


Fig. 1.6 Small bow compass with knurled nut at its centre

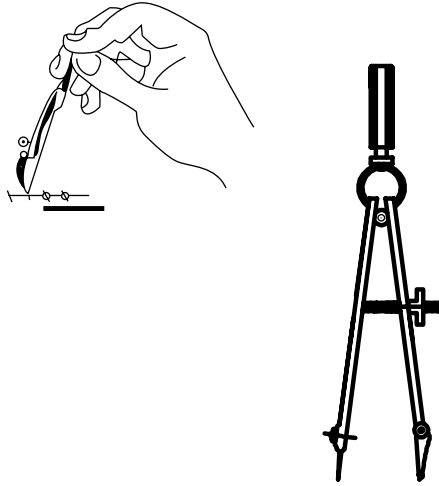


Fig. 1.7 Small bow compass with adjusting nut on one side

- **Large Size Divider:** The divider is used for transferring measurements from one part of the drawing to another part and also for dividing curved or straight lines into any number of equal parts. It is similar to the large size compass except that both the legs contain needle points, as shown in Fig. 1.8.



Fig. 1.8 Large size divider

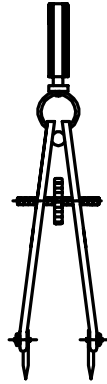


Fig. 1.9 Small bow divider

- **Small Bow Divider:** It is similar to the large size divider, except that the distance between the legs is adjusted by a knurled nut as shown in Fig. 1.9. It is more convenient for transferring smaller distances.

1.6 Set-Squares

Set-squares are made of transparent celluloid or plastic material and retain their shape and accuracy for a long time, as shown in Fig. 1.10. Set-squares are available in two forms:

- (i) 30°–60° set-square
- (ii) 45° set-square

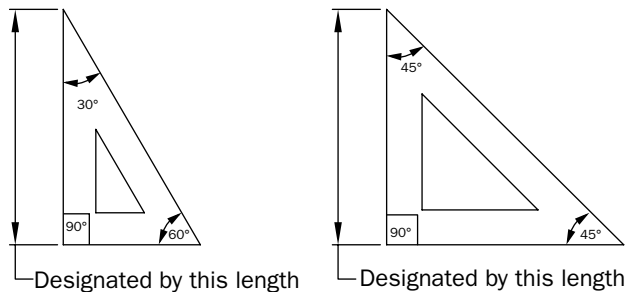


Fig. 1.10 Set-squares

1.7 Set of Scales

Scales are made of wood, steel celluloid, card board, etc. Scales may be flat or of triangular cross section. Both the longer edges of the scales are marked with divisions of centimetres, which are further sub-divided into millimetres, as shown in Fig. 1.11.

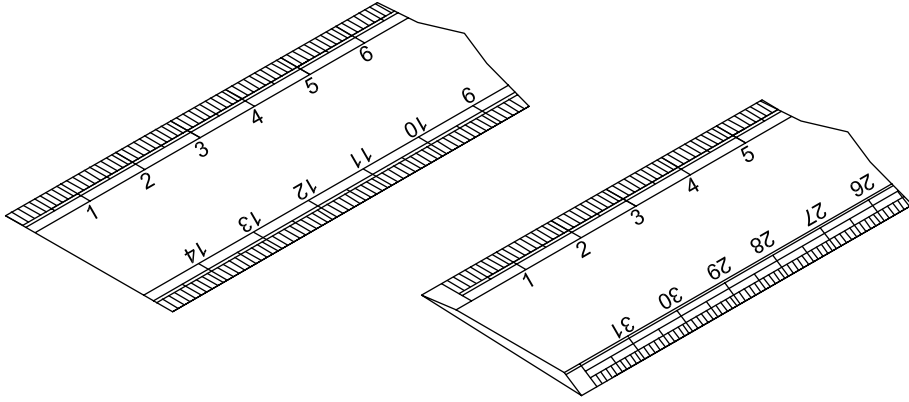


Fig. 1.11 Set of scales

Scales are used to transfer the true or relative dimensions of an object on to the drawing. Scales are required to make drawings accurately to any desired scale. Various other types of scales are discussed in Chapter 6.

1.8 Protractor

Protractor is made of either wood or tin or transparent celluloid material. It is used to draw or measure such angles which cannot be drawn with the set squares, as shown in Fig. 1.12.

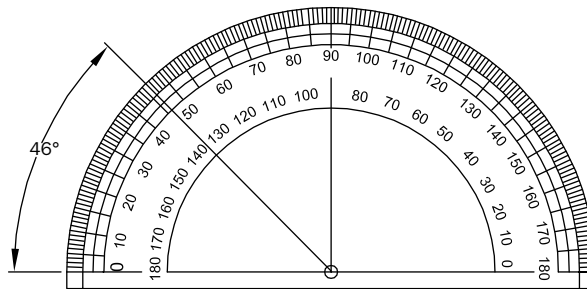


Fig. 1.12 Protractor

1.9 French Curves

French curves are generally made of wood, plastic or celluloid material. These are used for drawing curves which cannot be drawn with a compass. These curves are available in various shapes and sizes; a few of them are shown in Fig. 1.13. While using, first of all a series of points are plotted along the desired path and then the most suitable curve is made to fit along it. A smooth curve is then drawn along the edge of the curve. Care should be taken to see that no corner is formed anywhere within the drawn curve.

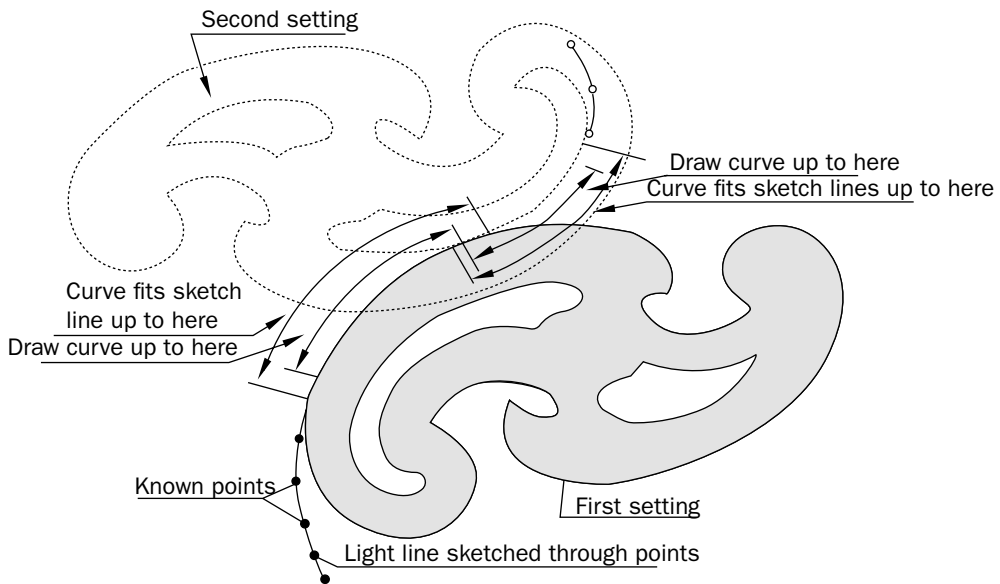


Fig. 1.13 French curves

1.10 Drawing Sheets

Drawing sheets are available in six standard sizes, specified by the Bureau of Indian Standards (BIS), as shown in Table 1.2. The sheet should be tough and strong, and when an eraser is used on it, its fibres should not disintegrate.

Table 1.2 Preferred drawing sheet sizes

S. No.	Designation	Trimmed size (mm)	Untrimmed size (mm)
1.	A ₀	841 × 1189	880 × 1230
2.	A ₁	594 × 841	625 × 880
3.	A ₂	420 × 594	450 × 625
4.	A ₃	297 × 420	330 × 450
5.	A ₄	210 × 297	240 × 330
6.	A ₅	148 × 210	165 × 240

Figure 1.14 shows the untrimmed size and trimmed size of the drawing sheet. The trimmed sizes of drawing sheets available are 841 × 1189 (A₀), 594 × 841 (A₁), 420 × 594 (A₂), etc., as shown in Fig. 1.15 The sizes of the successive sheets are obtained by folding the preceding size. The original ratio of sides needs to be constantly maintained when the sheet is halved (y/x). Therefore $y/x = x/(y/2)$ or $y/x = \sqrt{2} = 1.4142$. To have an area of 1 sqm (A₀) and at the same time to have $y/x = 1.4142$, $y = 1189$ mm and $x = 841$ mm.

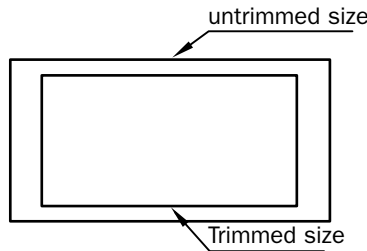


Fig. 1.14 Trimmed and untrimmed size drawing sheet

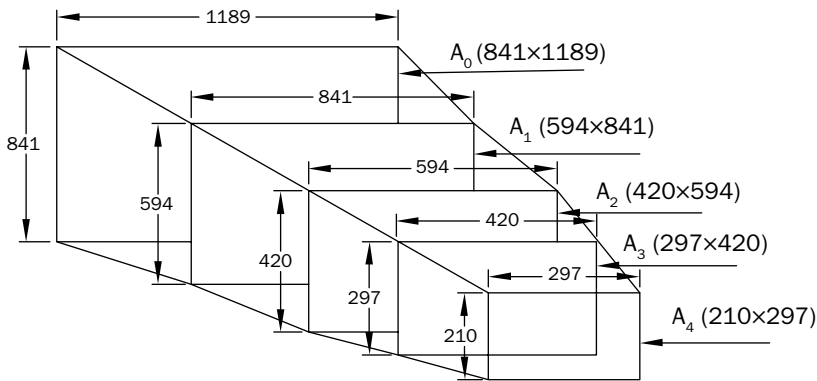


Fig. 1.15 Trimmed drawing sheet sizes

1.11 Drawing Pencils

The accuracy and appearance of a drawing depends upon the quality of the pencils used. The grade of a pencil is indicated by letters and numerals. The grade HB denotes medium hardness of the lead. The hardness of a pencil increases as the value of the numeral put before the letter H increases. Similarly, the lead becomes softer as the value of the numeral put before the letter B increases; so there are eighteen grades of pencil, which are as follows:

9H, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 5B, 6B, 7B. Out of these 9H is the hardest and 7B the softest pencil, as shown in Fig. 1.16.

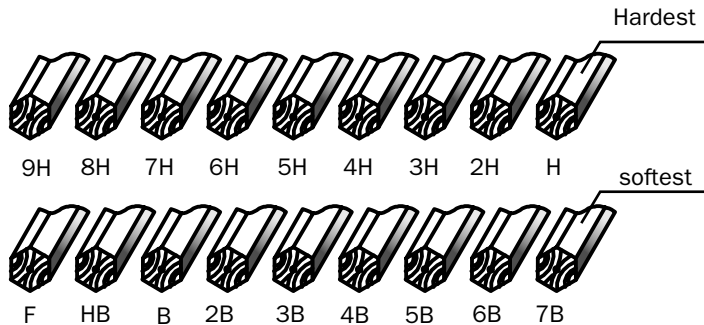


Fig. 1.16 Grades of pencil